

2016-2018

Chevrolet Volt

Service Manual

ACCESSORIES & EQUIPMENT

Cellular, Entertainment, and Navigation - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Communication Interface Module Bracket Bolt	2.5 N.m (22 lb in)
High Frequency Antenna Nut	9 N.m (80 lb in)
Radio Control Bolt	2.5 N.m (22 lb in)
Radio Control Switch Bolt	2.5 N.m (22 lb in)
Radio Front Center Speaker Bolt	2.5 N.m (22 lb in)
Radio Front Side Door Speaker Fastener	2.5 N.m (22 lb in)
Radio Front Speaker Bolt	2.5 N.m (22 lb in)
Radio Rear Compartment Speaker Fastener	6 N.m (53 lb in)
Radio Rear Side Door Speaker Fastener	2.5 N.m (22 lb in)
Radio Speaker Amplifier Bracket Bolt	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

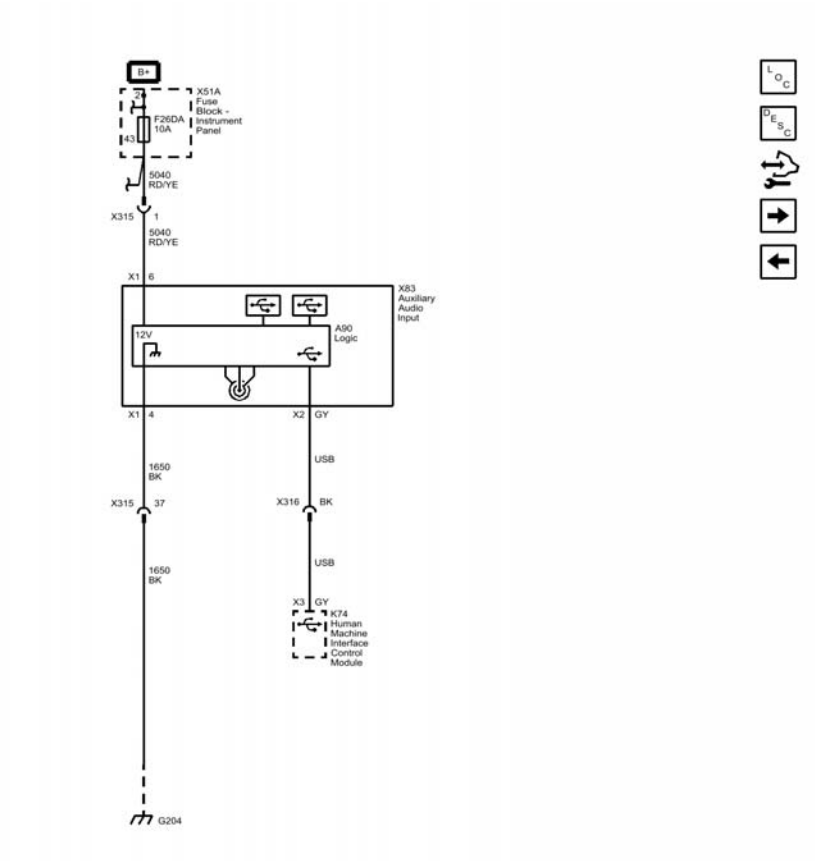
RADIO/NAVIGATION SYSTEM WIRING SCHEMATICS

Power, Ground, Antenna and Data Communication

Courtesy of GENERAL MOTORS COMPANY

Courtesy of GENERAL MOTORS COMPANY

Auxiliary Audio Input



Courtesy of GENERAL MOTORS COMPANY

Courtesy of GENERAL MOTORS COMPANY

Info Display

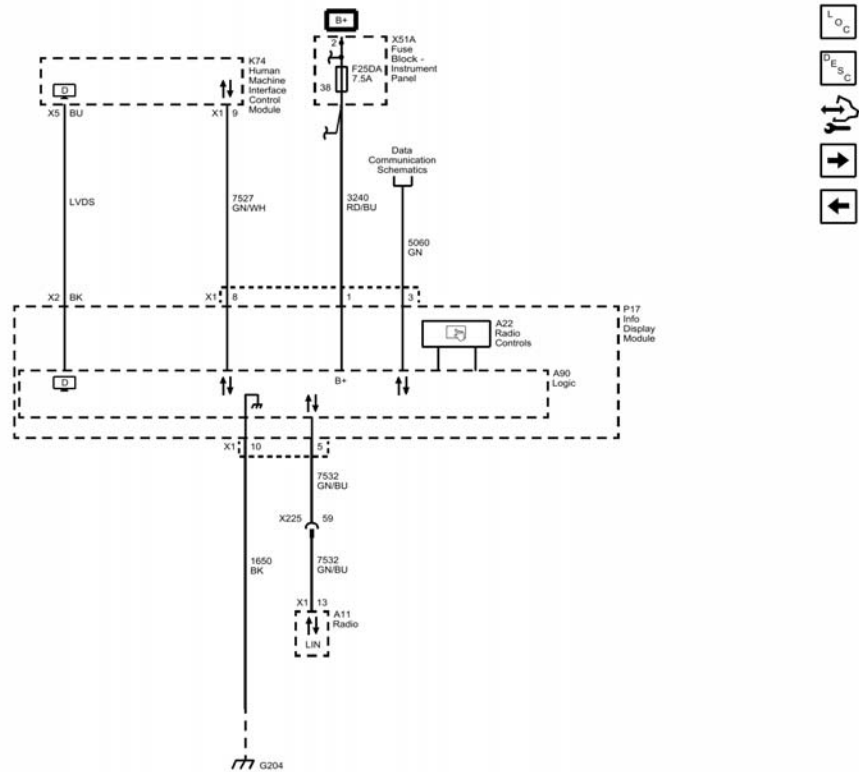


Fig. 4: Info Display

Courtesy of GENERAL MOTORS COMPANY

Speakers (UQA)

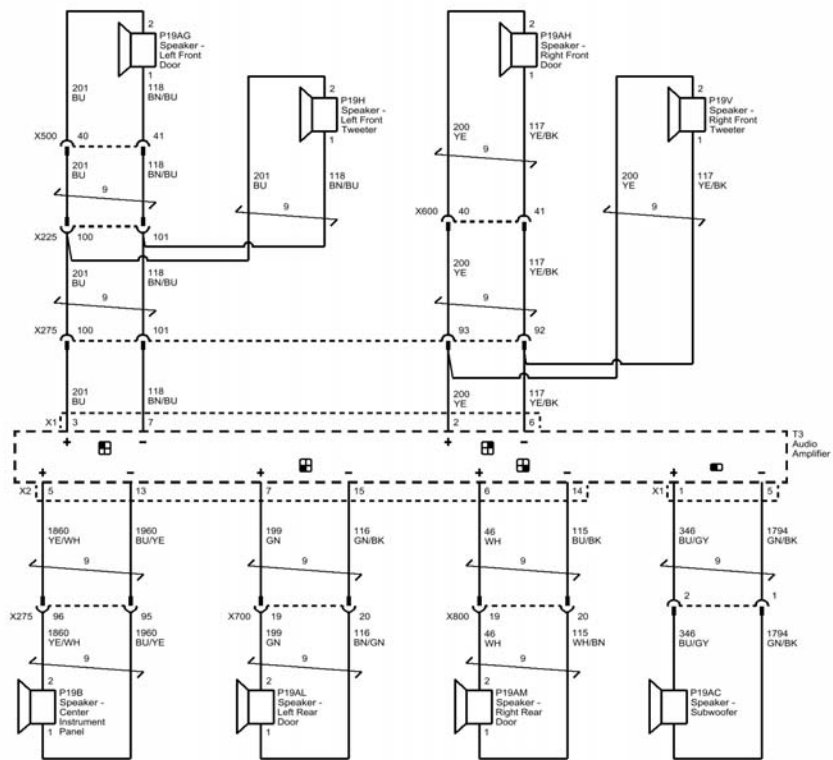


Fig. 5: Speakers (UQA)

Courtesy of GENERAL MOTORS COMPANY

Speakers (UZ6)

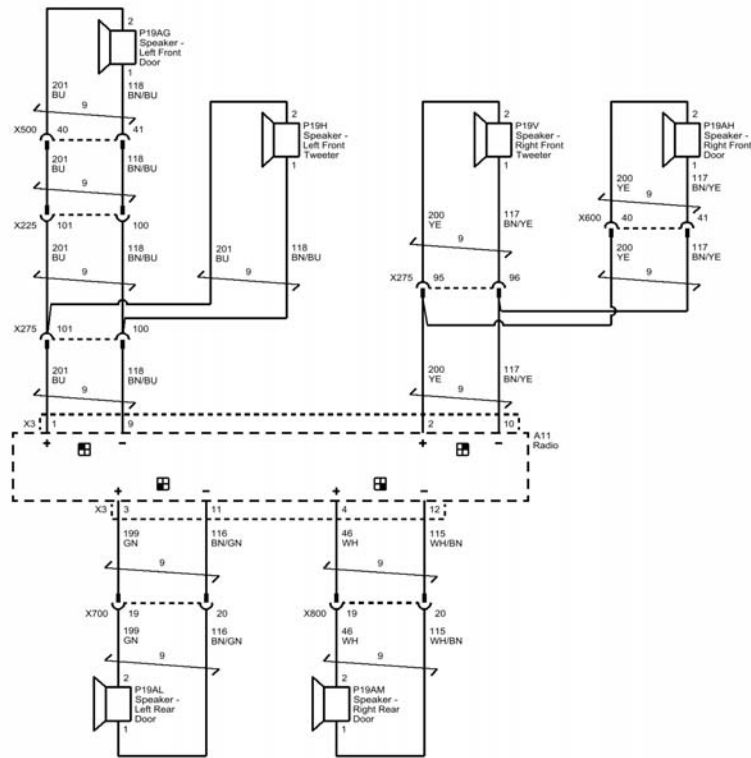


Fig. 6: Speakers (UZ6)

Courtesy of GENERAL MOTORS COMPANY

ONSTAR/TELEMATICS WIRING SCHEMATICS

OnStar Schematics

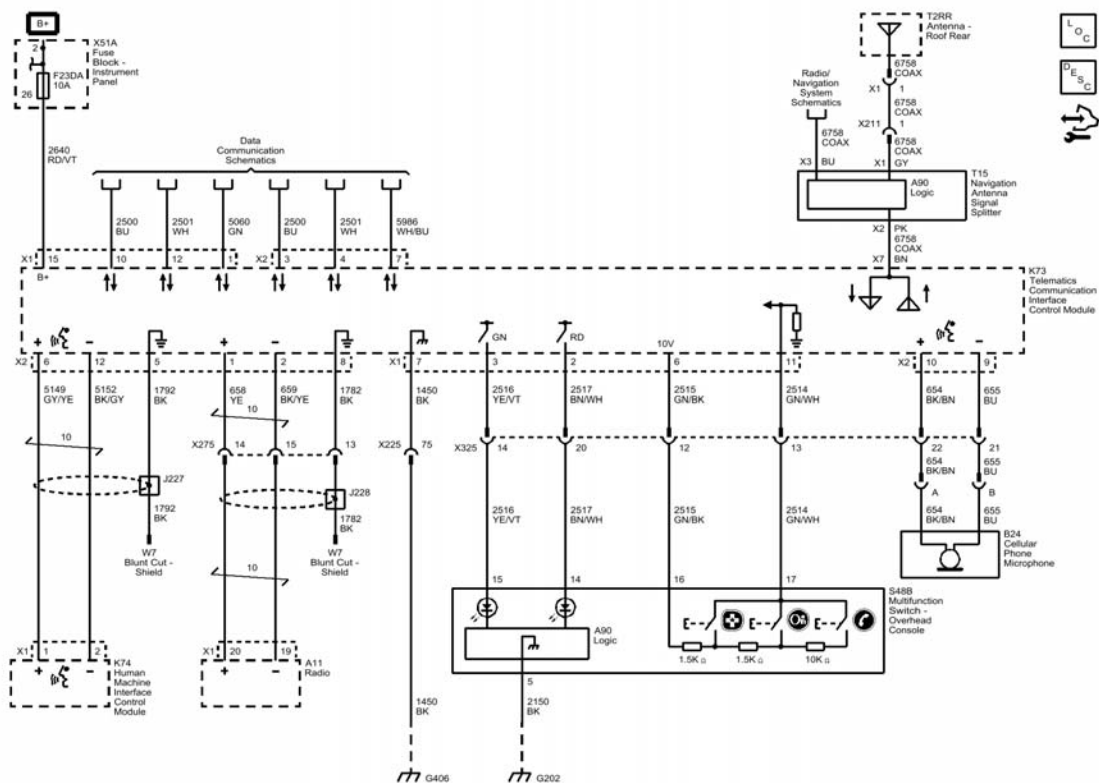


Fig. 7: OnStar Schematics

Courtesy of GENERAL MOTORS COMPANY

CELLULAR TELEPHONE WIRING SCHEMATICS

Cellular Telephone Microphone (-UE1)

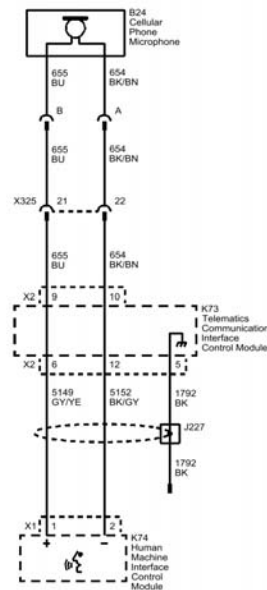


Fig. 8: Cellular Telephone Microphone (-UE1)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0997: AUXILIARY ELECTRONIC CONTROL UNIT PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0997 3A

Auxiliary Electronic Control Unit Performance Incorrect Component Installed

DTC B0997 39

Auxiliary Electronic Control Unit Performance Internal Electronic Failure

Circuit/System Description

The info display module monitors itself for internal failures and reports its condition to the Human Machine Interface Control Module when requested. The info display also reports electronic identification information when requested.

Conditions for Running DTC

- Ignition is ON or in the ACC position
- The system voltage is 9-16 V
- DTC B101E is not set as current in the Human Machine Interface Control Module
- The test is run once during Human Machine Interface Control Module wake up

Conditions for Setting the DTC

B0997 3A

The Info Display Module has reported identification information that differs from the information calibrated in the Human Machine Interface Control Module.

B0997 39

The Info Display Module reports an internal malfunction.

Action Taken When DTC Sets

The Human Machine Interface Control Module will set the DTC and the Info Display Module will have limited or no functionality.

Conditions for Clearing the DTC

The Human Machine Interface Control Module detects a compatible Info Display Module with no internal malfunctions reported.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, Infotainment system ON.

2. Verify DTC B101E is not set

- **If DTC B101E is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC B101E is not set**

3. Verify DTC B0997 is not set

- **If DTC B0997 is set**

Replace the P17 Info Display Module.

- **If DTC B0997 is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Radio Control Assembly Replacement](#)

DTC B1024: CIRCUIT BOARD TEMPERATURE SENSOR ABOVE MAXIMUM THRESHOLD (AUDIO AMPLIFIER)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1024 11

Circuit Board Temperature Sensor Above Maximum Threshold

Circuit/System Description

The audio amplifier monitors the internal circuitry for excessive temperature. When the amplifier senses an internal circuitry temperature greater than 95°C (203°F), the amplifier will set DTC B1024 11 and shut down until the internal circuitry cools below 90°C (194°F). No external circuit diagnosis is involved.

Conditions for Running the DTC

- Radio ON.
- Battery voltage must be between 9-16 volts.

Conditions for Setting the DTC

The audio amplifier detects an over-heat condition greater than 95°C (203°F) of the internal amplifier circuitry.

Action Taken When the DTC Sets

The audio amplifier will shut down and all speakers will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Extended use or extremely high volume especially in warm weather conditions may cause this DTC to set. Under these conditions it may be normal for this DTC to set to prevent permanent damage to the audio amplifier circuitry.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Allow the vehicle cabin to cool if the temperature inside the vehicle is excessive before proceeding with this diagnostic procedure.

1. Verify the DTC sets outside of the Conditions for Running and Setting. Since most occurrences of this DTC are caused by extreme vehicle cabin temperatures due to ambient conditions, review with the customer the conditions under which the DTC set.

- **If the DTC sets within the Conditions for Running and Setting.**

The system is operating as designed, All OK.

- **If the DTC sets outside the Conditions for Running and Setting.**

2. Using the scan tool, clear the DTC.
3. Verify the DTC does not set while operating the infotainment system under the conditions the customer

experienced the concern.

- **If the DTC sets**

Replace the T3 Audio Amplifier

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

Refer to [Control Module References](#) for audio amplifier replacement, setup, and programming

DTC B1024: CIRCUIT BOARD TEMPERATURE SENSOR THRESHOLD

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1024 53

Circuit Board Temperature Sensor Below Minimum Threshold

DTC B1024 54

Circuit Board Temperature Sensor Above Maximum Threshold

Circuit/System Description

The human machine interface control module monitors the internal circuitry for excessive temperature. When a temperature outside of the range is detected, the module sets the DTC and limits its operation to avoid damage.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The system voltage is 9-16 V
- The test is run once per second when the infotainment system is operating

Conditions for Setting the DTC

B1024 53

The module senses an internal temperature less than -40°C (-40°F).

B1024 54

The module senses an internal temperature greater than 69°C (156°F).

Action Taken When the DTC Sets

- The human machine interface control module sets the DTC.
- A message is displayed indicating that the system performance is being impacted by the excessive temperature condition.
- The module stops communicating on the MOST Bus network, but does not interrupt communication on the network.
- The infotainment system and the Info Display Module will have limited or no functionality.
- Components or other subsystems that interface with the infotainment system may have limited or no functionality.

Conditions for Clearing the DTC

- The internal temperature is between -40°C (-40°F) and 69°C (156°F).
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Under certain conditions it may be normal for this DTC to set to prevent permanent damage to the module.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Allow the vehicle cabin to cool if the temperature inside the vehicle is excessive before proceeding with this diagnostic procedure.

1. Verify the DTC sets outside of the Conditions for Running and Setting. Since most occurrences of this DTC are caused by extreme vehicle cabin temperatures due to ambient conditions, review with the customer the conditions under which the DTC set.

- **If the DTC sets within the Conditions for Running and Setting.**

The system is operating as designed, All OK.

- **If the DTC sets outside the Conditions for Running and Setting.**

2. Using the scan tool, clear the DTC.

3. Verify the DTC does not set while operating the infotainment system under the conditions the customer experienced the concern.

- **If the DTC sets**

Replace the K74 Human Machine Interface Control Module

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for human machine interface control module replacement, programming, and setup.

DTC B1025-B1135: AUDIO OUTPUT CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1025

Audio Output 1 Circuit

DTC B1035

Audio Output 2 Circuit

DTC B1045

Audio Output 3 Circuit

DTC B1065

Audio Output 5 Circuit

DTC B1075

Audio Output 6 Circuit

DTC B1085

Audio Output 7 Circuit

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Audio Output 1 Signal Circuits (Left Front Door and tweeter)	B1025 02	B1025 04	B1025 01	-
Audio Output 2 Signal Circuits (Right Front Door and tweeter)	B1035 02	B1035 04	B1035 01	-
Audio Output 3 Signal Circuits (Rear Subwoofer)	B1045 02	B1045 04	B1045 01	-
Audio Output 5 Signal Circuits (Left Rear Door)	B1065 02	B1065 04	B1065 01	-
Audio Output 6 Signal Circuits (Right Rear Door)	B1075 02	B1075 04	B1075 01	-
Audio Output 7 Signal Circuits (Center I/P)	B1085 02	B1085 04	B1085 01	-

Circuit/System Description

The Media Oriented Systems Transport (MOST) is a high-speed multimedia network technology. The serial MOST bus uses a ring topology and synchronous data communication to transmit audio, video, data and control information between any devices attached.

The audio amplifier is a participant on the MOST network. The audio amplifier receives audio inputs and control information from the MOST bus.

Each of the audio output channel circuits (+) and (-), at the audio amplifier have a DC bias voltage that is approximately one half of the battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.

The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.

If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.

- The test tones on the CD may be copied to a USB drive or other device to use during testing.
- Some audio output circuits are connected to more than one speaker, dependant on vehicle equipment. It may be necessary to disconnect one or more speakers during testing of some circuits.

Conditions for Running the DTC

NOTE: DTC B1325 must not be set as current for the amplifier to run any of the following tests.

DTC B1025 01, B1035 01, B1045 01, B1065 01, B1075 01, B1085 01

The test is run initially upon amplifier wake-up, and periodically every one second after amplifier operation begins.

DTC B1025 02, B1035 02, B1045 02, B1065 02, B1075 02, B1085 02

The test is run initially upon amplifier wake-up, and periodically every one second after amplifier operation begins.

DTC B1025 04, B1035 04, B1045 04, B1065 04, B1075 04, B1085 04

The test is run once during amplifier wake-up.

Conditions for Setting the DTC

DTC B1025 01, B1035 01, B1045 01, B1065 01, B1075 01, B1085 01

A short to voltage is detected on the specified (+) or (-) signal circuit

DTC B1025 02, B1035 02, B1045 02, B1065 02, B1075 02, B1085 02

A short to ground is detected on the specified (+) or (-) signal circuit

DTC B1025 04, B1035 04, B1045 04, B1065 04, B1075 04, B1085 04

An open is detected on the specified (+) or (-) signal circuit

Action Taken When the DTC Sets

The amplifier mutes the output channel and no sound is present from the speaker(s) that have a current circuit fault.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Special Tools

EL-50334-50 USB Cable and Adapter Kit

Circuit/System Verification

1. Ignition ON, infotainment system ON, mute OFF.
2. Verify clear audio is heard from each speaker, adjusting fade and balance controls to test each speaker individually.
 - **If audio is inoperative from one or more speakers, or the audio emitted is not clear**

Refer to Circuit/System Testing.
 - **If clear audio is heard from all speakers**
3. All OK.

Circuit/System Testing

NOTE: Some circuits supply audio signals to more than one speaker. It may be necessary to disconnect all speakers on the affected audio circuit when performing circuit tests.

1. Ignition OFF, disconnect the harness connector at the appropriate P19 Speaker. Ignition ON, infotainment system ON, mute OFF.
2. Test for 5 - 7 V between the appropriate signal circuit terminals listed below and ground.
 - Front door, tweeter, rear door and subwoofer speakers audio (-) circuit terminal 1
 - Front door, tweeter, rear door and subwoofer speakers audio (+) circuit terminal 2
 - **If less than 5 V**
 1. Ignition OFF, disconnect the X1 and X2 harness connectors at the T3 Audio Amplifier.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the T3 Audio Amplifier.
 - **If greater than 7 V**
 1. Ignition OFF, disconnect the X1 and X2 harness connectors at the T3 Audio Amplifier. Ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the T3 Audio Amplifier.
 - **If 5 - 7 V**
3. Test or replace the P19 Speaker.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Speaker Replacement Reference](#)
- Refer to [Control Module References](#) for audio amplifier replacement, programming, and setup.

DTC B124B: USB 1 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124B

USB 1 Circuit

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B124B, 2	B124B, 1	-	-
USB Cable	B124B	B124B	B124B	-
Ground	-	1	-	-
1. Fault may affect one or more components, dependant on fault location 2. Fault affects multiple components, dependant on vehicle equipment				

Circuit/System Description

The infotainment system has a USB port and a Auxiliary Audio Input Jack located in the center console. The receptacle assembly receives fused battery voltage and ground from the harness to power the internal hub device as well as providing additional amperage to power USB devices.

The internal hub device interfaces directly with the human machine interface control module via a standard USB cable. A Mini type USB connector is used to connect the human machine interface control module and the USB receptacle. Standard USB male to female connections are typically used for connecting USB cables together where an in-line connection is required. An in-line cable connection is typically found between the console and I/P harness.

Auxiliary Audio Input Jack

When a portable audio playback device is connected to the 3.5 mm (1/8 in.) auxiliary audio input jack an internal switch opens the detection signal circuit within the hub. The HMI detects the device and AUX becomes available as an audio source. Audio signals from the device are converted from analog to digital, these signals are then sent to the HMI from the auxiliary input jack via USB.

USB Port

The USB port allows connectivity to the infotainment system from portable media players or a USB storage device (memory stick/flash drive). When a device is connected to the USB port, the system detects the device and switches to USB as the audio source. Once connected, the device can be controlled from the radio controls.

Not all portable media player devices or file types are compatible. Refer to the owner's manual for information on USB devices, control, and operation.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is run once per second when the infotainment system is operating

Conditions for Setting the DTC

B124B 0B

The human machine interface control module detects an excessive current condition on the USB 5 V circuit.

B124B 04

The human machine interface control module does not detect the vehicle hub device.

B124B 11

The human machine interface control module detects an additional hub device attached to the vehicle USB port.

Action Taken When the DTC Sets

The USB port is inoperative while the DTC is current.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

- This DTC may be set due to the connection of an incompatible or faulty USB device.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **EL-50334-20** Multi-Media Interface Tester (MIT)
- **EL-50334-50** USB Cable and Adapter Kit
- **EL-50334-14** Infotainment Test Cable

Circuit/System Verification

1. Verify DTC B124B is not set. Since occurrences of this DTC can be caused by an incompatible or faulty USB device, review with the customer the conditions under which their concern occurred.
 - **If DTC B124B is set.**

Refer to Circuit/System Testing.
 - **If DTC B124B is not set.**
2. Ignition On/Vehicle in Service Mode. Infotainment system ON.
3. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
4. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
 - **If audio is not heard from the test tool**

Refer to Circuit/System Testing
 - **If audio is heard from test tool**
5. Verify the infotainment system can be switched to AUX as the audio source with the EL-50334-20 Multi-Media Interface Tester (MIT) connected to the auxiliary audio input jack.
 - **If the infotainment system can not be switched to AUX as the audio source**

Refer to Circuit/System Testing
 - **If the infotainment system can be switched to AUX as the audio source**
6. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the vehicle infotainment system while operating the test tool to begin audio playback.
 - **If audio is not heard from the test tool.**

Refer to Circuit/System Testing

- **If audio is heard from the test tool.**

7. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the X83 Auxiliary Audio Input.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Verify that a test lamp illuminates between the B+ circuit terminal 6 and ground.

- **If the test lamp does not illuminate**

1. Ignition OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- **If the test lamp illuminates**

4. Verify the USB cable is properly connected at all components and in-line connections, and there is no damage to the cable or connections.

- **If connection problems or cable damage is noted.**

Perform the appropriate repair or replacement to correct any issues.

- **If no connection problems or cable damage is noted.**

5. Connect the X1 harness connector at the X83 Auxiliary Audio Input.
6. Disconnect the vehicle USB cable X3 harness connector at the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input Adapter.
7. Connect the EL-50334-14 Infotainment Test Cable and the EL-50334-2 Type-A Female to Mini-B Male Cable together. Connect the assembled test cable to the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input.
8. Ignition On/Vehicle in Service Mode. Infotainment system ON.
9. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
10. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

1. Replace the X83 Auxiliary Audio Input Adapter. Connect all harness connectors.
2. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
3. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
 - If audio is not heard from the test tool, replace the K74 Human Machine Interface Control

Module.

- **If audio is heard from the test tool**

11. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input AUX port and select the AUX test mode.
12. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

1. Replace the X83 Auxiliary Audio Input Adapter. Connect all harness connectors.

- **If audio is heard from the test tool.**

13. Replace the vehicle USB cable between the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input Adapter.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Audio Disc Player and USB Receptacle Replacement](#)
- Refer to [Control Module References](#) for human machine interface control module replacement, programming, and setup.

DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124F

Universal Serial Bus (USB) Programming

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Certain devices in the entertainment system must be programmed with specific software and other information to operate correctly. This DTC is the result of an unsuccessful USB programming event of the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved

Conditions for Running the DTC

Once upon each USB Programming Event.

Conditions for Setting the DTC

The programming event was incomplete, or completed with errors.

Action Taken When the DTC Sets

The entertainment system has limited or no functionality.

Conditions for Clearing the DTC

The programming event completes successfully.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B124F is not set.
 - **If DTC B124F is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If DTC is set, replace the device that set the DTC.
 - If the DTC is not set
 - **If DTC B124F is not set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for device replacement, programming, and setup.

DTC B125A: ANTENNA SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125A 02

Antenna Signal Circuit Short to Ground

DTC B125A 04

Antenna Signal Circuit Open Circuit

DTC B125A 01

Antenna Signal Circuit Short to Battery

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	B125A 01	-

Circuit/System Description

The radio antenna for AM and FM radio reception is connected to the radio with a coaxial cable.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B125A 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125A 04

The radio detects an open in the antenna signal circuit center conductor.

B125A 01

The radio detects a short to battery in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Poor AM and FM radio reception is dependent on multiple influences, some of which may not be vehicle related. Areas which have high RF traffic or block the signal path may cause a degradation in radio reception. Radio reception may also be influenced by items within the vehicle, but are not part of the radio system. Such examples are aftermarket electrical accessories or other items which may generate noise in the vehicle electrical system.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Inspect the antenna for proper mounting or physical damage.
 - **If damage is found**
Repair or replace as necessary
 - **If no damage is found**
2. Ignition ON/Vehicle in Service Mode, A11 Radio ON.
3. Verify station reception is normal when tuned to several known good AM and FM stations.
 - **If AM or FM reception is poor.**
Refer to Circuit/System Testing
 - **If reception is normal**
4. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T2RR Antenna - Roof Rear.
2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.
 - **If the coax cable does not pass the test**
Replace the antenna coax cable
 - **If the coax cable passes the test**
3. Connect the antenna coax cable to the T2RR Antenna - Roof Rear.
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield at the radio end of the coax cable.
 - **If less than infinite resistance**
Replace the radio antenna base.
 - **If infinite resistance**
5. Test for less than 10 Ω between the coax cable outer shield and ground at the radio end of the coax cable.

- **If 10 Ω or greater**

1. Clean the mounting surface of the radio antenna base.
2. Connect the antenna coax cable to the T2RR Antenna - Roof Rear.
3. Test for less than 10 Ω between the coax cable outer shield and ground at the radio end of the coax cable.
 - If 10 Ω or greater, replace the antenna base.
 - If less than 10 Ω , connect all harness connectors. Verify station reception is normal when tuned to several known good AM and FM stations. If AM or FM reception concerns are still present, replace the A11 Radio.

- **If less than 10 Ω**

6. Test or replace the A11 Radio.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.
 - **If 5 Ω or greater**
Replace the coax cable
 - **If less than 5 Ω**
3. Test for less than 5 Ω between the coax cable outer shield end to end.
 - **If 5 Ω or greater**
Replace the coax cable
 - **If less than 5 Ω**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
 - **If less than infinite resistance**
Replace the coax cable
 - **If infinite resistance**
5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for radio replacement, programming, and setup.

DTC B125C: SATELLITE ANTENNA CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal message is not displayed on the radio.
 - **If DTC B125C is set as current or the No XM Signal message is displayed.**

Refer to Circuit/System Testing.

- **If DTC B125C is not set as current and the No XM Signal message is not displayed.**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the A11 Radio. Connect the **EL-48028** Digital Radio Test Antenna to the radio and place on the roof of the vehicle.
 2. Ignition ON/Vehicle in Service Mode, radio tuned to XM channel 1.
 3. Verify DTC B125C is not set as current and XM reception is improved.
 - **If DTC B125C is set as current or XM reception is not improved**
- Replace the A11 Radio.
- **If DTC B125C is not set as current and XM reception is improved**
4. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the T2RR Antenna - Roof Rear.
 5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.
 - **If the coax cable does not pass the test**

Replace the antenna coax cable

- If the coax cable passes the test

6. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.

- If 5 Ω or greater

Replace the coax cable

- If less than 5 Ω

3. Test for less than 5 Ω between the coax cable outer shield end to end.

- If 5 Ω or greater

Replace the coax cable

- If less than 5 Ω

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- If less than infinite resistance

Replace the coax cable

- If infinite resistance

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for radio replacement, programming, and setup.

DTC B1271: THEFT PROTECTION ACTIVE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1271 00

Theft Protection Active

Circuit/System Description

When the radio is initially installed in the vehicle, the radio receives VIN information via serial data. The radio stores a portion of the VIN and compares this sequence to the VIN information received each time the radio powers on. The VIN in the radio is a single one-time learn.

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. This DTC is generated by the module when the Theft Protection is activated.

Conditions for Running the DTC

This DTC test runs when the radio changes from OFF to ON.

Conditions for Setting the DTC

The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence.

Action Taken When the DTC Sets

The radio may be disabled or have limited functionality. The radio display will indicate that theft protection is active.

Conditions for Clearing the DTC

The radio receives the correct VIN information via serial data.

Diagnostic Aids

A possible cause of incorrect VIN info could be the radio was originally installed in another vehicle.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode, radio ON.
2. Verify DTC B1271 is not set.
 - **If DTC B1271 is set**
 Replace the A11 Radio.
 - **If DTC B1271 is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for radio replacement, programming, and setup.

DTC B127E: FRONT VIDEO DISPLAY OUTPUT SIGNAL

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

[DTC Descriptor](#)

DTC B127E 00

Front Video Display Output Signal

[Circuit/System Description](#)

The infotainment display and controls are a separate component from the radio, combined into an assembly. The assembly is supplied battery voltage and ground from the vehicle harness. The human machine interface control module communicates digital video data for on-screen display through a dedicated cable containing the LVDS data circuits.

Control information, touch communications and dimming level for the display are communicated via a LIN serial data circuit to the human machine interface control module.

If the human machine interface control module detects the display is not responding to the output on the LVDS circuits, the human machine interface control module sets the DTC.

[Conditions for Running the DTC](#)

- Ignition is ON or in the ACC position
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is continuously when the infotainment system is operating

Conditions for Setting the DTC

The human machine interface control module detects the display is not responding to the output on the LVDS circuits.

Action Taken When the DTC Sets

- The human machine interface control module sets this DTC
- No images are shown on the Info Display Module

Conditions for Clearing the DTC

- The human machine interface control module detects a properly synced digital video signal.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- EL-50334-2 Type A female to Mini B male USB Cable
- EL-50334-14 Infotainment Test Cable

Circuit/System Testing

1. Vehicle OFF/Ignition OFF.
2. Verify the LVDS interface cable is properly connected at the P17 Info Display Module and the K74 Human Machine Interface Control Module connections and there is no damage to the cable or connections.
3. Ignition ON/Vehicle in Service Mode, infotainment system ON.
4. Verify the P17 Info Display Module does not display an image.

- **If the P17 Info Display Module displays an image.**

All OK.

- **If the P17 Info Display Module does not display an image.**

5. Vehicle OFF/Ignition OFF.
6. Disconnect the LVDS interface cable from the P17 Info Display Module.
7. Connect the EL-50334-2 Type A female to Mini B male USB Cable to the P17 Info Display Module. Connect the EL-50334-14 Infotainment Test Cable to the adapter.
8. Disconnect the LVDS interface cable from the K74 Human Machine Interface Control Module. Connect the EL-50334-14 Infotainment Test cable to the K74 Human Machine Interface Module.
9. Ignition ON/Vehicle in Service Mode, infotainment system ON.
10. Verify the P17 Info Display Module displays an image.

- **If the P17 Info Display Module does not display an image**

1. Replace the P17 Info Display Module. Connect all harness connectors.
2. Ignition ON/Vehicle in Service Mode, infotainment system ON.
3. Verify the P17 Info Display Module displays an image.

- If the P17 Info Display Module still does not display an image, replace the K74 Human Machine Interface Control Module.
- If the P17 Info Display Module displays an image.

4. All OK.

- **If the P17 Info Display Module displays an image.**

11. Replace the vehicle LVDS interface cable from the P17 Info Display Module to the K74 Human Machine Interface Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Radio Control Assembly Replacement](#)
- Refer to [Control Module References](#) for human machine interface control module replacement, programming, and setup.

DTC B12A8: OPTICAL MEDIA DRIVE THEFT LOCKED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B12A8 00

Optical Media Drive Theft Locked

Circuit/System Description

When the Media Disc Player is initially installed in the vehicle, it receives VIN information via serial data. The Media Disc Player stores a portion of the VIN and compares this sequence to the VIN information received each time the Media Disc Player powers on. The VIN in the Media Disc Player is a single one-time learn.

The Media Disc Player theft deterrent system is intended to disable or limit Media Disc Player functionality if incorrect vehicle information is received by the Media Disc Player. The Media Disc Player disables functionality if the VIN information received by the Media Disc Player does not match the VIN information that has been learned by the Media Disc Player. This DTC is generated by the module when the Theft Protection is activated.

Conditions for Running the DTC

This test runs once per second while the Media Disc Player is being accessed.

Conditions for Setting the DTC

The Media Disc Player has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence.

Action Taken When the DTC Sets

The Media Disc Player may be disabled or have limited functionality.

Conditions for Clearing the DTC

The Media Disc Player receives the correct VIN information via serial data.

Diagnostic Aids

A possible cause of incorrect VIN information could be the Media Disc Player was originally installed in another vehicle.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B12A8 is not set.

- **If DTC B12A8 is set**

Replace the A33 Media Disc Player.

- **If DTC B12A8 is not set**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for media disc player replacement, programming, and setup.

DTC B1446 OR B1447: BACKUP POWER SOURCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1446

Replace Backup Power Source Below Minimum Threshold

DTC B1447

Backup Power Source Open Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Battery B+	B1447 03	B1447 04	-	-
Backup Battery Low Reference	B1447 03	B1447 04	-	-

Circuit/System Description

The backup power source provides voltage to the telematics communication interface control module, to be able to successfully place a call in the event of a main battery disconnect during a collision event.

Conditions for Running the DTC

B1446 03

- Ignition On/Vehicle in Service Mode.
- System voltage is between 9.5 and 15.5 V.
- DTC B1447 is not set.

B1447 04

- Ignition On/Vehicle in Service Mode.
- System voltage is between 9.5 and 15.5 V.
- The above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B1446 03

The telematics communication interface control module detects that the backup power source voltage has dropped below the minimum threshold value.

B1447 04

The telematics communication interface control module detects no voltage from the backup power source.

Action Taken When the DTC Sets

B1446 03

The OnStar® status LED turns red.

B1447 04

- The OnStar® status LED turns red.
- The telematics communication interface control module will be unable to place a call in the event of a main battery disconnect during a collision event.

Conditions for Clearing the DTC

- A current DTC B1446 will clear when the telematics communication interface control module detects the voltage of the backup power source is above the minimum threshold value.
- A current DTC B1447 will clear when the telematics communication interface control module detects voltage from the backup power source.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- Shorting the backup power source positive voltage circuit to the backup power source ground circuit or chassis ground will activate the internal circuit protection of the backup power source, rendering the backup power source inoperative.

- DTC B1447 may set if the K73 Telematics Communication Interface Control Module has been incorrectly disconnected or serviced. When disconnecting the K73 Telematics Communication Interface Control Module, disconnect the harness connector X1 at the K73 Telematics Communication Interface Control Module prior to disconnecting any other harness connectors. This will ensure the backup power source is preserved when voltage is removed from the K73 Telematics Communication Interface Control Module.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- Testing for Intermittent Conditions and Poor Connections
- Circuit Testing
- Wiring Repairs
- Connector Repairs

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 12.3 V between the B+ circuit terminal 14 and the low reference circuit terminal 13.
 - **If 12.3 V or less**
 1. Disconnect the C3 Telematics Communication Interface Control Module Battery.
 2. Test for infinite resistance between the circuits listed below and ground.
 - B+ circuit terminal 14
 - Low reference circuit terminal 13.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the circuits end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the C3 Telematics Communication Interface Control Module Battery.
 - **If greater than 12.3 V**
3. Replace the K73 Telematics Communication Interface Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to [Communication Interface Module Battery Replacement](#)
- Refer to [Control Module References](#) for telematics communication interface control module replacement, programming and setup.

DTC B2455: CELLULAR PHONE MICROPHONE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2455 02

Cellular Phone Microphone Circuit Short to Ground

DTC B2455 04

Cellular Phone Microphone Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone Signal	B2455 02	B2455 04	B2455 04	-
Microphone Low Signal	B2455 02	B2455 04	B2455 04	-

Circuit/System Description

The telematics communication interface control module provides the cellular phone microphone with a supplied voltage on the cellular phone microphone high signal circuit. When the microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the microphone low signal circuit.

Conditions for Running the DTC

- The Vehicle must be ON or in Service Mode.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B2455 02

The telematics communication interface control module detects a short to ground in the cellular phone microphone signal circuit for 10 s or greater.

B2455 04

The following conditions will set this DTC:

- The telematics communication interface control module detects an open/high resistance in the cellular phone

microphone signal circuit for 10 s or greater.

- The telematics communication interface control module detects an open/high resistance in the low signal circuit for 10 s or greater.

Action Taken When the DTC Sets

- The OnStar® status LED turns red.
- The telematics communication interface control module will not receive a signal from the cellular phone microphone.
- Calls can be placed but the caller cannot be heard.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the B24 cellular phone microphone, Ignition ON/Vehicle in Service Mode.
2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.
 - **If less than 8.0 V**
 1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the vehicle K73 Telematics Communication Interface Control Module.
- **If greater than 10.5 V**
1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module, Ignition ON/Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
- **If between 9.5-10.5 V**
3. Test for less than 1 V between the signal circuit terminal A and ground.
 - **If greater than 1 V**
 1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module, Ignition ON/Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
 4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
 - **If less than 8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the connector X2 at the K73 telematics communication interface control module.
 2. Test for infinite resistance between the low signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the vehicle K73 Telematics Communication Interface Control Module.
 - **If greater than 8 V**
 5. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Mobile Telephone Microphone Replacement](#)
- Refer to [Control Module References](#) for telematics communication interface control module replacement, programming and setup.

DTC B2462: GLOBAL POSITIONING SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2462 02

Global Positioning System Short to Ground

DTC B2462 04

Global Positioning System Open

Circuit/System Description

The navigation antenna is connected to the Telematics Communication Interface Control Module. The module supplies 5 V to the antenna to power the internal amplifier through the center conductor of the antenna coax cable.

When the vehicle is equipped with the optional navigation system, a Navigation Antenna Signal Splitter is installed to distribute the navigation signal to both the Telematics Communication Interface Control Module and the Human Machine Interface Control Module. The Human Machine Interface Control Module supplies 5 V through the coax cable to power the Navigation Antenna Signal Splitter.

Conditions for Running the DTC

- Radio On.
- System voltage is greater than 9 V and less than 16 V.
- The navigation system/telematics communication interface control module tests the GPS antenna every 10 s.

Conditions for Setting the DTC

B2462 02

The Telematics Communication Interface Control Module or Human Machine Interface Control Module detects a short to ground on the GPS antenna signal circuit.

B2462 04

The Telematics Communication Interface Control Module or Human Machine Interface Control Module detects a open/high resistance on the GPS antenna signal circuit.

Action Taken When the DTC Sets

- The Telematics Communication Interface Control Module or Human Machine Interface Control Module uses the last reported position and the vehicle speed signal to calculate the vehicle position.
- Route guidance may be inaccurate.
- Turn by turn navigation may be inaccurate or inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction - free ignition cycles have occurred.

Diagnostic Aids

- The scan tool Telematics Communication Interface Control Module GPS signal parameter will display a Yes or No dependent upon whether or not the module sees an increment of the seconds transmitted by GPS signals to the Telematics Communication Interface Control Module. Upon entering this screen, the GPS signal title will initially display Yes, regardless of the presence of time increment, for at least 2 seconds, while the algorithm in the scan tool determines the status of the clock. If increment is found, Yes is continually displayed. If the clock remains static, No is displayed. The scan tool looks for increment every second, regardless of current display.
- Inaccurate or aged GPS position concerns which are no longer present may have been due to the temporary loss of GPS signal reception by the vehicle. Conditions such as tunnels or parking structures will restrict the cellular phone and navigation antenna from a clear view of the satellites in the sky and may have caused this temporary data loss.
- The GPS requires a clear line of sight to the sky to operate properly. In most cases the GPS will not have reception near tall buildings or inside structures.

Reference Information

Schematic Reference

- [OnStar/Telematics Schematics](#)
- [Radio/Navigation System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [OnStar Description and Operation](#)
- [Radio/Audio System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-49903 OnStar Antenna Diagnostic Tool Kit

Circuit/System Verification

NOTE: The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 minutes after turning the ignition ON for the vehicle to acquire the GPS satellites signal.

1. Ignition ON/vehicle in Service Mode.
2. Verify that DTC B2462 is not set in the Telematics Communication Interface Control Module.
 - **If DTC B2462 is set in the Telematics Communication Interface Control Module and the vehicle is not equipped with a navigation system**

Refer to Circuit/System Testing Without Navigation System.
 - **If DTC B2462 is set in the Telematics Communication Interface Control Module and the vehicle is equipped with a navigation system**

Refer to Circuit/System Testing With Navigation System.
 - **If DTC B2462 is not set in the Telematics Communication Interface Control Module**
3. Verify an OnStar advisor can locate the vehicle after performing a blue button press.
 - **If the advisor can not locate the vehicle and the vehicle is not equipped with a navigation system**

Refer to Circuit/System Testing Without Navigation System
 - **If the advisor can not locate the vehicle and the vehicle is equipped with a navigation system**

Refer to Circuit/System Testing With Navigation System.
 - **If the advisor can locate the vehicle**
4. Verify DTC B2462 is not set in the Human Machine Interface Control Module.
 - **If DTC B2462 is set in the Human Machine Interface Control Module**

Refer to Circuit/System Testing With Navigation System - Step 9.
 - **If DTC B2462 is not set in the Human Machine Interface Control Module**
5. Verify that the NO GPS symbol/message is not displayed on the radio display.
 - **If the NO GPS symbol/message is displayed**

Refer to Circuit/System Testing With Navigation System - Step 9.
 - **If the NO GPS symbol/message is not displayed**
6. All OK.

Circuit/System Testing

without Navigation System

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF/vehicle OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module.
2. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-6 coax cable attach the grey connector to the combiner and the brown connector to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is set or the advisor can not locate the vehicle**

Replace the K73 Telematics Communication Interface Control Module.

- **If DTC B2462 is not set or the advisor can locate the vehicle**

4. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T2RR Antenna - Roof Rear. Refer to component testing.

- **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**

5. Test or replace the T2RR Antenna - Roof Rear.

with Navigation System

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF/vehicle OFF, disconnect the T2RR Antenna - Roof Rear coax cable at the T15 Navigation Antenna Signal Splitter.
2. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-7 coax cable attach one grey connector to the combiner and the other grey connector to the T15 Navigation Antenna Signal Splitter. Place the test antenna on the roof of the vehicle, ignition ON.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is not set or the advisor can locate the vehicle**

1. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the T2RR Antenna - Roof Rear. Refer to Component Testing.

- If the coax cable does not pass the test

Replace the coax cable.

- If the coax cable passes the test

2. Replace the T2RR Antenna - Roof Rear.

- **If DTC B2462 is set or if the advisor can not locate the vehicle**

4. Ignition OFF/vehicle OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module.
5. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-6 coax cable attach the grey connector to the combiner and the brown connector to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON.
6. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is set or the advisor can not locate the vehicle.**

Replace the K73 Telematics Communication Interface Control Module.

- **If DTC B2462 is not set or the advisor can locate the vehicle.**

7. Ignition OFF/vehicle OFF.

8. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the K73 Telematics

Communication Interface Control Module. Refer to Component Testing.

- **If the coax cable does not pass the test.**

Replace the coax cable.

- **If the coax cable passes the test.**

9. Ignition OFF/vehicle OFF, disconnect the blue GPS coax cable connector at the K74 Human Machine Interface Control Module.

10. Attach the EL-49903-1 OnStar test antenna blue connector to the K74 Human Machine Interface Control Module and place the test antenna on the roof of the vehicle.

11. Ignition ON/vehicle in Service Mode.

12. Verify DTC B2462 is not set or that the NO GPS symbol/message is not displayed on the radio.

- **If DTC B2462 is set or the NO GPS symbol/message is displayed**

Replace the K74 Human Machine Interface Control Module

- **If DTC B2462 is not set or if the NO GPS symbol/message is not displayed.**

13. Ignition OFF/vehicle OFF.

14. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the K74 Human Machine Interface Control Module. Refer to Component Testing.

- **If the coax cable does not pass the test.**

Replace the coax cable.

- **If the coax cable passes the test.**

15. Test or replace the T15 Navigation Antenna Signal Splitter.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**
- **The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.**

Coax Cable Test

1. Ignition OFF/vehicle OFF, disconnect the coax cable at both components.

2. Test for less than 5 Ω between the coax cable center terminal end to end.

- **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

3. Test for greater than 5 Ω between the coax cable outer shield end to end.

- **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for Human Machine Interface control module or Telematics Communication Interface Control Module replacement, programming, and setup.

DTC B2470: CELLULAR PHONE ANTENNA CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2470 02

Cellular Phone Antenna Circuit Malfunction Short to Ground

DTC B2470 04

Cellular Phone Antenna Circuit Malfunction Open Circuit

Circuit/System Description

The primary cellular phone antenna element is connected to the telematics communication interface control module (violet connector) via a shielded coaxial cable. Cellular communication takes place on both the primary cellular antenna signal circuit and the GPS/secondary cellular antenna signal circuit. This diagnostic only applies to the primary cellular antenna signal circuit. Internal to the antenna on the cellular antenna signal circuit resistance is used to apply a load, which the telematics communication interface control module uses to detect the presence of the antenna.

Conditions for Running the DTC

- Ignition in the RUN or ACC position.

- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 s.

Conditions for Setting the DTC

B2470 02

The telematics communication interface control module detects a short to ground on the primary cellular antenna signal circuit.

B2470 04

- The telematics communication interface control module detects an open or high resistance on the primary cellular antenna signal circuit.
- The above conditions are present for greater than 1 s.

Action Taken When the DTC Sets

The OnStar® status LED turns red.

Conditions for Clearing the DTC

- The telematics communication interface control module detects the presence of a cellular antenna.
- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903-1 Test Antenna Navn-Cell Conn

Circuit/System Testing

NOTE:

- The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.
- The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the violet primary cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the **EL-49903-1** Test Antenna Navn-Cell Comn connect the violet coax cable to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify the DTC does not set or a call can be completed to the OnStar Call Center while operating the vehicle within the conditions for running the DTC.

- **If the DTC sets or a call can not be completed to the OnStar Call Center**

Replace the K73 Telematics Communications Interface Control Module.

- **If the DTC does not set or a call can be completed to the OnStar Call Center**

4. Ignition OFF/Vehicle OFF.
5. Disconnect the **EL-49903-1** Test Antenna Navn-Cell Comn from the K73 Telematics Communication Interface Control Module
6. Test the coax cable. Refer to Component Testing.
 - **If the coax cable does not pass the test**
Replace the coax cable.
 - **If the coax cable passes the test**
7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to [Test Probe Caution](#)

NOTE:

- Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.
- To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Test for less than 5 Ω between the coax cable center terminal end to end.
 - **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

2. Test for greater than 5 Ω between the coax cable outer shield end to end.

- **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

3. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for telematics communication interface control module replacement, setup, and programming

DTC B2476 OR B2482: CELLULAR PHONE SELECT SERVICE SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2476 04

Cellular Phone Select Service Switch Open

DTC B2476 59

Cellular Phone Select Service Switch Protection Time-out

DTC B2482 00

Cellular Phone Select Service Switch Range/Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 02	B2476 04	B2476 04	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal Terminal 17	B2476 02	B2476 04	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-

Circuit/System Description

The OnStar® button assembly consists of 3 buttons: Call/Answer, OnStar® Call Center, and OnStar® Emergency. The telematics communication interface control module supplies the OnStar® button assembly with 10 V via the 10 V reference circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been pressed.

Conditions for Running the DTC

- Vehicle in Service Mode/Ignition ON.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B2476 04

The telematics communication interface control module detects an open/high resistance on the keypad supply voltage circuit.

B2482 and B2476 59

The telematics communication interface control module detects a valid signal on the keypad signal circuit for longer than 15 s. If one of the OnStar® buttons is held or stuck for 15 s or greater, the telematics communication interface control module will set this DTC.

Action Taken When the DTC Sets

- The OnStar® status LED turns red.
- No calls can be placed.
- The telematics communication interface control module will ignore all inputs from the OnStar® button assembly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

After any repair is made to the 10 V reference circuit or button signal circuit the fuse to the telematics communication interface control module must be removed for 30 s to reset the control module. Failure to do so could result in incorrect diagnosis.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[OnStar Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

NOTE:

- **10 V reference circuit measurement may vary with vehicle battery voltage.**
- **Test for voltage range with vehicle battery measuring at a minimum of 11.5 V**

1. Vehicle OFF/Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF/Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode/Ignition ON.
4. Test for 8.0 - 10.5 V between the 10 V reference circuit terminal 16 and ground.
 - **If less than 8.0 V**
 1. Vehicle OFF/Ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the 10 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 10 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If greater than 10.5 V**

1. Vehicle OFF/Ignition OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode/Ignition ON.
2. Test for less than 1 V between the 10 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.

- **If between 8.0 - 10.5 V**

5. Vehicle OFF/Ignition OFF.

6. Test for 500 - 900 Ω between the signal circuit terminal 17 and ground.

- **If less than 500 Ω**

1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.

- **If greater than 900 Ω**

1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode/Ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If between 500 - 900 Ω**

7. Test or replace the S48B Multifunction Switch - Overhead Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Roof Console Replacement](#)
- Refer to [Control Module References](#) for telematics communication interface control module replacement, programming and setup.

SYMPTOMS - CELLULAR COMMUNICATION

NOTE: The following steps must be completed before using the symptom table.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.

- The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to [**OnStar Description and Operation**](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to [**Checking Aftermarket Accessories**](#).
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [**Testing for Intermittent Conditions and Poor Connections**](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [**Bluetooth Malfunction**](#)
- [**No Global Positioning System \(GPS\) Reception**](#)
- [**OnStar Microphone Malfunction**](#)
- [**OnStar Audio Malfunction**](#)
- [**OnStar Button LED Malfunction**](#)
- [**OnStar Call Center Remote Function Requests Malfunction**](#)
- [**OnStar Button Malfunction**](#)
- [**Unable to Contact OnStar Call Center**](#)
- [**OnStar Voice Recognition Malfunction**](#)
- [**OnStar Steering Wheel Control Functions Malfunction**](#)

SYMPTOMS - ENTERTAINMENT

IMPORTANT: The following steps must be completed before using the symptom table.

1. Perform the [**Diagnostic System Check - Vehicle**](#) before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to [**Radio/Audio System Description and Operation**](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to [**Checking Aftermarket Accessories**](#).
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Application Malfunction](#)
- [Auxiliary Audio Input Malfunction](#)
- [Bluetooth Malfunction](#)
- [Digital Radio Poor or No Reception](#)
- [Navigation System - Voice Recognition Malfunction](#)
- [No Global Positioning System \(GPS\) Reception](#)
- [Radio Poor Reception](#)
- [Speaker Malfunction](#)

APPLICATION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The term application refers to any piece of software that works on a system (hardware) that is being operated by its own software. Applications are typically small software programs which use the hardware to perform a specific task, as opposed to operating the entire system.

Diagnostic Aids

- For an application to be used, it must be installed on both the vehicle infotainment system and a compatible mobile device.
- The application must work correctly on the device to work with the vehicle infotainment system.
- The user may be required to log-in to the application on the mobile device before using the application from the vehicle controls.
- Applications use the mobile device and connection to a service provider to operate. Connection quality issues, or service provider data transmission issues can give the appearance of a vehicle malfunction.
- The device must be connected to the system. This may be done wirelessly via Bluetooth®, or via the vehicle USB port.

When a mobile device is connected via Bluetooth®, some or all of the device controls may be unavailable from the radio controls. This varies dependant upon the device being used. Refer to the vehicle owners manual, supplements, and the device manufacturers information for information on devices, control, and operation.

Refer to the device manufacturers information for the preferred connection method.

- The device must be unlocked, and any additional applications should be closed.
- If the device has any sound enhancement features such as noise reduction or echo control, these features should be turned off.
- A low battery condition in the mobile device may not allow the device to connect to the system, or can create communication issues with the device. Verify the device battery state of charge and re-charge or replace as needed.
- If a 'Please See Device' or similar type error message is displayed, this may indicate the device has lost it's connection to the vehicle, or the device has lost it's external data connection.
- If a cable is used for connection, attempt to connect the device using a different cable; cables can deteriorate over time or become damaged.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the application is installed on the mobile device and is up to date.
 - **If the application is not installed or is not up to date.**
Install or update the application on the device.
 - **If the application is installed on the mobile device and is up to date**
2. Verify the application operates correctly on the mobile device.
 - **If the application is not operating correctly on the mobile device.**
Refer to the application website
 - **If the application is operating correctly on the mobile device.**
3. Verify the radio calibrations are current.

- **If the radio calibrations are not current**

Reprogram the radio and re-evaluate the concern.

- **If no update calibrations are available**

4. Verify the application is installed on the radio and is up to date.

- **If the application is not installed or is not up to date.**

Install or update the application on the radio.

- **If the application is installed on the radio and is up to date**

5. Vehicle in Service Mode, radio ON, connect the mobile device to the infotainment system. Refer to the owners manual for information on the preferred connection method for the device.

- **If the mobile device cannot connect to the vehicle infotainment system.**

- If unable to connect via Bluetooth, refer to [Bluetooth Malfunction](#).

- If unable to connect via USB, refer to [Auxiliary Audio Input Malfunction](#).

- **If the mobile device connects to the vehicle infotainment system.**

6. Launch the application.

7. Verify the applications operates properly with the vehicle infotainment system.

- **If the application does not function properly**

Refer to diagnostic aids.

- **If the application functions properly**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

Refer to [Control Module References](#) for radio replacement, setup, and programming

AUXILIARY AUDIO INPUT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124B

USB 1 Circuit

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to	Open/High	Short to	Signal
---------	----------	-----------	----------	--------

	Ground	Resistance	Voltage	Performance
B+	B124B, 2	B124B, 1	-	-
USB Cable	B124B	B124B	B124B	-
Ground	-	1	-	-
1. Fault may affect one or more components, dependant on fault location 2. Fault affects multiple components, dependant on vehicle equipment				

Circuit/System Description

The infotainment system has a USB port and a Auxiliary Audio Input Jack located in the center console. The receptacle assembly receives fused battery voltage and ground from the harness to power the internal hub device as well as providing additional amperage to power USB devices.

The internal hub device interfaces directly with the human machine interface control module via a standard USB cable. A Mini type USB connector is used to connect the human machine interface control module and the USB receptacle. Standard USB male to female connections are typically used for connecting USB cables together where an in-line connection is required. An in-line cable connection is typically found between the console and I/P harness.

Auxiliary Audio Input Jack

When a portable audio playback device is connected to the 3.5 mm (1/8 in.) auxiliary audio input jack an internal switch opens the detection signal circuit within the hub. The HMI detects the device and AUX becomes available as an audio source. Audio signals from the device are converted from analog to digital, these signals are then sent to the HMI from the auxiliary input jack via USB.

USB Port

The USB port allows connectivity to the infotainment system from portable media players or a USB storage device (memory stick/flash drive). When a device is connected to the USB port, the system detects the device and switches to USB as the audio source. Once connected, the device can be controlled from the radio controls.

Not all portable media player devices or file types are compatible. Refer to the owner's manual for information on USB devices, control, and operation.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is run once per second when the infotainment system is operating

Conditions for Setting the DTC

B124B 0B

The human machine interface control module detects an excessive current condition on the USB 5 V circuit.

B124B 04

The human machine interface control module does not detect the vehicle hub device.

B124B 11

The human machine interface control module detects an additional hub device attached to the vehicle USB port.

Action Taken When the DTC Sets

The USB port is inoperative while the DTC is current.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

- This DTC may be set due to the connection of an incompatible or faulty USB device.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-50334-20** Multi-Media Interface Tester (MIT)
- **EL-50334-50** USB Cable and Adapter Kit
- **EL-50334-14** Infotainment Test Cable

Circuit/System Verification

1. Verify DTC B124B is not set. Since occurrences of this DTC can be caused by an incompatible or faulty USB device, review with the customer the conditions under which their concern occurred.

- **If DTC B124B is set.**

Refer to Circuit/System Testing.

- **If DTC B124B is not set.**

2. Ignition On/Vehicle in Service Mode. Infotainment system ON.
3. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
4. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

Refer to Circuit/System Testing

- **If audio is heard from test tool**

5. Verify the infotainment system can be switched to AUX as the audio source with the EL-50334-20 Multi-Media Interface Tester (MIT) connected to the auxiliary audio input jack.

- **If the infotainment system can not be switched to AUX as the audio source**

Refer to Circuit/System Testing

- **If the infotainment system can be switched to AUX as the audio source**

6. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the vehicle infotainment system while operating the test tool to begin audio playback.

- **If audio is not heard from the test tool.**

Refer to Circuit/System Testing

- **If audio is heard from the test tool.**

7. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the X83 Auxiliary Audio Input.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Verify that a test lamp illuminates between the B+ circuit terminal 6 and ground.

- **If the test lamp does not illuminate**

1. Ignition OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- **If the test lamp illuminates**

4. Verify the USB cable is properly connected at all components and in-line connections, and there is no damage to the cable or connections.

- **If connection problems or cable damage is noted.**

Perform the appropriate repair or replacement to correct any issues.

- **If no connection problems or cable damage is noted.**

5. Connect the X1 harness connector at the X83 Auxiliary Audio Input.
6. Disconnect the vehicle USB cable X3 harness connector at the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input Adapter.
7. Connect the EL-50334-14 Infotainment Test Cable and the EL-50334-2 Type-A Female to Mini-B Male Cable together. Connect the assembled test cable to the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input.
8. Ignition On/Vehicle in Service Mode. Infotainment system ON.
9. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
10. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

1. Replace the X83 Auxiliary Audio Input Adapter. Connect all harness connectors.
2. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
3. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- If audio is not heard from the test tool, replace the K74 Human Machine Interface Control Module.

- **If audio is heard from the test tool**

11. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input AUX port and select the AUX test mode.
12. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**

1. Replace the X83 Auxiliary Audio Input Adapter. Connect all harness connectors.

- **If audio is heard from the test tool.**

13. Replace the vehicle USB cable between the K74 Human Machine Interface Control Module and the X83 Auxiliary Audio Input Adapter.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Audio Disc Player and USB Receptacle Replacement](#)
- Refer to [Control Module References](#) for human machine interface control module replacement, programming, and setup.

BLUETOOTH MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

Bluetooth® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The available features and functions are determined by the type of device and the software within the devices being used. For a feature or function to operate, it must be supported in both devices.

The Bluetooth® hardware is internal to the radio. The radio supports streaming of data (music, voice, information) from cellular phones and other mobile devices that support those features. The radio may also be capable of interfacing with cellular phones for hands-free features.

Refer to the vehicle owners manual, supplements, and the device manufacturers information for information on devices, control, operation. and pairing instructions.

Diagnostic Aids

- Verify the mobile device is properly configured for the feature being used. Refer to the device manufacturers information.
- Verify the function/feature that is being used is supported by the mobile device.
- The device must be paired to the radio to use the available Bluetooth® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- The system can store pairing information for multiple devices, but can only be actively connected to one at any given time.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-50334-20 Multi-Media Interface Tester (MIT)

Circuit/System Verification

1. Verify no DTCs are present.

- **If any DTCs are present**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no DTCs are present**

2. Verify the radio calibrations are current.

- **If the radio calibrations are not current**

Reprogram the radio and re-evaluate the concern.

- **If no update calibrations are available**

NOTE: The MIT tool can be used to test either cellular phone or streaming audio functions. Refer to the tool instructions, and perform the appropriate test(s) related to the customers concern in the following steps.

3. Vehicle in Service Mode, infotainment system ON.

4. Verify the infotainment system successfully pairs with the MIT tool.

- **If the infotainment system does not successfully pair with the MIT tool.**

Replace the A11 radio.

- **If the infotainment system successfully pairs with the MIT tool.**

5. Verify the infotainment system successfully completes the desired feature test using the MIT tool.

- **If the feature test is not successful**

Replace the A11 radio.

- **If the feature test is successful**

6. All OK. Refer to Diagnostic Aids.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for radio replacement, programming, and setup.

DIGITAL RADIO POOR OR NO RECEPTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal message is not displayed on the radio.

- **If DTC B125C is set as current or the No XM Signal message is displayed.**

Refer to Circuit/System Testing.

- **If DTC B125C is not set as current and the No XM Signal message is not displayed.**

3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the A11 Radio. Connect the **EL-48028** Digital Radio Test Antenna to the radio and place on the roof of the vehicle.
2. Ignition ON/Vehicle in Service Mode, radio tuned to XM channel 1.
3. Verify DTC B125C is not set as current and XM reception is improved.

- **If DTC B125C is set as current or XM reception is not improved**

Replace the A11 Radio.

- **If DTC B125C is not set as current and XM reception is improved**

4. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the T2RR Antenna - Roof Rear.
 5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.
- **If the coax cable does not pass the test**

Replace the antenna coax cable

- **If the coax cable passes the test**

6. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut,

damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.

- If 5 Ω or greater

Replace the coax cable

- If less than 5 Ω

3. Test for less than 5 Ω between the coax cable outer shield end to end.

- If 5 Ω or greater

Replace the coax cable

- If less than 5 Ω

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- If less than infinite resistance

Replace the coax cable

- If infinite resistance

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for radio replacement, programming, and setup.

ONSTAR MICROPHONE MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone High Signal Terminal 9	B2455 02	B2455 04	B2455 04	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone Low Signal Terminal 10	B2455 02	B2455 04	B2455 04	-
Cellular Telephone Voice Signal Terminal 6	2	1	2	-
Cellular Telephone Voice Low Signal Terminal 12	-	2	2	-
1. Voice Cannot be Heard by Telephone Conversation Partner 2. Customer Voice may be distorted for Telephone Conversation Partner				

Circuit/System Description

The telematics communication interface control module provides the Cellular Phone Microphone with a supplied voltage on the cellular phone microphone signal circuit. When the cellular phone microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the signal circuit.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: It is necessary to have the vehicle in a quiet, open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.

1. Vehicle in Service Mode.
2. Verify that DTC B2455 is not set.
 - If DTC B2455 is set

Refer to [DTC B2455](#).

- **If DTC B2455 is not set**

3. Verify that a successful OnStar voice command can be made.

- **If your voice can not be heard clearly**

Refer to Circuit/System Testing - Microphone Malfunction.

- **If your voice can be heard clearly**

4. Verify that your voice is heard clearly by the OnStar Call Center after completing a blue button press.

- **If your voice can not be heard clearly**

Refer to Circuit/System Testing - Cellular Telephone Voice Malfunction.

- **If your voice can be heard clearly**

5. All OK.

Circuit/System Testing

Microphone Malfunction

1. Vehicle OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, vehicle in Service Mode.

2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.

- **If less than 8.0 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the vehicle K73 Telematics Communication Interface Control Module.

- **If greater than 10.5 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K73 Telematics Communication Interface Control Module.

- **If between 8.0-10.5 V**

3. Test for less than 1 V between the signal circuit terminal A and ground.

- **If greater than 1 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
- **If less than 8 V**
1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the vehicle K73 Telematics Communication Interface Control Module.
 - **If greater than 9 V**
5. Test or replace the B24 Cellular Phone Microphone.

Cellular Telephone Voice Malfunction

1. Vehicle OFF and vehicle systems OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module and the X4 harness connector at the A11 Radio, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuits listed below and ground.
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
 - **If greater than 1 V**

Repair the short to voltage in the circuit.

 - **If less than 1 V**
3. Vehicle OFF.
4. Test for infinite resistance between the signal circuits listed below and ground.
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

 - **If infinite resistance**
5. Test for less than 2 Ω in the signal circuits listed below end to end.
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
 - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace the K73 Telematics Communication Interface Control Module.

7. Verify that your voice is heard clearly by the OnStar Call Center after completing a blue button press.

- **If your voice can not be heard clearly**

Replace the A11 Radio.

- **If your voice can be heard clearly**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

- Refer to [Mobile Telephone Microphone Replacement](#)
- Refer to [Control Module References](#) for telematics communication interface control module replacement, programming, and setup

NAVIGATION SYSTEM - VOICE RECOGNITION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voice Recognition Audio Signal	1	1	1	-
Voice Recognition Audio Low Reference	-	1	-	-
1. navigation voice recognition inoperative				

Circuit/System Description

When voice recognition for the navigation equipped infotainment system is started, voice signals from the cellular phone microphone are passed through the telematics communication interface control module to the radio via the voice recognition audio circuits.

Diagnostic Aids

- Refer to the Navigation System Owners Manual for voice recognition use and commands.
- Navigation voice commands are not available until the OK button has been selected.
- If the radio is off, the only commands available will be Hands Free and Help.
- When the system recognizes the command the system will either perform the function or ask to confirm the choice by clearly saying "yes" or "no".
- If experiencing difficulty with the system recognizing a command, confirm that the command is correct.
- Background noise such as a climate control fan positioned on high, open windows, or very loud outside noises,

can cause voice commands to be misunderstood.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the OnStar® voice recognition system is operating normally.
 - **If the OnStar® voice recognition system is not operating normally.**

Refer to **OnStar Voice Recognition Malfunction**.

- **If the OnStar® voice recognition system is operating normally.**
2. Vehicle in Service Mode, radio ON.

NOTE: **Refer to the Navigation System Owners Manual for voice recognition use and commands.**

3. Begin voice recognition for the radio and clearly speak one of the available commands.
4. Verify the infotainment system responds correctly to the command.
 - **If the infotainment system does not respond correctly to the command.**
 1. Clearly speak a different command.
 2. Verify the infotainment system responds correctly to the command.
 - If the infotainment system does not respond correctly to any commands, refer to Circuit/System Testing.
 - If the infotainment system responds correctly to the command.
 3. Refer to the navigation system owners manual for hints on speaking commands.
 - **If the infotainment system responds correctly to the command.**

5. All OK

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module Control Module and the X4 harness connector at the A11 Radio.
2. Vehicle in Service Mode.
3. Test for less than 1 V between the signal circuits listed below and ground:
 - voice recognition signal circuit A11 Radio X4 terminal 6
 - voice recognition low reference circuit A11 Radio X4 terminal 16
 - **If 1 V greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
4. Vehicle OFF.
5. Test for infinite resistance between the circuits listed below and ground:
 - voice recognition signal circuit A11 Radio X4 terminal 6
 - voice recognition low reference circuit A11 Radio X4 terminal 16
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
6. Test for less than 5 Ω between the terminals listed below:
 - A11 Radio X4 terminal 6 and the K73 Telematics Communication Interface Control Module Control Module X2 terminal 6
 - A11 Radio X4 terminal 16 and the K73 Telematics Communication Interface Control Module Control Module X2 terminal 12
 - **If 5 Ω greater**

Repair the open/high resistance in the circuit.
 - **If less than 5 Ω**
7. Replace the A11 Radio. Connect all harness connectors.

NOTE: Refer to the Navigation System Owners Manual for voice recognition use and commands.

8. Begin voice recognition for the radio and clearly speak one of the available commands.
9. Verify the infotainment system responds correctly to the command.
 - **If the infotainment system does not respond correctly to the command**
 1. Clearly speak a different command.
 2. Verify the infotainment system responds correctly to the command.
 - If the infotainment system does not respond correctly to any commands, replace the K73 Telematics Communication Interface Control Module.

- If the infotainment system responds correctly to the command

10. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for radio or telematics communication interface control module replacement, programming, and setup.

ONSTAR AUDIO MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Audio Signal	1	1	1	-
Audio Common Signal	-	1	-	-
1. No or noisy OnStar® audio				

Circuit/System Description

When an OnStar® keypress is made, a serial data message is sent to the audio system to mute all radio functions and output OnStar® originated audio. After the audio system is muted, the telematics communication interface control module transmits signals to the audio system on the audio signal and audio common circuits.

Reference Information

Schematic Reference

- [OnStar/Telematics Schematics](#)
- [Radio/Navigation System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[OnStar Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, radio ON.
2. Verify that audio is heard clearly through all speaker channels when tuning radio to a known good station.
 - **If audio is not heard clearly**

Refer to **Speaker Malfunction**
 - **If audio is heard clearly**
3. Verify that the Connecting to OnStar® message is heard clearly through the audio system when the OnStar® blue button is pressed.
 - **If OnStar message is noisy or distorted**

Refer to Circuit/System Testing
 - **If OnStar message is heard clearly**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio and the X2 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminals listed below and ground:
 - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2
 - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Vehicle OFF.
4. Test for infinite resistance between the signal circuits listed below and ground:
 - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2
 - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
5. Test for less than 2 Ω between the signal circuit terminals listed below:
 - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2 and the A11 Radio signal circuit terminal 20 X1
 - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2 and the A11

Radio signal circuit terminal 19 X1

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace the K73 Telematics Communication Interface Control Module.

7. Verify that the Connecting to OnStar® message is heard clearly through the audio system when the OnStar® blue button is pressed.

- **If audio is not heard clearly**

Replace the A11 Radio.

- **If audio is heard clearly**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for module replacement, programming, and setup.

NO GLOBAL POSITIONING SYSTEM (GPS) RECEPTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2462 02

Global Positioning System Short to Ground

DTC B2462 04

Global Positioning System Open

Circuit/System Description

The navigation antenna is connected to the Telematics Communication Interface Control Module. The module supplies 5 V to the antenna to power the internal amplifier through the center conductor of the antenna coax cable.

When the vehicle is equipped with the optional navigation system, a Navigation Antenna Signal Splitter is installed to distribute the navigation signal to both the Telematics Communication Interface Control Module and the Human Machine Interface Control Module. The Human Machine Interface Control Module supplies 5 V through the coax cable to power the Navigation Antenna Signal Splitter.

Conditions for Running the DTC

- Radio On.

- System voltage is greater than 9 V and less than 16 V.
- The navigation system/telematics communication interface control module tests the GPS antenna every 10 s.

Conditions for Setting the DTC

B2462 02

The Telematics Communication Interface Control Module or Human Machine Interface Control Module detects a short to ground on the GPS antenna signal circuit.

B2462 04

The Telematics Communication Interface Control Module or Human Machine Interface Control Module detects a open/high resistance on the GPS antenna signal circuit.

Action Taken When the DTC Sets

- The Telematics Communication Interface Control Module or Human Machine Interface Control Module uses the last reported position and the vehicle speed signal to calculate the vehicle position.
- Route guidance may be inaccurate.
- Turn by turn navigation may be inaccurate or inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction - free ignition cycles have occurred.

Diagnostic Aids

- The scan tool Telematics Communication Interface Control Module GPS signal parameter will display a Yes or No dependent upon whether or not the module sees an increment of the seconds transmitted by GPS signals to the Telematics Communication Interface Control Module. Upon entering this screen, the GPS signal title will initially display Yes, regardless of the presence of time increment, for at least 2 seconds, while the algorithm in the scan tool determines the status of the clock. If increment is found, Yes is continually displayed. If the clock remains static, No is displayed. The scan tool looks for increment every second, regardless of current display.
- Inaccurate or aged GPS position concerns which are no longer present may have been due to the temporary loss of GPS signal reception by the vehicle. Conditions such as tunnels or parking structures will restrict the cellular phone and navigation antenna from a clear view of the satellites in the sky and may have caused this temporary data loss.
- The GPS requires a clear line of sight to the sky to operate properly. In most cases the GPS will not have reception near tall buildings or inside structures.

Reference Information

Schematic Reference

- [OnStar/Telematics Schematics](#)
- [Radio/Navigation System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [OnStar Description and Operation](#)
- [Radio/Audio System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-49903 OnStar Antenna Diagnostic Tool Kit

Circuit/System Verification

NOTE: The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 minutes after turning the ignition ON for the vehicle to acquire the GPS satellites signal.

1. Ignition ON/vehicle in Service Mode.
2. Verify that DTC B2462 is not set in the Telematics Communication Interface Control Module.
 - **If DTC B2462 is set in the Telematics Communication Interface Control Module and the vehicle is not equipped with a navigation system**

Refer to Circuit/System Testing Without Navigation System.
 - **If DTC B2462 is set in the Telematics Communication Interface Control Module and the vehicle is equipped with a navigation system**

Refer to Circuit/System Testing With Navigation System.
 - **If DTC B2462 is not set in the Telematics Communication Interface Control Module**
3. Verify an OnStar advisor can locate the vehicle after performing a blue button press.
 - **If the advisor can not locate the vehicle and the vehicle is not equipped with a navigation system**

Refer to Circuit/System Testing Without Navigation System
 - **If the advisor can not locate the vehicle and the vehicle is equipped with a navigation system**

Refer to Circuit/System Testing With Navigation System.
 - **If the advisor can locate the vehicle**
4. Verify DTC B2462 is not set in the Human Machine Interface Control Module.
 - **If DTC B2462 is set in the Human Machine Interface Control Module**

Refer to Circuit/System Testing With Navigation System - Step 9.

- **If DTC B2462 is not set in the Human Machine Interface Control Module**

5. Verify that the NO GPS symbol/message is not displayed on the radio display.

- **If the NO GPS symbol/message is displayed**

Refer to Circuit/System Testing With Navigation System - Step 9.

- **If the NO GPS symbol/message is not displayed**

6. All OK.

Circuit/System Testing

without Navigation System

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF/vehicle OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module.
2. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-6 coax cable attach the grey connector to the combiner and the brown connector to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is set or the advisor can not locate the vehicle**

Replace the K73 Telematics Communication Interface Control Module.

- **If DTC B2462 is not set or the advisor can locate the vehicle**

4. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T2RR Antenna - Roof Rear. Refer to component testing.

- **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**

5. Test or replace the T2RR Antenna - Roof Rear.

with Navigation System

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF/vehicle OFF, disconnect the T2RR Antenna - Roof Rear coax cable at the T15 Navigation Antenna Signal Splitter.
2. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-7 coax cable attach one grey connector to the combiner and the other grey connector to the T15 Navigation Antenna Signal Splitter. Place the test antenna on the roof of the vehicle, ignition ON.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is not set or the advisor can locate the vehicle**

1. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the T2RR Antenna - Roof Rear. Refer to Component Testing.

- If the coax cable does not pass the test

Replace the coax cable.

- If the coax cable passes the test

2. Replace the T2RR Antenna - Roof Rear.

- **If DTC B2462 is set or if the advisor can not locate the vehicle**

4. Ignition OFF/vehicle OFF, disconnect the GPS and cellular coax cable connector at the K73 Telematics Communication Interface Control Module.
5. Attach both leads of the EL-49903-1 OnStar test antenna to the EL-49903-5 combiner. Using the EL-49903-6 coax cable attach the grey connector to the combiner and the brown connector to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON.
6. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.

- **If DTC B2462 is set or the advisor can not locate the vehicle.**

Replace the K73 Telematics Communication Interface Control Module.

- **If DTC B2462 is not set or the advisor can locate the vehicle.**

7. Ignition OFF/vehicle OFF.
8. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the K73 Telematics Communication Interface Control Module. Refer to Component Testing.

- **If the coax cable does not pass the test.**

Replace the coax cable.

- **If the coax cable passes the test.**

9. Ignition OFF/vehicle OFF, disconnect the blue GPS coax cable connector at the K74 Human Machine Interface Control Module.
10. Attach the EL-49903-1 OnStar test antenna blue connector to the K74 Human Machine Interface Control Module and place the test antenna on the roof of the vehicle.
11. Ignition ON/vehicle in Service Mode.
12. Verify DTC B2462 is not set or that the NO GPS symbol/message is not displayed on the radio.

- **If DTC B2462 is set or the NO GPS symbol/message is displayed**

Replace the K74 Human Machine Interface Control Module

- **If DTC B2462 is not set or if the NO GPS symbol/message is not displayed.**

13. Ignition OFF/vehicle OFF.
14. Test the coax cable between the T15 Navigation Antenna Signal Splitter and the K74 Human Machine Interface Control Module. Refer to Component Testing.

- **If the coax cable does not pass the test.**

Replace the coax cable.

- If the coax cable passes the test.

15. Test or replace the T15 Navigation Antenna Signal Splitter.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE:

- Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.
- To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.
- The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.

Coax Cable Test

1. Ignition OFF/vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between the coax cable center terminal end to end.

- If 5 Ω or greater

Replace the coax cable.

- If less than 5 Ω

3. Test for greater than 5 Ω between the coax cable outer shield end to end.

- If 5 Ω or greater

Replace the coax cable.

- If less than 5 Ω

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- If less than infinite resistance

Replace the coax cable.

- If infinite resistance

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for Human Machine Interface control module or Telematics Communication Interface Control Module replacement, programming, and setup.

ONSTAR BUTTON LED MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 02	B2476 04	B2476 04	-
Red LED Control Terminal 14	1	1	2	-
Green LED Control Terminal 15	1	1	2	-
Ground	-	B2476 04	-	-
1. OnStar® LED Inoperative 2. LED Illuminated At All Times				

Circuit Description

The OnStar® status LEDs are located with the OnStar buttons. The green LED is illuminated when the system is ON and operating normally. When the green LED is green and flashing, it is an indication that a call is in progress. When the red LED is illuminated, a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the LED will flash red during the call. The OnStar® LEDs are controlled by the telematics communication interface control module via the keypad green LED signal circuit and the keypad red LED signal circuit.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[OnStar Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE:

- If the green LED is off with the ignition ON and the LED does not function when commanded with the scan tool, contact the OnStar Center to confirm the vehicle has a current subscription.

1. Vehicle in Service Mode/Ignition ON.

2. Verify no DTCs are set.

- If any DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- If no DTCs are set

3. Verify that the green LED turns ON and OFF when commanding the Green Indicator ON and OFF with a scan tool.

- If the green LED does not turn ON and OFF

Refer to Circuit/System Testing - Green LED Test

- If the green LED turns ON and OFF

4. Verify that the red LED turns ON and OFF when commanding the Red Indicator ON and OFF with a scan tool.

- If the red LED does not turn ON and OFF

Refer to Circuit/System Testing - Red LED Test

- If the red LED turns ON and OFF

5. All OK.

Circuit/System Testing**Green LED Test**

1. Vehicle OFF/Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 min for all vehicle systems to power down. Doors closed, courtesy lamps OFF.

2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- If 10 Ω or greater

1. Vehicle OFF/Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- If less than 10 Ω

3. Vehicle in Service Mode/Ignition ON.

4. Test for less than 1 V between the control circuit terminal 15 and ground while commanding the Green Indicator OFF with a scan tool.

- If 1 V or greater

1. Vehicle OFF/Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode/Ignition ON.

2. Test for less than 1 V between the control circuit terminal 15 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
- **If less than 1 V**
5. Test for greater than 8 V between the control circuit terminal 15 and ground while commanding the Green Indicator ON with a scan tool.
 - **If 8 V or less**
 1. Vehicle OFF/Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
 2. Test for infinite resistance between the control circuit terminal 15 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.
 - **If greater than 8 V**
6. Test or replace the S48B Multifunction Switch - Overhead Console.

Red LED Test

1. Vehicle OFF/Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 min for all vehicle systems to power down. Doors closed, courtesy lamps OFF.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF/Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode/Ignition ON.
4. Test for less than 1 V between the control circuit terminal 14 and ground while commanding the Red Indicator OFF with a scan tool.
 - **If 1 V or greater**
 1. Vehicle OFF/Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode/Ignition ON.
 2. Test for less than 1 V between the control circuit terminal 14 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
 - **If less than 1 V**
5. Test for greater than 8 V between the control circuit terminal 14 and ground while commanding the Red Indicator ON with a scan tool.

- **If 8 V or less**

1. Vehicle OFF/Ignition OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
2. Test for infinite resistance between the control circuit terminal 14 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If greater than 8 V**

6. Test or replace the S48B Multifunction Switch - Overhead Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

- Refer to [Roof Console Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

ONSTAR CALL CENTER REMOTE FUNCTION REQUESTS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module has the capability of commanding the horn, initiating door lock/unlock, or operating the exterior lamps using the serial data circuits. These functions are commanded by the OnStar® Call Center per a customer request.

Diagnostic Aids

The customer concern may have been due to a lack of cellular service in a given area, or a failure in the National Cellular Network infrastructure that has since been corrected.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[OnStar Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE:

- It is necessary to inform the OnStar® Call Center advisor that this call is for vehicle diagnostic purposes.
- It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.

1. Vehicle in Service Mode.
2. Verify that the horn, lights, and the door locks on the vehicle operate properly.
 - If an applicable vehicle system does not operate properly
Refer to [Diagnostic System Check - Vehicle](#).
 - If all applicable vehicle systems operate properly
3. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
 - If unable to contact the OnStar® call center
Refer to [Unable to Contact OnStar Call Center](#)
 - If able to contact the OnStar Call Center
4. Verify with the OnStar advisor that all remote functions (door locks, lights, and horn) work.
 - If the remote functions do not operate when requested
Replace the K73 telematics communication interface control module
 - If the remote functions operate when requested
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for telematics communication interface control module replacement, programming and setup.

ONSTAR BUTTON MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 02	B2476 04	B2476 04	-
Signal Terminal 17	B2476 02	B2476 04	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-

Circuit/System Description

The OnStar® button assembly consists of 3 buttons, Call/Answer, OnStar® Call Center, and OnStar® Emergency. The telematics communication interface control module supplies the OnStar® button assembly with 10 V via the keypad supply voltage circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been activated.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Contact the OnStar® Call Center first before pressing the emergency button in order to notify them of the test.

1. Vehicle in Service Mode.
2. Verify no DTCs are set.
 - If any DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no DTCs are set**

3. Verify that each OnStar® button operates normally by pressing each button individually.

- **If none of the buttons operate normally**

Refer to Circuit System Testing.

- **If some, but not all, of the buttons operate normally**

Test or replace the S48B Multifunction Switch - Overhead Console.

- **If all of the buttons operate normally**

4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Test for 8.0 - 10.5 V between the 10 V reference circuit terminal 16 and ground.

- **If less than 8.0 V**

1. Vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.

2. Test for infinite resistance between the 10 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the 10 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If greater than 10.5 V**

1. Vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the 10 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K73 Telematics Communication Interface Control Module.

- **If between 8.0 - 10.5 V**

5. Vehicle OFF.

6. Test for 500 - 900 Ω between the signal circuit terminal 17 and ground.

- **If less than 500 Ω**

1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K73 Telematics Communication Interface Control Module.

- **If greater than 900 Ω**

1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If between 500 - 900 Ω**

7. Test or replace the S48B Multifunction Switch - Overhead Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

- Refer to [Roof Console Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

ONSTAR STEERING WHEEL CONTROL FUNCTIONS MALFUNCTION

Some vehicles equipped with the OnStar® system have the capability of accessing voice mailboxes and other automated phone systems by means of the steering wheel controls, while the OnStar® Personal Calling feature is in use. If the "Talk" or "Mute" button (depending upon the vehicle) on the steering wheel controls is depressed during an OnStar® Personal Calling call, the telematics communication interface control module receives the message on the serial data bus from either the radio or body control module. This message is interpreted as a request to turn any spoken numbers into dual tone multi-frequency tones to be delivered over the airwaves to the phone system the user is communicating with. Complete instructions for operation of these features can be found in the information provided to the customer with the OnStar® system.

The steering wheel controls are a resistor network that consist of multiple momentary contact switches and a series of resistors. The switches and resistor network are arranged so that each switch has a different resistance value. When a switch is pressed, a voltage drop occurs in the resistor network, which produces a specific voltage value unique to the switch selected, to be interpreted by either the radio or BCM. In the event the OnStar® steering wheel control functions are inoperative, technicians should refer to [Steering Wheel Controls Malfunction](#), to begin diagnosis of the steering wheel control concern.

RADIO POOR RECEPTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125A 02

Antenna Signal Circuit Short to Ground

DTC B125A 04

Antenna Signal Circuit Open Circuit

DTC B125A 01

Antenna Signal Circuit Short to Battery

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	B125A 01	-

Circuit/System Description

The radio antenna for AM and FM radio reception is connected to the radio with a coaxial cable.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B125A 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125A 04

The radio detects an open in the antenna signal circuit center conductor.

B125A 01

The radio detects a short to battery in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Poor AM and FM radio reception is dependent on multiple influences, some of which may not be vehicle related. Areas which have high RF traffic or block the signal path may cause a degradation in radio reception. Radio reception may also be influenced by items within the vehicle, but are not part of the radio system. Such examples are aftermarket electrical accessories or other items which may generate noise in the vehicle electrical system.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Inspect the antenna for proper mounting or physical damage.
 - **If damage is found**
Repair or replace as necessary
 - **If no damage is found**
2. Ignition ON/Vehicle in Service Mode, A11 Radio ON.
3. Verify station reception is normal when tuned to several known good AM and FM stations.
 - **If AM or FM reception is poor.**
Refer to Circuit/System Testing
 - **If reception is normal**
4. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T2RR Antenna - Roof Rear.
2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.

- **If the coax cable does not pass the test**

Replace the antenna coax cable

- **If the coax cable passes the test**

3. Connect the antenna coax cable to the T2RR Antenna - Roof Rear.
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield at the radio end of the coax cable.

- **If less than infinite resistance**

Replace the radio antenna base.

- **If infinite resistance**

5. Test for less than 10 Ω between the coax cable outer shield and ground at the radio end of the coax cable.

- **If 10 Ω or greater**

1. Clean the mounting surface of the radio antenna base.
2. Connect the antenna coax cable to the T2RR Antenna - Roof Rear.
3. Test for less than 10 Ω between the coax cable outer shield and ground at the radio end of the coax cable.
 - If 10 Ω or greater, replace the antenna base.
 - If less than 10 Ω , connect all harness connectors. Verify station reception is normal when tuned to several known good AM and FM stations. If AM or FM reception concerns are still present, replace the A11 Radio.

- **If less than 10 Ω**

6. Test or replace the A11 Radio.

Component Testing

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.

- **If 5 Ω or greater**

Replace the coax cable

- **If less than 5 Ω**

3. Test for less than 5 Ω between the coax cable outer shield end to end.

- **If 5 Ω or greater**

Replace the coax cable

- **If less than 5 Ω**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- **If less than infinite resistance**

Replace the coax cable

- **If infinite resistance**

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [High Frequency Antenna Replacement](#)
- Refer to [Control Module References](#) for radio replacement, programming, and setup.

SPEAKER REPLACEMENT REFERENCE

Component	Repair Instruction
Front Center Speaker	Radio Front Center Speaker Replacement
Front Tweeter Speakers	Radio Front Speaker Replacement
Front Door Speakers	Radio Front Side Door Speaker Replacement
Rear Door Speakers	Radio Rear Side Door Speaker Replacement
Rear Subwoofer	Radio Rear Compartment Speaker Replacement

SPEAKER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Amplifier B+	1	1	-	-
Amplifier LF Audio Signal	2	2	2, 3	2
Amplifier LR Audio Signal	2	2	2, 3	2
Amplifier RF Audio Signal	2	2	2, 3	2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Amplifier RR Audio Signal	2	2	2, 3	2
Amplifier Subwoofer Audio Signal	2	2	2, 3	2
Radio LF Audio Signal	B1025 02*, 2	B1025 02*, 2	B1025 02*, 2, 3	2
Radio LR Audio Signal	B1035 02*, 2	B1035 02*, 2	B1035 02*, 2, 3	2
Radio RF Audio Signal	B1045 02*, 2	B1045 02*, 2	B1045 02*, 2, 3	2
Radio RR Audio Signal	B1055 02*, 2	B1055 02*, 2	B1055 02*, 2, 3	2
Remote Enable Signal	B1265 02, 1	1, 4	-	-
Amplifier Control	B1287 02	B1287 04	B1287 01	-
Amplifier Ground	1	1	-	-
1. Audio inoperative, no sound from all speakers. 2. No or reduced audio from speaker(s) on the affected audio circuit. 3. Noticeable audio distortion may be present. 4. Fault may affect one or more components, dependant on vehicle equipment. * When equipped with an amplifier, the radio does not set this DTC.				

Circuit/System Description

Each of the audio output channel circuits (+) and (-), at the radio and audio amplifier (if equipped) have a DC bias voltage that is approximately one half of battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5 V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.

The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.

If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.

- When equipped with an amplifier, it is possible for some individual circuit faults to affect more than one speakers operation. Perform diagnostic tests in the sequence listed to avoid misdiagnosis.
- The amplifier control circuit will measure less than 1 V when the mute function is OFF, and approximately 8 V DC when at full mute. When mute is active, the radio stops sending the varying AC voltage to the amplifier/speakers.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-50 USB Cable and Adapter Kit

Circuit/System Verification

Without Amplifier

Radio ON, Mute OFF, verify clear audio is heard from each audio speaker.

- If audio is inoperative from all speakers, replace the radio.
- If audio is inoperative from one or more, but not all, speakers or the audio emitted from the speakers is not clear, refer to Speaker Circuit Malfunction - without Amplifier.

With Amplifier

Radio ON, Mute OFF, verify clear audio is heard from each audio speaker.

- If audio is not heard from all speakers, or the audio emitted from the speakers is not clear, refer to Speaker Circuit Malfunction- with Amplifier.

Circuit/System Testing

Speaker Malfunction - without Amplifier

NOTE: In the following tests, audio signal frequencies (Hz) will be tested. To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.

1. Vehicle OFF, disconnect the harness connector at the appropriate P19 Speaker. Vehicle in Service Mode, radio ON, mute OFF.
2. Test for 5 - 7 V between each audio signal circuit terminal 1 and terminal 2 and ground.
 - **If less than 5 V**
 1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
 2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the A11 Radio.
 - **If greater than 7 V**
 1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio. Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the A11 Radio.
 - **If between 5 - 7 V**
 3. Insert the EL-50334-6 Audio Test CD from the **EL-50334-50** USB cable and adapter kit. Play track number three (50 Hz bass test tone) from the test CD.
 4. Test for 49 - 51 Hz AC between each signal circuit terminal 1 and terminal 2 and ground.
 - **If not between 49 - 51 Hz AC**

Replace the A11 Radio.
 - **If between 49 - 51 Hz AC**
 5. Test or replace the P19 Speaker.

Speaker Malfunction- with Amplifier

1. Vehicle OFF, disconnect the X1 harness connector at the T3 Audio Amplifier.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 3. Verify that a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to **Power Mode Mismatch** .
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the T3 Audio Amplifier.

- **If the test lamp illuminates**

4. Disconnect the X2 harness connector at the T3 Audio Amplifier.

5. Verify a test lamp does not illuminate between the control circuit terminal 14 and ground.

- **If the test lamp illuminates**

1. Disconnect the X1 harness at the A11 Radio.

2. Verify a test lamp does not illuminate between the control circuit and ground.

- If the test lamp illuminates, repair the short to voltage on the circuit.
- If the test lamp does not illuminate, replace the A11 Radio.

- **If the test lamp does not illuminate**

6. Vehicle in Service Mode, A11 Radio ON.

7. Verify a test lamp illuminates between the control circuit terminal 14 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF. Disconnect the X1 harness at the A11 Radio.

2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the A11 Radio.

- **If the test lamp illuminates**

8. Radio ON, mute ON.

9. Test for 7.5 - 8.5 V between the control circuit terminal 12 and ground.

- **If greater than 8.5 V**

1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio. Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the A11 Radio.

- **If less than 7.5 V**

1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the A11 Radio.

- **If between 7.5 - 8.5 V**

10. Radio ON, mute OFF.

11. Test for less than 1 V between the control circuit terminal 12 and ground.

- **If greater than 1 V**

Replace the A11 Radio.

- **If less than 1 V**

12. Vehicle OFF, disconnect the X3 harness connector at the T3 Audio Amplifier.

13. Vehicle in Service Mode, A11 Radio ON.

14. Test for 5 - 7 V between the signal circuit terminals listed below and ground:

- Left front low level audio signal (+) terminal 14
- Left front low level audio signal (-) terminal 6
- Right front low level audio signal (+) terminal 5
- Right front low level audio signal (-) terminal 13
- Left rear low level audio signal (+) terminal 12
- Left rear low level audio signal (-) terminal 4
- Right rear low level audio signal (+) terminal 3
- Right rear low level audio signal (-) terminal 11
- **If less than 5 V**

1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the A11 Radio.

• **If greater than 7 V**

1. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio. Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the A11 Radio.

• **If between 5 - 7 V**

15. Insert the EL - 50334 - 6 Audio Test CD from the **EL-50334-50** USB cable and adapter kit. Play track number three (50 Hz bass test tone) from the test CD.

16. Test for 49 - 51 Hz AC between the audio signal circuit terminals listed below and ground:

- Left front low level audio signal (+) terminal 14
- Left front low level audio signal (-) terminal 6
- Right front low level audio signal (+) terminal 5
- Right front low level audio signal (-) terminal 13
- Left rear low level audio signal (+) terminal 12
- Left rear low level audio signal (-) terminal 4
- Right rear low level audio signal (+) terminal 3
- Right rear low level audio signal (-) terminal 11
- **If not between 49 - 51 Hz AC**

Replace the A11 Radio.

• **If between 49 - 51 Hz AC**

17. Vehicle OFF, connect all harness connectors.

18. Disconnect the harness connector at the appropriate P19 Speaker. Vehicle in Service Mode, A11 Radio ON.

19. Test for 5 - 7 V between the appropriate signal circuit terminals listed below and ground:

- Door speaker or tweeter speaker signal (+): terminal 2
- Door speaker or tweeter speaker signal (-): terminal 1
- Subwoofer speaker signal (+) terminal B
- Subwoofer speaker signal (-) terminal A
- **If less than 5 V**

1. Vehicle OFF, disconnect the X3 harness connector at the T3 Audio Amplifier.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the T3 Audio Amplifier.

• **If greater than 7 V**

1. Vehicle OFF, disconnect the X3 harness connector at the T3 Audio Amplifier. Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the T3 Audio Amplifier.

• **If between 5 - 7 V**

NOTE: In the following tests, audio signal frequencies (Hz) will be tested. To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.

20. Mute OFF, play track number three (50 Hz bass test tone) from the test CD.

21. Test for 49 - 51 Hz AC between the appropriate signal circuit terminals listed below and ground:

- Door speaker or tweeter speaker signal (+): terminal 2
- Door speaker or tweeter speaker signal (-): terminal 1
- Subwoofer speaker signal (+) terminal B
- Subwoofer speaker signal (-) terminal A
- **If not between 49 - 51 Hz AC**

Replace the T3 Audio Amplifier.

• **If between 49 - 51 Hz AC**

22. Test or replace the P19 Speaker.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Speaker Replacement Reference](#)
- Refer to [Control Module References](#) for amplifier or radio replacement, programming and setup

UNABLE TO CONTACT ONSTAR CALL CENTER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2470 02

Cellular Phone Antenna Circuit Malfunction Short to Ground

DTC B2470 04

Cellular Phone Antenna Circuit Malfunction Open Circuit

Circuit/System Description

The primary cellular phone antenna element is connected to the telematics communication interface control module (violet connector) via a shielded coaxial cable. Cellular communication takes place on both the primary cellular antenna signal circuit and the GPS/secondary cellular antenna signal circuit. This diagnostic only applies to the primary cellular antenna signal circuit. Internal to the antenna on the cellular antenna signal circuit resistance is used to apply a load, which the telematics communication interface control module uses to detect the presence of the antenna.

Conditions for Running the DTC

- Ignition in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 s.

Conditions for Setting the DTC

B2470 02

The telematics communication interface control module detects a short to ground on the primary cellular antenna signal circuit.

B2470 04

- The telematics communication interface control module detects an open or high resistance on the primary cellular antenna signal circuit.
- The above conditions are present for greater than 1 s.

Action Taken When the DTC Sets

The OnStar® status LED turns red.

Conditions for Clearing the DTC

- The telematics communication interface control module detects the presence of a cellular antenna.

- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903-1 Test Antenna Navn-Cell Conn

Circuit/System Testing

NOTE:

- **The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.**
- **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.**

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the violet primary cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the **EL-49903-1** Test Antenna Navn-Cell Conn connect the violet coax cable to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify the DTC does not set or a call can be completed to the OnStar Call Center while operating the vehicle within the conditions for running the DTC.

- **If the DTC sets or a call can not be completed to the OnStar Call Center**

Replace the K73 Telematics Communications Interface Control Module.

- **If the DTC does not set or a call can be completed to the OnStar Call Center**

4. Ignition OFF/Vehicle OFF.

5. Disconnect the **EL-49903-1** Test Antenna Navn-Cell Comn from the K73 Telematics Communication Interface Control Module

6. Test the coax cable. Refer to Component Testing.

- **If the coax cable does not pass the test**

Replace the coax cable.

- **If the coax cable passes the test**

7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to [Test Probe Caution](#)

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Test for less than 5 Ω between the coax cable center terminal end to end.

- **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

2. Test for greater than 5 Ω between the coax cable outer shield end to end.

- **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

3. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.

- **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

- Refer to [High Frequency Antenna Replacement](#)

- Refer to [Control Module References](#) for telematics communication interface control module replacement, setup, and programming

ONSTAR VOICE RECOGNITION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module is capable of interpreting voice commands received over the cellular microphone circuits. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over the cellular communication network. The module attempts to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[OnStar Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

NOTE:

- It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.
- The vehicle should be located in a quiet area.

1. Vehicle in Service Mode.
2. Verify that your voice is heard clearly by the OnStar Call center.
 - If your voice can not be heard clearly

Refer to [OnStar Microphone Malfunction](#)

- **If your voice can be heard clearly**

3. Verify that the system responds appropriately to all voice commands by pressing the voice command button and attempting to operate the system using multiple voice commands.

- **If the OnStar system does not respond to any voice commands**

Replace the K73 Telematics Communication Interface Control Module

- **If the OnStar system responds to some, but not all voice commands**

Refer to [OnStar Description and Operation](#) for tips on proper pronunciation

- **If the OnStar system responds to all voice commands**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair procedure.

Refer to [Control Module References](#) for telematics communication interface control module replacement, programming and setup

VOICE RECOGNITION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voice Recognition Audio Signal	1	1	1	-
Voice Recognition Audio Low Reference	-	1	-	-
1. infotainment system voice recognition inoperative				

Circuit/System Description

When voice recognition for the infotainment system is started, voice signals from the cellular phone microphone are passed through the telematics communication interface control module to the Human Machine Interface Control Module via the voice recognition audio circuits.

Diagnostic Aids

- Refer to the Owners Manual and/or the Navigation System Owners Manual for voice recognition use and commands.
- When the system recognizes the command the system will either perform the function or ask to confirm the choice by clearly saying "yes" or "no".
- If experiencing difficulty with the system recognizing a command, confirm that the command is correct.

- Background noise such as a climate control fan positioned on high, open windows, or very loud outside noises, can cause voice commands to be misunderstood.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the OnStar® voice recognition system is operating normally.
 - **If the OnStar® voice recognition system is not operating normally.**

Refer to OnStar Voice Recognition Malfunction.

- **If the OnStar® voice recognition system is operating normally.**
2. Vehicle in Service Mode, infotainment system ON.

NOTE: Refer to the Owners Manual and/or the Navigation System Owners Manual for voice recognition use and commands.

3. Begin voice recognition for the infotainment system and clearly speak one of the available commands.
4. Verify the infotainment system responds correctly to the command.
 - **If the infotainment system does not respond correctly to the command.**
 1. Clearly speak a different command.
 2. Verify the infotainment system responds correctly to the command.
 - If the infotainment system does not respond correctly to any commands, refer to Circuit/System Testing.
 - If the infotainment system responds correctly to the command.
3. Refer to the Owners Manual and/or the Navigation System Owners Manual for hints on speaking

commands.

- **If the infotainment system responds correctly to the command.**

5. All OK

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K74 Human Machine Interface Control Module.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K73 Telematics Communication Interface Control Module.

- **If less than 10 Ω**

3. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module. Vehicle in Service Mode.

4. Test for less than 1 V between the signal circuit terminal listed below and ground.

- Voice recognition audio signal terminal 6
- Voice recognition audio low reference terminal 12

- **If 1 V greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

5. Vehicle OFF.

6. Test for infinite resistance between the signal circuits listed below and ground:

- Voice recognition audio signal terminal 6
- Voice recognition audio low reference terminal 12

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

7. Test for less than 5 Ω between the terminals listed below:

- K74 Human Machine Interface Control Module signal circuit terminal 1 X1 and the K73 Telematics Communication Interface Control Module signal circuit terminal 6 X2
- K74 Human Machine Interface Control Module low reference circuit terminal 2 X1 and the K73 Telematics Communication Interface Control Module low reference circuit terminal 12 X2

- **If 5 Ω greater**

Repair the open/high resistance in the circuit.

- **If less than 5 Ω**

8. Replace the K74 Human Machine Interface Control Module. Connect all harness connectors.

NOTE: Refer to the Owners Manual and/or the Navigation System Owners Manual for voice recognition use and commands.

9. Begin voice recognition for the infotainment system and clearly speak one of the available commands.
10. Verify the infotainment system responds correctly to the command.
 - **If the infotainment system does not respond correctly to the command**
 1. Clearly speak a different command.
 2. Verify the infotainment system responds correctly to the command.
 - If the infotainment system does not respond correctly to any commands, replace the K73 Telematics Communication Interface Control Module.
 - **If the infotainment system responds correctly to the command**
11. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Human Machine Interface Control Module or Telematics Communication Interface Control replacement, programming and setup.

REPAIR INSTRUCTIONS

MOBILE TELEPHONE MICROPHONE REPLACEMENT

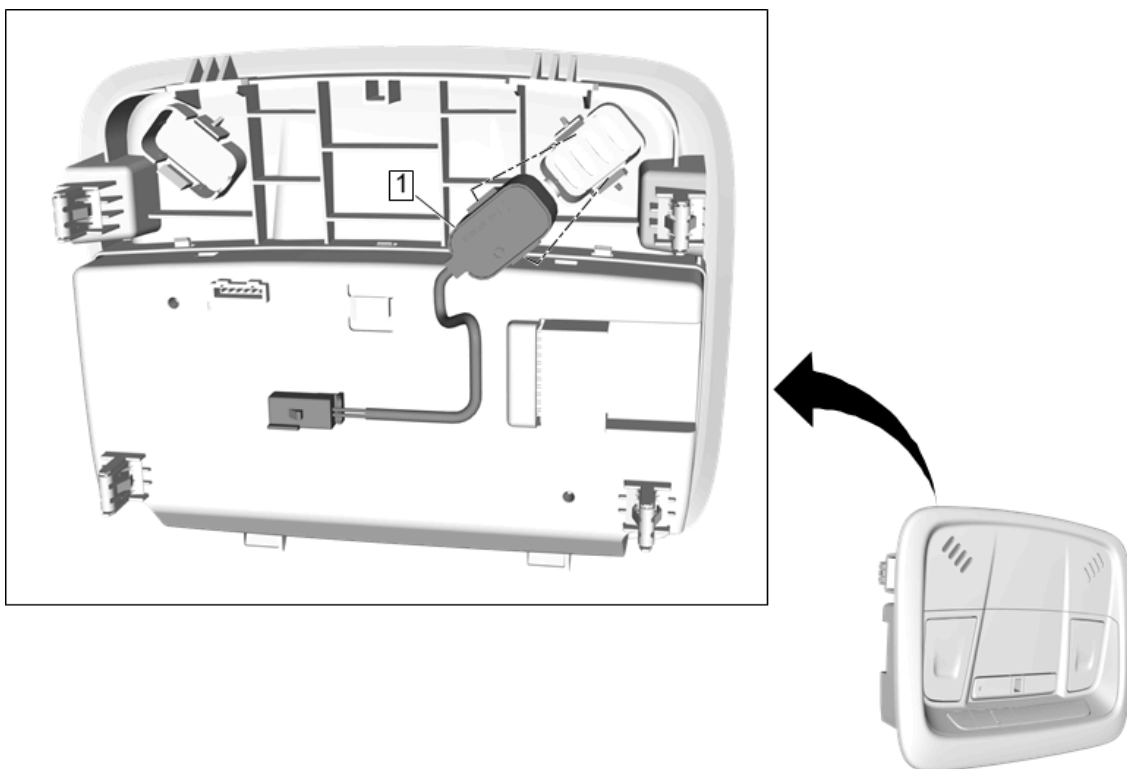


Fig. 9: Mobile Telephone Microphone
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
Preliminary Procedure Remove Roof Console. Refer to Roof Console Replacement	
1	Mobile Telephone Microphone Procedure Release the retaining tabs.

MOBILE TELEPHONE ANTENNA CABLE REPLACEMENT

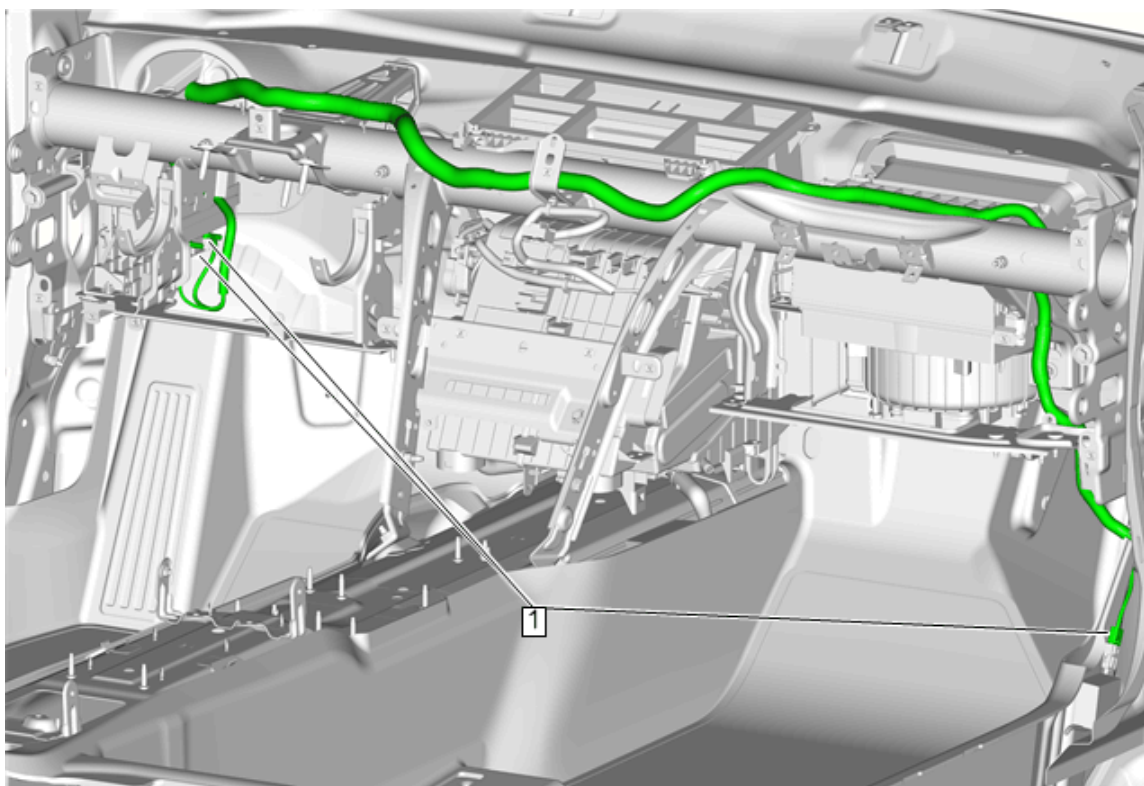


Fig. 10: Mobile Telephone Antenna Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Assembly. Refer to Instrument Panel Assembly Replacement	
1	Mobile Telephone Antenna Cable Procedure 1. Disconnect all electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

HUMAN MACHINE INTERFACE CONTROL MODULE REPLACEMENT

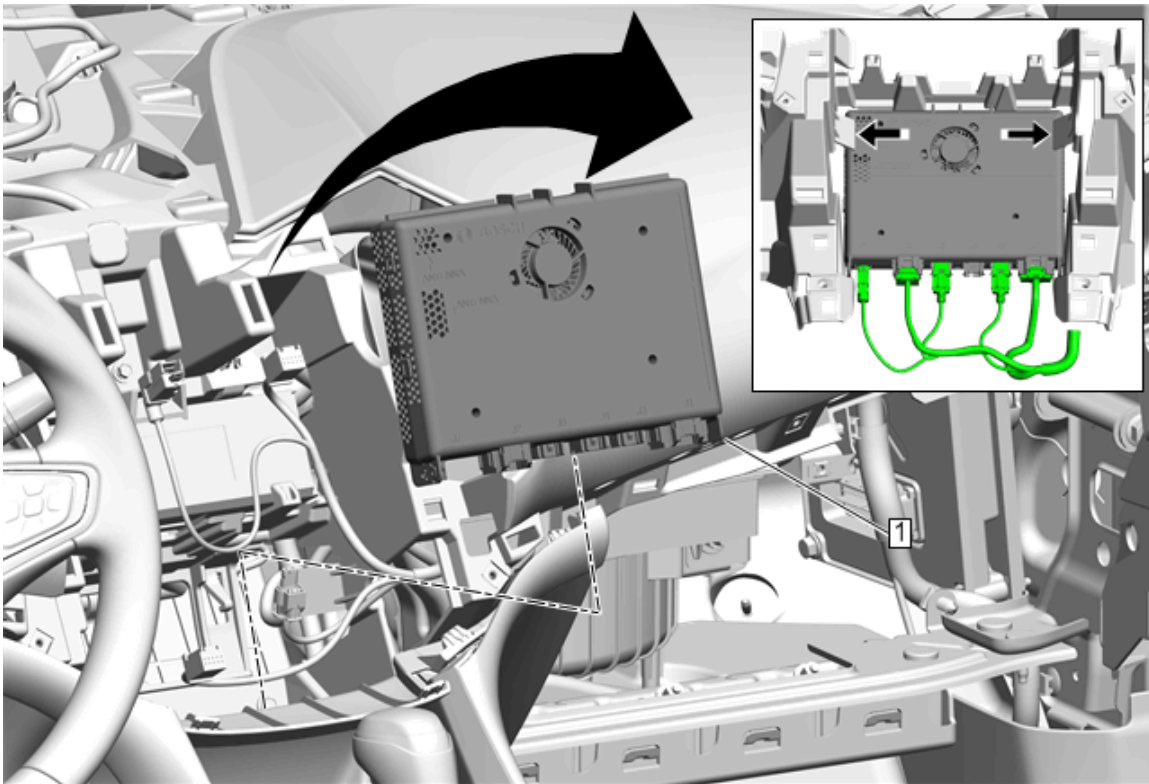


Fig. 11: Human Machine Interface Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Instrument Panel Center Air Outlet. Refer to Instrument Panel Center Air Outlet Replacement	
1	Human Machine Interface Control Module Procedure 1. Disconnect all electrical connectors. 2. Release the retaining tabs. 3. Refer to Control Module References for programming and set up procedures, if required.

COMMUNICATION INTERFACE MODULE REPLACEMENT

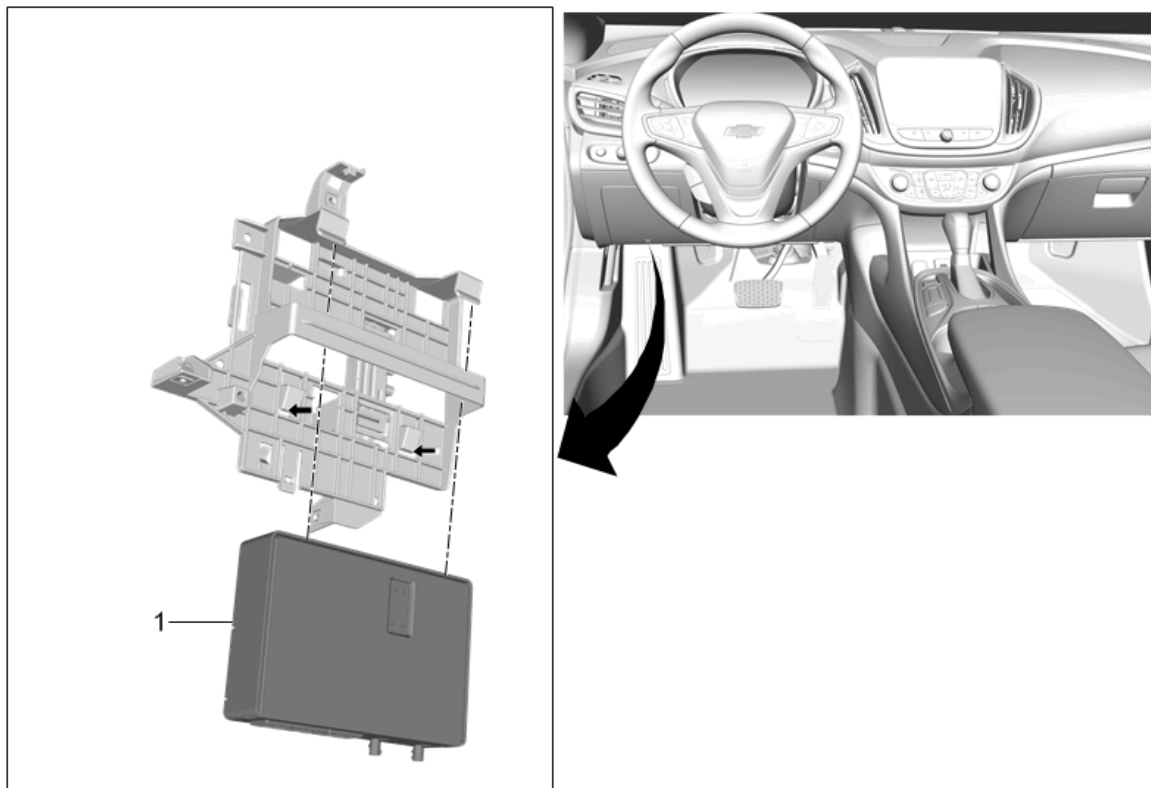


Fig. 12: Communication Interface Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Communication Interface Module Procedure 1. Disconnect the electrical connectors. 2. Push the retaining tabs outward and slide the module downward. 3. Perform the necessary programming and setup procedure: Control Module References

COMMUNICATION INTERFACE MODULE BATTERY REPLACEMENT

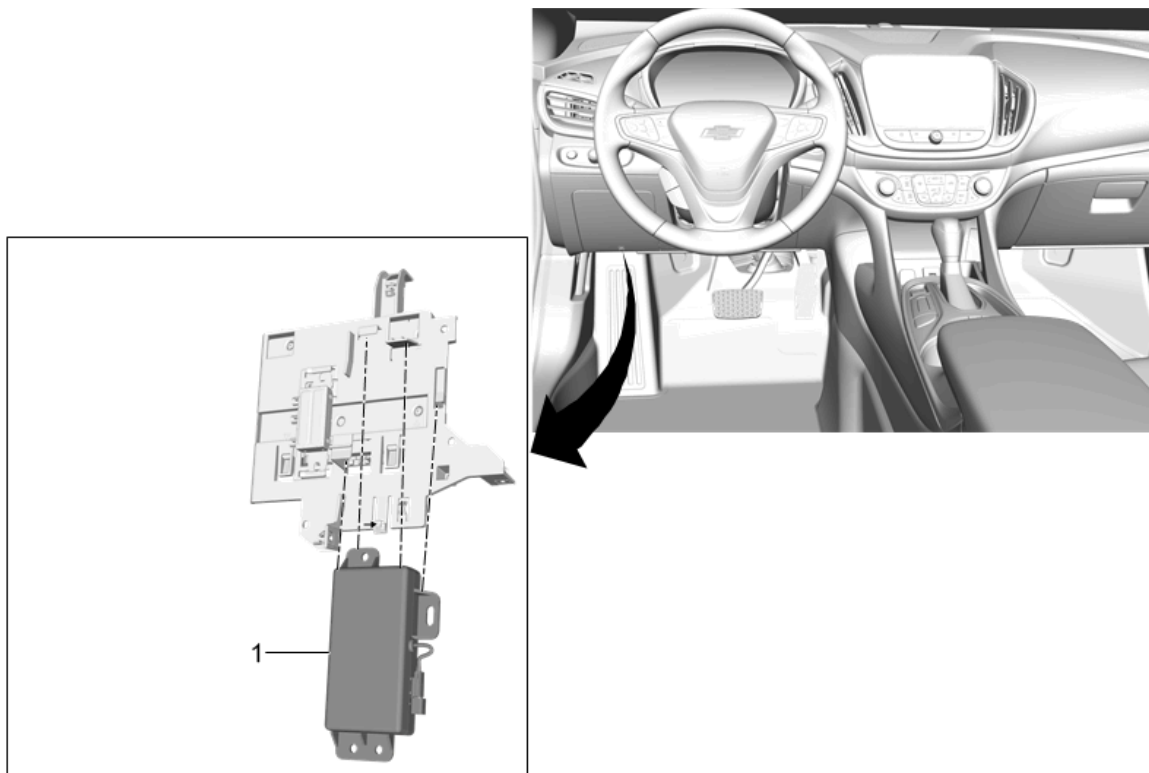


Fig. 13: Communication Interface Module Battery
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Communication Interface Module Bracket. Refer to Communication Interface Module Bracket Replacement	
1	Communication Interface Module Battery Procedure 1. Push the retaining tab outward and slide the module downward. 2. Refer to Control Module References for programming and setup information, if required.

COMMUNICATION INTERFACE MODULE BRACKET REPLACEMENT

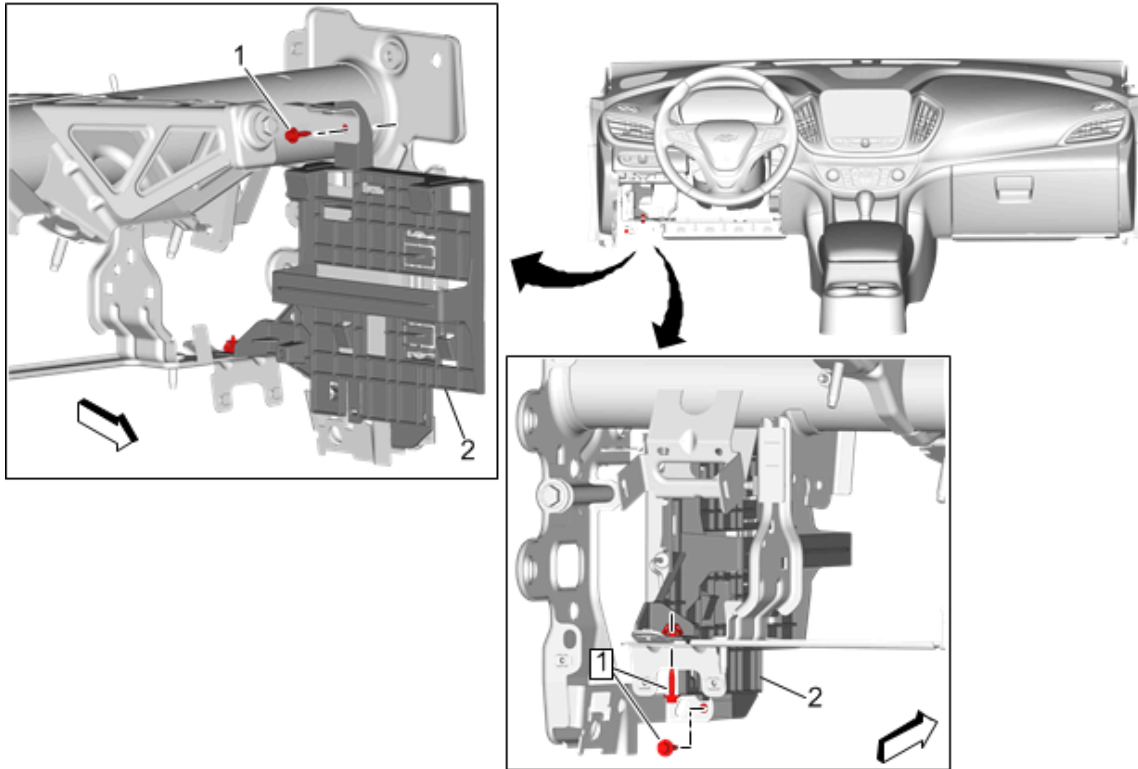


Fig. 14: Communication Interface Module Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Assembly. Refer to Instrument Panel Assembly Replacement	
1	Communication Interface Module Bracket Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Communication Interface Module Bracket Procedure 1. Disconnect all electrical connectors. 2. Transfer components as necessary.

RADIO REPLACEMENT

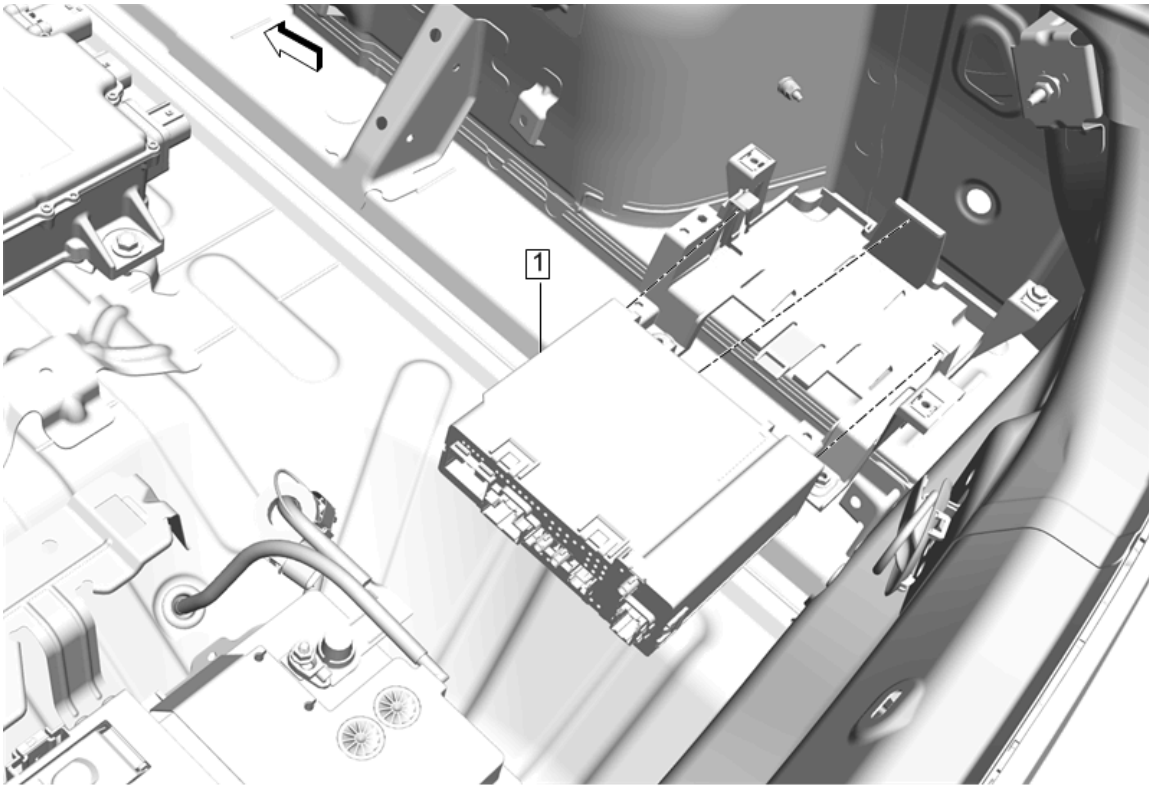


Fig. 15: Radio

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Radio Speaker Amplifier. Refer to Radio Speaker Amplifier Replacement	
1	Radio Procedure 1. Release the retaining tabs. 2. Disconnect all electrical connectors. 3. Refer to Control Module References for programming and setup information, if required.

RADIO CONTROL ASSEMBLY REPLACEMENT

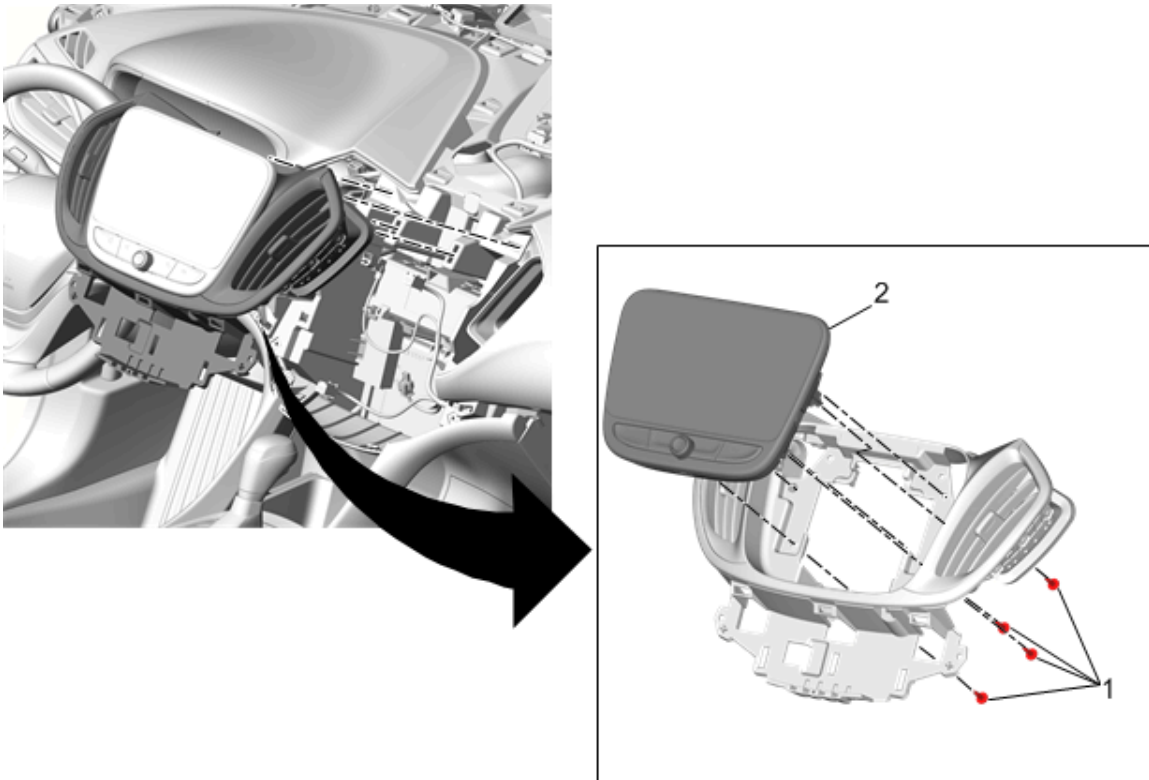


Fig. 16: Radio Control Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Center Air Outlet. Refer to Instrument Panel Center Air Outlet Replacement	
1	Radio Control Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Control Procedure 1. Transfer components as necessary. 2. Refer to Control Module References for programming and setup procedures, if required.

AUDIO DISC PLAYER AND USB RECEPTACLE REPLACEMENT

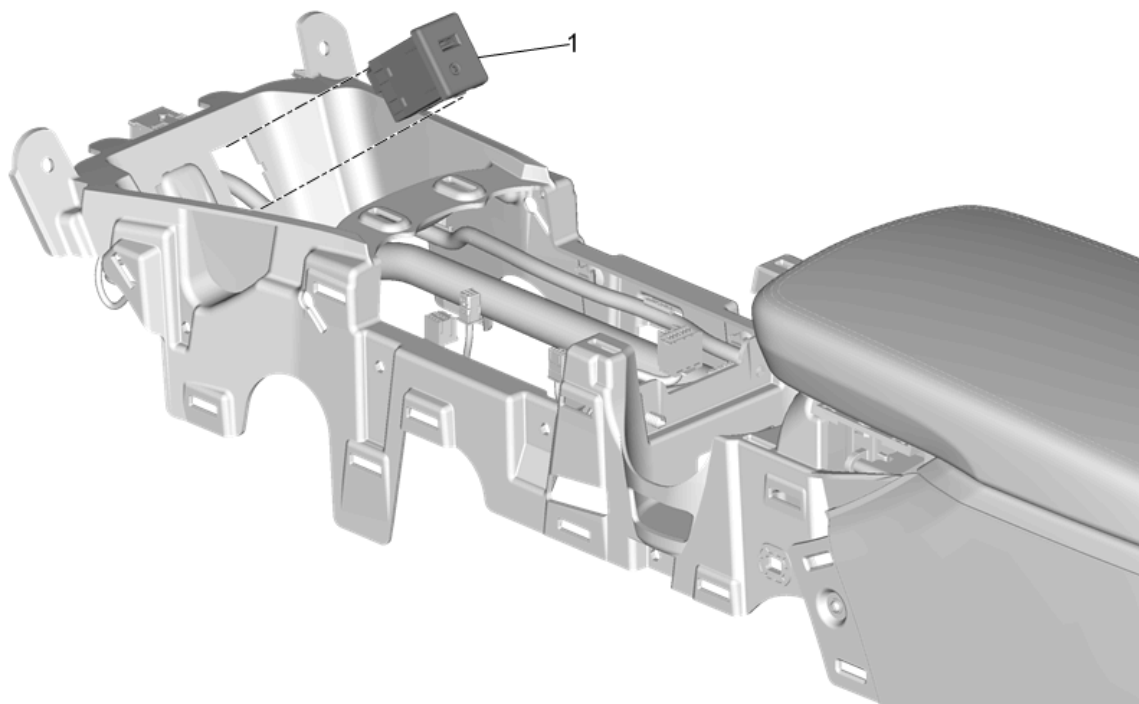


Fig. 17: Audio Disc Player And USB Receptacle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Front Floor Console. Refer to Front Floor Console Replacement	
1	Audio Disc Player and USB Receptacle Procedure 1. Depress the tabs on the receptacle to remove. 2. Disconnect the electrical connector.

RADIO SPEAKER AMPLIFIER REPLACEMENT

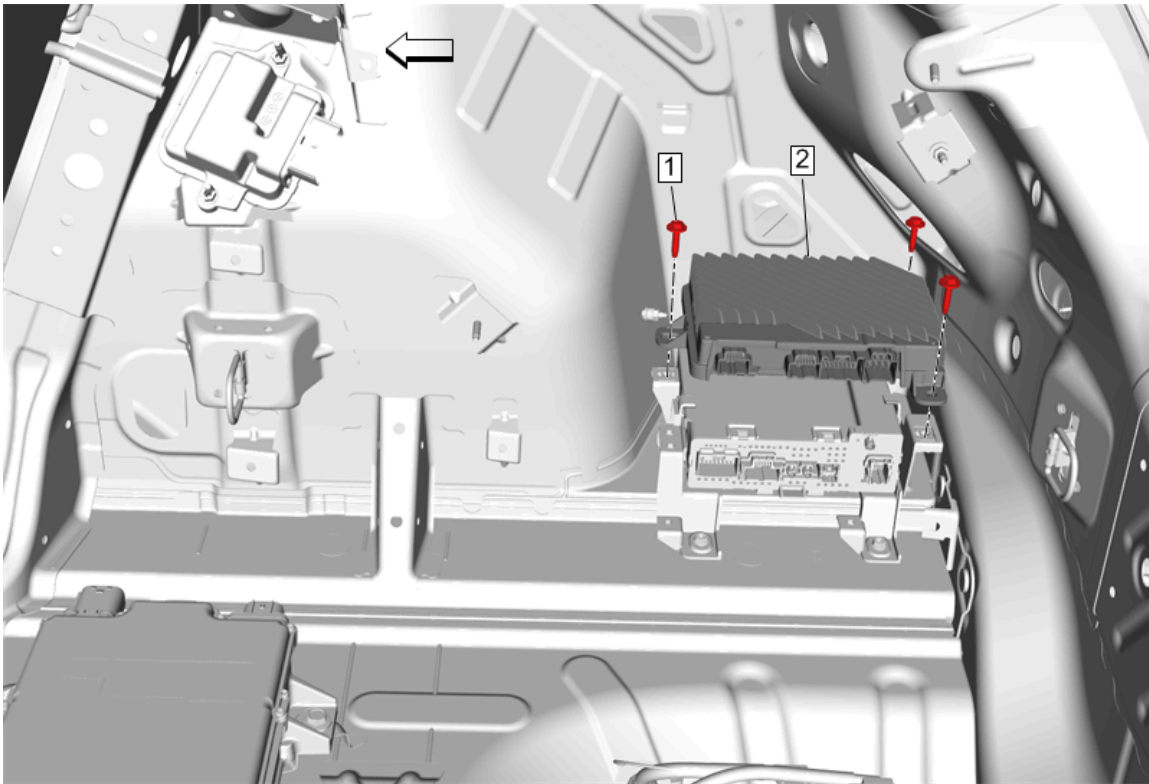


Fig. 18: Radio Speaker Amplifier

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Radio Rear Compartment Speaker. Refer to Radio Rear Compartment Speaker Replacement	
1	Radio Speaker Amplifier Bracket Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Radio Speaker Amplifier Procedure 1. Disconnect all electrical connectors. 2. Refer to Control Module References for programming and setup information, if required.

NAVIGATION SIGNAL SPLITTER REPLACEMENT

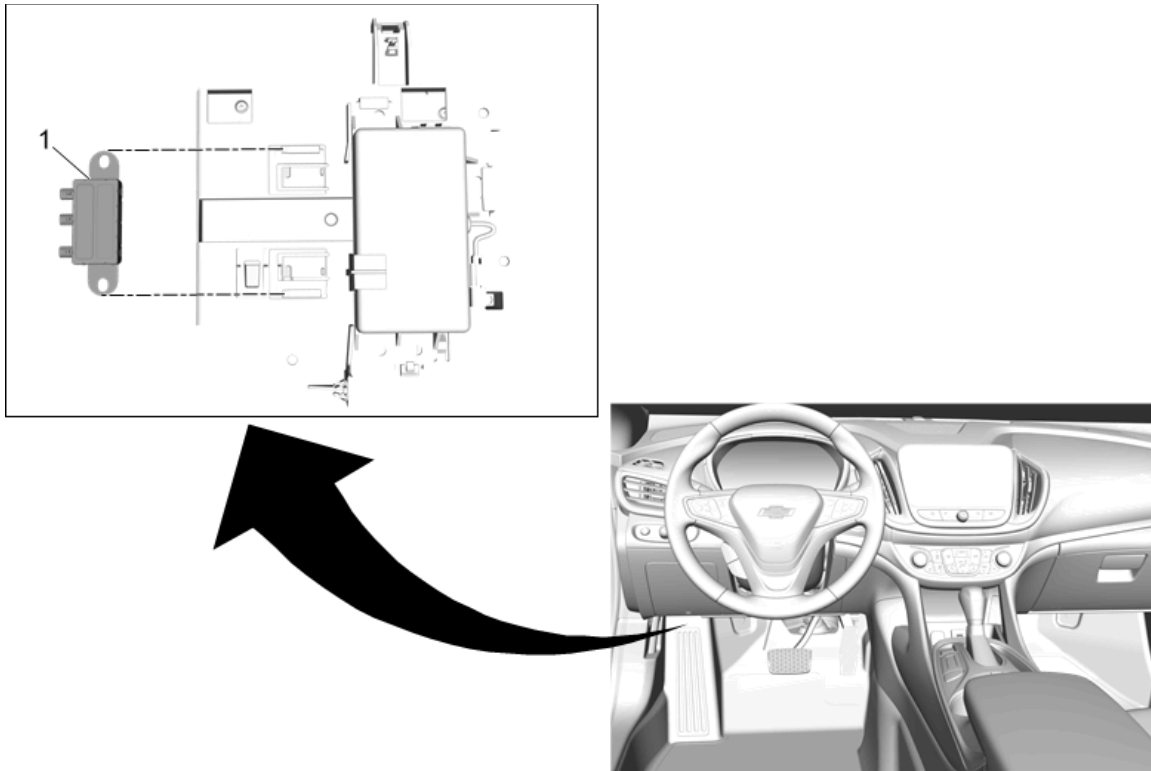


Fig. 19: Navigation Signal Splitter

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Communication Interface Module Bracket. Refer to <u>Communication Interface Module Bracket Replacement</u>	
1	Navigation Signal Splitter Procedure Release the retaining tabs.

TELEVISION ANTENNA CABLE REPLACEMENT

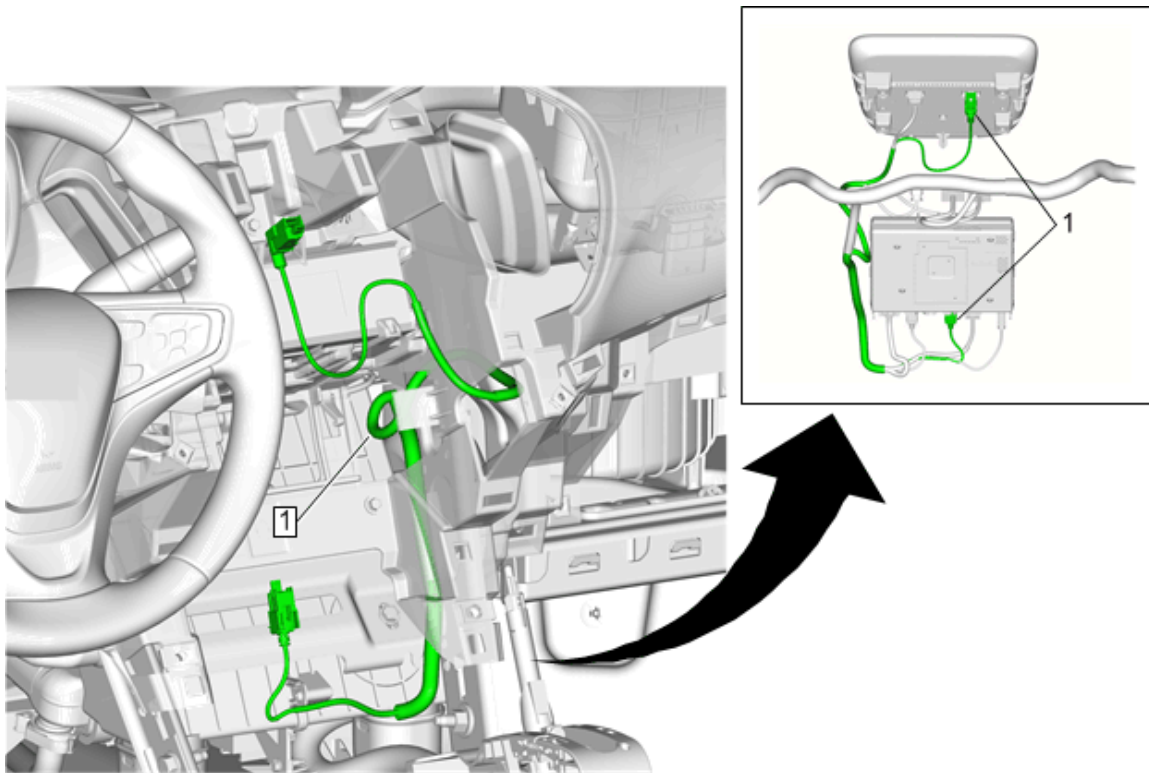


Fig. 20: Television Antenna Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Human Machine Interface Control Module. Refer to Human Machine Interface Control Module Replacement 2. Remove Instrument Panel Lower Center Trim Panel. Refer to Instrument Panel Lower Center Trim Panel Replacement (Upper) Instrument Panel Lower Center Trim Panel Replacement (Lower)	
1	Television Antenna Cable Procedure 1. Disconnect the electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

MOBILE TELEPHONE ANTENNA COAXIAL CABLE REPLACEMENT

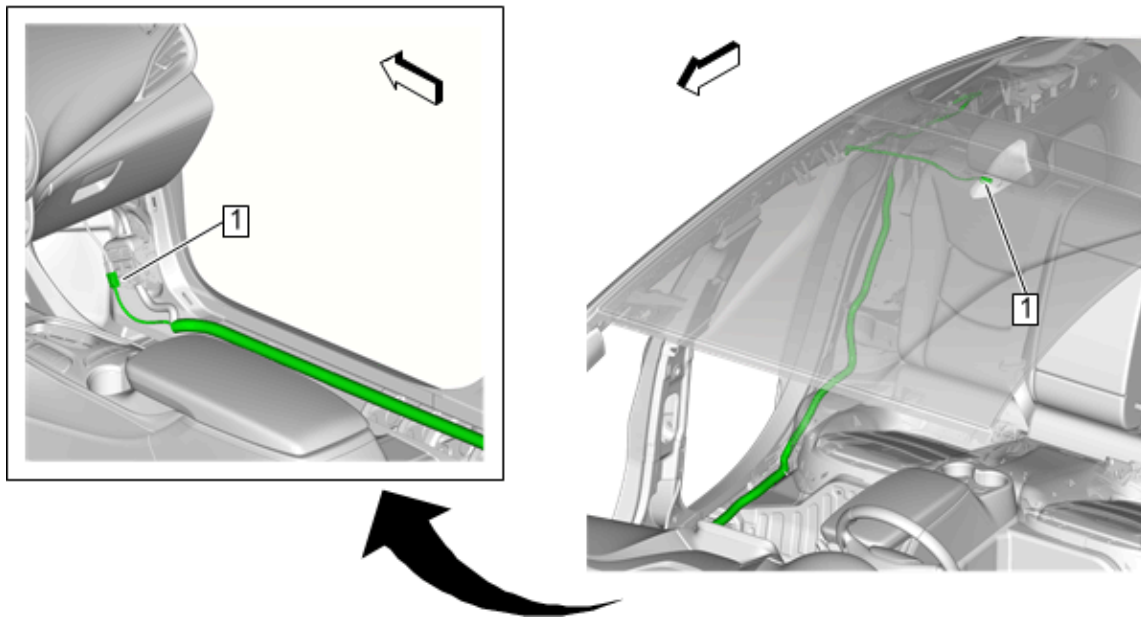


Fig. 21: Mobile Telephone Antenna Coaxial Cable
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Headlining Trim Panel. Refer to Headlining Trim Panel Replacement	
1	Mobile Telephone Antenna Coaxial Cable Procedure 1. Disconnect the electrical connectors. 2. Reposition the front floor panel carpet as necessary. 3. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

RADIO ANTENNA CABLE REPLACEMENT

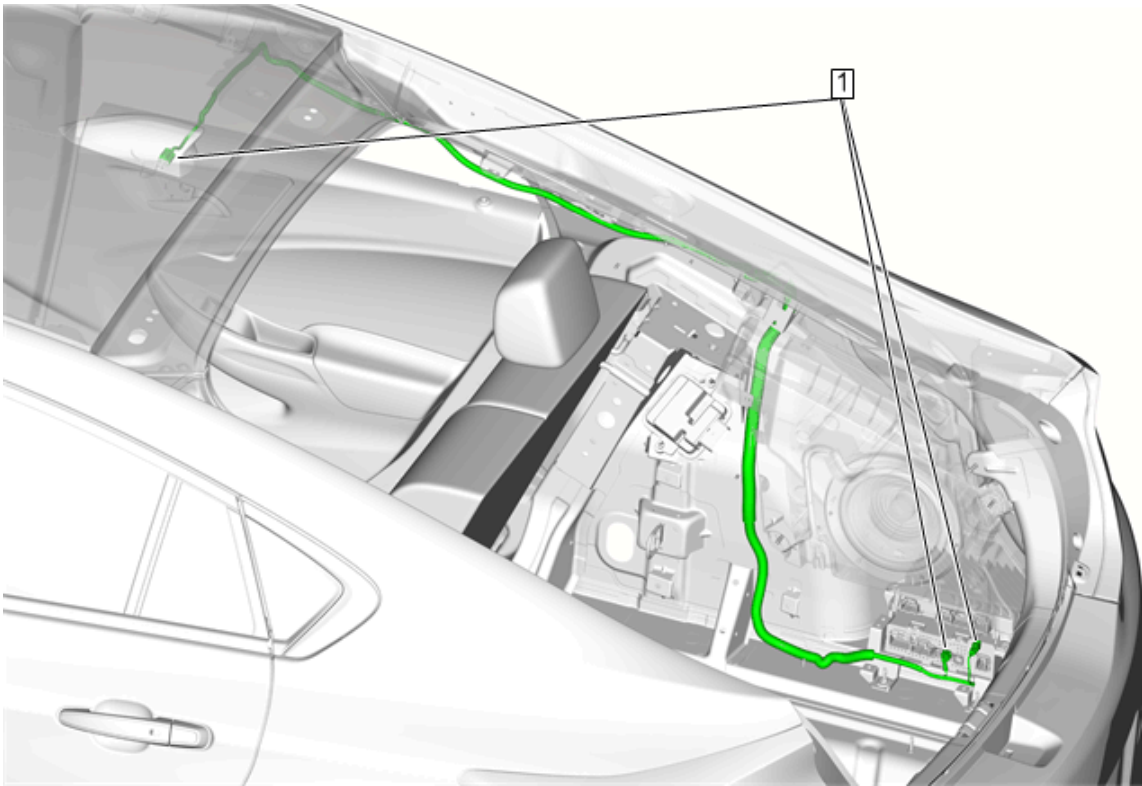


Fig. 22: Radio Antenna Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Headlining Trim Panel. Refer to Headlining Trim Panel Replacement 2. Remove Quarter Lower Rear Trim Panel (Right Side). Refer to Quarter Lower Rear Trim Panel Replacement (Right Side)	
1	Radio Antenna Cable Procedure 1. Disconnect the electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable. Harness Routing Views

NAVIGATION ANTENNA COAXIAL CABLE REPLACEMENT (INLINE TO ONSTAR TO SPLITTER)

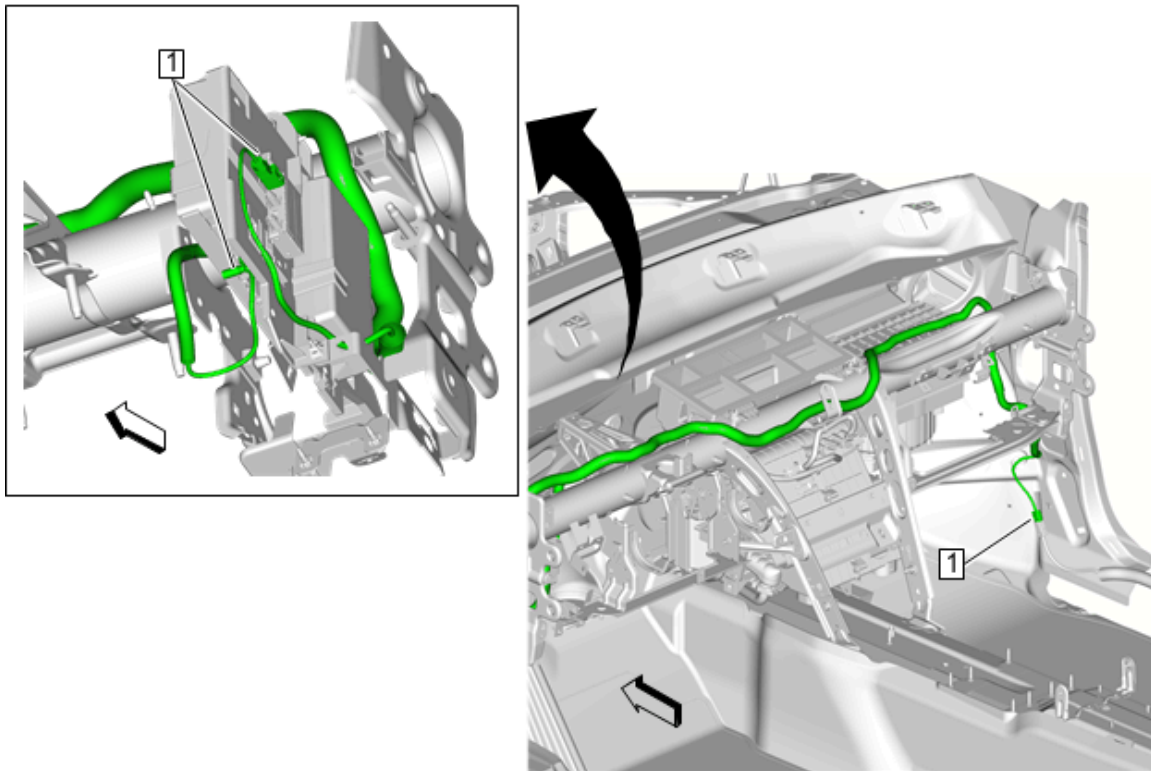


Fig. 23: Navigation Antenna Coaxial Cable (Inline To Onstar To Splitter)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Assembly. Refer to <u>Instrument Panel Assembly Replacement</u>	
1	Navigation Antenna Coaxial Cable Procedure 1. Disconnect all electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

NAVIGATION ANTENNA COAXIAL CABLE REPLACEMENT (ONSTAR TO SPLITTER)

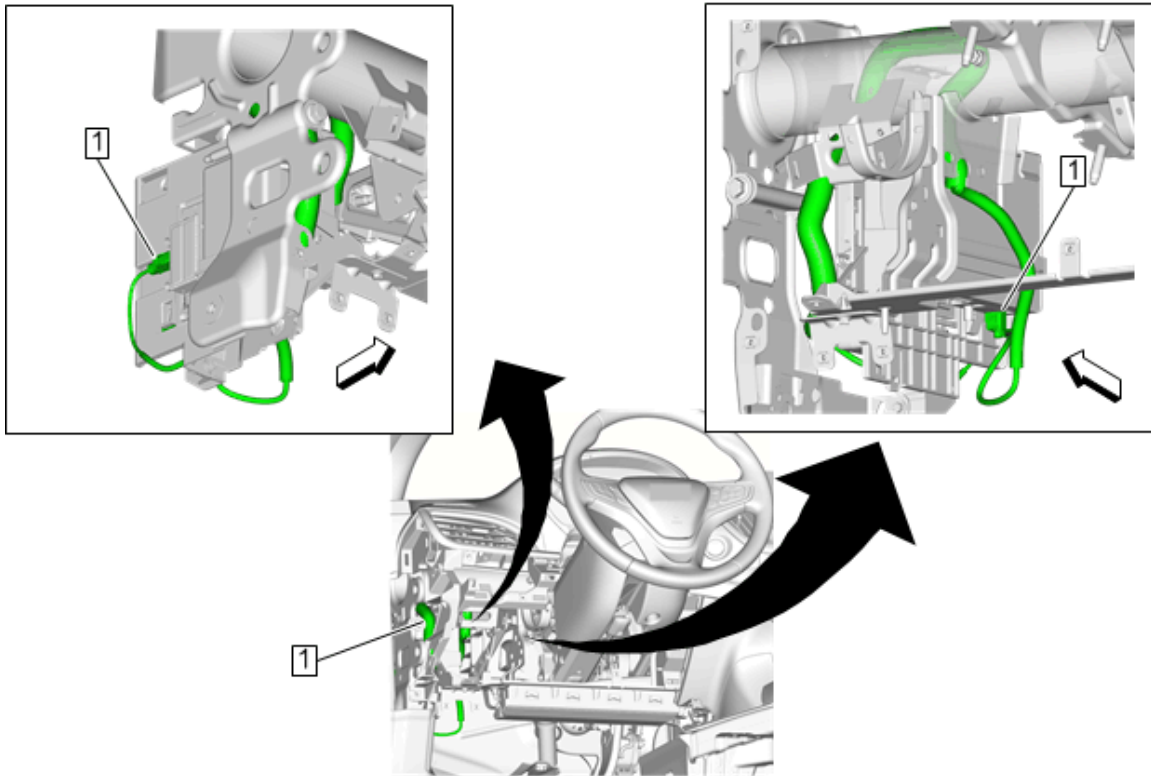


Fig. 24: Navigation Antenna Coaxial Cable (Onstar To Splitter)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Instrument Panel Knee Bolster. Refer to Instrument Panel Knee Bolster Replacement	
1	Navigation Antenna Coaxial Cable Procedure 1. Disconnect all electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

NAVIGATION ANTENNA COAXIAL CABLE REPLACEMENT (SPLITTER TO HMI)

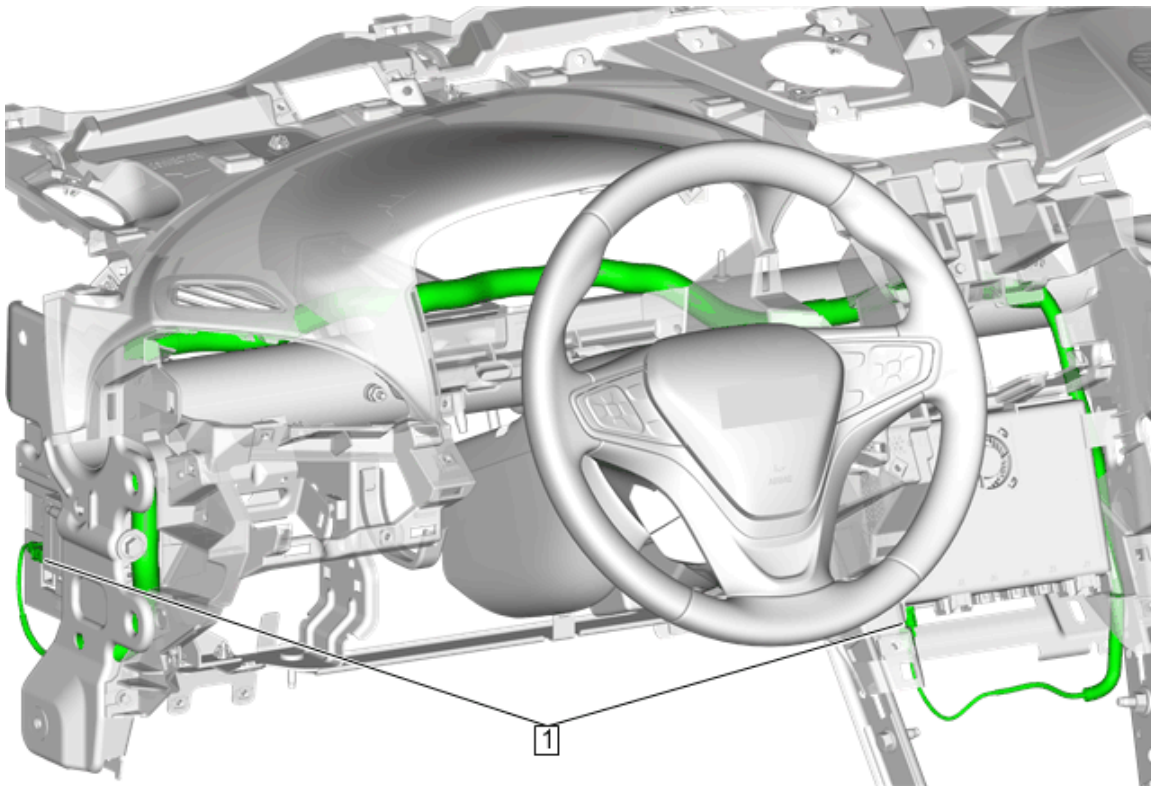


Fig. 25: Navigation Antenna Coaxial Cable (Splitter To HMI)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Heater and Air Conditioning Remote Control. Refer to Heater and Air Conditioning Remote Control Replacement 2. Remove Instrument Cluster. Refer to Instrument Cluster Replacement	
1	Navigation Antenna Coaxial Cable Procedure 1. Disconnect all electrical connectors. 2. If the cable is taped into the wiring harness, cut the ends off the old cable and route the new cable as close to the old one as possible. Use tie straps to secure the new cable.

RADIO FRONT CENTER SPEAKER REPLACEMENT

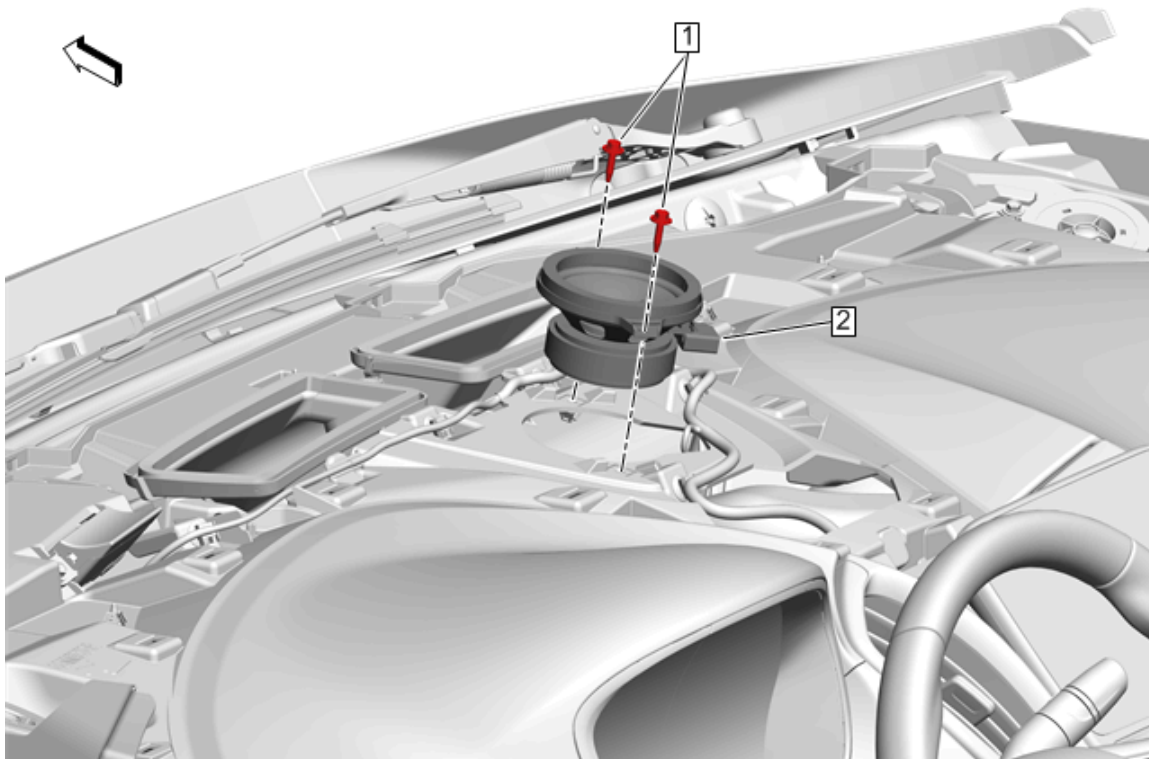


Fig. 26: Radio Front Center Speaker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Extension. Refer to Instrument Panel Extension Replacement	
1	Radio Front Center Speaker Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Front Center Speaker Procedure Disconnect the electrical connector.

RADIO FRONT SPEAKER REPLACEMENT

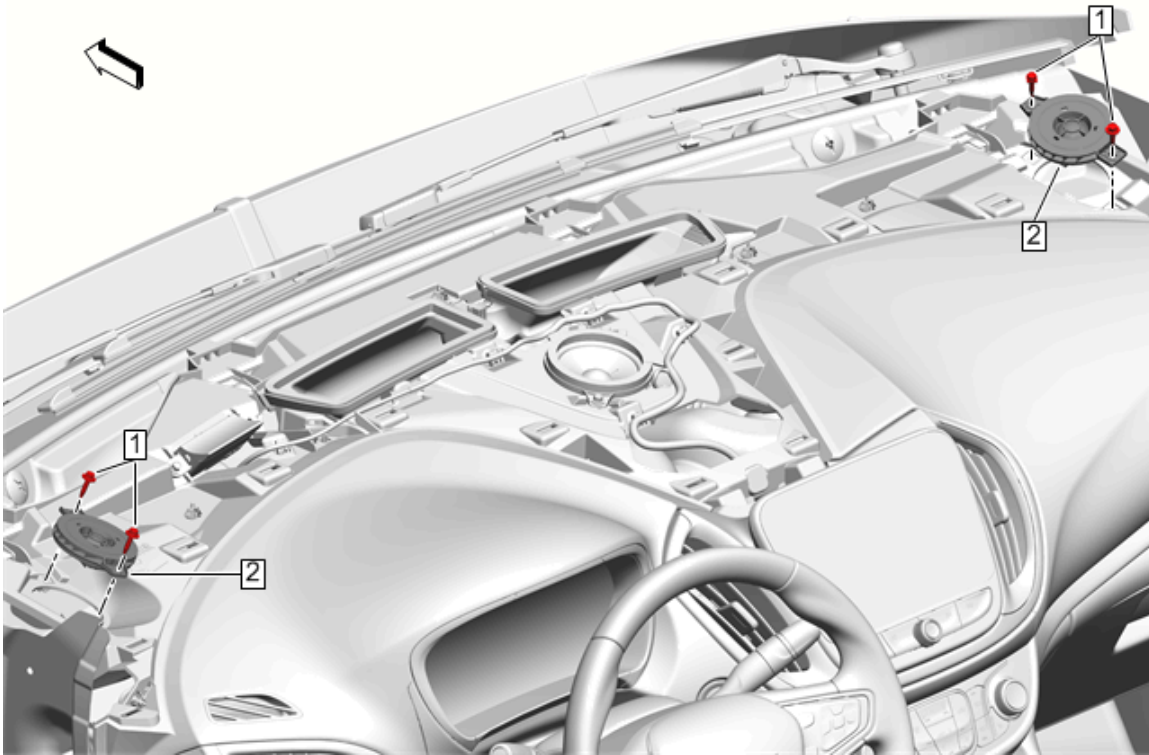


Fig. 27: Radio Front Speaker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Extension. Refer to Instrument Panel Extension Replacement	
1	Radio Front Speaker Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Front Speaker Procedure Disconnect the electrical connector.

HIGH FREQUENCY ANTENNA REPLACEMENT

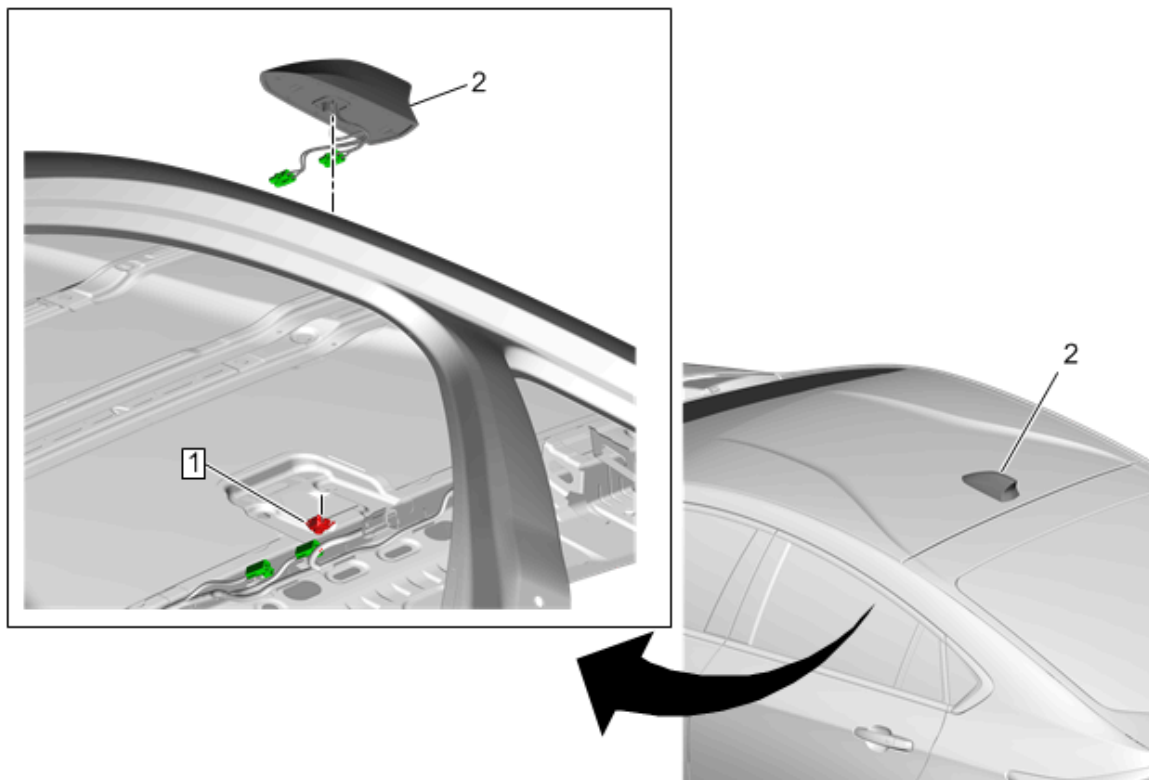


Fig. 28: High Frequency Antenna

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Headlining Trim Panel. Refer to Headlining Trim Panel Replacement	
1	High Frequency Antenna Nut CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	High Frequency Antenna Procedure Disconnect the electrical connectors.

RADIO FRONT SIDE DOOR SPEAKER REPLACEMENT

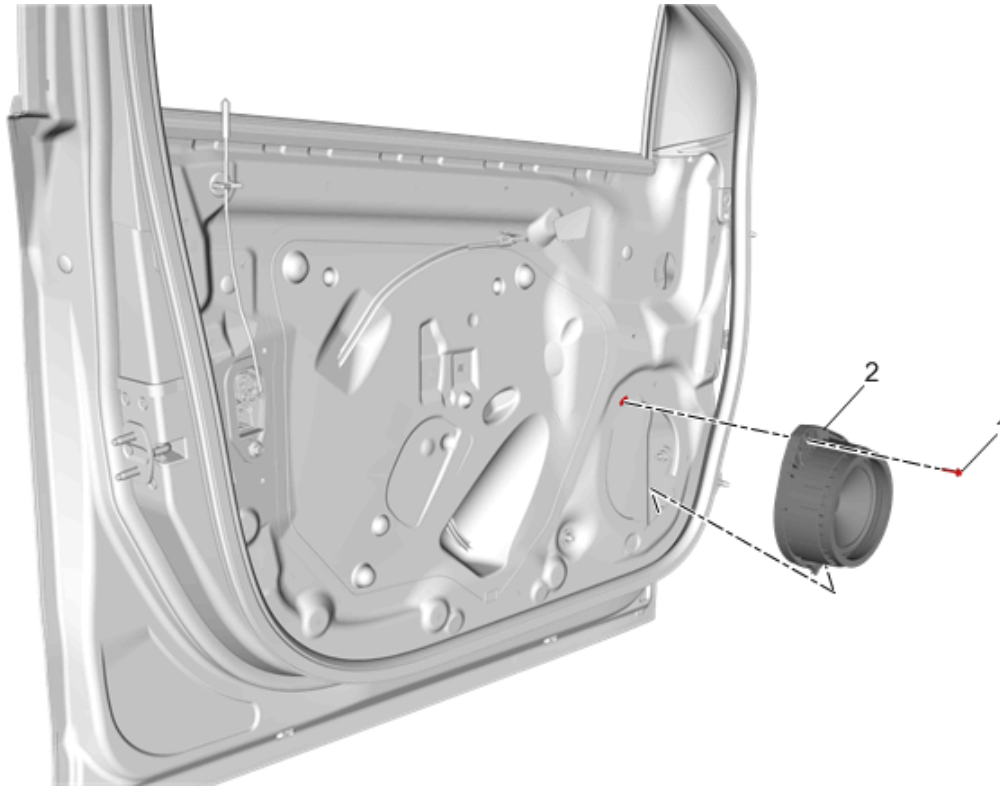


Fig. 29: Radio Front Side Door Speaker
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	
1	Radio Front Side Door Speaker Fastener CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Front Side Door Speaker Procedure 1. Disconnect the electrical connector. 2. Unclip and reposition the wiring harness.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (LEFT SIDE REAR)

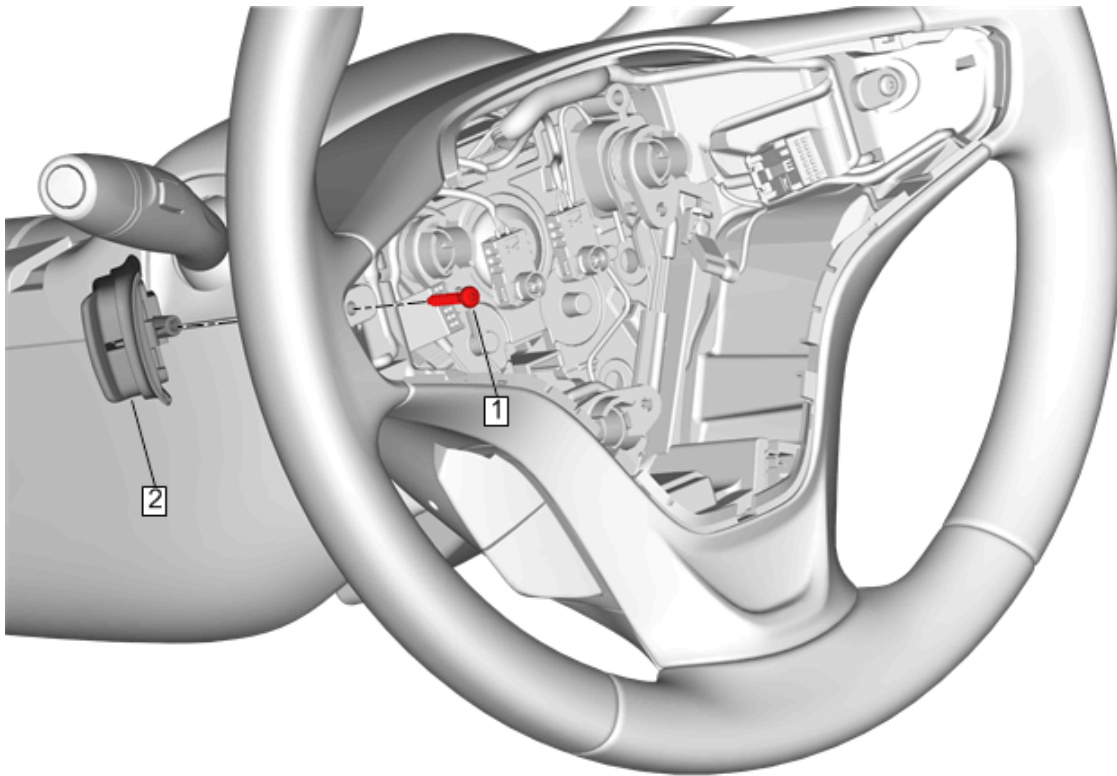


Fig. 30: Radio Control Switch - Steering Wheel (Left Side Rear)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Control Switch - Left Side Rear Procedure Disconnect the electrical connector.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (RIGHT SIDE REAR)

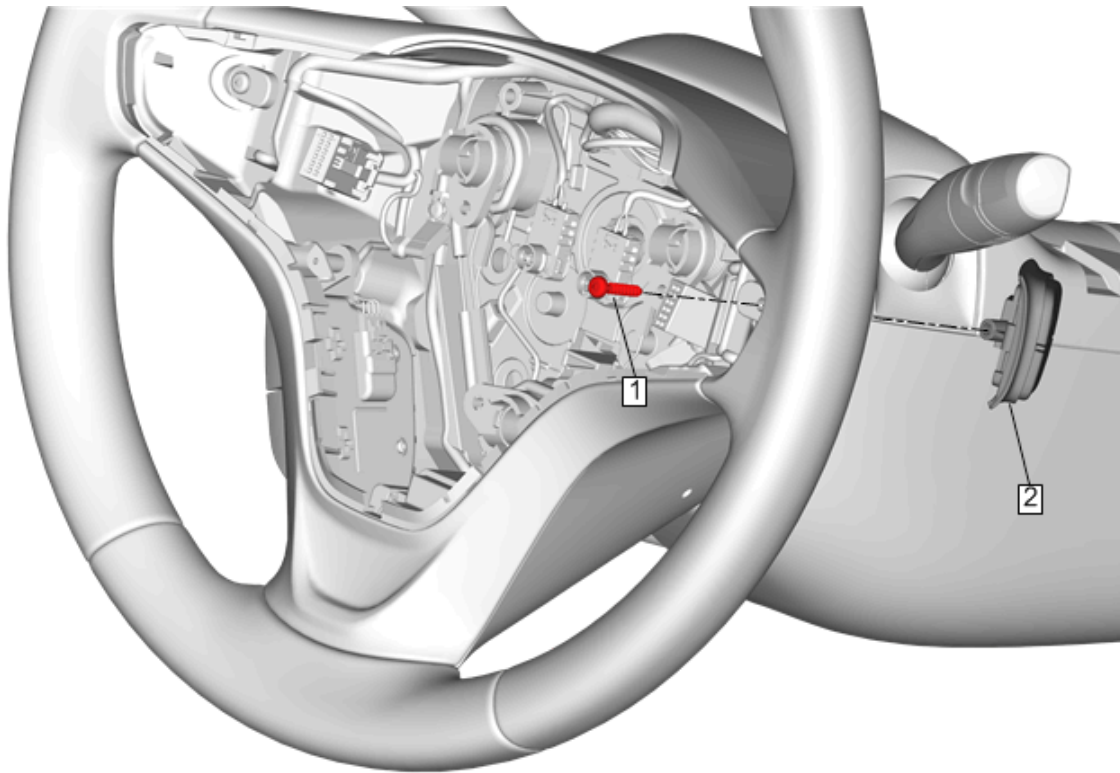


Fig. 31: Radio Control Switch - Steering Wheel (Right Side Rear)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Control Switch - Right Side Rear Procedure Disconnect the electrical connector.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (RIGHT SIDE FRONT)

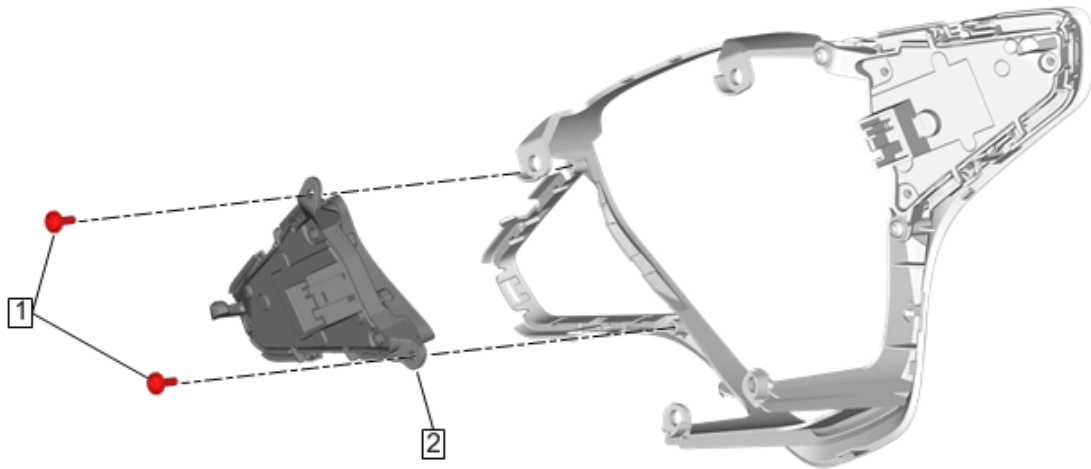


Fig. 32: Radio Control Switch - Steering Wheel (Right Side Front)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 1.5 N.m (13 lb in)
2	Radio Control Switch - Right Side Front Procedure Remove the radio control switch from the steering wheel spoke cover.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (LEFT SIDE LOWER)

Removal Procedure

1. Remove Steering Wheel Spoke Cover. Refer to [Steering Wheel Spoke Cover Replacement](#)

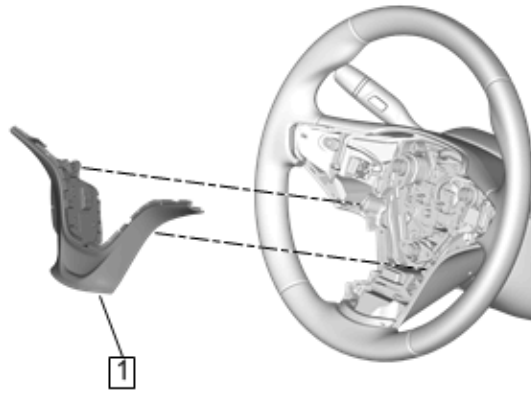


Fig. 33: Steering Wheel Spoke Lower Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove Steering Wheel Spoke Lower Cover (1)
 1. Use a flat bladed plastic tool to remove.
 2. Disconnect the electrical connector.

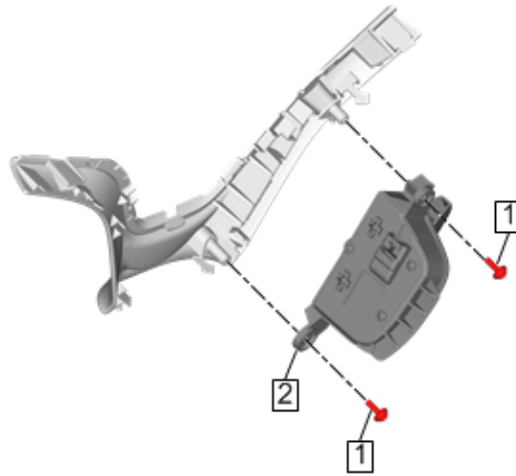


Fig. 34: Radio Control Switch And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Radio Control Switch Bolts (1) (Qty: 2)
4. Remove Radio Control Switch - Left Side Lower (2) @ Steering Wheel Spoke Lower Cover

Installation Procedure

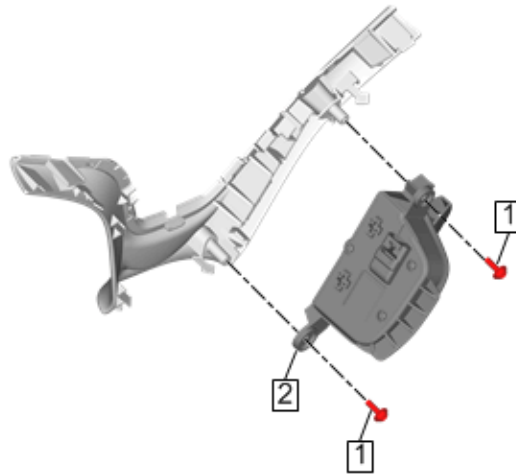


Fig. 35: Radio Control Switch And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Radio Control Switch - Left Side Lower (2) @ Steering Wheel Spoke Lower Cover

CAUTION: Refer to [Fastener Caution](#) .

2. Install and tighten Radio Control Switch Bolts (1) (Qty: 2) to 1.5 N.m (13 lb in)

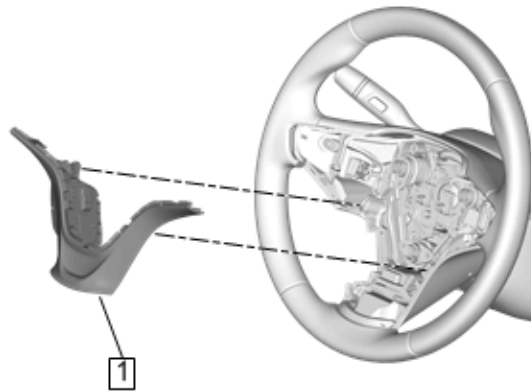


Fig. 36: Steering Wheel Spoke Lower Cover

Courtesy of GENERAL MOTORS COMPANY

3. Install Steering Wheel Spoke Lower Cover (1)
4. Install Steering Wheel Spoke Cover. Refer to [Steering Wheel Spoke Cover Replacement](#)

RADIO REAR SIDE DOOR SPEAKER REPLACEMENT

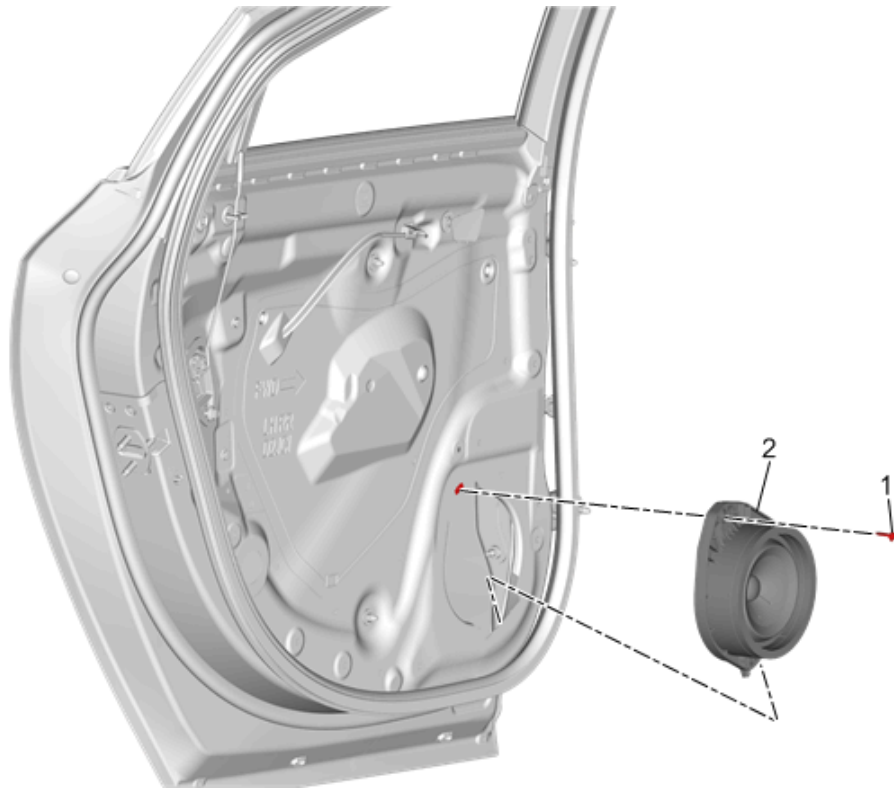


Fig. 37: Radio Rear Side Door Speaker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Side Door Trim. Refer to Rear Side Door Trim Replacement	
1	Radio Rear Side Door Speaker Fastener CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Radio Rear Side Door Speaker Procedure Disconnect the electrical connector.

RADIO REAR COMPARTMENT SPEAKER REPLACEMENT

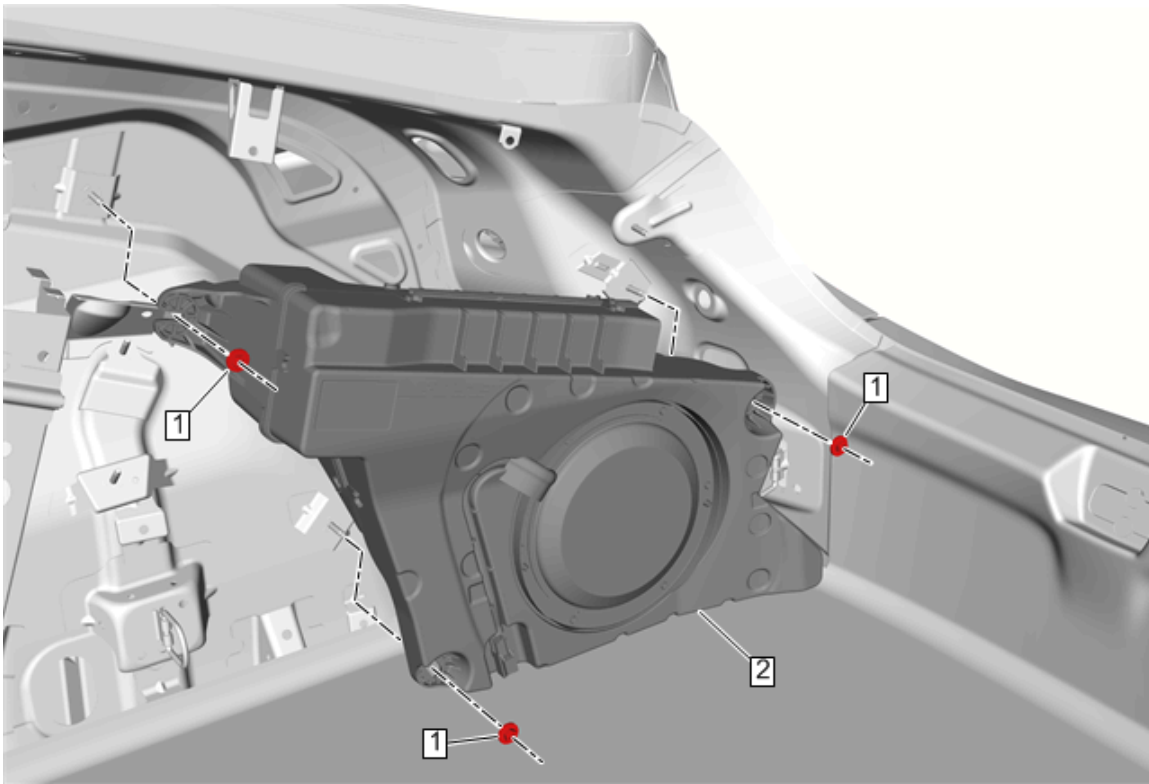


Fig. 38: Radio Rear Compartment Speaker
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel (Right Side). Refer to Quarter Lower Rear Trim Panel Replacement (Right Side)	
1	Radio Rear Compartment Speaker Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
2	Radio Rear Compartment Speaker Procedure 1. Unclip the wiring harness. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

DESCRIPTION AND OPERATION

ONSTAR DESCRIPTION AND OPERATION

This OnStar® system consists of the following components:

- Telematics communication interface control module
- OnStar® three button assembly
- Microphone
- Cellular antenna
- Navigation antenna
- Bluetooth® antenna (If equipped)
- Back up battery (If equipped)
- WiFi Hotspot (If equipped)
- TTY (Teletypewriter)

This system also interfaces with the factory installed vehicle audio system.

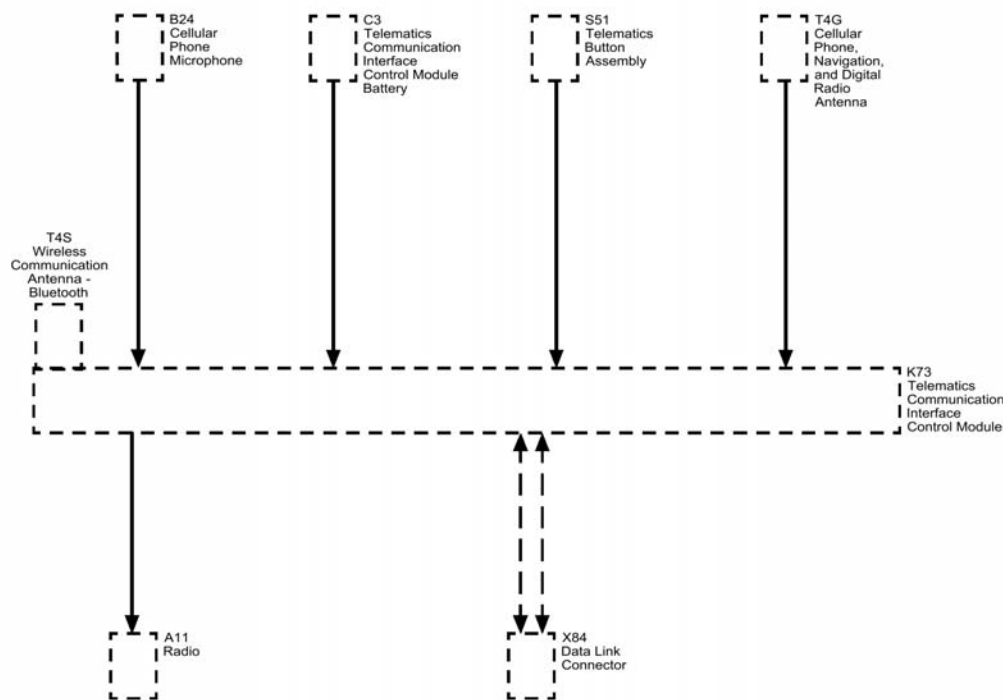


Fig. 39: OnStar System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
B24	B24 Cellular Phone Microphone
C3	C3 Telematics Communication Interface Control Module Battery
S51	S51 Telematics Button Assembly
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4S	T4S Wireless Communication Antenna - Bluetooth
K73	K73 Telematics Communication Interface Control Module
A11	A11 Radio
X84	X84 Data Link Connector

Telematics Communication Interface Control Module

The OnStar Generation 10 system uses Global System for Mobile Communication (GSM) to communicate data and voice signals over the national cellular network. The module may also have the ability to act as a Wireless Local Area Network (WLAN) Wi-Fi hotspot similar to a home wireless router. The module houses an internal WLAN antenna enabling hotspot connectivity and streaming high speed media to the entertainment system. The module also may enable Teletypewriter (TTY) and be capable of Bluetooth communication utilizing an internal antenna. The module is capable of up to 4G LTE speeds and houses 2 technology systems, one to process Global Positioning System (GPS) data, and another for cellular information. The module sends and receives all cellular communications over two cellular antennas and cellular antenna coax cables.

The OnStar Gen 10 system has two antenna inputs, a primary cellular signal and a combined GPS/secondary cellular signal. The OnStar® system uses the United States Global Positioning System (GPS) signals to provide location on demand. GPS is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near Earth where there is an unobstructed line of sight to four or more GPS satellites.

The module also has the capability of activating certain features such as, the horn, remote starting, initiating door lock/unlock, or activating the exterior lamps using the serial data circuits. These functions can be commanded by the OnStar® Call Center per a customer request or mobile device app depending on vehicle and customer subscription.

Dedicated circuits are used to connect the telematics communication interface control module to a microphone, the button assembly, radio, and if equipped the Back Up Battery (BUB). The telematics communication interface control module communicates with the rest of the vehicle over the serial data bus.

Power is provided by a dedicated, fused B+ circuit. Ground is provided through the vehicle wiring harness attached to the module. The power mode state is determined by the telematics communication interface control module through serial data messaging.

OnStar® Three Button Assembly

- The OnStar® button assembly may be part of the rearview mirror, or a separate, stand alone unit. The button assembly is comprised of 3 buttons or 3 capacitive touch buttons and status LED's or an error indicator. The buttons are defined as follows:
 - The answer/end button, which is black with a white phone icon or a white driver figure seated with voice signals near its face, allows the user to answer and end calls or initiate speech recognition.
 - The blue OnStar® call center button, which displays the OnStar® logo, allows the user to connect to the OnStar® call center.
 - The emergency button, which displays white letters "SOS" with red background, sends a high priority emergency call to the OnStar® call center when pressed.

If the LED does not illuminate, this may indicate that the customers OnStar® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

The telematics communication interface control module supplies 10 volts to the OnStar® button assembly on the keypad supply voltage circuit. When pressed, each button completes a circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit. Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed.

The OnStar® status LED or error indicator is located near the buttons. The LED is green when the system is ON and operating normally. When any indicator is illuminated and flashing, it is an indication that a call is in progress. When the LED is red, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStar® system is still able to make a call, the LED will flash red during the call.

Each LED or error indicator is controlled by either the telematics communication interface control module over dedicated LED signal circuits or by low speed GMLAN serial data depending on the inside rearview mirror option. Ground for the LED is provided by the wiring harness attached to the button assembly.

Secondary OnStar® Controls

Some vehicles may have an additional button that when pushed can engage the OnStar® system. The button may be a symbol of a face with sound waves, or may say MUTE, or be a symbol of a radio speaker with a slash through it.

By engaging the OnStar® system with this feature, the user can interact with the system by use of voice commands. A complete list of these commands is supplied in the information provided to the customer. If the information is not available for reference, at any command prompt the user can say "HELP" and the telematics communication interface control module will return an audible list of available commands.

OnStar® Microphone

The cellular microphone can be part of the rearview mirror assembly, or a stand-alone unit in the headliner or roof console. In either case, the telematics communication interface control module supplies approximately 10V to the microphone on the cellular microphone signal circuit. The microphone modifies the 10V depending on the volume and voice being detected. A cellular microphone low reference circuit or a drain wire provides a ground for the microphone. The microphone signal circuits pass through the telematics communication interface control module to support entertainment voice recognition.

Cellular and GPS Antennas

The combination antenna will have any of the following antenna elements when equipped with OnStar:

- Primary cellular element
- Secondary cellular element
- GPS element
- Digital radio element
- AM/FM element

The Gen 10 OnStar® system uses 2 cellular antenna elements to send and receive cellular data, the primary cellular element and the secondary cellular element. The primary cellular signal is carried by a coax cable that connects the antenna directly to the telematics communication interface control module. Details of the secondary cellular signal are further described below.

The GPS antenna element is used to collect the signals of the orbiting GPS satellites. Within the antenna is housed a low noise amplifier that allows for a more broad and precise reception of this data. Also housed within the antenna is circuitry to combine the GPS signal and the secondary cellular signal. Without navigation, the combination GPS/secondary cellular signal is carried by a coax cable that connects directly to the telematics communication interface control module. The cable also provides a path for DC current for powering the antenna. With navigation, the combination GPS/secondary cellular signal is carried by a coax cable that connects to the navigation signal splitter. The splitter supplies the GPS signal to the navigation/entertainment system and the GPS/cellular signal to the telematics communication interface control module.

The digital radio element collects digital radio signals from two satellites and where necessary terrestrial repeaters. The digital radio signal is carried by a coax cable and connected to the digital radio receiver. Refer to Radio/Audio System Description and Operation for further details.

The radio signal is sent from a broadcast station and is then received by the AM/FM radio antenna element. The AM/FM radio signal is carried by a coax cable and is connected to the radio. Refer to Radio/Audio System Description and Operation for further details.

OnStar® RemoteLink

OnStar® RemoteLink is a mobile app to link mobile devices to a vehicle for limited diagnostics and feature controls. After downloading the app and registering the device, vehicle owners with an eligible vehicle can use their mobile devices to access real-time data from their vehicle and perform specific commands remotely.

All communication between the app and the vehicle is powered by OnStar's® advanced connected vehicle technology. An active OnStar® account as well as a valid OnStar® username and password are required to use the app. The remote commands must be enabled by logging into the user's OnStar® account prior to using the app. Refer to the owners manual for available vehicle data and control features.

Compass Heading

The telematics communication interface module has a compass feature to calculate vehicle direction which is displayed via the instrument panel cluster or designated display. The compass heading is determined by dead reckoning until the GPS 3d fix is established. The dead reckoning is accomplished by using the yaw rate sensors and wheel ticks to determine heading changes from a GPS known heading. The GPS 3d fix heading is determined by the differential of two locations. If "CAL" is displayed on the Instrument Panel Cluster or designated display refer to the owners manual for steps to calibrate the compass.

Bluetooth® (If Equipped)

Bluetooth® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. Only vehicles with steering wheel controls will have Bluetooth® functionality. In order to utilize the vehicle's Bluetooth® system, a Bluetooth® equipped cellular phone is required.

The Bluetooth® antenna is internal to the telematics communication interface control module, radio or human machine interface module and is used to send and receive signals from a Bluetooth® enabled cellular phone. The available features and functions are determined by the software within the device being used and the telematics communication interface control module. The operating range of the signal from the vehicle is approximately 30 feet. Note that the operating range is dependent upon the cellular phone being used and battery level of the phone.

With Bluetooth® technology customers can experience hands-free calling as their Bluetooth® capable cellular phones are wirelessly connected to the vehicle. It will allow customers to place and receive calls using the steering

wheel controls and voice recognition. The vehicle audio system will allow you to listen to your call through the vehicle speakers and adjust volume through steering wheel or radio controls.

Not all Bluetooth® cellular phones are guaranteed to work with the vehicle's Bluetooth® system. Based on the cellular phone's service provider and the manufacturer's implementation of Bluetooth®, not all phones support all available Bluetooth® functionality. Bluetooth® enabled cellular phones will be tested for vehicle compatibility and a feature compatibility list will be provided via the GM Bluetooth® website: <http://www.gm.com/vc/bluetooth/>

Bluetooth® Features Supported

The following is a list of features supported by the Bluetooth® system. Note that not all devices will support all of the listed functions.

- Automatic reconnection - highest priority phone will automatically be connected to vehicle when vehicle ignition is on
- Hands-free dialing- via digits, redial, name tags (phone number saved to a nametag via voice recognition)
- Answering a call
- Ending a call
- Mute a Call
- Rejecting a call - ignore an incoming call
- Call Waiting
- Three-way Calling - initiated from hands-free system
- Send Number During a Call - this is used when calling a menu-driven phone system
- Transfer a Call - transfer call from vehicle to cellular phone and visa versa
- Voice Pass-Thru - allow access to the voice recognition commands on the cellular phone

Pairing a Bluetooth® Cellular Phone to the Vehicle

In order to use hands-free calling, the cellular phone must be paired to the vehicle. Up to five devices can be paired to the vehicle at one time, but only one can be connected at any given time. To pair a phone, the customer must know how to operate the Bluetooth® functionality of their phone. The pairing process must only be done one time for each phone, unless that phone's information is deleted. The system will always generate a password and will provide that password if the device you are pairing does not support Secure Simple Pairing (SSP). If the device being paired does support SSP the system will not provide the password and automatically pair the device. For safety reasons, the pairing process is disabled while the vehicle is moving.

Once the Bluetooth® cellular phone has been paired with vehicle, it will automatically connect to the vehicle when the ignition is on and the device is on. When more than one paired phone is in the vehicle, the phone with the highest priority will be connected. If the cellular phone is in use while getting into the vehicle, the phone can be switched to hands-free mode with the press of a button. In addition, a call in progress can be transferred from the vehicle hands-free mode to the phone to continue the call as the customer exits the vehicle.

Complete pairing instructions are provided in the Vehicle Owners Manual.

Back-up Battery (If Equipped)

NOTE: Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Disconnecting power to the OnStar® module in any way while the ignition is ON or with retained accessory power

activated may cause activation of the OnStar® Back-Up Battery. This action is per design as the back-up battery is designed to provide power to the telematics communication interface control module so an emergency notification call can be made after an event where the main battery is disabled. Once the Back-Up Battery is activated it will stay on until the power is restored back to the telematics communication interface control module. The telematics communication interface control module naturally chooses the main supply voltage as it's default supply, but if the main supply is removed or lost for any reason the OnStar® module will use the Back-Up Battery as a power supply as long as the default supply can not be detected. The back-up battery is not rechargeable and once discharged below 9.5 volts the back-up battery must be replaced.

Certain OnStar® equipped vehicles may also be equipped with a back-up battery. The back-up battery is a non-rechargeable, lithium battery intended to provide an auxiliary power source for the telematics communication interface control module in the event where power from the main vehicle battery is lost.

The back-up battery is intended to have a limited life span of approximately 4 years and is designed to maintain an open circuit voltage between 16 V and 9 V throughout this period. This allows the battery to power the basic functions of the telematics communication interface control module for least one 200 second (5 minute) call at the end of the 4 year span, should the main vehicle battery be lost. In the case of a vehicle losing vehicle battery power, OnStar will switch over to the backup battery based on an internal algorithm. It will look for an air-bag deploy, or near-deploy, messages from the SDM. If there are no messages the OnStar module will stay wake for a few minutes longer and monitor the buttons in the mirror. If not pressed, the modules will power down and shut off completely.

The back-up battery is connected to the telematics communication interface control module through the back-up battery positive voltage circuit and back-up battery ground circuit and is protected from a short circuit by means of an internal fuse. In the event the back-up battery, battery positive voltage circuit is shorted to the back-up battery ground circuit or chassis ground, the fuse will open and render the back-up battery permanently inoperable. The status of the back-up battery and its associated wiring is monitored by the telematics communication interface control module.

WiFi Hotspot

The telematics communication interface control module acts as a Wireless Local Area Network (WLAN) WiFi hotspot router and uses direct 4G LTE connectivity to the internet. It has the ability to connect up to 7 devices at one time. A data plan is required and when purchased, a security default password is established. There are several ways to change the SSID or password, by placing a call to the OnStar Call Center, by using the Gen 10 mobile app or through the scan tool.

The system utilizes a secure autoconnect feature between the telematics communication interface control module and the radio/HMI. No user interaction is required, it is always available and ready to connect to a dedicated in car device. The ignition must be in Run, Accessory or RAP for WiFi to operate.

Audio System Interface

When the OnStar® requires audio output, a serial data message is sent to the audio system to mute all radio functions and transmit OnStar® originated audio. The OnStar® audio is transmitted to the vehicle audio system by a dedicated signal circuit and a low reference circuit.

The audio system will mute and an audible ring will be heard through the speakers if the vehicle receives a call with the radio ON.

On some vehicles, the HVAC blower speed may be reduced when the OnStar® system is active to aid in reducing interior noise. When the system is no longer active, the blower speed will return to its previous setting.

OnStar® Sleep Cycle

The OnStar® system uses a unique sleep cycle to allow the system to receive cellular calls while the ignition is in the OFF position and retained accessory power mode has ended. This cycle enables the telematics communication interface control module to perform remote functions, such as door unlock, as commanded over the air by the OnStar® Call Center, and to continue to maintain an acceptable level of battery electrical drain.

The OnStar® system uses 4 states of readiness, depending upon the type of cellular market the vehicle is in when the ignition is put into the OFF state:

- High power
- Low power
- Sleep
- Digital standby

The high power state is in effect whenever the ignition is in the ON or RUN position, or retained accessory power is enabled, and the OnStar® system is sending or receiving calls or when the system is performing a remote function.

The low power state is in effect when the OnStar® system is idle with the ignition in the ON or RUN position, or with retained accessory power enabled.

The sleep state is entered after the vehicle has been shut off and the retained accessory power has timed out while in an analog cellular area. At a predetermined time recorded within the telematics communication interface control module, the system re-enters the low power state to listen for a call from the OnStar® Call Center for 1 minute. After this interval, the system will again return to the sleep state for 9 minutes. If a call is sent during the 1 minute interval, the OnStar® system will receive the call and immediately go into the high power mode to perform any requested functions. If no call is received during the 1 minute interval, the system will go back into the sleep mode for another 9 minutes. This process will continue for up to 48 hours, after which the OnStar® system will turn off until the ignition is turned to the ON or RUN position.

The digital standby power state is entered after the vehicle has been shut off and the retained accessory power has timed out while in a digital cellular area. When in digital standby mode, the OnStar® module is able to perform all remote functions as commanded by an OnStar® advisor at any time, for a continuous 120 hours. After 120 hours, the OnStar® module will go into sleep mode until a wake up signal from the vehicle is seen by the telematics communication interface control module. If the OnStar module loses the digital cellular signal it will revert to analog mode and follow the standard sleep state (9 minutes OFF, 1 minute standby) based on the time of the GPS signals, this will continue until a digital cellular signal is again received.

If the OnStar® system loses battery power while the system is in a standby or sleep mode, the system will remain OFF until battery power is restored and the ignition is turned to the ON or RUN position.

Features

OnStar® Personal Calling

The hands free, OnStar® personal calling cellular phone feature is an additional feature of the OnStar® system. This feature is embedded within the telematics communication interface control module; however it must be activated by an OnStar® advisor. OnStar® personal calling operates similar to most hand held cellular phones in that the availability for its usage is based on minutes or units. The customer must have a current OnStar®

subscription, as this feature cannot be utilized without it. To use OnStar® personal calling, the customer must also purchase units (minutes) as outlined in the owners guide provided with the OnStar® system. Units begin to deplete, 1 unit is equal to 1 minute, as the customer makes outbound phone calls, answers inbound phone calls, or while connected to the OnStar® virtual advisor. In addition, units may also have an expiration date, depending upon the type of units purchased.

Customers have the ability to store telephone numbers within the module, referenced by a nametag for the convenience of frequently dialed numbers. After storing a nametag, the user can dial this number by initiating the OnStar® personal calling feature, speaking the word "call," and repeating the nametag assigned.

Turn by Turn Navigation

Turn by Turn Navigation allows the driver to contact OnStar® to obtain directions for driving from a current location to a desired location. The Turn by Turn Navigation system stores your planned route and continually checks your position along that route, when you deviate from the planned route, the system will recognize this and prompt the driver with verbal prompts for how to proceed. The driver then responds verbally to direct the system to continue the current routing or to recalculate the route because of a missed turn.

Advisor Record Feature

The Advisor Record Feature allows the user to store any information given during a call with an OnStar® Advisor. Recording is activated by pressing the blue OnStar button during a call; pressing the button a second time stops the recording. The stored information can be played back by pressing the phone button on the three button assembly and using the voice command "Advisor Playback".

Teletypewriter (TTY) Users

OnStar has the ability to communicate to deaf, hard-of-hearing, or speech-impaired customers while in the vehicle. The available dealer-installed TTY system can provide in-vehicle access to all of the OnStar services, except Virtual Advisor and OnStar Turn-by-Turn Navigation.

Deactivated OnStar® Accounts

In the event a customer has not renewed their OnStar® account after expiration or the account was never activated, OnStar® will make a discrete cellular call to the vehicle to deactivate the OnStar® system. Before taking this action, customers are notified that the OnStar® system in their vehicle will be deactivated unless they elect to renew the account. After the OnStar® account has been deactivated, customers will experience the following:

- The OnStar® status LED will not illuminate.
- The OnStar® system will NOT attempt to connect to the OnStar® Call Center in the event of a collision or if the vehicle's front air bags deploy for any other reason.
- An emergency button press will play a demo message indicating the service has been deactivated.
- An OnStar® Call Center button press will connect the customer with a dedicated sales team who can sell an OnStar® subscription and reactivate the vehicle. Depending on the type of OnStar® hardware in the vehicle, the customer may first hear a demonstration message stating there is no current OnStar® subscription for the vehicle, and directing the customer what to do to activate services.
- OnStar® personal calling will not be available, as this feature requires the customer to have a current OnStar® account. Attempts to use this feature may result in cellular connection failure messages and the inability to connect to the number dialed.

Certain vehicles that have never had an active OnStar® account, or that have been deactivated, may be unable to

establish a connection with the OnStar® Call Center. When normal published diagnostic procedures do not indicate a possible cause for the no connect concern, the vehicle may have been deactivated. For deactivated vehicles, a no connect response should be considered normal operation. Further diagnosis and subsequent repair is only necessary should the customer elect to become an active OnStar® subscriber or renew the account subscription.

OnStar® Cellular, GPS, and Diagnostic Limitations

The proper operation of the OnStar® System is dependent on several elements outside the components integrated into the vehicle. These include the National Cellular Network Infrastructure, the cellular telephone carriers within the network, and the GPS.

The cellular operation of the OnStar® system may be inhibited by factors such as the users range from an analog or digital cellular tower, the state of the cellular carrier's equipment, and the location where the call is placed. Making an OnStar® key press in areas that lack sufficient cellular coverage or have a temporary equipment failure will result in either the inability of a call to complete with a data transfer or the complete inability to connect to the OnStar® Call Center. The OnStar® system may also experience connection issues if the identification numbers for the module, station identification number, electronic serial number or manufacturers electronic ID, are not recognized by the cellular carriers local signal receiving towers.

The satellites that orbit earth providing the OnStar system with GPS data have almost no failures associated with them. In the event of a no GPS concern, the failure will likely lie with the inability of the system to gain GPS signals because of its location, i.e. in a parking structure, hardware failure, or being mistaken with an OnStar® call which has reached the Call Center without vehicle data.

During diagnostic testing of the OnStar® system, the technician should ensure the vehicle is located in an area that has a clear unobstructed view of the open sky, and preferably, an area where analog or digital cellular calls have been successfully placed. These areas can be found by successfully making an OnStar® keypress in a known good OnStar® equipped vehicle and confirming success with the OnStar® Call Center advisor. Such places can be used as a permanent reference for future OnStar® testing.

Mobile Identification Number and Mobile Directory Number

The telematics communication interface control module utilizes 2 numbers for cellular device identification, call routing and connection, a mobile identification number and a mobile directory number. The mobile identification number represents the number used by the cellular carrier for call routing purposes while the mobile directory number represents the number dialed to reach the cellular device.

Operation of the OnStar® Speech Recognition Systems

OnStar® users communicate with 2 speech recognition systems. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over a phone line. The computer tries to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

- Personal Calling uses a speech recognition system that resides in the vehicle. When the user presses the phone button, the system states, Ready, and listens for the user's command. The user can speak commands to control the hands-free phone.
- Virtual advisor is a remote speech recognition system that the caller can access by making a phone call. The user connects to virtual advisor by requesting it during personal calling use. The user is then transferred to the virtual advisor server and talks to it via a cellular connection.

The OnStar® speech recognition systems use speech technology that is designed to understand a wide range of American English speakers. Although there is no one right way to speak English, the system will work best when

users try to modify their pronunciation should they encounter difficulty. Users who do not obtain good results are advised to try the tips and workarounds found in the Infotainment System Manual or the Owners Manual.

RADIO/AUDIO SYSTEM DESCRIPTION AND OPERATION

The entertainment system on this vehicle may have several different configurations available to it. To determine the specific configuration of the vehicle, please see the Service Parts ID Label, and refer to [RPO Code List](#).

Each item in the list below represents topics covered in detail below.

- Radio Circuit Operation
- Information Display and Controls
- Antenna System
- Radio Reception
- Speaker Operation
- Audio Amplifier (If equipped)
- Theft Deterrent
- Auxiliary Audio Input Jack (If equipped)
- USB Port (If equipped)
- Bluetooth® (UP9) (if equipped)
- Applications (if equipped)
- Navigation System Components and Features (if equipped)
- OnStar® (if equipped)
- Steering Wheel Controls (If equipped)
- Auto Volume Control

Radio Circuit Operation

Radio Power

The radio does not use a discrete ignition feed circuit for power moding. The power mode master provides the system power mode to the radio via serial data messages. The power mode master determines the system power mode by processing power mode information from ignition switch inputs. Serial data power modes supported by the radio are OFF, ACCESSORY, RUN, and CRANK REQUEST.

Radio Grounds

The vehicle harness provides a ground for the radio circuits. The radio may also be case grounded.

Radio Data Link Communication

The radio communicates with other modules via serial data.

Radio Audio Outputs

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio

source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Remote Enable Output

The remote enable circuit is a discrete 12 V signal supplied to infotainment system components when the radio is producing audio, needs the front display on, needs video entertainment system components on, or needs to produce chimes. This signal is used to control the power state of the components. There is no output on radio the remote enable circuit when the vehicle is in the CRANK powermode, this is to minimize current consumption from the attached modules and also to avoid audio pops during crank events.

Information Display and Controls

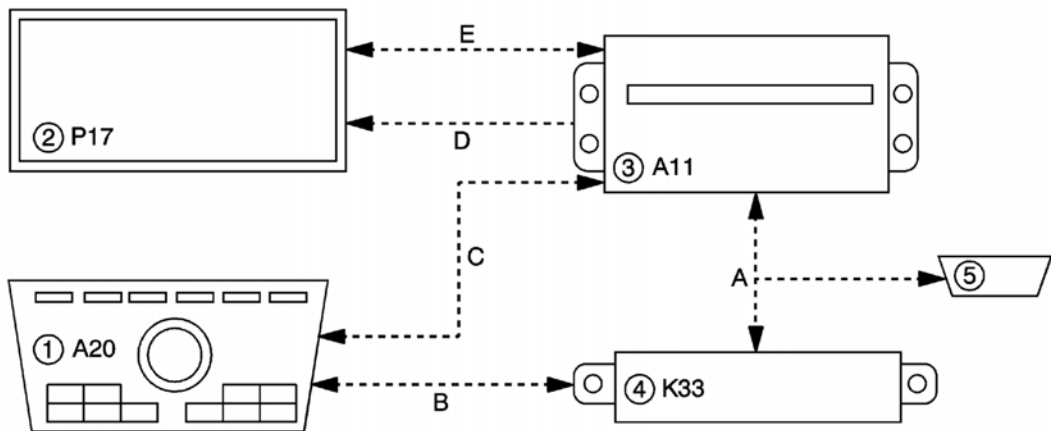


Fig. 40: Navigation Radio Communications Flow Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Radio/HVAC Controls
2	Info Display Module
3	Radio
4	HVAC Control Module
5	Data Link Connector
a	GMLAN
b	Local Interconnect Network
c	CAN Graphical Interface
d	Digital Video
e	Touch Screen Serial Data

The info display module has continuous power and ground. When the radio is on, a discrete 12 V signal is supplied on the remote enable circuit to the color display module. This signal is used to control the power state of the module, which is active when the signal is high and inactive when the signal is low.

The info display module receives digital video data from the radio for on-screen display information through a dedicated video cable. The radio communicates with the info display module over the touch screen serial data circuits for touch screen inputs and backlighting dimming level.

The radio controls communicate radio control inputs directly to the radio through the CAN Graphical Interface (CGI) data circuits. After receiving the message the radio will perform the requested function. Messages communicated between the radio and the radio/HVAC controls include the following:

- Button presses/knob rotations
- Commands for the state of indicators
- Radio control back-lighting

The HVAC controls are a separate component from the radio controls. HVAC data for controls and status indicators is communicated between the HVAC controls and the HVAC control module with a separate LIN serial data circuit. HVAC status screen information from the HVAC control module is transmitted to the radio on the GMLAN serial data circuit. The radio then displays the desired screen information on the info display using the video data circuits.

Antenna System

The multi-band antenna is located on the roof of the vehicle. This type of antenna may be used with the AM/FM radio, but is primarily for OnStar® cellular and GPS signals and the XM™ Satellite Radio Service System, if the vehicle has these features. Keep this antenna clear of snow and ice build up for clear reception. If the vehicle has a sunroof, the performance of the system may be affected if the sunroof is open. Loading items onto the roof of the vehicle can interfere with the performance of the system, ensure the multi-band antenna is not obstructed.

The radio provides battery voltage to the AM/FM amplifier in the antenna base using the center conductor of the antenna coaxial cable. When a 12 V signal is seen by the amplifier, both AM and FM signals are amplified.

Radio Reception

AM/FM Radio Signal

The radio signal is sent from a broadcast station and is then received by an antenna. The strength of the signal received depends on the following:

- The power output (wattage) of the broadcasting station
- The location of the vehicle (or receiver) relative to the broadcast tower.
- Height of the broadcast antenna
- Height of the receiving antenna
- Obstacles between the tower and the receiver
- Atmospheric conditions
- What band (AM or FM) the station is broadcasting
- Type of antenna and the ground plane

Digital Radio Receiver (If equipped)

The XM satellite receiver is integrated into the radio. XM satellite radio provides digital radio reception. The XM signal is broadcast from two satellites and, where necessary, terrestrial repeaters. The high power satellites allow the antenna to receive the XM signal even when foliage and other partial obstructions block the antennas view of the satellite. Terrestrial repeaters are used in dense urban areas. These repeaters will receive the satellite signal and re-broadcast them at much higher power levels in order to ensure reception in areas with densely packed tall buildings. A service fee is required in order to receive the XM service.

Radio Data System (RDS)

The RDS feature is available only on FM stations that broadcast RDS information. This system relies upon receiving specific information from these stations and only works when the information is available. While the radio is tuned to an FM-RDS station, the station name or call letters display. RDS data is carried in what is known as a "subcarrier". A subcarrier is a frequency that the FM broadcaster is authorized to use to send data that is not audible in the main audio program.

RDS functions will only work with FM broadcast stations that are broadcasting RDS data. Not all FM Broadcast stations broadcast RDS data or offer all of the RDS services.

The information displayed is dependent upon the information broadcast by the particular station. The information may vary greatly between stations. RDS functions may not work properly when reception is weak, reception is of poor quality, or RDS is not implemented properly by the FM Broadcaster. In some cases, a radio station broadcasting incorrect information may cause the RDS features of the radio to appear to work improperly.

With RDS, the radio can do the following:

- Display text information such as: station identification, type of programming, and general information (artist and song title, station messages, call in phone numbers, etc.).
- Seek to stations broadcasting the selected type of programming
- Receive announcements concerning local and national emergencies
- Receive alert warnings of local or national emergencies. When an alert announcement comes on the current radio station, ALERT! displays. You will hear the announcement, even if the volume is low or a CD is playing. If a CD is playing, play stops during the announcement. Alert announcements cannot be turned off. ALERT! is not affected by tests of the emergency broadcast system. This feature is not supported by all RDS stations.

Speaker Operation

Speakers turn electrical energy into mechanical energy to move air, using a permanent magnet and an electromagnet. The electromagnet is energized when the radio or amplifier (if equipped) delivers current to the voice coil on the speaker. The voice coil will form a north and south pole that will cause the voice coil and the speaker cone to move in relation to the permanent magnet. The current delivered to the speaker is rapidly changing alternating current (A/C). This causes the speaker cone to move in two directions producing sound.

Audio Amplifier (If equipped)

Amplifier Interface

A fused battery voltage circuit provides the main amplifier power. A switched 12 V output from the radio is used to control the power - state of the amplifier. To respond quickly to audio input and control signals, the amplifier is ON in all vehicle power modes except OFF and CRANK Request. The internal amplifier bridges are fully powered and unmuted when the amplifier receives the switched 12 V input.

Amplifier Operation

The purpose of the amplifier is to increase the power of a voltage or current signal. The output signal of an amplifier may consist of the same frequencies as the input signal or it may consist of only a portion of the frequencies as in the case of a subwoofer or midrange speaker. The radio creates a low level stereo audio output signal, which is sent at the user-defined volume level to the audio amplifier. The audio amplifier amplifies the signal and sends it to the appropriate speakers. Each of the audio output channel circuits (+) and (-), from the amplifier have a DC bias voltage that is approximately one half of battery voltage. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker

cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Theft Deterrent

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. The radio receives this information via serial data. A possible cause of incorrect VIN info could be the radio was originally installed in another vehicle.

The radio has the following theft operating modes as part of the theft deterrent system:

- Normal Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data matches the learned VIN sequence. In this mode the radio has full functionality.
- No VIN Mode: The radio has not received or learned a correct VIN sequence. In this mode the radio has limited functionality.
- Theft Detected Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence. In this mode the radio may be disabled or have limited functionality. The radio display will indicate that theft protection is active.

Auxiliary Audio Input Jack (If equipped)

The infotainment system may have a 3.5 mm (1/8 in.) auxiliary audio input jack located in the center console. The auxiliary audio input jack may interface directly with the radio, or be connected to the infotainment system via a Multimedia Player Interface Module. When a portable audio playback device is connected to the auxiliary jack, an internal switch detects the connection and the radio will switch to AUX as the audio source. Audio signals from the device are sent to the radio from the auxiliary jack via the left, right, and common audio signal circuits.

- When a device is first connected to the 3.5 mm (1/8 in.) input jack the infotainment system automatically switches to that device. If an auxiliary device has already been connected, press the AUX or CD/AUX button to select the device.
- Playback of an audio device that is connected to the 3.5 mm jack can only be controlled using the controls on the device.
- The volume control on the device may need to be adjusted to ensure sufficient playback volume through the infotainment system.

USB Port (If Equipped)

The infotainment system may have a USB connector located in the center console. The USB connector may interface directly with the radio, or be connected to the infotainment system via a Multimedia Player Interface Module. The USB connector supports both USB standards 1.1 and 2.0.

USB Supported Devices:

- USB Flash Sticks (Thumb Drives)
- Portable USB Hard Drives
- Portable Digital Media Players (iPOD®®, ZUNE®®, etc)

Depending on the USB device, some devices may not be recognized, or some features/functions may not be able to be controlled with the radio controls. USB HUB devices are not supported.

Bluetooth® (If Equipped)

Bluetooth® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The available features and functions are determined by the type of device and the software within the devices being used. For a feature or function to operate, it must be supported in both devices.

The first connection between devices is established through a process called pairing. In order to pair two devices, a password (passkey) has to be exchanged between the two devices. One device will generate the password, the other device accepts the password to complete the process. Once the devices are paired, future connections between the devices will occur automatically when the devices are on and within range of each other.

The Bluetooth® hardware is internal to the radio. The radio supports streaming of data (music, voice, information) from cellular phones and other mobile devices that support those features. The radio may also be capable of interfacing with cellular phones for hands-free features.

- The device must be paired to the radio to use the available Bluetooth® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- Up to five devices can be paired to the system, but only one can be connected at any given time.
- Streaming Audio allows playing music from the mobile device wirelessly. Music stored on the mobile device can be viewed and controlled from the display.
- To stream audio from a mobile device, the device must be unlocked, and any additional applications should be closed.

Refer to the vehicle owners manual, supplements, and the device manufacturers information for pairing instructions.

Applications (If equipped)

When the system is equipped with Bluetooth®, the system may be capable of using applications, commonly referred to as apps.

The term application refers to any piece of software that works on a system (hardware) that is being operated by its own software. Applications are typically small software programs which use the hardware to perform a specific task, as opposed to operating the entire system.

- For an application to be used, it must be installed on both the vehicle infotainment system and a compatible mobile device.
- The device must be connected to the system. This may be done wirelessly via Bluetooth®, or via the vehicle USB port. Refer to the device manufacturers information for the proper connection method.
- When the device is connected, the application on the radio is used to remotely access and control the application on the mobile device.
- The application must work correctly on the device to work with the vehicle infotainment system.
- The user may be required to log-in to the application on the mobile device before using the application from the vehicle controls.
- Using applications will use the device's data plan.
- The device must be unlocked, and any additional applications should be closed.

Refer to the owner's manual and supplements for information on mobile devices, control, and operation.

Navigation System Components and Features (if equipped)

The navigation system, if equipped, provides the following:

- Connection to the global positioning system (GPS) antenna, which provides the vehicle position information.
- Route guidance with verbal prompts to the operator.
- Map data for navigation and map route guidance, stored on the internal hard drive.
- Traffic and weather information for display on the navigation system map (with active subscription, where available).

Global Positioning System (GPS) Antenna

The global positioning system (GPS) antenna is part of the multi-band antenna located on the roof of the vehicle. The GPS antenna is used to collect the signals of the orbiting GPS satellites. Within the antenna is housed a low noise amplifier that allows for a more broad and precise reception of this data. The GPS antenna amplifier is powered through the coaxial cable.

The antenna is connected to the navigation radio through a signal splitter. The signal splitter is a component for dividing the navigation signal into two paths without any transmission loss. This allows the use of a single GPS antenna to provide a signal to both the navigation radio and the telematics communication interface module.

Route Guidance

The map will display the route to the selected destination. Voice prompts alert the operator of upcoming events (turns) and arrivals at the destination. The navigation system will automatically recalculate if the route is not followed. The navigation radio uses data received from the global positioning system (GPS) satellites, the vehicle speed signal, and serial data information to accurately display the current position of the vehicle.

Points of Interest

The map database provides point of interest information. Points of interest are locations that are frequently visited. Points of interest can be displayed on the map or set as a destination. The following are some of the available Points of interests:

- Gas Station
- Restaurant
- College
- Police Station

Traffic Information

XM NavTraffic™ is a subscription based service that enhances the navigation system with live traffic information. The service provides information on traffic conditions such as traffic speed, accidents, disabled vehicles, construction and road closings.

The integrated XM satellite radio receives the information. When Traffic Information is turned ON in the configuration menu, the available information will be displayed on the map screen.

The traffic information can vary based upon coverage in the area, and coverage is not available in all areas. No information will be displayed if coverage is not available, if there is no traffic information for the area, or if there is no subscription to receive the information.

A subscription fee is required in order to receive the XM NavTraffic™ service. No traffic data will be displayed without a current subscription.

Weather Information

XM NavWeather™ is a subscription based service that transmits weather information to the integrated XM satellite radio. Real time information such as current and future weather and road conditions, atmospheric conditions, and National Weather Service warnings is provided, as well as 3 day forecasts for some cities. Received information is available to be displayed on the Weather Info screen.

A subscription fee is required in order to receive the XM NavWeather™ service. No weather data will be displayed without a current subscription.

OnStar® (If equipped)

When OnStar is activated, a serial data message is sent to the radio that activates a software program. When the software begins its process, the fade goes to the front, Bass and Treble are set to the mid range, the outputs are mono, and the audio source is OnStar. OnStar takes priority over any other audio source. All of these actions are preset values stored in the radio.

For additional OnStar information, refer to [OnStar Description and Operation](#).

Steering Wheel Controls (If equipped)

Some audio functions are available using the steering wheel controls. The steering wheel controls duplicate the function of the primary controls available on the radio.

For additional information on steering wheel controls, refer to [Steering Wheel Controls Description and Operation](#) .

Auto Volume Control

With auto volume control, the audio system will adjust automatically to make up for road and wind noise as you drive, by increasing the volume as vehicle speed increases. To use auto volume control, set the volume at the desired level, and then select either Low, Medium, or High. To turn auto volume control off, select the Off screen button.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

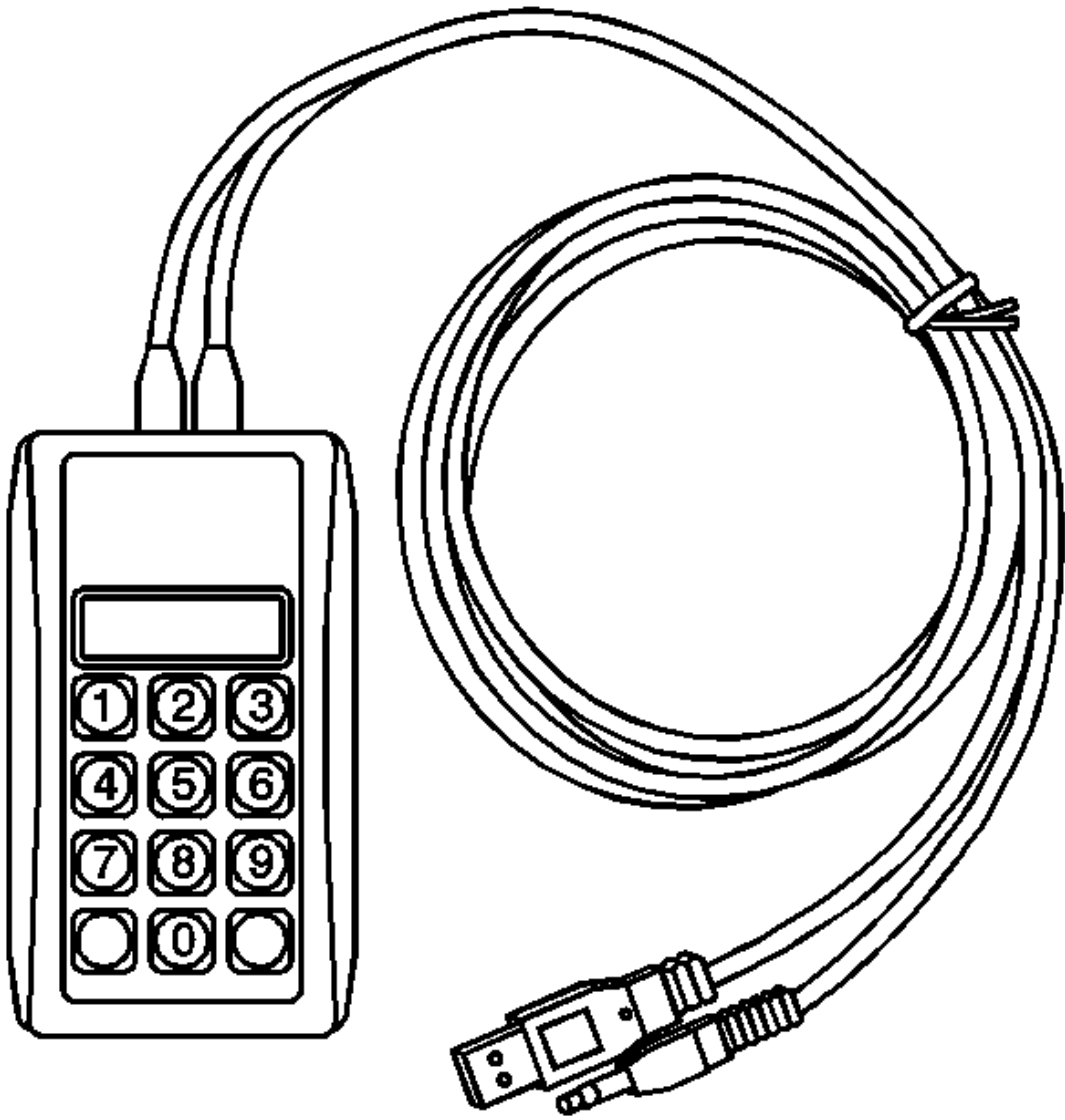
Illustration	Tool Number/Description
 A line drawing of a handheld electronic device, likely a multi-media interface tester. The device is rectangular with a numeric keypad (0-9) and a small display screen at the top. Two cables are connected to the top of the device. One cable is coiled into a large loop, and the other is a straight cable with a multi-pin connector. The connector has a rectangular base with a small square window and a series of pins along the side.	EL-50334-20 Multi-Media Interface Tester (MIT)

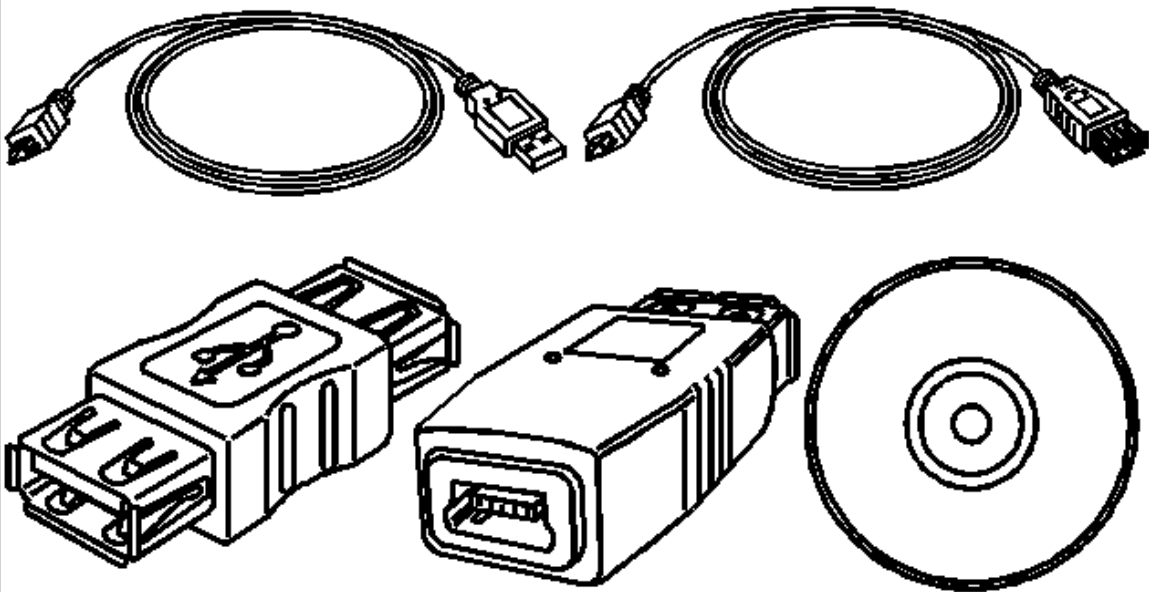
Illustration	Tool Number/Description
 The illustration shows the components of the EL-50334-50 USB Cable and Adapter Kit. At the top, there are two coiled cables. The cable on the left has a standard USB-A connector on one end and a custom rectangular connector on the other. The cable on the right has a standard USB-A connector on one end and a custom rectangular connector with a different pin configuration on the other. Below the cables, there are three items: a custom rectangular USB adapter with a USB-A port on one side and a custom rectangular port on the other; a custom rectangular adapter with a custom rectangular port on one side and a custom rectangular port on the other; and a circular disc, likely a CD-ROM or DVD-ROM, representing the software included in the kit.	EL-50334-50 USB Cable and Adapter Kit

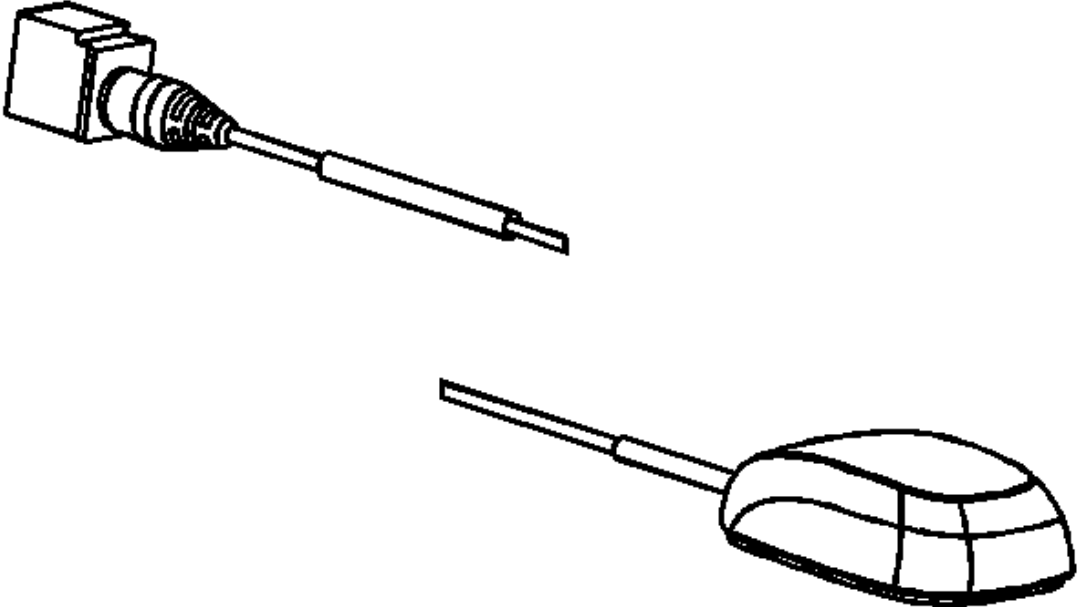
Illustration	Tool Number/Description
	EL-48028 Digital Radio Test Antenna

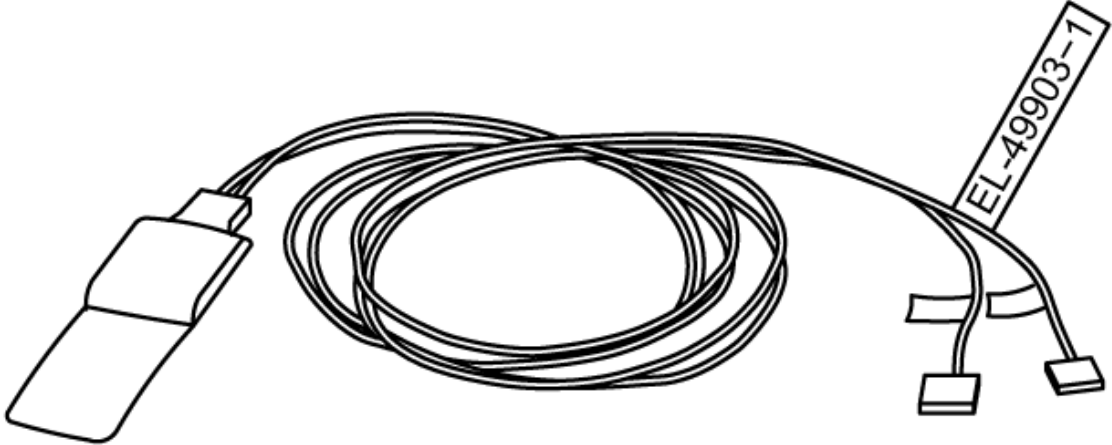
Illustration	Tool Number/Description
	EL-49903-1 Test Antenna, Navn- Cell Comn

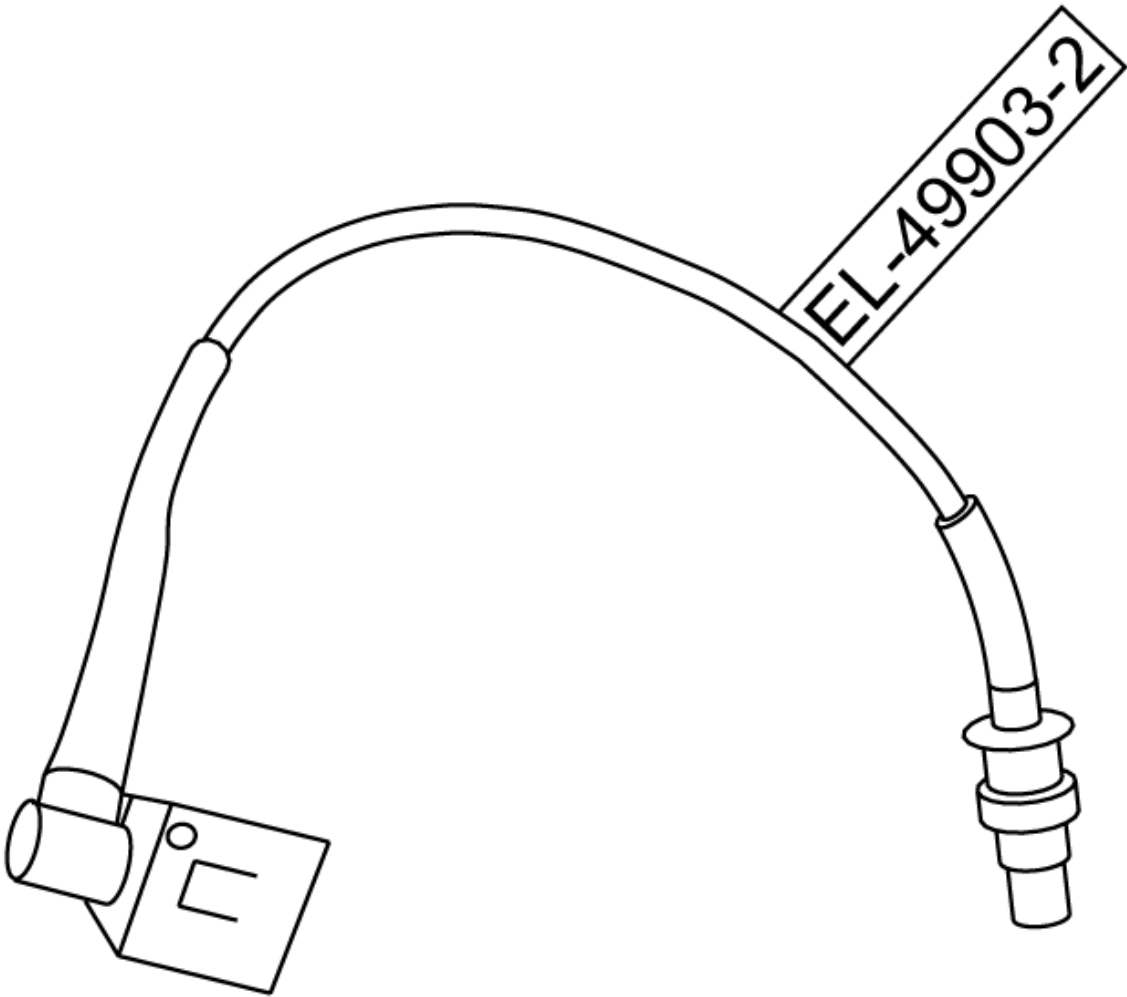
Illustration	Tool Number/Description
	EL-49903-2 Adapter Cable-UHF RT Angle

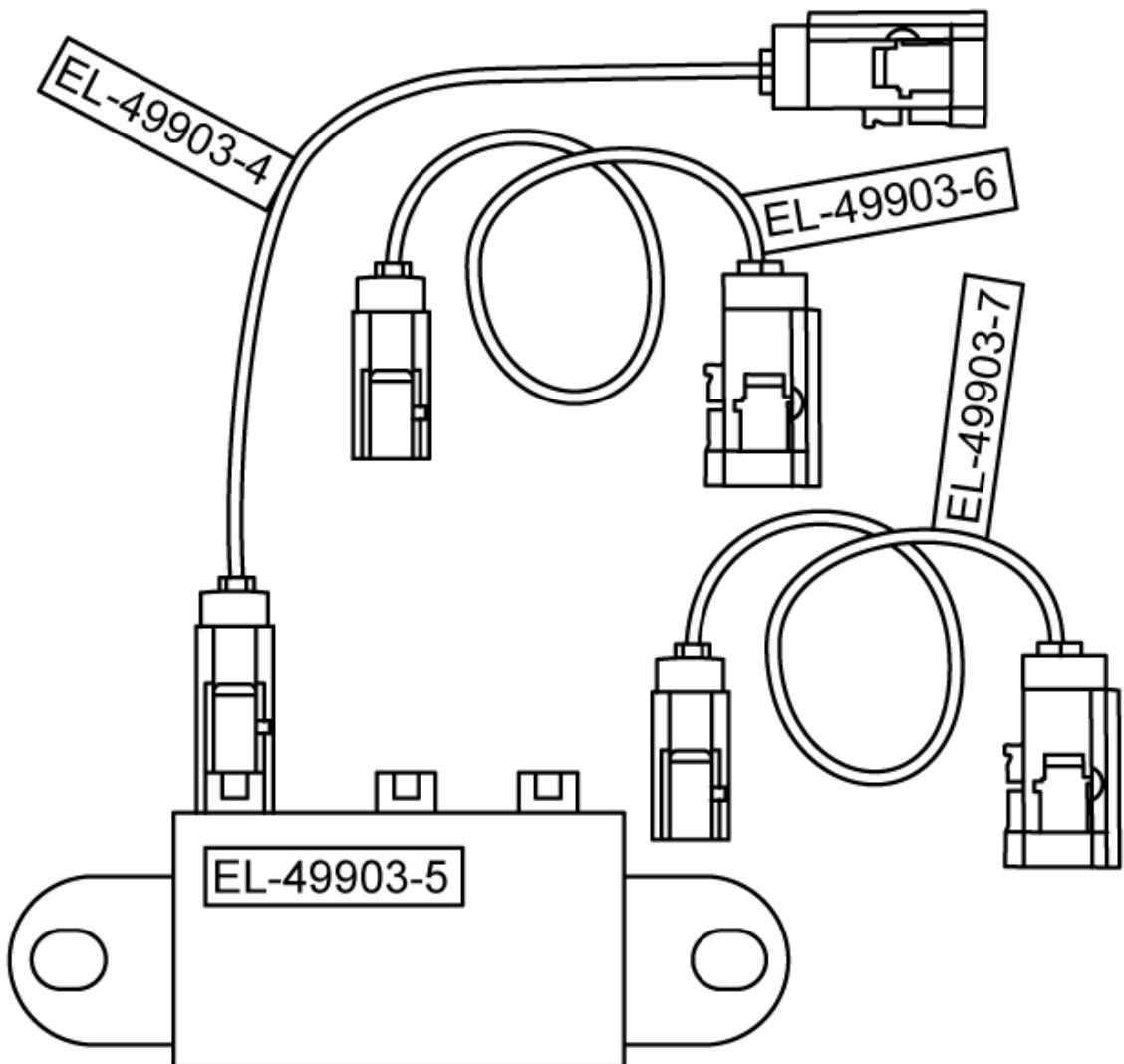
Illustration	Tool Number/Description
	EL-49903-3A Combiner Kit, Test Antenna

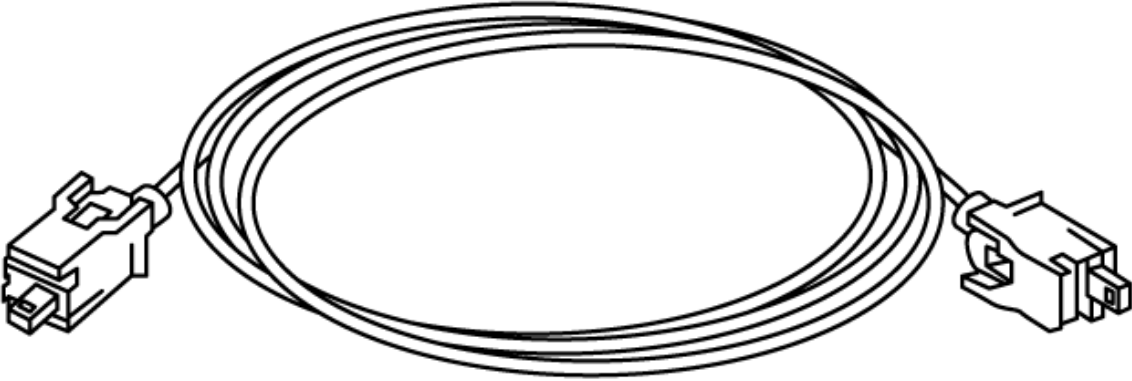
Illustration	Tool Number/Description
 A line drawing of a coiled cable. The cable is coiled into a large oval shape. At each end of the cable is a connector. The connectors are rectangular with a tab on top and a latch on the side. They appear to be standard automotive or industrial connectors.	EL-50334-12 Infotainment Test Cable - RSE

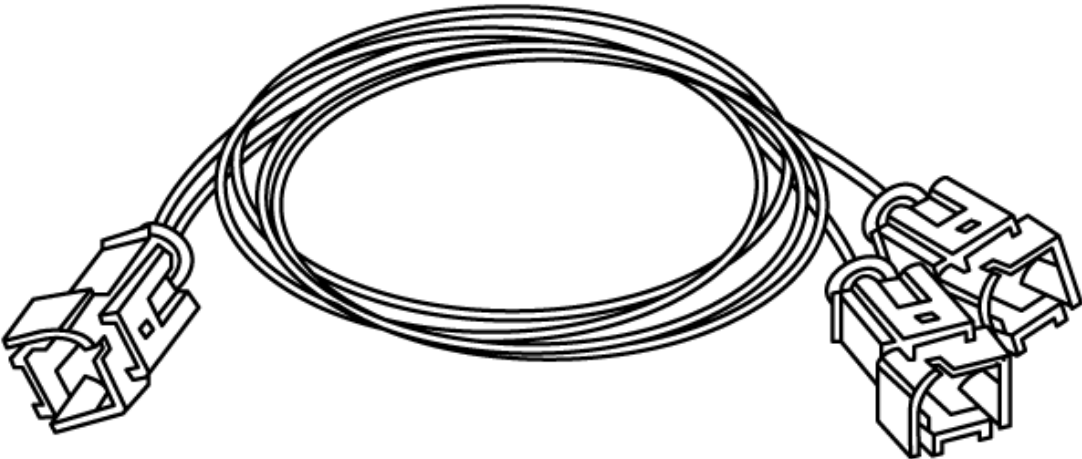
Illustration	Tool Number/Description
	EL-50334-13 Infotainment Test Cable - RSE Splitter

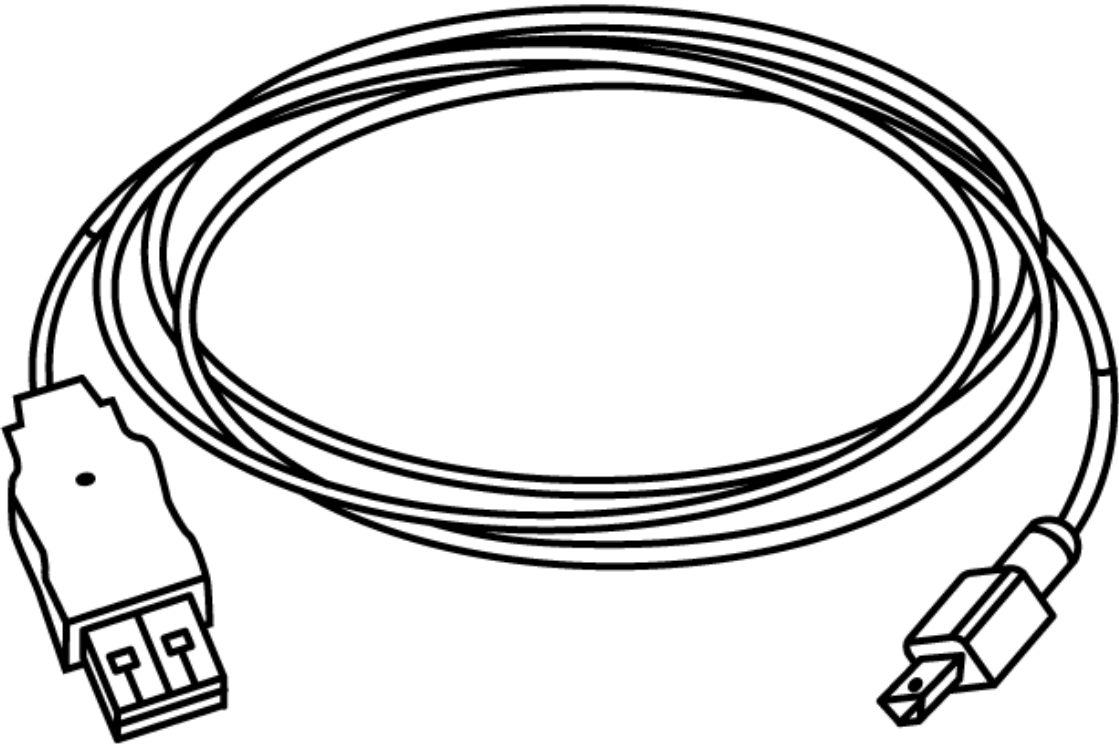
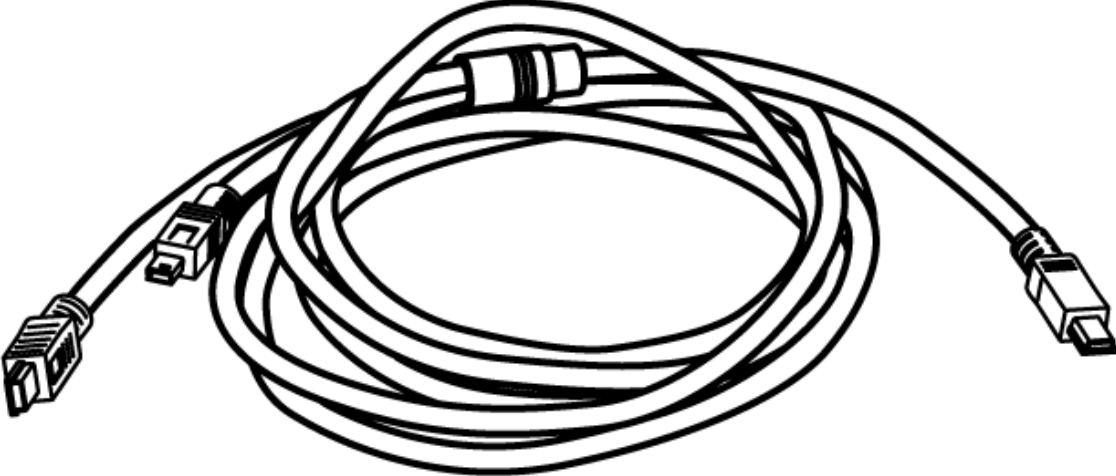
Illustration	Tool Number/Description
	EL-50334-14 Infotainment Test Cable

Illustration	Tool Number/Description
	EL-50334-15 Video Bypass Cable

SPECIAL TOOLS (MIT TOOL INSTRUCTIONS)

Bluetooth Pairing for Vehicles with Radio RPO: UF7

Either reset the pin code on the radio to 0000, or go under Device Info on the radio and see what the pin code is (to enter it later on the MIT).

1. Turn the BT discoverable ON in the radio Bluetooth settings.
2. Press Pair Device on radio (DO NOT PRESS SEARCH BLUETOOTH DEVICES ON THE RADIO).
3. Press the Pair button on the MIT.
4. When the three LED lights begin flashing on the MIT, enter the pin code (either 0000 if you reset it to that or what the radio pin code was).
5. MIT will then automatically connect with the radio and should show "MIT Connected" message.

Make test call and the audio streaming test.

Holden Radio Bluetooth Pairing Instructions

1. Using the radio controls, place the radio into "Discoverable Mode".
2. Place the MIT into Bluetooth mode by pressing TEST SELECTOR until the Bluetooth LED is illuminated.
3. With the MIT in Bluetooth mode Press and Release the #1 button (the Bluetooth LED will begin to slowly blink).
4. Now Press and release the PAIR/CALL button on the MIT (the Bluetooth LED will begin to blink a little faster).
5. On the radio Enter the PASSKEY when prompted: (press "0000" then Press "OK").
6. The MIT and radio will PAIR and CONNECT (the Bluetooth LED will be Fast Flashing).
7. Use as regular MIT at this point.

For all other Radios

Testing the Bluetooth Function

1. Verify connection of the MIT to the USB port.
2. Press and release the TEST SELECTOR button until the Bluetooth LED illuminates.
3. Disable all other Bluetooth devices present in the vehicle (ie. cell phones, laptops, etc.).

Standard Bluetooth Pairing/Bonding

1. Use the vehicle controls to place the radio into Bluetooth Pairing mode. The vehicle will prompt you with a security code.
2. Press and release the PAIR/CALL button. The Bluetooth LED will blink slowly while preparing to have a security code entered.
3. Wait for the all three LEDs to blink confirming it is ready to have the security code entered.
4. Enter the code with the MIT keypad and hit ENTER.
5. The Bluetooth LED will blink slowly while pairing/bonding and move to a quick flash once paired/bonded.

The vehicle should confirm pairing/bonding is complete.

Streaming Audio

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode.
2. On some radios the MIT automatically begins streaming audio via A2DP. The audio playback will confirm that the Bluetooth connection using streaming and the audio is working correctly.
3. On other radios you will need to select Bluetooth Audio from the Source menu to verify Audio Streaming.
4. Audio playback confirms that the Bluetooth connection using Streaming Audio is working correctly.
5. Placing a test call will temporarily stop the streaming audio function, but upon disconnection of that test call, the streaming audio from the MIT will resume.

To Place a Test Call

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode. If the vehicle is equipped with streaming audio, and the radio is set to play a Bluetooth audio file, the streaming audio playback will be audible.
2. Press and release PAIR/CALL button to place a test call. Streaming audio will be temporarily turned off.
3. Use the vehicle controls to answer the call.

NOTE: If the call is not answered within several rings, the MIT's audio files will not transmit, even though an active call is occurring.

4. Audio playback confirms that the Bluetooth connectivity is working correctly.

NOTE: The MIT will remain paired/bonded when the call is ended by the vehicle. To re-test the call function, place the MIT in Bluetooth mode and press and release the Pair button to reconnect. When testing is completed, delete MIT from the audio system before returning the vehicle to the customer.

5. Use the vehicle controls to end the call. If applicable, streaming audio will resume.

Testing the AUX/Line-In Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT AUX LED illuminates.
3. Use the vehicle controls to put the audio system into Audio (Line-In) mode.
4. Audio playback confirms that the audio input is working correctly.

Testing the USB Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT USB LED illuminates.
3. Use the vehicle controls to put the audio system into USB mode.

NOTE: Volume levels may vary dependent upon vehicle audio system.

4. Audio playback confirms that the USB is working correctly.

Troubleshooting Guide

If the MIT unit is still not working properly after following the below troubleshooting, the unit is malfunctioning and should be repaired or replaced.

Unit not Working

- Verify the MIT is powered on correctly as indicated by the green Power LED.
- If Power LED is not illuminated, verify USB power source is working properly.
- If USB power adapter is being used to power the MIT, check and, if necessary, replace the fuse in adapter.

Problem with Aux/Line-In Test

- Verify Aux/Line-In test cable is inserted properly into the vehicle audio input jack. Verify the MIT is in Aux/Line-In mode as indicated by the red AUX LED.
- Verify the vehicle audio system is in Auxiliary or Line-in mode. Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with USB Test

- Verify MIT is in USB mode as indicated by the red USB LED. Verify the vehicle audio system is in USB mode.

- Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with Bluetooth Pairing

- Delete previous devices stored in the device list of the radio and the pair the MIT
- Remove USB cable, and then reconnect to reset the MIT. Carefully follow the bonding instructions for the correct Passkey procedure.

Problem with Bluetooth Test Call Audio

- Verify the MIT is paired with the vehicle. This is indicated by the quick flashing Bluetooth LED.
 - Audio system should have indicated the MIT is bonded.
-

Article GUID: A00884689

ACCESSORIES & EQUIPMENT

Cruise Control - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Steering Wheel Spoke Cover Fastener	1.5 N.m (13 lb in)

SCHEMATIC WIRING DIAGRAMS

CRUISE CONTROL WIRING SCHEMATICS

Cruise Control

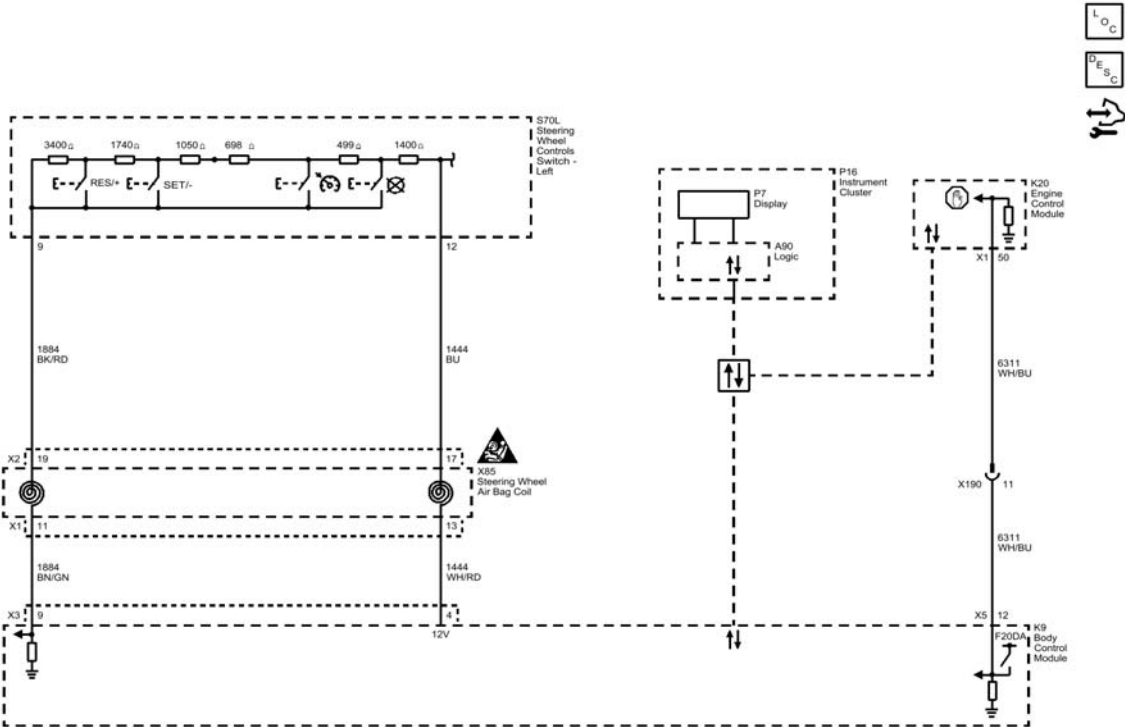


Fig. 1: Cruise Control

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0571: CRUISE CONTROL BRAKE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0571

Cruise Control Brake Switch Circuit

Circuit/System Description

The engine control module (ECM) monitors the brake pedal position sensor. When the brake pedal is applied, the ECM detects a predetermined voltage signal. The ECM sends a serial data message to the body control module (BCM) indicating the status of the stop lamps.

This diagnostic test functions on the assumption that a sudden decrease in vehicle speed is caused by a brake pedal application. When the ECM detects that there is a 4.2 km/h (2.6 mph) or greater decrease in vehicle speed within 0.25 s without a transition of the stop lamp switch, the ECM sets DTC P0571.

Conditions for Running the DTC

- The engine speed is greater than 700 RPM.
- The traction control system or the antilock brake system are not active and have not malfunctioned.
- The vehicle speed is greater than 48 km/h (30 mph).
- The diagnostic will disable when the wheel speed is less than 16 km/h (10 mph).

Conditions for Setting the DTC

The BCM detects either a low voltage signal on the stop lamp switch signal circuit when the serial data message from the ECM indicates the brakes are applied, or a high voltage signal on the stop lamp switch signal circuit when the serial data message from the ECM indicates the brakes are not applied.

Actions Taken When the DTC Sets

- The cruise control system is disabled.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.

- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- [Cruise Control Schematics](#)
- [Exterior Lights Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Cruise Control Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify that the stop lamps operate properly and that no B22 Brake Pedal Position Sensor related DTCs are set.

- **If brake pedal position sensor related DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no brake pedal position sensor related DTCs are set**

2. Verify that no DTCs are set, except DTC P0571.

- **If any other DTC is set, except DTC P0571**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If only DTC P0571 is set**

3. Replace the K20 Engine Control Module.

4. Verify DTC P0571 does not set when operating the vehicle within the conditions for running the DTC.

- **If the DTC sets**

Replace the K9 Body Control Module.

- If the DTC does not set

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for BCM or ECM replacement, programming and setup.

DTC P0572 OR P0573: BRAKE SWITCH CIRCUIT 1 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0572

Brake Switch Circuit 1 Low Voltage

DTC P0573

Brake Switch Circuit 1 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	C0297, P0572	P0572	P0573	P0703

Circuit/System Description

The brake pedal position sensor signal circuit is a B+ input from the body control module (BCM) to the engine control module (ECM). The BCM and ECM monitor the brake pedal position sensor signal circuit to detect when the brake pedal has been applied. When the brake pedal is applied, the BCM supplies B+ on the stop lamp signal circuit and also sends a serial data message to the ECM indicating that the brake pedal has been applied.

Conditions for Running the DTC

- The engine is running.
- Battery voltage is greater than 11.5 V.
- Brakes applied.

Conditions for Setting the DTC

P0572

This DTC will set when the ECM detects a short to ground or an open on the discrete brake signal circuit when

the serial data message from the BCM indicates the brakes are applied. This diagnostic will run when the serial data message and the voltage signal on the brake switch signal circuit do not match for 8 out of 10 times, and the condition is present for greater than 2 s.

P0573

This DTC will set when the ECM detects a short to voltage on the discrete brake signal circuit when the serial data message from the BCM indicates the brakes are not applied. This diagnostic will run when the serial data message and the voltage signal on the brake switch signal circuit do not match for 8 out of 10 times, and the condition is present for greater than 2 s.

Actions Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify that the stop lamps operate properly and that no B22 Brake Pedal Position Sensor related DTCs are

set.

- **If brake pedal position sensor related DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no brake pedal position sensor related DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: All components may need to be disconnected on the cruise control brake signal circuit to isolate a short to voltage, short to ground or an open/high resistance condition. Use the schematic to identify the proper brake signal terminal (circuit 6311) at the K20 Engine Control Module.

1. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module, Ignition On/Vehicle in Service Mode.

2. Connect a test lamp between the signal circuit terminal and ground.

3. Verify the test lamp turns ON and OFF when pressing and releasing the brake pedal.

- **If the test lamp is always OFF**

1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If not infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module, Ignition On/Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the source of voltage on the circuit.
- If less than 1 V replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming, and setup.

DTC P0575: CRUISE CONTROL SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0575

Cruise Control Switch Signal Message Counter Incorrect

Circuit/System Description

When a cruise control function switch is activated, the body control module (BCM) detects a predetermined voltage. The BCM sends a serial data message to the engine control module (ECM) indicating the function that has been requested.

Conditions for Running the DTC

- The ignition is ON.
- The vehicle speed is greater than 40 km/h (25 MPH) and the cruise control is engaged.

Conditions for Setting the DTC

- The ECM receives an invalid cruise control switch status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

DTC P0575 is a type C DTC.

Conditions for Clearing the DTC

DTC P0575 is a type C DTC.

Reference Information

Schematic Reference

[Cruise Control Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Cruise Control Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify that no DTCs are set, except DTC P0575.
 - **If any other DTC is set, except DTC P0575**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If only DTC P0575 is set**
2. Replace the K9 Body Control Module.
3. Verify DTC P0575 does not set when operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.
 - **If the DTC does not set**
4. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for BCM or ECM replacement, programming, and setup.

DTC P0703: BRAKE SWITCH SIGNAL MESSAGE COUNTER INCORRECT

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

[DTC Descriptor](#)

DTC P0703

Brake Switch Signal Message Counter Incorrect

[Circuit/System Description](#)

The body control module (BCM) monitors the brake pedal position sensor. When the brake pedal is applied, the

BCM detects a predetermined voltage signal. The BCM sends a serial data message to the engine control module (ECM) indicating the status of the stop lamps.

Conditions for Running the DTC

The engine is ON.

Conditions for Setting the DTC

- The ECM receives an invalid brake pedal status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no DTCs are set, except DTC P0703.
 - **If any other DTC is set, except DTC P0703**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If only DTC P0703 is set**

2. Replace the K9 Body Control Module.
3. Verify DTC P0703 does not set when operating the vehicle within the conditions for running the DTC.

- **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for BCM or ECM replacement, programming, and setup.

DTC P158A: CRUISE CONTROL CALIBRATION INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P158A

Cruise Control Calibration Incorrect

Circuit/System Description

The type of cruise control system the vehicle has is programmed into the body control module and the engine control module. If this information is not the same in both modules DTC P158A will set.

Conditions for Running the DTC

This diagnostic runs continuously.

Conditions for Setting the DTC

The type of cruise control system programmed into the body control module does not match what is programmed into the engine control module.

Actions Taken When the DTC Sets

DTC P158A is a Type C DTC.

Conditions for Clearing the DTC

DTC P158A is a Type C DTC.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no DTCs are set, except DTC P158A.
 - **If any other DTC is set, except DTC P158A**
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If only DTC P158A is set**
2. Reprogram the K9 Body Control Module and the K20 Engine Control Module one after the other. Do not place the Ignition On/Vehicle in Service Mode between each programming event.
3. Verify DTC P158A does not set when operating the vehicle within the conditions for running the DTC.
 - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for control module replacement, programming, and setup.

SYMPTOMS - CRUISE CONTROL

NOTE: The following steps must be completed before using the symptom tables.

1. Before using the symptom diagnostic table, perform the [Diagnostic System Check - Vehicle](#) in order to verify the following conditions:
 - There are no DTCs set.
 - The module can communicate via the serial data.
2. Review the system operation in order to understand the system functions. Refer to [Cruise Control Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the Cruise Control System. Refer to [Checking Aftermarket Accessories](#).
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C](#)
- [Cruise Control Indicator Malfunction](#)

CRUISE CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The instrument cluster illuminates the cruise control engaged indicator based on serial data messages received from the engine control module (ECM). The indicator is commanded ON when the cruise control system is controlling vehicle speed, and turned OFF with the system disengaged.

Reference Information

Schematic Reference

[Cruise Control Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the cruise control indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - **If the indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.
 - **If the indicator turns ON and OFF**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for instrument cluster replacement, programming and setup.

CRUISE CONTROL MALFUNCTION - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, OR P162C

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3794

Cruise Control Function Request Circuit

DTC P0564

Cruise Control Multifunction Switch Circuit

DTC P0565

Cruise Control Switch Circuit

DTC P0567

Cruise Control Resume Switch Circuit

DTC P0568

Cruise Control Set Switch Circuit

DTC P056C

Cruise Control Cancel Switch Circuit

DTC P0580

Cruise Control Multifunction Switch Circuit Low Voltage

DTC P0581

Cruise Control Multifunction Switch Circuit High Voltage

DTC P155A

Cruise Control Switch State Undetermined

DTC P155B

Cruise Control Set/Coast Switch 2 Circuit

DTC P155C

Cruise Control Resume/Acceleration Switch 2 Circuit

DTC P162C

Vehicle Speed Limiting/Warning Switch Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	P0564	B3794 08, P0567, P0568	B3794 61, P0564
1. Cruise Control Malfunction				

Circuit/System Description

The cruise control switch is an input to the body control module (BCM). The BCM monitors the cruise control on/off, set/coast, resume/accelerate and cancel switches via the cruise control switch signal circuit in order to detect when the driver has requested to perform a cruise control function. The BCM detects a specific voltage signal on the cruise control switch signal circuit when a switch is applied. The engine control module (ECM) receives the requested cruise control switch function from the BCM via a serial data message.

Conditions for Running the DTC

- The cruise control switch is ON.
- Ignition On/Vehicle in Service Mode

Conditions for Setting the DTC

B3794 08

The BCM detects an invalid voltage signal on the cruise control switch signal circuit for 1 s.

B3794 61

Stuck switch for either Resume/Accel or Set/Coast button for 60 s.

P0564, P0565, P0567, P0568, P056C

- The BCM detects an invalid voltage signal on the cruise control switch signal circuit for greater than 2 s and sends a serial data message to the ECM. The ECM sets these DTCs when the message is received.
- The ECM runs this diagnostic continuously.

P0580, P0581

- The ECM detects an invalid voltage signal on the cruise control switch signal circuit.
- The above condition is present for greater than 2 s.
- The ECM runs this diagnostic continuously.

P155A

The ECM is unable to determine the state of the cruise control switch.

P162C

The ECM is unable to determine the state of the vehicle speed limiting switch.

Actions Taken When the DTC Sets

B3794

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs

Conditions for Clearing the DTC

B3794

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify that the stop lamps operate properly and that no B22 Brake Pedal Position Sensor related DTCs are set.

- If brake pedal position sensor related DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- If no brake pedal position sensor related DTCs are set

3. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter changes between Off and On, Resume and Set when switching between each position on the cruise control switch.

- If the parameter does not change

Refer to Circuit/System Testing.

- If the parameter changes

4. Verify that no conditions that may inhibit cruise control operation are present. Refer to the K20 Engine Control Module scan tool data list Cruise Control Inhibit Reason parameter. Refer to the [Cruise Control Description and Operation](#) for a list of inhibit reasons.

- If the cruise control system has a reason why it is inhibited

Repair the condition that is causing the inhibit reason.

- If the cruise control system does not have any reasons why it may be inhibited

5. Verify that no cruise control related DTCs are set.

- If any cruise control related DTCs are set

Refer to Circuit/System Testing.

- If no cruise control related DTCs are set

6. All OK.

Circuit/System Testing

NOTE:

- An open ignition circuit or fuse before the control module will cause communication DTCs or power mode mismatch DTCs to set against or in the control module. This failure mode will be diagnosed in the no communications diagnostic procedure or power mode mismatch.
- This test assumes the ignition circuit has a module driver that will open under a high current condition before the fuse opens.
- The module driver can open under normal conditions such as battery run down protection or a retained accessory power mode.
- The ignition circuit referred to below is the 12 V reference/lighting control switch reference/voltage supply circuit from the K9 Body Control Module to the S70L Steering Wheel Controls Switch-Left.
- The signal circuit referred to below is the cruise control set/coast/resume/accelerate switch signal from the S70L Steering Wheel Controls Switch-Left to the K9 Body Control Module.

1. Ignition/Vehicle Off, disconnect the harness connector at the S70L Steering Wheel Controls Switch-Left,

Ignition On/Vehicle in Service Mode.

2. Verify a test lamp illuminates between the ignition circuit and ground.

- **If the test lamp does not illuminate**

1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module.

2. Test for greater than 100 Ω between the ignition circuit and ground.

- If 100 Ω or less, repair the short to ground on the circuit.

- If greater than 100 Ω

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , test or replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter is Open/Short to Ground or Undetermined State.

- **If not Open/Short to Ground or Undetermined State**

1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module, Ignition/Vehicle On.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K9 Body Control Module.

- **If Open/Short to Ground or Undetermined State**

4. Install a 3 A fused jumper wire between the signal circuit and the ignition circuit.

5. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter is Short to Battery or Undetermined State.

- **If not Short to Battery or Undetermined State**

1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If Short to Battery or Undetermined State**

6. Test or replace the S70L Steering Wheel Controls Switch-Left.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup.

REPAIR INSTRUCTIONS

CRUISE CONTROL SWITCH REPLACEMENT

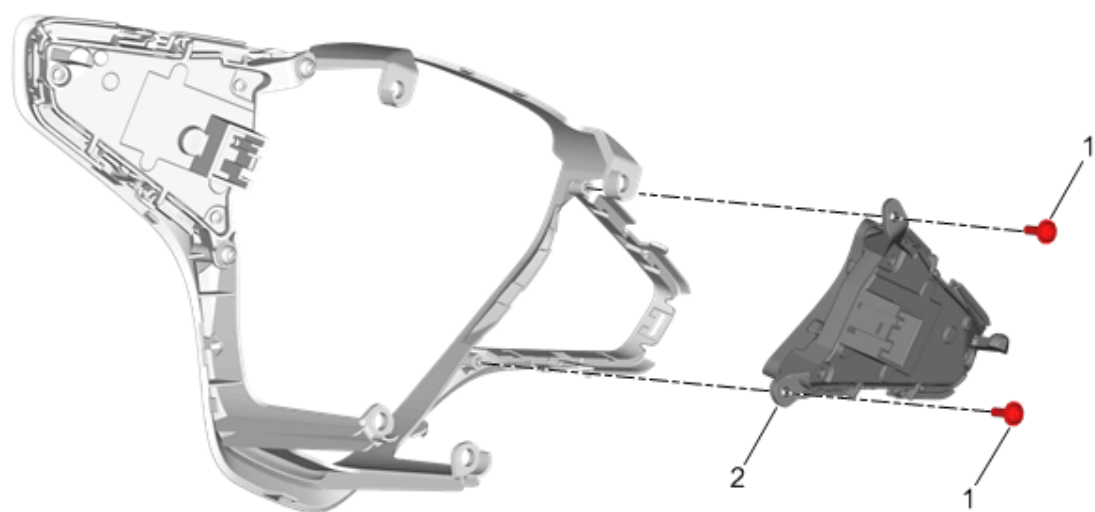


Fig. 2: Cruise Control Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Steering Wheel Spoke Cover Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 1.5 N.m (13 lb in)
2	Cruise Control Switch Procedure Remove the cruise control switch from the steering wheel spoke cover.

DESCRIPTION AND OPERATION

CRUISE CONTROL DESCRIPTION AND OPERATION

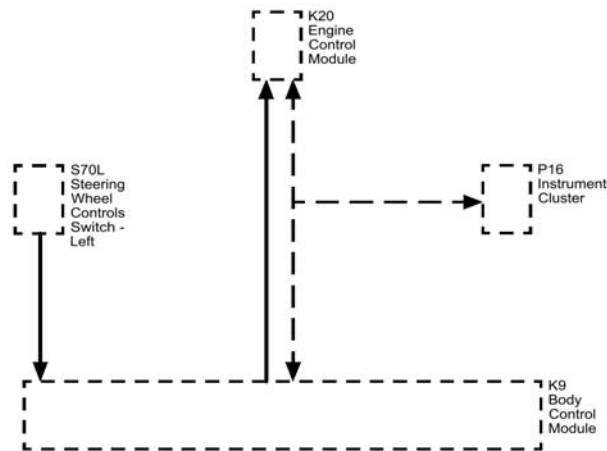


Fig. 3: Cruise Control System Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K20	K20 Engine Control Module
S70L	S70L Steering Wheel Controls Switch - Left
P16	P16 Instrument Cluster
K9	K9 Body Control Module

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions at speeds above 40 km/h (25 mph). Steep grades may cause variations in the selected vehicle speeds.

The following are the main components of the Cruise Control System:

- The accelerator pedal
- The brake pedal position (BPP) sensor
- The body control module (BCM)
- The cruise on/off switch
- The cruise control cancel switch
- The + RES switch (equivalent to resume/accelerate switch)
- The - SET switch (equivalent to set/coast switch)
- The engine control module (ECM)
- The throttle actuator control (TAC) motor (gasoline engines only)
- The vehicle speed sensor

The body control module (BCM) monitors the signal circuit of the cruise control switches, which are located on the steering wheel. The BCM relays the cruise control switch status to the engine control module (ECM) via the serial data circuit. The ECM uses the status of the cruise control switch to determine when to capture and maintain the vehicle speed. The ECM monitors the vehicle speed signal circuit in order to determine the desired vehicle speed.

Voltage is supplied to the cruise control switch via the steering wheel control switch reference voltage circuit supplied by the BCM. The cruise control function switches are arranged in a resistive ladder design, with each cruise control function switch having a different resistance value. The BCM detects a specific voltage value that is associated with the cruise control function switch being activated. The BCM sends a serial data message to the ECM indicating that the on/off switch is active. Similarly, when the normally open + RES switch or the normally open - SET switch are pressed, the switch closes and the BCM detects the predetermined voltage signal on the cruise control resume/accel and set/coast switch signal circuit. The BCM sends a serial data message to the ECM indicating that the + RES switch or the - SET switch is active.

Cruise Control Engaged

The Cruise Control System will engage and adjust vehicle speeds, based on the activation of the following cruise control switches, which are located on the steering wheel:

- On/Off
- + RES
- - SET

To engage the Cruise Control System, ensure that the vehicle speed is above 40.2 km/h (25 mph), turn the cruise On/Off switch ON and momentarily press the - SET switch. The ECM will engage the Cruise Control System and record the vehicle speed. The ECM sends a serial data message to the instrument panel cluster (IPC) in order to illuminate the Cruise Engaged indicator in the IPC. Refer to the vehicle owner's manual for the location and operation of the cruise control On/Off indicators and driver information center (DIC) messages.

Pressing the accelerator pedal while the Cruise Control System is engaged, allows the driver to override the Cruise Control System in order to accelerate the vehicle beyond the current set vehicle speed. When the accelerator pedal is released, the vehicle will decelerate and resume the current set vehicle speed.

The driver can also override the current set vehicle speed via the - SET switch and the + RES switch. When the Cruise Control System is engaged, pressing and holding the - SET switch will allow the vehicle to decelerate from the current set vehicle speed without deactivating the Cruise Control System. When the - SET switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the - SET switch will allow the vehicle to decelerate at a vehicle specific calibratable increment, commonly 1 km/h or 1 mph, each time that the - SET is momentarily pressed, with a minimum vehicle speed of 38 km/h (24 mph). Refer to the vehicle Owner's Manual for more information.

Pressing and holding the + RES switch, when the Cruise Control System is engaged, will allow the vehicle to accelerate to a greater vehicle speed than the current set vehicle speed. When the + RES switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the + RES switch will allow the vehicle to accelerate at a vehicle specific calibratable increment, commonly 1 km/h or 1 mph, each time that the + RES switch is momentarily pressed. Momentarily activating the + RES switch will recall the previous vehicle speed, after the

cruise control system has been disengaged by pressing the brake pedal, or CANCEL switch. Refer to the vehicle Owner's Manual for more information.

Cruise Control Disengaged

The engine control module (ECM) disengages the cruise control operation based on the signals from the following switches:

- The brake pedal position (BPP) sensor
- The On/Off switch
- The cruise control cancel switch

The Cruise Control System will disengage when the brake pedal is applied. The body control module (BCM) monitors the BPP sensor via the BPP sensor signal circuit as the voltage signal increases while the pedal is further applied. The ECM monitors the BPP signal through a discrete input and a serial data message signal from the BCM indicating the brake status. When either signal indicates the brake pedal is applied, the ECM will disengage the cruise control system.

The Cruise Control System will also disengage when the cruise control on/off switch is switched OFF, or the cruise control cancel switch is activated. The body control module (BCM) determines when the cruise control cancel switch is activated. When the normally open cancel switch is closed, the BCM detects the predetermined voltage signal on the cruise control function switch circuit. The vehicle speed stored in the memory of the engine control module will be erased when the cruise control On/Off switch is turned OFF, or the ignition switch is turned OFF. The BCM sends a serial data message to the ECM in order to disengage the cruise control system. When the Cruise Control System has been disengaged, the ECM sends a serial message to the instrument panel cluster (IPC) in order to turn OFF the Cruise Engaged indicator.

Every time the Cruise Control System is disengaged, the ECM will keep track of the reason for system disengagement. The last 8 disengagement reasons will be recorded within the ECM memory. The scan tool will display the last 8 Cruise Disengage History parameters, in which one out of approximately 50 possible reasons will be displayed in each of these 8 parameters. For the disengagement reason to be displayed within the scan tool parameter the Cruise Control System is active and disengagement is requested.

When engagement of the system is requested but an engagement inhibit is present, the most recent inhibit reason is recorded in the ECM history. The scan tool will display the most recent inhibit reason, in which one out of approximately 50 possible reasons will be displayed.

Cruise Control Inhibited

The engine control module (ECM) inhibits the cruise control operation when any of the following conditions exist:

- The ECM has not detected a brake pedal activation from the body control module (BCM) this ignition cycle.
- A Cruise Control System DTC has been set.
- The vehicle speed is less than 38.6 km/h (24 mph).
- The vehicle speed is too high.
- The vehicle is in PARK, REVERSE, NEUTRAL, or 1st gear.

- The engine RPM is low.
- The engine RPM is high.
- The system voltage is not between 9 volts and 16 volts.
- The Antilock Brake System (ABS)/Traction Control System (TCS) is active for more than a calibratable time (typically 0.3 to 0.7 seconds).

Cruise Control Inhibit Reasons

This is a general list of inhibit reasons. Not every inhibit reason is applicable to all vehicles. Refer to the scan tool inhibit reason list for the last 8 reasons that have been recorded during the current ignition cycle.

Scan Tool Name	Description	Long Description
Acceleration Rate too High	High acceleration	The vehicle acceleration rate is too high.
Acceleration Time	Rate limiting fault	Cruise torque request rate limiting active too long.
Adaptive Cruise Control Configuration Incorrect	Adaptive cruise control option mismatch	The cruise control type (adaptive cruise or conventional cruise) is mismatched between the engine control module (ECM) and the body control module (BCM).
Antilock Braking System Active	Antilock Braking System Active	The antilock braking system was active. Only reported on enhanced cruise control vehicles.
Automatic Braking Engine Torque Request Signal Communication Malfunction	Automatic braking engine torque request signal communication malfunction	An engine control module to electronic brake control module (EBCM) serial data fault is active or communication has been lost between the modules.
Automatic Braking Malfunction	Brake system malfunction	The electronic brake control module has detected a failure that does not allow automatic braking to be performed.
Axle Torque Serial Communication Malfunction	Axle Torque Serial Communication Malfunction	The adaptive cruise control is being inhibited by the ECM because a serial data signal timeout error has occurred with the hybrid max/min torque signals.
Battery Voltage Too High	Voltage above high voltage threshold	The ignition voltage is too high at the engine control module (typically 18 volts).
Battery Voltage Too Low	Voltage below low voltage threshold	The ignition voltage is low at the engine control module (typically 9 volts).
Brake Pedal Applied	Brake pedal apply	The brake pedal was applied.

Scan Tool Name	Description	Long Description
Brake Pedal Not Initialized	Brake before cruise	The brake pedal has not been seen as applied prior to driver request to engage cruise with set switch. A brake pedal apply must be seen before allowing cruise engagement during each key cycle. On a vehicle equipped with a manual transmission, a clutch pedal apply may satisfy the brake pedal apply criteria.
Brake Pedal Position Malfunction	Brake pedal position signal invalid	A brake pedal apply circuit fault has been detected.
Brake Pedal Position Signal Malfunction	DTC P0703 is active or maximum time elapsed without receiving a valid Brake Pedal Position signal.	A serial data fault is active or communication has been lost with the module sending the brake pedal apply state.
Brake Pedal Pressure Detected	Brake pedal driver applied pressure detected	A brake pedal apply has been detected based on brake pedal pressure as measured by the electronic brake control module.
Brake Pedal Released Position Not Learned	Brake apply sensor home position not learned	The brake pedal position sensor released position is not learned.
Brake System Malfunction	Adaptive cruise control automatic braking failed	Adaptive cruise control automatic braking inoperative.
Calculated Torque	Calculated engine torque	The engine torque calculation is incorrect.
Clutch Pedal Applied	Clutch switch active	The clutch pedal was applied.
Coast Below Minimum Speed	Coast below low speed inhibit	The Set/Coast switch was depressed and the vehicle slowed below the minimum cruise control operating speed.
Coast Mode	Coast disengage	Cruise control is in coast mode with the Set/Coast switch depressed and is requesting no throttle.
Control Function Active	DLC override	A scan tool is plugged into the Data Link Connector (DLC) connector.
Control Module Memory Malfunction	Memory failure	A control module memory failure has been detected.
Control Module Processor Malfunction	Processor integrity fault (random access memory corruption)	An engine control module software error has occurred.
Crawl Mode Active	Crawl Mode Active	Crawl mode is active and inhibiting cruise control.
Cruise Control Cancel Switch Active	Cancel switch active	The cruise control cancel switch was depressed.

Scan Tool Name	Description	Long Description
Cruise Control Software Malfunction	Sequence of completion checks	A cruise control software execution error has occurred.
Cruise Control Switch Inactive	On/Off switch in Off state	The cruise control On/Off switch is turned off.
Cruise Control Switch Invalid	Analog cruise switch input out of range	The cruise control switch voltage signal is in an invalid range.
Cruise Control Switch Serial Communication Malfunction	Serial data fault (cruise switch serial communication fault)	The cruise control switch serial data fault is active or communication has been lost with the module sending cruise control switch states.
Deceleration Rate Too High	High deceleration	The vehicle deceleration rate is too high.
Diagnostic Trouble Code (DTC) Set	Malfunction in PCM/ECM (DTC active)	A DTC is active or in history that inhibits cruise control operation.
Distance Sensing Cruise Control Brake Pedal Applied	Distance Sensing Cruise Control Brake Pedal Applied	Adaptive cruise control is being inhibited by the ECM because a brake pedal apply has occurred.
Distance Sensing Cruise Control Cancel Switch Active	Distance Sensing Cruise Control Cancel Switch Active	Adaptive cruise control is being inhibited by the ECM because the driver applied the cancel switch.
Distance Sensing Cruise Control Data	Serial data fault for adaptive cruise control throttle control and brake control signals sent by the distance sensing cruise control module	A distance sensing cruise control module serial data fault is active or communication has been lost between the distance sensing cruise control module and the engine control module.
Distance Sensing Cruise Control Inhibit	Distance sensing cruise control inhibited	The distance sensing cruise control system is inhibited.
Distance Sensing Cruise Control Invalid Engage	Distance Sensing Cruise Control Invalid Engage	Adaptive cruise control is being inhibited by the ECM because an invalid sequence of cruise control applies, brake pedal applies, or an invalid speed range has been detected.
Distance Sensing Cruise Control Off	Distance Sensing Cruise Control Off	Adaptive cruise control is being inhibited by the ECM because the driver has turned off the cruise on/off switch.
Distance Sensing Cruise Control Reduced Engine Power	Distance Sensing Cruise Control Reduced Engine Power	Adaptive cruise control is being inhibited by the ECM due to a fault resulting in "Reduced Engine Power".
Driven Wheel Speed Higher Than Non Driven Wheel Speed	Driven wheel speed greater (wheel slip detection)	The driven wheel speed is greater than the non driven wheel speed (slip detection).
Engine Control Module	PCM/ECM inhibit (RAM corruption)	Engine control module internal communication error.

Scan Tool Name	Description	Long Description
Engine Control Module (ECM) Reset	ECM running reset	An engine control module running reset has occurred.
Engine Overspeed Protection Active	Injectors disabled (engine overspeed fuel cut-off active)	Engine RPM limiter active with fuel cut off active.
Engine Overtemperature Protection Active	Engine metal overtemp active	The engine is over temperature. The engine is overheated.
Engine Run Time	Engine run time not elapsed	The engine has not been running long enough, typically five seconds.
Engine Speed	Engine speed too low or too high	The engine RPM is too low (near stall) or too high (near engine RPM fuel shutoff).
Excessive Accelerator Position Override	Pedal greater than cruise (override)	The driver has overridden cruise control set speed with accelerator pedal for greater than an allowable time.
1st Gear	First Gear	Transmission is engaged in 1st gear.
Gear Change without Applied Clutch Pedal	Manual transmission out of gear with no clutch pedal apply	Manual transmission shifted to Neutral without clutch pedal being applied.
Hill Descent Control Active	Hill Descent Control System Active	The hill descent control system has gone active.
Hill Descent Control Serial Communication Malfunction	Hill Descent Control Serial Communication Malfunction	An electronic brake control module serial data fault is active or communication has been lost between the EBCM and ECM.
Hybrid/EV System	Hybrid Cruise Disengage	Cruise control is inhibited on hybrid applications when "Regen on Demand" is requested by the driver via the tap-up/tap-down paddles.
Illegal Mode	Illegal cruise mode	The cruise control mode is incorrect based on switch states.
Lane Center Control Serial Data Error	Lane Center Control Serial Communication Malfunction	Adaptive cruise control is being inhibited by the ECM because a serial data error has been detected on a vehicle with Lane Center Control.
Non Driven Wheel Speed Higher Than Drive Wheel Speed	Non-driven wheel speed greater	The non driven wheel speed is greater than the driven wheel speed.
None	None	This disengagement reason may be displayed after a dead battery repair or module replacement.
Park Brake Applied	Park brake switch signal active	The parking brake is applied.
Power Take-Off Active	Power Take Off active	The Power Take Off (PTO) system is active.
Rear Axle in Low Range	Rear axle in low	The rear axle is in low range.

Scan Tool Name	Description	Long Description
Set/Coast and Resume/Accelerate Switches Active Simultaneously	SET and RESUME switches simultaneously active	The Set/Coast and Resume/Accelerate switches were pressed simultaneously.
Set/Coast Switch Active With Vehicle Speed Higher Than Set Point	Over schedule tap-down	The Set/Coast switch is selected, vehicle speed is above set speed and does not decrease. May be due to traveling down hill.
Speed Limiting/Warning System On	Speed limiter/warning On/Off switch turned on	Driver has turned on the Speed Limiter/Warning on/off switch. Cruise is disabled/inhibited and cruise on/off switch will be set to Off.
Throttle Actuator Control System	Electronic throttle control prevents cruise operation	The electronic throttle control system has detected a failure in the throttle control hardware.
Traction Control Active	Traction control active	The traction control system was active.
Traction Control System Malfunction	Traction Control System Malfunction	A fault is present in the traction control system.
Traction Control System Off	Traction Control System Off	The traction control system has been turned off by the driver.
Transfer Case in 4WD Low Range	Transfer case in 4WD Low	The transfer case is in low range.
Transmission Gear Ratio Malfunction	Transmission gear fault	A transmission DTC is active or in history, that inhibits cruise control operation.
Transmission Not in Forward Gear	Transmission in neutral, reverse or park	The transmission gear selector is not in a forward gear.
Vehicle Overspeed Protection Active	MPH limited fuel (vehicle overspeed fuel cut-off active)	The vehicle overspeed protection is active with fuel cut off active.
Vehicle Speed Higher Than Set Point	Over schedule	Vehicle speed has exceeded driver selected set speed by more than an allowable amount. This may occur while driving down a significant grade or driver overriding cruise while performing a passing maneuver.
Vehicle Speed Lower Than Set Point	Under schedule	The vehicle speed is below cruise control set speed by more than an allowable amount.
Vehicle Speed Too High	Vehicle speed exceeds high speed threshold	Vehicle speed has exceeded maximum cruise operating speed.
Vehicle Speed Too Low	Vehicle speed drops below low speed threshold	Vehicle speed dropped below the cruise control minimum operating speed. May be due to hilly terrain and low vehicle speed. Manual transmission gear selection and engine

Scan Tool Name	Description	Long Description
		torque may contribute to this disengagement reason.
Vehicle Stability System Active	Vehicle stability control active	The vehicle stability control system was active.
Vehicle Stability System Malfunction	Vehicle Stability System Malfunction	A fault has been detected in the vehicle stability control system.
Vehicle Stability System Off	Vehicle Stability System Off	The vehicle stability control system has been turned off by the driver.

Article GUID: A00884711

ACCESSORIES & EQUIPMENT

Data Communications - Description and Operation - Volt

DESCRIPTION AND OPERATION

BODY CONTROL SYSTEM DESCRIPTION AND OPERATION

The body control system consists of the body control module (BCM), communications, and various input and outputs. Some inputs, outputs and messages require other modules to interact with the BCM. The BCM also has discrete input and output terminals to control the vehicle's body functions. The BCM is wired to the high speed GMLAN serial data bus, low speed GMLAN serial data bus and Multiple LIN buses and acts as a gateway between them.

Power Mode Master

This vehicle body control module (BCM) functions as the power mode master (PMM). The ignition switch is a low current switch with multiple discrete ignition switch signals to the PMM for determining the power mode that will be sent over the serial data circuits to the other modules that need this information; the PMM will activate relays and other direct outputs of the PMM as needed. Refer to [Power Mode Description and Operation](#) for a complete description of power mode functions.

Gateway

The body control module (BCM) in this vehicle functions as a gateway or translator. The purpose of the gateway is to translate serial data messages between the GMLAN high speed bus and the GMLAN low speed bus for communication between the various modules. The gateway will interact with each network according to that network's transmission protocol.

All communication between the BCM and a scan tool is on the high speed GMLAN serial data circuits. A lost communication DTC typically is set in modules other than the module with a communication failure.

Body Control

The various body control module (BCM) input and output circuits are illustrated in the corresponding functional areas on the BCM electrical schematics. Refer to the [Body Control System Schematics](#) for more detailed information.

DATA LINK COMMUNICATIONS DESCRIPTION AND OPERATION

NOTE: This is an overview of different serial data buses used by GM control modules to communicate with each others. Use schematics to find out which serial data buses are configured for a specific vehicle.

Circuit Description

There are many components in a vehicle that rely on information from other sources, transmit information to other sources, or both. Serial data communication networks provide a reliable, cost effective, way for various components of the vehicle to "talk" to one another and share information.

GM uses a number of different communication buses to insure the timely and efficient exchange of information between control modules. When compared to each other, some of these buses are different in nature as far as speed, signal characteristics, and behavior. An example of this is the High Speed GMLAN and Low Speed GMLAN buses.

On the other hand, when other buses are compared to each other they have similar characteristics and simply operate in parallel. In this case they are used to group together components which have high interaction. Examples are the High Speed GMLAN, Powertrain Expansion, and Chassis Expansion buses. This allows them to communicate with each other on a bus with reduced message congestion insuring faster and the more timely exchange of information than if all vehicle control modules were on a single bus.

The majority of information that exists within a given network generally stays local; however some information will have to be shared on other networks. Control modules designated as Gateway's perform the function of transferring information between the various buses. A Gateway module is connected to at least 2 buses and will interact with each network according to its message strategy and transmission models.

GMLAN provides the capability for a receiving control module to monitor message transmissions from other control modules in order to determine if messages of interest are not being received. The primary purpose is to allow reasonable default values to be substituted for the information no longer being received. Additionally, a control module may set a Diagnostic Trouble Code to indicate that the control module it is expecting information from is no longer communicating.

High Speed GMLAN Circuit Description

A High Speed GMLAN Bus is used where data needs to be exchanged at a high enough rate to minimize the delay between the occurrence of a change in sensor value and the reception of this information by a control device using the information to adjust vehicle system performance.

The High Speed GMLAN serial data network consists of two twisted wires. One signal circuit is identified as GMLAN-High and the other signal circuit is identified as GMLAN-Low. At each end of the data bus there is a 120 Ω termination resistor between the GMLAN-High and GMLAN-Low circuits.

Data symbols (1's and 0's) are transmitted sequentially at a rate of 500 Kbit/s. The data to be transmitted over the bus is represented by the voltage difference between the GMLAN-High signal voltage and the GMLAN-Low signal voltage.

When the two wire bus is at rest the GMLAN-High and GMLAN-Low signal circuits are not being driven and this represents a logic "1". In this state both signal circuits are at the same voltage of 2.5 V. The differential voltage is approximately 0 V.

When a logic "0" is to be transmitted, the GMLAN-High signal circuit is driven higher to about 3.5 V and the GMLAN-Low circuit is driven lower to about 1.5 V. The differential voltage becomes approximately 2.0 (+/- 0.5) V.

Chassis High Speed GMLAN Circuit Description

The GMLAN Chassis Expansion Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for chassis components. This implementation splits message congestion between two parallel buses helping to insure timely message transmission and reception. Sometimes communication is required between the Chassis Expansion Bus and the primary High Speed GMLAN Bus. This is accomplished by using the K17

Electronic Brake Control Module (EBCM) as the Gateway module. Since the High Speed GMLAN Chassis Expansion Bus and primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

Powertrain High Speed GMLAN Circuit Description

The GMLAN Powertrain Expansion Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for Hybrid powertrain components or Diesel powertrain components in some cases. The bus is optional based upon feature content. Sometimes communication is required between the Powertrain Expansion Bus and the primary High Speed GMLAN Bus. This is accomplished by using the K20 Engine Control Module (ECM) as the Gateway module. Since the High Speed GMLAN Powertrain Expansion Bus and the primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

All diagnostic information is available only through the primary high speed GMLAN bus.

High Voltage Energy Management High Speed GMLAN Circuit Description

The GMLAN High Voltage Energy Management Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for Hybrid charging components of an electric vehicle. Sometimes communication is required between the Low Speed GMLAN Bus and the High Voltage Energy Management Bus. This is accomplished by using the K114B Hybrid Powertrain Control Module 2 as the Gateway module. Since the High Speed GMLAN High Voltage Energy Management Bus and primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

All diagnostic information is available only through the primary high speed GMLAN bus.

Object High Speed GMLAN Circuit Description

The GMLAN Object Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for the enhanced safety system. This implementation is used to isolate the heavy communication among the enhanced safety system devices from the other vehicle buses, reducing congestion. The K124 Active Safety Control Module is connected to the Object Bus as well as the Primary High Speed GMLAN Bus, the Chassis Expansion Bus, and the Low Speed GMLAN Bus. The K124 Active Safety Control Module acts as a Gateway module for all required communication between the Object Bus devices and devices on these other vehicle buses. The GMLAN Object Bus operates in the same manner as the Chassis Expansion and Primary High Speed buses and so the diagnostics are similar. The Object Bus is physically partitioned into a Front Object Bus and a Rear Object Bus with each partition having its own communication enable circuit to activate the partition, but functional operation of both is identical. The Front Object Bus standard devices are the K124 Active Safety Control Module, the K109 Frontview Camera Module, and the B233B Radar Sensor Module - Long Range. The Front Object Bus optional devices are the B233LF Radar Sensor Module - Short Range Left Front and the B233RF Radar Sensor Module - Short Range Right Front. The Rear Object Bus is optional and when present will have the K124 Active Safety Control Module and B233R Radar Sensor Module - Short Range Rear on the bus, and optionally the Radar Sensor Module - Short Range Right Rear. All Object Bus components are powered by the K124 Active Safety Control Module via the communication enable circuits, except the K109 Frontview Camera Module which is powered directly by battery.

Media Oriented Systems Transport (MOST) Circuit Description

The MOST Infotainment network is a dedicated high speed multimedia streaming data bus independent from GMLAN. The MOST bus will be configured in a physical hardwired loop with each device within the bus sends

and receives data on an assigned MOST addresses in a set order. Each device on the MOST bus will be required to have twisted pair copper wires (2 transmit TX, 2 receive RX, and 1 electronic control line which is a 12 V wakeup signal line). The A11 Radio is the MOST Master and will monitor the bus for vehicle configuration, Infotainment data messages and errors on the bus. The MOST initialization consists of a short 100 ms low voltage pulse on the electronic control line (or MOST control line) connected to all devices contained on the MOST ring. When the MOST devices receive this wakeup message, they will respond with a generic device response. Once these initial responses on the MOST bus are reported successfully without error to the A11 Radio, the next responses will report the MOST device addresses, their functionality requirements and capabilities within. The A11 Radio will learn this information and also record the address node sequence on the MOST bus at this point. This node address list will now be stored within the A11 Radio as the MOST bus configuration (called "Last Working MOST ID of Node 1 - 9" on scan tool data display).

When MOST receive, transmit, or control line faults are detected, transmit/receive messages will not be received as expected from the wakeup request. The A11 Radio and the K74 Human Machine Interface Control Module will then perform diagnostics to isolate these MOST faults. If the MOST control line is shorted low to 0 V for excess amount of time, the A11 Radio will set a U2098 DTC and K74 Human Machine Interface Control Module will set a U0029 02 DTC. At this point the MOST bus will be unable to communicate until the shorted MOST control line is repaired.

Once the shorted MOST control line diagnostics pass, the A11 Radio will attempt to resend the initial short pulse attempts up to 3 times on the MOST control line. If the expected responses are not received, the A11 Radio continues into a failure mode setting a U0028 DTC and will continue on to send 300 ms long pulses while DTC U0028 is current, which will enable the furthest upstream transmitting device to become the surrogate MOST Master in this MOST fault/diagnostic mode. When the A11 Radio receives this new MOST Master identity, the surrogate MOST master device can be identified based on scan tool data parameter "Surrogate MOST Master Node Upstream Position". The scan tool and schematics will be used to determine the MOST bus configuration and direction by utilizing the "Last Working MOST ID of Node 1 - 9" parameters from the A11 Radio data display. When a fault is present, it will indicate the newly enabled "Surrogate MOST Master Node Upstream Position" to the A11 Radio. This will assist in determining the location of the MOST device/bus/control fault. The MOST device and circuits upstream from the surrogate MOST master device, transmit, receive, or control lines will be the suspect areas for diagnostics at this point. These faults can be associated with any of the MOST transmit, receive, or control line twisted copper wires or possibly an internal device fault.

DTC U0028 will take approximately 10 s for diagnostics to set in the A11 Radio with an active fault condition. With the latest software, the A11 Radio will report the Surrogate MOST Master Node Upstream Position value when DTC U0028 is stored in history. When there is no MOST bus fault, this value is None. The U0028 DTC state and the Number of MOST Communication Breaks parameter must be used with the Surrogate MOST Master Node Upstream Position parameter for a successful diagnosis. This is used to help capture surrogate information on intermittent fault conditions. The Number of MOST Communication Breaks counter will increment each time the MOST bus state transitions from Normal Operation (Lock status) to Off State (Unlock status) and will accumulate from 0-65535. After the Number of MOST Communication Breaks counter increments 10 times, DTC U0028 will be set. It is important to clear DTC U0028 and reset the Surrogate MOST Master Node Upstream Position value to None after a successful repair. The Surrogate MOST Master Node Upstream Position value can be reset to None by disconnecting the A11 Radio power, disconnecting battery cables, or 50 ignition power down cycles. This will also reset the Number of MOST Communication Breaks counter to 0.

The K74 Human Machine Interface Control Module will set a U0029 00 DTC when it diagnoses a MOST bus not communicating properly after one attempt. When the DTC U0029 00 is set by the K74 Human Machine Interface Control Module without the corresponding DTC U0028 from the A11 Radio, it will be an indication of an intermittent wiring/device condition. The A11 Radio may also set a U0029 7F DTC if there is an intermittent wiring/device condition.

Low Speed GMLAN Circuit Description

Low Speed GMLAN Bus is used in applications where a high data rate is not required which allows for the use of less complex components. It is typically used for operator controlled functions where the response time requirements are slower than those required for dynamic vehicle control.

The Low Speed GMLAN Serial Data Network consists of a single wire, ground referenced bus with high side voltage drive. During on road vehicle operation data symbols (1's and 0's) are transmitted sequentially at the normal rate of 33.3 Kbit/s. For component programming only, a special high speed data mode of 83.3 Kbit/s may be used.

Unlike the high speed dual wire networks, the single wire low speed network does not use terminating resistors at either end of the network.

The data symbols to be transmitted over the bus are represented by different voltage signals on the bus. When the Low Speed GMLAN Bus is at rest and is not being driven, there is a low signal voltage of approximately 0.2 V. This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven higher to around 4.0 V or higher.

Local Interconnect Network (LIN) Circuit Description

The Local Interconnect Network (LIN) Bus consists of a single wire with a transmission rate of 10.417 Kbit/s. This bus is used to exchange information between a master control module and other smart devices which provide supporting functionality. This type of configuration does not require the capacity or speed of either a High Speed GMLAN Bus or Low Speed GMLAN Bus and is thus relatively simpler.

The data symbols (1's and 0's) to be transmitted are represented by different voltage levels on the communication bus. When the LIN Bus is at rest and is not being driven, the signal is in a high voltage state of approximately V_{batt} . This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven low to about ground (0.0 V).

Communication Enable Circuit Description

Control modules on GMLAN high speed type networks enable or disable communication based on the voltage level of this circuit. When the circuit voltage is high (around 12 V), communications are enabled. When the circuit is low, communications are disabled.

Data Link Connector (DLC)

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Terminal 1: Low speed GMLAN communications terminal
- Terminal 2: Class 2 communications terminal

- Terminal 3: Object high speed GMLAN serial bus (+) terminal
- Terminal 4: Scan tool power ground terminal
- Terminal 5: Common signal ground terminal
- Terminal 6: High speed GMLAN serial data bus (+) terminal
- Terminal 7: Keyword communications terminal
- Terminal 11: Object high speed GMLAN serial bus (-) terminal
- Terminal 12: Chassis high speed GMLAN serial bus (+) terminal
- Terminal 13: Chassis high speed GMLAN serial bus (-) terminal
- Terminal 14: High speed GMLAN serial data bus (-) terminal
- Terminal 16: Scan tool power, battery positive voltage terminal

Serial Data Reference

The scan tool communicates over the various buses on the vehicle. When a scan tool is installed on a vehicle, the scan tool will try to communicate with every control module that could be optioned into the vehicle. If an option is not installed on the vehicle, the scan tool will display No Comm (or Not Connected) for that optional control module. In order to avert misdiagnoses of No Communication with a specific control module, refer to [Data Link References](#) for a list of control modules and the buses they communicate with. Use schematics and specific vehicle build RPO codes to determine optional control modules.

Article GUID: A00884674

ACCESSORIES & EQUIPMENT

Data Communications - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE U CODE LIST

This list includes all Data Communications related U-code DTCs in alphanumeric order with descriptors for all devices. Not all DTCs listed will be applicable to all vehicles.

For symptom byte information, refer to [Symptom Byte List](#).

DTC	DTC Descriptor
U0001	High Speed CAN Bus Malfunction
U0002	High Speed CAN Bus
U0009	High Speed CAN Bus [-] Shorted to Bus [+]
U0020	Low Speed CAN Bus
U0028	MOST Bus
U0029	MOST Bus Performance
U0073	Control Module Communication Bus A Off
	Control Module Communication High Speed CAN Bus Off
U0074	Control Module Communication Bus B Off
	Control Module Communication Powertrain Expansion CAN Bus Off
U0075	Control Module Communication Object Detection CAN Bus Off
U0076	Control Module Communication Powertrain Sensor CAN Bus Off
U0077	Control Module Communication Chassis Expansion CAN Bus Off
U0078	Control Module Communication Low Speed CAN Bus Off
U007A	Control Module Communication High Voltage Energy Management CAN Bus Off
U007B	Control Module Communication High Speed Extension CAN Bus Off
U007C	Control Module Communication High Speed Extension CAN Bus 2 Off
U007D	Control Module Communication Low Speed Extension CAN Bus Off
U007E	Control Module Communication FlexRay 1A Bus Off
U007F	Control Module Communication FlexRay 1B Bus Off
U0100	Lost Communication With Engine Control Module
U0101	Lost Communication With Transmission Control Module
U0102	Lost Communication with Transfer Case Control Module
U0103	Lost Communication with Shift Lever Module
U0104	Lost Communication With Cruise Control Module
U0105	Lost Communication with Fuel Injector Control Module
U0106	Lost Communication with Glow Plug Control Module
U0109	Lost Communication with Fuel Pump Control Module (2013 and prior)
	Lost Communication with Chassis Control Module (2014 and beyond)

DTC	DTC Descriptor
U010C	Lost Communication with Turbocharger Boost Control Module
U010E	Lost Communication with Reductant Sensor Module
U010F	Lost Communication with Air Conditioning Control Module
U0111	Lost Communication with Battery Energy Control Module
U0112	Lost Communication with Battery Energy Control Module
U0114	Lost Communication with Four Wheel Drive Clutch Control Module
U0115	Lost Communication with Engine Control Module B
U0117	Lost Communication With Power Take-Off Control Module
U0121	Lost Communication With Electronic Brake Control Module
U0122	Lost Communication With Vehicle Stability Control Module
U0123	Lost Communication with Yaw Rate Sensor Module
U0125	Lost Communication With Multi-Axis Acceleration Sensor Module
U0126	Lost Communication With Steering Wheel Angle Sensor Module
U0128	Lost Communication With Park Brake Control Module
U0129	Lost Communication with Brake System Control Module
U012A	Lost Communication With Chassis Control Module
U0130	Lost Communication With Power Steering Control Module
U0131	Lost Communication With Power Steering Control Module
U0132	Lost Communication With Suspension Control Module
U0133	Lost Communication With Air Suspension Control Module
U0134	Lost Communication with Power Steering Control Module - Rear
U0136	Lost Communication With Differential Control Module - Rear
U0137	Lost Communication with Trailer Brake Control Module
U0139	Lost Communication With Suspension Control Module 2
U0140	Lost Communication With Body Control Module
U0146	Lost Communication with Serial Data Gateway Module
U0151	Lost Communication With Inflatable Restraint Sensing and Diagnostic Module
U0154	Lost Communication with Passenger Presence Module
U0155	Lost Communication With Instrument Cluster
U0158	Lost Communication With Head-Up Display
U0159	Lost Communication With Parking Assist Control Module
U0160	Lost Communication With Chime Alarm Control Module
U0164	Lost Communication with HVAC Control Module
U0166	Lost Communication with Auxiliary Heater Control Module
U0167	Lost Communication with Immobilizer Control Module
U0168	Lost Communication With Keyless Entry Control Module
U016B	Lost Communication with Electric A/C Compressor Control Module
U0170	Lost Communication with Passenger Presence Detection Sensor Module
U017E	Lost Communication with Seat Belt Retractor Motor Module
U0181	Lost Communication with Automatic Headlamp Leveling Control Module
U0182	Lost Communication With Lighting Control Module - Front

DTC	DTC Descriptor
U0184	Lost Communication With Radio
U0186	Lost Communication With Speaker Amplifier Module
U0196	Lost Communication With Rear Audio Control Module
U0191	Lost Communication With Television
U0193	Lost Communication With Digital Radio Receiver Control Module
U0197	Lost Communication With Telephone Control Module
U0198	Lost Communication with Telematics Communication Interface Control Module
U019E	Lost Communication With Transmission Range Control Module
U01A0	Lost Communication with Hybrid/EV Battery Interface Control Module 1
U01A1	Lost Communication with Hybrid/EV Battery Interface Control Module 2
U01A2	Lost Communication with Hybrid/EV Battery Interface Control Module 3
U01A3	Lost Communication with Hybrid/EV Battery Interface Control Module 4
U01A4	Lost Communication with Hybrid/EV Battery Interface Control Module 5
U01A5	Lost Communication with Hybrid/EV Battery Interface Control Module 6
U01A6	Lost Communication with Hybrid/EV Battery Interface Control Module 7
U01A7	Lost Communication with Hybrid/EV Battery Interface Control Module 8
U01B0	Lost Communication with Battery Monitor Module
U01B4	Lost Communication with Brake System Control Module 2
U0201	Lost Communication with Passenger Door Switch Panel Control Module
U0203	Lost Communication With Left Rear Door Switch Panel Control Module
U0204	Lost Communication With Right Rear Door Switch Panel Control Module
U0207	Lost Communication With Moveable Roof Control Module
U0208	Lost Communication with Seat Memory Control Module
U0209	Lost Communication With Front Seat Heating Control Module
U0210	Lost Communication With Rear Seat Heating Control Module
U0230	Lost Communication With Liftgate Control Module
U0231	Lost Communication with Rain Sensor Module
U0232	Lost Communication with Side Object Detection Control Module - Left
U0233	Lost Communication with Side Object Detection Control Module - Right
U0236	Lost Communication With Steering Column Lock Module
U0237	Lost Communication With Multimedia Player Interface Module
U023A	Lost Communication With Vehicle Direction Camera Control Module (<i>without UGN</i>)
	Lost Communication With Active Safety Control Module 1 (<i>with UGN</i>)
U023B	Lost Communication with Active Safety Control Module 2
U023C	Lost Communication with Night Vision Camera Control Module
U0241	Lost Communication With Left Headlamp High Beam Control Module
U0242	Lost Communication With Right Headlamp High Beam Control Module
U0248	Lost Communication with Remote Accessory Module
U0249	Lost Communication with Rear Seat Entertainment Control Module
U0250	Lost Communication with Impact Classification System Module

DTC	DTC Descriptor
U0252	Lost Communication With Trailer Interface Control Module
U0253	Lost Communication with Accessory Protocol Interface Module
U0254	Lost Communication With Remote Start Module
U0255	Lost Communication With Info Display Module
U0256	Lost Communication With Infotainment Faceplate Control Module
U0257	Lost Communication With Info Display Module/Infotainment Faceplate Control Module
U0259	Lost Communication with Special Purpose Vehicle Control Module
U025B	Lost Communication with Special Purpose Vehicle Control Module "C"
U025C	Lost Communication with Special Purpose Vehicle Control Module "D"
U0264	Lost Communication With Camera Module - Rear
U0265	Lost Communication with Left Front Short Range Radar Sensor Module
U0266	Lost Communication with Night Vision Camera
U0268	Lost Communication with Right Front Short Range Radar Sensor Module
U0269	Lost Communication with Front Long Range Object Sensor
U026A	Lost Communication with Frontview Camera Module
U026B	Lost Communication with Rear Short Range Object Sensor
	Lost Communication with Left Rear Short Range Radar Sensor Module
U026C	Lost Communication with Right Rear Short Range Radar Sensor Module
U026D	Lost Communication with Rear Middle Short Range Radar Sensor Module
U0284	Lost Communication with Active Grille Air Shutter 1 Motor Module
U0285	Lost Communication with Active Grille Air Shutter 2 Motor Module
U0293	Lost Communication with Hybrid/EV Powertrain Control Module
U0298	Lost Communication with DC/DC Converter Control Module
U029D	Lost Communication with NOx Sensor 1 Module
U029E	Lost Communication with NOx Sensor 2 Module
U02A3	Lost Communication With Particulate Matter Sensor Module
U0301	Software Incompatibility with Engine Control Module
U0302	Software Incompatibility with Transmission Control Module
U0305	Software Incompatibility With Cruise Control Module
U0315	Software Incompatibility with Electronic Brake Control Module
U031C	Software Incompatibility With Brake System Control Module 2
U0401	Invalid Data Received From Engine Control Module
U0402	Invalid Data Received From Transmission Control Module
U0403	Invalid Data Received From Transfer Case Control Module
U0405	Invalid Data Received From Cruise Control Module
U0414	Invalid Data Received From Four Wheel Drive Clutch Control Module
U0415	Invalid Data Received From Electronic Brake Control Module
U0416	Invalid Data Received From Vehicle Dynamics Control Module
U0417	Invalid Data Received From Park Brake Control Module
U0418	Invalid Data Received From Brake System Control Module

DTC	DTC Descriptor
U0420	Invalid Data Received From Power Steering Control Module
U0421	Invalid Data Received From Suspension Control Module
U0422	Invalid Data Received From Body Control Module
U0423	Invalid Data Received From Instrument Cluster
U0424	Invalid Data Received From HVAC Control Module
U0428	Invalid Data Received From Steering Wheel Angle Sensor Module
U042B	Invalid Data Received From Chassis Control Module
U0431	Invalid Data Received From Body Control Module "A"
U0432	Invalid Data Received From Multi-axis Acceleration Sensor Module
U0437	Invalid Data Received From Differential Control Module - Rear
U0438	Invalid Data Received From Trailer Brake Control Module
U0447	Invalid Data Received from Central Gateway Module
U0452	Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
U045A	Invalid Data Received From Parking Assist Control Module "A"
U0465	Invalid Data Received From Power Take-Off Control Module
U0499	Invalid Data Received From Telematics Communication Interface Control Module
U0513	Invalid Data Received From Yaw Rate Sensor Module
U053B	Invalid Data Received From Active Safety Control Module 1
U053C	Invalid Data Received From Active Safety Control Module 2
U056B	Invalid Data Received From Frontview Camera Module
U0594	Invalid Data Received From Hybrid/EV Powertrain Control Module
U063E	Lost Communication with Exhaust Heat Exchanger Exhaust Bypass Valve
U0656	Lost Communication with Turbocharger Boost Control Position Sensor
U0657	Lost Communication with Turbocharger/Supercharger Bypass Valve "A" Position Sensor
U1032	Lost Communication with Vehicle Dynamic Sensor 1
U1033	Lost Communication with Vehicle Dynamic Sensor 2
U1067	Lost Communication with Digital Map Control Module
U1069	Lost Communication with Driver Monitoring System Control Module
U106A	Lost Communication with Multifunction Energy Storage Capacitor Control Module
U106B	Lost Communication with Multifunction Battery Isolator Control Module
U1112	Lost Communication with Left Headlamp Leveling Device
U1113	Lost Communication with Right Headlamp Leveling Device
U1114	Lost Communication with Left Headlamp Vertical Motor
U1115	Lost Communication with Right Headlamp Vertical Motor
U1343	Chassis Control Module LIN Bus 1
U1345	Engine Control Module LIN Bus 1
U1347	Engine Control Module LIN Bus 3
U1359	Lost Communication with Transmission Range Indicator
U135A	Lost Communication with Shift to Park Range Actuator

DTC	DTC Descriptor
U135B	Lost Communication with Sunload Sensor
U135C	Lost Communication with Start-Stop Capacitor Control Module
U135D	Lost Communication with Transmission Control Module on Chassis Control Module LIN Bus 2
U135E	Lost Communication with Transmission Control Module on Engine Control Module LIN Bus 1
U1501	LIN Bus
U1502	LIN Bus
U1505	LIN Bus
U1509	LIN Bus
	A26 HVAC Controls / P17 Info Display Module Lost Communication with K33 HVAC Control Module on LIN Bus
U150E	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with A11 Radio on LIN Bus
U150F	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with K74 Human Machine Interface Control Module on LIN Bus
	K161 Vehicle Performance Data Recorder Lost Communication with K74 Human Machine Interface Control Module on LIN Bus
U1510	A11 Radio Lost Communication with A20 Radio/HVAC Control / P17 Info Display Module on LIN Bus
	K9 Body Control Module Lost Communication with B67 Ultrasonic Intrusion Sensor / B165 Content Theft Deterrent Sensor Module on LIN Bus
	K20 Engine Control Module Lost Communication with M96 Active Grille Air Shutter Actuator / M60A Active Grille Air Shutter 1 Motor Module on LIN Bus
	K33 HVAC Control Module Lost Communication with A26 HVAC Controls / A20 Radio/HVAC Controls / P17 Info Display Module on LIN Bus
	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary on LIN Bus
	K39 Liftgate Control Module Lost Communication with K171 Hands-Free Liftgate Sensor Control Module / S45A Liftgate Control Switch - Exterior on LIN Bus
	P16 Instrument Cluster Lost Communication with S70D Steering Wheel Controls Switch - Right Upper / S70R Steering Wheel Controls Switch - Right on LIN Bus
U1511	K20 Engine Control Module Lost Communication with M60B Active Grille Air Shutter 2 Motor Module on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K99 Steering Column Position Control Module on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342A UHF Low Energy Remote Control Access Sensor Transceiver 1 on LIN Bus

DTC	DTC Descriptor
U1512	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K124B Active Safety Control Module 2 Lost Communication with K187 Steering Column Friction Control Module on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342B UHF Low Energy Remote Control Access Sensor Transceiver 2 on LIN Bus
U1513	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342C UHF Low Energy Remote Control Access Sensor Transceiver 3 on LIN Bus
U1514	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342D UHF Low Energy Remote Control Access Sensor Transceiver 4 on LIN Bus
U1515	K9 Body Control Module Lost Communication with M75 Windshield Wiper Motor / M75L Windshield Wiper Motor Module - Left on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342E UHF Low Energy Remote Control Access Sensor Transceiver 5 on LIN Bus
U1516	K9 Body Control Module Lost Communication with B110 Battery Sensor Module on LIN Bus
U1517	K9 Body Control Module Lost Communication with K62 Sunroof Sunshade Motor Module on LIN Bus
U1518	P16 Instrument Cluster Lost Communication with K78 Head-Up Display Module / P29 Head-Up Display on LIN Bus
U1519	K40 Seat Memory Control Module Lost Communication with S52 Outside Rearview Mirror Switch on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K96 Mirror Control Module / K96D Mirror Control Module - Driver / K96L Mirror Control Module - Left on LIN Bus
U151A	K9 Body Control Module Lost Communication with B117 Rain Sensor / B177 Rain/Ambient Light Sensor Module / B200 Rain Sensor Module on LIN Bus
U151B	K9 Body Control Module Lost Communication with K61 Sunroof Control Module on LIN Bus
	K40 Seat Memory Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U151C	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary / K33A HVAC Control Module - Auxiliary on LIN Bus

DTC	DTC Descriptor
U151F	A11 Radio Lost Communication with A20 Radio/HVAC Controls / A22 Radio Controls / P17 Info Display Module on LIN Bus
U1520	K9 Body Control Module Lost Communication with P4 Security Siren / P25 Power Sounder Content Theft Deterrent Alarm Module on LIN Bus
	K33 HVAC Control Module Lost Communication with M6CR Air Temperature Door Actuator - Center Console Right Auxiliary on LIN Bus
	K40D Seat Memory Control Module - Driver Lost Communication with K134D Seat Bolster Memory Control Module - Driver on LIN Bus
	K40P Seat Memory Control Module - Passenger Lost Communication with K134P Seat Bolster Memory Control Module - Passenger on LIN Bus
U1521	K9 Body Control Module Lost Communication with S48E Multifunction Switch - Center Console on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1522	K9 Body Control Module Lost Communication with K65 Tire Pressure Indicator Module / B178 Tire Pressure Sensor Locator Module on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with M6UR Air Temperature Door Actuator - Right Upper Auxiliary on LIN Bus
U1523	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1524	K9 Body Control Module Lost Communication with K29 Seat Heating Control Module / K29F Seat Heating Control Module - Front on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with K10 Coolant Heater Control Module on LIN Bus
U1525	K33 HVAC Control Module Lost Communication with K10 Coolant Heater Control Module on LIN Bus
U1526	K9 Body Control Module Lost Communication with K29R Seat Heating Control Module - Rear on LIN Bus
U1528	K33 HVAC Control Module Lost Communication with M37B Mode Door Actuator - Auxiliary on LIN Bus
	K40D Seat Memory Control Module - Driver Lost Communication with S64D Seat Adjuster Switch - Driver on LIN Bus
	K40P Seat Memory Control Module - Passenger Lost Communication with S64P Seat Adjuster Switch - Passenger on LIN Bus
U152A	K33 HVAC Control Module Lost Communication with M6UL Air Temperature Door Actuator - Left Upper Auxiliary on LIN Bus
U152B	K33 HVAC Control Module Lost Communication with K32 Steering Wheel Heating Control Module on LIN Bus

DTC	DTC Descriptor
U152C	K9 Body Control Module Lost Communication with K18 Compass Module on LIN Bus
U152D	K9 Body Control Module Lost Communication with P2 Transmission Shift Lever Position Indicator on LIN Bus
	K33 HVAC Control Module Lost Communication with V1 Air Ionizer on LIN Bus
U1530	K9 Body Control Module Lost Communication with M35P Window Motor Module - Passenger / M74P Window Motor - Passenger on LIN Bus
U1531	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13LA Headlamp Assembly - Left on LIN Bus
U1532	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13RA Headlamp Assembly - Right on LIN Bus
U1534	K9 Body Control Module Lost Communication with M74D Window Motor - Driver on LIN Bus
U1538	K9 Body Control Module Lost Communication with S79D Window Switch - Driver / S146 Window/Outside Rearview Mirror Switch - Driver on LIN Bus
U153A	K9 Body Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U1540	K9 Body Control Module Lost Communication with M74RR Window Motor - Right Rear on LIN Bus
U1544	K9 Body Control Module Lost Communication with M74LR Window Motor - Left Rear on LIN Bus
U1548	K9 Body Control Module Lost Communication with S79LR Window Switch - Left Rear on LIN Bus
U1549	K9 Body Control Module Lost Communication with M45 Rear Wiper Motor on LIN Bus
U154A	K9 Body Control Module Lost Communication with S79RR Window Switch - Right Rear on LIN Bus
U154B	K9 Body Control Module Lost Communication with K49 Rear Seat Control Module on LIN Bus
U1550	K9 Body Control Module Lost Communication with S31D Seat Heating and Cooling Switch - Driver on LIN Bus
U1551	K9 Body Control Module Lost Communication with K33 HVAC Control Module on LIN Bus
U1555	K9 Body Control Module Lost Communication with S100LR Seat Heating/Venting /Cooling Switch - Left Rear on LIN Bus
U1556	K38 Chassis Control Module Lost Communication with K133 Trailer Brake Power Control Module on LIN Bus
U1558	K9 Body Control Module Lost Communication with S31P Seat Heating and Cooling Switch - Passenger on LIN Bus
U1559	K9 Body Control Module Lost Communication with K183 Short Range Remote Control Transceiver on LIN Bus
U155D	K9 Body Control Module Lost Communication with S100RR Seat Heating/Venting/Cooling Switch - Right Rear on LIN Bus

DTC	DTC Descriptor
U156D	K38 Chassis Control Module Lost Communication with S3 Transmission Shift Lever on LIN Bus
U15E1	A11 Radio Lost Communication with A26 HVAC Controls / P17 Info Display Module on LIN Bus
U15F0	K74 Human Machine Interface Control Module Lost Communication with P17 Info Display Module on LIN Bus
	A11 Radio Lost Communication with A20 Radio/HVAC Controls / A22 Radio Controls / P17 Info Display Module on LIN Bus
U15F1	K74 Human Machine Interface Control Module Lost Communication with K188 Human Machine Interface Control Module Bypass Module on LIN Bus
U15F3	K74 Human Machine Interface Control Module Lost Communication with K31 Navigation Control Module on LIN Bus
U1653	Chassis Systems High Speed Communication Enable Circuit
U1725	Left Headlamp High Beam Control Module Lost Communication with Left Headlamp Low Beam Control Module
U1726	Right Headlamp High Beam Control Module Lost Communication with Right Headlamp Low Beam Control Module
U1727	Right Headlamp High Beam Control Module Lost Communication with Right Headlamp Leveling Actuator
U1728	Left Headlamp High Beam Control Module Lost Communication with Left Headlamp Leveling Actuator
U1729	Right High Beam Control Module Lost Communication with Right Headlamp Horizontal Motor
U172A	Left High Beam Control Module Lost Communication with Left Headlamp Horizontal Motor
U1793	14V Power Module Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion Communication Bus
U1795	14V Power Module Powertrain Expansion Communication Bus Off
U179A	Lost Communication with Hybrid/EV Powertrain Control Module 2
U179C	Lost Communication with One or More Hybrid/EV Battery Interface Control Modules
U179D	Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus
U1803	Lost Communication with Hybrid/EV Powertrain Control Module 2
U1804	Lost Communication with Inside Rearview Mirror Control Module
U1806	Battery Energy Control Module High Voltage Energy Management CAN Bus Off
U1807	Battery Charger Control Module High Voltage Energy Management CAN Bus Off
U180A	Electric A/C Compressor Control Module High Speed CAN Bus Off
U180B	Battery Energy Control Module High Speed CAN Bus Off
U180C	Battery Charger Control Module High Speed CAN Bus Off
U180D	Electronic Brake Control Module Chassis Expansion CAN Bus Off
U1811	Battery Energy Control Module Powertrain Expansion CAN Bus Off
U1814	Powertrain Wake-Up Communication Circuit

DTC	DTC Descriptor
U1815	Lost Communication with Drive Motor Control Module 1 on Bus B
U1816	Lost Communication with Drive Motor Control Module B on Bus B
U1817	Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1818	Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus
U1821	Lost Communication with 14V Power Module on Powertrain Expansion Communication Bus
U1826	Lost Communication with Multi-Axis Acceleration Sensor Module on Powertrain Expansion CAN Bus
U1827	Lost Communication with Steering Angle Sensor Module on Powertrain Expansion CAN Bus
U182A	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus
U182D	Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182E	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182F	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U1831	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1833	Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
U1838	Lost Communication with Battery Charger Control Module on High Voltage Energy Management CAN Bus
U1839	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Engine Control Module
U183A	Lost Communication with Telematics Communication Interface Control Module on High Speed CAN Bus
U183B	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Transmission Control Module
U183C	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U183E	Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus
U1844	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Bus B
U1845	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module
U1846	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module

DTC	DTC Descriptor
U1847	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus
U1849	Drive Motor Control Module 1 Lost Communication with Transmission Control Module
U184A	Lost Communication with Body Control Module on Low Speed CAN Bus
U184B	Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus
U184C	Lost Communication with Instrument Cluster on Low Speed CAN Bus
U184D	Lost Communication with Radio on Low Speed CAN Bus
U184E	Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus
U184F	Electric A/C Compressor Control Module Lost Communication with Engine Control Module
U1850	Drive Motor Control Module 2 Lost Communication with Transmission Control Module
U1858	Electronic Brake Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Chassis Expansion CAN Bus
U185A	Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus
U185B	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185C	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185D	Fuel Injector Control Module Lost Communication with Engine Control Module
U185E	Fuel Injector Control Module Lost Communication with Body Control Module
U1860	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U1861	Battery Charger Control Module Lost Communication with Engine Control Module
U186A	Electronic Brake Control Module Lost Communication with Engine Control Module
U186B	Electronic Brake Control Module Lost Communication with Transmission Control Module
U1875	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module
U1876	Drive Motor Control Module 1 Lost Communication with Engine Control Module
U1879	Drive Motor Control Module 2 Lost Communication with Engine Control Module
U1885	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U1886	Battery Energy Control Module Lost Communication with Engine Control Module
U1888	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module

DTC	DTC Descriptor
U18A1	Lost Communication with Coolant Temperature Control Module on High Voltage Energy Management CAN Bus
U18A2	Lost Communication with Fuel Pump Driver Control Module
U18A3	Lost Communication with Human Machine Interface Control Module
U18A4	Lost Communication with Hybrid/EV Battery DC Charging Communications Gateway Module on High Voltage Energy Management CAN Bus
U18A5	Lost Communication with Fuel Injector Control Module on Powertrain Expansion CAN Bus
U18A6	Lost Communication with Right Object Detection Control Module on Dedicated Bus 1
U18A7	Lost Communication with Power Supply Transformer on Powertrain Expansion CAN Bus
U18A9	Lost Communication With Transmission Range Control Module on Chassis Expansion CAN Bus
U18AA	Transmission Range Control Module Lost Communication with Engine Control Module
U18AB	Transmission Range Control Module Lost Communication with Chassis Control Module on High Speed CAN Bus
U18AC	Transmission Range Control Module Lost Communication with Chassis Control Module on Chassis Expansion CAN Bus
U18AD	Transmission Range Control Module Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
U18AE	Lost Communication with Infotainment Control Touchpad on Dedicated Bus 1
U18AF	Lost Communications With Telematics Communications Interface Control Module on Ethernet Bus
U18B0	Lost Communications With Instrument Cluster on Ethernet Bus
U18B1	Lost Communications With Audio Amplifier on Ethernet Bus
U18B2	Lost Communication with Rear Audio Control Module on Ethernet Bus
U18B3	Lost Communications With Navigation Control Module on Ethernet Bus
U18B4	Lost Communication with Radio on Ethernet Bus
U18B5	Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus
U18B6	Lost Communication with Active Safety Control Module 1 on Chassis Expansion CAN Bus
U18B7	Lost Communication with Active Safety Control Module 2 on Chassis Expansion CAN Bus
U18B8	Lost Communication with Body Control Module on High Speed CAN Bus
U18B9	Primary High Speed CAN Bus Subnet Configuration List
U18BA	Lost Communication with Power Steering Control Module on High Speed CAN Bus
U18BB	Lost Communication with Power Steering Control Module on Chassis Expansion CAN Bus
U18BF	Secondary High Speed CAN Bus Subnet Configuration List

DTC	DTC Descriptor
U18C0	Lost Communication with Suspension Control Module on High Speed CAN Bus
U18C1	Lost Communication with Suspension Control Module on Chassis Expansion CAN Bus
U18C2	Lost Communication with Frontview Camera Module on Flexray Bus
U18C3	Lost Communication with Video Processing Control Module on High Speed CAN Bus
U18C4	Lost Communication with Video Processing Control Module on Low Speed CAN Bus
U18C5	Lost Communication with Electronic Brake Control Module on High Speed CAN Bus
U18CA	Lost Communication with Active Safety Control Module 1 on Flexray Bus
U18CB	Lost Communication with Active Safety Control Module 2 on Flexray Bus
U18CC	Transmission Range Control Module Lost Communication with ECM on Powertrain Expansion Bus
U18CF	Lost Communication with Active Safety Control Module 1 on High Speed CAN Bus
U18D0	Lost Communication with Active Safety Control Module 2 on High Speed CAN Bus
U18D1	Lost Communication with Transmission Range Control Module on Powertrain Expansion CAN Bus
U18D2	Lost Communication with Transmission Range Selector Control Module on Powertrain Sensor CAN Bus
U18D3	Lost Communication with Transmission Range Selector Control Module on Powertrain Expansion CAN Bus
U1900	Lost Communication With Speech to Text Interface Module
U1901	Lost Communication with Infotainment Multifunction Switch Module
U2098	MOST Communication Enable Circuit
U2099	High Speed Communication Enable Circuit
U209E	Object Detection Control Module High Speed Communication Enable Circuit 1
U209F	Object Detection Control Module High Speed Communication Enable Circuit 2
U2100	CAN Bus Communication
U2101	CAN Bus Maximum List of Control Modules
U2103	Fewer Controllers On Bus Than Programmed
U2105	Lost Communication with Engine Control Module
U2106	Lost Communication with Transmission Control Module
U2107	Lost Communication with Body Control Module
U2108	Lost Communication with Electronic Brake Control Module
U2125	Lost Communication with Telematic Unit
U2127	Lost Communication with Front HVAC Control Module
U2139	Lost Communication with Column Integration Module
U2144	Lost Communication with Distance Sensing Cruise Control Module
U216A	Lost Communication with Front Object Detection Control Module

DTC	DTC Descriptor
U216B	Lost Communication with Rear Object Detection Control Module
U2176	Lost Communication with Power Take-Off Control Module
U2178	Lost Communication With Trailer Interface Control Module
U2400	Fuel Injector Control Module High Speed CAN Bus Off
U2401	Battery Energy Control Module Dedicated Bus 1 Off
U2409	Transmission Range Control Module High Speed CAN Bus Off
U240A	Transmission Range Control Module Chassis Expansion CAN Bus Off
U240B	Radio Dedicated Bus Off
U240D	Transmission Range Selector Control Module Powertrain Expansion CAN Bus Off
U240E	Transmission Range Selector Control Module Powertrain Sensor CAN Bus Off
U240F	Transmission Range Control Module Lost Communication with EBCM on High Speed CAN Bus
U2410	Transmission Range Control Module Lost Communication with BCM on High Speed CAN Bus
U2411	Transmission Range Control Module Powertrain Expansion CAN Bus Off
U2412	Reductant Control Module Powertrain Sensor Bus Off
U2501	Invalid Data Received From Hybrid/EV Powertrain Control Module 2
U2502	Invalid Data Received From Electronic Brake Control Module on Chassis Expansion CAN Bus
U2503	Invalid Data Received From Object Detection Control Module
U2504	Invalid Data Received From Trailer Brake Driver Control Module
U2505	Invalid Data Received from Human Machine Interface Control Module on MOST Bus
U2506	Invalid Data Received From Dual Battery Control Module
U2507	Invalid Data Received from Instrument Cluster on MOST Bus
U2508	Invalid Data Received from Audio Amplifier on MOST Bus
U250B	Invalid Data Received from Active Safety Control Module 1 on Chassis Expansion CAN Bus
U250C	Invalid Data Received from Active Safety Control Module 2 on Chassis Expansion CAN Bus
U250D	Invalid Data Received from Transmission Control Module on Chassis Control Module LIN Bus 2
U250E	Invalid Data Received from Vehicle Dynamic Sensor 1
U250F	Invalid Data Received from Vehicle Dynamic Sensor 2
U2510	Invalid Data Received from Multifunction Energy Storage Capacitor Control Module
U2511	Invalid Data Received from Digital Map Control Module
U2512	Invalid Data Received from Video Processing Control Module
U2513	Invalid Data Received from Driver Monitoring System Control Module
U2520	Invalid Data Received from Active Safety Control Module 1 on High Speed CAN Bus

DTC	DTC Descriptor
U2602	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2603	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 1
U2604	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 2
U2605	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 3
U2606	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 4
U2608	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2609	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2611	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2612	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2613	Drive Motor 1 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2614	Drive Motor 2 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2615	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2616	Fuel Pump Driver Control Module Lost Communication with ECM
U2617	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 5
U2618	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 6
U2619	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 7
U2620	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 8
U2621	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 9
U2622	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 10
U2623	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 11
U2624	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 12
U2625	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 13

DTC	DTC Descriptor
U2626	Reductant Control Module Lost Communication With Engine Control Module on Powertrain Sensor CAN Bus
U2627	Reductant Control Module Lost Communication with Reductant Level Sensor
U2628	Reductant Control Module Lost Communication with Reductant Concentration Sensor
U2629	Reductant Control Module Lost Communication with Reductant Tank Temperature Sensor 1
U2630	Reductant Control Module Lost Communication with Reductant Tank Temperature Sensor 2
U2631	Reductant Control Module Lost Communication with Reductant Pressure Sensor
U3000	Control Module
U3001	Control Module Improper Shutdown Performance
U3012	Control Module Improper Wake-up Performance

DTC B1000: ELECTRONIC CONTROL UNIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B1000

Electronic Control Unit

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1000 is not set.

- **If DTC B1000 is set**

Replace the device that set the DTC.

- **If DTC B1000 is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC B1001: OPTION CONFIGURATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001

Option Configuration

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Some devices must be configured with serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC B1001. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1001 is not set.
 - **If DTC B1001 is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - **If DTC B1001 is not set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC B1016: VEHICLE IDENTIFICATION NUMBER INFORMATION NOT PROGRAMMED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B1016

Vehicle Identification Number Information Not Programmed

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The device performs a self test and vehicle identification number (VIN) verification. This DTC indicates that a VIN is not programmed or that the device has an internal fault. The internal fault detection is handled inside the device, no external circuits are involved.

Conditions for Running the DTC

The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected that the VIN is not programmed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 50 fault-free ignition cycles.
- The DTC can be cleared using a scan tool.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1016 is not set.
 - **If DTC B1016 is set**

1. Program the device that set the DTC.
2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
3. All OK.
 - **If DTC B1016 is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC B101D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B101D

Electronic Control Unit Hardware

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

- The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.
- The keyless entry control module will set this DTC with symptom byte 39 when the keyless entry control module antenna is activated.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- Do not replace a device based only on DTC B101D being set in history with the exception of the following devices:
 - K36 Inflatable Restraint Sensing and Diagnostic Module
 - K85 Passenger Presence Module
- If DTC B101D is set as current, replace the appropriate device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B101D is not set.
 - **If DTC B101D is set with symptom byte 43**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.

- If the DTC sets, replace the device that set the DTC.
- If the DTC does not set

3. All OK.

- **If DTC B101D is set with any symptom byte, except symptom byte 43**

Replace the device that set the DTC.

- **If DTC B101D is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC B101E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B101E

Electronic Control Unit Software

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC B101E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B101E is not set.
 - **If DTC B101E is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC B101E is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D

Electronic Control Unit Hardware

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC C056D is not set.
 - **If DTC C056D is set in a device that can be programmed**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC C056D is set in a device that cannot be programmed**

Replace the device that set the DTC.
 - **If DTC C056D is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC C056E

Electronic Control Unit Software

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC C056E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool References

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC C056E is not set.
 - **If DTC C056E is set**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - **If DTC C056E is not set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC P0601-P0607, P060A-P060C, P062F, P16E9-P16F0, OR P262B: CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0605

Control Module Programming Read Only Memory Performance

DTC P0606

Control Module Processor Performance

DTC P0607

Control Module Performance

DTC P060A

Control Module Monitoring Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P060C

Control Module Main Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P16E9

Control Module Serial Peripheral Interface Bus 2

DTC P16EA

Control Module Serial Peripheral Interface Bus 3

DTC P16EB

Control Module Serial Peripheral Interface Bus 4

DTC P16EC

Control Module Serial Peripheral Interface Bus 5

DTC P16ED

Control Module Serial Peripheral Interface Bus 6

DTC P16EE

Control Module Serial Peripheral Interface Bus 7

DTC P16EF

Control Module Serial Peripheral Interface Bus 8

DTC P16F0

Control Module Serial Peripheral Interface Bus 1

DTC P262B

Control Module Power Off Timer Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the device. This diagnostic also addresses if the device is not programmed. The device monitors its ability to read and write to the memory. It also monitors a timing function. No external circuits are involved.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The device detects an internal malfunction or incomplete programming.

Action Taken When the DTC Sets

- DTCs P0601 - P0607, P060A - P060C, and P16E9 - P16F0 are Type A DTCs.
- DTC P062F is a Type C DTCs.
- DTC P262B is a Type B DTC.
- The high voltage contactor relays may open.

Conditions for Clearing the DTC

- DTCs P0601 - P0607, P060A - P060C, and P16E9 - P16F0 are Type A DTCs.
- DTC P062F is a Type C DTCs.
- DTC P262B is a Type B DTC.

Diagnostic Aids

- The DTC P0606 may set in Hybrid/EV Powertrain Control Module 2 due to other faults. Do not replace the Hybrid/EV Powertrain Control Module 2 until other DTCs are diagnosed first.
- The DTC P0606 can falsely set in Hybrid/EV Powertrain Control Module 2 when the 12 V battery has been disconnected/re-connected or if the 12 V battery has been overcharged (over 18 V). In this case, do the following. If this DTC becomes history, use scan tool to clear this DTC. No further action is required:
 - Vehicle OFF and all vehicle systems off. It may take up to 2 minutes for all vehicle systems to power down.
 - Vehicle ON, verify that DTC P0606 is in history and contactors close. (If DTC P0606 remains current and contactors do not close, repeat the above step again).
 - Use scan tool to clear the DTC to turn off the malfunction indicator lamp (MIL).
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

NOTE: The DTC P0606 can falsely set in K114B Hybrid/EV Powertrain Control Module 2 when disconnecting the 12 V battery. See Diagnostic Aids section for more information.

1. Vehicle in Service Mode.
2. Verify DTC P0606 is not set.

- **If DTC P0606 is set with other DTCs set**

Diagnose all other DTCs first. Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If DTC P0606 is set without other DTCs set**

Replace the device that set the DTC.

- **If DTC P0606 is not set**

3. Verify DTC P0602 is not set.

- **If DTC P0602 is set**

1. Program the device that set the DTC.

2. Verify the DTC does not set.

- If the DTC sets, replace the device that set the DTC.

- If the DTC does not set

3. All OK.

- **If DTC P0602 is not set**

4. Verify DTC P0601, P0603, P0604, P0605, P0607, P060A, P060B, P060C, P062F, P16E9, P16EA, P16EB, P16EC, P16ED, P16EE, P16EF, P16F0, or P262B is not set.

- **If any of the DTCs are set**

Replace the device that set the DTC.

- **If none of the DTCs are set**

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC P06E4: CONTROL MODULE WAKE-UP CIRCUIT PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 2)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P06E4

Control Module Wake-Up Circuit Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wake Up Serial Data 2	P06E4, U0100-U02FF*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The accessory wake up serial data 2 circuit is energized by the K114B Hybrid/EV Powertrain Control Module 2 to immediately activate other devices connected to this circuit when the K9 Body Control Module signals the K114B Hybrid/EV Powertrain Control Module 2 that serial data is required.

Depending on the option content, devices that may receive the wake up signal are as follows:

- K1 14 V Power Module
- T18 Battery Charger
- K16 Battery Energy Control Module
- K17 Electronic Brake Control Module
- G1 A/C Compressor
- K71 Transmission Control Module / T12 Automatic Transmission Assembly
- K20 Engine Control Module
- K114A Hybrid/EV Powertrain Control Module 1 / T6 Power Inverter Module

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.
- The K114B Hybrid/EV Powertrain Control Module 2 attempts to wake up the devices connected to its control module output wake up circuit.
- Circuit check runs continuously.

Conditions for Setting the DTC

- The K114B Hybrid/EV Powertrain Control Module 2 detects a fault in the control module output wake up circuit.
- A circuit fault exists for greater than 6 s.

Action Taken When the DTC Sets

- The DTC P06E4 is a type A DTC.
- The devices is never signaled. Therefore, the specific subsystems will not function.
- The vehicle will not start while the circuit is shorted to ground.
- The malfunction indicator lamp (MIL) will illuminate, along with several DIC messages.

Conditions for Clearing the DTC

- The DTC P06E4 is a type A DTC.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

Short to ground will also set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B097B, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1451, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematic to determine which devices are on the K114B Hybrid/EV Powertrain Control Module 2 terminal 69 X2 accessory wake up serial data 2 circuit. Use the connector end view to identify the B+, ignition, and accessory wake up serial data 2 circuit terminals for each of those devices.

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the accessory wake up serial data circuit terminal 67 X2 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF and all vehicle systems OFF, remove the test lamp, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for greater than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 67 X2 and ground.
 - If 100 Ω or less, repair the short to ground in the accessory wake up serial data circuit.
 - If greater than 100 Ω
 3. Test for less than 2 Ω between the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 67 X2 and the K9 Body Control Module wake up circuit terminal 22 X4.
 - If 2 Ω or greater, repair the open/high resistance in the accessory wake up serial data circuit.
 - If less than 2 Ω
 4. Replace the K9 Body Control Module.
 - **If the test lamp illuminates**
4. Vehicle OFF, remove the test lamp, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω , but less than infinite resistance, between the accessory wake up serial data 2 circuit terminal 69 X2 and ground.
 - **If 100 Ω or less**

Refer to Testing the Accessory Wake Up Serial Data 2 Circuits for a Short to Ground.

- **If infinite resistance**

Test for an open/high resistance in the accessory wake up serial data 2 circuit.

- **If greater than 100 Ω and less than infinite resistance**

6. Vehicle in Service Mode.

7. Verify that a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

8. Vehicle in Service Mode.

9. Verify that a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

10. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Testing the Accessory Wake Up Serial Data 2 Circuits for a Short to Ground

1. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to [High Voltage Disabling](#).
2. Reconnect the 12 V battery.
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at an easily accessible device that shares the K114B Hybrid/EV Powertrain Control Module 2 terminal 69 X2 accessory wake up serial data 2 circuit. It may

take up to 2 min for all vehicle systems to power down.

4. Test for less than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data 2 circuit terminal 69 X2 and ground.

- **If 100 Ω or greater**

Replace the device that was just disconnected.

- **If less than 100 Ω**

5. Repeat step 3 until all devices on the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data 2 circuit terminal 69 X2 have been disconnected.
6. Repair the short to ground on the accessory wake up serial data 2 circuit.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup.

DTC P0A1F, P1A01, P1A05, OR P1A06: BATTERY ENERGY CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A1F

Battery Energy Control Module Performance

DTC P1A01

Battery Energy Control Module Long Term Memory Performance

DTC P1A05

Battery Energy Control Module Random Access Memory

DTC P1A06

Battery Energy Control Module Read Only Memory

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The Battery Energy Control Module will diagnose its own systems and determine when a fault condition is present. Diagnostics and system status is communicated from the Battery Energy Control Module to the Hybrid/EV Powertrain Control Module 2 through serial data. The Hybrid/EV Powertrain Control Module 2 is

the host controller for diagnostic trouble code (DTC) information.

This diagnostic applies to internal microprocessor integrity conditions within the Battery Energy Control Module. This fault is internal to the Battery Energy Control Module and no external circuits are involved.

Conditions for Running the DTC

- The Battery Energy Control Module is awake and communicating.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The Battery Energy Control Module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0A1F, P1A01, P1A05, and P1A06 are type A DTCs.
- Vehicle goes to reduced battery power mode. After vehicle is turned off, vehicle will not return to propulsion active mode.

Conditions for Clearing the DTC

DTCs P0A1F, P1A01, P1A05, and P1A06 are type A DTCs.

Diagnostic Aids

If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.

NOTE: If the power is interrupted at exactly the time the K16 Battery Energy Control Module is writing to its memory, it may set a false P1A01 DTC.

2. Verify that DTC P1A01 is not set.

- **If DTC P1A01 is set**

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.

2. Vehicle in Service Mode.

3. Verify that the DTC does not set.

- If the DTC sets, replace the K16 Battery Energy Control Module.
- If the DTC does not set

4. All OK.

- **If DTC P1A01 is not set**

3. Verify that DTC P0A1F, P1A05, or P1A06 is not set.

- **If any of the DTCs are set**

Replace the K16 Battery Energy Control Module.

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC P16B7: ELECTRIC A/C COMPRESSOR CONTROL MODULE WAKE-UP CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P16B7

Electric A/C Compressor Control Module Wake-Up Circuit Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wake Up Serial Data 2	P16B7, U016B*	U016B*	U016B*	-
* Other DTCs may set with this fault				

Circuit/System Description

The accessory wake up serial data 2 circuit is energized by the K114B Hybrid/EV Powertrain Control Module 2 to immediately activate the G1 A/C Compressor connected to this circuit when the body control module signals the K114B Hybrid/EV Powertrain Control Module 2 that serial data is required.

Conditions for Running the DTC

- The system voltage is greater than 10.25 V.
- The G1 A/C Compressor is awake.
- Vehicle ON.

- The G1 A/C Compressor receives serial data message from K114B Hybrid/EV Powertrain Control Module 2 and "Propulsion System Active" is TRUE for 500 ms continuously.

Conditions for Setting the DTC

The G1 A/C Compressor detects a fault in the wake up circuit.

Action Taken When the DTC Sets

DTC P16B7 is a type B DTC.

Conditions for Clearing the DTC

DTC P16B7 is a type B DTC.

Diagnostic Aids

Short to ground may set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P06E4 is not set.
 - **If DTC P06E4 is set**

Refer to **DTC P06E4 (Hybrid/EV Powertrain Control Module 2)**.

- **If DTC P06E4 is not set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's accessory wake up serial data 2 circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 harness connector at the G1 A/C Compressor. It may take up to 2 min for all vehicle systems to power down.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the accessory wake up serial data 2 circuit terminal 2 X1 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF and all vehicle systems OFF, remove the test lamp, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 2 Ω between the G1 A/C Compressor wake up circuit terminal 2 X1 and the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 43 X2.
 - If 2 Ω or greater, repair the open/high resistance in the accessory wake up serial data 2 circuit.
 - If less than 2 Ω
 3. Vehicle in Service Mode.
 4. Verify that a test lamp illuminates between the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data circuit terminal 67 X2 and ground.
 - If the test lamp does not illuminate, test the accessory wake up serial data circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
 - If the test lamp illuminates
 5. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
4. Test or replace the G1 A/C Compressor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P16B8-P16BA: ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P16B8

Electric A/C Compressor Control Module Random Access Memory Performance

DTC P16B9

Electric A/C Compressor Control Module Read Only Memory Performance

DTC P16BA

Electric A/C Compressor Control Module Long Term Memory Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The A/C Compressor will diagnose its own systems and determine when a fault condition is present. This diagnostic applies to internal microprocessor integrity conditions within the A/C compressor. This fault is internal to the A/C compressor and no external circuits are involved.

Conditions for Running the DTC

- System voltage is greater than 10.25 V.
- The device is awake and communicating.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

DTCs P16B8, P16B9, and P16BA are type A DTCs.

Conditions for Clearing the DTC

- DTCs P16B8, P16B9, and P16BA are type A DTCs.
- After the vehicle has been OFF for a sufficient amount of time to allow the devices to enter a sleep mode, the devices will re-enable the output on the following ignition cycle and the DTC will become history.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P16B8, P16B9, or P16BA is not set.

- **If any of the DTCs are set**

Replace the G1 A/C Compressor.

- If none of the DTCs are set

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, OR P3042: HYBRID/EV BATTERY INTERFACE CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E8E

Hybrid/EV Battery Interface Control Module 1 Performance

DTC P1E8F

Hybrid/EV Battery Interface Control Module 1 Random Access Memory Performance

DTC P1E90

Hybrid/EV Battery Interface Control Module 1 Read Only Memory Performance

DTC P1E91

Hybrid/EV Battery Interface Control Module 1 Long Term Memory Performance

DTC P1E94

Hybrid/EV Battery Interface Control Module 2 Performance

DTC P1E95

Hybrid/EV Battery Interface Control Module 2 Random Access Memory Performance

DTC P1E96

Hybrid/EV Battery Interface Control Module 2 Read Only Memory Performance

DTC P1E97

Hybrid/EV Battery Interface Control Module 2 Long Term Memory Performance

DTC P1E9A

Hybrid/EV Battery Interface Control Module 3 Performance

DTC P1E9B

Hybrid/EV Battery Interface Control Module 3 Random Access Memory Performance

DTC P1E9C

Hybrid/EV Battery Interface Control Module 3 Read Only Memory Performance

DTC P1E9D

Hybrid/EV Battery Interface Control Module 3 Long Term Memory Performance

DTC P1EA0

Hybrid/EV Battery Interface Control Module 4 Performance

DTC P1EA1

Hybrid/EV Battery Interface Control Module 4 Random Access Memory Performance

DTC P1EA2

Hybrid/EV Battery Interface Control Module 4 Read Only Memory Performance

DTC P1EA3

Hybrid/EV Battery Interface Control Module 4 Long Term Memory Performance

DTC P1F06

Hybrid/EV Battery Interface Control Module 1 Processor Performance

DTC P1F07

Hybrid/EV Battery Interface Control Module 2 Processor Performance

DTC P1F08

Hybrid/EV Battery Interface Control Module 3 Processor Performance

DTC P1F09

Hybrid/EV Battery Interface Control Module 4 Processor Performance

DTC P1FAC

Hybrid/EV Battery Interface Control Module 5 Read Only Memory Performance

DTC P1FAD

Hybrid/EV Battery Interface Control Module 7 Read Only Memory Performance

DTC P1FAE

Hybrid/EV Battery Interface Control Module 8 Read Only Memory Performance

DTC P1FAF

Hybrid/EV Battery Interface Control Module 9 Read Only Memory Performance

DTC P1FB0

Hybrid/EV Battery Interface Control Module 10 Read Only Memory Performance

DTC P1FB1

Hybrid/EV Battery Interface Control Module 5 Random Access Memory Performance

DTC P1FB2

Hybrid/EV Battery Interface Control Module 6 Random Access Memory Performance

DTC P1FB3

Hybrid/EV Battery Interface Control Module 7 Random Access Memory Performance

DTC P1FB4

Hybrid/EV Battery Interface Control Module 8 Random Access Memory Performance

DTC P1FB5

Hybrid/EV Battery Interface Control Module 9 Random Access Memory Performance

DTC P1FB6

Hybrid/EV Battery Interface Control Module 10 Random Access Memory Performance

DTC P1FB7

Hybrid/EV Battery Interface Control Module 5 Long Term Memory Performance

DTC P1FB8

Hybrid/EV Battery Interface Control Module 6 Long Term Memory Performance

DTC P1FB9

Hybrid/EV Battery Interface Control Module 7 Long Term Memory Performance

DTC P1FBA

Hybrid/EV Battery Interface Control Module 8 Long Term Memory Performance

DTC P1FBB

Hybrid/EV Battery Interface Control Module 9 Long Term Memory Performance

DTC P1FBC

Hybrid/EV Battery Interface Control Module 10 Long Term Memory Performance

DTC P1FBD

Hybrid/EV Battery Interface Control Module 5 Performance

DTC P1FBE

Hybrid/EV Battery Interface Control Module 6 Performance

DTC P1FBF

Hybrid/EV Battery Interface Control Module 7 Performance

DTC P1FC0

Hybrid/EV Battery Interface Control Module 8 Performance

DTC P1FC1

Hybrid/EV Battery Interface Control Module 9 Performance

DTC P1FC2

Hybrid/EV Battery Interface Control Module 10 Performance

DTC P1FCF

Hybrid/EV Battery Interface Control Module 5 Processor Performance

DTC P1FD0

Hybrid/EV Battery Interface Control Module 6 Processor Performance

DTC P1FD1

Hybrid/EV Battery Interface Control Module 7 Processor Performance

DTC P1FD2

Hybrid/EV Battery Interface Control Module 8 Processor Performance

DTC P1FD3

Hybrid/EV Battery Interface Control Module 9 Processor Performance

DTC P1FD4

Hybrid/EV Battery Interface Control Module 10 Processor Performance

DTC P1FF3

Hybrid/EV Battery Interface Control Module 6 Read Only Memory Performance

DTC P3031

Hybrid/EV Battery Interface Control Module 11 Read Only Memory

DTC P3032

Hybrid/EV Battery Interface Control Module 11 Random Access Memory

DTC P3033

Hybrid/EV Battery Interface Control Module 11 Long Term Memory Performance

DTC P3034

Hybrid/EV Battery Interface Control Module 11 Performance

DTC P3037

Hybrid/EV Battery Interface Control Module 11 Processor Performance

DTC P303C

Hybrid/EV Battery Interface Control Module 12 Read Only Memory

DTC P303D

Hybrid/EV Battery Interface Control Module 12 Random Access Memory

DTC P303E

Hybrid/EV Battery Interface Control Module 12 Long Term Memory Performance

DTC P303F

Hybrid/EV Battery Interface Control Module 12 Performance

DTC P3042

Hybrid/EV Battery Interface Control Module 12 Processor Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The Hybrid/EV Battery Interface Control Modules will diagnose their own systems and determine when a fault condition is present. This diagnostic applies to internal microprocessor integrity conditions within the Hybrid/EV Battery Interface Control Modules. This fault is internal to the Hybrid/EV Battery Interface Control

Modules and no external circuits are involved.

Conditions for Running the DTC

- The device is awake.
- The system voltage is at least 9 V.
- DTC U2603 - U2606 or U2617 - U2624 is not set.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

DTCs P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, and P3042 are type A DTCs.

Conditions for Clearing the DTC

DTCs P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, and P3042 are type A DTCs.

Diagnostic Aids

- The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify that DTC P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, or P3042 is not set.

- **If any of the DTCs are set**

Replace the K16 Battery Energy Control Module.

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1EB1: HYBRID/EV BATTERY INTERFACE CONTROL MODULE SOFTWARE INCOMPATIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EB1

Hybrid/EV Battery Interface Control Module Software Incompatible

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

This is the software incompatibility issue between the Hybrid/EV Battery Interface Control Modules and the Battery Energy Control Module. No external circuits are involved.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- DTC U2401, U2603, U2604, U2605, or U2606 is not set.

Conditions for Setting the DTC

- Any one of the Hybrid/EV Battery Interface Control Module software revision does not match.
- Battery Energy Control Module software and Hybrid/EV Battery Interface Control Module software are incompatible.

Action Taken When the DTC Sets

- Slave data that are incompatible with the Battery Energy Control Module software is set to Invalid, 0 V and -40Â°C (-40Â°F).
- DTC P1EB1 is a type A DTC.

Conditions for Clearing the DTC

DTC P1EB1 is a type A DTC.

Diagnostic Aids

If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.

2. Verify DTC P1EB1 is not set.

- **If DTC P1EB1 is set**

1. Program the K16 Battery Energy Control Module.

2. Verify the DTC does not set.

- **If the DTC sets without other DTCs set, replace the K16 Battery Energy Control Module.**
- **If the DTC sets along with any of the DTCs P1EB2, P1EB3, P1EB4, or P1EB5 set, refer to **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B.****
- **If the DTC does not set**

3. All OK.

- **If DTC P1EB1 is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, OR P303B: HYBRID/EV BATTERY INTERFACE CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1EB2

Hybrid/EV Battery Interface Control Module 1 Not Programmed

DTC P1EB3

Hybrid/EV Battery Interface Control Module 2 Not Programmed

DTC P1EB4

Hybrid/EV Battery Interface Control Module 3 Not Programmed

DTC P1EB5

Hybrid/EV Battery Interface Control Module 4 Not Programmed

DTC P1FA6

Hybrid/EV Battery Interface Control Module 5 Not Programmed

DTC P1FA7

Hybrid/EV Battery Interface Control Module 6 Not Programmed

DTC P1FA8

Hybrid/EV Battery Interface Control Module 7 Not Programmed

DTC P1FA9

Hybrid/EV Battery Interface Control Module 8 Not Programmed

DTC P1FAA

Hybrid/EV Battery Interface Control Module 9 Not Programmed

DTC P1FAB

Hybrid/EV Battery Interface Control Module 10 Not Programmed

DTC P3030

Hybrid/EV Battery Interface Control Module 11 Not Programmed

DTC P303B

Hybrid/EV Battery Interface Control Module 12 Not Programmed

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

When the Battery Energy Control Module is flash programmed, the Hybrid/EV Battery Interface Control Module operating software and calibrations are provided to the Battery Energy Control Module. The Hybrid/EV Battery Interface Control Module software and calibrations are then loaded to each of the Hybrid/EV Battery Interface Control Modules from the Battery Energy Control Module. This operation is automatic and requires no operator action. At this point, if any of the Hybrid/EV Battery Interface Control Modules are not programmed correctly, the appropriate DTC is set. This fault is internal to the Hybrid/EV Battery Interface Control Modules and no external circuits are involved.

Conditions for Running the DTC

- The Battery Energy Control Module is awake and communicating.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The Hybrid/EV Battery Interface Control Module is not programmed correctly.

Action Taken When the DTC Sets

DTCs P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, and P303B are type A DTCs.

Conditions for Clearing the DTC

- The Hybrid/EV Battery Interface Control Module is programmed correctly.
- DTCs P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, and P303B are type A DTCs.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

[Control Module References](#) for scan tool information

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify DTC P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, or P303B is not set.

- **If any of the DTCs are set**

1. Program the K16 Battery Energy Control Module.
2. Verify the DTC does not set.
 - If the DTC sets, replace the K16 Battery Energy Control Module.
 - If the DTC does not set
3. All OK.

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC P1EB9: HIGH VOLTAGE ENERGY MANAGEMENT COMMUNICATION BUS ENABLE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EB9

High Voltage Energy Management Communication Bus Enable Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management Communication Enable	P1EB9, U0100-U02FF*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 activates the high voltage energy management communication enable circuit when the vehicle is on. This circuit wakes up the devices for high voltage energy bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 2 detects a fault in the high voltage energy management communication enable circuit.

Action Taken When the DTC Sets

DTC P1EB9 is a type A DTC.

Conditions for Clearing the DTC

DTC P1EB9 is a type A DTC.

Diagnostic Aids

Short to ground will also set multiple no communication codes for devices on high voltage energy serial data bus.

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)
- [**Wiring Repairs**](#)

Scan Tool Reference

[**Control Module References**](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics to determine which devices are on the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2 high voltage energy management communication enable circuit. Use the connector end views to identify the B+, ignition, and high voltage energy management communication enable circuit terminals for each of those devices.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 100 Ω , but less than infinite resistance, between the high voltage energy management communication enable circuit terminal 65 X2 and ground.

- **If 100 Ω or less**

Refer to Testing the High Voltage Energy Management Communication Enable Circuits for a Short to Ground.

- **If infinite resistance**

Test for an open/high resistance in the high voltage energy management communication enable

circuit.

- **If greater than 100 Ω and less than infinite resistance**

3. Vehicle in Service Mode.

4. Verify that a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

5. Verify that a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

6. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Testing the High Voltage Energy Management Communication Enable Circuits for a Short to Ground

1. Perform the High Voltage Disabling procedure. Refer to [High Voltage Disabling](#) .

2. Reconnect the 12 V battery.

3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connector at an easily accessible device that shares the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2 high voltage energy management communication enable circuit. It may take up to 2 min for all vehicle systems to power down.

4. Test for less than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 high voltage energy management communication enable circuit terminal 65 X2 and ground.

- **If 100 Ω or greater**

Replace the device that was just disconnected.

- **If less than 100 Ω**

5. Repeat step 3 until all devices on the K114B Hybrid/EV Powertrain Control Module 2 high voltage energy management communication enable circuit terminal 65 X2 have been disconnected.
6. Repair the short to ground on the high voltage energy management communication enable circuit.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup.

DTC P1EB9: HIGH VOLTAGE ENERGY MANAGEMENT COMMUNICATION BUS ENABLE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1EC1

Battery Energy Control Module High Voltage Energy Management Communication Bus Enable Circuit Low Voltage

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management Communication Enable	P1EC1	P1EC1	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 activates the high voltage energy management communication enable circuit when the vehicle is on. The high voltage energy management communication enable circuit wakes up the Battery Energy Control Module for serial data communication.

The Battery Energy Control Module compares the high voltage energy management communication enable hardwire signal with a Hybrid/EV Powertrain Control Module 2 serial data message indicating that the high voltage energy management communication enable signal is active. If the high voltage energy management communication enable hardwire signal is low when the serial data message indicates it should be high, then DTC P1EC1 is set.

Conditions for Running the DTC

- The device is awake and communicating.
- The system voltage is at least 9 V.
- DTCs U2602, U180B, P1A0C, or P1A07 is not set.

Conditions for Setting the DTC

P1EC1

The ignition voltage on the high voltage energy management communication enable circuit is less than 5 V.

Action Taken When the DTC Sets

DTCs P1EC1 and P1EC2 are type A DTCs.

Conditions for Clearing the DTC

P1EC1

The ignition voltage on the high voltage energy management communication enable circuit is at least 5 V for 10 s.

DTCs P1EC1 and P1EC2 are type A DTCs.

Diagnostic Aids

Short to ground will also set multiple no communication codes for devices on high voltage management serial data bus.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

[Control Module References](#) for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50211** Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P1EB9 or U185B is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the devices' high voltage energy management communication enable circuit terminals.

1. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the high voltage energy management communication enable circuit terminal 5 X357 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the high voltage energy management communication enable circuit terminal 5 X357 at the A4 Hybrid/EV Battery Pack and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the high voltage energy management communication enable circuit end to end between the A4 Hybrid/EV Battery Pack terminal 5 X357 and the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2.
 - If greater than 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
4. Vehicle OFF, connect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
5. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to [High Voltage Disabling](#).
6. Reconnect the 12 V battery.
7. Vehicle OFF, connect the EL-50211 low voltage jumper harness extension.
8. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
9. Vehicle in Service Mode.
10. Verify that a test lamp illuminates between the high voltage energy management communication enable circuit terminal 10 X8 at K16 Battery Energy Control Module and ground.
 - **If the test lamp does not illuminate**

Repair the open/high resistance in the circuit.
 - **If the test lamp illuminates**
11. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0020: LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U0020

Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Devices connected to the GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have programmed information about what messages are needed to be exchanged on the serial data circuits. The messages are also supervised and some periodic messages are used by the receiver device as an availability indication of the transmitter device.

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communication to occur.
- The DTC U2100 does not have a current status.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTCs Sets

The device uses a default value for the missing parameter.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Circuit/System Verification

Diagnosis of this DTC is accomplished via the symptom or an additional DTC. Refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#) , or [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

DTC U0028: MOST BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U0028

MOST Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0100 - U02FF, U0028 00	U0100 - U02FF, U0028 00	-	-
Ignition	U0100 - U02FF, U1814, U2099, U0028 00	U0100 - U02FF, U0028 00	-	-
MOST Control	U2098 00, U2098 02, U0029 02	U0028 00	U2098 00, U2098 02	-
MOST Bus Serial Data (+)	U0028 00	U0028 00	U0028 00	-
MOST Bus Serial Data (-)	U0028 00	U0028 00	U0028 00	-
Ground	-	U0100 - U02FF, U0028 00	-	-

Circuit/System Description

The Media Oriented Systems Transport (MOST) bus consists of a physical ring in which multimedia devices share audio, video and infotainment system control data. Each device on the MOST bus transmits and receives data via the MOST Bus Serial Data (+/- transmit/receive) circuits. The MOST bus diagnostic master is the Radio. The MOST control circuit is connected to each device on the MOST bus. Each device provides a 12 V signal on the MOST control circuit. The Radio initiates communication on the MOST bus at Vehicle "On" by toggling the MOST control circuit low for 100 ms. Once each device recognizes the wakeup signal from the Radio on the MOST control circuit, they will respond to the Radio on the MOST bus to indicate no faults are present and normal communications will commence.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle is ON.

Conditions for Setting the DTC

A fault occurs on transmit, receive, electronic control lines, or internal device failure.

Action Taken When the DTC Sets

- Some or all of the infotainment system audio and displays may be inoperative.
- While a current U0028 is set, the Radio will continually send 400 ms low pulses on the MOST control circuit every 2.5 s. This is a Ring Break Diagnostic indication to the devices on the ring to report a Surrogate Master Upstream Position Node.

Conditions for Clearing the DTC

The MOST initialization is successful without errors and the MOST bus resumes normal communications.

Diagnostic Aids

- The EL-51578 MOST Bus Diagnostic Tool Kit when utilized will cause false GMLAN DTC's to be set as a result, along with loss of bypassed MOST device infotainment functionality. These DTC's and missing functionality should be ignored unless the system is completely assembled and a DTC or symptom is present during the repair verification steps.
- To troubleshoot the intermittent condition, manipulate or wiggle MOST wiring harness and observe the Radio's DTC U0028 status and the Radio scan tool Number of MOST Communication Breaks parameter value.
- If the issue still exists after performing all verification and test steps in this diagnostic procedure, bypass each MOST device individually on the MOST bus (except the Radio) while monitoring DTC U0028 status. If DTC U0028 remains current after each MOST device has been bypassed, disconnect the Radio MOST harness connector. The entire MOST ring can now be tested with all MOST devices (except the Radio) bypassed to determine if any circuit faults exist.
- The Radio's DTC U0028 will be set current with all MOST devices bypassed.

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-51578 MOST Bus Diagnostic Tool Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode. Radio ON.
2. If equipped, verify that the A33 Media Disc Player is operative by inserting or ejecting a disk.

- **If the disk can not be inserted or ejected**

Test the power, ground, and serial data circuits of the A33 Media Disc Player for an open/high resistance.

- **If the disk can be inserted or ejected**

3. Verify that the scan tool communicates with each MOST device, except the A33 Media Disc Player.

- **If any MOST device does not communicate with the scan tool**

Refer to **DTC U0100-U02FF** to diagnose power, ground, and serial data circuits of that MOST device.

- **If all MOST devices communicate with the scan tool**

4. Verify that DTC U2098 or DTC U0029 02 is not set.

- **If any of the DTCs are set**

Refer to **DTC U2098** .

- **If none of the DTCs are set**

5. Verify that DTC U0028 is not set.

- **If the DTC U0028 is set**

1. Using the scan tool, select the MOST Bus Diagnostic Starting Point function from A11 Radio Control Functions menu.
2. Determine the fault location from A11 Radio scan tool Control Functions, MOST Bus Diagnostic Starting Point. Reference Node Locations of MOST Bus Communication Break parameter value.
3. Refer to Circuit/System Testing.

- **If the DTC U0028 is not set**

6. Refer to Repair Verification.

Circuit/System Testing

NOTE: You must perform Circuit/System Verification before proceeding with Circuit/System Testing.

NOTE: Use the Radio scan tool, schematics and specific vehicle build RPO codes to determine optional devices and to identify the following:

- The MOST bus ring configuration
- Each MOST device's MOST control and serial data circuit terminals

NOTE: If the A11 Radio is the first node position in the "Node Locations of MOST Bus Communication Break" range, proceed to step 8.

1. Vehicle OFF, disconnect the harness connector containing the MOST circuits at the MOST device at the first Node position reported by Node Locations of MOST Bus Communication Break parameter value.
2. Connect the appropriate connector from the EL-51578 MOST Bus Diagnostic Tool Kit to the harness connector of the MOST device to bypass this MOST device.
3. Vehicle in Service Mode.

NOTE: MOST control (ECL) voltage will toggle from 9 - 13 V to 0 V while DTC U0028 is current.

4. Test for 9 - 13 V between the ECL connector from the EL-51578 MOST Bus Diagnostic Tool Kit and ground.

- **If less than 9 V**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connectors at the A11 Radio.
2. Disconnect the EL-51578 MOST Bus Diagnostic Tool Kit from the harness connector of the first Node location MOST device.
3. Test for less than 2 Ω in the MOST control circuit end to end between the MOST device that was just disconnected and the A11 Radio.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the A11 Radio.

- **If greater than 13 V**

1. Vehicle OFF, disconnect the harness connectors at the A11 Radio.
2. Disconnect the EL-51578 MOST Bus Diagnostic Tool Kit from the harness connector of the first Node location MOST device, Vehicle in Service Mode.
3. Test for less than 1 V between the MOST control circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the A11 Radio.

- **If between 9 - 13 V**

5. Verify that DTC U0028 status remains current.

- **If the status of DTC U0028 changes from current to history**

Replace the disconnected MOST device.

- **If the status of DTC U0028 remains current**

6. Vehicle OFF, disconnect the EL-51578 MOST Bus Diagnostic Tool Kit from the harness connector of the first Node location MOST device.
7. Reconnect the harness connector containing the MOST circuits at the first Node location MOST device.

NOTE: **If the A11 Radio is the last node position in the "Node Locations of MOST Bus Communication Break" range, disconnect the harness connector containing MOST circuits at the A11 Radio and proceed to step 13.**

8. Disconnect the harness connector containing the MOST circuits at the last Node location MOST device of the fault location identified by Node Locations of MOST Bus Communication Break parameter value.
9. Connect the appropriate connector from the EL-51578 MOST Bus Diagnostic Tool Kit to the harness connector of the last Node location MOST device to bypass this MOST device.
10. Vehicle in Service Mode.
11. Verify that DTC U0028 status remains current.

- **If the status of DTC U0028 changes from current to history**

Replace the disconnected MOST device.

- **If the status of DTC U0028 remains current**

12. Vehicle OFF, disconnect the EL-51578 MOST Bus Diagnostic Tool Kit from the harness connector of the last Node location MOST device.
13. Disconnect the harness connector containing the MOST circuits at the first Node location MOST device. The following tests will be performed on the MOST serial data circuits between the two MOST devices that are disconnected.
14. Vehicle in Service Mode.
15. Test for less than 1 V between each MOST serial data circuit and ground.

- **If any serial data circuits are 1 V or greater**

Repair the short to voltage in the circuit.

- **If each serial data circuits are less than 1 V**

16. Vehicle OFF, all access doors closed, and all vehicle systems OFF.
17. Test for infinite resistance between each MOST serial data circuit and ground.

- **If any serial data circuits are less than infinite resistance**

Repair the short to ground in the circuit.

- **If each serial data circuits are infinite resistance**

18. Test for infinite resistance between each pair of the MOST serial data circuits.

- **If any pair of serial data circuits are less than infinite resistance**

Repair the short between the circuits.

- **If each pair of serial data circuits are infinite resistance**

19. Test for less than 2 Ω in each MOST serial data circuit end to end.

- **If any serial data circuits are 2 Ω or greater**

Repair the open/high resistance in the circuit between the two MOST devices.

- **If each serial data circuits are less than 2 Ω**

20. Replace the A11 Radio.

21. Vehicle in Service Mode. Radio ON.

22. Verify that DTC U0028 does not set.

- **If the DTC U0028 sets**

Refer to Diagnostic Aids.

- **If the DTC U0028 does not set**

23. All OK.

Repair Instructions

Perform the Repair Verification after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

Repair Verification

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Install any components or connectors that have been removed or replaced during diagnosis.
3. Vehicle in Service Mode.
4. Clear the DTCs.
5. Verify the A11 Radio scan tool Surrogate MOST Master Node Upstream Position parameter value is None.

- **If the value is not None**

Disconnect the A11 Radio power or the battery cables for 1 min to reset this value to None.

- **If the value is None**

6. All OK.

DTC U0029: MOST BUS PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0029

MOST Bus Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The Media Oriented Systems Transport (MOST) bus master device shall set DTC U0029 when the MOST bus interruptions lasts long enough to interrupt MOST communication and functions, but not long enough to break the MOST bus ring.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle is ON.
- The Radio is ON.

Conditions for Setting the DTC

A current DTC sets when MOST bus communication has been interrupted more than 10 times during the monitoring cycle period.

Action Taken When the DTC Sets

Some or all of the infotainment system may be inoperative for brief periods of time.

Conditions for Clearing the DTC

A current DTC is cleared when MOST bus communication interruptions are no longer detected and the Number of MOST Communication Breaks counter remains at 0.

Diagnostic Aids

This is an intermittent connection detection DTC. All MOST device connectors should be checked for poor connections on both MOST bus circuits.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode. Radio ON.
2. Verify that DTC U0029 is not set with symptom byte 02.
 - **If DTC U0029 is set with symptom byte 02**

Refer to [DTC U2098](#) .
 - **If DTC U0029 is set with other symptom bytes except 02**
3. Verify that DTC U0028 is set.
 - **If the DTC is set**

Refer to [DTC U0028](#).
 - **If the DTC is not set**
4. Refer to [Testing for Intermittent Conditions and Poor Connections](#) to test for an intermittent condition.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0073 OR U2100: CONTROL MODULE COMMUNICATION BUS A OFF/CAN BUS COMMUNICATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U0073

DTC U2100

CAN Bus Communication

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

The serial data circuits are used to communicate information between the devices. The serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 s.

Action Taken When the DTCs Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- In the transmission control module, DTC U0073 will cause the transmission to go into default gears.
- In the engine control module and transmission control module, DTC U0073 will cause the malfunction indicator lamp (MIL) to illuminate.
- If equipped with eAssist, DTC U0073 in the hybrid powertrain control module is a type B DTC and will cause the malfunction indicator lamp to illuminate and result in the engine operating in conventional engine mode and will maintain 14 V module operation.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- The engine control module or transmission control module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- If equipped with eAssist, the hybrid powertrain control module turns off the MIL after the diagnostic runs and does not fail during subsequent ignition cycles. Normal operation will resume 5 s after subsequent ignition cycle.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Refer to [Data Link References](#) to determine which serial data communication system is used for a

specific device.

2. This DTC may not be retrieved with a current status. Diagnosis is accomplished using the symptom.
Refer to [Symptoms - Data Communications](#).

DTC U0074: CONTROL MODULE COMMUNICATION POWERTRAIN EXPANSION CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U0074

Control Module Communication Powertrain Expansion CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Powertrain High Speed GMLAN Serial Data (+)	U0074	U0074, U0100-U02FF*	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U0074, U0100-U02FF*	U0074	-
* Other DTCs may be set with this fault.				

Circuit/System Description

The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the engine control module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the powertrain high speed GMLAN bus during normal vehicle operation. The powertrain high speed GMLAN is a differential bus. The powertrain high speed GMLAN serial data bus (+) and powertrain high speed GMLAN serial data (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the powertrain high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the powertrain high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the powertrain high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The MIL and battery indicators will illuminate, along with several DIC messages.
- DTC U0074 is a type A DTC.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.
- DTC U0074 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- The engine will not start when there is a total malfunction of the powertrain high speed GMLAN serial data bus.
- Use [Data Link References](#) to determine which devices connect to the powertrain high speed GMLAN serial data bus.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

NOTE: Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- Powertrain high speed GMLAN devices and terminating resistors the vehicle is equipped with
- Device locations on the powertrain high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and powertrain high speed GMLAN serial data circuit terminals

1. Refer to [Data Link References](#) to determine which devices are on the powertrain expansion bus.
2. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors containing the powertrain high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Vehicle in Service Mode.
4. Test for less than 4.5 V between each powertrain high speed GMLAN serial data circuit at the device that was just disconnected and ground.

- **If 4.5 V or greater**

Refer to Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

5. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
6. Test for greater than 100 Ω between each powertrain high speed GMLAN serial data circuit at the device that was just disconnected and ground.

- **If 100 Ω or less**

Refer to Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 Ω**

7. Test for 110 - 130 Ω between each pair of the powertrain high speed GMLAN serial data circuits at the device that was just disconnected.

- **If less than 110 Ω**

Refer to Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 130 Ω**

Refer to Testing the Serial Data Circuits for an Open/High Resistance.

- **If between 110 - 130 Ω**

8. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.

- **If each serial data circuit is 4.5 V or less**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.

- If 10 Ω or greater, repair the open/high resistance in the circuit.
- If less than 10 Ω , replace the device that was disconnected.

- **If any serial data circuit is greater than 4.5 V**

3. Repeat step 1 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors containing the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.

- **If all serial data circuits are 100 Ω or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 Ω**

4. Repeat step 2 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
 - A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors containing the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

5. Repeat step 2 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.
 - Serial data circuits shorted together between a device and a terminating resistor.
 - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors containing the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

5. Repeat step 2 until one of the following conditions are isolated:

- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

4. Vehicle in Service Mode.

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

7. Replace the device that was disconnected.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0075: CONTROL MODULE COMMUNICATION OBJECT DETECTION CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U0075 00

Control Module Communication Object Detection CAN Bus Off

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Object High Speed GMLAN Serial Data (+)	U0075	U0075, U0100 - U02FF*	U0075	-
Object High Speed GMLAN Serial Data (-)	U0075	U0075, U0100 - U02FF*	U0075	-
Ground (Data Link Connector terminal 5)	-	1	-	-
* An open between the Data Link Connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. An open in only one object high speed GMLAN serial data circuit may allow degraded communication between the devices. 1. No communication with any object high speed GMLAN device.				

Circuit/System Description

The devices connected to the object high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices when the ignition switch is in any position other than OFF. The object high speed GMLAN serial data bus uses terminating resistors that are in parallel with the object high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Use the [Data Link References](#) to identify the object detection high speed GMLAN devices.
- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.

- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with the object high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC).
- Some devices may not have internal protection for specific voltage outputs and may open a battery positive voltage or ignition voltage source fuse. If a voltage input fuse is open and no short is found in that circuit, ensure that no device output voltage circuit is shorted to ground before replacing the device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify two or more devices are not communicating on the object high speed GMLAN serial data circuit. Refer to [Data Link References](#) to determine how many devices should be communicating on this bus.

- **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.

- **If two or more devices are not communicating**

3. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

1. Ignition/Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

5. Ignition ON/Vehicle In Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground:
 - Terminal 3
 - Terminal 11
 - **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuits listed below and ground:
 - Terminal 3
 - Terminal 11
 - **If 100 Ω or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 Ω**

9. Test for 50 - 70 Ω between the serial data circuit terminals 3 and 11.
 - **If less than 35 Ω**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35 - 50 Ω**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests. Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- Object high speed GMLAN devices and terminating resistors the vehicle is equipped with
- Device locations on the object high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and object high speed GMLAN serial data circuit terminals

NOTE: Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF, disconnect the harness connectors with the object high speed GMLAN serial data circuits at an easily accessible device, ignition ON/Vehicle In Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.

- **If each serial data circuit is 4.5 V or less**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Ignition/Vehicle OFF, disconnect the harness connectors with the object high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
 2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at an easily accessible device.
2. Test for greater than 100 Ω between each object high speed GMLAN serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 100 Ω or greater**

Replace the device that was disconnected.
 - **If any serial data circuit is less than 100 Ω**
3. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
4. Test for greater than 100 Ω between each object high speed GMLAN serial data circuit at the device connector that was just disconnected and ground.
 - **If both serial data circuits are 100 Ω or greater**

Replace the device that was disconnected.
 - **If any serial data circuit is less than 100 Ω**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.

- A short to ground on the serial data circuit between a device and a terminating resistor.
- A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
2. Test for greater than 110 Ω between each pair of object high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

3. Connect the harness connectors at the device that was disconnected.
4. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
5. Test for greater than 110 Ω between each pair of object high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

6. Repeat step 3 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.
 - Serial data circuits shorted together between a device and a terminating resistor.
 - Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
 - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
2. Test for less than 130 Ω between each pair of object high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

3. Connect the harness connectors at the device that was disconnected.
4. Disconnect the harness connectors with the object high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
5. Test for less than 130 Ω between each pair of object high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

6. Repeat step 3 until one of the following conditions are isolated:
 - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
 - An open/high resistance on the serial data circuit between a device and a terminating resistor.
 - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at an easily accessible device that is not communicating.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Ignition/Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON/Vehicle In Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
- **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
- **If the test lamp does not illuminate**
 1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the control module that controls the ignition circuit.
 - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each object high speed GMLAN serial data circuit end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below.
- X84 Data Link Connector terminal 3
 - X84 Data Link Connector terminal 11
 - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.
 - **If less than 2 Ω**
9. Replace the device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0077: CONTROL MODULE COMMUNICATION CHASSIS EXPANSION CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U0077

Control Module Communication Chassis Expansion CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	U0077	U0077, U0100 - U02FF*	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U0077, U0100 - U02FF*	U0077	-
Ground (DLC, terminal 5)	-	1	-	-
* An open in only one chassis high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the Data Link Connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any chassis high speed GMLAN device.				

Circuit/System Description

The GMLAN high speed chassis expansion bus functions the same as the GMLAN high speed bus, and the two buses operate in parallel. The expansion chassis bus was added to reduce message congestion on the primary high speed bus. Since the GMLAN high speed chassis bus and primary GMLAN high speed bus operate in the same manner, the diagnostics for each are the same.

The chassis high speed GMLAN serial data circuits also connect directly to the Data Link Connector (DLC).

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the chassis high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.
- DTC U0077 is a type A DTC.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.
- DTC U0077 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify two or more devices are not communicating on the chassis high speed GMLAN serial data circuit.
Refer to [Data Link References](#) to determine how many devices should be communicating on the bus.
 - **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.
 - **If two or more devices are not communicating**
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground.

- Terminal 12
- Terminal 13
- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

8. Test for greater than 100 Ω between the serial data circuits listed below and ground.

- Terminal 12
- Terminal 13
- **If 100 Ω or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 Ω**

9. Test for 50 - 70 Ω between the serial data circuit terminals 12 and 13.

- **If less than 35 Ω**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35 - 50 Ω**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- **Chassis high speed GMLAN devices the vehicle is equipped with**
- **Chassis high speed GMLAN serial data circuit terminating resistors**
- **Device locations on the chassis high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and chassis high speed GMLAN serial data circuit terminals**

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
 2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Vehicle OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
 2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily

accessible device.

3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.

- **If each serial data circuit is 100 Ω or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 Ω**

4. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.

- **If both serial data circuits are 100 Ω or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 Ω**

6. Repeat step 4 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
 - A short to ground on the serial data circuit between a device and a terminating resistor.
 - A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

7. Repeat step 4 until one of the following conditions are isolated:

- Serial data circuits shorted together between two devices or splice packs, if equipped.
- Serial data circuits shorted together between a device and a terminating resistor.
- Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
- A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuit is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

7. Repeat step 4 until one of the following conditions are isolated:

- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

4. Vehicle in Service Mode

5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

6. Vehicle in Service Mode.

7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

8. Vehicle in Service Mode

9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

11. Test for less than 130 Ω between each pair of chassis high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

- **If each pair of serial data circuits is 130 Ω or less**

12. Replace the device that was disconnected.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0078: CONTROL MODULE COMMUNICATION LOW SPEED CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U0078

Control Module Communication Low Speed CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

The low speed GMLAN serial data bus is used to communicate information between the devices. The serial data is transmitted over a single wire to the appropriate devices. The low speed GMLAN serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 seconds.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0078 is not set.

- **If DTC U0078 is set**

Refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#) .

- **If DTC U0078 is not set**

3. All OK

DTC U007A: CONTROL MODULE COMMUNICATION HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U007A

Control Module Communication High Voltage Energy Management CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy	U007A*	U007A*	U007A*	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Management High Speed GMLAN Serial Data (+)				
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A*	U007A*	-
* Other DTCs may be set with this fault.				

Circuit/System Description

Devices connected to the high voltage energy management high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices when the vehicle is on. The high voltage energy management high speed GMLAN serial data bus uses a terminating resistor that is in parallel with the high voltage energy management high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the high voltage energy management high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.

- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- The engine may not start when there is a total malfunction of the high voltage energy management high speed GMLAN serial data bus.
- Use [Data Link References](#) to determine which devices connect to the high voltage energy management high speed GMLAN serial data bus.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- High voltage energy management high speed GMLAN devices and terminating resistors the vehicle is equipped with
- Device locations on the high voltage energy management high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and high voltage energy management high speed GMLAN serial data circuit terminals

1. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to [High Voltage Disabling](#).
2. Reconnect the 12 V battery after performing the high voltage disabling procedure.

3. Refer to [Data Link References](#) to determine which devices are on the high voltage energy management expansion bus.
4. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors containing the high voltage energy management high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between each high voltage energy management high speed GMLAN serial data circuit at the device that was just disconnected and ground.

- **If any serial data circuit is 4.5 V or greater**

Refer to Testing the Serial Data Circuits for a Short to Voltage.

- **If all serial data circuits are less than 4.5 V**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
8. Test for greater than 100 Ω between each high voltage energy management high speed GMLAN serial data circuit at the device that was just disconnected and ground.

- **If any serial data circuit is 100 Ω or less**

Refer to Testing the Serial Data Circuits for a Short to Ground.

- **If all serial data circuits are greater than 100 Ω**

9. Test for 110 - 130 Ω between each pair of the high voltage energy management high speed GMLAN serial data circuits at the device that was just disconnected.

- **If less than 110 Ω**

Refer to Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 130 Ω**

Refer to Testing the Serial Data Circuits for an Open/High Resistance.

- **If between 110 - 130 Ω**

10. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors containing the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.

- If 10 Ω or greater, repair the open/high resistance in the circuit.
- If less than 10 Ω , replace the device that was disconnected.

- **If any serial data circuit is greater than 4.5 V**

3. Repeat step 1 until one of the following conditions are isolated:

- A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
- A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors containing the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.

- **If all serial data circuits are 100 Ω or greater**

Replace the device that was disconnected.

- **If any serial data circuit is less than 100 Ω**

4. Repeat step 2 until one of the following conditions are isolated:

- A short to ground on the serial data circuit between two devices or splice packs, if equipped.
- A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors containing the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

5. Repeat step 2 until one of the following conditions are isolated:

- Serial data circuits shorted together between two devices or splice packs, if equipped.
- Serial data circuits shorted together between a device and a terminating resistor.
- A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors containing the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

5. Repeat step 2 until one of the following conditions are isolated:
 - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
 - An open/high resistance on the serial data circuit between a device and a terminating resistor.
 - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

4. Vehicle in Service Mode.

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

7. Replace the device that was disconnected.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0100-U02FF: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to [Control Module U Code List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0100-U02FF	U0100-U02FF	-	-
Ignition	U0100 - U02FF, U1814, U2099, P06E4, P1EB9	U0100-U02FF	-	-
Low Speed GMLAN Serial Data	U0078, 1	U0100-U02FF	U0078, 1	-
High Speed GMLAN Serial Data (+)	U0073, 2	U0100-U02FF	U0073, 2	-
High Speed GMLAN Serial Data (-)	U0073, 2	U0100-U02FF	U0073, 2	-
Chassis High Speed GMLAN Serial Data (+)	U0077	U0077, U0100-U02FF	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U0077, U0100-U02FF	U0077	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U0074, U0100-U02FF	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U0074, U0100-U02FF	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U007A, U0100-U02FF	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U007A, U0100-U02FF	U007A	-
Ground	-	U0100-U02FF	-	-
1. Scan Tool Does Not Communicate With Most Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With Most High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC) on the driver side, the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). The Auxiliary Data Connector on the passenger side is used for expansion buses. When the vehicle is

on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non-communicating device. The DTC is unique to the device which is not communicating and one or more devices may set the same exact code. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- Specific subsystems will not function.
- DTC U0100 in the Transmission Control Module will cause the transmission to go into default gears.
- Both DTC U0100 in the Transmission Control Module and DTC U0101 in the Engine Control Module will cause the malfunction indicator lamp (MIL) to illuminate.

Conditions for Clearing the DTC

- The Engine Control Module or Transmission Control Module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely

associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.

- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with either the low or high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- Use [Data Link References](#) to determine what serial data communications the device uses.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- This diagnostic can be used for any device that is not communicating, regardless of the type of serial data circuit it is connected to, providing the vehicle is equipped with the device.

[Reference Information](#)

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

Circuit/System Verification

1. Determine the device that is not communicating. Refer to [Control Module U Code List](#).
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If none of the DTCs are set

3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, serial data communication enable, accessory wake up serial data 2, high voltage energy management communication enable, and serial data circuit terminals.

1. Using the High Voltage Device Chart below, verify that the non-communicating device is not a high voltage device. If the device is a high voltage device, perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to [High Voltage Disabling](#).
2. If high voltage disabling is required, reconnect the 12 V battery after performing the high voltage disabling procedure.
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect all the harness connectors at the device that is not communicating.
4. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

8. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

9. Test for less than 4.5 V between each GMLAN serial data circuit terminal and ground.

- **If 4.5 V or greater between a low speed GMLAN serial data circuit and ground**

Refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#) to test for a short to voltage.

- **If 4.5 V or greater between a high speed GMLAN serial data circuit and ground**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for a short to voltage.

- **If less than 4.5 V**

10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

11. Test for greater than 100 Ω between each GMLAN serial data circuit terminal and ground.

- **If 100 Ω or less between a low speed GMLAN serial data circuit and ground**

Refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#) to test for a short to ground.

- **If 100 Ω or less between a high speed GMLAN serial data circuit and ground**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for a short to ground.

- **If greater than 100 Ω**

12. Test for less than 2 Ω in each of the serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below:

- X84 DLC low speed GMLAN serial data circuit terminal 1
- X84 DLC high speed GMLAN serial data circuit terminal 6 or 14
- X84 DLC object high speed GMLAN serial data circuit terminal 3 or 11

- X84 DLC chassis high speed GMLAN serial data circuit terminal 12 or 13
- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit between the non communicating device and the device setting the DTC or a serial data splice pack.

- **If less than 2 Ω**

NOTE: The following test step is only applicable to a high speed GMLAN device with 2 pairs of serial data circuits or a high speed GMLAN device with an internal terminating resistor.

13. Test for 110 - 130 Ω between each pair of high speed GMLAN serial data circuits.

- **If less than 110 Ω**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for a short to ground or a short between the serial data circuits.

- **If greater than 130 Ω**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for an open/high resistance in the serial data circuit.

- **If between 110 - 130 Ω**

14. Replace the device that is not communicating.

High Voltage Device Chart

Device	Voltage System	Data Link Type
K16 Battery Energy Control Module (BECM)	300 V 12 V	• High Voltage Energy Management High Speed GMLAN • High Speed GMLAN • BECM Dedicated Bus

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U0300-U0336: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

Refer to [Control Module U Code List](#).

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set the appropriate communication DTCs. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0300-U0336 is not set.
 - **If DTC U0300-U0336 is set**
 1. Program the device specified by the DTC descriptor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device specified by the DTC descriptor.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC U0300-U0336 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U0400-U05FF: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

Refer to **Control Module U Code List**.

Circuit/System Description

Some devices are constantly receiving information from other devices through serial data communication network. The invalid data code will be set when a receiving device detects a discrepancy in information it receives from another device causing its integrity to be questioned. The symptom byte listed in the DTC Descriptor is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Engine running for 10 seconds.
2. Vehicle in Service Mode.
3. Verify DTC U0400-U05FF is not set.
 - **If DTC U0400-U05FF is set along with other DTCs set**

Diagnose all other DTCs first. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC U0400-U05FF is set without other DTCs set**

1. Program the device specified by the DTC descriptor.
2. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate device.
 - If the DTC does not set

3. All OK.

- **If DTC U0400-U05FF is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Control Module References for device replacement, programming and setup

DTC U1340-U135F: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to **Control Module U Code List**.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1340-U135F	U1340-U135F	-	-
Ignition	U1340-U135F	U1340-U135F	-	-
LIN Serial Data	U1340-U135F	U1340-U135F	U1340-U135F	-
Ground	-	U1340-U135F	-	-

Circuit/System Description

The Local Interconnect Network (LIN) Bus consists of a single wire with a transmission rate of 10.417 Kbit/s. The serial data is transmitted over a LIN circuit between a master control module and other LIN devices within a particular subsystem. If serial data communication is lost between any of the LIN devices on the LIN bus network, the master control module will set a no communication code against the non-communicating LIN device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- An open in the LIN bus serial data circuit between the splice pack and a LIN device will only affect that specific LIN device. This type of failure will set a loss of communication DTC for each LIN device affected and the other LIN devices will still communicate.
- This diagnostic procedure can be used to diagnose the common LIN DTCs: U1340, U1341, U1342, U1343, U1344, U1345, U1346, U1347, U1348, U1349, U134A, U134B, U134C, U134D, U134E, U134F, U1350, U1351, U1352, U1353, U1354, U1355, U1356, U1357, U1358, U1359, U135A, U135B, U135C, U135D, U135E, and U135F.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Determine the LIN device that is not communicating. Refer to [Control Module U Code List](#).
2. Vehicle in Service Mode.
3. Verify that DTC B1325, B1330, B1370, B1380, B1424, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

4. Verify that DTC U0100 - U02FF is not set.

- **If any of the DTCs are set**

Refer to [DTC U0100-U02FF](#).

- **If none of the DTCs are set**

5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics to determine the master control module and all LIN devices on the same LIN serial data circuit. Use the connector end views to identify the B+, ignition, ground, and LIN serial data circuit terminals for each of those devices.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connector at a LIN device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

NOTE: For accurate voltage reading, disconnect the battery charger prior to performing the following test step.

7. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

- **If less than 2 V**

1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.

2. Test for infinite resistance between the serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Reconnect the control module that set the DTC, Vehicle in Service Mode.

5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

- If less than 2 V, replace the control module setting the DTC.
- If greater than 2 V, replace the LIN device that causes a current DTC to set when connected.

- **If greater than 12 V**

1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.

2. Vehicle in Service Mode.

3. Test for less than 1 V between the serial data circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

4. Vehicle OFF, reconnect the control module that set the DTC, Vehicle in Service Mode.

5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

- If greater than 12 V, replace the control module setting the DTC.
- If less than 12 V, replace the LIN device that causes a current DTC to set when connected.

- **If between 2 - 12 V**

8. Replace the disconnected LIN device.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1500-U15FF: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to [Control Module U Code List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1500-U15BF	U1500-U15BF	-	-
Ignition	U1500-U15BF	U1500-U15BF	-	-
LIN Serial Data	U1500-U15BF	U1500-U15BF	U1500-U15BF	-
Ground	-	U1500-U15BF	-	-

Circuit/System Description

The serial data is transmitted over a Local Interconnect Network (LIN) single wire network circuit bus between a master control module and other LIN devices within a particular subsystem. If serial data communication is lost between any of the LIN devices on the LIN bus network, a no communication code against the non-communicating LIN device will be set. A master control module is the one that reports the non communication code. A loss of serial data communications DTC does not represent a failure of the master control module that set it.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication will be available between the master control module and the scan tool if there is a loss of communications with any of the other LIN devices on the LIN bus network.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- An open in the LIN bus serial data circuit between the splice pack and a LIN device will only affect that specific LIN device. This type of failure will set a loss of communication DTC for each LIN device affected and the other LIN devices will still communicate.
- This diagnostic procedure can be used to diagnose the common LIN DTCs: U1500, U1501, U1502, U1503, U1504, U1505, U1506, U1507, U1508, U1509, U150E, U150F, U1510, U1511, U1512, U1513, U1514, U1515, U1516, U1517, U1518, U1519, U151A, U151B, U151C, U1520, U1521, U1522, U1523, U1524, U1526, U1528, U152C, U152D, U1530, U1531, U1532, U1534, U1538, U153A, U1540, U1544, U1548, U1549, U154A, U154B, U1550, U1556, U1558, U15E1, U15E3, U15F0, and other DTCs within the U1500 - U15FF range.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: Use the schematics to determine the master control module and all LIN devices on the same LIN serial data circuit. Use the connector end view to identify the B+, ignition, ground, and LIN serial data circuit terminals for each of those devices.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connector at a LIN device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between each B+ circuit terminal and ground, if equipped.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

5. Verify a test lamp illuminates between each ignition circuit terminal and ground, if equipped.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

6. Verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground, if equipped.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

NOTE: For accurate voltage reading, disconnect the battery charger prior to performing the following test step.

7. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

- **If less than 2 V**

1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.

2. Test for infinite resistance between the serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Reconnect the control module that set the DTC, Vehicle in Service Mode.

5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
 - If less than 2 V, replace the control module setting the DTC.
 - If greater than 2 V, replace the LIN device that causes a current DTC to set when connected.
- **If greater than 12 V**
 1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
 2. Vehicle in Service Mode.
 3. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 4. Vehicle OFF, reconnect the control module that set the DTC, Vehicle in Service Mode.
 5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
 - If greater than 12 V, replace the control module setting the DTC.
 - If less than 12 V, replace the LIN device that causes a current DTC to set when connected.
- **If between 2 - 12 V**
8. Replace the disconnected LIN device.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U179A: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U179A

Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U179A	U179A	-	-
Ignition	U179A	U179A	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wakeup Serial Data	U1814	U179A	-	-
Low Speed GMLAN Serial Data	1	U179A	1	-
High Speed GMLAN Serial Data (+)	2	U179A, U0073	2	-
High Speed GMLAN Serial Data (-)	2	U179A, U0073	2	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U179A, U0074	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U179A, U0074	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U179A, U007A	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U179A, U007A	U007A	-
Ground	-	U179A	-	-
1. Scan Tool Does Not Communicate With Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U179A is a type A DTC.

Conditions for Clearing the DTC

DTC U179A is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.
 - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- If less than 2 Ω

11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U179D: LOST COMMUNICATION WITH BRAKE SYSTEM CONTROL MODULE 2 ON CHASSIS EXPANSION BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U179D

Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U179D	U179D	-	-
Ignition	U179D	U179D	-	-
Accessory Wake Up Serial Data 2	P06E4, U179D	U179D	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U179D, U0077*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U179D, U0077*	U0077*	-
Ground	-	U179D	-	-

* Other DTCs may set with this fault.

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the

transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- A driver information center message and/or a warning indicator may be displayed.
- The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.

- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**
 Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K177 Brake Booster Control Module. It may

take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Ignition/Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON/Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K177 Brake Booster Control Module.

- **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition/Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K177 Brake Booster Control Module.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each Chassis high speed GMLAN serial data circuits end to end between the K177 Brake Booster Control Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1803: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1803

Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1803	U1803	-	-
Ignition	U1803	U1803	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wakeup Serial Data	U1814	U1803	-	-
Low Speed GMLAN Serial Data	1	U1803	1	-
High Speed GMLAN Serial Data (+)	2	U1803, U0073	2	-
High Speed GMLAN Serial Data (-)	2	U1803, U0073	2	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U1803, U0074	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U1803, U0074	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U1803, U007A	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U1803, U007A	U007A	-
Ground	-	U1803	-	-
1. Scan Tool Does Not Communicate With Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

• **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

• **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.

• **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.

2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.

10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.

- If 2 Ω or greater

Repair the open/high resistance in the serial data circuit.

- If less than 2 Ω

11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1806: BATTERY ENERGY CONTROL MODULE HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1806

Battery Energy Control Module High Voltage Energy Management CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

The high voltage energy management high speed GMLAN serial data circuits are serial data buses used to communicate information between the Hybrid Powertrain Control Module 2, the Battery Energy Control Module, and the Battery Charger. If this serial data system is inoperative the devices will not communicate with each other on this bus, but they still communicate with the scan tool through high speed GMLAN bus.

The scan tool does not communicate with devices through the high voltage energy management high speed GMLAN bus. The high voltage energy high speed GMLAN serial data circuits connect directly to the auxiliary data connector and do not connect with the scan tool.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits for more than 1.4 seconds without success.

Action Taken When the DTC Sets

The DTC U1806 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1806 is a type B DTC.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U1806 is not set.
 - **If DTC U1806 is set**

Refer to [DTC U007A](#).
 - **If DTC U1806 is not set**
3. All OK

DTC U180B: BATTERY ENERGY CONTROL MODULE HIGH SPEED CAN BUS OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U180B

Battery Energy Control Module High Speed CAN Bus Off

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The high speed GMLAN serial data circuits are serial data buses used to communicate information between the devices. The high speed GMLAN serial data circuits connect directly to the data link connector (DLC) for programming purposes.

This diagnostic is used to check the high speed GMLAN communication bus status.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits for more than 1.4 seconds without success.

Action Taken When the DTC Sets

The DTC U180B is a type B DTC.

Conditions for Clearing the DTC

The DTC U180B is a type B DTC.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U180B is not set.

- **If DTC U180B is set**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) .

- **If DTC U180B is not set**

3. All OK

DTC U1814: POWERTRAIN WAKE-UP COMMUNICATION CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1814

Powertrain Wake-Up Communication Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U1814 02*	U0100-U02FF	-	-
* Vehicle will not start.				

Circuit/System Description

The body control module activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The body control module senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.
- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: Use the schematics to determine which devices are on the K9 body control module's ignition circuit terminal 22 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Vehicle OFF, disconnect the harness connector at an easily accessible device that shares the K9 body

control module's ignition circuit terminal 22 X4. Vehicle in Service Mode.

2. Verify that the DTC U1814 remains current.

- **If the DTC becomes history**

Replace the device that was just disconnected.

- **If the DTC remains current**

3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 body control module.

4. Vehicle OFF, disconnect the X4 harness connector at the K9 body control module.

5. Test for infinite resistance between the ignition circuit terminal 22 X4 at the K9 body control module and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Replace the K9 body control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
 - [Control Module References](#) for device replacement, programming and setup
-

Article GUID: A00884665

ACCESSORIES & EQUIPMENT

Data Communications - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC U1817: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE ON POWERTRAIN EXPANSION CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1817

Lost Communication with Hybrid Powertrain Control Module on Powertrain Expansion CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1817	U1817	-	-
Ignition	U1817	U1817	-	-
Accessory Wake Up Serial Data 2	P06E4, U1817*	U1817*	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U0074, U1817*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U0074, U1817*	U0074*	-
Ground	-	U1817*	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the powertrain high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

The Motor Control Modules and the Hybrid Powertrain Control Module 1 are all internal to the Power Inverter

Module. All circuits to the Hybrid Powertrain Control Module 1 are also internal to the Power Inverter Module and replaced as a single component.

Communication diagnostics for the serial data, including device power and ground as well as the wakeup circuits for Motor Control Modules and the Hybrid Powertrain Control Module 1 are all diagnosed from external sources only to the Power Inverter Module connector because any circuit fault condition within the Power Inverter Module will cause a complete replacement.

Conditions for Running the DTC

- The system voltage is more than 10 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U1817 is a type A DTC.

Conditions for Clearing the DTC

DTC U1817 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.

- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
 - **If DTC U0293 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0293 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

4. Verify that DTCs U1818, U1821, and U182D are not set.

- **If all of the DTCs are set together**

Refer to [**DTC U0074**](#) .

- **If all of the DTCs are not set together**

5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 and X2 harness connectors at the T6 Power Inverter Module. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between the T6 Power Inverter Module case and ground.

- **If 10 Ω or greater**

Check the ground connection and ground strap for the open/high resistance.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the T6 Power Inverter Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the T6 Power Inverter Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

10. Test for less than 2 Ω in each of the powertrain high speed GMLAN serial data circuits end to end between the T6 Power Inverter Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1818: LOST COMMUNICATION WITH ENGINE CONTROL MODULE ON POWERTRAIN EXPANSION COMMUNICATION BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1818

Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1818	U1818	-	-
Ignition	U1818	U1818	-	-
Accessory Wake Up Serial Data 2	P06E4*	U1818	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U1818, U0074*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U1818, U0074*	U0074*	-
Ground	-	U1818	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

- The system voltage is at least 10 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U1818 is a type A DTC.

Conditions for Clearing the DTC

DTC U1818 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0100 is not set.
 - **If DTC U0100 is set**
Refer to [DTC U0100-U02FF](#).
 - **If DTC U0100 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If none of the DTCs are set**
4. Verify that DTCs U1817, U1821, and U182D are not set.
 - **If all of the DTCs are set together**
Refer to [DTC U0074](#).
 - **If all of the DTCs are not set together**
5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K20 Engine Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

- Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
- Test for less than 2 Ω in each of the powertrain high speed GMLAN serial data circuits end to end between the K20 Engine Control Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

- Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U182D: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2 ON POWERTRAIN EXPANSION COMMUNICATION BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U182D

Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U182D	U182D	-	-
Ignition	U182D	U182D	-	-
Accessory Wake Up Serial Data	U1814	U182D	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U182D, U0074	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U182D, U0074	U0074*	-
Ground	-	U182D	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is at least 11 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received for 10 seconds.

Action Taken When the DTC Sets

The DTC U182D is a type B DTC.

Conditions for Clearing the DTC

The DTC U182D is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.

- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
3. Verify that DTCs U1817, U1818, and U1821 are not set.
 - **If all of the DTCs are set together**

Refer to [DTC U0074](#) .
 - **If all of the DTCs are not set together**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.

2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

10. Test for less than 2 Ω in each powertrain high speed GMLAN serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U182E OR U182F: DRIVE MOTOR CONTROL MODULE LOST COMMUNICATION WITH HYBRID PCM 2 ON POWERTRAIN EXPANSION COMMUNICATION BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U182E

Drive Motor Control Module 1 Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus

DTC U182F

Drive Motor Control Module 2 Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U182E, U182F	U182E, U182F	-	-
Ignition	U182E, U182F	U182E, U182F	-	-
Accessory Wake Up Serial Data	U1814, U2099	U182E, U182F	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U182E, U182F, U0074	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U182E, U182F, U0074	U0074*	-
Ground	-	U182E, U182F	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used

to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is at least 10 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The DTCs U182E and U182F are type B DTCs.

Conditions for Clearing the DTC

The DTCs U182E and U182F are type B DTCs.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.

- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground,

B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 harness connector at the T6 Power Inverter Module. It may take up to 2 minutes for all vehicle systems to power down.
10. Test for less than 2 Ω in each powertrain high speed GMLAN serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the T6 Power Inverter Module.
 - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1833: LOST COMMUNICATION WITH ELECTRONIC BRAKE CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1833

Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0121, U0129, U1833	U0121, U0129, U1833	-	-
Ignition	U0121, U0129, U1833	U0121, U0129, U1833	-	-
Accessory Wake Up Serial Data 2	P06E4, U0121, U0129, U1833	U0121, U0129, U1833	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0121, U0129, U1833, U0077*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0121, U0129, U1833, U0077*	U0077*	-
Ground	-	U0121, U0129, U1833	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is at least 10 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- A driver information center message and/or a warning indicator may be displayed.
- The DTC U1833 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1833 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0121 or U0129 is not set.
 - **If any of the DTCs are set**
Refer to [DTC U0100-U02FF](#).
 - **If none of the DTCs are set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
- **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
1. Vehicle OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
- **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
 - **If the test lamp does not illuminate**
1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.

10. Test for less than 2 Ω in each Chassis high speed GMLAN serial data circuits end to end between the K17 Electronic Brake Control Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U183E: LOST COMMUNICATION WITH TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U183E

Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U183E	U183E	-	-
Ignition	U183E	U183E	-	-
Serial Data Communication Enable	U1814, U2099	U183E	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U183E	U0078*	-
Ground	-	U183E	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be

used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.

- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0198 is not set.
 - **If DTC U0198 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0198 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If none of the DTCs are set

4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, serial data communication enable, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
 - **If the test lamp illuminates**
- 7. Vehicle in Service Mode.
- 8. If equipped, verify a test lamp illuminates between the serial data communication enable circuit terminal and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data communication enable circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the serial data communication enable circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
 - 9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
 - 10. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K73 Telematics Communication Interface Control Module and the device setting the DTC.
 - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.
 - **If less than 2 Ω**
 - 11. Replace the K73 Telematics Communication Interface Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1845 OR U1846: DRIVE MOTOR CONTROL MODULE LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U1845

Drive Motor Control Module 1 Lost Communication with Hybrid Powertrain Control Module

DTC U1846

Drive Motor Control Module 2 Lost Communication with Hybrid Powertrain Control Module

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

The Motor Control Modules and the Hybrid Powertrain Control Module 1 are all internal to the Power Inverter Module. The Motor Control Modules communicate only with the Hybrid Powertrain Control Module 1 with the Hybrid Powertrain Control Module 1 sending out diagnostic trouble code information to other devices regarding the Motor Control Modules. All circuits to the Hybrid Powertrain Control Module 1 and Motor Control Modules are also internal to the Power Inverter Module and replaced as a single component.

Communication diagnostics for the serial data, including device power and ground as well as the wakeup circuits for Motor Control Modules and the Hybrid Powertrain Control Module 1 are all diagnosed from external sources only to the Power Inverter Module connector because any circuit fault condition within the Power Inverter Module will cause a complete replacement.

Conditions for Running the DTC

- The system voltage is more than 10 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle

operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.
- If DTC U1845 or U1846 is only set current in the Hybrid Powertrain Control Module 1, the Power Inverter Module must be replaced due to all circuits between the Hybrid Powertrain Control Module 1 and Motor Control Modules being internal to the Power Inverter Module.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
 - **If DTC U0293 is set**

Refer to **DTC U0100-U02FF** .
 - **If DTC U0293 is not set**
3. Verify that DTC U1845 or U1846 is not set current only in the K114A Hybrid Powertrain Control Module 1.
 - **If any of the DTCs are set**

Replace the T6 Power Inverter Module.
 - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184A: LOST COMMUNICATION WITH BODY CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184A

Lost Communication with Body Control Module on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184A	U184A	-	-
Ignition	U184A	U184A	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Speed GMLAN Serial Data	U0078*	U0078, U184A	U0078*	-
Ground	-	U184A	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage

drops below a certain threshold.

- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify that DTC U0140 is not set.

- **If DTC U0140 is set**

Refer to [DTC U0100-U02FF](#).

- **If DTC U0140 is not set**

3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K9 Body Control Module. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K9 Body Control Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U184B: LOST COMMUNICATION WITH REMOTE HEATER AND AIR CONDITIONING CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U184B

Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0164, U184B	U0164, U184B	-	-
Ignition	U0164, U184B	U0164, U184B	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U0164, U184B	U0078*	-
Ground	-	U0164, U184B	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication

U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify that DTC U0164 is not set.
 - **If DTC U0164 is set**
Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0164 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

[Circuit/System Testing](#)

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K33 HVAC Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K33 HVAC Control Module.

• **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K33 HVAC Control Module.

• **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K33 HVAC Control Module and the device setting the DTC.

• **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

• **If less than 2 Ω**

9. Replace the K33 HVAC Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U184C: LOST COMMUNICATION WITH INSTRUMENT CLUSTER ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U184C

Lost Communication with Instrument Cluster on Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184C	U184C	-	-
Ignition	U184C	U184C	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184C	U0078*	-
Ground	-	U184C	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0155 is not set.
 - **If DTC U0155 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0155 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the P16 Instrument Cluster. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the P16 Instrument Cluster.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the P16 Instrument Cluster.

- **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the P16 Instrument Cluster and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U184D: LOST COMMUNICATION WITH RADIO ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U184D

Lost Communication with Radio on Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184D	U184D	-	-
Ignition	U184D	U184D	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184D	U0078*	-
Ground	-	U184D	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify that DTC U0184 is not set.
 - **If DTC U0184 is set**
Refer to [DTC U0100-U02FF](#).
 - **If DTC U0184 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

[Circuit/System Testing](#)

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the A11 Radio. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the A11 Radio.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the A11 Radio.

- **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.

8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the A11 Radio and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the A11 Radio.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U184E: LOST COMMUNICATION WITH INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U184E

Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184E	U184E	-	-
Ignition	U184E	U184E	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184E	U0078*	-
Ground	-	U184E	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the

stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition

fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0151 is not set.
 - **If DTC U0151 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0151 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K36 Inflatable Restraint Sensing and Diagnostic Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K36 Inflatable Restraint Sensing and Diagnostic Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U185A: LOST COMMUNICATION WITH BATTERY ENERGY CONTROL MODULE ON HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U185A

Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U185A*	U185A	-	-
Ignition	U185A*	U185A	-	-
High Voltage Fault Signal	U185A	U185A	-	-
Accessory Wake Up Serial Data 2	P06E4, U185A*	U185A*	-	-
High Voltage Energy Management Communication Enable	P1EB9, U185A*	U185A*	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A*	U007A, U185A*	U007A*	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A, U185A*	U007A*	-
Ground	-	U185A*	-	-
* Multiple DTCs may be set and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is more than 10 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received for more than 500 ms.

Action Taken When the DTC Sets

DTC U185A is a type A DTC.

Conditions for Clearing the DTC

DTC U185A is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage

drops below a certain threshold.

- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50211** Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0111 is not set.
 - **If DTC U0111 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0111 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system

is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, high voltage energy management communication enable, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K16 Battery Energy Control Module.
 - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K16 Battery Energy Control Module.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. If equipped, verify a test lamp illuminates between the high voltage energy management communication enable circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the high voltage energy management communication enable circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the high voltage energy management communication enable circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

8. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the device setting the DTC.

9. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

10. Vehicle OFF, reconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack.

11. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to [High](#)

Voltage Disabling .

12. Reconnect the 12 V battery.
13. Vehicle OFF, connect the EL-50211 low voltage jumper harness extension.
14. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
15. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

16. Vehicle in Service Mode.
17. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate**

Repair the short to ground or the open/high resistance in the circuit.

- **If the test lamp illuminates**

18. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate**

Repair the short to ground or the open/high resistance in the circuit.

- **If the test lamp illuminates**

19. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

Repair the short to ground or the open/high resistance in the circuit.

- **If the test lamp illuminates**

20. If equipped, verify a test lamp illuminates between the high voltage energy management communication enable circuit terminal and ground.

- **If the test lamp does not illuminate**

Repair the short to ground or the open/high resistance in the circuit.

- **If the test lamp illuminates**

21. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.

22. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the K16 Battery Energy Control Module and the A4 Hybrid/EV Battery Pack.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- If less than 2 Ω

23. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U185B: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE 2 ON HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U185B

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U185B	U185B	-	-
Ignition	U185B	U185B	-	-
Accessory Wake Up Serial Data	U1814	U185B	-	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A*	U007A, U185B	U007A*	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A, U185B	U007A*	-
Ground	-	U185B	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have

prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with the Hybrid/EV Powertrain Control Module 2 on high voltage energy management high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 2. If this message is not received within 1 s, this DTC is set.

Conditions for Running the DTC

- The device is awake and communicating.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 1 s.

Action Taken When the DTC Sets

- No Cell Balancing function. However, cell balancing switch diagnostics still run.
- DTC U185B is a type B DTC.

Conditions for Clearing the DTC

DTC U185B is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.

- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**

3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
 2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.

8. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the A4 Hybrid/EV Battery Pack.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Vehicle OFF, disable the high voltage system. Refer to [High Voltage Disabling](#) .

10. Reconnect the 12 V battery.

11. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.

12. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

13. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1860: ELECTRIC A/C COMPRESSOR CONTROL MODULE LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1860

Electric A/C Compressor Control Module Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1860	U1860	-	-
Ignition	U1860	U1860	-	-
Accessory Wake Up Serial Data	U1814	U1860	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1860	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1860	U0073*	-
Ground	-	U1860	-	-
* Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is greater than 10.25 V.

Conditions for Setting the DTC

The A/C Compressor is not able to receive the serial data message from the Hybrid Powertrain Control Module 2 for 3 seconds.

Action Taken When the DTC Sets

The DTC U1860 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1860 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.

- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

• **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.

• **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.

2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 harness connector at the G1 A/C Compressor. It may take up to 2 minutes for all vehicle systems to power down.

10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the G1 A/C Compressor.

• **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

• **If less than 2 Ω**

11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1876: DRIVE MOTOR CONTROL MODULE 1 LOST COMMUNICATION WITH ENGINE CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1876

Drive Motor Control Module 1 Lost Communication with Engine Control Module

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1876*	U1876	-	-
Ignition	U1876*	U1876*	-	-
Accessory Wake Up Serial Data 2	P06E4*	U1876*	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1876*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1876*	U0073*	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U0074, U1876*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U0074, U1876*	U0074*	-
Ground	-	U1876*	-	-
* Other DTCs may set with this fault and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

- The system voltage is greater than 9.5 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The DTC U1876 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1876 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0100 is not set.
 - **If DTC U0100 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0100 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K20 Engine Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

- Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 harness connector at the T6 Power Inverter Module. It may take up to 2 minutes for all vehicle systems to power down.
- Test for less than 2 Ω in each serial data circuits end to end between the K20 Engine Control Module and the T6 Power Inverter Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

- Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1879: DRIVE MOTOR CONTROL MODULE 2 LOST COMMUNICATION WITH ENGINE CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1879

Drive Motor Control Module 2 Lost Communication with Engine Control Module

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1879*	U1879	-	-
Ignition	U1879*	U1879*	-	-
Accessory Wake Up Serial Data 2	P06E4*	U1879*	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1879*	U0073*	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1879*	U0073*	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U0074, U1879*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U0074, U1879*	U0074*	-
Ground	-	U1879*	-	-
* Other DTCs may set with this fault and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

- The system voltage is greater than 9.5 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The DTC U1879 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1879 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of- communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage

drops below a certain threshold.

- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify that DTC U0100 is not set.

- **If DTC U0100 is set**

Refer to [DTC U0100-U02FF](#).

- **If DTC U0100 is not set**

3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K20 Engine Control Module. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 harness connector at the T6 Power Inverter Module. It may take up to 2 minutes for all vehicle systems to power down.

10. Test for less than 2 Ω in each serial data circuits end to end between the K20 Engine Control Module and the T6 Power Inverter Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U1885: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U1885

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1885*	U1885	-	-
Ignition	U1885*	U1885*	-	-
Accessory Wake Up Serial Data 2	P06E4, U1885*	U1885*	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1885*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1885*	U0073*	-
Ground	-	U1885*	-	-

* Other DTCs may set with this fault and multiple symptoms including a no start condition may occur.

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with Hybrid/EV Powertrain Control Module 1 on high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 1. If this message is not received

within 3 s, then this DTC is set.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- The DTC U180B is not set.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 3 s.

Action Taken When the DTC Sets

The DTC U1885 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1885 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.

- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.

- **If DTC U0293 is set**

Refer to [DTC U0100-U02FF](#) .

- **If DTC U0293 is not set**

3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If none of the DTCs are set

4. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 harness connector at the T6 Power Inverter Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal (or T6 Power Inverter Module case) and ground.
 - If 10 Ω or greater

Check the ground connection and ground strap for the open/high resistance.

- If less than 10 Ω

3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the T6 Power Inverter Module.

- **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the T6 Power Inverter Module.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the T6 Power

Inverter Module and the A4 Hybrid/EV Battery Pack.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Vehicle OFF, disable the high voltage system. Refer to [High Voltage Disabling](#) .

10. Reconnect the 12 V battery.

11. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. It may take up to 2 min for all vehicle systems to power down.

12. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

13. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U18A2: LOST COMMUNICATION WITH FUEL PUMP DRIVER CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U18A2

Lost Communication with Fuel Pump Driver Control Module

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18A2	U18A2	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U18A2	U18A2	-	-
Accessory Wake Up Serial Data 2	U1814, U2099, U18A2	U18A2	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U18A2, U0074*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U18A2, U0074*	U0074*	-
Ground	-	U18A2	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is

awake.

- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U2100, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K111 Fuel Pump Driver Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.

- **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the device setting the DTC.

10. Test for less than 2 Ω in each serial data circuits end to end between the K111 Fuel Pump Driver Control Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18B5: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U18B5

Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18B5	U18B5	-	-
Ignition	U18B5	U18B5	-	-
Accessory Wake Up Serial Data 2	P06E4, U1817*	U18B5	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0077, U18B5*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0077, U18B5*	U0077*	-
Ground	-	U18B5	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the Chassis high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

The Motor Control Modules and the Hybrid Powertrain Control Module 1 are all internal to the Power Inverter Module. Communication diagnostics for the serial data, including device power and ground as well as the wakeup circuits for Motor Control Modules and the Hybrid Powertrain Control Module 1 are all diagnosed from external sources only to the Power Inverter Module connector because any circuit fault condition within the Power Inverter Module will cause a complete replacement.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
 - **If DTC U0293 is set**

Refer to [DTC U0100-U02FF](#) .
 - **If DTC U0293 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 and X2 harness connectors at the T6 Power Inverter Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal (or module case) and ground.
 - **If 10 Ω or greater**
 1. Ignition/Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the ground circuit or ground strap.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the T6 Power Inverter Module.
 - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition/Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the T6 Power Inverter Module.
 - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
 - **If the test lamp does not illuminate**
 1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B

Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each of the Chassis high speed GMLAN serial data circuits end to end between the T6 Power Inverter Module and the device setting the DTC.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U18B9-U18BF: PRIMARY/SECONDARY HIGH SPEED CAN BUS SUBNET CONFIGURATION LIST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U18B9

Primary High Speed CAN Bus Subnet Configuration List

DTC U18BF

Secondary High Speed CAN Bus Subnet Configuration List

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

The devices on the high speed GMLAN serial data bus and the chassis high speed GMLAN serial data bus must be programmed with software that specifically identifies the correct type and quantity of devices on the bus based on RPO configuration. If a device was not properly configured after installation, the appropriate U Code may be set for that device. No external circuit diagnosis is involved.

Conditions for Running the DTC

- Voltage supplied to the device is in the normal operating voltage range.
- The vehicle power mode requires serial data communication to occur.

Conditions for Setting the DTC

- The device is not configured properly.
- The device recognises a programming error.
- CAN-Bus configuration is invalid

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)
- [**Wiring Repairs**](#)

Scan Tool Reference

[**Control Module References**](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U18B9-U18BF is not set.
 - **If DTC U18B9-U18BF is set along with other DTCs set**

Diagnose all other DTCs first. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC U18B9-U18BF is set without other DTCs set**

1. Program the device that set the DTC.
2. Vehicle OFF, remove the scan tool, open and close the driver door. Wait 60 seconds. Vehicle in Service Mode.
3. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate device.
 - If the DTC does not set
4. All OK.

- **If DTC U0400-U05FF is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC U2098: MOST COMMUNICATION ENABLE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U2098 00

MOST Communication Enable Circuit Malfunction

DTC U2098 02

MOST Communication Enable Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
MOST Control	U2098 00,	U0028 00	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	U2098 02, U0029 02			

Circuit/System Description

When the vehicle is ON, the A11 Radio initializes the Media Oriented Systems Transport (MOST) bus by sending a short 100 ms low voltage pulse on the electronic control line (or MOST control line) connected to all MOST devices contained on the MOST ring. When MOST receive, transmit, or control line faults are detected, transmit/receive messages will not received as expected from the wakeup request. The A11 Radio and the K74 Human Machine Interface Control Module will then perform diagnostics to isolate these MOST faults. If the MOST control line is shorted low to 0 V for excess amount of time, the A11 Radio will set a U2098 DTC and K74 Human Machine Interface Control Module will set a U0029 02 DTC. At this point the MOST bus will be unable to communicate until the shorted MOST control line is repaired.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle is ON.
- The Radio is ON.

Conditions for Setting the DTC

- The Radio senses a short to ground on the MOST control circuit.
- A current DTC is set when a MOST control circuit initialization is invoked and the circuit is detected to be pulled low (0 V) for longer than 1 s.

Action Taken When the DTC Sets

Many or all entertainment components may not function properly.

Conditions for Clearing the DTC

The DTC current status is cleared upon a successful MOST control circuit initialization occurs and the circuit is no longer pulled low.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: Use the schematics to determine which MOST devices are on the A11 Radio's MOST control circuit 7 X2. Use the connector end views to identify the MOST control circuit terminal for each of those MOST devices.

1. Vehicle OFF, disconnect the harness connectors at an easily accessible MOST device that shares the A11 Radio's MOST control circuit 7 X2. Vehicle in Service Mode.
2. Verify that the DTC U2098 or DTC U0029 02 remains current.
 - **If the DTC becomes history**

Replace the MOST device that was just disconnected.
 - **If the DTC remains current**
3. With the prior devices disconnected, repeat steps 1 and 2 for each MOST device on the MOST control circuit except the A11 Radio.
4. Vehicle OFF, disconnect the X2 harness connector at the A11 Radio.
5. Test for infinite resistance between the MOST control circuit terminal 7 X2 at the A11 Radio and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
6. Replace the A11 Radio.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U2099: HIGH SPEED COMMUNICATION ENABLE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U2099

High Speed Communication Enable Circuit

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U2099 02*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The body control module activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The body control module senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.
- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)

- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: Use the schematics to determine which devices are on the K9 body control module's ignition circuit terminal 23 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Vehicle OFF, disconnect the harness connector at an easily accessible device that shares the K9 body control module's ignition circuit terminal 23 X4. Vehicle in Service Mode.
2. Verify that the DTC U2099 remains current.
 - **If the DTC becomes history**

Replace the device that was just disconnected.
 - **If the DTC remains current**
3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 body control module.
4. Vehicle OFF, disconnect the X4 harness connector at the K9 body control module.
5. Test for infinite resistance between the ignition circuit terminal 23 X4 at the K9 body control module and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
6. Replace the K9 body control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U2160-U2231: CONTROL MODULE U CODE LIST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to [Control Module U Code List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U2160 - U2231	U2160 - U2231	-	-
Ignition	U2160 - U2231, U1814, U2099	U2160 - U2231	-	-
Object High Speed GMLAN Serial Data (+)	U0075	U2160 - U2231	U0075	-
Object High Speed GMLAN Serial Data (-)	U0075	U2160 - U2231	U0075	-
Chassis High Speed GMLAN Serial Data (+)	U0077	U2160 - U2231	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U2160 - U2231	U0077	-
High Speed GMLAN Serial Data (+)	U0073, 2	U2160 - U2231	U0073, 2	-
High Speed GMLAN Serial Data (-)	U0073, 2	U2160 - U2231	U0073, 2	-
Low Speed GMLAN Serial Data	U0078, 1	U2160 - U2231	U0078, 1	-
Ground	-	U2160 - U2231	-	-
1. Scan tool does not communicate with most low speed GMLAN device				
2. Scan tool does not communicate with most high speed GMLAN device				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have

prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored code.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial

data systems inoperative. This condition is due to the device using multiple GMLAN busses.

- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.
- This diagnostic procedure can be used to diagnose the common no communication DTCs: U216A, U216B, and other DTCs within U2160 - U2231 range.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Determine the device that is not communicating. Refer to [Control Module U Code List](#) .
2. Vehicle in Service Mode.
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect all the harness connectors at the device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

NOTE: This test step is only applicable to a low speed GMLAN device.

9. Test for less than 4.5 V between each low speed GMLAN serial data circuit terminal and ground.

- **If 4.5 V or greater**

Refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#) to test for a short to voltage in the serial data circuit.

- **If less than 4.5 V**

10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

11. Test for less than 2 Ω in each of the serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below.

- Low speed GMLAN serial data circuit terminal 1

- High speed GMLAN serial data circuit terminal 6 or 14

- Chassis high speed GMLAN serial data circuit terminal 12 or 13

- Object high speed GMLAN serial data circuit terminal 3 or 11

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit between the non communicating device and the device setting the DTC or a serial data splice pack.

- **If less than 2 Ω**

NOTE: The following test step is only applicable to a high speed GMLAN device with 2 pairs of serial data circuits or a high speed GMLAN device with an internal terminating resistor.

12. Test for 110 - 130 Ω between each pair of high speed GMLAN serial data circuits.

- **If less than 110 Ω**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for a short to ground or a short between the serial data circuits.

- **If greater than 130 Ω**

Refer to [Scan Tool Does Not Communicate with High Speed GMLAN Device](#) to test for an open/high resistance in the serial data circuit.

- **If between 110 - 130 Ω**

13. Replace the device that is not communicating.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U2401: BATTERY ENERGY CONTROL MODULE DEDICATED BUS 1 OFF

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U2401

Battery Energy Control Module Dedicated Bus 1 Off

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The Battery Energy Control Module dedicated bus is a communication bus used to communicate between the Battery Energy Control Module and the Hybrid/EV Battery Interface Control Modules inside the Hybrid/EV Battery Pack assembly. The Battery Energy Control Module dedicated bus does not communicate with the scan tool.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has received too many transmit errors on the Battery Energy Control Module

dedicated serial data circuits.

Action Taken When the DTC Sets

DTC U2401 is a type A DTC.

Conditions for Clearing the DTC

- DTC U2401 is a type A DTC.
- No bus off status.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify each scan tool Hybrid/EV Battery 1 - 96 parameters are between 3.45 - 4.05 V and all readings are within 0.03 V of each other.

- **If not between 3.45 - 4.05 V or not within 0.03 V of each other**

Refer to [**DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**](#)

- **If between 3.45 - 4.05 V and within 0.03 V of each other**

3. Verify that DTC U2401 is not set.

- **If the DTC is set**

Replace the K16 Battery Energy Control Module.

- **If the DTC is not set**

4. All OK.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

[**Control Module References**](#) for device replacement, programming and setup

DTC U2602: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U2602

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U2602	U2602	-	-
Ignition	U2602	U2602	-	-
Accessory Wake Up Serial Data	U1814	U2602	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U2602*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U2602*	U0073*	-
Ground	-	U2602	-	-

* Scan Tool Does Not Communicate With High Speed GMLAN Device

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with the Hybrid/EV Powertrain Control Module 2 on high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 2. If this message is not received within 400 ms, the Battery Energy Control Module increases its fail count. When this fail count is over X Cal Value (7) during Y Cal Value (10 samples), the diagnostic status of this code is set to Failed and transmitted over high voltage energy high speed GMLAN bus to the Hybrid/EV Powertrain Control Module 2.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- The DTC U180B is not set.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 400 ms.

Action Taken When the DTC Sets

The DTC U2602 is a type B DTC.

Conditions for Clearing the DTC

The DTC U2602 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 - 1. Vehicle OFF.
 - 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 1. Vehicle OFF.
 - 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
 - **If the test lamp does not illuminate**
 - 1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
 - 2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the A4 Hybrid/EV Battery Pack.
 - **If 2 Ω or greater**
 - Repair the open/high resistance in the serial data circuit.
 - **If less than 2 Ω**

11. Vehicle OFF, disable the high voltage system. Refer to [High Voltage Disabling](#).
12. Reconnect the 12 V battery.
13. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. It may take up to 2 min for all vehicle systems to power down.
14. Test for less than 2 Ω in each serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

15. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U2603-U2606 OR U2617-U2624: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV BATTERY INTERFACE CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U2603

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
1

DTC U2604

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
2

DTC U2605

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
3

DTC U2606

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module

DTC U2617

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
5

DTC U2618

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
6

DTC U2619

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
7

DTC U2620

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
8

DTC U2621

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
9

DTC U2622

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
10

DTC U2623

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
11

DTC U2624

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
12

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the

transmitter device.

The scan tool does not communicate the Hybrid/EV Battery Interface Control Modules 1 - 12 on Battery Energy Control Module dedicated bus.

Conditions for Running the DTC

- The device is awake and communicating.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

There is no temperature report message from Hybrid/EV Battery Interface Control Modules 1 - 12 to Battery Energy Control Module within 4 s.

Action Taken When the DTC Sets

The DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, and U2624 are type A DTCs.

Conditions for Clearing the DTC

The DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, and U2624 are type A DTCs.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Hybrid/EV Energy Storage Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)
- [**Wiring Repairs**](#)

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#) .

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify that DTC U2401 is not set.

- If the DTC is set

Refer to [DTC U2401](#).

- If the DTC is not set

3. Verify each scan tool Hybrid/EV Battery 1 - 96 parameters are between 3.45 - 4.05 V and all readings are within 0.03 V of each other.

- If not between 3.45 - 4.05 V or not within 0.03 V of each other

Refer to [DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B](#)

- If between 3.45 - 4.05 V and within 0.03 V of each other

4. Verify that DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624 is not set.

- If any of the DTCs are set

Replace the K16 Battery Energy Control Module.

- If none of the DTCs are set

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC U2616: FUEL PUMP DRIVER CONTROL MODULE LOST COMMUNICATION WITH ECM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U2616

Fuel Pump Driver Control Module Lost Communication with ECM

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U2616, U0100	U2616, U0100	-	-
Ignition	U2616, U0100	U2616, U0100	-	-
Accessory Wake Up Serial Data 2	U1814, U2099	U2616, U0100	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U0074*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U0074*	U0074*	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground	-	U2616, U0100	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be

interpreted as an intermittent fault, causing you to replace a part.

- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use [Data Link References](#) to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U2100, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
 - If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K20 Engine Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp illuminates**

7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K111 Fuel Pump Driver Control Module.

10. Test for less than 2 Ω in each serial data circuits end to end between the K20 Engine Control Module and the K111 Fuel Pump Driver Control Module.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DTC U3000: CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U3000

Control Module

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U3000 is not set.
 - **If DTC U3000 is set with symptom byte 43, 47, or 4B**
 1. Program the device that set the DTC.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the device that set the DTC.
 - If the DTC does not set
 - 3. All OK.
 - **If DTC U3000 is set with any symptom byte, except 43, 47, or 4B**

Replace the device that set the DTC.
 - **If DTC U3000 is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for device replacement, programming and setup

DTC U3012: CONTROL MODULE IMPROPER WAKE-UP PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC U3012

Control Module Improper Wake-up Performance

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)
- [**Wiring Repairs**](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U3012 is not set.

- **If DTC U3012 is set**

Replace the device that set the DTC.

- **If DTC U3012 is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

SYMPTOMS - DATA COMMUNICATIONS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no Diagnostic Trouble Codes (DTC) set.
 - The devices can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Data Link Communications Description and Operation** .

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Scan Tool Does Not Power Up**
- **Scan Tool Does Not Communicate with High Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Low Speed GMLAN Device**

SCAN TOOL DOES NOT POWER UP

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Data Link Connector B+	1	1	-	-
Data Link Connector Ground	-	1	-	-
1. Scan Tool Does Not Power Up				

Circuit/System Description

The data link connector (DLC) is a standardized 16 cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool B+ voltage at terminal 16
- Scan tool ground at terminal 4
- Common ground at terminal 5

Diagnostic Aids

- The scan tool will power up with the vehicle OFF. Some devices however, will not communicate unless the vehicle is ON and the power mode master device sends the appropriate power mode message.
- If the B+ circuit, ground circuits, and connections of the data link connector are functioning properly, the malfunction must be due to the scan tool.

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 2 Ω between each of the X84 data link connector ground circuit terminals listed below and ground.
 - Ground circuit terminal 4
 - Ground circuit terminal 5
 - **If 2 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 2 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 16 at the X84 data link connector and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp illuminates**
5. Refer to the scan tool user guide.

SCAN TOOL DOES NOT COMMUNICATE WITH HIGH SPEED GMLAN DEVICE

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (+)	1	U0100 - U02FF*	1	-
High Speed GMLAN Serial Data (-)	1	U0100 - U02FF*	1	-
Ground (DLC, terminal 5)	-	1	-	-
* No communications with one or more high speed GMLAN devices. An open in only one high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the data link connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any high speed GMLAN device				

Circuit/System Description

The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the engine control module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the High Speed GMLAN bus during normal vehicle operation. The high speed GMLAN is a differential bus. The high speed GMLAN serial data bus (+) and high speed GMLAN serial data bus (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis.
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.

- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with the high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine will not start when there is a total malfunction of the high speed GMLAN serial data bus.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed GMLAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio module (see bulletins). Some customers may comment of one or more of the following concerns:
 - Vehicle will not crank
 - Vehicle cranks but will not start
 - Vehicle stability enhancement system warning lights and messages
 - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- [**Data Communication Schematics**](#)
- [**Control Module References**](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- [**Circuit Testing**](#)
- [**Connector Repairs**](#)
- [**Testing for Intermittent Conditions and Poor Connections**](#)
- [**Wiring Repairs**](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify two or more devices are not communicating on the high speed GMLAN serial data circuit. Refer to

Data Link References to determine how many devices should be communicating on the bus.

- **If only one device is not communicating**

Refer to Circuit/System Testing - Testing the Device Circuits.

- **If two or more devices are not communicating**

3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the scan tool from the X84 data link connector. The following tests will be done at the X84 data link connector. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground.

- Terminal 6
- Terminal 14
- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuits listed below and ground.

- Terminal 6
- Terminal 14
- **If 100 Ω or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 Ω**

9. Test for 50 - 70 Ω between the serial data circuit terminals 6 and 14.

- **If less than 35 Ω**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If between 35 - 50 Ω**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors

installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

Repair the open/high resistance in the circuit between the X84 data link connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- High speed GMLAN devices the vehicle is equipped with
- High speed GMLAN serial data circuit terminating resistors
- Device locations on the high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and high speed GMLAN serial data circuit terminals

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Vehicle OFF.
 2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
3. Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.

4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 4.5 V or less**
 1. Vehicle OFF.
 2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
 - If 10 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 10 Ω , replace the device that was disconnected.
 - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
 - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
 - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
 - **If each serial data circuit is 100 Ω or greater**

Replace the device that was disconnected.
 - **If any serial data circuit is less than 100 Ω**
4. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
 - **If both serial data circuits are 100 Ω or greater**

Replace the device that was disconnected.
 - **If any serial data circuit is less than 100 Ω**
6. Repeat step 4 until one of the following conditions are isolated:
 - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
 - A short to ground on the serial data circuit between a device and a terminating resistor.
 - A short to ground on the serial data circuit between the X84 data link connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.

2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 110 Ω or greater**

Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

7. Repeat step 4 until one of the following conditions are isolated:
 - Serial data circuits shorted together between two devices or splice packs, if equipped.
 - Serial data circuits shorted together between a device and a terminating resistor.
 - Serial data circuits shorted together between the X84 data link connector and the first device or splice pack.
 - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.

- **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

7. Repeat step 4 until one of the following conditions are isolated:

- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

4. Vehicle in Service Mode

5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

6. Vehicle in Service Mode.

7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

8. Vehicle in Service Mode

9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the harness connectors at the control module that controls the ignition circuit.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.

11. Test for less than 130 Ω between each pair of high speed GMLAN serial data circuits at the device connector that was just disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

- **If each pair of serial data circuits is 130 Ω or less**

12. Replace the device that was disconnected.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH LOW SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Speed GMLAN Serial Data	1	U0100-U02FF*	1	-
Ground (DLC, terminal 5)	-	1*	-	-
* An open between the Data Link Connector (DLC) and the first splice pack/device will only affect the communication with the scan tool. 1. No communication with any low speed GMLAN device				

Circuit/System Description

The serial data is transmitted over a single wire to the appropriate devices. The transmission speed for GMLAN low speed is up to 83.33 Kbit/s. Under normal vehicle operating conditions, the speed of the bus is 33.33 Kbit/s. The devices toggle the serial data circuit between 0 - 5 V during normal communications. To wake the devices connected to the low speed GMLAN serial data circuit, a voltage wake up pulse of 10 V is sent out. If serial data is lost, devices will set a no communication code against the non-communicating device. A loss of serial data communications DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
 - A device on the data communication circuit was disconnected while the communication circuit is awake.
 - Power to one or more devices was interrupted during diagnosis
 - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
 - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
 - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with the low speed GMLAN serial data system inoperative. This condition is due to the device using both the high and low speed GMLAN systems.
- An open in the low speed GMLAN serial data circuit between the splice pack and a device will only

affect that specific device. This type of failure will set a loss of communication DTC for each device affected, and the other devices will still communicate.

- An open in the Data Link Connector ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine may not start when there is a total malfunction of the low speed GMLAN serial data circuit.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed LAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio device (see bulletins). Some customers may comment of one or more of the following concerns:
 - Vehicle will not crank
 - Vehicle cranks but will not start
 - Vehicle stability enhancement system warning lights and messages
 - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- [Data Communication Schematics](#)
- [Control Module References](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Data Link Communications Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Use the schematic to identify the following:

- Devices the vehicle is equipped with
- Device and splice pack locations on the low speed GMLAN serial data circuit

- **The low speed GMLAN serial data circuit terminals for each device or splice pack**

1. Attempt to communicate with all devices on the low speed GMLAN serial data circuit. Refer to [Data Link References](#).

2. Verify which devices are communicating on the low speed GMLAN serial data circuit.

- **If only one device is not communicating**

Diagnose that device only. Refer to [DTC U0100-U02FF](#).

- **If one or more devices are communicating but not all**

Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

- **If none of the devices are communicating**

3. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.

4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

5. Vehicle in Service Mode.

6. Test for less than 4.5 V between the serial data circuit terminal 1 and ground.

- **If 4.5 V or greater**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

- **If less than 4.5 V**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.

8. Test for greater than 100 Ω between the serial data circuit terminal 1 and ground.

- **If 100 Ω or less**

Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

- **If greater than 100 Ω**

9. Disconnect the appropriate harness connector at the first splice pack closest in the circuit to the X84 Data Link Connector.

10. Test for less than 2 Ω between the X84 Data Link Connector's serial data circuit terminal 1 and the splice pack harness connector's serial data input terminal.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

11. Replace the splice pack.

Circuit/System Testing

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs, Vehicle in Service Mode.
2. Test for less than 4.5 V between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.

- **If 4.5 V or greater**

Repair the short to voltage on the serial data circuit.

- **If less than 4.5 V**

3. Test for less than 4.5 V between each low speed GMLAN serial data circuit at a splice pack and ground.

- **If any serial data circuit is greater than 4.5 V**

1. Vehicle OFF, disconnect all devices on the failed serial data circuit, Vehicle in Service Mode.
2. Test for less than 1 V between each section of the failed serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V
3. Vehicle OFF, connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
 - If the scan tool does not communicate, replace the device that was just connected.
 - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
 - If the scan tool communicates and there are no more devices to connect

5. All OK.

- **If all serial data circuits are less than 4.5 V**

4. All OK.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs.
2. Test for infinite resistance between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
 - **If less than infinite resistance**

Repair the short to ground on the serial data circuit.

- **If infinite resistance**

3. Test for greater than 100 Ω between each low speed GMLAN serial data circuit at a splice pack and ground.

- **If any serial data circuit is 100 Ω or less**

1. Disconnect all devices on the failed serial data circuit.
2. Test for infinite resistance between each section of the failed serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
3. Connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
 - If the scan tool does not communicate, replace the device that was just connected.
 - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
 - If the scan tool communicates and there are no more devices to connect
5. All OK.

- **If all serial data circuits are greater than 100 Ω**

4. All OK.

Testing the Serial Data Circuit for an Open/High Resistance

1. Vehicle OFF and all vehicle systems OFF, disconnect the splice pack containing the devices that are not communicating on the low speed GMLAN serial data circuit.
2. Test for less than 2 Ω between the X84 Data Link Connector terminal 1 and the disconnected splice pack.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

3. Disconnect all devices on the failed serial data circuit.
4. Test for less than 2 Ω between each section of the failed serial data circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

5. Connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
6. Verify if the device communicates or not with the scan tool.

- **If the device does not communicates**

Replace the device.

- If the device communicates and there are more devices to connect

Connect the next device on the failed serial data circuit and repeat step 6.

- If all devices are connected and communicating

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Serial Data Circuit Wiring Repairs](#)
- [Control Module References](#) for device replacement, programming and setup

DATA LINK REFERENCES

This table identifies which serial data link that a particular module uses for in-vehicle data transmission. Some modules may use more than one data link to communicate. Some modules may have multiple communication circuits passing through them without actively communicating on that data link. This table is used to assist in correcting a communication malfunction. For the description and operation of these serial data communication circuits refer to [Data Link Communications Description and Operation](#).

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
A11	Radio	• Low Speed GMLAN • MOST Bus • Local Interconnect Network (LIN)	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U0028 • DTC U1500-U15FF
A26	HVAC Controls	• Low Speed GMLAN • Local Interconnect Network (LIN)	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U1500-U15FF
B174	Frontview Camera	• High Speed GMLAN • Low Speed GMLAN • Object High Speed GMLAN	• Scan Tool Does Not Communicate with High Speed GMLAN Device • Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U0075
B218L	Side Object Sensor Module - Left	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
B218R	Side Object Sensor Module - Right	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device
B233B	Radar Sensor Module - Long Range	Object High Speed GMLAN	DTC U0075
B284	Vehicle Dynamic Sensor	Chassis Expansion Bus	DTC U0077
B305	Ambient Light/Sunload Sensor and Battery State Of Charge Indicator	Local Interconnect Network (LIN)	DTC U1500-U15FF
G1	A/C Compressor	High Speed GMLAN	Scan Tool Does Not Communicate with High Speed GMLAN Device
K9	Body Control Module	• High Speed GMLAN • Low Speed GMLAN • Local Interconnect Network (LIN)	• Scan Tool Does Not Communicate with High Speed GMLAN Device • Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U1500-U15FF
K10	Coolant Heater Control Module	Local Interconnect Network (LIN)	DTC U1500-U15FF
K16	Battery Energy Control Module	• High Speed GMLAN • High Voltage Management Expansion Bus	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U007A
K17	Electronic Brake Control Module	• High Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0077
K20	Engine Control Module	• High Speed GMLAN • Powertrain Expansion Bus	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0074
K29F	Seat Heating Control Module - Front	Local Interconnect Network (LIN)	DTC U1500-U15FF
K29R	Seat Heating Control Module - Rear	Local Interconnect Network (LIN)	DTC U1500-U15FF

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: <u>Data Communication Schematics</u>			
K33	HVAC Control Module	• Low Speed GMLAN • Local Interconnect Network (LIN)	• <u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u> • <u>DTC U1500-U15FF</u>
K36	Inflatable Restraint Sensing and Diagnostic Module	• Low Speed GMLAN • Chassis Expansion Bus	• <u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u> • <u>DTC U0077</u>
K43	Power Steering Control Module	• High Speed GMLAN • Chassis Expansion Bus	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>DTC U0077</u>
K73	Telematics Communication Interface Control Module	• High Speed GMLAN • Low Speed GMLAN	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K74	Human Machine Interface Control Module	• High Speed GMLAN • MOST Bus	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>DTC U0028</u>
K84	Keyless Entry Control Module	Low Speed GMLAN	<u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K85	Passenger Presence Module	Low Speed GMLAN	<u>Scan Tool Does Not Communicate with Low Speed GMLAN Device</u>
K111	Fuel Pump Driver Control Module	Powertrain Expansion Bus	<u>DTC U0074</u>
K114A / T6	Hybrid/EV Powertrain Control Module 1 / Power Inverter Module	• High Speed GMLAN • Chassis Expansion Bus • Powertrain Expansion Bus	• <u>Scan Tool Does Not Communicate with High Speed GMLAN Device</u> • <u>DTC U0077</u> • <u>DTC U0074</u>

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
K114B	Hybrid/EV Powertrain Control Module 2	• Low Speed GMLAN • High Speed GMLAN • Powertrain Expansion Bus • High Voltage Management Expansion Bus	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0074 • DTC U007A
K124	Active Safety Control Module	• Low Speed GMLAN • High Speed GMLAN • Object High Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0075 • DTC U0077
K132	Pedestrian Alert Sound Control Module	High Speed GMLAN	Scan Tool Does Not Communicate with High Speed GMLAN Device
K177	Brake Booster Control Module	• High Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0077
K182	Parking Assist Control Module	• Low Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U0077
M74D	Window Motor - Driver	Local Interconnect Network (LIN)	DTC U1500-U15FF
M75	Windshield Wiper Motor	Local Interconnect Network (LIN)	DTC U1500-U15FF
P2	Transmission Shift Lever Position Indicator	Local Interconnect Network (LIN)	DTC U1500-U15FF
P16	Instrument Cluster	• Low Speed GMLAN • MOST Bus	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U0028

ACCESSORIES & EQUIPMENT

Data Communications - Repair Instructions - Volt

REPAIR INSTRUCTIONS

BODY CONTROL MODULE REPLACEMENT

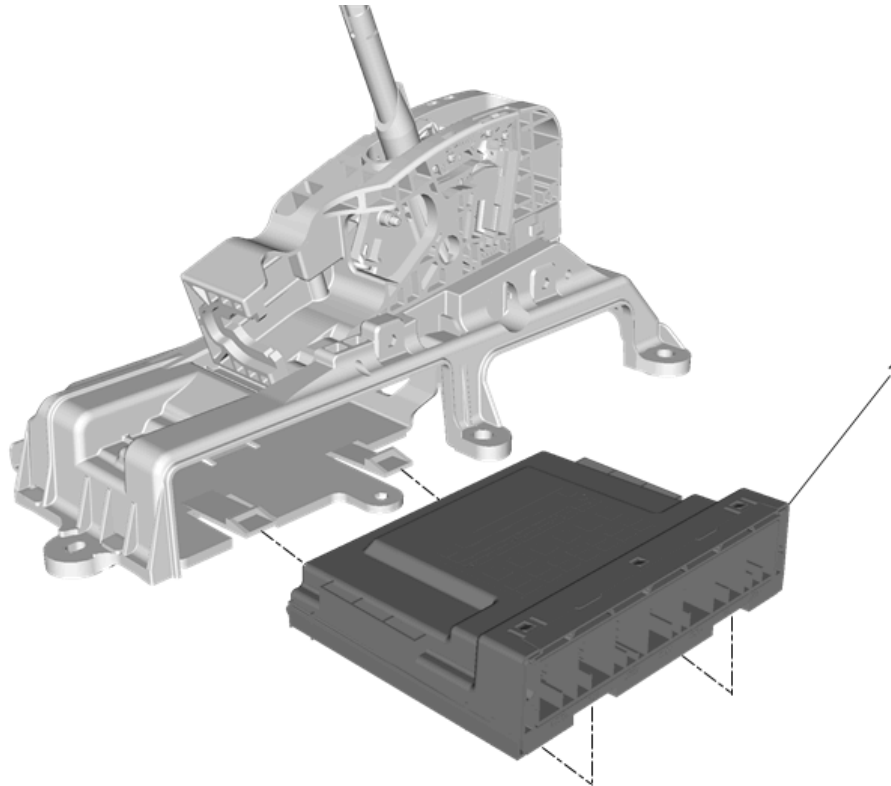


Fig. 1: Body Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Transmission Control Replacement (With Base)</u> <u>Transmission Control Replacement (Without Base)</u>	
1	Body Control Module Procedure 1. Release the retaining tabs. 2. <u>Control Module References</u> for programming and set up information, if required.

HYBRID POWERTRAIN CONTROL MODULE 2 REPLACEMENT

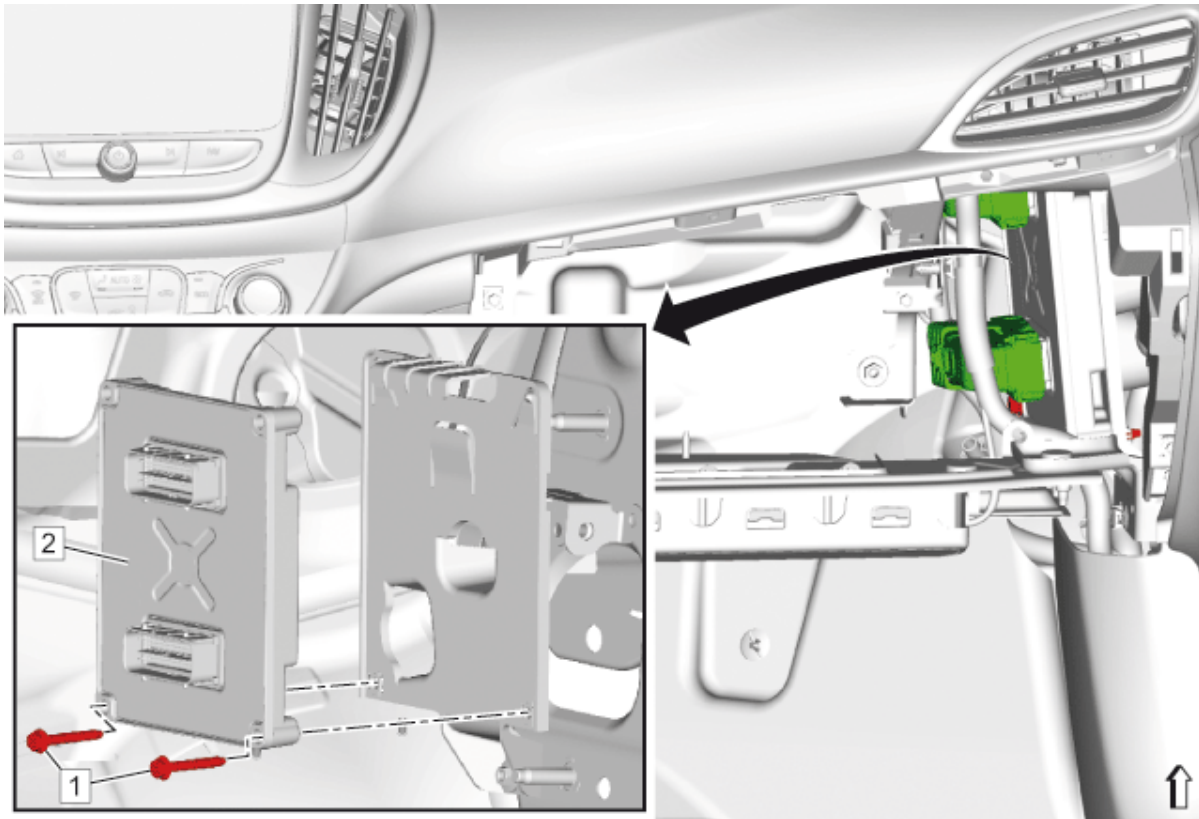


Fig. 2: Hybrid Powertrain Control Module 2
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Battery Negative Cable Disconnection and Connection 2. Instrument Panel Compartment Replacement 3. Instrument Panel Lower Trim Panel Insulator Replacement	
1	Hybrid Powertrain Control Module 2 Bracket Bolts (Qty: 2) CAUTION: Fastener Caution Tighten 9 N.m (80 lb in)
2	Hybrid Powertrain Control Module 2 Procedure 1. Disconnect the electrical connectors. 2. Remove the module from the retaining tab on the bracket. 3. Programming and Setup Control Module References

Article GUID: A00884655

SCHEMATIC WIRING DIAGRAMS

Communications Enable



Courtesy of GENERAL MOTORS COMPANY

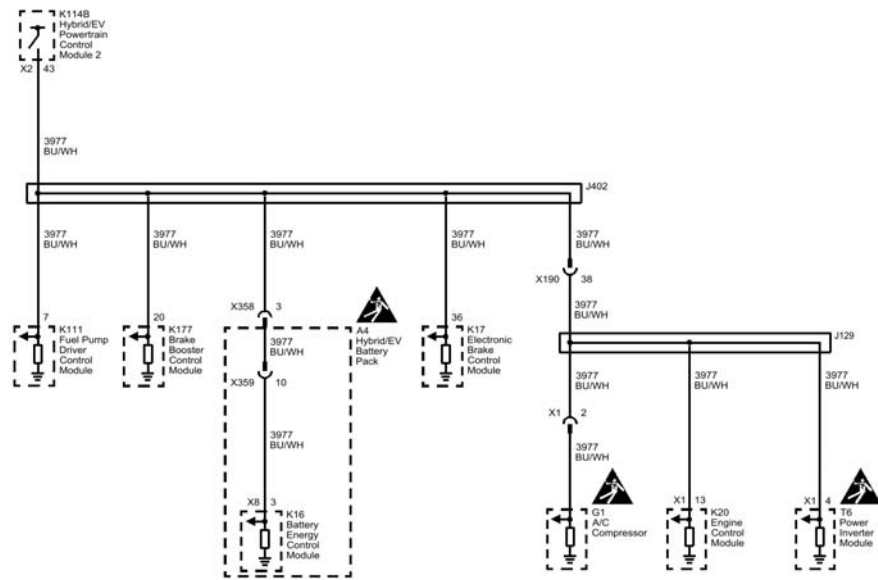


Fig. 2: Serial Data Wake-Up
 Courtesy of GENERAL MOTORS COMPANY

High Voltage Management and Powertrain Expansion Busses

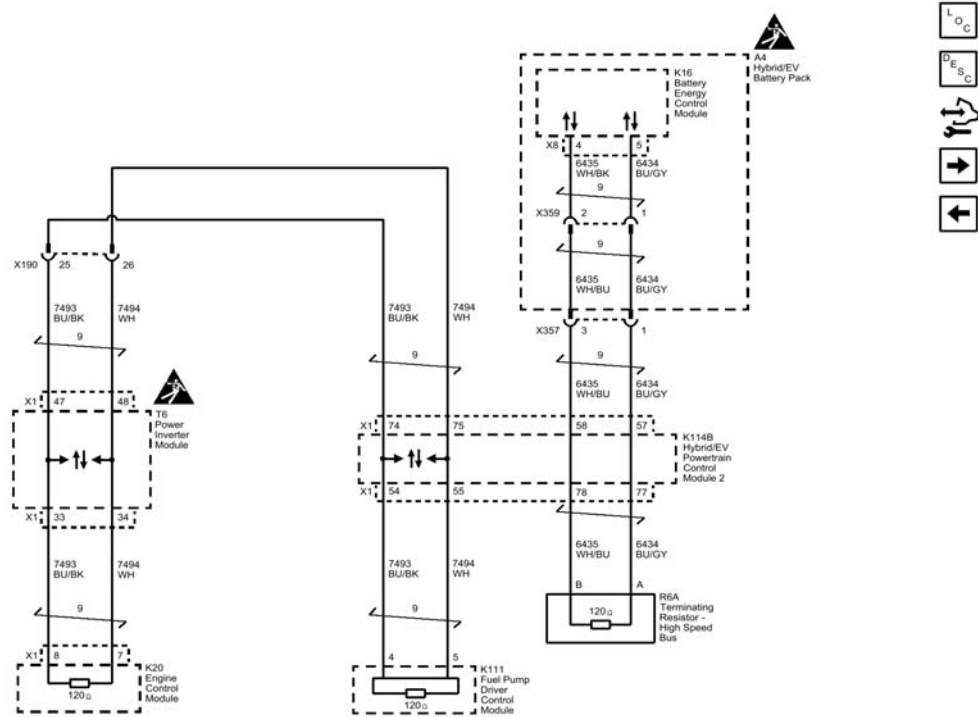


Fig. 3: High Voltage Management and Powertrain Expansion Busses
 Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN

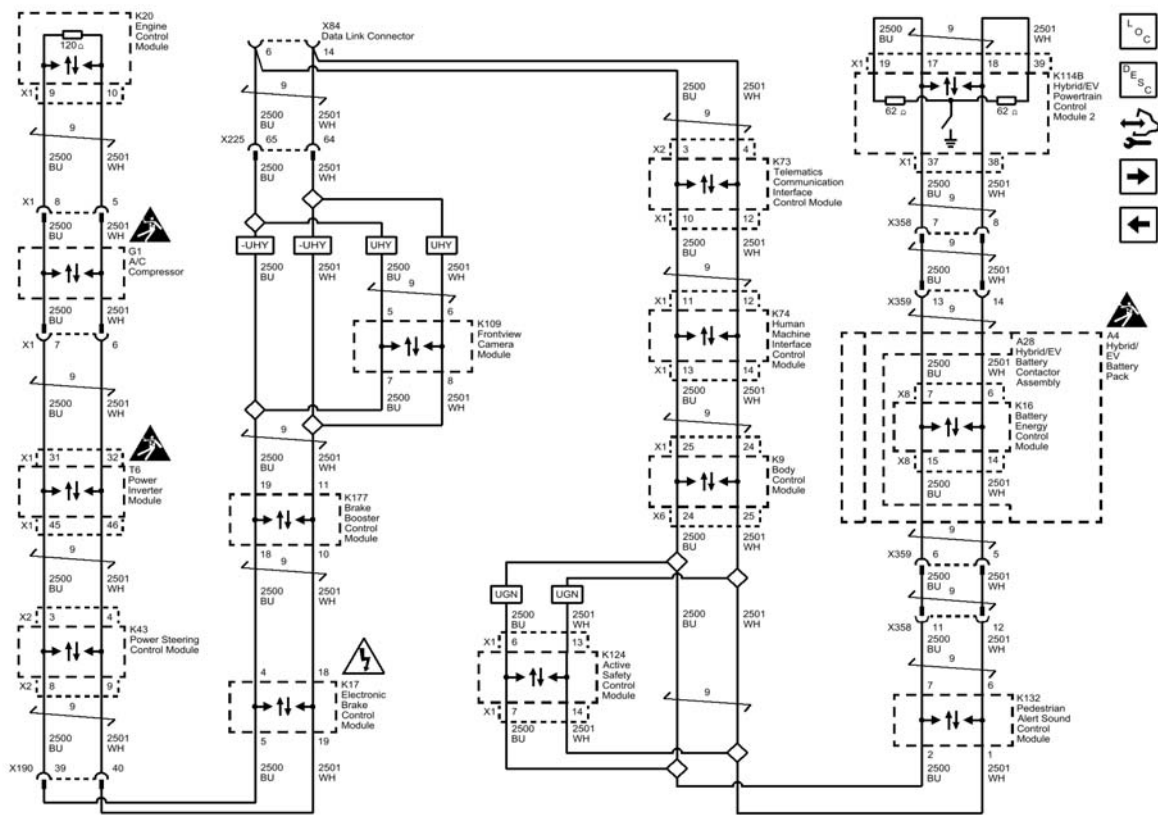


Fig. 4: High Speed GMLAN
Courtesy of GENERAL MOTORS COMPANY

Low Speed CAN

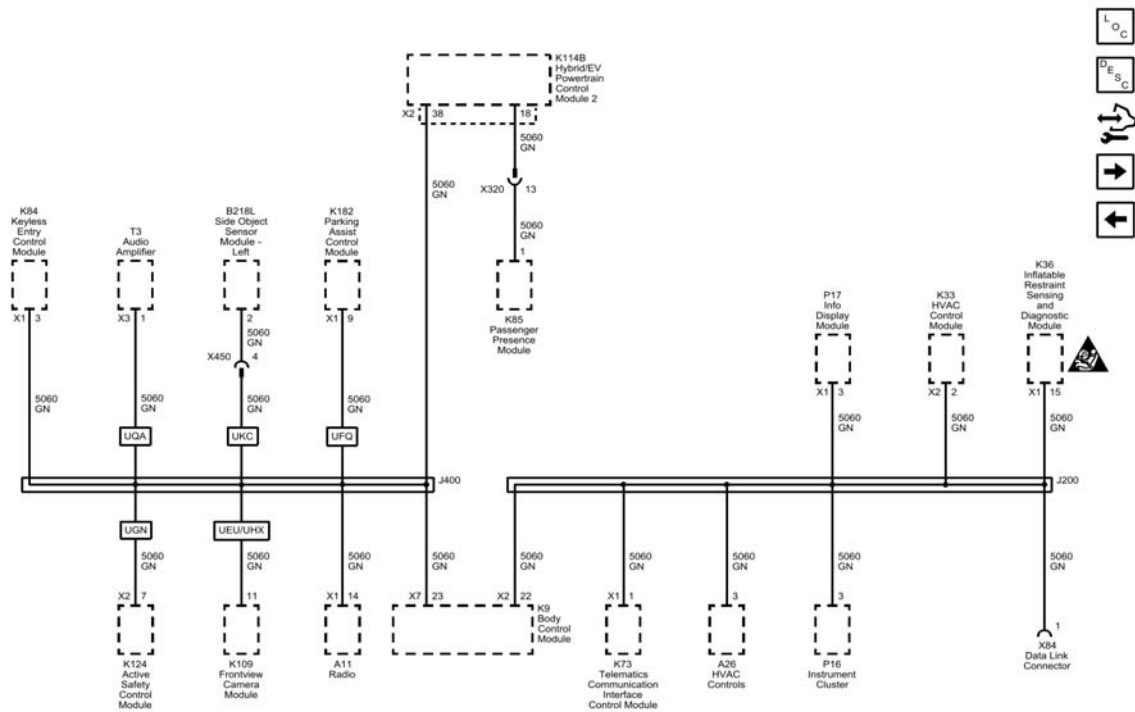


Fig. 5: Low Speed CAN

Courtesy of GENERAL MOTORS COMPANY

Chassis Expansion Bus

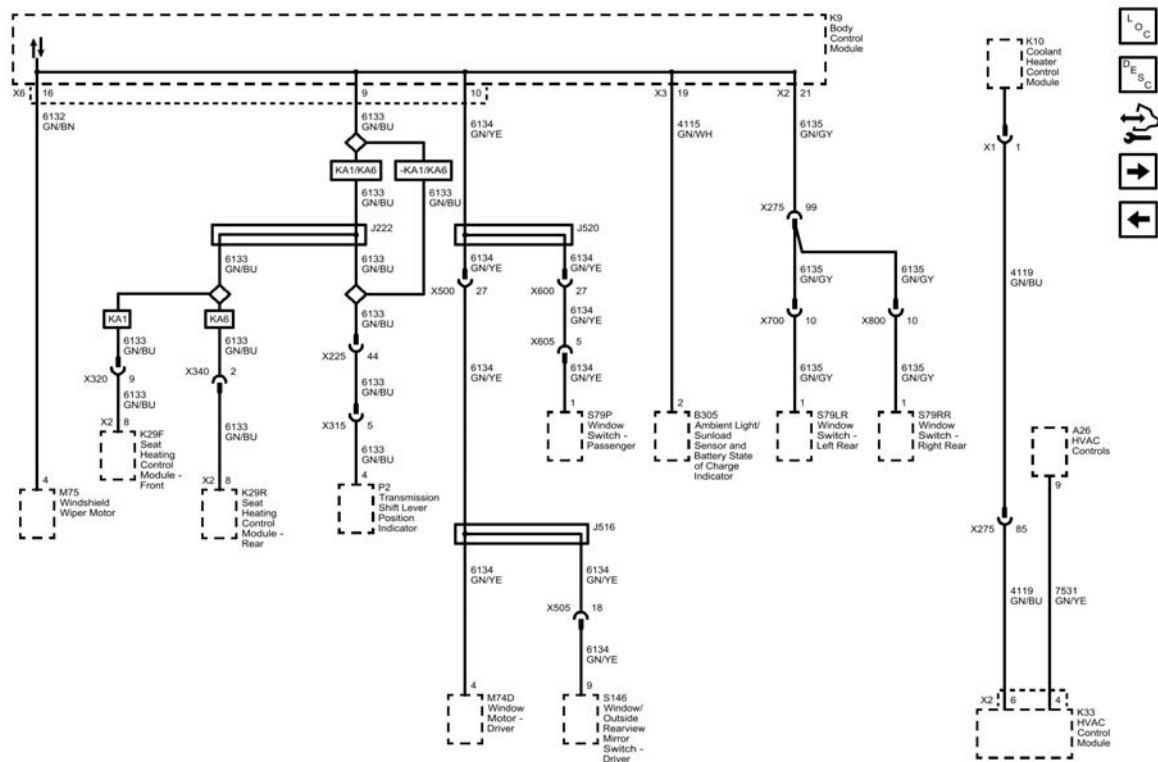


Fig. 7: Linear Interconnect Network (LIN)
Courtesy of GENERAL MOTORS COMPANY

MOST Bus and Communication Enable

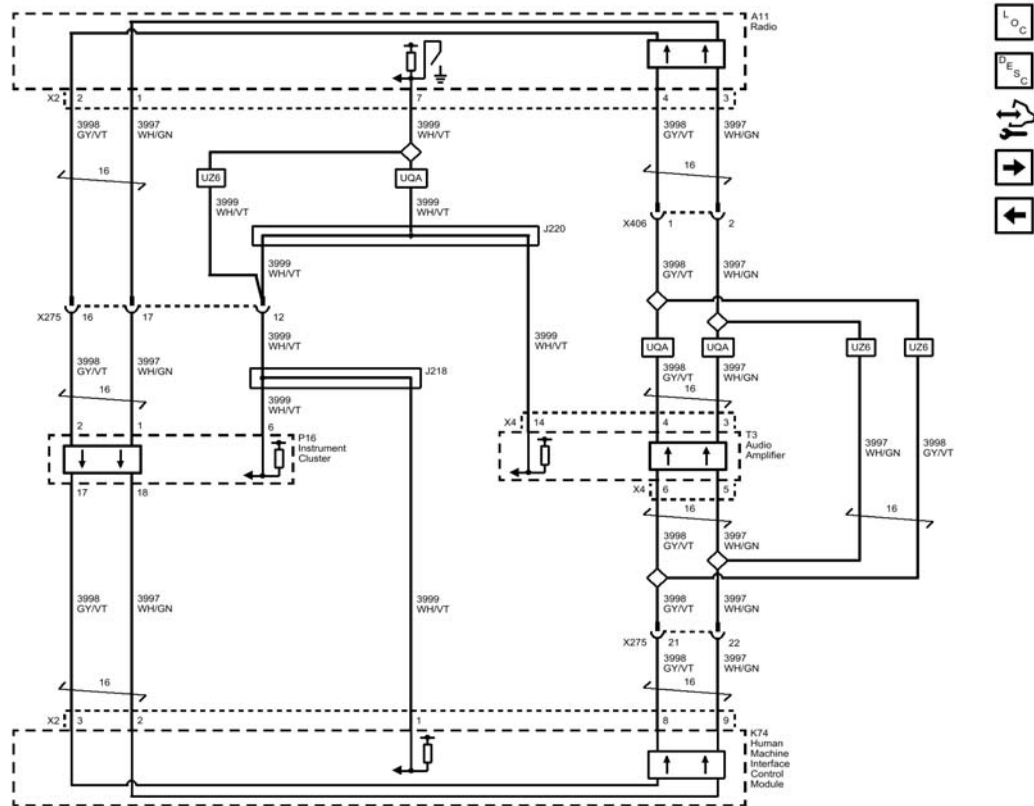


Fig. 8: MOST Bus and Communication Enable
Courtesy of GENERAL MOTORS COMPANY

Object High Speed GMLAN (UGN)

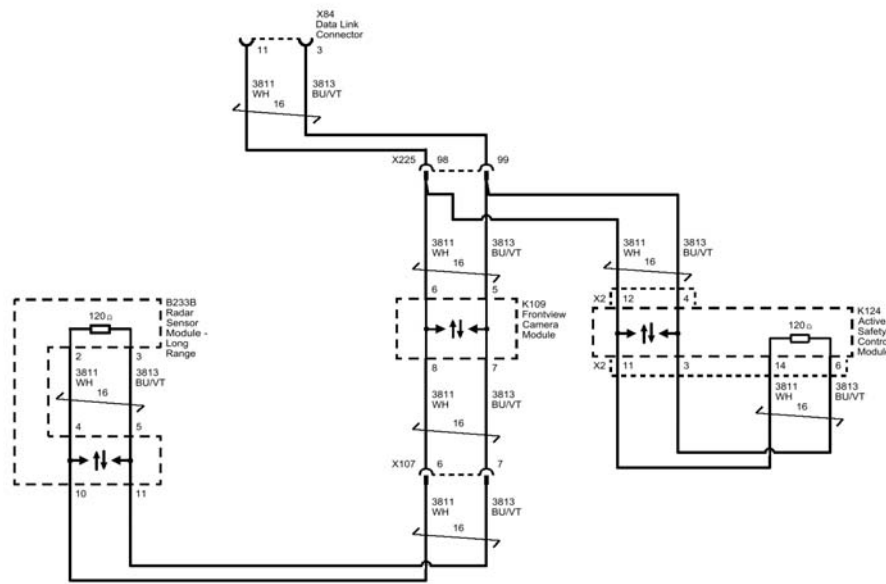


Fig. 9: Object High Speed GMLAN (UGN)
 Courtesy of GENERAL MOTORS COMPANY

BODY CONTROL SYSTEM WIRING SCHEMATICS

Power, Ground and Data Communication

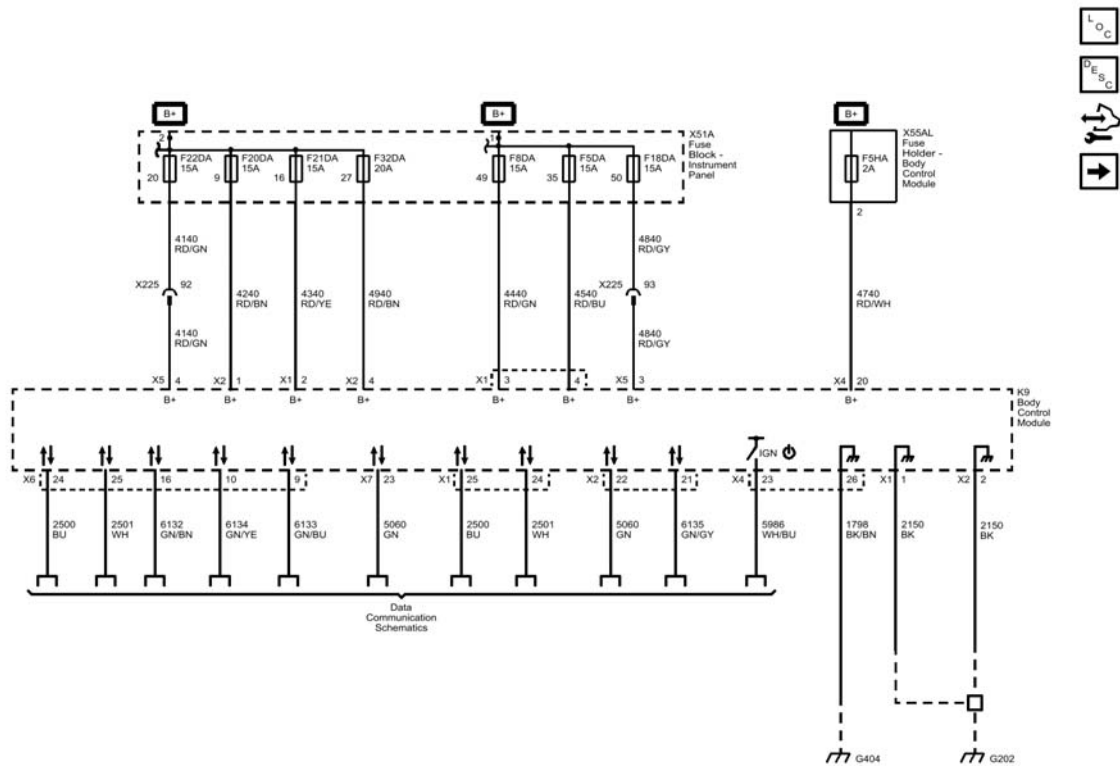


Fig. 10: Power, Ground and Data Communication
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (1 of 3)

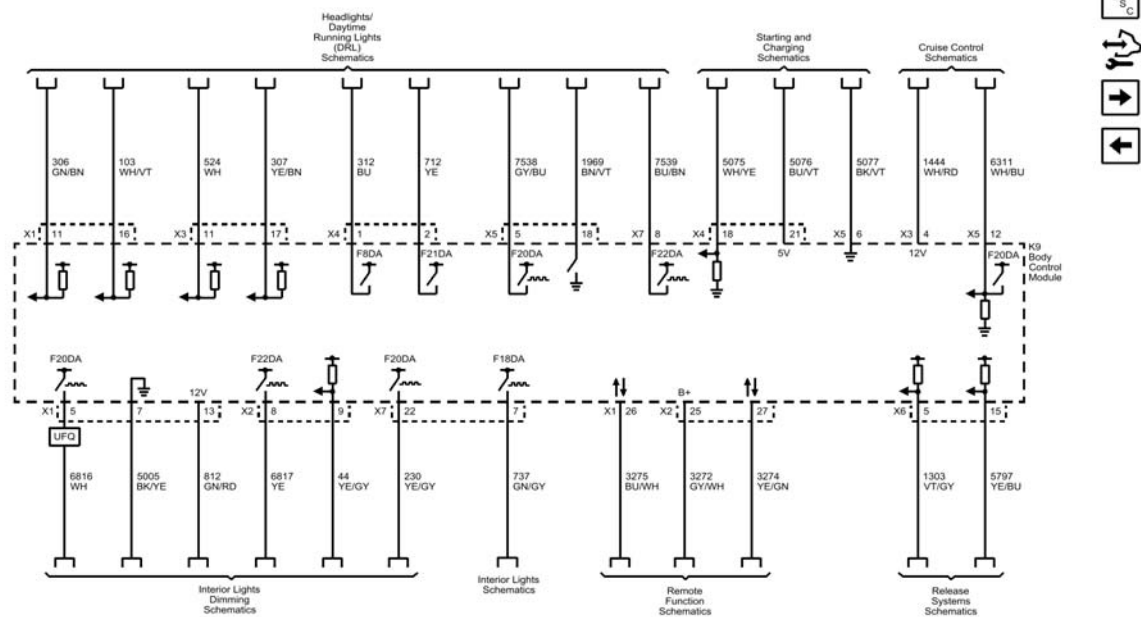


Fig. 11: Subsystem References (1 of 3)
Courtesy of GENERAL MOTORS COMPANY

Subsystem References (2 of 3)

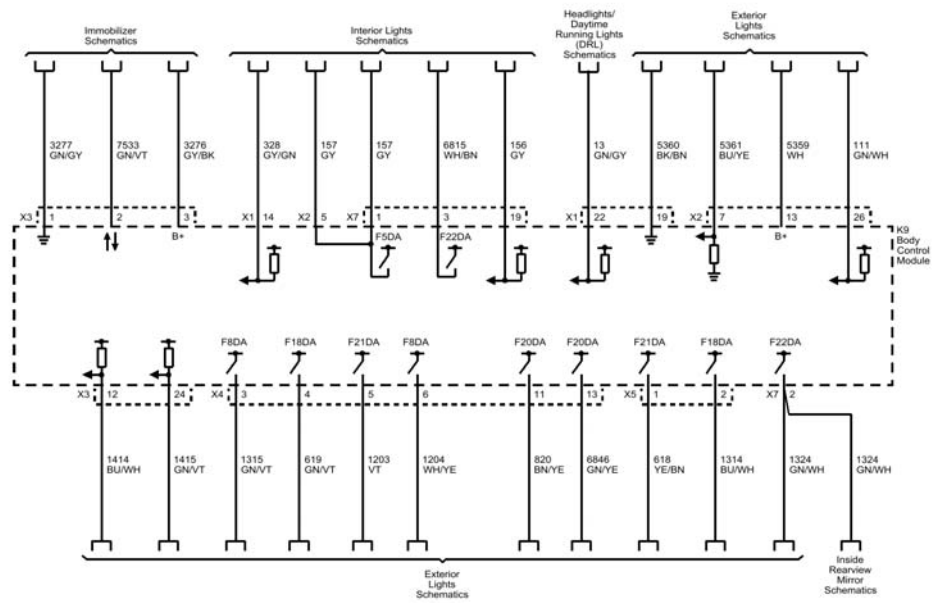


Fig. 12: Subsystem References (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Subsystem References (3 of 3)

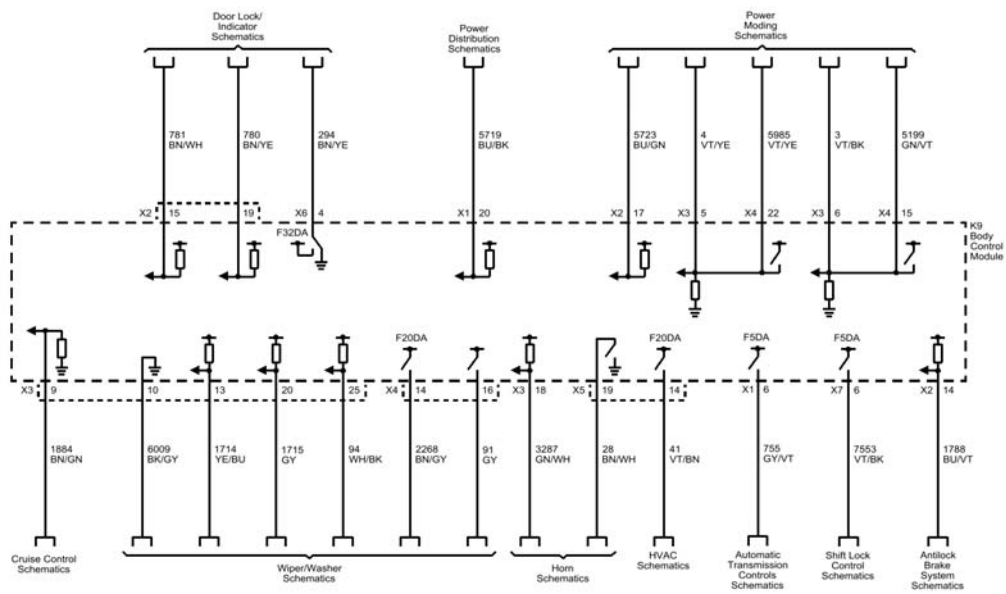


Fig. 13: Subsystem References (3 of 3)
Courtesy of GENERAL MOTORS COMPANY

Article GUID: A00884636

ACCESSORIES & EQUIPMENT

Data Communications - Special Tools and Equipment - Special Tools - Volt

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

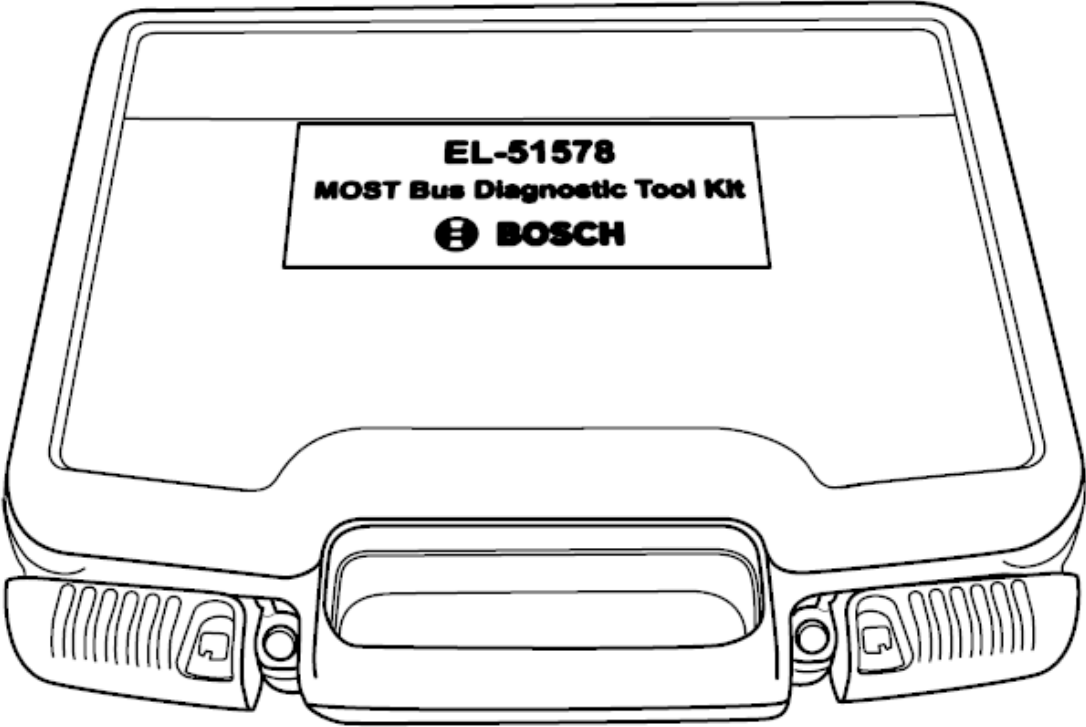
Illustration	Tool Number/Description
	EL - 51578 MOST Bus Diagnostic Tool Kit

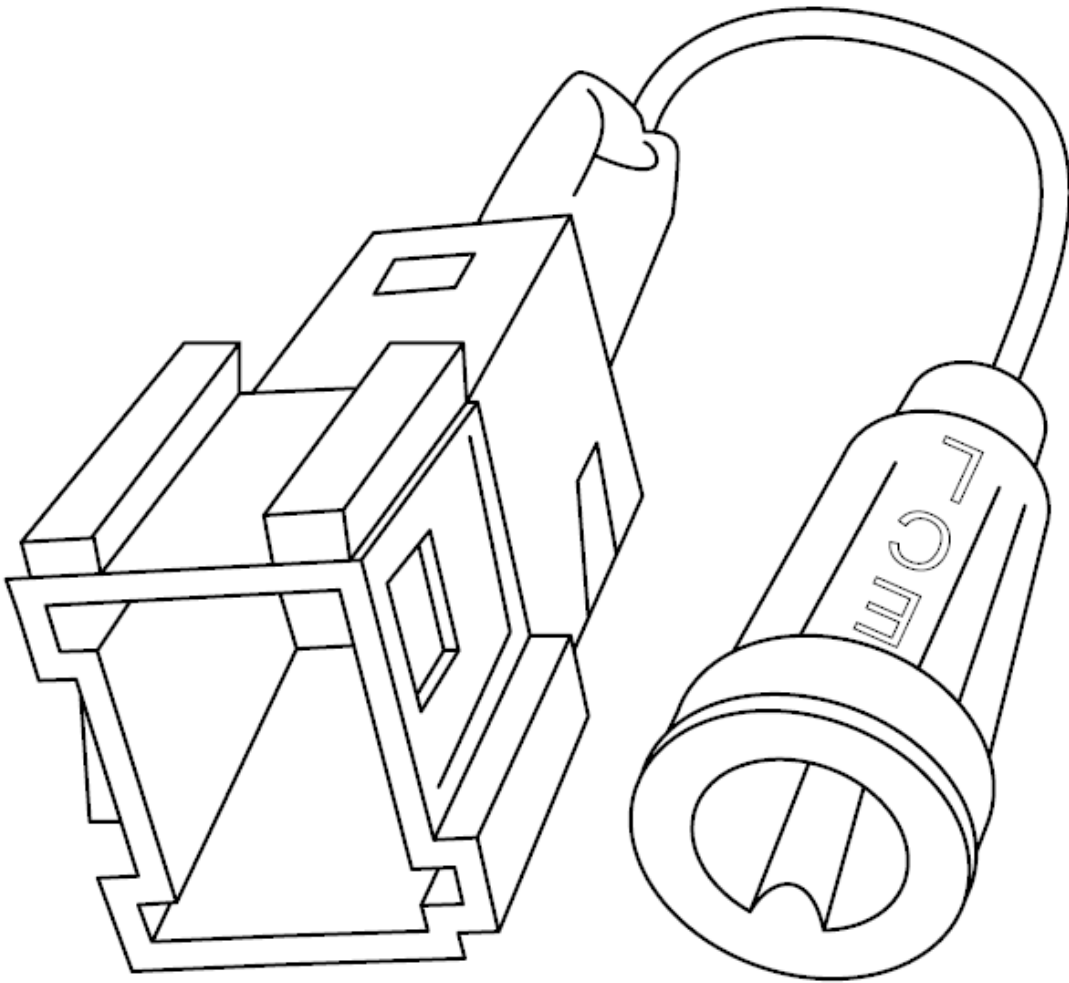
Illustration	Tool Number/Description
	EL - 51578 - 1 8 - Pin Black Connector Touch Pad

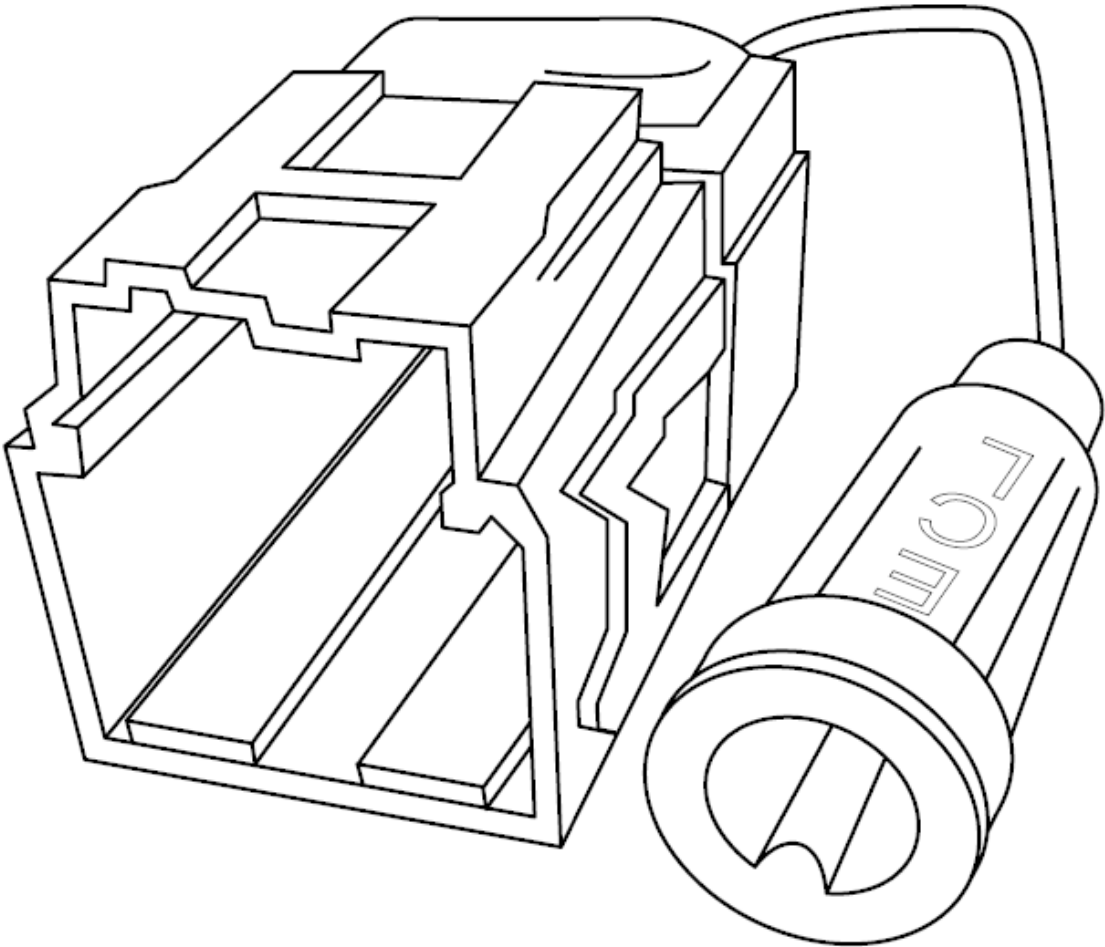
Illustration	Tool Number/Description
	EL - 51578 - 2 12 - Pin Gray Header HMI Control

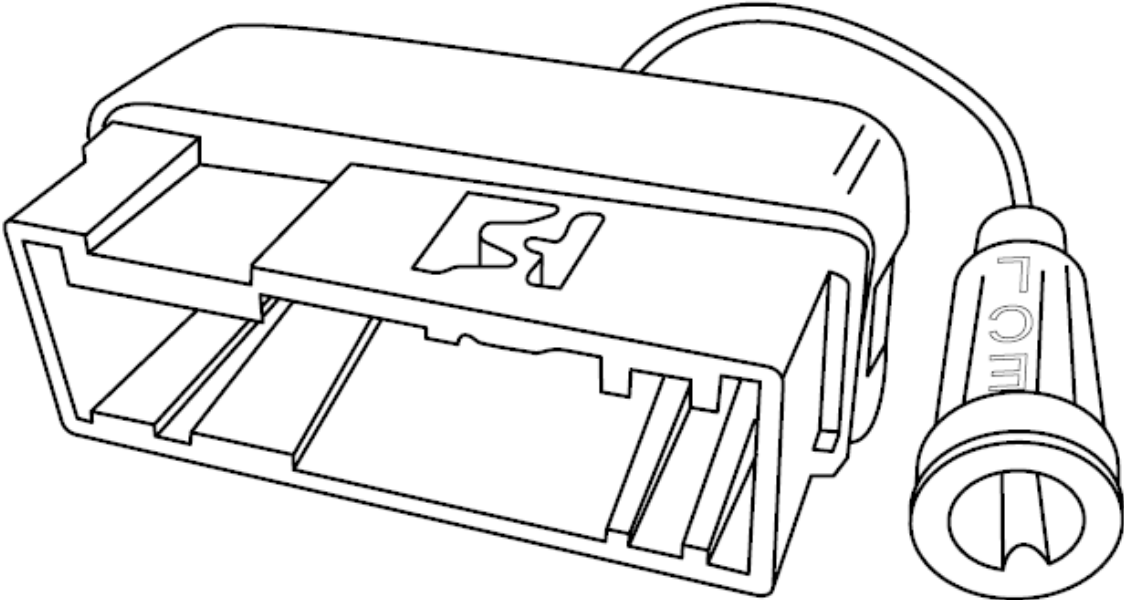
Illustration	Tool Number/Description
	EL - 51578 - 3 32 - Pin Gray Header IPC

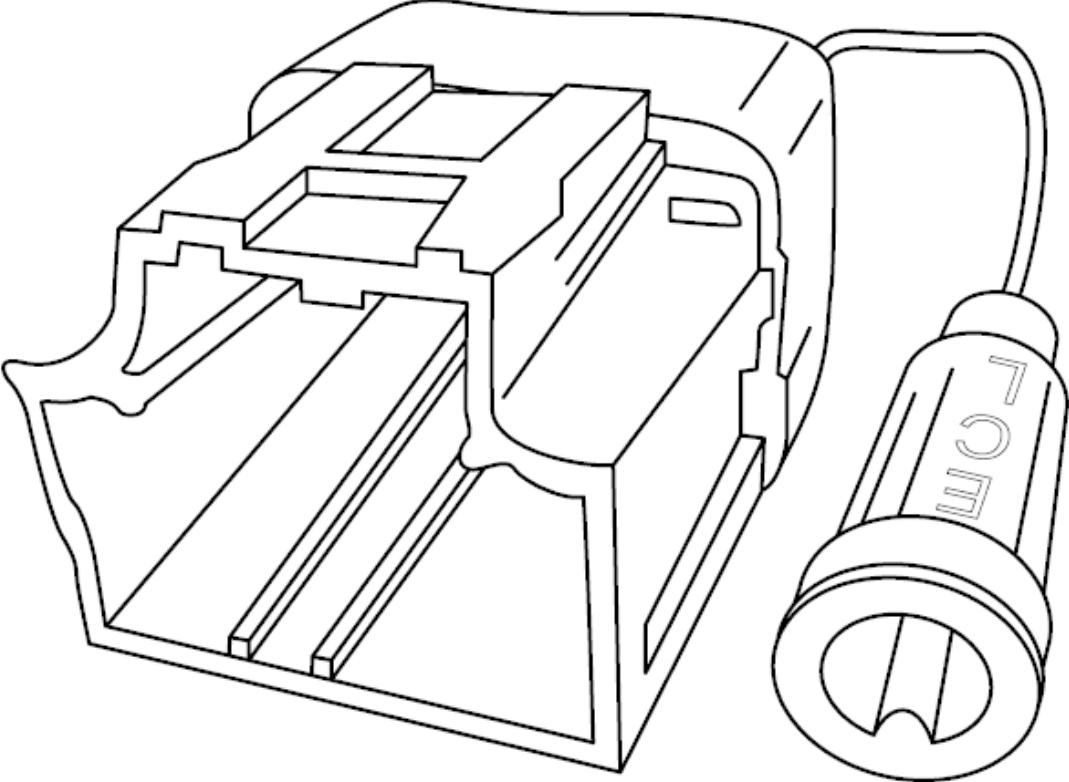
Illustration	Tool Number/Description
	EL - 51578 - 4 16 - Pin Brown Header AMP

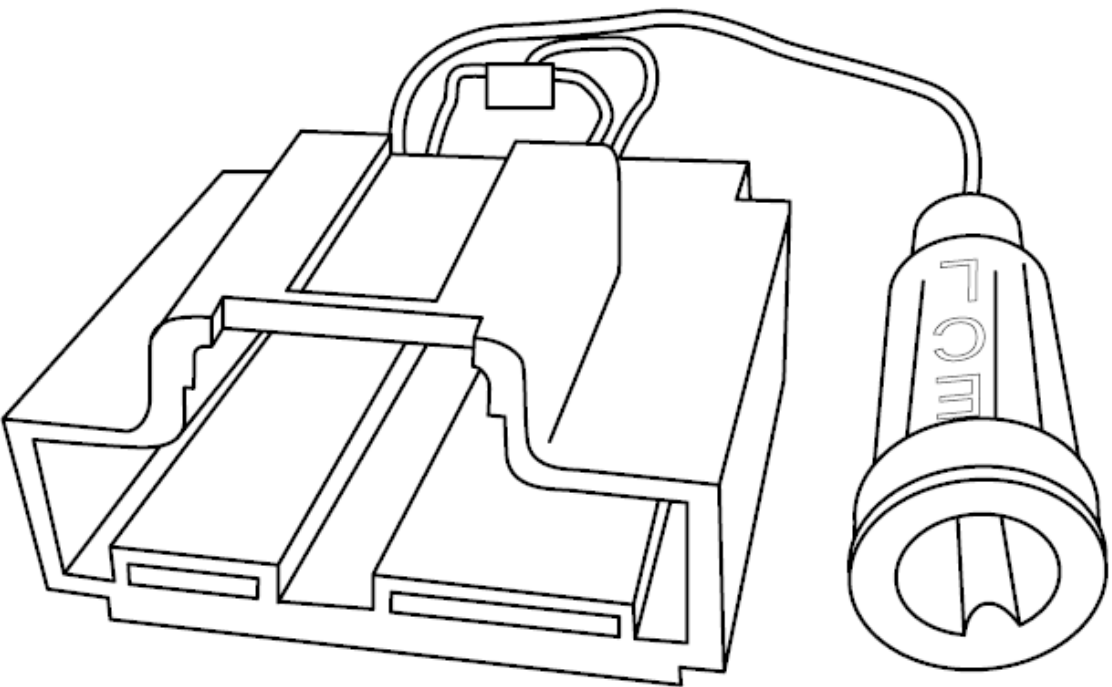
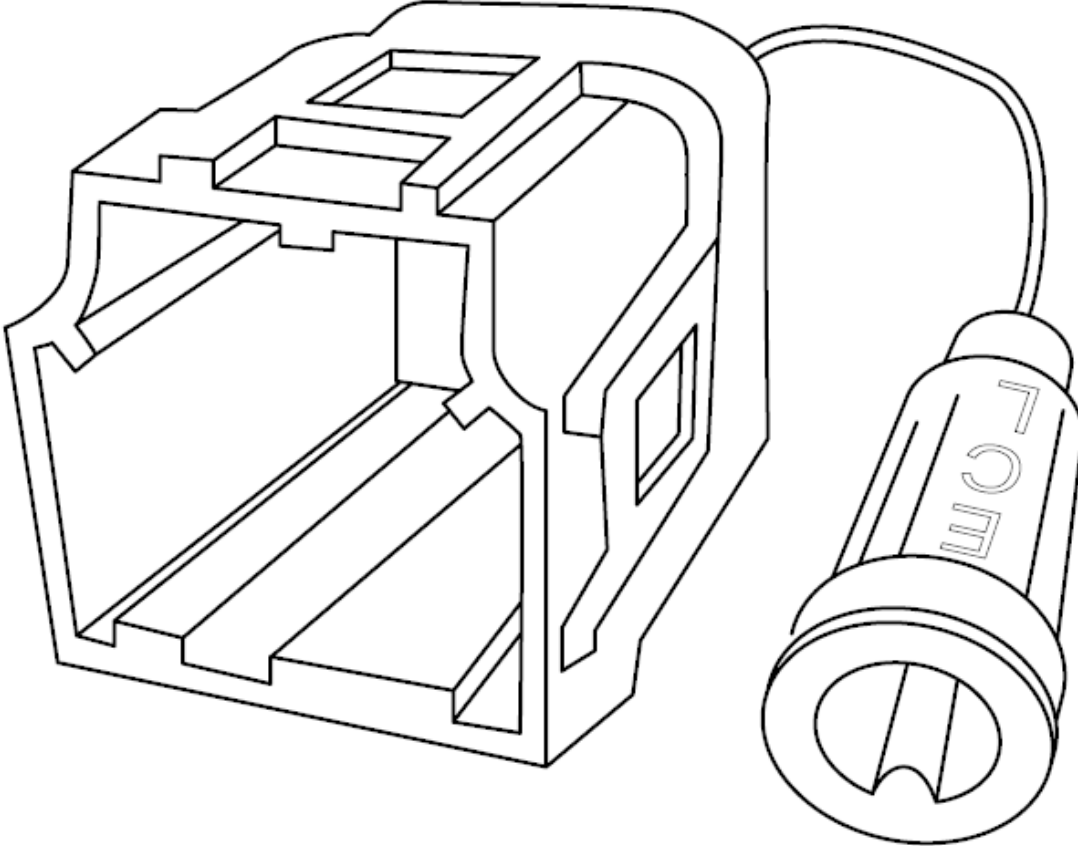
Illustration	Tool Number/Description
	EL - 51578 - 5 10 - Pin Black Connector CD

Illustration	Tool Number/Description
	EL - 51578 - 6 12 - Pin Black Header DVD

Article GUID: A00884731

ACCESSORIES & EQUIPMENT

Data Communications - Specifications - Fastener Specifications - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Hybrid Powertrain Control Module 2 Bracket Bolt	9 N.m (80 lb in)

Article GUID: A00884708

ACCESSORIES & EQUIPMENT

Wiring Systems and Power Management - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B097B: POWER MODE START SWITCH CIRCUIT (1 OF 2)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B097B

Power Mode Start Switch Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 04*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF switch indicator always OFF 2. Power mode mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the s switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

Control module voltage is 9 - 16 V.

Conditions for Setting the DTC

B097B 00

- The voltage seen at the BCM monitored switch does not match the voltage seen at the keyless entry control module monitored switch.
- The above condition exists for more than 1 s

B097B 02

- The control module detects a short to ground in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 04

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 05

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 08

- The control module detects a change in the ignition mode without observing a switch press
- The above condition occurs 4 consecutive times

B097B 61

- The control module detects a continuously closed vehicle ON/OFF switch
- The above condition exists for more than 1 min

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.

- A history DTC clears after 40 consecutive module ignition cycles without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTC B097B 61 is not set.

- **If DTC B097B 61 is set**

Test or replace the S83 Vehicle On/Off Switch.

- **If DTC B097B 61 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.

- **If 10 Ω or greater**

1. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If less than 10 Ω**

4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.

5. Disconnect the S83 Vehicle On/Off Switch.

6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.

- **If 11 V or less**

1. Connect the S83 Vehicle On/Off Switch.

2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.

3. Test for infinite resistance between the signal circuit terminal 6 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If greater than 11 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.

8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

9. Connect the harness connector at the S83 Vehicle On/Off Switch.

10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.

- **If not between 8 - 10 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 8 - 10 V**

11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V,

with the S83 Vehicle On/Off Switch pressed.

- **If not between 4 - 7 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 4 - 7 V**

12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.

13. Test for infinite resistance between the signal circuit terminal 11 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

14. Vehicle in Service Mode.

15. Test for less than 1 V between the signal circuit terminal 11 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch released.

- **If not between 4.5 - 5.5 k Ω**

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.

2. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , test or replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.

- **If not between 1 - 1.5 k Ω**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

18. Replace the K84 Keyless Entry Control Module.

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

2. Test for 4.5 - 5.5 k Ω between the terminal listed below with the S83 Vehicle ON/OFF Switch released:

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7

- **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. Test for 1 - 1.5k Ω between the terminals listed below with the S83 Vehicle On/Off Switch pressed, :

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7
- **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the appropriate control module replacement, programming and setup.

DTC B097B: POWER MODE START SWITCH CIRCUIT (2 OF 2)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B097B

Power Mode Start Switch Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 04*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF switch indicator always OFF 2. Power mode mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the s switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

Control module voltage is 9 - 16 V.

Conditions for Setting the DTC

B097B 00

- The voltage seen at the BCM monitored switch does not match the voltage seen at the keyless entry control module monitored switch.
- The above condition exists for more than 1 s

B097B 02

- The control module detects a short to ground in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 04

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 05

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 08

- The control module detects a change in the ignition mode without observing a switch press
- The above condition occurs 4 consecutive times

B097B 61

- The control module detects a continuously closed vehicle ON/OFF switch
- The above condition exists for more than 1 min

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears after 40 consecutive module ignition cycles without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTC B097B 61 is not set.
 - **If DTC B097B 61 is set**

Test or replace the S83 Vehicle On/Off Switch.

- **If DTC B097B 61 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.

- **If 10 Ω or greater**

1. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If less than 10 Ω**

4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.

5. Disconnect the S83 Vehicle On/Off Switch.

6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.

- **If 11 V or less**

1. Connect the S83 Vehicle On/Off Switch.

2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.

3. Test for infinite resistance between the signal circuit terminal 6 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If greater than 11 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.

8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

9. Verify the scan tool K84 Keyless Entry Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.

- **If 11 V or less**

1. Connect the S83 Vehicle On/Off Switch.
2. Vehicle OFF, disconnect the X1 harness connector at the K84 Keyless Entry Control Module and S83 Vehicle On/Off Switch.
3. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K84 Keyless Entry Control Module.

- **If greater than 11 V**

10. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.

11. Verify the scan tool K84 Keyless Entry Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

12. Test or replace the S83 Vehicle On/Off Switch

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.
2. Test for 4.5 - 5.5 k Ω between the terminal listed below with the S83 Vehicle ON/OFF Switch released:
 - Signal terminal 6 and ground terminal 4
 - Signal terminal 3 and low reference terminal 7
 - **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. Test for 1 - 1.5k Ω between the terminals listed below with the S83 Vehicle On/Off Switch pressed, :
 - Signal terminal 6 and ground terminal 4

- Signal terminal 3 and low reference terminal 7
- **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC B097C: POWER MODE RUN/CRANK INDICATOR CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B097C 02

Power Mode Run/Crank Indicator Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B097C 02	2	1	-
Ground	-	2	-	-
1. Vehicle ON/OFF switch indicator always ON 2. Vehicle ON/OFF switch indicator inoperative				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicates the vehicle power mode. When the vehicle is in the OFF mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

Conditions for Running the DTC

Control module voltage is 9 - 16 V

Conditions for Setting the DTC

- The BCM detects a short to ground in the control circuit.
- The above condition exists for more than 1 min.

Action Taken When the DTC Sets

The BCM disables the control output.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module power mode cycle counter reaches 40, without a repeat of the malfunction.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify the blue LED illuminates when the S83 Vehicle On/Off Switch is pressed and held up to 10 s, with the brake pedal released.
 - **If the blue LED does not illuminate**

Refer to Circuit/System Testing.
 - **If the blue LED illuminates**
2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Test for less than 1 V between the control circuit terminal 5 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - **If less than 1 V**
4. Vehicle OFF, connect the harness connector at the S83 Vehicle On/Off Switch.
5. Vehicle in Service Mode, disconnect the harness connector at the S83 Vehicle On/Off Switch.
6. Verify a test lamp illuminates between the control circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
7. Test or replace the S83 Vehicle On/Off Switch.

Component Testing

1. Vehicle OFF, disconnect the harness at the S83 Vehicle On/Off Switch.
2. Connect a jumper wire between the S83 Vehicle On/Off Switch terminal 4 and ground.
3. Connect a 3 A fused jumper wire between the S83 Vehicle On/Off Switch terminal 5 and B+.
4. Verify the blue LED illuminates.
 - **If the LED does not illuminate**

Replace the S83 Vehicle On/Off Switch.

- If the LED illuminates

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the body control module replacement, programming and setup.

DTC B1370: CONTROL MODULE IGNITION ON AND START CIRCUIT (INSTRUMENT CLUSTER)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370

Control Module Ignition On and Start Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Instrument Cluster Ignition (Instrument Panel Cluster terminal 8)	B1370 06	B1370 06	B1370 01	-

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed. The power mode master will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch.

Conditions for Running the DTC

B1370 01

Vehicle ON.

B1370 06

Vehicle ON, or Vehicle in Service Mode.

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 06

- Ignition circuit is open.
- Ignition circuit is shorted to ground.

Action Taken When the DTC Sets

The Instrument Cluster still functions except the malfunction indicator light is always off.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free Vehicle On/Off cycles have occurred.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Power Mode Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B144B is not set.

- **If DTC B144B is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC B144B is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the P16 Instrument Cluster.

2. Verify that a test lamp does not illuminate between the ignition circuit terminal 8 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode.

4. Verify that a test lamp illuminates between the ignition terminal 8 and ground.

- **If the test lamp does not illuminate and the Ignition fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , refer to **Power Mode Mismatch**.

- **If the test lamp does not illuminate and the Ignition fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the P16 Instrument Cluster.

- **If the test lamp illuminates**

5. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B144A: RUN POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B144A

Run Power Relay Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay coil control	B144A 02	-	-	-

Circuit/System Description

The body control module (BCM) feeds the ignition circuit by applying voltage when the vehicle is in Vehicle in Service Mode or Vehicle ON mode.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the ignition circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the ignition circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

[HVAC Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC control module.
2. Connect a test lamp between the ignition circuit terminal 9 and ground.
3. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the K33 HVAC control module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Control Module References for body control module and HVAC control module replacement, programming and setup.

DTC B144B: RUN/CRANK POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B144B

Run/Crank Power Relay Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B144B 02*	B144B 04*	B144B 01*	-
Control	B144B 02**	1	2	-
1. No start 2. Engine will continue to run after the ignition is turned OFF * DTC set in keyless entry control module ** DTC set in BCM				

Circuit/System Description

The body control module (BCM) controls the ignition main relay through the control circuit by applying voltage to the ignition main relay coil control circuit. The ignition main relay is energized when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested. This is part of the BCM's primary function in controlling the vehicle power mode.

The keyless entry control module controls the backup power for the ignition main relay through the control circuit by applying voltage to the ignition circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

System voltage is greater than 9 V

Conditions for Setting the DTC

B144B 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit

B144B 02 - BCM

A short to ground is detected on the ignition main relay coil control circuit

B144B 02 - Keyless Entry Control Module

The ignition output is active and a short to ground is detected 3 consecutive times on the ignition voltage circuit

B144B 04

The ignition output is not active and an open is detected 20 consecutive times on the ignition voltage circuit

Action Taken When the DTC Sets

B144B 01, B144B 04

No action is taken

B144B 02

The ignition relay is deactivated when the fault is set. After 100 ms, the ignition main relay will be activated. If the fault is still set, the relay will be deactivated. The ignition main relay will again be activated after 100 ms. If this also results in a fault, the ignition main relay will be deactivated until a new ignition request is received.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and an ignition request is received.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Diagnostic Aids

A short to voltage on the ignition main relay coil control will cause the engine to remain running after the vehicle mode is changed to OFF.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the KR73 Ignition Main Relay clicks ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.

- **If the KR73 Ignition Main Relay does not click ON and OFF**

Refer to Circuit/System Testing.

- **If the KR73 Ignition Main Relay clicks ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
2. Test for less than 1 V between the ignition circuit terminal 6 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If the test lamp illuminates**

5. Vehicle OFF, connect the X3 harness connector at the K9 Body Control Module.
6. Vehicle OFF and all vehicle systems OFF, disconnect the KR73 Ignition Main Relay. It may take up to 2 min for all vehicle systems to power down.
7. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

8. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.

9. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

10. Test or replace the KR73 Ignition Main Relay.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

DTC B1451: ACCESSORY POWER CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1451

Accessory Power Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B1451 02	B1451 04	B1451 01	-

Circuit/System Description

The keyless entry control module provides backup controls for the ignition power circuit, through the control circuit, by applying voltage to the circuit. The ignition power circuit is energized when the vehicle power mode is in Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

B1451 01, B1451 04

- Vehicle power mode is Vehicle OFF
- Module is awake
- DTC B1451 not already set
- System voltage between 6 and 16 V

B1451 02

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode
- Module is awake
- The DTC is only run when the output is active
- DTC B1451 is not already set
- System voltage between 6 and 16 V

Conditions for Setting the DTC

B1451 01

Ignition output is not active and a short to battery is detected 3 consecutive times.

B1451 02

Ignition output is active and a short to ground is detected 3 consecutive times.

B1451 04

Ignition output is not active and an open circuit is detected 20 consecutive times.

Action Taken When the DTC Sets

B1451 02

The ignition output is deactivated when a short to ground is detected. After 100 ms the output is activated again. This happens 3 times and then the output is deactivated until a new Vehicle ON or Vehicle in Service Mode request is received.

B1451 01, B1451 04

No action is taken.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present during a DTC check.
- A history DTC clears when the module power mode cycle counter reaches the reset threshold of 40, without a repeat of the malfunction.

Diagnostic Aids

- A short to voltage in the ignition control circuit will keep the vehicle modules awake, which can drain the vehicle's battery.
- A short to ground in the extension of this circuit through the body control module can back feed to the keyless entry control module. Check for a short to ground on the ignition circuit on the other side of the ignition pass thru, in the body control module, before replacing the body control module.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTC U1814 is not set.

- **If DTC U1814 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC U1814 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle in Service Mode, disconnect the X2 harness connector at the K84 Keyless Entry Control Module.
2. Verify that a test lamp illuminates between B+ circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K84 Keyless Entry Control Module.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K84 Keyless Entry Control Module and disconnect the X3 harness connector at the K9 Body Control Module.
4. Test for less than 1 V between the ignition circuit terminal 5 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
5. Vehicle in Service Mode.
6. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF. remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp illuminates**
7. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for the body control module and keyless entry control module replacement, programming and setup.

DTC B305E: INTERRUPTIBLE RAP RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B305E

Interruptible RAP Relay Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-

Circuit/System Description

The keyless entry control module controls the retained accessory power relay through the control circuit by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized when the ignition is in the Vehicle In Service Mode or the Vehicle On mode. The relay is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened

Conditions for Running the DTC

- System voltage is greater than 6 V.
- The DTC can only set when the output is actively being requested by the module.

Conditions for Setting the DTC

B305E 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit.

B305E 02

The ignition output is active and a short to ground is detected on the ignition voltage circuit.

B305E 05

The ignition output is active and an open or short to battery is detected on the ignition voltage circuit.

Action Taken When the DTC Sets

B305E 01, B305E 05

No action is taken.

B305E 02

The module output driver will be shut down and not supply voltage to the circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and the ignition output is active.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Power Moding Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the KR76 Retained Accessory Power Relay clicks ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.

- **If the KR76 Retained Accessory Power Relay does not click ON and OFF**

Refer to Circuit/System Testing.

- **If the KR76 Retained Accessory Power Relay clicks ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 86 and ground circuit terminal 85.
4. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the KR76 Retained Accessory Power Relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)**
- **Control Module References** for control module replacement, programming and setup.

DTC P15B9 OR P15BA: ELECTRIC A/C COMPRESSOR CONTROL MODULE IGNITION

ON/START SWITCH CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P15B9

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P15BA

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Electric A/C compressor control module ignition	P15B9	P15B9	P15BA	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode. The hybrid powertrain control module 2 receives the power mode status from the A/C compressor over serial data and compares this status to its own internal power mode status.

Conditions for Running the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

Conditions for Setting the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 ignition input is active.
- A/C compressor ignition input is not active for more than 2 s.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- Hybrid powertrain control module 2 ignition input is not active.
- A/C compressor ignition input is active for more than 2 s

Action Taken When the DTC Sets

P15B9, P15BA

DTCs P15B9 and P15BA are type B DTCs.

Conditions for Clearing the DTC

P15B9 or P15BA

DTCs P15B9 and P15BA, are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.

- **If the DTC is set**

Refer to **DTC B144B**.

- **If the DTC is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X1 harness connector at the G1 A/C Compressor.
2. Verify that a test lamp does not illuminate between the ignition circuit terminal 3 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode

4. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , refer to [Power Mode Mismatch](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, disconnect the harness connector at the G1 A/C Compressor and all devices that share the same ignition circuit.

2. Test for infinite resistance between the ignition circuit terminal 3 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Connect each of the devices one at a time and test for greater than 10 Ω between the ignition circuit terminal 3 and ground.

- If 10 Ω or less, disconnect the appropriate device and retest to verify if the short is in the circuit or the component.
- If greater than 10 Ω replace the appropriate device.

- **If the test lamp illuminates**

5. Replace the G1 A/C Compressor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

DTC P1A5E OR P1A5F: BATTERY ENERGY CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A5E

Battery Energy Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P1A5F

Battery Energy Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Energy Control Module Ignition	P1A5E	P1A5E	P1A5F	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay through the control circuit by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Battery energy control module is awake.
- System voltage greater than 9 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle OFF.
- Battery energy control module is awake.
- System voltage greater than 9 V.

Conditions for Setting the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Ignition input is active and not above 5 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Ignition input is not active and not below 5 V.

Action Taken When the DTC Sets

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Conditions for Clearing the DTC

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.
 - **If the DTC is set**

Refer to **DTC B144B**.
 - **If the DTC is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [**High Voltage Disabling**](#)
2. Connect the 12 V battery, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 4 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

4. Vehicle in Service Mode
5. Verify a test lamp illuminates between the ignition circuit terminal 4 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [**Power Mode Mismatch**](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, disconnect the harness connector at all devices that share the same ignition circuit.
2. Test for infinite resistance between the ignition circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance.

3. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)

4. Connect the **EL-50211** low voltage jumper harness extension.

5. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.

6. Test for infinite resistance between the ignition circuit terminal 9 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

7. Connect each of the devices that share the same ignition circuit one at a time and test for greater than 100 Ω between the ignition circuit terminal 9 and ground.

- If 100 Ω or less, disconnect the appropriate device and retest to verify if the short is in the circuit or the component.
- If greater than 100 Ω replace the appropriate device.

• **If the test lamp illuminates**

6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)

7. Connect the **EL-50211** low voltage jumper harness extension.

8. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.

9. Verify that a test lamp does not illuminate between the ignition circuit terminal 9 and ground.

• **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

• **If the test lamp does not illuminate**

10. Vehicle in Service Mode

11. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.

• **If the test lamp does not illuminate.**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

• **If the test lamp illuminates**

12. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

DTC P1A60: BATTERY ENERGY CONTROL MODULE IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A60

Battery Energy Control Module Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data Wake-Up	P1A60, P06E4, U1814, U2099	P1A60	-	-

Circuit/System Description

The hybrid powertrain control module 2 sends the serial data wake-up power mode status in a serial data message to the battery energy control module. The hybrid powertrain control module 2 also powers up the serial data wake-up circuit to the battery energy control module when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode
- Battery energy control module is awake
- System voltage greater than 9 V

Conditions for Setting the DTC

Ignition input is active, and 500 ms after the ignition input transitions high, a voltage below 5 V is detected 3 consecutive times

Action Taken When the DTC Sets

DTC P1A60 is a type B DTC.

Conditions for Clearing the DTC

DTC P1A60 is a type B DTC.

Diagnostic Aids

A short to voltage in the serial data wake-up circuit will keep the vehicle bus awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814, U2099, or P06E4 is not set.

- If any of the DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If none of the DTCs are set

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Connect the 12 V battery, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
3. Connect a test lamp between the serial data wake-up circuit terminal 5 and ground.
4. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 2 Ω in the serial data wake-up circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp turns ON and OFF**
5. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)
6. Connect the **EL-50211** low voltage jumper harness extension.
7. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
8. Connect a test lamp between the serial data wake-up circuit terminal 3 and ground.
9. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the **EL-50211** low voltage jumper harness extension.
 2. Test for less than 2 Ω in the serial data wake-up circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the **EL-50211** low voltage jumper harness extension.
 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
- **If the test lamp turns ON and OFF**

10. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup,

DTC P2534 OR P2535: IGNITION ON/START SWITCH CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2534

Ignition On/Start Switch Circuit Low Voltage

DTC P2535

Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2534	P2534	P2535	-

Circuit/System Description

The body control module (BCM) controls the ignition relay through the control circuit by applying voltage to the circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P2534, P2535

The control module is awake.

Conditions for Setting the DTC

P2534

The control module detects 2 V or less on the ignition voltage circuit.

P2535

The control module detects greater than 5 V or greater on the ignition voltage circuit, with the ignition turned OFF.

Action Taken When the DTC Sets

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Conditions for Clearing the DTC

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.

- **If the DTC is set**

Refer to **DTC B144B**.

- **If the DTC is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

For European Regions

WARNING: High voltage enabling and disabling shall be only performed by High Voltage Qualified Technicians. The procedures for high voltage enabling/disabling can be found in the service instructions and must be strictly followed at all times. The usage of the Protocol High Voltage Disabling / Enabling is mandatory. The High Voltage Qualified Technician is responsible for the adherence to the manufacturer's service instructions as well as current national legal regulations.

Failure to follow the procedures exactly as written may result in serious injury or death.

Questions regarding training can be answered by your national training center.

WARNING: Any hybrid/EV battery pack replacement shall be performed by High Voltage Qualified Technicians only. The replacement procedure can be found in the service instruction and must be strictly followed at all times. The High Voltage Qualified Technician is responsible for adherence to the manufacturer's service instructions as well as current national legal regulations. If the hybrid/EV battery pack needs to be replaced contact the Technical Assistance Centre for further instructions prior removal of the battery pack.

For Non-European Regions

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and

personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF and all vehicle systems off, disconnect the harness connector at the control module setting the DTC.
2. Verify that a test lamp does not illuminate between the ignition circuit and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [**Power Mode Mismatch**](#)

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the control module setting the DTC.

- **If the test lamp illuminates**

5. Replace the control module setting the DTC.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

[**Control Module References**](#) for the appropriate control module replacement, programming and setup.

DTC P2537: IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2537

Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2537, P06E4, U1814, U2099	P2537	-	-

Circuit/System Description

The control module continuously monitors the voltage on the ignition accessory circuit every 0.1s. Higher or lower than normal voltage may cause erratic vehicle operation.

Conditions for Running the DTC

P2537

Propulsion system is active for.5 s.

Conditions for Setting the DTC

P2537

The device detects the accessory voltage circuit is open for 0.1 s.

Action Taken When the DTC Sets

P2537

P2537 is a Type B DTC.

Conditions for Clearing the DTC

P2537

P2537 is a Type B DTC.

Diagnostic Aids

Short to ground may set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814, U2099, or P06E4 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If none of the DTCs are set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and

personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Hybrid/EV Powertrain Control Module 2 Circuit Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the accessory wake up serial data circuit terminal 67 and ground.
 - **If the test lamp does not illuminate.**
 1. Ignition OFF remove the test lamp, disconnect the X4 connector at the K9 Body Control Module.
 2. Test for less than 2 Ω on the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Engine Control Module Circuit Malfunction

1. Vehicle OFF and all vehicle systems off, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the Accessory Wake up Serial Data 2 circuit terminal 13 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the KR114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 2 Ω on the Accessory Wake up Serial Data 2 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the KR114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

4. Replace the control module setting the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup,

SYMPTOMS - WIRING SYSTEMS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to:
 - [Power Mode Description and Operation](#)
 - [Retained Accessory Power Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Power Mode Mismatch](#)
- [Retained Accessory Power Malfunction](#)
- [Vehicle ON/OFF Switch Indicator Malfunction](#)
- [Vehicle Will Not Change Power Mode](#)

IGNITION CAN/CANNOT BE TURNED OFF WITH TRANSMISSION IN ANY GEAR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	2	1	-	-
Ground	-	1	-	-
1. Ignition will not turn to OFF with vehicle in park 2. Ignition will turn to OFF with vehicle out of park				

Circuit/System Description

The electronic park lock system purpose is to prevent the ignition from being switched to the OFF position when the transmission shift lever is in any position other than Park and the vehicle may still be moving. The electronic park lock system incorporates the park position switch that located in the shift lock control switch. When the transmission shift lever is in Park, the park position switch closes and the BCM allows the ignition to be turned OFF.

If the vehicle is not in Park, the ignition will turn to ACC/ACCESSORY and display the message SHIFT TO PARK in the Driver Information Center. When the vehicle is shifted into Park, the ignition system will switch to OFF.

Diagnostic Aids

Verify that the transmission shift selector indicator matches the position of the gear shift lever while selecting between the Park, Reverse, Drive and Low positions.

Reference Information

Schematic Reference

[Shift Lock Control Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Electronic Park Lock Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Body Control Module In Park Switch Status parameter changes between On and Off when shifting the S3 Transmission Shift Lever in and out of Park.

- **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Body Control Module In Park Switch Status parameter is Off.

- **If not Off**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Off**

5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 2.
6. Verify the scan tool Body Control Module In Park Switch Status parameter is On.

- **If not On**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If On**

7. Test or replace the S3 Transmission Shift Lever.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Transmission Control Replacement \(With Base\)](#) [Transmission Control Replacement \(Without Base\)](#)
- [Control Module References](#) for the appropriate control module replacement, programming, and setup.

POWER MODE MISMATCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to the run/crank relay coil control circuit. The ignition main relay is energized when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing, no door is opened and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center.

The engine control module (ECM) controls the engine controls ignition relay by applying voltage to the engine controls relay control circuit.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Power Mode Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Use schematics to determine which ignition relay supplies the ignition feed for the appropriate devices. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Vehicle in Service Mode.
2. Verify that the appropriate devices controlled by the KR73 Ignition Main Relay turn ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.

- **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic A.

- **If the devices turn ON and OFF**

3. Verify that the appropriate devices controlled by the KR75 Engine Controls Ignition Relay turn ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.

- **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic B.

- **If the devices turn ON and OFF**

4. Verify that the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.

- **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic C.

- **If the devices turn ON and OFF**

5. All OK.

Circuit/System Testing

WARNING: High voltage enabling and disabling shall be only performed by High Voltage Qualified Technicians. The procedures for high voltage enabling/disabling can be found in the service instructions and must be strictly followed at all times. The usage of the Protocol High Voltage Disabling / Enabling is mandatory. The High Voltage Qualified Technician is responsible for the adherence to the manufacturer's service instructions as well as current national legal regulations.

Failure to follow the procedures exactly as written may result in serious injury or death.

Questions regarding training can be answered by your national training centre.

WARNING: Any hybrid/EV battery pack replacement shall be performed by High Voltage Qualified Technicians only. The replacement procedure can be found in the service instruction and must be strictly followed at all times. The High Voltage Qualified Technician is responsible for adherence to the manufacturer's service instructions as well as current national legal regulations. If the hybrid/EV battery pack needs to be replaced contact the Technical Assistance Centre for further instructions prior removal of the battery pack.

Diagnostic A

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR73 Ignition Main Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

7. Verify that a test lamp does not illuminate between the ignition circuit terminal 5 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 3 and the ignition circuits listed below.
 - Ignition circuit terminal 4
 - Ignition circuit terminal 5

9. Verify the device is activated.

- **If the device does not activate**

1. Vehicle OFF, disconnect the harness connector at the device.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the device.

- **If the device activates**

10. Test or replace the KR73 Ignition Main Relay.

Diagnostic B

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR75 Engine Controls Ignition Relay, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood

- **If the test lamp illuminates**

3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

- **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood

- **If the test lamp illuminates**

4. Connect a test lamp between the B+ circuit terminal 1 and the control circuit terminal 2.
5. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 engine control module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 engine control module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 engine control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 engine control module.

- **If the test lamp turns ON and OFF**

6. Verify that a test lamp does not illuminate between the ignition circuit terminal 5 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

7. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 3 and the ignition circuit terminal 5.
8. Verify device is activated.

- **If the device does not activate**

1. Vehicle OFF, disconnect the harness connector at the device.
2. Test for infinite resistance between the ignition circuit terminal 87 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the device.

- **If the device activates**

9. Test or replace the KR75 Engine Controls Ignition Relay.

Diagnostic C

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate**

Replace the X51A Fuse Block - Instrument Panel
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If the test lamp turns ON and OFF**
7. Verify that a test lamp does not illuminate between the ignition circuit terminal 87 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the ignition circuit terminal 87.

9. Verify device is activated.

- **If the device does not activate**

1. Vehicle OFF, disconnect the harness connector at the device.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the device.

- **If the device activates**

10. Test or replace the KR76 Retained Accessory Power Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the appropriate relay.

2. Test for 70 - 150 Ω between terminals (85 or 1) and (86 or 2).

- **If less than 70 or greater than 150 Ω**

Replace the relay.

- **If between 70 - 150 Ω**

3. Test for infinite resistance between the terminals listed below:

- (30 or 3) and (86 or 2)

- (30 or 3) and (87 or 5)

- (30 or 3) and (85 or 1)

- (85 or 1) and (87 or 5)

- (86 or 2) and (87 or 5)

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.

5. Test for less than 5.0 Ω between terminals (30 or 3) and (87 or 5).

- **If 5.0 Ω or greater**

Replace the relay.

- If less than 5.0 Ω

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

RETAINED ACCESSORY POWER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Switch B+	1	1	1	-
Relay Switch Ignition	1	1	1, 2	-
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-
Relay Coil Ground	-	B305E 05	-	-
Ground	-	1	-	-
1. Retained accessory power malfunction 2. Retained accessory power relay always ON				

Circuit/System Description

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing, no door is opened and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Use schematics to determine which devices are controlled by the KR76 Retained Accessory Power Relay. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Ignition ON.
2. Verify the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
 - **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing

- **If the devices turn ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

- **If the test lamp does not illuminate**

Replace the X51A Fuse Block - Instrument Panel

- **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If the test lamp turns ON and OFF**

7. Connect the KR76 Retained Accessory Power Relay.
8. Disconnect the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.
9. Vehicle OFF.
10. Verify that a test lamp does not illuminate between each of the ignition circuits listed below and ground.
 - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
 - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A
 - T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

11. Vehicle in Service Mode.
12. Verify that a test lamp illuminates between each of the ignition circuits listed below and ground.
 - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
 - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A

- T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1
- **If the test lamp does not illuminate and the circuit breaker or fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the K84 Keyless Entry Control Module.

- **If the test lamp does not illuminate and the circuit breaker or fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.

- **If the test lamp illuminates**

13. Test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR76 Retained Accessory Power Relay.

2. Test for 70 - 150 Ω between terminals 85 and 86.

- **If less than 70 or greater than 150 Ω**

Replace the relay.

- **If between 70 - 150 Ω**

3. Test for infinite resistance between the following terminals:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Test for less than 5.0 Ω between terminals 30 and 87.

- **If 5.0 Ω or greater**

Replace the relay.

- **If less than 5.0 Ω**

5. Install a 3 A fused jumper wire between relay terminal 41 and 12 V. Install a jumper wire between relay

terminal 40 and ground.

6. Test for less than 5.0 Ω between terminals 30 and 87.

- **If 5.0 Ω or greater**

Replace the relay.

- **If less than 5.0 Ω**

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Accessory Power Receptacle Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

VEHICLE ON/OFF SWITCH INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B097C 02	2	1	-
Ground	-	2	-	-
1. Vehicle ON/OFF switch indicator always ON 2. Vehicle ON/OFF switch indicator inoperative				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicates the vehicle power mode. When the vehicle is in the OFF mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for at least 5 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify the blue LED illuminates when the S83 Vehicle ON/OFF Switch is pressed and held for at least 5 s, with the brake pedal released.

- **If the blue LED does not illuminate**

Refer to Circuit/System Testing.

- **If the blue LED illuminates**

2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Test for less than 1 V between the control circuit terminal 5 and ground.

- **If 1 V or greater**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

4. Vehicle OFF, connect the harness connector at the S83 Vehicle ON/OFF Switch.

5. Vehicle in Service Mode, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

6. Verify a test lamp illuminates between the control circuit terminal 5 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

7. Test or replace the S83 Vehicle ON/OFF Switch.

Component Testing

1. Vehicle OFF, disconnect the harness at the S83 Vehicle ON/OFF Switch.

2. Connect a jumper wire between the S83 Vehicle ON/OFF Switch terminal 4 and ground.

3. Connect a 3 A fused jumper wire between the S83 Vehicle ON/OFF Switch terminal 5 and B+.

4. Verify the blue LED illuminates.

- **If the LED does not illuminate**

Replace the S83 vehicle ON/OFF switch.

- **If the LED illuminates**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the body control module replacement, programming and setup.

VEHICLE WILL NOT CHANGE POWER MODE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 05*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF Switch Indicator Always Off 2. Power Mode Mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains 2 individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through 2 resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify DTC B097B 08 or B097B 61 is not set.

- **If either DTC is set**

Test or replace the S83 Vehicle On/Off Switch.

- **If the DTCs are not set**

2. Verify the blue LED illuminates when the S83 Vehicle On/Off Switch is pressed and held for up to 10 s, with the brake pedal released.

- **If the blue LED does not illuminate**

Refer to Circuit/System Testing.

- **If the blue LED illuminates**

3. All OK.

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**

1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
- **If less than 10 Ω**
3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
 - **If 10 Ω or greater**
 - 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If less than 10 Ω**
4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.
5. Disconnect the S83 Vehicle On/Off Switch.
6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
 - **If 11 V or less**
 - 1. Connect the S83 Vehicle On/Off Switch.
 - 2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.
 - 3. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If greater than 11 V**
7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.
 - **If 1 V or greater**
 - 1. Disconnect the harness connector at the K9 Body Control Module.
 - 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - 3. Test for less than 2 Ω in signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If less than 1 V**
9. Connect the harness connector at the S83 Vehicle On/Off Switch.
10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.
 - **If not between 8 - 10 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 8 - 10 V**

11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V, with the S83 Vehicle On/Off Switch pressed.

- **If not between 4 - 7 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 4 - 7 V**

12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.

13. Test for infinite resistance between the signal circuit terminal 11 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

14. Vehicle in Service Mode.

15. Test for less than 1 V between the signal circuit terminal 11 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch released.

- **If not between 4.5 - 5.5 k Ω**

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.

2. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , test or replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.

- **If not between 1 - 1.5 k Ω**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

18. Replace the K84 Keyless Entry Control Module.

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 vehicle ON/OFF switch.

2. With the S83 vehicle ON/OFF switch released, test for 4.5 - 5.5 k Ω between the terminal listed below:

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7
- **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. With the S83 Vehicle On/Off Switch pressed, test for 1 - 1.5k Ω between the terminals listed below:

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7
- **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the appropriate control module replacement, programming and setup.

GENERAL ELECTRICAL DIAGNOSIS

Basic Knowledge Required

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in the service manual. You should understand the basic theory of electricity, and know the meaning of voltage (V), current (A), and resistance (Ω). You should also be able to read and understand a wiring diagram, as well as understand what happens in a circuit with an open or a shorted wire.

CHECKING AFTERMARKET ACCESSORIES

WARNING: Refer to [SIR Warning](#) .

Do not connect aftermarket accessories into the SIR circuits, all such circuits are indicated on circuit diagrams with the SIR symbol.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery

- Antenna location
- Transceiver wiring located too close to vehicle electronic modules or wiring
- Poor shielding or poor connectors on antenna feed line
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

CIRCUIT TESTING

The Circuit Testing section contains the following diagnostic testing information. Using this information along with the diagnostic procedures will identify the cause of the electrical malfunction.

- [Using Connector Test Adapters](#)
- [Probing Electrical Connectors](#)
- [Troubleshooting with a Digital Multimeter](#)
- [Troubleshooting with a Test Lamp](#)
- [Using Fused Jumper Wires](#)
- [Measuring Voltage](#)
- [Measuring Voltage Drop](#)
- [Measuring Frequency](#)
- [Testing Ground and Low Reference Circuits](#)
- [Testing for Continuity](#)
- [Testing for Short to Ground](#)
- [Testing for a Short to Voltage](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Inducing Intermittent Fault Conditions](#)
- [Testing for Electrical Intermittents](#)
- [Scan Tool Snapshot Procedure](#)
- [Circuit Protection - Fuses](#)
- [Circuit Protection - Circuit Breakers](#)
- [Circuit Protection - Fusible Links](#)

USING CONNECTOR TEST ADAPTERS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system

failure. Always use the J-35616-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the J-35616-F GM Approved Terminal Release Tool Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

PROBING ELECTRICAL CONNECTORS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: Always be sure to reinstall the connector position assurance (CPA) and terminal position assurance (TPA) when reconnecting connectors or replacing terminals.

Front probe

Disconnect the connector and probe the terminals from the mating side (front) of the connector.

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: When probing female 0.64 terminals, it is important to use the correct adapter. There have been some revisions to the test adapter for 0.64 terminals. The proper adapter for 0.64 terminals is the J-35616-64B which has a gold terminal and a black wire between the base and tip. Failure to use the proper test adapter may result in damage to the terminal being tested and improper diagnosis.

NOTE: The proper adapter for probing the terminals for fuses, relays, or diodes in an electrical center is J-35616-35. Using any other tool or adapter may damage the terminal being tested.

Refer to the following table as a guide in selecting the correct test adapter for front probing connectors:

Test Adapter	Description
J-35616-2A	150 Male Probe Adapter (gray)
J-35616-3	150 Female Probe Adapter (gray)

Test Adapter	Description
J-35616-4A	280 Male Probe Adapter (purple)
J-35616-5	280 Female Probe Adapter (purple)
J-35616-6	100W Male (round) Probe Adapter (brown)
J-35616-7	100W Female (round) Probe Adapter (brown)
J-35616-8	Weather Pack Male Probe Adapter (orange)
J-35616-9	Weather Pack Female Probe Adapter (orange)
J-35616-10	100W Male (round) Probe Adapter (green)
J-35616-11	100W Female (round) Probe Adapter (green)
J-35616-12	130 Male Probe Adapter (blue)
J-35616-13	130 Female Probe Adapter (blue)
J-35616-14	150 Male Probe Adapter (green)
J-35616-16	100 Male Probe Adapter (lt green)
J-35616-17	100 Female Probe Adapter (lt green)
J-35616-18	220 Male Probe Adapter (black)
J-35616-19	220 Female Probe Adapter (black)
J-35616-21	950 Female Probe Adapter (red)
J-35616-22	950 Male Probe Adapter (red)
J-35616-31	500 Male Probe Adapter (orange)
J-35616-32	500 Female Probe Adapter (orange)
J-35616-33	160/180 Male Probe Adapter (yellow)
J-35616-34	160/180 Female Probe Adapter (yellow)
J-35616-35	280 Male Probe Adapter (violet)
J-35616-40	480 Male Probe Adapter (dk blue)
J-35616-41	480 Female Probe Adapter (dk blue)
J-35616-42	630 Male Probe Adapter (red)
J-35616-43	630 Female Probe Adapter (red)
J-35616-44	800 Male Probe Adapter (yellow)
J-35616-45	800 Female Probe Adapter (yellow)
J-35616-54	280 Male (round) Probe Adapter (tan)
J-35616-55	280 Female (round) Probe Adapter (tan)
J-35616-64B	0.64 Male Probe Adapter (lt blue)
J-35616-65B	0.64 Female Probe Adapter (lt blue)
J-35616-66	150 Male (round) Probe Adapter (yellow)
J-35616-67	150 Female (round) Probe Adapter (yellow)

Backprobe

NOTE:

- Backprobe connector terminals only when specifically required in diagnostic procedures.
- Do not backprobe a sealed (Weather Pack®) connector, less than a 280 series Metri-Pack connector, a Micro-Pack connector, or a flat wire connector.

- **Backprobing can be a source of damage to connector terminals. Use care in order to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large of a test probe.**
- **After backprobing any connector, inspect for terminal damage. If terminal damage is suspected, test for proper terminal contact.**

Do not disconnect the connector and probe the terminals from the harness side (back) of the connector.

TROUBLESHOOTING WITH A DIGITAL MULTIMETER

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

Digital Multimeter (DMM) Basic Requirements

Service information is validated using digital multimeters that meet or exceed the following requirements. Using a multimeter that does not meet these basic requirements may give inaccurate readings which could lead to an incorrect diagnosis.

Display and Settings

1. Four digits displayed
2. Voltage, current, resistance, frequency, diode test settings, and min-max function
3. Display positive and negative values

Voltage

1. Have at least 10 M Ω input impedance
2. Test a DC voltage range of 0.1 - 1000 V.
3. Test an AC voltage range of 0.1 - 1000 V.

Current

1. Test a DC current range of 0.1 μ A - 10 A.
2. Test an AC current range of 0.1 μ A - 10 A.

Resistance

Test a resistance range of 0.1 Ω - 40 M Ω and displays infinite for a value greater than 40 M Ω (O.L. (Over-

load))

Frequency

Test for a frequency range of 0.5 HZ - 199 K HZ

Diode Test

1. Apply at least 2 mA when performing the diode bias test
2. Display the break over voltage drop (0 - 3 V) of a forward biased diode
3. Display infinite (O.L. (Over-load)) when a diode is reverse biased

Min-Max Readings

1. Can update at a 25 ms sample rate
2. Saves and displays minimum and maximum values

NOTE: **Circuits which include any solid state control modules, such as the engine control module (ECM), should only be tested with a 10 megohm or higher impedance digital multimeter such as the EL-39200.**

The DMM instruction manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for future reference.

A DMM should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The ohmmeter function on a DMM shows how much resistance exists between 2 points along a circuit. Low resistance in a circuit means good continuity.

NOTE: **Disconnect the power feed from the suspect circuit when measuring resistance with a DMM. This prevents incorrect readings. DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.**

Diodes and solid state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement take a reading once, then reverse the leads and take a second reading. If the readings differ the solid state component is affecting the measurement.

Following are examples of the various methods of connecting the DMM to the circuit to be tested:

- Probe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test driving. Refer to [**Probing Electrical Connectors**](#).
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.
- If the system that is being diagnosed has a specified pinout or breakout box, it may be used in order to

simplify connecting the DMM to the circuit or for testing multiple circuits quickly.

TROUBLESHOOTING WITH A TEST LAMP

Special Tools

EL-35616-200 Test Light - Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

A test lamp can simply and quickly test a low impedance circuit for voltage. A digital multimeter (DMM) should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The **EL-35616-200** kit is Micro-Pack compatible and comprised of a 12 V light bulb with an attached pair of leads.

To properly operate this tool use the following procedures.

When testing for voltage:

1. Attach one lead to ground.
2. Touch the other lead to various points along the circuit where voltage should be present.
3. When the bulb illuminates, there is voltage at the point being tested.

When testing for ground:

1. Attach one lead to battery positive voltage.
2. Touch the other lead to various points along the circuit where ground should be present.
3. When the bulb illuminates, there is ground at the point being tested.

USING FUSED JUMPER WIRES

Special Tools

EL 35616-20F Fused Jumper Wire

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: A fused jumper may not protect solid state components from being damaged.

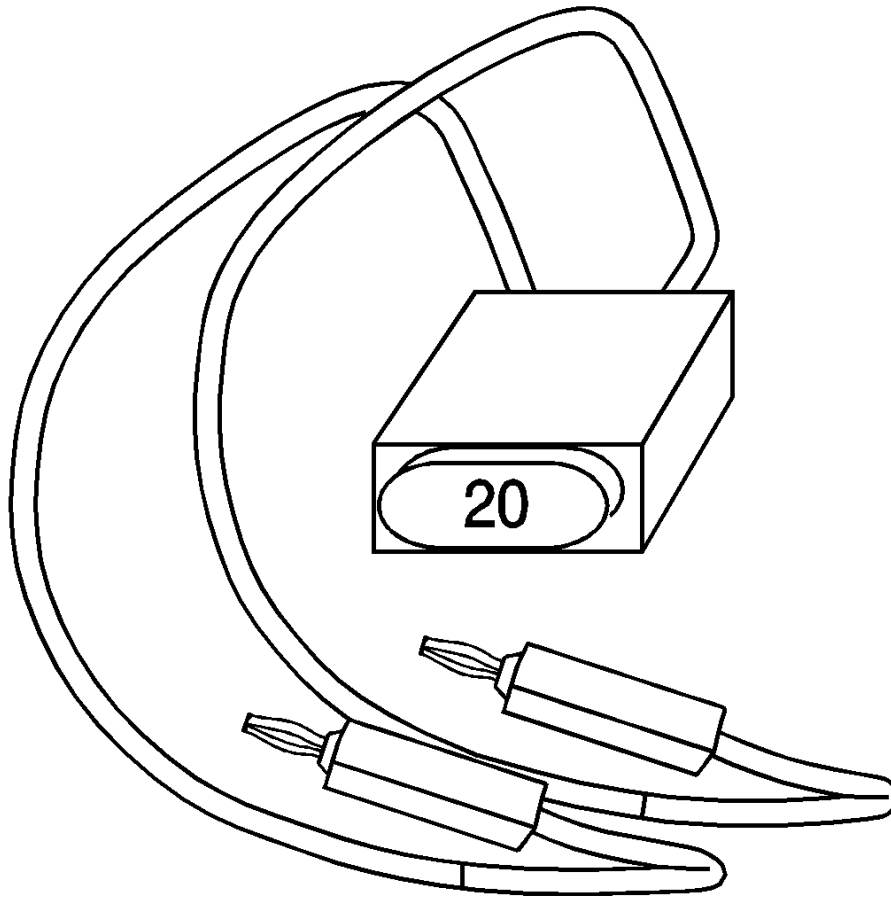


Fig. 1: Fused Jumper Wire

Courtesy of **GENERAL MOTORS COMPANY**

The **EL 35616-20F** Fused Jumper Wire includes banana jack connectors that provide adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

MEASURING VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with**

leather protectors

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure measures the voltage at a selected point in a circuit.

1. Disconnect the electrical harness connector for the circuit being tested, if necessary.
2. Enable the circuit and/or system being tested. Use the following methods:
 - Vehicle power mode to Vehicle in Service Mode or Vehicle On.
 - Turn ON the circuit and/or system with a scan tool in Output Controls.
 - Turn ON the switch for the circuit and/or system being tested.
3. Select the V (AC) or V (DC) position on the digital multimeter (DMM).
4. Connect the positive lead of the DMM to the point of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. The DMM displays the voltage measured at that point.

MEASURING VOLTAGE DROP

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure determines the difference in voltage potential between 2 points.

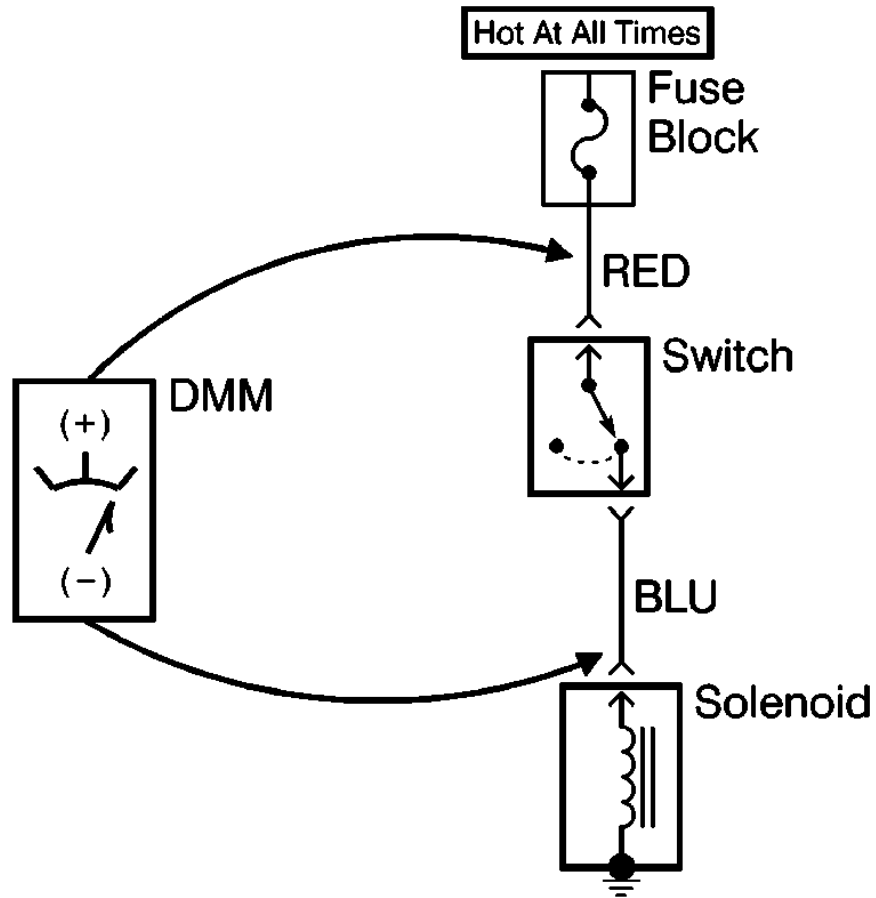


Fig. 2: Measuring Voltage Drop

Courtesy of GENERAL MOTORS COMPANY

1. Set the Digital Multimeter (DMM) to the V (DC) position.
2. Connect the positive lead of the DMM to one point of the circuit to be tested.
3. Connect the negative lead of the DMM to the other point of the circuit.
4. Operate the circuit.
5. The DMM displays the difference in voltage between the 2 points.

MEASURING FREQUENCY

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure determines the frequency of a signal.

NOTE: **Connecting the Digital Multimeter (DMM) to the circuit before pressing the Hz button will allow the DMM to autorange to an appropriate range.**

1. Apply power to the circuit.
2. Set the DMM to the V (AC) position.
3. Connect the positive lead of the DMM to the circuit to be tested.
4. Connect the negative lead of the DMM to a good ground.
5. Set to Hz on the DMM.
6. The DMM will display the frequency measured.

TESTING GROUND AND LOW REFERENCE CIRCUITS

Because a test lamp can light with up to 200 Ω in a ground or low reference circuit they are not recommended to be used for this type of test. A low impedance test lamp can light and indicate the circuit is good when there is as much as 20 - 30 Ω present, while a high impedance test lamp can light with up to 200 Ω present in the circuit. This is why the Digital Multi-Meter (DMM) is used when validating a ground or low reference circuit continuity.

When using the DMM there are many vehicle conditions that can affect the ground and low reference continuity testing. If these conditions are not met, a ground or low reference circuit test can fail on a good circuit. This may cause longer diagnosis time and incorrect component replacement.

Any current flow through a ground or low reference circuit, while being tested, will skew the DMM continuity reading, or display a reading higher than when there is no current flowing. Performing a ground or low reference circuit continuity test, in reference to the vehicles battery negative terminal, will have the highest risk of failing a good ground or low reference circuit test than any other ground reference point. The best ground test points would be a control module housing (if the control modules housing is metal and grounded), door jamb striker (if attached to metal), under dash metal frame work, engine block, or body ground studs (other than where the negative battery cable is attached).

A typical DMM ground or low reference circuit continuity reading can be as high as 100 Ω with the vehicle power mode in Vehicle ON or Vehicle in Service Mode, and drop to 15 - 25 Ω after switching the vehicle off. The reading will drop below 10 Ω after 30 - 40 s, then below 5 Ω after 60 s. Once the vehicle completely goes to sleep (generally 3-10 min) the reading will drop below 0.3 Ω .

The following list of conditions may need to be met to ensure a valid continuity reading on a ground or low reference circuit:

- Vehicle off
- Transmitter out of range of the vehicle
- Retained Accessory Power off (open and close the driver door after vehicle off)
- Battery charger set at a 2 A or less charge rate
- Scan tool not communicating with any vehicle control module (in some cases it may need to be disconnected from the DLC)
- All entry doors closed

- Headlamps off(auto headlamps disabled)
- Any delay lighting off
- HVAC after blow off
- Any accessory that can work when the vehicle power mode is Vehicle OFF
- Wait up to 60 s (after all other listed conditions are met)

Locking the doors with a remote transmitter can greatly reduce the time to achieve a valid ground or low reference continuity test result.

There are some low reference circuits that use a driver to isolate the circuit while the ignition is off. This is done in most cases for accidental reverse battery connections or reverse polarity jump starting. When this driver is present, the ignition will need to be on to validate the circuit.

TESTING FOR CONTINUITY

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedures verify good continuity in a circuit.

With a Digital Multimeter (DMM)

1. Set the DMM to the Ω position.
2. Disconnect the power feed (i.e. fuse, control module) from the suspect circuit.
3. Disconnect the load.
4. Select the MIN MAX function on the DMM.
5. Connect one lead of the DMM to one end of the circuit to be tested.
6. Connect the other lead of the DMM to the other end of the circuit.
7. If the DMM displays low or no resistance, the circuit has good continuity.

With a Test Lamp

NOTE: Only use the test lamp procedure on low impedance power and ground circuits.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.

6. If the test lamp illuminates (full intensity), then the circuit has good continuity.

TESTING FOR SHORT TO GROUND

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedures test for a short to ground in a circuit.

With a Digital Multimeter (DMM)

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the DMM to the Ω position.
4. Connect one lead of the DMM to one end of the circuit to be tested.
5. Connect the other lead of the DMM to a good ground.
6. If the DMM does NOT display infinite resistance (OL), there is a short to ground in the circuit.

With a Test Lamp

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to battery positive voltage.
4. Connect the other lead of the test lamp to one end of the circuit to be tested.
5. If the test lamp illuminates, there is a short to ground in the circuit.

Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
 - When the DMM displays voltage the short is in the wiring leading to the first connector or switch.
 - If the DMM does not display voltage refer to the next step.
4. Close each connector or switch until the DMM displays voltage in order to find which circuit is shorted.

TESTING FOR A SHORT TO VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure tests for a short to voltage in a circuit.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the digital multimeter (DMM) to the V (DC) position.
4. Connect the positive lead of the DMM to one end of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. Switch the vehicle power mode to Vehicle in Service Mode and operate all accessories.
7. If the voltage measured is greater than 1 V, there is a short to voltage in the circuit.

TESTING FOR INTERMITTENT CONDITIONS AND POOR CONNECTIONS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.

- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers (BEC)

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center (BEC). Use **EL-35616** kit to test for proper terminal contact. Failure to use **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different

between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter from the on the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#), and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#), and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:

- Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
- The condition only occurs on a cold start.
- The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference (EMI) or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator, etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#).
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

INDUCING INTERMITTENT FAULT CONDITIONS

Special Tools

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, torque, bumps/rough pavement, etc. In order to duplicate the customer's concern, it may be necessary to manipulate the wiring harness if the malfunction appears to be vibration related. Manipulation of a circuit can consist of a wide variety of actions, including:

- Wiggling the harness
- Disconnecting a connector and reconnecting
- Stressing the mechanical connection of a connector
- Pulling on the harness or wire in order to identify a separation/break inside the insulation
- Relocating a harness or wires

All these actions should be performed with some goal in mind. For instance, with a scan tool connected, wiggling the wires may uncover a faulty input to the control module. The snapshot option would be appropriate here. Refer to [Scan Tool Snapshot Procedure](#). Another option is, with the component commanded ON and OFF by the scan tool, to move related connectors and wiring and observe the component operation. With the vehicle ON, move related connectors and wiring while monitoring vehicle operation. If harness or connector movement affects the data displayed, component/system operation, or vehicle operation, inspect and repair the harness/connections as necessary.

You may need to load the vehicle in order to duplicate the concern. This may require the use of weights, floor jacks, jackstands, frame machines, etc. In these cases you are attempting to duplicate the concern by manipulating the suspension or frame. This method is useful in finding harnesses that are too short and their connectors pull apart enough to cause a poor connection. A DMM set to the Min/Max mode and connected to the suspect circuit while testing can yield desirable results. Refer to [Testing for Electrical Intermittents](#).

Certainly, using the senses of sight, smell, and hearing while manipulating the circuit can provide good results as well.

There may be instances where circuit manipulation alone will not meet the required criteria for the fault condition to appear. In such cases it may be necessary to expose the suspect circuit to other conditions while

manipulating the harness. Such conditions would include high moisture conditions, along with exceptionally high or low temperatures. The following discusses how to expose the circuit to these kinds of conditions.

High Temperature Conditions

If the complaint tends to be heat related, you can simulate the condition using the **EL-25070** heat gun.

Using the heat gun, you can heat up the suspected area or component. Manipulate the harnesses under high temperature conditions while monitoring the scan tool or DMM to locate the fault condition.

The high temperature condition may be achieved simply by test driving the vehicle at normal operating temperature. If a heat gun is unavailable, consider this option to enhance your diagnosis. This option does not allow for the same control, however.

Low Temperature Conditions

Depending on the nature of the fault condition, placing a fan in front of the vehicle while the vehicle is in the shade can have the desired effect.

If this is unsuccessful, use local cooling treatments such as ice or a venturi type nozzle (one that provides hot or cold air). This type of tool is capable of producing air stream temperatures down to -18°C (0°F) from one end and $+71^{\circ}\text{C}$ (160°F) from the other. This is ideally suited for localized cooling needs. In addition, circuit cooling spray can be used to cool down a component or circuit.

Once the vehicle, component, or harness has been sufficiently cooled, manipulate the harness or components in an effort to duplicate the concern.

Duplicating Failure Conditions

- If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions.
- Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set.
 1. Review and record Freeze Frame/Failure Records data.
 2. Clear the DTCs using the scan tool.
 3. Switch the vehicle power mode to Vehicle Off and wait 15 seconds.
 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text if a DTC is being diagnosed.
 5. Monitor DTC Status for the DTC being tested. The scan tool will indicate Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed.
- An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the concern occurs, may help you locate the concern.

TESTING FOR ELECTRICAL INTERMITTENTS

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

Perform the following procedures while wiggling the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test equipment.

- [Testing for Short to Ground](#)
- [Testing for Continuity](#)
- [Testing for a Short to Voltage](#)

If the fault is not identified, perform the procedure below using the MIN MAX feature on the **EL-39200** DMM. This feature allows you to manipulate the circuit without having to watch the DMM. The DMM will generate an audible tone when a change is detected.

NOTE: The DMM must be used in order to perform the following procedure since the DMM can monitor current, resistance or voltage while recording the minimum (MIN), and maximum (MAX) values measured.

1. Connect the DMM to both sides of a suspected connector (still connected), or from one end of a suspected circuit to the other. Refer to [Troubleshooting with a Digital Multimeter](#) for information on connecting the DMM to the circuit.
2. Set the rotary dial of the DMM to the V (AC) or V (DC) position.
3. Press the range button of the DMM in order to select the desired voltage range.

NOTE: The 100 ms RECORD mode is the length of time an input must stay at a new value in order to record the full change.

4. Select the MIN MAX function of the DMM. The DMM displays the 100 ms RECORD and emits an audible tone (beep).
5. Simulate the condition that is potentially causing the intermittent connection, either by wiggling the connections or the wiring, test driving, or performing other operations. Refer to [Inducing Intermittent Fault Conditions](#).
6. Listen for the audible Min Max Alert which indicates that a new minimum or maximum value has been recorded.
7. Press the MIN MAX button until the MAX value is displayed and note the value.
8. Press the MIN MAX button until the MIN value is displayed and note the value.
9. Determine the difference between the MIN and MAX values.
 - If the variation between the recorded MIN and MAX voltage values is 1 V or greater an intermittent open or high resistance condition exists. Repair the condition as necessary.
 - If the variation between the recorded MIN and MAX voltage values is less than 1 V an intermittent open or high resistance condition does not exist.

SCAN TOOL SNAPSHOT PROCEDURE

Reviewing Stored Data in Global Diagnostic System (GDS)

Overview

A snapshot is a recording of what a control module on the vehicle was receiving for information while the snapshot is being made. A snapshot is used to analyze the data during the time a vehicle condition is current. In GDS 2 there is not a traditional snapshot as there has been in the past. GDS 2 saves all past VIN and diagnostic data for future viewing. GDS 2 automatically records data whenever the user views Module Diagnostics, Vehicle Diagnostics and/or Systems Diagnostics. Module Diagnostics includes DTC Data, Identification Information, Data Display, Control Functions and Configuration/Reset Functions. Vehicle Diagnostics includes Vehicle Wide DTCs. Systems Diagnostics includes Inspection/Maintenance Status and Inspection/Maintenance Information.

Reviewing Stored Data

The Review Stored Data function allows viewing and playing of previously recorded vehicle data. This information can be used in analysis of vehicle problems and detection of trigger error conditions. The graph function can be used to compare multiple parameters to see if a component is functioning properly. Recorded sessions can be selected for viewing by the following two methods:

- From the Home Page, click on Review Stored Data. In the Review Stored Data page, highlight a vehicle in the Sessions screen located in the upper pane and highlight the desired Stored Data in the lower pane, then click the Review button.
- The user can view stored data without ending a current on-vehicle diagnostic session by clicking the Vehicle Menu button (when active) or Back button until the Session Manager is displayed in the menu. This is used when a user is viewing live data and wants the quickest way to review the data. Click on the Session Manager button. Highlight the desired Stored Data in the lower pane and click the Review button.

Stored Data Review Selections

The following information can be selected in the tabs at the top of the screen:

- Graphical Data Display - Allows a detailed review of parameter data. The buttons on the right side modify the graph data
- Diagnostic Data Display - Displays incoming information from the file. The current value of the parameters is displayed on the screen.
- Line Graph - Allows selected locked parameters to be graphed with parameters overlaid for data comparison. The current value of the parameters is displayed on the screen. Use the buttons on the right side to modify the graph data.
- Bookmarks - If bookmarks are present, this displays the Type, Description and Time of automatic and manually generated bookmarks.
- System Information - Displays the GDS 2 Software Version and MDI Serial Number used when the session was recorded.
- Selected Vehicle Configuration - Displays vehicle identifiers, such as transmission type, for the vehicle selected on the Stored Data Review screen in the Sessions field.
- RPO - Displays vehicle build information.

Graphical Data Display

On the Graphical Data Display tab there are multiple selections at the top of the page. The selections available are:

- Create Report - Opens an internet browser page where a data display report can be printed or saved for future reference.
- Unit Switch - Toggles graph units between English and metric.
- Lock - When a parameter is selected, clicking the lock button locks a selected parameter for viewing in the Line Graph tab. In the Line Graph tab, locked parameters are isolated and overlaid for data comparison.
- Up Arrow - Click the up arrow to move a highlighted parameter up a position on the list.
- Down Arrow - Click the down arrow to move a highlighted parameter down a position on the list.
- Save As - This selection is available in the Graphical Data Display and Diagnostic Data Display tabs. This allows the user to export the graph data to a worksheet for in depth analysis and to timestamp data.

Review Stored Data Functions

To review the session there are buttons at the bottom of the window to control the cursor. From left to right the buttons are:

- Insert Bookmark - This button allows the user to insert bookmarks anywhere along the timeline. This provision allows the user to record notes regarding the inserted bookmark.
- Return Bookmark - This button moves the cursor to the previous bookmark.
- Back - This button moves the cursor back 1 frame.
- Timeline Slider Control - This allows the user to slide and select any position on the Timeline required.
- Forward - This button moves the cursor forward 1 frame.
- Forward Bookmark - This button moves the cursor forward 1 bookmark.
- Bookmarks - Allows the user to toggle bookmark visibility ON and OFF.

Graphical Preference Selections

The vertical side bar on the right side of the screen in the Graphical Data Display and Line Graph tabs toggles the Graphical Selection Panel from hidden to visible. The graphical preference selections available are:

- Reset - Resets the graph display back to the initial standard GDS 2 setting.
- Grid Line Toggle - This toggle reverses the current state of showing or removing grid lines.
- Hash Mark Toggle - This toggle reverses the current state of showing or removing data acquisition points or hash marks.
- Horizontal Graph Compression - Compresses the scale of the graph horizontally.
- Horizontal Graph Expansion - Expands the scale of the graph horizontally.
- Vertical Graph Compression - Compresses the scale of the graph vertically.
- Vertical Graph Expansion - Expands the scale of the graph vertically.
- Move Centerline of Graph Up - Moves the centerline of the graph up incrementally.

- Move Centerline of Graph Down - Moves the centerline of the graph down incrementally.

CIRCUIT PROTECTION - FUSES

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

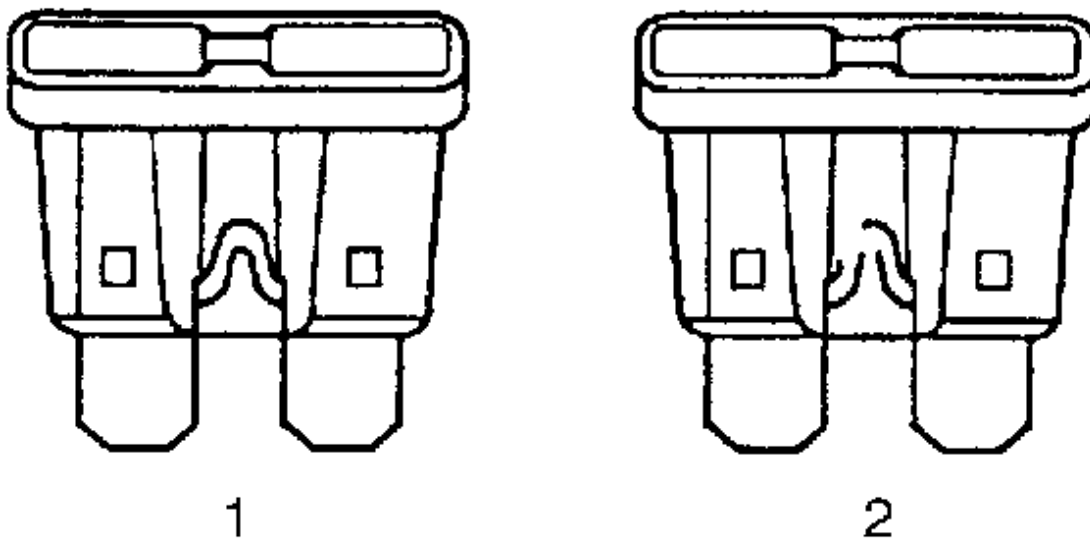


Fig. 3: Identifying Open Fuse Element

Courtesy of GENERAL MOTORS COMPANY

The fuse is the most common method of an automotive wiring circuit protection. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a one time protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is open, remove the suspected fuse and examine if the element in the fuse is broken (2). If not broken (1), also check for continuity using a Digital Multimeter (DMM) or a continuity tester.

If the element is broken or continuity is suspect, replace the fuse with one of equal current rating.

Fuse Types

Current Rating Amperes	Color
Auto Fuses, Mini Fuses	
2	Gray
3	Violet
5	Tan
7.5	Brown
10	Red
15	Blue
20	Yellow
25	White or Natural
30	Green
Maxi Fuses	
20	Yellow
30	Light Green
40	Orange or Amber
60	Blue
50	Red
J-Case Fuses	
20	Blue
30	Pink
40	Green
50	Red
60	Yellow
Midi Fuses	
80	Black
Mega Fuses	
100	Black
150	Black
200	Black

CIRCUIT PROTECTION - CIRCUIT BREAKERS

A circuit breaker is a protective device that is designed to open the circuit when a current load is in excess of the rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. Two types of circuit breakers are used.

Circuit Breaker

This type opens when excessive current passes through it for a period of time. It closes again after a few seconds, and if the cause of the high current is still present, it will open again. The circuit breaker will continue to cycle open and closed until the condition causing the high current is removed.

Positive Temperature Coefficient (PTC) Circuit Breaker

This type greatly increases its resistance when excessive current passes through it. The excessive current heats the PTC device, as the device heats its resistance increases. Eventually the resistance gets so high that the circuit is effectively open. Unlike the ordinary circuit breaker the PTC unit will not reset until the circuit is opened, by removing the voltage from its terminals. Once the voltage is removed the circuit breaker will re-close within a second or 2.

CIRCUIT PROTECTION - FUSIBLE LINKS

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: When repairing a fusible link, fusible links cut longer than 225 mm (approximately 9 in) will not provide sufficient overload protection.

Fusible link is wire designed to melt and break continuity when excessive current is applied. It is often located between or near the battery and starter or electrical center. Use a continuity tester or a Digital Multimeter (DMM) at each end of the wire containing the fusible link in order to determine if it is broken. If broken, it must be replaced with fusible link of the same gauge size.

WIRING REPAIRS

The Wiring Repairs section contains the following types of wiring repair information. Using these elements together will make wiring repair faster and easier:

- [Flat Wire Repairs](#)
- [Serial Data Circuit Wiring Repairs](#)
- [High Temperature Wiring Repairs](#)
- [Heated Oxygen Sensor Wiring Repairs](#)
- [Wire to Wire Repair](#)
- [Splicing Inline Harness Diodes](#)
- [Splicing Twisted or Shielded Cable](#)
- [SIR/SRS Wiring Repairs](#)

CONNECTOR REPAIRS

Connector Repairs contains a list of all connector repairs. The connector repairs are listed by the connector manufacturer and then by connector type. If the technician cannot identify the manufacturer of the connector, refer to Identifying Connectors below. Knowing the connector manufacturer will assist in finding the correct connector repair from the following list:

- [Connector Position Assurance Locks](#)
- [Terminal Position Assurance Locks](#)
- [AFL/EPC Connectors](#)

- [Bosch Connectors \(BSK\)](#) [Bosch Connectors \(0.64\)](#) [Bosch Connectors \(2.8 JPT\)](#) [Bosch Connectors \(ECM\)](#)
- [Delphi Connectors \(Weather Pack\)](#) [Delphi Connectors \(Push To Seat\)](#) [Delphi Connectors \(Pull To Seat\)](#) [Delphi Connectors \(Micro-Pack 100W\)](#) [Delphi Connectors \(Micro.64\)](#) [Delphi Connectors \(12-Way\)](#) [Delphi Connectors \(Steering Gear\)](#)
- [FCI Connectors \(Lever Lock\)](#) [FCI Connectors \(SIR\)](#)
- [FEP Connectors \(Steering Gear\)](#)
- [JST Connectors](#)
- [Kostal Connectors \(Glow Plug Control Module\)](#) [Kostal Connectors \(Transmission\)](#)
- [Molex Connectors \(Lever Lock\)](#) [Molex Connectors \(SIR\)](#)
- [Sumitomo Connectors](#)
- [Tyco/AMP Connectors \(CM 42-Way\)](#) [Tyco/AMP Connectors \(Sensor\)](#) [Tyco/AMP Connectors \(0.25 Cap\)](#) [Tyco/AMP Connectors \(43-Way\)](#) [Tyco/AMP Connectors \(Door Module\)](#) [Tyco/AMP Connectors \(Seat\)](#) [Tyco/AMP Connectors \(102-Way Inline\)](#) [Tyco/AMP Connectors \(SIR\)](#)
- [Yazaki Connectors \(2-Way\)](#) [Yazaki Connectors \(16-Way\)](#)
- [Repairing Connector Terminals \(Terminated Lead Repair\)](#) [Repairing Connector Terminals \(Terminal Repair\)](#)

Connector Anatomy

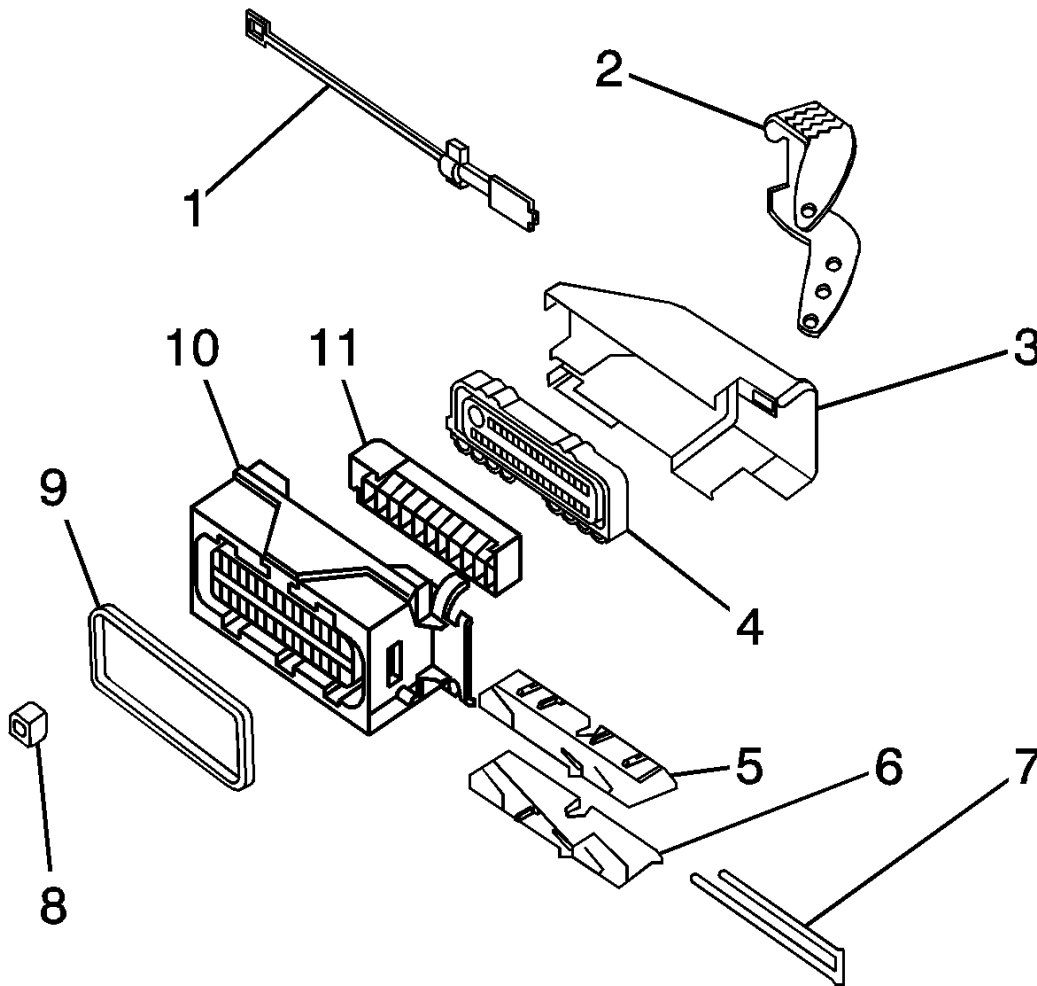


Fig. 4: Identifying Typical Connector Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Connector Positive Assurance (CPA)
2	Assist Lever
3	Wire Dress Cover
4	Seal Strain/Relief
5	Slide Left Hand
6	Slide Right Hand
7	Terminal Positive Assurance (TPA)
8	Terminal Positive Assurance (TPA)
9	Connector Seal
10	Connector Housing
11	Inner Connector

Identifying Connectors

Knowing the connector manufacturer is helpful when trying to locating the correct connector repair procedure.

There are many different connector designs used on GM vehicles and it is sometimes difficult to identify the connector manufacturer. The information in this document should help with the identification of connector manufactures.

The following connector manufacturers make most of the connectors found in GM vehicles:

- AFL/EPC (Alcoa Fujikura Ltd./Engineered Plastics Components)
- Bosch
- Delphi
- FCI (Framatome Connectors International)
- JAE (Japan Aviation Electronics)
- JST (Japan Solderless Terminals)
- Kostal
- Molex
- Sumitomo
- Tyco/AMP
- Yazaki

Identifying the manufacturer of a connector is often difficult. When trying to determine the manufacturer of a connector, look for specific identifying marks that are unique to that connector supplier. Most of these identify marks are hard to find or see. Check the connector carefully and refer to the information below for pictures and descriptions of connector identification markings.

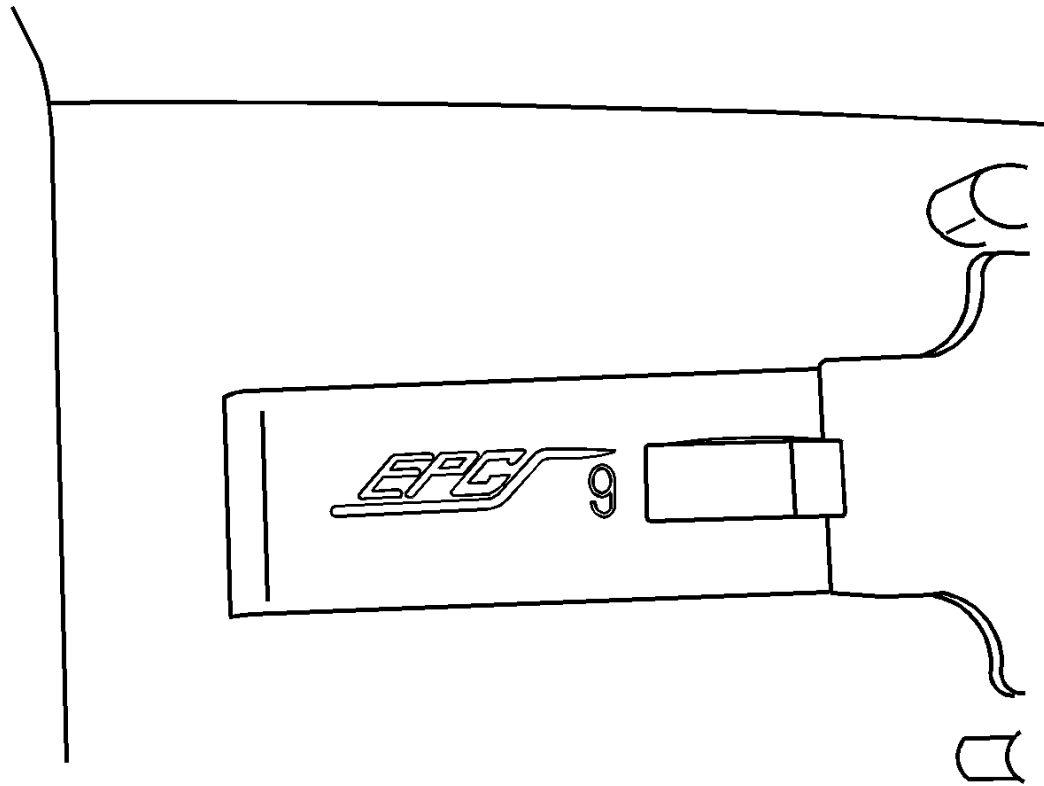


Fig. 5: View Of EPC Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- Most of AFL's connectors have EPC on their connector body. Some of the smaller connectors will not have any markings on them.

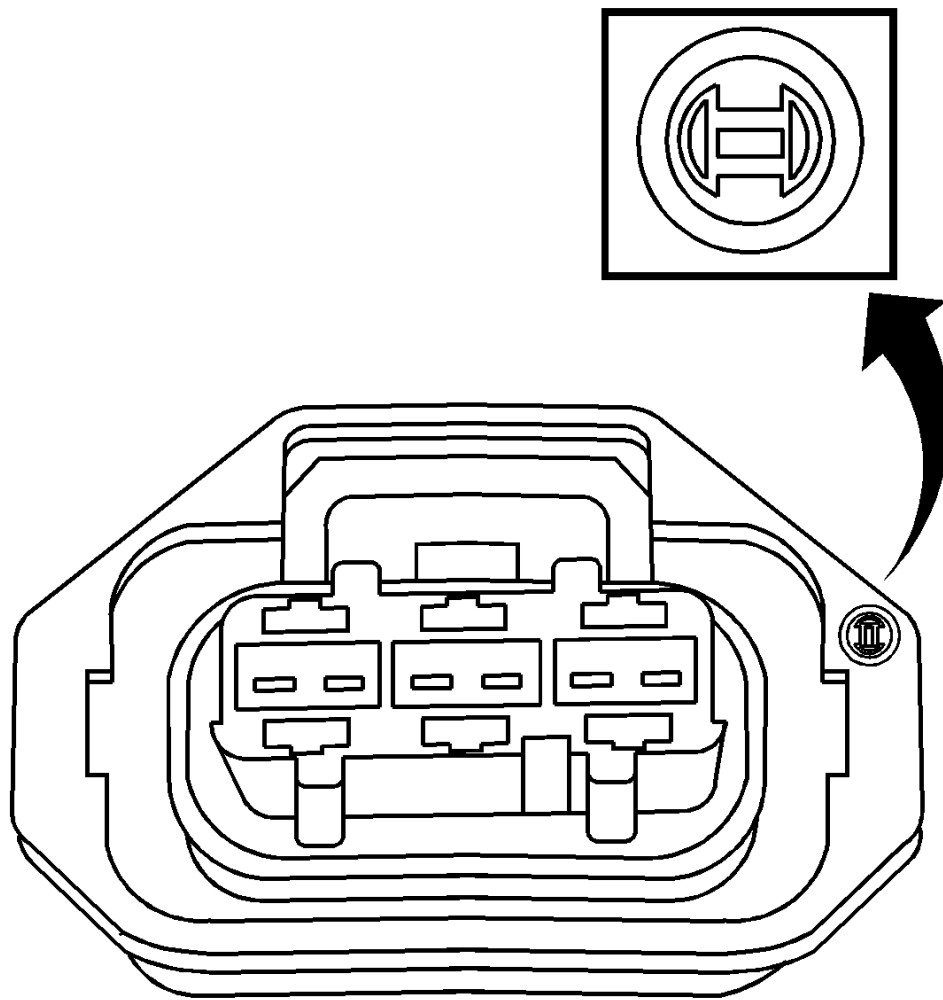


Fig. 6: View Of Bosch Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- In some cases Bosch will actually be printed on the connector. If Bosch does not appear on the connector, look for the Bosch logo. The Bosch logo is a circle with a blunted arrow inside. This logo can appear anywhere on the connector and is often very small.

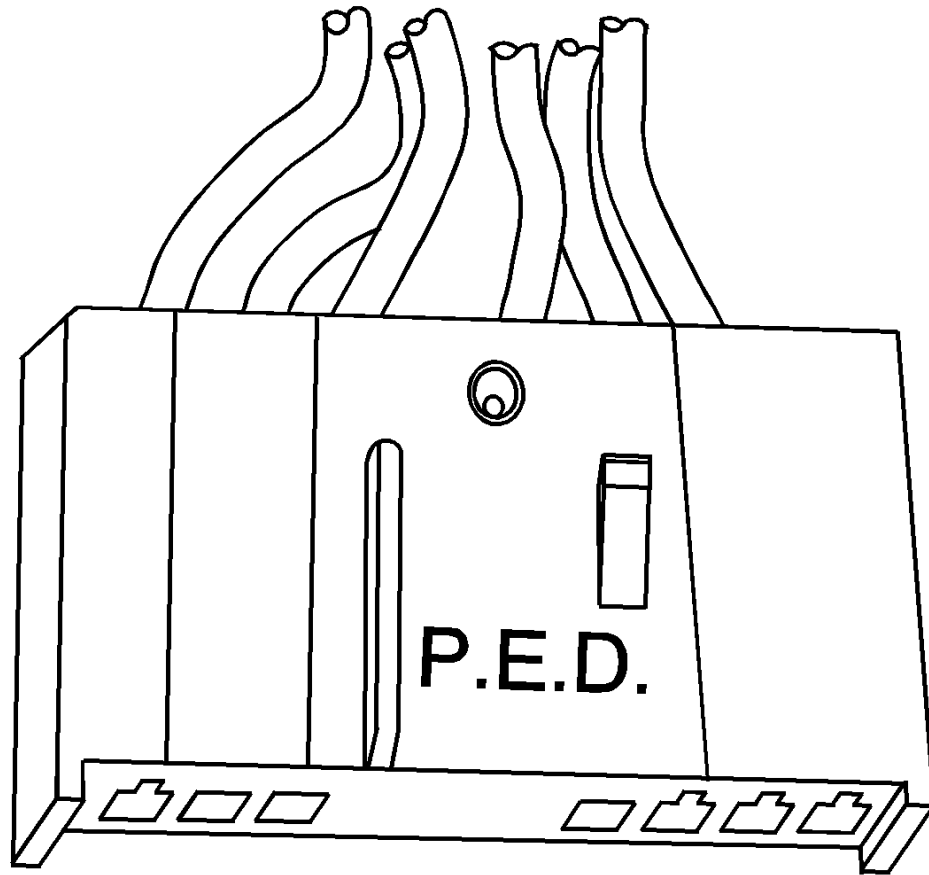


Fig. 7: View Of PED Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- In some cases Delphi will actually be printed on the connector. If Delphi is not printed on the connector, look for PED. In both cases there is no specific orientation for Delphi or PED and they can appear anywhere on the connector.

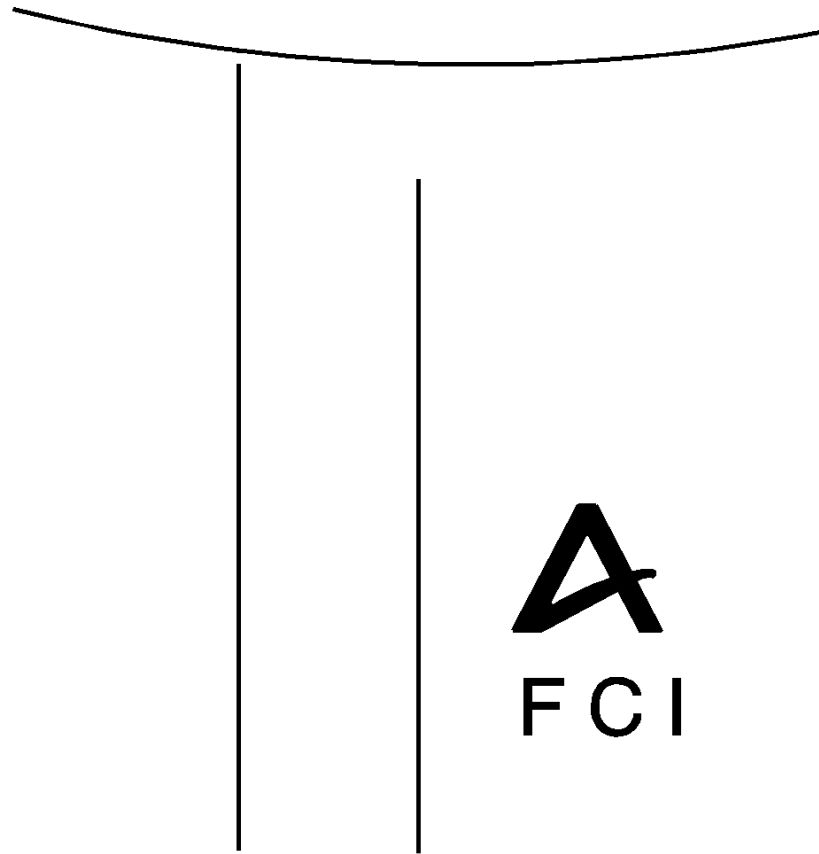


Fig. 8: View Of FCI Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- FCI connectors may have the FCI logo on their connectors. The logo is the letters FCI with an "A" above it.

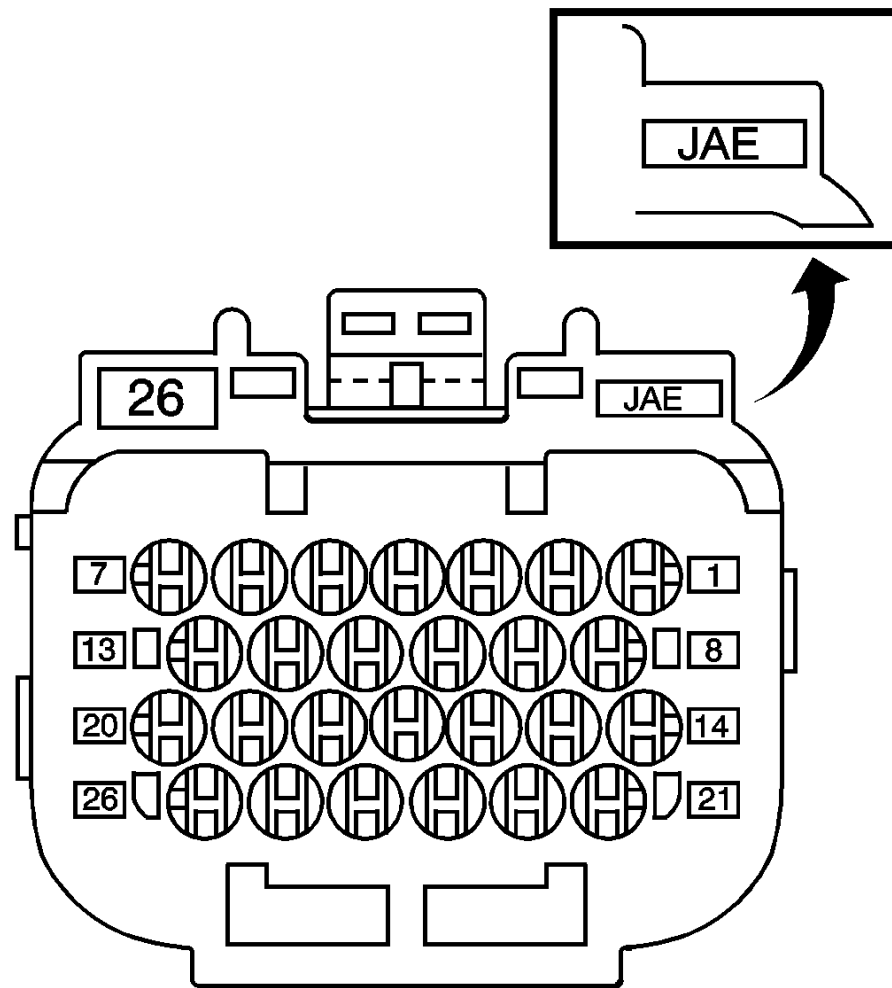


Fig. 9: View Of JAF Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- JAE connector have JAE in small letters on their connectors.

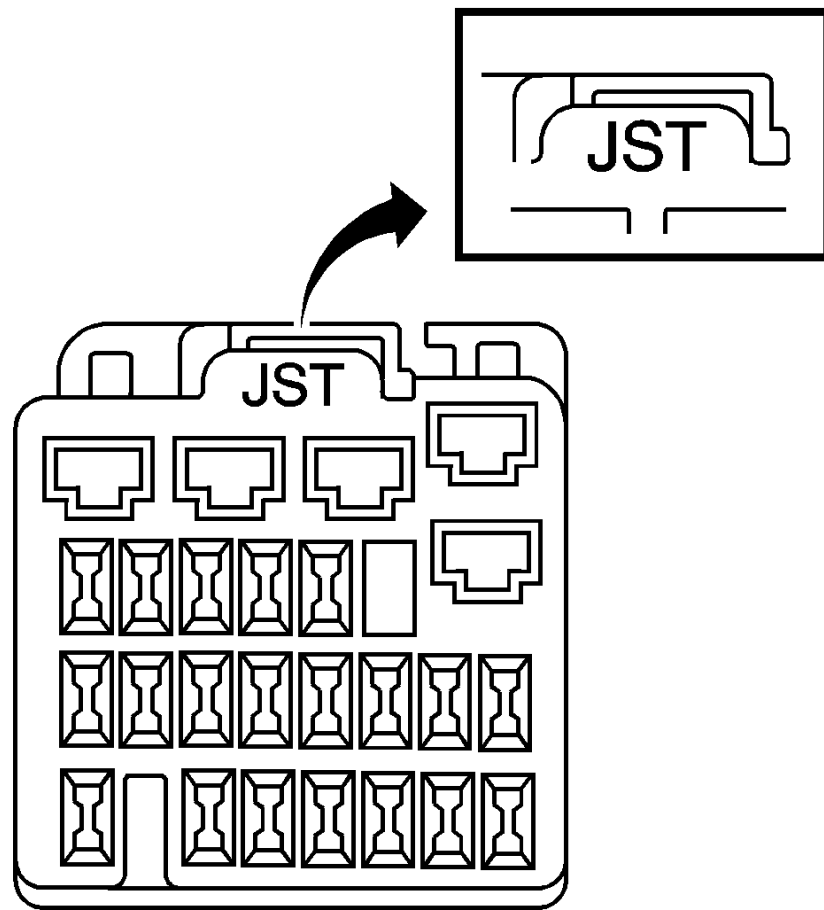


Fig. 10: View Of JST Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- JST connectors have JST in small letters on their connectors, similar to that above. The location of the logo will vary with the connector size and style.

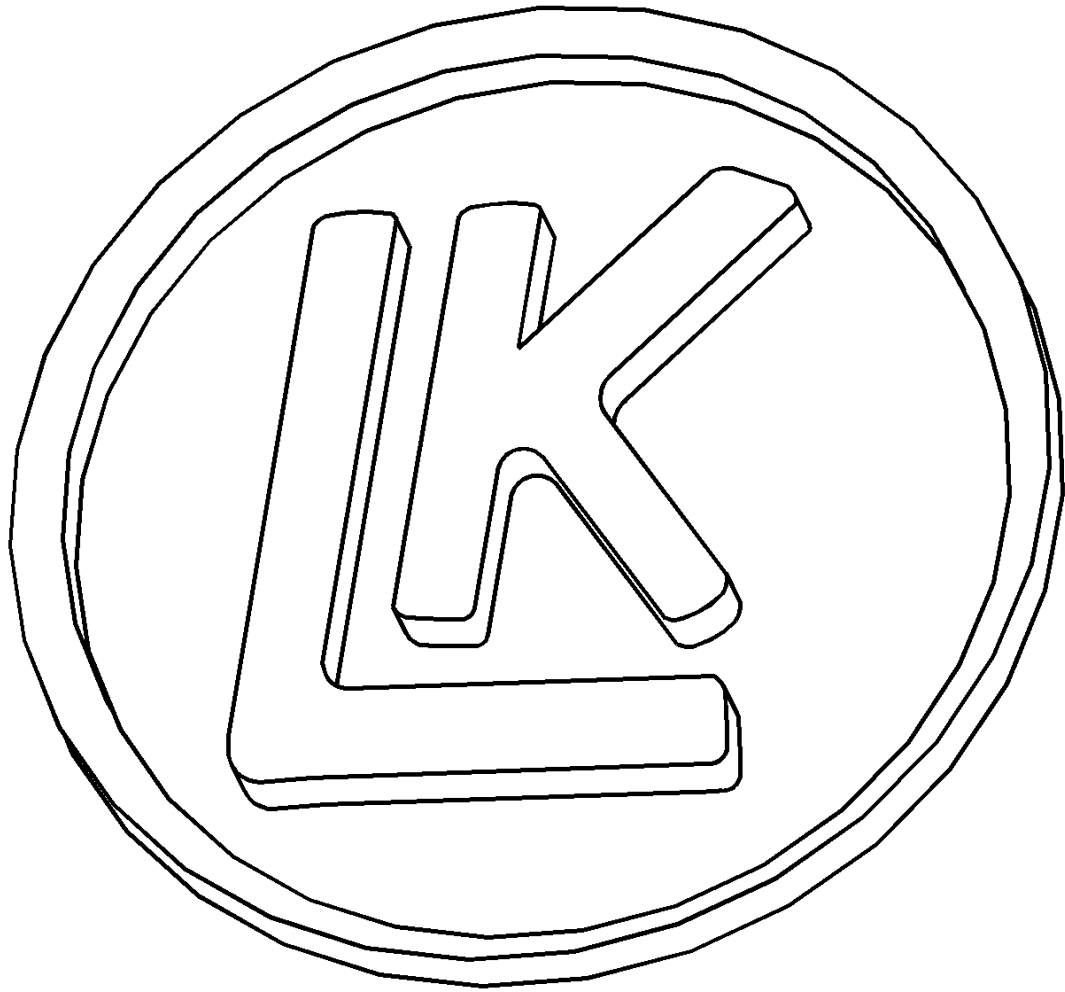


Fig. 11: View Of Kostel Connector Identifier

Courtesy of GENERAL MOTORS COMPANY

- Kostel has an "LK" with a circle around it. These connector are usually used as a transmissions connection.

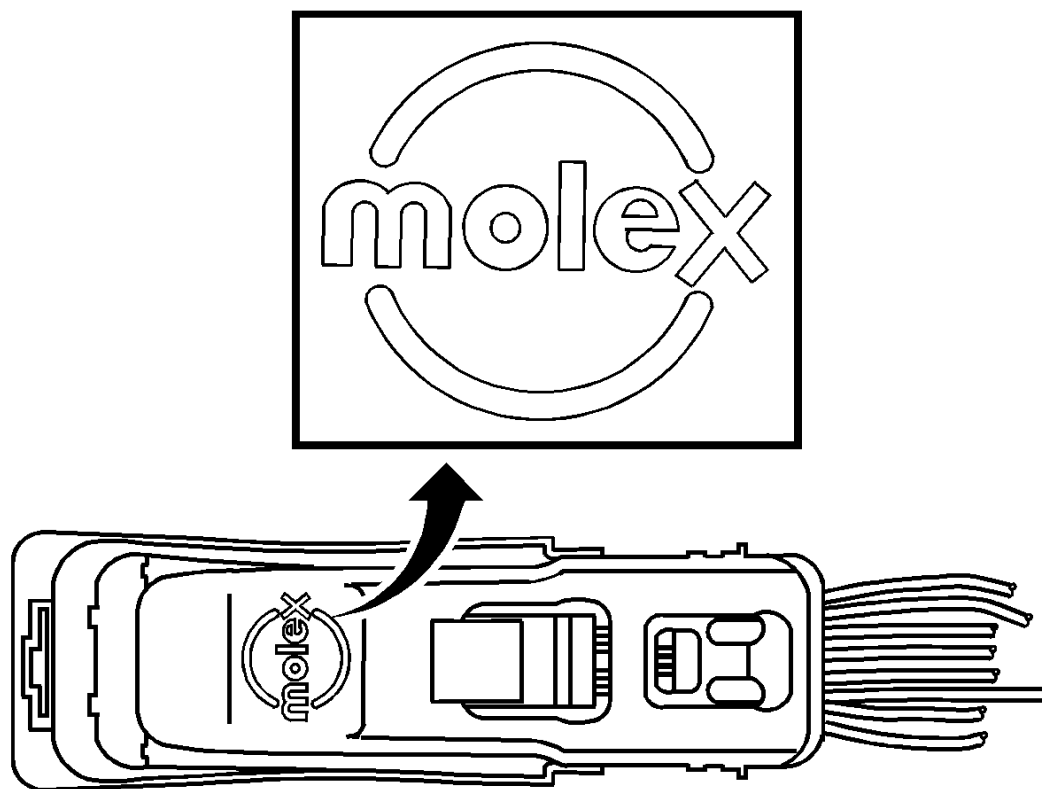


Fig. 12: View Of Molex Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

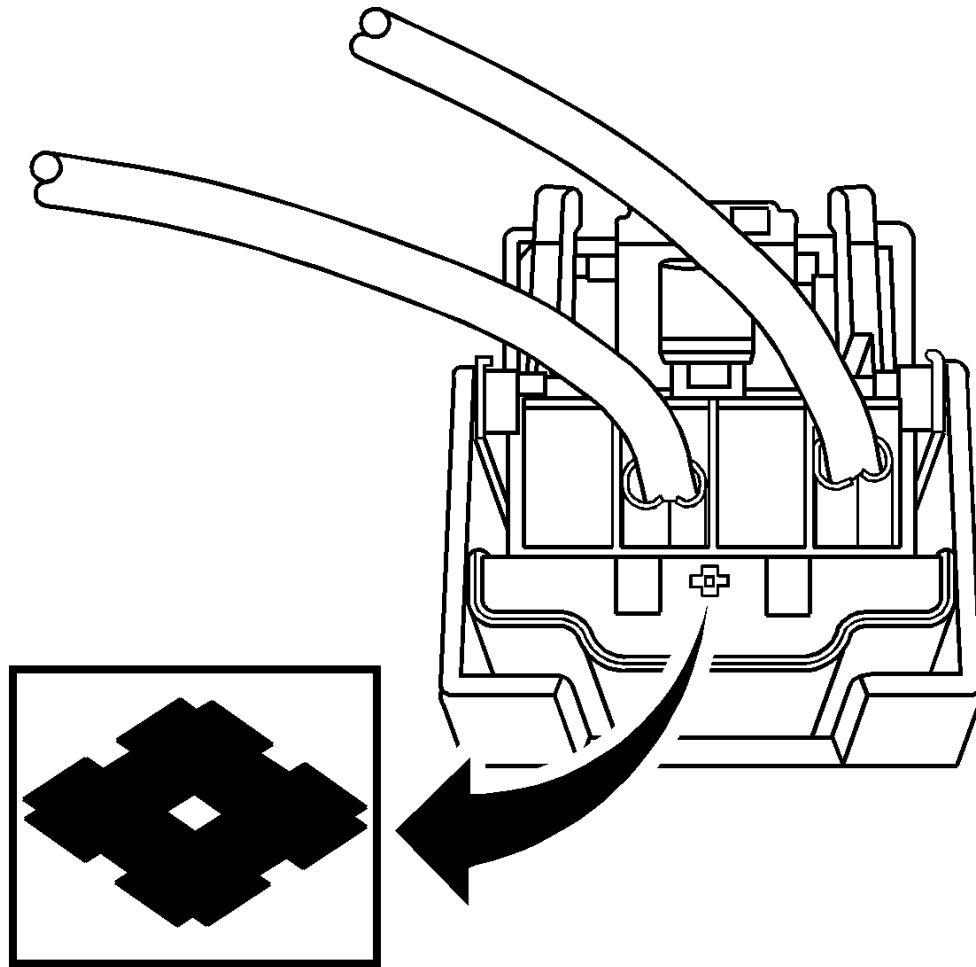


Fig. 13: View Of Sumitono Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- Most Molex connectors will have the Molex logo on the dresscover of the connector. In some cases the connectors may have MX followed by another letter. The third letter indicates where the connector was made. A connector with MXD is a Molex connector made in Detroit.

Sumitomo has a unique symbol on their connector and possibly a part number. The symbol is similar to that of a diamond lying on its side, similar to that shown. The logo could appear anywhere but the most common place is at the wire side of the housing.

- Tyco/AMP has many different and unique connector designs. Some may or may not have identifiable marks on them.

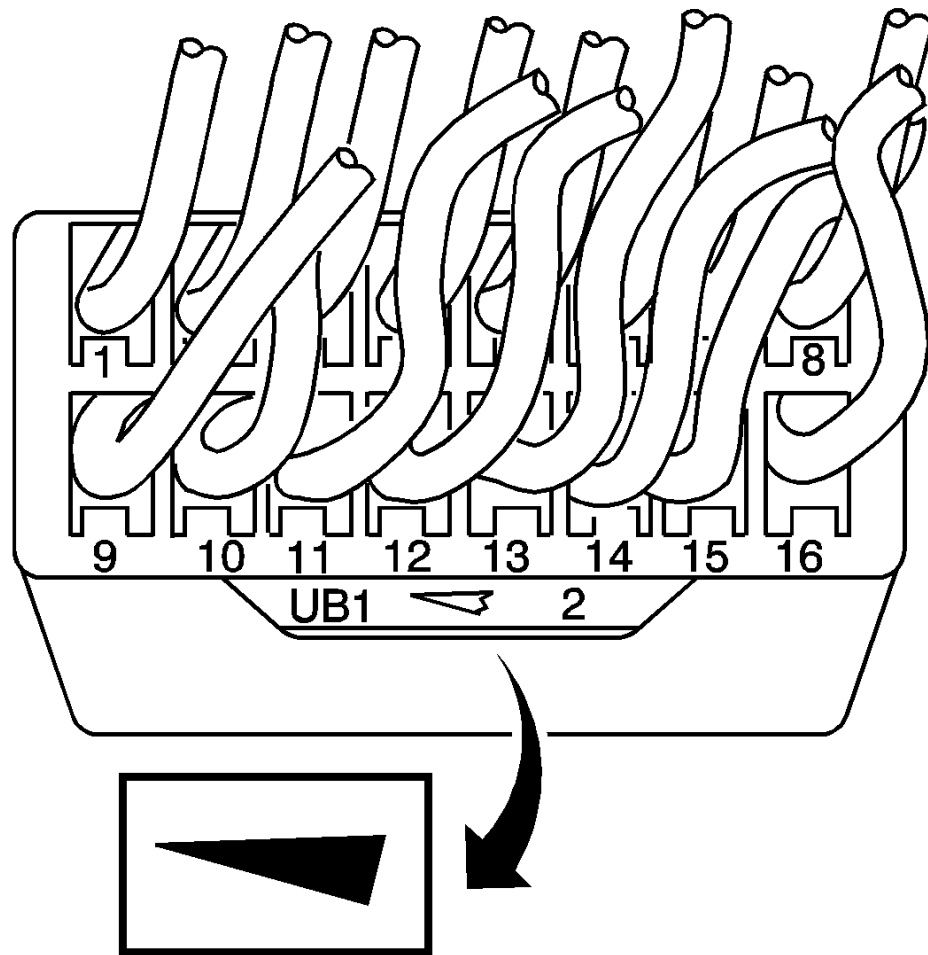


Fig. 14: View Of Yazaki Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- Yazaki has a wedge or arrow shape, similar to that shown.

Article GUID: A00884641

ACCESSORIES & EQUIPMENT

Displays and Gauges - Volt

SPECIFICATIONS

AMBIENT AIR TEMPERATURE SENSOR RESISTANCE

Temperature		Ambient Air Temp Sensor	Ambient Air Temp Sensor (Min)	Ambient Air Temp Sensor (Max)
°C	°F	(kΩ)	(kΩ)	(kΩ)
-40	-40	169.4	158.46	181.19
-30	-22	88.74	83.39	94.47
-20	-4	48.58	47.19	50.02
-10	14	27.67	26.93	28.44
0	32	16.33	15.92	16.75
10	50	9.95	9.71	10.19
20	68	6.24	6.1	6.38
30	86	4.02	3.94	4.11
40	104	2.66	2.61	2.71
50	122	1.8	1.73	1.87
60	140	1.24	1.2	1.29

SCHEMATIC WIRING DIAGRAMS

INSTRUMENT CLUSTER WIRING SCHEMATICS

Power, Ground, Data Communication and Indicators

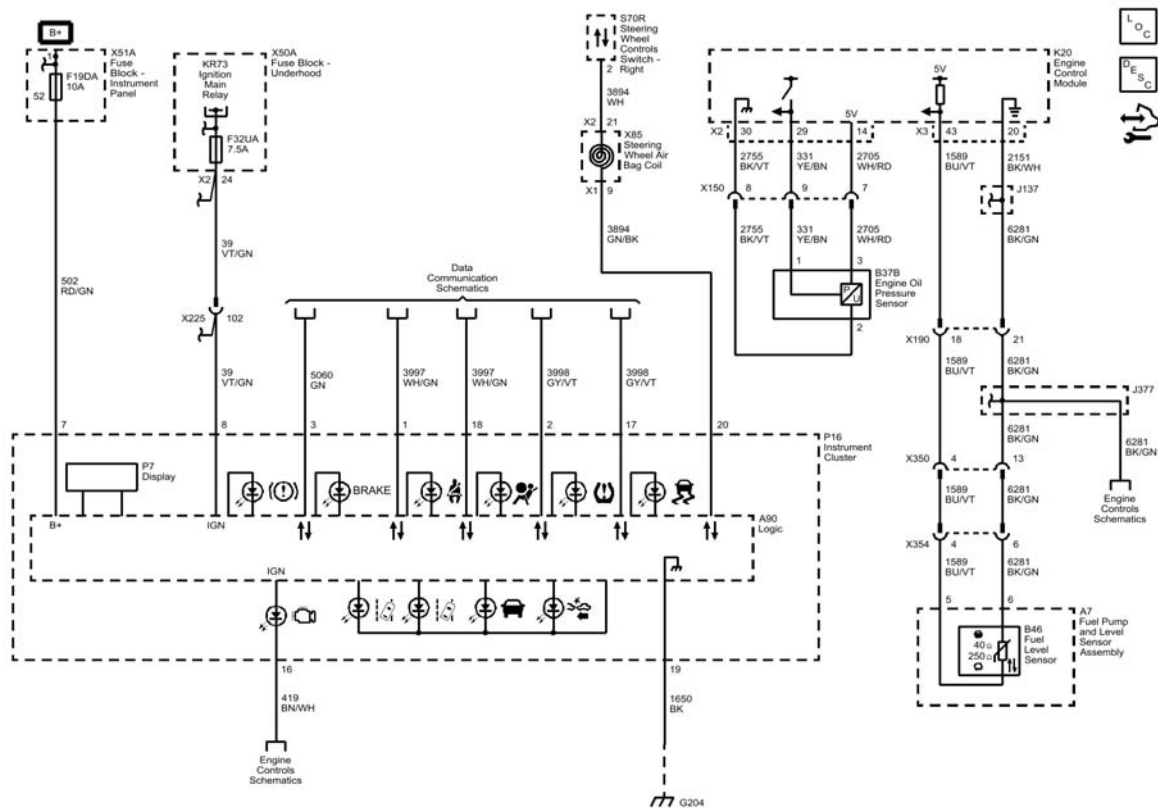


Fig. 1: Power, Ground, Data Communication and Indicators
 Courtesy of GENERAL MOTORS COMPANY

Driver Information Center

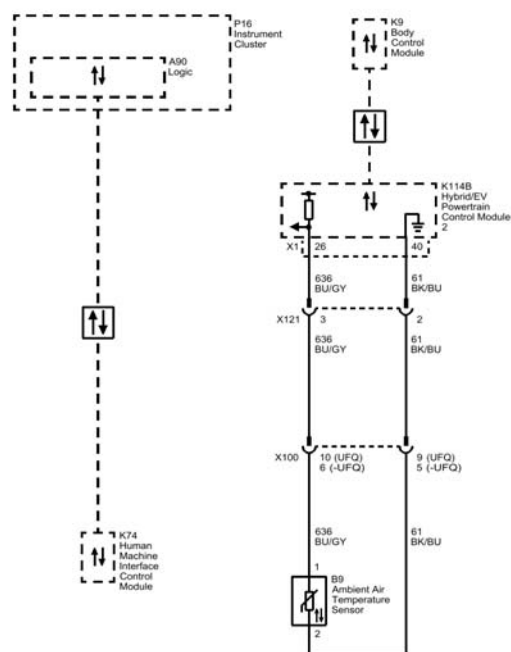


Fig. 2: Driver Information Center
 Courtesy of GENERAL MOTORS COMPANY

DRIVER INFORMATION SYSTEM WIRING SCHEMATICS

Shift Lever Position Indicator

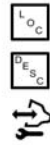
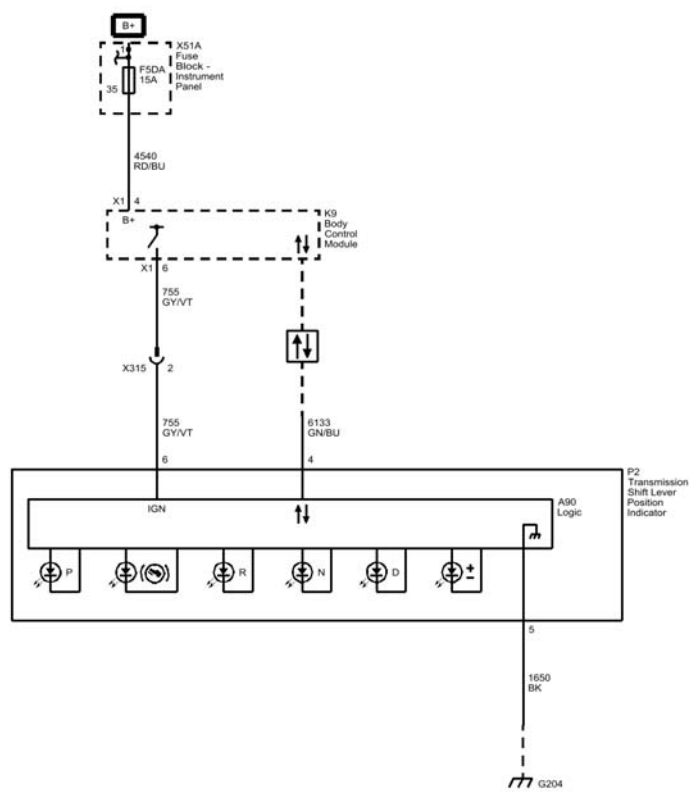


Fig. 3: Shift Lever Position Indicator
 Courtesy of GENERAL MOTORS COMPANY

AUDIBLE WARNINGS WIRING SCHEMATICS

Audible Warning

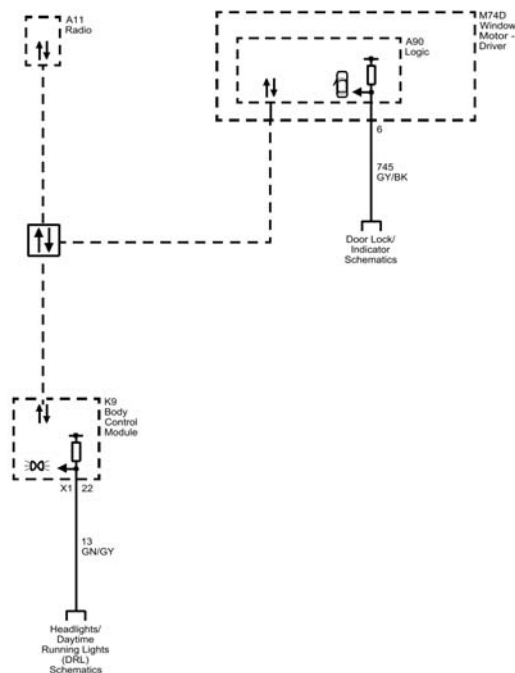


Fig. 4: Audible Warning
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B0158 02

Ambient Air Temperature Sensor Circuit Short to Ground

DTC B0158 05

Ambient Air Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to	Open/High	Short to	Signal
---------	----------	-----------	----------	--------

	Ground	Resistance	Voltage	Performance
Ambient Air Temperature Sensor Signal	B0158 02	B0158 05	B0158 05	-
Low Reference	-	B0158 05	B0158 05	-

Circuit/System Description

The Hybrid Powertrain Control Module 2 monitors the ambient air temperature sensor with a low reference circuit and 5 V signal circuit. The Hybrid Powertrain Control Module 2 monitors the voltage drop across the sensor, which is proportional to temperature. When the ambient air temperatures are cold, the resistance of the sensor is high and the voltage signals are high. When the ambient air temperatures are hot, the resistance of the sensors is low and the voltage signals are low. The Hybrid Powertrain Control Module 2 sends the ambient air temperature signal to the Instrument Cluster via serial data. The Instrument Cluster displays the temperature on the driver information center.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0158 02

The instrument cluster detects the sensor signal circuit is more than 88Â°C (190Â°F).

B0158 05

The instrument cluster detects the sensor signal circuit is less than -40Â°C (-40Â°F).

Action Taken When the DTC Sets

The Instrument Cluster uses a default air temperature value for further calculations. The driver information center displays no ambient air temperature information.

Conditions for Clearing the DTC

The DTC will become history if the instrument cluster no longer detects a malfunction.

Reference Information

Schematic Reference

Driver Information System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Instrument Cluster Description and Operation](#)
- [Driver Information Center \(DIC\) Description and Operation](#)

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other Instrument Cluster or Hybrid Powertrain Control Module 2 DTCs are present.
 - **If other DTCs are present**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **If no other DTCs are present**
3. Verify the Instrument Cluster scan tool Ambient Air Temperature parameter between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) and changes with air temperature changes.
 - **If parameter is not between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) or does not change with air temperature changes**

Replace the P16 Instrument Cluster.
 - **If parameter is between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) and changes with air temperature changes**
4. Verify the Hybrid Powertrain Control Module 2 scan tool Ambient Air Temperature parameter between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) and changes with air temperature changes.
 - **If parameter is not between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) or changes with air temperature changes**

Refer to Circuit/System Testing.
 - **If parameter is between -40°C (-40°F) to $+88^{\circ}\text{C}$ ($+190^{\circ}\text{F}$) and changes with air temperature changes**
5. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than $10\ \Omega$ between the low reference circuit terminal B and ground.

- **If 10 Ω or greater**

1. Disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Test for less than 1 V between the low reference circuit terminal B and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

5. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.
 - **If 98% or less**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 98%**
6. Install a 3 A fused jumper wire between the signal circuit terminal A and the low reference circuit terminal B.
7. Verify the scan tool Ambient Air Temperature parameter is less than 8%.
 - **If 8% or greater**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 8%**
8. Test or replace the B9 Ambient Air Temperature Sensor.

Component Testing

Static Test

1. Test the B9 Ambient Air Temperature Sensor by varying the sensor temperature while monitoring the sensor resistance.

2. Compare the readings with the [Ambient Air Temperature Sensor Resistance](#)

- **If not within the specified range**

Replace the B9 Ambient Air Temperature Sensor.

- **If within specified range**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for module replacement, programming, and setup

DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0550 32

Odometer Circuit General Memory Malfunction

Circuit/System Description

The instrument cluster is equipped with odometers that indicate the distance traveled by the vehicle. One type of odometer is the season odometer where the traveled distance can not be reset by the driver. This information is also stored in the body control module (BCM). In addition to storing the season odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules, and their stored season odometer information, can not be moved or transferred between different vehicles.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The BCM has detected an internal memory malfunction.

Action Taken When the DTC Sets

DTC B0550 32 is stored in the BCM memory.

Conditions for Clearing the DTC

The BCM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Driver Information Center (DIC) Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B0550 32 is not set.
 - **If DTC B0550 32 is set**
 1. Program the K9 Body Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K9 Body Control Module
 - If the DTC does not set
 - 3. All OK.
 - **If DTC B0550 32 is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for BCM replacement, programming and setup

DTC B071F: TRANSMISSION RANGE INDICATOR INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B071F 39

Transmission Range Indicator Internal Malfunction

Circuit/System Description

The transmission shift lever position indicator is located on the center console and indicates the current transmission shift lever position. The transmission shift lever position indicator receives power and ground and is controlled by the body control module (BCM) via serial data.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM has detected an internal malfunction in the transmission shift lever position indicator.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

The DTC will become history if the BCM no longer detects a malfunction.

Reference Information

Schematic Reference

Driver Information System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Indicator/Warning Message Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B071F 39 is not set.

- **If the DTC is set**

Replace the P2 Transmission Shift Lever Position Indicator.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Transmission Control Replacement (With Base)** **Transmission Control Replacement (Without Base)**

DTC B124F: MOST PROGRAMMING FAILURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124F 41

MOST Programming Failure Files Not Available

DTC B124F 42

MOST Programming Failure Not Programmed

DTC B124F 44

MOST Programming Failure Security Access Not Activated

DTC B124F 4A

MOST Programming Failure Security Checksum Error

Circuit/System Description

The instrument cluster can communicate with other devices on a Media Oriented Systems Transport (MOST) protocol and through the USB port. Software checks are performed to ensure the internal MOST circuitry is operating properly.

Conditions for Running the DTC

The Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The Instrument Cluster has detected an internal memory malfunction.

Action Taken When the DTC Sets

The DTC is stored in the Instrument Cluster memory.

Conditions for Clearing the DTC

The Instrument Cluster no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B124F is not set.
 - **If the DTC is set**
 1. Program the P16 Instrument Cluster.
 2. Verify the DTC is not set.
 - If the DTC is set, replace P16 Instrument Cluster.
 - If the DTC is not set

3. All OK.

- If the DTC is not set

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Instrument Cluster replacement, programming and setup

DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0072	P0073	P0073	P0071, P0074
Low Reference	-	P0073	-	P0071, P0074

Circuit/System Description

The ambient air temperature sensor is located behind the grille. The Hybrid/EV Powertrain Control Module 2 monitors the ambient air temperature sensor utilizing a low reference circuit and signal circuit. The Hybrid/EV Powertrain Control Module 2 monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensor is low. The Hybrid/EV Powertrain Control Module 2 converts the voltage value to a temperature value. The Hybrid/EV Powertrain Control Module 2 also sends the

temperature value to other control modules via serial data.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

During the first 20 s of run time after the 1 hour soaking period, the difference between the outside air temperature and the A/C High Pressure Switch Signal is greater than 30°C (86°F).

P0072

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is more than 60°C (140°F).

P0073

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is less than -40°C (-40°F).

P0074

The Hybrid/EV Powertrain Control Module 2 detects an unrealistic signal variance.

Action Taken When the DTC Sets

- DTC P0071 - P0074 are type B DTCs.

Conditions for Clearing the DTC

The DTC will become history if the ECM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Ambient Air Temperature parameter is between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) and changes with air temperature changes.
 - **If not between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) or changes with air temperature changes**

Refer to Circuit/System Testing.

- **If between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than $10\ \Omega$ between the low reference circuit terminal B (or 2) and ground.
 - **If $10\ \Omega$ or greater**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than $2\ \Omega$ in the low reference circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than $10\ \Omega$**
3. Vehicle in Service Mode.
4. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is less than -39°C (-38°F).
 - **If -39°C (-38°F) or greater**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than -39Â°C (-38Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is 57Â°C (+135Â°F) or greater.
 - **If less than 57Â°C (+135Â°F)**
 1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 57Â°C (135Â°F) or greater**
7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Ambient Air Temperature Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

DTC P0461-P0464: FUEL LEVEL SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0461

Fuel Level Sensor Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	P0463	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistances of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge. When the fuel level falls below approximately 11% the instrument cluster illuminates the low fuel level indicator.

Conditions for Running the DTC

- The engine is running
- The system voltage is between 11 - 16 V

Conditions for Setting the DTC

P0461 00

The ECM detects a change in fuel level of less than a specified amount (typically 3 - 10 L or 0.8 - 2.6 gal) over a specified driving distance (typically 240 - 320 km or 150 - 200 miles).

P0462

- The signal voltage is less than 0.25 V.
- The above conditions must be met for 5 seconds.

P0463

- The signal voltage is greater than 4.7 V.
- The above conditions must be met for 5 seconds.

P0464

- The fuel level change is greater than 10%.
- The above conditions must be met for 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

- P0461, P0462, P0463, and P0464 are Type B DTCs
- The fuel gauge defaults to empty
- The low fuel indicator illuminates

Conditions for Clearing the DTC

- P0461, P0462, P0463, and P0464 are Type B DTCs
- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify the scan tool Fuel Remaining in Tank parameter is between 5 - 95% and varies with fuel level.

- **If not between 5 - 95% or does not vary with fuel level**

Refer to Circuit/System Testing

- **If between 5 - 95% and varies with fuel level**

3. Verify that all fuel level gauge segments illuminate when performing the scan tool Driver Information Center Segments control function.

- **If any fuel level gauge segments do not illuminate**

Replace the P16 instrument cluster

- **If all fuel level gauge segments illuminate**

4. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B46 fuel level sensor.

2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the signal circuit terminal 5 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

4. Test or replace the B46 fuel level sensor.

Component Testing

1. Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.

- **If minimum resistance is not 37-43 Ω , maximum resistance is not 245-255 Ω , or if there are any spikes or dropouts**

Replace the fuel level sensor.

- **If minimum resistance is 37-43 Ω , maximum resistance is 245-255 Ω , and if there are no spikes or dropouts**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Displays and Gauges Component Replacement Reference**
- Refer to **Control Module References** for control module replacement, programming and setup

DTC P0521, P0522, OR P0523: ENGINE OIL PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0521

Engine Oil Pressure Sensor Performance

DTC P0522

Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Indicator Malfunction					

Circuit/System Description

The engine oil pressure sensor changes voltage based on the engine oil pressure. The engine oil pressure sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the engine oil pressure sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit of the engine oil pressure sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1 - 4 V. When the engine oil pressure is high, the engine oil pressure sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the engine oil pressure sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information to the instrument cluster via serial data. The instrument cluster will illuminate or display the engine oil pressure indicator when the engine oil pressure is low.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 s.

P0522

- The ECM detects that the engine oil pressure sensor signal circuit is less than 0.2 V.
- The above condition is present for greater than 10 s.

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.
- The above condition is present for greater than 10 s.

Action Taken When the DTC Sets

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this

information in the Failure Records on the scan tool.

- The instrument cluster illuminates the engine oil pressure indicator.

Conditions for Clearing the DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

Diagnostic Aids

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Indicator/Warning Message Description and Operation](#)
- [Instrument Cluster Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
 - **If not 0 psi (0 kPa)**

Refer to Circuit/System Testing.

- **If 0 psi (0 kPa)**
3. Engine running.

4. Verify actual engine oil pressure is within specified range. Refer to *Oil Pressure Diagnosis and Testing* in [Displays and Gauges Component Replacement Reference](#).
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
 - **If not within specified range**

Refer to Circuit/System Testing.
 - **If within specified range**
6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool Engine Oil Pressure parameter is less than 35 kPa (5 psi).

- **If 35 kPa (5 psi) or above**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If below 35 kPa (5 psi)**

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800 kPa (116 psi).

- **If 800 kPa (116 psi) or less**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 800 kPa (116 psi)**

9. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Displays and Gauges Component Replacement Reference](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

DISPLAYS AND GAUGES COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
B9 Ambient Air Temperature Sensor	Ambient Air Temperature Sensor Replacement
B37B Engine Oil Pressure Sensor	{1.5L L3A engine} Engine Oil Pressure Sensor Replacement
B46 Fuel Level Sensor	{1.5L L3A engine} Fuel Level Sensor Replacement
P2 Transmission Shift Lever Position Indicator	{5ET50 MKV} Front Floor Console Accessory Trim Plate Replacement
S39 Ignition Switch	Ignition and Start Switch Replacement
Oil Pressure Diagnosis and Testing	{1.5L L3A engine} Oil Pressure Diagnosis and Testing

SYMPTOMS - DISPLAYS AND GAUGES

NOTE: The following steps must be completed before using the symptom diagnostic tables.

1. Before using the symptom diagnostic tables, perform the [Diagnostic System Check - Vehicle](#) .
2. Review the system operation in order to understand the system functions. Refer to the following description and operations:
 - [Instrument Cluster Description and Operation](#)
 - [Indicator/Warning Message Description and Operation](#)
 - [Driver Information Center \(DIC\) Description and Operation](#)
 - [Audible Warnings Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the instrument panel cluster or the audible warning systems. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.
- Inspect for the proper fluid levels.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Gauges and Odometer

- [Instrument Cluster Display Malfunction](#)
- [Instrument Cluster Gauges Malfunction](#)
- [Fuel Gauge Malfunction](#)
- [Speedometer and/or Odometer Malfunction](#)
- [Outside Air Temperature Display Malfunction](#)

Audible Warnings

[Chime Malfunction](#)

CHIME MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The radio generates the audible warnings. The instrument cluster, the body control module (BCM), the inflatable restraint sensing and diagnostic module (SDM) or the object alarm module request audible warnings via Low Speed CAN-Bus signals.

Reference Information

Schematic Reference

Audible Warnings Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Audible Warnings Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Before performing this diagnostics, make sure no indicators are illuminated after the instrument cluster performs a lamp test. If any indicators are illuminated after the bulb test, perform the indicator diagnostics before this diagnostics.

1. Vehicle in Service Mode.
2. Verify all the radio speakers operate by adjust the radio balance and fade to each speaker.
 - **If any speaker does not operate properly**

Refer to **Speaker Malfunction** .
 - **If the speakers operate properly**
3. Verify the scan tool Driver Seat Belt Status and Passenger Seat Belt Status parameters are Buckled when both front seat belts are buckled.
 - **If not Buckled**

Refer to **Seat Belt Indicator Malfunction - Driver** .

- **If buckled**

4. Verify the scan tool Headlamp On Switch parameter is Inactive when the headlamps are OFF.

- **If not Inactive**

Refer to [Headlamps Malfunction](#) .

- **If Inactive**

5. Verify the scan tool Park Lamps Switch parameter is Inactive when the park lamp switch is OFF.

- **If not Inactive**

Refer to [Park, License, and/or Tail Lamps Malfunction](#) .

- **If Inactive**

6. Verify the scan tool Left Turn Signal Switch and Right Turn Signal Switch parameters are Inactive while the turn signal switch is OFF.

- **If not Inactive**

Refer to [Turn Signal Lamps and/or Indicators Malfunction](#) .

- **If Inactive**

7. Verify the scan tool Park Brake Switch parameter is Inactive when the park brake is OFF.

- **If not Inactive**

Refer to [Park Brake System Diagnosis](#) .

- **If Inactive**

8. Verify that all scan tool parameters listed below are Inactive when all the doors are closed.

- Driver Door Ajar Switch
- Passenger Door Ajar Switch
- Left Rear Door Ajar Switch
- Right Rear Door Ajar Switch
- **If not Inactive**

Refer to [Door Ajar Indicator Malfunction](#) .

- **If Inactive**

9. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for BCM or Radio replacement, programming and setup

FUEL GAUGE MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0461

Fuel Level Sensor Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	P0463	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistances of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge. When the fuel level falls below approximately 11% the instrument cluster illuminates the low fuel level indicator.

Conditions for Running the DTC

- The engine is running
- The system voltage is between 11 - 16 V

Conditions for Setting the DTC

P0461 00

The ECM detects a change in fuel level of less than a specified amount (typically 3 - 10 L or 0.8 - 2.6 gal) over a specified driving distance (typically 240 - 320 km or 150 - 200 miles).

P0462

- The signal voltage is less than 0.25 V.
- The above conditions must be met for 5 seconds.

P0463

- The signal voltage is greater than 4.7 V.
- The above conditions must be met for 5 seconds.

P0464

- The fuel level change is greater than 10%.
- The above conditions must be met for 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

- P0461, P0462, P0463, and P0464 are Type B DTCs
- The fuel gauge defaults to empty
- The low fuel indicator illuminates

Conditions for Clearing the DTC

- P0461, P0462, P0463, and P0464 are Type B DTCs
- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Fuel Remaining in Tank parameter is between 5 - 95% and varies with fuel level.
 - **If not between 5 - 95% or does not vary with fuel level**

Refer to Circuit/System Testing

 - **If between 5 - 95% and varies with fuel level**
3. Verify that all fuel level gauge segments illuminate when performing the scan tool Driver Information Center Segments control function.
 - **If any fuel level gauge segments do not illuminate**

Replace the P16 instrument cluster

 - **If all fuel level gauge segments illuminate**
4. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B46 fuel level sensor.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the signal circuit terminal 5 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
4. Test or replace the B46 fuel level sensor.

Component Testing

1. Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
 - **If minimum resistance is not 37-43 Ω , maximum resistance is not 245-255 Ω , or if there are any spikes or dropouts**

Replace the fuel level sensor.
 - **If minimum resistance is 37-43 Ω , maximum resistance is 245-255 Ω , and if there are no spikes or dropouts**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Displays and Gauges Component Replacement Reference](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

INSTRUMENT CLUSTER GAUGES MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
 2. Verify all gauge segments illuminate when performing the Driver Information Center Segments test with the scan tool.
 - **If any gauge segments do not illuminate**

Replace the P16 instrument cluster
 - **If all gauge segments illuminate**
 3. Drive the vehicle.
 4. Verify the gauge values match the values on the scan tool.
 - **If the values do not match**

Reprogram the P16 Instrument Cluster.
1. Drive the vehicle.
 2. Verify the gauge values match the values on the scan tool.

- If the values do not match

Replace the P16 Instrument Cluster.

- **If the values match**

5. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for Instrument Cluster or ECM replacement, programming and setup

INSTRUMENT CLUSTER DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify all gauge segments illuminate when performing the Instrument Cluster Initialization test with the scan tool.
 - **If the instrument cluster does not perform the initialization test sequence**

Replace the P16 Instrument Cluster.
 - **If the instrument cluster performs the initialization test sequence**
3. Verify all segments illuminate White, Blue, Green, Red, Black and Off when performing the Driver Information Center Segments test with the scan tool.
 - **If any segments do not illuminate**

Replace the P16 Instrument Cluster.
 - **If all segments illuminate**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for Instrument Cluster replacement, programming and setup

OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0072	P0073	P0073	P0071, P0074
Low Reference	-	P0073	-	P0071, P0074

Circuit/System Description

The ambient air temperature sensor is located behind the grille. The Hybrid/EV Powertrain Control Module 2 monitors the ambient air temperature sensor utilizing a low reference circuit and signal circuit. The Hybrid/EV Powertrain Control Module 2 monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensor is low. The Hybrid/EV Powertrain Control Module 2 converts the voltage value to a temperature value. The Hybrid/EV Powertrain Control Module 2 also sends the temperature value to other control modules via serial data.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

During the first 20 s of run time after the 1 hour soaking period, the difference between the outside air temperature and the A/C High Pressure Switch Signal is greater than 30°C (86°F).

P0072

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is more than 60°C (140°F).

P0073

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is less than -40°C (-40°F).

P0074

The Hybrid/EV Powertrain Control Module 2 detects an unrealistic signal variance.

Action Taken When the DTC Sets

- DTC P0071 - P0074 are type B DTCs.

Conditions for Clearing the DTC

The DTC will become history if the ECM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Ambient Air Temperature parameter is between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) and changes with air temperature changes.
 - **If not between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) or changes with air temperature changes**

Refer to Circuit/System Testing.
 - **If between -40°C (-40°F) and $+60^{\circ}\text{C}$ ($+140^{\circ}\text{F}$) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than $10\ \Omega$ between the low reference circuit terminal B (or 2) and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is less than -39 $^{\circ}$ C (-38 $^{\circ}$ F).

- **If -39 $^{\circ}$ C (-38 $^{\circ}$ F) or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than -39 $^{\circ}$ C (-38 $^{\circ}$ F)**

5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is 57 $^{\circ}$ C (+135 $^{\circ}$ F) or greater.

- **If less than 57 $^{\circ}$ C (+135 $^{\circ}$ F)**

1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V

3. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 57 $^{\circ}$ C (135 $^{\circ}$ F) or greater**

7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Ambient Air Temperature Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

SPEEDOMETER AND/OR ODOMETER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements. The instrument cluster will display dashes when its VIN does not match the VIN received from the BCM.

Diagnostic Aids

If the VIN mismatch is corrected the odometer will once again be displayed in the instrument cluster. If the vehicle is driven for a calibrated distance with a VIN mismatch, it will cause the instrument cluster odometer to enter into an error mode and lock itself. When this occurs the dashes will remain on the display even after correcting the VIN mismatch. The vehicle odometer status data display on the scan tool can be used to identify a locked odometer. The only way to unlock the instrument cluster (clear the dashes from the display) is to perform an SPS programming event. Failure to follow the diagnostic and programming procedures may result in either an improper odometer value or a module replacement.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify all gauge segments illuminate when performing the Driver Information Center Segments test with the scan tool.
 - **If any gauge segments do not illuminate**

Replace the P16 instrument cluster
 - **If all gauge segments illuminate**
3. Drive the vehicle.
4. Verify the displayed Instrument Cluster speedometer value matches the vehicle speed parameter on the scan tool.
 - **If the values do not match**

Replace the P16 Instrument Cluster.
 - **If the values match**
5. Verify the odometer display and the displayed distance counts up while driving the vehicle.
 - **If the odometer displays only "----" (dashes)**

Refer to Circuit/System Testing.
 - **If the odometer display does not count up**

Replace the P16 Instrument Cluster.
 - **If speedometer sweeps and displays the correct value, and the odometer display counts up**
6. All OK.

Circuit/System Testing

NOTE:

- **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**
- **If there are multiple modules not original to the vehicle and are not new correctly configured service parts, SPS may not be able to properly read or recover the vehicle odometer value. Follow government rules and documentation (including vehicle identification) regarding inaccurate/unknown odometer values.**

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes) odometer is still unlocked

1. Verify the scan tool Odometer Status parameter is Unlocked.
 - **If the reading is Locked**

Refer to correcting VIN mismatch - odometer locked.

- **If the reading is Unlocked**
2. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.
 - **If the VIN does not match**

Reprogram the BCM, then proceed to Step 3.

 - **If the VIN matches**
 3. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.
 - **If the VIN does not match**

Reprogram the instrument cluster. Then proceed with step 4.

 - **If the VIN matches**
 4. Vehicle in Service Mode.
 5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

 - **If the instrument cluster displays the correct value**
 6. All OK.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes) odometer is locked

1. Verify the scan tool Odometer Status parameter is Locked.
 - **If the reading is Unlocked**

Refer to Correcting VIN mismatch - odometer unlocked.

 - **If the reading is Locked**
2. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.
 - **If the VIN does not match**

Reprogram the Instrument Cluster. Then proceed with step 3.

 - **If the VIN matches**
3. Perform the BCM setup procedure in SPS.
4. Vehicle in Service Mode.
5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

 - **If instrument cluster is displaying the correct value**
6. All OK.

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup

REPAIR INSTRUCTIONS

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

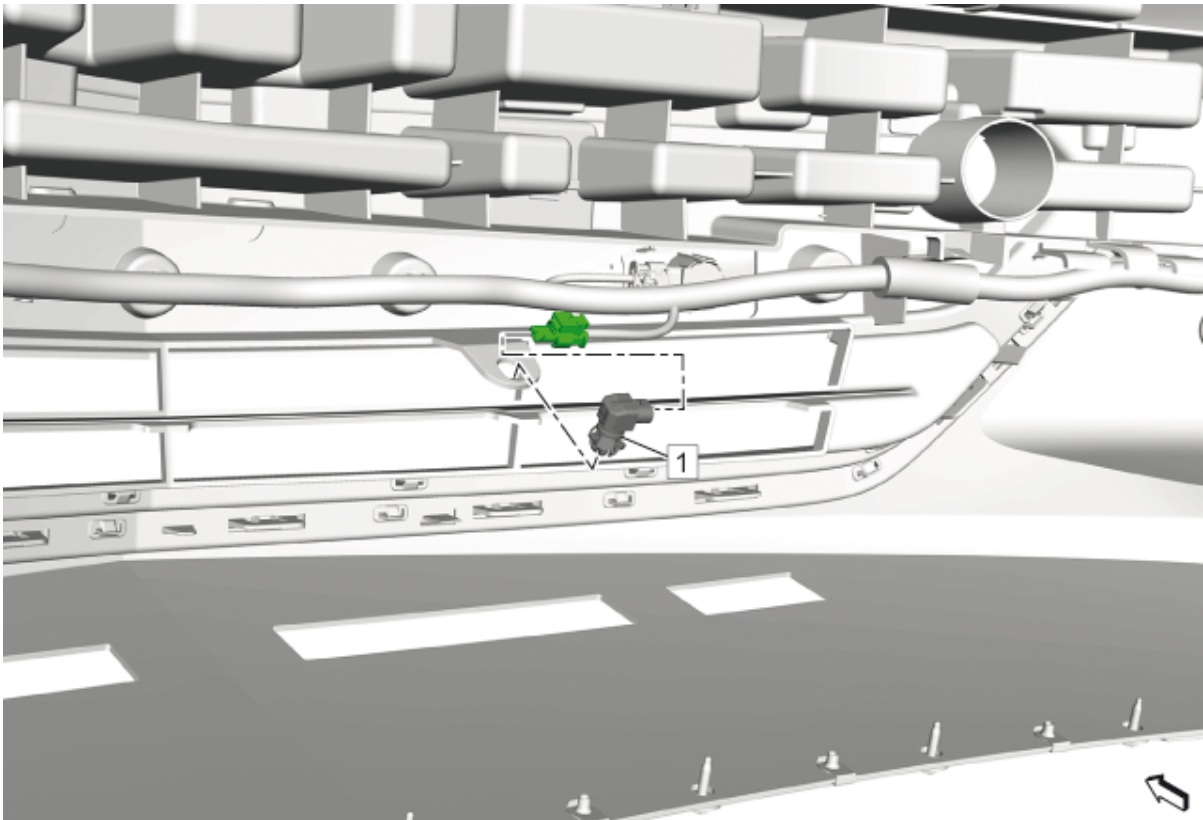


Fig. 5: Ambient Air Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Compartment Splash Shield. Refer to Front Compartment Splash Shield Replacement	
1	Ambient Air Temperature Gauge Sensor Procedure 1. Disconnect the electrical connectors. 2. Unlock the retaining tabs.

INSTRUMENT CLUSTER REPLACEMENT

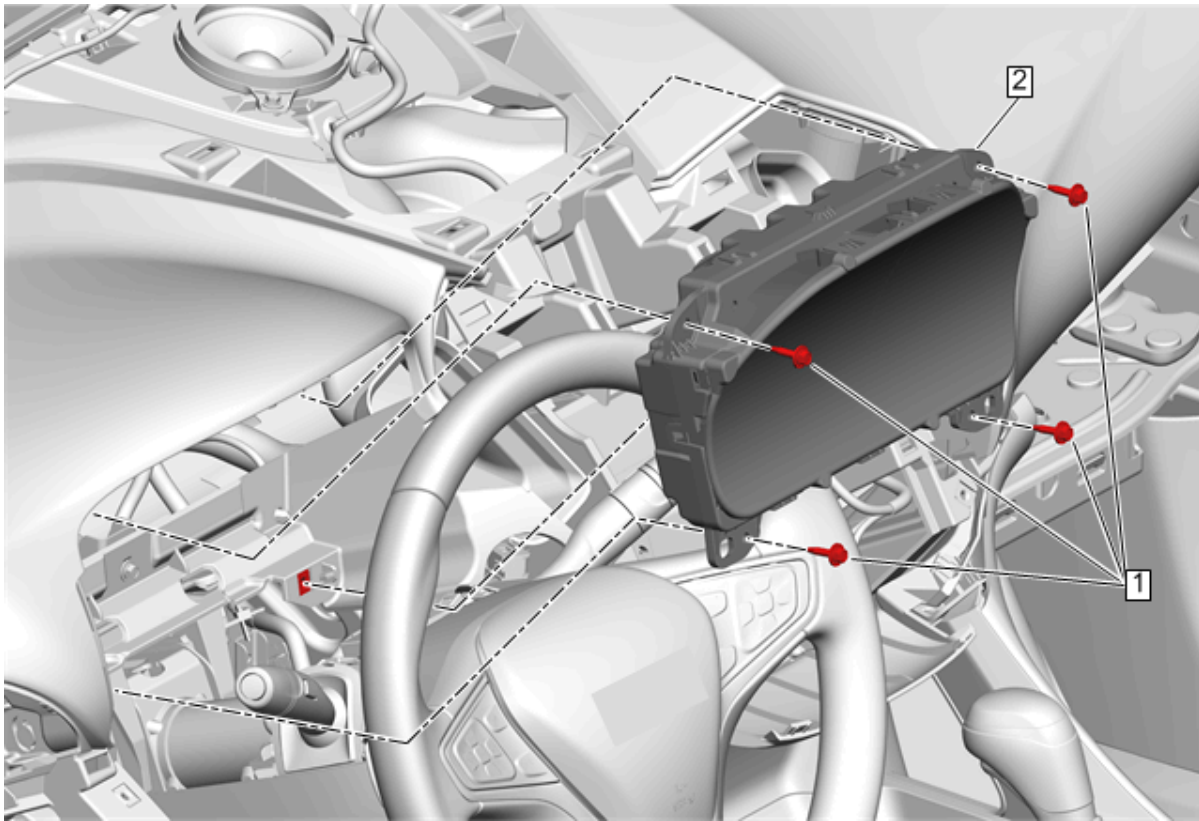


Fig. 6: Instrument Cluster

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Cluster Trim Plate. Refer to Instrument Panel Cluster Trim Plate Replacement	
1	Instrument Cluster Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Instrument Cluster Procedure 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and set up information, if required.

DESCRIPTION AND OPERATION

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. The radio generates the audible warnings through the speakers. The radio receives audible warning requests via the serial data circuit. If the radio receives multiple audible warning requests, the warning with the highest priority sounds first. On vehicles without a radio, a chime module generates the audible warnings and receives audible warning requests via the serial data circuit. Either the radio or the chime module is the chime producer. The following lists the audible warning sounds:

1. Single pulse gong
2. Multiple pulse gong
3. Single pulse beep
4. Multiple pulse beep
5. Click
6. Clack

Auto Stop Mode

The chime producer activates when the vehicle comes to a stop and the driver or passenger door is opened as requested by the body control module.

Fasten Safety Belt Warning

The chime producer activates the fasten safety belt audible warning as requested by the body control module (BCM). The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The fasten safety belt warning sounds and the fasten safety belt indicator illuminates when the following occurs:

- The ignition switch transitions to ON.
- The inflatable restraint sensing and diagnostic module (SDM) detects that the driver's seat belt is not buckled and the signal is low. The SDM sends a serial data message to the BCM indicating the seat belt status. The instrument cluster receives a serial data message from the BCM indicating the driver seat belt status.

If the seat belt is buckled when the ignition is turned ON, the chime does not sound. If the seat belt is buckled while the chime is sounding, the chime stops. If the seat belt is unbuckled after the initial transition to ON, the chime does not sound.

Lights On Warning

The chime producer activates the lights on warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The lights on warning sounds when the following occurs:

- The ignition is OFF.
- The BCM determines that the driver door is open and the signal circuit is low.
- The BCM determines that the headlamp switch is in the park or head position.

Brake Warning

The chime producer activates the brake audible warning as requested by multiple control modules. The BCM, electronic brake control module or the parking brake control module sends a serial data message to the chime producer indicating the chime as a multiple gong. The brake warning sounds and the BRAKE indicator illuminates when the following occurs:

- The ignition is ON.
- The vehicle speed is greater than 8 km/h (4.9 mph). The instrument cluster receives a serial data message from the engine control module (ECM) indicating the vehicle speed.
- The BCM determines that the parking brake is engaged and the signal circuit is low.
- The brake fluid is low.

Door Ajar Warning

The chime producer activates the door ajar audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime frequency of a medium rate and continuous duration. The door ajar warning sounds and the appropriate door ajar indicator illuminates in the driver information center when the following occurs:

- The BCM determines that a door (driver door, passenger door, left rear door, right rear door) is open and the signal circuit is low. The instrument cluster also receives a serial data message from the BCM indicating the door ajar status.
- The vehicle is not in PARK. The BCM receives a serial data message from the ECM/BCM indicating the gear position.

Object Detection

The chime producer activates the object detection audible warning as requested by the object alarm module. When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the object alarm module. The object alarm module evaluates the received sensor signals. As soon as an object is within the measuring range, the object alarm module sends a message via CAN-Bus to the chime producer in order to give out the acoustic distance signal. The measuring range is between 30 - 120 cm (11.81 - 47.24 in). From a distance of 120 cm (47.24 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.81 in), the sound becomes continuous.

Additional Warnings

The following warnings have an associated instrument cluster indicator or driver information center message:

- Turn Signal Indicators - The chime producer activates the audible warning as requested by the BCM. The chime produces two different chimes, one when the turn signal turns off and another when the turn signal turns on.
- Vehicle Overspeed Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Fuel Level Low Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.

- Oil Pressure Indicator - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Park Assist Fault Clean Rear Bumper Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Tire Pressure Low Indicator - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.

Refer to [Indicator/Warning Message Description and Operation](#).

DRIVER INFORMATION CENTER (DIC) DESCRIPTION AND OPERATION

The Driver Information Center display is in the instrument cluster. The Driver Information Center displays information about the vehicle. It also displays warning messages if a system problem is detected. For more information on Indicators and Warning messages, refer to [Indicator/Warning Message Description and Operation](#).

There are 3 switch functions for the driver information center:

- CONFIG: Press to select either the Simple or Enhanced instrument cluster configuration display.
- BACK: Press to return to the previous screen, exit a screen, or return to the main menu. Press BACK to minimize the DIC menu display.
- SELECT: Press the center of the knob to select the highlighted item. Turn the knob to scroll through the menu items.

Menu

Turn the SELECT knob to scroll through the possible menus. Press the center of the SELECT knob when a menu is highlighted to enter that menu. The possible Driver Information Center menu's are:

- Trip A
- Trip B
- Oil Life
- Tire Pressure
- Vehicle Messages
- Units
- Tutorial Mode

Trip A and Trip B

The trip displays show fuel used, average fuel economy, and distance traveled since the last trip reset.

Reset the trip data by pressing and holding the SELECT button when either Trip A or Trip B is displayed.

Oil Life

This displays the percentage of remaining oil life. The lower the percentage, the closer the vehicle is to needing an oil change.

When the oil life is depleted, the CHANGE ENGINE OIL SOON message displays. Change the oil as soon as possible.

The oil life must be reset after each oil change. Avoid accidental resetting of the Engine Oil Life System. It cannot be reset accurately until the next oil change. To reset the Engine Oil Life System, refer to [GM Oil Life System Resetting GM Oil Life System Resetting \(With Scan Tool\)](#) . The system is reset when 100% displays.

Outside Air Temperature

The outside air temperature can be accessed through the driver information center Trip/Fuel switch function. The driver information center shows the outside air temperature as a damped value. The time and rate of the temperature update is based on an algorithm in the instrument cluster. Factors such as last temperature reading, current temperature reading, length of time the vehicle was off, current vehicle speed, and the distance driven effect when the displayed temperature is updated. To get the vehicle to display the most accurate temperature faster, drive the vehicle. Constant moving traffic will update the display to the correct temperature more quickly than stop and go traffic.

Tire Pressure

The display will show a vehicle with the approximate pressures of all four tires. Tire pressure is displayed in either kilopascal (kPa) or in pounds per square inch (psi).

If a low or high tire pressure is detected, a message is displayed advising to check the tire pressure in the specified tire.

Vehicle Messages

Turn the SELECT knob to scroll through any active warning messages. Press SELECT to review the messages.

Units

Turn the SELECT knob to change the unit display to METRIC or US when the display is active. Press SELECT to confirm the setting. This will change the displays on the cluster and DIC to either metric or English (US) measurements.

Tutorial Mode

Select this menu item to view a screen that explains some of the unique features of the cluster.

Language

The driver information center is capable of displaying in different languages, corresponding to the radio language settings. The instrument cluster receives a GMLAN message with language information from the radio. This message is only sent one time, after a new language is selected. To set the language, see the owners manual.

INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION

Indicator LIGHT ON

Refer to the owner's manual for the descriptions and explanations of all indicator lights.

For diagnosis and repair information related to an indicator light, refer to the System Diagnosis and the Description of Operation that the message relates to.

Message Displayed

Refer to the owner's manual for descriptions and explanations of all messages displayed.

For diagnosis and repair information related to a displayed message, refer to the System Diagnosis and the Description of Operation that the message relates to.

CHANGE TIMING BELT MESSAGE

The Instrument Cluster monitors the odometer mileage to determine when timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100,000 miles (160,000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message. After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster for two minutes.

Transmission Shift Lever Position Indicator

The Transmission Shift Lever Position Indicator (if equipped) is located on the center console and indicates the current transmission shift lever position. The Transmission Shift Lever Position Indicator receives power and ground and is controlled by the Body Control Module (BCM) via serial data. The Transmission Control Module determines transmission shift lever position based on signals from the Transmission Internal Mode Switch and sends the shift lever position information to the BCM via serial data.

INSTRUMENT CLUSTER DESCRIPTION AND OPERATION

Displays Test

The instrument cluster displays a preview of information that includes electric range, charging, odometer, and battery status. This happens when the driver door is first opened, and following the welcome animation before starting the vehicle.

A CHARGING OVERRIDE/INTERRUPTION OCCURRED message may display on the lower left of the screen to indicate that a charging override or interruption has occurred due to:

- Override of charging settings by vehicle owner via OnStar.
- Unintended interruption of AC power at the vehicle's charge port.
- Interruption of charging by the utility company via OnStar as authorized by vehicle owner.

Refer to the owners manual for a complete list of vehicle charging status screen messages.

Indicators and Warning Messages

Refer to [Indicator/Warning Message Description and Operation](#).

Battery and Driver Efficiency Gauges

Refer to the owner's manual for descriptions and explanations of Battery and Driver Efficiency Gauges.

Fuel Level Gauge

The instrument cluster displays the fuel level based on the information from the ECM. The ECM converts the data from the fuel level sensors to a fuel level signal. The ECM sends the fuel level signal via a High Speed CAN-Bus signal to the BCM. The BCM then sends the information via a Low Speed CAN-Bus signal to the instrument cluster to display the fuel level. If the fuel level falls under 11% the instrument cluster switches on the low fuel level indicator. The fuel gauge defaults to empty if:

- The ECM detects a malfunction in the fuel level sensor circuit.
- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Speedometer

The instrument cluster displays the vehicle speed based on the information from the ECM. The ECM sends the vehicle speed information via a High Speed CAN-Bus signal to the BCM. The BCM then sends the vehicle speed information via a Low Speed CAN-Bus signal to the instrument cluster in order to display the vehicle speed, either in kilometers or miles, based on the vehicle requirements. The speedometer defaults to 0 km/h (0 MPH) if:

- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Odometer

The instrument cluster displays the vehicle odometer in the driver information center. The ECM send a distance rolling count message on GMLAN to the body control module (BCM). The BCM uses this information to calculate the vehicle odometer. This odometer value is then sent to the instrument cluster on GMLAN. The instrument cluster does not calculate the odometer. The odometer displays miles or kilometers as selected in the Units menu.

The odometer value is stored in multiple modules. The instrument cluster is a secondary storage module for the odometer, while the BCM is the primary storage and accumulator.

In addition to storing the odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules, and their stored odometer information, can not be move or transferred between different vehicles.

If the VINs do not match, the instrument cluster will go into an error mode and display "----" (dashes). If the VIN mismatch exists over a calibrated distance, the instrument cluster will "lock" the odometer display and only show dashes, even if the VIN mismatch is subsequently correct. The only way to clear or "unlock" the instrument cluster is to perform a BCM programming event using SPS.

Compass

The vehicle may have a compass display on the Driver Information Center. The compass receives its heading and other information from the Global Positioning System (GPS) antenna. If applicable, the GPS antenna is located with the telematics communication interface control module.

Driver Information Center Display

In the lower middle of the instrument cluster, an additional display is installed. Its task is to give additional

information, such as an odometer or error codes. This part of the instrument cluster is available in 4 different variants, mostly depending on the assembled engine. For further information refer to [**Driver Information Center \(DIC\) Description and Operation**](#).

Article GUID: A00884718

ACCESSORIES & EQUIPMENT

Fixed and Moveable Windows - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Front Side Door Window Channel Retainer Bolt	11 N.m (97 lb in)
Front Side Door Window Frame Inner Upper Screw	2.5 N.m (22 lb in)
Front Side Door Window Frame Rear Applique Outer Screw	2.5 N.m (22 lb in)
Front Side Door Window Regulator Nut	11 N.m (97 lb in)
Rear Side Door Window Channel Rear Retainer Bolt	11 N.m (97 lb in)
Rear Side Door Window Frame Inner Upper Screw	2.5 N.m (22 lb in)
Rear Side Door Window Frame Rear Applique Outer Screw	2.5 N.m (22 lb in)
Rear Side Door Window Regulator Nut	11 N.m (97 lb in)
Rear Side Door Window Weatherstrip Lower Bolt	11 N.m (97 lb in)

SCHEMATIC WIRING DIAGRAMS

MOVEABLE WINDOW WIRING SCHEMATICS

Driver

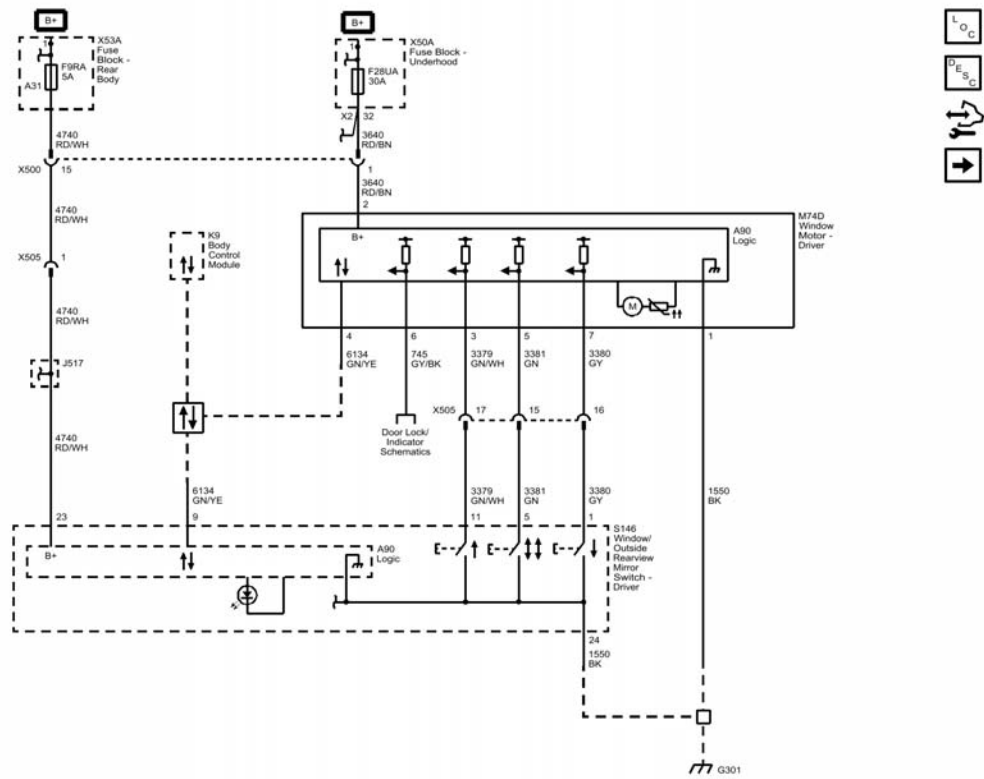


Fig. 1: Driver

Courtesy of GENERAL MOTORS COMPANY

Passenger

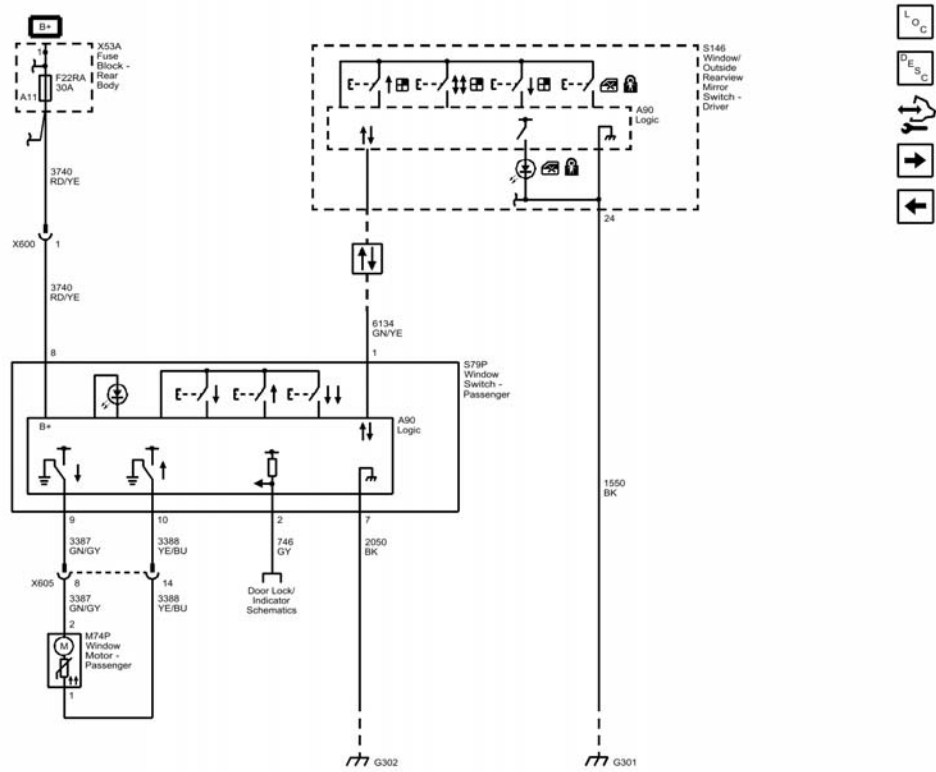


Fig. 2: Passenger
 Courtesy of GENERAL MOTORS COMPANY

Rear

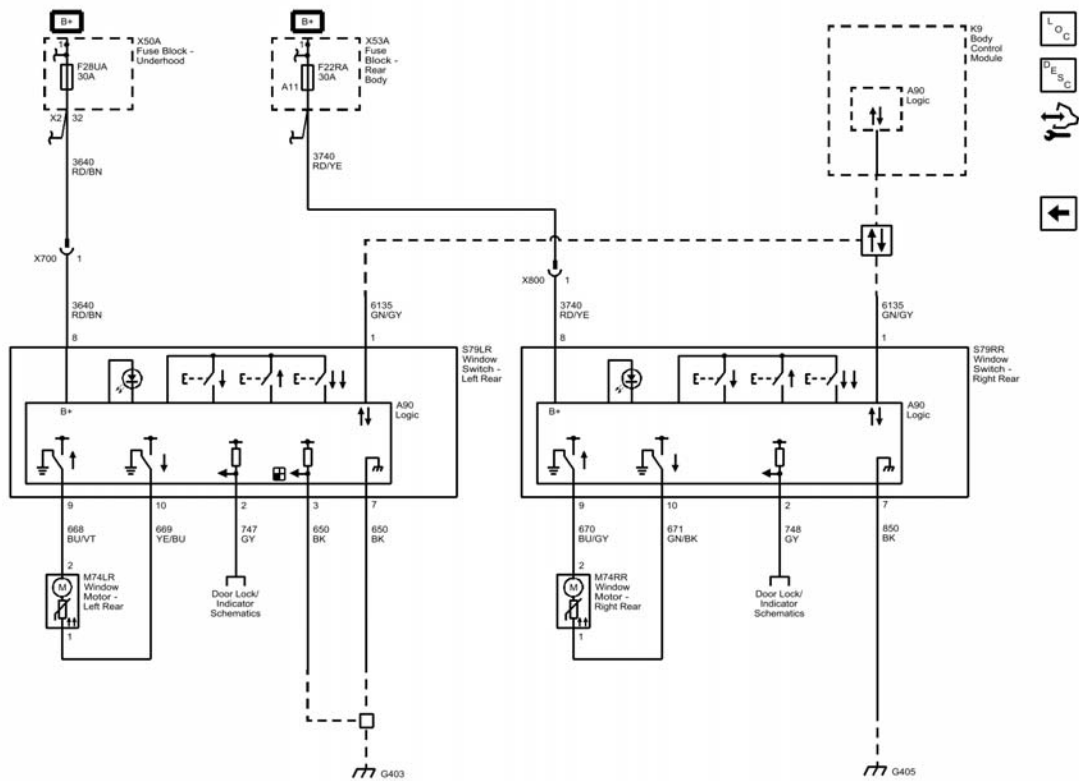


Fig. 3: Rear

Courtesy of GENERAL MOTORS COMPANY

DEFOGGER WIRING SCHEMATICS

Defogger

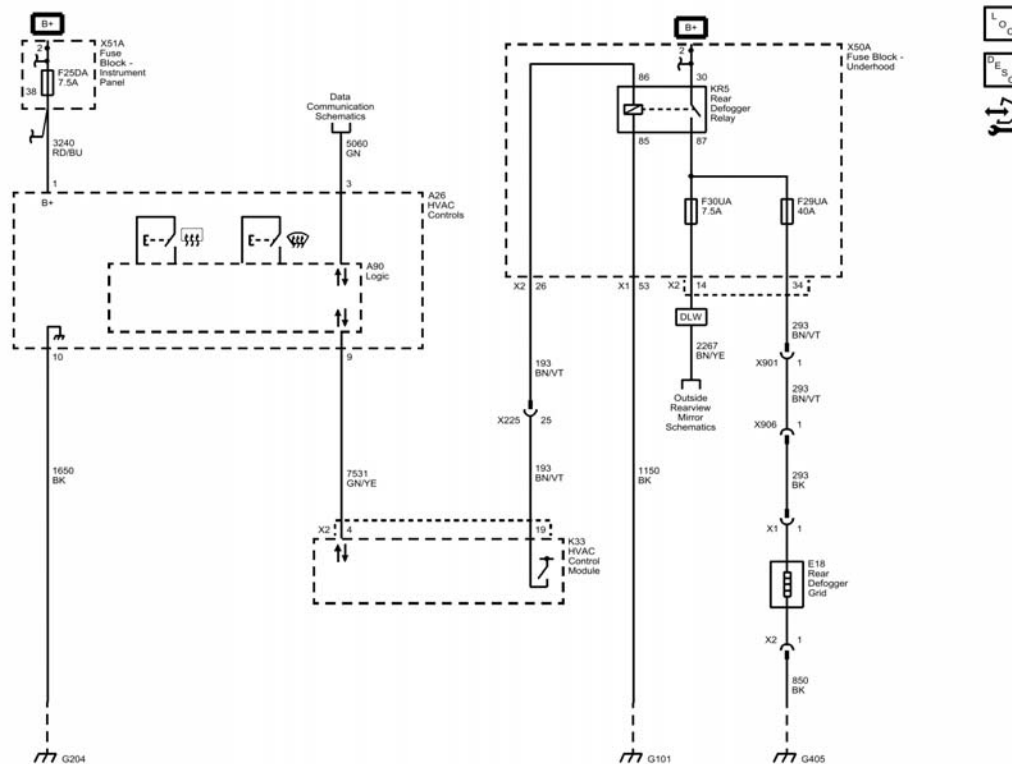


Fig. 4: Defogger

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0283: REAR DEFOGGER CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B0283

Rear Defogger Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Relay Coil	B0283 02	B0283 05	B0283 05	-
Ground - Relay Coil	-	B0283 05	-	-

Circuit/System Description

For an overview of the component/system, refer to: [Rear Window Defogger Description and Operation](#)

Circuit	Description
Control - Relay Coil	The output circuit is switched to 12 V to activate the component.
Ground - Relay Coil	Chassis Ground

Component	Description
KR5 Rear Defogger Relay	A relay is a switch that is actuated by a solenoid.
K33 HVAC Control Module	The control module controls a series of actuators to ensure optimal heating, ventilation and air conditioning of the passenger compartment. The control module does this by reading values from a variety of sensors and interprets the data and adjusts the actuators accordingly.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

- B0283 02 Control Circuit = Short to Ground
- B0283 05 Control Circuit = Open or Short to Battery

Actions Taken When the DTC Sets

- B0283 02 E18 Rear Defogger Grid = Disabled
- B0283 05 E18 Rear Defogger Grid = Disabled or Always On

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- [Circuit Testing](#)

- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Rear Defogger - On and Off

Verify the component turns On and Off: E18 Rear Defogger Grid

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **If the component turns On and Off**

3. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for less than 10 ohms between the test points: Ground circuit terminal 85 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 85 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Connect a test lamp between the test points: Control circuit terminal 86 & Ground circuit terminal 85
5. Ignition - On/Vehicle - In Service Mode
6. Perform the scan tool control function: Rear Defogger - On and Off

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K33 HVAC Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 19 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K33 HVAC Control Module
 - **If the test lamp is always On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: K33 HVAC Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K33 HVAC Control Module
 - **If the test lamp turns On and Off**
7. Test or replace the component: KR5 Rear Defogger Relay

Component Testing

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86
 - **If not between 70 and 110 ohms**

Replace the component: KR5 Rear Defogger Relay
 - **If between 70 and 110 ohms**
4. Test for infinite resistance between the test points:
 - Component terminal 30 & 85
 - Component terminal 30 & 86
 - Component terminal 30 & 87
 - Component terminal 85 & 87
 - **If less than infinite resistance**

Replace the component: KR5 Rear Defogger Relay
 - **If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & 12 V

Connect a jumper wire between the test points: Component terminal 85 & Ground
6. Test for less than 2 ohms between the test points: Component terminal 30 & 87
 - **If 2 ohms or greater**

Replace the component: KR5 Rear Defogger Relay

- If less than 2 ohms

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Relay Replacement \(Attached to Wire Harness\) Relay Replacement \(Within an Electrical Center\)](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B316B, B317A, B318A, OR B319A: WINDOW SWITCHES

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B316B

Driver Window Switch

DTC B317A

Passenger Window Switch

DTC B318A

Left Rear Window Switch

DTC B319A

Right Rear Window Switch

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Down @ M74D Window Motor - Driver	B316B 02	1	1	B316B 39
Signal - Up @ M74D Window Motor - Driver	B316B 02	2	2	B316B 39
Signal - Express @ M74D Window Motor - Driver	3	3	3	3
1. Driver Left Front Window Switch - Down = Inoperative 2. Driver Left Front Window Switch - Up = Inoperative				

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
3. Driver Left Front Window Switch - Express = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Power Windows Description and Operation](#)

Circuit	Description
B+ - S146 Window/Outside Rearview Mirror Switch - Driver	Supplied from a fuse.
B+ - M74D Window Motor - Driver	Supplied from a fuse.
B+ - S79P Window Switch - Passenger	Supplied from a fuse.
B+ - S79LR Window Switch - Left Rear	Supplied from a fuse.
B+ - S79RR Window Switch - Right Rear	Supplied from a fuse.
Signal - Down @ M74D Window Motor - Driver	The output circuit is switched to ground to activate the component.
Signal - Up @ M74D Window Motor - Driver	The output circuit is switched to ground to activate the component.
Signal - Express @ M74D Window Motor - Driver	The output circuit is switched to ground to activate the component.
Control - Up @ M74P Window Motor - Passenger	The output circuit is switched from ground to 12 V to activate the component.
Control - Down @ M74P Window Motor - Passenger	The output circuit is switched from ground to 12 V to activate the component.
Control - Up @ M74LR Window Motor - Left Rear	The output circuit is switched from ground to 12 V to activate the component.
Control - Down @ M74LR Window Motor - Left Rear	The output circuit is switched from ground to 12 V to activate the component.
Control - Up @ M74RR Window Motor - Right Rear	The output circuit is switched from ground to 12 V to activate the component.
Control - Down @ M74RR Window Motor - Right Rear	The output circuit is switched from ground to 12 V to activate the component.
Ground	Chassis Ground

Component	Description
S146 Window/Outside Rearview Mirror Switch - Driver	The S146 sends a serial data message to the K9 indicating the M74 function that has been requested.
M74D Window Motor - Driver	- Power Window Control - The control module also reads various switches and sensors and makes their values available via serial data.
S79P Window Switch - Passenger	The switch has a normally open contact.
M74P Window Motor - Passenger	An electric DC motor.
S79LR Window Switch - Left Rear	The switch has a normally open contact.
M74LR Window Motor - Left Rear	An electric DC motor.

Component	Description
S79RR Window Switch - Right Rear	The switch has a normally open contact.
M74RR Window Motor - Right Rear	An electric DC motor.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

B316B 00

- Control module K9 detects: Right Front Window Switch @ S146 Window/Outside Rearview Mirror Switch - Driver = Switch Stuck - For greater than 60 s
- Control module K9 detects: Left Rear Window Switch @ S146 Window/Outside Rearview Mirror Switch - Driver = Switch Stuck - For greater than 60 s
- Control module K9 detects: Right Rear Window Switch @ S146 Window/Outside Rearview Mirror Switch - Driver = Switch Stuck - For greater than 60 s

B316B 02

- Control module K9 detects: Signal - Down @ M74D Window Motor - Driver = Short to Ground - For greater than 60 s
- Control module K9 detects: Signal - Up @ M74D Window Motor - Driver = Short to Ground - For greater than 60 s

B316B 39

Control module K9 detects: S146 Window/Outside Rearview Mirror Switch - Driver = Signal Erratic

B317A 02

Control module K9 detects: S79P Window Switch - Passenger = Switch Stuck - For greater than 60 s

B318A 02

Control module K9 detects: S79LR Window Switch - Left Rear = Switch Stuck - For greater than 60 s

B319A 02

Control module K9 detects: S79RR Window Switch - Right Rear = Switch Stuck - For greater than 60 s

Actions Taken When the DTC Sets

Window Switch - Malfunction

Conditions for Clearing the DTC

B316B 00, B316B 02, B317A 02, B318A 02, B319A 02

- A current DTC will clear when the diagnostic runs and passes.

- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

B316B 39

If set as a current DTC - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. S146 Window/Outside Rearview Mirror Switch - Driver - Driver Left Front Window Switch - Not Pressed

Verify the scan tool parameter:

- Driver Window Main Control Down Switch = Inactive
- Driver Window Main Control Up Switch = Inactive
- Driver Window Main Control Express Switch = Inactive
- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. S146 Window/Outside Rearview Mirror Switch - Driver - No Button Pressed

Verify the scan tool parameter:

- Left Rear Window Main Control Down Switch = Inactive
- Left Rear Window Main Control Express Switch = Inactive

- Left Rear Window Main Control Up Switch = Inactive
- Right Rear Window Main Control Down Switch = Inactive
- Right Rear Window Main Control Express Switch = Inactive
- Right Rear Window Main Control Up Switch = Inactive
- Front Passenger Window Main Control Down Switch = Inactive
- Front Passenger Window Main Control Express Switch = Inactive
- Front Passenger Window Main Control Up Switch = Inactive
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

4. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Driver Left Front Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Driver Window Main Control Down Switch = Active
- Driver Window Main Control Up Switch = Active
- Driver Window Main Control Express Switch = Active
- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

5. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Left Rear Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Left Rear Window Main Control Down Switch = Active
- Left Rear Window Main Control Express Switch = Active
- Left Rear Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

6. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Right Rear Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Right Rear Window Main Control Down Switch = Active
- Right Rear Window Main Control Express Switch = Active
- Right Rear Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

7. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Right Front Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Front Passenger Window Main Control Down Switch = Active
- Front Passenger Window Main Control Express Switch = Active
- Front Passenger Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

8. S79P Window Switch - Passenger - Not Pressed

Verify the scan tool parameter: Passenger Window Switch at Door = Inactive

- **If not the specified state**

Test or replace the component: S79P Window Switch - Passenger

- **If the specified state**

9. Operate the component: S79P Window Switch - Passenger - Pressed & Pulled

Verify the scan tool parameter:

- Passenger Window Switch at Door = Up
- Passenger Window Switch at Door = Down
- Passenger Window Switch at Door = Express Down
- **If not the specified state**

Test or replace the component: S79P Window Switch - Passenger

- **If the specified state**

10. S79LR Window Switch - Left Rear - Not Pressed

Verify the scan tool parameter: Left Rear Window Switch at Door = Inactive

- **If not the specified state**

Test or replace the component: S79LR Window Switch - Left Rear

- **If the specified state**

11. Operate the component: S79LR Window Switch - Left Rear - Pressed & Pulled

Verify the scan tool parameter:

- Left Rear Window Switch at Door = Up

- Left Rear Window Switch at Door = Down
- Left Rear Window Switch at Door = Express Down
- **If not the specified state**

Test or replace the component: S79LR Window Switch - Left Rear

- **If the specified state**

12. S79RR Window Switch - Right Rear - Not Pressed

Verify the scan tool parameter: Right Rear Window Switch at Door = Inactive

- **If not the specified state**

Test or replace the component: S79RR Window Switch - Right Rear

- **If the specified state**

13. Operate the component: S79RR Window Switch - Right Rear - Pressed & Pulled

Verify the scan tool parameter:

- Right Rear Window Switch at Door = Up
- Right Rear Window Switch at Door = Down
- Right Rear Window Switch at Door = Express Down
- **If not the specified state**

Test or replace the component: S79RR Window Switch - Right Rear

- **If the specified state**

14. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: S146 Window/Outside Rearview Mirror Switch - Driver
3. Test for less than 10 ohms between the test points: Ground circuit terminal 24 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 24 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 23 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Test for infinite resistance between the test points: B+ circuit terminal 23 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the test lamp turns On**

6. Verify the scan tool parameter: Driver Window Main Control Down Switch = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: M74D Window Motor - Driver

- **If the specified state**

7. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 24

Verify the scan tool parameter: Driver Window Main Control Down Switch = Active

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Signal circuit terminal 7 @ M74D Window Motor - Driver

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: M74D Window Motor - Driver

- **If the specified state**

8. Verify the scan tool parameter: Driver Window Main Control Up Switch = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Test for infinite resistance between the test points: Signal circuit terminal 11 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: M74D Window Motor - Driver

• **If the specified state**

9. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 11 & Ground circuit terminal 24

Verify the scan tool parameter: Driver Window Main Control Up Switch = Active

• **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 11 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 11 @ Component harness & Signal circuit terminal 3 @ M74D Window Motor - Driver

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: M74D Window Motor - Driver

• **If the specified state**

10. Test for greater than 10 V between the test points: Signal circuit terminal 5 @ Component harness & Ground

• **If 10 V or less**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Test for infinite resistance between the test points: Signal circuit terminal 5 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If less than infinite resistance

1. Ignition/Vehicle - Off

2. Test for less than 2 ohms between the test points: Signal circuit terminal 5 @ Component harness & Signal circuit terminal 5 @ M74D Window Motor - Driver

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: M74D Window Motor - Driver

• **If the specified state**

11. Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Window Switch Replacement \(Right Side\)](#)
- Refer to [Front Side Door Window Control Switch Replacement](#)
- Refer to [Rear Side Door Window Switch Replacement](#)
- Refer to [Front Side Door Window Regulator Replacement](#)
- Refer to [Rear Side Door Window Regulator Replacement](#)

DTC B3205: DRIVER WINDOW MOTOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B3205

Driver Window Motor

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Power Windows Description and Operation](#)

Circuit	Description
B+ - M74D Window Motor - Driver	Supplied from a fuse.
Ground	Chassis Ground

Component	Description
M74D Window Motor - Driver	• Power Window Control • The control module and the DC motor are one assembly.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

B3205 00

M74D Window Motor - Driver = Incompatible Hardware or Equipment

B3205 09

M74D Window Motor - Driver = Internal Malfunction

B3205 42

Calibration Update = Failed

B3205 4B

- Battery - Disconnected/Replaced
- Front Side Door Wiring Harness - Disconnected
- M74D Window Motor - Driver - Disconnected

Actions Taken When the DTC Sets

B3205 00, B3205 39, B3205 42

M74D Window Motor - Driver = Inoperative

B3205 4B

- Window Express Up System Not Initialized
- Driver Information Display = Open, then Close Driver Window

Conditions for Clearing the DTC

B3205 00

M74D Window Motor - Driver - Replaced - A current DTC can be cleared after the procedure is performed.

B3205 39, B3205 42

M74D Window Motor - Driver - Replaced - A current DTC can be cleared after the procedure is performed.

B3205 4B

M74D Window Motor - Driver - Normalized - A current DTC can be cleared after the procedure is performed.

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Driver Window Motor - Up & Down

Verify the component works as specified: M74D Window Motor - Driver = Up & Down

- **If not the specified state**

Test or replace the component: M74D Window Motor - Driver

- **If the specified state**

3. Perform the scan tool control function: Driver Window Motor - Down
4. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Pulled = Up & Release

Verify the component works as specified: M74D Window Motor - Driver = Express Up

- **If not the specified state**

Use the following procedure: [Window Motor Programming - Express Function](#)

- **If the specified state**

5. Ignition/Vehicle & All vehicle systems - Off - For greater than 2 min
6. Ignition - On/Vehicle - In Service Mode
7. Perform the scan tool control function: Driver Window Motor - Down
8. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver - Pulled = Up & Release

Verify the component works as specified: M74D Window Motor - Driver = Express Up

- **If not the specified state**

Test or replace the component: M74D Window Motor - Driver.

- **If the specified state**

9. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Refer to [Front Side Door Window Regulator Replacement](#)

SYMPTOMS - FIXED AND MOVEABLE WINDOWS

Important Preliminary Checks Before Starting:

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:

- There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the power window system operation or rear window defogger system operation in order to familiarize yourself with the system functions. Refer to the following:
- **Rear Window Defogger Description and Operation**
 - **Power Windows Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

NOTE:

- **Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .**
- **The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.**

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Rear Window Defogger Malfunction**
- **Power Windows Malfunction**

REAR WINDOW DEFOGGER MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Switch	1	1	-	-
Control - Relay Coil	B0283 02	B0283 05	B0283 05	-
Control - E18 Rear Defogger Grid	1	1	2	-
Ground - Relay Coil	-	B0283 05	-	-
Ground - E18 Rear Defogger Grid	-	1	-	-
1. E18 Rear Defogger Grid - Inoperative 2. E18 Rear Defogger Grid - Always On				

Circuit/System Description

For an overview of the component/system, refer to: [Rear Window Defogger Description and Operation](#)

Circuit	Description
B+ - Relay Switch	Supplied from a fuse.
E18 Rear Defogger Grid Control - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to 12 V to activate the component.
E18 Rear Defogger Grid Ground - Component	Chassis Ground
Ground - Relay Coil	Chassis Ground

Component	Description
KR5 Rear Defogger Relay	A relay is a switch that is actuated by a solenoid.
E18 Rear Defogger Grid	Window defoggers are parallel resistive conductors in or on the glass that heat up when electric power is applied.
A26 HVAC Controls	The position of the defogger switch is read by the control module A26 and, via CAN bus, forwarded to the control module K33, which translates the bus message into a control signal for E18.
K33 HVAC Control Module	The control module controls a series of actuators to ensure optimal heating, ventilation and air conditioning of the passenger compartment. The control module does this by reading values from a variety of sensors and interprets the data and adjusts the actuators accordingly.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

- Electrical Center Identification Views
- Luggage Compartment/Rear of Vehicle Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Operate the component: Rear Defogger Switch - Pressed

Verify the scan tool parameter: Rear Defogger Switch = Off & On

- **If not the specified state**

Replace the component: A26 HVAC Controls

- **If the specified state**

3. Perform the scan tool control function: Rear Defogger - On and Off

Verify the component turns On and Off: E18 Rear Defogger Grid

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **If the component turns On and Off**

4. Operate the component: Rear Defogger Switch - Pressed
5. Verify the component turns On and Off: Rear Defogger Indicator

- **If the component does not turn On and Off**

Replace the component: A26 HVAC Controls

- **If the component turns On and Off**

6. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for less than 10 ohms between the test points: Ground circuit terminal 85 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 85 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Connect a test lamp between the test points: Control circuit terminal 86 & Ground circuit terminal 85
5. Ignition - On/Vehicle - In Service Mode
6. Perform the scan tool control function: Rear Defogger - On and Off

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: X2 @ K33 HVAC Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 19 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K33 HVAC Control Module

- **If the test lamp is always On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K33 HVAC Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K33 HVAC Control Module

- **If the test lamp turns On and Off**

7. Verify a test lamp turns On between the test points: B+ circuit terminal 30 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: B+ circuit terminal 30 @ Relay Socket & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for infinite resistance between the test points: B+ circuit terminal 30 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
3. Disconnect the electrical connector: X1 & X2 @ E18 Rear Defogger Grid
4. Test for infinite resistance between the test points: Control circuit terminal 87 @ Relay Socket & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
5. Replace the component: Fuse
6. Install the component: KR5 Rear Defogger Relay
7. Connect a test lamp between the test points: Control circuit terminal 1 X1 & Ground circuit terminal 1 X2
8. Ignition - On/Vehicle - In Service Mode
9. Perform the scan tool control function: Rear Defogger - On and Off

Verify the test lamp turns On and Off.

- If the test lamp does not turn On and Off - Test or replace the component: KR5 Rear Defogger Relay
- If the test lamp turns On and Off - Test or replace the component: E18 Rear Defogger Grid

- **If the test lamp turns On**

8. Momentarily connect a 40 A fused jumper wire between the test points: B+ circuit terminal 30 & Control circuit terminal 87

Verify the component does not turn On and Off when connecting and disconnecting the jumper wire: E18 Rear Defogger Grid

- **If the component turns On and Off**

Test or replace the component: KR5 Rear Defogger Relay

- **If the component does not turn On and Off**

9. Ignition/Vehicle & All vehicle systems - Off
10. Install the component: KR5 Rear Defogger Relay
11. Disconnect the electrical connector: X1 & X2 @ E18 Rear Defogger Grid
12. Test for less than 10 ohms between the test points: Ground circuit terminal 1 X2 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection
2. Test for less than 2 ohms between the test points: Ground circuit terminal 1 X2 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

13. Connect a test lamp between the test points: Control circuit terminal 1 X1 & Ground circuit terminal 1 X2
14. Ignition - On/Vehicle - In Service Mode
15. Perform the scan tool control function: Rear Defogger - On and Off

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

Repair the open/high resistance in the circuit: Control circuit

- **If the test lamp is always On**

Repair the short to voltage on the circuit: Control circuit

- **If the test lamp turns On and Off**

16. Test or replace the component: E18 Rear Defogger Grid

Component Testing

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & Component terminal 86
 - **If not between 70 and 110 ohms**

Replace the component: KR5 Rear Defogger Relay

- **If between 70 and 110 ohms**

4. Test for infinite resistance between the test points:

- Component terminal 30 & 85
- Component terminal 30 & 86
- Component terminal 30 & 87
- Component terminal 85 & 87
- **If less than infinite resistance**

Replace the component: KR5 Rear Defogger Relay

- **If infinite resistance**

5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & 12 V

Connect a jumper wire between the test points: Component terminal 85 & Ground

6. Test for less than 2 ohms between the test points: Component terminal 30 & Component terminal 87

- **If 2 ohms or greater**

Replace the component: KR5 Rear Defogger Relay

- **If less than 2 ohms**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- Refer to [Rear Window Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

POWER WINDOWS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - S146 Window/Outside Rearview Mirror Switch - Driver	U1538 00	U1538 00	-	-
B+ - S146 Window/Outside Rearview Mirror Switch - Driver	U1534 00	U1534 00	-	-
B+ - S79P Window Switch - Passenger	U153A 00	U153A 00	-	-
B+ - S79RR Window Switch - Right Rear	U1534 00, U154A 00	U154A 00	-	-
B+ - S79LR Window Switch - Left Rear	U1534 00, U154A 00	U1534 00	-	-
Serial Data - S146 Window/Outside Rearview Mirror Switch - Driver	U1534 00, U1538 00, U153A 00	U1538 00	U1538 00	-
Serial Data - M74D Window Motor - Driver	U1534 00, U1538 00, U153A 00	U1534 00	U1534 00	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data - S79P Window Switch - Passenger	U1534 00, U1538 00, U153A 00	U153A 00	U153A 00	-
Serial Data - S79LR Window Switch - Left Rear	U1534 00, U154A 00	U1534 00	U1534 00	-
Serial Data - S79RR Window Switch - Right Rear	U1534 00, U154A 00	U154A 00	U154A 00	-
Power Window Master Switch Left Front Down Signal	B316B 02	1	1	B316B 39
Power Window Switch Driver Express Signal	1	1	1	B316B 39
Power Window Master Switch Left Front Up Signal	B316B 02	1	1	B316B 39
Control - M74P Window Motor - Passenger	2	2	2	-
Control - M74LR Window Motor - Left Rear	3	3	3	-
Control - M74RR Window Motor - Right Rear	4	4	4	-
Ground - S146 Window/Outside Rearview Mirror Switch - Driver	-	U1538 00	-	-
Ground - M74D Window Motor - Driver	-	U1534 00	-	-
Ground - S79P Window Switch - Passenger	-	U153A 00	-	-
Ground - S79LR Window Switch - Left Rear	-	U1534 00	-	-
Ground - S79RR Window Switch - Right Rear	-	U154A 00	-	-
1. M74D Window Motor - Driver = Inoperative 2. M74P Window Motor - Passenger = Inoperative 3. M74LR Window Motor - Left Rear = Inoperative 4. M74RR Window Motor - Right Rear = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Power Windows Description and Operation](#)

Circuit	Description
B+ - M74D Window Motor - Driver	Supplied from a fuse.
B+ - M74P Window Motor - Passenger	Supplied from a fuse.
B+ - S79LR Window Switch - Left Rear	Supplied from a fuse.
B+ - S79RR Window Switch - Right Rear	Supplied from a fuse.

Circuit	Description
Power Window Switch Driver Down Signal	The output circuit is switched to ground to activate the component.
Power Window Switch Driver Express Signal	The output circuit is switched to ground to activate the component.
Power Window Switch Driver Up Signal	The output circuit is switched to ground to activate the component.
Power Window Motor Passenger Down Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Passenger Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Left Rear Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Left Rear Down Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Right Rear Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Right Rear Down Control	The output circuit is switched from ground to 12 V to activate the component.
Ground	Chassis Ground

Component	Description
S146 Window/Outside Rearview Mirror Switch - Driver	The S146 sends a serial data message to the K9 indicating the M74 function that has been requested.
M74D Window Motor - Driver	- Power Window Control - The control module and the DC motor are one assembly.
S79P Window Switch - Passenger	The switch has a normally open contact.
M74P Window Motor - Passenger	An electric DC motor.
S79LR Window Switch - Left Rear	The switch has a normally open contact.
M74LR Window Motor - Left Rear	An electric DC motor.
S79RR Window Switch - Right Rear	The switch has a normally open contact.
M74RR Window Motor - Right Rear	An electric DC motor.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Diagnostic Aids

M74D Window Motor - Driver - Window Express Up System Not Initialized

- Battery - Disconnected/Replaced
- Front Side Door Wiring Harness - Disconnected
- M74 Window Motor - Disconnected

M74D Window Motor - Driver - Normalized - [Window Motor Programming - Express Function](#)

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Driver Window Motor - Up & Down

Verify the component operates in both directions: M74D Window Motor - Driver

- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

3. Operate the component: Driver Left Front Window Switch - Pressed & Pulled

Verify the component works as specified: M74D Window Motor - Driver = Up/Express Up/Down/Express Down

- **If not the specified state**

Refer to: Circuit/System Testing - Test 2

- **If the specified state**

4. S146 Window/Outside Rearview Mirror Switch - Driver - Not Pressed

Verify the scan tool parameter:

- Left Rear Window Main Control Down Switch = Inactive
- Left Rear Window Main Control Express Switch = Inactive
- Left Rear Window Main Control Up Switch = Inactive

- Right Rear Window Main Control Down Switch = Inactive
- Right Rear Window Main Control Express Switch = Inactive
- Right Rear Window Main Control Up Switch = Inactive
- Front Passenger Window Main Control Down Switch = Inactive
- Front Passenger Window Main Control Express Switch = Inactive
- Front Passenger Window Main Control Up Switch = Inactive
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

5. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Left Rear Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Left Rear Window Main Control Down Switch = Active
- Left Rear Window Main Control Express Switch = Active
- Left Rear Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

6. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Right Rear Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Right Rear Window Main Control Down Switch = Active
- Right Rear Window Main Control Express Switch = Active
- Right Rear Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

7. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Right Front Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Front Passenger Window Main Control Down Switch = Active
- Front Passenger Window Main Control Express Switch = Active
- Front Passenger Window Main Control Up Switch = Active
- **If not the specified state**

Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

8. Perform the scan tool control function: Passenger Window Motor - Up & Down

Verify the component works as specified: M74P Window Motor - Passenger = Up & Down

- **If not the specified state**

Refer to: Circuit/System Testing - Test 3

- **If the specified state**

9. Perform the scan tool control function: Left Rear Window Motor - Up & Down

Verify the component works as specified: M74LR Window Motor - Left Rear = Up & Down

- **If not the specified state**

Refer to: Circuit/System Testing - Test 3

- **If the specified state**

10. Perform the scan tool control function: Right Rear Window Motor - Up & Down

Verify the component works as specified: M74RR Window Motor - Right Rear = Up & Down

- **If not the specified state**

Refer to: Circuit/System Testing - Test 3

- **If the specified state**

11. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: M74D Window Motor - Driver

3. Test for less than 10 ohms between the test points: Ground circuit terminal 1 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection

2. Test for less than 2 ohms between the test points: Ground circuit terminal 1 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify a test lamp turns On between the test points: B+ circuit terminal 2 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: M74D Window Motor - Driver B+ circuit terminal 2 @ Output terminal @ F28UA Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for infinite resistance between the test points: B+ circuit terminal 2 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: M74D Window Motor - Driver

- **If the test lamp turns On**

6. Test or replace the component: M74D Window Motor - Driver

Test 2

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: S146 Window/Outside Rearview Mirror Switch - Driver
3. Test for less than 10 ohms between the test points: Ground circuit terminal 24 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 24 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 23 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for infinite resistance between the test points: B+ circuit terminal 23 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver
 - **If the test lamp turns On**

6. Verify the scan tool parameter: Driver Window Main Control Down Switch = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: M74D Window Motor - Driver
3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: M74D Window Motor - Driver

- **If the specified state**

7. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 24

Verify the scan tool parameter: Driver Window Main Control Down Switch = Active

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: M74D Window Motor - Driver
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 7 @ M74D Window Motor - Driver
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: M74D Window Motor - Driver

- **If the specified state**

8. Verify the scan tool parameter: Driver Window Main Control Up Switch = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: M74D Window Motor - Driver
3. Test for infinite resistance between the test points: Signal circuit terminal 11 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: M74D Window Motor - Driver

- **If the specified state**

9. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 11 & Ground circuit terminal 24

Verify the scan tool parameter: Driver Window Main Control Up Switch = Active

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: M74D Window Motor - Driver
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 11 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 11 @ Component harness & Terminal 3 @ M74D Window Motor - Driver
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: M74D Window Motor - Driver
- **If the specified state**
10. Test for greater than 10 V between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - **If 10 V or less**
 - 1. Ignition/Vehicle - Off
 - 2. Disconnect the electrical connector: M35D Window Motor Module - Driver
 - 3. Test for infinite resistance between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If less than infinite resistance
 - 1. Ignition/Vehicle - Off
 - 2. Test for less than 2 ohms between the test points: Signal circuit terminal 5 @ Component harness & Signal circuit terminal 5 @ M35D Window Motor Module - Driver
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: M35D Window Motor Module - Driver
 - **If greater than 10 V**
11. Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

Test 3

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: S79P Window Switch - Passenger/S79LR Window Switch - Left Rear/S79RR Window Switch - Right Rear
3. Test for less than 10 ohms between the test points: Ground circuit terminal 7 & Ground
 - **If 10 ohms or greater**
 - 1. Disconnect Ground Connection
 - 2. Test for less than 2 ohms between the test points: Ground circuit terminal 7 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify a test lamp turns On between the test points: B+ circuit terminal 8 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Test for infinite resistance between the test points: B+ circuit terminal 8 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: S79 Window Switch

- **If the test lamp turns On**

6. Ignition/Vehicle - Off

7. Connect the electrical connector: S79 Window Switch

8. Disconnect the electrical connector: M74 Window Motor

9. Connect a test lamp between the test points: Control circuit terminal 1 & Control circuit terminal 2

10. Ignition - On/Vehicle - In Service Mode

11. Perform the scan tool control function: Window Motor

Verify the test lamp state:

Window Motor - Stop = Test lamp Off

Window Motor - Up = Test lamp On

Window Motor - Down = Test lamp On

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the electrical connector: S79 Window Switch

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for infinite resistance between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance

7. Test for less than 2 ohms between the test points:

- Control circuit terminal 1 @ Component harness & Control circuit terminal 10 @ S79 Window Switch
- Control circuit terminal 2 @ Component harness & Control circuit terminal 9 @ S79 Window Switch
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: S79 Window Switch

- **If the specified state**

12. Test or replace the component: M74 Window Motor

Component Testing

M74P Window Motor - Passenger/M74LR Window Motor - Left Rear/M74RR Window Motor - Right Rear

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector:
 - M74P Window Motor - Passenger
 - M74LR Window Motor - Left Rear
 - M74RR Window Motor - Right Rear
3. Connect a 25 A fused jumper wire between the test points: Control terminal 1 & B+

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2 & Ground

Reverse the jumper wires 2 times between the terminals.

Verify the component works as specified: M74 Window Motor = Up & Down

- **If not the specified state**

Replace the component:

- M74P Window Motor - Passenger
- M74LR Window Motor - Left Rear
- M74RR Window Motor - Right Rear
- **If the specified state**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Window Switch Replacement \(Right Side\)](#)
- Refer to [Front Side Door Window Control Switch Replacement](#)
- Refer to [Rear Side Door Window Switch Replacement](#)
- Refer to [Front Side Door Window Regulator Replacement](#)

- Refer to [Rear Side Door Window Regulator Replacement](#)

SIDE DOOR WINDOW MECHANICAL DIAGNOSIS

Cause	Correction
DEFINITION: A mechanical condition that requires a correction for proper operation of the side door window. Refer to Symptoms - Fixed and Moveable Windows prior to beginning this table.	
Intermittent Operation	Check proper glass alignment/attachment and door seal installation.
	Check switch and switch bezel to see if sticking.
	Check wire harness for pinched/shorted wire.
	THIS STEP APPLIES TO ALL TWO PIN MOTOR CONNECTORS ONLY. Perform electrical diagnostics, by first applying 12 volt power supply to the regulator motor to verify motor function.
Glass Binds	Check proper glass alignment/attachment.
	Check for defective seal and/or proper seal installation.
	Check for debris in glass run channel.
	Check for glass run channel position.
Regulator/Glass Rattles	Check for loose fasteners and retorque if required.
	Check that the glass is in the channel and reinstall if not positioned correctly.
Noisy Operation	Check for other components in the glass path such as wire harness, impact foam, lock rods, or cables.
	Check for proper glass alignment/attachment and door seal installation.
Windnoise	Check seals, mirror patch, and glass alignment.
False glass reversal, the glass goes down unexpectedly.	Check seals, reinitialize the glass and/or realign the glass.
	Check for debris in the glass run channel.

REPAIR INSTRUCTIONS

WINDSHIELD REPLACEMENT

Special Tools

- **BO-24402-A** Glass Sealant Remover (Cold Knife)
- **BO-39032** Stationary Glass Removal Tool
- Use an adhesive that is approved by GM

For equivalent regional tools, refer to [Special Tools](#)

CAUTION: To avoid breakage of the windshield, protect the surrounding area of the part which you are removing or installing.

NOTE: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

1. Open the hood.
2. Remove Windshield Wiper Arm. Refer to [Windshield Wiper Arm Replacement](#)

3. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
4. Remove Inside Rearview Mirror. Refer to [Inside Rearview Mirror Replacement](#)
5. Remove Front View Camera. Refer to [Front View Camera Replacement](#)
6. Disconnect the rain sensor connector, if equipped.

WARNING: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

7. Cover to protect the following parts from broken glass:

- Upper dash pad
- Defroster outlets and A/C outlets
- Seats and carpeting

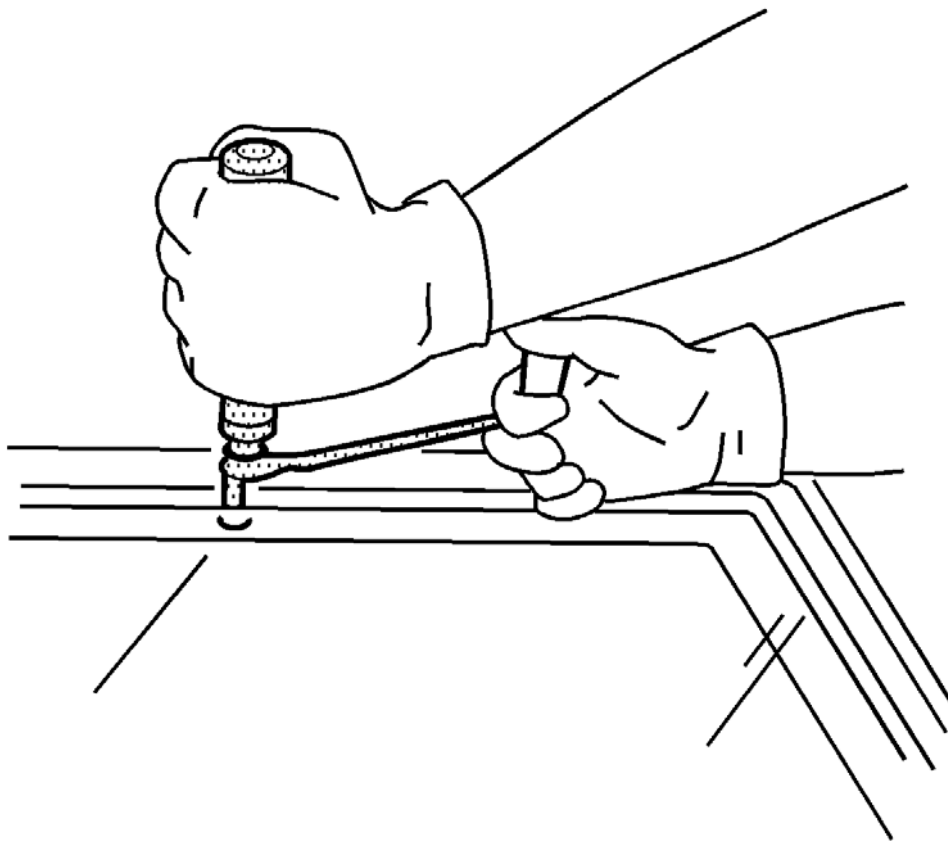


Fig. 5: Separating Urethane Adhesive From Window

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#)

NOTE: Keep the cutting edge of the tool against the window. Use care Not to damage the window corner retainers. If the window retainers get cut off when removing

the window it will be necessary to tape the window in place until cured.

8. This will allow the urethane adhesive to be separated from the window.

- Leave a base of urethane on the pinchweld flange.
- The only suitable lubrication is clear water.
- **BO-24402-A** Glass Sealant Remover (Cold Knife)
- **BO-39032** Stationary Glass Removal Tool

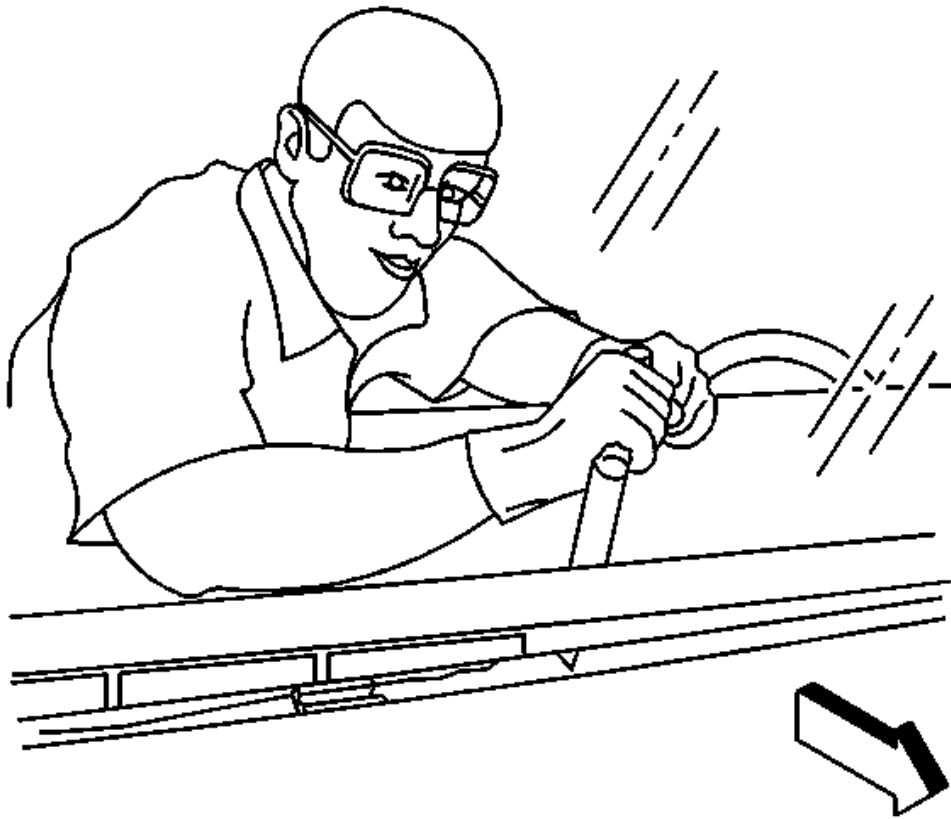


Fig. 6: Separating Bottom Of Window

Courtesy of GENERAL MOTORS COMPANY

9. Remove the bottom of the windshield from the urethane adhesive using a long utility knife or similar tool. Keep the cutting edge of the utility knife against the glass. Do this from inside the vehicle.

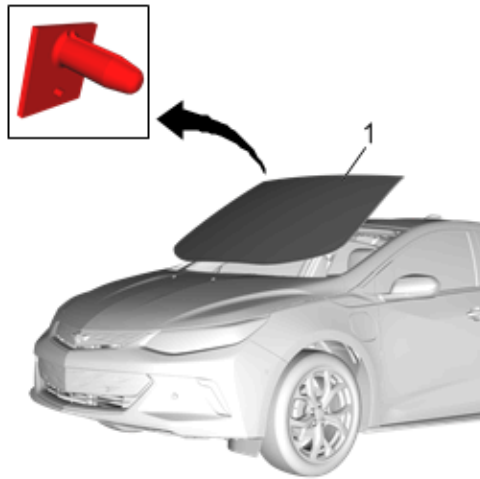


Fig. 7: Windshield

Courtesy of GENERAL MOTORS COMPANY

10. Remove the windshield (1) from the vehicle with an assistant, place the window on a clean soft surface.

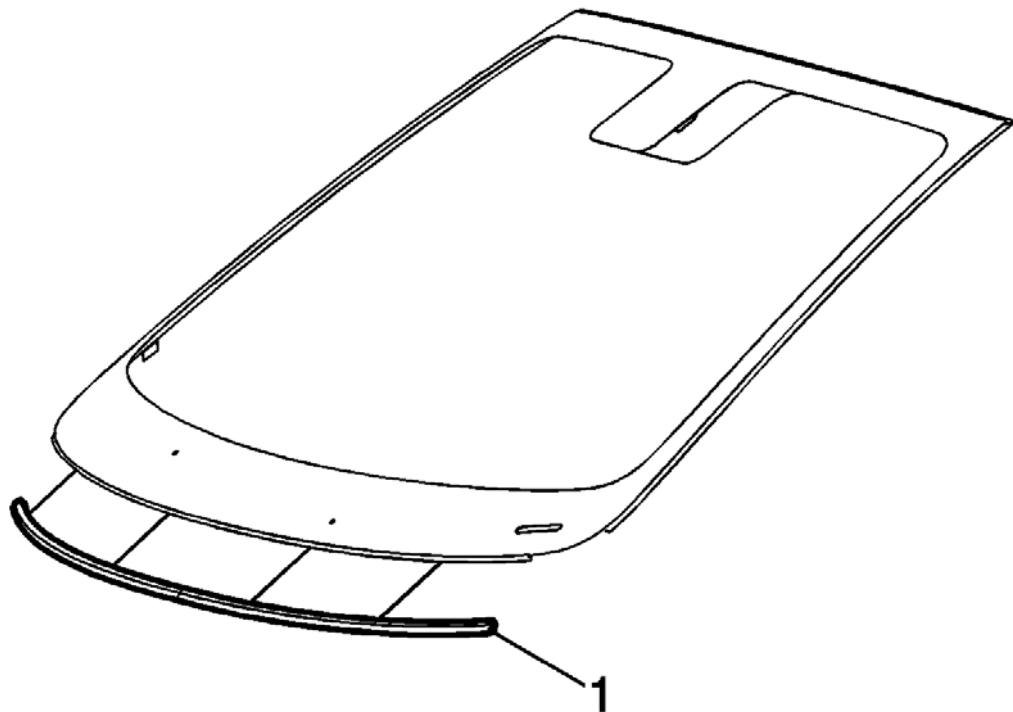


Fig. 8: Lower Windshield Molding

Courtesy of GENERAL MOTORS COMPANY

11. Remove the molding (1) from the lower edge of the old windshield if the new windshield is not equipped.

Installation Procedure

1. Install Adhesive. Refer to [Adhesive Installation of Windshields](#)
2. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
3. Install Windshield Wiper Arm. Refer to [Windshield Wiper Arm Replacement](#)
4. Install Inside Rearview Mirror. Refer to [Inside Rearview Mirror Replacement](#)
5. Install Front View Camera. Refer to [Front View Camera Replacement](#)
6. Connect the rain sensor connector, if equipped.
7. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.
8. Close the hood.

FRONT SIDE DOOR WINDOW ADJUSTMENT

Causes of Slow Moving Window

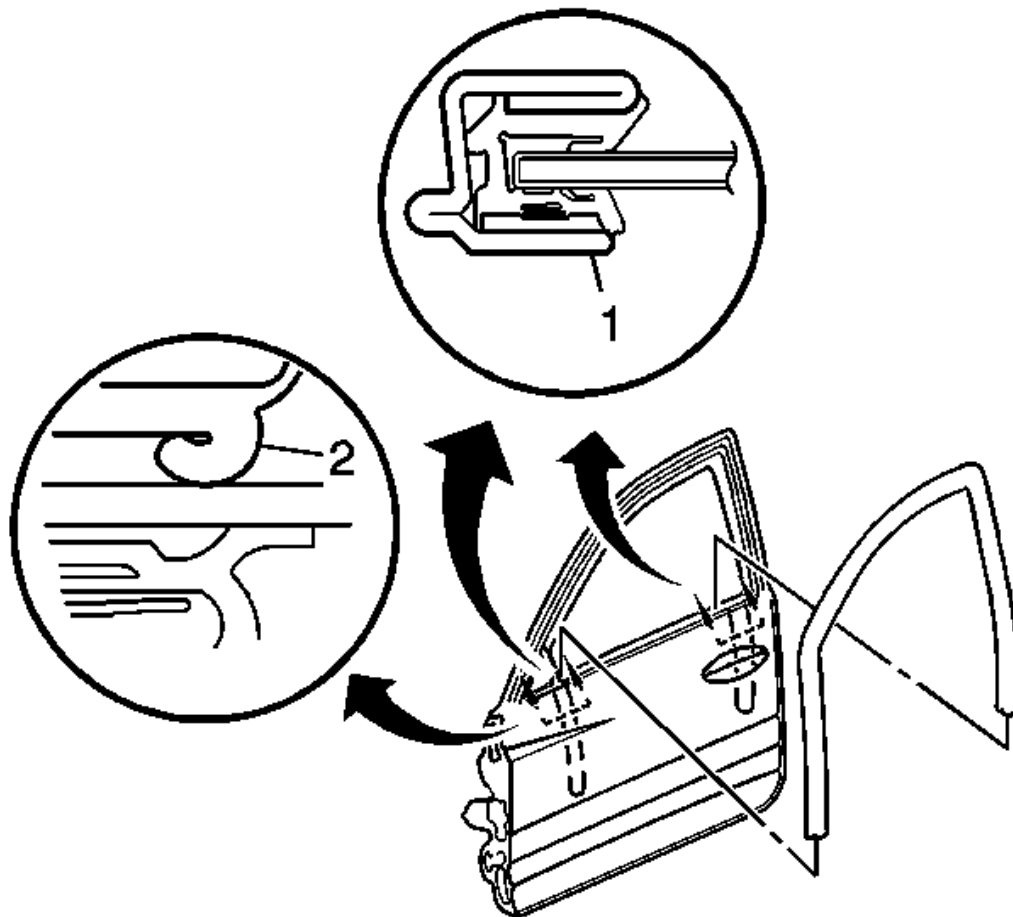


Fig. 9: Internal Detail For Front Door Window Adjustment
Courtesy of GENERAL MOTORS COMPANY

WARNING: Disconnect the power window switch when working inside the door. When operated, the Express Up/Down Feature allows the door window to move very quickly, without stopping, which could cause personal injury.

NOTE: Owners may comment that the windows operate slowly when going up or down.

1. Listed below are conditions that may cause a slow moving window.
 - The window run channel outboard lip at the rearview mirror is rolled over or the window run channel outboard lip at the rear of door frame (2).
 - The window is not seated in the run channel.
 - The window is misaligned in the opening.
 - The regulator is misaligned causing misalignment of the window.
 - Inspect the power window motor for being loose.
2. After inspecting the conditions above, do the following:

Remove the front door trim panel.
3. Remove the water deflector.
4. Ensure that the window guide is fully seated and clipped.
5. Ensure that the window is fully seated into the window guide run channel.
6. Inspect the window for equal distance between the front and rear run channels.

Adjustment Procedure

1. Inspect for the following conditions before making adjustments.
 - Using a flat-bladed tool, straighten the run channel lip by pulling it out to its correct position.
 - Use a flat-bladed tool to push the run channel rearward to seat it in the door frame.
 - Inspect the window guide retainer to window for the proper alignment to the slots in the window.
 - Inspect the window to be straight up and down position.

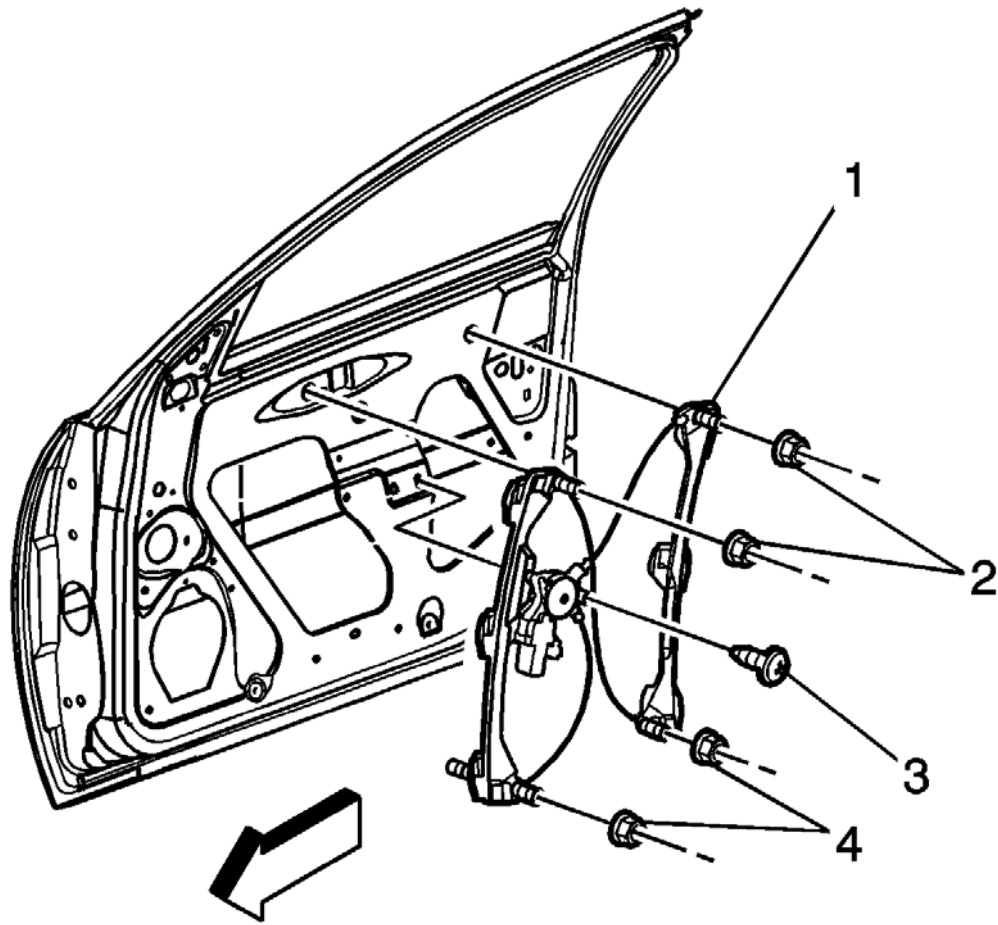


Fig. 10: Window Regulator Fastener Removal/Installation Sequence

Courtesy of GENERAL MOTORS COMPANY

- Loosen the nuts that attach the window regulator (1) to the inner door panel, in the specified sequence (2, 3, 4).

CAUTION: Refer to [Fastener Caution](#) .

2. Tighten the nuts that attach the front side door window regulator (1) to the inner door panel in the specified sequence (2, 3, 4) to 10 N.m (89 lb in).
3. Inspect the window for proper operation.
4. Install the water deflector.
5. Install the front door trim panel.

FRONT SIDE DOOR WINDOW REPLACEMENT

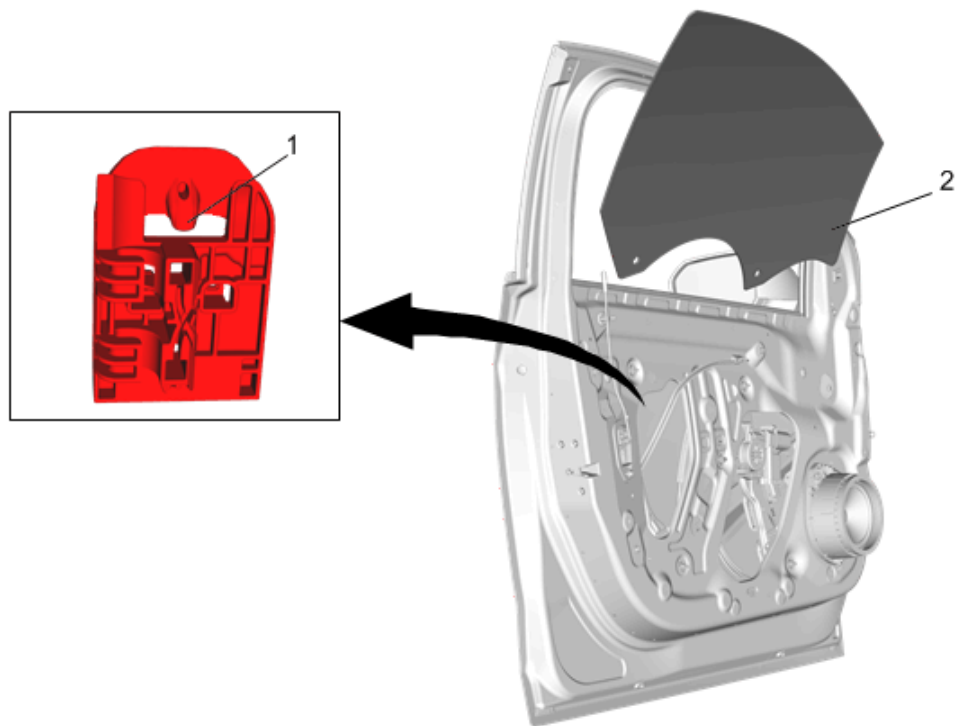


Fig. 11: Front Side Door Window

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Express Window Down Warning . CAUTION: When removing glass from the vehicle, apply tape to corners of glass and adjacent surfaces to help prevent paint damage. Preliminary Procedures 1. Remove Front Side Door Armrest Bracket. Refer to Front Side Door Armrest Bracket Replacement 2. Remove Front Side Door Window Garnish Molding. Refer to Front Side Door Window Garnish	

Callout	Component Name
	<u>Molding Replacement</u> 3. Remove Front Side Door Window Inner Sealing Strip. Refer to <u>Front Side Door Window Inner Sealing Strip Replacement</u> 4. Remove the water deflector. 5. Remove Front Side Door Window Channel Retainer. Refer to <u>Front Side Door Window Channel Retainer Replacement</u>
1	Front Side Door Window Regulator Guide Procedure 1. Position the window to access the regulator guides. 2. Using the proper tool release the window regulator guide from the window. 3. Use masking tape to tape the window in the full up position to the door frame. 4. Lower the window regulator full down. 5. Remove the masking tape from the window. 6. Tilt the window downward in the front, pull up on the back of the window and pull it out from the door frame.
2	Front Side Door Window Inspect the window for proper operation before installing the door trim panel.

REAR SIDE DOOR WINDOW ADJUSTMENT

Causes of Slow Moving Window

NOTE: Owners may comment that the windows operate slowly when going up or down.

1. Listed below are conditions that may cause a slow moving window:
 - The window run channel outboard lip at the rear of door frame.
 - The window is not seated in the run channel.
 - The window is misaligned in the opening.
 - The regulator is misaligned causing misalignment of the window.
2. After inspecting the conditions above, do the following:
 1. Remove the rear door trim panel.
 2. Remove the water deflector.
 3. Ensure that the window guide is fully seated and clipped.

Ensure that the window is fully seated in the window guide run channel.

4. Inspect the window for equal distance between the front and rear run channels.
5. Inspect the power window motor for being loose.
6. Inspect the window for alignment.

Adjustment Procedure

1. Remove the rear side door trim panel.

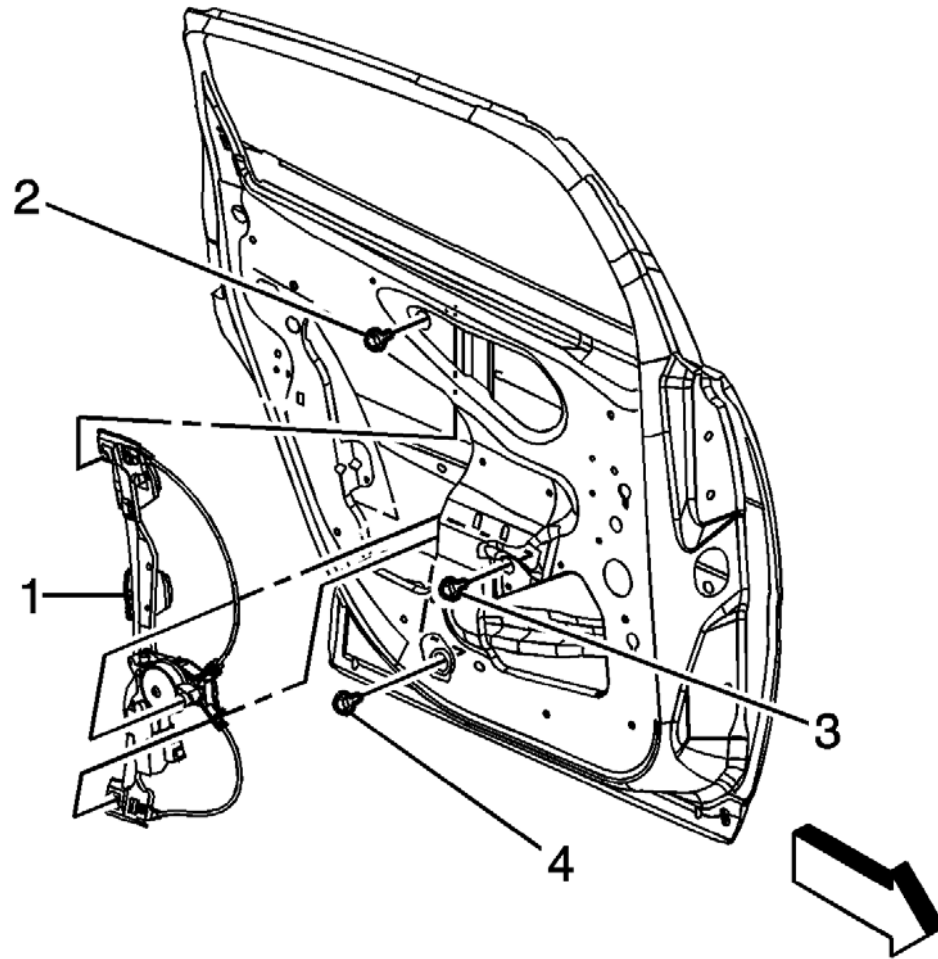


Fig. 12: Window Regulator And Fasteners With Removal/Installation Sequence
Courtesy of GENERAL MOTORS COMPANY

2. Inspect for the following conditions before making adjustments:

- Using a flat-bladed tool, straighten the run channel lip by pulling it out to its correct position.
- Use a flat-bladed tool to push the run channel rearward to seat it in the door frame.
- Inspect the window guide channel to window fasteners to ensure that they are in the proper slots and the window is not tilted forward.
- Inspect the window to be straight up and down position.
- Loosen the nuts that attach the window regulator (1) to the inner door panel, in the specified sequence (2, 3, 4).

CAUTION: Refer to [Fastener Caution](#) .

3. Loosen the nuts that attach the rear side door window regulator (1) to the inner door panel in the specified sequence (2, 3, 4).

Tighten the fasteners to 10 N.m (89 lb in).

4. Inspect the window for proper operation.

- 5. Install the water deflector.
- 6. Install the rear door trim panel.

REAR SIDE DOOR WINDOW REPLACEMENT

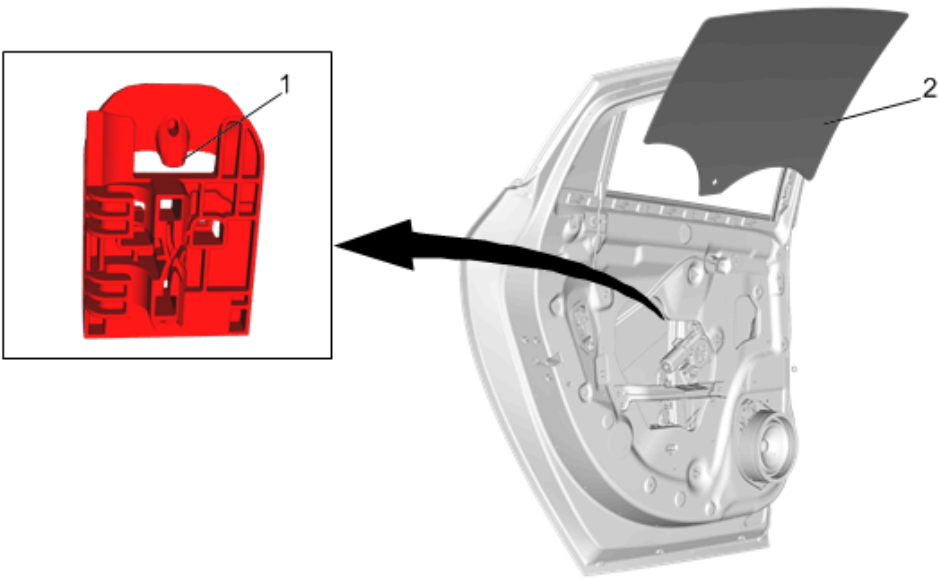


Fig. 13: Rear Side Door Window
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Express Window Down Warning . CAUTION: When removing glass from the vehicle, apply tape to corners of glass and adjacent surfaces to help prevent paint	

Callout	Component Name
damage. Preliminary Procedures 1. Remove Rear Side Door Window Weatherstrip. Refer to Rear Side Door Window Weatherstrip Replacement 2. Remove Rear Side Door Armrest Pull Cup Bracket. Refer to Rear Side Door Armrest Pull Cup Bracket Replacement 3. Remove Rear Side Door Window Inner Sealing Strip. Refer to Rear Side Door Window Inner Sealing Strip Replacement 4. Remove the water deflector. 5. Remove Rear Side Door Window Channel Rear Retainer. Refer to Rear Side Door Window Channel Rear Retainer Replacement	
1	Rear Side Door Window Regulator Retainer CAUTION: Refer to Fastener Caution . Procedure 1. Use masking tape to tape the window in the full up position to the door frame. 2. Using the proper tool release the window from the regulator guide. 3. Lower the window regulator full down. 4. Remove the masking tape from the window. 5. Remove the window from the door.
2	Rear Side Door Window Inspect the window for proper operation before install the door trim panel.

REAR WINDOW REPLACEMENT

Special Tools

- **BO-24402-A** Glass Sealant Remover (Cold Knife)
- **BO-39032** Stationary Glass Removal Tool
- Use an adhesive that is approved by GM

For equivalent regional tools, refer to [Special Tools](#)

Removal Procedure

WARNING: Refer to [Cracked Window Warning](#)

NOTE: Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and the interior trim.

1. Open the liftgate.
2. Remove Liftgate Lower Trim Finish Panel. Refer to [Liftgate Lower Trim Finish Panel Replacement](#)
3. Disconnect the electrical connectors.
4. Cover the following parts to protect from broken glass:
 - Seats
 - Carpeting

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#)

5. Using a utility knife, carefully cut the lace (1) from the sides and the top edge of the window to access the urethane adhesive bead, if equipped.

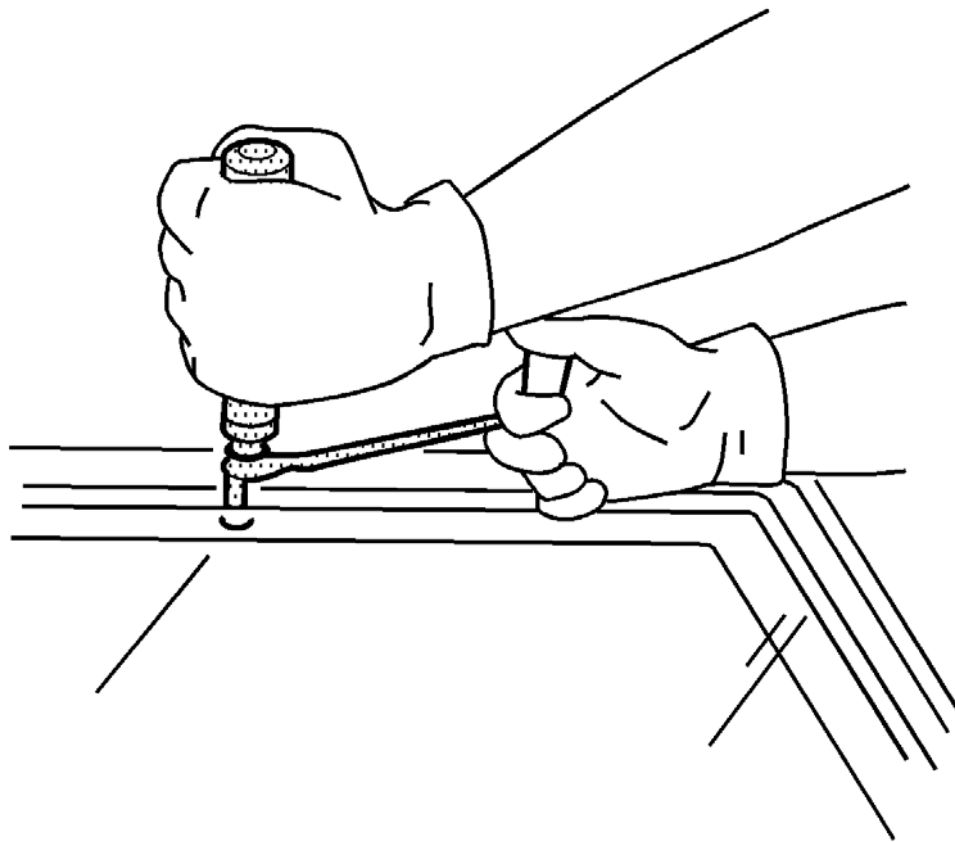


Fig. 14: Separating Urethane Adhesive From Window

Courtesy of GENERAL MOTORS COMPANY

NOTE: Keep the cutting edge of the tool against the window. Use care Not to damage the window corner retainers. If the window retainers get cut off when removing the window it will be necessary to tape the window in place until cured.

6. Remove the window from the urethane adhesive.
 - Leave a base of urethane approximately 2 mm (0.078 in) on the pinch-weld flange.

- The only suitable lubrication is clear water.
- **BO-24402-A** Glass Sealant Remover (Cold Knife)
- **BO-39032** Stationary Glass Removal Tool

NOTE: Keep the cutting edge of the knife/tool against the window. Do this from inside the vehicle.

7. If necessary, use a long utility knife or similar tool to remove the bottom corners of the window from the urethane adhesive.



Fig. 15: Window

Courtesy of GENERAL MOTORS COMPANY

8. With an assistant, remove the window (1) from the vehicle, place the window on a clean soft surface.

Installation Procedure

1. Install adhesive. Refer to [Adhesive Installation of Liftgate Windows](#)
2. Connect the electrical connectors.
3. Install Liftgate Lower Trim Finish Panel. Refer to [Liftgate Lower Trim Finish Panel Replacement](#)
4. Remove the double layer of masking tape around the perimeter of the painted surfaces and the interior trim.
5. Close the liftgate.

FRONT SIDE DOOR WINDOW FRAME REAR APPLIQUE REPLACEMENT

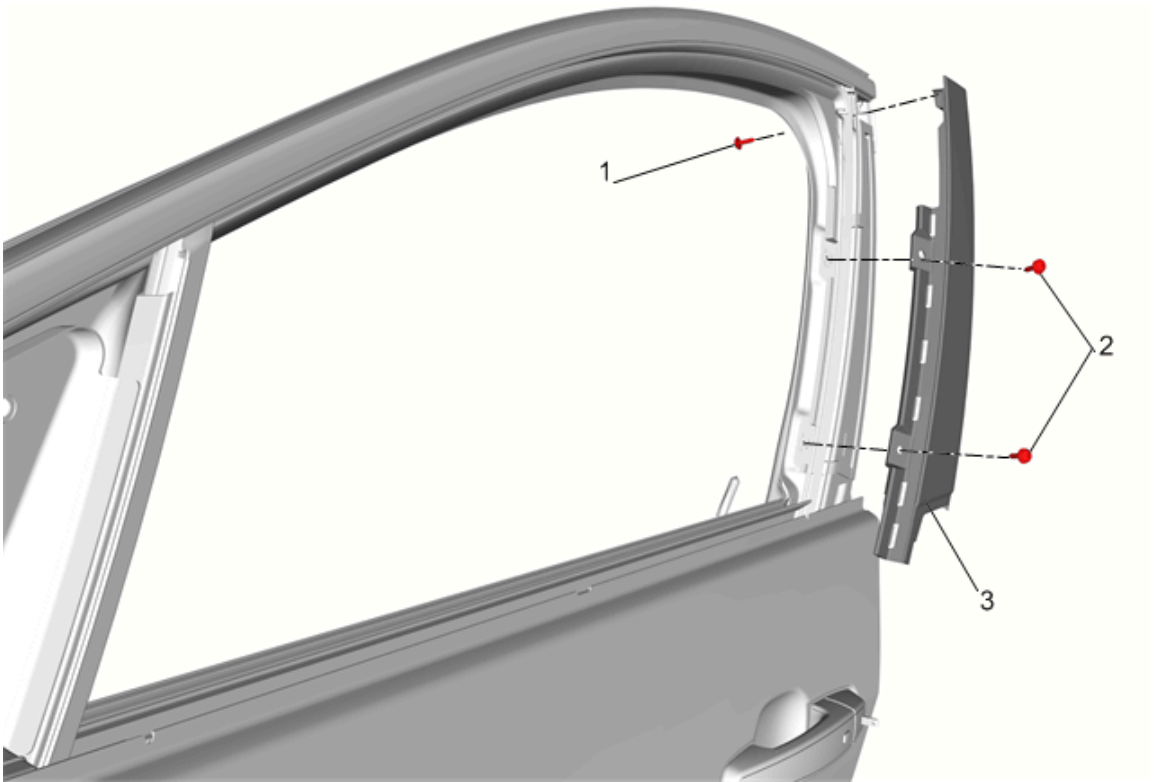


Fig. 16: Front Side Door Window Frame Rear Applique

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1.	Remove Front Side Door Window Inner Sealing Strip. Refer to Front Side Door Window Inner Sealing Strip Replacement
2.	Remove Front Side Door Window Belt Reveal Molding. Refer to Front Side Door Window Belt Reveal Molding Replacement
3.	Remove Front Side Door Window Upper Reveal Molding. Refer to Front Side Door Window Upper Reveal Molding Replacement
4.	Remove Front Side Door Window Weatherstrip. Refer to Front Side Door Window Weatherstrip Replacement
NOTE: It is not necessary to completely remove the weatherstrip. Reposition the upper rear edge of the front side door weatherstrip.	

Callout	Component Name
1	Front Side Door Window Frame Inner Upper Screw CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Front Side Door Window Frame Rear Applique Outer Screw (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
3	Front Side Door Window Frame Rear Applique 1. Use a solution of 50/50 isopropyl alcohol and water to clean the adhesive surface. 2. Peel the protective film from the foam tape and install the rear applique to the vehicle.

REAR SIDE DOOR WINDOW FRAME FRONT APPLIQUE REPLACEMENT

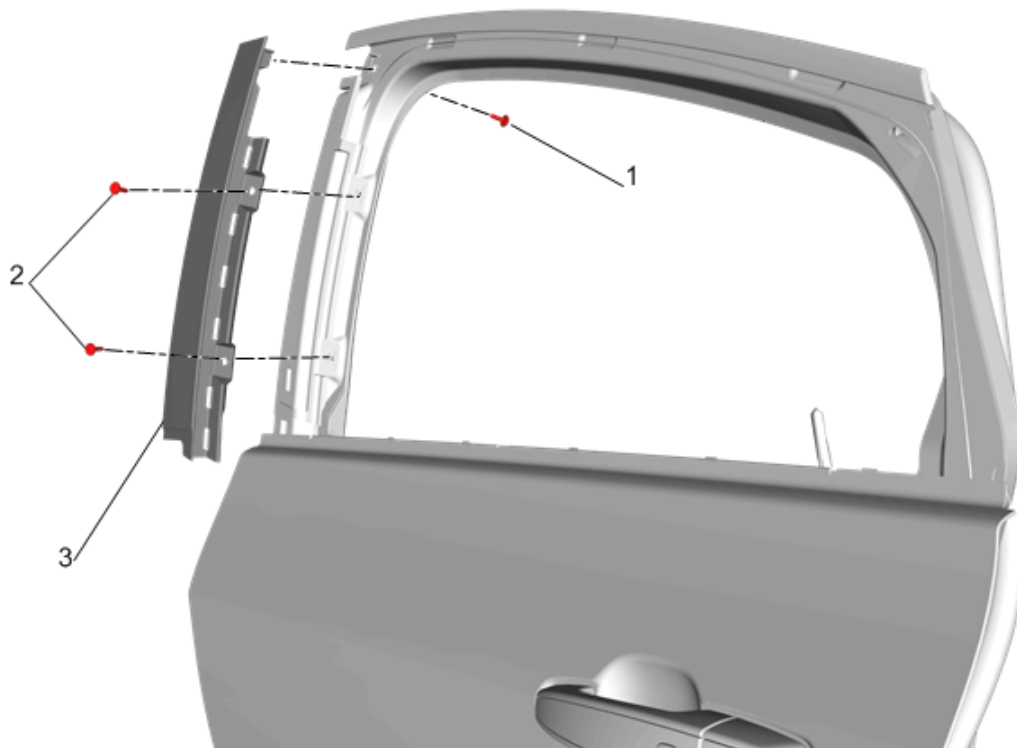


Fig. 17: Rear Side Door Window Frame Front Applique

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Side Door Window Belt Reveal Molding. Refer to Rear Side Door Window Belt Reveal Molding Replacement 2. Remove Rear Side Door Window Inner Sealing Strip. Refer to Rear Side Door Window Inner Sealing Strip Replacement 3. Remove Rear Side Door Window Upper Reveal Molding. Refer to Rear Side Door Window Upper Reveal Molding Replacement 4. Remove Rear Side Door Window Weatherstrip. Refer to Rear Side Door Window Weatherstrip Replacement NOTE: It is not necessary to completely remove the weatherstrip. Reposition the upper front edge of the rear side door weatherstrip.	
1	Rear Side Door Window Frame Applique Upper Screw CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Rear Side Door Window Frame Front Applique Outer Screw (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)

Callout	Component Name
3	Rear Side Door Window Frame Front Applique 1. Use a solution of 50/50 isopropyl alcohol and water to clean the adhesive surface. 2. Peel the protective film from the foam tape and install the rear applique to the vehicle.

FRONT SIDE DOOR WINDOW CONTROL SWITCH REPLACEMENT

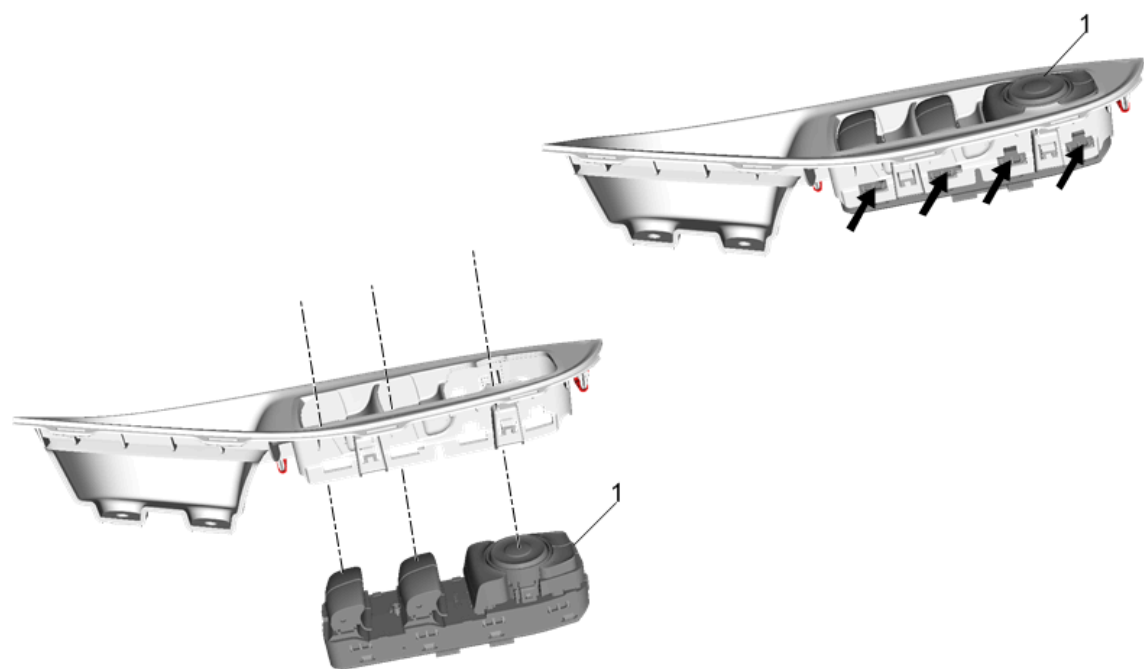


Fig. 18: Front Side Door Window Control Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Armrest Switch Mount Plate. Refer to Front Side Door Armrest Switch Mount Plate Replacement (Driver Side) Front Side Door Armrest Switch Mount Plate Replacement (Passenger Side)	
1	Front Side Door Window Control Switch Procedure 1. Release the tabs and remove the switch. 2. Refer to Control Module References for programming and setup information, if required.

FRONT SIDE DOOR WINDOW SWITCH REPLACEMENT (RIGHT SIDE)

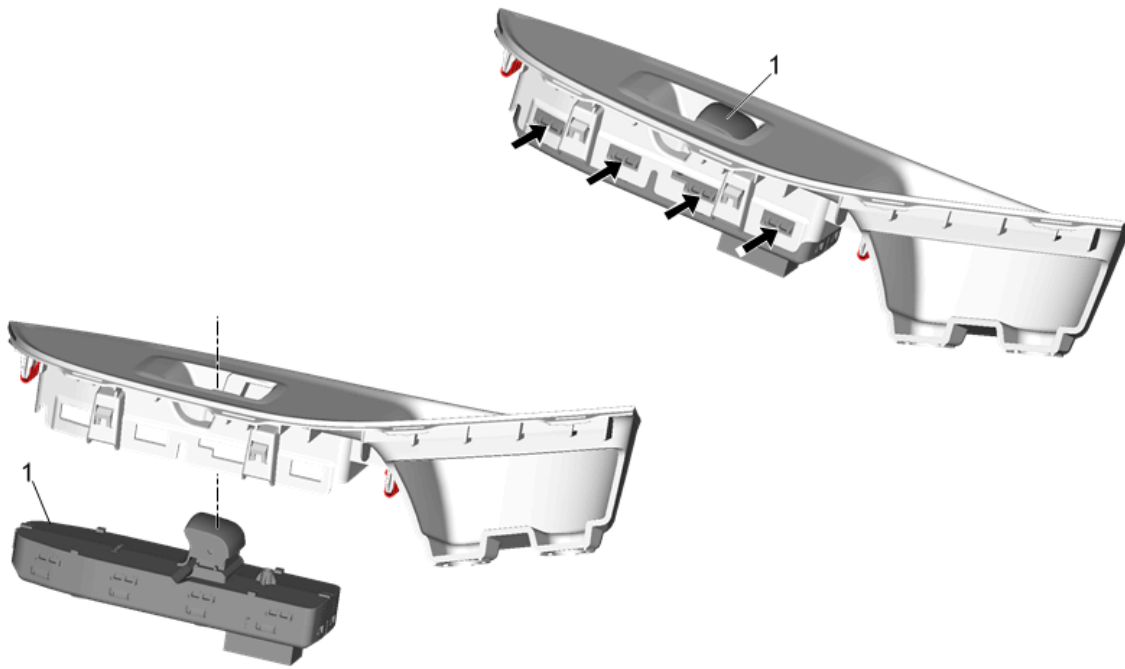


Fig. 19: Front Side Door Window Switch (Right Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Armrest Switch Mount Plate. Refer to Front Side Door Armrest Switch Mount Plate Replacement (Passenger Side)	
1	Front Side Door Window Switch Procedure 1. Release the tabs and remove the switch. 2. Refer to Control Module References for programming and setup information, if required.

REAR SIDE DOOR WINDOW SWITCH REPLACEMENT

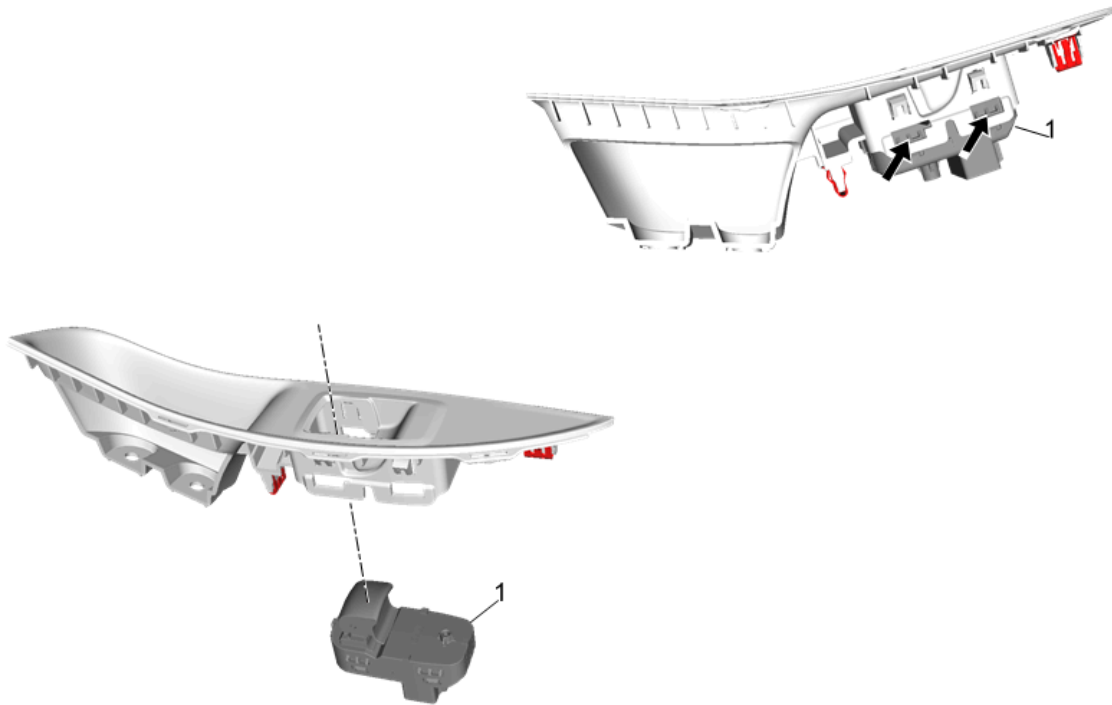


Fig. 20: Rear Side Door Window Switch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Side Door Armrest Switch Mount Plate. Refer to Rear Side Door Armrest Switch Mount Plate Replacement	
1	Rear Side Door Window Switch Procedure 1. Release the tabs and remove the switch. 2. Refer to Control Module References for programming and setup information, if required.

FRONT SIDE DOOR WINDOW REGULATOR REPLACEMENT

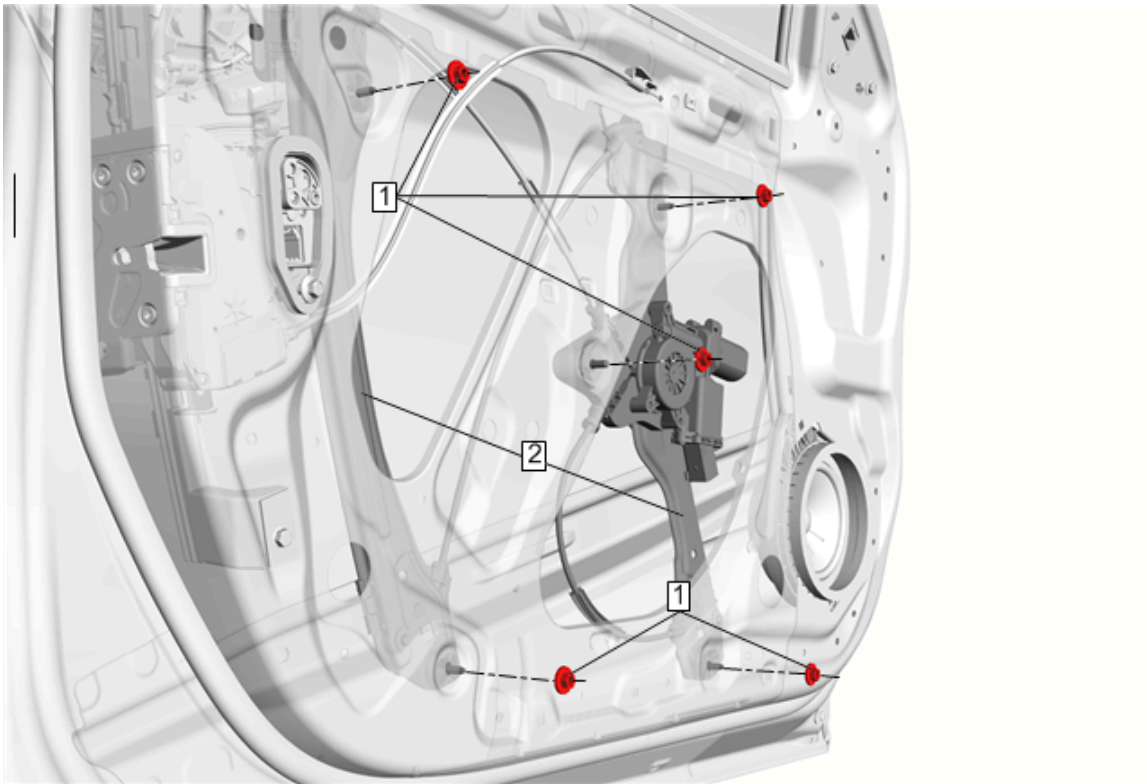


Fig. 21: Front Side Door Window Regulator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Disconnect the power window switch when working inside the door. When operated, the Express Up/Down Feature allows the door window to move very quickly, without stopping, which could cause personal injury.	Preliminary Procedure Release the window from the regulator and tape the window to the upper door frame before removing the regulator. Refer to Front Side Door Window Replacement

Callout	Component Name
1	Front Side Door Window Regulator Nut (Qty: 5) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 11 N.m (97 lb in)
2	Front Side Door Window Regulator Procedure 1. Disconnect the electrical connector. 2. Remove the window regulator through the opening in the inner door panel. 3. Transfer all parts as necessary. 4. Inspect the window for proper operation before installing the door trim panel.

WINDOW MOTOR PROGRAMMING - EXPRESS FUNCTION

Window Motor Normalized Procedure

A window motor that has not been normalized will no longer perform the express up and express down functions, this may occur during the following conditions:

- When a window motor has been disconnected
- When a door harness has been disconnected
- When the battery has been disconnected or replaced

NOTE: When DTC B3205 4B & 3210 4B are set, the following warnings will be displayed on the driver information center:

Open, then Close Driver Window

Open, then Close Passenger Window

These warnings will clear once the windows have been "Normalized" and the respective DTC will clear.

To normalize the window motor, follow these steps:

NOTE: The doors must be completely closed prior to normalizing the windows, a door that is open or ajar may cause the power window to function abnormally or to become inoperative while performing the normalizing procedure. If this occurs, verify that the door is completely closed then repeat the normalizing procedure.

1. Vehicle in Service Mode.

2. Starting with the window completely UP, press and hold the power window switch until the window is fully open and continue holding the switch down for approximately 5 seconds after the window is completely open.
3. Pull the power window switch up until the window is fully closed and continue holding the switch up for approximately 5 seconds after the window is completely closed.

The window should now be normalized and the window should perform the express up and express down functions.

Window Motor Relearn Procedure

A relearn procedure may need to be performed for any Local Interconnect Network (LIN) window motor for the following conditions:

- When the window glass is out of alignment
- When the window glass has been replaced
- When the door has been replaced
- When the window regulator has been replaced

NOTE: Prior to performing the relearn procedure the vehicle must have all 4 wheels properly inflated and mounted, the vehicle must be sitting on a level surface and all doors must be completely closed.

To relearn the window motor, follow these steps:

1. Vehicle in Service Mode.
2. With a scan tool, select Module Diagnosis, Body Control Module, Configuration/Reset Functions and then select the appropriate Clear Window Learn Values for the window motor requiring the relearn procedure.
3. After the learn procedure, exit the scan tool learn procedure completely, the power window cannot be normalized and will not function until you exit the program.
4. Starting with the window completely UP, press and hold the power window switch until the window is fully open and continue holding the switch down for approximately 5 seconds after the window is completely open.
5. Pull the power window switch up until the window is fully closed and continue holding the switch up for approximately 5 seconds after the window is completely closed.

The window is now reprogrammed.

REAR SIDE DOOR WINDOW REGULATOR REPLACEMENT

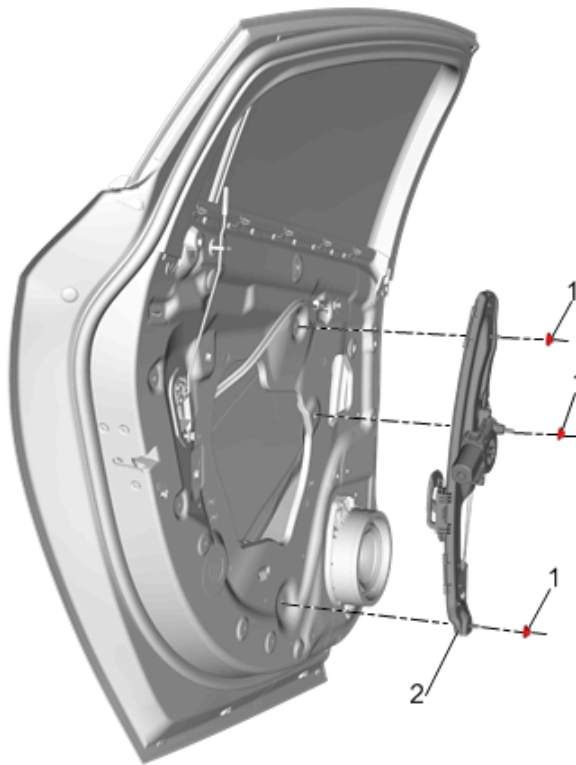


Fig. 22: Rear Side Door Window Regulator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Disconnect the power window switch when working inside the door. When operated, the Express Up/Down Feature allows the door window to move very quickly, without stopping, which could cause personal injury. Preliminary Procedure	

Callout	Component Name
	1. Remove Rear Side Door Armrest Pull Cup Bracket. Refer to Rear Side Door Armrest Pull Cup Bracket Replacement 2. Remove the water deflector.
1	Rear Side Door Window Regulator Nut (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 11 N.m (97 lb in)
2	Rear Side Door Window Regulator Procedure 1. After releasing the window from the regulator tape the window to the upper door frame before removing the regulator nuts. 2. Disconnect the electrical connector. 3. Transfer components as necessary. 4. Inspect the window for proper operation before installing the door trim panel.

FRONT SIDE DOOR WINDOW CHANNEL RETAINER REPLACEMENT

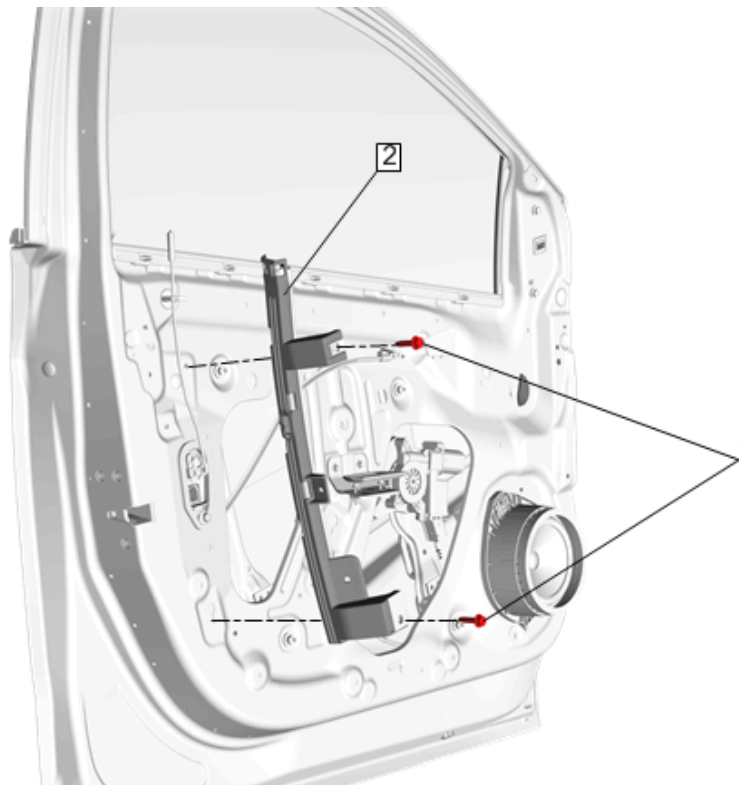


Fig. 23: Front Side Door Window Channel Retainer

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Position the window to the full up position. 2. Remove Front Side Door Armrest Bracket. Refer to Front Side Door Armrest Bracket Replacement 3. Remove the water deflector. 4. Unclip and reposition the wring harness attached to the window channel retainer.	
1	Front Side Door Window Channel Retainer Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Procedure Remove the bolts from the front side door window channel retainer. Tighten 11 N.m (97 lb in)
2	Front Side Door Window Channel Retainer NOTE: Inspect the window for proper operation before installing the water deflector.

REAR SIDE DOOR WINDOW CHANNEL REAR RETAINER REPLACEMENT

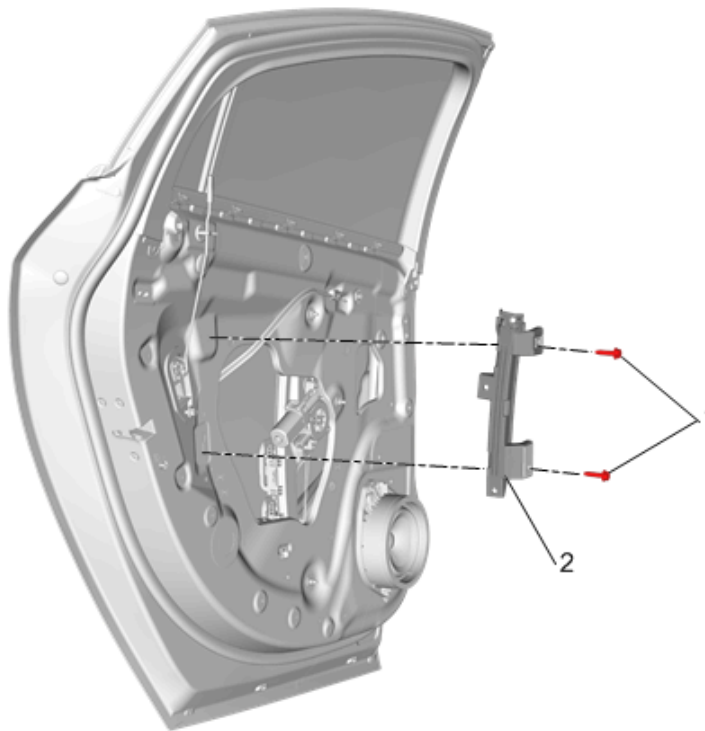


Fig. 24: Rear Side Door Window Channel Rear Retainer

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Position the window to the full up position. 2. Rear Side Door Armrest Pull Cup Bracket Replacement 3. Remove the water deflector.	
1	Rear Side Door Window Channel Rear Retainer Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Procedure Remove the bolts from the rear side door window channel rear retainer. Tighten 11 N.m (97 lb in)
2	Rear Side Door Window Channel Rear Retainer Procedure 1. Unclip wire harness from the rear side door window channel rear retainer. 2. Inspect the window for proper operation before installing the water deflector.

FRONT SIDE DOOR WINDOW INNER SEALING STRIP REPLACEMENT

Removal Procedure

1. Remove Front Side Door Window Garnish Molding. Refer to [Front Side Door Window Garnish Molding Replacement](#)
2. Lower the window.

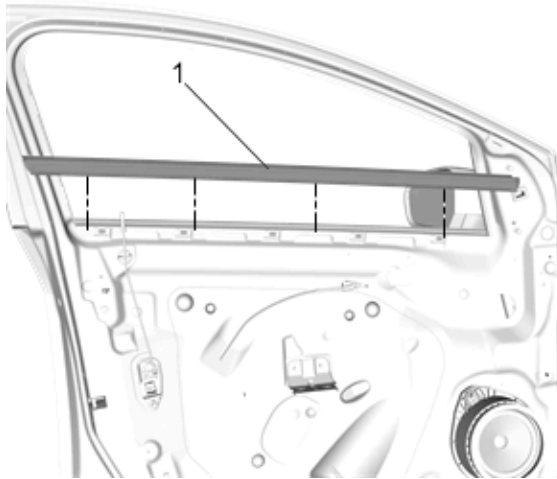


Fig. 25: Front Side Door Window Inner Sealing Strip
Courtesy of GENERAL MOTORS COMPANY

3. Pull up on the front side door window inner sealing strip (1) to remove from door.

Installation Procedure

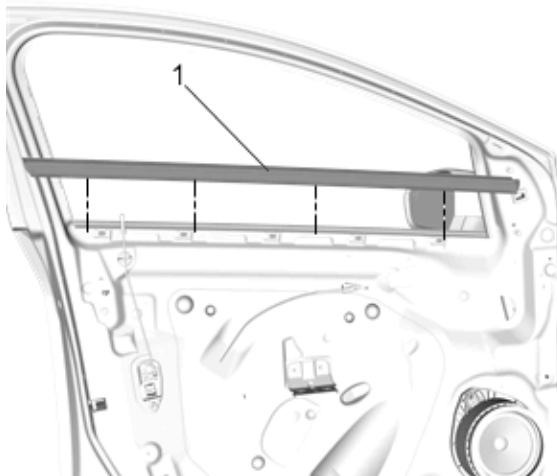


Fig. 26: Front Side Door Window Inner Sealing Strip
Courtesy of GENERAL MOTORS COMPANY

1. Push down on the front side door window inner sealing strip (1) to install onto the door.

NOTE: Inspect the window for proper operation before installing the door trim.

2. Install Front Side Door Window Garnish Molding. Refer to [Front Side Door Window Garnish Molding Replacement](#)

REAR SIDE DOOR WINDOW UPPER REVEAL MOLDING REPLACEMENT

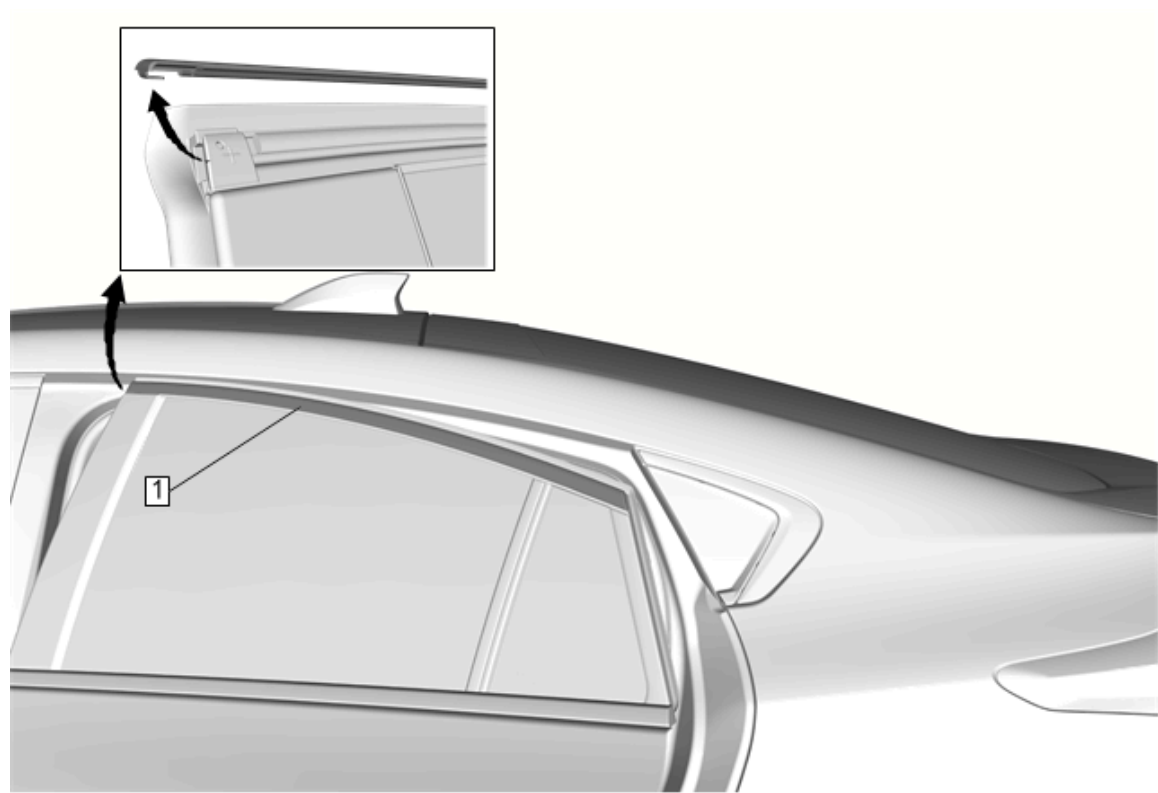


Fig. 27: Rear Side Door Window Upper Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the rear door.	
1	Rear Side Door Window Upper Reveal Molding Procedure Using the appropriate tool, release the upper reveal molding starting at the rear working to the front of the rear door. Slide molding forward to release the hook clip from the front of the rear door.

REAR SIDE DOOR WINDOW BELT REVEAL MOLDING REPLACEMENT

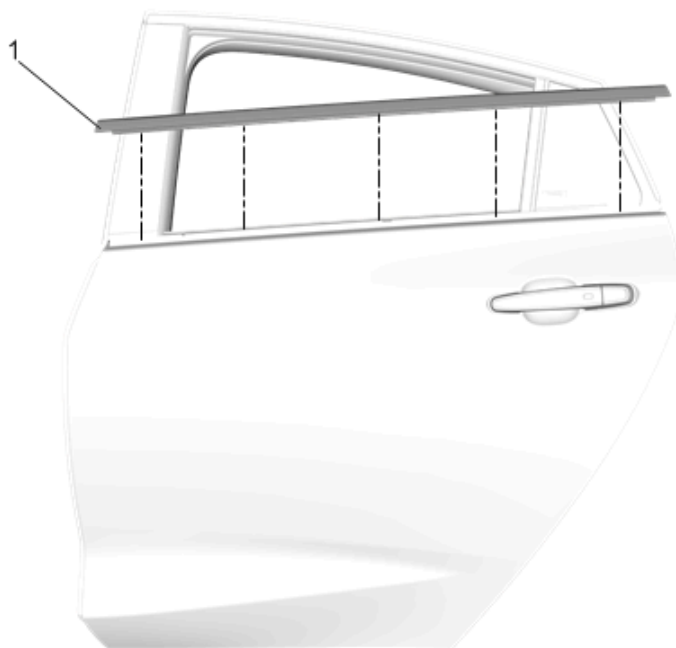


Fig. 28: Rear Side Door Window Belt Reveal Molding

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Place the door window in the full down position. 2. Apply a double layer of masking tape around the perimeter of the painted surfaces.	
1	Rear Side Door Window Belt Reveal Molding 1. Starting at the front outside molding, use a hook type tool to release the molding from the door while simultaneously lifting upward. 2. Install the belt molding to the door by pushing downward until fully seated.

FRONT SIDE DOOR WINDOW BELT REVEAL MOLDING REPLACEMENT

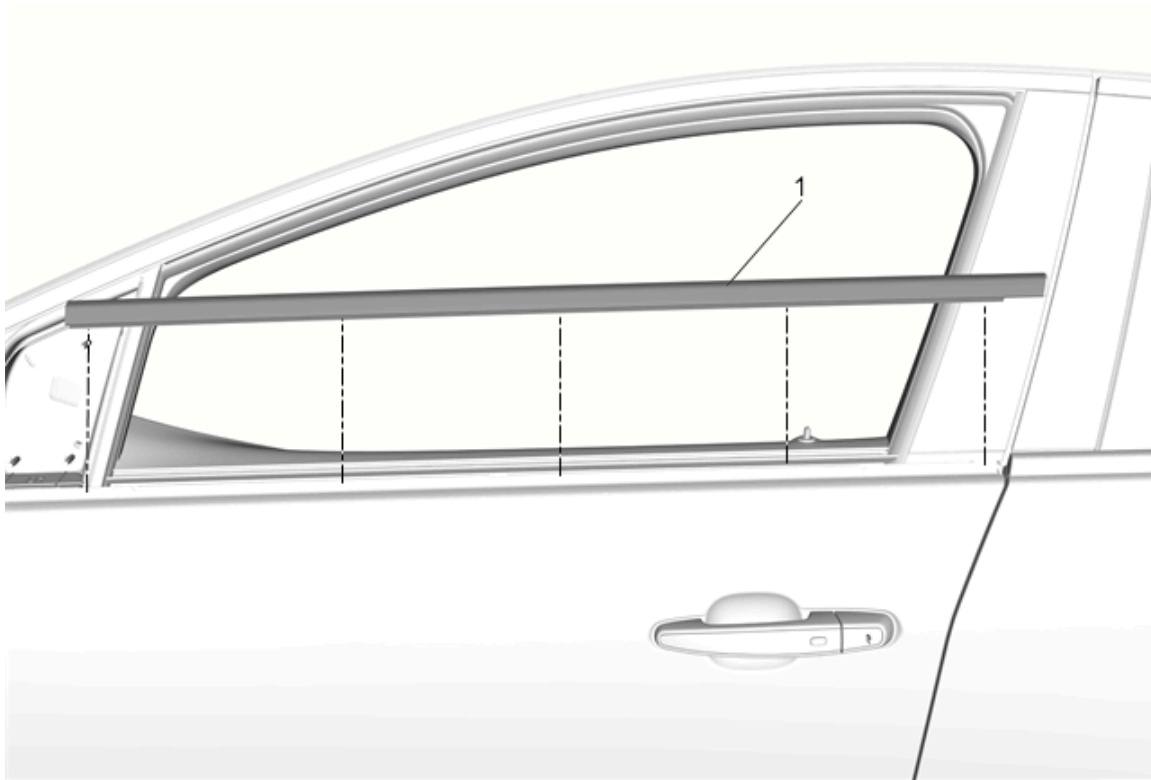


Fig. 29: Front Side Door Window Belt Reveal Molding

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Place the door window in the full down position. 2. Apply a double layer of masking tape around the perimeter of the painted surfaces. 3. Remove Outside Rearview Mirror. Refer to Outside Rearview Mirror Replacement	
1	Front Side Door Window Belt Reveal Molding 1. Starting at the front outside molding, use a hook type tool to release the molding from the door while simultaneously lifting upward. 2. Install the belt molding to the door by pushing downward until fully seated.

FRONT SIDE DOOR WINDOW UPPER REVEAL MOLDING REPLACEMENT

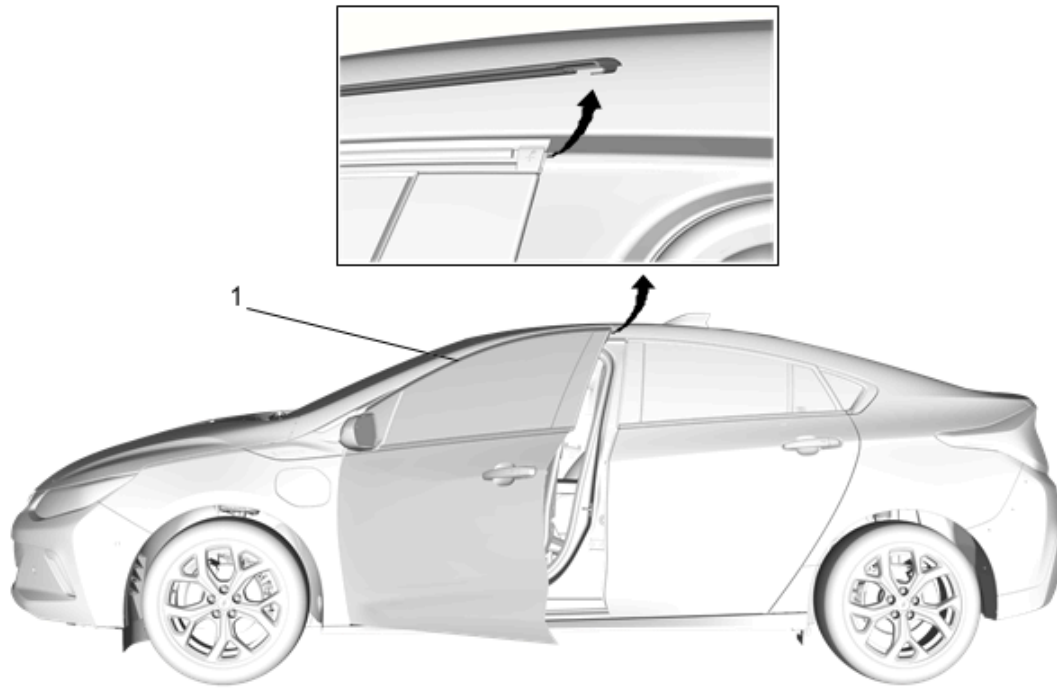


Fig. 30: Front Side Door Window Upper Reveal Molding
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the front door.	
1	Front Side Door Window Upper Reveal Molding Procedure Using the appropriate tool, release the upper reveal molding starting at the front working to the rear of the front door. Slide molding rearward to release the hook clip from the rear of the front door.

REAR SIDE DOOR WINDOW INNER SEALING STRIP REPLACEMENT

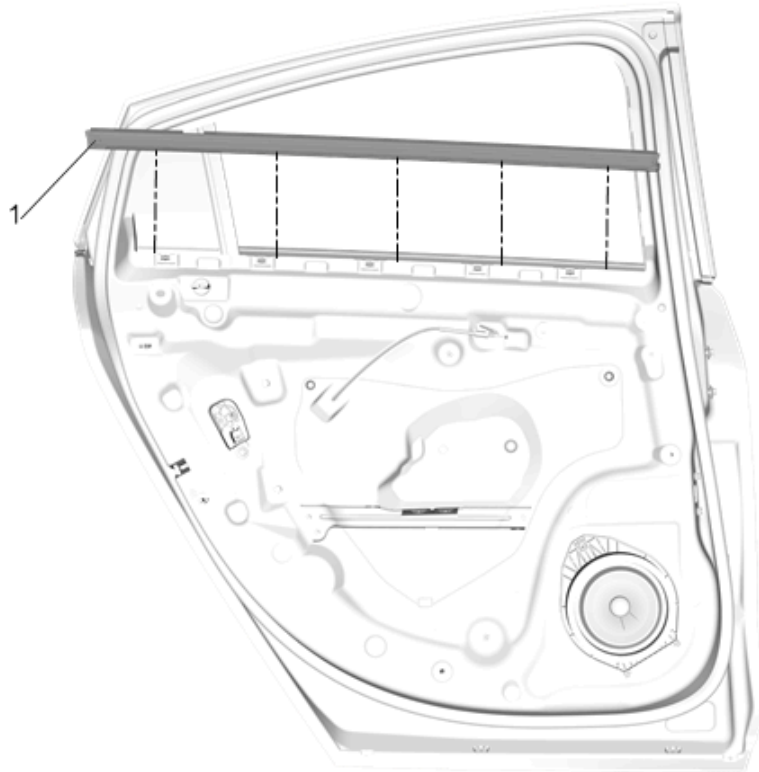


Fig. 31: Rear Side Door Window Inner Sealing Strip
 Courtesy of GENERAL MOTORS COMPANY

callout	Component Name
Preliminary Procedure Remove Rear Side Door Window Garnish Molding. Refer to Rear Side Door Window Garnish Molding Replacement	
1	Rear Side Door Window Inner Sealing Strip Procedure Using the proper tool pull window inner seal up to release from door panel.

FRONT SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT

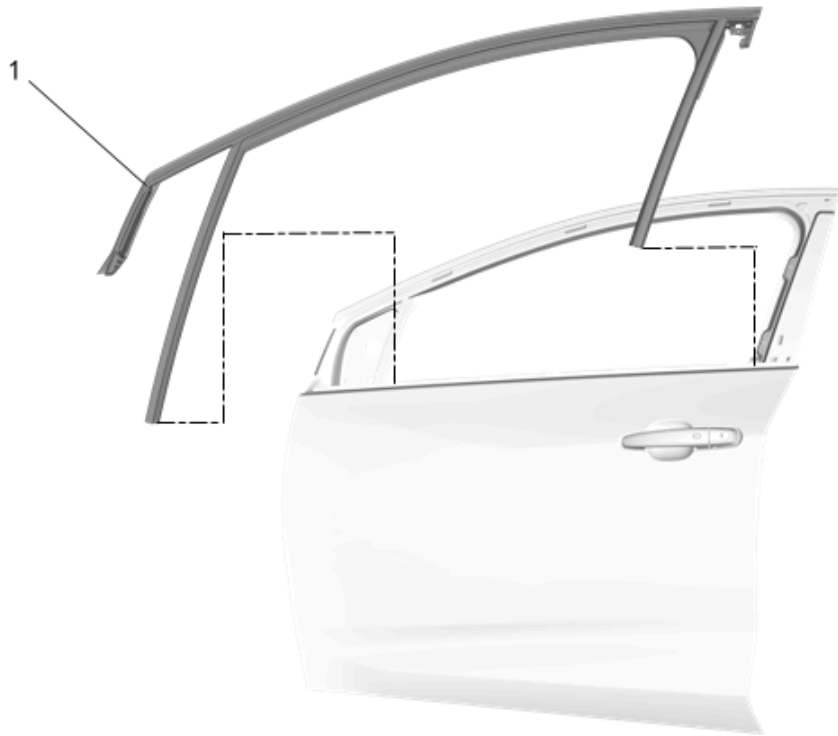


Fig. 32: Front Side Door Window Weatherstrip
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Front Side Door Window. Refer to Front Side Door Window Replacement 2. Remove Front Side Door Window Frame Rear Applique. Refer to Front Side Door Window Frame Rear Applique Replacement	
1	Front Side Door Window Weatherstrip Procedure 1. Start at the upper corner and pull down to release weatherstrip from the door frame. 2. Remove window weatherstrip from door. NOTE: Inspect the window for proper operation before installing the door trim panel.

REAR SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT

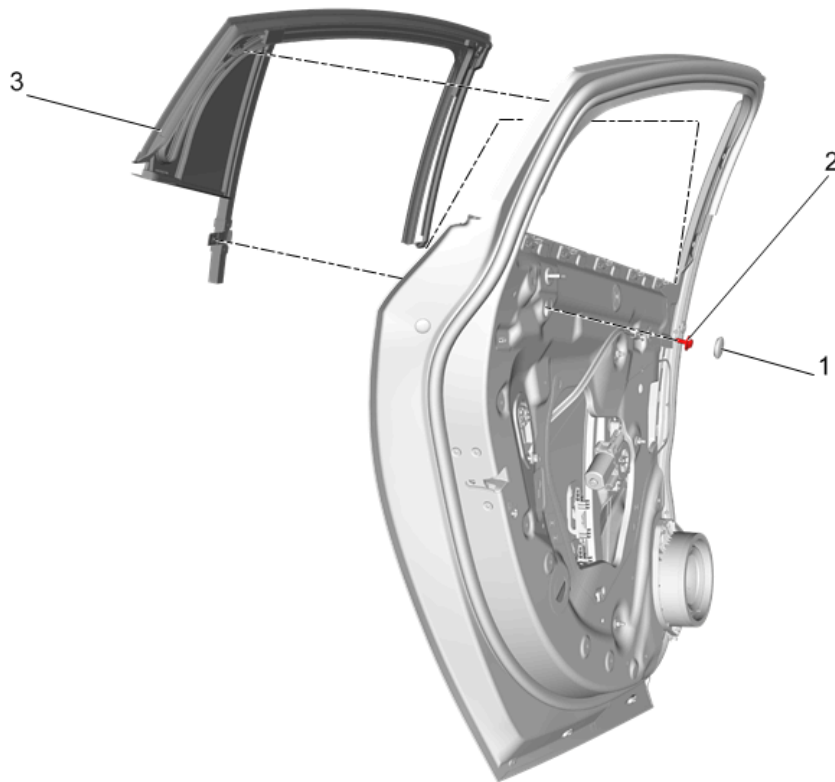


Fig. 33: Rear Side Door Window Weatherstrip
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Side Door Window Regulator. Refer to Rear Side Door Window Regulator Replacement 2. Remove tape and lower window into the door. 3. Remove Rear Side Door Window Frame Front Applique. Refer to Rear Side Door Window Frame Front Applique Replacement	
1	Rear Side Inner Door Panel Plug
2	Rear Side Door Window Weatherstrip Lower Bolt Tighten 11 N.m (97 lb in)
3	Rear Door Window Weatherstrip Procedure 1. Grasp the rear top corner of the outer window and weatherstrip, pull outward and down releasing the assembly from the door frame. 2. Inspect the window for proper operation before installing the water deflector.

ADHESIVE INSTALLATION OF WINDSHIELDS

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

1. Use a urethane adhesive systems which meet GM Specification GM 3651G.
2. Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.
3. Remove all mounds or loose pieces of urethane adhesive from the pinch-weld area.
4. If the original window is being reused, remove all but a thin film of the existing urethane adhesive from the window surface by using a clean utility knife or razor blade scraper.
5. Inspect for any of the following problems in order to help prevent future breakage of the window:
 - The flange of the window opening
 - High weld
 - Solder spots
 - Hardened sealer
 - Any other obstruction or irregularity in the pinch-weld flange

NOTE: If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15®, DuPont 2610®, Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 and 5130®, PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application.

6. After repairing the opening as indicated, perform the following steps:
 1. Remove all traces of broken glass from the outer cowl panel, seats, floor, and defroster ducts.
 2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

WARNING: Refer to [Window Retention Warning](#) .

7. Verify all primers and urethane adhesive are within expiration dates.

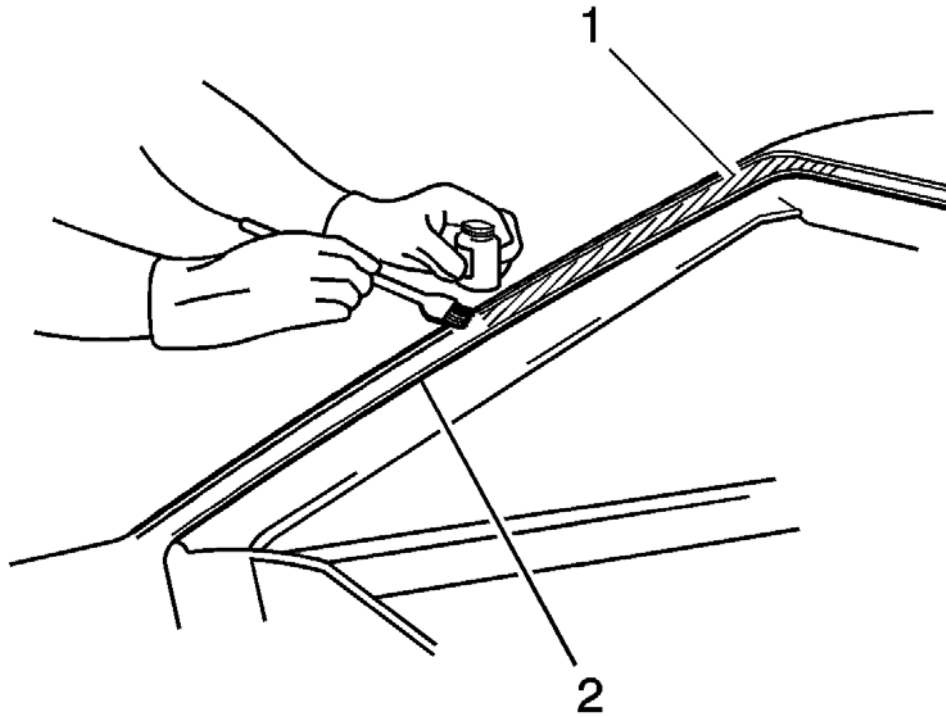


Fig. 34: Applying Pinch-Weld Primer

Courtesy of GENERAL MOTORS COMPANY

WARNING: Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

NOTE: Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches, or the primed surfaces.

8. Shake the pinch-weld primer black for at least 1 minute.
9. Use a new dauber in order to apply the primer to the surface of the pinch-weld flange (1).
10. Allow the pinch-weld primer to dry for approximately 10 minutes.

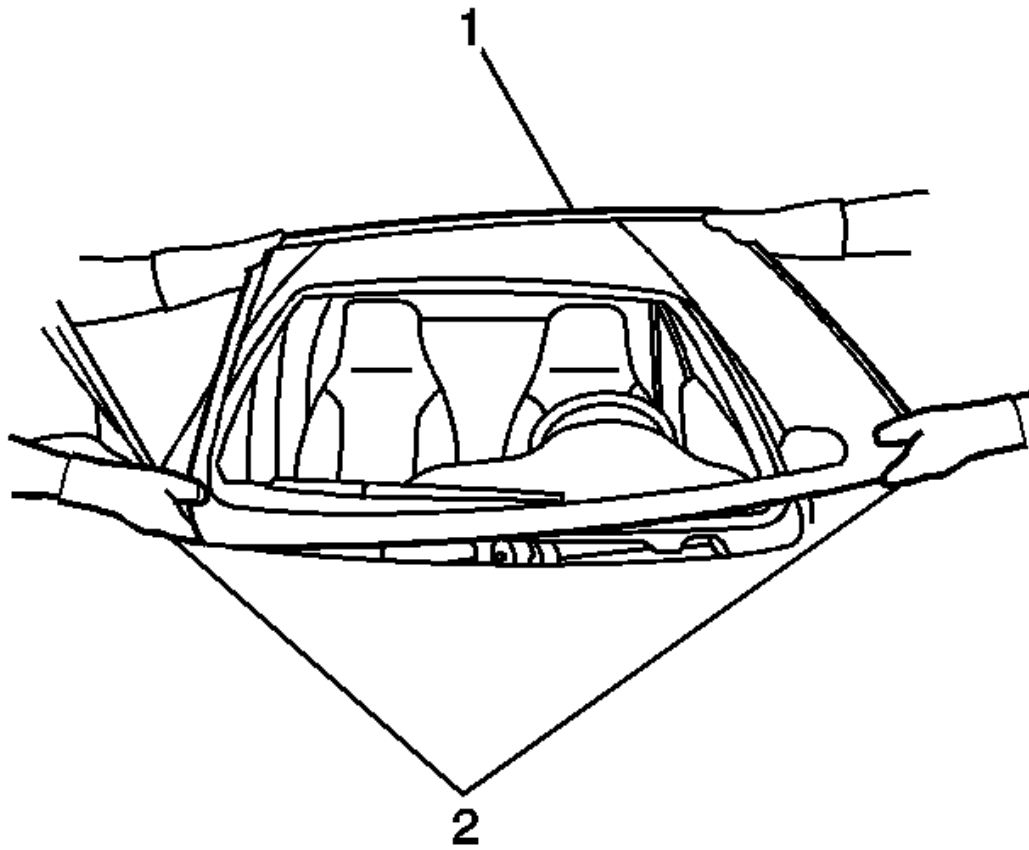


Fig. 35: Dry Fitting Window

Courtesy of GENERAL MOTORS COMPANY

11. With the aid of an assistant, dry fit the window (1) to the opening in order to determine the correct position.

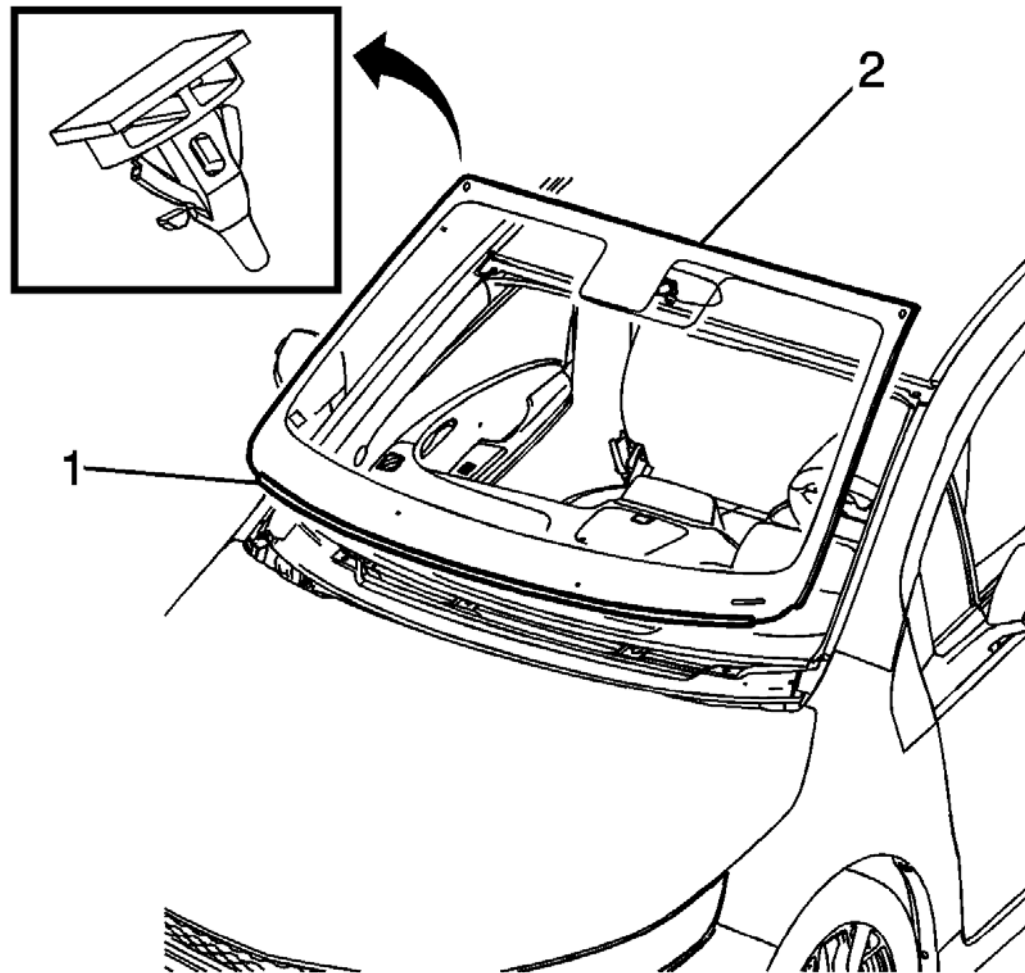


Fig. 36: Ensuring Proper Windshield Fit
Courtesy of GENERAL MOTORS COMPANY

12. Ensure the window (1) locator pins are positioned into the locator slots in the pinch-weld flange.

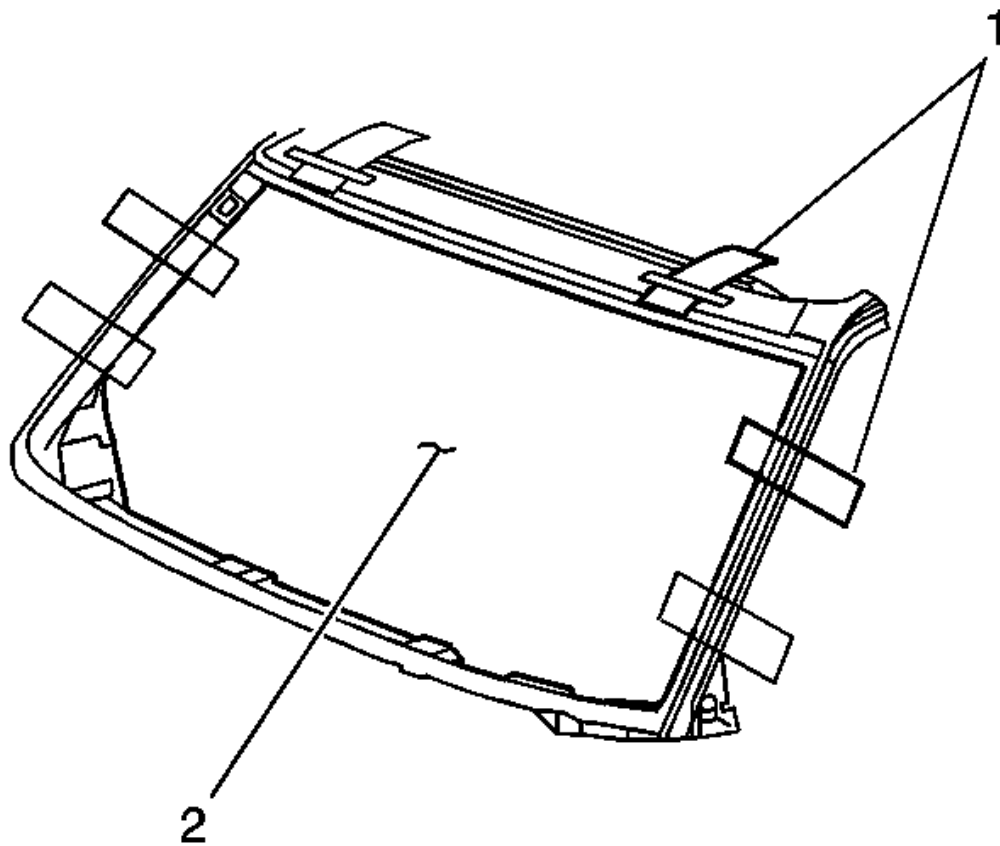


Fig. 37: Marking Location Of Window In Opening
Courtesy of GENERAL MOTORS COMPANY

13. Use masking tape in order to mark the locations (1) of the window (2) in the opening.
14. Cut the masking tape in the center and remove the window from the opening.
15. Place the window on a clean soft surface.

Install the lower windshield molding.

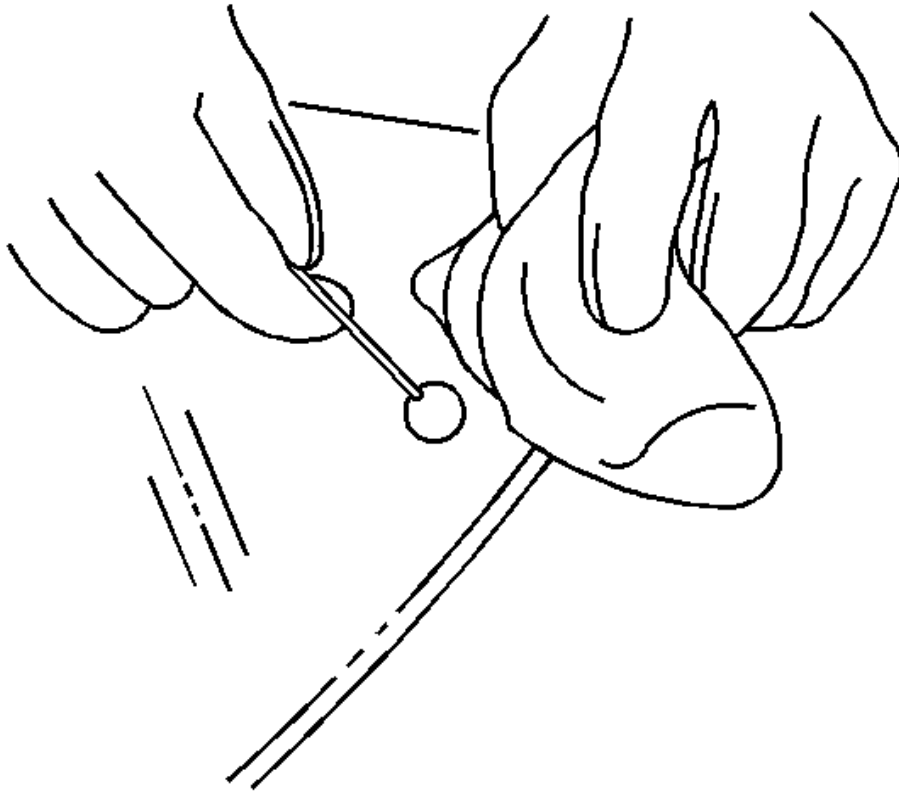


Fig. 38: Applying Glass Prep

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use care when applying glass prep clear on the window. This primer dries almost instantly, and may stain the viewing area of the window if not applied evenly.

16. Use a new dauber in order to apply glass prep clear to the area approximately 18 mm (0.71 in) around the entire perimeter of the window inner surface.

Immediately wipe the glass primed area using a clean, lint-free cloth.

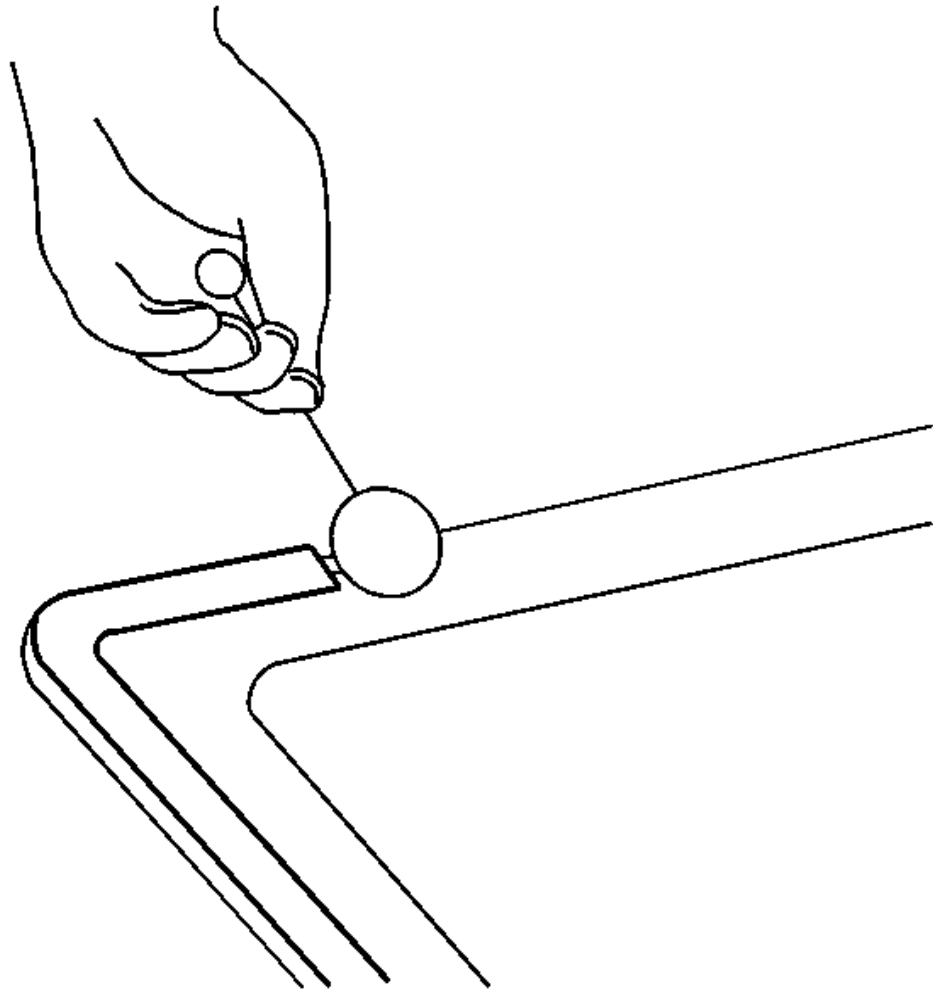


Fig. 39: Applying Glass Prep

Courtesy of GENERAL MOTORS COMPANY

17. Apply a second coat of the glass prep clear to the same area of the glass.

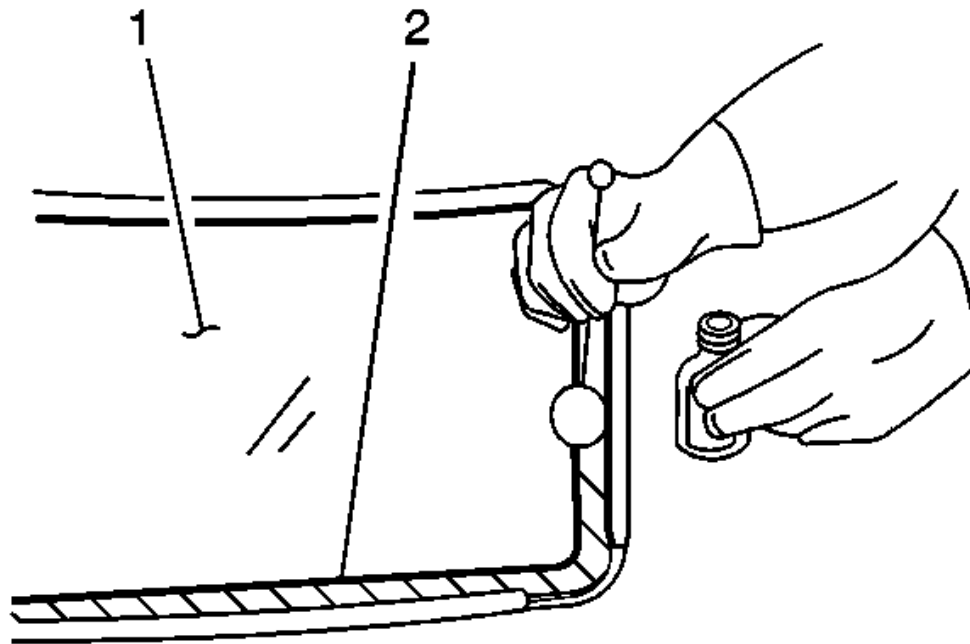


Fig. 40: Applying Glass Primer

Courtesy of GENERAL MOTORS COMPANY

NOTE: The glass primer black is effective up to 8 hours after applying it to the glass.
The primed surface of the glass must be kept clean.

18. Shake the glass primer black for at least 1 minute.
19. Use a new dauber in order to apply the glass primer black to the same areas (2) that glass prep clear was applied.
20. Allow the glass primer to dry for approximately 10 minutes.

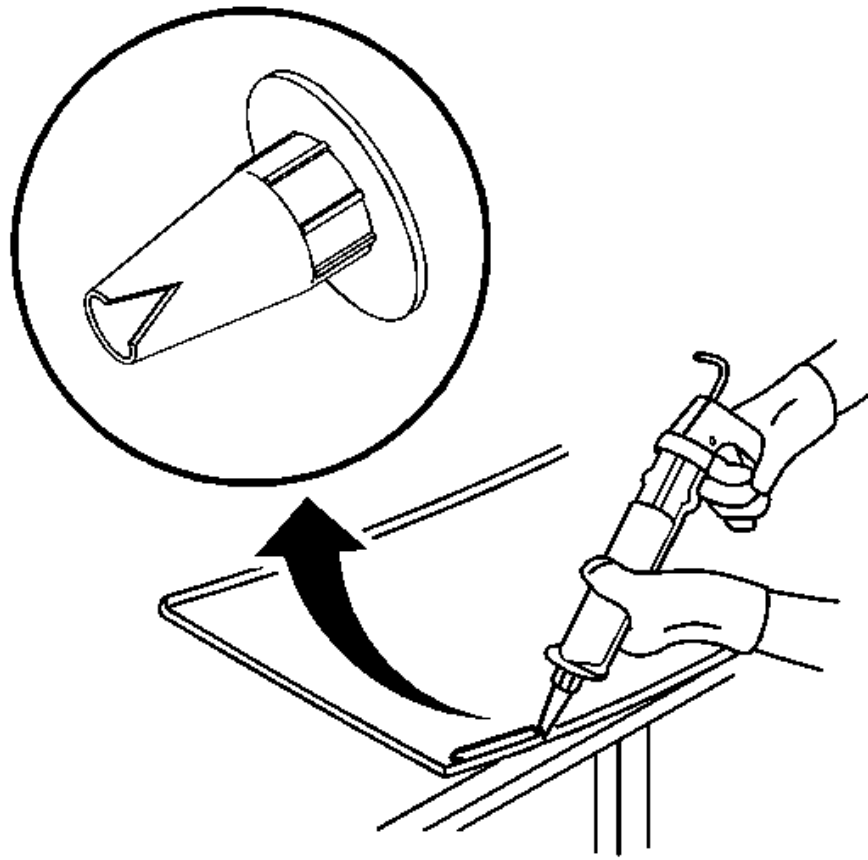


Fig. 41: Modified Applicator Nozzle
Courtesy of GENERAL MOTORS COMPANY

21. Cut the applicator nozzle in order to provide a bead of 12.7 mm (1/2 in) wide and 12.7 mm (1/2 in) high.

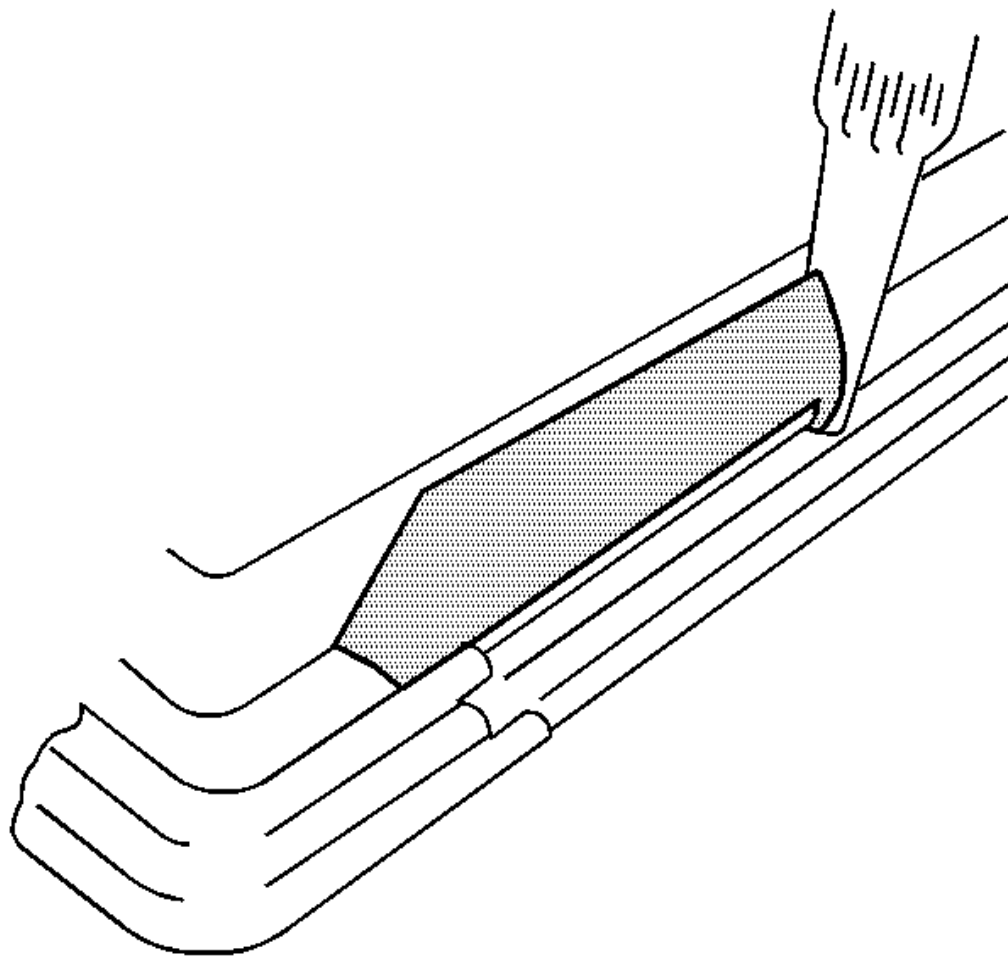


Fig. 42: Applying Continuous Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

22. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.

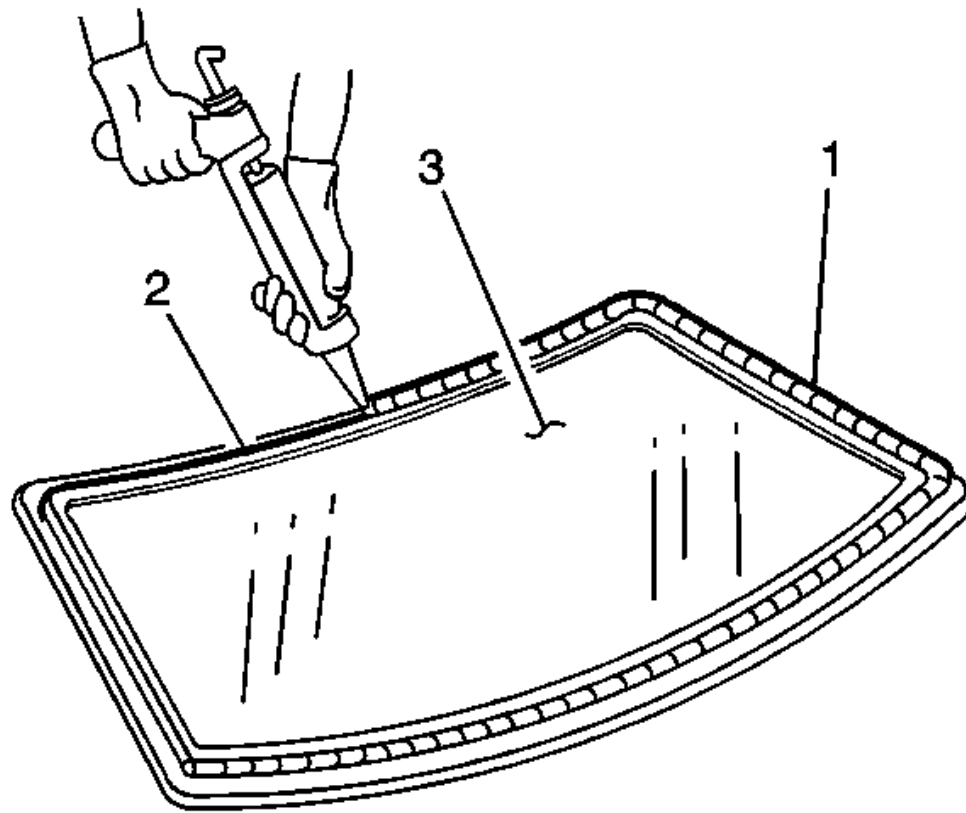


Fig. 43: Applying Urethane Adhesive To Inner Surface Of Window

Courtesy of GENERAL MOTORS COMPANY

23. Use the edge of the window as a guide for the nozzle in order to apply the urethane adhesive (1) to the inner surface of the window (3).

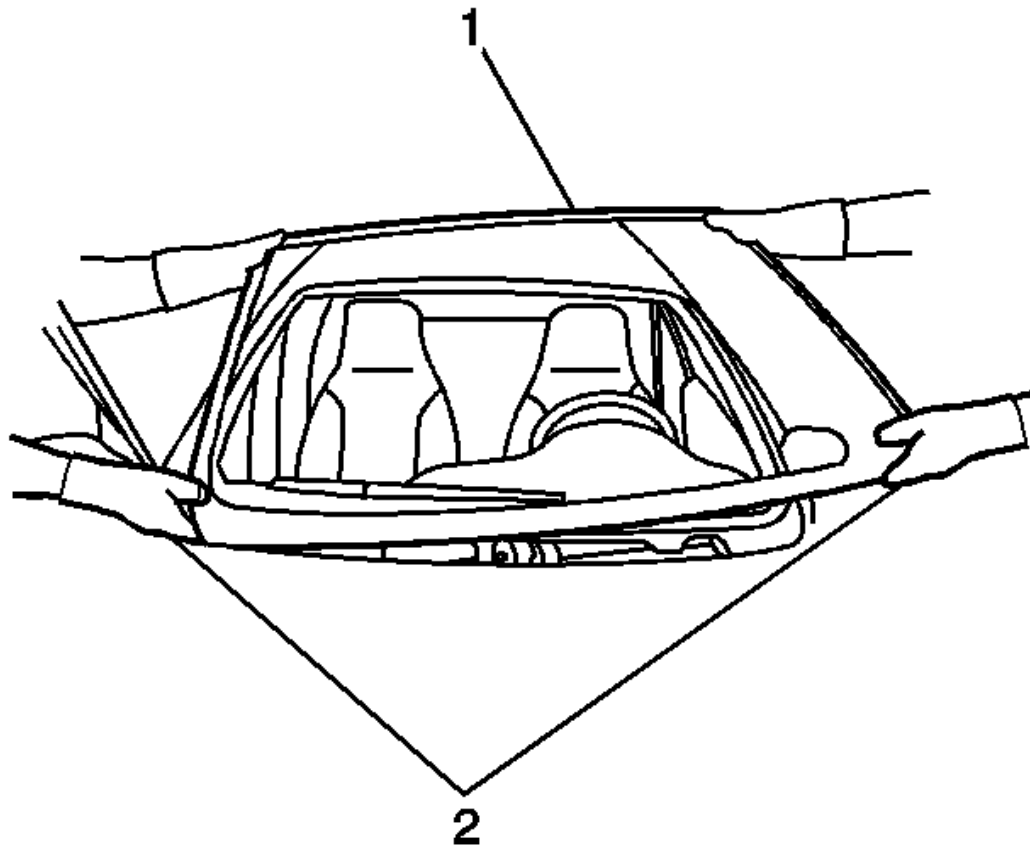


Fig. 44: Windshield Placement

Courtesy of GENERAL MOTORS COMPANY

24. With the aid of an assistant, place the window (1) in the opening.

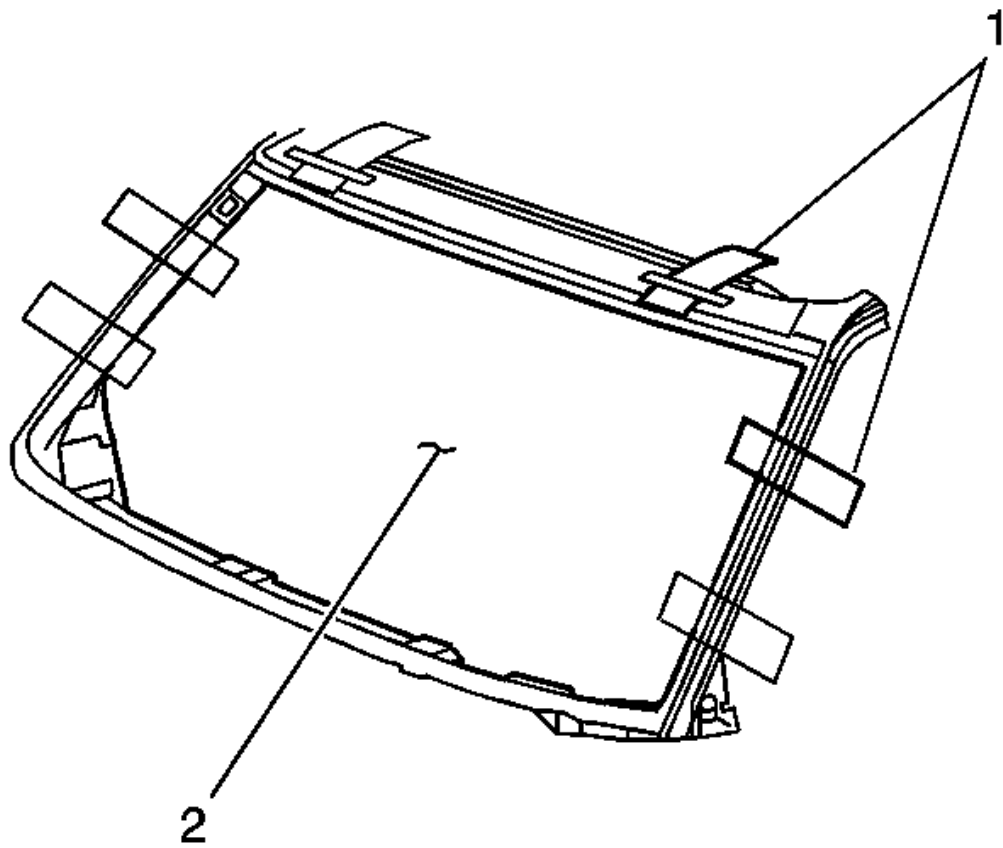


Fig. 45: Aligning Tape Lines On Window To Body
Courtesy of GENERAL MOTORS COMPANY

25. Align the masking tape (1) lines on the window (2) and the body.

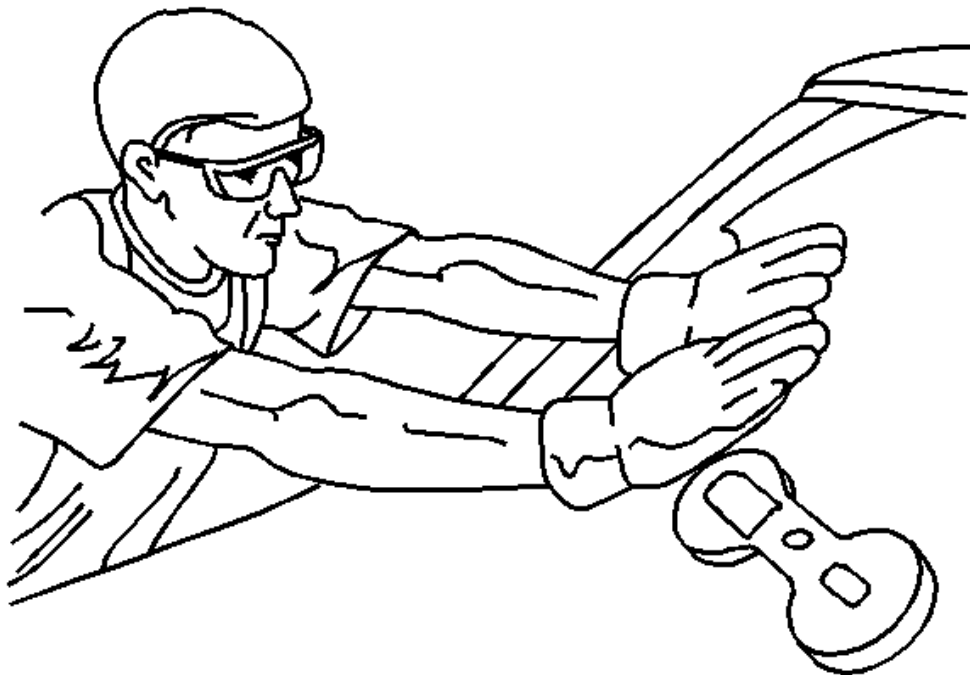


Fig. 46: Pressing Window Into Place

Courtesy of GENERAL MOTORS COMPANY

NOTE: To prevent damage to the window due to objects impacting an exposed edge, upon installation, the window must rest 1 mm (0.04 in) below the surface of the sheet metal.

26. Press firmly around the entire periphery of the windshield in order to wet-out the urethane bead.
27. Tape the window to the body in order to minimize movement until the urethane adhesive cures.

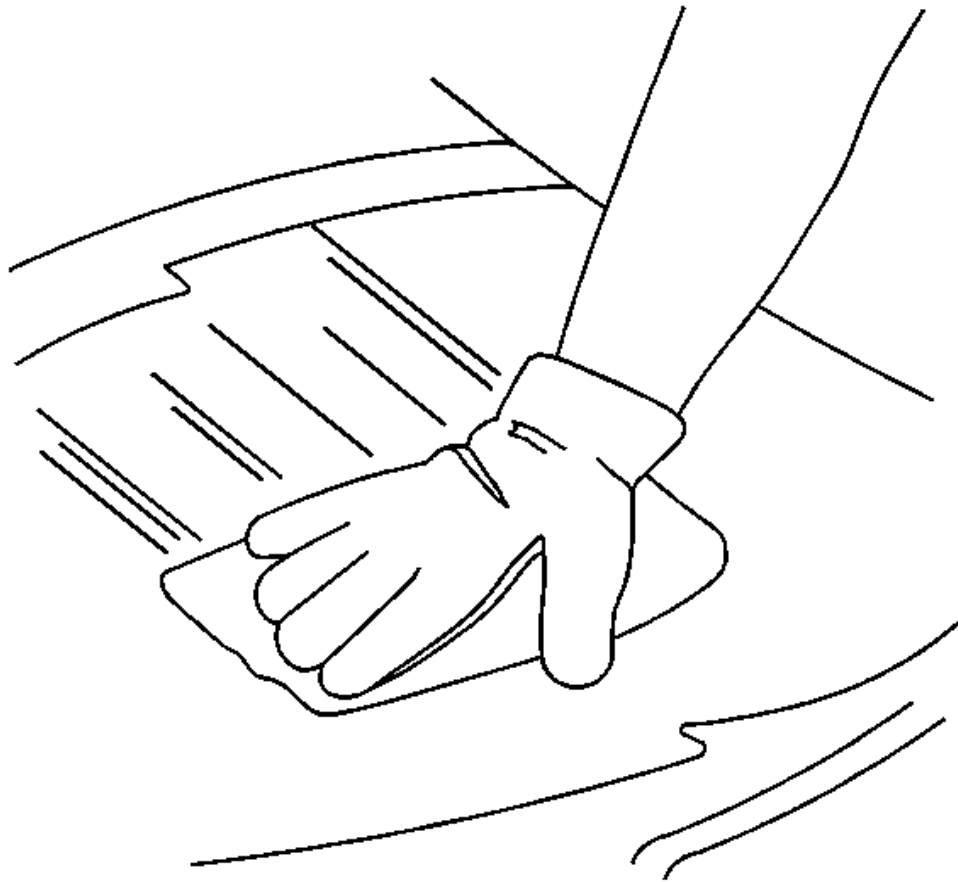


Fig. 47: Cleaning Excess Urethane Adhesive From Body
Courtesy of GENERAL MOTORS COMPANY

28. Clean any excess urethane adhesive from the body.

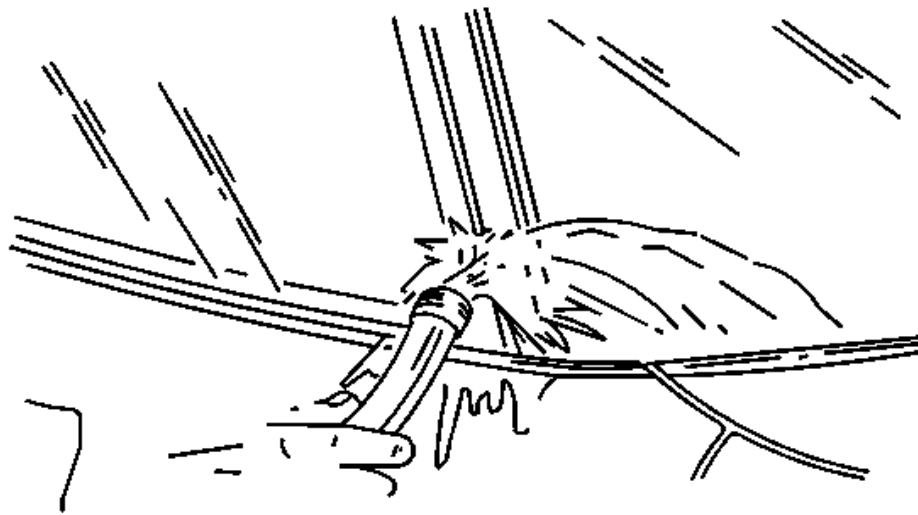


Fig. 48: Performing Water Hose Test

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.

29. Use a soft spray of warm water in order to immediately water test the window.
30. Inspect the window for leaks.
31. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
32. Retest the window for leaks.

WARNING: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21Â°C (70Â°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.
- For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.

Do NOT physically disturb the repair area until after these minimum times have elapsed.

33. Maintain the following conditions in order to properly cure the urethane adhesive:

- Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
- Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.
- Do not use compressed air in order to dry the urethane adhesive.

34. Complete the window installation.

ADHESIVE INSTALLATION OF LIFTGATE WINDOWS

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

1. Use a urethane adhesive systems which meet GM Specification GM 3651G.
2. Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.
3. Remove all mounds or loose pieces of urethane adhesive from the pinch-weld area.
4. If the original window is being reused, remove all but a thin film of the existing urethane adhesive from the window surface by using a clean utility knife or razor blade scraper.
5. Inspect for any of the following problems in order to help prevent future breakage of the window:
 - The flange of the window opening
 - High weld
 - Solder spots
 - Hardened sealer
 - Any other obstruction or irregularity in the pinchweld flange

NOTE: If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15® , DuPont 2610® , Sherwin-Williams PSE 4600 and NP70® and Martin-Semour 5120 and 5130® PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDEX 11158/13320 - 14653/14980 products are approved for this application.

6. After repairing the opening as indicated, perform the following steps:
 1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
 2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.

WARNING: Refer to [Window Retention Warning](#) .

7. Verify all primers and urethane adhesive are within expiration dates.

WARNING: Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane

adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

NOTE: Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.

8. Shake the pinch-weld primer black for at least 1 minute.
9. Use a new dauber in order to apply the primer to the surface of the pinch-weld flange.
10. Allow the pinch-weld primer to dry for approximately 10 minutes.
11. With the aid of an assistant, dry fit the window (1) to the opening in order to determine the correct position.

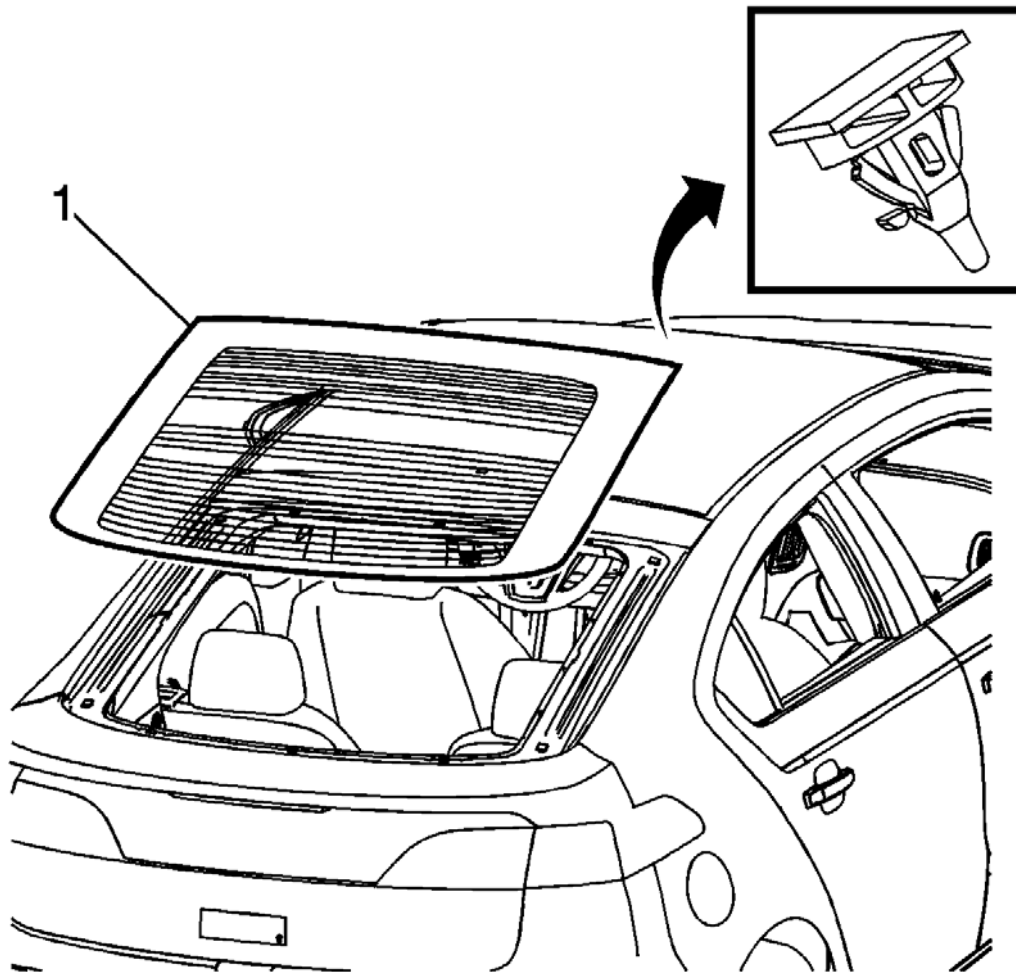


Fig. 49: Liftgate Window

Courtesy of GENERAL MOTORS COMPANY

12. Ensure the window (1) locator pins are positioned into the locator slots in the pinch-weld flange.
13. Use masking tape in order to mark the locations (1) of the window (2) in the opening.
14. Cut the masking tape in the center and remove the window from the opening.
15. Place the window on a clean soft surface.

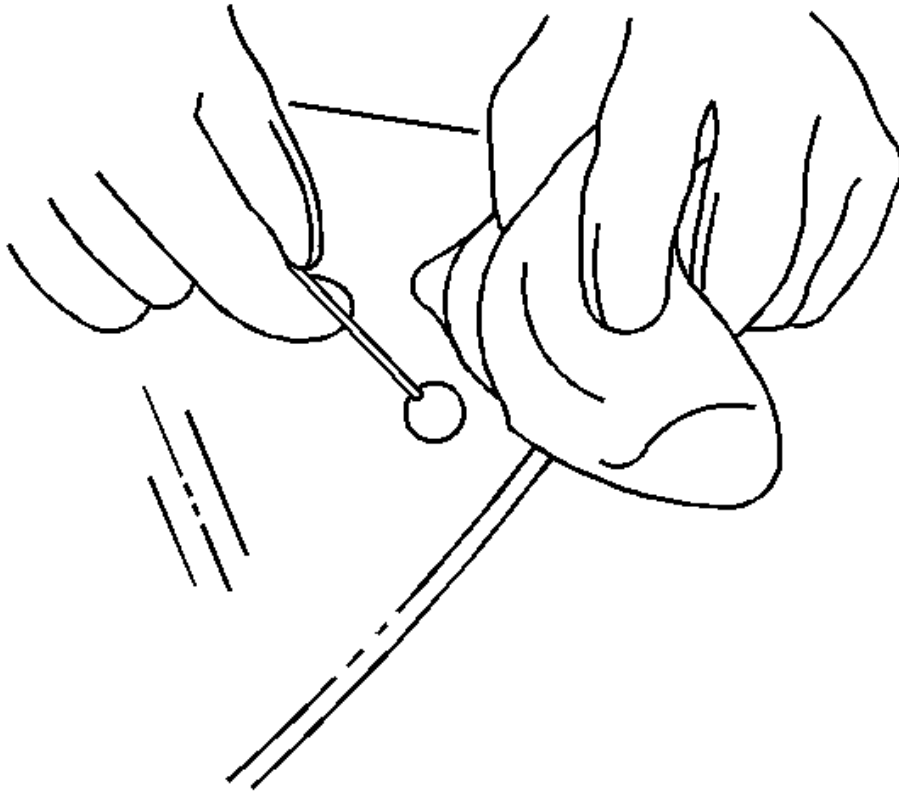


Fig. 50: Applying Glass Prep

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use care when applying glass prep clear on the window. This primer dries almost instantly, and may stain the viewing area of the window if not applied evenly.

16. Use a new dauber in order to apply glass prep clear to the area approximately 18 mm (0.71 in) around the entire perimeter of the window inner surface.

Immediately wipe the glass primed area using a clean, lint-free cloth.

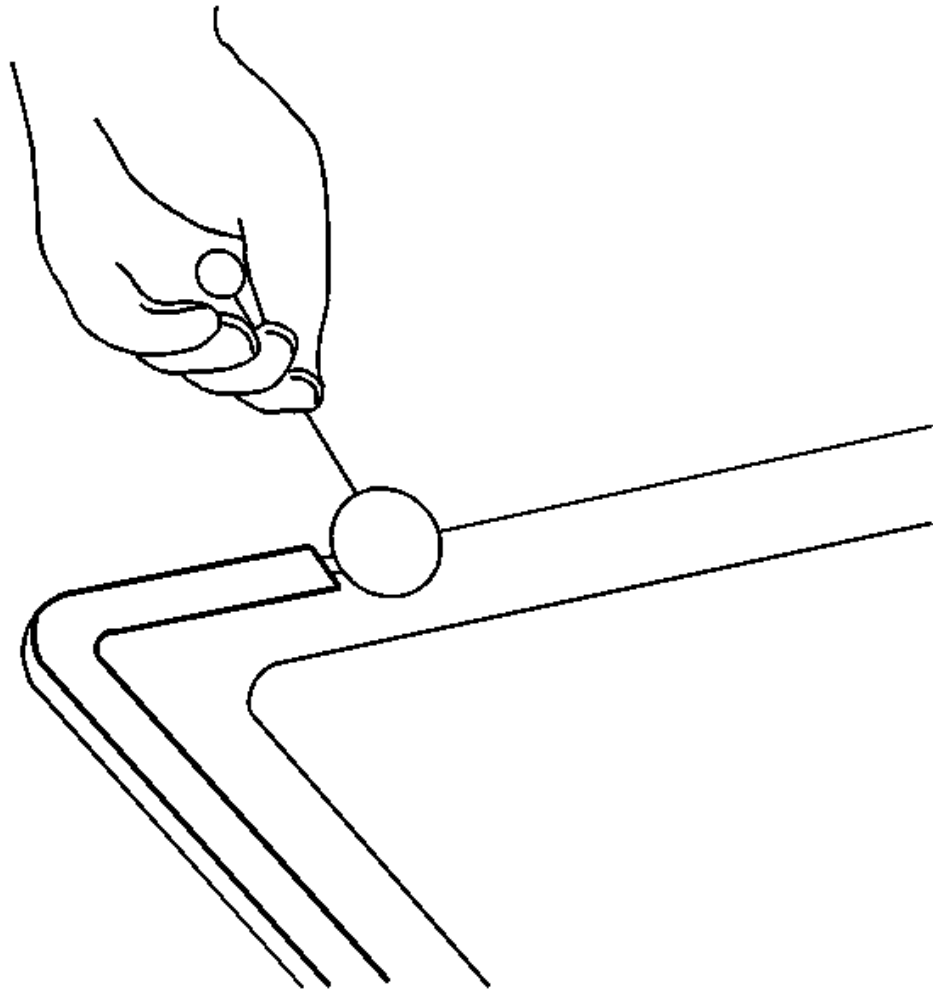


Fig. 51: Applying Glass Prep

Courtesy of GENERAL MOTORS COMPANY

17. Apply a second coat of the glass prep clear to the same area of the glass.

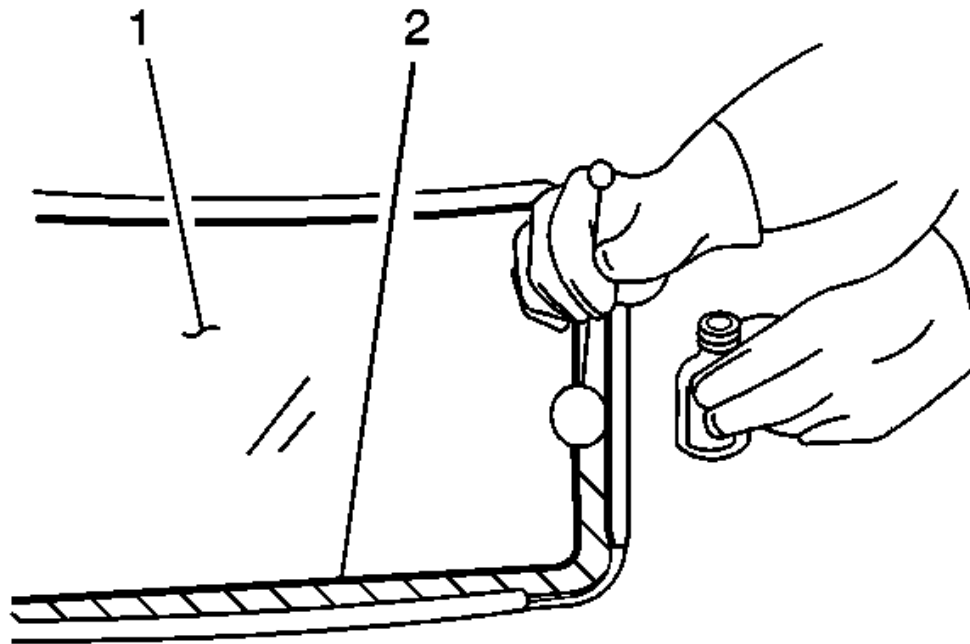


Fig. 52: Applying Glass Primer

Courtesy of GENERAL MOTORS COMPANY

NOTE: The glass primer black is effective up to 8 hours after applying it to the glass.
The primed surface of the glass must be kept clean.

18. Shake the glass primer black for at least 1 minute.
19. Use a new dauber in order to apply the glass primer black to the same areas (2) that glass prep clear was applied.
20. Allow the glass primer to dry for approximately 10 minutes.

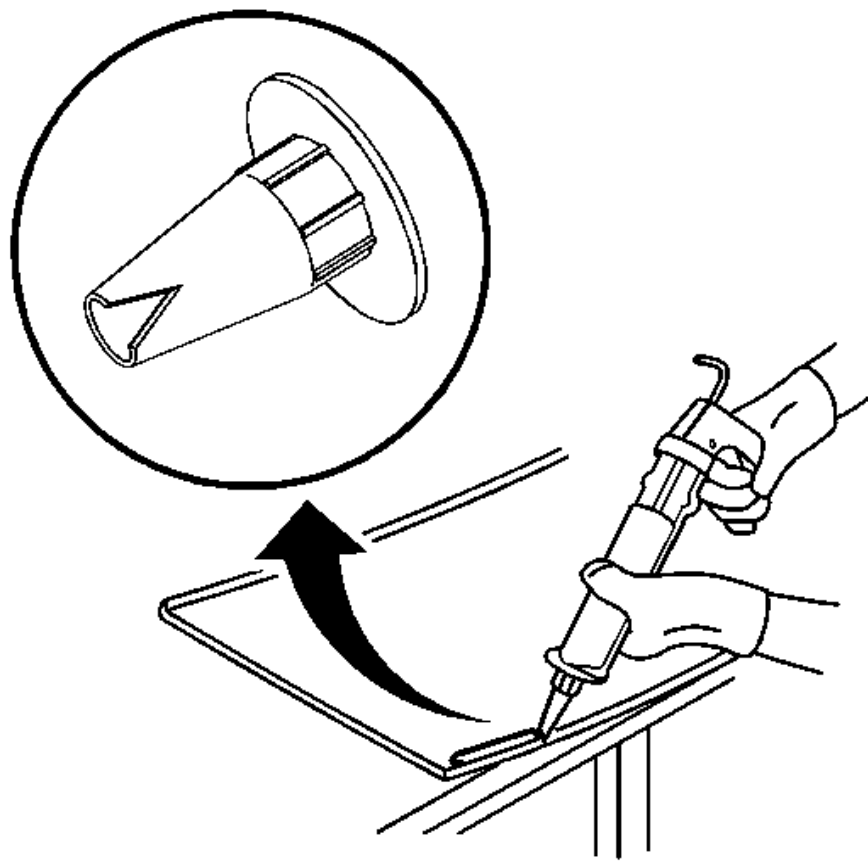


Fig. 53: Modified Applicator Nozzle
Courtesy of GENERAL MOTORS COMPANY

21. Cut the applicator nozzle in order to provide a bead of 12.7 mm (1/2 in) wide and 12.7 mm (1/2 in) high.

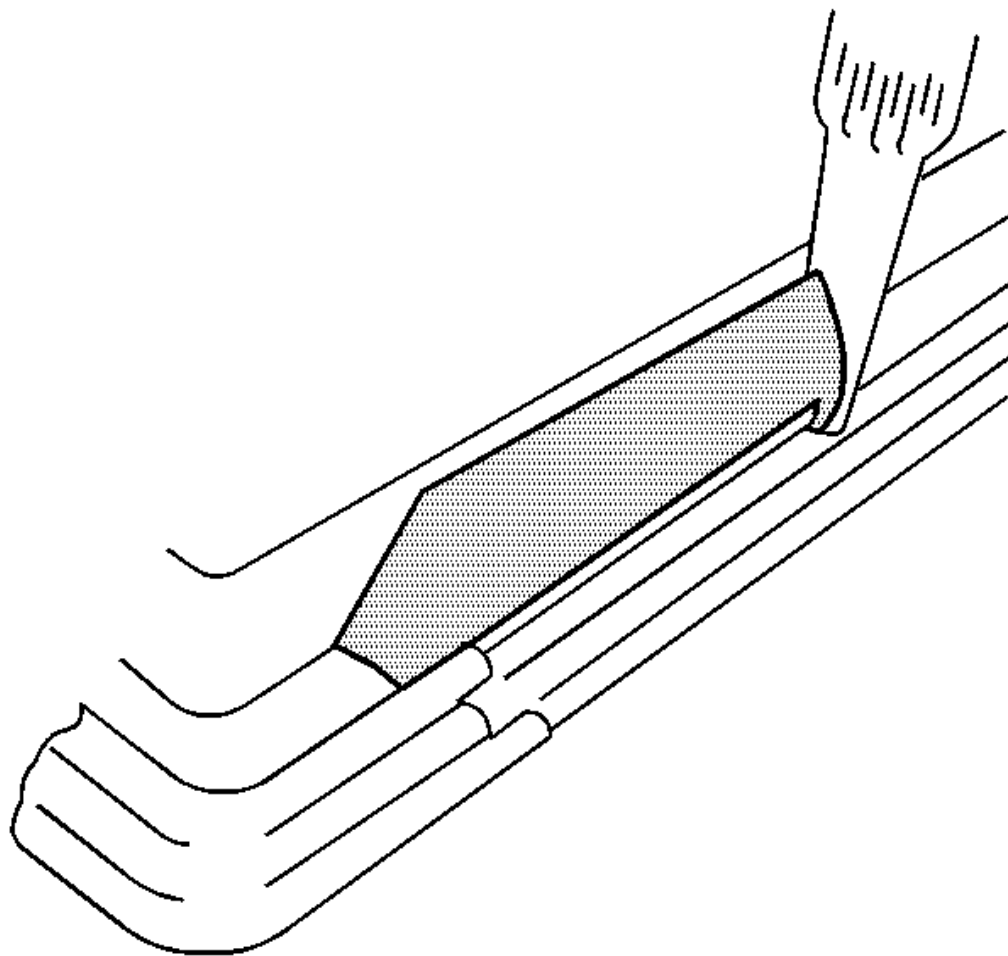


Fig. 54: Applying Continuous Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

22. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.

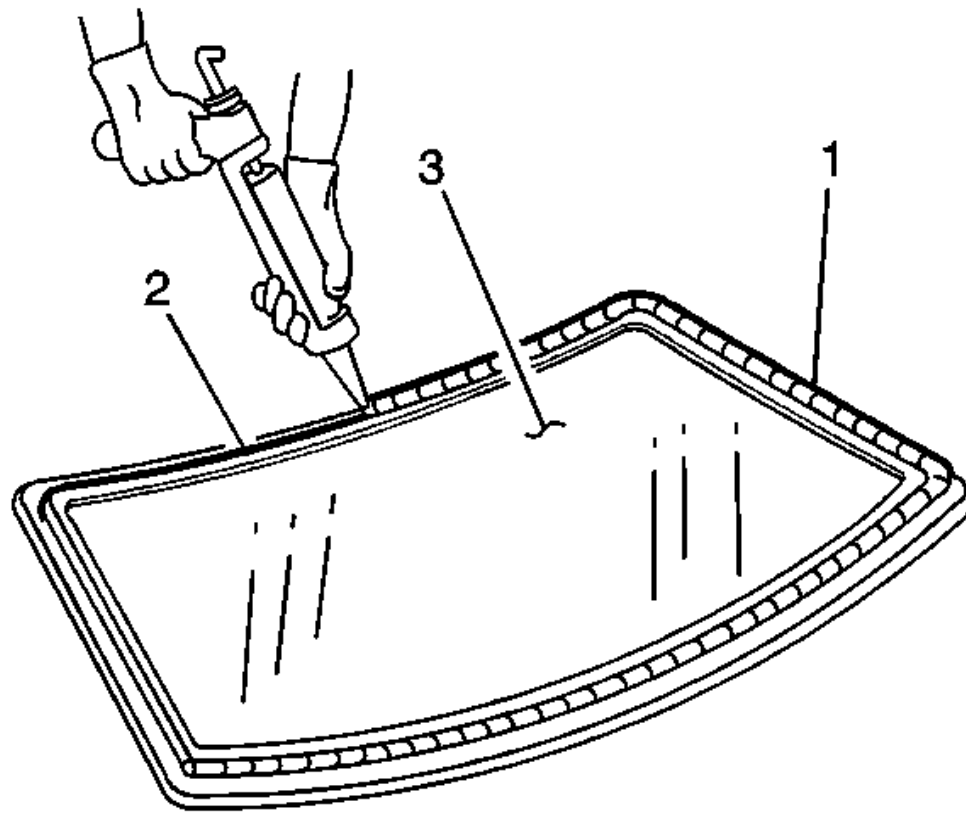


Fig. 55: Applying Urethane Adhesive To Inner Surface Of Window

Courtesy of GENERAL MOTORS COMPANY

23. Use the edge of the window as a guide for the nozzle in order to apply the urethane adhesive (1) to the inner surface of the window (3).
24. With the aid of an assistant, place the window locator pins into the slots in the liftgate.

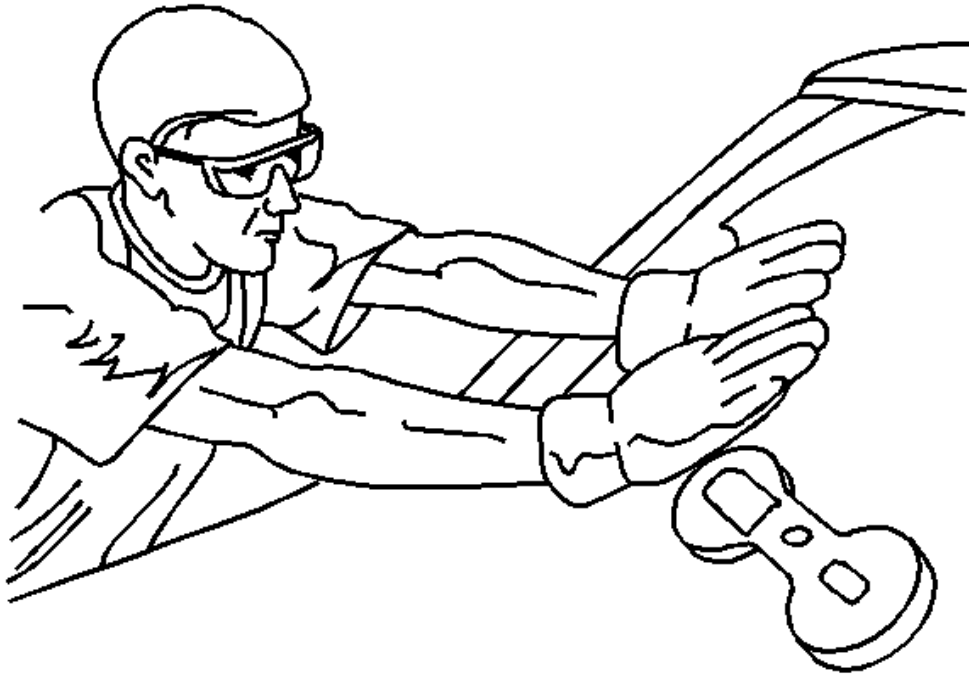


Fig. 56: Pressing Window Into Place

Courtesy of GENERAL MOTORS COMPANY

NOTE: To prevent damage to the window due to objects impacting an exposed edge, upon installation, the window must rest 1 mm (0.040 in) below the surface of the sheet metal.

25. Press firmly around the entire periphery of the window in order to wet-out the urethane bead.
26. Tape the window to the body in order to minimize movement until the urethane adhesive cures.

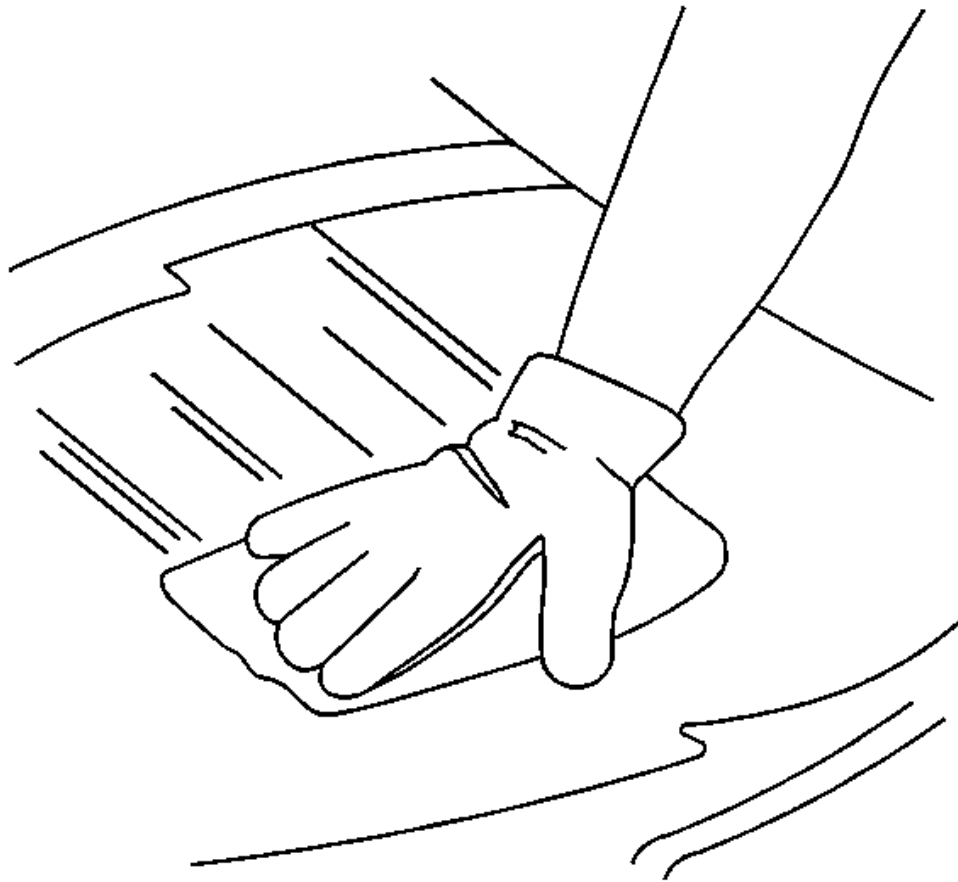


Fig. 57: Cleaning Excess Urethane Adhesive From Body
Courtesy of GENERAL MOTORS COMPANY

27. Clean any excess urethane adhesive from the body.

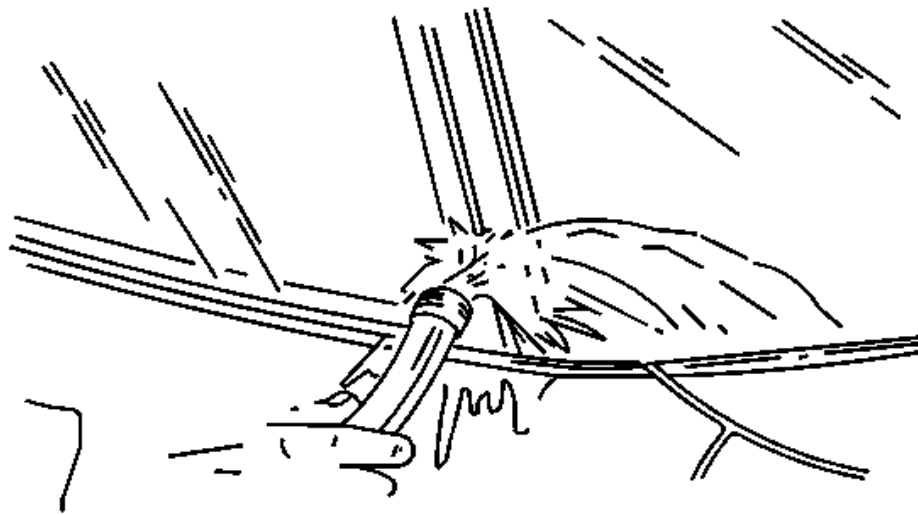


Fig. 58: Performing Water Hose Test

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.

28. Use a soft spray of warm water in order to immediately water test the window.
29. Inspect the window for leaks.
30. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
31. Retest the window for leaks.

WARNING: Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

- For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21°C (70°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.
- For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.

Do NOT physically disturb the repair area until after these minimum times have elapsed.

32. Maintain the following conditions in order to properly cure the urethane adhesive:

- Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
- Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.
- Do not use compressed air in order to dry the urethane adhesive.

33. Complete the window installation.

DESCRIPTION AND OPERATION

FULL-CUT METHOD DESCRIPTION

NOTE:

- If corrosion of the pinch-weld flange is present, or if sheet metal repairs or replacements are required, refinish the pinch-weld flange in order to present a clean, primer-only surface.
- If paint repairs are required, mask the flange bonding area, prior to applying the color coat, in order to provide a clean, primer-only surface.
- Appropriate materials for these primer applications are typically 2 component catalyzed products. Use materials such as BASF DE15®[®], DuPont 2610®[®], Sherwin-Williams PSE 4600 and NP70®[®] and Martin-Semour 5120, 5130®[®], PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application. Follow the manufacturer's directions for the mix, the application, and the drying times.
- After repairing the opening as indicated, shake the pinch-weld primer black #3 well. Using a new dauber, apply the primer to the primed surface of the flange in the bonding area. Allow the primer to dry for 10 minutes.

Use only the full cut method, also known in the field as full strip method, when installing windows.

This method includes the following:

- The replacement of a majority of the urethane adhesive bead. Remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinch-weld flange.
- Apply pinch-weld primer to any exposed painted areas on the pinch-weld flange.

No mounds or loose pieces of urethane adhesive should remain on the pinch-weld flange. Do not remove all traces of urethane adhesive.

POWER WINDOWS DESCRIPTION AND OPERATION

Power Windows System Components

The power window system consists of the following components:

- Driver window/outside rearview mirror switch
- Passenger window switch

- Left rear window switch
- Right rear window switch
- Right rear door latch
- Left rear door latch
- Window motors in each of the doors
- 25A Fuse
- Body control module (BCM)

Driver Express Up and Express Down Power Window Motor

The driver door contains a window motor is smart motor that will detect excessive resistance while performing the express up function and automatically reverse direction to prevent injury to any occupants that may become trapped between the closing window and the door frame. The automatic reverse safety feature can be overridden by pulling and holding the window switch.

The logic circuit within the window motor monitors the up, down and express signal circuits which are normally equal to B+ voltage. When a switch is used on the driver window/outside rearview mirror switch, the contacts close causing a voltage drop within the appropriate signal circuit. The driver window motor will detect the voltage drop and will command the window to move in the direction requested.

Passenger, Left Rear and Right Rear Express Down Window Motors

For the passenger, right rear and left rear doors, when their window switch is pressed in the down position, battery positive voltage is applied to their respective window motor control circuit and ground to the other window motor control circuit causing that window to open. When the individual window switch is pulled in the up position, voltage and ground is applied to the window motor in the opposite direction causing that window to close. The return path to ground is supplied through the inactive control circuit being normally grounded through the window switch.

Each passenger and rear window switch communicates to the BCM by a serial data circuit. When the driver wishes to control the passenger, left rear or right rear window, the driver will use the appropriate switch on the driver window/outside rearview mirror switch. When this switch is used, a serial data message is sent to the BCM requesting a window motor command, the BCM will then send a serial data message to the appropriate door window switch which will then command that window to move in the direction requested.

Lockout Switch Feature

The driver window/outside rearview mirror switch contains a window lockout switch, when the driver presses the window lockout switch, a serial data message is sent to the BCM which will send a disable command to the rear window switches, the rear window switches will then ignore all functions when a passenger uses the rear window switch. The rear window motor commands will still function normally when the driver uses the appropriate switches on the driver window/outside rearview mirror switch.

REAR WINDOW DEFOGGER DESCRIPTION AND OPERATION

Rear Window Defogger System Components

The rear window defogger system consists of the following components:

- HVAC Control Module
- HVAC Controls Switch Assembly
- Rear Defogger Relay

- Rear Defogger Grid
- Driver Outside Rearview Mirror
- Passenger Outside Rearview Mirror
- 40A Fuse

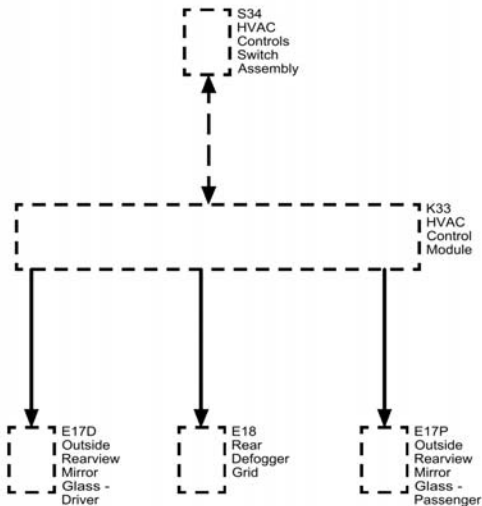


Fig. 59: S34-K33-X50A Defogger Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S34	S34 HVAC Controls Switch Assembly
E17D	E17D Outside Rearview Mirror Glass - Driver
E18	E18 Rear Defogger Grid
E17P	E17P Outside Rearview Mirror Glass - Passenger
K33	K33 HVAC Control Module

Rear Window Defogger Operation

The rear defog control system utilizes a single zone backlight design, driven with a single relay configuration. Additionally, up to two outside rear view mirrors can be heated if required. A switch for the customer to control the system is provided within the HVAC controls switch assembly. Also included in the HVAC controls switch assembly

is an indicator to inform the customer with the current state of the system. The system is only operational when the vehicle is ON/RUN.

Pressing the heated rear window switch causes the HVAC controls switch assembly to send a serial data message to the HVAC control module requesting rear window defog operation. The HVAC control module upon receipt of the serial data message will provide voltage to the coil side of the rear defogger relay, this will energize the relay causing the relay switch contacts to close allowing B+ voltage to flow through the rear defogger grid control circuit to the rear defogger grid.

When the rear heated rear window switch is pressed and the vehicle is ON/RUN, the rear window defogger grid will activate and will turn off automatically depending upon the vehicle speed (refer to owner's manual for rear window defogger operation cycles)

Heated Mirrors

The heated mirrors are also controlled through the rear defogger relay. Whenever the rear window defogger is turned on battery voltage is supplied to the mirror heater elements through the left and right mirror heater element control circuits.

STATIONARY WINDOW DESCRIPTION

Most stationary windows, specifically windshields, are retained to the body with adhesive which adheres the window to the body, increasing structural integrity. The reinstallation of the windows with adhesive requires complete replacement of the adhesive bead, and is known as the full cut method. All stationary windows must use a adhesive systems which meet GM Specification GMW-15672.

URETHANE ADHESIVE DESCRIPTION

For replacement of any adhesive-installed window, use the full cut method only.

Use an adhesive that is approved by GM, Specification GMW-15672.

Use these materials based on specific manufacturer. Do NOT intermix primers or adhesives from one manufacturer to another.

Always follow the system manufacturers instructions for application, handling, and curing.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

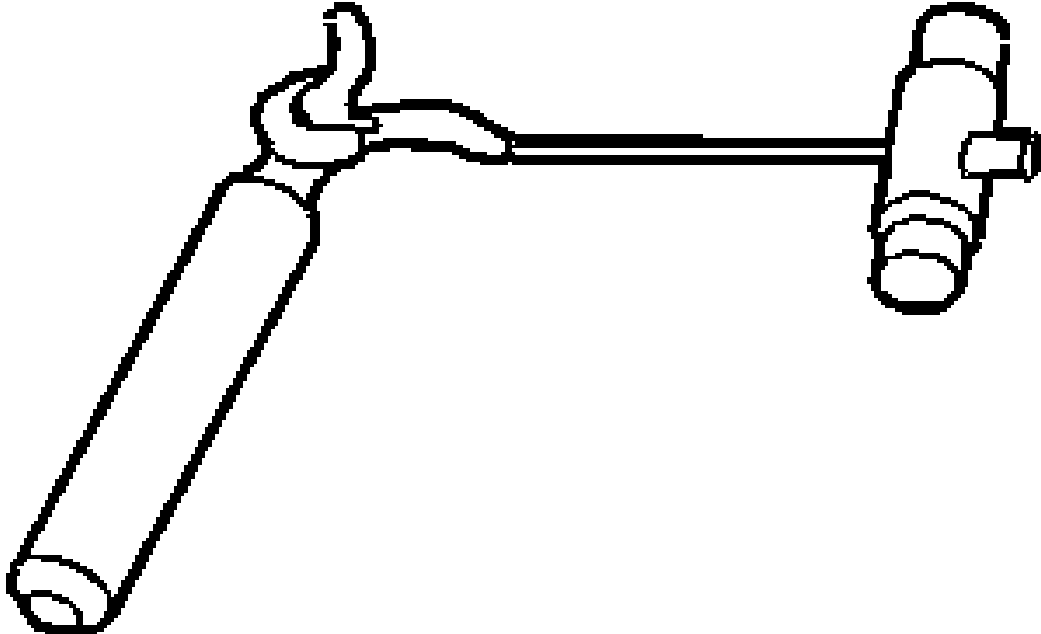
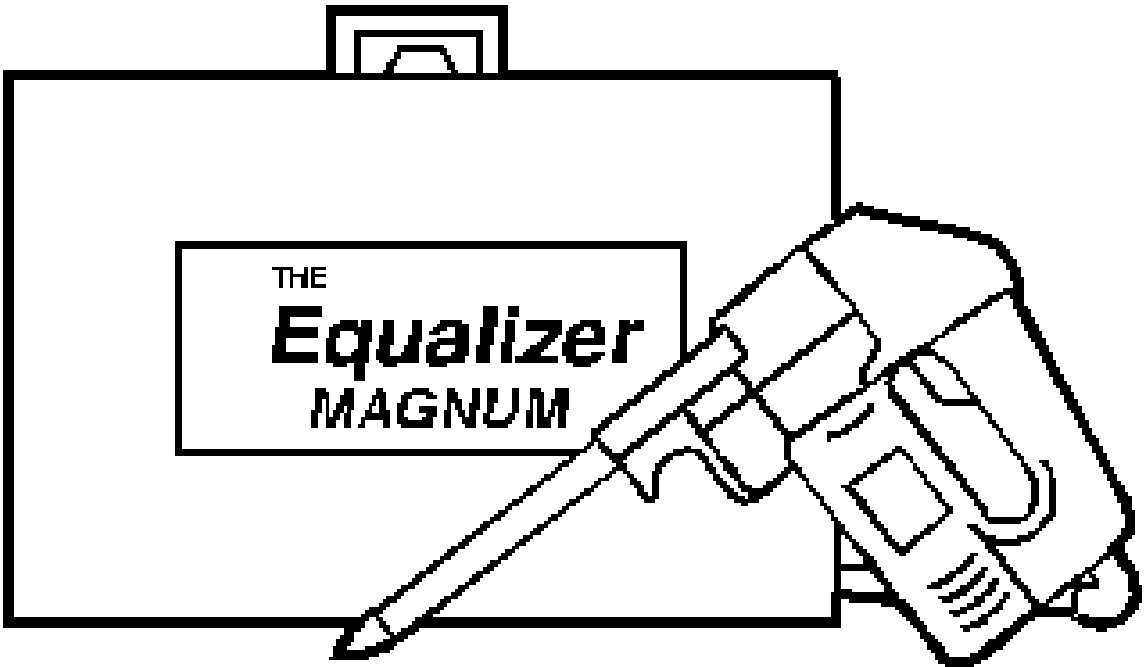
Illustration	Tool Number/Description
	BO-24402-A J-24402-A Glass Sealant Cold Knife Remover

Illustration	Tool Number/Description
 A line drawing of a rectangular toolbox with a handle on top. A label on the front reads "THE <i>Equalizer</i> MAGNUM". A stationary glass removal tool, which has a long, thin, pointed tip and a complex, multi-part handle, is resting diagonally across the front of the toolbox.	BO-39032 J-39032 Stationary Glass Removal Tool

Horns - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Horn Nut	22 N.m (16 lb ft)

SCHEMATIC WIRING DIAGRAMS

HORN WIRING SCHEMATICS

Horns

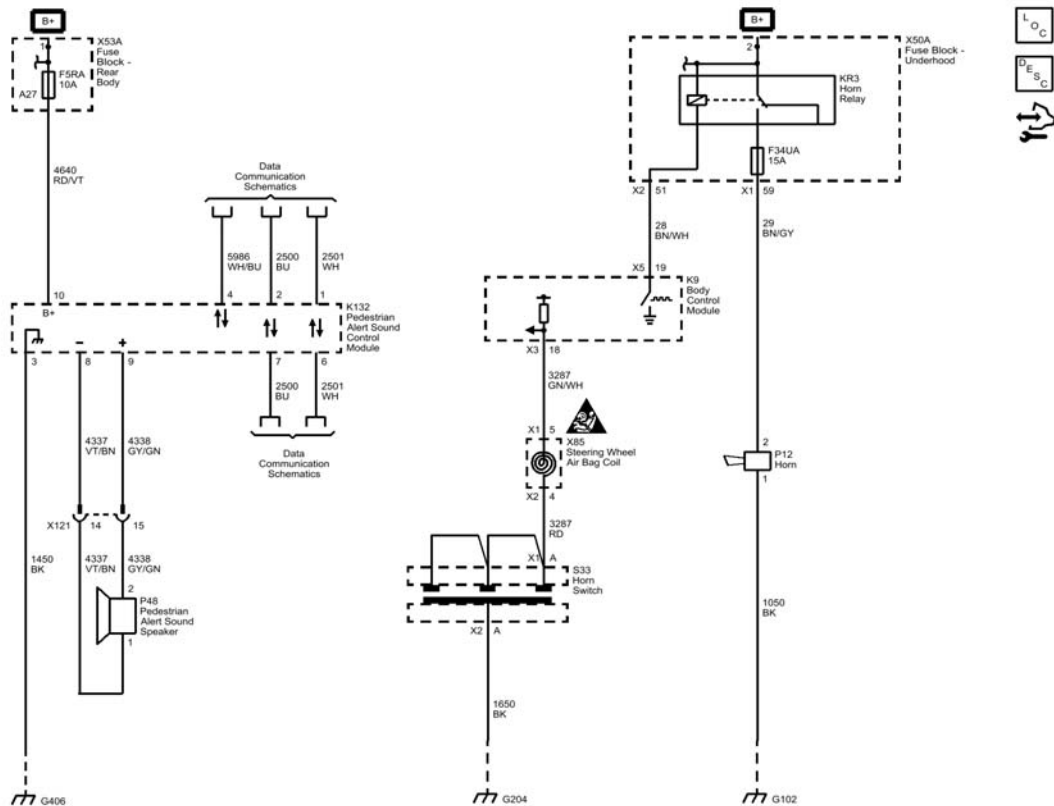


Fig. 1: Horns

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B010E: PEDESTRIAN FRIENDLY ALERT AUDIO OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:[Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis:[Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here:[Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B010E

Pedestrian Friendly Alert Audio Output Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Pedestrian Friendly Alert Speaker Control (-)	1	B010E 04	1	B010E 1B
Pedestrian Friendly Alert Speaker Control (+)	1	B010E 04	1	B010E 1B
1. P48 Pedestrian Alert Sound Speaker=Inoperative				

Circuit/System Description

For an overview of the component/system, refer to:[Pedestrian Alert Description and Operation](#)

Circuit	Description
Pedestrian Friendly Alert Speaker Control (-)	The output circuit is switched to 6 V to activate the component.
Pedestrian Friendly Alert Speaker Control (+)	The output circuit is switched to 6 V to activate the component.

Component	Description
P48 Pedestrian Alert Sound Speaker	Each of the speaker output [+] and [-] circuits has a DC bias voltage that is approximately one half of the battery voltage. When using a DMM, each of the circuits will measure approximately 6 V DC to ground. The audio being played is produced by a varying AC voltage that is centered around

Component	Description
	the DC bias voltage. The AC voltage causes the speaker cone to move and produce sound.
K132 Pedestrian Alert Sound Control Module	The control module K132 controls a speaker to emit an audible tone at low vehicle speeds to notify pedestrians of an approaching vehicle.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode & Transmission in Drive

Conditions for Setting the DTC

- B010E 1B - Control Circuit=Signal Cross Coupled
- B010E 04 - Control Circuit=Open/High Resistance

Actions Taken When the DTC Sets

Pedestrian Alert Sound System=Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
2. Verify the component is activated:P48 Pedestrian Alert Sound Speaker
 - **If the component does not produce a sound**

Refer to: Circuit/System Testing

- **If the component produces a sound**
3. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector:P48 Pedestrian Alert Sound Speaker
3. Test for less than 10 ohms between the test points:Low Reference terminal 1 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 2. Test for less than 2 ohms between the test points:Low Reference terminal 1 @Component harness & Terminal 2 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K132 Pedestrian Alert Sound Control Module
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
5. Test for 5 to 7 V between the test points:Control circuit terminal 2 & Ground
 - **If less than 5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 3. Test for infinite resistance between the test points:Control circuit terminal 2 @Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms between the test points:Control circuit terminal 9 @Component harness & Terminal 2 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K132 Pedestrian Alert Sound Control Module
 - **If greater than 7 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:Control circuit terminal 2 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.

- If less than 1 V - Replace the component:K132 Pedestrian Alert Sound Control Module
- **If between 5 and 7 V**

6. Test or replace the component:P48 Pedestrian Alert Sound Speaker

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Pedestrian Sound Alert Speaker Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B274E OR B274F: LOW NOTE HORN RELAY CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:[Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis:[Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here:[Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B274E

Low Note Horn Relay Control Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Relay Coil	1	2	DTC B274E 01	-
1. P12 Horn=Always On 2. P12 Horn=Inoperative				

Circuit/System Description

For an overview of the component/system, refer to:[Horns System Description and Operation](#)

Circuit	Description
Control - Relay Coil	The output circuit is switched to ground to activate the component.

Component	Description
X50A Fuse Block - Underhood	The fuse block houses various fuses and relays.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Conditions for Running the DTC

KR3 Horn Relay - The component is commanded On.

Conditions for Setting the DTC

Control Circuit=Short to Voltage

Actions Taken When the DTC Sets

Horn Relay Command - Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Perform the scan tool control function:Horn Relay - On and Off

Verify the component turns On and Off:P12 Horn

- **If the component does not turn On and Off**
- Refer to: Circuit/System Testing

- **If the component turns On and Off**

3. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector:K9 Body Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Momentarily connect a 3 A fused jumper wire between the test points:Control circuit terminal 19 X5 & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire:P12 Horn

- **If the component does not turn On and Off**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X2@X50A Fuse Block - Underhood
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points:Control circuit terminal 19 X5 @Control module harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for infinite resistance between the test points:Control circuit terminal 19 X5@Control module harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
7. Test for less than 2 ohms between the test points:Control circuit terminal 19 X5 @Control module harness & Control circuit terminal 51 X2@Fuse Block Harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Test or replace the component:X50A Fuse Block - Underhood

- **If the component turns On and Off**

5. Replace the component:K9 Body Control Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuse Block Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

SYMPTOMS - HORNS

Important Preliminary Checks Before Starting:

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that

all of the following are true:

- There are no DTCs set.
- The control modules can communicate via the serial data link.

2. Review the horn operation or pedestrian alert sound system operation in order to familiarize yourself with the system functions. Refer to the following:

- [Horns System Description and Operation](#)
- [Pedestrian Alert Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

NOTE:

- **Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .**
- **The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.**

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Horns Malfunction](#)
- [Pedestrian Alert System Malfunction](#)

HORNS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	2	2	-	-
B+ - Relay Switch	2	2	-	-
Signal - S33 Horn Switch	1	2	2	-
Control - P12 Horn	2	2	1	-
Control - Relay Coil	1	2	B274E 01	-
Ground - S33 Horn Switch	-	2	-	-
Ground - P12 Horn	-	2	-	-
1. P12 Horn=Always On 2. P12 Horn=Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Horns System Description and Operation](#)

Circuit	Description
B+ - Relay Coil	Supplied from a fuse.
B+ - Relay Switch	Supplied from a fuse.
Signal - S33 Horn Switch	The control module input circuit has an internal resistance connected to 12 V.
Control - P12 Horn	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.
Ground - S33 Horn Switch	Chassis Ground
Ground - P12 Horn	Chassis Ground

Component	Description
P12 Horn	The horn has an electromagnet which pulls a diaphragm inwards and simultaneously opens a contact which interrupts

Component	Description
	the current through the magnet. When the diaphragm springs back, the contact is closed and the cycle starts over. The vibration of the diaphragm produces the sound.
S33 Horn Switch	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.
X50A Fuse Block - Underhood	The fuse block houses various fuses and relays.

Diagnostic Aids

Rotate the steering wheel while pressing the horn pad to identify intermittent and poor connections within the steering column.

If the horn produces only a weak noise, inspect the following:

- Debris or water in the horn.
- Incorrect Mounting Refer to: [Fastener Specifications](#).
- Debris on the component.
- Vehicle components that vibrate while the horn is sounding.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify the scan tool parameter:Horn Switch=Inactive

- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

2. Operate the component:S33 Horn Switch - Pressed

Verify the scan tool parameter:Horn Switch=Active

- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

3. Perform the scan tool control function:Horn Relay Command - On and Off

Verify the component turns On and Off:P12 Horn & The horn should emit a clear and even tone.

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing - Test 2

- **If an abnormal noise is present**

- Refer to: Circuit/System Testing - Test 3

- **If the component turns On and Off & If no abnormal noise is present**

4. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: X1& X2@S33 Horn Switch

3. Test for less than 10 ohms between the test points:Ground circuit terminal X2 & Ground

- **If 10 ohms or greater**

1. Ground Connection - Disconnect

2. Test for less than 2 ohms between the test points:Ground circuit terminal A X2 @Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Verify the scan tool parameter:Horn Switch=Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X3 @K9 Body Control Module

3. Test for infinite resistance between the test points:Signal circuit terminal A X1@Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component:K9 Body Control Module

- **If the specified state**

6. Connect a 3 A fused jumper wire between the test points:Signal circuit terminal A X1 & Ground circuit terminal A X2

7. Verify the scan tool parameter:Horn Switch=Active

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: X3 @K9 Body Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points:Signal circuit terminal A X1 @Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points:Signal circuit terminal A X1 @Component harness & Terminal 18 X3 @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component:K9 Body Control Module

- **If the specified state**

8. Test or replace the component:S33 Horn Switch

Test 2

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector:P12 Horn

3. Test for less than 1 ohms between the test points:Ground circuit terminal 1 & Ground

- **If 1 ohms or greater**

1. Ground Connection - Disconnect

2. Test for less than 1 ohms between the test points:Ground circuit terminal 1 & Ground Connection

- If 1 ohms or greater - Repair the open/high resistance in the circuit.

- **If less than 1 ohms**

4. Connect a test lamp between the test points:Control circuit terminal 2 & Ground circuit terminal 1
5. Ignition - On / Vehicle - In Service Mode
6. Perform the scan tool control function:Horn Relay Command - On and Off

Verify the test lamp does not turn On and Off.

- **If the test lamp turns On and Off**

Test or replace the component:P12 Horn

- **If the test lamp does not turn On and Off**

7. Ignition/Vehicle - Off
8. Connect the electrical connector:P12 Horn
9. Disconnect the electrical connector: X1@X50A Fuse Block - Underhood
10. Ignition - On / Vehicle - In Service Mode
11. Momentarily connect a 15 A fused jumper wire between the test points:Control circuit terminal 59 X1 & B+

Verify the component turns On and Off when connecting and disconnecting the jumper wire:P12 Horn

- **If the component does not turn On and Off**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector:P12 Horn
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points:Control circuit terminal 2 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for infinite resistance between the test points:Control circuit terminal 2 @Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
7. Test for less than 2 ohms between the test points:Control circuit terminal 2 @Component harness & Control circuit terminal 59 X1 @Fuse Block Harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Test or replace the component:P12 Horn

- **If the component turns On and Off**

12. Connect the electrical connector: X1 @X50A Fuse Block - Underhood
13. Disconnect the electrical connector: X5 @K9 Body Control Module
14. Ignition - On / Vehicle - In Service Mode
15. Momentarily connect a 3 A fused jumper wire between the test points:Control circuit terminal 19 X5&

B+

Verify the component turns On and Off when connecting and disconnecting the jumper wire:P12 Horn

- **If the component does not turn On and Off**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector:X2@X50A Fuse Block - Underhood
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points:Control circuit terminal 19 X5 @Control module harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for infinite resistance between the test points:Control circuit terminal 19 X5 @Control module harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
7. Test for less than 2 ohms between the test points:Control circuit terminal 19 X5 @Control module harness & Terminal 51 X2 @Fuse Block Harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Test or replace the component:X50A Fuse Block - Underhood

- **If the component turns On and Off**

16. Replace the component:K9 Body Control Module

Test 3

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector:P12 Horn
3. Test for less than 1 ohms between the test points:Ground circuit terminal 1 & Ground
 - **If 1 ohms or greater**
 1. Ground Connection - Disconnect
 2. Test for less than 1 ohms between the test points:Ground circuit terminal 1 & Ground Connection
 - If 1 ohms or greater - Repair the open/high resistance in the circuit.
 - **If less than 1 ohms**
4. Disconnect the electrical connector: X1 @X50A Fuse Block - Underhood
5. Test for less than 1 ohms between the test points:Control circuit terminal 2 @Component harness & Control circuit terminal 59 X1 @Fuse Block Harness
 - If 1 ohms or greater - Repair the open/high resistance in the circuit.
 - **If less than 1 ohms**

6. Test or replace the component:P12 Horn

Component Testing

P12 Horn

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector:P12 Horn
3. Connect a jumper wire between the test points:Ground terminal 1 & Ground
4. Momentarily connect a 15 A fused jumper wire between the test points:Control terminal 2 & 12 V

Verify the component turns On and Off when connecting and disconnecting the jumper wire:P12 Horn

- **If the component does not turn On and Off**

Replace the component:P12 Horn

- **If the component turns On and Off**

5. All OK.

S33 Horn Switch

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X1 & X2 @S33 Horn Switch
3. Test for infinite resistance between the test points:Signal terminal X1 & Ground terminal A X2 - Switch Not Pressed

- **If less than infinite resistance**

Replace the component:S33 Horn Switch

- **If infinite resistance**

4. Test for less than 3 ohms between the test points:Signal terminal A X1 & Ground terminal A X2 - Switch - Pressed

- **If 3 ohms or greater**

Replace the component:S33 Horn Switch

- **If less than 3 ohms**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Engine Wiring Harness Junction Block Replacement](#)
- [Steering Wheel Horn Contact Replacement](#)
- [Horn Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

PEDESTRIAN ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - K132 Pedestrian Alert Sound Control Module	1	1	-	-
High Speed GMLAN Serial Data (-) 8 - Terminal 1	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00
High Speed GMLAN Serial Data (+) 8 - Terminal 2	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
Serial Data Communication Enable - Terminal 4	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
High Speed GMLAN Serial Data (-) 8 - Terminal 6	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
High Speed GMLAN Serial Data (+) 8 - Terminal 8	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	U0422 00		U0422 00	
Pedestrian Friendly Alert Speaker Control (-)	1	B010E 04	1	B010E 1B
Pedestrian Friendly Alert Speaker Control (+)	1	B010E 04	1	B010E 1B
Ground - K132 Pedestrian Alert Sound Control Module	-	1	-	-
1. P48 Pedestrian Alert Sound Speaker=Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Pedestrian Alert Description and Operation](#)

Circuit	Description
B+ - K132 Pedestrian Alert Sound Control Module	Supplied from a fuse.
Ground - K132 Pedestrian Alert Sound Control Module	Chassis Ground
Pedestrian Friendly Alert Speaker Control (-)	The output circuit is switched to 6 V to activate the component.
Pedestrian Friendly Alert Speaker Control (+)	The output circuit is switched to 6 V to activate the component.

Component	Description
P48 Pedestrian Alert Sound Speaker	Each of the speaker output [+] and [-] circuits has a DC bias voltage that is approximately one half of the battery voltage. When using a DMM, each of the circuits will measure approximately 6 V DC to ground. The audio being played is produced by a varying AC voltage that is centered around the DC bias voltage. The AC voltage causes the speaker cone to move and produce sound.
K132 Pedestrian Alert Sound Control Module	The control module K132 controls a speaker to emit an audible tone at low vehicle speeds to notify pedestrians of an approaching vehicle.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
2. Verify the component is activated:P48 Pedestrian Alert Sound Speaker

- **If the component does not produce a sound**

Refer to: Circuit/System Testing

- **If the component produces a sound**

3. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
3. Test for less than 10 ohms between the test points:Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the ground connection: G302
 2. Test for less than 2 ohms between the test points:Ground circuit terminal 3 & Terminal G302
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points:B+ circuit terminal 10 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: B+ circuit terminal 10 & Output terminal @

F9UA Fuse

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for infinite resistance between the test points: B+ circuit terminal 10 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component:K132 Pedestrian Alert Sound Control Module

- **If the test lamp turns On**

6. Ignition/Vehicle - Off
7. Connect the electrical connector:K132 Pedestrian Alert Sound Control Module
8. Disconnect the electrical connector:P48 Pedestrian Alert Sound Speaker
9. Test for less than 10 ohms between the test points:Low Reference terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 2. Test for less than 2 ohms between the test points:Low Reference terminal 2 @Component harness & Terminal 8 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K132 Pedestrian Alert Sound Control Module

- **If less than 10 ohms**

10. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
11. Test for 5 to 7 V between the test points:Control circuit terminal 1 & Ground
 - **If less than 5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 3. Test for infinite resistance between the test points:Control circuit terminal 1 @Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms between the test points:Control circuit terminal 1 @Component harness & Terminal 9 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K132 Pedestrian Alert Sound Control Module
 - **If greater than 7 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector:K132 Pedestrian Alert Sound Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:Control circuit terminal 1 @Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component:K132 Pedestrian Alert Sound Control Module
- **If between 5 and 7 V**

12. Test or replace the component:P48 Pedestrian Alert Sound Speaker

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Pedestrian Sound Alert Speaker Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - HORNS

Special Tools

- EL-38125-10 Splice Sleeve Crimping Tool (non GMNA)
- J-38125-5A Ultra Torch Special Tool
- J-38125-8 Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

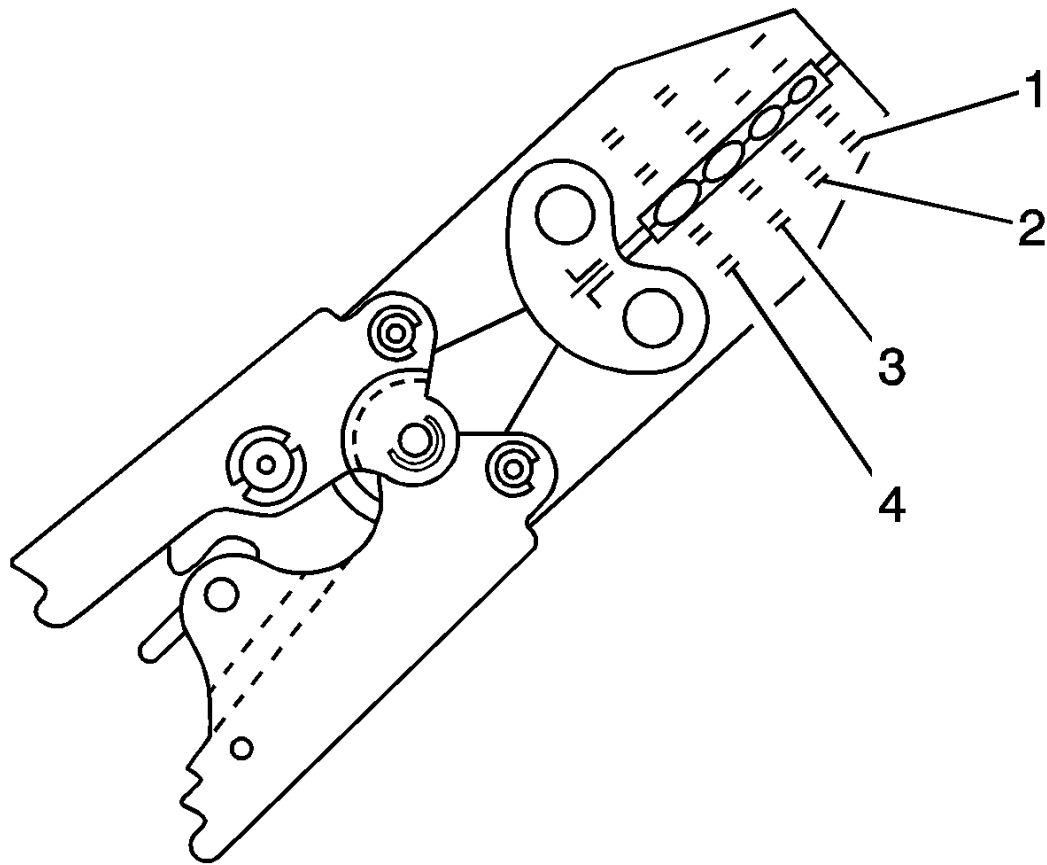


Fig. 2: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

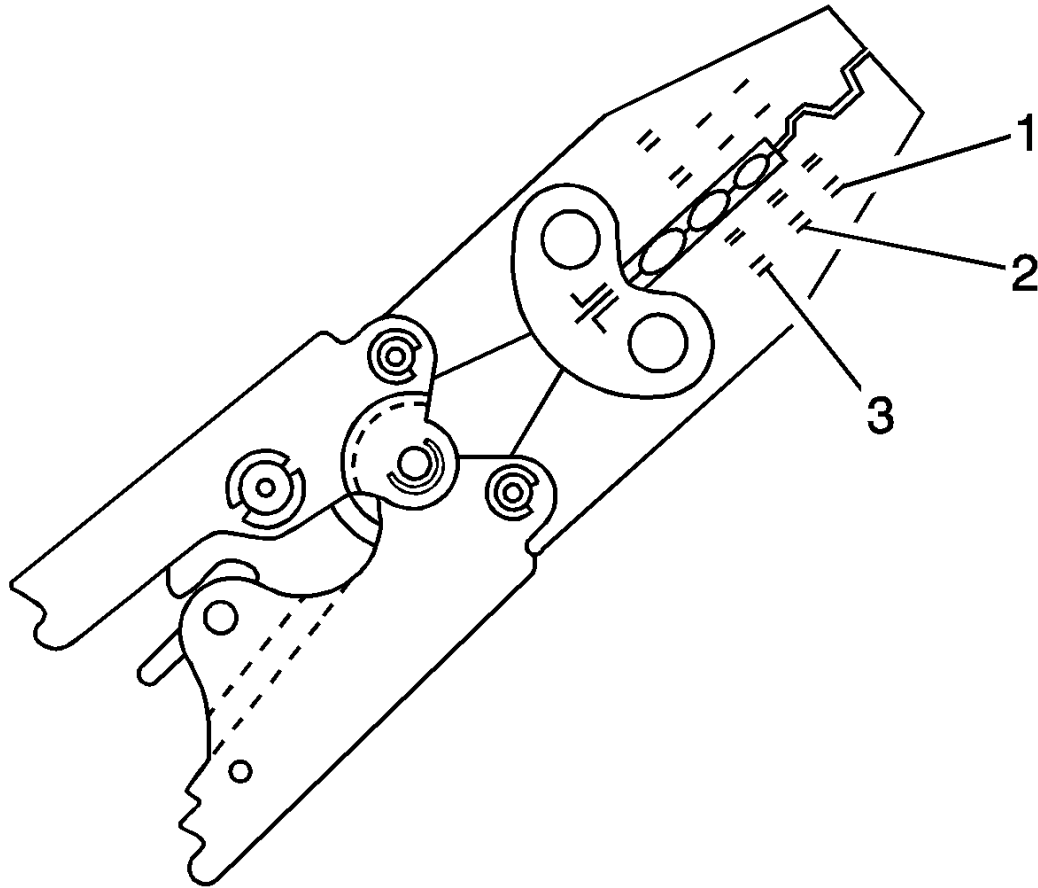


Fig. 3: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

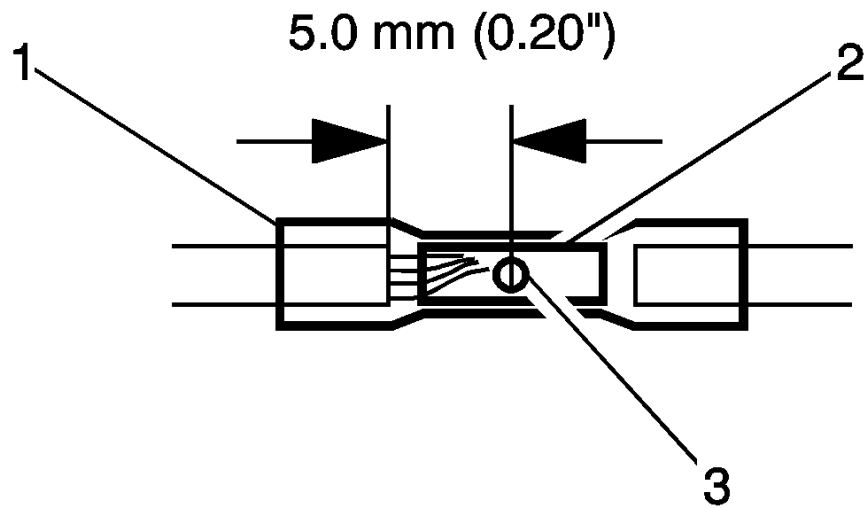


Fig. 4: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 5: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 6: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

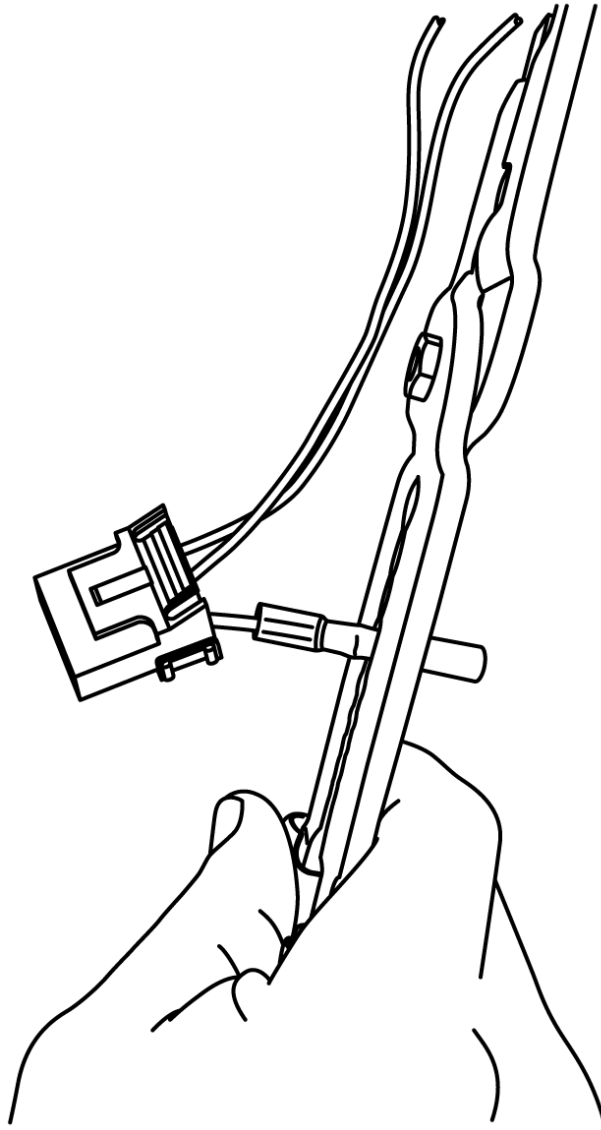


Fig. 7: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

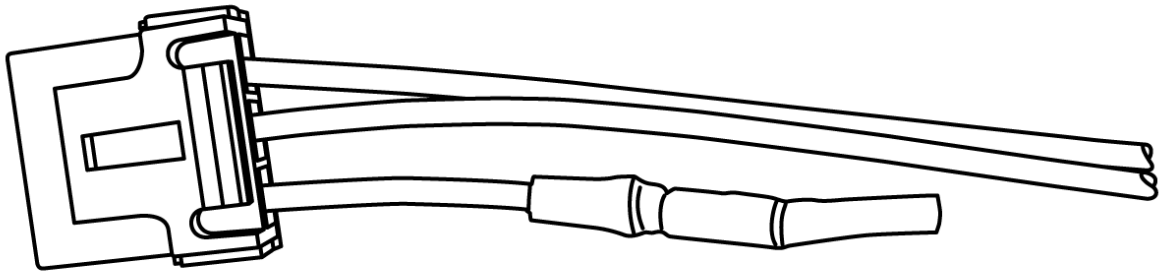


Fig. 8: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

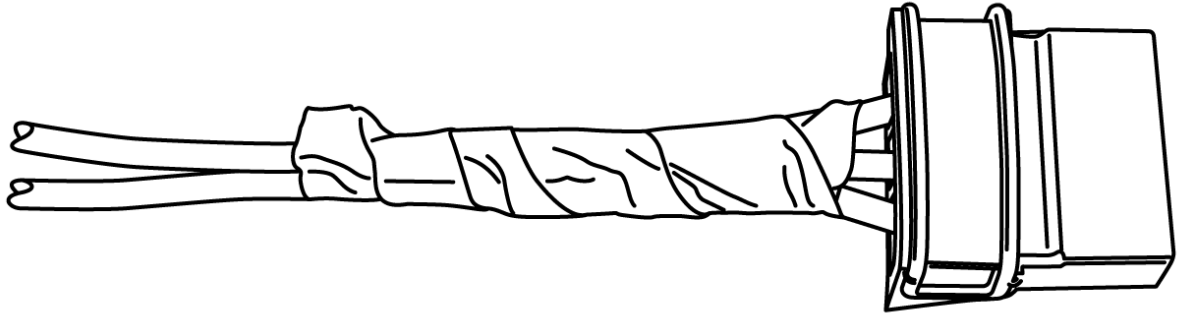


Fig. 9: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - HORNS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

HORN REPLACEMENT

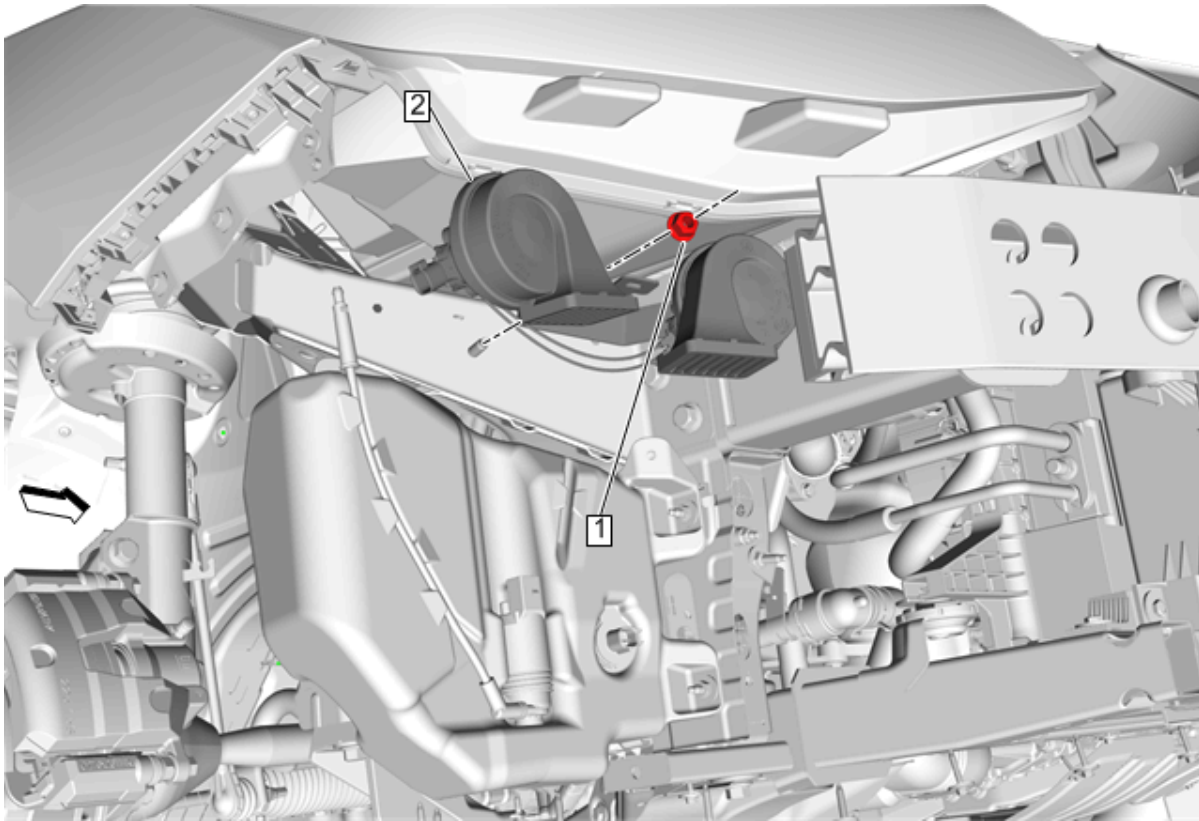


Fig. 10: Horn

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Bumper Fascia Removal and Installation</u>	
1	Horn Nut CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Horn Procedure Disconnect the electrical connector.

STEERING WHEEL HORN CONTACT REPLACEMENT

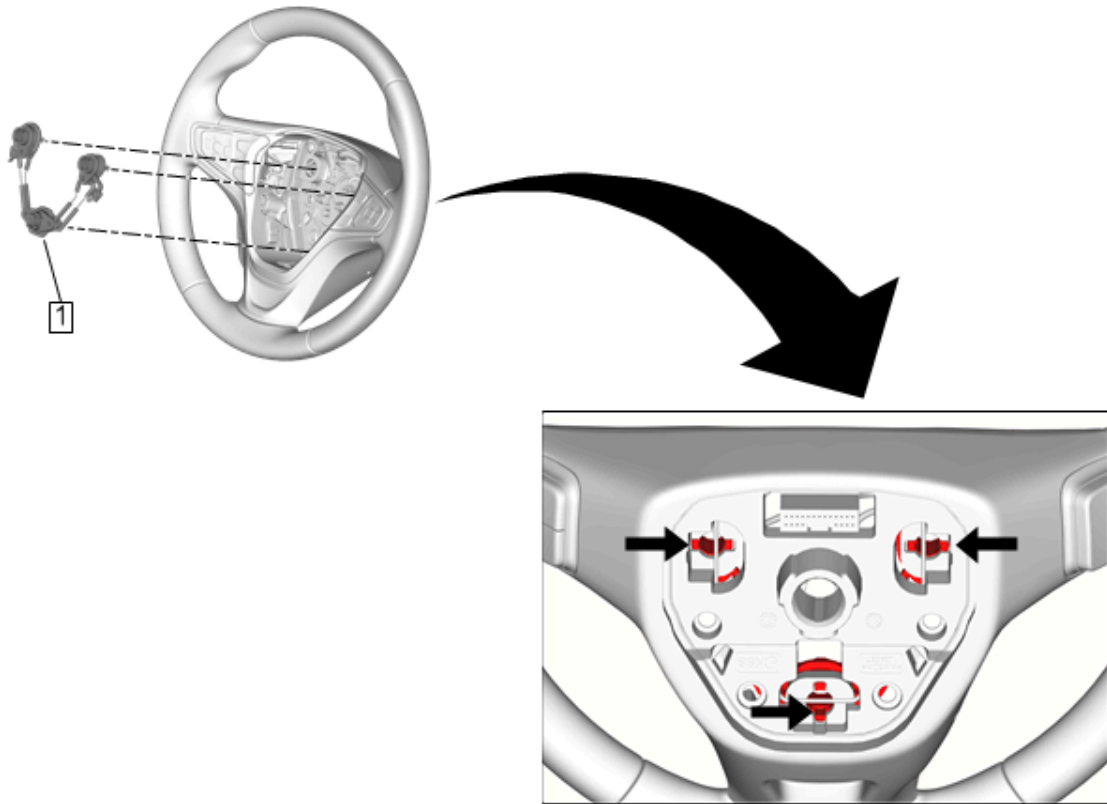


Fig. 11: Steering Wheel Horn Contact

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Steering Wheel Replacement</u>	
1	Steering Wheel Horn Contact Procedure 1. Disconnect the electrical connectors. 2. Release the retaining tabs and remove the steering wheel horn contact from the steering wheel.

PEDESTRIAN SOUND ALERT MODULE REPLACEMENT

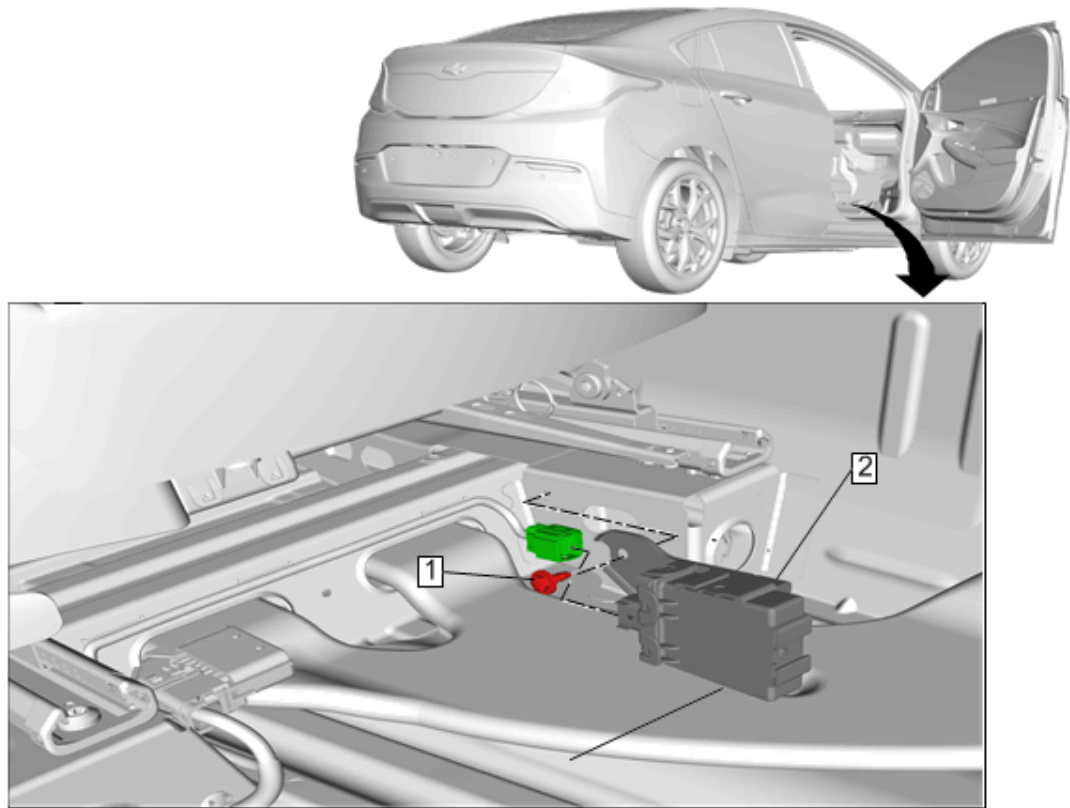


Fig. 12: Pedestrian Sound Alert Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Reposition the right side front seat to gain access to the module. Driver or Passenger Seat Removal and Installation	
NOTE: It is not necessary to remove the seat from the vehicle.	
1	Pedestrian Sound Alert Module Bracket Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

Callout	Component Name
2	Pedestrian Sound Alert Module Procedure 1. Disconnect the electrical connector. 2. Perform the necessary programming and setup procedure: Control Module References

PEDESTRIAN SOUND ALERT SPEAKER REPLACEMENT

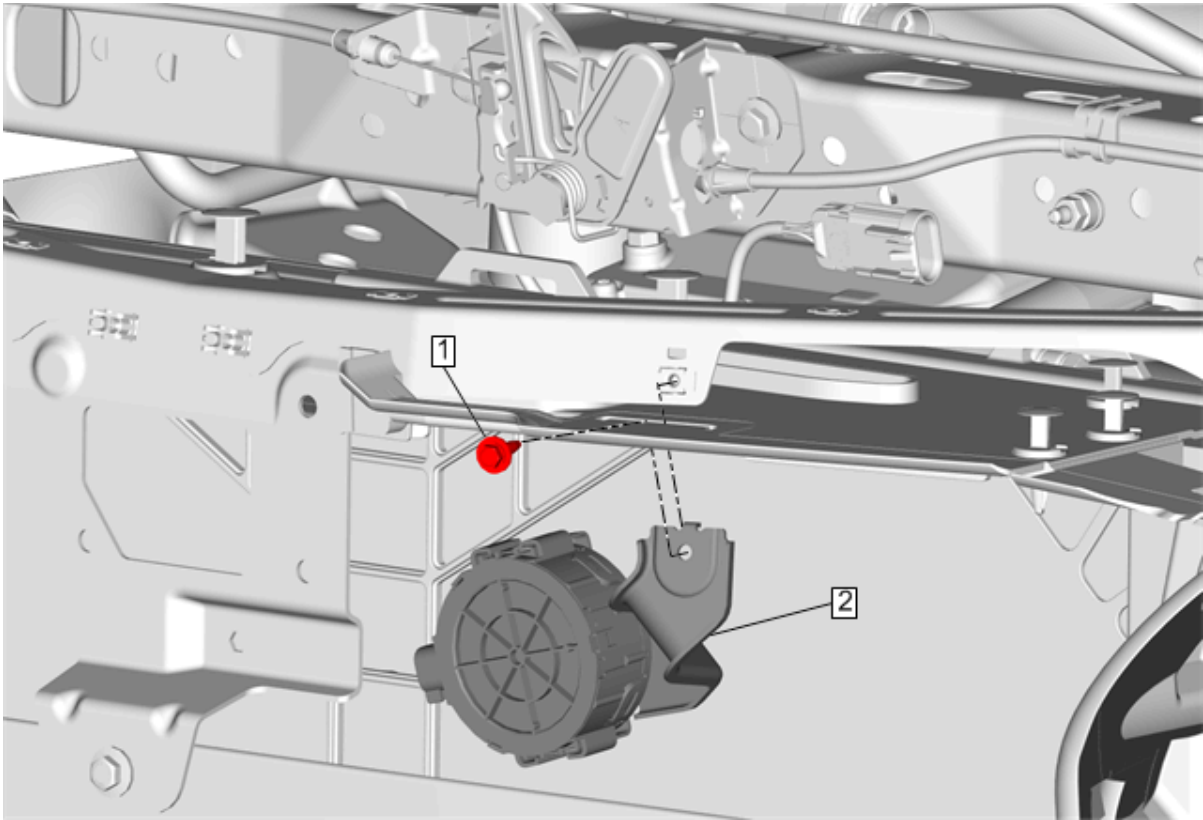


Fig. 13: Pedestrian Sound Alert Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Removal and Installation	
1	Pedestrian Sound Alert Speaker Bolt CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 2.5 N.m (22 lb in)
2	Pedestrian Sound Alert Speaker Procedure Disconnect the electrical connector.

DESCRIPTION AND OPERATION

HORNS SYSTEM DESCRIPTION AND OPERATION

System Description

The horn system consists of the following components:

- HORN fuse
- Underhood fuse block (contains PCB horn relay)
- Horn switch
- Horn-low note
- Horn-high note
- Body control module (BCM)

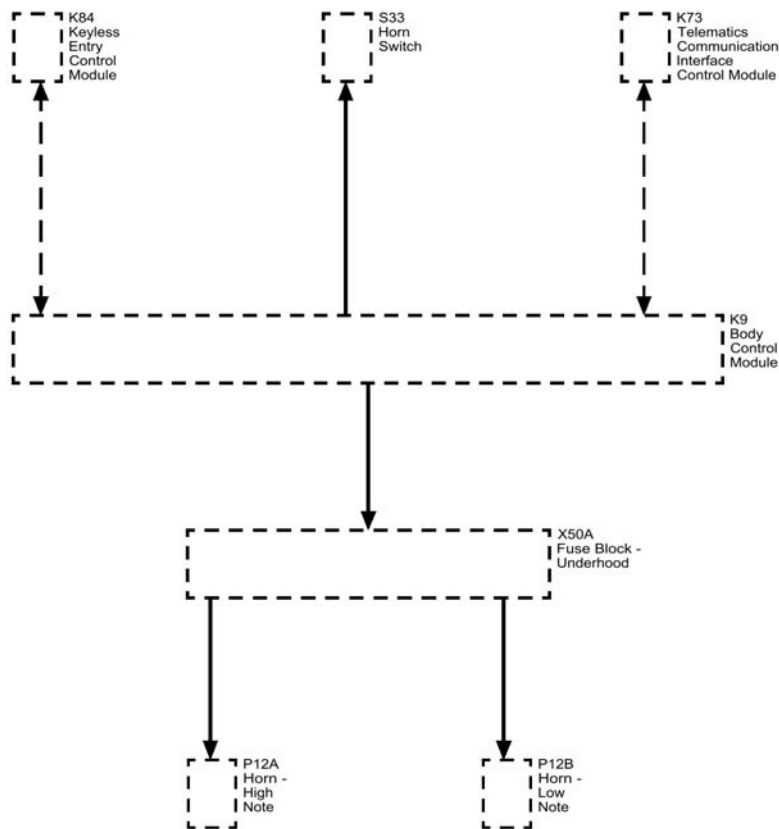


Fig. 14: Horns System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K84	K84 Keyless Entry Control Module
S33	S33 Horn Switch
K73	K73 Telematics Communication Interface Control Module
K9	K9 Body Control Module
X50A	X50A Fuse Block - Underhood
P12A	P12A Horn - High Note
P12B	P12B Horn - Low Note

System Operation

The vehicle horn system is activated under the following conditions:

- When the horn switch is depressed
- The BCM commands the horns ON under any of the following conditions:

- When the content theft deterrent system detects a vehicle intrusion - For further information refer to [Theft Systems Description and Operation](#) .
- When the panic button is depressed on the remote control door lock transmitter - For further information refer to [Keyless Entry System Description and Operation](#) .
- When the keyless entry system is used to lock the vehicle, a horn chirp may sound to notify the driver that the vehicle has been locked. The notification feature may be enabled or disabled through personalization. For further information refer to [Keyless Entry System Description and Operation](#) .
- When the OnStar® system is used to sound the horns if equipped - For further information, refer to [OnStar Description and Operation](#) .

Circuit Operation

Battery positive voltage is applied at all times to the horn relay coil and the horn relay switch. Pressing either of the horn switches applies ground to the horn relay control circuit. The BCM may also apply ground to the horn relay control circuit as described above. When the horn relay control circuit is grounded, the horn relay is energized and battery positive voltage is applied to the horns through the horn control circuit. The horns sound as long as ground is applied to the horn relay control circuit.

PEDESTRIAN ALERT DESCRIPTION AND OPERATION

Electric vehicles present a situation for visually impaired pedestrians who cannot hear an approaching electric vehicle, the pedestrian alert module creates sounds from a dedicated speaker to alert a visually impaired pedestrian, in a non-startling manner.

Operation of the Pedestrian Alert

- Emit sound from 0 to 12 MPH (20 KM/H)
- Fade in and out control for the sound ON and OFF
- Change the pitch of the sound dependent of vehicle speed

Article GUID: A00884702

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Theft Deterrent Module Bolt	1 N.m (9 lb in)

SCHEMATIC WIRING DIAGRAMS

IMMOBILIZER WIRING SCHEMATICS

Immobilizer



Fig. 1: Immobilizer

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B2955: SECURITY SENSOR DATA CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2955 00

Security Sensor Data Circuit Malfunction

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B2955 00	B2955 00	-	-
Serial Data	B2955 00	B2955 00	B2955 00	B2955 00
Low Reference	-	B2955 00	-	-

Circuit/System Description

When a keyless entry transmitter is inserted into the transmitter pocket/slot and the ignition mode switch is pressed, the transponder embedded in the transmitter is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The BCM detects a circuit fault on the immobilizer antenna circuits.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the condition for setting the DTC are no longer present.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K89 Immobilizer Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Verify a test lamp illuminates between the low reference circuit terminal 1 and B+.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Vehicle in Service Mode.

NOTE: In some instances, the K9 Body Control Module may only apply voltage for 3 s immediately after the ignition mode switch is pressed. It may be necessary to monitor the DMM while pressing the ignition mode switch to observe the voltage.

4. Test for greater than 9 V between the ignition circuit terminal 3 and ground.

- **If 9 V or less**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If greater than 9 V**

5. Vehicle in Service Mode.

6. Test for 12 - 13 V between the serial data circuit terminal 2 and ground.

- **If less than 12 V**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If greater than 13 V**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, vehicle ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If within 12 - 13 V**

7. Replace the K89 Immobilizer Control Module.

8. Verify DTC B2955 is not set.

- **If DTC B2955 is set**

Replace the K9 Body Control Module.

- **If DTC B2955 is not set or is set as history**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for body control module or immobilizer control module replacement, programming, and setup

DTC B302A: MOBILE TELEPHONE COMMUNICATIONS INTERFACE REQUESTED IMMOBILIZATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B302A

Mobile Telephone Communications Interface Requested Immobilization

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

As part of the vehicle telematics enhanced services, a request may be sent to the body control module (BCM) to disable vehicle starting. If a valid message is received by the BCM requesting that starting be disabled, the start enable message will not be sent to the engine control module (ECM).

Conditions for Running the DTC

The BCM continuously monitors for this DTC.

Conditions for Setting the DTC

A start disable message has been received from the telematics module.

Action Taken When the DTC Sets

Vehicle starting will be suspended and the security indicator will be illuminated.

Conditions for Clearing the DTC

- A current DTC will clear when the telematics start disable request is no longer received.
- A history DTC will clear after 100 ignition cycles in which the telematic start disable request is not seen.

Diagnostic Aids

- DTC B302A is only an indicator that a start disable request has been received from the vehicle telematics system and does not indicate a fault in the immobilizer or telematics system.
- To remove the start disable request, the vehicle account must be updated with the OnStar stolen vehicle team. This will require that a law enforcement agency or the customer contact OnStar to indicate that the vehicle has been successfully and safely recovered.
- If the OnStar system has been disabled or damaged during a theft attempt, the system will not be able to communicate and the start disable request will not be removed. OnStar must be functioning properly for the start disable request to be removed.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the OnStar system is not damaged and is operating properly, with no DTCs set.
 - **If the OnStar system is damaged, inoperative, or any OnStar DTCs are set**

These concerns must be corrected before the start disable can be removed.
 - **If the OnStar system is not damaged and is operating properly**
2. Press the blue OnStar button and ask the advisor to be transferred to the stolen vehicle team to verify the vehicle account has been updated.
3. Verify that OnStar is aware the vehicle has been recovered and that the vehicle account has been updated.
 - **If OnStar has not been notified that the vehicle has been recovered**

Contact the customer and advise them that for security purposes, they must contact OnStar and the law enforcement agency to update the vehicle account.
 - **If the account has been properly updated**
4. Once the vehicle account has been updated and the start disable request has been removed, DTC B302A will transition to a history DTC. Clear the history DTC.

DTC B3031: SECURITY CONTROLLER IN LEARN MODE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3031

Security Controller In Learn Mode

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When learning a coded key, the body control module (BCM) is placed in learn mode. DTC B3031 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. On some model year vehicles the instructions for adding keys includes the direction to always use two learned keys. This DTC will set if that direction is not followed. If only one learned key is available then Replacing Keys must be performed. Once the coded key is learned, learn mode will be exited and the DTC cleared. If the BCM does not exit learn mode, DTC B3031 will remain current and indicate a fault. The instrument cluster security indicator will illuminate and the driver information center will display a message.

Conditions for Running the DTC

The immobilizer system is the learn coded keys state.

Conditions for Setting the DTC

The DTC will set any time the BCM enters the learn coded keys state.

Action Taken When the DTC Sets

The security indicator will illuminate. The driver information center will display a message.

Conditions for Clearing the DTC

- A current DTC B3031 will be cleared upon the successful exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify all available keys are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.

NOTE: On some model year vehicles two learned keys are required to add additional keys. If only one learned key is used, this DTC will set. If only one learned key is available then Replacing Keys must be performed.

- **If a key is not correct**

Replace the key

- **If all keys are correct**

2. Verify the scan tool Immobilizer data displays two or more keys learned to the vehicle.

- **If not**

Add one additional key

- **If two or more keys are learned to the vehicle**

3. Perform the Replacing Keys procedure. Refer to [Key with Integrated Transmitter Programming](#).

4. Verify the K9 Body Control Module learns the vehicle key and exits the learn coded key state. The scan tool Master Keys Learned parameter should increment to 1.

- **If the K9 Body Control Module does not exit the learn coded key state after the programming attempt**

Replace the K9 Body Control Module

- **If the K9 Body Control Module exits the learn coded key state after the programming attempt**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for body control module replacement, programming, and setup.

DTC B3055: NO TRANSPONDER MODULATION OR NO TRANSPONDER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3055

No Transponder Modulation or No Transponder

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The BCM is unable to measure the key transponder value.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the key.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Diagnostic Aids

- Because DTC B3055 may be caused by a malfunctioning vehicle key, it is necessary to have all available keys at the time of diagnosis. A possible scenario would be a customer leaving the vehicle with a spare key during the service visit, but the key which they use everyday, not the spare key, is the cause of the DTC. Not having all available keys in this instance would result in the customer concern not being duplicate or a misdiagnosis.
- Ensure that the immobilizer control module is properly installed and fully seated. An audible and/or tactile click will indicate that the immobilizer control module is fully seated. To ensure proper transponder communication, the key must be in a specific location in relation to the immobilizer control module. If the immobilizer control module is not fully seated, transponder communication may not occur.

and DTC B3055 will set.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1370, B1380, or B1441 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify all available keys are correct for the vehicle.

- **If a key is not correct**

Replace the key

- **If all keys are correct**

4. Remove the battery from each of the available vehicle keys.
5. Verify that DTC B3055 does not set while attempting to start the vehicle with each available key. To start the vehicle with the key battery removed, the key must be placed in the key slot.

- **If DTC B3055 sets when attempting to start the vehicle with only one of the available keys**

Replace the appropriate key.

- If DTC B3055 sets when attempting to start the vehicle with all of the available keys

Replace the K89 Immobilizer Control Module.

- If DTC B3055 does not set

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for immobilizer control module replacement, programming, and setup

DTC B305C: IMMOBILIZER TRANSPONDER OF WRONG TYPE PROGRAMMED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B305C

Immobilizer Transponder of Wrong Type Programmed

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

When a vehicle key/keyless entry transmitter is inserted into the key slot/transmitter pocket and the vehicle on/off switch is pressed, the transponder embedded in the key/transmitter is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

- Battery voltage is greater than 9 volts
- Transponder authentication has occurred

Conditions for Setting the DTC

- The programmed transponder type does not match the equipped system on the vehicle.
- A transponder used for vehicles without BTM and/or ATH/ATS has been programmed to a vehicle with BTM and/or ATH/ATS.
- A transponder used for vehicles with BTM and/or ATH/ATS has been programmed to a vehicle without BTM and/or ATH/ATS.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a programmed transponder type that matches the equipped system on the vehicle.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Using each vehicle key, attempt to put the vehicle in Service Mode.
2. Verify DTC B305C does not set after each attempt to put the vehicle in Service Mode.
 - **If the DTC sets**

Replace the appropriate key or keyless entry transmitter.
 - **If the DTC does not set**
3. All OK.

DTC B3060: UNPROGRAMMED TRANSPONDER IDENTIFICATION CODE RECEIVED

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3060

Unprogrammed Transponder Identification Code Received

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The transponder value measured by the BCM is incorrect or not learned to the vehicle.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the key.
- A history DTC will be cleared after 100 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Perform the Vehicle Key Relearn procedure. Refer to [Key with Integrated Transmitter Programming](#).
2. Verify the scan tool Key Part Number parameter reads a Key Part Number when turning the vehicle ON with each key.
 - **If a Key Part Number is not read**

Replace the appropriate key.
 - **If a Key Part Number is read with each key**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Key with Integrated Transmitter Programming](#)

DTC B3899: INCORRECT IMMOBILIZER IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3899

Incorrect Immobilizer Identifier Received

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment

identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM), and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3899.

NOTE: When performing the following step, Immobilizer System Component Programming, the module may also need to be reset by using the SPS function Prepare For Removal.

2. Perform the Immobilizer System Component Programming. Refer to [Immobilizer System Component Programming](#).
3. Verify DTC B3899 does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for lock module replacement, programming, and setup.

DTC B389A: ENVIRONMENT IDENTIFICATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B389A

Environment Identification

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The Instrument Cluster, Electronic Brake Control Module, HVAC Control Module, Inflatable Restraint Sensing and Diagnostic Module, engine control module (ECM), and Steering Column Lock Module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect immobilizer identifier was broadcast by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the BCM broadcasts a correct immobilizer identifier.

Diagnostic Aids

If BCM programming is not completed after BCM replacement, the immobilizer identifier will not be learned. If DTC B389A sets immediately after the replacement and programming of a BCM, perform the programming procedure again.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B389A did not set immediately following the replacement and programming of the K9 Body Control Module.
 - **If the DTC set immediately after the replacement and programming of the K9 Body Control**

Module

The immobilizer learn procedure was not properly completed. Perform the BCM immobilizer learn using the body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to [Immobilizer System Component Programming](#).

- **If the DTC did not set immediately after the replacement and programming of the K9 Body Control Module**

2. Verify DTC B3902 is not set in any of the control modules listed below:

- K20 Engine Control Module
- K36 Inflatable Restraint Sensing and Diagnostic Module
- K17 Electronic Brake Control Module
- K33 HVAC Control Module
- P16 Instrument Cluster
- K60 Steering Column Lock Module (if equipped)
- **If DTC B3902 is set in any of the modules**

Refer to [DTC B3902](#).

- **If DTC B3902 is not set in any of the modules**

3. Perform the K9 Body Control Module immobilizer learn using body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to [Immobilizer System Component Programming](#).

4. Verify DTC B389A does not set after programming.

- **If the DTC sets after programming**

Replace the K9 Body Control Module.

- **If the DTC does not set after programming**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for body control module replacement, programming, and setup.

DTC B3902: INCORRECT IMMOBILIZER IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3902

Incorrect Immobilizer Identifier Received

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM), and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3902.

NOTE: When performing the following step, Immobilizer System Component Programming, the module may also need to be reset by using the SPS function Prepare For Removal.

2. Perform the Immobilizer System Component Programming [Immobilizer System Component Programming](#).
3. Verify DTC B3902 does not set after programming.
 - **If the DTC sets after programming**
Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module, or steering column lock module replacement, programming, and setup.

DTC B3924-B3928: INCORRECT ENVIRONMENTAL IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3924

Incorrect Environmental Identifier Received From Inflatable Restraint Sensing and Diagnostic Module

DTC B3925

Incorrect Environmental Identifier Received From HVAC Control Module

DTC B3926

Incorrect Environmental Identifier Received From Instrument Cluster

DTC B3927

Incorrect Environmental Identifier Received From Electronic Brake Control Module

DTC B3928

Incorrect Environmental Identifier Received From Telematics Communication Interface Control Module

For symptom byte information, refer to [Symptom Byte List](#).

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping of control modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, and telematics communication interface control module each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set the DTC.
2. Verify the DTC does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, or telematics communication interface control module replacement, programming, and setup.

DTC B3935: TRANSPONDER AUTHENTICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3935

Transponder Authentication

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils surrounding the key slot. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

- Vehicle is ON or in Service Mode.
- A valid transponder value has been read.

Conditions for Setting the DTC

- The transponder value is valid and matches the value stored in the BCM memory.
- The transponder calculation of the challenge from the BCM does not match the BCM calculation.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when a valid transponder value has been read and authenticated.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Replace the suspected inoperative or malfunctioning key.
2. Verify DTC B3935 is not set as current.
 - **If the DTC is set as current**

Replace the K9 Body Control Module.
 - **If the DTC is set as history**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for body control module replacement, programming, and setup

DTC B3976: UNCONFIGURED TRANSPONDER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3976

Unconfigured Transponder

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils surrounding the key slot. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

- Vehicle is ON or in Service Mode.
- The BCM is in the learn coded key state.

Conditions for Setting the DTC

The BCM has determined the current key is not configured as a proper vehicle key.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a properly configured vehicle key.
- A history DTC will be cleared after 100 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the engine starts with each available key.
 - **If the engine does not start with a key**
Replace the key.
 - **If the engine starts with all keys**
2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC B3978-B3982: INCORRECT ENVIRONMENTAL IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3978

Incorrect Environmental Identifier Received From Inflatable Restraint Sensing and Diagnostic Module

DTC B3979

Incorrect Environmental Identifier Received From HVAC Control Module

DTC B3980

Incorrect Environmental Identifier Received From Instrument Cluster

DTC B3981

Incorrect Environmental Identifier Received From Electronic Brake Control Module

DTC B3982

Incorrect Environmental Identifier Received From Telematics Communication Interface Control Module

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping of control modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic Module, and telematics communication interface control module each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect environment identifier was received by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier and it is received by the BCM.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set the DTC.
2. Verify the DTC does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to [Control Module References](#) for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic Module, or telematics communication interface control module replacement, programming, and setup.

DTC B3984: DEVICE 1 ENVIRONMENT IDENTIFIER NOT PROGRAMMABLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3984

Device 1 Environment Identifier Not Programmable

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM), and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect environment identifier is programmed or no environment identifier is programmed.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3984.
2. Verify DTC B3984 does not set after programming.
 - **If the DTC sets after programming**

Replace the control module that set the DTC.
 - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module, and steering column lock module replacement, programming, and setup.

DTC P0513: IMMOBILIZER KEY INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0513

Immobilizer Key Incorrect

Circuit/System Description

The body control module (BCM) sends the pre - release information to the hybrid/EV powertrain control module 1 via the serial data circuit. The hybrid/EV powertrain control module 1 then sends a challenge to the BCM. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. The engine control module (ECM) also monitors this challenge and calculates it's own result. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

Hybrid/EV Powertrain Control Module 1

The calculated response from the BCM does not equal the calculation performed by the hybrid/EV powertrain control module 1.

Engine Control Module

The calculated response from the BCM does not equal the calculation performed by the ECM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

- A current DTC P0513 will be cleared when a valid calculation is received.
- A history DTC will be cleared after 40 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Diagnostic Aids

The key referenced in the DTC descriptor does not refer to the vehicle key. In this case, key is referring to the challenge response.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K9 Body Control Module immobilizer learn using the Body Control Module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to [Immobilizer System Component Programming](#).
3. Verify the K9 Body Control Module successfully completes the learn procedure and DTC P0513 is not set.
 - **If the K9 Body Control Module does not successfully learn or DTC P0513 is set**

Perform the appropriate immobilizer learn using the IMMO Learn in SPS. Refer to [Immobilizer System Component Programming](#).
 - **If the K9 Body Control Module successfully completes the learn and DTC P0513 is not set**
4. All OK

DTC P0633: IMMOBILIZER KEY NOT PROGRAMMED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0633

Immobilizer Key Not Programmed

Circuit/System Description

When learning the immobilizer data, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. DTC P0633 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. Once the immobilizer data and challenge/response are learned, learn mode will be exited when the engine is successfully started. If the ECM does not exit learn mode, DTC P0633 will remain current and indicate a fault.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

DTC P0633 will set any time the ECM enters learn mode.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: DTC P0633 will clear upon a successful engine start. Any malfunction that will cause a no-start condition will prevent DTC P0633 from clearing. Prior to diagnosing DTC P0633, ensure that all power moding and engine control systems are operating properly and all conditions that may cause a no-start have been corrected. Do not replace the K20 Engine Control Module. Replacing the K20 Engine Control Module will not correct the no-start condition.

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.

- **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no immobilizer DTCs are set in the K9 Body Control Module**

2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to [Immobilizer System Component Programming](#).

3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.

- **If the engine does not start**

An undiagnosed no-start condition exists. Refer to the appropriate subsection and diagnostic to correct the no-start condition.

- **If the engine starts**

4. All OK.

DTC P162B: REMOTE VEHICLE SPEED LIMITING SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P162B

Remote Vehicle Speed Limiting Signal Message Counter Incorrect

Circuit/System Description

When a remote slow-down request is sent from OnStar, the vehicle communication interface control module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match the requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Conditions for Running the DTC

- The engine run time is greater than 5 s

- A remote slow-down request is sent from OnStar

Conditions for Setting the DTC

- The VIN embedded in the slow-down request does not match the VIN stored in the ECM.
- The rolling code counter embedded in the slow-down request does not increment for ten consecutive messages.

Action Taken When the DTC Sets

- ECM ignores all reduced vehicle speed request messages from the vehicle communication interface module.
- The ECM stores DTC P162B in history.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the vehicle is equipped with OnStar (RPO UE1) and DTC P162B is set
 - **If the vehicle is not equipped with OnStar (RPO UE1) and DTC P162B is set**

Replace the ECM.

- **If the vehicle is equipped with OnStar (RPO UE1) and DTC P162B is set**

2. Perform the Remote Vehicle Speed Limiting Reset procedure with the scan tool.

3. Verify DTC P162B is not set.

- **If DTC P162B is set**

1. Reprogram the ECM. Refer to [Control Module References](#) .

2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- If the DTC sets, replace the ECM. If the DTC continues to set after ECM replacement, replace the vehicle communication interface module.
- If the DTC does not set

3. All OK.

- **If DTC P162B is not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for telematics communication interface control module or engine control module replacement, programming, and setup

DTC P1631: IMMOBILIZER FUEL ENABLE SIGNAL NOT CORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1631

Immobilizer Fuel Enable Signal Not Correct

Circuit/System Description

The body control module (BCM) sends the pre - release information to the hybrid/EV powertrain control module 1 via the serial data circuit. The hybrid/EV powertrain control module 1 then sends a challenge to the BCM. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. The engine control module (ECM) also monitors this challenge and calculates it's own result. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

Hybrid/EV Powertrain Control Module 1

The hybrid/EV powertrain control module 1 receives incorrect immobilizer data from the BCM.

Engine Control Module

The ECM receives incorrect immobilizer data from the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC P1631 will be cleared when correct immobilizer data is received.
- A history DTC will be cleared after 40 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If no immobilizer DTCs are set in the K9 Body Control Module**

2. Perform the K9 Body Control Module immobilizer learn using the Body Control Module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to [Immobilizer System Component Programming](#).

3. Verify the K9 Body Control Module successfully completes the learn procedure and DTC P1631 is not set.

- **If the K9 Body Control Module does not successfully learn or DTC P1631 is set**

Perform the appropriate immobilizer learn using the IMMO Learn in SPS. Refer to [Immobilizer System Component Programming](#).

- **If the K9 Body Control Module successfully completes the learn and DTC P1631 is not set**

4. All OK

DTC P1649: IMMOBILIZER SECURITY CODE NOT PROGRAMMED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1649

Immobilizer Security Code Not Programmed

Circuit/System Description

When learning the security code, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. Once the security code and challenge/response are learned, learn mode will be exited when the engine is successfully started.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

The ECM has not learned a security code.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.

- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
 - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.
 - **If the engine does not start**

Replace the K20 Engine Control Module.
 - **If the engine starts**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for engine control module replacement, programming, and setup.

SYMPTOMS - IMMOBILIZER

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to [Immobilizer Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to [OnStar Stolen Vehicle Slowdown Active](#) to diagnose the symptom.

ONSTAR STOLEN VEHICLE SLOWDOWN ACTIVE

Diagnostic Instructions

NOTE: This procedure is not used in Brazil.

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

When a remote slow-down request is sent from OnStar, the Telematics Communication Interface Control Module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Reference Information

Schematic Reference

[OnStar/Telematics Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the vehicle is not in the OnStar initiated Stolen Vehicle Slowdown mode. This can be accomplished by verifying the scan tool Telematics Enhanced Service Immobilization parameter is No.
 - **If the scan tool Telematics Enhanced Service Immobilization parameter is Yes**
 1. Perform the Remote Vehicle Speed Limiting Reset procedure with the scan tool.
 2. Press the blue OnStar button and inform the advisor that you need to be transferred to the stolen vehicle team to update the vehicle account.
 - **If the scan tool BCM Telematics Enhanced Service Immobilization parameter is No**
2. All OK.

REPAIR INSTRUCTIONS

THEFT DETERRENT MODULE REPLACEMENT

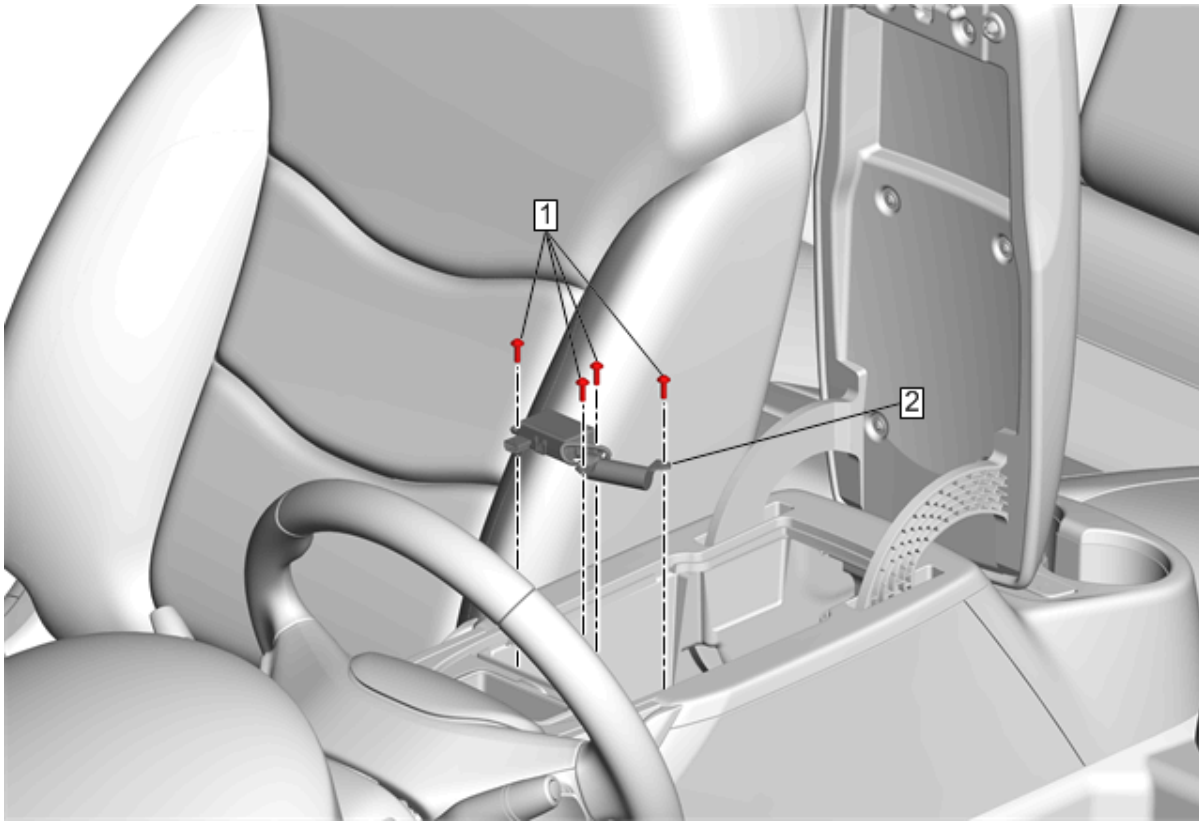


Fig. 2: Theft Deterrent Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Floor Console Compartment Divider. Refer to Front Floor Console Compartment Divider Replacement	
1	Theft Deterrent Module Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 1 N.m (9 lb in)
2	Theft Deterrent Module Procedure 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and set up procedures, if required.

IMMOBILIZER SYSTEM COMPONENT PROGRAMMING

This procedure will learn the immobilizer function. If the battery voltage is low, charge the battery before proceeding with the learn. If the body control module (BCM), power inverter module (PIM), or engine control module (ECM) have been replaced, they must be programmed before performing this learn procedure.

Depending on the immobilizer function being learned or the component replaced, different learn functions are required to be performed. These learn functions are as follows:

Function name on SPS tool:	Function description:	When the function should be used:	Notes:
Body Control Module IMMO Function with Existing Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while reusing the existing vehicle keys	The BCM has been replaced and the existing vehicle keys are being reused or a diagnostic has instructed to perform the learn	-
Body Control Module IMMO Function with New Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while using new vehicle keys	The BCM has been replaced and new vehicle keys are being reused	-
Engine Control Module and Power Inverter Module IMMO Learn	The ECM and PIM will relearn the immobilizer passwords and data	The ECM or PIM has been replaced or a diagnostic has instructed to perform the learn	-
Engine Control Module, Power Inverter Module, and Body Control Module IMMO Learn	The ECM, PIM, and BCM will learn new immobilizer passwords and data	The ECM, PIM, and BCM have been replaced (this selection will REQUIRE new vehicle keys be used)	Because both the ECM and BCM have been replaced and are learning new immobilizer passwords and data, all vehicle keys must also be replaced
Program Transponder or Remote Key (Add)	A new vehicle key will learn the immobilizer passwords and data	A new vehicle key is being added (does not affect other vehicle keys)	This function may not be available in all sales regions
Program Transponder or Remote Key (Delete)	All existing vehicle keys will be invalidated and any desired keys are relearned	All vehicle keys are desired to be invalidated and certain keys relearned or a diagnostic has instructed to perform the learn	This procedure may be used if a customer has had their keys lost or stolen and wishes to invalidate the keys, making them unable to start the vehicle

1. Connect a scan tool to the vehicle and access SPS.
2. Vehicle in Service Mode, engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.

4. Select SPS application and follow the on-screen instructions.
5. Select Reprogram ECU.
6. Select IMMO Immobilizer Learn - Setup.
7. Select the appropriate programming function based on the component that was replaced or is being programmed. Refer to the table at the top of this document for assistance in choosing the correct programming function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle is actually in the Service Mode before continuing on the SPS terminal. If the vehicle is not in the Service Mode, the learn procedure will fail.**
- **The transmitter slot is located in the bottom of the center console storage compartment. The rubber mat lining the bottom of the compartment needs to be removed to access the slot.**

8. Follow the on-screen instructions.

NOTE:

If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.

9. After programming all keys "Programming Complete" is displayed.
10. Press and hold the vehicle ON/OFF switch for 15 s.
11. Press the lock and unlock button on each transmitter that was programmed. This will awaken each transmitter and allow passive and active keyless entry functions to be established.
12. With a scan tool, clear any DTCs.
13. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Unable to Complete Programming

When attempting to program immobilizer components, various conditions may prevent the programming operation from completing. These conditions may be caused by normal system operation, a system malfunction, or an external influence. Common symptoms of a incomplete programming is receiving an error message during the attempt or having the SPS application become unresponsive.

- DTCs are set in the body control module (BCM)

The immobilizer system is a function of the BCM software. If immobilizer DTCs are set in the BCM, such as DTC B2955, a fault has been identified in the immobilizer system. If this is not corrected before attempting to program components, the programming may not complete. Correct all immobilizer DTCs before attempting to program any immobilizer components.

- The key has been programmed to another vehicle or is not the correct type for the vehicle

A key can only be programmed to a single vehicle. Once a key is programming to a vehicle, it is paired for the life of the key. The key can be learned to the same vehicle again and again, but it is not able to be

programmed to a different vehicle.

Many vehicle are available with both a base keyless entry system and an optional passive entry system. These keys typically look identical but cannot be substituted for one another. To verify the key is correct, compare the part number that is etched on the key to the part number identified in the parts catalog. The key should be correct for the system installed in the vehicle.

- The theft deterrent module is not properly secured or the key is not properly positioned in the pocket/slot.

A theft deterrent module that is not fully seated or is otherwise not properly secured may prevent a coupling between the transponder located in the key and the theft deterrent module. Being out of place by as little as 1 mm may prevent programming from completing. Make sure the theft deterrent module is properly installed and fully seated in it's clip.

The key shank must be fully extended so that the entire key shank fits into the programming slot.

To determine if the theft deterrent module is properly secured, remove the battery from the key and place the key into the pocket/slot. Attempt to change the vehicle mode by pressing the vehicle ON/OFF switch. The vehicle should change modes. If the NO REMOTE DETECTED message is displayed on the DIC, the theft deterrent module may not be properly secured.

- External interference is interrupting the programming operation

External RF interference and EMI may interrupt the low frequency coupling between the key and theft deterrent module. This interference may come from many different locations. Devices plugged into the vehicle power outlets such as cell phone chargers, laptop computers, GPS devices, etc. may cause interference. Vehicle location may also cause interference. Locations near airports and military installations may causer interference. Remove all customer installed devices and, if necessary, move the vehicle if interference is suspected.

KEY WITH INTEGRATED TRANSMITTER PROGRAMMING

Keys can be programming in various ways using the procedures outlined below. Using the Replacing Keys procedures will first erase all the known keys from the vehicle. Any existing keys and any new keys will then be programmed. This procedure should be used any time a key is required to be unlearned or erased from a vehicle. If a new key is being learned to a vehicle to replace a damaged, inoperative, or stolen key, the Replacing Keys procedure must be used. This ensures that the old key cannot be used to access or start the vehicle after programming.

The Adding Keys procedure does not erase any keys prior to programming. The procedure will simply program the key into the next available slot. The Adding Keys procedure should only be used when adding an additional key to the vehicle. The Adding Keys procedure should never be used to program a key to a vehicle that is having a key replaced, regardless of the cause for the replacement.

Replacing Keys (Without SPS)

NOTE:

- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
- **A total of seven keys maybe be learned to a single vehicle with one**

additional key only partially learned as it must remain in the key pocket during the procedure.

- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **This procedure may be used with or without existing learned keys being present. If existing keys are present, keep the keys away from the vicinity of the vehicle. Failure to keep learned keys away from the vehicle will result in the learn changing to the Adding Keys procedure.**
- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Remote Learn Pending, Please Wait.
2. After ten minutes, the DIC will display Press Engine Start Button To Learn. Press the vehicle ON/OFF switch. The DIC will again display Remote Learn Pending, Please Wait.
3. Repeat Step 2 two additional times, for a total of thirty minutes. All previously known keys have now been unlearned. Remaining keys can be relearned during the next steps. The DIC display will now display Ready For Remote # 1.

NOTE: **The key slot is located on the bottom of the center console storage compartment. The rubber mat lining the bottom of the compartment needs to be removed to access the slot.**

4. Remove the rubber mat in the instrument panel storage compartment. Extend the key blade on the new key and insert the key into the key slot.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

5. Press the vehicle ON/OFF switch. When the key is learned the DIC will indicate that it is ready to program the next key.
6. Remove the key from the key pocket and press the unlock button. To program additional keys, repeat Steps 4 through 6.
7. When all additional keys are programmed, press and hold the vehicle ON/OFF switch for 5 seconds to exit programming mode.

Replacing Keys (With SPS)

- NOTE:**
- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
 - **This procedure may be used with or without existing learned keys being present.**
 - **A total of seven keys may be learned to a single vehicle with one**

additional key only partially learned as it must remain in the key pocket during the procedure.

- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Delete) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle is actually in the Service Mode before continuing on the SPS terminal. If the vehicle is not in the Service Mode, the learn procedure will fail.**
- **The key slot is located on the bottom of the center console storage compartment. The rubber mat lining the bottom of the compartment needs to be removed to access the slot.**

7. Follow the on-screen instructions.

NOTE:

If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.

8. After programming all keys, Programming Complete, is displayed.
9. Press and hold the vehicle ON/OFF switch for 15 seconds.
10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Adding Keys (Without SPS)

NOTE:

- **To initiate, this procedure requires that 2 learned keys be available.**
- **A total of seven keys maybe be learned to a single vehicle with one additional key only partially learned as it must remain in the key pocket during the procedure.**
- **This procedure adds keys only. The procedure does not erase previously**

learned keys.

- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Place the recognized keys in the vehicle cupholder.
2. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Ready For Remote #2, 3, 4 or 5.

NOTE: **The key slot is located on the bottom of the center console storage compartment. The rubber mat lining the bottom of the compartment needs to be removed to access the slot.**

3. Remove the rubber mat in the instrument panel storage compartment. Extend the key blade on the new key and insert the key into the key slot.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

4. Press and hold the vehicle ON/OFF switch for two seconds. When the key is programmed, the DIC will show that it is ready to program the next key.
5. Remove the key from the slot and press the unlock button. To program additional keys, repeat Steps 3 through 5.
6. When all additional keys are programmed, press and hold the vehicle ON/OFF switch for 10 seconds to exit programming mode.

Adding Keys (With SPS)

- NOTE:**
- **This procedure may be used with or without existing learned keys being present.**
 - **A total of seven keys maybe be learned to a single vehicle with one additional key only partially learned as it must remain in the key pocket during the procedure.**
 - **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
 - **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.

6. Select the Program Transponder or Remote Key (Add) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle is actually in the Service Mode before continuing on the SPS terminal. If the vehicle is not in the Service Mode, the learn procedure will fail.**
- **The key slot is located on the bottom of the center console storage compartment. The rubber mat lining the bottom of the compartment needs to be removed to access the slot.**

7. Follow the on-screen instructions.

NOTE:

If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.

8. After programming all keys, Programming Complete, is displayed.

9. Press and hold the vehicle ON/OFF switch for 15 seconds.

10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.

11. With a scan tool, clear any DTCs.

12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Unable to Complete Programming

When attempting to program immobilizer components, various conditions may prevent the programming operation from completing. These conditions may be caused by normal system operation, a system malfunction, or an external influence. Common symptoms of a incomplete programming is receiving an error message during the attempt or having the SPS application become unresponsive.

- DTCs are set in the body control module (BCM)

The immobilizer system is a function of the BCM software. If immobilizer DTCs are set in the BCM, such as DTC B2955, a fault has been identified in the immobilizer system. If this is not corrected before attempting to program components, the programming may not complete. Correct all immobilizer DTCs before attempting to program any immobilizer components.

- The key has been programmed to another vehicle or is not the correct type for the vehicle

A key can only be programmed to a single vehicle. Once a key is programming to a vehicle, it is paired for the life of the key. The key can be learned to the same vehicle again and again, but it is not able to be programmed to a different vehicle.

Many vehicle are available with both a base keyless entry system and an optional passive entry system. These keys typically look identical but cannot be substituted for one another. To verify the key is correct, compare the part number that is etched on the key to the part number identified in the parts catalog. The key should be correct for the system installed in the vehicle.

- The theft deterrent module is not properly secured or the key is not properly positioned in the pocket/slot.

A theft deterrent module that is not fully seated or is otherwise not properly secured may prevent a coupling between the transponder located in the key and the theft deterrent module. Being out of place by as little as 1 mm may prevent programming from completing. Make sure the theft deterrent module is properly installed and fully seated in its clip.

The key shank must be fully extended so that the entire key shank fits into the programming slot.

To determine if the theft deterrent module is properly secured, remove the battery from the key and place the key into the pocket/slot. Attempt to change the vehicle mode by pressing the vehicle ON/OFF switch. The vehicle should change modes. If the NO REMOTE DETECTED message is displayed on the DIC, the theft deterrent module may not be properly secured.

- External interference is interrupting the programming operation

External RF interference and EMI may interrupt the low frequency coupling between the key and theft deterrent module. This interference may come from many different locations. Devices plugged into the vehicle power outlets such as cell phone chargers, laptop computers, GPS devices, etc. may cause interference. Vehicle location may also cause interference. Locations near airports and military installations may cause interference. Remove all customer installed devices and, if necessary, move the vehicle if interference is suspected.

DESCRIPTION AND OPERATION

IMMOBILIZER DESCRIPTION AND OPERATION

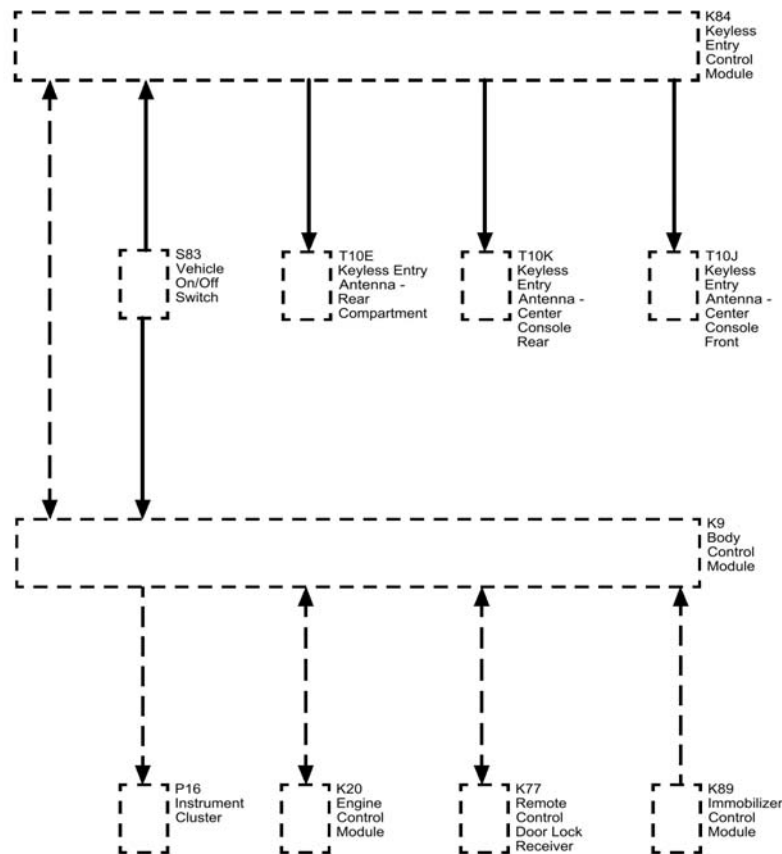


Fig. 3: Immobilizer System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

The immobilizer system functions are provided by the keyless entry control module, remote control door lock receiver, body control module (BCM), hybrid/EV powertrain control module 1, and engine control module (ECM), as well as any modules which store and report the environment identifier. The keyless start system use low frequency antennas in three different locations on the vehicle to determine the location of the transmitter. Multiple antenna are used to ensure complete coverage of the vehicle interior and rear compartment.

When the vehicle ON/OFF switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits it's response as an RF message. The transmitter transmits a signal that contains its unique value, which is received by the BCM through the remote control door lock receiver. The BCM then compares this value to a value stored in memory. The BCM also monitors various modules to determine if the stored environment identifiers match.

If both the environment identifier and the value received from the transponder match, the BCM will send the prerelease password via serial data to the hybrid/EV powertrain control module 1. If the encrypted code's unique value is incorrect or the environment identifier does not match, the BCM will send the fuel disable message to the hybrid/EV powertrain control module 1.

When the hybrid/EV powertrain control module 1 receives the BCM prerelease password, the hybrid/EV powertrain control module 1 will challenge the password. The hybrid/EV powertrain control module 1 sends this challenge to the BCM via serial data. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. Additionally, the ECM will also monitor this challenge and calculate its own response. If the BCM calculated response to the challenge equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

If RF communication is interrupted, a "No Remote Detected" message will be displayed on the DIC. In these cases, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat. The immobilizer antenna coil is located directly beneath the transmitter slot. Placing the transmitter in the pocket will create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The components of the theft system are as follows:

- BCM
- Hybrid/EV powertrain control module 1
- ECM
- Immobilizer antenna
- Ignition key or keyless entry transmitter
- Security indicator
- Various modules which store and report the environment identifier

Body Control Module (BCM)

The immobilizer system is an integral part of the BCM and is controlled internally within the BCM. The BCM can learn up to 8 keys (transponder values).

The BCM uses the following inputs:

- Environment identifier exchange with various modules
- Encrypted code from the vehicle key, received by the immobilizer antenna

The BCM uses the following outputs:

- Prerelease password communication with ECM
- Challenge/response with ECM

When the vehicle ON/OFF switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits its response as an RF message. The transmitter transmits a signal that contains its unique value, which is received by the BCM through the remote control door lock receiver. The BCM then compares this value to a value stored in memory. The BCM then performs one of the following functions:

- If the encrypted code value matches the values stored in the BCM memory, the BCM will send the prerelease password to the ECM via serial data.
- If the encrypted code unique value does not match the value stored in the BCM, the BCM will send the

start disable message to the ECM via serial data.

- If the BCM is unable to measure the ignition key encrypted code value, the BCM will not send any messages to the ECM.

Hybrid/EV Powertrain Control Module 1

When the hybrid/EV powertrain control module 1 receives the BCM prerelease password, the hybrid/EV powertrain control module 1 will challenge the password. The hybrid/EV powertrain control module 1 sends this challenge to the BCM via the serial data circuit. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1, the hybrid/EV powertrain control module 1 will allow vehicle propulsion.

The hybrid/EV powertrain control module 1 will disable vehicle propulsion if any of the following immobilization conditions occur:

- The prerelease password is invalid.
- The start disable password is sent by the BCM.
- No passwords are received. There is no communication with the BCM.
- The BCM calculated response to the challenge does not equal the calculation performed by the hybrid/EV powertrain control module 1.

Engine Control Module (ECM)

The ECM functions in the immobilizer system as a type of slave device. It does not generate the password challenge, but it does monitor the challenge and response messages between the BCM and hybrid/EV powertrain control module 1. The ECM will calculate its own result to the challenge. If the ECM response does not equal the BCM response, the ECM may also disable vehicle propulsion. To allow vehicle propulsion, the response from the BCM, ECM, and hybrid/EV powertrain control module 1 must all match.

The ECM will disable vehicle propulsion if any of the following immobilization conditions occur:

- The start disable password is sent by the BCM.
- No passwords are received. There is no communication with the BCM or hybrid/EV powertrain control module 1.
- The BCM calculated response to the challenge does not equal the calculation performed by the ECM.

Immobilizer Antenna

The immobilizer antenna contains an immobilizer coil. The coil passively powers the transponder located in the ignition key when the key is in the transmitter slot. When powered, the key transmits its unique value to the immobilizer antenna, which is then relayed to the BCM via a LIN serial data circuit. The immobilizer antenna also receives B+ and ground from the BCM.

The immobilizer antenna is used to:

1. Learn keys
2. To start vehicle with or without RF interference

3. To start vehicle when key battery is dead

Keyless Entry Transmitter

Each keyless entry transmitter contains a transponder with a unique encrypted value. The transponder's encrypted value is fixed and unable to be changed. The immobilizer system uses the transponder value to determine if a valid transmitter is being used to start the vehicle.

Environment Identifier

Various modules throughout the vehicle learn a specific environment identifier during the module programming process. The environment identifier is learned by each individual module and matches the environment identifier stored in the BCM. Prior to starting after a battery disconnect, each of the modules which store an environment identifier will compare their identifier to that of the identifier stored in the BCM. If all the identifiers match, the engine starting process will continue. If the environment identifiers do not match, engine starting will be disabled.

Security Indicator

The BCM will command the instrument panel cluster to illuminate the security indicator when the vehicle is in Service Mode to indicate a fault has occurred within the immobilizer system and when the engine starting is disabled.

REMOTE VEHICLE SPEED LIMITING DESCRIPTION AND OPERATION

Certain vehicles equipped with OnStar® now have an additional feature that allows for remote limiting of the vehicle's speed. This OnStar® feature is called Stolen Vehicle Slow-Down and is now part of the OnStar® Stolen Vehicle Assistance service. This feature, when used in conjunction with local law enforcement and strict guidelines at the OnStar® Call Center, will slow the vehicle by interacting with the engine control system.

When the engine control system receives a valid request from the OnStar® telematics communications interface module, it will enter into a reduced engine power/vehicle speed limiting mode, which will decelerate the vehicle. Once the request is active the engine control module begins reducing engine torque to match requested vehicle speed and a REDUCED ENGINE POWER indication is displayed. No DTCs will be set during this process.

Article GUID: A00884720

ACCESSORIES & EQUIPMENT

Instrument Panel and Console Trim - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake Pedal Bolt	22 N.m (16 lb ft)
Data Link Connector Bolt	2.5 N.m (22 lb in)
Front Floor Console Armrest Bolt	2 N.m (18 lb in)
Front Floor Console Bolt	9 N.m (80 lb in)
Front Floor Console Bracket Bolt	9 N.m (80 lb in)
Front Floor Console Cup Holder Bolt	2.5 N.m (22 lb in)
Front Floor Console Rear Cover Bolt	1 N.m (9 lb in)
Front Floor Console Retainer Bolt	9 N.m (80 lb in)
Heater and Air Conditioning Evaporator and Blower Module Bolt	5 N.m (44 lb in)
Heater and Air Conditioning Evaporator and Blower Module Nut	5 N.m (44 lb in)
Heater and Air Conditioning Evaporator Module Bolt	5 N.m (44 lb in)
Instrument Panel Airbag Bolt	9 N.m (80 lb in)
Instrument Panel Bolt	2.5 N.m (22 lb in)
Instrument Panel Bolt - Tie Bar	22 N.m (16 lb ft)
Instrument Panel Center Support Bracket Nut	22 N.m (16 lb ft)
Instrument Panel Cluster Trim Plate Bolt	2.5 N.m (22 lb in)
Instrument Panel Compartment Bolt	2.5 N.m (22 lb in)
Instrument Panel Knee Bolster Bolt	2.5 N.m (22 lb in)
Instrument Panel Lower Airbag Nut	9 N.m (80 lb in)
Instrument Panel Lower Trim Panel Bolt	1.5 N.m (13 lb in)
Instrument Panel Switch Trim Plate Bolt	2.5 N.m (22 lb in)
Instrument Panel Tie Bar Brace Bolt	22 N.m (16 lb ft)
Instrument Panel Tie Bar Reinforcement Bolt	22 N.m (16 lb ft)
Instrument Panel Upper Bolt	22 N.m (16 lb ft)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Wiring Harness Ground Nut	2.5 N.m (22 lb in)

REPAIR INSTRUCTIONS

INSTRUMENT PANEL LOWER TRIM PANEL INSULATOR REPLACEMENT

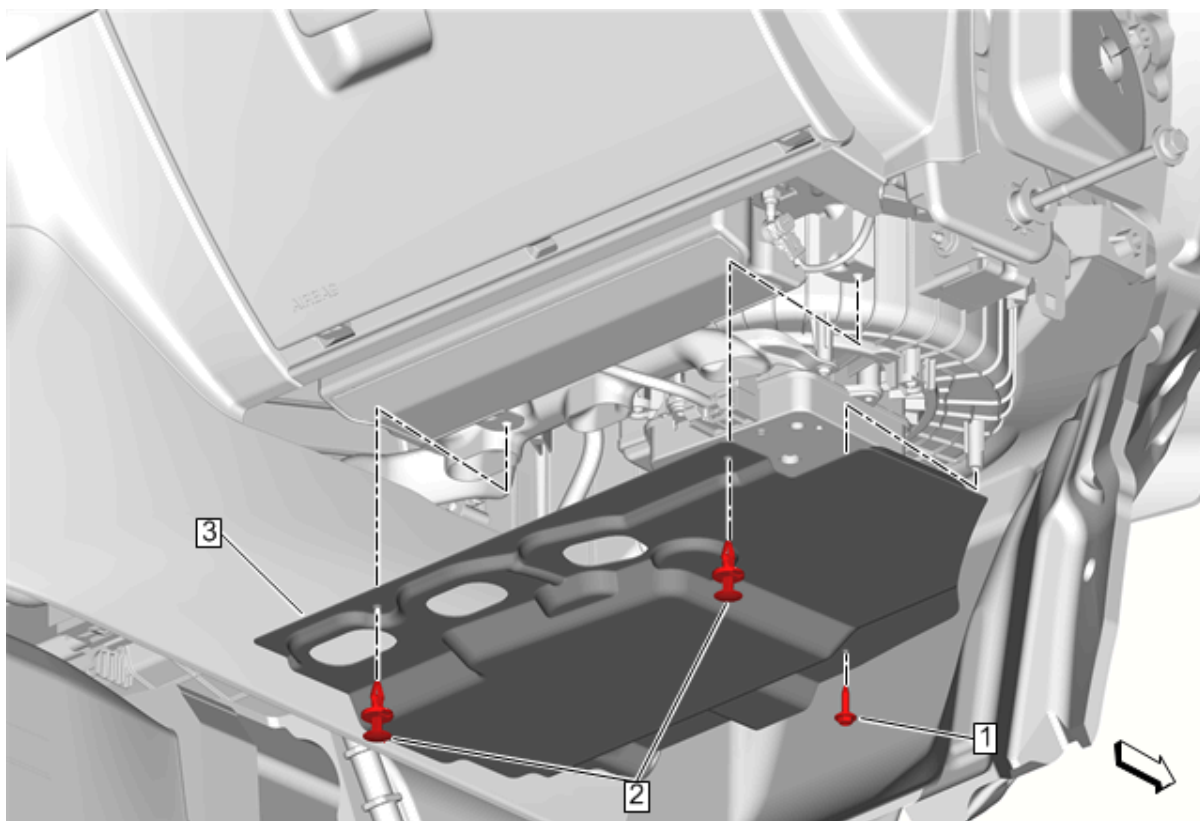


Fig. 1: Instrument Panel Lower Trim Panel Insulator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedure SIR Disabling and Enabling	
1	Instrument Panel Lower Trim Panel Bolt

Callout	Component Name
	CAUTION: Refer to Fastener Caution . 1.5 N.m (13 lb in)
2	Instrument Panel Lower Insulator Retainer (Qty: 2) Procedure Use a flat bladed plastic tool to remove the push-in retainers.
3	Instrument Panel Lower Trim Panel Insulator

INSTRUMENT PANEL SWITCH TRIM PLATE REPLACEMENT

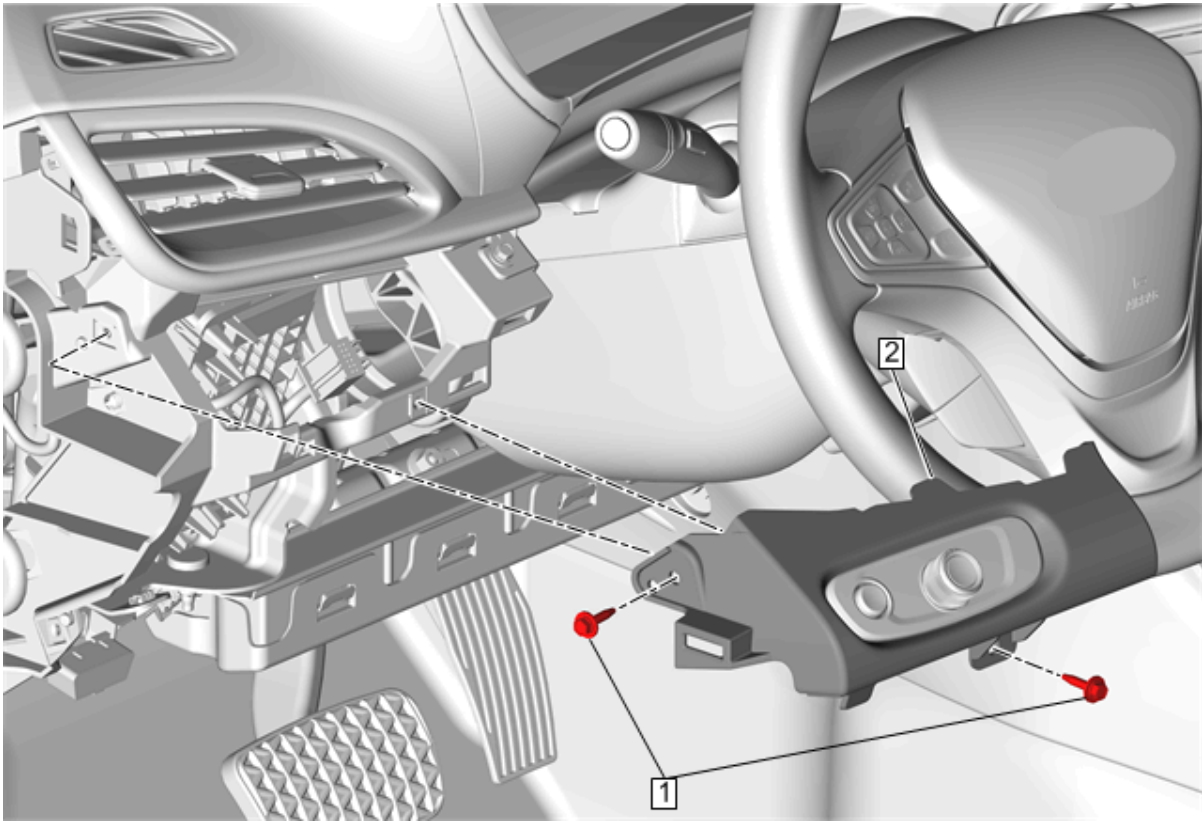


Fig. 2: Instrument Panel Switch Trim Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Knee Bolster Replacement	
1	Instrument Panel Switch Trim Plate Bolt (Qty: 2) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 2.5 N.m (22 lb in)
2	Instrument Panel Switch Trim Plate Procedure 1. Disconnect all electrical connectors. 2. Transfer components as necessary.

INSTRUMENT PANEL EXTENSION REPLACEMENT

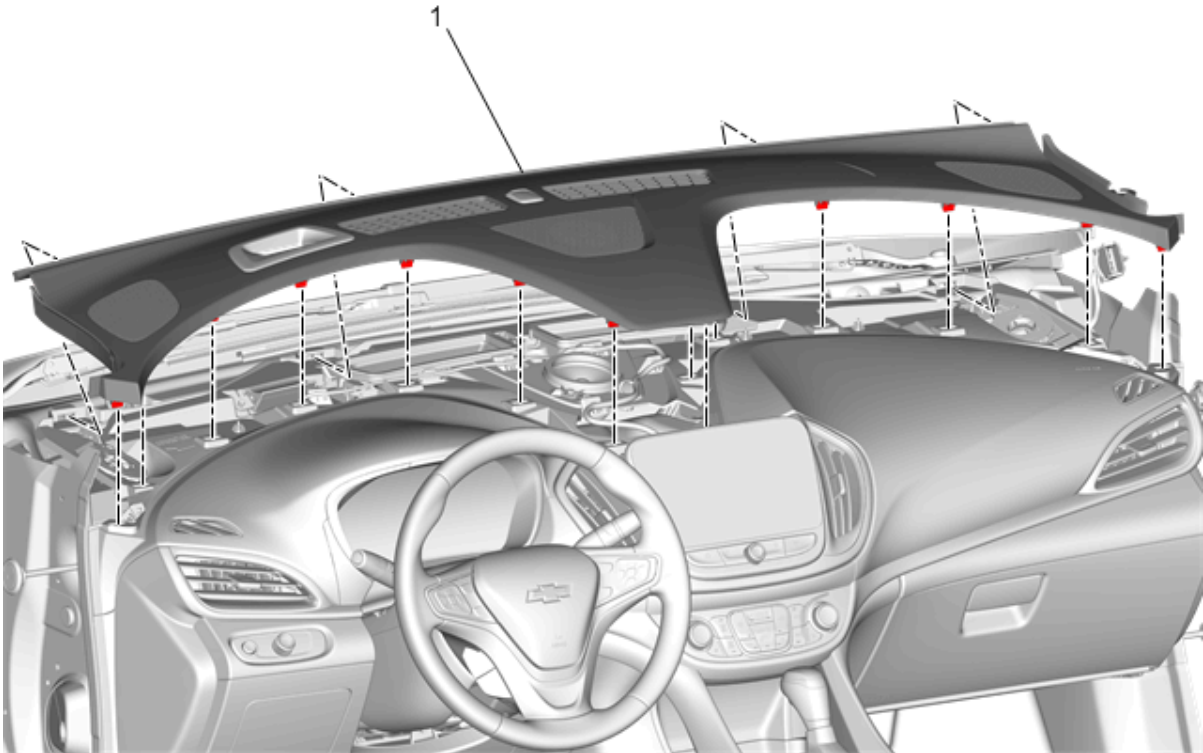


Fig. 3: Instrument Panel Extension
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Windshield Garnish Molding Replacement	
1	Instrument Panel Extension Procedure 1. Use a flat bladed plastic trim tool. 2. Disconnect electrical connections, if applicable.

Callout	Component Name
	3. Transfer components as necessary.

INSTRUMENT PANEL KNEE BOLSTER REPLACEMENT

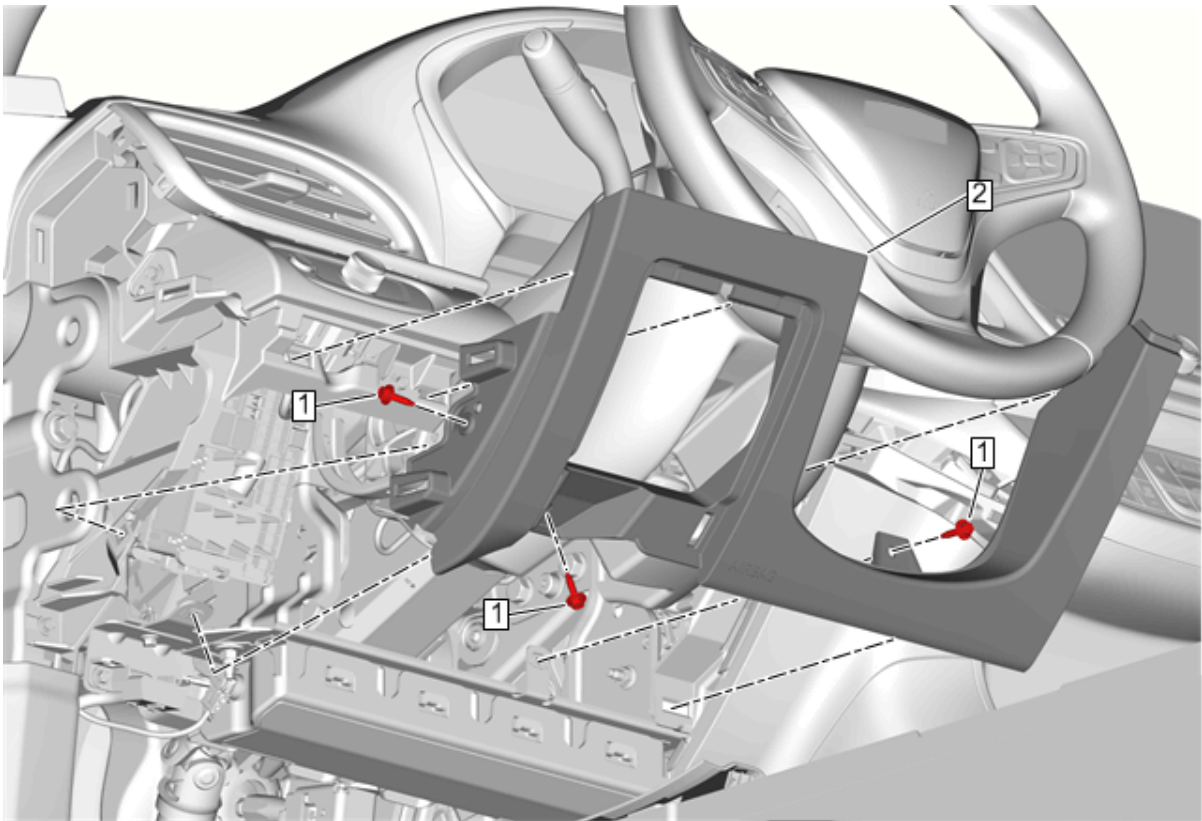


Fig. 4: Instrument Panel Compartment
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Outer Trim Cover Replacement</u> <u>Instrument Panel Fuse Block Access Hole Cover Replacement</u> <u>Front Floor Console Applique Replacement - Left Side</u>	
1	Instrument Panel Knee Bolster Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)

Callout	Component Name
2	Instrument Panel Knee Bolster Procedure Use a flat bladed plastic trim tool.

INSTRUMENT PANEL TRIM PLATE APPLIQUE REPLACEMENT - RIGHT SIDE

Removal Procedure

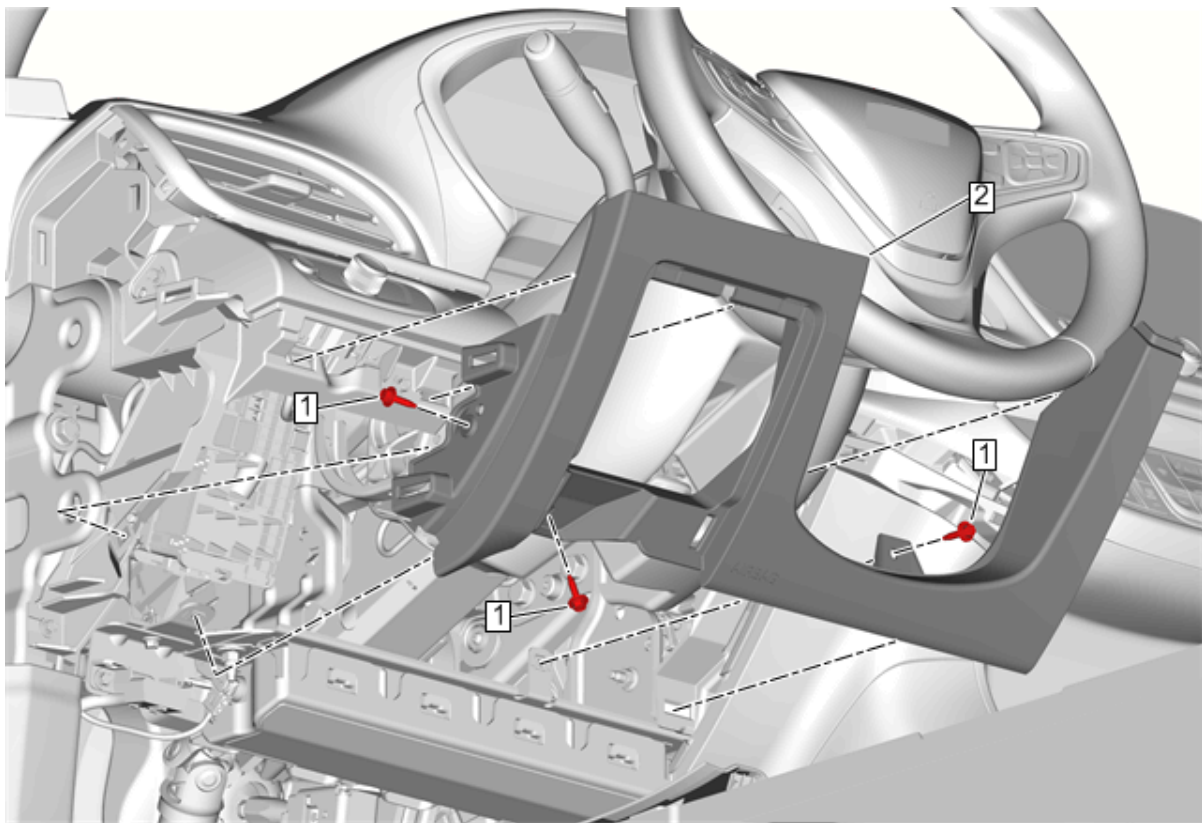


Fig. 5: Instrument Panel Compartment

Courtesy of GENERAL MOTORS COMPANY

1. Remove Instrument Panel Compartment (2) [Instrument Panel Compartment Replacement](#)

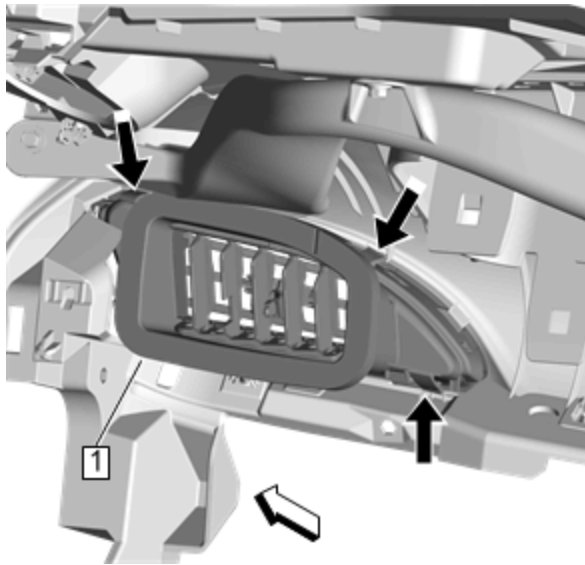


Fig. 6: Instrument Panel Outer Air Outlet

Courtesy of GENERAL MOTORS COMPANY

2. Depress the three tabs on the instrument panel outer air outlet (1) from behind the instrument panel to properly release the outlet.

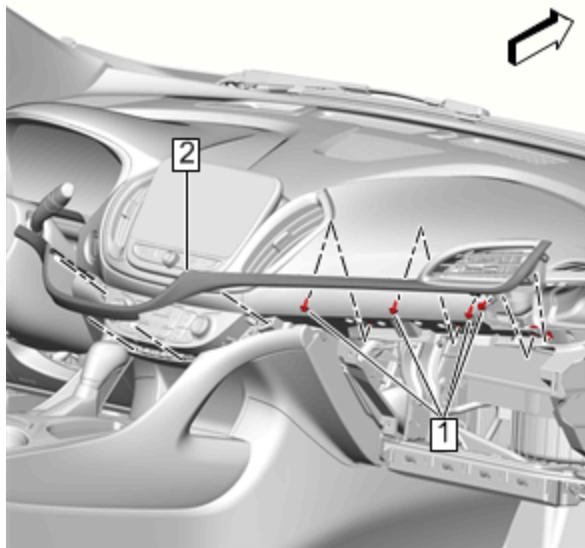


Fig. 7: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Remove Instrument Panel Bolt (1)
4. Remove Instrument Panel Trim Plate Applique - Right Side (2)
5. Use a flat bladed plastic tool to remove.

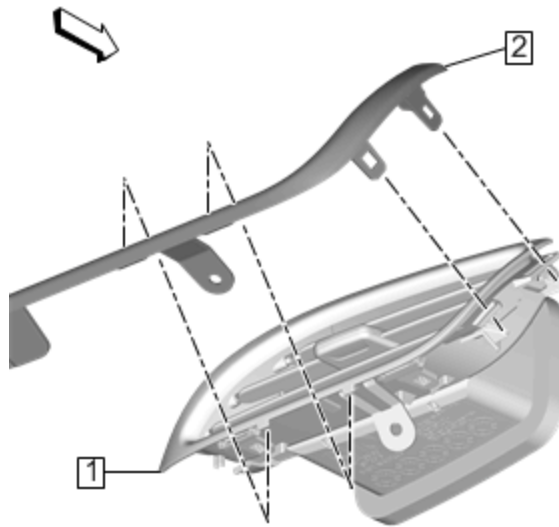


Fig. 8: Instrument Panel Outer Air Outlet

Courtesy of GENERAL MOTORS COMPANY

6. Release the plastic retaining tabs to separate the instrument panel outer air outlet (1) from the instrument panel trim plate applique (2).
7. Transfer components as necessary.

Installation Procedure

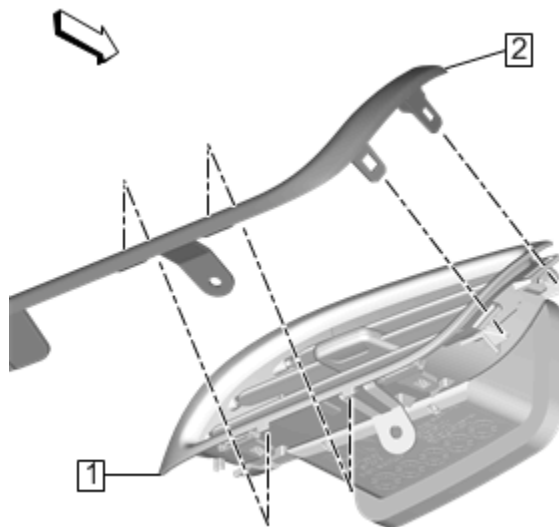


Fig. 9: Instrument Panel Outer Air Outlet

Courtesy of GENERAL MOTORS COMPANY

1. Install the instrument panel outer air outlet (1) to the instrument panel trim plate applique (2).

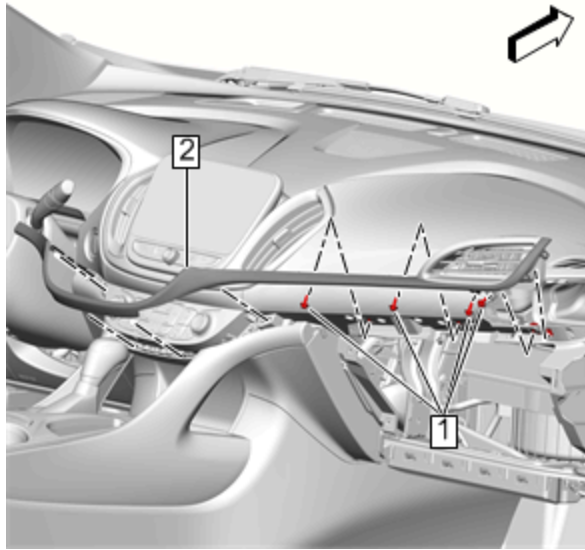


Fig. 10: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

2. Install Instrument Panel Trim Plate Applique - Right Side (2)

CAUTION: Refer to [Fastener Caution](#) .

3. Install Instrument Panel Bolt (1) and tighten 2.5 N.m (22 lb in)

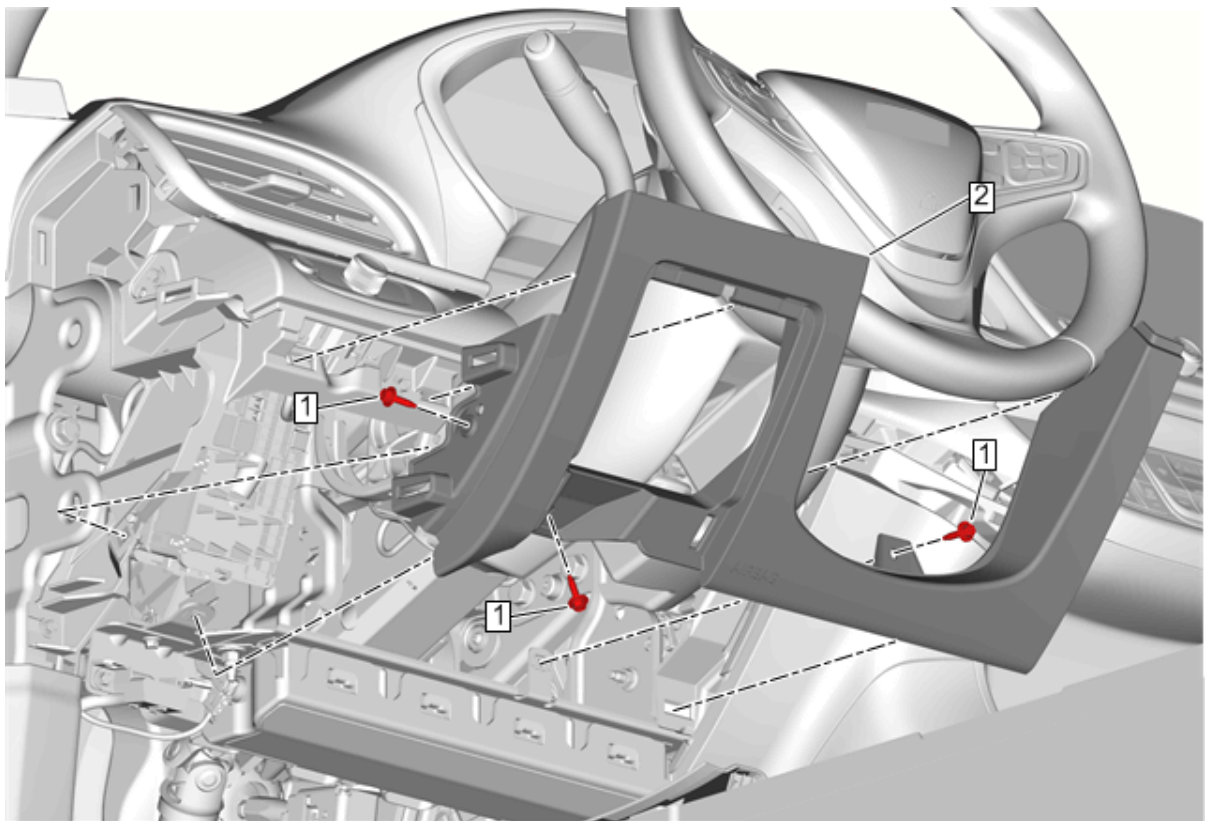


Fig. 11: Instrument Panel Compartment

Courtesy of GENERAL MOTORS COMPANY

4. Install Instrument Panel Compartment (2) [Instrument Panel Compartment Replacement](#)

INSTRUMENT PANEL TRIM PLATE APPLIQUE REPLACEMENT - LEFT SIDE

Removal Procedure

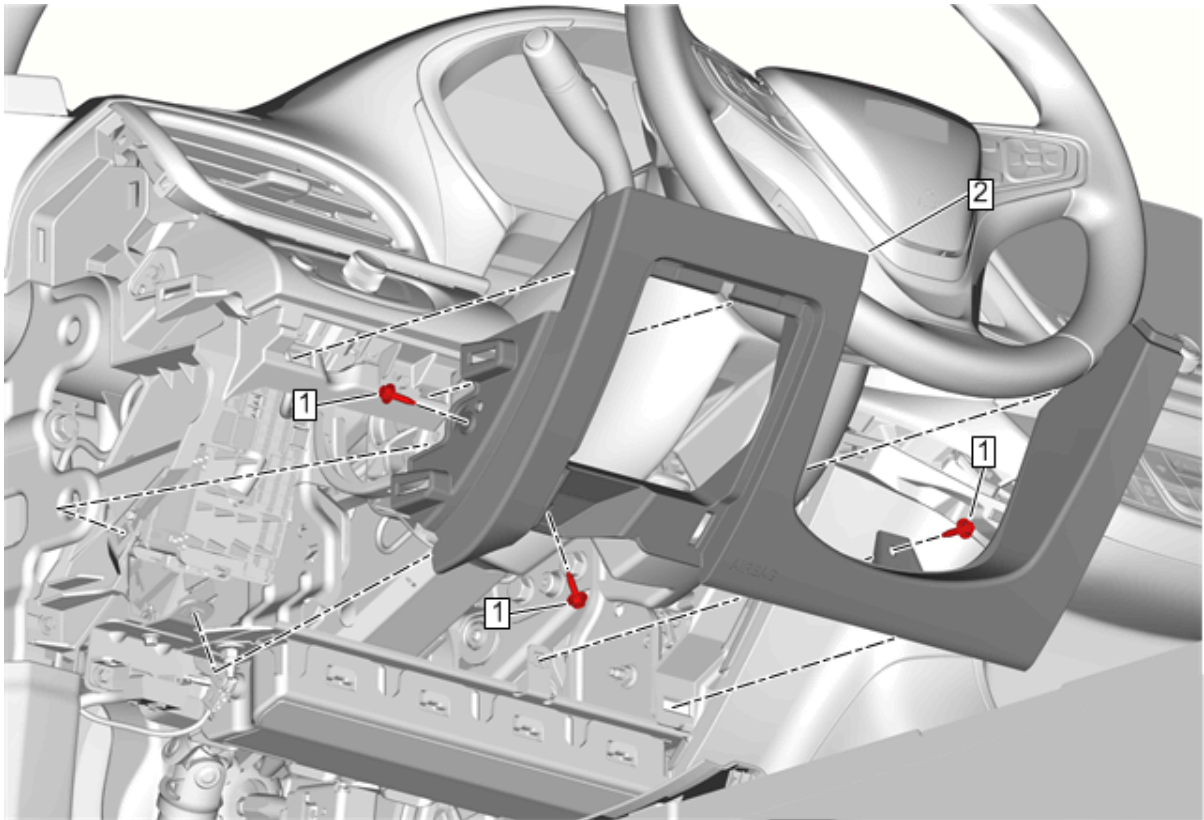


Fig. 12: Instrument Panel Compartment

Courtesy of GENERAL MOTORS COMPANY

1. Remove Instrument Panel Knee Bolster (2) [Instrument Panel Knee Bolster Replacement](#)

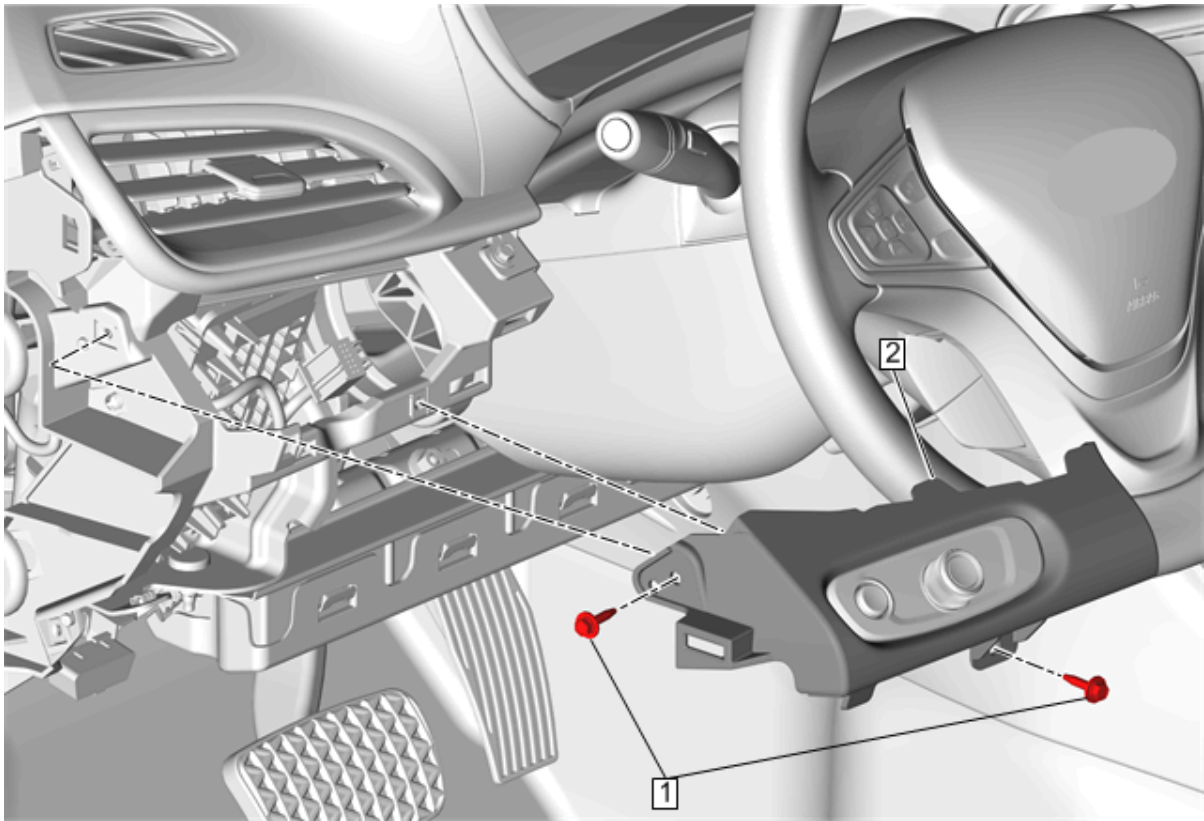


Fig. 13: Instrument Panel Switch Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Instrument Panel Switch Trim Plate (2) [Instrument Panel Switch Trim Plate Replacement](#)

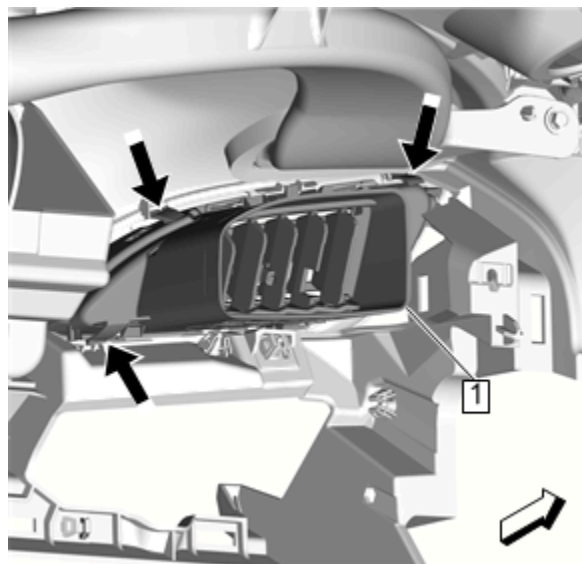


Fig. 14: Instrument Panel Outer Air Outlet
 Courtesy of GENERAL MOTORS COMPANY

3. Depress the three tabs on the instrument panel outer air outlet (1) from behind the instrument panel to properly release the outlet.

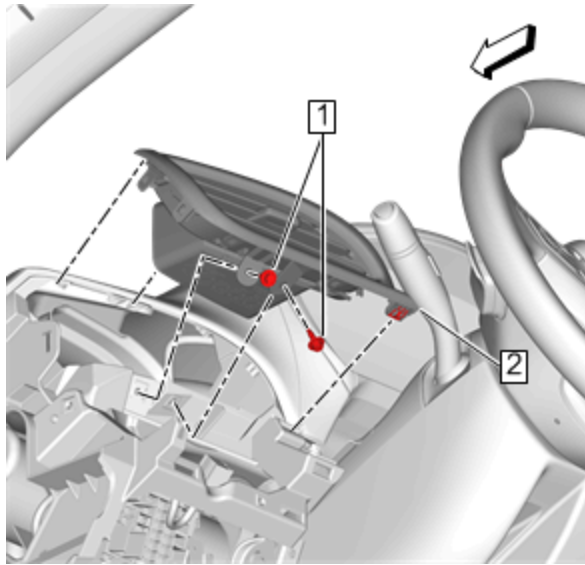


Fig. 15: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Remove Instrument Panel Bolt (1)
5. Remove Instrument Panel Outer Air Outlet - Left Side (2)
6. Use a flat bladed plastic tool to remove.

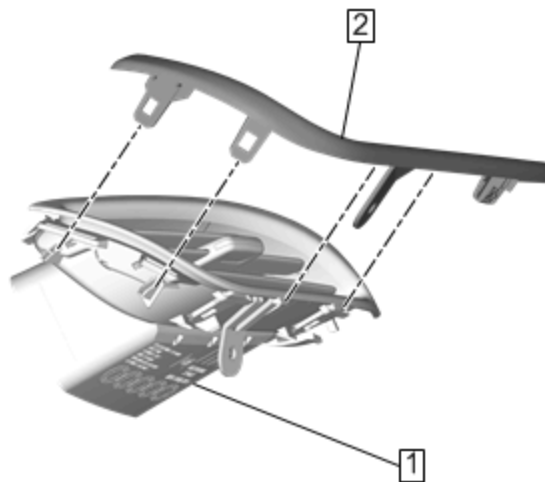


Fig. 16: Instrument Panel Outer Air Outlet

Courtesy of GENERAL MOTORS COMPANY

7. Release the plastic retaining tabs to separate the instrument panel outer air outlet (1) from the instrument panel trim plate applique (2).
8. Transfer components as necessary.

Installation Procedure

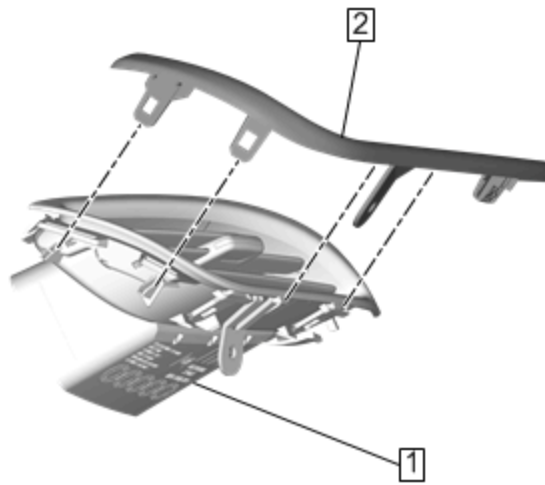


Fig. 17: Instrument Panel Outer Air Outlet
Courtesy of GENERAL MOTORS COMPANY

1. Install the instrument panel outer air outlet (1) to the instrument panel trim plate applique (2).

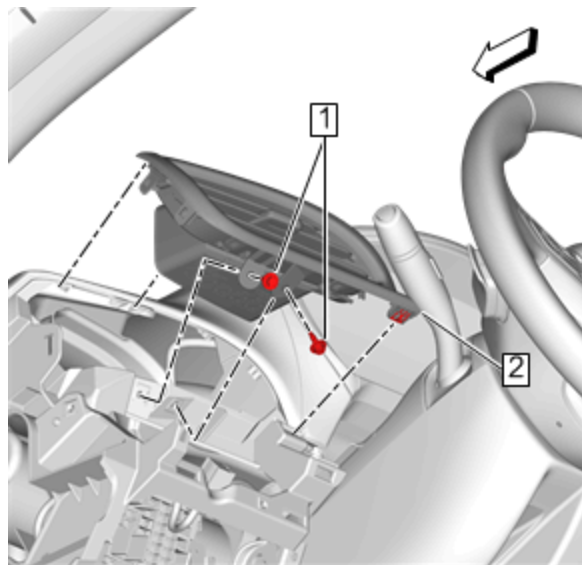


Fig. 18: Instrument Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install Instrument Panel Outer Air Outlet - Left Side (2)

CAUTION: Refer to **Fastener Caution** .

3. Install Instrument Panel Bolt (1) and tighten 2.5 N.m (22 lb in)

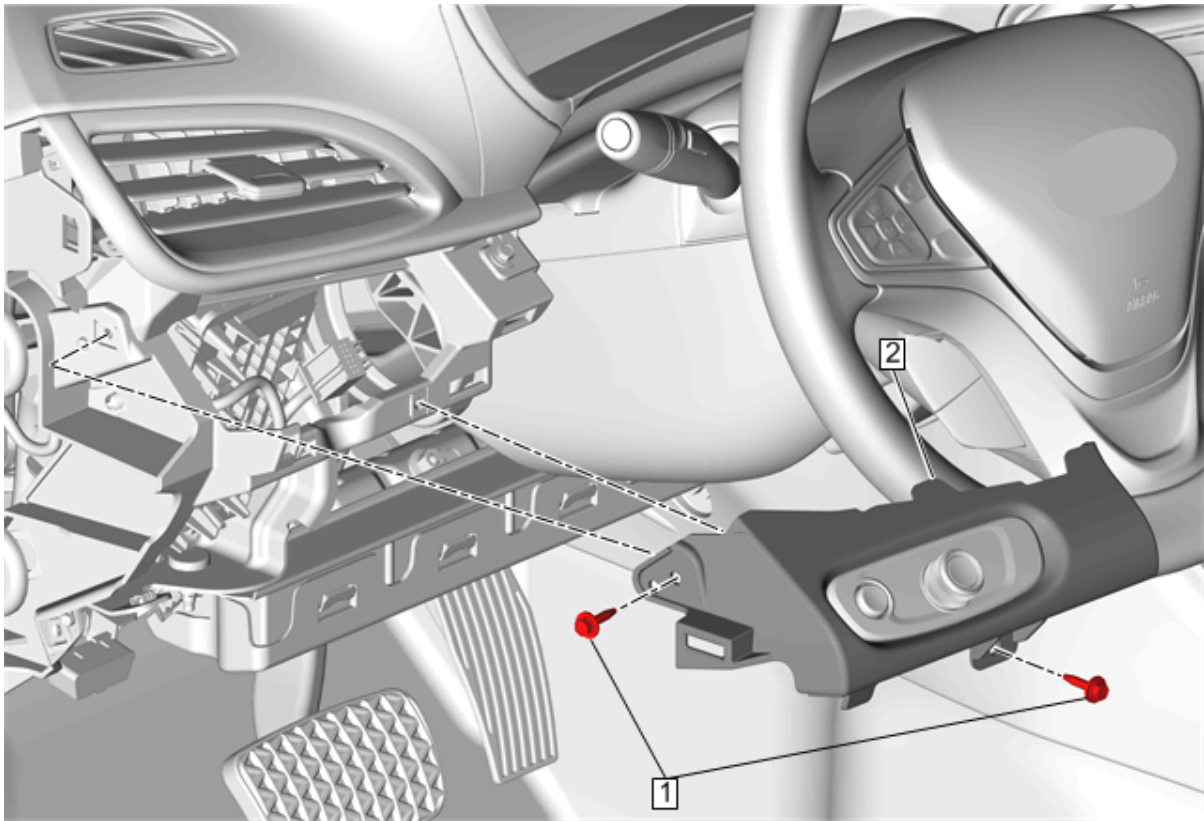


Fig. 19: Instrument Panel Switch Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

4. Install Instrument Panel Switch Trim Plate (2) [Instrument Panel Switch Trim Plate Replacement](#)

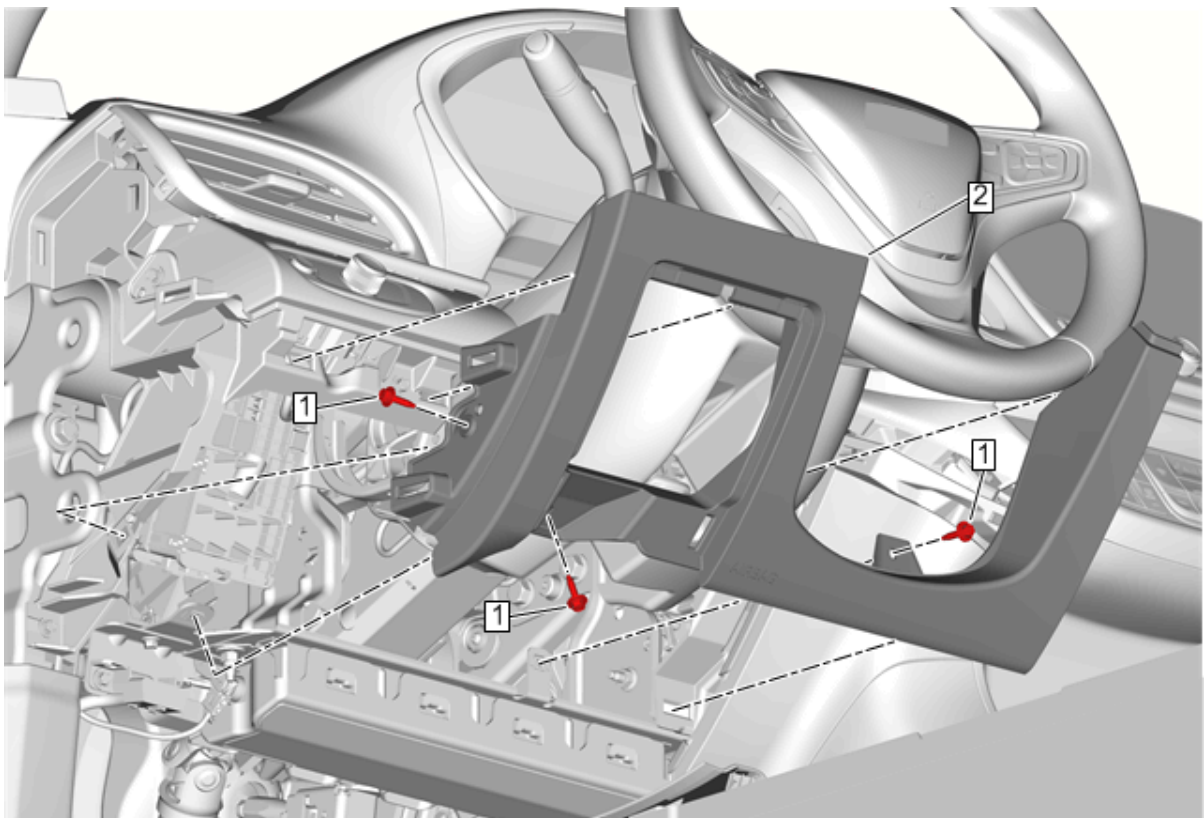


Fig. 20: Instrument Panel Compartment
 Courtesy of GENERAL MOTORS COMPANY

5. Install Instrument Panel Knee Bolster (2)[Instrument Panel Knee Bolster Replacement](#)

FORWARD COLLISION ALERT DISPLAY BEZEL REPLACEMENT

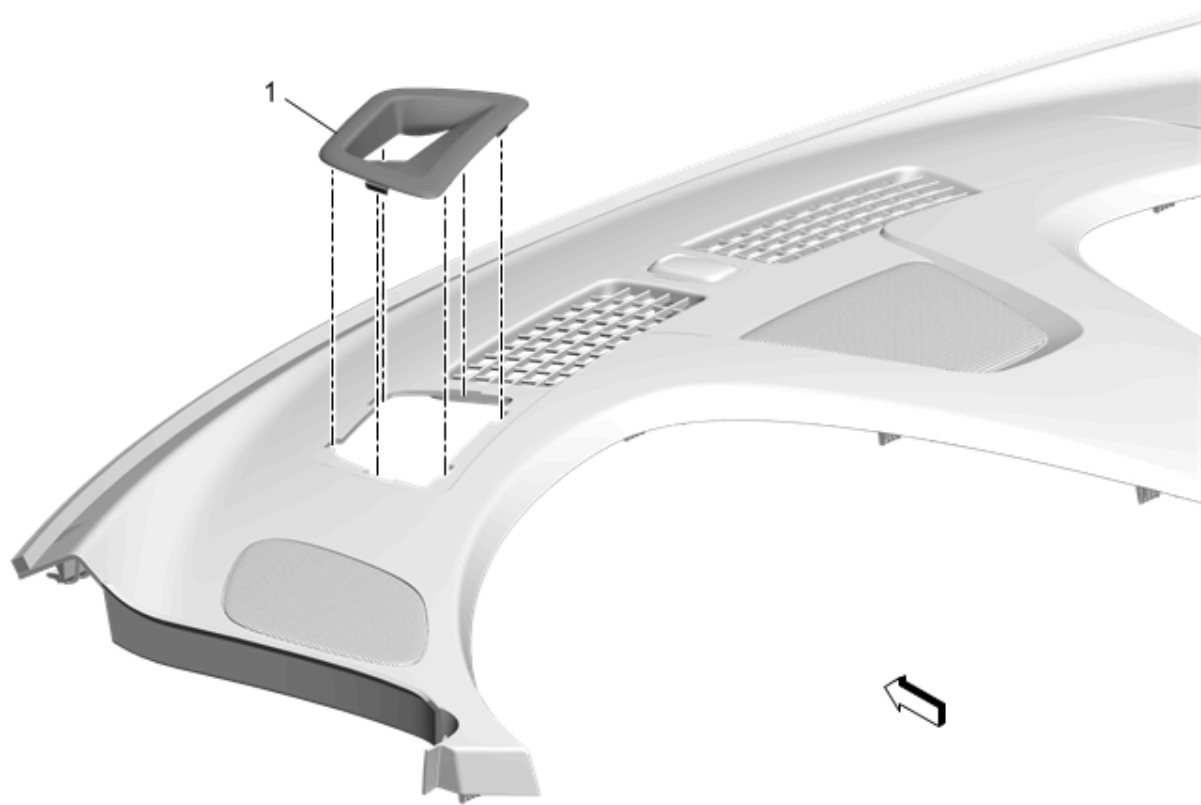


Fig. 21: Forward Collision Alert Display Bezel
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Instrument Panel Extension Replacement</u>	
1	Forward Collision Alert Display Bezel Procedure Release the plastic retaining tabs.

INSTRUMENT PANEL FUSE BLOCK ACCESS HOLE COVER REPLACEMENT

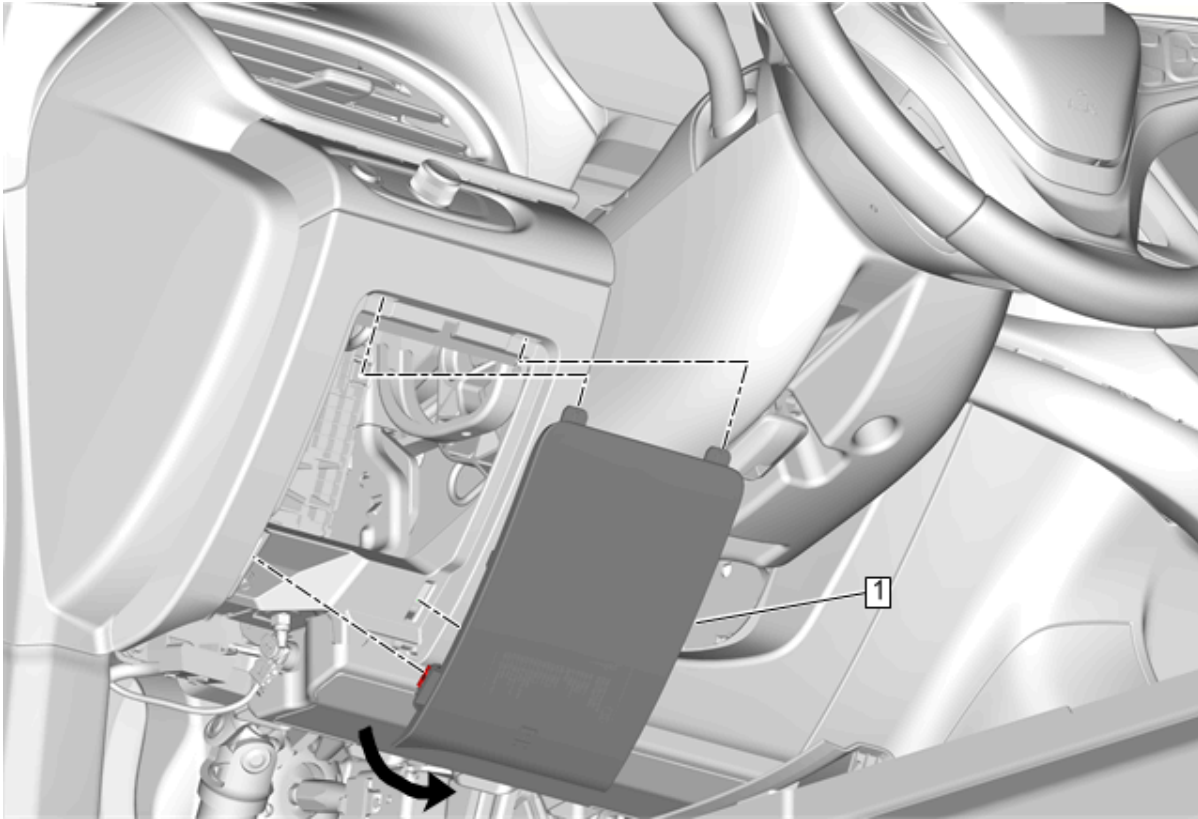


Fig. 22: Instrument Panel Fuse Block Access Hole Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Fuse Block Access Hole Cover Procedure Grasp the lower edge of the fuse block cover and pull outward disengaging the retainers securing the fuse block cover to the instrument panel knee bolster.

INSTRUMENT PANEL CLUSTER TRIM PLATE REPLACEMENT

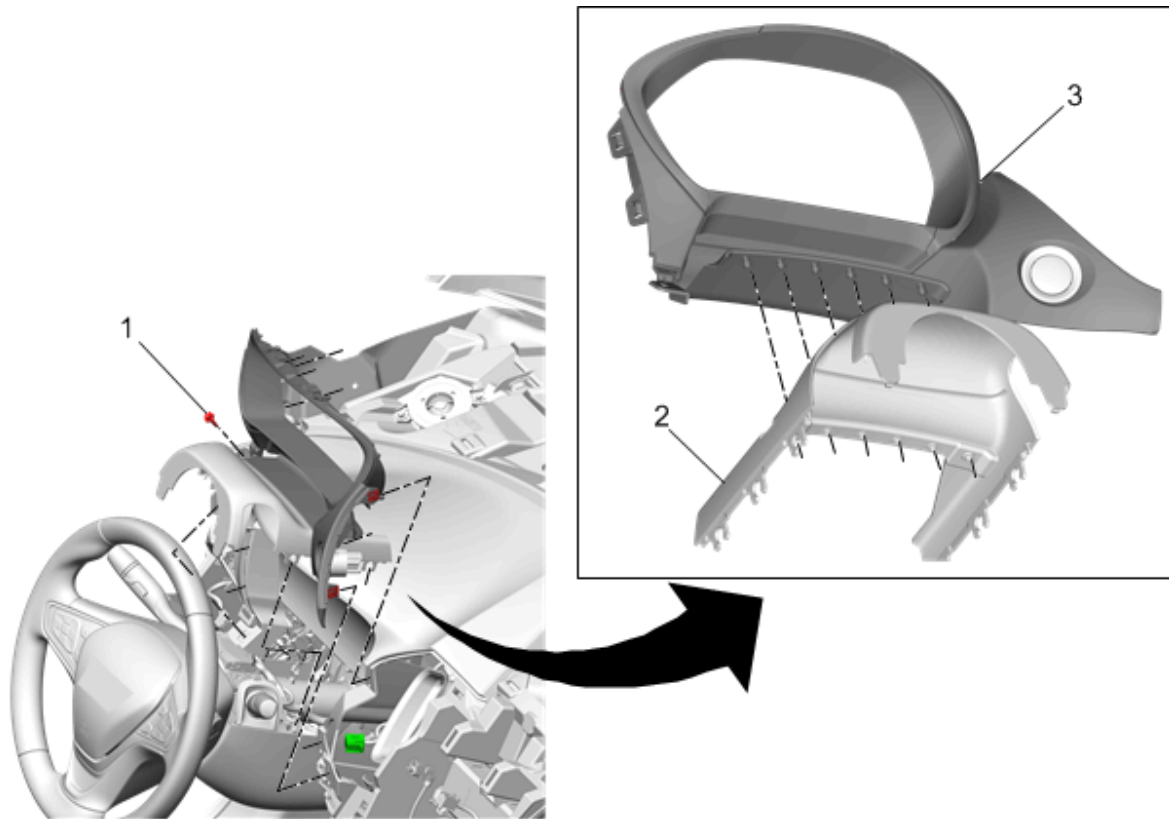


Fig. 23: Instrument Panel Cluster Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
NOTE: The instrument panel cluster trim plate and the steering column upper trim cover must be removed as an assembly, do not attempt to separate. Preliminary Procedure 1. <u>SIR Disabling and Enabling</u> 2. <u>Instrument Panel Trim Plate Applique Replacement - Left Side</u> 3. <u>Instrument Panel Center Air Outlet Replacement</u>	

INSTRUMENT PANEL OUTER TRIM COVER REPLACEMENT

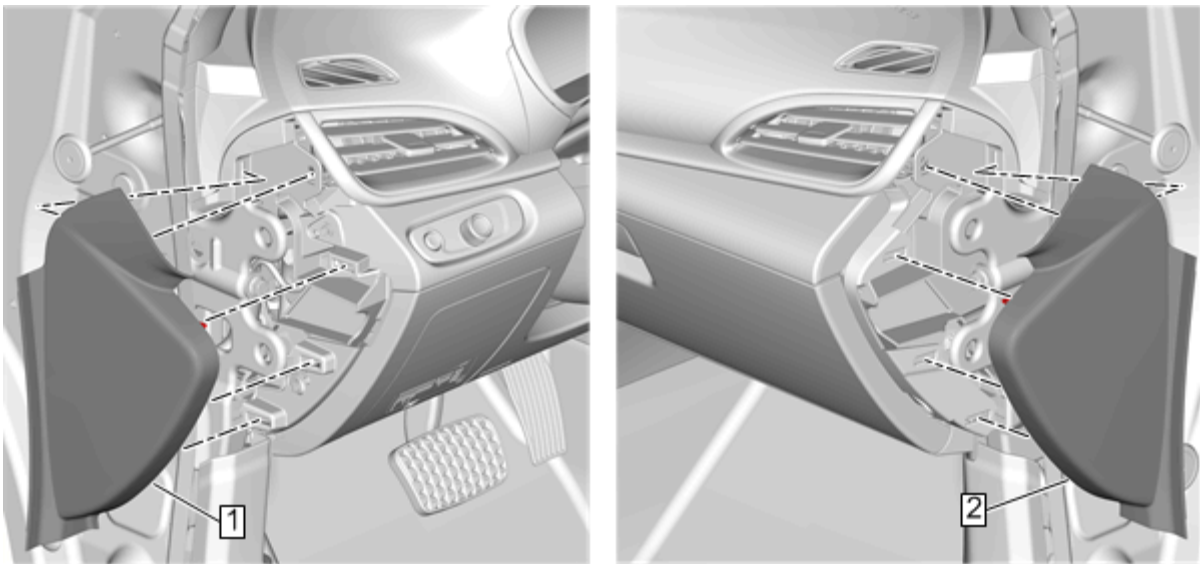


Fig. 24: Instrument Panel Outer Trim Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Outer Trim Cover - Left Procedure Use a flat bladed plastic trim tool.
2	Instrument Panel Outer Trim Cover - Right Procedure Use a flat bladed plastic trim tool.

INSTRUMENT PANEL LOWER CENTER TRIM PANEL REPLACEMENT (UPPER)

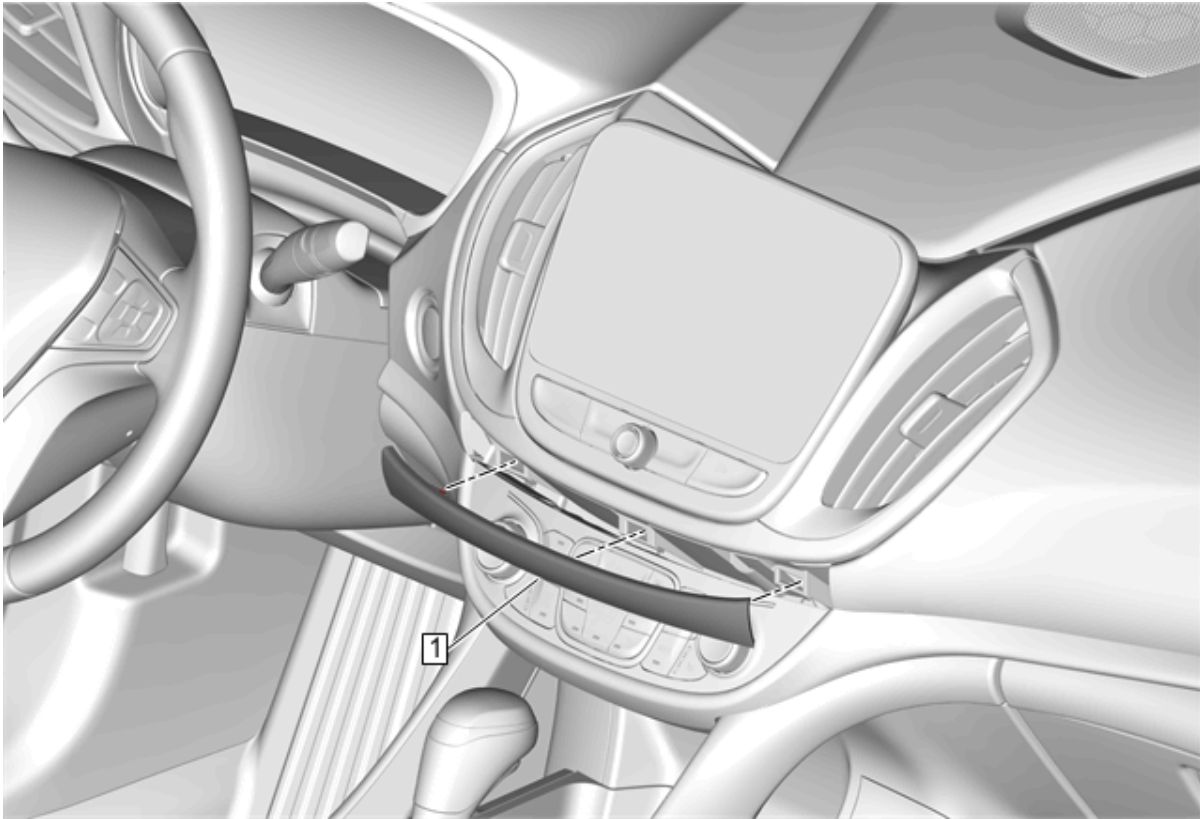


Fig. 25: Instrument Panel Lower Center Trim Panel (Upper)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Lower Center Trim Panel Procedure Use a flat bladed plastic trim tool.

INSTRUMENT PANEL LOWER CENTER TRIM PANEL REPLACEMENT (LOWER)

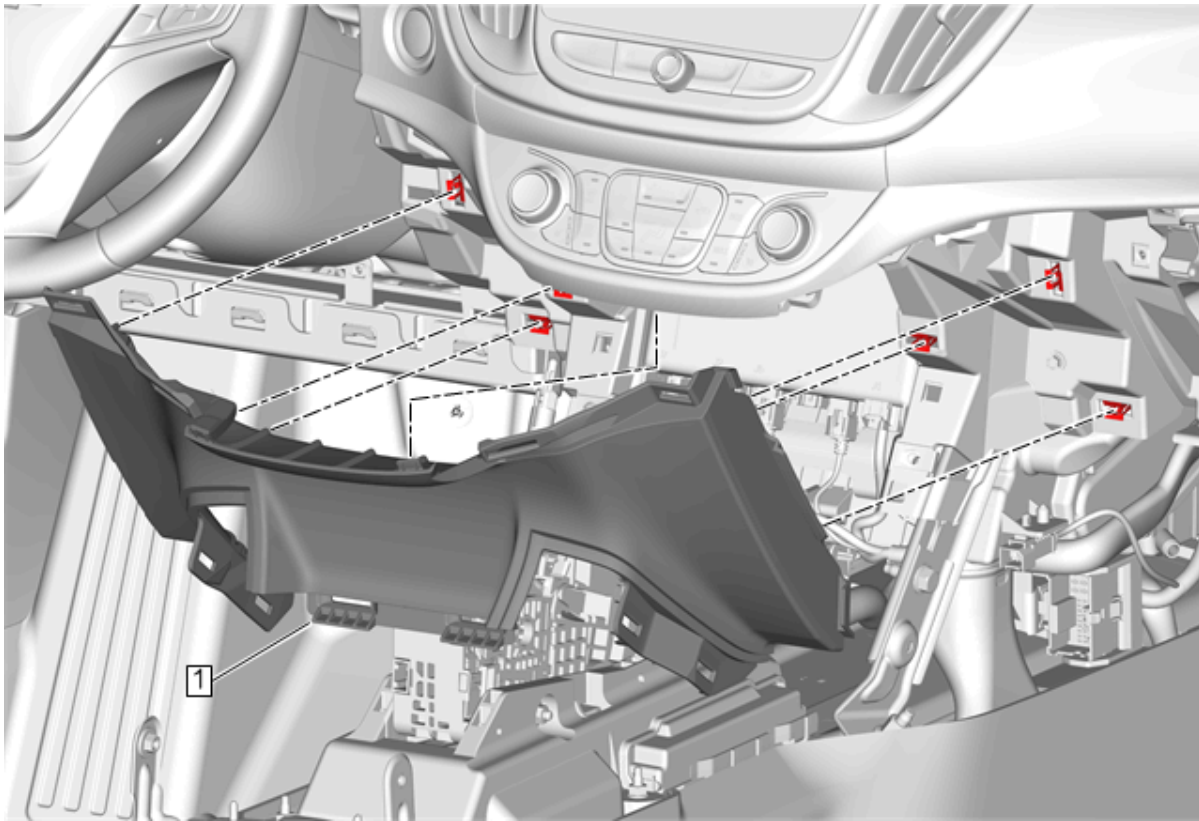


Fig. 26: Instrument Panel Lower Center Trim Panel

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. <u>Front Floor Console Replacement</u> 2. <u>Instrument Panel Knee Bolster Replacement</u> 3. <u>Instrument Panel Compartment Replacement</u>	
1	Instrument Panel Lower Center Trim Panel Procedure 1. Use a flat bladed plastic trim tool. 2. First release the retainers from the bottom and pull the panel down to disengage the top two tabs. 3. Disconnect electrical connections, if applicable.

INSTRUMENT PANEL COMPARTMENT REPLACEMENT

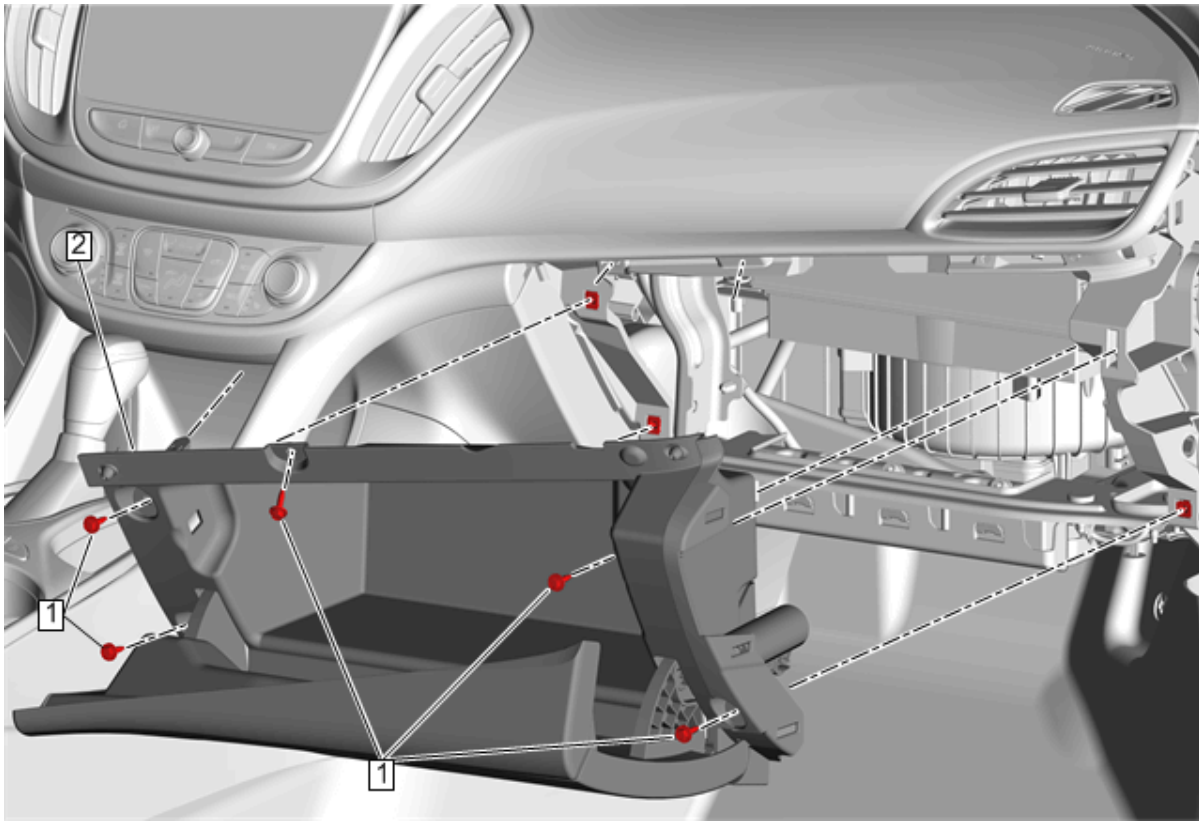


Fig. 27: Instrument Panel Compartment
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Instrument Panel Outer Trim Cover Replacement</u>	
1	Instrument Panel Compartment Bolt (Qty: 5) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Instrument Panel Compartment Procedure 1. Release the retaining tab. 2. Release the retainer. 3. Transfer components as necessary.

INSTRUMENT PANEL COMPARTMENT DOOR DAMPENER REPLACEMENT

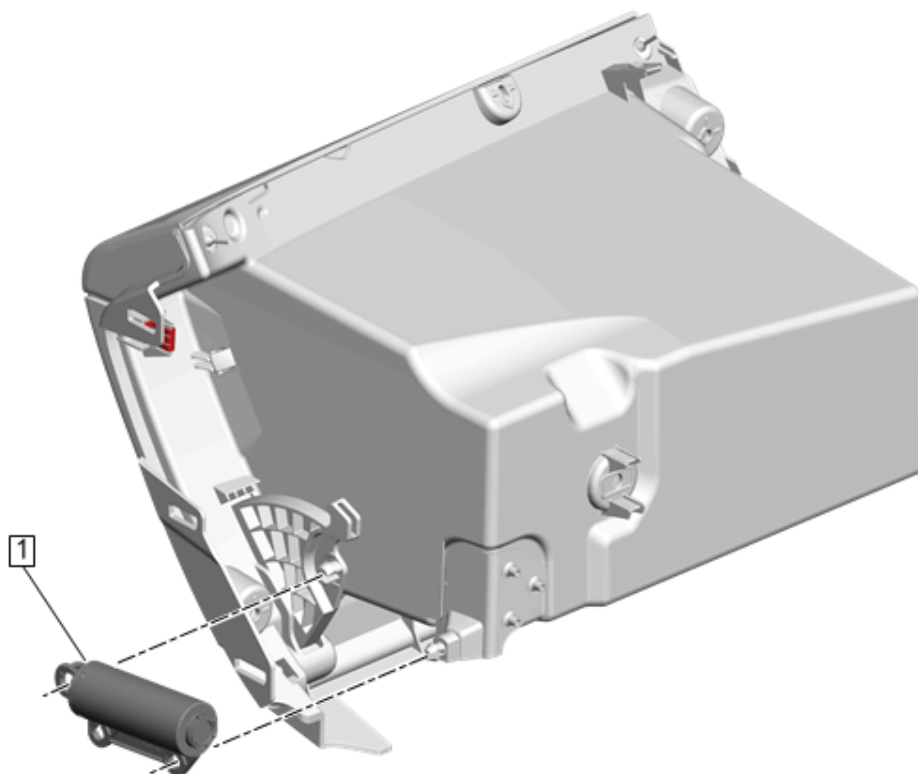


Fig. 28: Instrument Panel Compartment Door Dampener

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Instrument Panel Compartment Replacement</u>	
1	Instrument Panel Compartment Door Dampener Procedure Release the retaining tabs.

INSTRUMENT PANEL AIRBAG LOWER BRACKET REPLACEMENT (PASSENGER SIDE)

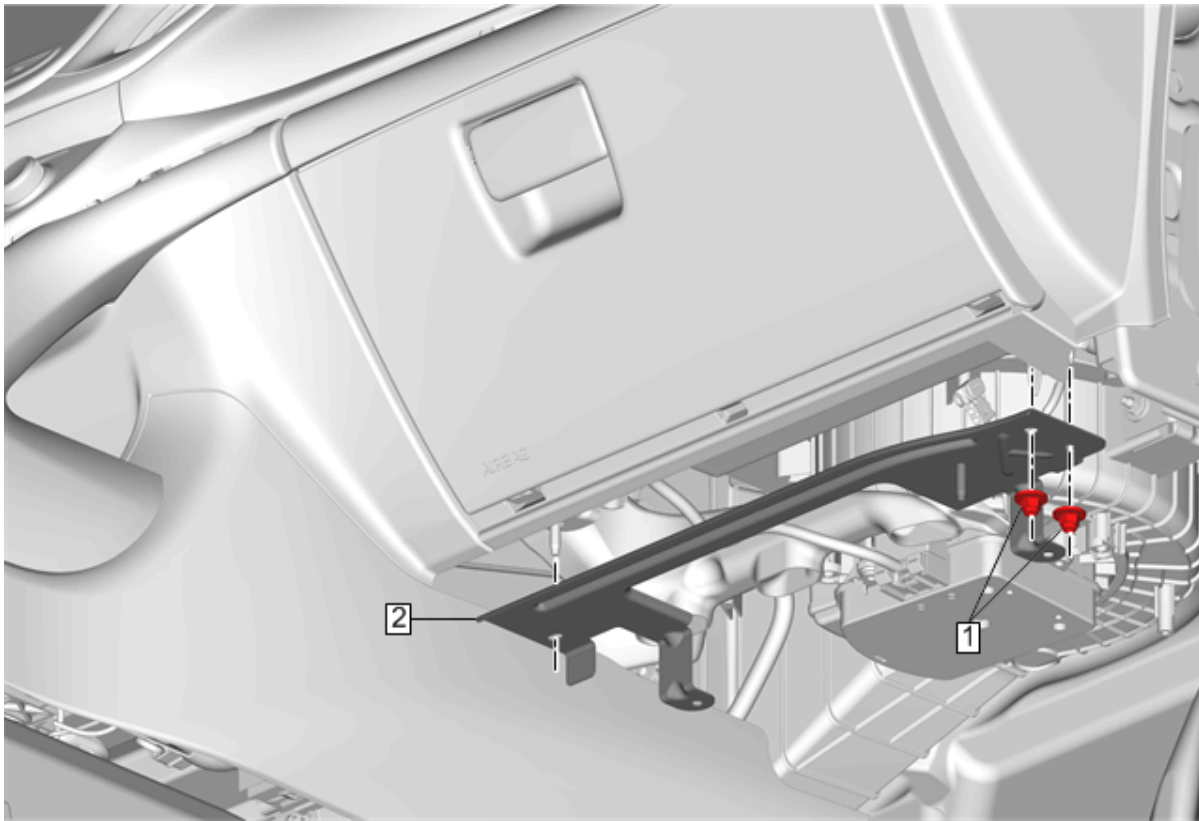


Fig. 29: Instrument Panel Airbag Lower Bracket (Passenger Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Lower Trim Panel Insulator Replacement</u> <u>Instrument Panel Lower Airbag Replacement - Passenger Side</u>	
1	Instrument Panel Lower Airbag Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Instrument Panel Airbag Lower Bracket

INSTRUMENT PANEL AIRBAG LOWER BRACKET REPLACEMENT (DRIVER SIDE)

Removal Procedure

WARNING: Refer to [SIR Inflator Module Handling and Storage Warning](#) .

WARNING: Refer to [SIR Warning](#) .

1. Disable the SIR system. [SIR Disabling and Enabling](#)

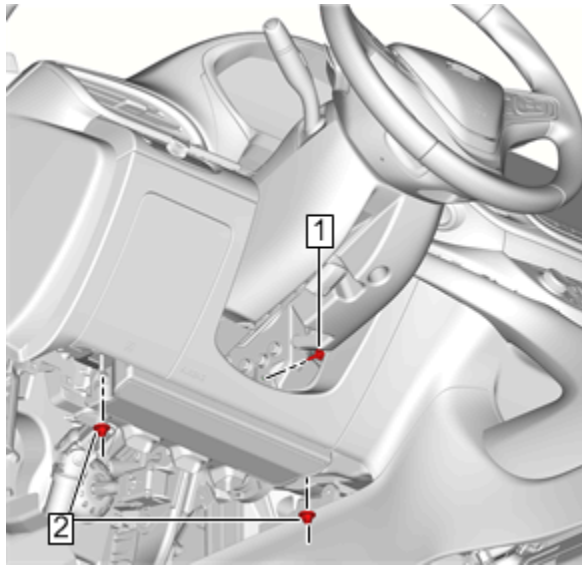


Fig. 30: Instrument Panel Knee Bolster Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Remove Instrument Panel Knee Bolster Bolt (1)
3. Remove Instrument Panel Lower Airbag Nut (2)

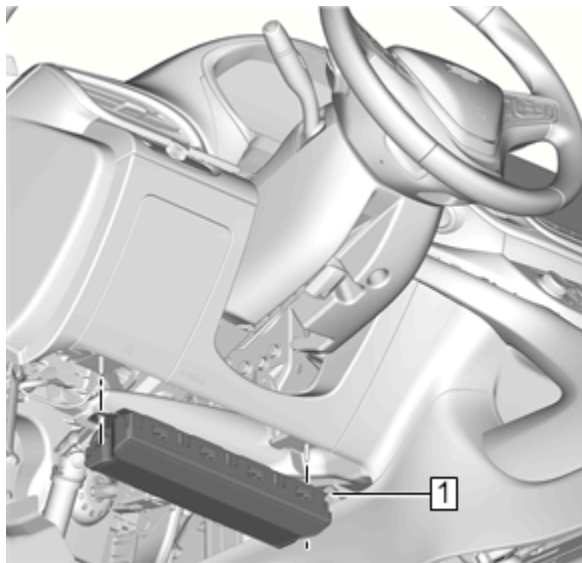


Fig. 31: Instrument Panel Lower Airbag - Driver Side
Courtesy of GENERAL MOTORS COMPANY

NOTE: The bracket may disassembly with the airbag.

4. Disconnect the electrical connector.
5. Remove Instrument Panel Lower Airbag - Driver Side (1)

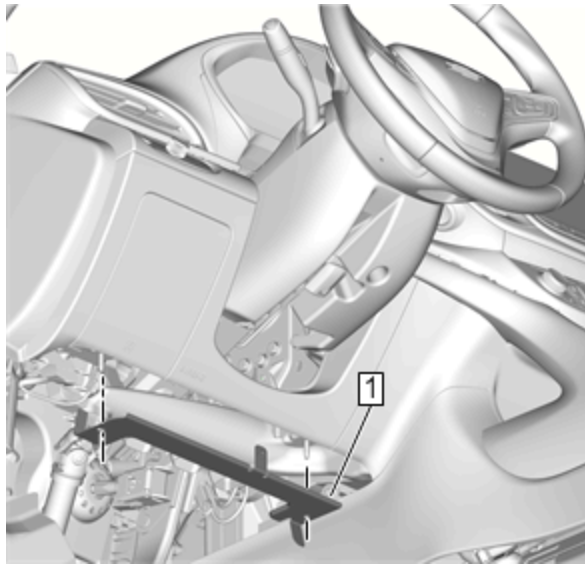


Fig. 32: Panel Airbag Lower Bracket

Courtesy of GENERAL MOTORS COMPANY

6. Remove Instrument Panel Airbag Lower Bracket (1)

Installation Procedure

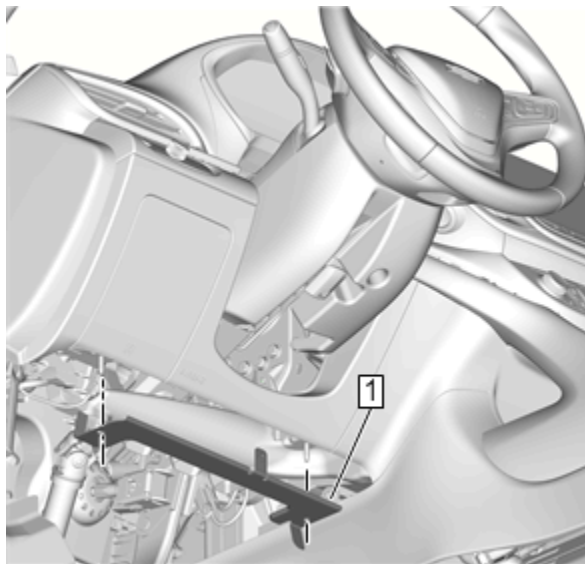


Fig. 33: Panel Airbag Lower Bracket

Courtesy of GENERAL MOTORS COMPANY

1. Install Instrument Panel Airbag Lower Bracket (1)

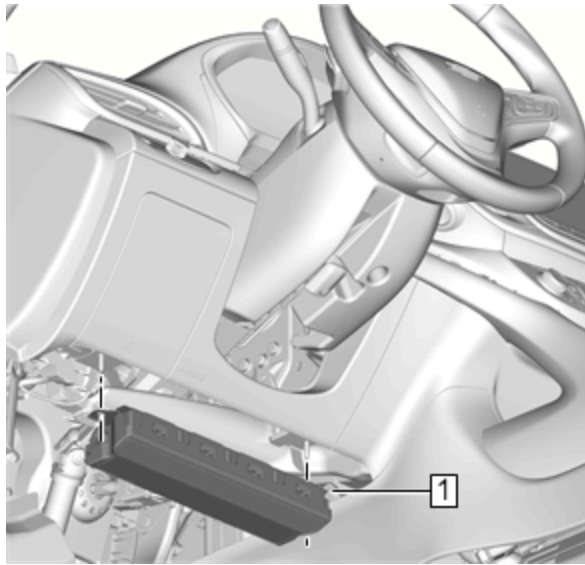


Fig. 34: Instrument Panel Lower Airbag - Driver Side
 Courtesy of GENERAL MOTORS COMPANY

2. Connect the electrical connector.
3. Install Instrument Panel Lower Airbag - Driver Side (1)

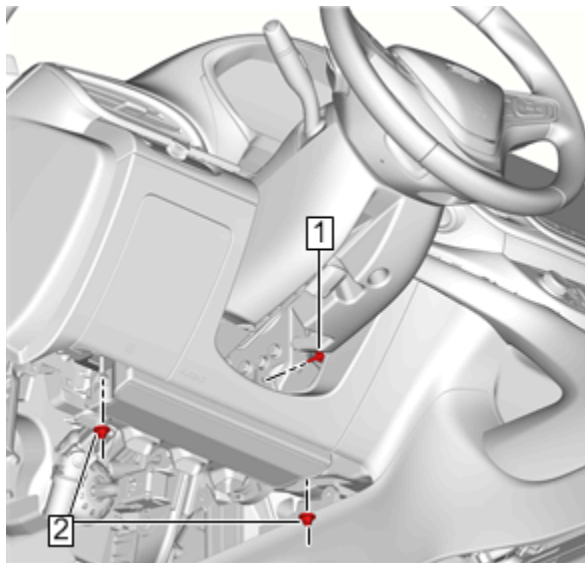


Fig. 35: Instrument Panel Knee Bolster Bolt
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

4. Install Instrument Panel Lower Airbag Nut (2) and tighten 9 N.m (80 lb in)
5. Install Instrument Panel Knee Bolster Bolt (1) and tighten 2.5 N.m (22 lb in)
6. Enable the SIR System. [SIR Disabling and Enabling](#)

INSTRUMENT PANEL ASSEMBLY REPLACEMENT

Removal Procedure

1. Disable the SIR system. [SIR Disabling and Enabling](#)

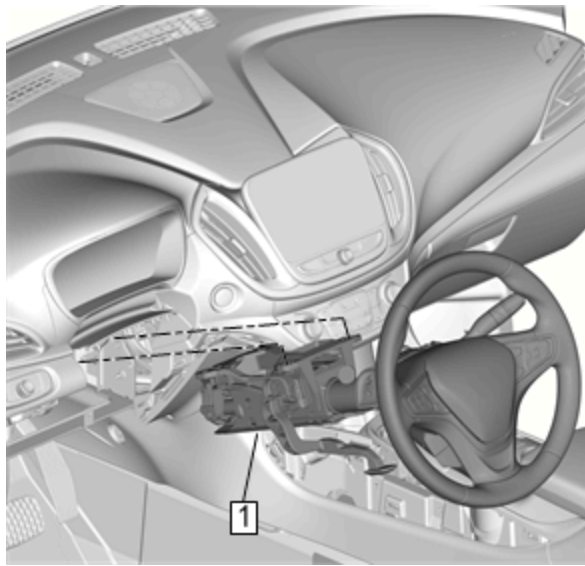


Fig. 36: Steering Column

Courtesy of GENERAL MOTORS COMPANY

2. Remove [Steering Column Replacement](#) (1)

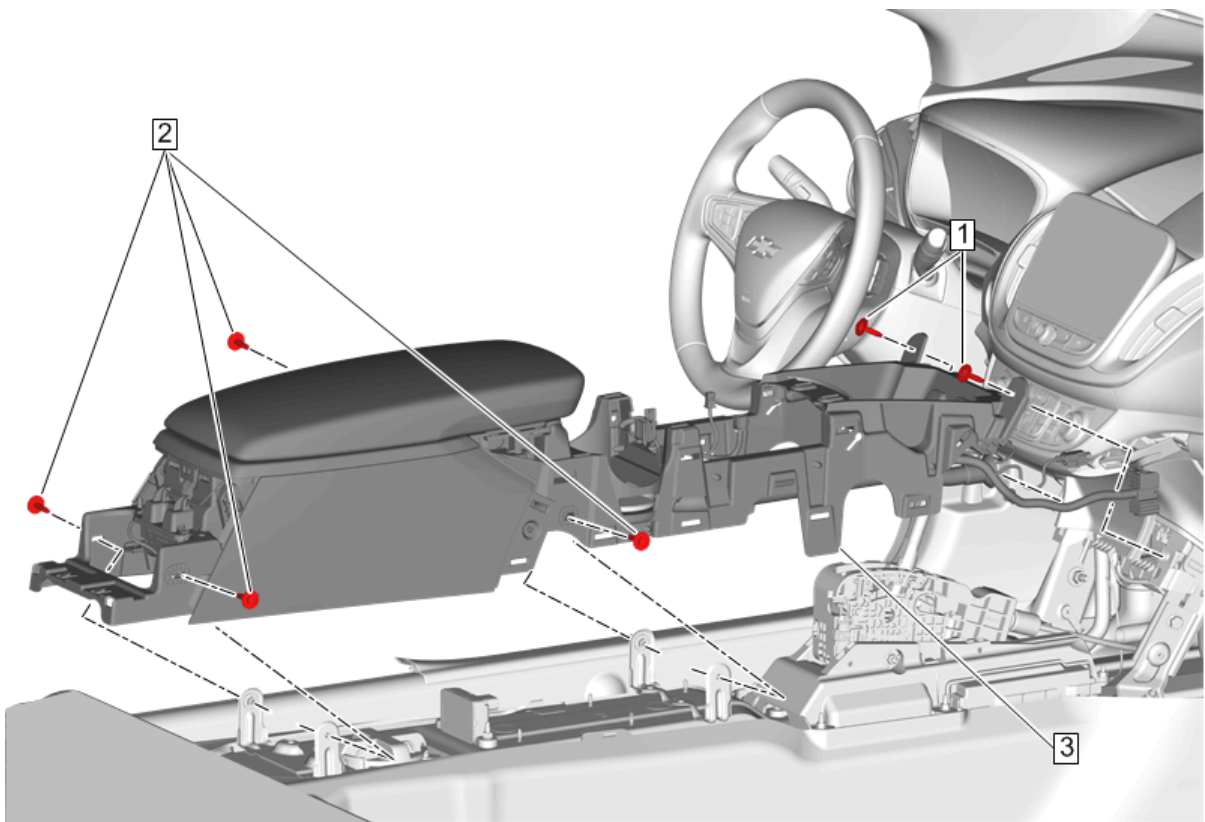


Fig. 37: Front Floor Console

Courtesy of GENERAL MOTORS COMPANY

3. Remove [Front Floor Console Replacement](#)(3)

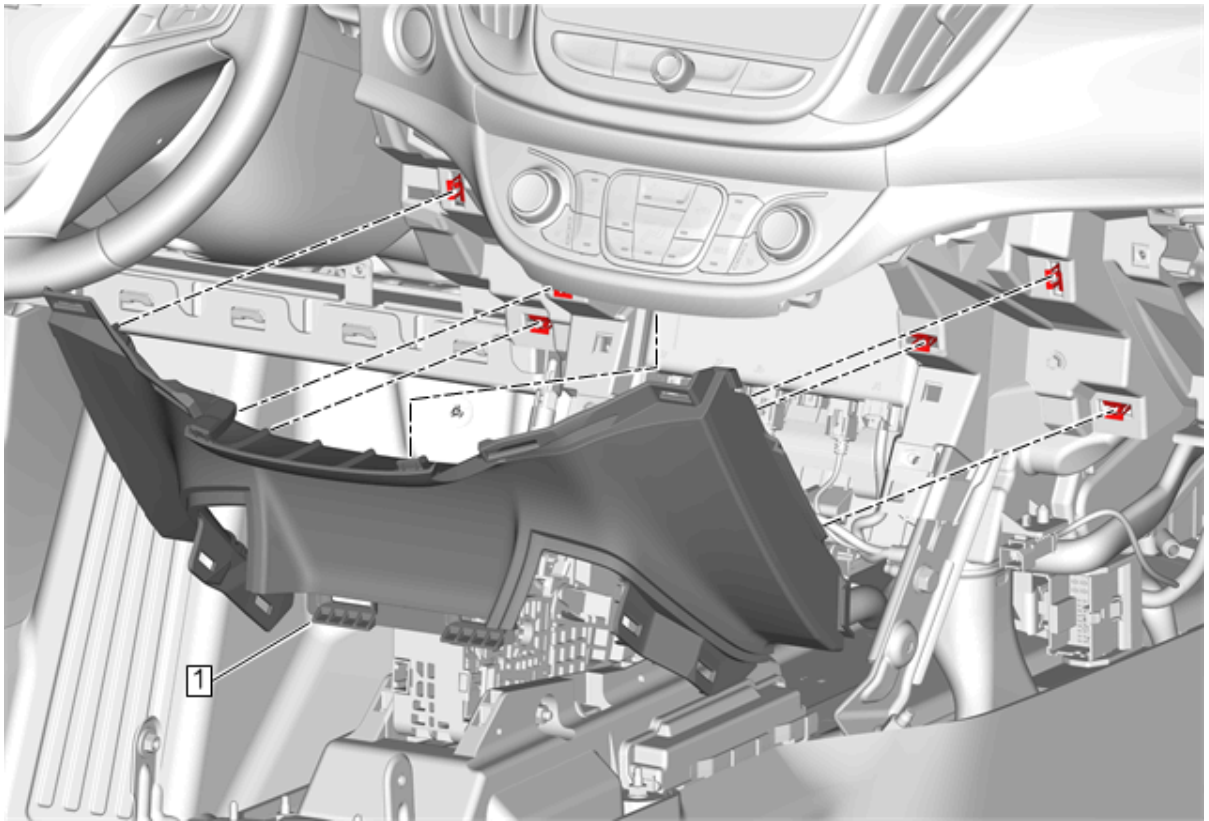


Fig. 38: Instrument Panel Lower Center Trim Panel

Courtesy of GENERAL MOTORS COMPANY

4. Remove Instrument Panel Lower Center Trim Panel Replacement (Upper)Instrument Panel Lower Center Trim Panel Replacement (Lower)(1)

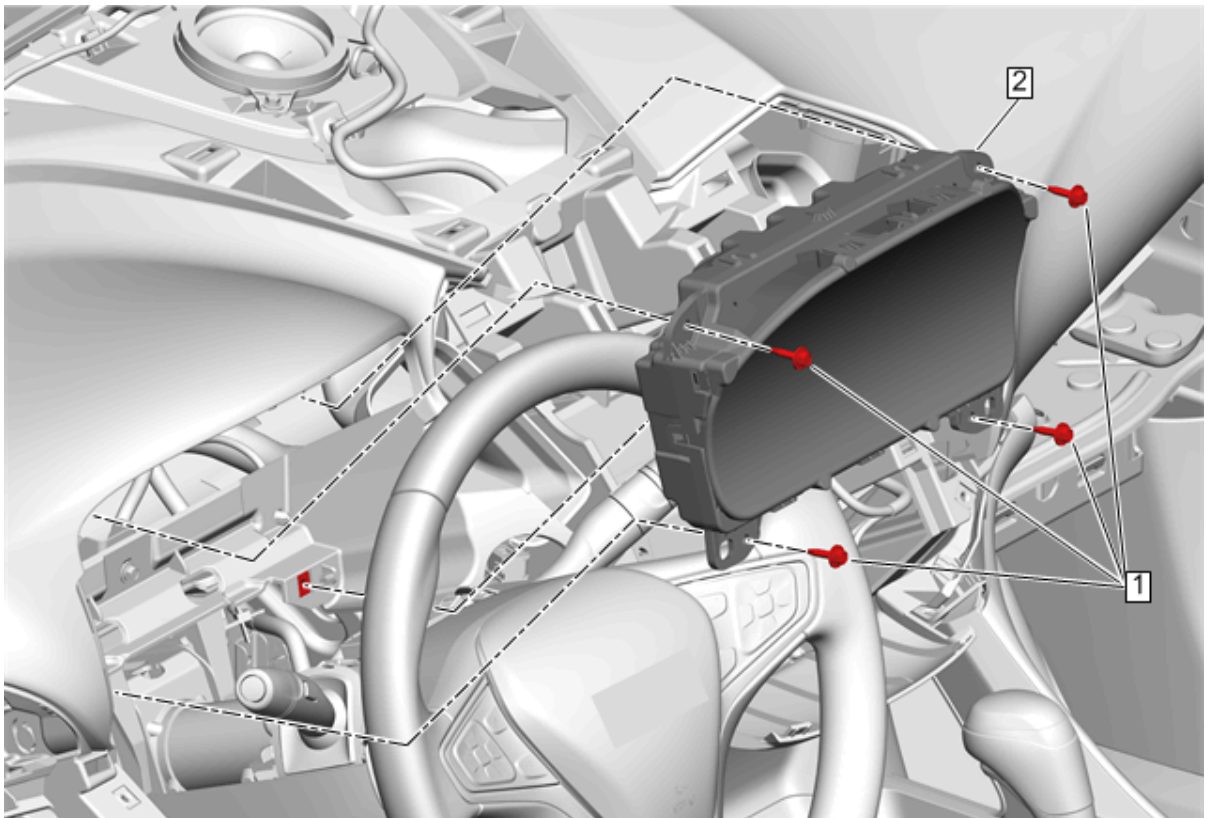


Fig. 39: Instrument Cluster

Courtesy of GENERAL MOTORS COMPANY

5. Remove **Instrument Cluster Replacement** (2)

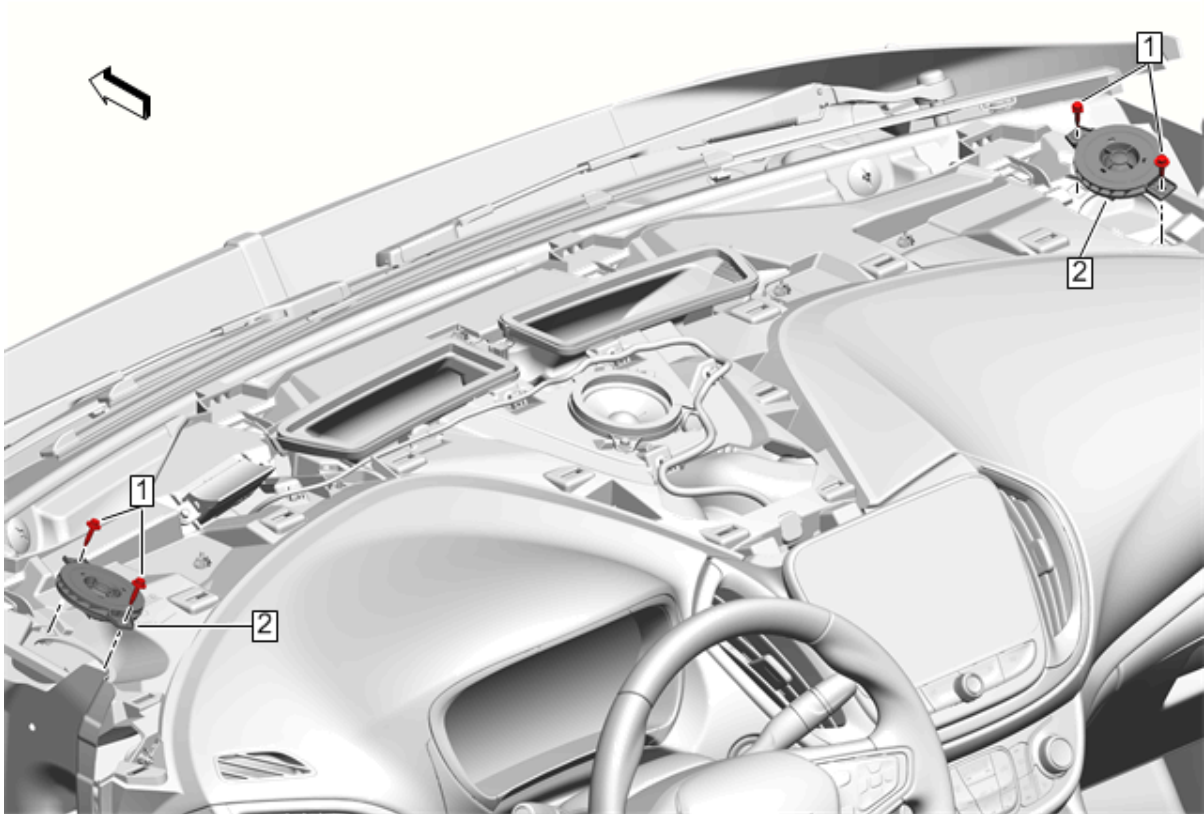


Fig. 40: Radio Front Speaker

Courtesy of GENERAL MOTORS COMPANY

6. Remove **Radio Front Speaker Replacement** (2)

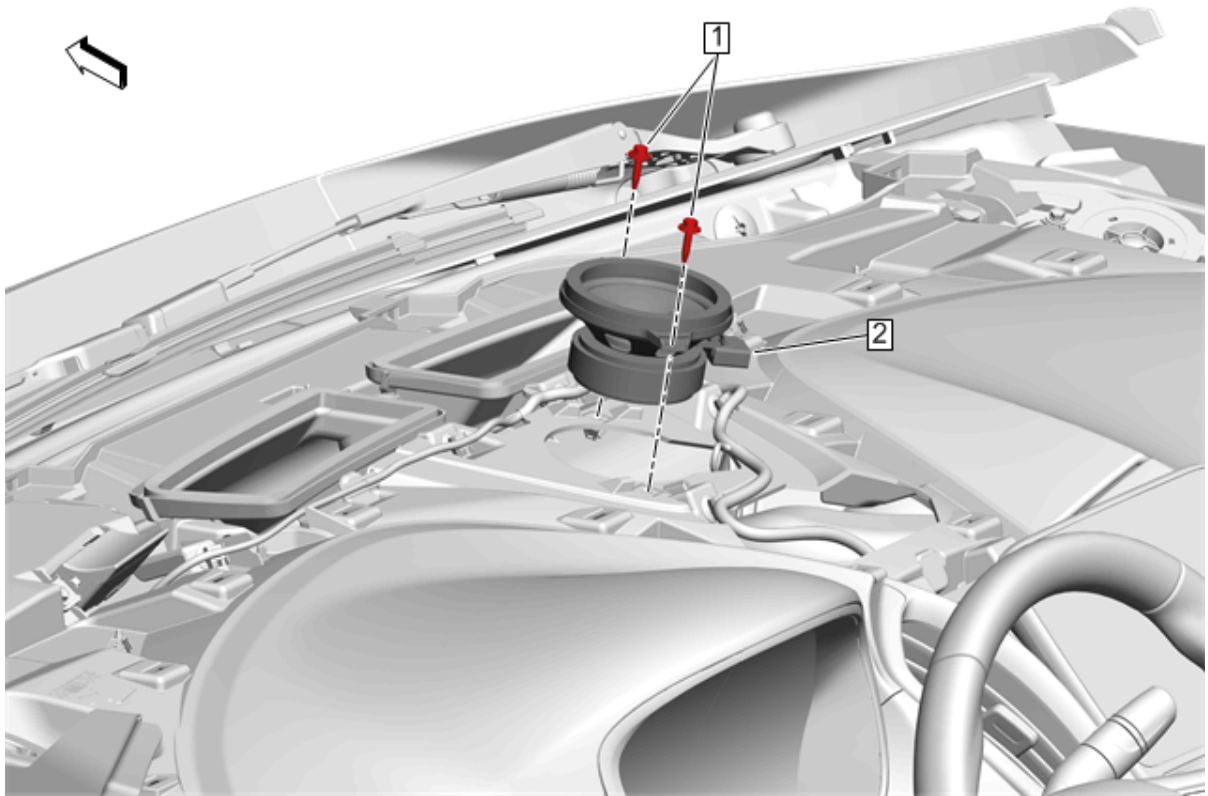


Fig. 41: Radio Front Center Speaker

Courtesy of GENERAL MOTORS COMPANY

7. Remove **Radio Front Center Speaker Replacement** (2)

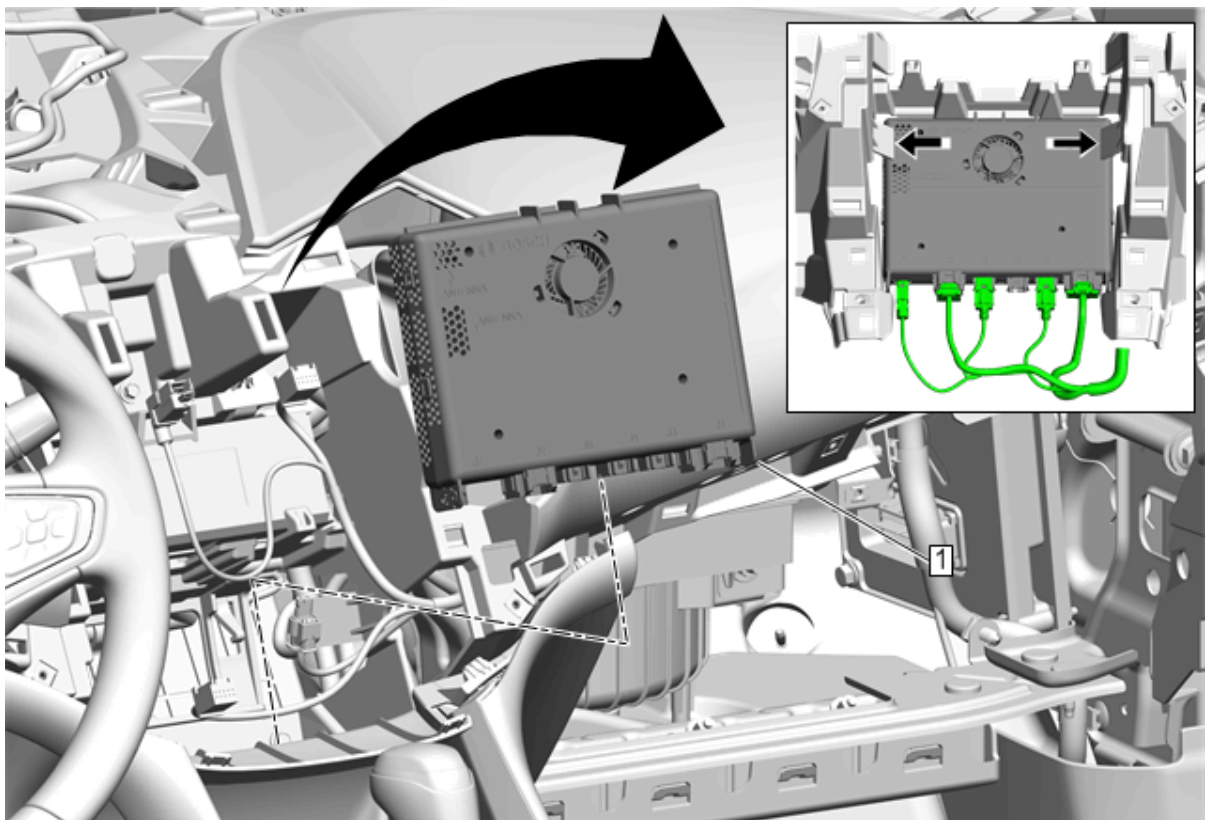


Fig. 42: Human Machine Interface Control Module

Courtesy of GENERAL MOTORS COMPANY

8. Remove **Human Machine Interface Control Module Replacement** (1)

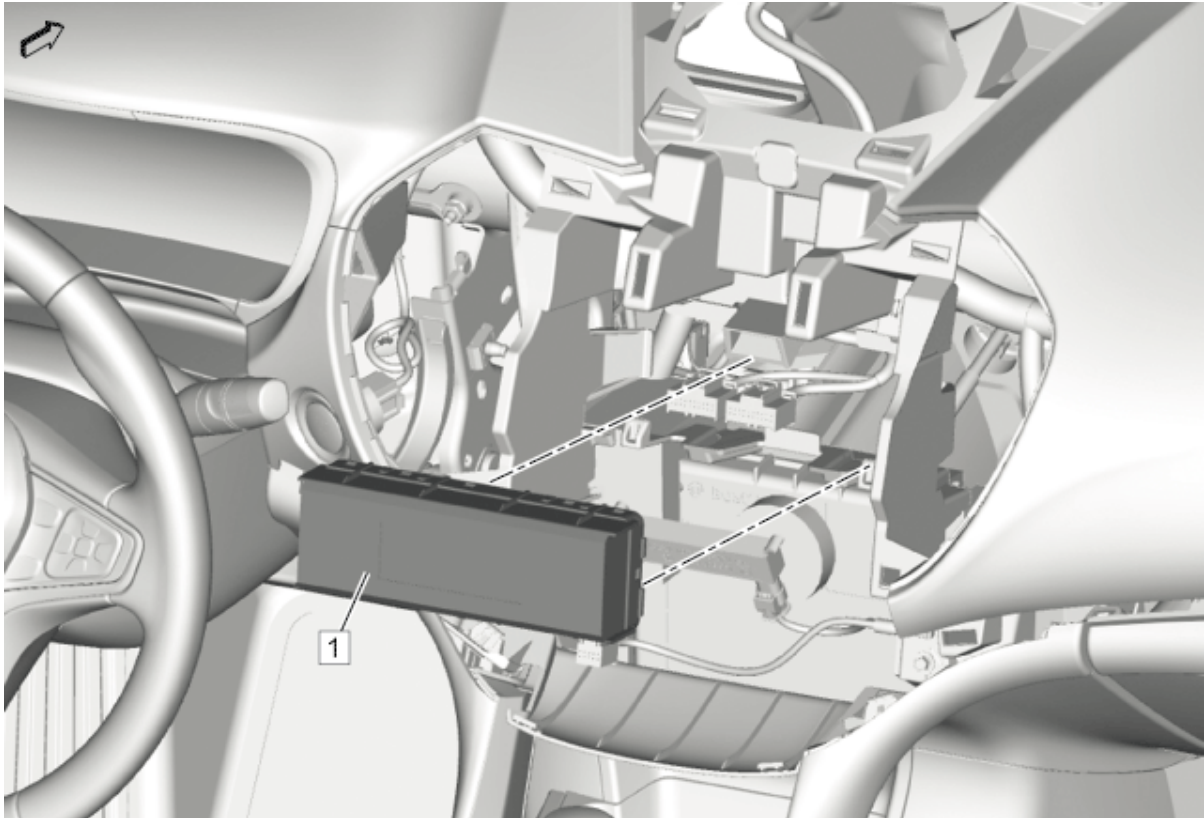


Fig. 43: Heater and Air Conditioning Remote Control

Courtesy of GENERAL MOTORS COMPANY

9. Remove **Heater and Air Conditioning Remote Control Replacement** (1)

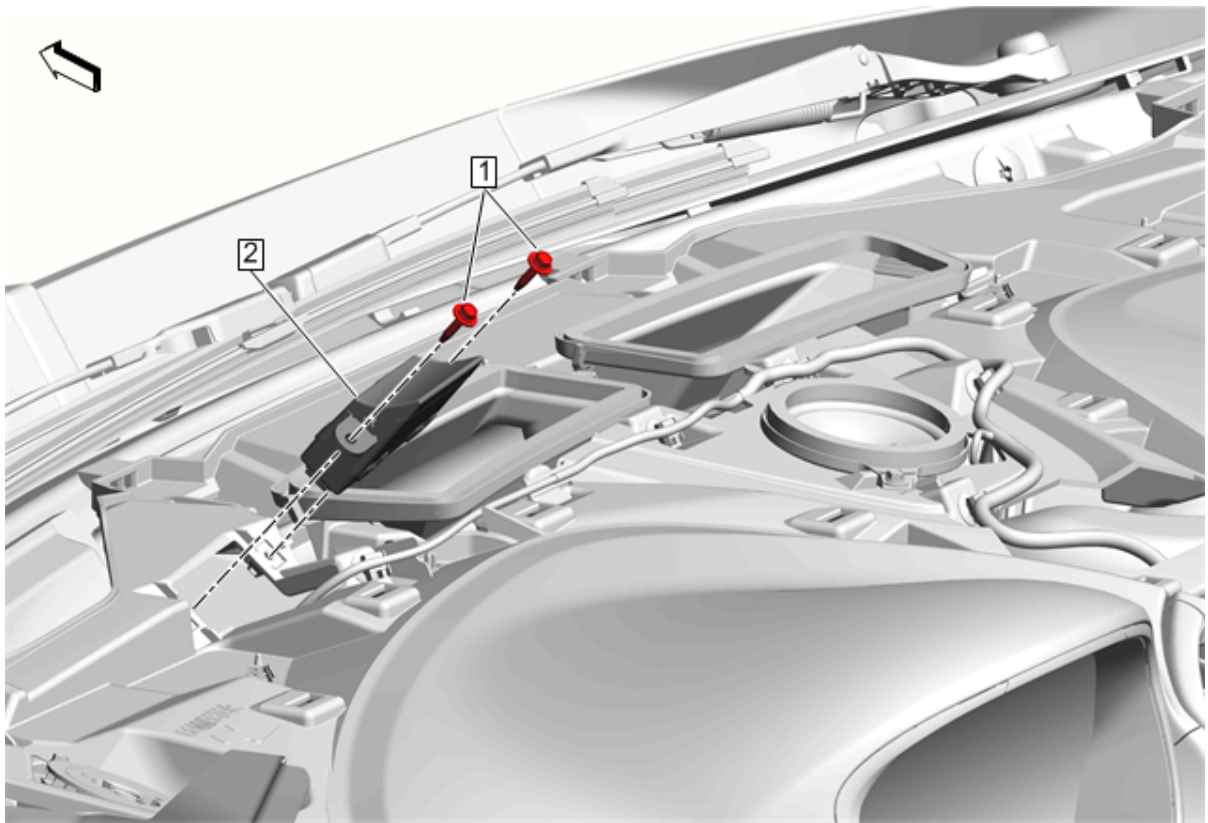


Fig. 44: Forward Collision Alert Display

Courtesy of GENERAL MOTORS COMPANY

10. Remove **Forward Collision Alert Display Replacement** (2)

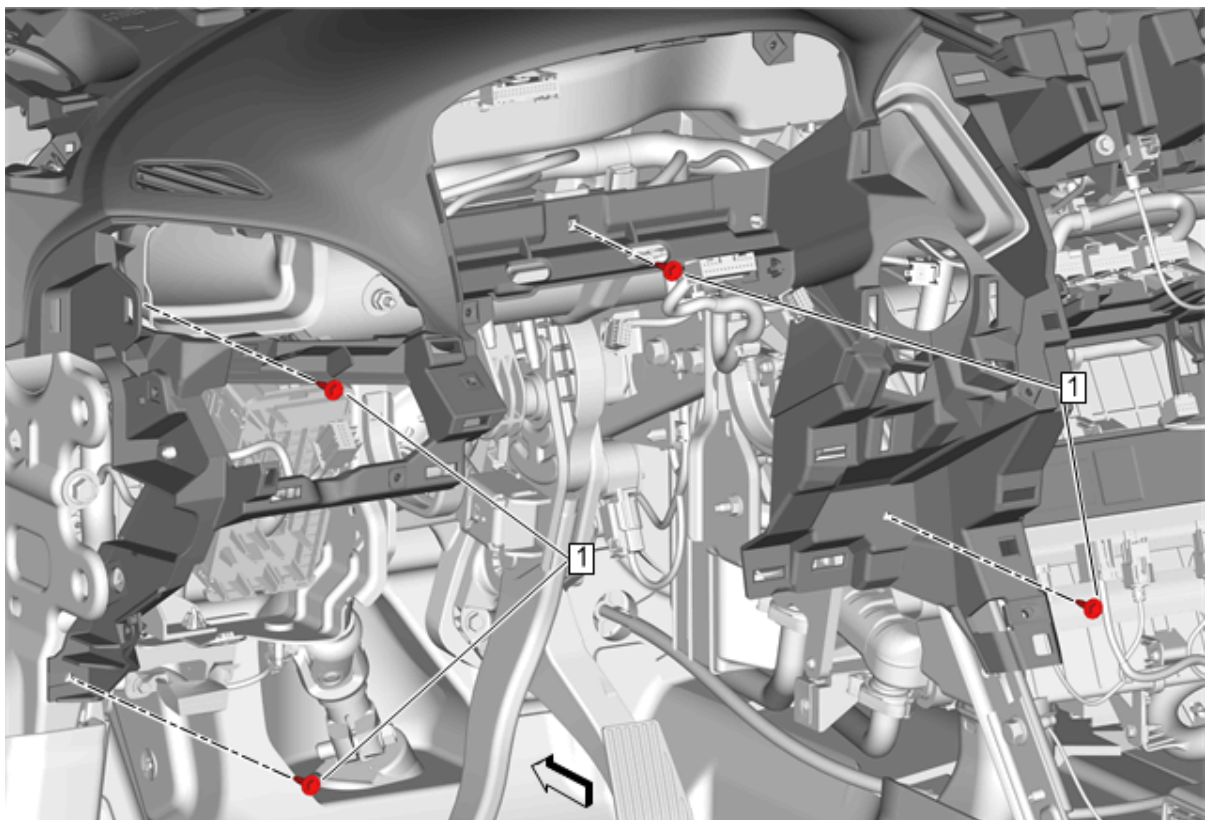


Fig. 45: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

11. Remove Instrument Panel Bolt (1)

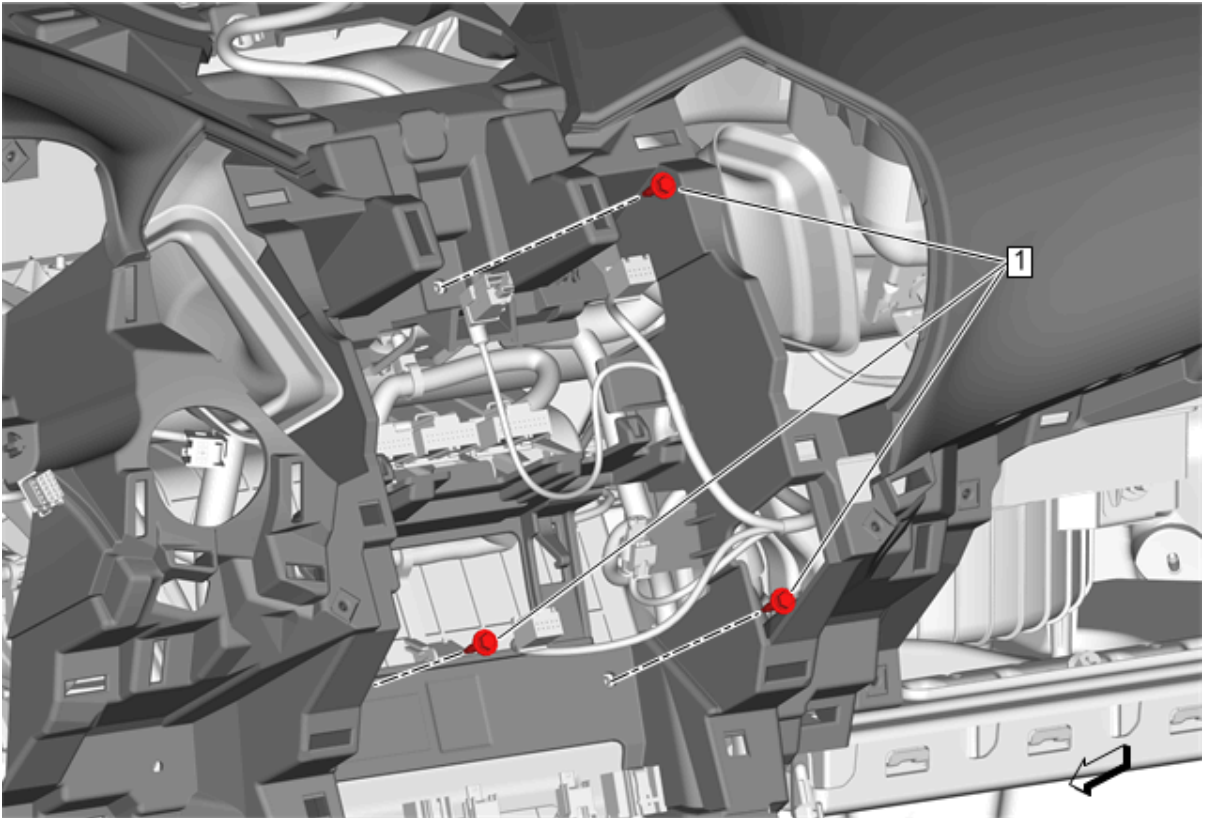


Fig. 46: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

12. Remove Instrument Panel Bolt (1)

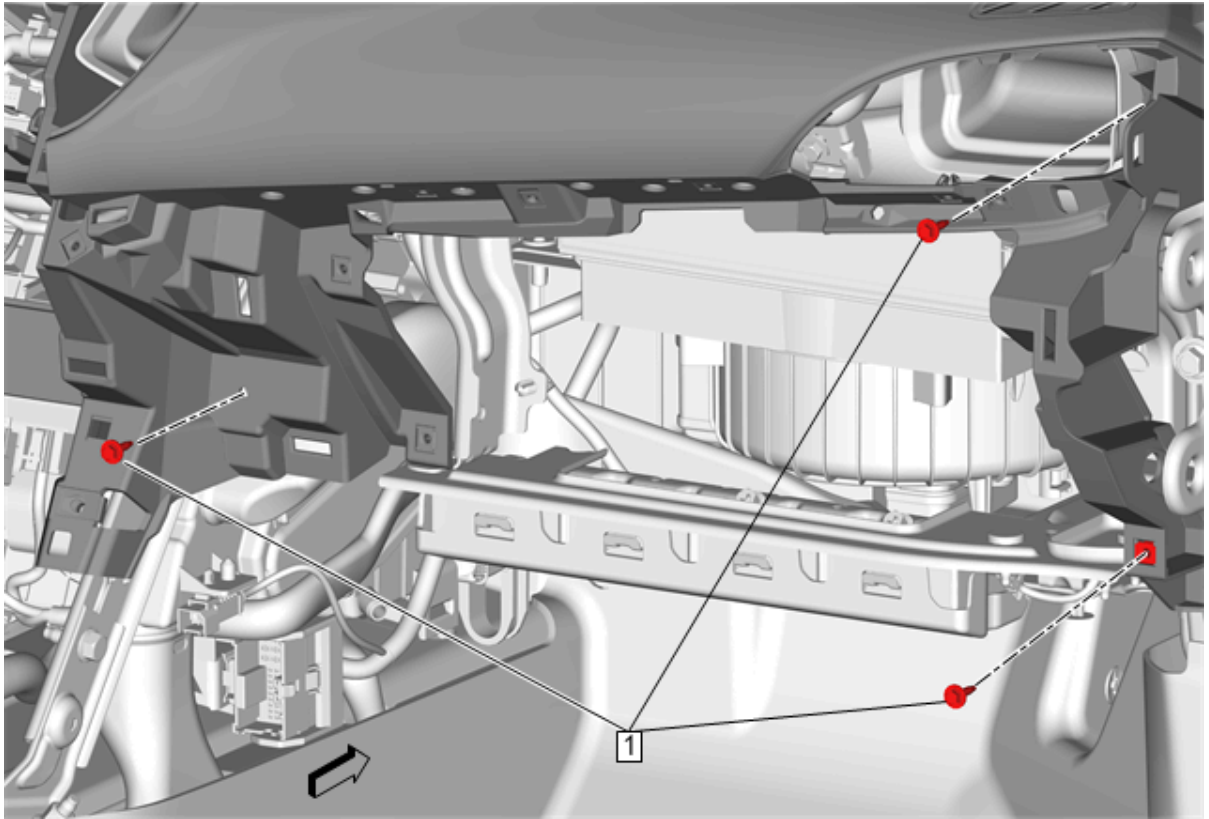


Fig. 47: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

13. Remove Instrument Panel Bolt (1)

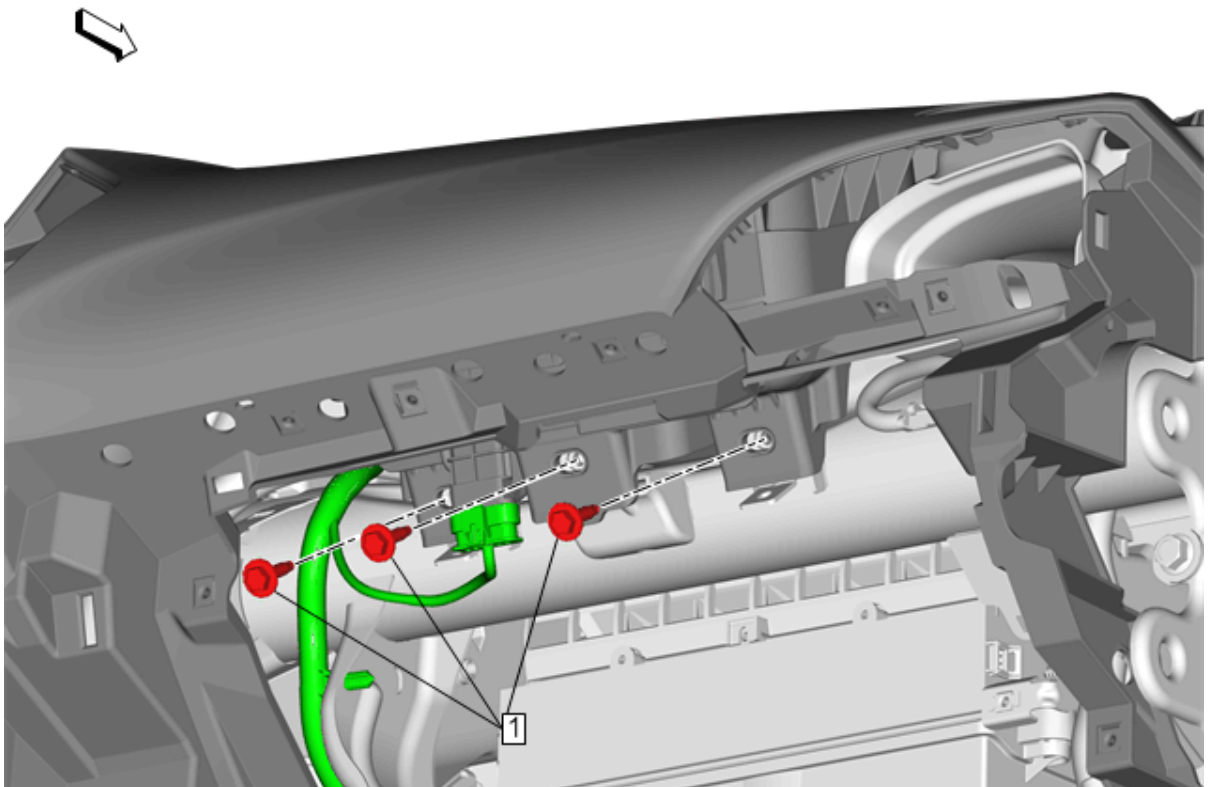


Fig. 48: Instrument Panel Airbag Bolt
Courtesy of GENERAL MOTORS COMPANY

14. Remove Instrument Panel Airbag Bolt (1)
15. Disconnect the electrical connector.

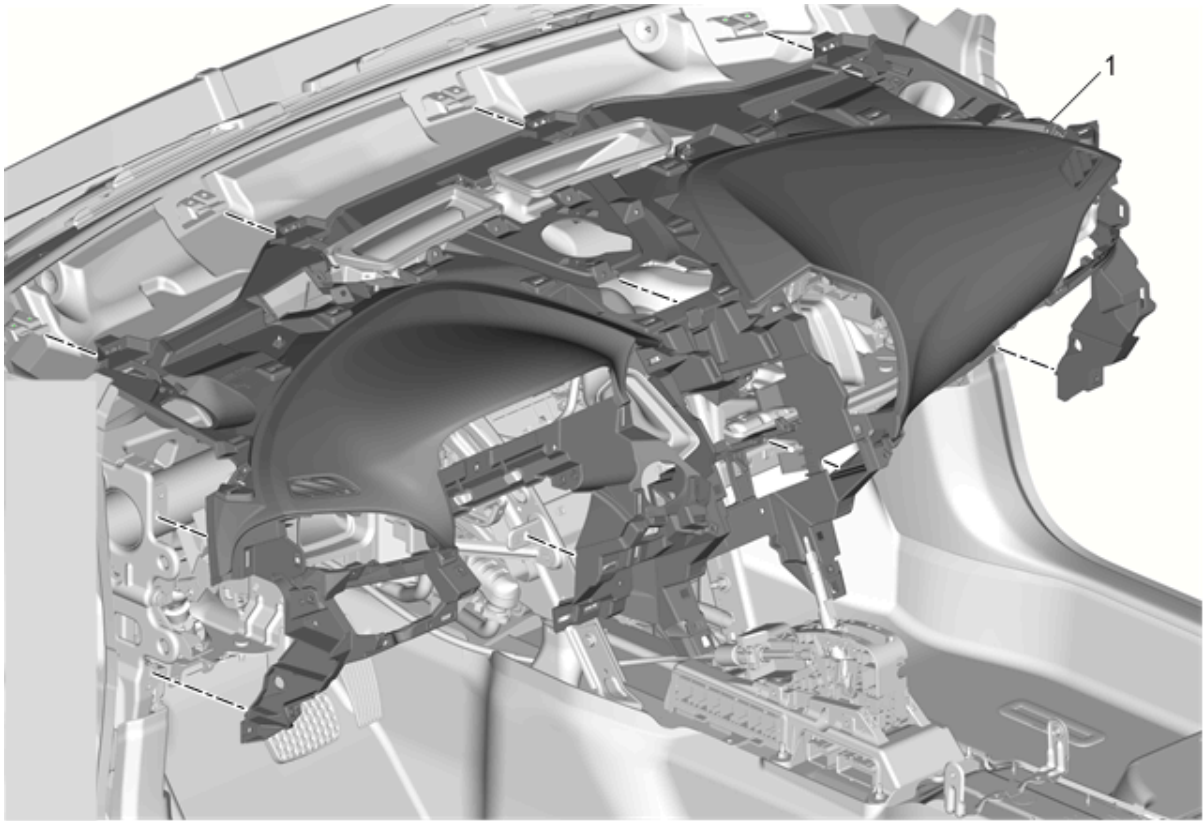


Fig. 49: Instrument Panel Carrier Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Note the location and routing of the instrument panel wiring harness prior to removal to ensure proper installation.
17. Disconnect the wiring harness from the instrument panel carrier.
18. With the aid of an assistant, remove the instrument panel carrier assembly from the vehicle.(1)
19. Transfer components as necessary.

Installation Procedure

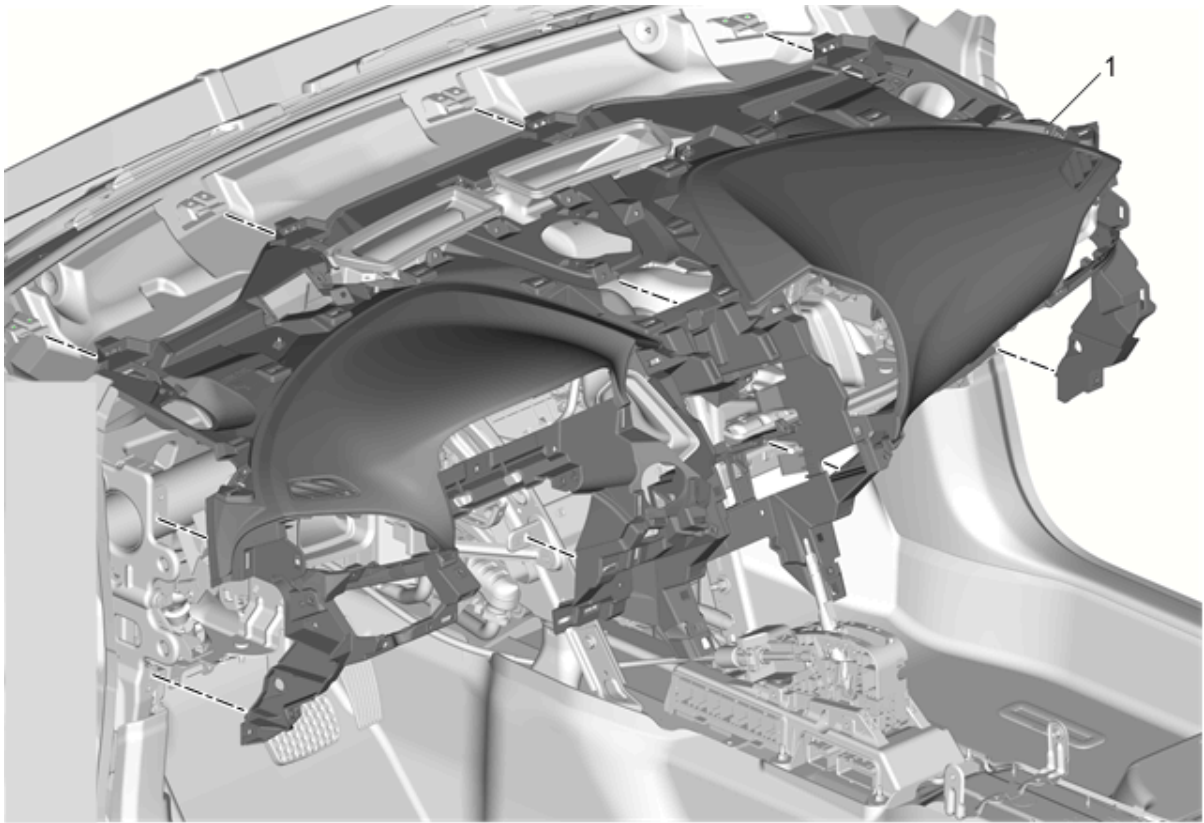


Fig. 50: Instrument Panel Carrier Assembly

Courtesy of GENERAL MOTORS COMPANY

1. With the aid of an assistant, position the instrument carrier in the vehicle.(1)
2. Reposition the instrument panel wiring harness into the vehicle position as was noted in the removal and connect the fasteners securing the instrument panel wiring harness to the instrument carrier.

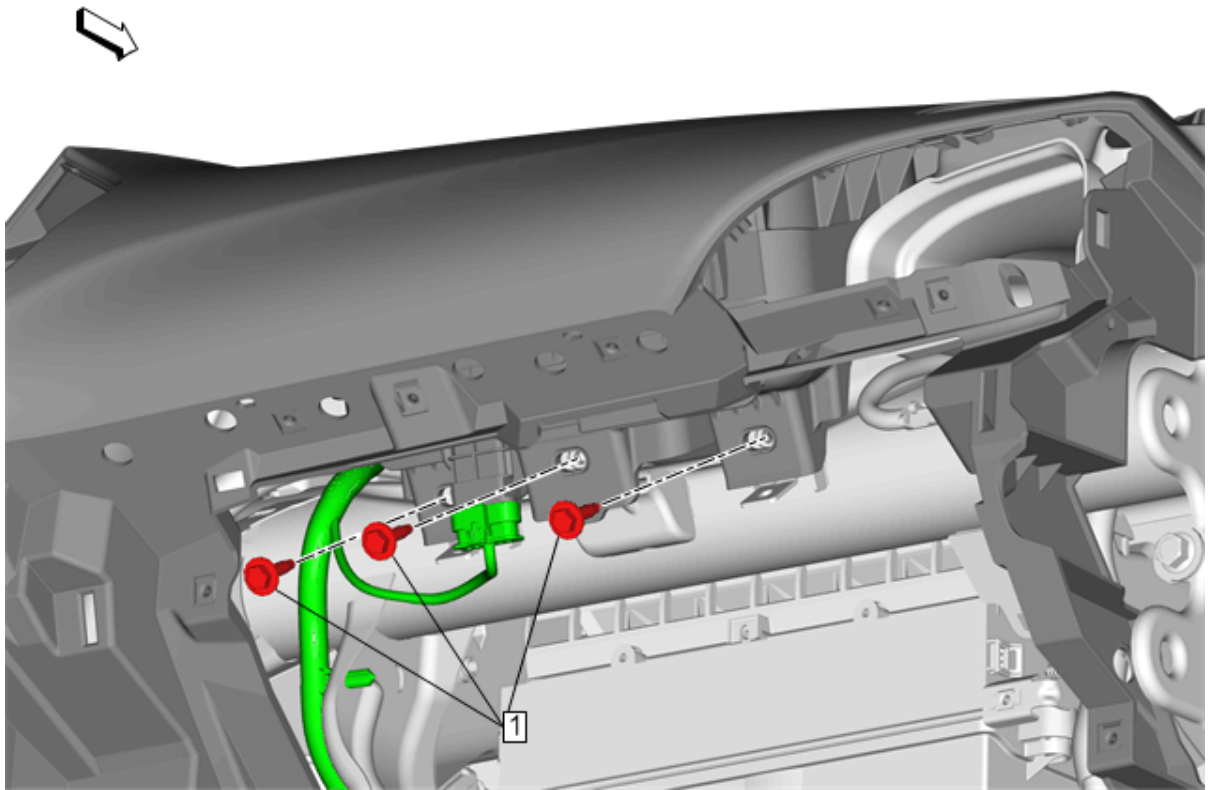


Fig. 51: Instrument Panel Airbag Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Instrument Panel Airbag Bolt (1) and tighten 9 N.m (7 lb ft)
4. Connect the electrical connector.

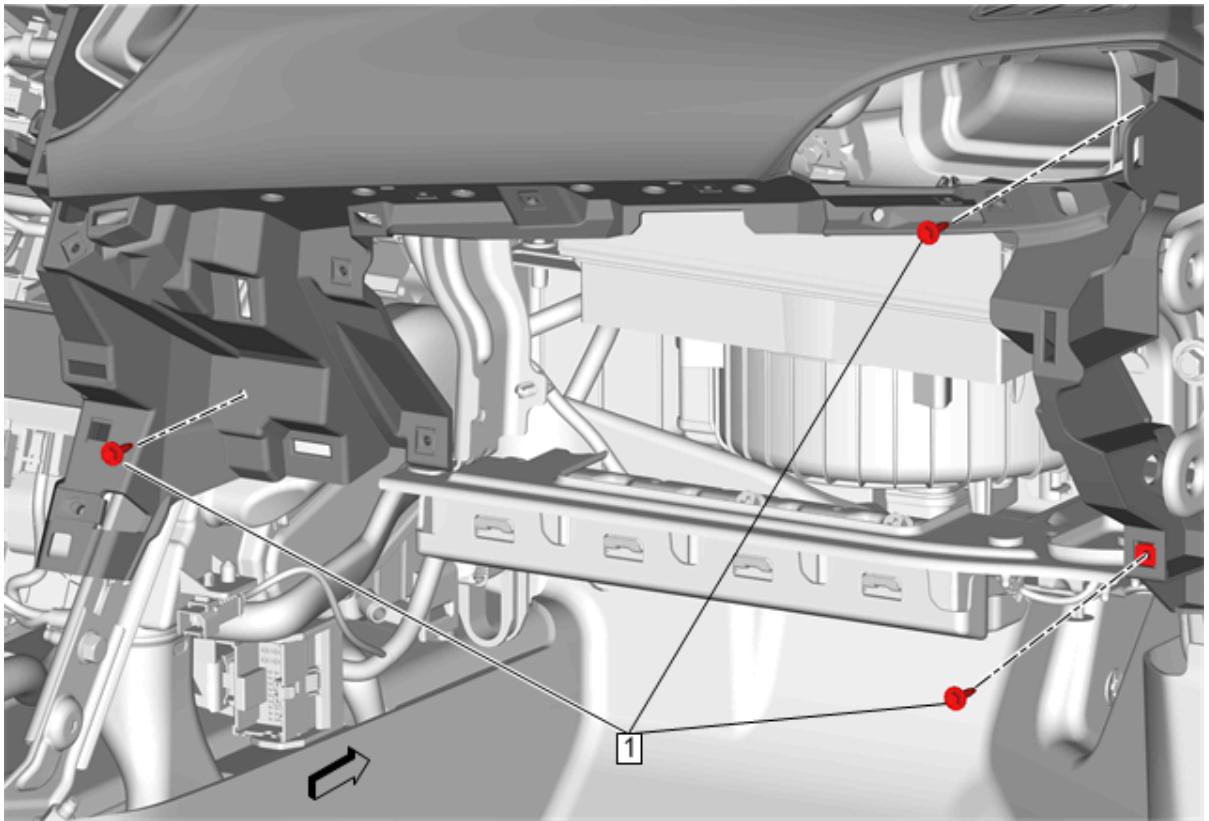


Fig. 52: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Install Instrument Panel Bolt (1) and tighten 2.5 N.m (22 lb in)

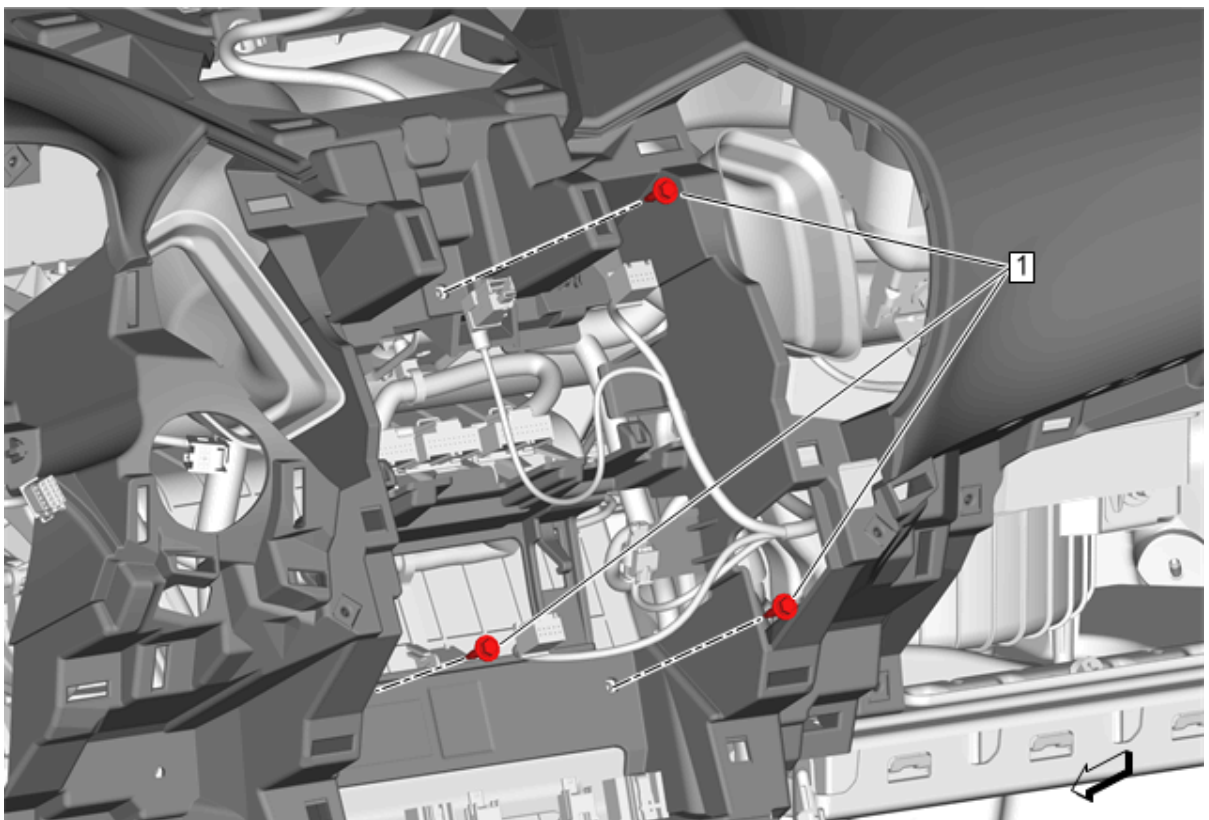


Fig. 53: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Install Instrument Panel Bolt (1) and tighten 2.5 N.m (22 lb in)

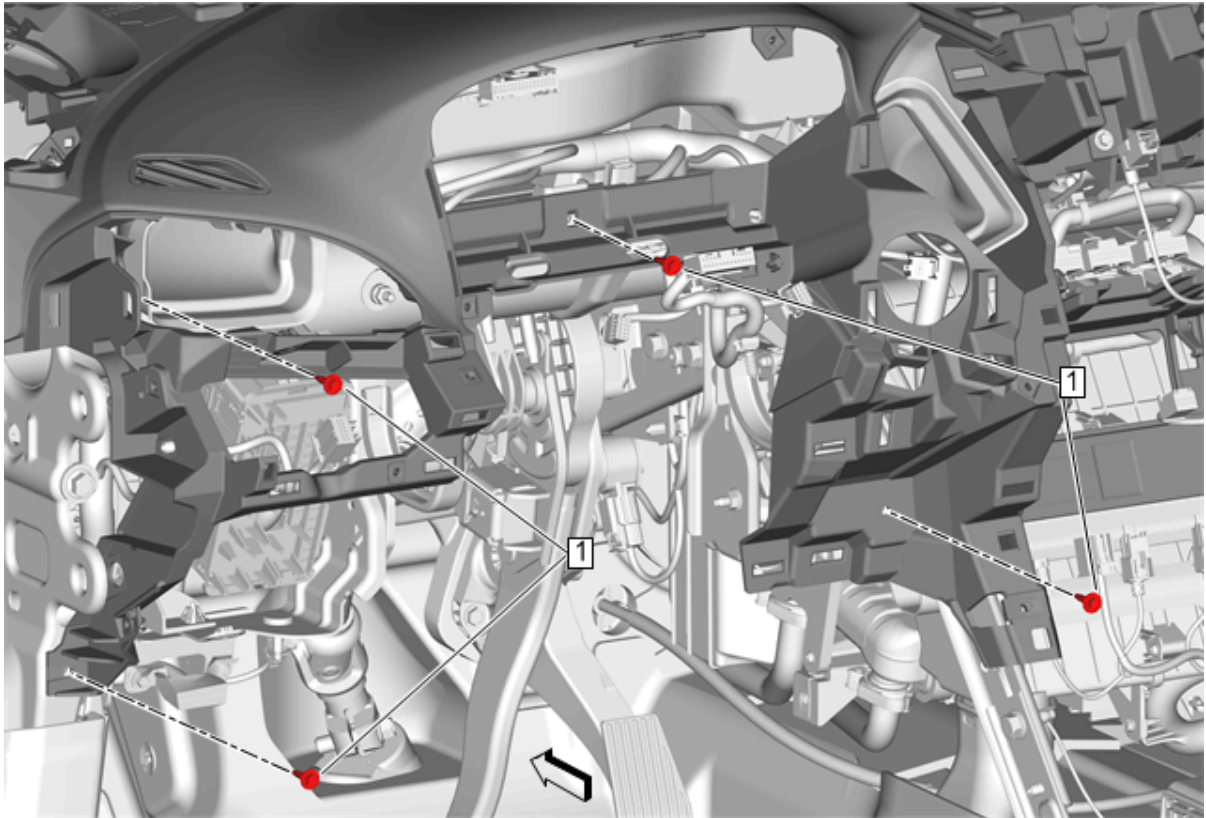


Fig. 54: Instrument Panel Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Install Instrument Panel Bolt (1) and tighten 2.5 N.m (22 lb in)

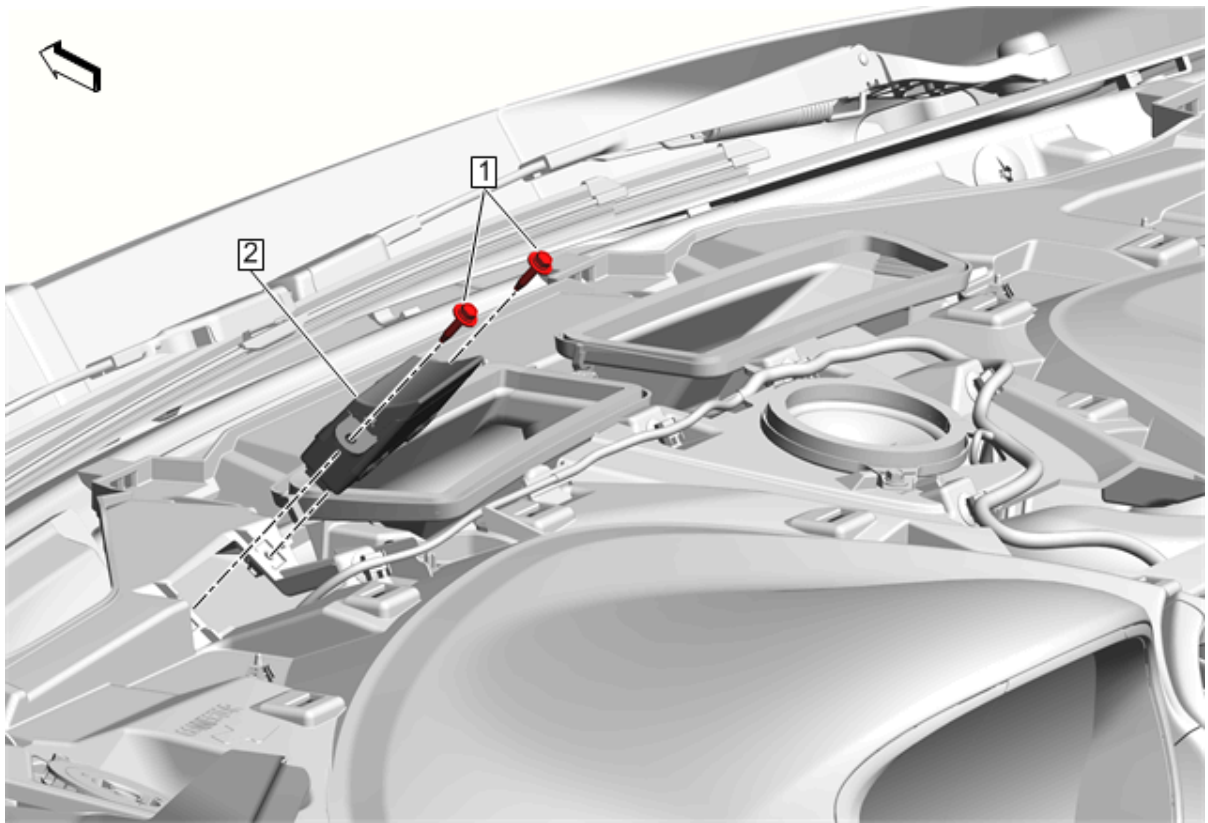


Fig. 55: Forward Collision Alert Display

Courtesy of GENERAL MOTORS COMPANY

8. Install **Forward Collision Alert Display Replacement** (2)

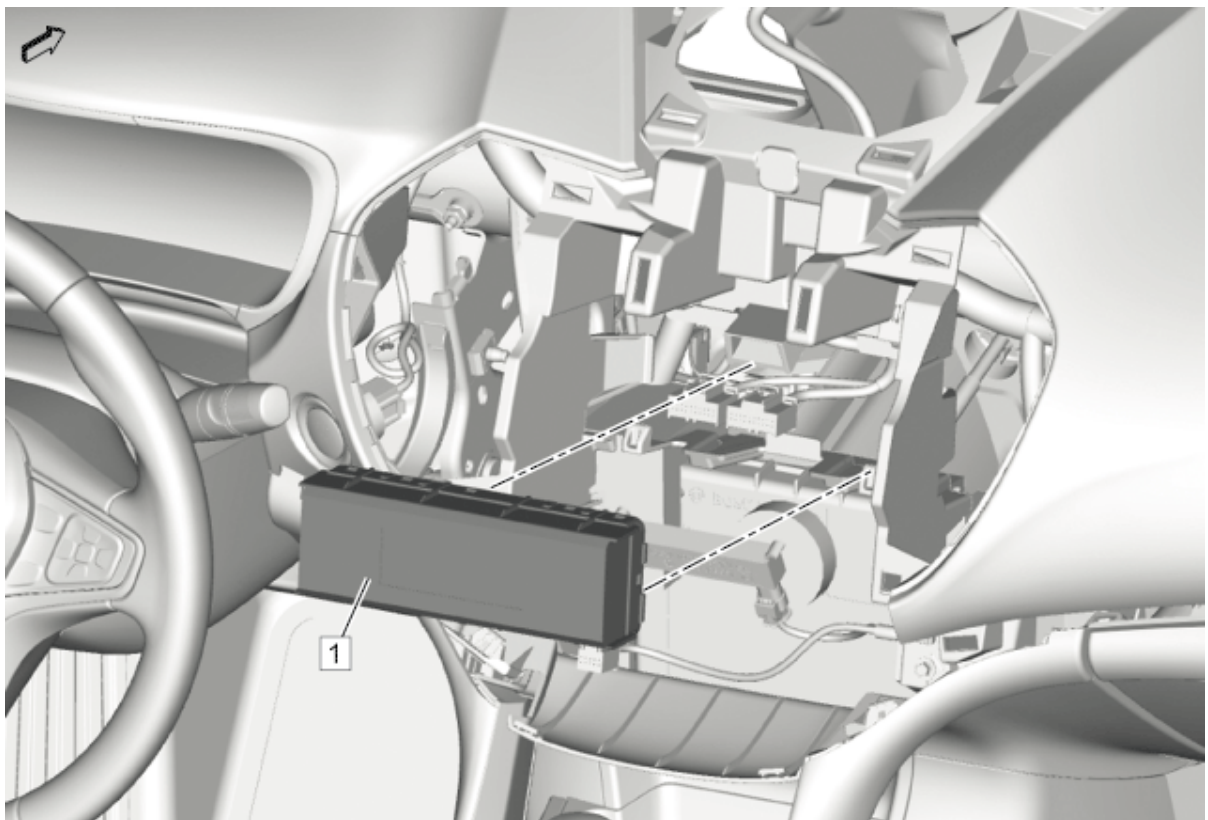


Fig. 56: Heater and Air Conditioning Remote Control

Courtesy of GENERAL MOTORS COMPANY

9. Install **Heater and Air Conditioning Remote Control Replacement** (1)

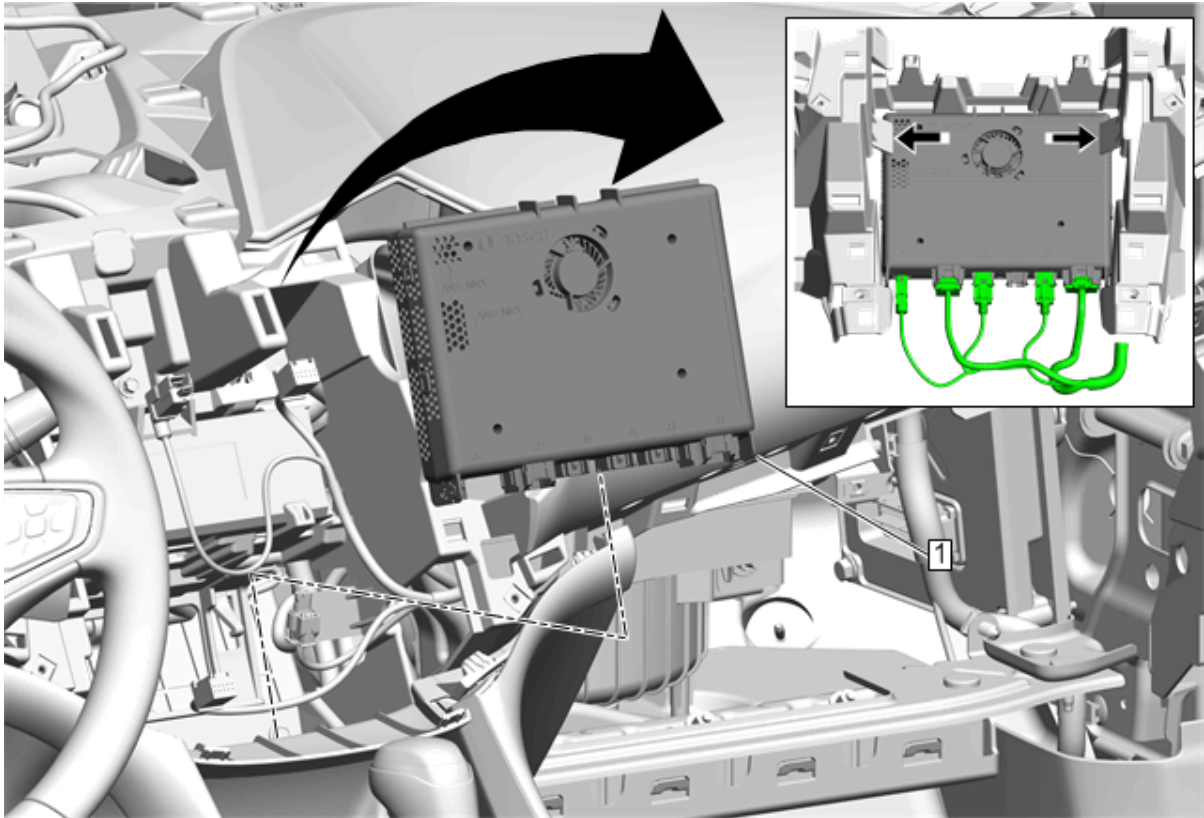


Fig. 57: Human Machine Interface Control Module

Courtesy of GENERAL MOTORS COMPANY

10. Install **Human Machine Interface Control Module Replacement** (1)

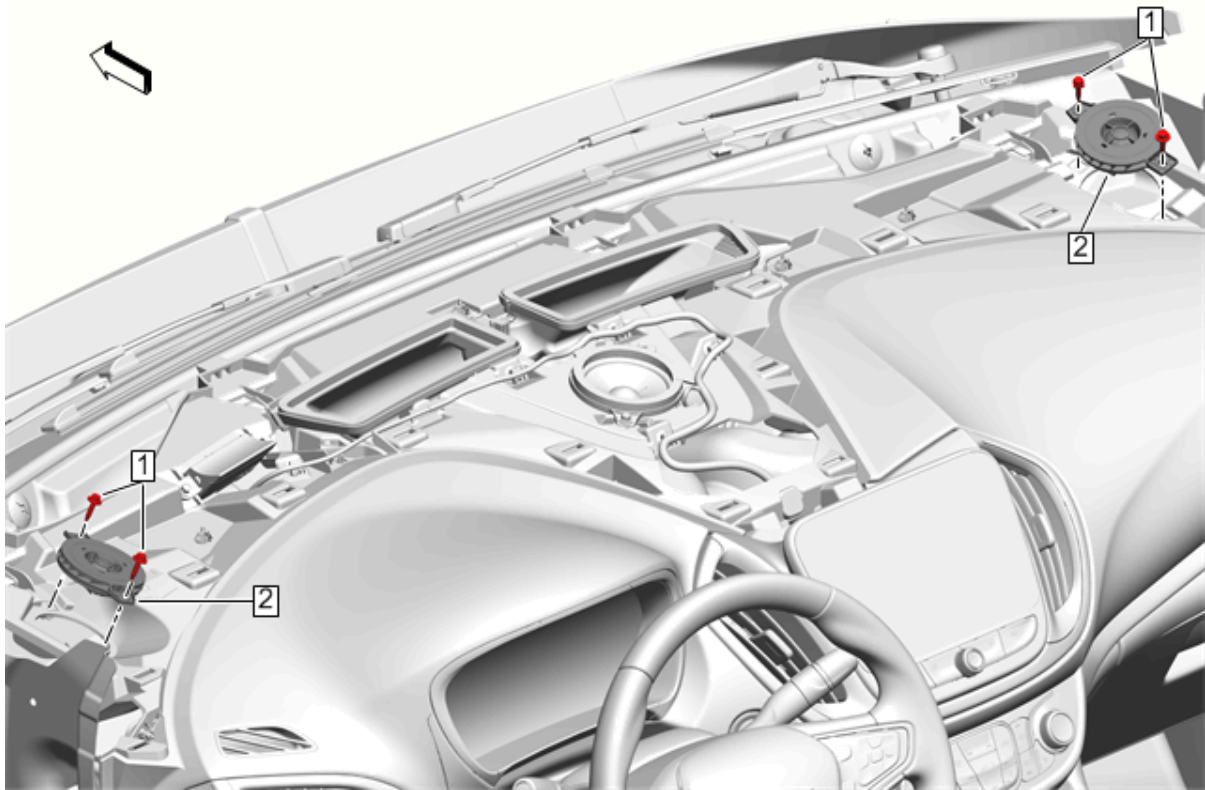


Fig. 58: Radio Front Speaker

Courtesy of GENERAL MOTORS COMPANY

11. Install **Radio Front Speaker Replacement** (2)

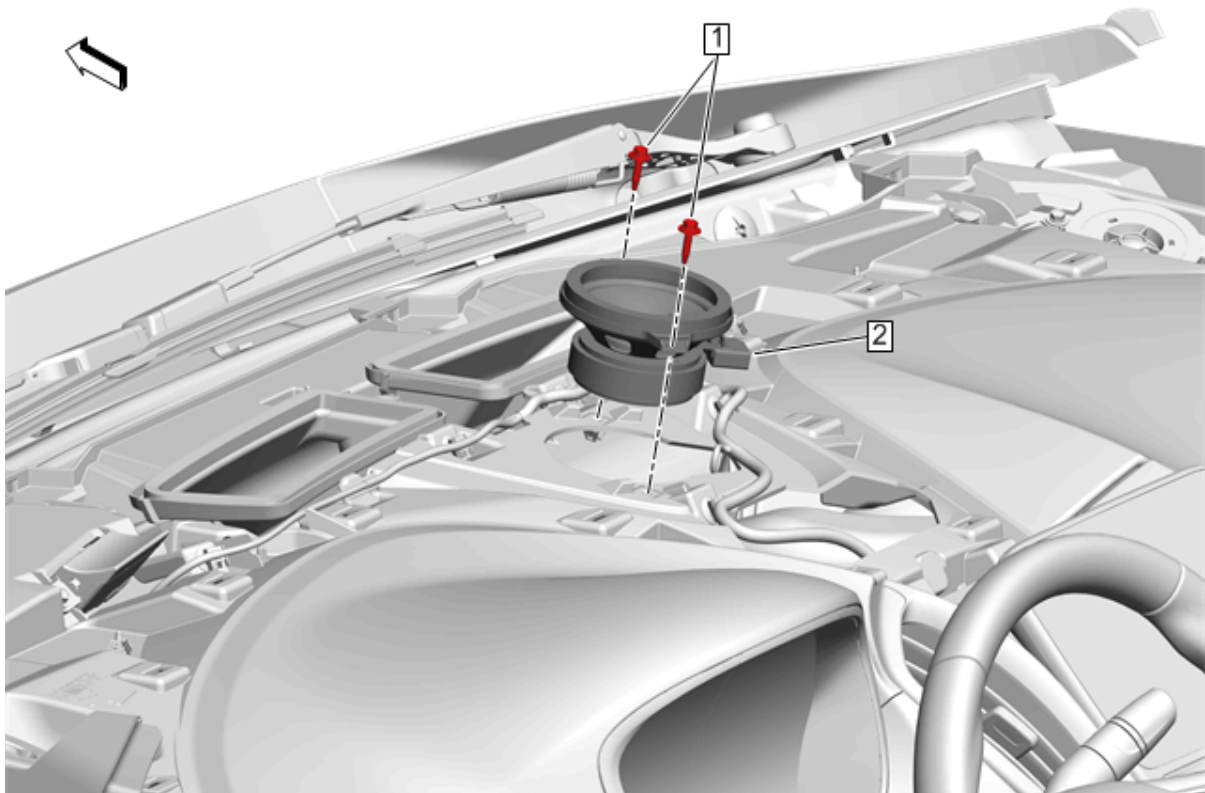


Fig. 59: Radio Front Center Speaker

Courtesy of GENERAL MOTORS COMPANY

12. Install **Radio Front Center Speaker Replacement** (2)

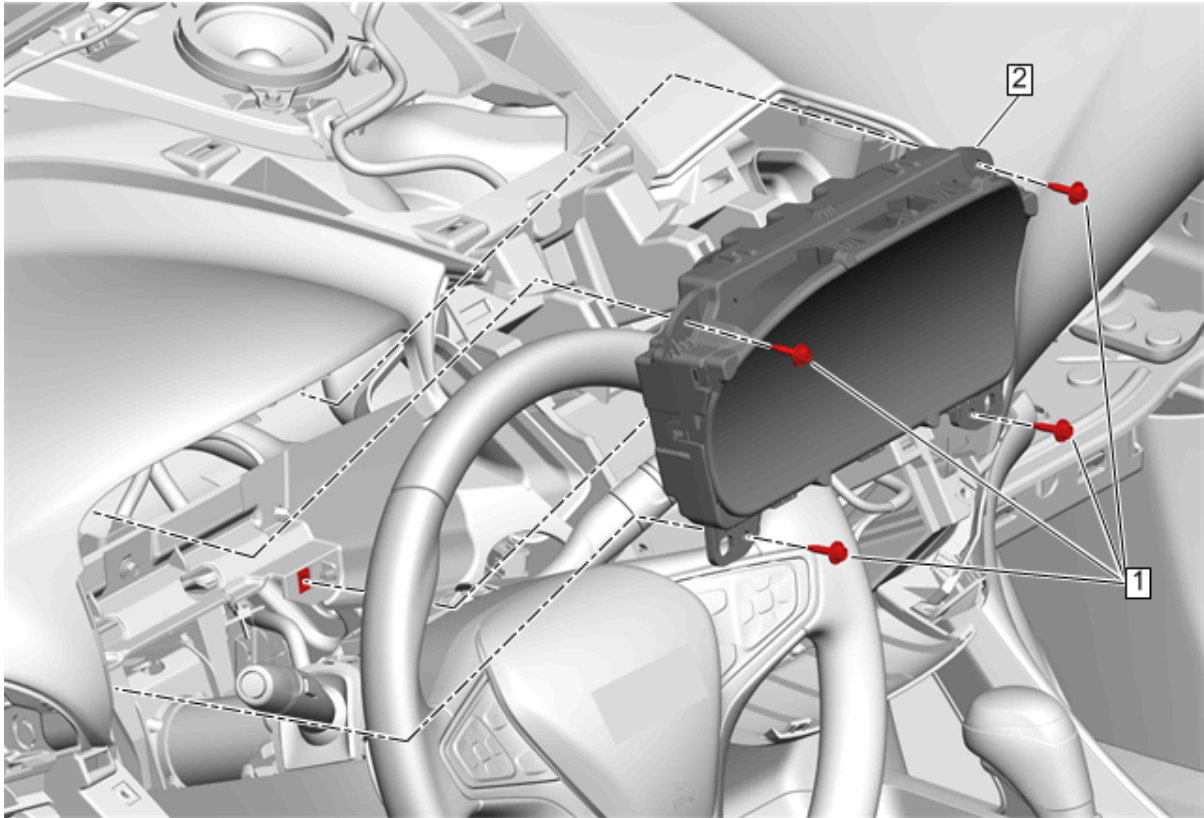


Fig. 60: Instrument Cluster

Courtesy of GENERAL MOTORS COMPANY

13. Install **Instrument Cluster Replacement** (2)

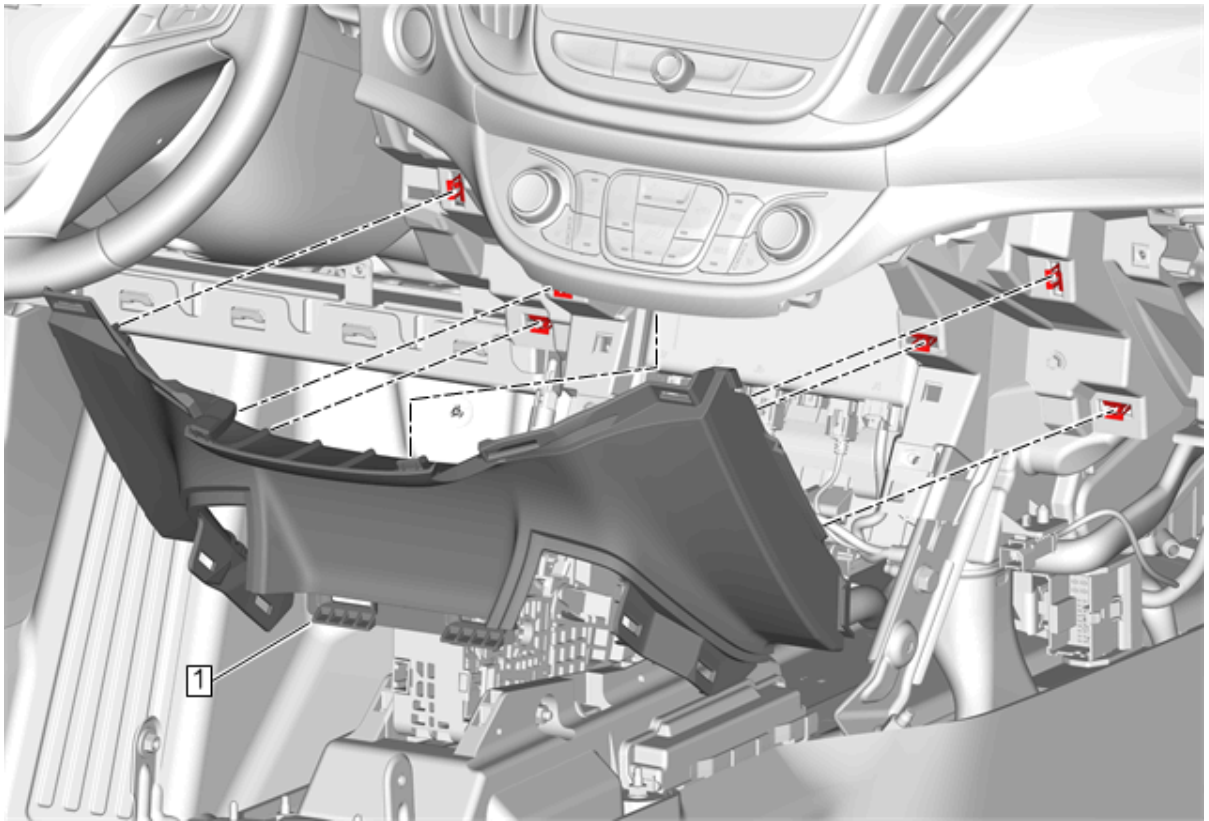


Fig. 61: Instrument Panel Lower Center Trim Panel

Courtesy of GENERAL MOTORS COMPANY

14. Install Instrument Panel Lower Center Trim Panel Replacement (Upper)Instrument Panel Lower Center Trim Panel Replacement (Lower) (1)

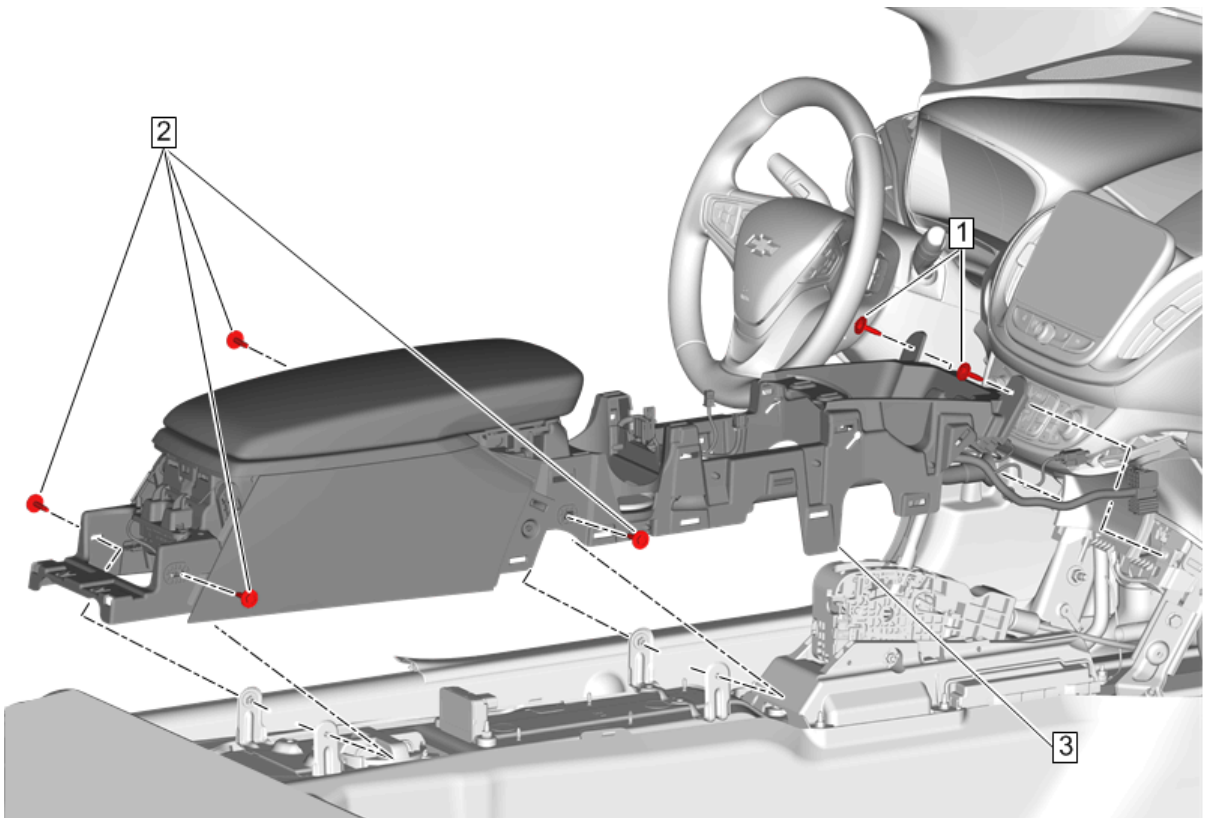


Fig. 62: Front Floor Console

Courtesy of GENERAL MOTORS COMPANY

15. Install **Front Floor Console Replacement** (3)

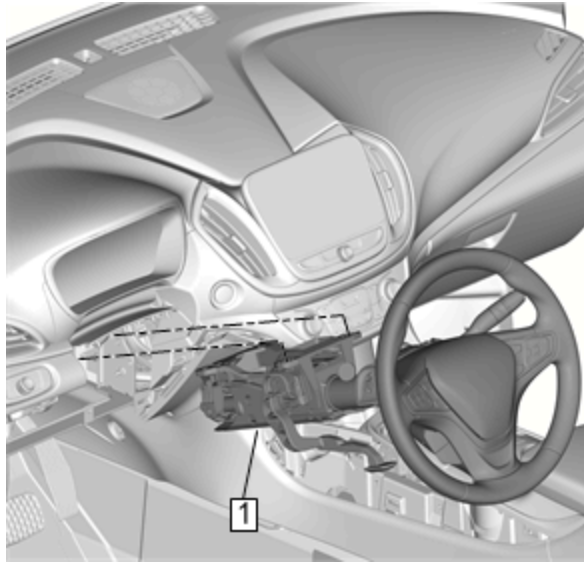


Fig. 63: Steering Column

Courtesy of GENERAL MOTORS COMPANY

16. Install **Steering Column Replacement** (1)
17. Enable the SIR System. **SIR Disabling and Enabling**

INSTRUMENT PANEL TIE BAR REPLACEMENT

Removal Procedure

1. Remove **Instrument Panel Assembly Replacement**

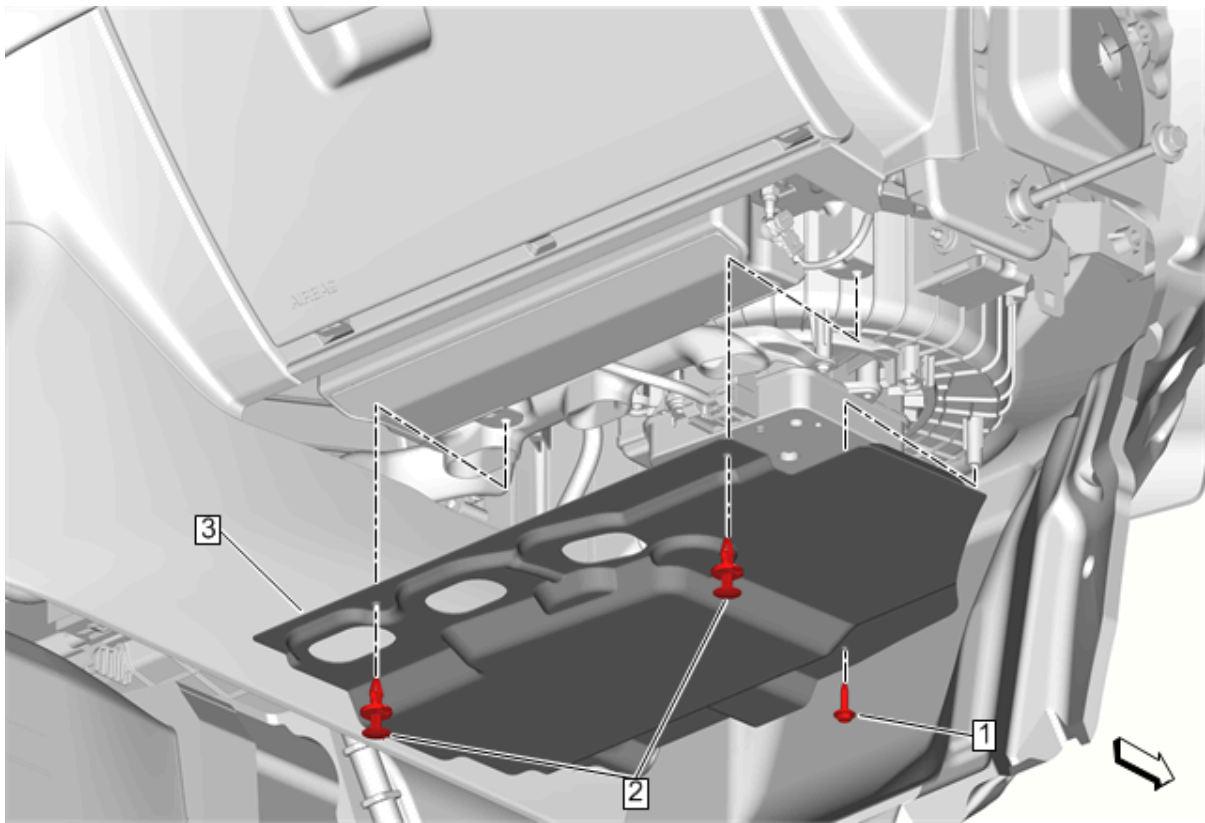


Fig. 64: Instrument Panel Lower Trim Panel Insulator
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Instrument Panel Lower Trim Panel Insulator Replacement (3)



Fig. 65: Instrument Panel Lower Airbag - Passenger Side

Courtesy of GENERAL MOTORS COMPANY

3. Remove **Instrument Panel Lower Airbag Replacement - Passenger Side** (2)

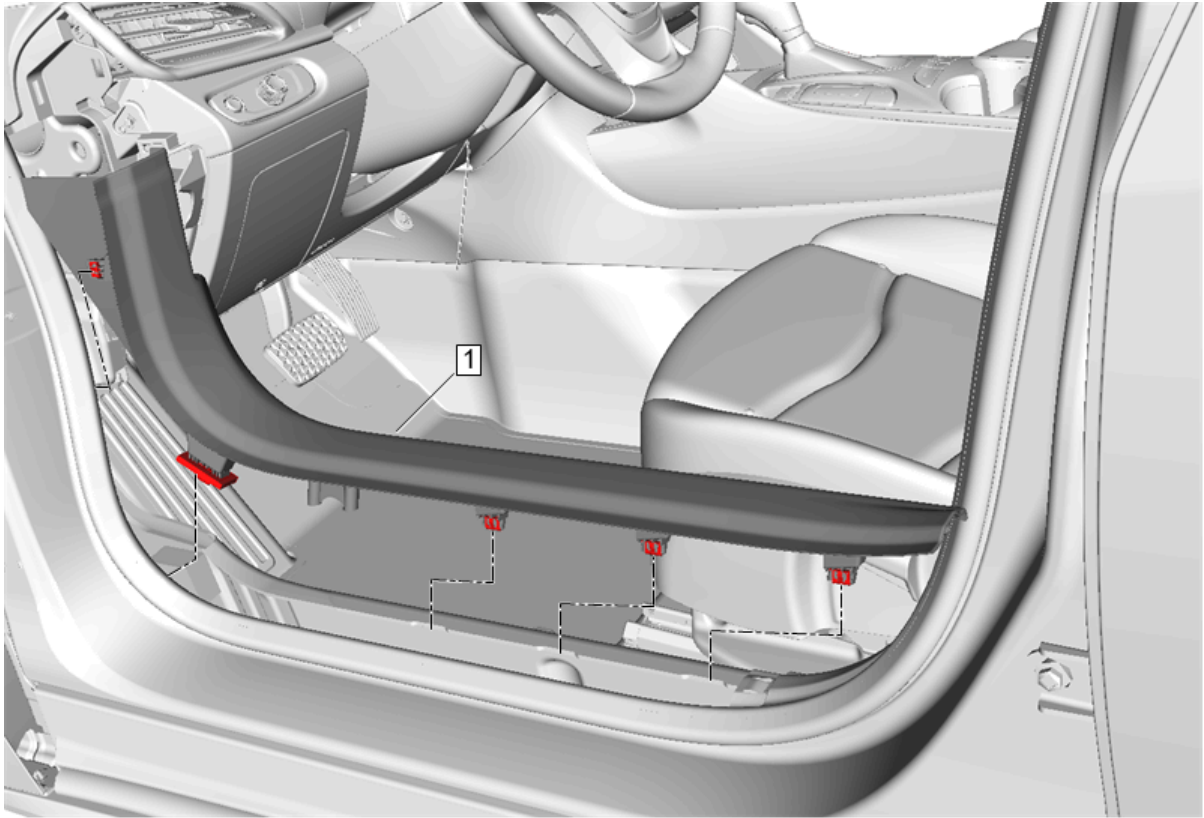


Fig. 66: Front Side Door Sill Trim Plate

Courtesy of GENERAL MOTORS COMPANY

4. Remove **Front Side Door Sill Trim Plate Replacement** (1)

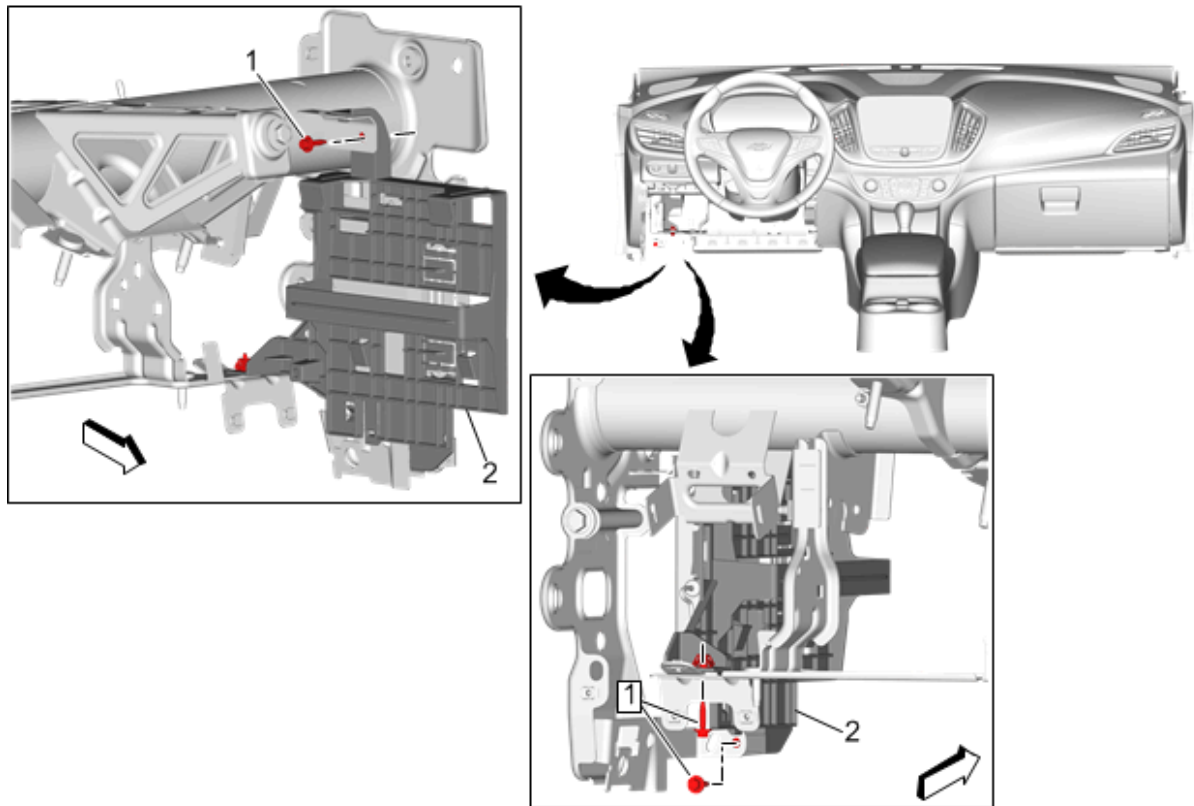


Fig. 67: Communication Interface Module Bracket

Courtesy of GENERAL MOTORS COMPANY

5. Remove **Communication Interface Module Bracket Replacement** (2)

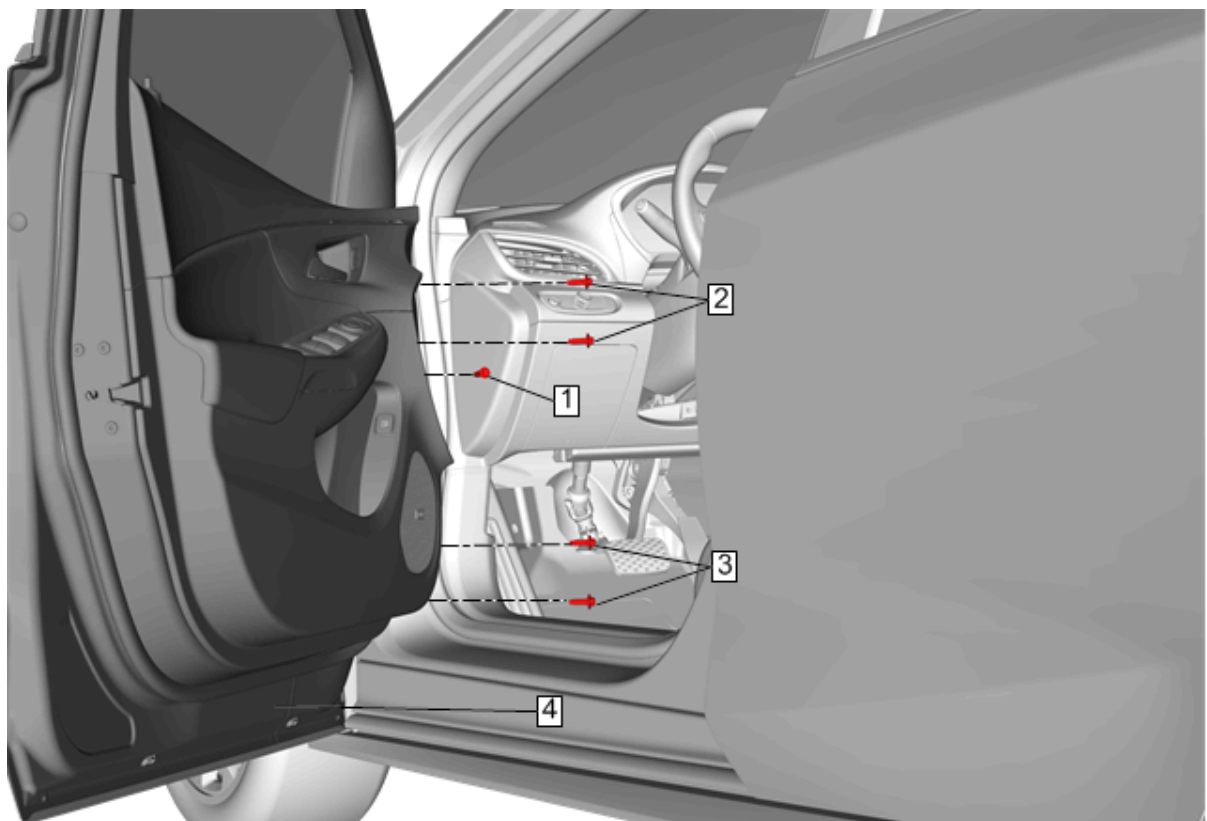


Fig. 68: Front Side Door

Courtesy of GENERAL MOTORS COMPANY

6. Remove **Front Side Door Replacement** (4)

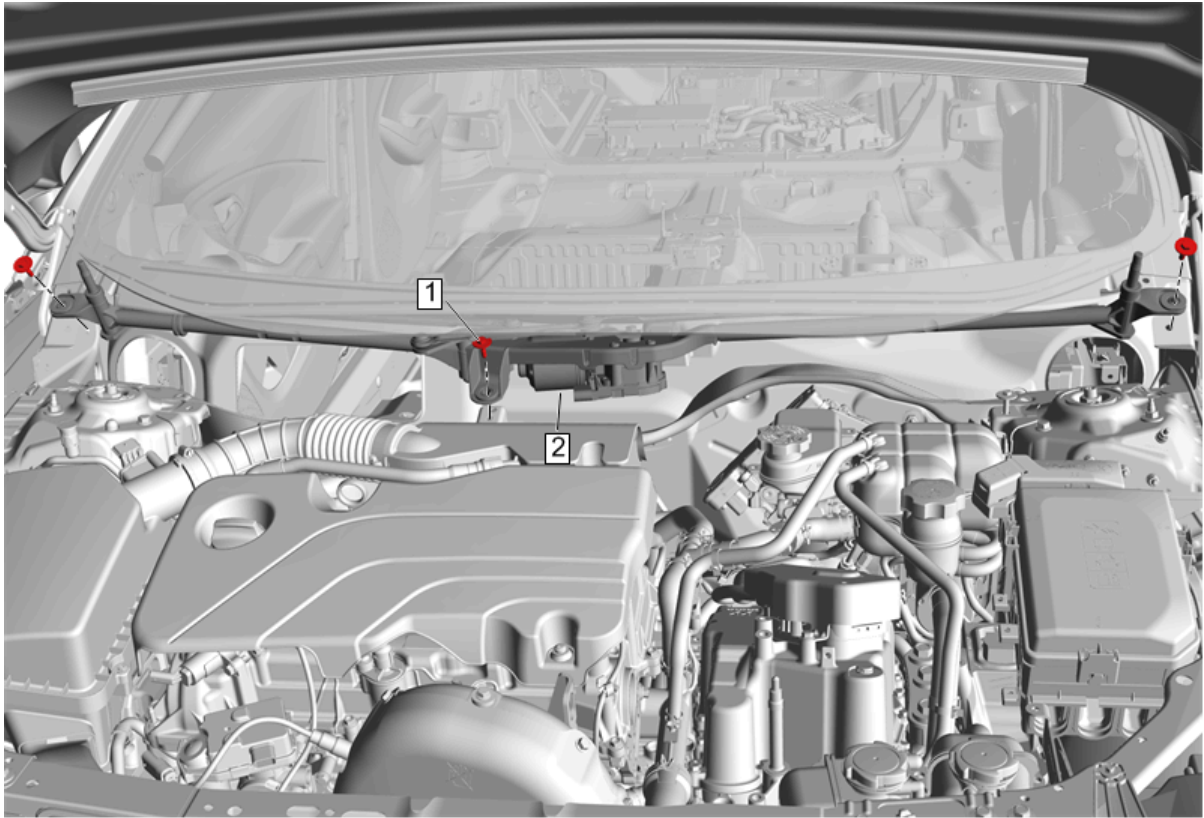


Fig. 69: Windshield Wiper System Module

Courtesy of GENERAL MOTORS COMPANY

7. Remove **Windshield Wiper System Module Replacement** (2)

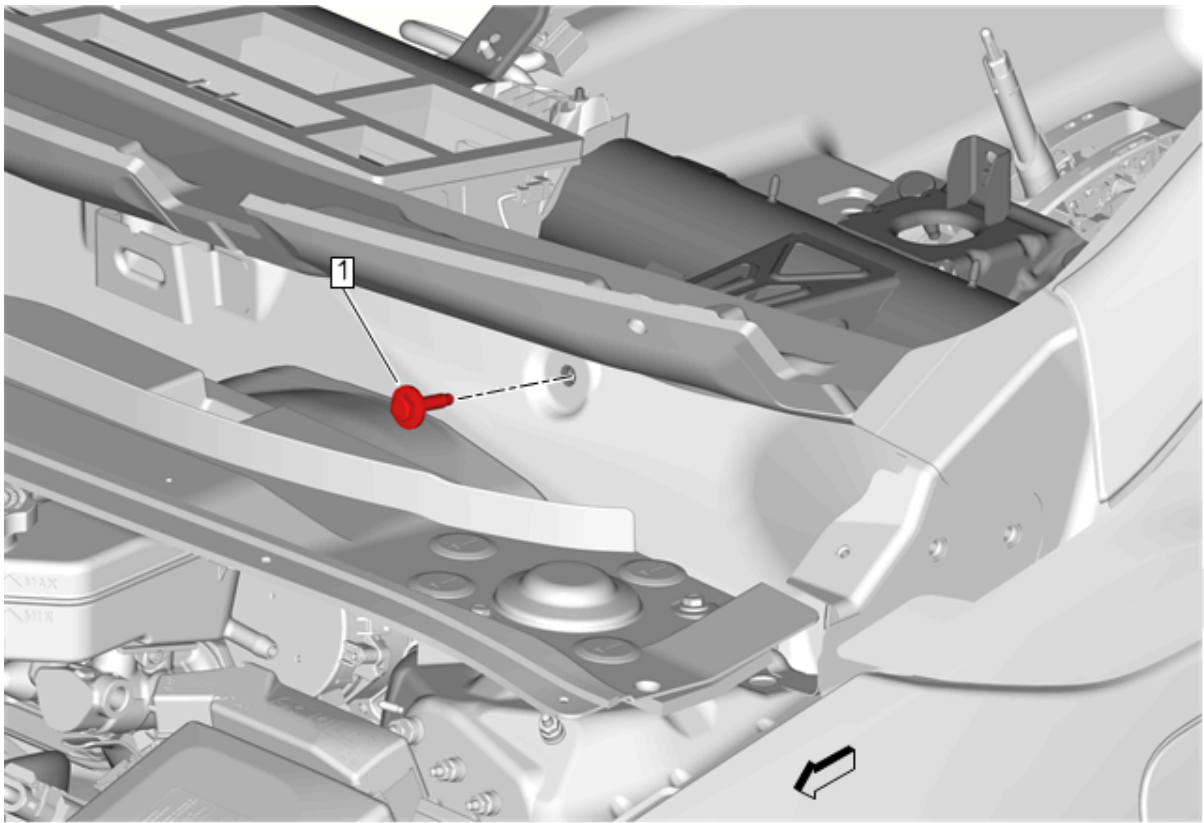


Fig. 70: Instrument Panel Upper Bolt
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Instrument Panel Upper Bolt (1)

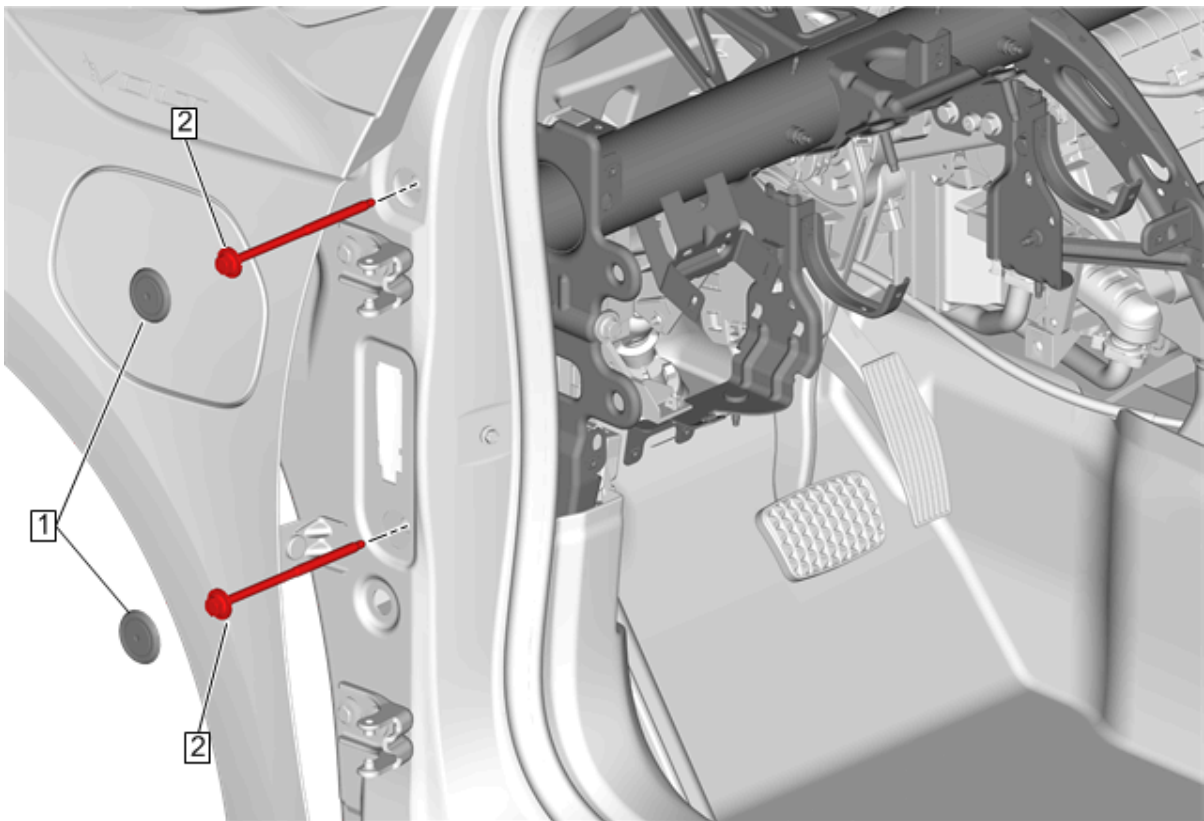


Fig. 71: Body Hinge Pillar Outer Panel Hole Plug And Bolt

Courtesy of GENERAL MOTORS COMPANY

9. Remove Body Hinge Pillar Outer Panel Hole Plug (1)
10. Remove Instrument Panel Bolt (2)

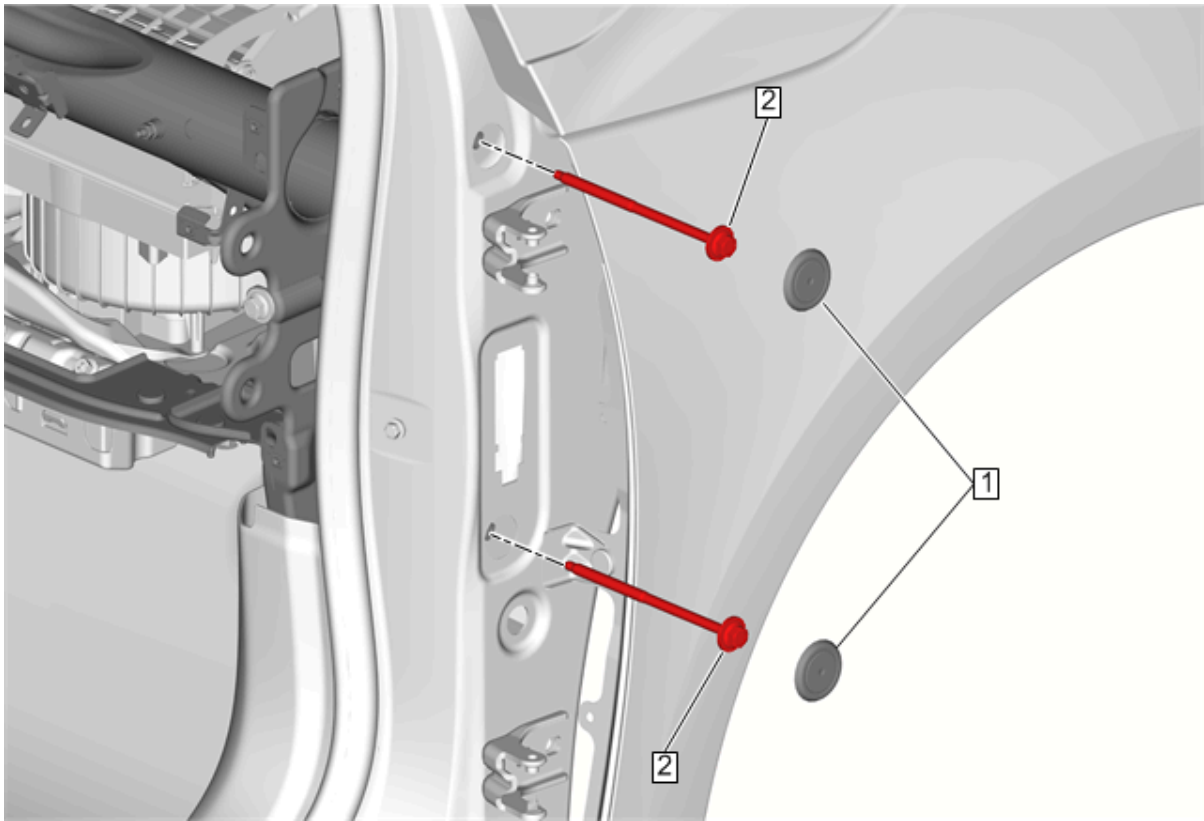


Fig. 72: Body Hinge Pillar Outer Panel Hole Plug And Bolt

Courtesy of GENERAL MOTORS COMPANY

11. Remove Body Hinge Pillar Outer Panel Hole Plug (1)
12. Remove Instrument Panel Bolt (2)

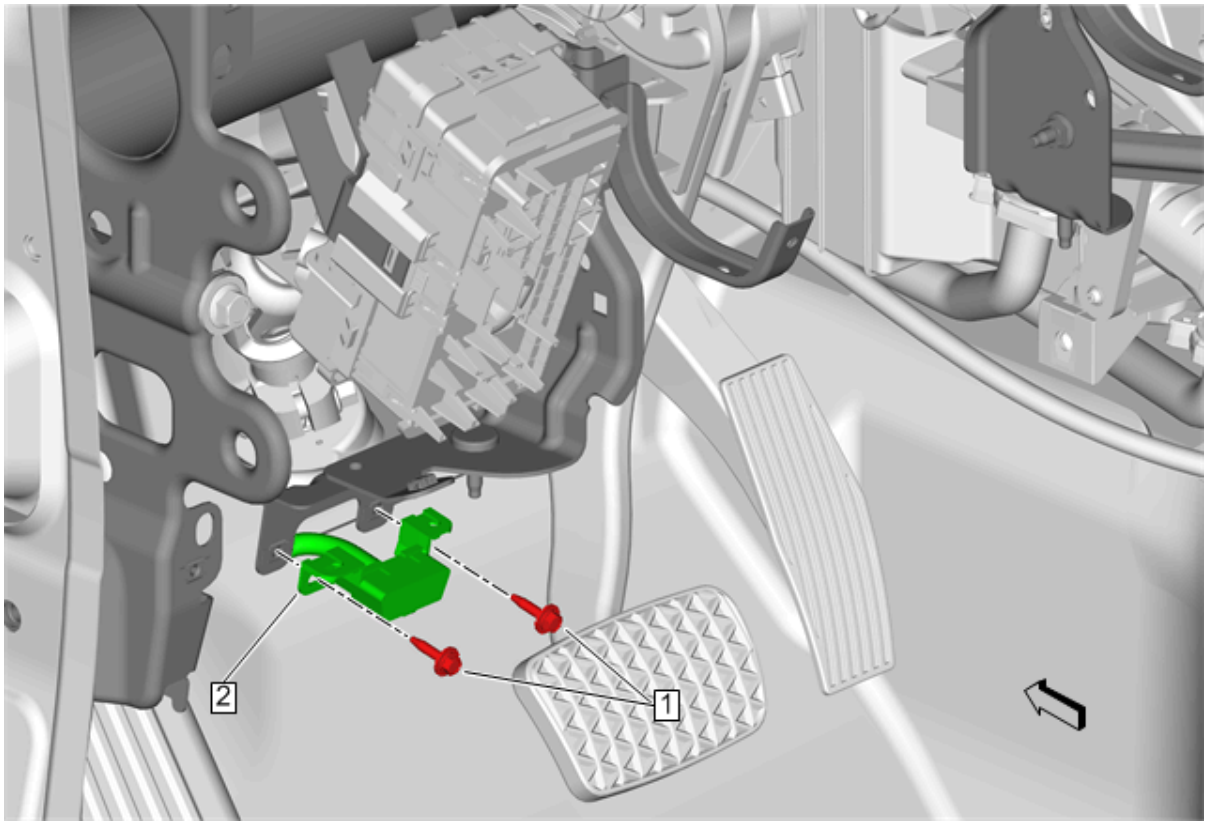


Fig. 73: Data Link Connector And Bolt

Courtesy of GENERAL MOTORS COMPANY

13. Remove Data Link Connector Bolt (1)

14. Reposition away Data Link Connector (2)

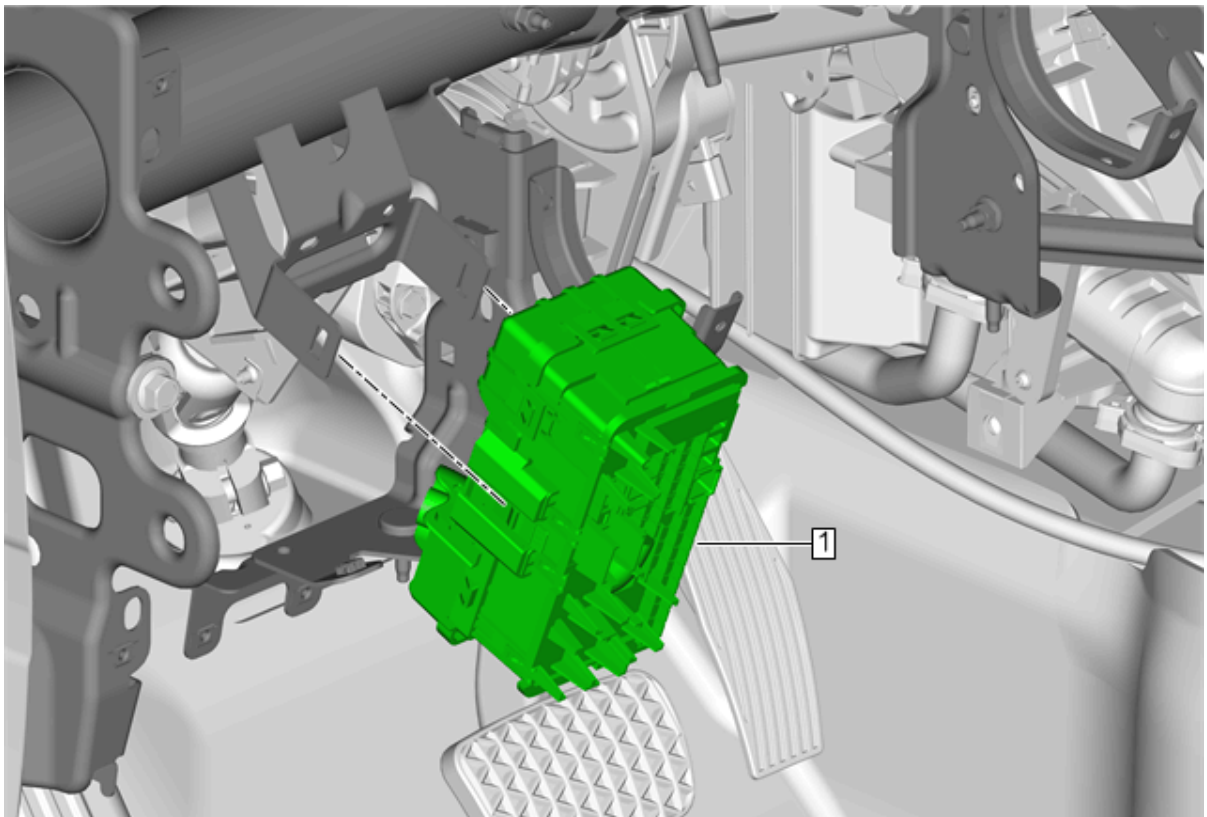


Fig. 74: Instrument Panel Wiring Harness Junction Block

Courtesy of GENERAL MOTORS COMPANY

15. Use a suitable tool to release the Instrument Panel Wiring Harness Junction Block (1) from the Instrument Panel Tie Bar and position out of the way.

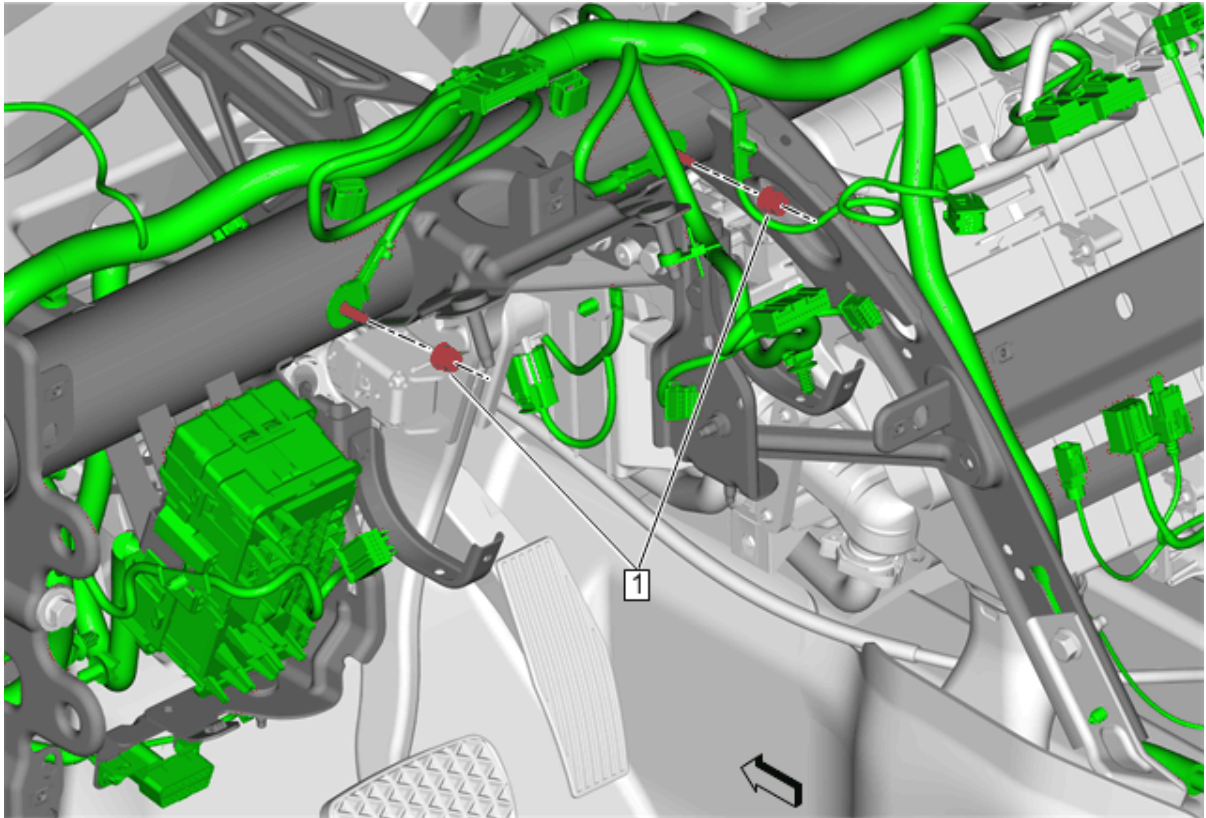


Fig. 75: Wiring Harness Ground Nut

Courtesy of GENERAL MOTORS COMPANY

16. Remove Wiring Harness Ground Nut (1)

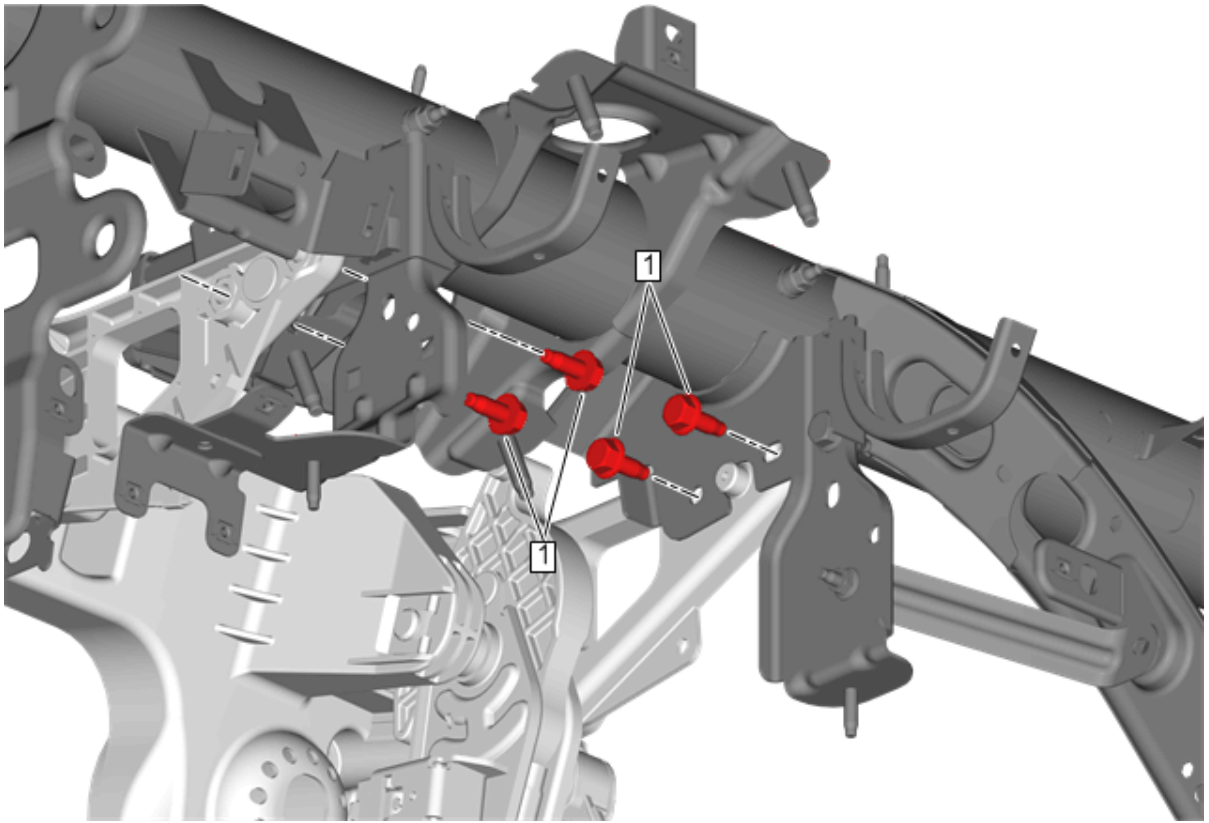


Fig. 76: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

17. Remove Brake Pedal Bolt (1)

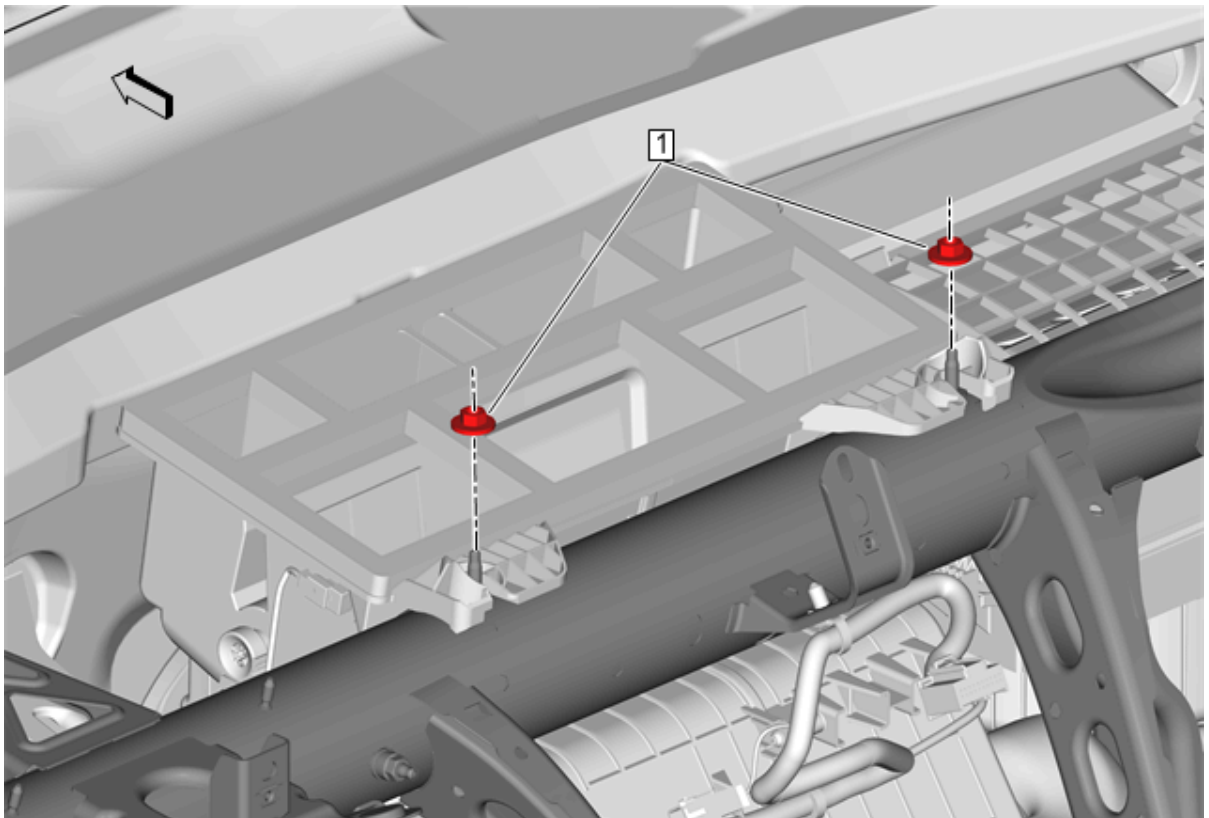


Fig. 77: Heater and Air Conditioning Evaporator and Blower Module Nut
Courtesy of GENERAL MOTORS COMPANY

18. Remove Heater and Air Conditioning Evaporator and Blower Module Nut (1)

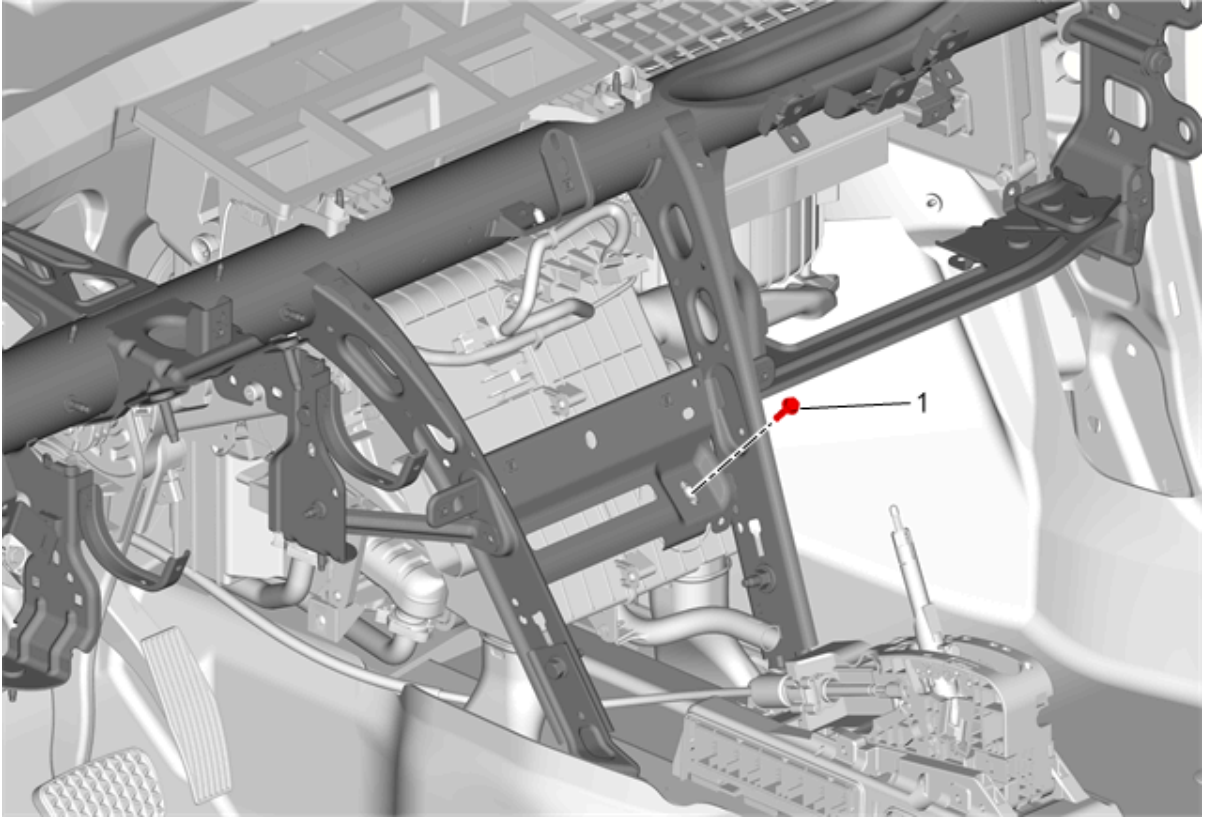


Fig. 78: Heater and Air Conditioning Evaporator Module Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Remove Heater and Air Conditioning Evaporator Module Bolt (1)

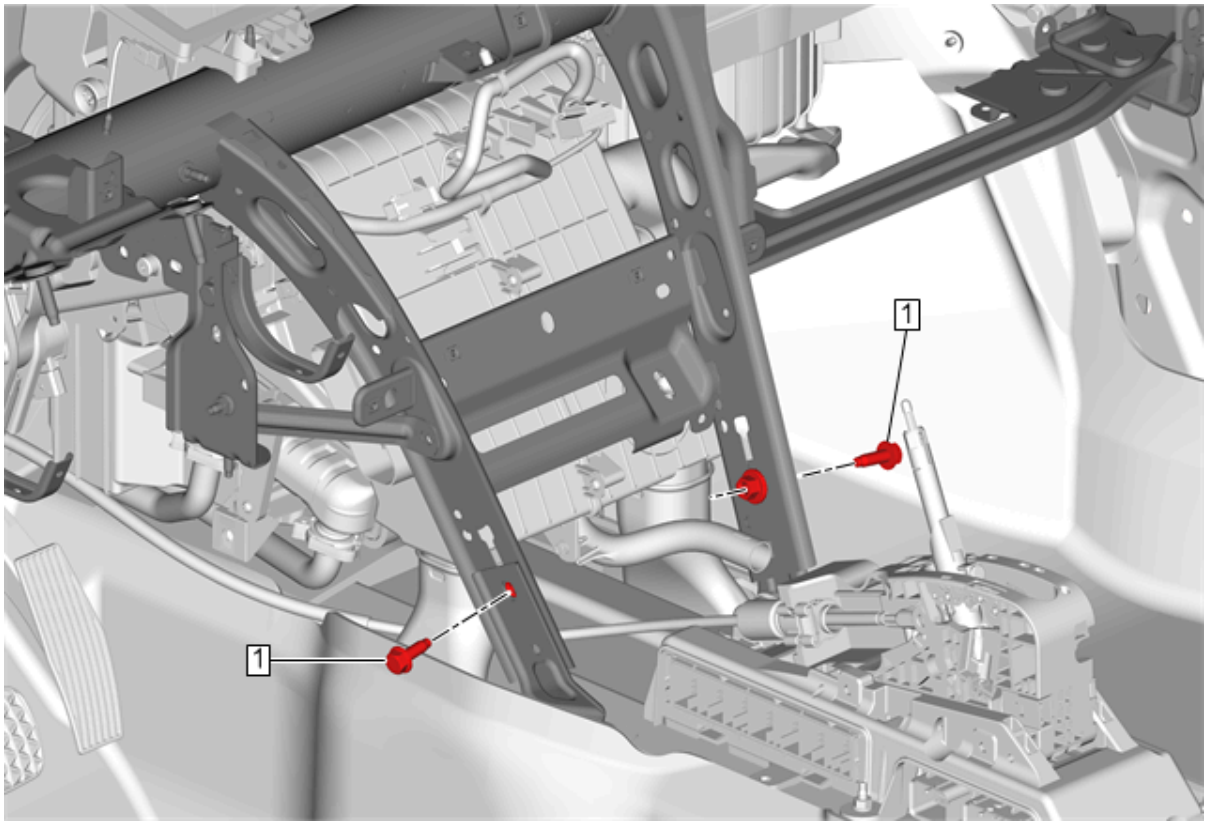


Fig. 79: Instrument Panel Tie Bar Brace Bolt
Courtesy of GENERAL MOTORS COMPANY

20. Remove Instrument Panel Tie Bar Brace Bolt (1)

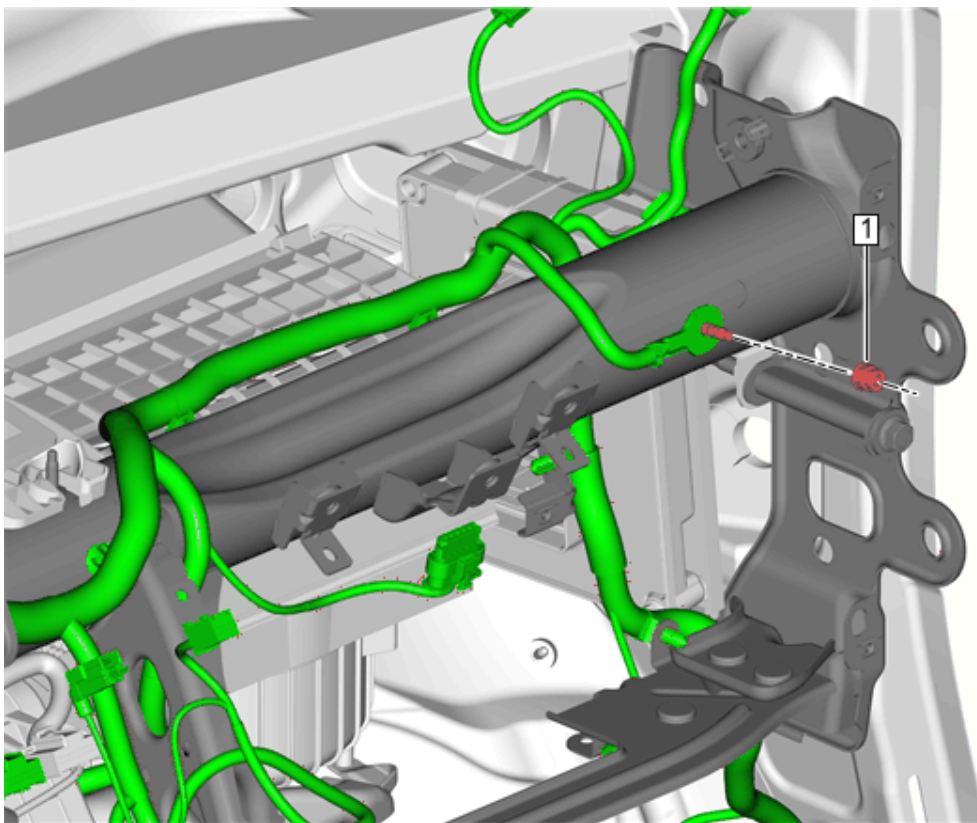


Fig. 80: Wiring Harness Ground Nut
Courtesy of GENERAL MOTORS COMPANY

21. Remove Wiring Harness Ground Nut (1)

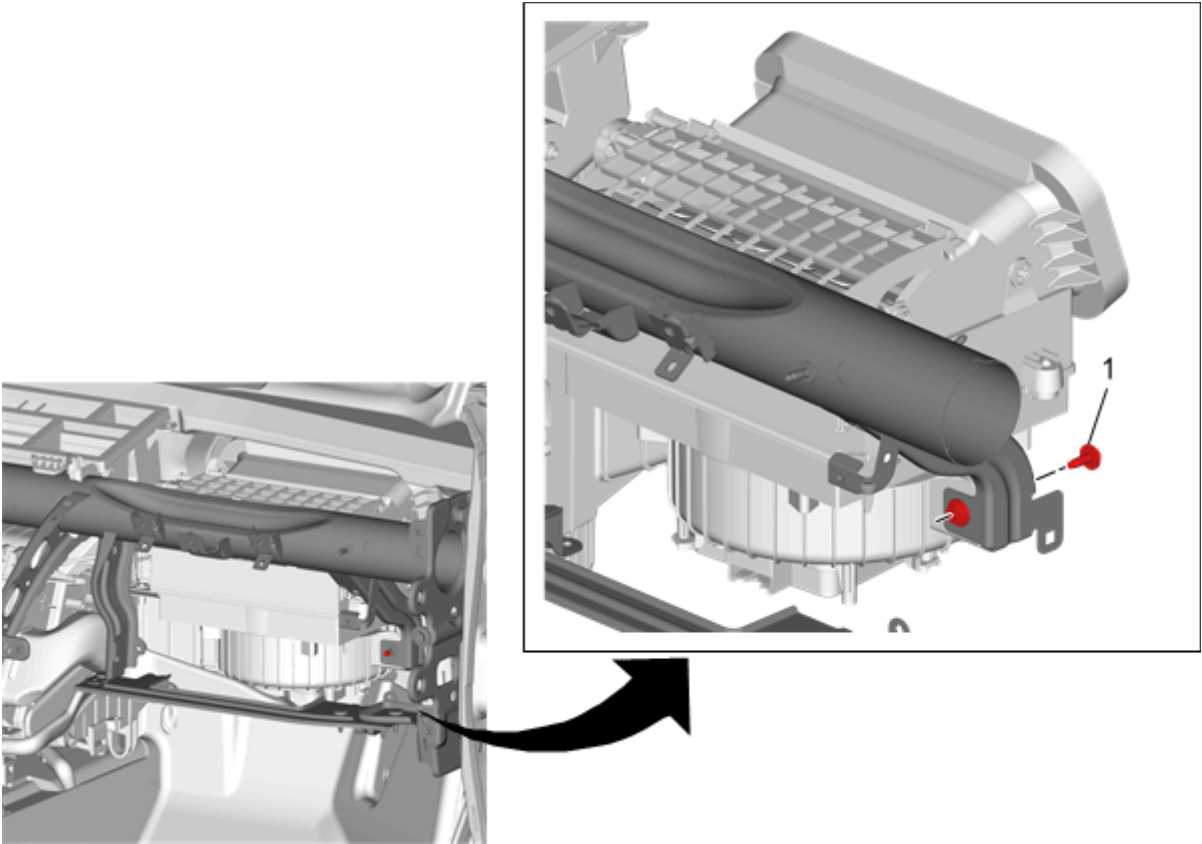


Fig. 81: Heater and Air Conditioning Evaporator and Blower Module Bolt
Courtesy of GENERAL MOTORS COMPANY

22. Remove Heater and Air Conditioning Evaporator and Blower Module Bolt (1)

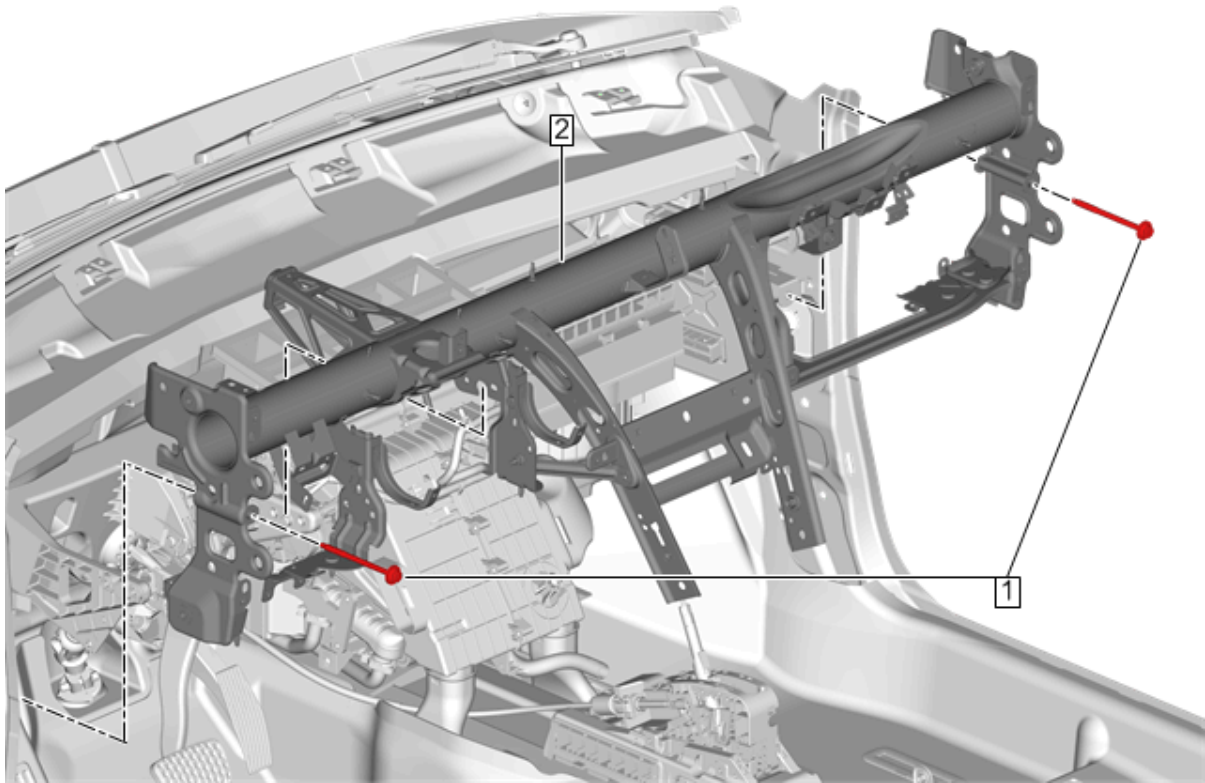


Fig. 82: Instrument Panel Tie Bar Reinforcement Bolt

Courtesy of GENERAL MOTORS COMPANY

23. Remove Instrument Panel Tie Bar Reinforcement Bolt (1)
24. Note the location and routing of the instrument panel wiring harness prior to removal to ensure proper installation.
25. Support the HVAC module in order to prevent damage.
26. With the aid of an assistant, remove the instrument panel tie bar assembly from the vehicle.(2)
27. Transfer components as necessary.

Installation Procedure

1. With the aid of an assistant, position the instrument panel tie bar assembly into the vehicle.
2. Install the instrument panel wiring harness assembly to the position noted in the removal procedure.

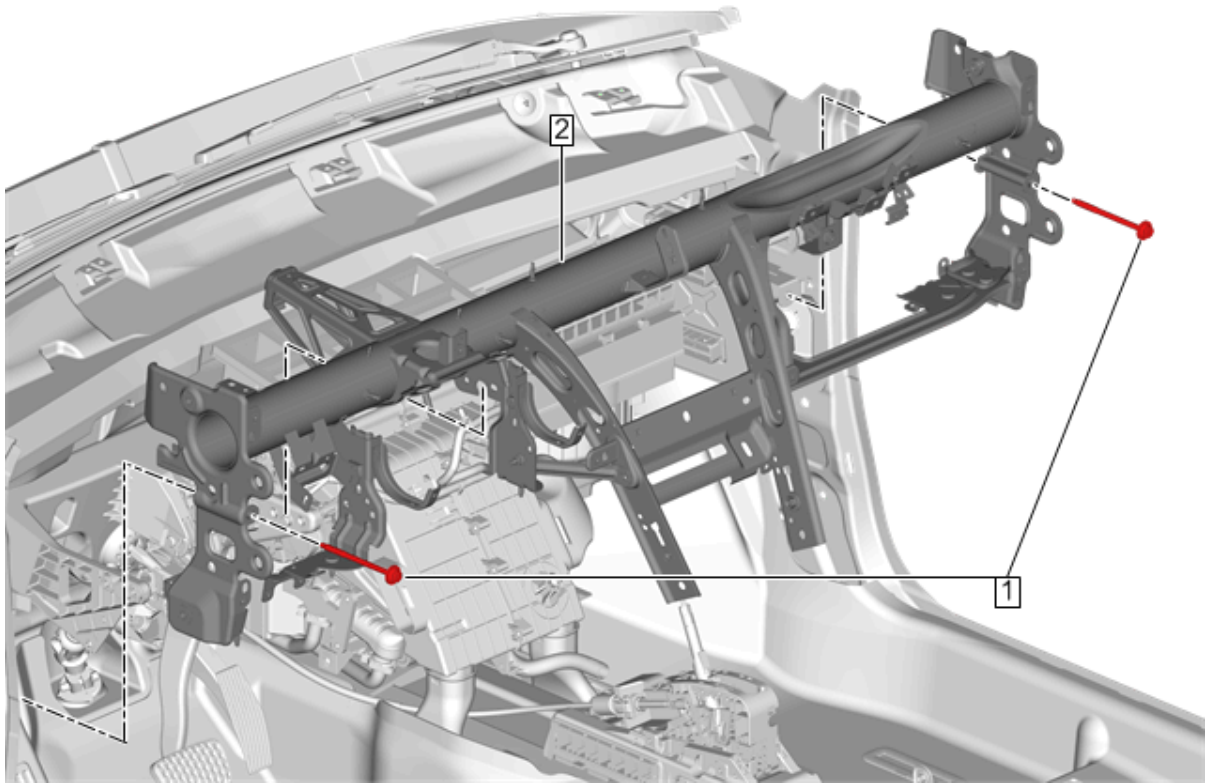


Fig. 83: Instrument Panel Tie Bar Reinforcement Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Instrument Panel Tie Bar (2)
4. Install Instrument Panel Tie Bar Reinforcement Bolt (1) and tighten 22 N.m (16 lb ft)

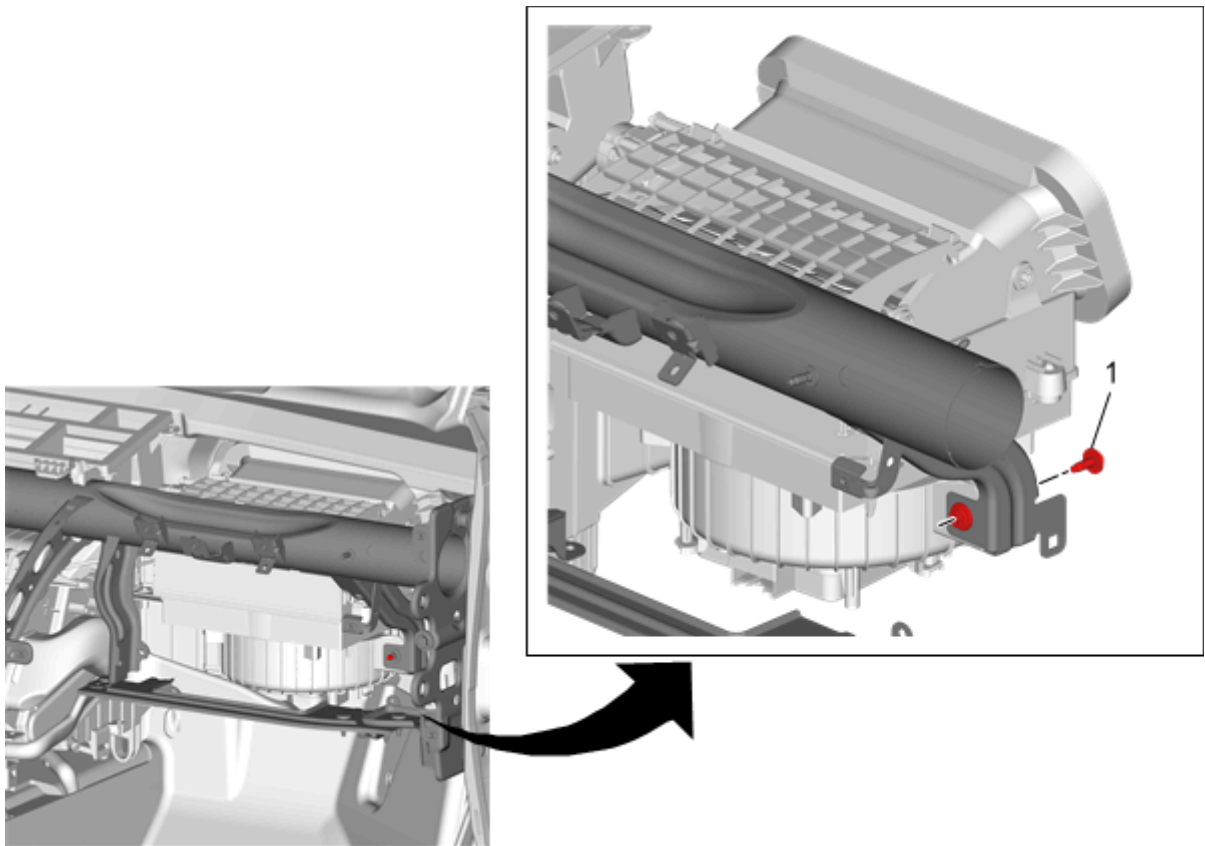


Fig. 84: Heater and Air Conditioning Evaporator and Blower Module Bolt
 Courtesy of GENERAL MOTORS COMPANY

5. Install Heater and Air Conditioning Evaporator and Blower Module Bolt (1) and tighten 5 N.m (44 lb in)

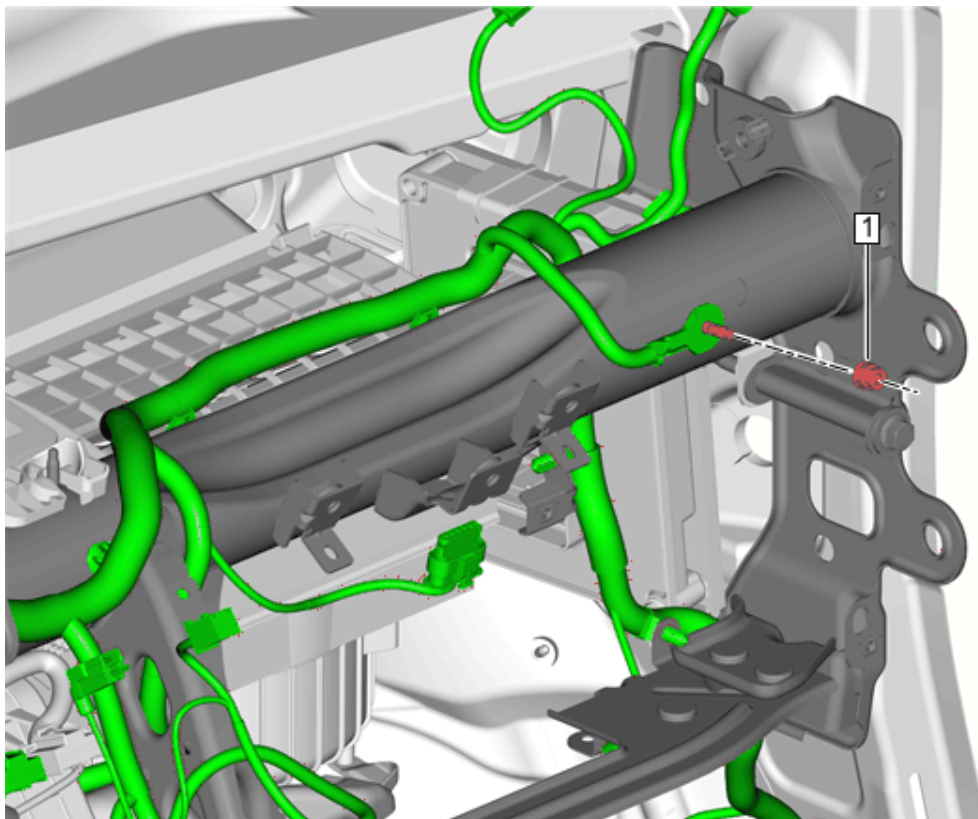


Fig. 85: Wiring Harness Ground Nut

Courtesy of GENERAL MOTORS COMPANY

6. Install Wiring Harness Ground Nut (1) and tighten 2.5 N.m (22 lb in)

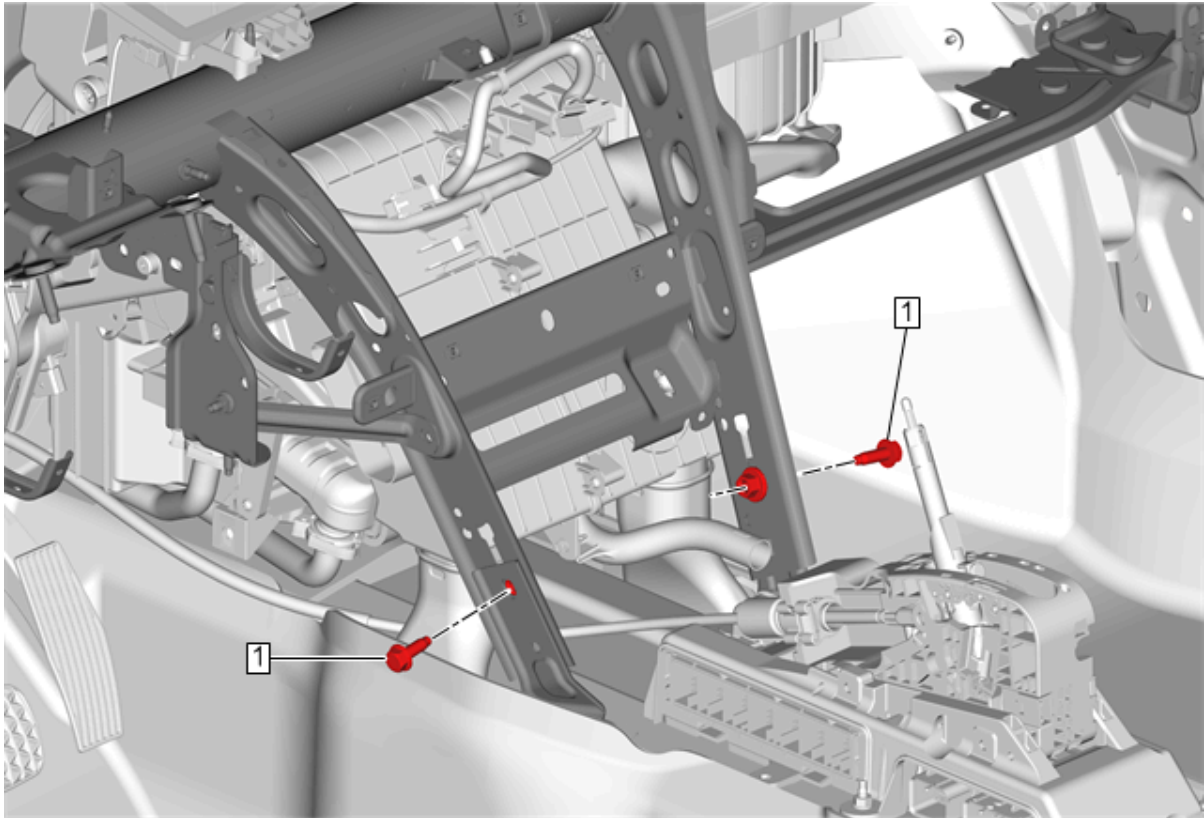


Fig. 86: Instrument Panel Tie Bar Brace Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Install Instrument Panel Tie Bar Brace Bolt (1) and tighten 22 N.m (16 lb ft)

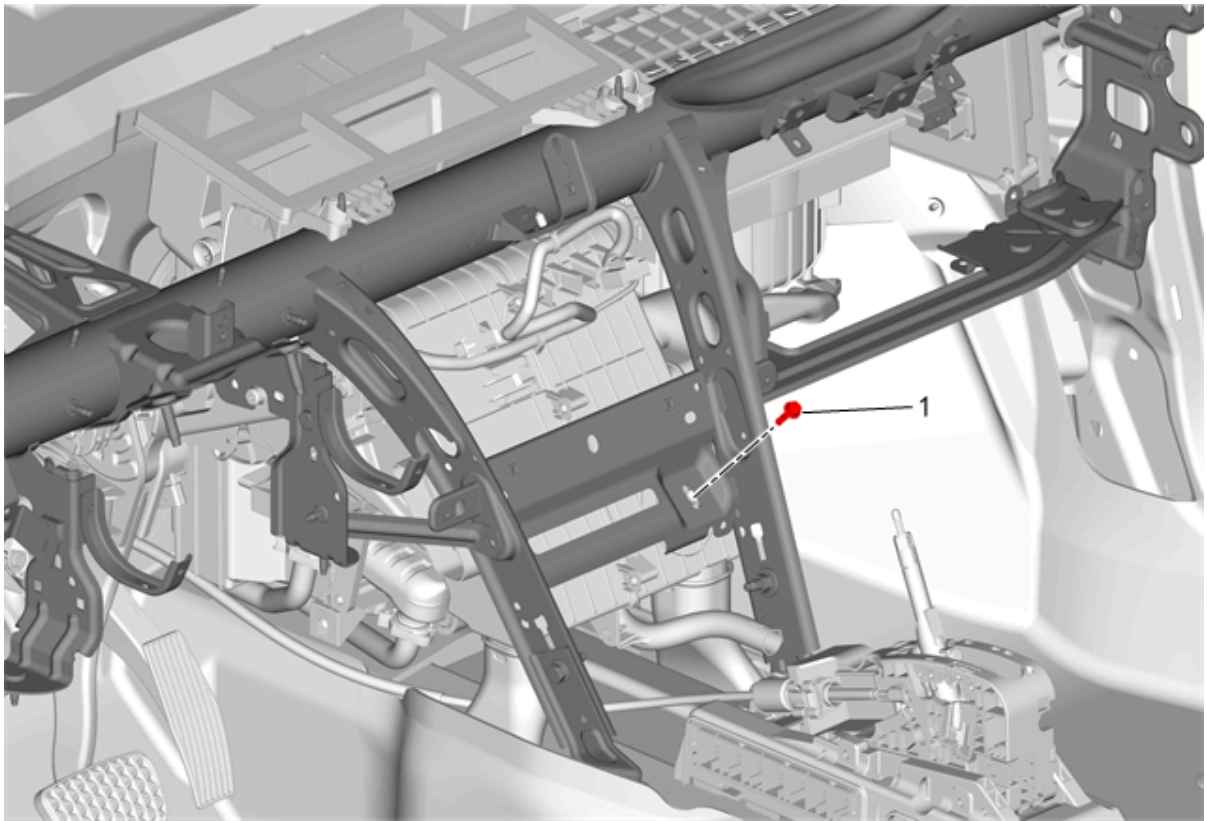


Fig. 87: Heater and Air Conditioning Evaporator Module Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install Heater and Air Conditioning Evaporator Module Bolt (1) and tighten 5 N.m (44 lb in)

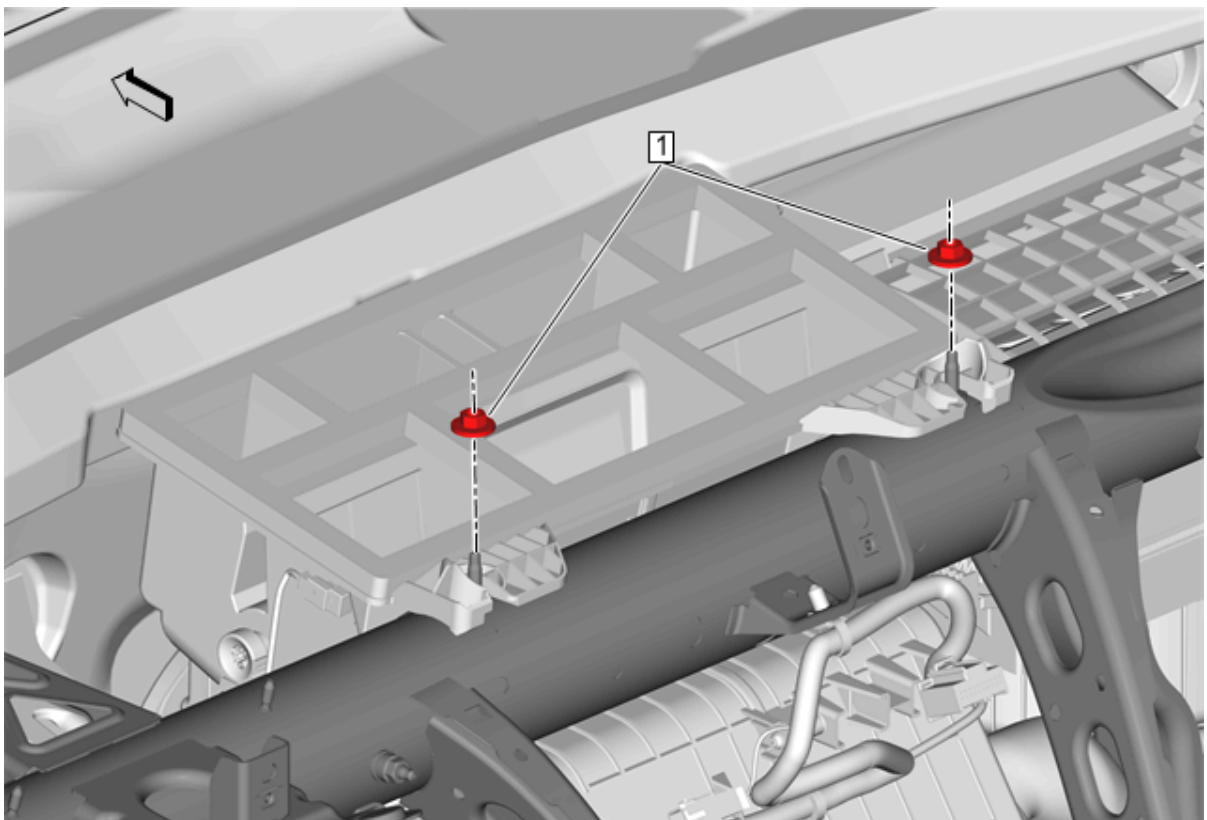


Fig. 88: Heater and Air Conditioning Evaporator and Blower Module Nut

Courtesy of GENERAL MOTORS COMPANY

9. Install Heater and Air Conditioning Evaporator and Blower Module Nut (1) and tighten 5 N.m (44 lb in)

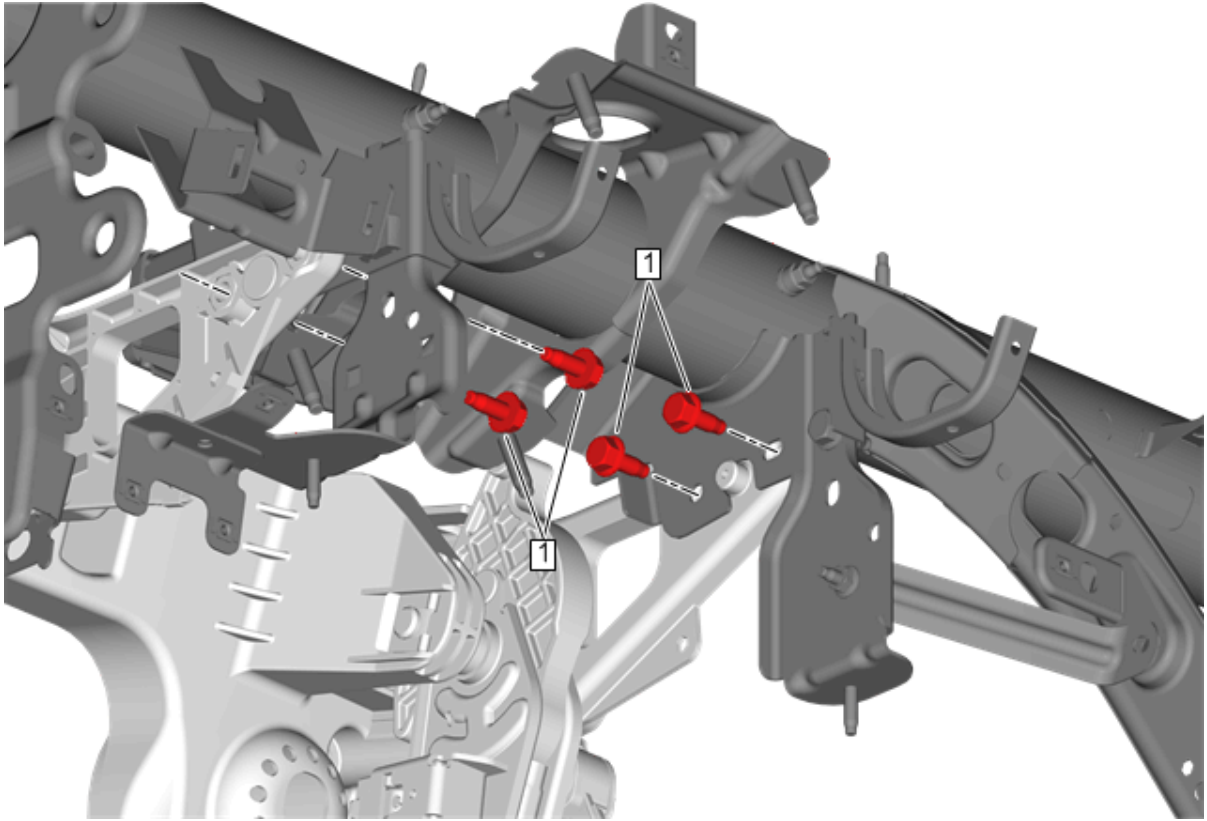


Fig. 89: Brake Pedal Bolt

Courtesy of GENERAL MOTORS COMPANY

10. Install Brake Pedal Bolt (1) and tighten 22 N.m (16 lb ft)

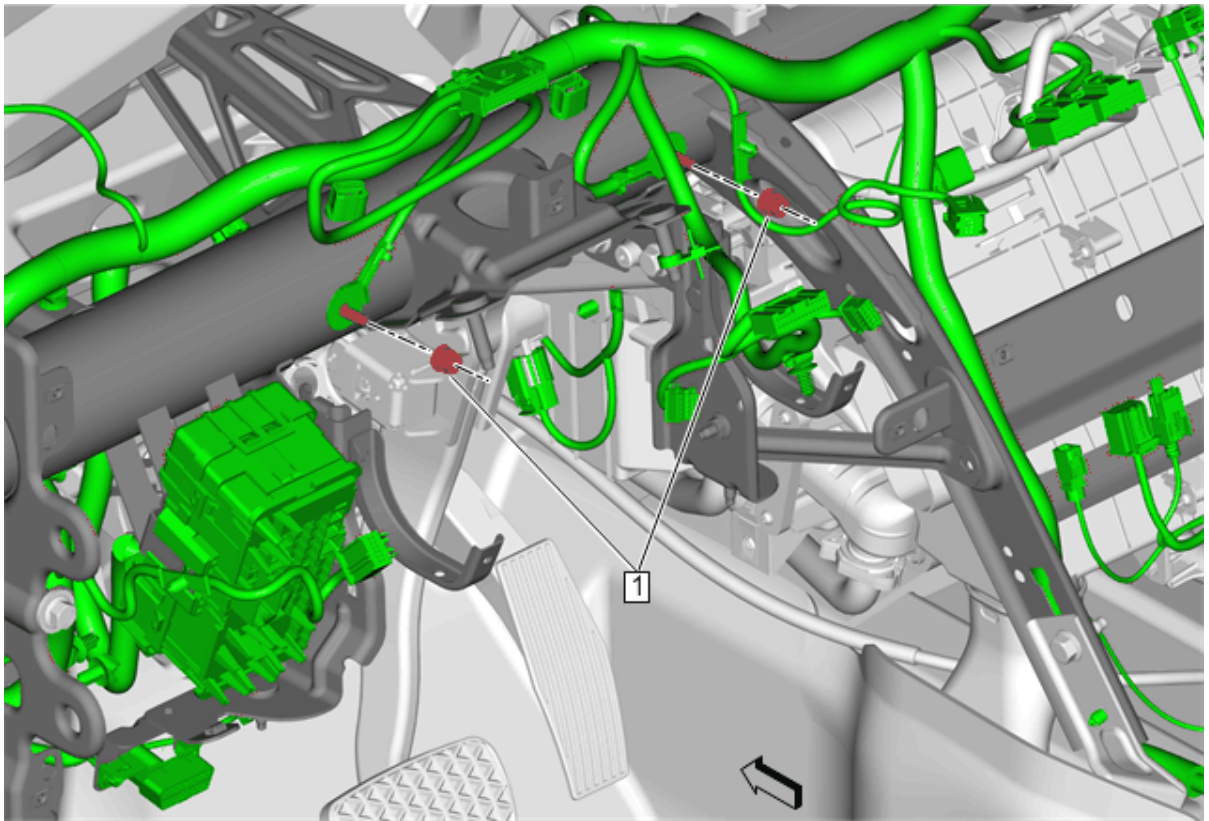


Fig. 90: Wiring Harness Ground Nut

Courtesy of GENERAL MOTORS COMPANY

11. Install Wiring Harness Ground Nut (1) and tighten 2.5 N.m (22 lb in)

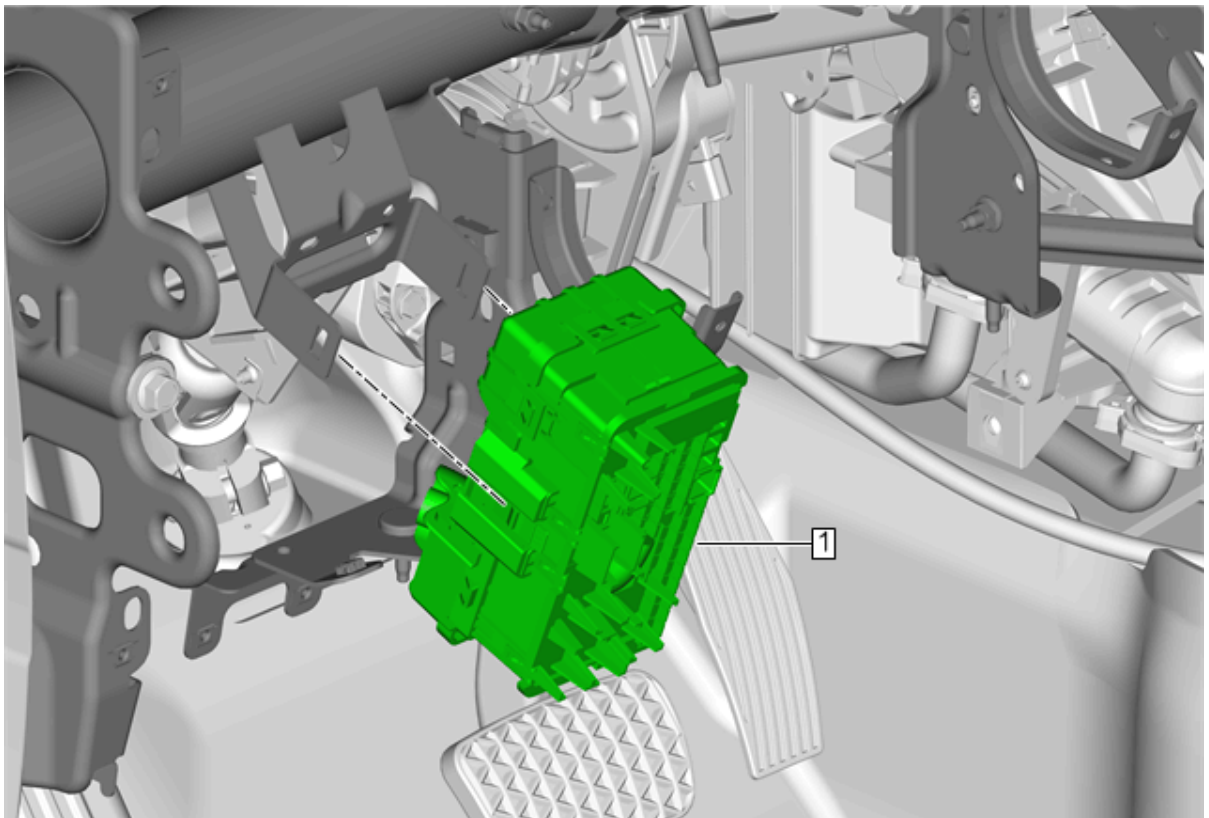


Fig. 91: Instrument Panel Wiring Harness Junction Block

Courtesy of GENERAL MOTORS COMPANY

12. Install the Instrument Panel Wiring Harness Junction Block (1) to the Instrument Panel Tie Bar.

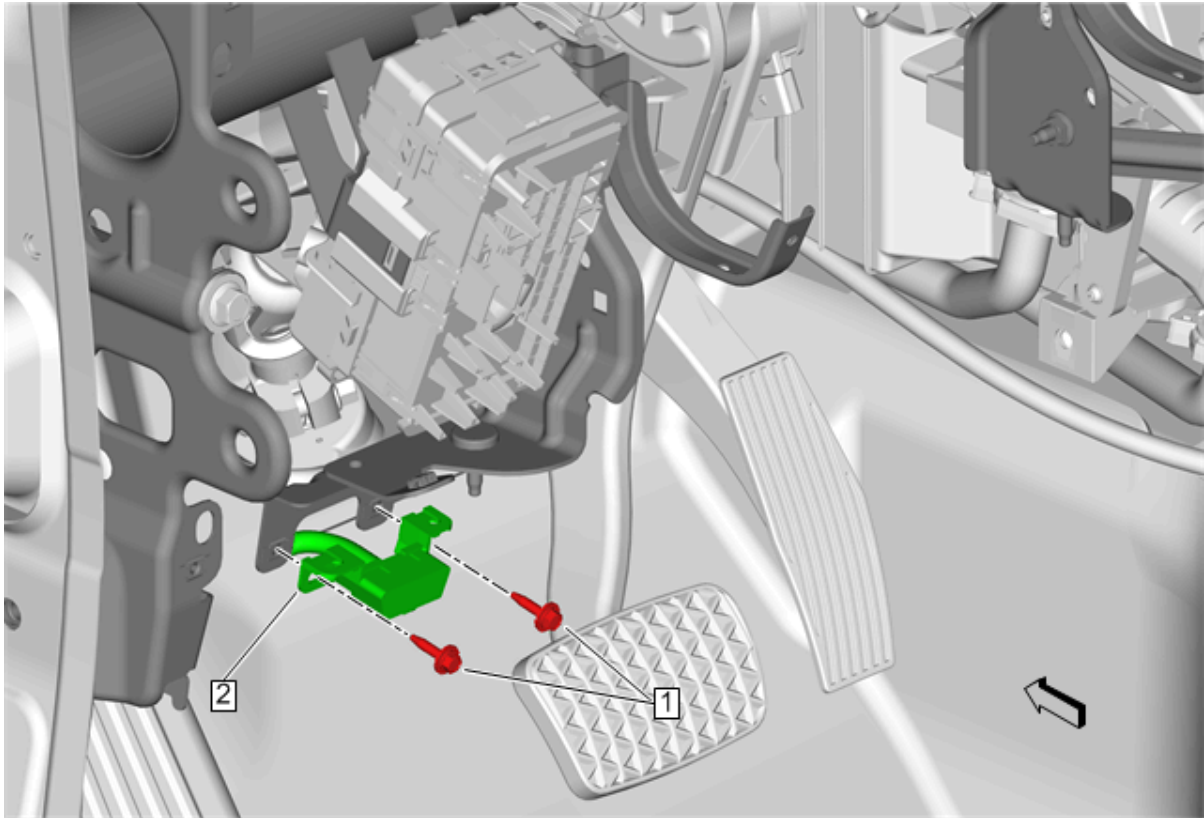


Fig. 92: Data Link Connector And Bolt

Courtesy of GENERAL MOTORS COMPANY

13. Install Data Link Connector (2)
14. Install Data Link Connector Bolt (1) and tighten 2.5 N.m (22 lb in)

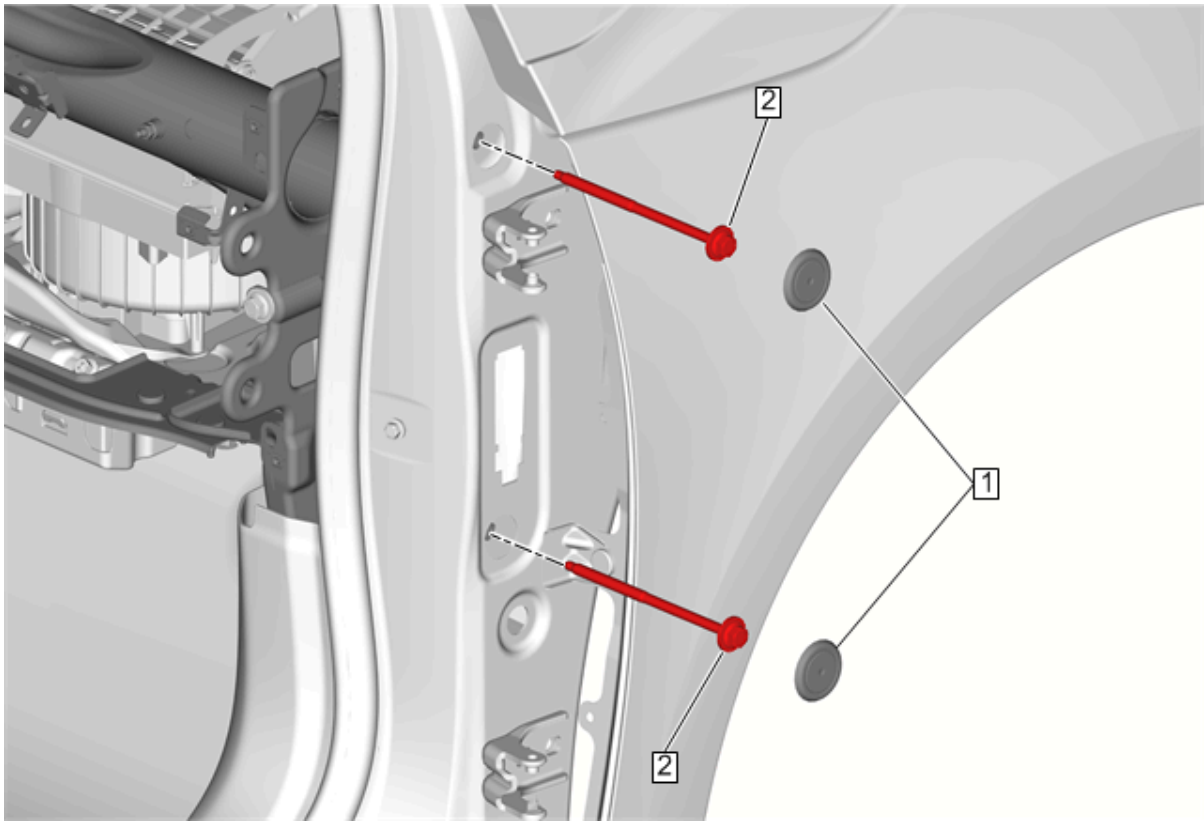


Fig. 93: Body Hinge Pillar Outer Panel Hole Plug And Bolt
Courtesy of GENERAL MOTORS COMPANY

15. Install Instrument Panel Bolt (2) and tighten 22 N.m (16 lb ft)
16. Install Body Hinge Pillar Outer Panel Hole Plug (1)

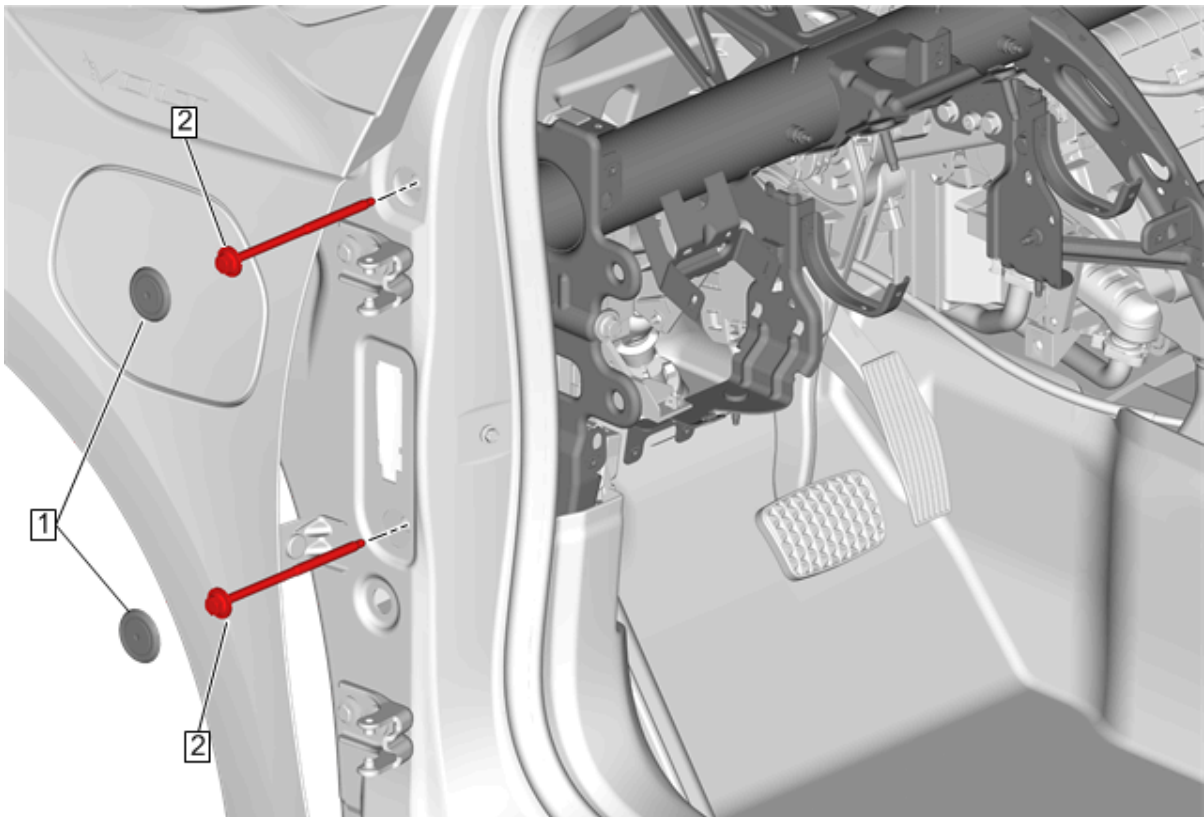


Fig. 94: Body Hinge Pillar Outer Panel Hole Plug And Bolt

Courtesy of GENERAL MOTORS COMPANY

17. Install Instrument Panel Bolt (2) and tighten 22 N.m (16 lb ft)
18. Install Body Hinge Pillar Outer Panel Hole Plug (1)

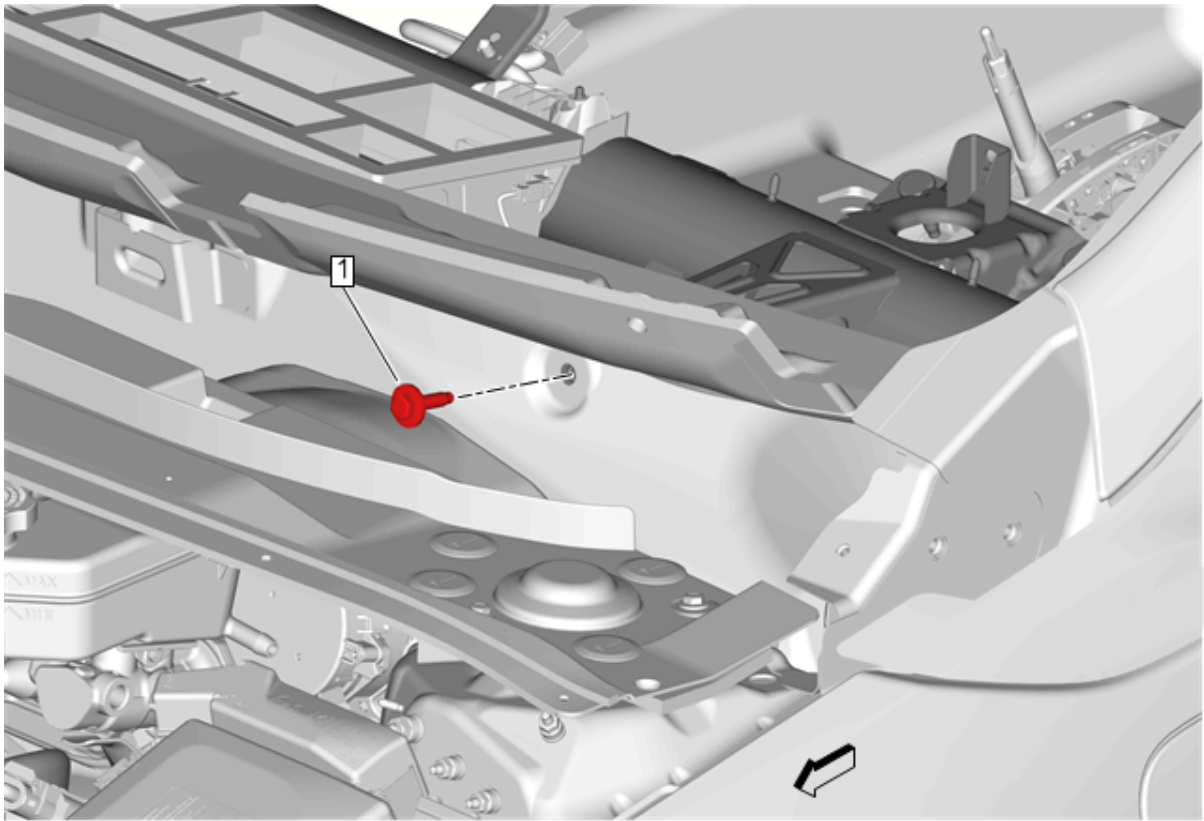


Fig. 95: Instrument Panel Upper Bolt

Courtesy of GENERAL MOTORS COMPANY

19. Install Instrument Panel Upper Bolt (1) and tighten 22 N.m (16 lb ft)

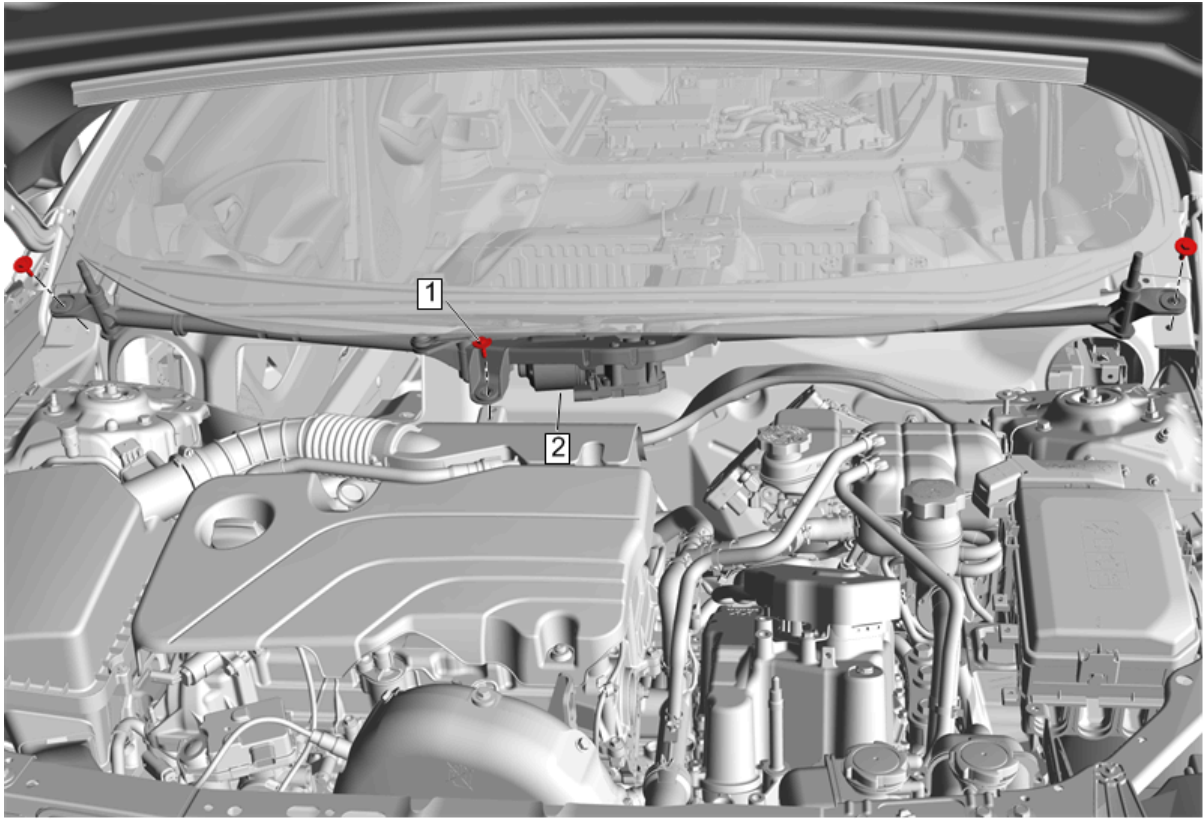


Fig. 96: Windshield Wiper System Module

Courtesy of GENERAL MOTORS COMPANY

20. Install **Windshield Wiper System Module Replacement** (2)

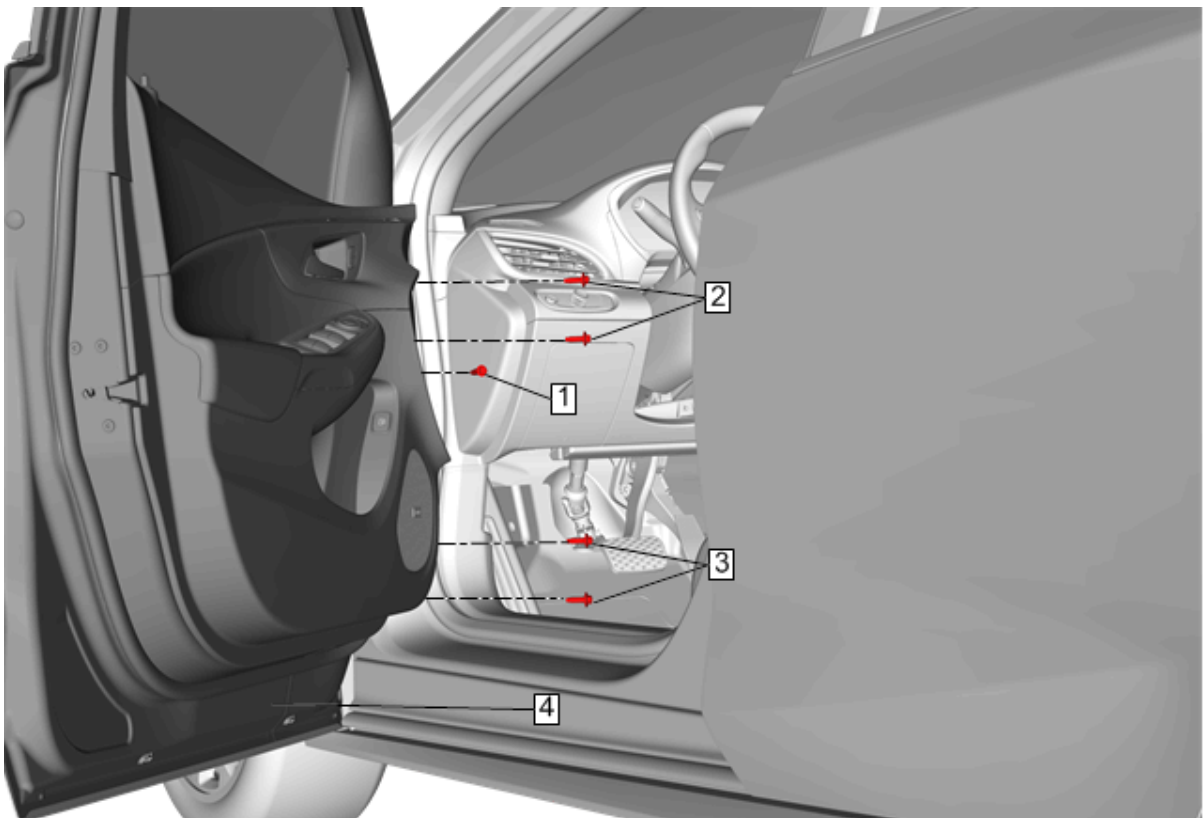


Fig. 97: Front Side Door

Courtesy of GENERAL MOTORS COMPANY

21. Install **Front Side Door Replacement** (4)

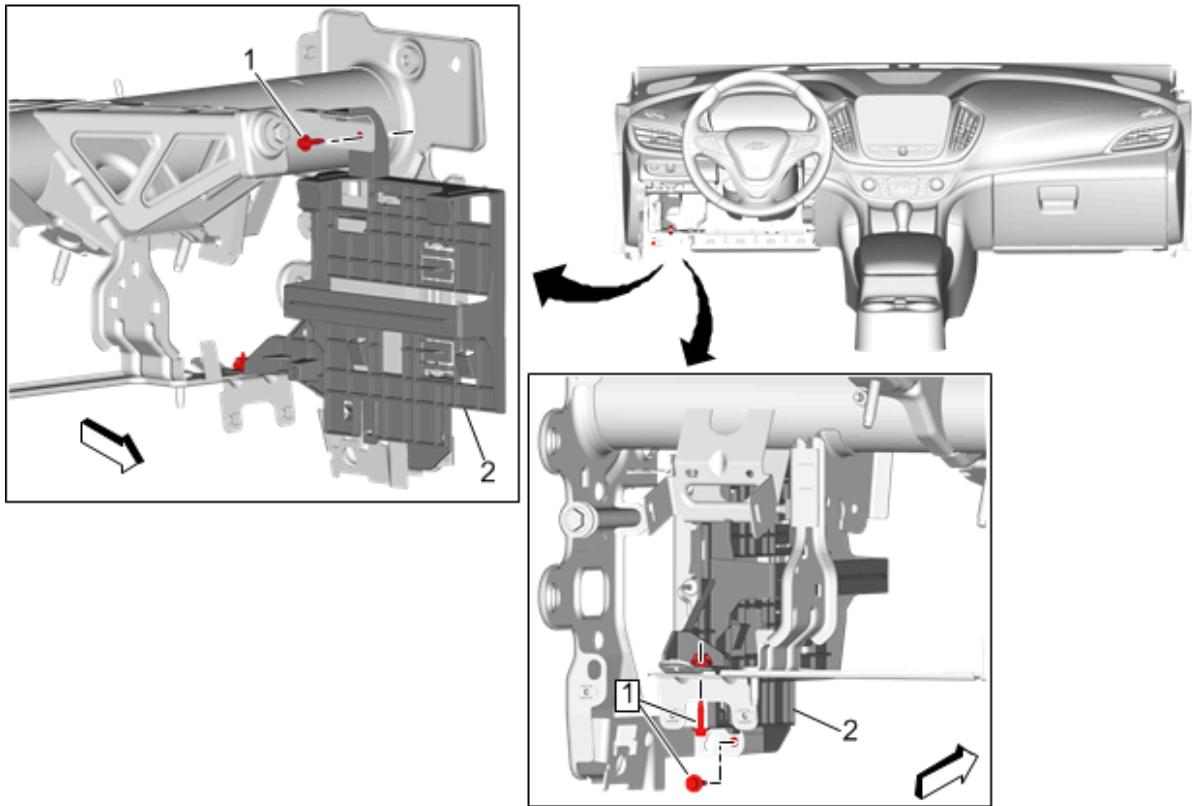


Fig. 98: Communication Interface Module Bracket

Courtesy of GENERAL MOTORS COMPANY

22. Install **Communication Interface Module Bracket Replacement** (2)

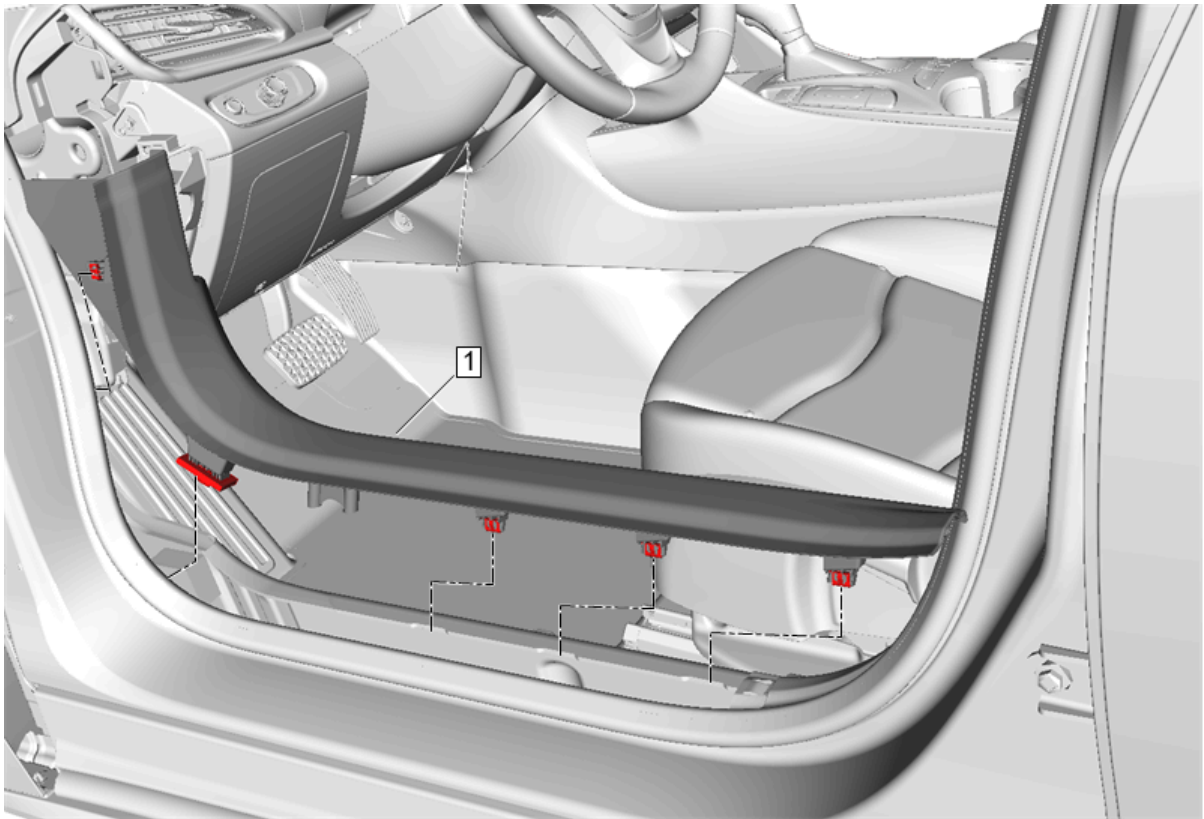


Fig. 99: Front Side Door Sill Trim Plate

Courtesy of GENERAL MOTORS COMPANY

23. Install **Front Side Door Sill Trim Plate Replacement** (1)



Fig. 100: Instrument Panel Lower Airbag - Passenger Side

Courtesy of GENERAL MOTORS COMPANY

24. Install **Instrument Panel Lower Airbag Replacement - Passenger Side** (2)

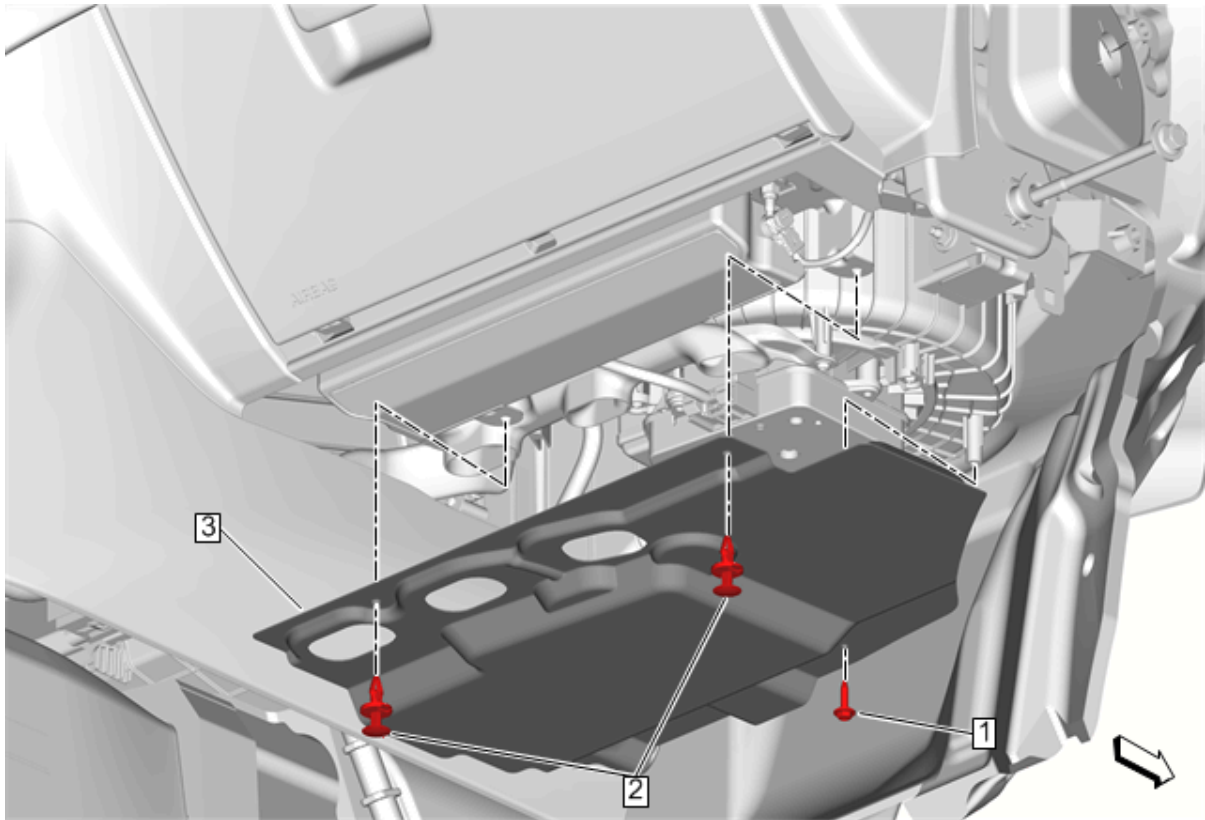


Fig. 101: Instrument Panel Lower Trim Panel Insulator

Courtesy of GENERAL MOTORS COMPANY

25. Install **Instrument Panel Lower Trim Panel Insulator Replacement** (3)

26. Install **Instrument Panel Assembly Replacement**

INSTRUMENT PANEL TIE BAR BRACE REPLACEMENT

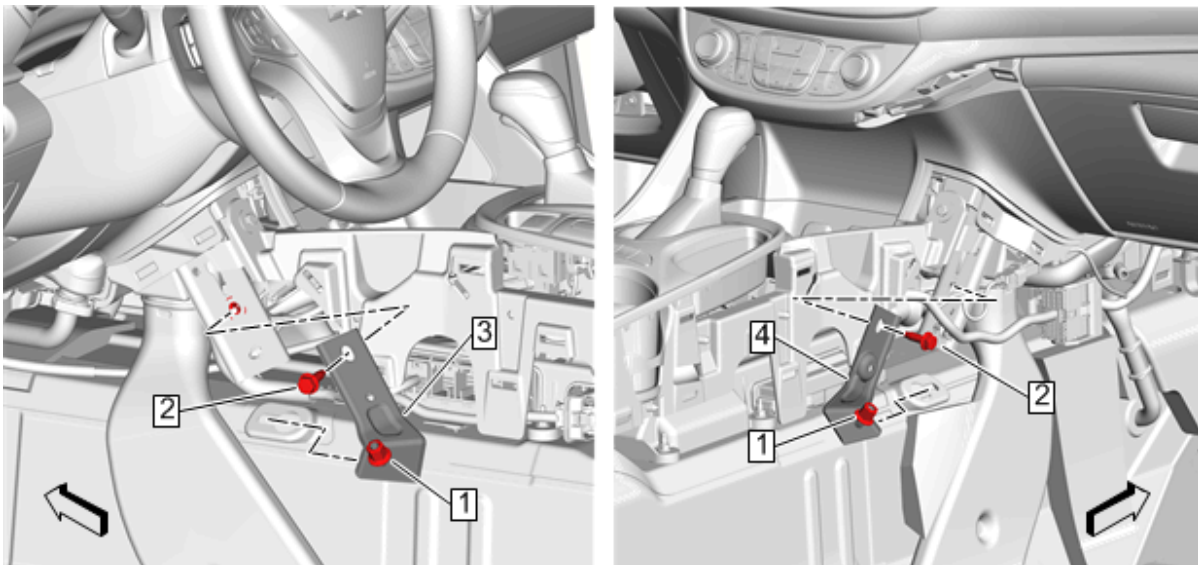


Fig. 102: Instrument Panel Tie Bar Brace

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. <u>Front Floor Console Extension Panel Replacement - Left Side</u> 2. <u>Front Floor Console Extension Panel Replacement - Right Side</u>	
1	Instrument Panel Center Support Bracket Nut (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 22 N.m (16 lb ft) Procedure Loosen the fastener and slide the bracket out of the keyhole slot.
2	Instrument Panel Tie Bar Brace Bolt (Qty: 2) Tighten 22 N.m (16 lb ft)
3	Instrument Panel Tie Bar Brace - Left Side Procedure Disconnect and reposition harness as necessary.
4	Instrument Panel Tie Bar Brace - Right Side Procedure Disconnect and reposition harness as necessary.

WIRE TO WIRE REPAIR - INSTRUMENT PANEL AND CONSOLE

Special Tools

- EL-38125-10 Splice Sleeve Crimping Tool (non GMNA)
- J-38125-5A Ultra Torch Special Tool
- J-38125-8 Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to Special Tools .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring,

cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness

branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

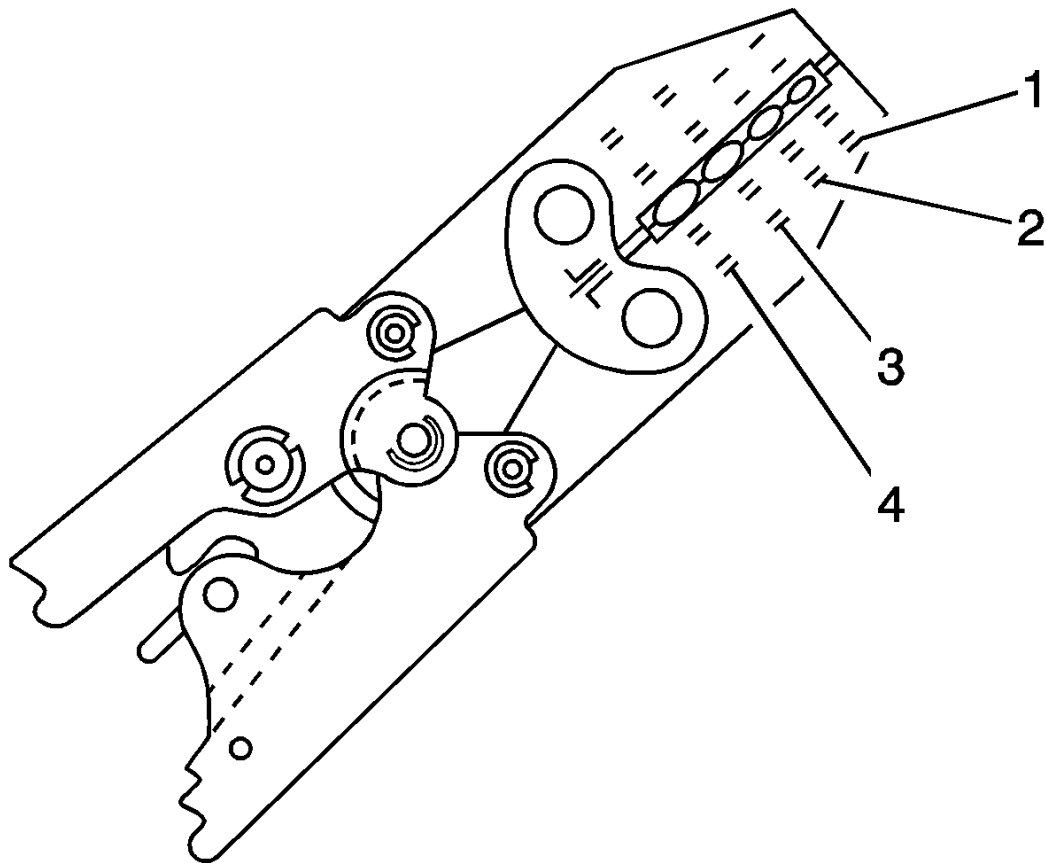


Fig. 103: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

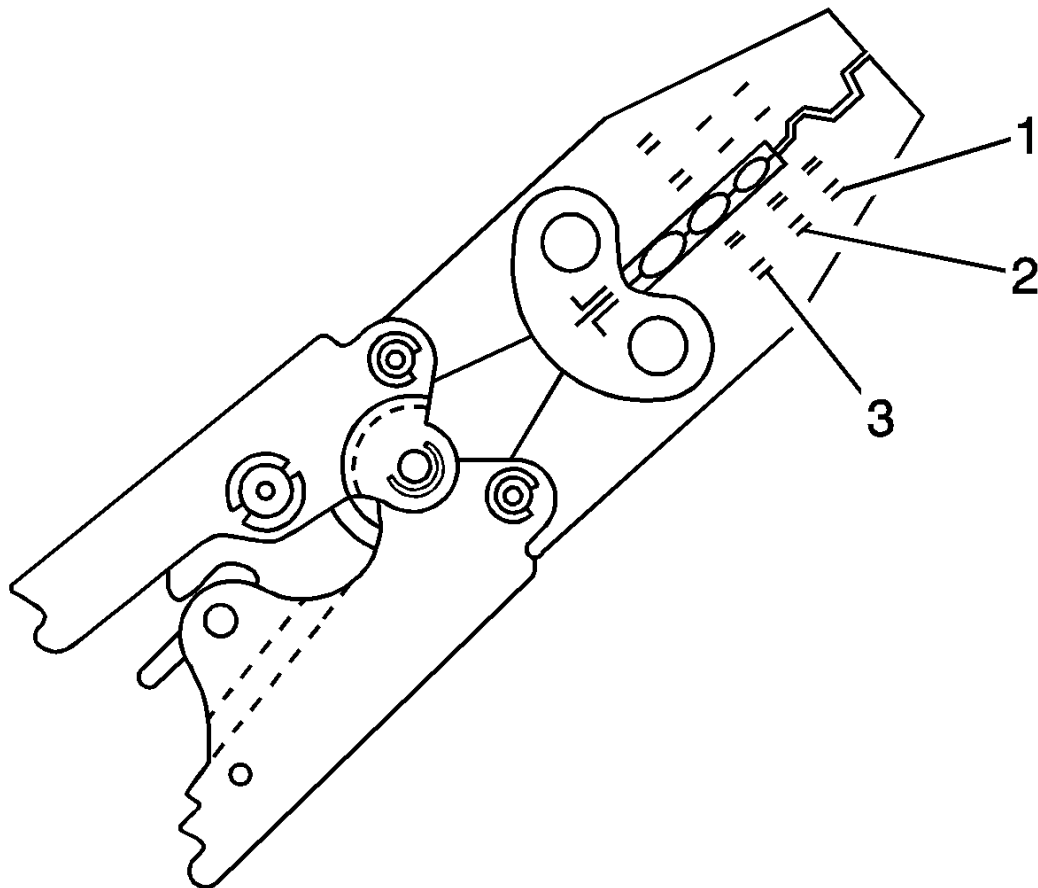


Fig. 104: Splice Sleeve Crimping Tool With 3 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under

crimp tool nest color).

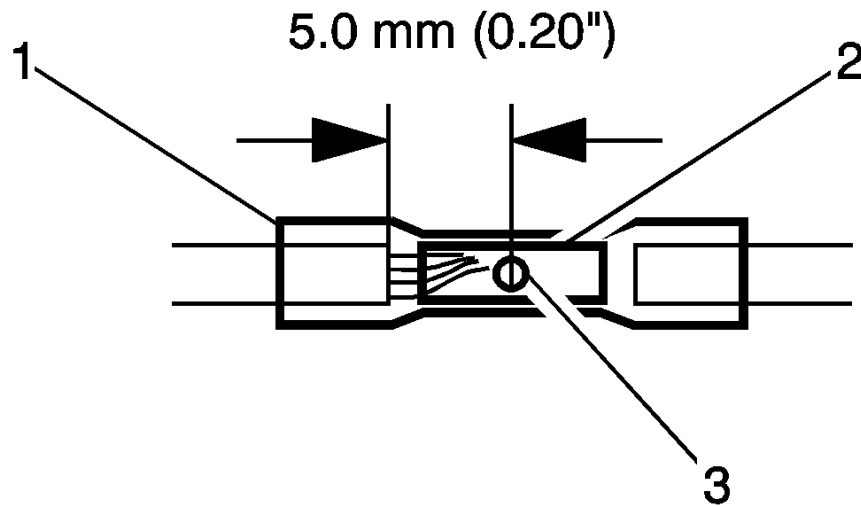


Fig. 105: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 106: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 107: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

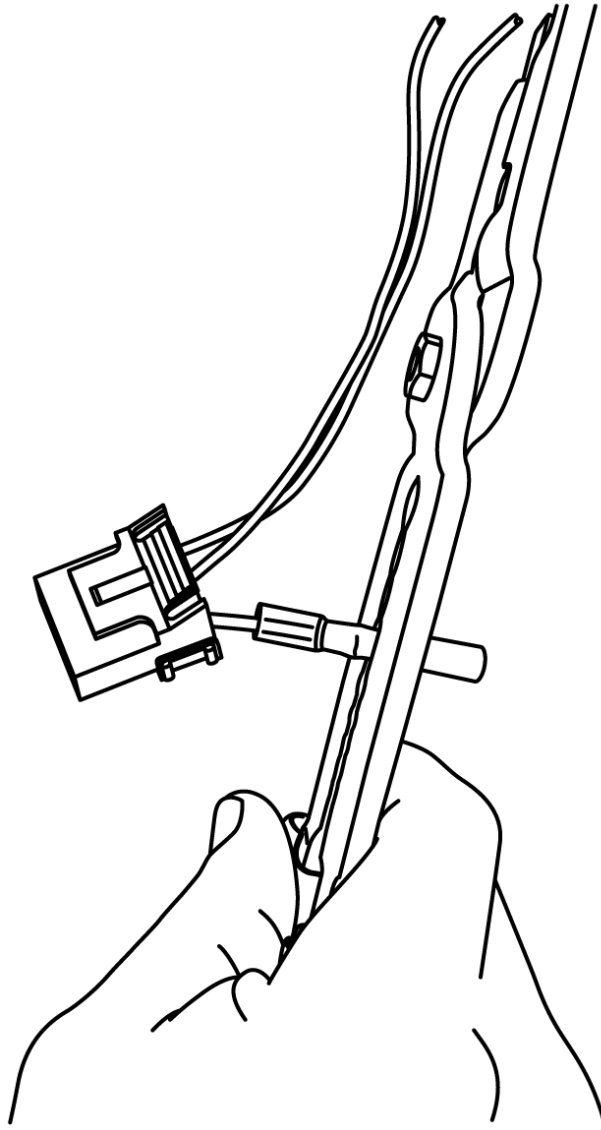


Fig. 108: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

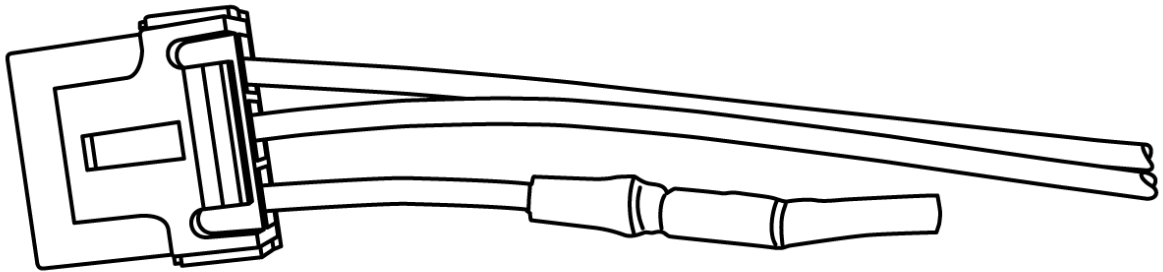


Fig. 109: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

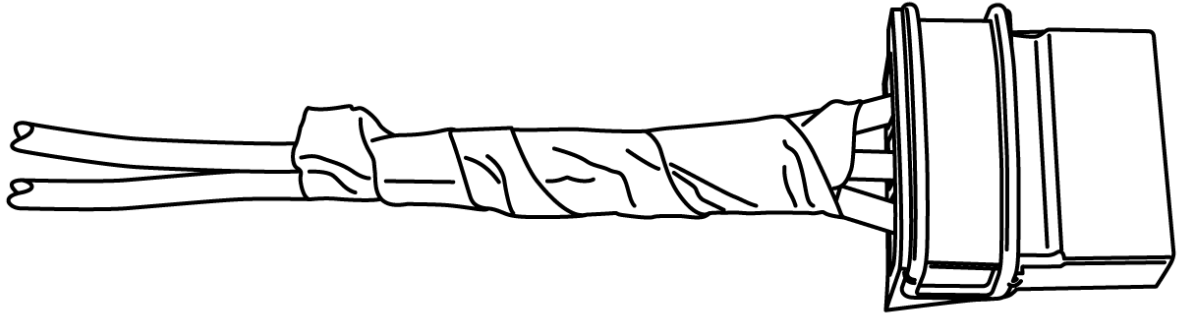


Fig. 110: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - INSTRUMENT PANEL AND CONSOLE

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

FRONT FLOOR CONSOLE COMPARTMENT DIVIDER REPLACEMENT

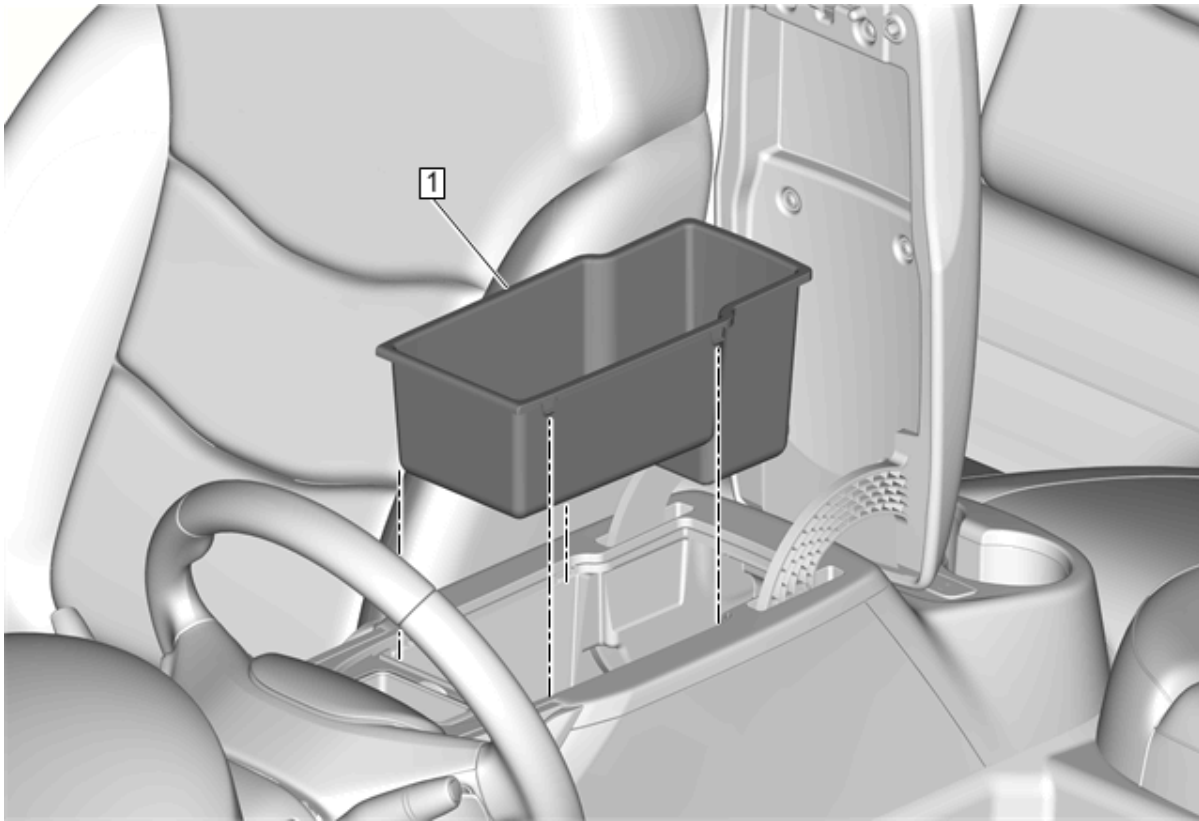


Fig. 111: Front Floor Console Compartment Divider

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Compartment Divider Procedure Use a flat bladed plastic trim tool.

FRONT FLOOR CONSOLE FRONT COMPARTMENT LINER REPLACEMENT

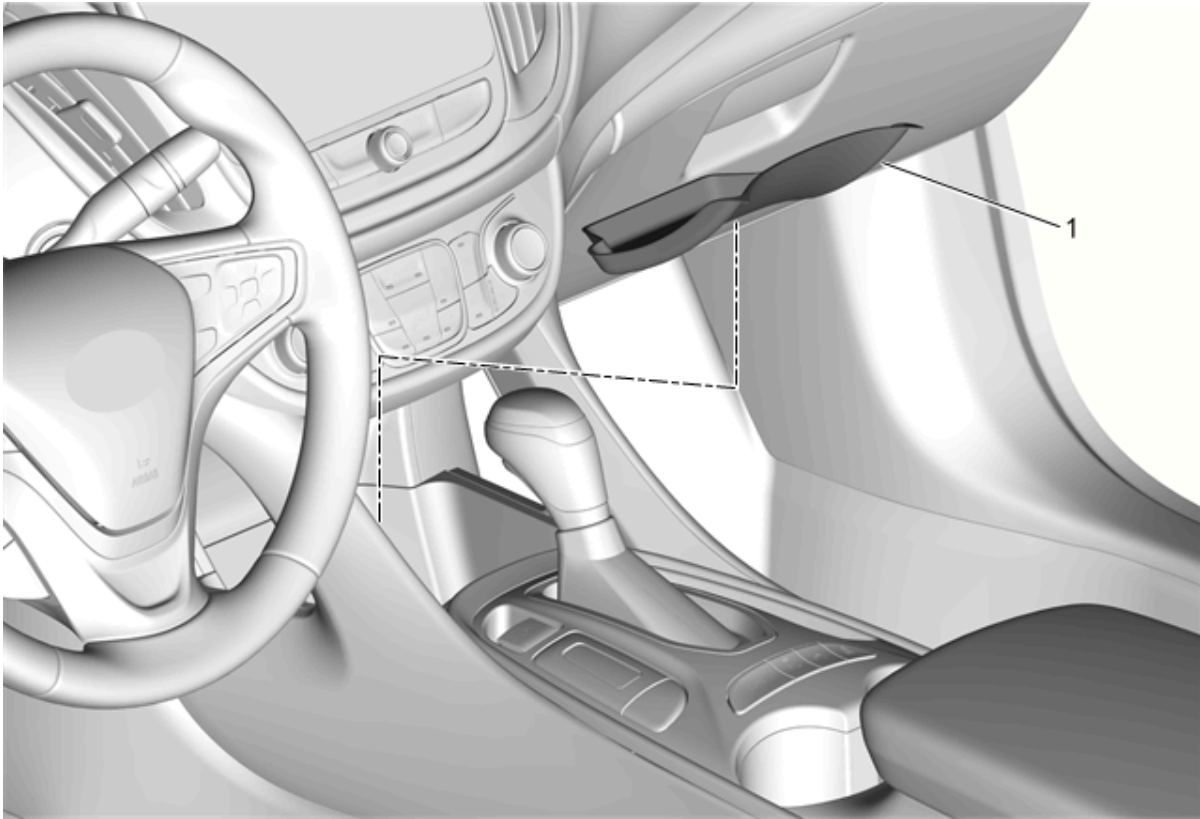


Fig. 112: Front Floor Console Front Compartment Liner

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Front Compartment Liner

FRONT FLOOR CONSOLE CUP HOLDER LINER REPLACEMENT

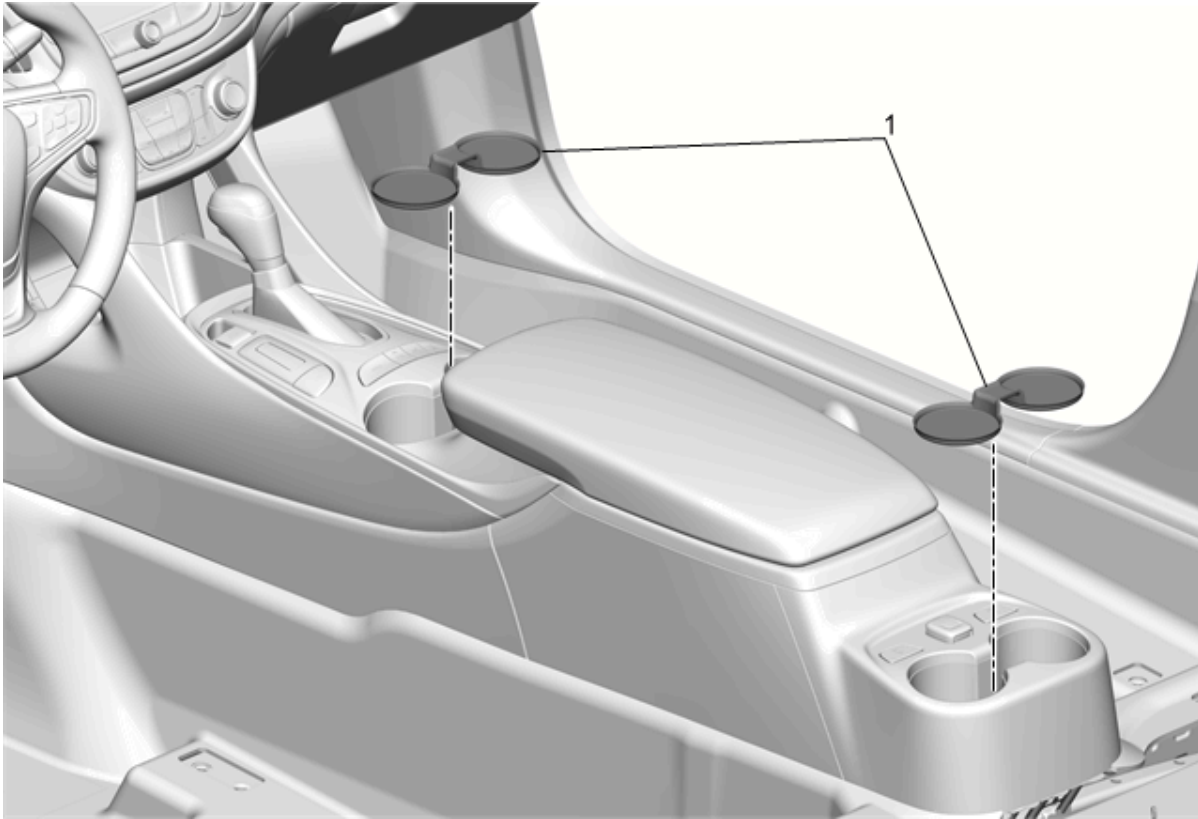


Fig. 113: Front Floor Console Cup Holder Liner

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Cup Holder Liner (Qty: 2)

FRONT FLOOR CONSOLE REAR CUP HOLDER REPLACEMENT

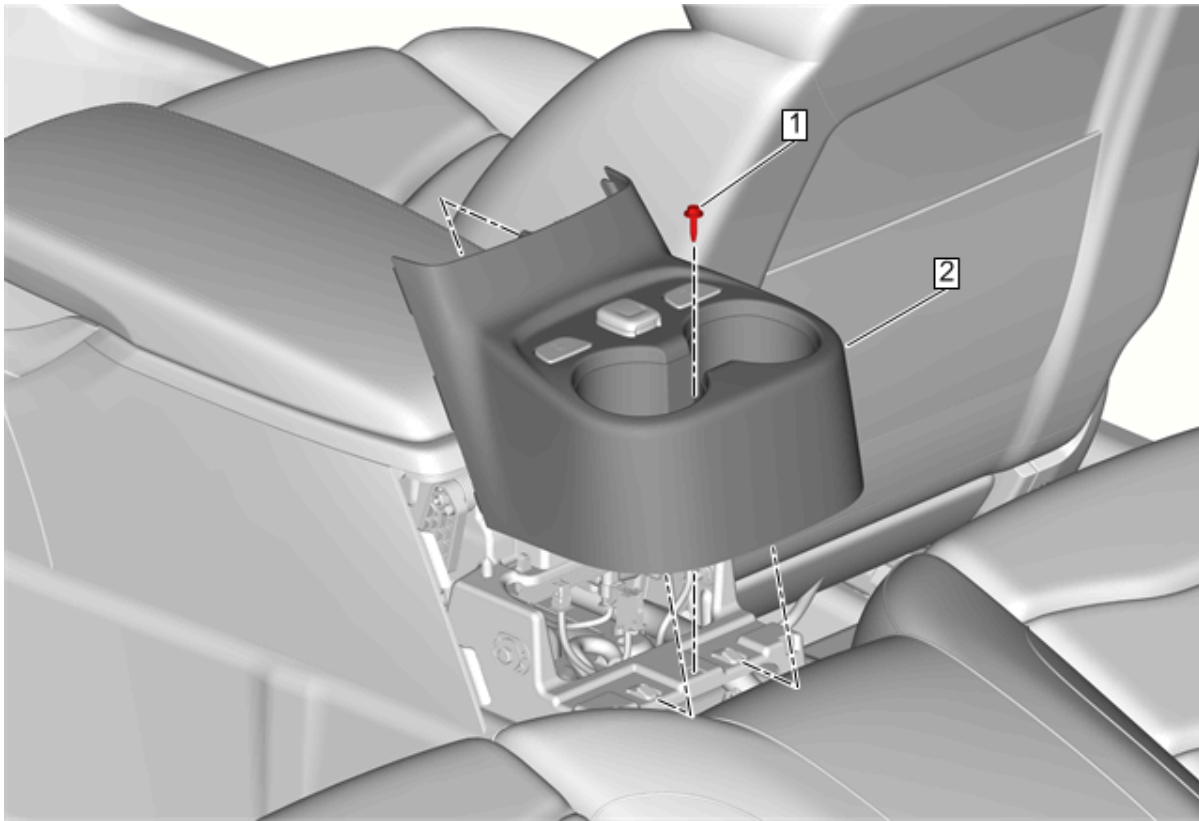


Fig. 114: Front Floor Console Rear Cup Holder

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Floor Console Cup Holder Liner Replacement</u>	
1	Front Floor Console Cup Holder Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Floor Console Rear Cup Holder Procedure 1. Use a plastic trim tool if necessary. 2. Disconnect all electrical connectors. 3. Transfer components as necessary.

FRONT FLOOR CONSOLE COMPARTMENT LINER REPLACEMENT

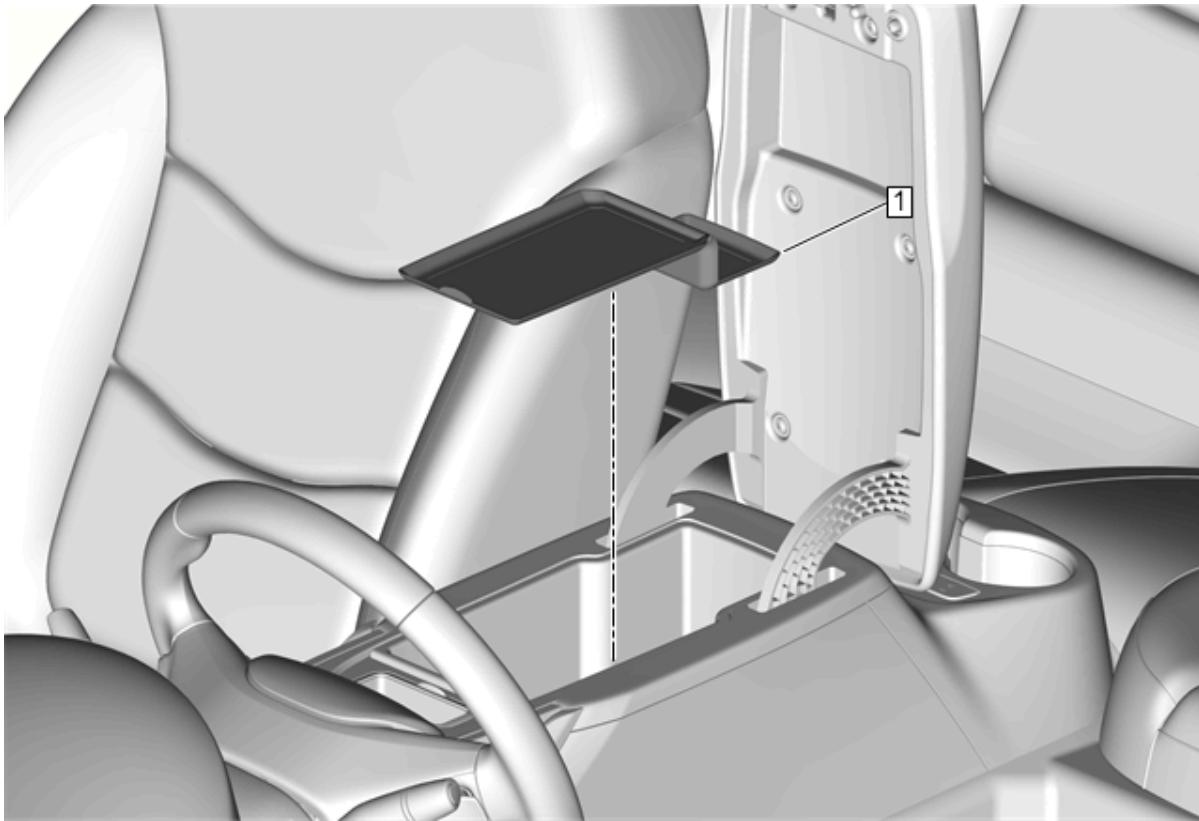


Fig. 115: Front Floor Console Compartment Liner

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Compartment Liner

FRONT FLOOR CONSOLE CENTER COMPARTMENT LINER REPLACEMENT

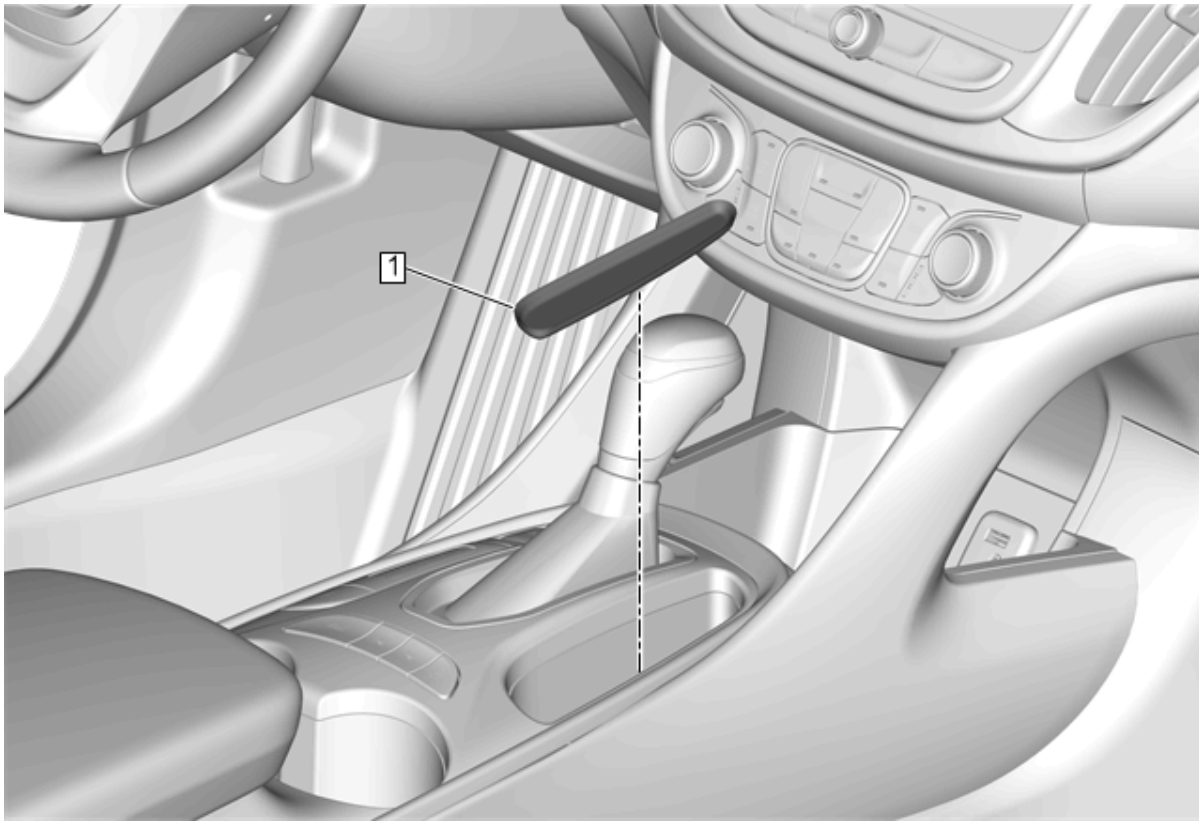


Fig. 116: Front Floor Console Center Compartment Liner

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Center Compartment Liner

FRONT FLOOR CONSOLE ACCESSORY TRIM PLATE REPLACEMENT

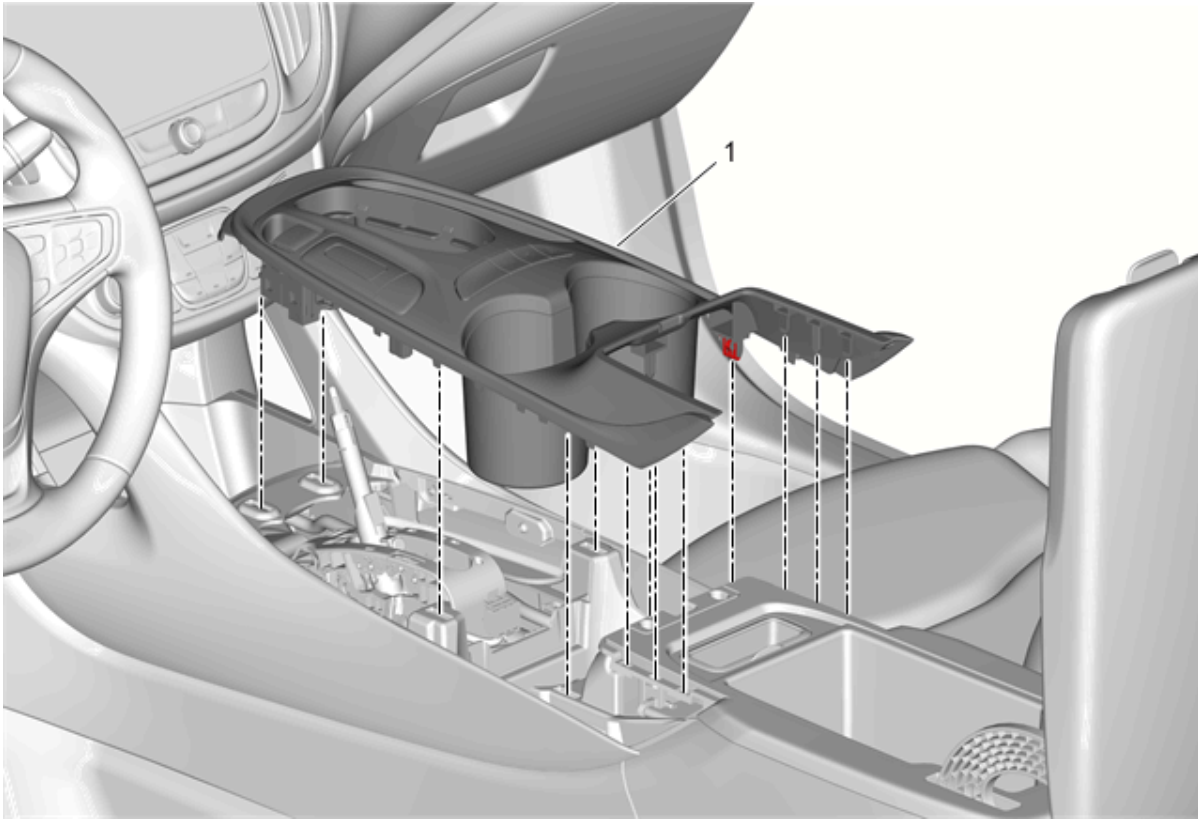


Fig. 117: Front Floor Console Accessory Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Transmission Control Lever Knob Replacement</u>	
1	Front Floor Console Accessory Trim Plate Procedure 1. Use a flat bladed plastic trim tool. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

FRONT FLOOR CONSOLE EXTENSION PANEL REPLACEMENT - RIGHT SIDE

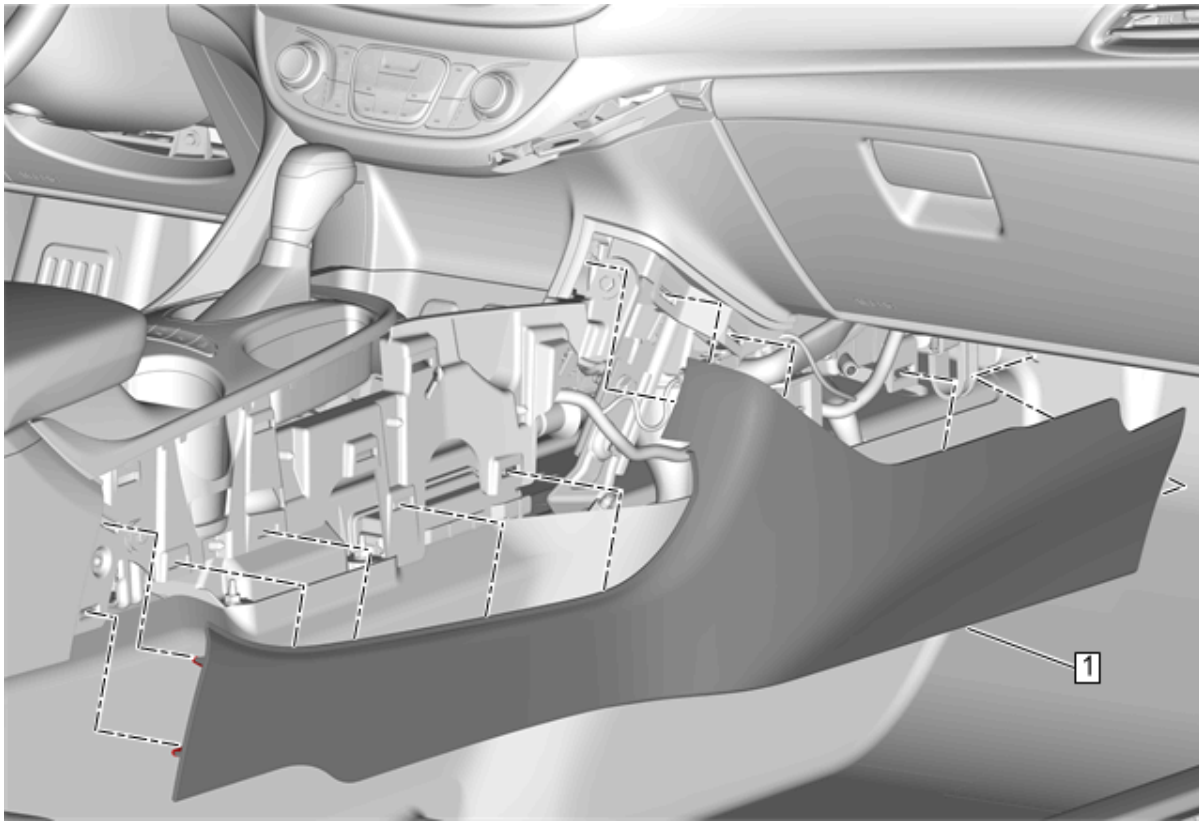


Fig. 118: Front Floor Console Extension Panel - Right Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Floor Console Applique Replacement - Right Side</u>	
1	Front Floor Console Extension Panel - Right Procedure 1. Move the front seat forward to access the retainers at the rear of the panel. 2. Starting from the rear, use a flat bladed plastic trim tool to aid in the removal of the panel from the front floor console assembly. 3. Pull the panel rearward to release the integral hook from the brace assembly. 4. When installing the extension panel, secure the integral hook to the brace first then secure the retainers.

FRONT FLOOR CONSOLE EXTENSION PANEL REPLACEMENT - LEFT SIDE

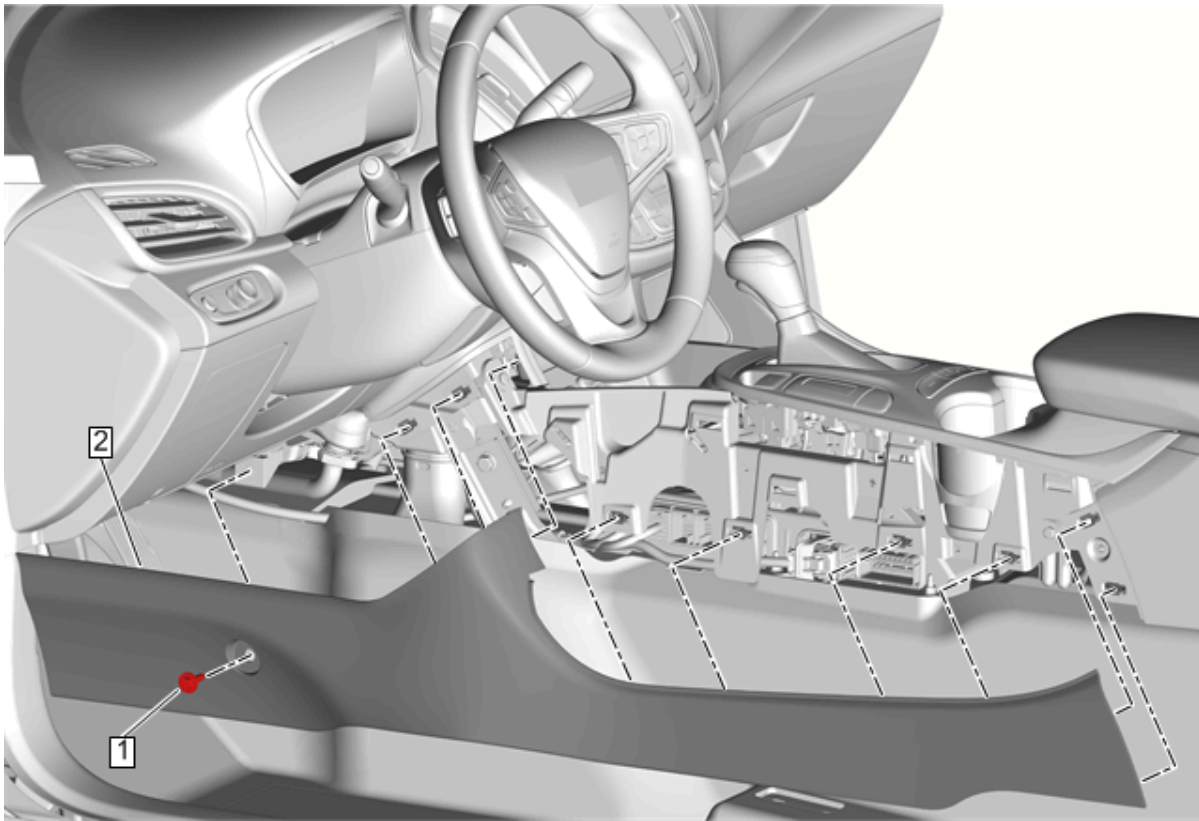


Fig. 119: Front Floor Console Extension Panel - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Floor Console Applique Replacement - Left Side</u>	
1	Front Floor Console Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 9 N.m (80 lb in)
2	Front Floor Console Extension Panel - Left Procedure 1. Move the front seat forward to access the retainers at the rear of the panel. 2. Starting from the rear, use a flat bladed plastic trim tool to aid in the removal of the panel from the front floor console assembly.

FRONT FLOOR CONSOLE REPLACEMENT

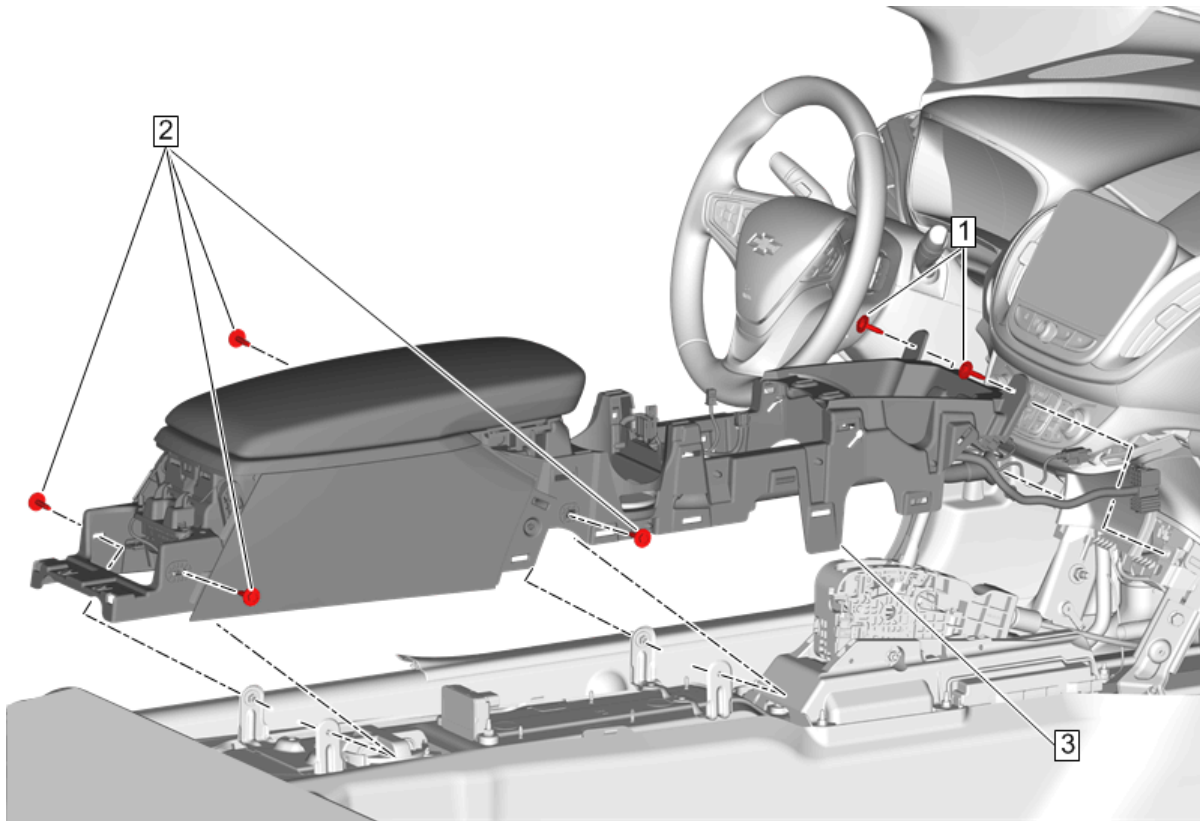


Fig. 120: Front Floor Console

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Extension Panel Replacement - Left Side Front Floor Console Extension Panel Replacement - Right Side Front Floor Console Rear Cup Holder Replacement Front Floor Console Accessory Trim Plate Replacement	
1	Front Floor Console Retainer Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Front Floor Console Bracket Bolt (Qty: 4) Tighten 9 N.m (80 lb in)

Callout	Component Name
3	Front Floor Console Assembly Procedure 1. Disconnect all electrical connectors. 2. Transfer components as necessary.

FRONT FLOOR LOWER CONSOLE REPLACEMENT

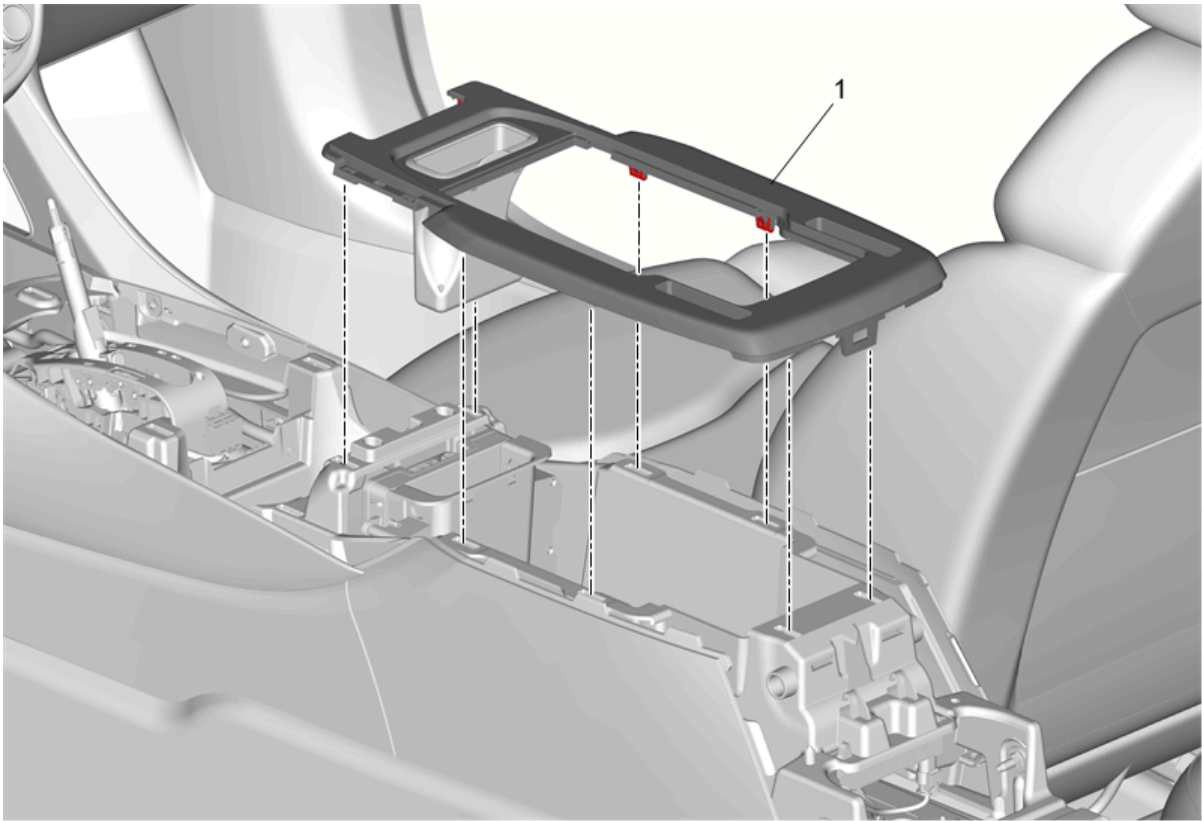


Fig. 121: Front Floor Lower Console
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Front Floor Console Armrest Replacement 2. Front Floor Console Accessory Trim Plate Replacement 3. Front Floor Console Compartment Divider Replacement	
1	Front Floor Lower Console Procedure 1. Use a plastic trim tool if necessary.

Callout	Component Name
	2. Transfer components as necessary.

FRONT FLOOR REAR CONSOLE SIDE TRIM PANEL REPLACEMENT - LEFT SIDE

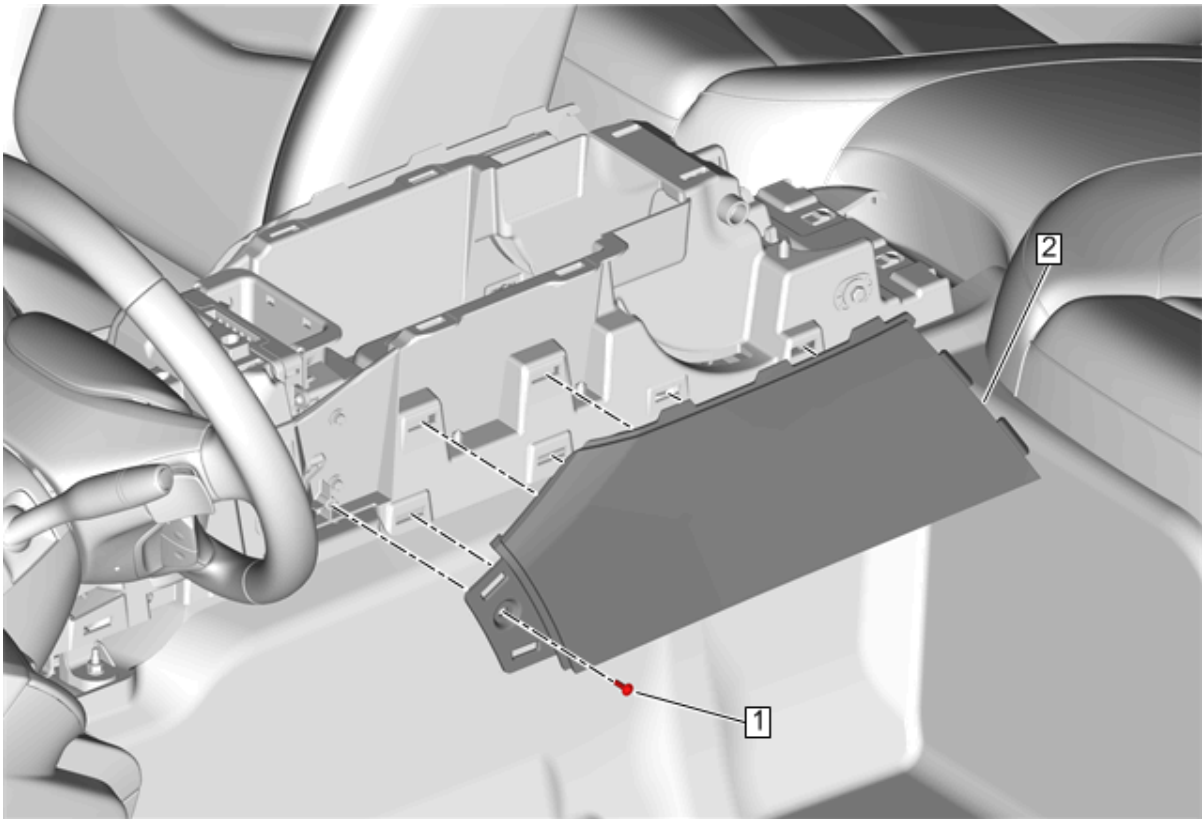


Fig. 122: Front Floor Rear Console Side Trim Panel - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. <u>Front Floor Lower Console Replacement</u>	
2. <u>Front Floor Console Extension Panel Replacement - Left Side</u>	
1	Front Floor Console Rear Cover Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 1 N.m (9 lb in)

Callout	Component Name
2	Front Floor Rear Console Side Trim Panel - Left Side Procedure 1. Move the front seat forward to access the retainers at the rear of the panel. 2. Use a plastic trim tool if necessary.

FRONT FLOOR REAR CONSOLE SIDE TRIM PANEL REPLACEMENT - RIGHT SIDE

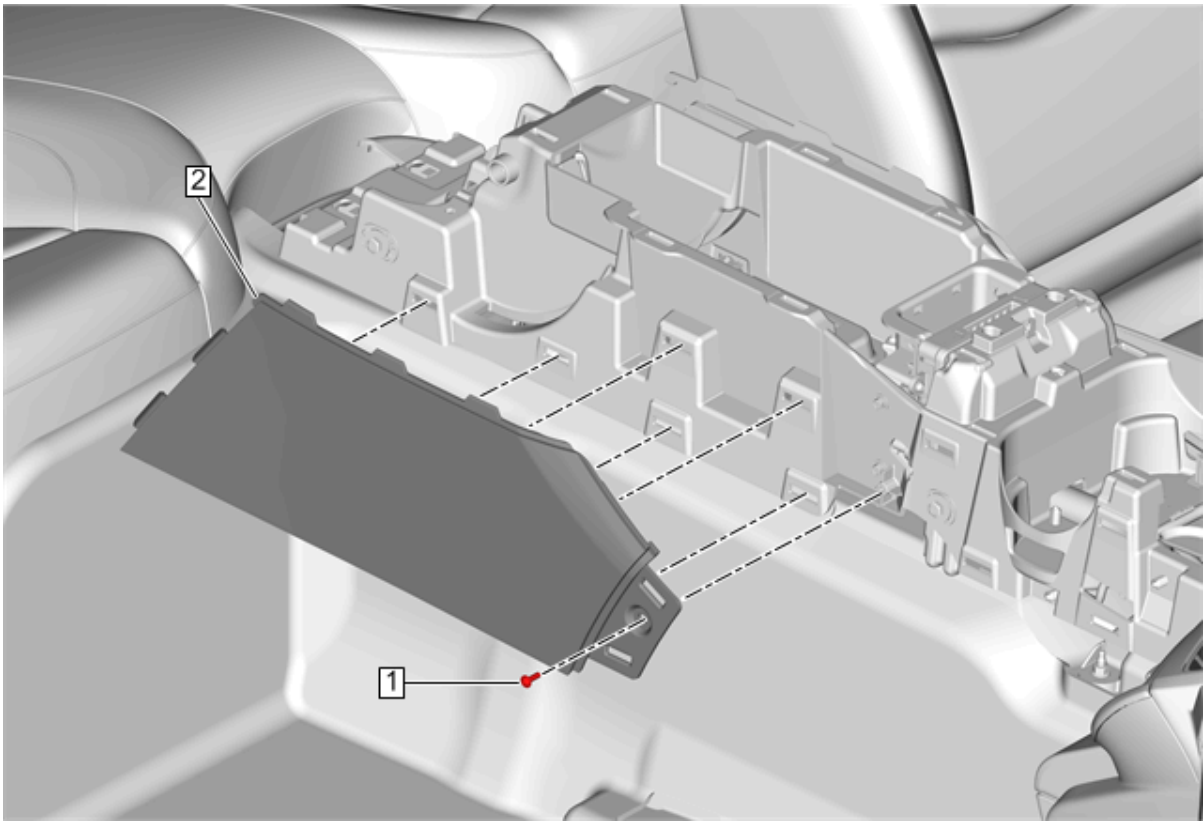


Fig. 123: Front Floor Rear Console Side Trim Panel - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. <u>Front Floor Lower Console Replacement</u> 2. <u>Front Floor Console Extension Panel Replacement - Right Side</u>	

Callout	Component Name
1	Front Floor Console Rear Cover Bolt CAUTION: Refer to Fastener Caution . Tighten 1 N.m (9 lb in)
2	Front Floor Rear Console Side Trim Panel - Right Side Procedure 1. Move the front seat forward to access the retainers at the rear of the panel. 2. Use a plastic trim tool if necessary.

FRONT FLOOR CONSOLE ARMREST LATCH REPLACEMENT

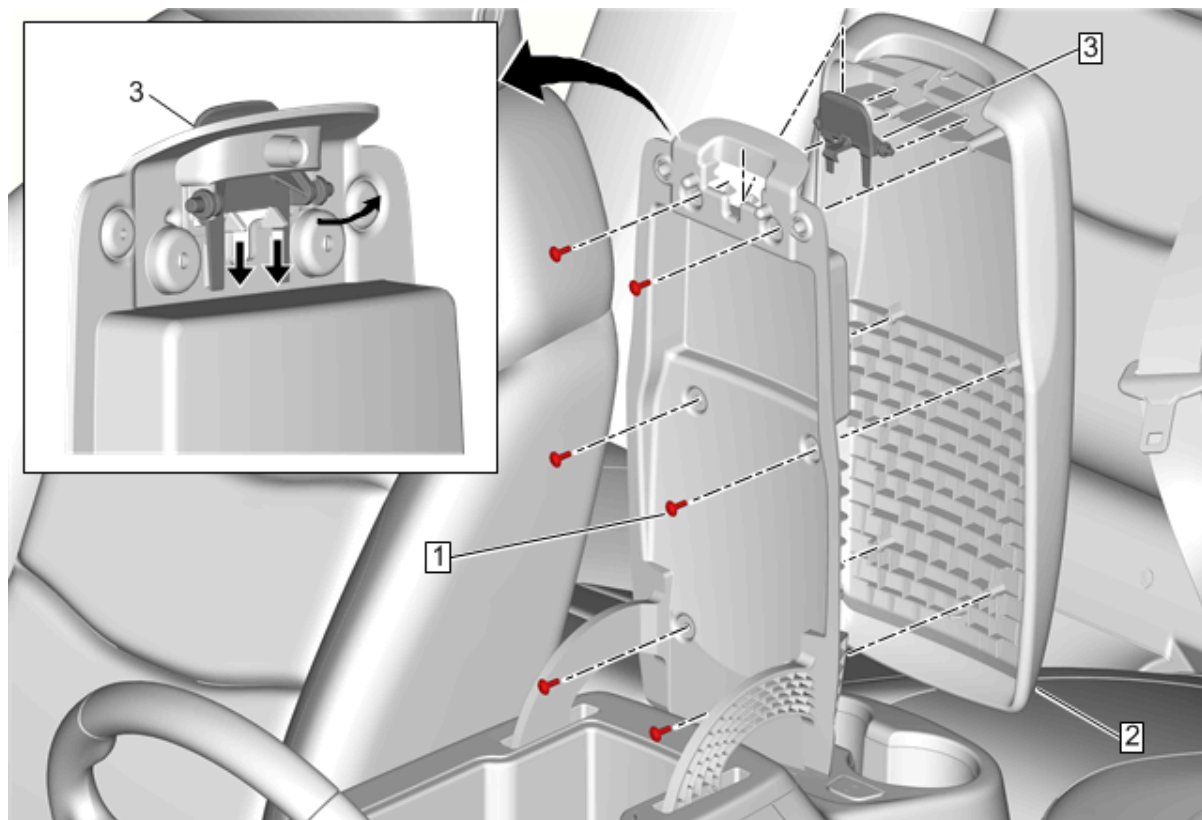


Fig. 124: Front Floor Console Armrest Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Armrest Bolt (Qty: 6)

Callout	Component Name
	CAUTION: Refer to Fastener Caution . 2 N.m (18 lb in)
2	Front Floor Console Armrest
3	Front Floor Console Armrest Latch Procedure Release the retaining tab.

FRONT FLOOR CONSOLE ARMREST REPLACEMENT

Removal Procedure

1. Remove Front Floor Console Rear Cup Holder Replacement

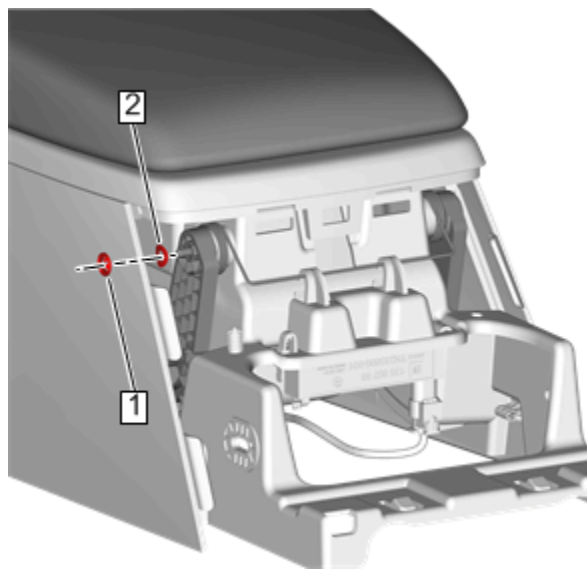


Fig. 125: Front Floor Console Armrest Hinge Washer

Courtesy of GENERAL MOTORS COMPANY

2. Use a suitable tool to release the Front Floor Console Armrest Clip Hinge Retention (1) from the Hinge Pin.
3. Remove Front Floor Console Armrest Hinge Washer (2)
4. Position the front seat as needed to access the Front Floor Console Armrest Hinge Pin.

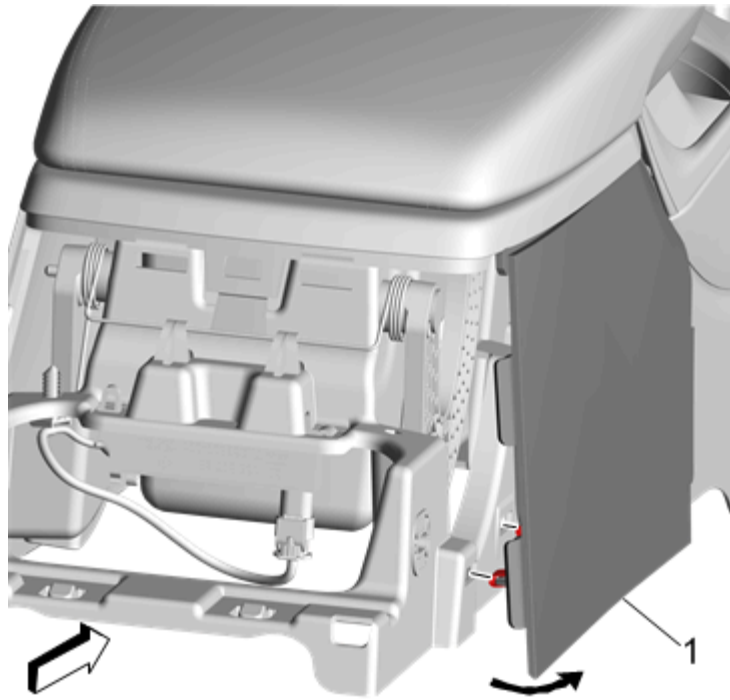


Fig. 126: Front Floor Rear Console Side Trim Panel

Courtesy of GENERAL MOTORS COMPANY

5. Release the lower clips of the front floor rear console side trim panel (1) to allow the door hinge pin to be removed. Careful not to damage the tabs on the top of the panel and the forward hidden fastener.

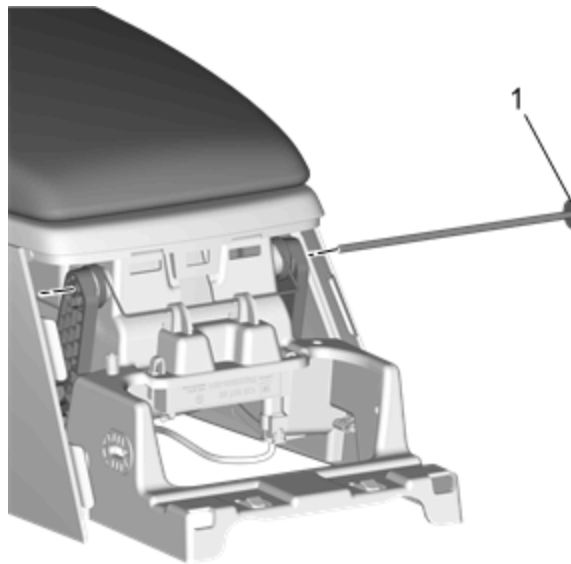


Fig. 127: Front Floor Console Compartment Door Hinge Pin

Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Floor Console Compartment Door Hinge Pin (1) @Armrest Assembly

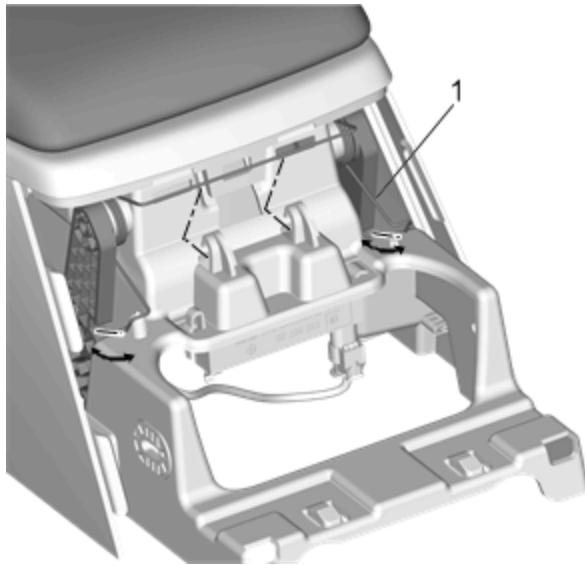


Fig. 128: Front Floor Console Armrest Hinge
 Courtesy of GENERAL MOTORS COMPANY

7. Use a suitable tool to release the ends of the Front Floor Console Armrest Hinge (1) from the Hinge Arm.

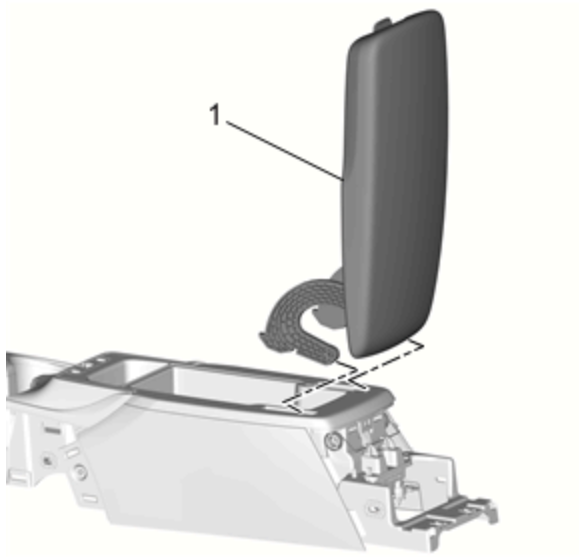


Fig. 129: Front Floor Console Armrest
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Floor Console Armrest (1) @Front Floor Console Assembly

Installation Procedure

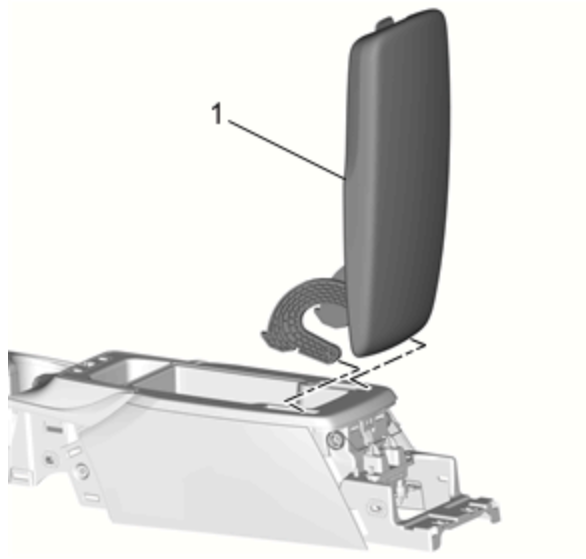


Fig. 130: Front Floor Console Armrest

Courtesy of GENERAL MOTORS COMPANY

1. Install Front Floor Console Armrest (1) @Front Floor Console Assembly

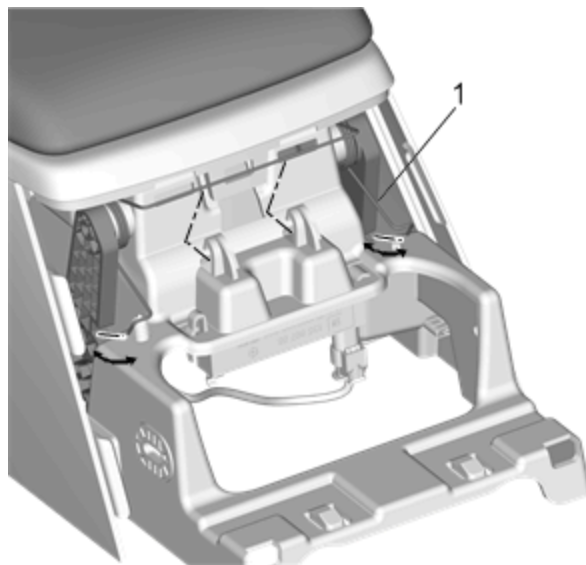


Fig. 131: Front Floor Console Armrest Hinge

Courtesy of GENERAL MOTORS COMPANY

2. Attach the ends of the Front Floor Console Armrest Hinge (1) to the Hinge Arm.

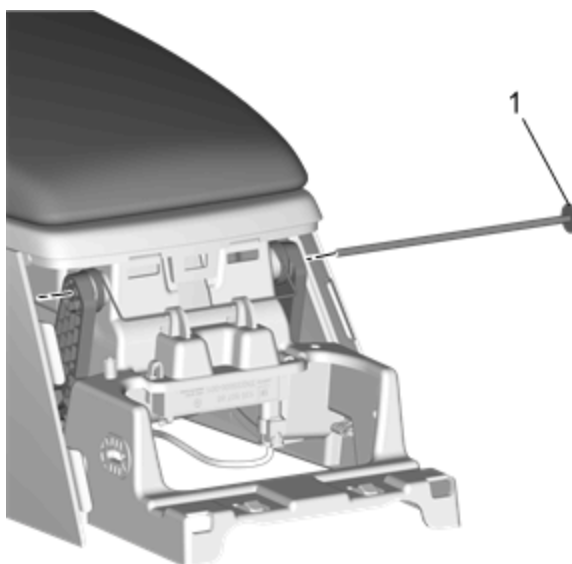


Fig. 132: Front Floor Console Compartment Door Hinge Pin
 Courtesy of GENERAL MOTORS COMPANY

3. Install Front Floor Console Compartment Door Hinge Pin (1) @ Armrest Assembly

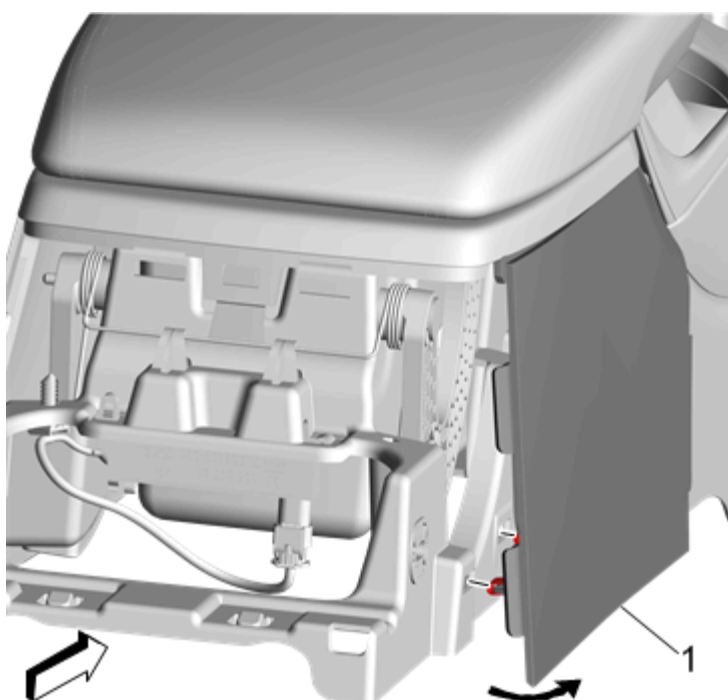


Fig. 133: Front Floor Rear Console Side Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

4. Install Front Floor Rear Console Side Trim Panel - Right Side (1)

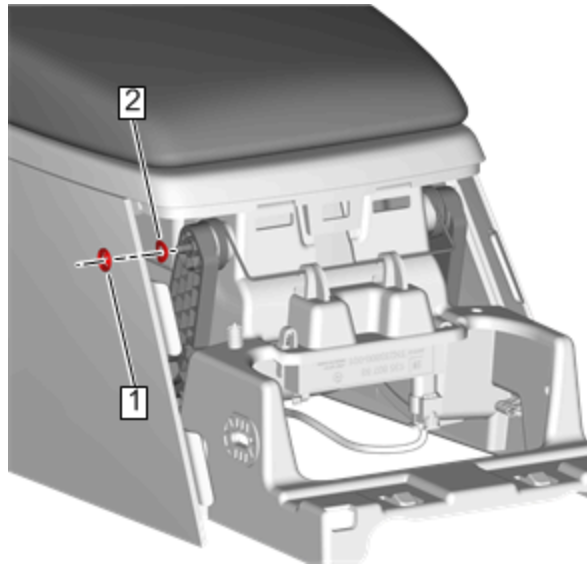


Fig. 134: Front Floor Console Armrest Hinge Washer
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Floor Console Armrest Hinge Washer (2)
6. Install Front Floor Console Armrest Clip Hinge Retention (1) @Hinge Pin
7. Install **Front Floor Console Rear Cup Holder Replacement**

FRONT FLOOR CONSOLE ARMREST HINGE REPLACEMENT

Removal Procedure

1. Remove **Front Floor Console Rear Cup Holder Replacement**

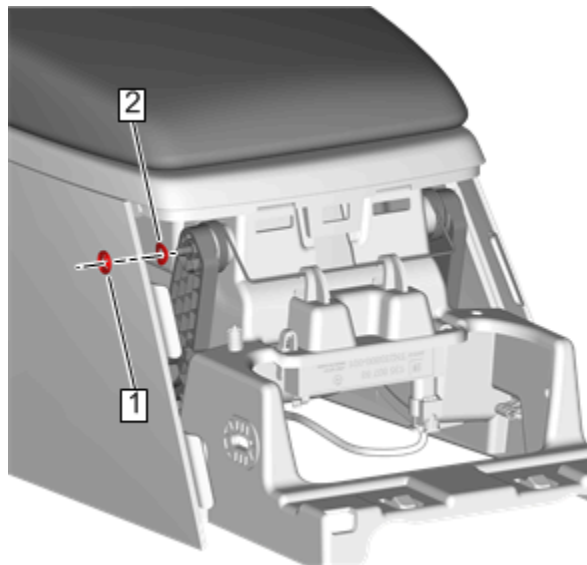


Fig. 135: Front Floor Console Armrest Hinge Washer
Courtesy of GENERAL MOTORS COMPANY

2. Use a suitable tool to release the Front Floor Console Armrest Clip Hinge Retention (1) from the Hinge Pin.
3. Remove Front Floor Console Armrest Hinge Washer (2)

4. Position the front seat as needed to access the Front Floor Console Armrest Hinge Pin.

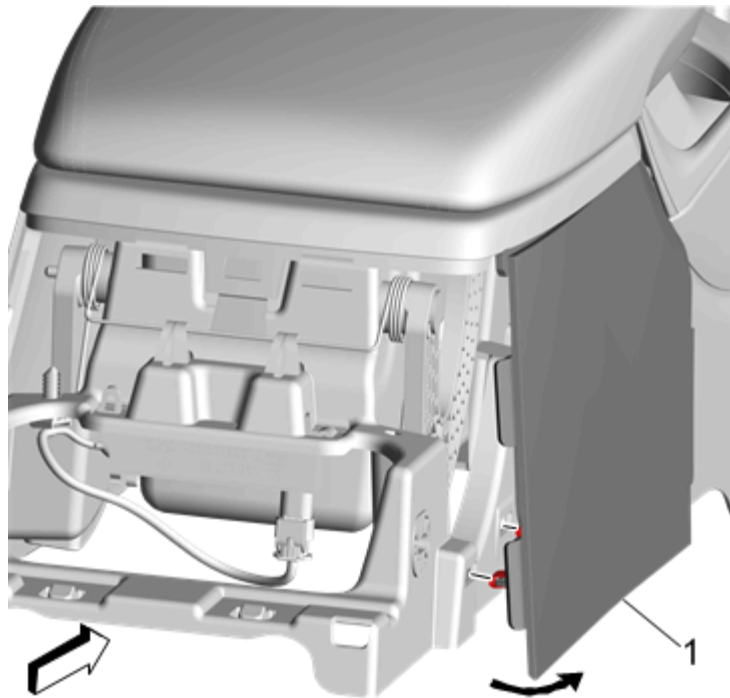


Fig. 136: Front Floor Rear Console Side Trim Panel

Courtesy of GENERAL MOTORS COMPANY

5. Release the lower clips of the front floor rear console side trim panel (1) to allow the door hinge pin to be removed. Careful not to damage the tabs on the top of the panel and the forward hidden fastener.

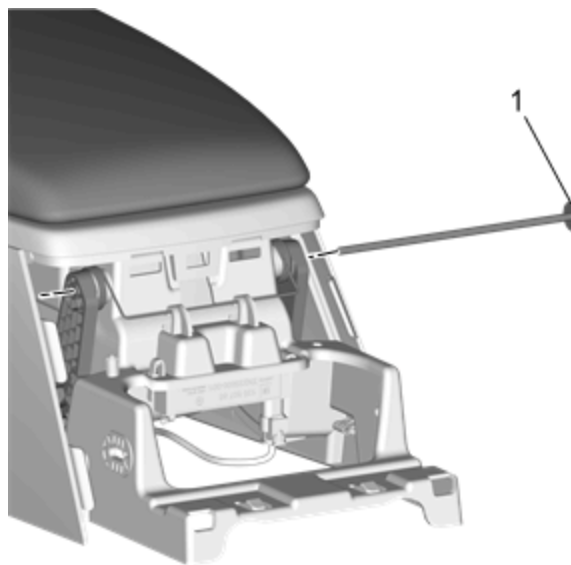


Fig. 137: Front Floor Console Compartment Door Hinge Pin

Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Floor Console Compartment Door Hinge Pin (1) @Armrest Assembly

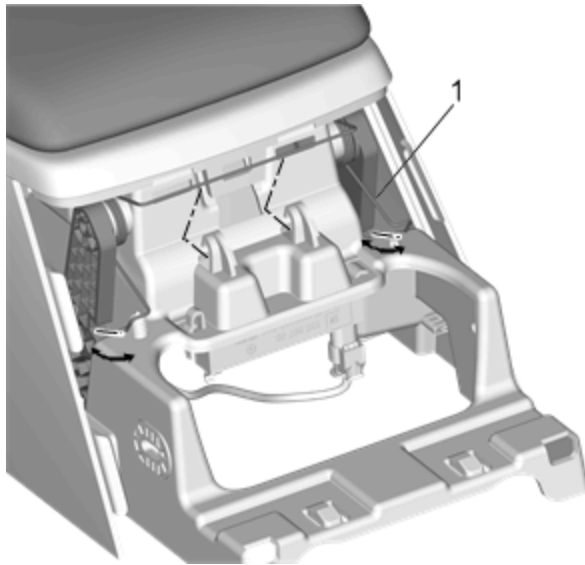


Fig. 138: Front Floor Console Armrest Hinge
 Courtesy of GENERAL MOTORS COMPANY

7. Use a suitable tool to release the ends of the Front Floor Console Armrest Hinge (1) from the Hinge Arm.

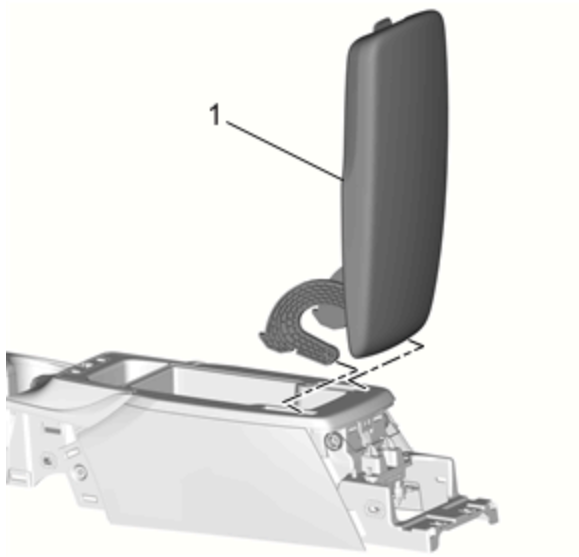


Fig. 139: Front Floor Console Armrest
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Floor Console Armrest (1) @Front Floor Console Assembly

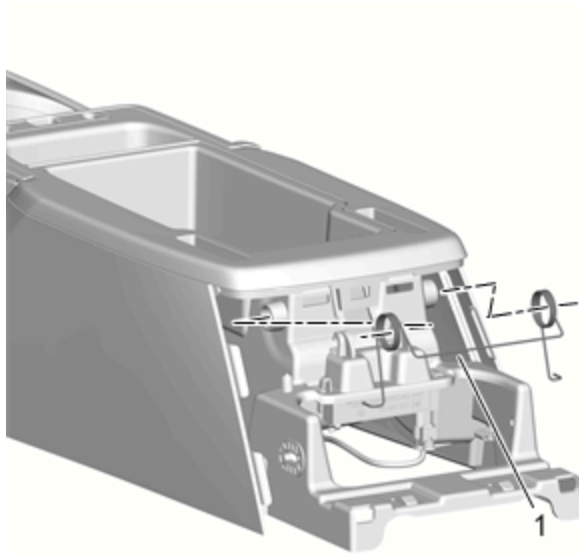


Fig. 140: Front Floor Console Armrest Hinge
Courtesy of GENERAL MOTORS COMPANY

9. Remove Front Floor Console Armrest Hinge (1) @ Hinge Arm

Installation Procedure

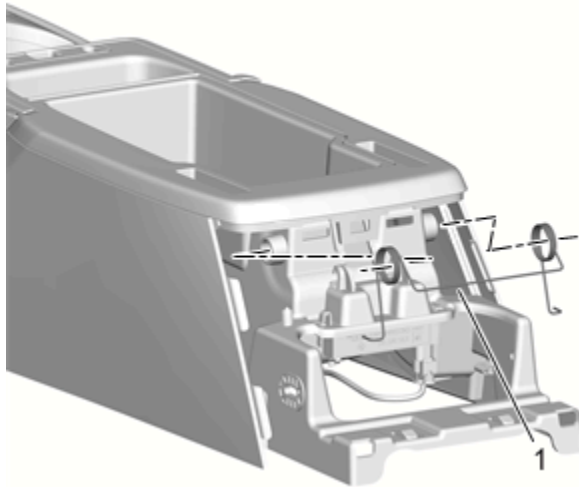


Fig. 141: Front Floor Console Armrest Hinge
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Floor Console Armrest Hinge (1) @ Hinge Arm

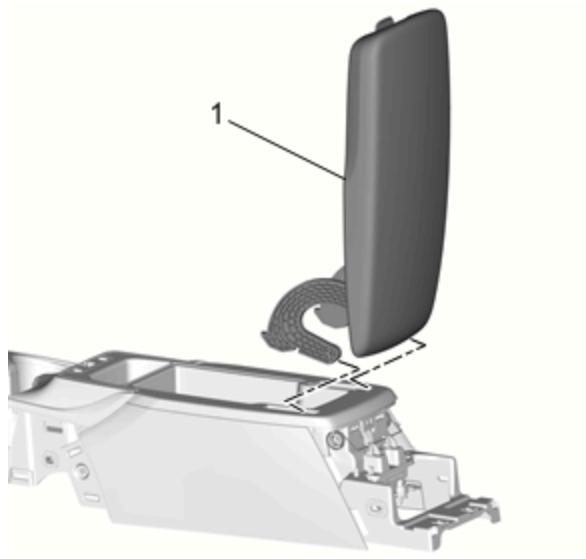


Fig. 142: Front Floor Console Armrest

Courtesy of GENERAL MOTORS COMPANY

2. Install Front Floor Console Armrest (1) @Front Floor Console Assembly

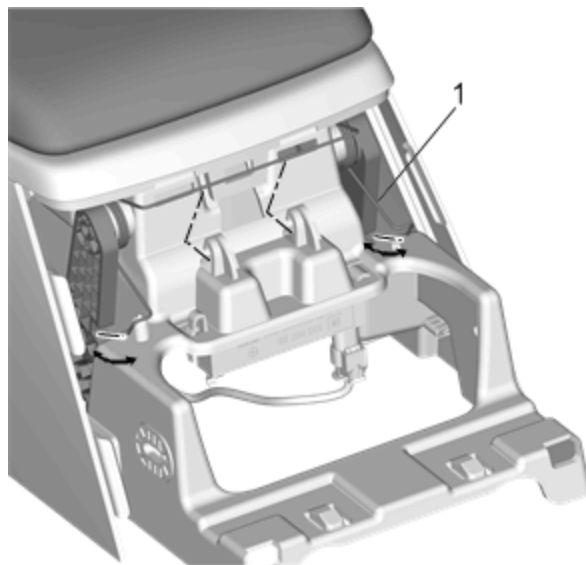


Fig. 143: Front Floor Console Armrest Hinge

Courtesy of GENERAL MOTORS COMPANY

3. Attach the ends of the Front Floor Console Armrest Hinge (1) to the Hinge Arm.

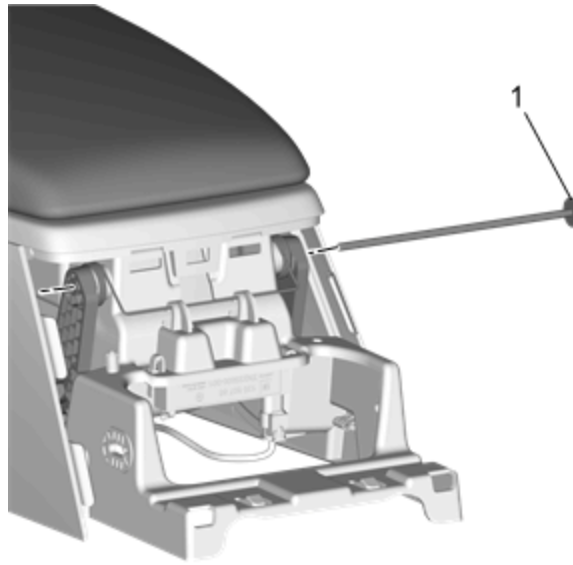


Fig. 144: Front Floor Console Compartment Door Hinge Pin
 Courtesy of GENERAL MOTORS COMPANY

4. Install Front Floor Console Compartment Door Hinge Pin (1) @ Armrest Assembly

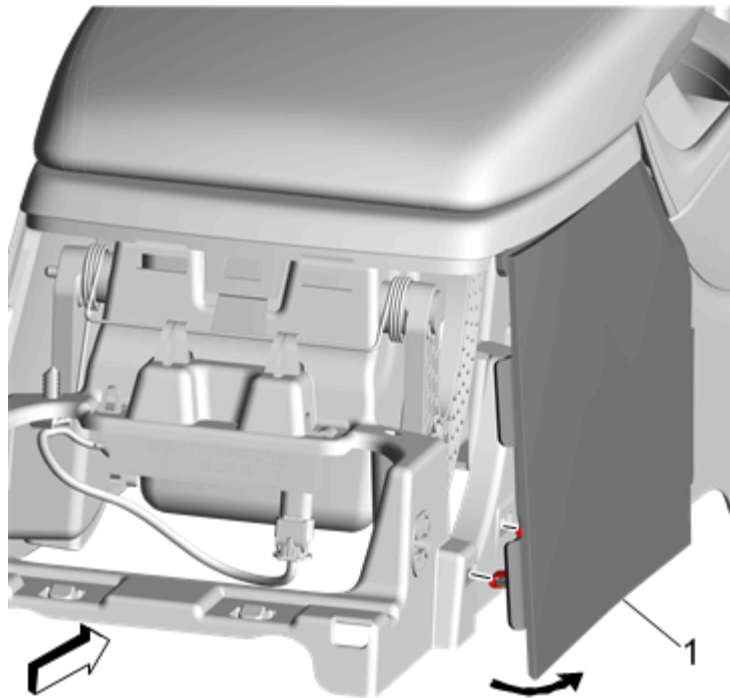


Fig. 145: Front Floor Rear Console Side Trim Panel
 Courtesy of GENERAL MOTORS COMPANY

5. Install Front Floor Rear Console Side Trim Panel - Right Side (1)

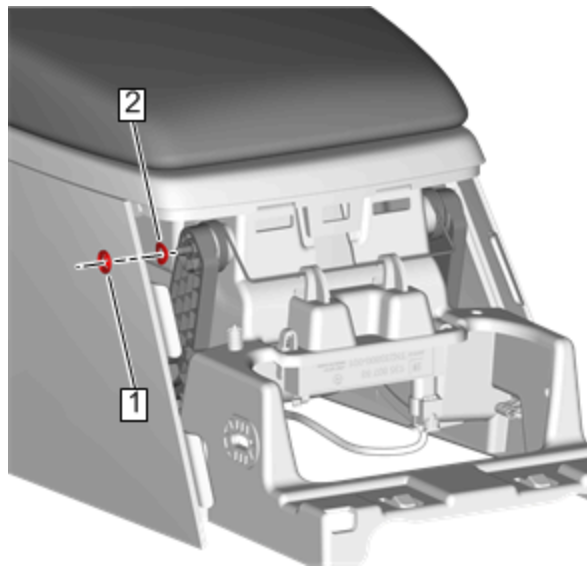


Fig. 146: Front Floor Console Armrest Hinge Washer
 Courtesy of GENERAL MOTORS COMPANY

6. Install Front Floor Console Armrest Hinge Washer (2)
7. Install Front Floor Console Armrest Clip Hinge Retention (1) @Hinge Pin
8. Install **Front Floor Console Rear Cup Holder Replacement**

FRONT FLOOR CONSOLE APPLIQUE REPLACEMENT - RIGHT SIDE

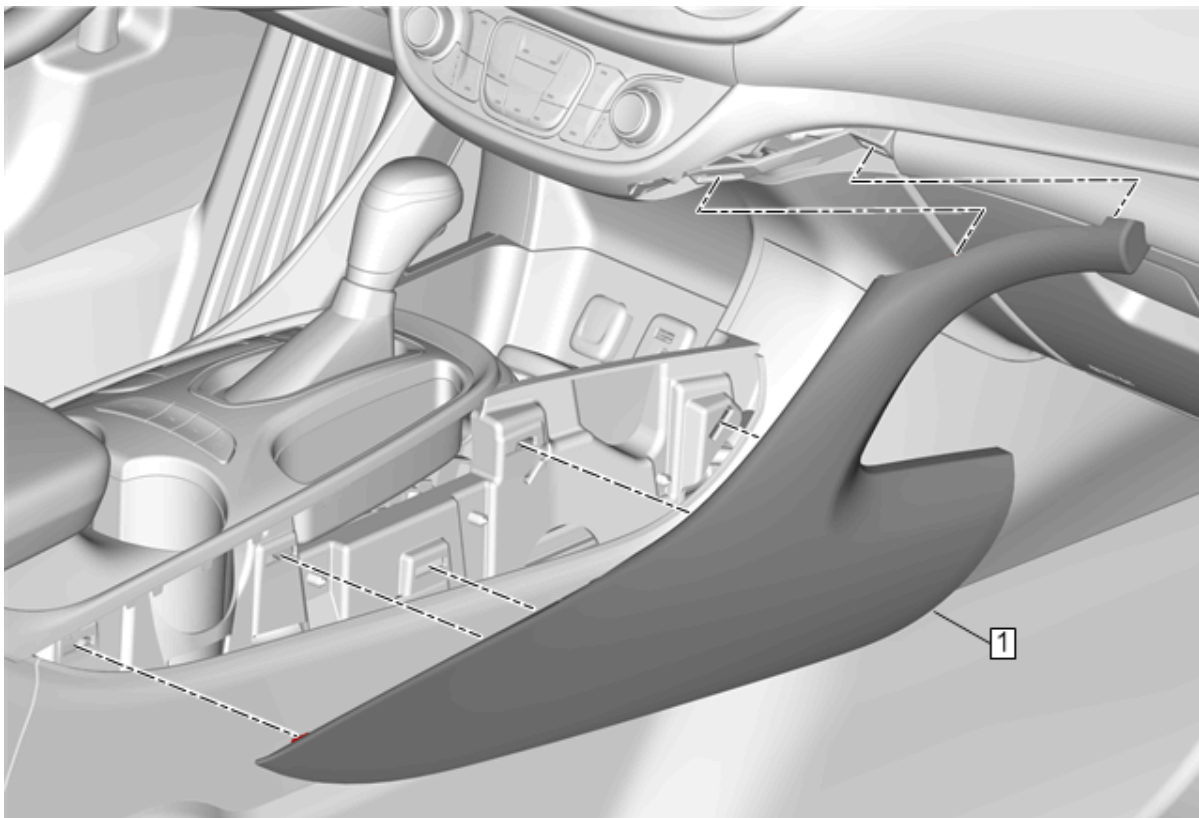


Fig. 147: Front Floor Console Applique - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Applique - Right Side Procedure Use a flat bladed plastic trim tool.

FRONT FLOOR CONSOLE APPLIQUE REPLACEMENT - LEFT SIDE

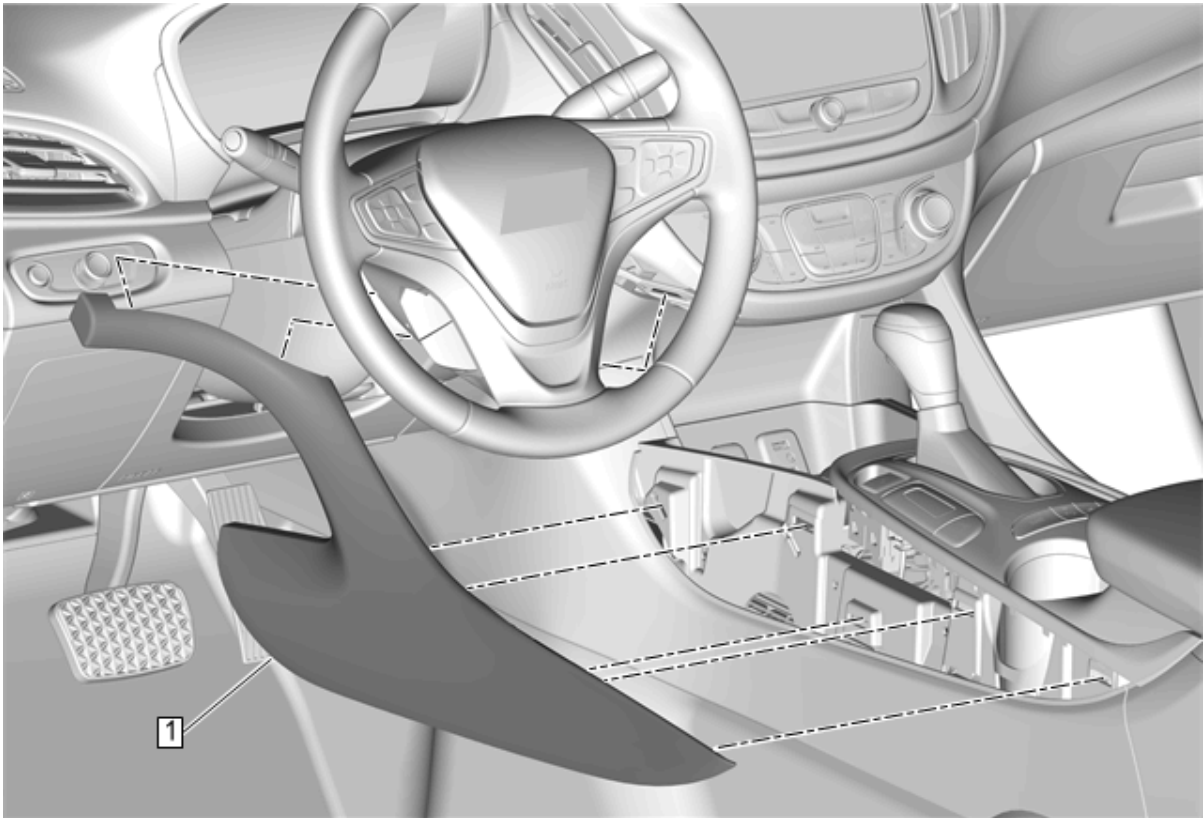


Fig. 148: Front Floor Console Applique - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Applique - Left Side Procedure Use a flat bladed plastic trim tool.

ROOF CONSOLE REPLACEMENT

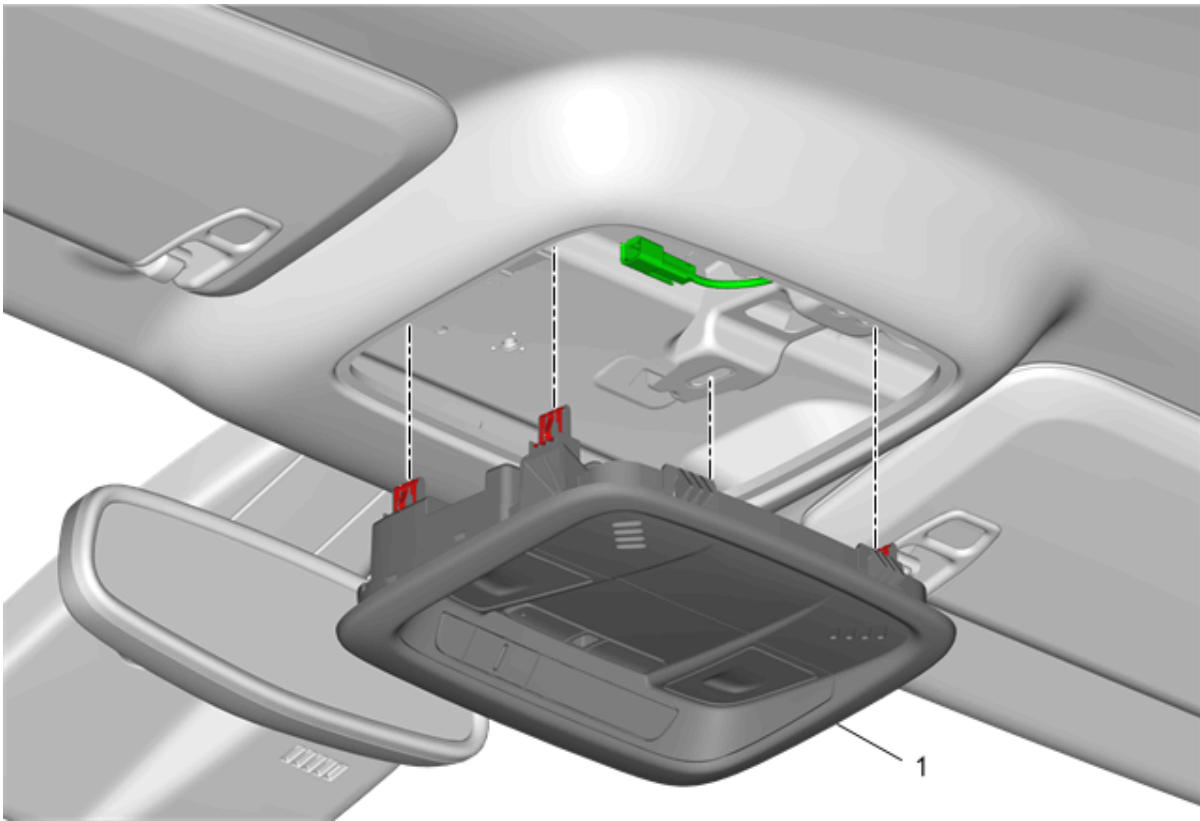


Fig. 149: Roof Console
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Roof Console Procedure 1. Grasp the roof console on both sides and pull down to disengage the clips. 2. Disconnect all electrical connectors. 3. Transfer components as necessary.

ACCESSORIES & EQUIPMENT

Mirrors - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Inside Rearview Mirror Screw	1.8 N.m (16 lb in)
Outside Rearview Mirror Bolt	10 N.m (89 lb in)
Outside Rearview Mirror Inner Actuator Fastener	0.8 N.m (71 lb in)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Inside Mirror Adhesive Kit	Adhesive	89021329	89020893

SCHEMATIC WIRING DIAGRAMS

INSIDE REARVIEW MIRROR WIRING SCHEMATICS

Inside Rearview Mirror (DD8)

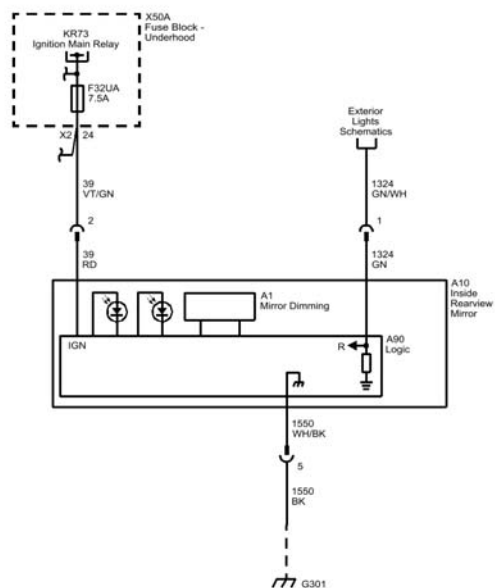


Fig. 1: Inside Rearview Mirror (DD8)

Courtesy of GENERAL MOTORS COMPANY

OUTSIDE REARVIEW MIRROR WIRING SCHEMATICS

Directional Controls and Motors

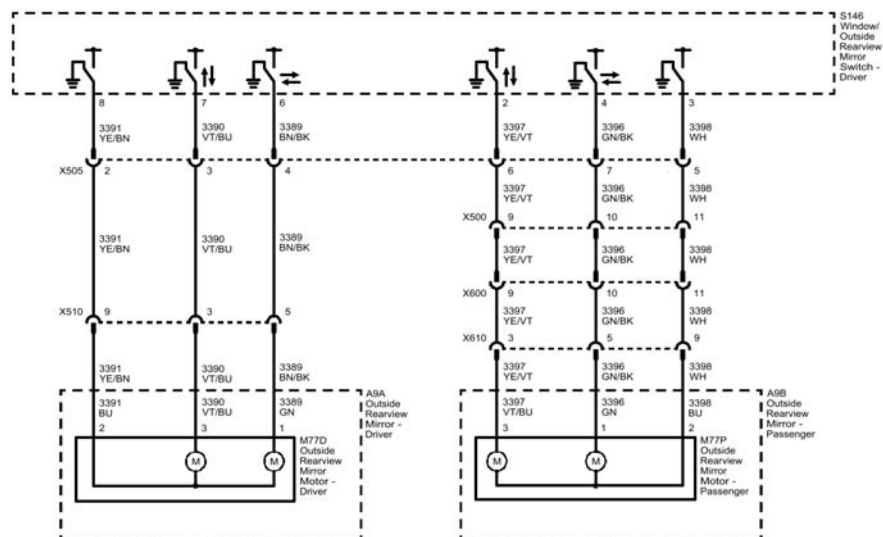


Fig. 2: Directional Controls and Motors
 Courtesy of GENERAL MOTORS COMPANY

Mirror Heaters (DLW)

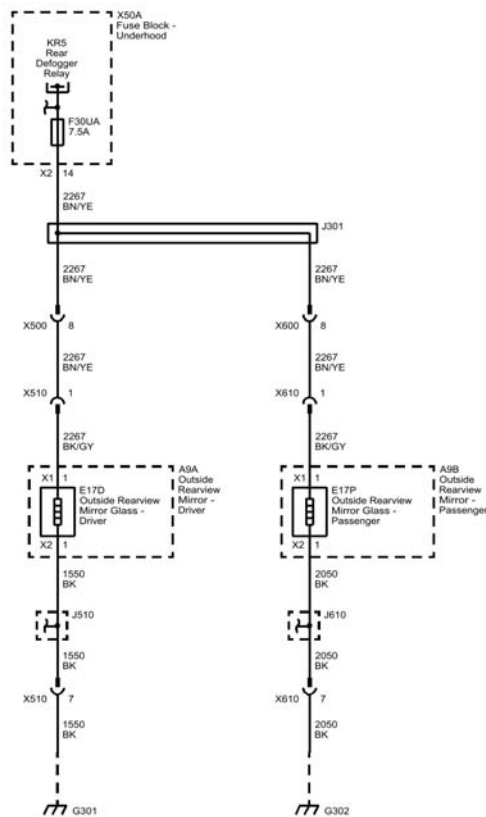


Fig. 3: Mirror Heaters (DLW)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - MIRRORS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to [Outside Mirror Description and Operation](#), and [Automatic Day-Night Mirror Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Heated Mirrors Malfunction](#)
- [Power Mirror Malfunction](#)
- [Automatic Day-Night Mirrors Malfunction](#)

HEATED MIRRORS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay B+	-	2	-	-
Relay Control	B0283 02	B0283 05	B0283 05	-
Relay Ground	-	B0283 05	-	-
Left Heated Mirror Element Control	2	1	3	-
Driver Outside Rearview Mirror Ground	-	1	-	-
Right Heated Mirror Element Control	2	1	3	-
Passenger Outside Rearview Mirror Ground	-	1	-	-
1. Single Heated Mirror Inoperative 2. Both Heated Mirrors Inoperative 3. Heated Mirrors Always On				

Circuit/System Description

The outside rearview mirror heater relay supplies voltage to the outside rearview mirror heater elements based on the current state of the rear window defogger. The relay supplies B+ through the driver/passenger mirror heating element control circuit when a request is seen.

Reference Information

Schematic Reference

[Outside Rearview Mirror Schematics](#)

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
 - **If the E18 Rear Defogger Grid does not turn ON or OFF**

Refer to [Rear Window Defogger Malfunction](#) .

- **If the E18 Rear Defogger Grid turns ON and OFF**
3. Verify the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger become warm when commanding the Rear Defogger On with a scan tool.
 - **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger do not become warm**

Refer to Circuit/System Testing.

- **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger become warm**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate A9 Outside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 7 and ground.
 - **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
- **If less than 10 Ω**
3. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 7.
4. Verify the test lamp turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the A9 Outside Rearview Mirror.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block-Underhood
 - **If the test lamp turns ON and OFF**
5. Test or replace the A9 Outside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Outside Rearview Mirror Glass Replacement**
- Refer to **Fuse Block Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup

AUTOMATIC DAY-NIGHT MIRRORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	-	-
Backup Lamp Signal	B2545 02	2	2	-
Ground	-	1	-	-
1. Automatic Mirror Dimming Inoperative 2. Mirror Automatic Day-Night Disable Feature Malfunction				

Circuit/System Description

The inside rearview mirror uses 2 photocell sensors. One sensor is the rear light sensor, located on the face side of the mirror, facing the rear of the vehicle. The rear light sensor is used to determine light conditions present at the mirror face. The other sensor is the front light sensor, located on the backside of the mirror, facing the front of the vehicle. The front light sensor is used to determine the exterior light conditions at the front of the vehicle. With a low exterior light condition detected by the front light sensor and a high light condition from the rear light sensor, the inside rearview mirror will automatically darken the face of the inside rearview mirror.

With the gear selector lever in the REVERSE position, backup lamp control voltage is supplied as an input to the inside rearview mirror. The mirror monitors this input to disable the automatic day-night feature. This allows the driver to see objects in the mirror clearly when backing up, regardless of the rear light sensor status.

Reference Information

Schematic Reference

Inside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic Day-Night Mirror Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Cover the rear window with a blanket or other suitable item.
3. Verify the A10 Inside Rearview Mirror face dims when shining a bright light into the rear light sensor
 - **If the A10 Inside Rearview Mirror does not dim**

Refer to Circuit/System Testing - Inside Review Mirror Dimming Inoperative
 - **If the A10 Inside Rearview Mirror dims**
4. Verify the A10 Inside Rearview Mirror face transitions from dim to bright while commanding the Backup Lamps Active and Inactive with a scan tool.
 - **If the A10 Inside Rearview Mirror does not transition between dim and bright.**

Refer to Circuit/System Testing - Day-Night Disable Malfunction
 - **If the A10 Inside Rearview Mirror transitions between bright and dim states**
5. All OK.

Circuit/System Testing

Inside Review Mirror Dimming Inoperative

1. Vehicle OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the A10 Inside Rearview Mirror.
 - **If the test lamp illuminates**

5. Replace the A10 Inside Rearview Mirror.

Day-Night Disable Malfunction

1. Vehicle OFF, disconnect the harness connector at the A10 Inside Rearview Mirror.
2. Connect a test lamp between the control circuit terminal 1 and ground
3. Vehicle in Service Mode, verify the test lamp turns ON and OFF while commanding the Backup Lamps Active and Inactive with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Backup Lamps Malfunction](#) .
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, refer to [Backup Lamps Malfunction](#)
 - **If the test lamp turns ON and OFF**
4. Replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Inside Rearview Mirror Replacement](#)

POWER MIRROR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Outside Rearview Mirror Switch	1	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+				
Driver Mirror Motor Horizontal Control	1	2	2	-
Driver Mirror Motor Vertical Control	1	2	2	-
Passenger Mirror Motor Horizontal Control	1	3	3	-
Passenger Mirror Motor Vertical Control	1	3	3	-
Outside Rearview Mirror Switch Ground	-	1	-	-
1. Both Outside Power Mirrors Inoperative 2. Driver Outside Power Mirror Malfunction 3. Passenger Outside Power Mirror Malfunction				

Circuit/System Description

The outside rearview mirror switch controls the outside rearview mirrors based on the position of the mirror selector switch and which movement position is selected. The outside rearview mirror switch has four positions: up, down, left, and right. B+ is applied to the switch from the power mirror fuse and when a movement position switch is selected, voltage is sent to the commanded mirror via a mirror control circuit. The opposite mirror control circuit acts as a ground circuit for the bi-directional mirror motor. Ground is the applied through the switch.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT with the S146 Window/Outside Rearview Mirror Switch-Driver.
 - **If both outside mirror glasses do not move**
Refer to Circuit/System Testing - Both Outside Rearview Mirrors Inoperative.
 - **If the driver outside mirror glass does not move UP, DOWN, LEFT or RIGHT**
Refer to Circuit/System Testing - Driver Outside Mirror Movement Malfunction.
 - **If the passenger outside mirror glass does not move UP, DOWN, LEFT or RIGHT**
Refer to Circuit/System Testing - Passenger Outside Mirror Movement Malfunction.
 - **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT**
3. All OK.

Circuit/System Testing

Both Outside Rearview Mirrors Inoperative

1. Vehicle OFF, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 24 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 23 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for infinite resistance between each of the control circuit terminals listed below and ground:

- Control circuit terminal 2
- Control circuit terminal 3
- Control circuit terminal 4
- Control circuit terminal 6
- Control circuit terminal 7
- Control circuit terminal 8
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the S146 Window/Outside Rearview Mirror Switch-Driver.

• **If the test lamp illuminates**

4. Test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.

Driver Outside Mirror Movement Malfunction

1. Vehicle OFF, disconnect the harness connector at the M77D Outside Rearview Mirror Motor-Driver.
Vehicle in Service Mode

2. Connect a test lamp between the control circuit terminal 2 and control circuit terminal 3.

3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S146 Window/Outside Rearview Mirror Switch-Driver.

• **If the test lamp remains OFF during either of the commands**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver.

2. Test for infinite resistance between each control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.

• **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver, Vehicle in Service Mode.

2. Test for less than 1 V between each control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch-Driver

• **If the test lamp turns ON during each of the commands**

4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2.

5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S146 Window/Outside Rearview Mirror Switch-Driver.

• **If the test lamp remains OFF during either of the commands**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside

Rearview Mirror Switch-Driver.

2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.
- **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver, Vehicle in Service Mode.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch-Driver
- **If the test lamp turns ON during each of the commands**
6. Test or replace the M77D Outside Rearview Mirror Motor-Driver.

Passenger Outside Mirror Movement Malfunction

1. Vehicle OFF, disconnect the harness connector at the M77P Outside Rearview Mirror Motor-Passenger. Vehicle in Service Mode
2. Connect a test lamp between the control circuit terminal 2 and control circuit terminal 3.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S146 Window/Outside Rearview Mirror Switch-Driver.
 - **If the test lamp remains OFF during either of the commands**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver, Vehicle in Service Mode.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch-Driver
 - **If the test lamp turns ON during each of the commands**
4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2.

5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S146 Window/Outside Rearview Mirror Switch-Driver.

- **If the test lamp remains OFF during either of the commands**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver.
2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver, Vehicle in Service Mode.
2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch-Driver

- **If the test lamp turns ON during each of the commands**

6. Test or replace the M77P Outside Rearview Mirror Motor-Passenger.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Window Control Switch Replacement](#)
- Refer to [Front Side Door Window Switch Replacement \(Right Side\)](#)
- Refer to [Rear Side Door Window Switch Replacement](#)

REPAIR INSTRUCTIONS

OUTSIDE REARVIEW MIRROR REPLACEMENT

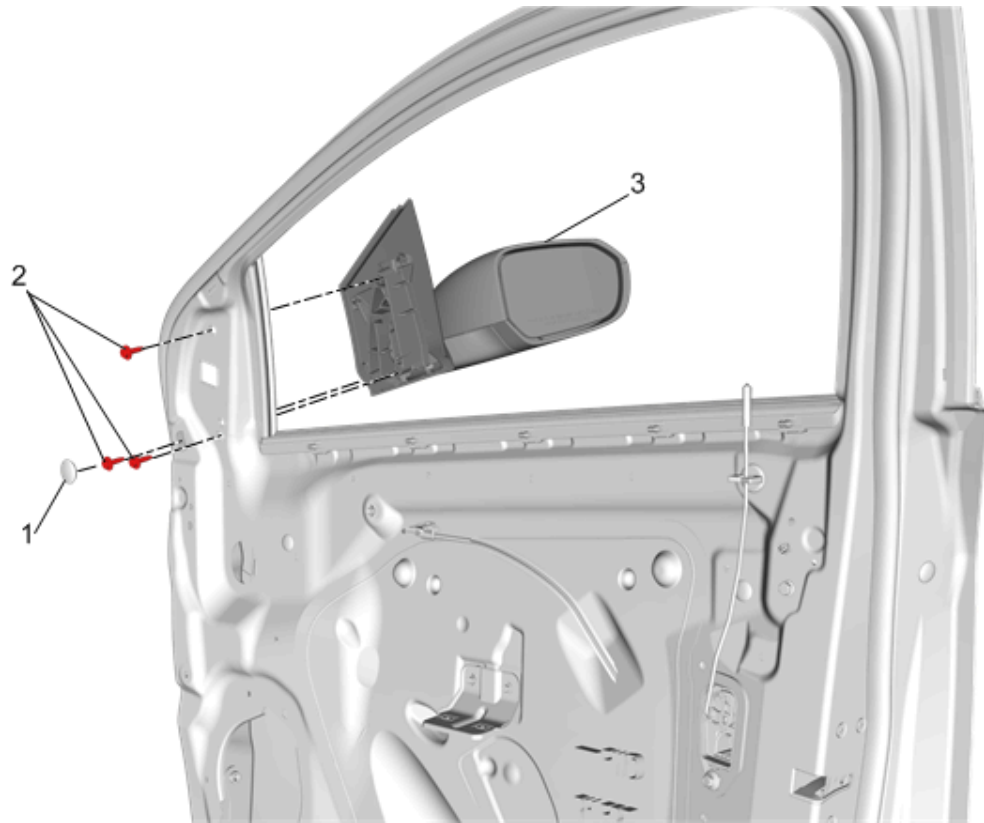


Fig. 4: Outside Rearview Mirror

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Glass and Sheet Metal Handling Warning .	
Preliminary Procedure - Remove Front Side Door Window Garnish Molding. Refer to Front Side Door Window Garnish Molding Replacement - Remove Front Side Door Window Upper Reveal Molding. Refer to Front Side Door Window Upper Reveal Molding Replacement	
1	Plug Procedure Remove the plug that covers the lower front mirror bolt.
2	Outside Rearview Mirror Bolt (Qty: 3) CAUTION:

Callout	Component Name
	Refer to <u>Fastener</u> <u>Caution</u> . Procedure Disconnect the electrical connector. Tighten 10 N.m (89 lb in)
3	Outside Rearview Mirror Procedure Lift bottom of mirror and pull mirror out from under the weatherstrip. NOTE: Inspect the outside rearview mirror for proper operation before installing the front side door window garnish molding.

OUTSIDE REARVIEW MIRROR GASKET REPLACEMENT

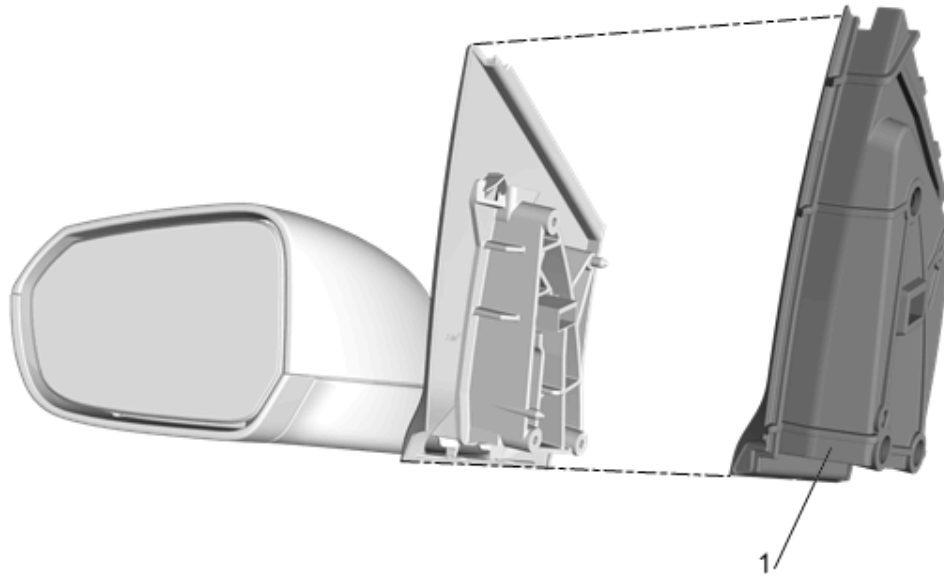


Fig. 5: Outside Rearview Mirror Gasket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Outside Rearview Mirror. Refer to Outside Rearview Mirror Replacement	
1	Outside Rearview Mirror Gasket NOTE: Inspect the mirror and window for proper operation before install the trim panel.

OUTSIDE REARVIEW MIRROR HOUSING UPPER COVER REPLACEMENT

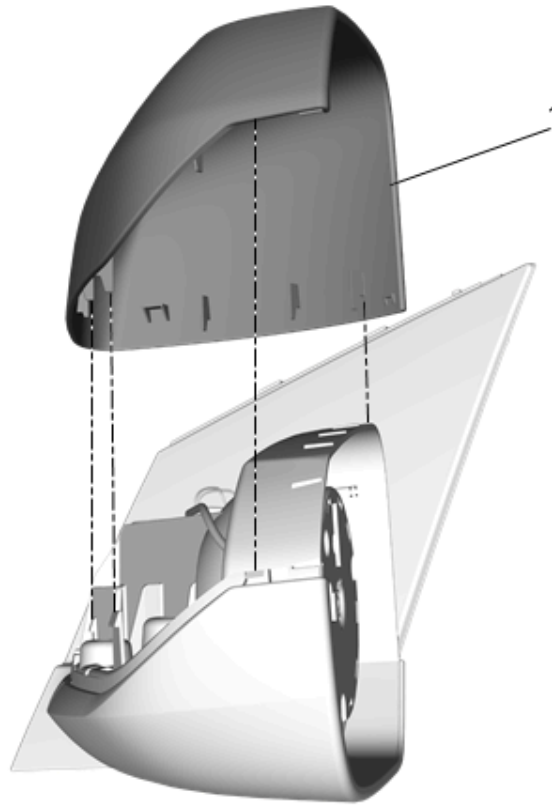


Fig. 6: Outside Rearview Mirror Housing Upper Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Outside Rearview Mirror Glass. Refer to Outside Rearview Mirror Glass Replacement	
1	Outside Rearview Mirror Upper Housing Cover Procedure Using the appropriate tool, release the outside rearview mirror upper housing cover.

OUTSIDE REARVIEW MIRROR INNER ACTUATOR REPLACEMENT

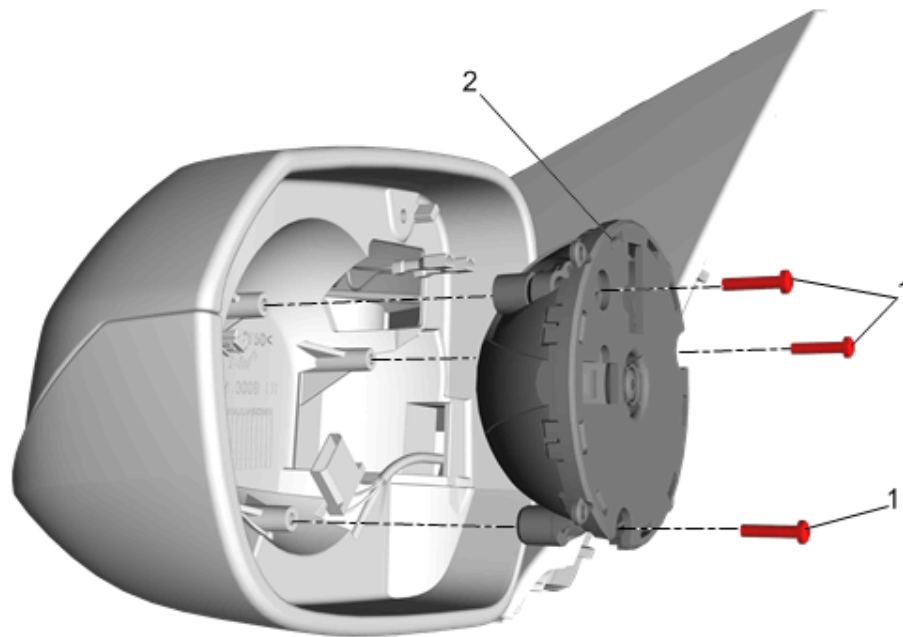


Fig. 7: Outside Rearview Mirror Inner Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Outside Rearview Mirror Glass. Refer to Outside Rearview Mirror Glass Replacement	
1	Outside Rearview Mirror Inner Actuator Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . Procedure Disconnect the electrical connector. Tighten 0.8 N.m (7 lb in)
2	Outside Rearview Mirror Inner Actuator

OUTSIDE REARVIEW MIRROR GLASS REPLACEMENT

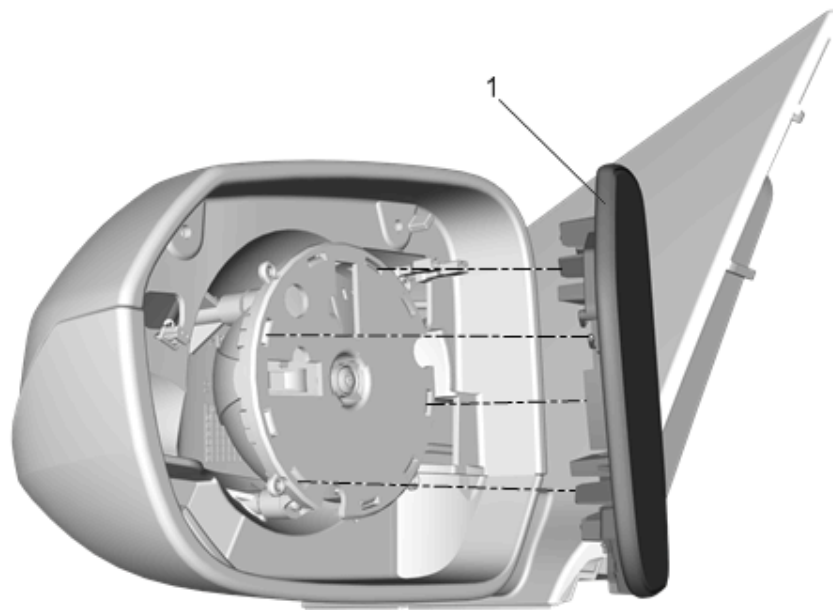


Fig. 8: Outside Rearview Mirror Glass

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Outside Rearview Mirror Glass WARNING: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury. Procedure 1. Place masking tape over the mirror glass. 2. Carefully push the outside rearview mirror glass upward and into the inside corner of the mirror housing, allowing access to the bottom edge.

Callout	Component Name
	3. Grasp the bottom edge of the mirror glass firmly, lift it up and pull rearward until the mirror glass retainers release the actuator motor ring. 4. Disconnect all electrical connectors. 5. Place the mirror glass in line with the inner actuator retainers. 6. Place one hand on the back of the mirror housing, using the flat palm of the other hand press inward locking the mirror glass retainers to the inner actuator ring. 7. Remove the masking tape from the mirror glass.

INSIDE REARVIEW MIRROR REPLACEMENT

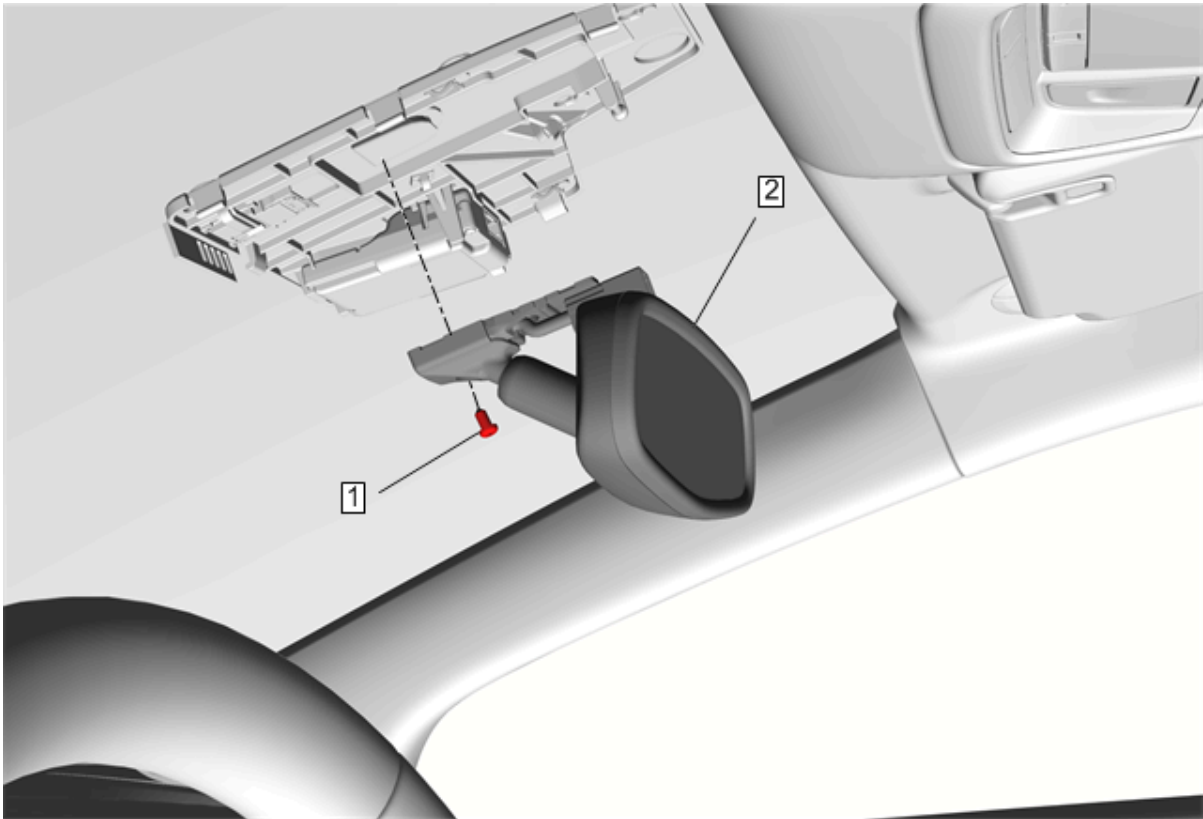


Fig. 9: Inside Rearview Mirror
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Windshield Multifunction Sensor Mount Bracket Lower Cover. Refer to Windshield Multifunction Sensor Mount Bracket Lower Cover Replacement	
1	Inside Rearview Mirror Screw CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Procedure 1. Adjust the mirror to the full upward position. 2. Loosen the set screw located at the base of the mirror. 3. Slide the mirror upward off of the rearview mirror button. Tighten 1.8 N.m (16 lb in)
2	Inside Rearview Mirror

DESCRIPTION AND OPERATION

AUTOMATIC DAY-NIGHT MIRROR DESCRIPTION AND OPERATION

Inside Rearview Mirror with the Automatic Day-Night Feature System Operation

The inside rearview mirror uses 2 photocell sensors. One sensor is the headlight sensor, located on the face side of the mirror. The headlight sensor is used to determine light conditions present at the mirror face. The other sensor is the ambient light sensor, located on the rear of the mirror or windshield side. The ambient light sensor is used to determine the exterior light conditions. With a low exterior light condition detected, and a high light condition from behind of the car, at the headlight sensor, the inside rearview mirror will automatically darken the face of the mirror.

In the daytime, the mirror is in a normal state because of the high exterior light condition that is indicated by the ambient light sensor. With the gear selector lever in the REVERSE position, backup lamp supply voltage is supplied as an input to the inside rearview mirror. The mirror monitors this input to disable the automatic day-night feature. This allows the driver to see objects in the mirror clearly when backing up, even during the night.

OUTSIDE MIRROR DESCRIPTION AND OPERATION

Power Mirror System Components

The power mirror system consists of the following components:

- Outside rearview mirror switch
- Mirror selector switch
- Driver outside rearview mirror
- Passenger outside rearview mirror

Each of the outside rearview mirror contains two motors. The vertical motor operates the mirror in the up and down directions, and the horizontal motor operates the mirror in the left and right directions.

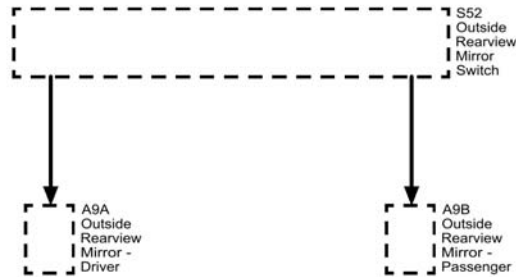


Fig. 10: Power Mirror System Block Diagram (Without A45)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S52	S52 Outside Rearview Mirror Switch
A9A	A9A Outside Rearview Mirror - Driver
A9B	A9B Outside Rearview Mirror - Passenger

Power Mirror System Controls

The outside rearview mirror switch is a four position directional switch: Up, Down, Left and Right.

The mirror select switch is a three position switch: left, neutral/fold, and right.

Power Mirror System Operation

The outside rearview mirror switch receives battery voltage from the underhood fuse block. The power mirror switch also receives a constant ground.

The four positions of the direction switch have dual switch contacts. Each of the contacts are connected to opposing sides of the appropriate power mirror motors through the selector switch. The selector switch completes these circuits depending on the position of the selector switch, L or R.

If the selector switch is placed in the L position and the up switch is pressed, battery voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor vertical control circuit and ground through the left mirror motor common control circuit. If the down switch is pressed, battery voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor common control circuit

and ground through the left mirror motor vertical control circuit.

The remainder of the mirror functions operate in the same manner as described above. Placing the power mirror switch in opposing positions, left/right or up/down, will reverse the polarity to the mirror motor, reversing the direction of movement.

Heated Mirrors (If Equipped)

The heated mirrors are controlled through the rear defog relay. Whenever the rear window defogger is turned on battery voltage is supplied to the mirror heater elements through the left and right mirror heater element control circuits.

Article GUID: A00884712

ACCESSORIES & EQUIPMENT

Object Detection and Pedestrian Protection - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Forward Collision Alert Display Bolt	2.5 N.m (22 lb in)
Forward Range Radar Sensor Fastener	6 N.m (53 lb in)
Parking Assist Control Module Nut	5 N.m (44 lb in)
Pedestrian Sound Alert Speaker Bolt	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

OBJECT DETECTION WIRING SCHEMATICS

Front Park Assist (UFQ)

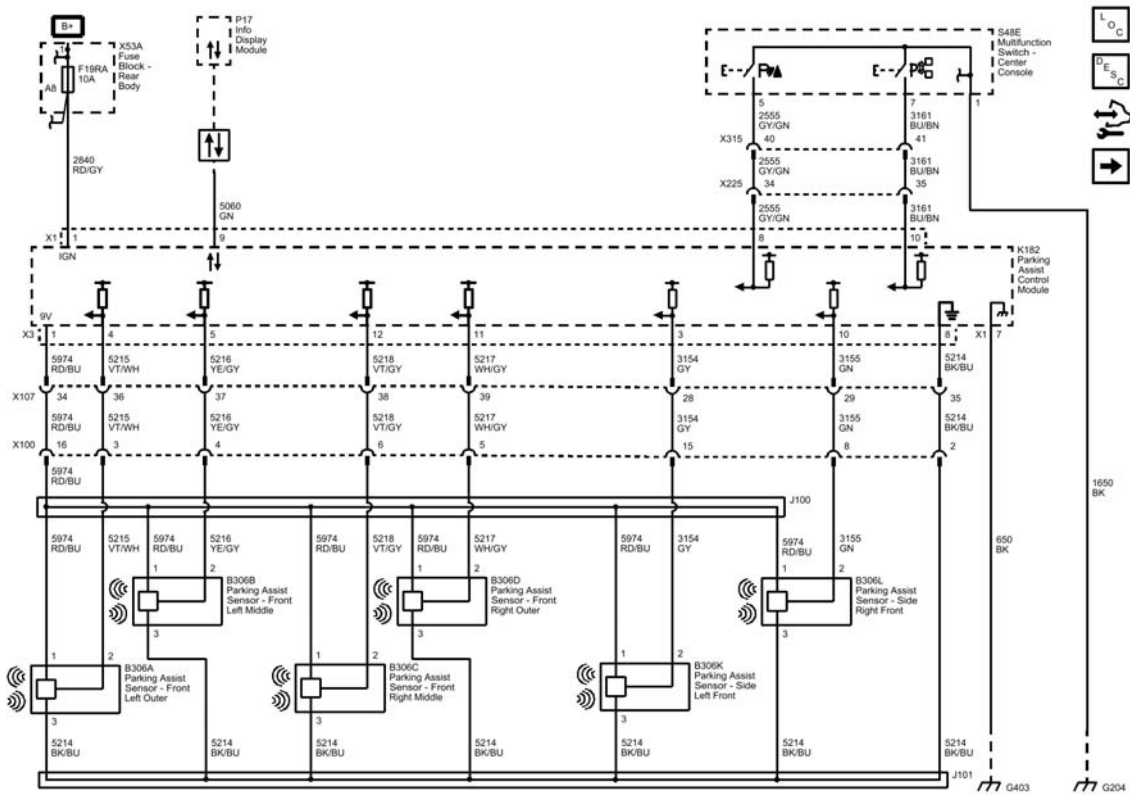


Fig. 1: Front Park Assist (UFQ)

Courtesy of GENERAL MOTORS COMPANY

Rear Park Assist (UFQ)

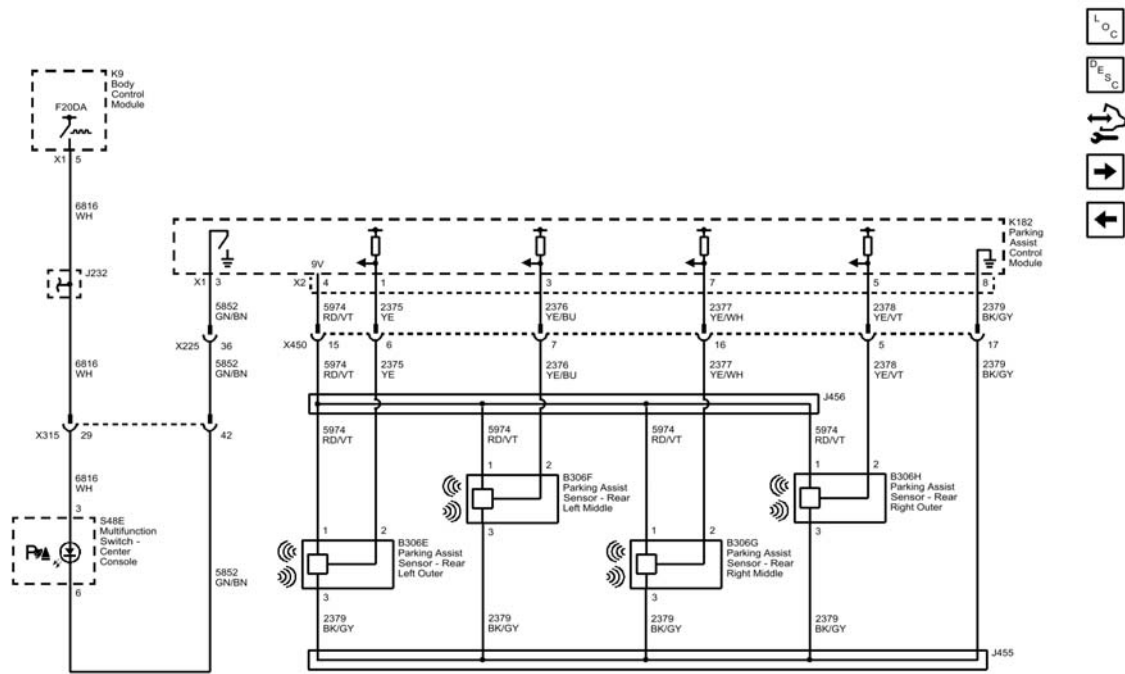


Fig. 2: Rear Park Assist (UFQ)
 Courtesy of GENERAL MOTORS COMPANY

Rearview Camera

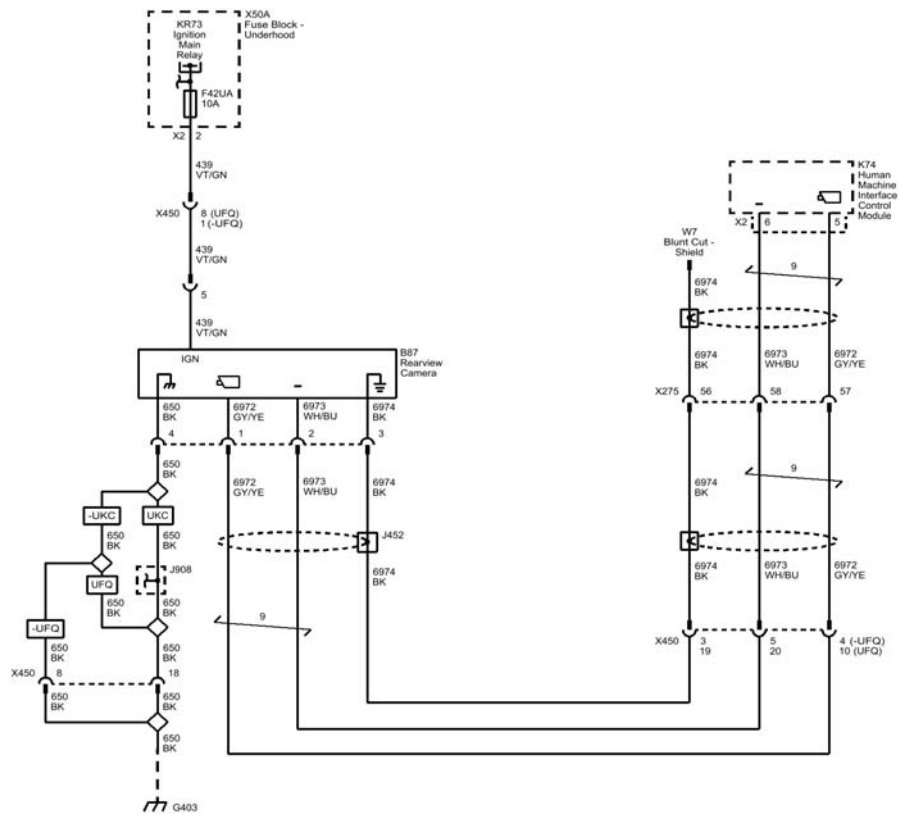


Fig. 3: Rearview Camera

Courtesy of GENERAL MOTORS COMPANY

Comprehensive Safety - Camera and Module Power, Ground, and Controls (UEU/UHX/-UGN)

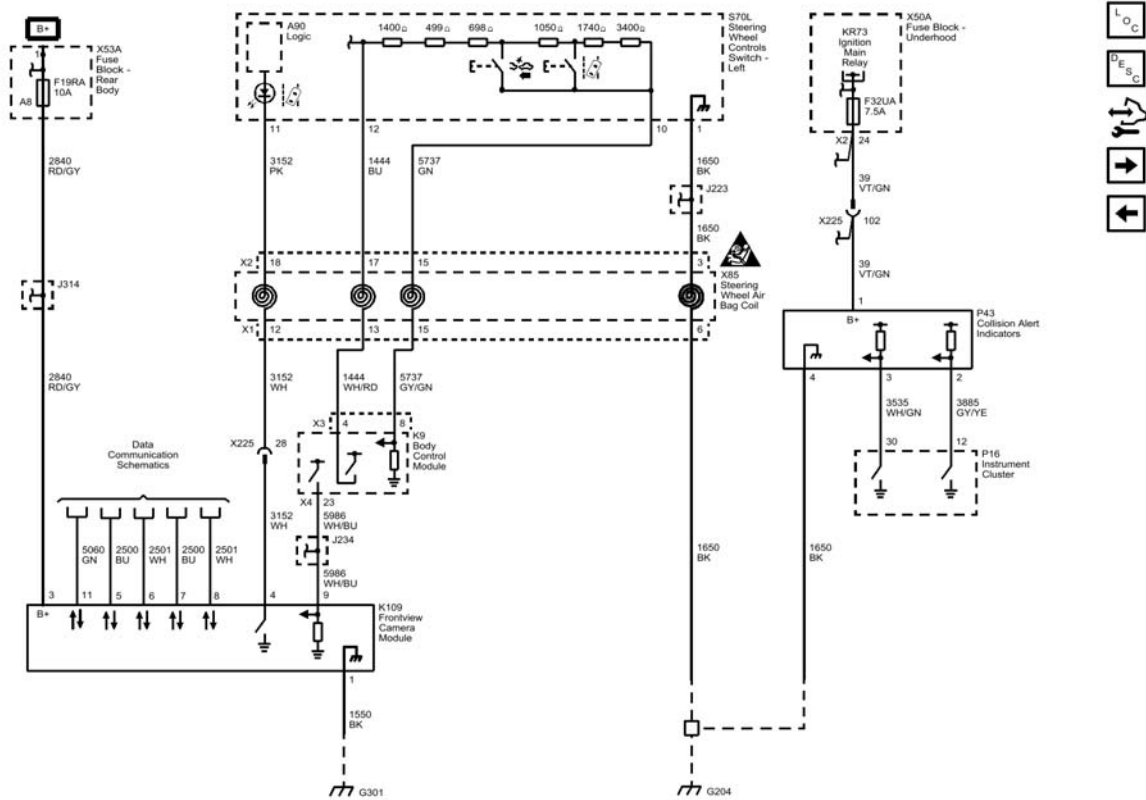


Fig. 4: Comprehensive Safety - Camera and Module Power, Ground, and Controls (UEU/UHX/-UGN)
 Courtesy of GENERAL MOTORS COMPANY

Side Object Detection (UKC)

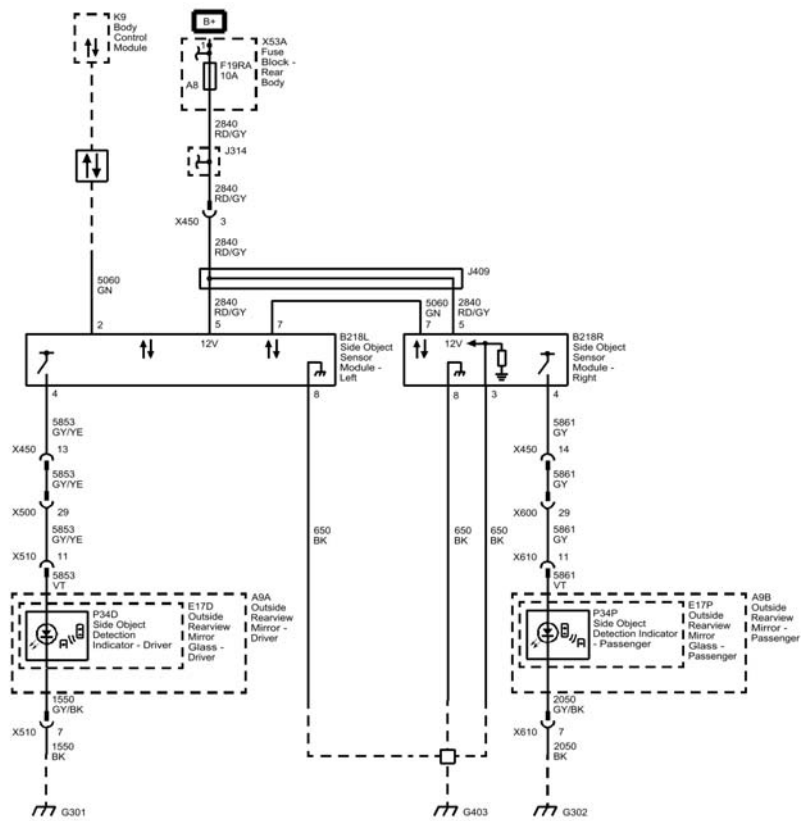


Fig. 5: Side Object Detection (UKC)

Courtesy of GENERAL MOTORS COMPANY

Comprehensive Safety - Camera and Module Power, Ground and Controls (UEU/UHX/UGN)

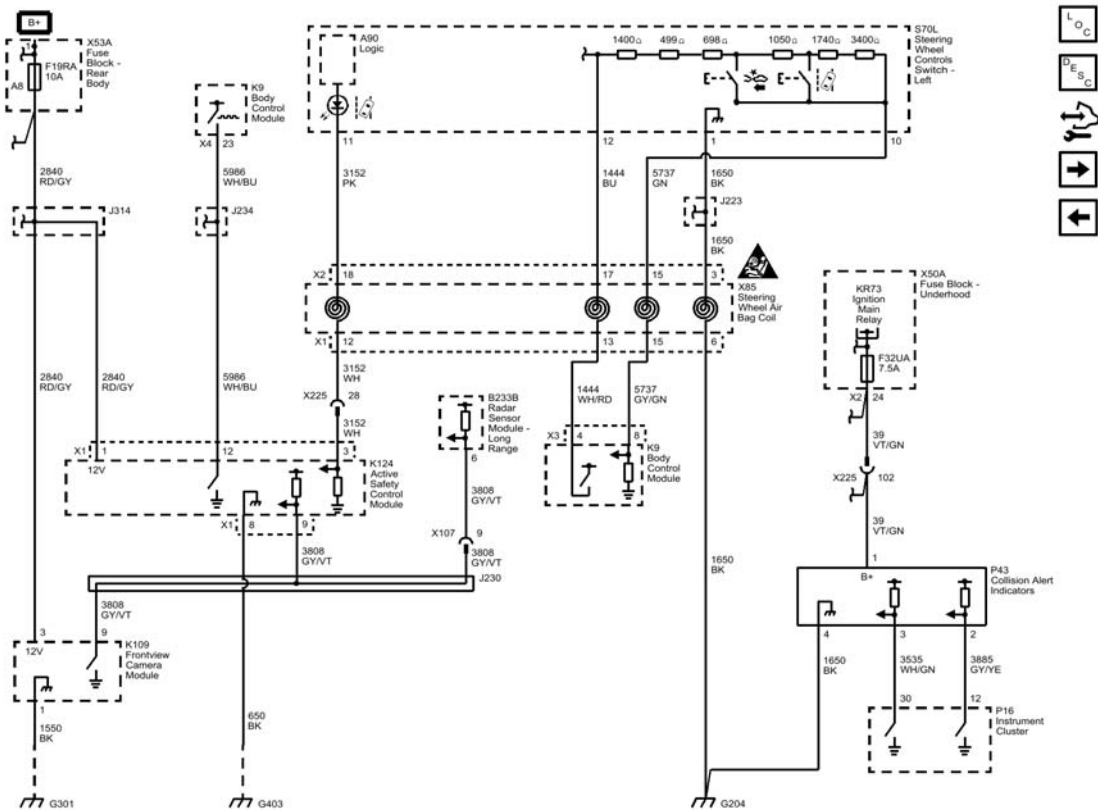


Fig. 6: Comprehensive Safety - Camera and Module Power, Ground and Controls (UEU/UHX/UGN)
 Courtesy of GENERAL MOTORS COMPANY

Comprehensive Safety - Serial Data Camera, Module and Long Range Radar (UEU/UHX/UGN)

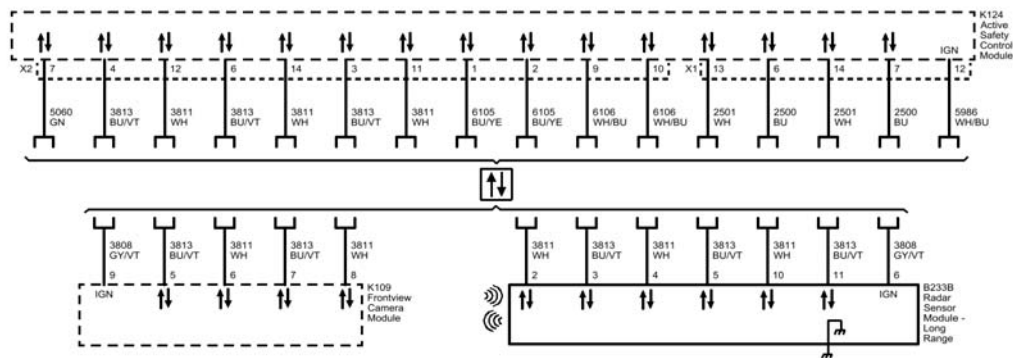
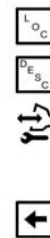


Fig. 7: Comprehensive Safety - Serial Data Camera, Module and Long Range Radar (UEU/UHX/UGN)
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B094B OR B094C: LEFT SIDE OBJECT DETECTION CONTROL MODULE/RIGHT SIDE OBJECT DETECTION CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B094B 00

Left Side Object Detection Control Module - Malfunction

DTC B094B 08

Left Side Object Detection Control Module - Performance - Signal Invalid

DTC B094B 45

Left Side Object Detection Control Module - Variant Not Programmed

DTC B094B 54

Left Side Object Detection Control Module - High Temperature

DTC B094B 58

Left Side Object Detection Control Module - Performance

DTC B094C 00

Right Side Object Detection Control Module - Malfunction

DTC B094C 08

Right Side Object Detection Control Module - Performance - Signal Invalid

DTC B094C 45

Right Side Object Detection Control Module - Variant Not Programmed

DTC B094C 54

Right Side Object Detection Control Module - High Temperature

DTC B094C 58

Right Side Object Detection Control Module - Performance

Circuit/System Description

The side object sensor - left or side object sensor - right can set this code if the module determines there is a fault due to the reason listed in the symptom byte.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The control module has detected a malfunction.

Action Taken When the DTC Sets

- The Side Blind Zone and Rear Cross Traffic Alert Systems will not function.
- The driver information center will display "Service Side Detection System".

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

If DTC B094B 58 or B094C 58 is set, check for anything that can interfere with the radar signal. Verify area in front of radar is clean of mud, ice, snow, etc. Also verify the fascia panels in front of the radar are damage-free and not obstructed by any add-on accessories such as emblems, etc.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that B094B 45 or B094C 45 is not set.
 - **If DTC is set**
 1. Program the appropriate B94 Side Object Sensor.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the appropriate B94 Side Object Sensor.
 - If the DTC does not set
3. All OK.
 - **If DTC is not set**
3. Verify that B094B 00, B094C 00, B094B 08, B094C 08, B094B 54 or B094C 54 is not set.
 - **If DTC is set**

Replace the appropriate B94 Side Object Sensor.
 - **If the DTC is not set**

4. Verify that B094B 58 or B094C 58 is not set.

- **If DTC is set**

Verify the area in front of the sensor is clean, unobstructed, and damage-free.

- If not clean, unobstructed, and damage-free, clean or repair as necessary.
- If clean, unobstructed, and damage-free, replace the appropriate B94 Side Object Sensor.

- **If DTC is not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming, and setup

DTC B0954, B0955, B0956, OR B0957: PARKING ASSIST FRONT SENSOR CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B0954

Parking Assist Front Sensor Left Corner Circuit

DTC B0955

Parking Assist Front Sensor Left Middle Circuit

DTC B0956

Parking Assist Front Sensor Right Middle Circuit

DTC B0957

Parking Assist Front Sensor Right Corner Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06,	B0954 06, B0955 06,	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
		B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 03	B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 07	
Left Front Object Sensor Signal	B0954 06	B0954 06	B0954 01	B0954 08, B0954 21
Left Middle Front Object Sensor Signal	B0955 06	B0955 06	B0955 01	B0955 08, B0955 21
Right Middle Front Object Sensor Signal	B0956 06	B0956 06	B0956 01	B0956 08, B0956 21
Right Front Object Sensor Signal	B0957 06	B0957 06	B0957 01	B0957 08, B0957 21
Low Reference	-	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01, B0960 01, B0961 01	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the 9 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle ON
- The park assist is activated. The activation takes place through putting in the reverse gear or through operating the park assist switch.

Conditions for Setting the DTC

B0954 01, B0955 01, B0956 01, or B0957 01

The parking assist control module has detected the voltage at the sensor circuit is greater than 11.5 V or the object sensor is not grounded.

B0954 06, B0955 06, B0956 06, or B0957 06

The parking assist control module has detected the voltage at the sensor circuit is less than 0.5 V.

B0954 08, B0955 08, B0956 08, or B0957 08

The parking assist control module has received an invalid signal.

B0954 21, B0955 21, B0956 21, or B0957 21

The object sensor determines no change in the position of an object while the vehicle is in motion.

B0954 3A, B0955 3A, B0956 3A, or B0957 3A

The parking assist control module determines the wrong sensor type is installed.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B1405 is not set.

- **If the DTC is set**

Refer to **DTC B1405**

- **If the DTC is not set**

3. Verify that DTC B0954 01, B0955 01, B0956 01, B0957 01 B0954 21, B0955 21, B0956 21 or B0957 21 is not set.

- **If the DTC is set**

1. Verify the B78 Front Object Sensors are not contaminated with snow, mud, dirt, slush, or ice.

- If contaminated, clean sensor.
- If there is no contamination

2. Refer to Circuit/System Testing.

- **If the DTC is not set**

4. Verify that DTC B0954 3A, B0955 3A, B0956 3A or B0957 3A is not set.

- **If the DTC is set**

Replace the B78 Front Object Sensor with the correct sensor type.

- **If the DTC is not set**

5. Vehicle ON, transmission in REVERSE.

6. Verify the scan tool Parking Assist System Status parameter displays Enabled.

- **If the Parking Assist System displays Disabled**

Refer to Circuit/System Testing.

- **If the Parking Assist System displays Enabled**

7. All OK.

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, disconnect the harness at the appropriate B78 Front Object Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector X3 at the K182 Parking Assist Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω replace the K182 Parking Assist Control Module.

- **If less than 10 Ω**

3. Vehicle ON.

4. Test for 7.5 - 10.5 V between the 9 V reference circuit terminal 1 and ground.

- **If less than 7.5 V**

1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.

2. Test for infinite resistance between the 9 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 9 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
- **If greater than 10.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
 2. Test for less than 1 V between the 9 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module.
- **If between 7.5 - 10.5 V**
 5. Test for 7.5 - 9.5 V between the signal circuit terminal 2 and ground.
 - **If less than 7.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If greater than 9.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module.
 - **If between 7.5 - 9.5 V**
 6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Advanced Parking Assist Alarm Sensor Replacement](#)
- Refer to [Control Module References](#) for parking assist control module replacement, programming and setup

DTC B0958, B0959, B0960, OR B0961: PARKING ASSIST REAR SENSOR CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B0958

Parking Assist Rear Sensor Left Corner Circuit

DTC B0959

Parking Assist Rear Sensor Left Middle Circuit

DTC B0960

Parking Assist Rear Sensor Right Middle Circuit

DTC B0961

Parking Assist Rear Sensor Right Corner Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 04, B0955 04, B0956 04, B0957 04, B0958 04, B0959 04, B0960 04, B0961 04, B1405 03	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01, B0960 01, B0961 01, B1405 07	-
Left Parking Assist Sensor Signal	B0958 02	B0958 04	B0958 01	B0958 08, B0958 18, B0958 22
Left Middle Parking Assist Sensor Signal	B0959 02	B0959 04	B0959 01	B0959 08, B0959 18, B0959 22
Right Middle Parking Assist Sensor Signal	B0960 06	B0960 06	B0960 01	B0960 08, B0960 18, B0960 22
Right Parking Assist Sensor Signal	B0961 06	B0961 06	B0961 01	B0961 08, B0961 18, B0961 22
Low Reference	-	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01,	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
		B0960 01, B0961 01		

Circuit/System Description

The parking assist sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The Parking Assist Control Module supplies 9 V to the parking assist sensors via the 9 V reference circuit and provides ground via the low reference circuit. The Parking Assist Control Module triggers the sensors in a sequential loop. After each sensor transmits, the Parking Assist Control Module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- The parking assist is activated. The activation takes place through putting the vehicle in reverse.

Conditions for Setting the DTC

B0958 01, B0959 01, B0960 01, or B0961 01

The Parking Assist Control Module has detected the voltage at the sensor circuit is greater than 11.5 V or the object sensor is not grounded.

B0958 02, B0959 02, B0960 02, or B0961 02

The Parking Assist Control Module has detected sensor circuit is shorted to ground.

B0958 04, B0959 04, B0960 04, or B0961 04

The Parking Assist Control Module has detected the voltage at the sensor circuit is less than 0.5 V.

B0958 08, B0959 08, B0960 08, or B0961 08

The Parking Assist Control Module has received an invalid signal.

B0958 18, B0959 18, B0960 18, or B0961 18

The Parking Assist Control Module has received an invalid signal.

B0958 22, B0959 22, B0960 22 or B0961 22

The object sensor determines no change in the position of an object while the vehicle is in motion.

B0958 3A, B0959 3A, B0960 3A, or B0961 3A

The Parking Assist Control Module determines the wrong sensor type is installed.

B0958 3B, B0955 3B, B0956 3B, or B0957 3B

The Parking Assist Control Module determines the sensor failed a self test.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays "Park Assist Temporarily Unavailable" or "Service Park Assist".

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify that DTC B1405 is not set.
 - **If the DTC is set**

Refer to **DTC B1405**
 - **If the DTC is not set**
3. Verify that DTC B0958 3A, DTC B0958 3B, B0959 3A, B0959 3B, B0960 3A, B0960 3B, B0961 3A or B0961 3B is not set.
 - **If the DTC is set**

Replace the B306 Parking Assist Sensor.

- **If the DTC is not set**
- 4. Verify that DTC B0958, B0959, B0960, or B0961 is not set.
 - **If the DTC is set**
 1. Check the B306 Parking Assist Sensor for contamination with snow, mud, dirt, slush, or ice.
 - If contaminated, clean sensor.
 - If there is no contamination
 2. Refer to Circuit/System Testing.
 - **If the DTC is not set**
- 5. Ignition On/Vehicle ON, transmission in R.
- 6. Verify the scan tool Parking Assist System Status parameter displays Enabled.
 - **If the Parking Assist System displays Disabled**

Refer to Circuit/System Testing.
 - **If the Parking Assist System displays Enabled**
- 7. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, scan tool disconnected, disconnect the harness at the appropriate B306 Parking Assist Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector X2 at the K182 Parking Assist Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K182 Parking Assist Control Module.
 - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode.
4. Test for 7.8 - 10.2 V between the 9 V reference circuit terminal 1 and ground.
 - **If less than 7.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the 9 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 9 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If greater than 10.2 V**

1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
2. Test for less than 1 V between the 9 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module.
 - **If between 7.8 - 8.2 V**
5. Test for 7 - 12.0 V between the signal circuit terminal 2 and ground.
 - **If less than 10.3 V**
 1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If greater than 12.0 V**
 1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module, ignition ON/Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module.
 - **If between 10.3 - 12.0 V**
 - 6. Test or replace the appropriate B306 Parking Assist Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Rear Parking Assist Alarm Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B0967 OR B0968: PARKING ASSIST ON/OFF SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0967

Parking Assist On/Off Switch Circuit

DTC B0968

Parking Assist On/Off Switch Indicator Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parking Assist Switch Signal	B0967 02, 1	1	1	-
Parking Assist Switch Indicator Illumination	B0968 06, 2	B0968 06, 2	2	-
Parking Assist Switch Indicator Control	B0968 06, 2	B0968 06, 2	B0968 01	-
Parking Assist Switch Ground	-	1	-	-
1. Parking Assist Switch Malfunction 2. Parking Assist Indicator Malfunction				

Circuit/System Description

The parking assist can be activated/deactivated by pressing the parking assist switch. By engaging the reverse gear the parking assist can also be activated. By subsequently pressing the parking assist switch the parking assist can be disabled again.

The indicator in the parking assist switch shows the status of the parking assist. If the lamp is ON, the parking assist is activated.

Conditions for Running the DTC

- Ignition ON
- The parking assist is activated. The activation takes place by putting in the reverse gear or by pressing the parking assist switch.

Conditions for Setting the DTC

B0967 02

The parking assist control module has detected a short to ground.

B0968 01

The parking assist control module has detected a short to battery.

B0968 06

The parking assist control module has detected a short to ground or open.

Action Taken When the DTC Sets

- The parking assist is disabled.

- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)
Parking Assist Description and Operation (with Rear Park Assist, UD7)
Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B0967 02 is not set.
 - **If the DTC is set**
 Refer to Parking Assist Switch Malfunction.
 - **If the DTC is not set**
3. Verify that DTC B0968 01 or B0968 06 is not set.
 - **If the DTC is set**
 Refer to Parking Assist Switch Indicator Malfunction.
 - **If the DTC is not set**
4. Activate and deactivate the parking assist switch and verify the scan tool Park Assist Switch parameter changes between Active and Inactive.

- **If the Parking Assist Switch parameter does not change between Active and Inactive**

Refer to Circuit/System Testing.

- **If the Parking Assist Switch parameter changes between Active and Inactive**

5. All OK.

Circuit/System Testing

Parking Assist Indicator Malfunction

1. Vehicle OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1.6 - 3.6 V between the control circuit terminal 6 and ground.
 - **If less than 1.6 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω , refer to [Interior Backlighting Malfunction](#) .
 - **If greater than 3.6 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition on.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, refer to [Interior Backlighting Malfunction](#) .
 - **If between 1.6 - 3.6 V**
3. Connect a test lamp between the control circuit terminal 7 and signal circuit terminal 6.
4. Verify the test lamp turns On and Off when commanding the Parking Assist Switch On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit
 - If less than 1 V
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit
 - If infinite resistance, replace the K182 Parking Assist Control Module.
 - **If the test lamp turns ON and OFF**

5. All OK.

Parking Assist Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Park Assist Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K182 Parking Assist Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify the scan tool Park Assist Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If Active**
7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Vehicle Stability Control System Switch Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B096B: PARKING ASSIST SWITCH PARALLEL PARKING CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B096B

Parking Assist Switch Parallel Parking Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parallel Park Assist Switch Signal	B096B 02	1	-	-
Parallel Parking Assist Switch Ground	-	1	-	-
1. Parallel Parking Assist Switch Malfunction				

Circuit/System Description

The parallel parking assist can be activated/deactivated by pressing the parallel parking assist switch.

Conditions for Running the DTC

- Vehicle ON
- The parallel parking assist is activated. The activation takes place through pressing the parallel parking assist switch.

Conditions for Setting the DTC

The parking assist control module has detected a short to ground.

Action Taken When the DTC Sets

- The parallel parking assist is disabled.
- An indicator in the driver information center shows the parking assistance is not available.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the ground circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Advanced Parking Assist Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K182 Parking Assist Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Advanced Parking Assist Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, vehicle ON.
2. Test for less than 1 V between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.

- **If Active**

7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Vehicle Stability Control System Switch Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B096C OR B096D: PARKING ASSIST SIDE SENSOR FRONT CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B096C

Parking Assist Side Sensor Left Front Circuit

DTC B096D

Parking Assist Side Sensor Right Front Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 03	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 07	-
Left Side Object Sensor Signal	B096C 06	B096C 06	B096C 01	B096C 08, B096C 21
Right Side Object Sensor Signal	B096D 06	B096D 06	B096D 01	B096D 08, B096D 21
Low Reference	-	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the 9 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle in Service Mode
- The parallel parking assist is activated. The activation takes place through operating the parallel parking assist switch.

Conditions for Setting the DTC

B096C 01 or B096D 01

The parking assist control module has detected the voltage at the sensor circuit is too high.

B096C 06 or B096D 06

The parking assist control module has detected the voltage at the sensor circuit is too low.

B096C 08 or B096D 08

The parking assist control module has received an invalid signal.

B096C 21 or B096D 21

The object sensor determines no change in the position of an object while the vehicle is in motion.

B096C 3A or B096D 3A

The parking assist control module determines the wrong sensor type is installed.

Action Taken When the DTC Sets

- The parallel parking assist is disabled.
- An indicator in the driver information center shows the parking assistance is not available.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)**Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)****Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify that DTC B1405 is not present.

- **If the DTC is set**

Refer to [DTC B1405](#)

- **If the DTC does not set**

3. Verify that DTC B096C 01 or B096D 01 is not present.

- **If the DTC is set**

Check the appropriate sensor for contamination with mud, ice or snow. If no contamination is diagnosed, refer to Circuit/System Testing.

- **If the DTC does not set**

4. Verify that DTC B096C 3A or B096D 3A is not present.

- **If the DTC is set**

Replace the appropriate sensor with a sensor by correct sensor type.

- **If the DTC does not set**

5. Verify that DTC B096C 21 or B096D 21 is not present.

- **If the DTC is set**

Check the appropriate sensor for contamination with mud, ice or snow. If no contamination is diagnosed, replace the appropriate sensor.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF for 30 s, disconnect the harness connector at the appropriate B94 Side Object Sensor - Front. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K182 Parking Assist Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode, engine running.

4. Test for 7.5 - 10.5 V between the 9 V reference circuit terminal 1 and ground.

- **If less than 7.5 V**

1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.

2. Test for infinite resistance between the 9 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 9 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If greater than 10.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 9 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module.
 - **If between 7.5 - 10.5 V**
 5. Test for 7.5 - 9.5 V between the signal circuit terminal 2 and ground.
 - **If less than 7.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K182 Parking Assist Control Module.
 - **If greater than 9.5 V**
 1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K182 Parking Assist Control Module
 - **If between 11.5 - 13.5 V**
 6. Test or replace the appropriate B94 Side Object Sensor - Front.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Advanced Parking Assist Alarm Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B0987: VEHICLE DIRECTION CAMERA INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0987 01

Vehicle Direction Camera Indicator Circuit Short to Battery

DTC B0987 06

Vehicle Direction Camera Indicator Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Indicator Ignition	B0987 06	B0987 06	-	-
Lane Departure Warning Switch Indicator Control	B0987 06	B0987 06	B0987 01	-

Circuit/System Description

The lane departure warning is enabled and disabled through a switch located in the left steering wheel controls switch. When enabled, the frontview camera module will illuminate the indicator located in the switch.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The frontview camera module has detected a short to battery or open/high resistance in the control circuit.

Action Taken When the DTC Sets

- Lane departure warning is disabled.
- SERVICE FRONT CAMERA is displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

[Object Detection Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B356A is not set.
 - **If the DTC is set**

Refer to [DTC B356A](#).
 - **If the DTC is not set**
3. Verify the lane departure warning indicator turns ON and OFF while pressing and releasing the lane departure warning switch.
 - **If the indicator does not turn ON and OFF**

Refer to Circuit/System Testing.
 - **If the indicator turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left, ignition ON.

NOTE: **Verify interior lighting dimming is turned all the way up.**

2. Test for 6.2 - 12.0 V between the dimming control circuit terminal 4 and ground.
 - **If less than 6.2 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Interior Backlighting Malfunction](#) .
- **If greater than 12.0 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, refer to [Interior Backlighting Malfunction](#) .
- **If between 6.2 - 12.0 V**
3. Connect a test lamp between the control circuit terminal 5 and B+.
4. Verify the test lamp turns ON and OFF when commanding the Lane Departure Warning Indicator parameter ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K109 Frontview Camera Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K109 Frontview Camera Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S70L Steering Wheel Controls Switch - Left.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cruise Control Switch Replacement](#) - Steering Wheel Controls Switch - Left replacement.
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B1011: SYSTEM DISABLED INFORMATION STORED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1011

System Disabled Information Stored

Circuit/System Description

The front view camera module permanently monitors the serial data bus for error messages. When a malfunction is detected by the front view camera module, the system will be disabled and an error message will be stored in the front view camera module disable history buffer which is used to store information about the front camera features that are disabled.

Conditions for Running the DTC

- Ignition ON
- Front view camera enabled

Conditions for Setting the DTC

The front view camera module detects a malfunction.

Action Taken When the DTC Sets

- The front view camera module is disabled.
- The front view camera module disable history buffer stores information why the system was disabled.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

The front view camera module disable history buffers are used to store information about the front view camera module features that are disabled. The Buffers will only update if the disable condition changes.

Example: If the data received from the steering wheel angle sensor is Invalid across many ignition cycles then it will only appear in 1 history buffer and not all history buffers. If this condition is the current reason why the front view camera module is disabled then it will be set in front view camera module disable history buffer 1. If a new reason occurs, such as vehicle speed validity is invalid, then the invalid steering wheel angle sensor fault will shift into disable history buffer 2 and vehicle speed validity invalid will be in disable history buffer 1. Since there are only 4 disable history buffers, the invalid steering wheel angle sensor will age out if 4 other disable reasons occur since the last invalid steering wheel angle sensor event occurred. Front view camera module disable history buffer 1 contains the current reason that one of the front view camera module features is disabled.

The front view camera module disable history buffers can display the following values:

- Lane Departure Warning Indicator Malfunction

- Lane Departure Warning Switch Malfunction
- Camera Obstructed
- Accelerator Pedal Position Out of Range
- Driven Wheel Speed Signal Invalid
- Non-Driven Wheel Speed Signal Invalid
- Brake Pedal Moderate Travel Signal Invalid
- Brake Pedal Initial Travel Position Achieved
- Lost Communication with Steering Wheel Angle Sensor Module
- Invalid Data Received From Steering Wheel Angle Sensor Module
- Forward Collision Alert Switch Malfunction
- Clutch Pedal Position (CPP) Sensor Performance
- Clutch Pedal Position (CPP) Sensor Performance
- Transmission Gear Engaged
- Acceleration Sensor Longitudinal Signal
- Invalid Data Received From Yaw Rate Sensor Module
- Power Mode Controlled by Backup Device
- System Power Mode
- Overvoltage
- Undervoltage
- Undefined

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no DTC is set.
 - If a DTC is present, diagnose this first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Verify the scan tool Vehicle Direction Camera System parameter is NORMAL.
 - If not the specified value, refer to **Lane Departure Warning System Malfunction**, and **Forward Collision Alert System Malfunction**.
3. Verify the scan tool Vehicle Direction Camera Calibration Status parameter is CALIBRATED.
 - If not the specified value, calibrate the K109 Frontview Camera Module. Refer to **Front View Camera Module Learn**.

Circuit/System Testing

NOTE: Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.

1. Verify the scan tool Front View Camera Module Disable History displays no current malfunction. Refer to Diagnostic Aids.
 - If a current malfunction is displayed, diagnose the system that sets the malfunction.
2. If no malfunction is displayed in the Front View Camera Module Disable History, refer to **Lane Departure Warning System Malfunction**, and **Forward Collision Alert System Malfunction**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for front view camera module programming and setup

DTC B1015: VEHICLE IDENTIFICATION NUMBER INFORMATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1015

Vehicle Identification Number Information

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When the ignition is turned ON, the advanced parking assist control module and the frontview camera module receive the vehicle identification number (VIN) from the body control module (BCM). The modules will

compare the VIN received to the VIN stored in memory.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

The stored VIN does not match the received VIN.

Action Taken When the DTC Sets

- The parking assist system or the lane departure warning system is disabled.
- The driver information center may display a system service message.

Conditions for Clearing the DTC

The stored VIN matches the VIN stored in the body control module.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B1015 is not set.
 - **If the DTC is set**
 1. Program the control module that set the DTC.
 2. Verify that DTC B1015 is not set.

- If the DTC is set, replace the control module that set the DTC.
- If the DTC is not set

3. All OK

- **If the DTC is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair

Refer to [Control Module References](#) for control module replacement, programming, and setup.

DTC B101D: ELECTRONIC CONTROL UNIT HARDWARE (DTC SET IN K109 FRONTVIEW CAMERA MODULE)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B101D

Electronic Control Unit Hardware

DTC B101D 3C

Electronic Control Unit Hardware Performance Internal Communications Failure

For symptom byte information, refer to [Symptom Byte List](#)

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

B101D

The frontview camera module has detected an internal malfunction

B101D 3C

The frontview camera module has detected a software malfunction

Action Taken When the DTC Sets

- Lane departure warning is disabled
- SERVICE LANE DEPARTURE SYSTEM is displayed on the DIC.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B101D symptom byte 3C is not set as current.
 - **If DTC B101D symptom byte 3C is set as current**
Reprogram the K109 Frontview Camera Module
 - **If DTC B101D symptom byte 3C is not set as current**
2. Verify that DTC B101D is not set as current.
 - **If DTC B101D is set as current**
Replace the K109 Frontview Camera Module
 - **If DTC B101D is not set as current**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, setup, and programming

DTC B127B: REARVIEW CAMERA INPUT SIGNAL CIRCUIT MISSING REFERENCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

B127B 2B

Rearview Camera Input Signal Circuit Missing Reference

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	B127B 2B	-	-
Backup Signal	1	B127B 2B	-	-
Camera Module signal +	1	B127B 2B	1	-
Camera Module signal -	3	B127B 2B	1	-
Ground	-	B127B 2B	-	-
Shield	3	3	3	-
1. Rear Vision Camera Malfunction 2. Rear Vision Camera image always displayed 3. Poor Quality Image				

Circuit/System Description

When the vehicle is placed in reverse with the engine running, a video signal is sent from the rearview camera to the human machine interface control module. If the human machine interface control module does not see a signal from the camera it will set B127B 2B and display "Service Rear Vision System". The rearview camera is powered with ignition voltage and does not have a reverse signal circuit.

Conditions for Running the DTC

The vehicle must be in reverse with the engine running.

Conditions for Setting the DTC

B127B 2B

Signal from the rearview camera not received by the Human Interface Machine Control Module for 2.5 s.

Action Taken When the DTC Sets

- The human machine interface control module commands the driver information center to display "Service Rear Vision System".
- The human machine interface control module stores the DTC in memory.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Diagnostic Aids

A poor video image can be caused by ice, snow, and mud buildup on the lens of the rearview camera. Also, extreme lighting conditions can affect performance, such as operating in the dark or with bright sunlight shining on the camera. Extreme high or low temperatures can also affect the image quality. An open in the shield of the video signal circuit can also cause a distorted screen.

Terminal fretting or incorrectly seated connectors can cause a poor image displayed condition. Check the circuit terminals for fretting or incorrectly seated connector. If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Vision Camera Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: If the condition is intermittent or cannot be duplicated, disconnect the

connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Vehicle ON.
2. Verify that DTC B2545 is not set.
 - **If the DTC is set**

Refer to [**DTC B2545**](#) .
 - **If the DTC is not set**
3. Verify the rearview camera has no debris on the lens and that the bezel and bezel seal are not damaged.
 - **If debris is found on the lens**

Clean the lens. If the lens, bezel, or bezel seal are damaged, replace as necessary.
 - **If no debris on the lens**
4. Vehicle ON, transmission in R.
5. Verify the backup lamps are illuminated.
 - **If the backup lamps are not illuminated**

Refer to [**Backup Lamps Malfunction**](#) .
 - **If the backup lamps are illuminated**
6. Verify a clear rear vision image is displayed on the P17 Info Display Module.
 - **If a clear image is not displayed**

Refer to Circuit/System Testing.
 - **If a clear image is displayed**
7. All OK.

Circuit/System Testing

NOTE:

- **Circuit/System Verification must be performed before Circuit/System Testing.**
- **Under normal operating conditions the Human Interface Machine Control Module will become very hot. The module should be allowed to cool down prior to removal for any service procedure.**

1. Vehicle OFF, disconnect the harness connector at the B87 Rearview Camera. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle ON.

4. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse. Refer to [Power Mode Mismatch](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the B87 Rearview Camera.

- **If the test lamp illuminates**

5. Vehicle OFF, disconnect the X2 harness connector at the K74 Human Machine Interface Control Module, vehicle ON.

6. Test for less than 1 V between the signal circuit terminal listed below and ground:

- B87 Rearview Camera signal (+) circuit terminal 5
- B87 Rearview Camera signal (-) circuit terminal 6
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

7. Test for infinite resistance between the signal circuit terminal listed below and ground:

- B87 Rearview Camera signal (+) circuit terminal 5
- B87 Rearview Camera signal (-) circuit terminal 6
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Test for less than 2 Ω in the signal (+) circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

9. Test for less than 2 Ω in the signal (-) circuit end to end.

- **If 2 Ω or greater**

Test the signal circuit for an open/high resistance.

- **If less than 2 Ω**

10. Replace the B87 Rearview Camera.

11. Vehicle ON, transmission in R,

12. Verify a clear rear vision image is displayed on the P17 Info Display Module.

- **If a clear rear vision image is not displayed**

Replace the K74 Human Machine Interface Control Module.

- **If a clear rear vision image is displayed**

13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Rearview Driver Information Camera Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC B1405: CONTROL MODULE VOLTAGE REFERENCE OUTPUT 2 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1405 02

Control Module Voltage Reference Output 2 Circuit Short to Ground

DTC B1405 03

Control Module Voltage Reference Output 2 Circuit Low Voltage

DTC B1405 07

Control Module Voltage Reference Output 2 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06,	B0954 06, B0955 06,	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
		B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 03	B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 07	
Low Reference	-	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01, B0960 01, B0961 01	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the object sensor supply voltage circuit and provides ground via the object sensor low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the object sensor signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Ignition ON
- Transmission in REVERSE

Conditions for Setting the DTC

B1405 02

The parking assist control module has detected the object sensor supply voltage circuit is shorted to ground.

B1405 03

The parking assist control module has detected the object sensor supply voltage circuit is low.

B1405 07

The parking assist control module has detected the object sensor supply voltage circuit is high.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7) Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ) Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X2 and X3 harness connectors at the K41 Front and Rear Parking Assist Control Module.
2. Test for infinite resistance between the 12 V reference circuit terminal 4 X2 and ground.
 - **If less than infinite resistance**
 1. Ignition OFF, disconnect the harness connector at each of the B78 Rear Object Sensors.
 2. Test for infinite resistance between the 12 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than 2 Ω , replace the appropriate B78 Rear Object Sensor.
 - **If infinite resistance**
3. Test for infinite resistance between the 12 V reference circuit terminal 1 X3 and ground.
 - **If less than infinite resistance**
 1. Ignition OFF, disconnect the harness connector at each of the B78 Front Object Sensors.
 2. Test for infinite resistance between the 12 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than 2 Ω , replace the appropriate B78 Front Object Sensor.

- **If infinite resistance**

4. Ignition ON.

5. Test for less than 1 V between the 12 V reference circuit terminal 4 X2 and ground.

- **If greater than 1 V**

1. Ignition OFF, disconnect the harness connector at each of the B78 Rear Object Sensors.

2. Test for less than 1 V between the 12 V reference circuit and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the appropriate B78 Front Object Sensor.

- **If less than 1 V**

6. Test for less than 1 V between the 12 V reference circuit terminal 1 X3 and ground.

- **If greater than 1 V**

1. Ignition OFF, disconnect the harness connector at each of the B78 Front Object Sensors.

2. Test for less than 1 V between the 12 V reference circuit and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the appropriate B78 Front Object Sensor.

- **If less than 1 V**

7. Connect the X2 and X3 harness connector at the K41 Front and Rear Parking Assist Control Module, ignition ON.

8. Verify DTC B1405 is not set.

- **If DTC B1405 is set**

1. Ignition OFF, disconnect the harness connector at each of the B78 Object Sensors.

2. Verify DTC B1405 is not set.

- If DTC B1405 is set

Replace the K41 Front and Rear Parking Assist Control Module.

- If DTC B1405 is not set.

3. Verify the DTC B1405 does not set while connecting the harness connector at each B78 Object Sensor, one at a time.

- If DTC B1405 does set

Replace the B78 Object Sensor that was connected immediately before DTC B1405.

- If DTC B1405 does not set.

9. All OK.

- **If DTC B1405 is not set.**

10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear Parking Assist Alarm Sensor Replacement**

- Refer to [Control Module References](#) for control module replacement, programming and setup

DTC B356A: VEHICLE DIRECTION WARNING SWITCH CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B356A 02

Vehicle Direction Warning Switch Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Switch Signal	B356A 02	1	-	-
Switch Ground	-	1	-	-
1. Lane departure cannot be enabled or disabled, forward collision alert timing sensitivity not adjustable.				

Circuit/System Description

The Vehicle Direction Warning Switch DTC detects a short to ground on the circuit that contains the lane departure warning and forward collision setting switches. The lane departure warning feature is enabled and disabled through the lane departure switch located in the left steering wheel controls switch. When enabled, the frontview camera module will illuminate the indicator located in the switch. The forward collision alert distance is adjustable using the forward collision switch located in the left steering wheel controls switch. The setting is shown in the driver information center.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

The frontview camera module has detected a short to ground for more than 10 s.

Action Taken When the DTC Sets

- Lane departure and forward collision warning features are disabled.
- Service Front Camera is displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Lane Departure Warning Switch Status parameter while pressing and releasing the lane departure warning switch. The parameter should change between Open and Closed.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. Verify the driver information center displays and adjusts forward collision alert setting while repeatedly pressing and releasing the forward collision switch. The setting should change cycle between far, medium, near, and off.
 - **If the display does not change**

Refer to Circuit/System Testing.
 - **If the display changes**
4. All OK.

Circuit/System Testing

1. Ignition OFF, remove the ignition key, open the driver door, disconnect the scan tool, all vehicle systems OFF, this may take up to 2 min. Disconnect the harness connector at the S70L Steering Wheel Controls

Switch - Left.

2. Test for less than 10 Ω between the ground circuit terminal 7 and ground.

- **If 10 Ω or greater**

1. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Verify the scan tool Lane Departure Warning Switch Status parameter is Open.

- **If not Open**

1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.

2. Test for infinite resistance between the signal circuit terminal 2 at the S70L Steering Wheel Controls Switch - Left and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K109 Frontview Camera Module.

- **If Open**

5. Reconnect the harness at S70L Steering Wheel Controls Switch - Left. Ignition ON.

6. Verify the scan tool Lane Departure Warning Switch Status parameter while pressing and releasing the vehicle direction warning switch. The parameter should change between Open and Closed.

- **If the parameter does not change**

Test or replace the S70L Steering Wheel Controls Switch - Left.

- **If the parameter changes**

7. All OK.

Component Test

Static Test

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left.

2. Test for infinite resistance between the control circuit terminal 2 and ground circuit terminal 7.

- **If less than infinite resistance**

Replace the S70L Steering Wheel Controls Switch - Left.

- **If infinite resistance**

3. Test for 1.0k - 1.5k Ω between the control circuit terminal 2 and ground circuit terminal 7 while pressing forward collision alert switch.

- **If not between 1.0k - 1.5k Ω**

Replace the S70L Steering Wheel Controls Switch - Left.

- **If between 1.0k - 1.5k Ω**

4. Test for 3.8k - 5.8k Ω between the control circuit terminal 2 and ground circuit terminal 7 while pressing lane departure warning switch.

- **If not between 3.8k - 5.8k Ω**

Replace the S70L Steering Wheel Controls Switch - Left.

- **If between 3.8k - 5.8k Ω**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cruise Control Switch Replacement](#) - Steering Wheel Controls Switch - Left replacement.
- Refer to [Control Module References](#) for module replacement, programming and setup.

DTC B390C: LONG RANGE RADAR SENSOR MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B390C

Long Range Radar Sensor Module

Circuit/System Description

After replacement, the radar sensor module - long range must complete an alignment procedure. The alignment procedure can be completed by driving the vehicle for approximately 30 min.

Conditions for Running the DTC

- Module alignment procedure started.
- Vehicle operating on the road.

Conditions for Setting the DTC

The radar sensor module - long range was unable to complete alignment process within approximately 30 min of drive time.

Action Taken When the DTC Sets

- The radar sensor module - long range is disabled.
- Any systems that rely on data from the radar sensor module - long range are disabled.
- A service message may be displayed on the driver information center.

Conditions for Clearing the DTC

The radar sensor module - long range is successfully aligned.

Diagnostic Aids

The radar sensor module - long range must be securely mounted. Verify it is secured properly in its mount.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Active Safety System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B390C is not set
 - **If the DTC is set**
 1. Perform the Radar Sensor Module - Long Range Learn procedure.
 2. Verify DTC B390C is not set after the calibration procedure has been completed.
 - If the DTC is set after calibration, replace the B233B Radar Sensor Module - Long Range.
 - If the DTC is not set after calibration
 3. All OK.
 - **If DTC B390C 66 is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to [Control Module References](#) for radar sensor module - long range replacement, programming, and setup.

DTC B390D: FRONTVIEW CAMERA MODULE INCORRECT MOUNTING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B390D 66

Frontview Camera Module Incorrect Mounting

Circuit/System Description

The frontview camera module has determined that it is not properly mounted.

Conditions for Running the DTC

Vehicle operating on the road.

Conditions for Setting the DTC

The frontview camera module was unable to see the road ahead.

Action Taken When the DTC Sets

- The frontview camera module is disabled.
- The Active Safety System is disabled.
- Service Driver Assist is displayed on the driver information center and/or heads up display.

Conditions for Clearing the DTC

The frontview camera module is successfully aligned.

Diagnostic Aids

- The frontview camera module needs to be securely mounted. Verify it is secured properly in its mount.
- The frontview camera module needs to have a clear field of vision to the road ahead. Check for anything that can impair the camera's vision.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify there are no DTCs set, except for DTC B101E 4B in the B233B Radar Sensor Module - Long Range or K109 Frontview Camera Module.

- **If other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

NOTE: Before conducting alignment, verify that the K109 Frontview Camera Module will not have difficulty seeing the lines on the road. If the view of the K109 Frontview Camera Module is blocked with mud, dirt, snow, ice, or slush, if the windshield is damaged, or if weather limits visibility, such as while driving in fog, rain, or snow conditions, the calibration procedure may not be able to be completed.

3. Perform the calibration procedure. Refer to [Front View Camera Module Learn](#).
4. Verify DTC B390D 66 is not set

- **If DTC B390D 66 is set**

Replace and calibrate the K109 Frontview Camera Module.

- **If DTC B390D 66 is not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for frontview camera module replacement, programming, and setup.

DTC P15F6: FRONT OBJECT DETECTION CONTROL MODULE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P15F6

Front Object Detection Control Module Torque Request Signal Message Counter Incorrect

Circuit/System Description

The Frontview Camera Module communicates with the Engine Control Module (ECM), requesting engine speed or torque reduction as necessary.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The ECM detects that the engine speed and torque modification messages from the Frontview Camera Module are either corrupted or intermittently missing.

Action Taken When the DTC Sets

- The Frontview Camera Module sends a serial data message to display the appropriate indicator message
- The Frontview Camera Module features are unavailable.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The engine control module clears the history DTC when a current DTC is not detected in 40 consecutive drive cycles.

Diagnostic Aid

This is an informational DTC set by the engine control module. It is set to provide an indication that the Frontview Camera Module will not be able to perform as intended. Diagnose any other DTCs first. During normal diagnostic and/or repair verification technicians may find that a "Service Driver Assist System" message may be displayed by the Frontview Camera Module. Do not replace the Frontview Camera Module for this condition.

If the Service Driver Assist System message is displayed with no DTCs set, perform the following steps:

1. Remove the key from the ignition, open and close the driver's door to turn off retained accessory power, and wait 60 s.

2. Ignition ON, if the Service Driver Assist message is still present, operate the vehicle at speeds greater than 15 km/h (10 mph) to complete the self test. The Frontview Camera Module should request the message to turn off.
3. If the telltales remain on with no DTCs set after the drive cycle, disconnect the battery for at least 60 s, then reconnect the battery.
4. Operate the vehicle at speeds greater than 40 km/h (25 mph), the Frontview Camera Module should request all indicators to turn off.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **DTC P15F6 is an informational DTC.**
- **Diagnose all other K20 Engine Control Module DTCs prior to DTC P15F6.**

1. Verify there are no other DTCs set in the K20 Engine Control Module and that there are no communication DTCs set in the vehicle.

- **If any DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If no DTCs are set**

2. Clear DTCs and operate the vehicle in the conditions that the customer experienced.
3. Verify DTC P15F6 does not set.

- **If the DTC sets**

Replace K109 Frontview Camera Module

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming, and setup.

SYMPTOMS - OBJECT DETECTION

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control module can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to:
 - [Cross Traffic Alert Description and Operation](#)
 - [Forward Collision Alert Description and Operation](#)
 - [Lane Departure Warning Description and Operation](#)
 - [Parking Assist Description and Operation \(with Rear Park Assist, UD7\)](#)[Parking Assist Description and Operation \(with Front and Rear Park Assist, UFQ\)](#)[Parking Assist Description and Operation \(with Parallel Parking or Automatic Parking Assist\)](#)
 - [Rear Vision Camera Description and Operation](#)
 - [Side Blind Zone Alert Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- This system can use various sensors that need to be clean in order to function properly. Make sure to check the following sensors for obstructions:
 - Parking assist sensors located in the rear bumper cover

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

- [Forward Collision Alert System Malfunction](#)
- [Lane Departure Warning System Malfunction](#)
- [Parking Assist System Malfunction](#)
- [Rear Vision Camera System Malfunction](#)
- [Rear Cross Traffic Alert System Malfunction](#)
- [Side Blind Zone Alert System Malfunction](#)

FORWARD COLLISION ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0987 01

Vehicle Direction Camera Indicator Circuit Short to Battery

DTC B0987 06

Vehicle Direction Camera Indicator Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Indicator Ignition	B0987 06	B0987 06	-	-
Lane Departure Warning Switch Indicator Control	B0987 06	B0987 06	B0987 01	-

Circuit/System Description

The lane departure warning is enabled and disabled through a switch located in the left steering wheel controls switch. When enabled, the frontview camera module will illuminate the indicator located in the switch.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The frontview camera module has detected a short to battery or open/high resistance in the control circuit.

Action Taken When the DTC Sets

- Lane departure warning is disabled.

- SERVICE FRONT CAMERA is displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B356A is not set.
 - **If the DTC is set**

Refer to **DTC B356A**.
 - **If the DTC is not set**
3. Verify the lane departure warning indicator turns ON and OFF while pressing and releasing the lane departure warning switch.
 - **If the indicator does not turn ON and OFF**

Refer to Circuit/System Testing.
 - **If the indicator turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left, ignition ON.

NOTE: **Verify interior lighting dimming is turned all the way up.**

2. Test for 6.2 - 12.0 V between the dimming control circuit terminal 4 and ground.
 - **If less than 6.2 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Interior Backlighting Malfunction](#) .
 - **If greater than 12.0 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, refer to [Interior Backlighting Malfunction](#) .
 - **If between 6.2 - 12.0 V**
3. Connect a test lamp between the control circuit terminal 5 and B+.
4. Verify the test lamp turns ON and OFF when commanding the Lane Departure Warning Indicator parameter ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K109 Frontview Camera Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K109 Frontview Camera Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S70L Steering Wheel Controls Switch - Left.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cruise Control Switch Replacement](#) - Steering Wheel Controls Switch - Left replacement.
- Refer to [Control Module References](#) for control module replacement, programming and setup.

PARKING ASSIST SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The ultrasonic parking assist system is designed to identify and notify the driver of an object in the vehicle's path when moving reverse at speeds of less than 8 km/h (5 MPH). The distance and location of the object is determined by four object sensors, located in the rear bumper. The parking assist system will notify the driver using an audible signal through the radio.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parking Assist Switch Indicator Ignition	B0968 06, 2	B0968 06, 2	-	-
Parking Assist Switch Signal	B0967 02, 1	1	1	-
Parking Assist Switch Indicator Control	B0968 06, 2	B0968 06, 2	B0968 01	-
Parking Assist Switch Ground	-	1	-	-
1. Parking Assist Switch Malfunction 2. Parking Assist Indicator Malfunction				

Circuit/System Description

The parking assist system is enabled and disabled through the parking assist switch. When enabled, the parking assist indicator will illuminate.

The switch and indicator are connected to the front and rear parking assist control module. The front and rear parking assist control module supplies a reference voltage to the parking assist switch. When the switch is pressed, the signal circuit is grounded. The front and rear parking assist control module can control the park assist indicator by grounding the control circuit to illuminate the LED which indicates that the system is enabled.

The front and rear parking assist control module supplies a reference voltage and a low reference to the object sensors. The sensors will return a signal based on the reflections from objects within range of the sensors.

When an object is detected, the front and rear parking assist control module will send serial data to the radio to

provide an audible alert.

Diagnostic Aids

The following is a brief description of potential causes for a disable condition which may aid in diagnosis:

- **Manual Disable** - The parking assist system has been disabled through the parking assist switch or audio system personalization menu.
- **Hitch/Object Attached** - The front and rear parking assist control module is detecting an object that is attached to the vehicle. Common items such as a hitch receiver, trailer, or a bicycle rack may cause this concern. Additionally, damage to the rear of the vehicle or a misaligned sensor may cause this concern. If the vehicle is damaged in a manner that causes the sensor to detect the bumper itself, the front and rear parking assist control module will interpret this as an attached object and disable the system. Carefully inspect the bumper, bumper mounting surface, and sensor retainers before continuing with normal diagnosis. After the detected cause has been addressed the vehicle must be driven at speed greater than 40 km/h (25 mph).
- **Reverse Overspeed** - The vehicle is travelling too fast in reverse at speeds of greater than 8 km/h (5 mph).
- **Inhibit** - The front and rear parking assist control module has lost or received invalid GMLAN signal(s).
- **Sensor Disturbance** - An outside interference is causing sensor movement. Such interference may be caused a heavy pounding, like that of a nearby jackhammer, or large changes in pressure, such as a large truck air brakes.
- **Sensor Ring Time** - If the sensor fails its own diagnostic initialization the front and rear parking assist control module will set this error. After the detected cause has been addressed the vehicle must be driven at speed greater than 40 km/h (25 mph). The following is a list of reasons this cause may have set:
 - One or more of the sensors may be blocked by snow, mud, ice, or other debris. This might happen after going through a car wash in cold weather.
 - Silicone insulator surrounding sensor maybe missing, cut, or twisted.
 - Improperly installed sensor, sensor maybe be crooked due to a tight wire harness.
 - One or more of the sensors may be scratched or the paint maybe chipped.
 - Excessive paint thickness on a sensor may cause an excessive sensor ring time. When replacing or refinishing a sensor, do not apply an excessive amount of paint or clear coat.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)
Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)
Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the Parking Assist Control Module Parking Assist Switch scan tool parameter changes between Active and Inactive while pressing and releasing the parking assist switch.
 - **If the parameter does not change between Active and Inactive**

Refer to Circuit/System Testing - Parking Assist Switch Circuit Malfunction.
 - **If the parameter changes between Active and Inactive**
3. Verify the parking assist switch indicator turns On and Off while commanding the Parking Assist Control Module Parking Assist Switch LED On and Off with a scan tool.
 - **If the indicator does not turn ON and OFF**

Refer to Circuit/System Testing - Parking Assist Switch Indicator Circuit Malfunction.
 - **If the indicator does turn ON and OFF**
4. Transmission in R.
5. Verify the Parking Assist Control Module Calculated Transmission Range scan tool parameter is Reverse.
 - **If the parameter is not Reverse**

Refer to [Backup Lamps Malfunction](#) .
 - **If the parameter is Reverse**
6. Transmission in R.
7. Verify the scan tool Parking Assist System Status parameter displays Enabled.
 - **If the parameter is not Enabled**

Refer to Diagnostic Aids to determine the cause.
 - **If the parameter is Enabled**
8. Vehicle ON, transmission in R for 5 s, then transmission in Drive, no objects near the front or rear of vehicle, verify there are no beeping tones for park assist.
 - **If there are park assist beeping tones**

Inspect the front park assist sensors for proper installation and verify they are clean of debris.

- **If there are no park assist beeping tones**

9. Vehicle ON, transmission in R, no objects near the front or rear of vehicle, verify there are no beeping tones for park assist.

- **If there are park assist beeping tones**

Inspect the rear park assist sensors for proper installation and verify they are clean of debris.

- **If there are no park assist beeping tones**

10. All OK.

Circuit/System Testing

Parking Assist Switch Circuit Malfunction

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch - Center Console. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle ON.

4. Verify the scan tool Parking Assist Switch Status parameter is inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the harness connector at the K41 Front and Rear Parking Assist Control Module.

2. Test for infinite resistance between the control circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K41 Front and Rear Parking Assist Control Module.

- **If Inactive**

5. Test for less than 1 V between the control circuit terminal 5 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

6. Connect a test lamp between the control circuit terminal 6 and the ground circuit terminal 1.

7. Verify that a test lamp turns On and Off when Commanding the Parking Assist Switch On and Off with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the harness connector at the K41 Front and Rear Parking Assist Control

Module

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K41 Front and Rear Parking Assist Control Module.
- **If the test lamp is always ON**
1. Vehicle OFF, disconnect the harness connector at the K41 Front and Rear Parking Assist Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K41 Front and Rear Parking Assist Control Module
- **If the test lamp turns ON and OFF**
8. All OK.

Parking Assist Switch Indicator Circuit Malfunction

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch - Center Console, vehicle in Service Mode.
2. Test for greater than 11 V between terminal 6 and ground.
 - **If less than 11 V**

Test the voltage circuit for a short to ground or an open/high resistance.

 - **If greater than 11 V**
3. Command the Park Assist Switch LED output control ON with the scan tool. Test for greater than 11 V between the control circuit terminal 6 and the ground circuit terminal 1.
 - **If less than 11 V**

Test the signal circuit for an open/high resistance.

 - **If greater than 11 V**
4. Command the Park Assist Switch Indicator Off with the scan tool.
5. Test for less than 1 V between the terminal 6 and ground.
 - **If 1 V or greater**

Test the signal circuit for a short to voltage.
6. If all circuits test normal, replace the S48E Multifunction Switch - Center Console.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Vehicle Stability Control System Switch Replacement](#)
- Refer to [Advanced Parking Assist Alarm Sensor Replacement](#)
- Refer to [Rear Parking Assist Alarm Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

PARALLEL PARKING ASSIST SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
8V Reference	B1405 02	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 03	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 07	-
Parking Assist Switch Signal	B0967 02	1	-	-
Side Object Sensor Left Front Signal	B096C 06	B096C 06	B096C 01	B096C 08, B096C 21
Side Object Sensor Right Front Signal	B096D 06	B096D 06	B096D 01	B096D 08, B096D 21
Low Reference	-	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06	-	-
Parking Assist Switch Ground	-	1	-	-
1. Parking Assist Switch Malfunction				

Circuit/System Description

The parallel parking assist is activated/deactivated by pressing the parking assist switch at speeds below 30 km/h (18 mph). The activated parallel parking assist then searches for an appropriate parking spot. If a spot is

detected, feedback is given to the driver through the indicator in the driver information center. The driver accepts the decision by stopping the vehicle. The system calculates the optimal path into the parking lot and will then guide the vehicle into the chosen spot by taking over the steering control from the driver. The driver only needs to shift gears, brake and accelerate following the instructions given on the driver information center.

The system consists of the 8 parking assist sensors from the normal parking assist located in the front and rear bumper, and two additional parallel parking assist sensors on the side of the vehicle. The additional parallel parking assist sensors are used to measure the parking lot size. The parallel parking assist system uses the 8 parking assist sensors to identify objects in the vehicle's path when moving into the parking lot.

Diagnostic Aids

The following is a brief description of potential causes which may aid in diagnosis:

- Possible disengagement reasons:
 - Steering input by driver. The driver must not interfere with the steering function during a parking maneuver.
 - Vehicle speed. The vehicle is travelling at speeds of greater than 10 km/h (6 MPH) while performing a parking maneuver.
 - Electronic stability control or anti-lock brakes are activated.
 - Failure within the system - check for DTCs.
- Manual Disable - The parking assist system has been disabled through the parking assist switch or audio system personalization menu.
- Hitch/Object Attached - The parking assist control module is detecting an object that is attached to the vehicle. Common items such as a hitch receiver, trailer, or a bicycle rack may cause this concern. Additionally, damage to the rear of the vehicle or a misaligned sensor may cause this concern. If the vehicle is damaged in a manner that causes the sensor to detect the bumper itself, the parking assist control module will interpret this as an attached object and disable the system. Carefully inspect the bumper, bumper mounting surface, and sensor retainers before continuing with normal diagnosis. After the detected cause has been addressed the vehicle must be driven at speed greater than 40 km/h (25 MPH).
- Sensor Disturbance - An outside interference is causing sensor movement. Such interference may be caused a heavy pounding, like that of a nearby jackhammer, or large changes in pressure, such as a large truck's air brakes.
- Sensor Ring Time - If the sensor fails its own diagnostic initialization the parking assist control module will set this error. After the detected cause has been addressed the vehicle must be driven at speed greater than 40 km/h (25 MPH). The following is a list of reasons this cause may have set:
 - One or more of the sensors may be blocked by snow, mud, ice, or other debris. This might happen after going through a car wash in cold weather.
 - Silicone insulator surrounding sensor maybe missing, cut, or twisted.
 - Improperly installed sensor, sensor maybe be crooked due to a tight wire harness.
 - One or more of the sensors may be scratched or the paint maybe chipped.
 - Excessive paint thickness on a sensor may cause an excessive sensor ring time. When replacing or refinishing a sensor, do not apply an excessive amount of paint or clear coat.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Parallel Parking or Automatic Parking Assist)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the correct operation of the parking assist system.

- **If the parking assist system malfunctions**

Refer to Parking Assist System Malfunction.

- **If the parking assist system functions properly**

2. Vehicle ON.

3. Verify the scan tool Advanced Parking Assist Switch parameter changes between Active and Inactive while pressing and releasing the parallel parking assist switch.

- **If the parameter does not change**

Refer to Circuit/System Testing.

- **If the parameter changes**

NOTE: After completing the next step the vehicle might need to be driven in the forward direction at speed greater than 40 km/h (25 MPH).

4. Verify the scan tool Park Assist System Status parameter is Enable.

- **If the parameter is not Enable**

Refer to Diagnostic Aids to determine the cause of the inhibit.

- **If the parameter is Enable**

5. All OK.

Circuit/System Testing

1. Vehicle in Service Mode.
2. Disconnect the harness connector at the S48E Multifunction Switch - Center Console.
3. Verify the scan tool Advanced Parking Assist Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X1 harness connector at the K41 Front and Rear Parking Assist Control Module.
 2. Test for infinite resistance between the S48E Multifunction Switch - Center Console signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K41 Front and Rear Parking Assist Control Module.
 - **If Inactive**
4. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground terminal 1.
5. Verify the scan tool Advanced Parking Assist Switch parameter Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the harness connector at the K41 Front and Rear Parking Assist Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the S48E Multifunction Switch - Center Console signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - 3. Vehicle OFF
 - 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K41 Front and Rear Parking Assist Control Module.
 - **If Active**
6. Test or replace the S48E Multifunction Switch - Center Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Vehicle Stability Control System Switch Replacement](#) for S48E Multifunction Switch - Center Console replacement
- Refer to [Control Module References](#) for control module replacement, programming and setup.

REAR CROSS TRAFFIC ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Side Object Sensor - Left Ground	-	U0232	-	-
Side Object Sensor - Left B+	-	U0232	-	-
Side Object Sensor - Left Communication (terminal 7)	1	U0232	1	-
Side Object Sensor - Left Communication (terminal 2)	1	U0233	1	Â
Side Object Sensor - Right Ground (terminal 8)	-	U0233	1	-
Side Object Sensor - Right Ground (terminal 3)	-	U0233	1	Â
Side Object Sensor - Right B+	1	U0233	-	-
Side Object Sensor - Right Communication	1	U0232	1	-
1. Rear Cross Traffic Alert System Malfunction				

Circuit/System Description

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of objects nearby. When an object is detected in the rear cross traffic zone, the module will send out a signal through serial data communication to turn on the visual icons on the rear vision camera screen and also audio chime notification for the appropriate side. Each sensor is supplied B+ and ground. The right sensor receives an additional ground. Both sensors communicate independently on the serial data line. The serial data enters the left sensor in a pass-thru configuration, that connects to the right sensor. The scan tool is able to individually communicate with each sensor.

Diagnostic Aids

- The rear cross traffic alert system uses the same side blind zone sensors so a malfunction may affect either or both systems.
- The conditions for disabling the rear cross traffic alert system are captured by DTCs. The drivers information center will display Service Side Detection System if one of the sensors has failed.
- The rear cross traffic system can be disabled if any off the following occur:
 - The driver has selected the Off mode through vehicle personalization menus. The selected mode is retained over ignition cycles. A driver information center message stating that the Rear Cross Traffic System Alert Off shall be displayed.
 - There is a loss of serial data communication with a sensor or between modules.
 - A blockage condition exists (i.e. mud/snow buildup in front of the sensor). A driver information message stating that the side detection system is temporarily unavailable will be displayed. The rear

cross traffic system transitions back to the normal operating state when the blockage is removed. Bumper sticks, fascia damage, labels, and heavy rain storms may also cause this condition. The blockage determination is performed with the vehicle in a drive gear.

- The rear cross traffic alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.
- Because the sensors are identical, they may be swapped from one side of the vehicle to the other in an attempt to isolate a concern. Sensors should NOT be swapped from one vehicle to another.
- The rear cross traffic alert system is designed to ignore stationary objects; however, the system may occasionally detect pedestrians, shopping carts, or other objects. This is normal system operation and does not require service.
- The rear cross traffic alert system may indicate an object if a trailer is attached to the vehicle, or a bicycle or object is extending out to either side of the vehicle. The system may also temporarily disable the system and display the "Side Detection System Unavailable" message.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool can communicate with the right side object sensor.
 - **If the scan tool can not communicate with the right side object sensor**

Refer to Circuit/System Testing - Right Side Object Sensor Malfunction.

- **If the scan tool can communicate with the right side object sensor**
3. Verify the scan tool can communicate with the left side object sensor.
- **If the scan tool can not communicate with the left side object sensor**

Refer to Circuit/System Testing - Left Side Object Sensor Malfunction.

- **If the scan tool can communicate with the left side object sensor**
4. Verify that the rear cross traffic indicators alerts turn ON and then turn OFF when commanding the Object Detection Alert Indicators ON and OFF with a scan tool.
 - **If alert indicators do not turn ON and OFF**
 1. Verify the system is enabled.
 - If disabled, refer to diagnostic aids for cause of disable.
 - If enabled, test or replace the radio.
 - **If indicators turn ON and OFF**
 5. All OK.

Circuit/System Testing

Left Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the Side Object Sensor - Left.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle Off.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the Side Object Sensor - Left.
 - **If the test lamp illuminates**

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω in each of the serial data circuits end to end between the control module harness connector terminal 2 and the DLC terminal 1.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace Side Object Sensor - Left.

Right Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the Side Object Sensor - Right.
2. Test for less than 10 Ω between the following ground circuit terminals and ground.

- Terminal 3
- Terminal 8
- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle Off.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the Side Object Sensor - Right.

- **If the test lamp illuminates**

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω in each of the serial data circuits end to end between the control module harness connector terminal 7 and the DLC terminal 1.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace Side Object Sensor - Right.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

Refer to [Control Module References](#) control module replacement, programming and setup

REAR VISION CAMERA SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Camera Module signal +	2	1	1	-
Camera Module signal -	2	1	1	-
Shield	-	2	-	-
Ground	-	1	-	-
1. Rear vision camera inoperative				
2. Poor Quality Image				

Circuit/System Description

When the transmission is placed into REVERSE, a serial message is sent to the K74 Human Machine Interface Control Module indicating that camera operation is requested. Ignition voltage and ground are supplied to the rearview camera. The rearview camera sends video information to the radio through a video signal + and a video signal - circuit. A grounded shielding also wraps the video signal circuits to reduce electronic interference which may degrade the video signal and cause a distorted or otherwise degraded image.

Diagnostic Aids

A poor video image can be caused by ice, snow, and mud buildup on the lens of the rearview camera. Also, extreme lighting conditions can affect performance, such as operating in the dark or with bright sunlight shining on the camera. Extreme high or low temperatures can also affect the image quality. An open in the shield of the video signal circuit can also cause a distorted screen.

Terminal fretting or incorrectly seated connectors can cause a poor image displayed condition. Check the circuit terminals for fretting or incorrectly seated connector. If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance

condition due to terminal fretting corrosion.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Vision Camera Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Vehicle in Service Mode.
2. Verify that DTC B2545 is not set.
 - **If the DTC is set**
Refer to **DTC B2545** .
 - **If the DTC is not set**
3. Verify the rearview camera there is no debris on the lens and that the bezel or bezel seal is not damaged.
 - **If debris are found on the lens**
Clean the lens. If the lens, bezel, or bezel seal are damaged, replace as necessary.
 - **If no debris on the lens**
4. Vehicle ON, transmission in REVERSE.
5. Verify the backup lamps are On.
 - **If the backup lamps are not ON**

Refer to [Backup Lamps Malfunction](#) .

- **If the backup lamps are ON**

6. Engine running, transmission in REVERSE.

7. Verify a clear rear vision image is displayed on the radio.

- **If a clear image is not displayed**

Refer to Circuit/System Testing.

- **If a clear image is displayed**

8. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B87 Rearview Camera. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

- **If 10 Ω or greater**

Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, test or replace the KR74 Ignition Run Relay.

- **If the test lamp illuminates**

5. Vehicle OFF, disconnect the X2 harness connector at the K74 Human Machine Interface Module, Vehicle in Service Mode.

6. Test for less than 1 V between the signal circuit terminal listed below and ground:

- Signal (+) circuit terminal 5 at the B87 Rearview Camera.

- Signal (-) circuit terminal 6 at the B87 Rearview Camera.
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

7. Test for infinite resistance between the signal circuit terminal listed below and ground:

- Signal (+) circuit terminal 5 at the B87 Rearview Camera.
- Signal (-) circuit terminal 6 at the B87 Rearview Camera.
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Test for less than 2 Ω in the signal (+) circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

9. Test for less than 2 Ω in the signal (-) circuit end to end.

- **If 2 Ω or greater**

Test the signal circuit for an open/high resistance.

- **If less than 2 Ω**

10. Replace the B87 Rearview Camera.

11. Engine running, transmission in REVERSE, verify a clear rear vision image is displayed on the A11 Radio.

- **If a clear rear vision image is not displayed on the A11 Radio**

Replace the K74 Human Machine Interface Module.

- **If a clear rear vision image displayed on the A11 Radio**

12. All Ok.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Rearview Driver Information Camera Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

SIDE BLIND ZONE ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Left Indicator	B094D 02	B094D 04	B094D 01	-
Ground - Left Indicator	-	B094D 04	-	-
Control - Right Indicator	B094E 02	B094E 04	B094E 01	-
Ground - Right Indicator	-	B094E 04	-	-

Circuit/System Description

The side blind zone alert system detects and reports objects on either side of the vehicle, within a specified blind spot zone. The system alerts with a visual indicator placed on each side rear view mirror, to the presence of objects that may not be visible in the inside rearview mirror and outside rearview mirrors. Although this system is intended to help drivers avoid lane change crashes, it does not replace driver vision and therefore should be considered a lane change aid. Even with the side blind zone system, the driver must check carefully for objects outside of the reporting zone (e.g., a fast approaching vehicle) before changing lanes. In the event that the system senses a malfunction through its diagnostic routines, the system will be disabled and the driver will be visually notified.

When the system detects a vehicle in the side blind zone while driving forward, independent if passing a vehicle or being passed, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

Side blind zone alert is active when the vehicle is out of park or the parking brake is off on manual transmission vehicles and from speeds of 10 km/h (6.2 MPH) up to 140 km/h (87 MPH). Driving faster deactivates the system, indicated by dimly lighting the warning symbols in the mirrors. Driving under this speed again will turn off the warning symbols. If then a vehicle is detected in the blind zone, the warning symbols will turn on normally on the appropriate side. When the vehicle is started, both outside mirror displays will briefly come on to indicate that the system is operating.

Diagnostic Aids

- The conditions for disabling the side blind zone alert system are captured by DTCs. The drivers information center will display Service Side Detection System if one of the sensors has failed.
- The side blind zone system can be disabled if any off the following occur:
 - The driver has selected the Off mode through vehicle personalization menus. The selected mode is retained over ignition cycles. A driver information center message stating that the side blind zone system is off shall be displayed and the outside mirror indicators will be OFF.
 - There is a loss of serial data communication with a sensor or between modules.
 - A blockage condition exists (i.e. mud/snow buildup in front of the sensor). A driver information message stating that the side detection system is temporarily unavailable will be displayed. The rear cross traffic system transitions back to the normal operating state when the blockage is removed. Bumper sticks, fascia damage, labels, and heavy rain storms may also cause this condition. The

blockage determination is performed with the vehicle in a drive gear.

- The side blind zone alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.
- Because the sensors are identical, they may be swapped from one side of the vehicle to the other in an attempt to isolate a concern. Sensors should NOT be swapped from one vehicle to another.
- The side blind zone system is designed to ignore stationary objects; however, the system may occasionally detect guard rails, signs, trees, shrubs, or other stationary objects as an object in the blind zone. This is normal system operation and does not require service.
- The side blind zone system may indicate an object in the blind zone if a trailer is attached to the vehicle, or a bicycle or object is extending out to either side of the vehicle. The system may also temporarily disable the system and display the "Side Detection System Unavailable" message.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool can communicate with the left side object sensor.
 - **If the scan tool can not communicate with the left side object sensor**

Refer to Circuit/System Testing - Left Side Object Sensor Malfunction.

- **If the scan tool can communicate with the left side object sensor**

3. Verify the scan tool can communicate with the right side object sensor.
 - **If the scan tool can not communicate with the right side object sensor**
 Refer to Circuit/System Testing - Right Side Object Sensor Malfunction.
 - **If the scan tool can communicate with the right side object sensor**
4. Vehicle OFF, vehicle ON.
5. Verify that the side blind zone alert system indicator located in the appropriate outside rearview mirror turns ON and OFF when commanding the appropriate Object Detection Alert Indicator On and Off with a scan tool.
 - **If one or both indicators do not turn ON and OFF**
 Refer to Circuit/System Testing - Side Object Indicator Malfunction.
 - **If both indicators turn ON and OFF**
6. All OK.

Circuit/System Testing

Left Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the B218L Side Object Sensor Module - Left. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle Off.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B218L Side Object Sensor Module - Left.
 - **If the test lamp illuminates**
4. Vehicle OFF and all vehicle systems OFF. Disconnect the It may take up to 2 minutes for all vehicle

systems to power down.

5. Test for less than 2 Ω between the serial data circuit terminal 2 and the DLC terminal 1.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace B218L Side Object Sensor Module - Left.

Right Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the B218R Side Object Sensor Module - Right. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the following ground circuit terminals and ground.

- Terminal 3
- Terminal 8
- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle Off.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the B218R Side Object Sensor Module - Right.

- **If the test lamp illuminates**

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.

5. Test for less than 2 Ω between the serial data circuit terminal 7 and the DLC terminal 1.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Replace B218R Side Object Sensor Module - Right.

Side Object Indicator Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector for the appropriate A9 Outside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.
 - X510 - Driver Door Harness to Outside Rearview Mirror
 - X610 - Passenger Door Harness to Outside Rearview Mirror
2. Test for less than 10 Ω between the ground circuit terminal 11 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle ON, connect a test lamp between the control circuit terminal 15 and the ground circuit terminal 11.
4. Verify the test lamp turns ON and OFF when commanding the Object Detection Alert Indicators ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the harness connector at the appropriate B218 Side Object Sensor Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the B218 Side Object Sensor Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the harness connector at the B218 Side Object Sensor Module, Vehicle ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the B218 Side Object Sensor Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Outside Rearview Mirror Glass Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

LANE DEPARTURE WARNING SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Ground Circuit	-	2	-	-
Lane Departure Warning Switch Signal Circuit	B356A 02	2	2	-
Lane Departure Warning Switch Indicator Control Circuit	-	B0987 06	B0987 01	-
Lane Departure Warning Switch Indicator Power Circuit	-	1	1	-
1. Lane Departure Warning Inoperative. 2. Lane Departure Warning Switch Illumination cannot be turned ON or OFF.				

Circuit/System Description

The lane departure warning system is enabled and disabled through the lane departure switch. When enabled, the lane departure warning indicator will illuminate. The switch and indicator are connected to the Frontview Camera Module. The Frontview Camera module supplies a reference voltage to the lane departure switch. When the switch is pressed, the signal circuit is grounded. When enabled, the Frontview Camera Module will illuminate the indicator located in the switch when lane departure warning system is enabled.

When the system is operating and can detect the lane markings, the Frontview Camera Module will request via serial data communications that the instrument cluster illuminates the green lane departure ready-to-assist indicator. If the Frontview Camera Module detects that the vehicle unintentionally crosses a lane marking without the turn signal being used, the module will request the vehicle direction display to flash the amber lane departure warning indicator. An audible warning will also sound three times when the amber lane departure warning indicator in the vehicle direction display is flashing.

Diagnostic Aids

Certain factors will affect the operation of the lane departure warning system. When the system is operating properly, the green lane departure warning indicator will illuminate on the instrument cluster. This indicates that all of the required operating conditions to permit lane departure warning have been met. The green lane departure warning indicator will not appear when the system is having difficulty seeing the lines on the road or if the view of the front view camera is blocked with mud, dirt, snow, ice, or slush, if the windshield is damaged, or when weather limits visibility, such as while driving in fog, rain, or snow conditions. This is normal operation, the vehicle does not need service. Additionally, lane departure warnings may occasionally occur in a properly operating vehicle due to tar marks, shadows, cracks in the road, or other road imperfections. This is normal system operation and the vehicle does not require service. The driver information center may also display Lane Departure System Unavailable due to the temporary conditions listed above.

The driver information center may also display LANE DEPARTURE WARNING SYSTEM UNAVAILABLE when the front camera module and bracket assembly is not properly installed. It may be helpful to verify the correct installation of the front camera and bracket assembly. Calibrate the front camera module after repair. Refer to [Front View Camera Module Learn](#)

Additionally, the Front View Camera Disable History can give useful hints about what affected the operation of the lane departure warning system. For the Front View Camera Disable History, refer to [DTC B1011](#).

Reference Information

Schematic Reference

[Object Detection Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Lane Departure Warning Description and Operation](#)
- [Forward Collision Alert Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Refer to Diagnostic Aids before performing Circuit/System Verification.

1. Ignition ON.
2. Verify the K43 Power Steering Control Module (if equipped) and the K17 Electronic Brake Control Module do not have any DTCs set.

- If any DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If the DTC is not set

3. Verify that DTC B356A is not set.

- If the DTC is set

Refer to [DTC B356A](#).

- **If the DTC is not set**

4. Verify that DTC B0987 is not set.

- **If the DTC is set**

Refer to [DTC B0987](#).

- **If the DTC is not set**

5. Verify that DTC B1011 is not set.

- **If the DTC is set**

Refer to [DTC B1011](#).

- **If the DTC is not set**

6. Verify the scan tool Frontview Camera Disable History 1 parameter does not have a current Malfunction

- **If the parameter is Malfunction**

Refer to Diagnostic Aids.

- **If the parameter is Normal**

7. Verify the scan tool Frontview Camera System Status parameter is Normal.

- **If the parameter is Undefined or Malfunction**

Refer to Diagnostic Aids.

- **If the parameter is Normal**

8. Verify the scan tool Lane Departure Warning Switch Status parameter changes between Open and Closed while pressing and releasing the lane departure warning switch.

- **If the parameter does not change between Open and Closed**

Refer to Lane Departure Warning Switch Malfunction in Circuit/System Testing.

- **If the parameter changes between Open and Closed**

9. Verify the scan tool Lane Departure Warning Switch indicator turns on and off while pressing and releasing the lane departure warning switch.

- **If the indicator does not turn on and off**

Refer to Lane Departure Warning Switch Indicator Malfunction in Circuit/System Testing.

- **If the indicator turns on and off**

10. Verify the area of the K109 Frontview Camera Module for contamination.

- **If it needs to be cleaned**

Clean the windshield.

- **If it does not need to be cleaned**

11. All OK.

Circuit/System Testing

Lane Departure Warning Switch Malfunction

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the S70L Steering Wheel Controls Switch - Left ground circuit terminal 7 and ground.
 - **If 5 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Lane Departure Warning Switch Status parameter is Open.
 - **If not Open**
 1. Ignition OFF. Disconnect the K109 Frontview Camera Module.
 2. Test for infinite resistance between the S70L Steering Wheel Controls Switch - Left signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K109 Frontview Camera Module.
 - **If Open**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 7.
6. Verify DTC B356A 02 sets.
 - **If DTC does not set**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K109 Frontview Camera Module.
 - **If DTC sets**
7. Test or replace the S70L Steering Wheel Controls Switch - Left.

Lane Departure Warning Switch Indicator Malfunction

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left, ignition ON.

NOTE: **Verify interior lighting dimming is turned all the way up.**

2. Test for 6.2 - 12.0 V between the dimming control circuit terminal 4 and ground.
 - **If less than 6.2 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Interior Backlighting Malfunction](#) .
 - **If greater than 12.0 V**
 1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, refer to [Interior Backlighting Malfunction](#) .
 - **If between 6.2 - 12.0 V**
3. Connect a test lamp between the control circuit terminal 5 and the control voltage circuit terminal 4.
4. Verify the test lamp turns ON and OFF when commanding the Lane Departure Warning Indicator parameter ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the S70L Steering Wheel Controls Switch - Left.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K109 Frontview Camera Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the S70L Steering Wheel Controls Switch - Left.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cruise Control Switch Replacement](#) - Steering Wheel Controls Switch - Left replacement.
- Refer to [Control Module References](#) for Frontview Camera Module replacement, programming and setup.

REPAIR INSTRUCTIONS

FORWARD RANGE RADAR SENSOR REPLACEMENT

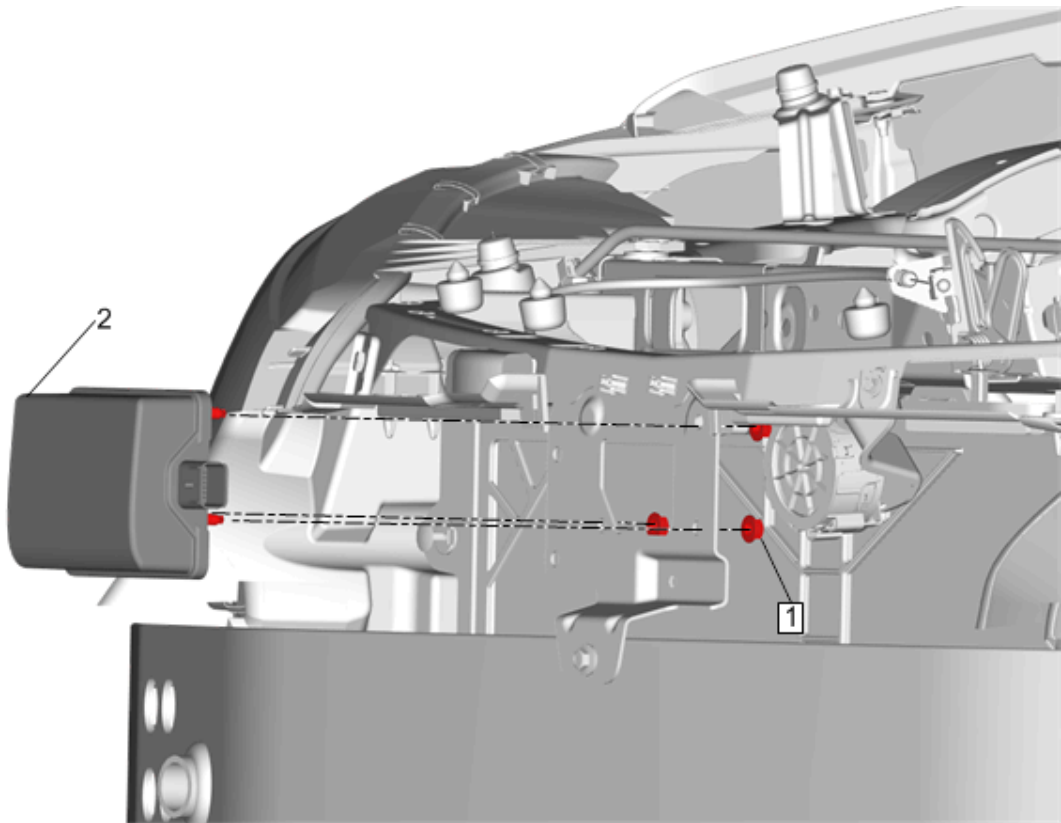


Fig. 8: Forward Range Radar Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to Front Bumper Fascia Removal and Installation	
1	Forward Range Radar Sensor Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)

Callout	Component Name
2	Forward Range Radar Sensor Procedure 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and setup information, if required.

ACTIVE SAFETY CONTROL MODULE REPLACEMENT

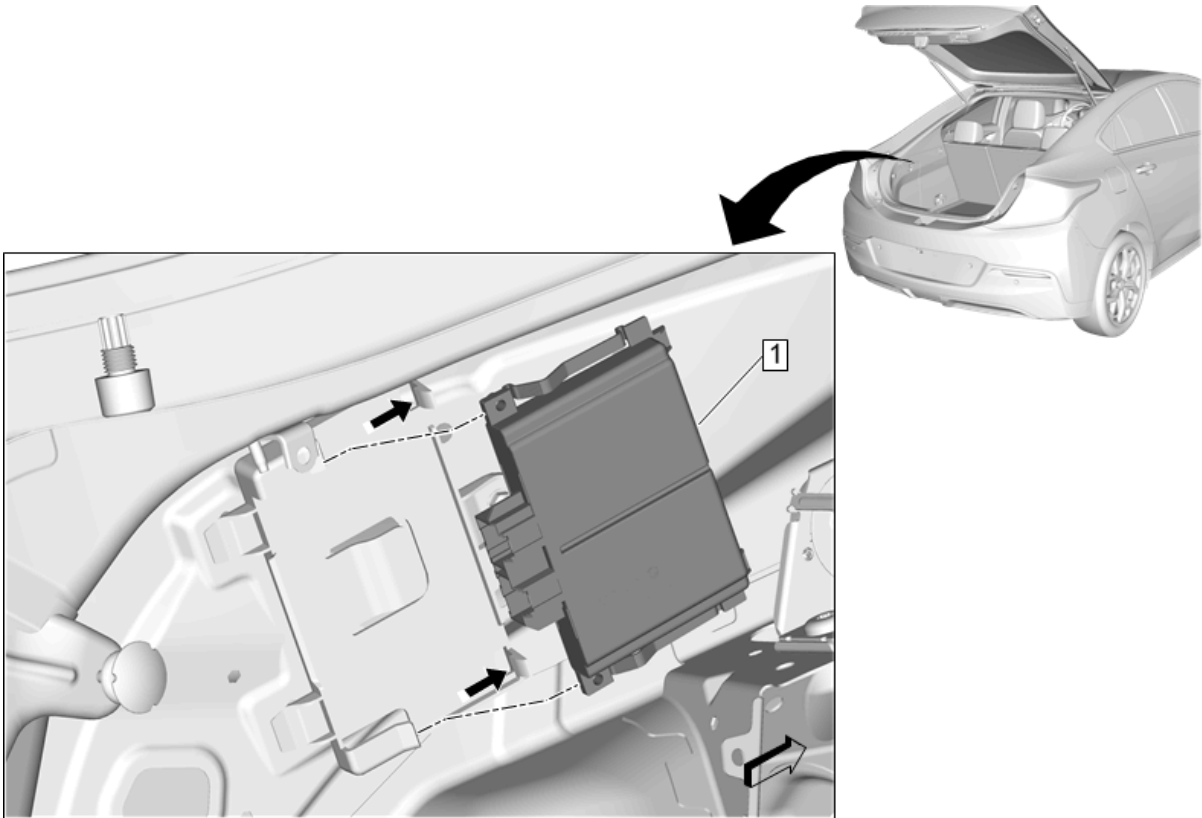


Fig. 9: Active Safety Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel (Left Side). Refer to Quarter Lower Rear Trim Panel Replacement (Left Side)	
1	Active Safety Control Module Procedure 1. Disconnect the electrical connectors. 2. Release the retaining tabs. 3. Perform the necessary programming and setup procedure: Control Module

Callout	Component Name
	References

FORWARD COLLISION ALERT DISPLAY REPLACEMENT

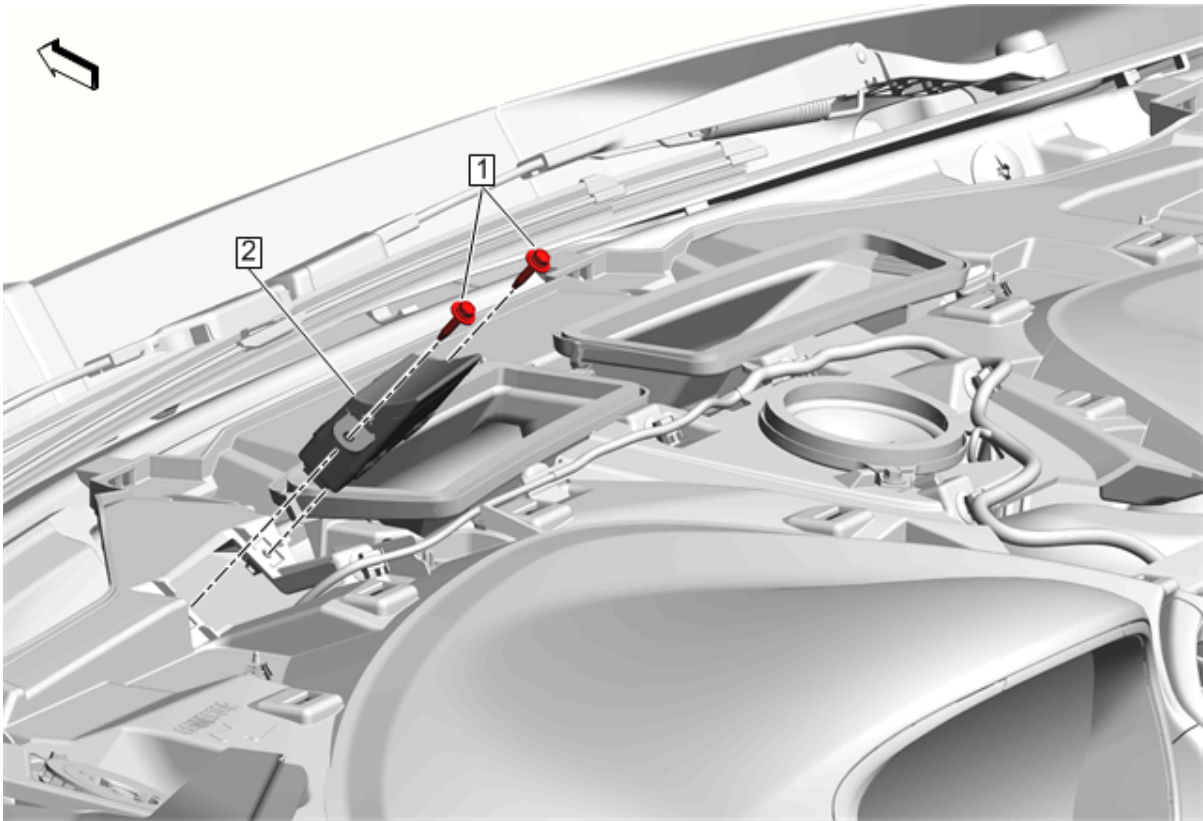


Fig. 10: Forward Collision Alert Display
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Extension. Refer to Instrument Panel Extension Replacement	
1	Forward Collision Alert Display Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Forward Collision Alert Display Procedure Disconnect the electrical connector.

PARKING ASSIST CONTROL MODULE REPLACEMENT

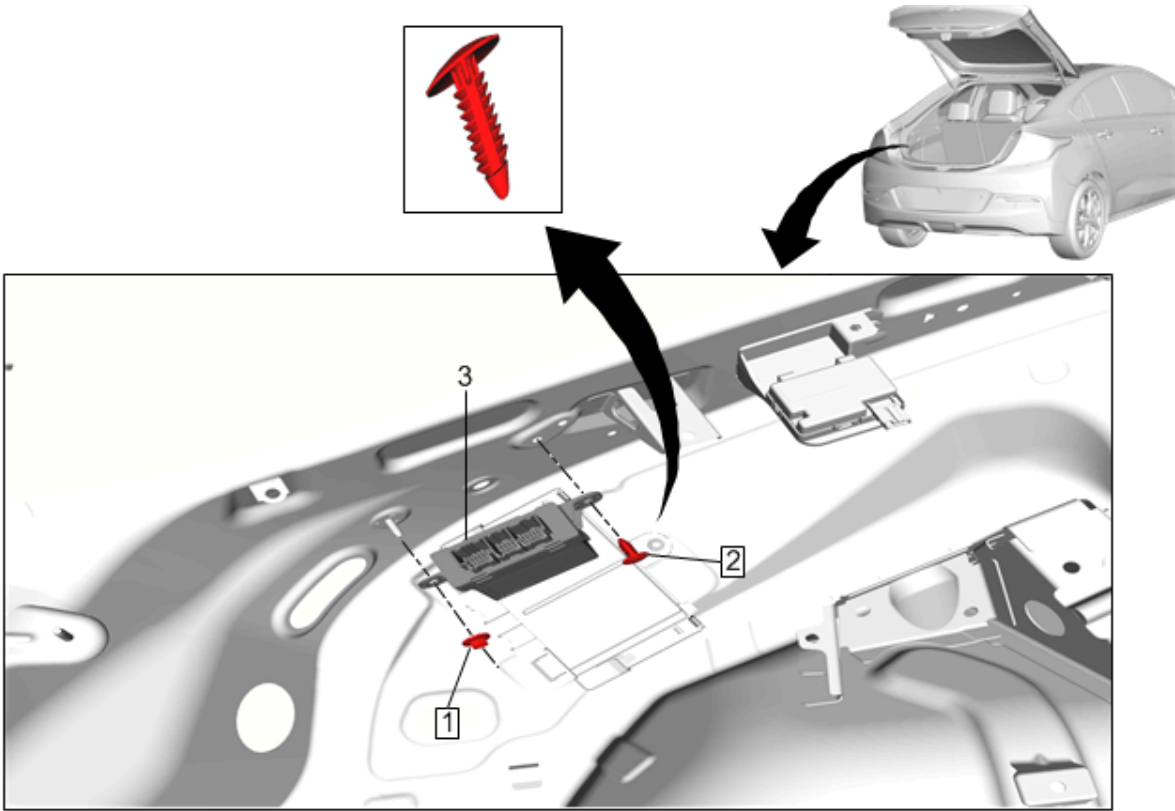


Fig. 11: Parking Assist Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel (Left Side). Refer to Quarter Lower Rear Trim Panel Replacement (Left Side)	
1	Parking Assist Control Module Nut CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
2	Parking Assist Control Module Retainer
3	Parking Assist Control Module Procedure 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and setup information, if

Callout	Component Name
	required.

ADVANCED PARKING ASSIST ALARM SENSOR REPLACEMENT

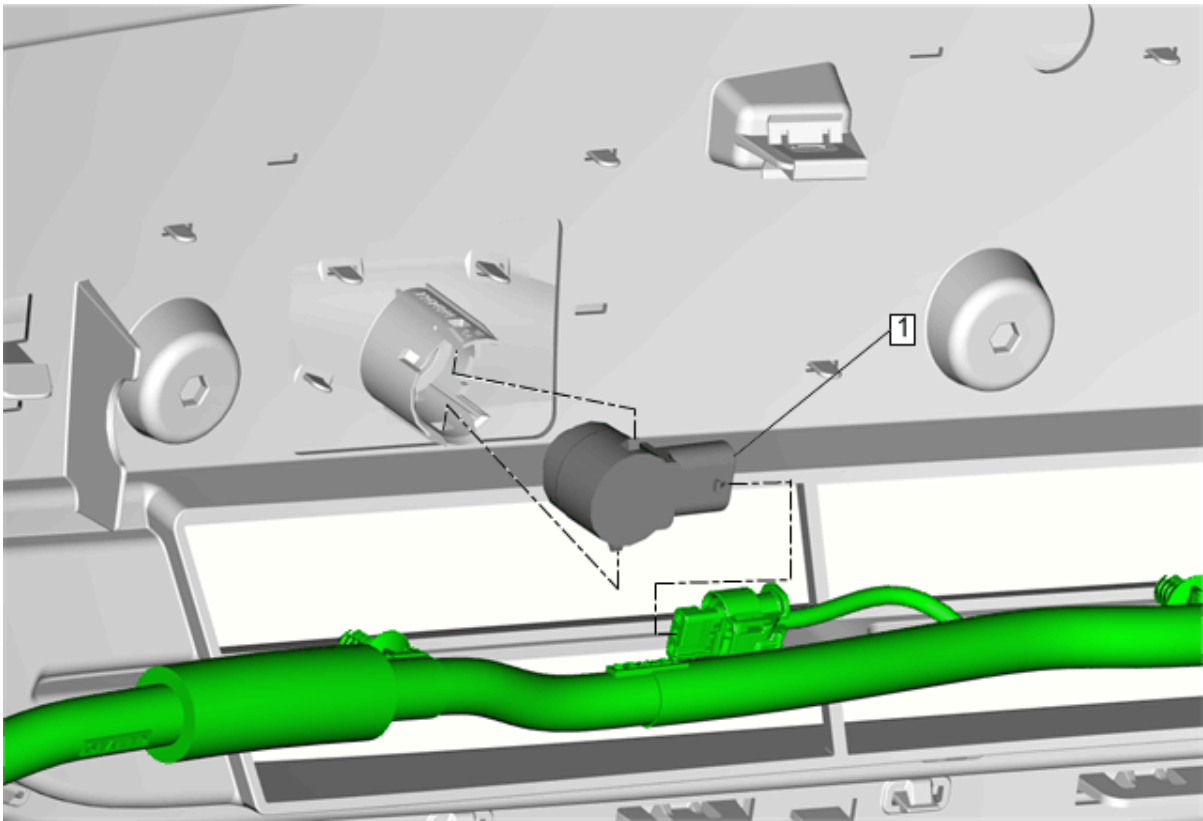


Fig. 12: Advance Parking Assist Alarm Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia Energy Absorber. Refer to Front Bumper Fascia Energy Absorber Replacement	
1	Advance Parking Assist Alarm Sensor Procedure 1. Disconnect the electrical connector. 2. Release the locking tab from the advance parking assist alarm sensor bracket. 3. Perform the necessary programming and setup procedure: Control Module References NOTE: Do not refinish previously

Callout	Component Name
	painted sensors. Excess paint build up will cause the sensor to be inoperative

SIDE OBJECT SENSING ALERT MODULE REPLACEMENT

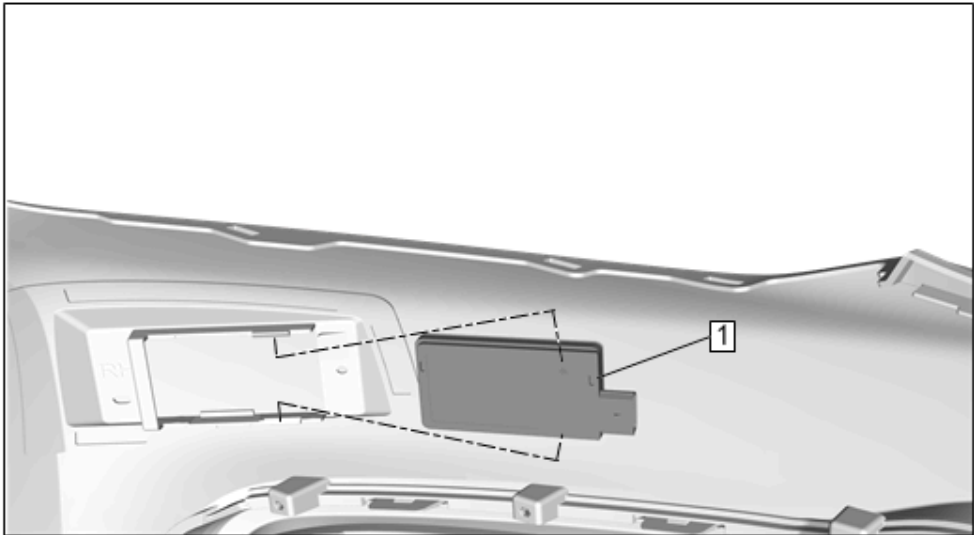


Fig. 13: Side Object Sensing Alert Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Fascia. Refer to Rear Bumper Fascia Removal and Installation	
1	Side Object Sensing Alert Module Procedure 1. Disconnect the electrical connector. 2. Release the tab retainers and slide the module out of the retaining bracket. 3. Refer to Control Module References for programming and setup information, if required.

REAR PARKING ASSIST ALARM SENSOR REPLACEMENT

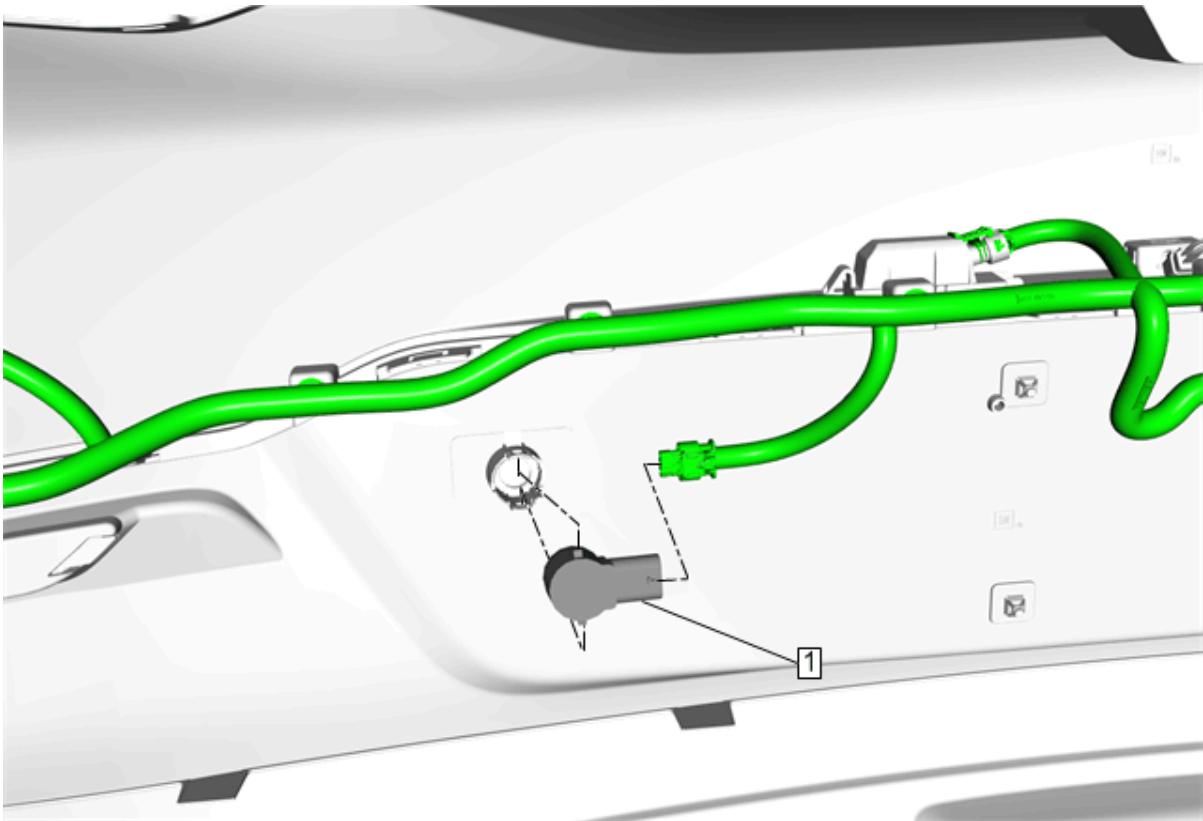


Fig. 14: Rear Parking Assist Alarm Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Energy Absorber. Refer to Rear Bumper Energy Absorber Replacement	
1	Rear Parking Assist Alarm Sensor Procedure 1. Disconnect the electrical connector. 2. Release the locking tab from the rear object alarm sensor bracket. 3. Perform the necessary programming and setup procedure: Control Module
	References NOTE: Do not refinish previously painted sensors. Excess paint build up will cause the

Callout	Component Name
	sensor to be inoperative.

FRONT VIEW CAMERA REPLACEMENT

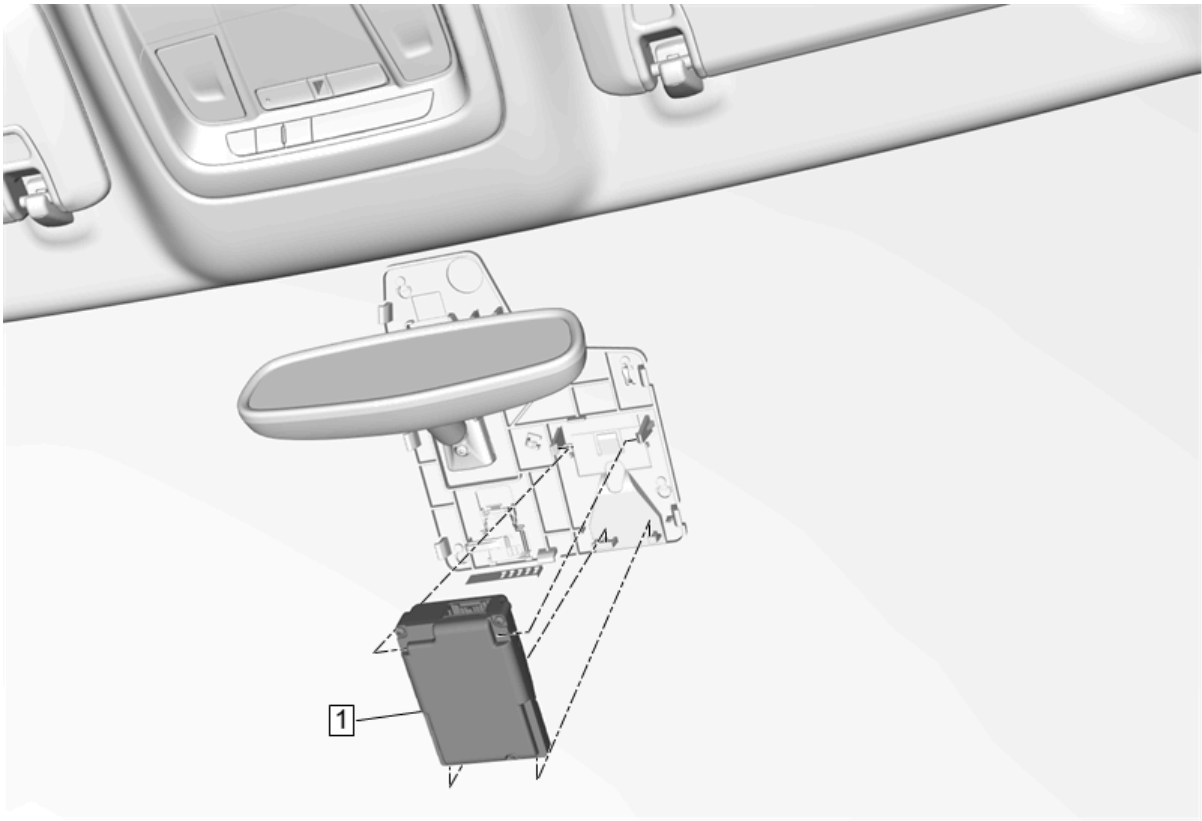


Fig. 15: Front View Driver Information Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Windshield Multifunction Sensor Mount Bracket Lower Cover. Refer to Windshield Multifunction Sensor Mount Bracket Lower Cover Replacement	
1	Front View Driver Information Camera Procedure - Using a suitable plastic tool, insert the tool between the edge of the front view camera retainers and camera, turn the tool to release the retainers and rotate the camera downward. - Disconnect the electrical connector. - Refer to Control Module References for programming and setup information, if required.

REARVIEW DRIVER INFORMATION CAMERA REPLACEMENT

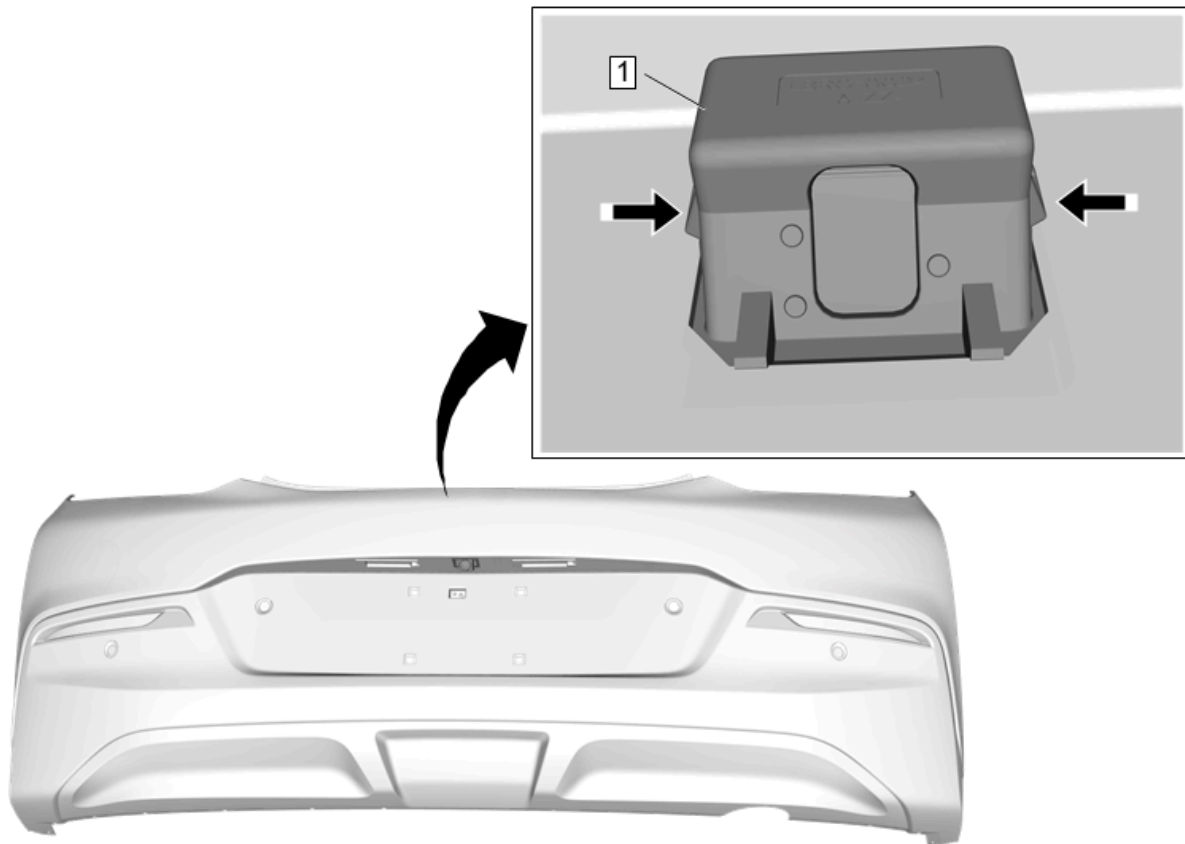


Fig. 16: Rearview Driver Information Camera
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Bumper Fascia. Refer to Rear Bumper Fascia Removal and Installation 2. Disconnect the electrical connector.	
1	Rearview Driver Information Camera Procedure Release the plastic retaining tabs.

FRONT VIEW CAMERA MODULE LEARN

Calibration

For North American SPS users, **Calibration MAY NOT start automatically** and will need to be initiated with GDS2. For European SPS users, **Calibration MAY start automatically** and will not need to be initiated with GDS2.

The calibration process for the front view camera system is necessary when a front view camera module is replaced by a new one. This process is required when only replacing the windshield and the front view camera module has been mounted again properly. This process shall be completed within 3 - 5 minutes when the ideal driving conditions are met. If conditions are not met correct, the front view camera module shall continuously run the service point calibration until successfully completed. This process shall work across ignition cycles and shall not be required to be re-initialized at start up. If the Lane Departure Warning Switch is pressed during

calibration, the indicator will flash momentarily and then stay out - this is normal operation.

To calibrate the front camera, operate the vehicle in the following conditions until the calibration is complete:

- Clean windshield.
- Avoid lane changes.
- Maintain vehicle speeds between 56 - 90 km/h (35 - 56 MPH).
- Ensure the road contains visible references (well defined lane markings, curbs, etc.).

Calibration Procedure (If Manual Initiation Required)

1. Apply the parking brake.
2. Place the transmission in Park (if applicable)
3. Install scan tool
4. Navigate to the module diagnostics menu
5. Select Frontview Camera Module
6. Select Configuration/Reset Functions menu Item
7. Select the Frontview Camera Learn procedure and follow the directions displayed on the screen.
8. Drive the vehicle to complete calibration.

Once the procedure is complete, the amber indicator will turn off . Shortly after the green ready to assist light should turn on as long as all conditions are met for normal operation. The system is then ready to assist.

If Slow to Calibrate

One or more of the following conditions may increase the length of time required to complete the self-calibration procedure:

- Heavy traffic
- Stop and go traffic
- Mountain roads
- Curves in roadway
- Poor contrast lane markings
- Botts' Dots type lane markings
- Operating the vehicle speed is greater than 90 km/h (56 MPH)
- Driving through snow or fog, or driving directly into the sun
- Camera not properly installed. Verify it is snapped into tabs and is secure. Refer to [**Front View Camera Replacement**](#).

No Calibration

Conditions that will prevent completion of the self-calibration procedure:

- Dirty windshield glass or obstruction on windshield
- Operating the vehicle with speed less than 56 km/h (35 MPH)

- No visible lane markings
- Severe weather where lane markings cannot be seen
- Camera not properly installed. Verify it is snapped into tabs and is secure. Refer to [Front View Camera Replacement](#).

PARKING ASSIST SENSOR LEARN CALIBRATION

Calibration

The calibration process for the Parking Assist system is necessary when a parking assist sensor has been replaced or improperly learned.

To calibrate the Parking Assist sensors:

NOTE: **Parking Assist Sensors should be at or near room temperature**

1. Select **Parking Assist Sensor Learn** in the scan tool
2. Operate the vehicle in the following conditions until the calibration is complete:
 - Nothing is within 50 cm of the parking assist sensors
 - Ensure the parking assist sensors are clean
3. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, open and close driver door. It may take up to 2 min for all vehicle systems to power down.
4. Verify Parking Assist system is operating correctly and there are no DTCs set.

No Calibration

Conditions that will prevent completion of the self-calibration procedure:

- Dirty or contaminated obstruction on the parking assist sensor
- Objects are within 50 cm of the parking assist sensors

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup

RADAR SENSOR MODULE - LONG RANGE LEARN

NOTE: **"Adaptive Cruise Temporarily Unavailable" service message may be displayed if this calibration procedure has to be performed. The radar may have become misaligned.**

After replacing and programming the Long Range Radar Sensor Module, it is necessary to perform a calibration procedure to align the radar. This is indicated to the technician by DTC B101E 4B. Calibration is performed while driving the vehicle with the scantool connected. Calibration is initialized using a scantool and the scantool must remain connected until calibration is complete. During this time the "Service Driver Assist" service message will be displayed. Once the procedure is complete, the service message will turn off and normal operation will resume.

Calibration is not required if the existing module was reprogrammed only. Calibration needs to be conducted if the module was replaced or removed and re-secured.

If calibration is not successful, it could be due to improper driving environment, module and bracket assembly bent out of position or incorrect module mounting. A typical driving environment is usually sufficient to calibrate the module within 10 - 30 minutes. The module needs to be mounting properly in the bracket and aimed straight ahead within +/- 3 degrees.

Calibration Procedure

1. Verify no other DTCs except for B101E 4B Electronic Control Unit Software are present.

- **If other DTCs are present**

Refer to service information and repair as necessary.

- **If no other DTCs are present**

2. Prior to driving the vehicle make sure the surface in front of the radar (vehicle emblem) is clean. Also verify the mounting area is not damaged and allows the module to face the intended direction.
3. Prepare scantool to be mobile for Long Range Radar Calibration driving phase. The scantool needs to stay connected during the driving phase of the calibration.
4. Engine running.
5. Initiate calibration using Long Range Radar Sensor Module Learn in the scantool. The driver information display will display "Service Driver Assist" message during calibration.

NOTE: **Do not back out of screen or press any other buttons until the calibration is complete.**

6. Drive the vehicle within the following conditions for 10 - 30 minutes or until calibration is complete. The "Service Driver Assist" message will turn off when calibration is complete.
 - Drive at speeds greater than 56 kph (35 mph)
 - Minimize tight curves
 - Avoid extreme acceleration or deceleration
 - Follow one or multiple vehicles. (typical vehicle traffic is sufficient, but vehicles 30 - 50 m (100 - 165 ft) away are most effective at decreasing the calibration time)
 - Drive in an environment that has stationary objects on the side of the road (street signs, guard rails, mail boxes, fences, etc)
7. Verify proper calibration by observing that the "Service Driver Assist" message turns off within 10 - 30 minutes of normal driving.
 - **If "Service Driver Assist" message fails to turn off**
 1. Verify correct operating conditions were met
 - If incorrect driving environment, refer to If Slow to Calibrate and repeat calibration procedure following recommended operating conditions.
 - If correct driving environment
 2. Verify DTC B390C 66 Incorrect Mounting is not set
 - If B390C 66 is set

Refer to **DTC B390C**.

- If B390C 66 is not set
- **If "Service Driver Assist" message turns off**

8. Drive at speeds greater than 40 kph (25 mph) and verify engagement of Adaptive Cruise Control (cruise control icon will change from white to green)

- **If Adaptive Cruise Control will not engage**

Check vehicle for DTCs and correct as required.

- **If Adaptive Cruise Control engages**

9. All OK.

If Slow to Calibrate

The ideal calibration condition is driving on a freeway or two lane road with medium traffic. One or more of the following conditions may increase the length of time required to complete the self-calibration procedure:

- Heavy traffic - following too close behind vehicles for long periods (more than 40 min)
- Stop and go or very slow traffic
- Mountain roads
- Constant sharp curves in roadway
- No traffic - if no traffic is available, may need to add vehicle ahead to support calibration
- Limited or no stationary structures on side of the road - need structures such as street signs, guard rails, mail boxes, parked cars, etc.
- Driving in tunnels

DESCRIPTION AND OPERATION

PARKING ASSIST DESCRIPTION AND OPERATION (WITH REAR PARK ASSIST, UD7)

The ultrasonic parking assist system is designed to identify and notify the driver of an object in the vehicles path when reversing at speeds of less than 8 km/h (5 MPH). The distance and location of the object is determined by 4 object sensors located in the rear bumper. The parking assist system will notify the driver using an audible beep signal through the radio rear speakers.

The parking assist system is made up of the following components:

- Parking assist control module
- Rear object alarm sensors

Parking Assist Control Module

The parking assist control module provides an 8 V reference and a low reference to the four object alarm sensors. The parking assist control module receives individual signals from each of the four sensors and determines the location and distance of an object based on these inputs. When an object is detected, the parking assist control module will send a data message via CAN-Bus to the radio requesting an audible alert.

Rear Object Alarm Sensors

The object alarm sensors are located in the rear bumper of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor echo time, it is used to determine the distance to the object. The sensors report this information to the parking assist control module.

Rear Parking Assist Operation

When the vehicle is first placed into reverse there will be one audible beep through the rear speakers, to indicate that the system is working. If rear speakers are inoperable no audible signals will occur.

When backing up at speed of less than 8 km/h (5 MPH), the system is constantly monitoring for object of interest located behind the vehicle. The rear parking assist system can detect objects greater than 7.6 cm (3 in) wide and 25.4 cm (10 in) tall. The system cannot detect objects below the bumper, underneath the vehicle. If an object is detected within 2.5 m (8 ft) there will be a audible beep notification out of both rear speakers based upon the distance to the object. As the vehicle gets closer to an object, the time between the beeps become shorter.

If the vehicle stops in a range zone the beeping will stop after 5 s. When the distance between the object and the vehicle changes, beeping will start again.

If the rear parking assist system detects a malfunction the single audible beep will not chime when put into reverse along with a DTC being stored. The object alarm module will send a serial data message to the instrument panel cluster to display the SERVICE PARK ASSIST message on the driver information center.

Parking Assist System Driver Information Center Messages

SERVICE PARK ASSIST

The driver information center displays SERVICE PARK ASSIST when the parking assist control module detects a malfunction in the rear parking assist system and the system is disabled. The driver information center also displays SERVICE PARK ASSIST when a loss of communication occurs with the parking assist control module.

PARK ASSIST OFF

The PARK ASSIST OFF message is displayed in the driver information center when the parking assist system is disabled due to conditions that disable or inhibit the system. The parking assist control module requests the driver information center display PARK ASSIST OFF when it detects that one of the following conditions:

- The rear parking assist system is manually disabled by the vehicle operator through the audio system personalization menu.
- The park brake is applied or not fully released.
- An object is attached to the rear of the vehicle, such as a trailer, bicycle rack, trailer hitch receiver, or tow bar. Also, an object extending beyond a lowered endgate will disable the system.
- The parking assist sensors are covered by snow, mud, dirt or ice.
- The vehicle bumper is damaged.

- Excessive paint thickness on a replacement parking assist sensor.
- The parking assist sensors are disrupted by vibrations, like those caused by a large nearby vehicle or from heavy equipment such as a jackhammer.

PARKING ASSIST DESCRIPTION AND OPERATION (WITH FRONT AND REAR PARK ASSIST, UFQ)

The parking assist system is designed to identify and notify the driver of an object in the vehicle path when moving forward or reversing at speeds of less than 8 km/h (5 MPH). The distance and location of the object is determined by 8 object sensors: 4 located in the rear bumper and 4 located in the front bumper. The parking assist system will notify the driver using an audible beep signal through the radio.

The parking assist system is made up of the following components:

- Advanced parking assist control module
- Front object alarm sensors
- Rear object alarm sensors
- Parking assist switch
- Parking assist switch indicator

Advanced Parking Assist Control Module

The advanced parking assist control module provides a reference voltage and a low reference to the 8 object alarm sensors. The advanced parking assist control module receives individual signals from each of the 8 sensors and determines the location and distance of an object based on these inputs. When an object is detected, the advanced parking assist control module will send a data message via CAN-Bus to the radio requesting an audible alert.

Object Alarm Sensors

The object alarm sensors are located in the front and rear bumpers of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located in front of or behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor echo time, it is used to determine the distance to the object. The sensors report this information to the advanced parking assist control module.

Parking Assist Switch

The parking assist can be activated and deactivated by pressing the parking assist switch. By engaging the reverse gear the parking assist can also be activated. By subsequently pressing the parking assist switch the parking assist can be disabled again.

Parking Assist Switch Indicator

The indicator in the parking assist switch shows the status of the parking assist. If the lamp is ON, the parking assist is activated.

Parking Assist Operation

When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the parking assist control module. The advanced parking assist control module evaluates the received sensor signals. As soon as an object is within the measuring range, the advanced parking assist control module sends a message via CAN-Bus to the radio in order to give out the acoustic distance signal.

The parking assist system can detect objects greater than 7.6 cm (3 in) wide and 25.4 cm (10 in) tall. The system cannot detect objects below the bumper, underneath the vehicle. If an object is detected, one of the following will occur:

- The measuring range of the front object alarm sensors is between 30 - 120 cm (11.8 - 47.2 in). From a distance of 120 cm (47.2 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.8 in), the sound becomes continuous.
- The measuring range of the rear object alarm sensors is between 30 - 250 cm (11.8 - 98.4 in). From a distance of 250 cm (98.4 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.8 in), the sound becomes continuous.

The parking assist can be activated and deactivated by pressing the parking assist switch. When REVERSE gear is selected, park assist automatically is engaged for both front and rear sensors. When the vehicle is put into DRIVE from REVERSE the front assist sensors will be active up to speeds of 8 km/h (5 MPH) to assist with parking maneuvers. Once the vehicle is above 8 km/h (5 MPH) the front sensors are disabled and will not be re-enabled until either REVERSE gear is selected or the parking assist switch is pressed to activate the system. Once the parking assist switch is pressed during a key cycle the front sensors become active at speeds under 8 km/h (5 MPH). If the park assist switch is pressed again in the same key cycle the message "Park Assist Off" will be displayed in the driver information center if the vehicle speed is under 8 km/h (5 MPH) and front sensors detect an object within 120 cm (47.2 in). The LED indicator on the parking assist switch provides the ON/OFF state of the system. If the indicator is ON, the system is active and ready to assist.

The advanced parking assist control module carries out a self test and monitors the sensors for electrical and mechanical faults. Monitored is the power supply of each sensor and the sensor signals, which need to alter when the vehicle moves. If this is not the case, the sensor is acoustically blocked or faulty. Mud, ice and snow may cause obstruction of the function of the sensors. Besides that the advanced parking assist control module checks whether the correct type of sensor is installed. If any of these tests fails, a DTC with corresponding symptom is set, the parking assist is deactivated and the parking assist indicator in the instrument panel cluster is activated.

Parking Assist System Driver Information Center Messages

SERVICE PARK ASSIST

The driver information center displays SERVICE PARK ASSIST when the advanced parking assist control module detects a malfunction in the parking assist system and the system is disabled. The driver information center also displays SERVICE PARK ASSIST when a loss of communication occurs with the advanced parking assist control module.

PARK ASSIST OFF

The PARK ASSIST OFF message is displayed in the driver information center when the parking assist system is disabled due to conditions that disable or inhibit the system. The advanced parking assist control module

requests the driver information center display PARK ASSIST OFF when it detects that one of the following conditions:

- The parking assist system is manually disabled using the parking assist switch.
- An object is attached to the rear of the vehicle, such as a trailer, bicycle rack, trailer hitch receiver, or tow bar. Also, an object extending beyond a lowered tailgate will disable the system.
- The parking assist sensors are covered by snow, mud, dirt, slush, or ice.
- The vehicle bumper is damaged.
- Excessive paint thickness on a replacement parking assist sensor.
- The parking assist sensors are disrupted by vibrations, like those caused by a large nearby vehicle or from heavy equipment such as a jackhammer.

PARKING ASSIST DESCRIPTION AND OPERATION (WITH PARALLEL PARKING OR AUTOMATIC PARKING ASSIST)

NOTE: The parallel parking assist system can steer the vehicle automatically. Be aware that, in some unlikely situations, the vehicle steering wheel and wheels/tires may move without warning. Please be especially aware of situations when vehicle front tires are lifted above the ground on a vehicle hoist as the wheels could move without warning. Please exercise special care if any work is performed with the vehicle running and in gear while elevated on a hoist.

In addition to the 8 ultrasonic sensors used for front and rear park assist, the parallel parking assist system uses, additional sensors located on the front fascia and/or two additional sensors located on the rear fascia. These sensors face toward the side of the vehicle and are used to aid the driver in positioning the vehicle in a parallel parking maneuver.

NOTE: Any malfunction in the Parking Assist system may disable parallel parking. Parallel parking will NOT operate if the Parking Assist system is disabled.

Parallel Parking Assist Components

The parking assist system is made up of the following components:

- Parking assist control module
- Front parking assist sensors
- Rear parking assist sensors
- Parking assist side sensors
- Parallel Parking assist switch
- Parking assist switch indicator (if equipped)

Parking Assist Control Module

The parking assist control module provides a reference voltage and a low reference to the parking assist sensors. The parking assist control module receives individual signals from each of the sensors and determines the location and distance of an object based on these inputs. When an object is detected, the parking assist control module will send a serial data message to the radio requesting an audible alert or to the memory seat module for

a haptic alert (if equipped). Refer to the owner's manual for more information on Vehicle Personalization.

Parking Assist Sensors and Parking Aid Side Sensors

The parking assist sensors are located in the bumpers of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located in front of or behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor ring time, it is used to determine the distance to the object. The sensors report this information to the parking assist control module. The parking assist sensors detect object to approximately 2.5 m (8 ft). The parking assist side sensors (located on the side of the vehicle) detect objects to approximately 4.5 m (15 ft).

Parking Assist Switch

The parking assist can be enabled and disabled by pressing the parking assist switch. By engaging the reverse gear the parking assist can be activated. By pressing the parking assist switch the parking assist can be disabled again.

Parking Assist Switch Indicator (if equipped)

The indicator in the parking assist switch shows the status of the parking assist. If the indicator is ON, the parking assist is enabled.

Parallel Parking Assist Switch

The parallel parking assist can be activated and deactivated by pressing the parallel parking assist switch.

Parking Assist Operation

For traditional parking assist operation, refer to Parking Assist description and operation

Parallel Parking Assist Operation

The parallel parking assist system aids the driver when attempting a parallel parking maneuver. The parking assist control module uses the parallel parking assist sensors located in the front fascia, along with the front and rear parking assist sensors, to guide the driver into a parking space.

The parallel parking assist switch is used to initiate the parallel parking assist system when traveling at speeds below approximately 30 km/h (18 mph) (refer to owners manual for exact speed). While driving along a row of vehicles in which the driver wishes to parallel park, the parallel parking assist switch is pressed. This will enable the parallel parking assist system and the parking assist control module will begin seeking potential parking spots using the parallel parking assist sensor.

When a parking spot of suitable size is found, the parking assist control module will display a stop message on the driver information center. The driver accepts the decision by stopping the vehicle. The system calculates the optimal path into the parking lot and will then guide the vehicle into the chosen spot by taking over the steering control from the driver. The driver only needs to shift gears, brake and accelerate following the instructions given on the driver information center. Once in the spot, the parking assist control module uses the front and rear park assist sensors to center the vehicle in the parking spot.

If the parallel parking assist system is unable to complete a parallel parking maneuver, a message indicating that

the maneuver has been aborted will be displayed on the driver information center.

Parking Assist System Driver Information Center Messages

SERVICE PARK ASSIST

The driver information center displays SERVICE PARK ASSIST when the parking assist control module detects a malfunction in the parking assist system and the system is disabled. The driver information center also displays SERVICE PARK ASSIST when a loss of communication occurs with the parking assist control module.

PARK ASSIST OFF

The PARK ASSIST OFF message is displayed in the driver information center when the parking assist system is disabled due to conditions that disable or inhibit the system. The parking assist control module requests the driver information center display PARK ASSIST OFF when it detects that one of the following conditions:

- The parking assist system is manually disabled using the park assist switch.
- An object is attached to the vehicle which is interfering with the park assist system field of view. Example items are a trailer, bicycle rack, trailer hitch receiver, tow bar, aftermarket front license plate frame, or a bent front license plate.
- The parking assist sensors are covered by snow, mud, dirt or ice.
- The vehicle bumper is damaged.
- Excessive paint thickness on a replacement parking assist sensor.
- The parking assist sensors are disrupted by vibrations, like those caused by a large nearby vehicle or from heavy equipment such as a jackhammer.

LANE DEPARTURE WARNING DESCRIPTION AND OPERATION

The lane departure warning system is a convenience feature of the front view camera that issues a warning when the system detects that the vehicle has unintentionally crossed a lane marking. The front view camera is located behind the windshield, looking out at the road ahead and detecting any lane markings. When the vehicle unintentionally leaves a detected lane, a visual and audible alert is given to the driver.

The lane departure warning system is made up of the following components:

- Front view camera module
- Lane departure warning switch
- Instrument cluster/Vehicle Direction Display
- Radio

Front View Camera Module

The camera detects visual queues such as lane markings. When it is determined that the vehicle has unintentionally moved outside of the lane, a visual and audible warning is given to the driver. The front view camera module receives an input from the lane departure warning switch and controls the lane departure warning switch indicator output. The front view camera module also communicates via serial data with the instrument cluster and radio to request visual and audible alerts.

Lane Departure Warning Switch

The lane departure warning switch provides an input to the front view camera module to turn the lane departure warning system ON and OFF. The front view camera module provides a signal voltage to the normally open momentary switch. When the switch is pressed, the signal circuit is pulled to ground, indicating to the front view camera module that the system has been requested to turn ON or OFF. The lane departure warning switch also contains the lane departure warning switch indicator, which is controlled by the front view camera module to indicate the ON and OFF status of the lane departure warning system. When the system has been enabled by the lane departure warning switch, the front view camera module applies ground to the switch indicator and illuminates the LED. The location of the lane departure warning switch can vary with different vehicles. For the exact location please refer to the user's manual.

Instrument Cluster

The vehicle direction display contains green and amber lane departure warning indicators. These indicate to the driver the current status of the lane departure warning system and are controlled via serial data by the front view camera module. When the vehicle speed is above 56 km/h (35 MPH) and the system has detected the required lane markings and is ready to assist, the green indicator will be illuminated on the vehicle direction display. If the vehicle has unintentionally left the lane, the amber indicator will flash.

Radio

The radio controls the audible alert for the lane departure warning. If the vehicle has unintentionally left the lane, the radio will command three beeps as an audible alert to the driver.

Lane Departure Warning Operation

System operation can be describe by the following modes:

- Off State: The system has been turned off by the driver, using the lane departure warning switch. The lane departure warning indicator will not be illuminated.
- Not Ready To Assist: The system is enabled and the lane departure warning indicator is illuminated, but not ready to assist when any of the following conditions is true:
 - Vehicle speed is less than 56 km/h (35 MPH). The system is designed to function at speeds greater than 56 km/h (35 MPH).
 - The system cannot detect lane markings. This may be because there are no lane markings, as on a country road or that the lane markings cannot be determined due to snow, rain, or other driving conditions.
 - The windshield area in front of the camera or the camera lens is blocked by fog, dirt, damage to the windshield or other elements that may prevent the camera from detecting lane markings.
- Ready To Assist: The system is enabled and ready to warn of the unintentional lane crossing. The system is ready to assist when the green lane departure warning indicator is illuminated on the vehicle direction display.

Lane Crossing Alerts

- When one of the following conditions are met, the system will not give alerts:
 - The correct turn signal is activated. An activated turn signal is interpreted as an intentional lane

crossing.

- The operator makes an intentional steering maneuver.
- The operator makes an intentional accelerating maneuver.
- The operator makes an intentional braking maneuver.
- Lane crossing alert consists of the following:
 - Three chimes are activated through the radio.
 - The amber lane departure warning indicator will flash.

Lane Departure Warning System Driver Information Center Messages

The front view camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the user's manual.

LANE KEEP ASSIST DESCRIPTION AND OPERATION

NOTE:

- **The Lane Keep Assist system DOES NOT continuously steer the vehicle**
- **The Lane Keep Assist system replaces Lane Departure Warning System**
- **Lane Departure Warning will have more alerts than Lane Keep Assist (visual, audible, and haptic warning)**

The system assists driver to keep vehicle in-lane by providing a steering push back to the vehicle when an unintended lane departure is detected. See the user's manual for more detailed information on vehicle personalization.

The lane keep assist system is made up of the following components:

- Front view camera module
- Lane Keep Assist switch/control indicator
- Instrument cluster/Vehicle Direction Display
- Radio
- Safety Alert Seat (if equipped)
- Yaw rate sensor
- Electric power steering

Front View Camera Module

The camera detects visual queues such as lane markings. When it is determined that the vehicle has unintentionally moved outside of the lane, visual, and audible or haptic warning is given to the driver. The front view camera module receives an input from the lane keep assist switch and controls the lane keep assist switch indicator output. The front view camera module also communicates via serial data with the instrument cluster, radio, and memory seat module to request visual, and audible or haptic alerts.

Lane Keep Assist Switch

The lane keep assist switch provides an input to the front view camera module to turn the lane keep assist system ON and OFF. The front view camera module provides a signal voltage to the normally open momentary switch. When the switch is pressed, the signal circuit is pulled to ground, indicating to the front view camera module that the system has been requested to turn ON or OFF. The lane keep assist switch also contains the lane keep assist switch indicator, which is controlled by the front view camera module to indicate the ON and OFF status of the lane keep assist system. When the system has been enabled by the lane keep assist switch, the front view camera module applies ground to the switch indicator and illuminates the LED. The location of the lane keep assist switch can vary with different vehicles. For the exact location please refer to the user's manual.

Instrument Cluster

The vehicle direction display contains green and amber lane keep assist indicators. These indicate to the driver the current status of the lane keep assist system and are controlled via serial data by the front view camera module. When the vehicle speed is above 56 km/h (35 MPH) and the system has detected the required lane markings and is ready to assist, the green indicator will be illuminated on the vehicle direction display. If the vehicle has unintentionally left the lane, the amber indicator will flash.

Radio

The radio controls the audible alert for the lane keep assist. If the vehicle has unintentionally left the lane, the radio will command three beeps as an audible alert to the driver.

Safety Alert Seat (if equipped)

The memory seat module controls the haptic alert provided by the seats. If the vehicle has unintentionally left the lane, and the Electric Power Steering determines the corrective action requires an above threshold amount of effort, the memory seat module will command three pulses to the left or right side of the seat, depending on the lane departure direction.

Yaw Rate Sensor

The steering intervention is based on the forward looking sensor outputs, such as lateral offset of the vehicle, relative yaw angle and time to line crossing. Over that, other vehicle dynamics signals are needed, e.g. velocity, steering angle, yaw rate for the purpose of a driver suppression.

Electric Power Steering

The electric power steering uses a torque sensor to detect driver inputs and relays that information to the frontview camera module. The electric power steering is used to provide steering push back.

Lane Keep Assist Operation

There is two stages of warning/intervention for the driver: The first stage is the steering push back, if the lane keep assist system detects that the vehicle will cross the lane marking despite it is intervening, a second stage warning shall be issued. The second stage warning is a chime or a haptic seat vibration, **if equipped** with haptic seats. If a haptic seat vibration is used as stage 2 warning, the vibration shall take place on the side of the seat, where the lane departure happened.

System operation can be described by the following modes:

- Off State: The system has been turned off by the driver using the lane keep assist switch. The lane keep assist indicator will not be illuminated.
- Not Ready To Assist: The system is enabled and the lane keep assist indicator is illuminated, but not ready to assist when any of the following conditions is true:
 - Vehicle speed is less than 37 MPH (60 km/h). The system is designed to function at speeds greater than 37 MPH (60 km/h).
 - The system cannot detect lane markings. This may be because there are no lane markings, as on a country road or that the lane markings cannot be determined due to snow, rain, or other driving conditions.
 - The windshield area in front of the camera or the camera lens is blocked by fog, dirt, damage to the windshield or other elements that may prevent the camera from detecting lane markings.
- Ready To Assist: The system is enabled and ready to warn of the unintentional lane crossing. The system is ready to assist when the green lane keep assist indicator is illuminated on the vehicle direction display.

Lane Crossing Alerts

- When one of the following conditions are met, the system will not give alerts:
 - The correct turn signal is activated. An activated turn signal is interpreted as an intentional lane crossing.
 - The operator makes an intentional steering maneuver.
 - The operator makes an intentional accelerating maneuver.
 - The operator makes an intentional braking maneuver.
- Lane crossing alert consists of the following:
 - The amber lane keep assist indicator will flash.
 - "push-back" steering torque input (or nudge) from Electric Power Steering to help prevent a lane departure
 - Three chimes are activated through the radio.
 - or **if equipped** , three pulses to the left or right side of the seat.

Lane Keep Assist System Driver Information Center Messages

The front view camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the user's manual.

CROSS TRAFFIC ALERT DESCRIPTION AND OPERATION

The rear cross traffic alert system is designed to provide enhanced customer visibility while backing up by providing warnings to the driver on impending rear cross traffic. The rear cross traffic alert system is designed to detect and track objects of interest within a specified coverage zone behind the vehicle. The system is designed to alert the driver, with a visual display and either an audible sound or a haptic w, to the presence of objects of interest that may cause a collision with the host vehicle. Although the system is intended to assist drivers in backing up, it does not replace driver's vision. The driver is responsible to check carefully for objects outside of the coverage zone (e.g., a fast approaching vehicle) for a safe backing maneuver. In the event that the system senses a malfunction through its diagnostic functions, the system will be disabled and the driver will be

visually notified.

Rear Cross Traffic Alert System Components

The side blind zone alert system is made up of the following components:

- Left side object sensor module (also used for side blind zone alert)
- Right side object sensor module (also used for side blind zone alert)
- Visual Display Icons located on the rear vision display screen
- Audio System chime or Haptic Seat notification

Side Object Sensor Modules

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of objects nearby. When an object is detected in the rear cross traffic zone, the module will send out a signal through serial data communication to turn on the visual icons and also audio chime notification. Each sensor is supplied B+ and ground. The right sensor receives an additional ground. Both sensors communicate independently on the serial data line. The serial data enters the left sensor in a pass-thru configuration, that connects to the right sensor. The scan tool is able to individually communicate with each sensor.

Display Icons

The rear cross traffic alert system visual alert display consists of two visual icons, one on each side of the display screen of the rear vision camera, that are used to alert the driver on rear cross traffic from each side of the host vehicle respectively.

Rear Cross Traffic Alert Operation

The rear cross traffic alert system is designed to detect objects of interest as small as a 125cc motorcycle with rider. The detection zone extends approximately 30 m (99 ft) from the rear corner of the car and covers an area from behind the vehicle to 125 degrees towards the front at a height of 0.45 m (1.5 ft) to 2 m (6.5 ft) above ground. The system operates when vehicle speed is 10 kph (6 mph) or less and is designed to detect objects moving at speeds up to 36 kph (22 mph).

When the vehicle is backing up, the side object sensors receive energy that is reflected from external objects and determine if the objects are objects of interest or not. The system may at times detect pedestrians, shopping carts, or similar moving objects. This is normal and should not be considered as a false alert or problem with the system. The rear cross traffic alert system will estimate vehicle travel trajectory and use the information in conjunction with object travel trajectory information to determine if there is a potential collision between the vehicle and the object of interest. The rear cross traffic alert function will only alert on objects of interest that pose a potential collision with the host vehicle. The system is not designed to provide an alert to objects that have no potential collision with vehicle. In addition, the system will not alert to stationary objects such as signs, parked cars, etc.

Rear Cross Traffic Alert Driver Information Center Messages

REAR CROSS TRAFFIC ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the

vehicle owners manual for instructions on how to set personalization options on the driver information center.

SERVICE SIDE DETECTION SYSTEM

This message indicates that the system requires service. Since the sensors are also used for side blind zone alert, this feature will also be inoperative.

SIDE DETECTION SYSTEM UNAVAILABLE

This message indicates that the system has been temporarily disabled because the sensor is blocked or can otherwise not accurately detect vehicles or objects. Such instances may be mud, dirt, snow, ice, or slush build-up on the rear fascia, heavy rainfall, excessive road spray, fascia damage or stickers.

The rear cross traffic alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.

SIDE BLIND ZONE ALERT DESCRIPTION AND OPERATION

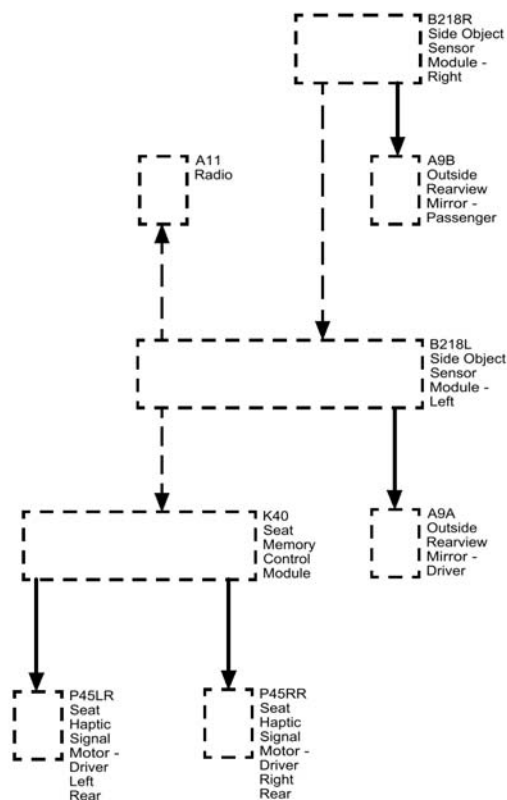


Fig. 17: Side Blind Zone Alert System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B218R	B218R Side Object Sensor Module - Right
A9B	A9B Outside Rearview Mirror - Passenger
A11	A11 Radio
B218L	B218L Side Object Sensor Module - Left
A9A	A9A Outside Rearview Mirror - Driver
K40	K40 Seat Memory Control Module
P45LR	Seat Haptic Movement Motor - Driver Left Rear
P45RR	Seat Haptic Movement Motor - Driver Right Rear

NOTE: Not all items in block diagram may apply to specific vehicle. Refer to schematics for specific vehicle wiring diagrams.

Description and Operation

The side blind zone alert system shall detect and report "objects of interest" on either side of the vehicle, within a specified "blind spot" zone. The system is designed to alert the driver, with a visual display placed on the side view mirror, to the presence of objects of interest that may not be visible in the inside rearview mirror and outside rear view mirrors. Although this system is intended to help drivers avoid lane change crashes, it does not replace driver vision and therefore should be considered a lane change aid. Even with the side blind zone alert system, the driver must check carefully for objects outside of the reporting zone (e.g., a fast approaching vehicle) before changing lanes. In the event that the system senses a malfunction through its diagnostic routines, the system will be disabled and the driver will be visually notified.

When the system detects a vehicle in the side blind zone while driving forward, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

Side blind zone alert is active when the vehicle is out of park or the parking brake is off on manual transmission vehicles and at speeds up to approximately 140 km/h (87 MPH). If a vehicle is detected in the blind zone, the warning symbols will turn illuminate on the appropriate side. When the vehicle is started, both outside mirror displays will briefly come on to indicate that the system is operating. The warning symbols will vary brightness based on the ambient light conditions.

Side Blind Zone Alert System Components

The side blind zone alert system is made up of the following components:

- Left side object sensor module (also used for rear cross traffic alert)
- Right side object sensor module (also used for rear cross traffic alert)
- Driver outside rearview mirror
- Passenger outside rearview mirror

Side Object Sensor Modules

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of objects nearby. When an object is detected in the side blind zone, the side object sensor module supplies voltage to illuminate the visual indicator on the appropriate side rear view mirror. Each sensor is supplied B+ and ground. The right sensor receives an additional ground. Both sensors communicate independently on the serial data line. The serial data enters the left sensor in a pass-thru configuration, that connects to the right sensor. The scan tool is able to individually communicate with each sensor.

Outside Rearview Mirrors

The outside rearview mirrors contain an icon that is backlit with high intensity, amber-colored LED's located on the mirror surface. The display brightness adapts to day/night conditions. The side blind zone alert indicator icon in the left or right outside rearview mirror is illuminated if the left or right side object sensor module detects a vehicle in the side blind zone to inform the driver that there is a vehicle driving in the blind spot zone.

Side Blind Zone Alert Operation

When the vehicle is started, both outside mirror displays will briefly come on to indicate that the system is operating. The system is designed to detect objects of interest as small as a 125cc motorcycle with rider. The detection zone starts at the outside rearview mirror and extends out to 3.5 m (11 ft) at the back corner of the vehicle and 3 m (10 ft) behind the vehicle at a height of 0.5 m (1.5 ft) to 2.0 m (6 ft) above the ground. The system may light up an indicator due to guardrails, signs, trees, shrubs, and other non-moving objects. This is normal system operation; the vehicle does not need service.

When the system detects a vehicle in the side blind zone while driving forward, independent if passing a vehicle or being passed, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

Foul weather may affect the operation of the side blind zone system. Occasional missed alerts can occur under normal circumstances and will increase in wet conditions. The number of missed alerts will increase with increased rainfall or road spray. Heavy rainfall, as well as mud, dirt, snow, ice, or slush build-up on the rear fascia, can completely disable the system.

If the vehicle is towing a trailer or has an object such as a bicycle rack attached to the rear of the vehicle, the side blind zone system may not function properly and the indicators may illuminate intermittently or remain illuminated all the time.

Side Blind Zone Alert Driver Information Center Messages

SIDE BLIND ZONE ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the vehicle owners manual for instructions on how to set personalization options on the driver information center.

SERVICE SIDE DETECTION SYSTEM

This message indicates that the system requires service. When the message is displayed, the indicators will remain illuminated at all times, notifying the driver that the side blind zone system should not be relied upon when changing lanes. Since the sensors are also used for rear cross traffic alert, this feature will also be

inoperative.

SIDE DETECTION SYSTEM UNAVAILABLE

This message indicates that the system has been temporarily disabled because the sensor is blocked or can otherwise not accurately detect vehicles or objects. Such instances may be mud, dirt, snow, ice, or slush build-up on the rear fascia, heavy rainfall, excessive road spray, fascia damage or stickers.

The rear cross traffic alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.

FORWARD COLLISION ALERT DESCRIPTION AND OPERATION

The forward collision alert system is a convenience feature of the frontview camera module that issues a warning to the driver when a potential collision risk exists. The frontview camera module is located behind the windshield, looking toward the roadway ahead and detecting vehicles within a distance of approximately 60 meters (197 ft). The forward collision alert system is always active and operates at speeds above 40 kph (25 mph).

When the frontview camera module detects a vehicle in the path ahead, the green vehicle ahead indicator in the vehicle direction display is illuminated. When following a vehicle ahead too closely, the amber collision alert indicator will illuminate and stay on until the following distance is increased. The green vehicle ahead indicator will then be illuminated again. When approaching another vehicle too rapidly, the collision alert symbol will flash in the vehicle direction display and an audible alert sounds. The forward collision alert sensitivity can be adjusted using the forward collision alert switch in the left steering wheel controls.

Front Automatic Braking (if equipped)

When the system detects a vehicle ahead in your path that is traveling in the same direction that you may be about to crash into, it can provide a boost to braking or automatically brake the vehicle. This can help avoid or lessen the severity of crashes when driving in a forward gear. Depending on the situation, the vehicle may automatically brake moderately or hard. This front automatic braking can only occur if a vehicle is detected.

The system works when driving in a forward gear between 5 mph (8 km/h) and 37 mph (60 km/h). It can detect vehicles up to approximately 197 ft (60 m).

Forward collision does not provide a warning to help avoid a crash unless it detects a vehicle. Forward collision alert may not detect a vehicle ahead if the frontview camera module is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Ensure the windshield, headlamps, and frontview camera module are clean and in good repair. In some cases the forward collision alert system may provide unnecessary alerts for turning vehicles, vehicles in other lanes, objects that are not vehicles, or shadows. These alerts are normal operation and the vehicle does not need service.

The forward collision alert system is made up of the following components:

- Frontview camera module

- Forward collision alert switch
- Instrument cluster/Vehicle direction display
- Infotainment system

Frontview Camera Module

The frontview camera module detects vehicles in front of the host vehicle. The frontview camera module communicates via serial data to the instrument cluster to illuminate the appropriate indicators in the vehicle direction display. The frontview camera module also communicates via serial data with the driver information center to display messages and the radio to request audible alerts.

Forward Collision Alert Switch

The forward collision alert switch provides an input to the frontview camera module to select between four alert timing sensitivity settings. These setting will change the sensitivity for both the following too closely and forward collision alert indicators. In addition to the sensitivity setting, the alert distance will change based upon vehicle speed. The frontview camera module provides a signal voltage to the normally open switch. When the switch is pressed, the signal circuit is pulled to ground through a resistor, indicating to the frontview camera module that the system has been requested to change the alert timing sensitivity. The first button press shows the current alert timing setting on the driver information center. With every button press, the alert timing sensitivity is changed. The current alert timing setting will be maintained until it is changed. The preset alert timing setting is displayed in the top line of the driver information center. The position of the forward collision alert switch can vary with different vehicles. For the exact position please refer to the owner's manual.

Instrument Cluster

The vehicle direction display contains the indicators for the collision alert system and are controlled by the instrument cluster via serial data messages from the frontview camera module. The green vehicle ahead indicator indicates to the driver that the frontview camera module system has detected a vehicle in the driving path ahead. The amber collision alert indicator will illuminated continuously if the system determines that the vehicle ahead is too close. When approaching another vehicle too rapidly, the red collision alert symbol will flash.

Infotainment System

The infotainment system controls the audible alert for the forward collision alert system and is activated via serial data from the frontview camera module. If the host vehicle is approaching another vehicle too rapidly, the infotainment system will command an audible alert to the driver.

Forward Collision Alert System Driver Information Center Messages

The frontview camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the owner's manual.

- FORWARD COLLISION ALERT OFF
- SERVICE FRONT CAMERA

ACTIVE SAFETY SYSTEM DESCRIPTION AND OPERATION

Forward Collision Alert

The forward collision alert system is a convenience feature of the frontview camera module that issues a warning to the driver when a potential collision risk exists. The frontview camera module is located behind the windshield, looking out at the road ahead and detecting vehicles directly ahead. When the system detects a vehicle in the path ahead, the green vehicle ahead indicator is illuminated on the instrument cluster. When approaching another vehicle too rapidly, the collision alert symbol will flash in the head-up display (if equipped) or a series of red collision alert indicators will flash. An audible alert sound will simultaneously sound or the safety alert seat will provide haptic feedback. The visual alert cannot be changed, but the driver can select between audible or haptic alerts in the vehicle personalization menus. The forward collision alert system can also be turned on or off through the vehicle personalization menus. See the vehicle owner manual for more detailed information on vehicle personalization.

Forward collision alert does not provide a warning to help avoid a crash, unless it detects a vehicle. Forward collision alert may not detect a vehicle ahead if the frontview camera module is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Keep the windshield, headlamps, and frontview camera module clean and in good repair.

Forward collision alert may provide unnecessary alerts for turning vehicles, vehicles in other lanes, objects that are not vehicles, or shadows. These alerts are normal operation and the vehicle does not need service.

The forward collision alert system is made up of the following components:

- Frontview camera module
- Forward collision alert switch
- Instrument cluster
- Collision alert indicators (without UV6)
- Head-up display (with UV6)
- Infotainment system
- Safety alert seat, if equipped

Active Emergency Braking System

The active emergency braking systems includes the intelligent brake assist system and the automatic collision preparation system. The intelligent brake assist and the automatic collision preparation systems are designed provide a boost to braking or automatically brake the vehicle to help avoid or lessen the severity of crashes when driving in a forward gear.

Intelligent brake assist is designed to pre-fill the brake hydraulic system to reduce system response time and increase pressure when quickly applying the brakes. Using the frontview camera module and the distance sensing cruise control module, the system monitors the approach speed and distance to a vehicle ahead. If the Intelligent brake assist system determines a collision risk exists, it will begin preparations to the brake hydraulic system. When active, minor brake pedal pulsations or pedal movement may occur and this should be considered normal. Intelligent brake assist will resort to normal braking operation after an intelligent brake assist even has occurred when the brake pedal is released.

When driving in a forward gear at speeds 9 kph (5 mph), the automatic collision preparation system uses the

frontview camera module and distance sensing cruise control module to determine if an imminent collision risk exists. If the brakes have not been applied, the system will automatically apply the brakes in an effort to mitigate the collision or reduce collision damage. The system has a detection range of approximately 60 m (197 ft) and will only function when a vehicle is detected, as indicated by the green vehicle ahead indicator is illuminated on the instrument cluster.

Automatic collision preparation is not a substitute for normal vehicle braking and should not be relied on to brake the vehicle. Automatic collision preparation may not detect a vehicle ahead if the frontview camera module or distance sensing cruise control module is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Keep the windshield, headlamps, distance sensing cruise control module, and frontview camera module clean and in good repair.

The active emergency braking system are made up of the following components:

- Frontview camera module
- Distance sensing cruise control module
- Electronic brake control module

Frontview Camera Module

The frontview camera module detects vehicles in front of the vehicle. The frontview camera module communicates with the instrument cluster via serial data to illuminate the appropriate amber or green vehicle ahead indicator, collision alert symbol will flash in the head-up display, or collision alert indicators. The frontview camera module also communicates via serial data with the infotainment system and memory seat module to request audible or haptic alerts.

The frontview camera module works in conjunction with the distance sensing cruise control module to track vehicles ahead and determine if a collision risk exists. If a collision risk exists, the active emergency braking systems will be activated to reduce collision damage.

Distance Sensing Cruise Control Module

The distance sensing cruise control module works in conjunction with the frontview camera module to track vehicles ahead and determine if a collision risk exists. If a collision risk exists, the active emergency braking systems will be activated to reduce collision damage.

Electronic Brake Control Module

The electronic brake control module is used by the active emergency braking system to pre-fill and prepare for braking by the intelligent brake assist and actively brake the vehicle by the automatic collision preparation system.

Forward Collision Alert Switch

The forward collision alert switch provides an input to the frontview camera module to select the alert timing sensitivity when approaching another vehicle too rapidly. The forward collision alert switch is part of the steering wheel controls switch - left and provides inputs to the body control module (BCM), which then

communicates with the frontview camera module via serial data.

The BCM applies a reference voltage and monitors a low signal voltage from the normally open switch. When the switch is pressed, the signal circuit is pulled low through a specific series of resistors, indicating that the system has been requested to change the alert timing sensitivity. The first button press will show the current alert timing setting on the driver information center. With every subsequent button press, the alert timing sensitivity is changed.

Instrument Cluster

The instrument cluster communicates via serial data with the frontview camera module and will illuminate the amber or green vehicle ahead indicator as requested by the frontview camera module. The instrument cluster also controls the head-up display or the collision alert indicators.

Collision Alert Indicators (without UV6)

The collision alert indicators are a series of red LEDs that will flash when approaching another vehicle too rapidly. The collision alert indicators are located in the upper instrument panel area and reflect off the windshield when illuminated.

The collision alert indicators receive power and ground and are discretely controlled by the instrument cluster through a pair of low control circuits. When requested by the frontview camera module, the instrument panel will pulse the low control circuits, flashing the LEDs as a visual alert that another vehicle is being approached too rapidly.

Head-up Display (with UV6)

The instrument cluster controls the head-up display via serial data. The instrument cluster will command the head-up display to flash the collision alert indicator as a visual alert when approaching another vehicle too rapidly as requested by the frontview camera module.

Infotainment System

The infotainment system controls the audible alerts for the forward collision alert system. If the host vehicle is approaching another vehicle too rapidly, the frontview camera module will command the infotainment system issue an audible alert to the driver.

Safety Alert Seat

The memory seat module controls the haptic alert provided by the seats. If the vehicle is approaching another vehicle too quickly, the frontview camera module will command the memory seat module to pulse both sides of the seat.

REAR VISION CAMERA DESCRIPTION AND OPERATION

Rear Vision Camera System Operation

The rear vision camera system consists of a video camera/module located at the rear of the vehicle and the infotainment display.

When the transmission is placed into REVERSE, a 12 volt signal is sent to the rear vision camera by the body

control module (BCM). This signal indicates to the camera that the vehicle is in reverse and image display is requested. The rear vision camera receives ignition voltage and a constant ground to power the camera. Video signal + and video signal - circuits carry the video image from the rear vision camera to the infotainment display. Additionally, the video signal circuits are shielded to prevent any interference which may lead to a loss of video signal resolution and a degraded video image. The shield is provided a ground path by the rear vision camera.

The following conditions may cause a degraded rear vision camera image:

- Ice, snow, or mud has built up on the rear vision camera
- Dark conditions
- Extreme light conditions, such as glare from the sun or the headlights of another vehicle
- Damage to the rear of the vehicle
- Extreme high temperatures or extreme temperature changes

If a malfunction is detected in the system, Service Rear Vision Camera may be displayed on the infotainment display as an indicator to the customer that a problem exists that requires service.

Article GUID: A00884657

ACCESSORIES & EQUIPMENT

Power Seats - Volt

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - SEATS

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

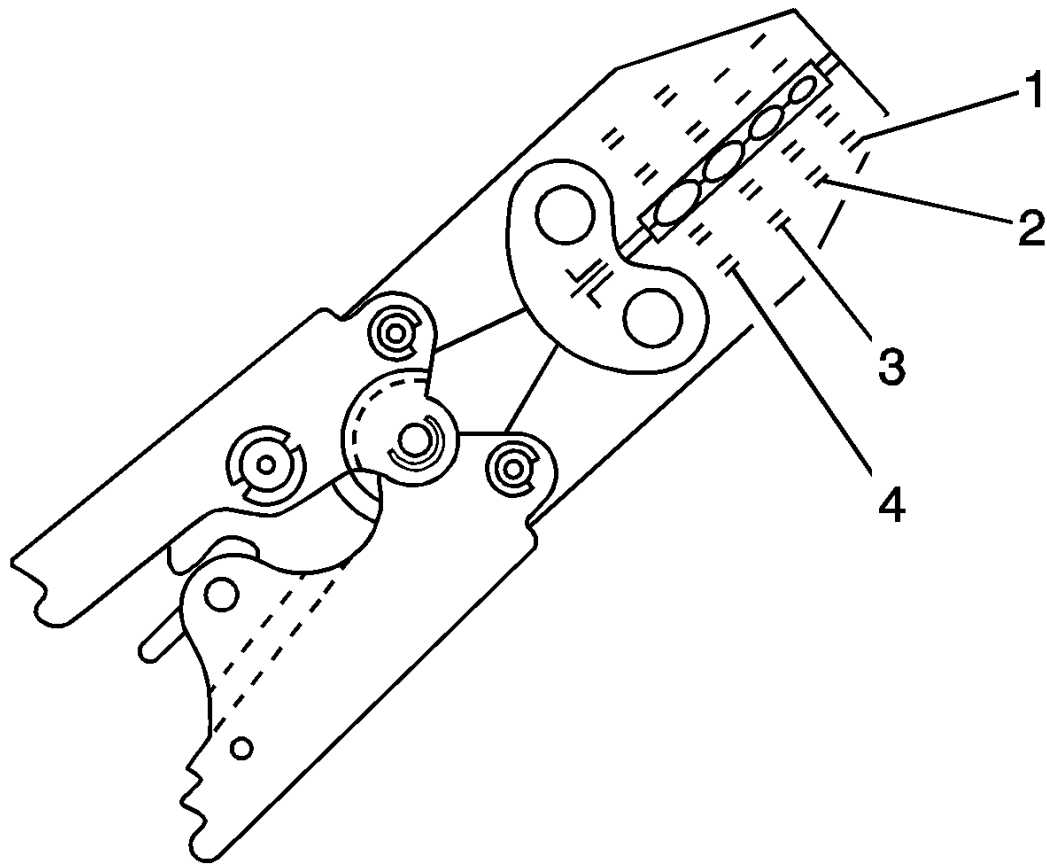


Fig. 1: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

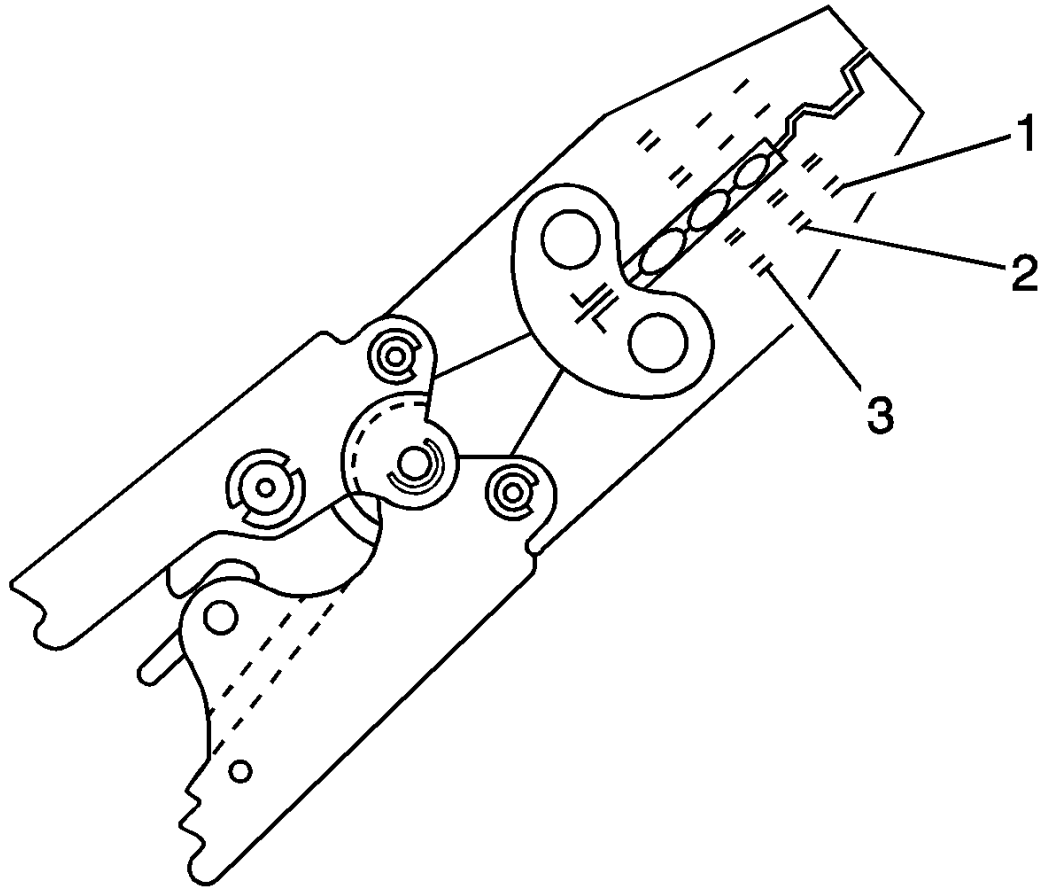


Fig. 2: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

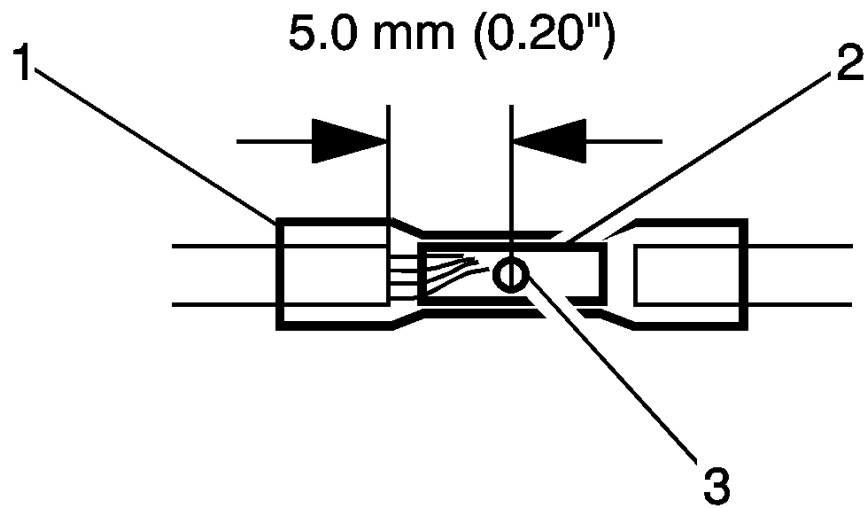


Fig. 3: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 4: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 5: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

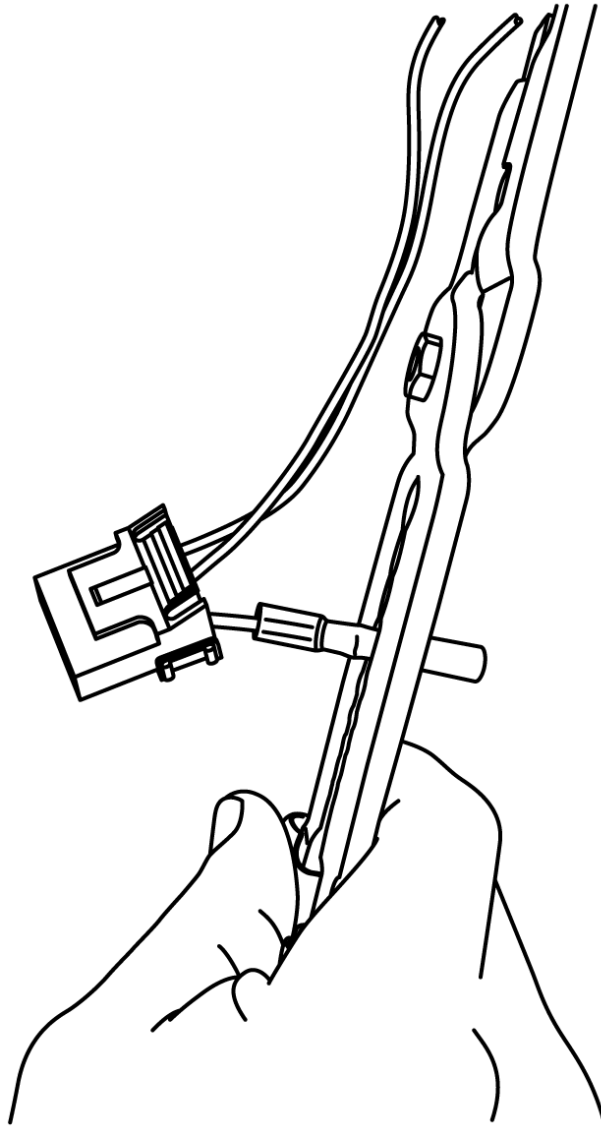


Fig. 6: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

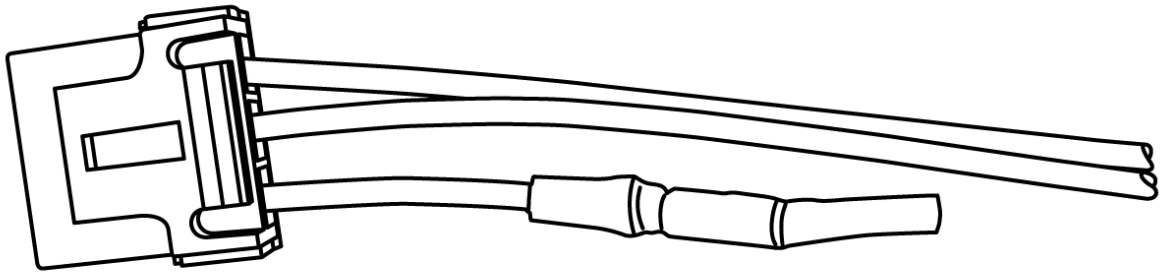


Fig. 7: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

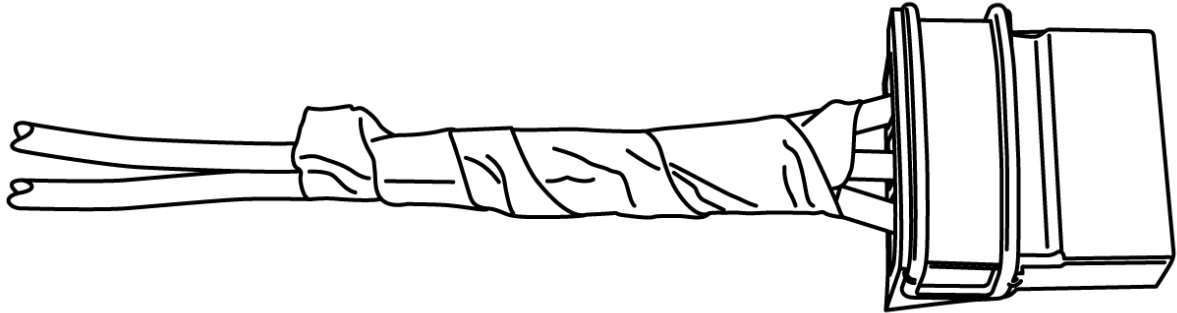


Fig. 8: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - SEATS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

FRONT SEAT WIRING HARNESS REPLACEMENT



Fig. 9: Front Seat Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Disable the SIR system. Refer to SIR Disabling and Enabling . 2. Remove the driver or passenger seat. Refer to Driver or Passenger Seat Removal and Installation .	
1	Front Seat Wiring Harness NOTE: Typical wiring harness shown, individual harness may be different due to option

Callout	Component Name
	content. Various seat components may need to be removed from the seat to access the harness depending on seat and content options.

Article GUID: A00884751

ACCESSORIES & EQUIPMENT

Programming and Setup - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE REFERENCES

Reference Information

- [Data Link References](#)
- [Diagnostic System Check - Vehicle](#)
- [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
- [Symptoms - Vehicle](#)

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
A11	Radio Scan Tool Information	Radio/Navigation System Schematics	Radio Replacement	Radio Programming and Setup
B218L/R	Side Object Sensor Module Scan Tool Information	Object Detection Schematics	Side Object Sensing Alert Module Replacement	Side Object Sensor Module Programming and Setup
E54	Hybrid/EV Battery Pack Coolant Heater	Hybrid/EV Cooling Schematics	Heater Coolant Heater Replacement	Coolant Heater Control Module Programming and Setup
G1	A/C Compressor	HVAC Schematics	Air Conditioning and Drive Motor Battery Cooling Compressor Replacement	Air Conditioning Compressor Control Module Programming and Setup
K1	14 Volt Power Module	Starting and Charging Schematics	Accessory DC Power Control Module Replacement	14 Volt Power Module Accessory DC Power Control Module Programming and Setup
K9	Body Control Module Scan Tool Information	Body Control System Schematics	Body Control Module Replacement	Body Control Module Programming and Setup
K16	Battery Energy Control Module Scan Tool Information	Hybrid/EV Energy Storage Schematics	Battery Energy Control Module Replacement	Battery Energy Control Module Programming and Setup
K17	Electronic Brake Control Module Scan Tool Information	Antilock Brake System Schematics	Electronic Brake Control Module Replacement	Electronic Brake Control Module Programming and Setup

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
				<u>Setup</u>
K20	<u>K20 Engine Control Module: Scan Tool Information</u>	<u>Engine Controls Schematics</u>	<u>Engine Control Module Replacement</u>	<u>K20 Engine Control Module: Programming and Setup</u>
K29	Driver Seat and Passenger Seat Heater Control Module	<u>Heated/Cooled Seat Schematics</u>	<u>Front Seat Heater Control Module Replacement</u>	<u>Seat Heating Control Module Programming and Setup</u>
K29R	Rear Seat Heater Control Module	<u>Heated/Cooled Seat Schematics</u>	<u>Rear Seat Heater Control Module Replacement</u>	<u>Rear Seat Heater Control Module Programming and Setup</u>
K33	<u>Heating, Ventilation and Air Conditioning Control Module Scan Tool Information</u>	<u>HVAC Schematics</u>	<u>Heater and Air Conditioning Remote Control Replacement</u>	<u>HVAC Control Module Programming and Setup</u>
K36	<u>Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Sensing and Diagnostic Module Replacement</u>	<u>Inflatable Restraint Sensing and Diagnostic Module Programming and Setup</u>
K41	<u>Parking Assist Control Module Scan Tool Information</u>	<u>Object Detection Schematics</u>	<u>Parking Assist Control Module Replacement</u>	<u>Parking Assist Control Module Programming and Setup</u>
K43	<u>Power Steering Control Module Scan Tool Information</u>	<u>Power Steering Schematics</u>	<u>Electric Belt Drive Rack and Pinion Steering Gear Replacement</u>	<u>Power Steering Control Module Programming and Setup</u>
K73	<u>Telematics Communication Interface Control Module Scan Tool Information</u>	<u>OnStar/Telematics Schematics</u>	<u>Communication Interface Module Replacement</u>	<u>Telematics Communication Interface Control Module Programming and Setup (with UKF)Telematics Communication Interface Control Module Programming and Setup (with UE1)</u>
K74	<u>Human Machine Interface Control Module Scan Tool Information</u>	<u>Radio/Navigation System Schematics</u>	<u>Human Machine Interface Control Module Replacement</u>	<u>Human Machine Interface Control Module Programming and</u>

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
				<u>Setup</u>
K77	Remote Control Door Lock Receiver	<u>Remote Function Schematics</u>	<u>Remote Control Door Lock Receiver Replacement</u>	<u>Remote Control Door Lock Receiver Programming and Setup</u>
K84	Keyless Entry Control Module	<u>Remote Function Schematics</u>	<u>Keyless Entry Control Module Replacement</u>	<u>Keyless Entry Control Module Programming and Setup</u>
K85	<u>Inflatable Restraint Passenger Presence System Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Front Passenger Presence Module Replacement</u>	<u>Passenger Presence System Programming and Setup</u>
K89	Immobilizer Control Module	<u>Immobilizer Schematics</u>	<u>Theft Deterrent Module Replacement</u>	<u>Immobilizer Control Module Programming and Setup</u>
K109	Front View Camera Module	<u>Object Detection Schematics</u>	<u>Front View Camera Replacement</u>	<u>Front View Camera Module Programming and Setup</u>
K111	<u>Fuel Pump Power Control Module Scan Tool Information</u>	<u>Engine Controls Schematics</u>	<u>Fuel Pump Power Control Module Replacement</u>	<u>Fuel Pump Power Control Module Programming and Setup</u>
K114B	<u>Hybrid Powertrain Control Module 2 Scan Tool Information</u>	<u>Hybrid/EV Cooling Schematics</u> or <u>Hybrid/EV Energy Storage Schematics</u>	<u>Hybrid Powertrain Control Module 2 Replacement</u>	<u>Hybrid Powertrain Control Module 2 Programming and Setup</u>
K132	<u>Pedestrian Alert Sound Control Module Scan Tool Information</u>	<u>Horn Schematics</u>	<u>Pedestrian Sound Alert Module Replacement</u>	<u>Pedestrian Alert Sound Control Module Programming and Setup</u>
K177	<u>Brake Booster Control Module Scan Tool Information</u>	<u>Hydraulic Brake Schematics</u>	<u>Power Brake Master Cylinder Booster Assembly Replacement</u>	<u>Brake Booster Control Module Programming and Setup</u>
P16	<u>Instrument Cluster Scan Tool Information</u>	<u>Instrument Cluster Schematics</u>	<u>Instrument Cluster Replacement</u>	<u>Instrument Cluster Programming and Setup</u>
T3	Audio Amplifier	<u>Radio/Navigation System Schematics</u>	<u>Radio Speaker Amplifier Replacement</u>	<u>Audio Amplifier Programming and Setup</u>

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
T6	Power Inverter Module • Hybrid Powertrain Control Module Scan Tool Information • Motor Control Module 1 Scan Tool Information • Motor Control Module 2 Scan Tool Information	Hybrid/EV Controls Schematics	Drive Motor Power Inverter Module Removal	Drive Motor Power Inverter Module Programming and Setup
T18/K57	Battery Charger/Battery Charger Control Module	Plug-In Charging Schematics	Drive Motor Battery Charger Replacement	Battery Charger Programming and Setup

REPAIR INSTRUCTIONS

K20 ENGINE CONTROL MODULE: PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector (DLC). If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set

the Inspection/Maintenance (I/M) system status indicators to NO.

- Note the engine oil life remaining percentage.

Replace and Program Control Module

To program a replacement K20 Engine Control Module (ECM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Before removing the old control module, perform the SPS function Prepare Control Module for Removal, if available.

NOTE: The Prepare Control Module for Removal function can only be performed when communication with the old control module is still possible.

4. Replace the ECM.
5. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
 - K20 Engine Control Module and follow on-screen instructions.
6. Clear the DTCs after completing the Programming procedure.
 7. If equipped, Perform the SPS function Immobilizer Learn and follow the on-screen instructions. Refer to [Immobilizer System Component Programming](#).
 8. Perform the following SPS function:

1. Setup

NOTE: If both controller options below are listed, select K20 Engine Control Module.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
 - K20 Engine Control Module and follow on-screen instructions.
2. Configuration - If applicable
9. Clear DTCs.

Reprogram Control Module

To reprogram an existing K20 Engine Control Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

4. Clear DTCs after completing the Programming procedure.

NOTE: If vehicle fails to start during Configuration and Setup, perform the SPS Function Immobilizer Learn and follow the on-screen instructions.

5. Perform the following SPS function:

1. Setup

NOTE: If both controller options below are listed, select K20 Engine Control Module.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

2. Configuration - If applicable

6. Clear DTCs.

Unsuccessful Programming Recovery

If programming a control module is not successful, perform the following procedure:

1. Verify the control module, data link connector and programming tool connections are secure and the tool software is up to date.
2. Ignition - On/Vehicle - In Service Mode
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

4. Verify the control module programming is successful.

• **If the programming is not successful**

1. Ignition/Vehicle - Off - For greater than 1 min
2. Ignition - On/Vehicle - In Service Mode
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.
- If the programming is not successful, replace the appropriate component: K20 Engine Control Module or K71 Transmission Control Module
- If the programming is successful

4. All OK.

- If the programming is successful

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for ECM replacement, programming and setup

ACCESSORY DC POWER CONTROL MODULE PROGRAMMING AND SETUP

This device requires no programming or setup.

ACTIVE SAFETY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the active safety control module is not properly configured with the correct calibration software, the active safety control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming or programming failure, active safety control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program Active Safety Control Module or Reprogram Active Safety Control Module

To program a replacement or an existing active safety control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Active Safety Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the active safety control module, DLC and programming tool connections are secure and

the SPS software is up to date.

2. Verify the active safety control module can be reprogrammed.

- **If the active safety control module cannot be reprogrammed**

1. Ignition OFF for one minute, ignition ON.

2. Verify the active safety control module can be reprogrammed.

- If the active safety control module cannot be reprogrammed, replace the K124 Active Safety Control Module.
- If the active safety control module can be reprogrammed.

3. All OK.

- **If the active safety control module can be reprogrammed**

3. All OK.

AIR CONDITIONING COMPRESSOR CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.

2. On the SPS Supported Controllers screen, select Electric A/C Compressor Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, vehicle in Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup

AUDIO AMPLIFIER PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

During programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select T3 Audio Amplifier - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

BATTERY CHARGER PROGRAMMING AND SETUP

This device requires no programming or setup.

BATTERY ENERGY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.

- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Battery Energy Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Vehicle OFF for at least one minute.
4. Turn the Vehicle in Service Mode and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

BODY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking,

over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.

- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- **EL-46079** Tire Pressure Monitor Diagnostic Tool or **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement K9 Body Control Module (BCM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE: Make sure the vehicle ignition switch state is in appropriate position for the following step.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle OFF power mode. The Service Programming System will power mode the vehicle.

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.
4. Perform the following for the appropriate ignition type prior to proceeding with the next step:
 - Key Ignition System: Key in the ignition and any additional keys must be away from the vehicle at least 3 m.
 - Push Button Start System: Keyless entry transmitter must be in the programming pocket. Refer to the owner manual for the exact pocket location. All additional transmitters must be away from the vehicle at least 3 m.

NOTE: The following programming step may take between 10 - 12 min and progress will appear to have stopped during this process. This is a normal security timer response and a restart should not be performed. If the DTC B389A set immediately after programming a replacement BCM, the Immobilizer Learn

procedure was not properly completed. The Immobilizer Learn procedure needs to be performed again.

5. On the SPS Supported Controllers screen, select Z1 Immobilizer Learn. On the next screen, select Body Control Module IMMO Learn with Existing Transponder or Remote Key and follow the on-screen instructions. When Immobilizer Learn is complete, press the Unlock button on the keyless entry transmitter to allow the keyless entry transmitter to exit the Immobilizer Learn mode.

NOTE: When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle ON power mode.

6. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
7. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
8. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
9. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
 3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
 4. Use the scan tool to clear the DTCs.

Reprogram Control Module

To program an existing K9 Body Control Module, perform the following procedure:

1. Install EL-49642 SPS programming support tool.

NOTE: Make sure the vehicle ignition switch state is in appropriate position for the following step.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle ON power mode.

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.

NOTE: When performing the Tire Pressure Monitor Sensor Learn during BCM setup,

the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

4. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
5. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
6. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
7. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
 3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
 4. Use the scan tool to clear the DTCs.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON/Vehicle In Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition/Vehicle OFF for one minute, ignition ON/Vehicle In Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

BRAKE BOOSTER CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during**

programming, programming failure or control module damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program Control Module or Reprogram Control Module

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Brake Booster Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

COOLANT HEATER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming or any setup procedures.

DRIVE MOTOR POWER INVERTER MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Immobilizer Learn - Setup and follow the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Power Inverter Module - MCVM Operations

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module MCVM Operations and follow the

on-screen instructions. Refer to [Solenoid Valve Characterization Reprogramming](#) for additional information.

4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least 1 minute.
4. Turn the vehicle ON and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

ELECTRONIC BRAKE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

3. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Setup while following the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

FRONT VIEW CAMERA MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set

the Inspection/Maintenance (I/M) system status indicators to NO.

- If the windshield was replaced, the Frontview camera module must be calibrated.
- If the Frontview camera module was removed and reinstalled, no action is necessary.

Following Replacement of Windshield

Do not reprogram the frontview camera module when only the windshield is replaced, unless directed by a service procedure, or a service bulletin.

The K109 Frontview Camera Module must be calibrated, refer to [Front View Camera Module Learn](#) .

Front View Camera Module Replacement

If the Front View Camera Module needs to be replaced, the following procedures must be performed:

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to [Front View Camera Module Learn](#) .

Front View Camera Module Reprogramming

Do not reprogram the Front View Camera Module, unless directed by a service procedure, or a service bulletin.

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to [Front View Camera Module Learn](#) .

FUEL PUMP POWER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

GARAGE DOOR OPENER PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming but does require the following setup procedures after a new ECU is installed:

The customer must learn the device they wish to control. This must be done at the device (garage door opener, electric gate, etc.) and cannot be performed at a dealership. Refer to the vehicle owner's manual for programming instructions.

SEAT HEATING CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

HUMAN MACHINE INTERFACE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- During programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependent upon the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

NOTE: **The vehicle must remain in PARK during the programming procedure.**

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module -

Programming and follow the on-screen instructions.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 8.

4. Connect a USB drive to the computer.
5. Access the Service Programming System (SPS) and follow the on-screen instructions.
6. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - USB File Transfer.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 12.
- All existing files on the USB drive will be erased when the new files are copied.

7. Upon completion of the file transfer, remove the USB drive from the computer.
8. Vehicle in Service Mode, infotainment system ON.
9. Connect the USB drive to the USB port in the vehicle.
10. The infotainment system will recognize that update files are available. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
11. Upon completion of programming, remove the USB drive. Follow the infotainment display on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
13. Vehicle OFF, Retained Accessory Power (RAP) OFF, remove the key fob from range of the vehicle, and let the vehicle sit for five minutes. Retest system operation to verify the repair.

Reprogram Control Module

To program an existing control module, perform the following procedure:

NOTE: The vehicle must remain in PARK during the programming procedure.

1. Install the EL-49642 SPS Programming Support Tool.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 6.

2. Connect a USB drive to the computer.
3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - USB File Transfer.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 10.
- All existing files on the USB drive will be erased when the new files are copied.

5. Upon completion of the file transfer, remove the USB drive from the computer.
6. Vehicle in Service Mode, infotainment system ON.

7. Connect the USB drive to the USB port in the vehicle.
8. The infotainment system will recognize that update files are available. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
9. Upon completion of programming, remove the USB drive. Follow the infotainment display on-screen instructions.
10. Access the Service Programming System (SPS) and follow the on-screen instructions.
11. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - Programming and follow the on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
13. Vehicle OFF, Retained Accessory Power (RAP) OFF, remove the key fob from range of the vehicle, and let the vehicle sit for five minutes. Retest system operation to verify the repair.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

NOTE: If USB programming was interrupted, a 5 minute recovery time period may be necessary before the software will reinitialize. Wait 3 minutes with the vehicle OFF, all access doors closed, and all vehicle systems OFF. Upon restarting the USB portion of the programming, the display will show a countdown timer for up to 5 minutes before proceeding with the USB File Transfer.

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF, all access doors closed, all vehicle systems OFF for one minute, Vehicle in Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

HVAC CONTROL MODULE PROGRAMMING AND SETUP

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

- NOTE:**
- **Do NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
 - **Verify the programming tool is equipped with the latest software and is**

securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the below mentioned special tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn Off or disable systems that may put a load on the vehicle's battery. For example, interior lights, daytime running lights, HVAC, and radio.**
- **During the programming procedure, follow the Service Programming System (SPS) prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to No.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Programming an Existing or New Control Module

To program an existing or new control module, perform the following procedure:

1. Install the special tool: EL-49642 SPS Programming Support Tool
2. Ignition - On/Vehicle - In Service Mode
3. Access SPS and follow the on-screen instructions for the control module: K33 HVAC Control Module
4. Perform the SPS function: Programming

Unsuccessful Programming Recovery

If programming a control module is not successful, perform the following procedure:

1. Verify the control module, data link connector and programming tool connections are secure and the tool software is up to date.
2. Ignition - On/Vehicle - In Service Mode
3. Perform the SPS function: Programming

Verify the control module programming is successful.

- **If the programming is not successful**

1. Ignition/Vehicle - Off - For greater than 1 min
2. Ignition - On/Vehicle - In Service Mode
3. Perform the SPS function: Programming
 - If the programming is not successful - Replace the component: K33 HVAC Control Module
 - If the programming is successful

4. All OK.

- If the programming is successful

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

HVAC CONTROLS PROGRAMMING AND SETUP

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

NOTE:

- Do NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Verify the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the below mentioned special tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn Off or disable systems that may put a load on the vehicle's battery. For example, interior lights, daytime running lights, HVAC, and radio.
- During the programming procedure, follow the Service Programming System (SPS) prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to No.

Programming an Existing or New Control Module

This control module does not require SPS programming or any setup procedures.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

HYBRID POWERTRAIN CONTROL MODULE 2 PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure

or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.

- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

CAUTION: DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"
5. With a scan tool, perform the [Hybrid/EV Battery Pack Capacity Learn](#) and follow the on-screen instructions.
6. With a scan tool, select the Passenger Compartment Heater Coolant Control Solenoid Valve Learn Procedure and follow the on-screen instructions.
7. With a scan tool, perform the [Clear Secured High Voltage DTCs](#) and follow the on-screen instructions.
8. With a scan tool, Clear All DTCs.
9. With a scan tool, select Hybrid/EV Battery Pack Charging Adaptive Learn Reset in the Hybrid Powertrain Control Module 2 Reset Functions menu and follow the on-screen instructions.

Reprogram Control Module

To program an existing control module, perform the following procedure:

CAUTION: DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

IMMOBILIZER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct power mode.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

The air bag indicator light may remain ON after the body control module (BCM), or SDM is replaced, and during the programming procedure for the BCM until after the procedure is completed. When installing a new SDM, there may be several DTCs set prior to programming. Once programmed, these DTCs should be history and can be cleared.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing Inflatable Restraint Sensing and Diagnostic Module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K36 Inflatable Restraint Sensing and Diagnostic Module - Programming and Setup and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery**NOTE:**

GMNA Regions: When SPS failure message E4489 occurs during programming or calibration, do not call TCSC immediately. Record at which point the failure occurred before it displayed the E4489 message. When this occurs, proceed to GDS2. Download the appropriate vehicle configuration and select the Inflatable Restraint Sensing and Diagnostic Module. Under Identification Information, look at parameters: Software Module 1 Identifier and Software Module 2 Identifier. If either of these are populated with a value of 1 or more, replace the Inflatable Restraint Sensing and Diagnostic Module. Record these parameter values on the back of the job card.

Non GMNA Regions: When SPS displays message indicating that programming may

fail and the programming event fails at 0%, replace the Inflatable Restraint Sensing and Diagnostic Module. Verify no other DTC's or issues exist with the module prior to replacement. Record all DTCs and relevant information on the back of the job card.

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

INSTRUMENT CLUSTER PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct power mode.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Instrument Cluster - Prepare Control Module for Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Programming and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select Instrument Cluster - Setup and Configuration and follow the

on-screen instructions.

6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

KEYLESS ENTRY CONTROL MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Keyless Entry Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Turn the vehicle to Service Mode and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

RADAR SENSOR MODULE - LONG RANGE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the Long Range Radar Sensor Module is not properly configured with the correct calibration software, the Long Range Radar Sensor Module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming or programming failure, Long Range Radar Sensor Module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program Radar Sensor Module - Long Range or Reprogram Radar Sensor Module - Long Range

To program a replacement or an existing Long Range Radar Sensor Module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select B233B Radar Sensor Module - Long Range - Programming and follow the on-screen instructions.
3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
4. Following programming, the module alignment must be calibrated.

Refer to [Radar Sensor Module - Long Range Learn](#) .

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for radar sensor module - long range replacement, programming and setup.

PARKING ASSIST CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Sensor Replacement

Following Parking Assist Sensor replacement, the sensors must be calibrated. Refer to [Parking Assist Sensor Learn Calibration](#) .

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. Following Parking Assist Control Module replacement, the sensors must be calibrated. Refer to [**Parking Assist Sensor Learn Calibration**](#) .

Reprogram Control Module

Do not reprogram the parking assist control module, unless directed by a service procedure, or a service bulletin.

To reprogram an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the K182 Parking Assist Control Module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the parking assist control module can be reprogrammed.
 - **If the K182 Parking Assist Control Module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the parking assist control module can be reprogrammed.
 - If the K182 Parking Assist Control Module cannot be reprogrammed, replace the parking assist control module.
 - If the K182 Parking Assist Control Module can be reprogrammed.
 3. All OK.
 - **If the K182 Parking Assist Control Module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

Refer to [**Control Module References**](#) for control module replacement, programming and setup

PASSENGER PRESENCE SYSTEM PROGRAMMING AND SETUP

When the passenger presence system is replaced or serviced, perform the rezeroing procedure for the passenger presence system. Refer to [**Passenger Presence System Rezeroing**](#) for the rezeroing procedure.

PEDESTRIAN ALERT SOUND CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program ECU

To program a replacement control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Reprogram ECU

To reprogram an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for pedestrian alert sound control module replacement, programming and setup

POWER STEERING CONTROL MODULE PROGRAMMING AND SETUP

The following service procedures require either a programming or a setup event performed for a complete repair.

The electronic power steering control module is part of the power steering assist motor assembly and is electronically paired with the steering gear's sensors.

- If the complete steering gear INCLUDING the assist motor assembly was replaced, or for reprogramming of an existing power steering system WITHOUT replacement, refer to the POWER STEERING CONTROL MODULE REPROGRAMMING instructions in this article.
- If ONLY the Power Steering Assist Motor assembly is replaced, follow the POWER STEERING CONTROL MODULE REPLACEMENT instructions.

Replace and Program Control Module

NOTE: During the procedures listed below, critical data is retrieved from vehicle components and stored in the scan tool computer's hard drive. This data is needed during the programming and setup sequences.

Ensure the same scan tool is used and capable of reading, storing, and writing the vehicle's system data.

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. Replace the Power Steering Assist Motor containing the Power Steering Control Module. Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#) .
3. With the Power Steering Assist Motor replaced and reconnected, on the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Electronic Power Steering - Configuration & Setup and follow the on-screen instructions.
5. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
6. Ignition ON.
7. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Power Steering Control Module Reprogramming

Do not program or reprogram the electronic power steering control module unless directed by a service procedure or a service bulletin.

NOTE: This procedure applies to reprogramming of the existing steering gear or the initial programming if the complete steering gear assembly including the assist motor was replaced. If only the power steering control module is replaced, follow the Power Steering Control Module Replacement instructions above.

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-

screen instructions.

3. On the SPS Supported Controllers screen, select Electronic Power Steering - Configuration & Setup and follow the on-screen instructions.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Ignition ON.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Steering Angle Sensor Centering and Software Endstop Learning

For the steering angle sensor centering and software endstop learning, refer to [Power Steering Control Module Calibration](#) .

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

RADIO CONTROL PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

RADIO PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.

- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- If programming of the control module is being performed at the direction of a bulletin or PI, follow the instructions provided in that document.
- During audio system programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependant upon vehicle equipment, the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.
- The length of time for the USB programming to complete will vary depending on the number and size of the files in the update.
- All data will be erased from the USB device BEFORE the calibration is downloaded onto the device. To ensure important information is NOT erased, always verify that NO information is stored on the device BEFORE beginning the calibration download. If required, transfer important files to another storage device BEFORE beginning the calibration download.
- The XM satellite radio (if equipped) is integrated into the radio. If XM was activated in the previous radio, the replacement radio will require additional activation steps after programming to transfer customer subscription information.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- USB 2.0 flash drive with a minimum capacity of 4 GB.

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.
4. When programming is complete, access the Service Programming System (SPS) and follow the on-screen instructions.

5. Connect a USB drive to the computer.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 8.

6. On the SPS Supported Controllers screen, select A11 Radio - USB File Transfer, and follow the on-screen instructions.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 14.
- All existing files on the USB drive will be erased when the new files are copied.

7. Upon completion of the file transfer, remove the USB drive from the computer.

8. Vehicle in Service Mode, radio ON.

9. Connect the USB drive to the USB port in the vehicle.

10. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.

11. When programming is complete, remove the USB device from the vehicle USB port.

12. Access the Service Programming System (SPS) and follow the on-screen instructions.

13. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.

14. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Reprogram Control Module

To reprogram an existing control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.

2. Connect a USB drive to the computer.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 6.

3. Access the Service Programming System (SPS) and follow the on-screen instructions.

4. On the SPS Supported Controllers screen, select A11 Radio - USB File Transfer, and follow the on-screen instructions.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 11.
- All existing files on the USB drive will be erased when the new files are copied.

5. Upon completion of the file transfer, remove the USB drive from the computer.

6. Vehicle in Service Mode, radio ON.

7. Connect the USB drive to the USB port in the vehicle.

8. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted.

Programming will take several minutes.

9. When programming is complete, remove the USB device from the vehicle USB port.
10. Access the Service Programming System (SPS) and follow the on-screen instructions.
11. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

XM Activation (If Equipped)

IMPORTANT: After replacement of an XM receiver, call XM radio to deactivate the receiver that has been removed from the vehicle.

1. Turn the radio ON, tune to the XM channel 0, and record the radio ID. The radio ID will be needed for activation of the receiver.
2. From the USA, Call XM radio at 1-800-556-3600 to activate the receiver. From Canada, call 1-877-438-9677.
3. Park the vehicle outside in an area with an unobstructed view of the southern sky.
4. Leave the vehicle outside with the ignition switch in the ACC position and the radio on for 30 minutes to activate XM service.
5. Once activated, the radio will receive the remaining XM channels.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

REAR SEAT HEATER CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

REMOTE CONTROL DOOR LOCK RECEIVER PROGRAMMING AND SETUP

Diagnostic Aids

The remote control door lock receiver only functions as an antenna, receiving the signals sent by the keyless entry transmitter and forwarding them to the body control module (BCM). The keyless entry software is contained wholly within the BCM.

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

SIDE OBJECT SENSOR MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select B218R Right Side Object Sensor Module or B218L Left Side Object Detection - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP (WITH UKF)

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Each of the following service procedures require programming or setup procedures to be performed on the telematics communication interface control module.

Communication Interface Module Replacement

NOTE:

- It is critical to use the service replacement telematics communication interface control module only in the vehicle for which it was ordered.
- Failure to perform the following procedures could result in DTC(s) being set.
- Perform the following procedure only once. Repeat attempts of the procedure may result in a delay of the activation process.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select ONSU Onstar® Module Setup and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP (WITH UE1)

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the **EL-49642** SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- Before beginning any programming first determine which Generation of the Telematics Communication Interface Control Module you are working with. One way to accomplish this is by using a scan tool. The Telematics Communication Interface Control Module Generation will be listed under the Selected Vehicle Configuration section, in addition the Generation (9 or 10) can be determined from the Module ID data table. Additional programming steps may be necessary depending on the generation of the module.
- It is critical to use the service replacement Communication Interface Module only in the vehicle for which it was ordered.
- Failure to perform the following procedures will result in a red LED, DTC(s) being set, and limited or incomplete OnStar® services.
- An OnStar® button press to the OnStar® call center is required to complete the procedure.
- To fully activate an OnStar® module, both the setup and activation request procedures must be completed on all vehicles with and without an active OnStar® subscription to insure the unit has been setup properly for the vehicle it has been installed into and also to update the OnStar® with the correct unit information.
- To initialize the Turn-by-Turn feature, the vehicle must first be driven In open sky condition at speeds greater than 10 mph (16 kph) or more for a minimum of 5 miles (8 km), and perform at least 2 left and 2 right 90 degree turns coming to complete stops prior to each turn.
- On vehicles up fitted with TTY capabilities, it is necessary to perform a power cycle of the OnStar® Interface Module (OTIM), and toggle the TTY mode after completing the Communication Interface Module installation and setup procedures.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

NOTE:

- **Due to a change in SPS you must select 'Reprogram ECU', for Telematics Communication Interface Control Module Programming from the Selected Programming Process even if the unit is being replaced.**
- **If 'Replace and Program ECU' is selected the Telematics Communication Interface Control Module will not be listed in the Supported Controllers screen. You must go back and select 'Reprogram ECU'.**

•

3. In the SPS Supported Controllers screen, select Telematics Communication Interface Control Module Programming and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. After Telematics Communication Interface Control Module Programming and Service Activation, if the

vehicle is equipped with RPO VV4, on the Supported Controllers screen select 'OnStar WiFi Enable (Gen 10 only) Programming' and follow the on-screen instructions.

6. Press the OnStar® Blue Button to call OnStar® and have the system activated. If the customer refused OnStar® services (terms and conditions) and the vehicle is equipped with RPO VV4 have the OnStar® consultant turn off the WiFi demo message that occurs after every ignition on event.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

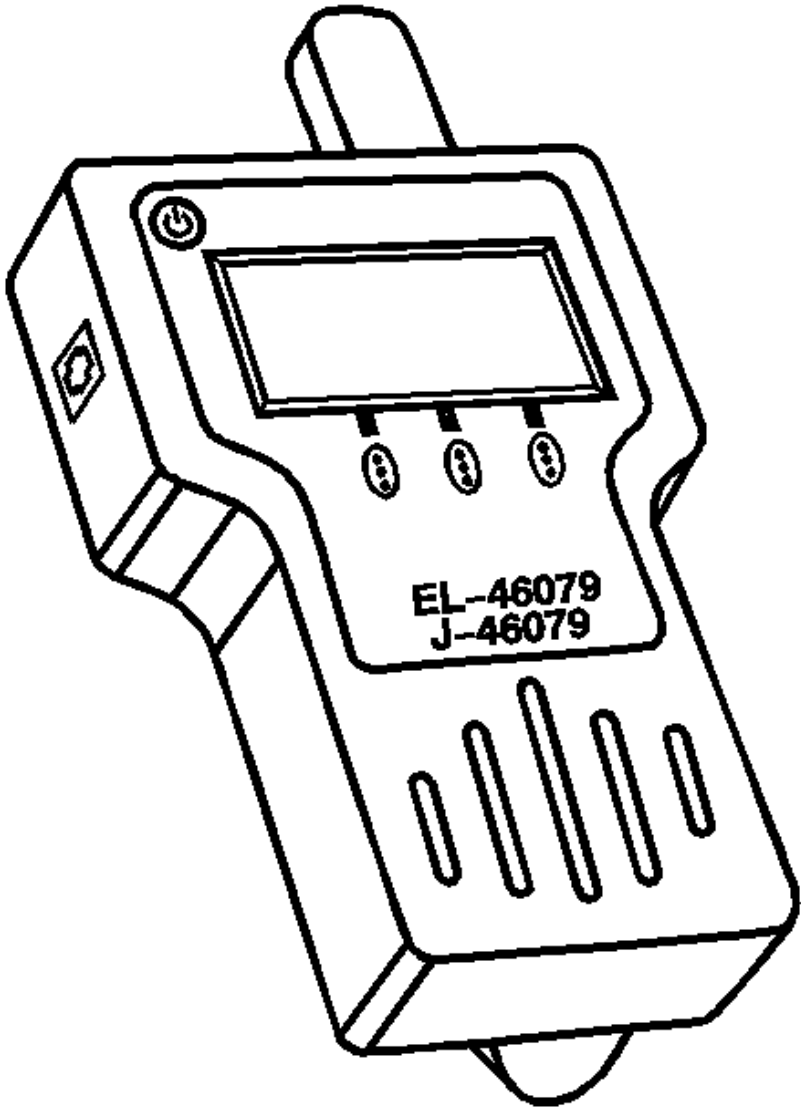
Illustration	Tool Number/Description
	EL 46079 J 46079 Tire Pressure Monitor Diagnostic Tool

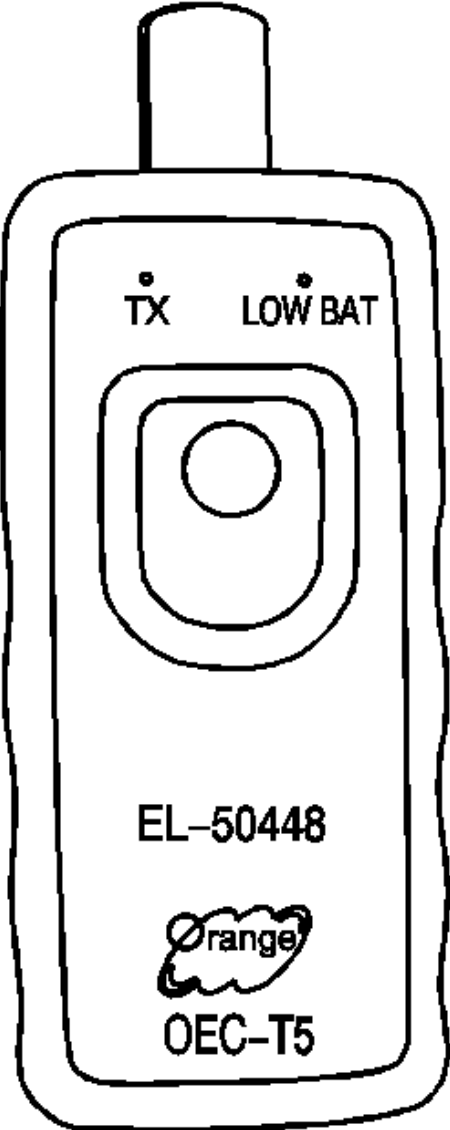
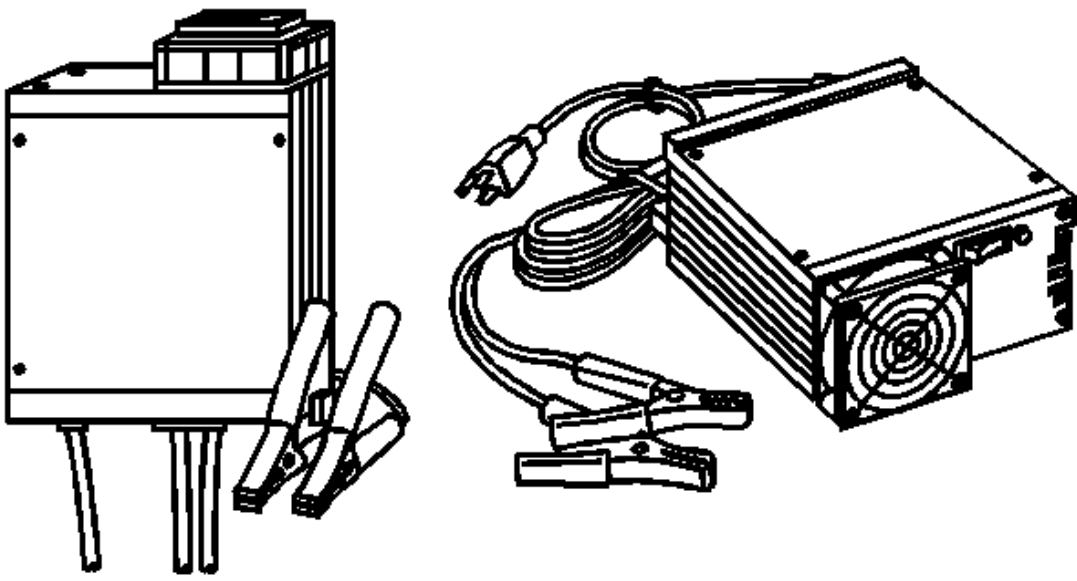
Illustration	Tool Number/Description
	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Illustration	Tool Number/Description
	EL 49642 EL 50113 Europe - Use recommended equivalent workshop equipment SPS Programming Support Tool

Article GUID: A00884642

ACCESSORIES & EQUIPMENT

Remote Functions - Volt

SCHEMATIC WIRING DIAGRAMS

REMOTE FUNCTION WIRING SCHEMATICS

Keyless Entry

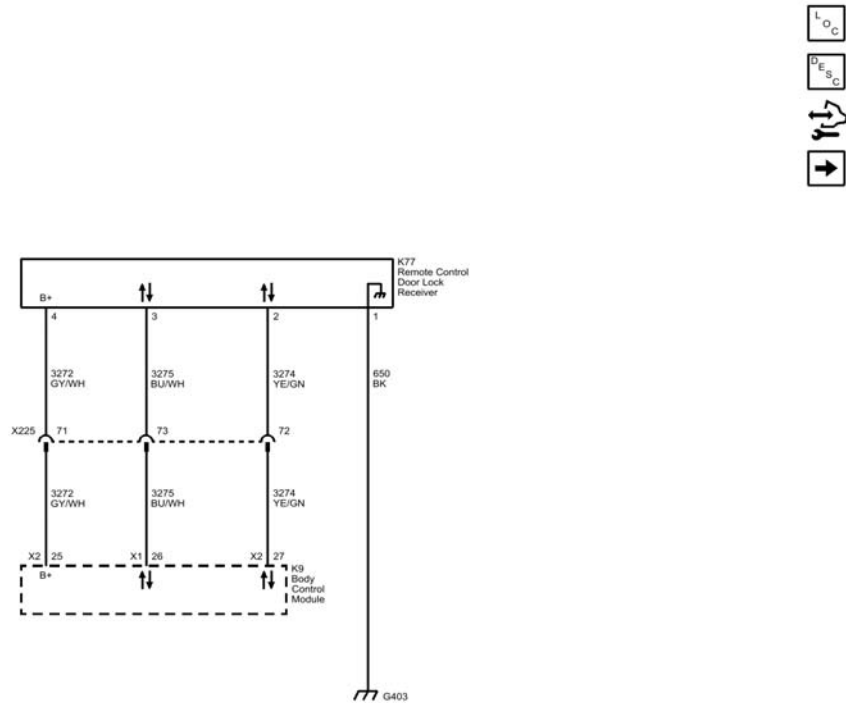


Fig. 1: Keyless Entry

Courtesy of GENERAL MOTORS COMPANY

Passive Start

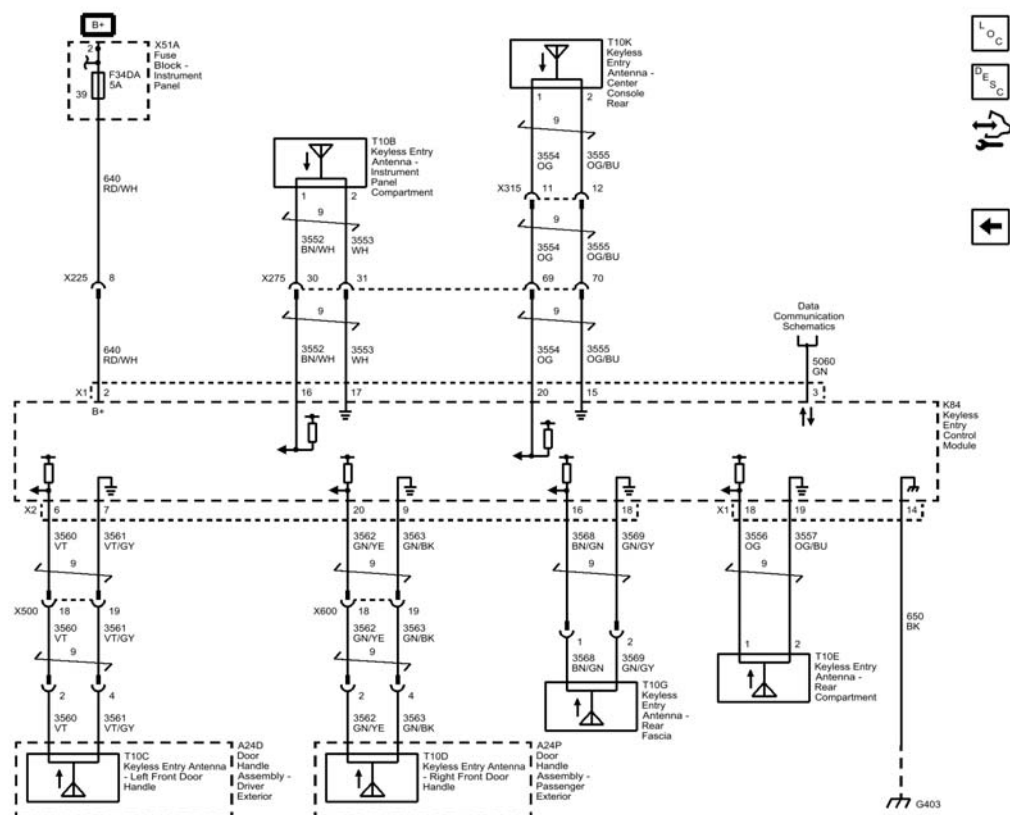


Fig. 2: Passive Start

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B305D: CHALLENGE ACTIVE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B305D

Challenge Active Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Challenge Active	B305D 02	-	B305D 01	-

Circuit/System Description

The body control module (BCM) communicates with the remote control door lock receiver through the keyless entry challenge active circuit. The challenge active signal is activated by the keyless entry control module and sent to the BCM when active communication between the vehicle and the keyless entry transmitter is initiated.

Conditions for Running the DTC

- System voltage between 9 - 16 V
- Signal output activated by the keyless entry control module

Conditions for Setting the DTC

B305D 01

A short to voltage is detected on the challenge active circuit.

B305DB 02

A short to ground is detected on the challenge active circuit.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present.
- A history DTC will clear after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

- [Power Moding Schematics](#)
- [Power Distribution Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON, connect a test lamp between the control circuit terminal 5 and ground circuit terminal 3.
4. Verify the test lamp turns ON and OFF when switching the ignition ON and OFF.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the KR76 Retained Accessory Power Relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- Refer to **Control Module References** for keyless entry control module replacement, programming and setup.

DTC B3101: KEYLESS ENTRY DATA LINK CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3101

Keyless Entry Data Link Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B3101 00	B3101 00	-	-
Serial Data - Enable Line	B3101 00	B3101 00	B3101 00	B3101 00
Serial Data - Receive	B3101 00	B3101 00	B3101 00	B3101 00
Low Reference	-	B3101 00	-	-

Circuit/System Description

The body control module (BCM) communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the BCM, depending on which button is pressed on the transmitter. The BCM receives the message and performs the appropriate function.

Conditions for Running the DTC

A button is pressed on the keyless entry transmitter.

Conditions for Setting the DTC

No response is received from the remote control door lock receiver after the BCM requests information from or sends configuration commands to the remote control door lock receiver.

Action Taken When the DTC Sets

In the case of power loss, the remote control door lock receiver is disabled for 65 s. Otherwise no action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present.
- A history DTC will clear after 40 consecutive power mode cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K77 Remote Control Door Lock Receiver. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal 1 and ground.
 - **If 30 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If less than 30 Ω**
3. Vehicle in Service Mode.
4. Test for greater than 11.5 V between the B+ circuit terminal 4 and ground.
 - **If 11.5 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If Infinite resistance.
 3. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 11.5 V**
5. Test for 3 - 6 V between the serial data circuit terminal 2 and ground.
- **If less than 3 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 6 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If within than 3 - 6 V**
6. Vehicle OFF, disconnect the X1 and X2 harness connectors at the, Vehicle in Service Mode.
7. Test for less than 1 V between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
- **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
8. Vehicle OFF.
9. Test for infinite resistance between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
- **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
10. Test for less than 2 Ω between the K9 Body Control Module serial data circuit terminal 26 X1 and the K77 Remote Control Door Lock Receiver serial data circuit terminal 3.
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
11. Replace the K77 Remote Control Door Lock Receiver.

12. Verify DTC B3101 is not set as current.

- **If DTC B3101 is set as current**

Replace the K9 Body Control Module.

- **If DTC B3101 is not set or is set as history**

13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for body control module or remote control door lock receiver replacement, programming, and setup

DTC B3105: KEYLESS ENTRY TRANSMITTERS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3105

Keyless Entry Transmitters

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The body control module monitors the number of keyless entry transmitters programmed. Until at least one transmitter is programmed, the body control module determines a malfunction condition exists.

Conditions for Running the DTC

The body control module has been set up without transmitters being programmed.

Conditions for Setting the DTC

No keyless entry transmitter programmed to the body control module.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

A current DTC is cleared when at least one transmitter has been programmed to the body control module.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the transmitter is a correct transmitter for the vehicle. This can be accomplished by comparing the part number printed on the transmitter to the appropriate part number in the parts catalog.
 - **If the transmitter is incorrect**

Replace the transmitter.
 - **If the transmitter is correct**
2. Program the transmitter. Refer to Key with Integrated Transmitter Programming.
3. Verify the transmitter has successfully completed the programming procedure.
 - **If the transmitter does not program successfully**

Replace the transmitter.
 - **If the transmitter programs successfully**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Key with Integrated Transmitter Programming

DTC B3106: KEYLESS ENTRY DATA LINK

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3106

Keyless Entry Data Link

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

The body control module (BCM) communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the BCM, depending on which button is pressed on the transmitter. The BCM receives the message and performs the appropriate function.

Conditions for Running the DTC

A keyless entry transmitter button is pressed.

Conditions for Setting the DTC

The transmitter that is sending a signal to the remote control door lock receiver is different from those transmitters stored in the BCM.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present and the ignition mode switch is cycled.
- A history DTC will clear after 40 consecutive power mode cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. With a valid and learned transmitter, press a button on the transmitter.
2. Verify that DTC B3106 is not set.
 - **If DTC B3106 is set**

Replace the K77 Remote Control Door Lock Receiver.
 - **If DTC B3106 is not set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for remote control door lock receiver replacement, programming, and setup

DTC B3109-B3113: KEYLESS ENTRY TRANSMITTER (1-5) BATTERY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3109

Keyless Entry Transmitter 1 Battery

DTC B3110

Keyless Entry Transmitter 2 Battery

DTC B3111

Keyless Entry Transmitter 3 Battery

DTC B3112

Keyless Entry Transmitter 4 Battery

DTC B3113

Keyless Entry Transmitter 5 Battery

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function. The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:

- DTC B3109
- DTC B3110
- DTC B3111
- DTC B3112
- DTC B3113
- **If any of the DTCs are set**

1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three consecutive times.

2. Verify the DTC does not set.

- If the DTC sets, replace the keyless entry transmitter.
- If the DTC does not set

3. All OK.

- **If none of the DTCs are set**

2. All OK.

DTC B310D-B310F: KEYLESS ENTRY TRANSMITTER (6-8) BATTERY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B310D

Keyless Entry Transmitter 6 Battery

DTC B310E

Keyless Entry Transmitter 7 Battery

DTC B310F

Keyless Entry Transmitter 8 Battery

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function.

The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:

- DTC B310D
- DTC B310E
- DTC B310F
- **If any of the DTCs are set**

1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three

consecutive times.

2. Verify the DTC does not set.

- If the DTC sets, replace the keyless entry transmitter.
- If the DTC does not set

3. All OK.

- **If none of the DTCs are set**

2. All OK.

DTC B3119: KEYLESS ENTRY ANTENNA 1

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3119 02

Keyless Entry Antenna 1 Short to Ground

DTC B3119 05

Keyless Entry Antenna 1 High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Driver Door	B3119 02	B3119 05	B3119 05	-
Keyless Entry Antenna Low Reference - Driver Door	-	B3119 05	-	-

Circuit/System Description

The driver door handle antenna is located in the driver door handle assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior door handle button is pressed, the Keyless Entry Control Module communicates with the driver door handle keyless entry antenna.

Conditions for Running the DTC

The exterior door handle button is pressed in the driver door handle within 15 minutes of last door closing.

Conditions for Setting the DTC

B3119 02

The Keyless Entry Control Module detects a short to ground on the driver door keyless entry antenna signal circuit.

B3119 05

The Keyless Entry Control Module detects a short to voltage or an open on the driver door keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Doors will not unlock/lock when a exterior door handle button is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B3122, B3123, or B3124 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the T10C Keyless Entry Antenna - Driver Door Handle, Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Vehicle OFF, install a DMM between the signal circuit terminal 2 and ground. Set the DMM to capture DC voltage using the MIN MAX function.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 4 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 2 and the low reference circuit terminal 4. Set the DMM to capture DC voltage using the MIN MAX function.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
10. Replace the T10C Keyless Entry Antenna - Driver Door Handle.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
12. Verify DTC B3119 is not set as current.
 - **If DTC B3119 is set as current**

Replace the K84 Keyless Entry Control Module.
 - **If DTC B3119 is not set or is set as history**
13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Outside Handle Bracket Replacement \(Driver Side\)](#) [Front Side Door Outside Handle Bracket Replacement \(Passenger Side\)](#)
- Refer to [Control Module References](#) for replacement, programming, and setup

DTC B3120: KEYLESS ENTRY ANTENNA 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3120 02

Keyless Entry Antenna 2 Short to Ground

DTC B3120 05

Keyless Entry Antenna 2 High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Passenger Door	B3120 02	B3120 05	B3120 05	-
Keyless Entry Antenna Low Reference - Passenger Door	-	B3120 05	-	-

Circuit/System Description

The passenger front door handle antenna is located in the passenger front door handle assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior door handle button is pressed, the Keyless Entry Control Module communicates with the passenger front door handle keyless entry antenna.

Conditions for Running the DTC

The exterior door handle button is pressed in the passenger front door handle is within 15 minutes of the last change of door ajar status for any door.

Conditions for Setting the DTC

B3120 02

The Keyless Entry Control Module detects a short to ground on the passenger front door keyless entry antenna signal circuit.

B3120 05

The Keyless Entry Control Module detects a short to B+ or an open on the passenger front door keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Doors will not unlock/lock when the exterior door handle button is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B3122, B3123, or B3124 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the T10D Keyless Entry Antenna Passenger Door Handle, Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and

manually set the DMM range to 000.0 V.

3. Vehicle OFF, install a DMM between the signal circuit terminal 2 and ground. Set the DMM to capture DC voltage using the MIN MAX function.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

6. Test for less than 1 V between the low reference circuit terminal 4 and ground.

- **If 1 V or greater**

1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 2 and the low reference circuit terminal 4. Set the DMM to capture DC voltage using the MIN MAX function.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

10. Replace the T10D Keyless Entry Antenna Passenger Door Handle.

11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
12. Verify DTC B3120 is not set as current.
 - **If DTC B3120 is set as current**

Replace the K84 Keyless Entry Control Module.

 - **If DTC B3120 is not set or is set as history**
13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Outside Handle Bracket Replacement \(Driver Side\)](#) [Front Side Door Outside Handle Bracket Replacement \(Passenger Side\)](#)
- Refer to [Control Module References](#) for replacement, programming, and setup

DTC B3121: KEYLESS ENTRY ANTENNA 3

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3121

Keyless Entry Antenna 3

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Rear Fascia	B3121 02	B3121 05	B3121 05	-
Keyless Entry Antenna Low Reference - Rear Fascia	B3121 02	B3121 05	B3121 05	-

Circuit/System Description

The rear fascia antenna is located in the rear fascia assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior rear closure touch pad is pressed, the keyless entry control module communicates with the rear fascia keyless entry antenna.

Conditions for Running the DTC

- The rear closure touch pad is pressed.
- The scan tool activates a device control function to simulate the above action.

Conditions for Setting the DTC

B3121 02

The keyless entry control module detects a short to ground on the rear fascia keyless entry antenna signal circuit.

B3121 05

The keyless entry control module detects a short to B+ or an open on the rear fascia keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Rear closure will not open when rear closure touch pad is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B3122, B3123, or B3124 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10G Keyless Entry Antenna - Rear Fascia, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - **If 1 V or greater**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
- **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the low reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
10. Replace the T10G Keyless Entry Antenna - Rear Fascia.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
12. Verify DTC B3121 is not set.
 - **If DTC B3121 is set**

Replace the K84 Keyless Entry Control Module.
 - **If DTC B3121 is not set**
13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Low Frequency Rear Bumper Antenna Replacement](#)
- Refer to [Control Module References](#) for keyless entry control module replacement, programming, and setup

DTC B3122: KEYLESS ENTRY ANTENNA 4

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3122

Keyless Entry Antenna 4

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Low Reference - Center Console Front	B3122 02	B3122 05	B3122 05	-

Circuit/System Description

The front center console antenna is located in front of the center console assembly and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the front center console antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3122 02

The keyless entry control module detects a short to ground on the front center console keyless entry antenna signal circuit.

B3122 05

The keyless entry control module detects a short to B+ or an open on the front center console keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10J Keyless Entry Antenna - Center Console Front, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture

DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.

4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the low reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**

10. Replace the T10J Keyless Entry Antenna - Center Console Front.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify DTC B3122 is not set.

- **If DTC B3122 is set**

Replace the K84 Keyless Entry Control Module.

- **If DTC B3122 is not set**

13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Low Frequency Instrument Panel Antenna Replacement](#)
- Refer to [Control Module References](#) for keyless entry control module replacement, programming, and setup

DTC B3123: KEYLESS ENTRY ANTENNA 5

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3123

Keyless Entry Antenna 5

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Low Reference - Center Console Rear	B3123 02	B3123 05	B3123 05	-

Circuit/System Description

The rear center console antenna is located in rear of the center console assembly and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the rear center console antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3123 02

The keyless entry control module detects a short to ground on the rear center console keyless entry antenna signal circuit.

B3123 05

The keyless entry control module detects a short to B+ or an open on the rear center console keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed. The exterior door handle buttons will not operate the keyless entry system.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10K Keyless Entry Antenna - Center Console Rear, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the low reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
10. Replace the T10K Keyless Entry Antenna - Center Console Rear.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify DTC B3123 is not set.
 - **If DTC B3123 is set**

Replace the K84 Keyless Entry Control Module.
 - **If DTC B3123 is not set**
13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Low Frequency Console Antenna Replacement](#)
- Refer to [Control Module References](#) for keyless entry control module replacement, programming, and setup

DTC B3124: KEYLESS ENTRY ANTENNA 6

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3124

Keyless Entry Antenna 6 Short to Ground

DTC B3124

Keyless Entry Antenna 6 High Voltage/Open

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Rear Compartment	B3124 02	B3124 05	B3124 05	-
Keyless Entry Antenna Low Reference - Rear Compartment	B3124 02	B3124 05	B3124 05	-

Circuit/System Description

The rear compartment antenna is located on the rear compartment floor near the seat back, centered, and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the rear compartment antenna.

Diagnostic Aids

- Objects in the trunk may block the reception of the rear mounted antennas. Verify the trunk is free of large metal objects before performing any diagnostics.
- The keyless entry transmitter must be properly located within the range of an antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3124 02

The keyless entry control module detects a short to ground on the rear compartment keyless entry antenna signal circuit.

B3124 05

The keyless entry control module detects a short to B+ or an open on the rear compartment keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.

- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10E Keyless Entry Antenna - Rear Compartment, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Activate the antenna by pressing the ignition mode switch.

5. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

6. Test for less than 1 V between the low reference circuit terminal 2 and ground.

- **If 1 V or greater**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.

2. Test for less than 1 V between the low reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.

8. Activate the antenna by pressing the ignition mode switch.

9. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.

2. Test for infinite resistance between the low reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

10. Replace the T10E Keyless Entry Antenna - Rear Compartment.

11. Activate the antenna by pressing the ignition mode switch.

12. Verify DTC B3124 is not set.

- **If DTC B3124 is set**

Replace the K84 Keyless Entry Control Module.

- **If DTC B3124 is not set**

13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Low Frequency Rear Compartment Antenna Replacement**
- Refer to **Control Module References** for keyless entry control module replacement, programming, and setup

SYMPTOMS - REMOTE FUNCTIONS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Keyless Entry System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Keyless Entry System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections, wiring, terminals, connectors, poor voltage and ground connections, temperature sensitivity, electromagnetic interference, electrical noise and/or incorrect control module installed may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Garage Door Opener Malfunction**
- **No Remote Detected**
- **Keyless Entry System Malfunction (Active)Keyless Entry System Malfunction (Passive)**
- **Remote Vehicle Start Malfunction**

GARAGE DOOR OPENER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	-	-
Ground	-	1	-	-
1. Universal Home Remote Malfunction				

Circuit/System Description

The universal home remote is a transmitter operating between 288 and 434 MHz. The universal home remote has three buttons that may be programmed for individual transmitter/receiver combinations to control up to three garage doors, security gates, lighting systems, etc. Each button represents a unique transmitter code section, which operates independently of the other buttons, and may be considered a separate transmitter.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Garage Door Opener Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Special Tools

EL-41540 Universal Home Remote Tester

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the S25 Garage Door Opener.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

- **If 10 Ω or greater**

Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.
- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the S25 Garage Door Opener.

- **If the test lamp illuminates**

5. Verify the LED on the S25 Garage Door Opener illuminates or flashes when each button on the S25 Garage Door Opener is pressed.

- **If the LED does not illuminate or flash when each button is pressed**

Replace the S25 Garage Door Opener.

- **If the LED illuminates or flashes when each button is pressed**

NOTE: This step will clear any learned transmitters from the S25 Garage Door Opener. This will require reprogramming by the customer to reestablish universal home remote functionality.

6. Press and hold the two outer buttons on the S25 Garage Door Opener for greater than 30 seconds. The LED on the S25 Garage Door Opener will illuminate for 20 seconds, then begin to flash quickly for another 10 seconds. When the LED stops flashing, the system has been cleared and placed into default mode.

7. Place the **EL-41540** Universal Home Remote Tester so that it is adjacent to the S25 Garage Door Opener.

8. Verify the appropriate **EL-41540** Universal Home Remote Tester Indicator Lights illuminate when each button on S25 Garage Door Opener the is pressed, one at a time.

- **If the if tester does not respond to each button press**

Replace the S25 Garage Door Opener.

- **If the if tester responds to each button press**

9. Using the Hand Held Transmitter from the **EL-41540** Universal Home Remote Tester kit, program a single button on the S25 Garage Door Opener. Refer to the instructions provided with the **EL-41540** Universal Home Remote Tester for programming instructions.

NOTE: When performing step 9, press the button that was programmed in step 8.

10. Verify the Programmed indicator on the **EL-41540** Universal Home Remote Tester illuminates when the programmed button on the S25 Garage Door Opener is pressed.

- If the Programmed indicator does not illuminate when the programmed button is pressed

Replace the S25 Garage Door Opener.

- If the Programmed LED illuminates when the programmed button is pressed

11. Instruct the customer to program the S25 Garage Door Opener. Refer to the vehicle owners manual. If further malfunction occurs, a possible rolling code or incompatibility with the S25 Garage Door Opener will prevent programming.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for Garage Door Opener replacement, programming, and setup

NO REMOTE DETECTED

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Low Reference - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Signal - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Low Reference - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Signal - Rear Compartment	B3124 02	B3124 05	B3124 05	-
Keyless Entry Antenna Low Reference - Rear Compartment	B3124 02	B3124 05	B3124 05	-

Circuit/System Description

When a transmitter authentication is requested, the front console, rear console, and rear compartment antennas simultaneously broadcast a challenge within the passenger compartment to the transmitter. If the response from the transmitter via radio frequency (RF) is a valid response, the body control module (BCM) determines there is a transmitter within the vehicle. If no response is received, the BCM determines that no transmitter is in the vehicle, and NO REMOTE DETECTED will be displayed on the DIC.

Diagnostic Aids

A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, 12 V power outlet USB converters, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Conditions caused by external influences such as these are considered to be normal. Following this diagnostic will not diagnose an RF interference condition. If RF interference is suspected, question the customer about the conditions or location where the NO REMOTE DETECTED condition occurs.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: This condition may be caused by low vehicle battery voltage. If the battery is not sufficiently charged (above 10 volts), the system will have difficulties detecting the transmitter and the NO REMOTE DETECTED message will be displayed. Correct the low battery voltage condition to eliminate this condition.

1. Verify that DTC B3119, B3120, B3121, B3122, B3123, or B3124 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

2. Lock the vehicle using the keyless entry transmitter.
3. Verify that each door unlocks and opens by approaching the vehicle with a valid transmitter and operating their respective exterior door handle button.

- **If both doors do not unlock/unlatch and open**

Refer to [Keyless Entry System Malfunction \(Active\)Keyless Entry System Malfunction \(Passive\)](#).

- **If both doors unlock/unlatch and open**

4. Verify the vehicle starts with the transmitter located in the key pocket/slot.

- **If the vehicle does not start**

Perform the [Remote Control Door Lock and Theft Deterrent Transmitter Programming](#) procedure.

- **If the vehicle starts**

5. Verify the NO REMOTE DETECTED message is not displayed on the DIC while attempting to start the vehicle, placing the keyless entry transmitter in various locations within the vehicle interior at each start attempt. The vehicle should start.

- **If the NO REMOTE DETECTED message is displayed at any time**

Refer to Circuit/System Testing.

- **If the NO REMOTE DETECTED message is not displayed and the vehicle starts**

6. Inspect for any sources of RF interference such as cell phone chargers, power supplies, etc. that would interrupt transmitter and antenna communication. If inspection does not reveal any items causing RF interference, discuss with the customer the conditions or location where the NO REMOTE DETECTED condition occurs. Discuss any devices that are normally kept in the vehicle, such as a laptop or cell phone charger, which may have been removed when the vehicle was brought in for service. It may be necessary to explain to the customer how RF interference degrades the performance of the system.

Circuit/System Testing

NOTE: To determine the appropriate T10 Keyless Entry Antenna to disconnect and diagnose, place the transmitter in various location within the vehicle's interior and attempt to start. The location of the transmitter when the NO REMOTE DETECTED message occurs will correspond with the T10 Keyless Entry Antenna that requires diagnosis.

1. Ignition OFF, disconnect the harness connector at the appropriate T10 Keyless Entry Antenna, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.

- **If 1 V or greater**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

6. Test for less than 1 V between the low reference circuit terminal 2 and ground.

- **If 1 V or greater**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.

- **If 1 V or less**

1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the low reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If greater than 1 V**

10. Replace the appropriate T10 Keyless Entry Antenna.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify the NO REMOTE DETECTED message is not displayed and the vehicle starts.
 - **If the NO REMOTE DETECTED message is displayed and the vehicle does not start**
Replace the K84 Keyless Entry Control Module.

- **If the NO REMOTE DETECTED message is not displayed and the vehicle starts**

13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Low Frequency Instrument Panel Antenna Replacement](#)
- Refer to [Low Frequency Console Antenna Replacement](#)
- Refer to [Low Frequency Rear Compartment Antenna Replacement](#)
- Refer to [Control Module References](#) for module replacement, programming, and setup

KEYLESS ENTRY SYSTEM MALFUNCTION (ACTIVE)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The keyless entry will unlock the vehicle doors or open the rear compartment when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the keyless entry transmitter sending a radio frequency to the remote control door lock receiver, which then sends the signal to the body control module (BCM). The BCM interprets the signal and activates the requested function. A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Diagnostic Aids

- Unwanted or inadvertent door lock/unlock activation may be requested by the OnStar® Remote Link app. It is possible that a customer may be unaware of account usage, result in an unwanted or phantom door lock/unlock. If normal system diagnosis does results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).
- If available, the EL 43241 Keyless Entry Tester may be used to diagnose a low transmitter battery or a malfunctioning transmitter. To test, place the transmitter on the test pad of the EL 43241 and press each transmitter button one at a time, holding each button for three seconds. If the green light on the tester does not illuminate and a tone does not sound, first replace the transmitter battery and retest. If the malfunction continues after replacing the transmitter battery, replace the transmitter.
- When using the EL 43241 Keyless Entry Tester, first inspect the keyless entry transmitter part number to determine that it is the correct model for the vehicle. An incorrect part number transmitter may pass the test, but it will not activate the keyless entry system.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

J 43241 Keyless Entry Tester

Circuit/System Testing

1. Verify that the vehicle key is correct for the vehicle. This can be accomplished by comparing the part number printed on the key to the appropriate part number in the parts catalog.
 - **If the key is incorrect**

Replace the vehicle key.

- **If the key is correct**

2. Operate the transmitter while observing the appropriate scan tool Key Fob Function parameter for the appropriate transmitter.
3. Verify the scan tool Key Fob Function parameter corresponds with the function selected on the transmitter.

- **If the Key Fob Function parameter does not correspond with the transmitter selection**

NOTE: Before replacing the transmitter, inspect the transmitter battery contacts for any corrosion or damage. If no corrosion or damage is found, replace the transmitter battery and retest before replacing the transmitter.

1. Replace the transmitter.
2. Operate the transmitter while observing the appropriate scan tool Key Fob Function parameter for the appropriate transmitter.
3. Verify the scan tool Key Fob Function parameter correspond with the function selected on the transmitter.
 - If the Key Fob Function parameter does not correspond with the transmitter selection, replace the K9 Body Control Module.
 - If the Key Fob Function parameter corresponds with the transmitter selection
4. All OK.

- **If the Key Fob Function parameter corresponds with the transmitter selection**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Key with Integrated Transmitter Programming](#)
- Refer to [Control Module References](#) for body control module replacement, programming, and setup

KEYLESS ENTRY SYSTEM MALFUNCTION (PASSIVE)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The keyless entry antennas are used as short range low frequency transmitters. As a locked vehicle is approached with a keyless entry transmitter and a exterior door handle button/rear closure touch pad is pressed, the keyless entry antenna broadcasts a challenge to the transmitter in an approximate 1 meter range. If the response from the transmitter via radio frequency (RF) is valid, the door/rear closure will be passively unlocked

allowing access to the vehicle. A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Diagnostic Aids

Unwanted or inadvertent door lock/unlock activation may be requested by the OnStar® Remote Link app. It is possible that a customer may be unaware of account usage, result in an unwanted or phantom door lock/unlock. If normal system diagnosis does results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B3119, B3120, or B3121 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify that the transmitter is a correct transmitter for the vehicle. This can be accomplished by comparing the part number printed on the transmitter to the appropriate part number in the parts catalog.

- **If the transmitter is incorrect**

Replace the transmitter.

- **If the transmitter is correct**

4. Verify the scan tool Exterior Driver Door Handle Switch, Exterior Passenger Door Handle Switch, and Trunk Lid Exterior Unlatch Switch parameters change between Active and Inactive while operating their respective exterior door handle button/rear closure touch pad.

- **If any of the parameters does change**

Refer to [Exterior Door Handle Switch Malfunction](#) .

- **If all of the parameters change**

5. Lock the vehicle using the keyless entry transmitter.
6. Verify that each door and rear compartment unlocks and opens by approaching the vehicle with a valid transmitter and operating their respective exterior door handle button/rear closure touch pad.

- **If both doors and the rear compartment do not unlock/unlatch and open**

Refer to Passive Transmitter Malfunction.

- **If only one door or the rear compartment does not unlock/unlatch and open**

Refer to Antenna Circuit Malfunction.

- **If both doors and the rear compartment unlocks/unlatches and opens**

7. All OK.

Circuit/System Testing

Passive Transmitter Malfunction

1. Lock the vehicle using the keyless entry transmitter.
2. Verify that each door and rear compartment unlocks and opens by approaching the vehicle with a valid transmitter and operating their respective exterior door handle button/rear closure touch pad.
 - **If both doors and the rear compartment do not unlock/unlatch and open**
 1. Replace the transmitter battery.
 2. Lock the vehicle using the keyless entry transmitter.
 3. Verify that each door and rear compartment unlocks and opens by approaching the vehicle with a valid transmitter and operating their respective exterior door handle button/rear closure touch pad.
 - If both doors and the rear compartment do not unlock/unlatch and open, replace the transmitter.
 - If both doors and the rear compartment unlock/unlatch and open
4. All OK.
 - **If both doors and the rear compartment unlock/unlatch and open**
3. The concern may be caused by temporary RF interference. Discuss the conditions in which the concern occurs with the customer. RF interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could

lead to a malfunction.

Antenna Circuit Malfunction

1. Vehicle OFF, disconnect the harness connector at the inoperative T10 Keyless Entry Antenna, Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

3. Vehicle OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by operating the appropriate exterior door handle button/rear closure touch pad.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the low reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by operating the appropriate exterior door handle button/rear closure touch pad.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
 - **If 1 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If greater than 1 V**
10. Replace the appropriate T10 Keyless Entry Antenna.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by operating the appropriate exterior door handle button/rear closure touch pad.
12. Verify that the door/rear compartment unlocks and opens when the release handle/touch pad is operated.
 - **If the door/rear compartment does not unlock and open**

Replace the K84 Keyless Entry Control Module.
 - **If the door/rear compartment unlocks and opens**
13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Outside Handle Bracket Replacement \(Driver Side\)](#) [Front Side Door Outside Handle Bracket Replacement \(Passenger Side\)](#)
- Refer to [Control Module References](#) for replacement, programming, and setup

REMOTE VEHICLE START MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of each diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

Remote start begins as a radio frequency message received by the Body Control Module (BCM) from a keyless entry transmitter. The BCM monitors system conditions such as content theft deterrent, hood ajar status,

and body DTCs to determine if a remote start event will occur. If conditions are determined to be acceptable, the remote start message is sent to the Engine Control Module (ECM). The ECM monitors system conditions such as engine control parameters and the immobilizer system to determine if engine starting will be allowed. If conditions are acceptable, the ECM will activate the appropriate vehicle systems.

Diagnostic Aids

- The scan tool Body Control Module Remote Vehicle Start Disable History 1 Data and Remote Vehicle Start Disable History 2 Data lists can be used to help isolate an intermittent malfunction with remote vehicle starting. These data lists identify the status of various items that may disable remote vehicle starting during the past two remote vehicle start attempts. Any parameters that does not equal the expected result required for remote vehicle starting should be diagnosed in their respective subsection.
- Unwanted or inadvertent door lock/unlock activation may be requested by the OnStar® Remote Link app. It is possible that a customer may be unaware of account usage, result in an unwanted or phantom door lock/unlock. If normal system diagnosis does results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).
- A remote start event will not always start the vehicle engine. If the high voltage battery state of charge is sufficient to operate the vehicle systems or the vehicle is plugged in and the ambient air temperature is above -3°C (26°F), the engine will not start. This temperature is adjustable through vehicle personalization.
- If the vehicle has a current vehicle DTC that illuminates the malfunction indicator lamp, the cause of the DTC must be diagnosed before proceeding with the remote start malfunction diagnostic.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the scan tool Body Control Module Push Button Ignition Switch parameter changes between Active and Inactive when pressing and releasing the S38 Vehicle On/Off Switch.

- **If the parameter does not change**

Refer to [Vehicle Will Not Change Power Mode](#) .

- **If the parameter changes**

2. Verify that remote vehicle start is enabled through vehicle personalization.

- **If remote vehicle start is not enabled through vehicle personalization**

Use vehicle personalization to turn on remote vehicle start functionality. Refer to the vehicle owners manual.

- **If remote vehicle start is enabled**

3. Verify that the keyless entry functions operate with all available keyless entry transmitters.

- **If the keyless entry functions do not operate properly**

Refer to [Keyless Entry System Malfunction \(Active\)Keyless Entry System Malfunction \(Passive\)](#).

- **If the keyless entry functions operate properly**

4. Verify none of the conditions that prevent remote starting operation exist on the vehicle. Refer to [Keyless Entry System Description and Operation](#)

- **If any of the conditions are present**

Refer to the appropriate subsection in which the failure occurred or address the condition.

- **If none of the conditions are present**

5. All OK.

REPAIR INSTRUCTIONS

LOW FREQUENCY INSTRUMENT PANEL ANTENNA REPLACEMENT

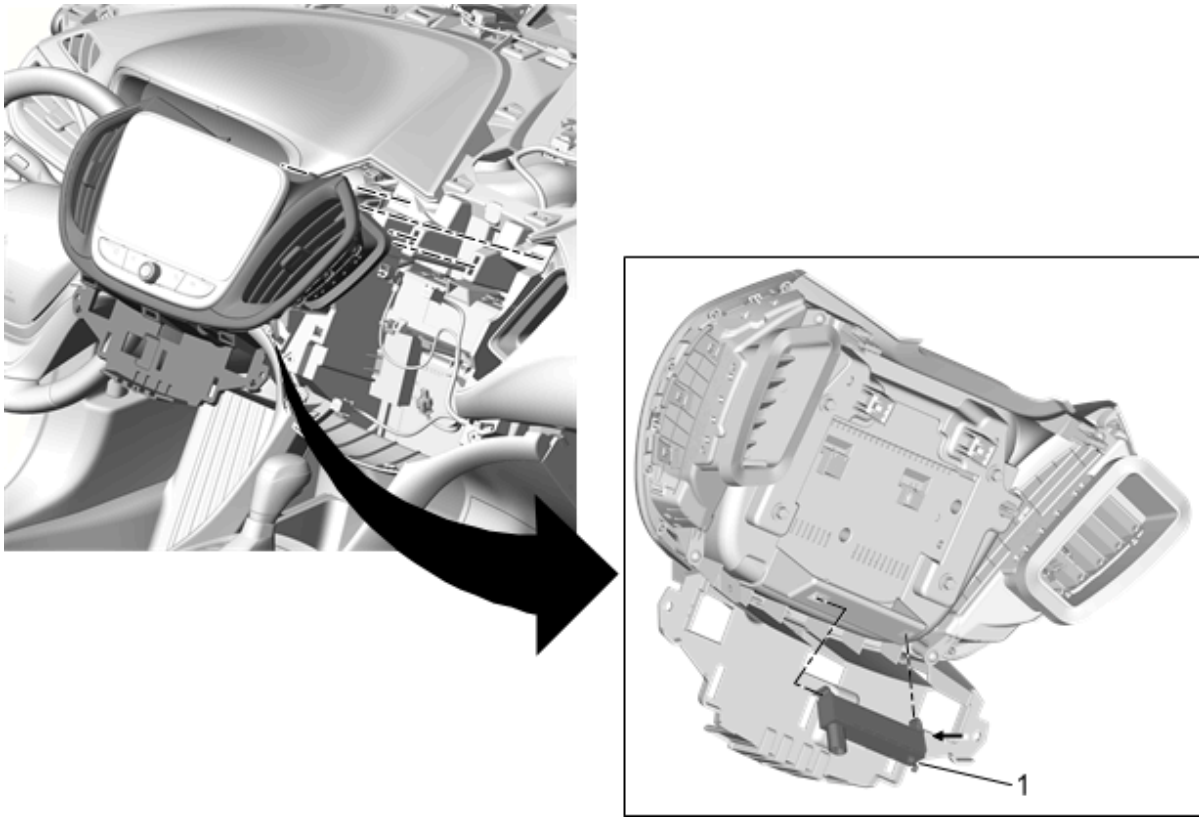


Fig. 3: Low Frequency Instrument Panel Antenna
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Center Air Outlet. Refer to <u>Instrument Panel Center Air Outlet Replacement</u>	
1	Low Frequency Instrument Panel Antenna Procedure Release the plastic retaining tabs.

LOW FREQUENCY CONSOLE ANTENNA REPLACEMENT

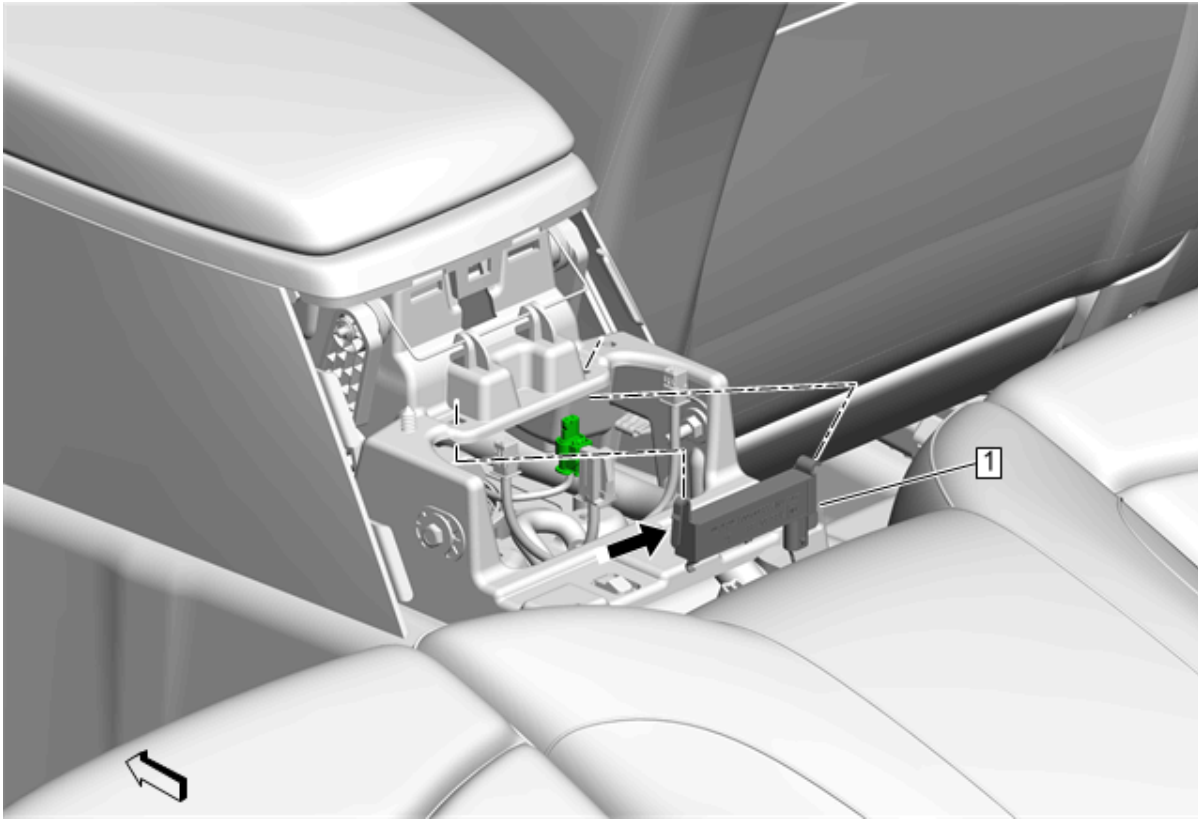


Fig. 4: Low Frequency Console Antenna
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Floor Console Rear Cup Holder. Refer to Front Floor Console Rear Cup Holder Replacement	
1	Low Frequency Console Antenna Procedure 1. Release the plastic retaining tabs. 2. Disconnect the electrical connector.

LOW FREQUENCY REAR COMPARTMENT ANTENNA REPLACEMENT

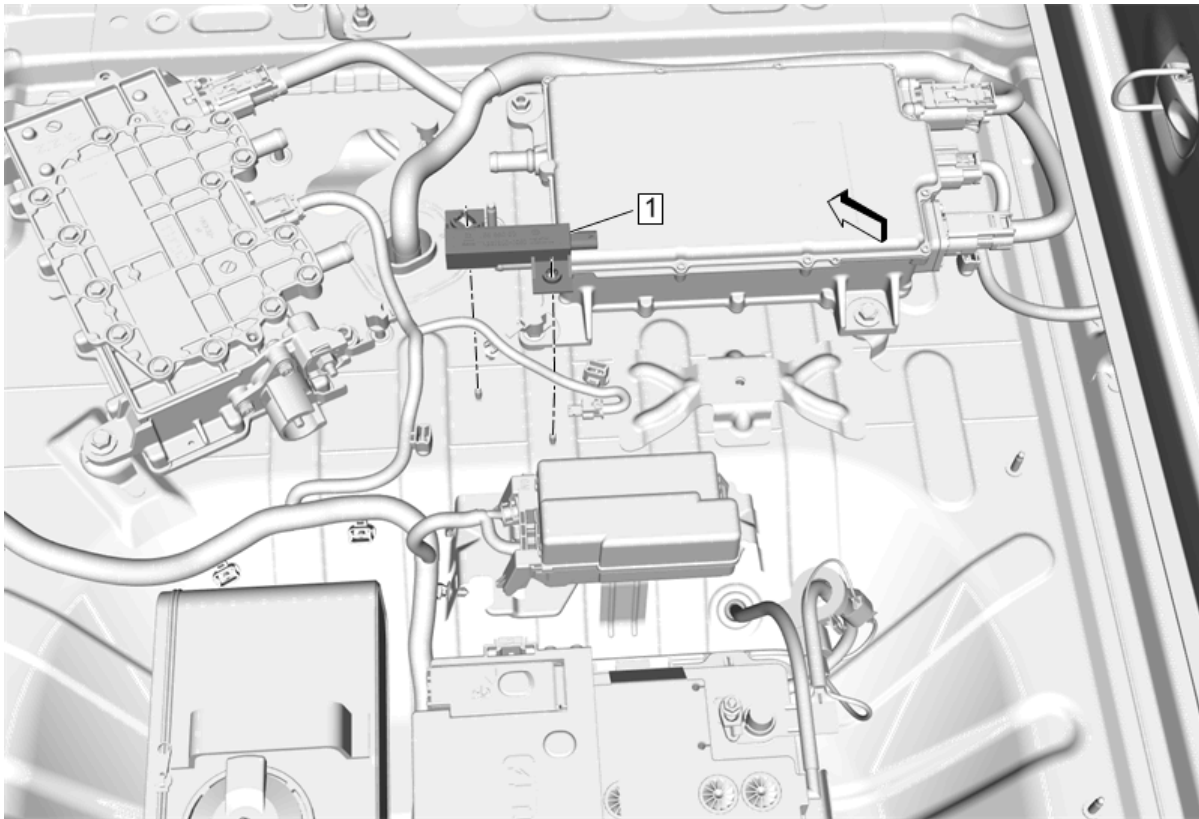


Fig. 5: Low Frequency Rear Compartment Antenna

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Compartment Floor Stowage Trim Compartment. Refer to <u>Rear Compartment Floor Stowage Trim Compartment Replacement</u>	
1	Low Frequency Rear Compartment Antenna Procedure 1. Release the plastic retaining tabs. 2. Disconnect the electrical connector.

LOW FREQUENCY REAR BUMPER ANTENNA REPLACEMENT

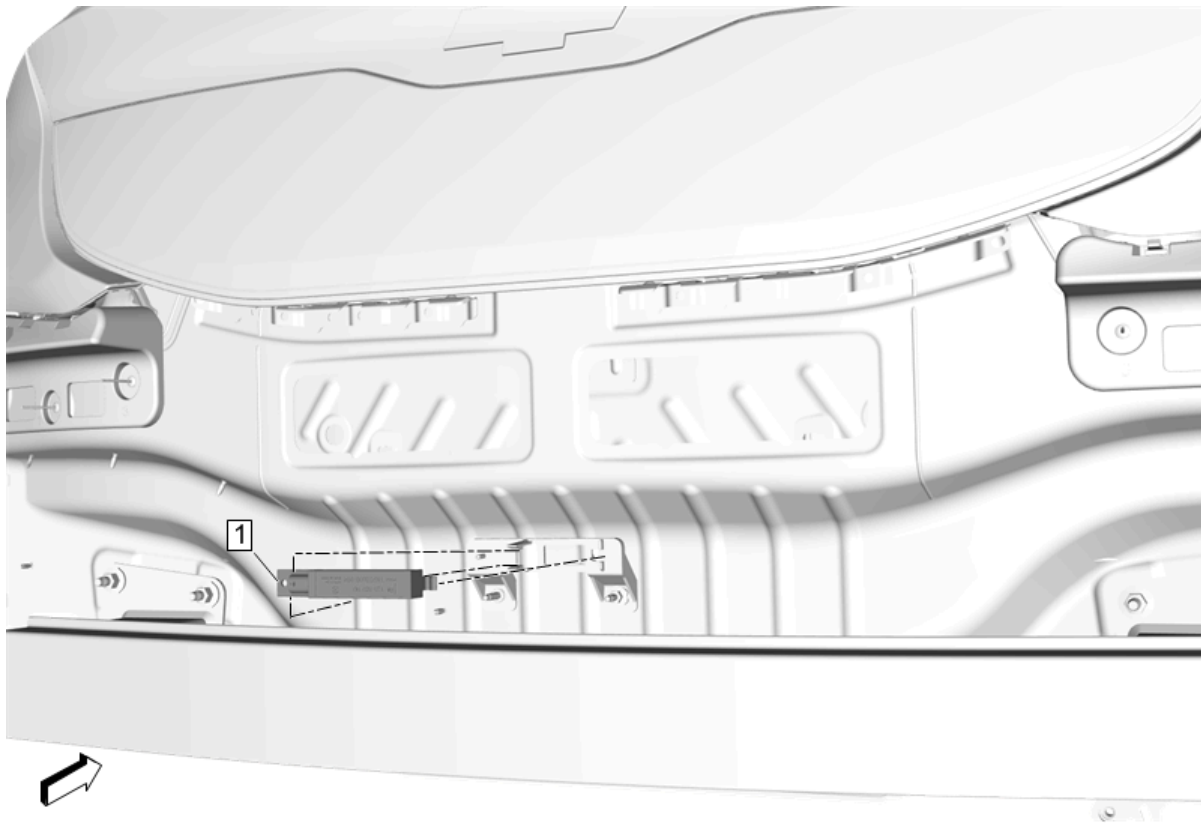


Fig. 6: Low Frequency Rear Bumper Antenna

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Fascia. Refer to Rear Bumper Fascia Removal and Installation	
1	Low Frequency Rear Bumper Antenna Procedure 1. Release the plastic retaining tabs. 2. Disconnect the electrical connector.

KEYLESS ENTRY CONTROL MODULE REPLACEMENT

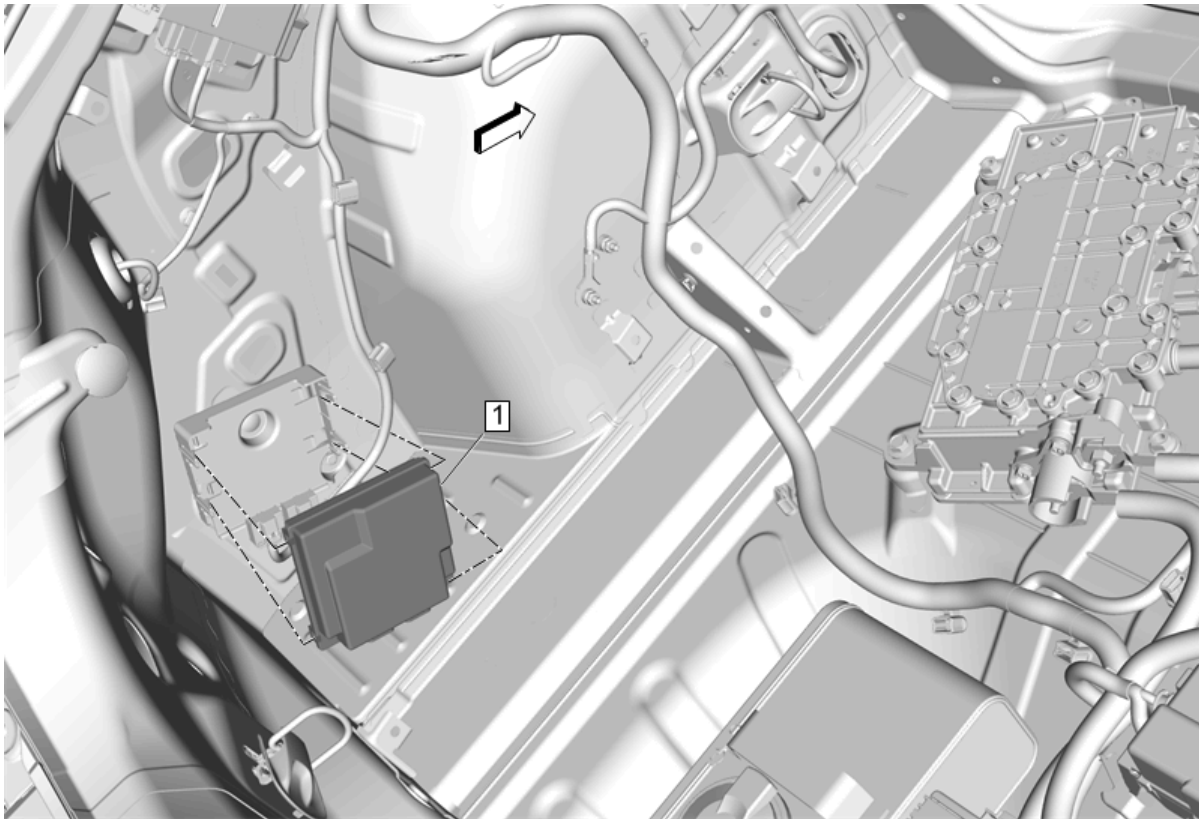


Fig. 7: Keyless Entry Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the left side quarter lower rear trim panel. Refer to Quarter Lower Rear Trim Panel Replacement (Left Side)	
1	Keyless Entry Control Module Procedure 1. Release the plastic retaining tabs. 2. Disconnect the electrical connectors. 3. Refer to Control Module References for programming and setup information, if required.

REMOTE CONTROL DOOR LOCK RECEIVER REPLACEMENT

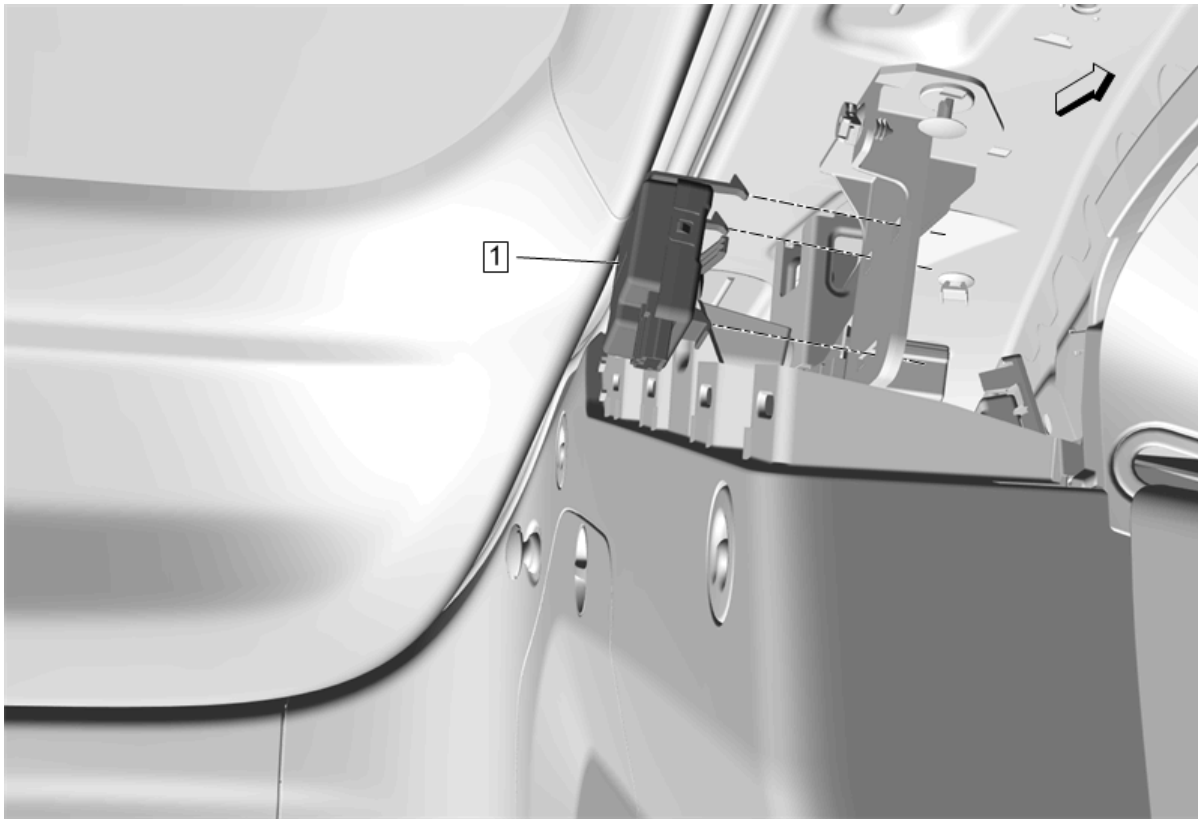


Fig. 8: Remote Control Door Lock Receiver

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the left side body lock pillar upper trim panel. Refer to Body Lock Pillar Upper Trim Panel Replacement	
1	Remote Control Door Lock Receiver Procedure 1. Disconnect the electrical connector. 2. Unsnap the 2 upper receiver tabs and tilt the receiver downward from the receiver bracket. 3. Refer to Control Module References for programming and set up, if required.

REMOTE CONTROL DOOR LOCK AND THEFT DETERRENT TRANSMITTER PROGRAMMING

Programming Transmitters

Transmitters can be programming in various ways using the procedures outlined below. Using the Replacing Transmitters procedures will first erase all the known transmitters from the vehicle. Any existing transmitters and any new transmitters will then be programmed. This procedure should be used any time a transmitter is required to be unlearned or erased from a vehicle. If a new transmitter is being learned to a vehicle to replace a damaged, inoperative, or stolen transmitter, the Replacing Transmitters procedure must be used. This ensures that the old transmitter cannot be used to access or start the vehicle after programming.

The Adding Transmitters procedure does not erase any transmitters prior to programming. The procedure will simply program the transmitter into the next available slot. The Adding Transmitters procedure should only be used when adding an additional transmitter to the vehicle. The Adding Keys procedure should never be used to program a transmitter to a vehicle that is having a transmitter replaced, regardless of the cause for the replacement.

Replacing Transmitters (Without SPS)

NOTE:

- **Verify all mechanical keys operate correctly before beginning any programming procedures.**
- **This procedure will unlearn all previously learned transmitters. All transmitters that are to be programmed must be with the vehicle at the time of service.**
- **This procedure will take approximately 35 minutes to complete.**
- **A total of 8 transmitters can be learned to a single vehicle.**
- **This procedure will only learn the vehicle transmitter information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **This procedure may be used with or without existing learned transmitters being present. If existing transmitters are present, keep the transmitters away from the vicinity of the vehicle. Failure to keep learned transmitters away from the vehicle will result in the learn changing to the Adding Transmitters procedure.**

1. Insert the mechanical key of the new transmitter into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The driver information center will display Remote Learn Pending, Please Wait.
2. After ten minutes, the driver information center will display Press Engine Start Button To Learn. Press the ignition mode switch. The driver information center will again display Remote Learn Pending, Please Wait.
3. Repeat Step 2 two additional times, for a total of thirty minutes. All previously known transmitters have now been unlearned. Remaining transmitters can be relearned during the next steps. The driver information center display will now display Ready For Remote # 1.

NOTE:

The transmitter pocket is located inside the center console storage area, near the front of the storage compartment. If a large keyring prevents the transmitter from being placed fully into the pocket, remove the keyring and place the transmitter in the pocket. Failure to lay the transmitter fully into the pocket may result in an inability to program.

4. Place the new transmitter into the transmitter pocket.
5. Press and release the ignition mode switch. When the transmitter is learned, the driver information center will indicate that it is ready to program the next transmitter.
6. Remove the transmitter from the transmitter pocket and press the unlock button. To program additional transmitters, repeat Steps 4 through 6.

7. When all additional transmitters are programmed, press and hold the ignition mode switch for 15 seconds to exit programming mode.
8. Verify each transmitter and key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter. On vehicles with a keyed ignition switch, verify the mechanical key by starting the vehicle using the ignition switch. When verifying operation, make sure that no other transmitters are near the vehicle.

Replacing Transmitters (With SPS)

NOTE:

- **Verify all mechanical keys operate correctly before beginning any programming procedures.**
- **This procedure will unlearn all previously learned transmitters. All transmitters that are to be programmed must be with the vehicle.**
- **This procedure may be used with or without existing learned transmitters being present.**
- **This procedure will take more than 15 minutes to complete.**
- **A total of eight transmitters can be learned to a single vehicle.**
- **This procedure will only learn the vehicle transmitter information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Delete) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the ignition to the run position. Make sure the vehicle is actually in the run mode before continuing on the SPS terminal. If the vehicle is not in the run mode, the learn procedure will fail. To verify the vehicle is in Run mode, verify the green LED is illuminated on the ignition mode switch.**
- **The transmitter pocket is located inside the center console storage area, near the front of the storage compartment. If a large keyring prevents the transmitter from being placed fully into the pocket, remove the keyring and place the transmitter in the pocket. Failure to lay the transmitter fully into the pocket may result in an inability to program.**

7. Follow the on-screen instructions.

8. After programming all transmitters, Programming Complete, is displayed.
9. Press and hold the ignition mode switch for 15 seconds.
10. Press the lock and unlock button on each transmitter that was programmed. This will awaken each transmitter and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each transmitter and key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter. On vehicles with a keyed ignition switch, verify the mechanical key by starting the vehicle using the ignition switch. When verifying operation, make sure that no other transmitters are near the vehicle.

Adding Transmitters (Without SPS)

NOTE:

- **Verify all mechanical keys operate correctly before beginning any programming procedures.**
- **To initiate, this procedure requires that 1 learned transmitter be available.**
- **A total of eight transmitters can be learned to a single vehicle.**
- **This procedure adds transmitters only. The procedure does not erase previously learned transmitters.**

1. Place the recognized transmitter(s) in the vehicle cupholder.
2. Insert the mechanical key of the new transmitter into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The driver information center will display Ready For Remote #2, 3, 4, etc.

NOTE:

The transmitter pocket is located inside the center console storage area, near the front of the storage compartment. If a large keyring prevents the transmitter from being placed fully into the pocket, remove the keyring and place the transmitter in the pocket. Failure to lay the transmitter fully into the pocket may result in an inability to program.

3. Place the new transmitter into the transmitter pocket.
4. Press and release the ignition mode switch. When the transmitter is learned, the driver information center will indicate that it is ready to program the next transmitter.
5. Remove the transmitter from the transmitter pocket and press the transmitter unlock button. To program additional transmitters, repeat Steps 3 through 5.
6. When all additional transmitters are programmed, press and hold the ignition mode switch for 15 seconds to exit programming mode.
7. Verify each transmitter and key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter. On vehicles with a keyed ignition switch, verify the mechanical key by starting the vehicle using the ignition switch. When verifying operation, make sure that no other transmitters are near the vehicle.

Adding Transmitters (With SPS)

NOTE:

- **Verify all mechanical keys operate correctly before beginning any programming procedures.**
- **This procedure may be used with or without existing learned transmitters being present.**
- **This procedure will take more than 15 minutes to complete.**
- **A total of eight transmitters can be learned to a single vehicle.**
- **This procedure will only learn the vehicle transmitter information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Add) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the ignition to the run position. Make sure the vehicle is actually in the run mode before continuing on the SPS terminal. If the vehicle is not in the run mode, the learn procedure will fail. To verify the vehicle is in Run mode, verify the green LED is illuminated on the ignition mode switch.**
- **The transmitter pocket is located inside the center console storage area, near the front of the storage compartment. If a large keyring prevents the transmitter from being placed fully into the pocket, remove the keyring and place the transmitter in the pocket. Failure to lay the transmitter fully into the pocket may result in an inability to program.**

7. Follow the on-screen instructions.
8. After programming all transmitters, Programming Complete, is displayed.
9. Press and hold the ignition mode switch for 15 seconds.
10. Press the lock and unlock button on each transmitter that was programmed. This will awaken each transmitter and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each transmitter and key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter. On vehicles with a keyed ignition switch, verify the mechanical key by starting the vehicle using the ignition switch. When verifying operation, make sure that no other transmitters are near the vehicle.

DESCRIPTION AND OPERATION

GARAGE DOOR OPENER DESCRIPTION AND OPERATION

The garage door opener is fixed and rolling code capable. Rolling code is a system that allows the code that the customers receiver receives from the garage door opener to change every time the garage door opener is used within operating range of the receiver. Rolling code programming requires the customer to push a learn/program button on the garage door opener receiver at their home. This button is usually located on the receiver unit under a cover (light cover) on one end of the unit. The customer must follow the garage door opener manufacturers instructions to program/learn the receiver to accept the Universal Home Remote System as an authorized opener for their unit. When the receiver and the garage door opener are initially programmed together, a code is established and a new code is created for every new transmission. The software in the receiver recognizes the garage door opener and accepts the new code.

The garage door opener is compatible with most, but not all types and brands of transmitters.

The garage door opener is a transmitter operating between 288 - 434 MHz. The power and range of the transmitter is limited to comply with laws governing the generation of radio frequency interference. The transmitter is programmed by the user to accept the signal generated by the user's transmitters.

The garage door opener has 3 buttons that may be programmed for individual transmitter/receiver combinations to control up to 3 garage door openers, security gates, lighting systems, etc. Each button represents a transmitter code section of the transmitter, which operates separately from any other button, and may be considered a separate transmitter. Operation consists of simply pressing a button to activate the corresponding transmitter.

NOTE: Do not use the garage door opener (GDO) with any garage door opener that does not have the stop and reverse safety feature. This includes any garage door opener model manufactured before April 1, 1982.

KEYLESS ENTRY SYSTEM DESCRIPTION AND OPERATION

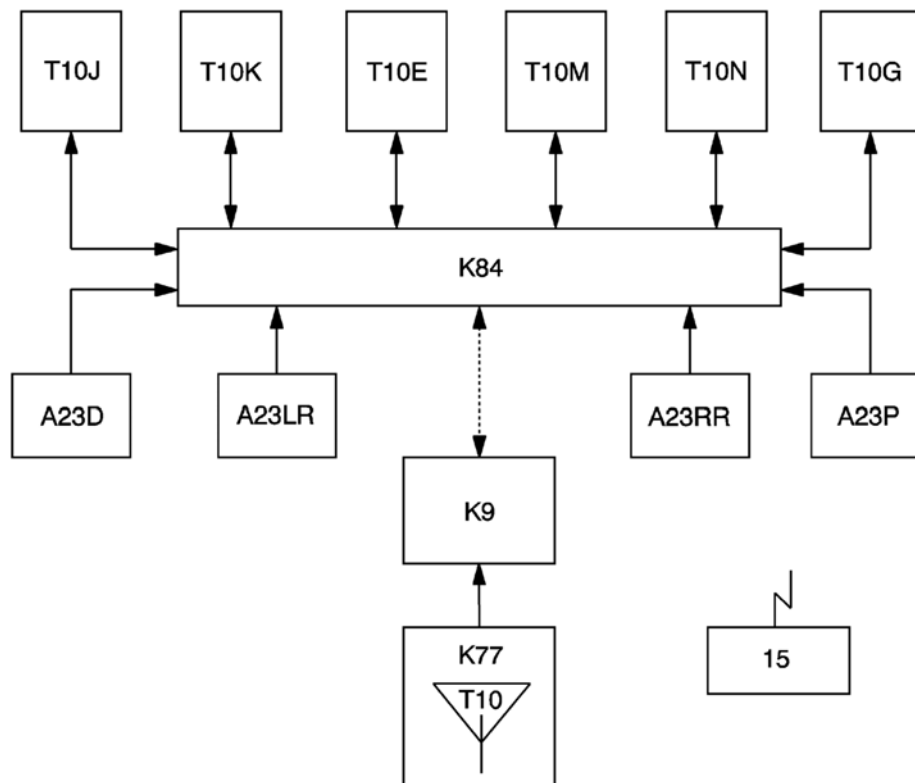


Fig. 9: Keyless Entry System Block Diagram
 Courtesy of GENERAL MOTORS COMPANY

Solid line - Hard Wire I/O	
Dash line - Serial Data	
A23D	Door Latch - Driver
A23LR	Door Latch - Left Rear
A23P	Door Latch - Passenger
A23RR	Door Latch - Right Rear
K9	Body Control Module (BCM)
K77	Remote Control Door Lock Receiver
K84	Keyless Entry Control Module
T10	Keyless Entry Antenna
T10E	Keyless Entry Antenna - Rear Compartment
T10G	Keyless Entry Antenna - Rear Fascia
T10J	Keyless Entry Antenna - Center Console Front
T10K	Keyless Entry Antenna - Center Console Rear
T10M	Keyless Entry Antenna - Driver Door Handle
T10N	Keyless Entry Antenna - Passenger Door Handle
15	Keyless Entry Transmitter

Keyless Entry System Description and Operation - Active

The keyless entry system is a vehicle entry device. The keyless entry system is used in conjunction with the door locks to unlock the vehicle. Keyless entry will lock/unlock the vehicle doors or open the rear compartment

lid when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the transmitter sending a radio frequency to the remote control door lock receiver antenna that has a direct link to the body control module (BCM). The BCM interprets the signal and activates the requested function or requests the appropriate control module to activate the function via a serial data message. A low transmitter battery or radio frequency interference from aftermarket devices, such as 2-way radios, power inverters, computers, etc., may cause a system malfunction. High radio frequency traffic areas, such as gas stations that use pay-at-the-pump radio frequency transponders, may also cause interference that could lead to a malfunction. Keyless entry allows you to operate the following features:

- Door lock/unlock
- Remote start
- Charge port door release
- Illuminated entry lamps
- Panic alarm/vehicle locator
- Remote vehicle start

Keyless Entry System Description and Operation - Passive

Passive keyless entry allows entry to a locked vehicle without pressing any buttons on the keyless entry transmitter. You must only have the transmitter with you. The passive entry system use low frequency antennas in several different areas on the vehicle to determine the location of the transmitter. When passively opening a locked door or the rear compartment, you must have a programmed transmitter with you in your pocket, purse, or briefcase.

When an exterior door handle button is pressed or the rear compartment touch pad is pressed, the low frequency antenna sends out a challenge to the keyless entry transmitter. Because of the low frequency, communication range is limited. The antenna will emit the challenge in a one meter range. The transmitter must be within this range to receive the challenge. The transmitter receives this challenge and emits it's response as an RF message, which is received by the remote control door lock receiver. If the response is correct, the door or rear compartment will unlock and open.

As a customer convenience feature, the keyless entry system will notify the driver if the transmitter has been left in the vehicle after exiting by chirping the vehicle horn three times. This may be turned off using vehicle personalization. Also, if the transmitter is left in the vehicle after the central door lock switch has been used to lock the vehicle, the driver door will remain unlocked after exiting the vehicle. This is intended to prevent locking the transmitter in the vehicle and being unable to access it.

Keyless Entry System Description and Operation - Keyless Start

The keyless start portion of the keyless entry system allows vehicle starting, having only the transmitter as your key. The keyless start system uses low frequency antennas in three different locations on the vehicle to determine the location of the transmitter. Multiple antennas are used to ensure complete coverage of the vehicle interior and rear compartment. When using the keyless start system, a programmed transmitter must be in the vehicle's interior, such as the driver's pocket, purse, or briefcase.

When the ignition mode switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits it's response as an RF message, which is received by the remote control door lock receiver. If the response is correct, vehicle starting will be allowed. If RF

communication is interrupted, a "No Remote Detected" message will be displayed on the DIC. In these cases, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat. The immobilizer antenna coil is located directly beneath the transmitter slot. Placing the extended key blade in the slot will create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The keyless entry system has the following components:

- Vehicle key with integrated keyless entry transmitter
- Driver and front passenger door antennas (part of the door handle assembly)
- Driver and front passenger door handle switches (part of the door handle assembly)
- Rear fascia antenna
- Front instrument panel console antenna
- Center console antenna
- Rear compartment antenna
- Body control module (BCM)
- Keyless entry control module
- Immobilizer antenna coil
- Remote control door lock receiver

Keyless Entry Transmitters

The keyless entry transmitters are used to lock and unlock the vehicle door while away from the immediate area of the vehicle. Keyless entry functions may work at up to 20 m (65 ft) from the vehicle. The keyless entry transmitter is an integral part of the vehicle key.

Door Antenna

The keyless entry door antennas are used to transmit low frequency communications to the keyless entry transmitters.

The keyless entry door antennas are located in the left front and right front exterior door handle bracket. The antennas are serviced as part of the door handle assembly. The antennas are controlled by the keyless entry control module. When the exterior door handle button is pressed, the respective antenna will send out a challenge to the keyless entry transmitter, which begins the passive entry communications.

Rear Fascia Antenna

The rear fascia antenna is used to transmit low frequency communication to the keyless entry transmitters for entry to rear compartment.

The rear fascia antenna is located behind the rear fascia. The antenna is controlled by the keyless entry control module. When the rear compartment touch pad is pressed, the antenna sends out a challenge to the keyless entry transmitter, which begins the passive entry communications.

Front Console Passive (Instrument Panel) Antenna

This antenna is located in the lower instrument panel near the front of the center console.

The front console antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Center Console Antenna

This antenna is located in the rear of the center console.

The rear console antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Rear Compartment Antenna

This antenna is located in the center of the rear compartment metal floor pan, near the seatback.

The rear compartment antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Remote Control Door Lock Receiver

The remote control door lock receiver is located on the vehicle windshield, directly in front of the inside rearview mirror.

The remote control door lock receiver is control by and directly communicates with the body control module (BCM). When the transmitter receives a low frequency challenge from an antenna, it responds with an RF message. This RF message is received by the remote control door lock receiver and communicated to the BCM. If the RF message is a valid response to the low frequency challenge, vehicle access or starting will be allowed.

Immobilizer Antenna Coil Assembly

The keyless entry immobilizer coil assembly is located in the upper instrument panel, directly beneath the upper instrument panel storage compartment. If the transmitter battery is dead, weak, or the RF signal is being interrupted, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat, to create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The immobilizer antenna coil is controlled by the BCM. The immobilizer control module is also active when learning vehicle keys.

Keyless Entry Control Module

The keyless entry control module is a multi-function module which performs the following keyless entry system functions:

- Activating vehicle antennas for passive keyless entry functions
- Activating vehicle antennas for keyless start functions

- Backup control for the ECM accessory wakeup and the run/crank relay
- If equipped, controls the electronic steering column lock
- Receiver of the exterior door handle switch inputs and door open switch (not the door ajar switch)
- Ignition mode switch monitoring

OnStar® Remote Link (if equipped)

A vehicle operator may have the ability to perform some of the keyless entry functions using applications on personal devices such as but not limited to smart phones. A condition may appear as if there is a malfunction in the vehicle. If it is suspected that this may be the case contact Technical Assistance if a condition cannot be determined through normal vehicle diagnostics.

Body Control Module (BCM)

The BCM is a multi-function module that performs the following functions:

- Receive and authenticate active transmitter and keyless start signals from the remote control door lock receiver
- Determines the functionality requested by the transmitter signal
- Performs the function requested by the transmitter signal

Unlock Driver Door Only - Active

Momentarily press the transmitter UNLOCK button to perform the following functions:

- Unlock only the driver door
- Illuminate the interior lamps for a determined length of time or until the ignition mode switch is pressed
- Flash the exterior lights, if enabled through personalization
- Disarm the content theft deterrent system
- Deactivate the content theft deterrent system when in the alarm mode

Unlock All Doors - Second Operation - Active

Momentarily press the transmitter UNLOCK button a second time, within 5 seconds of the first press, to perform the following function:

Unlock the remaining doors and rear compartment

Unlock Driver Door Only - Passive

If enabled through personalization, approach the driver door with a valid keyless entry transmitter and press the door handle button to perform the following functions:

- Unlock and open only the driver door when door handle is operated
- Disarm the content theft deterrent system, if equipped
- Deactivate the content theft deterrent system when in the alarm mode

Unlock All Doors - Passive

Approach any non driver door (front or rear) or, if enabled through personalization, the driver door with a valid keyless entry transmitter and press the door handle button to perform the following functions:

- Unlock all vehicle doors and rear compartment
- Disarm the content theft deterrent system, if equipped
- Deactivate the content theft deterrent system when in the alarm mode

Lock All Doors - Active

Press the transmitter LOCK button to perform the following functions:

- Lock all vehicle doors
- Immediately turn off the interior lamps
- Flash the exterior lights, if enabled through personalization
- Chirp the horn, if enabled through personalization
- Arm the content theft deterrent system

Lock All Doors - Passive

Exit the vehicle (with vehicle off) with the keyless entry transmitter to automatically perform the following functions, if equipped.

- Lock all vehicle doors and rear compartment after a delay
- Flash the exterior lights, if enabled through personalization
- Chirp horn, if enabled through personalization
- Arm the content theft deterrent system

When all doors are closed, they can also be locked from the exterior by pressing the door handle button while having a valid transmitter within range.

If more than one keyless entry transmitter is within a vehicle and the keyless entry system detects that one or more transmitters have been left in the vehicle after vehicle is locked, any transmitter left within the vehicle will be temporarily deactivated until:

- A button on the deactivated transmitter is pressed (will only activate the transmitter whose button is pressed)
- A passive unlock of vehicle occurs
- Change in power mode occurs

Rear Compartment Release - Passive

Approach the rear of the vehicle with a valid keyless entry transmitter. Press the trunk release touch pad. The trunk will open.

Vehicle Locator/Panic Alarm/Active

A single press of the panic button performs the following functions. Some functions may be dependent on personalization settings:

- Pulses the horn three times
- Flashes the exterior lamps three times

A press and hold of the panic button performs the following functions:

- Pulses the horn and flashes the parking lamps for 30 second or until the following conditions occur:
 - The panic button is pressed
 - The ignition mode switch is pressed with a valid key in the vehicle

Remote Start

The remote vehicle start function allows engine starting while not in the vehicle. It also allows the vehicle HVAC system and other vehicle systems to enable, providing a comfortable vehicle upon entry. The remote vehicle start sequence begins by pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the keyless entry transmitter. The turn signal lamps will illuminate to indicate the vehicle has received the remote start request. Each time a remote vehicle start is performed, the vehicle doors are locked, however they may then be unlocked/locked with the transmitter at any time. Only the first and second vehicle transmitters are able to control the remote vehicle start function. Any additional remote transmitters programmed to the vehicle will perform all other remote functions. Once activated, the engine is allowed to run for 10 minutes. The remote vehicle start time may be extended by an additional 10 minutes by again pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the transmitter. This feature is called a remote vehicle start continue and allows a maximum of 20 minutes of engine running. If the remote vehicle start continue is performed at 7 minutes into the initial 10 minute time-out, a total of 17 minutes of engine running would occur. The remote vehicle start event may be suspended at any time by pressing only the remote vehicle start button on the transmitter or by entering the vehicle and turning ON the hazard lamps.

In between ignition cycles, only two remote start events may occur or be attempted. Once two events or attempts have been made, future remote start events will be suspended until the vehicle is operated using the ignition mode switch.

Enable/Disable Remote Start

Using the driver information center, remote start may be enabled or disabled as a part of vehicle personalization. Refer to the vehicle owners manual for more information.

Remote Start System Disabled

If any of the conditions listed below occur, a remote start event may be aborted or canceled:

- Vehicle is in valet mode
- Vehicle doors are ajar
- Rear compartment lid is ajar
- The hood is open
- The doors are not locked
- The hazard switch is ON
- Vehicle power mode is incorrect
- Vehicle speed is greater than 0

- Transmission is not in P
- Excessive engine coolant temperature
- Low oil pressure
- The malfunction indicator lamp (MIL) is commanded ON
- The low fuel level indicator lamp is commanded ON
- Engine crank time is greater than 30 seconds
- Excessive engine speed
- Accelerator pedal position too high
- Remote start timer equals 0
- Immobilizer system indicates a theft attempt
- Vehicle propulsion system fault conditions
- High voltage battery fault conditions

Keyless Entry Personalization

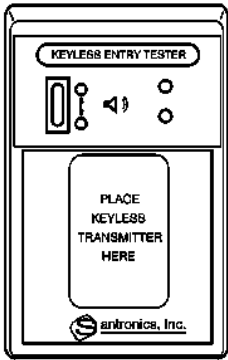
Vehicle lock/unlock functions and remote start settings may be personalized for the vehicle. For functional descriptions and programming instructions, refer to the vehicle owners manual.

Replace Battery in Remote Key Message

A REPLACE BATTERY IN REMOTE KEY message may be seen on the driver information center when the transmitter's battery voltage has been lower than 2.16 volts for three consecutive ignition cycles.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	EL 43241 Keyless Entry Tester

ACCESSORIES & EQUIPMENT

Seat Hardware, Trim, and Upholstery - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Driver or Passenger Seat Back Cushion Frame Bolt	35 N.m (26 lb ft)
Driver or Passenger Seat Bolt	45 N.m (33 lb ft)
Driver or Passenger Seat Inner Adjuster Front Finish Cover Fastener	2.5 N.m (22 lb in)
Front Seat Adjuster Handle Fastener	2.5 N.m (22 lb in)
Front Seat Belt Anchor Plate Tensioner Cover Fastener	2.5 N.m (22 lb in)
Front Seat Cushion Outer Finish Cover Fastener	2.5 N.m (22 lb in)
Front Seat Vertical Actuator Handle Fastener	2.5 N.m (22 lb in)
Front Seat Vertical Actuator Lever Fastener	2.5 N.m (22 lb in)
Rear Seat Armrest Bracket Fastener	3 N.m (27 lb in)
Rear Seat Armrest Fastener	3 N.m (27 lb in)
Rear Seat Back Bolster Fastener	9 N.m (80 lb in)
Rear Seat Back Cushion Hinge Fastener	45 N.m (33 lb ft)
Rear Seat Back Latch Fastener	45 N.m (33 lb ft)

DIAGNOSTIC INFORMATION AND PROCEDURES

SEAT - HARD TO MOVE FORWARD AND REARWARD

Condition	Action
NOTE: Replace all seat adjusters as an assembly. Replace both sides at	

the same time.	
The adjusters are not in parallel alignment with each other.	1. Loosen the floor pan attaching bolts. 2. Position the seat fully forward. 3. Tighten the bolts. Refer to Driver or Passenger Seat Removal and Installation.

SEATS - ADJUSTER TRACK LOCKS AHEAD OF OTHER TRACK

Condition	Action
NOTE: Replace all seat adjusters as an assembly. Replace both sides at the same time.	
The adjusters are out of time.	Remove and reinstall the front bucket seat. Refer to Driver or Passenger Seat Removal and Installation .

REPAIR INSTRUCTIONS

DRIVER OR PASSENGER SEAT REMOVAL AND INSTALLATION

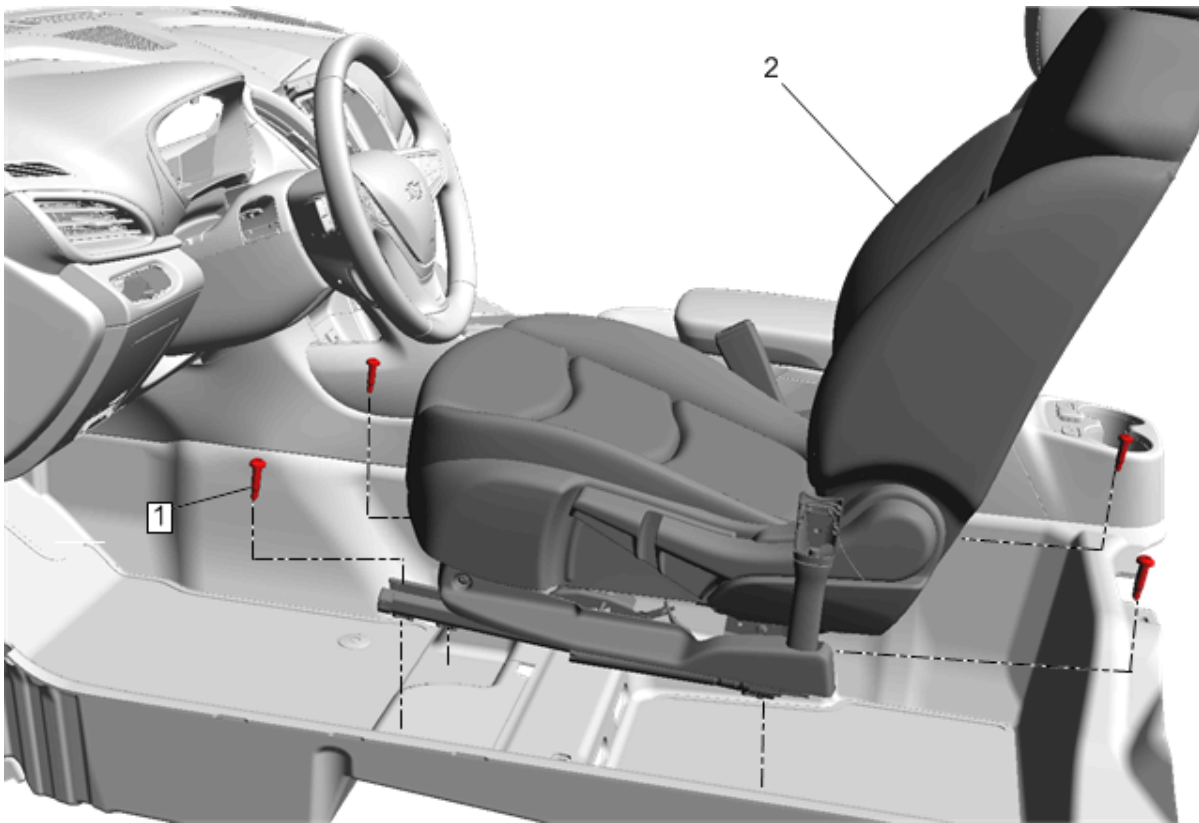


Fig. 1: Driver or Passenger Seat
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Disable SIR system. Refer to SIR Disabling and Enabling 2. Disconnect the seat belt from the tensioner. Refer to Front Seat Belt Retractor Replacement	
1	Driver or Passenger Seat Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Procedure Adjust the seat to the full forward position to gain access to the rear bolts. Tighten 45 N.m (33 lb ft)

Callout	Component Name
2	Driver or Passenger Seat Procedure 1. Disconnect the electrical connector. 2. With the aid of an assistant, remove the front seat.

DRIVER OR PASSENGER SEAT INNER ADJUSTER FRONT FINISH COVER REPLACEMENT

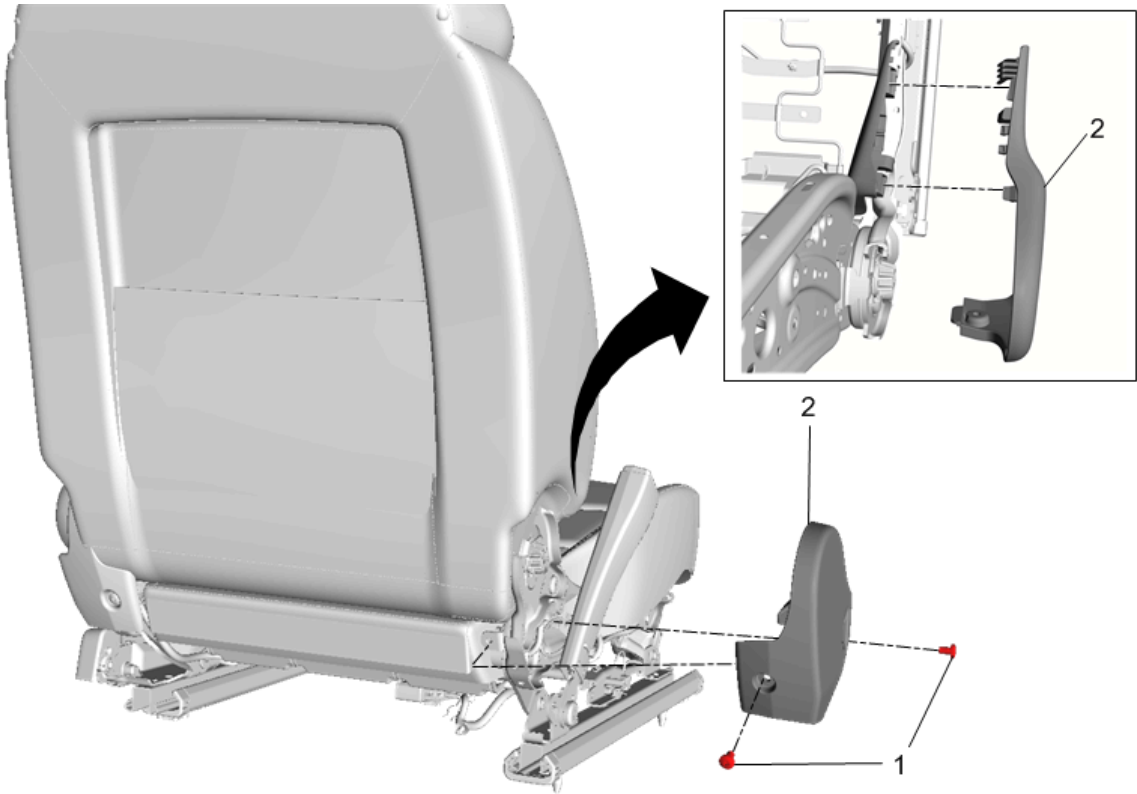


Fig. 2: Driver or Passenger Seat Inner Adjuster Front Finish Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Driver or Passenger Seat. Refer to Driver or Passenger Seat Removal and Installation	
1	Driver or Passenger Seat Inner Adjuster Front Finish Cover Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten

Callout	Component Name
	2.5 N.m (22 lb in)
2	Driver or Passenger Seat Inner Adjuster Front Finish Cover Procedure Use a suitable tool to separate the seat inner adjuster front finish cover.

DRIVER OR PASSENGER SEAT ADJUSTER VERTICAL ACTUATOR HANDLE REPLACEMENT

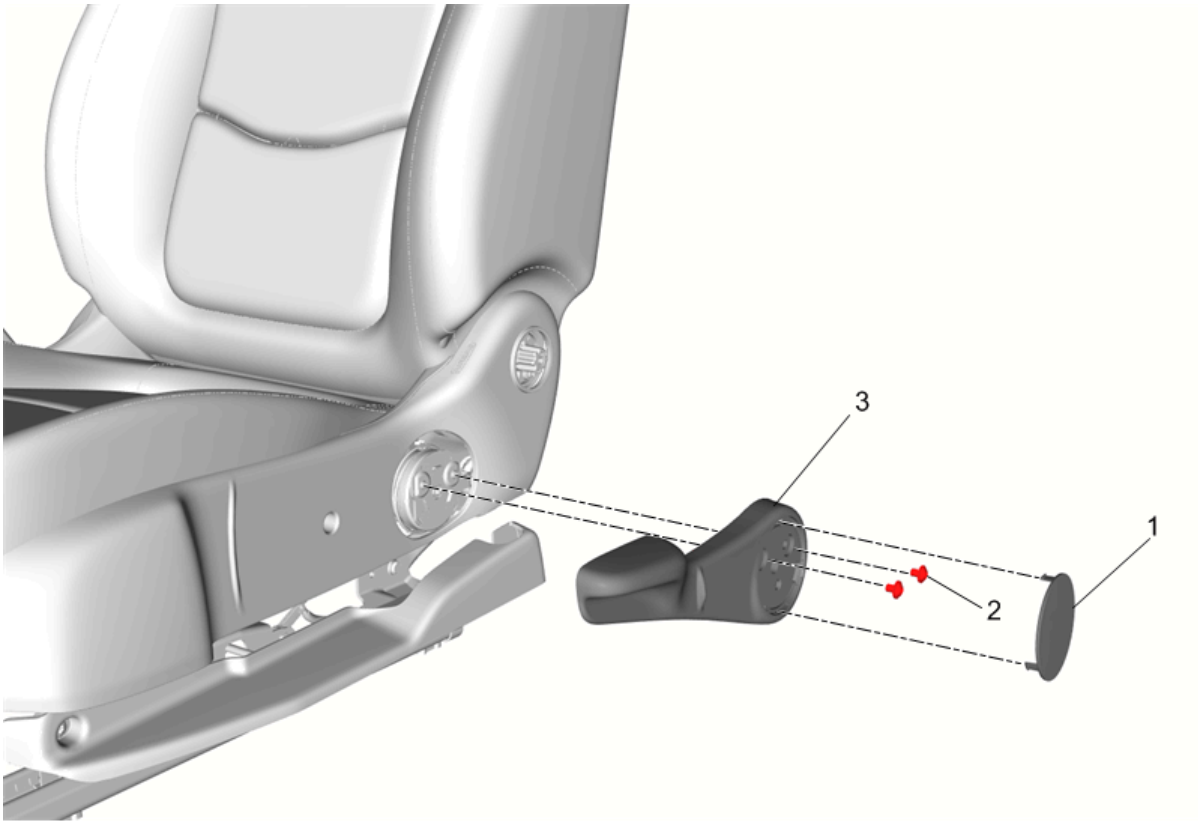


Fig. 3: Driver or Passenger Seat Adjuster Vertical Actuator Handle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Driver or Passenger Seat Adjuster Handle. Refer to Driver or Passenger Seat Adjuster Handle Replacement	
1	Front Seat Vertical Actuator Handle Cap
2	Front Seat Vertical Actuator Handle Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)

Callout	Component Name
3	Driver or Passenger Seat Vertical Actuator Handle

DRIVER OR PASSENGER SEAT ADJUSTER HANDLE REPLACEMENT

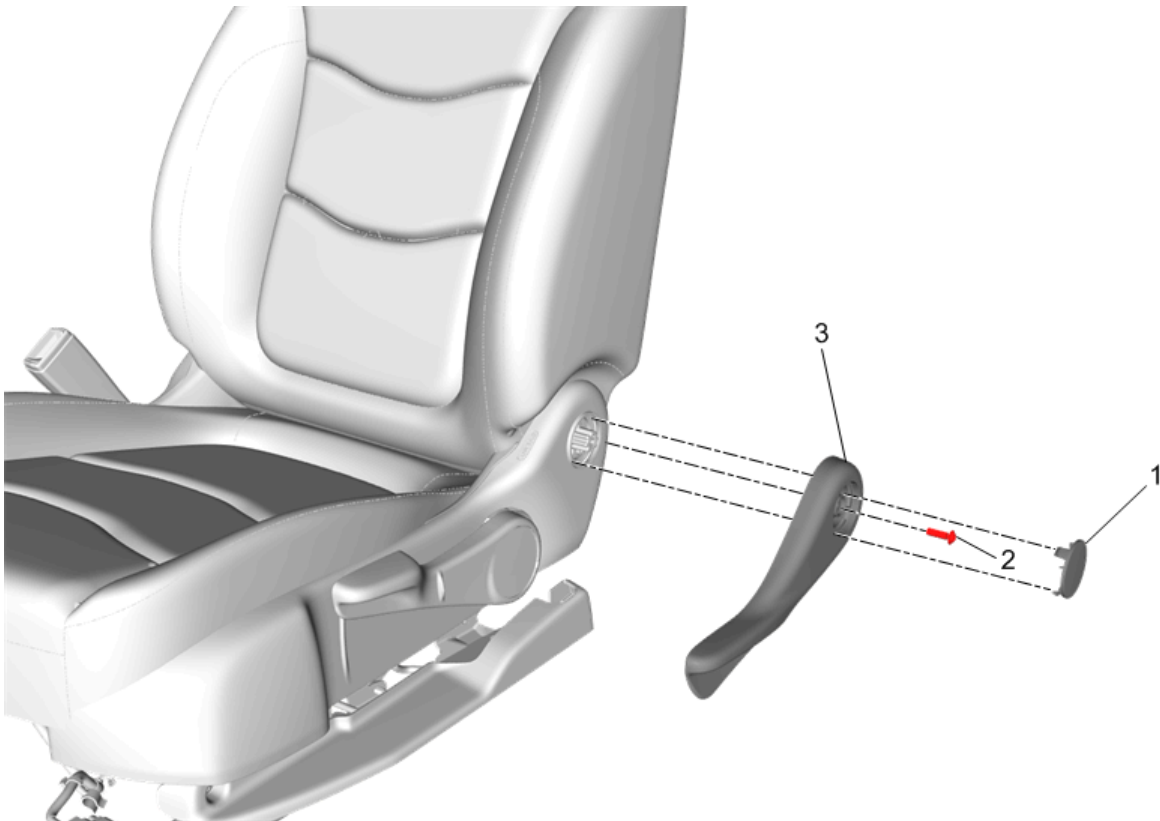


Fig. 4: Driver or Passenger Seat Adjuster Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Adjuster Finish Cover Bolt Cap
2	Front Seat Adjuster Handle Fastener CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
3	Front Seat Adjuster Handle

DRIVER OR PASSENGER SEAT HEAD RESTRAINT REPLACEMENT

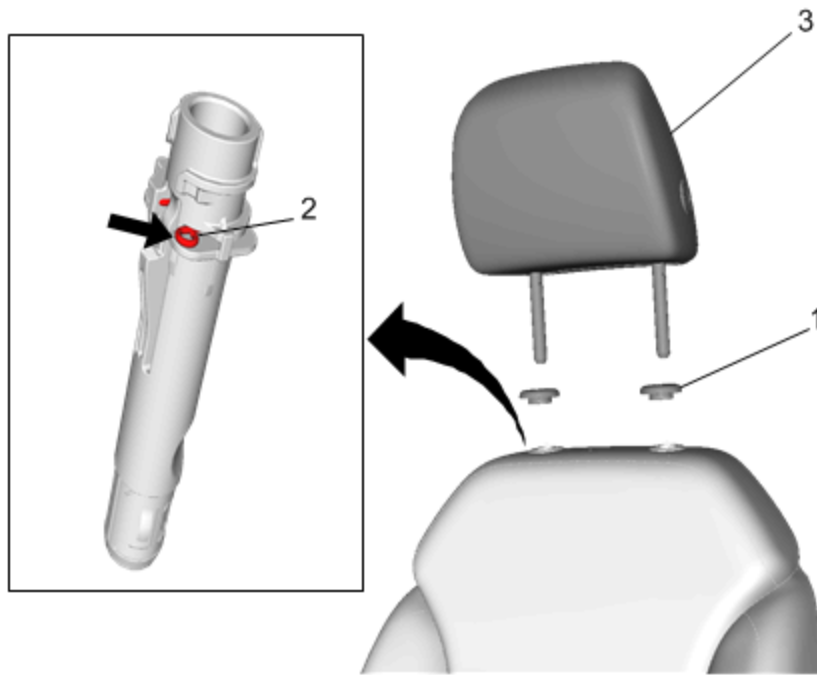


Fig. 5: Driver or Passenger Seat Head Restraint
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Driver or Passenger Front Seat Head Restraint Guide Bezel (Qty: 2) Procedure 1. Raise the headrest to gain access to the head restraint guide bezel. 2. Twist the bezel counter clockwise and push the bezel upward on the head restraint adjuster rod.
2	Driver or Passenger Seat Head Restraint Clip (Qty: 2) Procedure Using a suitable pointed or flat bladed tool, push the metal clip rearward while pulling upward on the head restraint.
3	Driver or Passenger Seat Head Restraint

FRONT SEAT BELT ANCHOR PLATE TENSIONER COVER REPLACEMENT



Fig. 6: Front Seat Belt Anchor Plate Tensioner Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Belt Anchor Plate Tensioner Cover Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Seat Belt Anchor Plate Tensioner Cover Procedure Unclip and reposition the electrical harness from the seat belt anchor plate tensioner cover.

DRIVER OR PASSENGER SEAT CUSHION FRAME REPLACEMENT

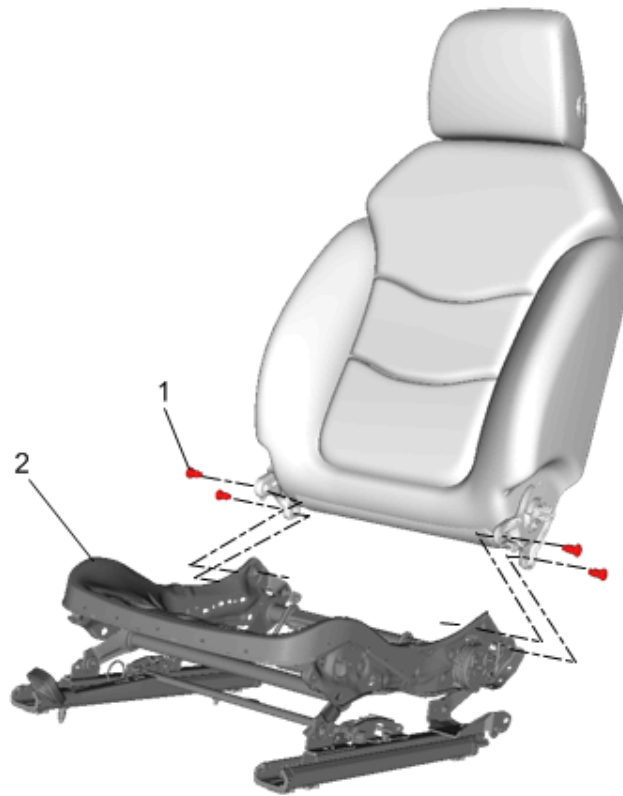


Fig. 7: Driver or Passenger Seat Cushion Frame

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Remove Driver or Passenger Seat. Refer to Driver or Passenger Seat Removal and Installation 2. Remove Front Seat Belt Anchor Plate Tensioner. Refer to Front Seat Belt Anchor Plate Tensioner Replacement 3. Remove Front Seat Belt Buckle. Refer to Front Seat Belt Buckle Replacement 4. Remove Front Seat Cushion Cover and Pad. Refer to Front Seat Cushion Cover and Pad Replacement	
1	Driver or Passenger Seat Back Cushion Frame Bolt (Qty: 4) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 35 N.m (26 lb ft)
2	Driver or Passenger Seat Cushion Frame Procedure 1. Disconnect the electrical connector. 2. Transfer components as necessary.

FRONT SEAT CUSHION PAD SUPPORT REPLACEMENT



Fig. 8: Front Seat Cushion Pad Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . Preliminary Procedure Remove Front Seat Cushion Cover and Pad. Refer to Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Cushion Pad Support Procedure Disconnect and reposition harness as necessary.

FRONT SEAT CUSHION OUTER FINISH COVER REPLACEMENT

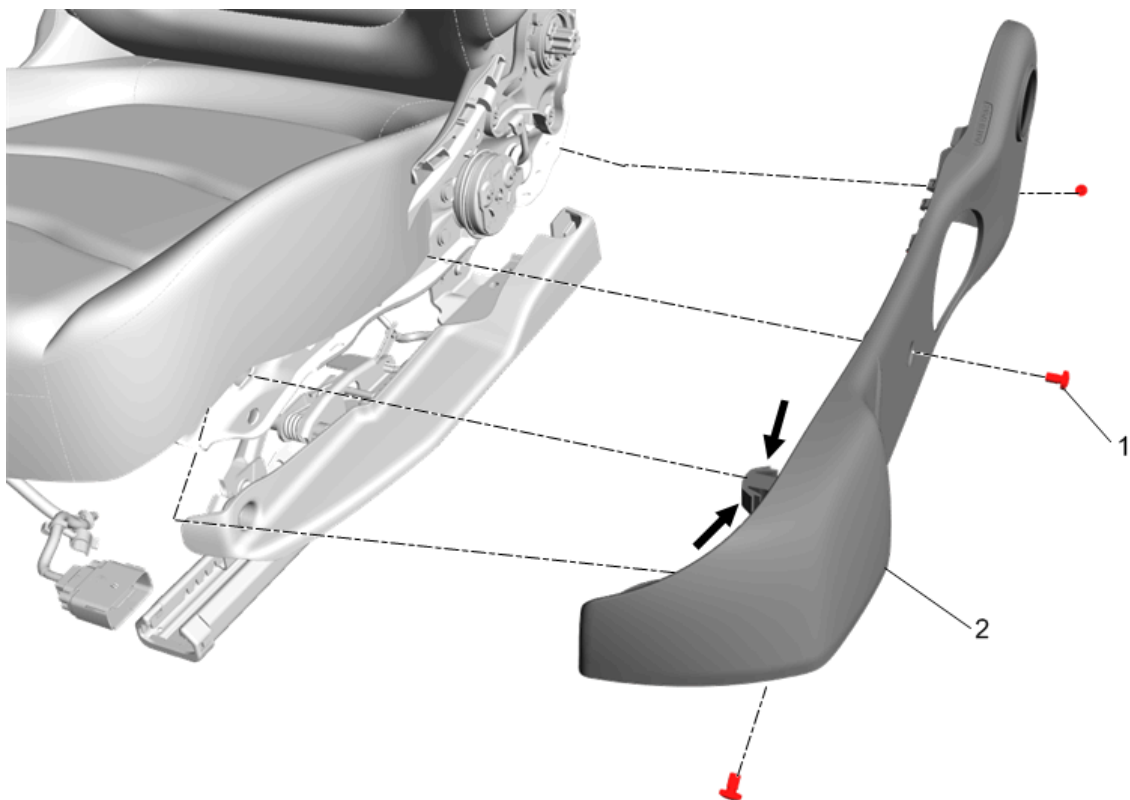


Fig. 9: Front Seat Cushion Outer Finish Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Driver or Passenger Seat Adjuster Vertical Actuator Handle. Refer to Driver or Passenger Seat Adjuster Vertical Actuator Handle Replacement	
1	Front Seat Cushion Outer Finish Cover Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Front Seat Cushion Outer Finish Cover Procedure Squeeze retainer to release.

FRONT SEAT CUSHION COVER AND PAD REPLACEMENT

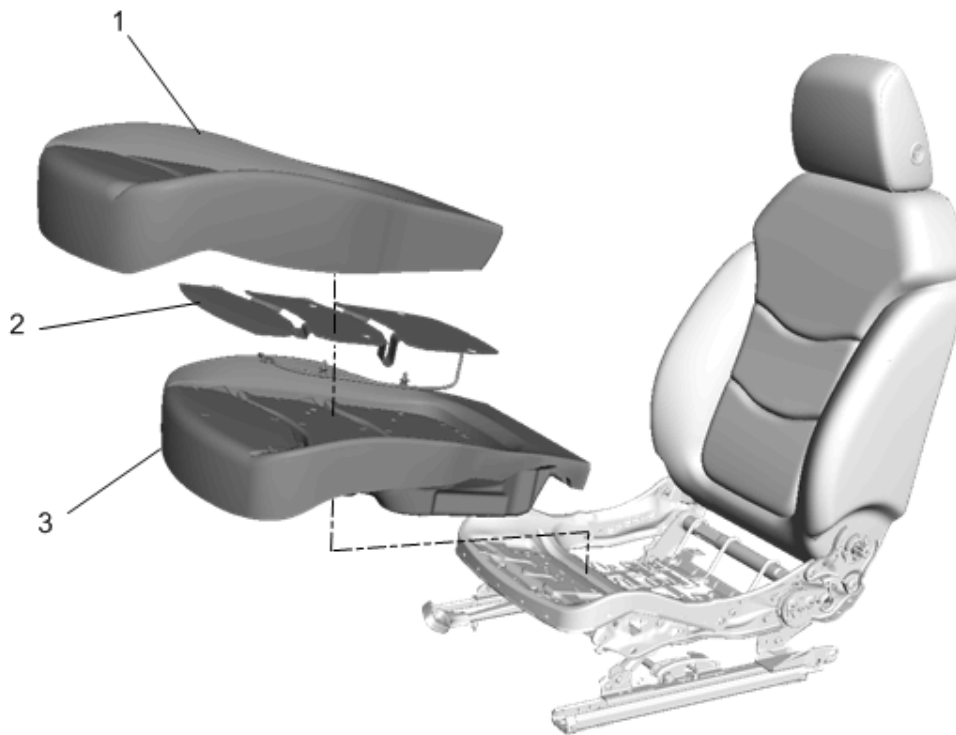


Fig. 10: Front Seat Cushion Cover and Pad
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Remove Driver or Passenger Seat. Refer to Driver or Passenger Seat Removal and Installation 2. Remove Driver or Passenger Seat Inner Adjuster Front Finish Cover. Refer to Driver or Passenger Seat Inner Adjuster Front Finish Cover Replacement 3. Remove Front Seat Cushion Outer Finish Cover. Refer to Front Seat Cushion Outer Finish Cover Replacement	
1	Front Seat Cushion Cover Procedure 1. Disengage the J-channel retainers from the seat cushion frame. 2. Disconnect the electrical connectors that attach to the seat cushion, if equipped. 3. Remove the seat cushion cover and pad from the seat cushion frame as an assembly. 4. Remove the hog rings and separate the seat cushion cover from the seat cushion pad by pulling the cover away from the pad.

Callout	Component Name
	5. If servicing the passenger seat, re-zero the passenger presence system. Refer to Passenger Presence System Rezeroing
2	Front Seat Cushion Heater Install Front Seat Cushion Heater. Refer to Front Seat Cushion Heater Replacement
3	Front Seat Cushion Pad

FRONT SEAT BACK CUSHION PAD SUPPORT REPLACEMENT

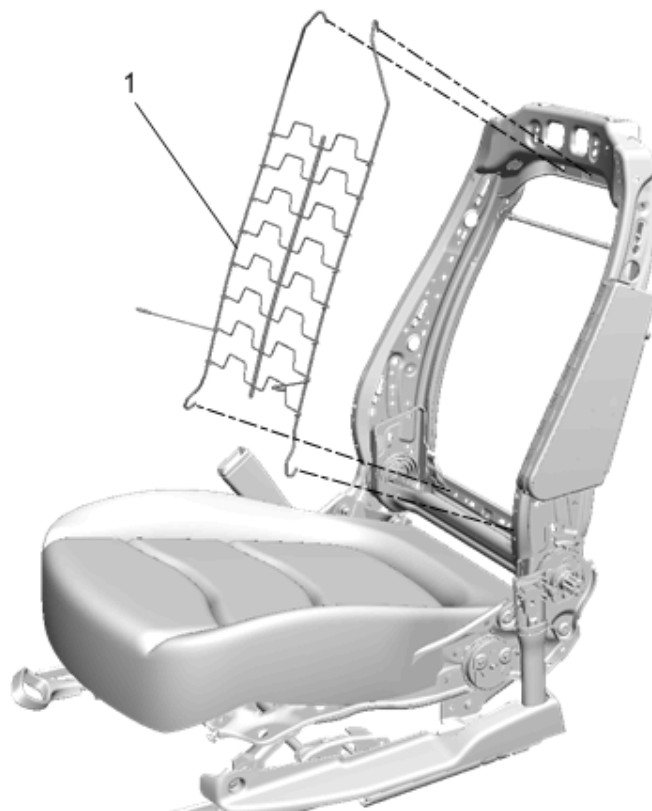


Fig. 11: Front Seat Back Cushion Pad Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Procedure Remove Driver or Passenger Seat Back Cover and Pad. Refer to Driver or Passenger Seat Back Cover and Pad Replacement	
1	Front Seat Cushion Pad Support

DRIVER OR PASSENGER SEAT BACK COVER AND PAD REPLACEMENT

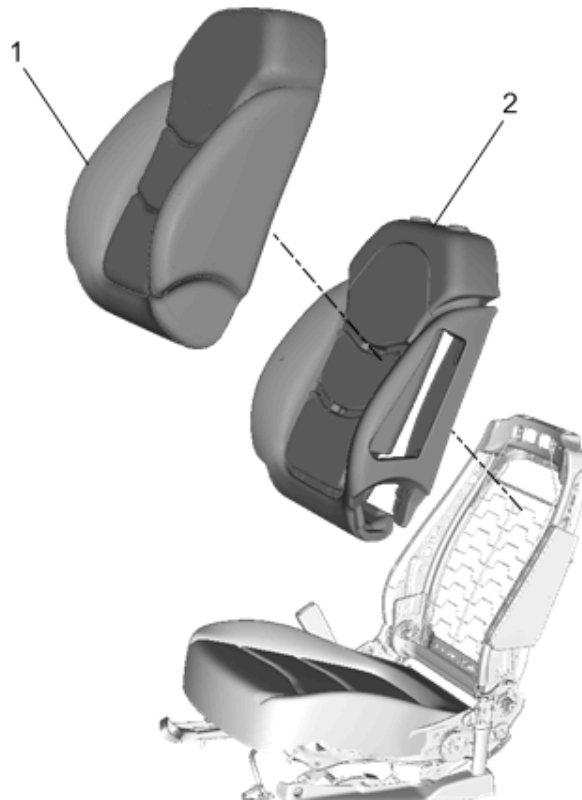


Fig. 12: Driver or Passenger Seat Back Cover and Pad

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover	

Callout	Component Name
from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury. Preliminary Procedures 1. Remove Driver or Passenger Seat. Refer to Driver or Passenger Seat Removal and Installation 2. Remove Driver or Passenger Seat Inner Adjuster Front Finish Cover. Refer to Driver or Passenger Seat Inner Adjuster Front Finish Cover Replacement 3. Remove Front Seat Cushion Outer Finish Cover. Refer to Front Seat Cushion Outer Finish Cover Replacement 4. Remove Driver or Passenger Seat Head Restraint. Refer to Driver or Passenger Seat Head Restraint Replacement	
1	Driver or Passenger Seat Back Cushion Cover Procedure 1. Disengage the j-channel retainers and tabs at the bottom of the seat back cover from the seat back cushion frame. 2. Disconnect the electrical connector that is attached to the seat back cushion, if equipped.
2	Front Seat Back Cushion Pad Procedure 1. Remove the hog rings. 2. Separate the seat cover from the seat cushion pad by pulling the cover away from the pad. 3. Transfer the seat heater, if equipped. NOTE: Seat back cover can be damaged upon

Callout	Component Name
	reinstalling cover to seat back pad. When reinstalling the seat cushion cover to the seat pad, start in upper outboard corner and install outboard side of the cover. Then start at the upper inboard corner and install inboard side of cover.

DRIVER OR PASSENGER SEAT BACK CUSHION PAD WIRE REPLACEMENT

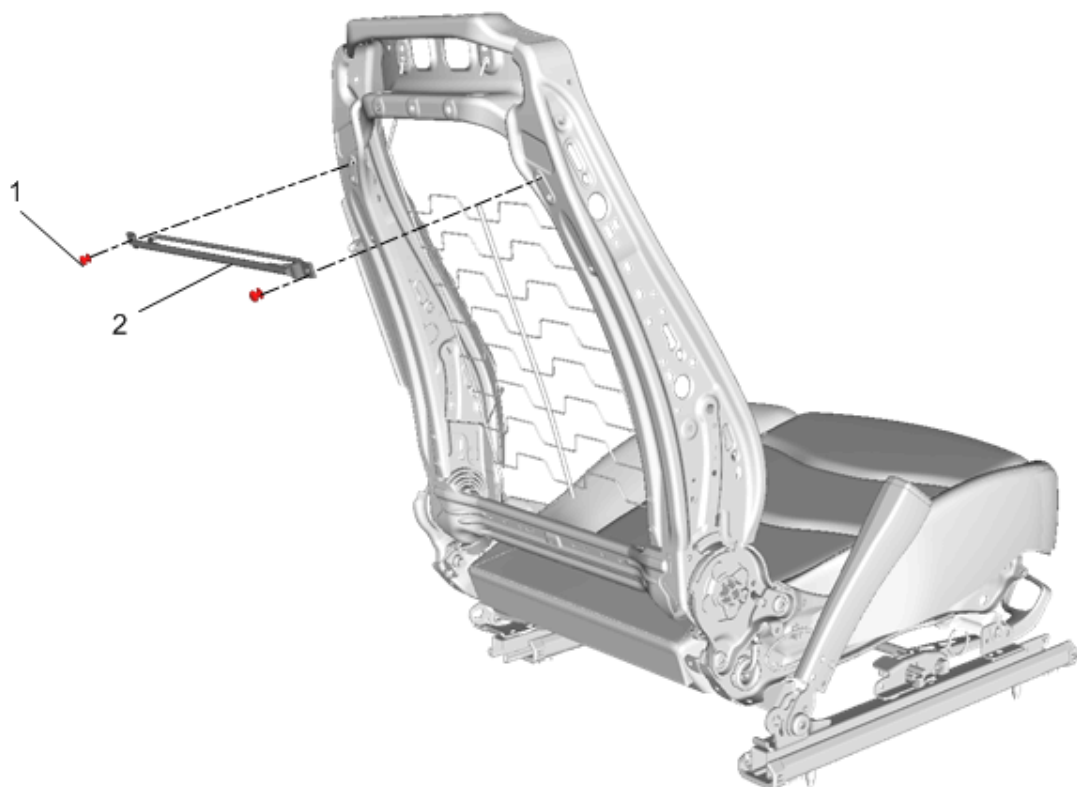


Fig. 13: Driver or Passenger Seat Back Cushion Pad Wire

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove Driver or Passenger Seat Back Cover and Pad. Refer to Driver or Passenger Seat Back Cover and Pad Replacement	
1	Driver or Passenger Seat Back Cushion Pad Wire Rivet (Qty: 2) WARNING: Use the proper eye protection when drilling to prevent metal chips from causing physical injury. Procedure Drill out all of the rivets before removing the pad wire.
2	Driver or Passenger Seat Back Cushion Pad Wire Procedure When re-installing the cushion pad wire, re-rivet at the same location on the cushion frame with new rivets.

DRIVER OR PASSENGER SEAT BACK CUSHION FRAME REPLACEMENT

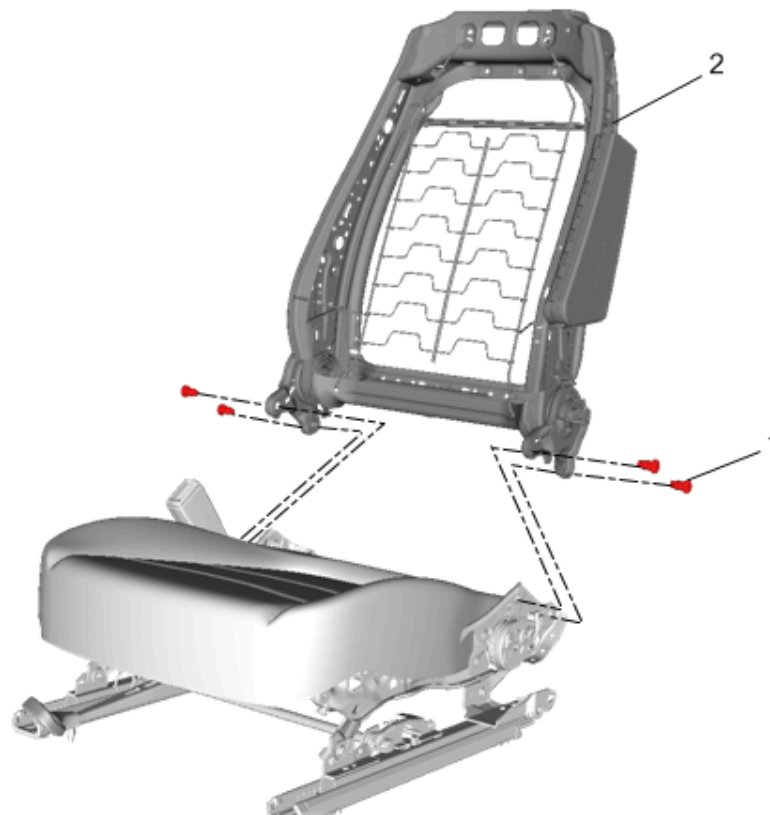


Fig. 14: Driver or Passenger Seat Back Cushion Frame

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Remove Driver or Passenger Seat. Refer to Driver or Passenger Seat Removal and Installation 2. Remove Driver or Passenger Seat Back Cover and Pad. Refer to Driver or Passenger Seat Back Cover and Pad Replacement	
1	Driver or Passenger Seat Back Cushion Frame Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 35 N.m (26 lb ft)

Callout	Component Name
2	Driver or Passenger Seat Back Cushion Frame Procedure 1. Disconnect the electrical connector. 2. Transfer components as necessary.

REAR SEAT ARMREST REPLACEMENT

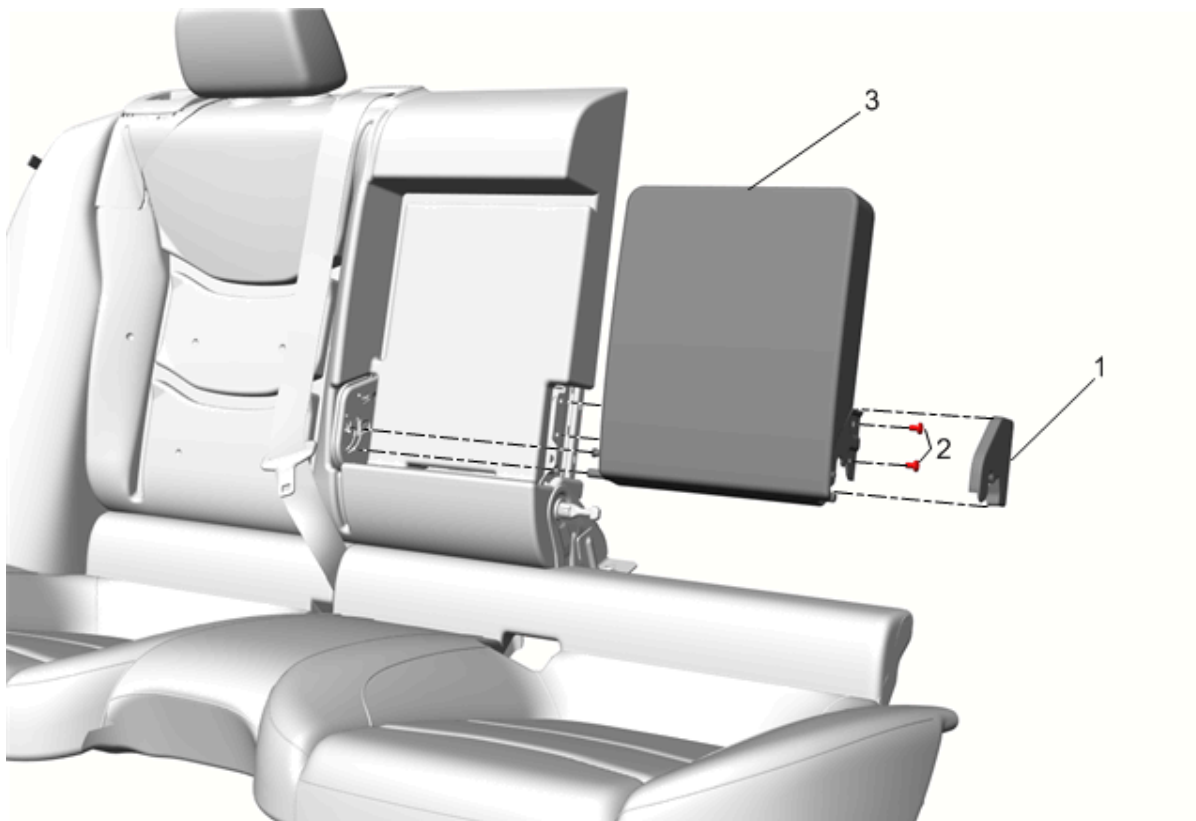


Fig. 15: Rear Seat Armrest

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Armrest Cushion Cover
2	Rear Seat Armrest Fastener (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 3 N.m (27 lb in)

Callout	Component Name
3	Rear Seat Armrest Procedure Release the retainer on the hinge bracket.

REAR SEAT ARMREST BRACKET REPLACEMENT

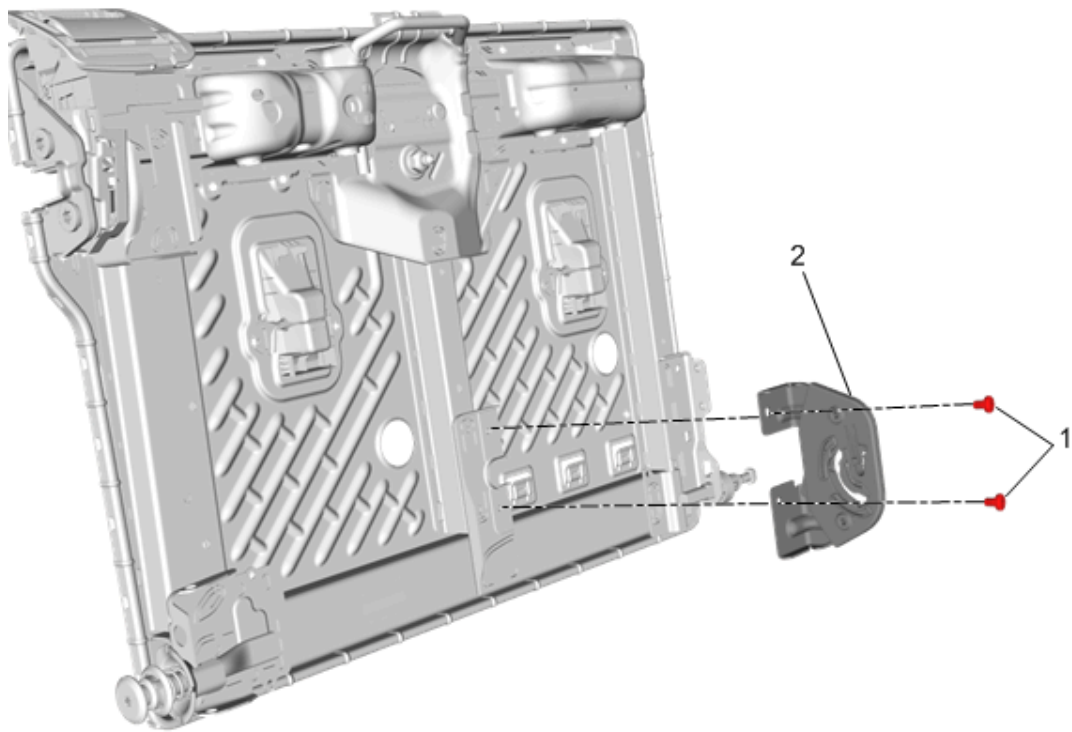


Fig. 16: Rear Seat Armrest Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Seat Back Cushion Cover and Pad. Refer to Rear Seat Back Cushion Cover and Pad Replacement (40%)Rear Seat Back Cushion Cover and Pad Replacement (60%)	
1	Rear Seat Armrest Bracket Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 3 N.m (27 lb in)
2	Rear Seat Armrest Bracket

REAR SEAT HEAD RESTRAINT REPLACEMENT

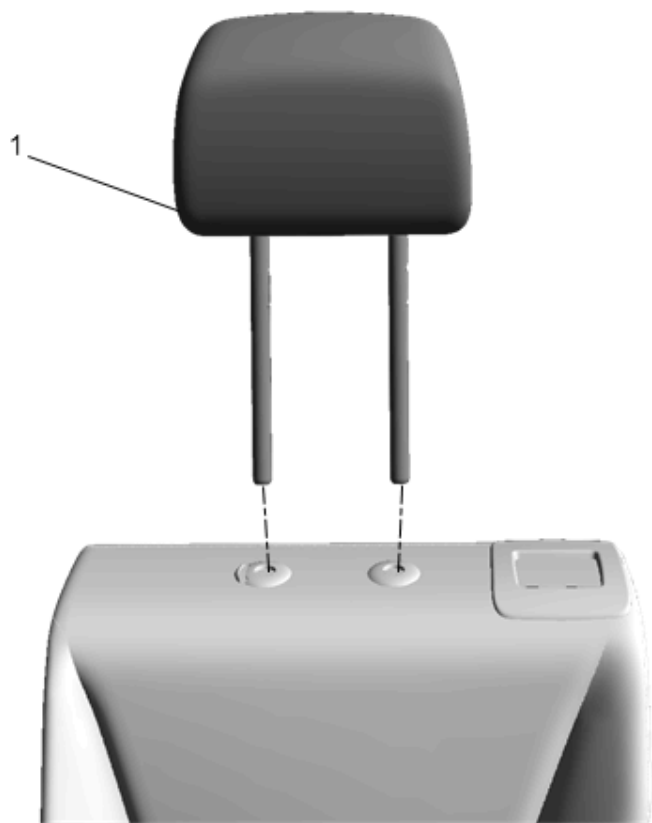


Fig. 17: Rear Seat Head Restraint
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Head Restraint Procedure 1. Lower the rear seat back forward to gain space between the head restraint and the roof. 2. Depress both buttons on the head restraint guides and pull upward to remove the head restraint from the seat.

REAR SEAT HEAD RESTRAINT GUIDE REPLACEMENT

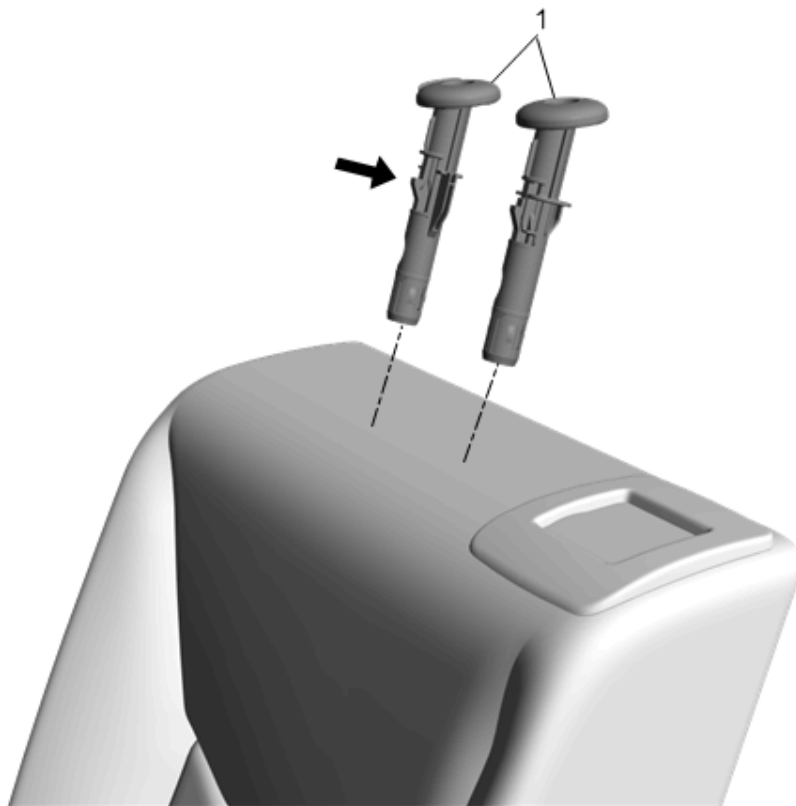


Fig. 18: Rear Seat Head Restraint Guide

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Seat Head Restraint. Refer to Rear Seat Head Restraint Replacement	
1	Rear Seat Head Restraint Guide (Qty: 2) Procedure Using a suitable flat-bladed tool, slide the tool on the inside of the guide until it finds the slot. Then push the tool forward pulling the guide tab inward, while pulling upward to remove the guide from the seat back frame.

REAR SEAT BACK BOLSTER REPLACEMENT

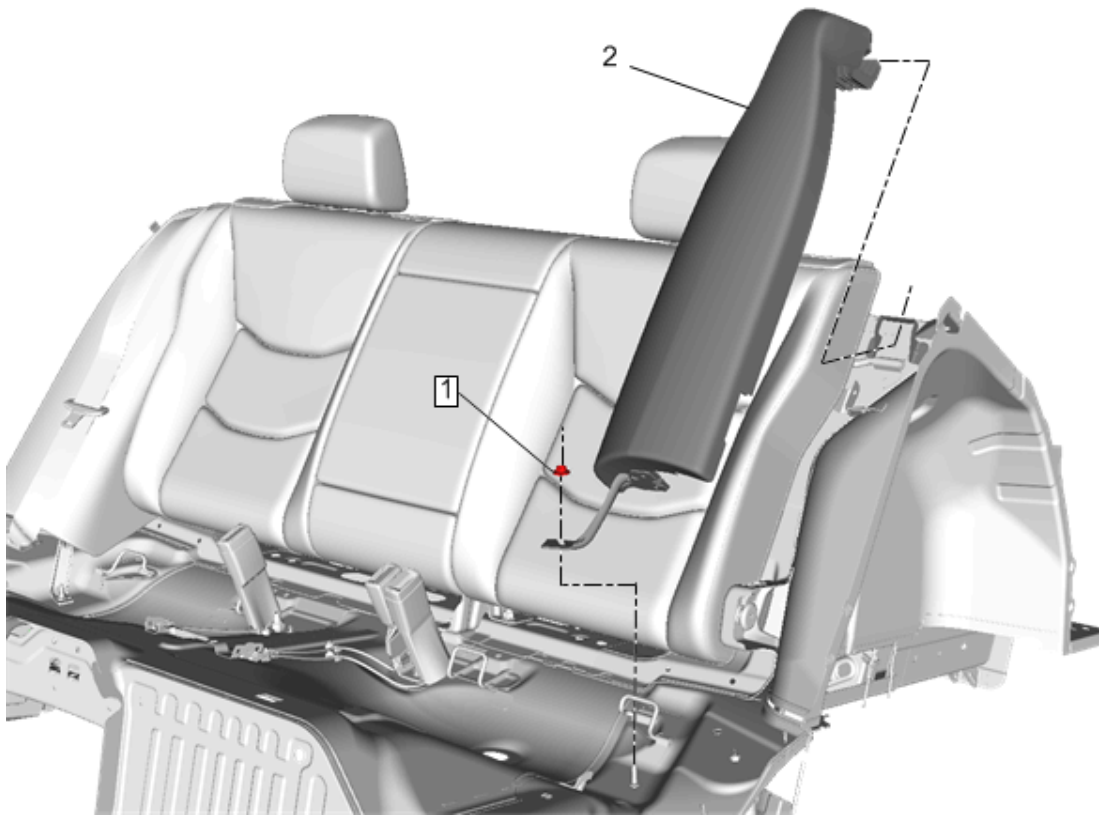


Fig. 19: Rear Seat Back Bolster

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedures 1. Disable SIR system. Refer to SIR Disabling and Enabling 2. Remove Rear Seat Cushion. Refer to Rear Seat Cushion Removal and Installation	
1	Rear Seat Back Bolster Fastener CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Rear Seat Back Bolster

REAR SEAT CUSHION COVER AND PAD REPLACEMENT

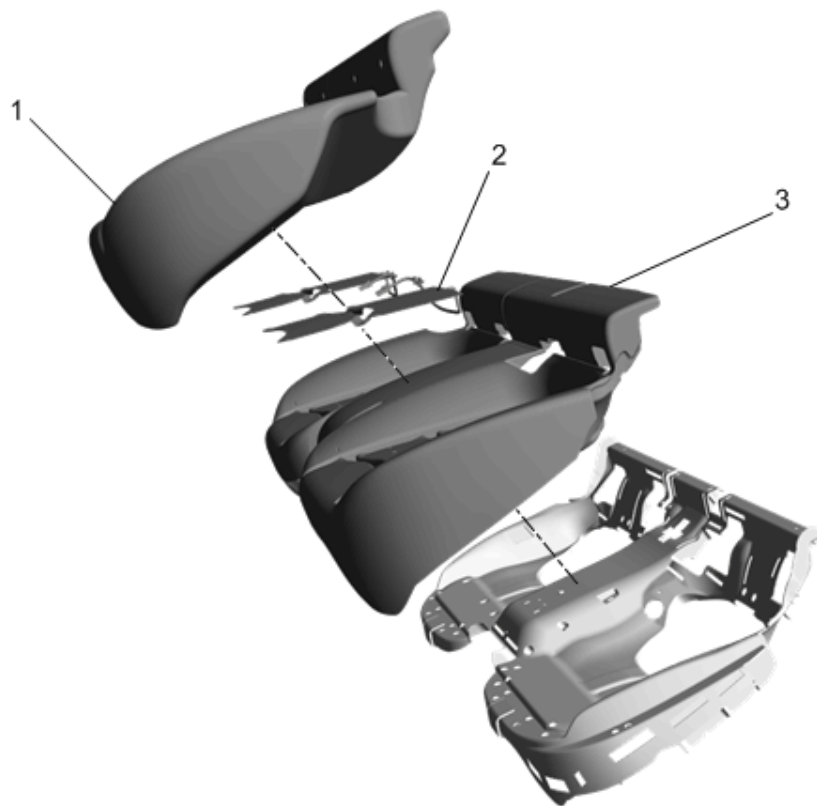


Fig. 20: Rear Seat Cushion Cover and Pad

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Seat Cushion. Refer to Rear Seat Cushion Removal and Installation	
1	Rear Seat Cushion Cover Procedure Remove the hog rings, disconnect the j-channel retainer, and remove the push-in retainers that secure the rear seat cushion cover to the pad.
2	Rear Seat Cushion Heater Procedure Disconnect all electrical connectors.
3	Rear Seat Cushion Pad

REAR SEAT CUSHION REMOVAL AND INSTALLATION

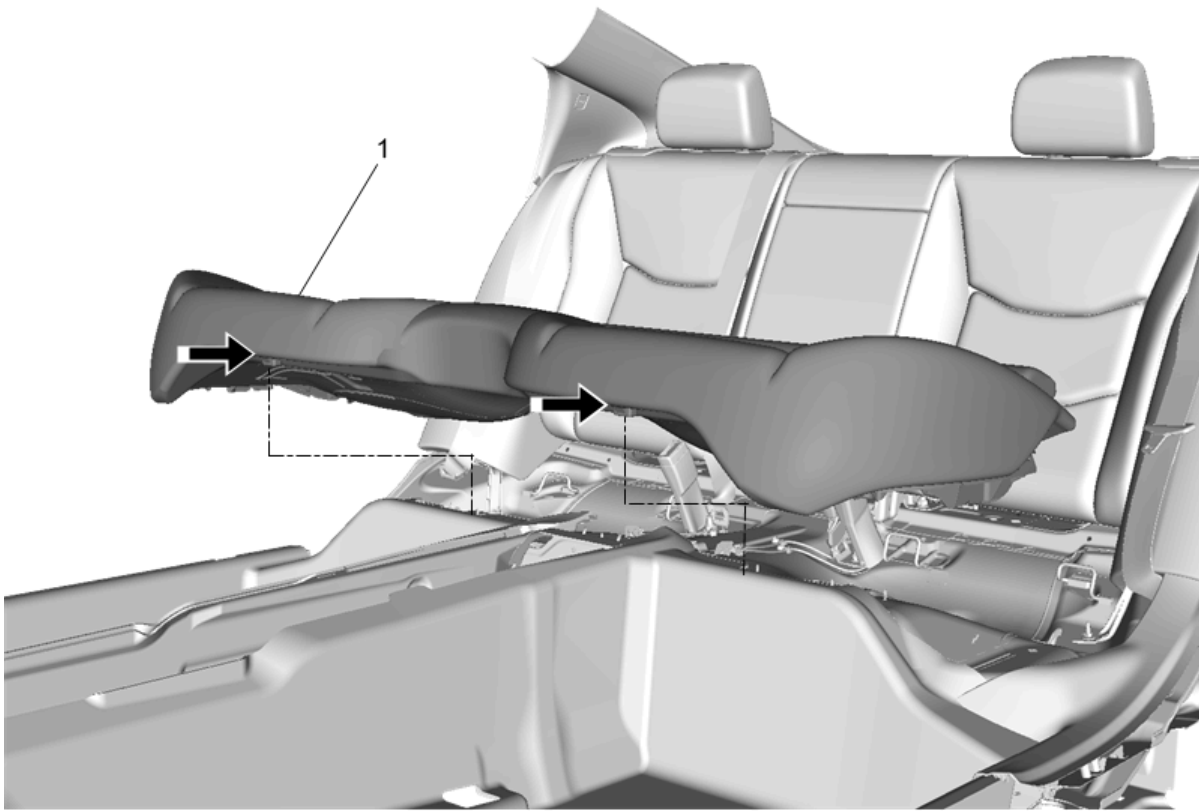


Fig. 21: Rear Seat Cushion

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Cushion Procedure 1. Press inward on the two retainer tabs to release. These can be felt through a slot where the seat cushion cover meets the seat cushion pan. 2. Pull up on the front of the seat cushion and lift out of the vehicle. 3. {If equipped} Disconnect the electrical connectors.

REAR SEAT CUSHION FRAME REPLACEMENT



Fig. 22: Rear Seat Cushion Frame

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Seat Cushion Cover and Pad. Refer to Rear Seat Cushion Cover and Pad Replacement	
1	Rear Seat Cushion Frame Procedure Transfer components as necessary.

REAR SEAT LATCH REPLACEMENT

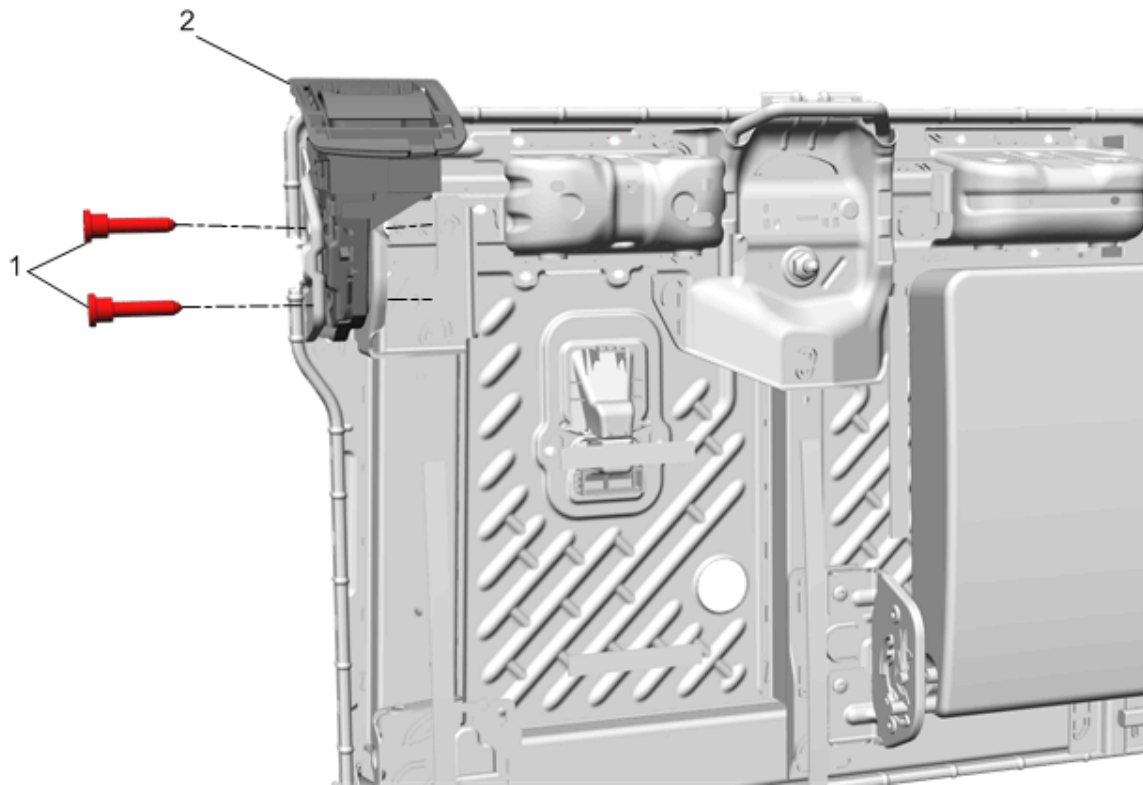


Fig. 23: Rear Seat Latch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Seat Back Cushion Cover and Pad. Refer to Rear Seat Back Cushion Cover and Pad Replacement (40%) Rear Seat Back Cushion Cover and Pad Replacement (60%)	
1	Rear Seat Back Latch Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 45 N.m (33 lb ft)
2	Rear Seat Latch

REAR SEAT BACK CUSHION REMOVAL AND INSTALLATION (60%)

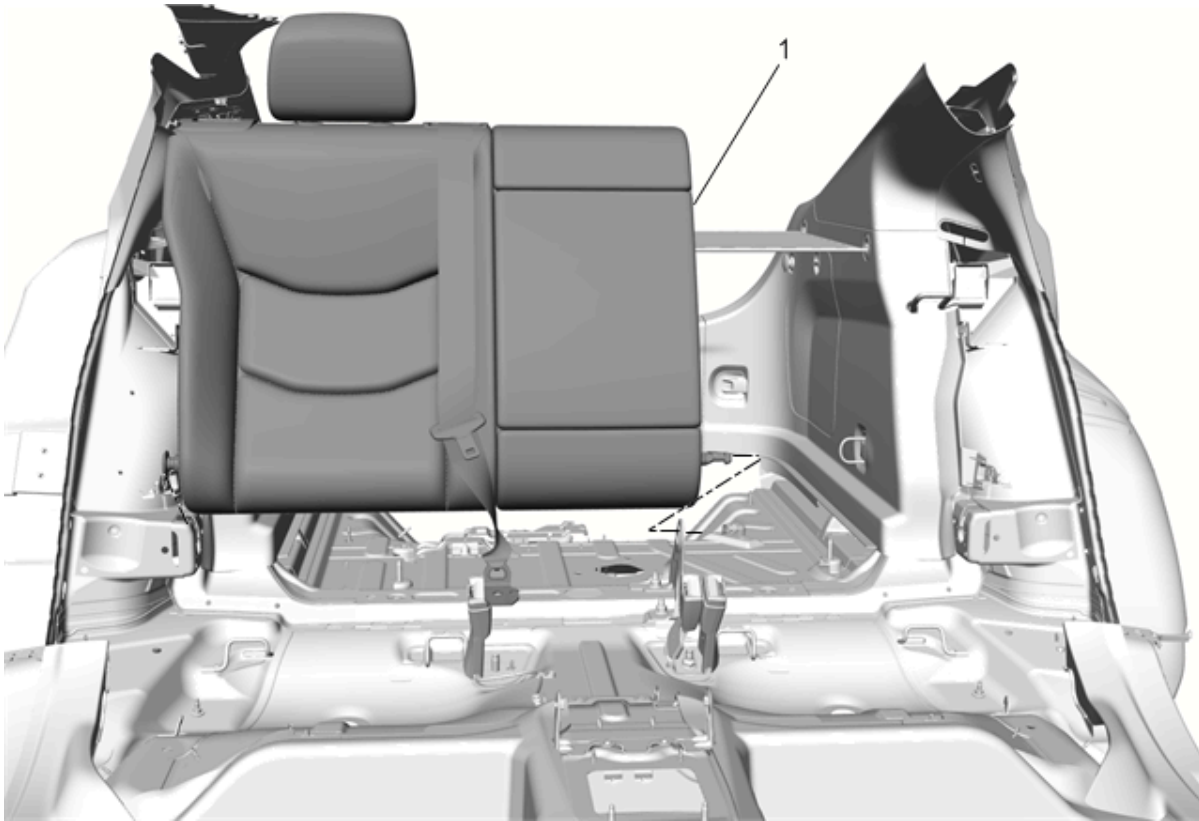


Fig. 24: Rear Seat Back Cushion (60%)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Seat Back Bolster. Refer to Rear Seat Back Bolster Replacement 2. Remove the rear seat belt buckle nut. Refer to Rear Seat Belt Buckle Replacement	
1	Rear Seat Back Cushion Procedure 1. Pull the rear seat back cushion latch release located on the top of the rear seat back cushion, and fold the rear seat back cushion forward. 2. Push in on the rear seat back cushion pivot support, and release from bracket. 3. Pull up on the outer side of the rear seat back cushion and remove the rear seat back cushion from the bracket and hinge.

REAR SEAT BACK CUSHION REMOVAL AND INSTALLATION (40%)

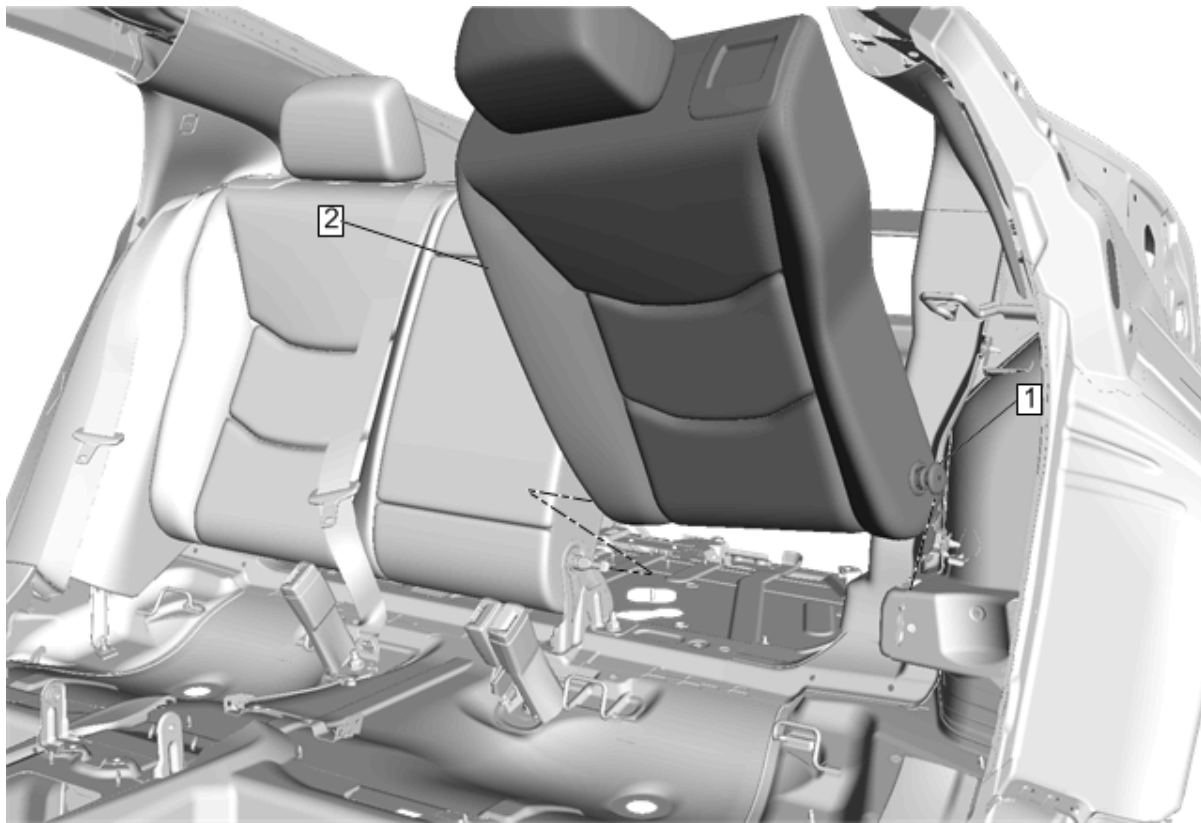


Fig. 25: Rear Seat Back Cushion (40%)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Seat Back Bolster. Refer to Rear Seat Back Bolster Replacement	
1	Rear Seat Back Cushion Pivot Support Procedure 1. Pull the rear seat back cushion latch release located on the top of the rear seat back cushion, and fold the rear seat back cushion forward. 2. Push in on the rear seat back cushion pivot support, and release from bracket.
2	Rear Seat Back Cushion Procedure Pull up on the outer side of the rear seat back cushion and remove the rear seat back cushion from the bracket and hinge.

REAR SEAT BELT OPENING COVER REPLACEMENT

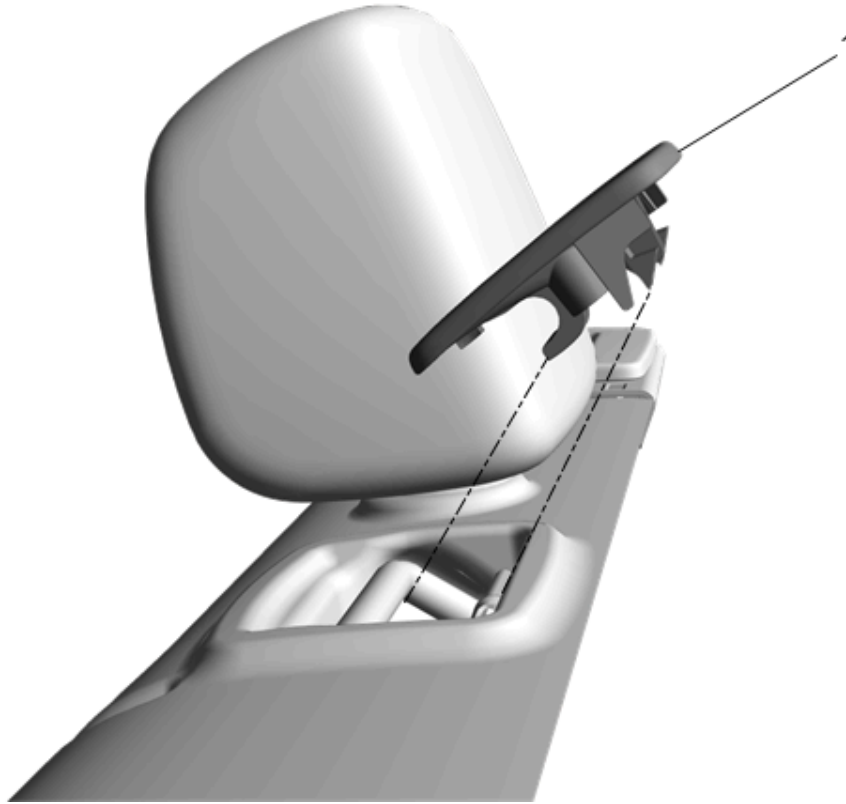


Fig. 26: Rear Seat Belt Opening Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Belt Opening Cover Procedure 1. Using a suitable flat-bladed tool, push inward on the rear tabs while pulling upward. 2. Position the belt through the slot in the opening cover slot.

REAR SEAT BACK CUSHION COVER AND PAD REPLACEMENT (40%)

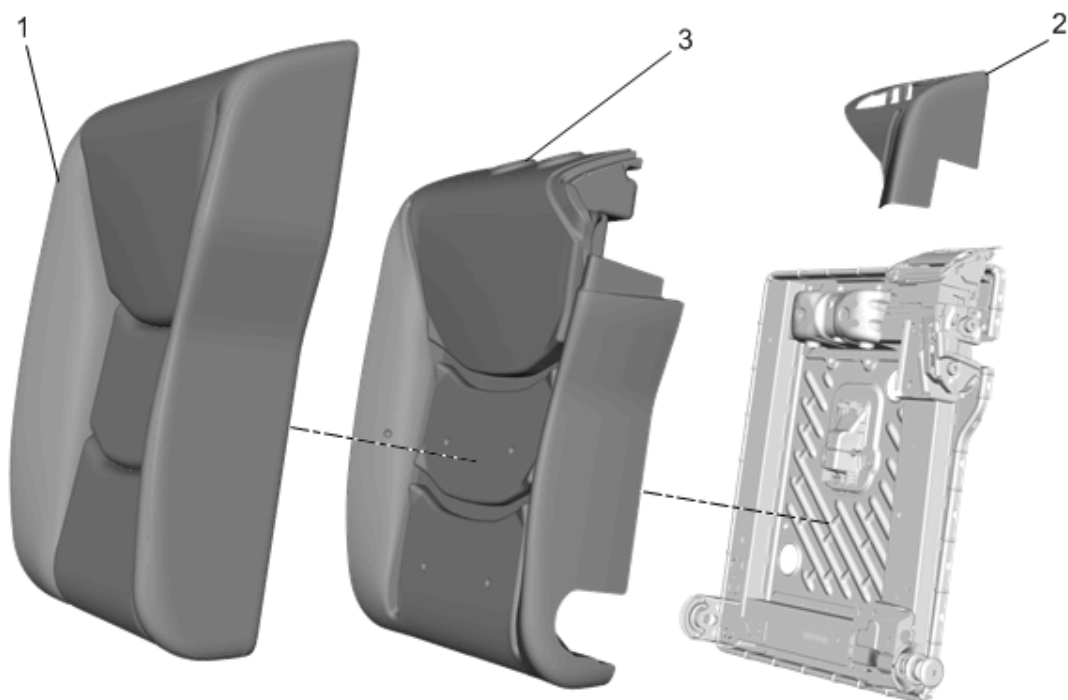


Fig. 27: Rear Seat Back Cushion Cover and Pad (40%)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Seat Back Cushion. Refer to Rear Seat Back Cushion Removal and Installation (40%) 2. Remove Rear Seat Back Latch Release Handle Bezel. Refer to Rear Seat Back Latch Release Handle Bezel Replacement 3. Remove Rear Seat Head Restraint Guide. Refer to Rear Seat Head Restraint Guide Replacement 4. Remove Rear Seat Anchor Plate Bezel. Refer to Rear Seat Anchor Plate Bezel Replacement	
1	Rear Seat Back Cushion Cover Procedure 1. Remove the hog rings from the seat back pad. 2. Disconnect the J-channel from the seat back cushion frame. 3. Disconnect the electrical connector, if equipped with heated seat. 4. Remove the seat back cushion cover from the pad.
2	Rear Seat Support Refer to Rear Seat Support Replacement

Callout	Component Name
3	Rear Seat Back Cushion Pad

REAR SEAT BACK CUSHION COVER AND PAD REPLACEMENT (60%)

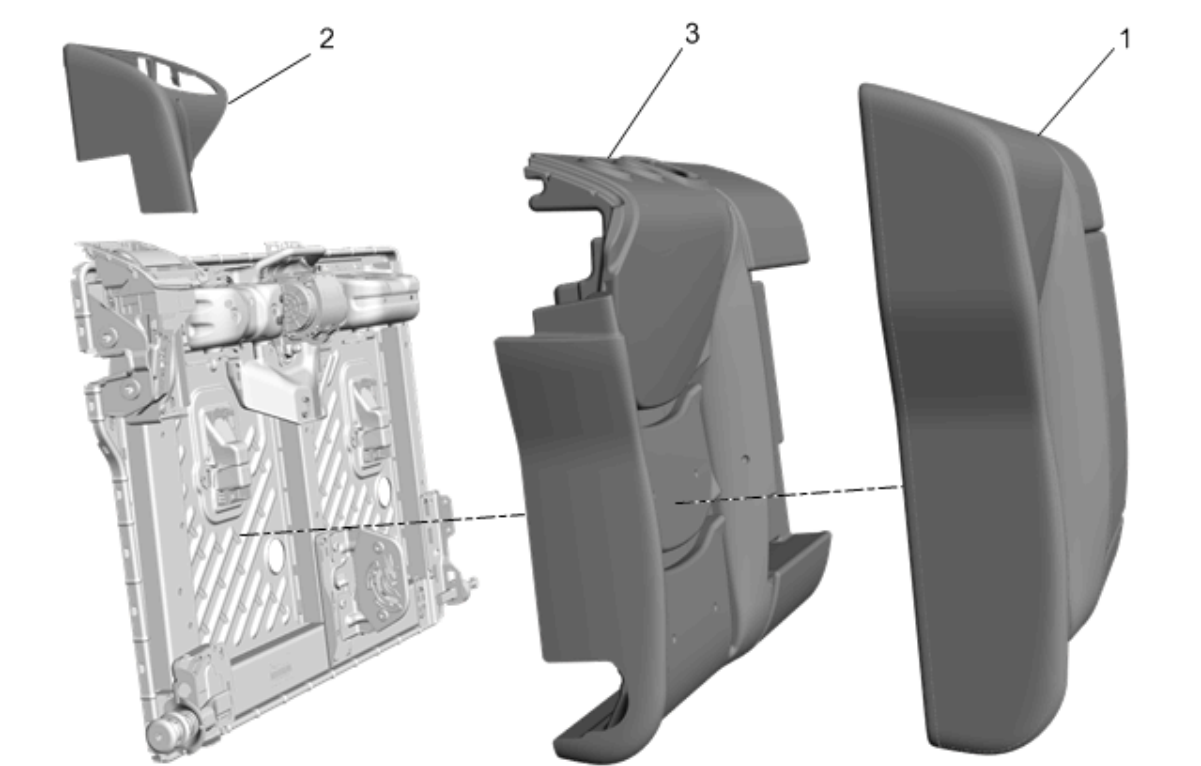


Fig. 28: Rear Seat Back Cushion Cover and Pad (60%)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Seat Back Cushion. Refer to Rear Seat Back Cushion Removal and Installation (60%) 2. Remove Rear Seat Back Latch Release Handle Bezel. Refer to Rear Seat Back Latch Release Handle Bezel Replacement 3. Remove Rear Seat Belt Opening Cover. Refer to Rear Seat Belt Opening Cover Replacement 4. Remove Rear Seat Head Restraint Guide. Refer to Rear Seat Head Restraint Guide Replacement 5. Remove Rear Seat Armrest. Refer to Rear Seat Armrest Replacement 6. Remove Rear Seat Anchor Plate Bezel. Refer to Rear Seat Anchor Plate Bezel Replacement	
1	Rear Seat Back Cushion Cover Procedure

Callout	Component Name
	1. Disconnect the J-channel from the seat back cushion frame. 2. Disconnect the electrical connector, if equipped with heated seat. 3. Remove the seat back cushion cover from the pad.
2	Rear Seat Support Refer to Rear Seat Support Replacement
3	Rear Seat Back Cushion Pad

REAR SEAT BACK CUSHION FRAME REPLACEMENT

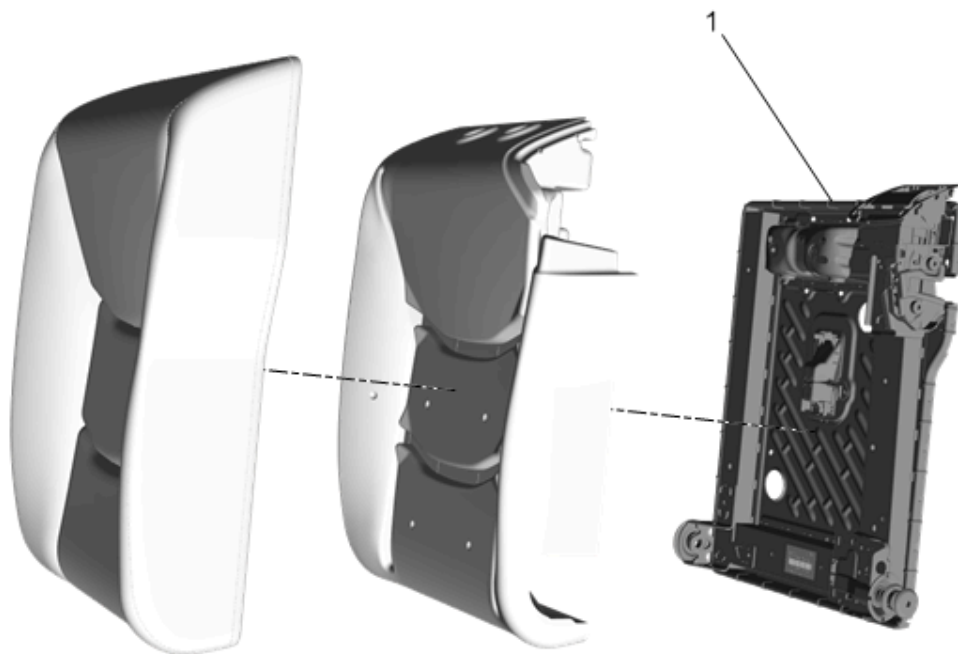


Fig. 29: Rear Seat Back Cushion Frame
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Seat Back Cushion Cover and Pad. Refer to Rear Seat Back Cushion Cover and Pad Replacement (40%)Rear Seat Back Cushion Cover and Pad Replacement (60%)	
1	Rear Seat Back Cushion Frame Procedure Transfer components as necessary.

REAR SEAT BACK CUSHION HINGE REPLACEMENT

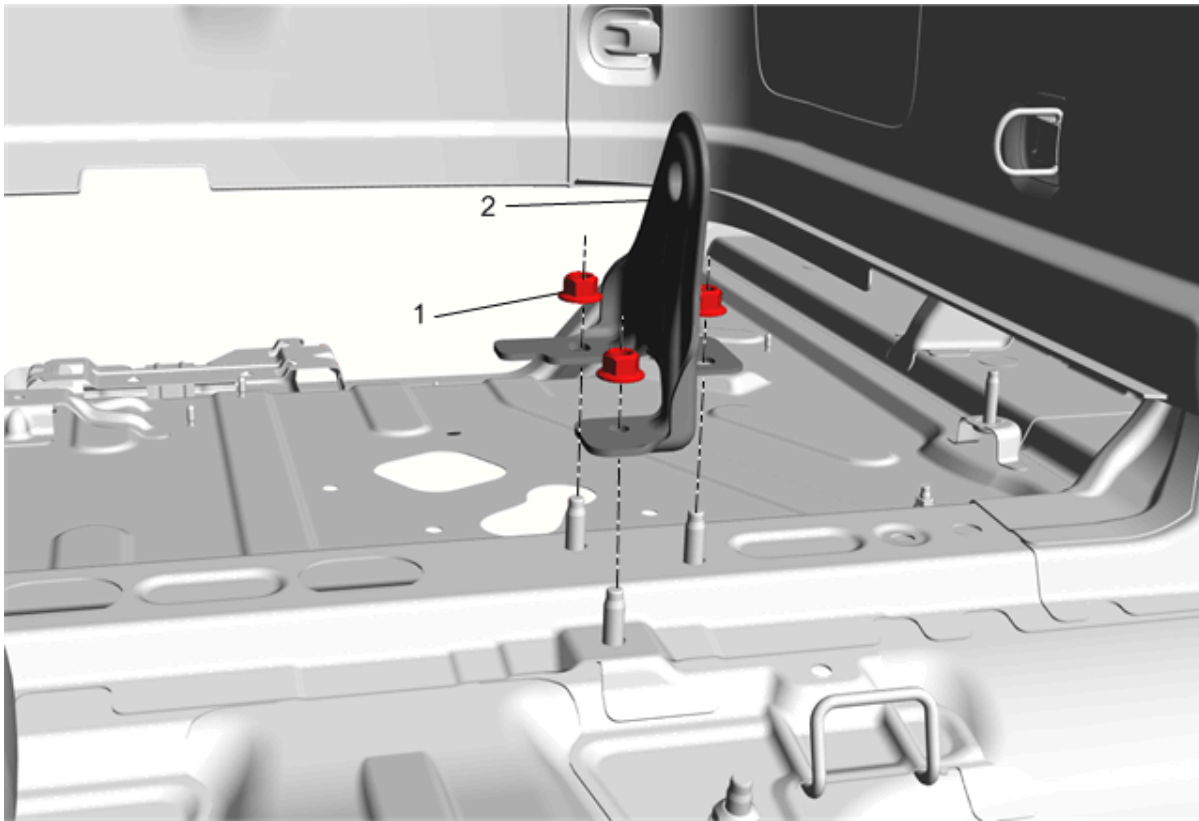


Fig. 30: Rear Seat Back Cushion Hinge

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Rear Seat Back Cushion. Refer to Rear Seat Back Cushion Removal and Installation (60%)Rear Seat Back Cushion Removal and Installation (40%) 2. Remove Rear Compartment Floor Stowage Trim Compartment. Refer to Rear Compartment Floor Stowage Trim Compartment Replacement	
1	Rear Seat Back Cushion Hinge Fastener (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 45 N.m (33 lb ft)
2	Rear Seat Back Cushion Hinge Procedure Detach the rear seat back cushion hinge from the guide pin.

REAR SEAT SUPPORT REPLACEMENT

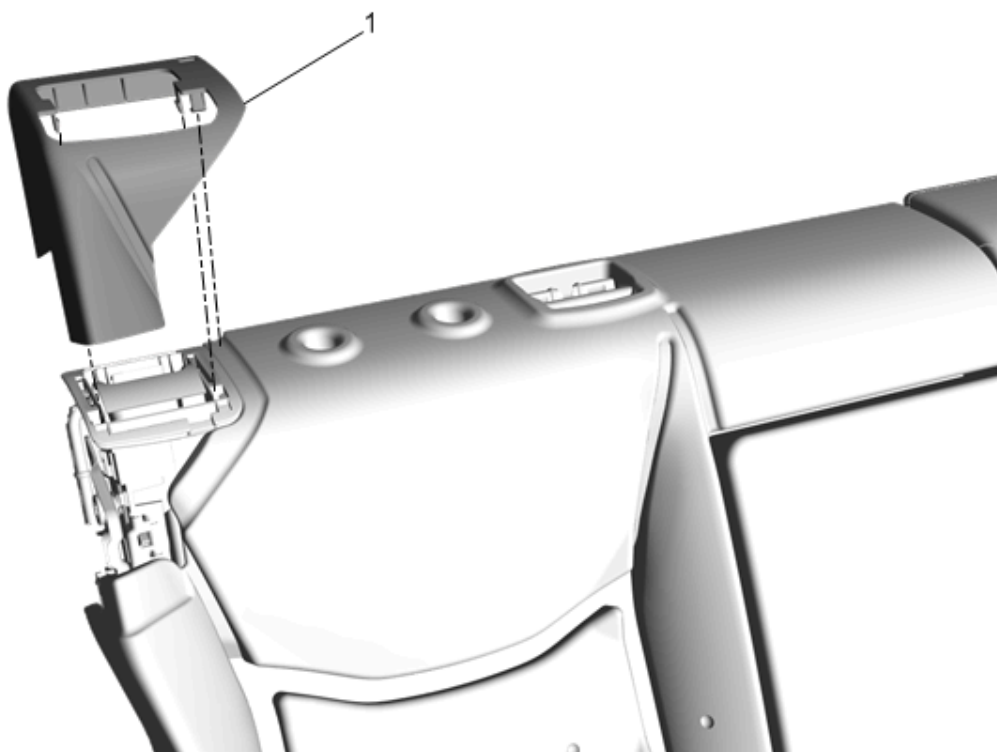


Fig. 31: Rear Seat Support

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the seat back cover. Refer to Rear Seat Back Cushion Cover and Pad Replacement (40%) Rear Seat Back Cushion Cover and Pad Replacement (60%)	
1	Rear Seat Support Procedure Release the rear seat anchor plate bezel using a suitable flat-bladed tool.

REAR SEAT BACK LATCH RELEASE HANDLE BEZEL REPLACEMENT

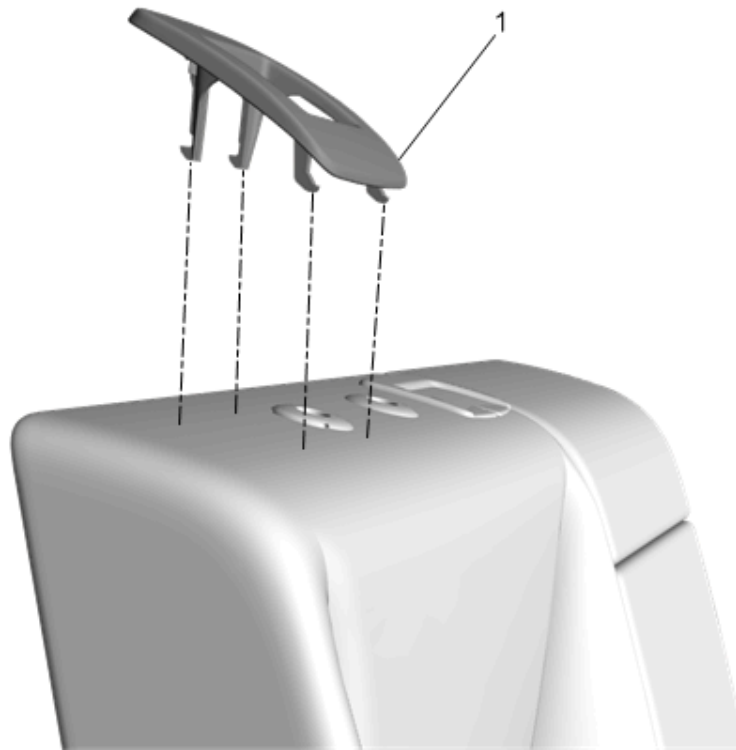


Fig. 32: Rear Seat Back Latch Release Handle Bezel

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Back Cushion Latch Release Handle Bezel Procedure Using a suitable flat-bladed tool, push inward on the rear tabs while pulling upward from the rear of the bezel to release it from the seat.

REAR SEAT ANCHOR PLATE BEZEL REPLACEMENT

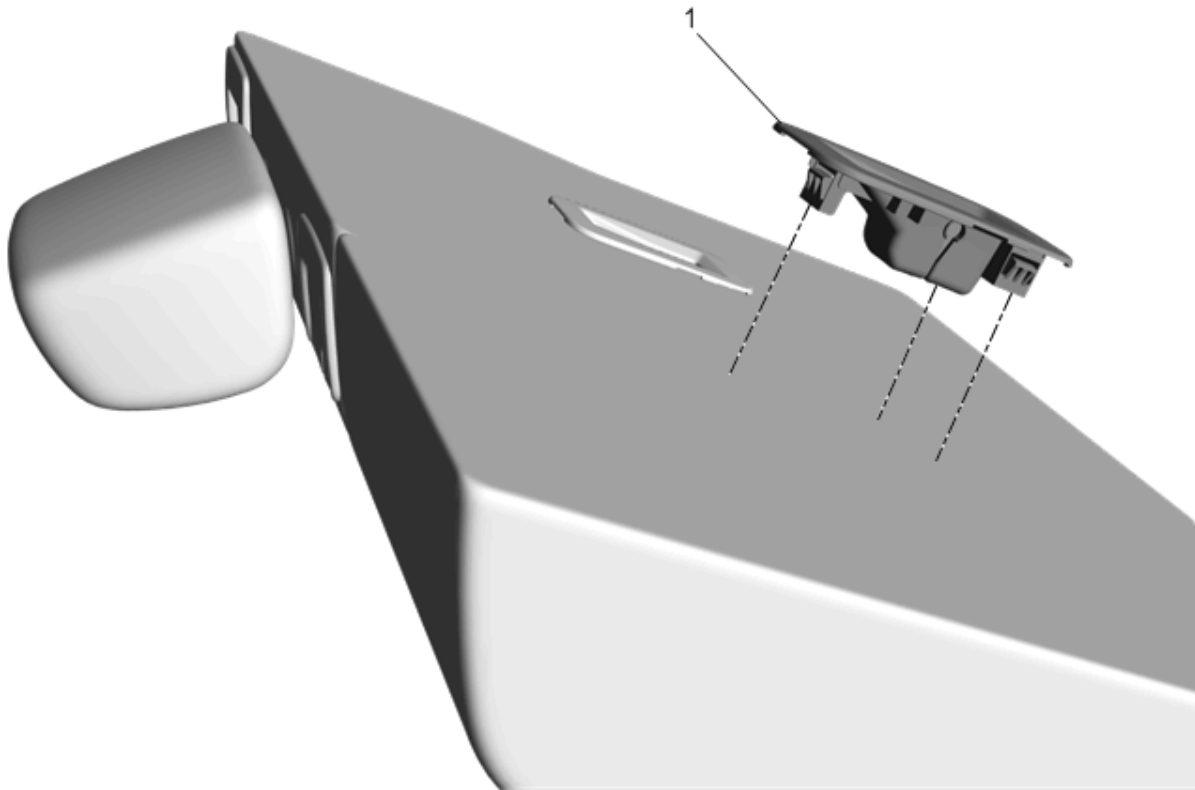


Fig. 33: Rear Seat Anchor Plate Bezel

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Anchor Plate Bezel Procedure Release the rear seat anchor plate bezel using a suitable flat-bladed tool.

Article GUID: A00884701

ACCESSORIES & EQUIPMENT

Seat Heating and Cooling - Volt

SCHEMATIC WIRING DIAGRAMS

HEATED/COOLED SEAT WIRING SCHEMATICS

Heated Seats (KA1)

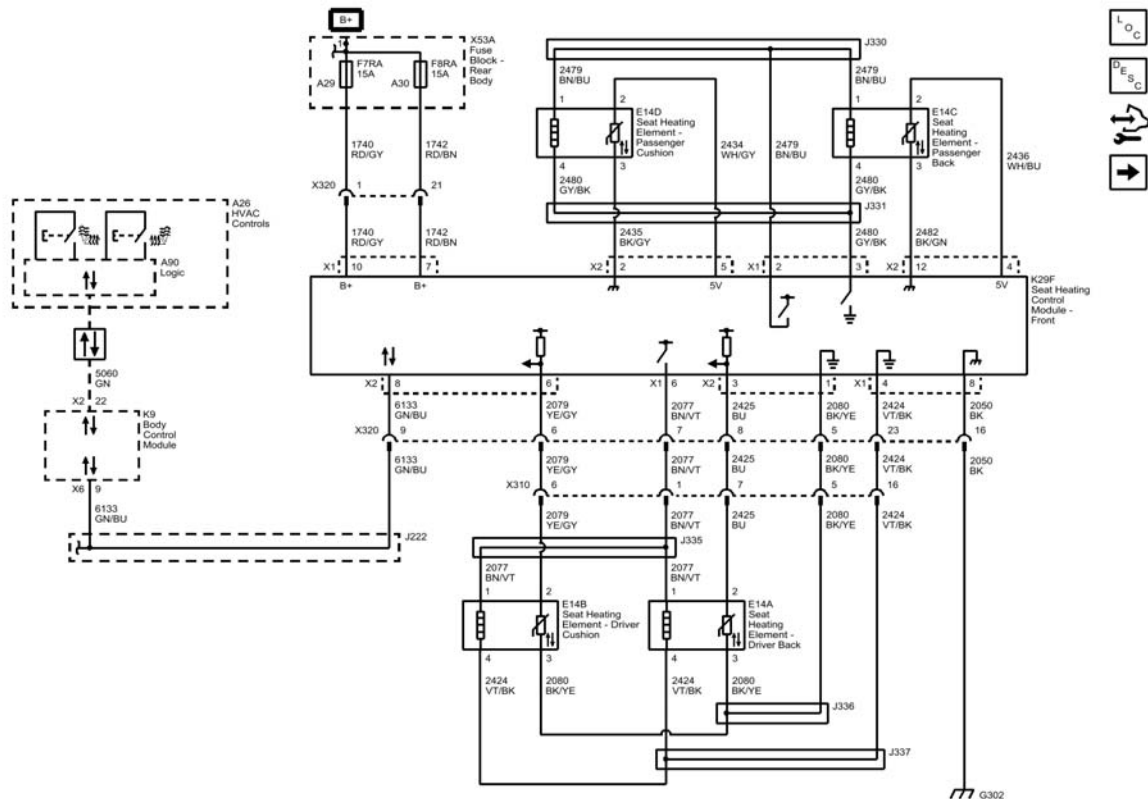


Fig. 1: Heated Seats (KA1)

Courtesy of GENERAL MOTORS COMPANY

Heated Seats (KA6)

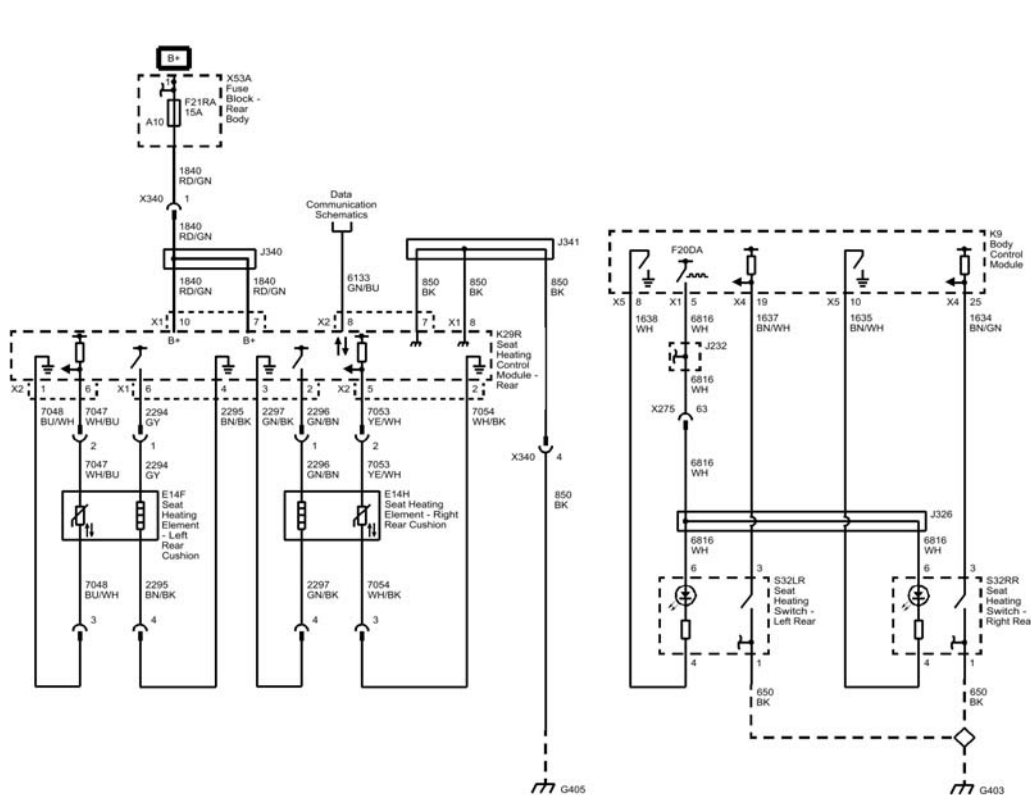


Fig. 2: Heated Seats (KA6)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B191A OR B191B: FRONT/REAR HEATED SEAT MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B191A 39

Front Heated Seat Module

DTC B191B 39

Rear Heated Seat Module

Circuit/System Description

An internal fault is detected inside the control module. No external circuits are involved.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The control module detects an internal fault.

Action Taken When the DTC Sets

The seat heating control module will disable all heated seat functions.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Heated Seats Description and Operation](#)
- [Rear Heated Seats Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

DTC B191A

1. Ignition ON.
2. Verify DTC B191A is not set.
 - **If the DTC is set**

Replace the K29F Seat Heating Control Module - Front.

- **If the DTC is not set**

3. All OK.

DTC B191B

1. Ignition ON.
2. Verify DTC B191B is not set.

- **If the DTC is set**

Replace the K29R Seat Heating Control Module - Rear.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K29F Seat Heating Control Module - Front or K29R Seat Heating Control Module - Rear replacement, programming and setup

SYMPTOMS - SEAT HEATING AND COOLING

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control module(s) can communicate via the serial data link.
2. Refer to the system description and operation from the following list in order to familiarize yourself with the system functions:
 - [Heated Seats Description and Operation](#)
 - [Rear Heated Seats Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power seats. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the seat adjuster track for conditions which may cause binding or objects within the seat adjustment range which obstruct movement or interfere with wiring.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for](#)

Intermittent Conditions and Poor Connections .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Front Heated Seat Malfunction](#)
- [Rear Heated Seat Malfunction](#)

FRONT HEATED SEAT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 10 X1	U1524, 1	U1524, 1	-	-
B+ Terminal 7 X1	6	6	-	-
Driver Heated Seat Back Temperature Sensor Signal	2	5	5	-
Driver Heated Seat Back Temperature Sensor Low Reference	-	5	-	-
Driver Heated Seat Element Voltage Control Terminal 6 X1	1	2	1	-
Driver Heated Seat Element Ground Control Terminal 4 X1	1	2	1	-
Driver Heated Seat Back Element Voltage Control	1	3	1	-
Driver Heated Seat Back Element Ground Control	1	3	1	-
Driver Heated Seat Cushion Temperature Sensor Signal	2	5	5	-
Driver Heated Seat Cushion Temperature Sensor Low Reference	-	5	-	-
Driver Heated Seat Cushion Element Voltage Control	1	4	1	-
Driver Heated Seat Cushion Element Ground Control	1	4	1	-
Passenger Heated Seat Back Temperature Sensor Signal	6	9	9	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Heated Seat Back Temperature Sensor Low Reference	-	9	-	-
Passenger Heated Seat Element Voltage Control Terminal 2 X1	1	6	1	-
Passenger Heated Seat Element Ground Control Terminal 3 X1	1	6	1	-
Passenger Heated Seat Back Element Voltage Control	1	7	1	-
Passenger Heated Seat Back Element Ground Control	1	7	1	-
Passenger Heated Seat Cushion Temperature Sensor Signal	6	9	9	-
Passenger Heated Seat Cushion Temperature Sensor Low Reference	-	9	-	-
Passenger Heated Seat Cushion Element voltage Control	1	8	1	-
Passenger Heated Seat Cushion Element Ground Control	1	8	1	-
Front Seat Heating Control Module Ground	-	U1524, 1	-	-
1. Driver and passenger heated seats are inoperative. 2. Driver heated seat is inoperative 3. Driver seat back heat function is inoperative 4. Driver seat cushion heat function is inoperative 5. Degraded driver heated seat operation 6. Passenger heated seat is inoperative 7. Passenger seat back heat function is inoperative 8. Passenger seat cushion heat function is inoperative 9. Degraded passenger heated seat operation				

Circuit/System Description

The driver and passenger heated seat switches are located with the HVAC controls. When a heated seat switch is pressed, a LIN bus serial data message is sent from the HVAC controls to the HVAC control module. In turn the HVAC control module sends a low speed GMLAN serial data message to the body control module (BCM) indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a LIN bus serial data message to the seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating elements per the BCM command.

The seat heating control module controls heated seat operation for the driver and passenger seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module

through a common low side drive control circuit.

The seat back and cushion temperature sensors (thermistors) are packaged with the seat heating elements located just under the seat covers. The seat heating control module supplies each temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

Diagnostic Aids

- A short to ground or B+ in either the heating element voltage control circuit or ground control circuit will cause both the driver and front passenger heated seats to be inoperative.
- An open in either the voltage control circuit or ground control circuit between the module and the splice will cause the seat cushion and seat back the heated seat function to be inoperative for that seat.
- A short to ground on either the seat cushion or seat back temperature sensor signal circuit will cause the heated seat function to be inoperative for that seat.
- An open in either the voltage control circuit or ground control circuit between the splice and the heating element will cause just that one heating element to be inoperative.
- The following faults will cause a degraded heated seat operation for both the seat back and seat cushion.
 - An open or a short to voltage on either the seat cushion or seat back temperature sensor signal circuit.
 - An open in either the seat cushion or seat back temperature sensor low reference circuit.
 - A fault in either the seat cushion or seat back temperature sensor.
- A broken wire in a heating element may cause a degraded heated seat operation for that particular heating element.
- When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.4 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the driver and passenger seat heating elements.
- With both the seat cushion and seat back heater elements disconnected, if the high side output of the module is measured it will display a low current bleed off voltage between 3.4 - 12 V. This bleed off voltage does not have a meaningful diagnostic purpose. With one or both of the heater elements connected you would just see the 3.4 V biased voltage from this circuit.
- If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Heated Seats Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.

NOTE: Review the Diagnostic Fault Information table and Diagnostic Aids in order to get a better understanding of the possible heated seat system faults before proceeding Circuit/System Verification and Circuit/System Testing.

2. Verify the scan tool Body Control Module Driver Seat Heating/Venting/Cooling Mode parameter changes between OFF and Seat Back and Cushion Heating when pressing the driver heated seat switch.

- **If the parameter does not change**

Replace the A26 HVAC Controls.

- **If the parameter changes**

3. Verify the scan tool Passenger Seat Heating/Venting/Cooling Mode parameter changes between OFF and Seat Back and Cushion Heating when pressing the passenger heated seat switch.

- **If the parameter does not change**

Replace the A26 HVAC Controls.

- **If the parameter changes**

4. Verify the driver and front passenger heated seats operate.

- **If the driver and front passenger heated seats are inoperative**

Refer to Circuit/System Testing - Both Heated Seats are Inoperative

- **If the seat cushion and back heating elements are inoperative of one seat**

Refer to Circuit/System Testing - One Heated Seat is Inoperative

- **If just one of the heating elements is inoperative**

Refer to Circuit/System Testing - One Heating Element is Inoperative.

- **If the driver seat exhibits a degraded heated seat operation**

Refer to Circuit/System Testing - Degraded Heated Seat Operation Driver Seat

- **If the passenger seat exhibits a degraded heated seat operation**

Refer to Circuit/System Testing - Degraded Heated Seat Operation Passenger Seat

- **If both heated seats operate**

5. All OK.

Circuit/System Testing

Both Heated Seats are Inoperative

NOTE: Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Vehicle OFF, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.

2. Verify a test lamp illuminates between each B+ circuit terminal listed below and ground.

- Terminal 7

- Terminal 10

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K29F Seat Heating Control Module - Front.

- **If the test lamp illuminates**

3. Vehicle OFF.

4. Test for infinite resistance between each control circuit terminal listed below and ground, one at a time.

- Terminal 2

- Terminal 6

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Vehicle ON.
6. Test for less than 1 V between each control circuit terminal listed below and ground, one at a time.
 - Terminal 2
 - Terminal 6
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**
7. Replace the K29F Seat Heating Control Module - Front.

One Heated Seat is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 7 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K29F Seat Heating Control Module - Front.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K29F Seat Heating Control Module - Front. Disconnect the harness connector at the E14 Seat Heating Element - Cushion and the E14 Seat Heating Element - Back, Vehicle ON.

NOTE: **When performing this test ensure that you are testing from the correct terminal. Testing from the incorrect terminal will cause a misdiagnosis of the circuit. Three of the four terminals in this connector will not only display a voltage reading but a different voltage reading.**

4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
 - E14 Seat Heating Element - Cushion terminal 2
 - E14 Seat Heating Element - Back terminal 2
 - **If less than 4.8 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.

• **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29F Seat Heating Control Module - Front.
- **If between 4.8 - 5.2 V**
5. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4 of the E14 Seat Heating Element - Back, Vehicle ON.

NOTE: **The test lamp should turn ON for approximately 10 s after the heated seat is commanded ON.**

6. Verify the test lamp turns ON after pressing the heated seat switch.
 - **If the test lamp is always OFF**
1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front.
2. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.
- **If the test lamp turns ON**
7. Vehicle OFF, connect the harness connector at the E14 Seat Heating Element - Cushion, Vehicle ON.
8. Verify the test lamp turns ON after pressing the heated seat switch.
 - **If the test lamp is always OFF**

NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

Test or replace the E14 Seat Heating Element - Cushion.

- **If the test lamp turns ON**

NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

9. Test or replace the E14 Seat Heating Element - Back.

One Heating Element is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the appropriate E14 Seat Heating Element.
2. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4, Vehicle ON.
3. Verify the test lamp turns ON after pressing the heated seat switch.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front.
 2. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - **If the test lamp turns ON**

NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

4. Test or replace the E14 Seat Heating Element.

Degraded Heated Seat Operation Driver Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at each component listed below. It may take up to 2 min for all vehicle systems to power down.
 - E14B Seat Heating Element - Driver Cushion
 - E14A Seat Heating Element - Driver Back
2. Test for less than 40 Ω between each low reference circuit terminal listed below and ground, one at a time.
 - E14B Seat Heating Element - Driver Cushion terminal 3
 - E14A Seat Heating Element - Driver Back terminal 3
 - **If 40 Ω or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.
 - **If less than 40 Ω**
3. Vehicle ON.

4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
 - E14B Seat Heating Element - Driver Cushion terminal 2
 - E14A Seat Heating Element - Driver Back terminal 2
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29F Seat Heating Control Module - Front.
 - **If between 4.8 - 5.2 V**
5. Vehicle OFF, connect the harness connector at the E14B Seat Heating Element - Driver Cushion and the E14A Seat Heating Element - Driver Back. Disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
6. Test for 500 Ω - 300 k Ω between the signal circuit and the low reference circuit terminals listed below, one at a time.
 - E14B Seat Heating Element - Driver Cushion terminal 6 and terminal 1
 - E14A Seat Heating Element - Driver Back terminal 3 and terminal 1
 - **If not between 500 Ω - 300 k Ω**

Replace the E14 Seat Heating Element.
 - **If between 500 Ω - 300 k Ω**
7. Replace the K29F Seat Heating Control Module - Front.

Degraded Heated Seat Operation Passenger Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at each component listed below. It may take up to 2 min for all vehicle systems to power down.
 - E14D Seat Heating Element - Passenger Cushion
 - E14C Seat Heating Element - Passenger Back

2. Test for less than 40 Ω between each low reference circuit terminal listed below and ground, one at a time.
 - E14D Seat Heating Element - Passenger Cushion terminal 3
 - E14C Seat Heating Element - Passenger Back terminal 3
 - **If 40 Ω or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.
 - **If less than 40 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
 - E14D Seat Heating Element - Passenger Cushion terminal 2
 - E14C Seat Heating Element - Passenger Back terminal 2
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29F Seat Heating Control Module - Front.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29F Seat Heating Control Module - Front.
 - **If between 4.8 - 5.2 V**
 - 5. Vehicle OFF, connect the harness connector at the E14D Seat Heating Element - Passenger Cushion and the E14C Seat Heating Element - Passenger Back. Disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
 - 6. Test for 500 Ω - 300 k Ω between the signal circuit and the low reference circuit terminals listed below, one at a time.
 - E14D Seat Heating Element - Passenger Cushion terminal 5 and terminal 2
 - E14C Seat Heating Element - Passenger Back terminal 4 and terminal 12
 - **If not between 500 Ω - 300 k Ω**

Replace the E14 Seat Heating Element.

- **If between 500 Ω - 300 k Ω**

7. Replace the K29F Seat Heating Control Module - Front.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Heater and Air Conditioning User Interface Control Replacement](#)
- Refer to [Driver or Passenger Seat Back Heater Replacement](#)
- Refer to [Front Seat Cushion Heater Replacement](#)
- Refer to [Control Module References](#) for K29F Seat Heating Control Module - Front replacement, programming and setup

REAR HEATED SEAT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 10 X1	U1526, 1	U1526, 1	-	-
B+ Terminal 7 X1	4	4	-	-
Left Rear Heated Seat Switch Signal	7	2	2	-
Indicator Dimming Control Terminal 6	B2625 02	6	6	-
Left Rear Heated Seat High Indicator Control Terminal 4	6	6	-	-
Left Rear Heated Seat Cushion Temperature Sensor Signal	2	3	3	-
Left Rear Heated Seat Cushion Temperature Sensor Low Reference	-	3	-	-
Left Rear Heated Seat Cushion Element Voltage Control	1	2	1	-
Left Rear Heated Seat Cushion Element Ground Control	1	2	1	-
Right Rear Heated Seat Switch Signal	7	4	4	-
Indicator Dimming Control Terminal 6	B2625 02	6	6	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Rear Heated Seat High Indicator Control Terminal 4	6	6	-	-
Right Rear Heated Seat Cushion Temperature Sensor Signal	4	5	5	-
Right Rear Heated Seat Cushion Temperature Sensor Low Reference	-	5	-	-
Right Rear Heated Seat Cushion Element Voltage Control	1	4	1	-
Right Rear Heated Seat Cushion Element Ground Control	1	4	1	-
Rear Seat Heating Control Module Ground Terminal 7 X2	-	8	-	-
Rear Seat Heating Control Module Ground Terminal 8 X1	-	U1526, 1	-	-
1. Left and right rear heated seats are inoperative 2. Left rear heated seat is inoperative 3. Degraded left rear heated seat operation 4. Right rear heated seat is inoperative 5. Degraded right rear heated seat operation 6. Rear heated seat switch indicator malfunction 7. The heated seat is always ON 8. No effect				

Circuit/System Description

When a heated seat switch is pressed, the heated seat switch signal circuit from the body control module (BCM) is pulled low indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a LIN bus serial data message to the rear seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating element per the BCM command.

The rear seat heating control module controls heated seat operation for the left and right rear seats. When active, power is applied to the seat cushion heater element through a pulse width modulated (PWM) voltage supply control circuit. The heater element is switched to ground by the module through a low side drive control circuit.

The seat cushion temperature sensor (thermistor) is packaged with the seat heating element located just under the seat cover. The rear seat heating control module supplies the temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

Diagnostic Aids

- A short to ground or B+ in either the heating element voltage control circuit or ground control circuit will cause both rear heated seats to be inoperative.
- A short to ground on the seat cushion temperature sensor signal circuit will cause the heated seat function to be inoperative for that seat.
- The following faults will cause a degraded heated seat operation.
 - An open or a short to voltage on the seat cushion temperature sensor signal circuit.
 - An open in the seat cushion temperature sensor low reference circuit.
 - A fault in the seat cushion temperature sensor.
- A broken wire in a heating element may cause a degraded heated seat operation for that particular heating element.
- When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.5 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the left and right rear seat heating elements.
- With the seat cushion heater element disconnected, if the high side output of the control module is measured it will display a low current 12 V bleed off voltage. This bleed off voltage does not have a meaningful diagnostic purpose. With the heater elements connected you would just see the 3.5 V biased voltage from this circuit.
- If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Heated Seats Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle ON.

NOTE: Review the Diagnostic Fault Information table and Diagnostic Aids in order to get a better understanding of the possible heated seat system faults before proceeding Circuit/System Verification and Circuit/System Testing.

2. Verify the scan tool Body Control Module Left Rear Seat Heating/Venting/Cooling Mode parameter changes between Off and Seat Back and Cushion Heating when pressing the left rear heated seat switch.

- **If the parameter does not change**

Refer to Circuit/System Testing - Heated Seat Switch Circuit Test.

- **If the parameter changes**

3. Verify the scan tool Right Rear Seat Heating/Venting/Cooling Mode parameter changes between Off and Seat Back and Cushion Heating when pressing the right rear heated seat switch.

- **If the parameter does not change**

Refer to Circuit/System Testing - Rear Heated Seat Switch Circuit Test.

- **If the parameter changes**

4. Verify the left and right rear heated seats operate.

- **If both rear heated seats are inoperative**

Refer to Circuit/System Testing - Both Rear Heated Seats are Inoperative

- **If just one of the rear heated seats is inoperative**

Refer to Circuit/System Testing - One Rear Heated Seat is Inoperative

- **If the left rear seat exhibits a degraded heated seat operation**

Refer to Circuit/System Testing - Degraded Heated Seat Operation Left Rear Seat

- **If the right rear seat exhibits a degraded heated seat operation**

Refer to Circuit/System Testing - Degraded Heated Seat Operation Right Rear Seat

- **If both heated seats operate**

5. Verify the rear heated seat switch indicator illuminates after pressing the rear seat heating switch.

- **If the indicator does not illuminate**

Refer to Circuit/System Testing - Heated Seat Switch Indicator Circuit Test.

- **If the indicator illuminates**

6. All OK.

Circuit/System Testing

Rear Heated Seat Switch Circuit Test

NOTE: Circuit/System Verification must be performed before proceeding with Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch - Rear. It may take up to 2 min for all vehicle system to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the appropriate scan tool Rear Seat Heating/Venting/Cooling Mode parameter is Off.
 - **If not Off**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Off**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool scan tool Rear Seat Heating/Venting/Cooling Mode parameter is Seat Back and Cushion Heating - High.
 - **If not Seat Back and Cushion Heating - High**
 1. Vehicle OFF, remove the jumper wire, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle ON.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Seat Back and Cushion Heating - High**
7. Test or replace the S32 Seat Heating Switch - Rear.

Both Heated Seats are Inoperative

NOTE: Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K29R Seat Heating

Control Module - Rear, Vehicle ON.

2. Verify a test lamp illuminates between each B+ circuit terminal listed below and ground.
 - Terminal 7
 - Terminal 10
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K29R Seat Heating Control Module - Rear.
 - **If the test lamp illuminates**
3. Vehicle OFF.
4. Test for infinite resistance between each control circuit terminal listed below and ground, one at a time.
 - Terminal 2
 - Terminal 6
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
5. Vehicle ON.
6. Test for less than 1 V between each control circuit terminal listed below and ground, one at a time.
 - Terminal 2
 - Terminal 6
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
7. Replace the K29R Seat Heating Control Module - Rear.

One Heated Seat is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the X1 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.

2. Verify a test lamp illuminates between the B+ circuit terminal 7 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K29R Seat Heating Control Module - Rear.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K29R Seat Heating Control Module - Rear and disconnect the harness connector at the appropriate E14 Seat Heating Element - Rear Cushion, Vehicle ON.

NOTE: When performing this test ensure that you are testing from the correct terminal. Testing from the incorrect terminal will cause a misdiagnosis of the circuit. Three of the four terminals in this connector will not only display a voltage reading but a different voltage reading.

4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.
 - **If between 4.8 - 5.2 V**
5. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4, Vehicle ON.

NOTE: The test lamp should turn ON for approximately 20 s after the heated seat

is commanded ON.

6. Verify the test lamp turns ON after pressing the rear heated seat switch.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29R Seat Heating Control Module - Rear.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.

- **If the test lamp turns ON**

NOTE: Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.

7. Test or replace the E14 Seat Heating Element - Rear Cushion.

Degraded Heated Seat Operation Left Rear Seat

NOTE: Circuit/System Verification must be performed before proceeding with Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the E14F Seat Heating Element - Left Rear Cushion. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 40 Ω between the low reference circuit terminal 3 and ground.

- **If 40 Ω or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.

- **If less than 40 Ω**

3. Vehicle ON.

4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.

- **If between 4.8 - 5.2 V**

5. Vehicle OFF, connect the harness connector at the E14F Seat Heating Element - Left Rear Cushion and disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
6. Test for 500 Ω - 300 k Ω between the signal circuit terminal 6 and the low reference circuit terminal 1.

- **If not between 500 Ω - 300 k Ω**

Replace the E14F Seat Heating Element - Left Rear Cushion.

- **If between 500 Ω - 300 k Ω**

7. Replace the K29R Seat Heating Control Module - Rear.

Degraded Heated Seat Operation Right Rear Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at the E14H Seat Heating Element - Right Rear Cushion. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 40 Ω between the low reference circuit terminal 3 and ground.
 - **If 40 Ω or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.
 - **If less than 40 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K29R Seat Heating Control Module - Rear.
- **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.
- **If between 4.8 - 5.2 V**
 5. Vehicle OFF, connect the harness connector at the E14H Seat Heating Element - Right Rear Cushion and disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
 6. Test for 500 Ω - 300 k Ω between the signal circuit terminal 5 and the low reference circuit terminal 2.
 - **If not between 500 Ω - 300 k Ω**

Replace the E14H Seat Heating Element - Right Rear Cushion.
 - **If between 500 Ω - 300 k Ω**
 7. Replace the K29R Seat Heating Control Module - Rear.

Heated Seat Switch Indicator Circuit Test

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch - Rear, Vehicle ON.

NOTE: **The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.**

2. Verify a test lamp illuminates at LOW intensity between the control circuit terminal 6 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module
 - **If the test lamp illuminates at FULL intensity**
 1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K9 Body Control Module, Vehicle ON.
 2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp illuminates at LOW intensity**
3. Connect a test lamp illuminate between control circuit terminal 6 and control circuit terminal 4.
 4. Verify the test lamp Does Not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
 5. Verify the test lamp illuminates when commanding the Rear Seat Heating Indicator Active with a scan tool.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, Vehicle ON.
 2. Test for less than 1 V between the control circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
 6. Test or replace the S32 Seat Heating Switch - Rear.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Rear Seat Heater Switch Replacement](#)
- Refer to [Rear Seat Cushion Heater Replacement](#)
- Refer to [Control Module References](#) for K29R Seat Heating Control Module - Rear replacement, programming and setup

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - SEATS

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:

- Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.

- Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
- Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.

2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
- Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
- Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
- Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
- If the wire is damaged, repeat this procedure after removing the damaged section.

4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.

5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

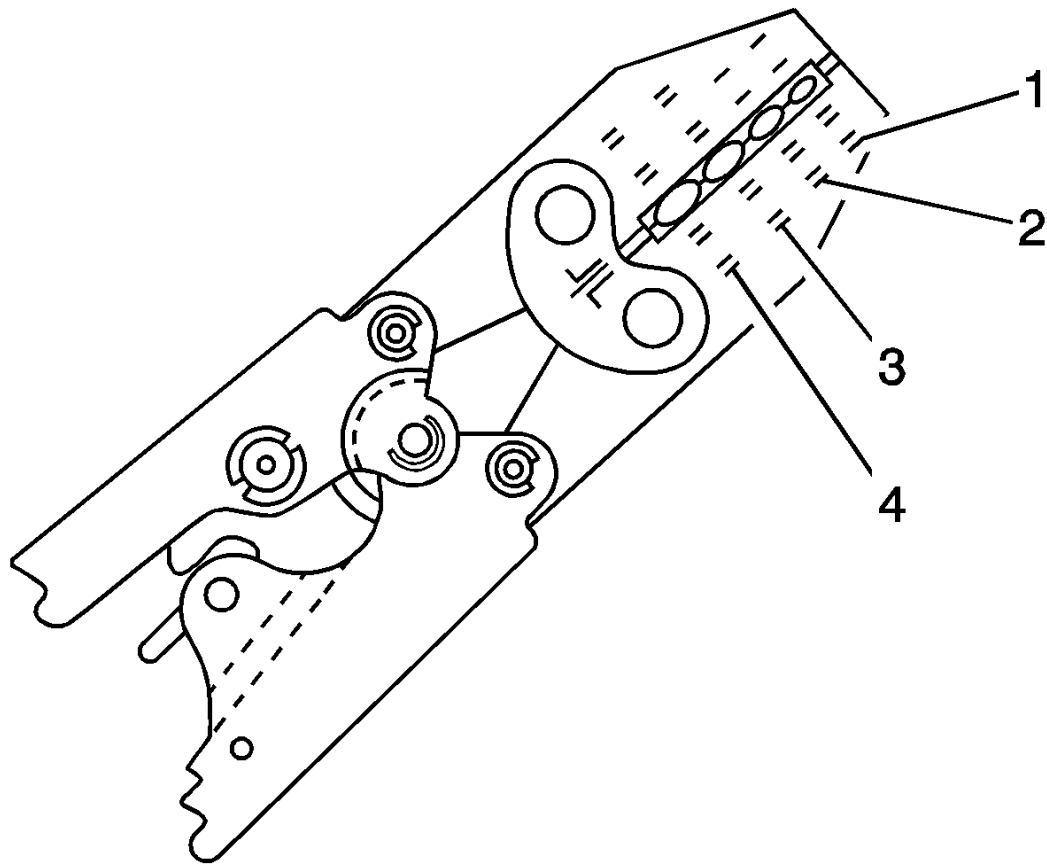


Fig. 3: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

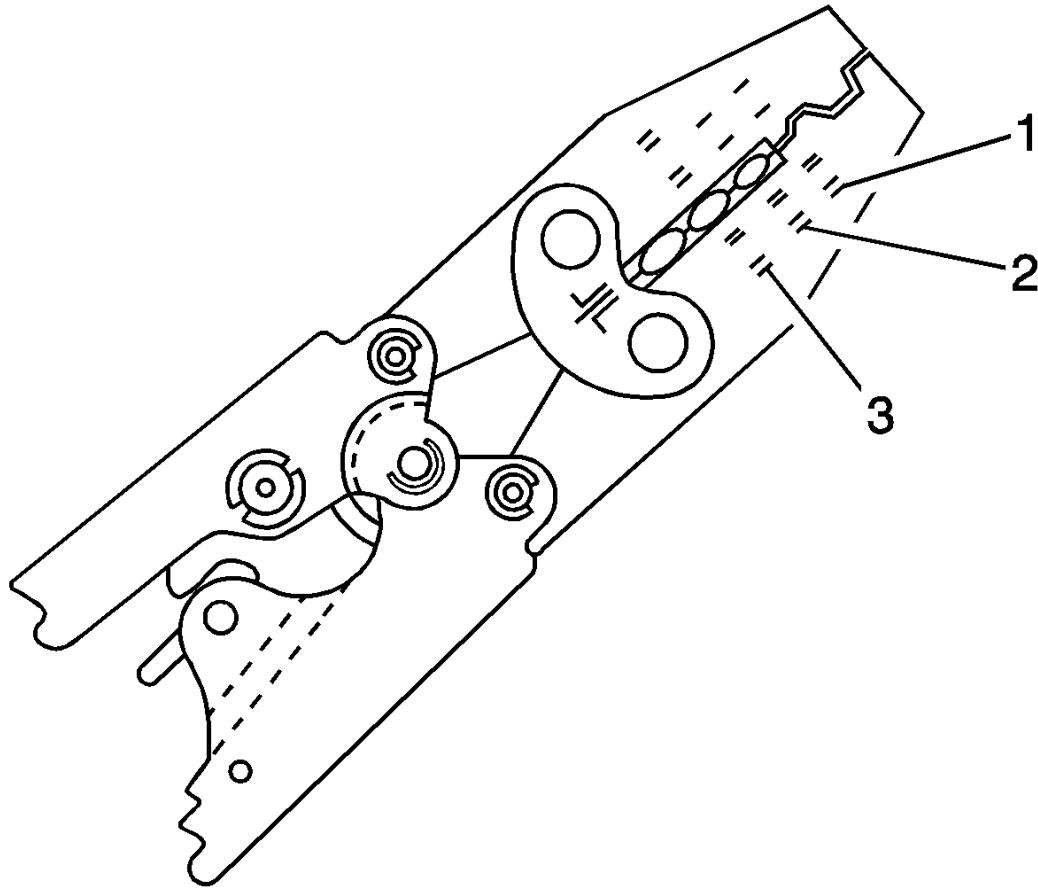


Fig. 4: Splice Sleeve Crimping Tool With 3 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

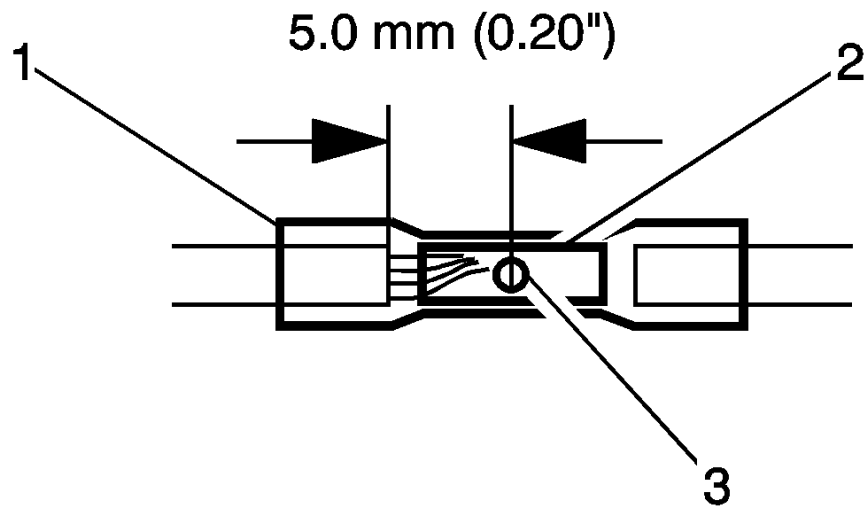


Fig. 5: Identifying DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 6: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 7: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

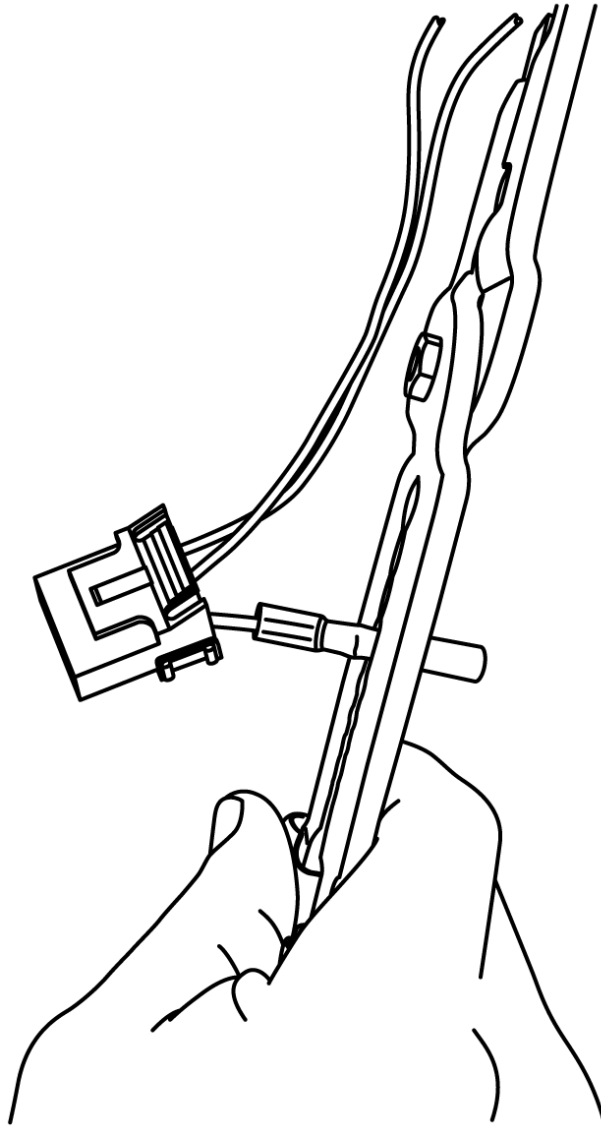


Fig. 8: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

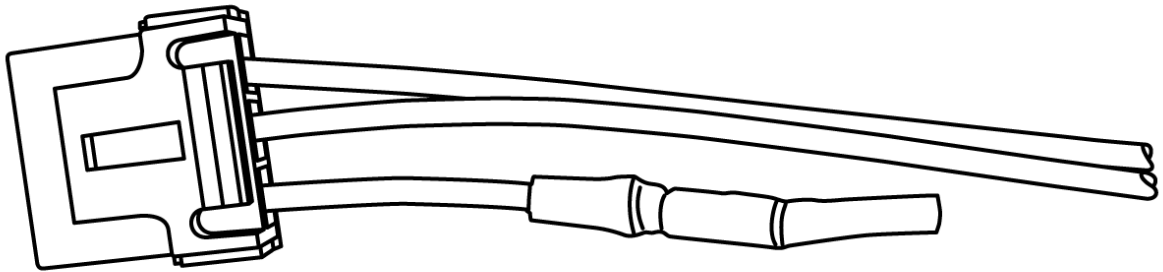


Fig. 9: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

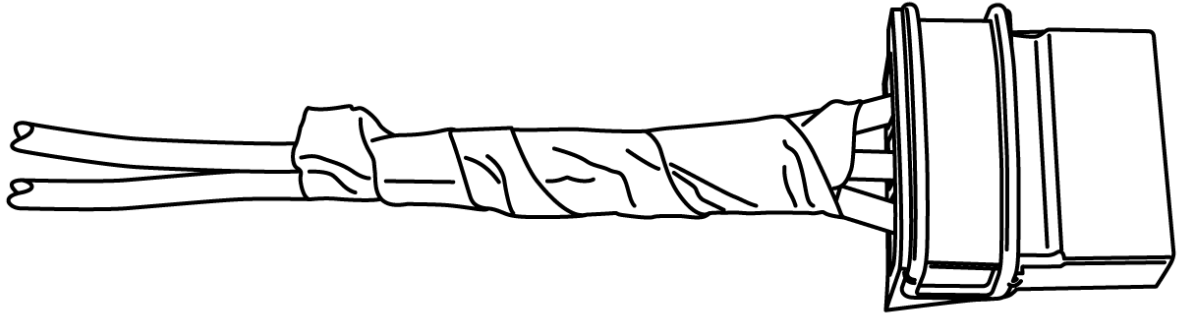


Fig. 10: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - SEATS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

FRONT SEAT HEATER CONTROL MODULE REPLACEMENT

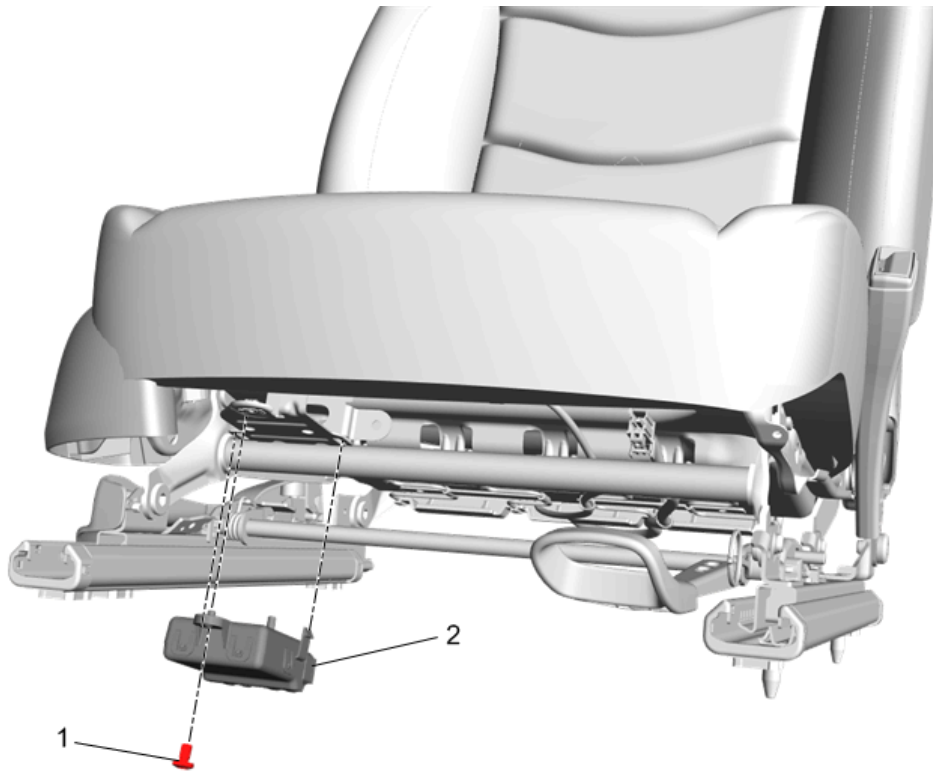


Fig. 11: Front Seat Heater Control Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Heater Control Module Fastener CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Seat Heater Control Module Procedure 1. Disconnect the electrical connector. 2. Disconnect the module from the bracket, then pull downward away from the bottom of the seat. 3. Refer to <u>Control Module References</u> for programming and setup information, if required.

DRIVER OR PASSENGER SEAT BACK HEATER REPLACEMENT

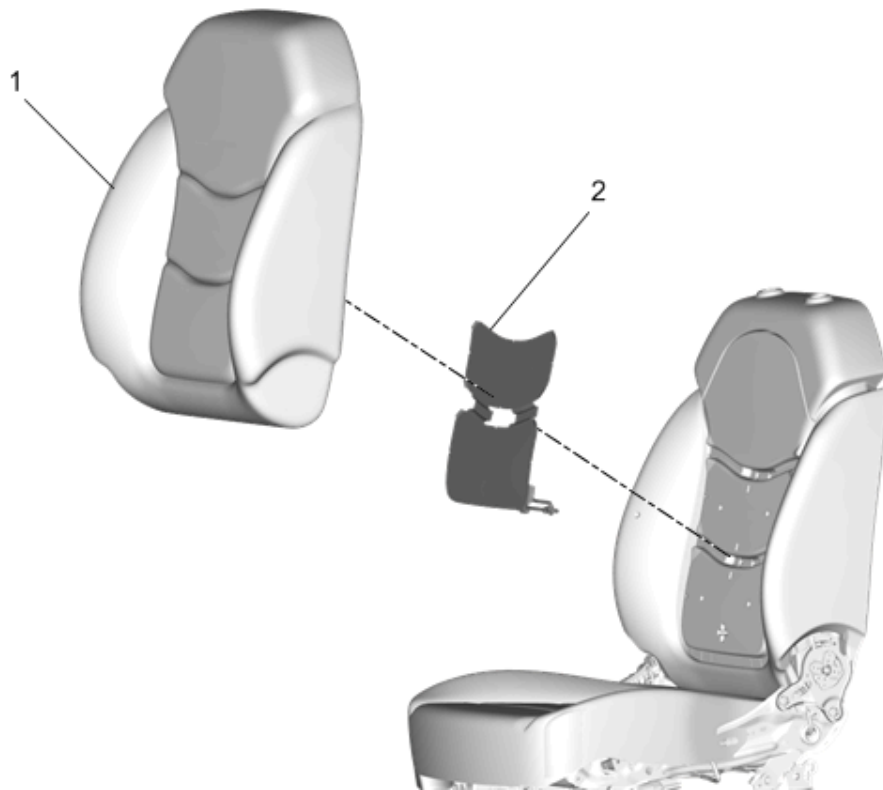


Fig. 12: Driver Or Passenger Seat Back Cushion Heater

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover	

Callout	Component Name
from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury.	
Preliminary Procedure Remove Driver or Passenger Seat Back Cover and Pad. Refer to <u>Driver or Passenger Seat Back Cover and Pad Replacement</u>	
1	Driver or Passenger Seat Back Cushion Cover
2	Driver or Passenger Seat Back Cushion Heater Procedure 1. Disconnect the electrical connector. 2. Remove the heater element leaving the old adhesive strips intact on the seat cushion. The new seat heater adhesive strips will be placed over the old adhesive strips.

FRONT SEAT CUSHION HEATER REPLACEMENT

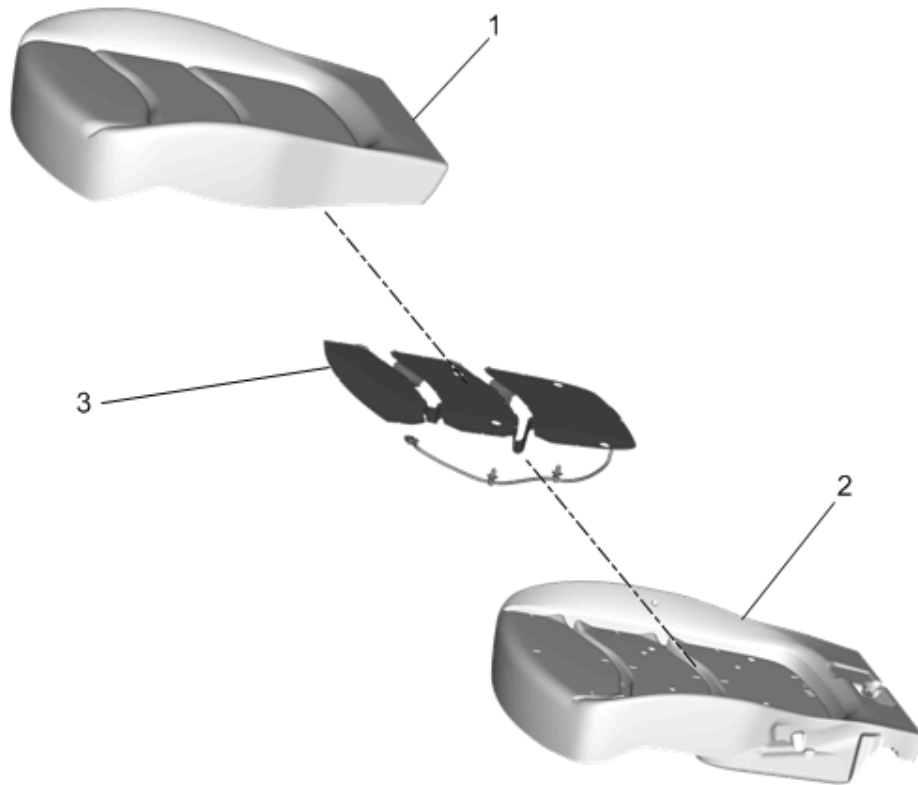


Fig. 13: Front Seat Cushion Heater

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning .	
Preliminary Procedure Remove Front Seat Cushion Cover and Pad. Refer to Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Cushion Cover
2	Front Seat Cushion Pad
3	Front Seat Cushion Heater Procedure 1. Disconnect the heater element and peel away from the cushion to remove. 2. Note the routing of the wiring harness and connector location for installation.

REAR SEAT HEATER SWITCH REPLACEMENT

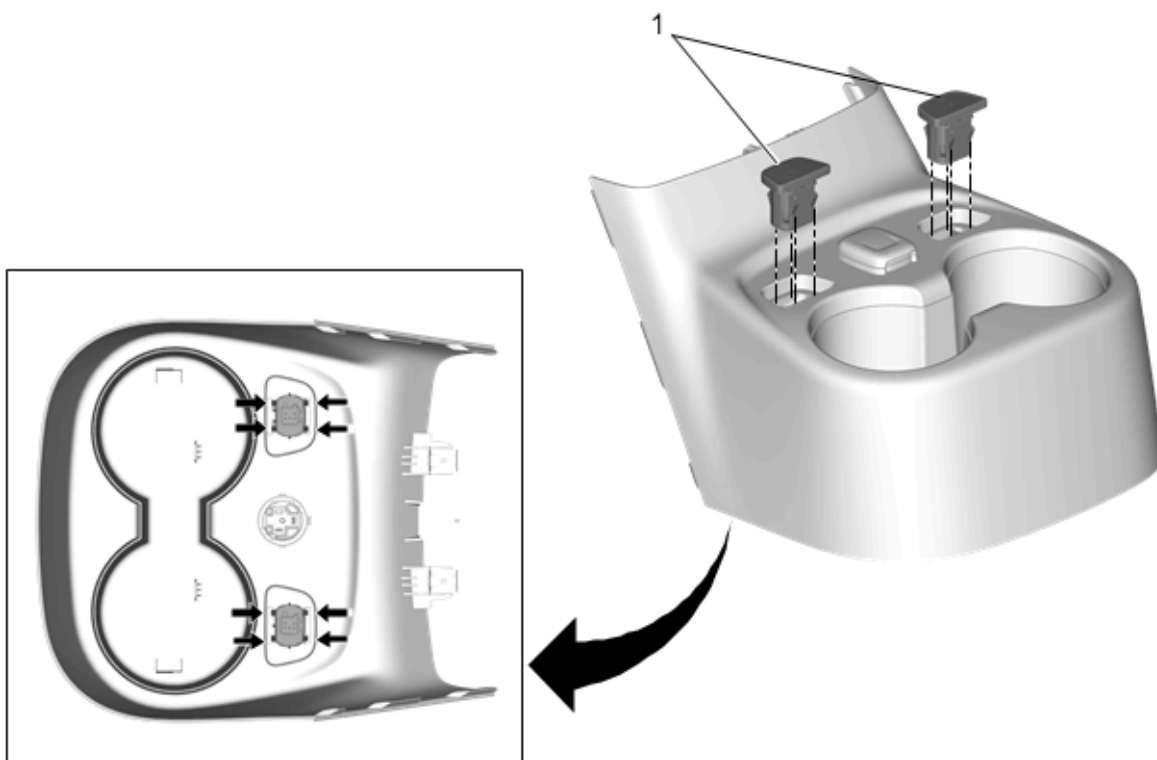


Fig. 14: Rear Seat Heater Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Floor Console Rear Cup Holder. Refer to Front Floor Console Rear Cup Holder Replacement	
1	Rear Seat Heater Switch (Qty: 2) Procedure Release the tabs and remove the switch.

REAR SEAT HEATER CONTROL MODULE REPLACEMENT

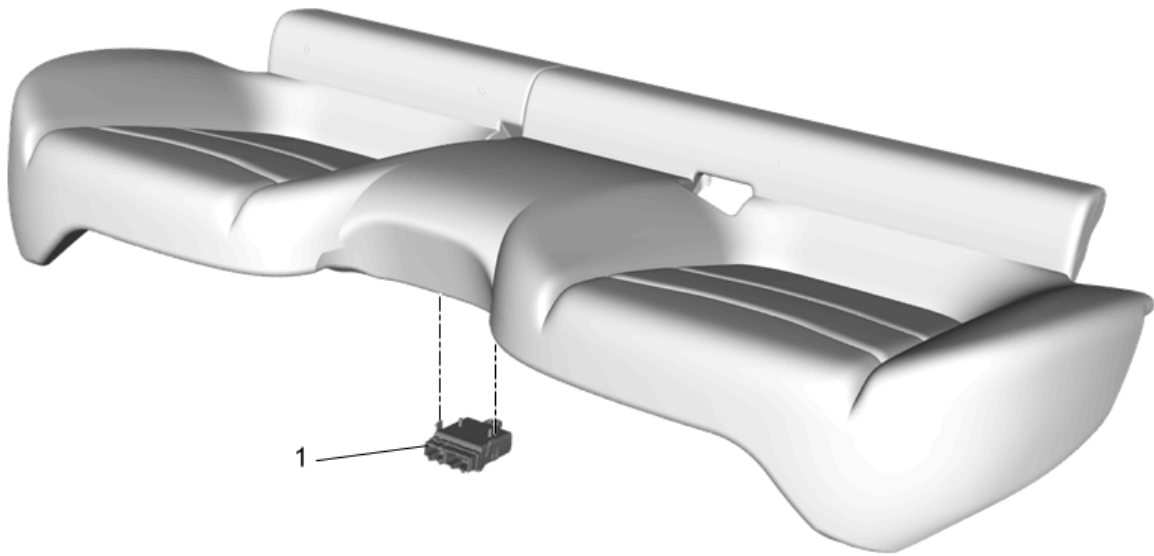


Fig. 15: Rear Seat Heater Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Seat Cushion. Refer to Rear Seat Cushion Removal and Installation	
1	Rear Seat Heater Control Module

REAR SEAT CUSHION HEATER REPLACEMENT

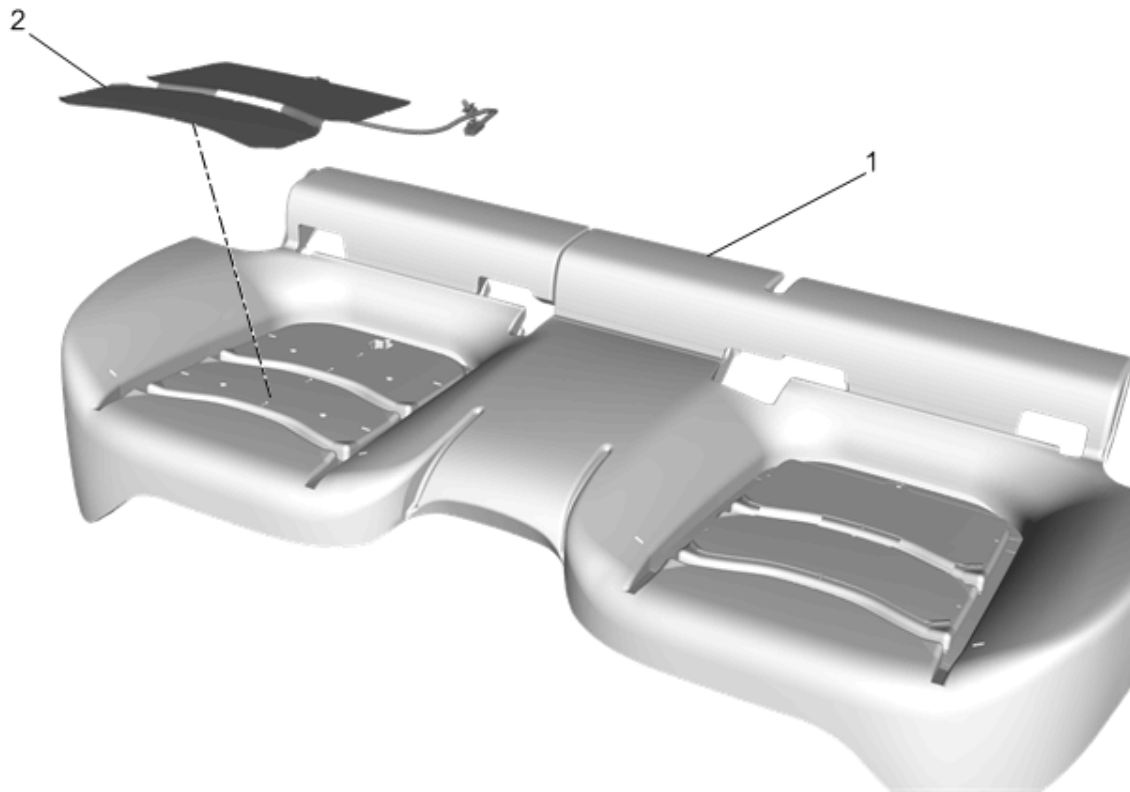


Fig. 16: Rear Seat Cushion Heater

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Seat Cushion Cover and Pad. Refer to Rear Seat Cushion Cover and Pad Replacement	
1	Rear Seat Cushion Pad
2	Rear Seat Cushion Heater Procedure 1. Disconnect the electrical connectors. 2. Disconnect the heater element and peel away from the cushion to remove. 3. Note the routing of the wiring harness and connector location for installation.

DESCRIPTION AND OPERATION

HEATED SEATS DESCRIPTION AND OPERATION

Heated Seat Components

The heated seat system consists of the following components:

- Heated seat switches
- Body control module

- Seat heating control module
- Driver seat cushion heating element
- Driver seat cushion temperature sensor
- Driver seat back heating element
- Driver seat back temperature sensor
- Passenger seat cushion heating element
- Passenger seat cushion temperature sensor
- Passenger seat back heating element
- Passenger seat back temperature sensor

Heated Seat Switches

The driver and passenger heated seats are controlled by separate heated seat switches located on the center stack near the HVAC controls. The vehicle must be ON to operate the heated seat system. The BCM is the heated seat system master. It monitors heated seat switch activations to determine user requested operating mode. Based on the requested operating mode, the BCM sends a LIN Bus serial data message to the seat heating control module how to drive the self-regulated heating pads. The BCM also controls the indicators used to provide the operator with feedback as to the operating status of the system. With each press of the switch, the system will cycle through High, Medium, Low, and then back to Off again. The BCM also controls the seat temperature and mode indicators, via the serial data line, used to provide the operator with feedback as to the operating status of the system.

Heated Seat Operation

The seat heating control module controls heated seat operation for the driver and passenger seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module through a common low side drive control circuit.

When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.5 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the driver and passenger seat heating elements. During heated seat operation, the seat heating control module interrupts control of the heating elements every 10 s for approximately 10 ms to make this biased voltage check.

With both the seat cushion and seat back heater elements disconnected, if the high side output of the module is measured it will display a low current 12 V bleed off voltage. This bleed off voltage does not have a meaningful diagnostic purpose. With one or both of the heater elements connected you would just see the 3.5 V biased voltage from this circuit.

Temperature Regulation

The seat back and cushion temperature sensors (thermistors) are packaged with the seat heating elements located just under the seat covers. The seat heating control module supplies each temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

REAR HEATED SEATS DESCRIPTION AND OPERATION

Heated Seat Components

The rear heated seat system consists of the following components:

- Rear heated seat switches
- Body control module
- Rear seat heating control module
- Left rear seat cushion heating element
- Left rear seat cushion temperature sensor
- Right rear seat cushion heating element
- Right rear seat cushion temperature sensor

Heated Seat Switches

When a heated seat switch is pressed, the heated seat switch signal circuit from the body control module (BCM) is pulled low indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a LIN bus serial data message to the rear seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating element per the BCM command.

Rear Heated Seat Operation

The rear seat heating control module controls heated seat operation for the left and right rear seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module through a common low side drive control circuit.

When inactive the rear seat heating control module connects the heating element low side outputs to a common reference point internal to the control module which is biased to approximately 3.5 V. The control module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling either the left or right rear seat heating element. During heated seat operation, the control module interrupts control of the heating elements every 10 s for approximately 10 ms to make this biased voltage check.

Temperature Regulation

The seat cushion temperature sensor (thermistors) is packaged with the seat heating element located just under the seat cover. The rear seat heating control module supplies the temperature sensor with a 5 V reference signal circuit and a low reference circuit. The control module monitors the voltage from the signal circuit to determine

the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the rear seat heating control module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

The temperature level may automatically be lowered after approximately 30 min of operation.

Article GUID: A00884700

ACCESSORIES & EQUIPMENT

Secondary and Configurable Customer Controls - Volt

SCHEMATIC WIRING DIAGRAMS

STEERING WHEEL SECONDARY/CONFIGURABLE CONTROL WIRING SCHEMATICS

Steering Wheel Controls

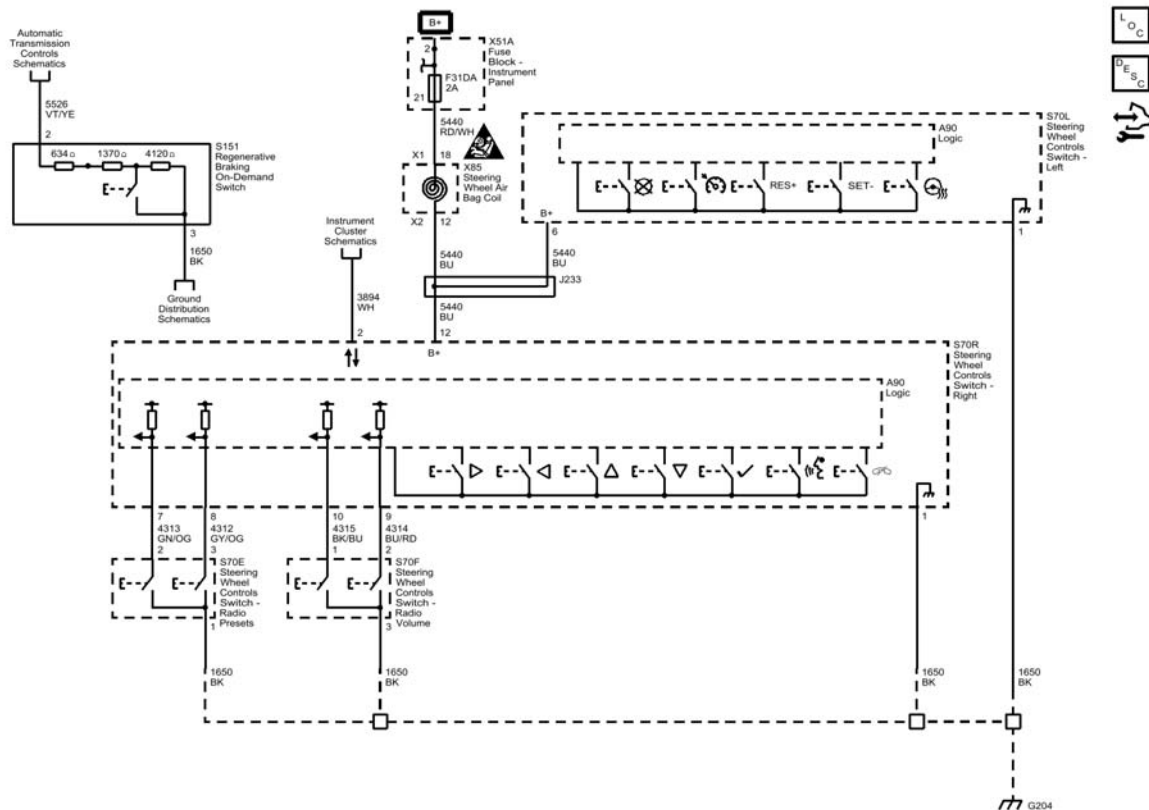


Fig. 1: Steering Wheel Controls

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B3622: STEERING WHEEL CONTROLS SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3622

Steering Wheel Controls Signal Circuit

For symptom byte information refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1510 00	U1510 00	-	-
Volume Up Signal-Terminal 8	B3622 39, B3622 59	1	-	-
Volume Down Signal-Terminal 7	B3622 39, B3622 59	1	-	-
Next Preset Signal-Terminal 9	B3622 39, B3622 59	1	-	-
Previous Preset Signal-Terminal 10	B3622 39, B3622 59	1	-	-
Serial Data	U1510 00, B3622 59	U1510 00	U1510 00, B3622 59	-
Low Reference	-	U1510 00	-	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The steering wheel controls are divided into a right-hand set and left-hand set. The right - hand switch communicates with the instrument cluster through serial data and provides input from the rear left - hand switch and rear right - hand switch. The instrument cluster identifies the switch selection and activates the feature.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

B3622 39

An internal electrical malfunction has been detected in the steering wheel controls switch.

B3622 59

A stuck switch has been detected in the steering wheel controls switch.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

The DTC will clear when the conditions for setting the DTC are no longer present.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify all the associated primary controls on the radio (Volume, Mute, Seek, etc.) operate properly.
 - **If any of the primary controls do not function properly**

Refer to [Symptoms - Entertainment](#) .

- **If all of the primary controls function properly**
3. Verify the scan tool Steering Wheel Control Switches parameter changes when pressing the S70R Steering Wheel Controls Switch - Right buttons.
 - **If the parameter does not change for some of the S70R Steering Wheel Controls Switch - Right switches**

Replace S70R Steering Wheel Controls Switch - Right.
 - **If the parameter does not change for all of the S70R Steering Wheel Controls Switch - Right switches**

Refer to S70R Steering Wheel Controls Switch Circuit/System Testing.
 - **If the parameter changes for all S70R Steering Wheel Controls Switch - Right buttons**
 - 4. Verify the scan tool Steering Wheel Control Switches parameter changes between Volume Up and Volume Down when depressing the S70F Steering Wheel Controls Switch - Radio Volume switch.

- **If the parameter does not change**

Refer to S70F Steering Wheel Controls Switch - Radio Volume Circuit/System Testing.

- **If the parameter changes**

5. Verify the scan tool Steering Wheel Control Switches parameter changes between Next Preset and Previous Preset when depressing the S70E Steering Wheel Controls Switch - Radio Presets switch.

- **If the parameter does not change**

Refer to S70E Steering Wheel Controls Switch - Radio Presets Circuit/System Testing.

- **If the parameter changes**

6. All OK.

Circuit/System Testing

S70F Steering Wheel Controls Switch - Radio Volume

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.
4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:

- Terminal 1
- Terminal 2

- **If 4.5 V or less**

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S70R Steering Wheel Controls Switch - Right.

- **If greater than 4.5 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.
6. Verify the scan tool Steering Wheel Control Switches parameter is Volume Down Button.

- **If not Volume Down Button**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Volume Down Button**

7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.

8. Verify the scan tool Steering Wheel Control Switches parameter is Volume Up Button.

- **If not Volume Up Button**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Volume Up Button**

9. Test or replace the S70F Steering Wheel Controls Switch - Radio Volume.

S70E Steering Wheel Controls Switch - Radio Presets

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:

- Terminal 2

- Terminal 3

- **If 4.5 V or less**

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , test or replace the S70R Steering Wheel Controls Switch - Right.

- **If greater than 4.5 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.

6. Verify the scan tool Steering Wheel Control Switches parameter is Next Preset.

- **If not Next Preset**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Next Preset**

7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.

8. Verify the scan tool Steering Wheel Control Switches parameter is Previous Preset.

- **If not Previous Preset**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Previous Preset**

9. Test or replace the S70E Steering Wheel Controls Switch - Radio Presets.

S70R Steering Wheel Controls Switch-Right

1. Ignition OFF, disconnect the harness connector X1 at the P16 Instrument Cluster.

2. Disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right. Ignition ON.

3. Test for less than 1 V between the S70R Steering Wheel Controls Switch - Right serial data circuit terminal 2 and ground.

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If less than 1 V**

4. Ignition OFF.

5. Test for infinite resistance between the serial data circuit terminal 2 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume.

2. Test for infinite resistance between the following signal terminals and the ground terminal 3 with the switch in the open position.

- Terminal 1

- Terminal 2

- **If less than infinite resistance on either circuit**

Replace the S70F Steering Wheel Controls Switch - Radio Volume.

- **If infinite resistance**

3. Test for less than 10 Ω between the following signal terminals and the ground terminal 3 with the S70F Steering Wheel Controls Switch - Radio Volume in the Up position or Down position.

- Terminal 1
- Terminal 2
- **If 10 Ω or greater**

Replace the S70F Steering Wheel Controls Switch - Radio Volume.

- **If less than 10 Ω**

4. Ignition OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets.

5. Test for infinite resistance between the following signal terminals and the ground terminal 1 with the switch in the open position.

- Terminal 2
- Terminal 3
- **If less than infinite resistance on either circuit**

Replace the S70E Steering Wheel Controls Switch - Radio Presets.

- **If infinite resistance**

6. Test for less than 10 Ω between the following signal terminals and the ground terminal 1 with the S70E Steering Wheel Controls Switch - Radio Presets in the Up position or Down position.

- Terminal 2
- Terminal 3
- **If 10 Ω or greater**

Replace the S70E Steering Wheel Controls Switch - Radio Presets.

- **If less than 10 Ω**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Steering Wheel Spoke Cover Replacement**

SYMPTOMS - SECONDARY AND CONFIGURABLE CUSTOMER CONTROLS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.

- Review the system description and operation in order to familiarize yourself with the system functions. Refer to [Steering Wheel Controls Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the steering wheel controls. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Refer to [Steering Wheel Controls Malfunction](#) in order to diagnose the symptom.

STEERING WHEEL CONTROLS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1510 00	U1510 00	-	-
Volume Up Signal	B3622 39, B3622 59	1	-	-
Volume Down Signal	B3622 39, B3622 59	1	-	-
Next Preset Signal	B3622 39, B3622 59	1	-	-
Previous Preset Signal	B3622 39, B3622 59	1	-	-
Serial Data	-	U1510 00	-	-
Low Reference	-	U1510 00	-	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The steering wheel controls are divided into a right-hand set and left-hand set. The right - hand switch

communicates with the instrument cluster through serial data and provides input from the rear left - hand switch and rear right - hand switch. The instrument cluster identifies the switch selection and activates the feature.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON. Verify the driver information center (DIC) illuminates.

- **If the DIC does not illuminate**

Test or replace the instrument cluster.

- **If the DIC illuminates**

2. Verify all the associated primary controls on the radio (Volume, Mute, Seek, etc.) operate properly.

- **If any of the primary controls do not function properly**

Refer to Symptoms - Entertainment .

- **If all of the primary controls function properly**

3. Verify the scan tool Steering Wheel Control Switches parameter changes when pressing the S70R Steering Wheel Controls Switch - Right buttons.

- **If the parameter does not change for some of the S70R Steering Wheel Controls Switch - Right switches**

Replace S70R Steering Wheel Controls Switch - Right.

- **If the parameter does not change for all of the S70R Steering Wheel Controls Switch - Right**

switches

Refer to S70R Steering Wheel Controls Switch Circuit/System Testing.

- **If the parameter changes for all S70R Steering Wheel Controls Switch - Right buttons**

4. Verify the scan tool Steering Wheel Control Switches parameter changes between Volume Up and Volume Down when depressing the S70F Steering Wheel Controls Switch - Radio Volume switch.

- **If the parameter does not change**

Refer to S70F Steering Wheel Controls Switch - Radio Volume Circuit/System Testing.

- **If the parameter changes**

5. Verify the scan tool Steering Wheel Control Switches parameter changes between Next Preset and Previous Preset when depressing the S70E Steering Wheel Controls Switch - Radio Presets switch.

- **If the parameter does not change**

Refer to S70E Steering Wheel Controls Switch - Radio Presets Circuit/System Testing.

- **If the parameter changes**

6. All OK.

Circuit/System Testing

S70F Steering Wheel Controls Switch - Radio Volume

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:

- Terminal 1
- Terminal 2

- **If 4.5 V or less**

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the S70R Steering Wheel Controls Switch - Right.

- **If greater than 4.5 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.

6. Verify the scan tool Steering Wheel Control Switches parameter is Volume Down Button.

- **If not Volume Down Button**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Volume Down Button**

7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.

8. Verify the scan tool Steering Wheel Control Switches parameter is Volume Up Button.

- **If not Volume Up Button**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Volume Up Button**

9. Test or replace the S70F Steering Wheel Controls Switch - Radio Volume.

S70E Steering Wheel Controls Switch - Radio Presets

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:

- Terminal 2
- Terminal 3

- **If 4.5 V or less**

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the S70R Steering Wheel Controls Switch - Right.

- **If greater than 4.5 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.

6. Verify the scan tool Steering Wheel Control Switches parameter is Next Preset.

- **If not Next Preset**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Next Preset**

7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.

8. Verify the scan tool Steering Wheel Control Switches parameter is Previous Preset.

- **If not Previous Preset**

Test or replace the S70R Steering Wheel Controls Switch - Right.

- **If Previous Preset**

9. Test or replace the S70E Steering Wheel Controls Switch - Radio Presets.

S70R Steering Wheel Controls Switch-Right

1. Ignition OFF, disconnect the harness connector X1 at the P16 Instrument Cluster.

2. Disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right. Ignition ON.

3. Test for less than 1 V between the S70R Steering Wheel Controls Switch - Right serial data circuit terminal 2 and ground.

- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If less than 1 V**

4. Ignition OFF.

5. Test for infinite resistance between the serial data circuit terminal 2 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

6. Replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume.

2. Test for infinite resistance between the following signal terminals and the ground terminal 3 with the

switch in the open position.

- Terminal 1
- Terminal 2
- **If less than infinite resistance on either circuit**

Replace the S70F Steering Wheel Controls Switch - Radio Volume.

- **If infinite resistance**

3. Test for less than 10 Ω between the following signal terminals and the ground terminal 3 with the S70F Steering Wheel Controls Switch - Radio Volume in the Up position or Down position.

- Terminal 1
- Terminal 2
- **If 10 Ω or greater**

Replace the S70F Steering Wheel Controls Switch - Radio Volume.

- **If less than 10 Ω**

4. Ignition OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets.

5. Test for infinite resistance between the following signal terminals and the ground terminal 1 with the switch in the open position.

- Terminal 2
- Terminal 3
- **If less than infinite resistance on either circuit**

Replace the S70E Steering Wheel Controls Switch - Radio Presets.

- **If infinite resistance**

6. Test for less than 10 Ω between the following signal terminals and the ground terminal 1 with the S70E Steering Wheel Controls Switch - Radio Presets in the Up position or Down position.

- Terminal 2
- Terminal 3
- **If 10 Ω or greater**

Replace the S70E Steering Wheel Controls Switch - Radio Presets.

- **If less than 10 Ω**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Steering Wheel Spoke Cover Replacement**

REPAIR INSTRUCTIONS

RESET TEEN DRIVER KEY PIN

If the PIN has been lost the only way to clear a Teen Key is to follow the Body Control Module (BCM) Configuration/Reset Functions Reset Teen Driver Key PIN procedure in the scan tool. This procedure will clear all Teen Keys

- 1. Connect a scan tool to the vehicle.
- 2. Select the Reset Teen Driver Key PIN.
- 3. After resetting the PIN, all teen keys will be cleared.
- 4. Verify teen keys are cleared.

DESCRIPTION AND OPERATION

STEERING WHEEL CONTROLS DESCRIPTION AND OPERATION

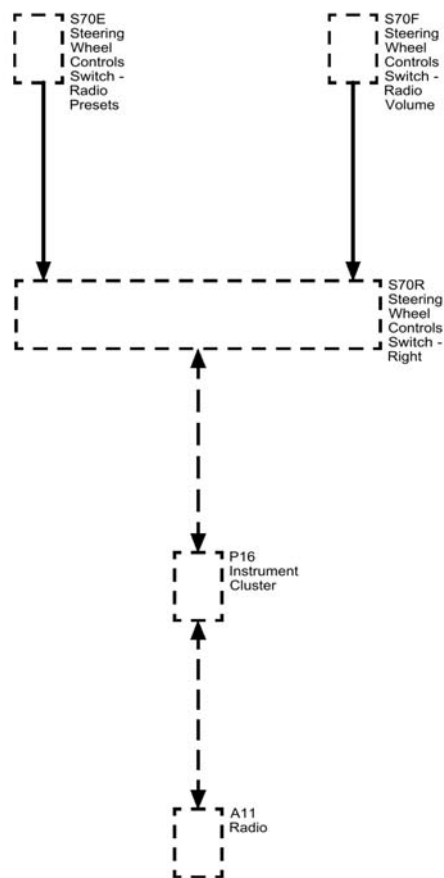


Fig. 2: Secondary Controls Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
S70E	Steering Wheel Controls Switch - Radio Presets
S70F	Steering Wheel Controls Switch - Radio Volume
S70R	S70R Steering Wheel Controls Switch - Right
P16	P16 Instrument Cluster
A11	A11 Radio

The steering wheel control switches duplicate the function of the primary controls of the associated component, through a network of momentary contact switches.

The Steering Wheel Controls are divided into a right-hand set and left-hand set. The right-hand switch is connected to the IPC LIN serial data and provides input from the left-hand, left-hand rear, and right-hand rear switches

The right-hand switch controller consists of UP/DOWN/LEFT/RIGHT directional, center "select", Push-to-Talk, and Mute buttons. The LEFT/RIGHT buttons navigate the display regions of the cluster. The UP/DOWN buttons navigate the menus. The right-hand rear switch consists of volume up and volume down buttons. The left-hand rear switch consists of favorite up and favorite down buttons.

Article GUID: A00884721

ACCESSORIES & EQUIPMENT

Theft Deterrent - Volt

SCHEMATIC WIRING DIAGRAMS

THEFT DETERRENT SYSTEM WIRING SCHEMATICS

Theft Deterrent System

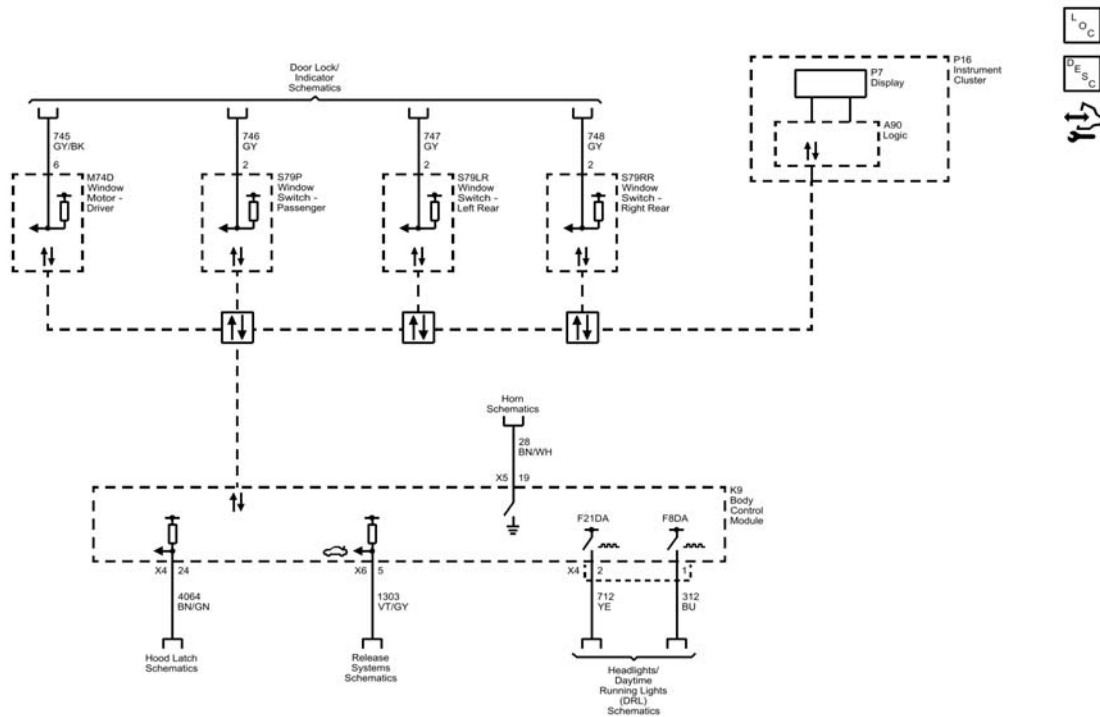


Fig. 1: Theft Deterrent System

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B291A: CONTENT THEFT DETERRENT ASSEMBLY INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B291A 39

Content Theft Deterrent Assembly Internal Malfunction

Circuit/System Description

The body control module performs various internal fault detection test to determine if a software or hardware concern exists within the power sounder. No external circuits are involved.

Conditions for Running the DTC

- The vehicle is OFF.
- The vehicle is in Park.

Conditions for Setting the DTC

The Body Control Module has detected an internal failure within the Content Theft Deterrent Sensor Module.

Action Taken When the DTC Sets

The intrusion and inclination functionality is disabled.

Conditions for Clearing the DTC

- A current DTC is cleared when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free vehicle cycles.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle in Service Mode.
2. Verify DTC B291A is not set.
 - **If the DTC is set**

Replace the P4 Power Sounder.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC B291B: CONTENT THEFT DETERRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B291B 00

Content Theft Deterrent Sensor Malfunction

DTC B291B 39

Content Theft Deterrent Sensor Internal Malfunction

DTC B291B 3B

Content Theft Deterrent Sensor Self-Test Malfunction

DTC B291B 42

Content Theft Deterrent Sensor Calibration Not Programmed

DTC B291B 4B

Content Theft Deterrent Sensor Calibration Not Learned

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B291B 3B	B291B 3B	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data	U1515, B291B 3B	B291B 3B	U1515, B291B 3B	B291B 00
Ground	-	B291B 3B	-	-

Circuit/System Description

The Body Control Module performs various communication fault detection tests to determine if a software, hardware, or communication concern exists with the Content Theft Deterrent Sensor Module.

Conditions for Running the DTC

- The vehicle is OFF.
- The vehicle is in Park.

Conditions for Setting the DTC

The Body Control Module cannot establish communications with the Content Theft Deterrent Sensor Module.

Action Taken When the DTC Sets

The intrusion and inclination alarm output is disabled.

Conditions for Clearing the DTC

- A current DTC is cleared when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free vehicle cycles.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and vehicle systems OFF, disconnect the harness connector at the B165 Content Theft Deterrent Sensor Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B165 Content Theft Deterrent Sensor Module.
 - **If the test lamp illuminates**
5. Vehicle OFF, arm the content theft deterrent system.
6. Test for greater than 4.5 V between the serial data circuit terminal 4 and ground.
 - **If 4.5 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 4.5 V**
7. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
8. Test for less than 1 V between the B165 Content Theft Deterrent Sensor Module serial data circuit terminal 4 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

9. Replace the B165 Content Theft Deterrent Sensor Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for Body Control Module replacement, programming, and setup

SYMPTOMS - THEFT DETERRENT

NOTE: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following **Theft Systems Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Theft Deterrent System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Content Theft Deterrent Malfunction (without UTT or UTP)Content Theft Deterrent Malfunction (with UTP)Content Theft Deterrent Malfunction (with UTT)**
- **Inclination/Intrusion Sensor Malfunction**
- **Theft Deterrent Alarm Malfunction (with UTR)Theft Deterrent Alarm Malfunction (with UTP)**

CONTENT THEFT DETERRENT MALFUNCTION (WITHOUT UTT OR UTP)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The content theft deterrent system is a software based system in which the Body Control Module (BCM) actively monitors certain inputs to determine if unauthorized vehicle access is being attempted. Based on inputs such as the door ajar switches, the rear compartment ajar switch, and the hood ajar switch, the BCM determines whether a content theft deterrent alarm is warranted. If unauthorized access is being detected, the BCM will pulse the vehicle horn and flash the exterior lamps as a means of theft deterrence.

Diagnostic Aids

The scan tool BCM Content Theft Deterrent Trigger History 1, 2, and 3 parameters can be used to help isolate an intermittent unwanted content theft deterrent alarm. These parameters are a rolling history of the previous three causes of a theft deterrent alarm. If all three parameters are indicating the same alarm trigger, the indicated input should be the starting point when diagnosing an intermittent concern.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle OFF.
2. Verify each indicator/message transitions between the ajar and closed state while opening and closing each vehicle door, hood, and rear compartment.
 - **If the indicator/message does not change**

Refer to [Door Ajar Indicator Malfunction](#) , [Hood Ajar Indicator/Message Malfunction](#) , or [Rear Hatch/Gate Ajar Indicator Malfunction](#) .

- **If each indicator/message changes**

3. Vehicle in Service Mode, completely lower the driver door window and close all vehicle doors, vehicle OFF.
4. Arm the content theft deterrent system by locking the door with the keyless entry transmitter.
5. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Armed.

- **If not Armed**

Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#) .

- **If Armed**

6. Without disarming the system, reach in through the open driver window and open the driver door.
7. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Alarm.

- **If not Alarm**

Replace the K9 Body Control Module.

- **If Alarm**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

CONTENT THEFT DETERRENT MALFUNCTION (WITH UTP)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The content theft deterrent system is a software based system in which the Body Control Module (BCM) actively monitors certain inputs to determine if unauthorized vehicle access is being attempted. Based on inputs such as the door ajar switches, the rear compartment ajar switch, and the hood ajar switch, the BCM determines whether a content theft deterrent alarm is warranted. If unauthorized access is being detected, the BCM will pulse the security siren and flash the exterior lamps as a means of theft deterrence.

Diagnostic Aids

The scan tool BCM Content Theft Deterrent Trigger History 1, 2, and 3 parameters can be used to help isolate an intermittent unwanted content theft deterrent alarm. These parameters are a rolling history of the previous three causes of a theft deterrent alarm. If all three parameters are indicating the same alarm trigger, the indicated input should be the starting point when diagnosing an intermittent concern.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF.
2. Verify each indicator/message transitions between the ajar and closed state while opening and closing each vehicle door, hood, and rear compartment.
 - **If the indicator/message does not change**

Refer to Door Ajar Indicator Malfunction , Hood Ajar Indicator/Message Malfunction , or Rear Hatch/Gate Ajar Indicator Malfunction .
 - **If each indicator/message changes**
3. Vehicle in Service Mode, completely lower the driver door window and close all vehicle doors, vehicle OFF.
4. Arm the content theft deterrent system by locking the door with the keyless entry transmitter.
5. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Armed.
 - **If not Armed**

Refer to Keyless Entry System Malfunction (Active) Keyless Entry System Malfunction (Passive) .
 - **If Armed**
6. Without disarming the system, reach in through the open driver window and open the driver door.
7. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Alarm.

- **If not Alarm**

Replace the K9 Body Control Module.

- **If Alarm**

8. Verify the security siren is pulsing.

- **If the security siren is not pulsing**

Refer to [Theft Deterrent Alarm Malfunction \(with UTP\)](#).

- **If the security siren is pulsing**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

CONTENT THEFT DETERRENT MALFUNCTION (WITH UTT)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The content theft deterrent system is a software based system in which the Body Control Module (BCM) actively monitors certain inputs to determine if unauthorized vehicle access is being attempted. Based on inputs such as the door ajar switches, the rear compartment ajar switch, the intrusion/inclination sensor, and the hood ajar switch, the BCM determines whether a content theft deterrent alarm is warranted. If unauthorized access is being detected, the BCM will sound the power sounder and flash the exterior lamps as a means of theft deterrence.

Diagnostic Aids

The scan tool BCM Content Theft Deterrent Trigger History 1, 2, and 3 parameters can be used to help isolate an intermittent unwanted content theft deterrent alarm. These parameters are a rolling history of the previous three causes of a theft deterrent alarm. If all three parameters are indicating the same alarm trigger, the indicated input should be the starting point when diagnosing an intermittent concern.

Reference Information

Schematic Reference

[Theft Deterrent System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle OFF.
2. Verify each indicator/message transitions between the ajar and closed state while opening and closing each vehicle door, hood, and rear compartment.
 - **If the indicator/message does not change**

Refer to [Door Ajar Indicator Malfunction](#) , [Hood Ajar Indicator/Message Malfunction](#) , or [Rear Hatch/Gate Ajar Indicator Malfunction](#) .
 - **If each indicator/message changes**
3. Vehicle in Service Mode.
4. Verify the intrusion/inclination sensor disable LED turns ON and OFF as the intrusion/inclination sensor disable switch is cycled.
 - **If the LED does not turn ON and OFF**

Refer to [Inclination/Intrusion Sensor Malfunction](#).
 - **If the LED turns ON and OFF**
5. Completely lower the driver door window and close all vehicle doors, vehicle OFF.
6. Arm the content theft deterrent system by locking the door with the keyless entry transmitter.
7. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Armed.
 - **If not Armed**

Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#) .
 - **If Armed**
8. Without disarming the system, reach in through the open driver window and open the driver door.
9. Verify the scan tool Content Theft Deterrent Alarm Status parameter is Alarm.

- **If not Alarm**

Replace the K9 Body Control Module.

- **If Alarm**

10. Verify the P25 Power Sounder Content Theft Deterrent Alarm Module is sounding.

- **If the P25 Power Sounder Content Theft Deterrent Alarm Module is not sounding**

Refer to [Theft Deterrent Alarm Malfunction \(with UTR\)](#)[Theft Deterrent Alarm Malfunction \(with UTP\)](#).

- **If the P25 Power Sounder Content Theft Deterrent Alarm Module is sounding**

11. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

INCLINATION/INTRUSION SENSOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B291B 3B	B291B 3B	-	-
Control	1	1	1	-
Signal	2	2	2	-
Serial Data	U1515, B291B 3B	B291B 3B	U1515, B291B 3B	B291B 00
Ground	-	B291B 3B	-	-
1. Intrusion/inclination sensor cannot be disabled 2. Intrusion/inclination sensor indicator malfunction				

Circuit/System Description

The Body Control Module performs various communication fault detection tests to determine if a software, hardware, or communication concern exists with the Content Theft Deterrent Sensor Module.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B165 Content Theft Deterrent Sensor Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B165 Content Theft Deterrent Sensor Module.

- **If the test lamp illuminates**

5. Vehicle OFF, arm the content theft deterrent system.

6. Test for greater than 4.5 V between the serial data circuit terminal 4 and ground.

- **If 4.5 V or less**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the serial data circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the serial data circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If greater than 4.5 V**

7. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

8. Test for less than 1 V between the B165 Content Theft Deterrent Sensor Module serial data circuit terminal 4 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

9. Vehicle OFF, connect the harness connector at the B165 Content Theft Deterrent Sensor Module.

Disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 minutes for all vehicle systems to power down.

10. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

11. Vehicle OFF, connect the harness connector at the S48B Multifunction Switch - Overhead Console.

Disconnect the harness connector at the B165 Content Theft Deterrent Sensor Module, vehicle in Service Mode.

12. Test for less than 1 V between the circuit terminal listed below and ground:

- Control circuit terminal 2

- Signal circuit terminal 4

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

13. Connect a 3 A fused jumper wire between the control circuit terminal 2 and B+.
14. Verify the intrusion/inclination sensor disable LED is illuminated.
 - **If the indicator is not illuminated**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, replace the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S48B Multifunction Switch - Overhead Console.
 - **If the indicator is illuminated**
15. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - **If less than infinite resistance**
 1. Vehicle OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the S48B Multifunction Switch - Overhead Console.
 - **If infinite resistance**
16. Test for less than 10 Ω between the signal circuit terminal 1 and ground with the intrusion/inclination sensor disable switch pressed.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console.
 2. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, replace the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S48B Multifunction Switch - Overhead Console.
 - **If less than 10 Ω**
17. Replace the B165 Content Theft Deterrent Sensor Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

THEFT DETERRENT ALARM MALFUNCTION (WITH UTR)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	1	-
Serial Data	U1522	1	U1522	-
Ground	-	1	-	-
1. Content theft deterrent power sounder inoperative				

Circuit/System Description

The content theft deterrent system uses the power sounder to provide an audible alert when in the alarm mode. The power sounder receives a constant B+ and ground. The Body Control Module commands the power sounder via serial data. The power sounder is also equipped with a battery backup. If the power sounder is disconnected while the vehicle is OFF, the battery backup will allow the power sounder to sound the audible content theft deterrent alert.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the P25 Power Sounder Content Theft Deterrent Alarm Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P25 Power Sounder Content Theft Deterrent Alarm Module.
 - **If the test lamp illuminates**
5. Vehicle OFF, arm the content theft deterrent system.
6. Test for greater than 4.5 V between the serial data circuit terminal 3 and ground.
 - **If 4.5 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 4.5 V**
7. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
8. Test for less than 1 V between the P25 Power Sounder Content Theft Deterrent Alarm Module serial data circuit terminal 3 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
9. Test or replace the P25 Power Sounder Content Theft Deterrent Alarm Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

THEFT DETERRENT ALARM MALFUNCTION (WITH UTP)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Switch B+	1	1	-	-
Relay Coil B+	1	1	-	-
Relay Coil Control	2	1	1	-
Security Siren Control	1	1	2	-
Ground	-	1	-	-
1. Security siren inoperative 2. Security siren always on				

Circuit/System Description

The content theft deterrent system uses the security to provide an audible alert when in the alarm mode. The security siren is controlled by the Body Control Module through the security siren relay. The security siren relay coil and switch each receive B+ at all times. When the content theft deterrent system determines that an alarm condition exists, it will pulse the security siren by grounding the security siren relay control circuit. This will create an electromagnetic field in the relay and pull the relay switch closed, applying B+ to the security siren, causing it to sound.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR101 Security Siren Relay, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminals listed below and ground:
 - Terminal 2
 - Terminal 3
 - **If the test lamp does not illuminate**
 Test or replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
3. Test for less than 1 V between the control circuit terminal 4 and ground.
 - **If 1 V or greater**
 Repair the short to voltage on the circuit.
 - **If less than 1 V**
4. Vehicle OFF.
5. Connect a test lamp between the B+ circuit terminal 2 and the control circuit terminal 1.
6. Completely lower the driver door window and close all vehicle doors. Arm the content theft deterrent system by locking the doors with the keyless entry transmitter. Wait 30 seconds for the content theft deterrent system to arm.
7. Without disarming the system, reach in through the open driver window and open the driver door.
8. Verify the test lamp turns ON and OFF.
 - **If the test lamp is always ON**
 1. Disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp is always OFF**
 1. Disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
9. Disconnect the harness connector at the P4 Security Siren.
 10. Test for less than 10 Ω between the ground circuit terminal B and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 11. Connect the harness connector at the P4 Security Siren.
 12. Connect a 10 A fused jumper wire between the B+ circuit terminal 3 and the control circuit terminal 4.
 13. Verify the P4 Security Siren is sounding.
 - **If the P4 Security Siren is not sounding**
 1. Disconnect the harness connector at the P4 Security Siren.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the P4 Security Siren.
 - **If the P4 Security Siren is sounding**
 14. Test or replace the KR101 Security Siren Relay.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- Refer to [Control Module References](#) for Body Control Module replacement, programming, and setup

DESCRIPTION AND OPERATION

THEFT SYSTEMS DESCRIPTION AND OPERATION

When armed, the content theft deterrent system is designed to deter vehicle content theft by pulsing the horns and exterior lamps for approximately 30 seconds when an unauthorized vehicle entry is detected. If equipped, a siren will also be activated. However, the content theft deterrent system does not affect engine starting.

An unauthorized entry can be any of the following with the content theft deterrent system armed:

- When any door is opened without using the UNLOCK command from a keyless entry transmitter
- Unauthorized entry into the underhood area
- Unauthorized entry into the rear compartment
- Unauthorized access to the charge port
- Disconnection of the charge cord when charging
- After a battery reconnect, if the battery was disconnected with the content theft deterrent system armed

The components of the content theft deterrent system are:

- Body Control Module (BCM)
- Remote Control Door Lock Receiver
- Security Indicator
- Door Ajar Switches
- Rear Compartment Ajar Switch
- Hood Ajar Switch
- Charge Port Door Ajar Switch
- External siren, if equipped

Arming the Content Theft Deterrent System

Use the following procedure in order to arm the system:

1. Place the shift lever in P (park).
2. Turn the vehicle OFF.
3. Open any door.

NOTE: The system is not armed if the doors are locked manually; the power door lock switch or remote keyless entry transmitter must be used to arm the content theft deterrent system.

4. Lock the doors with the power door lock switch or the LOCK button on the transmitter. The system is in standby mode and will not start the arming timer until all doors are closed.
5. The system will begin the arm sequence immediately after the last door is closed. If the keyless entry transmitter is used to arm the system after the vehicle doors are closed, the arm sequence will begin as soon as the LOCK command is received from the transmitter.
6. Immediately pressing the LOCK button a second time will bypass the delayed arming function and immediately arm the system.

Locking the Vehicle Without Arming the Content Theft Deterrent System

Locking the vehicle may be accomplished without arming the content theft deterrent system. Use of the manual door locks or using the key to lock the doors will lock the vehicle, but will not arm the content theft deterrent system.

Disarming an Armed System/Silencing an Alarm

If system arming has been requested by the power door lock switch or the keyless entry transmitter, it must be disarmed.

NOTE: **Disconnecting the battery or pulling fuses does not disable the arm mode, since the BCM stores the content theft deterrent alarm status in memory.**

- To disarm the content theft deterrent system in standby mode, perform one of the following:
 - Press either power door unlock switch.
 - Press the UNLOCK button on the keyless entry transmitter.
- To disarm the content theft deterrent system in the armed mode (non-event) or when activated (during an alarm event):
 - Press the UNLOCK button on the keyless entry transmitter.
 - Press the vehicle ON/OFF switch with a valid key in the vehicle

Content Theft Deterrent Circuit Description

The following is a description of each component used in the content theft deterrent system:

Body Control Module

The content theft deterrent system is an internal function of the BCM which utilizes serial data and various switch inputs information to perform content theft deterrent functions. When the BCM detects an unauthorized entry, it activates the horns and exterior lamps. The BCM has 4 basic modes (disarmed, standby, armed, and alarm) for operating the content theft deterrent system. The different modes are described below.

1. The BCM has the content theft deterrent system in a disarmed mode until the following conditions are detected:
 - Vehicle OFF.
 - Doors locked by either the power door lock switch or the LOCK button on the transmitter.
2. The BCM enters the standby mode when the above conditions are detected. If a door was already opened when the arm mode was requested, the standby mode does not start the timer until the last door is closed.
3. When the last door is closed, a 30 second timer is activated. Once the timer has expired, the BCM enters the armed mode. After this delay, any forced entry activates the alarm mode.
4. When the BCM detects a forced entry, the BCM enters the alarm mode. The BCM activates the horns and exterior lamps for 30 seconds. If equipped, a siren will also be activated. This is followed by a three minute time-out with the horn no longer active. If no new intrusions are detected after the time-out, the horn is not active. The system must be disarmed or the intrusion condition removed after the time-out for the system to exit alarm mode.

Remote Control Door Lock Receiver

The keyless entry system can arm and disarm the content theft deterrent system. When the remote control door lock receiver receives a door lock or unlock signal from the transmitter, the remote control door lock receiver sends a message to the BCM via serial data to perform the appropriate arm/disarm functions.

Security Indicator

The security indicator is illuminated in the instrument panel. The content theft deterrent system uses the security indicator to inform the driver of system status prior to arming.

Door Ajar Switches

The content theft deterrent system uses the door ajar switches as a status indicator to activate the alarm. The door ajar switches are monitored by the body control module via a discrete input from each door ajar switch. If the BCM receives a signal indicating a door is opened when the content theft deterrent system is armed, the BCM activates the alarm.

Hood Ajar Switch

The content theft deterrent system uses the hood ajar switch as a status indicator to activate the alarm. The BCM monitors the hood ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the hood has been opened when the content theft deterrent system is armed, the BCM activates the alarm.

Rear Compartment Ajar Switch

The content theft deterrent system uses the rear compartment ajar switch as a status indicator to activate the alarm. The BCM monitors the rear compartment ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the rear compartment has been opened when content theft deterrent system is armed, the BCM activates the alarm.

Charge Port Door Ajar Switch

The content theft deterrent system uses the charge port door ajar switch as a status indicator to activate the alarm. If the BCM receives a signal indicating the charge port door has been opened when content theft deterrent system is armed, the BCM activates the alarm. Additionally, if the BCM receives a message that the charge port cord is disconnected from the vehicle while the content theft deterrent is armed, the BCM will active the alarm.

Inputs

The BCM monitors the following inputs for content theft deterrent:

- The door ajar switches
- The keyless entry transmitter LOCK/UNLOCK buttons; a message from the Remote function receiver module/Remote control door lock receiver
- The immobilizer status - The BCM uses the immobilizer status for disarming the system or silencing an alarm when the correct vehicle key is used to start the vehicle
- The rear compartment ajar switch
- The hood ajar switch
- The charge port door ajar switch

Outputs

The BCM controls the following for content theft deterrent:

- The horn relay
 - The exterior lamps
 - Siren, if equipped
-

Article GUID: A00884705

ACCESSORIES & EQUIPMENT

Tire Pressure Monitoring - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Tire Pressure Indicator Sensor Fastener	1.4 N.m (12.4 lb in)

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0569: SYSTEM CONFIGURATION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0569 00

System Configuration Malfunction

Circuit/System Description

If the tire type and pressure information is not entered during the body control module (BCM) setup, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the ignition is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0569 will be set and the tire type and pressure information will need to be entered for the system to function correctly.

Conditions for Running the DTC

Ignition On/Vehicle in Service Mode.

Conditions for Setting the DTC

The tire type and pressure information is not entered into the BCM during programming and setup.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has undergone the tire type and pressure selection setup procedure and one ignition cycle has occurred.

Diagnostic Aids

A newly replaced BCM will set DTC C0569 after programming on it's initial ignition ON cycle if the module setup information has not been entered.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation (UJM)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Enter the tire type and pressure information into the K9 Body Control Module with a scan tool. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.
3. Ignition OFF, then Ignition On/Vehicle in Service Mode.
4. Verify DTC C0569 is not set.
 - **If the DTC is set**

Replace the K9 Body Control Module.
 - **If the DTC is not set.**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming, and setup.

DTC C0750, C0755, C0760, OR C0765: TIRE PRESSURE SENSORS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0750 03

Left Front Tire Pressure Sensor Low Voltage

DTC C0750 29

Left Front Tire Pressure Sensor Too Few Pulses

DTC C0750 39

Left Front Tire Pressure Sensor Internal Malfunction

DTC C0755 03

Right Front Tire Pressure Sensor Low Voltage

DTC C0755 29

Right Front Tire Pressure Sensor Too Few Pulses

DTC C0755 39

Right Front Tire Pressure Sensor Internal Malfunction

DTC C0760 03

Left Rear Tire Pressure Sensor Low Voltage

DTC C0760 29

Left Rear Tire Pressure Sensor Too Few Pulses

DTC C0760 39

Left Rear Tire Pressure Sensor Internal Malfunction

DTC C0765 03

Right Rear Tire Pressure Sensor Low Voltage

DTC C0765 29

Right Rear Tire Pressure Sensor Too Few Pulses

DTC C0765 39

Right Rear Tire Pressure Sensor Internal Malfunction

Circuit/System Description

The tire pressure monitor system has a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR) which in turn translates the received sensor data into sensor presence, sensor mode, and tire pressure before passing it onto the body control module (BCM). Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the first sensor to go into Drive mode, then checks if all sensors have gone into Drive mode. If one or more sensors does not go into these modes, or does not transmit at all, the BCM will set DTC C0750, C0755, C0760, or C0765 respectively.

Conditions for Running the DTC

Vehicle speed is greater than 40 km/h (25 MPH).

Conditions for Setting the DTC

- A sensor does not transmit or transmits invalid data to the BCM.
- A sensor low battery condition.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the malfunction is no longer present and one ignition cycle occurs.

Diagnostic Aids

- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool is placed along the tire sidewall and no further than 15 cm (6 in) from the sensor and the antenna is aiming upward.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#).
- Occasionally sensor transmissions are not received by the BCM due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal being blocked by another component.
- Occasionally sensors can become mislocated due to previous tire rotations where the sensor learn procedure was not performed. Always learn the sensors to ensure the DTC set is for that actual physical corner of the vehicle. Refer to [Tire Pressure Indicator Sensor Learn](#).
- A sensor low battery condition will set a sensor DTC but will not illuminate the low tire pressure indicator or display a message on the driver information center, if equipped. The sensor battery condition can be verified in the scan tool BCM data list. If a sensor low battery condition is indicated on the scan tool, the sensor will need

to be replaced. Refer to [Tire Pressure Indicator Sensor Replacement](#).

- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference.

Reference Information

Description and Operation

[Tire Pressure Monitor Description and Operation \(UJM\)](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify there are no communication DTCs set along with DTC C0750, C0755, C0760, and C0765.
 - **If a communication DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If a communication DTC is not set**
2. Verify the scan tool Tire Pressure Sensor Rolling Count parameter of all 4 tire pressure sensors is above 50%.
 - **If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires**

NOTE: When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.

1. Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to [Tire and Wheel Removal and Installation](#) .
 - If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the [Tire Pressure Indicator Sensor Learn](#).
 - If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal.
 - **If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires**
3. Verify if all 4 tire monitor pressure sensor DTCs are not set.
 - If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#)
4. Perform the [Tire Pressure Indicator Sensor Learn](#).
5. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
 - **If a Tire Pressure Sensor Mode parameter does not change to Drive**
 1. Replace the appropriate B2 Tire Pressure Sensor.
 2. Perform the [Tire Pressure Indicator Sensor Learn](#).

- If the Tire Pressure Sensor Mode parameter changes to Drive

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Tire Pressure Indicator Sensor Replacement](#)
- Refer to [Tire Pressure Indicator Sensor Learn](#)

DTC C0775: TIRE PRESSURE MONITORING SYSTEM SENSORS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0775 00

Tire Pressure Monitoring System Sensors Malfunction

Circuit/System Description

If the body control module (BCM) has been reprogrammed or replaced and the tire pressure sensor learn procedure has not been performed, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0775 will be set in the BCM and the tire pressure sensor learn procedure will need to be performed for the system to function correctly.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The body control module (BCM) has not learned tire pressure sensor ID and location information from the tire pressure sensors.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type warning message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has received tire pressure sensor ID and location after tire pressure sensor indicator learn procedure has been performed.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation (UJM)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Tire Pressure Indicator Sensor Learn.
2. Verify DTC C0775 is not set.
 - **If the DTC is set**
 1. Test the keyless entry antenna for proper operation. Refer to Keyless Entry System Malfunction (Active) Keyless Entry System Malfunction (Passive) .
 2. Clear DTC.
 3. Verify DTC does not set.
 - If the DTC sets, replace the K9 Body Control Module.
 - If the DTC does not set.
 - **If the DTC is not set**
3. All OK.

All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming, and setup.

SYMPTOMS - TIRE PRESSURE MONITORING

1. Perform the Diagnostic System Check - Vehicle , before using the Symptom Tables in order to verify that all of the following are true:
 - The control modules can communicate via the serial data link.
 - If one of the current or previous sensor learn is not successful.
 - If there are dashes displayed in the driver information center. Refer to Tire Pressure Rolling Count Procedure
2. Review the system operation in order to familiarize yourself with the system functions. Refer to Tire Pressure Monitor Description and Operation (UJM).

Visual/Physical Inspection

- Inspect if tires are inflated per placard values.
- Inspect for aftermarket devices which could affect the operation of the Tire Pressure Monitoring (TPM) System. Refer to Checking Aftermarket Accessories .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to [Low Tire Pressure Indicator Malfunction](#) in order to diagnose the symptom.

LOW TIRE PRESSURE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The tire pressure monitor system has a radio frequency transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR), using radio frequency (RF) transmissions. The RCDLR then decodes the RF data and passes it to the body control module (BCM). In turn, the BCM translates the data contained in the tire pressure sensor radio frequency transmissions into sensor presence, sensor mode, and tire pressure. Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the sensors to go into Drive mode.

Each sensor has its own unique identification (ID) code, which it transmits as part of each RF message, that must be learned into the BCM memory. Once all 4 IDs have been learned and vehicle speed is greater than 40 km/h (25 mph), the BCM continuously compares IDs and pressure data in the received transmissions to the learned IDs and vehicle placard pressures to determine if all 4 sensors are present and if one or more tires are low. If the BCM detects a low tire pressure condition or a malfunction in the system, it will send a serial data message to the instrument cluster requesting the appropriate tire pressure monitor indicator illumination and also to display the appropriate data message on the driver information center, if equipped.

Diagnostic Aids

- If unsure about the condition, cycle the ignition and observe the tire pressure monitor indicator icon. If the tire pressure monitor indicator icon is continuously illuminated after the instrument cluster bulb check is completed, a low tire pressure condition is present. Check the tires for damage or leaks and inflate to the tire placard specifications. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) . If the tire pressure monitor indicator icon flashes for 1 min after the instrument cluster bulb check is completed and then remains illuminated, a tire pressure monitor system DTC is set. Perform the [Diagnostic System Check - Vehicle](#) to proceed with the proper diagnosis.
- Temperature can greatly effect tire pressures. Low tire pressure on a cold morning may cause the tire pressure monitor indicator icon to turn ON. The air pressure in the tire increases as the ambient temperature rises or as the tire warms up while the vehicle is driven. The pressure may increase enough to exceed the predetermined low pressure threshold which will turn OFF the tire pressure monitor indicator icon.
- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool antenna is no further than 15 cm (6 in) from the sensor and is aiming upward.
- Aftermarket wheel valve stem locations can cause a sensor to not function correctly.

- A sensor may have been damaged due to a previous wheel/tire service or flat tire event. This is a courtesy item as it is not covered by warranty.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#).
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor's information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal is being blocked by another component.
- Occasionally sensor transmissions are not received by the BCM due to vehicle level RF interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference. Refer to [Tire Pressure Rolling Count Procedure](#).

Reference Information

Description and Operation

[Tire Pressure Monitor Description and Operation \(UJM\)](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Low tire pressure in one or more tires is indicated by a continuously illuminated tire pressure monitor indicator icon after the instrument cluster bulb check is completed. If equipped with a driver information center, a check tire pressure type message will also be displayed.

When a tire pressure monitor DTC is set, the tire pressure monitor indicator icon will flash for 1 min after the instrument cluster bulb check is completed and then remains illuminated. If equipped with a driver information center, a service tire monitor type message will also be displayed.

1. Adjust all tire pressures to the correct pressure. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#).
2. Drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
3. Verify the low tire pressure indicator is OFF.
 - **If the low tire pressure indicator is ON**
 1. Perform the [Tire Pressure Indicator Sensor Learn](#).
 2. Record all 4 Tire Pressure Parameters values from the scan tool.
 3. Check and record the tire pressures with a known accurate hand held tire pressure gauge.
 4. Verify that the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi) from the actual tire pressure readings.
 - If the scan tool Tire Pressure parameters differ more than 27.6 kPa (4 psi), replace the appropriate

B2 Tire Pressure Sensor then perform the [Tire Pressure Indicator Sensor Learn](#).

- If the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi)

5. Verify the BCM Tire Type and Pressure selections are setup correctly with a scan tool. Refer to the [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) .

- If the BCM Tire Type and Pressure selections are incorrect, input the proper placard values for the vehicle with the scan tool then drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
- If the BCM Tire Type and Pressure selections are correct

6. Ignition On/Vehicle in Service Mode.

7. Verify the low tire pressure monitor indicator icon turns ON and OFF when commanding All Indicators ON and OFF with a scan tool.

- If the low tire pressure monitor icon does not turn ON and OFF, replace the P16 Instrument Cluster.
- If the low tire pressure monitor icon turns ON and OFF

8. All OK

- **If the tire pressure indicator is OFF**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Tire Pressure Indicator Sensor Replacement](#)
- Refer to [Tire Pressure Indicator Sensor Learn](#)
- Refer to [Control Module References](#) for control module replacement, programming, and setup.

TIRE PRESSURE ROLLING COUNT PROCEDURE

Introduction

The Tire Pressure Rolling Count parameter for each sensor can be used to help confirm if the sensor transmissions are being received. As the vehicle is being driven, the Tire Pressure Rolling Count increments with every received TPM sensor transmission. If a suspected Sensor is not incrementing, incrementing very slowly compared to others or not at all, that could be a result of interference from aftermarket devices. The sensor transmission success rate (the rate at which each sensors transmission is being received by the RCDLR) can be verified in the scan tool.

NOTE: Scan tool procedure will be used if Tire Pressure Sensor exhibits "no Signal or poor intermittent signal reception" Before proceeding, check for the following:

Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- A sensor does not transmit or transmits invalid data to the RCDLR.
- A sensor might exhibit low battery condition.
- If equipped, the driver information center displays " dashes" for the suspected sensor.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the

sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#)

- Occasionally sensor transmissions are not received by the RCDLR due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting

How to determine if Sensor Signal is poor or has no signal

Use Scan Tool and follow on screen instructions:

1. Select Module Diagnosis
2. Select Body Control Module
3. Select Configuration/Reset Functions
4. Select Tire Pressure Sensor Signal Reset
5. The Tire Pressure Sensor Rolling Count parameters will be displayed

If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires

NOTE: When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.

- Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to [Tire and Wheel Removal and Installation](#) .
- If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the [Tire Pressure Indicator Sensor Learn](#).
- If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal. Unplug the device and re-run test.

If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires (Follow normal TPM troubleshooting in Service information)

1. Verify if all 4 tire monitor pressure sensor DTCs are not set.
2. If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#) .
3. Perform the [Tire Pressure Indicator Sensor Learn](#).
4. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
5. If a Tire Pressure Sensor Mode parameter does not change to Drive.
6. Replace the appropriate B2 Tire Pressure Sensor.
7. Perform the [Tire Pressure Indicator Sensor Learn](#).
8. If the Tire Pressure Sensor Mode parameter changes to Drive.
9. All OK.

REPAIR INSTRUCTIONS

TIRE PRESSURE INDICATOR SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Dismount the tire from the rim. Refer to [Tire Dismounting and Mounting](#)



Fig. 1: Tire Pressure Indicator Sensor Components

Courtesy of GENERAL MOTORS COMPANY

NOTE: Never fit the tire pressure indicator sensor on unapproved wheel rims.

NOTE: Whenever the tire will be removed from the rim, install a new valve stem and a new bolt. Do not reuse the old parts.

4. Remove and DISCARD the bolt (1) from the tire pressure transmitter (2) and pull it straight off the tire pressure valve stem (3).

CAUTION: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

5. Remove and DISCARD the tire pressure valve stem by pulling it through the rim.

Installation Procedure

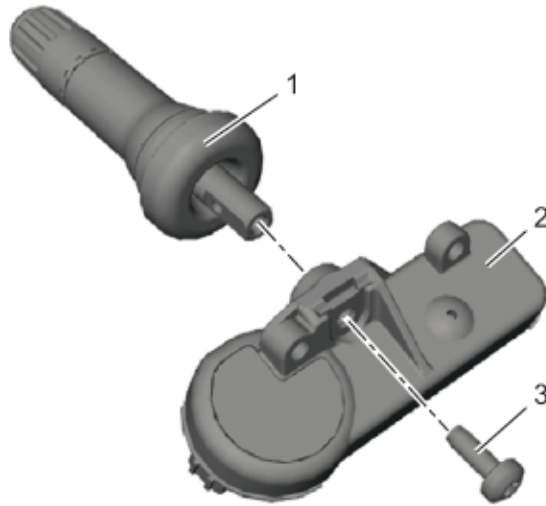


Fig. 2: Tire Pressure Indicator Sensor Components

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the flat of the valve lines up with the flats of the snap in the enclosure.
- Valve stems and bolts are single use items.

1. Assemble the tire pressure transmitter (2) to the NEW valve stem (1) and install the NEW bolt (3).

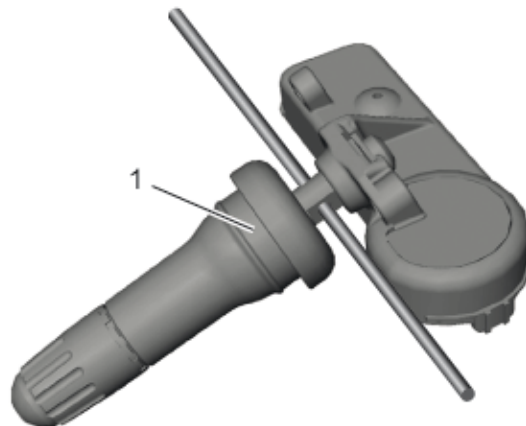


Fig. 3: Anti Rotation Pin

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Insert an anti rotation pin (1) through the cross-drilled hole in the valve stem and tighten the bolt to 1.4 N.m (12.4 lb in).

NOTE: When mounting the tires, use an approved tire mounting lubricant.

3. Apply tire soap to the rubber portion of the valve stem (2).

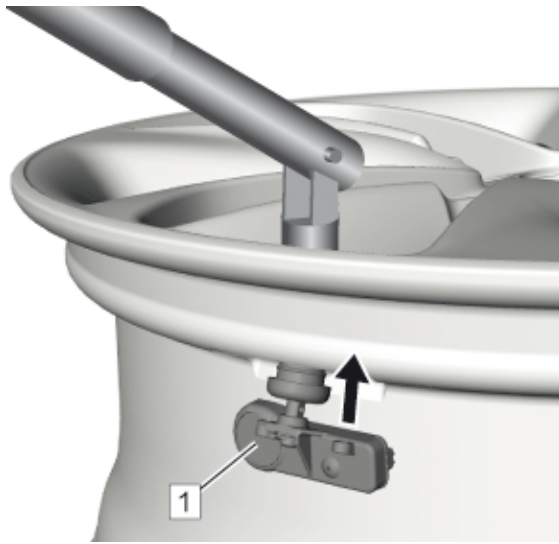


Fig. 4: Pull Valve Stem Through Rim Using Special Tool

Courtesy of GENERAL MOTORS COMPANY

4. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim.

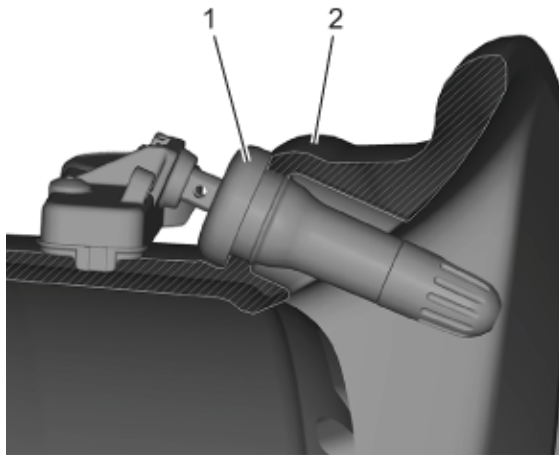


Fig. 5: Proper Valve Stem Seating

Courtesy of GENERAL MOTORS COMPANY

5. Check the valve stem (1) for correct seat on the rim (2).
 - The rim hole edge has to be completely in the notch of the valve stem.
 - The valve and the rim hole have to be concentric.

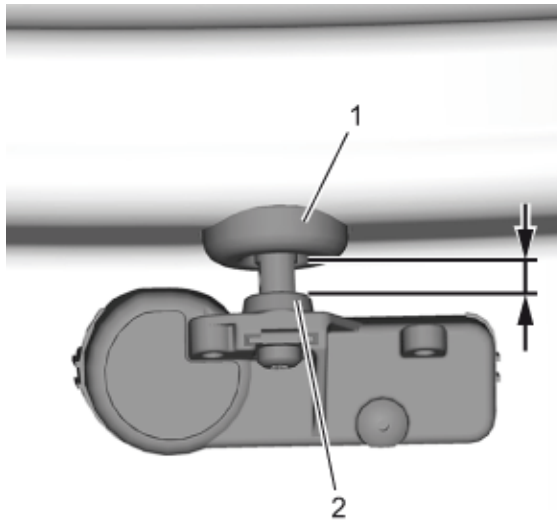


Fig. 6: Tire Pressure Transmitter To Valve Stem Gap

Courtesy of GENERAL MOTORS COMPANY

6. Make sure that there is a gap between the valve stem (1) and the tire pressure transmitter (2).

NOTE: The tire should not have contact with the tire pressure indicator sensor during installation to prevent a damage of the tire pressure indicator sensor.

7. Mount the tire to the rim. Refer to [Tire Dismounting and Mounting](#)
8. Inflate the tire to the specified pressure as stated on the tire placard.
9. Install the NEW dust cap.
10. Balance the tire and wheel assembly.
11. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
12. Learn the tire pressure indicator sensor. Refer to [Tire Pressure Indicator Sensor Learn](#).
13. Lower the vehicle.

TIRE PRESSURE INDICATOR SENSOR LEARN

Special Tools

- **EL-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools \(UJM\)](#).

Learn Mode Description

The tire pressure monitor system uses the instrument cluster, body control module (BCM), 4 radio frequency transmitting pressure sensors, remote control door lock receiver (RCDLR) and the serial data circuit to perform the tire pressure monitor learn mode functions. The sensor learn procedure must be performed after every tire rotation, BCM replacement, or sensor replacement. Once the Learn mode has been enabled, each of the sensors unique identification codes can be learned into the BCM memory. When a sensor ID has been learned, the BCM sounds a horn chirp indicating the sensor has transmitted its ID and the BCM has received and learned it. The BCM must learn the sensor IDs in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will

individually illuminate indicating which location is to be learned in the proper sequence.

Sensor Functions Using EL-46079, EL-50448, or Equivalent

Each sensor has an internal low frequency coil. When the tire pressure monitor special tool is used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in Learn Mode-Remotely Triggered. When the BCM receives a learn mode transmission while in Learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

Learn Mode Cancellation

The Learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor or 5 min overall has elapsed to match all four sensors. If the relearn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the relearn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the BCM memory.
- If equipped, the driver information center will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the Learn procedure to be repeated for the system to function properly.

Tire Pressure Monitor Learn Procedure

NOTE: In the event a particular sensor is activated and the horn does not chirp, it may be necessary to rotate the wheel so that the valve stem is in a different position due to the sensor signal is being blocked by another component. Make sure the TPM tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning.

1. Apply park brake (manual transmission only).
2. Ignition On/Vehicle in Service Mode, using a scan tool or driver information center buttons (refer to owners manual), initiate the Tire Pressure Sensors Learn mode. A double horn chirp will sound indicating the Learn mode has been enabled. The left front turn signal will also be illuminated.
3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure monitor special tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for a horn chirp. If the horn does not chirp, repeat the sensor activation sequence with the tool. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
4. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 3 for the remaining 3 sensors in the following order:
 1. Right front
 2. Right rear
 3. Left rear
5. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the BCM exits the Learn mode.

DESCRIPTION AND OPERATION

TIRE PRESSURE MONITOR DESCRIPTION AND OPERATION (UJM)

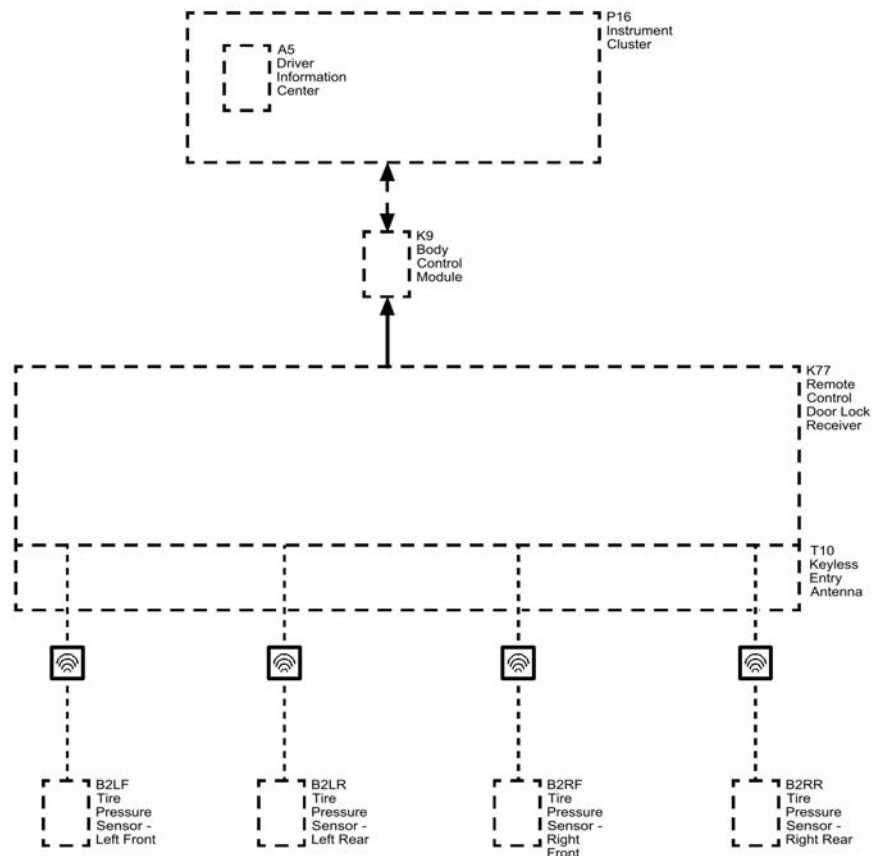


Fig. 7: Tire Pressure Monitoring System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
K9	K9 Body Control Module
K77	K77 Remote Control Door Lock Receiver
T10	T10 Keyless Entry Antenna
B2LF	B2LF Tire Pressure Sensor - Left Front
B2LR	B2LR Tire Pressure Sensor - Left Rear
B2RF	B2RF Tire Pressure Sensor - Right Front
B2RR	B2RR Tire Pressure Sensor - Right Rear

Special Tools

- **EL-46079/J-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools \(UJM\)](#).

The tire pressure monitor system warns the driver when a significant loss of tire pressure occurs in any of the 4 tires and allows the driver to display the individual tire pressures and their locations on the driver information center.

The system uses the body control module (BCM), driver information center, instrument cluster, remote control door lock receiver (RCDLR), and a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly, and the serial data circuit to perform the system functions. Each sensor has an internal power supply with an approximate 10 year service life.

When the vehicle is stationary, the sensor's internal accelerometer is inactive, which puts the sensors into a Stationary state. In this state the sensors sample tire pressure once every 30 seconds and do not transmit at all if the tire pressure does not change. As vehicle speed increases, centrifugal force activates the sensors internal accelerometer causing the sensors to go into Wake and then Drive mode. In Drive mode, the sensors sample tire pressure once every 30 seconds and transmit in Drive mode once every 60 seconds. The RCDLR receives and translates the data contained in each sensors RF transmission into sensor presence, sensor mode, and tire pressure and passes it to the BCM. In turn, the BCM sends the tire pressure and tire location data to the driver information center via the serial data circuit where they are displayed.

The sensors continuously compare their last pressure sample to their current pressure sample and will transmit in Learn Mode-Pressure Triggered if a 8.3 kPa (1.2 psi) change in tire pressure has been detected in either a Stationary or Drive state. When the tire pressure monitor system detects a significant loss of tire pressure, the tire pressure monitor indicator icon is illuminated on the instrument cluster and if equipped, a tire pressure low, add air to tire type message is displayed on the driver information center. Both the indicator icon and driver information center message can be cleared by adjusting the tire pressures to the recommended pressures and driving the vehicle above 40 km/h (25 mph) for at least 2 minutes.

If power is disconnected from the BCM or if the vehicle battery is disconnected, each tire pressure monitor sensor ID is retained but all of the tire pressure information is lost. Under these circumstances the BCM cannot assume that the tire pressures were maintained over an unknown period of time. If equipped, the driver information center will display all dashes and the scan tool will indicate a default tire pressure value of 1020 kPa (148 psi) for each tire. Driving the vehicle above 40 km/h (25 mph) for at least 2 minutes will activate the sensors causing the driver information center to display the current tire pressures. The **EL-46079/J-46079** tire pressure monitor diagnostic tool, **EL-50448** tire pressure monitor sensor activation tool, or equivalent may also be used to activate the sensors as well.

The BCM has the ability to detect malfunctions within the tire pressure monitor system. In the event a DTC is set, the tire pressure monitor indicator icon on the instrument cluster, if equipped will flash for 1 minute and then remain illuminated after the ignition is turned ON and the instrument cluster bulb check has been completed. Any malfunction detected will cause the driver information center to display a service tire monitor system type message. For more information on other functions of the BCM, refer to [Keyless Entry System Description and Operation](#) .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS (UJM)

Illustration	Tool Number/Description
--------------	----------------------------

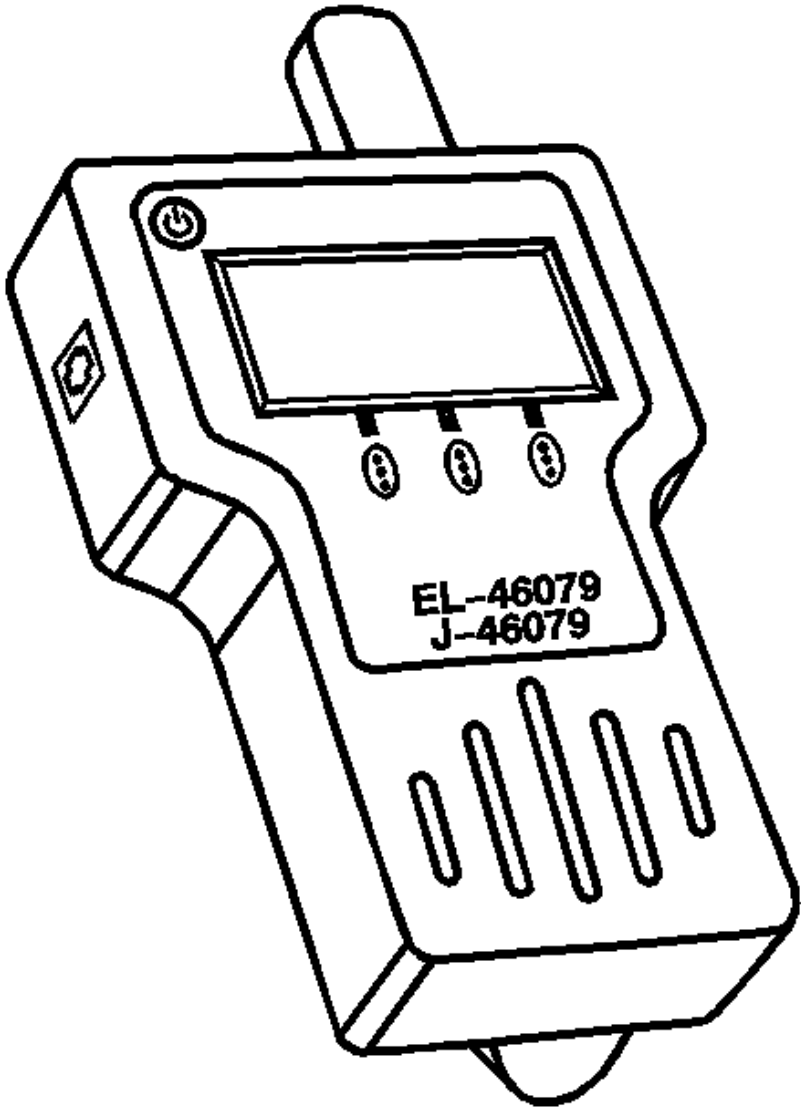
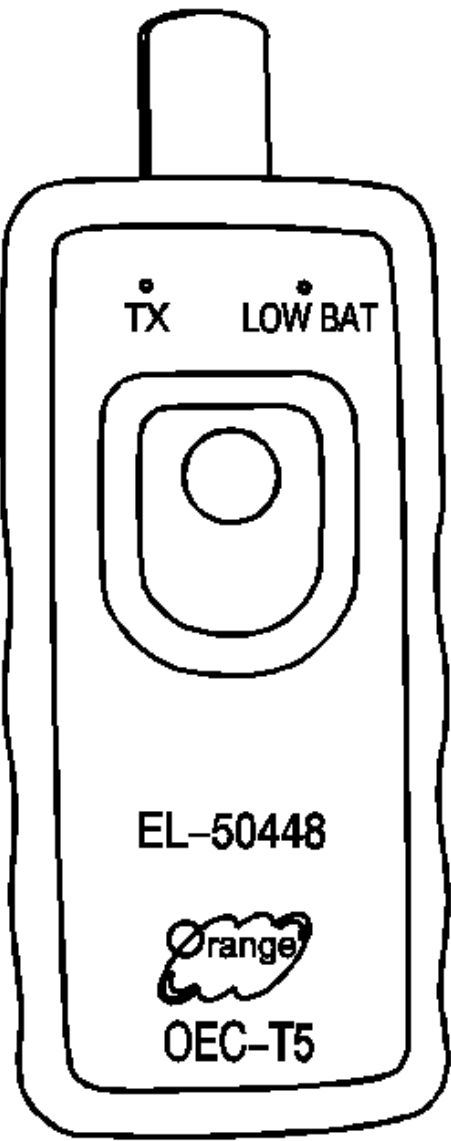
Illustration	Tool Number/Description
	EL 46079 Tire Pressure Monitor Diagnostic Tool

Illustration	Tool Number/Description
	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Article GUID: A00884699

ACCESSORIES & EQUIPMENT

Vehicle Access - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Front Side Door Latch Bolt	11 N.m (97 lb in)
Front Side Door Lock Cylinder Opening Cover Screw	4.7 N.m (42 lb in)
Front Side Door Lock Striker Screw	22 N.m (16 lb ft)
Front Side Door Outside Handle Bracket Screw	5 N.m (44 lb in)
Liftgate Latch Bolt	22 N.m (16 lb ft)
Liftgate Latch Striker Bolt	22 N.m (16 lb ft)
Liftgate Outside Handle Bolt	2.5 N.m (22 lb ft)
Rear Side Door Latch Bolt	11 N.m (97 lb in)
Rear Side Door Lock Cylinder Opening Cover Screw	4.7 N.m (42 lb in)
Rear Side Door Lock Striker Screw	22 N.m (16 lb ft)
Rear Side Door Outside Handle Bracket Screw	5 N.m (44 lb in)

SCHEMATIC WIRING DIAGRAMS

DOOR LOCK/INDICATOR WIRING SCHEMATICS

Door Ajar and Status Switches

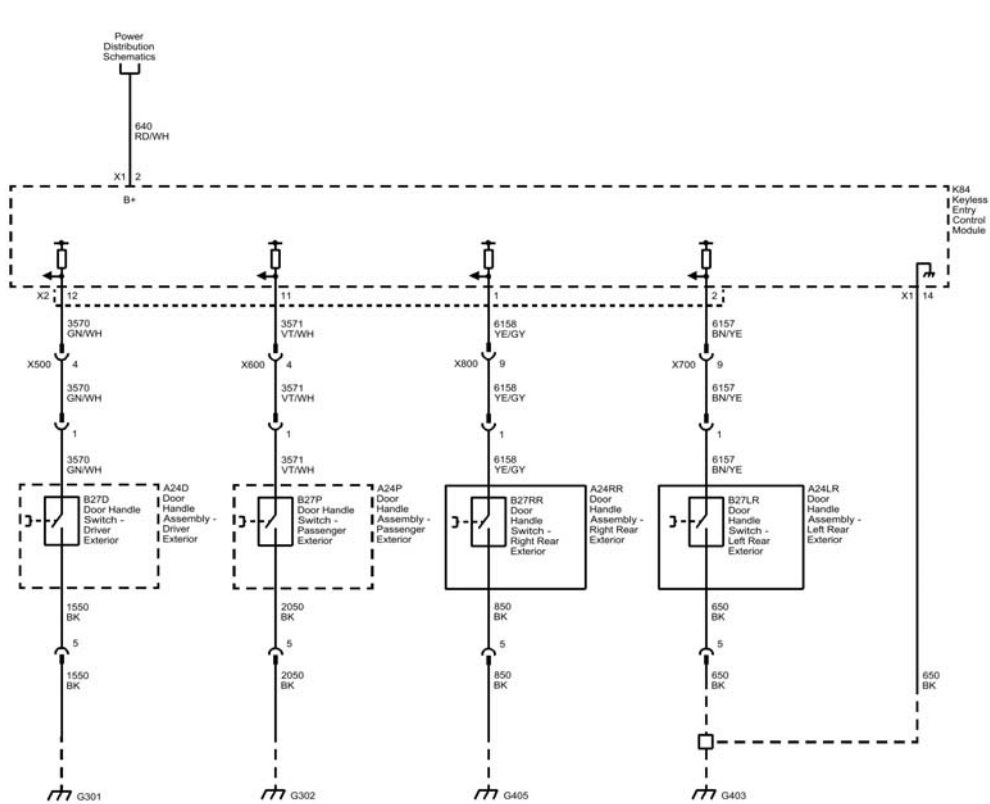


Fig. 2: Door Handle Switches
 Courtesy of GENERAL MOTORS COMPANY

Door Locks

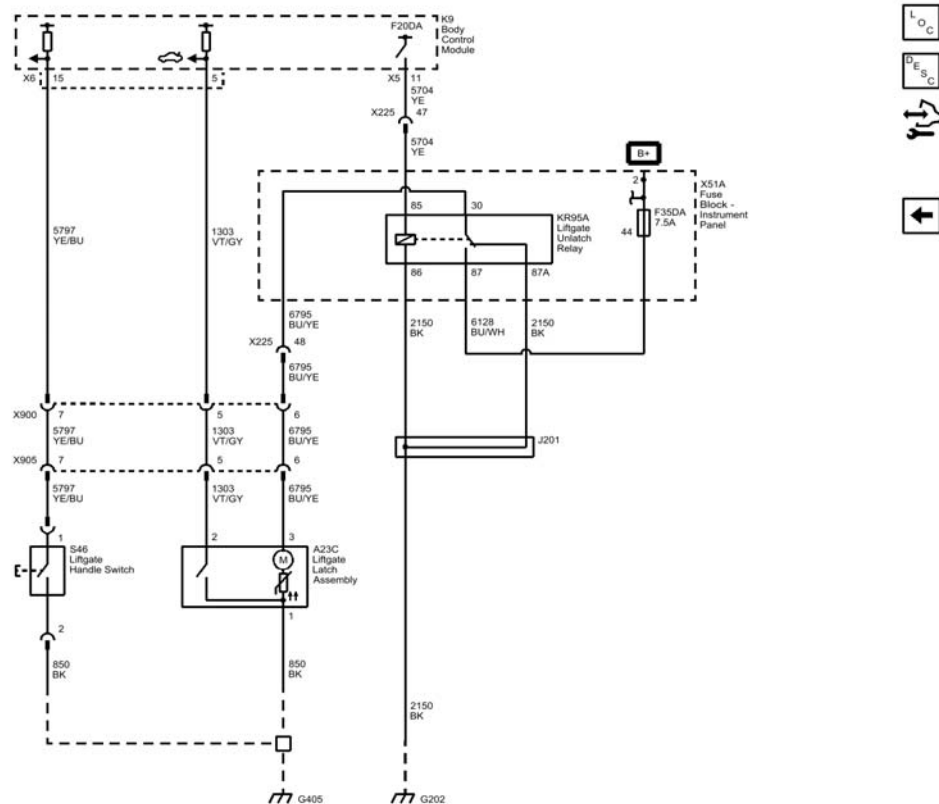


Fig. 5: Liftgate Release

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B1474 OR B3849: PASSENGER/DRIVER EXTERIOR DOOR HANDLE SWITCH CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B1474

Passenger Exterior Door Handle Switch Circuit

DTC B3849

Driver Exterior Door Handle Switch Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - B27D Door Handle Switch - Driver Exterior	B3849 02	1	1	-
Signal - B27P Door Handle Switch - Passenger Exterior	B1474 02	2	2	-
Ground - A24D Door Handle Assembly - Driver Exterior	-	1	-	-
Ground - A24P Door Handle Assembly - Passenger Exterior	-	2	-	-
1. B27D Door Handle Switch - Driver Exterior = Disabled 2. B27P Door Handle Switch - Passenger Exterior = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B27D Door Handle Switch - Driver Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
B27P Door Handle Switch - Passenger Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

B1474 02

Signal @ B27P Door Handle Switch - Passenger Exterior = Short to Ground - For greater than 60 s

B3849 02

Signal @ B27D Door Handle Switch - Driver Exterior = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

B1474 02

B27P Door Handle Switch - Passenger Exterior = Disabled

B3849 02

B27D Door Handle Switch - Driver Exterior = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

- [Door Lock/Indicator Schematics](#)
- [Remote Function Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. B27D Door Handle Switch - Driver Exterior - Not Pressed

Verify the scan tool parameter: Exterior Driver Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. B27P Door Handle Switch - Passenger Exterior - Not Pressed

Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

4. Operate the component: B27D Door Handle Switch - Driver Exterior - Pressed

Verify the scan tool parameter: Exterior Driver Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

5. Operate the component: B27P Door Handle Switch - Passenger Exterior - Pressed

Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

6. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: A24D Door Handle Assembly - Driver Exterior or A24P Door Handle Assembly - Passenger Exterior

3. Test for less than 10 ohms between the test points: Ground circuit terminal 5 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection

2. Test for less than 2 ohms between the test points: Ground circuit terminal 5 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K84 Keyless Entry Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K84 Keyless Entry Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K84 Keyless Entry Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 - 5. Ignition/Vehicle - Off
 - 6. Test for less than 2 ohms between the test points:
 - Signal circuit terminal 1 @ A24D Door Handle Assembly - Driver Exterior & Terminal 12 X2 @ Control module harness
 - Signal circuit terminal 1 @ A24P Door Handle Assembly - Passenger Exterior & Terminal 11 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K84 Keyless Entry Control Module
 - **If the specified state**
8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24D Door Handle Assembly - Driver Exterior or A24P Door Handle Assembly - Passenger Exterior
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed
 - **If less than infinite resistance**

Replace the component: A24 Door Handle Assembly
 - **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 1 & Ground terminal 5 - Pressed

- **If 3 ohms or greater**

Replace the component: A24 Door Handle Assembly

- **If less than 3 ohms**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B1534 OR B1535: LEFT/RIGHT REAR DOOR HANDLE SWITCH CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B1534

Left Rear Door Handle Switch Circuit

DTC B1535

Right Rear Door Handle Switch Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - B27LR Door Handle Switch - Left Rear Exterior	B1534 02	1	1	-
Signal - B27RR Door Handle Switch - Right Rear Exterior	B1535 02	2	2	-
Ground - B27LR Door Handle Switch - Left Rear Exterior	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground - B27RR Door Handle Switch - Right Rear Exterior	-	2	-	-
1. B27LR Door Handle Switch - Left Rear Exterior = Disabled 2. B27RR Door Handle Switch - Right Rear Exterior = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B27LR Door Handle Switch - Left Rear Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
B27RR Door Handle Switch - Right Rear Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition/Vehicle = On

Conditions for Setting the DTC

B1534 02

Control module K84 detects: Signal @ B27LR Door Handle Switch - Left Rear Exterior = Short to Ground - For greater than 60 s

B1535 02

Control module K84 detects: Signal @ B27RR Door Handle Switch - Right Rear Exterior = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

B1534 02

B27LR Door Handle Switch - Left Rear Exterior = Disabled

B1535 02

B27RR Door Handle Switch - Right Rear Exterior = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Inactive
 - **If not the specified state**

Refer to: Circuit/System Testing
 - **If the specified state**
3. Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Inactive
 - **If not the specified state**

Refer to: Circuit/System Testing
 - **If the specified state**
4. Operate the component: B27LR Door Handle Switch - Left Rear Exterior - Pressed

Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

5. Operate the component: B27RR Door Handle Switch - Right Rear Exterior - Pressed

Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

6. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: A24LR Door Handle Assembly - Left Rear Exterior or A24RR Door Handle Assembly - Right Rear Exterior

3. Test for less than 10 ohms between the test points: Ground circuit terminal 5 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection

2. Test for less than 2 ohms between the test points: Ground circuit terminal 5 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K84 Keyless Entry Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K84 Keyless Entry Control Module

- **If the specified state**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X2 @ K84 Keyless Entry Control Module
 3. Ignition On/Vehicle in Service Mode.
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points:
 - Signal circuit terminal 1 @ A24LR Door Handle Assembly - Left Rear Exterior & Terminal 2 X2 @ Control module harness
 - Signal circuit terminal 1 @ A24RR Door Handle Assembly - Right Rear Exterior & Terminal 1 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K84 Keyless Entry Control Module
 - **If the specified state**
8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24LR Door Handle Assembly - Left Rear Exterior or A24RR Door Handle Assembly - Right Rear Exterior
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed
 - **If less than infinite resistance**

Replace the component: A24 Door Handle Assembly
 - **If infinite resistance**
4. Test for less than 3 ohms between the test points: Signal terminal 1 & Ground terminal 5 - Pressed
 - **If 3 ohms or greater**

Replace the component: A24 Door Handle Assembly
 - **If less than 3 ohms**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Rear Side Door Outside Handle Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B297B OR B297C: DRIVER DOOR OPEN SWITCH CIRCUIT NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B297B 5A

Driver Door Open Switch Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B297B 5A	B297B 5A	B297B 5A	-
Ground	-	B297B 5A	-	-

Circuit/System Description

The keyless entry control module provides a 12 V signal to the driver door open switch signal circuit. The driver window motor provides a 12 V signal to the driver door ajar switch signal circuit. The door open switches and the door ajar switches are integral to the driver door latch assembly.

The door open switch and the door ajar switch contacts will be open with the door is fully closed, the door switches within the door latch are designed so that the when the door is ajar, the contact in the door ajar switch closes, the voltage is pulled low and the window motor will then send a serial data message to the body control module indicating that the door is ajar. When the door is opened further, the contact in the door open switch will then close providing a ground for the door open signal circuit, the keyless entry control module will then detect that the door is open.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V.

Conditions for Setting the DTC

- The keyless entry control module detects the driver door open switch is Active while receiving a serial data message from the body control module that the driver door ajar switch is Inactive.
- The condition must be present for greater than 2 seconds

Action Taken When the DTC Sets

The keyless entry control module will not notify the driver if a transmitter remains in the vehicle after exiting

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the keyless entry control module receives a serial data message from the body control module that the door is ajar before the keyless entry control module detects the door open switch is active, then the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- [Remote Function Schematics](#)
- [Door Lock/Indicator Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Body Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.

- **If the parameter does not change**

Refer to [Door Ajar Indicator Malfunction](#)

- **If the parameter changes**

3. Verify the scan tool Keyless Entry Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.

- **If the parameter does not change**

Refer to Circuit/System Testing

- **If the parameter changes**

4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Driver Door Ajar Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K84 Keyless Entry Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the circuit terminals 2 and ground.
6. Verify the scan tool Driver Door Ajar Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If Active**
7. Test or replace the A23D Door Latch Assembly-Driver

Component Testing

1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the open position.

- **If less than infinite resistance**

Replace the A23D Door Latch Assembly-Driver.

- **If infinite resistance**

3. Test for less than 3 Ω between the signal terminal 2 and the ground terminal 3 with the switch in the closed position.

- **If 3 Ω or greater**

Replace the A23D Door Latch Assembly-Driver.

- **If less than 3 Ω**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Latch Replacement](#)
- Refer to [Control Module References](#) for keyless entry control module replacement, programming and setup

DTC B3125, B3130, OR B3135: DRIVER DOOR ONLY UNLOCK CIRCUIT/ALL DOORS UNLOCK CIRCUIT/ALL DOORS LOCK CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B3125

Driver Door Only Unlock Circuit

DTC B3130

All Doors Unlock Circuit

DTC B3135

All Doors Lock Circuit

Symptom Byte Information:

[Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
B+ - K9 Body Control Module	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Ground - K9 Body Control Module	-	1, 2, 3, 4	-	-
Control - A23D Door Latch Assembly - Driver	B3125 02, B3130 02, B3135 02	1	B3125 01, B3130 01, B3135 01	-
Control - A23P Door Latch Assembly - Passenger	B3125 02, B3130 02, B3135 02	2	B3125 01, B3130 01, B3135 01	-
Control - A23LR Door Latch Assembly - Left Rear	B3125 02, B3130 02, B3135 02	3	B3125 01, B3130 01, B3135 01	-
Control - A23RR Door Latch Assembly - Right Rear	B3125 02, B3130 02, B3135 02	4	B3125 01, B3130 01, B3135 01	-
1. A23D Door Latch Assembly - Driver = Inoperative 2. A23P Door Latch Assembly - Passenger = Inoperative 3. A23LR Door Latch Assembly - Left Rear = Inoperative 4. A23RR Door Latch Assembly - Right Rear = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
B+ - K9 Body Control Module	Supplied from a fuse.
Ground - K9 Body Control Module	Chassis Ground
Control - Driver Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Control - All Doors Lock	The output circuit is switched from ground to 12 V to activate the component.
Control - Passenger Door Unlock	The output circuit is switched from ground to 12 V to activate the component.

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside).
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc. The control module also reads various switches and sensors

Component	Description
	and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

B3125 01, B3130 01, B3135 01

Control module K9 detects: A23 Door Latch Assembly - Control Circuit = Short to Battery

B3125 02, B3130 02 and B3135 02 Condition 1

Control module K9 detects: A23 Door Latch Assembly - Control Circuit = Short to Ground

B3125 02, B3130 02 and B3135 02 Condition 2

Control module K9 detects: B+ circuit terminal 4 X2 @ K9 Body Control Module = Open

B3125 02, B3130 02 and B3135 02 Condition 3

Control module K9 detects: B+ circuit terminal 4 X2 @ K9 Body Control Module = Short to Ground

Actions Taken When the DTC Sets

All Doors Lock Command & All Doors Unlock Command = Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

- [Door Lock/Indicator Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\) Relay Replacement \(Within an Electrical Center\)](#)

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the scan tool parameter: Driver Door Lock Switch = Inactive & Lock & Unlock

- **If not the specified state**

Refer to: [Power Door Locks Malfunction](#)

- **If the specified state**

3. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the component works as specified:

- A23D Door Latch Assembly - Driver = Lock & Unlock
- A23LR Door Latch Assembly - Left Rear = Lock & Unlock
- A23P Door Latch Assembly - Passenger = Lock & Unlock
- A23RR Door Latch Assembly - Right Rear = Lock & Unlock
- **If the component does not activate - A23D Door Latch Assembly - Driver**

Refer to: Circuit/System Testing - Test 1

- **If the component does not activate - A23LR Door Latch Assembly - Left Rear**

Refer to: Circuit/System Testing - Test 2

- **If the component does not activate - A23P Door Latch Assembly - Passenger**

Refer to: Circuit/System Testing - Test 2

- **If the component does not activate - A23RR Door Latch Assembly - Right Rear**

Refer to: Circuit/System Testing - Test 2

- **If none of the components operate**

Refer to: Circuit/System Testing - Test 3

- **If all functions work properly**

4. All OK.

Circuit/System Testing

Test 1

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Connect a test lamp between the test points: Control terminal 7 & Control terminal 8
4. Ignition - On/Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.

- **If the test lamp turns On and Off**

Test or replace the component: A23D Door Latch Assembly - Driver

- **If the test lamp does not turn On and Off**

7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 @ K9 Body Control Module
9. Test for less than 2 ohms between the test points:
 - Control circuit terminal 7 @ A23D Door Latch Assembly - Driver & Terminal 1 X6 @ Control module harness
 - Control circuit terminal 8 @ A23D Door Latch Assembly - Driver & Terminal 4 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - **If less than 2 ohms**
10. Test or replace the component: K9 Body Control Module

Test 2

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector:
 - A23LR Door Latch Assembly - Left Rear
 - A23P Door Latch Assembly - Passenger
 - A23RR Door Latch Assembly - Right Rear
3. Connect a test lamp between the test points:
 - A23P Door Latch Assembly - Passenger Control terminal 8 & Control terminal 9
 - A23LR Door Latch Assembly - Left Rear Control terminal 7 & Control terminal 8
 - A23RR Door Latch Assembly - Right Rear Control terminal 8 & Control terminal 9
4. Ignition - On/Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.

- **If the test lamp turns On and Off**

Test or replace the component: A23 Door Latch Assembly

- **If the test lamp does not turn On and Off**

7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 @ K9 Body Control Module
9. Ignition - On/Vehicle - In Service Mode
10. Test for less than 2 ohms between the test points:
 - Control circuit terminal 7 @ A23LR Door Latch Assembly - Left Rear & Terminal 2 X6 @ Control module harness
 - Control circuit terminal 8 @ A23LR Door Latch Assembly - Left Rear & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 8 @ A23P Door Latch Assembly - Passenger & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 9 @ A23P Door Latch Assembly - Passenger & Terminal 2 X6 @ Control module harness
 - Control circuit terminal 8 @ A23RR Door Latch Assembly - Right Rear & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 9 @ A23RR Door Latch Assembly - Right Rear & Terminal 2 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - **If less than 2 ohms**
11. Test or replace the component: K9 Body Control Module

Test 3

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: X2 & X6 @ K9 Body Control Module
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 X6 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 X6 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 4 X2 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: B+ circuit terminal 4 X2 & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector:
 - A23D Door Latch Assembly - Driver
 - A23LR Door Latch Assembly - Left Rear
 - A23P Door Latch Assembly - Passenger
 - A23RR Door Latch Assembly - Right Rear
3. Test for infinite resistance between the test points:
 - Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: A23 Door Latch Assembly

- **If the test lamp turns On**

6. Ignition/Vehicle - Off
 7. Connect the electrical connector: X2 @ K9 Body Control Module
 8. Ignition - On/Vehicle - In Service Mode
 9. Test for less than 1 V between the test points:
 - Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If 1 V or less**

10. Ignition/Vehicle - Off
 11. Test for infinite resistance between the test points:
 - Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

12. Replace the component: K9 Body Control Module

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector:
 - A23D Door Latch Assembly - Driver
 - A23P Door Latch Assembly - Passenger
 - A23LR Door Latch Assembly - Left Rear
 - A23RR Door Latch Assembly - Right Rear
3. Connect a 25 A fused jumper wire between the test points:
 - A23D Door Latch Assembly - Driver Control terminal 7 & B+
 - A23P Door Latch Assembly - Passenger Control terminal 8 & B+
 - A23LR Door Latch Assembly - Left Rear Control terminal 7 & B+
 - A23RR Door Latch Assembly - Right Rear Control terminal 8 & B+

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points:
 - A23D Door Latch Assembly - Driver Control terminal 8 & Ground
 - A23P Door Latch Assembly - Passenger Control terminal 9 & Ground
 - A23LR Door Latch Assembly - Left Rear Control terminal 8 & Ground
 - A23RR Door Latch Assembly - Right Rear Control terminal 9 & Ground
5. Reverse the jumper wires 2 times between the terminals.

Verify the component works as specified: A23 Door Latch Assembly = Lock & Unlock

- **If not the specified state**

Replace the component: A23 Door Latch Assembly

- **If the specified state**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Latch Replacement](#)
- Refer to [Rear Side Door Latch Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B3140, B3145, B3150, OR B3155: DRIVER/PASSENGER DOOR UNLOCK/LOCK SWITCH

CIRCUITS

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B3140 00

Driver Door Unlock Switch Circuit

DTC B3145 00

Passenger Door Unlock Switch Circuit

DTC B3150 00

Driver Door Lock Switch Circuit

DTC B3155 00

Passenger Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal terminal 2 @ S13D Door Lock Switch - Driver	B3150 00	2	2	-
Signal terminal 3 @ S13D Door Lock Switch - Driver	B3140 00	3	3	-
Signal terminal 2 @ S13P Door Lock Switch - Passenger	B3155 00	4	4	-
Signal terminal 3 @ S13P Door Lock Switch - Passenger	B3145 00	5	5	-
Ground - S13D Door Lock Switch - Driver	-	1	-	-
Ground - S13P Door Lock Switch - Passenger	-	6	-	-
1. S13D Door Lock Switch - Driver = Inoperative 2. Driver Door Lock Switch = Inoperative 3. Driver Door Unlock Switch = Inoperative 4. Passenger Door Lock Switch = Inoperative 5. Passenger Door Unlock Switch = Inoperative				

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6. S13P Door Lock Switch - Passenger = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
S13D Door Lock Switch - Driver	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
S13P Door Lock Switch - Passenger	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Conditions for Running the DTC

Ignition/Vehicle = On

Conditions for Setting the DTC

B3140 00

Control module K9 detects: Driver Door Lock Switch Circuit = Short to Ground - For greater than 60 s

B3145 00

Control module K9 detects: Passenger Door Unlock Switch Circuit = Short to Ground - For greater than 60 s

B3150 00

Control module K9 detects: Driver Door Unlock Switch Circuit = Short to Ground - For greater than 60 s

B3155 00

Control module K9 detects: Passenger Door Lock Switch Circuit = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

B3140 00

Driver Door Lock Switch = Disabled

B3145 00

Passenger Door Unlock Switch = Disabled

B3150 00

Driver Door Unlock Switch = Disabled

B3155 00

Passenger Door Lock Switch = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify the scan tool parameter: Driver Door Lock Switch = Inactive
 - **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

3. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the scan tool parameter: Driver Door Lock Switch = Lock & Unlock

- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

4. Verify the scan tool parameter: Passenger Door Lock Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing - Test 2

- **If the specified state**

5. Operate the component: S13P Door Lock Switch - Passenger - Lock & Unlock

Verify the scan tool parameter: Passenger Door Lock Switch = Lock & Unlock

- **If not the specified state**

Refer to: Circuit/System Testing - Test 2

- **If the specified state**

6. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: S13D Door Lock Switch - Driver

3. Test for less than 10 ohms between the test points: Ground circuit terminal 4 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection

2. Test for less than 2 ohms between the test points: Ground circuit terminal 4 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify the scan tool parameter: Driver Door Lock Switch = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X2 @ K9 Body Control Module
3. Test for infinite resistance between the test points:
 - Signal circuit terminal 2 @ Component harness & Ground
 - Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module

- **If the specified state**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 4
7. Verify the scan tool parameter: Driver Door Lock Switch = Lock

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X2 @ K9 Body Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 2 @ Component harness & Terminal 19 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module

- **If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 4
9. Verify the scan tool parameter: Driver Door Lock Switch = Unlock

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X2 @ K9 Body Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness &

Terminal 15 X2 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K9 Body Control Module

- **If the specified state**

10. Test or replace the component: S13D Door Lock Switch - Driver

Test 2

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: S13P Door Lock Switch - Passenger
3. Test for less than 10 ohms between the test points: Ground circuit terminal 4 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 4 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Passenger Door Lock Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X6 @ K9 Body Control Module
 3. Test for infinite resistance between the test points:
 - Signal circuit terminal 2 @ Component harness & Ground
 - Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 4
7. Verify the scan tool parameter: Passenger Door Lock Switch = Lock
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X6 @ K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 2 @ Component harness &

Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 2 @ Component harness & Terminal 13 X6 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K9 Body Control Module

• **If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 4

9. Verify the scan tool parameter: Passenger Door Lock Switch = Unlock

• **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: X6 @ K9 Body Control Module

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & Terminal 6 X6 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K9 Body Control Module

• **If the specified state**

10. Test or replace the component: S13P Door Lock Switch - Passenger

Component Testing

S13 Door Lock Switch - Test

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: S13 Door Lock Switch

3. Test for infinite resistance between the test points:

- Signal terminal 2 & Ground terminal 4 - Switch - Not Pressed
- Signal terminal 3 & Ground terminal 4 - Switch - Not Pressed
- **If less than infinite resistance**

Replace the component: S13 Door Lock Switch

- **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 2 & Ground terminal 4 - Lock Switch - Pressed
 - **If 3 ohms or greater**
 Replace the component: S13 Door Lock Switch
 - **If less than 3 ohms**
5. Test for less than 3 ohms between the test points: Signal terminal 3 & Ground terminal 4 - Unlock Switch - Pressed
 - **If 3 ohms or greater**
 Replace the component: S13 Door Lock Switch
 - **If less than 3 ohms**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Door Lock Switch Replacement - Driver Side](#)
- Refer to [Door Lock Switch Replacement - Passenger Front](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B3265: TRUNK LID UNLATCH OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B3265

Trunk Lid Unlatch Output Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Relay Coil	B3265 02	B3265 04	B3265 01	-
Ground - Relay Coil	-	B3265 04	-	-

Circuit/System Description

For an overview of the component/system, refer to: [Rear Hatch/Gate Description and Operation](#)

Circuit	Description
Control - Relay Coil	The output circuit is switched to 12 V to activate the component.
Ground - Relay Coil	Chassis Ground

Component	Description
KR95A Liftgate Unlatch Relay	A relay is a switch that is actuated by a solenoid.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Conditions for Running the DTC

KR95A Liftgate Unlatch Relay - The component is commanded On.

Conditions for Setting the DTC

- B3265 01 - Control Circuit = Short to Battery
- B3265 02 - Control Circuit = Short to Ground
- B3265 04 - Control Circuit = Open

Actions Taken When the DTC Sets

A23C Liftgate Latch Assembly = Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

[Release Systems Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Electrical Center Identification Views](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify the component produces a clicking sound: A23C Liftgate Latch Assembly

- **If the component does not produce a sound**

Refer to: Circuit/System Testing

- **If the component produces a sound**

3. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Remove the component: KR95A Liftgate Unlatch Relay
3. Test for less than 10 ohms between the test points: Ground circuit terminal 86 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 86 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Connect a test lamp between the test points: Control circuit terminal 85 & Ground circuit terminal 86
5. Ignition - On/Vehicle - In Service Mode
6. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K9 Body Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 85 @ Relay Socket & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 85 @ Relay Socket & Terminal 11 X5 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module
 - **If the test lamp is always On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 85 @ Relay Socket & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K9 Body Control Module
 - **If the test lamp turns On and Off**
7. Test or replace the component: KR95A Liftgate Unlatch Relay

Component Testing

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR95A Liftgate Unlatch Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86
 - **If not between 70 and 110 ohms**

Replace the component: KR95A Liftgate Unlatch Relay
 - **If between 70 and 110 ohms**
4. Test for infinite resistance between the test points:
 - Component terminal 30 & 85
 - Component terminal 30 & 86
 - Component terminal 30 & 87
 - Component terminal 85 & 87
 - **If less than infinite resistance**

Replace the component: KR95A Liftgate Unlatch Relay
 - **If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & 12 V

Connect a jumper wire between the test points: Component terminal 85 & Ground
6. Test for less than 2 ohms between the test points: Component terminal 30 & 87

- If 2 ohms or greater

Replace the component: KR95A Liftgate Unlatch Relay

- If less than 2 ohms

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC B3618: EXTERIOR LIFTGATE WINDOW UNLATCH SWITCH CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC B3618 00

Exterior Liftgate Window Unlatch Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3618 00	1	1	-
Ground	-	1	-	-
1. S46 Liftgate Handle Switch = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Rear Hatch/Gate Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
-----------	-------------

Component	Description
S46 Liftgate Handle Switch	• The switch has a normally open contact. • When the switch is activated, the signal circuit to the control module is grounded.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Signal Circuit = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

S46 Liftgate Handle Switch = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Luggage Compartment/Rear of Vehicle Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Operate the component: S46 Liftgate Handle Switch - Pressed

Verify a click can be heard or felt at the component when it is turned On and Off: A23C Liftgate Latch Assembly

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing

- **If a click can be heard or felt**

3. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: S46 Liftgate Handle Switch
3. Test for less than 10 ohms between the test points: Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 2 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the component is not activated: A23C Liftgate Latch Assembly
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module
 - **If the specified state**
6. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 2
7. Verify the component produces a clicking sound: A23C Liftgate Latch Assembly
 - **If a click cannot be heard or felt**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: K9 Body Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 15 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module
- **If a click can be heard or felt**
8. Test or replace the component: S46 Liftgate Handle Switch

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: S46 Liftgate Handle Switch
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 2 - The switch is in the open position.
 - **If less than infinite resistance**

Replace the component: S46 Liftgate Handle Switch
 - **If infinite resistance**
4. Test for less than 3 ohms between the test points: Signal terminal 1 & Ground terminal 2 - The switch is in the closed position.
 - **If 3 ohms or greater**

Replace the component: S46 Liftgate Handle Switch
 - **If less than 3 ohms**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Liftgate Release Switch Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0CCC, P0CCE, OR P0CCF: CHARGE PORT DOOR POSITION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0CCC 00

Charge Port Door Position Sensor Circuit

DTC P0CCE 00

Charge Port Door Position Sensor Circuit Low Voltage

DTC P0CCF 00

Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Signal	P0CCE 00	P0CCE 00	P0CCC 00	P0CCF 00	-
Ground	-	P0CCE 00	P0CCC 00	-	-

Circuit/System Description

The hybrid/EV powertrain control module 2 provides a 5V signal through a pull-up resistor to the charge port door position sensor circuit. The other end of the charge port door position sensor circuit is connected to the charge port door position switch. The hybrid/EV powertrain control module 2 monitors the voltage on the charge port door position sensor circuit. In normal operation, the hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

Conditions for Running the DTC

Hybrid/EV powertrain control module 2 must be awake.

Conditions for Setting the DTC

P0CCC 00

The hybrid/EV powertrain control module 2 detects the charge port door position sensor signal circuit voltage is mid range between expected high and low voltage values

P0CCE 00

The hybrid/EV powertrain control module 2 detects a short to ground in the charge port position sensor circuit.

P0CCF 00

The hybrid/EV powertrain control module 2 detects a short to voltage or an open/high resistance in the charge port position sensor circuit.

Action Taken When the DTC Sets

The Charge Door Open message will not illuminate when the charge port door is open or ajar.

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00 and P0CCF 00 are type C DTCs

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charge Port Door Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Charge Port Door parameter changes between Open and Closed when opening and closing the charge port door.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal A and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If between 4.8 - 5.2 V**

4. Test or replace the B197 Charge Port Door Position Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch.
2. Test for 180 - 190 Ω between the signal terminal A and the ground terminal C with the switch in the open position.

- **If 191 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

- **If 179 Ω or less**

Replace the B197 Charge Port Door Position Switch.

- **If 180 - 190 Ω**

3. Test for 2040 - 2065 Ω between the signal terminal A and the ground terminal C with the switch in the closed position.

- **If 2066 Ω or greater**

Replace the B197 Charge Port Door Position Switch.

- **If 2039 Ω or less**

Replace the B197 Charge Port Door Position Switch.

- **If 2040 - 2065 Ω**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Charge Port Door Ajar Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for the hybrid/EV powertrain control module 2 replacement, programming and setup

DTC P04B6: FUEL FILL DOOR STUCK CLOSED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P04B6 00

Fuel Fill Door Stuck Closed

Circuit/System Description

The hybrid powertrain control module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the refuel request switch is pressed, the two switch contacts close. This provides B+ to the Wake-up Circuit input of the hybrid powertrain control module 2 and lowers the voltage on the fuel door request signal circuit input to the hybrid powertrain control module 2. The hybrid powertrain control module 2 detects the voltage on the signal circuits and commands the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The hybrid powertrain control module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door.

Conditions for Running the DTC

- The hybrid powertrain control module 2 is awake
- The fuel tank is being filled.

Conditions for Setting the DTC

The hybrid powertrain control module 2 has detected that the fuel level in the fuel tank has increased but detects that the fuel filler door was always in the closed position.

Action Taken When the DTC Sets

The driver information center will display the Service Refuel System message.

Conditions for Clearing the DTC

DTC P04B6 is a type B DTC.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Fuel Door Position parameter changes between Open and Closed when opening and closing the fuel filler door.
 - **If the parameter does not change**

Refer to Fuel Filler Door Ajar Indicator Malfunction
 - **If the parameter changes**
3. All OK.

DTC P04B8-P04BA: FUEL FILL DOOR POSITION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P04B8 00

Fuel Fill Door Position Sensor Circuit

DTC P04B9 00

Fuel Fill Door Position Sensor Circuit Low Voltage

DTC P04BA 00

Fuel Fill Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Signal	P04B9 00	P04B9 00	P04B8 00	P04BA 00	-
Ground	-	P04B9 00	P04B8 00	-	-

Circuit/System Description

The hybrid powertrain control module 2 provides a 5V signal through a pull-up resistor to the fuel door position sensor circuit. The other end of the fuel door position sensor circuit is connected to the fuel door position sensor in the fuel door status switch assembly. The hybrid powertrain control module 2 monitors the voltage on the fuel door position sensor circuit. In normal operation, when the Fuel Door moves to the open position, the switch in the fuel door lock position closes and lowers the voltage on the fuel door position sensor circuit.

Conditions for Running the DTC

Hybrid powertrain control module 2 is awake.

Conditions for Setting the DTC

P04B8 00

The hybrid powertrain control module 2 detects the fuel door position signal circuit voltage is mid range between expected high and low voltage values.

P04B9 00

The hybrid powertrain control module 2 detects a short to ground in the fuel door open signal circuit.

P04BA 00

The hybrid powertrain control module 2 detects a short to voltage or an open or high resistance in the fuel door open signal circuit.

Action Taken When the DTC Sets

The driver information center will continuously display the Wait To Refuel message after the refuel request switch is pressed.

Conditions for Clearing the DTC

DTC P04B8 00, P04B9 00 and P04BA 00 are type B DTCs

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Fuel Door Position parameter changes between Open and Closed when opening and closing the fuel filler door.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B208 Fuel Door Status Switch Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid Powertrain Control Module 2.
 2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid Powertrain Control Module 2.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid Powertrain Control Module 2, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
 - **If between 4.8 - 5.2 V**
4. Test or replace the B208 Fuel Door Status Switch Assembly.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B208 Fuel Door Status Switch Assembly.
2. Test for 180 - 190 Ω between the signal terminal 1 and the ground terminal 2 with the switch in the open position.
 - **If 191 Ω or greater**

Replace the B208 Fuel Door Status Switch Assembly.
 - **If 179 Ω or less**

Replace the B208 Fuel Door Status Switch Assembly.
 - **If 180 - 190 Ω**
3. Test for 2040 - 2065 Ω between the signal terminal 1 and the ground terminal 2 with the switch in the closed position.
 - **If 2066 Ω or greater**

Replace the B208 Fuel Door Status Switch Assembly.

- If 2039 Ω or less

Replace the B208 Fuel Door Status Switch Assembly.

- If 2040 Ω - 2065 Ω

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for the hybrid powertrain control module 2 replacement, programming and setup

DTC P04BB, P04BC, OR P04C0: FUEL FILL DOOR LOCK CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P04BB 00

Fuel Fill Door Lock Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Door Lock Actuator Lock Control	P04BB 00	P04BB 00	P04BB 00	-
Fuel Door Lock Actuator Unlock Control	P04BB 00	P04BB 00	P04BB 00	-

Circuit/System Description

The hybrid powertrain control module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the refuel request switch is pressed, the two switch contacts close. This provide B+ to the Wake-up Circuit input of the hybrid powertrain control module 2 and lowers the voltage on the fuel door request signal circuit input to the hybrid powertrain control module 2. The hybrid powertrain control module 2 detects the voltage on the signal circuits and commands the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The hybrid powertrain control module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door.

Conditions for Running the DTC

Hybrid Powertrain Control Module 2 is awake

Conditions for Setting the DTC

The hybrid powertrain control module 2 has detected a short to ground, short to voltage or an open/high resistance on either of the lock actuator control circuits

Action Taken When the DTC Sets

- The fuel door latch will malfunction and the fuel filler door may not be able to be opened.
- The Wait to Refuel message always be displayed on the driver information center.

Conditions for Clearing the DTC

DTC P04BB 00 is type B DTCs

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the function of the fuel door lock actuator when commanding the Fuel Fill Door to Lock and Unlock with a scan tool.
 - **If the Lock and Unlock function for the fuel door lock actuator does not work**
Refer to Circuit/System Testing.
 - **If the Lock and Unlock function for the fuel door lock actuator works**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the M97 fuel door lock actuator.
2. Test for greater than 10 V between the control circuit terminal 1 and ground.
 - **If 10 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K114B hybrid powertrain control module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω , replace the K114B hybrid powertrain control module 2.
 - **If greater than 10 V**
3. Test for greater than 10 V between the control circuit terminal 2 and ground.
 - **If 10 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K114B hybrid powertrain control module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω , replace the K114B hybrid powertrain control module 2.
 - **If greater than 10 V**
4. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
5. Verify the test lamp turns ON when commanding the Fuel Fill Door to Lock and Unlock with a scan tool.
 - **If the test lamp remains OFF during either of the commands**
 1. Vehicle OFF, disconnect the harness connector at the K114B hybrid powertrain control module 2. Vehicle in Service Mode
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V replace the K114B hybrid powertrain control module 2
 - **If the test lamp turns ON during each of the commands**
6. Test or replace the M97 fuel door lock actuator.

Component Testing

Fuel Door Lock Actuator

1. Vehicle OFF, disconnect the harness connector at the M97 fuel door lock actuator.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a

jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M97 fuel door lock actuator should perform the LOCK and UNLOCK function.

- **If the actuator does not perform the LOCK and UNLOCK function**

Replace the M97 fuel door lock actuator.

- **If the actuator performs the LOCK and UNLOCK function**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Fuel Tank Filler Door Lock Actuator Replacement](#)
- Refer to [Control Module References](#) for the hybrid powertrain control module 2 replacement, programming and setup

DTC P04C8, P04CA, OR P04CB: FUEL FILL DOOR OPEN REQUEST SWITCH CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P04C8 00

Fuel Fill Door Open Request Switch Circuit

DTC P04CA 00

Fuel Fill Door Open Request Switch Circuit Low Voltage

DTC P04CB 00

Fuel Fill Door Open Request Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Signal	P04CA 00	P04C8 00	P04C8 00	P04CB 00	-
Ground	-	P04C8 00	P04C8 00	P04CB 00	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the Refuel Request Switch is pressed, the

two switch contacts close. This provide B+ to the Wake-up Circuit input of the Hybrid/EV Powertrain Control Module 2 and changes the voltage level on the fuel door request signal circuit input to the Hybrid/EV Powertrain Control Module 2. The Hybrid/EV Powertrain Control Module 2 detects the voltage changes on the signal circuits and commands the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The Hybrid/EV Powertrain Control Module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door.

Conditions for Running the DTC

The Hybrid/EV Powertrain Control Module 2 is awake

Conditions for Setting the DTC

P04C8 00

The Hybrid/EV Powertrain Control Module 2 the fuel fill door open request switch circuit voltage is mid-range between expected high and low voltage values.

P04CA 00

The Hybrid/EV Powertrain Control Module 2 detects a short to ground in the refuel request signal circuit.

P04CB 00

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage or an open/high resistance in the refuel request signal circuit.

Action Taken When the DTC Sets

The Refuel Request Switch will still function normally.

Conditions for Clearing the DTC

DTC P04C8 00, P04CA 00 and P04CB 00 are type B DTCs

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- **Circuit Testing**

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the M97 Fuel Door Lock Actuator will UNLOCK when pressing the S117 Refuel Request Switch.
 - **If the UNLOCK function for the M97 Fuel Door Lock Actuator does not work**

Refer to Circuit/System Testing
 - **If the UNLOCK function for the M97 Fuel Door Lock Actuator works**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.

2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If between 4.8 - 5.2 V**
4. Test or replace the S117 Refuel Request Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Tank Filler Door Lock Release Switch Replacement](#)
- Refer to [Control Module References](#) for the Hybrid/EV Powertrain Control Module 2 replacement, programming and setup

DTC P169D: FUEL FILL DOOR OPEN REQUEST SWITCH WAKE-UP CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P169D 00

Fuel Fill Door Open Request Switch Wake-Up Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	P169D 00	P169D 00	-	-
Fuel Door Open Request Wake-Up Signal	P169D 00	P169D 00	1	-
1. Fuel Door Switch Malfunction				

Circuit/System Description

The hybrid powertrain control module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the refuel request switch is pressed, the two switch contacts close. This provides B+ to the Wake-up Circuit input of the hybrid powertrain control module 2 and lowers the voltage on the fuel door request signal circuit input to the hybrid powertrain control module 2.

The hybrid powertrain control module 2 detects the voltage on the signal circuits and commands the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The hybrid powertrain control module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door

Conditions for Running the DTC

- The hybrid powertrain control module 2 is awake
- A refuel request has been commanded

Conditions for Setting the DTC

The hybrid powertrain control module 2 detects that the Fuel Fill Door Open Request Switch Wake-Up Circuit value does not match the expected corresponding value for the Fuel Fill Door Open Request resistor ladder switch input.

Action Taken When the DTC Sets

- The fuel filler door unlatch request will only function when the hybrid powertrain control module 2 is awake.
- The driver information center will display the Service Refueling System message.

Conditions for Clearing the DTC

DTC P169D 00 is a type B DTC

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the operation of the fuel filler door when commanding the fuel door lock actuator to UNLATCH by pressing the refuel request switch.

- **If the fuel door lock actuator does not UNLATCH**

Refer to Circuit/System Testing

- **If the fuel door lock actuator does UNLATCH**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch. Vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

4. Test for infinite resistance between the signal circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the harness connector at the S117 Refuel Request Switch. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

4. Connect a test lamp between the signal circuit terminal 7 and ground.

5. Verify the test lamp turns ON and OFF by pressing the S117 Refuel Request Switch.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the S117 Refuel Request Switch.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch, Vehicle in

Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, test or replace the S117 Refuel Request Switch.

• **If the test lamp turns ON and OFF**

6. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch.

2. Test for infinite resistance between the signal terminal 2 and the B+ terminal 1 with the switch in the open position.

• **If less than infinite resistance**

Replace the S117 Refuel Request Switch.

• **If infinite resistance**

3. Test for less than 3 Ω between the signal terminal 2 and the B+ terminal 1 with the switch in the closed position.

• **If 3 Ω or greater**

Replace the S117 Refuel Request Switch.

• **If less than 3 Ω**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Tank Filler Door Lock Release Switch Replacement](#)
- Refer to [Control Module References](#) for the hybrid powertrain control module 2 replacement, programming and setup

SYMPTOMS - VEHICLE ACCESS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#), before using the Symptom Tables in order to verify that all of the following are true:

- There are no DTCs set
- The control modules can communicate via the serial data link

2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following systems description:

- [Door Ajar Indicator Description and Operation](#)
- [Rear Hatch/Gate Description and Operation](#)

- [Power Door Locks Description and Operation](#)
- [Liftgate Ajar Indicator Description and Operation](#)
- [Fuel Fill Door Description and Operation](#)
- [Charge Port Door Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Exterior Door Handle Switch Malfunction](#)
- [Power Door Lock Key Cylinder Switches Malfunction](#)
- [Door Ajar Indicator Malfunction](#)
- [Power Door Locks Malfunction](#)
- [Hatch Release Malfunction](#)
- [Rear Hatch/Gate Ajar Indicator Malfunction](#)
- [Fuel Filler Door Release Malfunction](#)
- [Fuel Filler Door Ajar Indicator Malfunction](#)
- [Charger Door Ajar Indicator Malfunction](#)

CHARGER DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0CCC 00

Charge Port Door Position Sensor Circuit

DTC P0CCE 00

Charge Port Door Position Sensor Circuit Low Voltage

DTC P0CCF 00

Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Signal	P0CCE 00	P0CCE 00	P0CCC 00	P0CCF 00	-
Ground	-	P0CCE 00	P0CCC 00	-	-

Circuit/System Description

The hybrid/EV powertrain control module 2 provides a 5V signal through a pull-up resistor to the charge port door position sensor circuit. The other end of the charge port door position sensor circuit is connected to the charge port door position switch. The hybrid/EV powertrain control module 2 monitors the voltage on the charge port door position sensor circuit. In normal operation, the hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

Conditions for Running the DTC

hybrid/EV powertrain control module 2 must be awake.

Conditions for Setting the DTC

P0CCC 00

The hybrid/EV powertrain control module 2 detects the charge port door position sensor signal circuit voltage is mid range between expected high and low voltage values

P0CCE 00

The hybrid/EV powertrain control module 2 detects a short to ground in the charge port position sensor circuit.

P0CCF 00

The hybrid/EV powertrain control module 2 detects a short to voltage or an open/high resistance in the charge port position sensor circuit.

Action Taken When the DTC Sets

The Charge Door Open message will not illuminate when the charge port door is open or ajar.

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00 and P0CCF 00 are type C DTCs

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charge Port Door Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Charge Port Door parameter changes between Open and Closed when opening and closing the charge port door.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal A and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control

Module 2.

2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If between 4.8 - 5.2 V**
4. Test or replace the B197 Charge Port Door Position Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B197 Charge Port Door Position Switch.
2. Test for 180 - 190 Ω between the signal terminal A and the ground terminal C with the switch in the open position.
 - **If 191 Ω or greater**

Replace the B197 Charge Port Door Position Switch.
 - **If 179 Ω or less**

Replace the B197 Charge Port Door Position Switch.
 - **If 180 - 190 Ω**
3. Test for 2040 - 2065 Ω between the signal terminal A and the ground terminal C with the switch in the closed position.
 - **If 2066 Ω or greater**

Replace the B197 Charge Port Door Position Switch.
 - **If 2039 Ω or less**

Replace the B197 Charge Port Door Position Switch.
 - **If 2040 - 2065 Ω**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Charge Port Door Ajar Indicator Switch Replacement](#)
- Refer to [Control Module References](#) for the hybrid/EV powertrain control module 2 replacement, programming and setup

EXTERIOR DOOR HANDLE SWITCH MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - B27D Door Handle Switch - Driver Exterior	B3849 02	1	1	-
Signal - B27P Door Handle Switch - Passenger Exterior	B1474 02	2	2	-
Signal - B27LR Door Handle Switch - Left Rear Exterior	B1534 02	3	3	-
Signal - B27RR Door Handle Switch - Right Rear Exterior	B1535 02	4	4	-
Ground - A24D Door Handle Assembly - Driver Exterior	-	1	-	-
Ground - A24P Door Handle Assembly - Passenger Exterior	-	2	-	-
Ground - A24LR Door Handle Assembly - Left Rear Exterior	-	3	-	-
Ground - A24RR Door Handle Assembly - Right Rear Exterior	-	4	-	-
1. B27D Door Handle Switch - Driver Exterior = Disabled 2. B27P Door Handle Switch - Passenger Exterior = Disabled 3. B27LR Door Handle Switch - Left Rear Exterior = Disabled 4. B27RR Door Handle Switch - Right Rear Exterior = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.

Circuit	Description
Ground	Chassis Ground

Component	Description
B27D Door Handle Switch - Driver Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
B27P Door Handle Switch - Passenger Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
B27LR Door Handle Switch - Left Rear Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
B27RR Door Handle Switch - Right Rear Exterior	The switch has a normally open contact. When the switch is activated, the signal circuit to the control module is grounded.
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. B27D Door Handle Switch - Driver Exterior - Not Pressed

Verify the scan tool parameter: Exterior Driver Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. B27P Door Handle Switch - Passenger Exterior - Not Pressed

Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

4. B27LR Door Handle Switch - Left Rear Exterior - Not Pressed

Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

5. B27RR Door Handle Switch - Right Rear Exterior - Not Pressed

Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

6. Operate the component: B27D Door Handle Switch - Driver Exterior - Pressed

Verify the scan tool parameter: Exterior Driver Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

7. Operate the component: B27P Door Handle Switch - Passenger Exterior - Pressed

Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

8. Operate the component: B27LR Door Handle Switch - Left Rear Exterior - Pressed

Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

9. Operate the component: B27RR Door Handle Switch - Right Rear Exterior - Pressed

Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

10. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: A24 Door Handle Assembly

3. Test for less than 10 ohms between the test points: Ground circuit terminal 5 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection

2. Test for less than 2 ohms between the test points: Ground circuit terminal 5 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K84 Keyless Entry Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K84 Keyless Entry Control Module

- **If the specified state**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X2 @ K84 Keyless Entry Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points:
 - Signal circuit terminal 1 @ A24D Door Handle Assembly - Driver Exterior & Terminal 12 X2 @ Control module harness
 - Signal circuit terminal 1 @ A24P Door Handle Assembly - Passenger Exterior & Terminal 11 X2 @ Control module harness
 - Signal circuit terminal 1 @ A24LR Door Handle Assembly - Left Rear Exterior & Terminal 2 X2 @ Control module harness
 - Signal circuit terminal 1 @ A24RR Door Handle Assembly - Right Rear Exterior & Terminal 1 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K84 Keyless Entry Control Module

- **If the specified state**

8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24 Door Handle Assembly
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed

- **If less than infinite resistance**

Replace the component: A24 Door Handle Assembly

- **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 1 & Ground terminal 5 - Pressed

- **If 3 ohms or greater**

Replace the component: A24 Door Handle Assembly

- **If less than 3 ohms**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)
- Refer to [Rear Side Door Outside Handle Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

FUEL FILLER DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Door Position Sensor Signal	P04B9 00	P04B9 00	P04BA 00	P04DC 00
Fuel Door Status Switch Ground	-	P04B9 00	-	-

Circuit/System Description

The hybrid powertrain control module 2 provides a 5V signal through a pull-up resistor to the fuel door position sensor circuit. The other end of the fuel door position sensor circuit is connected to the fuel door position sensor in the fuel door status switch assembly. The hybrid powertrain control module 2 monitors the voltage on the fuel door position sensor circuit. In normal operation, when the fuel door moves to the open position, the switch in the fuel door lock position closes and lowers the voltage on the fuel door lock position sensor circuit.

Reference Information

Schematic Reference

[Release Systems Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Fuel Fill Door Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Fuel Door Position parameter changes between Open and Closed when opening and closing the fuel filler door.
 - **If the parameter does not change**
Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B208 Fuel Door Status Switch Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid Powertrain Control Module 2.
 2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid Powertrain Control Module 2.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid Powertrain Control Module 2, Vehicle in Service Mode.

2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If between 4.8 - 5.2 V**

4. Test or replace the B208 Fuel Door Status Switch Assembly.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B208 Fuel Door Status Switch Assembly.
2. Test for 180 - 190 Ω between the signal terminal 1 and the ground terminal 2 with the switch in the open position.

- **If 191 Ω or greater**

Replace the B208 Fuel Door Status Switch Assembly.

- **If 179 Ω or less**

Replace the B208 Fuel Door Status Switch Assembly.

- **If 180 - 190 Ω**

3. Test for 2040 - 2065 Ω between the signal terminal 1 and the ground terminal 2 with the switch in the closed position.

- **If 2066 Ω or greater**

Replace the B208 Fuel Door Status Switch Assembly.

- **If 2039 Ω or less**

Replace the B208 Fuel Door Status Switch Assembly.

- **If 2040 - 2065 Ω**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **Fuel Tank Filler Pipe Housing Replacement**
- Refer to **Control Module References** for the hybrid powertrain control module 2 replacement, programming and setup

FUEL FILLER DOOR RELEASE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Refuel Request Switch B+	P04CA 00	P04CA 00	-	-
Refuel Request Wakeup Signal	P169D 00	P169D 00	P169D 00	-
Refuel Request Signal	P04CA 00	P04CA 00	P04CB 00	-
Fuel Fill Door Lock Control	P04BB 00	P04BB 00	P04BB 00	-
Fuel Fill Door Unlock Control	P04BB 00	P04BB 00	P04BB 00	-
Refuel Request Switch Low Reference	-	P04CA 00	-	-

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the refuel request switch is pressed, the two switch contacts close. This provide B+ to the wake-up circuit input of the hybrid/EV powertrain control module 2 and lowers the voltage on the fuel door request signal circuit input to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 detects the voltage on the signal circuits and commands the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The hybrid/EV powertrain control module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel Fill Door Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the M97 Fuel Door Lock Actuator will LOCK and UNLOCK when commanding the Fuel Fill Door Lock to Lock and Unlock with a scan tool.
 - **If the LOCK and UNLOCK function for the M97 Fuel Door Lock Actuator does not work**
Refer to Circuit/System Testing - Fuel Door Release Inoperative.
 - **If the LOCK and UNLOCK function for the M97 Fuel Door Lock Actuator works**
3. Verify the M97 Fuel Door Lock Actuator will UNLOCK when pressing the S117 Refuel Request Switch.
 - **If the UNLOCK function for the M97 Fuel Door Lock Actuator does not work**
Refer to Circuit/System Testing - Refuel Request Switch Inoperative When Module Is Awake
 - **If the M97 Fuel Door Lock Actuator UNLOCKS**
4. Vehicle OFF, it may take up to 2 minutes for the K114B Hybrid/EV Powertrain Control Module 2 to enter the sleep mode.
5. Verify the M97 Fuel Door Lock Actuator will UNLOCK when pressing the Refuel Request Switch.
 - **If the UNLOCK function for the M97 Fuel Door Lock Actuator does not work**
Refer to Circuit/System Testing - Refuel Request Switch Inoperative When Module Is Asleep
 - **If the M97 Fuel Door Lock Actuator UNLOCKS**
6. All OK.

Circuit/System Testing

Fuel Door Release Inoperative

1. Vehicle OFF, disconnect the harness connector at the M97 Fuel Door Lock Actuator.
2. Test for greater than 10 V between the control circuit terminal 1 and ground.
 - **If 10 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 10 V**
3. Test for greater than 10 V between the control circuit terminal 2 and ground.
 - **If 10 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If greater than 10 V**
4. Connect a test lamp between control circuit terminal 1 and control circuit terminal 2, Vehicle in Service Mode.
5. Verify the test lamp turns ON when commanding the LOCK and UNLOCK states with a scan tool.
 - **If the test lamp remains OFF during either of the commands**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V replace the K114B Hybrid/EV Powertrain Control Module 2
 - **If the test lamp turns ON during each of the commands**
6. Test or replace the M97 Fuel Door Lock Actuator.

Refuel Request Switch Inoperative When Module Is Awake

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the 5 V reference circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If between 4.8 - 5.2 V**

4. Test or replace the S117 Refuel Request Switch.

Refuel Request Switch Inoperative When Module Is Asleep

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch. Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
4. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the harness connector at the S117 Refuel Request Switch. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
4. Connect a test lamp between the signal circuit terminal 7 and ground.
5. Verify the test lamp turns ON and OFF by pressing the S117 Refuel Request Switch.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the S117 Refuel Request Switch.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the S117 Refuel Request Switch.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the S117 Refuel Request Switch.

- **If the test lamp turns ON and OFF**

6. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Component Testing

Fuel Door Open Request Switch

1. Vehicle OFF, disconnect the harness connector at the S117 Refuel Request Switch.
2. Test for infinite resistance between the signal terminal 2 and the B+ terminal 1 with the switch in the open position.
 - **If less than infinite resistance**
Replace the S117 Refuel Request Switch.
 - **If infinite resistance**
3. Test for less than 3 Ω between the signal terminal 2 and the B+ terminal 1 with the switch in the closed position.
 - **If 3 Ω or greater**
Replace the S117 Refuel Request Switch.
 - **If less than 3 Ω**
4. All OK

Fuel Door Lock Actuator

1. Vehicle OFF, disconnect the harness connector at the M97 Fuel Door Lock Actuator.
2. Install a 25 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M97 Fuel Door Lock Actuator should perform the LOCK and UNLOCK function.
 - **If the actuator does not perform the LOCK and UNLOCK function**
Replace the M97 Fuel Door Lock Actuator.
 - **If the actuator performs the LOCK and UNLOCK function**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Tank Filler Door Lock Actuator Replacement](#)
- Refer to [Fuel Tank Filler Door Lock Release Switch Replacement](#)
- Refer to [Control Module References](#) for the Hybrid/EV Powertrain Control Module 2 replacement, programming and setup

HATCH RELEASE MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Short to Ground	Short to Voltage	Signal Performance
B+ - Relay Switch	2	2	-	-
Signal - S46 Liftgate Handle Switch	B3618 00	1	1	-
Control - Relay Coil	B3265 02	2	2	-
Control - A23C Liftgate Latch Assembly	2	2	2	-
Ground - S46 Liftgate Handle Switch	-	1	-	-
Ground - Relay Coil	-	2	-	-
Ground - A23C Liftgate Latch Assembly	-	2	-	-
1. S46 Liftgate Handle Switch - Disabled 2. A23C Liftgate Latch Assembly - Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Rear Hatch/Gate Description and Operation](#)

Circuit	Description
B+ - Relay Switch	Supplied from a fuse.
Signal	The control module input circuit has an internal resistance connected to 12 V.
Control - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.
Ground - Component	Chassis Ground

Component	Description
S46 Liftgate Handle Switch	• The switch has a normally open contact. • When the switch is activated, the signal circuit to the control module is grounded.
A23C Liftgate Latch Assembly	The DC motor unlatches the liftgate. Once the liftgate is unlatched, a switch in the latch will close, grounding the signal circuit to the BCM.
KR95A Liftgate Unlatch Relay	A relay is a switch that is actuated by a solenoid.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Luggage Compartment/Rear of Vehicle Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify a click can be heard or felt at the component when it is turned On and Off: A23C Liftgate Latch Assembly

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing - Test 2

- **If a click can be heard or felt**

3. Operate the component: S46 Liftgate Handle Switch - Pressed

Verify a click can be heard or felt at the component when it is turned On and Off: A23C Liftgate Latch Assembly

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing - Test 2

- **If a click can be heard or felt**

4. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Remove the component: KR95A Liftgate Unlatch Relay
3. Test for less than 10 ohms between the test points: Ground circuit terminal 86 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 86 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Connect a test lamp between the test points: Control circuit terminal 85 & Ground circuit terminal 86
5. Ignition - On/Vehicle - In Service Mode
6. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K9 Body Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 85 @ Relay Socket & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 85 @ Relay Socket & Terminal 11 X5 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K9 Body Control Module

• **If the test lamp is always On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K9 Body Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 85 @ Relay Socket & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K9 Body Control Module

• **If the test lamp turns On and Off**

7. Verify a test lamp turns On between the test points: B+ circuit terminal 87 & Ground

• **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: B+ circuit terminal 87 @ Relay Socket & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

• **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for infinite resistance between the test points: B+ circuit terminal 87 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
3. Disconnect the electrical connector: A23C Liftgate Latch Assembly
4. Test for infinite resistance between the test points: Control circuit terminal 30 @ Relay Socket & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
5. Replace the component: Fuse
6. Install the component: KR95A Liftgate Unlatch Relay
7. Connect a test lamp between the test points: Control circuit terminal 3 & Ground circuit terminal 1
8. Ignition - On/Vehicle - In Service Mode
9. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify the test lamp turns On and Off.

- If the test lamp does not turn On and Off - Test or replace the component: KR95A Liftgate Unlatch Relay
- If the test lamp turns On and Off - Test or replace the component: A23C Liftgate Latch Assembly

- **If the test lamp turns On**

8. Momentarily connect a 7.5 A fused jumper wire between the test points: B+ circuit terminal 87 & Control circuit terminal 30

Verify the component does not turn On and Off when connecting and disconnecting the jumper wire:
A23C Liftgate Latch Assembly

- **If the component turns On and Off**

Test or replace the component: KR95A Liftgate Unlatch Relay

- **If the component does not turn On and Off**

9. Ignition/Vehicle & All vehicle systems - Off
10. Install the component: KR95A Liftgate Unlatch Relay
11. Disconnect the electrical connector: A23C Liftgate Latch Assembly
12. Test for less than 10 ohms between the test points: Ground circuit terminal 1 & Ground

- **If 10 ohms or greater**

1. Disconnect Ground Connection
2. Test for less than 2 ohms between the test points: Ground circuit terminal 1 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

13. Connect a test lamp between the test points: Control circuit terminal 3 & Ground circuit terminal 1
14. Ignition - On/Vehicle - In Service Mode
15. Perform the scan tool control function: Rear Body Closure Unlatch - Unlatch

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

Repair the open/high resistance in the circuit: Control Circuit

- **If the test lamp is always On**

Repair the short to voltage on the circuit: Control Circuit

- **If the test lamp turns On and Off**

16. Test or replace the component: A23C Liftgate Latch Assembly

Test 2

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: S46 Liftgate Handle Switch
3. Test for less than 10 ohms between the test points: Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 2 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the component is not activated: A23C Liftgate Latch Assembly
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module
 - **If the specified state**
6. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 2
7. Verify the component produces a clicking sound: A23C Liftgate Latch Assembly
 - **If a click cannot be heard or felt**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 15 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module
 - **If a click can be heard or felt**
8. Test or replace the component: S46 Liftgate Handle Switch

Component Testing

A23C Liftgate Latch Assembly-Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23C Liftgate Latch Assembly
3. Connect a jumper wire between the test points: Ground terminal 1 & Ground
4. Momentarily connect a 7.5 A fused jumper wire between the test points: Control terminal 3 & 12 V

Verify the component turns On and Off when connecting and disconnecting the jumper wire: A23C Liftgate Latch Assembly

- **If the component does not turn On and Off**

Replace the component: A23C Liftgate Latch Assembly

- **If the component turns On and Off**

5. All OK.

S46 Liftgate Handle Switch

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: S46 Liftgate Handle Switch
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 2 - Not Pressed

- **If less than infinite resistance**

Replace the component: S46 Liftgate Handle Switch

- **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 1 & Ground terminal 2 - Pressed

- **If 3 ohms or greater**

Replace the component: S46 Liftgate Handle Switch

- **If less than 3 ohms**

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR95A Liftgate Unlatch Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86

- **If not between 70 and 110 ohms**

Replace the component: KR95A Liftgate Unlatch Relay

- **If between 70 and 110 ohms**

4. Test for infinite resistance between the test points:
 - Component terminal 30 & 85
 - Component terminal 30 & 86

- Component terminal 30 & 87
- Component terminal 85 & 87
- **If less than infinite resistance**

Replace the component: KR95A Liftgate Unlatch Relay

- **If infinite resistance**

5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & 12 V

Connect a jumper wire between the test points: Component terminal 85 & Ground

6. Test for less than 2 ohms between the test points: Component terminal 30 & 87

- **If 2 ohms or greater**

Replace the component: KR95A Liftgate Unlatch Relay

- **If less than 2 ohms**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- Refer to [Liftgate Latch Replacement](#)
- Refer to [Liftgate Release Switch Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Ajar @ A23D Door Latch Assembly - Driver	1	2	2	-
Signal - Ajar @ A23P Door Latch Assembly - Passenger	1	2	2	-
Signal - Ajar @ A23LR Door Latch Assembly - Left Rear	1	2	2	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Ajar @ A23RR Door Latch Assembly - Right Rear	1	2	2	-
Ground - A23D Door Latch Assembly - Driver	-	2	-	-
Ground - A23P Door Latch Assembly - Passenger	-	2	-	-
Ground - A23LR Door Latch Assembly - Left Rear	-	2	-	-
Ground - A23RR Door Latch Assembly - Right Rear	-	2	-	-
1. Door Ajar Indicator = Always On 2. Door Open - Door Ajar Indicator = Not Displayed				

Circuit/System Description

For an overview of the component/system, refer to: [Door Ajar Indicator Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23 Door Latch Assembly	The lock assemblies also contain a door ajar switch that is open when the door is closed.
M74 Window Motor	- Power Window Control - The control module also reads various switches and sensors and makes their values available via serial data.
S79 Window Switch	- Power Window Control - The control module also reads various switches and sensors and makes their values available via serial data.

Reference Information

Schematic Reference

[Door Lock/Indicator Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify the appropriate scan tool door ajar switch parameter changes when opening and closing the vehicle doors.
 - **{Driver Door Ajar Switch} If the parameter state does not change**
Refer to Circuit/System Testing - Test 1
 - **{Passenger Door Ajar Switch} If the parameter state does not change**
Refer to Circuit/System Testing - Test 2
 - **{Left Rear Door Ajar Switch} If the parameter state does not change**
Refer to Circuit/System Testing - Test 3
 - **{Right Rear Door Ajar Switch} If the parameter state does not change**
Refer to Circuit/System Testing - Test 4
 - **If the parameter state changes**
3. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Driver Door Ajar Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: M74D Window Motor - Driver
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: M74D Window Motor - Driver
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 3
7. Verify the scan tool parameter: Driver Door Ajar Switch = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: M74D Window Motor - Driver
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Signal circuit terminal 6 @ M74D Window Motor - Driver
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: M74D Window Motor - Driver
 - **If the specified state**
8. Test or replace the component: A23D Door Latch Assembly - Driver

Test 2

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23P Door Latch Assembly - Passenger
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Passenger Door Ajar Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: S79P Window Switch - Passenger
 3. Test for infinite resistance between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: S79P Window Switch - Passenger
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 5 & Ground circuit terminal 3
7. Verify the scan tool parameter: Passenger Door Ajar Switch = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: S79P Window Switch - Passenger
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 5 @ Component harness & Signal circuit terminal 2 @ S79P Window Switch - Passenger
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: S79P Window Switch - Passenger
 - **If the specified state**

8. Test or replace the component: A23P Door Latch Assembly - Passenger

Test 3

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23LR Door Latch Assembly - Left Rear
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Left Rear Door Ajar Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: S79LR Window Switch - Left Rear
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: S79LR Window Switch - Left Rear
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 3
7. Verify the scan tool parameter: Left Rear Door Ajar Switch = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: S79LR Window Switch - Left Rear
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 2 @ S79LR Window Switch - Left Rear

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: S79LR Window Switch - Left Rear

- **If the specified state**

8. Test or replace the component: A23LR Door Latch Assembly - Left Rear

Test 4

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23RR Door Latch Assembly - Right Rear
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Right Rear Door Ajar Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: S79RR Window Switch - Right Rear
 3. Test for infinite resistance between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: S79RR Window Switch - Right Rear
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 5 & Ground circuit terminal 3
7. Verify the scan tool parameter: Right Rear Door Ajar Switch = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: S79RR Window Switch - Right Rear
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 5 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V

5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 5 @ Component harness & Terminal 2 @ S79RR Window Switch - Right Rear
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: S79RR Window Switch - Right Rear
- **If the specified state**
8. Test or replace the component: A23RR Door Latch Assembly - Right Rear

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A23 Door Latch Assembly
3. Test for infinite resistance between the test points:
 - A23D Door Latch Assembly - Driver Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
 - A23P Door Latch Assembly - Passenger Signal terminal 5 & Ground terminal 3 - The switch is in the open position.
 - A23LR Door Latch Assembly - Left Rear Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
 - A23RR Door Latch Assembly - Right Rear Signal terminal 5 & Ground terminal 3 - The switch is in the open position.
 - **If less than infinite resistance**

Replace the component: A23 Door Latch Assembly
 - **If infinite resistance**
4. Test for less than 3 ohms between the test points:
 - A23D Door Latch Assembly - Driver Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
 - A23P Door Latch Assembly - Passenger Signal terminal 5 & Ground terminal 3 - The switch is in the closed position.
 - A23LR Door Latch Assembly - Left Rear Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
 - A23RR Door Latch Assembly - Right Rear Signal terminal 5 & Ground terminal 3 - The switch is in the closed position.
 - **If 3 ohms or greater**

Replace the component: A23 Door Latch Assembly
 - **If less than 3 ohms**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Latch Replacement](#)
- Refer to [Rear Side Door Latch Replacement](#)
- Refer to [Front Side Door Window Switch Replacement \(Right Side\)](#)
- Refer to [Rear Side Door Window Switch Replacement](#)
- Refer to [Front Side Door Window Regulator Replacement](#)

POWER DOOR LOCK KEY CYLINDER SWITCHES MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	1	1	-
Ground	-	1	-	-
1. B29D Door Lock Key Cylinder Switch - Driver = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside). The assembly also contains a normally open door ajar switch that closes as soon as the door is not fully closed.
S146 Window/Outside Rearview Mirror Switch - Driver	The switch assembly has a 4-way switch to control the mirror movement (up, down, left, right) and a 2-position switch to select the left and right mirror.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Operate the component: S13D Door Lock Switch - Driver - Unlock
2. Operate the component: B29D Door Lock Key Cylinder Switch - Driver - Lock
3. Verify the component activates: A23LR Door Latch Assembly - Left Rear/A23P Door Latch Assembly - Passenger/A23RR Door Latch Assembly - Right Rear
 - **If the component does not work as specified**

Refer to: Circuit/System Testing
 - **If all functions work properly**
4. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 @ Component harness & Ground Connection

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Ignition - On/Vehicle - In Service Mode

5. Test for greater than 10 V between the test points: Signal circuit terminal 4 & Ground circuit terminal 3

- **If 10 V or less**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: S146 Window/Outside Rearview Mirror Switch - Driver

3. Test for infinite resistance between the test points: Signal circuit terminal 4 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2 ohms between the test points: Signal circuit terminal 4 @ Component harness & Signal circuit terminal 14 @ S146 Window/Outside Rearview Mirror Switch - Driver

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If greater than 10 V**

6. Test or replace the component: A23D Door Latch Assembly - Driver

Component Testing

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver

3. Test for infinite resistance between the test points: Signal terminal 4 & Ground terminal 3 - The switch is in the open position.

- **If less than infinite resistance**

Replace the component: A23D Door Latch Assembly - Driver

- **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 4 & Ground terminal 3 - The switch is in the closed position.

- **If 3 ohms or greater**

Replace the component: A23D Door Latch Assembly - Driver

- **If less than 3 ohms**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Window Control Switch Replacement](#)
- Refer to [Front Side Door Latch Replacement](#)

POWER DOOR LOCKS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
B+ - K9 Body Control Module	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Signal terminal 2 @ S13D Door Lock Switch - Driver	B3150 00	2	2	-
Signal terminal 3 @ S13D Door Lock Switch - Driver	B3140 00	3	3	-
Signal terminal 2 @ S13P Door Lock Switch - Passenger	B3155 00	4	4	-
Signal terminal 3 @ S13P Door Lock Switch - Passenger	B3145 00	5	5	-
Control - A23D Door Latch Assembly - Driver	B3125 02, B3130 02, B3135 02	7	B3125 01, B3130 01, B3135 01	-
Control - A23P Door Latch Assembly - Passenger	B3125 02, B3130 02, B3135 02	8	B3125 01, B3130 01, B3135 01	-
Control - A23LR Door Latch Assembly - Left Rear	B3125 02, B3130 02, B3135 02	9	B3125 01, B3130 01, B3135 01	-
Control - A23RR Door Latch Assembly - Right Rear	B3125 02, B3130 02, B3135 02	10	B3125 01, B3130 01, B3135 01	-
Ground - S13P Door Lock Switch - Passenger	-	6	-	-
Ground - S13D Door Lock Switch - Driver	-	1	-	-
Ground - K9 Body Control Module	-	7, 8, 9, 10	-	-
1. S13D Door Lock Switch - Driver = Inoperative 2. Driver Door Lock Switch = Inoperative				

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
3. Driver Door Unlock Switch = Inoperative 4. Passenger Door Lock Switch = Inoperative 5. Passenger Door Unlock Switch = Inoperative 6. S13P Door Lock Switch - Passenger = Inoperative 7. A23D Door Latch Assembly - Driver = Inoperative 8. A23P Door Latch Assembly - Passenger = Inoperative 9. A23LR Door Latch Assembly - Left Rear = Inoperative 10. A23RR Door Latch Assembly - Right Rear = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: [Power Door Locks Description and Operation](#)

Circuit	Description
B+ - K9 Body Control Module	Supplied from a fuse.
Signal	The control module input circuit has an internal resistance connected to 12 V.
Control - Driver Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Control - All Doors Lock	The output circuit is switched from ground to 12 V to activate the component.
Control - Passenger Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Ground - S13D Door Lock Switch - Driver	Chassis Ground
Ground - S13P Door Lock Switch - Passenger	Chassis Ground
Ground - K9 Body Control Module	Chassis Ground

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside).
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.
S13P Door Lock Switch - Passenger	- The switch has a normally open contact. - When the switch is activated, the signal circuit to the control module is grounded.
S13D Door Lock Switch - Driver	- The switch has a normally open contact. - When the switch is activated, the signal circuit to the control module is grounded.

Reference Information

Schematic Reference

- [Door Lock/Indicator Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Component View Reference

[Door Component Views](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\) Relay Replacement \(Within an Electrical Center\)](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify the scan tool parameter: Driver Door Lock Switch = Inactive
 - **If not the specified state**

Refer to: Circuit/System Testing - Test 1
 - **If the specified state**
3. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the scan tool parameter: Driver Door Lock Switch = Lock & Unlock
 - **If not the specified state**

Refer to: Circuit/System Testing - Test 1
 - **If the specified state**
4. Verify the scan tool parameter: Passenger Door Lock Switch = Inactive
 - **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

5. Operate the component: S13P Door Lock Switch - Passenger - Lock & Unlock

Verify the scan tool parameter: Passenger Door Lock Switch = Lock & Unlock

- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **If the specified state**

6. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the component works as specified:

- A23D Door Latch Assembly - Driver = Lock & Unlock
- A23LR Door Latch Assembly - Left Rear = Lock & Unlock
- A23P Door Latch Assembly - Passenger = Lock & Unlock
- A23RR Door Latch Assembly - Right Rear = Lock & Unlock
- **If the component does not activate - A23D Door Latch Assembly - Driver**

Refer to: Circuit/System Testing - Test 2

- **If the component does not activate - A23LR Door Latch Assembly - Left Rear**

Refer to: Circuit/System Testing - Test 3

- **If the component does not activate - A23P Door Latch Assembly - Passenger**

Refer to: Circuit/System Testing - Test 3

- **If the component does not activate - A23RR Door Latch Assembly - Right Rear**

Refer to: Circuit/System Testing - Test 3

- **If none of the components operate**

Refer to: Circuit/System Testing - Test 4

- **If all functions work properly**

7. All OK.

Circuit/System Testing

Test 1

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: S13D Door Lock Switch - Driver/S13P Door Lock Switch - Passenger
3. Test for less than 10 ohms between the test points: Ground circuit terminal 4 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 4 @ Component harness & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X2/X6 @ K9 Body Control Module
 3. Test for infinite resistance between the test points:
 - Signal circuit terminal 2 @ Component harness & Ground
 - Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 4
7. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Unlock
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X2 or X6 @ K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points:
 - Signal circuit terminal 3 @ S13D Door Lock Switch - Driver & Terminal 15 X2 @ Control module harness
 - Signal circuit terminal 3 @ S13P Door Lock Switch - Passenger & Terminal 6 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K9 Body Control Module

- **If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 4
9. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Lock
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X2 or X6 @ K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points:
 - Signal circuit terminal 2 @ S13D Door Lock Switch - Driver & Terminal 19 X2 @ Control module harness
 - Signal circuit terminal 2 @ S13P Door Lock Switch - Passenger & Terminal 13 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module
 - **If the specified state**
10. Test or replace the component: S13D Door Lock Switch - Driver/S13P Door Lock Switch - Passenger

Test 2

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Connect a test lamp between the test points: Control circuit terminal 7 & Control circuit terminal 8
4. Ignition - On/Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.

- **If the test lamp turns On and Off**

Test or replace the component: A23D Door Latch Assembly - Driver

- **If the test lamp does not turn On and Off**

7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 @ K9 Body Control Module
9. Test for less than 2 ohms between the test points:
 - Control circuit terminal 7 @ Component harness & Terminal 1 X6 @ Control module harness

- Control circuit terminal 8 @ Component harness & Terminal 4 X6 @ Control module harness
- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- **If less than 2 ohms**

10. Test or replace the component: K9 Body Control Module

Test 3

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector:
 - A23LR Door Latch Assembly - Left Rear
 - A23P Door Latch Assembly - Passenger
 - A23RR Door Latch Assembly - Right Rear
3. Connect a test lamp between the test points:
 - A23P Door Latch Assembly - Passenger: Control circuit terminal 9 & Control circuit terminal 8
 - A23LR Door Latch Assembly - Left Rear: Control circuit terminal 7 & Control circuit terminal 8
 - A23RR Door Latch Assembly - Right Rear: Control circuit terminal 9 & Control circuit terminal 8
4. Ignition - On/Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.

- **If the test lamp turns On and Off**

Test or replace the component: A23 Door Latch Assembly

- **If the test lamp does not turn On and Off**

7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 @ K9 Body Control Module
9. Ignition - On/Vehicle - In Service Mode
10. Test for less than 2 ohms between the test points:
 - Control circuit terminal 7 @ A23LR Door Latch Assembly - Left Rear & Terminal 2 X6 @ Control module harness
 - Control circuit terminal 8 @ A23LR Door Latch Assembly - Left Rear & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 8 @ A23P Door Latch Assembly - Passenger & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 9 @ A23P Door Latch Assembly - Passenger & Terminal 2 X6 @ Control module harness
 - Control circuit terminal 8 @ A23RR Door Latch Assembly - Right Rear & Terminal 4 X6 @ Control module harness
 - Control circuit terminal 9 @ A23RR Door Latch Assembly - Right Rear & Terminal 2 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - **If less than 2 ohms**

11. Test or replace the component: K9 Body Control Module

Test 4

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: X2 & X6 @ K9 Body Control Module
3. Test for less than 10 ohms between the test points: Ground circuit terminal 3 X6 & Ground
 - **If 10 ohms or greater**
 1. Disconnect Ground Connection
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 3 X6 & Ground Connection
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 4 X2 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: B+ circuit terminal 4 X2 & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector:
 - A23D Door Latch Assembly - Driver
 - A23LR Door Latch Assembly - Left Rear
 - A23P Door Latch Assembly - Passenger
 - A23RR Door Latch Assembly - Right Rear
 3. Test for infinite resistance between the test points:
 - Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
 - Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: A23 Door Latch Assembly
 - **If the test lamp turns On**
6. Ignition/Vehicle - Off

7. Connect the electrical connector: X2 @ K9 Body Control Module

8. Ignition - On/Vehicle - In Service Mode

9. Test for less than 1 V between the test points:

- Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
- Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
- Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
- **If greater than 1 V**

Repair the short to voltage on the circuit.

- **If 1 V or less**

10. Ignition/Vehicle - Off

11. Test for infinite resistance between the test points:

- Control circuit terminal 1 X6 @ K9 Body Control Module & Ground
- Control circuit terminal 2 X6 @ K9 Body Control Module & Ground
- Control circuit terminal 4 X6 @ K9 Body Control Module & Ground
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

12. Replace the component: K9 Body Control Module

Component Testing

S13 Door Lock Switch - Test

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: S13 Door Lock Switch

3. Test for infinite resistance between the test points:

- Signal terminal 2 & Ground terminal 4 - Switch - Not Pressed
- Signal terminal 3 & Ground terminal 4 - Switch - Not Pressed
- **If less than infinite resistance**

Replace the component: S13 Door Lock Switch

- **If infinite resistance**

4. Test for less than 3 ohms between the test points: Signal terminal 2 & Ground terminal 4 - Lock Switch - Pressed

- **If 3 ohms or greater**

Replace the component: S13 Door Lock Switch

- **If less than 3 ohms**

5. Test for less than 3 ohms between the test points: Signal terminal 3 & Ground terminal 4 - Unlock Switch

- Pressed

- **If 3 ohms or greater**

Replace the component: S13 Door Lock Switch

- **If less than 3 ohms**

6. All OK.

A23 Door Latch Assembly

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector:

- A23D Door Latch Assembly - Driver
- A23P Door Latch Assembly - Passenger
- A23LR Door Latch Assembly - Left Rear
- A23RR Door Latch Assembly - Right Rear

3. Connect a 25 A fused jumper wire between the test points: Control terminal 8 & B+

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points:

- A23D Door Latch Assembly - Driver: Control terminal 7 & Ground
- A23P Door Latch Assembly - Passenger: Control terminal 9 & Ground
- A23LR Door Latch Assembly - Left Rear: Control terminal 7 & Ground
- A23RR Door Latch Assembly - Right Rear: Control terminal 9 & Ground

5. Reverse the jumper wires 2 times between the terminals.

Verify the component works as specified: A23 Door Latch Assembly = Lock & Unlock

- **If not the specified state**

Replace the component: A23 Door Latch Assembly

- **If the specified state**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Front Side Door Latch Replacement](#)
- Refer to [Rear Side Door Latch Replacement](#)
- Refer to [Door Lock Switch Replacement - Driver Side](#)
- Refer to [Door Lock Switch Replacement - Passenger Front](#)
- Refer to [Front Side Door Window Control Switch Replacement](#)

- For control module replacement, programming, and setup refer to: [Control Module References](#)

REAR HATCH/GATE AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	2	2	-
Ground	-	3	-	-
1. Trunk Open Display Message = Always On 2. Trunk Open Display Message = Disabled 3. A23C Liftgate Latch Assembly = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: [Liftgate Ajar Indicator Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23C Liftgate Latch Assembly	The DC motor unlatches the liftgate. Once the liftgate is unlatched, a switch in the latch will close, grounding the signal circuit to the control module K9.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Reference Information

Schematic Reference

[Release Systems Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Component View Reference

Luggage Compartment/Rear of Vehicle Component Views

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Operate the component: Liftgate - Closed

Verify the scan tool parameter: Rear Closure Ajar Switch = Inactive

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. Operate the component: Liftgate - Ajar

Verify the scan tool parameter: Rear Closure Ajar Switch = Active

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

4. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23C Liftgate Latch Assembly
3. Ignition - On/Vehicle - In Service Mode
4. Verify the scan tool parameter: Rear Closure Ajar Switch = Inactive
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.

- If infinite resistance - Replace the component: K9 Body Control Module

- **If the specified state**

5. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 1
6. Verify the scan tool parameter: Rear Closure Ajar Switch = Active
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 2 @ Component harness & Terminal 5 X6 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module
 - **If the specified state**
7. Test or replace the component: A23C Liftgate Latch Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23C Liftgate Latch Assembly
3. Test for infinite resistance between the test points: Signal terminal 2 & Ground terminal 1 - The switch is in the open position.
 - **If less than infinite resistance**
Replace the component: A23C Liftgate Latch Assembly
 - **If infinite resistance**
4. Test for less than 3 ohms between the test points: Signal terminal 2 & Ground terminal 1 - The switch is in the closed position.
 - **If 3 ohms or greater**
Replace the component: A23C Liftgate Latch Assembly
 - **If less than 3 ohms**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Liftgate Latch Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DOOR WILL NOT OPEN/CLOSE, DOOR BINDING, OR LOCKS, HANDLES, OR CYLINDERS DO NOT FUNCTION

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to address the mechanical diagnosis of the door latching system, which could include the inside and outside handles, latch rods/cables, latches, or latch cylinders.			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Were you sent here from a Vehicle Access Symptom Table?	Go to Step 3	Go to Symptoms - Vehicle Access
3	Does the door open with the outside handle?	Go to Step 4	Go to Step 10
4	Does the door open with the inside handle?	Go to Step 5	Go to Step 11
5	Does the manual latch knob latch and unlatch the latch smoothly without binding?	Go to Step 6	Go to Step 12
6	Does the door latch switch and/or the keyless entry transmitter latch and unlatch the door latch or door latches?	Go to Step 7	Go to Step 14
7	Is the outside key cylinder loose or does it rattle or fall out? (if equipped)	Go to Step 15	Go to Step 8
8	Does the outside key cylinder latch and unlatch the latch and function smoothly without binding? (if equipped)	Go to Step 9	Go to Step 16
9	Does the door bind, does it take excessive effort to open, or is it misaligned?	Go to Step 17	Go to Step 18
10	If the door will not open with the outside handle, or the handle is obstructed or loose, check the following: • For cold weather freezing, thaw as necessary. • Check the handle for foreign material. Remove material as necessary. • Check the handle grab bar for looseness or damage. Repair as necessary. • Check the handle for full travel. If the issue is not resolved, remove the trim panel as necessary to gain access to door hardware and check the following: • Check the handle chassis for loose fasteners, broken chassis inserts, loose or missing spring, or a loose, missing or bent rod lever.	Go to Step 18	Go to Step 11

Step	Action	Yes	No
	• Check for bent rod to the outside handle. • Check that the handle grab bar engages the rod lever properly. • Check for interference of rod and handle to other components in the door. • Check that handle rod is securely attached at both latch and handle. • Check if rod is positioned properly in the clip on the latch. At rest position, the handle should be fully against the down stop and the latch lever should be at the bottom of its travel. Correct by opening clip, repositioning rod in clip and closing clip till it snaps, as necessary. Did you find and correct the condition?		
11	Door will not open with the inside handle: • Check the inside handle for foreign material. Remove material as necessary. • Check that the handle is secure. Correct as necessary. • If rear door, verify child security is not engaged. • Remove the trim panel as necessary to and check the inside handle rod/cable attachments at both the latch and handle. If the cable is kinked or pinched, correct as necessary. Did you find and correct the condition?	Go to Step 18	Go to Step 12
12	The door will not or is difficult to unlatch with the inside manual latch knob: • For cold weather freezing, thaw as necessary • Check the latch knob for a loose condition. Repair or replace as necessary. Check the latch knob for binding or dragging using the following procedure: 1. Remove the latch knob. 2. If condition goes away, check for drag/interference of the latch knob against the inner belt seal, or the trim panel. Correct as	Go to Step 18	Go to Step 13

Step	Action	Yes	No
	required. If further action is required, remove the trim panel and check the latch rod and latch knob for interference with the following: • Water deflector/paper • Side impact foam • Rod grommet in sheet metal • Glass run channel • Other rods or cables • Trim panel Did you find and correct the condition?		
13	With a manual lock, if the latch will not function properly do the following: 1. Function the lock/unlatch lever on the latch to unlatch the latch. Check for high internal resistance. 2. With the door open, manually close the latch with a screwdriver. 3. Check the latch for internal binding by actuating the latch with the inside door handle lever. 4. Manually close the latch with a screwdriver again. 5. Check the latch for internal binding by actuating the latch with the outside door handle lever. Did you find and correct the condition?	Go to Step 18	Go to Step 14
14	If power locks are included in vehicle options and do not function with either the keyless entry transmitter or switch: 1. For cold weather freezing, thaw as necessary. 2. Remove trim pad as required and check the following: • Verify door harness has appropriate power connectors for switches and latch. • Check harness connector pins for corrosion.	Go to Step 18	Go to Step 15

Step	Action	Yes	No
	- Assure wire harness connectors are seated and locked properly at latch and switch. Remove and re-seat if required. - Check door harness for cuts/chafing /corrosion. Correct/replace as required. - Check for 12V at latch and door switch. Correct/proceed accordingly. - Check BCM for trouble codes. Correct/proceed accordingly. 3. If power locks still do not function do the following: - Remove latch from door cavity. - Connect latch to electrical connector outside the door. - Function power lock/unlatch switch in both latch and unlatch directions. Watch for lock/unlatch lever on latch to move completely from one position to the other. - If lever does not move, remove connector from old latch and attach to new latch outside of door cavity. - Verify new latch is functional, if so, attach rods and install new latch in door. Did you find and correct the condition?		
15	If the key cylinder is loose do the following: - Remove the trim if necessary. - Check that the retaining clip is properly seated. (if equipped) - Check that the fastener is properly torqued. (if equipped) Did you find and correct the condition?	Go to Step 18	Go to Step 16
16	The outside key cylinder will not latch and unlatch the latch and function smoothly without binding: - For cold weather freezing, thaw as necessary - Remove trim if required. - Check that the key cylinder rod is securely attached both to the key cylinder pawl and the	Go to Step 18	Go to Step 17

Step	Action	Yes	No
	latch. 4. Check that key cylinder lever, rod and latch lever are free of interferences. Remove interferences as required. 5. Check that latch cylinder rod is routed properly. Re-route as required. 6. Remove rod from latch cylinder and actuate cylinder. Check for internal resistance. Lubricate latch cylinder as required 7. Verify Cylinder rotates with vehicle key. If not, code and replace cylinder to match vehicle key. See latch cylinder coding and replacing. Did you find and correct the condition?		
17	The door is difficult to open: • Check for interference with the fender, adjacent door, body opening or door striker and adjust as necessary. • Check for binding door hinges. Lubricate or align/adjust as necessary. • Check the door check link for binding. Lubricate as necessary. • Adjust the door as necessary. Did you find and correct the condition?	Go to Step 18	Go to appropriate Door Lock Striker Adjustment procedure.
18	Verify proper operation of the door closing system. • Outside handle • Inside handle • Manual lock/unlatch • Outside key cylinder • Inside latch knob • Double pull handle • Power lock/unlatch • Key fob • Door switches • Door opening/closing effort Is the condition still present?	Go to Step 1	System OK

REPAIR INSTRUCTIONS

FUEL TANK FILLER DOOR LOCK ACTUATOR REPLACEMENT

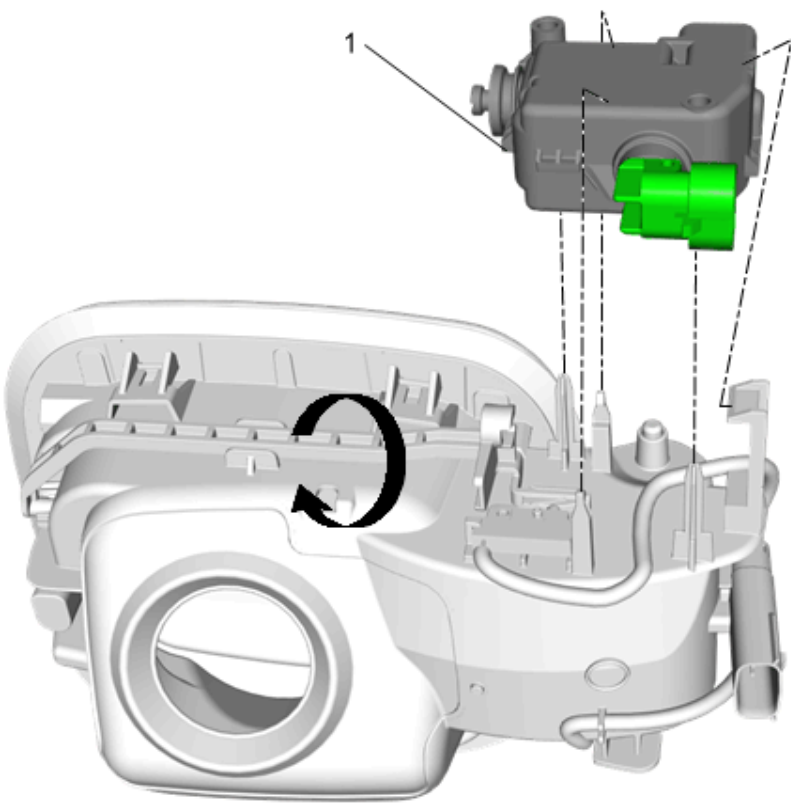


Fig. 6: Fuel Tank Filler Door Lock Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Fuel Tank Filler Pipe Housing. Refer to Fuel Tank Filler Pipe Housing Replacement .	
1	Fuel Tank Filler Door Lock Actuator
	Procedure 1. Disconnect the electrical connector. 2. Remove the actuator rod from the actuator shaft, with light pressure, pressing sideways on the rod at the shafts end, and rotating the rod outward from the housing. 3. Release the 3 retainers while using light outward pressure on the actuator.

FRONT SIDE DOOR INSIDE HANDLE CABLE REPLACEMENT

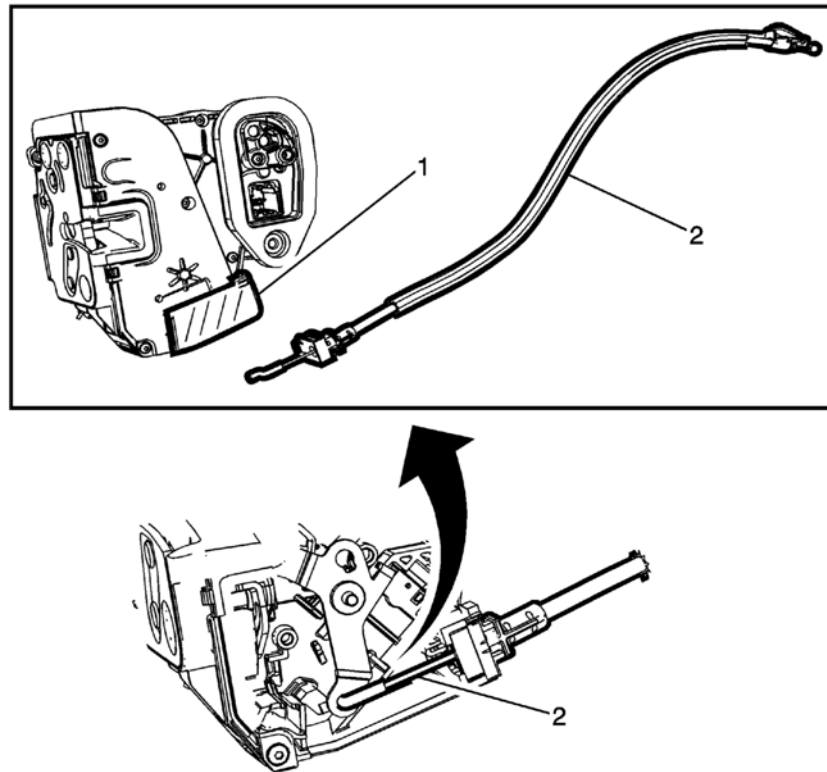


Fig. 7: Side Door Inside Handle Cable & Access Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door latch and handle bracket assembly from the door. Refer to Front Side Door Latch Replacement .	
1	Front Side Door Inside Handle Cable Access Cover Procedure 1. Use a suitable tool, open the access cover to view the cable end. 2. Release the cable end from the latch assembly.
2	Front Side Door Inside Handle Cable NOTE: Ensure that the door lock system operates properly before installing the trim.

REAR SIDE DOOR INSIDE HANDLE CABLE REPLACEMENT

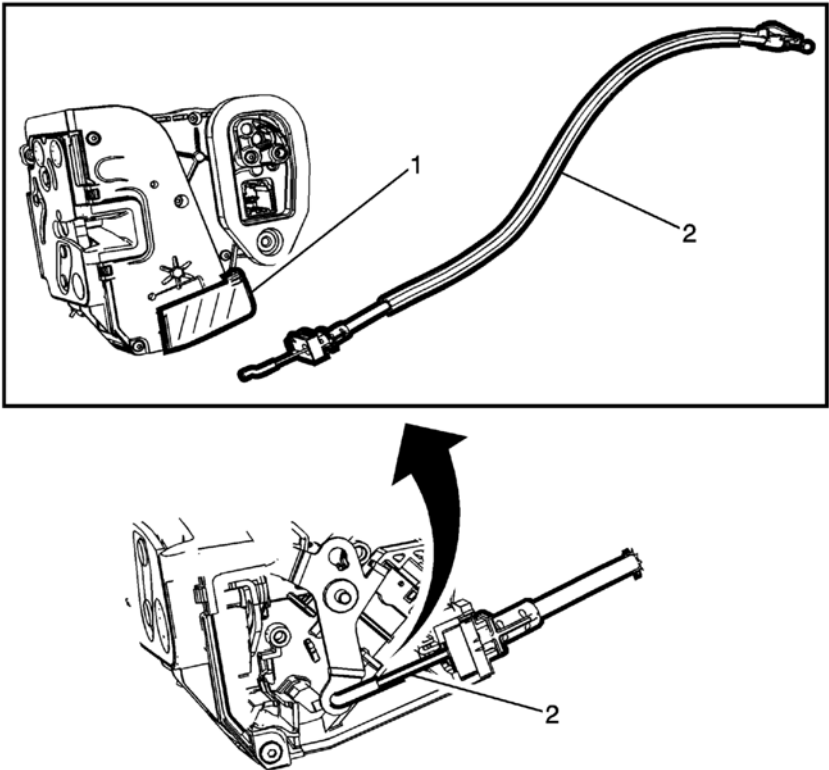


Fig. 8: Side Door Inside Handle Cable & Access Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the rear side door latch and handle bracket assembly from the door. Refer to Rear Side Door Latch Replacement .	
1	Rear Side Door Inside Handle Cable Cover Procedure 1. Use a suitable tool, open the access cover to view the cable end. 2. Release the cable end from the latch assembly.
2	Rear Side Door Inside Handle Cable NOTE: Ensure that the door lock system operates properly before installing the

Callout	Component Name
	trim.

FRONT SIDE DOOR LOCK CYLINDER REPLACEMENT

Removal Procedure

NOTE: When performing this procedure the latch and handle bracket assembly Must be removed from the vehicle to replace the door lock cylinder assembly.

1. Remove Front Side Door Latch. Refer to [Front Side Door Latch Replacement](#)

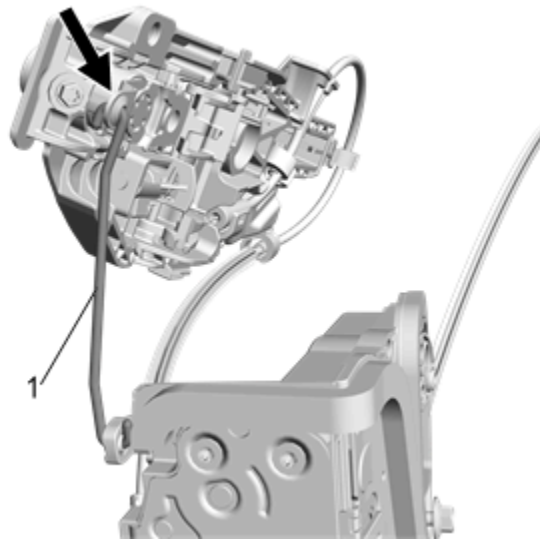


Fig. 9: Front Side Door Lock Cylinder Rod

Courtesy of GENERAL MOTORS COMPANY

NOTE: Its not necessary to disconnect the inside or outside handle cables to replace the door lock cylinder.

2. Remove Front Side Door Lock Cylinder Rod (1) @ Front Side Door Lock Cylinder.

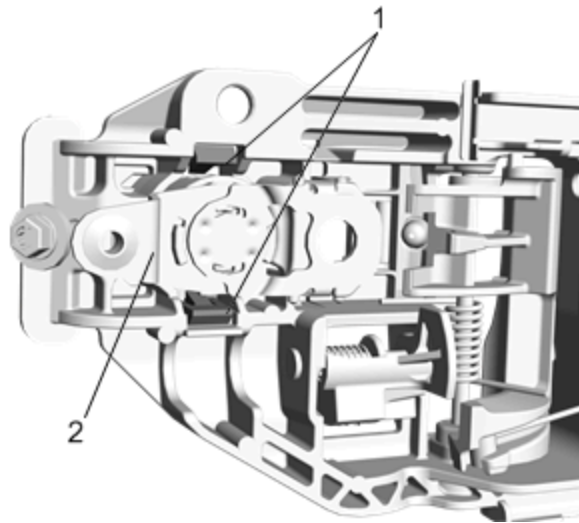


Fig. 10: Lock Cylinder Retainers

Courtesy of GENERAL MOTORS COMPANY

3. From the back side of the outside handle bracket, use a suitable tool, push up and down on the lock cylinder retainers (1) releasing the retainer from the cylinder (2).

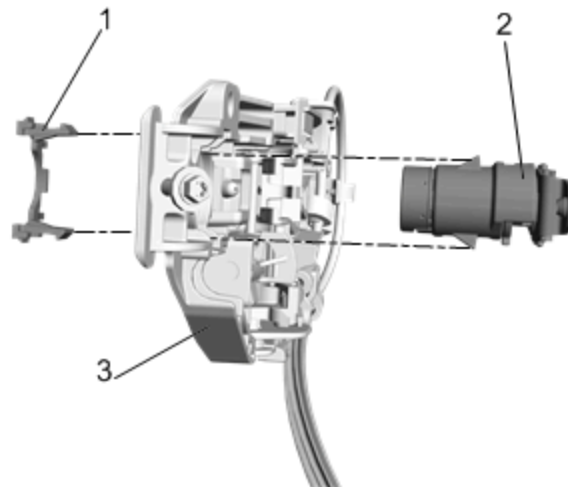


Fig. 11: Lock Cylinder Retainer, Lock Cylinder And Handle Bracket

Courtesy of GENERAL MOTORS COMPANY

4. With the lock cylinder retainer (1) removed, pull the lock cylinder (2) rearward releasing it from the handle bracket (3).

Installation Procedure

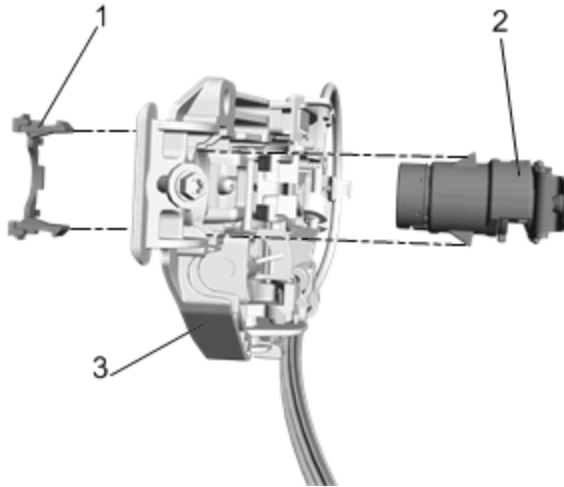


Fig. 12: Lock Cylinder Retainer, Lock Cylinder And Handle Bracket

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the door lock cylinder is engage all the way into the side door handle locator tabs. Insert the key into the door lock cylinder, turn left to right checking for binding before install the assembly to the vehicle.

1. Install the lock cylinder retainer (1) to the front side door outside handle bracket assembly (3).
2. Install the door lock cylinder (2) in the front side door outside handle bracket, push forward locking the lock cylinder (2) into the lock cylinder retainer.

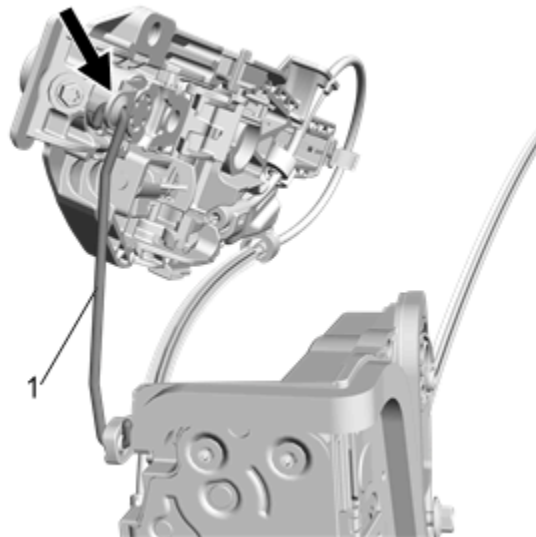


Fig. 13: Front Side Door Lock Cylinder Rod

Courtesy of GENERAL MOTORS COMPANY

3. Install Front Side Door Lock Cylinder Rod (1) @ Front Side Door Lock Cylinder.
4. Install Front Side Door Latch. Refer to [Front Side Door Latch Replacement](#)
5. Ensure that the door lock system operates properly before installing the trim.

OPENING THE LIFTGATE WITHOUT ELECTRICAL POWER

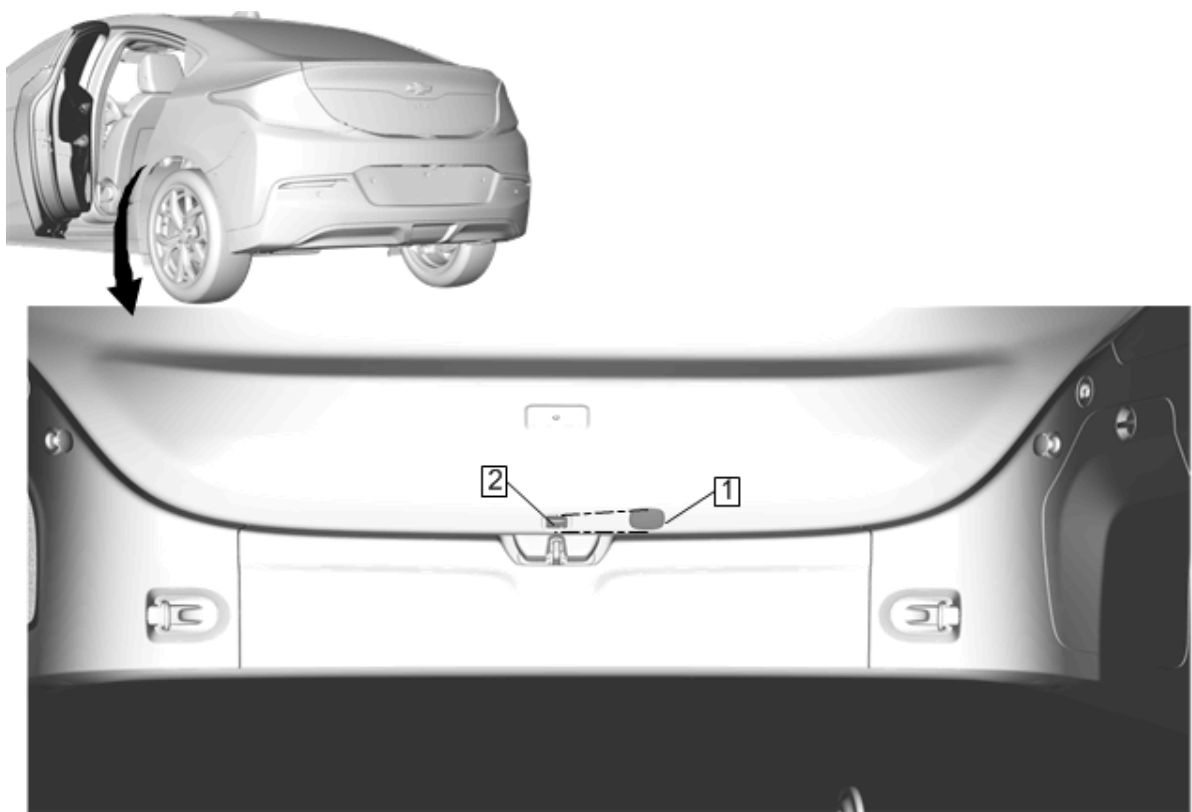


Fig. 14: Liftgate Latch Release Adapter Hole Plug And Liftgate Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Liftgate Latch Release Adapter Hole Plug
2	Liftgate Latch Procedure Insert a flat bladed service type tool into the square hole and turn it clockwise until the primary latch releases. NOTE: Rotation to release latch should be approximately 30 degrees. Excessive rotation can cause damage to the latch.

FRONT SIDE DOOR OUTSIDE HANDLE REPLACEMENT (BASE)

Removal Procedure

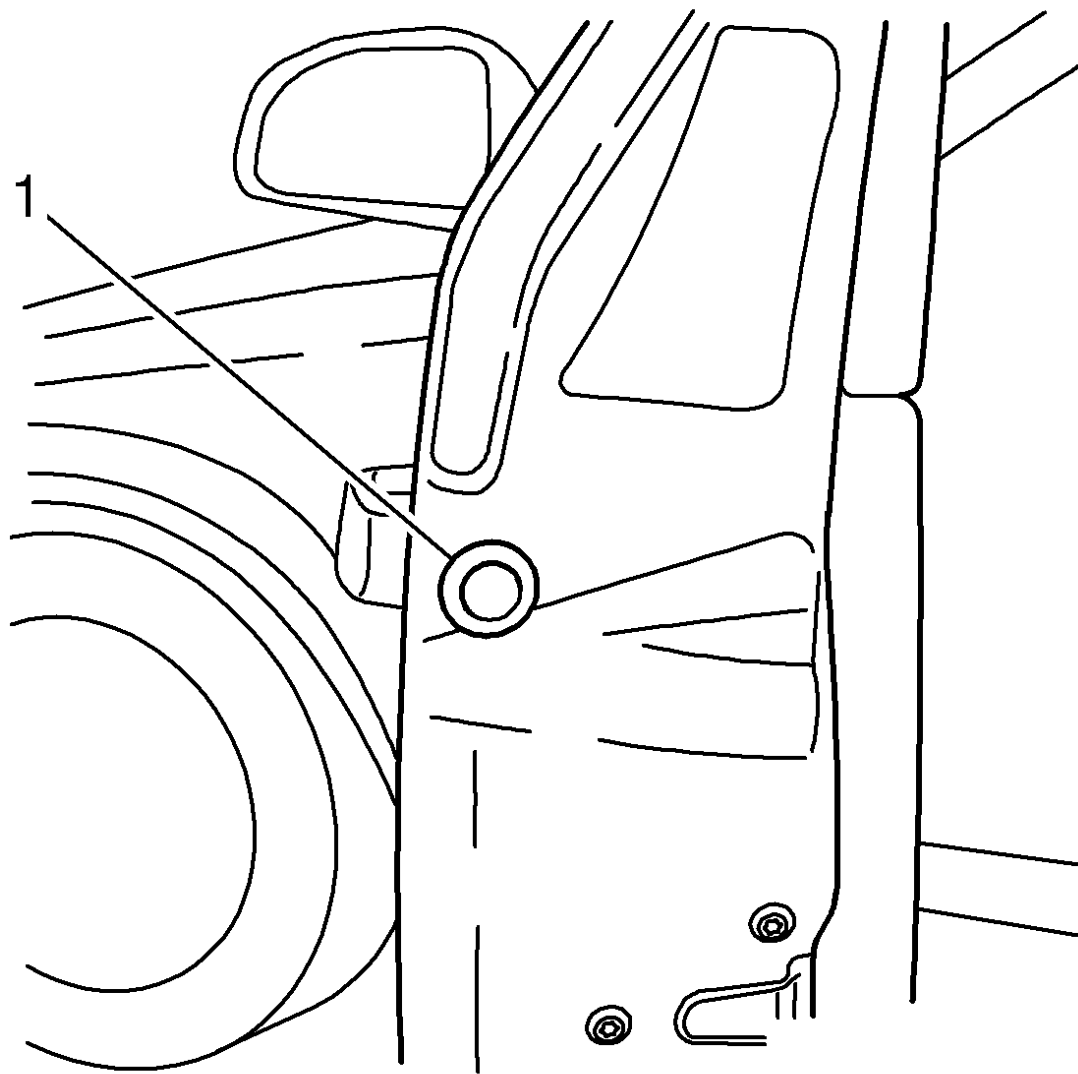


Fig. 15: Cover Cap

Courtesy of GENERAL MOTORS COMPANY

NOTE: **USE HAND TOOL ONLY.** Using a battery operated gun or power tool can **BREAK** the door handle bracket.

1. Remove the cover cap that conceals the screw (1) from the inside edge of the door.

Using a small flat-bladed tool, release the cover cap from the door.

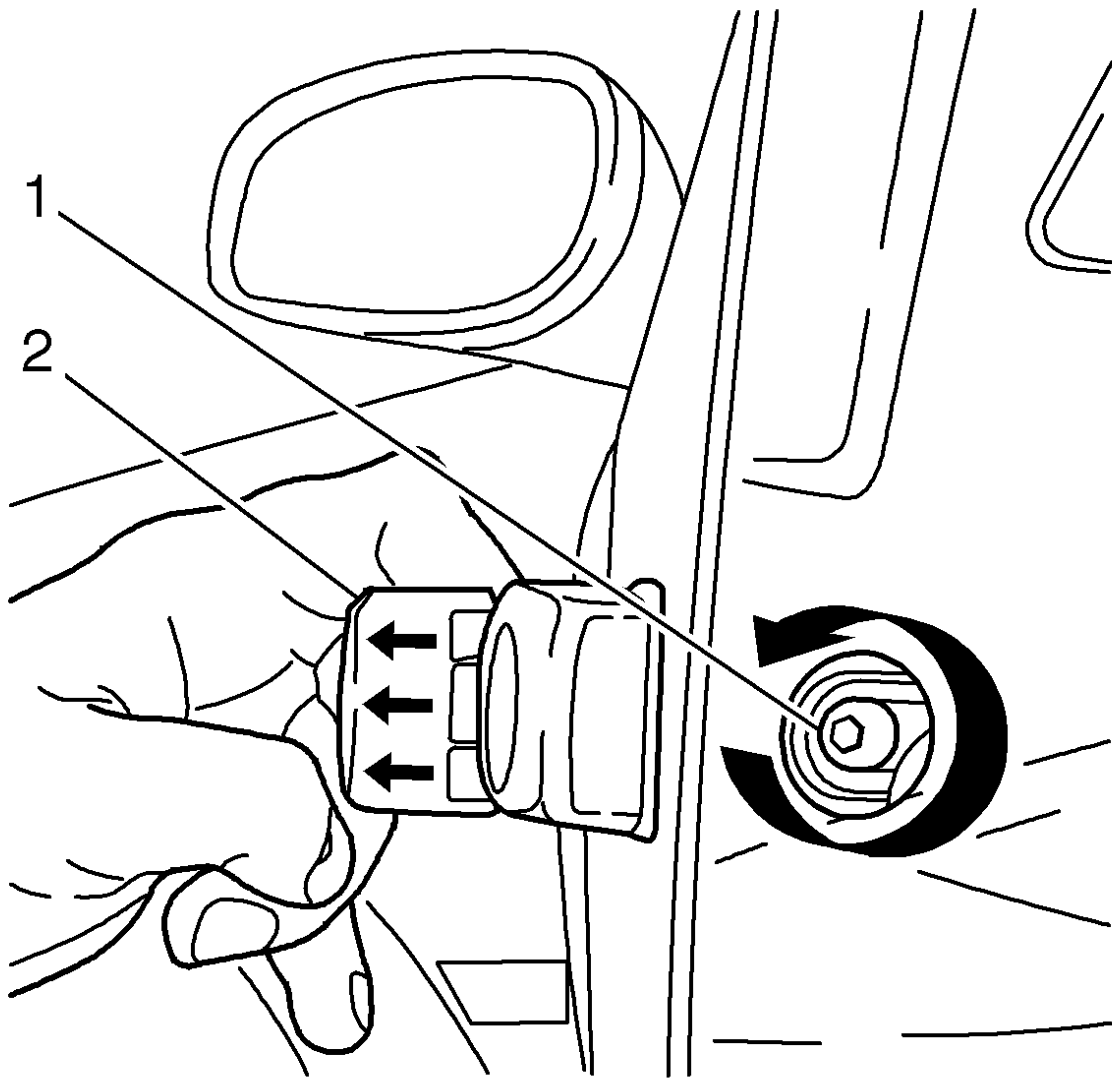


Fig. 16: Securing Door Outside Handle In Pulled Position

Courtesy of GENERAL MOTORS COMPANY

NOTE: The door outside handle (2) must now be secured in the pulled position.

2. Remove the door handle from the door.

1. Pull the door handle (2) outwards and hold.

NOTE: USE HAND TOOL ONLY. DO NOT TURN THE SCREW PAST 12.5 ROTATIONS TOTAL, this will break the door handle bracket.

2. While holding handle (2) in the full open position, using a manual screwdriver loosen the screw (1) TEN full turns. The handle (2) will stay in the full open position without being held.



Fig. 17: Bezel And Cylinder/Cover

Courtesy of GENERAL MOTORS COMPANY

3. Remove the bezel with cylinder/cover and blank cylinder (1) from the door. If unable to remove the bezel, complete one full turn of the screw at a time until bezel can be released. DO NOT TURN MORE THAN 2.5 ROTATIONS.

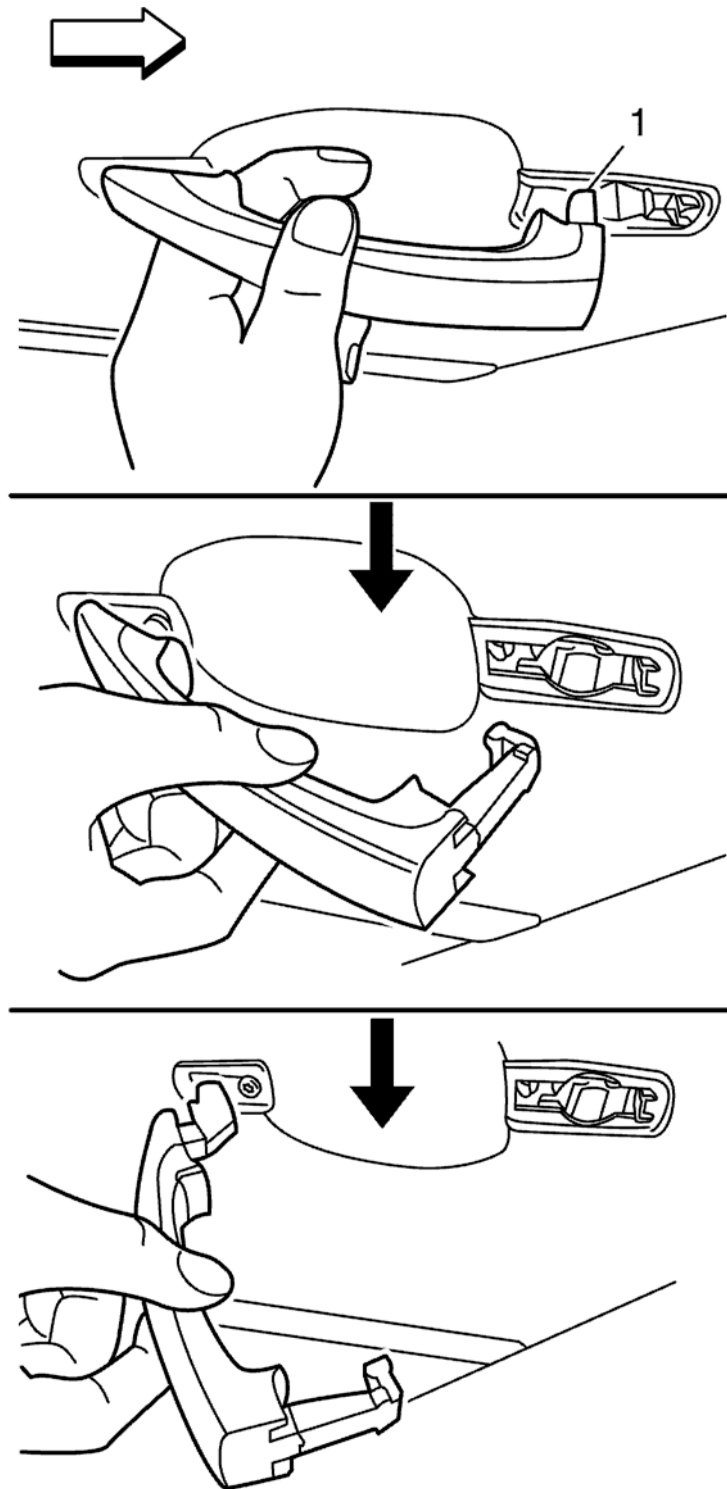


Fig. 18: Side Door Outside Handle Removal Procedure
Courtesy of GENERAL MOTORS COMPANY

3. Remove the door handle (1) from the door as follows:
 1. Slide the door handle rearward releasing it from the door handle bracket.
 2. Open the door handle fully.

3. Remove the door handle from the door.

Installation Procedure

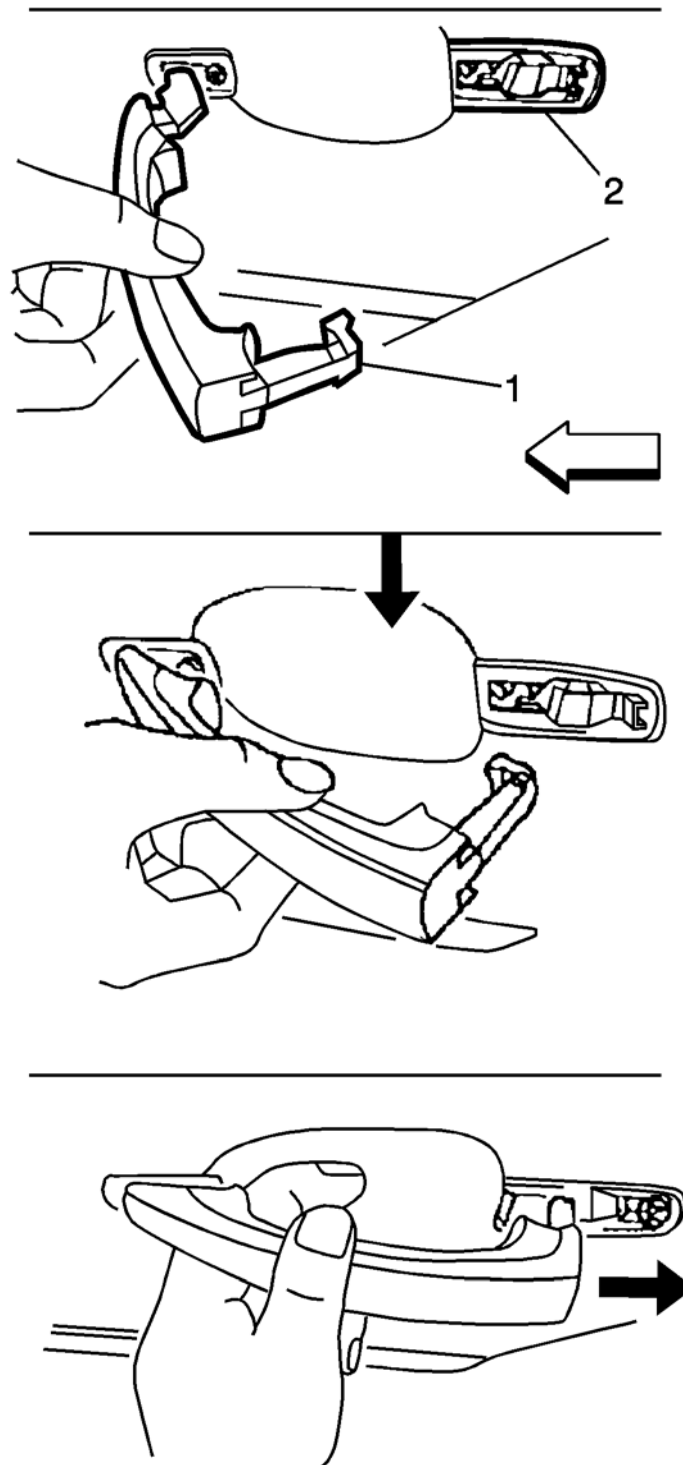


Fig. 19: Side Door Outside Handle Installation Procedure
Courtesy of GENERAL MOTORS COMPANY

1. Install the door handle (1) to the door (2) as follows:
 1. Insert the door handle into the door handle pocket.
 2. Slide the door handle forward securing it into the door handle bracket.



Fig. 20: Bezel And Cylinder/Cover Installation Procedure

Courtesy of GENERAL MOTORS COMPANY

NOTE: Handle will snap back to flush condition, continue to turn the fastener in the clockwise (right) direction until proper torque is reached.

2. Install the bezel with cylinder/cover and blank cylinder (1) in the door.

Hold the bezel or cover flush to the door sheet metal and turn the cylinder clamp screw (2) until proper torque is reached.

3. Tighten the screw to 6 N.m (53 lb in).

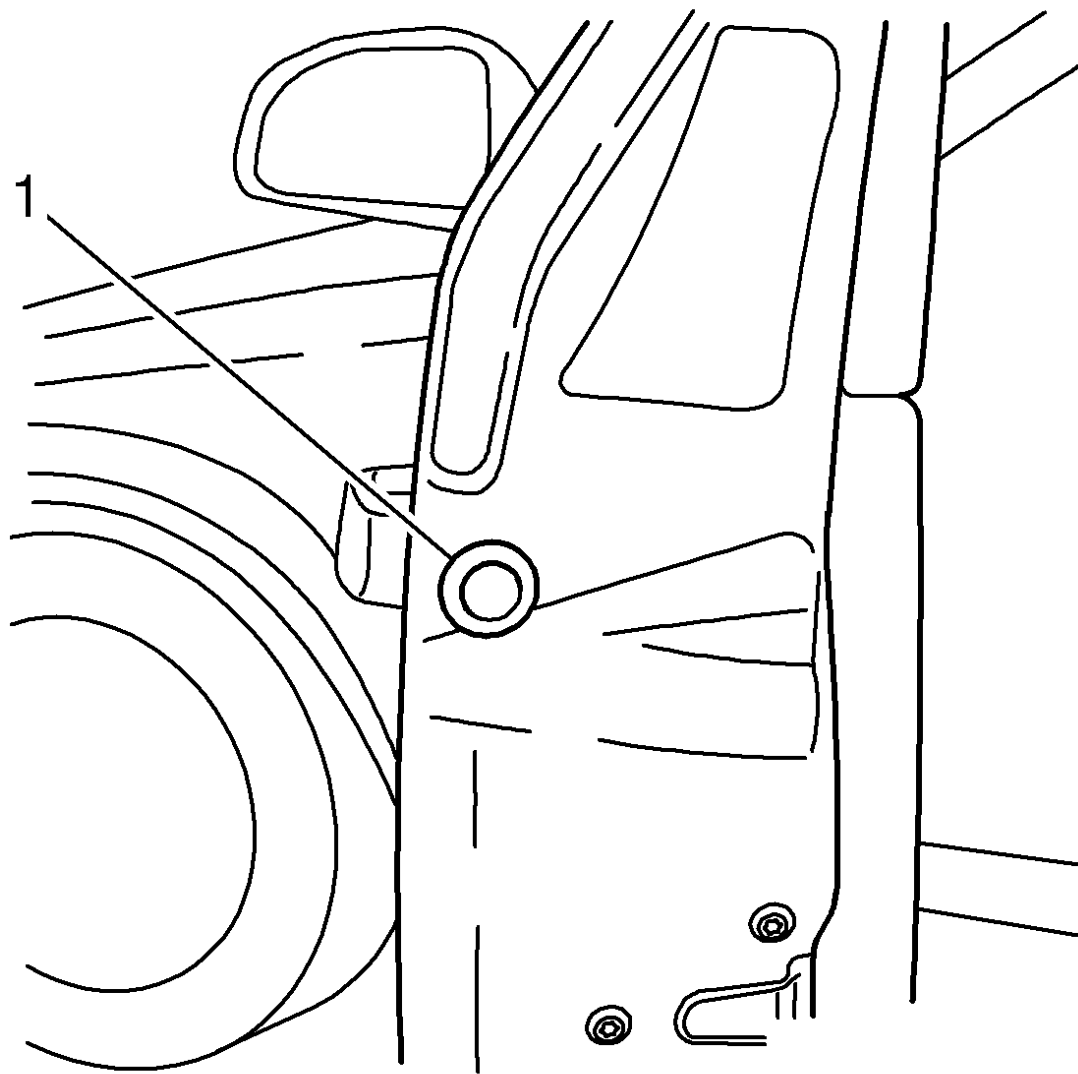


Fig. 21: Cover Cap

Courtesy of GENERAL MOTORS COMPANY

4. Install the cover cap that conceals the screw (1) to the inside edge of the door.
5. Ensure that the door lock system operates properly.

FRONT SIDE DOOR OUTSIDE HANDLE REPLACEMENT (PASS KEY ENTRY ATH)

Special Tools

BO 51363 Door Handle Spring Retainer

Removal Procedure

1. Remove the front side door armrest bracket. Refer to [Front Side Door Armrest Bracket Replacement](#) .
2. Remove the door water deflector.
3. Place the window in the full up position.
4. Disconnect the electrical connector from the door handle for the pass key entry (ATH).

NOTE: USE HAND TOOL ONLY. Using a battery operated gun or power tool can BREAK the door handle bracket.

When removing the door lock cylinder screw Do Not go past the hard stop.

5. Loosen the screw for the front side door lock cylinder opening cover. Refer to [Front Side Door Lock Cylinder Opening Cover Replacement](#).

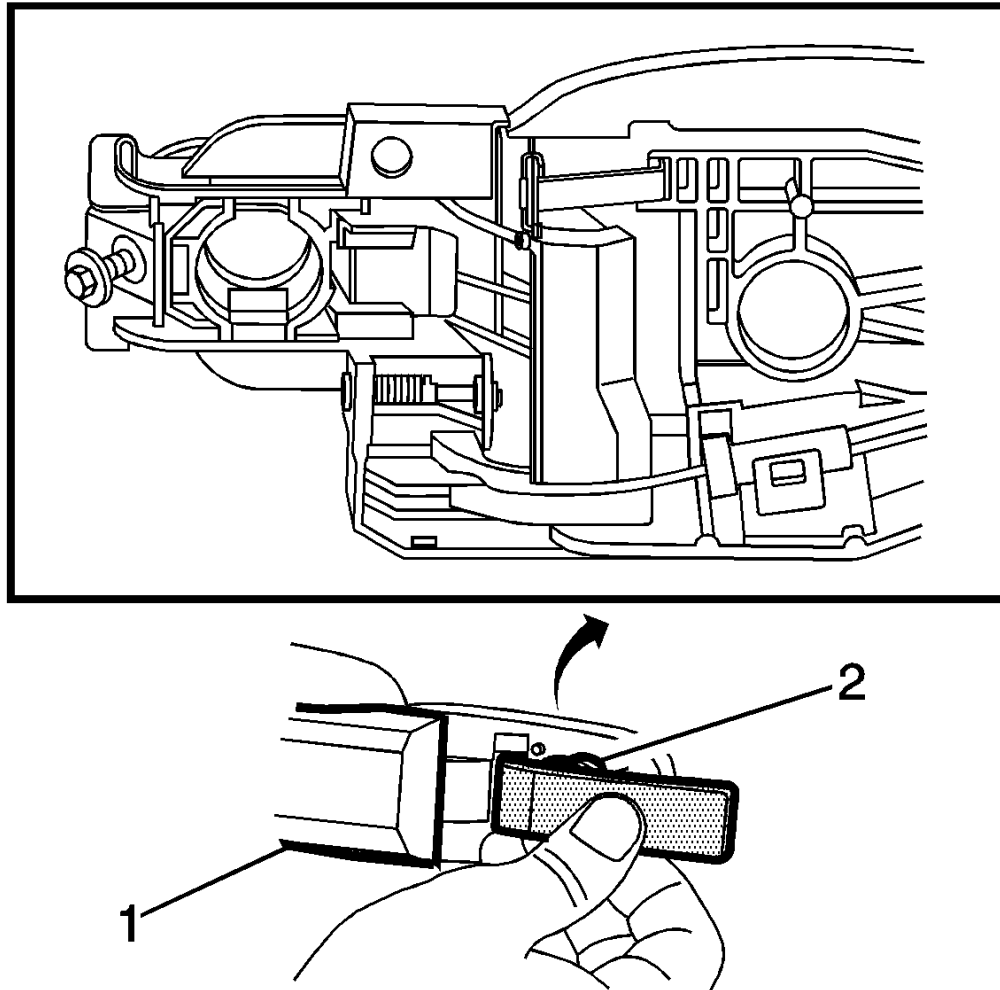


Fig. 22: Front Side Door Outside Handle And Door Handle Spring Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Pull front side door outside handle (1) outward and insert **BO-51363** Door Handle Spring Retainer over the lock cylinder (2) and under door handle (1).
7. Press rear part of **BO-51363** Door Handle Spring Retainer towards the door. The front side door outside handle (1) should now be held in the extended position.
8. Release pressure on **BO-51363** Door Handle Spring Retainer which allows front side door outside handle (1) to slightly retract.

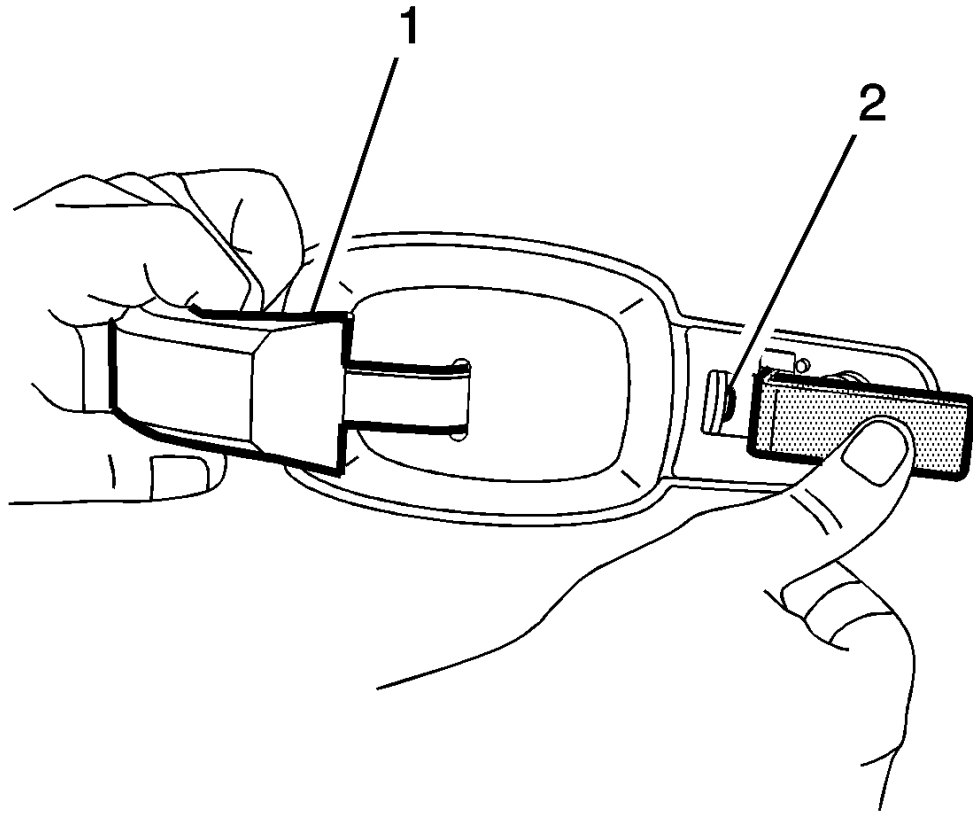


Fig. 23: Front Side Door Outside Handle & Mechanism

Courtesy of GENERAL MOTORS COMPANY

9. Slide front side door outside handle (1) rearward and then pull outward releasing outside door handle from front side door handle mechanism (2).

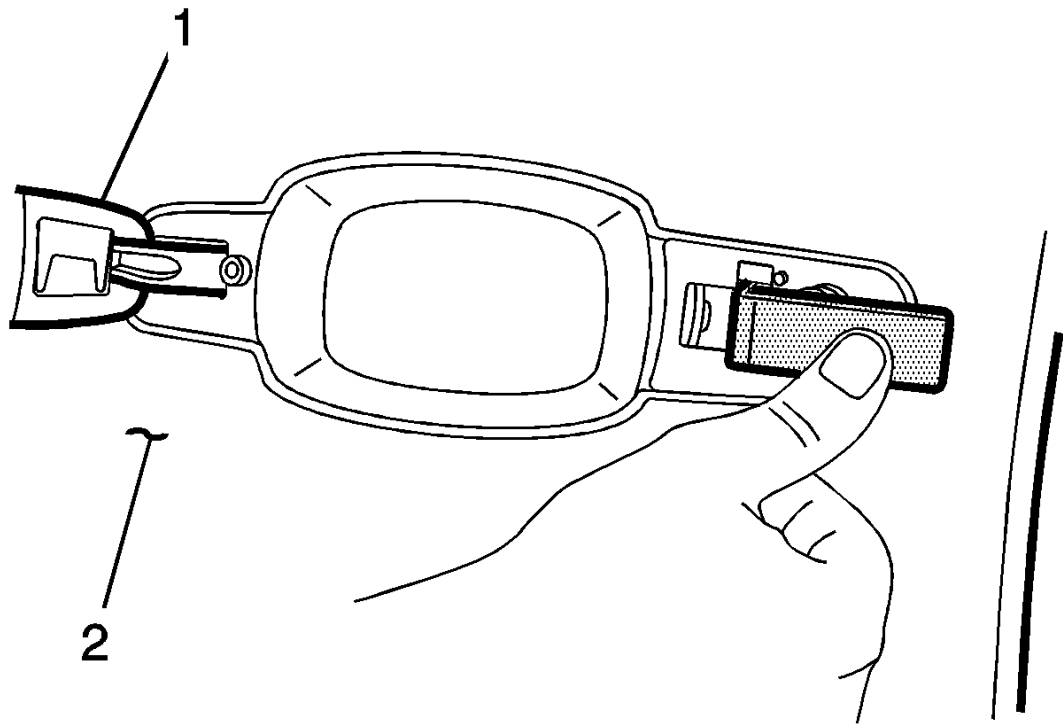


Fig. 24: Front Side Door Outside Handle At 90 Degrees

Courtesy of GENERAL MOTORS COMPANY

10. Pull front side door outside handle (1) forward until door handle is approximately at a 90 degree angle to door (2).

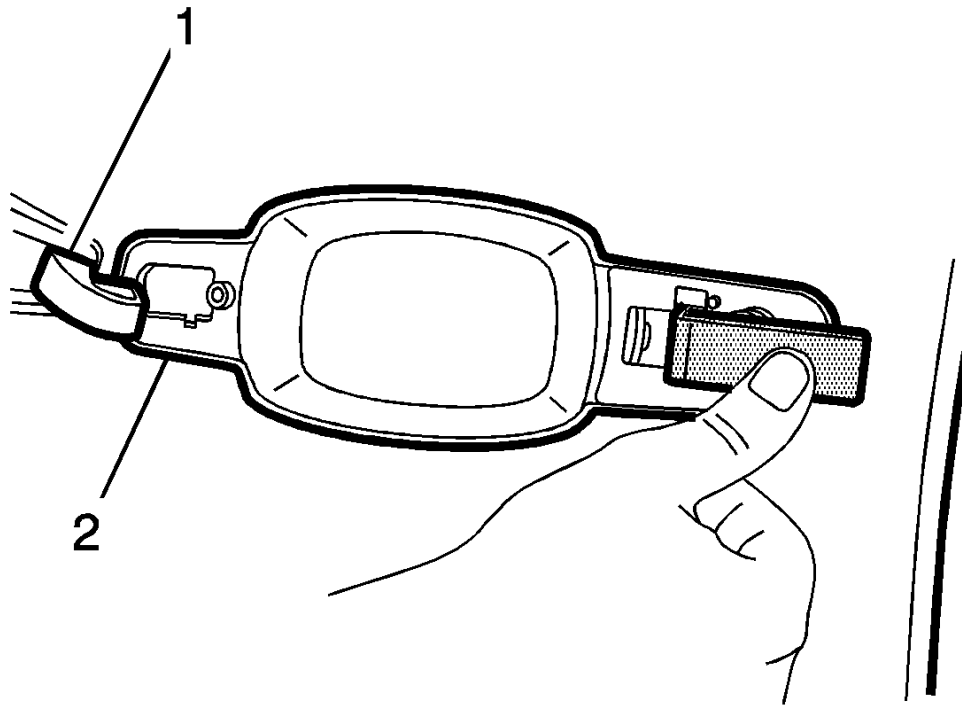


Fig. 25: Removing Front Side Door Outside Handle

Courtesy of GENERAL MOTORS COMPANY

11. Gentle pull front side door outside handle (1) outward and remove from door (2).

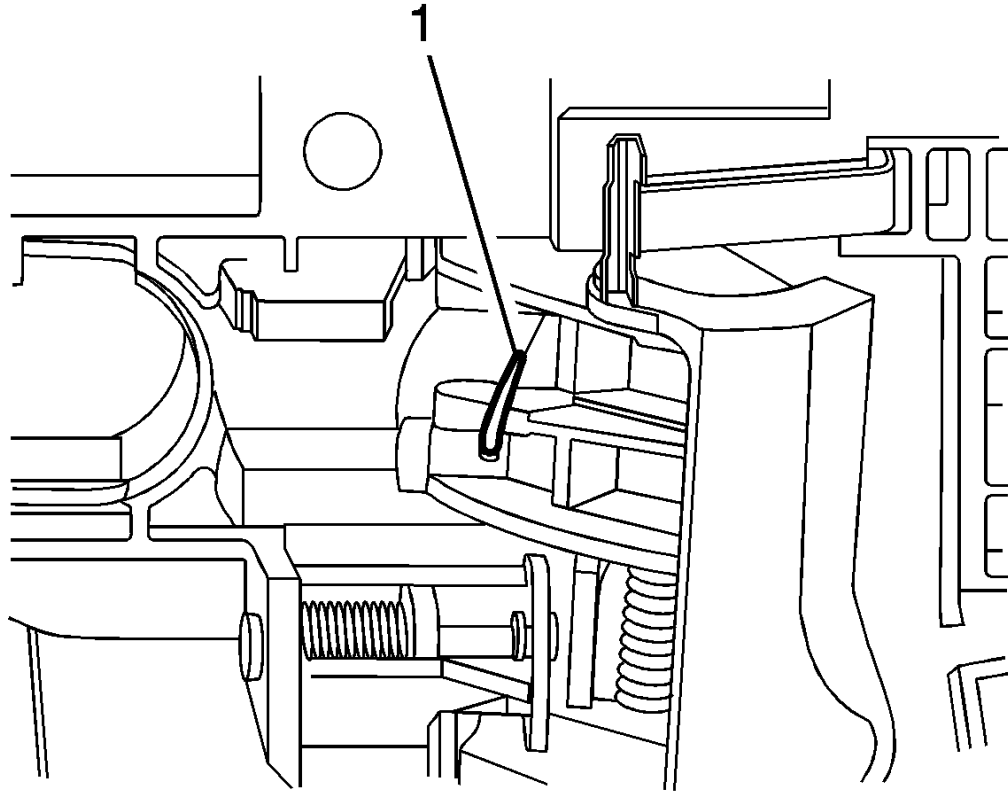


Fig. 26: Hooked Pick Tool And Door Handle Mechanism

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- It is NOT necessary to remove the door panel if the BO-51363 Door Handle Spring Retainer slips off of the door handle mechanism.
- DO NOT hook the outer parts of the door handle mechanism. The hooked pick tool or equivalent tool could slip off and damage the front door.

12. If **BO-51363** Door Handle Spring Retainer slips off of door handle mechanism during repair, use a hooked pick tool (1) or equivalent to access the handle mechanism.

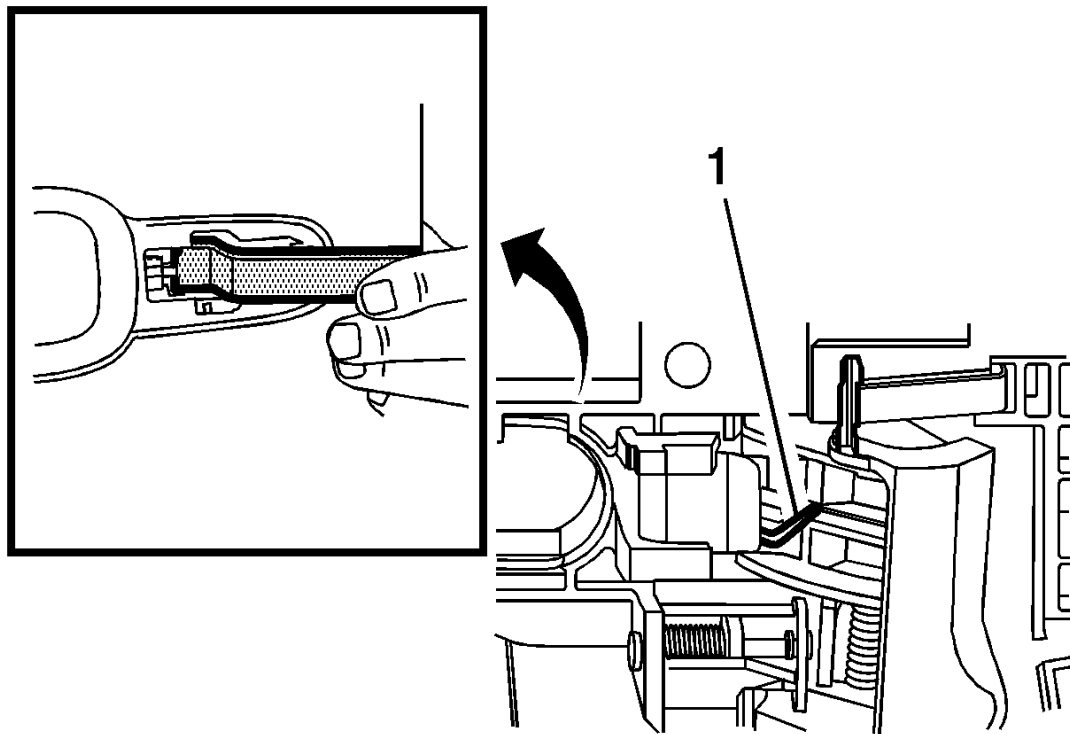


Fig. 27: Door Handle Spring Retainer And Hooked Pick Tool

Courtesy of GENERAL MOTORS COMPANY

13. Pull door handle mechanism outward to the open position and reinstall **BO-51363** Door Handle Spring Retainer into door handle mechanism. The hooked pick tool (1) or equivalent tool can then be removed.

Installation Procedure

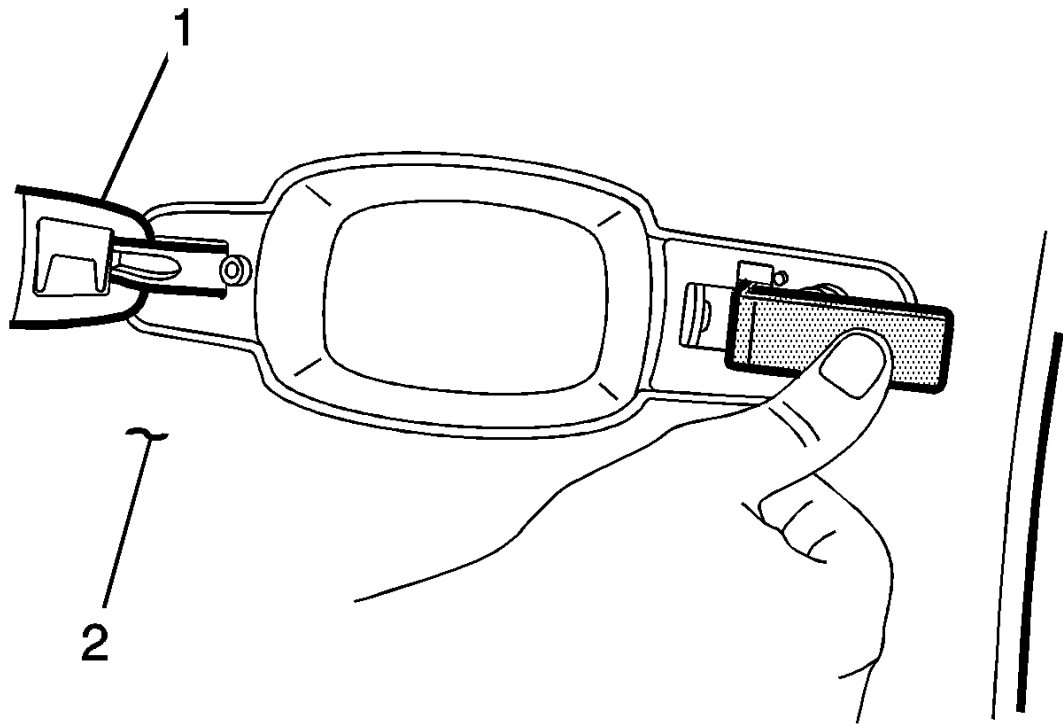


Fig. 28: Front Side Door Outside Handle At 90 Degrees

Courtesy of GENERAL MOTORS COMPANY

1. While holding **BO-51363** Door Handle Spring Retainer in place, install front side door outside handle (1) into door (2) at approximately a 90 degree angle to door.

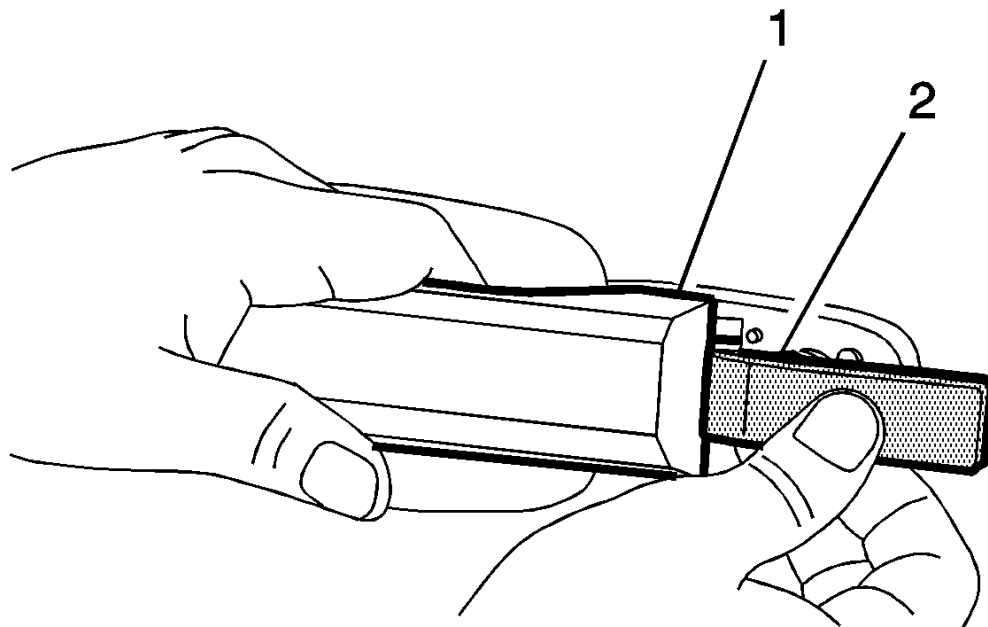


Fig. 29: Front Side Door Outside Handle & Mechanism

Courtesy of GENERAL MOTORS COMPANY

2. Rotate front side door outside handle (1) rearward into front side door handle mechanism (2).

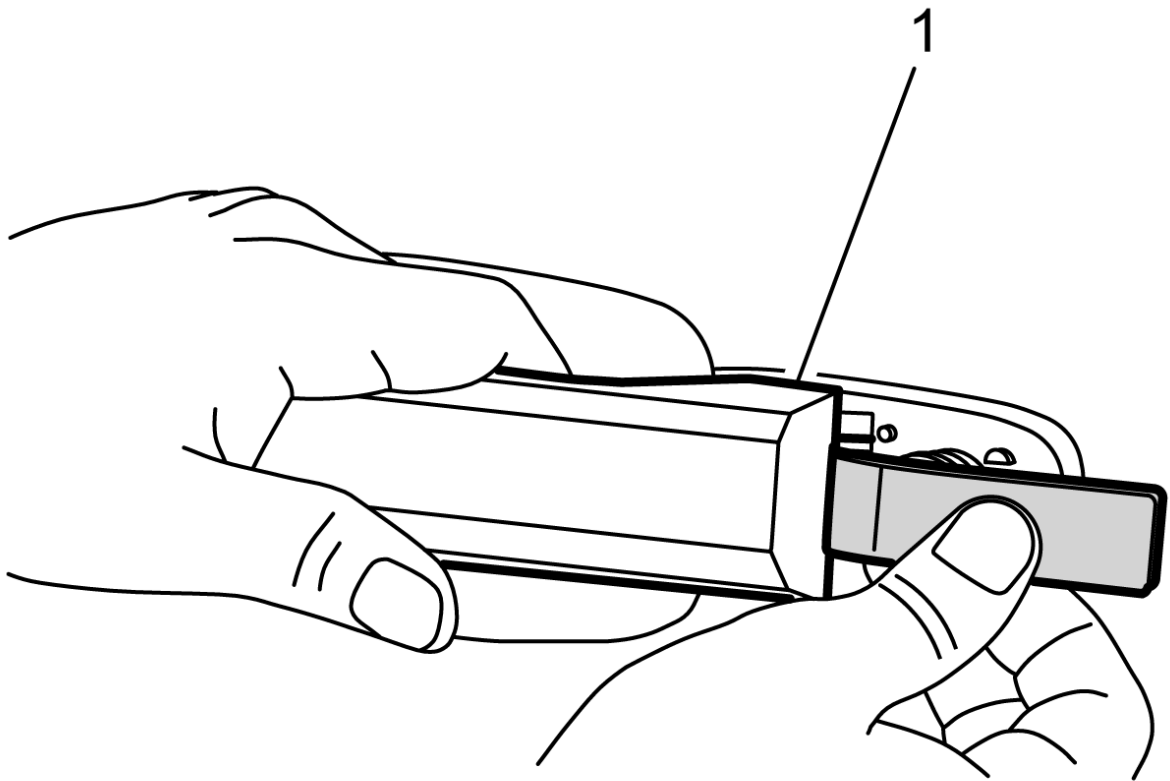


Fig. 30: Front Side Door Outside Handle

Courtesy of GENERAL MOTORS COMPANY

3. Slide front side door outside handle (1) forward to lock into position.

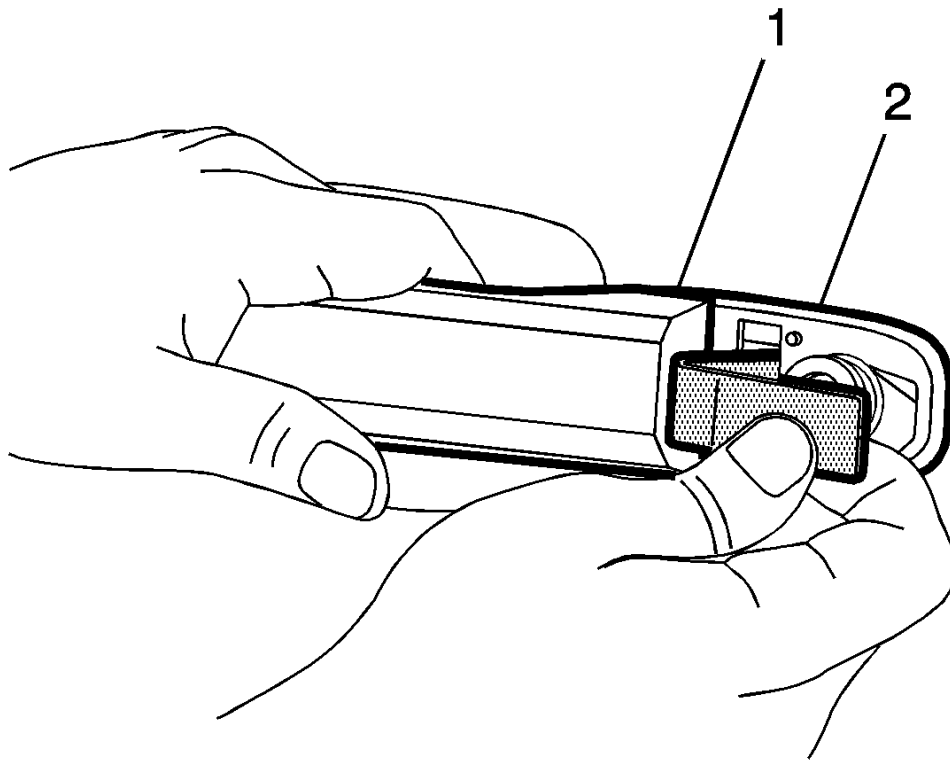


Fig. 31: Front Side Door Outside Handle & Spring Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Release pressure on **BO-51363** Door Handle Spring Retainer. Pull front side door outside handle (1) outward and remove **BO-51363** Door Handle Spring Retainer from door (2).
5. Tighten the screw for the front side door lock cylinder opening cover. Refer to [**Front Side Door Lock Cylinder Opening Cover Replacement**](#).
6. Connect the electrical connector at the door handle for the pass key entry (ATH).
7. Install the door water deflector.
8. Install the front side door armrest bracket. Refer to [**Front Side Door Armrest Bracket Replacement**](#).
9. Ensure that the door lock system operates properly.

FRONT SIDE DOOR OUTSIDE HANDLE BRACKET REPLACEMENT (DRIVER SIDE)

Removal Procedure

1. Remove Front Side Door Window Channel Retainer. Refer to [**Front Side Door Window Channel Retainer Replacement**](#)
2. Remove Front Side Door Lock Cylinder Opening Cover. Refer to [**Front Side Door Lock Cylinder**](#)

Opening Cover Replacement

3. Remove Front Side Door Outside Handle. Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)

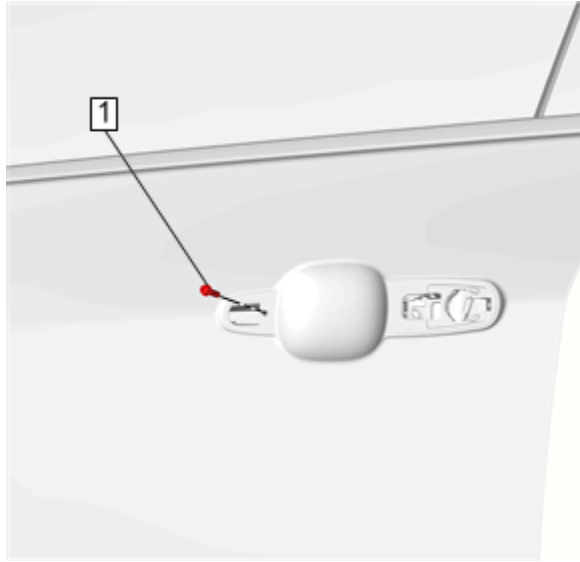


Fig. 32: Front Side Door Outside Handle Bracket Screw
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front side door outside handle bracket screw (1)

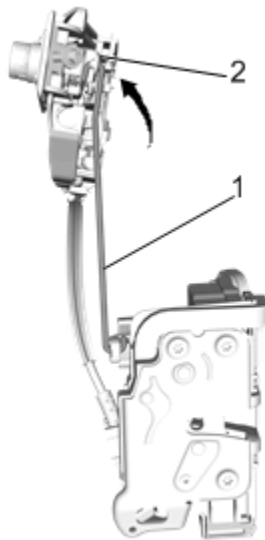


Fig. 33: Front Side Door Lock Rod And Front Side Door Lock Cylinder
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Side Door Lock Rod (1) @ Front Side Door Lock Cylinder (2)

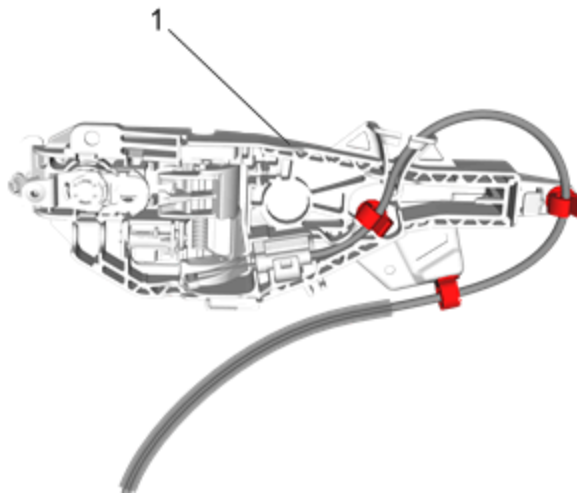


Fig. 34: Side Door Outside Handle Bracket
 Courtesy of GENERAL MOTORS COMPANY

6. Lower down the front side door outside handle bracket (1) to the inside door opening.

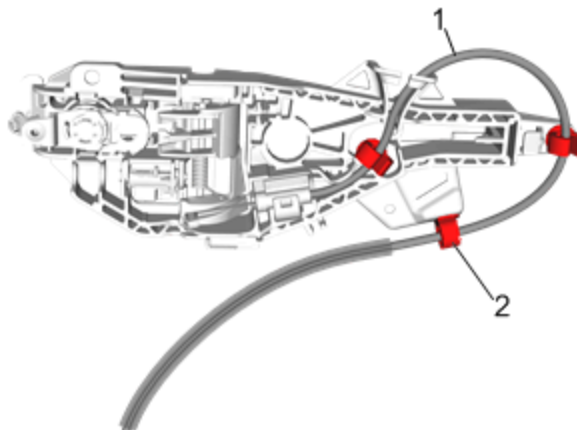


Fig. 35: Side Door Outside Cable And Retainers
 Courtesy of GENERAL MOTORS COMPANY

7. Remove Front side door outside cable (1) @ retainers (2)

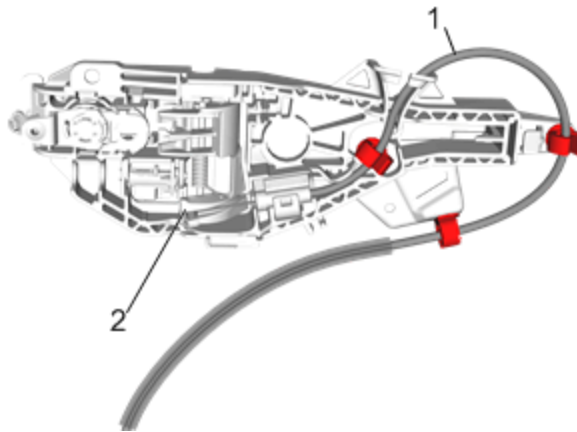


Fig. 36: Side Door Outside Handle Bracket Cable And Counter Balance
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Front side door outside handle bracket cable (1) @ counter balance (2)

Installation Procedure

1. Transfer the lock cylinder.

NOTE: It may be necessary to transfer the wire harness retainers from the old handle bracket.

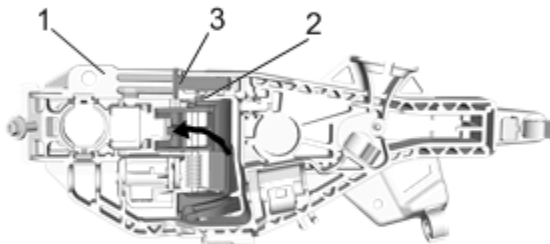


Fig. 37: Side Door Outside Handle Bracket, Counter Balance And Bracket Clip
 Courtesy of GENERAL MOTORS COMPANY

2. Reset the front side door outside handle bracket counter balance as follows:
 1. The outside door handle Can Not be install until the counter balance is reset.
 2. Grasp the front side door outside handle bracket (1) with one hand.

3. From the back side of the counter balance (2) push forward on the counter balance until it can be held in place using the bracket clip (3).

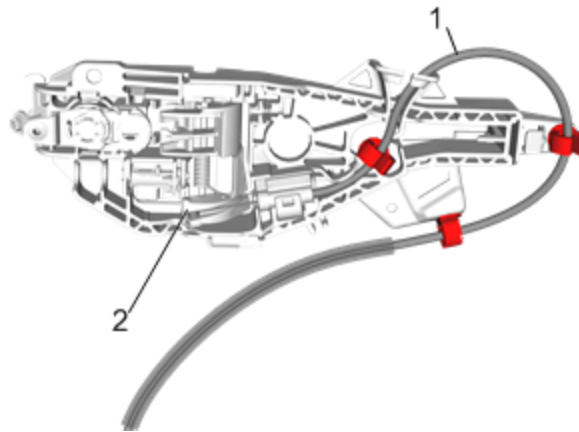


Fig. 38: Side Door Outside Handle Bracket Cable And Counter Balance
Courtesy of GENERAL MOTORS COMPANY

3. Install Front side door outside handle bracket cable (1) @ counter balance (2)

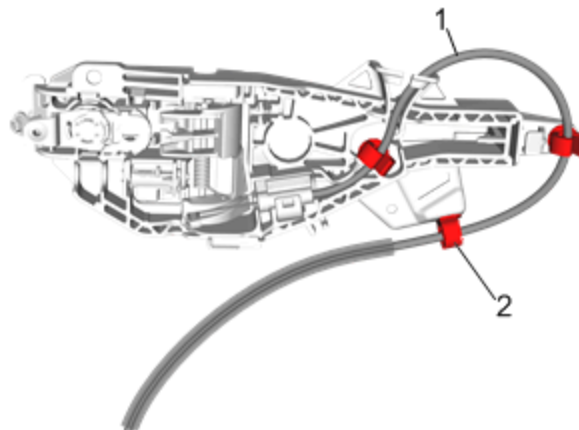


Fig. 39: Side Door Outside Cable And Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Install Front side door outside cable (1) @ retainers (2)

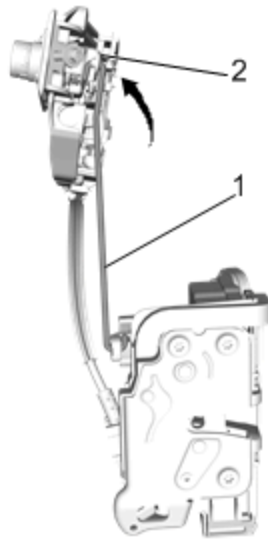


Fig. 40: Front Side Door Lock Rod And Front Side Door Lock Cylinder
 Courtesy of GENERAL MOTORS COMPANY

5. Install Front Side Door Lock Rod (1) @ Front Side Door Lock Cylinder (2)

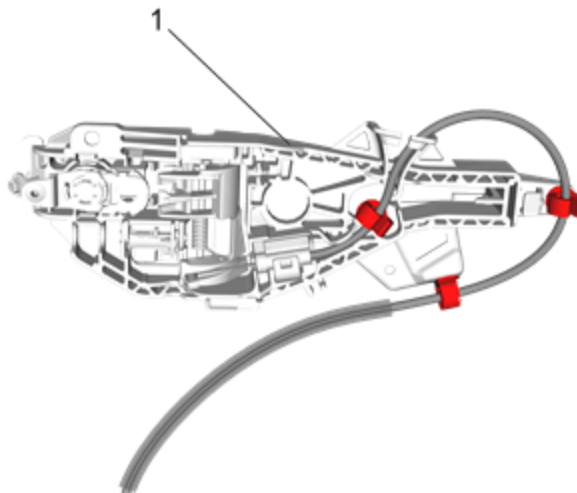


Fig. 41: Side Door Outside Handle Bracket
 Courtesy of GENERAL MOTORS COMPANY

6. Raise the front side door outside handle bracket (1) up to the outside door opening.

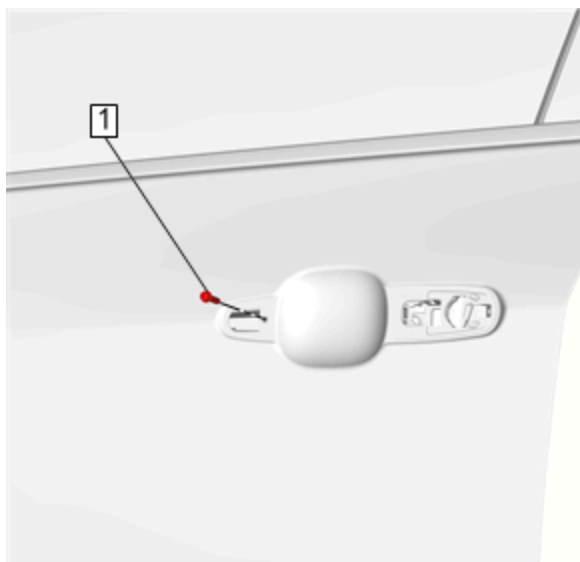


Fig. 42: Front Side Door Outside Handle Bracket Screw

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

7. Install and tighten Front side door outside handle bracket screw (1) to 5 N.m (44 lb in)

NOTE:

- Ensure that the counter balance is reset and locked in the detent of the handle bracket. The counter balance Can Not be reset after the handle bracket has been reinstalled in the door.
- Bracket should be slid full rearward prior to tightening bracket screw.

8.

9. Install Front Side Door Lock Cylinder Opening Cover. Refer to [Front Side Door Lock Cylinder Opening Cover Replacement](#)

10. Install Front Side Door Outside Handle. Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)

11. Install Front Side Door Window Channel Retainer. Refer to [Front Side Door Window Channel Retainer Replacement](#)

12. Ensure the door system operates properly.

FRONT SIDE DOOR OUTSIDE HANDLE BRACKET REPLACEMENT (PASSENGER SIDE)

Removal Procedure

1. Remove Front Side Door Window Channel Retainer. Refer to [Front Side Door Window Channel Retainer Replacement](#)

2. Remove Front Side Door Lock Cylinder Opening Cover. Refer to [Front Side Door Lock Cylinder Opening Cover Replacement](#)

3. Remove Front Side Door Outside Handle. Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)

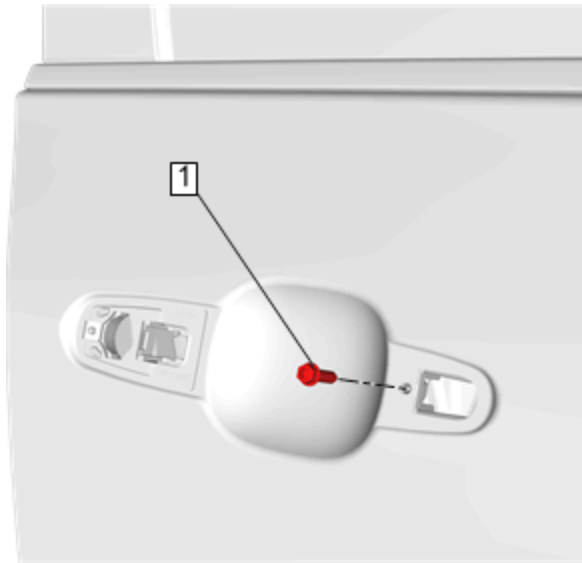


Fig. 43: Side Door Outside Handle Bracket Screw
 Courtesy of GENERAL MOTORS COMPANY

4. Remove Front side door outside handle bracket screw (1)

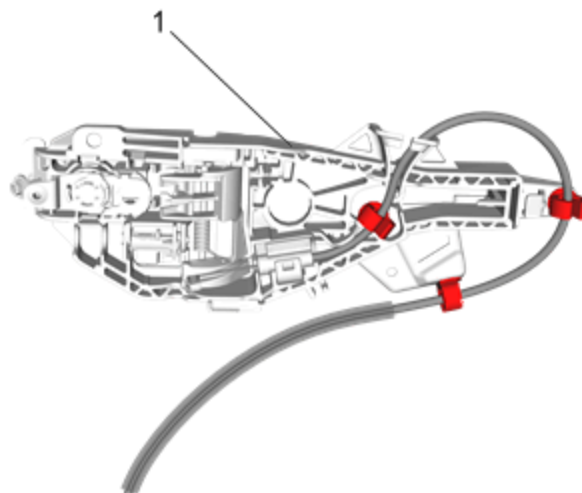


Fig. 44: Side Door Outside Handle Bracket
 Courtesy of GENERAL MOTORS COMPANY

5. Lower the front side door outside handle bracket (1) to the inside door opening.

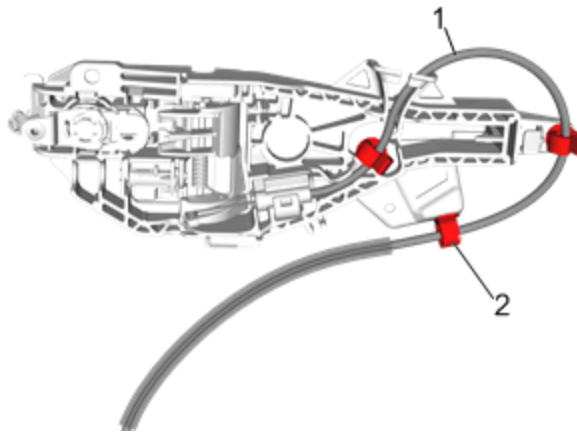


Fig. 45: Side Door Outside Cable And Retainers

Courtesy of GENERAL MOTORS COMPANY

6. Remove Front side door outside cable (1) @ retainers (2)

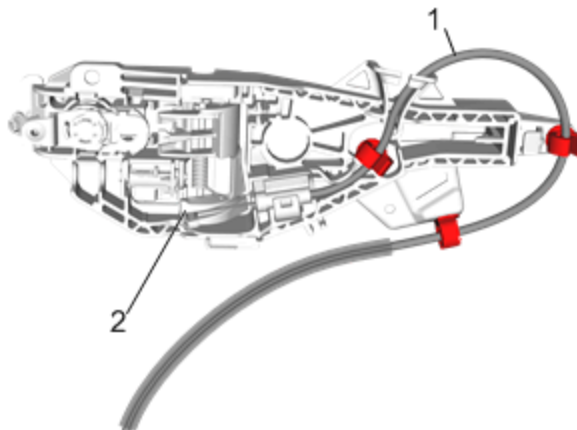


Fig. 46: Side Door Outside Handle Bracket Cable And Counter Balance

Courtesy of GENERAL MOTORS COMPANY

7. Remove Front side door outside handle bracket cable (1) @ counter balance (2)

Installation Procedure

NOTE: It may be necessary to transfer the wire harness retainers from the old handle bracket.

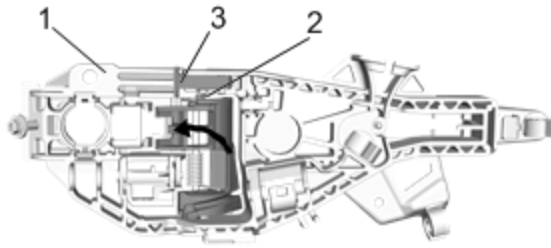


Fig. 47: Side Door Outside Handle Bracket, Counter Balance And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

1. Reset the front side door outside handle bracket counter balance as follows:
 1. The outside door handle Can Not be install until the counter balance is reset.
 2. Grasp the front side door outside handle bracket (1) with one hand.
 3. From the back side of the counter balance (2) push forward on the counter balance until it can be held in place using the bracket clip (3).

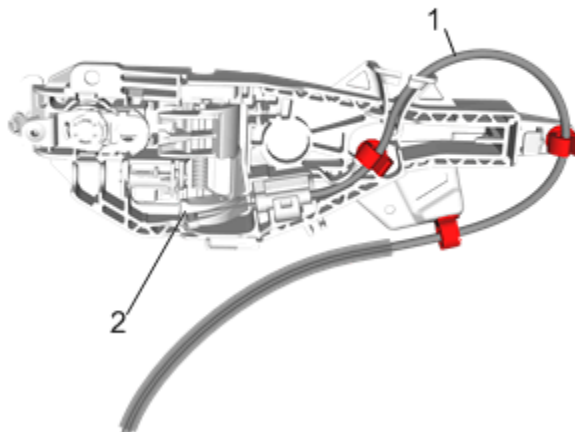


Fig. 48: Side Door Outside Handle Bracket Cable And Counter Balance
Courtesy of GENERAL MOTORS COMPANY

2. Install Front side door outside handle bracket cable (1) @ counter balance (2)

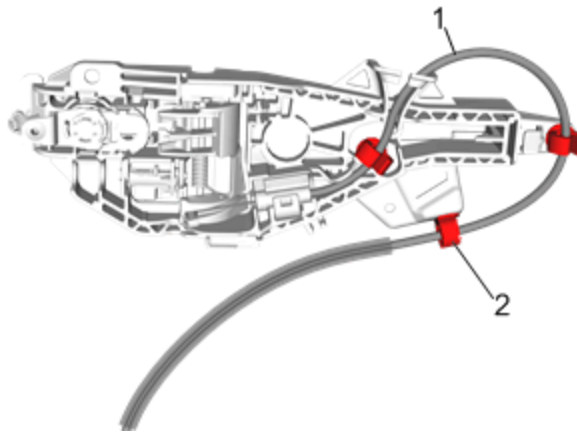


Fig. 49: Side Door Outside Cable And Retainers
 Courtesy of GENERAL MOTORS COMPANY

3. Install Front side door outside cable (1) @ retainers (2)

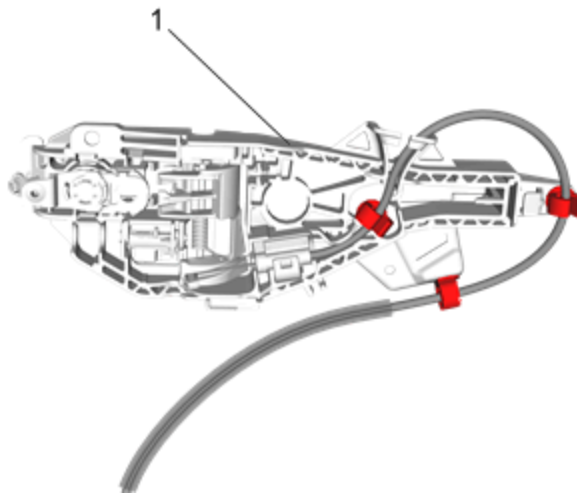


Fig. 50: Side Door Outside Handle Bracket
 Courtesy of GENERAL MOTORS COMPANY

4. Raise the front side door outside handle bracket (1) up to the outside door opening.

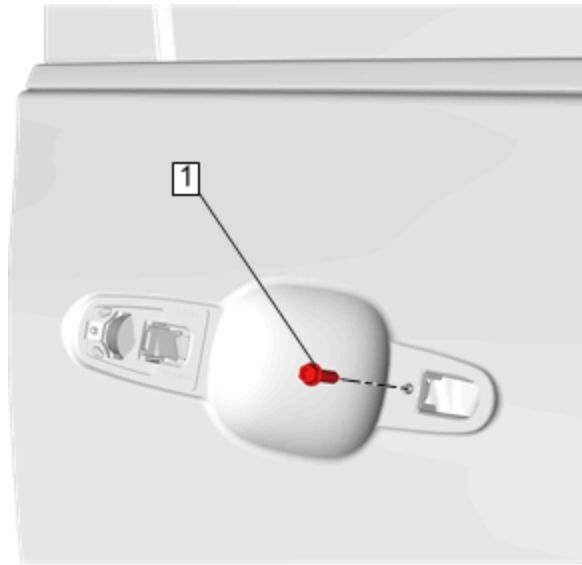


Fig. 51: Side Door Outside Handle Bracket Screw

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

5. Install and tighten Front side door outside handle bracket screw (1) to 5 N.m (44 lb in)

NOTE:

- Ensure that the counter balance is reset and locked in the detent of the handle bracket. The counter balance Can Not be reset after the handle bracket has been reinstalled in the door.
- Bracket should be slid full rearward prior to tightening bracket screw.

6. Install Front Side Door Lock Cylinder Opening Cover. Refer to [Front Side Door Lock Cylinder Opening Cover Replacement](#)

7. Install Front Side Door Outside Handle. Refer to [Front Side Door Outside Handle Replacement \(Base\)](#)[Front Side Door Outside Handle Replacement \(Pass Key Entry ATH\)](#)

8. Install Front Side Door Window Channel Retainer. Refer to [Front Side Door Window Channel Retainer Replacement](#)

9. Ensure the door system operates properly.

FRONT SIDE DOOR OUTSIDE HANDLE CABLE REPLACEMENT

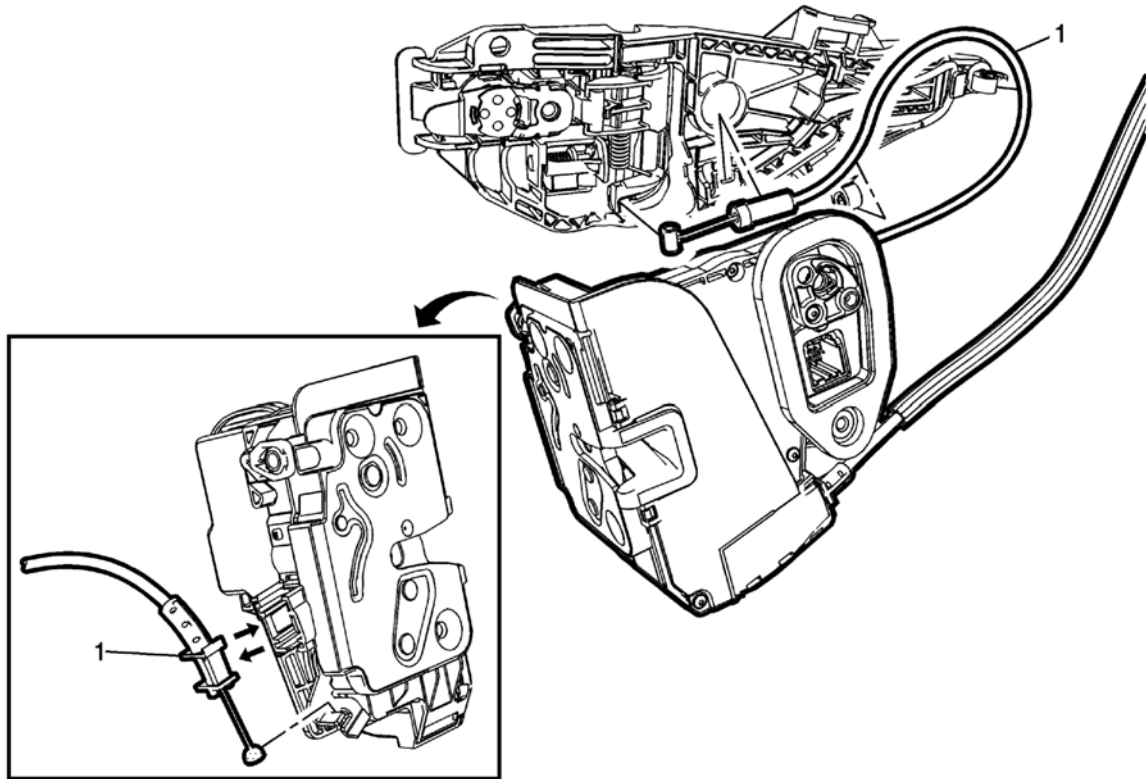


Fig. 52: Side Door Outside Handle Cable

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door latch and handle bracket assembly from the door. Refer to Front Side Door Latch Replacement .	
1	Front Side Door Outside Handle Cable Procedure 1. Remove the front side door outside handle cable from the retainers. 2. Release the cable from the back of the latch assembly. 3. Remove the front side door outside handle cable from the front side door outside handle bracket. NOTE: Ensure that the door lock system operates properly before installing the trim.

REAR SIDE DOOR OUTSIDE HANDLE BRACKET REPLACEMENT

Removal Procedure

1. Remove Rear Side Door Window Channel Rear Retainer. Refer to [Rear Side Door Window Channel Rear Retainer Replacement](#)
2. Remove Rear Side Door Lock Cylinder Opening Cover. Refer to [Rear Side Door Lock Cylinder Opening Cover Replacement](#)
3. Remove Rear Side Door Outside Handle. Refer to [Rear Side Door Outside Handle Replacement](#)

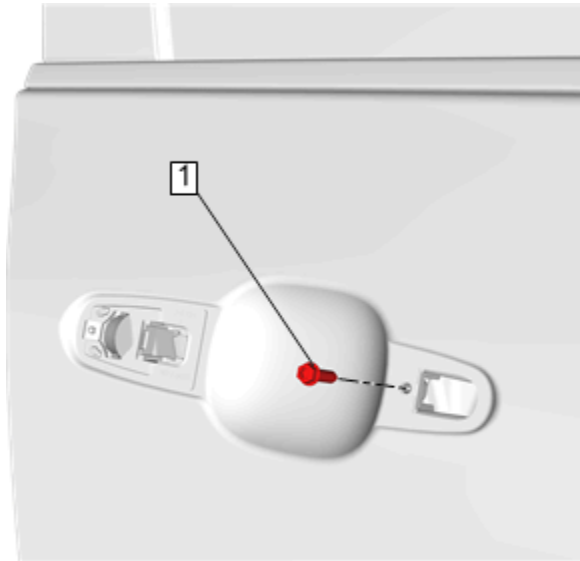


Fig. 53: Side Door Outside Handle Bracket Screw
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear side door outside handle bracket screw (1)

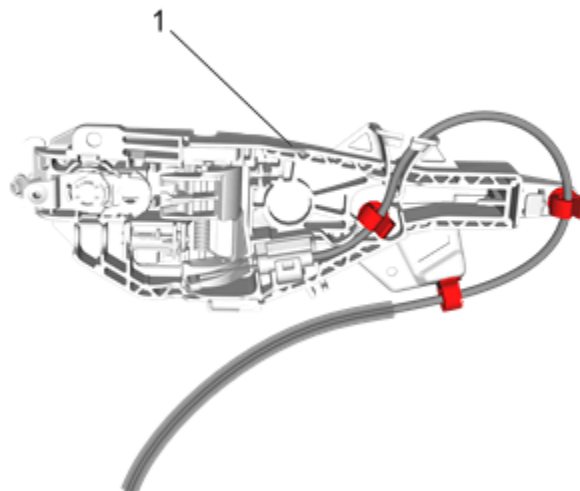


Fig. 54: Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Lower the rear side door outside handle bracket (1) down to the inside door opening.

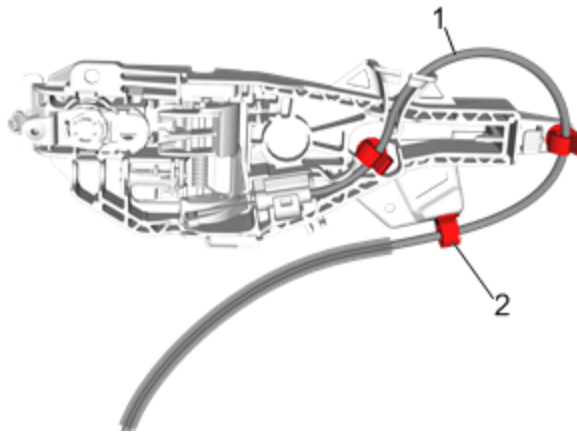


Fig. 55: Side Door Outside Cable And Retainers

Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear side door outside cable (1) @ retainers (2)

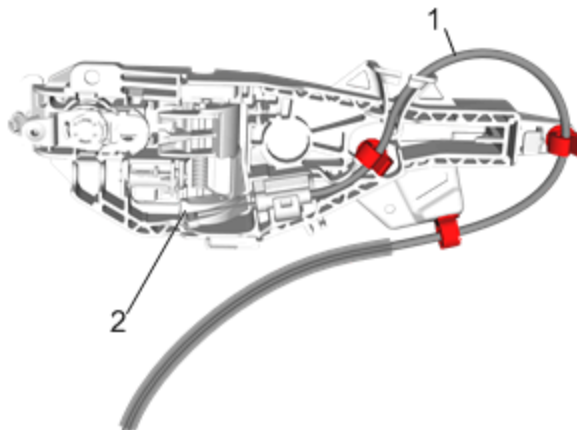


Fig. 56: Side Door Outside Handle Bracket Cable And Counter Balance

Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear side door outside handle bracket cable (1) @ counter balance (2)

Installation Procedure

NOTE: It may be necessary to transfer the wire harness retainers from the old handle bracket.

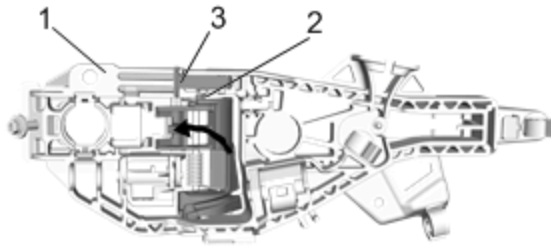


Fig. 57: Side Door Outside Handle Bracket, Counter Balance And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

1. Reset the rear side door outside handle bracket counter balance as follows:
 1. The outside door handle Can Not be install until the counter balance is reset.
 2. Grasp the rear side door outside handle bracket (1) with one hand.
 3. From the back side of the counter balance (2) push forward on the counter balance until it can be held in place using the bracket clip (3).

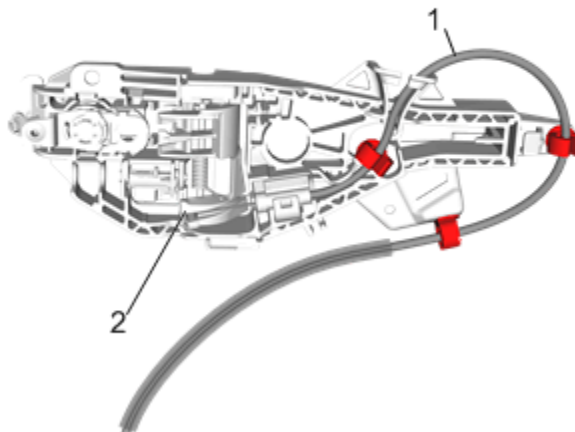


Fig. 58: Side Door Outside Handle Bracket Cable And Counter Balance
Courtesy of GENERAL MOTORS COMPANY

2. Install Rear side door outside handle bracket cable (1) @ counter balance (2)

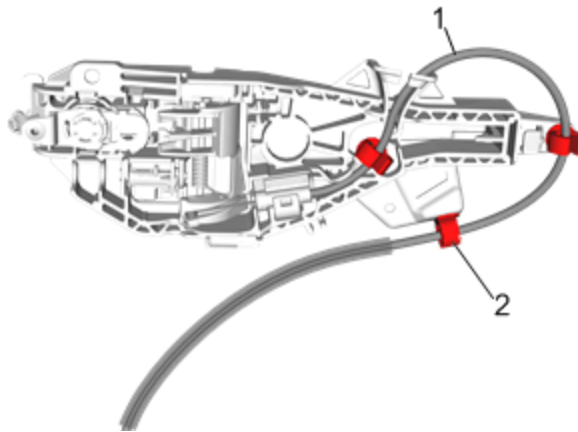


Fig. 59: Side Door Outside Cable And Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install Rear side door outside cable (1) @ retainers (2)

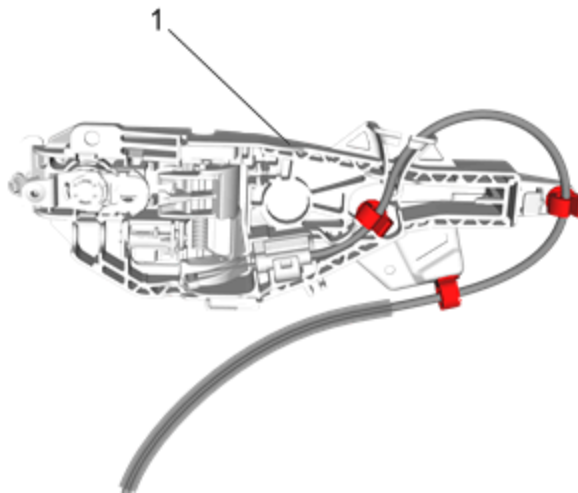


Fig. 60: Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Raise the rear side door outside handle bracket (1) up to the outside door opening.

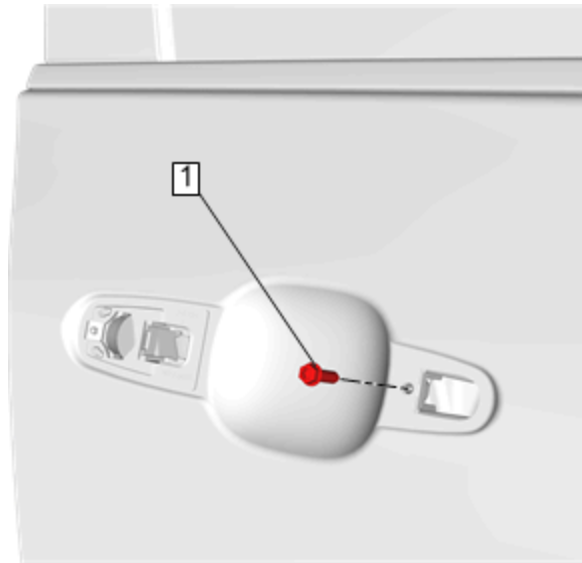


Fig. 61: Side Door Outside Handle Bracket Screw

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

5. Install and tighten Rear side door outside handle bracket screw (1) to 5 N.m (44 lb in)

NOTE:

- Ensure that the counter balance is reset and locked in the detent of the handle bracket. The counter balance Can Not be reset after the handle bracket has been reinstalled in the door.
- Bracket should be slid full rearward prior to tightening bracket screw.

6. Install Rear Side Door Lock Cylinder Opening Cover. Refer to [Rear Side Door Lock Cylinder Opening Cover Replacement](#)
7. Install Rear Side Door Outside Handle. Refer to [Rear Side Door Outside Handle Replacement](#)
8. Install Rear Side Door Window Channel Rear Retainer. Refer to [Rear Side Door Window Channel Rear Retainer Replacement](#)
9. Ensure the door system operates properly.

LIFTGATE OUTSIDE HANDLE REPLACEMENT

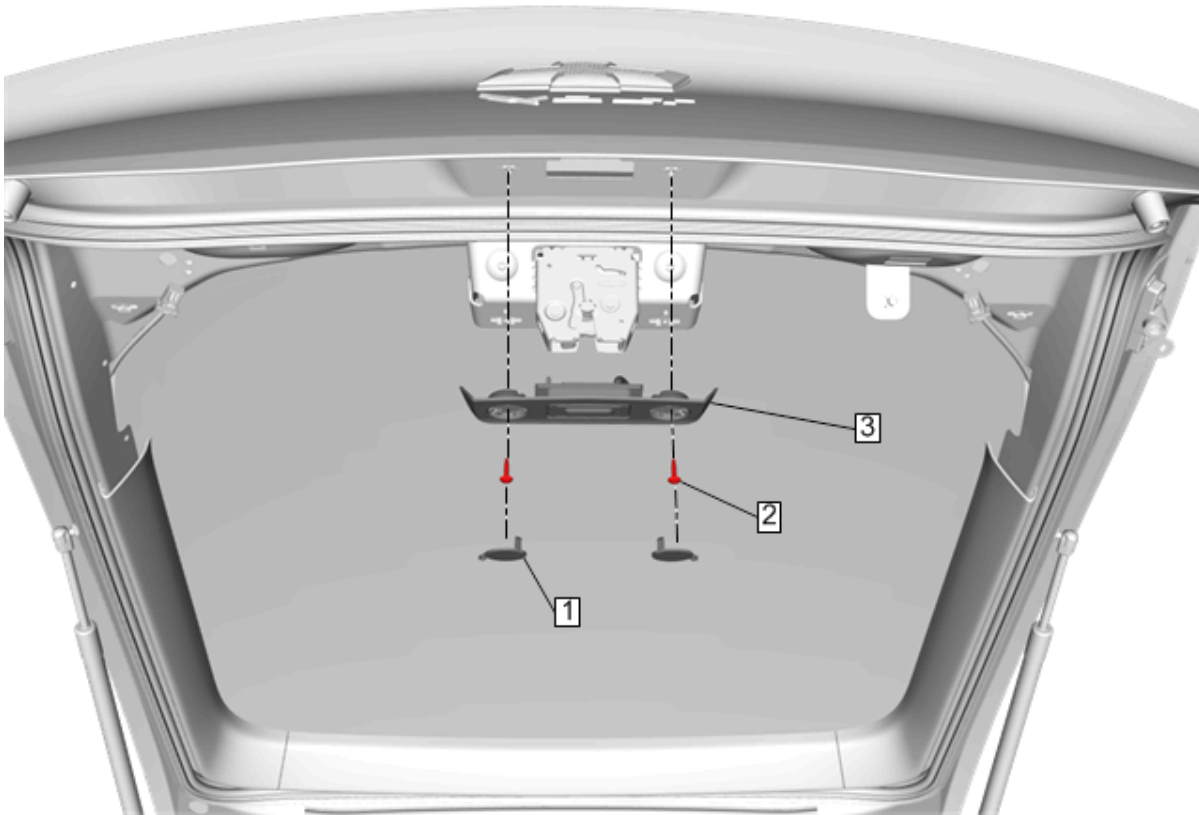


Fig. 62: Liftgate Outside Handle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Liftgate Lower Trim Finish Panel. Refer to Liftgate Lower Trim Finish Panel Replacement .	
1	Liftgate Outside Handle Bolt Cap (Qty: 2)
2	Liftgate Outside Handle Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
3	Liftgate Outside Handle Procedure 1. Release the retainers. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

LIFTGATE LATCH REPLACEMENT

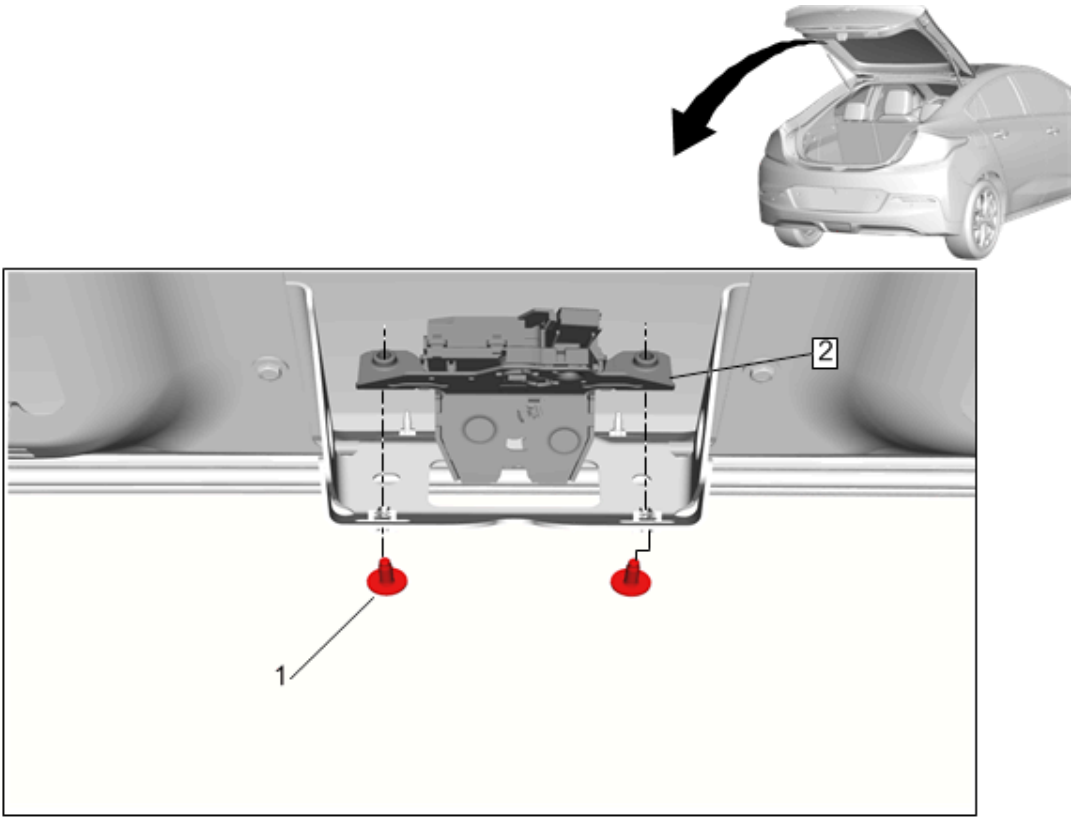


Fig. 63: Liftgate Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Liftgate Lower Trim Finish Panel. Refer to Liftgate Lower Trim Finish Panel Replacement	
1	Liftgate Latch Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Liftgate Latch Procedure Disconnect the electrical connector.

REAR SIDE DOOR OUTSIDE HANDLE REPLACEMENT

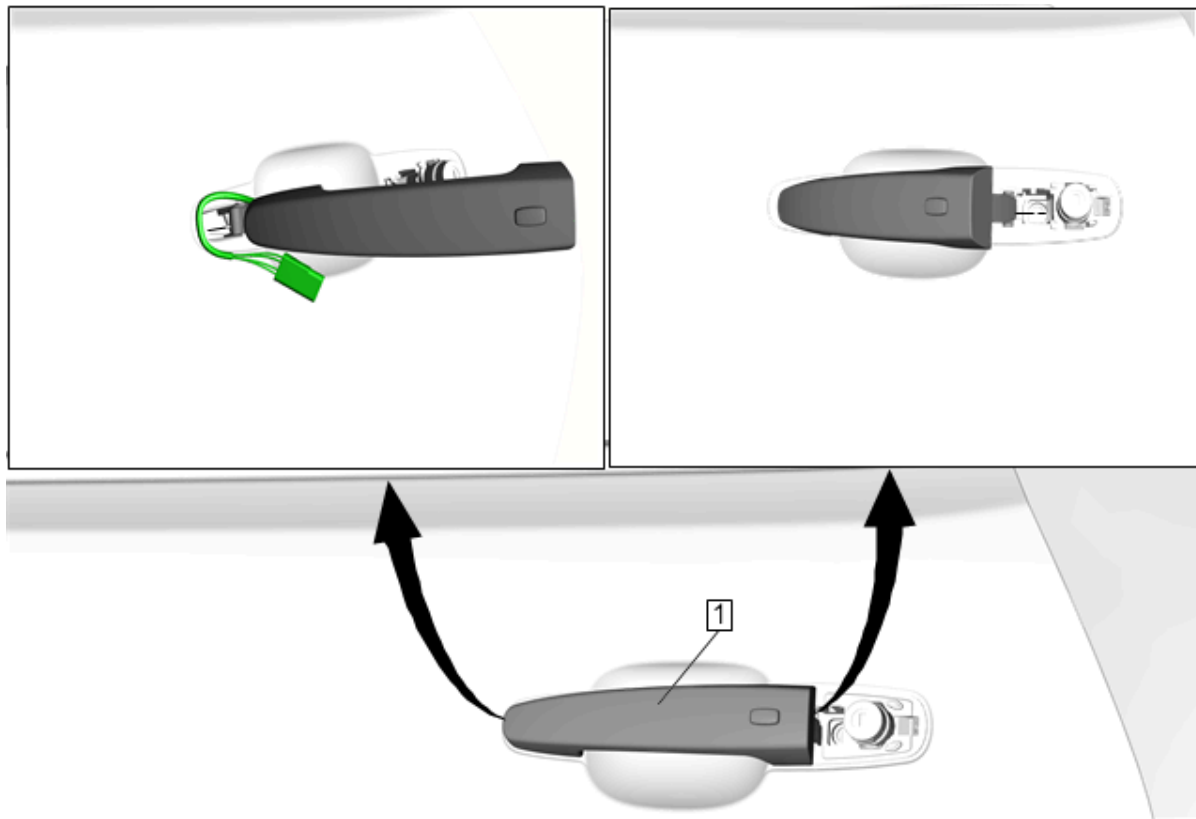


Fig. 64: Rear Side Door Outside Handle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Rear Side Door Lock Cylinder Opening Cover. Refer to Rear Side Door Lock Cylinder Opening Cover Replacement 2. Remove Rear Side Door Trim. Refer to Rear Side Door Trim Replacement 3. Remove the rear side door water deflector. 4. Disconnect the electrical connector.	
1	Rear Side Door Outside Handle 1. Pull the rear side door outside handle outward and hold it in the open position. 2. Slide the rear side door outside handle rearward and then outwards in a swinging motion releasing the handle from the rear side door outside handle bracket. 3. Install the rear side door outside handle into the handle bracket. 4. While screwing in the screw for the lock cylinder opening cover, hold the handle in the open position, this will avoid the door handle from snapping once the spring pressure is relieved and the door handle returns to the close position.

REAR SIDE DOOR OUTSIDE HANDLE CABLE REPLACEMENT

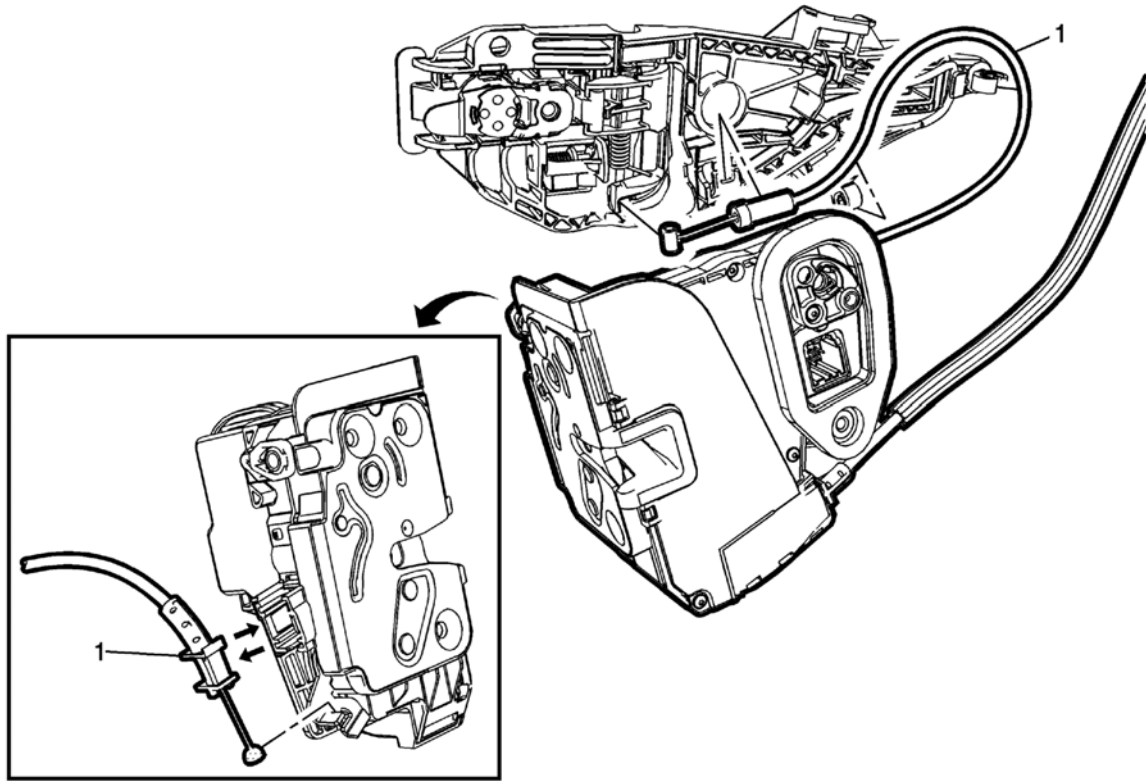


Fig. 65: Rear Side Door Outside Handle Cable
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the rear side door latch and handle bracket assembly from the door. Refer to Rear Side Door Latch Replacement .	
1	Rear Side Door Outside Handle Cable Procedure 1. Remove the rear side door outside handle cable from the retainers. Do not remove the inside door handle cable from the latch. 2. Release the cable from the back of the latch assembly. 3. Unhook the cable from the handle bracket. NOTE: Ensure that the door lock system operates properly before installing the trim.

FRONT SIDE DOOR LATCH REPLACEMENT

Removal Procedure

1. Remove Front Side Door Window Channel Retainer. Refer to [Front Side Door Window Channel Retainer Replacement](#)

NOTE: Disconnect the window from the window regulator, place the window in the full up position, use masking tape to tape the window to the upper door frame.

2. Remove Front Side Door Window Regulator. Refer to [Front Side Door Window Regulator Replacement](#)
3. Remove Front Side Door Outside Handle Bracket. Refer to [Front Side Door Outside Handle Bracket Replacement \(Driver Side\)](#)[Front Side Door Outside Handle Bracket Replacement \(Passenger Side\)](#)
4. Remove Front Side Door Locking Rod Knob. Refer to [Front Side Door Locking Rod Knob Replacement](#)
5. Disconnect the electrical connector.

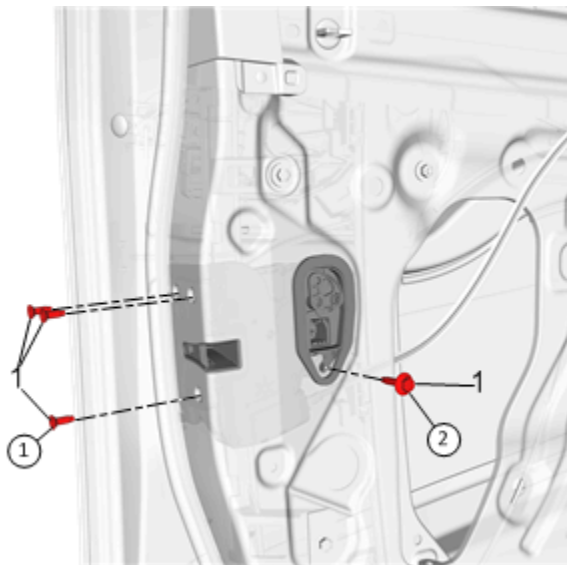


Fig. 66: Four Fasteners

Courtesy of GENERAL MOTORS COMPANY

6. Remove Four bolts (1) @ the Front Side Door Latch

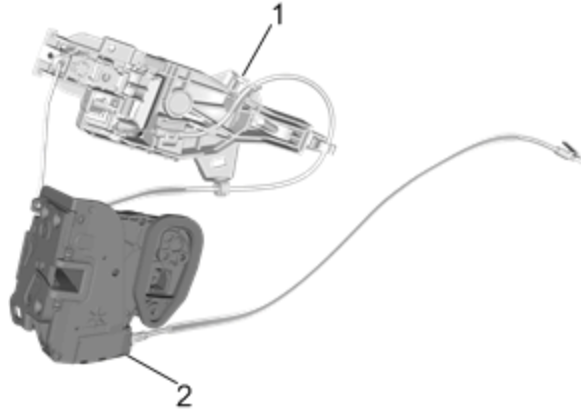


Fig. 67: Front Door Outside Handle Bracket And Front Side Door Latch
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Door Outside Handle Bracket (1) @ the Front Side Door Latch (2)
8. Remove Front Side Door Outside Handle Cable. Refer to [Front Side Door Outside Handle Cable Replacement](#)
9. Remove Front Side Door Inside Handle Cable. Refer to [Front Side Door Inside Handle Cable Replacement](#)

Installation Procedure

1. Install Front Side Door Inside Handle Cable. Refer to [Front Side Door Inside Handle Cable Replacement](#)
2. Install Front Side Door Outside Handle Cable. Refer to [Front Side Door Outside Handle Cable Replacement](#)
3. Transfer components as necessary.

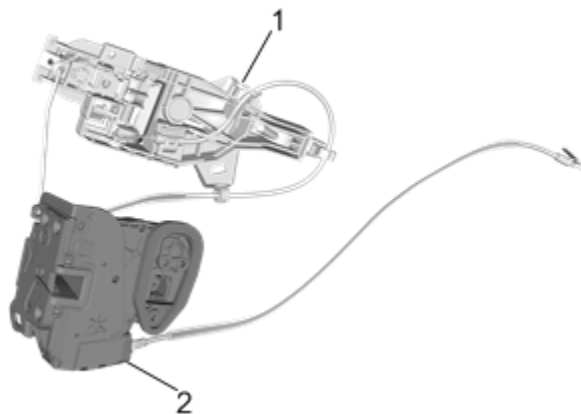


Fig. 68: Front Door Outside Handle Bracket And Front Side Door Latch

Courtesy of GENERAL MOTORS COMPANY

4. Install Front Door Outside Handle Bracket (1) @ the Front Side Door Latch (2)

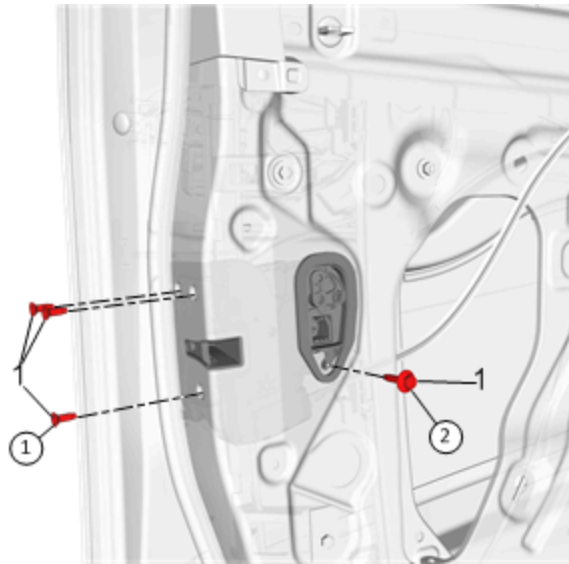


Fig. 69: Four Fasteners

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

NOTE: Install and torque the four latch bolts in proper sequence to prevent damage to the latch mechanism.

5. Install and tighten Four bolts (1) @ the Front Side Door Latch to 11 N.m (97 lb in)
6. Install Front Side Door Locking Rod Knob. Refer to [Front Side Door Locking Rod Knob Replacement](#)
7. Install Front Side Door Outside Handle Bracket. Refer to [Front Side Door Outside Handle Bracket Replacement \(Driver Side\)](#)[Front Side Door Outside Handle Bracket Replacement \(Passenger Side\)](#)
8. Install Front Side Door Window Regulator. Refer to [Front Side Door Window Regulator Replacement](#)
9. Install Front Side Door Window Channel Retainer. Refer to [Front Side Door Window Channel Retainer Replacement](#)
10. Connect the electrical connector.
11. Inspect the door latch and outside handle for proper operation before installing the door trim.
12. Remove the tape from the front side door window and frame.

REAR SIDE DOOR LATCH REPLACEMENT

Removal Procedure

1. Remove Rear Side Door Window Channel Rear Retainer. Refer to [Rear Side Door Window Channel Rear Retainer Replacement](#)

NOTE: Disconnect the window from the window regulator, place the window in the full up position, use masking tape to tape the window to the upper

door frame.

2. Remove Rear Side Door Window Regulator. Refer to [Rear Side Door Window Regulator Replacement](#)
3. Remove Rear Side Door Outside Handle Bracket. Refer to [Rear Side Door Outside Handle Bracket Replacement](#)
4. Remove Rear Side Door Locking Rod Knob. Refer to [Rear Side Door Locking Rod Knob Replacement](#)
5. Disconnect the electrical connector.

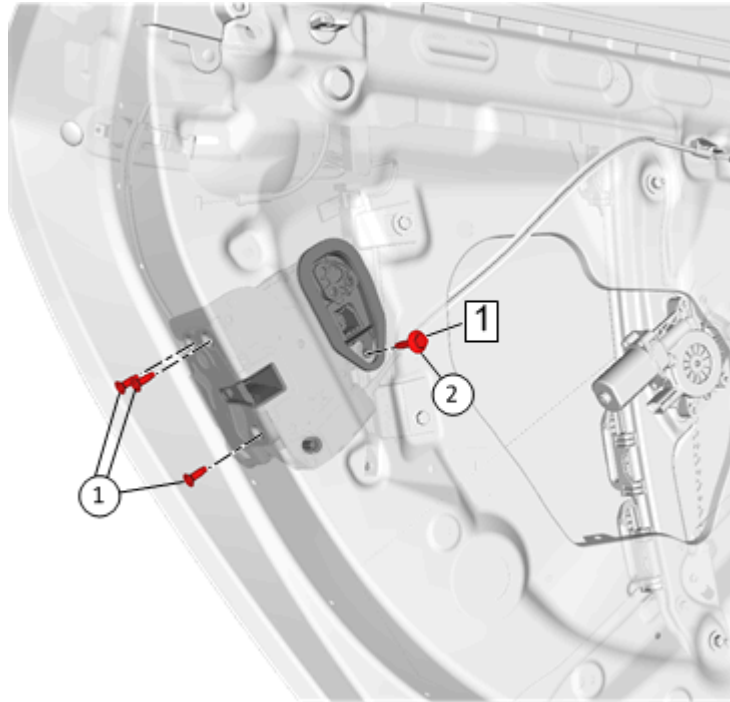


Fig. 70: Rear Side Door Latch Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Side Door Latch Bolts (1) (Qty: 4)

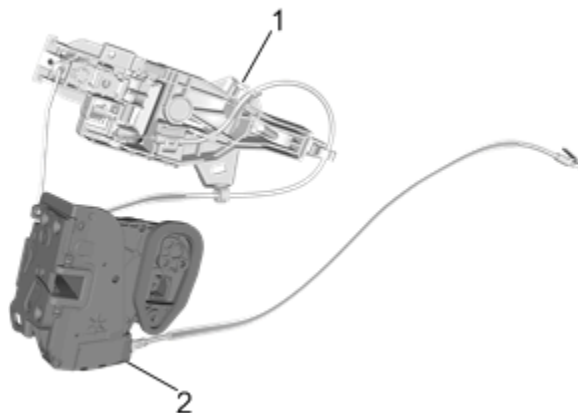


Fig. 71: Rear Door Outside Handle Bracket And Rear Side Door Latch

Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear Door Outside Handle (1) @ the Rear Side Door Latch (2)
8. Remove Rear Side Door Outside Handle Cable. Refer to [Rear Side Door Outside Handle Cable Replacement](#)
9. Remove Rear Side Door Inside Handle Cable. Refer to [Rear Side Door Inside Handle Cable Replacement](#)

Installation Procedure

1. Install Rear Side Door Inside Handle Cable. Refer to [Rear Side Door Inside Handle Cable Replacement](#)
2. Install Rear Side Door Outside Handle Cable. Refer to [Rear Side Door Outside Handle Cable Replacement](#)
3. Transfer components as necessary.

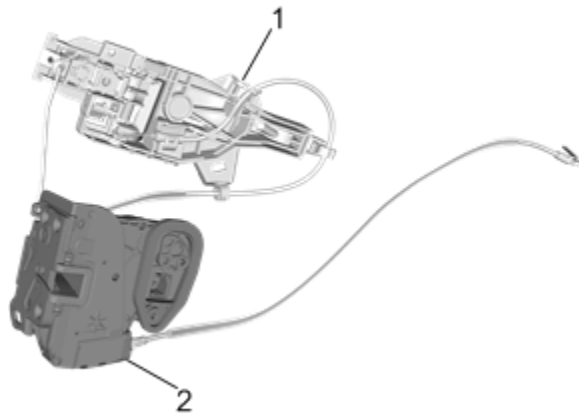


Fig. 72: Rear Side Door Outside Handle Bracket And Rear Side Door Latch

Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Side Door Outside Handle Bracket (1) @ the Rear Side Door Latch (2)

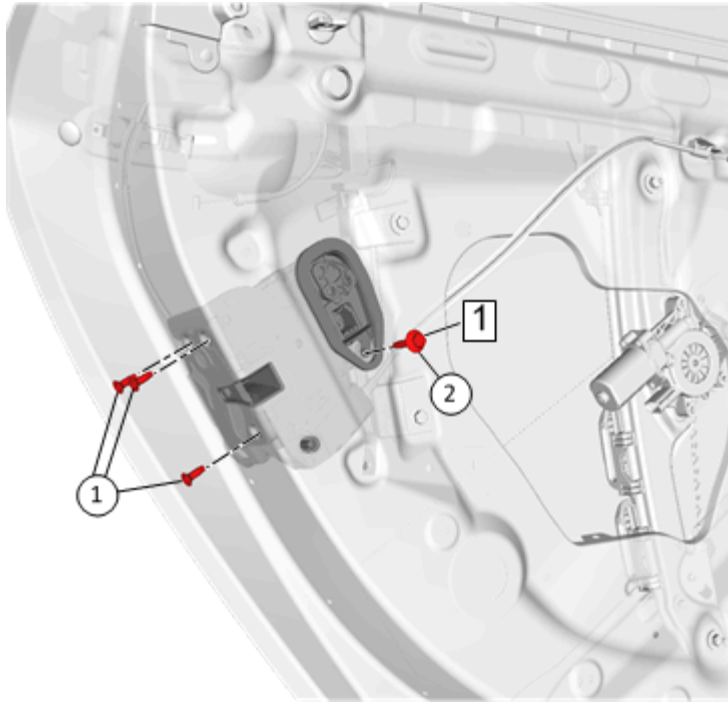


Fig. 73: Rear Side Door Latch Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

NOTE: Install and torque the four latch bolts in proper sequence to prevent damage to the latch mechanism.

5. Install and tighten Rear Side Door Latch Bolts (1) (Qty: 4) to 11 N.m (97 lb in)
6. Install Rear Side Door Locking Rod Knob. Refer to [Rear Side Door Locking Rod Knob Replacement](#)
7. Install Rear Side Door Outside Handle Bracket. Refer to [Rear Side Door Outside Handle Bracket Replacement](#)
8. Install Rear Side Door Window Regulator. Refer to [Rear Side Door Window Regulator Replacement](#)
9. Install Rear Side Door Window Channel Rear Retainer. Refer to [Rear Side Door Window Channel Rear Retainer Replacement](#)
10. Connect the electrical connector.
11. Inspect the door latch and outside handle for proper operation before installing the door trim.
12. Remove the tape from the rear side door window and frame.

FRONT SIDE DOOR LOCK CYLINDER OPENING COVER REPLACEMENT

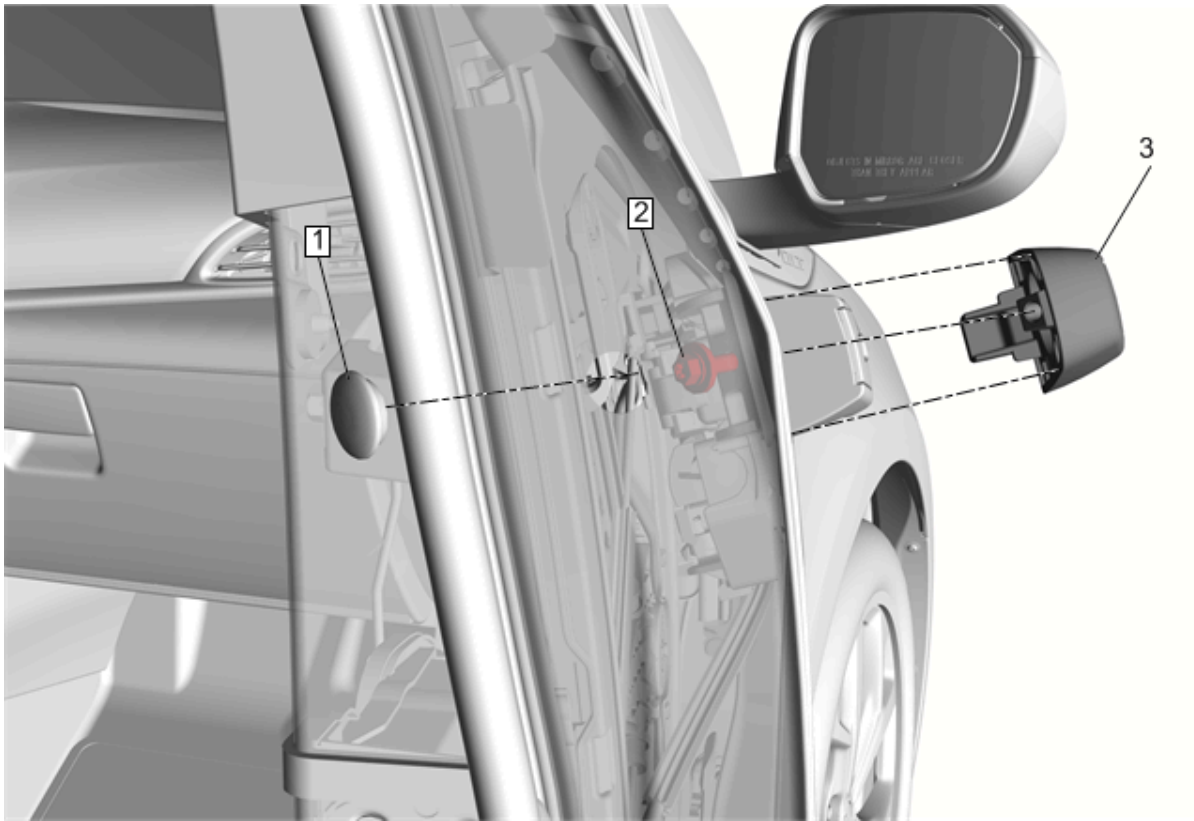


Fig. 74: Passenger Side Door Lock Cylinder Opening Cover (Front)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Passenger Side Door Inner Panel Hole Plug Procedure Using the appropriate tool, remove the cap that conceals the screw from the inside of the door opening.
2	Passenger Side Door Lock Cylinder Opening Cover Screw CAUTION: Refer to Fastener Caution . NOTE: USE HAND TOOL ONLY. Using a battery operated gun or power tool can BREAK the component.

Callout	Component Name
	Turn screw out until lock cylinder cover can be removed. DO NOT go passed the hard stop. Tighten 4.7 N.m (42 lb in)
3	Passenger Side Door Lock Cylinder Opening Cover Procedure 1. Pull the passenger side door outside handle outward to release the door lock cylinder opening cover. 2. Pull the lock cylinder opening cover from the door.

REAR SIDE DOOR LOCK CYLINDER OPENING COVER REPLACEMENT

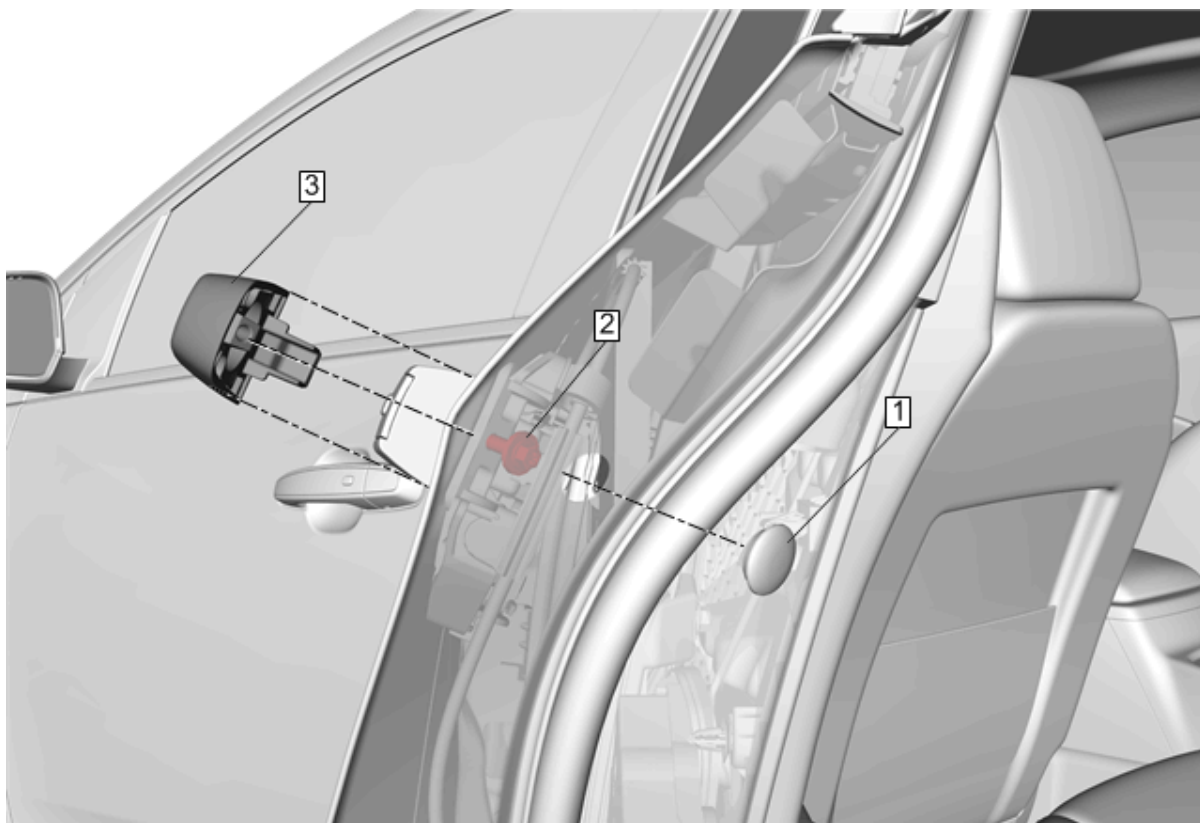


Fig. 75: Rear Side Door Lock Cylinder Opening Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Inner Panel Hole Plug Procedure Using the appropriate tool, remove the cap that conceals the screw from the inside of the door opening.
2	Rear Side Door Lock Cylinder Opening Cover Screw CAUTION: Refer to Fastener Caution . NOTE: USE HAND TOOL ONLY. Using a battery operated gun or power tool can BREAK the component. Turn screw out until lock cylinder cover can be removed. DO NOT go passed the hard stop. Tighten 4.7 N.m (42 lb in)
3	Rear Side Door Lock Cylinder Opening Cover Procedure 1. Pull the rear side door outside handle outward to release the door lock cylinder opening cover. 2. Pull the lock cylinder opening cover from the door.

FRONT SIDE DOOR LOCKING ROD REPLACEMENT

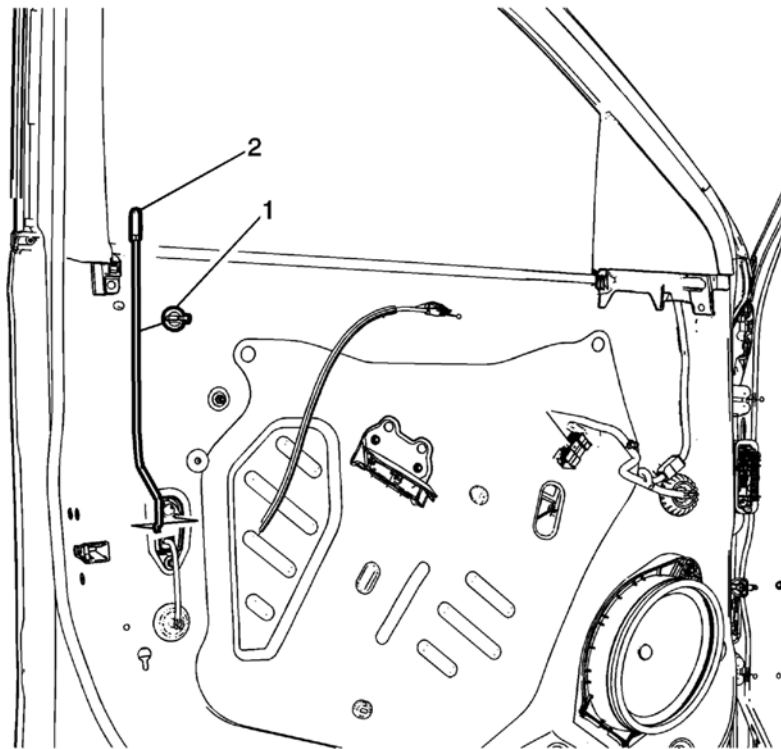


Fig. 76: Front Side Door Locking Rod

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to Front Side Door Trim Replacement .	
1	Front Side Door Locking Rod Clip Procedure Release the locking rod from the clip.
2	Front Side Door Locking Rod Procedure Turn the locking rod downward, pull outward while turning, releasing it from the latch. NOTE: Ensure that the door lock system operates properly before installing the trim.

FRONT SIDE DOOR LOCKING ROD CLIP REPLACEMENT

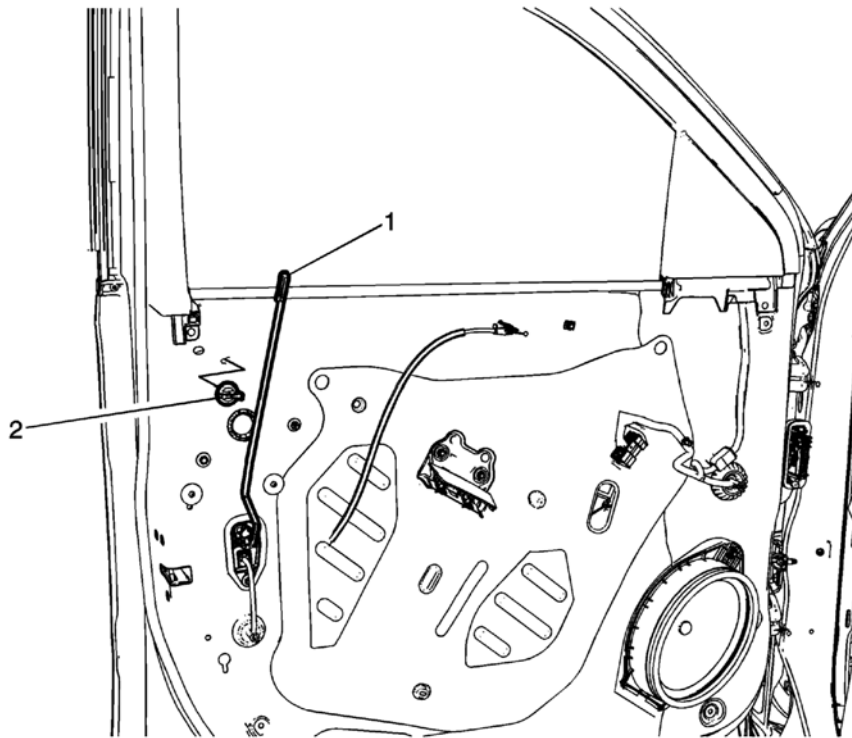


Fig. 77: Front Side Door Locking Rod Clip
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to Front Side Door Trim Replacement .	
1	Front Side Door Locking Rod Knob Procedure Separate the front side door locking rod knob from the clip and move to the side.
2	Front Side Door Locking Rod Clip Procedure Turn the front side door locking rod clip 180 degrees and pull from the door. NOTE: Inspect the front side door lock for proper operating before installing the door trim.

FRONT SIDE DOOR LOCKING ROD KNOB REPLACEMENT

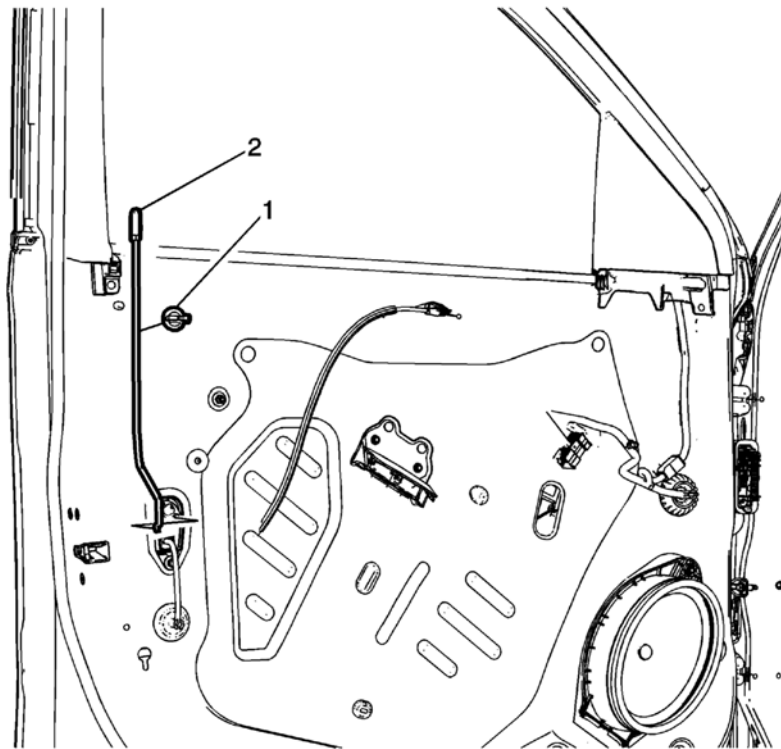


Fig. 78: Front Side Door Locking Rod Knob
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door trim. Refer to Front Side Door Trim Replacement .	
1	Front Side Door Locking Rod Clip Procedure Release the locking rod from the clip.
2	Front Side Door Locking Rod Procedure Turn the locking rod downward, pull outward while turning, releasing it from the latch. NOTE: Ensure that the door lock system operates properly before installing the trim.

FRONT SIDE DOOR LOCK CYLINDER ROD REPLACEMENT

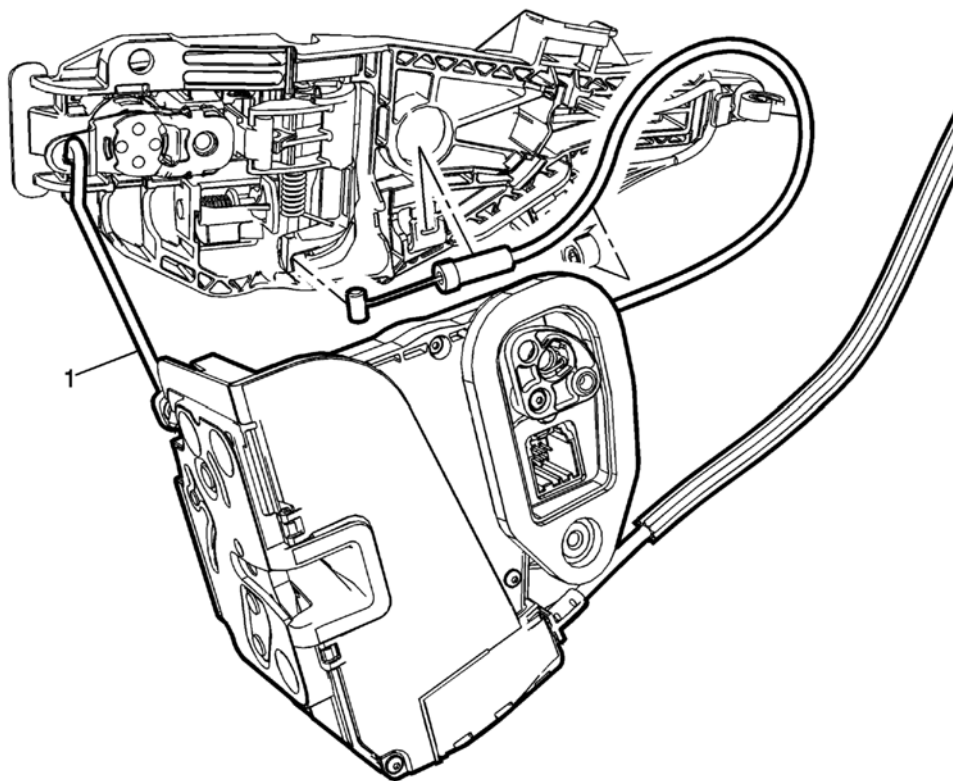


Fig. 79: Front Side Door Lock Cylinder Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front side door latch and handle bracket assembly from the door. Refer to Front Side Door Latch Replacement .	
1	Front Side Door Lock Cylinder Rod Procedure 1. Remove the front side door lock cylinder rod from the lock cylinder by turning the housing bracket clockwise. 2. Release the lock cylinder rod from the latch only, do not remove the handle cables from the latch. NOTE: Ensure that the door lock system operates properly before installing the trim.

FRONT SIDE DOOR OUTSIDE HANDLE CABLE RETAINER REPLACEMENT

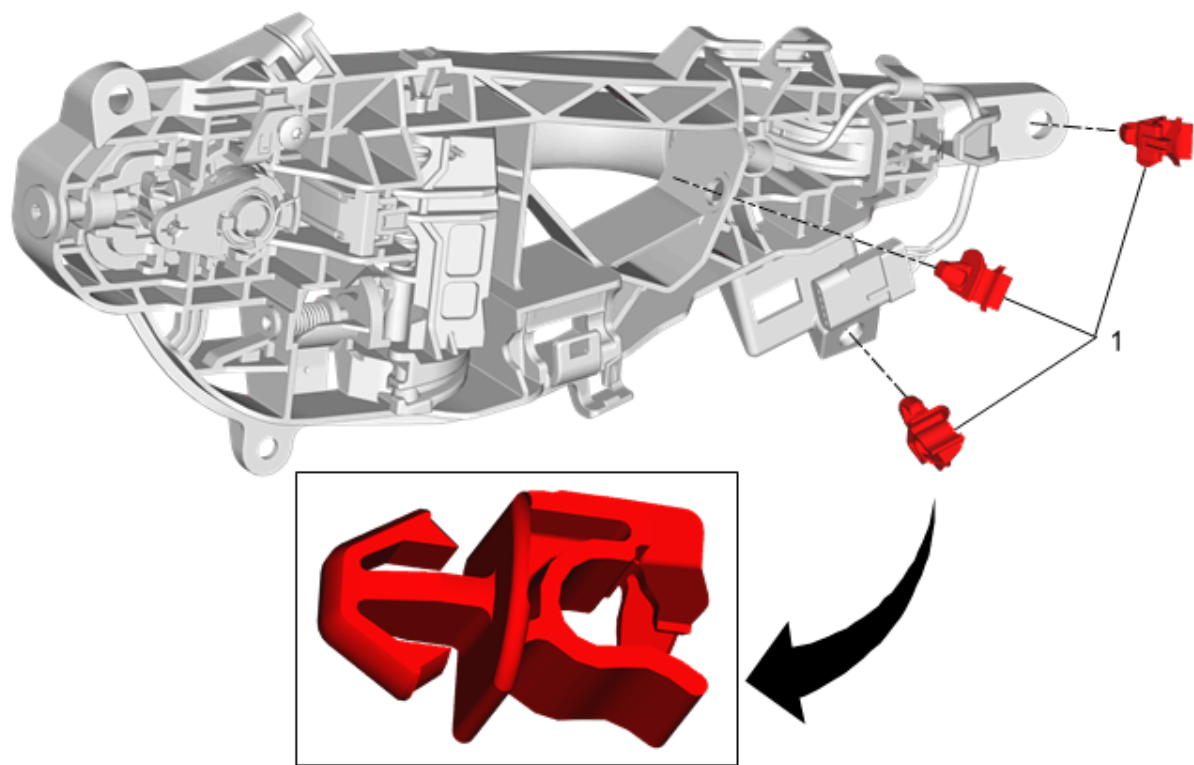


Fig. 80: Front Side Door Outside Handle Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Outside Handle Bracket. Refer to Front Side Door Outside Handle Bracket Replacement (Driver Side) Front Side Door Outside Handle Bracket Replacement (Passenger Side)	
1	Front Side Door Outside Handle Cable Retainer (Qty: 3) Procedure Squeeze tab end of retainer and pull retainer from handle bracket.

REAR SIDE DOOR LOCKING ROD KNOB REPLACEMENT

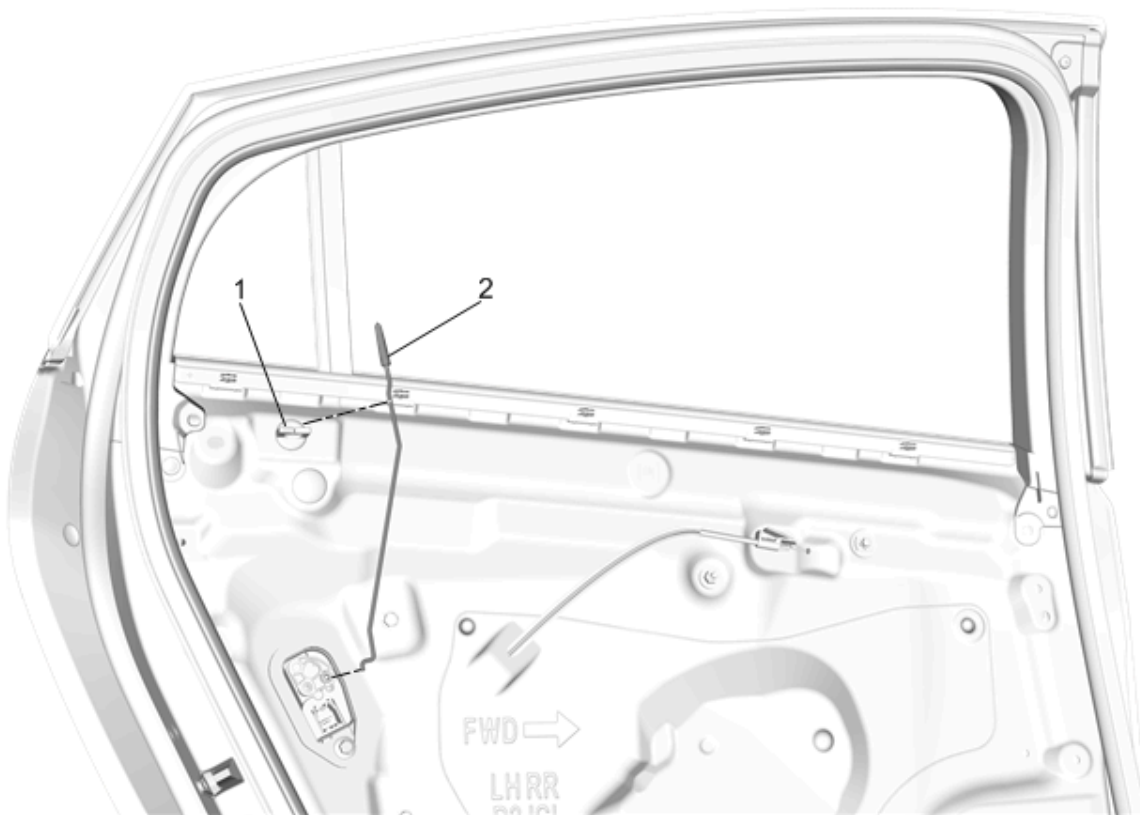


Fig. 81: Rear Side Door Locking Rod Knob

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Side Door Trim. Refer to Rear Side Door Trim Replacement	
1	Rear Side Door Locking Rod Knob Retainer Procedure Release the locking rod knob from the retainer. NOTE: Ensure that the door lock system operates properly before installing the trim.
2	Rear Side Door Locking Rod Knob Procedure Turn the locking rod down, pull upward and turning while releasing it from the latch.

FRONT SIDE DOOR LOCK STRIKER ADJUSTMENT

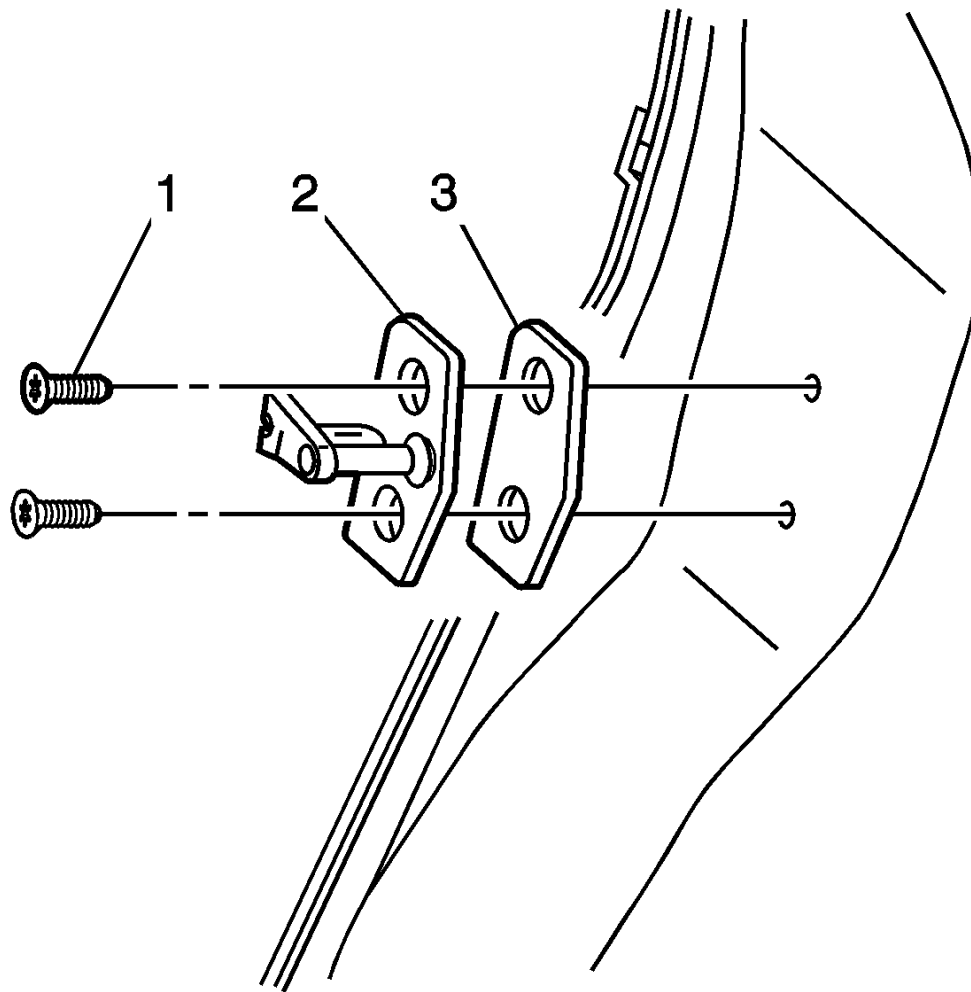


Fig. 82: Door Lock Striker And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: To determine if the striker adjustment is required, proceed as follows.

1. Ensure that the door is properly aligned with the door opening before proceeding with the striker adjustment.
2. Open and close the door on the striker (2). Note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the latch.

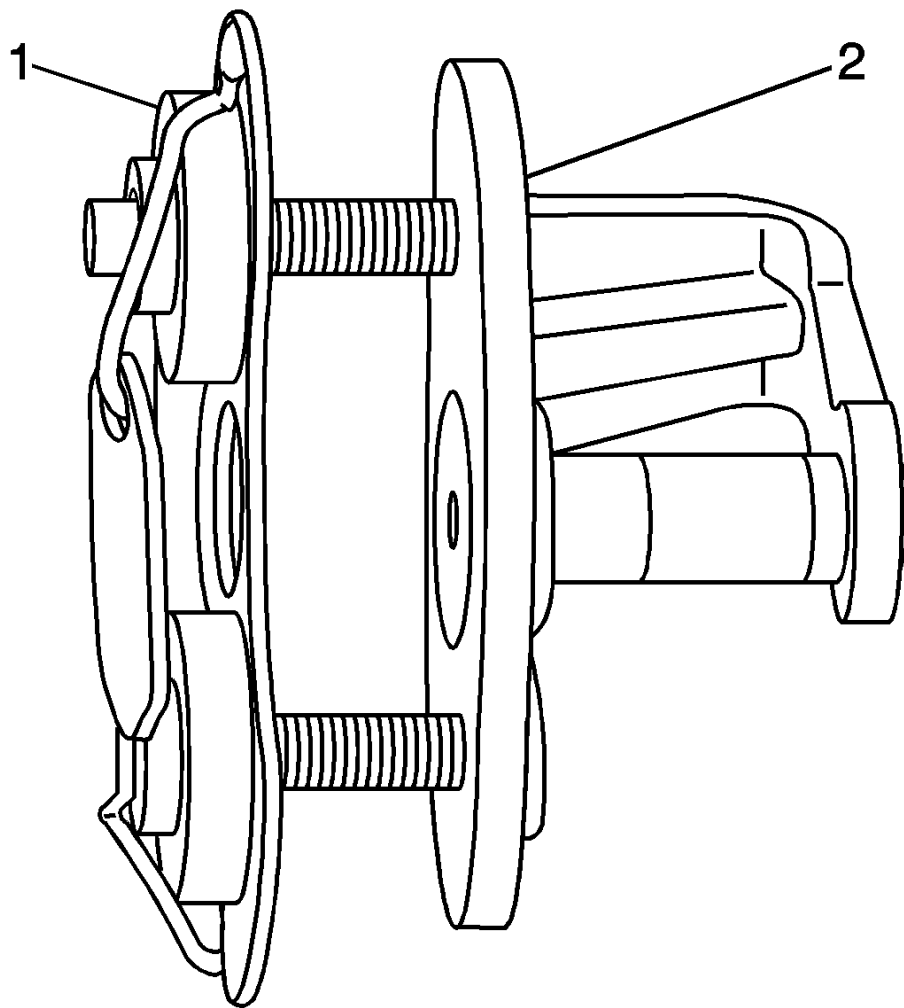


Fig. 83: Door Striker Anchor Plate And Door Striker

Courtesy of GENERAL MOTORS COMPANY

3. The striker plate weld nuts (1) are welded in place. Using a soft marker, mark around the striker (2) for reference of the original position. Loosen the striker screws just enough to allow the movement of the door striker and shims if equipped.

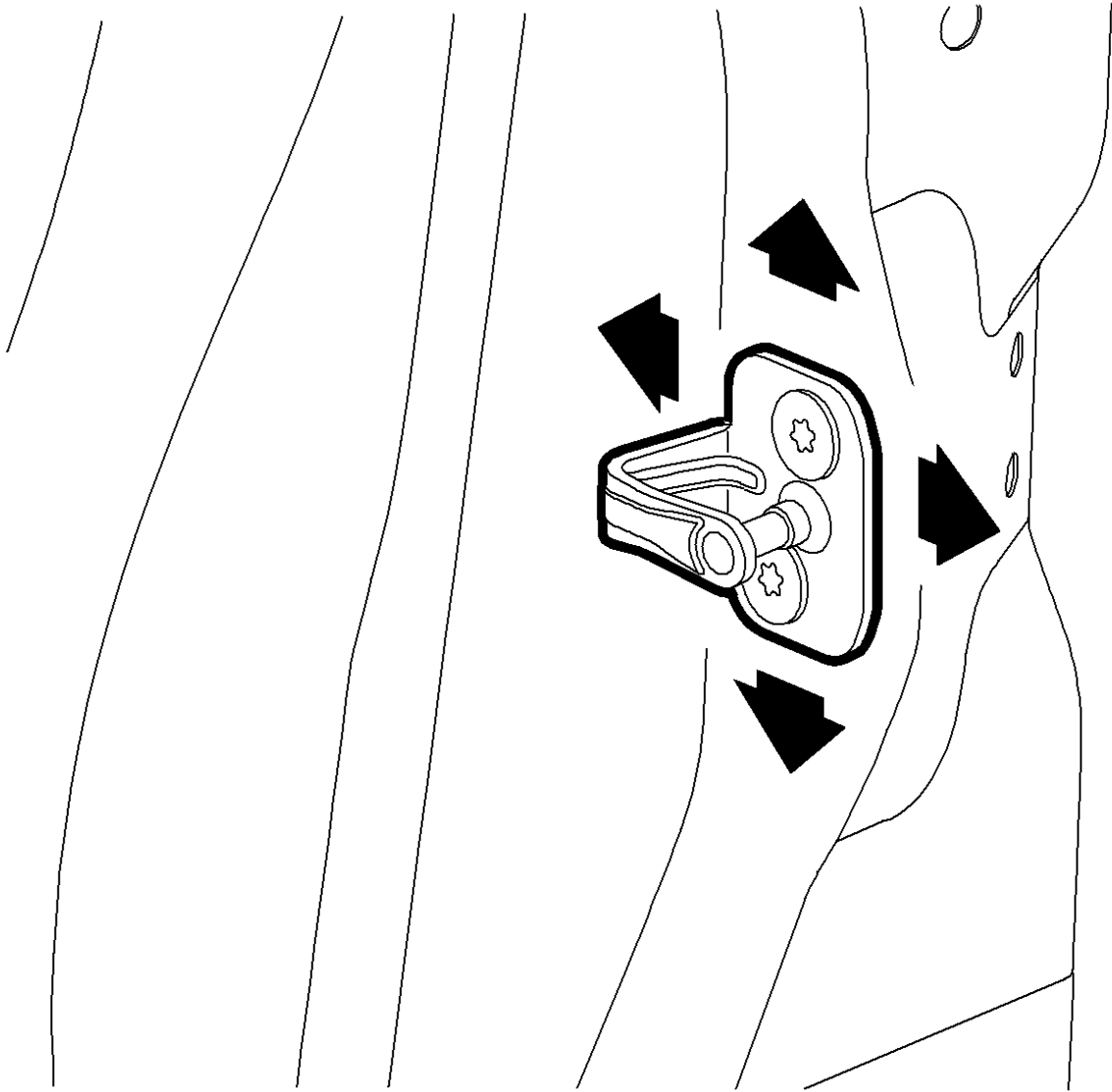


Fig. 84: Adjusting Door Striker

Courtesy of GENERAL MOTORS COMPANY

4. Adjust the door striker up or down and inboard or outboard as required.
5. Move the striker to eliminate drag on the striker and door latch and to achieve proper door position within door opening. Start with up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for proper door seal engagement ensuring that the door closing efforts are correct.

CAUTION: Refer to Fastener Caution .

6. Adjust the striker and add spacers as required and tighten the screws to 22 N.m (16 lb ft).
7. Inspect the door for proper operation.
8. Close the door.

FRONT SIDE DOOR LOCK STRIKER REPLACEMENT

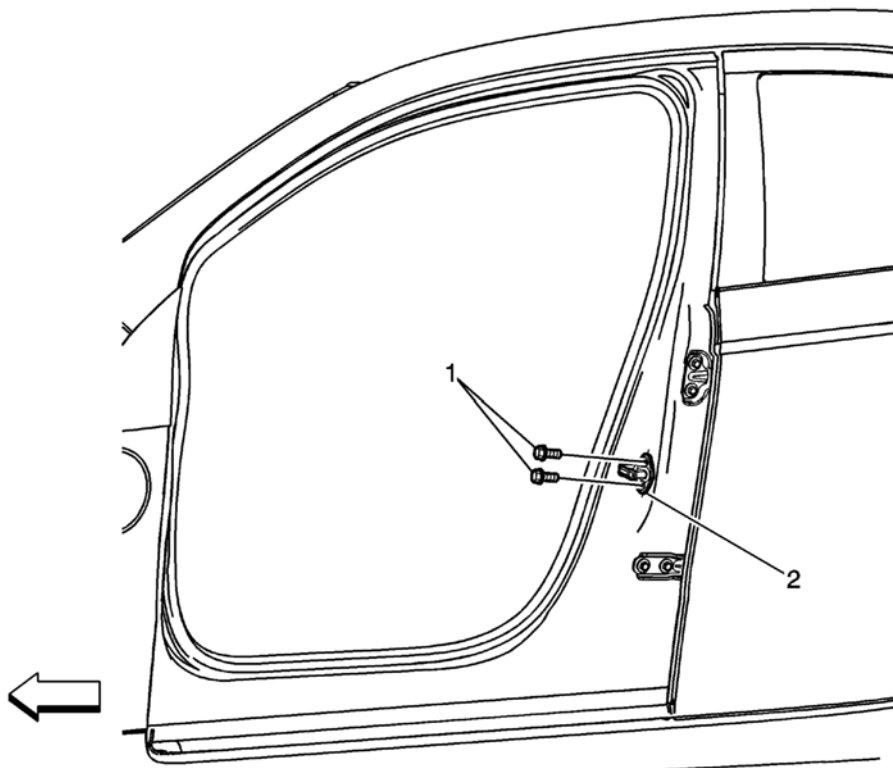


Fig. 85: Front Side Door Lock Striker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Door Lock Striker Screws (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Front Door Lock Striker Procedure Ensure the alignment of the striker. Refer to Front Side Door Lock Striker Adjustment.

LIFTGATE LATCH STRIKER REPLACEMENT

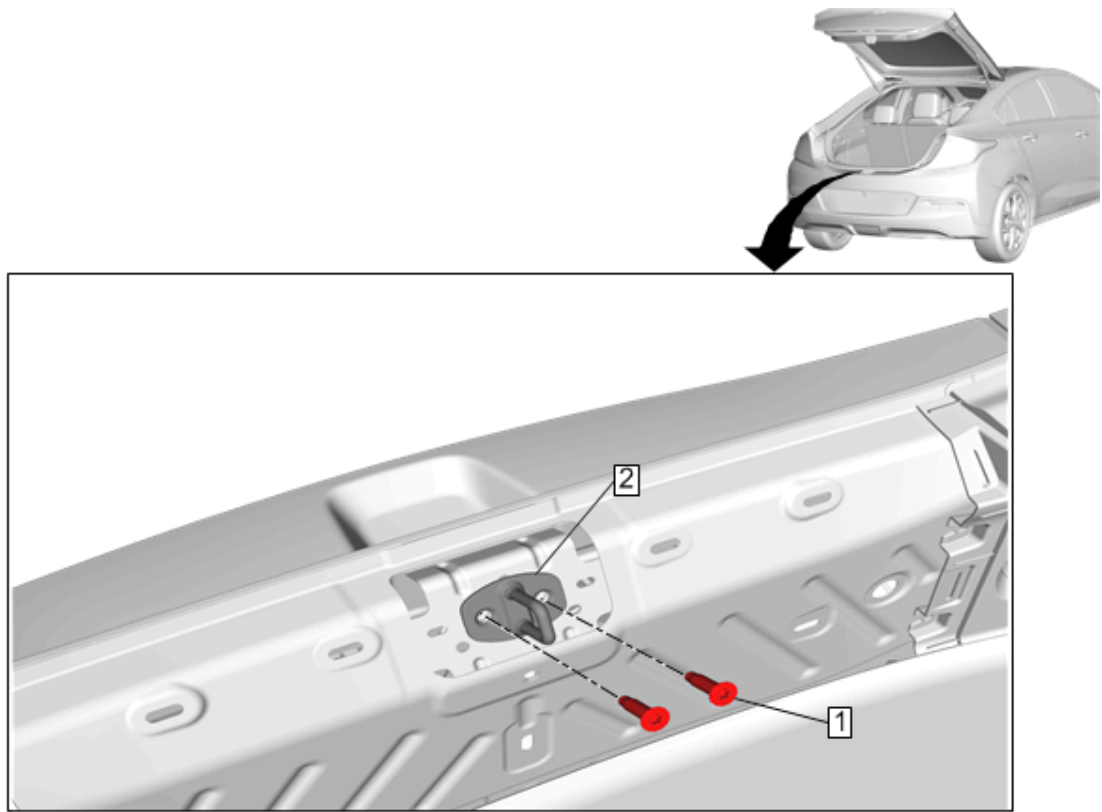


Fig. 86: Liftgate Latch Striker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear End Trim Finish Panel Opening Cover. Refer to Rear End Trim Finish Panel Opening Cover Replacement	
1	Liftgate Latch Striker Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Liftgate Latch Striker Procedure Mark the location of the striker with a grease pencil to ensure proper alignment during installation.

REAR SIDE DOOR LOCK STRIKER ADJUSTMENT

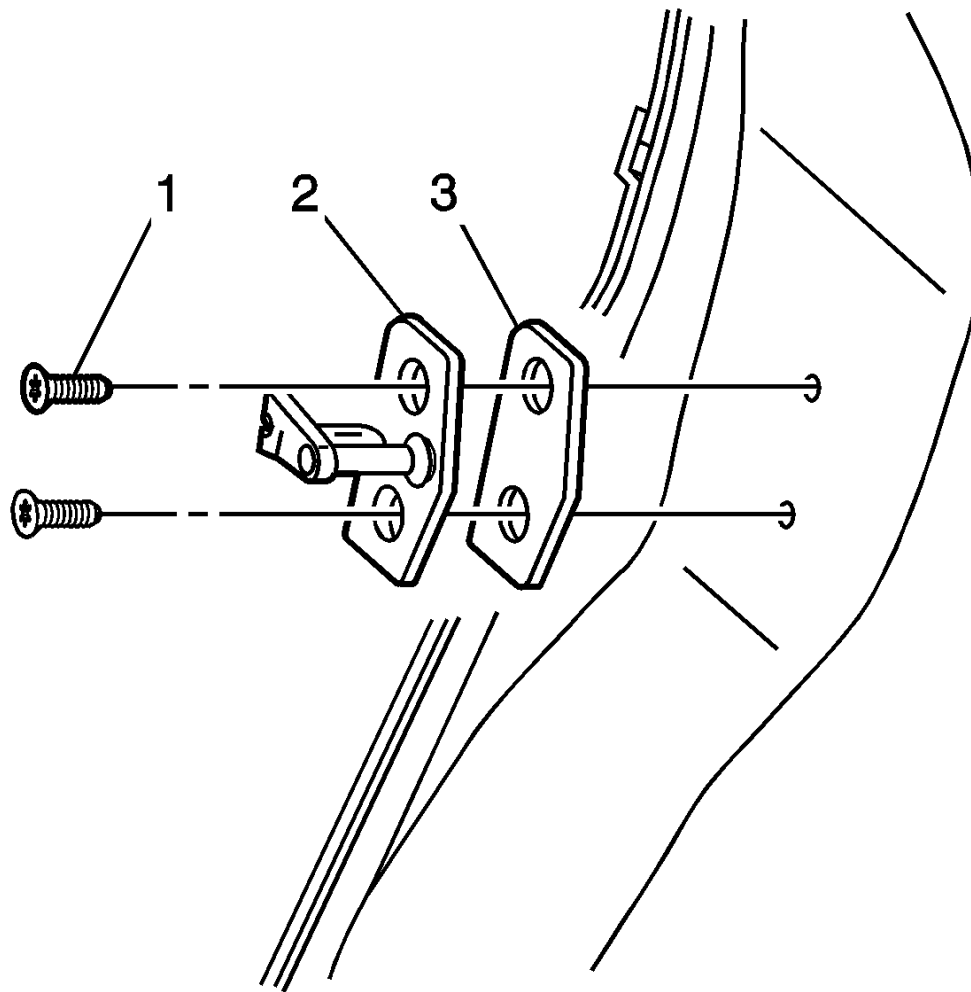


Fig. 87: Door Lock Striker And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: To determine if the striker adjustment is required, proceed as follows.

1. Ensure that the door is properly aligned with the door opening before proceeding with the striker adjustment.
2. Open and close the door on the striker (2). Note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the latch.

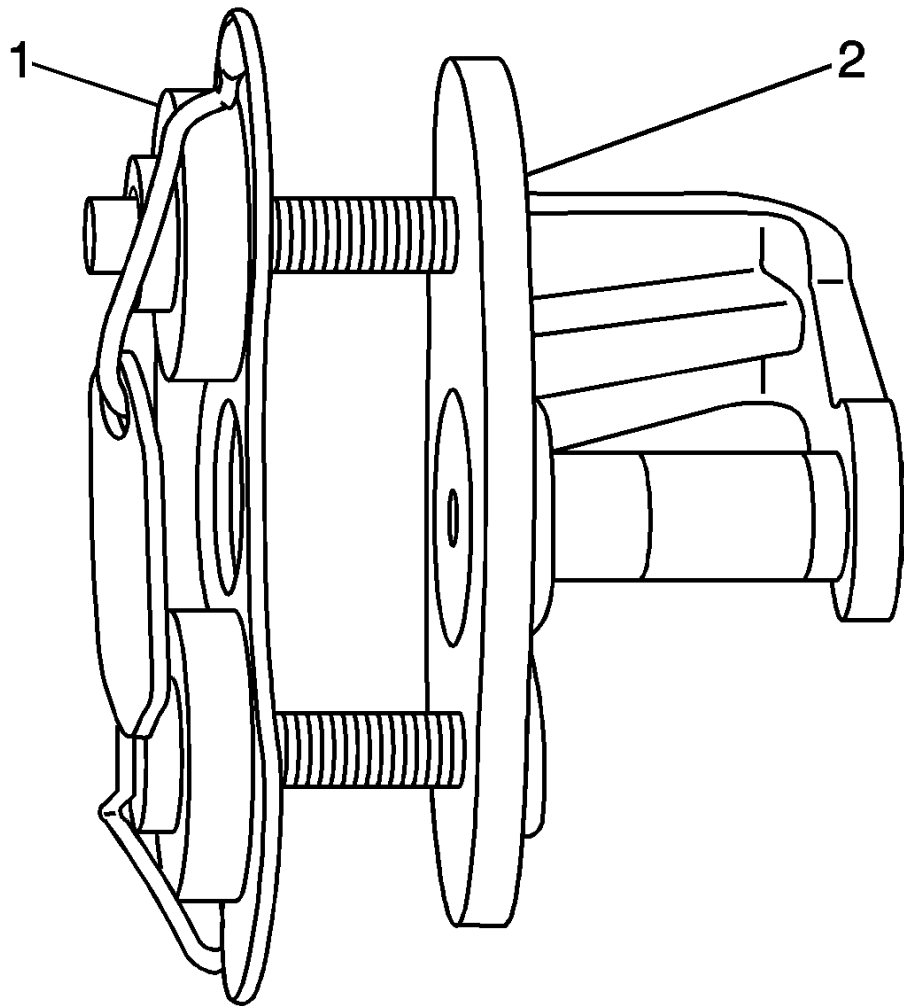


Fig. 88: Door Striker Anchor Plate And Door Striker

Courtesy of GENERAL MOTORS COMPANY

3. The striker plate weld nuts (1) are welded in place. Using a soft marker, mark around the striker (2) for reference of the original position. Loosen the striker screws just enough to allow the movement of the door striker and shims if equipped.

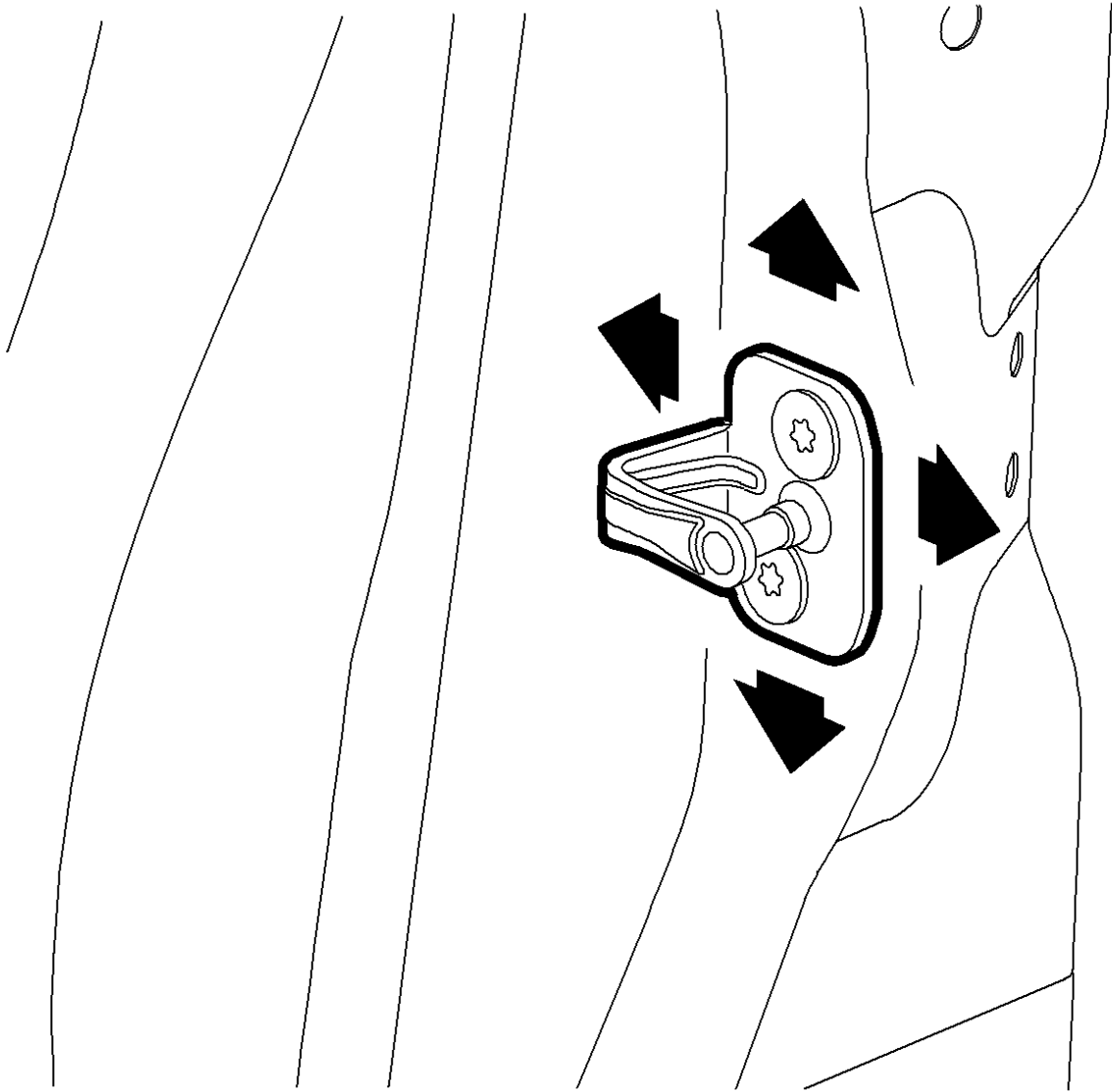


Fig. 89: Adjusting Door Striker

Courtesy of GENERAL MOTORS COMPANY

4. Adjust the door striker up or down and inboard or outboard as required.
5. Move the striker to eliminate drag on the striker and door latch and to achieve proper door position within door opening. Start with up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for proper door seal engagement ensuring that the door closing efforts are correct.

CAUTION: Refer to Fastener Caution .

6. Adjust the striker and add spacers as required and tighten the screws to 22 N.m (16 lb ft).
7. Inspect the door for proper operation.
8. Close the door.

REAR SIDE DOOR LOCK STRIKER REPLACEMENT

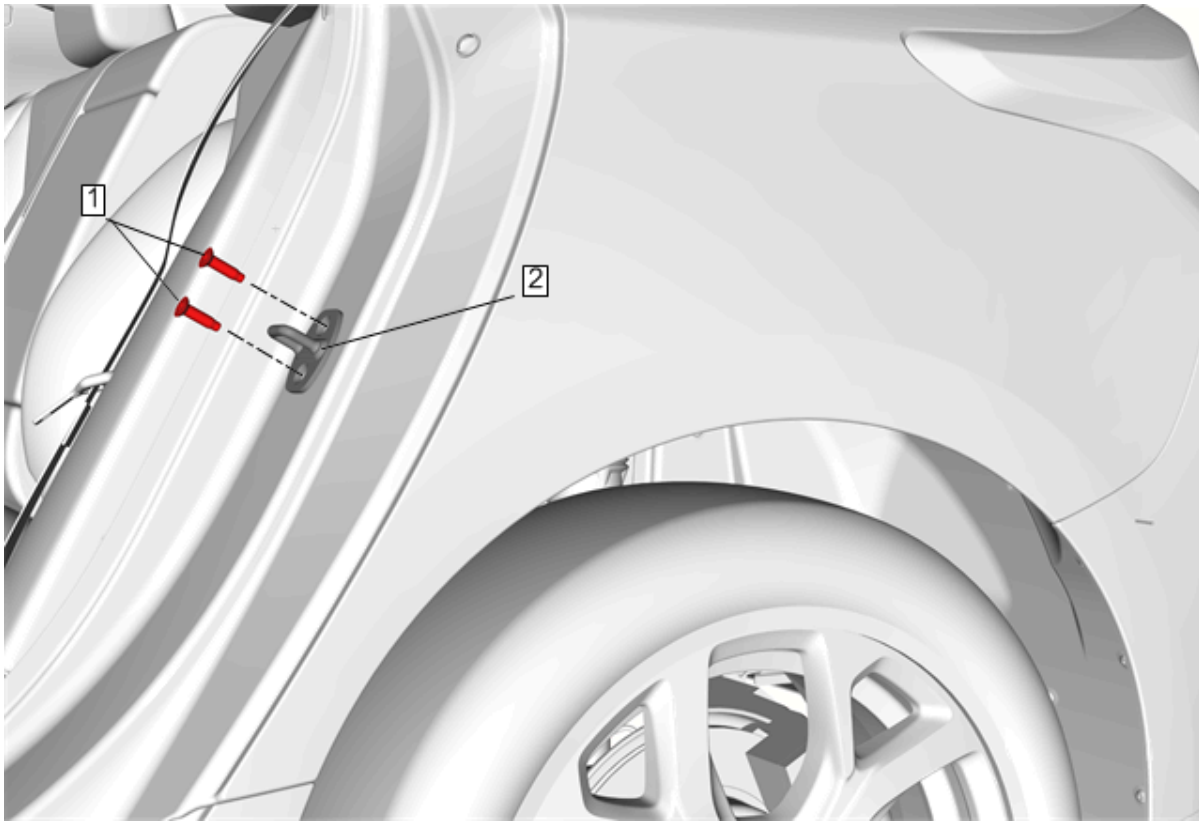


Fig. 90: Rear Side Door Lock Striker

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Lock Striker Screw (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 22 N.m (16 lb ft)
2	Rear Side Door Lock Striker Procedure Adjust Rear Side Door Lock Striker. Refer to Rear Side Door Lock Striker Adjustment

OPENING THE FUEL TANK FILLER DOOR WHEN THE DOOR LOCK MALFUNCTIONS

1. Remove the right rear wheelhouse panel liner. Refer to [Rear Wheelhouse Liner Replacement](#) .
2. Reach in behind the fuel filler pipe housing and manually slide the actuator rod forward, using light pressure, to override the actuator to release the fuel tank filler door.

FUEL TANK FILLER DOOR LOCK RELEASE SWITCH REPLACEMENT

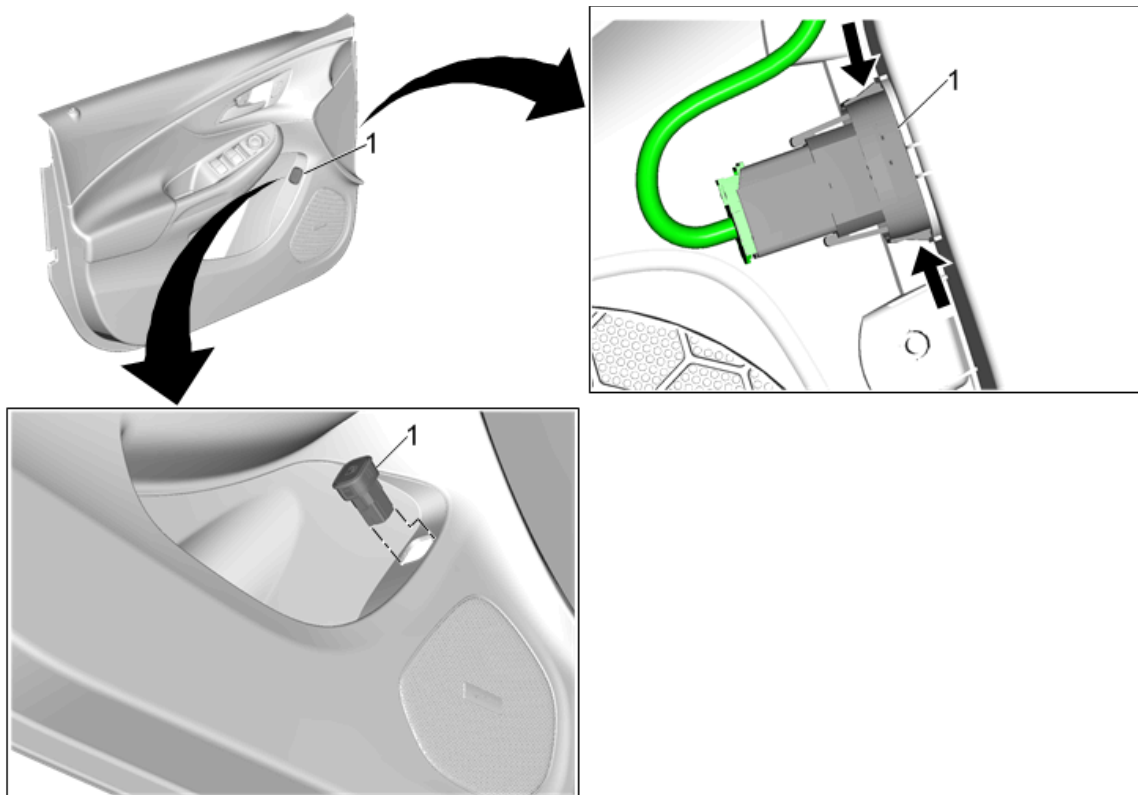


Fig. 91: Fuel Tank Filler Door Lock Release Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	
1	Fuel Tank Filler Door Lock Release Switch Procedure 1. From the backside of the door trim panel, use a plastic trim tool to gently push in on the side tabs to release the switch from the front side door trim. 2. Disconnect the electrical connector.

LIFTGATE RELEASE SWITCH REPLACEMENT

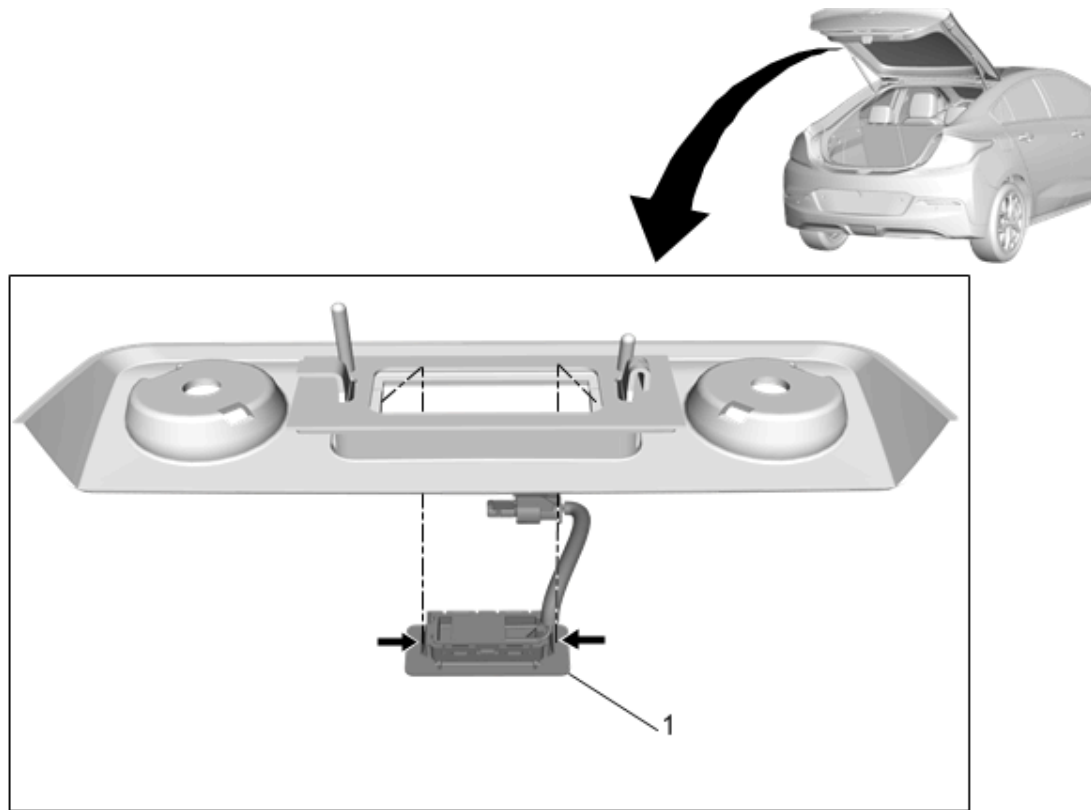


Fig. 92: Liftgate Release Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Liftgate Outside Handle. Refer to Liftgate Outside Handle Replacement	
1	Liftgate Release Switch Procedure Using a trim type tool, gently push in on the tabs to release the switch.

DOOR LOCK SWITCH REPLACEMENT - DRIVER SIDE

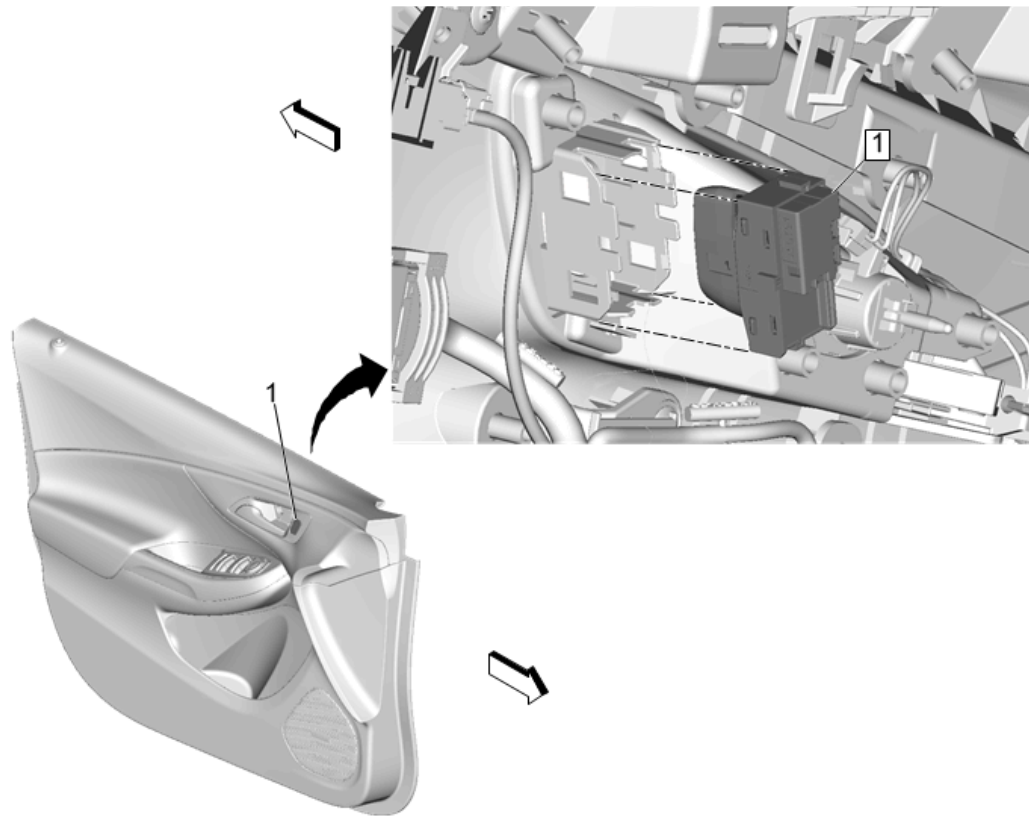


Fig. 93: Door Lock Switch - Driver Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	
1	Door Lock Switch Procedure 1. From the backside of the door trim panel, use a plastic trim tool to gently push in on the side tabs to release the switch from the front side door trim. 2. Disconnect the electrical connector. 3. Refer to Control Module References for programming and setup information, if required.

DOOR LOCK SWITCH REPLACEMENT - PASSENGER FRONT

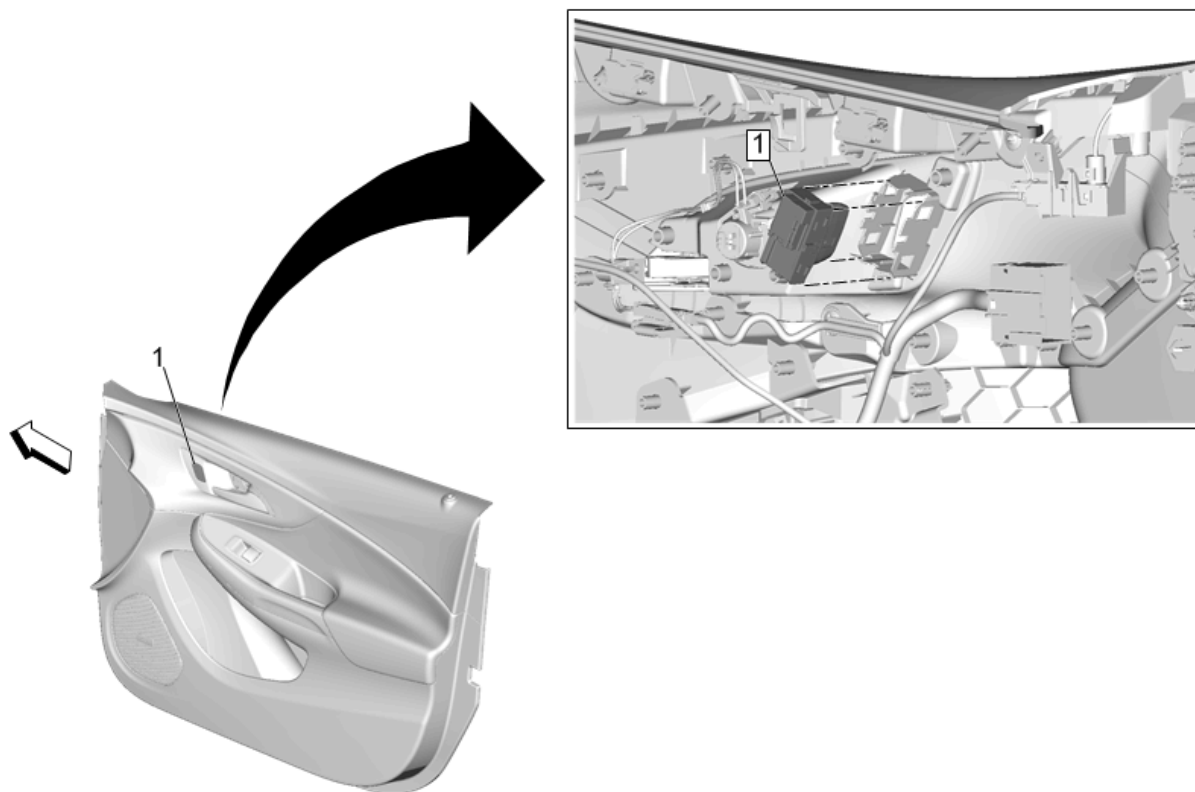


Fig. 94: Door Lock Switch - Passenger Front
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	
1	Door Lock Switch Passenger Front Procedure 1. From the backside of the door trim panel, use a plastic trim tool to gently push in on the side tabs to release the switch from the front side door trim. 2. Disconnect the electrical connector. 3. Refer to Control Module References for programming and setup information, if required.

DESCRIPTION AND OPERATION

CHARGE PORT DOOR DESCRIPTION AND OPERATION

Charge Port System Components

The charge port system consists of the following components:

- Charge port door position sensor
- Hybrid/EV powertrain control module 2

Charge Port Ajar Message

When the vehicle is in the Service Mode or ON, the hybrid/EV powertrain control module 2 supplies a 5V signal to the charge port door position switch through the charge port door sensor signal circuit. The charge port door position switch contains a resistor ladder interface for switch position between two resistors for sensing used by the hybrid/EV powertrain control module 2 to determine if the charge port door is in the open position or the closed position. The hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

DOOR AJAR INDICATOR DESCRIPTION AND OPERATION

Door Ajar Indicator System Components

The door ajar indicator system consists of the following components:

- Body control module (BCM)
- Instrument cluster
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch
- Driver window motor
- Passenger window switch
- Left rear window switch
- Right rear window switch

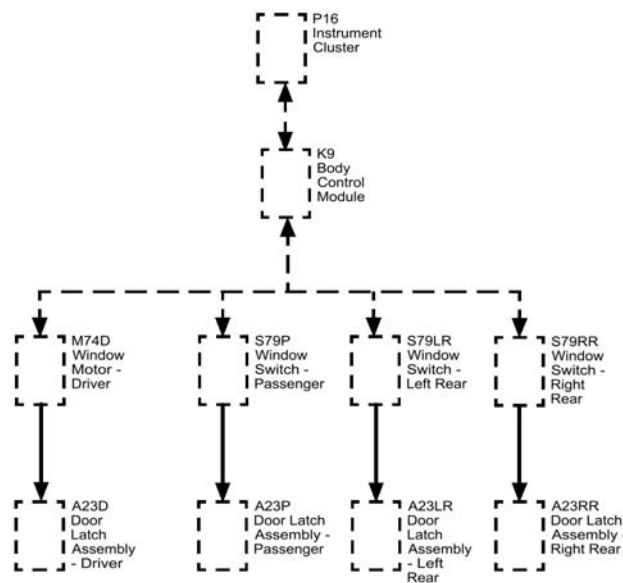


Fig. 95: Door Ajar Indicator With AXG/AED/AEQ Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
M74D	M74D Window Motor - Driver
S79P	S79P Window Switch - Passenger
S79LR	S79LR Window Switch - Left Rear
S79RR	S79RR Window Switch - Right Rear
A23D	A23D Door Latch Assembly - Driver
A23P	A23P Door Latch Assembly - Passenger
A23LR	A23LR Door Latch Assembly - Left Rear
A23RR	A23RR Door Latch Assembly - Right Rear
K9	K9 Body Control Module

Driver Door Ajar

The driver window motor provides a 12V signal to the driver door ajar switch signal circuit. The driver door ajar switch is integral to the driver door latch assembly. When the driver door is opened, the normally open door ajar switch closes. With the door ajar switch closed, ground is provided to the door ajar switch signal circuit and the voltage within the signal circuit drops. The driver window motor will detect the voltage drop and will send a serial data message to the body control module which will then send a message to the instrument panel cluster to command the door ajar message

Passenger Door Ajar

The passenger window switches each provide a 12 V signal to their respective door ajar switch signal circuits. The door ajar switches are integral to each door latch assembly. When a door is opened, the normally open door ajar switch closes. With the door ajar switch closed, ground is provided to the door ajar switch signal circuit and the voltage within the signal circuit drops. The window switches will detect the voltage drop and will send a serial data message to the body control module which will then send a message to the instrument panel cluster to command the door ajar message.

FUEL FILL DOOR DESCRIPTION AND OPERATION

Refueling System Components

The refueling system consists of the following components:

- Refuel request switch
- Fuel door position sensor
- Fuel door latch
- Hybrid powertrain control module 2

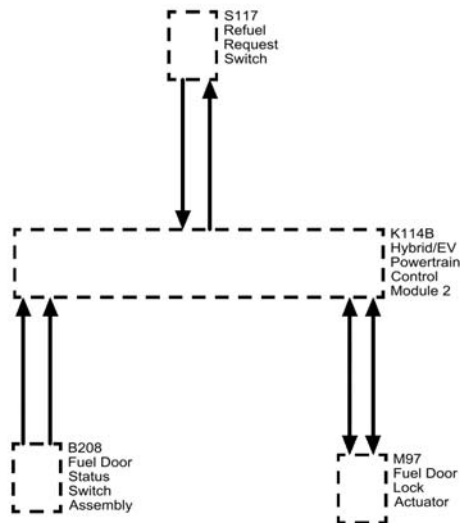


Fig. 96: Refueling System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Refueling System Overview

To effectively manage evaporative fuel emissions, hybrid vehicles with extended electrical range capability must be equipped with a "pressurized" fuel system that can be sealed from atmosphere when the internal combustion engine is not operating.

When the fuel system is sealed, the internal pressure will vary with changes in temperature, such as the natural variation in ambient temperature that occurs throughout the day. To maintain evaporative emissions compliance, vehicle refueling can only be permitted once the fuel system has been adequately vented to atmosphere through the carbon canister. The Refueling Management feature described in this document provides the necessary means to regulate customer access to the fuel cap and manage venting of the fuel system in order to facilitate vehicle refueling without compromising evaporative emissions compliance.

Refueling System Operation

The hybrid/EV powertrain control module 2 monitors the voltage values of the fuel fill door open request wake-up signal circuit and the fuel door request signal circuit. When the refuel request switch is pressed, the two switch contacts close. This provides B+ to the wake-up circuit input and changes the voltage level of the fuel door request signal as it passes through a single resistor instead of 2 resistors. The hybrid/EV powertrain control module 2 will detect the 12 volts on the wake-up circuit and the voltage change on the fuel door request circuit, it will then command the fuel system to vent and sends a serial data message to the driver information center to display the Wait to Refuel message. The hybrid/EV powertrain control module 2 then energizes the fuel door lock/unlock actuator to unlock the fuel door.

After the system has been vented, the hybrid powertrain control module 2 will send a command to unlock the fuel filler door and will send a serial data message to the driver information center to display the Ready To Refuel message. After the vehicle has been refueled, the hybrid powertrain control module 2 will send a serial data message to the driver information center to display the Close Fuel Door message until the fuel filler door is closed. The hybrid powertrain control module 2 will then command the fuel filler door to lock 5 seconds after the fuel filler door is closed or the vehicle speed exceeds 40 km/h (25 mph).

LIFTGATE AJAR INDICATOR DESCRIPTION AND OPERATION

Hatch Open Indicator

The body control module (BCM) monitors the voltage level of the rear hatch ajar signal circuit which is normally at the system voltage when the hatch is closed. When the hatch is ajar or open, a switch within the rear hatch latch closes providing a path to ground for the hatch ajar signal circuit. The voltage within the signal circuit will then drop to 0 volts, the BCM will then detect the voltage drop and will send a serial data message to the instrument panel cluster (IPC). The IPC will then display an icon of the vehicle with the hatch open.

POWER DOOR LOCKS DESCRIPTION AND OPERATION

Door Lock System Components

The power door lock system consists of the following components:

- Driver door lock switch
- Passenger door lock switch
- Key cylinder switch
- Body control module (BCM)
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch
- Exterior door handle switches
- Keyless entry control module

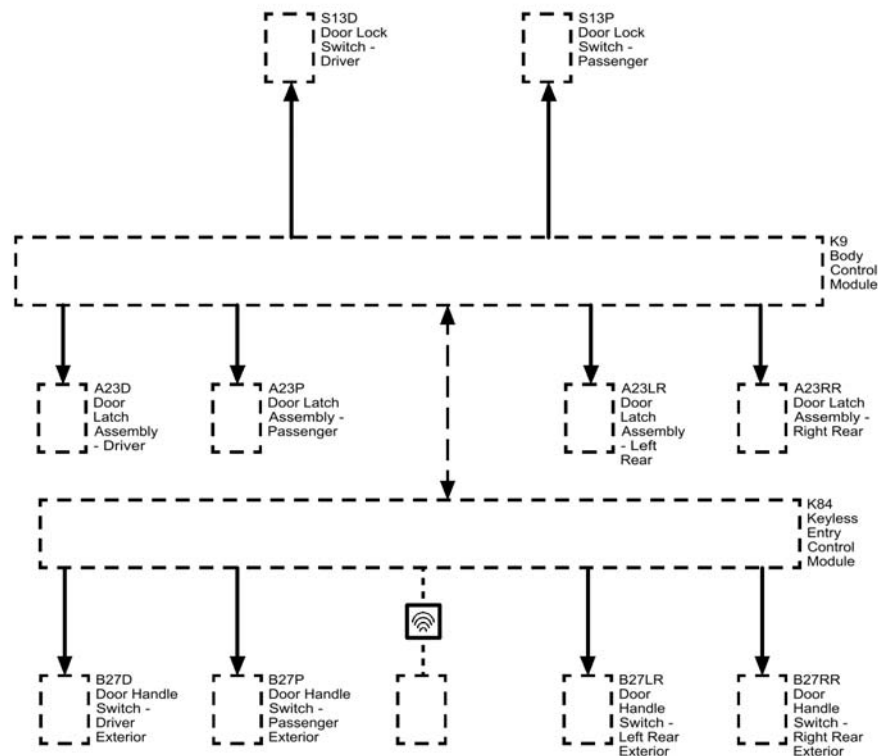


Fig. 97: Power Door Locks System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S13D	S13D Door Lock Switch - Driver
S13P	S13P Door Lock Switch - Passenger
K9	K9 Body Control Module
A23RR	A23RR Door Latch Assembly - Right Rear
A23LR	A23LR Door Latch Assembly - Left Rear
A23P	A23P Door Latch Assembly - Passenger
A23D	A23D Door Latch Assembly - Driver
K84	K84 Keyless Entry Control Module
B27RR	B27RR Door Handle Switch - Right Rear Exterior
B27LR	B27LR Door Handle Switch - Left Rear Exterior
B27P	B27P Door Handle Switch - Passenger Exterior
B27D	B27D Door Handle Switch - Driver Exterior

Door Lock and Unlock Operation

When the driver or passenger door lock switch is activated in the lock or unlock position, the BCM will receive a ground signal on either the door lock switch lock or unlock signal circuits.

The BCM, upon receipt of a lock switch lock or unlock signal, will supply battery voltage to the door lock actuator lock or unlock control circuits. Since the opposite side of the lock actuator is connected to ground through the other lock actuator control circuit, the doors will then lock or unlock as commanded.

The following three circuits are used to operate the lock:

- Driver door unlock
- Passenger door unlock
- All door lock

The driver door lock actuator is isolated so it can be unlocked by itself using the keyless entry transmitter.

Key Cylinder Switch

The driver window switch monitors the voltage level of the driver door lock motor status signal circuit. When the key is inserted into the driver door key cylinder and turned to the Lock position, a switch within the driver door latch closes causing the voltage to drop within the driver door lock motor status signal circuit. The driver window switch will detect the drop in voltage and will send a serial data message to the BCM commanding all the doors to Lock.

The driver key cylinder switch is used by the customer for programming the keyless entry transmitters. The driver window/outside rearview mirror switch monitors the voltage level of the key switch unlock signal circuit and when it detects a reprogramming request, it will send a serial data message to the body control module.

Passive Door Lock/Unlock Operation

The exterior door handle switch signal circuits provide inputs to the keyless entry control module when the exterior door handle switches are activated. These inputs allow the keyless entry control module to detect a door lock or a door unlock request. The keyless entry control module provides a 12 V signal to each exterior door handle switch via the door handle switch signal circuits. When a door handle switch is pressed, the switch closes and the voltage signal within the signal circuit is pulled to ground. The keyless entry control module will detect the voltage drop and a low frequency antenna will transmit a challenge to the keyless entry transmitter. If the challenge is met, the keyless entry transmitter will respond and the keyless entry control module will send a serial data message to the body control module to command the door(s) to be locked or unlocked

REAR HATCH/GATE DESCRIPTION AND OPERATION

Rear Hatch Release System Components

- Liftgate Latch
- Liftgate Release Switch
- Liftgate Relay
- Body Control Module
- 15 A Fuse

Rear Hatch Release Operation

The rear hatch can be released by placing the transaxle in park, unlocking all the doors and then pressing the touchpad located at the rear of the vehicle above the license plate.

Pressing the touchpad closes a contact providing a ground for the rear closure handle switch open signal circuit. The body control module (BCM) will detect the voltage drop and will pulse 12 V to one side of the relay coil and provide a ground for the other side of the relay coil, this will briefly energize the liftgate relay closing the switch contacts and provide B+ voltage to the liftgate latch. When the doors are locked, the BCM will disable the rear hatch release system by ignoring the liftgate release switch input command and not providing 12 V for the liftgate relay.

Article GUID: A00884719

ACCESSORIES & EQUIPMENT

Wipers and Washers - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Dash Upper Extension Panel Opening Cover Bolt	9 N.m (80 lb in)
Front Suspension Strut Housing Brace Bolt	22 N.m (16 lb ft)
Windshield Washer Solvent Container Nut	9 N.m (80 lb in)
Windshield Wiper Arm Nut	30 N.m (22 lb ft)
Windshield Wiper System Module Bolt	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

WIPER/WASHER WIRING SCHEMATICS

Windshield Wiper/Washer

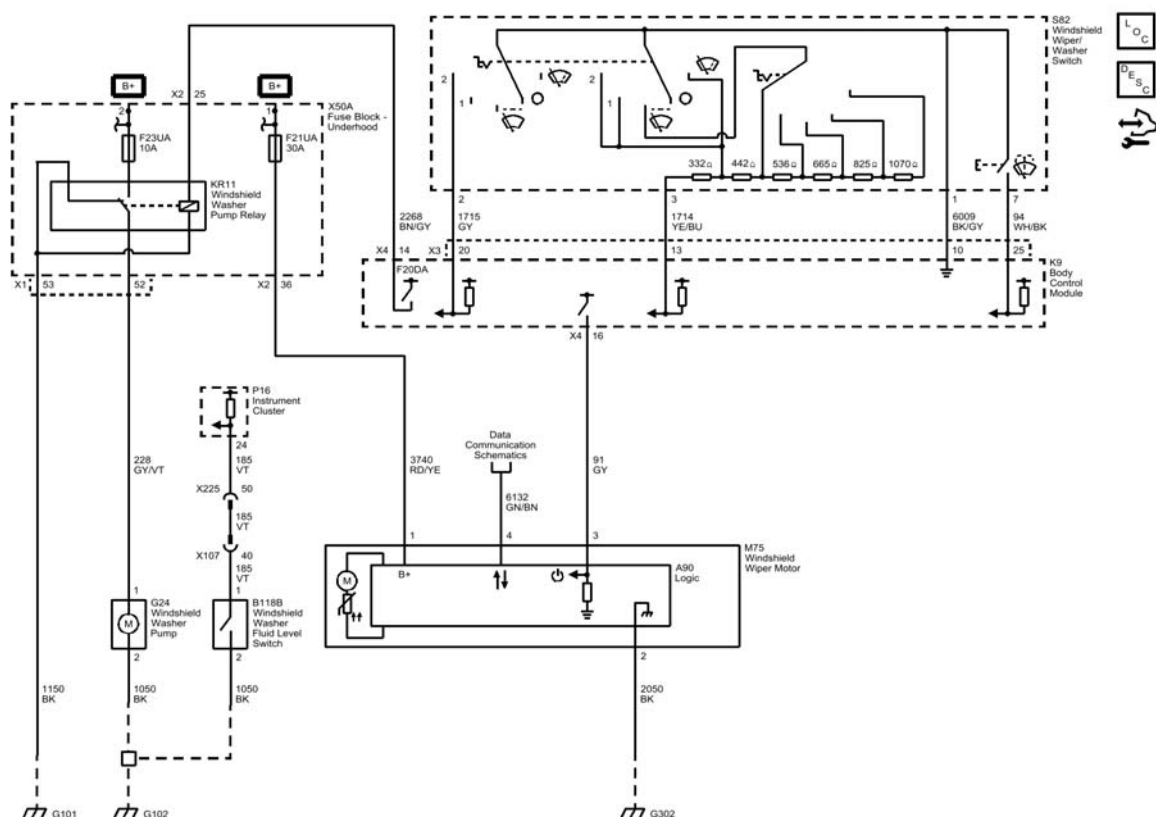


Fig. 1: Windshield Wiper/Washer
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B3715: WINDSHIELD WIPER RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B3715

Windshield Wiper Relay Circuit

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Motor Module	1	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+				
Windshield Wiper Motor Serial Data	U1515 00	U1515 00	U1515 00	-
Windshield Wiper Motor Relay Coil Supply Voltage	-	-	-	-
Windshield Wiper/Washer Switch Signal Terminal 3	4	3	-	-
Windshield Wiper/Washer Switch Signal Terminal 1	4	2	-	-
Windshield Wiper Motor Module Ground	-	1, 2, 3	-	-
Windshield Wiper/Washer Switch Low Reference	-	1	1	-
1. Windshield Wipers Inoperative 2. Windshield Wipers High Speed Inoperative 3. Windshield Wipers Intermittent or Low Speed Inoperative 4. Windshield Wipers Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield wiper motor based on inputs from the windshield wiper/washer switch, and when intermittent mode is selected, the rain/ambient light sensor module. The BCM monitors the windshield wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper/washer switch utilizes resistive multiplexing to signal a low speed and intermittent operation request to the BCM while a separate discrete signal circuit is used to indicate a high speed wiper request. When the wiper switch is placed in the low speed or intermittent position, the BCM monitors the voltage drop, which changes dependent upon switch position, over an internal pulled high resistor. The BCM will respond by commanding on the low speed or intermittent wipers. With the windshield wiper/washer switch in the high speed position, the BCM's high speed signal circuit is pulled low. The BCM will respond by commanding the windshield wiper motor to operate at high speed via serial data.

Conditions for Running the DTC

- The DTC runs only when a wiper output is actively being requested by the BCM.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

- A short to ground is detected in the front wiper relay control circuit or in the high speed relay control circuit.

Action Taken When the DTC Sets

The BCM will not activate the wiper output.

Conditions for Clearing the DTC

- A current DTC will clear when the condition for setting the fault is no longer present.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that there are no communications DTCs set.

- **If any communication DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no communication DTCs are set**

3. Verify that DTC B371A is not set.

- **If DTC B371A is set**

Refer to DTC B371A.

- **If DTC B371A is not set**

4. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when activating the high speed windshield wipers.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

5. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when activating the low speed windshield wipers.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

6. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the intermittent speed windshield wipers.

- **If the parameter does not change**

Test or replace the S82 Windshield Wiper/Washer Switch.

- **If the parameter changes**

7. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

- **If the M75 Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction

- **If the M75 Windshield Wiper Motor cycles between Off, Low, and High**

8. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.

6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Test for greater than 8 V between the signal circuit terminal 3 and ground.

- **If less than 8 V**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit and ground

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If 8 V or greater**

8. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.

9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

10. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Wiper Motor Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, M75 Windshield Wiper Motor
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 3 and ground.
6. Verify the test lamp turns ON and OFF when turning the high speed wipers ON and OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
7. Remove the test lamp.
8. Test for 8 - 9 V between the serial data circuit terminal 4 and ground.
 - **If less than 8 V**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
- **If greater than 9 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V or greater, replace the K9 Body Control Module.
- **If 8 - 9 V**
9. Test or replace the M75 Windshield Wiper Motor.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 1 and the low reference terminal 2 with the high speed switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 1 and the low reference circuit terminal 2 with the high speed switch in the closed position.
 - **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If less than 2 Ω**
4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 2 with the low speed switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
5. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.

- Delay 1 : 3.75-3.85kΩ
- Delay 2 : 2.75-2.85kΩ
- Delay 3 : 1.95-2.05kΩ
- Delay 4 : 1.25-1.35kΩ
- Delay 5 : 765-775Ω
- **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within the specified range**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Windshield Wiper System Module Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Fuse Block Replacement**
- **Control Module References** for body control module replacement, programming and setup.

DTC B371A: WINDSHIELD WIPER MOTOR INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B371A 39

Windshield Wiper Motor Internal Malfunction

Circuit/System Description

B+ voltage and ground are supplied to the windshield wiper motor. Whenever the vehicle is ON or in Service Mode, the body control module (BCM) sends the wiper/washer switch status through the LIN communication bus. If a fault occurs at any time in the windshield wiper motor, the BCM will set the DTC.

Conditions for Running the DTC

The BCM runs the diagnostic to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This diagnostic runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The BCM receives an invalid signal from the windshield wiper motor.

Action Taken When the DTC Sets

The BCM ignores all additional inputs.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that there is no communications DTC set.
 - **If there is a communications DTC set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - **If there is no communications DTC set**
3. Verify that DTC B371A is not set.
 - **If DTC B371A is set**

Replace the M75 Windshield Wiper Motor.
 - **If DTC B371A is not set**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Windshield Wiper System Module Replacement](#)

DTC B371C: FRONT WIPER MOTOR 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B371C

Front Wiper Motor 2

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

B+ voltage and ground are supplied to the windshield wiper motor. Whenever the vehicle is ON or in Service Mode, the body control module (BCM) sends the wiper/washer switch status through the LIN communication bus. If a fault occurs at any time in the windshield wiper motor, the BCM will set the DTC.

Conditions for Running the DTC

The BCM runs the diagnostic to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This diagnostic runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The BCM receives an invalid signal from the windshield wiper motor.

Action Taken When the DTC Sets

The BCM ignores all additional inputs.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that there is no communications DTC set.

- **If there is a communications DTC set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If there is no communications DTC set**

3. Verify that DTC B371C is not set.

- **If DTC B371C is set**

Replace the M75 Windshield Wiper Motor.

- **If DTC B371C is not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Windshield Wiper System Module Replacement](#)

DTC B3873: FRONT WASHER RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873

Front Washer Relay Circuit

For symptom byte information, refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B3873 02	B3873 04	B3873 01	-

Circuit/System Description

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

Conditions for Running the DTC

- Vehicle ON or in Service Mode
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

B3873 01

The body control module detects a short to B+ in the windshield washer pump relay control circuit

B3873 02

The body control module detects a short to ground in the windshield washer pump relay control circuit

B3873 04

The body control module detects an open or high resistance in the windshield washer pump relay control circuit

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G24 Windshield Washer Pump activates when commanding the Windshield Washer Relay On and Off with a scan tool.
 - **If the G24 Windshield Washer Pump does not activate**

Refer to Circuit/System Testing
 - **If the G24 Windshield Washer Pump activates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
 2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 14 X4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump is not activated**
3. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
4. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse

Block - Underhood.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the X50A Fuse Block - Underhood.
- **If the G24 Windshield Washer Pump activates**
5. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Fuse Block Replacement](#)
- [Control Module References](#) for body control module replacement, programming and setup.

SYMPTOMS - WIPER/WASHER SYSTEMS

NOTE: The following steps must be completed before using the symptom tables:

1. Perform [Diagnostic System Check - Vehicle](#), in order to verify that all of the following conditions are true:
 - No DTCs are set.
 - The control modules can communicate via the serial data link.
2. Refer to [Wiper/Washer System Description and Operation](#) in order to familiarize yourself with the system functions.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the windshield wiper/washer system. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Inspect the washer fluid reservoir for the proper fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Windshield Wiper System Malfunction](#)
- [Washer Malfunction](#)

WINDSHIELD WIPER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Motor Module B+	1	1	-	-
Windshield Wiper Motor Serial Data	U1515 00	U1515 00	U1515 00	-
Windshield Wiper Motor Relay Coil Supply Voltage	-	-	-	-
Windshield Wiper/Washer Switch Signal Terminal 3	4	3	-	-
Windshield Wiper/Washer Switch Signal Terminal 1	4	2	-	-
Windshield Wiper Motor Module Ground	-	1, 2, 3	-	-
Windshield Wiper/Washer Switch Low Reference	-	1	1	-
1. Windshield Wipers Inoperative 2. Windshield Wipers High Speed Inoperative 3. Windshield Wipers Intermittent or Low Speed Inoperative 4. Windshield Wipers Always ON				

Circuit/System Description

The body control module (BCM) controls the windshield wiper motor based on inputs from the windshield wiper/washer switch, and when intermittent mode is selected, the rain/ambient light sensor module. The BCM monitors the windshield wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper/washer switch utilizes resistive multiplexing to signal a low speed and intermittent operation request to the BCM while a separate discrete signal circuit is used to indicate a high speed wiper request. When the wiper switch is placed in the low speed or intermittent position, the BCM monitors the voltage drop, which changes dependent upon switch position, over an internal pulled high resistor. The BCM will respond by commanding on the low speed or intermittent wipers. With the windshield wiper/washer switch in the high speed position, the BCM's high speed signal circuit is pulled low. The BCM will respond by commanding the windshield wiper motor to operate at high speed via serial data.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that there are no communications DTCs set.

- **If any communication DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no communication DTCs are set**

3. Verify that DTC B371A is not set.

- **If DTC B371A is set**

Refer to [DTC B371A](#).

- **If DTC B371A is not set**

4. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when activating the high speed windshield wipers.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

5. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when activating the low speed windshield wipers.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

6. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the intermittent speed windshield wipers.

- **If the parameter does not change**

Test or replace the S82 Windshield Wiper/Washer Switch.

- **If the parameter changes**

7. Verify the M75 Windshield Wiper Motor changes between Off, Low, and High when cycling the S82 Windshield Wiper/Washer Switch between Off, Low, and High.

- **If the M75 Windshield Wiper Motor does not cycle between Off, Low, and High**

Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction

- **If the M75 Windshield Wiper Motor cycles between Off, Low, and High**

8. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.

6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control

Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Test for greater than 8 V between the signal circuit terminal 3 and ground.
 - **If less than 8 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If 8 V or greater**
8. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
10. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Wiper Motor Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M75 Windshield Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.

4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, M75 Windshield Wiper Motor
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 3 and ground.
6. Verify the test lamp turns ON and OFF when turning the high speed wipers ON and OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
7. Remove the test lamp.
8. Test for 8 - 9 V between the serial data circuit terminal 4 and ground.
 - **If less than 8 V**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the serial data circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the serial data circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 9 V**
1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the serial data circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V or greater, replace the K9 Body Control Module.
 - **If 8 - 9 V**
9. Test or replace the M75 Windshield Wiper Motor.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 1 and the low reference terminal 2 with the high speed switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

 - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 1 and the low reference circuit terminal 2 with the high speed switch in the closed position.
 - **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.

 - **If less than 2 Ω**
4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 2 with the low speed switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.

 - **If infinite resistance**
5. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.
 - Delay 1 : 3.75-3.85k Ω
 - Delay 2 : 2.75-2.85k Ω
 - Delay 3 : 1.95-2.05k Ω
 - Delay 4 : 1.25-1.35k Ω
 - Delay 5 : 765-775 Ω
 - **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within the specified range**

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Windshield Wiper System Module Replacement](#)
- [Windshield Wiper and Washer Switch Replacement](#)
- [Fuse Block Replacement](#)
- [Control Module References](#) for body control module replacement, programming and setup.

LOW WASHER FLUID INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	2	1	-	-
Ground	-	1	-	-
1. Low washer fluid message always displayed 2. Low washer fluid message never displayed				

Circuit/System Description

The check washer fluid message is controlled by the instrument cluster using signal from the Windshield Washer Fluid level Sensor. The washer fluid level signal circuit is supplied voltage through a resistor then monitored within the instrument cluster. The Windshield Washer Fluid level Sensor is normally open so the instrument cluster detects voltage on the Windshield Washer Fluid level Sensor signal circuit whenever the washer fluid level sensor is low. When the washer fluid reaches the point where the driver should be informed that the washer fluid is low, the washer fluid level sensor closes. When the washer fluid level sensor is closed the washer fluid level signal circuit voltage is pulled low, and the instrument cluster displays the Adding Washer Fluid message on the driver information center. In order to prevent the Adding Washer Fluid message from being displayed while sloshing is occurring in the washer fluid container, the instrument cluster is programmed with a 1 min delay before changing states of the check washer fluid message during an ignition cycle.

Reference Information

Schematic Reference

[Wiper/Washer Schematics](#)

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for Scan Tool Information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Washer Fluid Level Switch parameter changes between ON and OFF, when filling and emptying the windshield water bottle.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B118B Windshield Washer Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Washer Fluid Level Switch parameter is Off
 - **If not Off**
 1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the P16 Instrument Cluster.

• **If Off**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 2.

6. Verify the scan tool Washer Fluid Level Switch parameter is On.

• **If not On**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the P16 Instrument Cluster, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the P16 Instrument Cluster.

• **If On**

7. Test or replace the B118B Windshield Washer Fluid Level Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Windshield Washer Solvent Container Replacement](#)
- [Control Module References](#) for instrument cluster replacement, programming and setup

WASHER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873

Front Washer Relay Circuit

For symptom byte information, refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	-	3	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Washer Switch Signal	1, 2	1	1	-
Windshield Washer Pump Control	3	3	2	-
Windshield Washer Pump Relay Control	B3873 02	B3873 04	B3873 01	-
Underhood Fuse Block Ground	-	3	-	-
Windshield Washer Pump Ground	-	3	-	-
1. Windshield Washer Switch Malfunction 2. Windshield Washer Pump Always ON 3. Windshield Washer Pump Inoperative				

Circuit/System Description

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when

pressing the windshield washer switch.

- **If the parameter does not change**

Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

- **If the parameter changes**

3. Verify the G24 Windshield Washer Pump activates and deactivates when commanding the Windshield Washer Relay Active and Inactive with a scan tool.

- **If the G24 Windshield Washer Pump does not activate or does not deactivate**

Refer to Circuit/System Testing - Windshield Washer Pump Malfunction

- **If the G24 Windshield Washer Pump activates and deactivates**

4. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Windshield Washer Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 2.

6. Verify the scan tool Windshield Washer Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
- **If Active**

7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.
 - **If the test lamp turns ON and OFF**

Test or replace the G24 Windshield Washer Pump.
 - **If the test lamp does not turn ON and OFF**
5. Vehicle OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 48 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Vehicle OFF, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal 1 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump is not activated**
9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
 10. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than Infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the G24 Windshield Washer Pump.
 - **If the G24 Windshield Washer Pump activates**
 11. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 12. Verify the G24 Windshield Washer Pump is not activated.
 - **If the G24 Windshield Washer Pump is activated**
 1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
 2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 14 X4 and ground, vehicle in Service Mode.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump is not activated**
 13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
 14. Verify the G24 Windshield Washer Pump activates.
 - **If the G24 Windshield Washer Pump does not activate**
 1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the X50A Fuse Block - Underhood.
 - **If the G24 Windshield Washer Pump activates**
 15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 5 and the low reference terminal 2 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 5 and the low reference circuit terminal 2 with the switch in the closed position.
 - **If 2 Ω or greater**

Replace the S82 Windshield Wiper/Washer Switch.
 - **If less than 2 Ω**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Windshield Washer Pump Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Fuse Block Replacement**
- **Control Module References** for body control module replacement, programming and setup.

WIPER BLADE ELEMENT CHECK

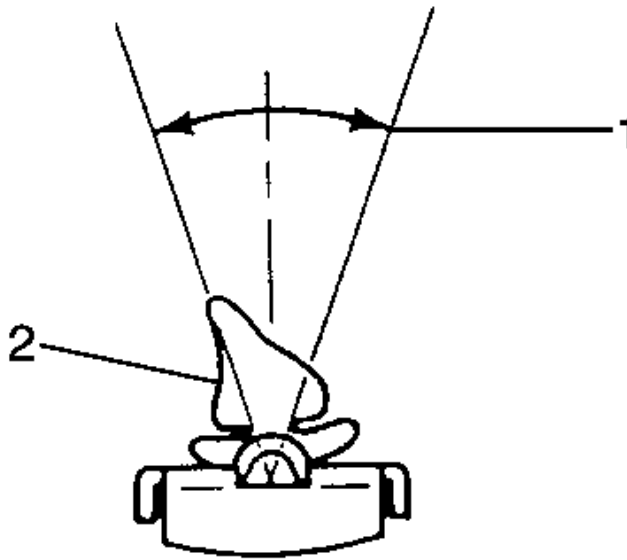


Fig. 2: Wiper Blade Element Check

Courtesy of GENERAL MOTORS COMPANY

1. Remove the wiper blade from the wiper arm. Refer to [Windshield Wiper Blade Replacement](#).
2. Look down the entire length of the blade element.
3. The rubber part of the element (2) that contacts the window must be on the center line of the blade plus or minus 15 degrees (1).
4. Replace the blade element (2) if the element exceeds 15 degrees from the centerline of the blade, or if the element is cracked or torn. Refer to [Windshield Wiper Blade Replacement](#)
5. Install the wiper blade onto the windshield wiper arm.

REPAIR INSTRUCTIONS

WINDSHIELD WIPER AND WASHER SWITCH REPLACEMENT

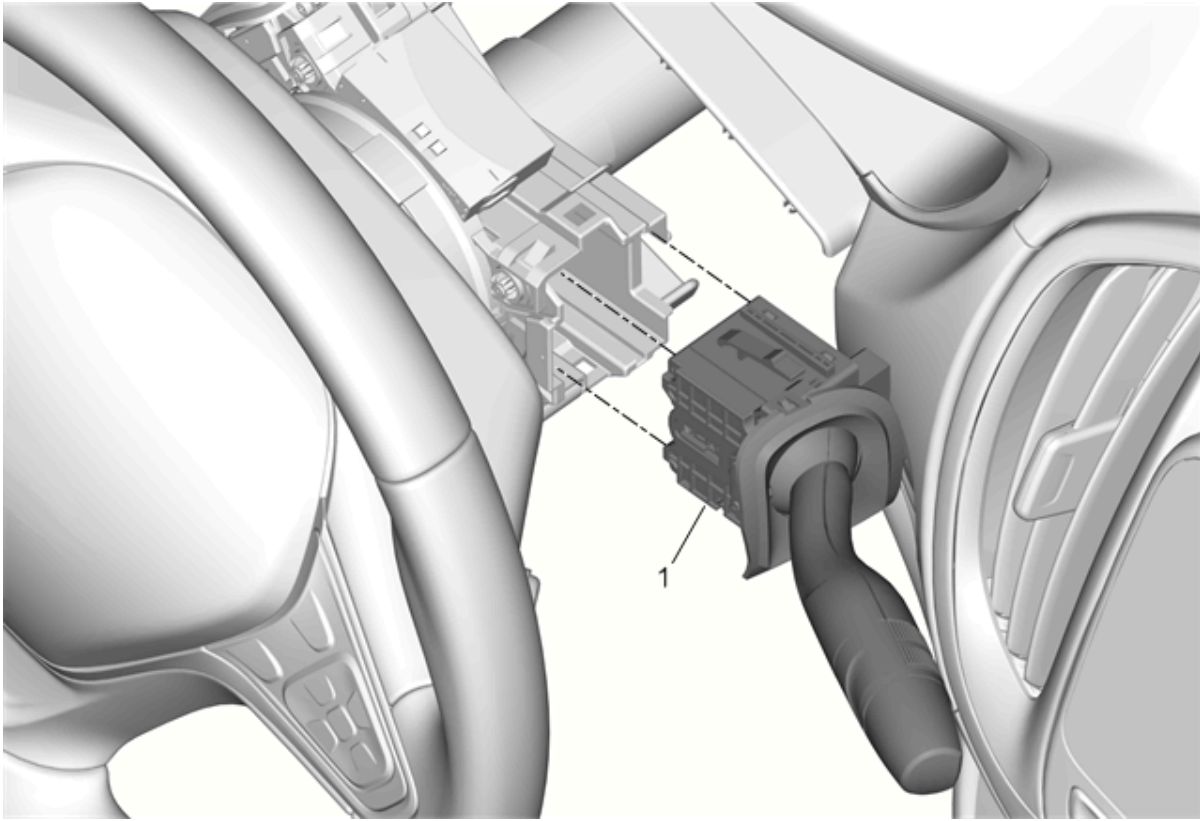


Fig. 3: Windshield Wiper and Washer Switch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Steering Column Lower Trim Cover Replacement</u> - Reposition the steering column upper trim cover as necessary.	
1	Windshield Wiper and Washer Switch Procedure - Disconnect the electrical connector. - Release the retaining tabs and remove the windshield wiper and washer switch from the turn signal switch bracket.

WINDSHIELD WASHER NOZZLE HOSE REPLACEMENT

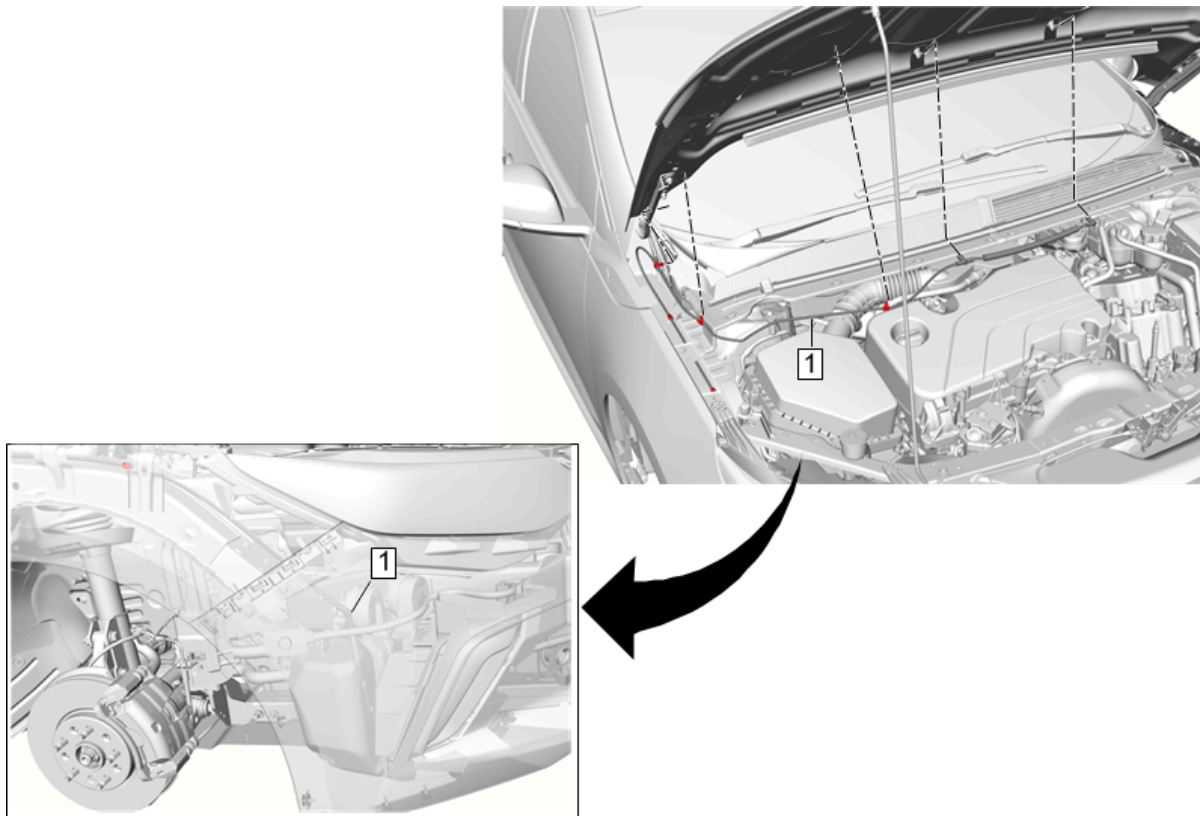


Fig. 4: Windshield Washer Nozzle Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the	

Callout	Component Name
	presence of high voltage. - Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: - Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. - Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. - Visually and functionally inspect the gloves before use. - Wear the Insulation gloves with leather

Callout	Component Name
	protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. <u>Front Wheelhouse Liner Replacement (Left Side)</u> <u>Front Wheelhouse Liner Replacement (Right Side)</u> 2. Drain the windshield washer solvent into a suitable clean container. 3. Remove Windshield Washer Nozzle Hose@Windshield Washer Solvent Container <u>Windshield Washer Solvent Container Replacement</u> 4. <u>Hood Insulator Replacement</u>
1	Windshield Washer Nozzle Hose Procedure 1. Remove the three washer nozzle hose retainers from the front wheelhouse panel inner front brace. 2. Remove the washer nozzle hose retainer from the hood hinge. 3. Remove the two washer nozzle hose retainers from the hood inner panel. 4. Remove the washer nozzle hose from both windshield washer nozzles. 5. Carefully remove the washer nozzle hose from the engine compartment.

WINDSHIELD WASHER NOZZLE REPLACEMENT

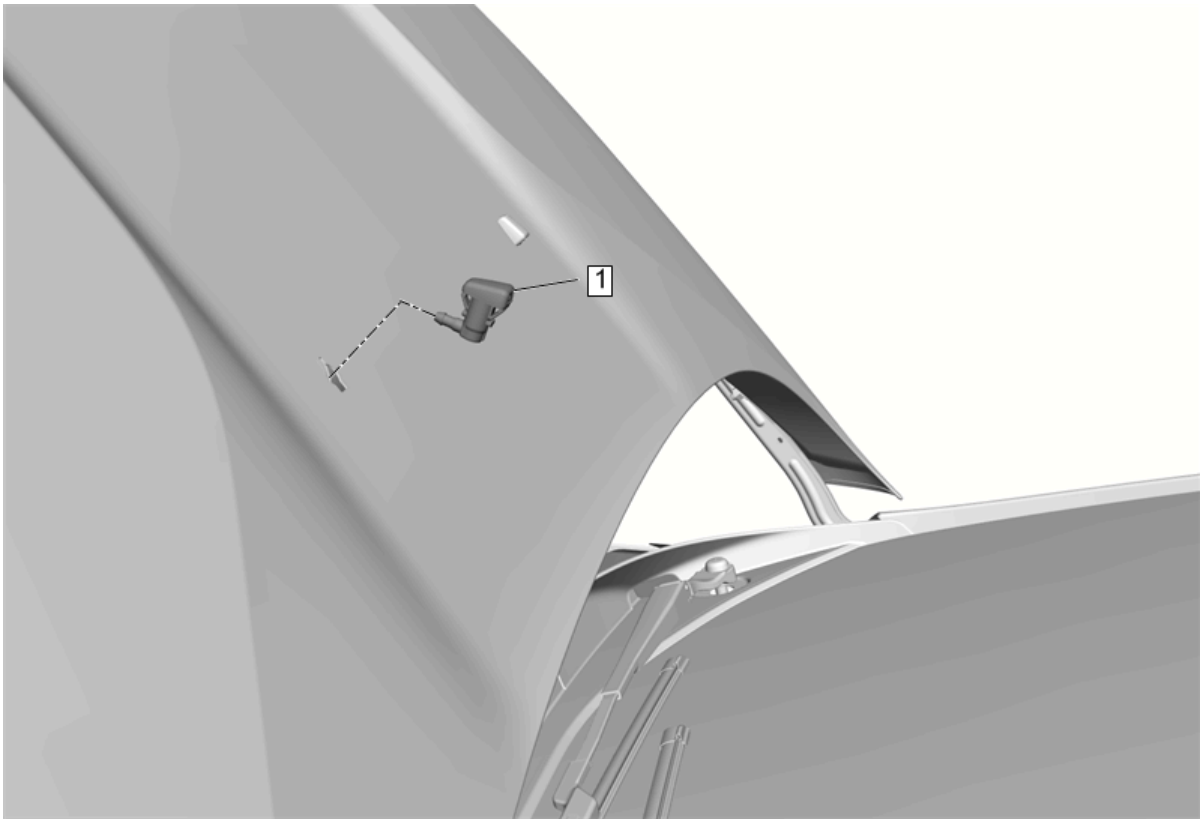


Fig. 5: Windshield Washer Nozzle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Open the hood. 2. <u>Hood Insulator Replacement</u> 3. Disconnect the windshield washer pump hose.	
1	Windshield Washer Nozzle Procedure Depress the windshield washer nozzle tabs and push the nozzle upward and outward from the hood.

WINDSHIELD WASHER SOLVENT CONTAINER FILLER TUBE REPLACEMENT

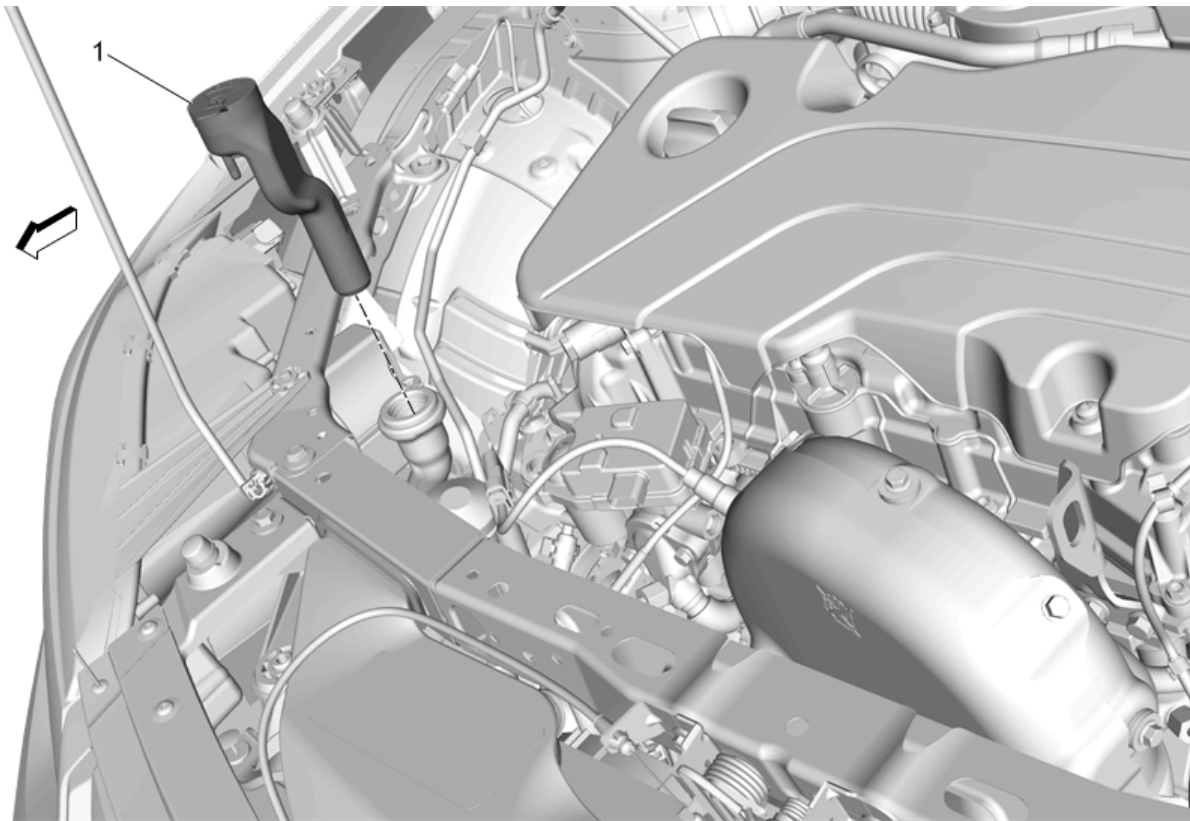


Fig. 6: Windshield Washer Solvent Container Filler Tube

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the hood.	
1	Windshield Washer Solvent Container Filler Tube Procedure Pull upward on the filler tube in order to disconnect the filler tube from the windshield washer solvent container grommet.

WINDSHIELD WASHER SOLVENT CONTAINER GROMMET REPLACEMENT

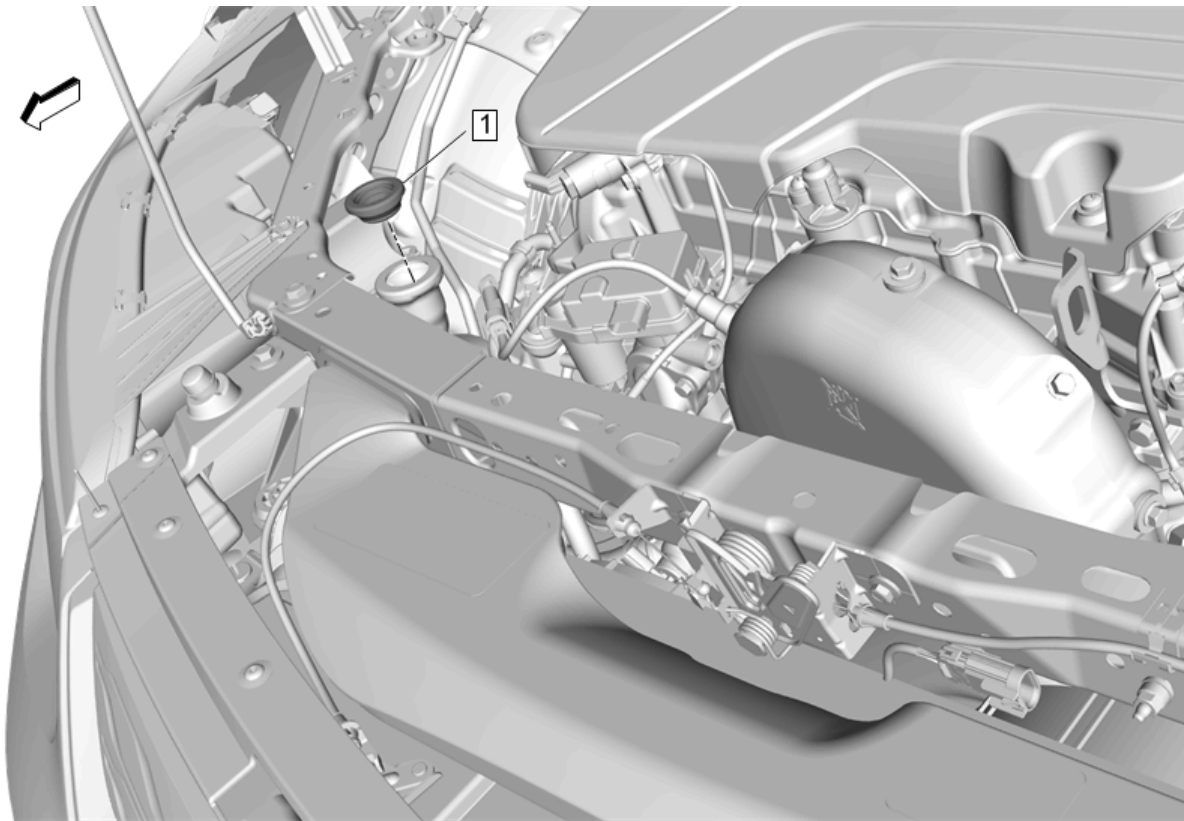


Fig. 7: Windshield Washer Solvent Container Grommet

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Windshield Washer Solvent Container Filler Tube Replacement</u>	
1	Windshield Washer Solvent Container Grommet Procedure 1. Carefully squeeze the grommet while using a flat-bladed tool to pry upward under the edge of the grommet. 2. When installing a new grommet, use full strength windshield washer fluid as a lubricant on the grommet. 3. Place the grommet to the windshield washer solvent container. 4. Use the palm of the hand to seat the grommet into the windshield washer solvent container.

WINDSHIELD WASHER SOLVENT CONTAINER REPLACEMENT

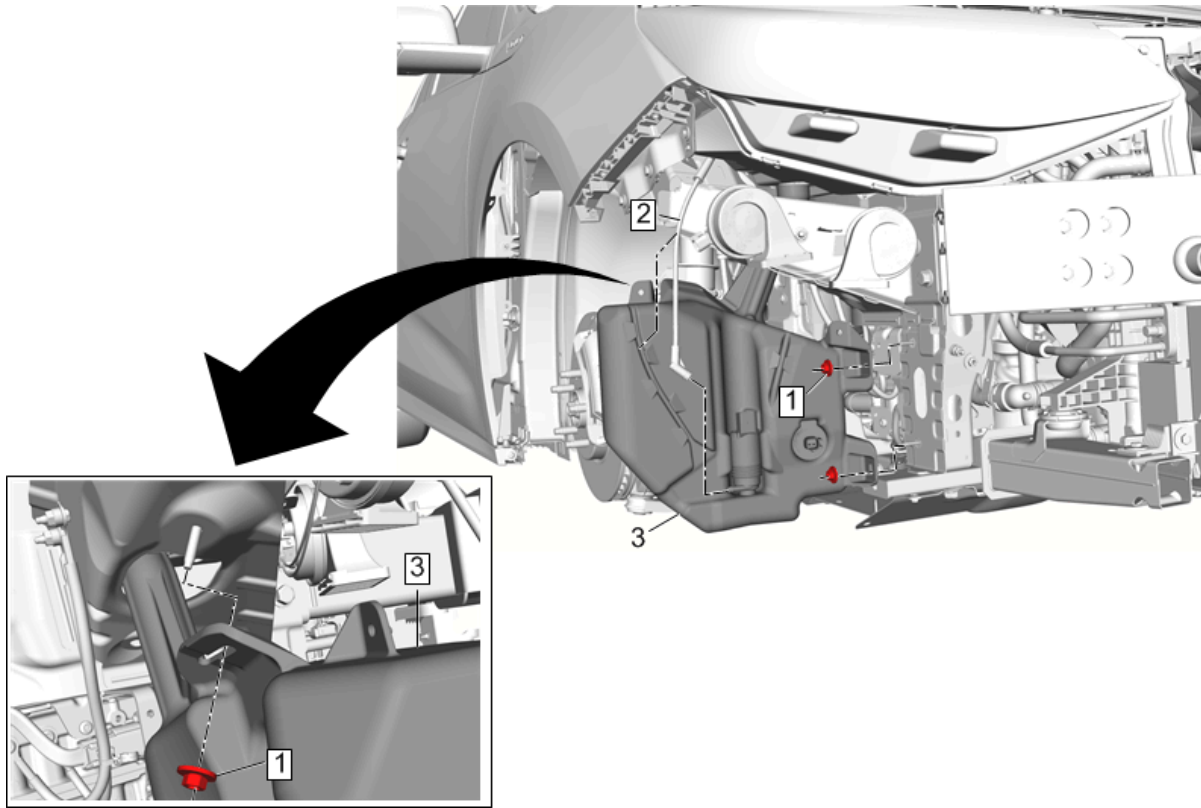


Fig. 8: Windshield Washer Solvent Container
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Windshield Washer Solvent Container Filler Tube Replacement 2. Headlamp Replacement - Disconnect the electrical connectors.	
1	Windshield Washer Solvent Container Nut (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Windshield Washer Pump Hose Procedure Disconnect the windshield washer pump hose.
3	Windshield Washer Solvent Container Procedure

Callout	Component Name
	1. Remove the windshield washer solvent container from the vehicle. 2. Drain the windshield washer solvent into a suitable clean container. 3. Transfer components as necessary. 4. Fill the washer container with clean washer solvent once the installation has been completed.

WINDSHIELD WASHER PUMP REPLACEMENT

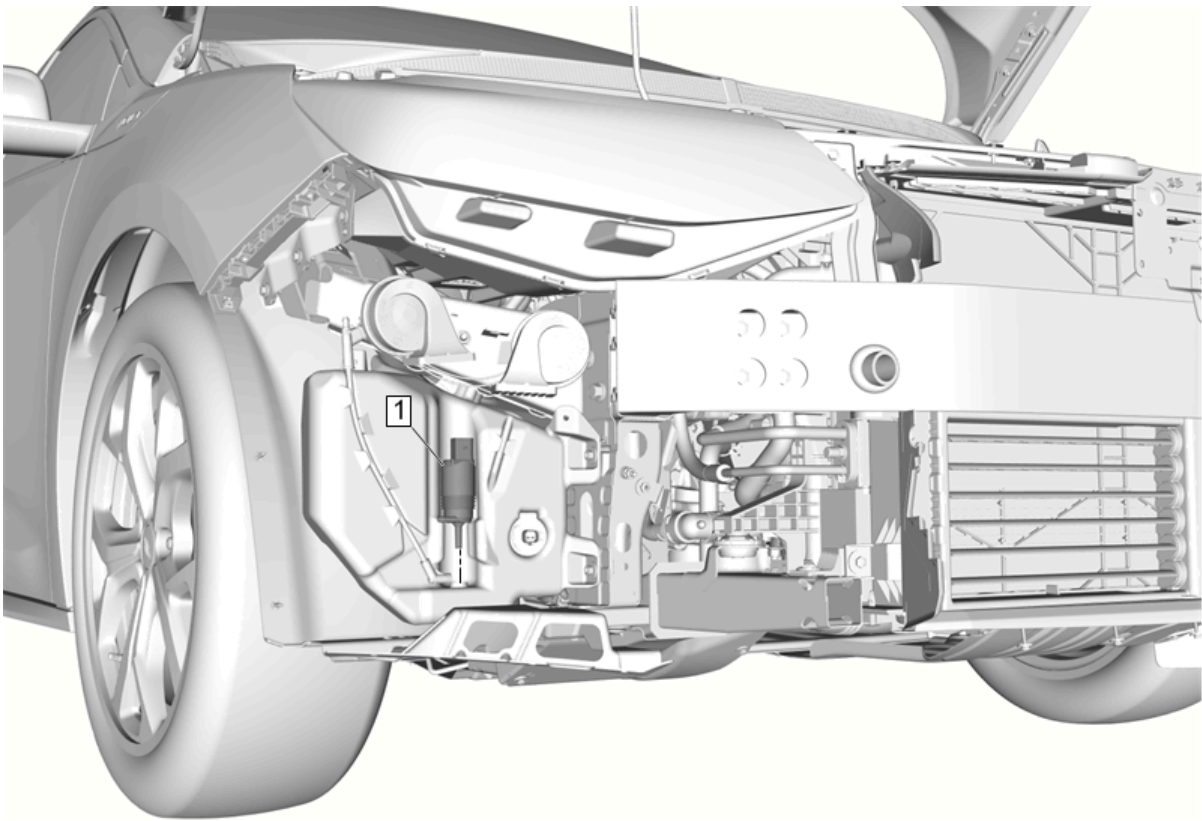


Fig. 9: Windshield Washer Pump
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. <u>Front Bumper Fascia Removal and Installation</u> 2. Place a clean suitable drain pan under the windshield washer solvent container to contain any lost windshield washer solvent.	
1	Windshield Washer Pump Procedure 1. Disconnect the electrical connector. 2. Disconnect the windshield washer pump hose.

Callout	Component Name
	3. Using two flat-bladed tools underneath the washer pump grommet, turn the flat-blades in opposite directions to disengage the washer pump from the washer pump grommet. 4. Remove the washer pump grommet and discard.

WINDSHIELD WASHER PUMP GROMMET REPLACEMENT

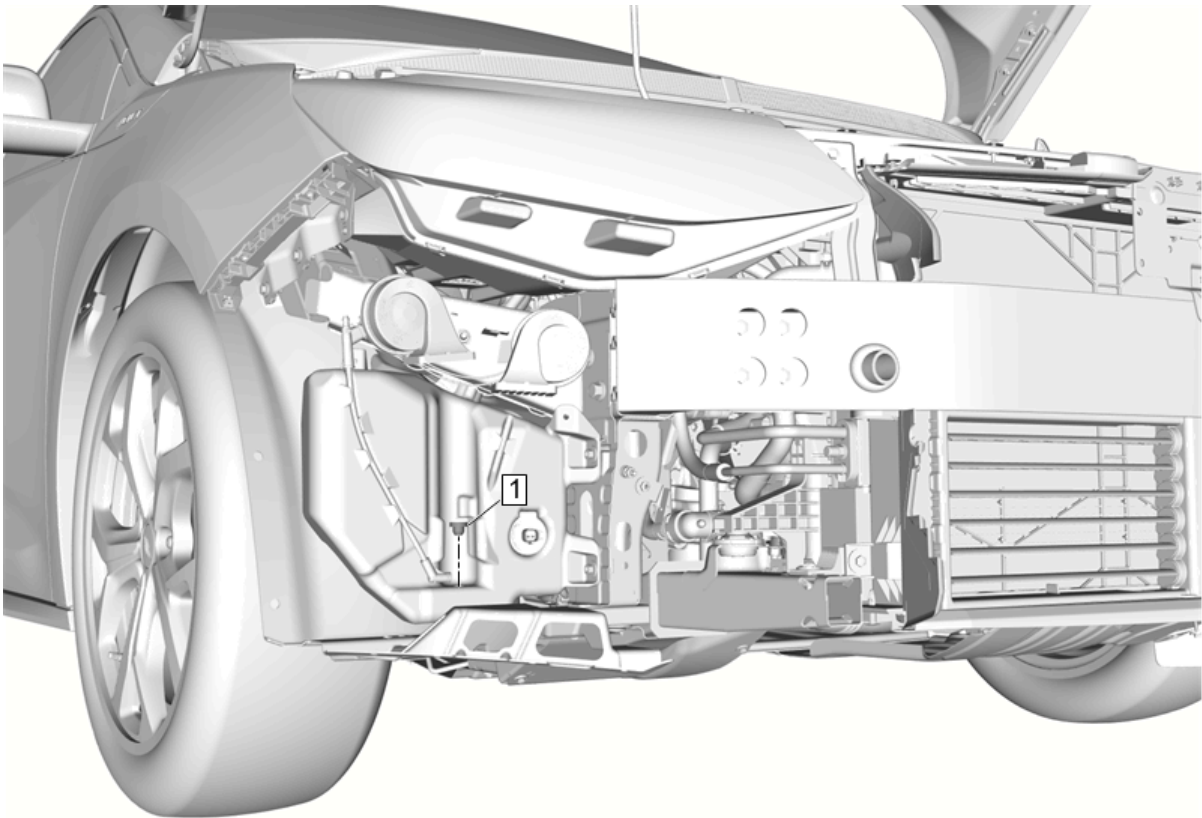


Fig. 10: Windshield Washer Pump Grommet
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Windshield Washer Pump Replacement</u>	
1	Windshield Washer Pump Grommet

DASH UPPER EXTENSION PANEL OPENING COVER REPLACEMENT

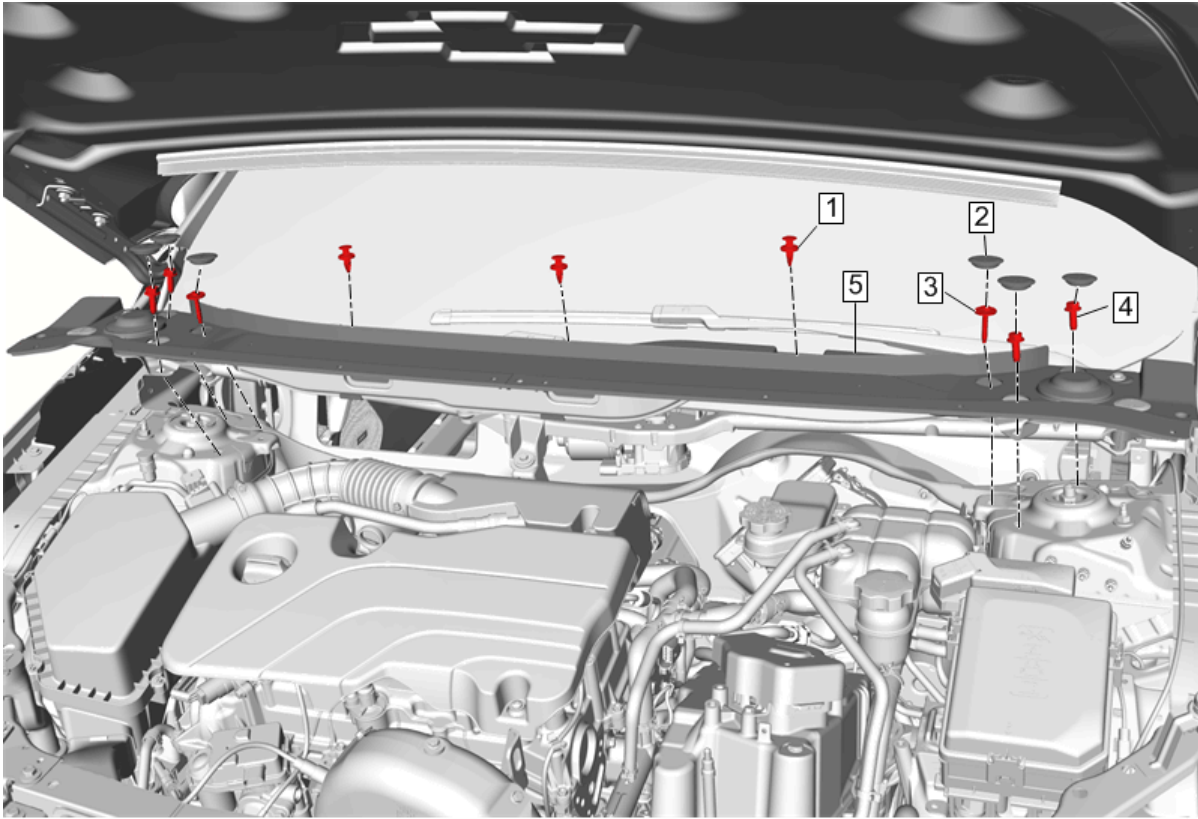


Fig. 11: Dash Upper Extension Panel Opening Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Air Inlet Grille Panel Replacement</u>	
1	Dash Upper Extension Panel Opening Cover Retainer (Qty: 3)
2	Dash Upper Extension Panel Opening Cover Bolt Plug (Qty: 6)
3	Dash Upper Extension Panel Opening Cover Bolt (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 22 N.m (16 lb in)
4	Front Suspension Strut Housing Brace Bolt (Qty: 4) Tighten 22 N.m (16 lb ft)
5	Dash Upper Extension Panel Opening Cover Procedure Transfer components as necessary. NOTE:

Callout	Component Name
	Dash Upper Extension Panel Opening Cover and Front Suspension Strut Housing Brace are removed as an assembly.

AIR INLET GRILLE PANEL REPLACEMENT

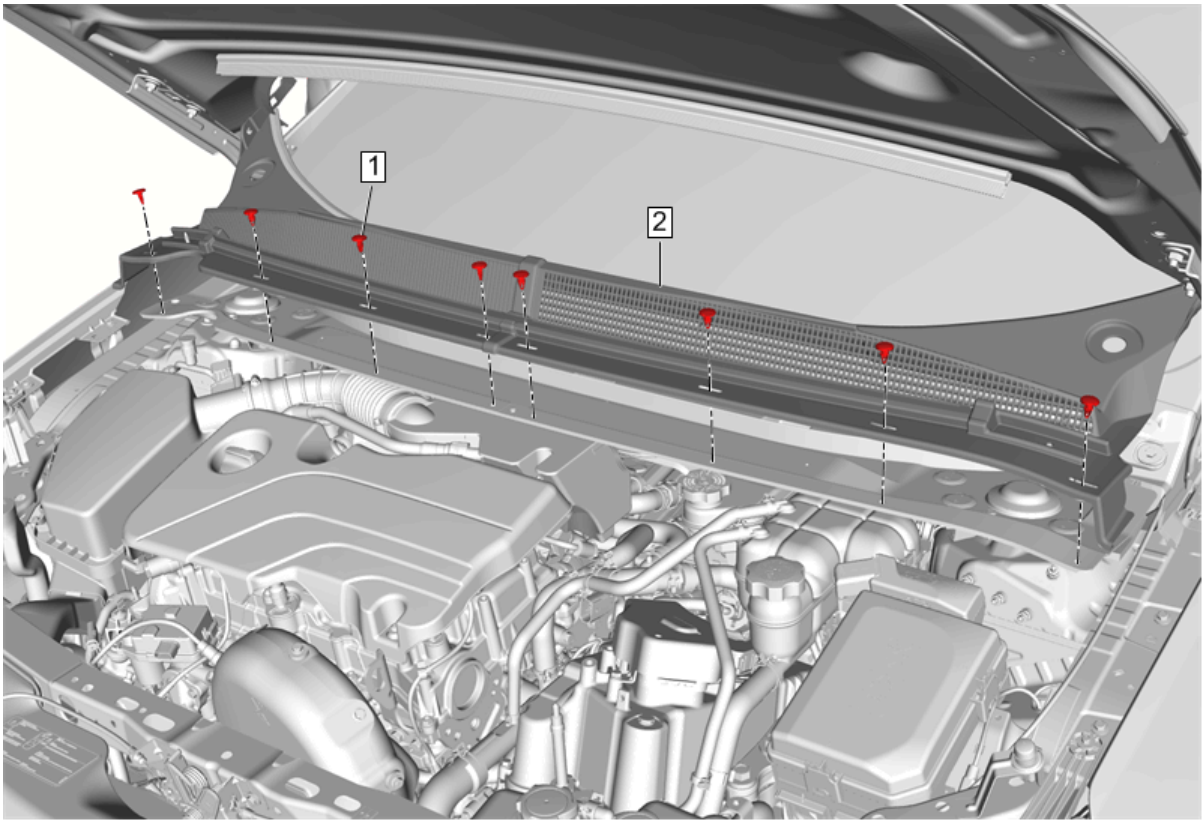


Fig. 12: Air Inlet Grille Panel
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage	

Callout	Component Name
	component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.

Callout	Component Name
• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. <u>Windshield Wiper Arm Replacement</u> 2. <u>Air Inlet Grille Panel Extension Replacement</u> 3. <u>Hood Rear Weatherstrip Replacement</u>	
1	Air Inlet Grille Panel Retainer (Qty: 8) Procedure Use a flat bladed plastic tool to remove the push-in retainers.

Callout	Component Name
2	Air Inlet Grille Panel Procedure Lift the grille panel forward and upward to clear the pivot shafts from the vehicle.

AIR INLET GRILLE PANEL EXTENSION REPLACEMENT

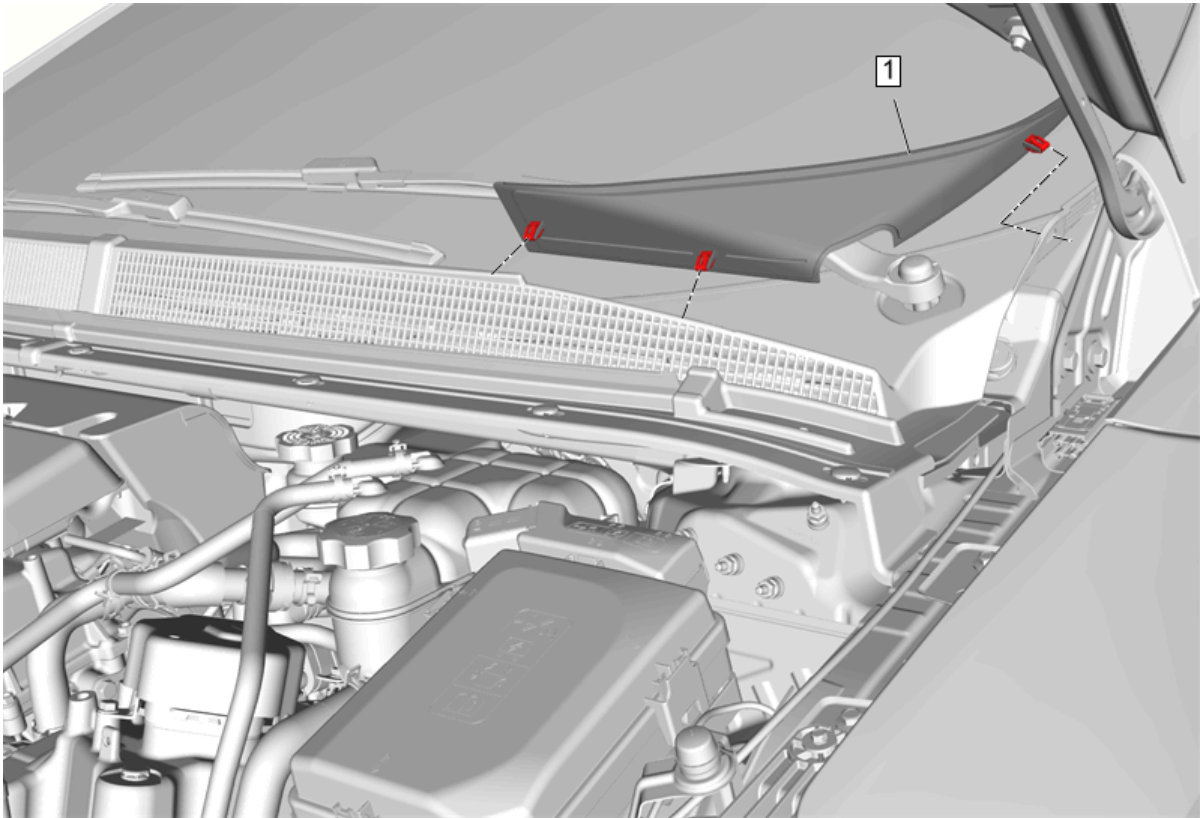


Fig. 13: Air Inlet Grille Panel Extension
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Air Inlet Grille Panel Extension Procedure Disengage the retainers while working from the front to rear then pull the extension forward to remove.

WINDSHIELD WIPER ARM REPLACEMENT

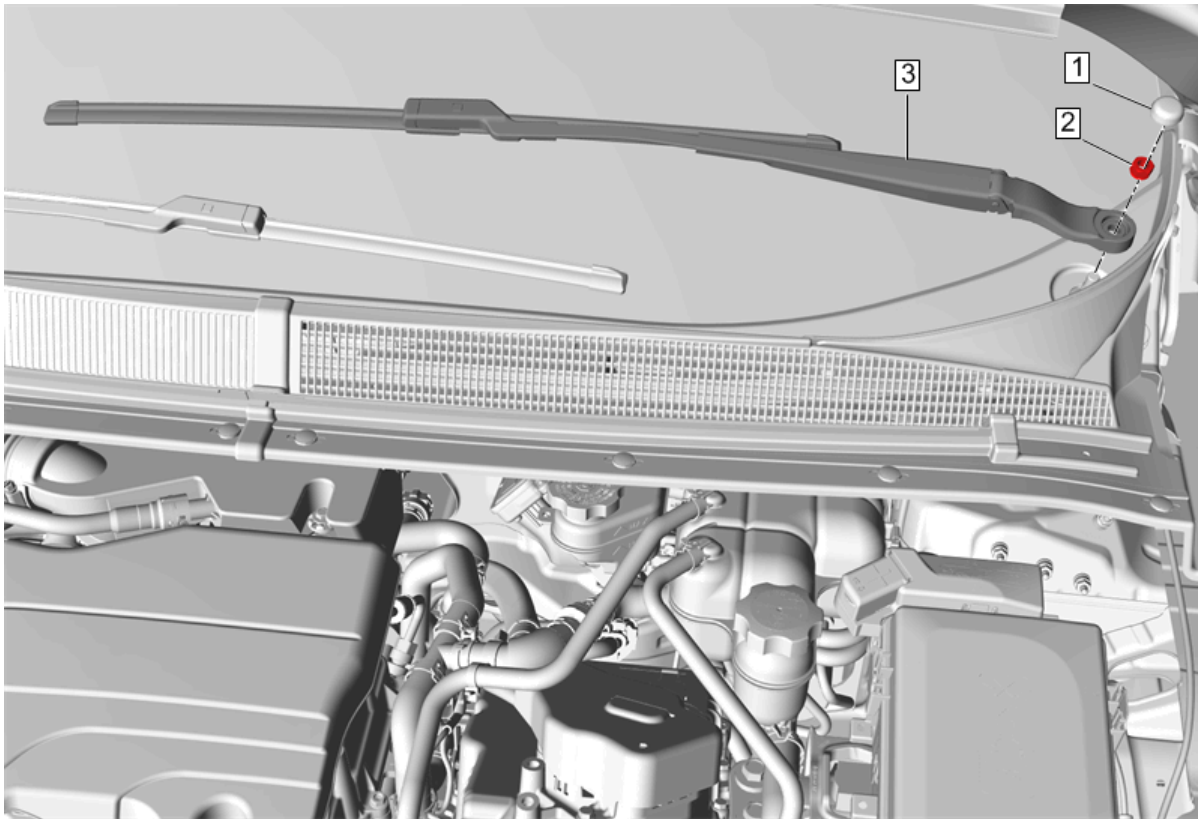


Fig. 14: Windshield Wiper Arm

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the hood.	
1	Windshield Wiper Arm Finish Cap Procedure Using a flat balded tool, remove the cap from the wiper arm.
2	Windshield Wiper Arm Nut CAUTION: Refer to Fastener Caution . Tighten 30 N.m (22 lb ft)
3	Windshield Wiper Arm CAUTION: To avoid breakage of the windshield,

Callout	Component Name
	protect the surrounding area of the part which you are removing or installing. Procedure 1. Use the J 39822 Wiper Arm Puller to remove the wiper arm from the wiper motor pivot shaft. 2. Clean the pivot shaft splines with a soft wire brush. 3. Grasp the rear of the wiper arm, place the arm over the pivot shaft. 4. Align the tip of the wiper blade to the small transparent circle in the lower center windshield blackout area. 5. Install the windshield wiper arm nut. 6. Cycle the wiper arm with a spray of windshield washer solvent, PARK the wiper arms and re-check the alignment of the wiper blade tip to the windshield transparent circle. Special Tools J 39822 Wiper Arm Puller

WINDSHIELD WIPER BLADE REPLACEMENT

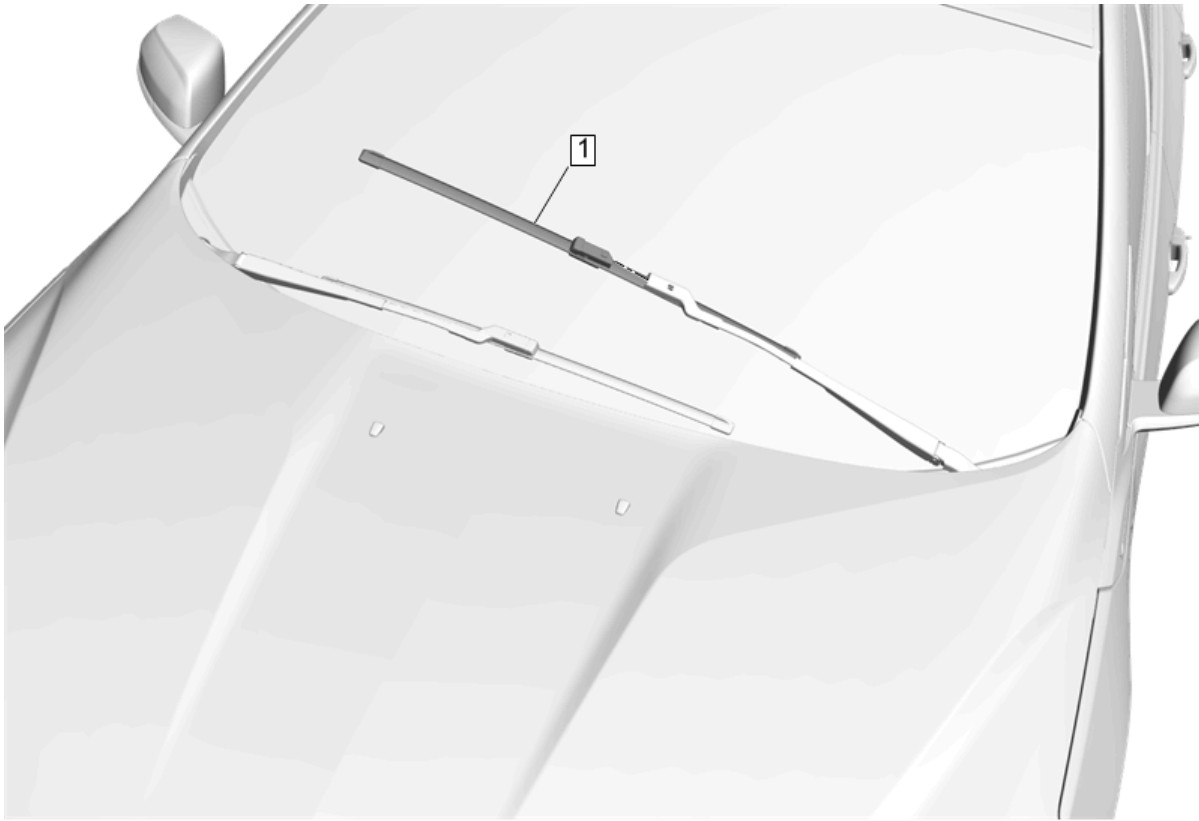


Fig. 15: Windshield Wiper Blade
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Windshield Wiper Blade Procedure 1. Lift the windshield wiper arm from the windshield. 2. Depress the small square tab on the topside of the wiper arm. 3. Rotate the blade downward and slide the wiper blade from the wiper arm.

WINDSHIELD WIPER SYSTEM MODULE REPLACEMENT

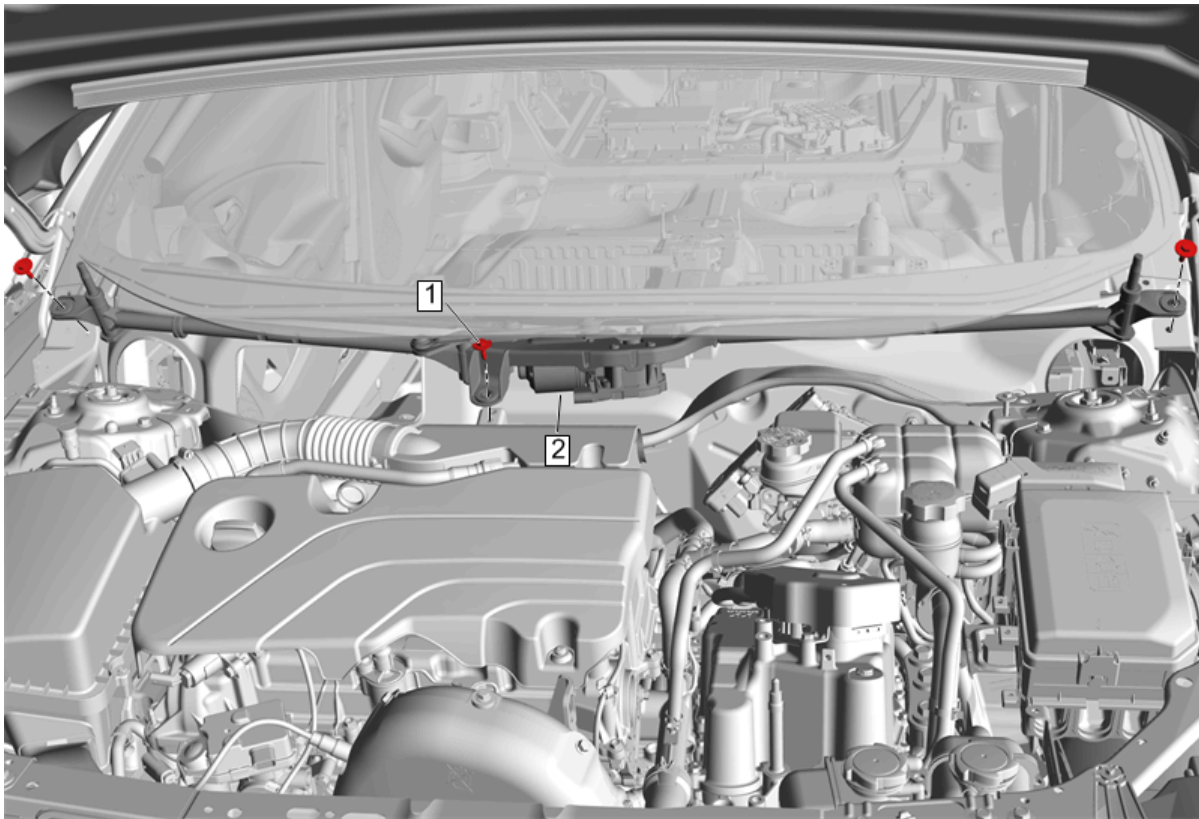


Fig. 16: Windshield Wiper System Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to	

Callout	Component Name
	test for the presence of high voltage. - Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: - Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. - Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. - Visually and functionally inspect the gloves before use. - Wear the Insulation gloves with

Callout	Component Name
	leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. CAUTION: To avoid breakage of the windshield, protect the surrounding area of the part which you are removing or installing. Preliminary Procedures 1. Open the hood. 2. <u>Front Suspension Strut Housing Brace Replacement</u>
1	Windshield Wiper System Module Bolt (Qty: 3) CAUTION: Refer to <u>Fastener Caution</u> .

Callout	Component Name
	Tighten 9 N.m (80 lb in)
2	Windshield Wiper System Module Procedure 1. Slide a 3 foot piece of 5/16 inch rubber hose, cut along its length, along the edge of the windshield to prevent any accidental damage. Remove the hose before reinstalling components. 2. Lift the front edge of the assembly and pull slightly forward in order to disengage the center support from the backside of the plenum. 3. Disconnect the electrical connector. 4. Remove the system module from the plenum. NOTE: • The lower part of the windshield is not supported by the body structure. It cannot support a technician's weight when leaning on the lower edge of the windshield while performing repairs. The glass also may crack if the exposed edge of the windshield is hit with any tool. • The windshield wiper transmission and motor are a one

Callout	Component Name
	piece module assembly and replaced together.

WINDSHIELD MULTIFUNCTION SENSOR MOUNT BRACKET COVER REPLACEMENT

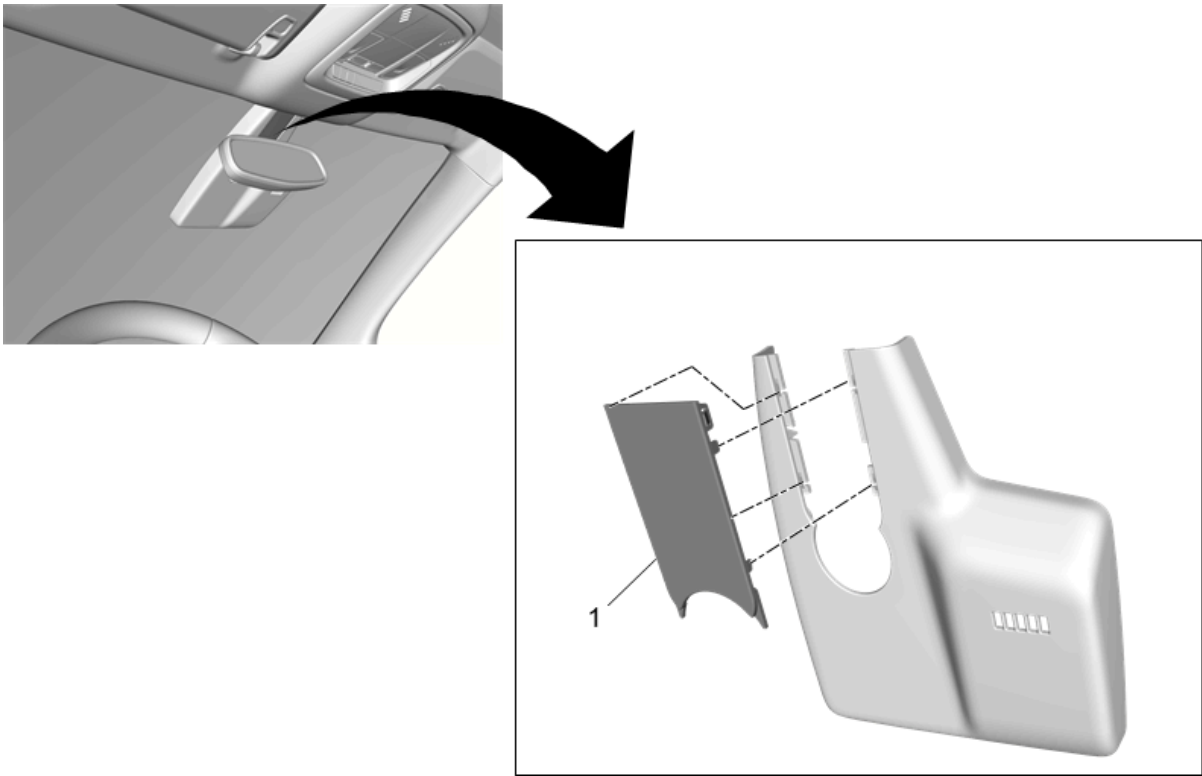


Fig. 17: Windshield Multifunction Sensor Mount Bracket Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Windshield Multifunction Sensor Mount Bracket Cover Procedure - Using a plastic trim tool, carefully pry downward on the sides of the bracket lower cover to release from the window. - Squeeze tabs on bracket cover and pull apart from bracket lower cover.

WINDSHIELD MULTIFUNCTION SENSOR MOUNT BRACKET LOWER COVER REPLACEMENT

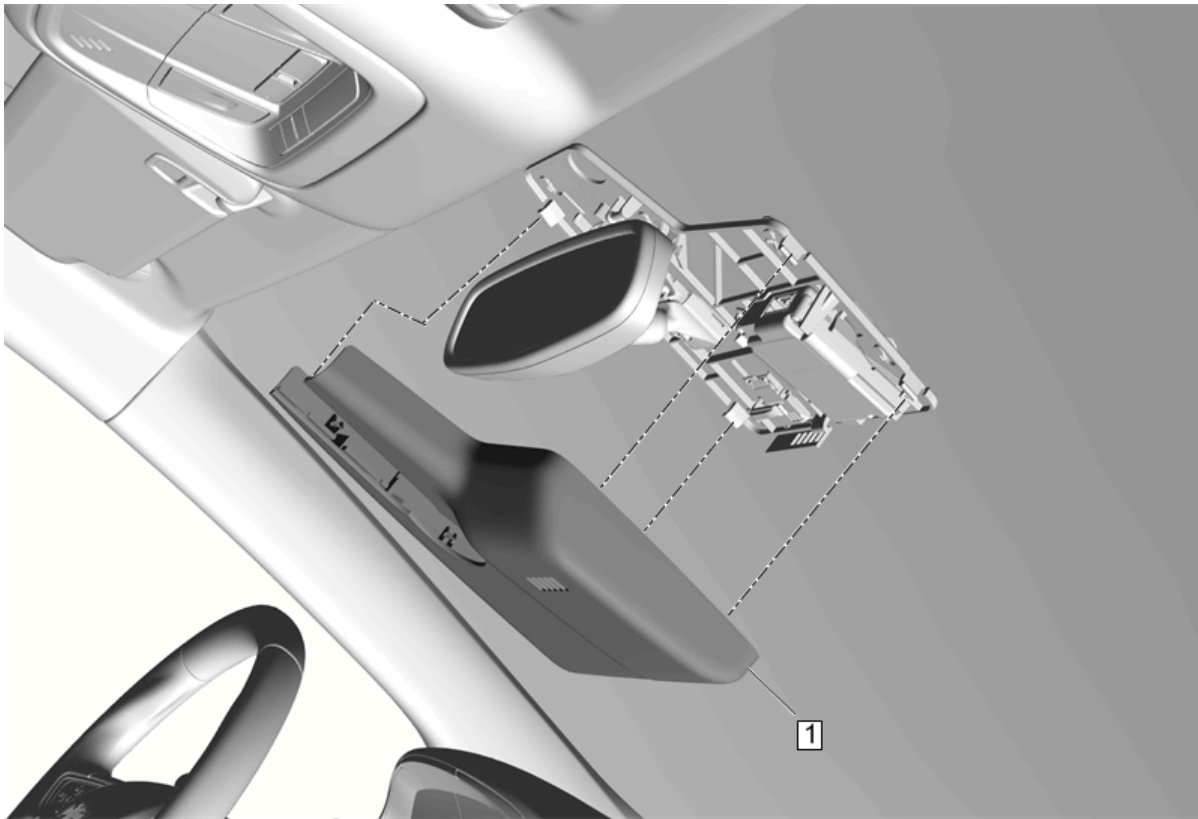


Fig. 18: Windshield Multifunction Sensor Mount Bracket Lower Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Windshield Multifunction Sensor Mount Bracket Cover Replacement</u>	
1	Windshield Multifunction Sensor Mount Bracket Lower Cover

WINDSHIELD GLASS CLEANING

Exterior

Clean the windshield with windshield cleaner, GM P/N 19287404 (18 oz.) or 19259280 (6 oz.) (Canadian P/N 88865156) or equivalent. The cleaner should not harm the paint finish or scratch the glass. The glass is clean when the water no longer beads, but sheets across the entire glass surface.

Interior

The interior glass should be cleaned with plain water only applied with a clean terry cloth towel. Water only eliminates any film or haze on the window and helps prevent fogging.

WIPER BLADE ELEMENT CLEANING

Lift each blade assembly off of the windshield and clean the element with a cloth saturated with full strength washer solvent. Hold the blade in one hand and wipe the element with the saturated cloth until the black residue disappears. Then rinse the blade assembly elements with clean drinkable water.

WIPER CHATTER REPAIR

Some vehicles may exhibit a condition where the windshield wipers chatter and/or wipe unevenly. Several items may contribute to this condition. To completely repair this condition, ALL of the items listed should be inspected and corrected as necessary.

1. Inspect the wiper blade element set. Refer to [Wiper Blade Element Check](#)
2. Clean the wiper blade elements. Refer to [Wiper Blade Element Cleaning](#)
3. Clean the windshield. Refer to [Windshield Glass Cleaning](#)

DESCRIPTION AND OPERATION

WIPER/WASHER SYSTEM DESCRIPTION AND OPERATION

Wiper/Washer System Components

The wiper/washer system consists of the following electrical components:

- Windshield Washer Pump Relay
- Windshield Washer Pump
- Windshield Wiper Motor
- Windshield Wiper/Washer Switch
- Underhood Fuse Block (Contains Windshield Washer Pump PCB Relay)
- Body Control Module (BCM)

Windshield Wiper System

The body control module (BCM) controls the wiper motor based on an input from the wiper switch, and when wiper operation is requested, the BCM will send serial data messages to the windshield wiper motor module. The front wiper system consists of a driver's side and passenger's side wiper arm which are connected by a mechanical linkage driven by the windshield wiper motor module. The windshield wiper motor module contains the necessary electronics, motor, and position sensors to execute front wiper commands from the BCM. The windshield wiper motor module clears the front windshield by controlling the up and down wiper arm movement by the use of a reversing motor and an internal position sensor. The sensor keeps track of the gear wheel position and when the windshield wiper motor module determines that the wiper arms are at a position to reverse direction, it reverses the motor supply voltage by use of its internal motor control circuitry. The BCM communicates with the windshield wiper motor module through serial data. The windshield wiper motor module provides system status and diagnostic information to the BCM for diagnostic reporting and operational purposes.

The BCM utilizes resistive multiplexing through the wiper switch to discern the requested action from the driver. The BCM will respond by commanding the specific wiper function to operate as follows:

1. Using intermittent wipes, the wipers pause briefly on the windshield. If the wiper level is moved to OFF or if additional wipes are not required, the wipers may move to the base of the windshield.
2. If the ignition is put in OFF while the wipers are on LO, HI, or INT, they will immediately stop.
3. If the ignition is put in OFF while the wipers are performing wipes due to windshield washing, the wipers continue to run until they reach the base of the windshield.
4. the wipe delay interval is a function of the INTERMITTENT Delay Interval Switch setting. When

enabled, the Intermittent with Speed feature affects each of the 5 normal Intermittent Delay Intervals as a function of vehicle Speed. The Delay Intervals shall be biased to a shorter delay period with faster vehicle speeds and to a longer delay period with a slower vehicle speed.

The windshield wiper system MIST operation is identical to LOW speed operation, except that the MIST switch is a press and release type switch. When the wiper switch is moved to the MIST position (1X) and released, low speed wiper motor operation is started and will continue until 1 cycle is complete. If the wiper switch is moved to the MIST position and held, the wiper motor will operate in the LOW speed mode until the switch is released.

To initiate high speed wiping operation, the BCM provides continuous high speed wiper operation through setting the serial data signal to high speed Wipe. When the wiper switch lever is moved to the high position (HI) and released, high speed wiper motor operation is started and high speed wiping operation is performed.

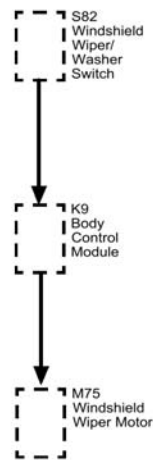


Fig. 19: Windshield Wiper System Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S82	S82 Windshield Wiper/Washer Switch
K9	K9 Body Control Module
M75	M75 Windshield Wiper Motor

Windshield Washer System

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer

pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

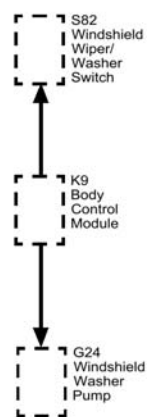
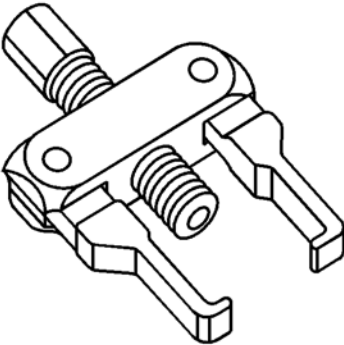


Fig. 20: Windshield Washer System Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S82	S82 Windshield Wiper/Washer Switch
K9	K9 Body Control Module
G24	G24 Windshield Washer Pump

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	J - 39822 Wiper Arm Puller

GENERAL INFORMATION

Air/Wind Noise - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

AIR/WIND NOISE

Air / Wind Noise-Diagnosis and Tests

Tools

- Stethoscope
- Duct tape, foam, etc.

WARNING: Refer to [Assistant Driving Warning](#) .

Overview

To analyze a reported wind noise condition, use the following outline:

- Speak with the customer to obtain as much information as possible.
- Perform a static evaluation of the vehicle to identify potential areas of concern.
- Test drive the vehicle to determine the source of the noise.
- Select the appropriate solution.
- After repair, re-evaluate the vehicle to confirm the customer's complaint is resolved.

When test driving the vehicle, choose a regular route with smooth and straight roads. The area should have little traffic and little noise in order to minimize interference with the test. Drive the vehicle at the speed in which the noise was noticed, or until the noise is heard. Maintain safe and legal speeds.

You can diagnose the following types of wind noise:

- Wind whistle / wind leaks
- Wind rush

When moving at highway speeds, air pressure inside the vehicle becomes greater than the air pressure outside. When a leak occurs, the escaping air causes a hiss or a whistle. Wind whistle / wind leaks are repairable when properly root caused.

Wind rush occurs when air presses over the vehicle's body, and is related to the aerodynamics of the vehicle. Some wind rush is repairable as it relates to part fits and body panel fits. A thorough root cause analysis is required before concluding that the wind noise is not repairable.

Air / Wind Noise - Diagnostic Procedure

Use the following procedure in order to diagnose wind noise:

1. It is important to obtain as many details from the customer as possible in order to assure that you are

addressing the issue that the customer hears. Note the following details:

- The perceived location (B-pillar, mirror, roof, rear of vehicle, front of vehicle, high or low in vehicle)
- The location where the noise is loudest (specific location along the door header, front edge of sunroof, etc.)
- The volume of the noise (very loud, can only hear when radio is off and no ambient noises)
- The ambient conditions (temperature, windy, direction of wind, quiet)
- The road surface (rough, smooth, smooth concrete, ribbed concrete, asphalt)
- The vehicle speed (city, highway, all speeds)
- The interior fan speed (off, low, high, floor mode, defrost, etc.)
- The position of the windows (closed, partially open, full open, which windows are open-front and/or rear, driver and/or passenger)
- The position of the sunroof (closed, partially open, full open)
- What the noise sounds like (whistle, hiss, swoosh, etc.)

2. Using the details learned from the customer, perform a visual inspection of the vehicle for possible causes of the wind noise.

- Misinstalled / torn weatherstrips (door glass seals, door to body seals, sunroof seals) - improper crimping, pins not fully engaged, seals not fully seated, seals pinched or deformed
- Poor Door fits (panels proud to each other, door headers protruding out, etc.)
- Poor Sunroof fits (sunroof proud to roof)
- Poor Windshield fits (windshield proud to roof, windshield lace/molding gaps/distortions, etc.)
- Roof Rack improperly installed (cross bar position fore-aft or backwards)
- Mirrors misinstalled (gapping of mirror patch, mirror skull cap gaps, mirror gasket pinched, seals pinched, etc.)
- Poor Molding fits (windshield moldings, belt moldings, grilles, emblems)
- Any exterior aftermarket items installed (bug deflector, rain guards, etc.)
- Loose fasteners, broken weld joints, sealer and/or adhesive skips

3. Use the customer information to duplicate the driving conditions in order to duplicate the customer concern. Make sure you are working on the issue that the customer hears.

4. Tape off the area of concern on the outside of the vehicle to turn the noise off. Start with a large area of taping to identify the general area of the noise. Then progressively remove sections of the tape until the noise returns. This method can help pinpoint the source of the noise quickly.

5. If necessary, utilize some of the specific diagnostic procedures below (air pressure, bubble, etc.) to understand the leak path.

6. Based on a thorough understanding of the leak path from inside to outside, select the appropriate resolution (refit doors, reposition weatherstrips, reposition gaskets, replace seals, etc.).

7. After repair, test drive the vehicle to confirm the customer complaint is resolved.

TRACING POWDER OR CHALK TEST

Clean the weatherstrips and the contact surfaces with cleaning solvent.

1. Apply powder or chalk in an unbroken line to the contact surface of the weatherstrip surrounding the perimeter of the suspected areas.
2. Close the panel very lightly so as to not disturb the chalk or over-travel the door. Closing the panel completely presses the weatherstrip firmly against the mating surface.
3. Inspect the applied line on the weatherstrip. The applied line is marred where contact is good. A corresponding imprint is on the mating surfaces.
4. Gaps or irregularities in the powder or the chalk line on the mating surfaces indicate the areas with a poor seal.

AIR PRESSURE TEST

1. Close all the windows.
2. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode (or panel mode with fresh air vent on - no recirc).
3. Unlock and close the doors.
4. Listen for escaping air along the door and the window seals with a stethoscope or a length of heater hose.
5. If unsuccessful in identifying the leak path, consider masking off the pressure relief valves (to increase cabin pressure) and perform the evaluation again.

SOAP SUDS OR BUBBLE TEST

1. Close all the windows.
2. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode (or panel mode with fresh air vent on - no recirc).
3. Unlock and close the doors.
4. Apply the soap solution to the potential leak areas.
5. Look for bubbles revealing escaping air.
6. If unsuccessful in identifying the leak path, consider masking off the pressure relief valves (to increase cabin pressure) and perform the evaluation again.

REPAIR INSTRUCTIONS

EXTERIOR WINDNOISE

WARNING: Refer to [Assistant Driving Warning](#) .

Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:
 - [Air Pressure Test](#)
 - [Soap Suds or Bubble Test](#)

- Tracing Powder or Chalk Test

INTERIOR WINDNOISE

WARNING: Refer to Assistant Driving Warning .

Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

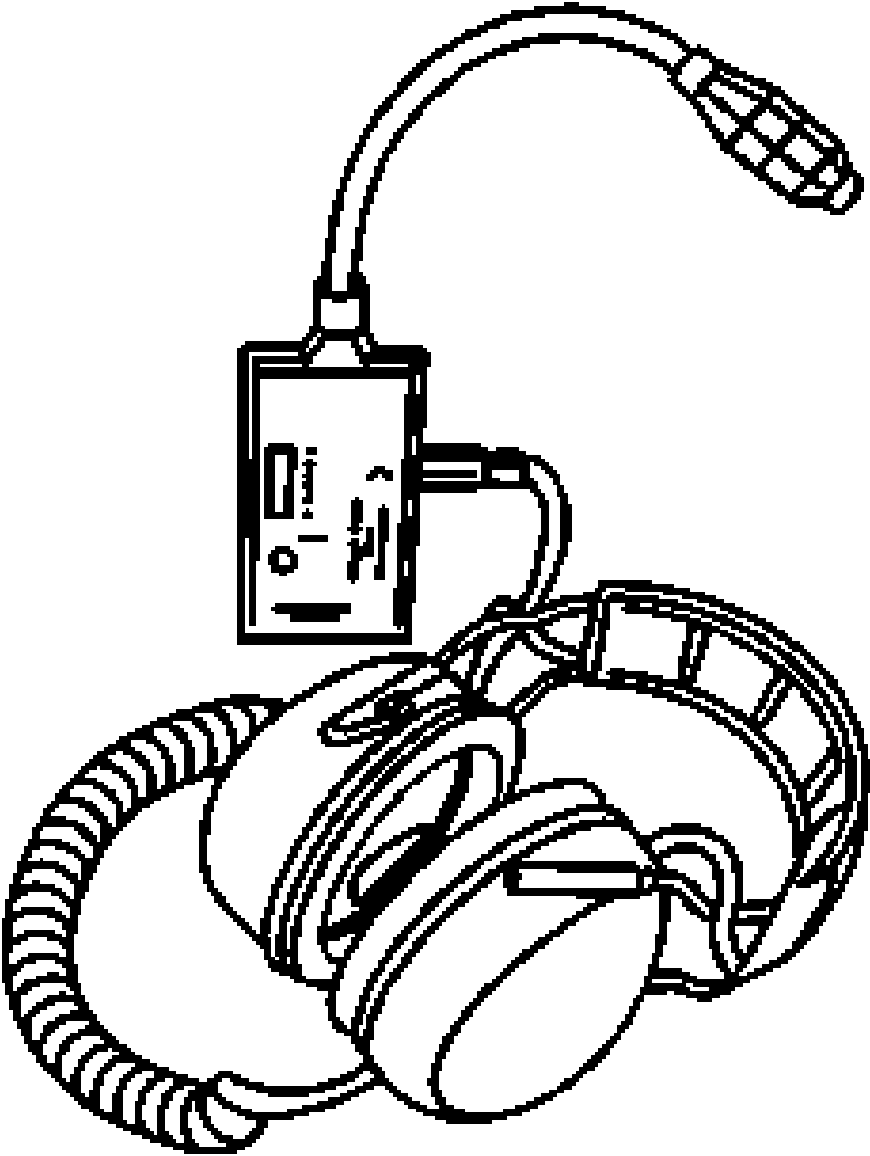
1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:
 - Air Pressure Test
 - Soap Suds or Bubble Test
 - Tracing Powder or Chalk Test

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	--------------------------------

Illustration	Tool Number/ Description
	CH-39570 J 39570 Chassis Ear

Illustration	Tool Number/ Description
	GE-41416 J 41416 Ultrasonic Leak Detector

Article GUID: A00884732

ACCESSORIES & EQUIPMENT

Bumpers and Fascias - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Front Bumper Fascia Bolt	2.2 N.m (19 lb in)
Front Bumper Fascia Center Air Deflector Bolt	2.5 N.m (22 lb in)
Front Bumper Fascia Center Support Bolt	22 N.m (16 lb ft)
Front Bumper Fascia Guide Bolt	2.5 N.m (22 lb in)
Front Bumper Fascia Lower Stiffener Bolt	9 N.m (80 lb in)
Front Bumper Impact Absorber Bolt	58 N.m (43 lb ft)
Front Bumper Impact Bar Bolt	22 N.m (16 lb ft)
Front Bumper Shutter Bolt	2.5 N.m (22 lb in)
Headlamp Bolt	2.5 N.m (22 lb in)
Rear Bumper Fascia Bolt	2.5 N.m (22 lb in)
Rear Bumper Impact Bar Nut	58 N.m (43 lb ft)

SCHEMATIC WIRING DIAGRAMS

ACTIVE GRILLE AIR SHUTTER WIRING SCHEMATICS

Active Grille Air Shutter

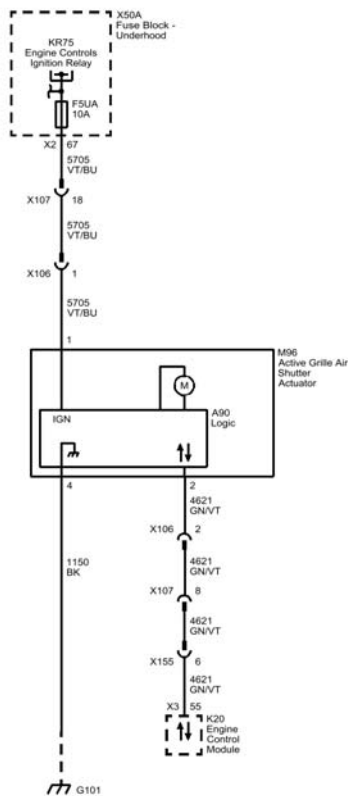


Fig. 1: Active Grille Air Shutter
 Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P059F OR P151E: ACTIVE GRILLE AIR SHUTTER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F

Active Grille Air Shutter 1 Performance

DTC P151E

Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to	Open/High	Short to	Signal Performance
---------	----------	-----------	----------	--------------------

	Ground	Resistance	Voltage	
Ignition	P059F, P151E	P059F, P151E	-	-
Local Interconnect Network Serial Data Bus	U1510	U1510	U1510	U1510
Ground	-	P059F, P151E	-	-

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The Local Interconnect Network (LIN) Serial Data Bus signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 5 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated. The malfunction indicator lamp will illuminate in the second key cycle after a failed movement attempt is made in each of two back to back key cycles.
- The DTC P151E will set if there is a serial data communication failure.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Active Grille Air Shutter Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify DTC U1510 is not set.
 - **If DTC U1510 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If DTC U1510 is not set**
3. Verify the active grille air shutter position parameter changes from 0% (fully closed) to 100% (fully open) when using the scan tool ECM Active Grille Air Shutter Position control function.
 - **If the louvers at the front bumper do not open and close**

Refer to Circuit/System Testing.
 - **If the louvers at the front bumper open and close**
4. Verify none of the following conditions are present:
 - Snow or ice packed in the front fascia which prevents the louvers from moving.
 - Debris or foreign objects which prevent the louvers from moving.
 - **If any of the conditions are present**

Clear any snow, ice or foreign objects from the front grille.
 - **If none of the conditions are present**
5. All OK

Circuit/System Testing

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connector(s) at the active grille air shutter actuator(s). It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit and ground.
 - **If 10 Ω or greater**
 1. Ignition/Vehicle Off.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition On/Vehicle in Service Mode.

4. Verify a test lamp illuminates between the ignition circuit and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition/Vehicle Off.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse. Refer to [Power Mode Mismatch](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition/Vehicle Off.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- **If the test lamp illuminates**

5. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.

1. Test for infinite resistance between the LIN Serial Data Bus circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the LIN Serial Data Bus circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

3. Test for less than 1 V between the LIN Serial Data Bus circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

6. Test or replace the M60A Active Grille Air Shutter 1 Motor Module.

7. Verify DTCs P059F, P151E or U1510 are not set while operating the vehicle under the conditions for setting the DTC.

- **If the DTC is set**

Replace the K20 Engine Control Module.

- **If the DTC is not set**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

SYMPTOMS - ACTIVE GRILLE AIR SHUTTER

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to [Active Grille Air Shutter Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

[Active Grille Air Shutter 1 Malfunction](#)

ACTIVE GRILLE AIR SHUTTER 1 MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F

Active Grille Air Shutter 1 Performance

DTC P151E

Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P059F,	P059F, P151E	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	P151E			
Local Interconnect Network Serial Data Bus	U1510	U1510	U1510	U1510
Ground	-	P059F, P151E	-	-

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The Local Interconnect Network (LIN) Serial Data Bus signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 5 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated. The malfunction indicator lamp will illuminate in the second key cycle after a failed movement attempt is made in each of two back to back key cycles.
- The DTC P151E will set if there is a serial data communication failure.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Active Grille Air Shutter Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify DTC U1510 is not set.
 - **If DTC U1510 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If DTC U1510 is not set**
3. Verify the active grille air shutter position parameter changes from 0% (fully closed) to 100% (fully open) when using the scan tool ECM Active Grille Air Shutter Position control function.
 - **If the louvers at the front bumper do not open and close**

Refer to Circuit/System Testing.
 - **If the louvers at the front bumper open and close**
4. Verify none of the following conditions are present:
 - Snow or ice packed in the front fascia which prevents the louvers from moving.
 - Debris or foreign objects which prevent the louvers from moving.
 - **If any of the conditions are present**

Clear any snow, ice or foreign objects from the front grille.
 - **If none of the conditions are present**
5. All OK

Circuit/System Testing

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connector(s) at the active grille air shutter actuator(s). It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit and ground.
 - **If 10 Ω or greater**
 1. Ignition/Vehicle Off.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition On/Vehicle in Service Mode.

4. Verify a test lamp illuminates between the ignition circuit and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition/Vehicle Off.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse. Refer to [Power Mode Mismatch](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition/Vehicle Off.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- **If the test lamp illuminates**

5. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.

1. Test for infinite resistance between the LIN Serial Data Bus circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the LIN Serial Data Bus circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

3. Test for less than 1 V between the LIN Serial Data Bus circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

6. Test or replace the M60A Active Grille Air Shutter 1 Motor Module.

7. Verify DTCs P059F, P151E or U1510 are not set while operating the vehicle under the conditions for setting the DTC.

- **If the DTC is set**

Replace the K20 Engine Control Module.

- **If the DTC is not set**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

REPAIR INSTRUCTIONS

FRONT BUMPER FASCIA ENERGY ABSORBER REPLACEMENT

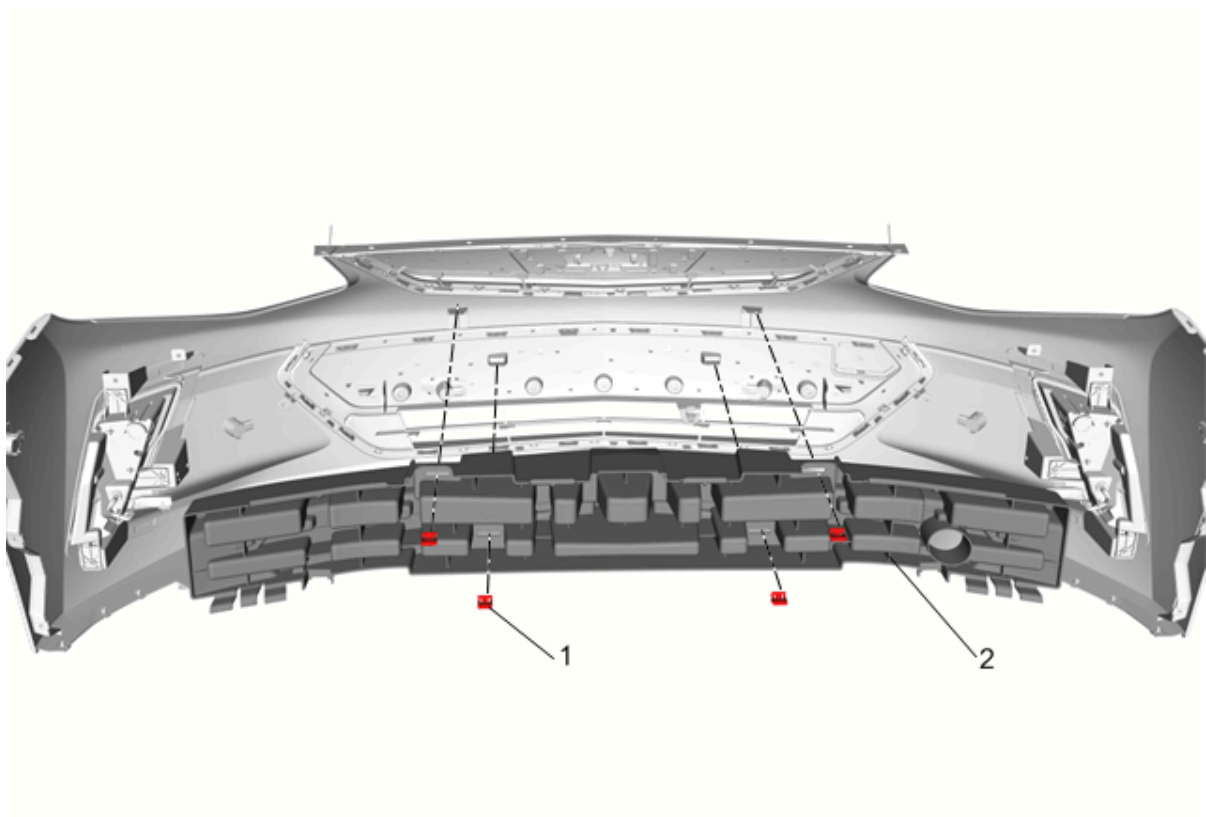


Fig. 2: Front Bumper Fascia Energy Absorber
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Fascia Removal and Installation 2. Place the bumper fascia face down on a clean protective surface. 3. Reposition front bumper fascia wiring harness if needed.	
1	Front Bumper Fascia Energy Upper Absorber Clip (Qty: 4)
2	Front Bumper Fascia Energy Upper Absorber

FRONT BUMPER IMPACT ABSORBER REPLACEMENT

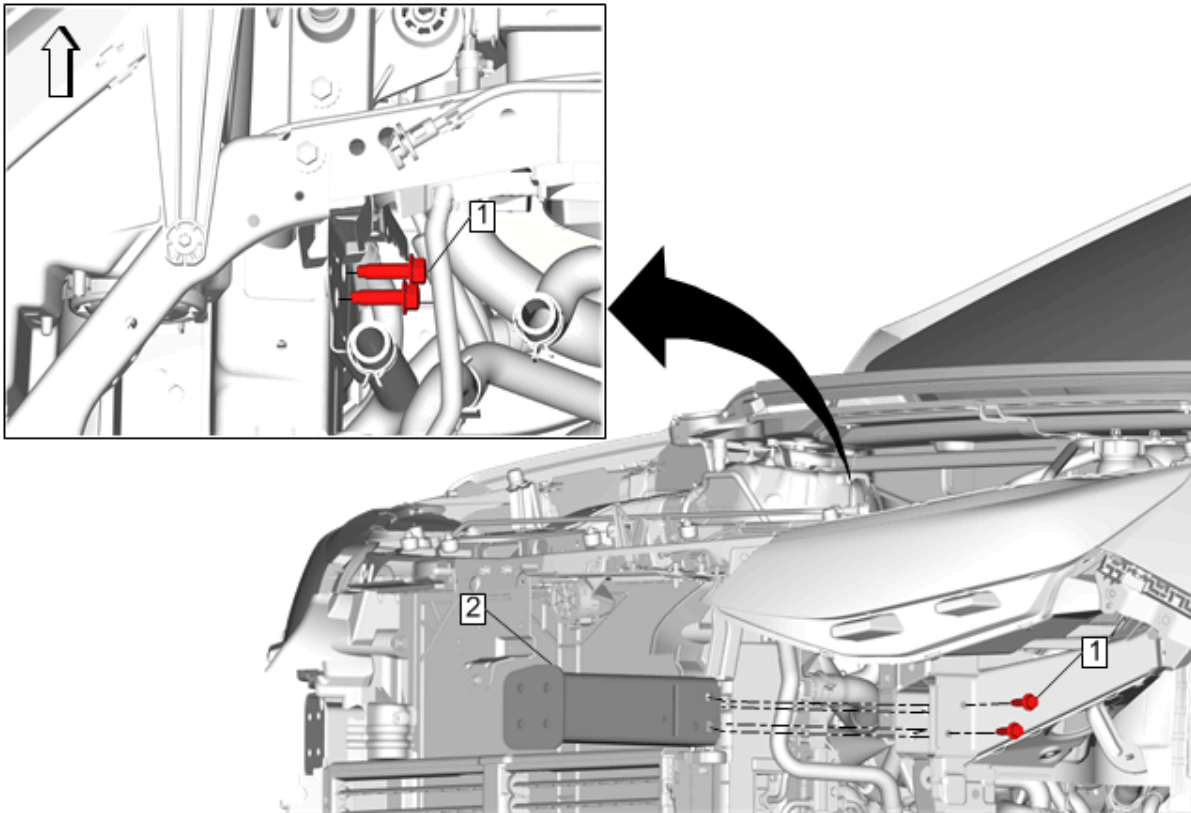


Fig. 3: Front Bumper Impact Absorber
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Bumper Impact Bar Replacement</u>	
1	Front Bumper Impact Absorber Bolt (Qty: 4) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 58 N.m (43 lb ft)
2	Front Bumper Impact Absorber

FRONT BUMPER IMPACT BAR REPLACEMENT

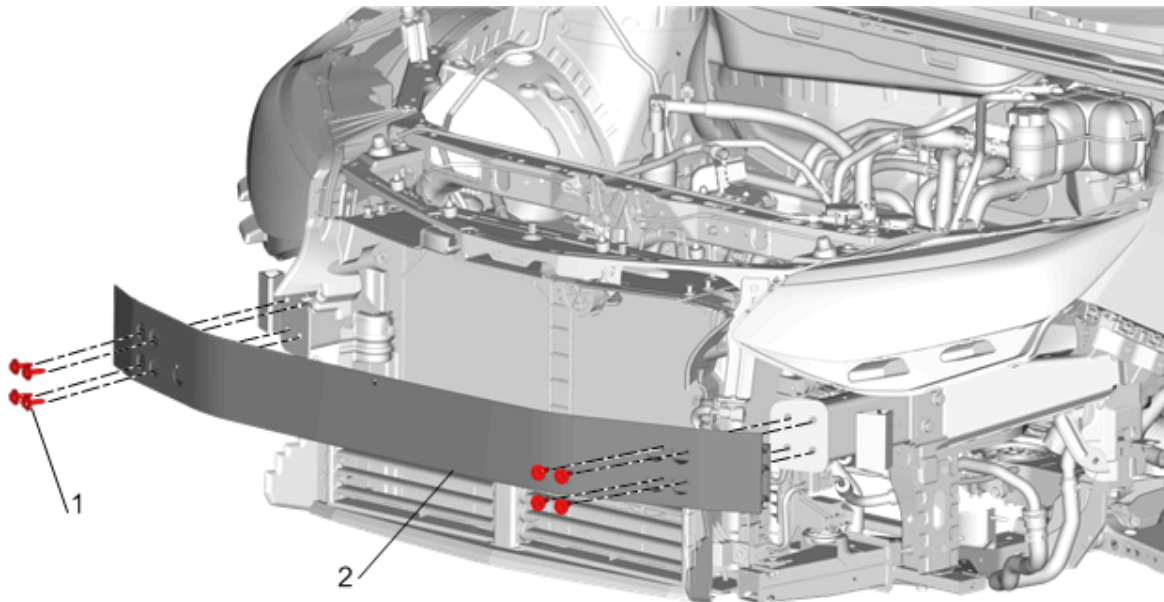


Fig. 4: Front Bumper Impact Bar

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Bumper Fascia Lower Stiffener Replacement</u>	
1	Front Bumper Impact Bar Bolt (Qty: 8) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 22 N.m (16 lb ft)
2	Front Bumper Impact Bar Procedure 1. Disconnect the electrical connectors. 2. Transfer components as necessary.

FRONT BUMPER FASCIA REMOVAL AND INSTALLATION

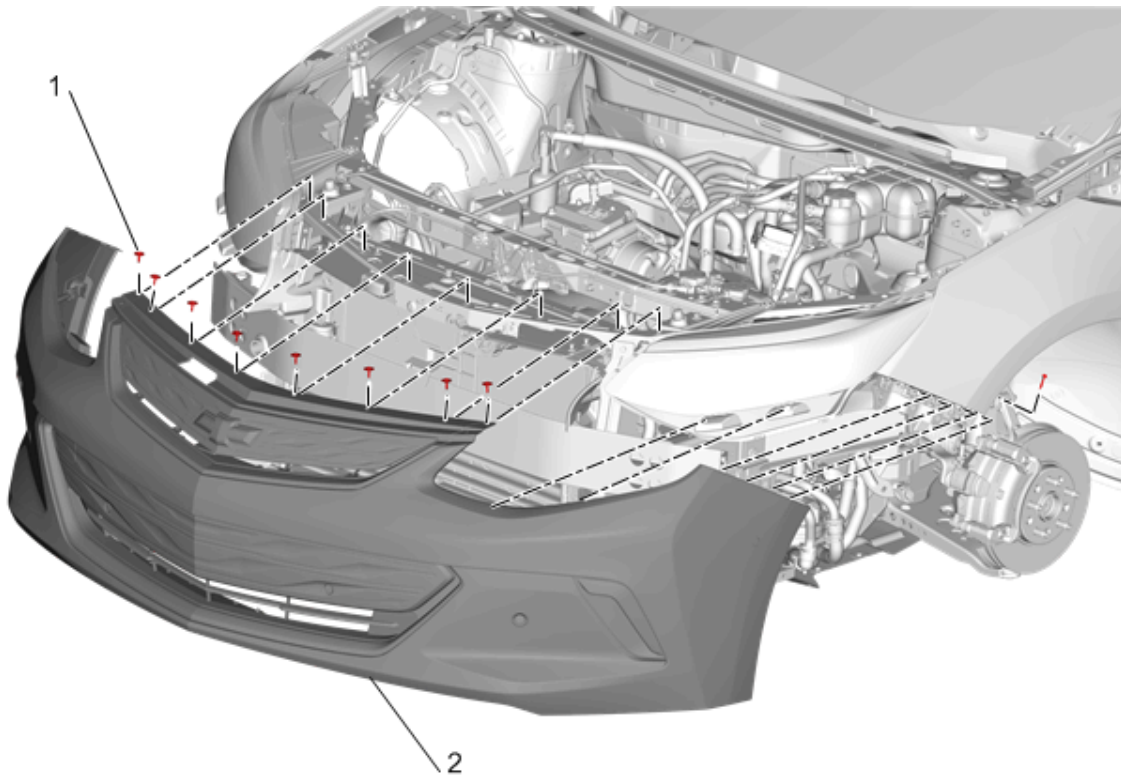


Fig. 5: Front Bumper Fascia
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Front Compartment Splash Shield Replacement</u> <u>Front Wheelhouse Liner Replacement (Left Side)</u> <u>Front Wheelhouse Liner Replacement (Right Side)</u>	
1	Front Bumper Fascia Bolt (Qty: 8) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Bumper Fascia Procedure Carefully push a small nylon wedge between the fascia and the front fascia retainers. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time

Callout	Component Name
	and pull on the fascia at the same time to gradually remove the fascia from the front fascia retainers of the fender. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

FRONT BUMPER FASCIA GUIDE REPLACEMENT

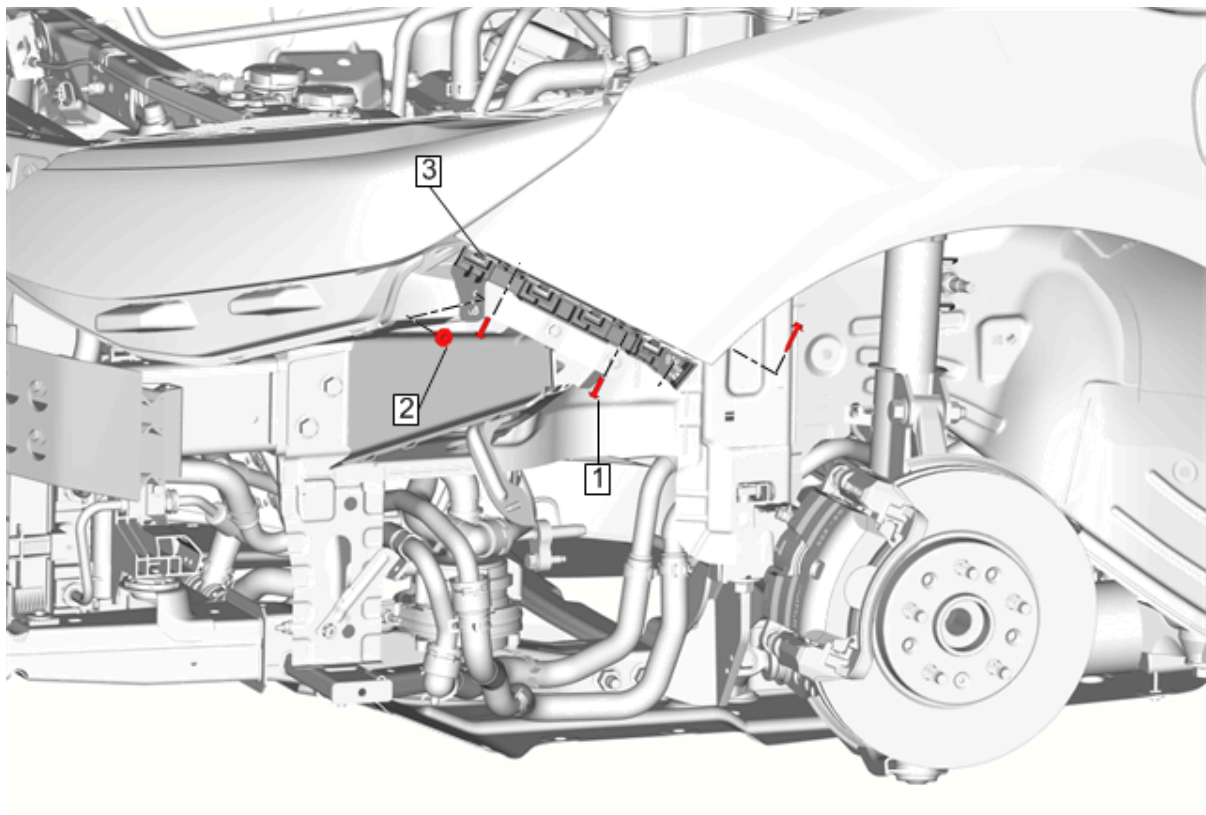


Fig. 6: Front Bumper Fascia Guide
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Bumper Fascia Removal and Installation</u>	
1	Front Bumper Fascia Guide Bolt (Qty: 3) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)

Callout	Component Name
2	Headlamp Bolt Tighten 2.5 N.m (22 lb in)
3	Front Bumper Fascia Guide

FRONT BUMPER FASCIA CENTER SUPPORT REPLACEMENT

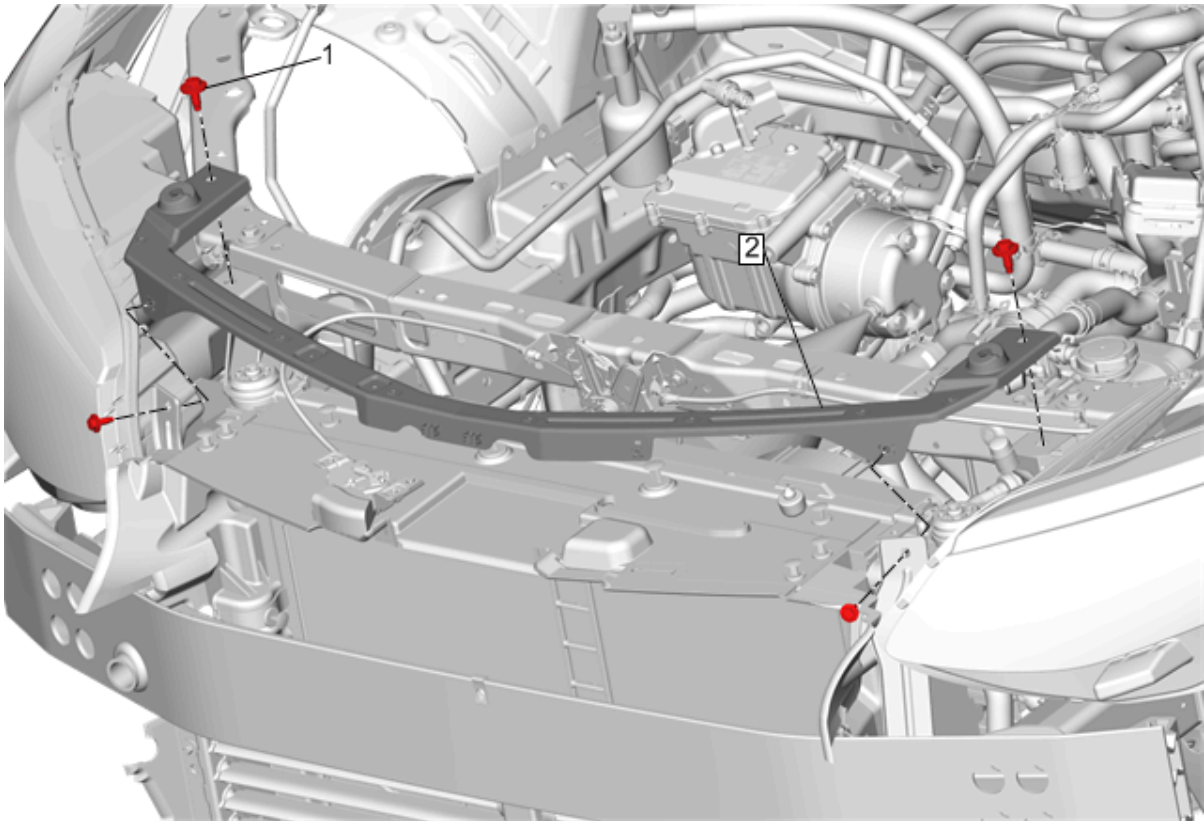


Fig. 7: Front Bumper Fascia Center Support
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
<u>Front Bumper Fascia Removal and Installation</u>	
1	Front Bumper Fascia Center Support Bolt (Qty: 4) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 22 N.m (16 lb ft)
2	Front Bumper Fascia Center Support

FRONT BUMPER SHUTTER REPLACEMENT

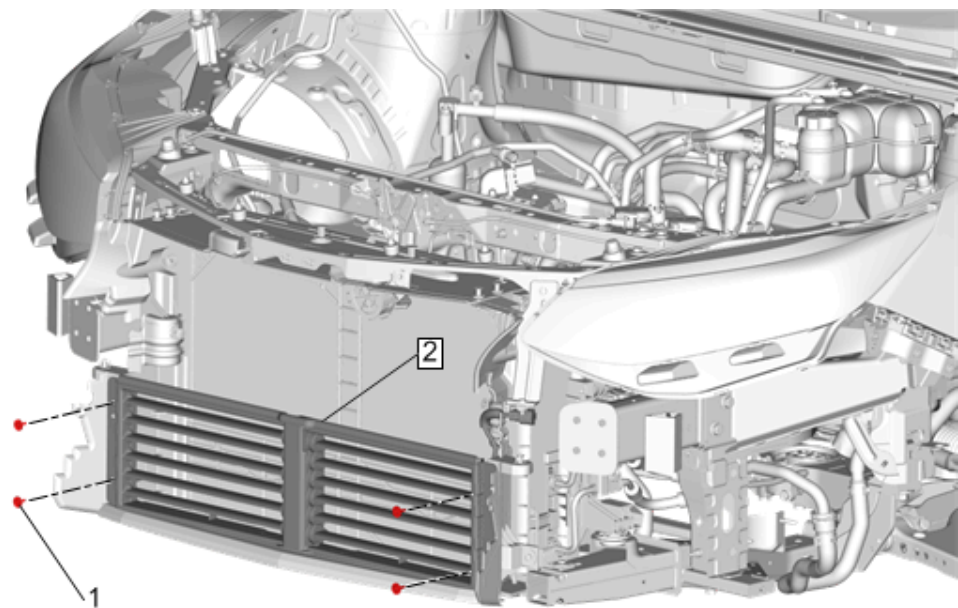


Fig. 8: Front Bumper Shutter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Bumper Fascia Removal and Installation	
1	Front Bumper Shutter Bolt (Qty: 4) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Bumper Shutter Procedure 1. Disconnect the electrical connector. 2. Transfer components as necessary. 3.

FRONT BUMPER FASCIA LOWER STIFFENER REPLACEMENT

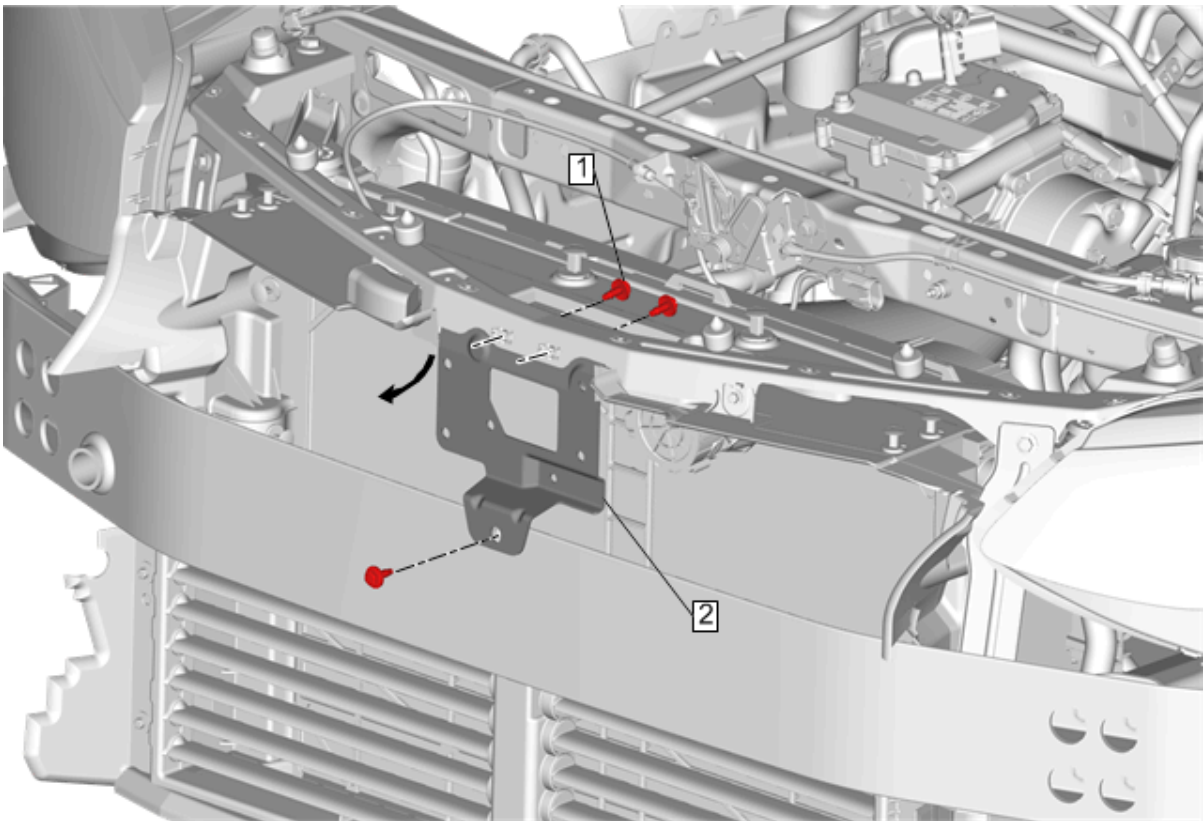


Fig. 9: Front Bumper Fascia Lower Stiffener (Center)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. <u>Front Bumper Fascia Removal and Installation</u> 2. { If equipped } <u>Forward Range Radar Sensor Replacement</u>	
1	Front Bumper Fascia Lower Stiffener Bolt (Qty: 3) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 9 N.m (80 lb in)
2	Front Bumper Fascia Lower Stiffener

FRONT BUMPER FASCIA CENTER AIR DEFLECTOR REPLACEMENT

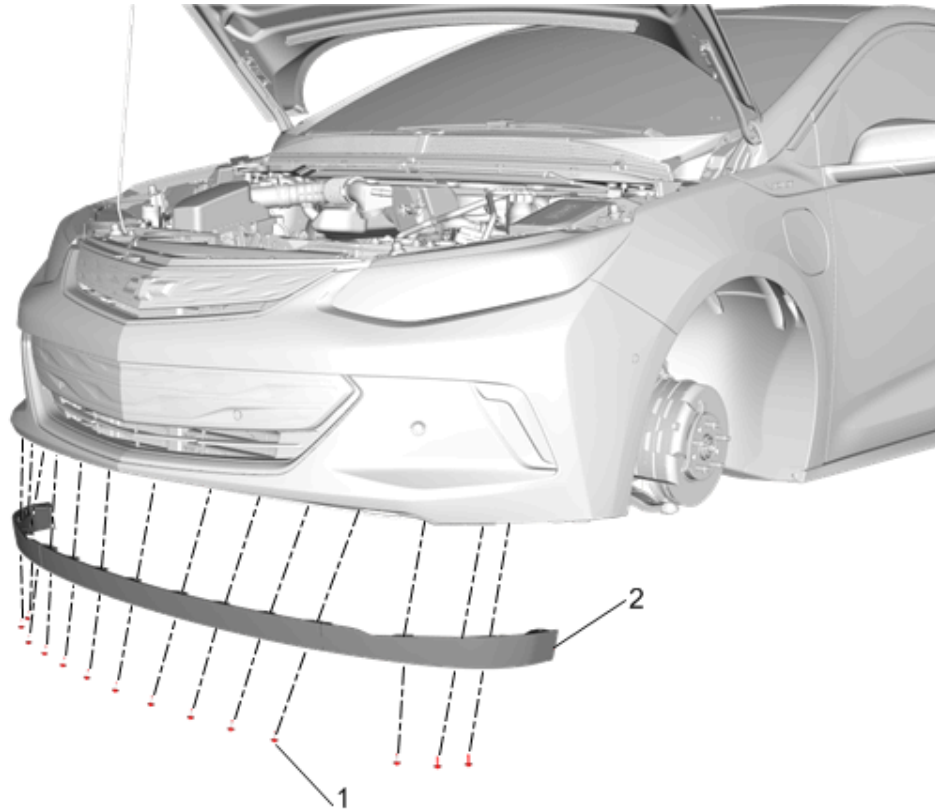


Fig. 10: Front Bumper Fascia Center Air Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Front Bumper Fascia Center Air Deflector Bolt (Qty: 14) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Front Bumper Fascia Center Air Deflector

REAR BUMPER FASCIA REMOVAL AND INSTALLATION

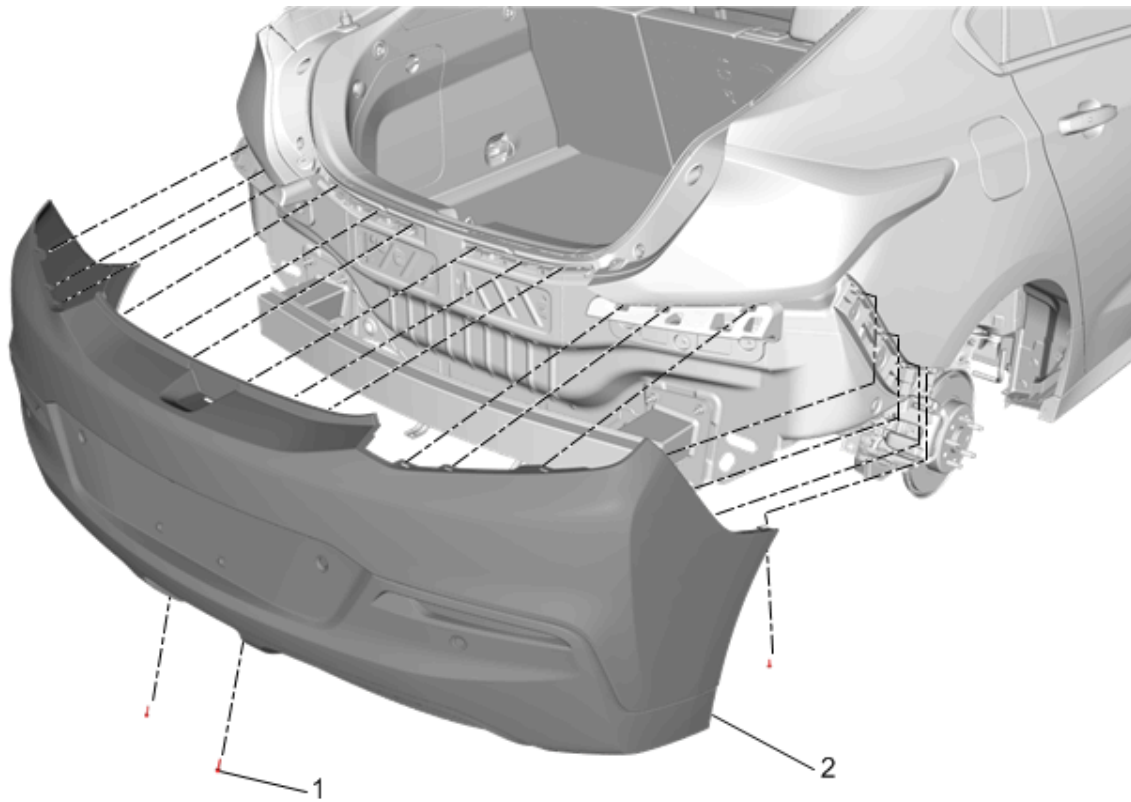


Fig. 11: Rear Bumper Fascia

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Rear Wheelhouse Liner Replacement</u>	
1	Rear Bumper Fascia Bolt (Qty: 4) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Rear Bumper Fascia Procedure - Carefully push a small nylon wedge between the fascia and the rear fascia guide. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the fascia from the rear fascia guide. - Disconnect all electrical connectors. - Transfer components as necessary.

REAR BUMPER FASCIA GUIDE REPLACEMENT

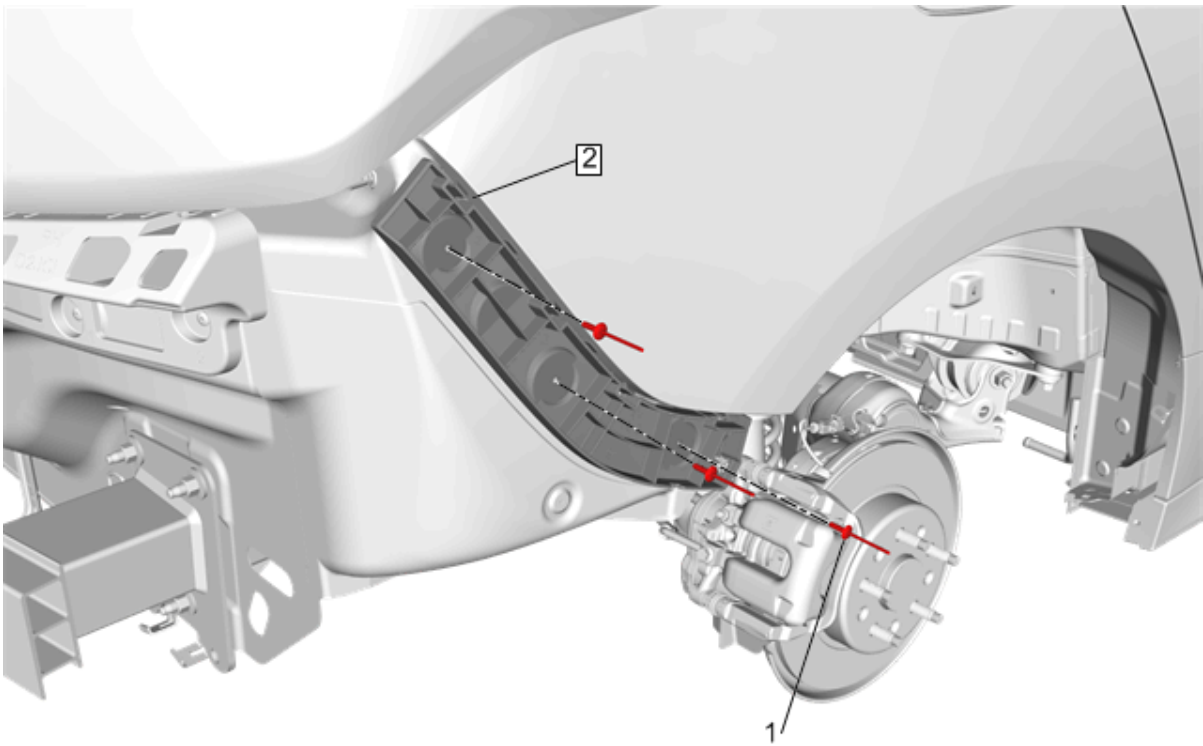


Fig. 12: Rear Bumper Fascia Guide
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Eye Protection Warning .	
Preliminary Procedure Rear Bumper Fascia Removal and Installation	
1	Rear Bumper Fascia Guide Rivet (Qty: 3)
2	Rear Bumper Fascia Guide

REAR BUMPER UPPER FASCIA REPLACEMENT

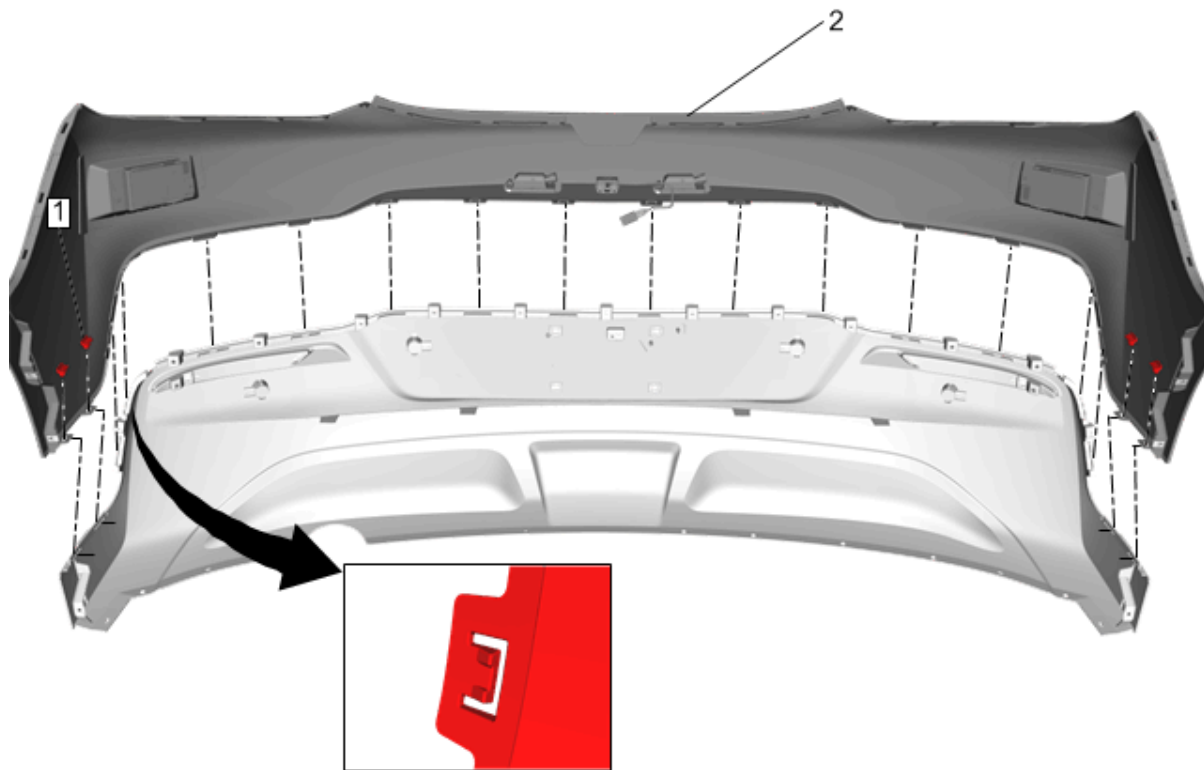


Fig. 13: Rear Bumper Upper Fascia

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
<u>Rear Bumper Fascia Removal and Installation</u>	
1	Rear Bumper Upper Fascia Clip (Qty: 4)
2	Rear Bumper Upper Fascia Procedure 1. Place the bumper fascia face down on a clean protective surface. 2. Carefully push a small nylon wedge between the upper fascia and the lower fascia. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the upper fascia from the lower fascia. 3. Transfer components as necessary.

REAR BUMPER LOWER FASCIA REPLACEMENT

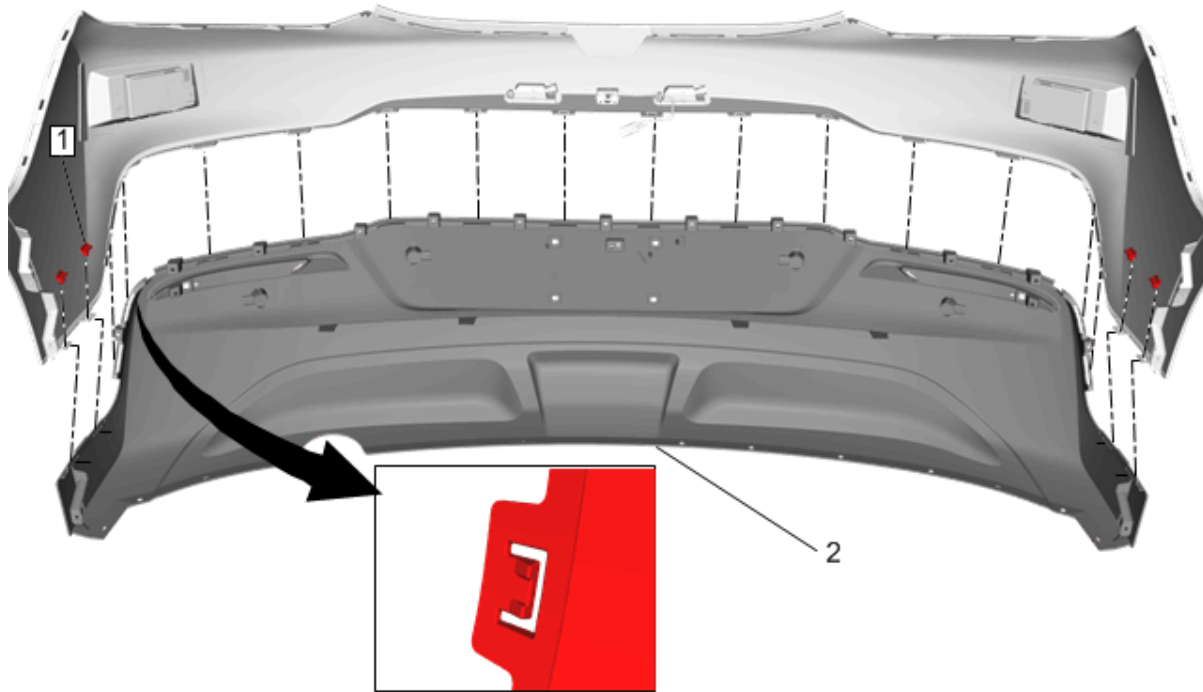


Fig. 14: Rear Bumper Lower Fascia

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
<u>Rear Bumper Fascia Removal and Installation</u>	
1	Rear Bumper Lower Fascia Clip (Qty: 4)
2	Rear Bumper Lower Fascia Procedure 1. Place the bumper fascia face down on a clean protective surface. 2. Carefully push a small nylon wedge between the upper fascia and the lower fascia. Insert a small flat-bladed tool into the fascia slot and depress the snaps one at a time and pull on the fascia at the same time to gradually remove the upper fascia from the lower fascia. 3. Transfer components as necessary.

REAR BUMPER ENERGY ABSORBER REPLACEMENT

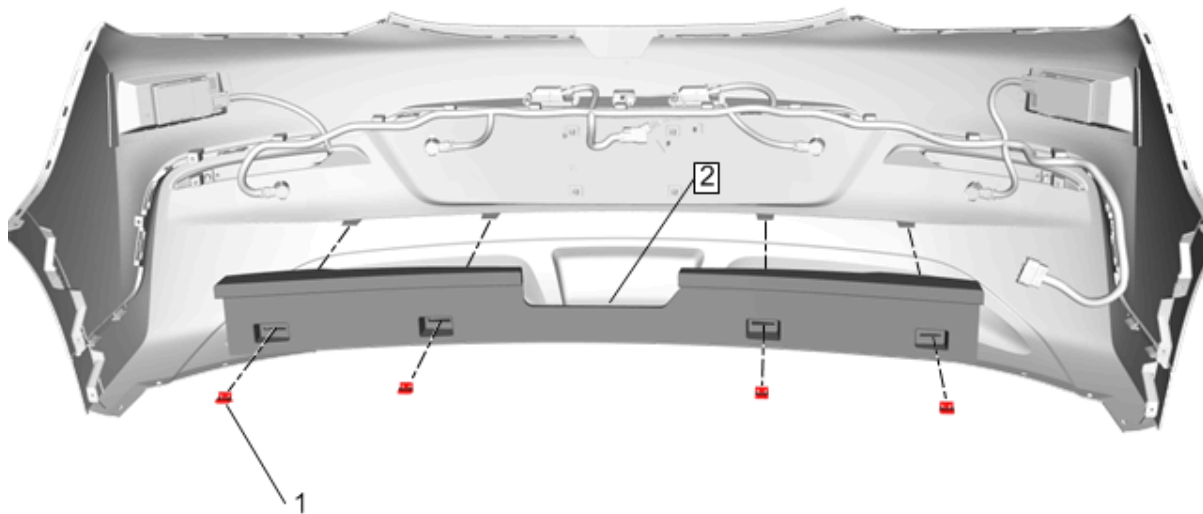


Fig. 15: Rear Bumper Energy Absorber
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Rear Bumper Fascia Removal and Installation</u> - Reposition electrical connectors for the rear object alarm sensors.	
1	Rear Bumper Fascia Energy Absorber Clip (Qty: 4)
2	Rear Bumper Fascia Energy Absorber

REAR BUMPER IMPACT BAR REPLACEMENT

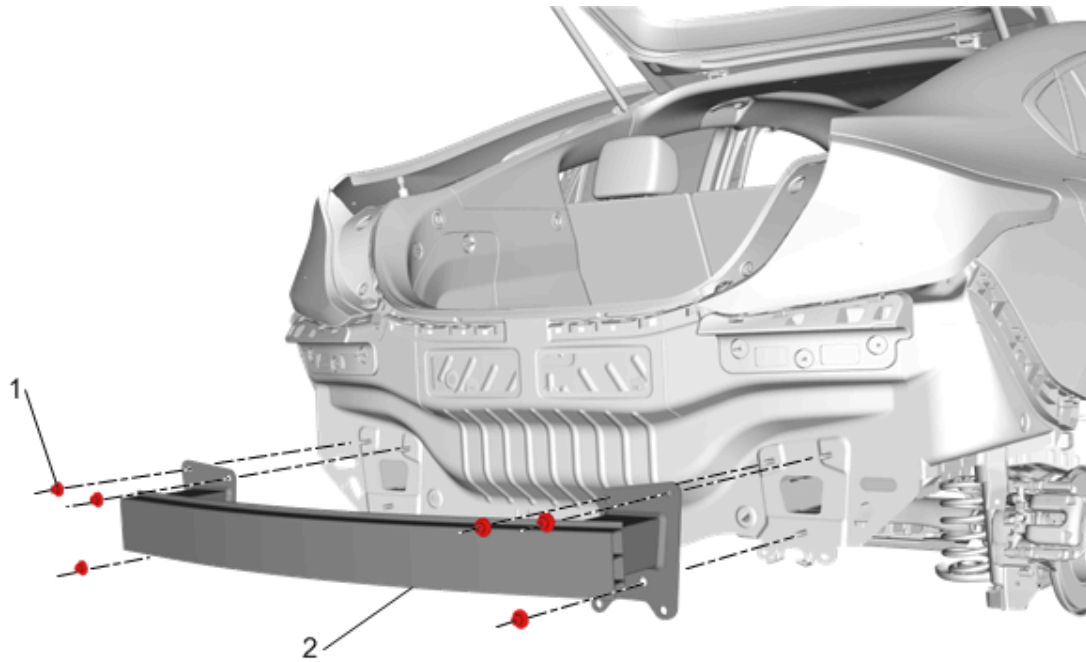


Fig. 16: Rear Bumper Impact Bar

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Rear Bumper Fascia Removal and Installation</u>	
1	Rear Bumper Impact Bar Nut (Qty: 6) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 58 N.m (43 lb ft)
2	Rear Bumper Impact Bar Procedure Transfer components as necessary.

DESCRIPTION AND OPERATION

ACTIVE GRILLE AIR SHUTTER DESCRIPTION AND OPERATION

The active grille air shutter system closes shutters in the front grille to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required.

If high levels of airflow are required the active grille air shutter system will open one or both shutters. The control signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuators to operate. If the conditions for opening the shutters are reached the engine control module commands the active grille air shutter actuators to open one or both shutters.

The dual active grille air shutter system consists of two aero shutter mechanisms located in the front grille for controlling the amount of air flowing through the grille. It includes three wires; ground, power and a Local Interconnect Network (LIN) Bus serial data circuit from the engine control module to the shutter actuator. The engine control module determines shutter state based on various vehicle conditions such as vehicle speed, coolant temperature, fan state, refrigerant system pressure, A/C compressor state and ambient temperature. The engine control module has the ability to command each shutter individually to the open or closed positions through communications on the LIN Bus.

The actuators are powered by an ignition circuit that is active when the key is in the RUN position. The vehicle may have to be driven for up to 13 minutes at speeds greater than 41 km/h (25 mph) before a shutter begins to move. If low ambient temperature is detected, the shutters will remain in the closed position.

Article GUID: A00884632

ACCESSORIES & EQUIPMENT

Collision Repair - Volt

SPECIFICATIONS

DIMENSIONS - BODY

Point-to-point measurements are for reference only. All measurements are given in millimeters. Use these measurements for diagnosing and estimating. Point-to-point measurements are duplicated with tram bar pointers set at equal lengths. All die marks, holes, slots, and fasteners are measured to the center. All dimensions are symmetrical unless otherwise specified.

Point-to-Point Measurements

Engine Compartment

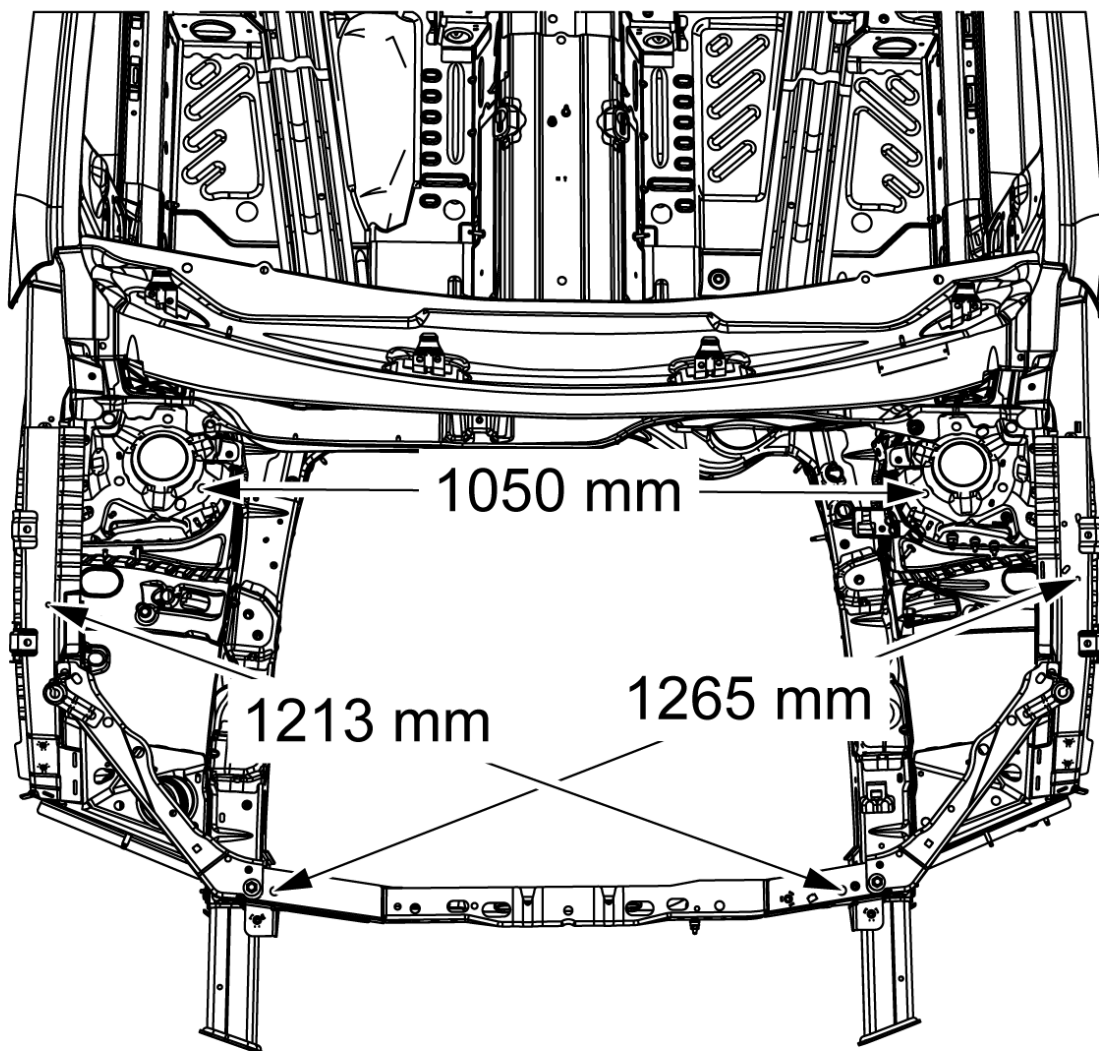


Fig. 1: Engine Compartment Dimensions

Courtesy of GENERAL MOTORS COMPANY

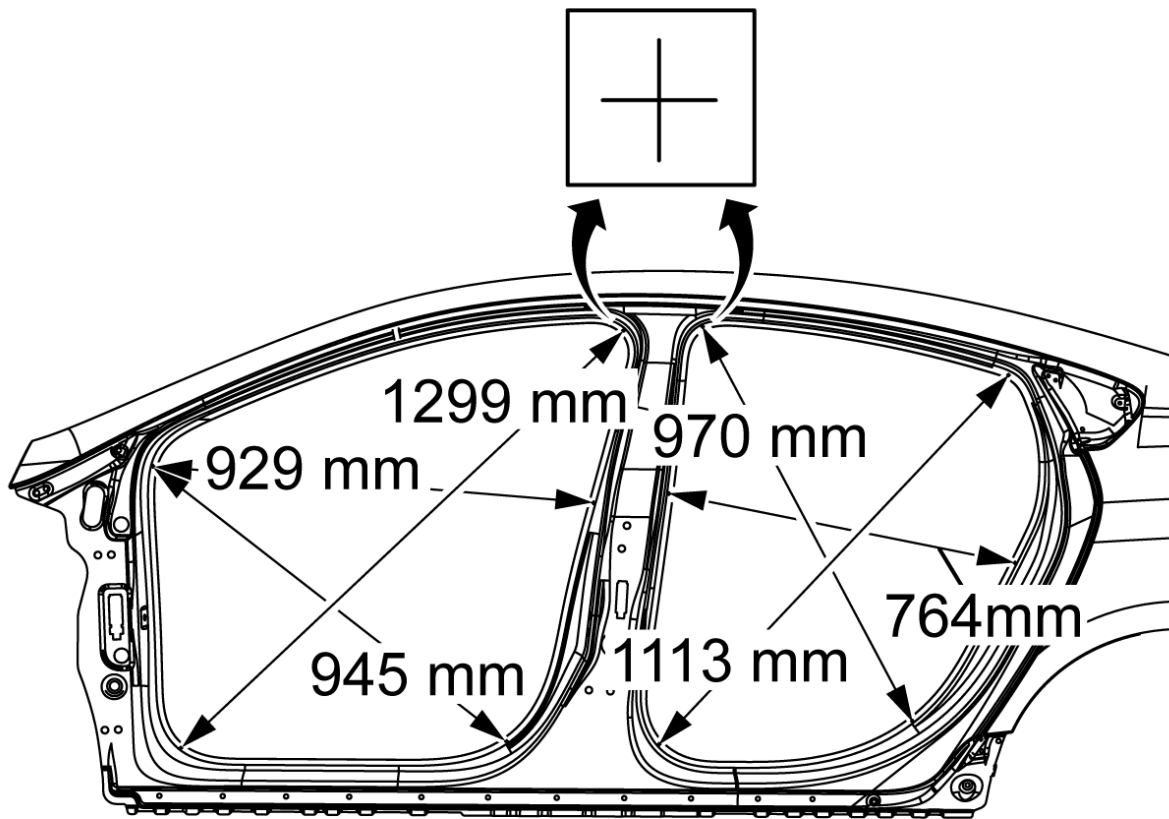


Fig. 2: Side Dimensions

Courtesy of GENERAL MOTORS COMPANY

Rear End

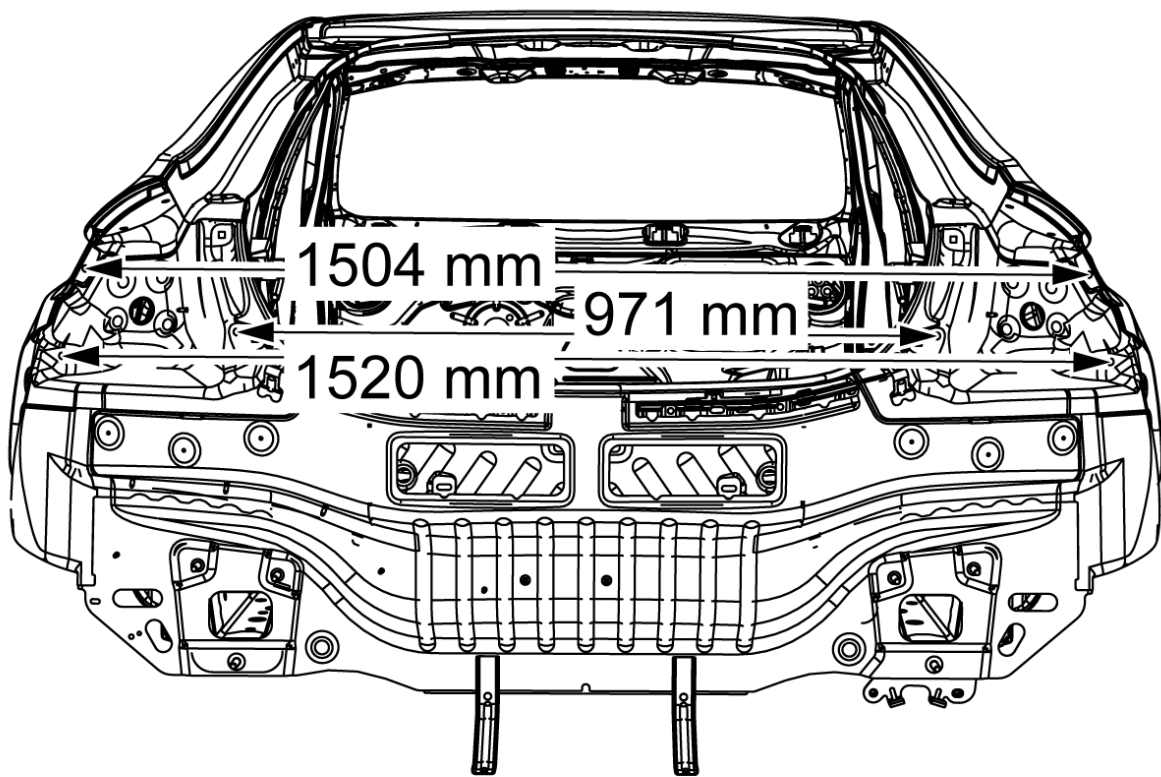


Fig. 3: Rear End Dimensions

Courtesy of GENERAL MOTORS COMPANY

Rear End Upper

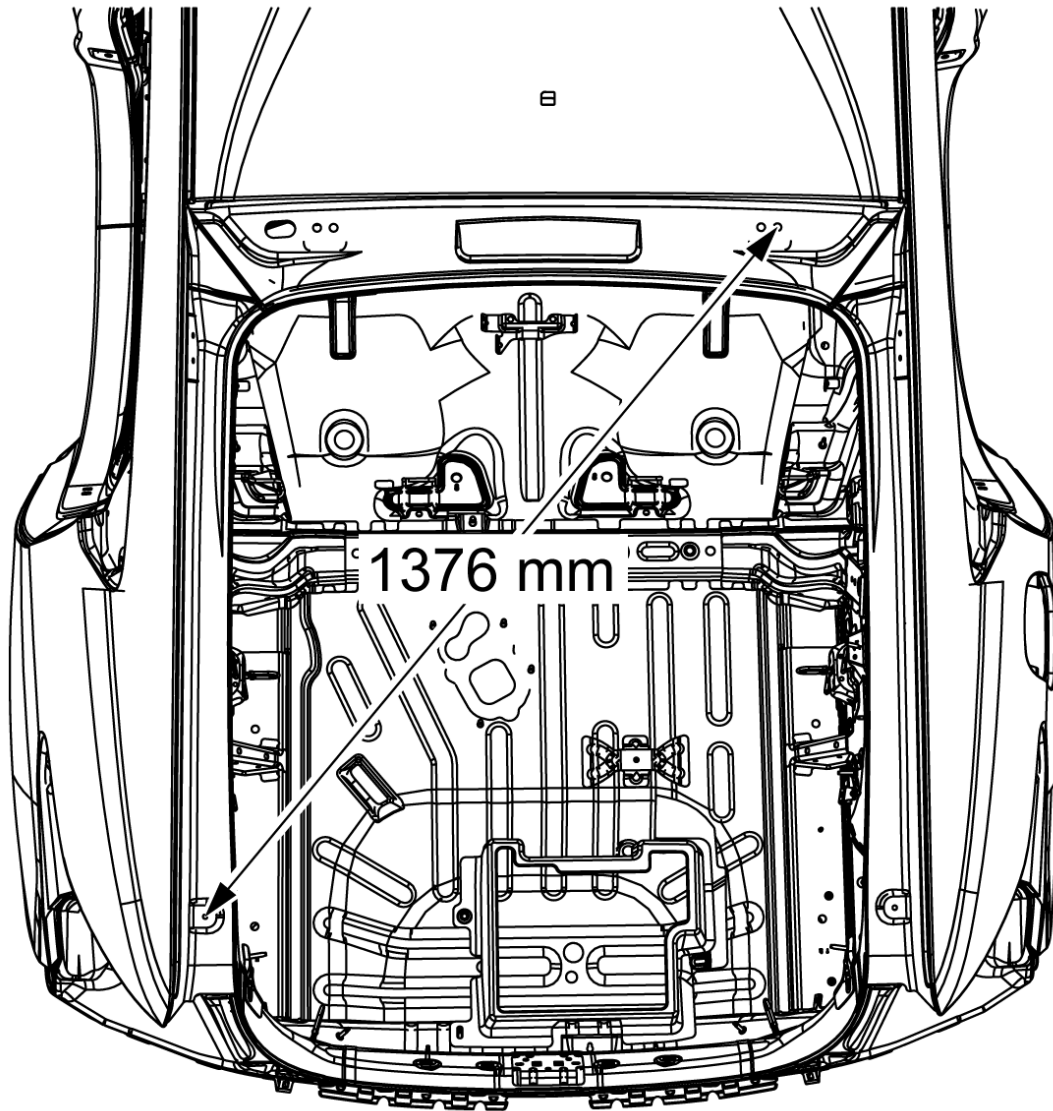


Fig. 4: Rear End Upper Dimensions

Courtesy of GENERAL MOTORS COMPANY

VISUAL IDENTIFICATION

STRUCTURE IDENTIFICATION

View Front

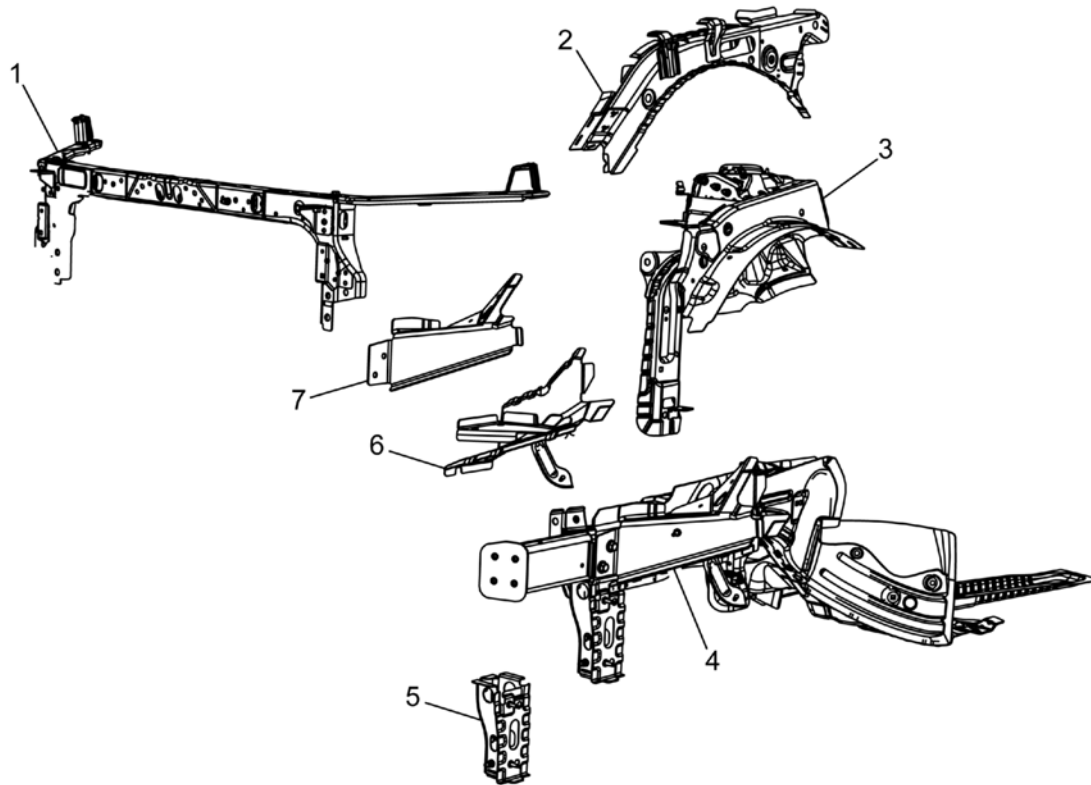


Fig. 5: Front View Structure

Courtesy of GENERAL MOTORS COMPANY

Number	Description	Material	Procedure
1	Front End Upper Tie Bar	<u>Mild Steel</u>	<u>Front End Upper Tie Bar Replacement</u>
2	Front Compartment Upper Side Rail	<u>High Strength Low Alloy Steel</u>	<u>Front Compartment Upper Side Rail Replacement</u>
3	Front Wheelhouse Panel	<u>High Strength Low Alloy Steel</u>	<u>Front Wheelhouse Panel Replacement</u>
4	Front Rail	<u>Ultra High Strength Steel</u>	<u>Front Rail Replacement</u>
5	Front End Lower Tie Bar	<u>High Strength Low Alloy Steel</u>	<u>Front End Lower Tie Bar Replacement</u>
6	Front Wheelhouse Panel Brace	<u>Ultra High Strength Steel</u>	<u>Front Wheelhouse Panel Brace Replacement</u>
7	Front Wheelhouse Extension	<u>Ultra High Strength Steel</u>	<u>Front Wheelhouse Extension Replacement</u>

View Side Inner

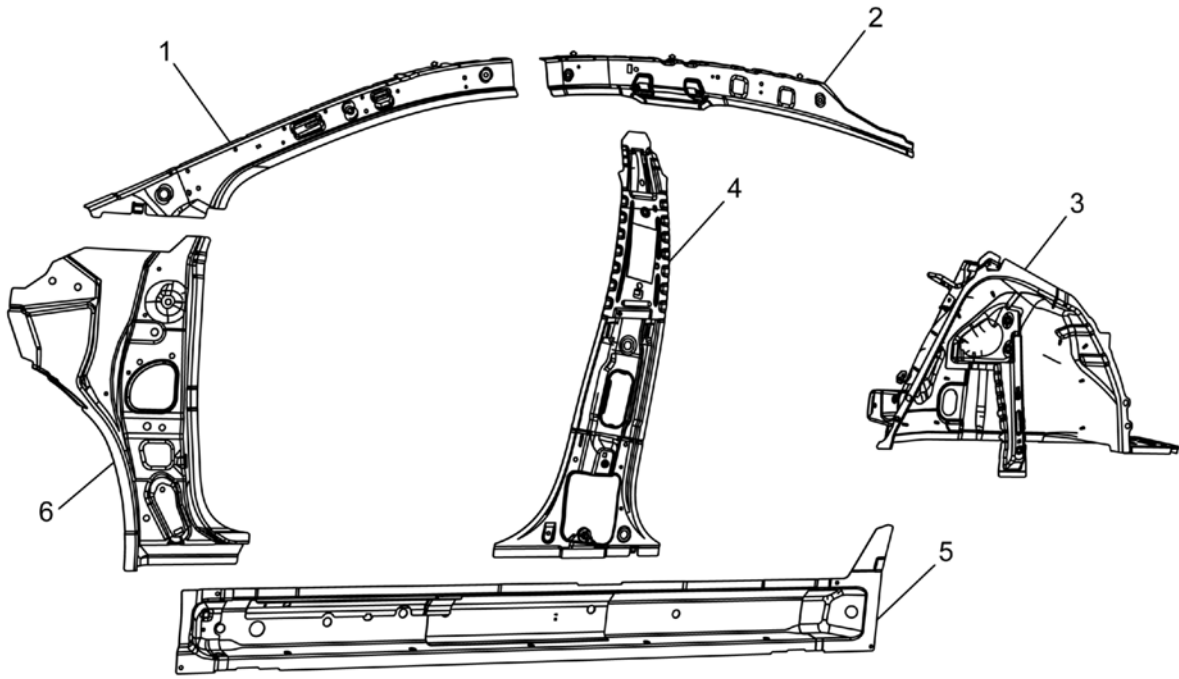


Fig. 6: Side Inner View Structure

Courtesy of GENERAL MOTORS COMPANY

Number	Description	Material	Procedure
1	Windshield Inner Upper Frame Reinforcement	<u>Ultra High Strength Steel</u>	<u>Windshield Inner Upper Frame Reinforcement Replacement</u>
2	Roof Inner Side Rail Replacement	<u>Ultra High Strength Steel</u>	<u>Roof Inner Side Rail Replacement</u>
3	Rear Wheelhouse Inner Panel	<u>Mild Steel</u>	<u>Rear Wheelhouse Inner Panel Replacement</u>
4	Center Pillar Inner Panel	<u>Ultra High Strength Steel</u>	<u>Center Pillar Inner Panel Replacement</u>
5	Rocker Inner Panel	<u>Ultra High Strength Steel</u>	<u>Rocker Inner Panel Replacement</u>
6	Body Hinge Pillar Inner Panel	<u>High Strength Low Alloy Steel</u>	<u>Body Hinge Pillar Inner Panel Replacement</u>

View Side Outer

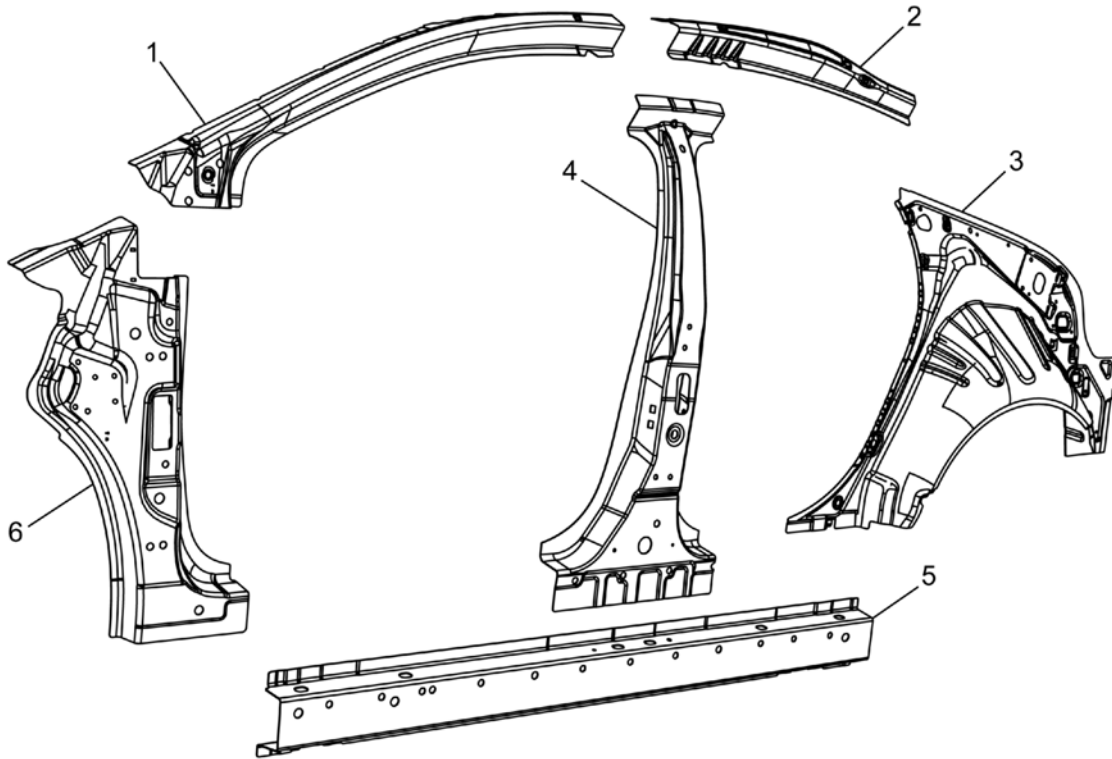


Fig. 7: Side Outer View Structure
Courtesy of GENERAL MOTORS COMPANY

Number	Description	Material	Procedure
1	Body Side Frame Upper Front Extension	<u>Ultra High Strength Steel</u>	<u>Body Side Frame Upper Front Extension Replacement</u>
2	Roof Side Rail Reinforcement	<u>High Strength Low Alloy Steel</u>	<u>Roof Side Rail Reinforcement Replacement</u>
3	Rear Wheelhouse Outer Panel	<u>Mild Steel</u>	<u>Rear Wheelhouse Outer Panel Replacement</u>
4	Center Pillar	<u>Ultra High Strength Steel</u>	<u>Center Pillar Replacement</u>
5	Rocker Outer Panel Reinforcement	<u>Ultra High Strength Steel</u>	<u>Rocker Outer Panel Reinforcement Replacement</u>
6	Front Hinge Pillar Body	<u>Ultra High Strength Steel</u>	<u>Front Hinge Pillar Body Replacement</u>

View Side

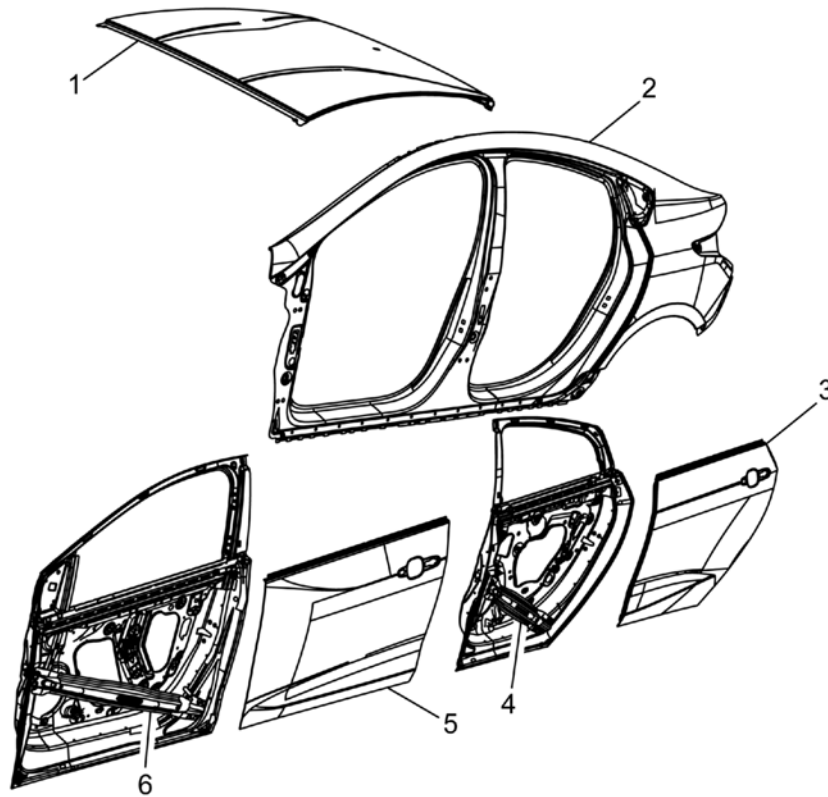


Fig. 8: Side View Structure

Courtesy of GENERAL MOTORS COMPANY

Number	Description	Material	Procedure
1	Roof Outer Panel Replacement	<u>Mild Steel</u>	<u>Roof Outer Panel Replacement</u>
2	Body Side Outer Panel	<u>Mild Steel</u>	• <u>Body Side Outer Panel Replacement</u> • <u>Body Side Outer Panel Sectioning</u>
3	Rear Side Door Outer Panel	<u>Mild Steel</u>	<u>Rear Side Door Outer Panel Replacement</u>
4	Rear Door Inner Reinforcement Beam	<u>Ultra High Strength Steel</u>	Not Serviced
5	Front Side Door Outer Panel	<u>Mild Steel</u>	<u>Front Side Door Outer Panel Replacement</u>
6	Front Door Inner Reinforcement Beam	<u>Ultra High Strength Steel</u>	Not Serviced

View Rear

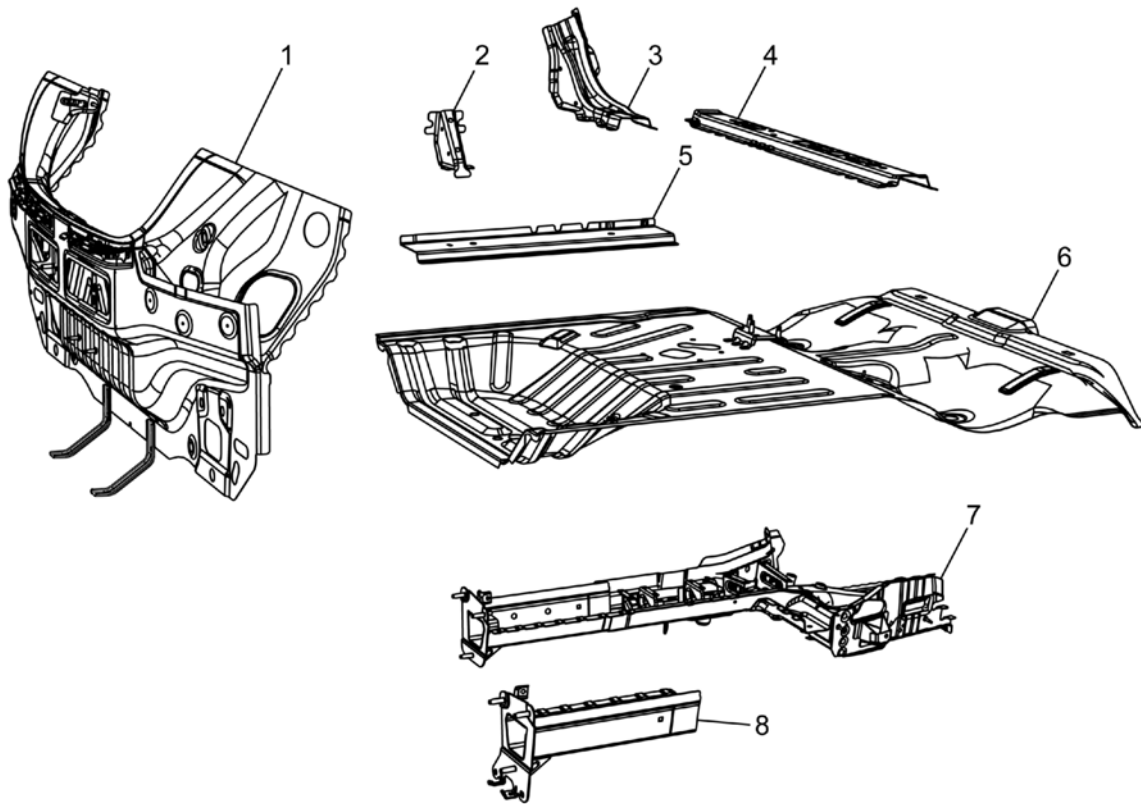


Fig. 9: Rear View Structure

Courtesy of GENERAL MOTORS COMPANY

Number	Description	Material	Procedure
1	Body Rear End Panel	Mild Steel	Body Rear End Panel Replacement
2	Rear Floor Panel Filler	High Strength Low Alloy Steel	Rear Floor Panel Filler Replacement
3	Floor Panel Number 5 Cross Bar Extension	Mild Steel	Floor Panel Number 5 Cross Bar Extension Replacement
4	Floor Panel Number 5 Cross Bar	High Strength Low Alloy Steel	Floor Panel Number 5 Cross Bar Replacement
5	Rear Floor Panel Filler	Ultra High Strength Steel	• Rear Floor Panel Filler Replacement - Left Side • Rear Floor Panel Filler Replacement - Right Side
6	Rear Floor Panel	Mild Steel	Rear Floor Panel Sectioning
7	Rear Rail	Ultra High Strength Steel	Rear Rail Replacement
8	Rear Rail Section	Ultra High Strength Steel	Rail Replacement - Rear Section

REPAIR INSTRUCTIONS

FRONT END UPPER TIE BAR REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .

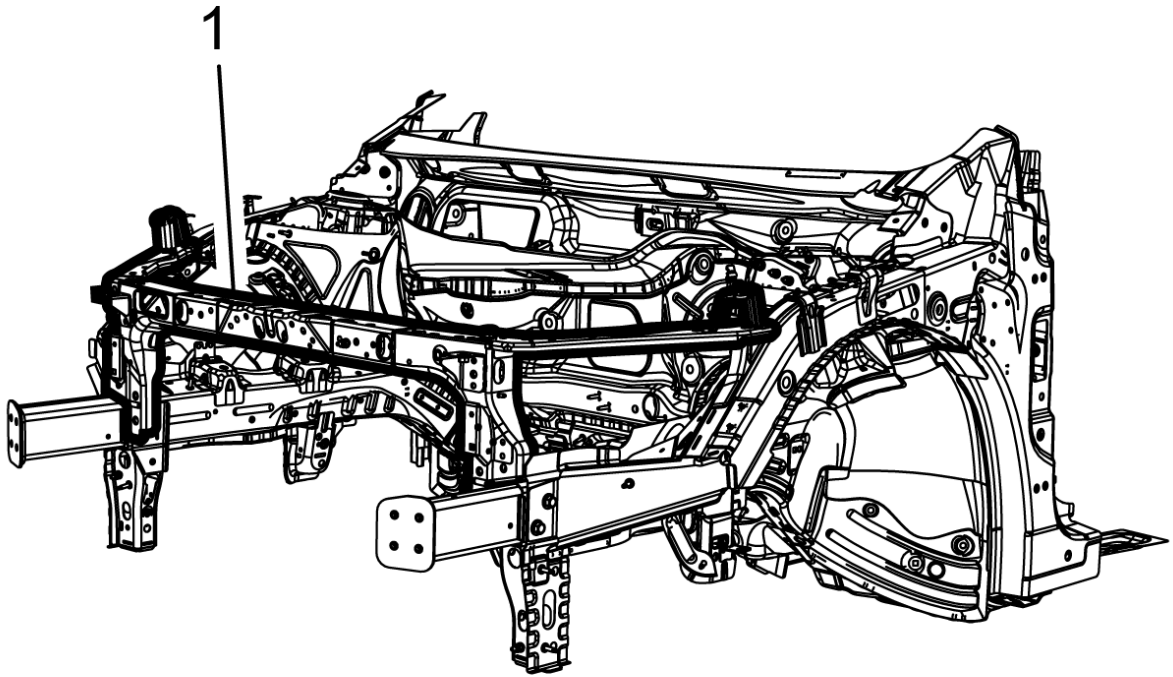


Fig. 10: Front End Upper Tie Bar

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from front end tie bar (1).

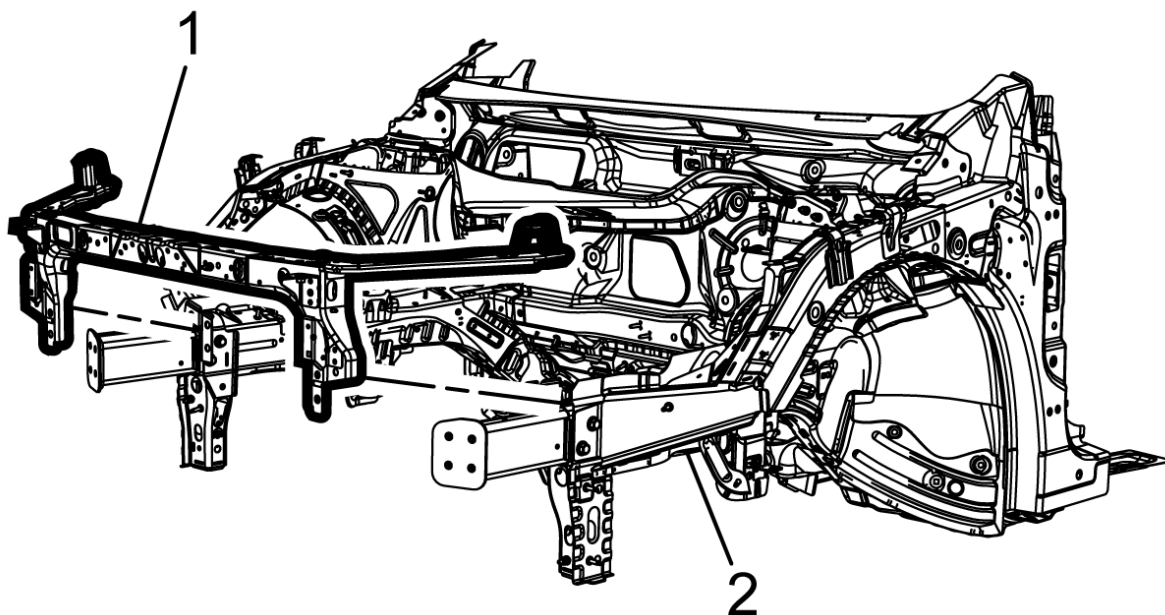


Fig. 11: Front End Upper Tie Bar

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front end upper tie bar (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

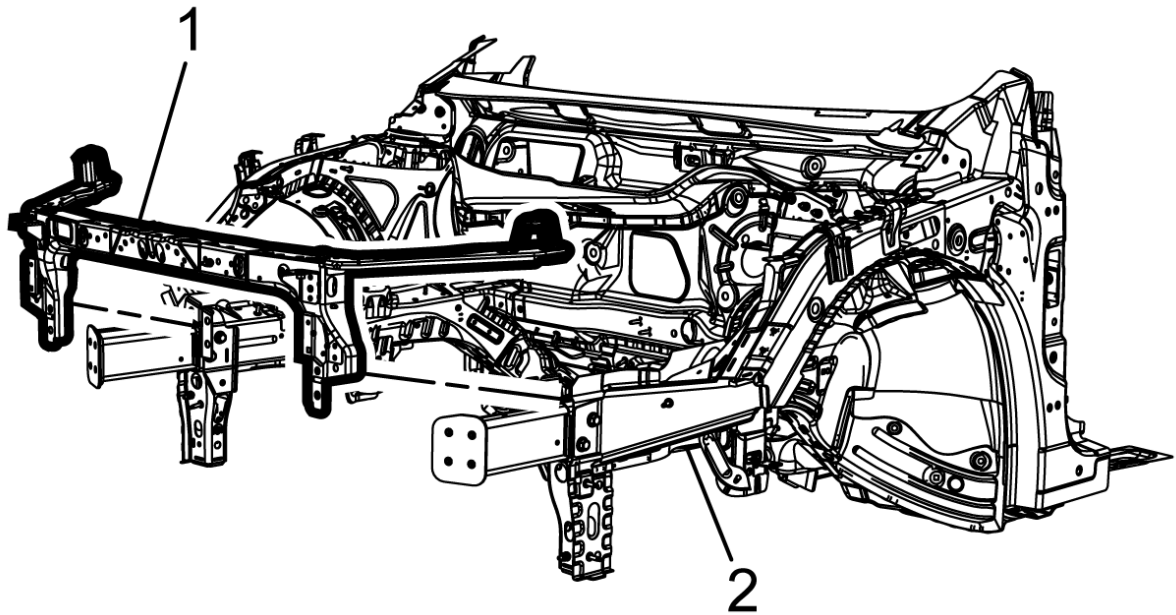


Fig. 12: Front End Upper Tie Bar

Courtesy of GENERAL MOTORS COMPANY

2. Position the front end upper tie bar (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the front end upper tie bar (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding.**](#)

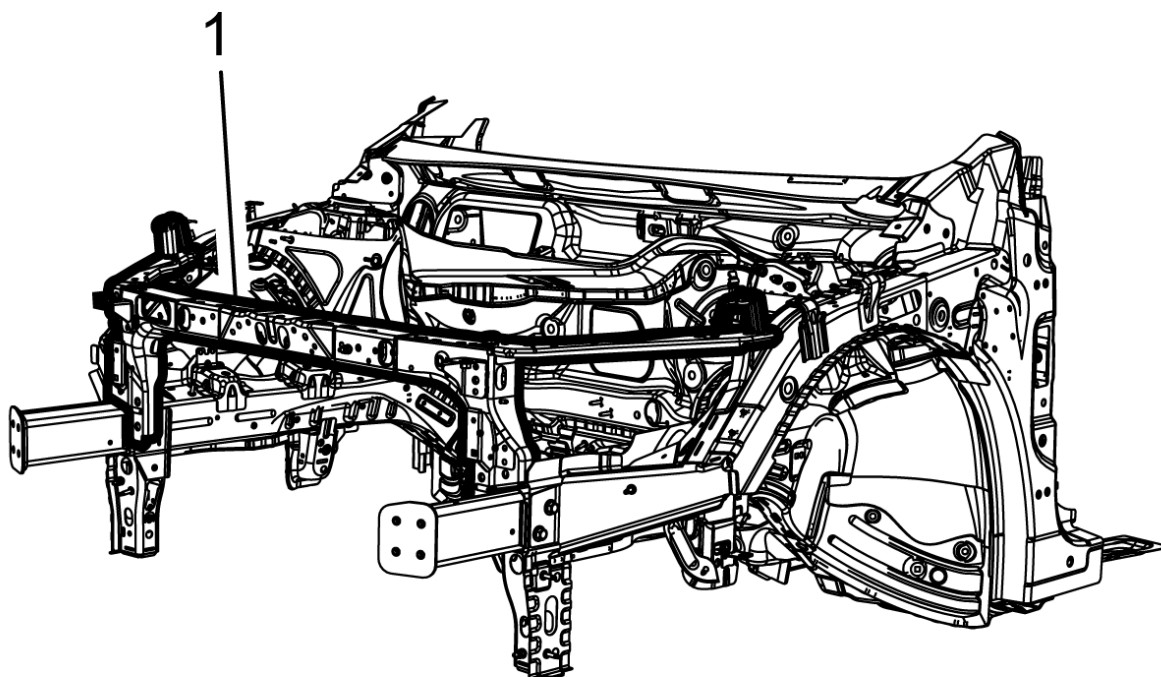


Fig. 13: Front End Upper Tie Bar

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the front end upper tie bar (1) into position.
6. Weld the front end upper tie bar (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

FRONT END LOWER TIE BAR REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

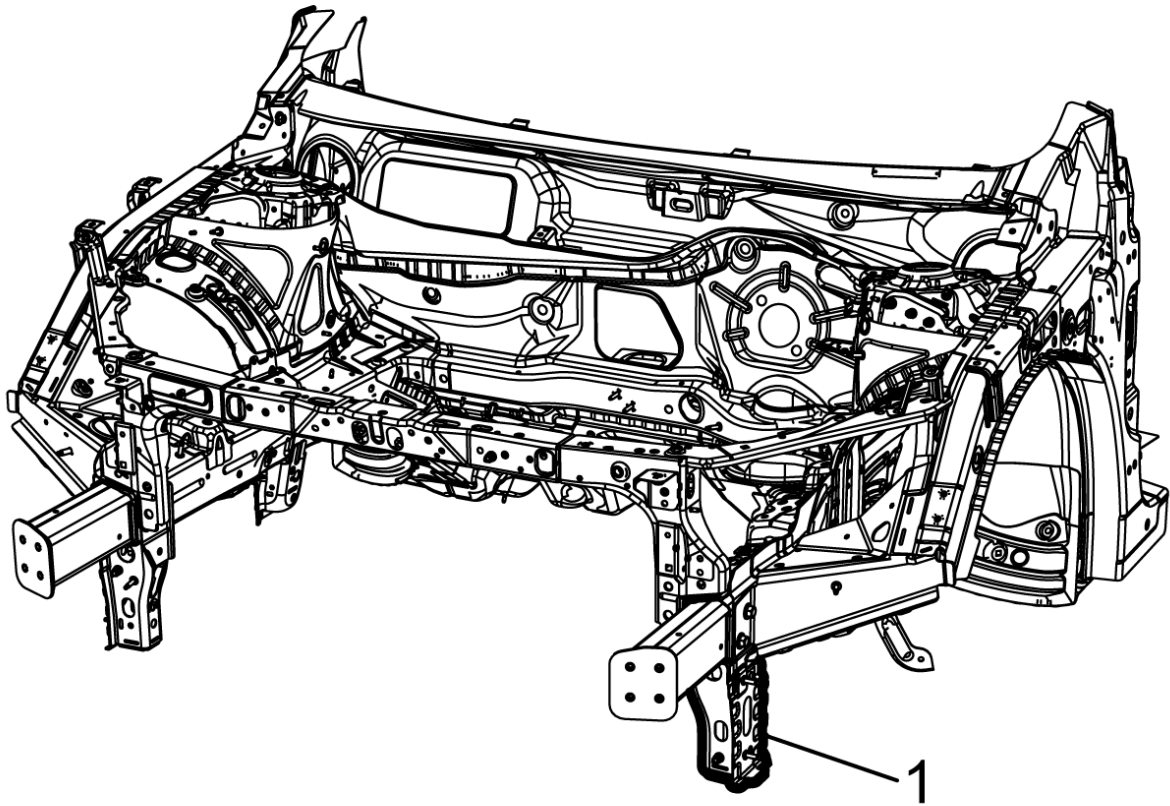


Fig. 14: Front End Lower Tie Bar

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the front end lower tie bar (1).

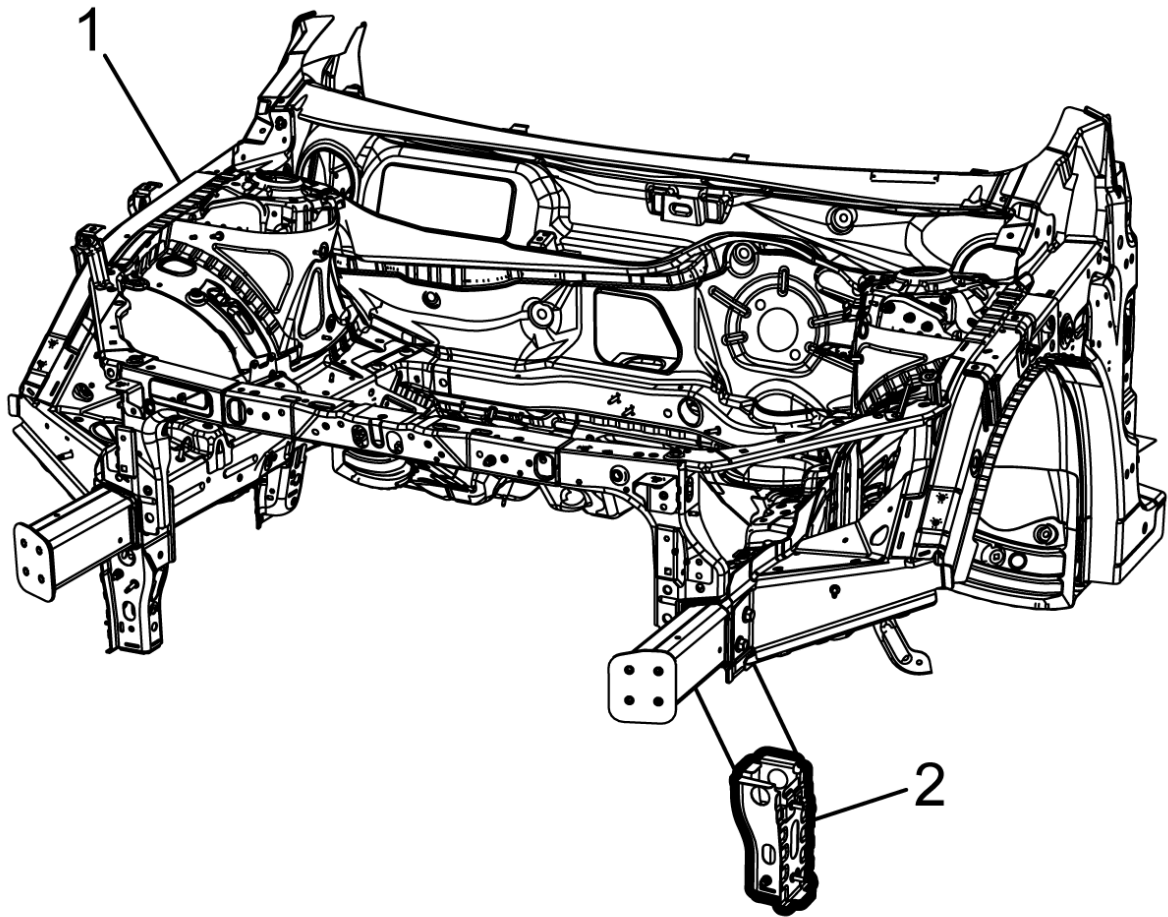


Fig. 15: Front End Lower Tie Bar

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front end lower tie bar (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

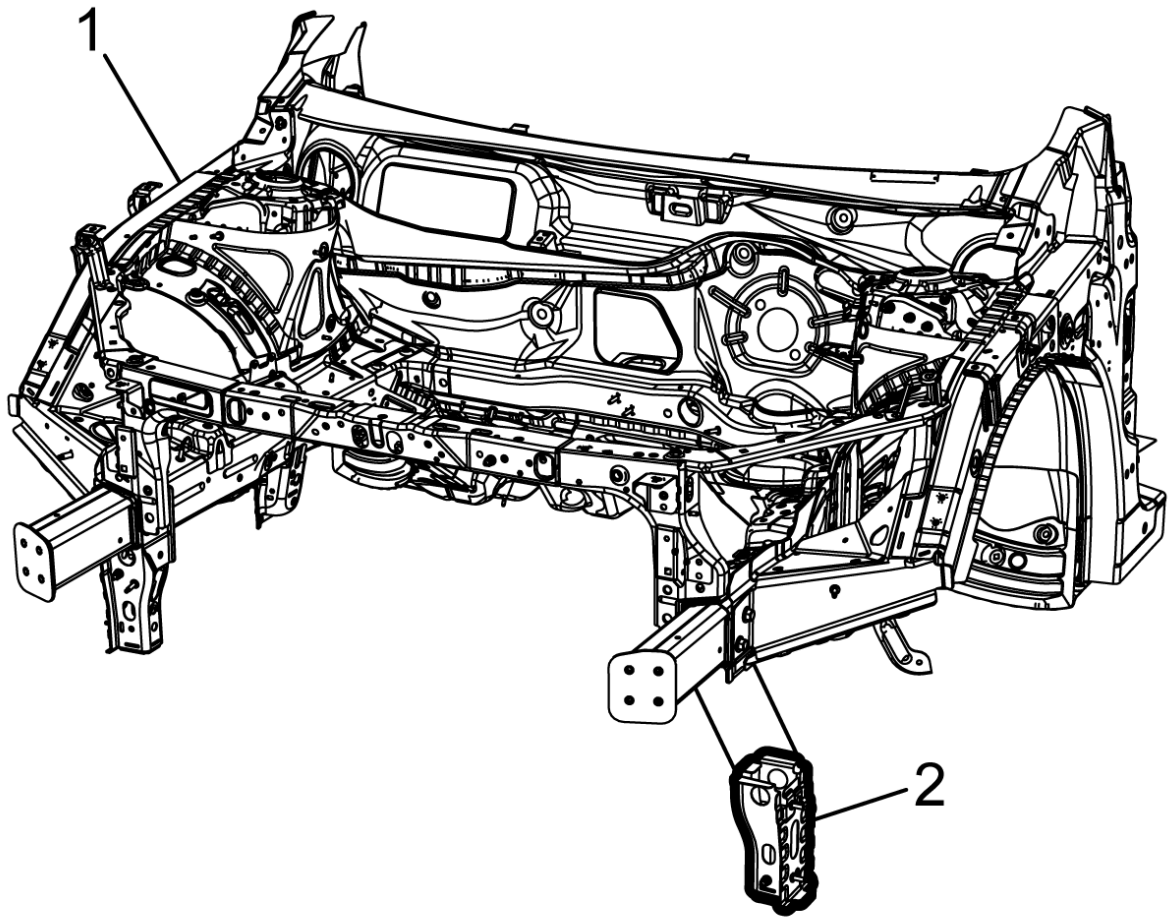


Fig. 16: Front End Lower Tie Bar

Courtesy of GENERAL MOTORS COMPANY

2. Position the front end lower tie bar (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the front end lower tie bar (2).

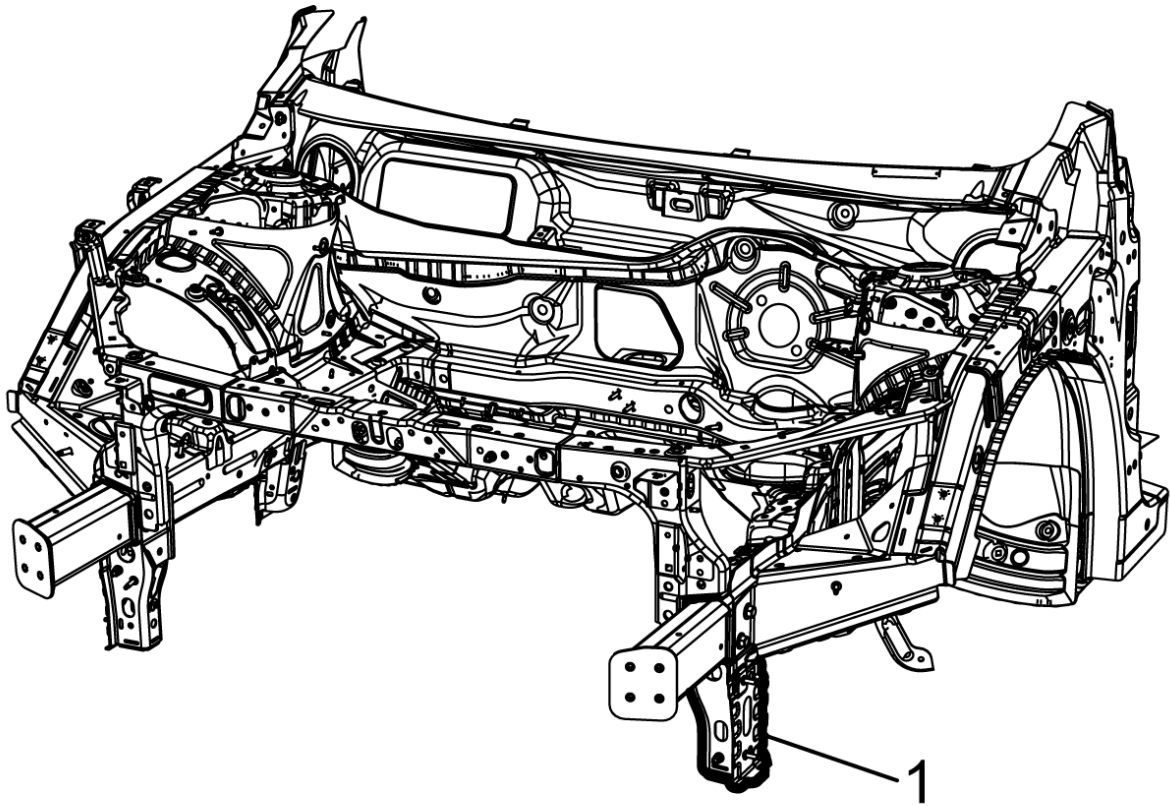


Fig. 17: Front End Lower Tie Bar

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the front end lower tie bar (1) into position.
6. Weld the front end lower tie bar (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Install the body side outer panel as necessary.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

FRONT WHEELHOUSE PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

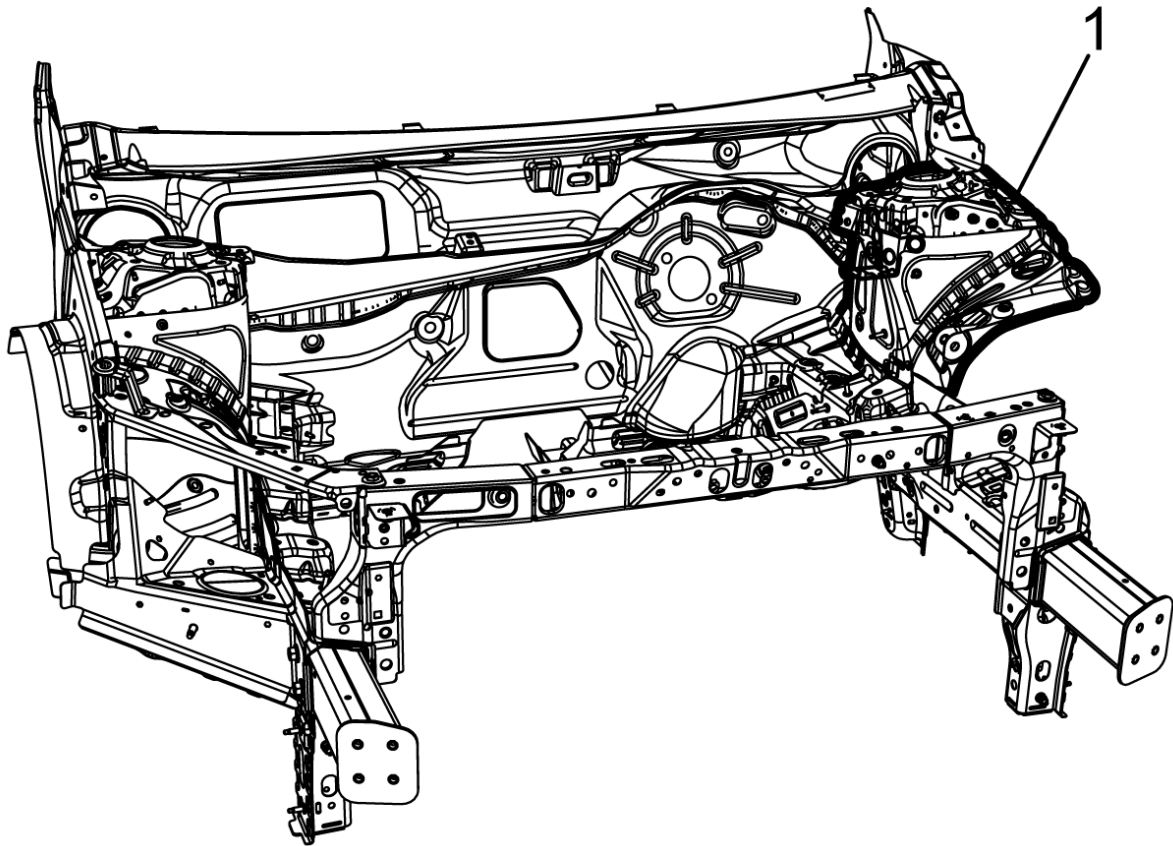


Fig. 18: Front Wheelhouse Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the front wheelhouse panel (1).

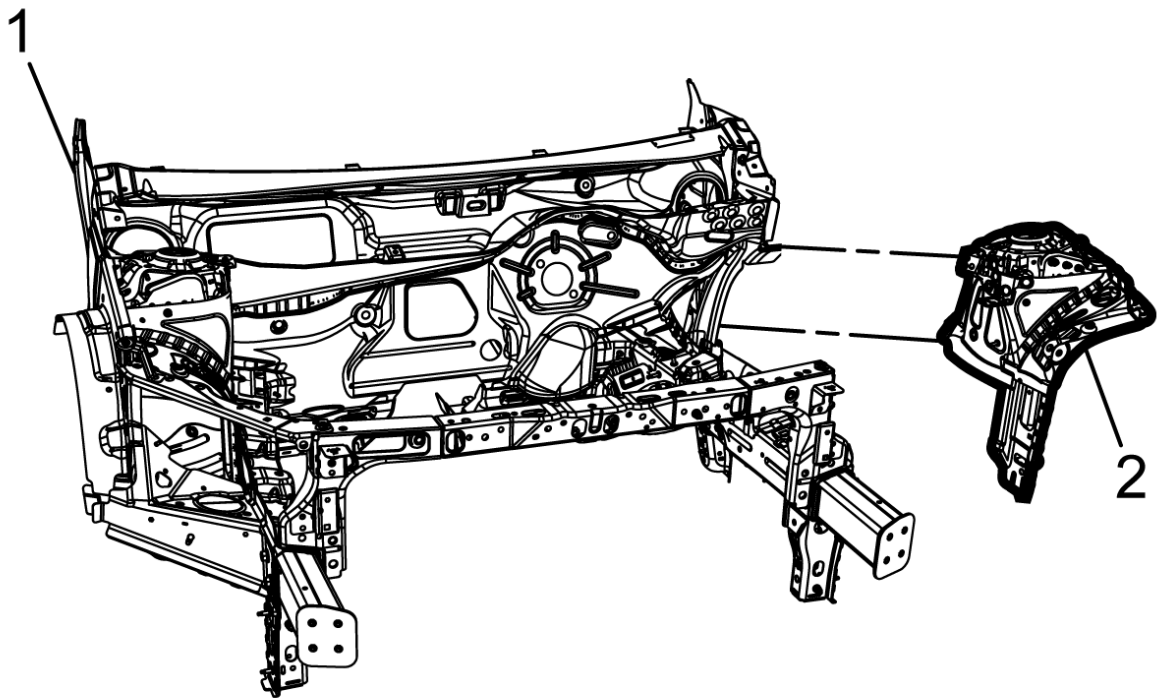


Fig. 19: Front Wheelhouse Panel

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front wheelhouse panel (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

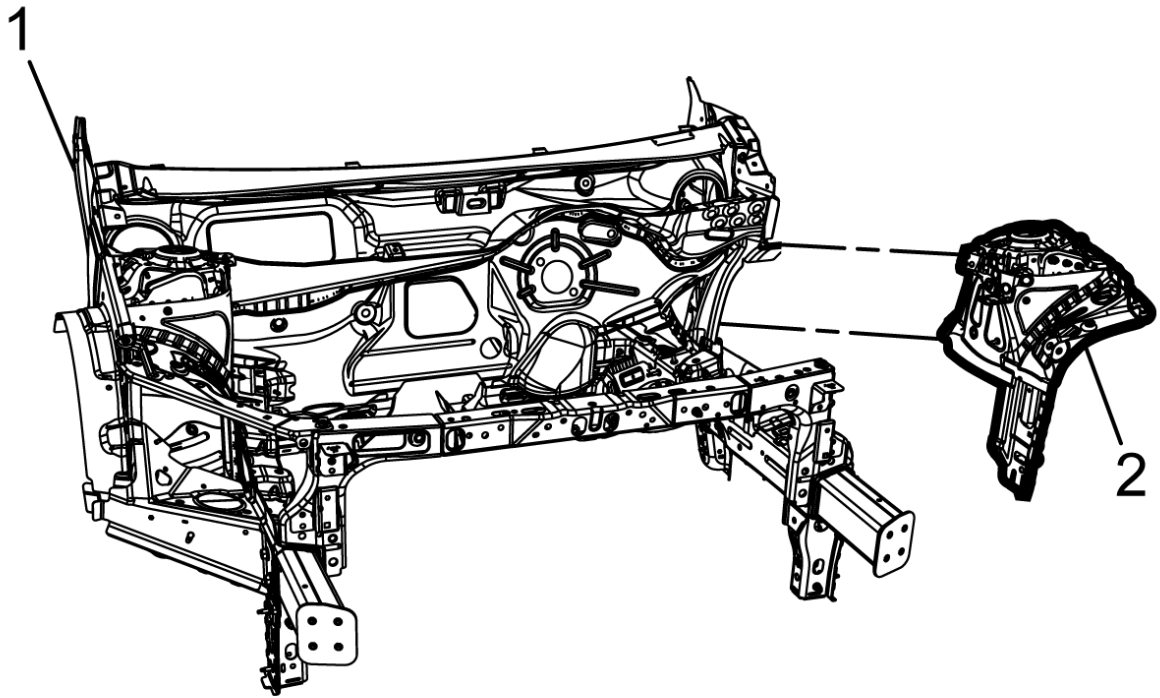


Fig. 20: Front Wheelhouse Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the front wheelhouse panel (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the front wheelhouse panel (2).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding.**

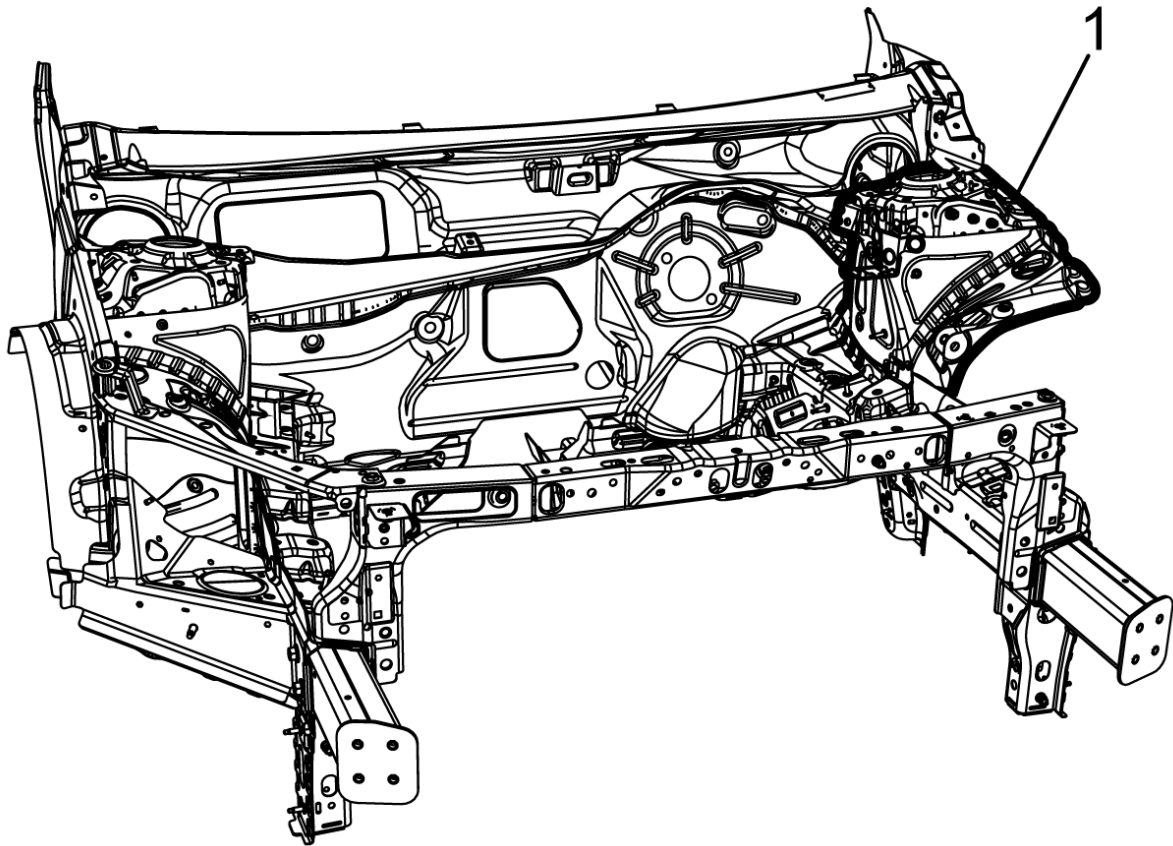


Fig. 21: Front Wheelhouse Panel

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the front wheelhouse panel (1) into position.
6. Weld the front wheelhouse panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

FRONT WHEELHOUSE EXTENSION REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#)
2. Inspect the high voltage system. [High Voltage System Inspection](#)
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)

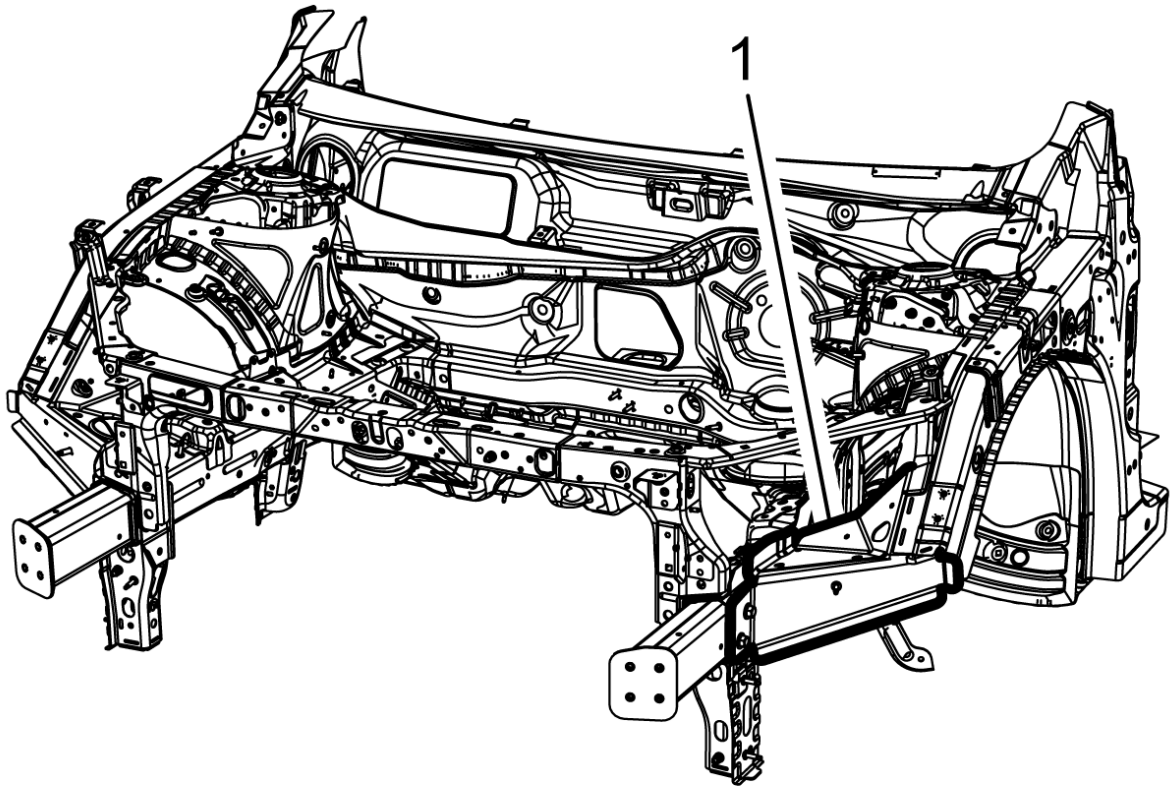


Fig. 22: Front Wheelhouse Extension

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the front wheelhouse extension (1).

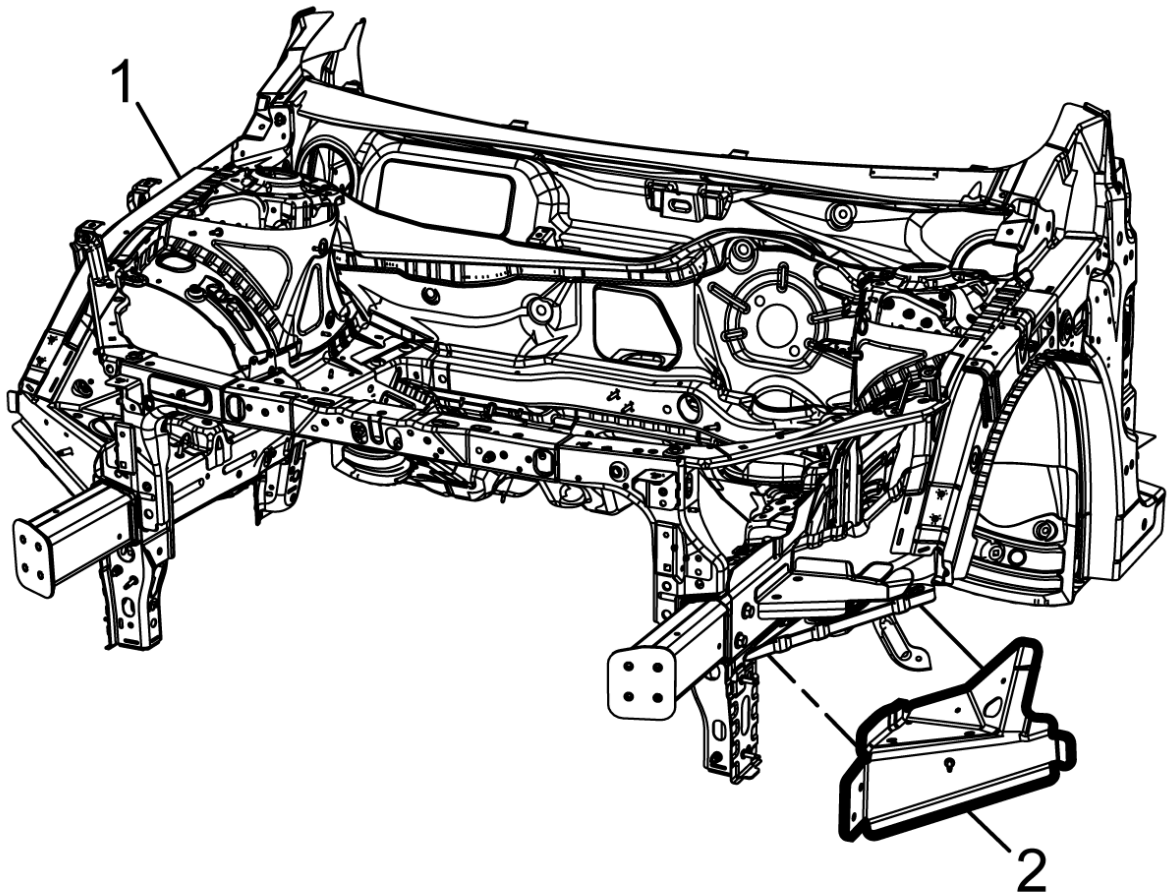


Fig. 23: Front Wheelhouse Extension

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front wheelhouse extension (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#)

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

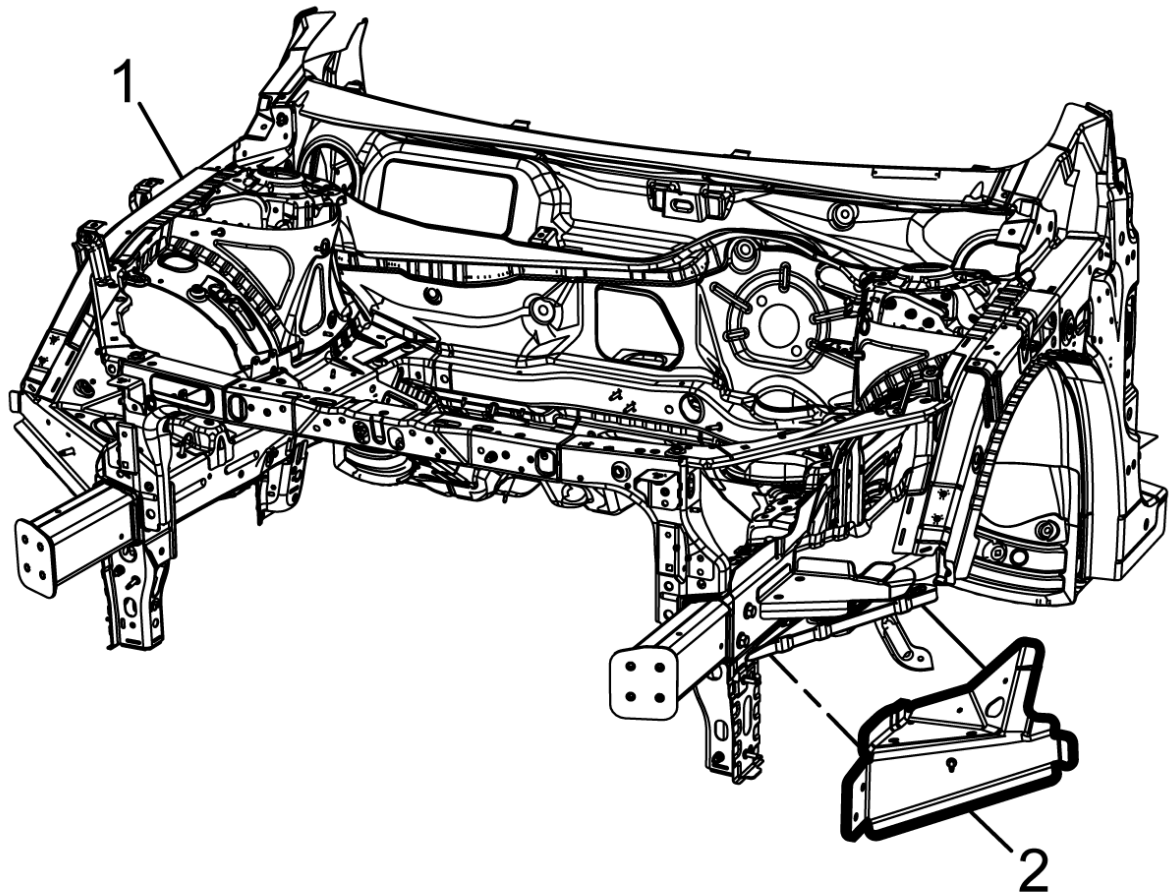


Fig. 24: Front Wheelhouse Extension

Courtesy of GENERAL MOTORS COMPANY

2. Position the front wheelhouse extension (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the front wheelhouse extension (2).

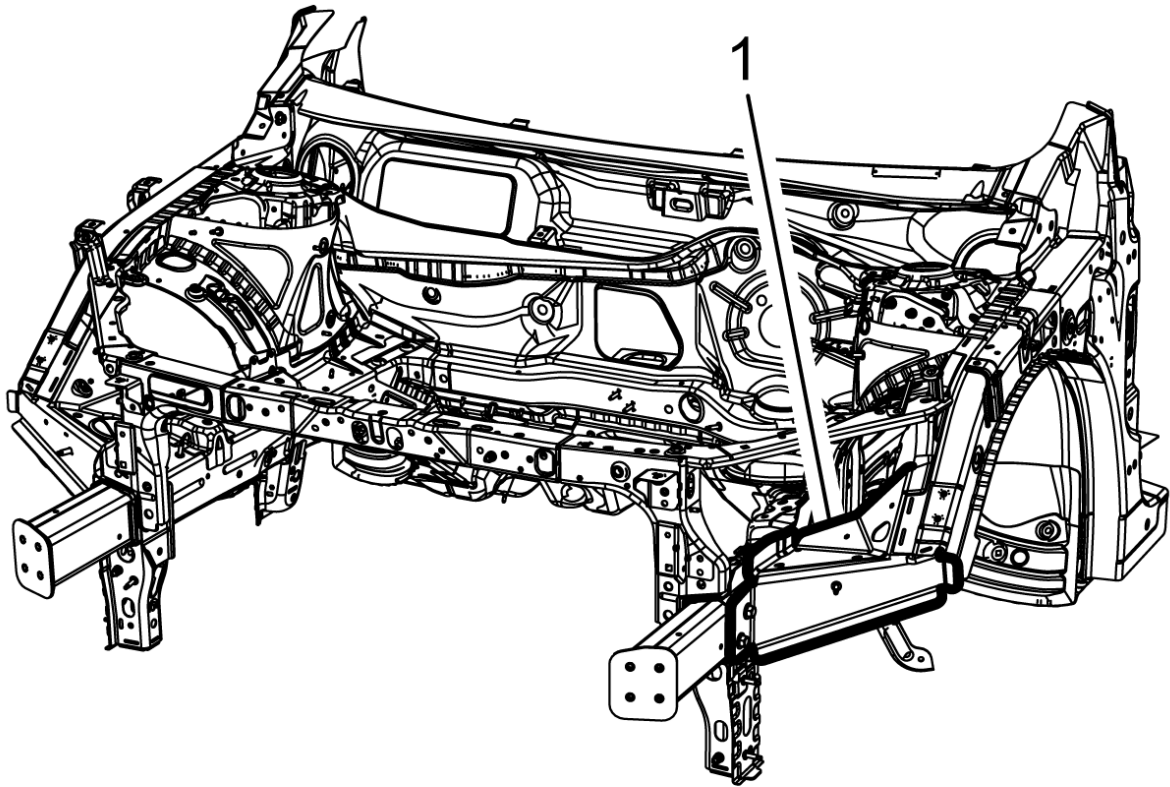


Fig. 25: Front Wheelhouse Extension

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#)
5. Clamp the front wheelhouse extension (1) into position.
6. Weld the front wheelhouse extension (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#)
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#)
12. Enable the SIR System. [SIR Disabling and Enabling](#)

FRONT WHEELHOUSE PANEL BRACE REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#)
2. Inspect the high voltage system. [High Voltage System Inspection](#)
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)

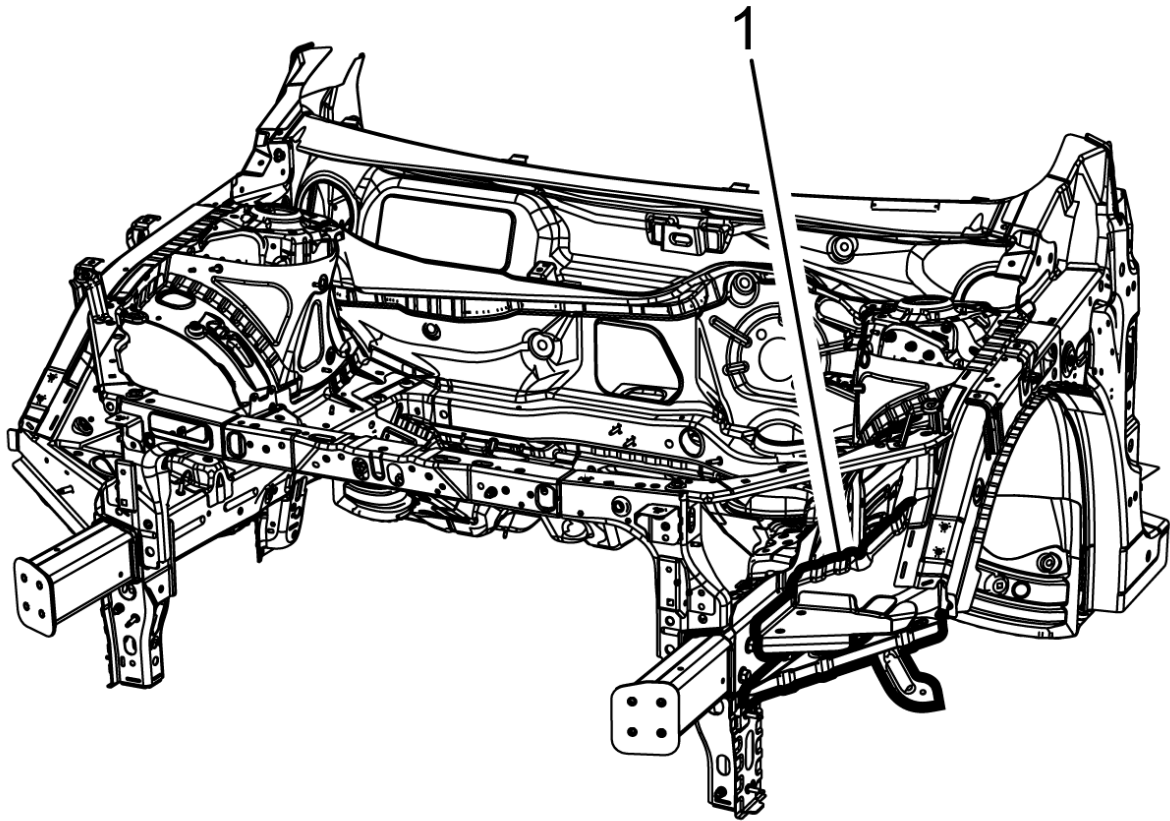


Fig. 26: Front Wheelhouse Panel Brace

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the front wheelhouse panel brace (1).

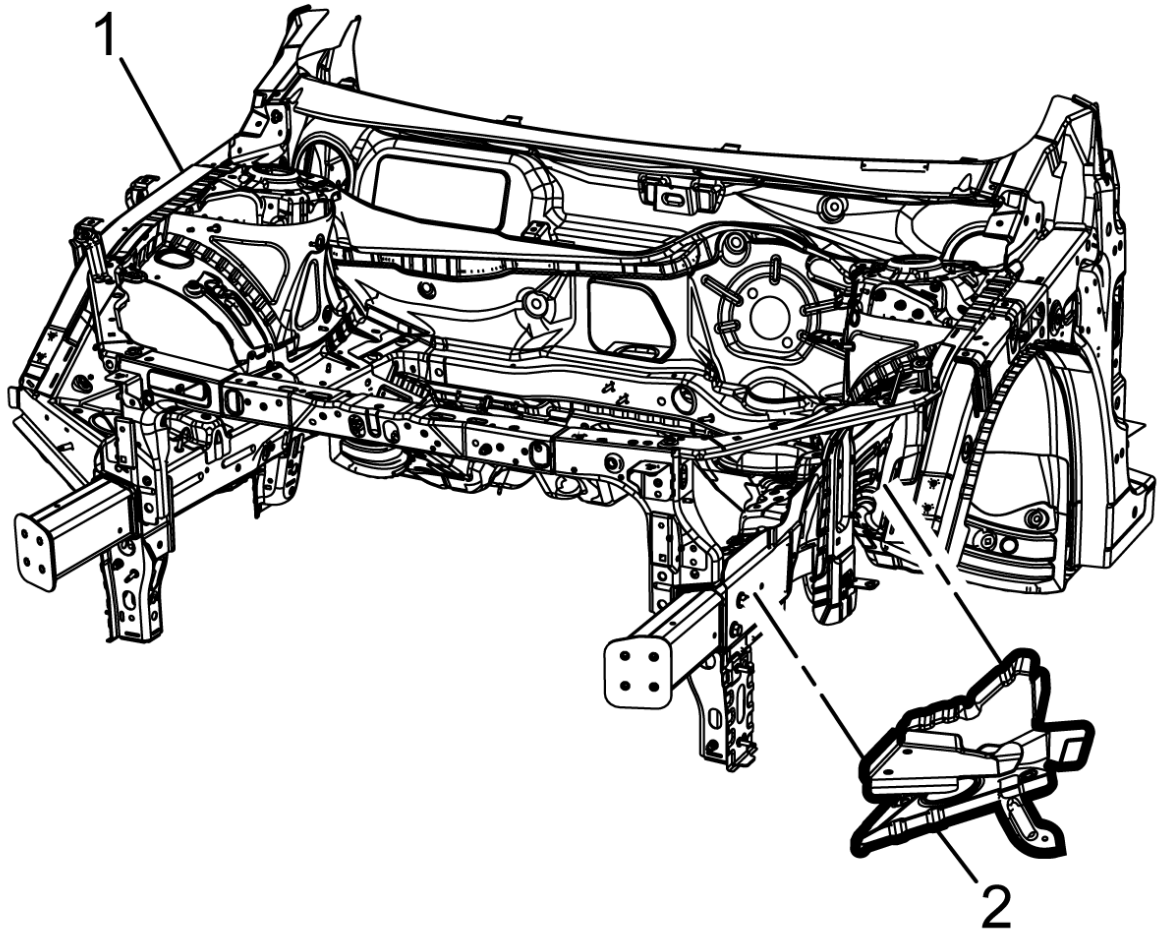


Fig. 27: Front Wheelhouse Panel Brace

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front wheelhouse panel brace (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#)

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

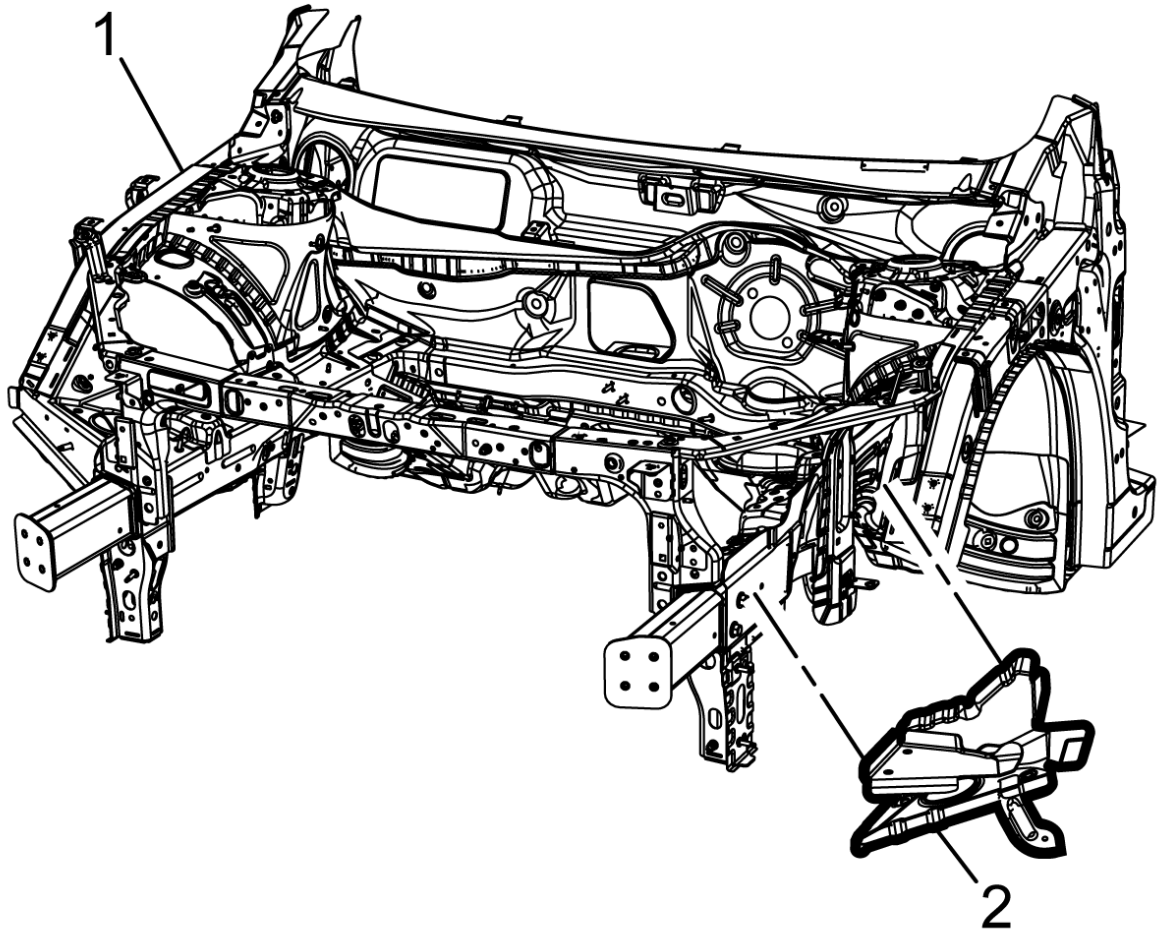


Fig. 28: Front Wheelhouse Panel Brace

Courtesy of GENERAL MOTORS COMPANY

2. Position the front wheelhouse panel brace (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the front wheelhouse panel brace (2).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding**

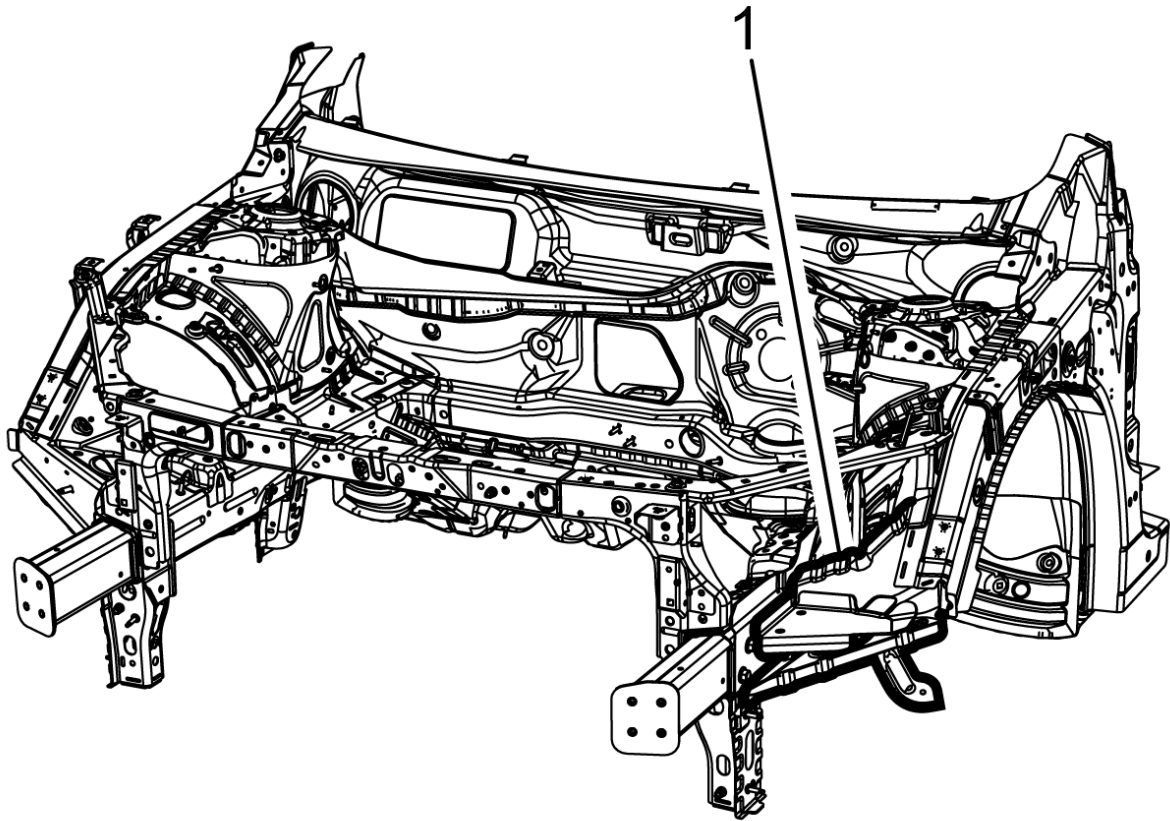


Fig. 29: Front Wheelhouse Panel Brace

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the front wheelhouse panel brace (1) into position.
6. Weld the front wheelhouse panel brace (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#)
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#)
12. Enable the SIR System. [SIR Disabling and Enabling](#)

FRONT COMPARTMENT UPPER SIDE RAIL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

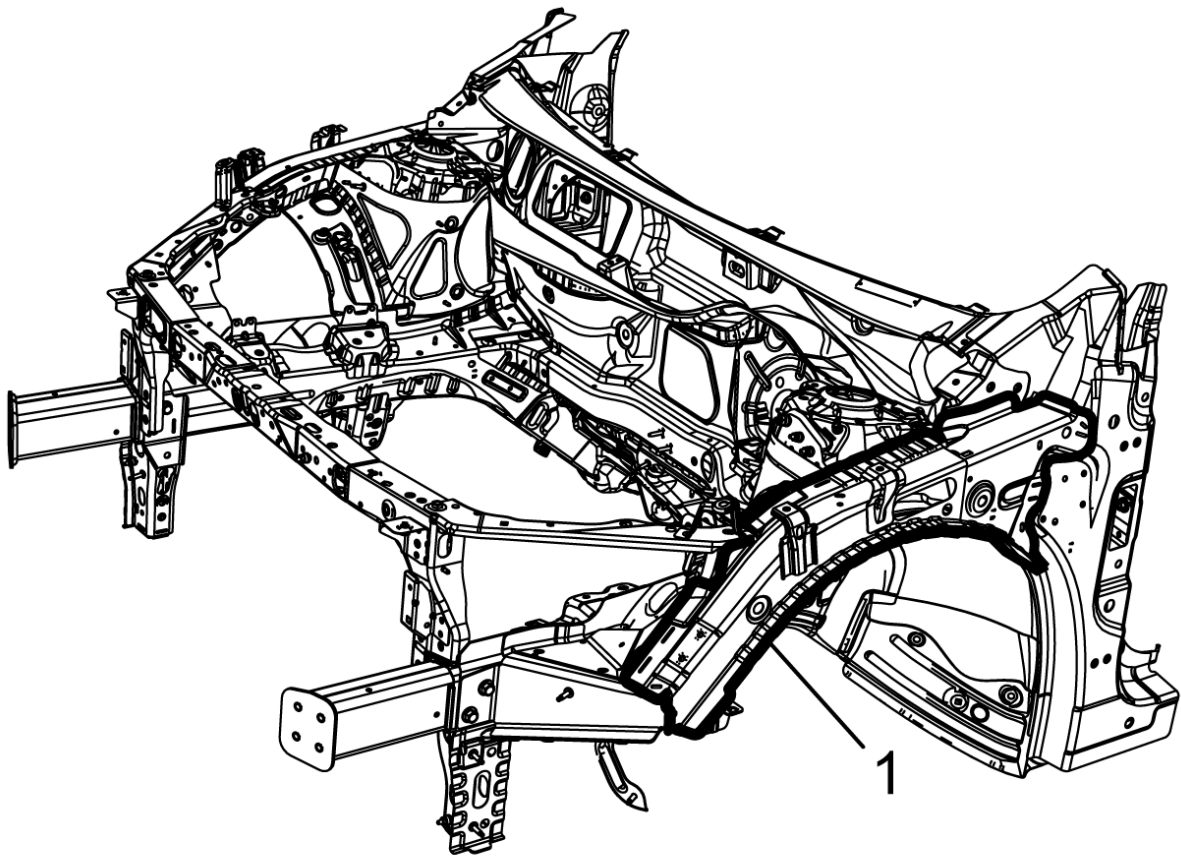


Fig. 30: Front Compartment Upper Side Rail

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory spot welds from front compartment upper side rail (1).

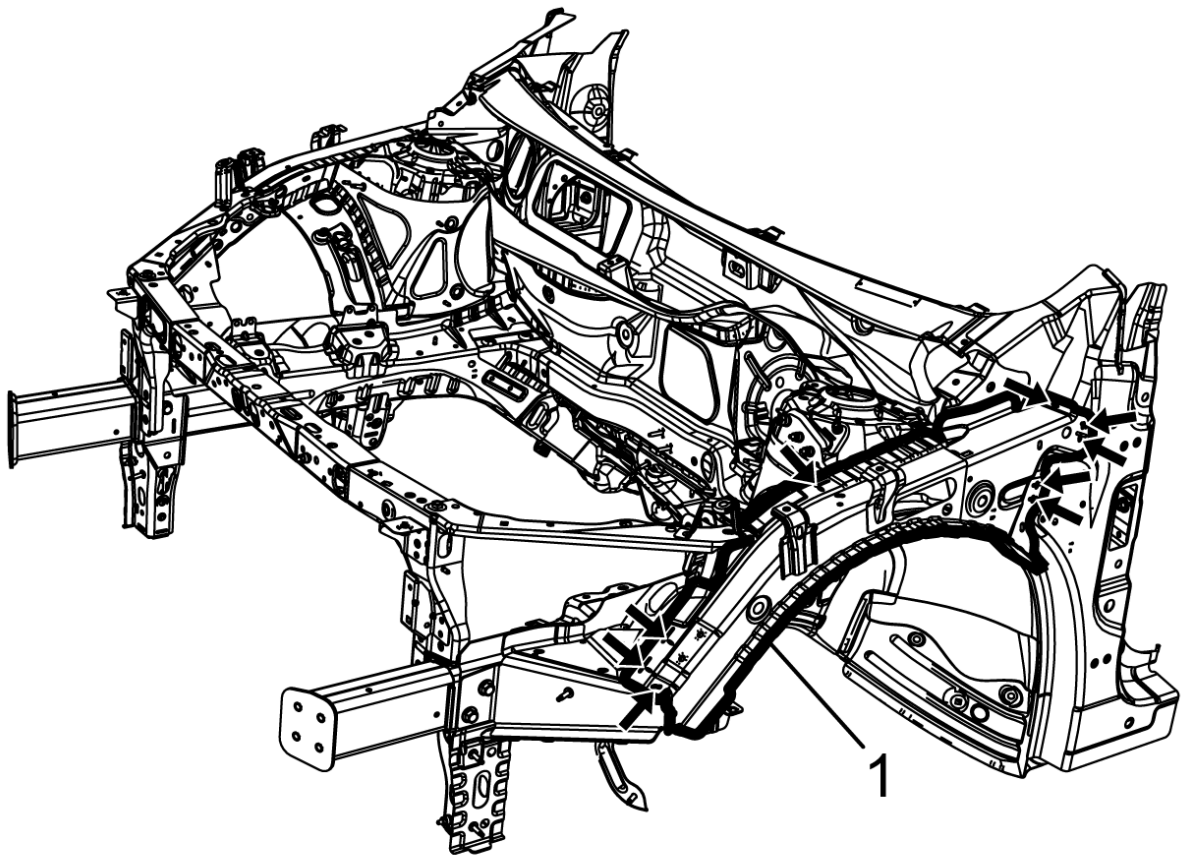


Fig. 31: Front Compartment Upper Side Rail Brazing Welds
Courtesy of GENERAL MOTORS COMPANY

7. Remove all factory brazing welds (1) from front compartment upper side rail.

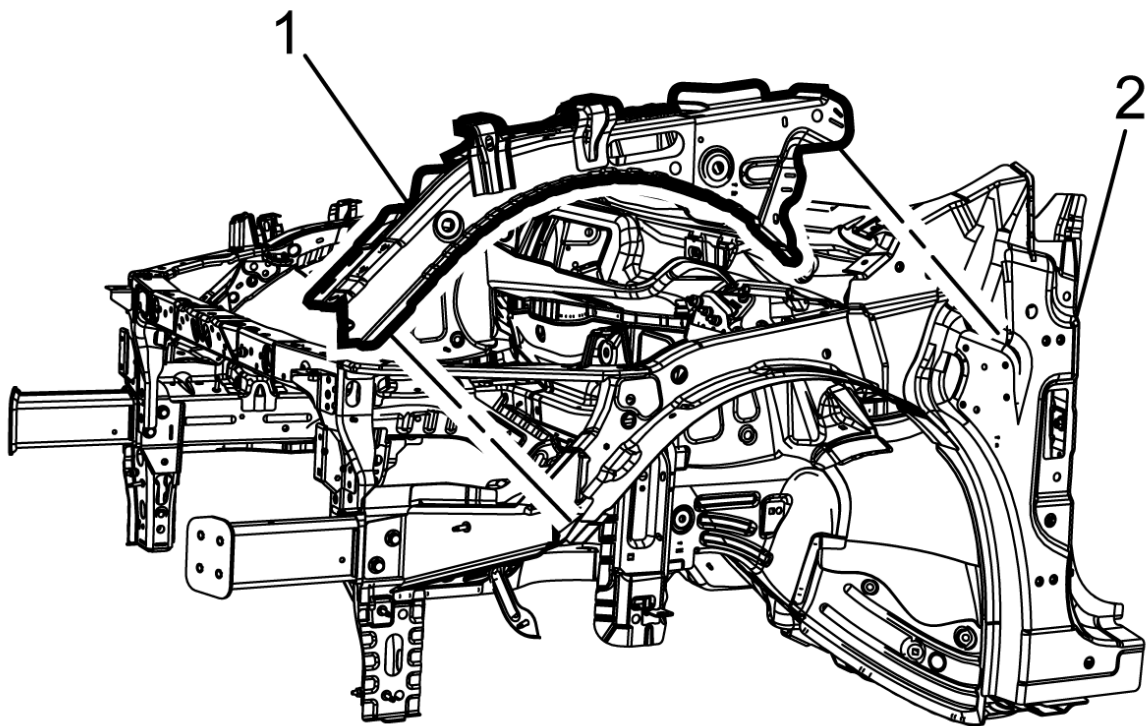


Fig. 32: Front Compartment Upper Side Rail
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged front compartment upper side rail (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

NOTE: MIG Brazing Welds equivalent to the factory brazing welds are recommended.

1. Prepare all mating surfaces for welding as necessary.

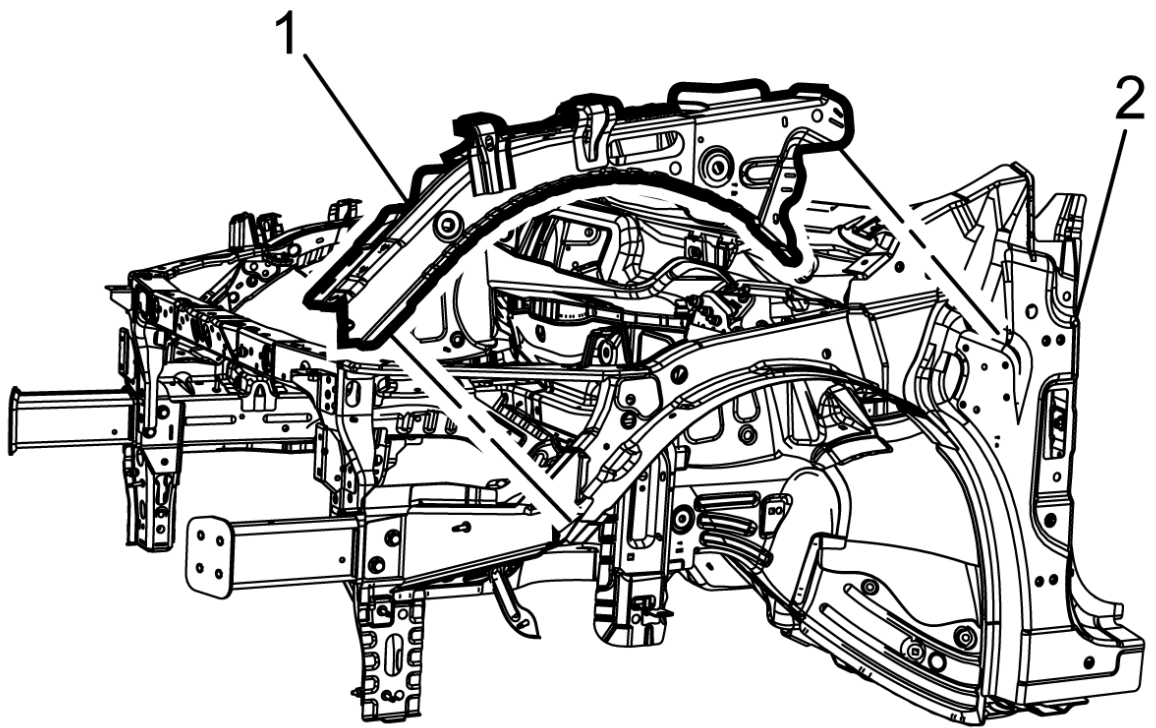


Fig. 33: Front Compartment Upper Side Rail
Courtesy of GENERAL MOTORS COMPANY

2. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
3. Position the front compartment upper side rail (1) on the vehicle (2) using 3-dimensional measuring equipment.
4. Verify the fit of the front compartment upper side rail (1).

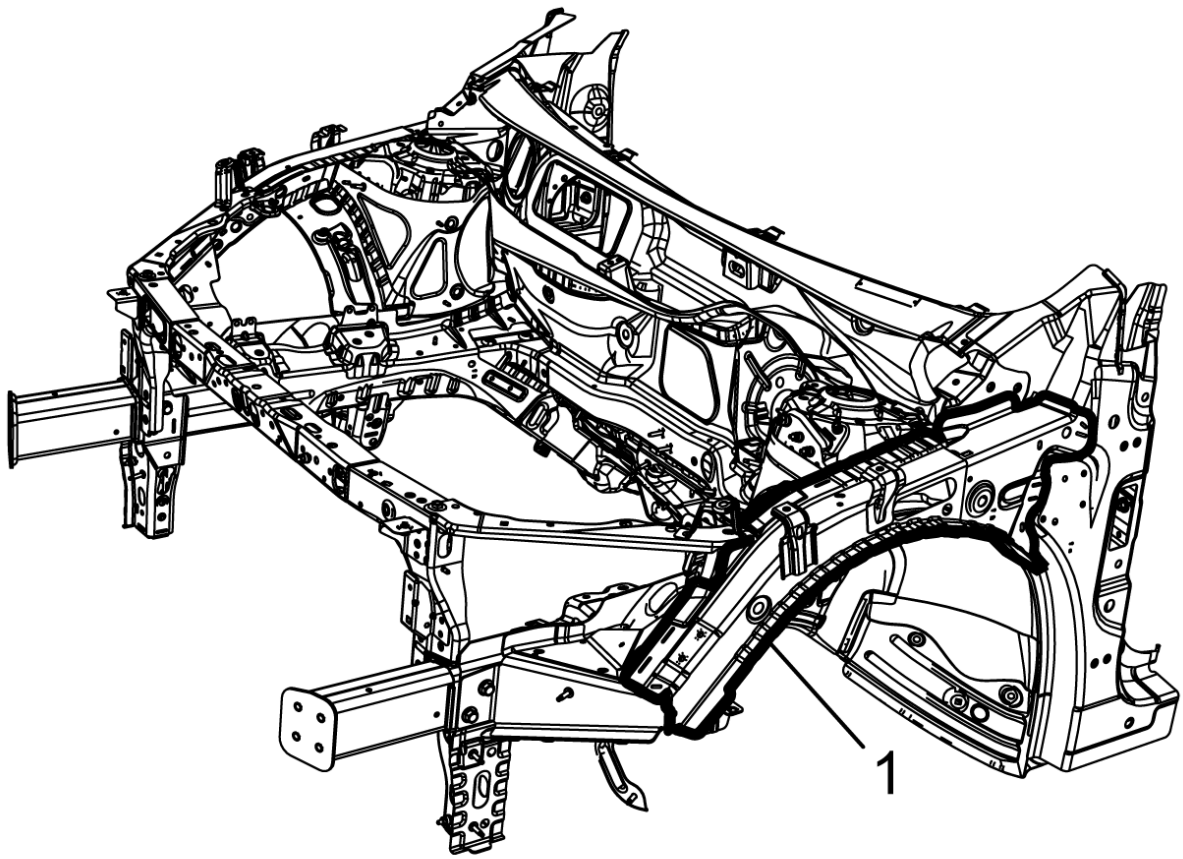


Fig. 34: Front Compartment Upper Side Rail
Courtesy of GENERAL MOTORS COMPANY

5. Clamp the front compartment upper side rail (1) into position.
6. Weld the front compartment upper side rail (1) accordingly.

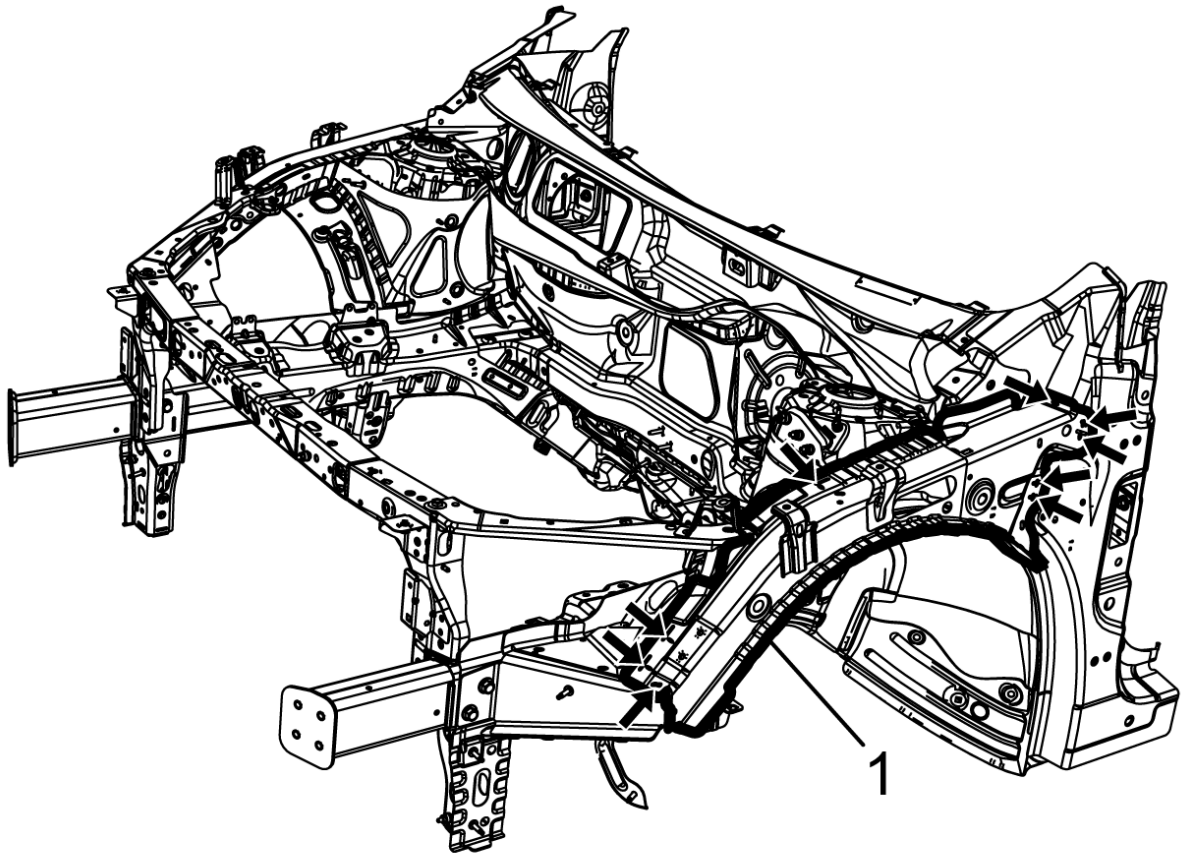


Fig. 35: Front Compartment Upper Side Rail Brazing Welds
Courtesy of GENERAL MOTORS COMPANY

7. Replace factory brazing welds with MIG brazing welds (1) on front compartment upper side rail accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
9. Install the body side outer panel as necessary.
10. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
11. Install all related panels and components.
12. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#) .
13. Enable the SIR system. Refer to [SIR Disabling and Enabling](#) .

WINDSHIELD INNER UPPER FRAME REINFORCEMENT REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The windshield inner upper frame reinforcement is an ultra-high strength dual phase steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.

4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the windshield inner upper frame reinforcement.

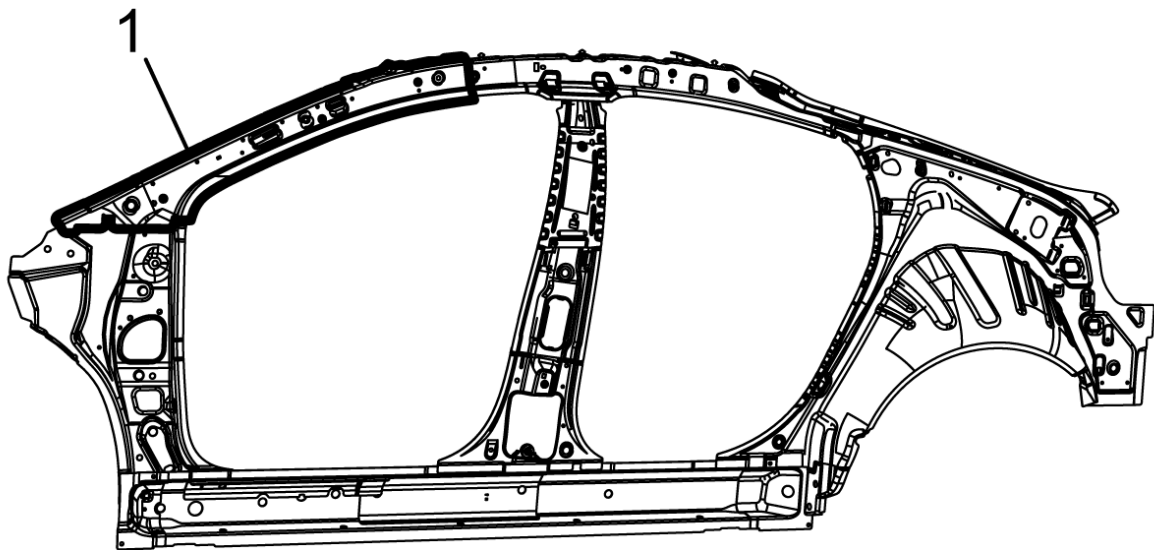


Fig. 36: Windshield Inner Upper Frame Reinforcement

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from the windshield inner upper frame reinforcement (1).

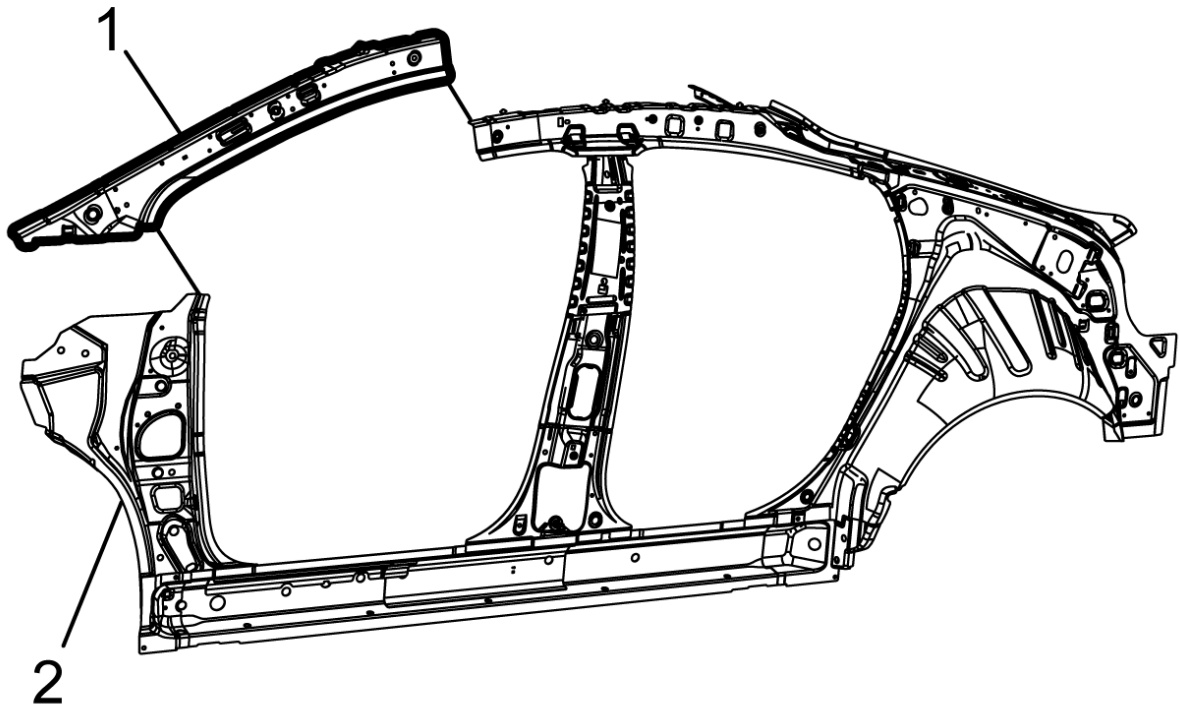


Fig. 37: Windshield Inner Upper Frame Reinforcement
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged windshield inner upper frame reinforcement (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

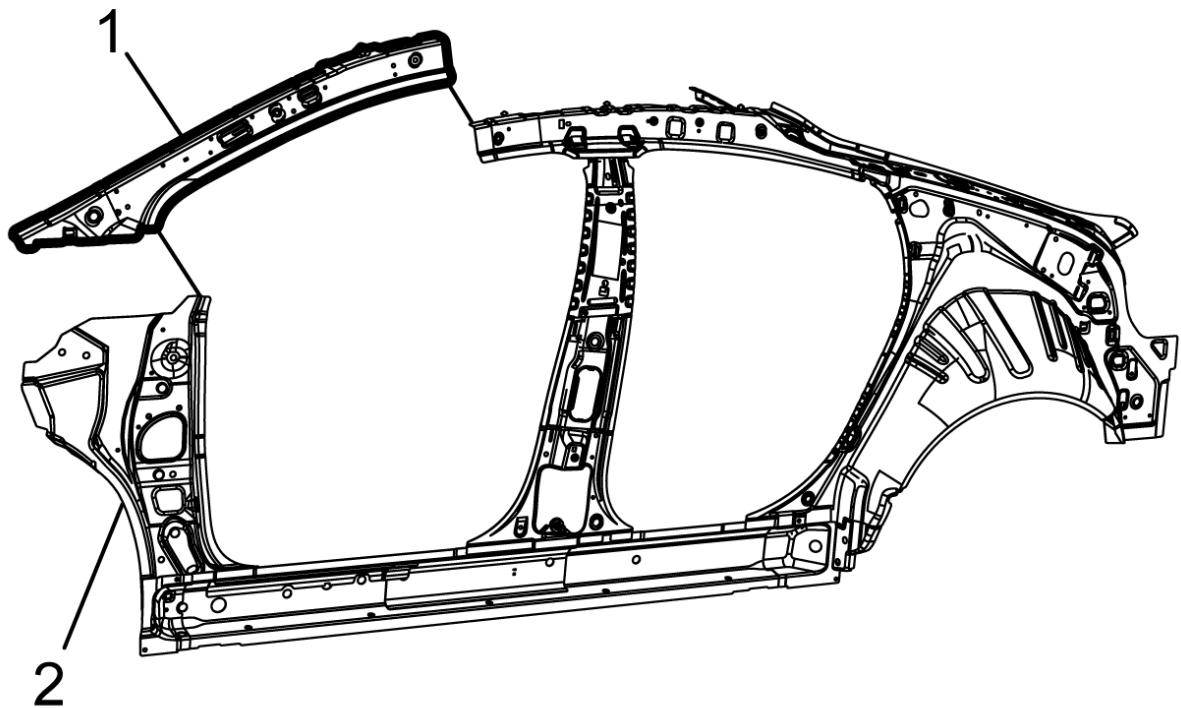


Fig. 38: Windshield Inner Upper Frame Reinforcement
Courtesy of GENERAL MOTORS COMPANY

2. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#).
3. Position the windshield inner upper frame reinforcement (1) on the vehicle (2) using 3-dimensional measuring equipment.
4. Verify the fit of the windshield inner upper frame reinforcement (1).
5. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#)

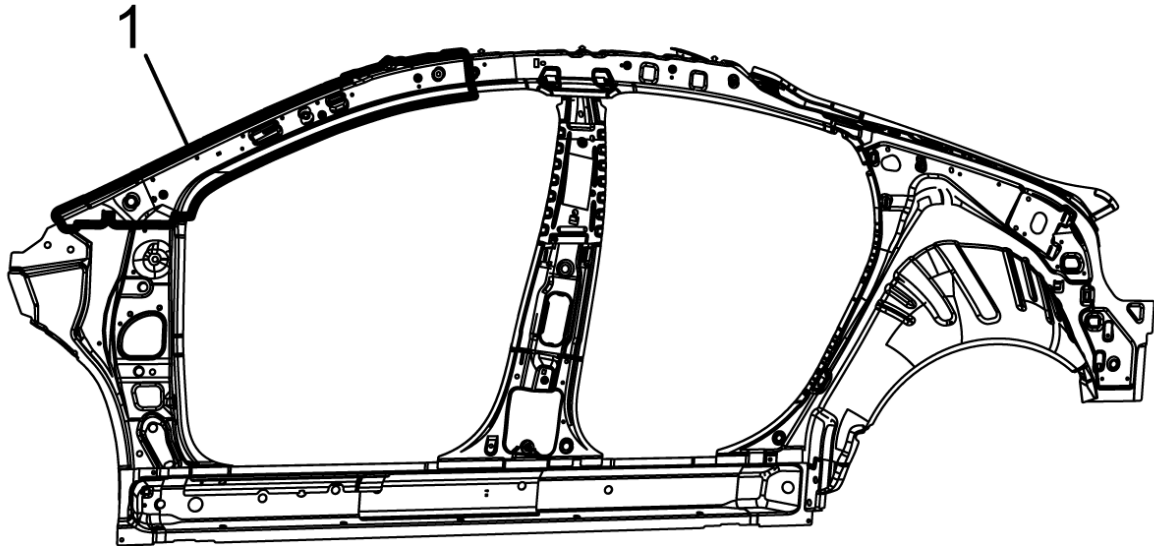


Fig. 39: Windshield Inner Upper Frame Reinforcement
Courtesy of GENERAL MOTORS COMPANY

6. Clamp the windshield inner upper frame reinforcement (1) into position.
7. Weld the windshield inner upper frame reinforcement (1) accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

9. Install the body side outer panel as necessary
10. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
11. Install all related panels and components.
12. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
13. Enable the SIR System. [SIR Disabling and Enabling](#) .

FRONT HINGE PILLAR BODY REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The front hinge pillar is an ultra-high strength steel and cannot be sectioned or repaired. Refer to [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .

2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the front hinge pillar.

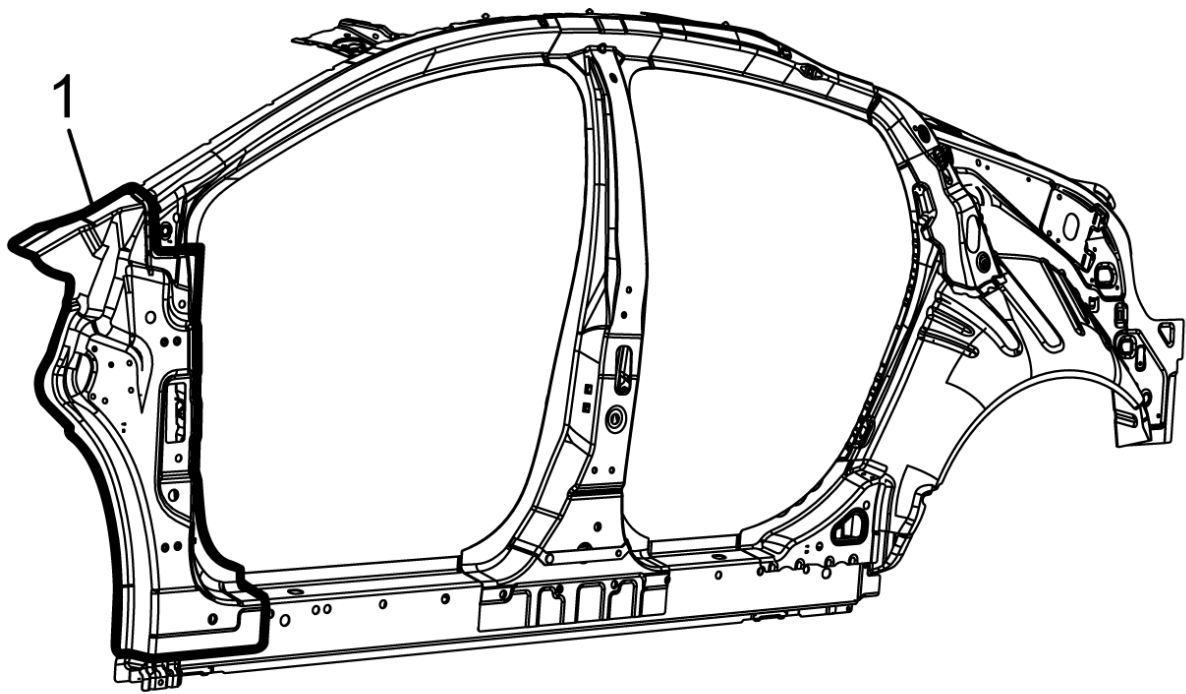


Fig. 40: Front Hinge Pillar Body

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from front hinge pillar body (1).

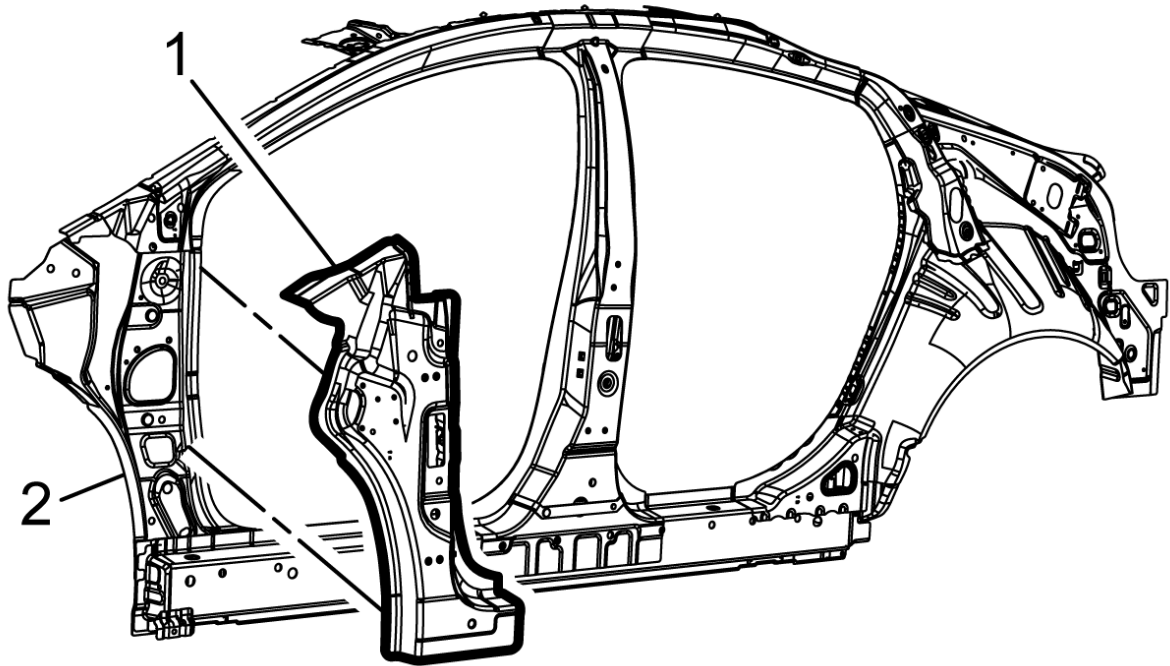


Fig. 41: Front Hinge Pillar Body

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged front hinge pillar body (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

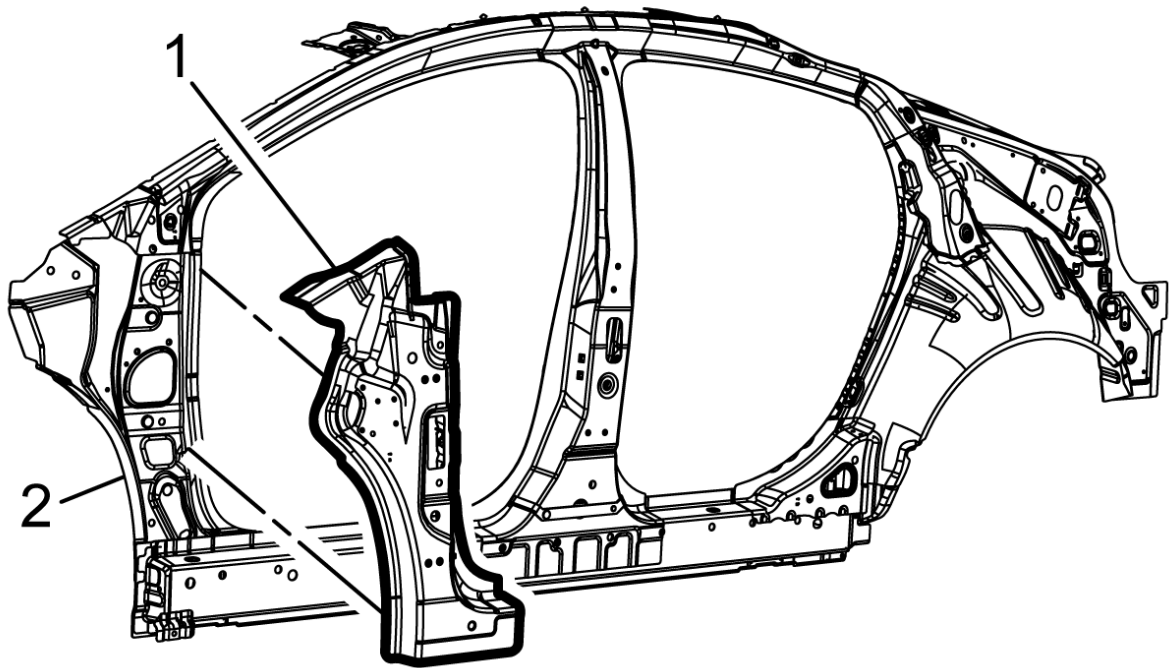


Fig. 42: Front Hinge Pillar Body

Courtesy of GENERAL MOTORS COMPANY

2. Position the front hinge pillar body (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the front hinge pillar body (1).

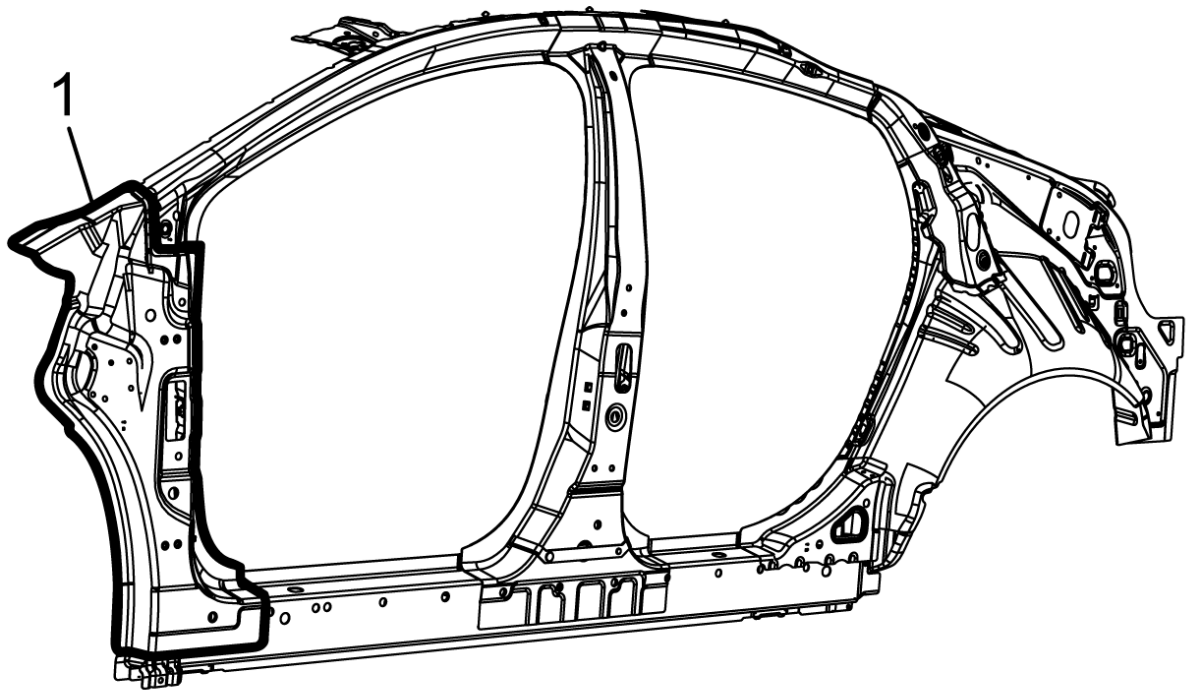


Fig. 43: Front Hinge Pillar Body

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the front hinge pillar body (1) into position.
6. Weld the front hinge pillar body (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Install the body side outer panel as necessary.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

ROOF OUTER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

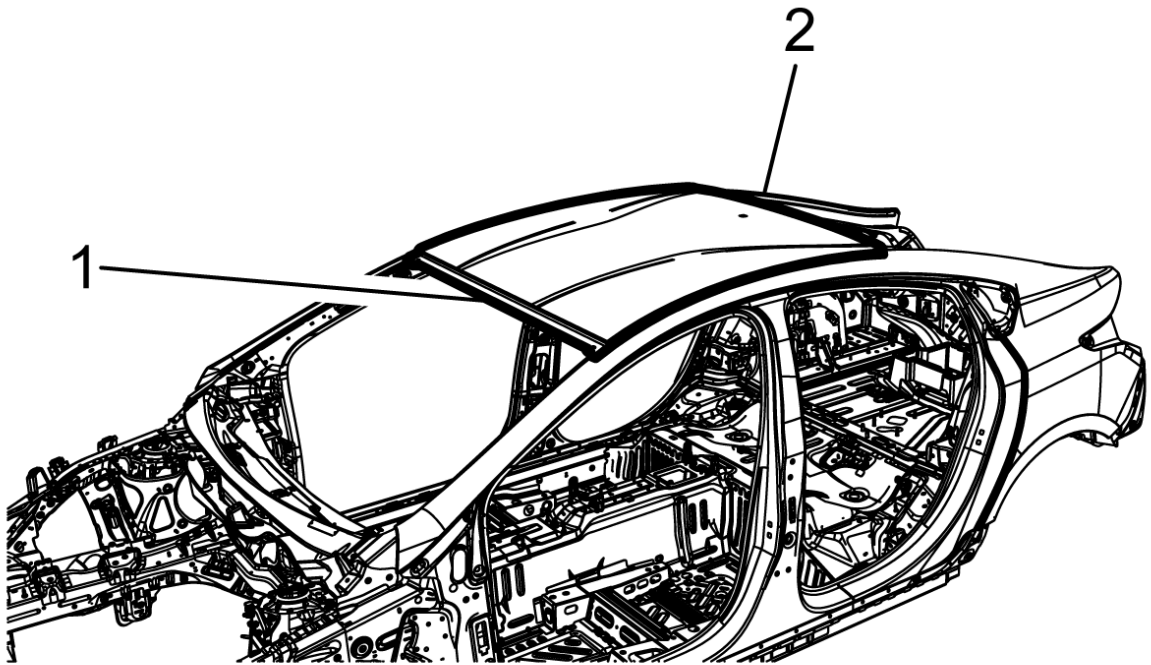


Fig. 44: Roof Outer Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds (1) from the roof outer panel (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

7. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

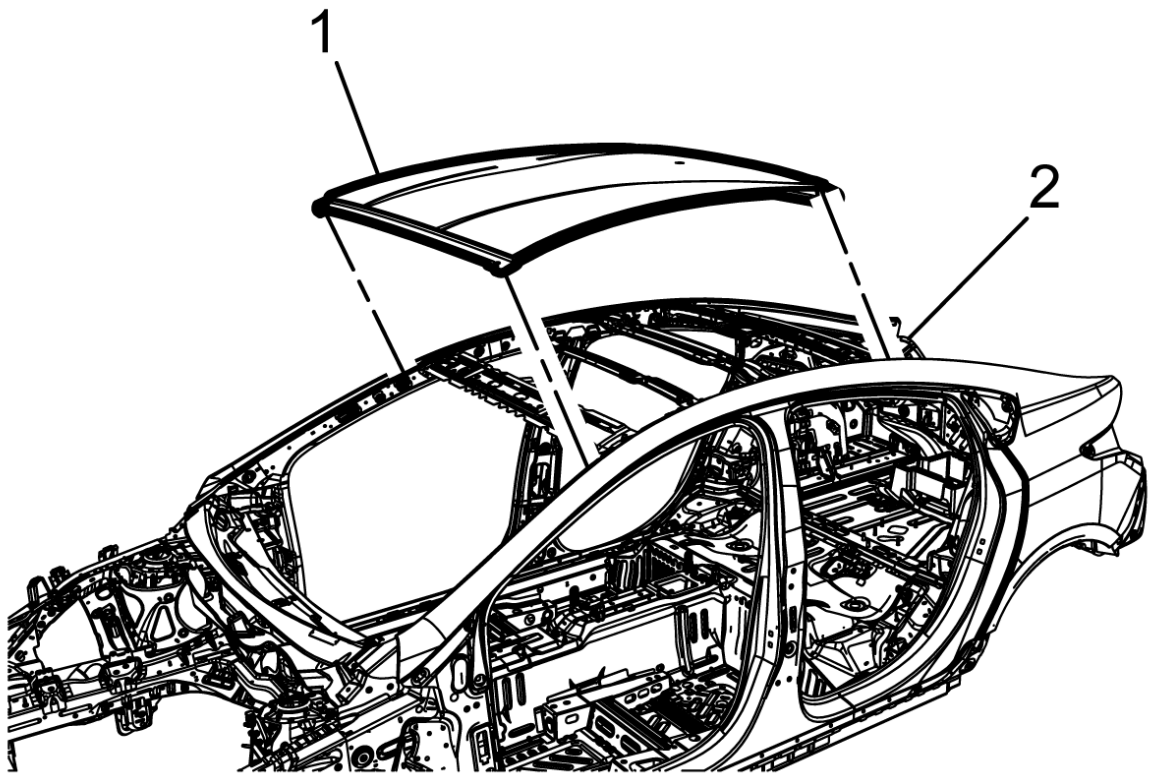


Fig. 45: Roof Outer Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged roof panel (1) from vehicle (2).

Installation Procedure

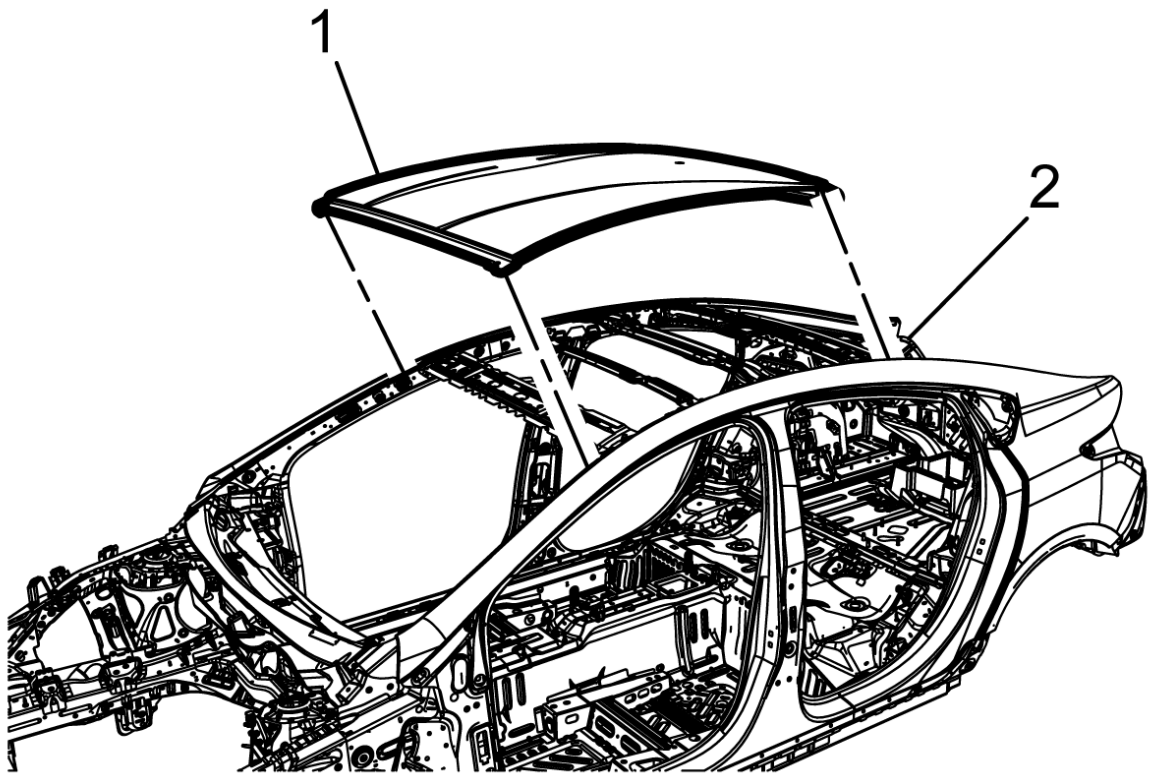


Fig. 46: Roof Outer Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Dry fit the roof panel (1) to the vehicle (2).
2. Remove roof panel (1) from vehicle (2) and prepare all mating surfaces for welding as necessary.

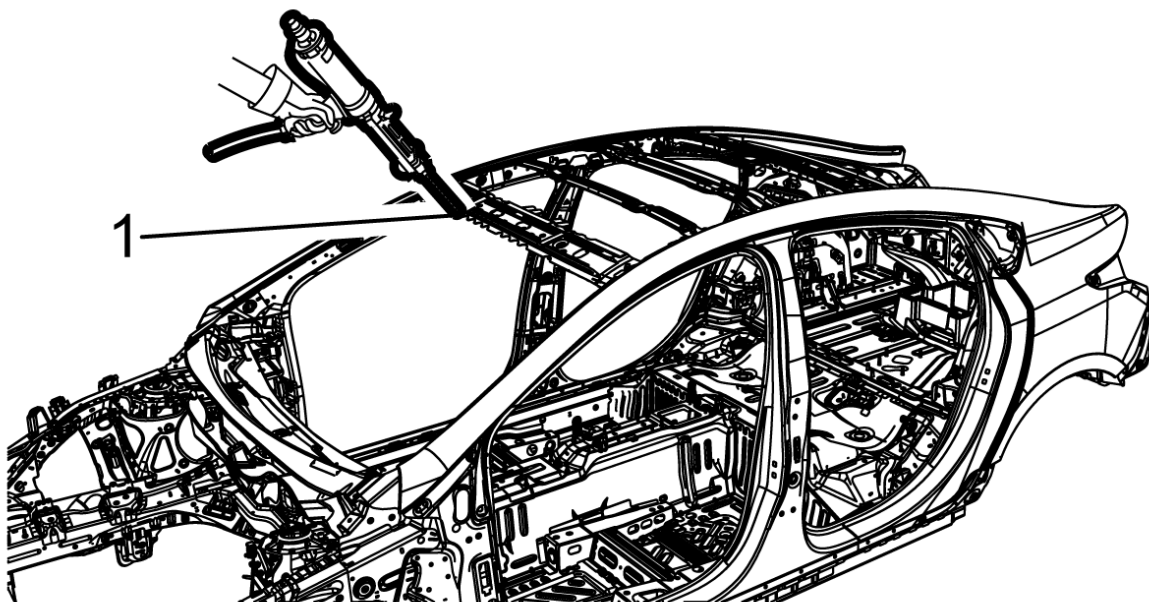


Fig. 47: Apply Anti-Flutter Foam To Roof Bows

Courtesy of GENERAL MOTORS COMPANY

3. Apply anti-flutter foam-slow set 40 - 50 minute working time, or equivalent, to roof bows (1) as noted from original roof bows.

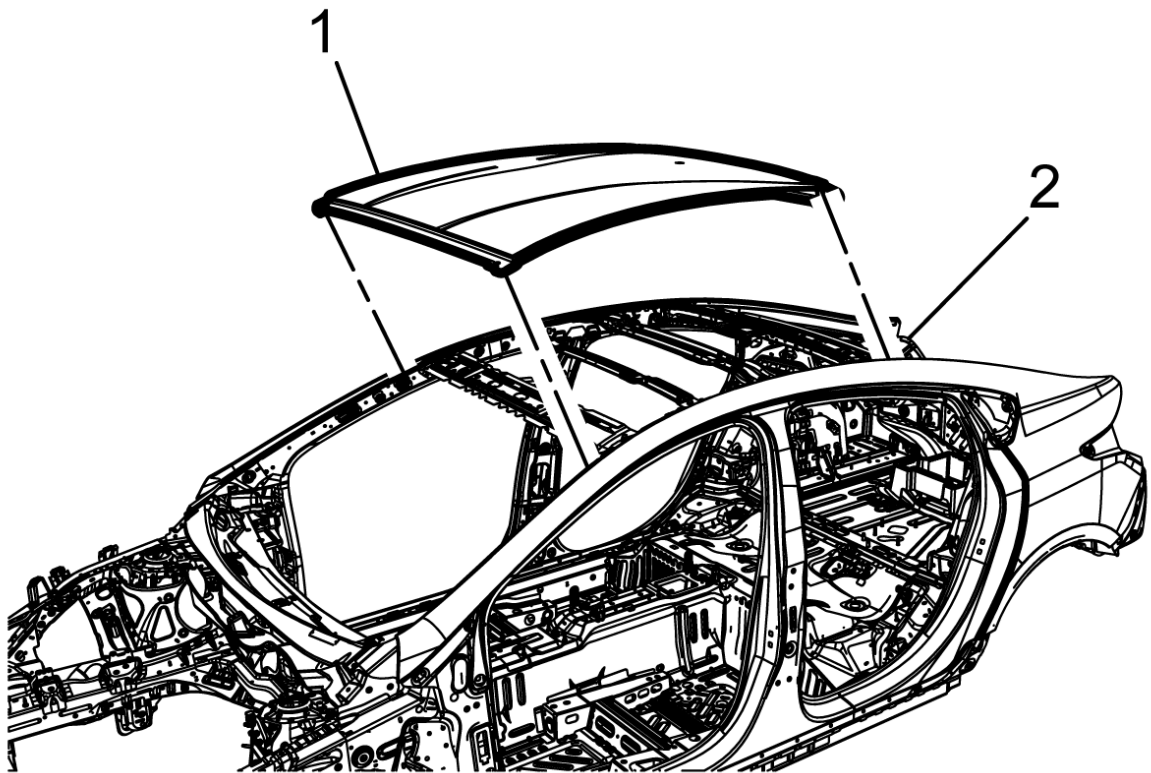


Fig. 48: Roof Outer Panel

Courtesy of GENERAL MOTORS COMPANY

4. Position the roof outer panel (1) on the vehicle (2) using 3-dimensional measuring equipment.
5. Verify the fit of the roof outer panel (1).
6. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding**
7. Clamp the roof outer panel (1) to the vehicle (2).

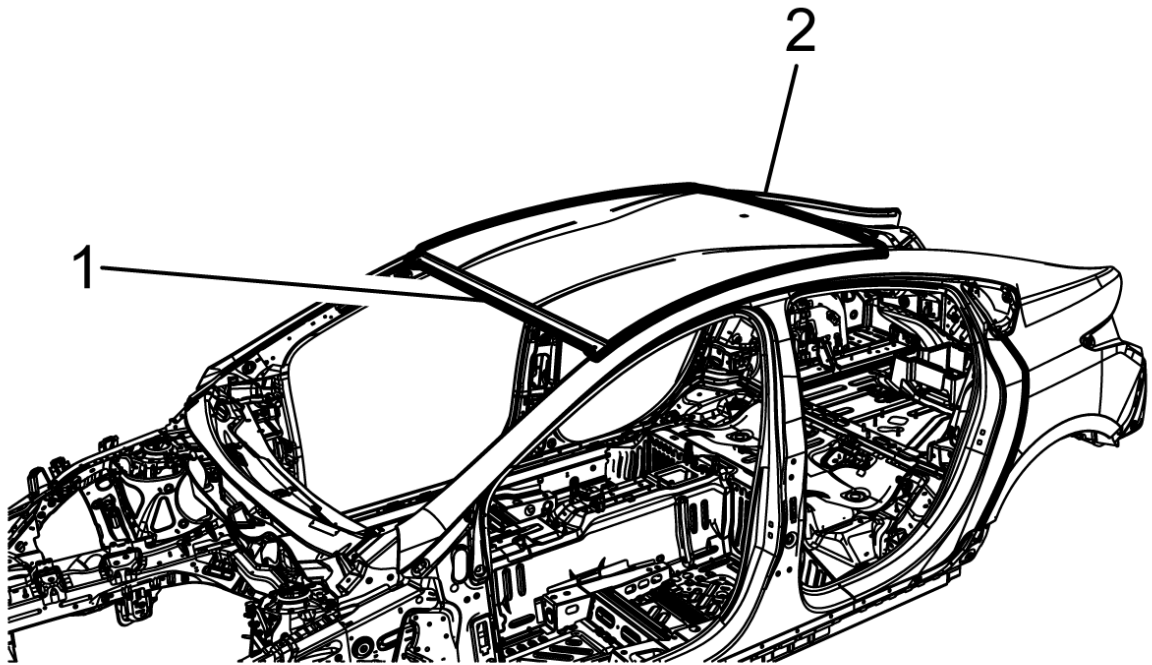


Fig. 49: Roof Outer Panel

Courtesy of GENERAL MOTORS COMPANY

8. Weld the front and rear roof outer panel (1) accordingly to the vehicle (2).
9. Weld both sides of the roof outer panel to the vehicle (2). To create a solid weld with minimum heat distortion, make 25 mm (1 in) stitch welds along the seam with 25 mm (1 in) gaps between them. Then go back and complete the stitch weld.
10. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

11. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#)
12. Install all related panels and components.
13. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
14. Enable the SIR System. [SIR Disabling and Enabling](#) .

ROOF INNER SIDE RAIL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The roof inner side rail is an ultra-high strength dual phase steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the roof inner side rail.

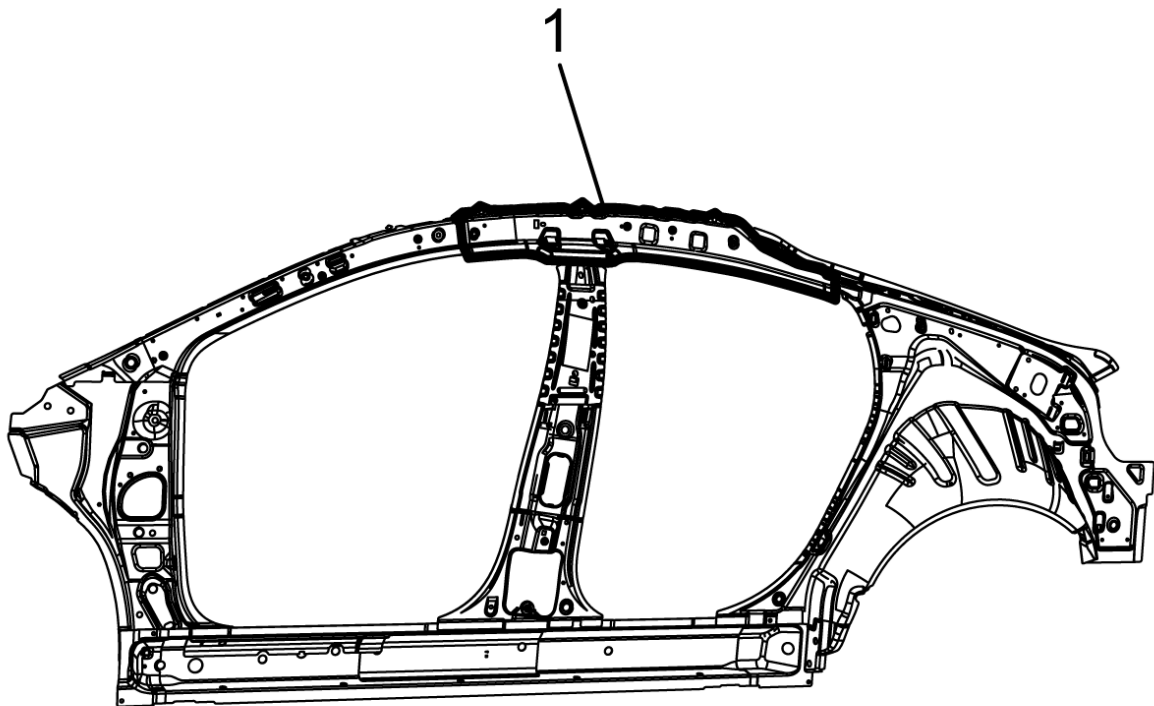


Fig. 50: Roof Inner Side Rail

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from the roof inner side rail (1).

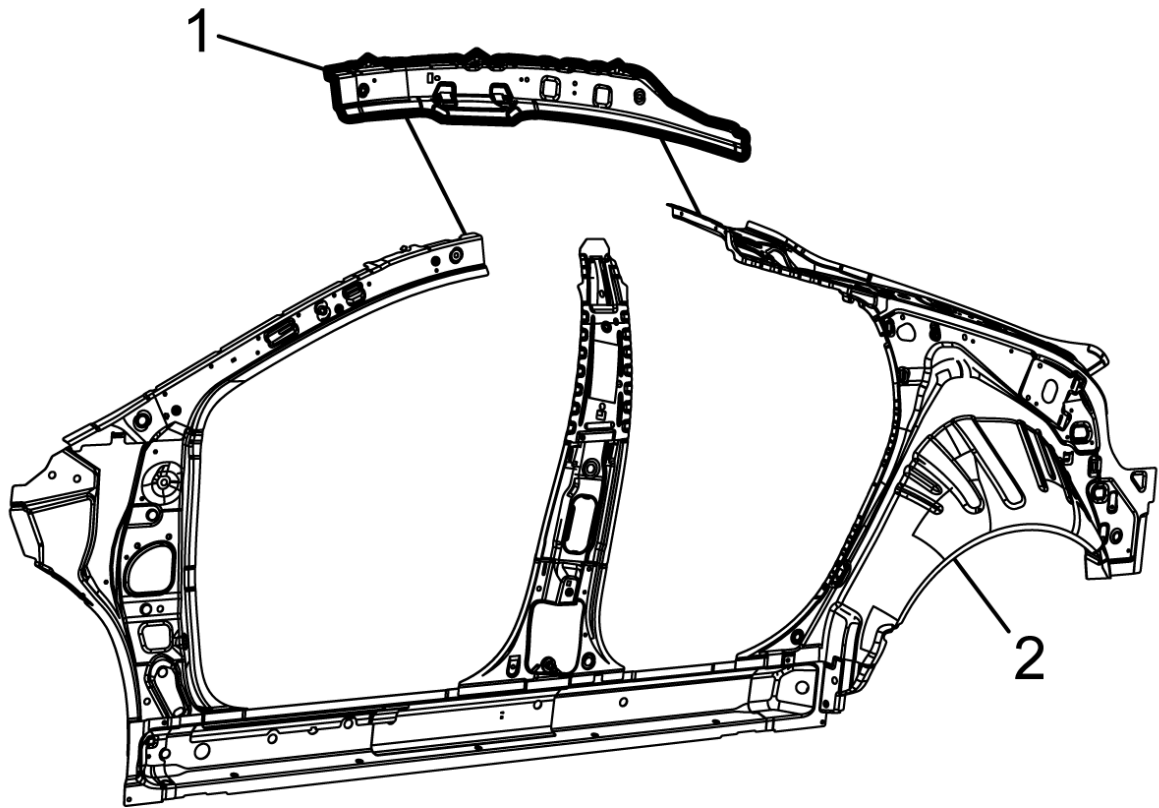


Fig. 51: Roof Inner Side Rail

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged roof inner side rail (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

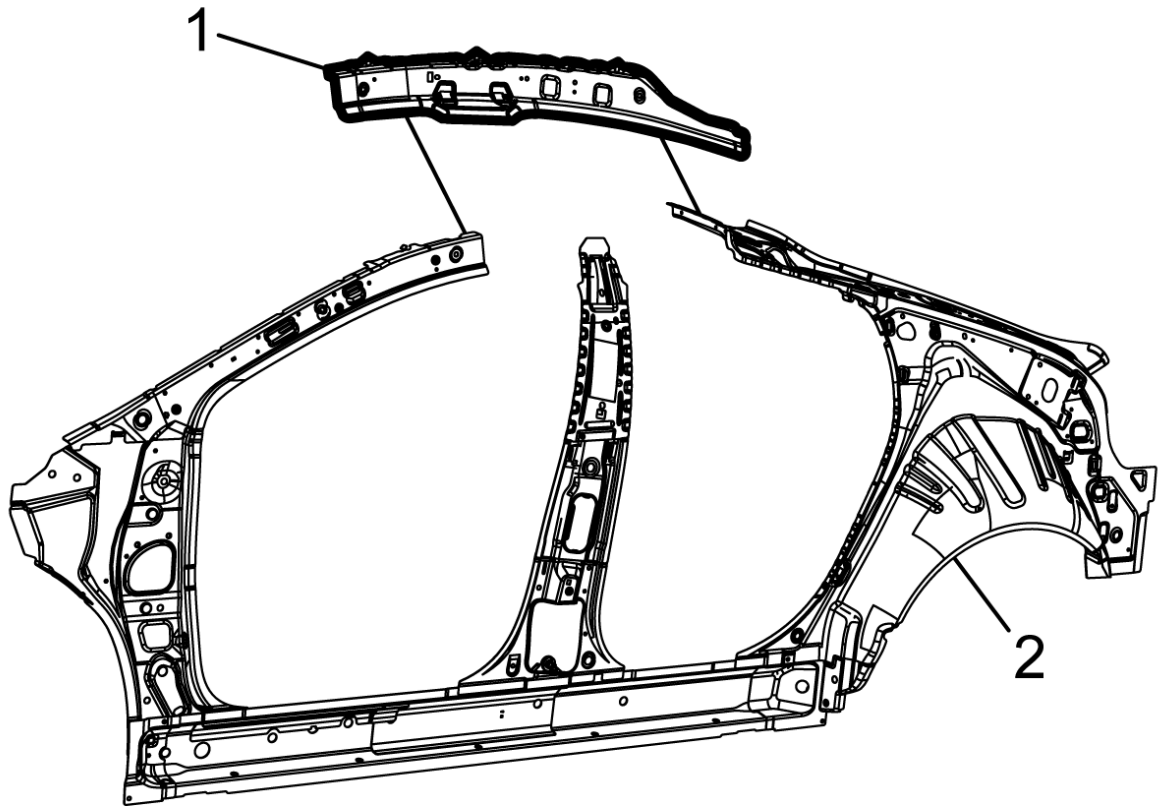


Fig. 52: Roof Inner Side Rail

Courtesy of GENERAL MOTORS COMPANY

2. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#).
3. Position the roof inner side rail (1) on the vehicle (2) using 3-dimensional measuring equipment.
4. Verify the fit of the roof inner side rail (1).
5. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#)

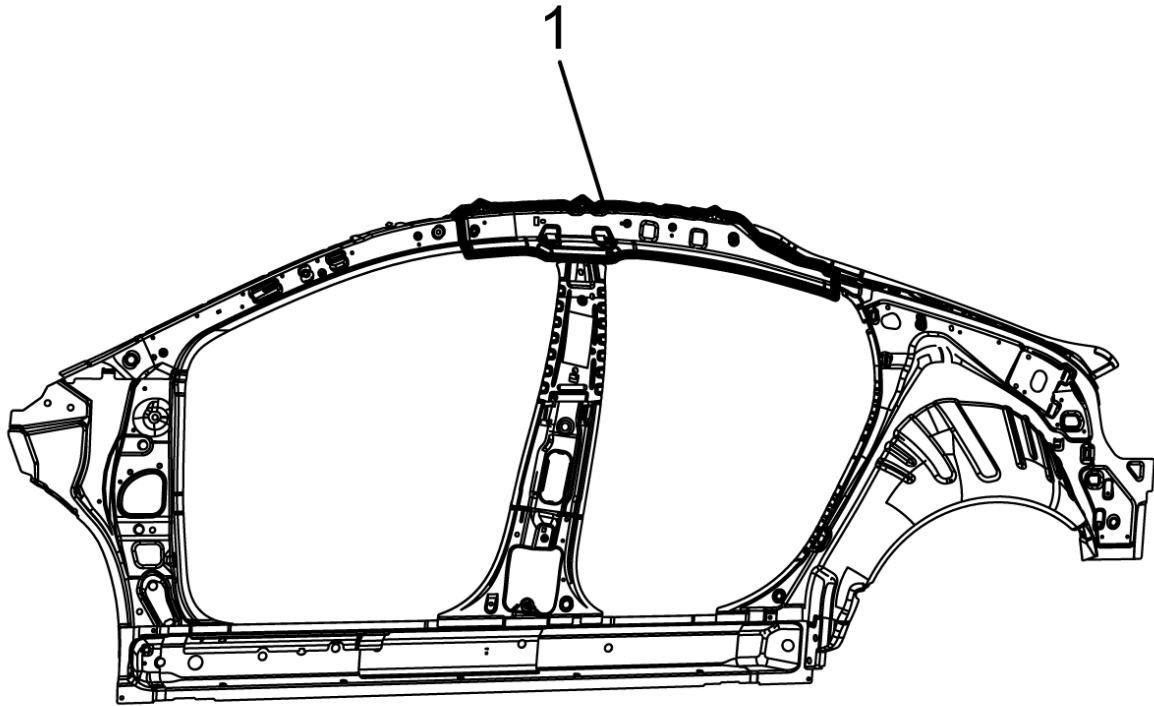


Fig. 53: Roof Inner Side Rail

Courtesy of GENERAL MOTORS COMPANY

6. Clamp the roof inner side rail (1) into position.
7. Weld the roof inner side rail (1) accordingly.
8. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
9. Install the body side outer panel as necessary.

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#)

10. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
11. Install all related panels and components.
12. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
13. Enable the SIR System. [SIR Disabling and Enabling](#) .

ROCKER INNER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The rocker outer panel reinforcement is an ultra-high strength dual phase steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#)

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar

1. Disable the SIR system. [SIR Disabling and Enabling](#) .

2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the rocker inner panel.

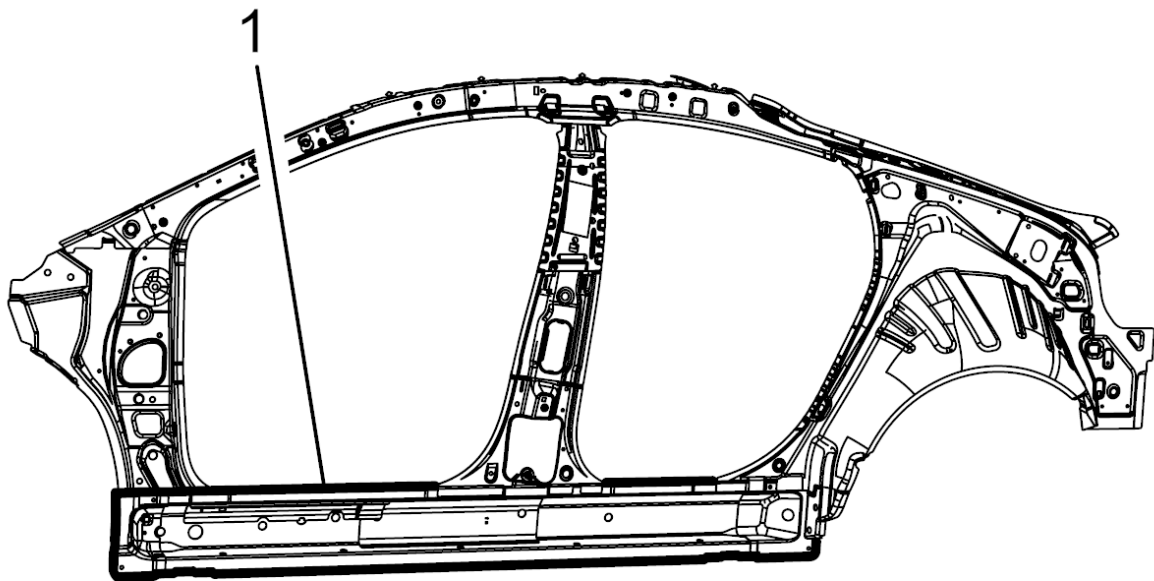


Fig. 54: Rocker Inner Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from the rocker inner panel (1).

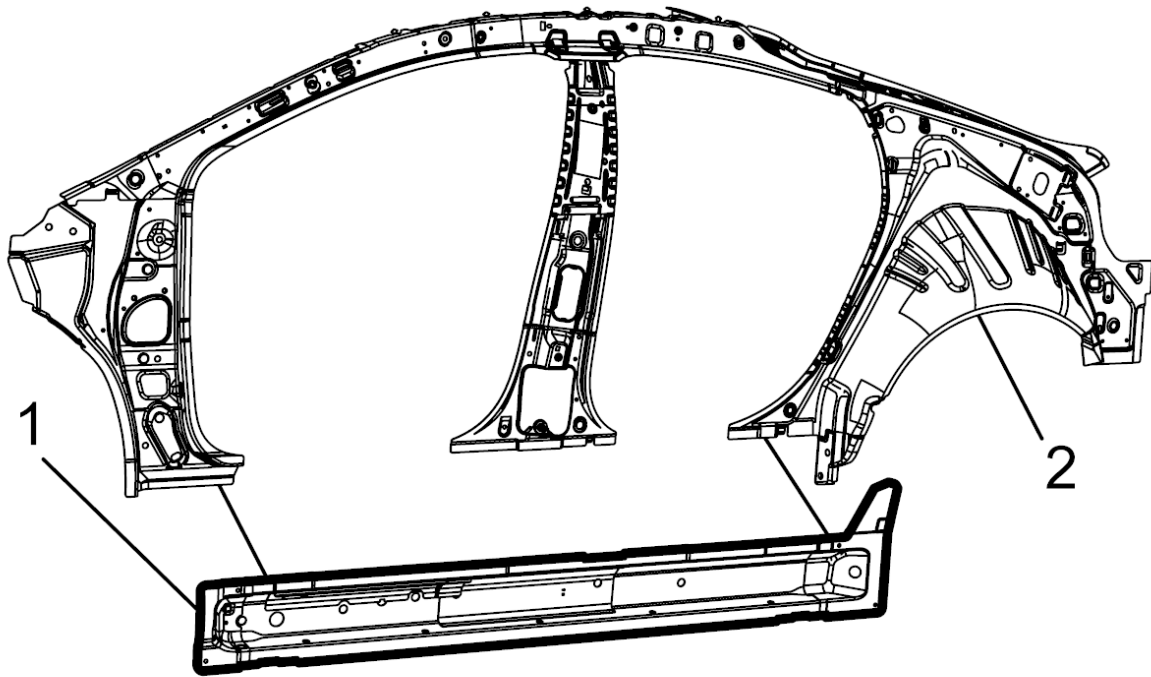


Fig. 55: Rocker Inner Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged rocker inner panel (1) from vehicle.

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

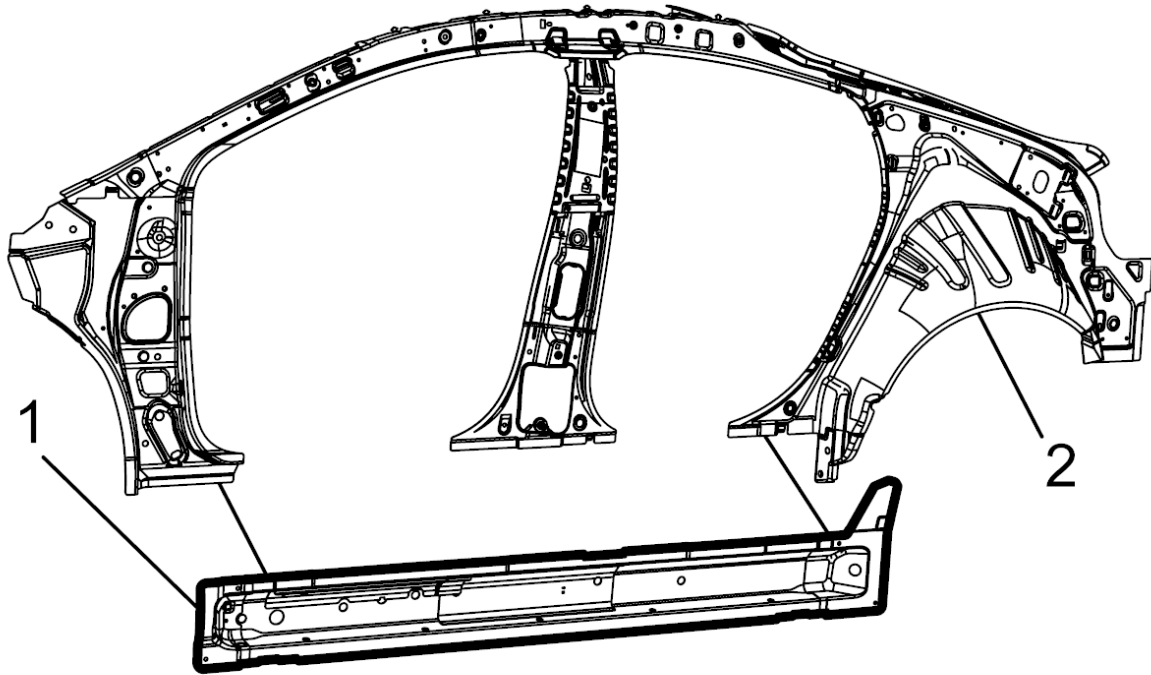


Fig. 56: Rocker Inner Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the rocker inner panel (1) on the vehicle using 3-dimensional measuring equipment.
3. Verify the fit of the rocker inner panel (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding.**

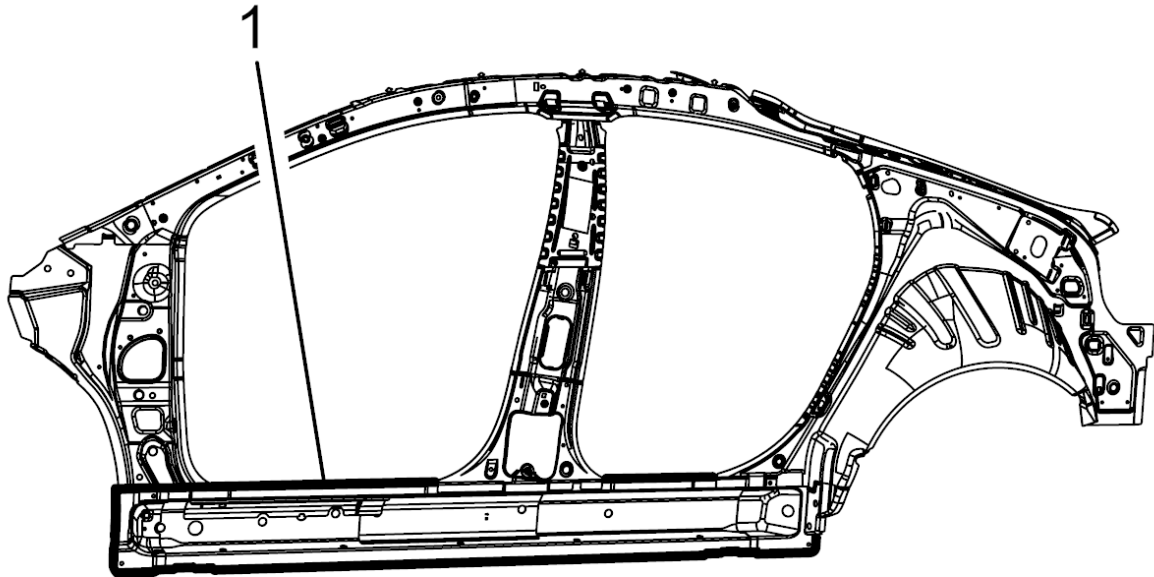


Fig. 57: Rocker Inner Panel

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the rocker inner panel (1) into position.
6. Weld the rocker inner panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

ROCKER OUTER PANEL REINFORCEMENT REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The rocker outer panel reinforcement is an ultra-high strength dual phase steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#)

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#)
2. Inspect the high voltage system. [High Voltage System Inspection](#)
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage

to the vehicle structure as possible, prior to replacing any damaged parts.

5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)
6. Section the body side outer panel as required for access to replace the rocker outer panel reinforcement.

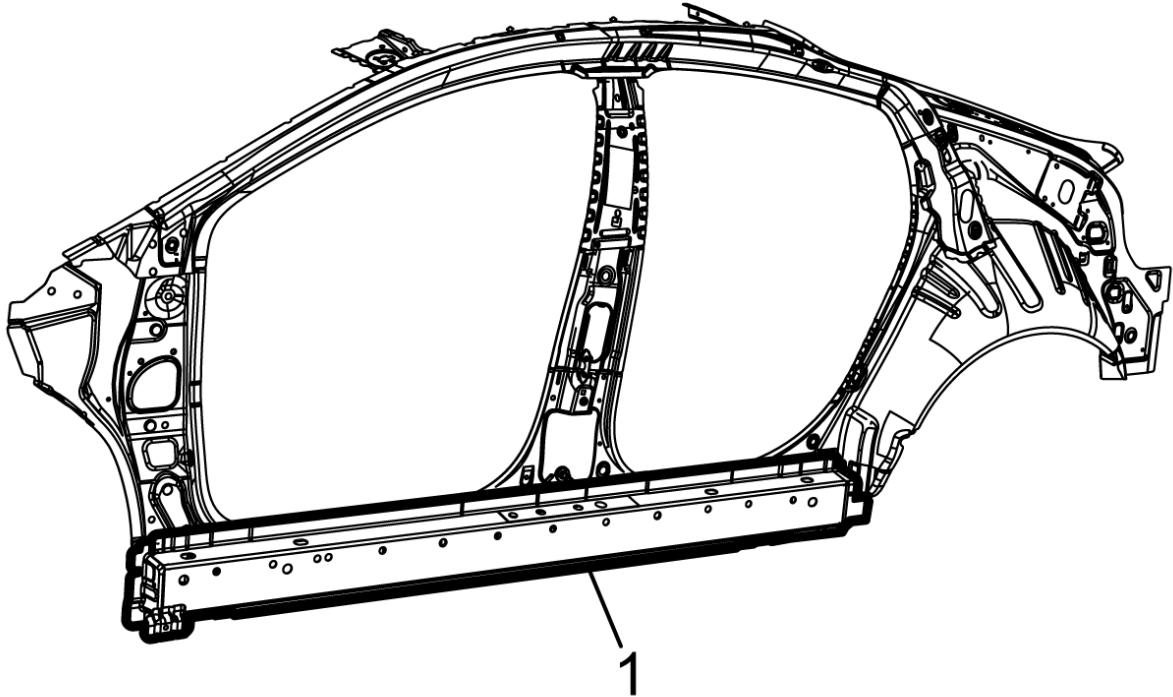


Fig. 58: Rocker Outer Panel Reinforcement
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#)

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from the rocker outer panel reinforcement (1).

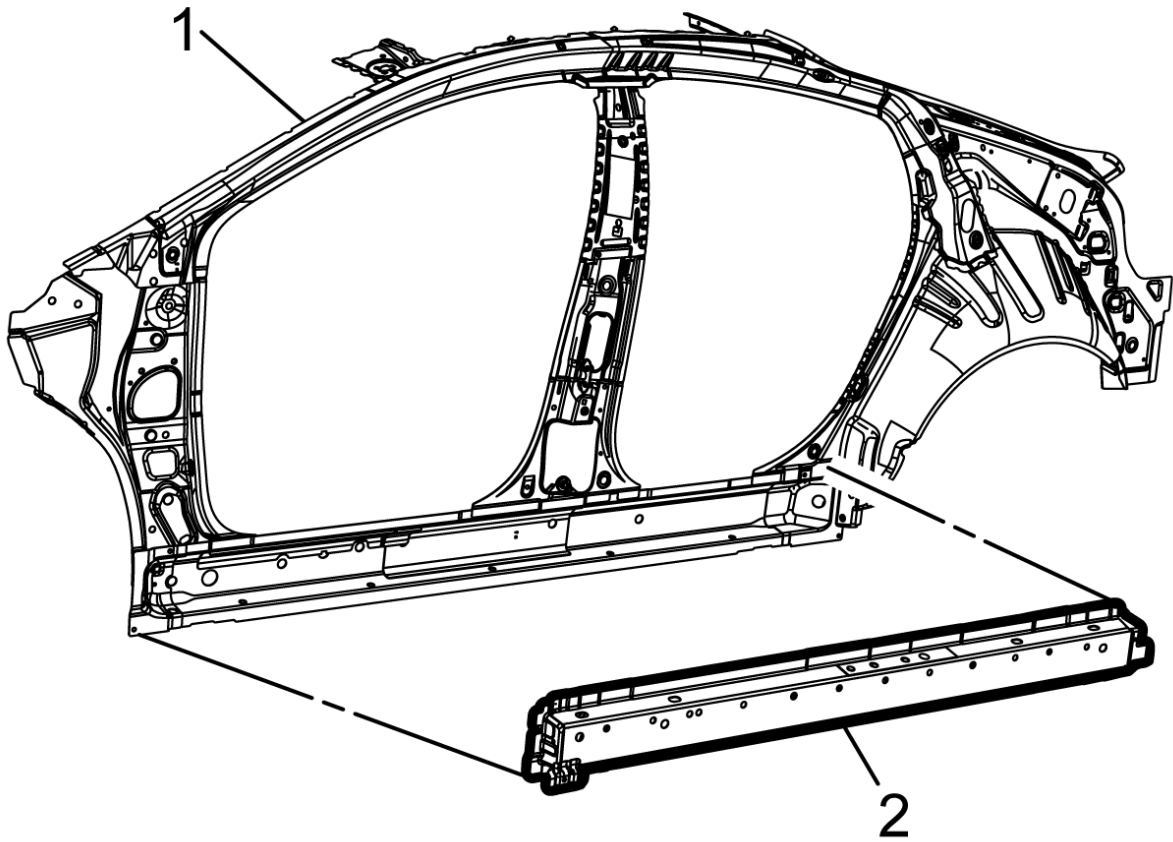


Fig. 59: Rocker Outer Panel Reinforcement
Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged rocker outer panel reinforcement (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#)

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

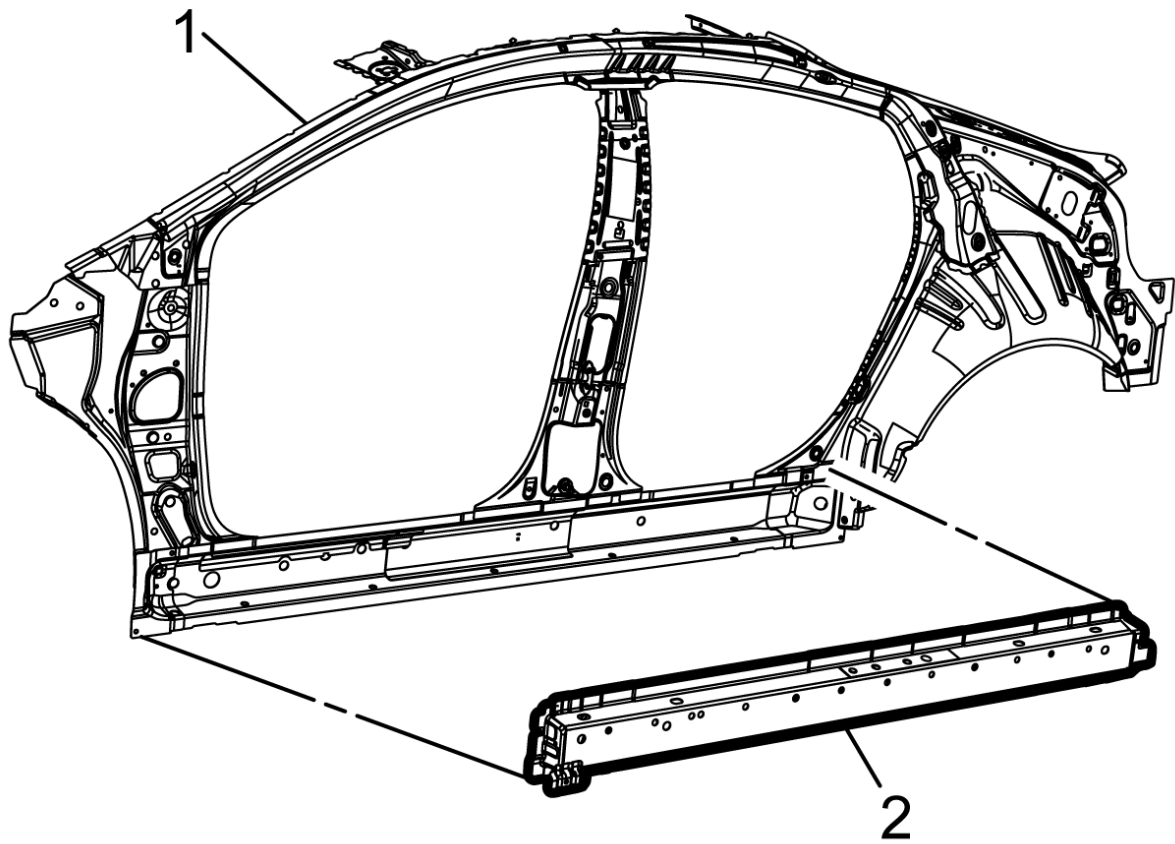


Fig. 60: Rocker Outer Panel Reinforcement

Courtesy of GENERAL MOTORS COMPANY

2. Position the rocker outer panel reinforcement (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the rocker outer panel reinforcement (2).
4. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#)

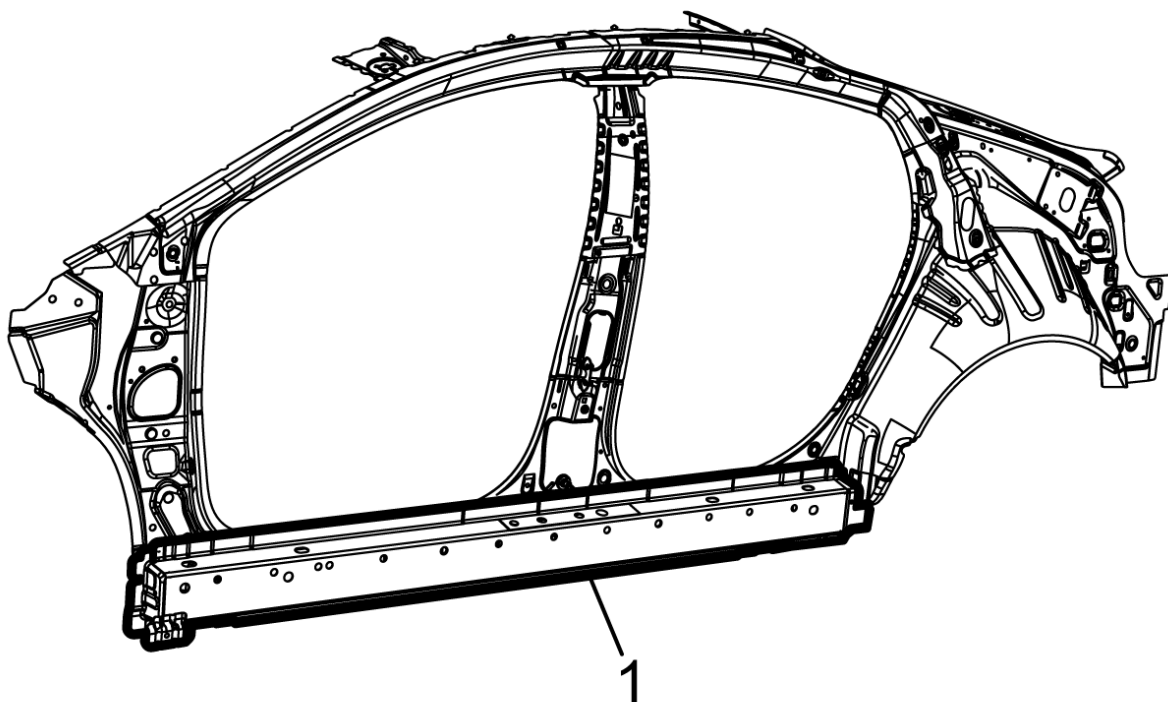


Fig. 61: Rocker Outer Panel Reinforcement

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the rocker outer panel reinforcement (1) into position.
6. Weld the rocker outer panel reinforcement (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#)
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#)
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#)
12. Enable the SIR System. [SIR Disabling and Enabling](#)

BODY SIDE FRAME UPPER FRONT EXTENSION REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The body side frame upper front extension reinforcement is an ultra-high strength steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.

4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

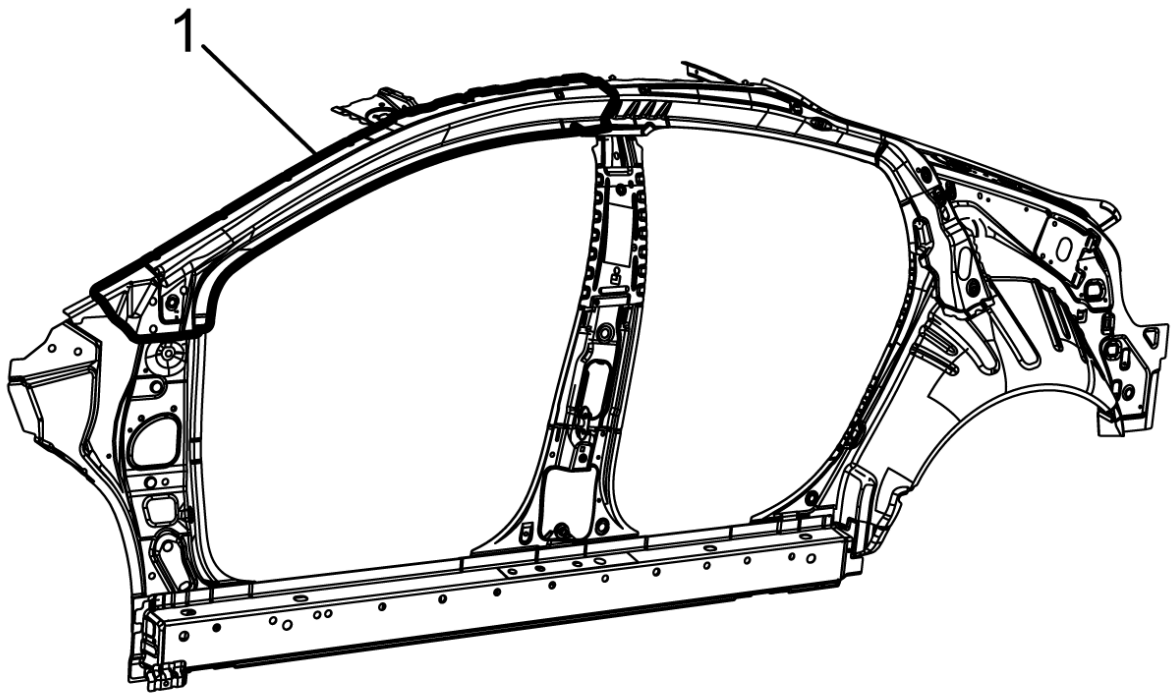


Fig. 62: Body Side Frame Upper Front Extension Reinforcement

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the body side frame upper front extension reinforcement (1).

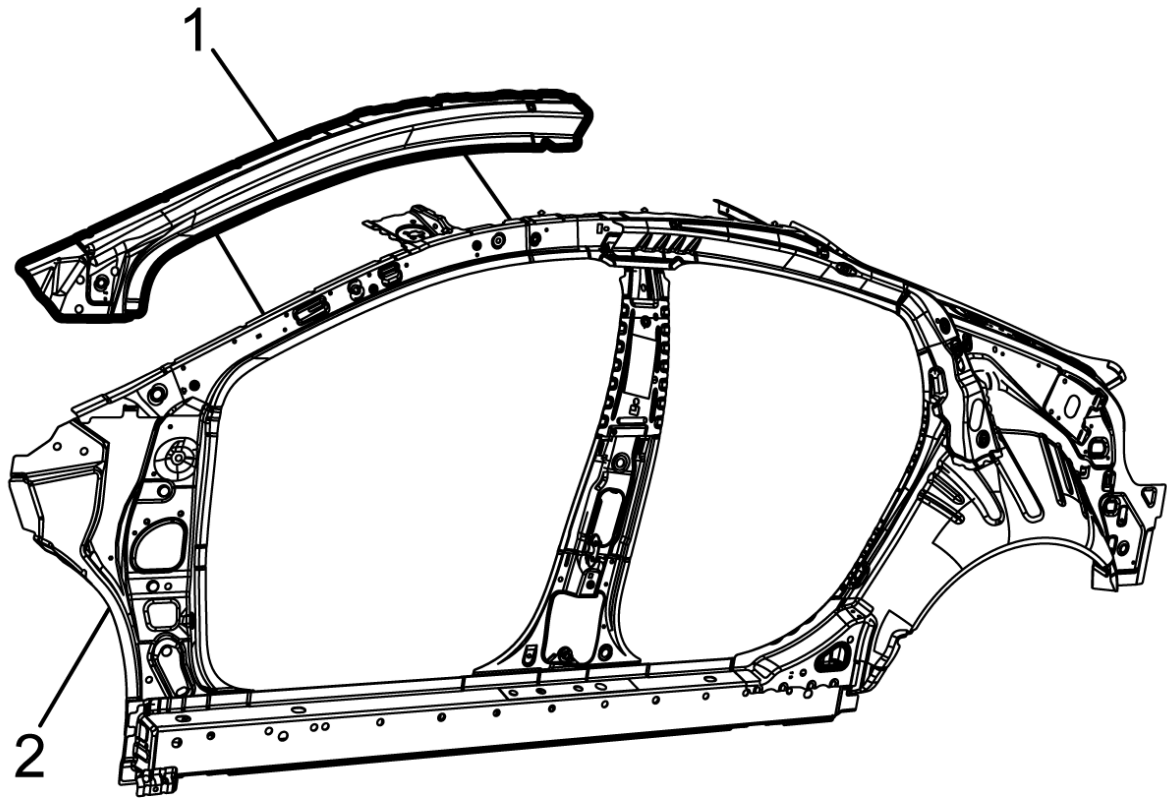


Fig. 63: Body Side Frame Upper Front Extension Reinforcement
Courtesy of GENERAL MOTORS COMPANY

7. Remove the body side frame upper front extension reinforcement (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

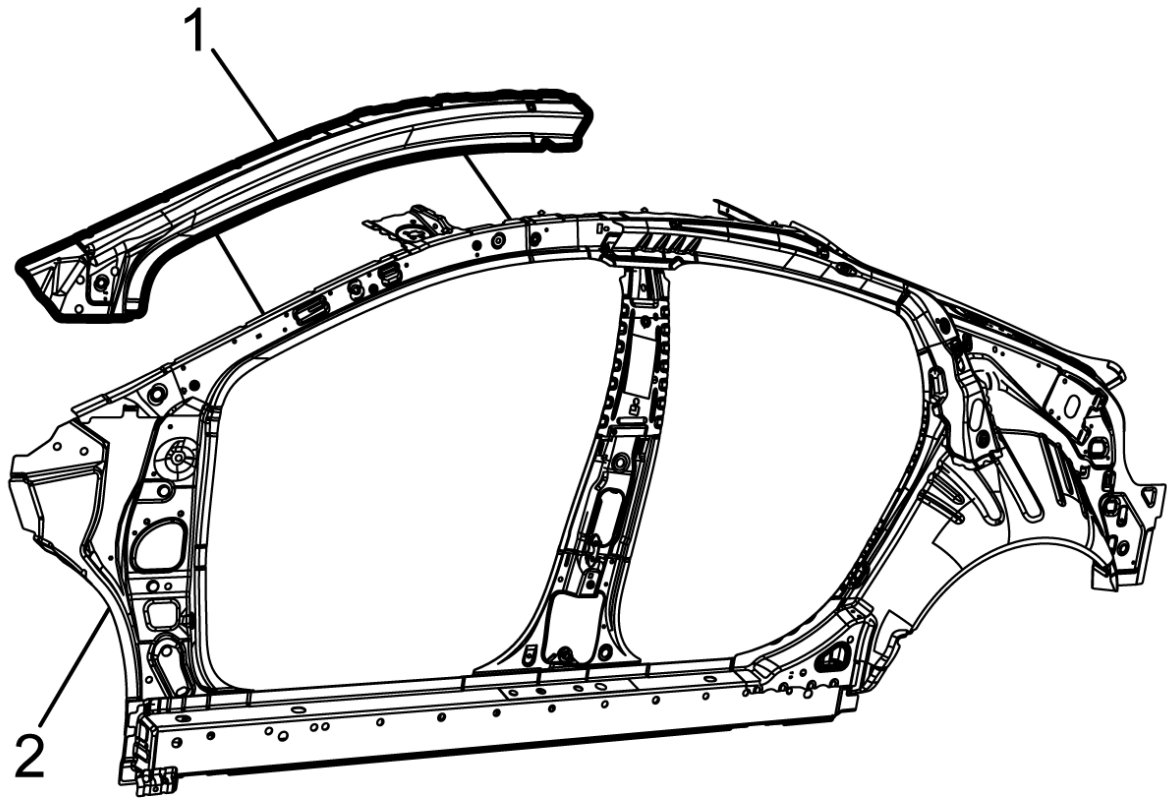


Fig. 64: Body Side Frame Upper Front Extension Reinforcement
Courtesy of GENERAL MOTORS COMPANY

2. Position the body side frame upper front extension reinforcement (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the body side frame upper front extension reinforcement (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. [**Metal Panel Bonding**](#)

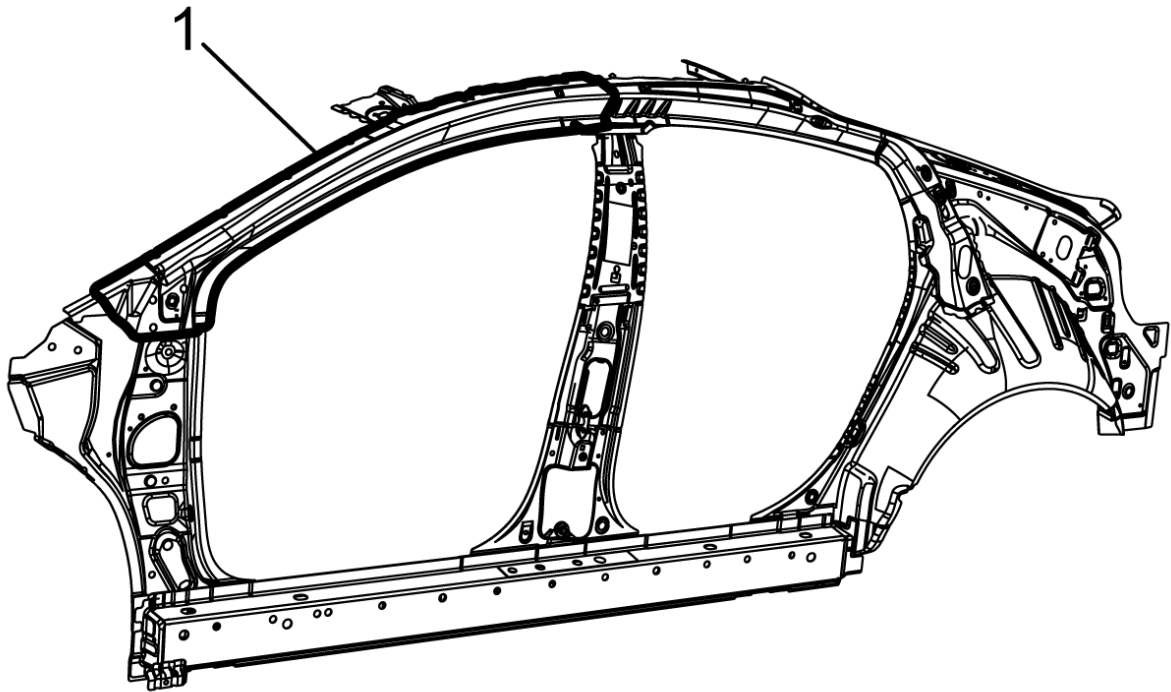


Fig. 65: Body Side Frame Upper Front Extension Reinforcement
Courtesy of GENERAL MOTORS COMPANY

5. Clamp the body side frame upper front extension reinforcement (1) into position.
6. Weld the body side frame upper front extension reinforcement (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

BODY SIDE OUTER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

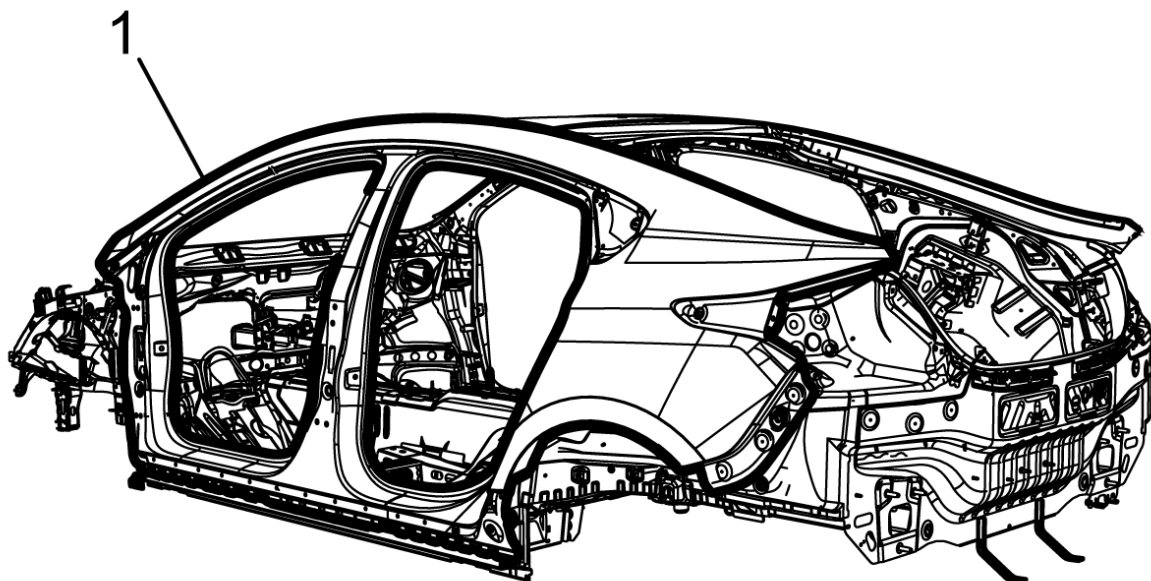


Fig. 66: Body Side Outer Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the body side outer panel (1).

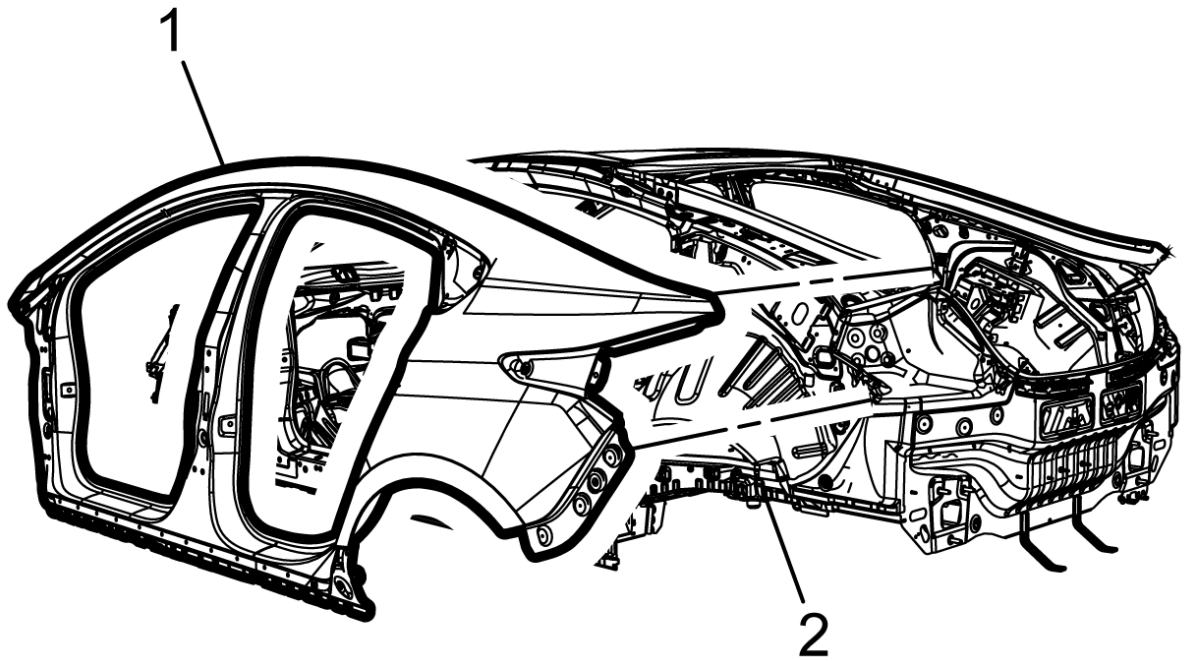


Fig. 67: Body Side Outer Panel

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged body side outer panel (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

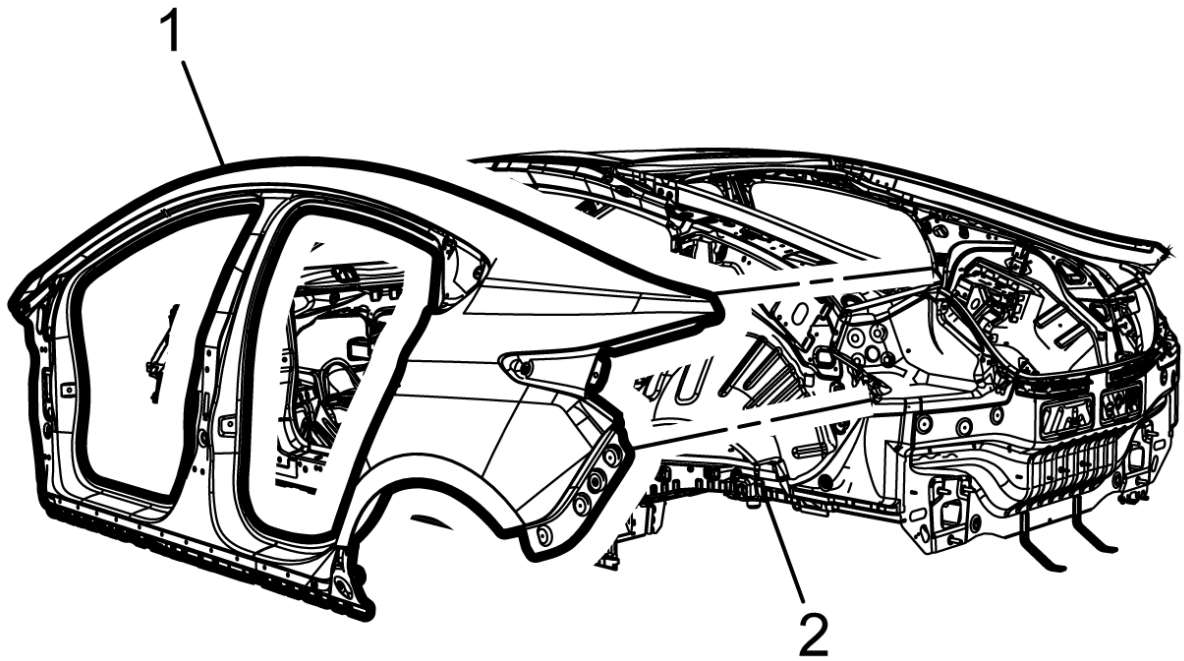


Fig. 68: Body Side Outer Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the body side outer panel (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the body side outer panel (1).

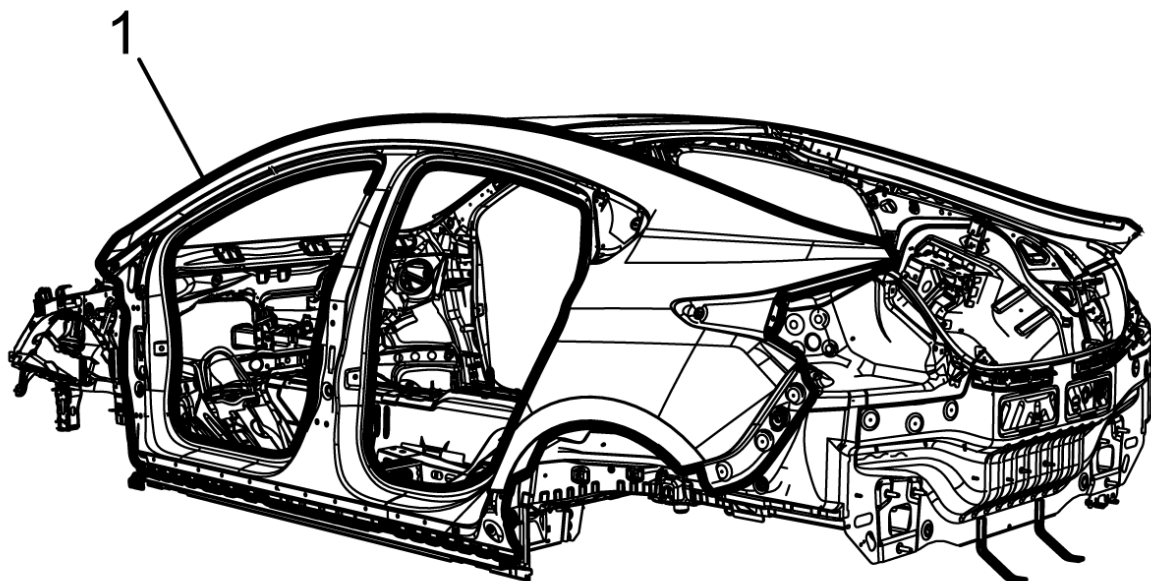


Fig. 69: Body Side Outer Panel

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the body side outer panel (1) into position.
6. Weld the body side outer panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

8. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

BODY SIDE OUTER PANEL SECTIONING

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

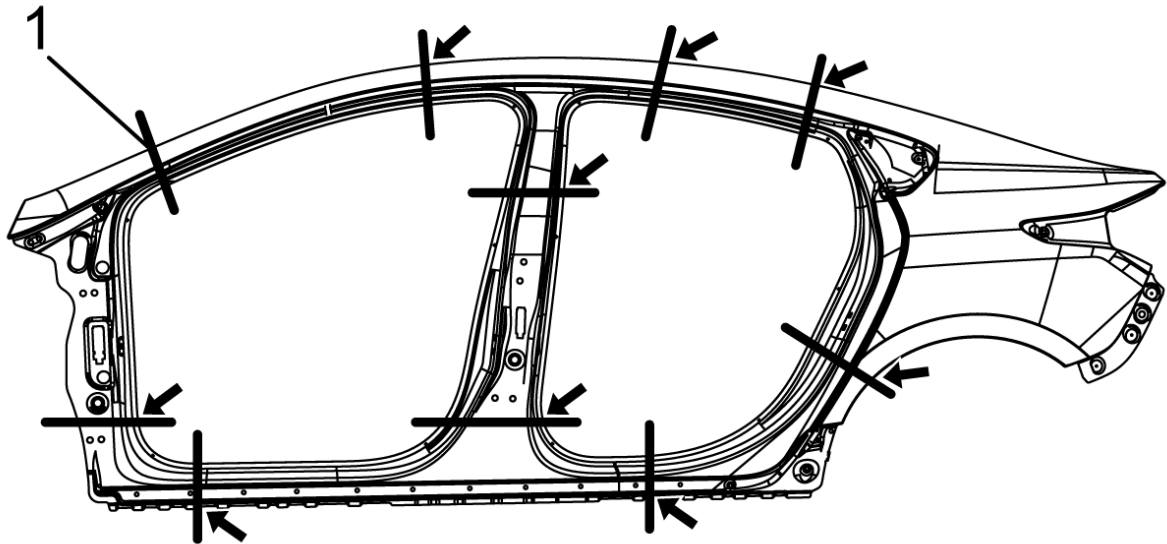


Fig. 70: Body Side Outer Panel Sectioning Areas
Courtesy of GENERAL MOTORS COMPANY

6. Section the body side outer panel within the recommended areas (1).

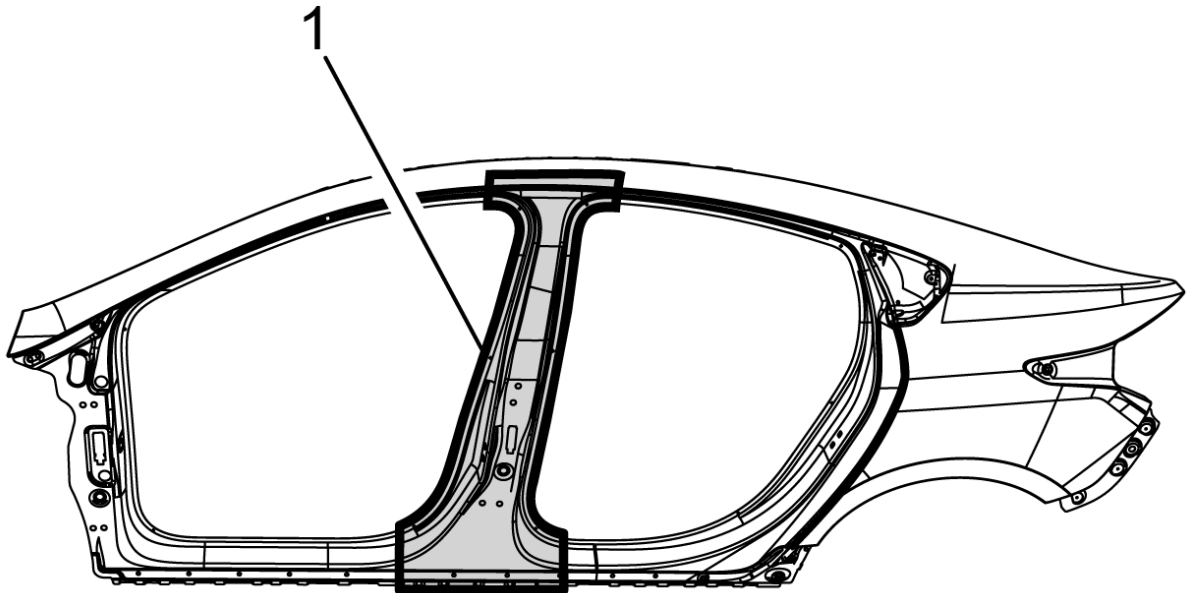


Fig. 71: Center Pillar Of Body Side Outer Panel Sectioning Area
Courtesy of GENERAL MOTORS COMPANY

7. Section the center pillar of the body side outer panel within the recommended area (1).

NOTE: The following steps are to be used for both the body side outer and the center pillar sections.

8. Locate and remove all factory welds. Note the number and location of welds for installation of the body side outer section.

NOTE: Do not damage any other panel or reinforcements when cutting at the marked locations.

9. Cut the body side outer panel at the recommended areas (1).

10. Remove the body side outer section.

NOTE: If impact resistant adhesive is present remove and replace as necessary.

11. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

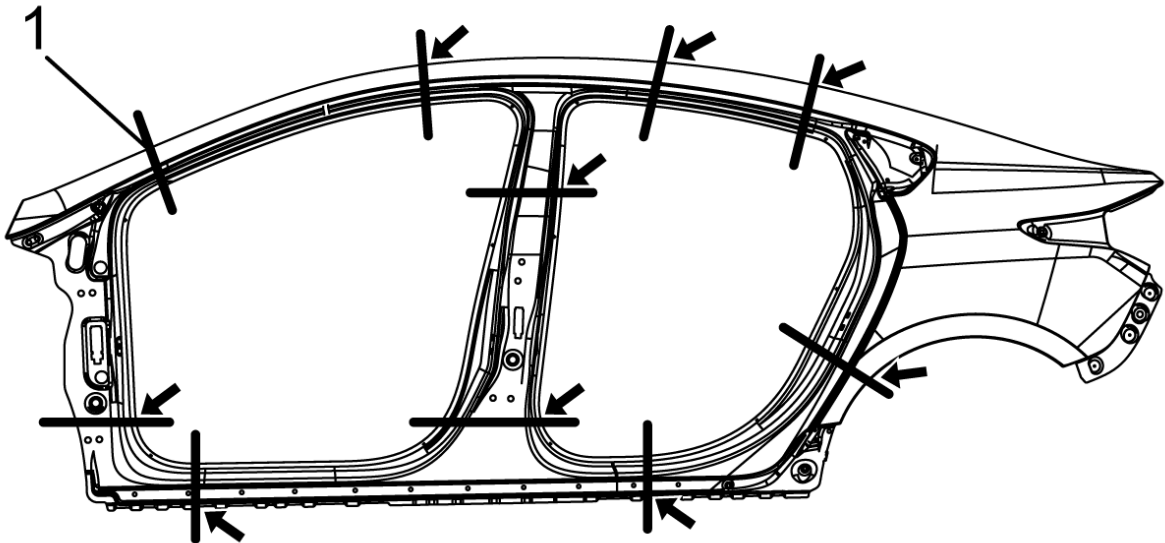


Fig. 72: Body Side Outer Panel Sectioning Areas

Courtesy of GENERAL MOTORS COMPANY

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

NOTE: If MIG/MAG is going to be used drill 8 mm (5/16 in) plug weld holes as necessary in locations noted from the original body side outer panel (1).

1. From the service part, cut the body side outer panel in corresponding locations (1) to overlap the remaining original panel by 25 mm (1 in) at each joint locations.

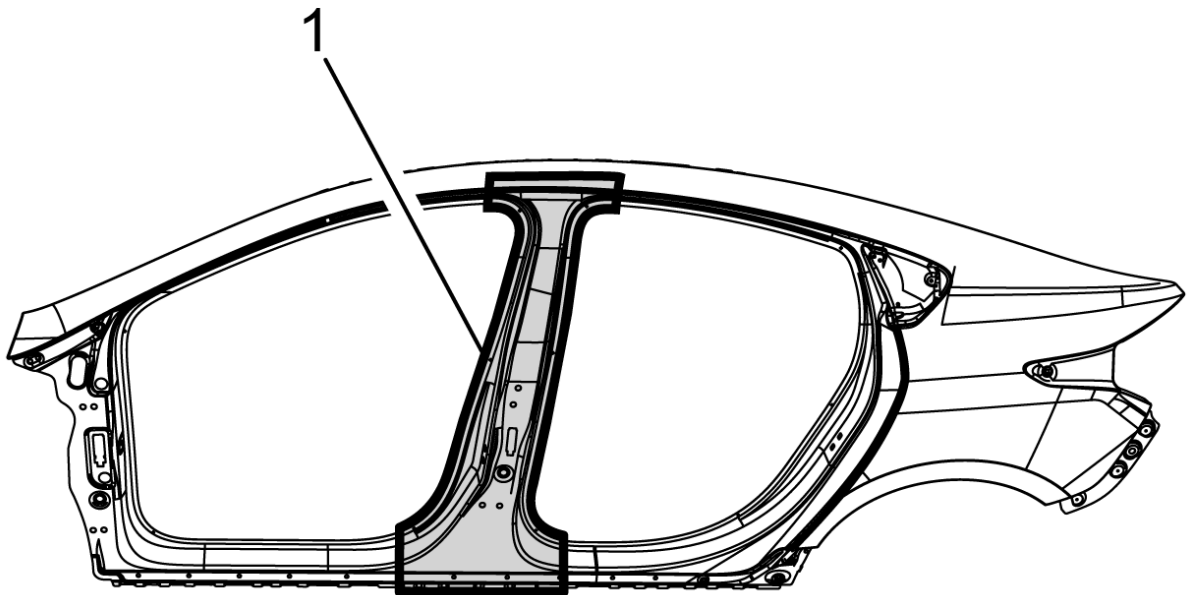


Fig. 73: Center Pillar Of Body Side Outer Panel Sectioning Area
Courtesy of GENERAL MOTORS COMPANY

2. From the service part, cut the body side outer panel for the center pillar section in corresponding locations (1) to overlap the remaining original panel by 25 mm (1 in) at each joint locations.

NOTE: **The following steps are to be used for both the body side outer and the center pillar sections.**

3. Prepare all mating surfaces for welding, as necessary.
4. Apply GM - approved Weld-Thru coating or equivalent to all mating surfaces. [Anti-Corrosion Treatment and Repair](#) .
5. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#).
6. Position the new service panel and clamp in place.
7. Weld accordingly.
8. Clean and prepare all welded surfaces.
9. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

10. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
11. Install all related panels and components.
12. Enable the SIR System. [SIR Disabling and Enabling](#) .
13. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#) .

REAR FLOOR PANEL SECTIONING

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .

3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).

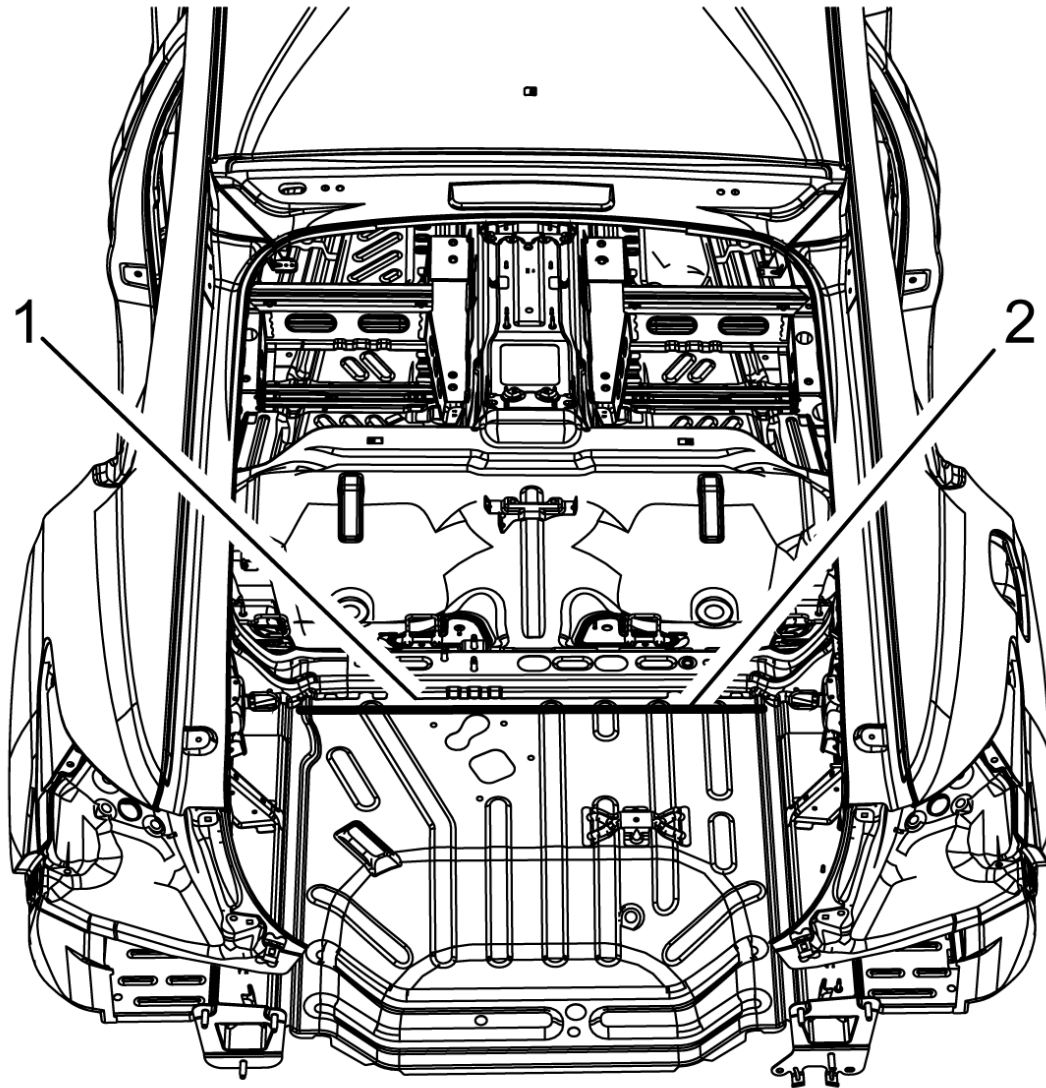


Fig. 74: Marking Cut Location Rearward From No. 5 Bar
Courtesy of GENERAL MOTORS COMPANY

6. Measure 40 mm rearward from the rear edge of the #5 bar (1). Mark the cut location (2).

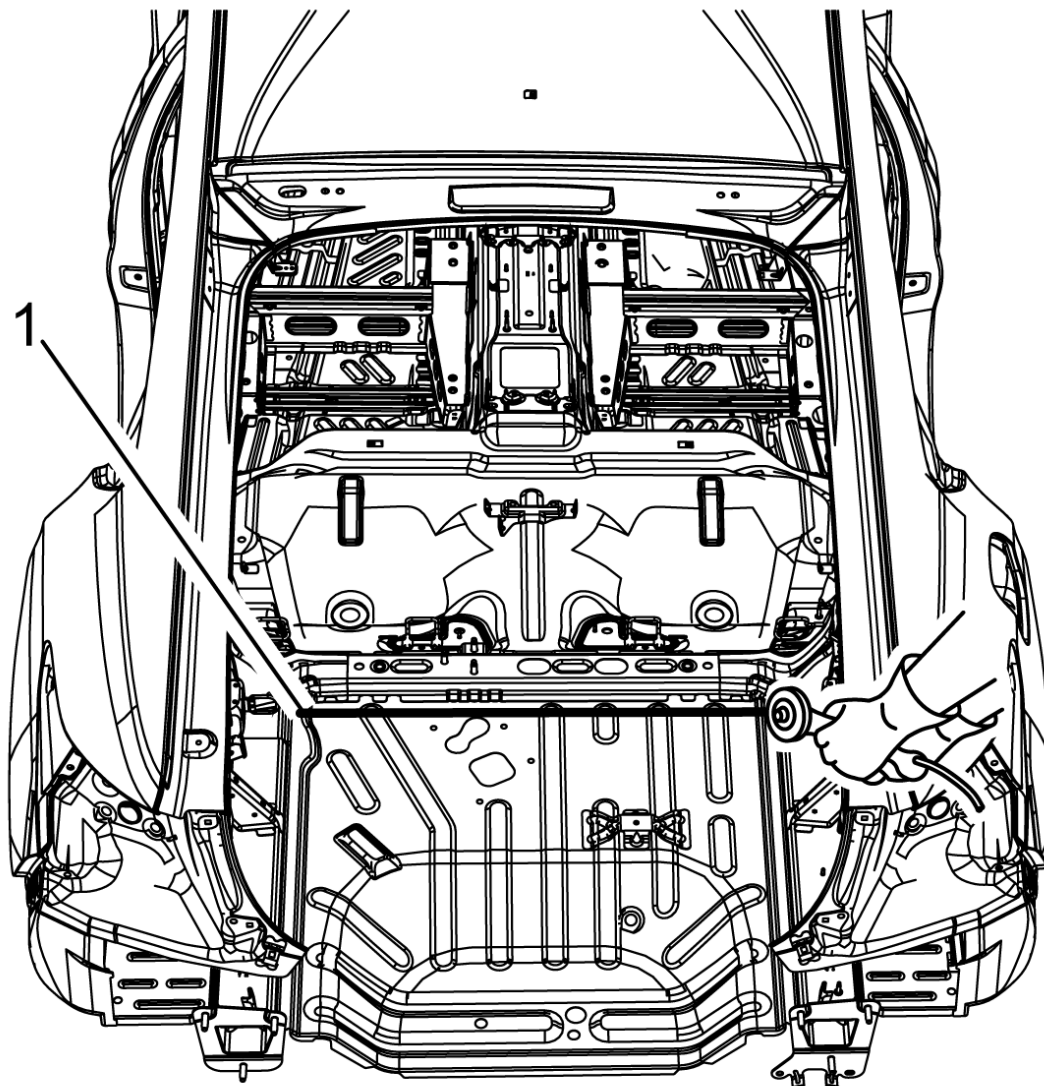


Fig. 75: Marked Cut Location

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to **Structure Identification**.

7. Cut the floor at the marked location (1).

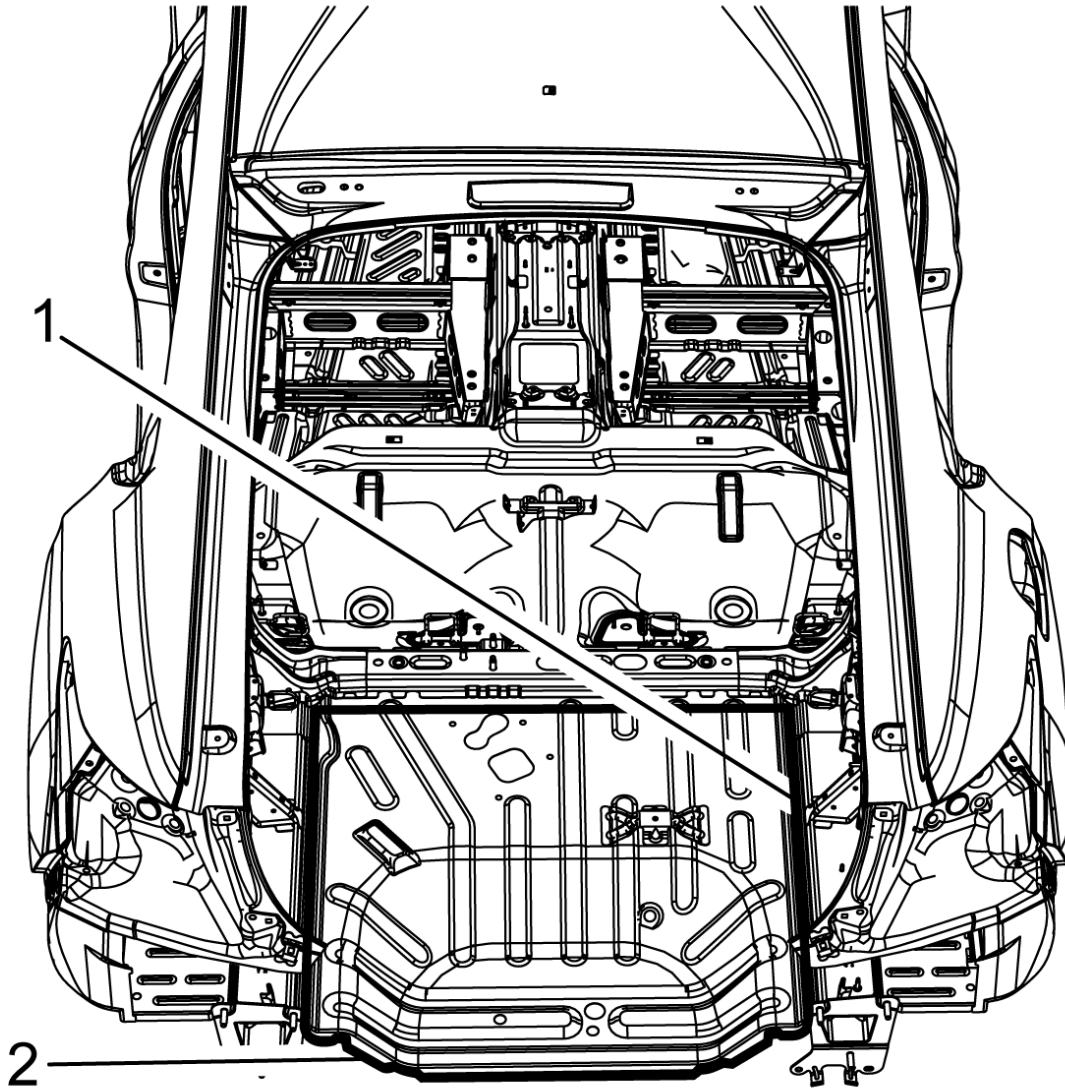


Fig. 76: Rear Floor Panel Section

Courtesy of GENERAL MOTORS COMPANY

8. Remove all factory welds (1).
9. Remove floor section (2) from vehicle.

NOTE: If impact resistant adhesive is present remove and replace as necessary.

10. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

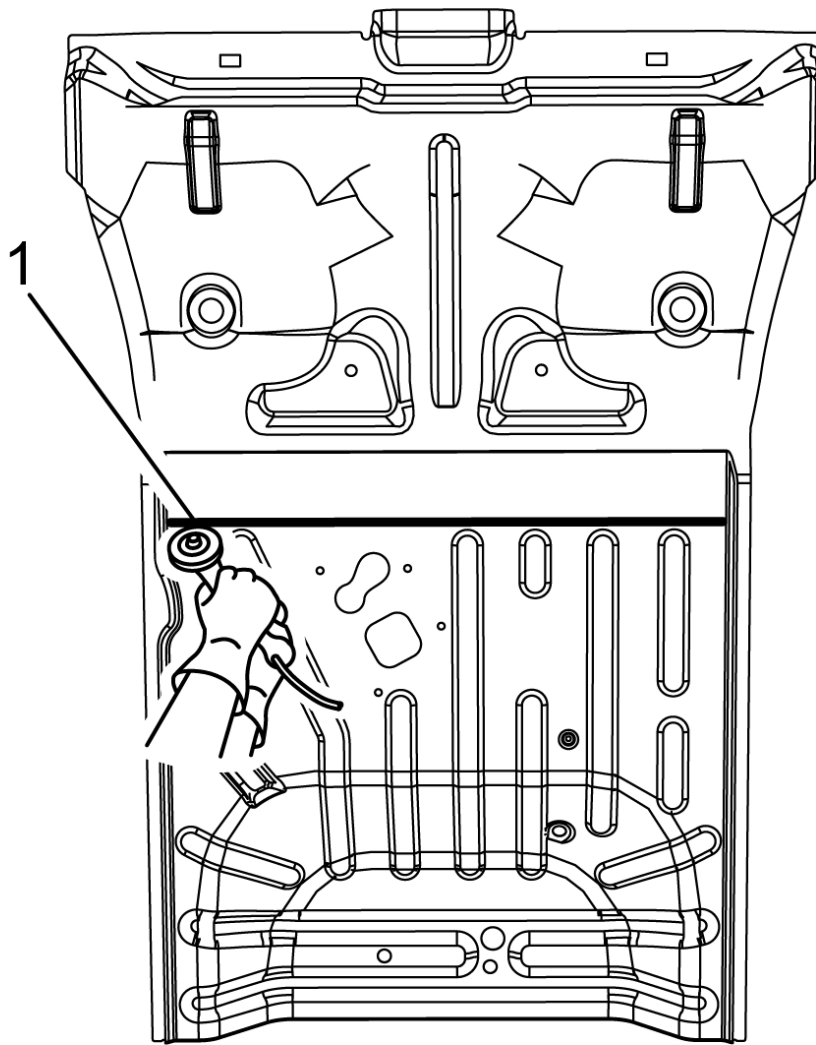


Fig. 77: Cutting Service Part In Corresponding Location

Courtesy of GENERAL MOTORS COMPANY

NOTE: The service part is supplied as a complete floor and will need to be cut at the proper location for sectioning. The service part will overlap the original floor panel by approximately 40 mm at the cut location.

11. Locate rear edge of the #5 bar location (1). Mark the cut location.
12. Cut the service part at the marked location (1).

Installation Procedure

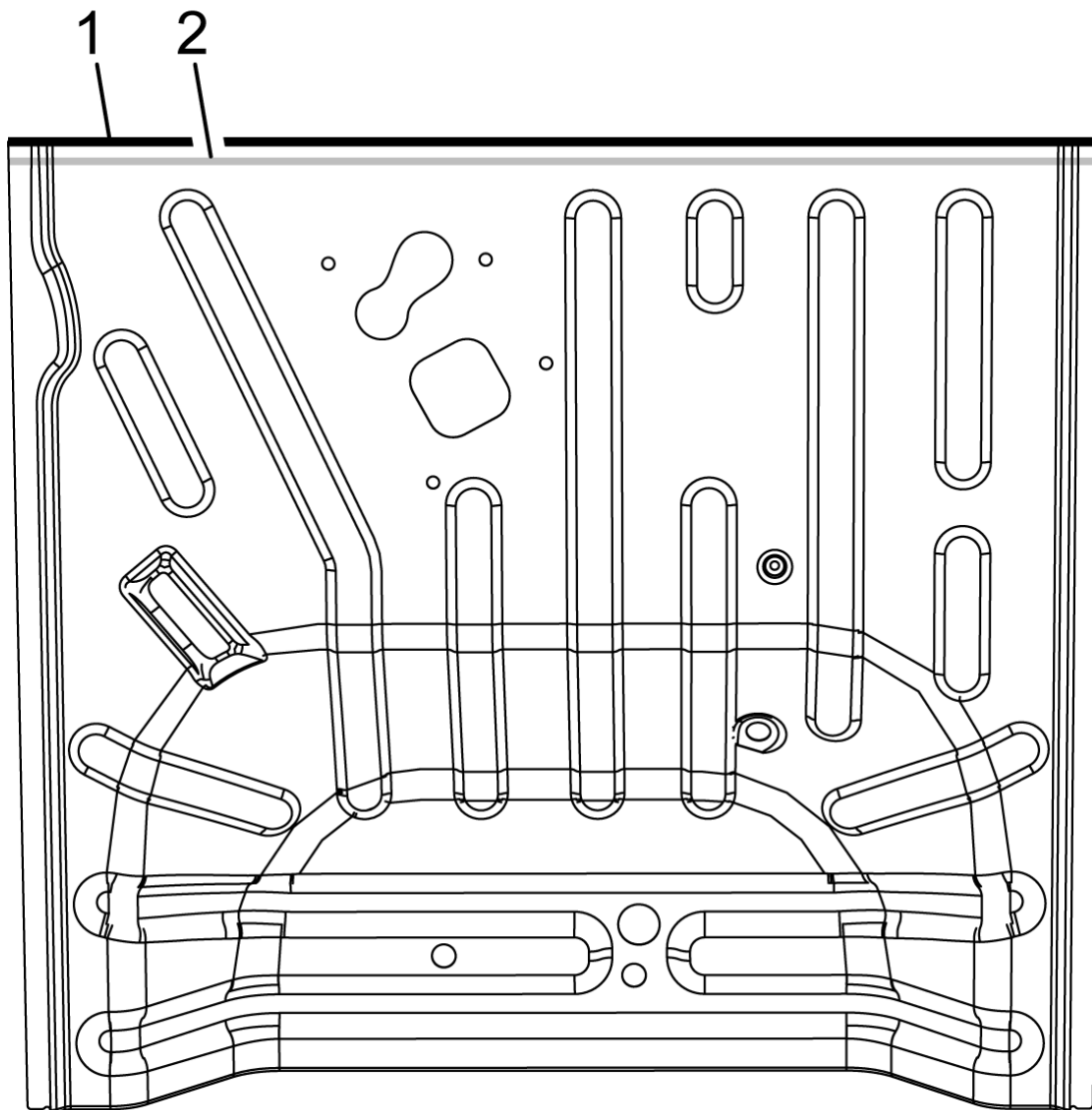


Fig. 78: Marking Service Part For Plug Welding Locations

Courtesy of GENERAL MOTORS COMPANY

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Create 1 row of plug welds in the service part as follows. Measure 20 mm from the front edge of the service part (1). Mark a straight line across the width of the service part (2).

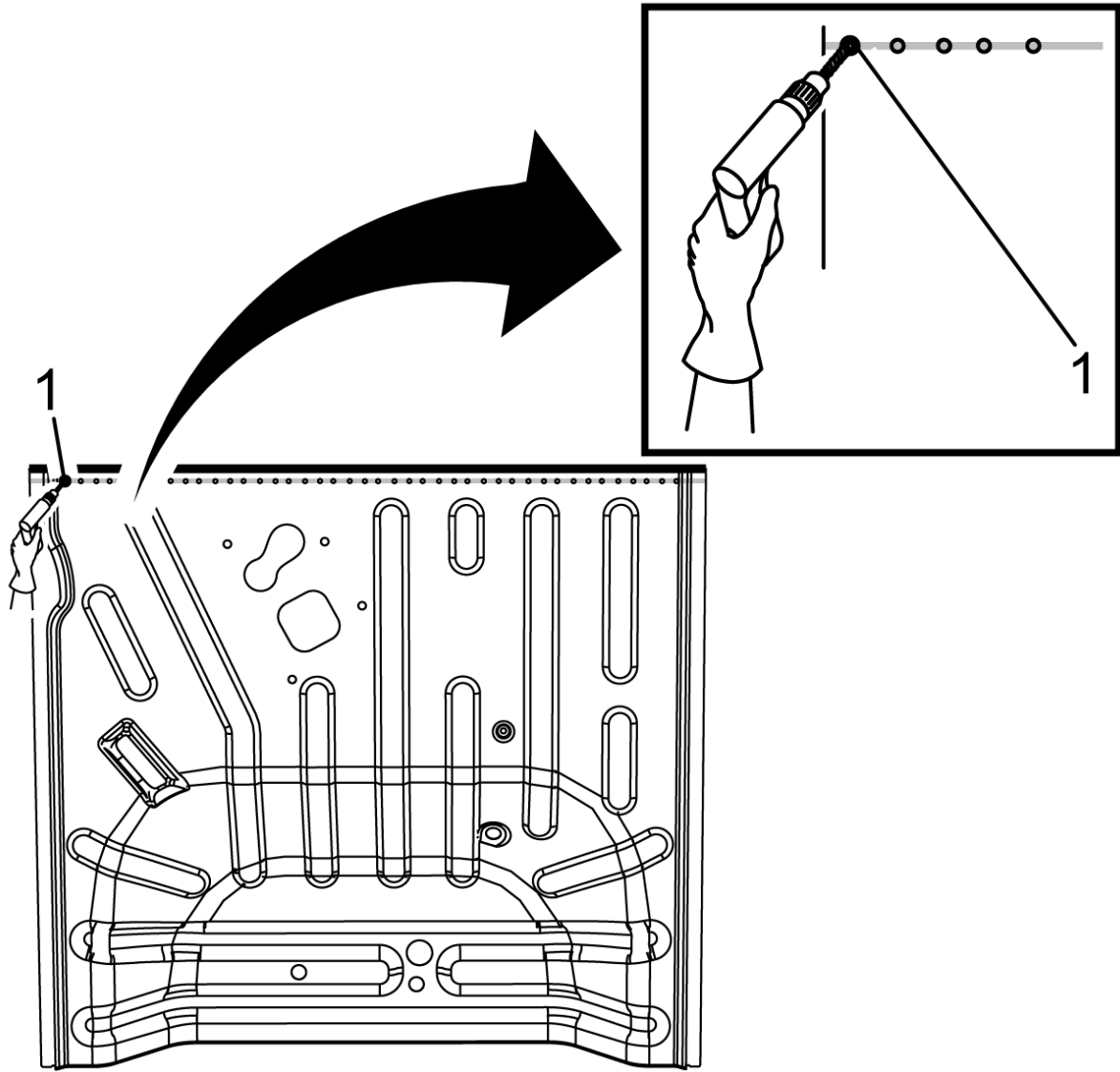


Fig. 79: Drilling Plug Weld Holes

Courtesy of GENERAL MOTORS COMPANY

2. Drill 8 mm (5/16 in) plug weld holes, every 40 mm along the marked row.
3. Prepare all mating surfaces for welding, as necessary.
4. Apply GM-approved Weld-Thru Coating or equivalent to all mating surfaces. Refer to [Anti-Corrosion Treatment and Repair](#) .
5. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).

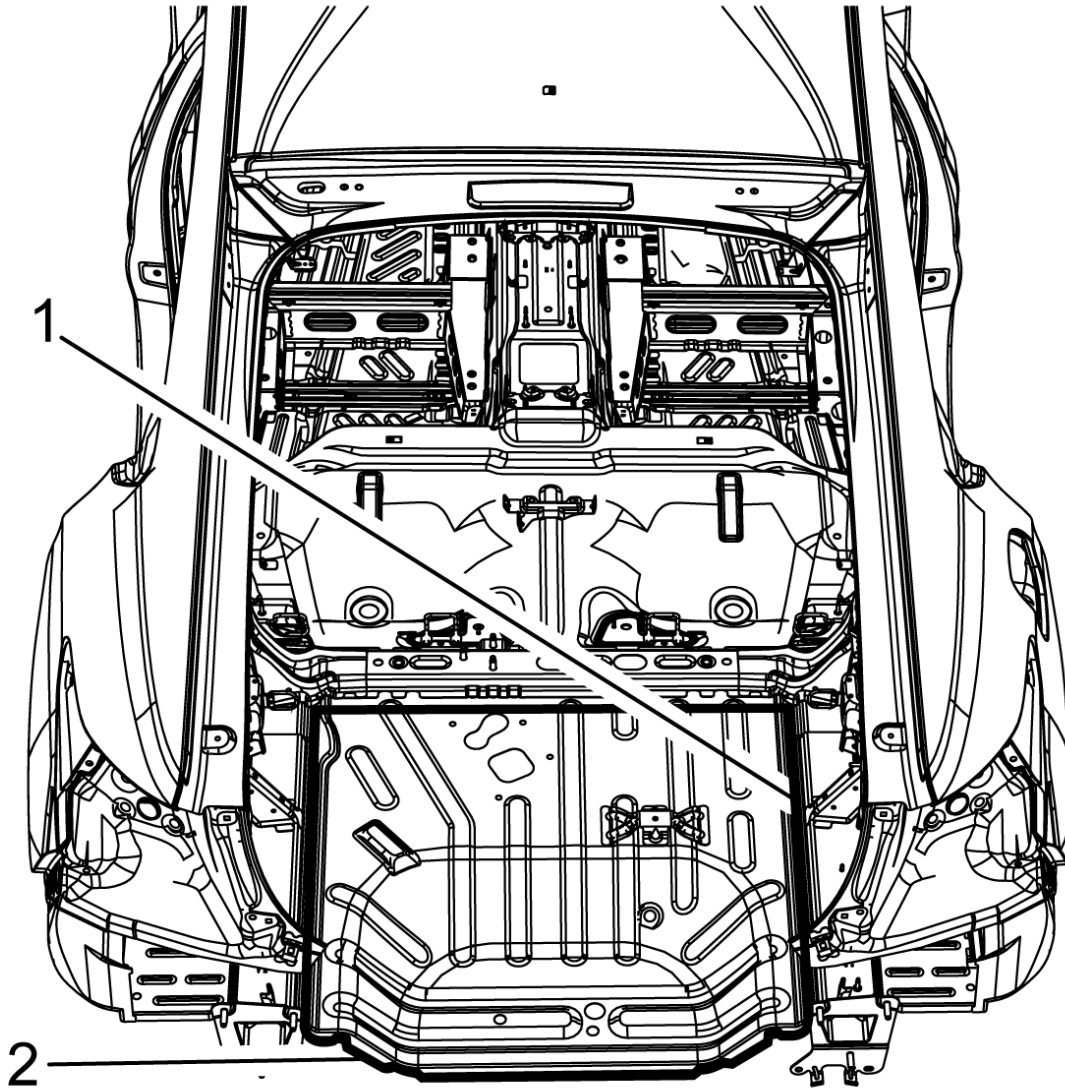


Fig. 80: Rear Floor Panel Section

Courtesy of GENERAL MOTORS COMPANY

6. Position the rear floor section (2) to the vehicle using 3-dimensional measuring equipment. Clamp the part in place.
7. Weld accordingly (1).
8. Clean and prepare all welded surfaces for painting.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
10. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
11. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
12. Install all related panels and components.
13. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#) .
14. Enable the SIR system. Refer to [SIR Disabling and Enabling](#) .

REAR WHEELHOUSE INNER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

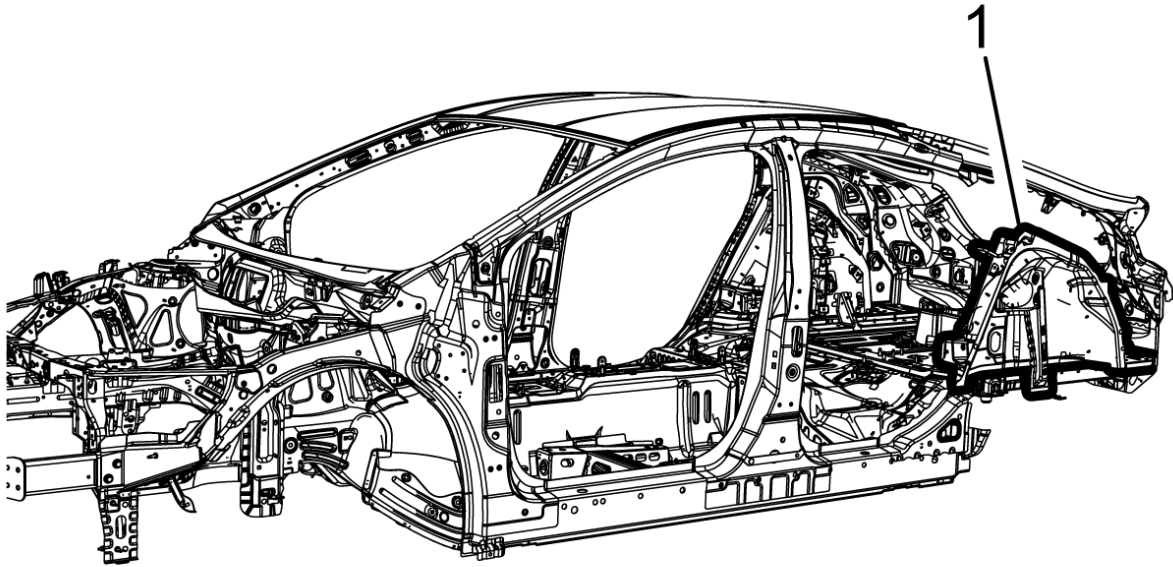


Fig. 81: Rear Wheelhouse Inner Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to **Structure Identification**.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the rear wheelhouse inner panel (1).

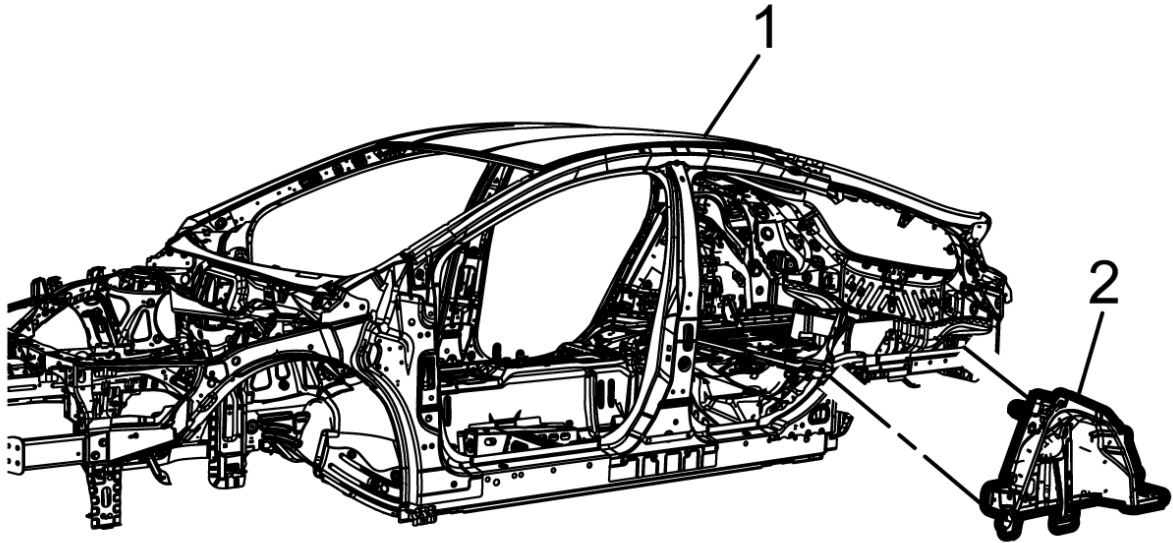


Fig. 82: Rear Wheelhouse Inner Panel

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear wheelhouse inner panel (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

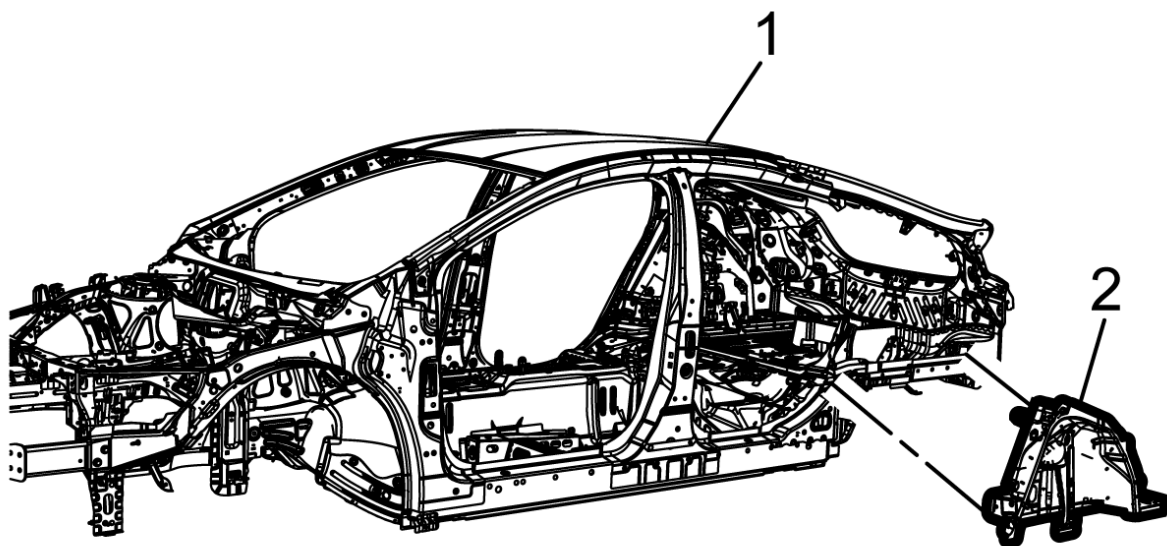


Fig. 83: Rear Wheelhouse Inner Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear wheelhouse inner panel (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the rear wheelhouse inner panel (2).

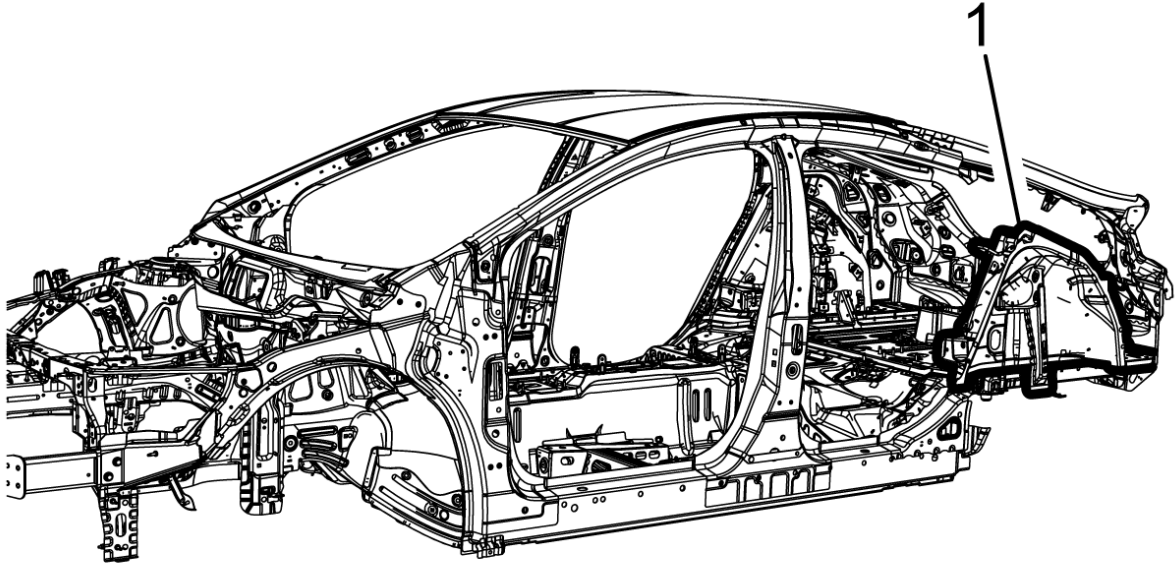


Fig. 84: Rear Wheelhouse Inner Panel

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the rear wheelhouse inner panel (1) into position.
6. Weld the rear wheelhouse inner panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Install the body side outer panel as necessary.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

REAR WHEELHOUSE OUTER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.

5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the rear wheelhouse outer panel.

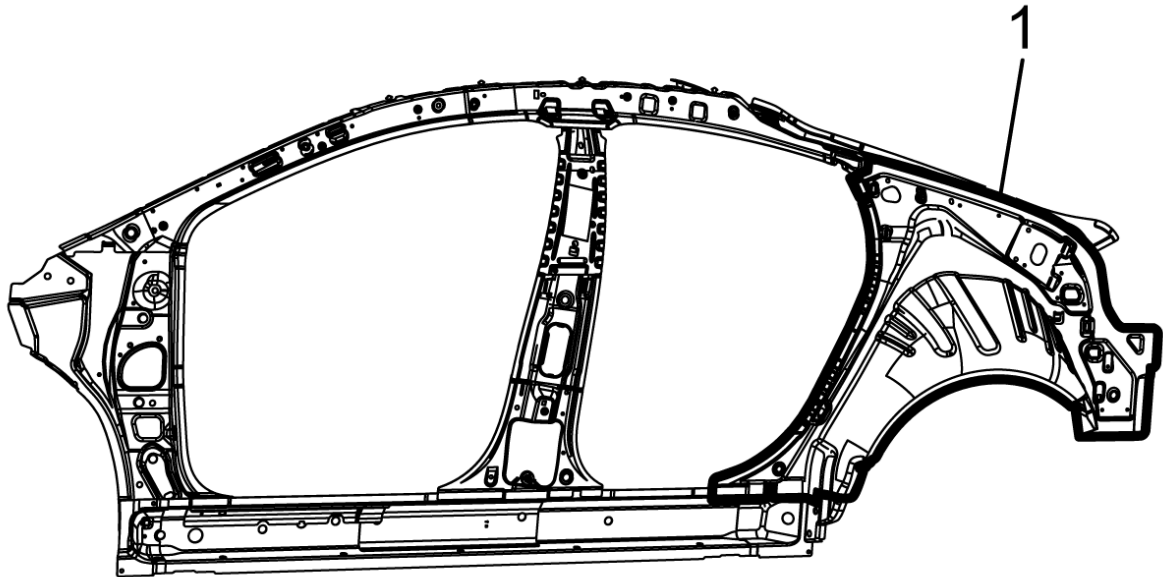


Fig. 85: Rear Wheelhouse Outer Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from rear wheelhouse outer panel (1).

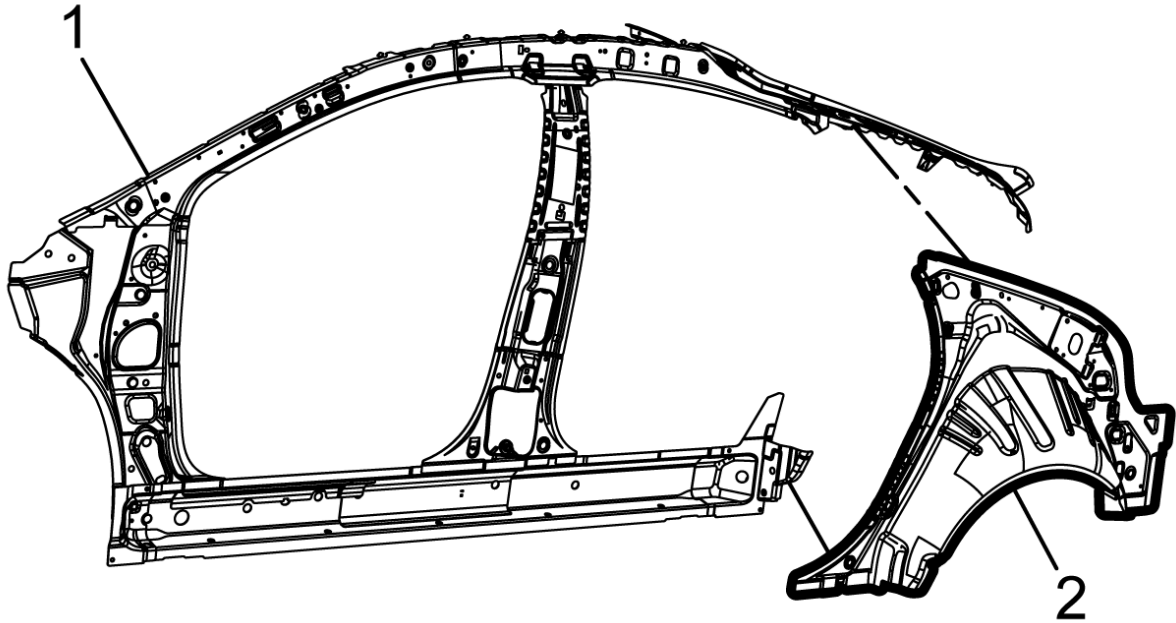


Fig. 86: Rear Wheelhouse Outer Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged rear wheelhouse outer panel (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

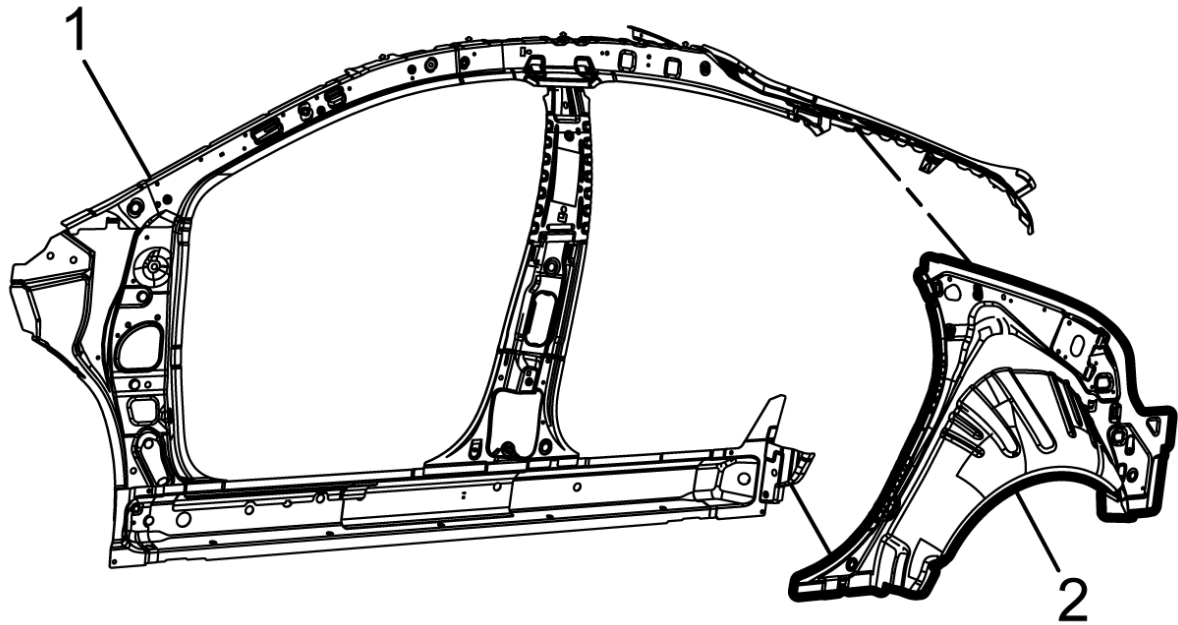


Fig. 87: Rear Wheelhouse Outer Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear wheelhouse outer panel (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the rear wheelhouse outer panel (2).

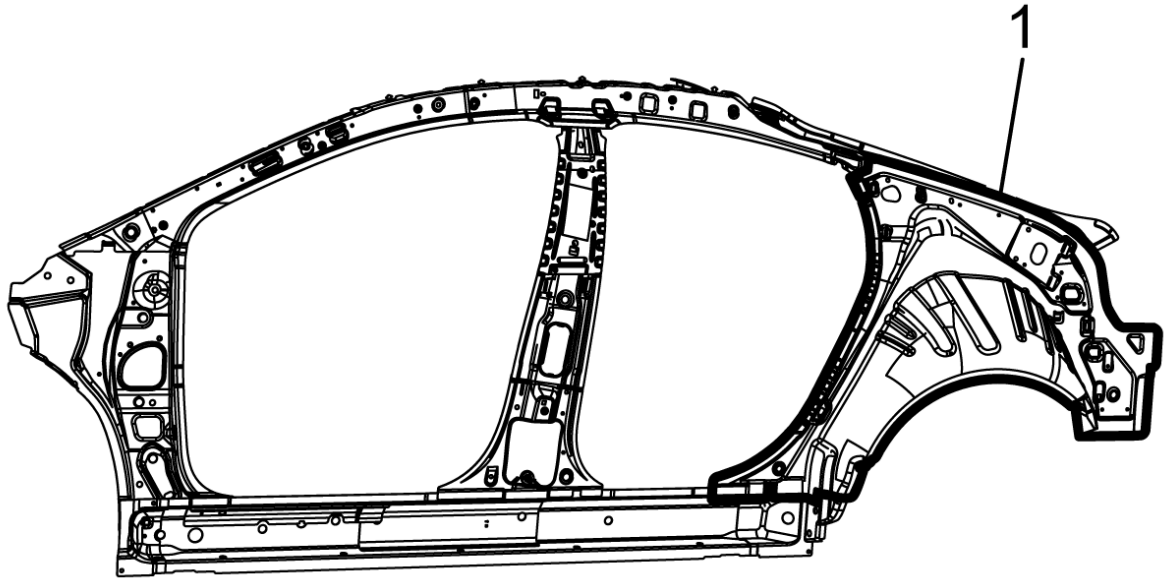


Fig. 88: Rear Wheelhouse Outer Panel

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the rear wheelhouse outer panel (1) into position.
6. Weld the rear wheelhouse outer panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Install the body side outer panel as necessary.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

FLOOR PANEL NUMBER 5 CROSS BAR REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

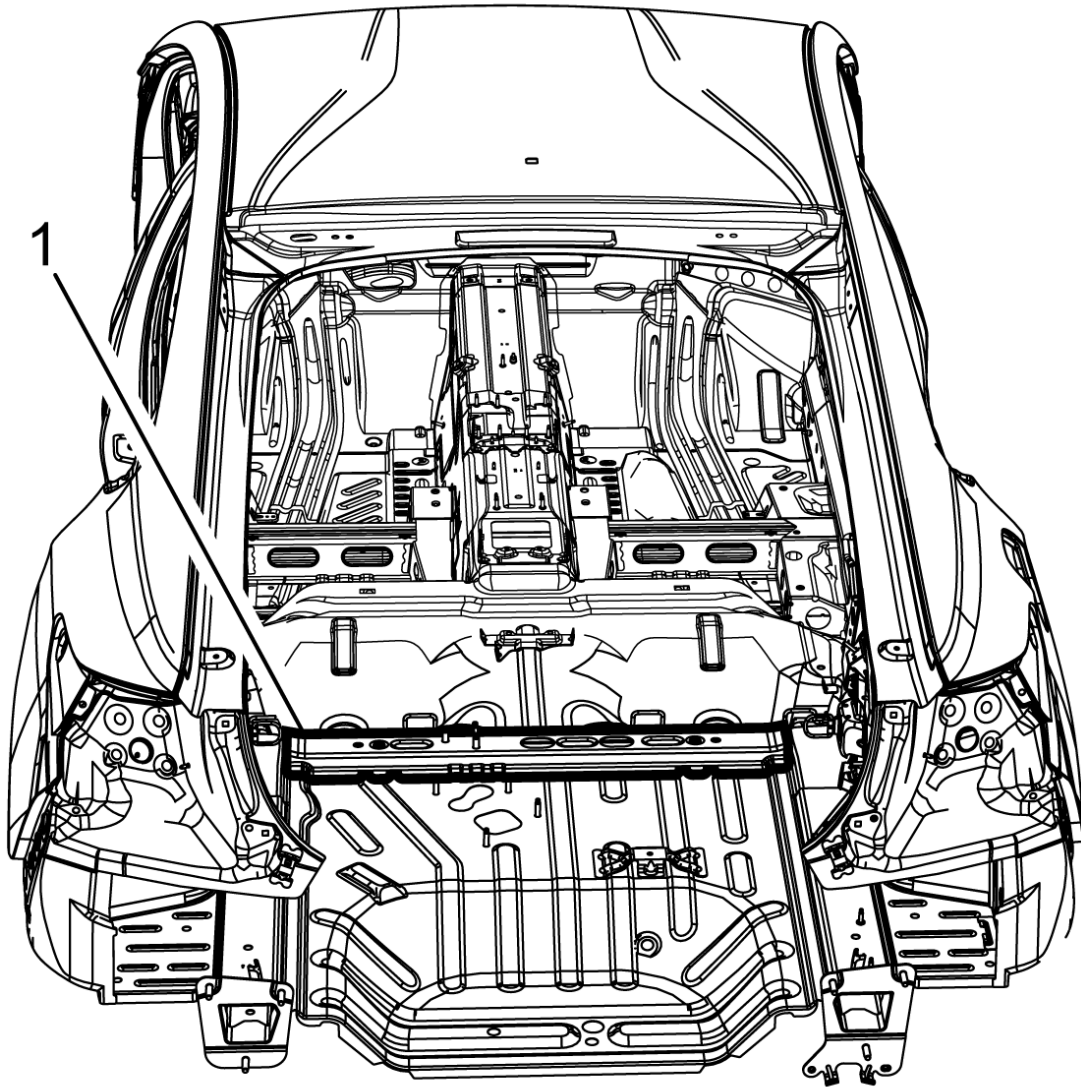


Fig. 89: Floor Panel Number 5 Cross Bar

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to **Structure Identification**.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the floor panel number 5 cross bar (1)..

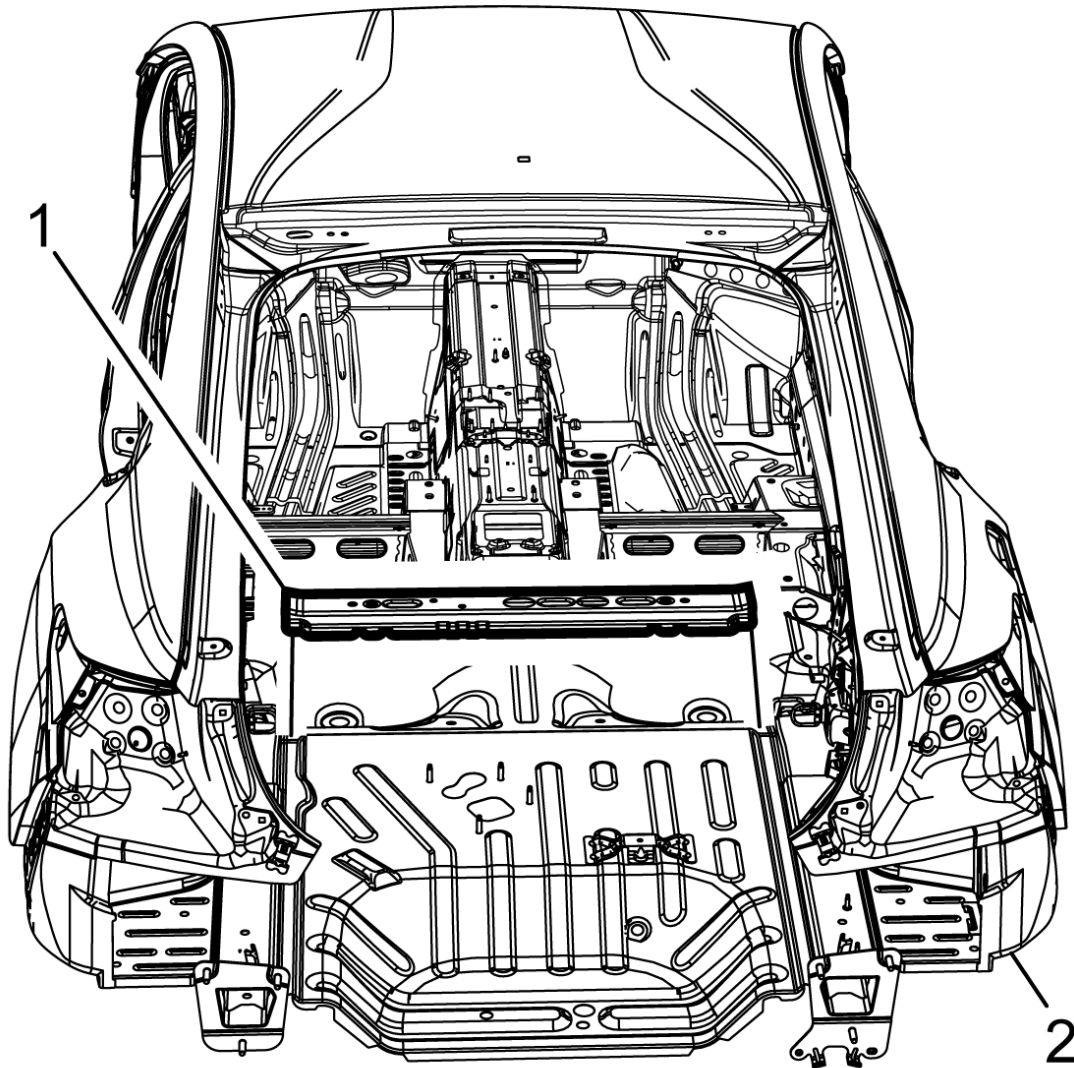


Fig. 90: Floor Panel Number 5 Cross Bar

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged floor panel number 5 cross bar (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

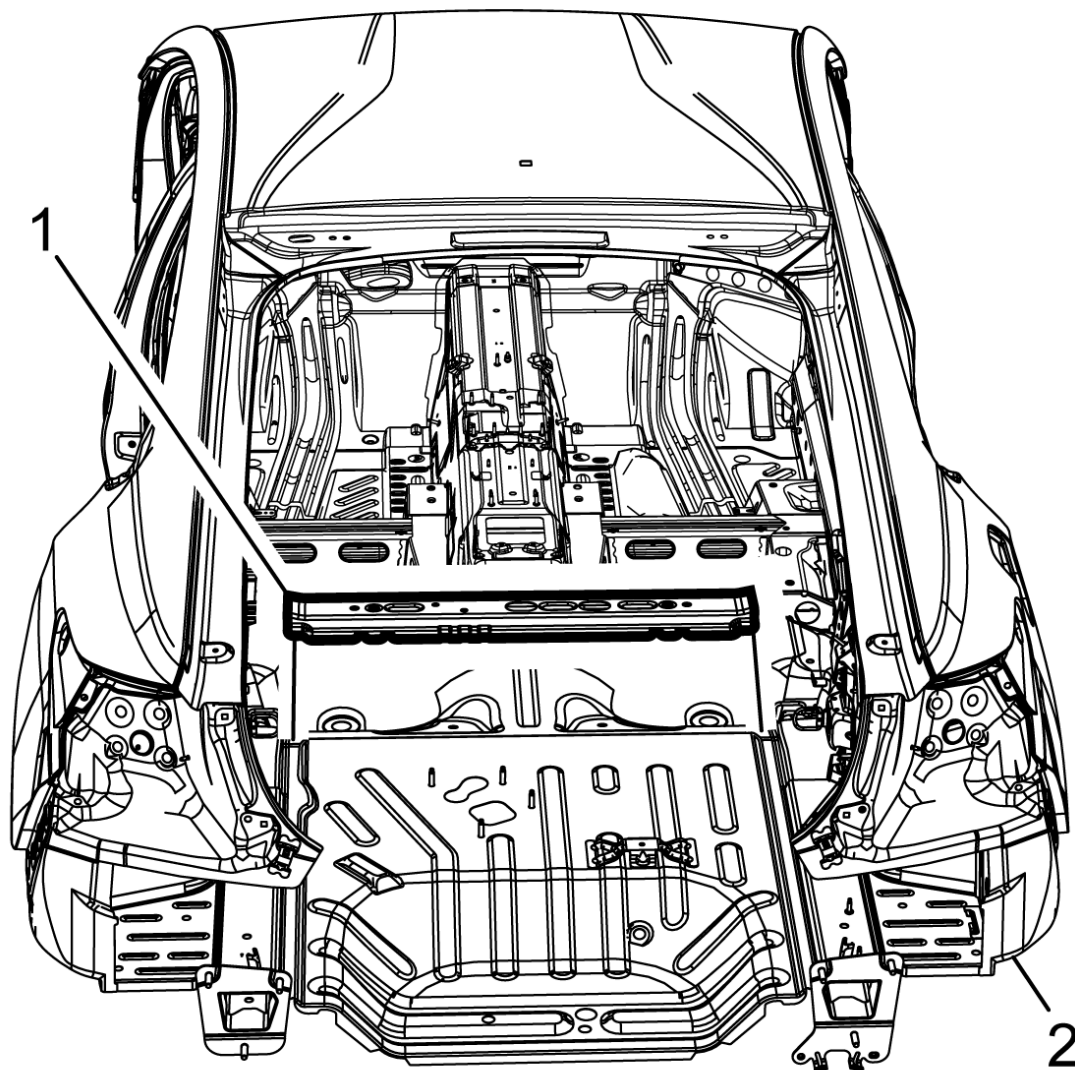


Fig. 91: Floor Panel Number 5 Cross Bar

Courtesy of GENERAL MOTORS COMPANY

2. Position the floor panel number 5 cross bar (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the floor panel number 5 cross bar (1).

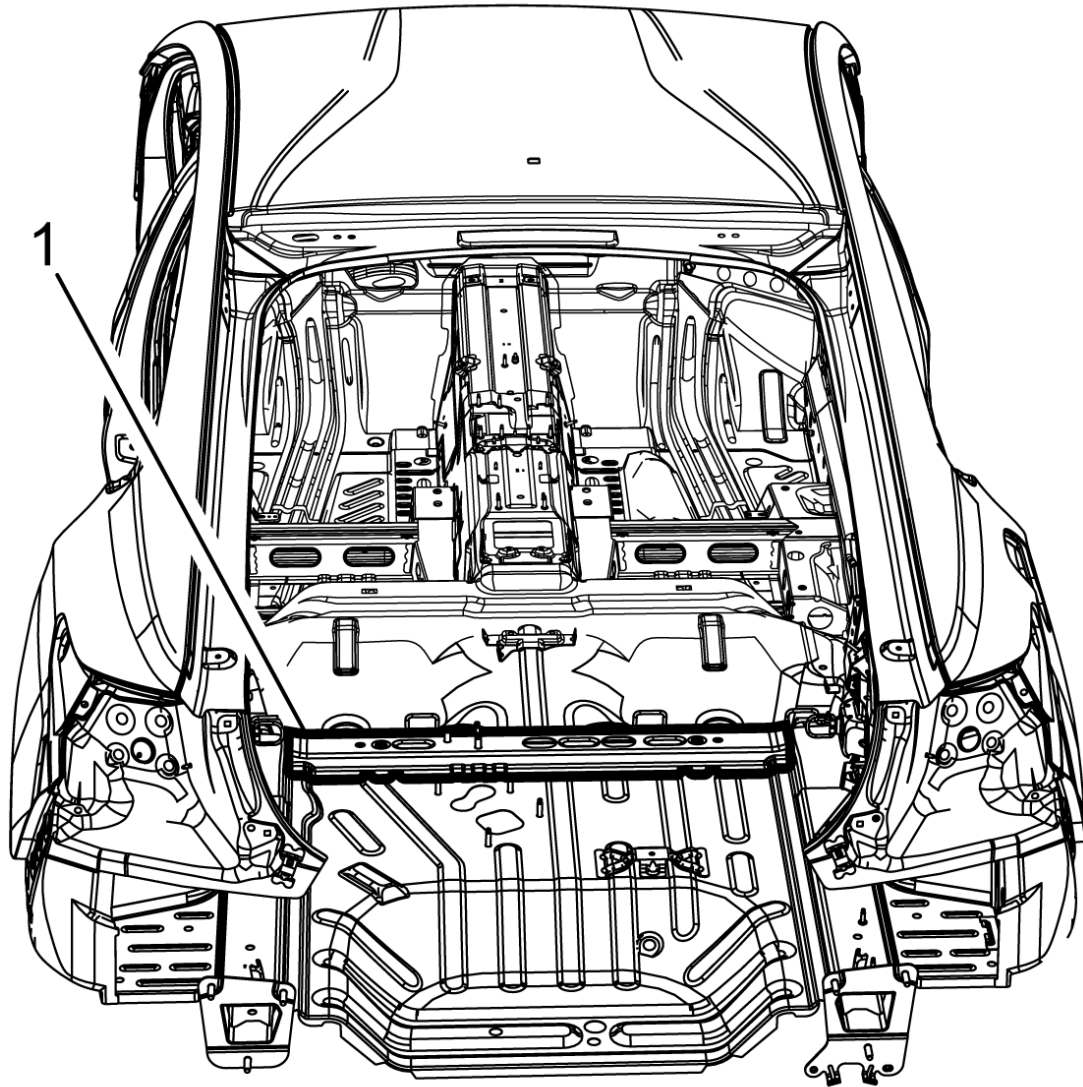


Fig. 92: Floor Panel Number 5 Cross Bar
Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the floor panel number 5 cross bar (1) into position.
6. Weld the floor panel number 5 cross bar (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
9. Install all related panels and components.
10. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
11. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

FLOOR PANEL NUMBER 5 CROSS BAR EXTENSION REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .

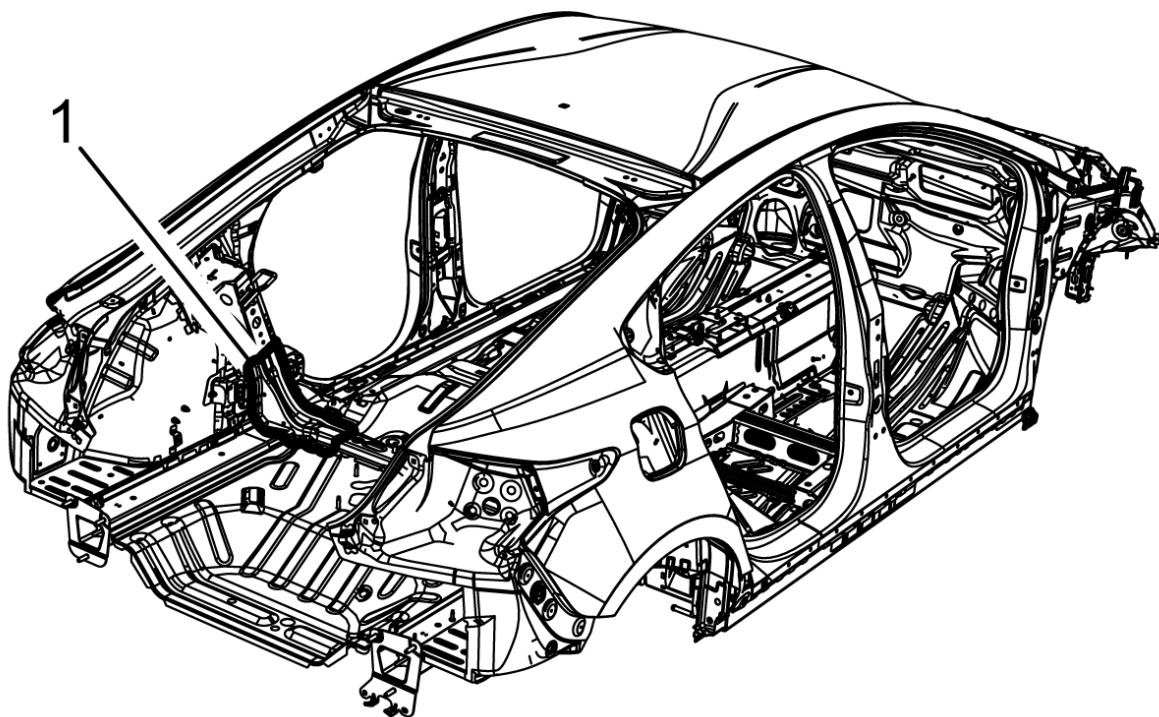


Fig. 93: Floor Panel Number 5 Cross Bar Extension

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the floor panel number 5 cross bar extension (1).

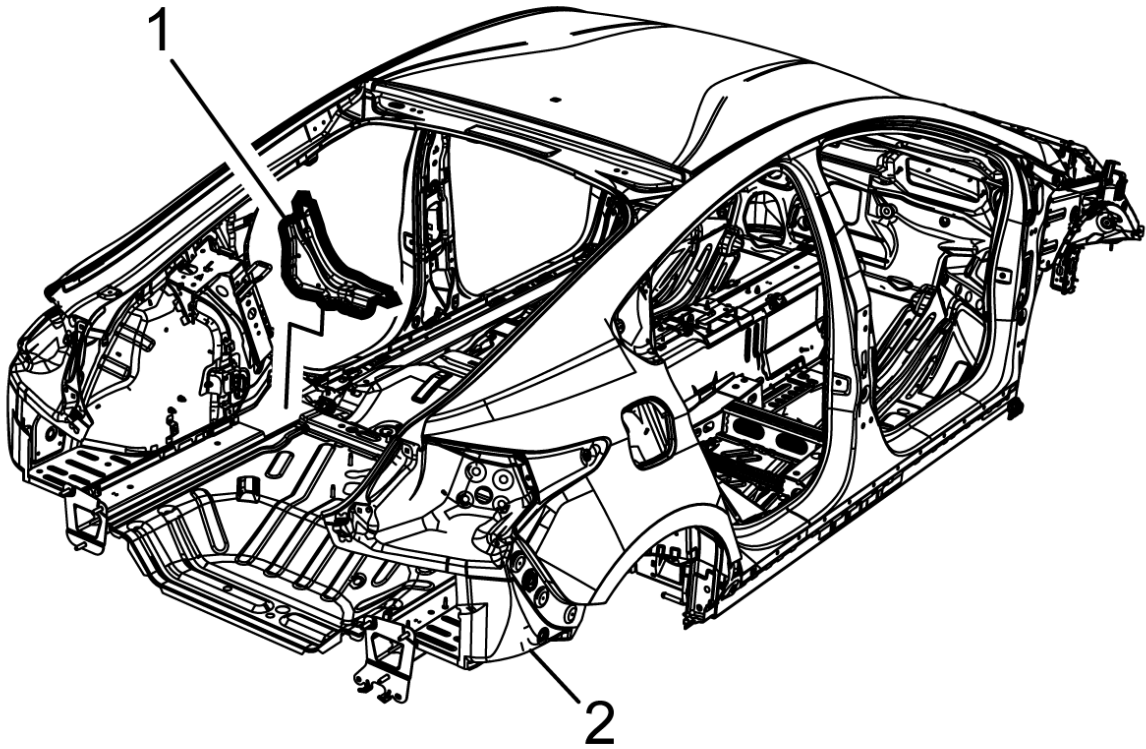


Fig. 94: Floor Panel Number 5 Cross Bar Extension
Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged floor panel number 5 cross bar extension (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

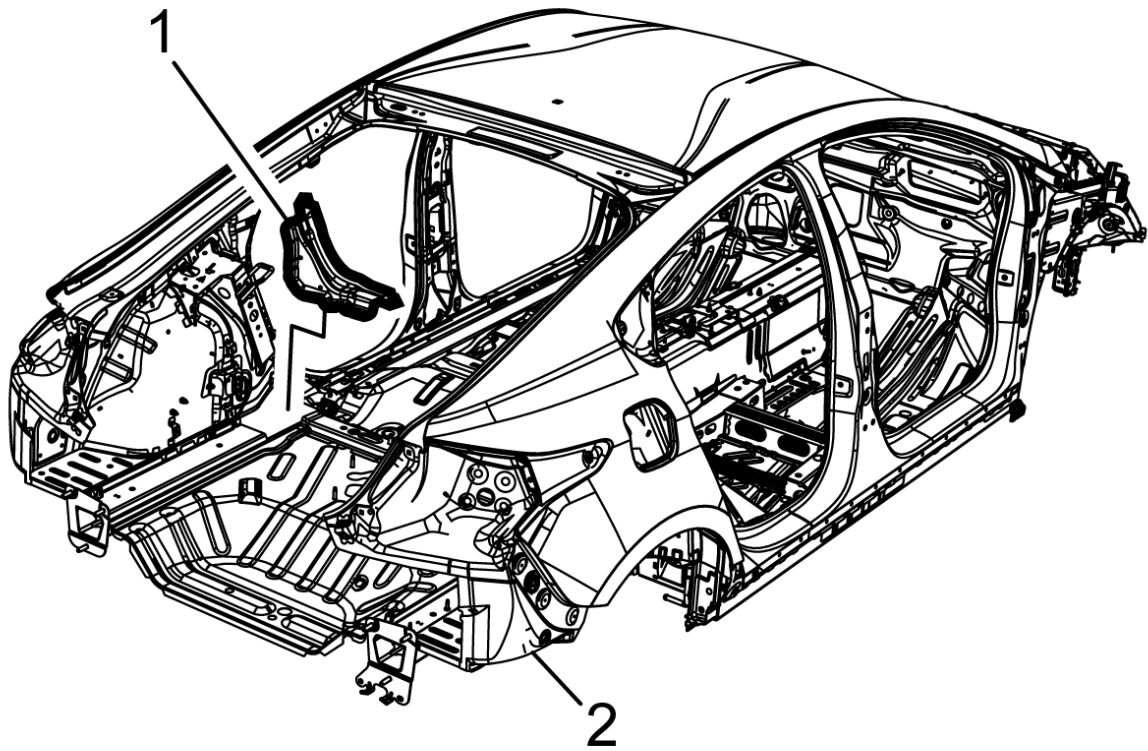


Fig. 95: Floor Panel Number 5 Cross Bar Extension

Courtesy of GENERAL MOTORS COMPANY

2. Position the floor panel number 5 cross bar extension (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the floor panel number 5 cross bar extension (1).

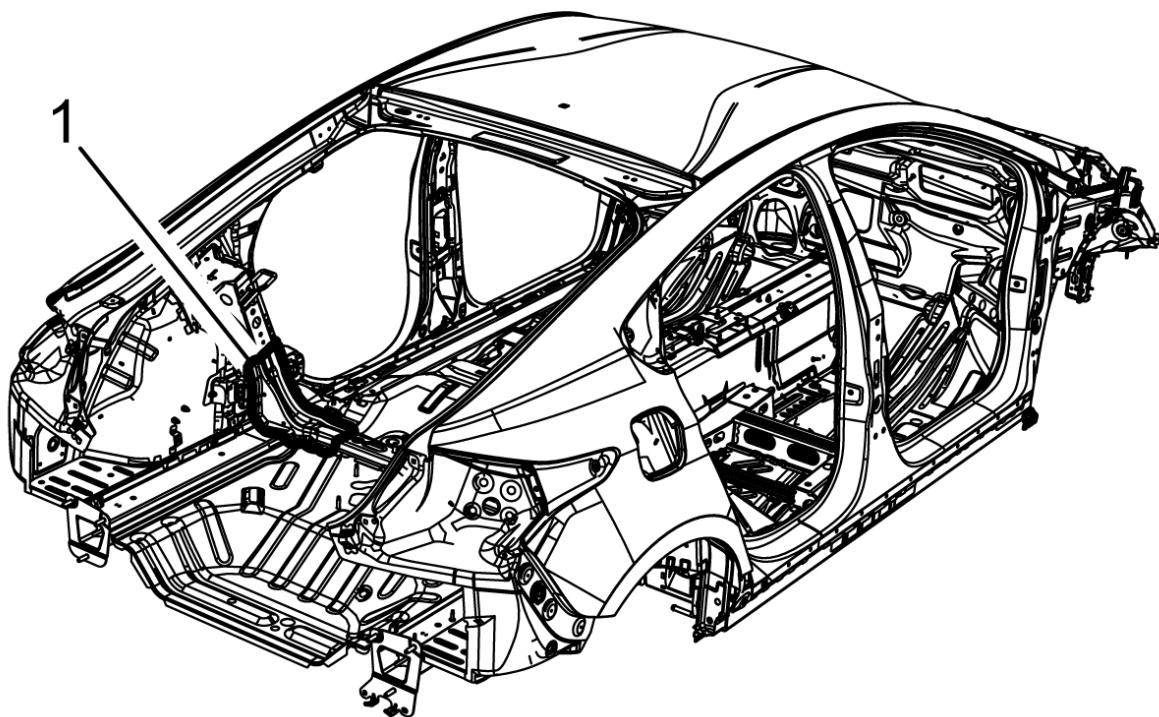


Fig. 96: Floor Panel Number 5 Cross Bar Extension
Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#).
5. Clamp the floor panel number 5 cross bar extension (1) into position.
6. Weld the floor panel number 5 cross bar extension (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

BODY REAR END PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .

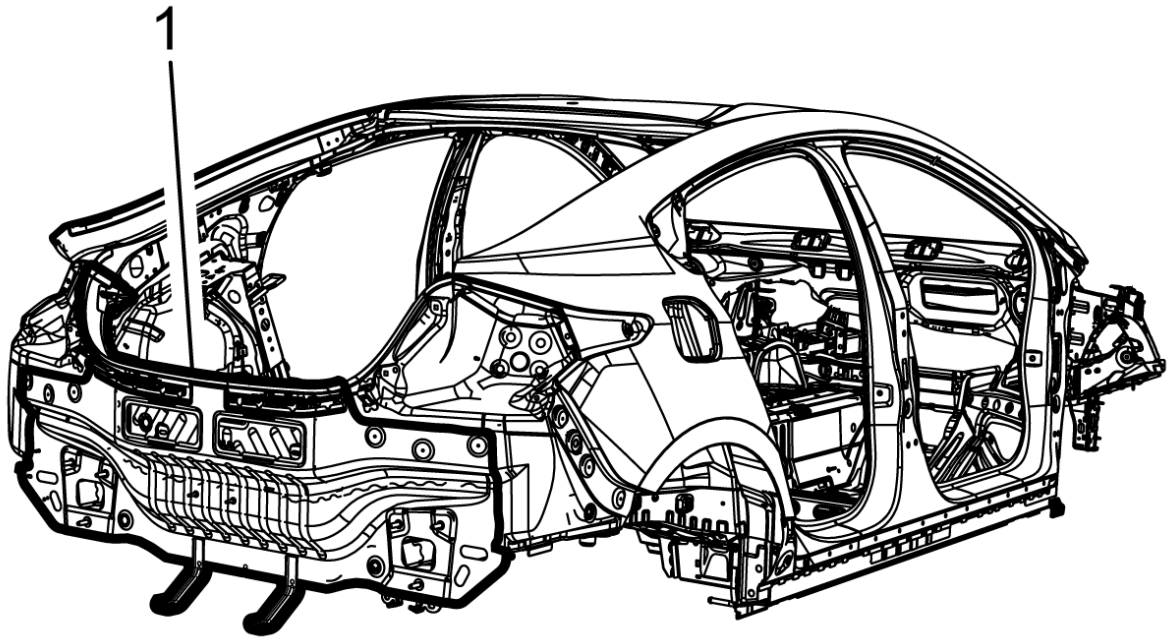


Fig. 97: Body Rear End Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from body rear end panel (1).

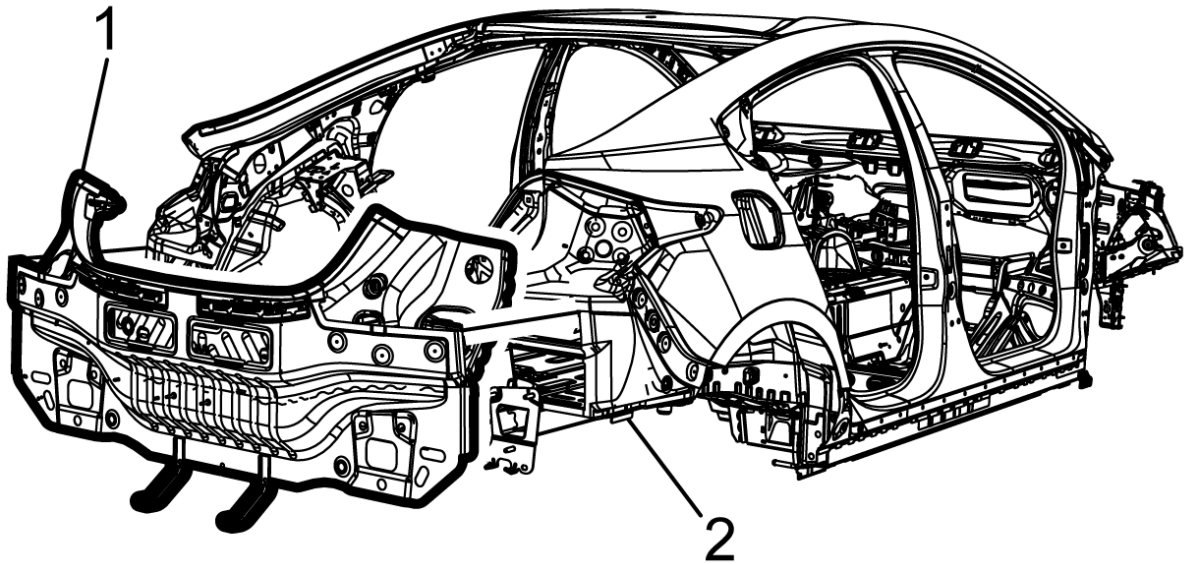


Fig. 98: Body Rear End Panel

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged body rear end panel (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#)

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Resistance Type Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

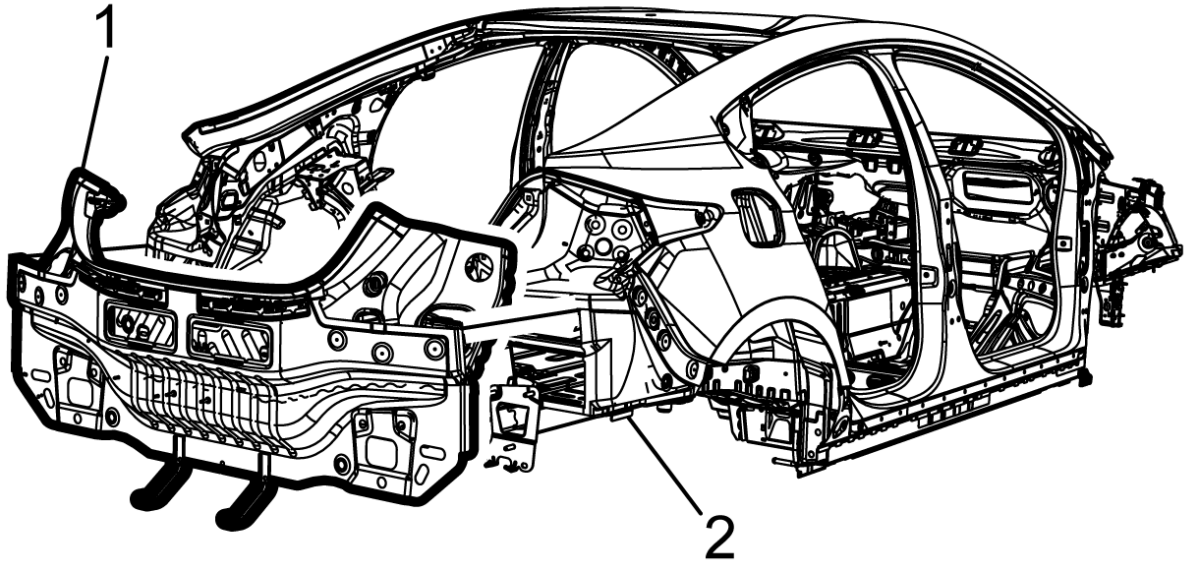


Fig. 99: Body Rear End Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the body rear end panel (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the body rear end panel (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding**

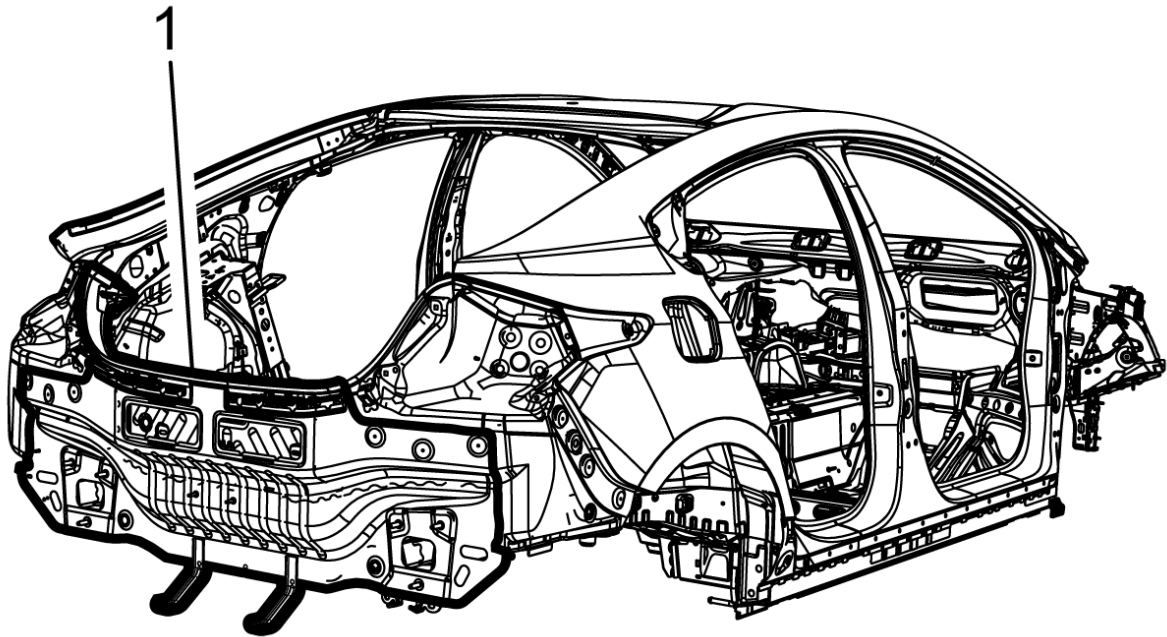


Fig. 100: Body Rear End Panel

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the body rear end panel (1) into position.
6. Weld the body rear end panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

FRONT RAIL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The front rail is an ultra-high strength steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#)

NOTE: Left shown, right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. [Dimensions - Body](#).
5. Note the location and remove the sealers and anti-corrosion materials from the repair area. [Anti-Corrosion Treatment and Repair](#) .

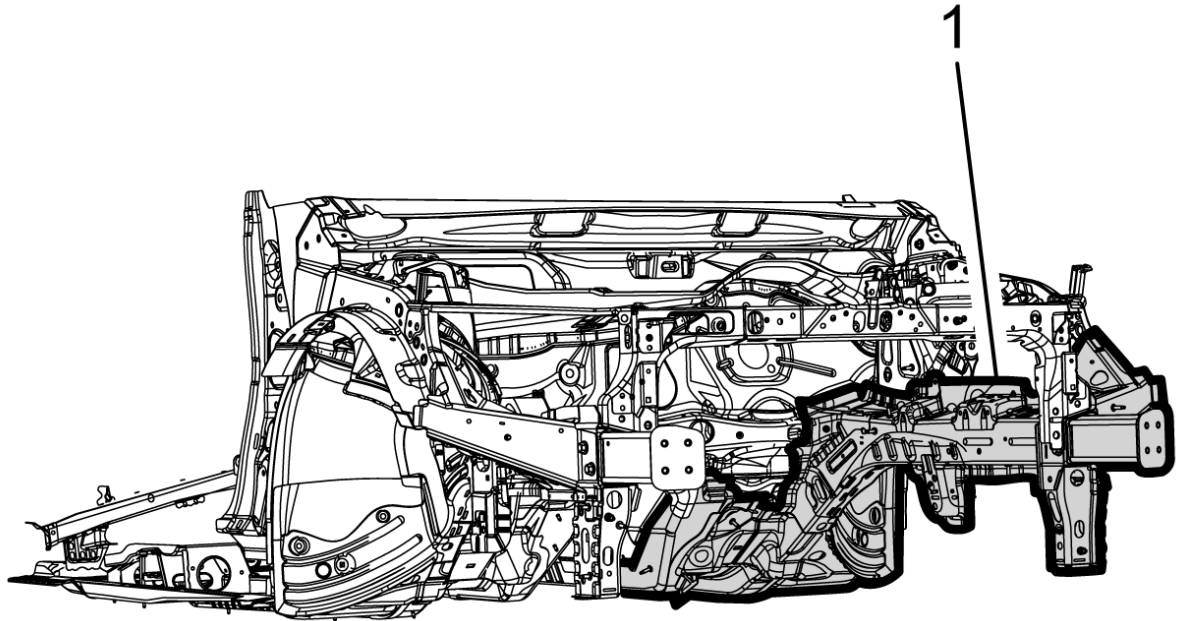


Fig. 101: Front Rail

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

6. Locate and remove out all factory welds. Note the number and location of the welds for installation of the front rail (1).

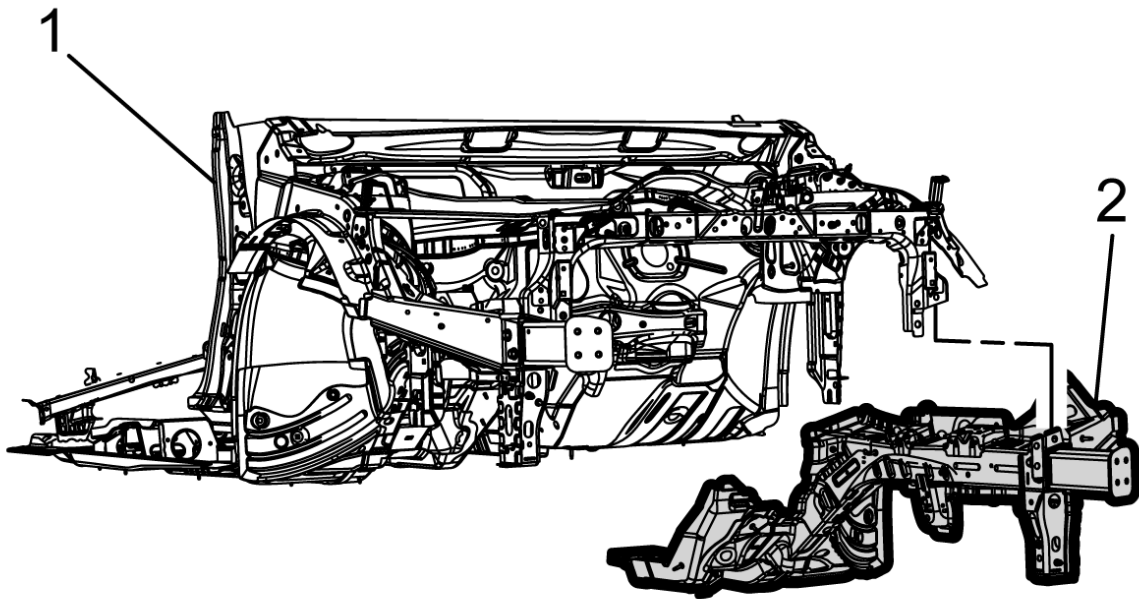


Fig. 102: Front Rail

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged front rail (2) from the vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

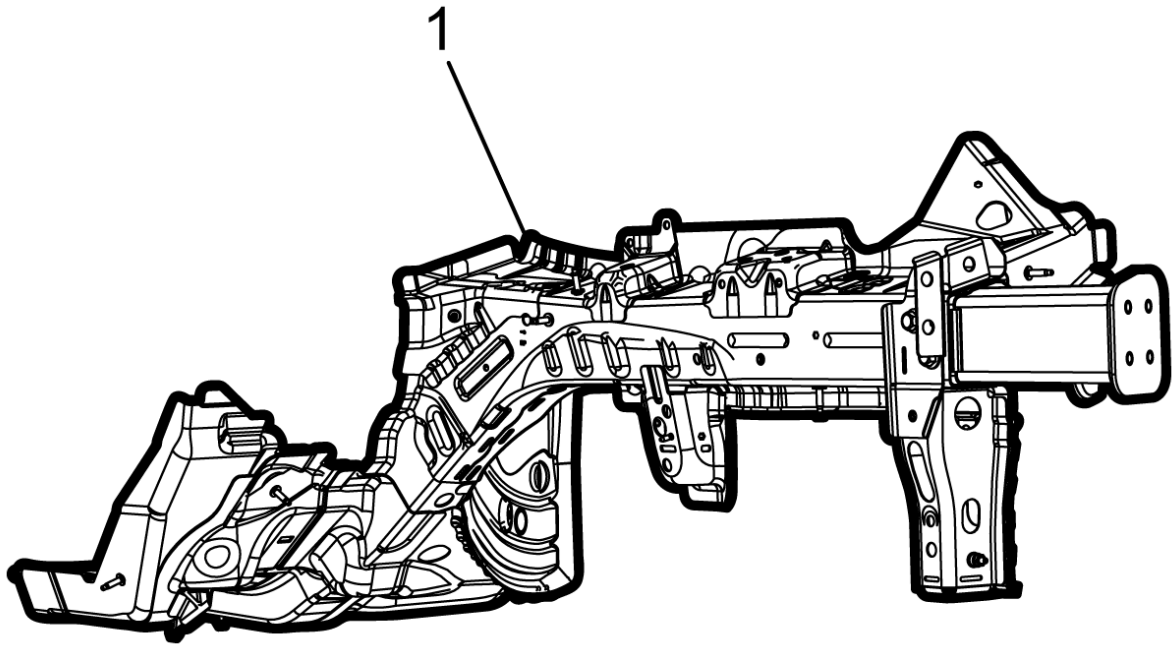


Fig. 103: Service Part Front Rail

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1 1/2 in) apart.

1. Drill 8 mm (5/16 in) plug weld holes in the service part front rail (1) as necessary in the locations noted from the original panel.
2. Prepare all mating surfaces as necessary.
3. Apply GM-approved Weld-Thru Coating or equivalent to all mating surfaces. [Anti-Corrosion Treatment and Repair](#) .

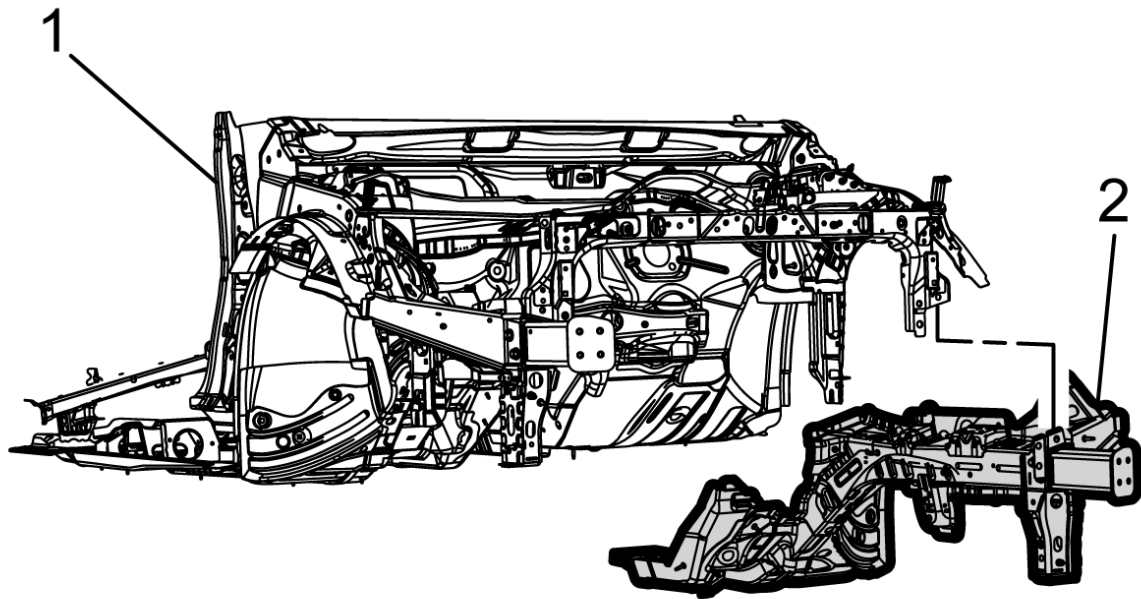


Fig. 104: Front Rail

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding.**
5. Position the front rail (1) to the vehicle (2) using 3-dimensional measuring equipment. Clamp the rail in place.

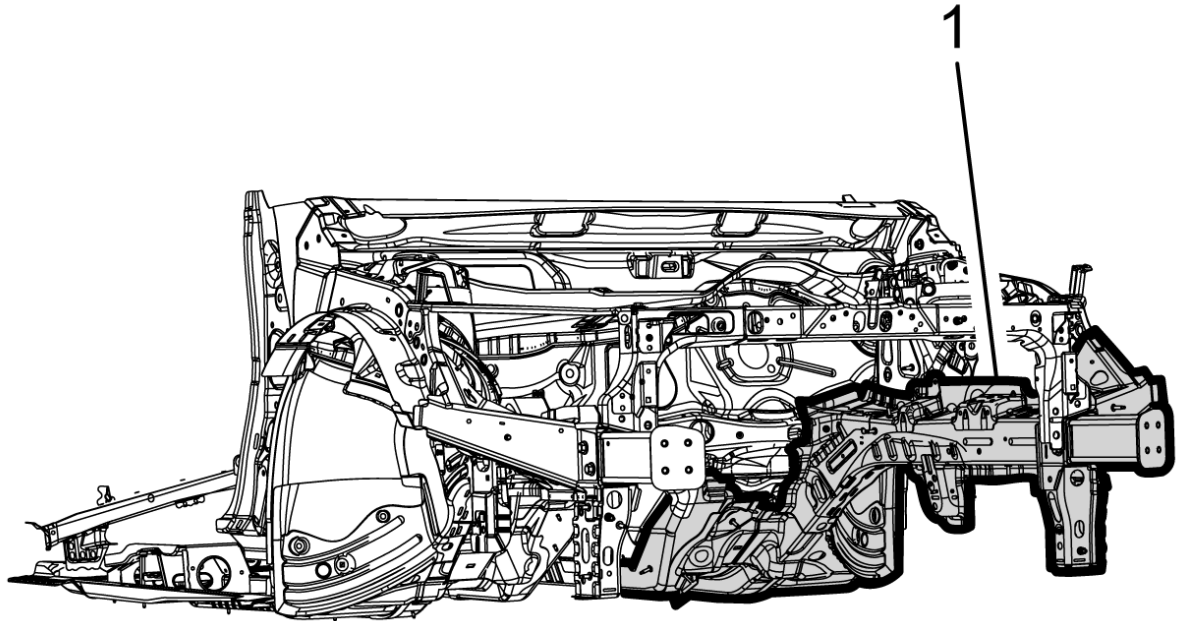


Fig. 105: Front Rail

Courtesy of GENERAL MOTORS COMPANY

6. Weld the front rail (1) accordingly.
7. Clean and prepare all welded surfaces.
8. Install all related panels and components.
9. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
10. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
11. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

REAR RAIL END REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

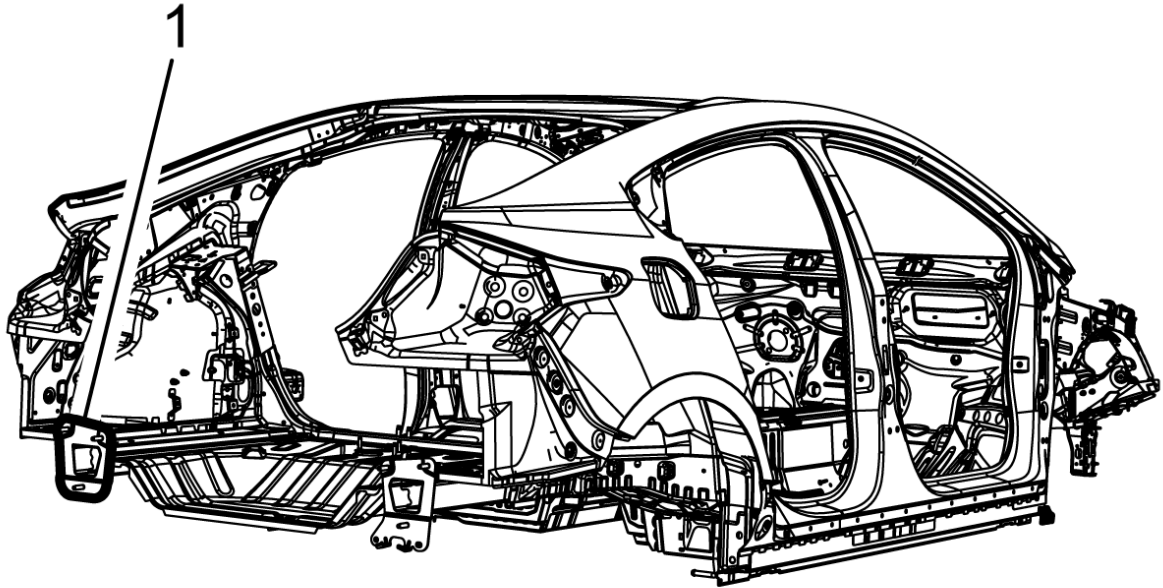


Fig. 106: Rear Rail End

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from rear rail end (1).

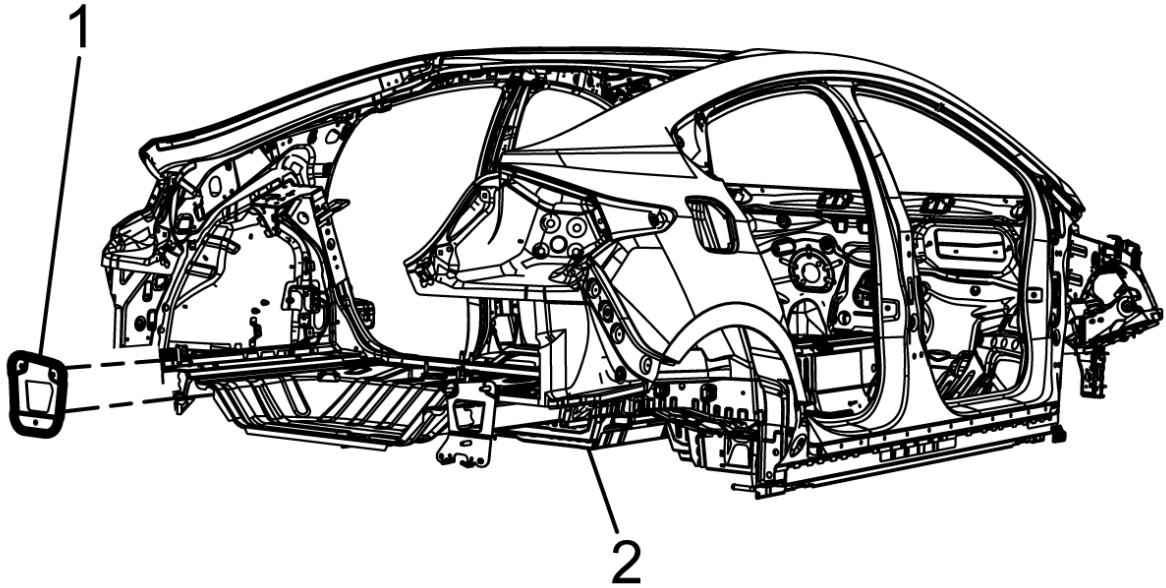


Fig. 107: Rear Rail End

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear rail end (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

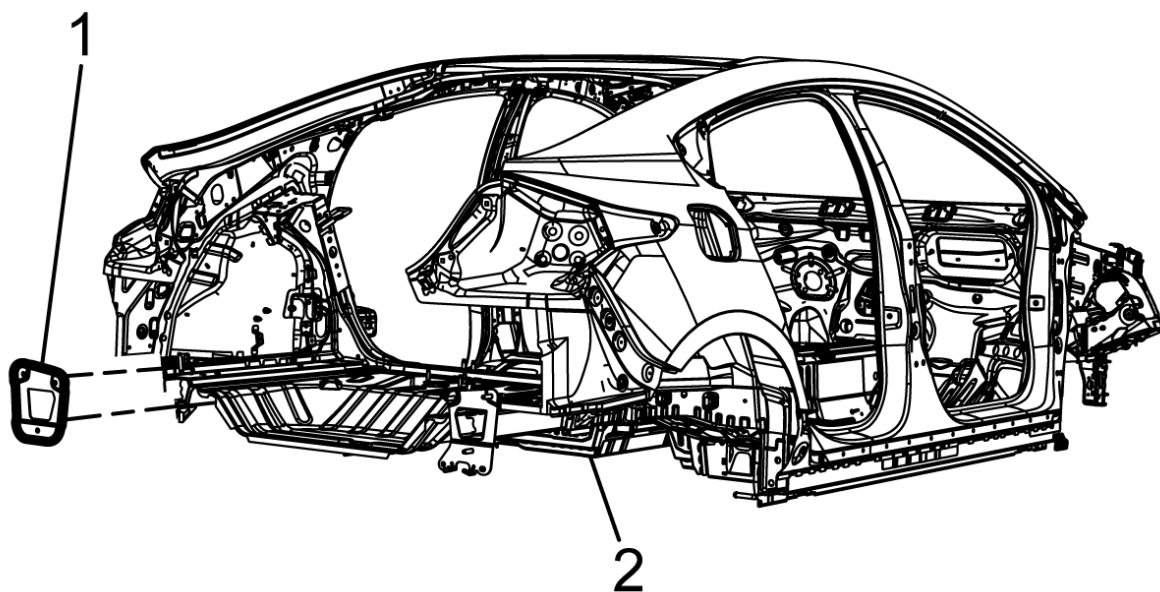


Fig. 108: Rear Rail End

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear rail end (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the rear rail end (1).

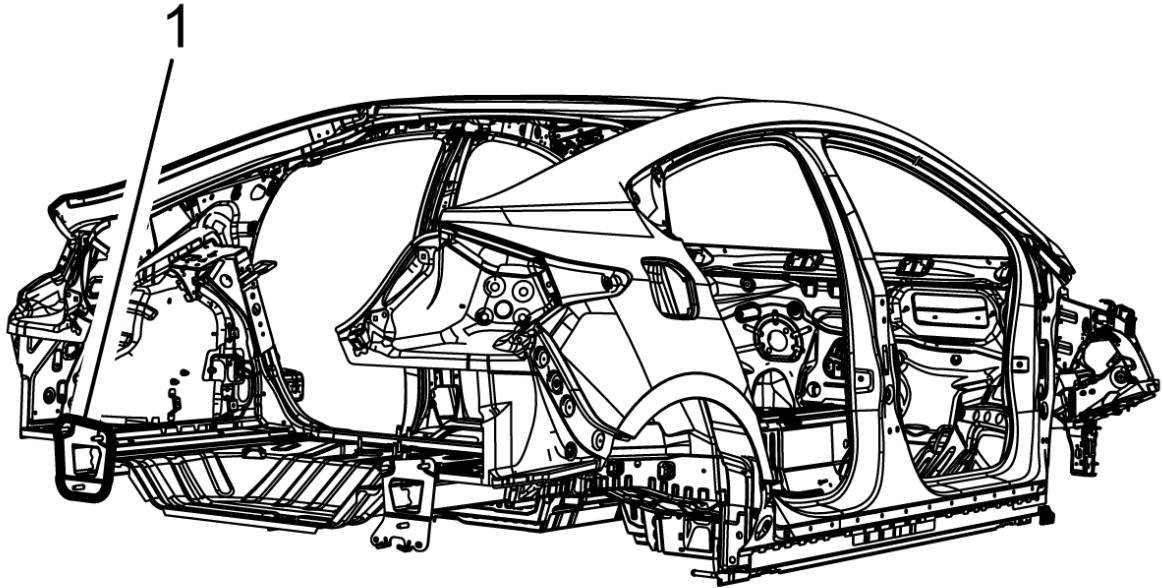


Fig. 109: Rear Rail End

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#).
5. Clamp the rear rail end (1) into position.
6. Weld the rear rail end (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#)
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#)
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

BODY HINGE PILLAR INNER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: The Roof side rail reinforcement is a High strength low alloy steel. [High Strength Low Alloy Steel](#).

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage

to the vehicle structure as possible, prior to replacing any damaged parts.

5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the Front Hinge Pillar.

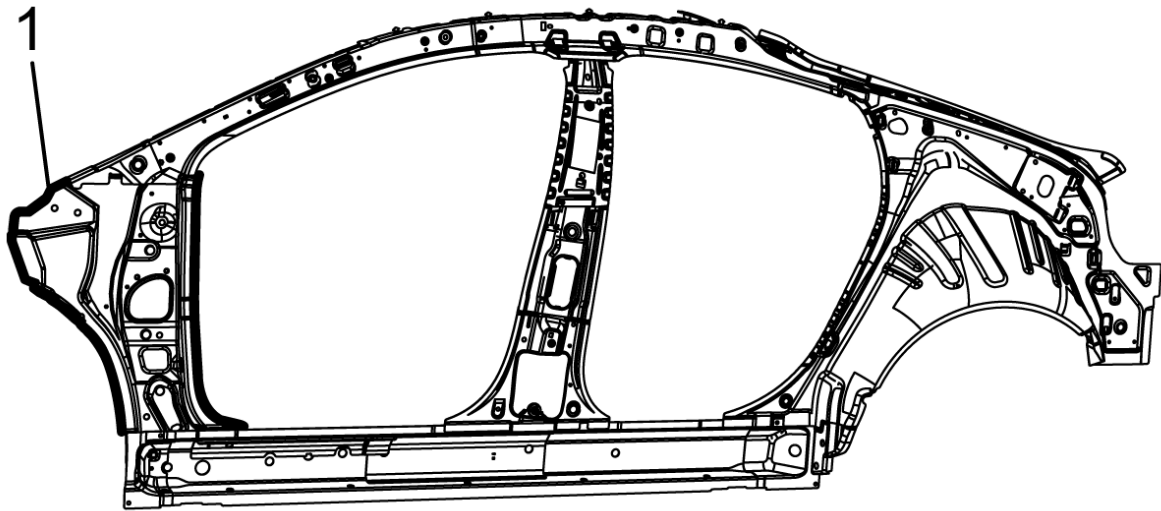


Fig. 110: Body Hinge Pillar Inner

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from body hinge pillar inner (1).

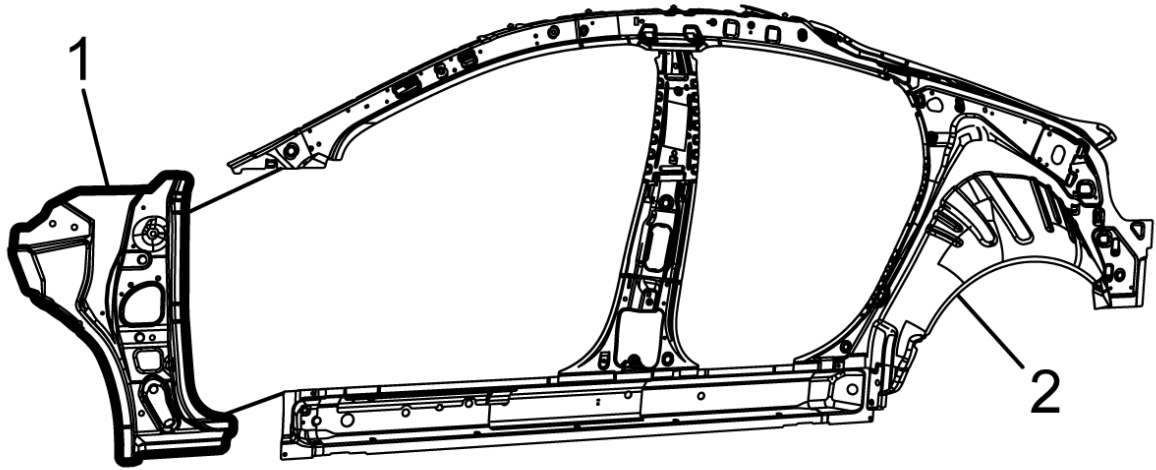


Fig. 111: Body Hinge Pillar Inner

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged body hinge pillar inner (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

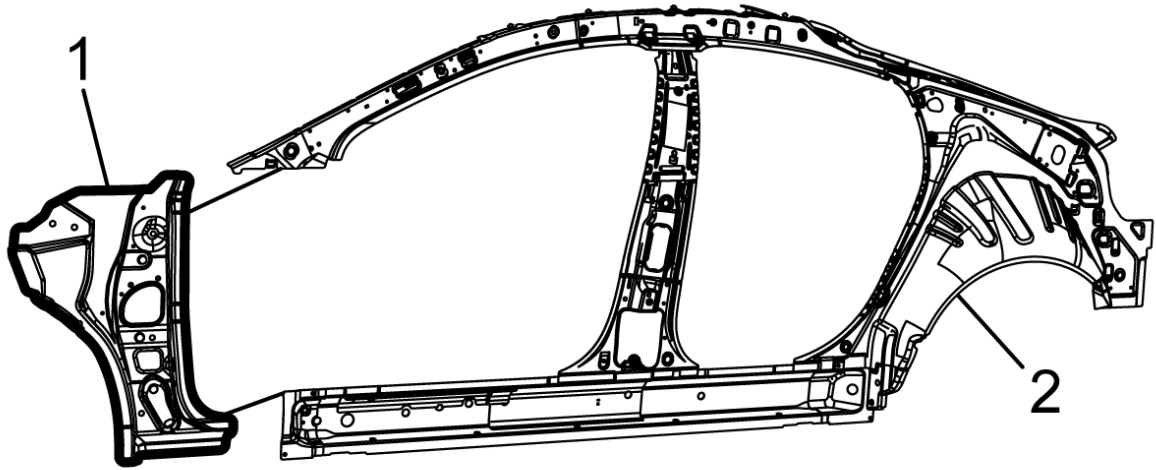


Fig. 112: Body Hinge Pillar Inner

Courtesy of GENERAL MOTORS COMPANY

2. Position the body hinge pillar inner (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the body hinge pillar inner (1).

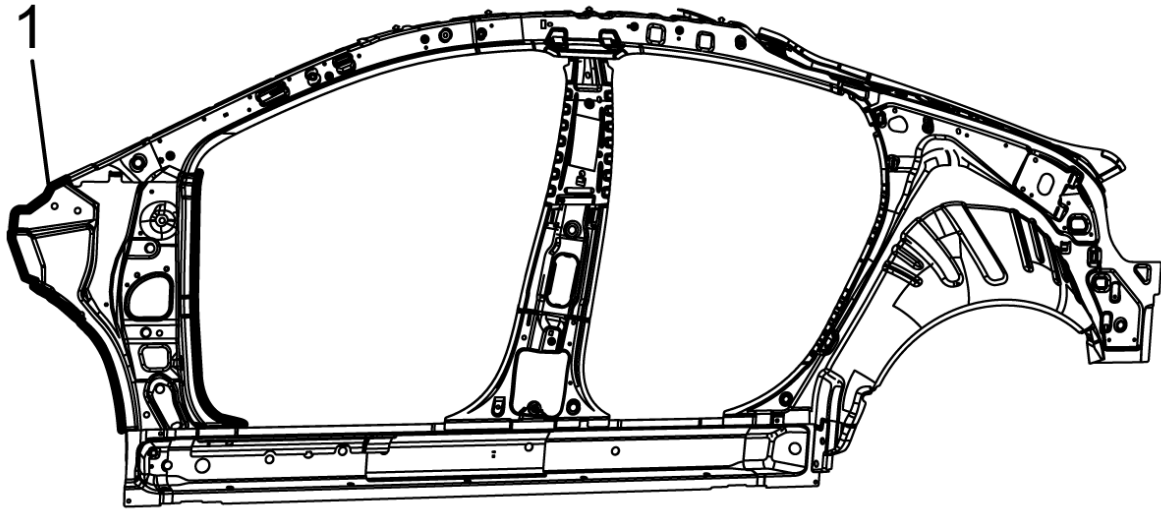


Fig. 113: Body Hinge Pillar Inner

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#).
5. Clamp the body hinge pillar inner (1) into position.
6. Weld the body hinge pillar inner (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Install the body side outer panel as necessary.

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , or [Adhesive Installation of Liftgate Windows](#) .

9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

CENTER PILLAR INNER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The center pillar inner panel is an ultra-high strength steel and cannot be sectioned or repaired. [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the center inner panel.

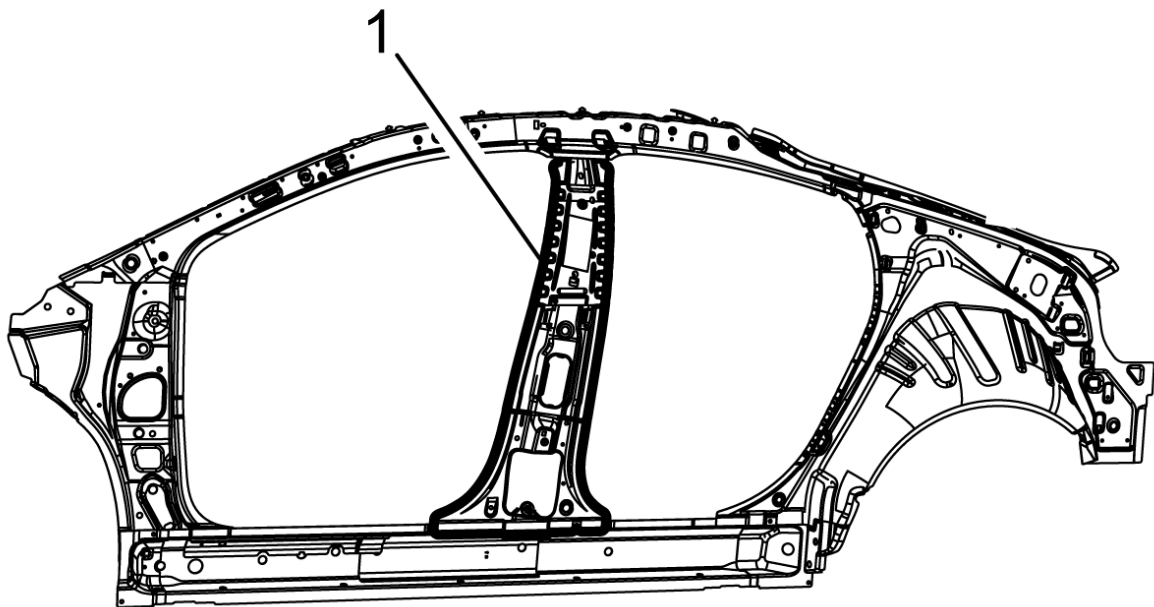


Fig. 114: Center Inner Panel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from the center inner panel (1).

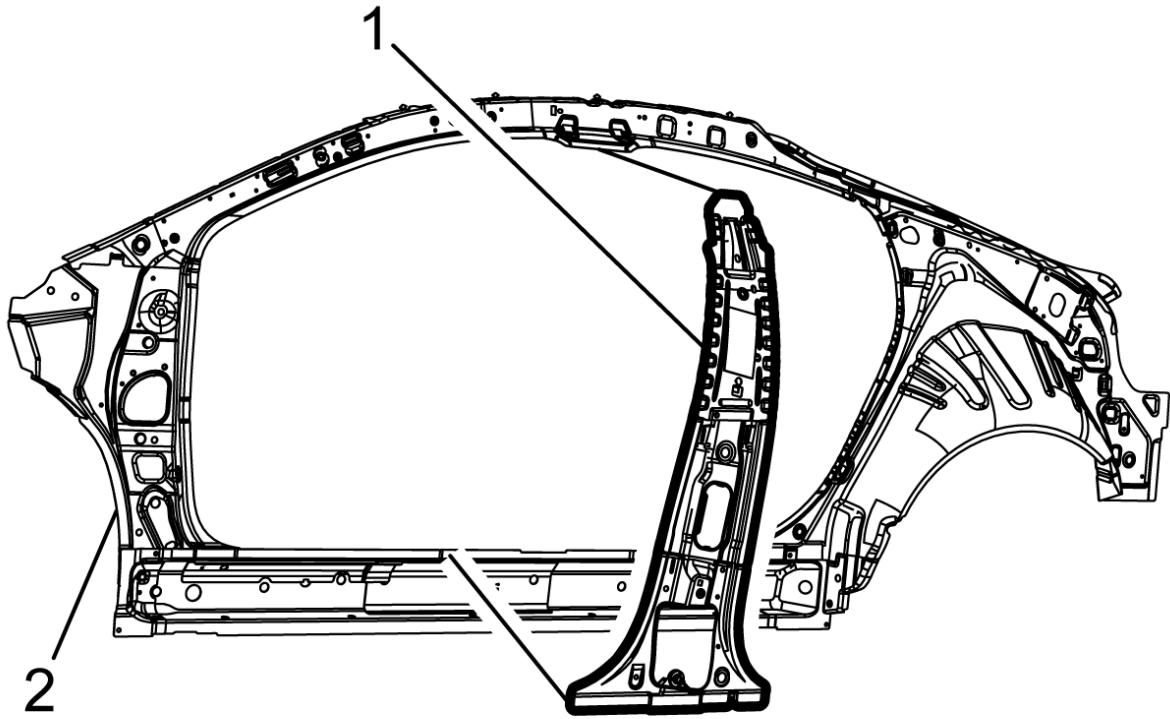


Fig. 115: Center Inner Panel

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged center inner panel (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

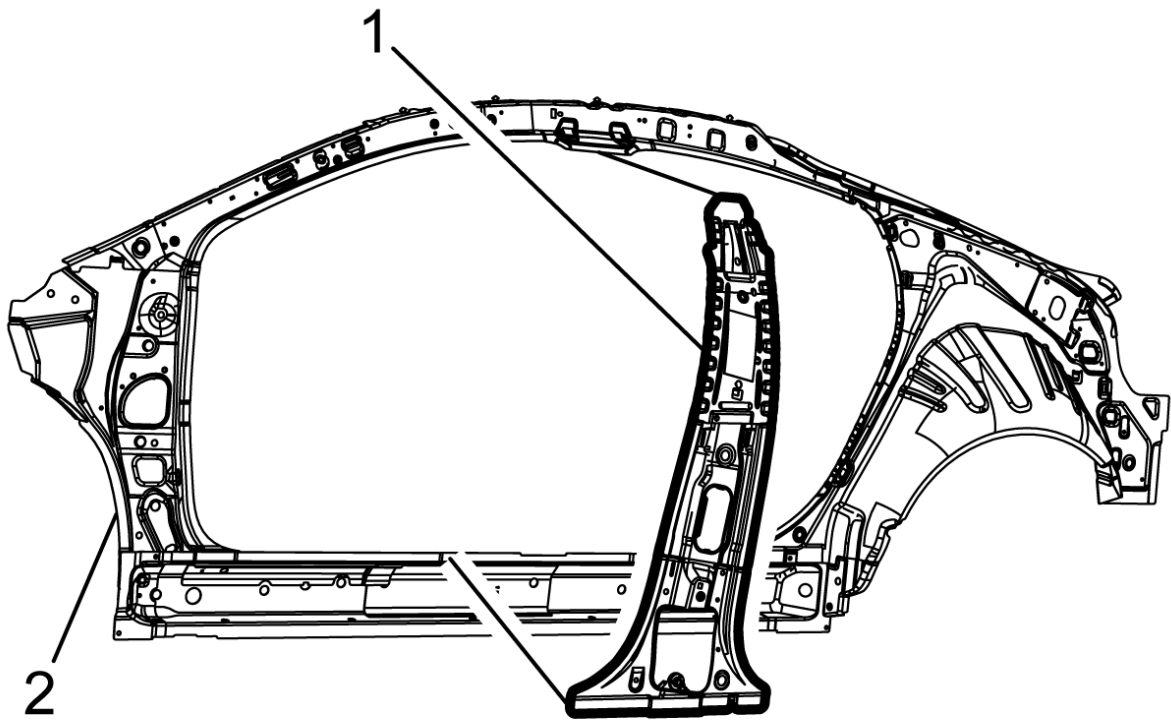


Fig. 116: Center Inner Panel

Courtesy of GENERAL MOTORS COMPANY

2. Position the center inner panel (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the center inner panel (1).

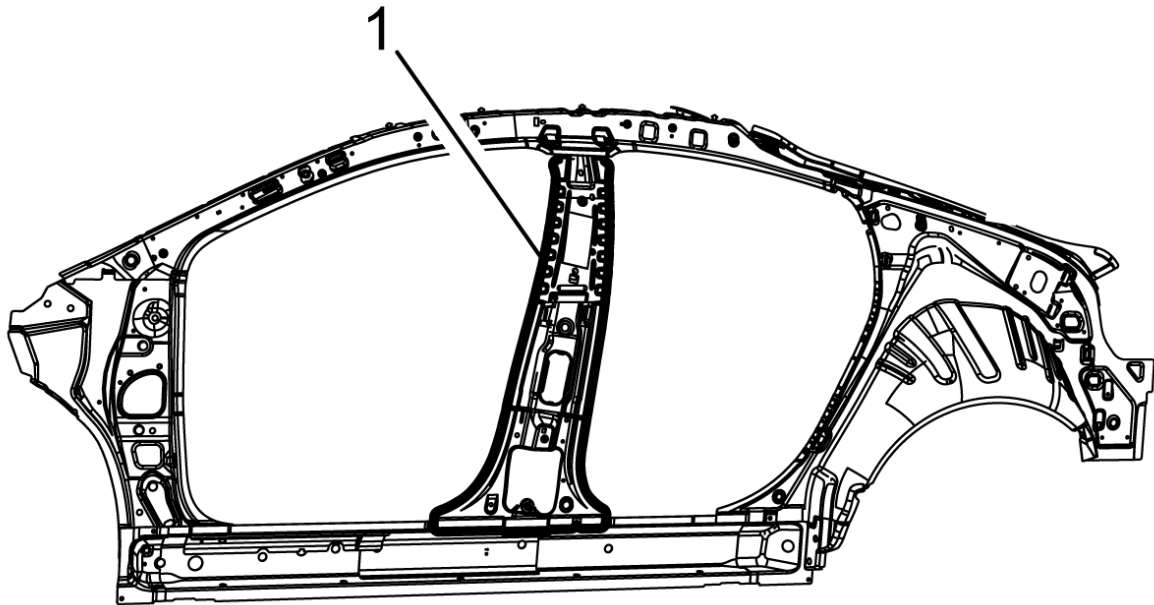


Fig. 117: Center Inner Panel

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the center inner panel (1) into position.
6. Weld the center inner panel (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Install the body side outer panel as necessary.
9. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#) .
12. Enable the SIR System. [SIR Disabling and Enabling](#) .

CENTER PILLAR REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: The front hinge pillar is an ultra-high strength steel and cannot be sectioned or repaired. Refer to [Ultra High Strength Steel](#).

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: Left shown right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .

3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
6. Section the body side outer panel as required for access to replace the center pillar.

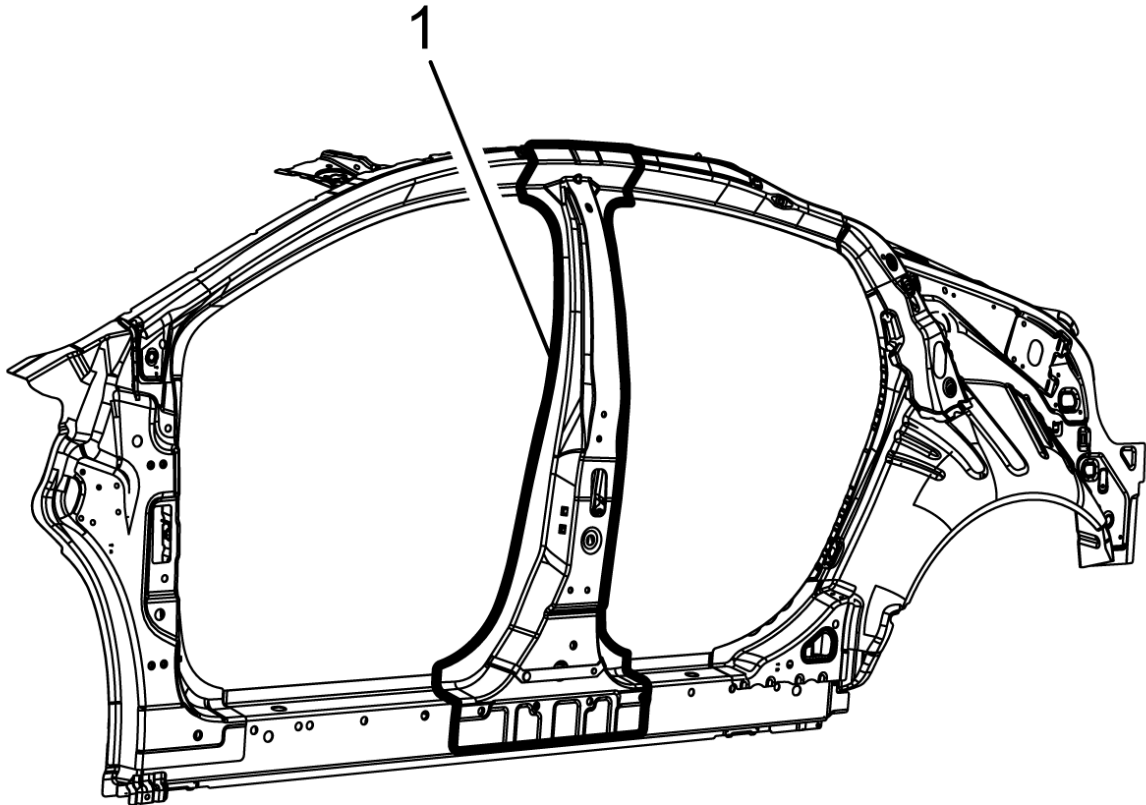


Fig. 118: Center Pillar

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

7. Remove all factory welds from center pillar (1).

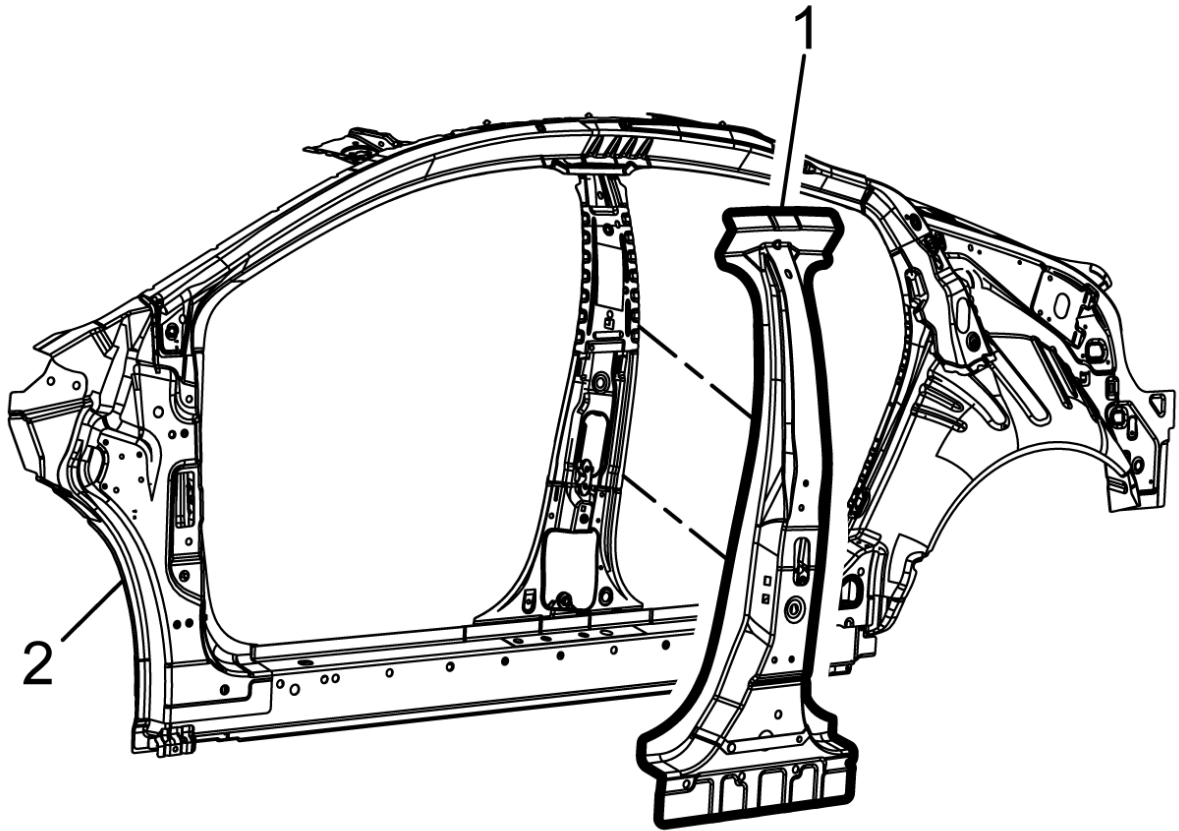


Fig. 119: Center Pillar

Courtesy of GENERAL MOTORS COMPANY

8. Remove the damaged center pillar (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

9. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

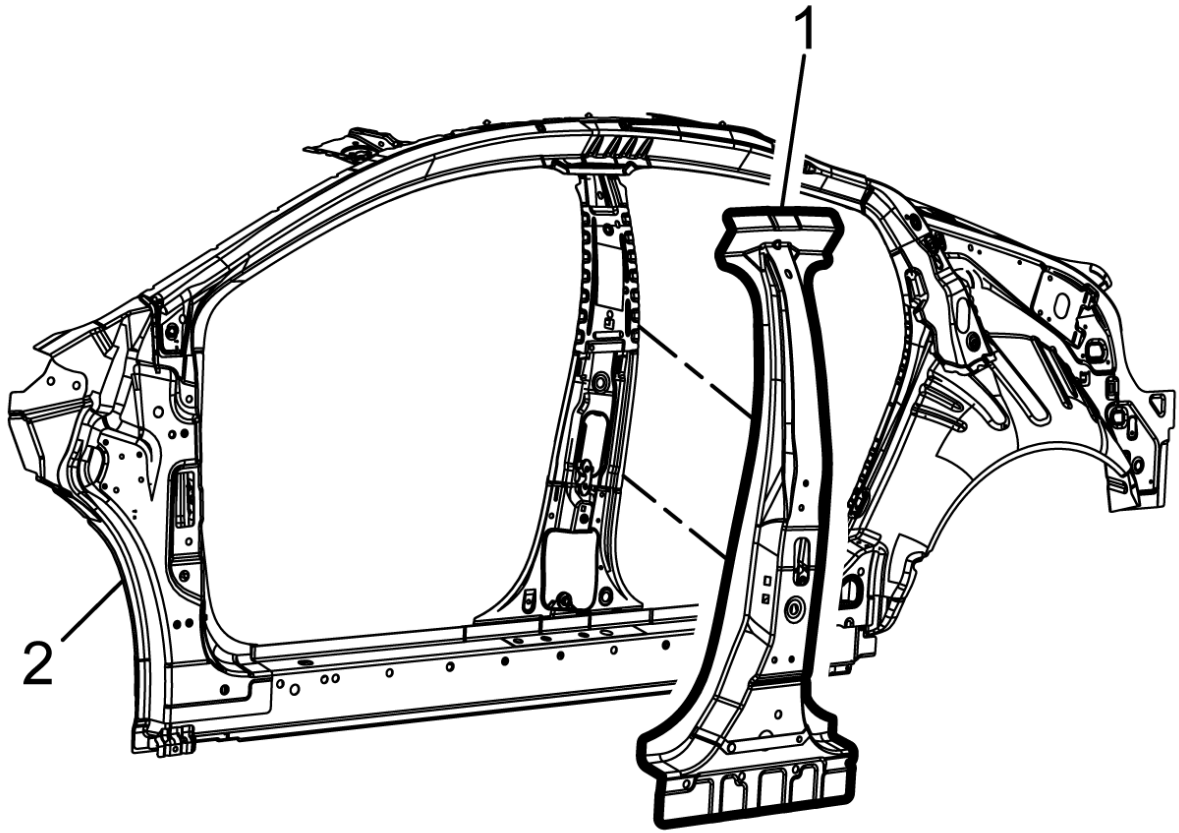


Fig. 120: Center Pillar

Courtesy of GENERAL MOTORS COMPANY

2. Position the center pillar (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the center pillar.

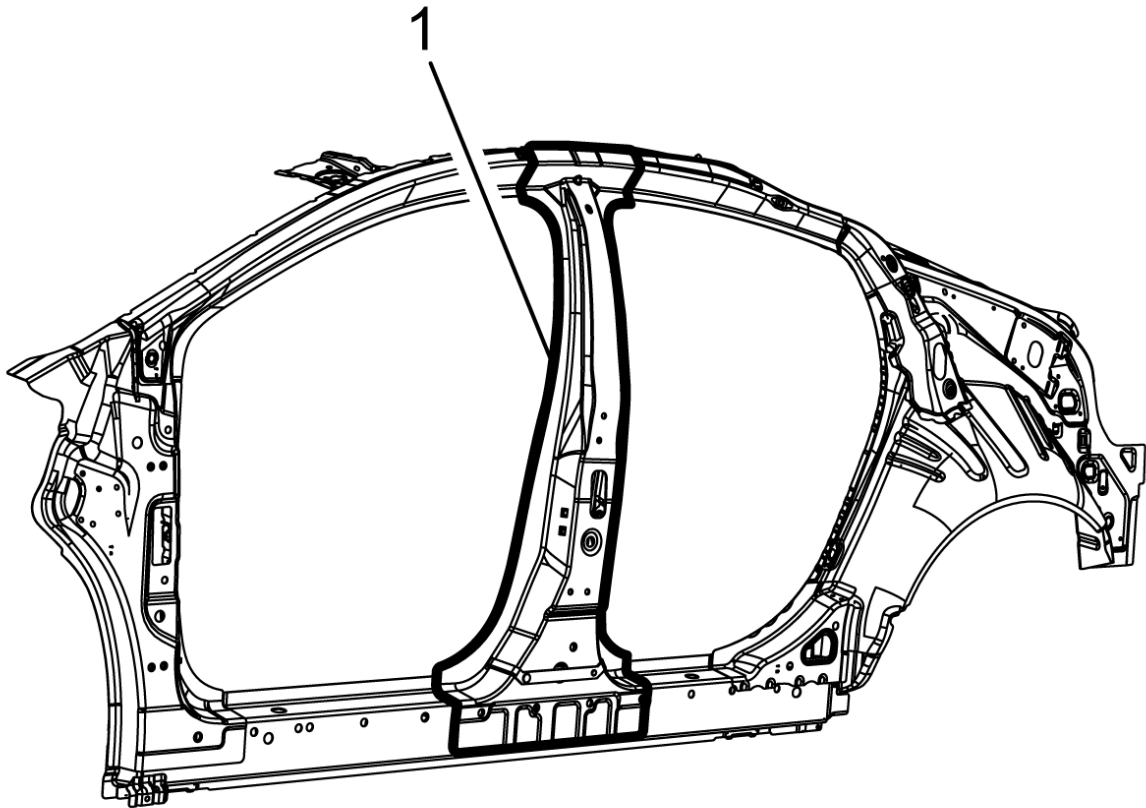


Fig. 121: Center Pillar

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the center pillar (1) into position.
6. Weld the center pillar (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Install the body side outer panel as necessary.
9. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
10. Install all related panels and components.
11. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

FRONT SIDE DOOR OUTER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any

High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

NOTE: Before beginning the repair, refer to [Metal Panel Bonding](#) for proper adhesive applicator preparations and general information.

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove the door from the vehicle. Refer to [Front Side Door Replacement](#) .
4. Remove the outer door handle.
5. Remove the outside rearview mirror.

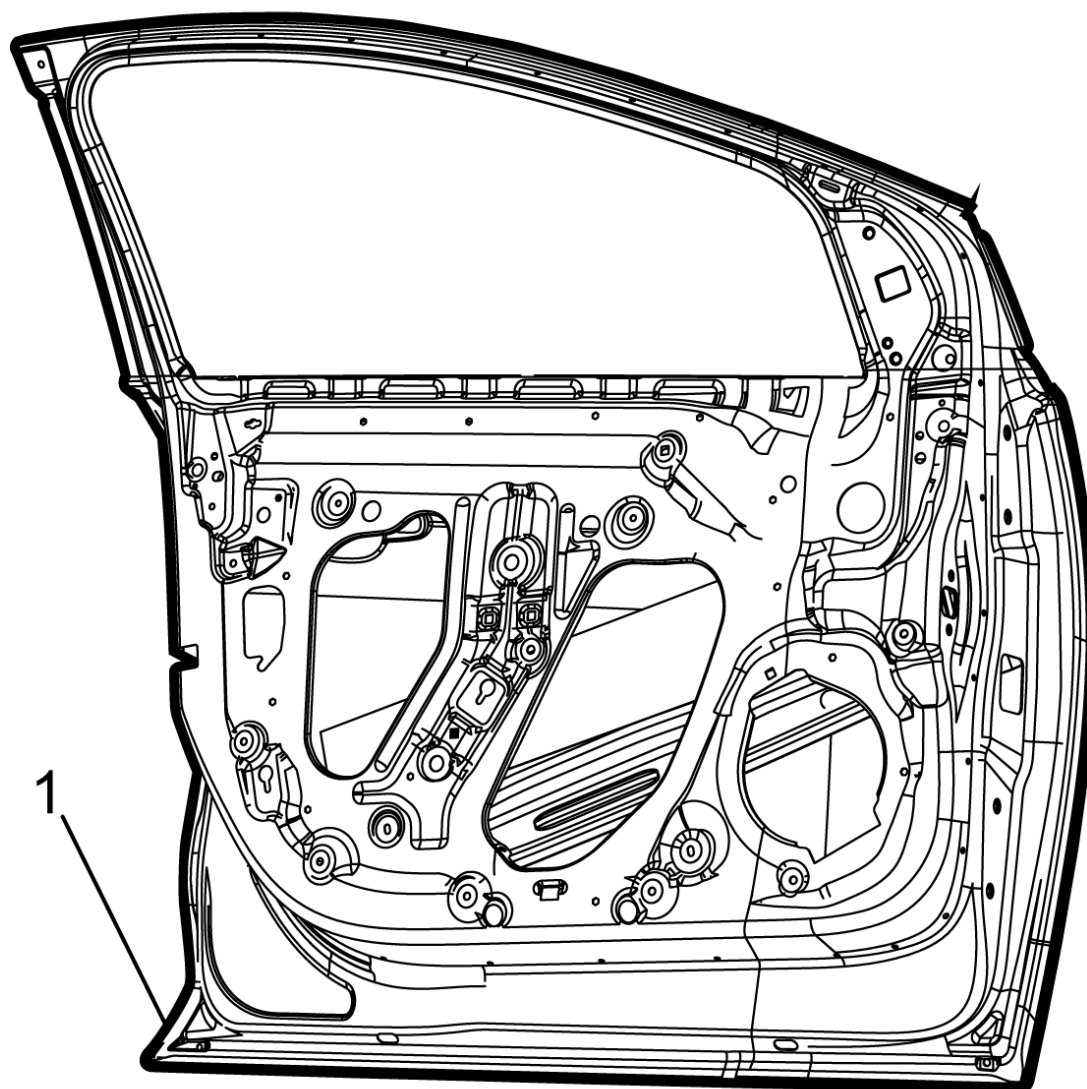


Fig. 122: Door Shell

Courtesy of GENERAL MOTORS COMPANY

6. Grind the edges of the door outer panel to separate the outer door panel from the door shell (1).

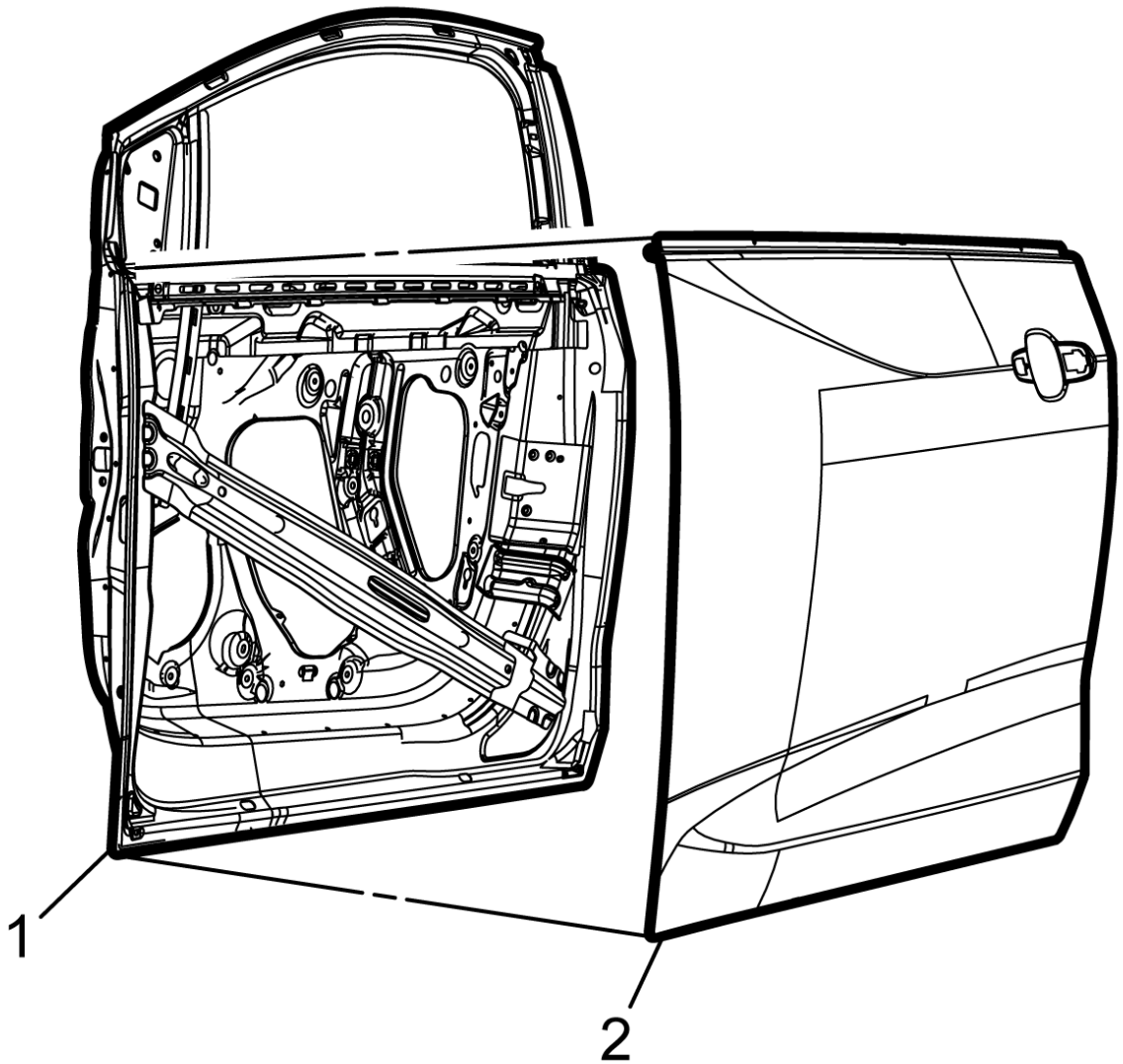


Fig. 123: Outer Door Panel And Door Shell

Courtesy of GENERAL MOTORS COMPANY

WARNING: Inspection of the door guard beam for damage must be performed before replacement of the door outer panel. If damage to the door guard beam is found the door must be replaced. Failure to do so may compromise the structural integrity of the vehicle and may cause personal injury if the vehicle is involved in a collision.

7. Remove the outer door panel (2) from the door shell (1).
8. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

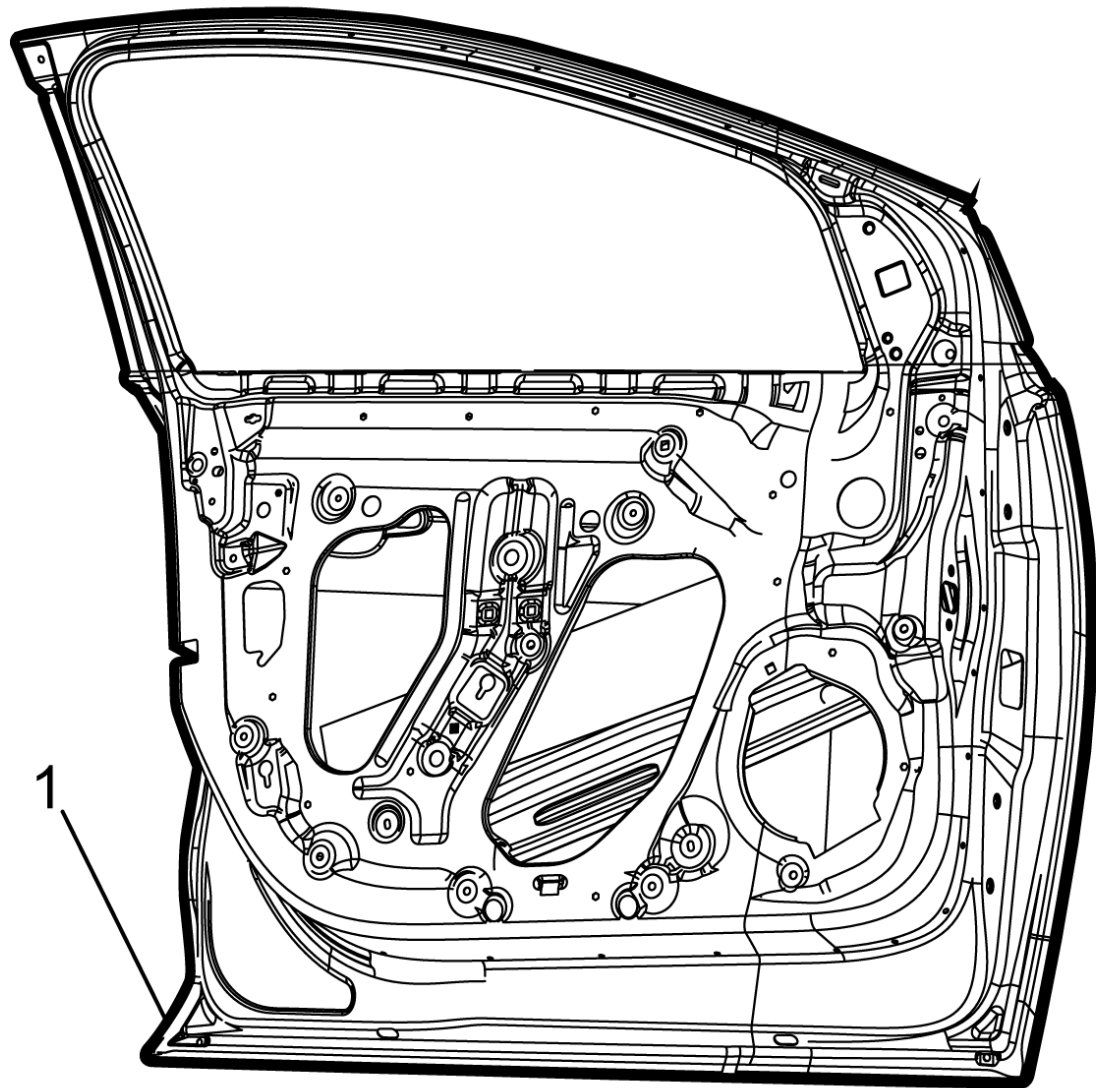


Fig. 124: Door Shell

Courtesy of GENERAL MOTORS COMPANY

9. Straighten the edges of the door shell (1).

Installation Procedure

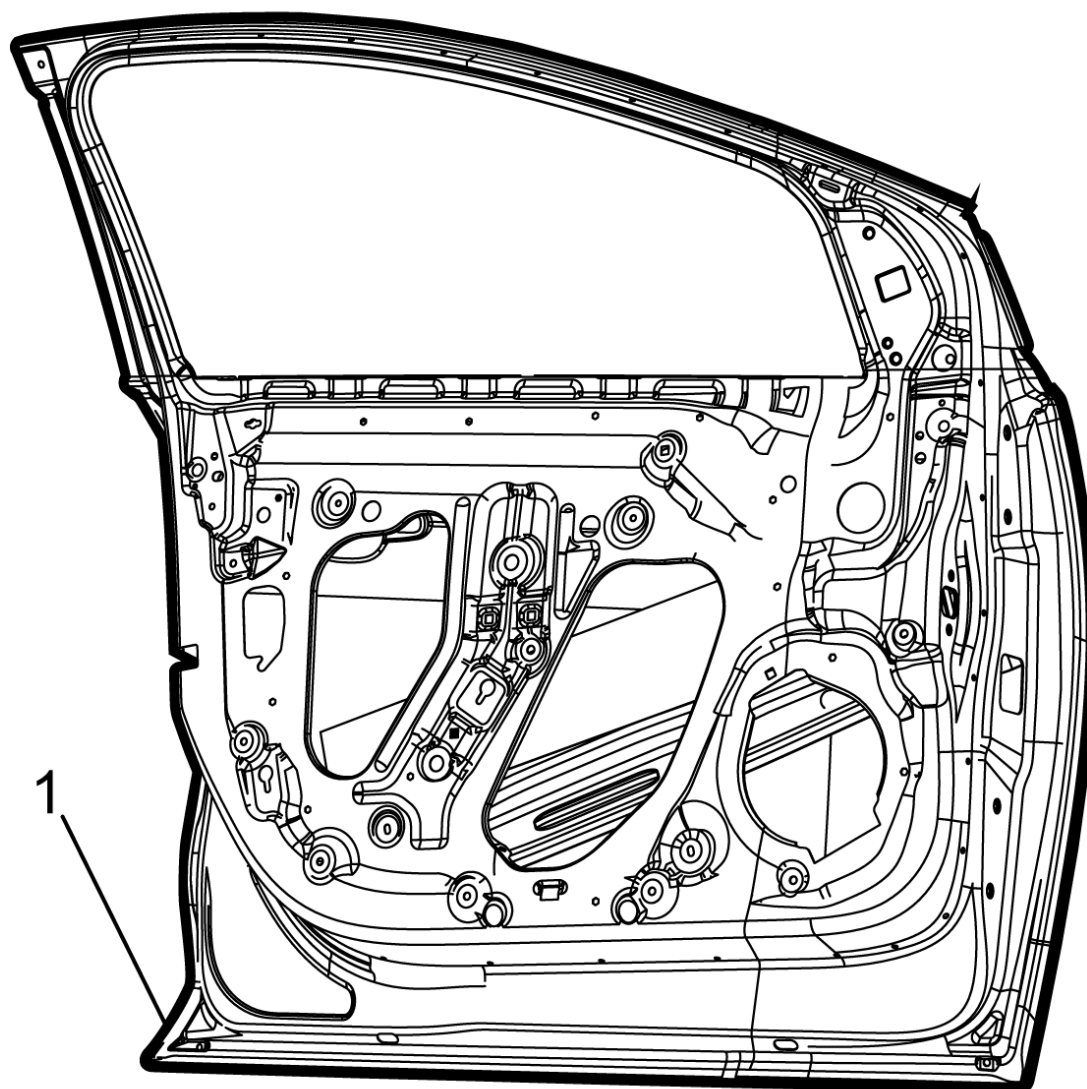


Fig. 125: Door Shell

Courtesy of GENERAL MOTORS COMPANY

1. Using a grinding disk grind the surface of the door shell (1) mating flanges to bare steel.

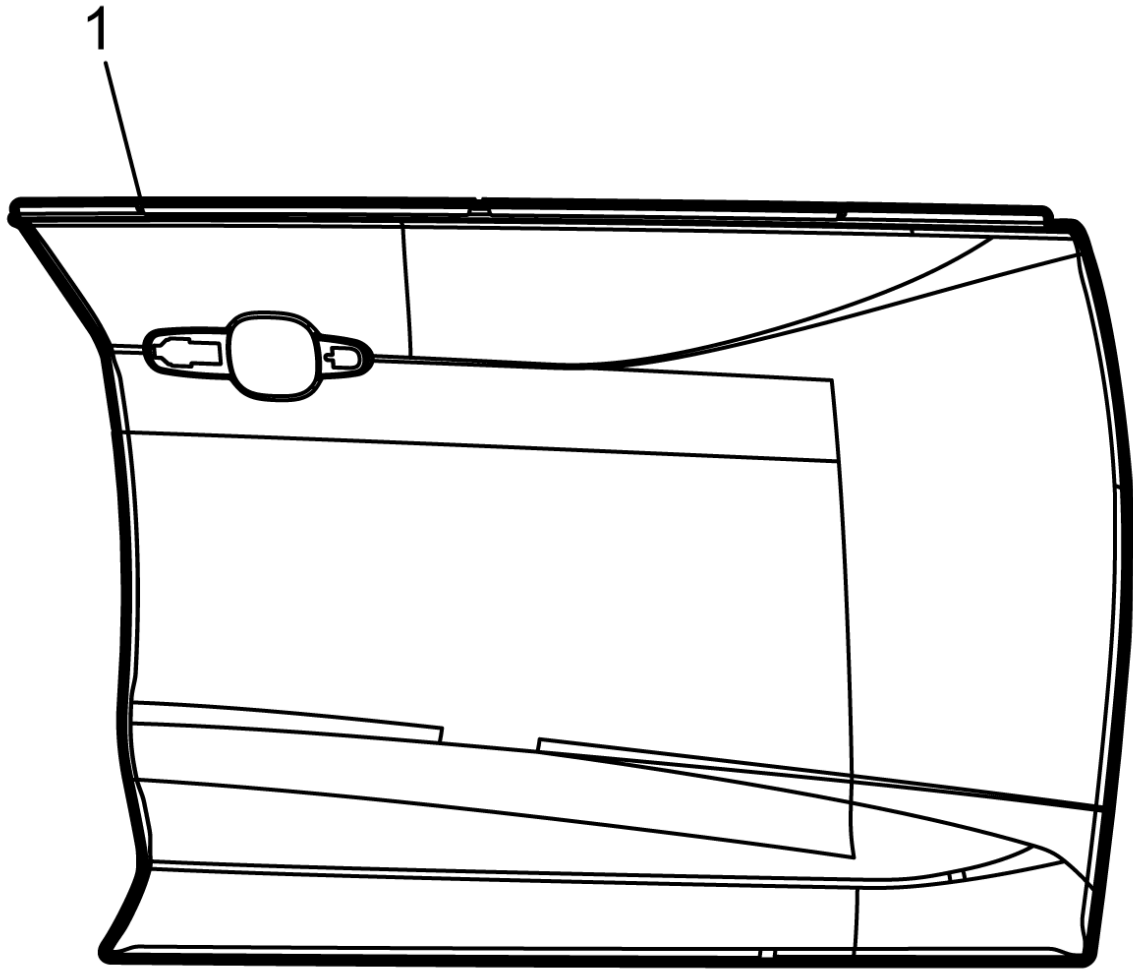


Fig. 126: Door Outer Panel

Courtesy of GENERAL MOTORS COMPANY

2. Scuff the opposing mating surfaces of the door outer panel (1) to remove the gloss of the E-Coat.
3. Clean the mating surfaces.

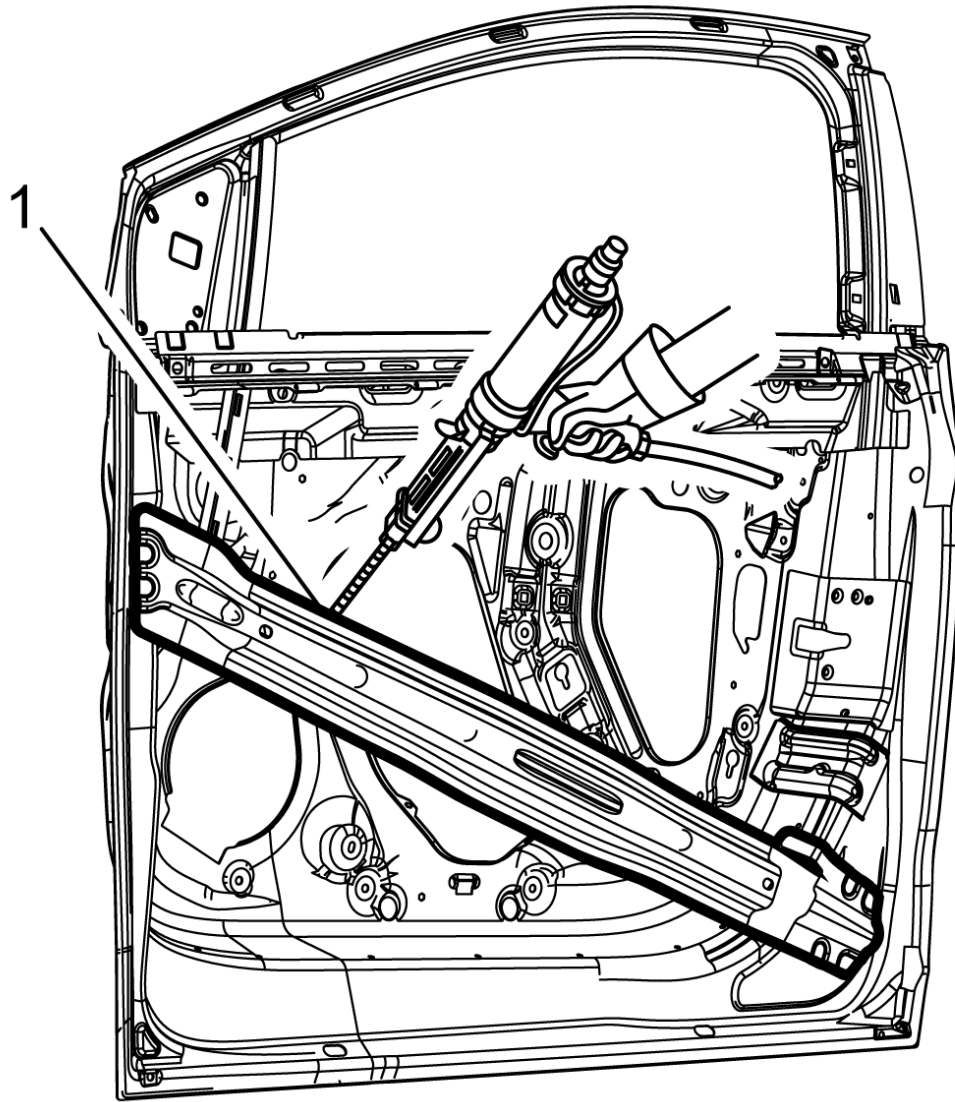


Fig. 127: Apply Anti-Flutter Foam On Inner Safety Beam

Courtesy of GENERAL MOTORS COMPANY

4. Apply anti-flutter foam-slow set 40 - 50 minute working time, or equivalent, in 4 - 6 evenly spaced on the inner safety beam (1).

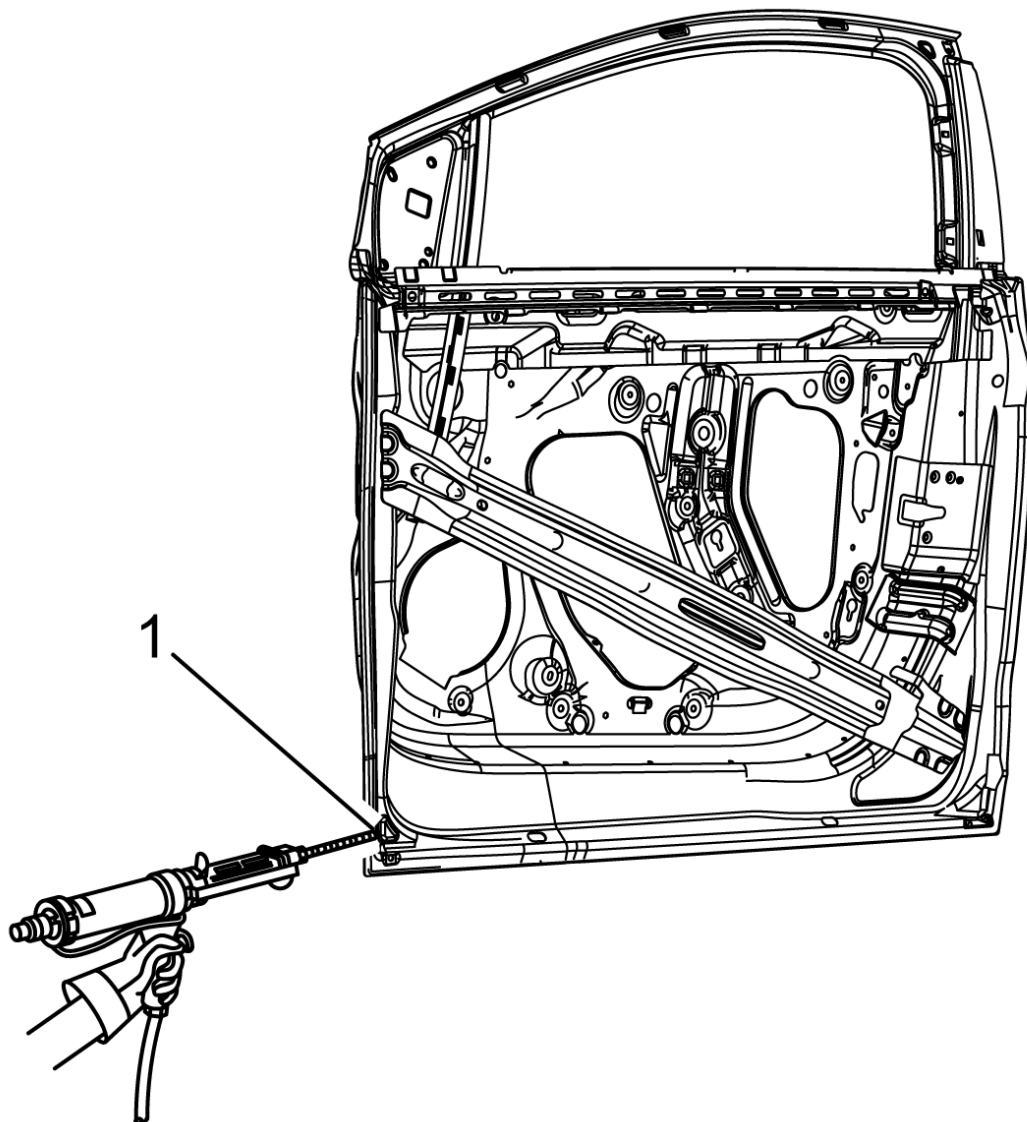


Fig. 128: Apply Bead Of Metal Panel Bonding Adhesive To Mating Surfaces
Courtesy of GENERAL MOTORS COMPANY

NOTE: The adhesive has a 40 - 50 minute working time. Do not allow the door to totally cure off the vehicle, as proper alignment of the door outer panel to the door shell will be difficult.

5. Apply a 3 - 6 mm (1/8 - 1/4 in) bead of metal panel bonding adhesive **Metal Panel Bonding**, to both of the mating surfaces.
6. Using a small acid brush, spread a coat of adhesive to cover all the bare metal surfaces to ensure corrosion protection.

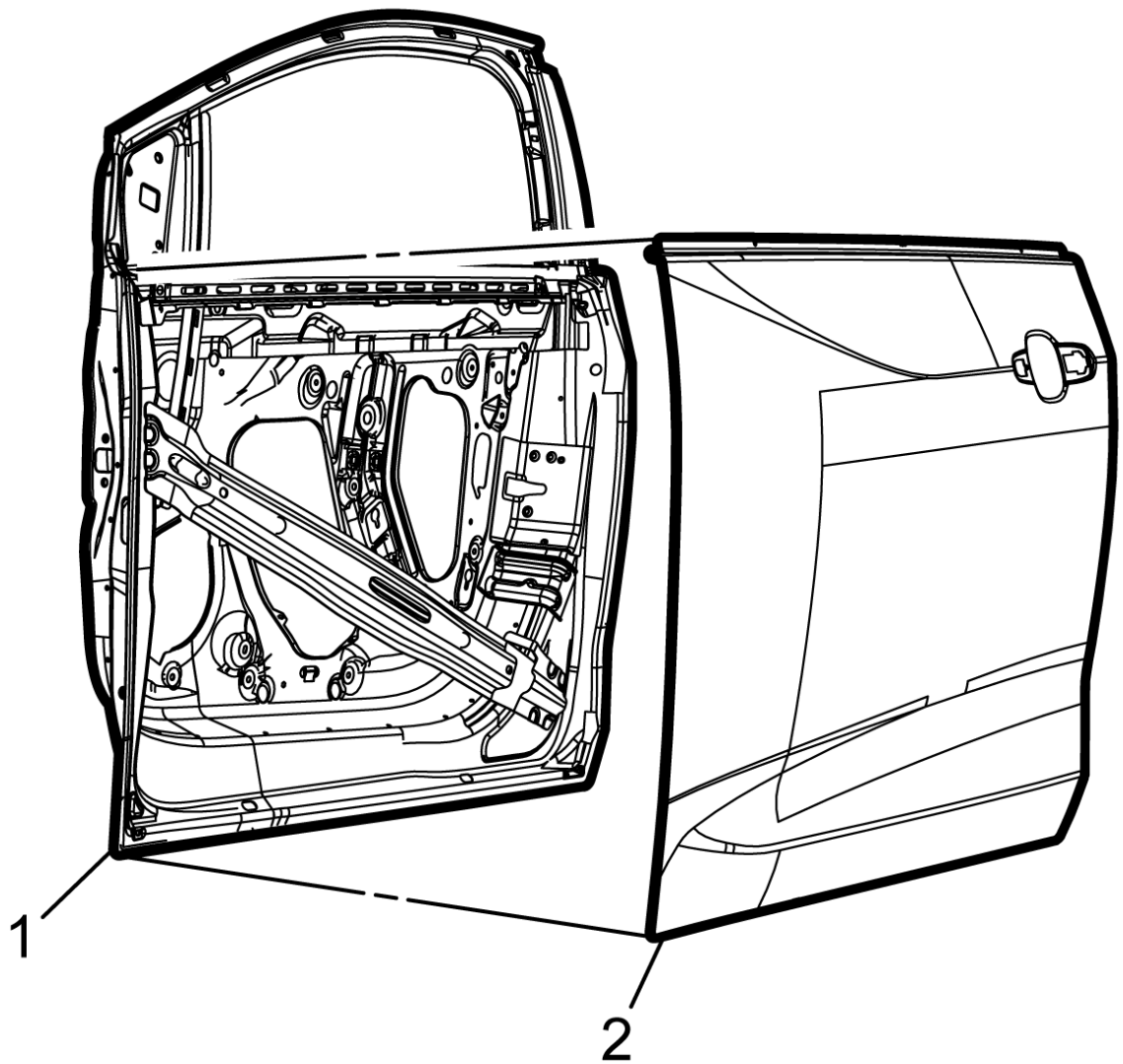


Fig. 129: Outer Door Panel And Door Shell

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT pull the panels apart after joined together. If necessary, slide the panels against each other to realign the panels.

7. Install the door outer panel (1) to the door shell (2).

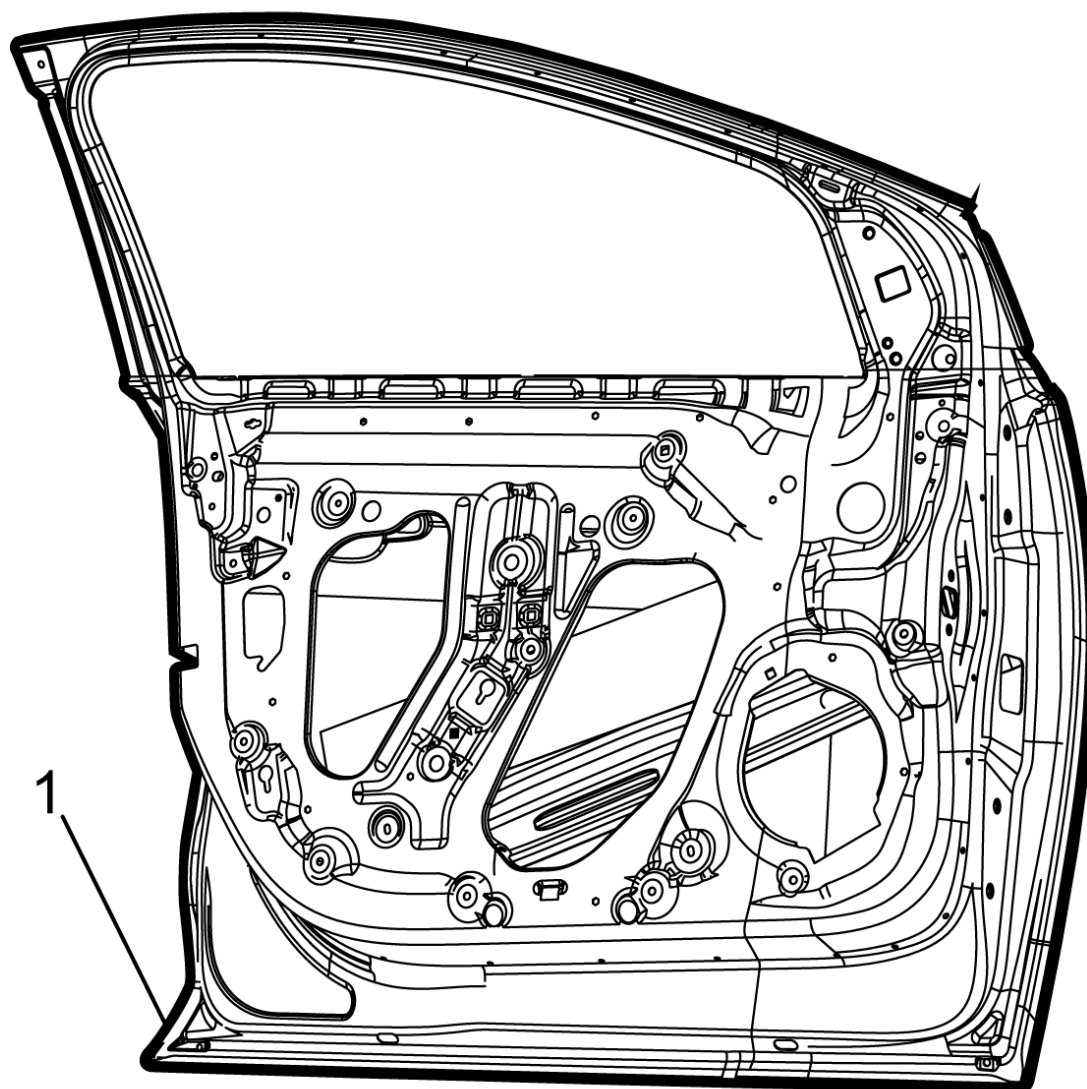


Fig. 130: Door Shell

Courtesy of GENERAL MOTORS COMPANY

8. Clamp the door outer panel into position, as required.
9. Using a hammer, re-hem the hem flanges around the door shell (1). Continue to hammer in stages along the hem flanges.
10. Using lacquer thinner remove the excess adhesive from the door panel area.
11. Install the door to the vehicle. Inspect the door outer panel for proper alignment. Adjust the alignment, as required. Refer to [**Front Side Door Replacement**](#) .
12. Clean and prepare all welded surfaces.
13. Apply sealers and anti-corrosion materials to the repair area, as necessary. Refer to [**Anti-Corrosion Treatment and Repair**](#) .
14. Paint the repaired area. Refer to [**Basecoat/Clearcoat Paint Systems**](#) .
15. Install the outer door handle.
16. Install the outside rearview mirror.
17. Install the door to the vehicle. Refer to [**Front Side Door Replacement**](#) .
18. Enable the SIR system. Refer to [**SIR Disabling and Enabling**](#) .

19. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#) .

REAR SIDE DOOR OUTER PANEL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

NOTE: Before beginning the repair, refer to [Metal Panel Bonding](#) for proper adhesive applicator preparations and general information.

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove the door from the vehicle. Refer to [Rear Side Door Replacement](#) .
4. Remove the outer door handle.

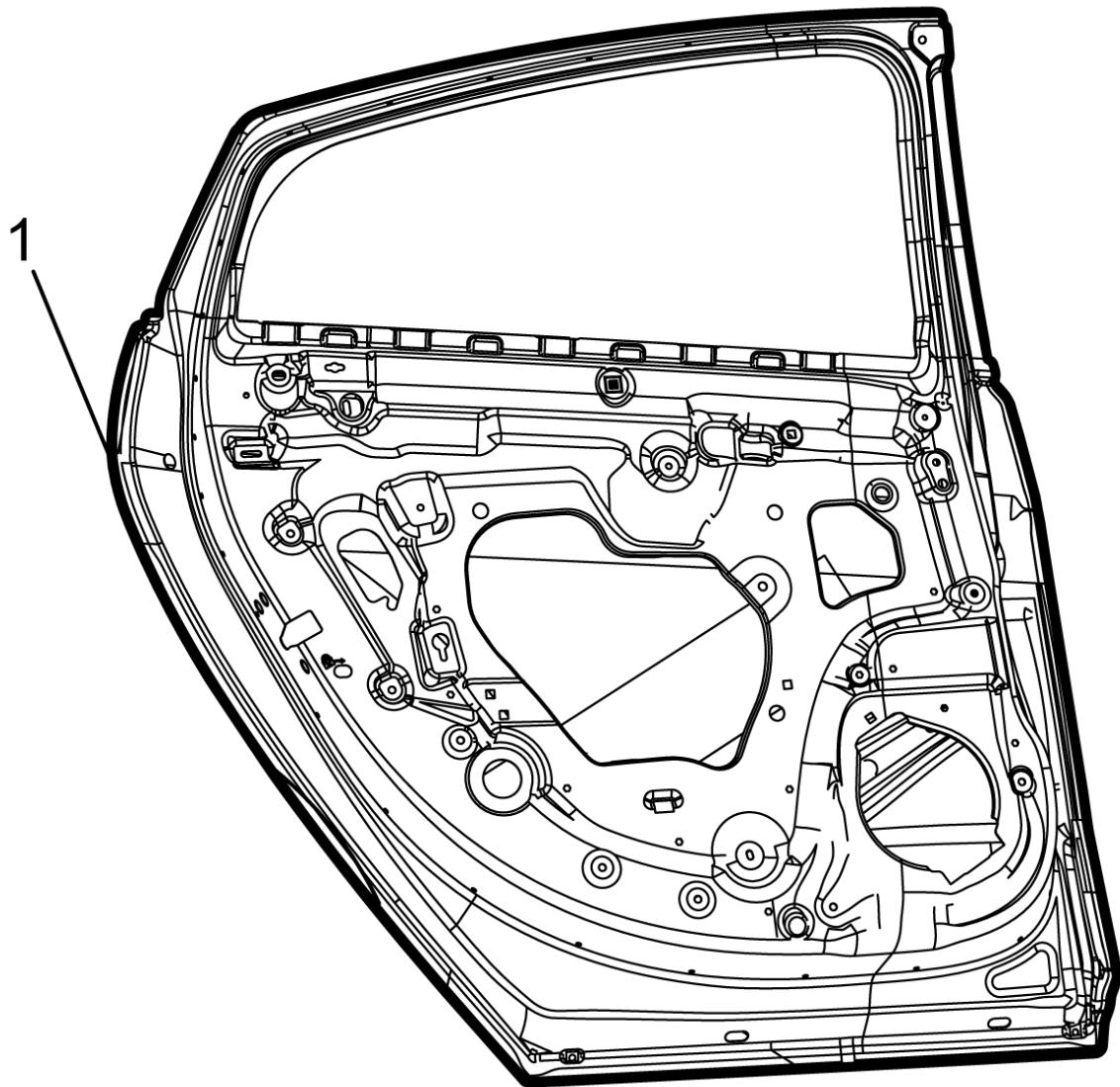


Fig. 131: Door Shell

Courtesy of GENERAL MOTORS COMPANY

5. Grind the edges of the door outer panel to separate the outer door panel from the door shell (1).

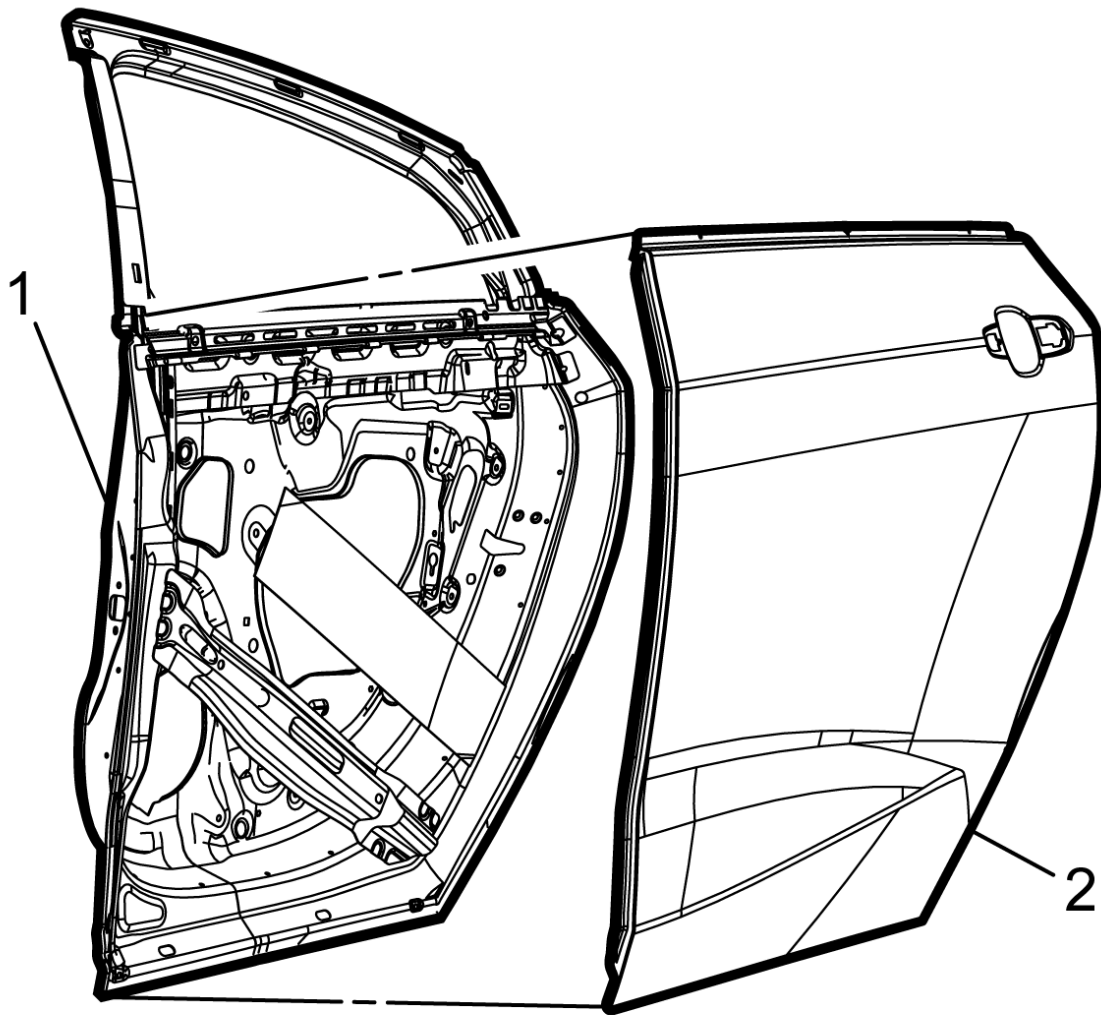


Fig. 132: Outer Door Panel And Door Shell

Courtesy of GENERAL MOTORS COMPANY

WARNING: Inspection of the door guard beam for damage must be performed before replacement of the door outer panel. If damage to the door guard beam is found the door must be replaced. Failure to do so may compromise the structural integrity of the vehicle and may cause personal injury if the vehicle is involved in a collision.

6. Remove the outer door panel (2) from the door shell (1).
7. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

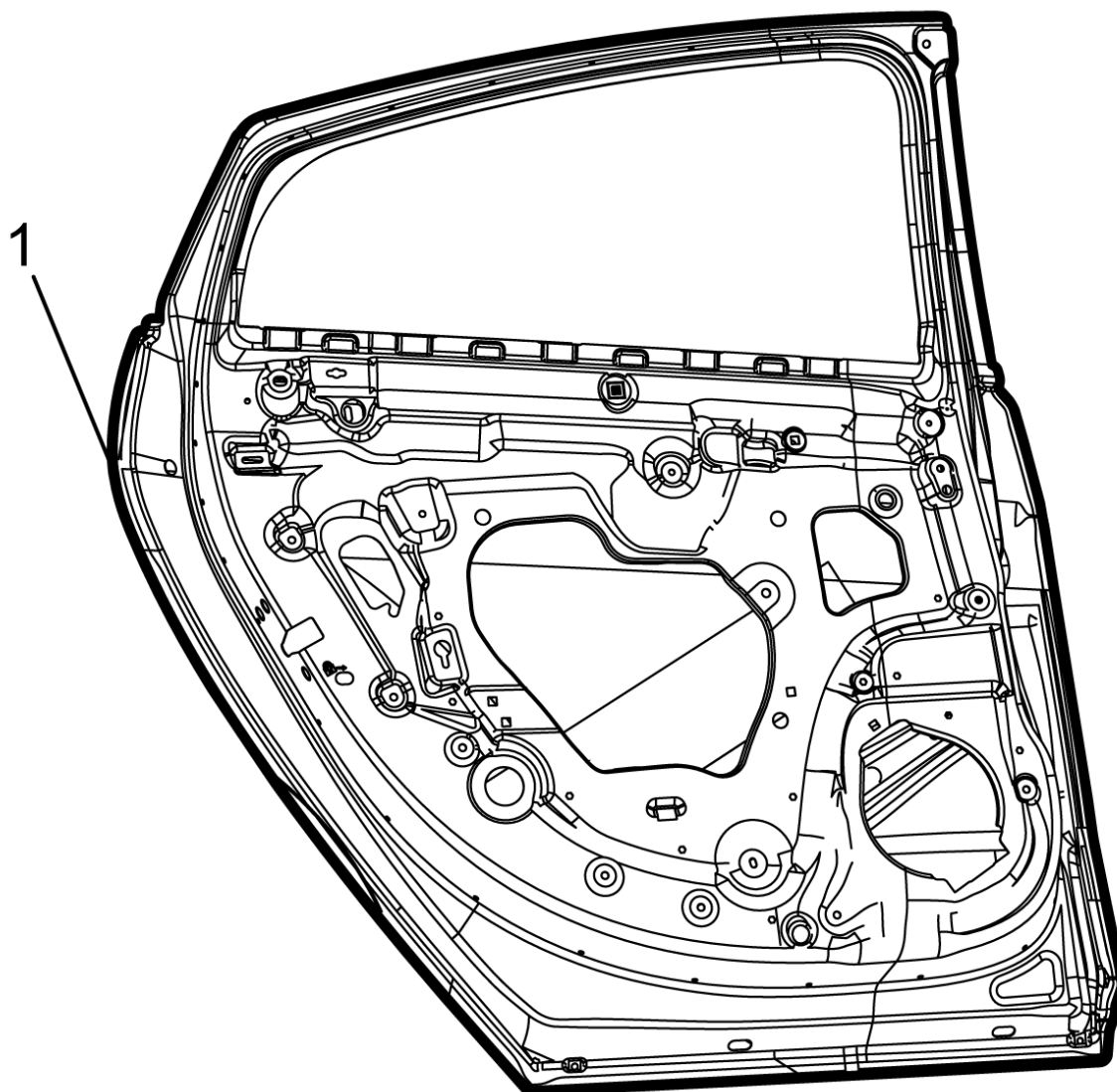


Fig. 133: Door Shell

Courtesy of GENERAL MOTORS COMPANY

8. Straighten the edges of the door shell (1).

Installation Procedure

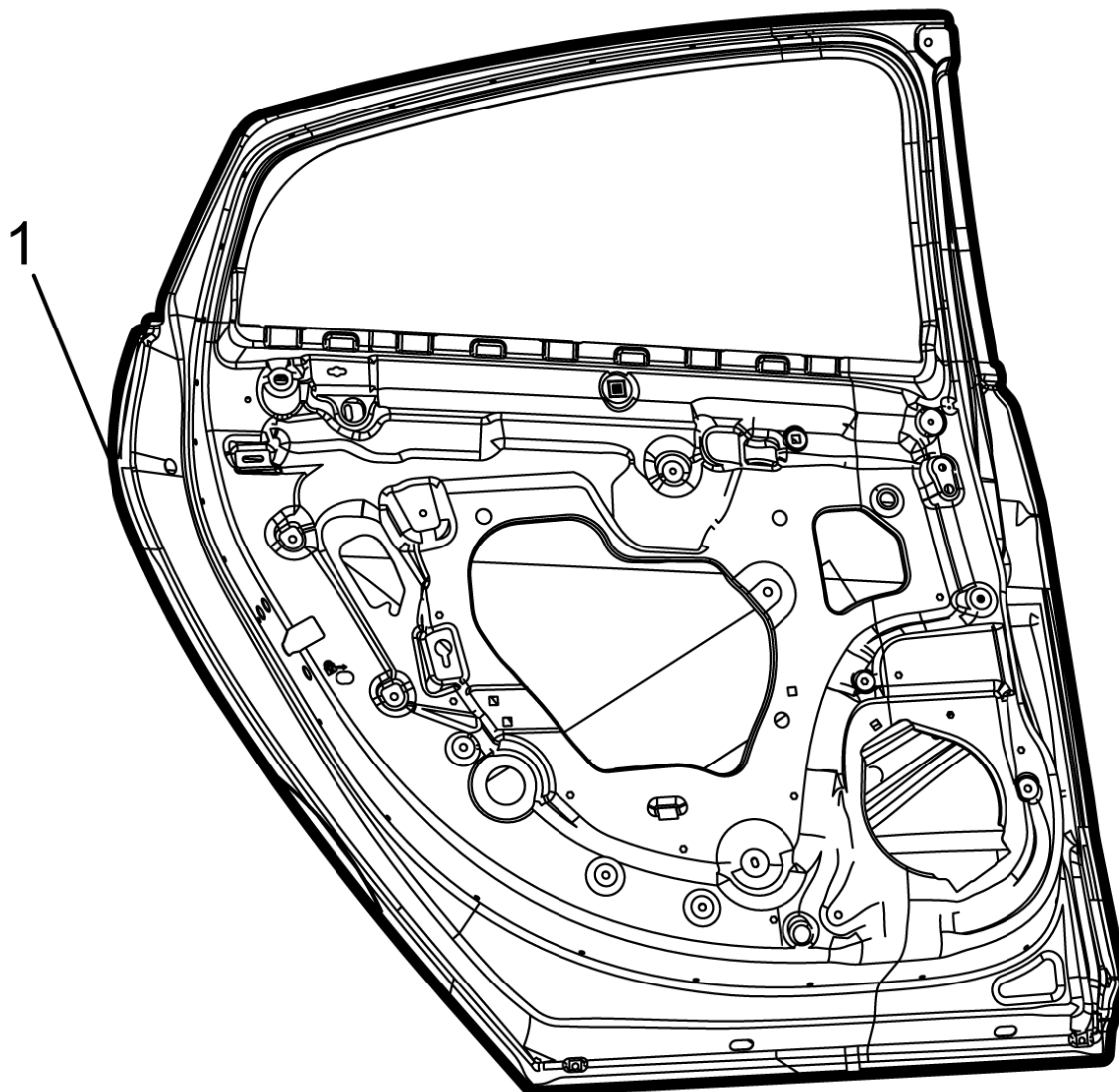


Fig. 134: Door Shell

Courtesy of GENERAL MOTORS COMPANY

1. Using a grinding disk grind the surface of the door shell (1) mating flanges to bare steel.

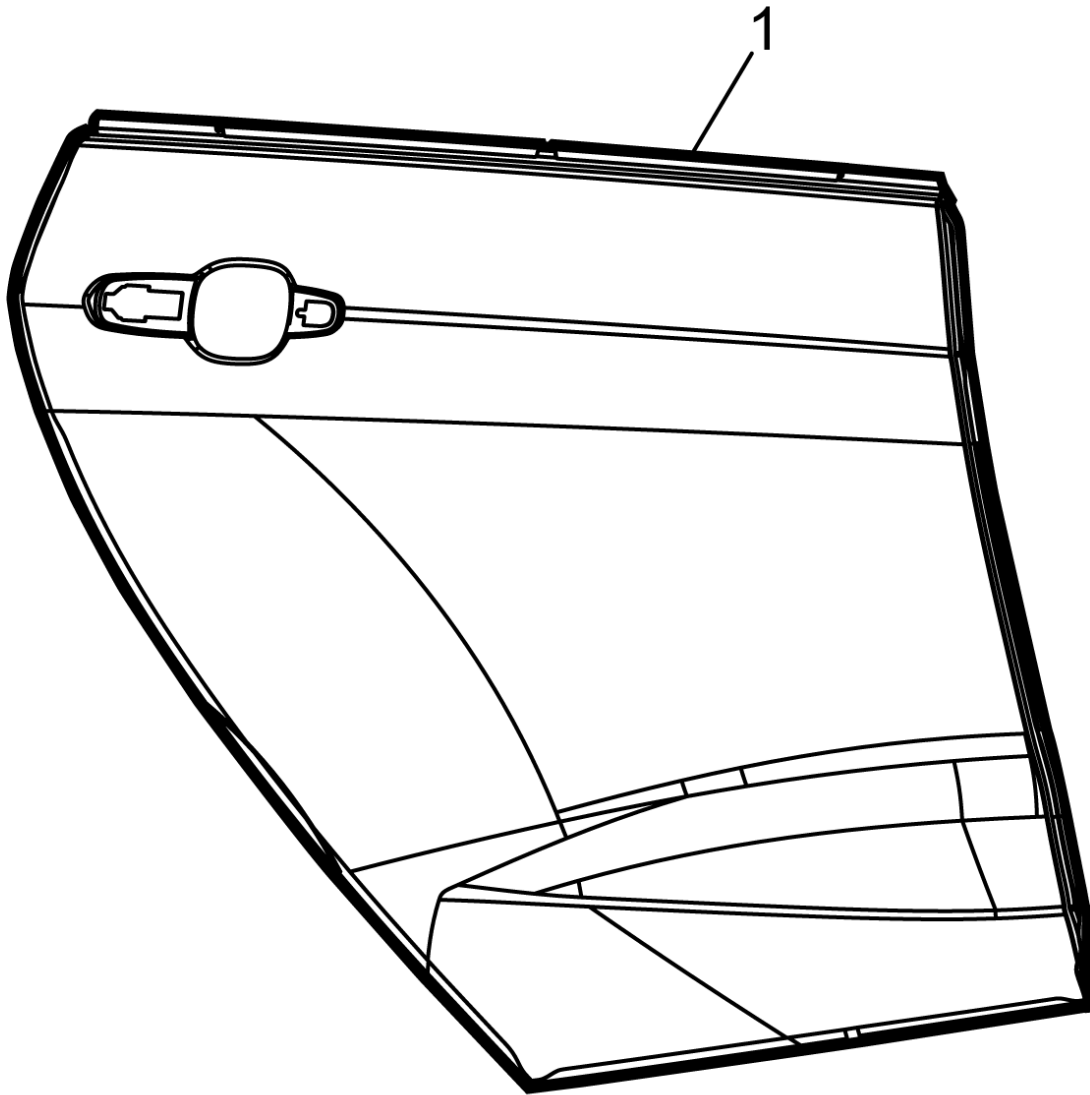


Fig. 135: Door Outer Panel

Courtesy of GENERAL MOTORS COMPANY

2. Scuff the opposing mating surfaces of the door outer panel (1) to remove the gloss of the E-Coat.
3. Clean the mating surfaces.

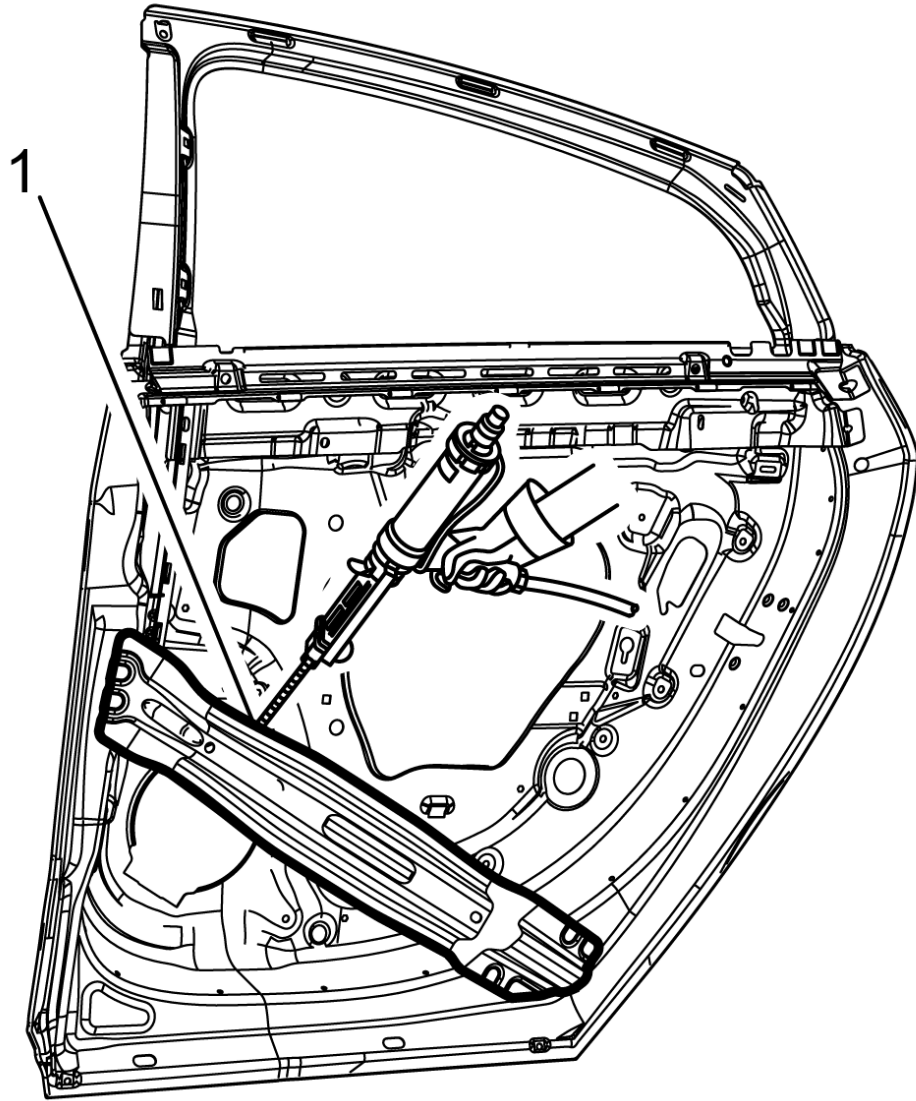


Fig. 136: Apply Anti-Flutter Foam To Inner Safety Beam

Courtesy of GENERAL MOTORS COMPANY

4. Apply anti-flutter foam-slow set 40 - 50 minute working time, or equivalent, in 4 - 6 evenly spaced on the inner safety beam (1).

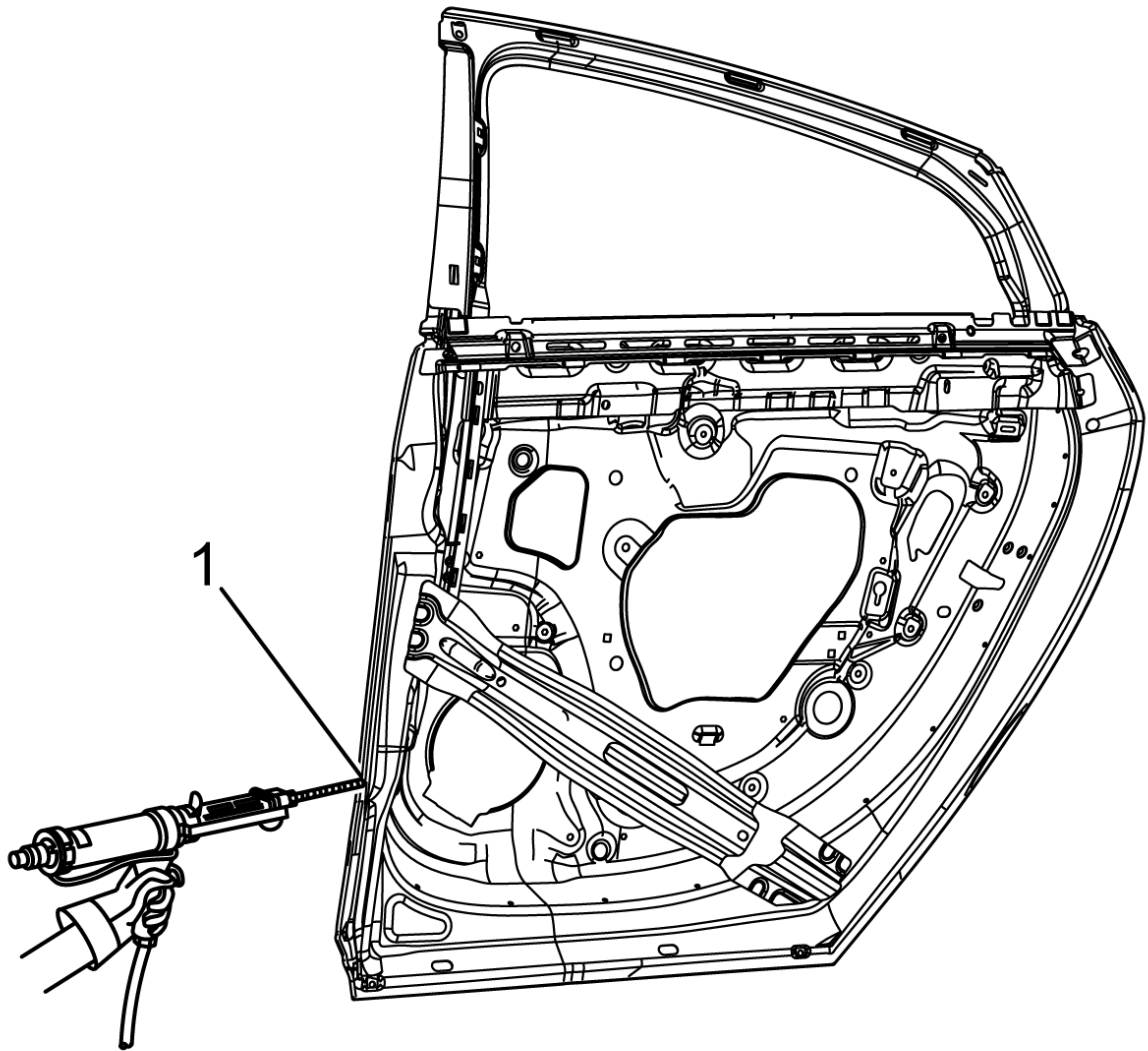


Fig. 137: Apply Bead Of Metal Panel Bonding Adhesive To Mating Surfaces

Courtesy of GENERAL MOTORS COMPANY

NOTE: The adhesive has a 40 - 50 minute working time. Do not allow the door to totally cure off the vehicle, as proper alignment of the door outer panel to the door shell will be difficult.

5. Apply a 3 - 6 mm (1/8 - 1/4 in) bead of metal panel bonding adhesive **Metal Panel Bonding**, to both of the mating surfaces.
6. Using a small acid brush, spread a coat of adhesive to cover all the bare metal surfaces to ensure corrosion protection.

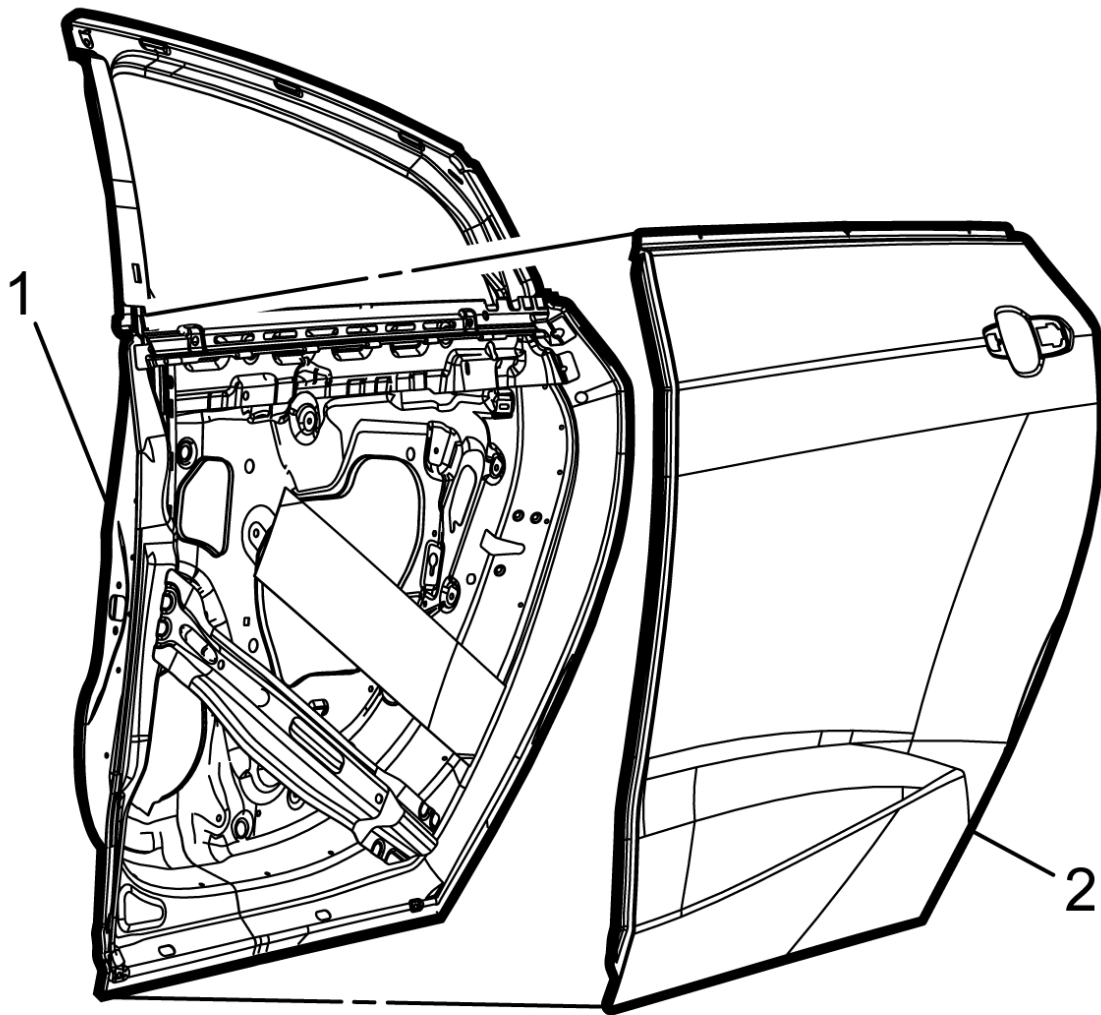


Fig. 138: Outer Door Panel And Door Shell

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT pull the panels apart after joined together. If necessary, slide the panels against each other to realign the panels.

7. Install the door outer panel (2) to the door shell (1).

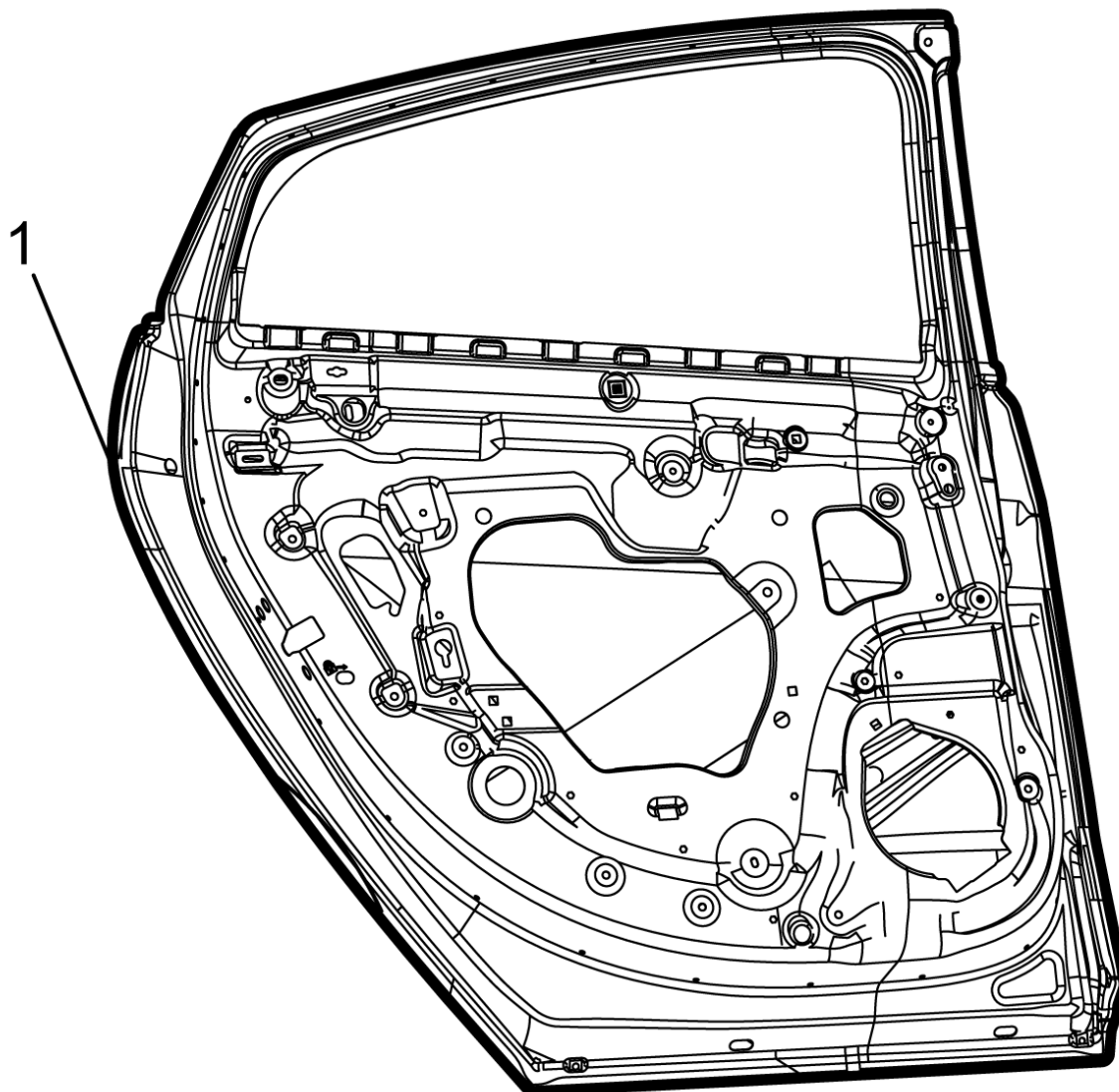


Fig. 139: Door Shell

Courtesy of GENERAL MOTORS COMPANY

8. Clamp the door outer panel into position, as required.
9. Using a hammer, re-hem the hem flanges around the door shell (1). Continue to hammer in stages along the hem flanges.
10. Using lacquer thinner remove the excess adhesive from the door panel area.
11. Install the door to the vehicle. Inspect the door outer panel for proper alignment. Adjust the alignment, as required. Refer to [Rear Side Door Replacement](#) .
12. Clean and prepare all welded surfaces.
13. Apply sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
14. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
15. Install the outer door handle.
16. Install the door to the vehicle. Refer to [Front Side Door Replacement](#) .
17. Enable the SIR system. Refer to [SIR Disabling and Enabling](#) .
18. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#) .

ROOF SIDE RAIL REINFORCEMENT REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: There are sectioning procedures available for various locations of the body side outer panel. The sectioning procedure and location should be chosen based on the extent of damage to the vehicle and any additional inner reinforcements that need to be replaced. Refer to the body side outer panel sectioning procedures for the specific location where sectioning is required.

NOTE: The roof side rail reinforcement is a High strength low alloy steel. [High Strength Low Alloy Steel](#).

NOTE: Left shown right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the damage. Repair as much of the damage as possible.
5. Remove the sealers and anti-corrosion materials from the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

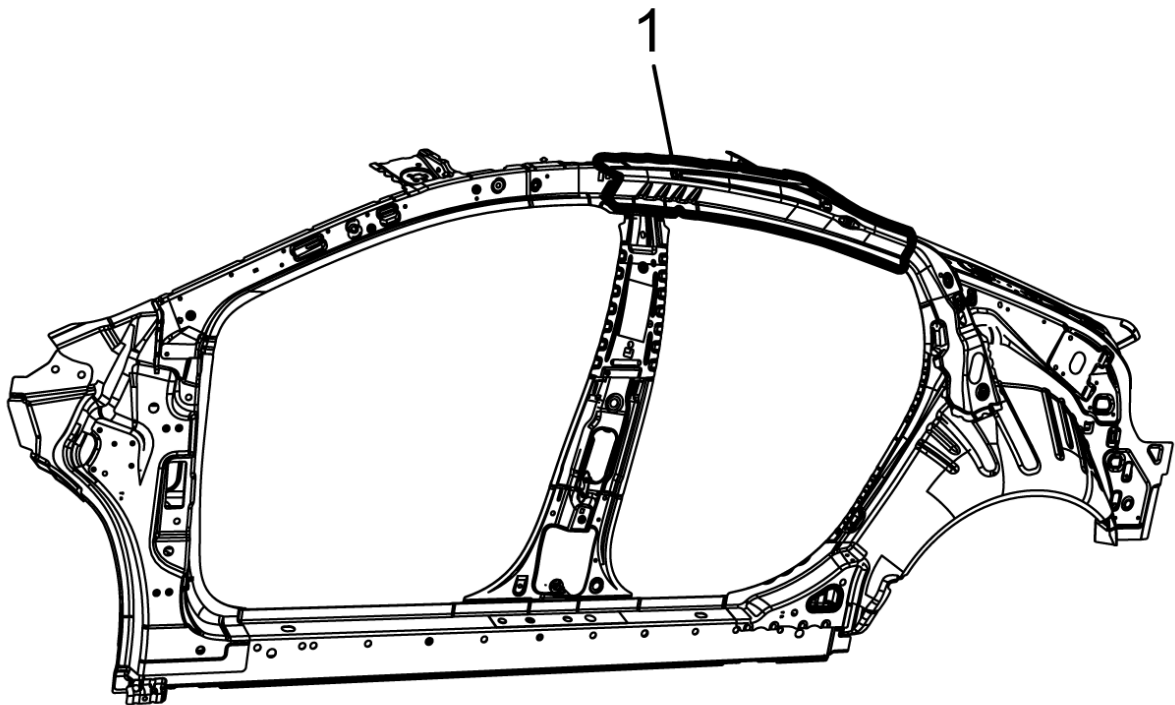


Fig. 140: Roof Side Rail Reinforcement

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the roof side rail reinforcement (1).

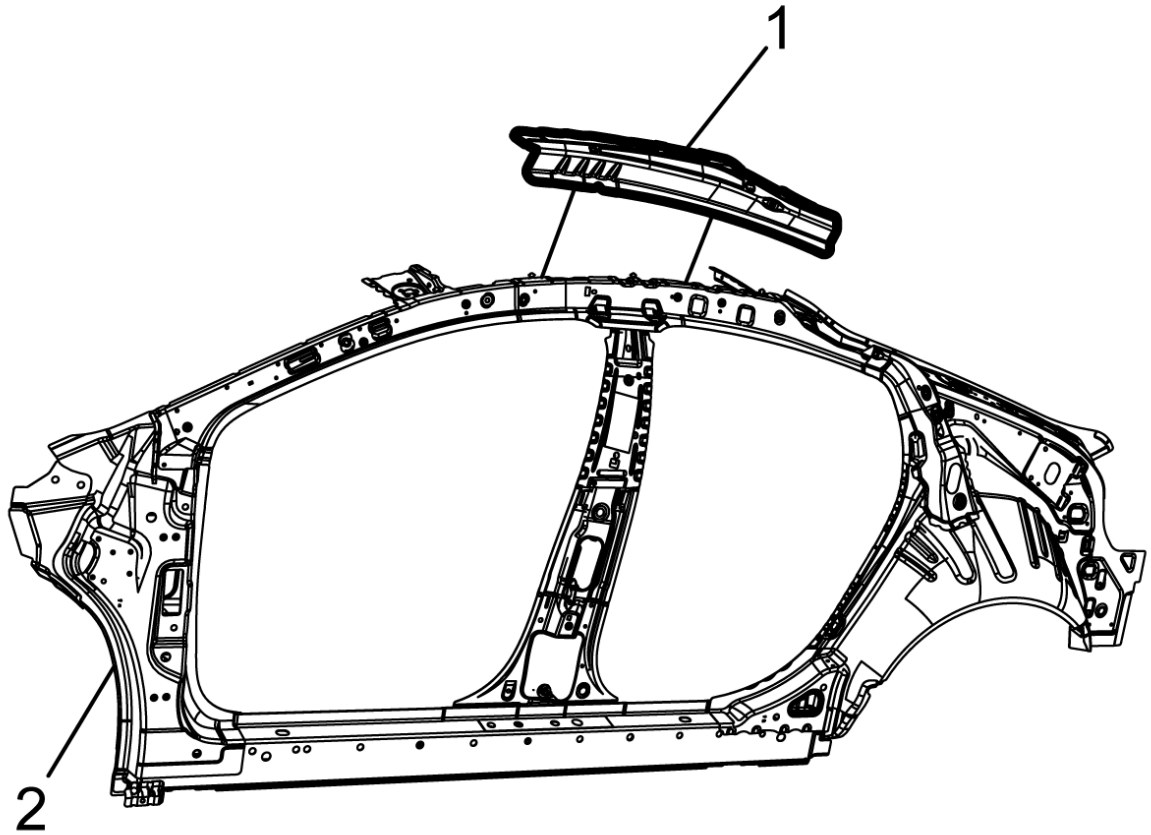


Fig. 141: Roof Side Rail Reinforcement

Courtesy of GENERAL MOTORS COMPANY

7. Remove the roof side rail reinforcement (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

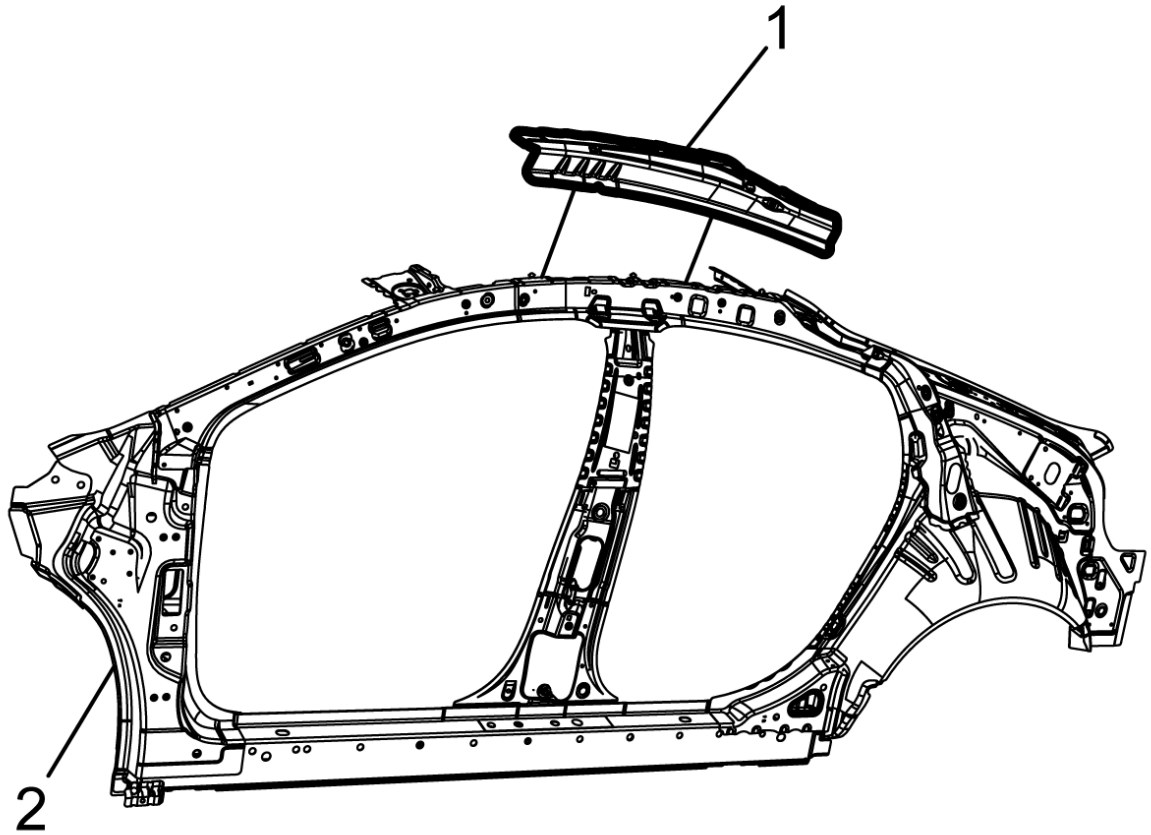


Fig. 142: Roof Side Rail Reinforcement

Courtesy of GENERAL MOTORS COMPANY

2. Position the roof side rail reinforcement (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the roof side rail reinforcement (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding**

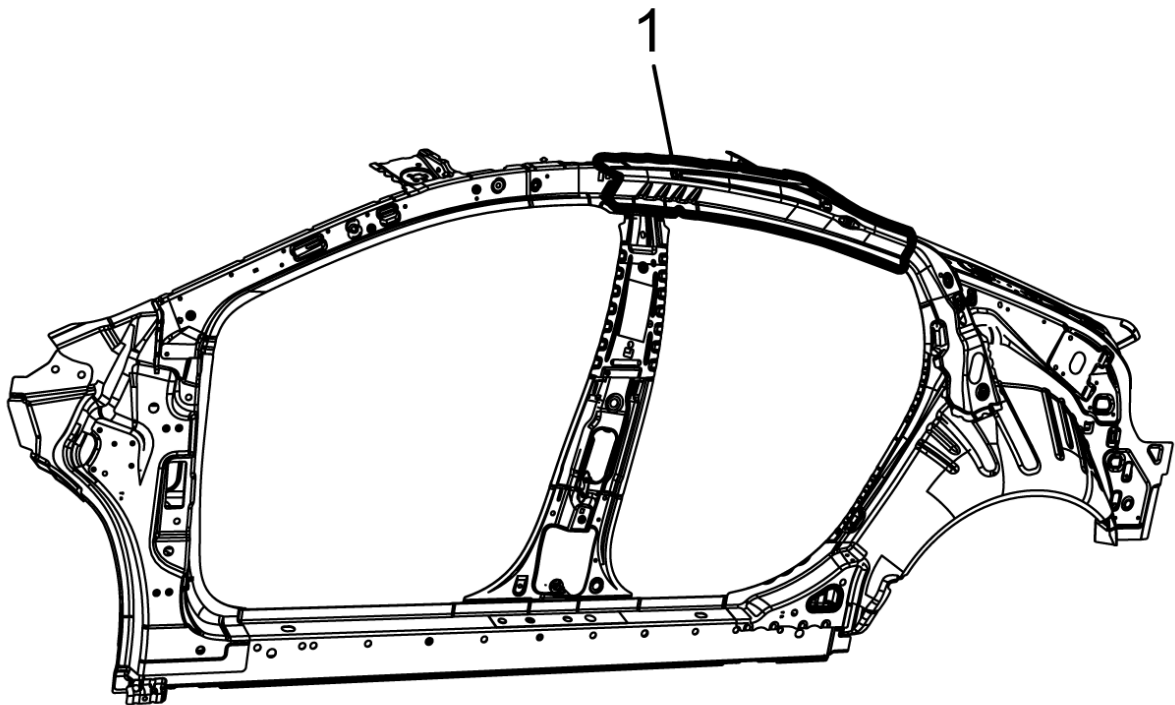


Fig. 143: Roof Side Rail Reinforcement

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the roof side rail reinforcement (1) into position.
6. Weld the roof side rail reinforcement (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .

NOTE: Before refinishing, refer to [Adhesive Installation of Windshields](#) , and [Adhesive Installation of Liftgate Windows](#) .

8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

REAR RAIL REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown, right similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications. [Dimensions - Body](#).
5. Note the location and remove the sealers and anti-corrosion materials from the repair area. [Anti-Corrosion Treatment and Repair](#) .

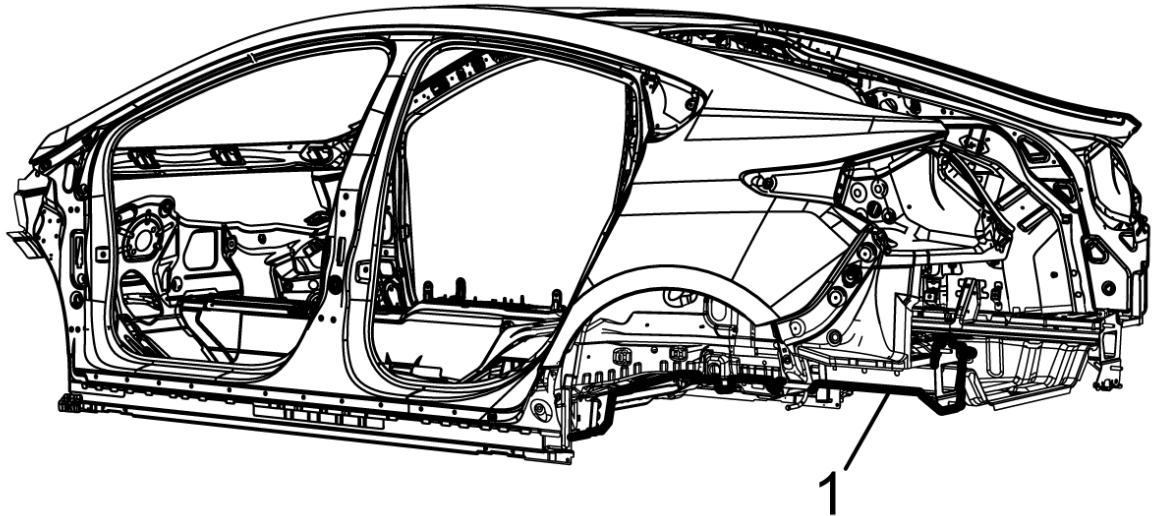


Fig. 144: Rear Rail

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements.

6. Locate and remove out all factory welds. Note the number and location of the welds for installation of the rear rail (1).

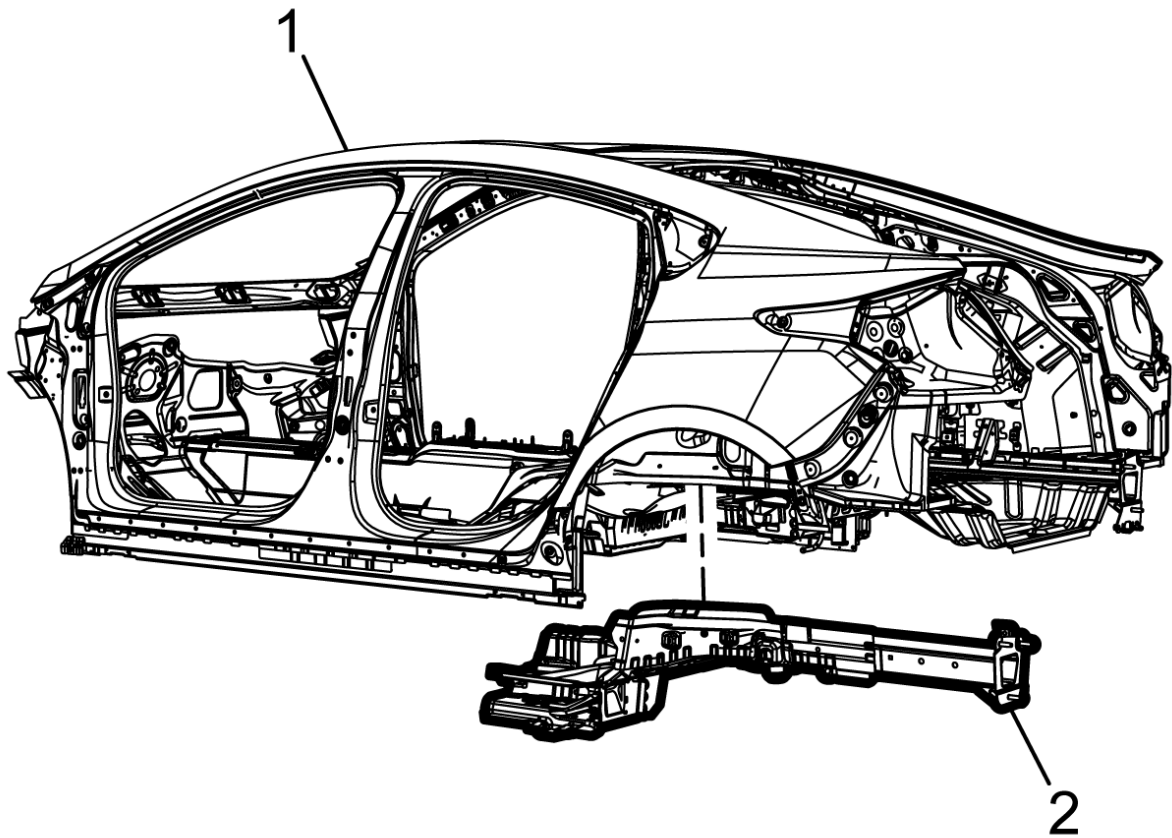


Fig. 145: Rear Rail

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear rail (2) from the vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

NOTE: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1 1/2 in) apart.

1. Drill 8 mm (5/16 in) plug weld holes in the service part front rail as necessary in the locations noted from

the original panel.

2. Prepare all mating surfaces as necessary.
3. Apply GM-approved Weld-Thru Coating or equivalent to all mating surfaces. [Anti-Corrosion Treatment and Repair](#) .

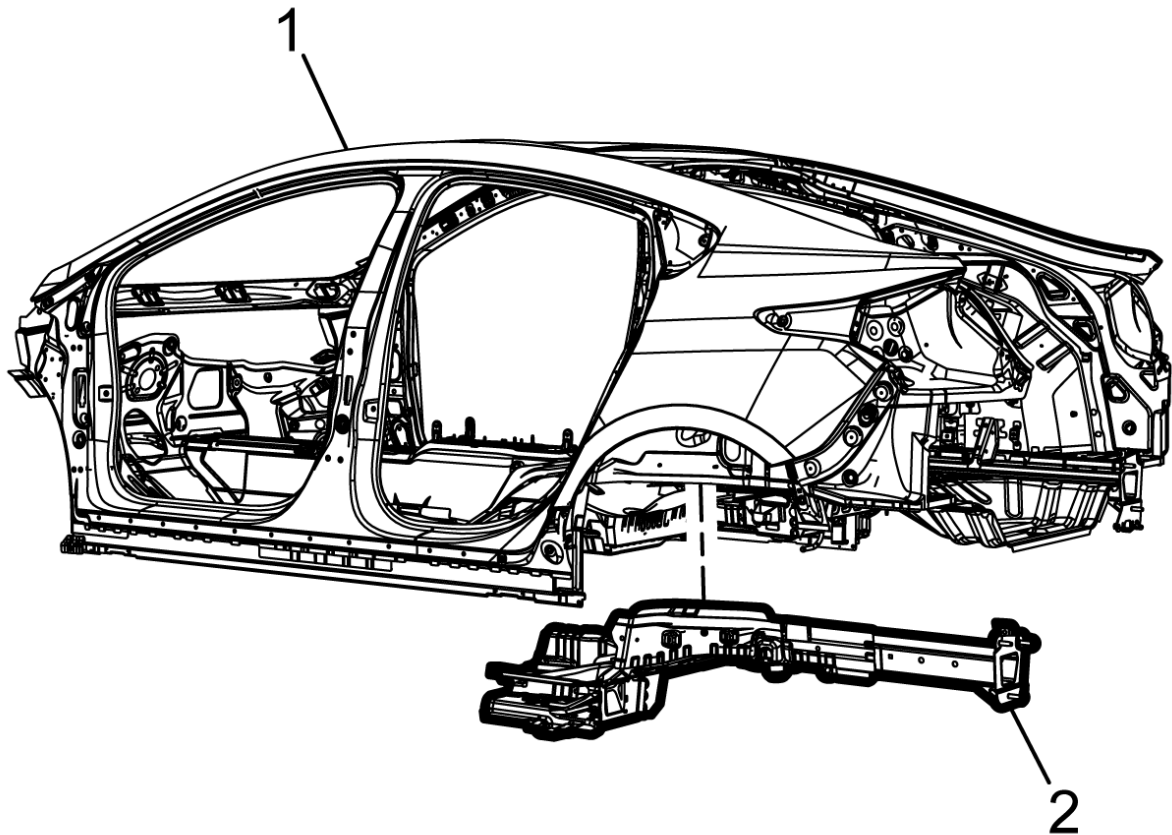


Fig. 146: Rear Rail

Courtesy of GENERAL MOTORS COMPANY

4. Position the rear rail (1) to the vehicle using 3-dimensional measuring equipment.
5. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#)
6. Clamp the rail into position.

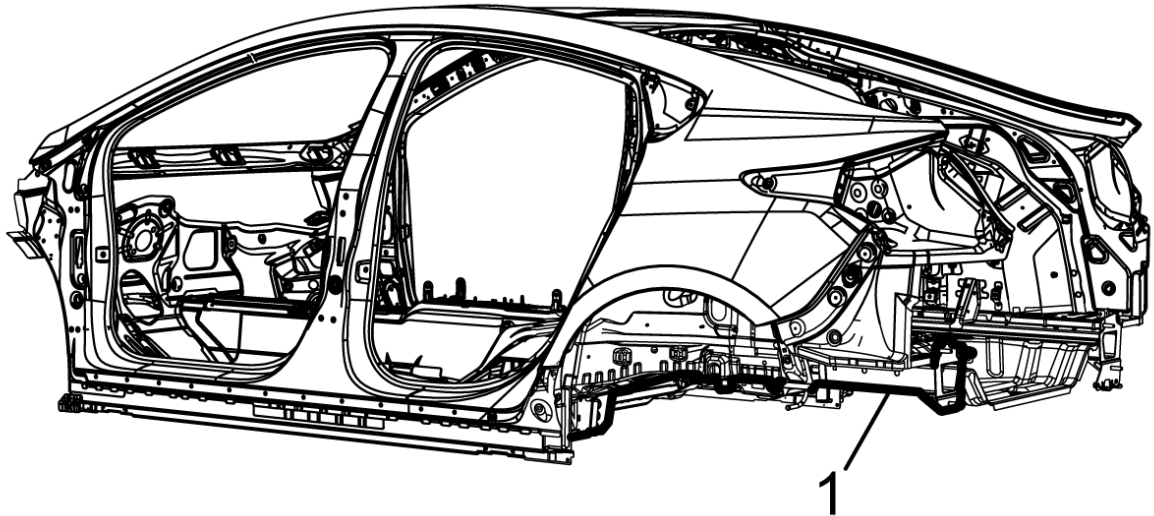


Fig. 147: Rear Rail

Courtesy of GENERAL MOTORS COMPANY

7. Weld the rear rail (1) accordingly.
8. Clean and prepare all welded surfaces.
9. Install all related panels and components.
10. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
11. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
12. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
13. Enable the SIR System. [SIR Disabling and Enabling](#) .

RAIL REPLACEMENT - REAR SECTION

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Right shown, left similar.

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .

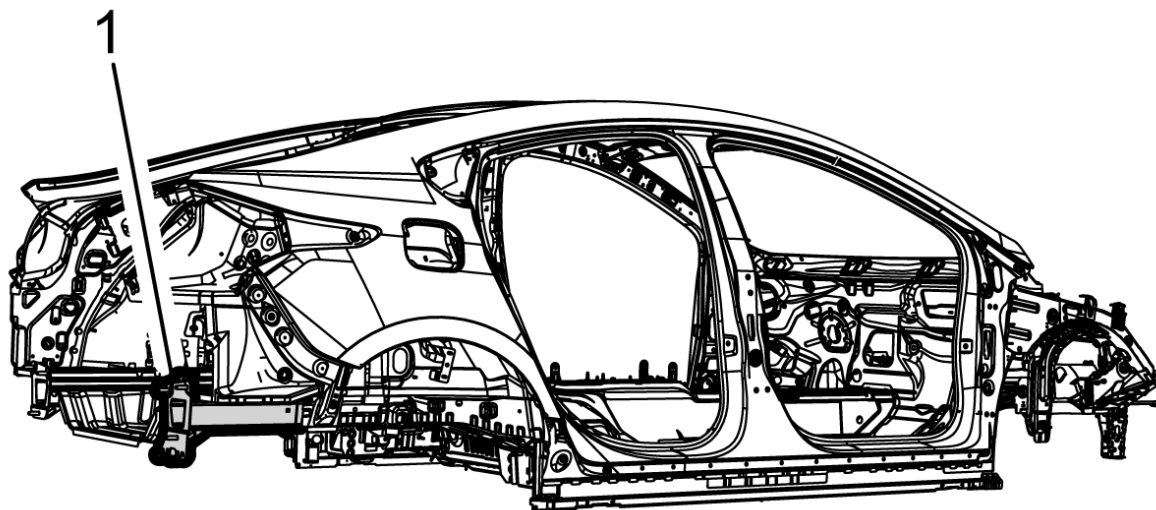


Fig. 148: Rear Rail Section

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from rear rail section (1).

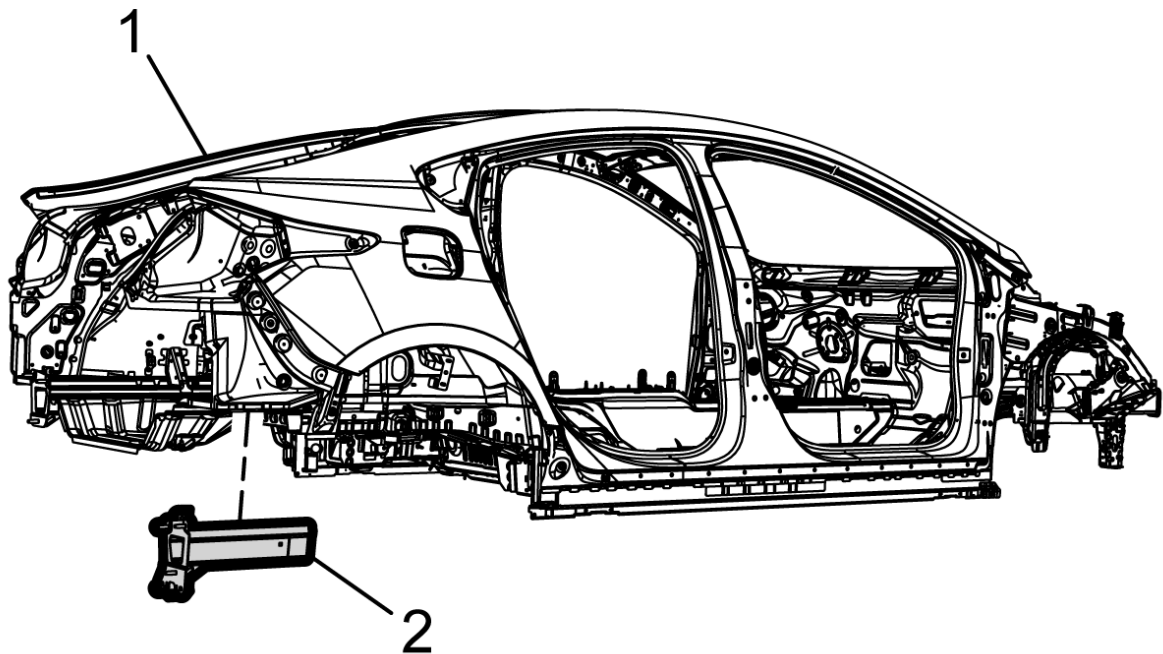


Fig. 149: Rear Rail Section

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear rail section (2) from vehicle (1).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

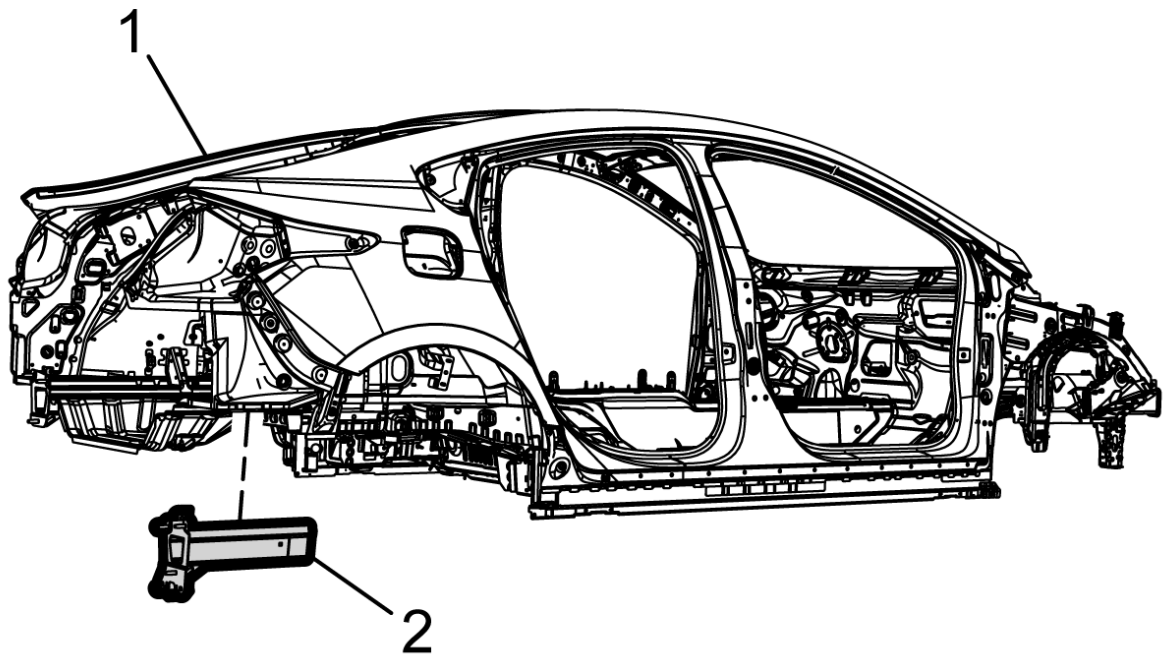


Fig. 150: Rear Rail Section

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear rail section (2) on the vehicle (1) using 3-dimensional measuring equipment.
3. Verify the fit of the rear rail section (2).

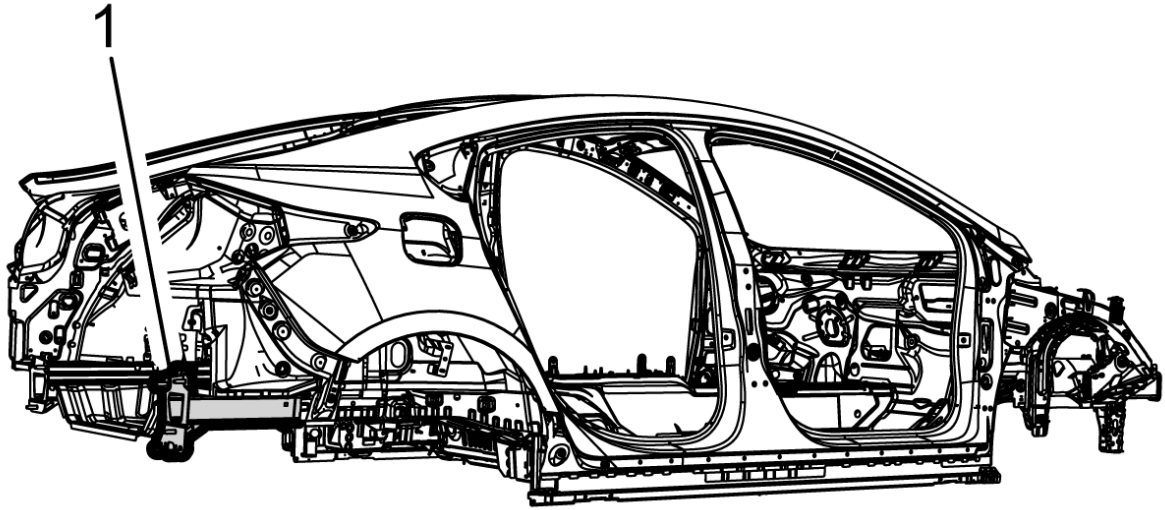


Fig. 151: Rear Rail Section

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. [Metal Panel Bonding](#).
5. Clamp the rear rail section (1) into position.
6. Weld the rear rail section (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

REAR FLOOR PANEL FILLER REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

NOTE: Left shown right similar.

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

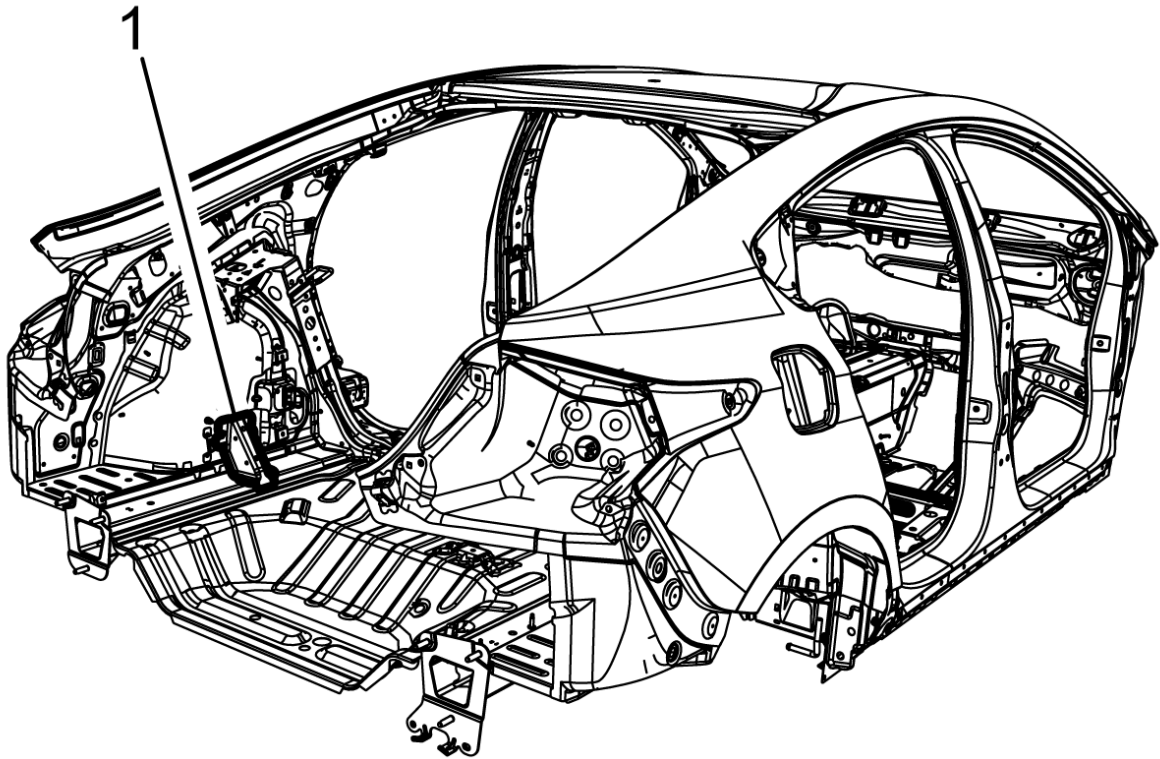


Fig. 152: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to [Structure Identification](#).

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from rear floor panel filler (1).

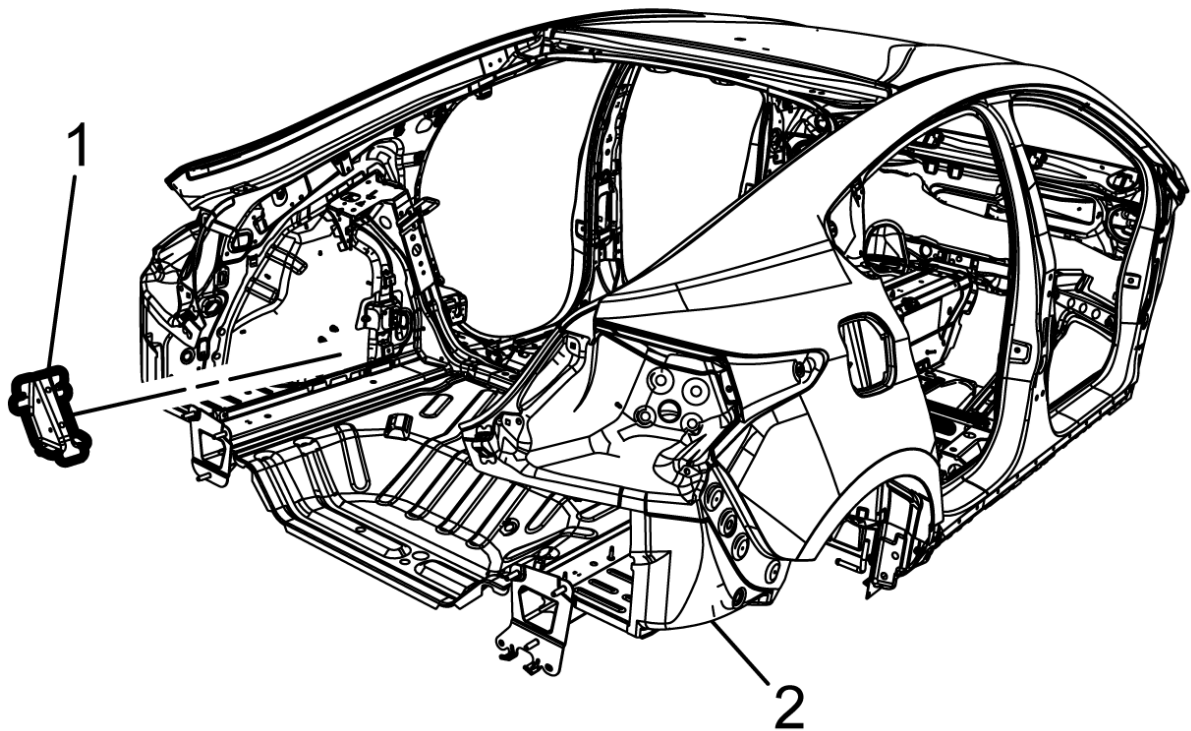


Fig. 153: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear floor panel filler (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces as necessary.

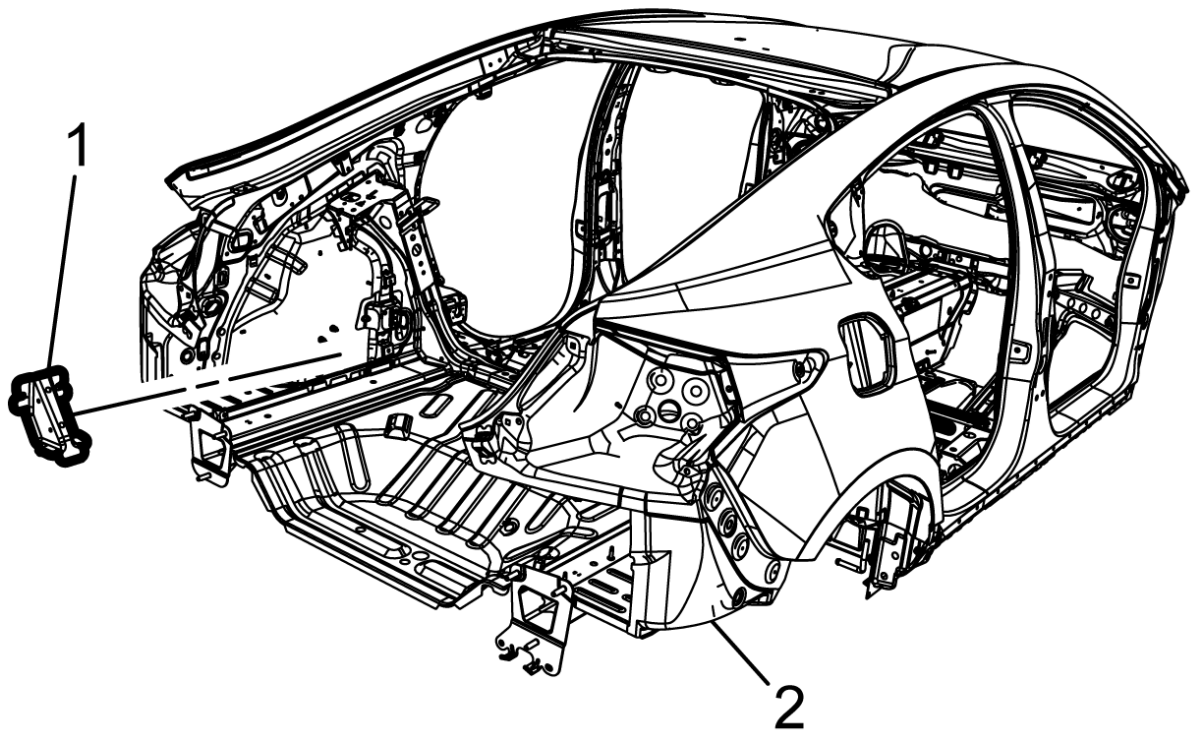


Fig. 154: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear floor panel filler (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the rear floor panel filler (1).

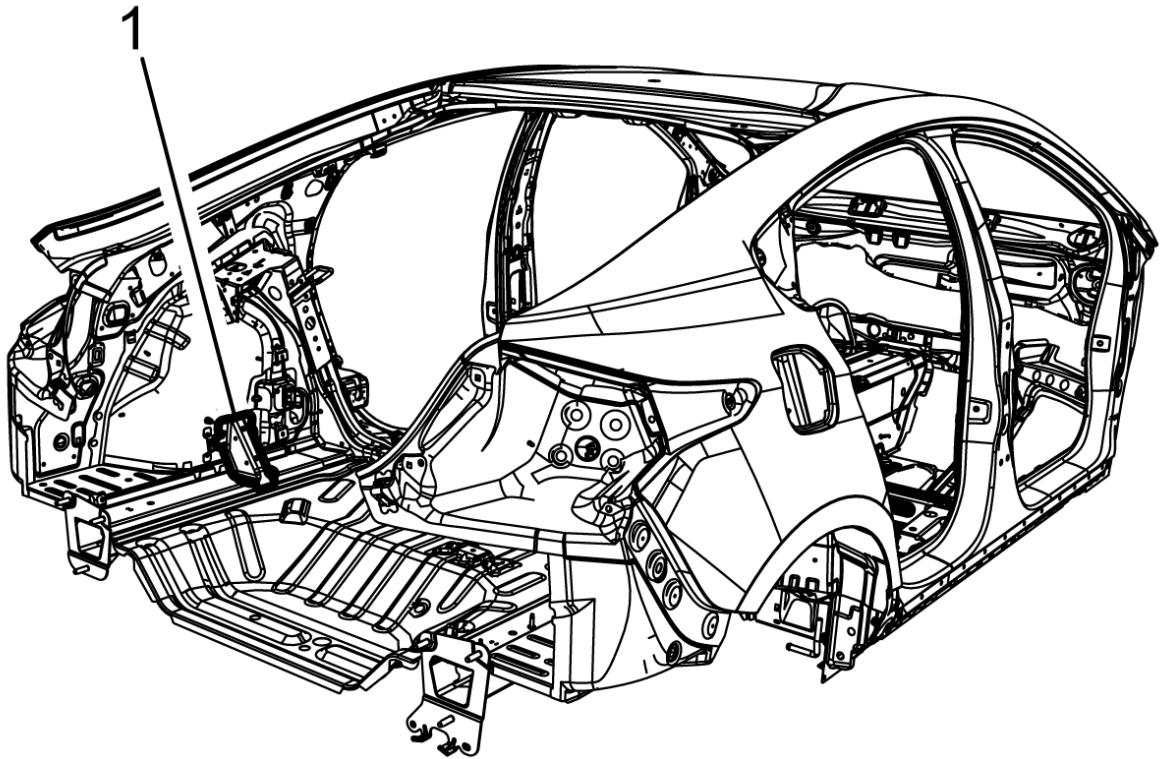


Fig. 155: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the rear floor panel filler (1) into position.
6. Weld the rear floor panel filler (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#), [Basecoat/Clearcoat Paint Systems](#).
9. Install all related panels and components.
10. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
11. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

REAR FLOOR PANEL FILLER REPLACEMENT - LEFT SIDE

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE)

and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

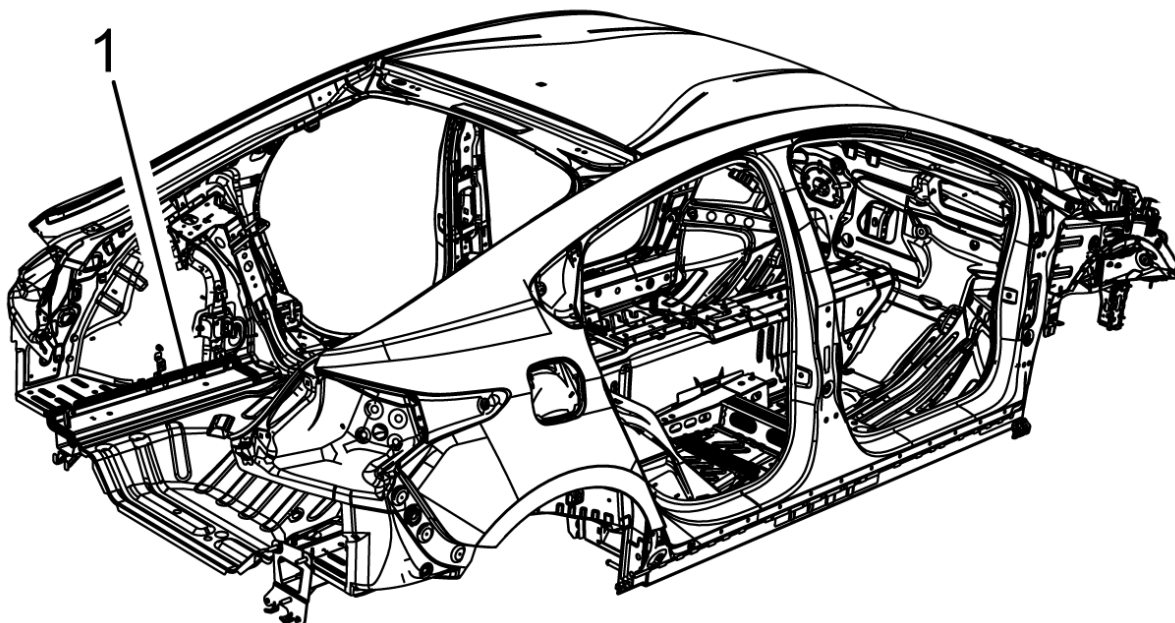


Fig. 156: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to **Structure Identification**.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the rear floor panel filler (1).

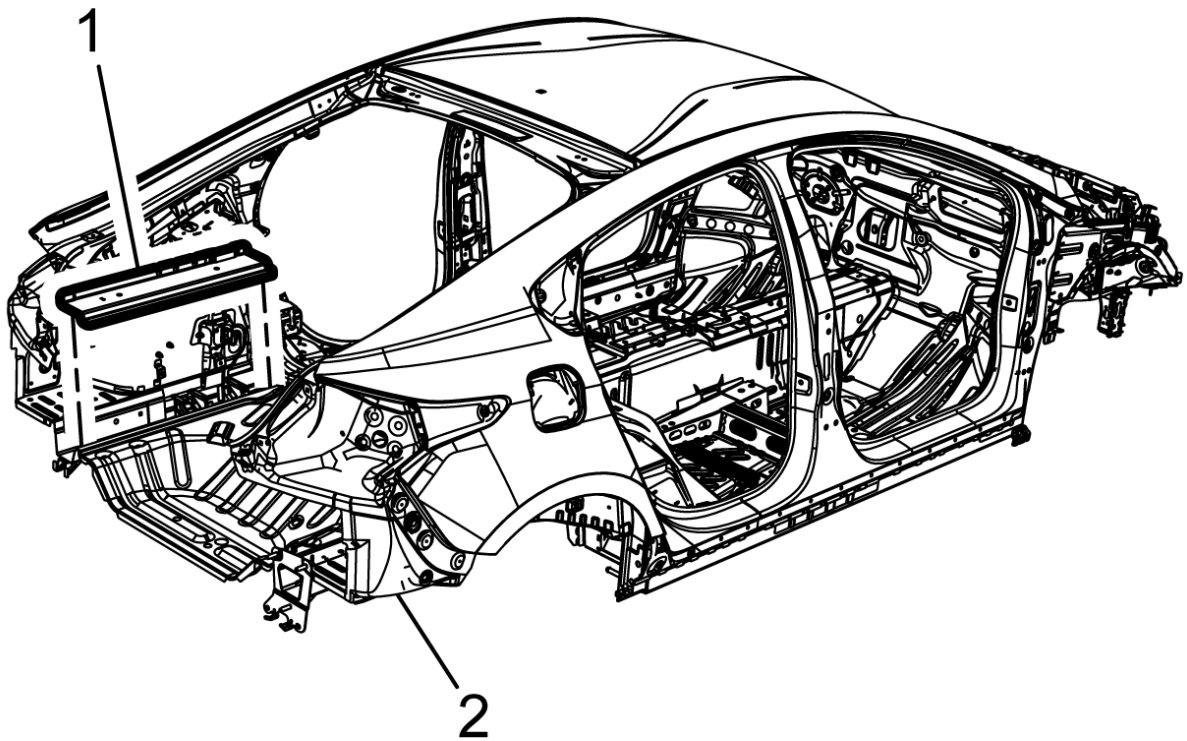


Fig. 157: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear floor panel filler (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

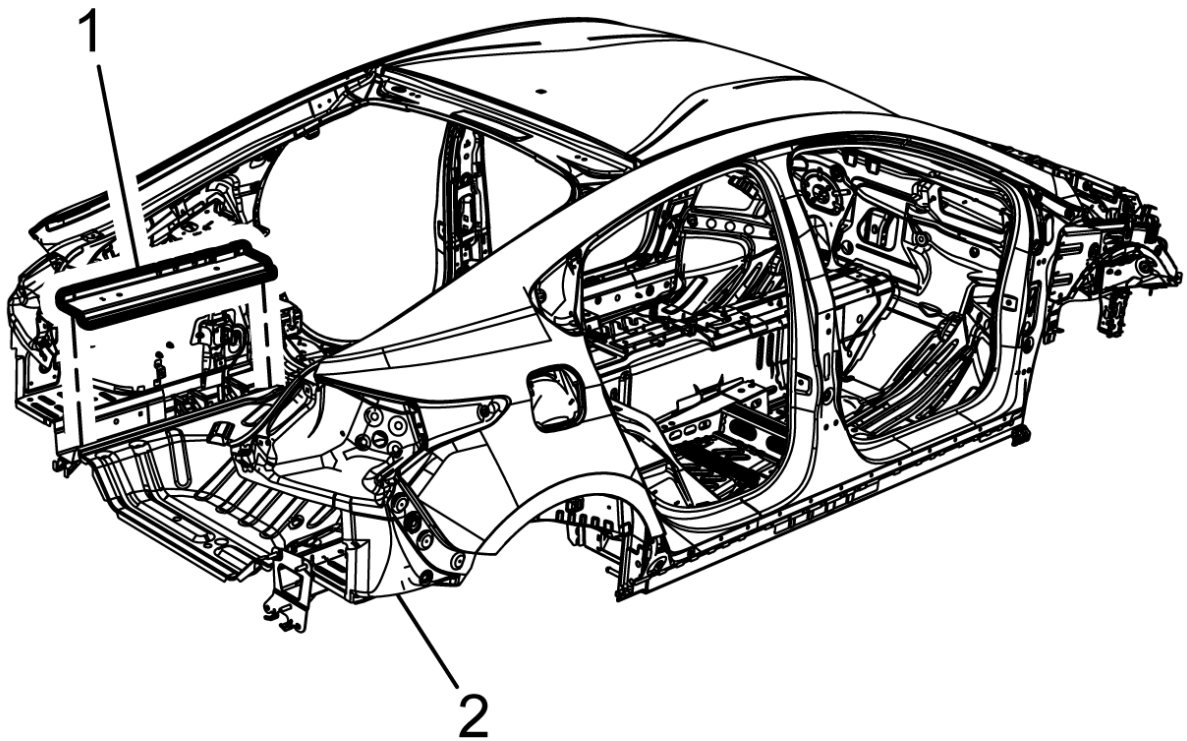


Fig. 158: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear floor panel filler (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the rear floor panel filler (1).

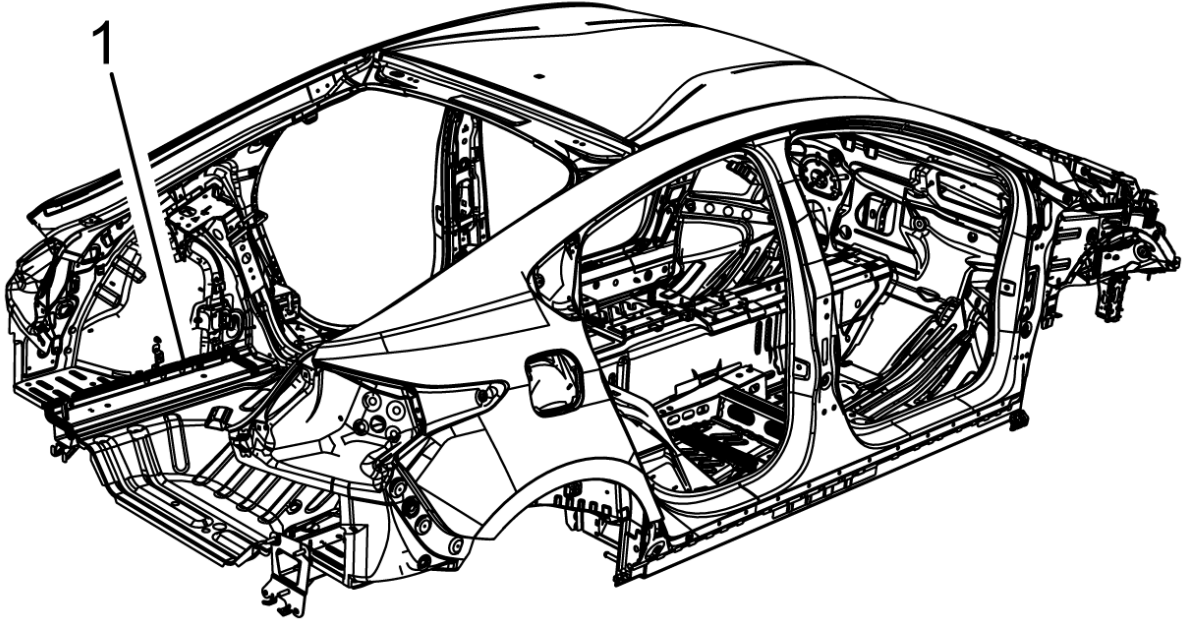


Fig. 159: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the rear floor panel filler (1) into position
6. Weld the rear floor panel filler (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
9. Install all related panels and components.
10. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
11. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

REAR FLOOR PANEL FILLER REPLACEMENT - RIGHT SIDE

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR System. Refer to [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. Refer to [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

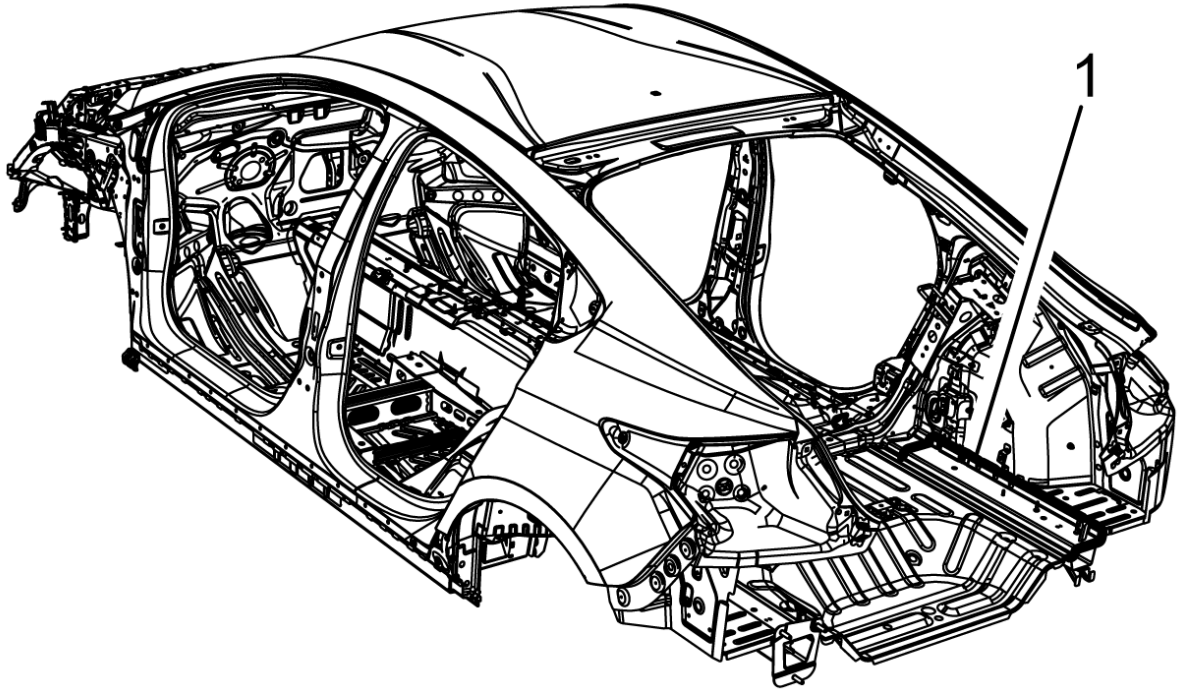


Fig. 160: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Refer to **Structure Identification**.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from the rear floor panel filler (1).

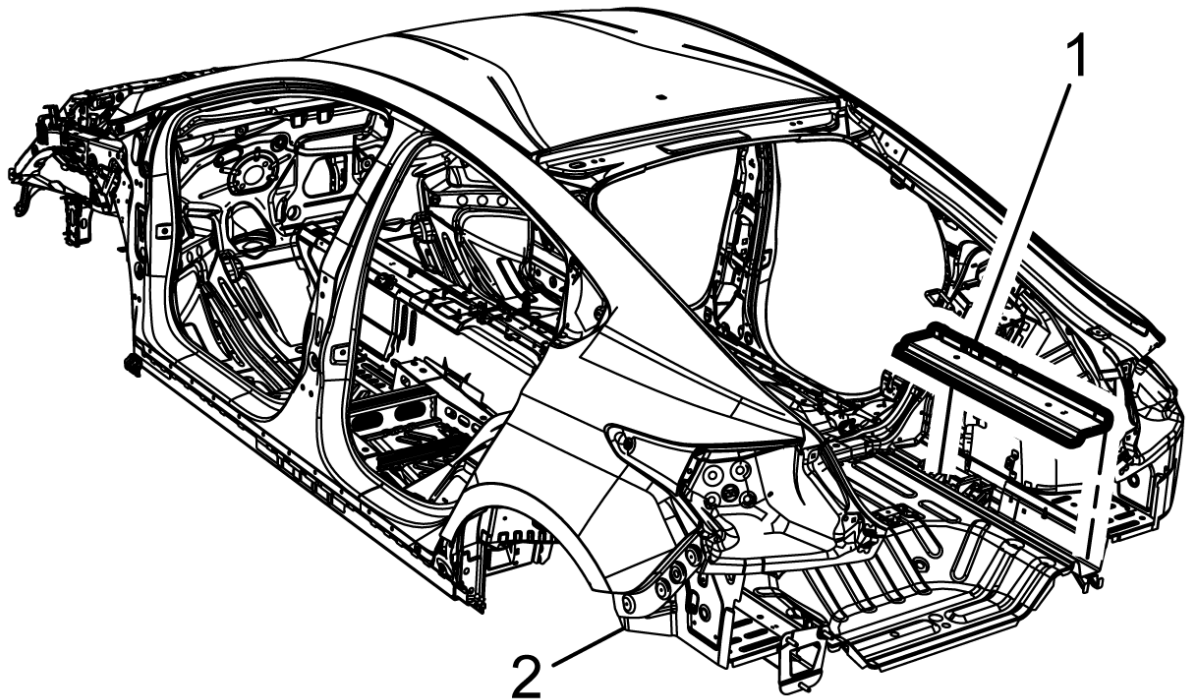


Fig. 161: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged rear floor panel filler (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. Refer to [Metal Panel Bonding](#).

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces for welding as necessary.

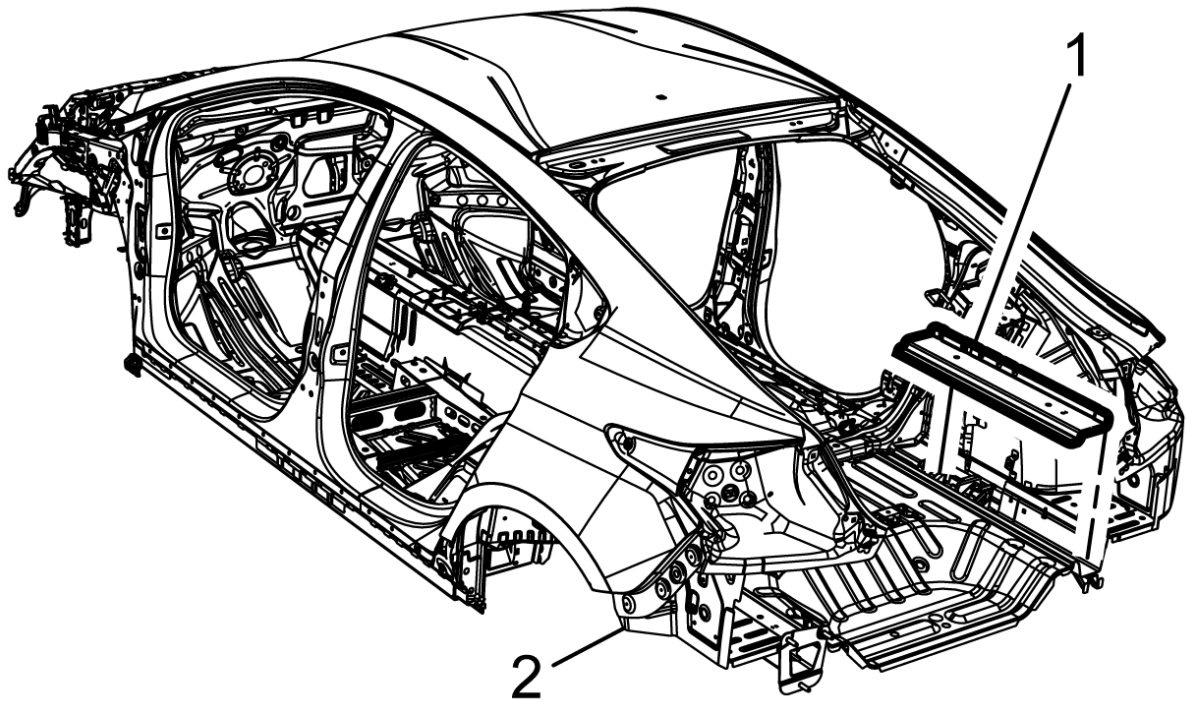


Fig. 162: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

2. Position the rear floor panel filler (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the rear floor panel filler (1).

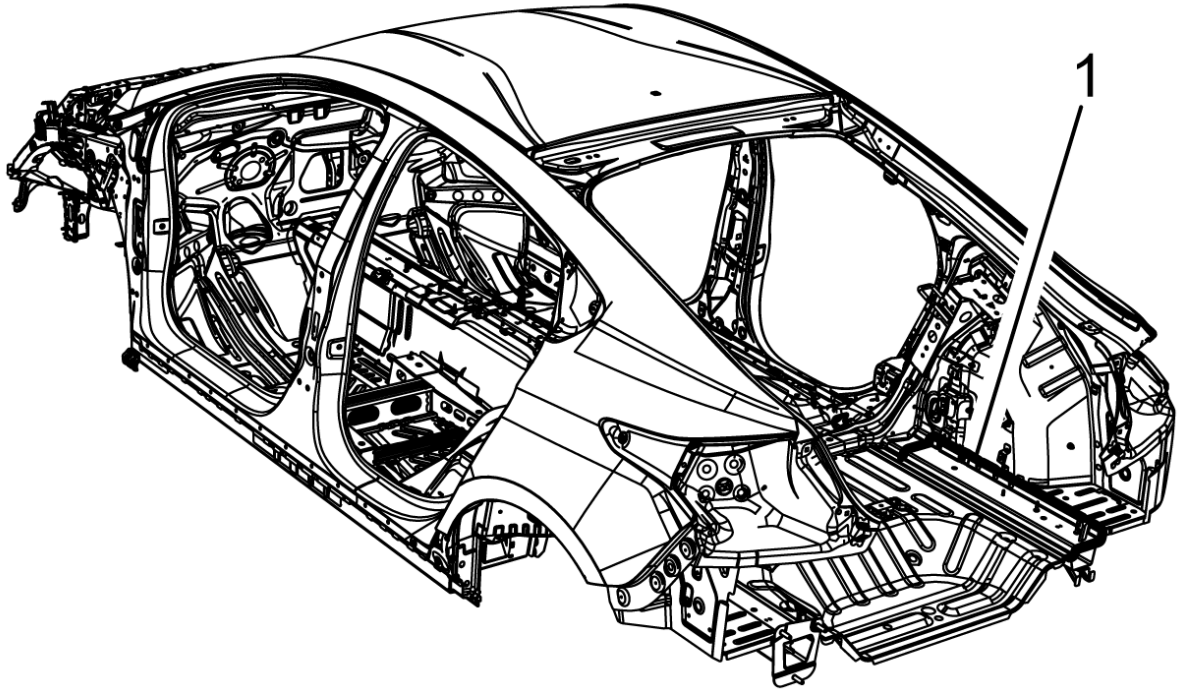


Fig. 163: Rear Floor Panel Filler

Courtesy of GENERAL MOTORS COMPANY

4. Apply the impact resistant adhesive to the repair area, as necessary. Refer to [Metal Panel Bonding](#).
5. Clamp the rear floor panel filler (1) into position
6. Weld the rear floor panel filler (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#).
8. Paint the repaired area. Refer to [Basecoat/Clearcoat Paint Systems](#).
9. Install all related panels and components.
10. If disabled, enable the high voltage system. Refer to [High Voltage Enabling](#).
11. Enable the SIR system. Refer to [SIR Disabling and Enabling](#).

BATTERY TRAY REPLACEMENT

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

WARNING: Refer to [Collision Sectioning Warning](#) .

WARNING: Refer to [Glass and Sheet Metal Handling Warning](#) .

CAUTION: Refer to [Collision Repair Anchoring Caution](#) .

1. Disable the SIR system. [SIR Disabling and Enabling](#) .
2. Inspect the high voltage system. [High Voltage System Inspection](#) .
3. Remove all related panels and components.
4. Visually inspect the vehicle for additional damage to the vehicle structure. Repair as much of the damage to the vehicle structure as possible, prior to replacing any damaged parts.
5. Remove the sealers and anti-corrosion materials from the repair area, as necessary. [Anti-Corrosion Treatment and Repair](#) .

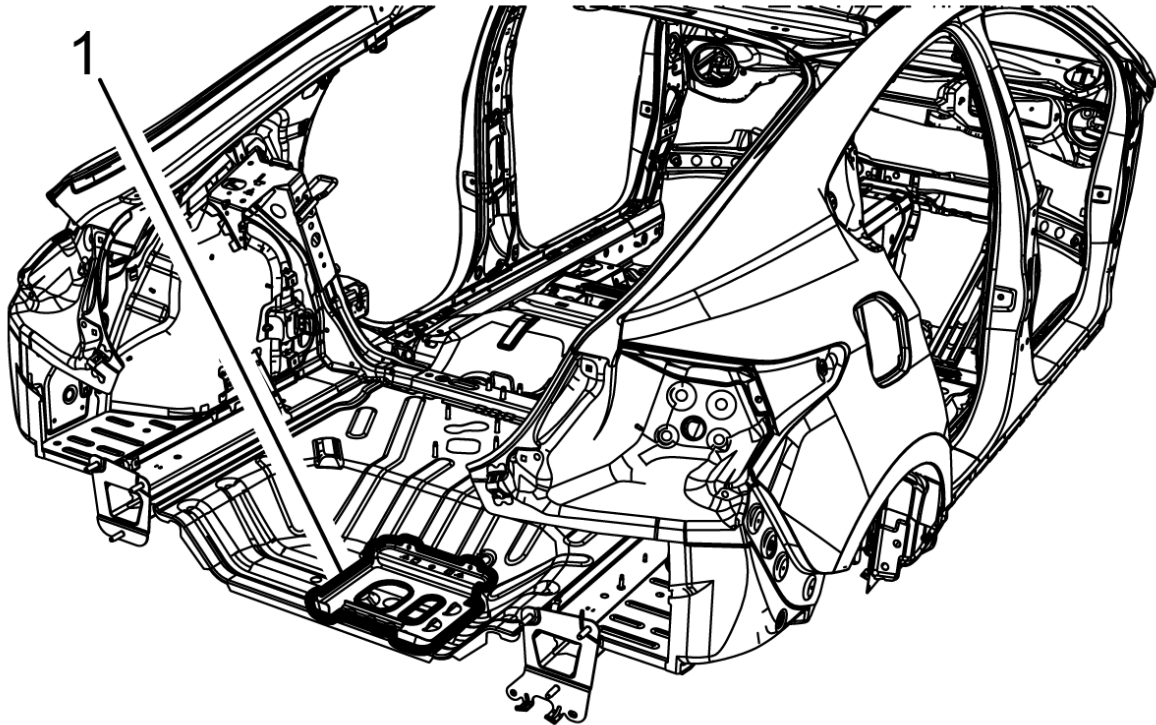


Fig. 164: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage or cut attaching panels and reinforcements. Structure Identification.

NOTE: Record the number and location of the original welds for installation of the service assembly.

6. Remove all factory welds from battery tray (1).

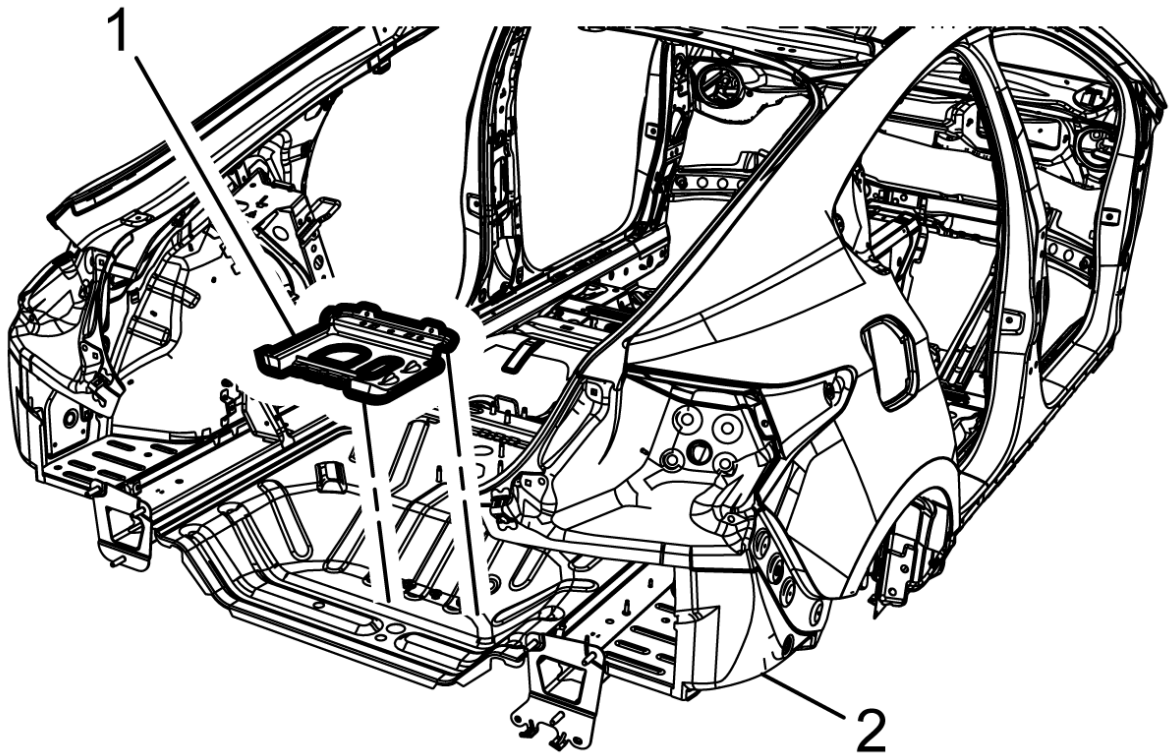


Fig. 165: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged battery tray (1) from vehicle (2).

NOTE: If impact resistant adhesive is present remove and replace as necessary.

8. Remove the impact resistant adhesive from the repair area, as necessary. [Metal Panel Bonding](#)

Installation Procedure

NOTE: Squeeze Type Resistance Spot Welds equivalent to the factory spot welds are recommended. If access to use Squeeze Type Resistance Spot Welds is not possible, MIG/MAG plug welds may be used, to replace those specific welds.

1. Prepare all mating surfaces as necessary.

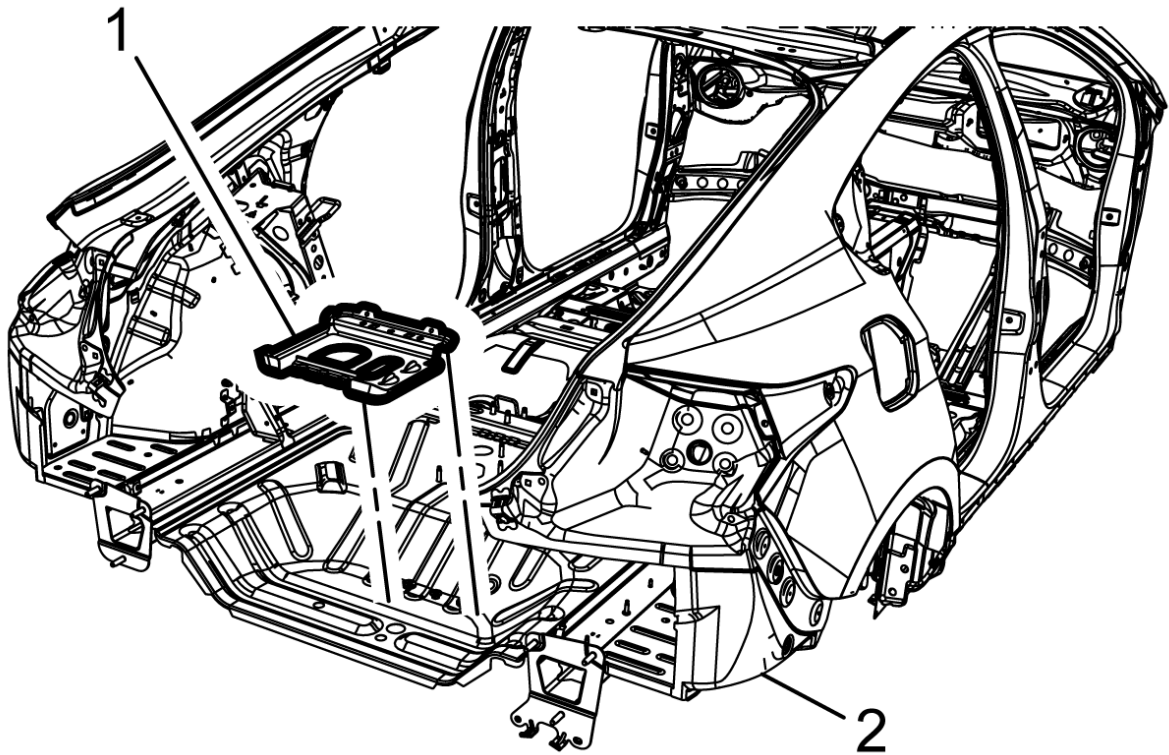


Fig. 166: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

2. Position the battery tray (1) on the vehicle (2) using 3-dimensional measuring equipment.
3. Verify the fit of the battery tray (1).
4. Apply the impact resistant adhesive to the repair area, as necessary. **Metal Panel Bonding**

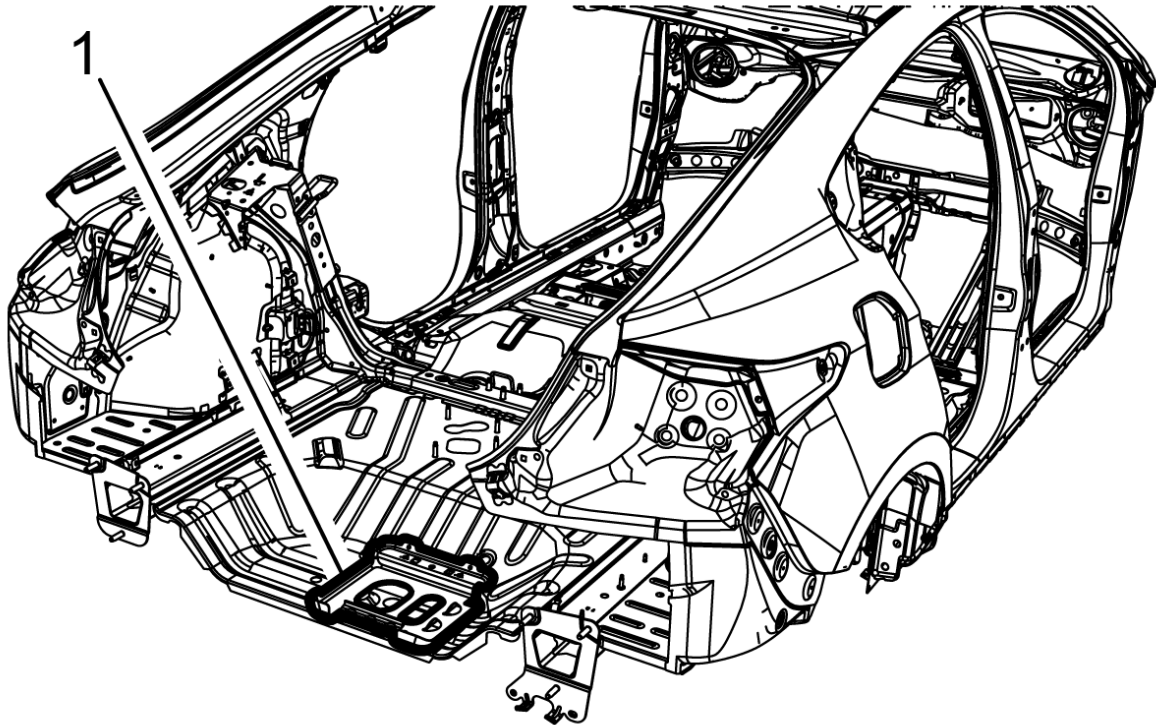


Fig. 167: Battery Tray

Courtesy of GENERAL MOTORS COMPANY

5. Clamp the battery tray (1) into position.
6. Weld the battery tray (1) accordingly.
7. Apply the sealers and anti-corrosion materials to the repair area as necessary. [Anti-Corrosion Treatment and Repair](#) .
8. Paint the repaired area. [Basecoat/Clearcoat Paint Systems](#) .
9. Install all related panels and components.
10. If disabled, enable the high voltage system. [High Voltage Enabling](#) .
11. Enable the SIR System. [SIR Disabling and Enabling](#) .

RESISTANCE SPOT WELDED FULL PANEL REPLACEMENT

NOTE: Use this procedure for all panels that are replaced at the factory seams, unless a specific procedure exists in the Collision Repair section of this vehicle's service information.

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#) .
2. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications.

WARNING: Refer to [Foam Sound Deadeners Warning](#) .

5. Note the location and remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

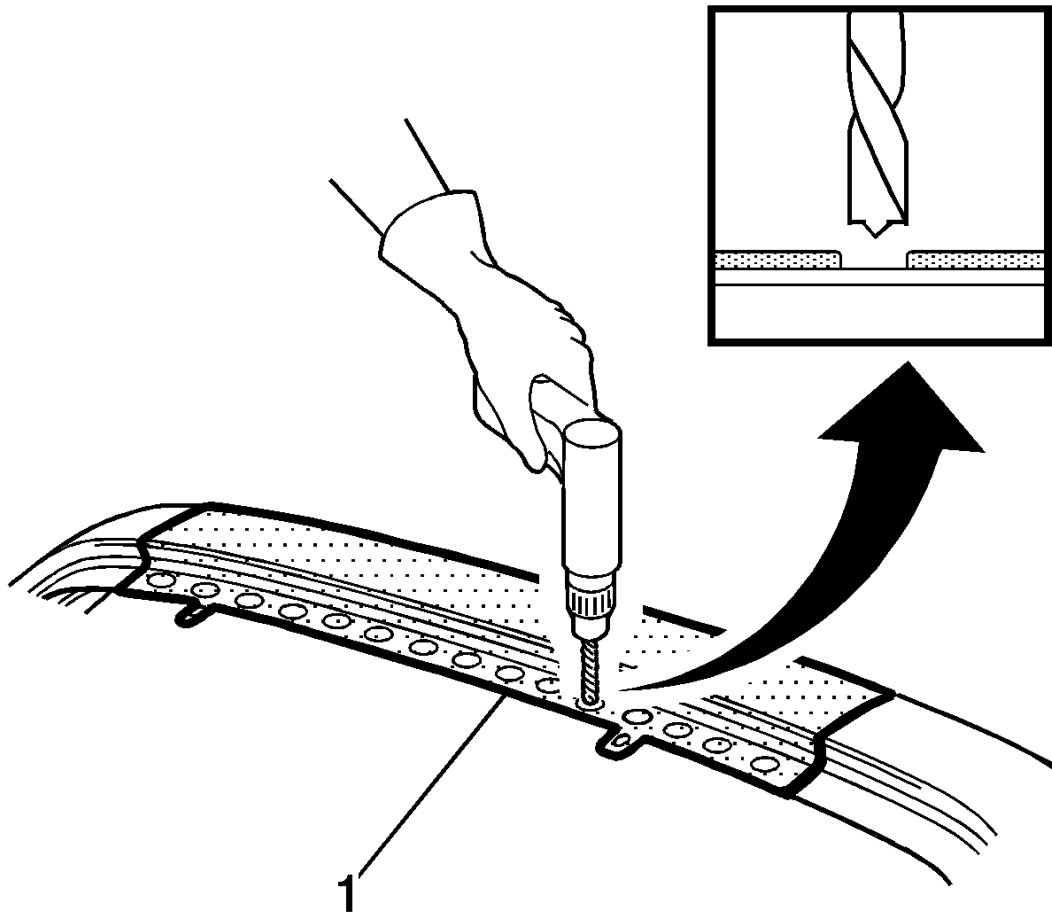


Fig. 168: Drilling Out Factory Welds (Full Panel)

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

6. Locate and drill out all factory welds (1). Note the number and location of the welds for installation of the service part.

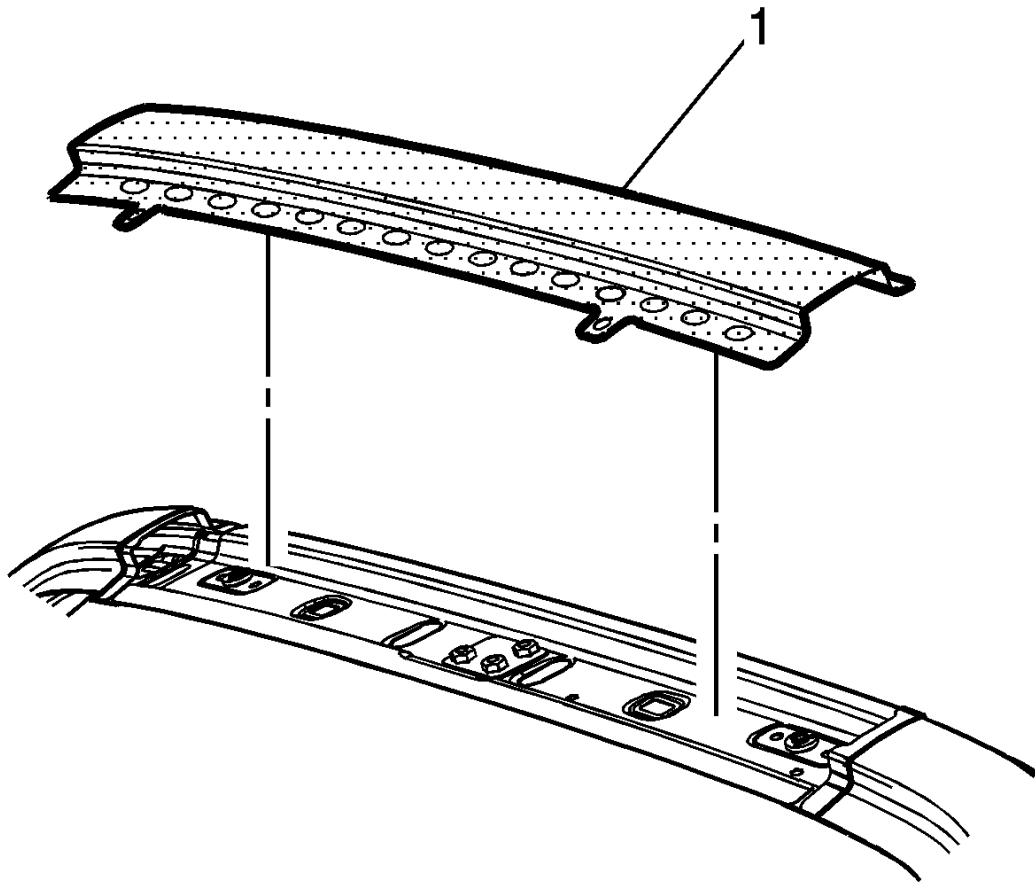


Fig. 169: Damaged Part (Full Panel)

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged part (1).

Installation Procedure

NOTE: If the location of the original plug weld holes cannot be determined, space the plug weld holes every 40 mm (1 1/2 in) apart. Where structural adhesive was present, space the plug weld holes every 20 mm (3/4 in) apart.

1. Prepare all mating surfaces as necessary.
2. Apply GM-approved Weld-Thru Coating or equivalent to all mating surfaces. Refer to [Anti-Corrosion Treatment and Repair](#).
3. Position the service part. Clamp in place.

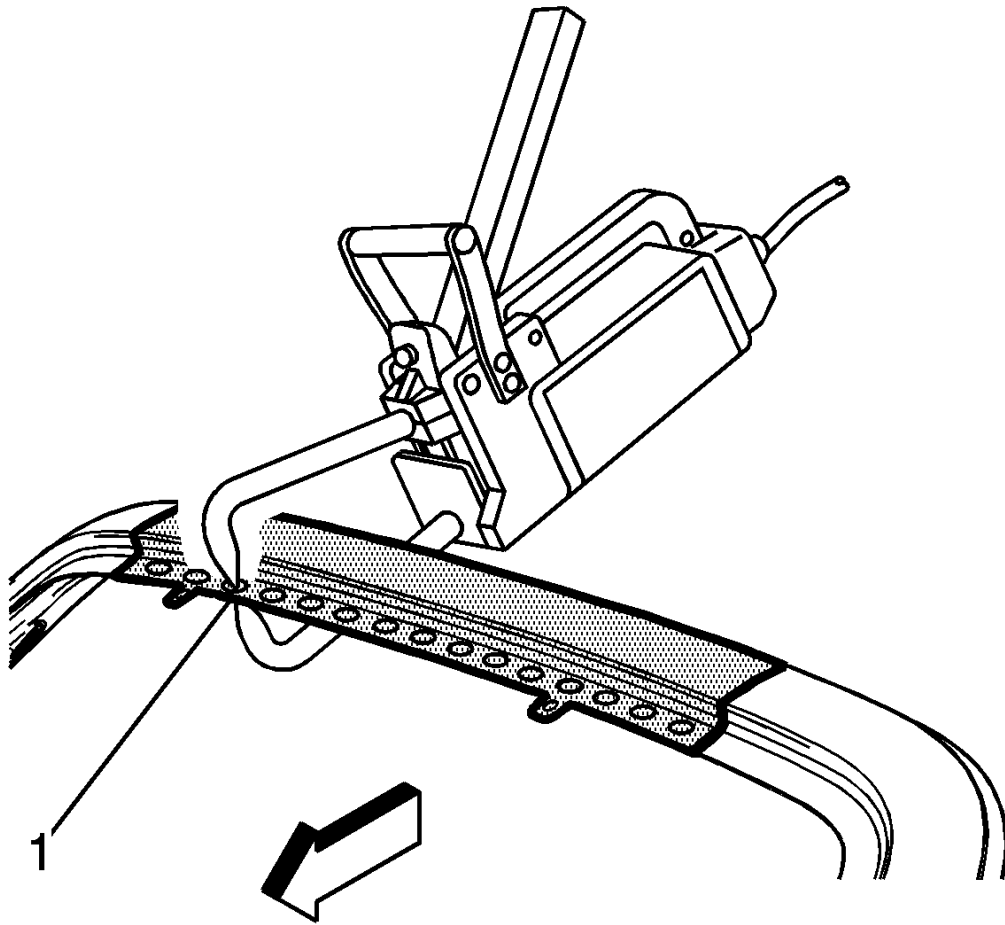


Fig. 170: Welding New Part (Full Panel)

Courtesy of GENERAL MOTORS COMPANY

4. Apply welds accordingly (1).
5. Clean and prepare all welded surfaces.
6. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
7. Paint the repair area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
8. Install all related panels and components.
9. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
10. Enable the SIR system. Refer to [SIR Disabling and Enabling](#) .

MIG WELDED FULL PANEL REPLACEMENT

Removal Procedure

WARNING: Refer to [Approved Equipment for Collision Repair Warning](#) .

NOTE: Use this procedure for all panels that are replaced at the factory seams, unless a specific procedure exists in the Collision Repair section of this vehicle's

service information.

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#) .
2. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
3. Remove all related panels and components.
4. Repair as much of the damage as possible to factory specifications.

WARNING: Refer to [Foam Sound Deadeners Warning](#) .

5. Note the location and remove the sealers and anti-corrosion materials from the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .

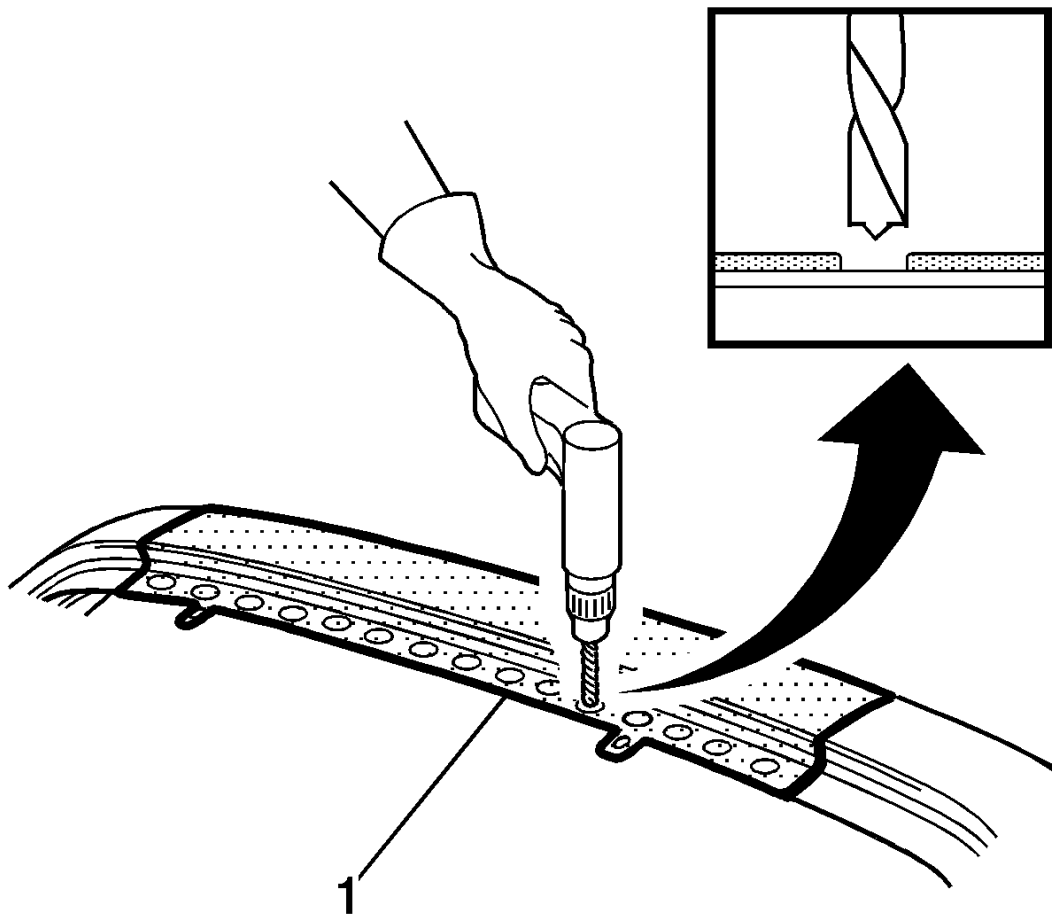


Fig. 171: Drilling Out Factory Welds (Full Panel)

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not damage any inner panels or reinforcements.

6. Locate and drill out all factory welds (1). Note the number and location of the welds for installation of the service part.

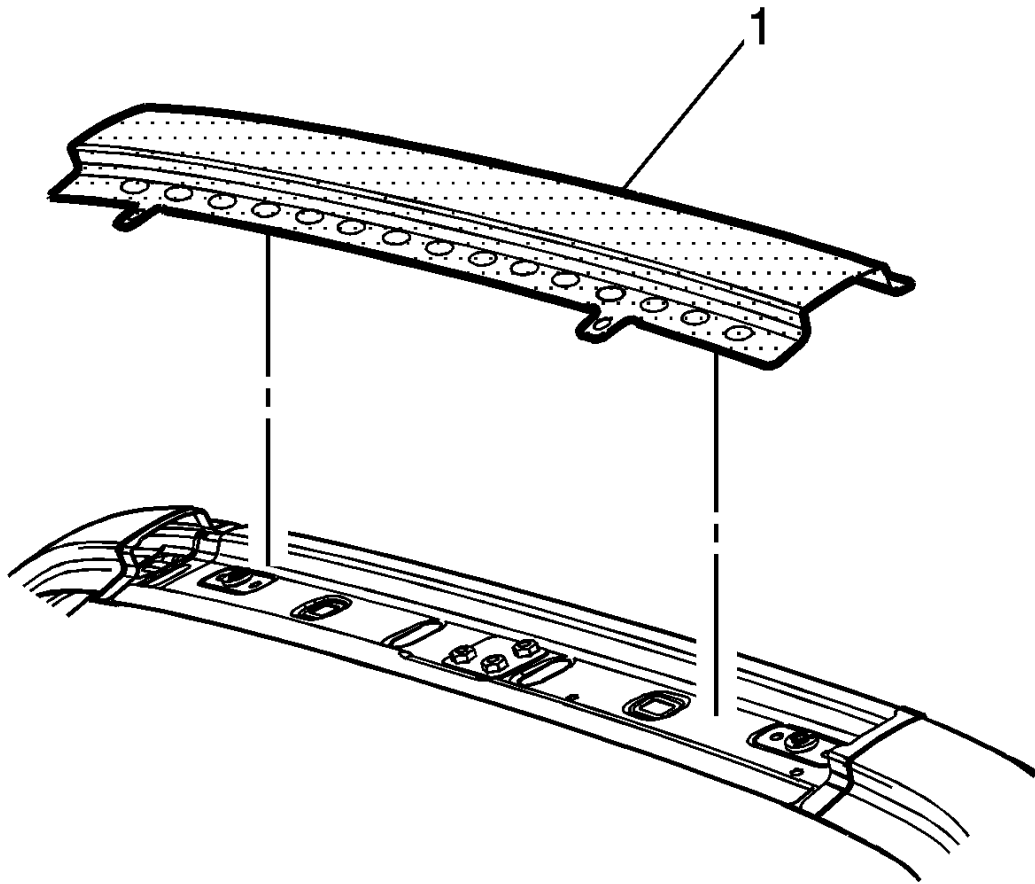


Fig. 172: Damaged Part (Full Panel)

Courtesy of GENERAL MOTORS COMPANY

7. Remove the damaged part (1).

Installation Procedure

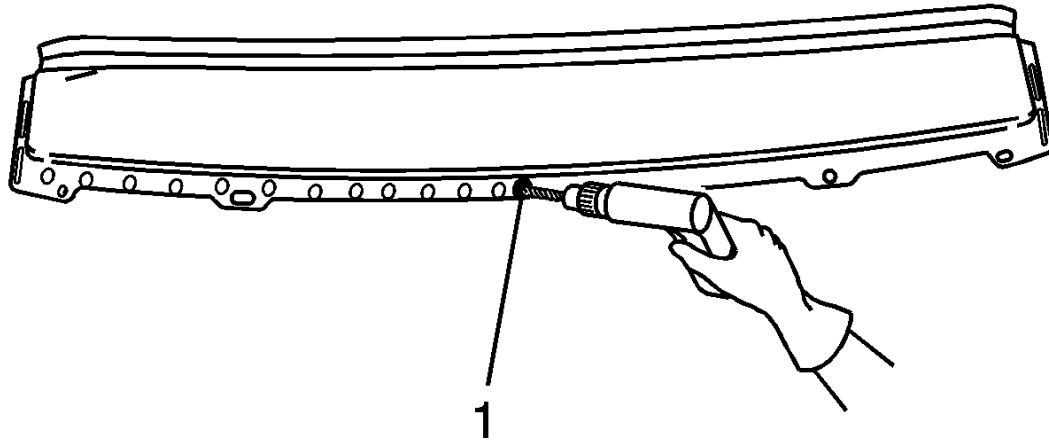


Fig. 173: Drilling Plug Weld Holes (Full Panel)
Courtesy of GENERAL MOTORS COMPANY

NOTE: If the location of the original plug weld holes can not be determined, space the plug weld holes every 40 mm (1 1/2 in) apart. Where structural adhesive was present, space the plug weld holes every 20 mm (3/4 in) apart.

1. Drill 8 mm (5/16 in) plug weld holes in the service part as necessary in the locations noted from the original panel (1).
2. Prepare all attachment surfaces as necessary.
3. Prepare all mating surfaces as necessary.
4. Apply GM-approved Weld-Thru Coating or equivalent to all mating surfaces. Refer to [Anti-Corrosion Treatment and Repair](#) .
5. Position the service part. Clamp in place.

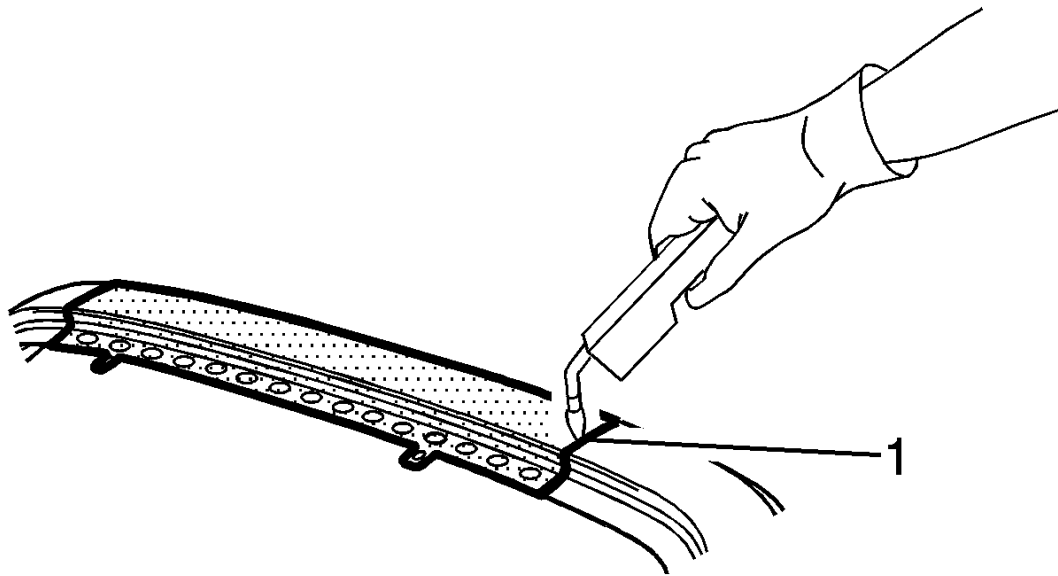


Fig. 174: Plug Welding Service Part (Full Panel)
Courtesy of GENERAL MOTORS COMPANY

6. Plug weld accordingly (1).
7. Clean and prepare all welded surfaces.
8. Apply the sealers and anti-corrosion materials to the repair area, as necessary. Refer to [Anti-Corrosion Treatment and Repair](#) .
9. Paint the repair area. Refer to [Basecoat/Clearcoat Paint Systems](#) .
10. Install all related panels and components.
11. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
12. Enable the SIR system. Refer to [SIR Disabling and Enabling](#) .

DESCRIPTION AND OPERATION

DUAL PHASE STEEL

This information provides repair recommendations and general guidelines for steel classified as Dual Phase Steel, also known as DP. This type of steel normally has a tensile strength below 780 MPa.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

NOTE: The use of heat to repair damage is not recommended for this classification of steel.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- When recommended in a specific sectioning procedure, this type of steel can be used as a weld plate for reinforcing the sectioning location.
- Squeeze Resistance Spot Welding can be used to replace factory spot welds, where applicable.
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG Brazing can be used on this type of steel.

HIGH STRENGTH LOW ALLOY STEEL

This information provides repair recommendations and general guidelines for steel classified as High Strength Low Alloy Steel, also known as HSLA. This type of steel normally has a tensile strength range from 300 - 700 MPa.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650°C (1200°F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- When recommended in a specific sectioning procedure, this type of steel can be used as a weld plate for reinforcing the sectioning location.
- Squeeze Resistance Spot Welding can be used to replace factory spot welds, where applicable.
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG Brazing can be used on this type of steel.

METAL PANEL BONDING

This information is intended to provide general guidelines for adhesive bonding of steel panels. Panel bonding of steel is only recommended when the panel is originally bonded to the vehicle.

The adhesives listed in this document are known to meet the General Motors specifications and requirements for bonding of steel body panels.

Bonding procedures in general are applicable only at factory joints.

The use of adhesive to section steel panels is not recommended by General Motors.

Rivets, or other mechanical fasteners, may be used in combination with adhesive bonding of steel panels. The

specified rivets, or fasteners, should be used with adhesive, when replacing the original panel.

Two types of adhesives are listed here. Impact Resistant Adhesive is used in joints in frame rail assemblies and strut tower assemblies and other body structure joints that have critical strength requirements. The factory applied Impact Resistant Adhesive is purple in color when cured. The Impact Resistant adhesives available for servicing these joints are considerably stronger once cured than panel bonding adhesives. The other bonding adhesives are non-impact resistant, offer a lower strength rating and can be used in all other joints that are not originally made with Impact Resistant Adhesive.

NOTE: Always follow the adhesive manufacturer's instructions for application, handling, and curing for the specific product.

Adhesives currently meeting the performance requirements include the adhesive products listed below meet these guidelines:

Steel Panel Bonding Impact Resistant

Manufacturer and Part Number	Description
Pliogrip 5770P	Pliogrip 5770P Structural Impact Durable Adhesive Available from Ashland 800-PLIOGRIP www.ashland.com/products/pliogrip-structural-adhesives
Fusor 2098	Fusor 2098 Impact Resistant Adhesive Available from Lord Fusor 800-234-3876 www.fusor.com
3M 07333	3M Impact Resistant Structural Adhesive Available from 3M www.3MCollision.com

Steel Panel Bonding

Manufacturer and Part Number	Description
GM P/N 12378566 (US)	Fast Set Panel Bonding Adhesive
GM P/N 88901674 (Canada)	
Lord Fusor P/N 110B/111B	
GM P/N 12378567 (US)	Medium Set Panel Bonding Adhesive
GM P/N 88901675 (Canada)	
Lord Fusor P/N 108B/109B	
3M P/N 8116	Panel Bonding Adhesive
Ashland Plio Grip Panel 60 ©2015 General Motors. All rights reserved.	Panel Bonding Adhesive

MILD STEEL

This information provides repair recommendations and general guidelines for steel classified as Mild Steel. This type of steel normally has a tensile strength less than 270 MPa. This includes the common steel names of:

- Mild Steel
- Bake Hardenable Steel (BH)
- Solid Solution Strengthened Steel

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

Recommended Repairs:

- Cold repairs can be performed on this type of steel, unless the damage includes kinks. If the damage includes kinks, the part should be replaced.
- Controlled use of heat can be used to repair damage, if the heat does not exceed 650°C (1200°F). The heat should be applied a maximum of 2 times, for up to 90 seconds.
- Sectioning or partial replacement of this type of steel is recommended only at approved locations, in a specific sectioning procedure.
- When recommended in a specific sectioning procedure, this type of steel can be used as a weld plate for reinforcing the sectioning location.
- Squeeze Resistance Spot Welding can be used to replace factory spot welds, where applicable
- MIG plug welding and MIG stitch welding can be used on this type of steel.
- MIG Brazing can be used on this type of steel.

ULTRA HIGH STRENGTH DUAL PHASE STEEL

This information provides repair recommendations and general guidelines for steel classified as Ultra High Strength Dual Phase Steel, also known as DPX. This type of steel normally has a tensile strength of 780 MPa, or greater.

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

NOTE:

- **Repair of this type of steel is not recommended.**
- **This type of steel should be replaced at factory joints only. Sectioning or partial replacement is not recommended.**
- **The use of heat to repair damage is not recommended for this type of steel.**
- **Stitch Welding is not recommended for this type of steel (unless replacing a factory installed stitch weld).**
- **This type of steel should not be used as a weld plate for reinforcing the sectioning location.**

Recommended Repairs:

- Squeeze Resistance Spot Welding can be used to replace factory spot welds, where applicable.
- MIG plug welding can be used to replace factory spot welds.
- MIG Brazing can be used to replace factory spot welds.

ULTRA HIGH STRENGTH STEEL

This information provides repair recommendations and general guidelines for steel classified as Ultra High Strength Steel, also known as UHSS. This type of steel normally has a tensile strength of 780 MPa, or greater.

This includes the common steel names of

- Ultra High Strength Dual Phase Steel (DPX)

- Martensitic Steel (M)
- Boron/Press Hardened Steel (B)
- Multi-Phase Steel (MP)
- TRIP Steel (TR)

General Motors recommends the following when repairing or replacing this type of steel during collision repair.

NOTE:

- **Repair of this type of steel is not recommended.**
- **This type of steel should be replaced only, at factory joints. Sectioning or partial replacement is not recommended.**
- **The use of heat to repair damage is not recommended for this type of steel.**
- **Stitch Welding is not recommended for this type of steel (unless replacing a factory installed stitch weld).**
- **This type of steel should not be used as a weld plate for reinforcing the sectioning location.**

Recommended Repairs

- Squeeze Resistance Spot Welding can be used to replace factory spot welds, where applicable.
- MIG plug welding can be used to replace factory spot welds.
- MIG Brazing can be used to replace factory spot welds.

Article GUID: A00884709

ACCESSORIES & EQUIPMENT

Frame and Underbody - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Drivetrain and Front Suspension Cradle Bolt	
• First Pass:	70 N.m (52 lb ft)
• Final Pass:	45 - 60 Degrees
Drivetrain and Front Suspension Crossmember Extension Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	30 - 45 Degrees
Drivetrain and Front Suspension Crossmember Extension Nut	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees
Electric Belt Drive Rack and Pinion Steering Gear Bolt	
• First Pass:	55 N.m (41 lb ft)
• Final Pass:	150 - 165 Degrees
Front Lower Control Arm Front Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Front Lower Control Arm Rear Bushing Nut	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	30 - 45 Degrees
Stabilizer Shaft Insulator Clamp Bolt	
• First Pass:	22 N.m (16 lb ft)
• Final Pass:	30 - 45 Degrees
Transmission Mount Strut Bolt - Drivetrain and Front Suspension Cradle Side	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	60 - 75 Degrees
Transmission Mount Strut Bolt - Transmission Side	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	60 - 75 Degrees

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Drivetrain and Front Suspension Brace Bolt	58 N.m (43 lb ft)
Front Compartment Splash Shield Bolt M4	2.5 N.m (22 lb in)
Front Compartment Splash Shield Bolt M6	7 N.m (62 lb in)
Front Compartment Splash Shield Plastic Nut	3 N.m (27 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Front Compartment Air Deflector Fastener M4	2.5 N.m (22 lb in)
Front Compartment Air Deflector Fastener M6	7 N.m (62 lb in)
Front Compartment Air Deflector Bolt	3 N.m (27 lb in)
Front Wheelhouse Liner Bolt	2.5 N.m (22 lb in)
Heater Water Bypass Valve Bracket Bolt	9 N.m (80 lb in)
Lower Ball Joint to Steering Knuckle Nut	
• First Pass:	35 N.m (26 lb ft)
• Final Pass:	30 - 45 Degrees
Radiator Air Side Baffle Bolt	9 N.m (80 lb in)
Rear Tire Front Air Deflector Fastener	2.5 N.m (22 lb in)
Rear Wheelhouse Liner Bolt	2.5 N.m (22 lb in)
Rear Wheelhouse Panel Liner Nut	2.5 N.m (22 lb in)
Stabilizer Shaft Link Nut	65 N.m (48 lb ft)
Underbody Front Air Deflector Nut	3 N.m (27 lb in)
Underbody Front Air Deflector Bolt	2.5 N.m (22 lb in)
Underbody Rear Air Deflector Nut	3 N.m (27 lb in)
Underbody Rear Air Deflector Screw	2.5 N.m (22 lb in)

REPAIR INSTRUCTIONS

FRONT COMPARTMENT SPLASH SHIELD REPLACEMENT

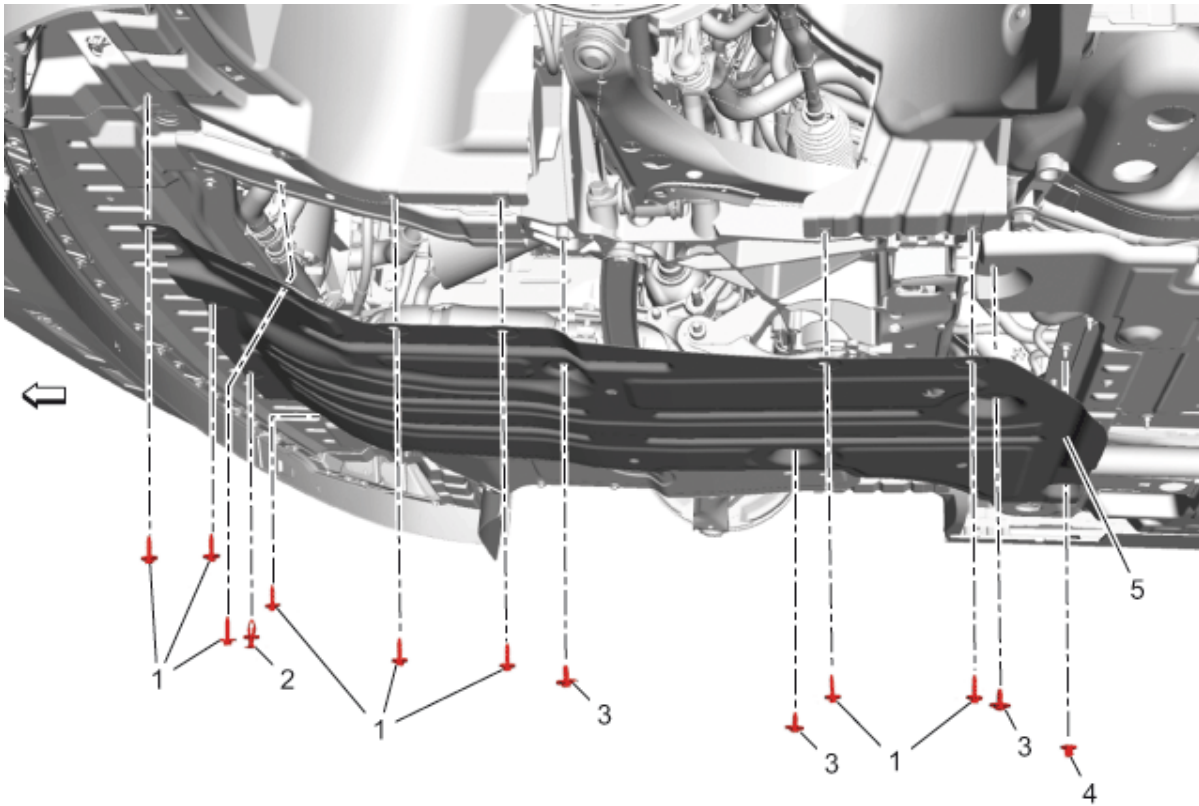


Fig. 1: Front Compartment Splash Shield

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Front Compartment Splash Shield Bolt (Qty: 8) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Front Compartment Splash Shield Retainer
3	Front Compartment Splash Shield Bolt (Qty: 3) Tighten 7 N.m (62 lb in)
4	Front Compartment Splash Shield Plastic Nut Tighten 3 N.m (27 lb in)
5	Front Compartment Splash Shield

FRONT COMPARTMENT AIR DEFLECTOR REPLACEMENT

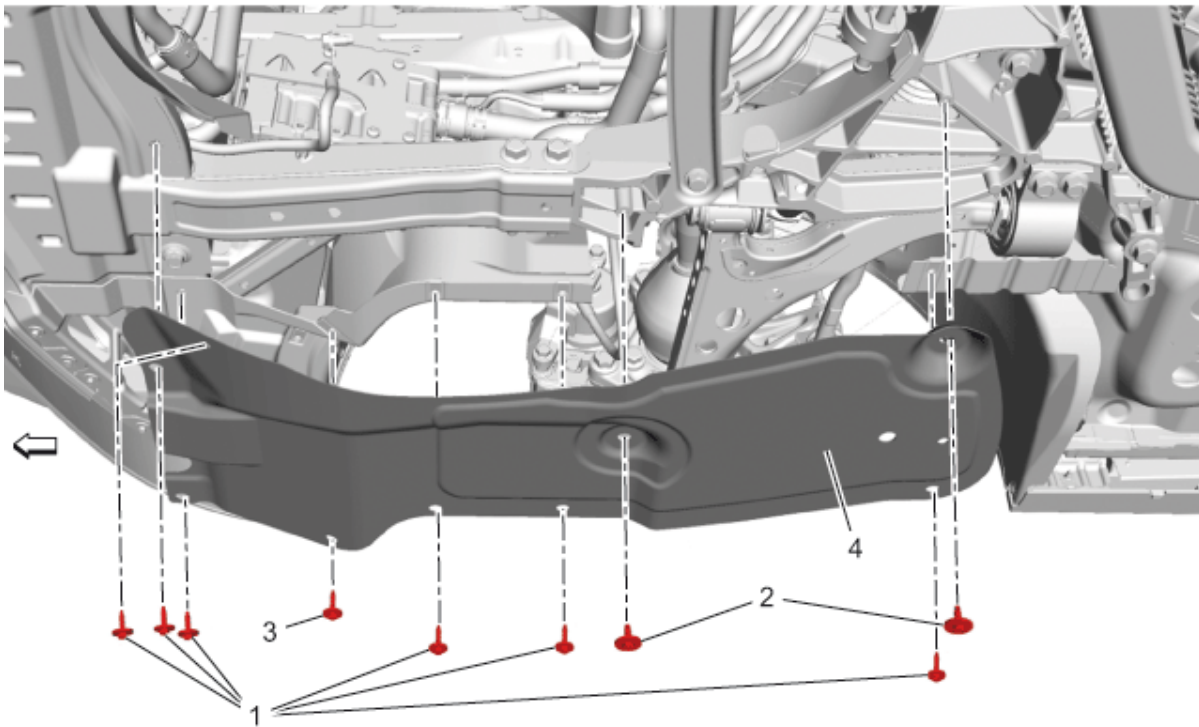


Fig. 2: Front Compartment Air Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Front Compartment Air Deflector Fastener (Qty: 6) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Front Compartment Air Deflector Fastener (Qty: 2) Tighten 7 N.m (62 lb in)
3	Front Compartment Air Deflector Bolt Tighten 3 N.m (27 lb in)
4	Front Compartment Air Deflector Procedure Slide the front compartment air deflector from in between the front tire front air deflector and the wheelhouse liner.

FRONT UNDERBODY AIR DEFLECTOR REPLACEMENT

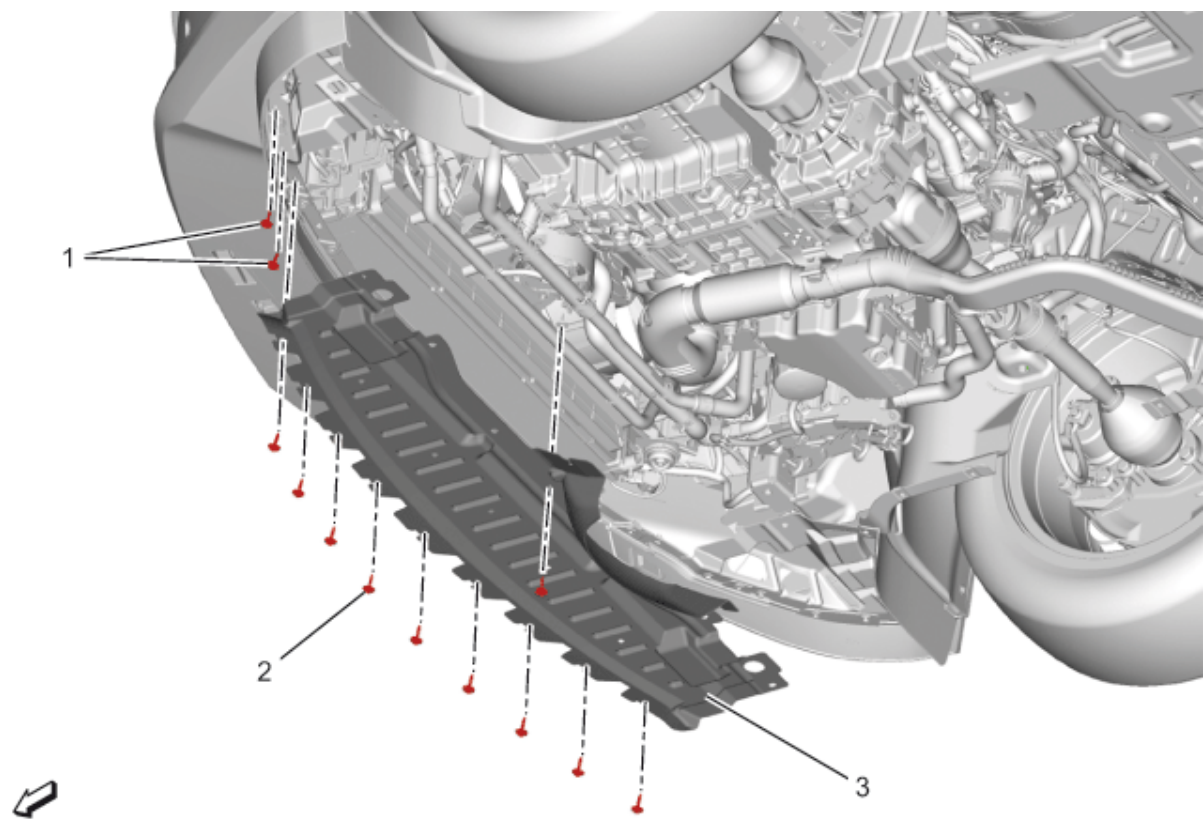


Fig. 3: Front Underbody Air Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Front Compartment Splash Shield Replacement	
2. Front Compartment Air Deflector Replacement	
1	Front Wheelhouse Liner Bolt (Qty: 2) CAUTION: Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Front Underbody Air Deflector Bolt (Qty: 10) Tighten 2.5 N.m (22 lb in)
3	Front Underbody Air Deflector Procedure Slightly bend the front wheelhouse liner on one side away to remove the front underbody air

Callout	Component Name
	deflector.

UNDERBODY FRONT AIR DEFLECTOR REPLACEMENT - LEFT SIDE

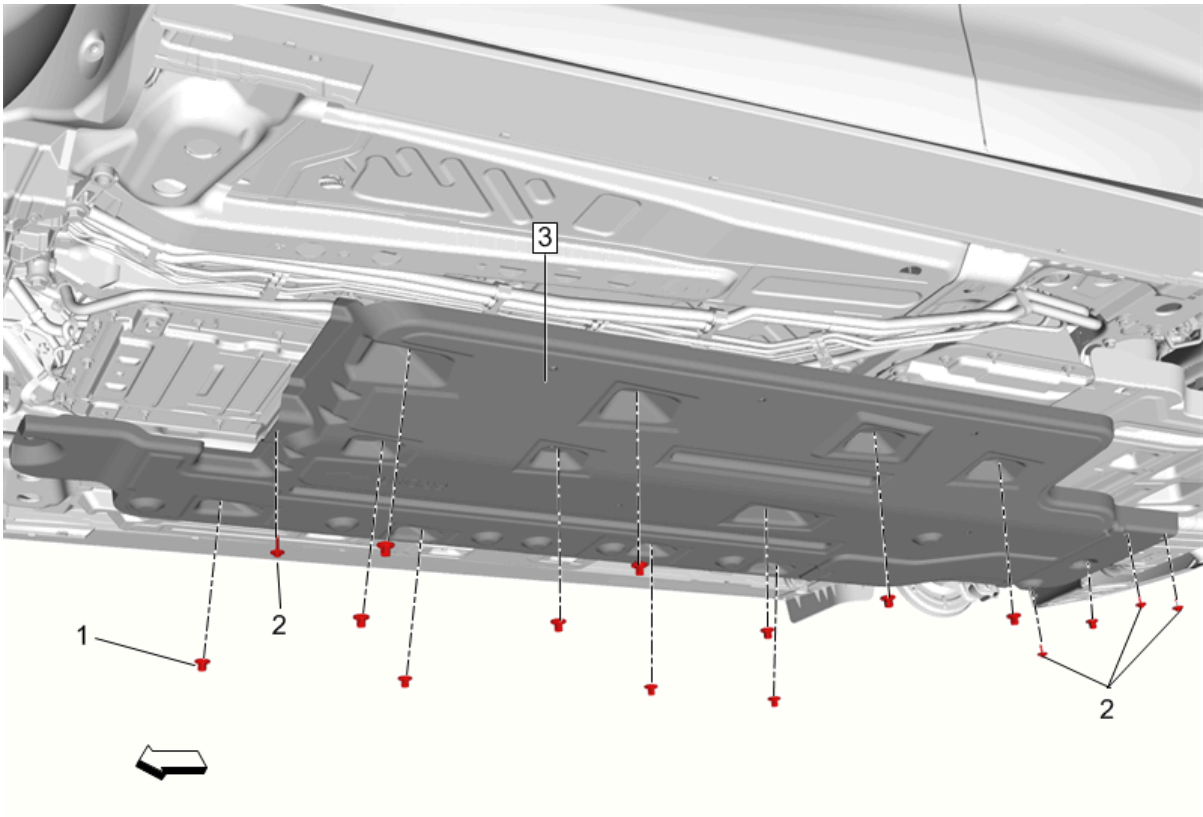


Fig. 4: Underbody Front Air Deflector - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Compartment Splash Shield Replacement</u>	
1	Underbody Front Air Deflector Nut (Qty: 12) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 3 N.m (27 lb in)
2	Underbody Front Air Deflector Bolt (Qty: 4) Tighten 2.5 N.m (22 lb in)
3	Underbody Front Air Deflector

UNDERBODY FRONT AIR DEFLECTOR REPLACEMENT - RIGHT SIDE

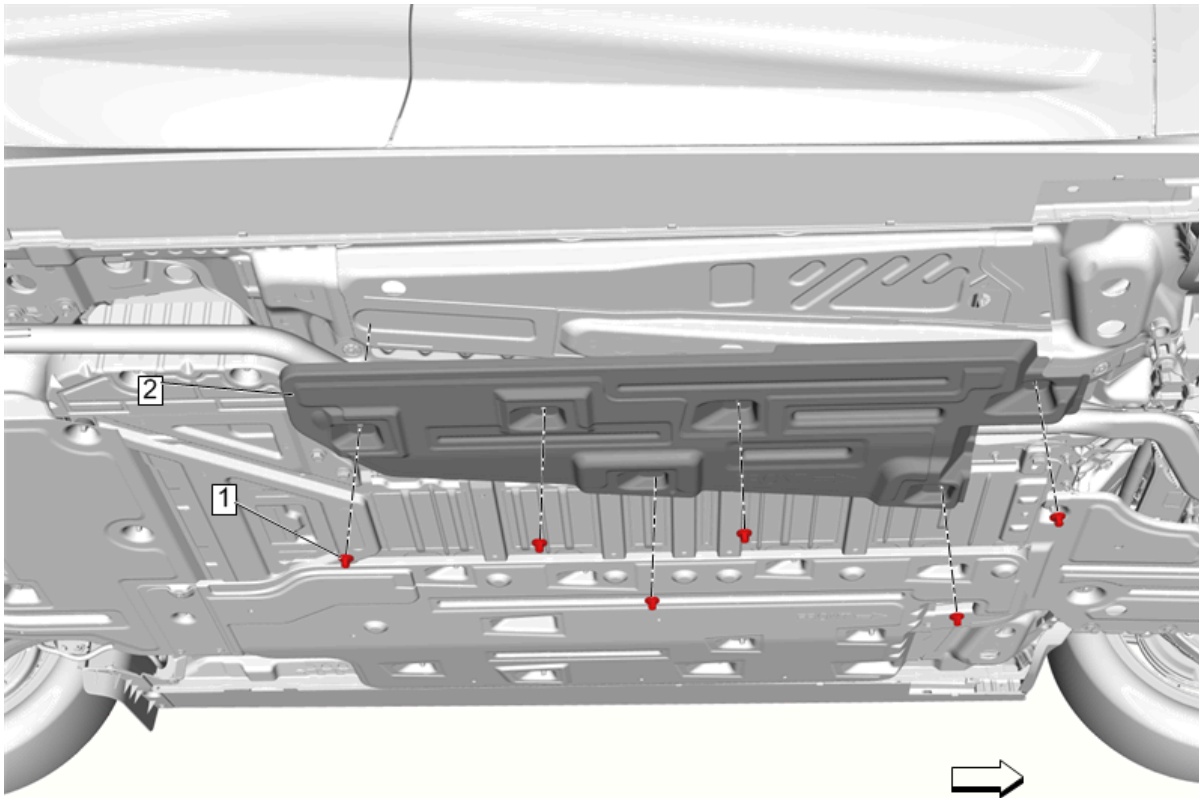


Fig. 5: Underbody Front Air Deflector - Right Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Underbody Front Air Deflector Nut (Qty: 6) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 3 N.m (27 lb in)
2	Underbody Front Air Deflector

UNDERBODY REAR AIR DEFLECTOR REPLACEMENT

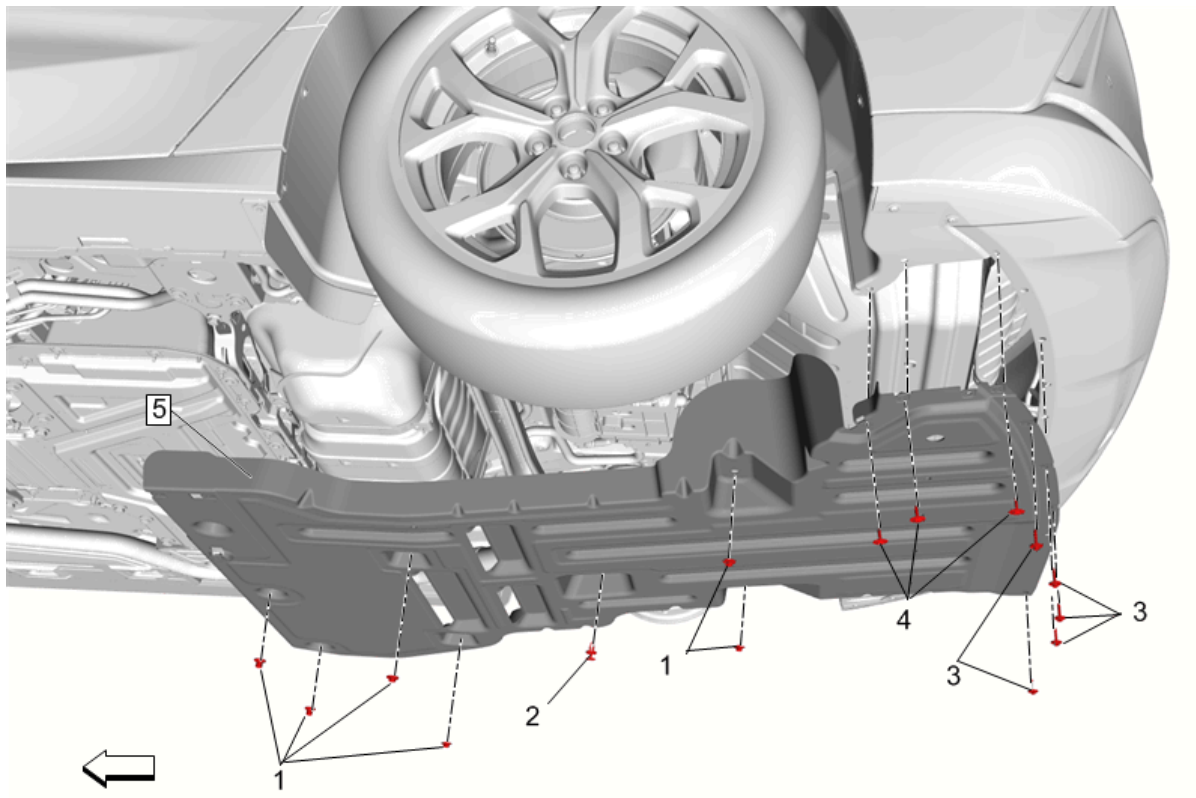


Fig. 6: Underbody Rear Air Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Underbody Front Air Deflector Replacement - Left Side</u>	
1	Underbody Rear Air Deflector Nut (Qty: 6) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 3 N.m (27 lb in)
2	Underbody Rear Air Deflector Push in Retainer
3	Underbody Rear Air Deflector Screw (Qty: 5) Tighten 2.5 N.m (22 lb in)
4	Rear Wheelhouse Liner Bolt (Qty: 3) Tighten 2.5 N.m (22 lb in)
5	Underbody Rear Air Deflector

DRIVETRAIN AND FRONT SUSPENSION CROSSMEMBER EXTENSION REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Support the radiator using mechanics wire.
2. Remove the drivetrain and front suspension cradle. [Drivetrain and Front Suspension Cradle Replacement](#)
3. Remove the front underbody air deflector. [Front Underbody Air Deflector Replacement](#)

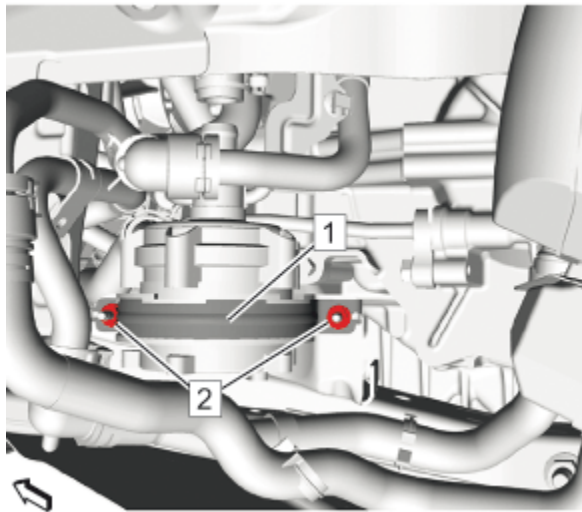


Fig. 7: Generator Control Module Coolant Pump Bracket And Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the generator control module coolant pump bracket (1) from the drivetrain and front suspension cross member extension. [Generator Control Module Coolant Pump Replacement](#)

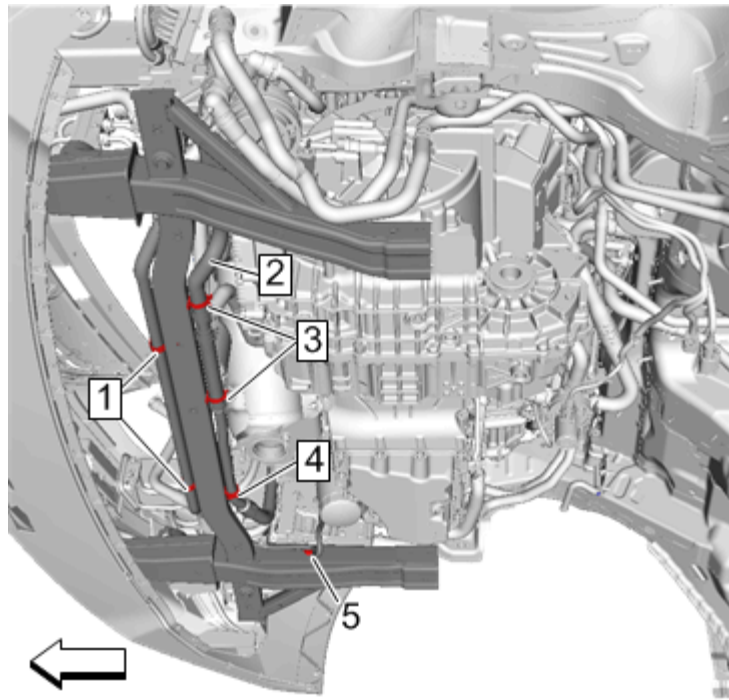


Fig. 8: Hose Clamps And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Remove the hose clamps (1, 4).
6. Disconnect the hose (2) from the clamps (3).
7. Disconnect the retainer (5) from the drivetrain and front suspension cross member extension.

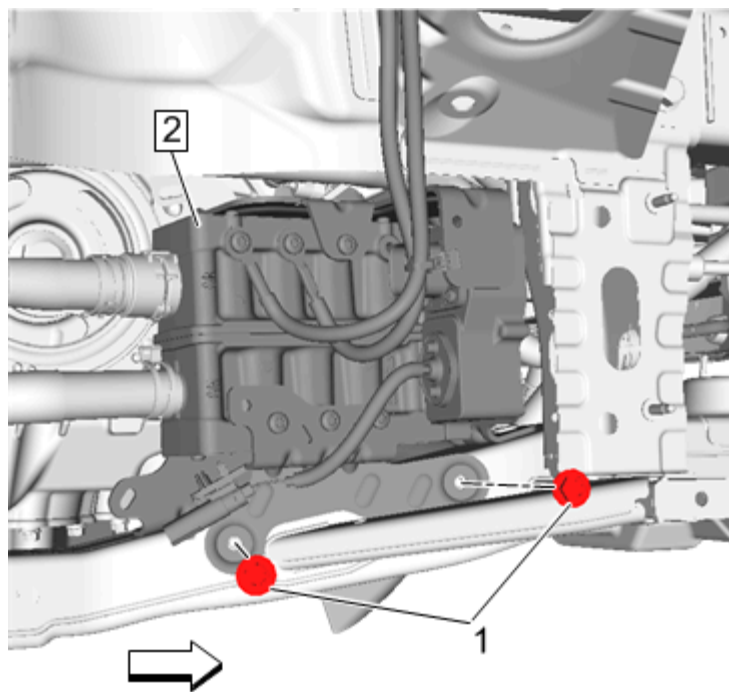


Fig. 9: Heater Coolant Heater And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the heater coolant heater bolts (1).

9. Support the heater coolant heater (2) with a strap or mechanics wire.
10. Disconnect all wiring harness retainers from the drivetrain and front suspension cross member extension.
11. Support the drivetrain and front suspension cross member extension using a suitable jack.

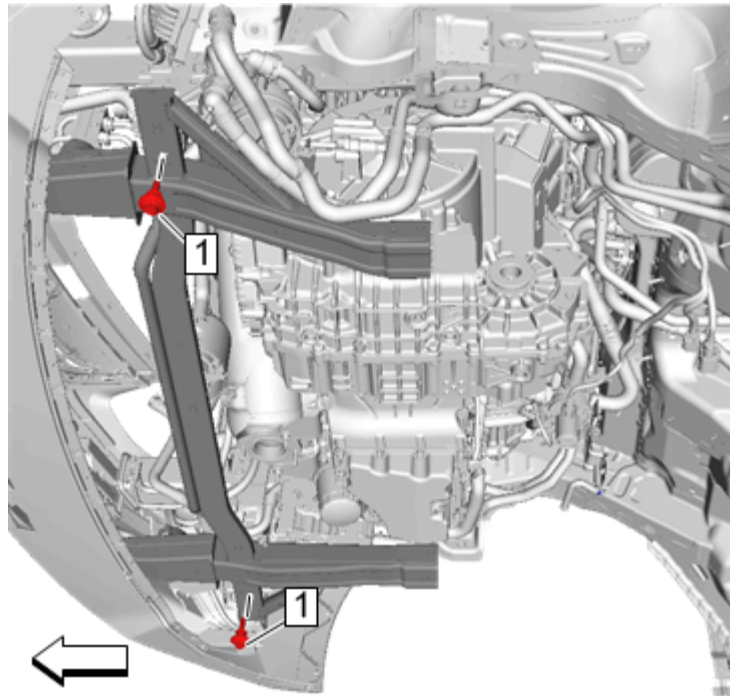


Fig. 10: Front Suspension Cross Member Extension Bolts

Courtesy of GENERAL MOTORS COMPANY

12. Remove and DISCARD the drivetrain and front suspension cross member extension bolts (1).

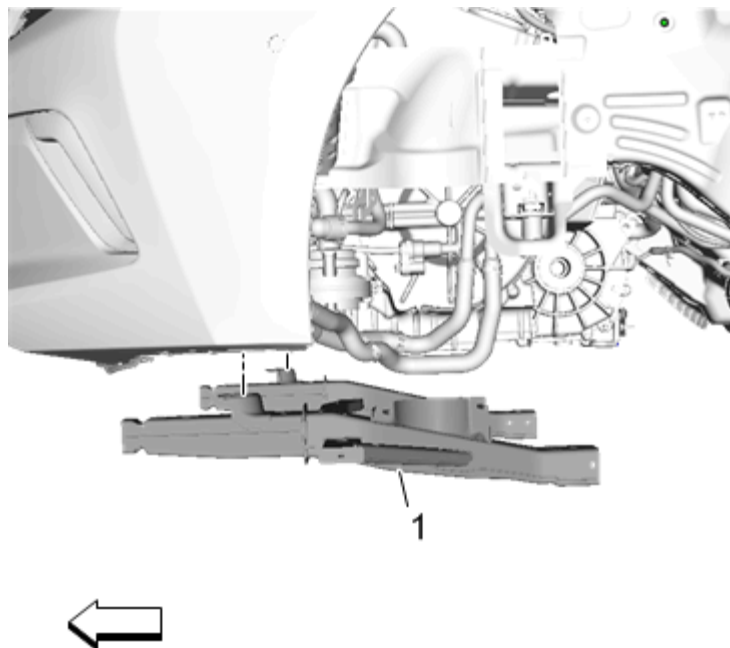


Fig. 11: Drivetrain And Front Suspension Cross Member Extension

Courtesy of GENERAL MOTORS COMPANY

13. Lower the drivetrain and front suspension cross member extension (1).

Installation Procedure

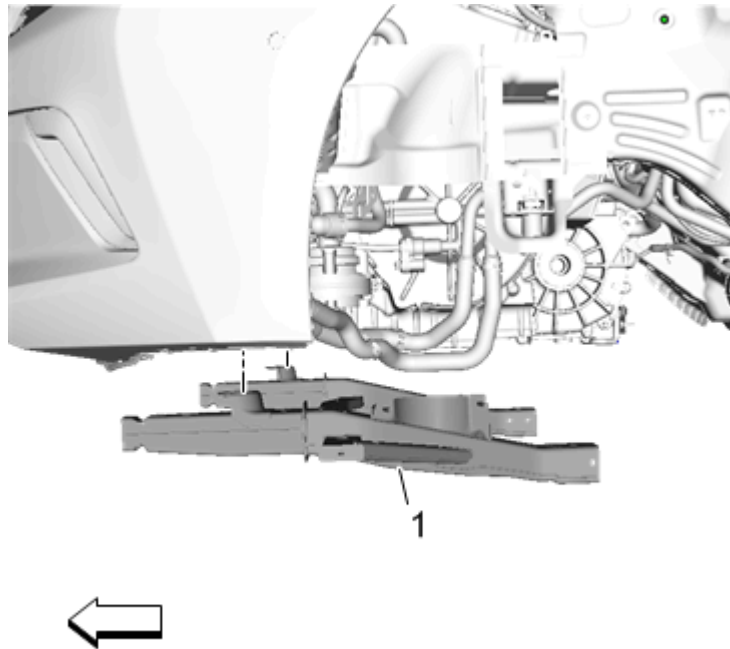


Fig. 12: Drivetrain And Front Suspension Cross Member Extension

Courtesy of GENERAL MOTORS COMPANY

1. Raise the drivetrain and front suspension cross member extension (1) into position.
2. Connect all wiring harness retainers to the drivetrain and front suspension cross member extension.

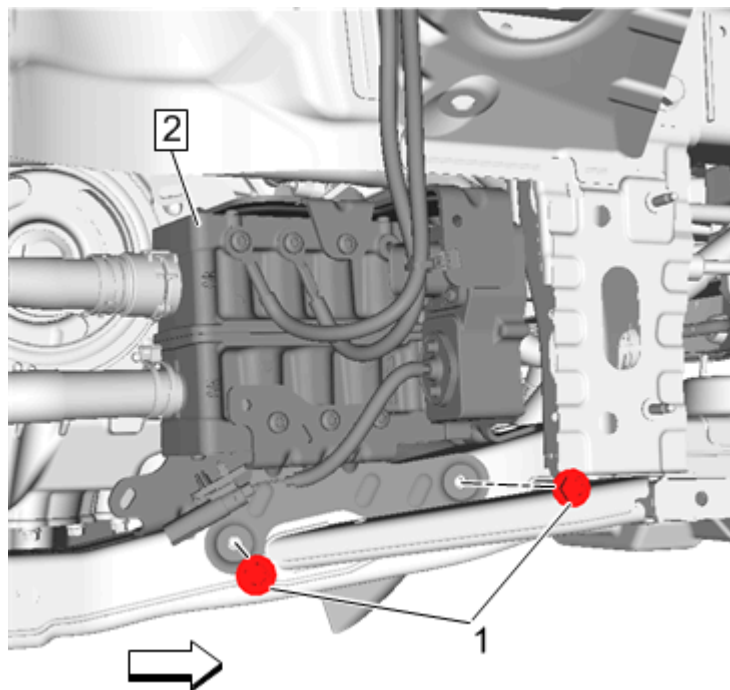


Fig. 13: Heater Coolant Heater And Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Install the heater coolant heater bolts (1) and tighten to 9 N.m (80 lb in).
4. Remove the strap or mechanics wire from the heater coolant heater.

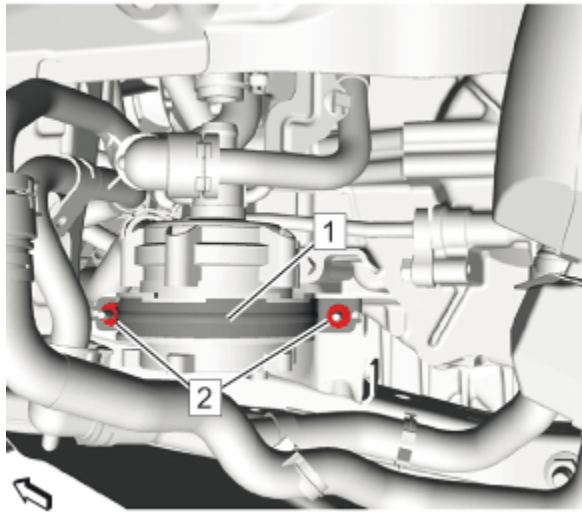


Fig. 14: Generator Control Module Coolant Pump Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Install the generator control module coolant pump bracket (1) to the drivetrain and front suspension cross member extension. Generator Control Module Coolant Pump Replacement

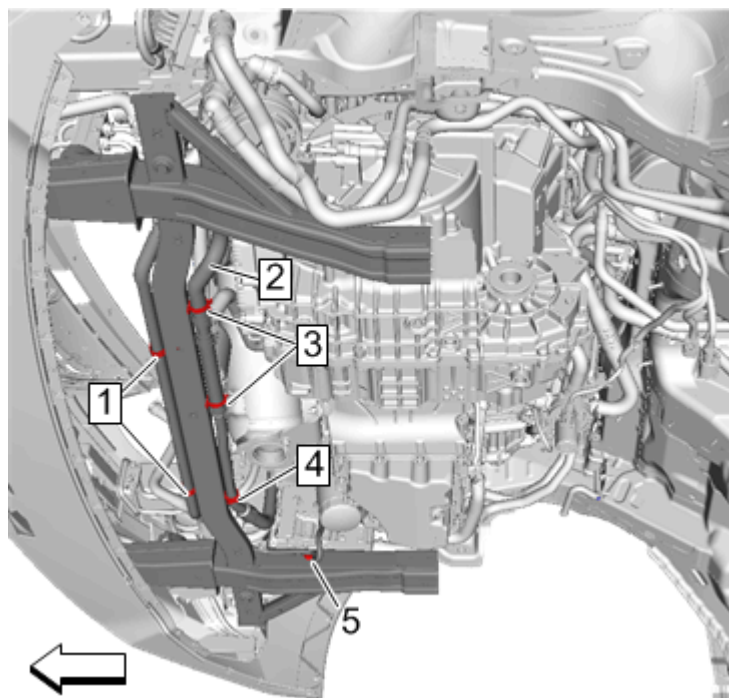
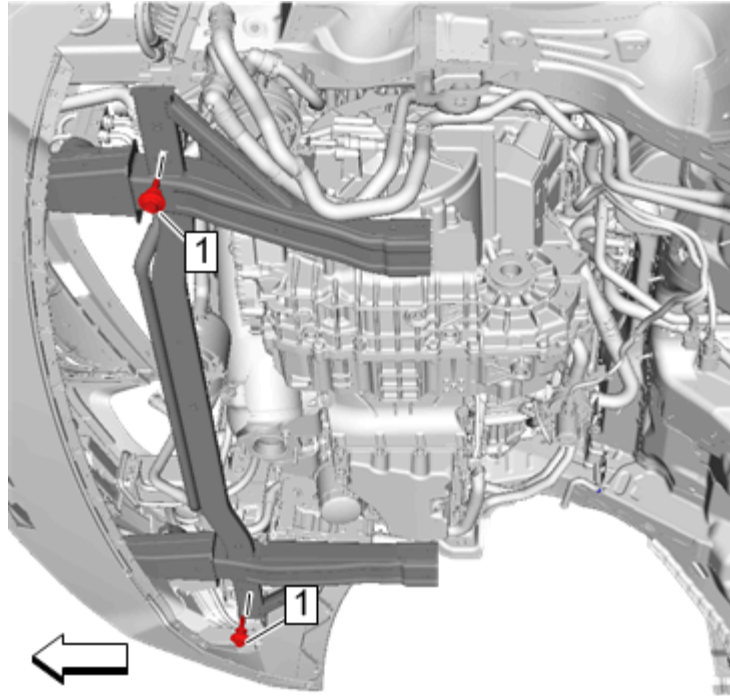


Fig. 15: Hose Clamps And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Install the hose clamps (1, 4).

7. Connect the hose (2) to the clamps (3).
8. Connect the retainer (5) from the drivetrain and front suspension cross member extension.
9. Loosely install the NEW drivetrain and front suspension cross member extension bolts to support the cradle extension.
10. Install the drivetrain and front suspension cradle. [Drivetrain and Front Suspension Cradle Replacement](#)
11. Remove the jack supporting the drivetrain and front suspension cross member extension.



[Fig. 16: Front Suspension Cross Member Extension Bolts](#)

Courtesy of GENERAL MOTORS COMPANY

WARNING: [Torque-to-Yield Fastener Warning](#)

CAUTION: [Fastener Caution](#)

12. Tighten the NEW drivetrain and front suspension cross member extension bolts (1) as follows:

Tighten:

1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 45 - 60 degrees use the **EN-45059** meter
13. Install the front underbody air deflector. [Front Underbody Air Deflector Replacement](#)
 14. Lower the vehicle. [Lifting and Jacking the Vehicle](#)
 15. Remove mechanics wire from the radiator.

DRIVETRAIN AND FRONT SUSPENSION CRADLE REPLACEMENT

Special Tools

- **EN-45059** Angle Meter
- **CH-51034** - A Cradle Alignment Pins

Equivalent regional tools: [Special Tools](#)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

NOTE: Vehicle alignment is not required if the cradle is being lowered or dropped to perform another procedure. This vehicle is equipped with a cradle to body aligning feature: cradle to body through holes or self-aligning pins that are part of the cradle or body. Only align if replacing the cradle with a **NEW** part and transferring components.

1. Disable the high voltage system. [High Voltage Disabling](#)
2. Disconnect the steering intermediate shaft from the steering gear. [Intermediate Steering Shaft Replacement](#)
3. Remove the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
4. Remove Front Wheelhouse Liner [Front Wheelhouse Liner Replacement \(Left Side\)](#)[Front Wheelhouse Liner Replacement \(Right Side\)](#)
5. Remove Front Underbody Air Deflector [Front Underbody Air Deflector Replacement](#)

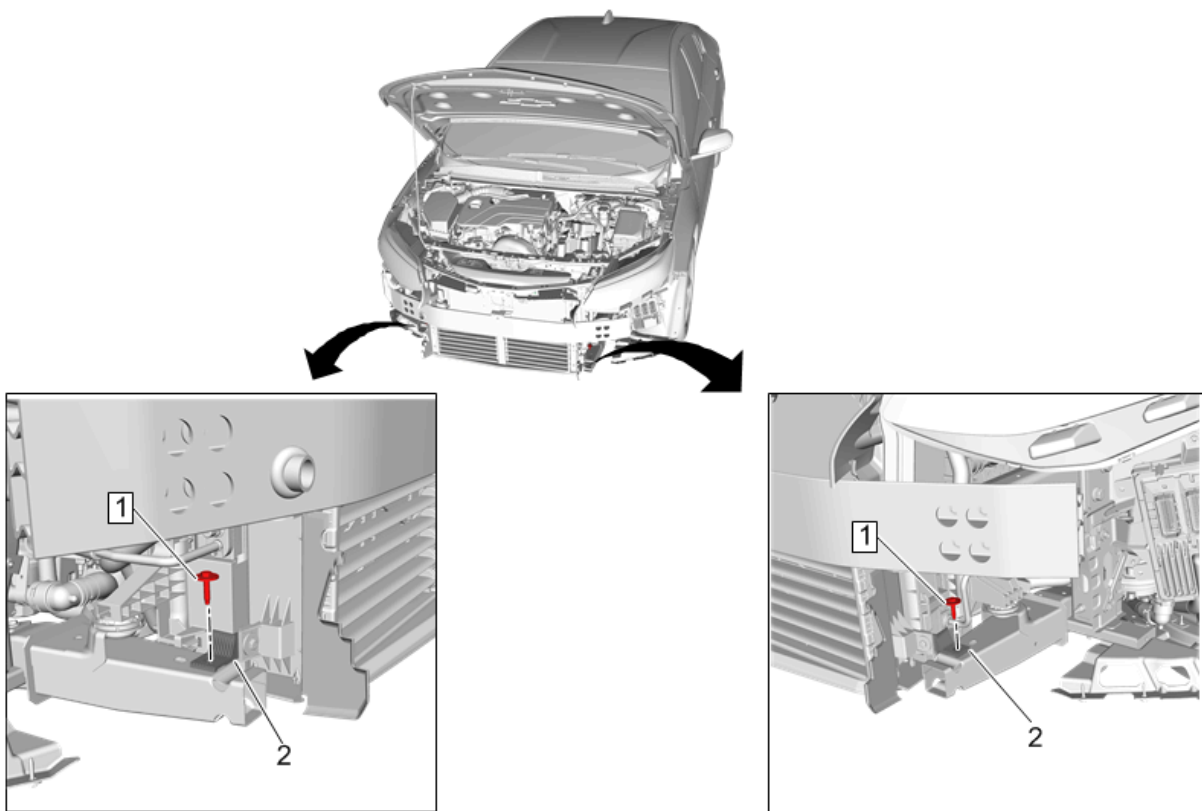


Fig. 17: Radiator Air Side Baffle Bolt And Radiator Air Lower Baffle Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Remove Radiator Air Side Baffle Bolt (1) @ Radiator Air Lower Baffle Bracket (2)

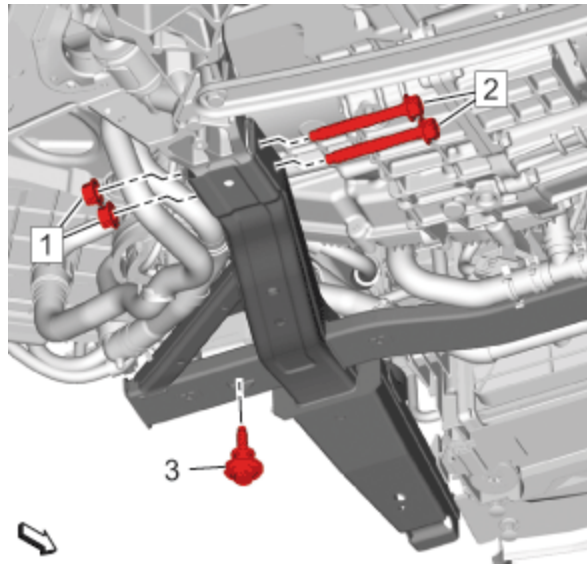


Fig. 18: Drivetrain And Front Suspension Crossmember Extension Fasteners
 Courtesy of GENERAL MOTORS COMPANY

7. Loosen Drivetrain and Front Suspension Cradle Extension Bolt (3)

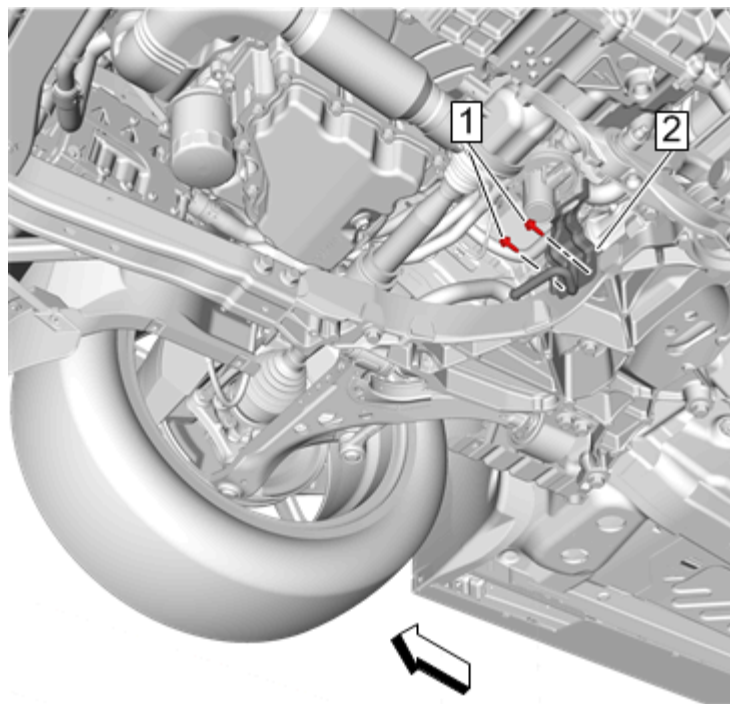


Fig. 19: Heater Water Bypass Valve Bracket Bolt And Heater Water Bypass Valve Bracket
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Heater Water Bypass Valve Bracket Bolt (1) @Heater Water Bypass Valve Bracket (2)

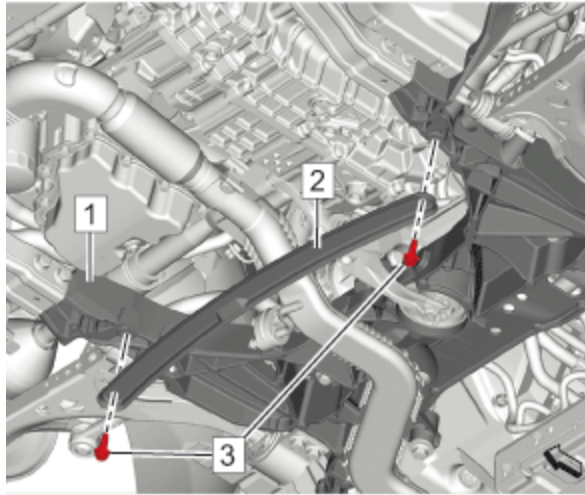


Fig. 20: Drivetrain And Front Suspension Cradle, Brace And Bolt
 Courtesy of GENERAL MOTORS COMPANY

9. Remove the drivetrain and front suspension brace (2) from the drivetrain and front suspension cradle (1).
10. Remove Exhaust Muffler [Exhaust Muffler Replacement](#)

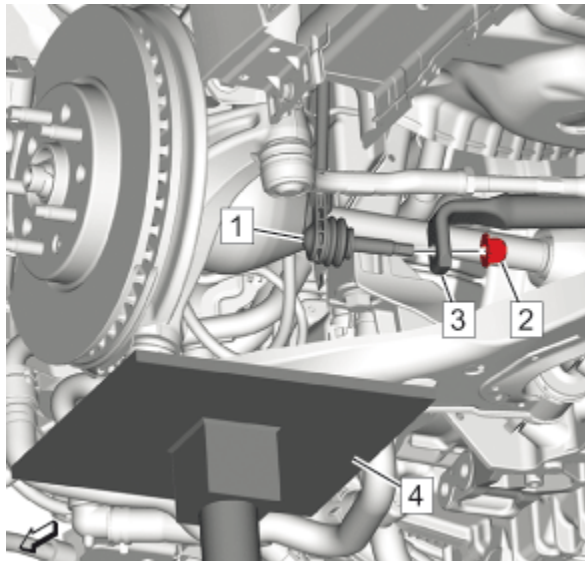


Fig. 21: Stabilizer Shaft Link, Stabilizer Shaft And Nut
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to release the nuts. Use a suitable tool.

NOTE: Support the front suspension with a hydraulic jack to disconnect the stabilizer shaft links.

11. Remove Stabilizer Shaft Link Nut (2)
12. Disconnect Stabilizer Shaft Link (1) @Stabilizer Shaft (3)

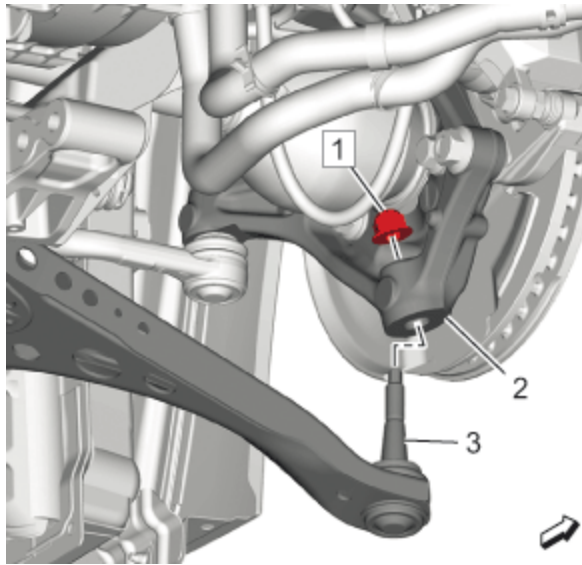


Fig. 22: Steering Knuckle, Lower Ball Joint And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the front suspension under the front lower control arm ball joint with a hydraulic jack to release the nut.

13. Remove Lower Ball Joint Nut (1)
14. Separate the steering knuckle (2) from the lower ball joint stud (3).
15. Disconnect the outer tie rod from the steering knuckle. [Steering Linkage Outer Tie Rod Replacement](#)

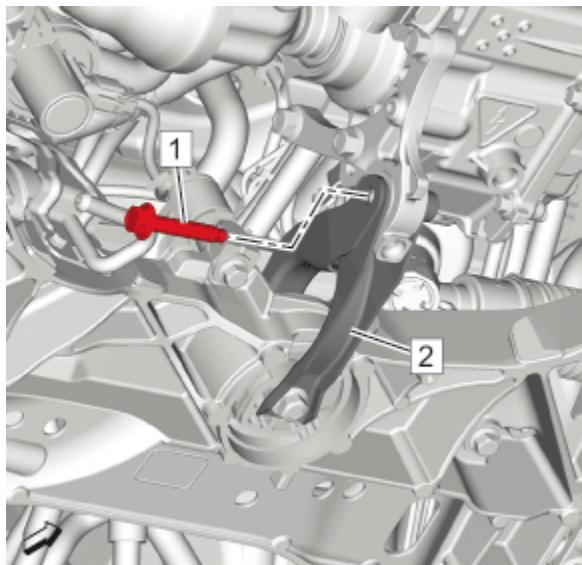


Fig. 23: Transmission Mount Strut Bolt And Transmission Mount Strut

Courtesy of GENERAL MOTORS COMPANY

16. Remove Transmission Mount Strut Bolt (1) @Transmission Mount Strut (2) and DISCARD

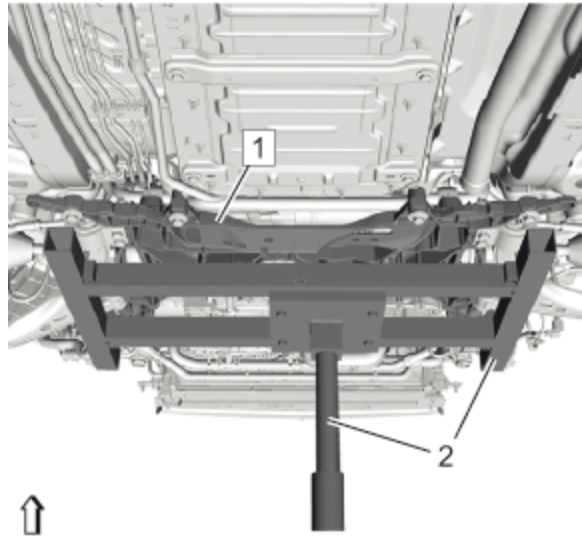


Fig. 24: Drivetrain And Front Suspension Cradle Supported With Suitable Hydraulic Jack
 Courtesy of GENERAL MOTORS COMPANY

17. Support the drivetrain and front suspension cradle (1) with a suitable hydraulic jack (2).
18. Wiring Harness@Drivetrain and Front Suspension Cradle - Disconnect as necessary
19. Wiring Harness@Electric Belt Drive Rack and Pinion Steering Gear - Disconnect as necessary

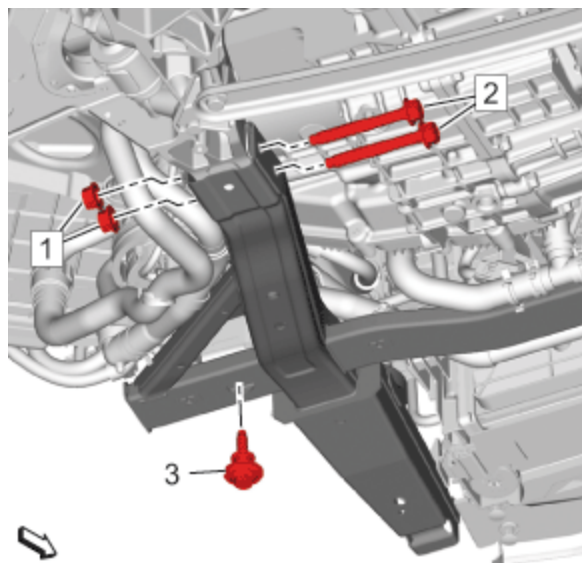


Fig. 25: Drivetrain And Front Suspension Crossmember Extension Fasteners
 Courtesy of GENERAL MOTORS COMPANY

20. Loosen the Drivetrain and Front Suspension Cradle (2) and Drivetrain and Front Suspension Cradle Extension bolts (3) and lower both cradle and extension until the 4 bolts (2) which attach the Drivetrain and Front Suspension Cradle to the Drivetrain and Front Suspension Cradle Extension can be removed.

NOTE: **Note: Drivetrain and Front Suspension Cradle Extension removal is not required for Drivetrain and Front Suspension Cradle replacement.**

21. Remove and DISCARD Drivetrain and Front Suspension Cradle to Drivetrain and Front Suspension

Cradle Extension bolts (2) and nuts (1).

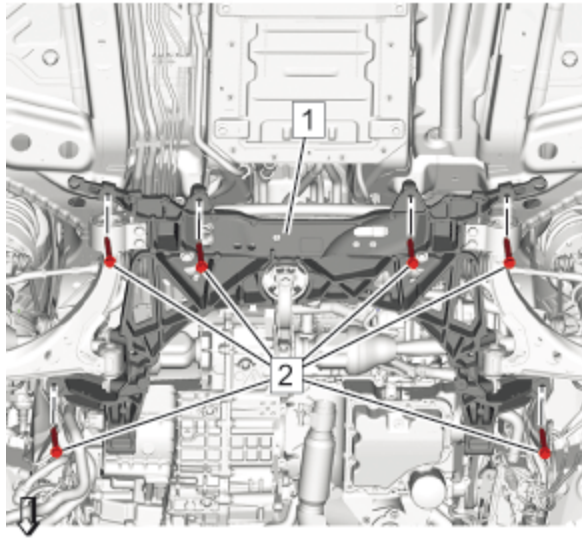


Fig. 26: Drivetrain And Front Suspension Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

22. Remove and DISCARD the drivetrain and front cradle bolts (2).
23. Carefully lower the drivetrain and front suspension cradle as far as necessary to disconnect the wiring harness.

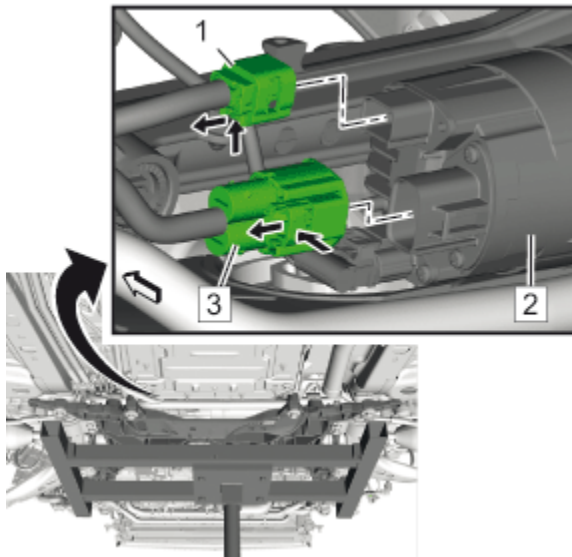


Fig. 27: Power Steering Assist Motor And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

NOTE: Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.

24. Disconnect Electrical Connector (1) @Power Steering Assist Motor (2)
25. Disconnect Electrical Connector (3) @Power Steering Assist Motor (2)

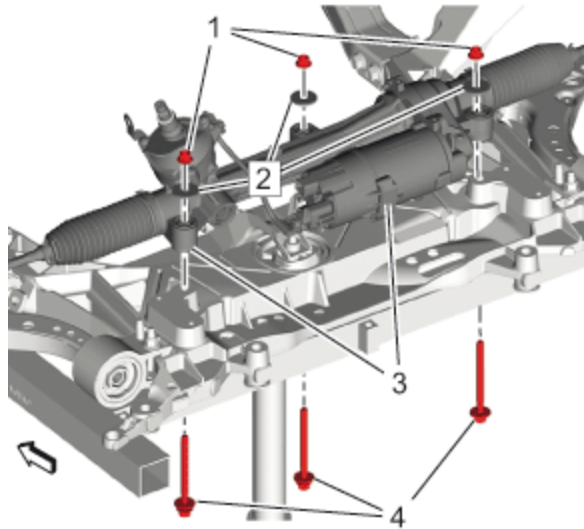


Fig. 28: Electric Belt Drive Rack And Pinion Steering Gear, Bolts, Nuts And Washers
 Courtesy of GENERAL MOTORS COMPANY

NOTE: If the steering gear bolts are not removed, the vehicle sheet metal could become distorted.

26. Remove the left 2 of the 3 steering gear bolts (4) and nuts (1) and DISCARD the bolts and nuts. Loosen the third bolt on the right, so the steering gear (3) can be pivoted forward as the cradle is lowered. This will allow the steering gear input shaft to clear the hole in the floor as the Drivetrain and Front Suspension Cradle is lowered.

NOTE: Continue to carefully lower the drivetrain and front suspension cradle, pivoting the steering gear, moving rearward and downward until the drivetrain and front suspension cradle is clear of the drivetrain and front suspension cradle extension.

27. Carefully lower the drivetrain and front suspension cradle.

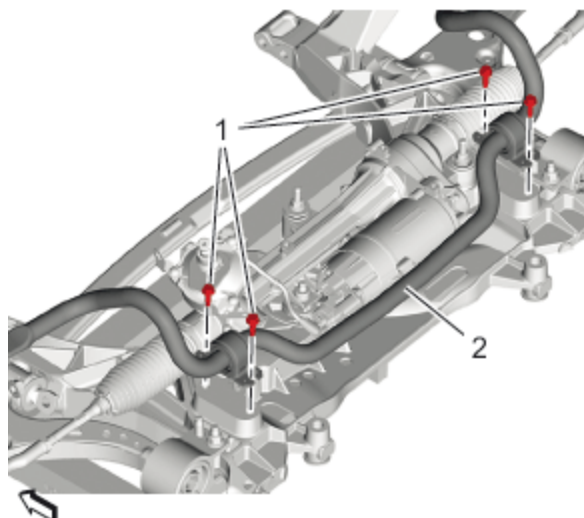


Fig. 29: Stabilizer Shaft And Bolts

Courtesy of GENERAL MOTORS COMPANY

- 28. Remove Stabilizer Shaft Bracket Bolt (1) and DISCARD
- 29. Remove Stabilizer Shaft (2)

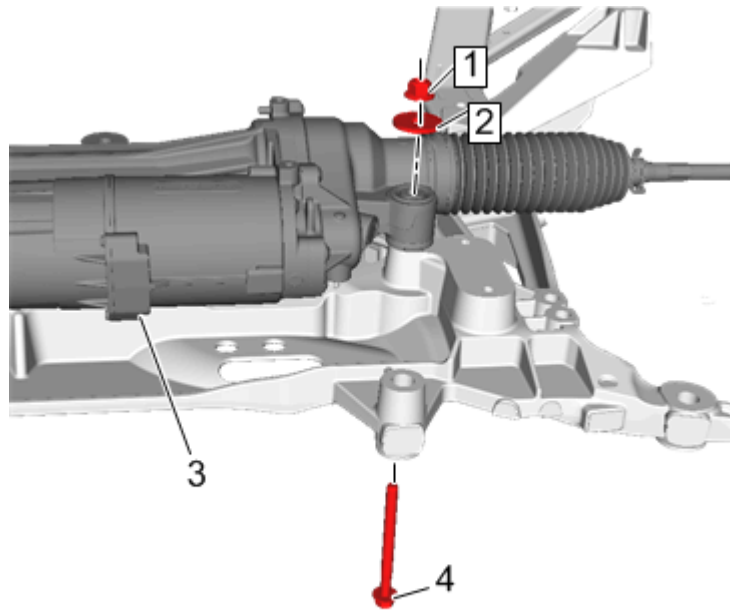


Fig. 30: Steering Gear Bolt And Electric Belt Drive Rack and Pinion Steering Gear
Courtesy of GENERAL MOTORS COMPANY

- 30. Remove Steering Gear Bolt (4) @ Electric Belt Drive Rack and Pinion Steering Gear (3) and DISCARD
- 31. Remove Steering Gear Nut (1) @Electric Belt Drive Rack and Pinion Steering Gear (3)
- 32. Remove the 3 washers (2) from the electric belt drive rack and pinion steering gear.
- 33. Remove Electric Belt Drive Rack and Pinion Steering Gear (3)

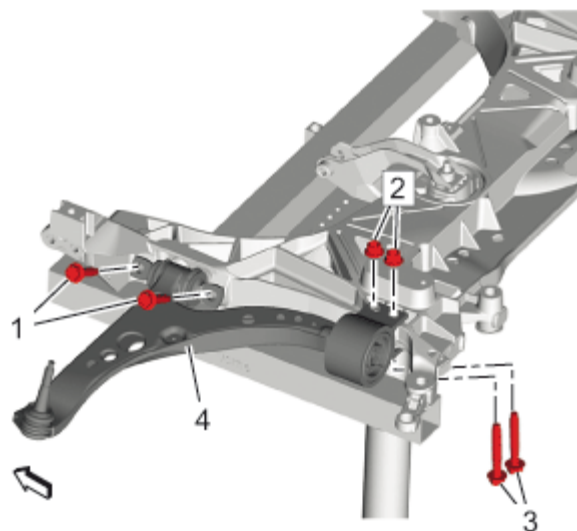


Fig. 31: Front Lower Control Arm, Bushing Bolts And Nuts

Courtesy of GENERAL MOTORS COMPANY

34. Remove Front Lower Control Arm Bushing Bolt (1) and DISCARD
35. Remove Front Lower Control Arm Rear Bushing Bolt (3) and DISCARD
36. Remove Front Lower Control Arm Rear Bushing Nut (2) and DISCARD
37. Remove Front Lower Control Arm (4)

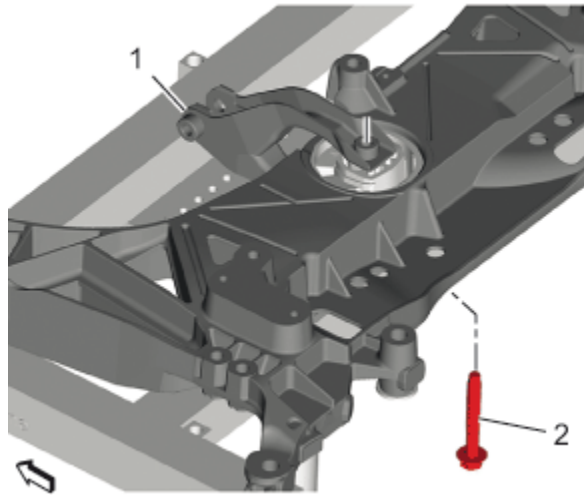


Fig. 32: Transmission Mount Strut And Bolt

Courtesy of GENERAL MOTORS COMPANY

38. Remove Transmission Mount Strut Bolt (2) and DISCARD
39. Remove Transmission Mount Strut (1)
40. Transfer components as necessary.

Installation Procedure

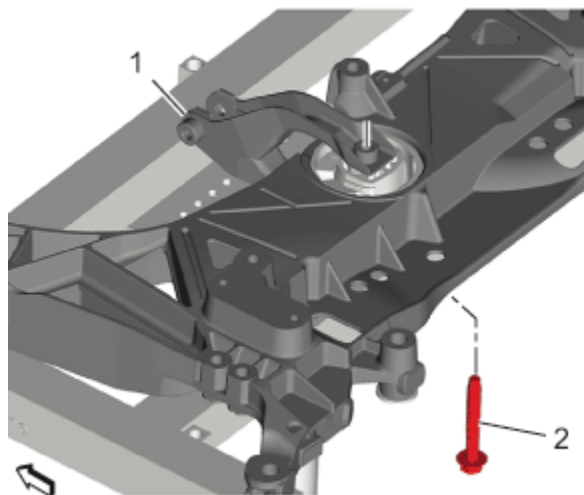


Fig. 33: Transmission Mount Strut And Bolt

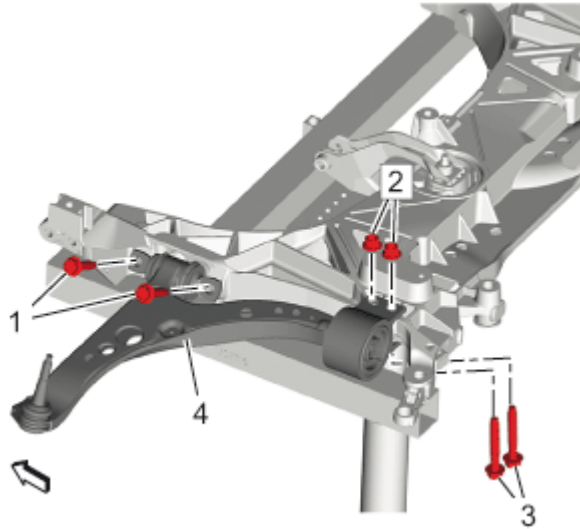
Courtesy of GENERAL MOTORS COMPANY

1. Install Transmission Mount Strut (1)

WARNING: [Torque-to-Yield Fastener Warning](#)

CAUTION: [Fastener Caution](#)

2. Install New Transmission Mount Strut Bolt (2)[Transmission Mount Strut Replacement](#)



[Fig. 34: Front Lower Control Arm, Bushing Bolts And Nuts](#)

Courtesy of GENERAL MOTORS COMPANY

3. Install Front Lower Control Arm (4)

WARNING: [Torque-to-Yield Fastener Warning](#)

4. Install New Front Lower Control Arm Rear Bushing Bolt (3)[Lower Control Arm Replacement](#)

5. Install New Front Lower Control Arm Rear Bushing Nut (2)[Lower Control Arm Replacement](#)

WARNING: [Torque-to-Yield Fastener Warning](#)

6. Install New Front Lower Control Arm Bushing Bolt (1)[Lower Control Arm Replacement](#)

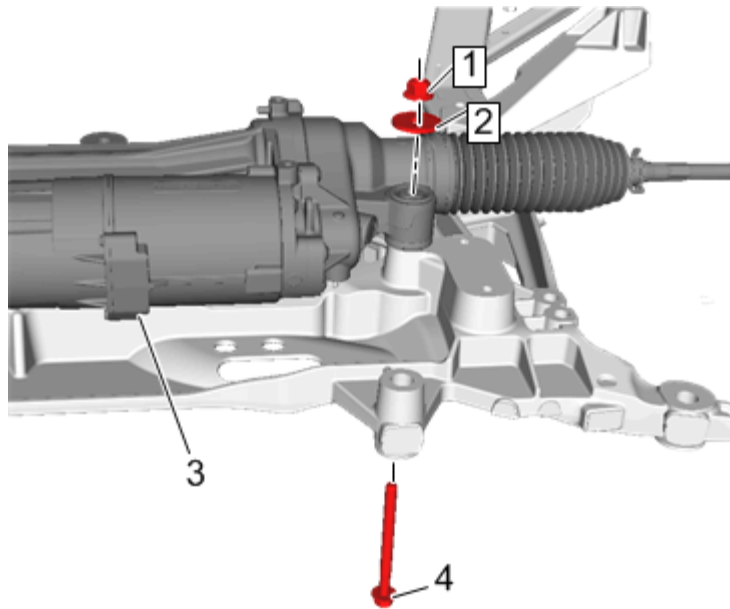


Fig. 35: Steering Gear Bolt And Electric Belt Drive Rack and Pinion Steering Gear
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install one new bolt (4), washer (2) and nut (1) loosely, on the right side to allow steering gear to pivot on cradle during drivetrain and front suspension cradle installation.

7. Install Electric Belt Drive Rack and Pinion Steering Gear ((3)
8. Install the 1 washer (2) to the electric belt drive rack and pinion steering gear.
9. Install Steering Gear Nut (1) @Electric Belt Drive Rack and Pinion Steering Gear
10. Install Steering Gear Bolt(4) @Electric Belt Drive Rack and Pinion Steering Gear (3)[Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)

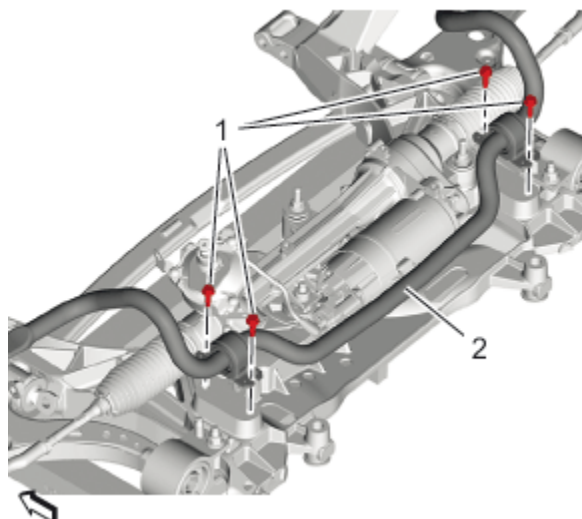


Fig. 36: Stabilizer Shaft And Bolts

Courtesy of GENERAL MOTORS COMPANY

11. Install Stabilizer Shaft (2)
12. Install Stabilizer Shaft Bracket Bolt (1) and tighten the NEW bolt. [Stabilizer Shaft Replacement](#)

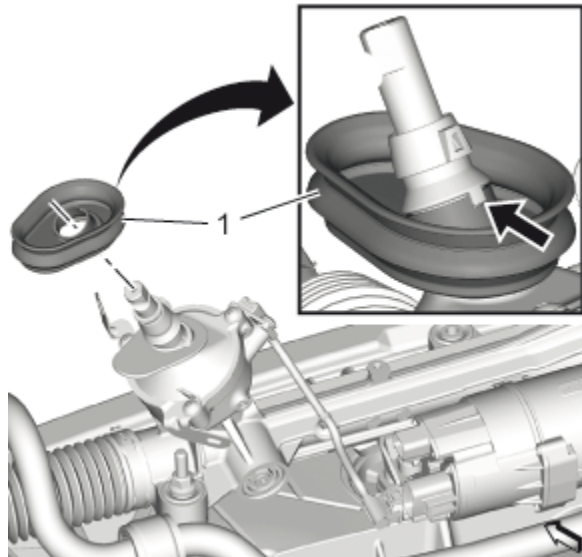


Fig. 37: Steering Column Dash Outer Seal

Courtesy of GENERAL MOTORS COMPANY

13. Make sure the notch in the steering column dash outer seal (1) is still correctly aligned to the nose on the electric belt drive rack and pinion steering gear.

NOTE: Pivot the electric belt drive rack and pinion steering forward as the drivetrain and front suspension cradle is being raised up to the vehicle. Insert the front horns of the drivetrain and front suspension cradle extension as the drivetrain and front suspension cradle gets closer to the body. Once the drivetrain and front suspension cradle is inserted into the drivetrain and front suspension cradle extension, pivot the steering gear rearward so steering shaft goes up into the floor as the cradle is raised up to the vehicle.

14. Raise the drivetrain and front suspension cradle to the vehicle.

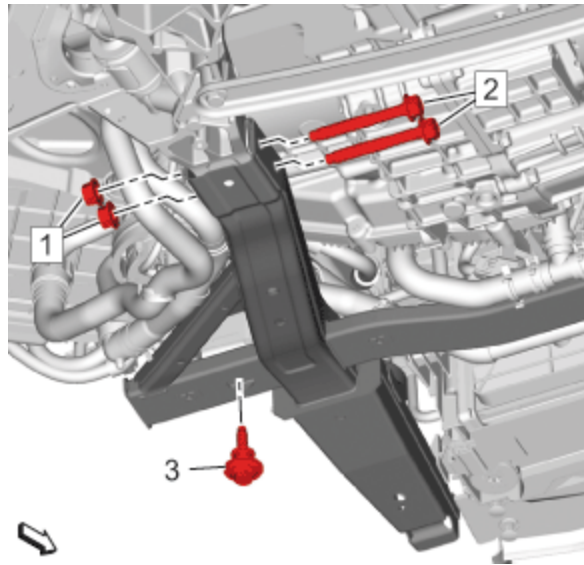


Fig. 38: Drivetrain And Front Suspension Crossmember Extension Fasteners
 Courtesy of GENERAL MOTORS COMPANY

15. Install New Insert NEW Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2)
16. Install New Drivetrain and Front Suspension Cradle Nut (1)

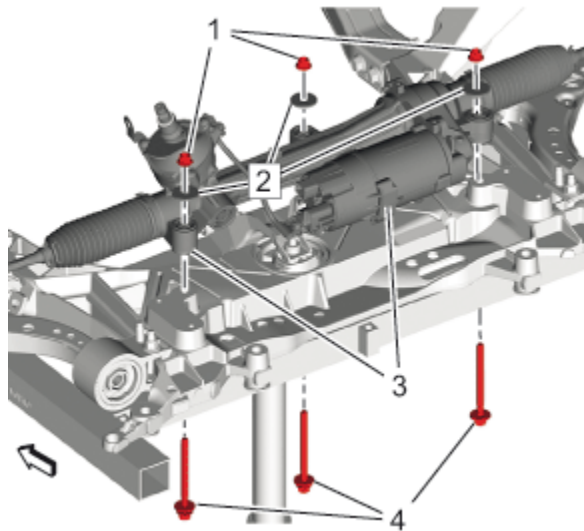


Fig. 39: Electric Belt Drive Rack And Pinion Steering Gear, Bolts, Nuts And Washers
 Courtesy of GENERAL MOTORS COMPANY

17. Install the two washers (2) to the electric belt drive rack and pinion steering gear.
18. Install the remaining steering gear bolts (4), washers (2) and nuts (1). **Electric Belt Drive Rack and Pinion Steering Gear Replacement**

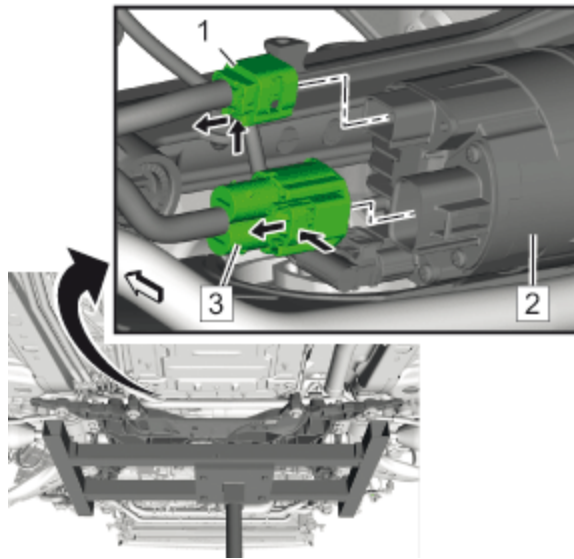


Fig. 40: Power Steering Assist Motor And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

19. Connect Electrical Connector(1)@Power Steering Assist Motor(2)
20. Connect Electrical Connector(3) @Power Steering Assist Motor (2)

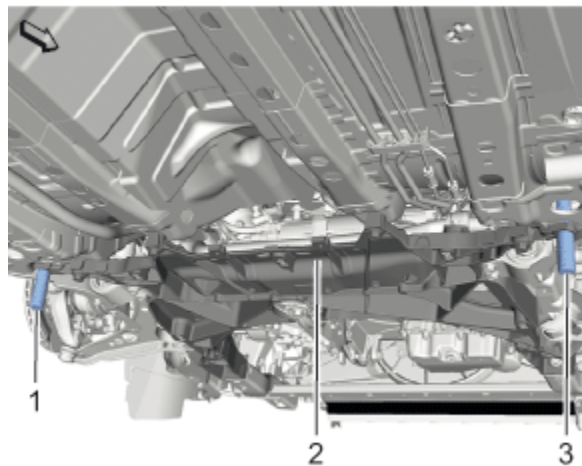


Fig. 41: Drivetrain And Front Suspension Cradle And Alignment Pins
 Courtesy of GENERAL MOTORS COMPANY

21. Install the 2 **CH-51034 - A** Cradle Alignment Pins (1, 3) to arrange the drivetrain and front suspension cradle during tightening.
22. Make sure that the drivetrain and front suspension cradle (2) fits closely to the vehicle.
23. Make sure that the 2 **CH-51034 - A** Cradle Alignment Pins fit closely to the drivetrain and front suspension cradle (2).

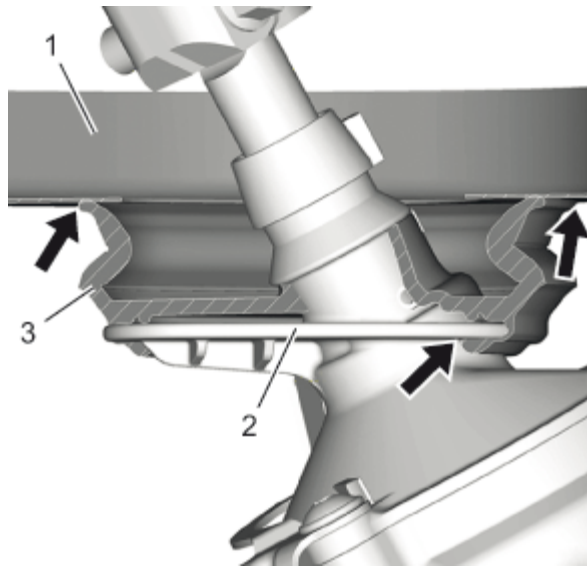


Fig. 42: Steering Column Dash Outer Seal, Electric Belt Drive Rack And Pinion Steering Gear
Courtesy of GENERAL MOTORS COMPANY

24. Make sure the steering column dash outer seal (3) fits correctly on the electric belt drive rack and pinion steering gear (2). See arrows.
25. Make sure the steering column dash outer seal (3) fits correctly on the dash panel front lower cross bar (1). See arrows.
26. Wiring Harness@Drivetrain and Front Suspension Cradle - Connect as necessary
27. Wiring Harness@Electric Belt Drive Rack and Pinion Steering Gear - Connect as necessary

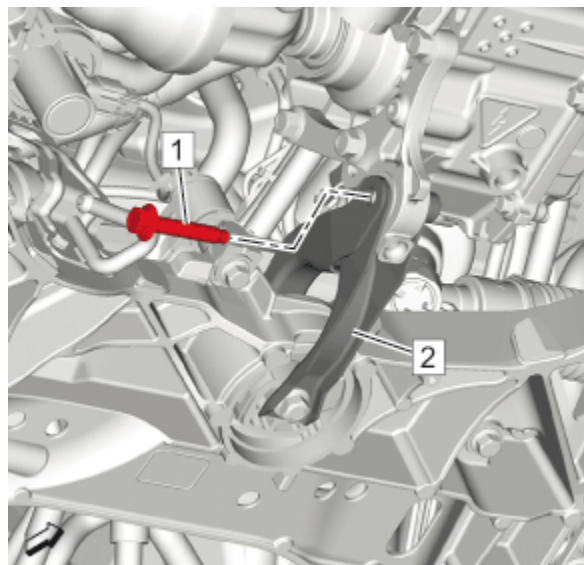


Fig. 43: Transmission Mount Strut Bolt And Transmission Mount Strut
Courtesy of GENERAL MOTORS COMPANY

28. Install New Transmission Mount Strut Bolt(1)@Transmission Mount Strut(2) - Do NOT tighten. - **Transmission Mount Strut Replacement**

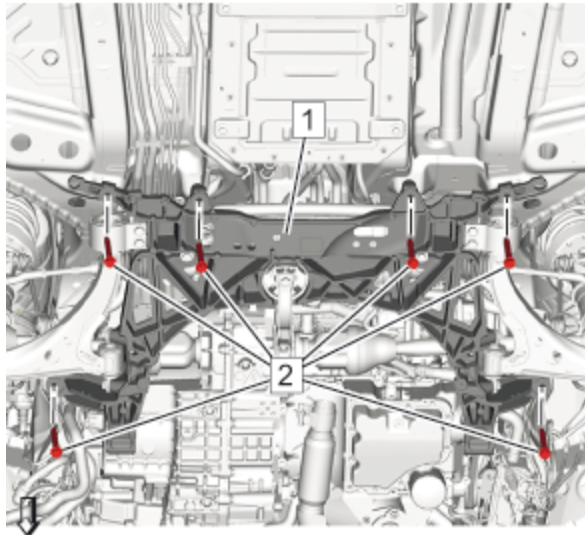


Fig. 44: Drivetrain And Front Suspension Cradle Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

29. Install New Drivetrain and Front Suspension Cradle Bolt (2).

Tighten:

1. First Pass:70 N.m (52 lb ft)
2. Final Pass:45 - 60 degrees, use the **EN-45059** meter

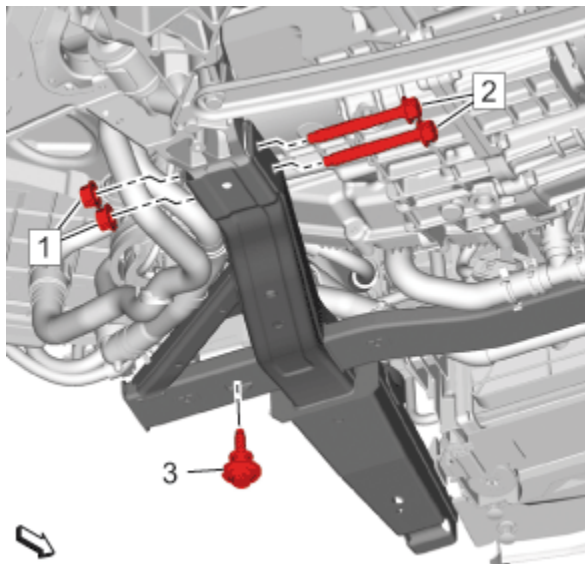


Fig. 45: Drivetrain And Front Suspension Crossmember Extension Fasteners

Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

30. Install New Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2).Drivetrain and Front Suspension Crossmember Extension Replacement

31. Install New Drivetrain and Front Suspension Crossmember Extension Bolt (3).[Drivetrain and Front Suspension Crossmember Extension Replacement](#)
32. Install New Drivetrain and Front Suspension Cradle Nut (1).

Tighten

1. First Pass:100 N.m (74 lb ft)
2. Final Pass: 45 - 60 Degrees, use the **EN-45059** Angle Meter

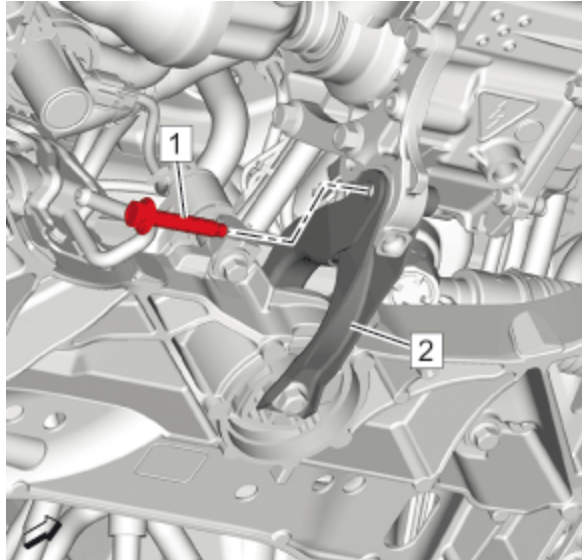


Fig. 46: Transmission Mount Strut Bolt And Transmission Mount Strut
Courtesy of GENERAL MOTORS COMPANY

WARNING: [Torque-to-Yield Fastener Warning](#)

33. Install New Transmission Mount Strut Bolt(1) @Transmission Mount Strut(2)[Transmission Mount Strut Replacement](#)

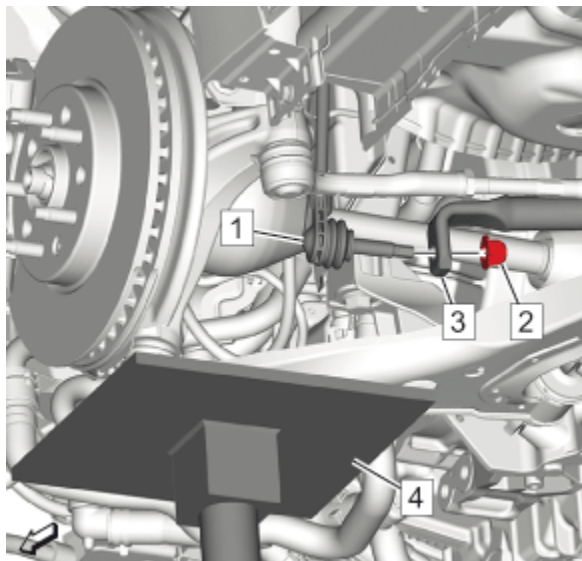


Fig. 47: Stabilizer Shaft Link, Stabilizer Shaft And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to tighten the nuts. Use a suitable tool.

NOTE: Support the front suspension with a hydraulic jack to connect the stabilizer shaft links.

34. Connect Stabilizer Shaft Link(1)@Stabilizer Shaft(3)

35. Install Stabilizer Shaft Link Nut(2)@Stabilizer Shaft Link(1) and tighten the nut - [Stabilizer Shaft Replacement](#)

36. Connect the outer tie rod to the steering knuckle [Steering Linkage Outer Tie Rod Replacement](#)

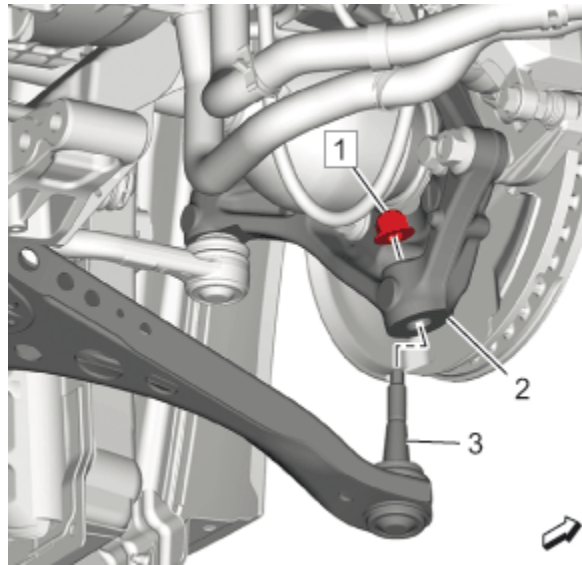


Fig. 48: Steering Knuckle, Lower Ball Joint And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the lower control arm under the ball joint with a hydraulic jack to tighten the nut.

37. Install the lower ball joint stud (3) to the steering knuckle (2).

WARNING: [Torque-to-Yield Fastener Warning](#)

38. Install Lower Ball Joint Nut (1)[Lower Control Arm Replacement](#)

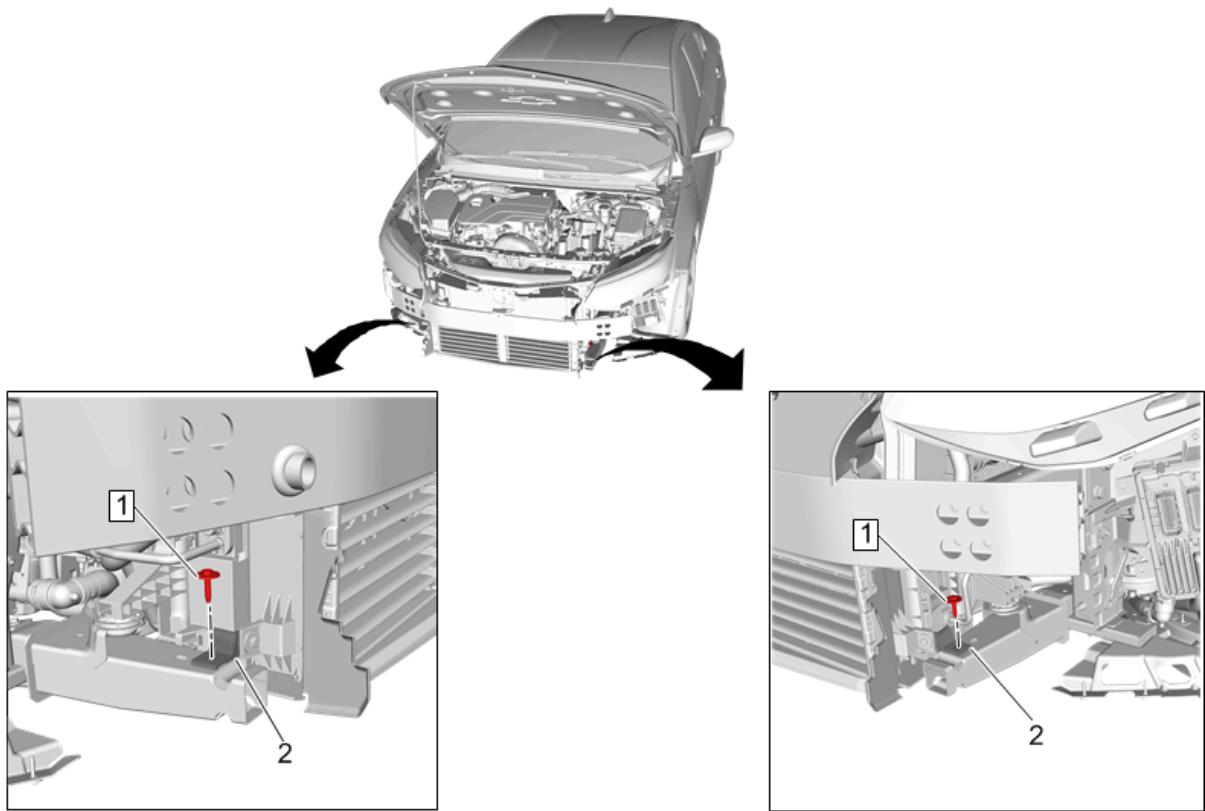


Fig. 49: Radiator Air Side Baffle Bolt And Radiator Air Lower Baffle Bracket

Courtesy of GENERAL MOTORS COMPANY

39. Install Radiator Air Side Baffle Bolt (1) @Radiator Air Lower Baffle Bracket (2) and tighten **Radiator Air Lower Baffle and Deflector Replacement**

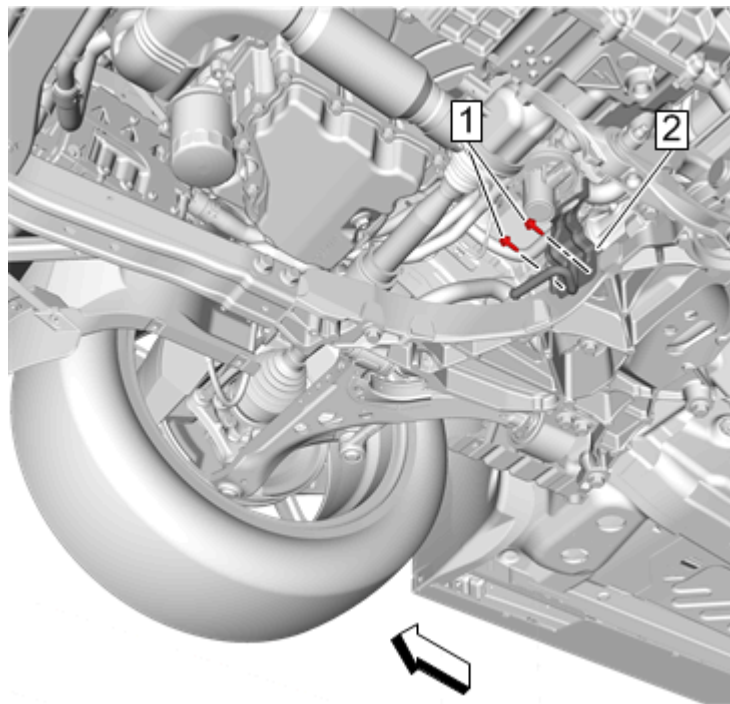


Fig. 50: Heater Water Bypass Valve Bracket Bolt And Heater Water Bypass Valve Bracket

Courtesy of GENERAL MOTORS COMPANY

40. Install Heater Water Bypass Valve Bracket Bolt (1) @Heater Water Bypass Valve Bracket (2) and tighten - [Heater Water Shutoff Valve Replacement](#)
41. Install Exhaust Muffler [Exhaust Muffler Replacement](#)

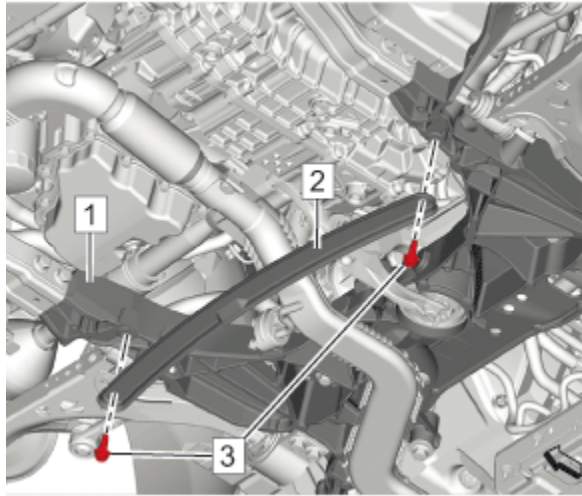


Fig. 51: Drivetrain And Front Suspension Cradle, Brace And Bolt
Courtesy of GENERAL MOTORS COMPANY

42. Install the drivetrain and front suspension brace (2) to the drivetrain and front suspension cradle (1).
43. Install Drivetrain and Front Suspension Cradle Bolt (3) and tighten 58 N.m (43 lb ft)
44. Install Front Underbody Air Deflector [Front Underbody Air Deflector Replacement](#)
45. Install Front Wheelhouse Liner [Front Wheelhouse Liner Replacement \(Left Side\)](#)[Front Wheelhouse Liner Replacement \(Right Side\)](#)
46. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
47. Connect the steering intermediate shaft to the steering gear. [Intermediate Steering Shaft Replacement](#)
48. Enable the high voltage system. [High Voltage Enabling](#)
49. Check the steering wheel angle sensor centering. [Steering Wheel Angle Sensor Centering](#)
50. If the drivetrain and front suspension cradle was replaced with a NEW cradle, perform a wheel alignment. [Wheel Alignment Measurement](#)

DRIVETRAIN AND FRONT SUSPENSION CRADLE REMOVAL AND INSTALLATION

Special Tools

- **EN-45059** Angle Meter
- **CH-51034** - A Cradle Alignment Pins

Equivalent regional tools: [Special Tools](#)

Removal Procedure

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap

to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

NOTE: Vehicle alignment is not required if cradle is being lowered or dropped to perform another procedure. This vehicle is equipped with a cradle to body aligning feature: cradle to body through holes or self-aligning pins that are part of cradle or body. Only align if replacing the cradle with NEW part and transferring components.

1. Disable the high voltage system. [High Voltage Disabling](#)
2. Disconnect the steering intermediate shaft from the steering gear. [Intermediate Steering Shaft](#)

Replacement

3. Remove the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
4. Remove Front Wheelhouse Liner [Front Wheelhouse Liner Replacement \(Left Side\)](#)[Front Wheelhouse Liner Replacement \(Right Side\)](#)
5. Remove Front Underbody Air Deflector [Front Underbody Air Deflector Replacement](#)

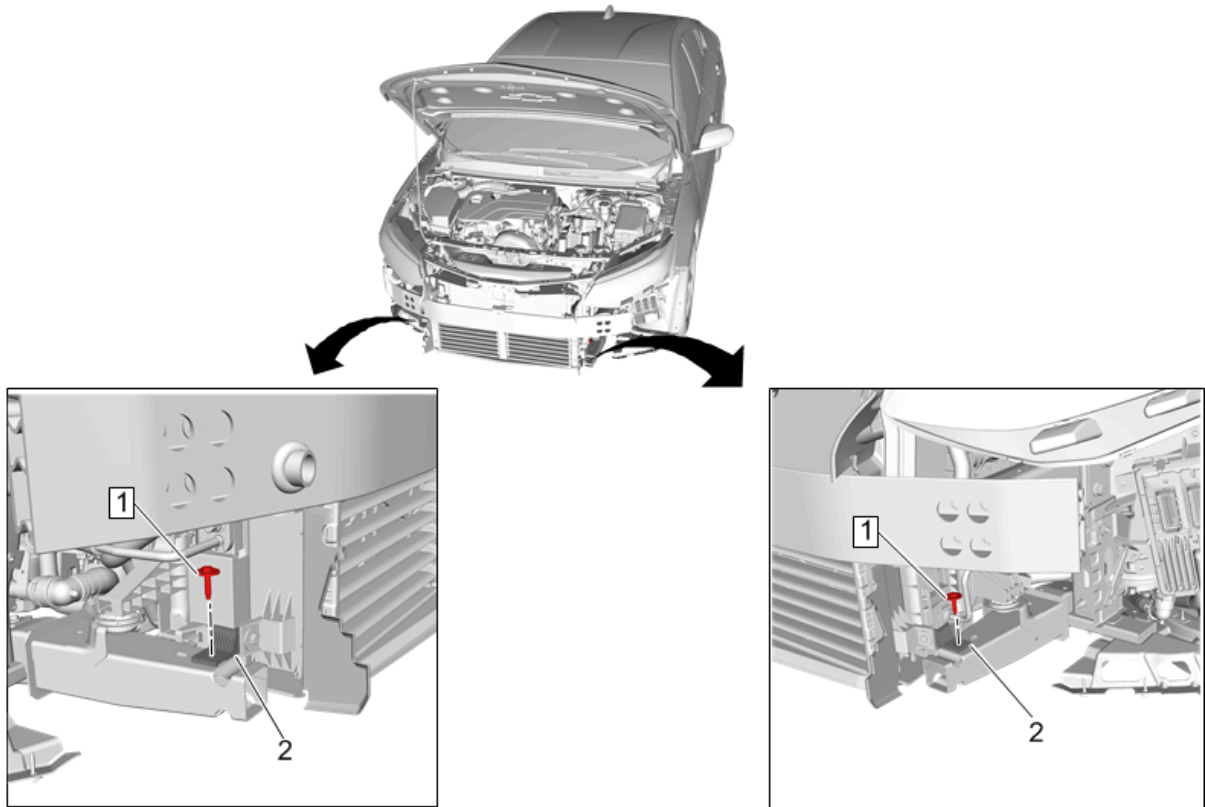


Fig. 52: Radiator Air Side Baffle Bolt And Radiator Air Lower Baffle Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Remove Radiator Air Side Baffle Bolt (1) @ Radiator Air Lower Baffle Bracket (2)

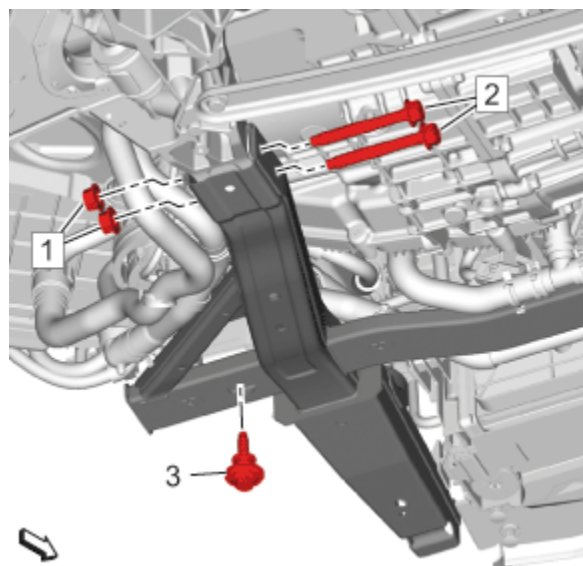


Fig. 53: Drivetrain And Front Suspension Crossmember Extension Fasteners
Courtesy of GENERAL MOTORS COMPANY

7. Loosen Drivetrain and Front Suspension Cradle Extension Bolt (3)

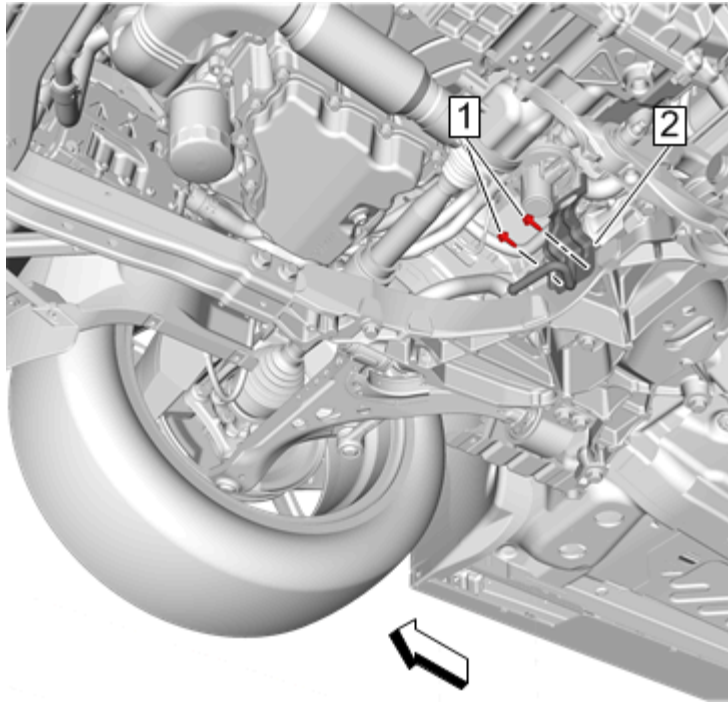


Fig. 54: Heater Water Bypass Valve Bracket Bolt And Heater Water Bypass Valve Bracket
Courtesy of GENERAL MOTORS COMPANY

8. Heater Water Bypass Valve Bracket Bolt (1) @Heater Water Bypass Valve Bracket (2)

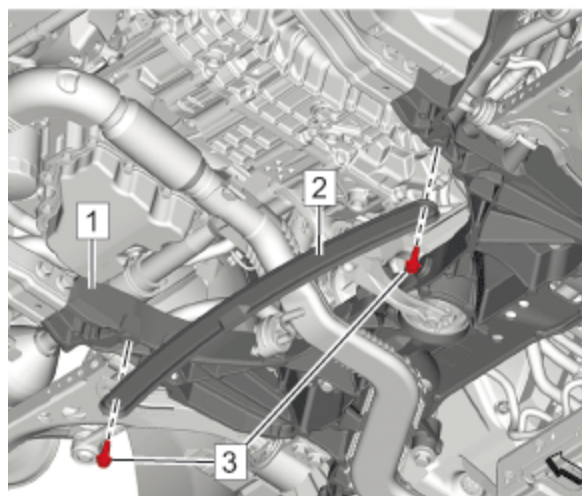


Fig. 55: Drivetrain And Front Suspension Cradle, Brace And Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove the drivetrain and front suspension brace (2) from the drivetrain and front suspension cradle (1).
10. Remove Exhaust Muffler [Exhaust Muffler Replacement](#)

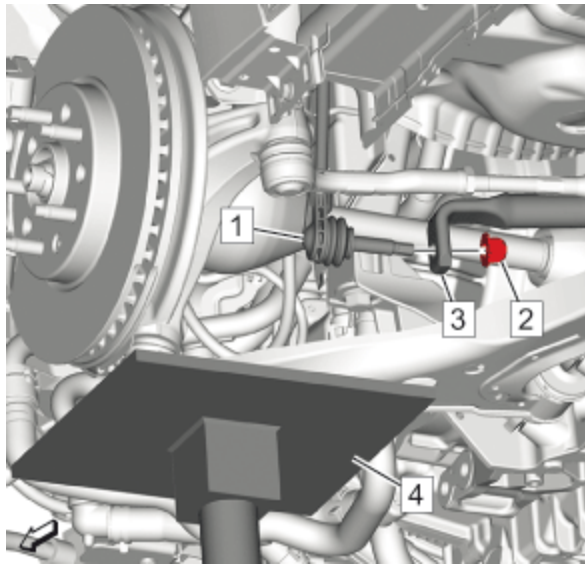


Fig. 56: Stabilizer Shaft Link, Stabilizer Shaft And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to release the nuts. Use a suitable tool.

NOTE: Support the front suspension with a hydraulic jack to disconnect the stabilizer shaft links.

11. Remove Stabilizer Shaft Link Nut (2)
12. Disconnect Stabilizer Shaft Link (1) @Stabilizer Shaft(3)

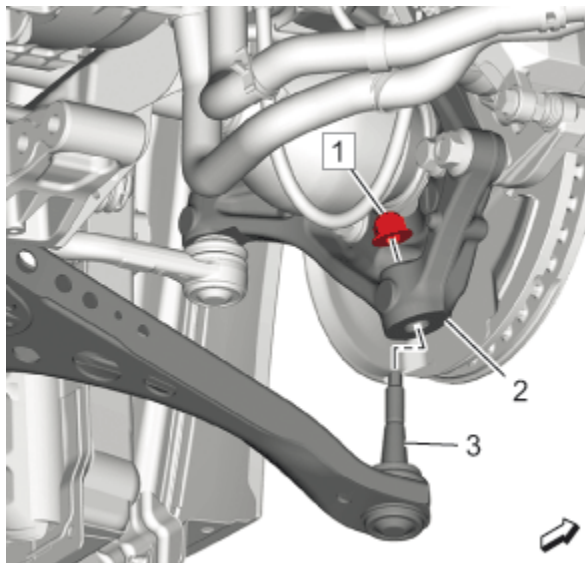


Fig. 57: Steering Knuckle, Lower Ball Joint And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the front suspension under the front lower control arm ball joint with a hydraulic jack to release the nut.

13. Remove Lower Ball Joint Nut (1)
14. Separate the steering knuckle (2) from the lower ball joint stud (3).
15. Disconnect the outer tie rod from the steering knuckle. [Steering Linkage Outer Tie Rod Replacement](#)

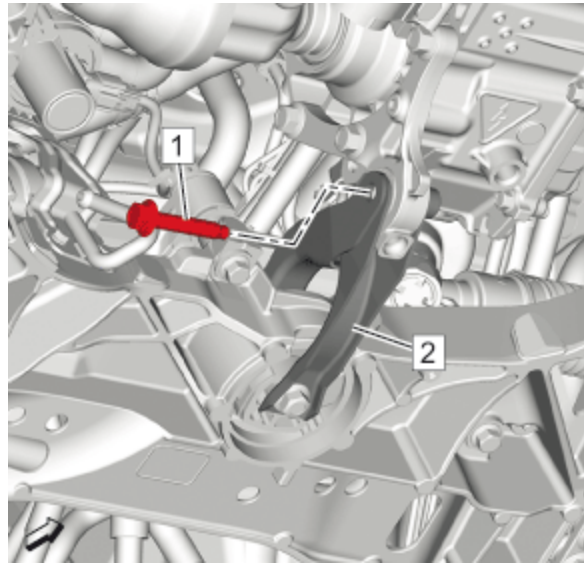


Fig. 58: Transmission Mount Strut Bolt And Transmission Mount Strut
Courtesy of GENERAL MOTORS COMPANY

16. Remove Transmission Mount Strut Bolt (1) @Transmission Mount Strut (2) and DISCARD

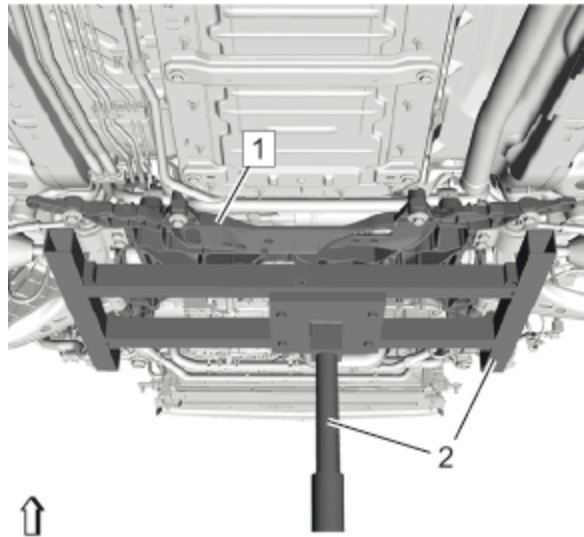


Fig. 59: Drivetrain And Front Suspension Cradle Supported With Suitable Hydraulic Jack
Courtesy of GENERAL MOTORS COMPANY

17. Support the drivetrain and front suspension cradle (1) with a suitable hydraulic jack (2).
18. Wiring Harness@Drivetrain and Front Suspension Cradle - Disconnect as necessary
19. Wiring Harness@Electric Belt Drive Rack and Pinion Steering Gear - Disconnect as necessary

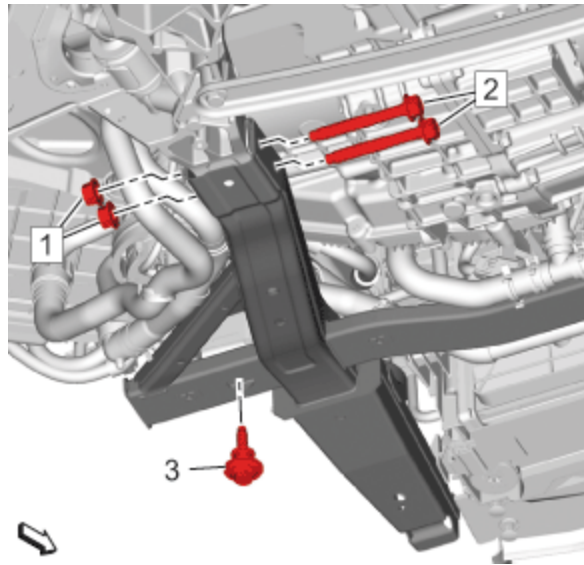


Fig. 60: Drivetrain And Front Suspension Crossmember Extension Fasteners
Courtesy of GENERAL MOTORS COMPANY

20. Loosen the Drivetrain and Front Suspension Cradle (2) and Drivetrain and Front Suspension Cradle Extension bolts (3) and lower both cradle and extension until the 4 bolts (2) which attach the Drivetrain and Front Suspension Cradle to the Drivetrain and Front Suspension Cradle Extension can be removed.

NOTE: **Note: Drivetrain and Front Suspension Cradle Extension removal is not required for Drivetrain and Front Suspension Cradle replacement.**

21. Remove and DISCARD Drivetrain and Front Suspension Cradle to Drivetrain and Front Suspension Cradle Extension bolts (2) and nuts (1).

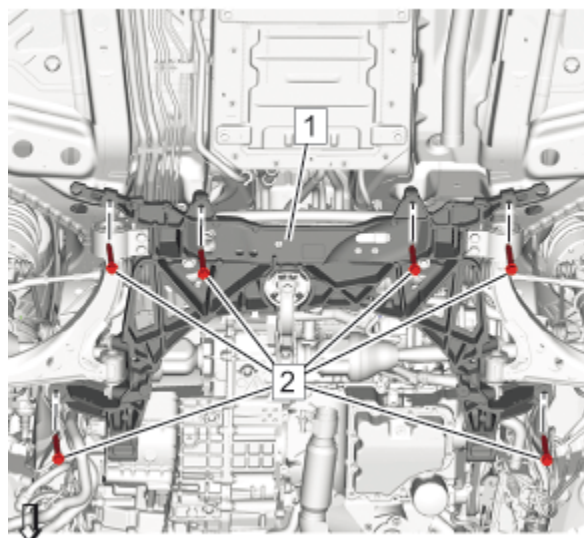


Fig. 61: Drivetrain And Front Suspension Cradle Bolts
Courtesy of GENERAL MOTORS COMPANY

22. Remove and DISCARD the drivetrain and front cradle bolts (2).
23. Carefully lower the drivetrain and front suspension cradle as far as necessary to disconnect the wiring

harness.

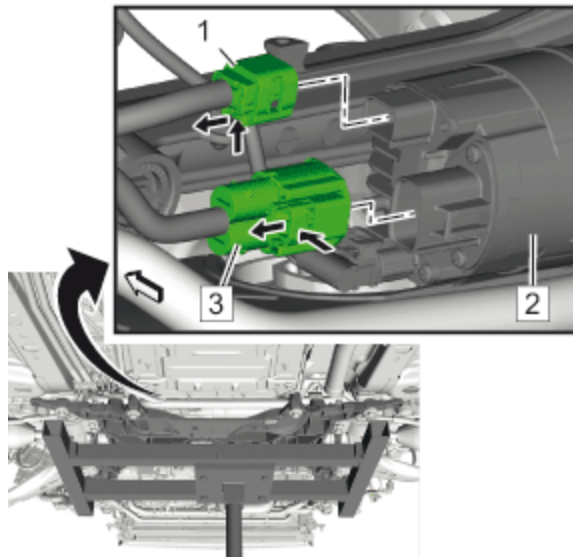


Fig. 62: Power Steering Assist Motor And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

NOTE: Wiring harness routing is critical. Note the exact routing of the steering gear wiring harness before repositioning it.

24. Disconnect Electrical Connector(1)@Power Steering Assist Motor (2)

25. Disconnect Electrical Connector (3) @Power Steering Assist Motor (2)

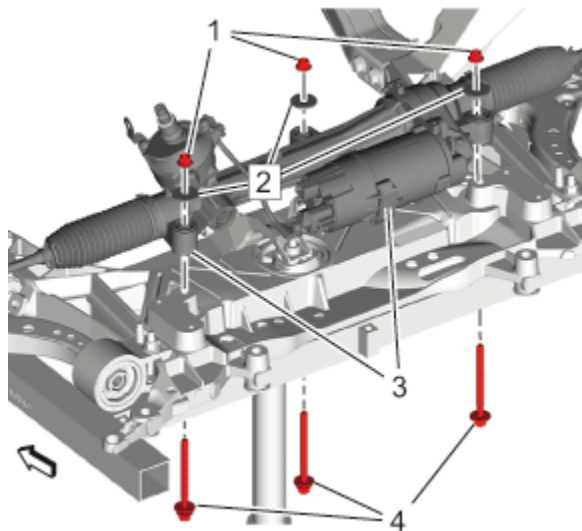


Fig. 63: Electric Belt Drive Rack And Pinion Steering Gear, Bolts, Nuts And Washers

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the steering gear bolts are not removed, the vehicle sheet metal could become distorted.

26. Remove the left 2 of the 3 steering gear bolts (4) and nuts (1) and DISCARD the bolts and nuts. Loosen

the third bolt on the right, so the steering gear (3) can be pivoted forward as the cradle is lowered. This will allow the steering gear input shaft to clear the hole in the floor as the Drivetrain and Front Suspension Cradle is lowered.

NOTE: Continue to carefully lower the drivetrain and front suspension cradle, pivoting the steering gear, moving rearward and downward until the drivetrain and front suspension cradle is clear of the drivetrain and front suspension cradle extension.

27. Carefully lower the drivetrain and front suspension cradle.

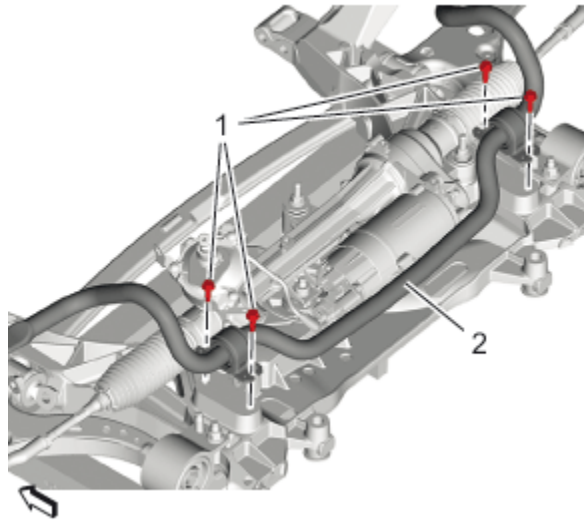


Fig. 64: Stabilizer Shaft And Bolts

Courtesy of GENERAL MOTORS COMPANY

28. Remove Stabilizer Shaft Bracket Bolt (1) and DISCARD

29. Remove Stabilizer Shaft (2)

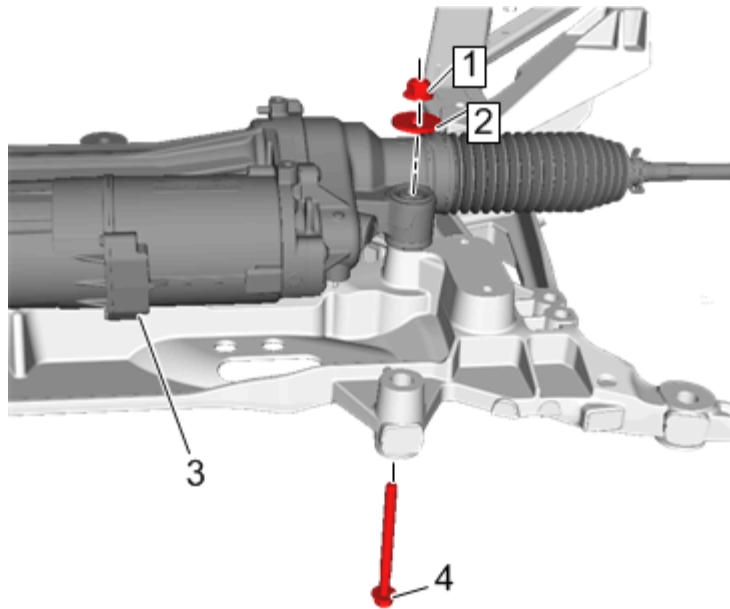


Fig. 65: Steering Gear Bolt And Electric Belt Drive Rack and Pinion Steering Gear
Courtesy of GENERAL MOTORS COMPANY

30. Remove Steering Gear Bolt (4) @Electric Belt Drive Rack and Pinion Steering Gear(3) and DISCARD
31. Remove Steering Gear Nut(1)@Electric Belt Drive Rack and Pinion Steering Gear(3)
32. Remove the 3 washers (2) from the electric belt drive rack and pinion steering gear.
33. Remove Electric Belt Drive Rack and Pinion Steering Gear(3)

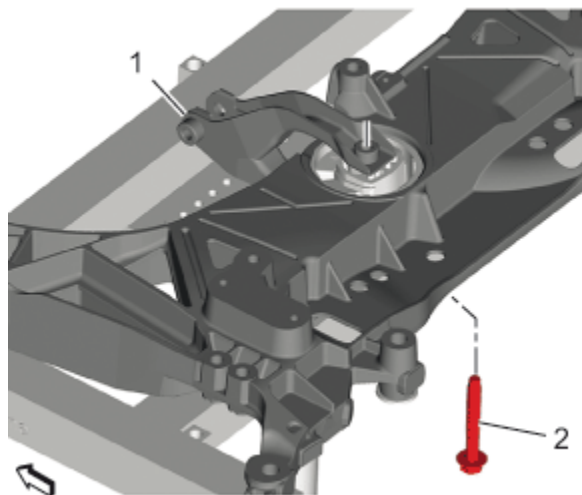


Fig. 66: Transmission Mount Strut And Bolt
Courtesy of GENERAL MOTORS COMPANY

34. Remove Transmission Mount Strut Bolt (2) and DISCARD
35. Remove Transmission Mount Strut (1)

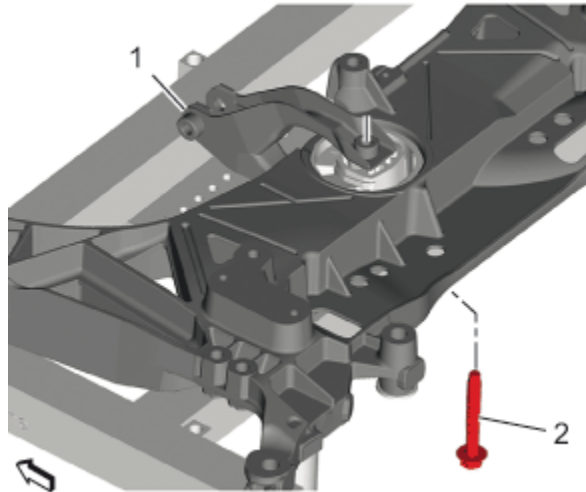


Fig. 67: Transmission Mount Strut And Bolt

Courtesy of GENERAL MOTORS COMPANY

1. Install Transmission Mount Strut (1)

WARNING: Torque-to-Yield Fastener Warning

CAUTION: Fastener Caution

2. Install New Transmission Mount Strut Bolt (2)Transmission Mount Strut Replacement

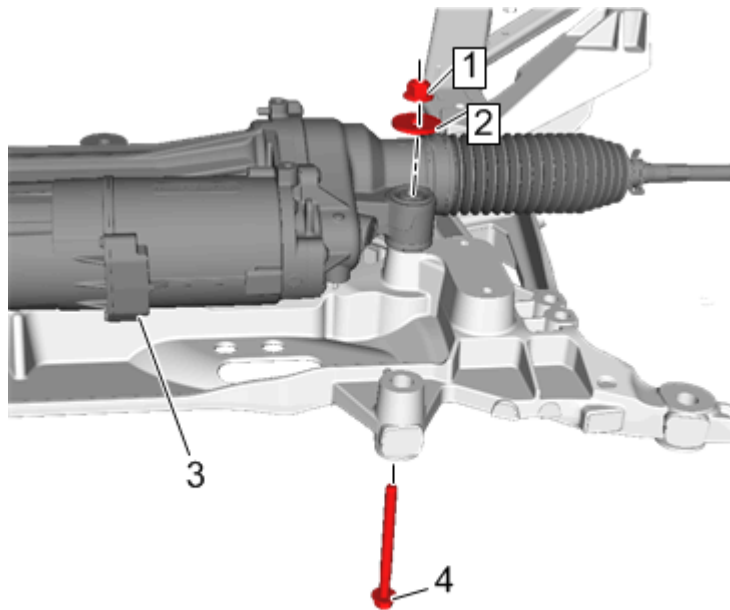


Fig. 68: Steering Gear Bolt And Electric Belt Drive Rack and Pinion Steering Gear

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install one new bolt (4), washer (2) and nut (1) loosely, on the right side to allow steering gear to pivot on cradle during drivetrain and front suspension cradle installation.

3. Install Electric Belt Drive Rack and Pinion Steering Gear (3)
4. Install the 1 washer (2) to the electric belt drive rack and pinion steering gear.
5. Install Steering Gear Nut(1)@Electric Belt Drive Rack and Pinion Steering Gear
6. Install Steering Gear Bolt(4)@Electric Belt Drive Rack and Pinion Steering Gear(3) - [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)

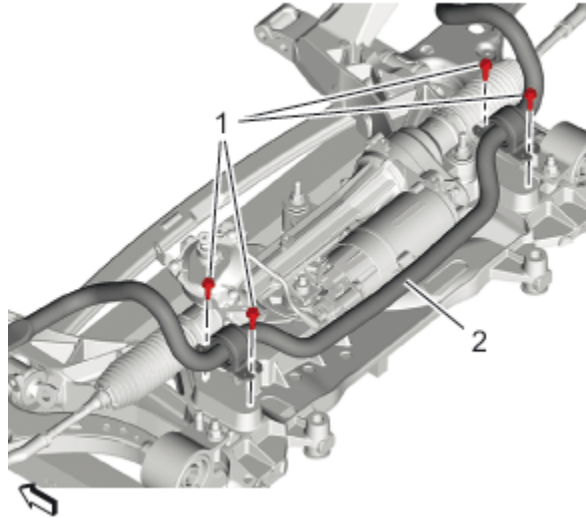


Fig. 69: Stabilizer Shaft And Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Install Stabilizer Shaft (2)
8. Install New Stabilizer Shaft Bracket Bolt (1) and tighten the NEW bolt. [Stabilizer Shaft Replacement](#)

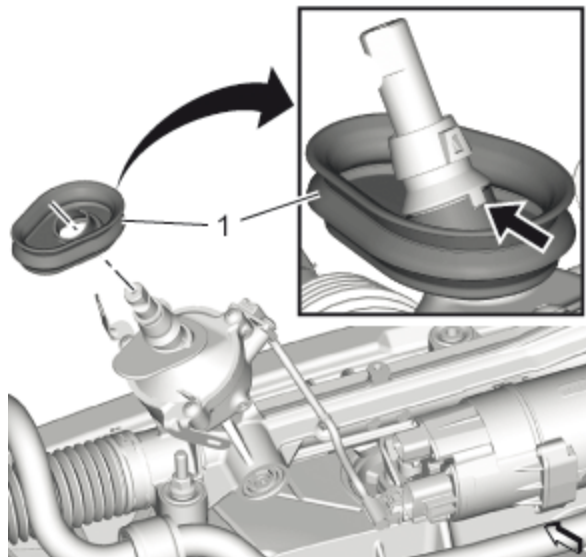


Fig. 70: Steering Column Dash Outer Seal

Courtesy of GENERAL MOTORS COMPANY

9. Make sure the notch in the steering column dash outer seal (1) is still correctly aligned to the nose on the electric belt drive rack and pinion steering gear.

NOTE:

Pivot the electric belt drive rack and pinion steering forward as the drivetrain and front suspension cradle is being raised up to the vehicle. Insert the front horns of the drivetrain and front suspension cradle into the drivetrain and front suspension cradle extension as the drivetrain and front suspension cradle gets closer to the body. Once the drivetrain and front suspension cradle is inserted into the drivetrain and front suspension cradle extension, pivot the steering gear rearward so steering shaft goes up into the floor as the cradle is raised up to the vehicle.

10. Raise the drivetrain and front suspension cradle to the vehicle.

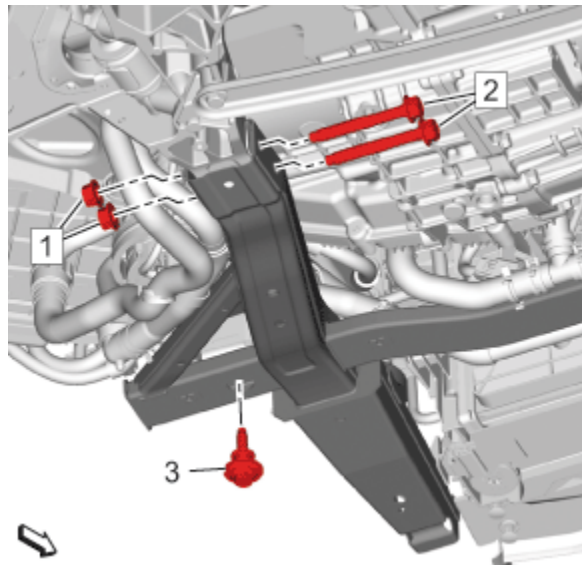


Fig. 71: Drivetrain And Front Suspension Crossmember Extension Fasteners
Courtesy of GENERAL MOTORS COMPANY

11. Insert NEW Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) - Install the NEW bolts snug
12. Install New Drivetrain and Front Suspension Cradle Nut (1)

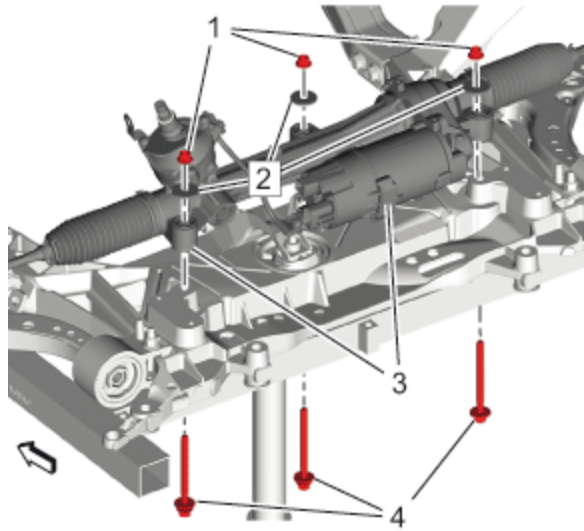


Fig. 72: Electric Belt Drive Rack And Pinion Steering Gear, Bolts, Nuts And Washers
Courtesy of GENERAL MOTORS COMPANY

13. Install the two washers (2) to the electric belt drive rack and pinion steering gear.
14. Install the remaining steering gear bolts (4), washers (2) and nuts (1). **Electric Belt Drive Rack and Pinion Steering Gear Replacement**

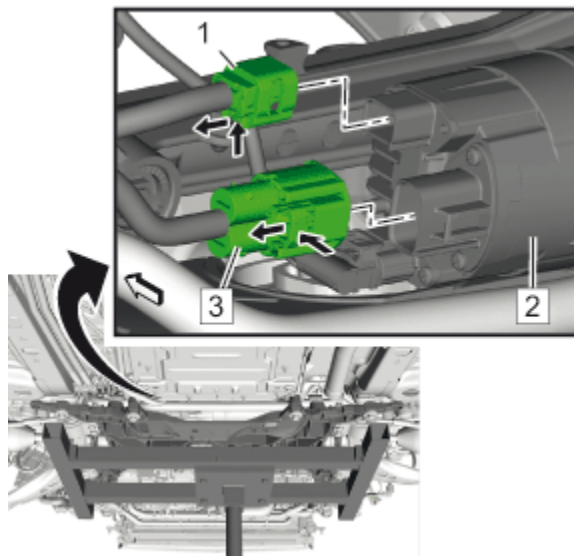


Fig. 73: Power Steering Assist Motor And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

15. Connect Electrical Connector(1)@Power Steering Assist Motor(2)
16. Connect Electrical Connector(3)@Power Steering Assist Motor(2)

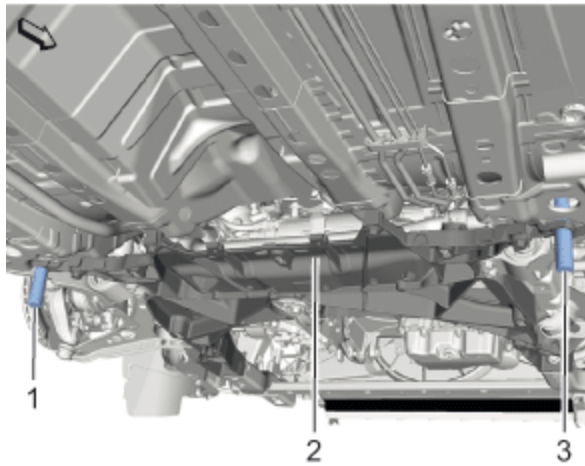


Fig. 74: Drivetrain And Front Suspension Cradle And Alignment Pins

Courtesy of GENERAL MOTORS COMPANY

17. Install the 2 **CH-51034-A** cradle alignment pins (1, 3) to arrange the drivetrain and front suspension cradle during tightening.
18. Make sure that the drivetrain and front suspension cradle (2) fits closely to the vehicle.
19. Make sure that the 2 **CH-51034-A** cradle alignment pins fit closely to the drivetrain and front suspension cradle (2).

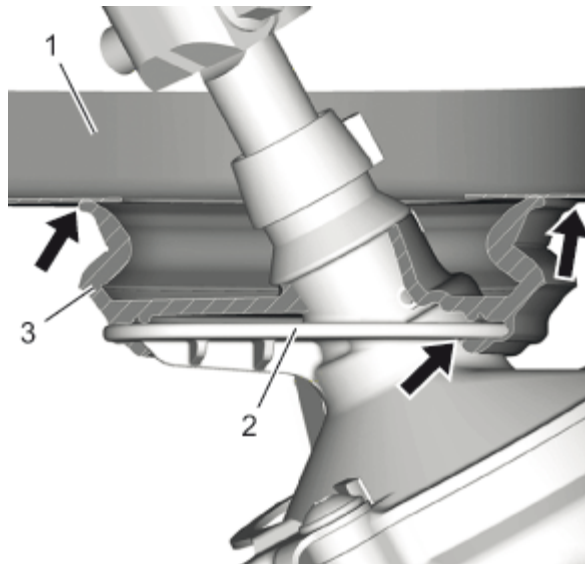


Fig. 75: Steering Column Dash Outer Seal, Electric Belt Drive Rack And Pinion Steering Gear

Courtesy of GENERAL MOTORS COMPANY

20. Make sure the steering column dash outer seal (3) fits correctly on the electric belt drive rack and pinion steering gear (2). See arrows.
21. Make sure the steering column dash outer seal (3) fits correctly on the dash panel front lower cross bar (1). See arrows.
22. Wiring Harness@Drivetrain and Front Suspension Cradle - Connect as necessary

23. Wiring Harness@Electric Belt Drive Rack and Pinion Steering Gear - Connect as necessary

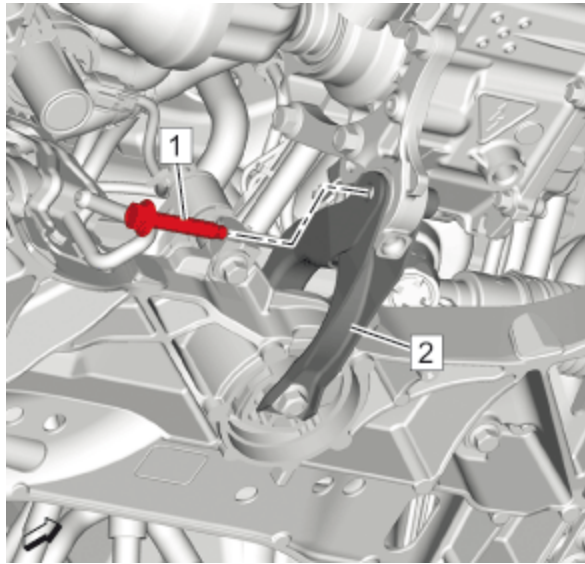


Fig. 76: Transmission Mount Strut Bolt And Transmission Mount Strut
Courtesy of GENERAL MOTORS COMPANY

24. Install New Transmission Mount Strut Bolt(1)@Transmission Mount Strut(2) - Do NOT tighten.
Transmission Mount Strut Replacement

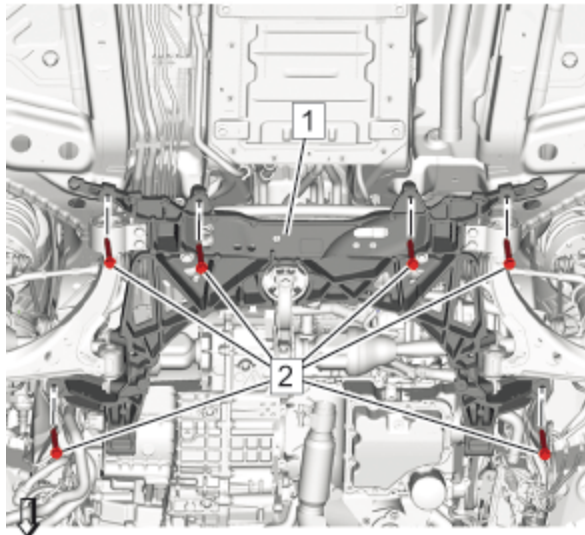


Fig. 77: Drivetrain And Front Suspension Cradle Bolts
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Torque-to-Yield Fastener Warning**

25. Install New Drivetrain and Front Suspension Cradle Bolt (2)

Tighten:

1. First Pass:70 N.m (52 lb ft)
2. Final Pass:45 - 60 degrees, use the **EN-45059** meter

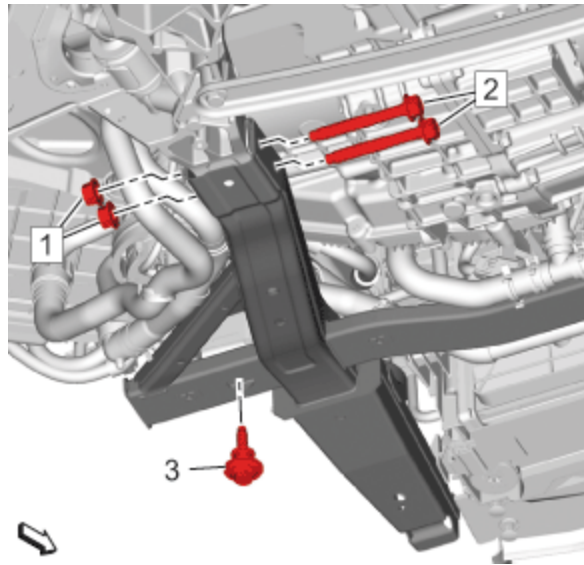


Fig. 78: Drivetrain And Front Suspension Crossmember Extension Fasteners
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

26. Install New Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) [Drivetrain and Front Suspension Crossmember Extension Replacement](#)
27. Install New Drivetrain and Front Suspension Crossmember Extension Bolt (3) [Drivetrain and Front Suspension Crossmember Extension Replacement](#)
28. Install New Drivetrain and Front Suspension Cradle Nut (1)

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: 45 - 60 Degrees, use the **EN-45059** Angle Meter

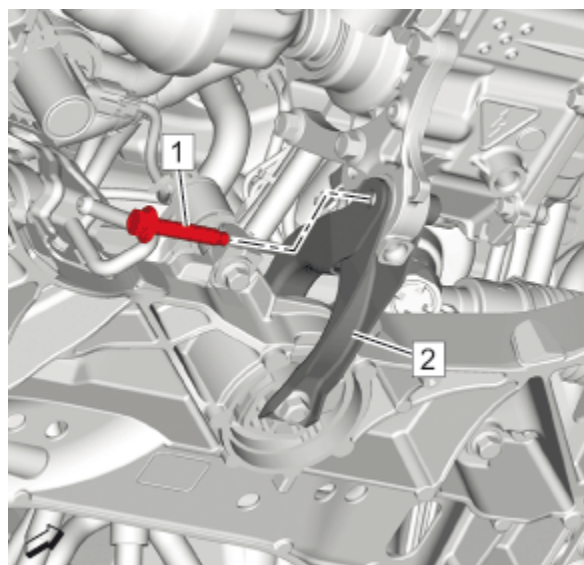


Fig. 79: Transmission Mount Strut Bolt And Transmission Mount Strut
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

29. Install New Transmission Mount Strut Bolt(1)@Transmission Mount Strut (2)Transmission Mount Strut Replacement

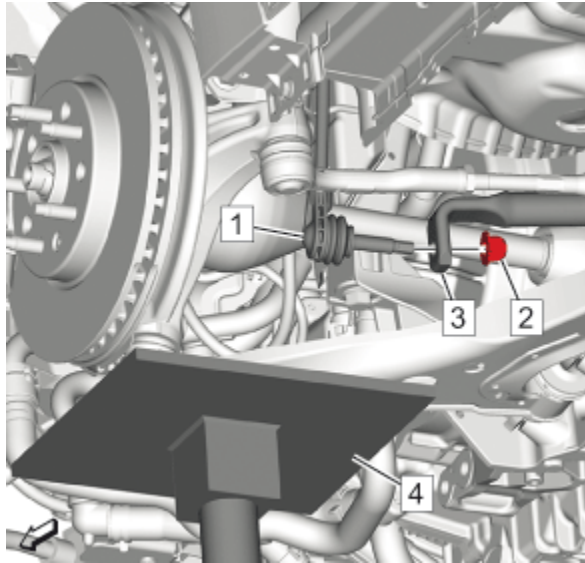


Fig. 80: Stabilizer Shaft Link, Stabilizer Shaft And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to tighten the nuts. Use a suitable tool.

NOTE: Support the front suspension with a hydraulic jack to connect the stabilizer shaft links.

30. Connect Stabilizer Shaft Link(1)@Stabilizer Shaft(3)
31. Install Stabilizer Shaft Link Nut(2)@Stabilizer Shaft Link(1) and tighten the nut Stabilizer Shaft Replacement
32. Connect the outer tie rod to the steering knuckle.Steering Linkage Outer Tie Rod Replacement

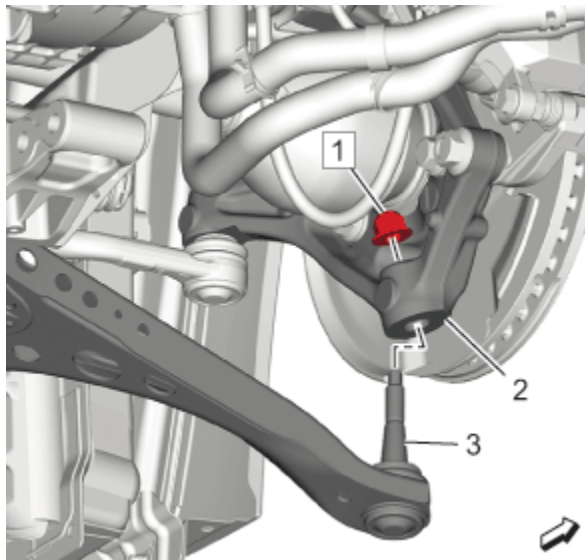


Fig. 81: Steering Knuckle, Lower Ball Joint And Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the lower control arm under the ball joint with a hydraulic jack to tighten the nut.

33. Install the lower ball joint stud (3) to the steering knuckle (2).

WARNING: Torque-to-Yield Fastener Warning

34. Install Lower Ball Joint Nut (1)Lower Control Arm Replacement

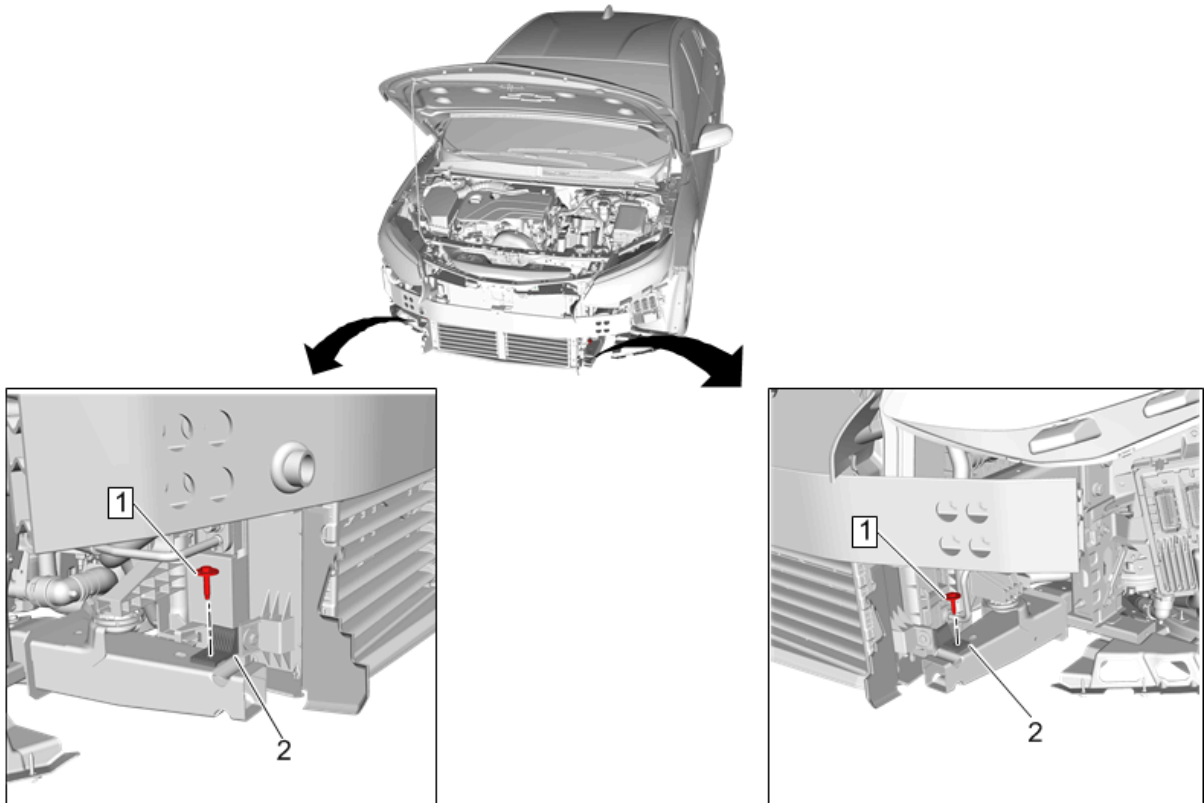


Fig. 82: Radiator Air Side Baffle Bolt And Radiator Air Lower Baffle Bracket

Courtesy of GENERAL MOTORS COMPANY

35. Radiator Air Side Baffle Bolt (1) @Radiator Air Lower Baffle Bracket (2) and tighten Radiator Air Lower Baffle and Deflector Replacement

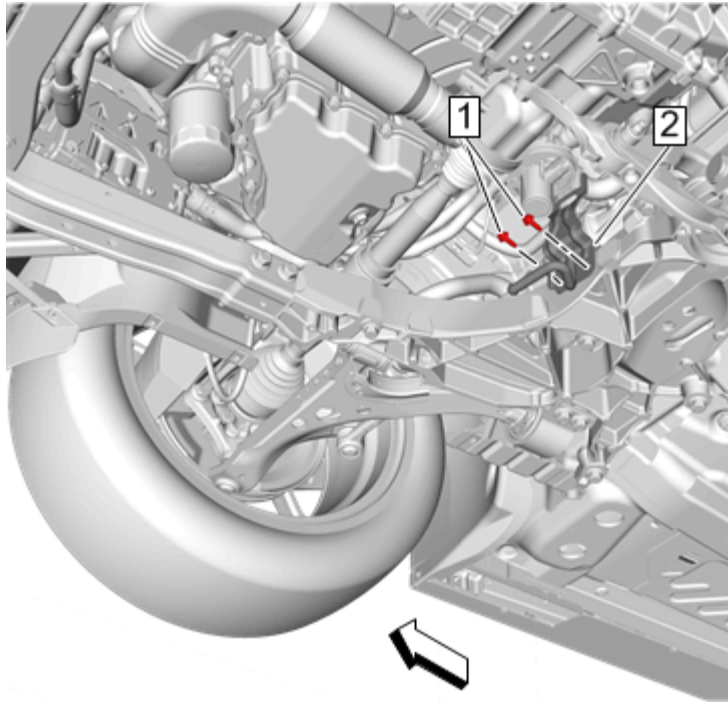


Fig. 83: Heater Water Bypass Valve Bracket Bolt And Heater Water Bypass Valve Bracket
 Courtesy of GENERAL MOTORS COMPANY

- 36. Install Heater Water Bypass Valve Bracket Bolt (1) @Heater Water Bypass Valve Bracket (2) and tighten [Heater Water Shutoff Valve Replacement](#)
- 37. Install Exhaust Muffler [Exhaust Muffler Replacement](#)

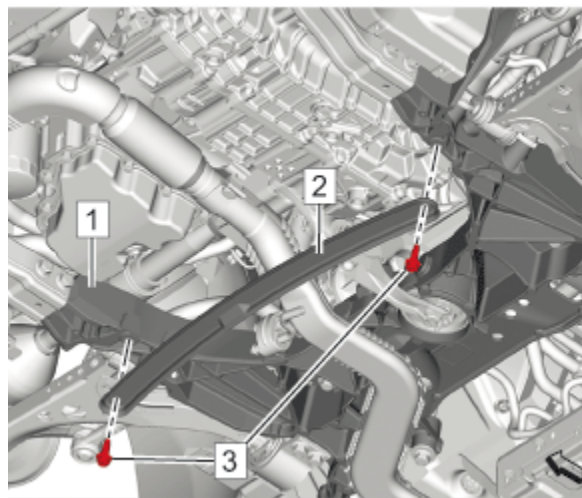


Fig. 84: Drivetrain And Front Suspension Cradle, Brace And Bolt
 Courtesy of GENERAL MOTORS COMPANY

- 38. Install the drivetrain and front suspension brace (2) to the drivetrain and front suspension cradle (1).
- 39. Install Drivetrain and Front Suspension Cradle Bolt (3) and tighten 58 N.m (43 lb ft)
- 40. Install Front Underbody Air Deflector [Front Underbody Air Deflector Replacement](#)
- 41. Install Front Wheelhouse Liner [Front Wheelhouse Liner Replacement \(Left Side\)](#)[Front Wheelhouse](#)

Liner Replacement (Right Side)

42. Install the front tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
43. Connect the steering intermediate shaft to the steering gear. [Intermediate Steering Shaft Replacement](#)
44. Enable the high voltage system. [High Voltage Enabling](#)
45. Check the steering wheel angle sensor centering. [Steering Wheel Angle Sensor Centering](#)

FRONT WHEELHOUSE LINER REPLACEMENT (LEFT SIDE)

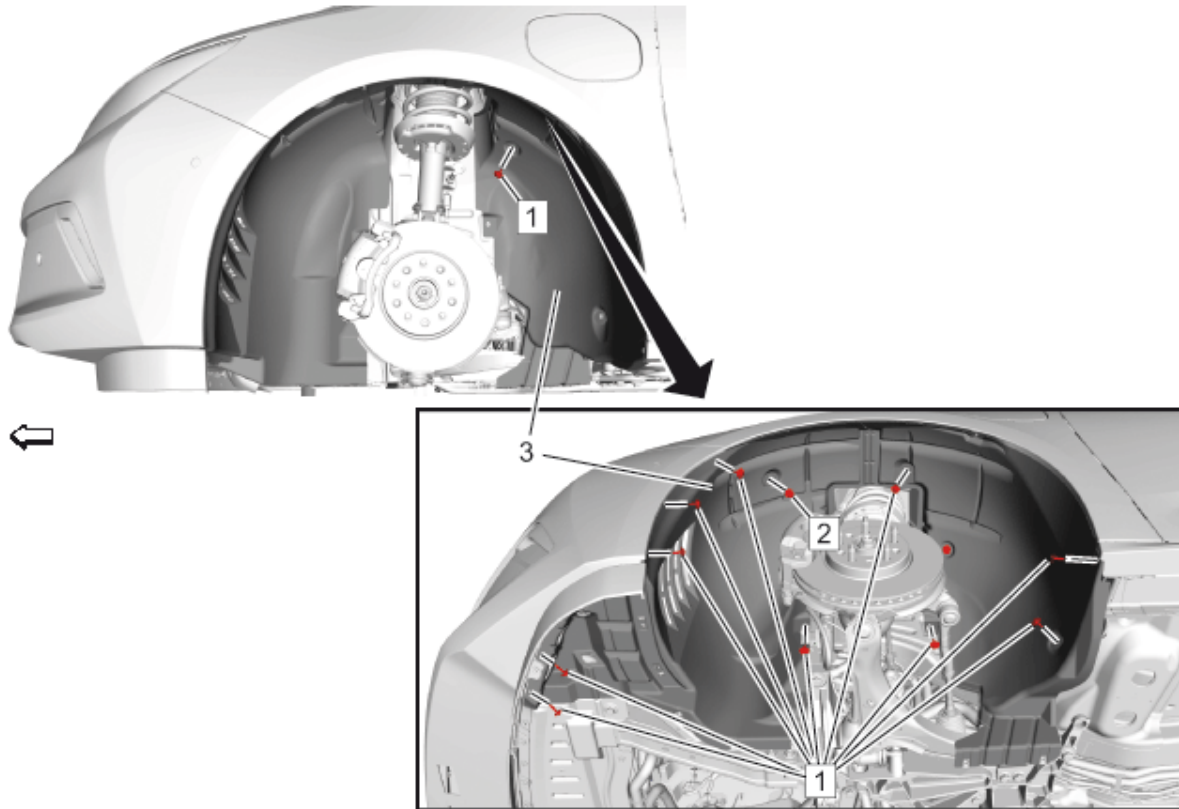


Fig. 85: Front Wheelhouse Liner (Left Side)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Tire and Wheel Removal and Installation	
2. Left Side Front Compartment Splash Shield Replacement	
3. Right Side Front Compartment Air Deflector Replacement	
4. Front Tire Front Air Deflector Replacement	
1	Front Wheelhouse Liner Bolt (Qty: 10) CAUTION: Fastener Caution

Callout	Component Name
	Tighten 2.5 N.m (22 lb in)
2	Front Wheelhouse Liner Retainer
3	Front Wheelhouse Liner

FRONT WHEELHOUSE LINER REPLACEMENT (RIGHT SIDE)

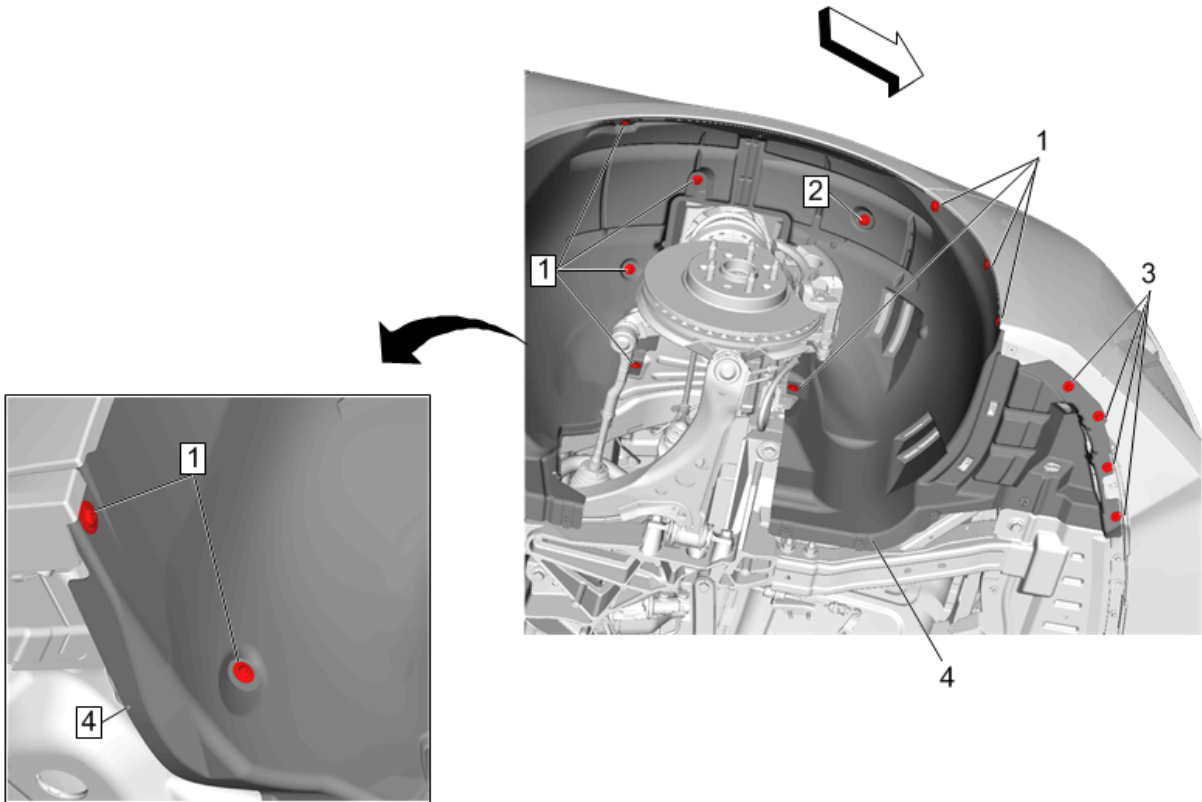


Fig. 86: Front Wheelhouse Liner (Right Side)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Tire and Wheel Removal and Installation</u> <u>Front Compartment Air Deflector Replacement</u> <u>Front Tire Front Air Deflector Replacement</u>	
1	CAUTION: Fastener Caution Front Wheelhouse Liner Screw (Qty: 10) Tighten 2.5 N.m (22 lb in)
2	Retainer

Callout	Component Name
3	Front Wheelhouse Liner Bolt (Qty: 4)
4	Front Wheelhouse Liner

REAR WHEELHOUSE LINER REPLACEMENT

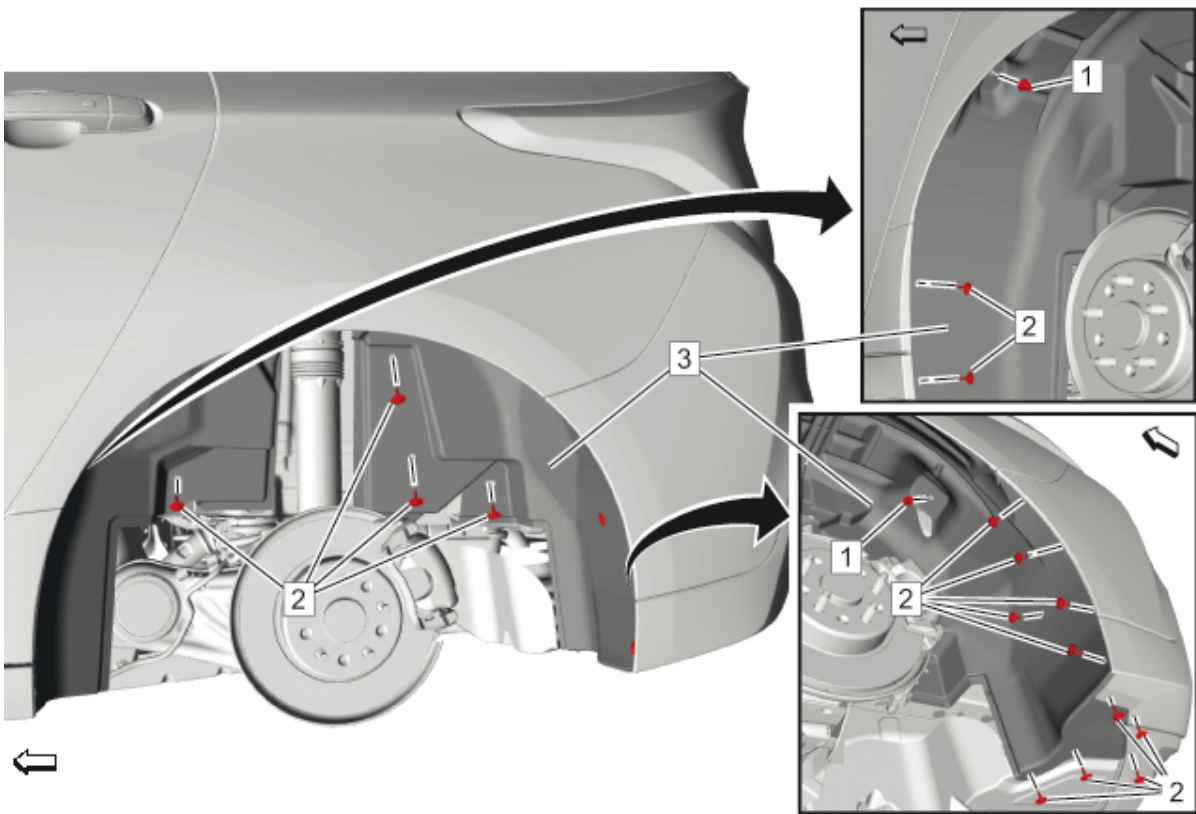


Fig. 87: Rear Wheelhouse Liner
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Tire and Wheel Removal and Installation</u> <u>Rear Tire Front Air Deflector Replacement</u>	
1	Rear Wheelhouse Panel Liner Nut (Qty: 2) Tighten 2.5 N.m (22 lb in)
2	Rear Wheelhouse Liner Bolt (Qty: 16) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten

Callout	Component Name
	2.5 N.m (22 lb in)
3	Rear Wheelhouse Liner

FRONT TIRE FRONT AIR DEFLECTOR REPLACEMENT

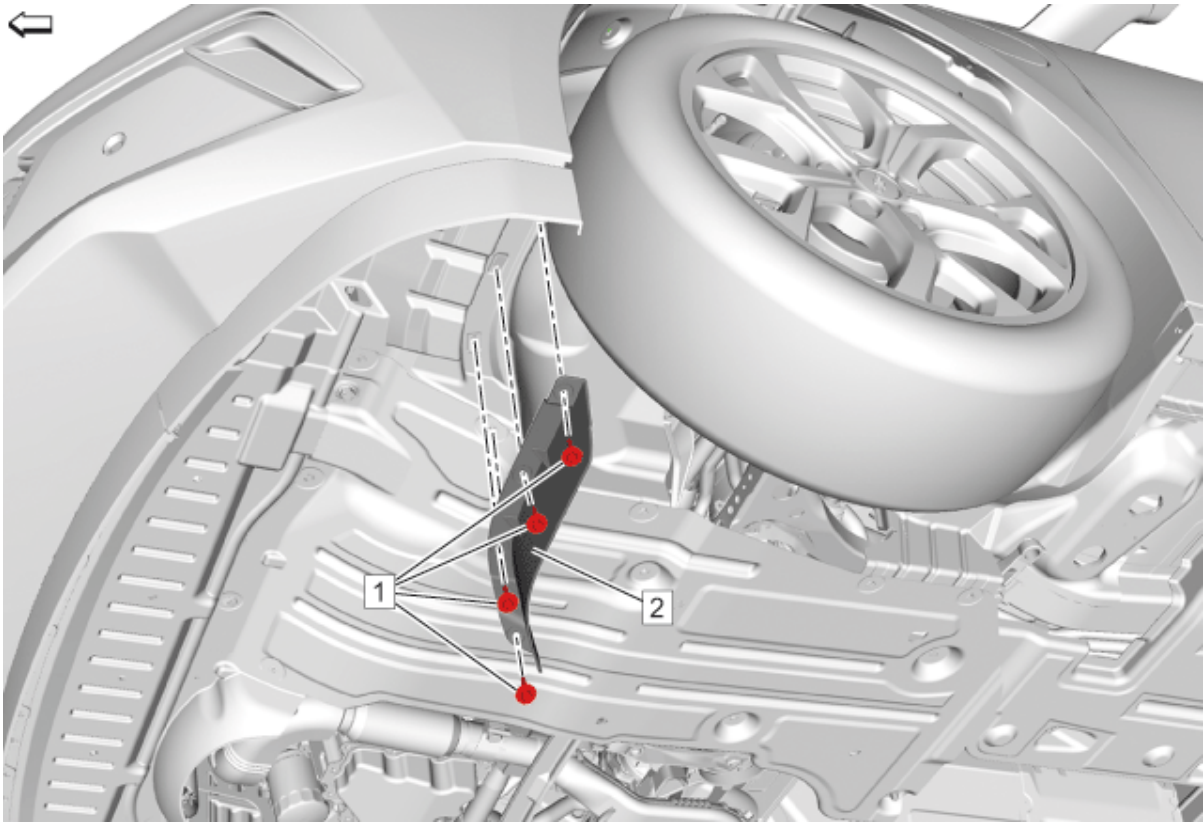


Fig. 88: Front Tire Front Air Deflector
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Front Tire Front Air Deflector Bolt (Qty: 4) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Front Tire Front Air Deflector

REAR TIRE FRONT AIR DEFLECTOR REPLACEMENT

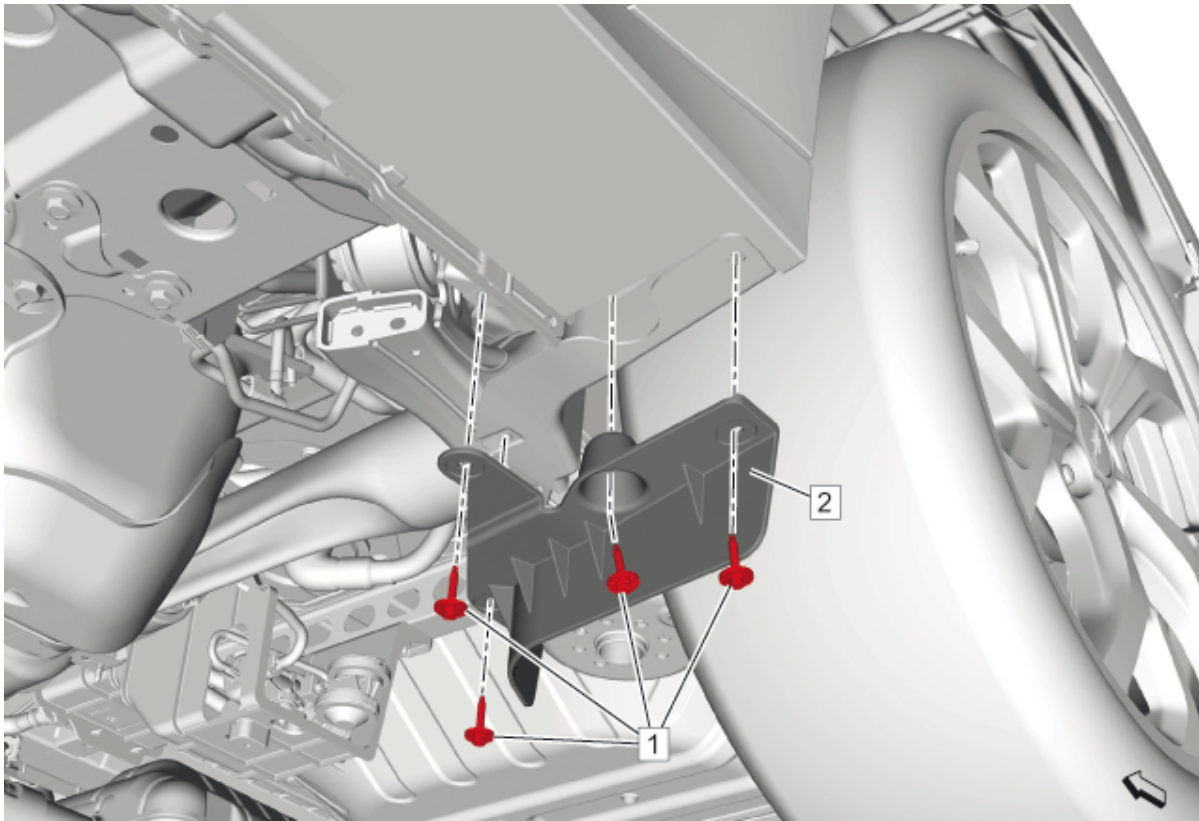


Fig. 89: Rear Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Rear Tire Front Air Deflector Fastener (Qty: 4) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Rear Tire Front Air Deflector

FLOOR PANEL NUMBER 4 CROSS BAR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**

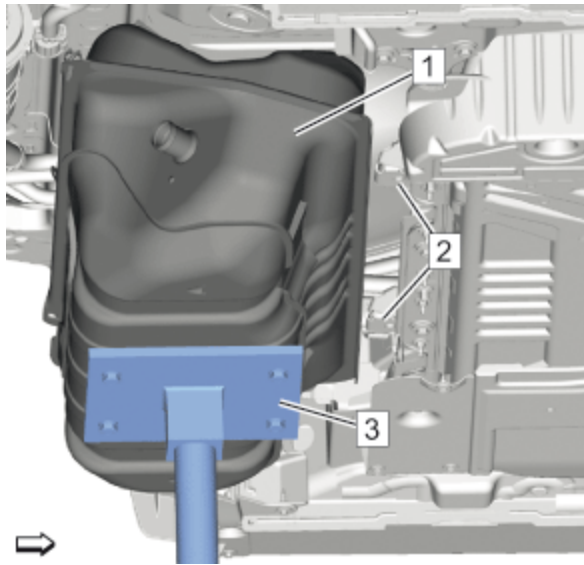


Fig. 90: Fuel Tank And Suitable Jack

Courtesy of GENERAL MOTORS COMPANY

2. Remove Fuel Tank (1)[Fuel Tank Replacement](#)
3. Support the drive motor battery with a suitable jack.

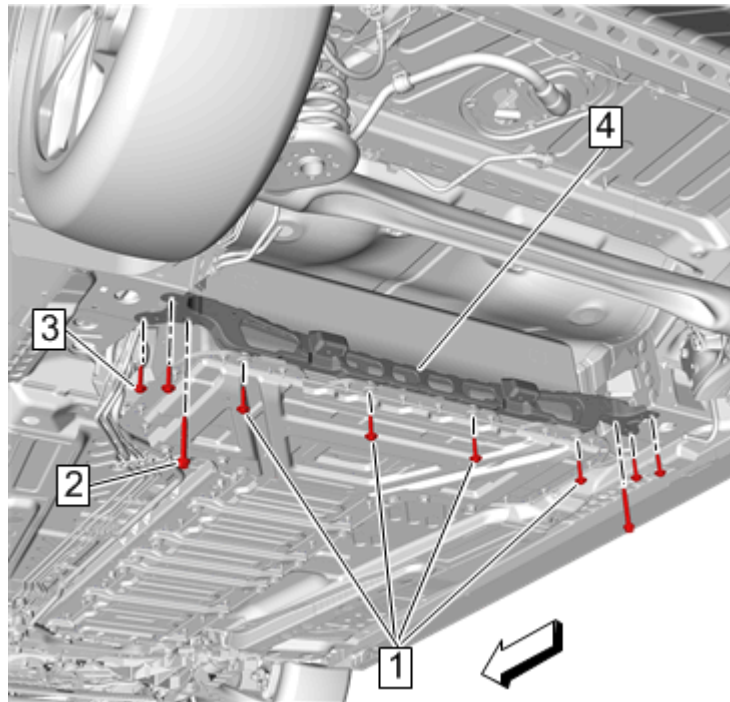


Fig. 91: Floor Panel Number 4 Crossbar, Drive Motor Battery Tray Bolts And High Voltage Battery Hold Down Retainer Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove Drive Motor Battery Tray Bolt (1)
5. Remove High Voltage Battery Hold Down Retainer Bolt (2)
6. Remove High Voltage Battery Hold Down Retainer Bolt (3)
7. Remove Floor Panel Number 4 Crossbar (4)

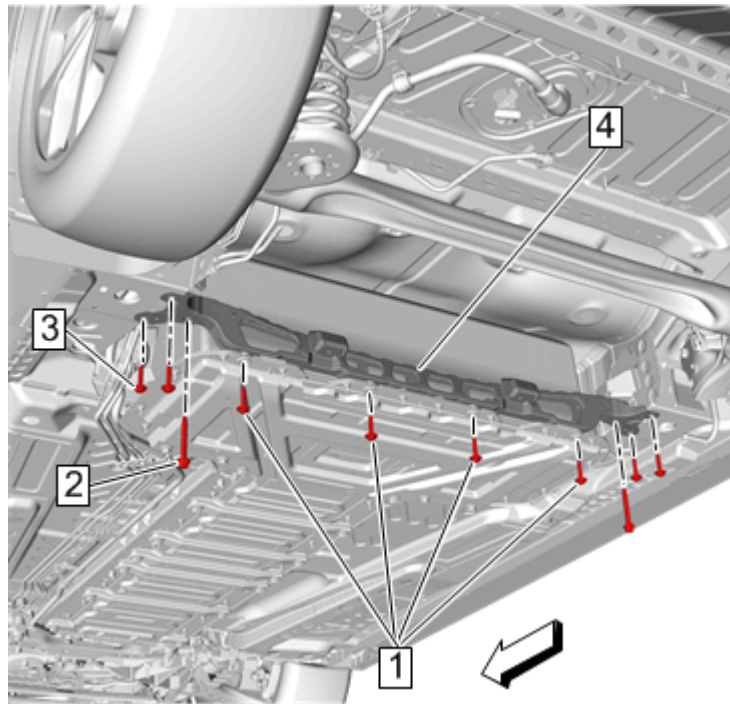


Fig. 92: Floor Panel Number 4 Crossbar, Drive Motor Battery Tray Bolts And High Voltage Battery Hold Down Retainer Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Floor Panel Number 4 Crossbar (4)

CAUTION: Refer to [Fastener Caution](#) .

2. Install Drive Motor Battery Tray Bolt (1) and tighten 22 N.m (16 lb ft)
3. Install High Voltage Battery Hold Down Retainer Bolt (2) and tighten 58 N.m (43 lb ft)
4. Install High Voltage Battery Hold Down Retainer Bolt (3) and tighten 22 N.m (16 lb ft)
5. Remove the drive motor battery support jack.

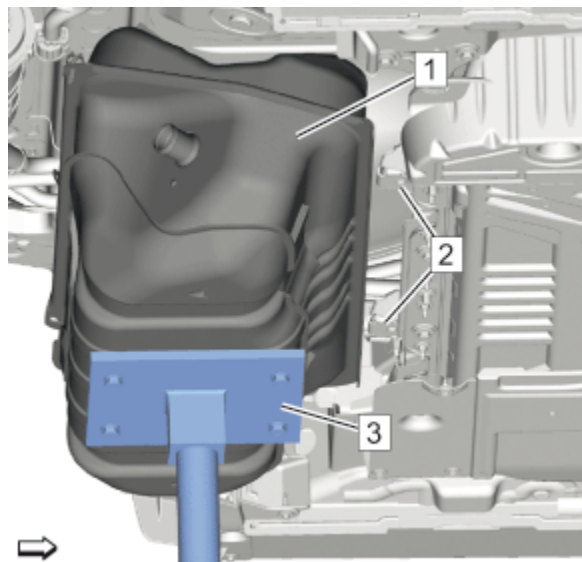


Fig. 93: Fuel Tank And Suitable Jack
Courtesy of GENERAL MOTORS COMPANY

- 6. Install Fuel Tank (1)[Fuel Tank Replacement](#)
- 7. Lower the vehicle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

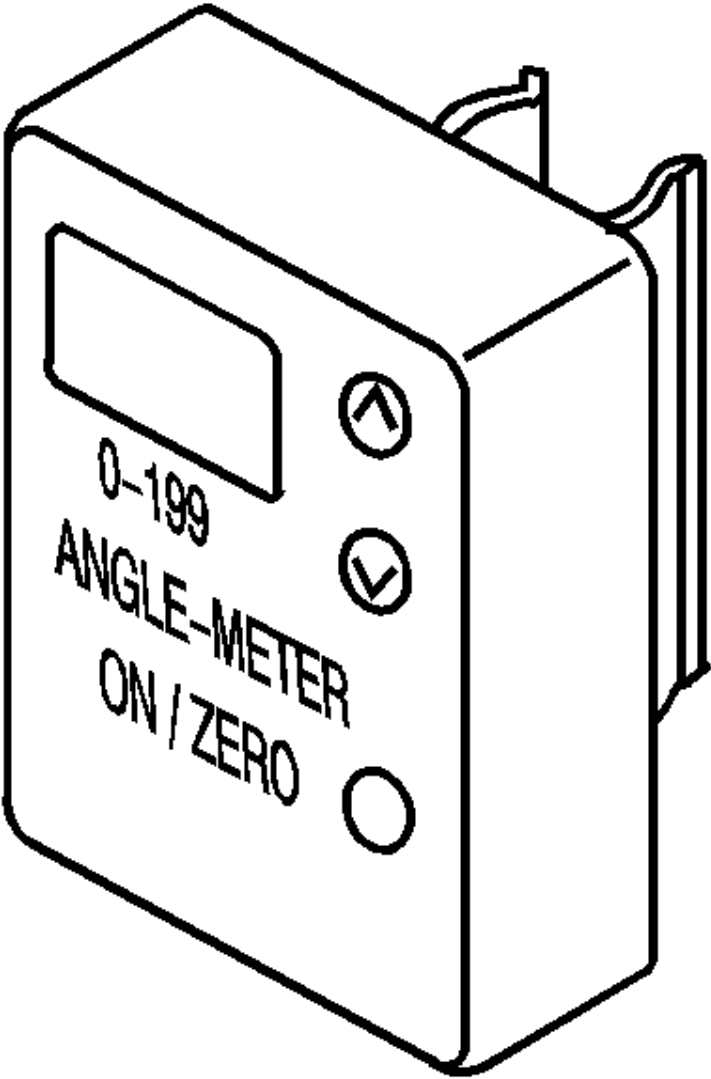
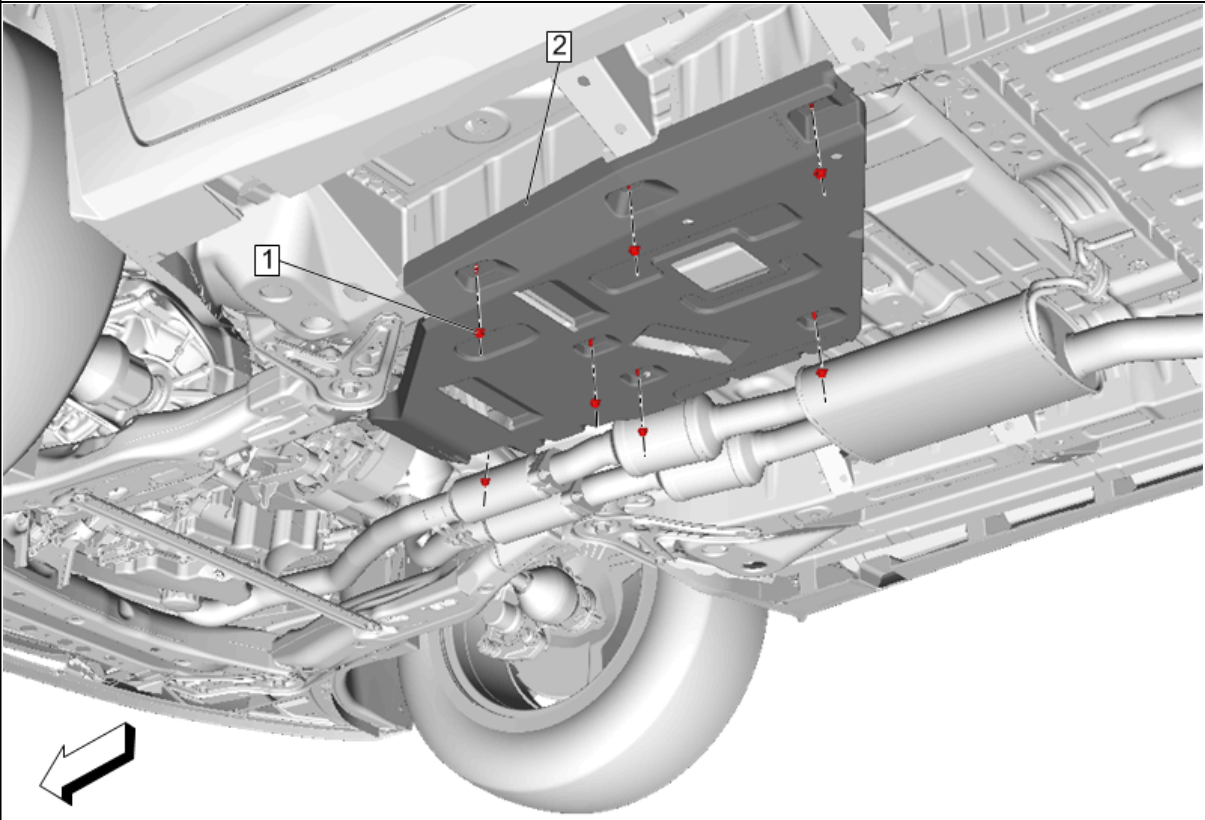
Illustration	Tool Number/ Description
	EN-45059 J-45059 Angle Meter

Illustration	Tool Number/ Description
	CH-51034-A Cradle Alignment Pins

Article GUID: A00884654

ACCESSORIES & EQUIPMENT

Paint and Coatings - Volt

SPECIFICATIONS

CLEARCOAT REPAIR SPECIFICATIONS - 3M PRODUCTS

Paint Condition	Wet Sanding	Scratch Refinement	Compounding	Rotary Polisher	Dual Action Orbital Polisher	Hand Glazing/ Polishing
New vehicle prep or fine wheel marks	-	-	-	-	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6-inch Backup Pad P/N 05776	• Perfect-It Wax P/N 39026/39526 • Detail Cloth P/N 06016
Swirl marks, water spotting, or light oxidation	-	-	-	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit SBS/Perfect-it Backup Pad P/N 05717/18	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6-inch Backup Pad P/N	• Perfect-It 3000 Swirl Mark Remover P/N 06066 • Perfect-It III Foam DA Pad P/N 05729 • Detail Cloth P/N 06016 • Perfect-It Wax P/N 39026/39526

Paint Condition	Wet Sanding	Scratch Refinement	Compounding	Rotary Polisher	Dual Action Orbital Polisher	Hand Glazing/ Polishing
					05776	
Overspray or medium oxidation	-	-	• Perfect-It III Cleaning Clay P/N 38070 • Perfect-It 3000 Rubbing Compound P/N 06060/62 • Superbuff III Buff Pad P/N 05703/04	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit SBS/Perfect-it Backup Pad P/N 05717/18	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6-inch Backup Pad P/N 05776	• Perfect-It 3000 Swirl Mark Remover P/N 06066 • Perfect-It III Foam DA Pad P/N 05729 • Detail Cloth P/N 06016 • Perfect-It Wax P/N 39026/39526
Heavy oxidation or minor acid rain pitting	Micro Fine 2000	-	• Perfect-It 3000 Rubbing Compound P/N 06060/62 • Superbuff III Buff Pad P/N 05703/04	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit SBS/Perfect-It Backup Pad P/N 05717/18	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6 in Backup Pad P/N 05776	• Perfect-It 3000 Swirl Mark Remover P/N 06066 • Perfect-It III Foam DA Pad P/N 05729 • Detail Cloth P/N 06016 • Perfect-It Wax P/N 39026/39526
Dust nibs, minor scratches, or major acid rain	Micro Fine 1500 or 2000	• Trizact Hookit II Foam Disc 6 in 3000	• Perfect-It 3000 Rubbing Compound P/N	• Perfect-It 3000 Swirl Mark Remover P/N 06064	• Perfect-It 3000 Swirl Mark Remover	• Perfect-It 3000 Swirl Mark Remover P/N 06066

Paint Condition	Wet Sanding	Scratch Refinement	Compounding	Rotary Polisher	Dual Action Orbital Polisher	Hand Glazing/ Polishing
pitting		P/N 02075 • Hookit II Soft Interface Pad 6 in P/N 05274 • Hookit II Painters Disc Pad 6 in P/N 05251	06060/62 • Superbuff III Buff Pad P/N 05703/04	• Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit SBS/Perfect-It Backup Pad P/N 05717/18	P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6 in Backup Pad P/N 05776	• Perfect-It III Foam DA Pad P/N 05729 • Detail Cloth P/N 06016 • Perfect-It Wax P/N 39026/39526
Orange peel, paint runs or sags	• Hookit II Film Disc 6 in P1200 P/N 00868 • Hookit II Film Disc 6 in P1500 P/N 000850 • Hookit II Painters Disc Pad P/N 05251	• Trizact Hookit II Foam Disc 6 in 3000 P/N 02075 • Hookit II Soft Interface Pad 6 in P/N 05274 • Hookit II Painters Disc Pad 6 in P/N 05251	• Perfect-It 3000 Rubbing Compound P/N 06060/62 • Superbuff III Buff Pad P/N 05703/04	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit SBS/Perfect-It Backup Pad P/N 05717/18	• Perfect-It 3000 Swirl Mark Remover P/N 06064 • Perfect-It Foam Polishing Pad P/N 05725/38 • Hookit DA 6 in Backup Pad P/N 05776	• Perfect-It 3000 Swirl Mark Remover P/N 06066 • Perfect-It III Foam DA Pad P/N 05729 • Detail Cloth P/N 06016 • Perfect-It Wax P/N 39026/39526

INTRODUCTION

BASECOAT/CLEARCOAT PAINT SYSTEMS

WARNING: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the

manufacturers of painting materials, equipment, and protective gear.

All paint finish repairs of rigid exterior surfaces must meet GM standards. Refer to the latest revision of the GM Approved Refinish Materials book to identify the paint systems you may use that have been engineered to meet GM standards. The GM Approved Refinish Materials book supplies all approved products, including volatile organic compound (VOC) compliant regulations recommended by the individual manufacturer, and detailed procedures for materials used in their paint system.

The latest revision of the GM Approved Refinish Materials booklet is located on the Genuine GM Parts website at www.genuinegmparts.com.

ANTI-CORROSION TREATMENT AND REPAIR

Corrosion Preventative Paint (Chassis Coating) and Primer Coatings

NOTE: Always use these products according to their manufacturer's recommendations. Corrosion Resistant paint and primers will only function properly when mixed properly and when applied to a properly prepared metal surface. Always follow paint manufacturers recommendations for application and use of Corrosion Preventative Paint Products.

Corrosion Preventative Primers are also referred to as Direct to Metal or DTM primers. Extensive testing is done for corrosion resistance and adhesion of these products. Most paint manufacturers require a bare metal treatment chemical first be applied before the paint or primer product is applied. These coatings are very important to providing a properly prepared metal surface for the paint or primer to perform properly. The GM Approved Primers are listed in the GM Approved Refinish Materials book. The latest revision of the GM Approved Refinish Materials booklet is located on the GM Genuine Parts website at www.genuinegmparts.com.

Corrosion Preventative Paint Products are recommended for under-carriage areas like frames, drive line and suspension components that often show corrosion and need to be painted in the field. Any place where bare metal is exposed for stud repair or where corrosion prevention is desired from a paint like product that will not likely be top coated with color can use this Corrosion Preventative Paint. A Phosphate metal treatment MUST be applied to the cleaned and dried surface that is free of corrosion scale. This Phosphate prep works well on both Aluminum and steel. While sandblasting can be performed for corrosion removal, it is not necessary for these products to work properly. Application of this product must be performed to Manufacturer's recommendations for them to work properly. See product listing below for Corrosion Preventative Paint Products.

Stock number	Type	Description
36500 or 36502	Kryptonite Solvent Based Chassis Coating	Solvent based rust protective coating for all areas of under vehicle corrosion protection on aluminum and steel.
25418	Pure Prep Phosphate Metal Treatment	Phosphate bare metal treatment for metal preparation of clean or oxidized metal surfaces, areas of under vehicle corrosion protection on aluminum and steel

Undercoating and Closed Cavity Coatings

WARNING: When applying sound deadeners, or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run

channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anti-corrosion material is essential.

After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed. Refer to the GM Approved Refinish Materials book which identifies the paint systems you may use.

The latest revision of the GM Approved Refinish Materials booklet is located on the GM Genuine Parts website at www.genuinegmparts.com.

After a collision, some vehicle structure areas such as frame rails, cross-members and rocker panel sections may need to be repaired. In most cases, the anti-corrosion materials need to be removed to perform these repairs. These materials are classified into two types: Closed Cavity coatings and Undercoat coatings. The primary difference is the way the products set up or "dry". Both are intended to protect the surface they are applied to from corrosion caused by water, salt water or Magnesium Chloride blended de-icing compounds used to thaw icy winter roads. They also can provide a measure of sound deadening.

The Closed Cavity coatings remain sticky to the touch and will seep into seams initially and over extended periods of time. Closed Cavity coatings provide the best corrosion protection inside of rocker panel sections, pillar sections, frame rails, cross-members, doors, rear compartment lids and closed areas of hoods - anywhere that is concealed or closed off to exterior surfaces.

The Undercoat coatings are "dry to the touch" and offer the best corrosion protection and sound deadening for floor pans, wheelhouses, inside rear compartment and underhood areas - anywhere the coated surface is exposed.

Below is a listing of Undercoat coatings and Closed Cavity coatings that GM believes to be reliable. While others may exist, we have found these products, or equivalents to them, can be used with satisfactory results. Always use these products according to their manufacturer's recommendations.

The following products are available from *Automotive International/Valugard. Contact them at 1-800-543-7156, or at www.valugard.net

Stock number	Type	Description
VG-104	WAX/SOLVENT BASED UNDERCOAT	Traditional Wax/Solvent based Undercoating available in aerosol or spray gun canister Meets OE specifications for corrosion resistance
VG-076M	HYBRID (SOLV./WATER) UNDERCOAT	Meets OE specifications for corrosion resistance
VG-140	WATER BASED UNDERCOAT	Meets OE specifications for corrosion resistance
VG-101	WAX BASED CLOSED CAVITY COATING	Meets OE specifications for corrosion resistance
VG-UCG	CANISTER UNDERCOATING GUN	High quality undercoating gun uses canister packaging of undercoating

Stock number	Type	Description
VG-CRG	CANISTER CLOSED CAVITY COATING GUN	High quality closed cavity coating gun uses canister packaging of coating and comes with 30 in inner panel application tube with nozzle

The following products are available through your local *3M[®] distributor. Information about 3M[®] product retailers in your area may be obtained at 1-866-364-3577 or at www.mmm.com/automotive.

Stock number	Type	Description
08804	No Cleanup Water-Based Undercoating - Black	Coarse texture SBR rubber and acrylic applied with 3M No-Cleanup Gun 08801
08964	No Cleanup Undercoating - Black	Smooth texture SBR rubber applied with 3M No-Cleanup Gun 08801
08881	16 oz aerosol Undercoating	Calcium Carbonate and asphalt based undercoating
08882	17 oz aerosol Underseal [™] Undercoating - Black	Rubber based, paintable undercoating
08883	19.7 oz aerosol Rubberized Undercoating - Black	Synthetic polymer based undercoating
08891	Rust Fighter - 1 Amber Closed Cavity Coating - quart canister	Synthetic Resin remains tacky seeps into crevices; Applied with 3M Applicator Gun 08997 and Application Wand 08998
08892	Rust Fighter - 1 Amber Closed Cavity Coating - 24 oz aerosol	Synthetic Resin remains tacky seeps into crevices; aerosol can
08801	No Cleanup Undercoating Gun	-

The following products are available from *Crest Industries, Inc. at 1-800-822-4100 or www.crestaauto.com.

Stock number	Type	Description
AH-C	HONEY COAT/WAX BASED CLOSED CAVITY COATING	16.5 OZ AEROSOL CAN AMBER COLORED SEEPS INTO CREVICES AND REMAINS PLIABLE 36 in spray wand with 360 degree nozzle available (WA-HC)
BZ-BAC BZ-BACB	AMBER COAT/WAX BASED CLOSED CAVITY COATING	GALLON - AMBER COLORED (BZ-BAC) OR BLACK (BZ-BACB) SEEPS INTO CREVICES AND REMAINS PLIABLE APPLIED WITH WZ-GRP GUN AND SIPHON HOSE Flexible spray wand also available (WA-ND)
AC-R	RUBBER COAT/RUBBER BASED UNDERCOATING, PAINTABLE	17.75 OZ AEROSOL
AR-C	SUPER RUBBER COAT/LOW V.O.C. RUBBER BASED UNDERCOATING, PAINTABLE	17.75 OZ AEROSOL
BA-C	AUTO COAT/RUBBER BASED UNDERCOATING, PAINTABLE	28.7 FL OZ CONE-TOP CAN AND GALLON APPLIED WITH GU-C UNDERCOATING GUN
GU-C	UNDERCOATING GUN	ATTACHES TO BA-C CONE-TOP CAN

Stock number	Type	Description
WZ-GRP	GUN AND SIPHON HOSE	USED WITH BZ-BAC AND BZ-BACB
WA-ND	FLEXIBLE SPRAY WAND	USED WITH WZ-GRP

The following products are available from *Kent Automotive. Contact them at 1-888-YES-KENT (888-937-5368) or at www.kent-automotive.com.

Stock number	Type	Description
P60305	Wax Based Inner Panel Rustproofers - CLOSED CAVITY COATING	24 oz Aerosol (can apply with 36 in wand and 360 degree nozzle kit)
KT14912	Rubber Guard Low VOC Rubber Based Undercoating	24 oz Aerosol (can apply with 36 in wand and 360 degree nozzle kit)
KT14725	Aerosol Extension Wand Kit	36 in wand and 360 degree nozzle
KT14796	Rubber Guard Low VOC Rubber Based Undercoating	QUART - Applied with undercoating gun
P30025	Siphon Feed Gun	-
P86079	360 Degree Wand for siphon feed gun	-

Weld Thru Coating

Part Number	Description
4353	Weld-Through Primer

*We believe these sources and their products to be reliable. There may be additional manufacturers of such material. General Motors does not endorse, indicate any preference for or assume any responsibility for the products from these firms or for any such items which may be available from other sources.

Seam Sealers

Sealers are intended to prevent water and dust from entering the vehicle and also are anti-corrosion barriers. Sealers are applied to such areas as rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof, and various other panel to panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints, and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer in order to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required in order to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody, and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup, and color application techniques should be followed.

Deadener materials, spray-on type, are used on various metal panels in order to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, are removed during repair operations, or a new replacement panel is installed, the

deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anti-corrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces.

PAINT IDENTIFICATION

WARNING: Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment, and protective gear.

NOTE: Always refer to the GM Approved Refinish Materials book. This book identifies the paint systems you may use.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

Use the service parts identification label to identify the type of paint technology, paint codes, trim level, and any special order paint colors on the vehicle. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#).

REPAIR INSTRUCTIONS

CLEARCOAT REPAIR WITHOUT REPAINTING

Repair Procedure

1. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870 or the equivalent.
2. Environmental damage may be corrected. Refer to [Environmental Fallout \(Acid Rain\)](#), or [Rail Dust Damage Repair](#).

IMPORTANT: Follow all of the instructions from the manufacturer of the polishing material.

3. Use a paint gauge before, during, and after sanding and/or polishing, to avoid removing too much clearcoat. Refer to [Paint Gauges](#).

ENVIRONMENTAL FALLOUT (ACID RAIN)

CAUTION: Refer to [Clearcoat/Ultraviolet Screeners Caution](#).

NOTE: Always refer to the manufacturer's packaged instructions for the detailed procedures of materials used for compounding and/or polishing.

Since the severity of the condition varies from area to area, proper diagnosis of the contamination extent is critical to the success of the repairs. Perform the diagnosis under high intensity fluorescent lighting on the horizontal surfaces (hood, roof panel, rear compartment lid), after the surfaces have been properly cleaned by washing the vehicle with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.

There are 3 basic types of acid rain damage:

Surface Level Contamination

May be repaired by simply washing the vehicle, cleaning the surface with a silicone wax and grease remover, neutralizing acidic residue, and finesse polishing - Refer to Surface Level Contamination Repair.

Clearcoat Etching

Slight etching is still noticeable after the above washing and finesse polishing procedure. Refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Basecoat Etching

Severe etching beyond the clearcoat into the basecoat in the affected areas will require refinishing. Refer to [Basecoat/Clearcoat Paint Systems](#).

Surface Level Contamination Repair

1. Thoroughly wash and dry the contaminated area with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.
2. Clean the affected area with silicone, wax and grease remover.
3. Remove and neutralize acidic residue by cleaning the contaminated areas with a mixture of baking soda and water (1 tablespoon of baking soda per 1 liter or 1 quart of water). Rinse thoroughly and dry the panel completely.
4. Apply finesse-type polish with a foam panel. If damage has been repaired, remove any swirl marks with a dual action orbital polisher and foam pad. Refer to [Clearcoat Repair Specifications - 3M Products](#).
5. If some damage remains, refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Slight Clearcoat Damage - Wet Sanding, Finesse Polishing

1. Select a small contaminated test area.
2. Film thickness should be taken prior to the sanding and polishing. Refer to [Paint Gauges](#).
3. Wet sand and finesse polish the contaminated test area. Refer to [Clearcoat Repair Specifications - 3M Products](#). If during the polishing you suspect or observe that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding, or base color is transferred to the polishing pad during polishing, then the affected areas will require refinishing. Refer to [Basecoat/Clearcoat Paint Systems](#).

PAINT GAUGES

Paint thickness gauges measure the total thickness of the vehicle finish. It is important to accurately measure the thickness of the finish on each vehicle as the thickness of the finish will vary on each vehicle. Use a paint gauge before the sanding process in order to accurately measure how much finish there is to remove before, during, and after the sanding process. Paint gauges range from magnetic pull type to sophisticated electronic types, and are available from a variety of sources. The older magnetic type gauges, at best have a 5 percent accuracy range and are not sensitive enough to detect removal of 0.02 mm 0.5 mil (0.0005 in) clearcoat. The newer type magnetic gauges have improved accuracy ranges. Most gauges are confined to checking either ferrous metal, steel, non-ferrous metal, or aluminum panel. At this time, there are no viable gauges for reading film thickness on composite (SCM doors, RIM fenders) panels. The more sophisticated (ETG) electronic paint thickness gauges digital type gauges are able to read film thickness on both ferrous and non-ferrous metal panel. Digital ETG gauges may have

an accuracy range of 1 percent and include thickness standards for recalibration. The following paint thickness gauges are available. Call 1-800-GM-TOOLS for information:

Paint Thickness Gauges

- 147-5437-ETG Standard model
- 147-5437-ETG-P Standard model with print option
- 147-5437-N-ETG-N Non-ferrous model for aluminum panels
- 147-5437-NP-ETG-NP Non-ferrous model with print option
- 147-54437-SD-ETG Steel and aluminum gauge

CLEARCOAT THICKNESS

The clearcoat on the vehicle is typically 0.059 - 0.078 mm (1.5 - 2 mils [0.0015 - 0.0020 in]) thick. The clearcoat contains ultraviolet screeners. Removing more than 0.5 mils (0.019 in) of the clearcoat may result in early paint failure.

RAIL DUST DAMAGE REPAIR

WARNING: Refer to [Eye Protection Warning](#) .

NOTE: If rail dust has penetrated into the basecoat, the panel requires refinishing. Ensure all the rail dust has been removed prior to refinishing or the rust spots will return.

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Move the vehicle to a cool shaded area and ensure the vehicle surfaces are cool during the removal process.
2. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870, or equivalent.
3. Wipe the area dry.
4. Clean the affected area with silicone, wax and grease remover.
5. Perform the removal process according to the manufacturer's directions of the type of repair material used (Gel Type Oxalic Acid or Clay Type Non-Acid Based). If, upon inspection, some particles are still present, the process may be repeated. If the damage has been repaired, complete the repair to the entire panel.
6. Polish the entire panel after the removal process. Refer to [Clearcoat Repair Specifications - 3M Products](#). If small pits remain in the clearcoat after all of the damage has been repaired, refer to [Clearcoat Repair without Repainting](#).

Article GUID: A00884710

ACCESSORIES & EQUIPMENT

Plastic Panel Information and Repair - Volt

SPECIFICATIONS

FLEXIBLE PLASTIC PART REPAIR MATERIALS

Product - 88861039, *88861040, High Strength Plastic Repair 50 ml

Components - 12 cartridges with 2 mixers each

Structural and Cosmetic

Recommended Repair Material

Product	Components	Recommended Repair Material	Work Time 70Â°F	Handling Strength at 70Â°F
88861039 *88861040 High Strength Plastic Repair 50 ml	12 cartridges with 2 mixers each	Structural and cosmetic bonding and repairing of all flexible plastics. Requires GM P/N 12378462 on TPO plastics. Will also bond e-coated/primed metals.	90 seconds	10 minutes
* TPO, TEO, (Polyolefin Plastics) require the application of polyolefin adhesive primer before the GM P/N 88861039 repair compound is applied.				

Working Time

Product	Adhesive Sandability at 70Â°F	Part Paintability at 70Â°F	Adhesive Full Cure at 70Â°F	Program
88861039 *88861040 High Strength Plastic Repair 50 ml	20 minutes	30 minutes	24 hours	Bumper covers, emblems, door trims, exterior and interior repairs*
* TPO, TEO, (Polyolefin Plastics) require the application of polyolefin adhesive primer before the GM P/N 88861039 repair compound is applied.				

RIGID PLASTIC PART REPAIR MATERIALS

Thermoset Plastic Type	Type of Repair	Recommended Repair Material	Availability
Sheet metal compound (SMC), RIM rigid plastic parts	Cosmetic filling	GM Goodwrench® Structural Bonding Epoxy (GM P/N 12345726 or	GM Dealer

Thermoset Plastic Type	Type of Repair	Recommended Repair Material	Availability
		equivalent)	
		Sikkens Polystop LP™ or equivalent polyester repair putty	Refer to a local paint supplier
Most rigid plastic parts	Cosmetic repair, adhesive bonding	GM Goodwrench® Structural Bonding Epoxy (GM P/N 12345726 or equivalent)	GM Dealer
		Lord Fusor® SMC Body Panel Repair Adhesive or equivalent	Refer to local paint supplier
Most rigid plastic parts	Adhesive bonding	GM Goodwrench® Structural Bonding Epoxy (GM P/N 12345726 or equivalent)	GM Dealer
		Dynatron Dyna-Weld Plio Grip® or equivalent (OE structural adhesive)	Refer to local paint supplier
Most rigid plastic parts	Adhesive structural* bonding	GM Goodwrench® Structural Bonding Epoxy (GM P/N 12345726 or equivalent)	GM Dealer
Most rigid plastic parts	Adhesive bonding Structural bonding	Ashland Pliogrip® 7773B - 3-minute Ashland Pliogrip® 7779B - 10-minute Ashland Pliogrip® 7770B - 35-minute	Supplied by Crest Industries 1-800-822-4100 fax 1-800-344-4461
SRIM most rigid plastic parts	Cosmetic repair, adhesive bonding	GM Goodwrench® SRIM™ repair kit (GM P/N 12378523) or SIA™ Adhesives, INC. SRIM™ repair kit P/N 30208030001 adhesive 200ML TUBES P/N 30208020001 50ML TUBES P/N 30208010001	SIA Adhesives, INC. customer service 1-330-374-2468
* Structural adhesive bonding may require the use of a pneumatic applicator, A8-37479-1A, or equivalent, to speed the application of the GM P/N 12345726 epoxy.			Kent-Moore 1-800-GM-TOOLS

REPAIR INSTRUCTIONS

GENERAL PLASTIC REPAIR

WARNING: In order to reduce the risk of personal injury when exposed to toxic fumes while grinding, cutting, or applying repair material on any type of sheet molded compound or RIM rigid plastic, observe the following guidelines:

- Work in a properly ventilated area
- Apply protective cream to any exposed skin
- Remove any mixture that comes into contact with skin
- Wash skin with cold water to remove glass and resin dust
- Use a sander with a vacuum attachment
- Follow the repair material manufacturer's instructions

Also, always wear the following:

- An approved respirator, or air supplied respirator
- Eye protection
- Rubber gloves
- Earplugs
- Protective clothing

The following procedures should be followed when repairing all types of thermoset plastic:

- Follow the manufacturer's application and curing recommendations.
- Do not intermix systems. Use the supplies and the repair materials from the same manufacturer.
- Clean the inner and outer surfaces of the repair area with a soap impregnated scouring pad in order to remove any dirt or mold release agent.
- Clean the area with a wax and grease remover, using only enough of the remover to dampen a cloth. Allow the panel to dry thoroughly.
- Remove the surface finish from the area to be repaired. Adhesives are designed to adhere to the plastic substrate, not the finish.
- Prime a metal surface before applying the repair material.
- Inspect the rear side of the work area before making repairs in order to avoid possible damage to wires, motors, etc.

DESCRIPTION AND OPERATION

HOW TO IDENTIFY PLASTIC PARTS

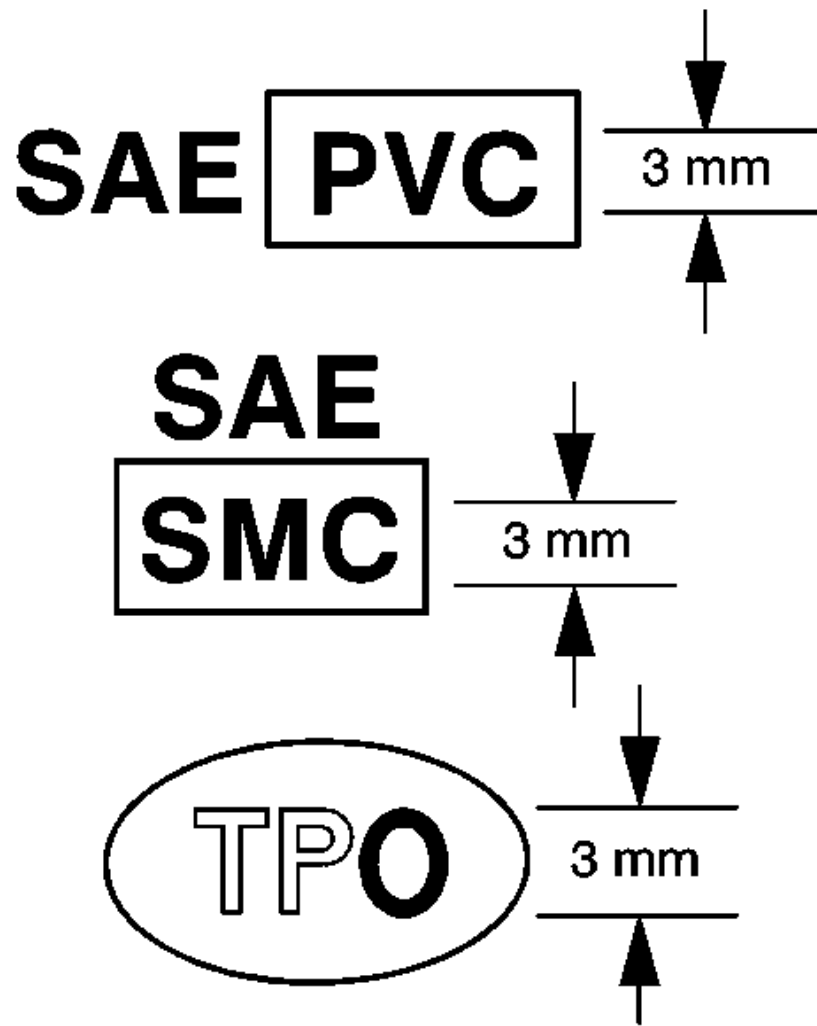


Fig. 1: Identifying SAE Code

Courtesy of GENERAL MOTORS COMPANY

Plastic parts can be identified by the SAE code, which is usually found on the rear of the part, and/or by the characteristics of the plastic. Knowing the type of plastic aids in selecting the proper repair materials and in selecting the proper repair procedure.

Look for the SAE code stamped into the part.

Code Found

Match the code to those in the plastic identification chart to determine whether the plastic is thermoplastic or thermoset plastic, and whether the plastic is rigid or flexible. Refer to [**Plastic Identification and Refinishing Systems**](#).

No Code Found

WARNING: Do NOT use a plastic burn test to distinguish the type of plastic. The burn test produces vapors which are harmful.

Perform one or both of the following tests to determine if the part is thermoplastic polyolefin or thermoset non-polyolefin.

Float Test

1. Cut a shaving of plastic from the back of the part.

The shaving should be free of mold release agents and paint.

2. Place the shaving in a container of water.

- Thermoplastic polyolefin floats.
- Thermoset non-polyolefin sinks.

Abrasion Test

- Sand a spot near the damaged area with Grade 36 Roloc Disc.
- Thermoplastic polyolefin material melts or frays when sanded.
- Thermoset non-polyolefin material sands cleanly.

Thermoplastic and thermoset plastics can be either rigid or flexible. Thermoplastic plastic parts are best repaired with a hot iron plastic material-feed welder, but are usually replaced. Thermoset plastic can be repaired with epoxy or other more rigid 2 package repair material.

- For rigid thermoset repair materials, refer to [Rigid Plastic Part Repair Materials](#).
- For flexible thermoset repair materials, refer to [Flexible Plastic Part Repair Materials](#).
- For general repair instructions, refer to [General Plastic Repair](#).

PLASTIC IDENTIFICATION AND REFINISHING SYSTEMS

Identifying Symbol - Old Symbol in (s)	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common / Trade Names	Type of Plastic
ABS	Acrylonitrile / Butadiene-Styrene	Armrest Support, Console, IPC, Steering Column Bracket / Jacket, Trim Molding	ABS, Absafil, Magnum, Cyclocac, Dyel, Kralastic, Lustran	Thermoplastic
ABS + PC	Acrylonitrile / Butadiene-Styrene + Polycarbonate	Instrument Panel, IPC	Bayblend, Cycloy, KHA, Pulse	Rigid
ABS / PVC	ABS/Vinyl (Soft)	Head Rest Cover, Instrument Panel Pad, Trim Molding / Panel	ABS Vinyl	Flexible, Vinyl
EPDM	Ethylene Propylene Diene Monomer	Body Panel, Bumper Impact Strip	EPDM, Nordel	Rigid

Identifying Symbol - Old Symbol in (s)	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common / Trade Names	Type of Plastic
EVA (EVAC)	Ethylene / Vinyl Acetate	Head Rest Cover, Misc Soft Trim	Elvax, Microthane	Flexible
PA	Polyamide	Headlamp Bezels, Quarter Panel Extensions, Exterior Finish Trim Panels	Nylon, Capron, Zytel, Rilsan, Minion, Vydyne, Welland	Rigid
PA, PAG, PAGG	Polyamide	Exterior Finish Trim Panel, Headlamp Bezel, Quarter Panel Extension	Capron, Minlon, Nylon, Rilsan, Vydyne, Wellamid, Zytel	Rigid, Thermoset
PA + PPE	Polymide + Polyphenylene Ether	Exterior Trim, Fender	GTX	Rigid, Thermoset
PBT + TEEE (PBTP + EEBC)	Polybutylene, Terephthalate + Ether, Ester Block Compound	Fascia, Rocker Panel Molding	Bexloy M	Rigid
PC	Polycarbonate	Interior Rigid / Hard Trim Panel, Valance Panel	Calibre, Lexan, Merlon, Makrolon	Rigid, Thermoset
PC + PETP	Polycarbonate + Polybutylene, Terephthalate	Bumper Fascia	Macroblend, Valox, Xenoy	Flexible, Thermoset
PE	Polyethylene	Fuel Tank Shield, Inner Fender Panel, Interior Trim Panel, Seat Belt Cover, Spoiler, Valance	Alathon, Dylan, Foriflex, Hi-fax, Hosalen, Marlex, Paxon	Rigid, Thermoplastic
PF	Phenol Formaldehyde	Ashtray	Amberol, Bakelite, Durez, Genal, Phenolic, Plyophen, Resinox	Rigid, Thermoset
PP	Polypropylene	Bumper Fascia, Cowl Panel, Deflector Panel, Door Panel, Inner Fender, Interior Molding, Kick Panel, Load Floor, Radiator Shroud, Wheel Cover	Azdel, Daplen, Escorene, Marlex, Novolen, Oleflo, Profax, Tenite	Flexible, Thermoplastic
PPE (PPO)	Polyphenylene Ether	Bezels, Chromed Plastic, Headlamp Door, Ornaments	Noryl, Oleflo, Prevex	Rigid, Thermoset

Identifying Symbol - Old Symbol in (s)	Chemical Composition or Plastic Family Name	Typical Area(s) Where Part is Used	Examples of Common / Trade Names	Type of Plastic
PS	Polystyrene	Dash Panel, Door Panel	Durathon, Dylan, Lustrex, Polystyrol, Styron	Flexible, Soft
PUR	Polyurethane, Thermoset (Unsaturated)	Bumper Fascia, Filler Panel, Front/Rear Body Panel, Pickup Box	Bayflex, Castethane, RIM, RRIM, SRIM	Thermoset
PVC	Polyvinyl Chloride (Vinyl)	Interior Soft Trim, I/P Skins, Roof Cover	Geon, Pliovic, Unichem, Vinoflex, Vinyl, Vinylite	Flexible, Vinyl
SAN (SA)	Styrene Acrylonitrile	Center Console, Glove Box Door, Interior Trim Panel	Foracryl, Lustran, Tyril	Rigid
TEO (EP, EPM, TPO)	Ethylene / Propylene (Rubber)	Air Dam, Bumper Fascia, Valance Panel	EPI, EPII, TPO, TPR (Thermoplastic Rubber)	Flexible, Thermoplastic
TPO	Thermal Plastic Oletin	Bumper Covers	TPO	Flexible Thermoplastic
TPU (TPUR)	Polyurethane, Polyolefin	Bumper Fascia, Gravel Deflector, Soft Filler Panel, Window Molding	Estane, Pellethane, Roylar, Toxin	Flexible, Thermoplastic
UP	Polyester / Thermoset	Air Scoop, Air Spoiler, Fascia Extension, Hood, Instrument Housing, Rear Compartment Lid, Roof, Ventilation Grid	Fiberglass, Premiglass, Selectron, SMC, Vibrinmat	Rigid, Thermoset
For symbols not listed in this table, contact the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.				

ACCESSORIES & EQUIPMENT

Squeaks and Rattles - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

SQUEAKS AND RATTLES

Special Tools

- CH-39570 Chassis Ear
- GE-41416 Ultrasonic Leak Detector

For equivalent regional tools, refer to [Special Tools](#).

NOTE: Squeaks and rattles are caused by improperly controlled relative motion between vehicle components. There are 4 ways to prevent squeaks and rattles.

To aid in diagnosing, use CH-39570 ear or GE-41416 detector.

- Attach the component that squeaks or rattles securely.
- Separate the components that squeak or rattle to prevent contact.
- Insulate the components that squeak or rattle.
- Insulate low uniform friction surfaces to eliminate stickslip motion.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	-----------------------------

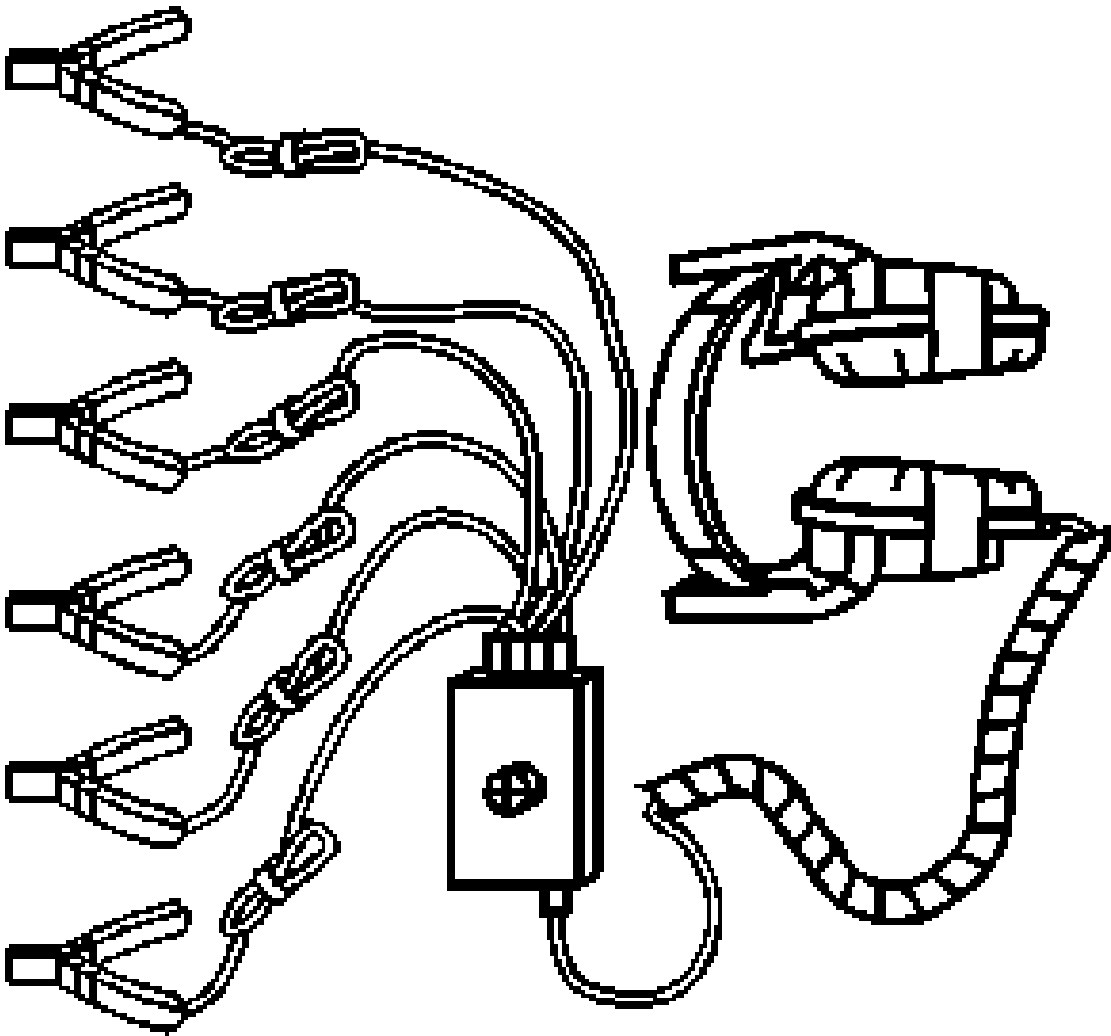
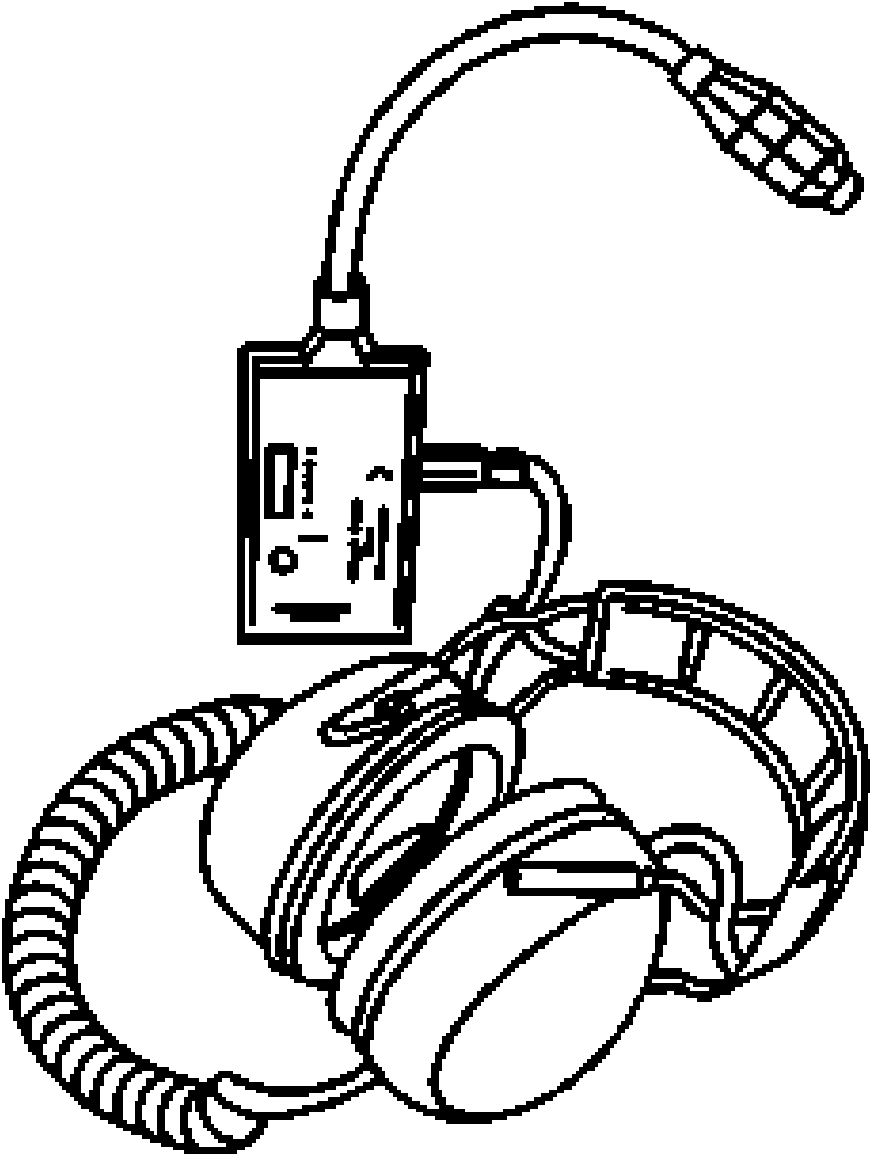
Illustration	Tool Number/ Description
	CH-39570 J 39570 Chassis Ear

Illustration	Tool Number/ Description
	GE-41416 J 41416 Ultrasonic Leak Detector

Article GUID: A00884679

GENERAL INFORMATION

Waterleaks - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

WATERLEAK TEST PREPARATION

- GM vehicles are designed to operate under normal environmental conditions.
- The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications cannot take into consideration any artificial conditions, i.e., high pressure car washes.
- The water leak test procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.
- The first step in diagnosing a leak is determining the conditions under which a leak occurs. If the general leak area can be found, the exact entry point can be isolated using a water hose or an air hose. Some trim panels or components may need to be removed in order to repair the leak.
- If leaks are found around a door, door window, rear compartment lid or liftgate area this does not necessarily indicate a bad weatherstrip. An adjustment to these areas may resolve the condition.

1. Watertest Stand Assembly

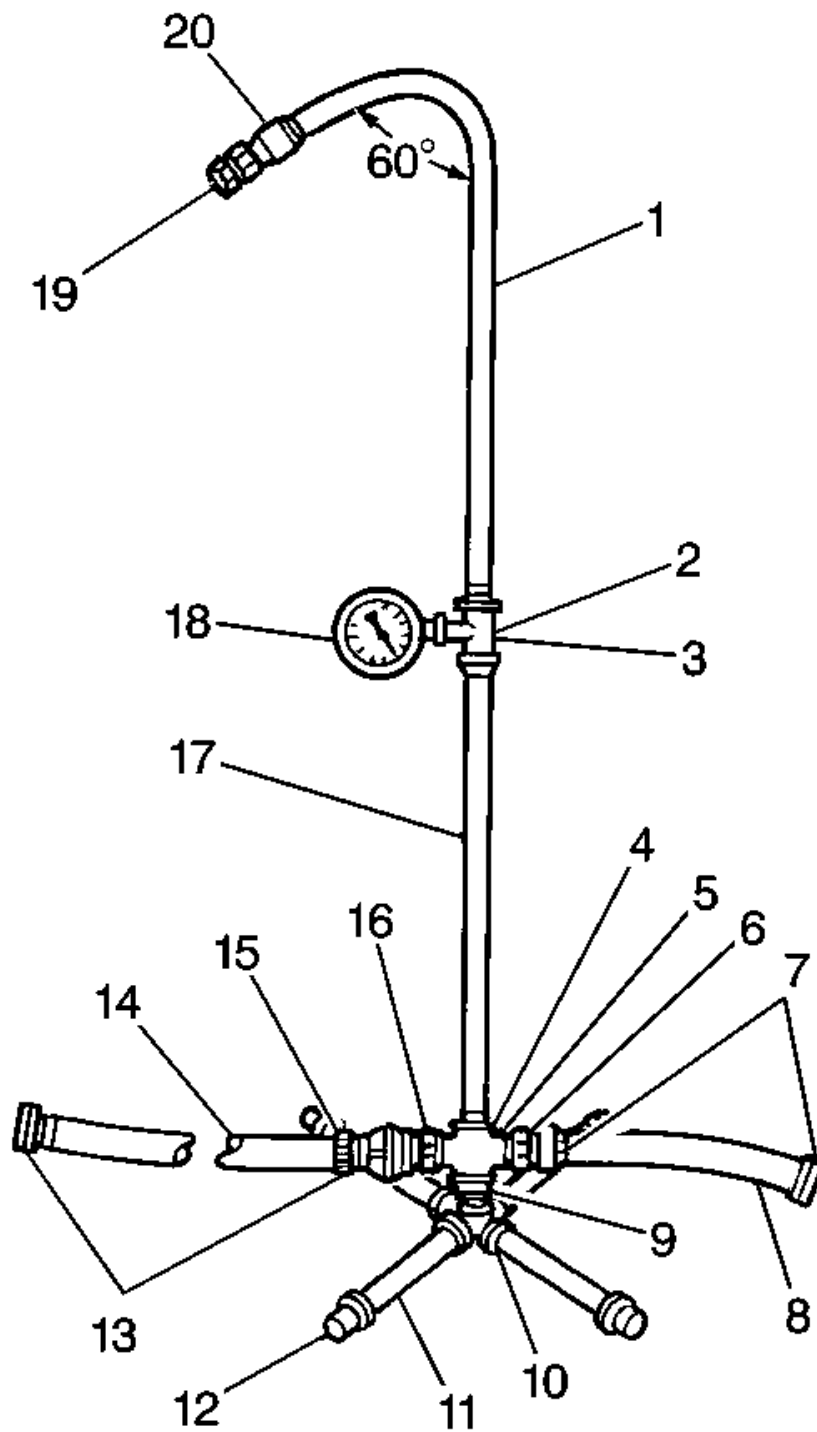


Fig. 1: View Of Watertest Stand Assembly
Courtesy of GENERAL MOTORS COMPANY

Assemble the water test stand as shown.

Callout	Component Name
1	Pipe (0.5 x 36 in)

Callout	Component Name
2	Reducing Tee, Right Stand Only (0.5 x 0.5 x 0.25 in)
3	Coupling, Left Stand Only, (0.5 in)
4	Tee, Left Stand Only (0.5 in)
5	Cross, Right Stand Only (0.5 in)
6	Pipe to Hose Nipple, Right Stand Only (0.5 in)
7	Female Hose Coupling (5/8 in)
8	Input Hose, Right Stand Only (2.0 ft) (5/8 in diameter)
9	Close Nipple (0.5 in)
10	Cross (0.5 in) with Weld-On Cap (0.5 in)
11	Nipple (0.5 x 12 in)
12	Cap (0.5 in)
13	Female Hose Coupling (5/8 in)
14	Cross Hose (12 ft) (5/8 in diameter)
15	Hose Quick Connect
16	Pipe to Hose Nipple (0.5 in)
17	Pipe (0.5 x 60 in)
18	Water Pressure Gauge, Right Stand Only
19	Full Jet Spray Nozzle, No. 1/2GG-25 or Equivalent
20	Coupling (0.5 in)

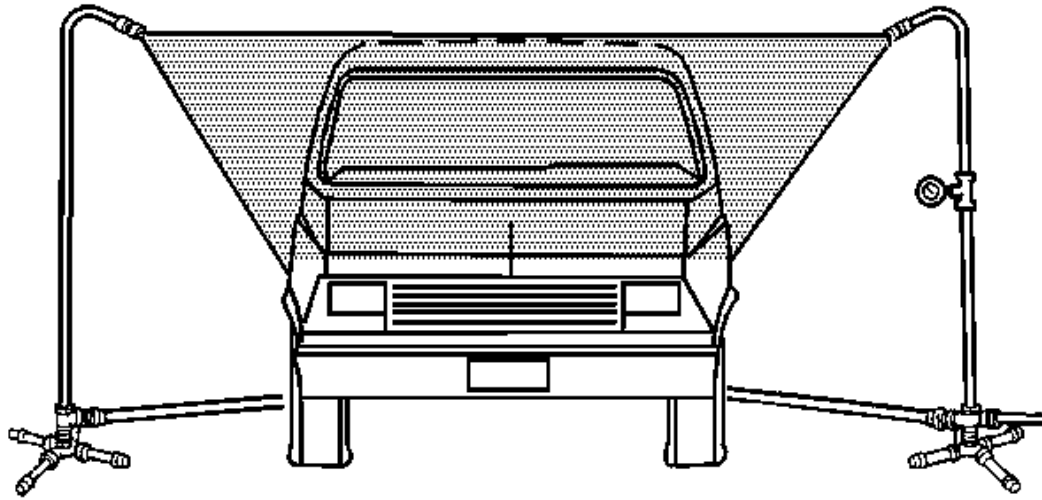


Fig. 2: Illustrating How Water Spray From Stands Should Overlap Vehicle
Courtesy of GENERAL MOTORS COMPANY

2. Position the stands as shown.

The water spray from the stands should overlap the vehicle as shown.

3. Have an assistant inside of the vehicle during the test in order to locate any leaks.

4. The water pressure at the nozzle should maintain a 155 kPa (22 psi), for at least 4 minutes.

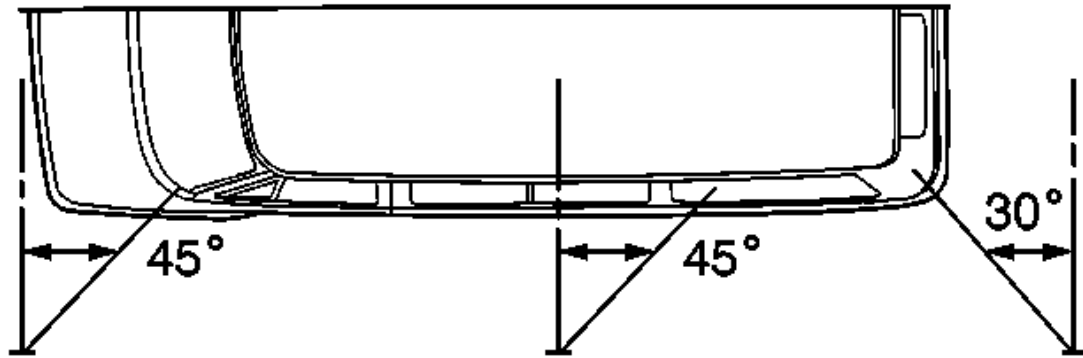


Fig. 3: Identifying Proper Water Spray Angles
Courtesy of GENERAL MOTORS COMPANY

5. In order to check the windshield, aim the water spray 30 degrees down and 45 degrees toward the rear.
Aim the water towards the corner of the windshield.
6. In order to check the side windows for leaks, position the water stand towards the center of the rear quarter, aiming the water spray 30 degrees down and 45 degrees toward the rear.
7. In order to check the back window, aim the water spray 30 degrees down and 30 degrees toward the front.

DUST LEAKS

Dust may leak into the vehicle where water will not. This happens particularly in the lower portion of the interior.

Forward motion of the vehicle can create a slight vacuum which pulls air and dust into the vehicle.

In order to determine the location of dust leaks, perform the following steps:

1. Remove the mats from the floor.
2. Remove the mats from the kick panel.
3. Remove the insulation from the floor.
4. Remove the insulation from the kick panel.
5. Drive the vehicle on a dusty road.
6. Examine the interior.

Dust in the shape of a small cone or slit will usually be found at the point of leakage.

7. Mark the points of leakage.

NOTE: **Ensure that the interior is darkened when performing this step.**

8. Shine bright lamps on the underside of the floor and the cowl.
9. Have an assistant mark any points inside of the vehicle for any points where the light shines through.
 - Inspect the weld joints.
 - Inspect the body mounts.
10. Seal any leaks with an air-drying, body-sealing compound.

WATER HOSE TEST

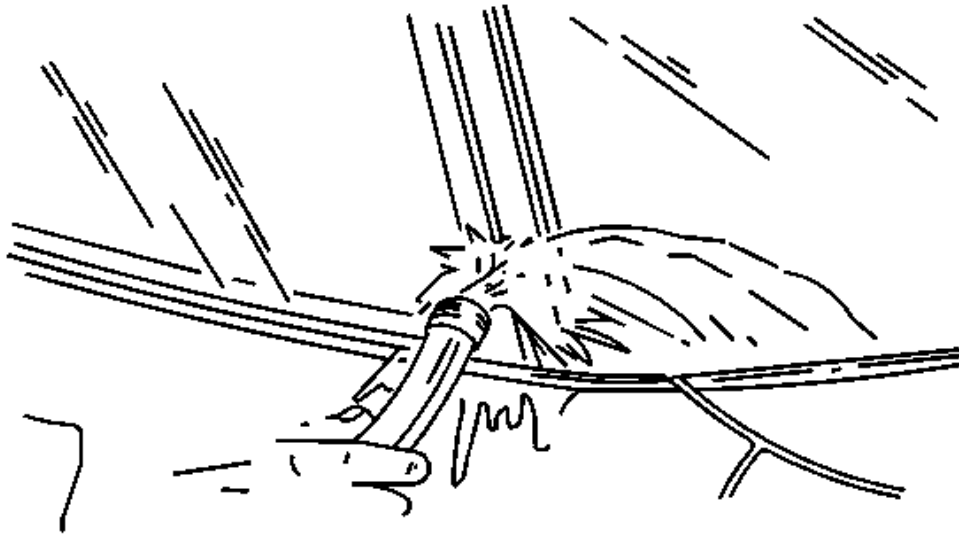


Fig. 4: Performing Water Hose Test

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a water hose without the nozzle attached.

1. Have an assistant inside of the vehicle in order to locate the leak.
2. Begin testing at the base of the window or the windshield.
3. Slowly move the hose upward and across the top of the vehicle.

AIR HOSE TEST

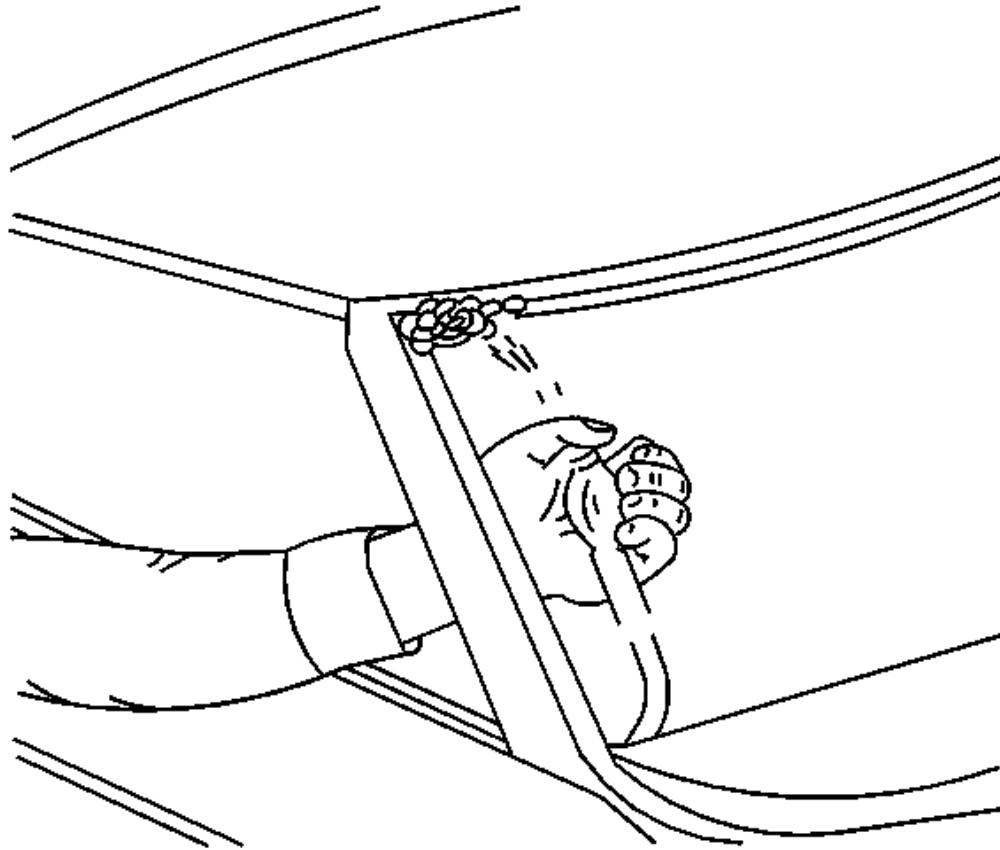


Fig. 5: Performing Air Hose Test

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The air hose test should only be used on fully cured urethane adhesive. Otherwise, damage to the urethane adhesive bead could result in additional leaks.

1. Using a liquid detergent, diluted with water in a spray bottle, spray the window at the edges. Begin at the bottom and gradually move up and across the top.

NOTE: The compressed air should not exceed 205 kPa (30 psi).

2. Have an assistant inside of the vehicle with an air hose.
3. Have the assistant aim the compressed air at the suspected areas.

Bubbles will form in the soap solution at the location of the leak.

REPAIR INSTRUCTIONS

BODY WATERLEAK REPAIR

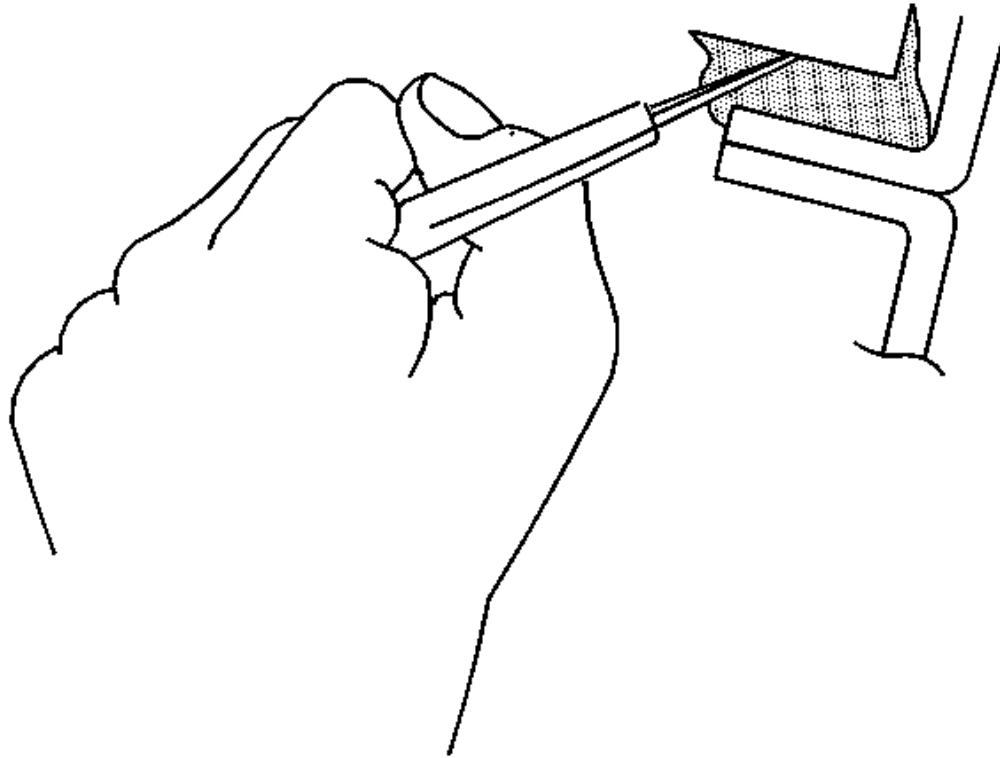


Fig. 6: Cutting Out Adhesive Caulking (1 Of 2)

Courtesy of GENERAL MOTORS COMPANY

WARNING: If the vehicle interior is exposed to moisture and becomes soaked up to the level of the sensing and diagnostic module (SDM), the SDM and SDM harness connector must be replaced. The SDM could be activated when powered, which could cause airbag deployment and result in personal injury.

Depending on the location of the waterleak, you may have to remove certain interior components in order to repair the leak.

1. If the floor carpet is wet refer to [Floor Carpet Drying](#) .

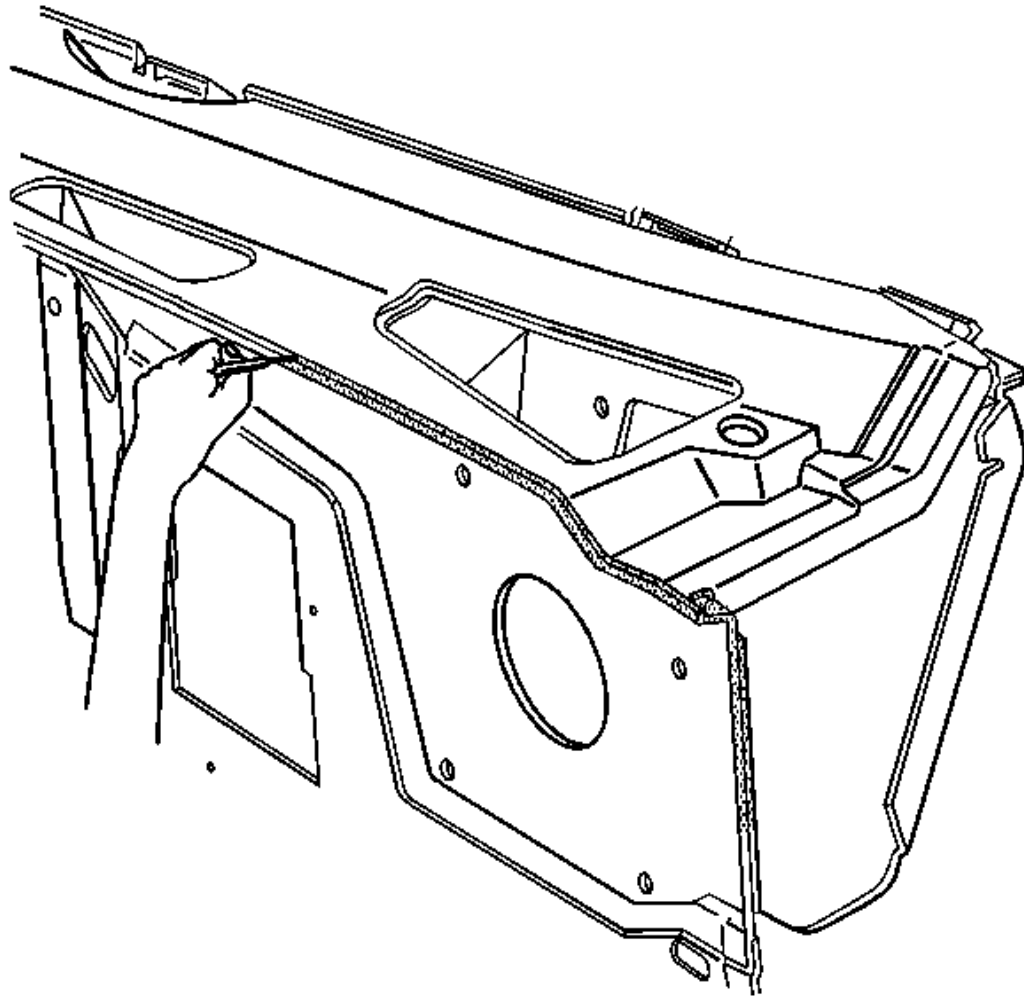


Fig. 7: Cutting Out Adhesive Caulking (2 Of 2)

Courtesy of GENERAL MOTORS COMPANY

2. Cut out a portion of the adhesive caulking in the leak area from inside or outside of the vehicle.
3. Clean and remove all loose particles of the adhesive old caulking from the area.
4. Apply joint body and seam sealer where the old adhesive caulking was removed.
5. Allow the adhesive caulking to dry for several hours.
6. Test for leaks.
7. Install the trim, if removed.

STATIONARY WINDOW WATERLEAK REPAIR

WARNING: If any water enters the vehicle interior up to the level of the carpet or higher and soaks the carpet, the sensing and diagnostic module (SDM) and the SDM harness connector may need to be replaced. The SDM could be activated when powered, which could cause deployment of the air bag(s) and result in personal injury. Before attempting these procedures, the SIR system must be disabled. Refer to Disabling the SIR System.

With the ignition OFF, inspect the SDM mounting area, including the carpet. If any significant soaking or evidence of significant soaking is detected, you must perform the following tasks:

- 1. Remove all water.**
- 2. Repair the water damage.**
- 3. Replace the SDM harness connector.**
- 4. Replace the SDM.**

Failure to follow these tasks could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

1. If the floor carpet is wet refer to [**Floor Carpet Drying**](#) .
 2. Remove the trim moldings or the headliner in order to repair the leak, if needed.
 3. Determine the source of water entry.
 4. If water is leaking at the edge of the windshield, reseal the windshield using Urethane Adhesive Systems which meet GM Specification GM 3651G.
 5. If water leaks into the vehicle at the sides of the stationary windows, reseal the window using Urethane Adhesive Systems which meet GM Specification GM 3651G.
-

Article GUID: A00884727

BRAKES

Antilock Brake System - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake Master Cylinder Reservoir Brake Pipe Fitting	32 N.m (24 lb ft)
Brake Pipe Fitting	18 N.m (13 lb ft)
Brake Pressure Modulator Valve Bracket Bolt	22 N.m (16 lb ft)
Brake Pressure Modulator Valve Bracket Nut	22 N.m (16 lb ft)
Brake Pressure Modulator Valve Primary Pipe	32 N.m (24 lb ft)
Brake Pressure Modulator Valve Secondary Pipe	32 N.m (24 lb ft)
Electronic Brake Control Module Bolt	3 N.m (27 lb in)
Front Wheel Speed Sensor Fastener	9.5 N.m (84 lb in)
Rear Wheel Speed Sensor Bolt	9 N.m (80 lb in)
Vehicle Dynamic Sensor Nut	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

ANTILOCK BRAKE SYSTEM WIRING SCHEMATICS

Power, Ground, Data Communication and Brake Pedal Control

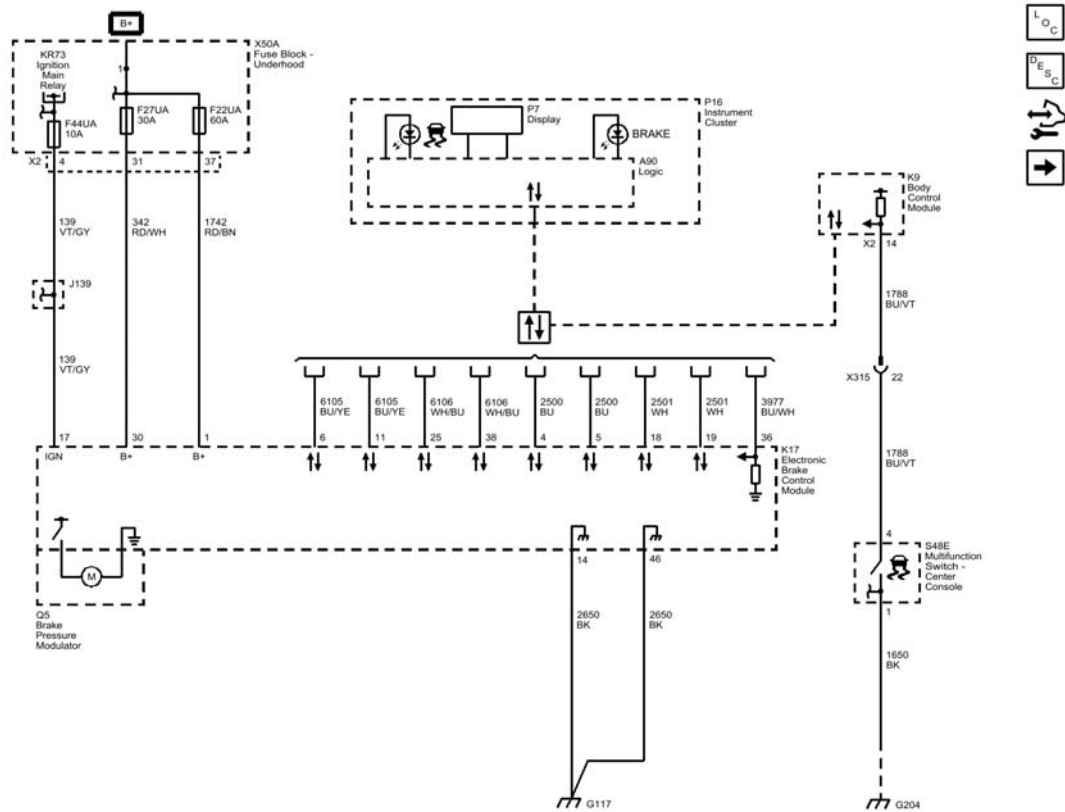


Fig. 1: Power, Ground, Data Communication and Brake Pedal Control
 Courtesy of GENERAL MOTORS COMPANY

Vehicle Stability

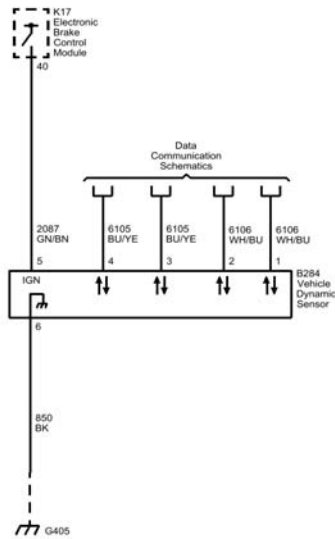


Fig. 2: Vehicle Stability

Courtesy of **GENERAL MOTORS COMPANY**

Wheel Speed Signals

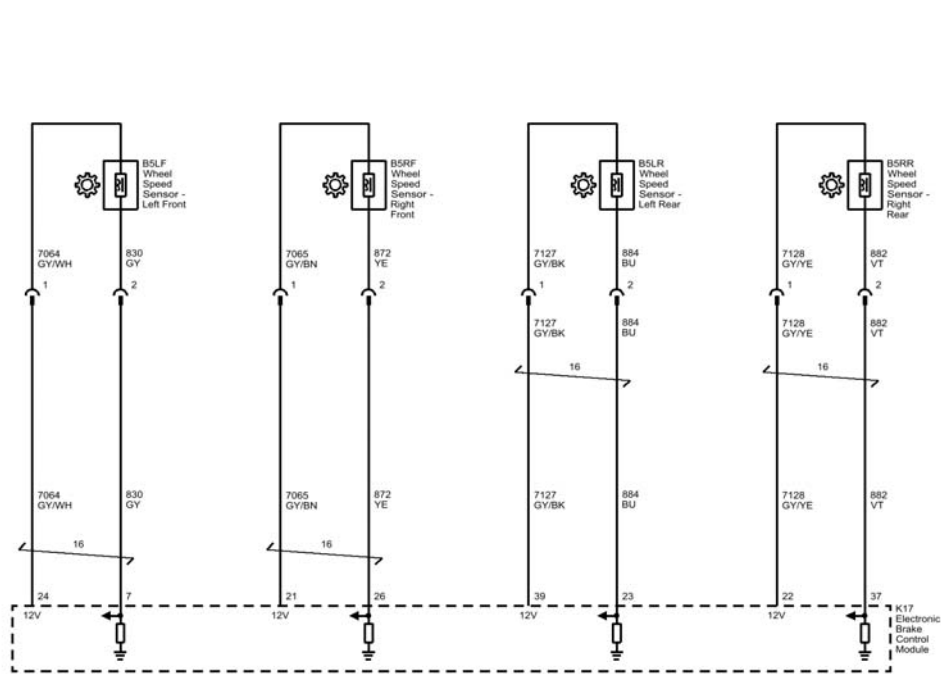


Fig. 3: Wheel Speed Signals

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B2745: TRACTION CONTROL SWITCH CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B2745

Traction Control Switch Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Signal	B2745 02	1	1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Ground	-	1	-	-
1. Traction Control Switch Malfunction.				

Circuit/System Description

The body control module monitors the electronic stability control switch. When the electronic stability control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. When the electronic stability control switch is pressed and held for five seconds, the body control module will request the electronic brake control module to disable the stability control. The Electronic Brake Control Module will request the Instrument Cluster to turn the Traction Control Off and Stability Control Off indicator ON to notify the driver of the deactivation.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The body control module detects a short to ground on the signal circuit.

Action Taken When the DTC Sets

The body control module ignores the traction control switch signal input.

Conditions for Clearing the DTC

- When the condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the Instrument Cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - Traction Control Off indicator
 - Stability Control Off indicator
 - Traction/stability Control indicator
 - **If any indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.
 - **If all indicators turn ON and OFF**
3. Verify the scan tool Body Control Module, Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the S48E Multifunction Switch-Instrument Panel.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
4. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Instrument Panel. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Body Control Module, Traction Control Switch parameter is Inactive.
 - **If Active**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 14 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground.

6. Verify the scan tool Traction Control Switch parameter is Active.

- **If Inactive**

1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Test or replace the S48E Multifunction Switch-Instrument Panel.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S48E Multifunction Switch-Instrument Panel.

2. Test for infinite resistance between the signal terminal 4 and the ground terminal 1 with the switch in the open position.

- **If less than infinite resistance**

Replace the S48E Multifunction Switch-Instrument Panel.

- **If infinite resistance**

3. Test for less than 2 Ω between the signal circuit terminal 4 and the ground terminal 1 with the switch in the closed position.

- **If 2 Ω or greater**

Replace the S48E Multifunction Switch-Instrument Panel.

- **If less than 2 Ω**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Vehicle Stability Control System Switch Replacement**
- **Control Module References** for Body Control Module or Instrument Cluster replacement, programming and setup.

DTC C0010-C0019, C001C, OR C001D: INLET CONTROL/OUTLET CONTROL

Diagnostic Instructions

- Perform the prior to [Diagnostic System Check - Vehicle](#) using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C0010

Left Front Inlet Control

DTC C0011

Left Front Outlet Control

DTC C0014

Right Front Inlet Control

DTC C0015

Right Front Outlet Control

DTC C0018

Left Rear Inlet Control

DTC C0019

Left Rear Outlet Control

DTC C001C

Right Rear Inlet Control

DTC C001D

Right Rear Outlet Control

Circuit/System Description

The solenoid valves are integral parts of the brake pressure modulator valve assembly. The brake pressure modulator valve assembly contains an inlet solenoid valve and an outlet solenoid valve for each wheel. The solenoid valves are not engaged during normal system operation. When the ABS, electronic brake force distribution or traction control/stability control operation is required the electronic brake control module turns the required solenoid valves ON.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The electronic brake control module detects a short to ground or open/high resistance on the internal control circuit.

Action Taken When the DTC Sets

- The electronic brake control module disables the ABS, the electronic brake force distribution and the traction control/stability control for the duration of the ignition cycle.
- The ABS warning indicator turns ON.
- The traction control/stability control-active indicator turns ON.
- The brake force distribution indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The electronic brake control module will turn OFF the indicators and enable the system functions in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition ON/Vehicle in Service mode.
2. Verify that DTC C0010, C0011, C0014, C0015, C0018, C0019, C001C or C001D are not set while operating the vehicle under normal driving conditions.
 - If any of the DTCs are set

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

3. Replace the Q5 Brake Pressure Modulator

- **If none of the DTCs are set**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for electronic brake control module replacement, programming and setup.

DTC C0051: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0051

Steering Wheel Angle Sensor

For symptom byte information refer to [Symptom Byte List](#)

Circuit/System Description

The steering wheel angle sensor is integrated into the steering gear assembly. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation.

The electronic brake control module receives high speed serial data inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The electronic brake control module utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C0051 66

The steering wheel angle sensor signal rate of change is too fast greater than 30°/s.

C0051 4B

The steering wheel angle sensor signal is found to not be calibrated.

C0051 1A

The steering wheel angle sensor signal is above the maximum specification.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- A Service Stabile Trak message may be displayed on the driver information center.
- A Service Brake Assist message may be displayed on the driver information center.
- A Service Power Steering Drive with Care message may be displayed on the driver information center.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Check and adjust all tires to the stated cold air pressure as identified on the tire placard.
- The car should not pull in either direction causing the steering wheel to be off center while driving in a straight line on a level surface.
- Confirm that all tires are of the proper size and matching brands. If a mis-sized or non-matching brand tire is present, inform the customer that in order for the vehicle stability enhanced system to function normally, tires need to be a uniform size and rolling diameter.
- Inspect the serial data circuits and connections at the power steering control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. With a scan tool check the Power Steering Control Module for any DTCs.
 - **If any DTCs are present in the Power Steering Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) in Power Steering Diagnostic Information and Procedures.

- **If there are no DTCs present in the Power Steering Control Module**

1. With a scan tool check to see if DTCs U0126, U0130, or U0131 are set.

- **If DTCs U0126, U0130, or U0131 are set**

Refer to [DTC U0100-U02FF](#)

- **If DTCs U0126, U0130, and U0131 are not set**

2. With a scan tool check to see if DTCs DTC C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are set in the Electronic Brake Control Module

- **If DTCs C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are set in the Electronic Brake Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If DTCs C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are not set in the Electronic Brake Control Module**

3. Perform the [Steering Wheel Angle Sensor Centering](#) procedure.

- **If the Steering Angle Sensor Centering procedure corrected the DTC**

Proceed to step 6

- **If the Steering Angle Sensor Centering procedure did not correct the DTC**

4. Replace the steering gear assembly

- **If steering gear assembly replacement corrected the DTC**

Proceed to step 6

- **If steering gear assembly replacement did not correct the DTC**

5. Replace the K17 Electronic Brake Control Module.

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- [Control Module References](#) for module replacement, programming and setup.

DTC C006B: STABILITY SYSTEM ACTIVE TOO LONG

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C006B

Stability System Active Too Long

Circuit/System Description

The electronic brake control module activates the stability system depending on steering angle and multi-axis acceleration sensor input. When the traction control or stability control operation is required the EBCM turns the required solenoid valves ON.

The electronic brake control module receives high speed serial data inputs from the steering angle sensor and multi-axis sensor, that identify the position and direction of the steering wheel rotation as well as vehicle yaw and lateral movement. The electronic brake control module utilizes these signal to calculate the driver intended driving direction.

The steering wheel angle sensor is integrated into the steering gear assembly. The multi-axis sensor is located internally into the inflatable restraint and sensing diagnostic module.

Conditions for Running the DTC

- Ignition ON
- Stability control is active.

Conditions for Setting the DTC

Stability control is active for more than 15 s.

Action Taken When the DTC Sets

- The EBCM disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicators and enable the system functions in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the serial data circuits and connections at the power steering control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Circuit/System Verification

1. Vehicle in Service Mode.
2. With a scan tool check the Power Steering Control Module for any DTCs.
 - **If any DTCs are present in the Power Steering Control Module**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle in Power Steering Diagnostic Information and Procedures.

3. Verify that the steering gear assembly is not incorrectly installed.
 - **If the steering gear assembly is installed incorrectly**

Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)

- If the steering gear assembly is installed correctly

4. Perform the [Steering Wheel Angle Sensor Centering](#) procedure.

- If the Steering Angle Sensor Centering procedure corrected the DTC

Proceed to step 7

- If the Steering Angle Sensor Centering procedure did not correct the DTC

5. Verify that the inflatable restraint and sensing diagnostic module is installed correctly.

- If inflatable restraint and sensing diagnostic module is not installed correctly

Refer to [Airbag Sensing and Diagnostic Module Replacement](#)

- If inflatable restraint and sensing diagnostic module is installed correctly

6. Replace the K17 Electronic Brake Control Module.

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- [Control Module References](#) for module replacement, programming and setup.

DTC C0186, C018B, C0196, C019B, C027E, OR C0287 (WITH UGN): LATERAL ACCELERATION/LONGITUDINAL ACCELERATION/YAW RATE SIGNALS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0186

Lateral Acceleration Sensor Signal

DTC C018B

Lateral Acceleration Signals 1-2 Not Plausible

DTC C0196

Yaw Rate Signal

DTC C019B

Yaw Rate Signals 1-2 Not Plausible

DTC C027E

Longitudinal Acceleration Signals 1-2 Not Plausible

DTC C0287

Longitudinal Acceleration Sensor Signal

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U0125, U0126, C0186 71, C0196 71, C0287 71	U0125, U0126, C0186 71, C0196 71, C0287 71	-	C0186 5A, C0196 5A
Ground	-	U0125, U0126, C0186 71, C0196 71, C0287 71	-	C0186 5A, C0196 5A

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, external to the electronic brake control module. The electronic brake control module supplies ignition voltage to the multi-axis acceleration sensor. The multi-axis acceleration sensor communicates with the electronic brake control module via serial data. The electronic brake control module activates the ABS, the traction control and the stability control depending on the multi-axis acceleration sensor input.

Conditions for Running the DTC

- Ignition ON begins the initialization of the brake system power-up self test.
- Drive the vehicle at speeds greater than 16 km/h (10 MPH) to complete the active brake system test.

Conditions for Setting the DTC

C0186 00 or C018B 5A

The lateral acceleration signal is out of the specified range.

C0186 5A

The lateral acceleration signal is not plausible with the yaw rate signal, steering angle signal and vehicle speed.

C0186 71

- The electronic brake control module received an invalid lateral acceleration signal.
- An open/high resistance is detected on the multi-axis acceleration ground circuit.

- A short to ground or open/high resistance is detected on the multi-axis acceleration ignition circuit.

C0196 00 or C019B 5A

The yaw rate signal is out of the specified range.

C0196 5A

- The yaw rate signal offset is out of the specified range.
- The yaw rate signal is not plausible with the lateral acceleration signal, the steering angle signal and the vehicle speed.

C0196 71

- A short to ground or open/high resistance is detected on the ignition circuit.
- The electronic brake control module received an invalid lateral acceleration signal.
- An open/high resistance is detected on the multi-axis acceleration ground circuit.

C027E 5A

The longitudinal acceleration signal is not plausible.

C0287 4B

The longitudinal acceleration sensor is not calibrated.

C0287 5A

The longitudinal acceleration signal is not plausible with the vehicle speed.

C0287 71

- An open/high resistance is detected on the multi-axis acceleration ground circuit.
- The electronic brake control module received an invalid longitudinal acceleration signal.
- A short to ground or open/high resistance is detected on the multi-axis acceleration ignition circuit.

Action Taken When the DTC Sets

- The adaptive cruise control is inhibited.
- The traction control Off indicator turns ON.
- The traction/stability control indicator turns ON.
- A Traction Control Off message may be displayed.
- A Service Stabilitrak message may be displayed.
- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.

- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition ON.
2. Verify DTC C0186 5A, C018B 5A, C0196 5A, C019B 5A, C027E 5A, C0287 4B, or C0287 5A is not set.
 - **If any of the DTCs are set**
 1. Perform the **Vehicle Yaw Sensor Learn (with UGN)****Vehicle Yaw Sensor Learn (without UGN)** procedures to complete the learn.
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - If the DTC sets, replace the K17 Electronic Brake Control Module.
 - If the DTC does not set
3. All OK.
 - **If none of the DTCs are set**
3. Verify the B119 Multi-axis Acceleration Sensor is installed correctly.
 - **If loose or incorrect installation**
Correct the installation of the component.
 - **If installed correctly**
4. Ignition OFF, all vehicle system OFF, and the scan tool disconnected, disconnect the harness connector at

the B119 Multi-axis Acceleration Sensor. It may take up to 2 minutes for all vehicle systems to power down.

5. Test for less than 10 Ω between the ground circuit terminal 6 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

6. Ignition ON.

7. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate**

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K17 Electronic Brake Control Module.

- **If the test lamp illuminates**

8. Replace the B119 Multi-axis Acceleration Sensor.

9. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

10. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Vehicle Dynamic Sensor Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C0500-C0504, C0506-C0510, OR C0512-C0516: WHEEL SPEED SENSORS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

[Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0500

Left Front Wheel Speed Sensor Circuit Open

DTC C0501

Left Front Wheel Speed Sensor Circuit Range Performance

DTC C0502

Left Front Wheel Speed Sensor Short to Ground

DTC C0503

Left Front Wheel Speed Sensor Short to Battery

DTC C0504

Left Front Wheel Speed Sensor Circuit Signal Erratic/Intermittent

DTC C0506

Right Front Wheel Speed Sensor Circuit Open

DTC C0507

Right Front Wheel Speed Sensor Circuit Range Performance

DTC C0508

Right Front Wheel Speed Sensor Short to Ground

DTC C0509

Right Front Wheel Speed Sensor Short to Battery

DTC C050A

Right Front Wheel Speed Sensor Circuit Signal Erratic/Intermittent

DTC C050C

Left Rear Wheel Speed Sensor Circuit Open

DTC C050D

Left Rear Wheel Speed Sensor Circuit Range Performance

DTC C050E

Left Rear Wheel Speed Sensor Short to Ground

DTC C050F

Left Rear Wheel Speed Sensor Short to Battery

DTC C0510

Left Rear Wheel Speed Sensor Circuit Signal Erratic/Intermittent

DTC C0512

Right Rear Wheel Speed Sensor Circuit Open

DTC C0513

Right Rear Wheel Speed Sensor Circuit Range Performance

DTC C0514

Right Rear Wheel Speed Sensor Short to Ground

DTC C0515

Right Rear Wheel Speed Sensor Short to Battery

DTC C0516

Right Rear Wheel Speed Sensor Circuit Signal Erratic/Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Wheel Speed Sensor Ignition	C0502	C0500	-	C0501, C0504
Left Front Wheel Speed Sensor Signal	C0500, C0502	C0500	C0503	C0501, C0504
Right Front Wheel Speed Sensor Ignition	C0508	C0506	-	C0507, C050A
Right Front Wheel Speed Sensor Signal	C0506, C0508	C0506	C0509	C0507, C050A
Left Rear Wheel Speed Sensor Ignition	C050E	C050C	-	C050D, C0510
Left Rear Wheel Speed Sensor Signal	C050C, C050E	C050C	C050F	C050D, C0510
Right Rear Wheel Speed Sensor Ignition	C0514	C0512	-	C0513, C0516
Right Rear Wheel Speed Sensor Signal	C0512, C0514	C0512	C0515	C0513, C0516

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C0500, C0502, C0503, C0506, C0508, C0509, C050C, C050E, C050F, C0512, C0514, C0515

- An open or a high resistance is detected on a wheel speed sensor circuit.
- A short to ground or an open/high resistance is detected on a wheel speed sensor signal circuit.
- A short to voltage is detected on a wheel speed sensor signal circuit.

C0501, C0504, C0507, C050A, C050D, C0510, C0513, C0516

- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Incorrectly mounted wheel speed sensor
- Debris on the wheel speed sensor or the tone ring
- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.

- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
 - **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 1.6 km/h (1 MPH) of each other**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate B5 Wheel Speed Sensor and the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.
2. Test for less than 1 V between the appropriate K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - B5LF Wheel Speed Sensor - Left Front - terminal 24 and terminal 7

- B5LR Wheel Speed Sensor - Left Rear - terminal 39 and terminal 23
- B5RF Wheel Speed Sensor - Right Front - terminal 21 and terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 22 and terminal 37
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Vehicle OFF.

4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:

- B5LF Wheel Speed Sensor - Left Front - terminal 24 and terminal 7
- B5LR Wheel Speed Sensor - Left Rear - terminal 39 and terminal 23
- B5RF Wheel Speed Sensor - Right Front - terminal 21 and terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 22 and terminal 37
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal listed below:

- B5LF Wheel Speed Sensor - Left Front - terminal 24
- B5LR Wheel Speed Sensor - Left Rear - terminal 39
- B5RF Wheel Speed Sensor - Right Front - terminal 21
- B5RR Wheel Speed Sensor - Right Rear - terminal 22
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal listed below:

- B5LF Wheel Speed Sensor - Left Front - terminal 7
- B5LR Wheel Speed Sensor - Left Rear - terminal 23
- B5RF Wheel Speed Sensor - Right Front - terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 37
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

7. Replace the B5 Wheel Speed Sensor.

8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Front Wheel Speed Sensor Replacement
- Rear Wheel Speed Sensor Replacement
- Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C052B, C052D, C052F, C055B, OR C05AE: ABS PUMP MOTOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC C052B

ABS Pump Motor Performance

DTC C052D

ABS Pump Motor Supply Control Circuit High

DTC C052F

ABS Pump Motor Supply Circuit

DTC C055B

ABS Pump Motor Supply Circuit Low

DTC C05AE

ABS Pump Motor Calibration Not Learned

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	P0562, C055B	P0560	-	P0560, C052B

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 30	P0562, C055B	P0560	-	P0560, C052B
Ground Terminal 14	-	P0560	P0563, C052D	P0560, C052B
Ground Terminal 46	-	P0560	P0563, C052D	P0560, C052B

Circuit/System Description

The electronic brake control module monitors two different blocks of memory to determine its capability to control the system shutdown process.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

- Keep alive voltage regulator not functional.
- Processor loses complete battery power.
- Battery voltage is under 9 V and the vehicle is not moving.

Action Taken When the DTC Sets

- A warning indicator may be displayed.
- A driver information center message may be displayed.
- The electronic brake control module disables ABS, traction control system and vehicle stability enhancement system for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The electronic brake control module clears the history DTC when a current DTC is not detected in 40 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

Check to ensure battery shunt is not opened.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
 - Terminal 1
 - Terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. Verify that a test lamp illuminates between the ignition circuit terminal 17 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.

- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp illuminates**

7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C0552, C10C0, C10C4, OR C1251: YAW RATE (WITHOUT UGN)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C10C0 00

Yaw Rate Circuit Performance

DTC C10C4 00

Yaw Rate 1 - 2 Not Plausible

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The multi-axis acceleration sensor communicates with the electronic brake control module via serial data. The electronic brake control module activates the stability control function depending on the multi-axis acceleration sensor input. The inflatable restraint sensing and diagnostic module uses the multi-axis acceleration sensor to determine if the vehicle is in a roll over or near collision incident.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The yaw rate acceleration signal is not plausible with the vehicle acceleration.

Action Taken When the DTC Sets

- The Air Bag Indicator turns ON.
- The traction/stability control indicator turns ON.
- The electric brake control module disables the stability control and the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify the K36 Inflatable Restraint Sensing and Diagnostic Module is installed correctly.
 - **If loose or incorrect installation**

Correct the installation of the component.
 - **If installed correctly**
 1. Perform the Vehicle Yaw Sensor Learn (with UGN)Vehicle Yaw Sensor Learn (without UGN).
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - If the DTC sets, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - If the DTC sets, replace the K17 Electronic Brake Control Module.
 - If the DTC does not set
 4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC C0555-C0558: WHEEL SPEED SENSOR INCORRECT COMPONENT INSTALLED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

[Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0555

Left Front Wheel Speed Sensor Incorrect Component Installed

DTC C0556

Right Front Wheel Speed Sensor Incorrect Component Installed

DTC C0557

Left Rear Wheel Speed Sensor Incorrect Component Installed

DTC C0558

Right Rear Wheel Speed Sensor Incorrect Component Installed

Diagnostic Fault Information

Component	Condition	DTC
Wheel Speed Sensor	• Incorrect part sensor installed • Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or worn wheel bearing • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness	C0555, C0556, C0557, C0558

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor

receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C0555, C0556, C0557, C0558

- Incorrect part number wheel speed sensor installed
- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Debris on the wheel speed sensor or the tone ring
- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.
- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If any of the DTCs are set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
 - **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 1.6 km/h (1 MPH) of each other**
3. All OK.

Circuit/System Testing

1. Ignition On
2. Verify DTCs C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are not set.
 - **If any listed DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If none of the listed DTCs are set**
3. Inspect the appropriate B5 Wheel Speed Sensor and encoder ring for contamination, metallic particles, physical damage, incorrect installation and the correct component.
 - **If contamination, physical damage, incorrect installation, or the wrong component is diagnosed**

Replace the appropriate B5 Wheel Speed Sensor.

- If no contamination, physical damage, incorrect installation, or the wrong component is not diagnosed

4. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Front Wheel Speed Sensor Replacement](#)
- [Rear Wheel Speed Sensor Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C059B OR C0560: RIGHT/LEFT FRONT BRAKE PRESSURE SENSOR MISSING CALIBRATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C059B

Right Front Brake Pressure Sensor Missing Calibration

DTC C0560

Left Front Brake Pressure Sensor Missing Calibration

Circuit/System Description

The brake pressure sensors located in the brake pressure modulator send testpulses to determine if they are calibration with each other.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

This diagnostic detects that the brake pressure module testpulses differ from the nominal value by more than 10%.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information

center.

- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the Q5 Brake Pressure Modulator.
 - **If the DTC does not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0571, C0572, OR C0574: BRAKE MASTER CYLINDER PRESSURE SENSOR 1 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0571

Brake Master Cylinder Pressure Sensor 1 Circuit Low Voltage

DTC C0572

Brake Master Cylinder Pressure Sensor 1 Circuit High Voltage

DTC C0574

Brake Master Cylinder Pressure Sensor 1 Circuit Performance

Circuit/System Description

The electronic brake control module uses input from the master cylinder pressure sensor for more accurate control during a vehicle stability enhancement system event. The master cylinder pressure sensor is internal to the brake pressure modulator.

Conditions for Running the DTC

- The brake pedal is not applied.
- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C0571

A short to ground or open is detected on the sensor signal circuit.

C0572

A short to battery is detected on the sensor signal circuit.

C0574

The master cylinder pressure sensor raw offset is out of specified range.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.

- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform a brake hydraulic system test, refer to Hydraulic Brake System Diagnosis .
 - **If the brake hydraulic system test does not pass**
Repair as necessary.
 - **If the brake hydraulic system tests normal**
2. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement

- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C0575, C0576, OR C0578: LEFT REAR BRAKE PRESSURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C0575

Left Rear Brake Pressure Sensor Circuit Low Voltage

DTC C0576

Left Rear Brake Pressure Sensor Circuit High Voltage

DTC C0578

Left Rear Brake Pressure Sensor Circuit Performance

Circuit/System Description

The Electronic Brake Control Module detects an issue with the Left Rear Brake Pressure Sensor which is located internally in the Brake Pressure Modulator Valve.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

C0575

The Electronic Brake Control Module detects the Left Rear Brake Pressure Sensor is shorted to ground.

C0576

The Electronic Brake Control Module detects the Left Rear Brake Pressure Sensor is shorted to voltage.

C0578

The Electronic Brake Control Module detects the Left Rear Brake Pressure Sensor is out of the specified value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.

- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.
 - **If the DTC sets**
 Replace the Q5 Brake Pressure Modulator.
 - **If the DTC does not set**
2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement

- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C05A3, C05A4, OR C10EE: WHEEL SPEED SENSOR SUPPLY CIRCUIT/WHEEL SPEED SENSOR FREQUENCY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

[Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C05A3

Wheel Speed Sensor Supply Circuit High

DTC C05A4

Wheel Speed Sensor Supply Circuit Low

DTC C10EE

Wheel Speed Sensor Frequency

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Wheel Speed Sensor Ignition	C0502, C05A4	C0500, C05A3	-	C0501, C0504, C10EE
Left Front Wheel Speed Sensor Signal	C0502	C0500	C0503	C0501, C0504, C10EE
Right Front Wheel Speed Sensor Ignition	C0508, C05A4	C0506, C05A3	-	C0507, C050A, C10EE
Right Front Wheel Speed Sensor Signal	C0508	C0506	C0509	C0507, C050A, C10EE
Left Rear Wheel Speed Sensor Ignition	C050E, C05A4	C050C, C05A3	-	C050D, C0510, C10EE
Left Rear Wheel Speed Sensor Signal	C050E	C050C	C050F	C050D, C0510, C10EE
Right Rear Wheel Speed Sensor Ignition	C0514, C05A4	C0512, C05A3	-	C0513, C0516, C10EE
Right Rear Wheel Speed Sensor Signal	C0514	C0512	C0515	C0513, C0516, C10EE

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of

permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C05A3, C05A4

- An open or a high resistance is detected on a wheel speed sensor circuit.
- A short to ground or an open/high resistance is detected on a wheel speed sensor signal circuit.
- A short to voltage is detected on a wheel speed sensor signal circuit.

C10EE

- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Incorrectly mounted wheel speed sensor
- Debris on the wheel speed sensor or the tone ring
- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.
- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.

- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
 - **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 1.6 km/h (1 MPH) of each other**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate B5 Wheel Speed Sensor and the harness connector at the K17 Electronic Brake Control Module, vehicle in service mode.
2. Test for less than 1 V between the appropriate K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - B5LF Wheel Speed Sensor - Left Front - terminal 24 and terminal 7
 - B5LR Wheel Speed Sensor - Left Rear - terminal 39 and terminal 23

- B5RF Wheel Speed Sensor - Right Front - terminal 21 and terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 22 and terminal 37
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Vehicle OFF.

4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:

- B5LF Wheel Speed Sensor - Left Front - terminal 24 and terminal 7
- B5LR Wheel Speed Sensor - Left Rear - terminal 39 and terminal 23
- B5RF Wheel Speed Sensor - Right Front - terminal 21 and terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 22 and terminal 37
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal listed below:

- B5LF Wheel Speed Sensor - Left Front - terminal 24
- B5LR Wheel Speed Sensor - Left Rear - terminal 39
- B5RF Wheel Speed Sensor - Right Front - terminal 21
- B5RR Wheel Speed Sensor - Right Rear - terminal 22
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal listed below:

- B5LF Wheel Speed Sensor - Left Front - terminal 7
- B5LR Wheel Speed Sensor - Left Rear - terminal 23
- B5RF Wheel Speed Sensor - Right Front - terminal 26
- B5RR Wheel Speed Sensor - Right Rear - terminal 37
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

7. Replace the B5 Wheel Speed Sensor.

8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C05AD: BRAKE BLENDING SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C05AD

Brake Blending System Performance

Circuit/System Description

The electronic brake control module uses input from the master cylinder pressure sensor for more accurate control during a vehicle stability enhancement system event. The master cylinder pressure sensor is internal to the brake pressure modulator.

Conditions for Running the DTC

- The brake pedal is not applied.
- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

An anomaly in brake pressure in the master cylinder or hydraulic lines has been detected.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information

center.

- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

The diagnostic for DTC C05AD will have you test and inspect the base hydraulic brake system for any issues. The hydraulic brake system must be thoroughly inspected for any bent or kinked brake lines, both metal and rubber. Also the vehicles brake calipers must also be able to slide and apply freely.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Perform a brake hydraulic system test, refer to [Hydraulic Brake System Diagnosis](#) .
 - **If the brake hydraulic system test does not pass**

Repair as necessary.
 - **If the brake hydraulic system tests normal**
2. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)
- [Control Module References](#) for Control Module replacement, programming and setup.

DTC C05B0 OR C05B1: ABS FRONT HYDRAULIC CIRCUIT LEAK DETECTED/ABS REAR HYDRAULIC CIRCUIT LEAK DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C05B0

ABS Front Hydraulic Circuit Leak Detected

DTC C05B1

ABS Rear Hydraulic Circuit Leak Detected

Circuit/System Description

The electronic brake control module uses input from the master cylinder pressure sensor for more accurate control during a vehicle stability enhancement system event. The master cylinder pressure sensor is internal to the brake pressure modulator.

Conditions for Running the DTC

- The brake pedal is applied.
- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The Electronic Brake Control Module detects a pressure loss associated to a hydraulic leak.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform a brake hydraulic system test, refer to Hydraulic Brake System Diagnosis .
 - **If the brake hydraulic system test does not pass**

Repair as necessary.
 - **If the brake hydraulic system tests normal**
2. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement
- Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C05B2: STEERING WHEEL ANGLE SENSOR SIGNAL - YAW RATE SENSOR SIGNAL NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C05B2

Steering Wheel Angle Sensor Signal - Yaw Rate Sensor Signal Not Plausible

Circuit/System Description

The electronic brake control module receives high speed serial data inputs from the steering angle sensor and multi-axis sensor, that identify the position and direction of the steering wheel rotation as well as vehicle yaw and lateral movement. The electronic brake control module utilizes these signal to calculate the driver intended driving direction.

The steering wheel angle sensor is integrated into the steering gear assembly. The multi-axis sensor is located internally into the inflatable restraint and sensing diagnostic module.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The difference between model yaw rate out of steering angle, model yaw rate out of wheel speeds and measured yaw rate has to be less than 2 deg/s during straight ahead driving and cornering.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- A Service StabiliTrak message may displayed on the driver information center.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the serial data circuits and connections at the power steering control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Circuit/System Verification

1. Vehicle in Service Mode.
2. With a scan tool check the Power Steering Control Module for any DTCs.
 - **If any DTCs are present in the Power Steering Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) in Power Steering Diagnostic Information and Procedures.

- **If there are no DTCs are present in the Power Steering Control Module**
3. Verify that the steering gear assembly is not incorrectly installed.
 - **If the steering gear assembly is installed incorrectly**

Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)

- **If the steering gear assembly is installed correctly**
4. Perform the [Steering Wheel Angle Sensor Centering](#) procedure.
 - **If the Steering Angle Sensor Centering procedure corrected the DTC**

Proceed to step 7

- **If the Steering Angle Sensor Centering procedure did not correct the DTC**
5. Verify that the inflatable restraint and sensing diagnostic module is installed correctly.
 - **If inflatable restraint and sensing diagnostic module is not installed correctly**

Refer to [Airbag Sensing and Diagnostic Module Replacement](#)

- If inflatable restraint and sensing diagnostic module is installed correctly

6. Replace the K17 Electronic Brake Control Module.

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- [Control Module References](#) for module replacement, programming and setup.

DTC C106A OR C106B: PUMP MOTOR RELAY CIRCUIT LOW/PUMP MOTOR RELAY CIRCUIT HIGH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C106A

Pump Motor Relay Circuit Low

DTC C106B

Pump Motor Relay Circuit High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
B+ Terminal 30	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
Ground Terminal 14	-	C056D 00, C12DA 00, C12D7 00	-	-
Ground Terminal 46	-	U0129 00, U1833 00	-	-

Circuit/System Description

Battery positive voltage is supplied to the electronic brake control module at all times through a 60 A fuse located in the underhood fuse block. The electronic brake control module uses this voltage to power the pump motor. The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is

integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS or the action control system operation is required the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C106A

The electronic brake control module detects the ABS pump motor relay circuit is shorted to ground.

C106B

The electronic brake control module detects the ABS pump motor relay circuit is shorted to voltage.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
 - Terminal 1
 - Terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. Verify that a test lamp illuminates between the ignition circuit terminal 17 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup.

DTC C106D-C106F OR C1070: VALVE RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C106D

Valve Relay Circuit

DTC C106E

Valve Relay Circuit Performance

DTC C106F

Valve Relay Circuit Low

DTC C1070

Valve Relay Circuit High

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
B+ Terminal 30	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
Ground Terminal 14	-	C056D 00, C12DA 00, C12D7 00	-	-
Ground Terminal 46	-	U0129 00, U1833 00	-	-

Circuit/System Description

Battery positive voltage is supplied to the electronic brake control module at all times through a 60 A fuse located in the underhood fuse block. The electronic brake control module uses this voltage to power the pump

motor. The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS or the action control system operation is required the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C106D

The electronic brake control module detects the valve relay has not switched ON successfully.

C106E

The electronic brake control module detects the valve relay is exposed to fatal error to avoid damage.

C106F

The electronic brake control module detects the valve relay circuit is shorted to ground.

C1070

The electronic brake control module detects the valve relay circuit is shorted to voltage.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
 - Terminal 1
 - Terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. Verify that a test lamp illuminates between the ignition circuit terminal 17 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp illuminates**
7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup.

DTC C10AC: BRAKE SYSTEM CALCULATED COMPONENT OVERHEAT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC C10AC 00

Brake System Calculated Component Overheat

Circuit/System Description

The electronic brake control module monitors how often the traction control or the stability control system activates in order to calculate an estimate of the front brake discs temperature. In most cases the high temperatures are caused by extended traction control activation. If the electronic brake control module calculates that the front brake components temperatures are too high, the electronic brake control module will temporarily suspend the traction control system function until the front brake discs cool down.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The electronic brake control module detects the calculated temperature of the brake components is higher than 500 $\hat{\text{A}}$ $^{\circ}\text{C}$ (932 $\hat{\text{A}}$ $^{\circ}\text{F}$).

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control, the stability control and the electronic brake distribution for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

DTC C10AC does not indicate a malfunction has occurred. This DTC indicates there was excessive ABS, traction control or stability control activation that caused the high temperatures.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Since most occurrences of this DTC are caused by excessive brake usage, review with the customer the conditions under which the DTC set.

1. Allow the brakes to cool down before performing test.

2. Verify that no other DTCs are set.

- If any other DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If no other DTCs are set

3. Verify DTC C10AC does not set while driving the vehicle under normal braking conditions.

- If the DTC sets

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming, and setup

DTC C10EA: POWERTRAIN CONTROL MODULE INDICATED REQUESTED TORQUE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C10EA

Powertrain Control Module Indicated Requested Torque

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the regenerative braking. When certain engine control module DTCs are set, the engine control module will not be able to perform the regenerative braking. A serial data message is sent to the electronic brake control module indicating that regenerative braking is not allowed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The engine control module diagnoses a condition preventing the engine control portion of the regenerative braking function and sends a serial data message to the electronic brake control module indicating that regenerative braking is not allowed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic

stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C10EA.

- **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Replace the K20 Engine Control Module.
4. Verify that DTC C10EA does not set while operating the vehicle under the Conditions for Running the DTC. You may also operate the vehicle under the conditions that you observed from the Freeze Frame/Failure Records data.

- **If DTC C10EA sets**

Replace the K17 Electronic Brake Control Module.

- **If DTC C10EA does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C10EB: ENGINE CONTROL MODULE INDICATED TRACTION CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C10EB

Engine Control Module Indicated Traction Control

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the traction control. The electronic brake control module sends a serial data message to the engine control module requesting torque reduction. When certain engine control module DTCs are set, the engine control module will not be able to perform the torque reduction for traction control. A serial data message is sent to the electronic brake control module indicating that traction control is not allowed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The engine control module diagnoses a condition preventing the engine control portion of the traction control function and sends a serial data message to the electronic brake control module indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C10EB.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**

3. Replace the K20 Engine Control Module.
4. Verify that DTC C10EB does not set while operating the vehicle under the Conditions for Running the DTC. You may also operate the vehicle under the conditions that you observed from the Freeze Frame/Failure Records data.

- **If DTC C10EB sets**

Replace the K17 Electronic Brake Control Module.

- **If DTC C10EB does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C112B: ACTIVE BRAKE SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C112B

Active Brake System Performance

Circuit/System Description

The Electronic Brake Control Module detects that there has been no pressure increase for a period of time.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The Electronic Brake Control Module detects that there has been no pressure increase for a period of time.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- Accelerating to 60 KPH and maintaining this speed for 5 s with no pressure increase noted by the electronic brake control module.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[ABS Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K17 Electronic Brake Control Module.
 - **If the DTC does not set**
2. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C112F: ISOLATION VALVE PERFORMANCE

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

[DTC Descriptor](#)

DTC C112F

Isolation Valve Performance

Circuit/System Description

The electronic brake control module calculates and monitors the internal temperature of the brake pressure modulator valves. In most cases the high temperatures are caused by extended traction control activation. If the electronic brake control module calculates that the brake pressure modulator valves temperatures are too high, the electronic brake control module will temporarily suspend the traction control system function until the brake pressure modulator valves cool down.

Conditions for Running the DTC

Vehicle ON or in Service Mode.

Conditions for Setting the DTC

The electronic brake control module detects the calculated temperature of the brake pressure modulator valves is higher than 195°C (383°F).

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control, the stability control and the electronic brake distribution for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

DTC C112F does not indicate a malfunction has occurred. This DTC indicates there was excessive ABS, traction control or stability control activation that caused the high temperatures.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Since most occurrences of this DTC are caused by excessive brake usage, review with the customer the conditions under which the DTC set.

1. Allow the brakes to cool down before performing test.
2. Verify that no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Verify DTC C112F does not set while driving the vehicle under normal braking conditions.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming, and setup

DTC C1200: POWERTRAIN SENSED BRAKE PEDAL INFORMATION MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1200

Powertrain Sensed Brake Pedal Information Message Counter Incorrect

Circuit/System Description

The body control module monitors the brake pedal position sensor and sends a serial data message to the both the electronic brake control module and engine control modules when the brake pedal is applied. The engine control module compares the correlation between the brake pedal positions and the brake control brake pedal position sensor to sense the driver's application of the brake pedal.

Conditions for Running the DTC

- Vehicle ON
- The brake pedal is applied.
- The ignition voltage is greater than 10 V.
- The accelerator pedal position is greater than 20 %.

Conditions for Setting the DTC

The brake pedal position sensor signal is not applied while the brake control brake pedal position sensor indicates the brake pedal is applied.

Action Taken When the DTC Sets

A driver information center message and/or a warning indicator will not be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- DTC C1200 may set if the brake pedal is applied while accelerating.
- Check the Engine Control Module for any accelerator pedal DTCs and correct them first before diagnosing this DTC.

Reference Information

Schematic Reference

- [Antilock Brake System Schematics](#)
- [Exterior Lights Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1200.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are not set**

3. Verify the brake pedal position sensor or the brake pedal is not binding causing residual brake pressure to be detected.

- **If a condition is found**

Repair or replace the applicable component.

- **If a condition is not found**

4. Verify the scan tool electronic brake control module Brake Pedal Position Sensor Signal parameter changes between Applied and Released when applying and releasing the brake pedal.

- **If the parameter does not change**

Refer to [Symptoms - Lighting](#) .

- **If the parameter changes**

5. Replace the K17 Electronic Brake Control Module.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C1203: INVALID DATA RECEIVED FROM INTEGRATED CHASSIS CONTROL MODULE

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

[DTC Descriptors](#)

DTC C1203

Invalid Data Received From Integrated Chassis Control Module

Circuit/System Description

The electronic shift braking request data is delivered from the chassis control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the electronic shift braking request signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

The DTC is stored in memory. No indicators or service messages are displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the chassis control module for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1203.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C124C-C124E OR C1269: WHEEL SPEED SENSOR INCORRECT MOUNTING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

[Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C124C

Left Front Wheel Speed Sensor Incorrect Mounting

DTC C124D

Right Front Wheel Speed Sensor Incorrect Mounting

DTC C124E

Left Rear Wheel Speed Sensor Incorrect Mounting

DTC C1269

Right Rear Wheel Speed Sensor Incorrect Mounting

Diagnostic Fault Information

Component	Condition	DTC
Wheel Speed Sensor	• Loose or improperly mounted sensor	C0555, C0556,

Component	Condition	DTC
	- Physical damage - Debris on the wheel speed sensor or the encoder ring - Loose or worn wheel bearing - Air gap between the wheel speed sensor and the encoder ring too large - Water intrusion in the wiring harness	C0557, C0558

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C124C, C124D, C124E, C1269

- Loose or improperly mounted sensor
- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Debris on the wheel speed sensor or the tone ring
- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.
- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If any of the DTCs are set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.

- **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 1.6 km/h (1 MPH) of each other**

3. All OK.

Circuit/System Testing

1. Ignition On
2. Verify DTCs C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are not set.
 - **If any listed DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the listed DTCs are set**
3. Inspect the appropriate B5 Wheel Speed Sensor and encoder ring for contamination, metallic particles, physical damage, incorrect installation and the correct component.
 - **If contamination, physical damage, incorrect installation, or the wrong component is diagnosed**

Replace the appropriate B5 Wheel Speed Sensor.
 - **If no contamination, physical damage, incorrect installation, or the wrong component is not diagnosed**
 4. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Front Wheel Speed Sensor Replacement](#)
- [Rear Wheel Speed Sensor Replacement](#)
- [Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C1259: POWERTRAIN AUTOMATIC BRAKING REQUEST MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1259

Powertrain Automatic Braking Request Message Counter Incorrect

Circuit/System Description

The automatic braking request signal is delivered from the engine control module (ECM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the automatic braking request signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any

DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1259.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1268: ACCELERATOR PEDAL OVERRIDE ACTIVE MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1268

Accelerator Pedal Override Active Message Counter Incorrect

Circuit/System Description

The accelerator pedal position data is delivered from the engine control module (ECM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the accelerator pedal position signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.

- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1268.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1284 OR C1285: BRAKE ASSIST INFORMATION 1 MESSAGE COUNTER INCORRECT/BRAKE ASSIST INFORMATION 2 MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1284

Brake Assist Information 1 Message Counter Incorrect

DTC C1285

Brake Assist Information 2 Message Counter Incorrect

Circuit/System Description

The brake assist data is delivered from the brake booster control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the brake assist signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the brake booster control module for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1284 or C1285.
 - **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1286: COMMANDED AXLE TORQUE MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1286

Commanded Axle Torque Message Counter Incorrect

Circuit/System Description

The commanded axle torque data is delivered from the engine control module (ECM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the commanded axle torque signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service Stability Trak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1286.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1287: REGENERATIVE BRAKING AXLE TORQUE ACHIEVED MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1287

Regenerative Braking Axle Torque Achieved Message Counter Incorrect

Circuit/System Description

The regenerative braking axle torque data is delivered from the hybrid powertrain control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the regenerative braking axle torque signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service Stability Trak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1287.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1288: AUTONOMOUS BRAKING ACCELERATOR ACTUAL POSITION STATUS MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1288

Autonomous Braking Accelerator Actual Position Status Message Counter Incorrect

Circuit/System Description

The autonomous braking accelerator actual position data is delivered from the engine control module (ECM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the autonomous braking accelerator actual position signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any

DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1288.

- **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1289: CHARGING SYSTEM PARK BRAKE AUTONOMOUS APPLY REQUEST MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1289

Charging System Park Brake Autonomous Apply Request Message Counter Incorrect

Circuit/System Description

The charging system park brake autonomous apply request data is delivered from the Hybrid Powertrain Control Module 2 (VICM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the charging system park brake autonomous apply signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the vehicle integration control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1289.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1445: SYSTEM DISABLED INFORMATION STORED TEMPERATURE HIGH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1445 54

System Disabled Information Stored Temperature High

Circuit/System Description

The electronic brake control module receives data from other modules; engine control module, body control module, 14 V accessory power module, hybrid powertrain control module 1, and hybrid powertrain control module 2. The multi-axis acceleration sensor and the steering wheel angle sensor are needed to perform brake control functions. The module must ensure that all serial data and sensor inputs are properly received and learned.

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

DTC C1445 54

This diagnostics detects an over temperature condition with one of the twelve solenoids due to an extended ABS, traction control and vehicle stability event lasting more than 45 seconds.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.

- The electronic brake control module disables the ABS, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- It may take two Vehicle ON cycles to clear this DTC.
- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Check for hydraulic leaks, air in the brake system or incorrect brake bleed.
- Excessive traction control event for greater than 45 seconds.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

DTC C1445 54

NOTE: This diagnostic detects an over temperature condition with 1 of the 12 solenoids due to an extended ABS, traction control and vehicle stability event lasting more than 45 seconds. This does not indicate a failure with the Electronic Brake Control Module.

1. Verify DTC C1445 54 does not set while operating the vehicle under normal driving conditions.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC C144B: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C144B

Electronic Control Unit Software

For symptom byte information refer to [Symptom Byte List](#)

Circuit/System Description

The electronic brake control module determines that the electronic park brake portion of the module is programmed incorrectly.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The electronic brake control module is not properly programmed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed in the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.

- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

A newly replaced electronic brake control module can set one or more DTC on its initial vehicle in service mode cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC C144B is not set

- **If the DTC is set**

Program the K17 Electronic Brake Control Module. Refer to **Electronic Brake Control Module Programming and Setup** .

1. Verify the DTC does not reset.
 - If the DTC resets, replace the K17 Electronic Brake Control Module.
 - If the DTC does not reset

2. All OK

- **If the DTC does not set**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup.

DTC C158F OR C1590-C1592: TRACTION CONTROL PRIME SOLENOID VALVE CIRCUITS/TRACTION CONTROL ISOLATION SOLENOID VALVE CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C158F

Traction Control Front Prime Solenoid Valve Circuit

DTC C1590

Traction Control Front Isolation Solenoid Valve Circuit

DTC C1591

Traction Control Rear Prime Solenoid Valve Circuit

DTC C1592

Traction Control Rear Isolation Solenoid Valve Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
B+ Terminal 30	C0256 04, C12E6 00	C0256 04, C12E6 00	-	-
Ground Terminal 14	-	C056D 00, C12DA 00, C12D7 00	-	-
Ground Terminal 46	-	U0129 00, U1833 00	-	-

Circuit/System Description

The traction control prime (fill) and isolation (return) solenoid valves are located internally to the brake pressure modulator. The electronic brake control module activates the valve relay to supply voltage to the valve solenoids. This voltage is referred to as the system voltage. The electronic brake control module activates

individual valve solenoids by grounding the valve solenoid control circuits. This verification is used to perform hydraulic checks at the normally open base brake valve, the front hydraulic circuit and the block.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

C158F

The electronic brake control module detects a general failure with the front hydraulic traction control circuit fill valve.

C1590

The electronic brake control module detects a general failure with the front hydraulic traction control circuit isolation valve.

C1591

The electronic brake control module detects a general failure with the rear hydraulic traction control circuit fill valve.

C1592

The electronic brake control module detects a general failure with the rear hydraulic traction control circuit isolation valve.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
 - Terminal 1
 - Terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.

6. Verify that a test lamp illuminates between the ignition circuit terminal 17 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup.

DTC C1594: ADAPTIVE CRUISE CONTROL BRAKING REQUEST - ACCELERATOR PEDAL POSITION NOT PLAUSIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1594

Adaptive Cruise Control Braking Request - Accelerator Pedal Position Not Plausible

Circuit/System Description

Adaptive cruise control is allowed via serial data inputs from various modules to the active safety control module. The adaptive cruise control braking request signal is delivered from the active safety control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the adaptive cruise control braking request signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.

- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

- Inspect the active safety control module for any DTCs.
- Inspect the engine control module for any DTCs, specifically for accelerator pedal DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1594.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**

3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC P0560, P0562, OR P0563: SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0560

System Voltage

DTC P0562

System Low Voltage

DTC P0563

System High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 1	P0562	P0560	-	P0560
B+ Terminal 30	P0562	P0560	-	P0560
Ground Terminal 14	-	P0560	P0563	P0560
Ground Terminal 46	-	P0560	P0563	P0560

Circuit/System Description

The electronic brake control module monitors two different blocks of memory to determine its capability to control the system shutdown process.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

- Keep alive voltage regulator not functional.
- Processor loses complete battery power.
- Battery voltage is under 9 V and the vehicle is not moving.

Action Taken When the DTC Sets

- A warning indicator may be displayed.
- A driver information center message may be displayed.
- The electronic brake control module disables ABS, traction control system and vehicle stability enhancement system for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The electronic brake control module clears the history DTC when a current DTC is not detected in 40 consecutive drive cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Check to ensure battery shunt is not opened.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminals listed below and ground:
 - Terminal 14
 - Terminal 46
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the B+ circuit terminals listed below and ground.
 - Terminal 1
 - Terminal 30
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. Verify that a test lamp illuminates between the ignition circuit terminal 17 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or the short to ground in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
7. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC P05FF: BRAKE PRESSURE SENSOR AND BRAKE PEDAL POSITION SENSOR CORRELATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P05FF

Brake Pressure Sensor / Brake Pedal Position Sensor Correlation

Circuit/System Description

The K177 Brake Booster Control Module has an internal brake travel sensor. The K17 Electronic Brake Control Module (EBCM) communicates with the K177 Brake Booster Control Module to determine if the amount of travel by the internal brake travel sensor is equal to the amount of expected pressure.

Conditions for Running the DTC

- Vehicle in Service Mode.
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

- The electronic brake control module detects the brake pressure is high when the internal brake travel sensor is reading low travel.
- The electronic brake control module detects the brake pressure is low when the internal brake travel sensor is reading high travel.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no other DTCs are set.

- **If any DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no DTCs are set**

NOTE: To ensure the complete brake modulator and high pressure accumulator pressure relief procedure is allowed to occur; the brake controller must see 1 pedal apply with the propulsion system enabled, followed by a proper shutdown without applying the brake pedal.

2. Vehicle ON, apply and release the brake pedal.

NOTE: Vehicle OFF, without applying the brake pedal ensure the brake modulator and high pressure accumulator pressure relief occurs. This process will take approximately 1-3 minutes.

3. Vehicle OFF, without applying the brake pedal.
4. Remove the remote keyless entry transmitter and close all of the vehicle doors. Wait approximately 1-3 minutes until the brake modulator and the high pressure accumulator pressure relief is complete and the vehicle powers down.
5. Vehicle in Service Mode.
6. Verify the scan tool parameters listed below are within 0 - 2 mm of each other as the brake pedal is applied:
 - Input Rod Position Sensor.
 - Output Rod Position Sensor.
 - Brake Pedal Position Calculated from Input Rod Position Sensor 1.
 - Brake Pedal Position Calculated from Input Rod Position Sensor 2.
 - **If the parameters are not within the specified range**

Replace the K177 Brake Booster Control Module.

- **If the parameters are within the specified range**

7. Inspect for binding brake pedal, correct mounting of the K177 Brake Booster Control Module, or for brake fluid leaks.

- **Were any of the above conditions found**

Repair as necessary.

- **If no conditions were found**

8. Perform a brake hydraulic system test, refer to [Hydraulic Brake System Diagnosis](#).

- **If the brake hydraulic system test does not pass**

Repair as necessary.

- **If the brake hydraulic system tests normal**

9. Replace the K177 Brake Booster Control Module.

10. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not set**

11. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Control Module replacement, programming and setup.

DTC P0601-P0604, P0606, P060B, OR P062F: CONTROL MODULE (ELECTRONIC BRAKE CONTROL MODULE)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module- Calibration Set Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

The electronic brake control module (EBCM) detects an internal malfunction.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- Ignition voltage is between 8 V and 16 V.

Conditions for Setting the DTC

The EBCM detects an internal failure or incomplete programming for more than 10 s.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction control/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the EBCM may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged.
- The EBCM ground circuits do not have an open or high resistance.
- The EBCM power circuits do not have an open, short to ground, or high resistance.

Circuit/System Verification

1. Vehicle in Service Mode, clear the DTC information with a scan tool.
2. Verify no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If no other DTCs are set**

3. Verify DTC P0602 is not set.

- **If the DTCs is set**

1. Program the K17 Electronic Brake Control Module. Refer to [Control Module References](#) .

2. Verify DTC P0602 is not set.

- If the DTC is set, replace the K17 Electronic Brake Control Module.
- If the DTC is not set

3. All OK.

- **If none of the DTCs are set**

4. Verify DTC P0601, P0603, P0604, P0606, or P062F is not set.

- **If any of the DTCs are set**

Replace the K17 Electronic Brake Control Module.

- **If none of the DTCs are set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

DTC P0856: TRACTION CONTROL TORQUE REQUEST CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0856

Traction Control Torque Request Signal Message Counter Incorrect

Circuit/System Description

When traction control is active, the electronic brake control module sends a serial data message to the engine control module requesting torque reduction. When certain electronic brake control module DTCs are set, the engine control module will not be able to perform the torque reduction for traction control. A serial data message is sent to the electronic brake control module indicating that traction control is not allowed.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The engine control module detects a fault that prevents it from performing a traction control function and sends a serial data message to the electronic brake control module indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The electronic brake control module will turn OFF the indicator in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that no other DTCs are set except for P0856.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If only DTC P0856 is set**

2. Replace the K20 Engine Control Module.

3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If DTC does not set**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for electronic brake control module and engine control module replacement,

programming and setup

DTC P15F8: AUTOMATIC BRAKING ENGINE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P15F8

Automatic Braking Engine Torque Request Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the vehicle performance. During a automatic brake event the electronic brake control module sends a serial data message to the engine control module requesting torque reduction. If the engine control module receives corrupt data from the electronic brake control module, DTC P15F8 will set in the engine control module. The engine control module then sends a serial data message to the electronic brake control module that torque reduction is not allowed.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The engine control module detects a corrupted data message from the electronic brake control module.

Action Taken When the DTC Sets

- The ABS remains functional.
- DTC P15F8 is a Type B DTC.
- The traction Off indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Stabilitrak message may be displayed on the driver information center.

Conditions for Clearing the DTC

DTC P15F8 is a Type B DTC.

Diagnostic Aids

Inspect the serial data circuits and connections at the engine control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean

and tight.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that no other DTCs are set except for DTC P15F8.

- **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If only DTC P15F8 is set**

2. Replace the K17 Electronic Brake Control Module.

3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC sets**

Replace the K20 Engine Control Module.

- **If DTC does not set**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module and engine control module replacement, programming and setup

DTC P15FD: WHEEL SPEED SENSOR MESSAGE SEQUENCE INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P15FD

Wheel Speed Sensor Message Sequence Incorrect

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives a 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed. The EBCM sends the wheel speed information as a high speed controller area network (CAN) serial data message.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

A supervised periodic message that includes the wheel speed serial data has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function or operate in degraded mode.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Diagnostic Aids

- This DTC can be set due to an incorrect part wheel speed sensor installed.
- Inspect the wheel encoder ring for rust or corrosion.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Circuit/System Verification

Ignition ON, observe the scan tool EBCM Wheel Speed Sensor parameters. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 20 km/h (13 MPH).

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0035, C0040, C0045, or C0050 is not set in the EBCM.

- **If any listed DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) to diagnose that DTC prior to this diagnostic.

- **If any listed DTC is not set**

3. Replace the K17 Electronic Brake Control Module.
4. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.

- **If the DTC sets**

Replace the module that set the DTC.

- **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup

DTC P1B12: DRIVER INTENDED BRAKING TORQUE SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for a overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1B12

Driver Intended Braking Torque Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module provides brake pedal position information to the engine control module, via the serial data circuit. The engine control module monitors a series of 16 rolling counts, with each count assigned a value, when the engine control module determines that too many of the counts have an incorrect value, the engine control module sets DTC P1B12.

Conditions for Running the DTC

- The propulsion system is active.
- DTC P1B12 runs continuously when the above condition is met.

Conditions for Setting the DTC

The engine control module detects that 10 of the 16 rolling counts have an incorrect value.

Action Taken When the DTC Sets

DTC P1B12 is a Type C DTC.

Conditions for Clearing the DTC

DTC P1B12 is a Type C DTC.

Diagnostic Aids

- DTC P1B12 is an informational DTC.
- Verify the electronic brake control module and engine control module contain the latest calibrations.
- Diagnose all other engine control module DTCs prior to DTC P1B12.
- Find out from the customer the conditions under which the DTC was set. This information may help duplicate the concern like the specific number of brake pedal applies in a row prior to the fault set.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set except for DTC P1B12 is set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If no other DTCs are set**
2. Replace the K17 Electronic Brake Control Module.
3. Verify the DTC P1B12 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If only DTC P1B12 is set**

Replace the K20 Engine Control Module.
 - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for Electronic Brake Control Module and Engine Control Module replacement, programming and setup.

DTC P215A: VEHICLE SPEED-WHEEL SPEED CORRELATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

[Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P215A

Vehicle Speed-Wheel Speed Correlation

Diagnostic Fault Information

Component	Condition	DTC
Wheel Speed Sensor	• Loose or improperly mounted sensor • Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or worn wheel bearing • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness • Incorrect wheel/tire combination	C0555, C0556, C0557, C0558, P215A

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Conditions for Running the DTC

- Vehicle On or Vehicle in Service Mode
- Ignition voltage is greater than 10 V.

Conditions for Setting the DTC

P215A

- Loose or improperly mounted sensor
- The tone ring may be demagnetized
- Water intrusion in the wiring harness
- Debris on the wheel speed sensor or the tone ring

- Missing tooth or teeth on the wheel speed sensor tone ring
- Air gap between the wheel speed sensor and the tone ring too large
- Electrical magnetic interference with the wheel speed sensor harness

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the wheel speed sensor magnetic encoder ring.
- Inspect the wheel speed sensor magnetic encoder ring for debris or corrosion.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If any of the DTCs are set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.
- An incorrect wheel and tire size or mounting issue may also cause DTC P215A to set.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Test drive the vehicle in a straight line at a speed greater than 20 km/h (13 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
 - **If any parameter is not within 1.6 km/h (1 MPH) of each other**

Refer to Circuit/System Testing.

- **If each parameter is within 1.6 km/h (1 MPH) of each other**
3. All OK.

Circuit/System Testing

1. Ignition On
2. Verify DTCs C0500-C0504, C0506-C0510, C050A, C050C-C050F, or C0512-C0516 are not set.
 - **If any listed DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If none of the listed DTCs are set**
3. Inspect the appropriate B5 Wheel Speed Sensor and encoder ring for contamination, metallic particles, physical damage, incorrect installation and the correct component.
 - **If contamination, physical damage, incorrect installation, or the wrong component is diagnosed**

Replace the appropriate B5 Wheel Speed Sensor.
 - **If no contamination, physical damage, incorrect installation, or the wrong component is not diagnosed**
 4. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC P2299: BRAKE PEDAL POSITION/ACCELERATOR PEDAL POSITION INCOMPATIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2299

Brake Pedal Position/Accelerator Pedal Position Incompatible

Circuit/System Description

The body control module monitors the brake pedal position sensor and sends a serial data message to the both the electronic brake control module and engine control modules when the brake pedal is applied. The engine control module compares the correlation between the brake pedal positions and the brake control brake pedal position sensor to sense the driver's application of the brake pedal.

Conditions for Running the DTC

- Vehicle ON
- The brake pedal is applied.
- The ignition voltage is greater than 10 V.
- The accelerator pedal position is greater than 20 %.

Conditions for Setting the DTC

The brake pedal position sensor signal is not applied while the brake control brake pedal position sensor indicates the brake pedal is applied.

Action Taken When the DTC Sets

A driver information center message and/or a warning indicator will not be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- DTC P2299 may set if the brake pedal is applied while accelerating.
- Diagnose all other stop lamp DTCs or Symptoms prior to performing this diagnostic procedure.

Reference Information

Schematic Reference

- [Antilock Brake System Schematics](#)
- [Exterior Lights Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for P2299.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no other DTCs are not set**
3. Verify the brake pedal position sensor or the brake pedal is not binding causing residual brake pressure to be detected.
 - **If a condition is found**

Repair or replace the applicable component.
 - **If a condition is not found**
4. Verify the scan tool electronic brake control module Brake Pedal Position Sensor Signal parameter changes between Applied and Released when applying and releasing the brake pedal.
 - **If the parameter does not change**

Refer to [Symptoms - Lighting](#) .
 - **If the parameter changes**
5. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Electronic Brake Control Module replacement, programming and setup

SYMPTOMS - ANTILOCK BRAKE SYSTEM

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to [ABS Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [ABS Indicator Malfunction](#)
- [Traction Control/Stability Control Indicator Malfunction](#)

ABS INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster turns ON the ABS indicator for 5 seconds after Vehicle in Service Mode or when the electronic brake control module detects a fault and sends a serial data message to the instrument cluster commanding the indicator ON.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no DTCs are set.
 - **If any DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no DTCs are set**
3. Verify the instrument cluster ABS indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - **If ABS indicator does not turn ON and OFF**
Replace the P16 instrument cluster.
 - **If the ABS indicator turns ON and OFF**
 4. Verify the ABS indicator turns OFF 5 seconds after the ignition is turned ON.
 - **If the ABS indicator does not turn OFF**
Replace the K17 electronic brake control module.
 - **If the ABS indicator turns OFF**
 5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for electronic brake control module or instrument cluster replacement, programming and setup

TRACTION CONTROL/STABILITY CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit Description

The instrument cluster illuminates the traction/stability control indicator for five seconds after the ignition is turned ON. When the electronic brake control module detects a fault it sends a serial data message to the instrument cluster commanding the traction/stability control indicator on.

Reference Information

Schematic Reference

[Antilock Brake System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[ABS Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

When the ignition is turned ON, the traction/stability control indicator lamp should illuminate, then after 5 seconds it should turn OFF.

1. Vehicle in Service Mode.
2. Verify the instrument cluster traction/stability control indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
 - **If the indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster.
 - **If the indicator turns ON and OFF**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for Instrument Cluster replacement, programming and setup

REPAIR INSTRUCTIONS

CONNECTOR RECONNECTION - WHEEL SPEED SENSOR

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.

- The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

NOTE: Before performing the ABS Automated Bleed Procedure, first perform a

pressure bleed of the base brake system. Refer to [Hydraulic Brake System Bleeding](#) . The automated bleed procedure is recommended when one of the following conditions exist:

- Base brake system bleeding does not achieve the desired pedal height or feel
- Extreme loss of brake fluid has occurred
- Air ingestion is suspected in the secondary circuits of the brake modulator assembly

The ABS Automated Bleed Procedure uses a scan tool to cycle the system solenoid valves and run the pump in order to purge any air from the secondary circuits. These circuits are normally closed off, and are only opened during system initialization at vehicle start up and during ABS operation. The automated bleed procedure opens these secondary circuits and allows any air trapped in these circuits to flow out toward the brake corners.

Performing the Automated Bleed Procedure

CAUTION: The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove all four tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .
3. Inspect the brake system for leaks and visual damage. Repair or replace components as needed.
4. Lower the vehicle.
5. Inspect the battery state of charge. Refer to [Battery Inspection/Test](#) .
6. Install a scan tool.
7. Place the Power button in Service Only Mode.
8. With the scan tool, establish communications with the ABS system. Select Control Functions. Select Automated Bleed from the Control Functions menu.
9. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
10. Following the directions given on the scan tool, pressure bleed the base brake system. Refer to [Hydraulic Brake System Bleeding](#) .
11. Follow the scan tool directions until the desired brake pedal height is achieved.
12. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
 - If a DTC is detected, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , and diagnose the appropriate DTC.
 - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to [Hydraulic Brake System Bleeding](#) .

13. When the desired pedal height is achieved, press the brake pedal to inspect for firmness.
14. Install the tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .
15. Lower the vehicle.
16. Remove the scan tool.
17. Inspect the brake fluid level. Refer to [Master Cylinder Reservoir Filling](#) .
18. Road test the vehicle while inspecting that the pedal remains high and firm.

STEERING WHEEL ANGLE SENSOR CENTERING

The steering angle sensor does not require centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Wheel alignment
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage
- Power steering control module replacement
- Electronic brake control module replacement

The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align and center the front wheels forward.
2. Apply the parking brake, or set the transmission in Park.
3. Install the scan tool to the data link connector.
4. Vehicle in Service Mode.
5. With the scan tool select the Power Steering Control Module.
6. Select the Steering Wheel Angle Sensor Centering under Configuration/Reset Functions list.
7. Follow the scan tool directions to complete the learn procedure.
8. With the scan tool select the Electronic Brake Control Module.
9. Select the Steering Wheel Angle Sensor Centering under Configuration/Reset Functions list.
10. Follow the scan tool directions to complete the learn procedure.
11. Clear any DTCs that may be set.
12. Vehicle OFF.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

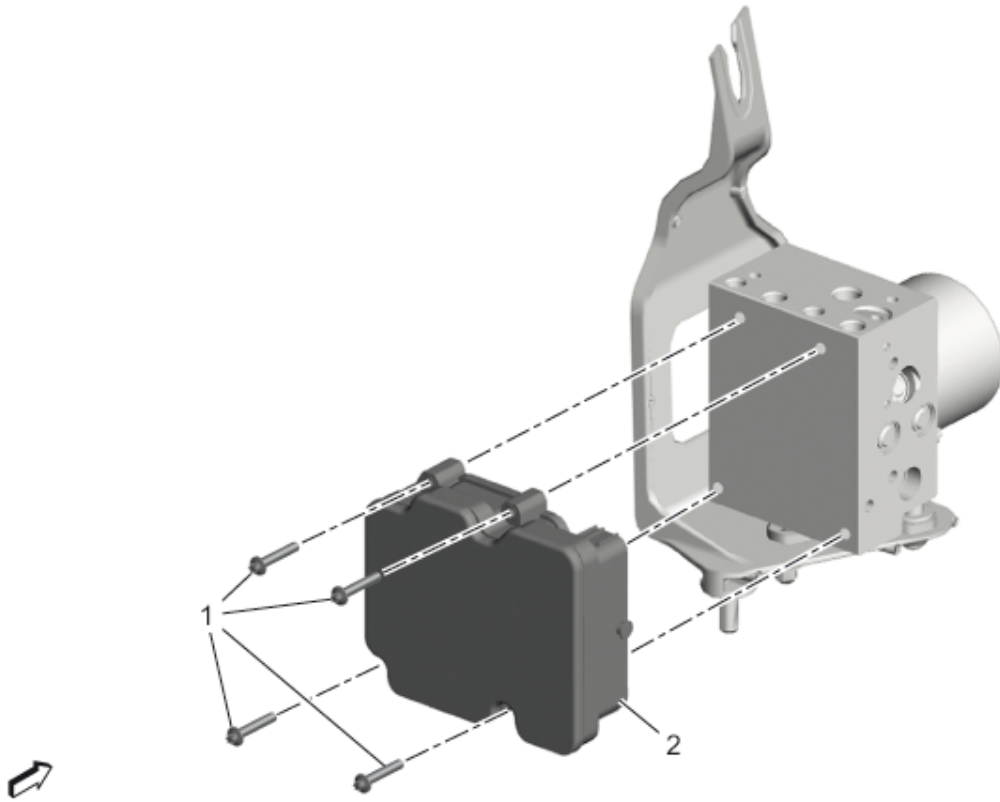


Fig. 4: Electronic Brake Control Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Brake Fluid Irritant Warning . CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution . Preliminary Procedure Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement	
1	Electronic Brake Control Module Bolt (Qty: 4) CAUTION:

Callout	Component Name
	Refer to Fastener Caution . Tighten 3 N.m (27 lb in)
2	Electronic Brake Control Module Procedure 1. Program the electronic brake control module. Control Module References 2. Bleed the brake system. Hydraulic Brake System Bleeding

ELECTRONIC BRAKE CONTROL MODULE WITH BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

CAUTION: Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.

1. Disable the high voltage system. [High Voltage Disabling](#)
2. Remove Dash Upper Extension Panel Opening Cover [Dash Upper Extension Panel Opening Cover Replacement](#)

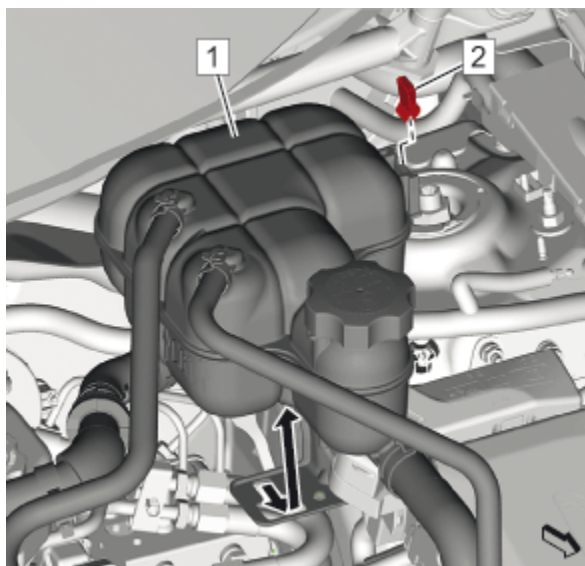


Fig. 5: Radiator Surge Tank And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Surge Tank Bracket Clip (2)

NOTE: Do NOT disconnect the engine coolant hoses.

4. Position aside Radiator Surge Tank (1)

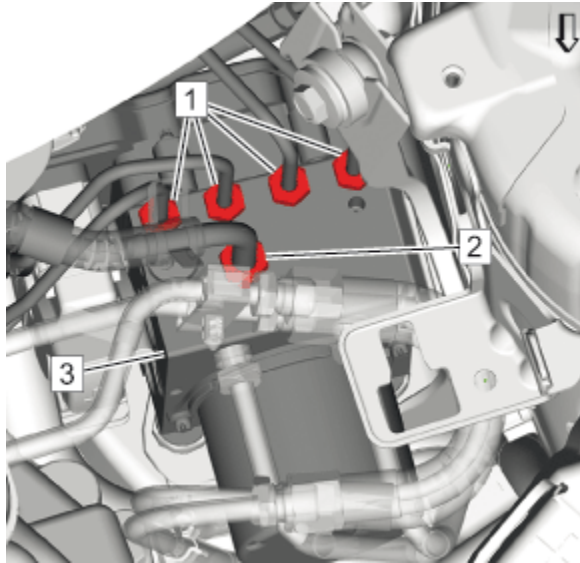


Fig. 6: Brake Pressure Modulator Valve And Brake Pipe Fittings
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fittings to prevent brake fluid loss and contamination.

5. Remove Brake Pipe Fitting (1) @Brake Pressure Modulator Valve (3)
6. Remove Brake Pipe Fitting (2) @Brake Pressure Modulator Valve (3)

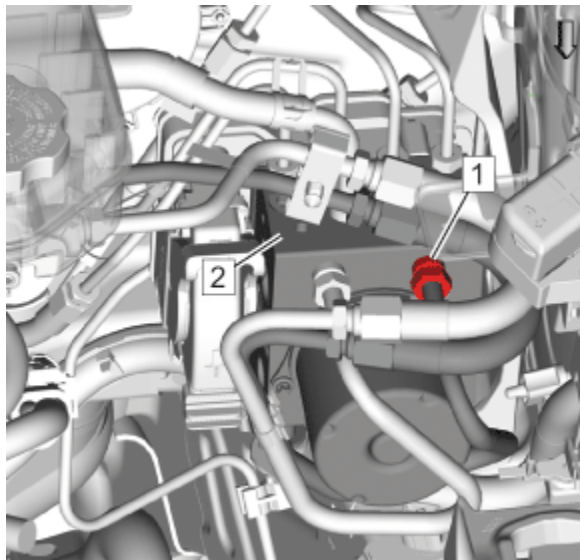


Fig. 7: Brake Pressure Modulator Valve And Brake Pressure Modulator Valve Primary Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fittings to prevent brake fluid loss and contamination.

7. Remove Brake Pressure Modulator Valve Primary Pipe (1) @Brake Pressure Modulator Valve (2)

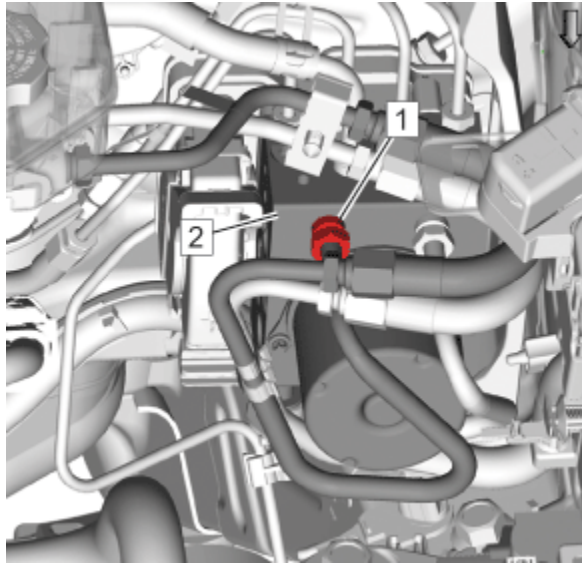


Fig. 8: Brake Pressure Modulator Valve And Brake Pressure Modulator Valve Primary Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fittings to prevent brake fluid loss and contamination.

8. Remove Brake Pressure Modulator Valve Primary Pipe (1) @Brake Pressure Modulator Valve (2)

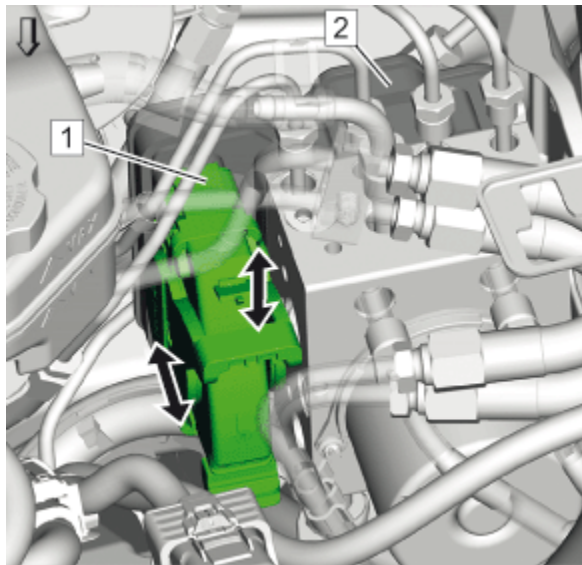


Fig. 9: Electronic Brake Control Module And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Electrical Connector (1) @Electronic Brake Control Module (2)

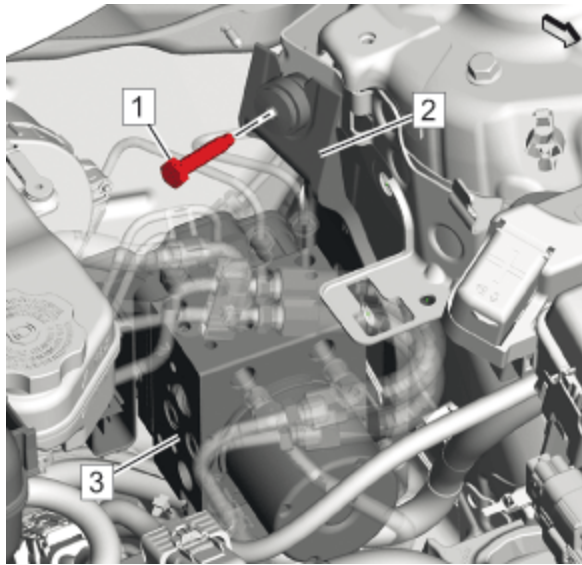


Fig. 10: Brake Pressure Modulator Valve, Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

10. Remove Brake Pressure Modulator Valve Bracket Bolt (1)

NOTE: Protect the windshield edge before removing the component.

11. Carefully remove the brake pressure modulator valve (3) and the brake pressure modulator valve bracket (2) from the vehicle.
12. Remove Brake Pressure Modulator Valve Bracket **Brake Pressure Modulator Valve Bracket Replacement**

Installation Procedure

1. Install Brake Pressure Modulator Valve Bracket **Brake Pressure Modulator Valve Bracket Replacement**

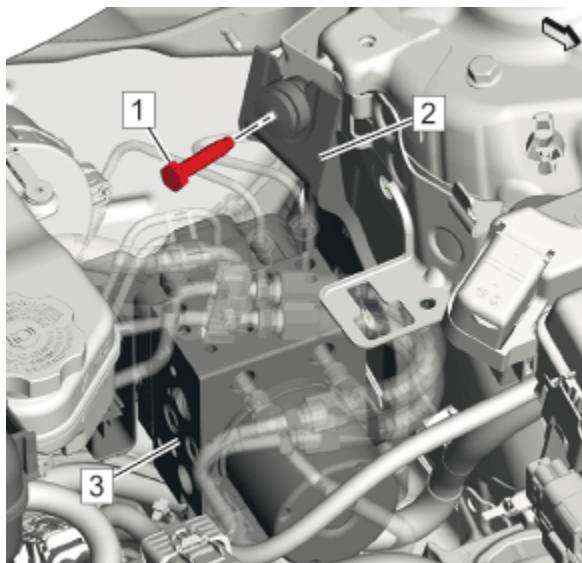


Fig. 11: Brake Pressure Modulator Valve, Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

2. Carefully install the brake pressure modulator valve (3) and the brake pressure modulator valve bracket (2) to the vehicle.

CAUTION: Refer to [Fastener Caution](#) .

3. Install Brake Pressure Modulator Valve Bracket Bolt (1) and tighten 22 N.m (16 lb ft)

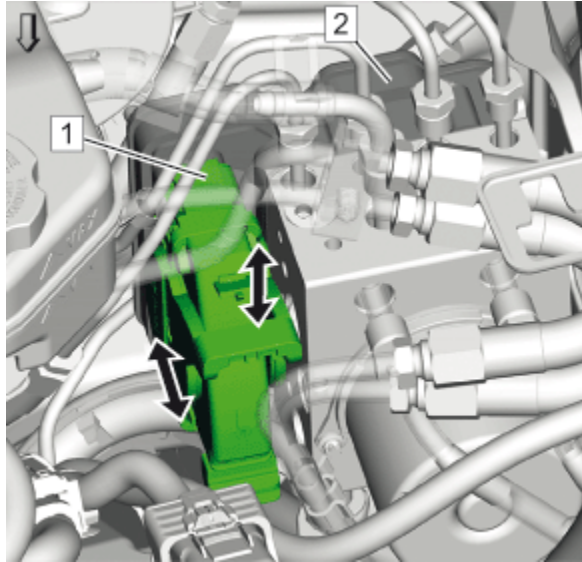


Fig. 12: Electronic Brake Control Module And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector (1) @Electronic Brake Control Module (2)

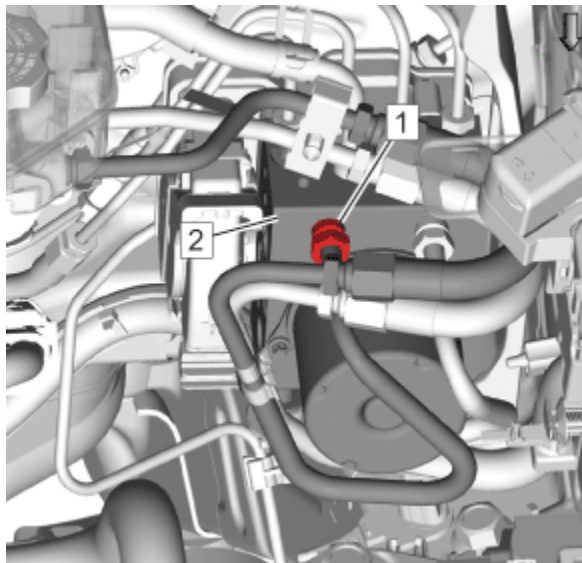


Fig. 13: Brake Pressure Modulator Valve And Brake Pressure Modulator Valve Primary Pipe
Courtesy of GENERAL MOTORS COMPANY

WARNING: Make sure brake pipes are correctly connected to brake pressure modulator valve. If brake pipes are switched by mistake, wheel lockup will occur and personal injury may result. The only two ways this condition can be detected are by using a Scan Tool or by doing an Antilock stop.

5. Install Brake Pressure Modulator Valve Primary Pipe (1) @Brake Pressure Modulator Valve (2) and tighten 32 N.m (24 lb ft)

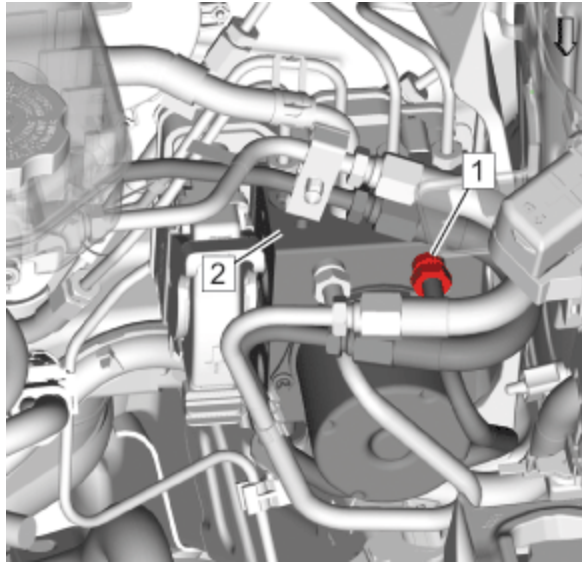


Fig. 14: Brake Pressure Modulator Valve And Brake Pressure Modulator Valve Primary Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure, that the electronic brake control module is fully seated into the grommets after the brake pipes are tightened.

6. Install Brake Pressure Modulator Valve Primary Pipe (1) @Brake Pressure Modulator Valve (2) and tighten 32 N.m (24 lb ft)

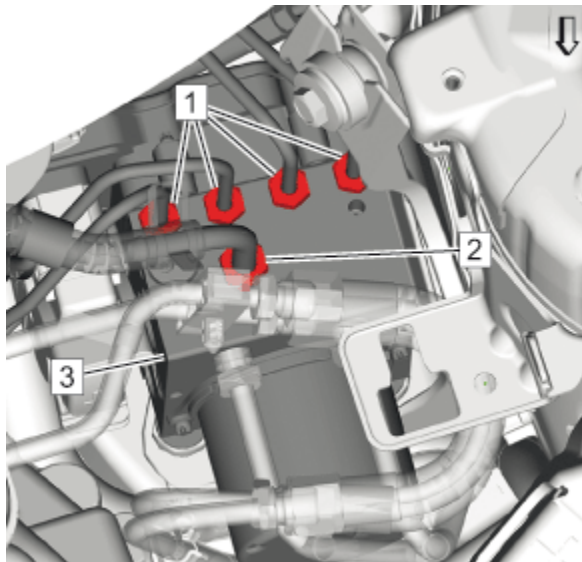


Fig. 15: Brake Pressure Modulator Valve And Brake Pipe Fittings
Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure, that the electronic brake control module is fully seated into the grommets after the brake pipes are tightened.

7. Install Brake Pipe Fitting (1) @Brake Pressure Modulator Valve (3) and tighten 18 N.m (13 lb ft)

8. Install Brake Pipe Fitting (2) @Brake Pressure Modulator Valve (3) and tighten 32 N.m (24 lb ft)

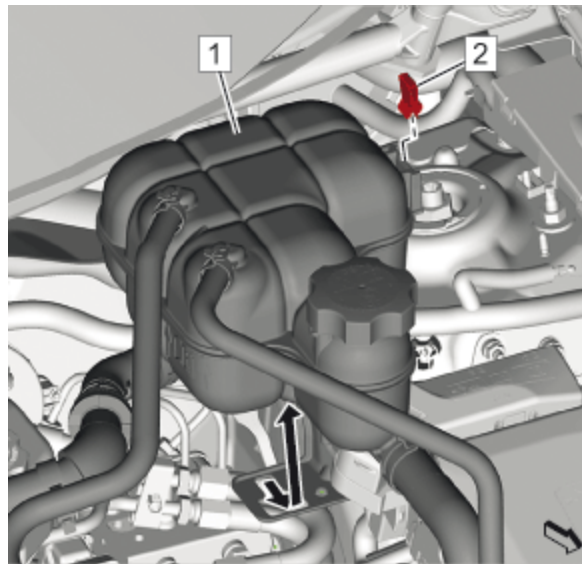


Fig. 16: Radiator Surge Tank And Bracket Clip

Courtesy of GENERAL MOTORS COMPANY

9. Install Radiator Surge Tank (1)
10. Install Radiator Surge Tank Bracket Clip (2)
11. Install Dash Upper Extension Panel Opening Cover [Dash Upper Extension Panel Opening Cover Replacement](#)
12. Enable the high voltage system. [High Voltage Enabling](#)
13. Program the electronic brake control module. [Control Module References](#)
14. Bleed the brake system. [Hydraulic Brake System Bleeding](#)

BRAKE PRESSURE MODULATOR VALVE BRACKET REPLACEMENT

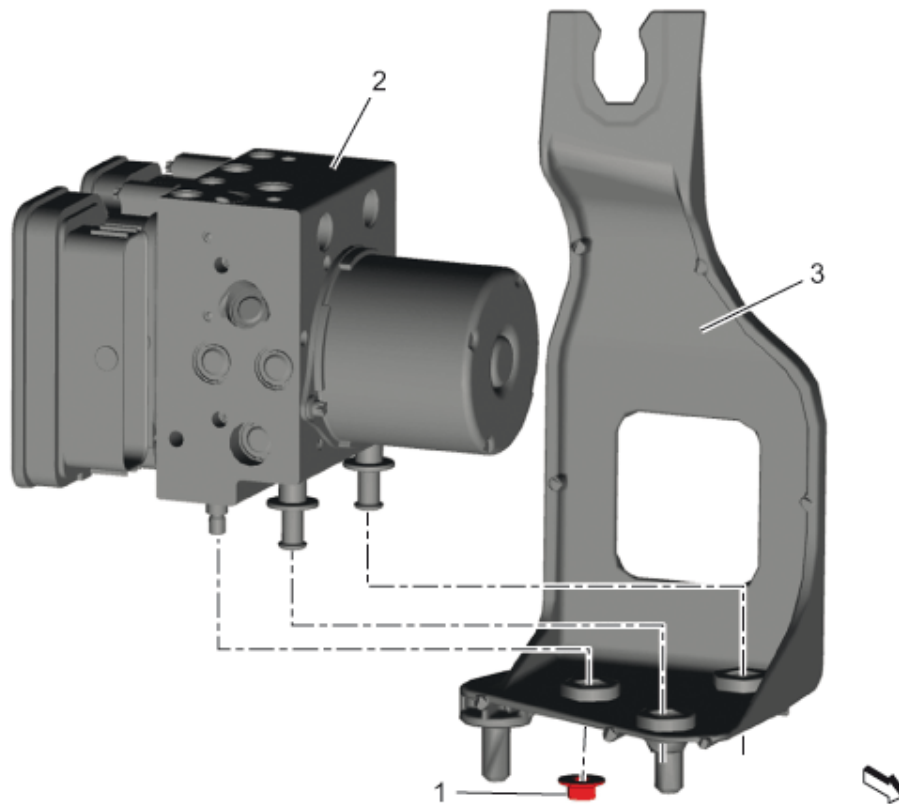


Fig. 17: Brake Pressure Modulator Valve Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement</u>	
1	Brake Pressure Modulator Valve Bracket Nut CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 22 N.m (16 lb ft)
2	Electronic Brake Control Module with Brake Pressure Modulator Valve
3	Brake Pressure Modulator Valve Bracket

FRONT WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

1. Remove **Tire and Wheel Removal and Installation**
2. Remove **Front Wheelhouse Liner Replacement (Left Side)** **Front Wheelhouse Liner Replacement (Right Side)**

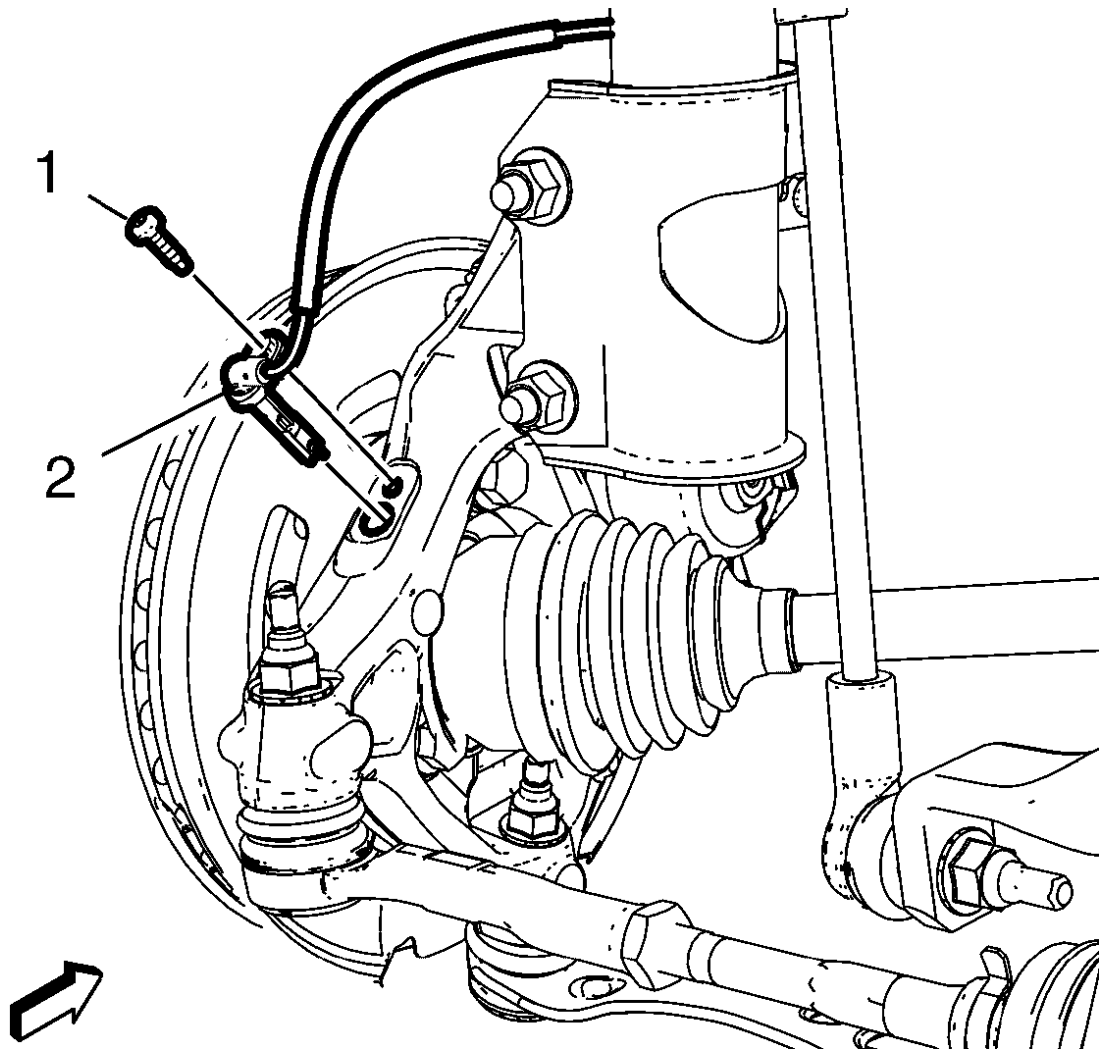


Fig. 18: Front Wheel Speed Sensor And Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheel Speed Sensor Fastener (1)
4. Remove Front Wheel Speed Sensor (2)

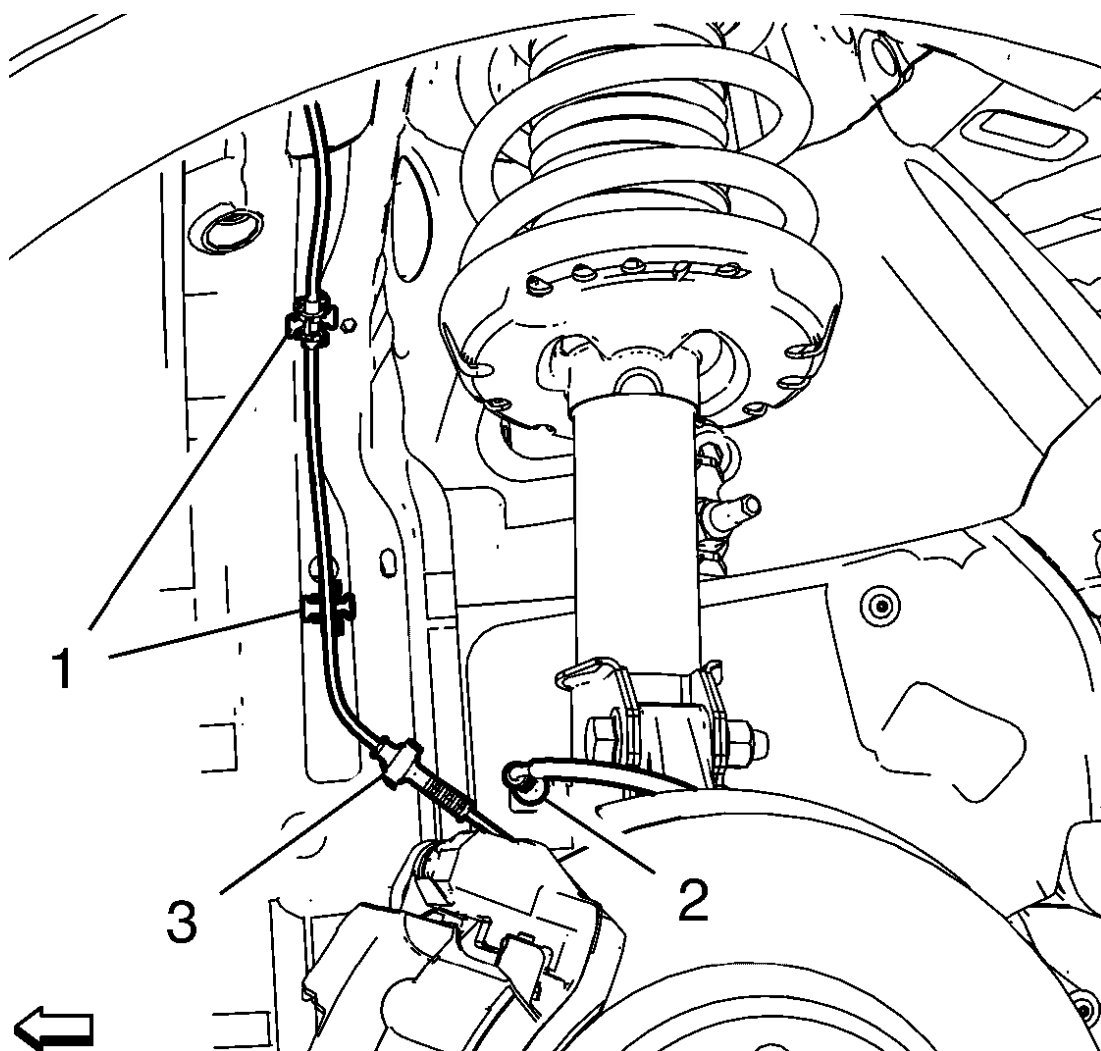


Fig. 19: Front Wheel Speed Sensor Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

5. Unclip Front Wheel Speed Sensor Wiring Harness (1 - 3)

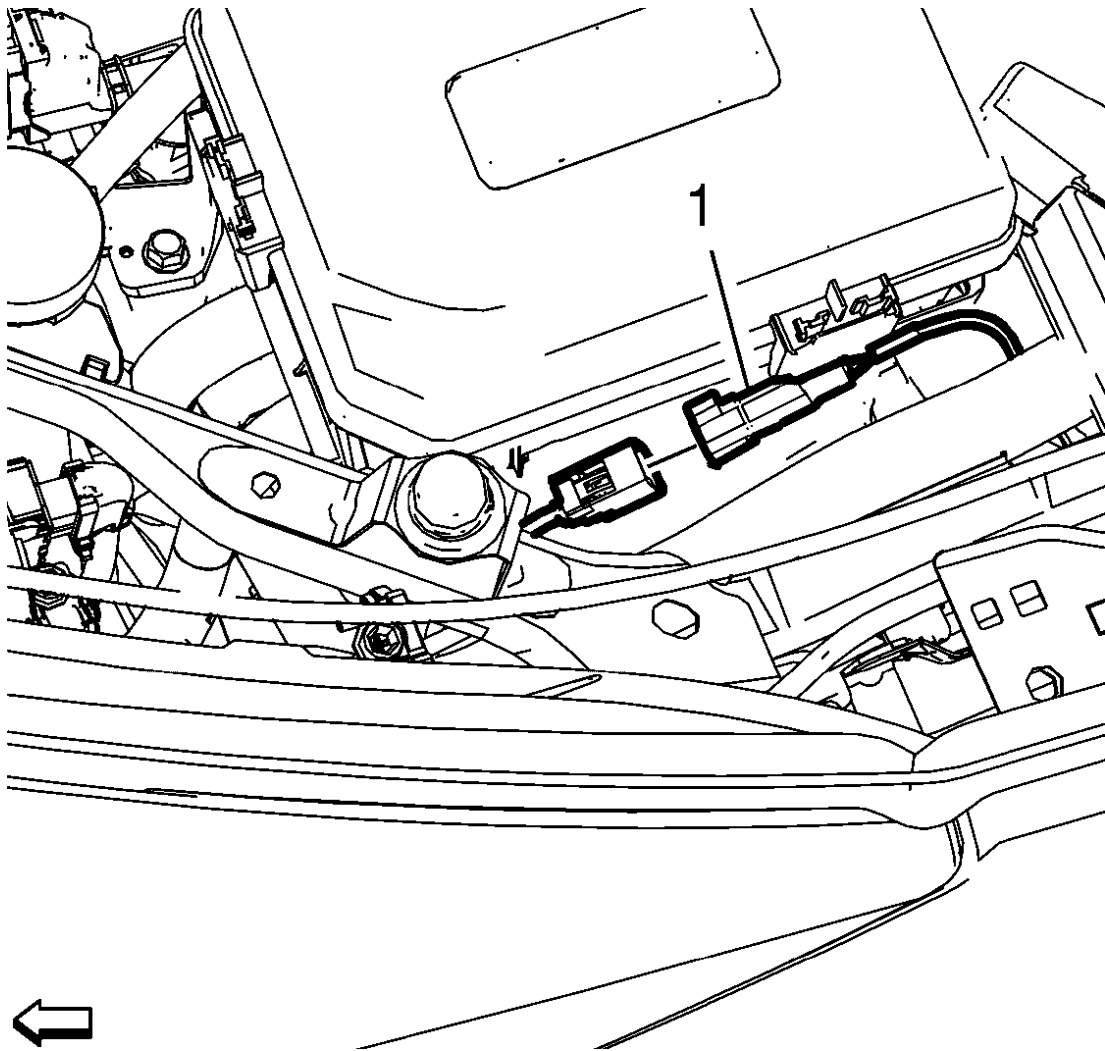


Fig. 20: Wheel Speed Sensor Connector

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Wheel Speed Sensor Connector (1)

Installation Procedure

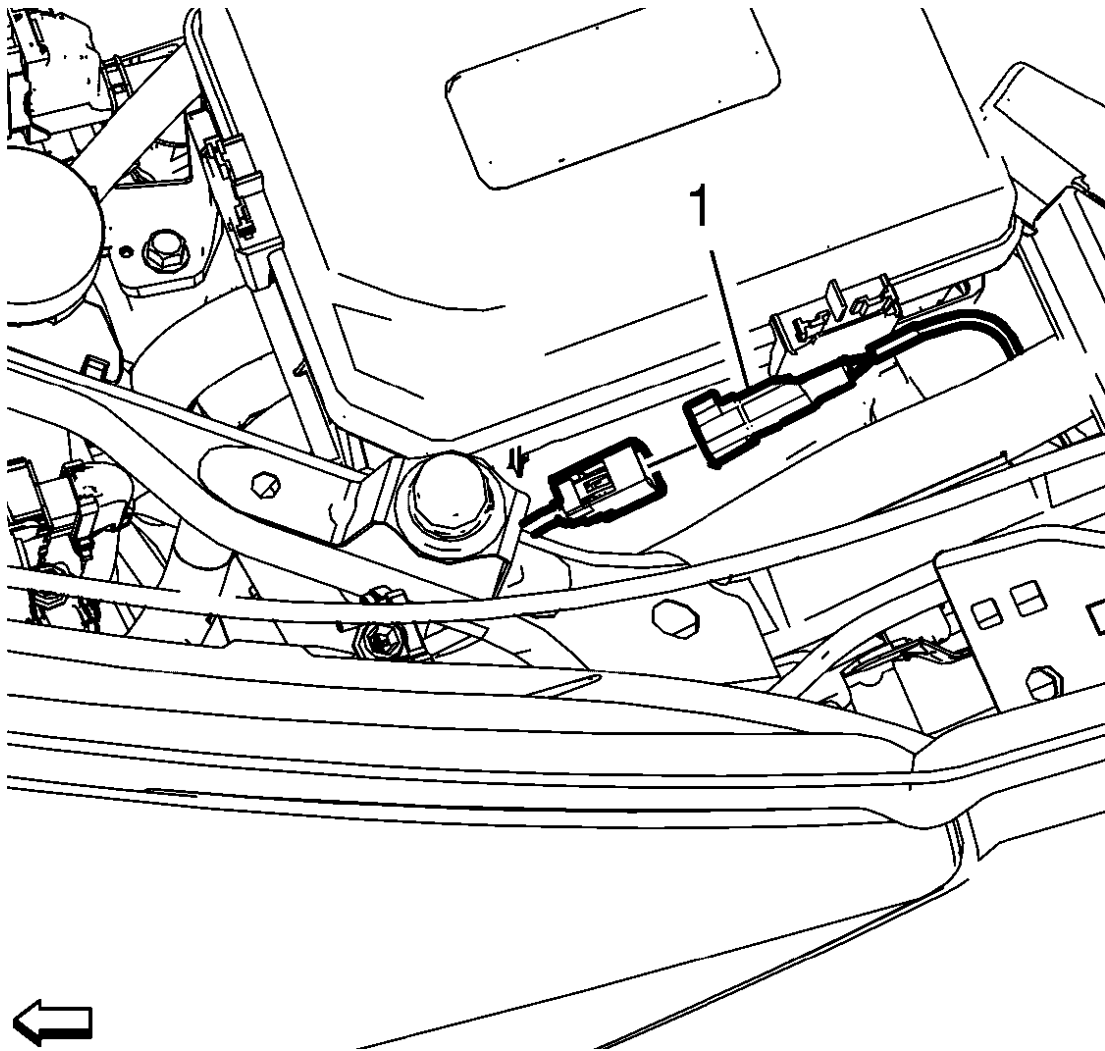


Fig. 21: Wheel Speed Sensor Connector

Courtesy of GENERAL MOTORS COMPANY

1. Connect Wheel Speed Sensor Connector (1)

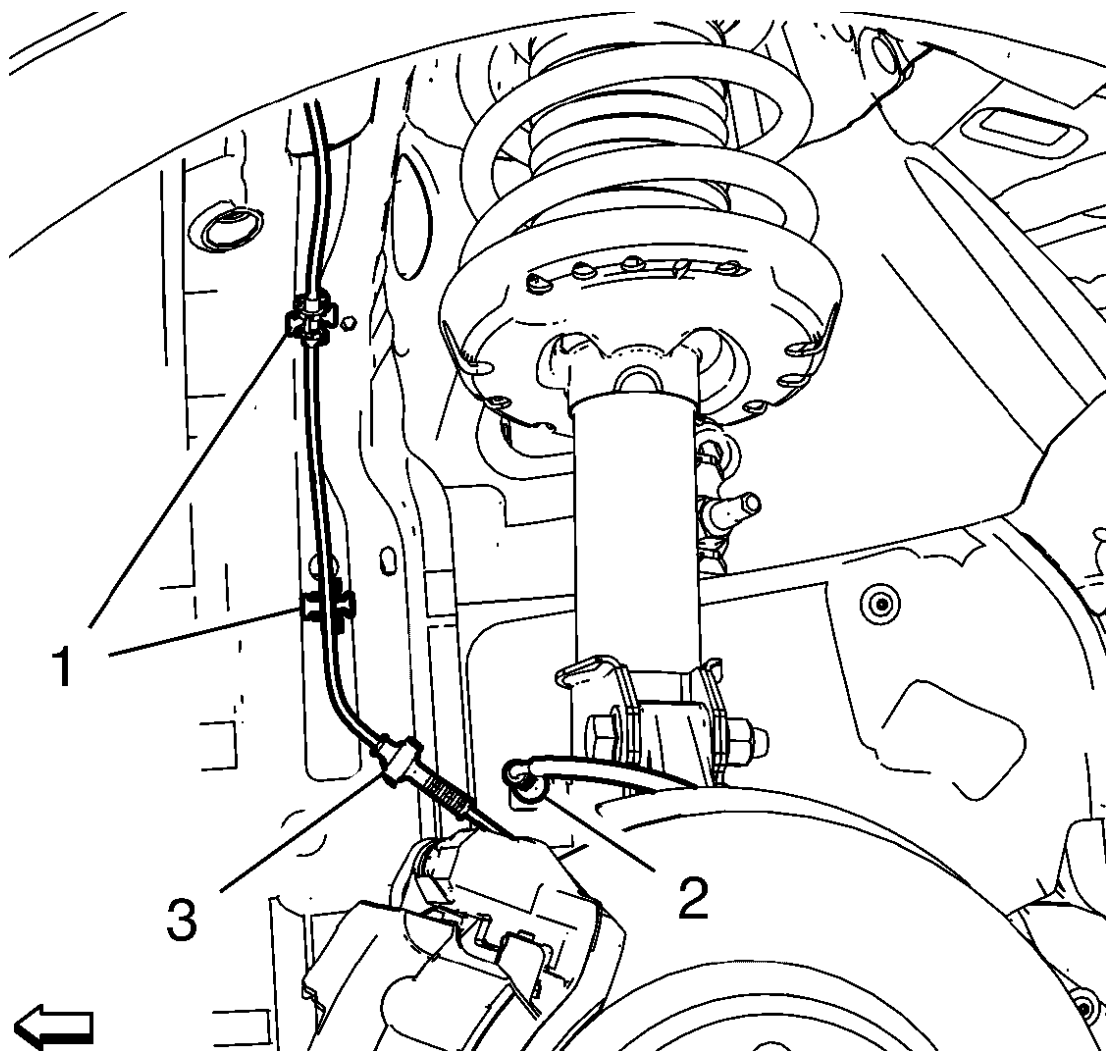


Fig. 22: Front Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

2. Install Front Wheel Speed Sensor Wiring Harness (1-3)

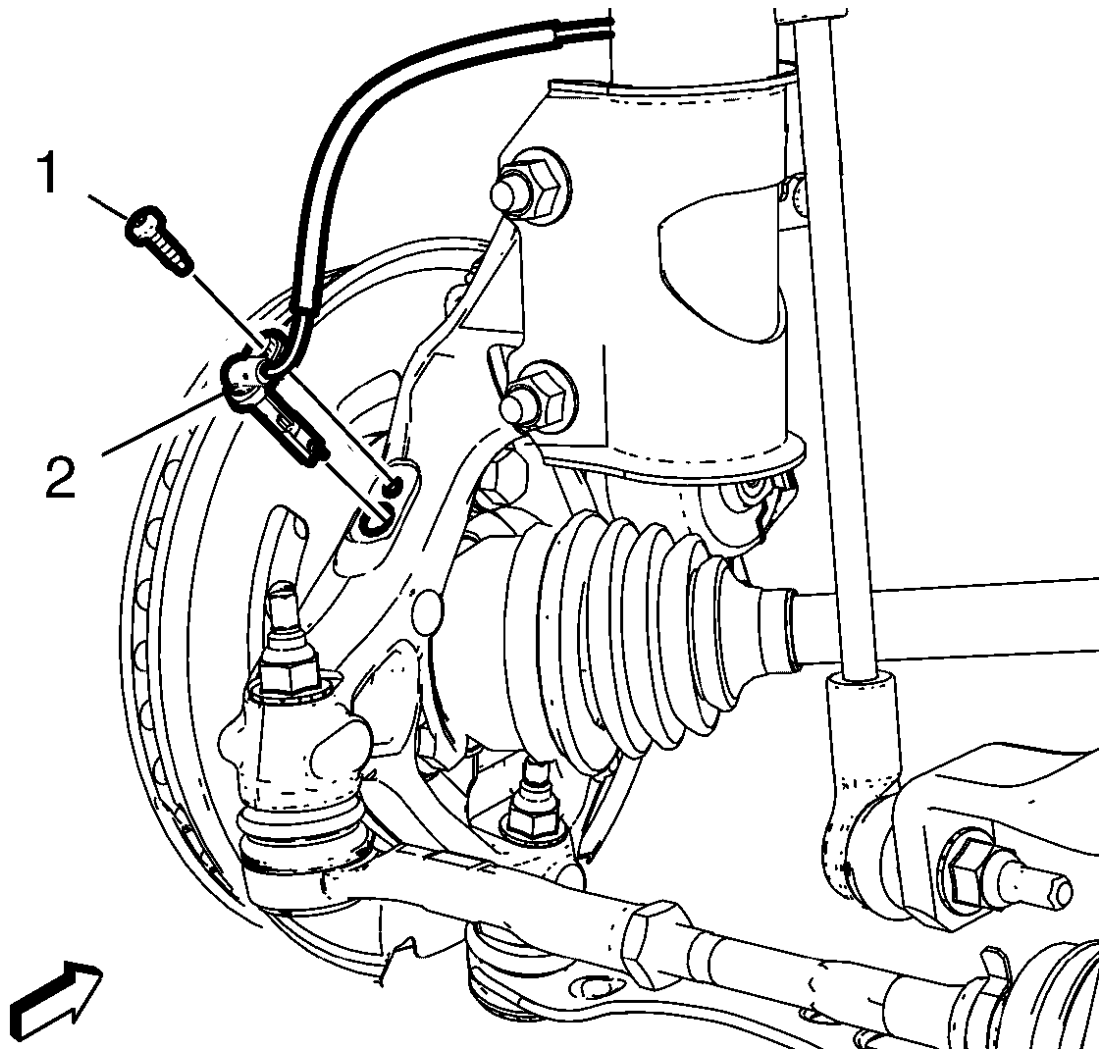


Fig. 23: Front Wheel Speed Sensor And Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Wheel Speed Sensor (2)

CAUTION: Fastener Caution

4. Install Front Wheel Speed Sensor Fastener (1) and tighten 9.5 N.m (84 lb in)
5. Install Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)
6. Install Tire and Wheel Removal and Installation

REAR WHEEL SPEED SENSOR REPLACEMENT

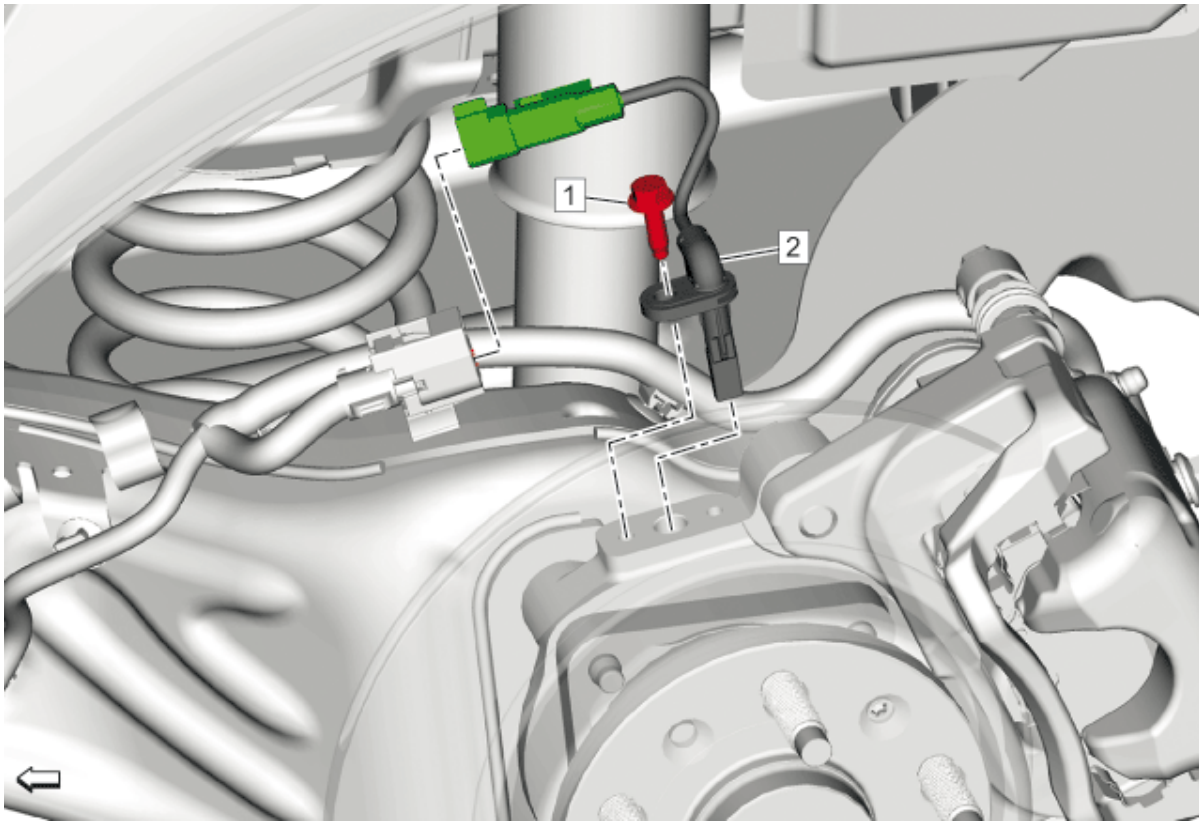


Fig. 24: Rear Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Procedure <u>Tire and Wheel Removal and Installation</u>	
1	Rear Wheel Speed Sensor Bolt CAUTION: <u>Fastener</u> <u>Caution</u> Procedure Disconnect the electrical connector. Tighten 9 N.m (80 lb in)
2	Rear Wheel Speed Sensor

VEHICLE STABILITY CONTROL SYSTEM SWITCH REPLACEMENT

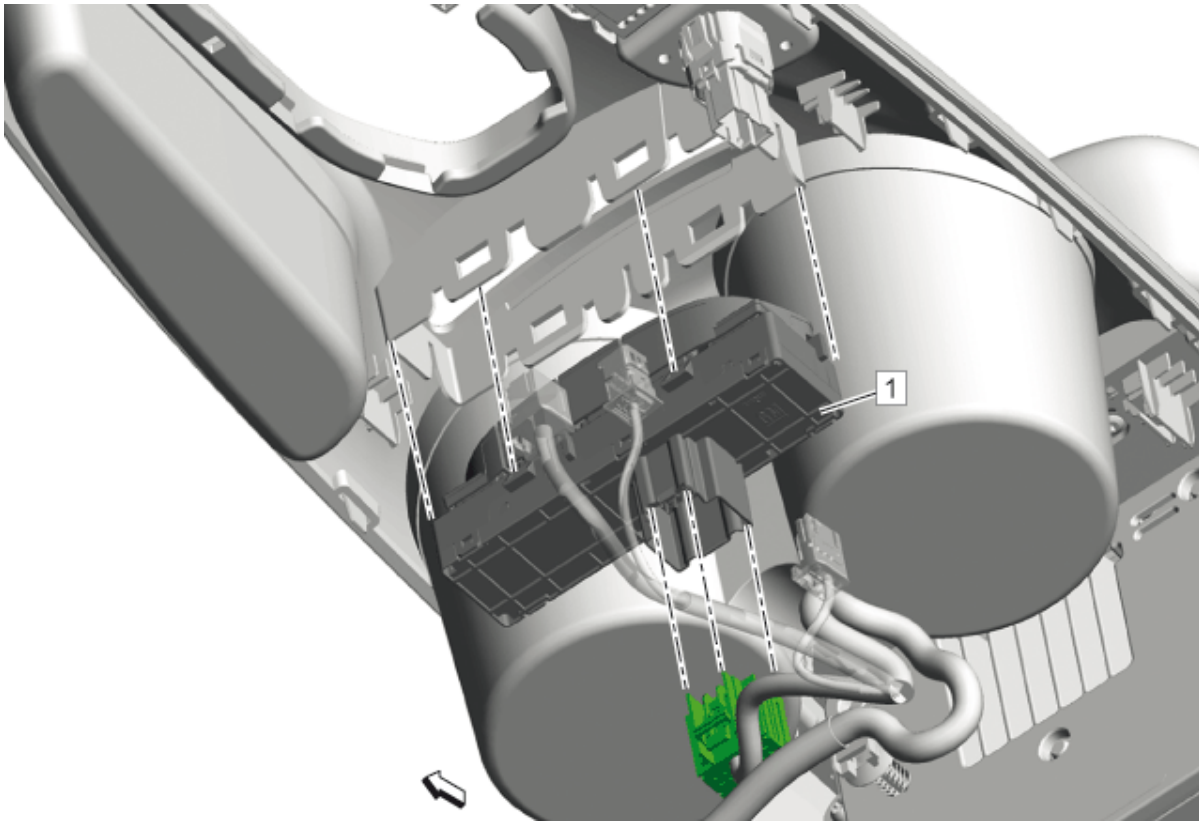


Fig. 25: Vehicle Stability Control System Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Floor Console Accessory Trim Plate Replacement</u>	
1	Vehicle Stability Control System Switch

VEHICLE YAW SENSOR LEARN (WITH UGN)

The yaw rate sensor does not require calibration often. Calibrating the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Yaw Rate Sensor replacement
- Electronic Brake Control Module replacement
- Inflatable Restraint Sensing and Diagnostic Module replacement

The yaw rate sensor learn procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface
2. Apply the parking brake, or set the transmission in the Park position.
3. Install the scan tool to the data link connector.
4. Ignition ON/Vehicle in Service Mode.
5. Select Yaw Rate Sensor Learn in the Electronic Brake Control Module Configuration/Reset Functions list.

6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

VEHICLE YAW SENSOR LEARN (WITHOUT UGN)

The yaw rate sensor does not require calibration often. Calibrating the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Inflatable Restraint Sensing and Diagnostic Module replacement

The yaw rate sensor learn procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface
2. Apply the parking brake, or set the transmission in the Park position.
3. Install the scan tool to the data link connector.
4. Ignition ON, engine OFF.
5. Select Yaw Rate Sensor Learn in the Inflatable Restraint Sensing and Diagnostic Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

VEHICLE DYNAMIC SENSOR REPLACEMENT

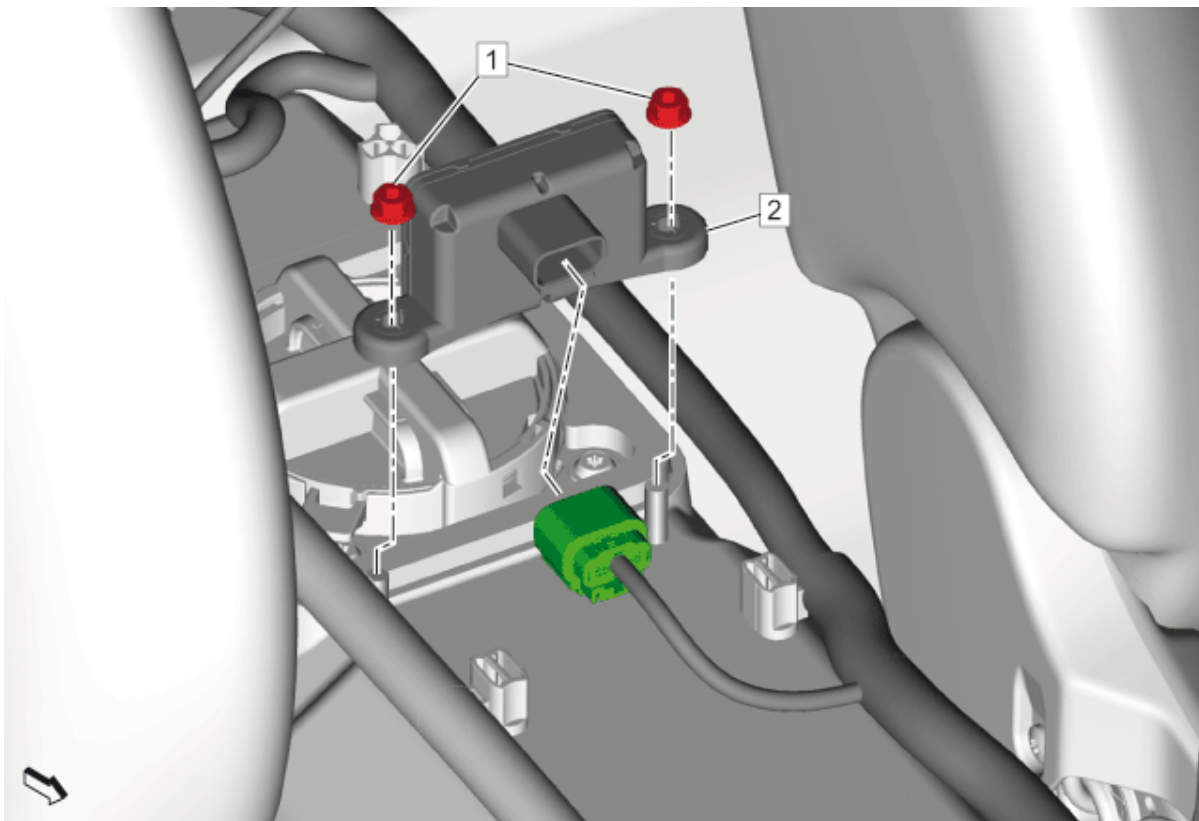


Fig. 26: Vehicle Dynamic Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Floor Console Replacement</u>	
1	Vehicle Dynamic Sensor Nut (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 9 N.m (80 lb in)
2	Vehicle Dynamic Sensor Procedure 1. Disconnect the electrical connector. 2. <u>Vehicle Yaw Sensor Learn (with UGN)Vehicle Yaw Sensor Learn (without UGN)</u>

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

This vehicle is equipped with a Bosch ABS/SCB/TC/VSC module.

This module provides the following vehicle performance enhancement systems:

- Antilock Brake System (ABS)
- Electric Parking Brake (EBP apply and EPB release (automatic))
- Extended Hill Start Assist (EHSA)
- Regenerative Braking (in conjunction with the Eboost module)
- Electronic Brake Distribution
- Traction Control (TC)
- Vehicle Stability Control (VSC)

The following components are involved in the operation of the above systems:

- Electronic brake control module (EBCM) - The EBCM controls the system functions and detects failures.

The EBCM contains the following components:

- System relay - The system relay is internal to the EBCM. The system relay is energized when the power button is placed in ON/RUN or a remote function actuation (RFA) commands remote START. The system relay supplies battery positive voltage to the valve solenoids and to the ABS pump motor. This voltage is referred to as system voltage.
- Solenoids - The solenoids are commanded ON and OFF by the EBCM to operate the appropriate

valves in the brake pressure modulator valve.

- Brake pressure modulator valve - The brake pressure modulator valve uses a 4-circuit configuration to control hydraulic pressure to each wheel independently.

The brake pressure modulator valve contains the following components:

- ABS pump motor and pump
- Isolation valves
- Dump valves
- Electronic hydraulic control unit
- Steering angle sensor--The EBCM receives serial data message inputs from the steering angle sensor. The steering angle sensor signal is used to calculate the desired yaw rate. The steering angle sensor is mounted internally to the electric power steering gear.
- Traction control switch--Traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Multi-axis acceleration sensor--The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor. The EBCM receives serial data message inputs from the yaw rate, lateral acceleration and longitudinal acceleration sensor and activates stability control depending on multi-axis acceleration sensor input.

Depending on vehicle options, the vehicle multi-axis sensor may be installed internal to the inflatable restraint sensing diagnostic module, separately externally, or a combination of both. Confirm with vehicle RPO codes and schematics.

- Wheel speed sensors - The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives ignition voltage from the electronic brake control module (EBCM) and provides a DC square wave signal back to the module. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed.
- Electronic park brake motors - Controlled by the EBCM and attached to each rear caliper.

General Antilock Brake Operation

General Operation

The Bosch ESPheV Hydraulic Unit and iBooster work in conjunction to provide both friction and regenerative braking. The iBooster Brake Booster assembly works very similarly to a standard vacuum booster, except brake boost is provided by an electric motor instead of engine vacuum. When the driver applies the brake pedal the iBooster and master cylinder delivers fluid to the ESPheV unit. The ESPheV unit then balances the friction and regenerative braking via a series of valves and a low pressure fluid line that is connected to the brake fluid reservoir. The ESPheV unit can move fluid to and from the reservoir via this low pressure line to meet the drivers braking demand with friction that cannot be achieved via regenerative braking. In order to balance the brake pedal feel of the driver, the iBooster braking support force is changed to match the brake fluid pressure in the system. When there is no regenerative braking possible (i.e. standstill), the separation valve inside the ESPheV is closed and the master cylinder only supplies brake fluid to the front axle. The rear axle braking demand is supplied by the ESP pump pulling fluid from the reservoir.

A pressure transducer on the primary master cylinder circuit (Master Cylinder Pressure), a pedal travel sensor

on the input piston assembly, and the brake switch are inputs into the electronic control unit. These inputs are used to determine the driver's braking intent which is used to control the torque applied to the wheels.

Base Brakes (Friction Braking)

The braking torque applied to the wheels in proportion to the driver's braking intent is achieved with a combination of regenerative braking from the powertrain and hydraulically applied friction braking controlled by the electro-hydraulic control unit. The friction braking achieved by the electro-hydraulic control unit controlling a combination of valves and ESP Pump Motor Duty in a way that moves fluid in and out of the wheels via the low pressure line connected to the brake fluid reservoir. The Bosch ESPheV system is designed to be used with a Bosch iBooster in order to achieve seamless driver brake pedal feel.

Base Brake Valves (No Valve Action)

The Separation Valve (SV) and Pressure Control Relief (PCR) Valves are open and closed respectively when they are not being controlled. In this state the brake fluid delivered by the master cylinder is sent directly to the wheels. This mode is used during a failsafe state to ensure proper friction braking and during the first apply of a new vehicle power cycle for diagnostics.

Base Brake Valves (Regenerative Braking)

When regenerative braking is available from the electric powertrain, the ESPheV unit will try to utilize this as much as possible. It does this by leaving the SV valve open and opening the PCR valve to return the brake fluid in the system to the brake fluid reservoir. If the regenerative braking is not able to meet the driver brake demand, the fluid can be reintroduced into the system by the ABS Pump pulling fluid from the reservoir. In order to match the driver brake pedal feel with the amount of fluid in the brake system, the iBooster support force is adjusted to match the expected feel.

Base Brake Valves (No Regenerative Braking)

When there is no regenerative braking available, i.e. vehicle is at standstill or very low speed, the SV valve will close with a driver brake apply. The SV valve closing diverts all the fluid from the master cylinder to the front brakes. The rear brake fluid will be pulled from the brake fluid reservoir via the low pressure line by the ABS Pump.

Electronic Brake Control Feature Descriptions

Antilock Braking System

The ABS system includes one hydraulic modulator that is capable of performing ABS and Electronic Brake force Distribution (EBD) functions. The ABS monitors wheel speeds and other select vehicle parameters. The ABS and EBD operations shall meet the brake balance requirements defined by four regions of friction utilization and Z critical parameter in the base brake SSTs. The EBD shall balance brake forces both longitudinally and laterally at full speed range. This function shall improve vehicle stability during normal braking by means of all corners brake pressure control without the use of a conventional mechanical proportioning valve(s). In addition, the included sub-functions (such as split coefficient yaw control and Cornering Brake Control - CBC) have to reduce unwanted yawing while braking in any condition (straight-line as well as any cornering). When braking on straight line homogeneous road surface the EBD shall provide optimum front and rear brake balance and control the rear brakes with equal pressure. During braking in a turn or steering while braking the EBD shall provide appropriate side-to-side brake proportioning through CBC to

optimize vehicle deceleration and meet vehicle stability specified in ABS vehicle performance requirements. The ECU and relays are integral to the hydraulic modulator.

Straight Line Stability (SLS)

SLS is used when vehicles exhibit excess yaw during straight line non-ABS, or threshold, brake applies. Vehicles with short wheelbases often exhibit this behavior. Straight Line Stability control shall have the capability to adjust front and rear brake corner pressures to assist the driver to maintain intended straight line vehicle path.

Enhanced Corner Brake Control (ECBC)

Enhanced Corner Brake Control shall have the ability to detect vehicle path deviation during very slight cornering maneuvers. Corner Brake Control may not engage in these maneuvers because the turn is not big enough. Also, ECBC shall integrate EBD and CBC to control both front and rear inner wheels to maintain vehicle stability.

Panic Brake Assist (PBA)

PBA detects that the driver intent is to stop the vehicle as quickly as possible, but does not apply sufficient brake pressure to do so. The feature will detect this driver intent then actively apply brake pressure to maximum pressure, thus activating the ABS system and stopping the vehicle as quickly as possible.

Hydraulic Fade Compensation (HFC)

The Hydraulic Fade Compensation (HFC) function detects a fading brake condition and activates the ESC modulator to increase the brake pressure above current master cylinder pressure from the driver apply. Once activated, HFC will drive all wheels into ABS. Built on a brake disc/pad temperature model, brake pressure and deceleration rate, brake pressure will be added to the already applied pressure from the driver. This increases the total brake pressure in the system and enhancing stopping distance in fading situations. The driver will experience fading brakes while using low or medium brake pedal force application. The HFC will activate only during high brake pedal force application.

Engine Drag Control (EDC)

This feature is designed to mitigate drop-throttle-oversteer. During maximum cornering while applying throttle, the vehicle could exhibit oversteer when the driver quickly releases the throttle. This feature will slowly reduce the engine torque in order to maintain vehicle stability.

Engine Torque Steer Control

Engine Torque Steer Control uses engine torque reductions to minimize torque steer. This is a pre-emptive engine torque reduction used on vehicles that exhibit excessive torque steer during large accelerator pedal inputs. This feature will also improve the Intersection maneuver (standing launch with 90 deg turn) performance.

Extended Hold Hill Start Assist (EHHSA)

Extended Hold Hill Start Assist is a feature that will hold the vehicle while on a grade, to prevent the vehicle from rolling down the hill. This feature will activate the Electronic Park Brake under driver exist scenarios.

Dynamic Braking with Electronic Park Brake

Dynamic Braking with the Electronic Park Brake (EPB) provides autonomous braking when the EPB switch is pressed when the vehicle is in motion. With the use of this feature, if the EPB switch is pressed while the vehicle is moving, the EBCM will apply braking at all 4 corners until the vehicle is stopped, then the EPB will apply and EBCM will release pressure

Reduced Boost Ratio During ABS (RBR)

On brake by wire systems, it is possible to reduce the amount of pressure applied by the system upstream of the wheel valves to improve ABS wheel control on low μ surfaces. This in essence reduces the amount of driver applied pressure when low μ ABS is detected. The overall goal of this feature is to improve ABS feel.

EV Powerhop and Powertrain Mount Control

Powerhop is defined as an oscillation of the driven wheels due to acceleration on high coefficient surfaces. This wheel oscillation causes the vehicle to bounce resulting in driver discomfort, failure of driveline components and potentially other damage to the vehicle. Powertrain Mount Resonance is also related to wheel oscillation. With the TCS feature "ON", power hop shall be detected using wheel speed sensor signals. With the TCS feature "OFF", the EBCM and ECM shall be required to mitigate power hop. If the vehicle is exhibiting this signature, the traction control system will attenuate powerhop by reducing engine torque and applying brake pressure.

Vehicle Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the EBCM determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated by the EBCM using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the EBCM attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of applied brake pressure varies, depending on the correction required.

Power-up Self-Test

The electronic brake control module (EBCM) is able to detect many malfunctions whenever the ignition is ON. However, certain failures cannot be detected unless active diagnostic tests are performed on the components. Shorted solenoid coil or motor windings, for example, cannot be detected until the components are commanded ON by the EBCM. Therefore, a power-up self-test is required at the beginning of each ignition cycle to verify correct operation of components before the various control systems can be enabled. The EBCM performs the power-up self-test when the ignition is first turned ON. The system relay, solenoids and the antilock brake system (ABS) pump motor are commanded ON and OFF to verify proper operation and the EBCM verifies the ability to return the system to base braking in the event of a failure. The power-up self-test may be heard by the

driver, depending on how soon the engine is cranked and started after turning ON the ignition.

Driver Information Indicators

The following indicators are used to inform the driver of several different factors.

Brake Warning Indicator

The instrument panel cluster illuminates the brake warning indicator when the following occurs.

- The electronic brake control module (EBCM) detects that the park brake is engaged. The instrument panel cluster receives a serial data message from the BCM requesting illumination. The brake warning indicator flashes at a rate of approximately twice per second when the park brake is engaged.
- The electronic brake control module (EBCM) detects a low brake fluid condition or a base brake pressure differential and sends a serial data message to the instrument panel cluster requesting illumination.
- The instrument panel cluster performs the bulb check.
- The EBCM detects an antilock brake system (ABS)-disabling malfunction which also disables electronic brake distribution and sends a serial data message to the instrument panel cluster requesting illumination.

ABS Indicator

The instrument panel cluster illuminates the ABS indicator when the following occurs:

- The electronic brake control module (EBCM) detects an ABS-disabling malfunction and sends a serial data message to the instrument panel cluster requesting illumination.
- The instrument panel cluster performs the bulb check.
- The instrument panel cluster detects a loss of serial data communication with the EBCM.
- A DTC is set during the previous ignition cycle which requires a United Nations Economic Commission for Europe regulation number 13 (ECE 13) response at the beginning of the current ignition cycle. The EBCM sends a serial data message to the instrument panel cluster requesting illumination.

Traction Control/Stability Control Indicator

The instrument cluster turns the traction control/stability control indicator ON when the following occurs:

- The electronic brake control module (EBCM) detects an ABS/TC/VSC-disabling malfunction and sends a serial data message to the instrument panel cluster requesting illumination.
- The instrument panel cluster performs the bulb check.
- The instrument panel cluster detects a loss of serial data communication with the EBCM.
- A DTC is set during the previous ignition cycle which requires a United Nations Economic Commission for Europe regulation number 13 (ECE 13) response at the beginning of the current ignition cycle. The EBCM sends a serial data message to the instrument panel cluster requesting illumination.
- The EBCM is actively controlling propulsive torque or brake torque due to a loss of traction or vehicle stability event.
- The TC/VSC system has been manually disabled by the vehicle operator.

United Nations Economic Commission for Europe Regulation Number 13 (ECE 13) Response

The electronic brake control module (EBCM) illuminates the antilock brake system (ABS) indicator when a malfunction which disables ABS is detected. Usually, the ABS indicator is turned OFF during the following ignition cycle unless the fault is detected during that ignition cycle. However, the setting of a wheel speed sensor related DTC may cause the ABS indicator to remain illuminated during the following ignition cycle until the vehicle is operated at a speed greater than 13 km/h (8 mph) or, occasionally, 64 km/h (40 mph), depending on which DTC sets. This allows the EBCM to verify that no malfunction exists, before turning OFF the ABS indicator. It is important to verify that United Nations Economic Commission for Europe regulation number 13 (ECE 13) is not the cause of an ABS indicator which is illuminated when no DTCs are set, before attempting to diagnose other possible causes.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

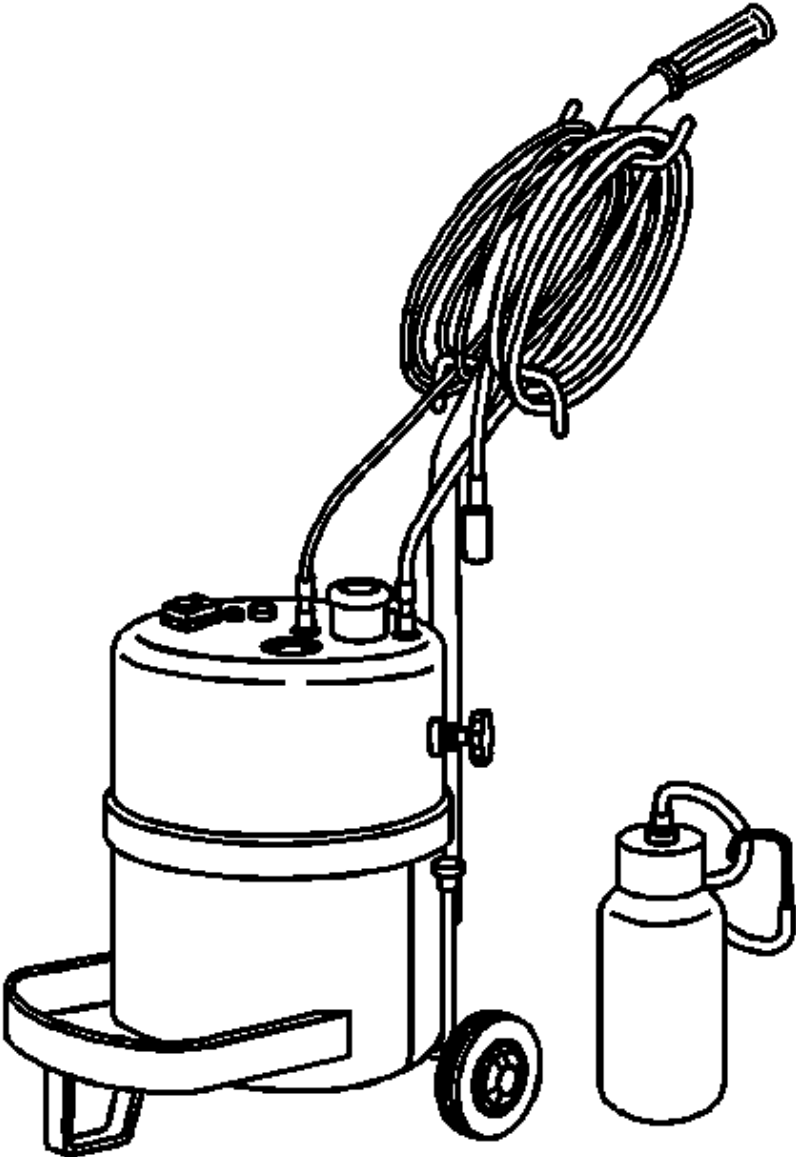
Illustration	Tool Number/ Description
	CH 29532-A J 29532-A Pressure Brake Bleeder

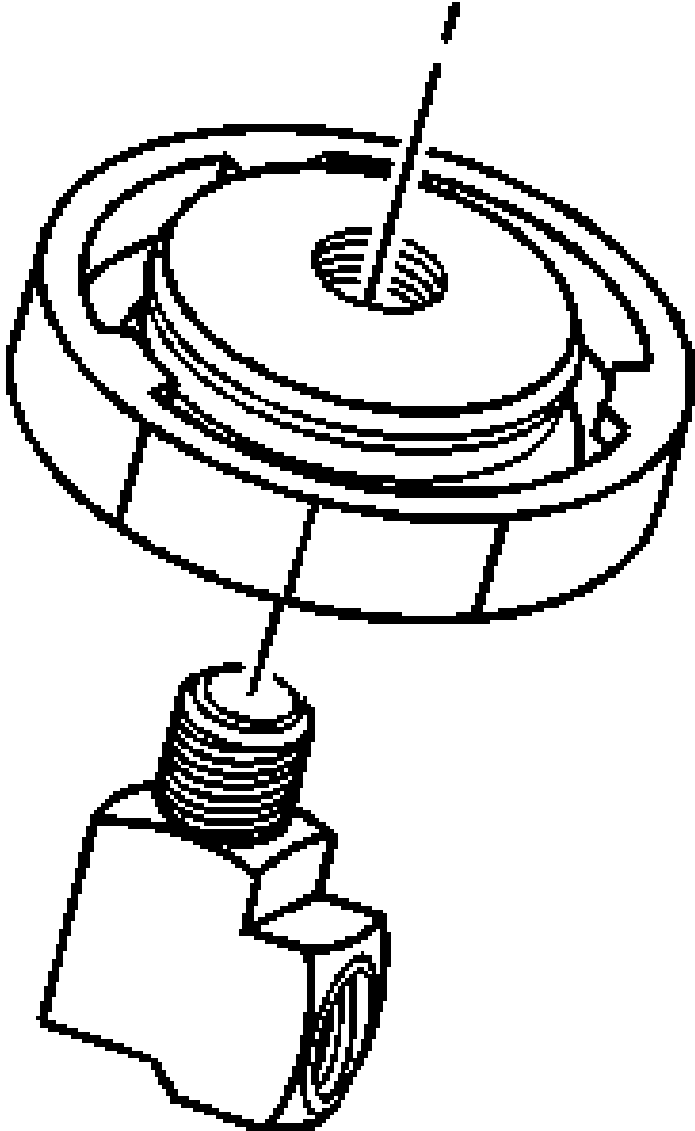
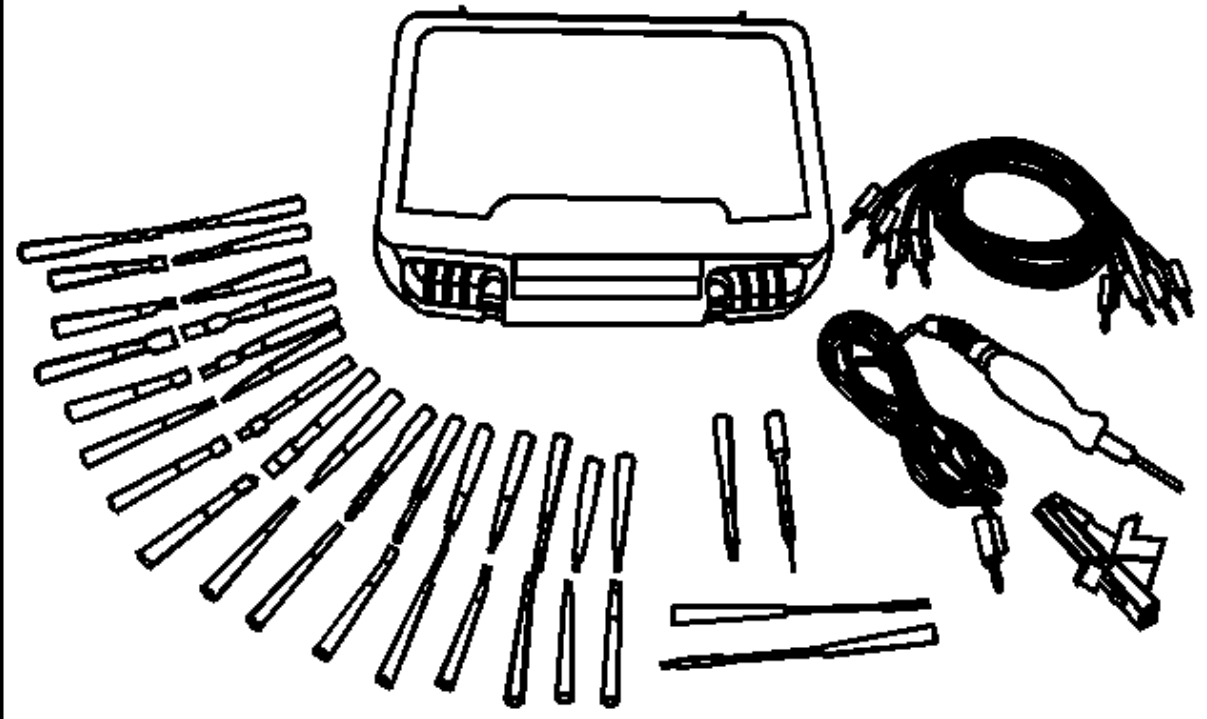
Illustration	Tool Number/ Description
	CH 35589-A J 35589-A Brake Pressure Bleeder Adapter

Illustration	Tool Number/ Description
	EL 35616-F J 35616 Terminal Test Kit

Article GUID: A00884651

BRAKES
Disc Brakes - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Brake Hose Fitting Gasket	
Brake Caliper Dust Boot Seal	
Brake Caliper Piston Seal	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Brake Caliper Guide Pin Bolt - Front	40 N.m (30 lb ft)
Brake Caliper Guide Pin Bolt - Rear	36 N.m (27 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Brake Caliper Bleeder Valve - Front	10 N.m (89 lb in)
Brake Caliper Bleeder Valve - Rear	13 N.m (115 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake Caliper Bracket Bolt - Front	
• First Pass:	150 N.m (111 lb ft)
• Final Pass:	15-30 Degrees
Brake Caliper Bracket Bolt - Rear	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	15-30 Degrees
Brake Hose Fitting Bolt - Front and Rear	40 N.m (30 lb ft)
Brake Rotor Bolt - Front and Rear	9 N.m (80 lb in)
Shock Absorber Bolt	100 N.m (74 lb ft)
Wheel Bearing and Hub Assembly - Rear	
• First Pass:	50 N.m (37 lb ft)
• Final Pass:	30-45 Degrees

DISC BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Front Brakes		
• Caliper Bore Diameter-Front (15" Brake System) (J67)	60 mm	2.362 in
• Rotor Diameter (15" Brake System) (J67)	276 mm	10.866 in
• Rotor Thickness (15" Brake System) (J67)	26 mm	1.024 in
• Rotor Discard Thickness (15" Brake System) (J67)	23 mm	0.906 in
• Rotor Maximum Allowable Assembled Lateral Runout (15" Brake System) (J67)	0.04 mm	0.0016 in
• Rotor Maximum Allowable Scoring (15" Brake System) (J67)	0.4 mm	0.0158 in

Application	Specification	
	Metric	English
• Rotor Minimum Allowable Thickness After Refinish (15" Brake System) (J67)	23.2 mm	0.9134 in
• Rotor Maximum Allowable Thickness Variation (15" Brake System) (J67)	0.006 mm	0.0002 in
• Brake Pad Thickness New without Pad Plate	11.4 mm	0.449 in
• Brake Pad Discard Thickness without Pad Plate	2 mm	0.079 in
Rear Brakes		
• Caliper Bore Diameter-Rear (15" Brake System)	38 mm	1.496 in
• Rotor Diameter (15" Brake System)	264 mm	10.394 in
• Rotor Thickness (15" Brake System)	10 mm	0.394 in
• Rotor Discard Thickness (15" Brake System)	8 mm	0.315 in
• Rotor Maximum Allowable Assembled Lateral Runout (15" Brake System)	0.04 mm	0.0016 in
• Rotor Maximum Allowable Scoring (15" Brake System)	0.4 mm	0.0157 in
• Rotor Minimum Allowable Thickness After Refinish (15" Brake System)	8.2 mm	0.323 in
• Rotor Maximum Allowable Thickness Variation (15" Brake System)	0.006 mm	0.0002 in
• Brake Pad Thickness New without Pad Plate	10 mm	0.394 in
• Brake Pad Discard Thickness without Pad Plate	2 mm	0.079 in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Hydraulic Brake System	DOT 3 Motor Vehicle Brake Fluid	19299818	19299819

DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE ROTOR THICKNESS MEASUREMENT

Special Tools

CH-230-A Disc Gauge

Equivalent regional tools: [Special Tools](#)

WARNING: Refer to [Brake Dust Warning](#) .

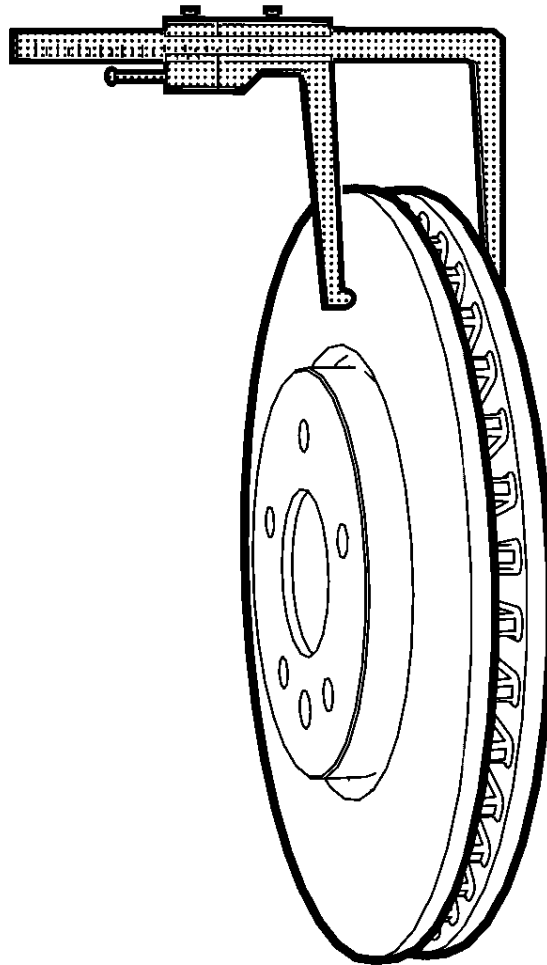


Fig. 1: Disc Gauge On Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to [Front Disc Brake Pads Replacement](#), and/or [Rear Disc Brake Pads Replacement](#), if equipped.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

NOTE: Ensure the measurements are only taken within the friction surfaces.

3. Install the CH-230-A gauge for lateral runout measurement.
 1. Measure and record the thickness of the brake rotor at 4 or more points from the brake rotor inside to

outside.

2. Compare the lowest thickness measurement to the disc brake component specifications. Refer to [Disc Brake Component Specifications](#).
4. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
5. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
6. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement. Refer to [Front Brake Rotor Replacement](#), and/or [Rear Brake Rotor Replacement](#).

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

Special Tools

CH-45101 Hub and Wheel Runout Gauge

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

NOTE: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to [Front Disc Brake Pads Replacement](#), and/or [Rear Disc Brake Pads Replacement](#), if equipped.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

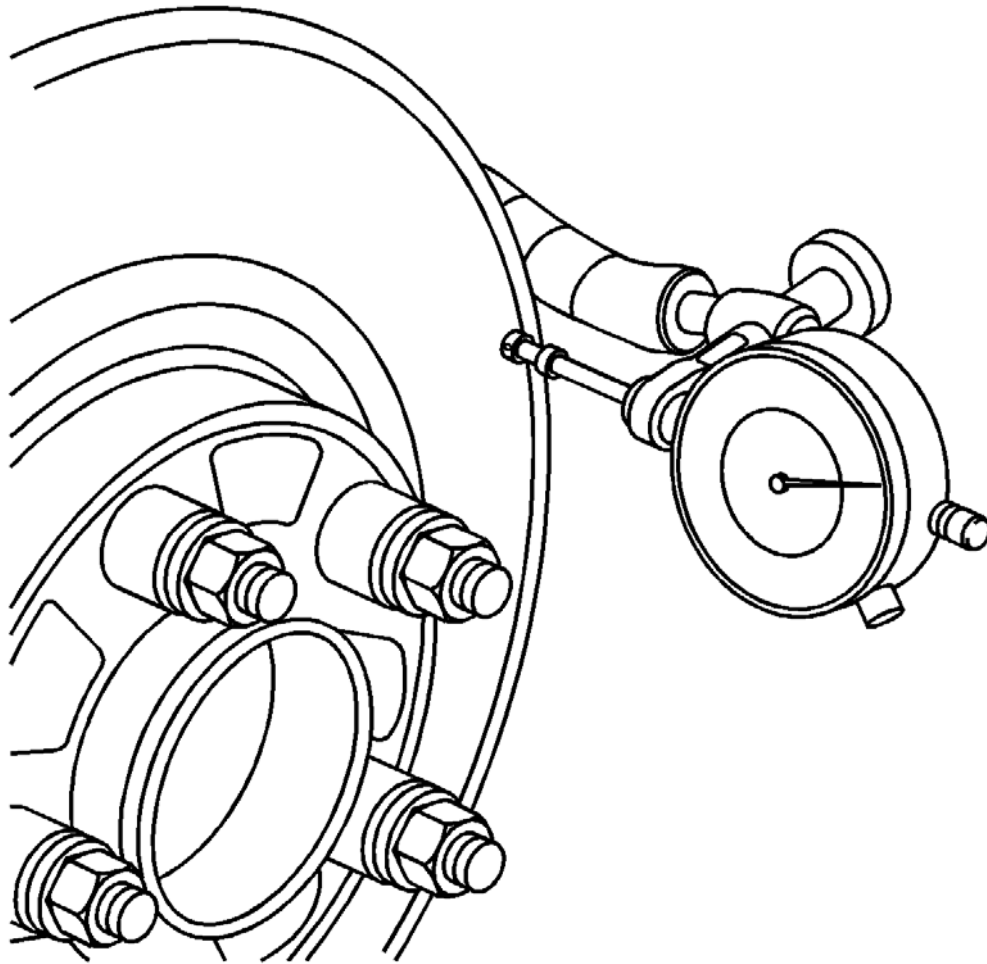


Fig. 2: Mounting Dial Indicator To Measure Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the measurements are only taken within the friction surfaces.

3. Install the CH-45101 runout gauge for lateral runout measurement and compare with the correct specifications. Refer to [Disc Brake Component Specifications](#).

NOTE: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

4. If the brake rotor lateral runout measurement exceeds the specification, the rotor requires refinishing or replacement. Refer to [Front Brake Rotor Replacement](#), [Rear Brake Rotor Replacement](#), or [Brake Rotor Refinishing](#).

BRAKE ROTOR SURFACE AND WEAR INSPECTION

WARNING: Refer to [Brake Dust Warning](#) .

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to [Front Disc Brake Pads Replacement](#), or/and [Rear Disc Brake Pads Replacement](#).

2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following Braking Surface Conditions:
 - Heavy rust and/or pitting.
 - Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the rotor. Refer to [Brake Rotor Refinishing](#).
 - Cracks and/or heat spots.
 - Excessive bluing discoloration.
4. If the friction surfaces of the brake rotor exhibit one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement. Refer to [Front Brake Rotor Replacement](#), [Rear Brake Rotor Replacement](#), or [Brake Rotor Refinishing](#).

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT MEASUREMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit
- **CH-45101** Hub and Wheel Runout Gauge
- **CH-45101-100** Conical Brake Rotor Washers

For equivalent regional tool, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

NOTE:

- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 and 11300 km (3000 and 7000 mi).
- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#).

NOTE:

Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:
 1. Remove the brake rotor from the vehicle. Refer to [Front Brake Rotor Replacement](#), and/or [Rear Brake Rotor Replacement](#).
 2. Using the **CH-42450-A** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
 3. Using the **CH-41013** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the brake rotor.

4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
2. Install the rotor to the hub/axle flange.

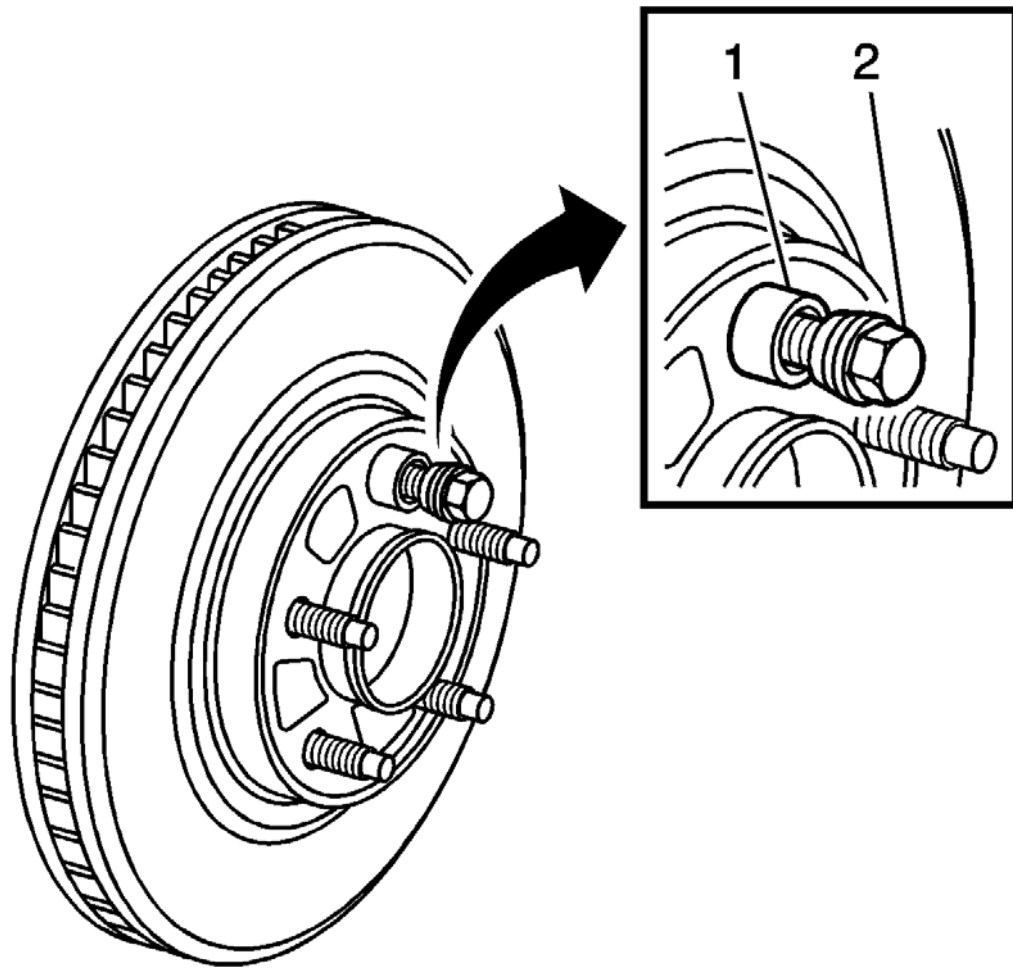


Fig. 3: Conical Brake Rotor Washer And Lug Nut
Courtesy of GENERAL MOTORS COMPANY

3. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** washers (1), and one lug nut (2) onto the upper-most wheel stud.
4. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

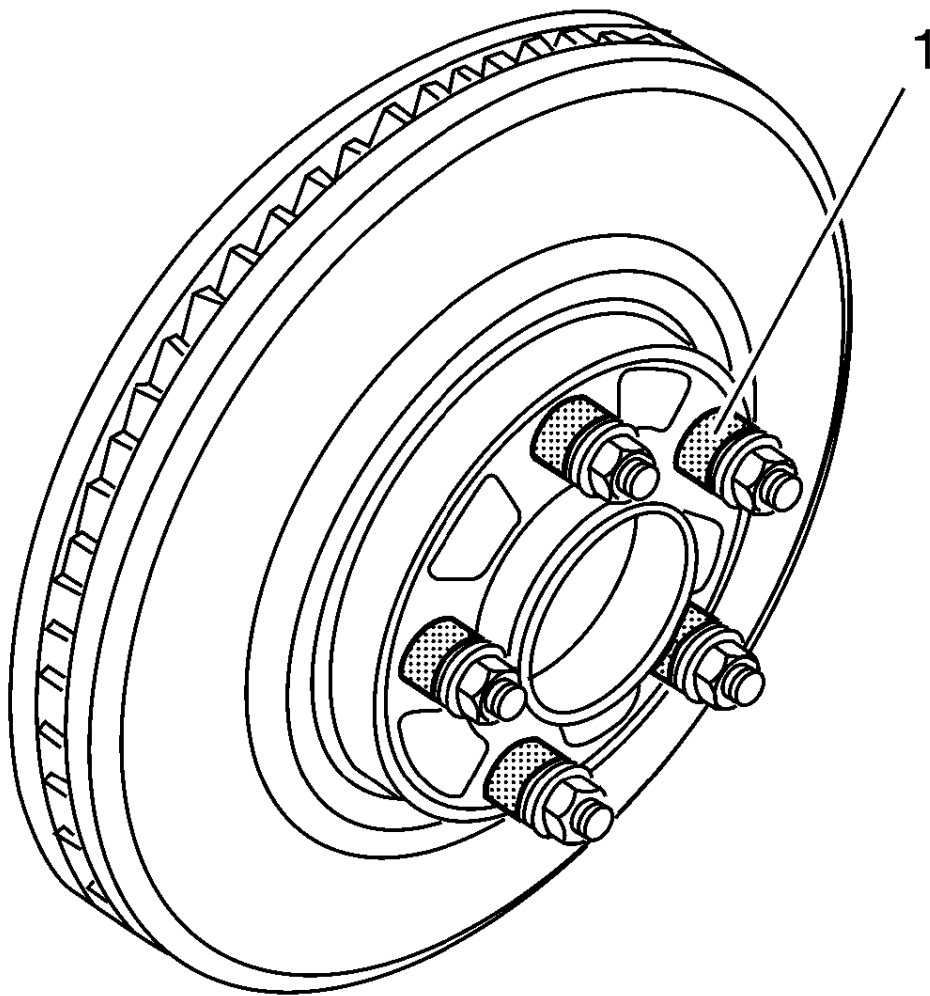


Fig. 4: Conical Brake Rotor Washers And Lug Nuts

Courtesy of GENERAL MOTORS COMPANY

5. Install the remaining **CH-45101-100** washers (1) and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
6. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to [Tire and Wheel Removal and Installation](#) .
7. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 13.
8. If the brake rotor meets the following criteria, proceed to step 9.
 - The rotor is within specifications and is being REUSED.
 - The rotor has NOT been refinished.
 - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level.

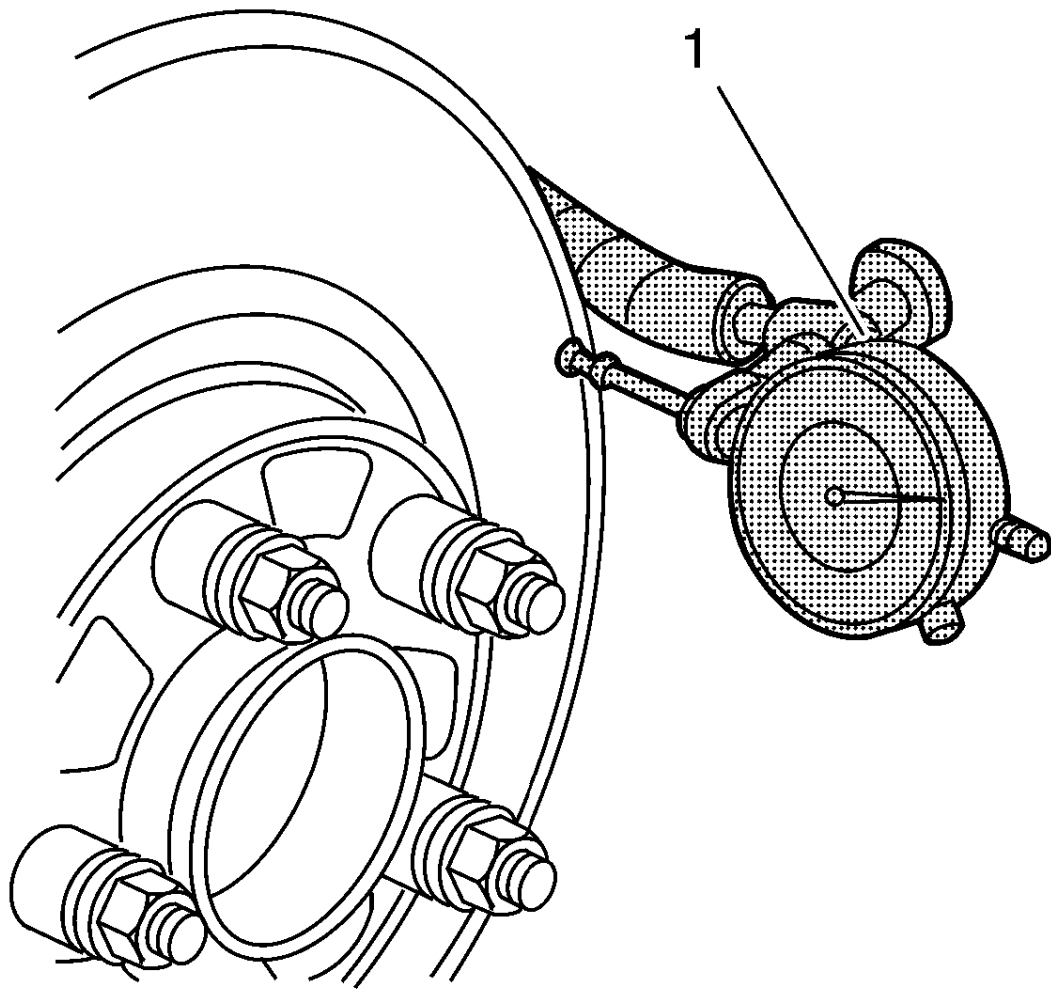


Fig. 5: Measuring Brake Rotor Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

9. Mount the **CH-45101** gauge (1) or equivalent, to the strut and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
10. Measure and record the assembled LRO of the brake rotor.
 1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
 2. Rotate the rotor until the highest reading is displayed on the dial.
 3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
 4. Measure and record the amount of LRO.
11. Compare the brake rotor assembled LRO to the disc brake component specifications. Refer to **Disc Brake Component Specifications**
12. If the brake rotor assembled LRO is within specifications, proceed to step 17.

If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to **Brake Rotor Refinishing**. After refinishing the rotor, proceed to step 13.

13. Mount the **CH-45101** gauge (1) or equivalent, to the strut and position the indicator button so it contacts the

brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.

14. Measure and record the assembled LRO of the brake rotor.

1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
2. Rotate the rotor until the highest reading is displayed on the dial.
3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
4. Measure and record the amount of LRO.

15. Compare the brake rotor assembled LRO to the disc brake component specifications.

16. If the brake rotor assembled LRO measurement exceeds the specification, replace the brake rotors. Refer to [Front Brake Rotor Replacement](#), and/or [Rear Brake Rotor Replacement](#).

17. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** washers.

BRAKE PAD INSPECTION

Special Tools

CH-230-A Disc Gauge

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

1. Remove brake pads. Refer to [Front Disc Brake Pads Replacement](#), and/or [Rear Disc Brake Pads Replacement](#).

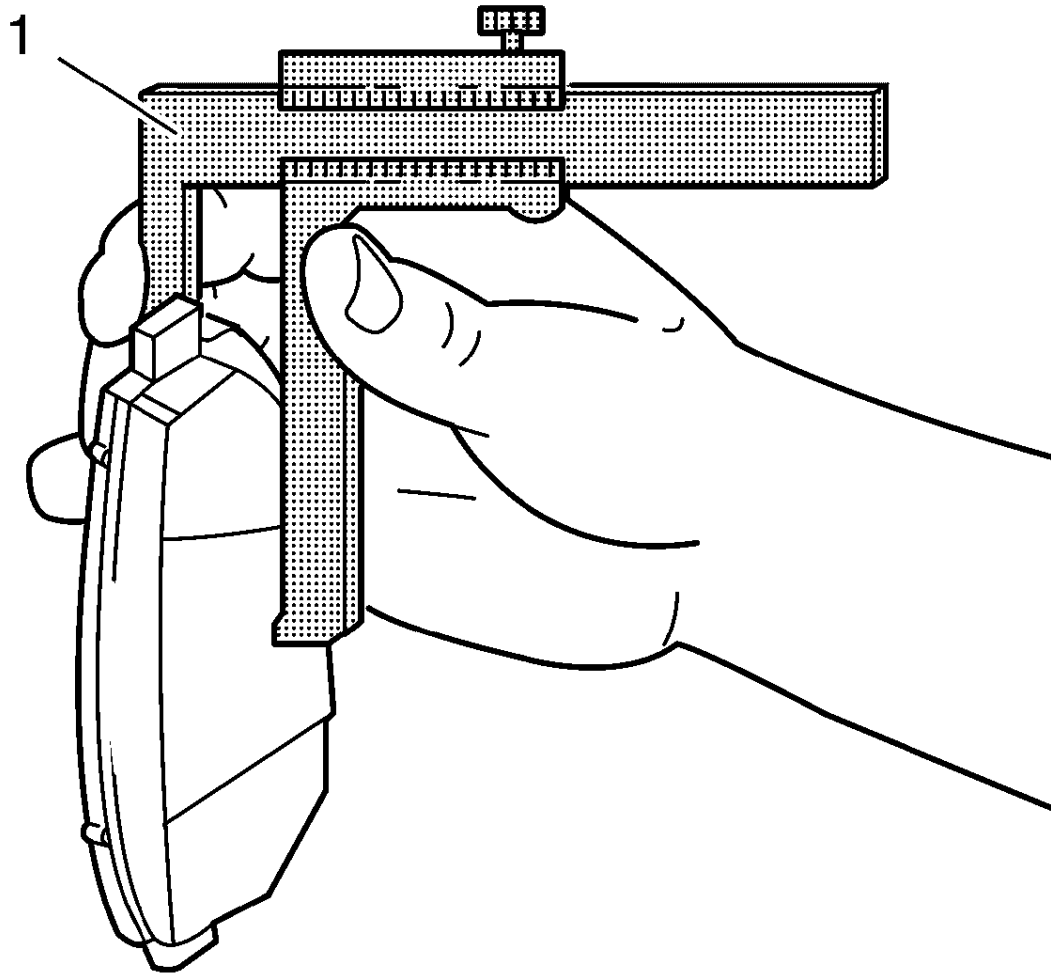


Fig. 6: Measuring Brake Pad Thickness

Courtesy of GENERAL MOTORS COMPANY

2. Measure remaining brake pad thickness at several points, using the **CH-230-A** disc gauge (1).
3. Compare brake pad thickness to disc brake component specifications.

BRAKE CALIPER INSPECTION

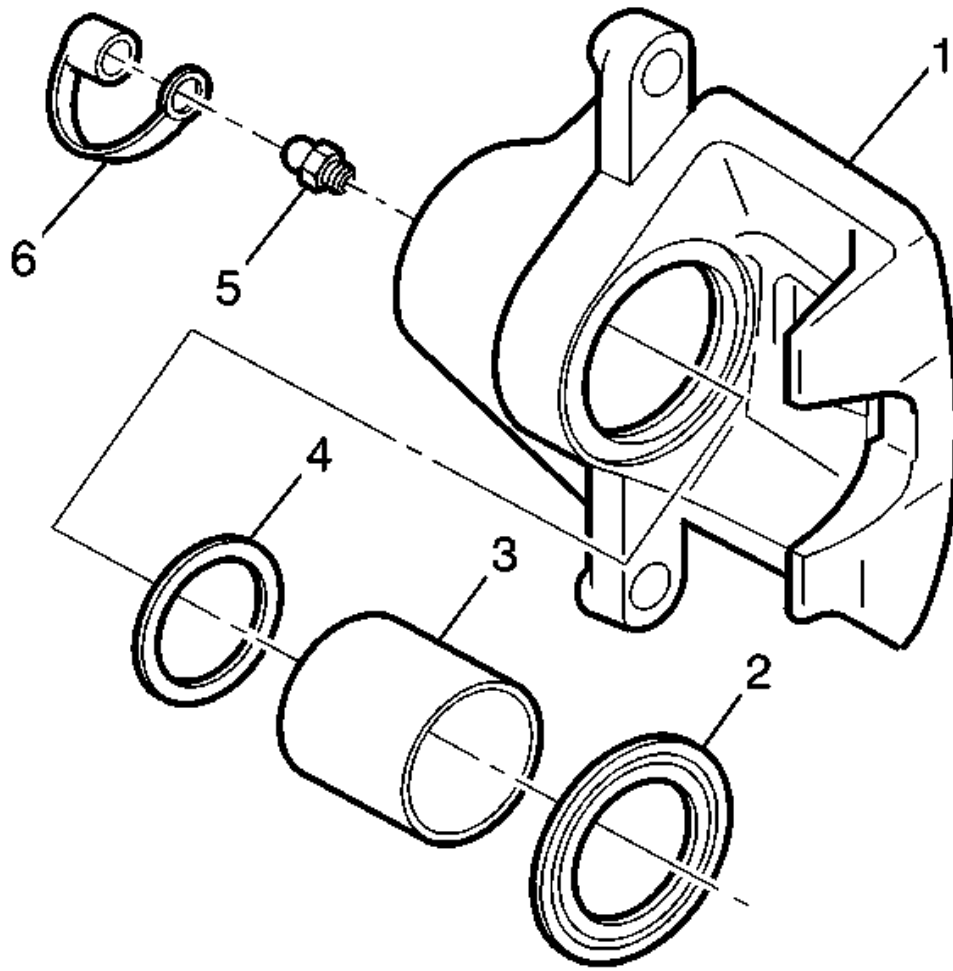


Fig. 7: Brake Caliper Components

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Dust Warning](#) .

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

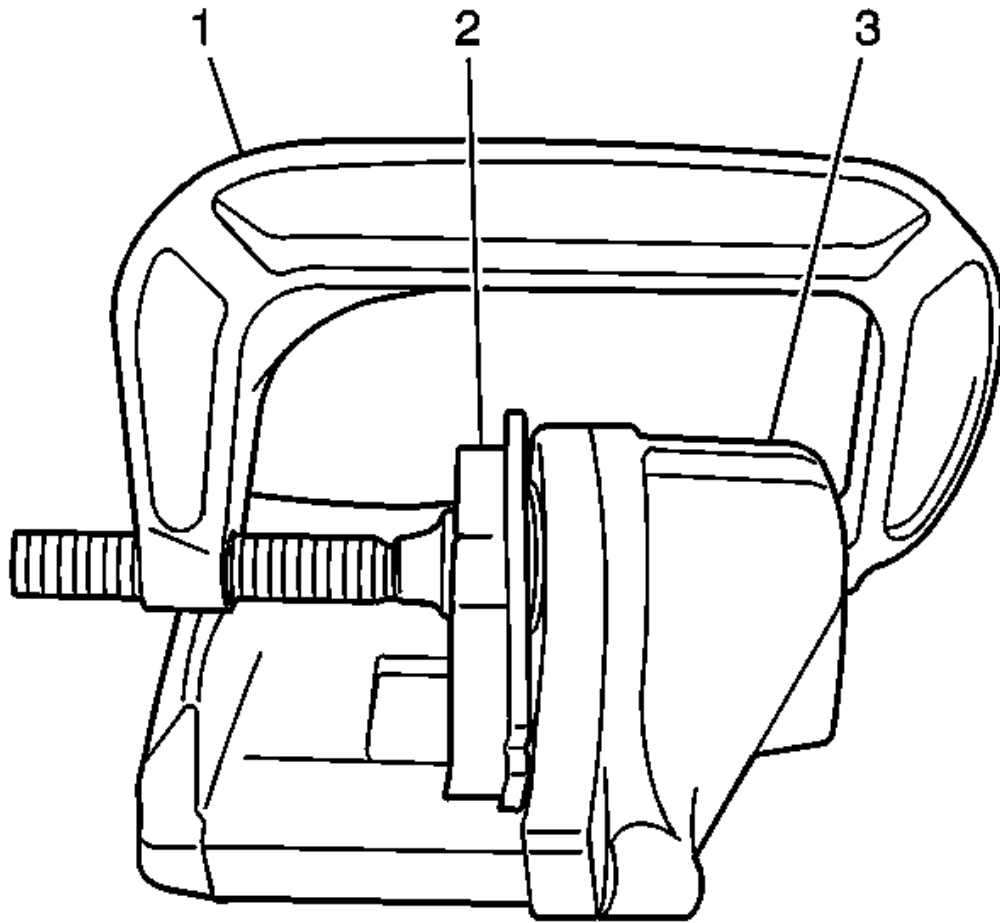


Fig. 8: Compressing Caliper Piston

Courtesy of GENERAL MOTORS COMPANY

4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:

The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.

- For single piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.
- For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

FRONT DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: Refer to [Brake Dust Warning](#) .

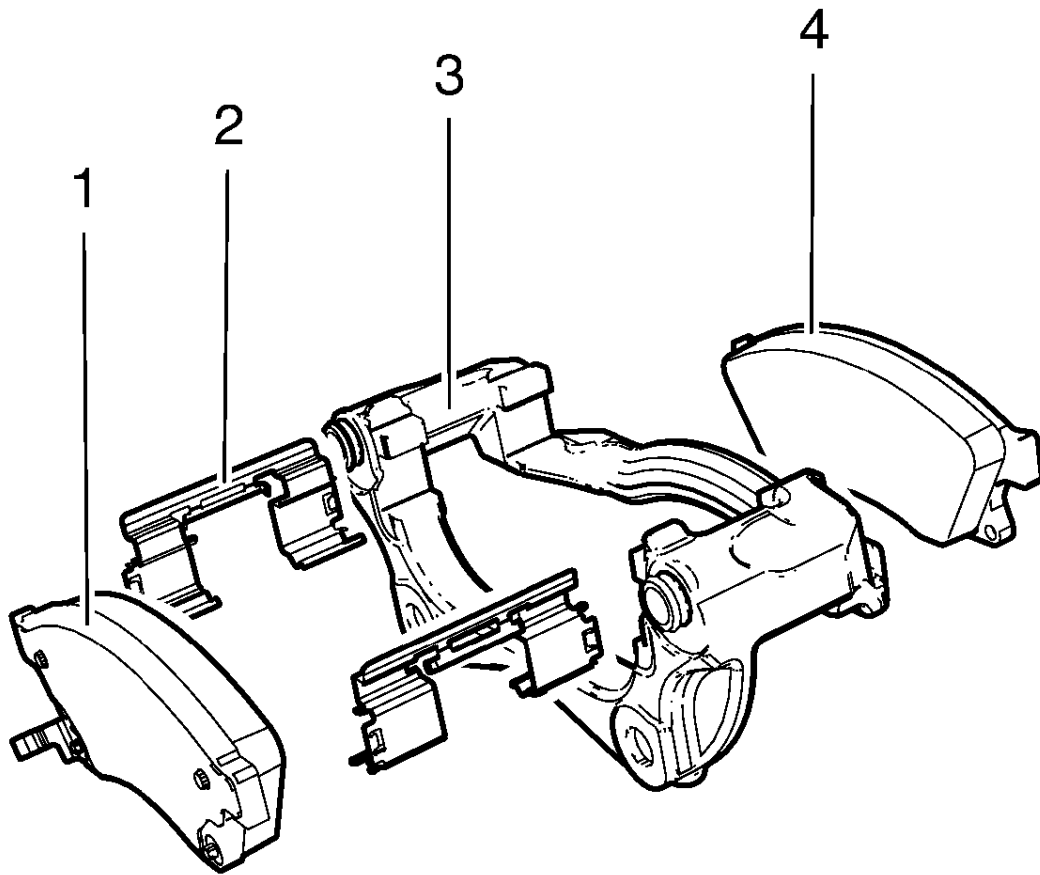


Fig. 9: Exploded View Of Brake Pads And Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
5. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket (3). If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced. Compress the front caliper pistons
7. Compress the front caliper pistons.
 1. Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad (1).
 2. Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
 3. Remove the C-clamp from the caliper.
8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth

on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.

9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do Not remove the hydraulic brake hose from the caliper. Refer to [Front Brake Caliper Replacement](#).
10. Remove the disc brake pads (1, 2) from the brake caliper mounting bracket (3).
11. Inspect the disc brake pad mounting hardware for the following:
 - Missing mounting hardware.
 - Excessive corrosion.
 - Bent pad retainer spring (2).
 - Looseness at the brake caliper mounting bracket (3).
 - Looseness at the disc brake pads (1, 4).
 - Excessive contaminants in the brake caliper mounting bracket (3) surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.

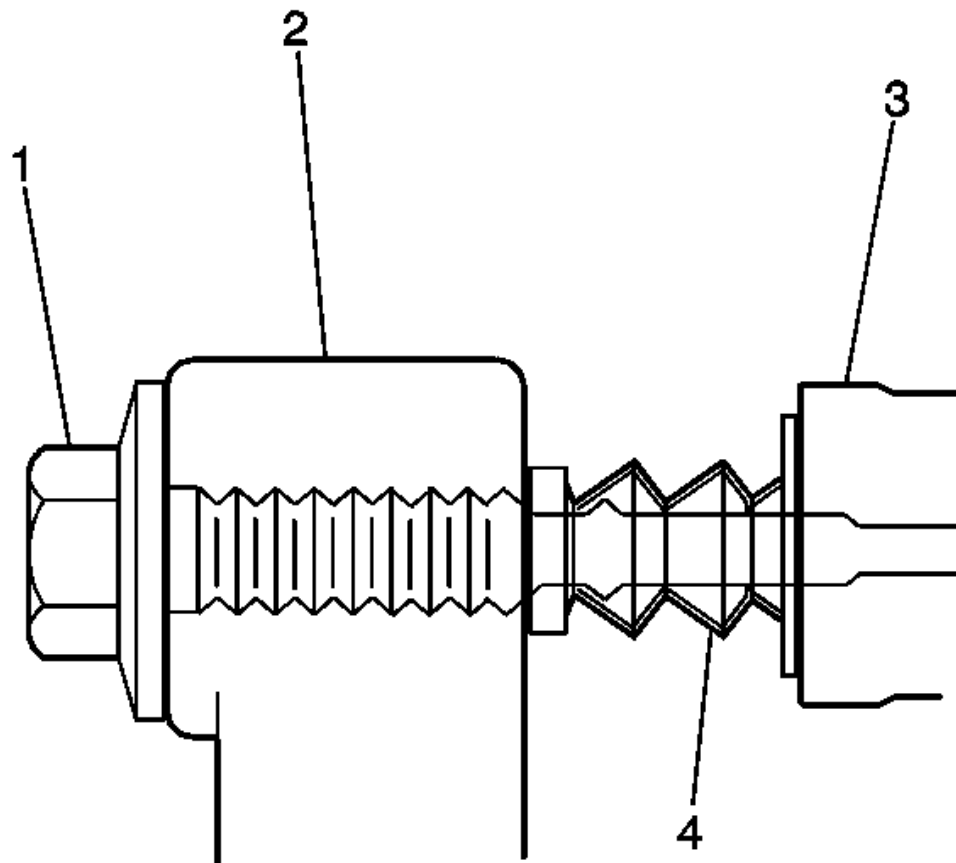


Fig. 10: Caliper, Guide Pin Bolt, Caliper Mounting Bracket And Guide Pin Seal/Boot
Courtesy of GENERAL MOTORS COMPANY

14. Inspect the brake caliper mounting hardware for the following:

- Binding
- Seizing
- Looseness in the brake caliper mounting bracket (3).
- Bent or damaged brake caliper mounting bolts (1).
- Cracked or torn boots (4).
- Missing boots.
- Bent or damaged brake caliper mounting bracket (3).
- Cracked or damaged brake caliper (2).

15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.

16. Install the disc brake pads to the brake caliper mounting bracket.

17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to [Front Brake Caliper Replacement](#).

REAR DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: Brake Dust Warning

1. Remove Rear Brake Caliper Bracket. Refer to Rear Brake Caliper Bracket Replacement

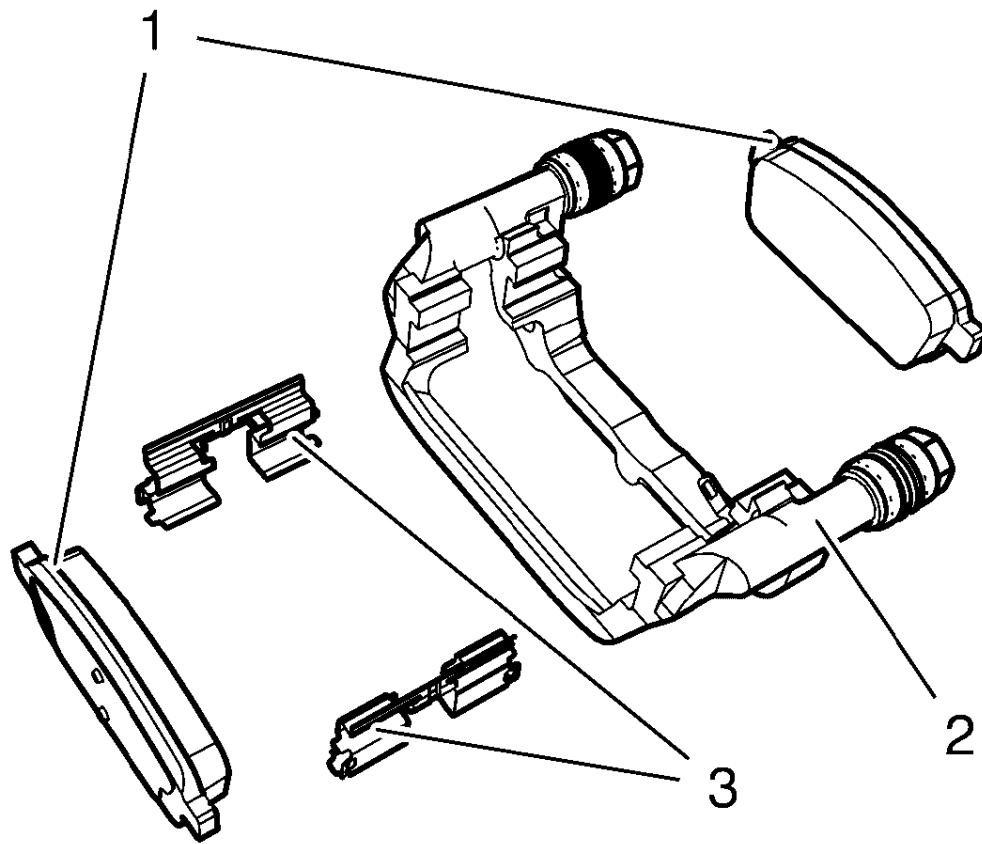


Fig. 11: Exploded View Of Brake Pads And Brake Caliper Mounting Bracket

Courtesy of GENERAL MOTORS COMPANY

2. Remove the disc brake caliper from the caliper mounting bracket (2).
3. Remove the disc brake pads (1) from the caliper mounting bracket (2).
4. Inspect the disc brake pad mounting hardware (3) (if installed) for the following:
 - Missing mounting hardware.
 - Excessive corrosion.
 - Brake pad fastener spring is bent.
 - Looseness at the brake caliper mounting bracket.
 - Looseness at the disc brake pads.
 - Excessive contaminants in the brake caliper mounting bracket surface and threads.
5. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
6. Ensure the disc brake pads are held firmly on the brake caliper mounting bracket, yet slide easily on the

mounting hardware without binding.

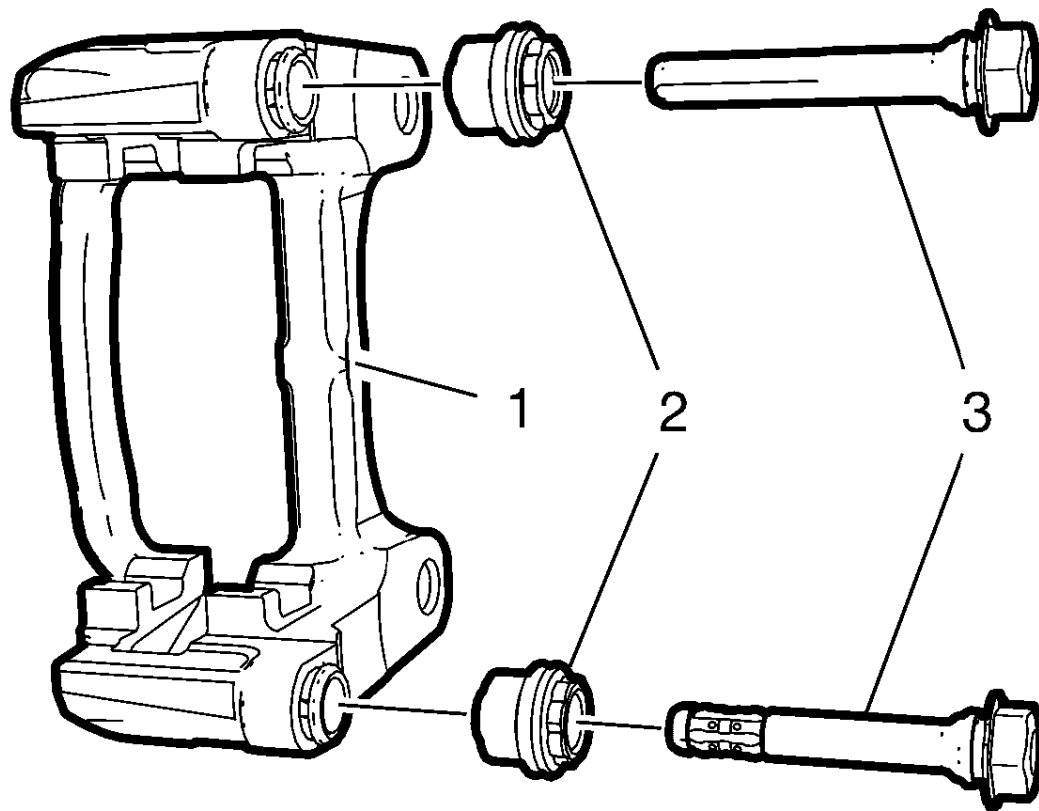


Fig. 12: Brake Caliper Mounting Bracket And Components
Courtesy of GENERAL MOTORS COMPANY

7. Inspect the brake caliper mounting hardware for the following:

- Binding
- Seizing
- Looseness in the brake caliper mounting bracket (1)
- Bent or damaged brake caliper mounting bolts
- Cracked or torn boots (4)
- Missing boots
- Bent or damaged brake caliper mounting bracket (3)
- Cracked or damaged brake caliper (2)

8. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.

9. Install the disc brake pads to the caliper mounting bracket.

10. Install the disc brake caliper to the mounting bracket.

11. Install Rear Brake Caliper Bracket. Refer to [Rear Brake Caliper Bracket Replacement](#)

REPAIR INSTRUCTIONS

FRONT DISC BRAKE PADS REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

WARNING: Refer to [Torque-to-Yield Fastener Warning](#) .

NOTE: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
6. Place a large C-clamp over the brake caliper body and against the outer brake pad.
7. Using the C-clamp, carefully compress the brake caliper piston fully into the brake caliper bore.

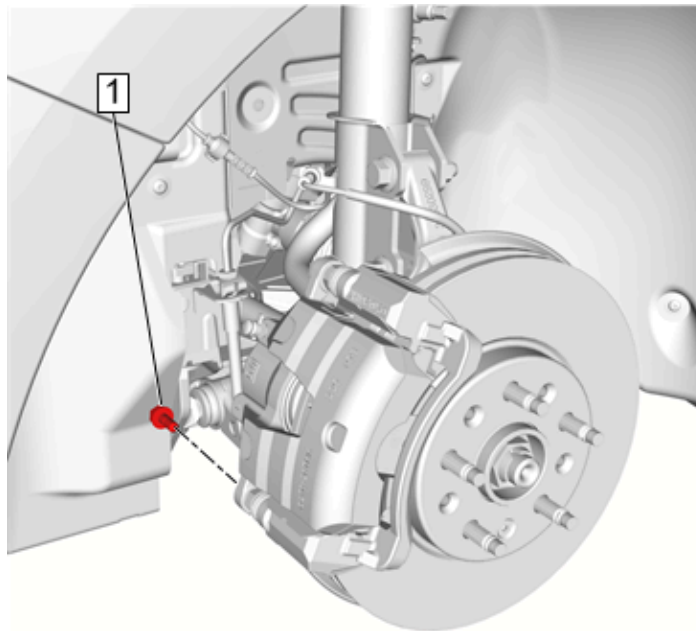


Fig. 13: Brake Caliper Guide Pin Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- DO NOT use any air tools to remove or install the guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the

brake caliper while removing or installing caliper guide pin bolt. **DO NOT** allow the open end wrench to come in contact with the brake caliper. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

8. Remove and DISCARD Brake Caliper Guide Pin Bolt (1)

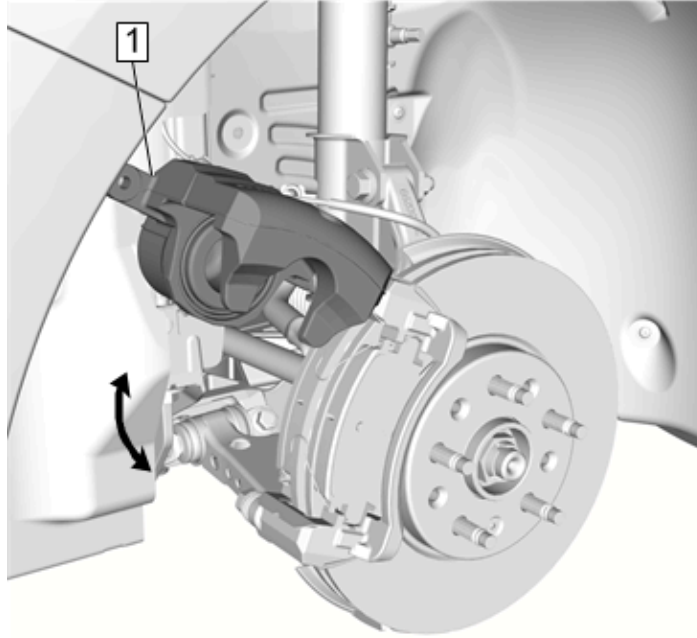


Fig. 14: Front Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

9. Remove Front Brake Caliper (1)

10. Pivot the brake caliper upward and secure with heavy mechanics wire, or equivalent.

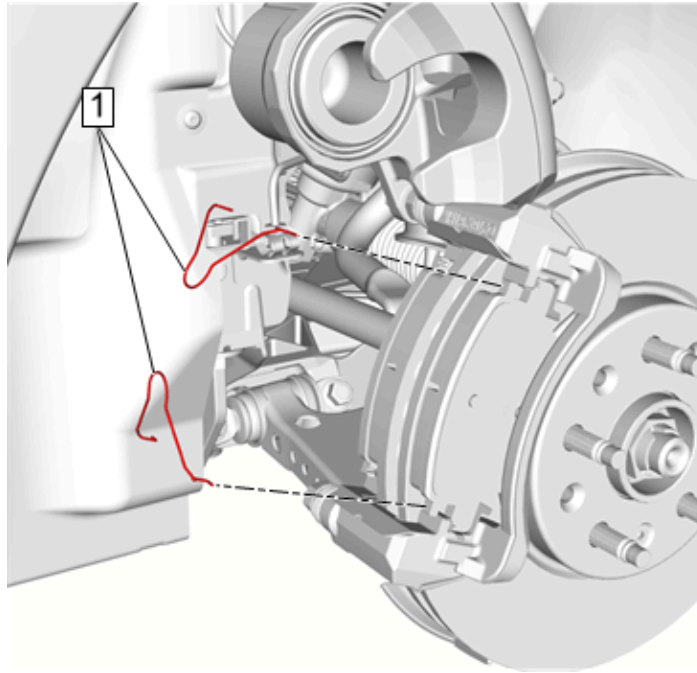


Fig. 15: Front Brake Caliper Springs

Courtesy of GENERAL MOTORS COMPANY

11. Remove Front Brake Caliper Springs (1) (Qty: 2)

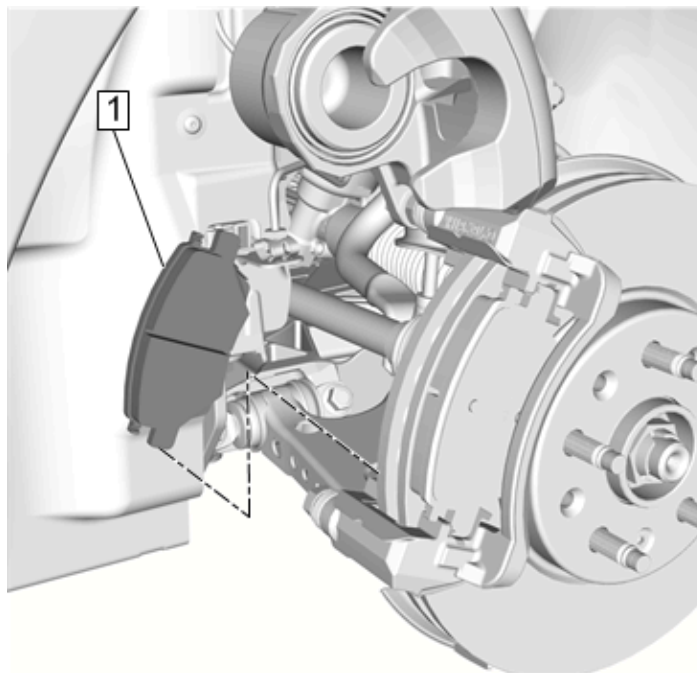


Fig. 16: Inner Disc Brake Pad

Courtesy of GENERAL MOTORS COMPANY

12. Remove Inner Disc Brake Pad (1)

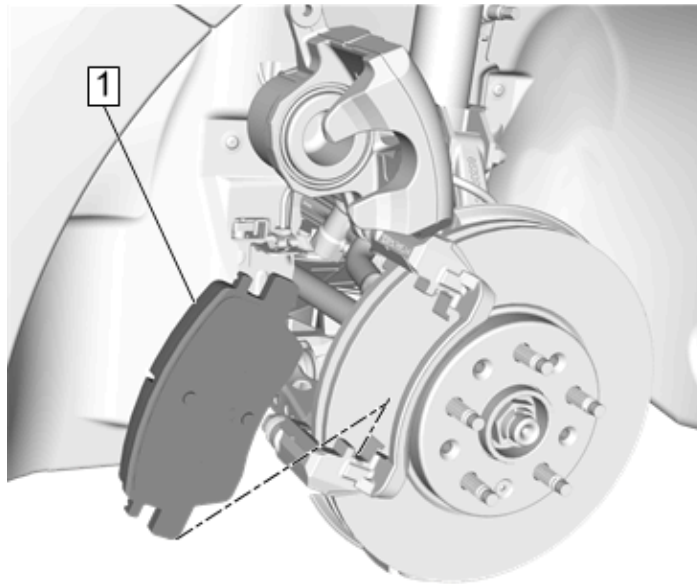


Fig. 17: Outer Disc Brake Pad

Courtesy of GENERAL MOTORS COMPANY

13. Remove Outer Disc Brake Pad (1)

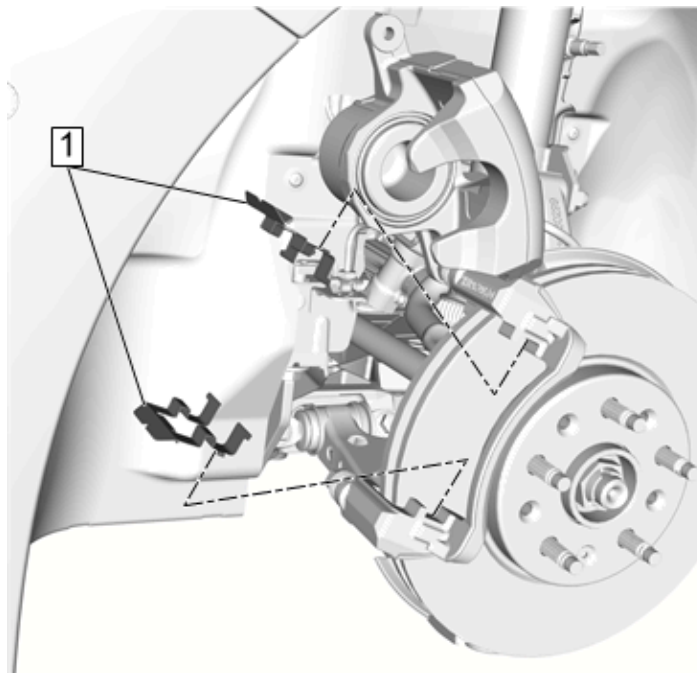


Fig. 18: Front Disc Brake Pad Retaining Springs

Courtesy of GENERAL MOTORS COMPANY

14. Remove Front Disc Brake Pad Retaining Springs (1) (Qty: 2)
15. Thoroughly clean the disc brake pad retaining spring contact area and mating surfaces of the brake caliper bracket of any corrosion and debris.
16. Inspect the front brake caliper guide pins for freedom of movement and inspect the condition of the guide pin boots.

17. Move the brake caliper guide pins inboard and outboard within the brake caliper bracket guide pin bores, without disengaging the guide pins from the guide pin boots, and observe for the following conditions:
- Restricted brake caliper guide pin movement
 - Looseness in the brake caliper bracket guide pin bores
 - Seized or binding brake caliper guide pins
 - Split, torn, or otherwise damaged brake caliper guide pin boots
18. If any of the conditions listed are found, the brake caliper guide pins and/or brake caliper guide pin boots require replacement.

Installation Procedure

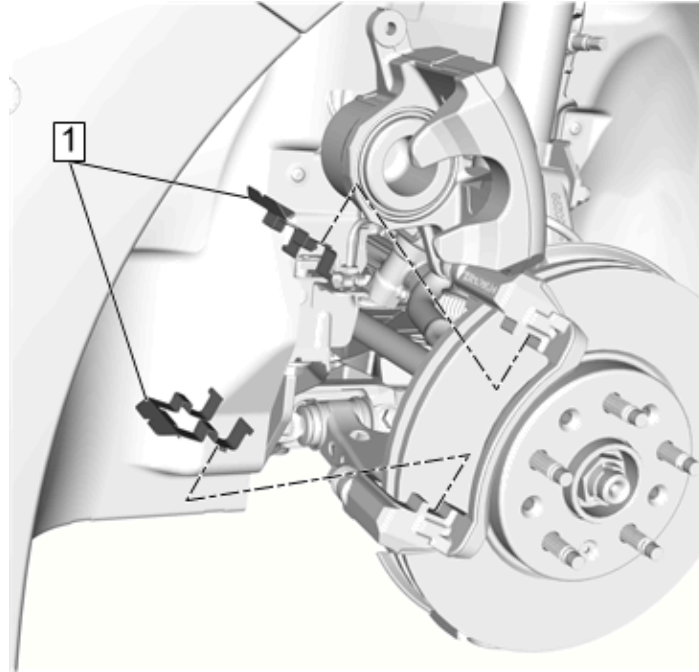


Fig. 19: Front Disc Brake Pad Retaining Springs
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Disc Brake Pad Retaining Springs (1) (Qty: 2)

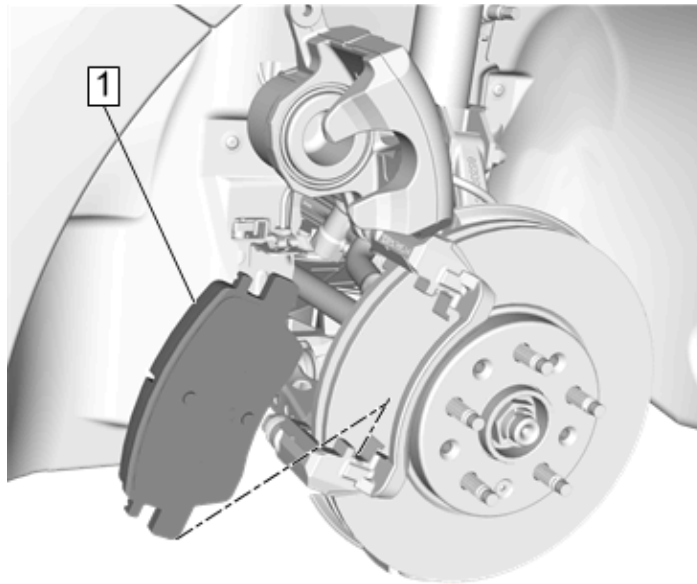


Fig. 20: Outer Disc Brake Pad

Courtesy of GENERAL MOTORS COMPANY

2. Install Outer Disc Brake Pad (1)

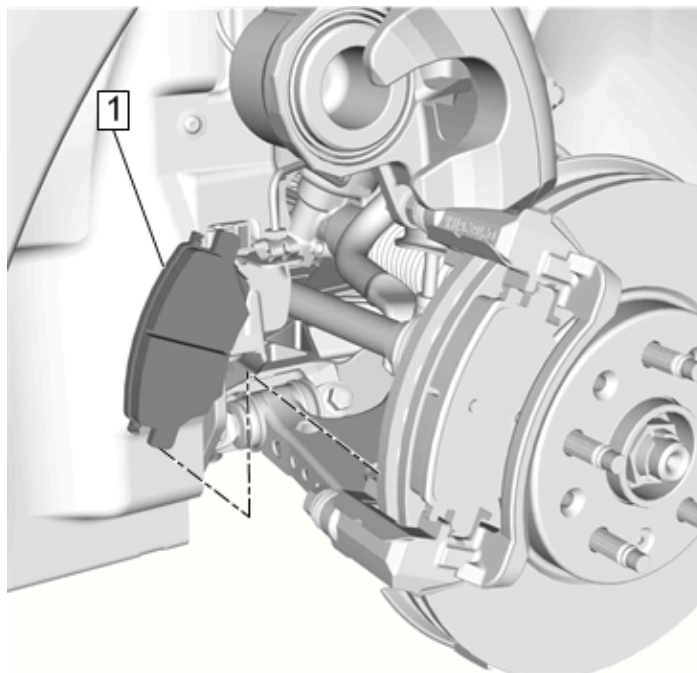


Fig. 21: Inner Disc Brake Pad

Courtesy of GENERAL MOTORS COMPANY

NOTE: The inner disc brake pad must be positioned with the wear sensor at the disc brake pad leading edge.

3. Install Inner Disc Brake Pad (1)

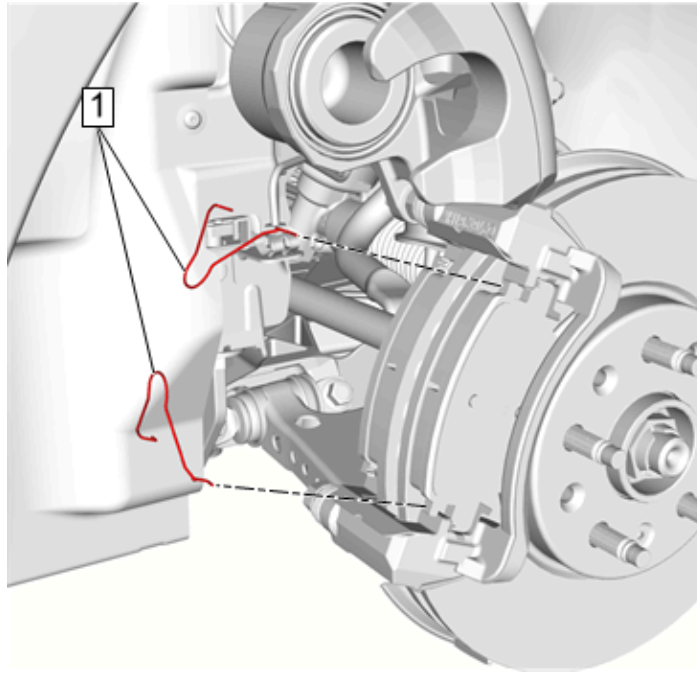


Fig. 22: Front Brake Caliper Springs

Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Caliper Springs (1) (Qty: 2)

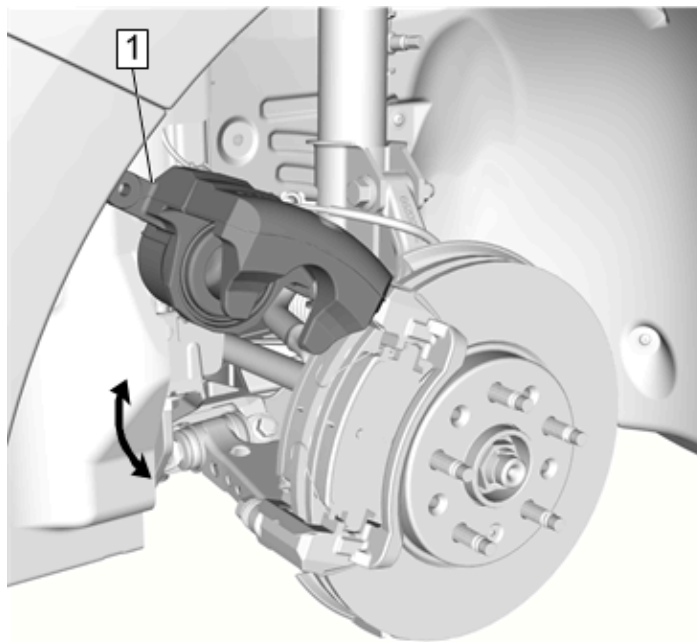


Fig. 23: Front Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The phenolic brake caliper piston can be damaged if it contacts the edges of the brake pads upon installation. To avoid phenolic brake caliper piston damage, carefully hold the brake pads against the rotor and do NOT allow the caliper piston to contact the edges of the brake pads while installing the caliper. If the brake caliper piston sustains any damage, the entire caliper will need to be replaced.

5. Install Front Brake Caliper (1)

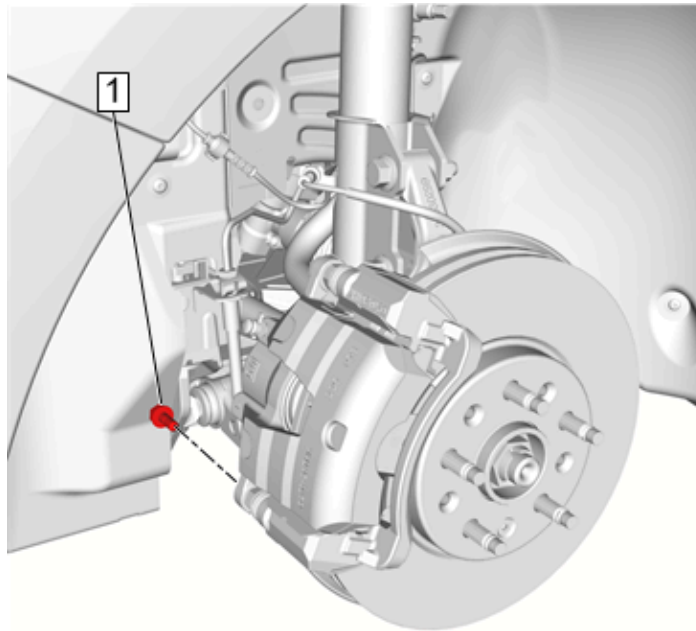


Fig. 24: Brake Caliper Guide Pin Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

NOTE: Install a NEW bolt.

6. Install and tighten NEW Brake Caliper Guide Pin Bolt (1) to 40 N.m (30 lb ft)
7. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
8. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
9. Slowly release the brake pedal.
10. Wait 15 seconds, then repeat steps 9-10 until a firm brake pedal is obtained. This will properly seat the brake caliper pistons and brake pads.
11. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)
12. Burnish the brake pads and rotors. Refer to [Brake Pad and Rotor Burnishing](#)

REAR DISC BRAKE PADS REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#)

WARNING: Refer to [Brake Fluid Irritant Warning](#)

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#)

NOTE: Always replace disc brake pads in axle sets.

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Set the parking brake in service mode. With Scan Tool.
 1. Connect the scan tool.
 2. Ignition ON, engine OFF.
 3. Select Electronic Brake Control Module.
 4. Select Control Functions.

NOTE: Do not apply any brake pressure during the following step.

5. Select Rear Brake Caliper Piston Retract.
5. Turn OFF the ignition.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

6. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
7. Remove the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

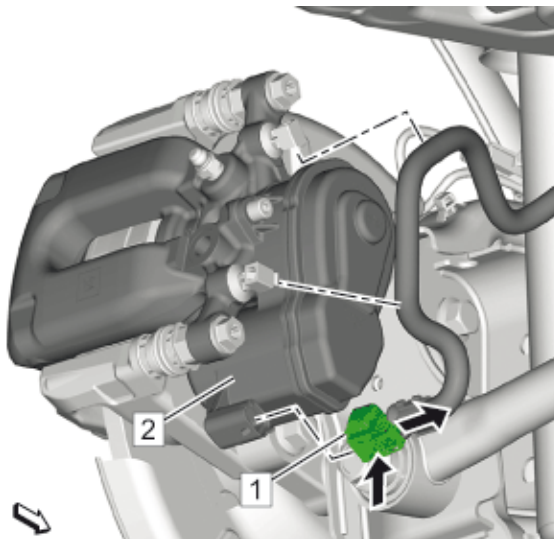


Fig. 25: Brake Caliper And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Electrical Connector (1)
9. Remove Wiring Harness @ Brake Caliper (2)

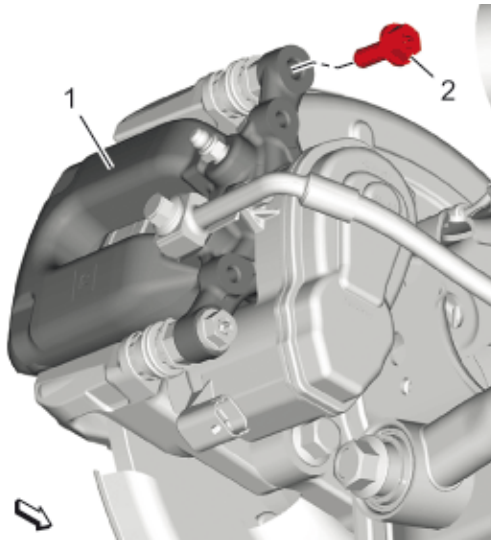


Fig. 26: Brake Caliper And Guide Pin Bolt
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

- NOTE:**
- Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.
 - Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

10. Remove and DISCARD Brake Caliper Guide Pin Bolt (2)

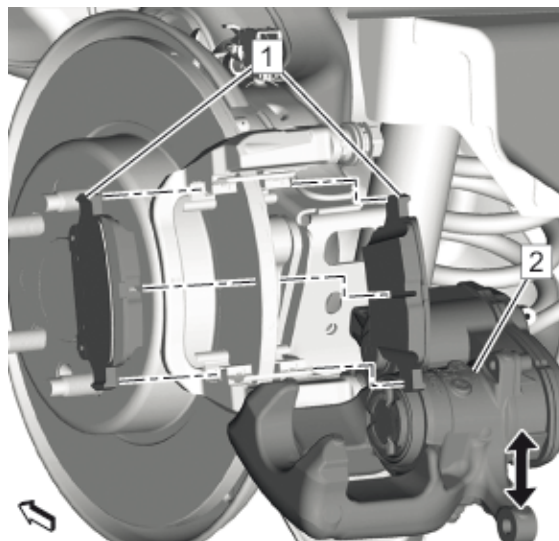


Fig. 27: Rear Brake Caliper And Rear Disc Brake Pads
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible

brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

11. Without disconnecting the hydraulic brake flexible hose, pivot the rear brake caliper (2) downward and secure with heavy mechanics wire, or equivalent.
12. Remove Rear Disc Brake Pads (1) (Qty: 2)

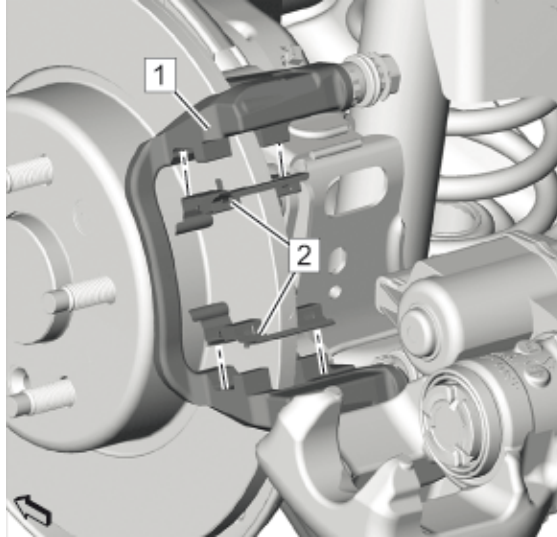


Fig. 28: Rear Brake Caliper Bracket And Brake Pad Springs
Courtesy of GENERAL MOTORS COMPANY

NOTE: If installing NEW brake pads, DISCARD the springs.

13. Remove Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)
14. Thoroughly clean the brake pad hardware mating surfaces of the caliper bracket of any debris and corrosion.
15. Inspect the rear brake caliper guide pins for freedom of movement and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots.
16. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

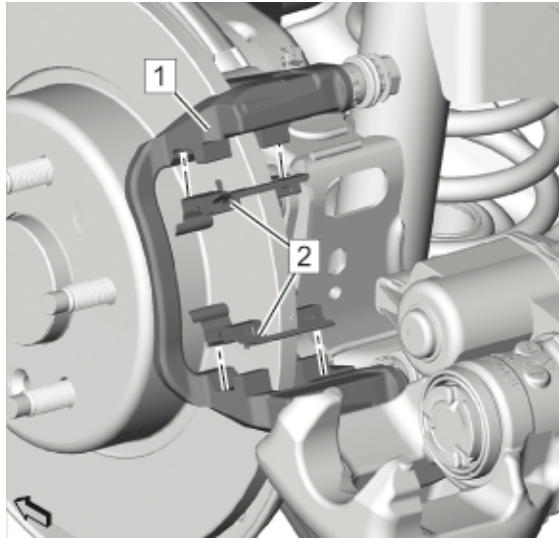


Fig. 29: Rear Brake Caliper Bracket And Brake Pad Springs

Courtesy of GENERAL MOTORS COMPANY

1. Ensure the brake pad hardware mating surfaces are clean.

NOTE: If installing new brake pads, install new brake pad springs.

2. Install Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)

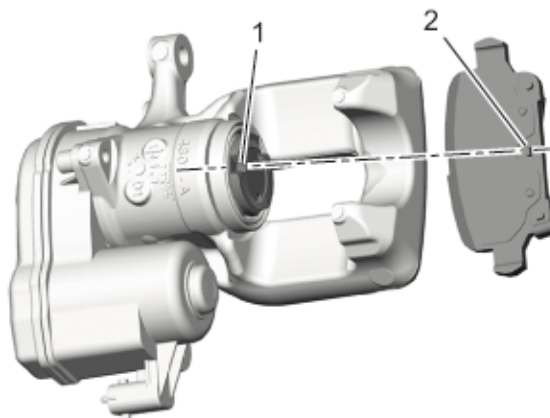


Fig. 30: Inner Brake Pad Nose And Piston Slot

Courtesy of GENERAL MOTORS COMPANY

3. Ensure the brake caliper piston slots are aligned vertically and the inner brake pad nose (2) fits into the piston slot (1).

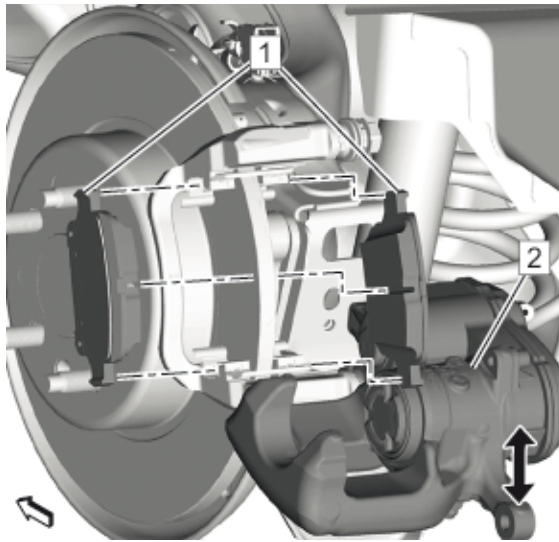


Fig. 31: Rear Brake Caliper And Rear Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: The disc brake pad equipped with wear sensor has to be mounted in lower position on the inner side of the rotor.

4. Install Rear Disc Brake Pads (1) (Qty: 2) @ Rear Brake Caliper Bracket

NOTE: Do not rotate the brake caliper piston.

5. Push the brake caliper piston into the brake caliper housing. Use a suitable tool.

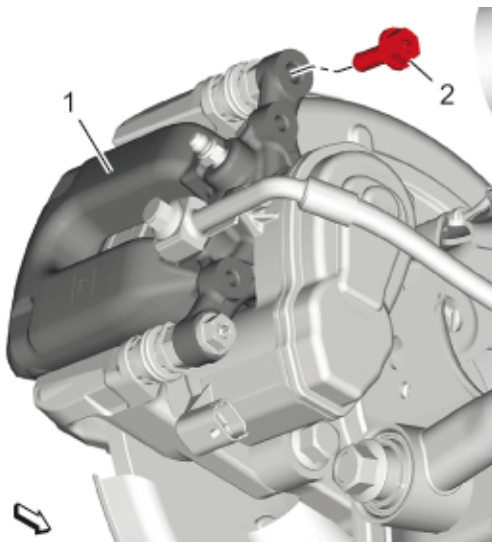


Fig. 32: Brake Caliper And Guide Pin Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Remove the support, and rotate the rear brake caliper (1) into position over the disc brake pads and to the caliper mounting bracket.

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.

7. Install the NEW upper rear brake caliper guide pin bolt (2) and tighten to 36 N.m (27 lb ft). Counter the hex flange on the rear brake caliper bracket using a suitable wrench.

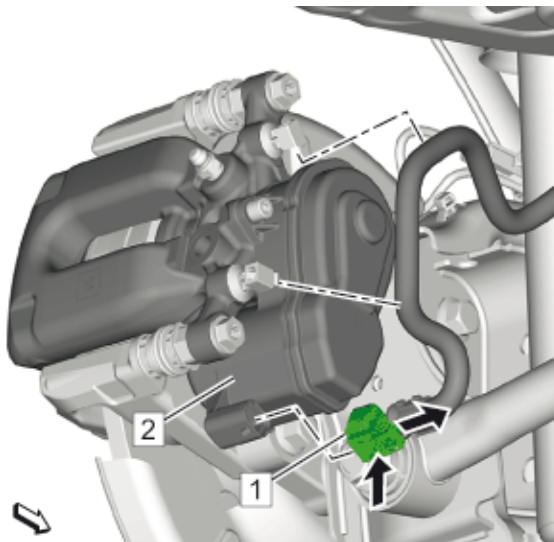


Fig. 33: Brake Caliper And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Install Wiring Harness @ Brake Caliper (2)
9. Connect Electrical Connector (1)
10. Install the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
11. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
12. Slowly release the brake pedal.
13. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
14. Inspect the fluid level in the brake master cylinder reservoir.
15. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)
16. Perform Parking Brake Calibration. Refer to [Park Brake Calibration](#)
17. Burnish the brake pads and rotors. Refer to [Brake Pad and Rotor Burnishing](#)

BRAKE PAD AND ROTOR BURNISHING

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surfaces are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the disc brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

NOTE: Use care to avoid overheating the brakes while performing this step.

3. Using moderate to firm pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

FRONT BRAKE CALIPER REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#)

WARNING: Refer to [Brake Fluid Irritant Warning](#)

WARNING: Use of eye goggles is necessary to prevent personal injury.

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#)

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .

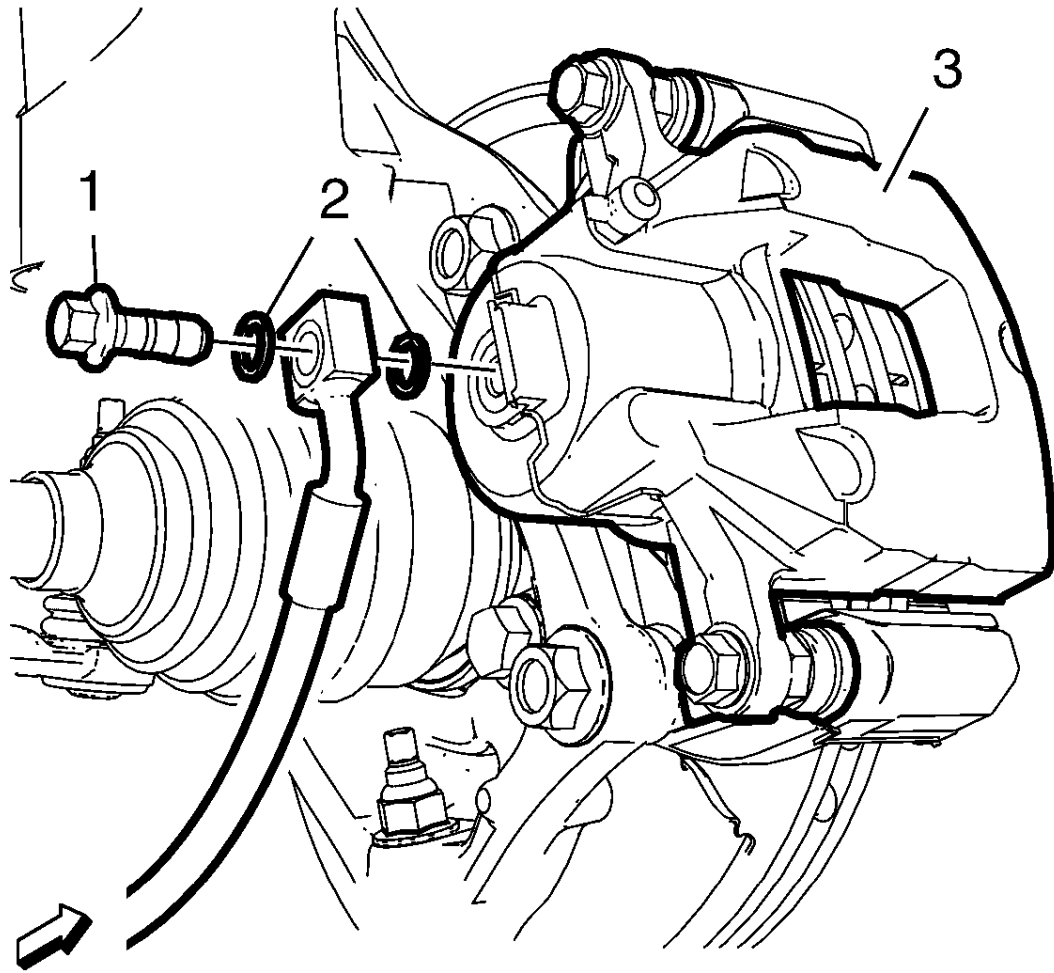


Fig. 34: Brake Hose Fitting Bolt, Sealing Washers And Front Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

3. Remove Brake Hose Fitting Bolt (1) @ Front Brake Caliper (3)
4. Remove Brake Hose @ Front Brake Caliper (3)
5. Cap the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.
6. Remove and DISCARD Sealing Washer (2) @ Front Brake Caliper
7. Remove and DISCARD Sealing Washer (2) @ Brake Hose

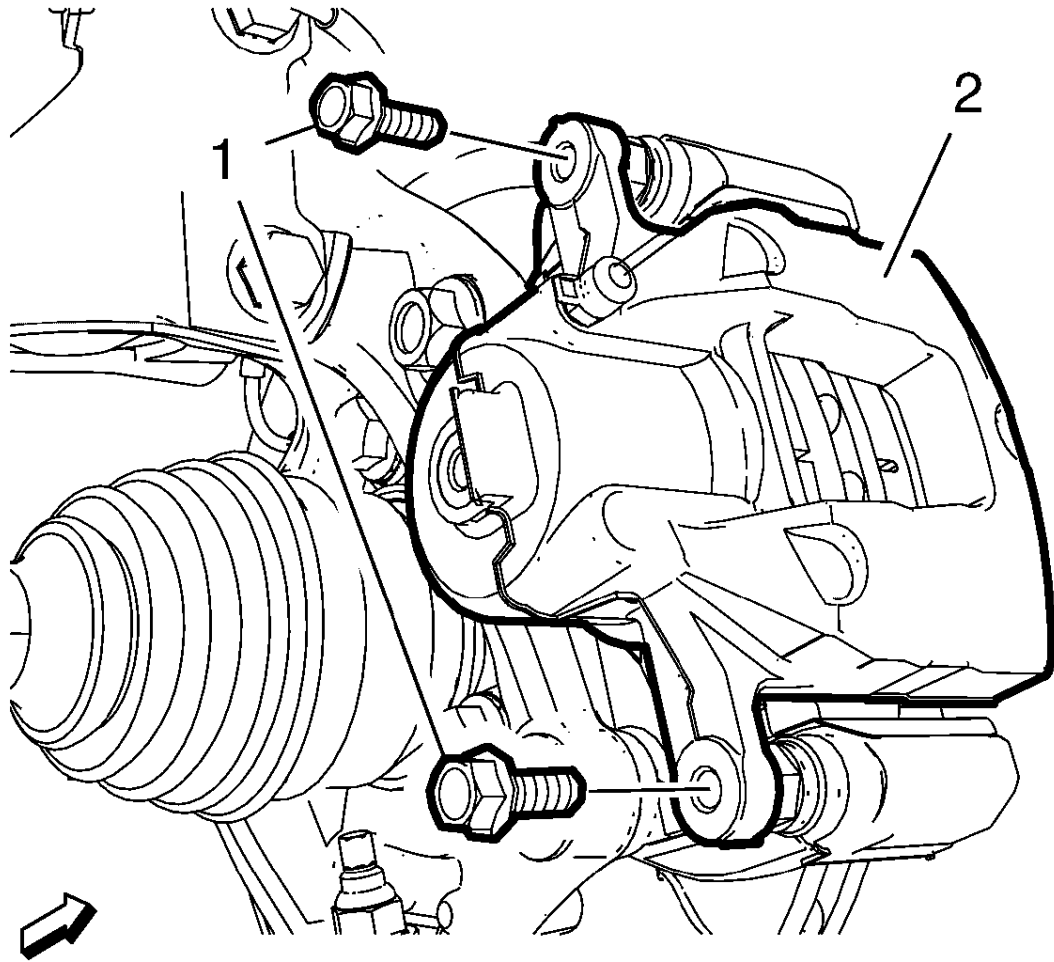


Fig. 35: Brake Caliper Guide Pin Bolts And Front Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2)
9. Remove Front Brake Caliper (2)

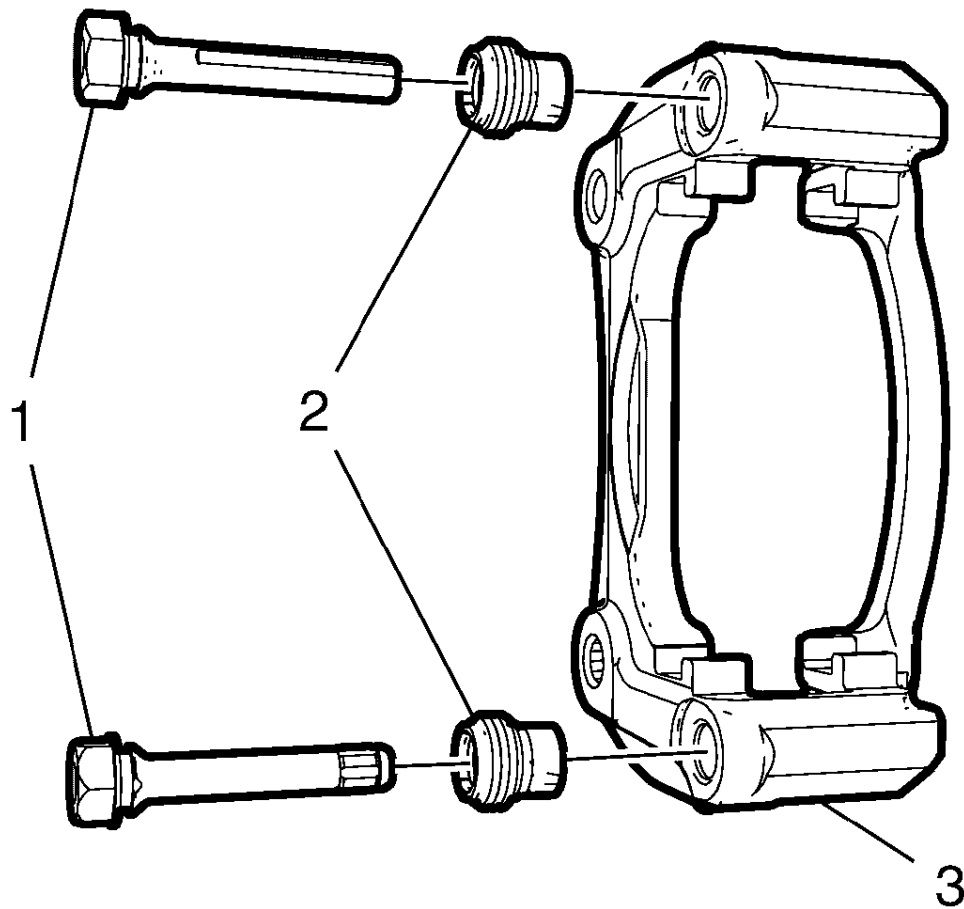


Fig. 36: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

10. Inspect the brake caliper guide pins (1) for freedom of movement, and inspect the condition of the guide pin boots (2). Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots
11. If a condition exists - Replace damaged components.

Installation Procedure

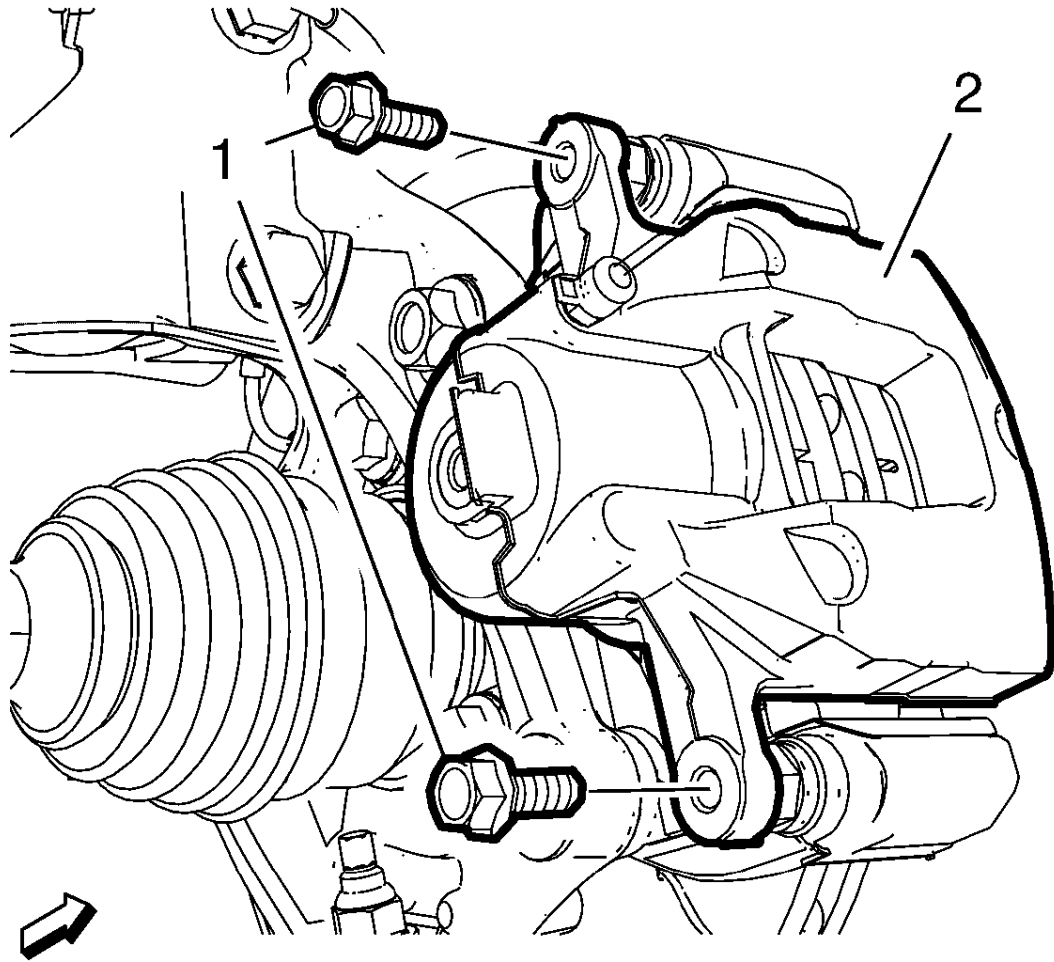


Fig. 37: Brake Caliper Guide Pin Bolts And Front Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Caliper (2)

CAUTION: Fastener Caution

2. Install and tighten Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2) to 40 N.m (30 lb ft)

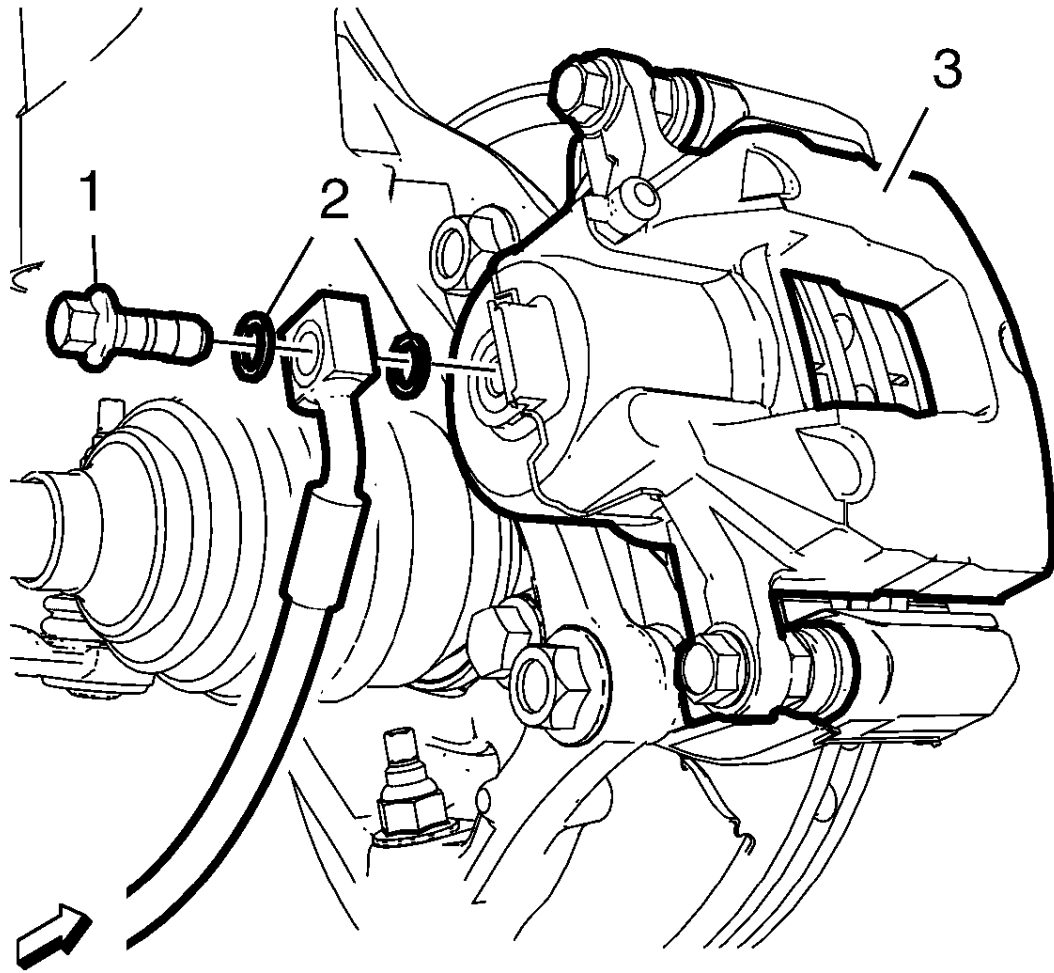


Fig. 38: Brake Hose Fitting Bolt, Sealing Washers And Front Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

3. Install NEW Sealing Washers (2) (Qty: 2) Install a NEW seal.
4. Remove the caps from the brake caliper opening and the brake hose.
5. Install Brake Hose @ Front Brake Caliper (3)
6. Install and tighten Brake Hose Fitting Bolt (1) @ Front Brake Caliper (3) to 40 N.m (30 lb ft)
7. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
8. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .
9. Remove the support and lower the vehicle.
10. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then repeat step 11 and 12 until a firm brake pedal is obtained.

REAR BRAKE CALIPER REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#)

WARNING: Refer to [Brake Fluid Irritant Warning](#)

WARNING: Use of eye goggles is necessary to prevent personal injury.

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#)

1. Set the parking brake in service mode.
 1. Connect the scan tool.
 2. Ignition ON, engine OFF.
 3. Select "Electronic Brake Control Module".
 4. Select "Control Functions".

NOTE: Do not apply any brake pressure during the following step.

5. Select "Rear Brake Caliper Piston Retract".
2. Turn OFF the ignition.
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
4. Remove the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

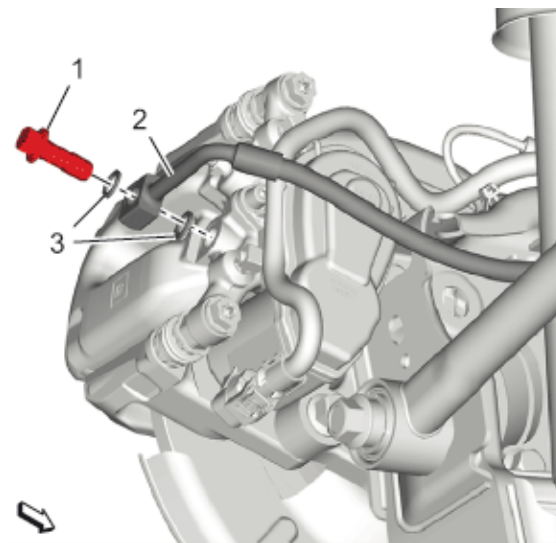


Fig. 39: Brake Hose, Fitting Bolt And Sealing Washers
Courtesy of GENERAL MOTORS COMPANY

5. Remove Brake Hose Fitting Bolt (1) @ Rear Brake Caliper
6. Remove Brake Hose (2) @ Rear Brake Caliper
7. Cap the brake hose fitting to prevent brake fluid loss and contamination.
8. DISCARD the brake hose fitting gaskets. (3) (Qty: 2)

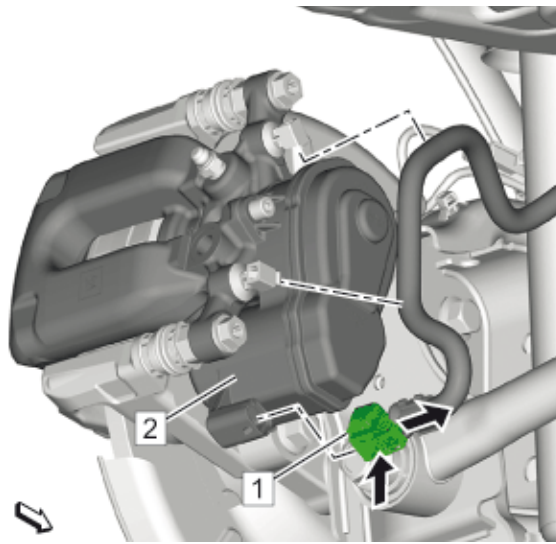


Fig. 40: Brake Caliper And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the electrical connector (1) and remove the wiring harness from the brake caliper assembly (2).

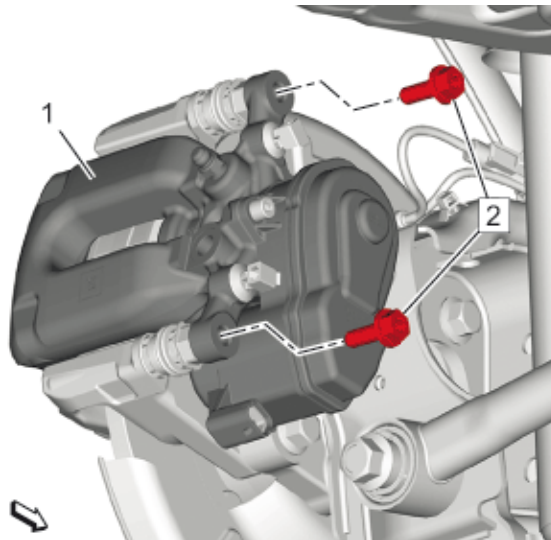


Fig. 41: Rear Brake Caliper And Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

- 10. Remove Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1)
- 11. Remove Rear Brake Caliper

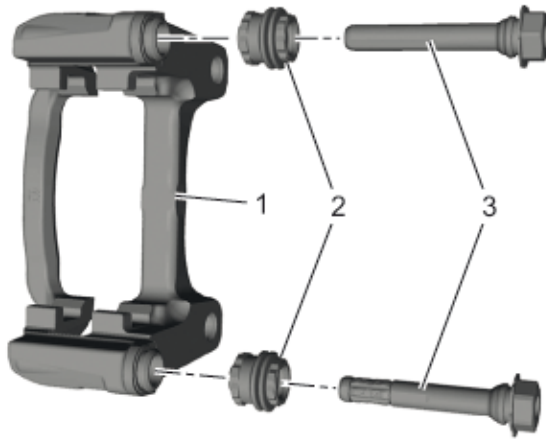


Fig. 42: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

12. Inspect the brake caliper guide pins (3) for freedom of movement, and inspect the condition of the guide pin boots (2). Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins
 - Split or torn boots
13. If a condition exists - Replace damaged components.
14. Remove Rear Parking Brake Actuator. Refer to [Rear Parking Brake Actuator Replacement](#)

Installation Procedure

1. Install Rear Parking Brake Actuator. Refer to [Rear Parking Brake Actuator Replacement](#)

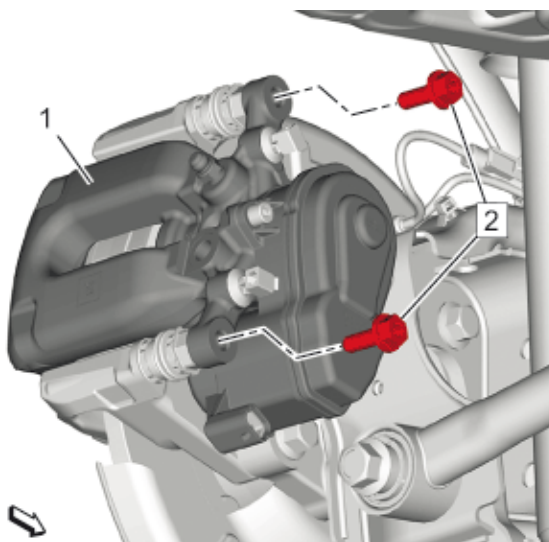


Fig. 43: Rear Brake Caliper And Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install Rear Brake Caliper (1)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Do not rotate the brake caliper piston.

3. Install and tighten Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper to 36 N.m (27 lb ft)

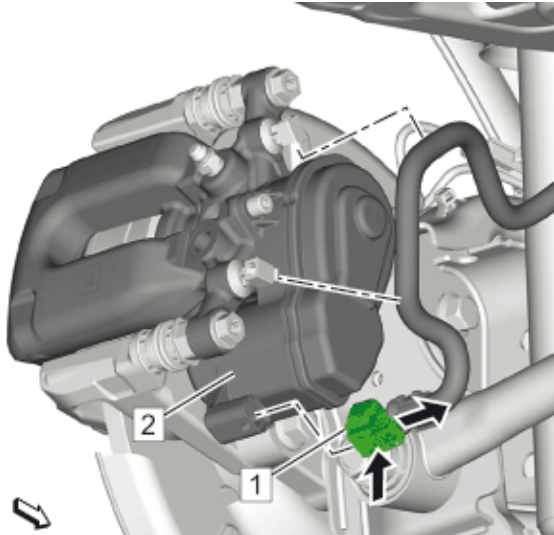


Fig. 44: Brake Caliper And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector (1) and fix the wiring harness with 2 cable straps to the brake caliper assembly (2).

5. Remove the caps from the brake caliper opening and the brake hose.

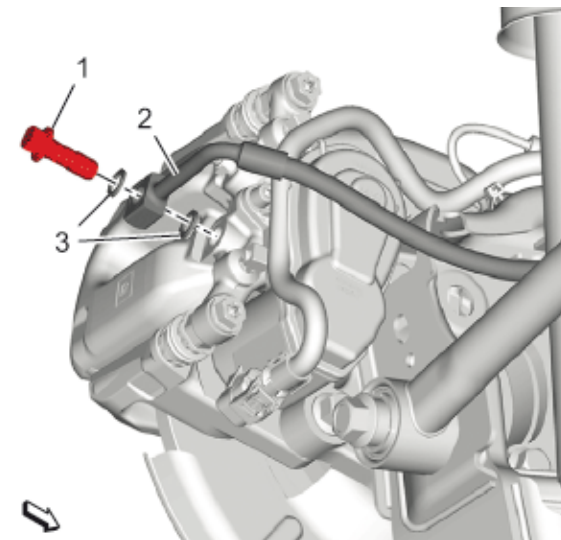


Fig. 45: Brake Hose, Fitting Bolt And Sealing Washers

Courtesy of GENERAL MOTORS COMPANY

6. Install NEW brake hose fitting gaskets. (3) (Qty: 2)

7. Install and tighten Brake Hose Fitting Bolt (1) @ Rear Brake Caliper to 40 N.m (30 lb ft)

8. Bleed the brake system. Refer to [Hydraulic Brake System Bleeding](#)
9. Install the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .
10. Remove the support and lower the vehicle.
11. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
12. Slowly release the brake pedal.
13. Wait 15 seconds, then repeat step 10 and 11 until a firm brake pedal is obtained.
14. Calibrate the park brake. Refer to [Park Brake Calibration](#) .

REAR BRAKE CALIPER GUIDE PIN REPLACEMENT

Removal Procedure

1. Remove the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

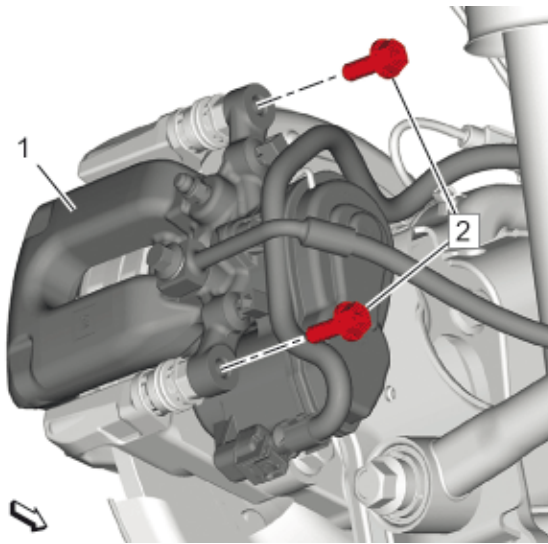


Fig. 46: Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

2. Remove Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1)
3. Remove the brake caliper assembly and support with heavy mechanics wire.

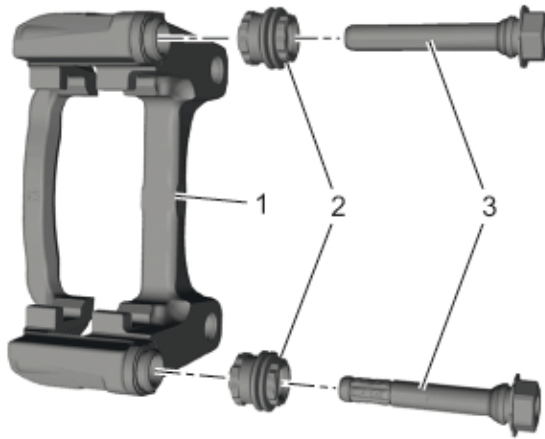


Fig. 47: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Brake Caliper Guide Pins (3) (Qty: 2)

Installation Procedure

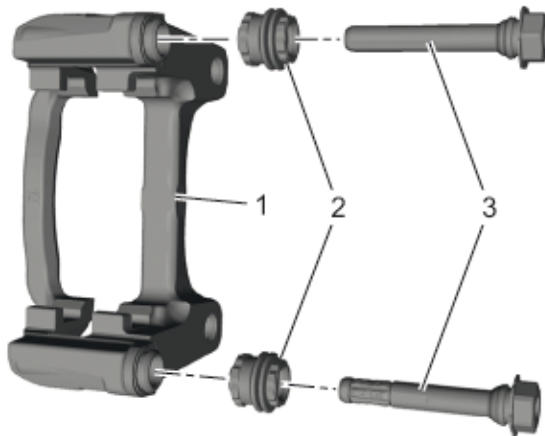


Fig. 48: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Apply a light coating of high temperature, silicone brake lubricant to the brake caliper bracket guide pin bores, the inner portion of the guide pin seals, and the brake caliper guide pins. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)
2. Install Rear Brake Caliper Guide Pins (3) (Qty: 2)
3. Inspect the brake caliper guide pins (3) for free movement, and inspect the condition of the guide pin boots (2). Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
 - Restricted caliper guide pin movement
 - Looseness in the brake caliper mounting bracket
 - Seized or binding caliper guide pins

- Split or torn boots

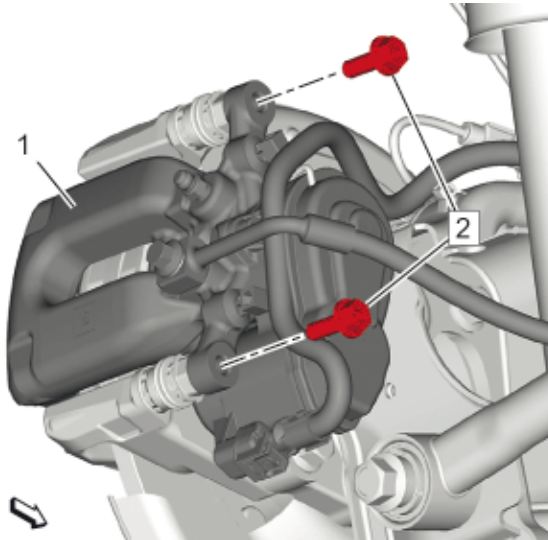


Fig. 49: Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

4. Install and tighten Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Front Brake Caliper (1) to 36 N.m (27 lb ft)
5. Install the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

FRONT BRAKE CALIPER OVERHAUL

Disassembly Procedure

WARNING: Refer to [Brake Dust Warning](#) .

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

WARNING: Use of eye goggles is necessary to prevent personal injury.

WARNING: Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.

CAUTION: Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.

1. Remove the brake caliper from the vehicle. Refer to [Front Brake Caliper Replacement](#).

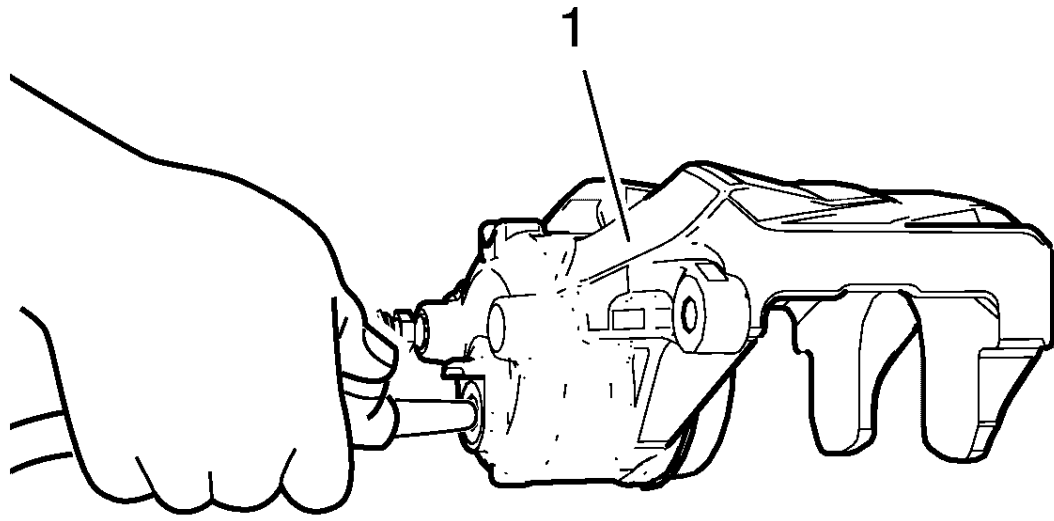


Fig. 50: Using Low Pressure Compressed Air To Remove Brake Caliper Piston
Courtesy of GENERAL MOTORS COMPANY

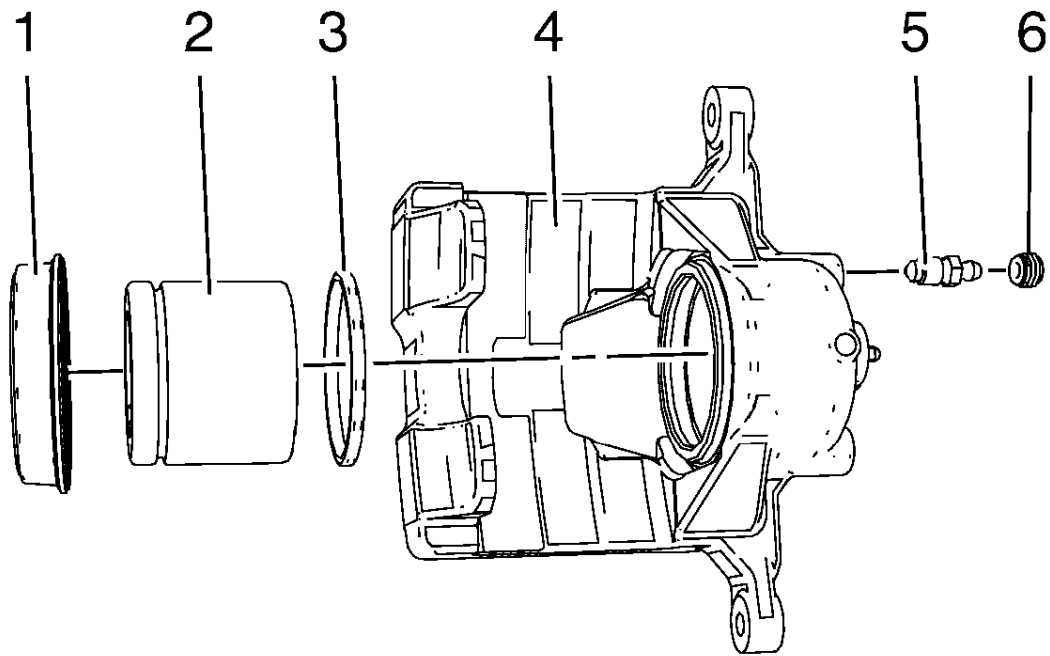


Fig. 51: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

2. Remove the brake caliper piston from the caliper bore by directing low pressure compressed air into the caliper (1) through the fluid inlet hole.
3. Remove the piston dust boot seal (1) from the seal counterbore in the caliper (4). Discard the boot seal.
4. Using a small wooden or plastic tool, remove the piston seal (3) from the caliper bore. Discard the piston seal.
5. Remove the bleeder valve cap (6).
6. Remove the bleeder valve (5).

NOTE: **Do not use abrasives to clean the brake caliper piston.**

7. If cracks, scoring, pitting, excessive rust, and/or excessive corrosion are present in the caliper bore, replace the caliper assembly.
8. If light rust or light corrosion are present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
9. Clean the brake caliper piston bore and seal counterbore, and the caliper piston with denatured alcohol, or equivalent.
10. Dry the caliper piston bore and counterbore, and the piston with non-lubricated, filtered, compressed air.

11. Inspect the caliper piston for cracks, scoring, and/or damage to the plating. Replace the caliper piston if any of these conditions exist.
12. Inspect the caliper mounting holes for cracks, scoring, pitting, rust and/or excessive corrosion. Replace the caliper assembly if any of these conditions exist.

Assembly Procedure

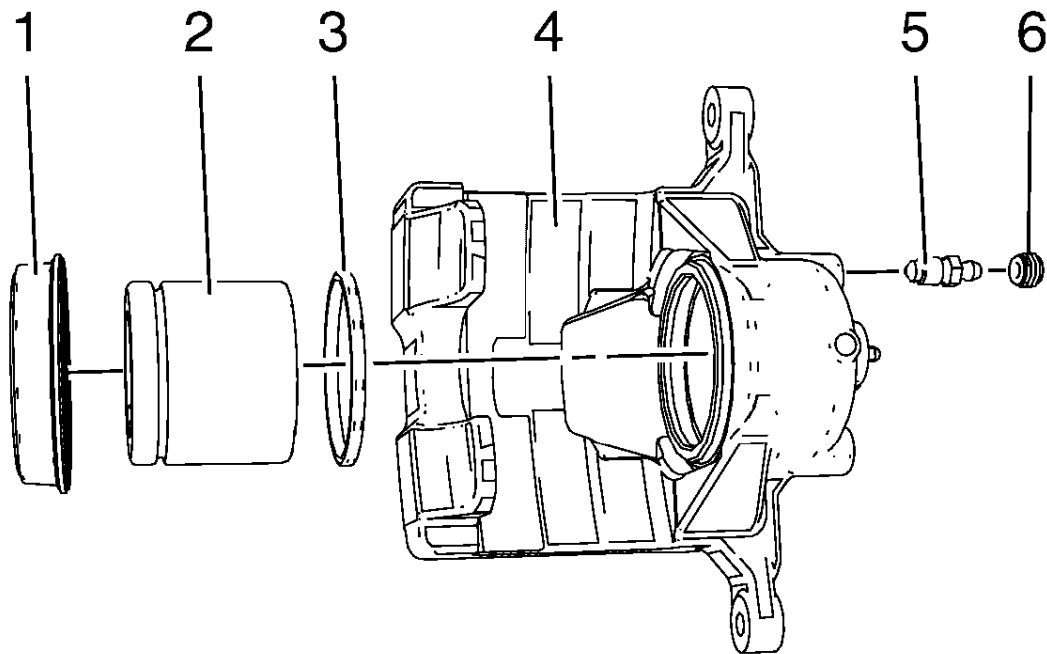


Fig. 52: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

1. Lubricate the new piston seal (3) with brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended brake fluid.
2. Install the lubricated, new piston seal into the caliper bore.

CAUTION: Refer to [Fastener Caution](#) .

3. Install the bleeder valve (5) to the caliper and tighten the valve to 10 N.m (88.508 lb in).
4. Install the bleeder valve cap (6).
5. Apply a thin coat of brake fluid from a clean, sealed brake fluid container to the brake caliper (4) bore. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended brake fluid.

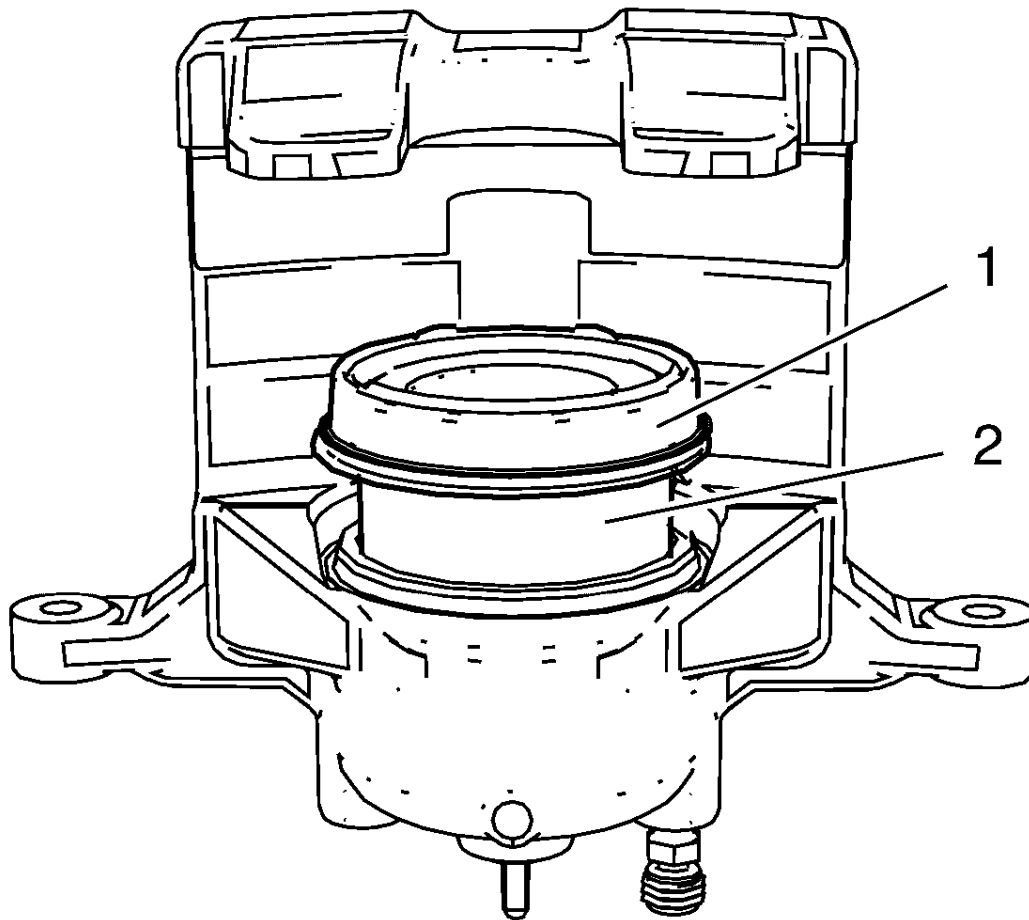


Fig. 53: Caliper Piston And Caliper Piston Dust Boot Seal

Courtesy of GENERAL MOTORS COMPANY

6. Install the new piston dust boot seal (1) over the caliper piston.
7. Install the bottom half of the caliper piston (2) into the caliper bore.
8. Compress the caliper piston to the bottom of the caliper bore.
9. Fully seat the piston dust boot seal into caliper counterbore.
10. Install the brake caliper to the vehicle. Refer to [Front Brake Caliper Replacement](#).

REAR BRAKE CALIPER MOUNT PLATE REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

2. Remove Rear Brake Rotor. Refer to [Rear Brake Rotor Replacement](#)
3. Remove Rear Wheel Speed Sensor. Refer to [Rear Wheel Speed Sensor Replacement](#)

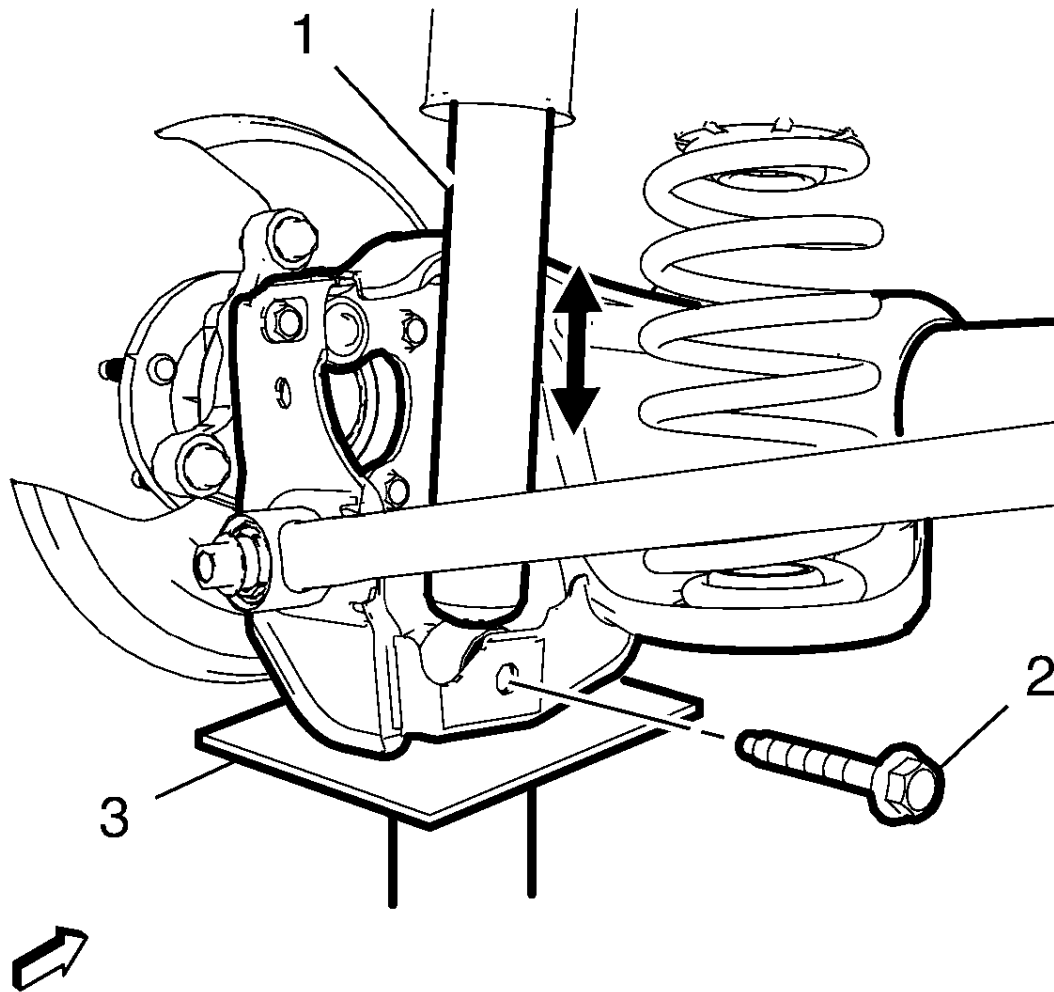


Fig. 54: Rear Shock Absorber, Bolt And Hydraulic Lift
Courtesy of GENERAL MOTORS COMPANY

4. Support the rear axle with a hydraulic lift table. (3)
5. Remove Rear Shock Absorber Bolt (2)
6. Push up to the shock absorber (1) gain access to the rear wheel bearing and hub bolts.

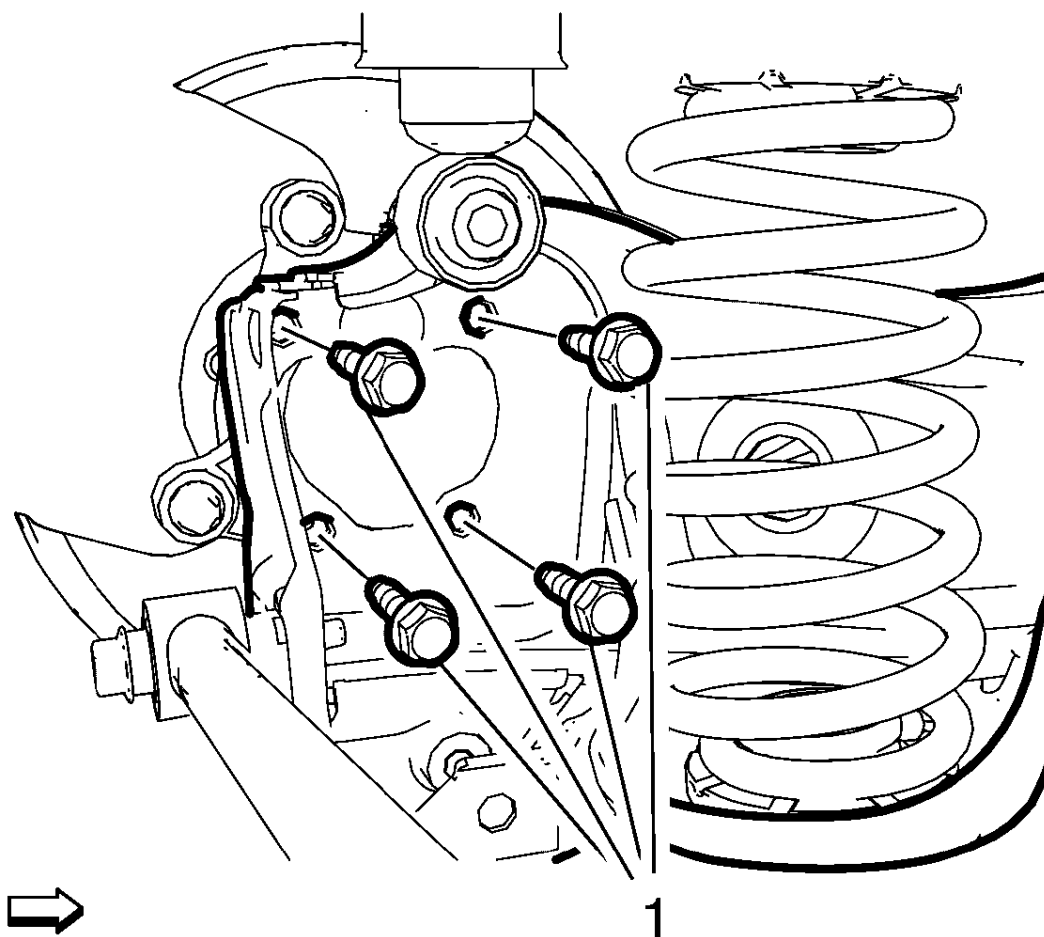


Fig. 55: Rear Wheel Bearing And Hub Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Remove Bolts (1) (Qty: 4)

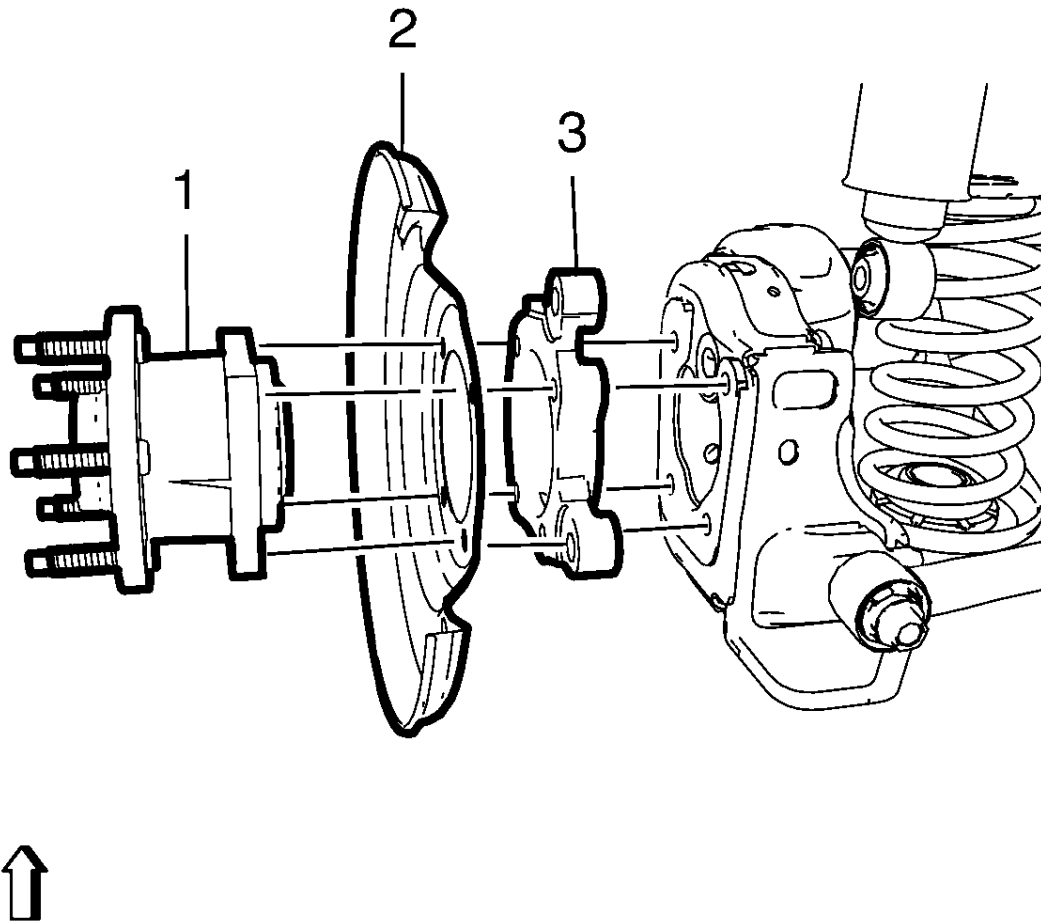


Fig. 56: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Wheel Bearing and Hub Assembly (1)
9. Remove the rear brake shield (2).
10. Remove the rear brake caliper mount plate (3).

Installation Procedure

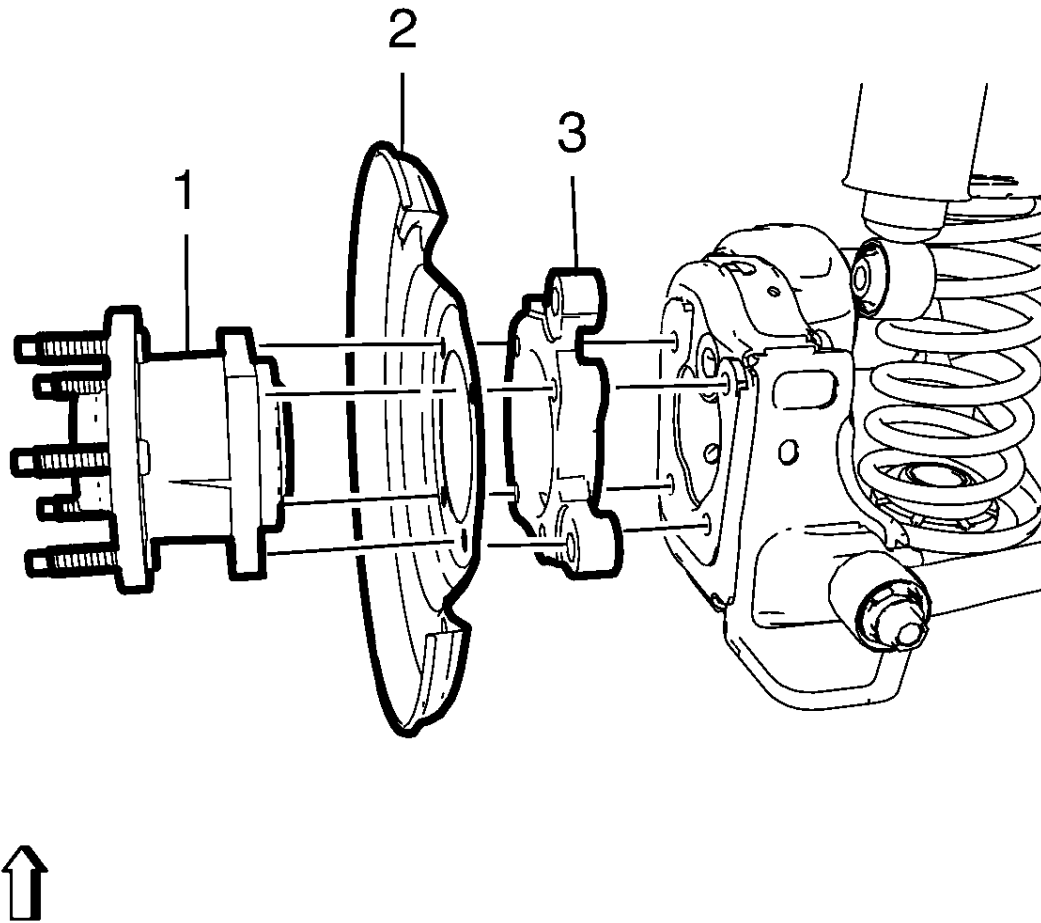


Fig. 57: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the rear brake caliper mount plate (3).
2. Install the rear brake shield (2).
3. Install Rear Wheel Bearing and Hub Assembly (1)

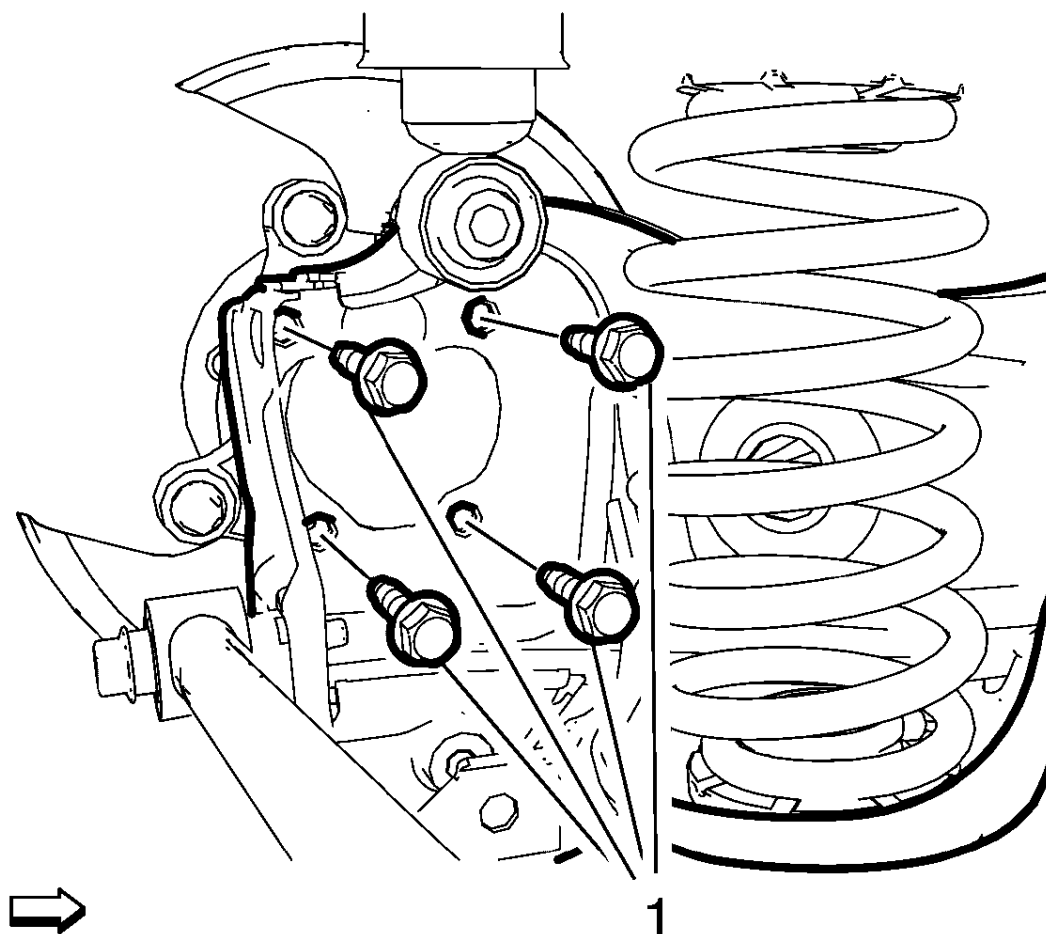


Fig. 58: Rear Wheel Bearing And Hub Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

4. Apply thread locking adhesive to the fasteners.
5. Install and tighten Bolts (1) (Qty: 4)
 1. First Pass: 50 N.m (37 lb ft).
 2. Final Pass: 30 - 45 degrees, use the **EN-45059** meter

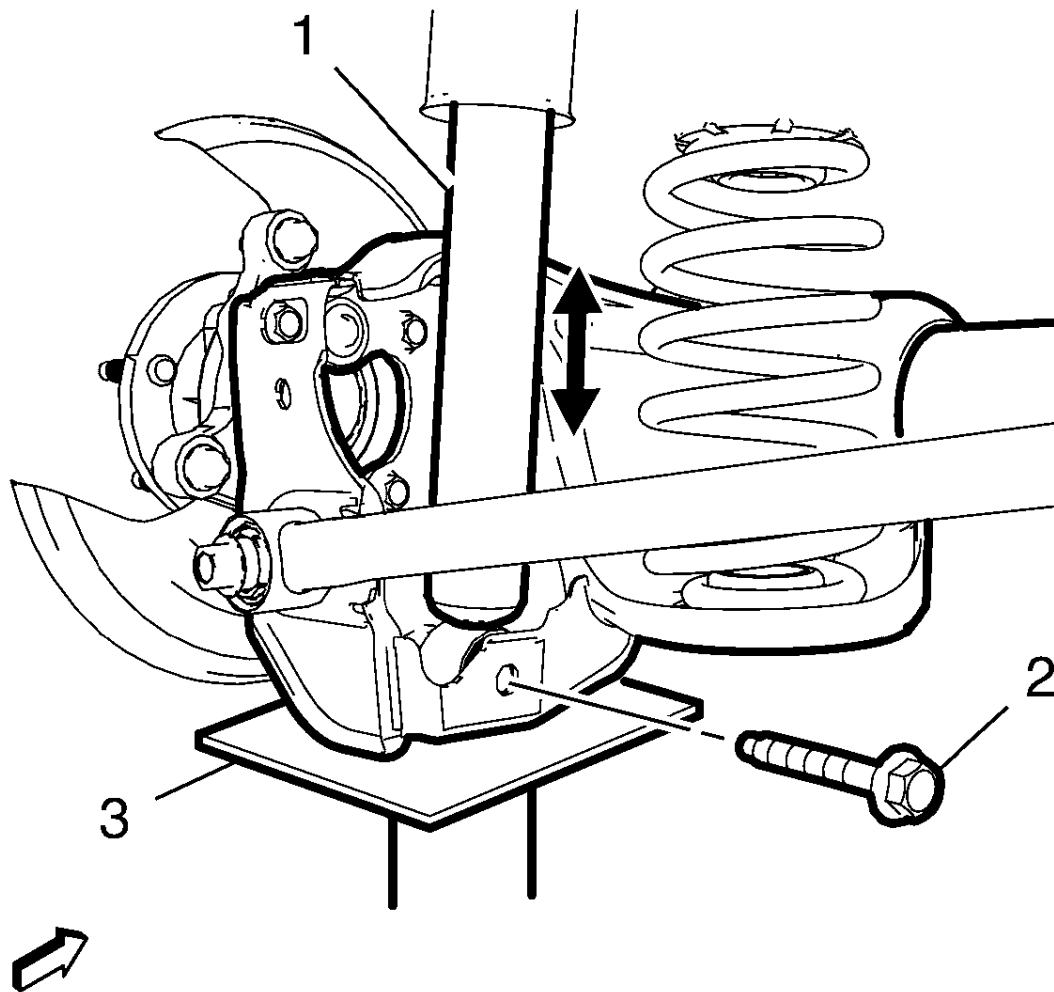


Fig. 59: Rear Shock Absorber, Bolt And Hydraulic Lift

Courtesy of GENERAL MOTORS COMPANY

NOTE: Service may offer bolts without micro-encapsulated thread locking adhesive. If this is the case, apply thread locking adhesive to the bolt.

6. Support the rear axle with a tall jack stand near the shock absorber.
7. Install, but do NOT tighten Rear Shock Absorber Bolt (2)
8. Install Rear Wheel Speed Sensor. Refer to [Rear Wheel Speed Sensor Replacement](#)
9. Install Rear Brake Rotor. Refer to [Rear Brake Rotor Replacement](#)
10. Install Tire and Wheel. Refer to [Tire and Wheel Removal and Installation](#)
11. Lower the vehicle.

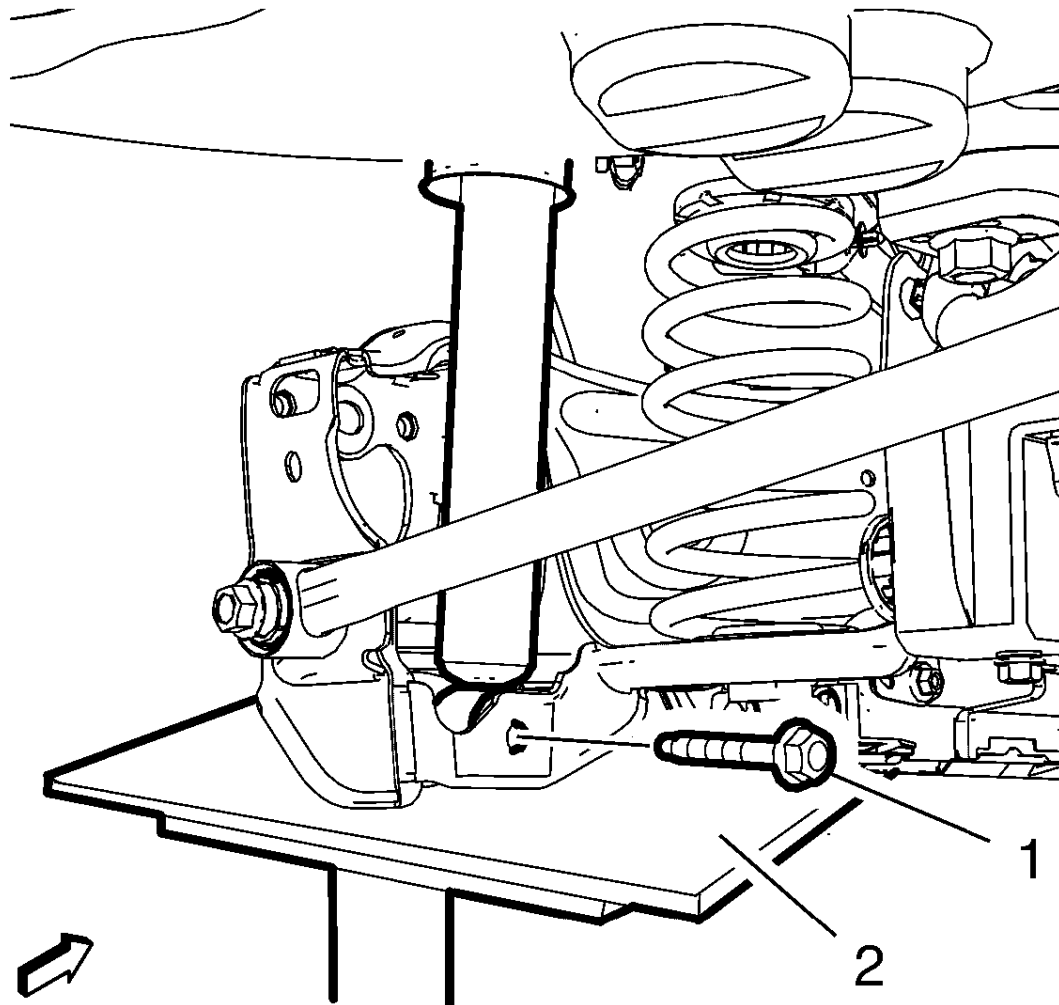


Fig. 60: Rear Shock Absorber Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the bolt with vehicle standing on the ground.

12. Tighten Rear Shock Absorber Bolt (1) to 100 N.m (74 lb ft)

FRONT BRAKE CALIPER HARDWARE REPLACEMENT

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Refer to [Brake Dust Warning](#)

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

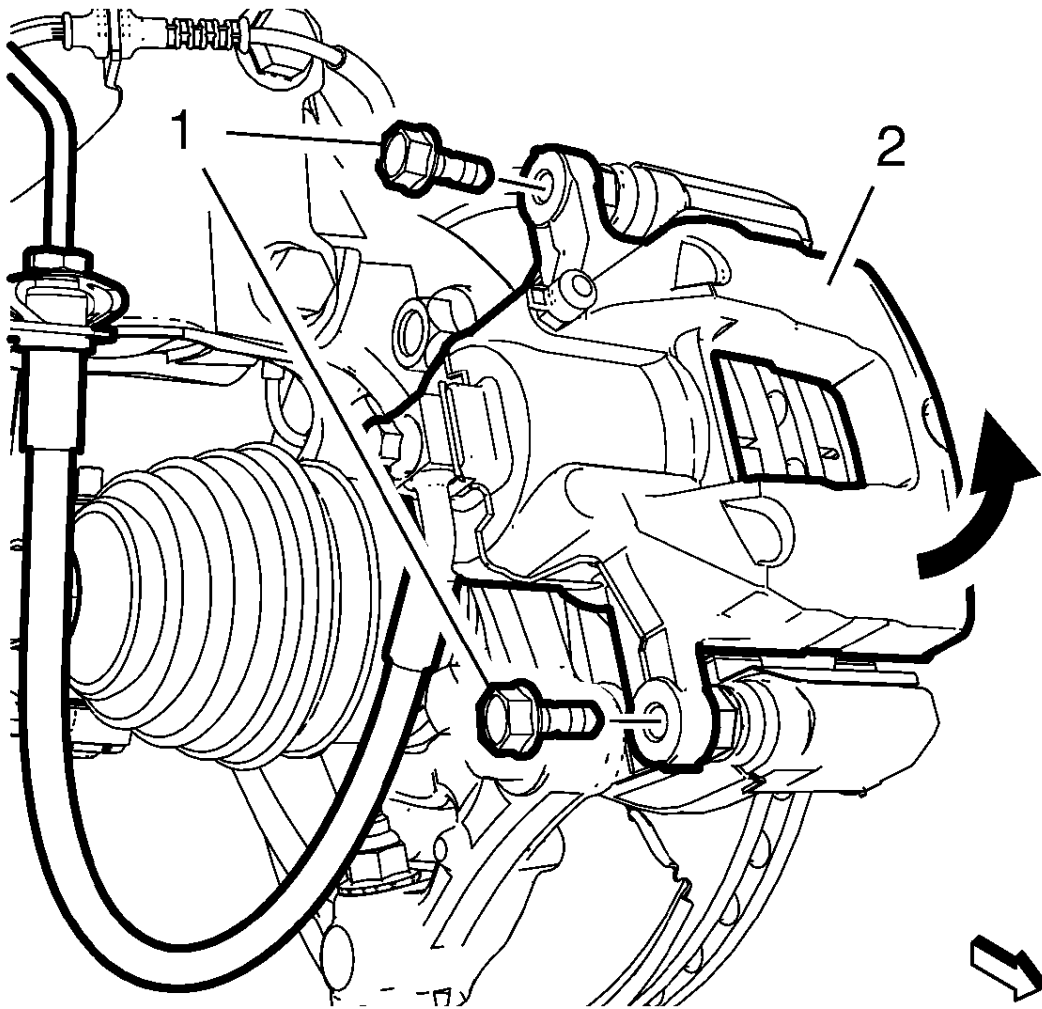


Fig. 61: Front Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

NOTE:

- Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Remove and DISCARD Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove Front Brake Caliper (2)

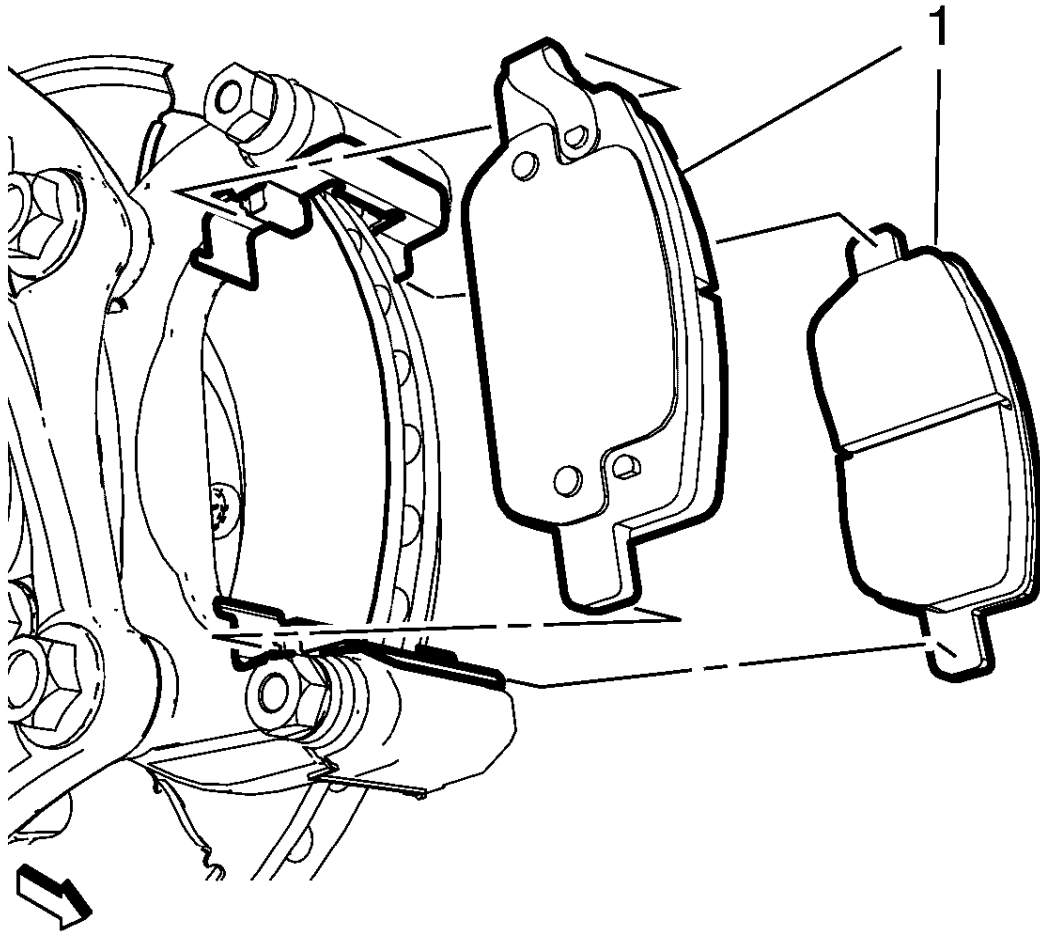


Fig. 62: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

5. Remove the disc brake pads. (1) (Qty: 2)

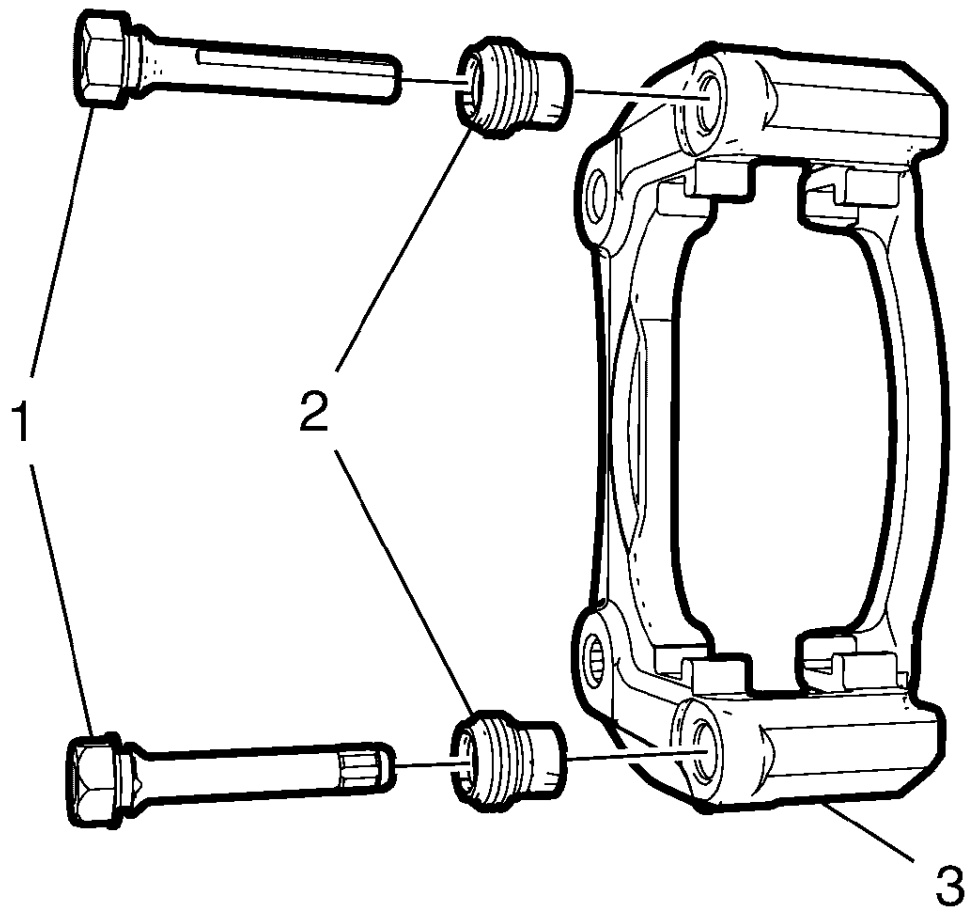


Fig. 63: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket

Courtesy of GENERAL MOTORS COMPANY

NOTE: The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.

6. Remove Front Brake Caliper Guide Pins (1) (Qty: 2) @ Front Brake Caliper Bracket (3)

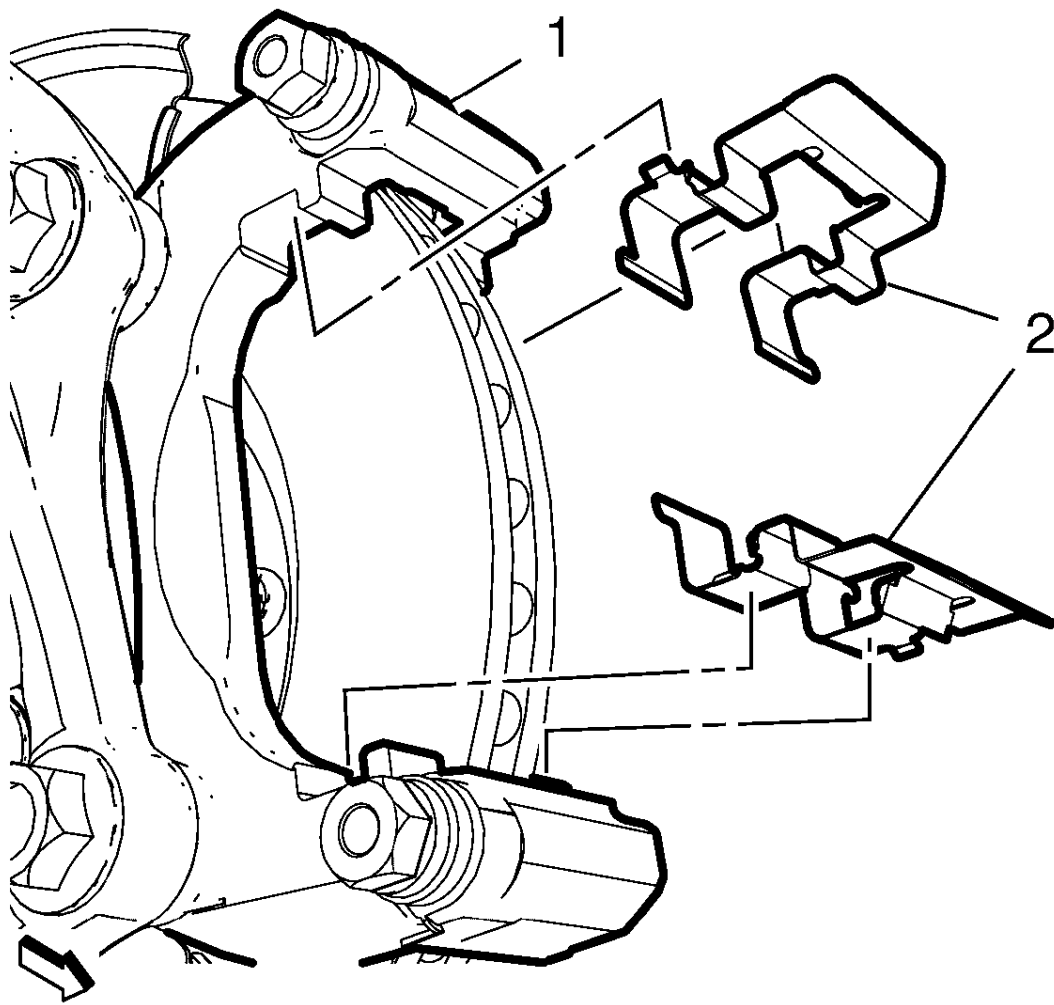


Fig. 64: Brake Pad Springs And Caliper Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Remove Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)

Installation Procedure

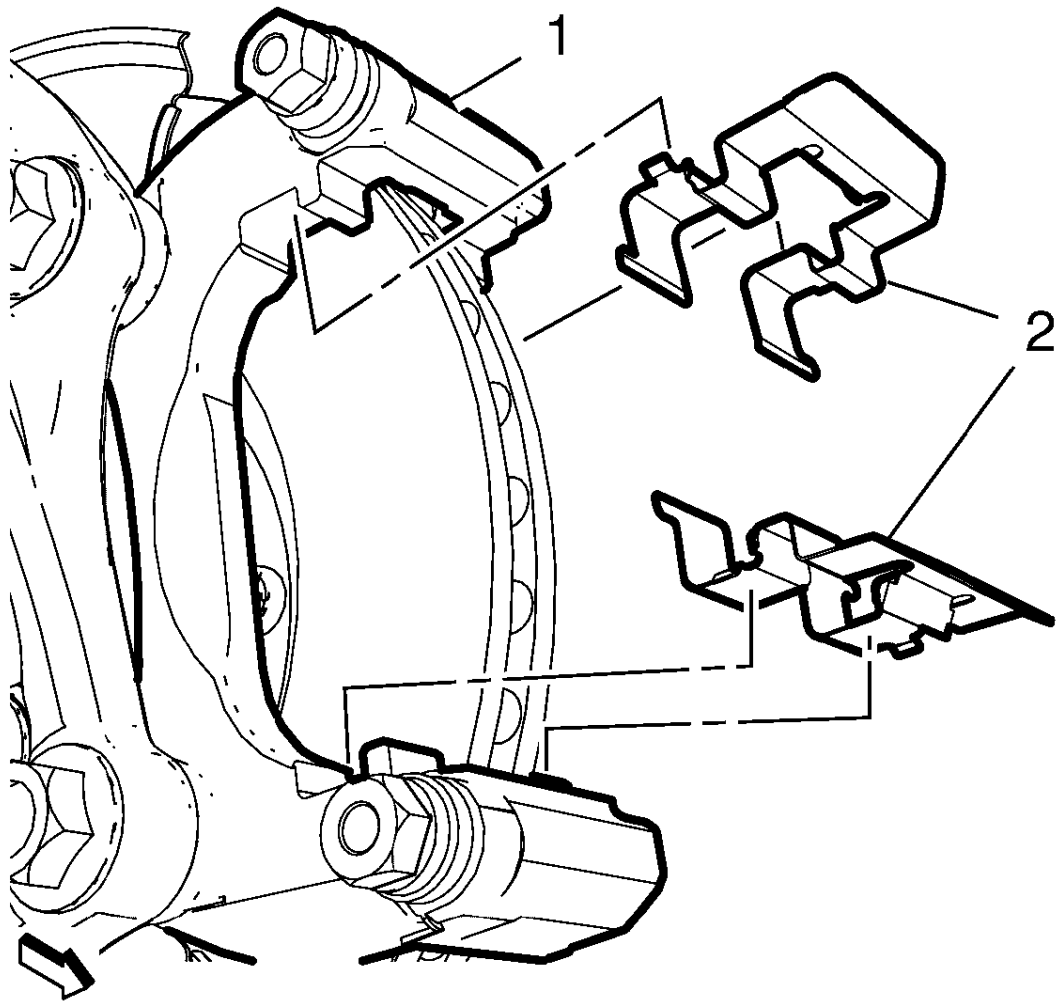


Fig. 65: Brake Pad Springs And Caliper Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)

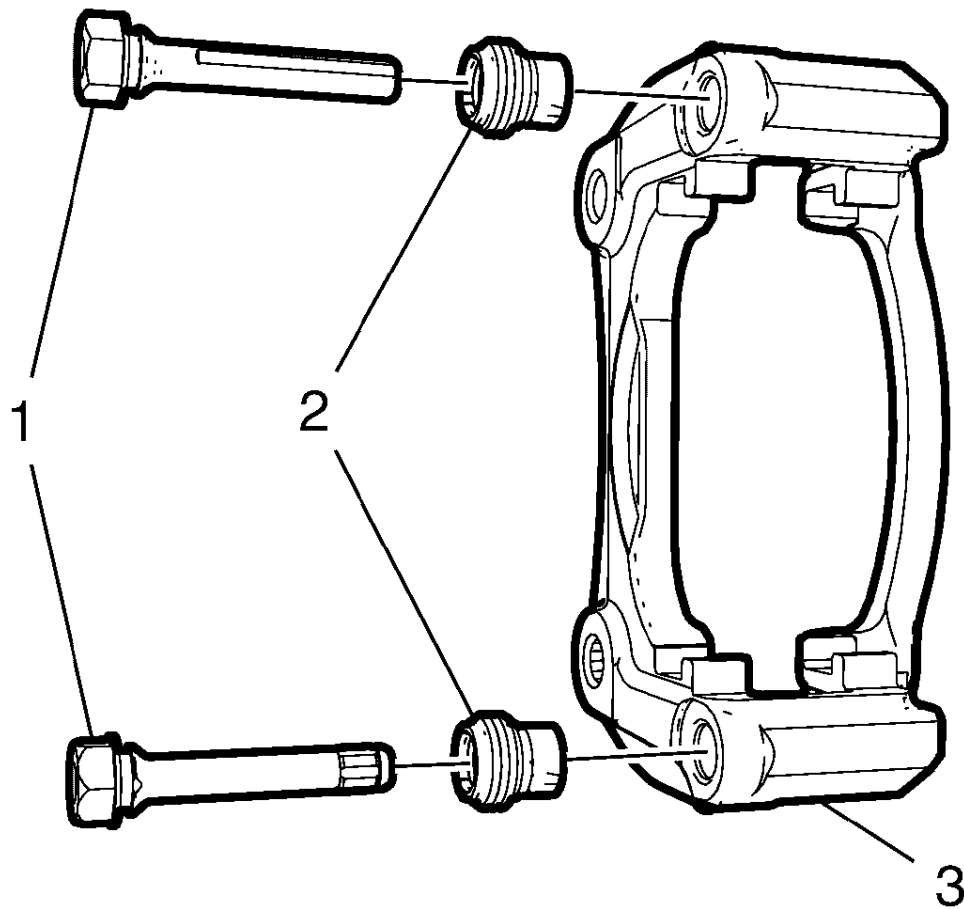


Fig. 66: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Seat the brake caliper guide pin seal in the groove of the brake caliper guide pin. (2)

NOTE: **The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.**

3. Install Front Brake Caliper Guide Pins (1) (Qty: 2) @ Front Brake Caliper Bracket (3)

4. Inspect the brake caliper guide pins (1) for freedom of movement, and inspect the condition of the guide pin boots (2). Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:

- Restricted caliper guide pin movement
- Looseness in the brake caliper mounting bracket
- Seized or binding caliper guide pins
- Split or torn boots

5. Ensure the brake caliper guide pin seal is fully seated in the groove of the brake caliper guide pin and the guide pin slides freely in caliper bracket bore.

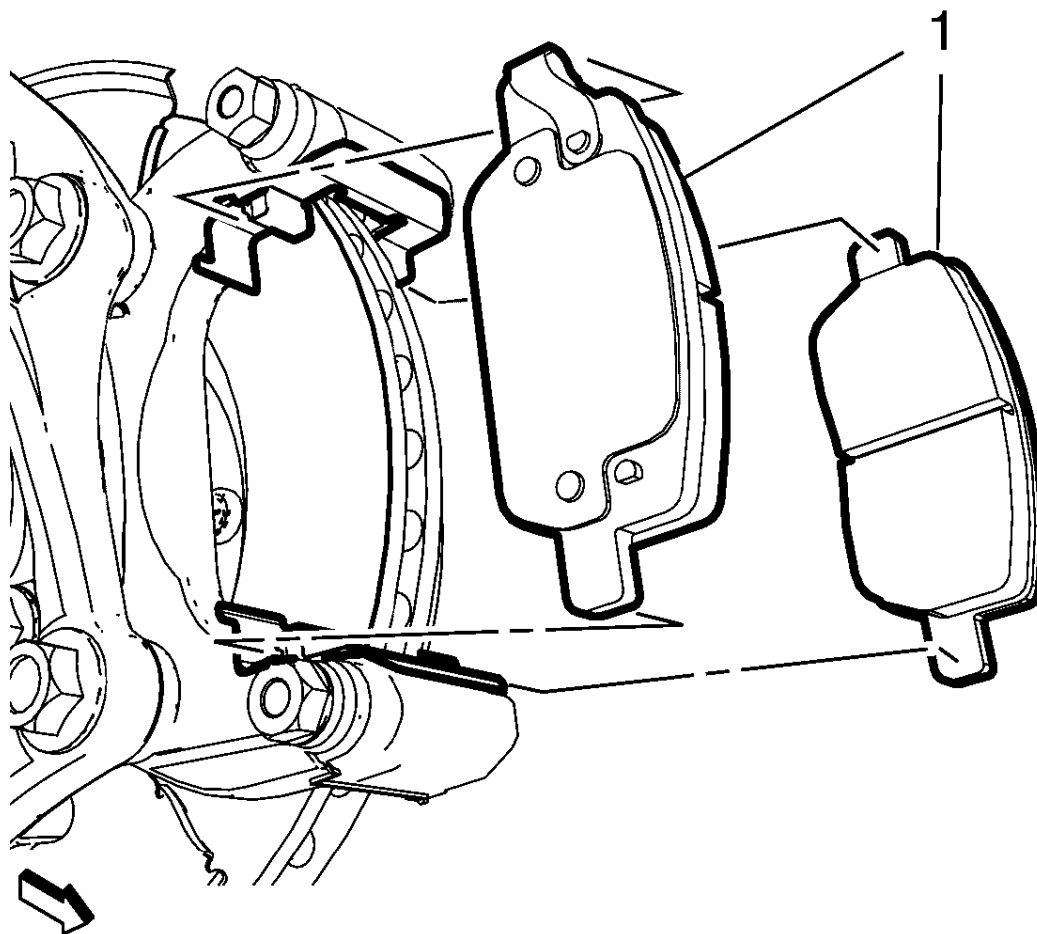


Fig. 67: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

6. Install the disc brake pads. (1) (Qty: 2)

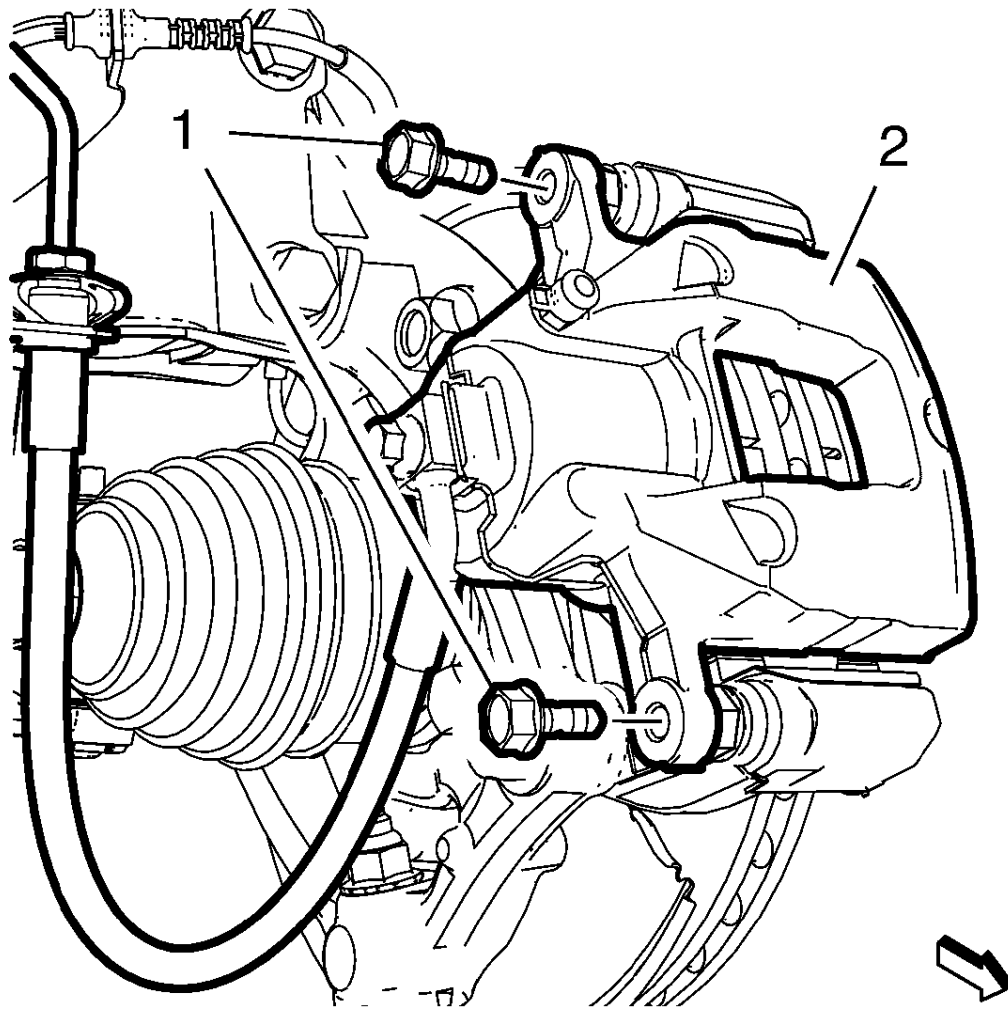


Fig. 68: Rear Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

7. Install Front Brake Caliper (2)

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.

8. Install NEW Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2) and tighten to 40 N.m (30 lb ft). Install NEW bolts.
9. Install Tire and Wheel. Refer to [Tire and Wheel Removal and Installation](#)

REAR BRAKE CALIPER HARDWARE REPLACEMENT

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle.

Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Refer to [Brake Dust Warning](#)

WARNING: Refer to [Brake Fluid Irritant Warning](#)

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)

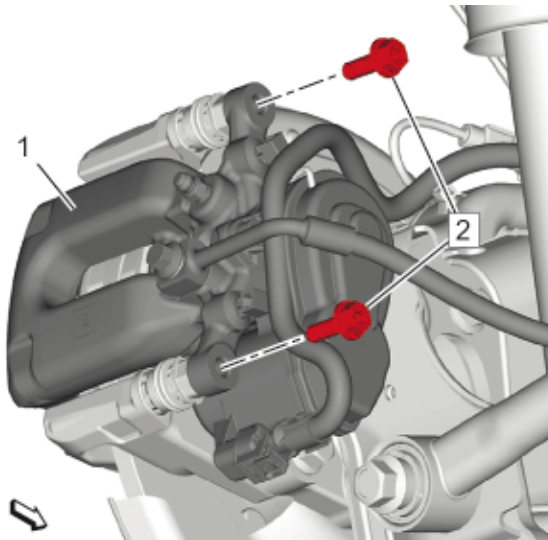


Fig. 69: Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

NOTE:

- Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Remove and DISCARD Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper assembly and support with heavy mechanics wire.

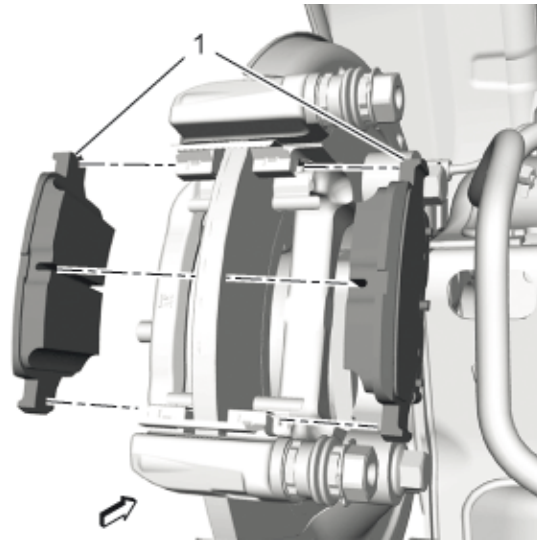


Fig. 70: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

5. Remove the disc brake pads. (1) (Qty: 2)

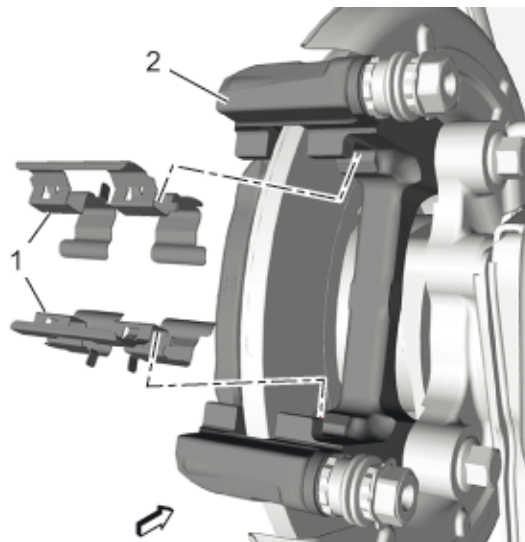


Fig. 71: Brake Caliper Bracket And Brake Pad Springs

Courtesy of GENERAL MOTORS COMPANY

6. Remove Brake Pad Springs (1) (Qty: 2) @ Brake Caliper Bracket (2)

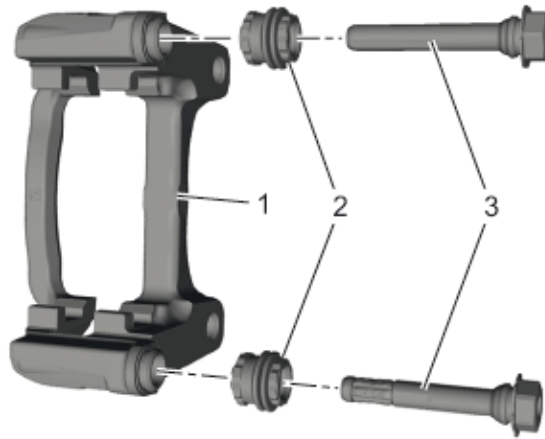


Fig. 72: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Seat the brake caliper guide pin seal in the groove of the brake caliper guide pin. (2) (Qty: 2)

NOTE: **The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.**

8. Install Rear Brake Caliper Guide Pins (3) (Qty: 2)

NOTE: **If reusing the brake caliper guide pins (3) and the guide pin seals (2). Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:**

- Restricted caliper guide pin movement
- Looseness in the brake caliper mounting bracket
- Seized or binding caliper guide pins
- Split or torn boots

9. Ensure the brake caliper guide pin seal is fully seated in the groove of the brake caliper guide pin and the guide pin slides freely in caliper bracket bore.

Installation Procedure

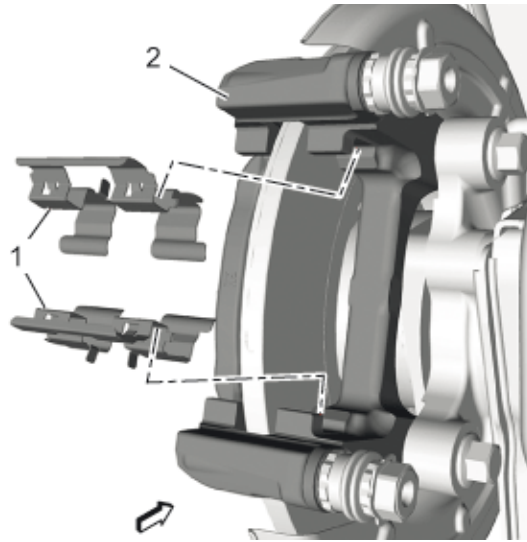


Fig. 73: Brake Caliper Bracket And Brake Pad Springs

Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pad Springs (1) (Qty: 2) @ Brake Caliper Bracket (2)

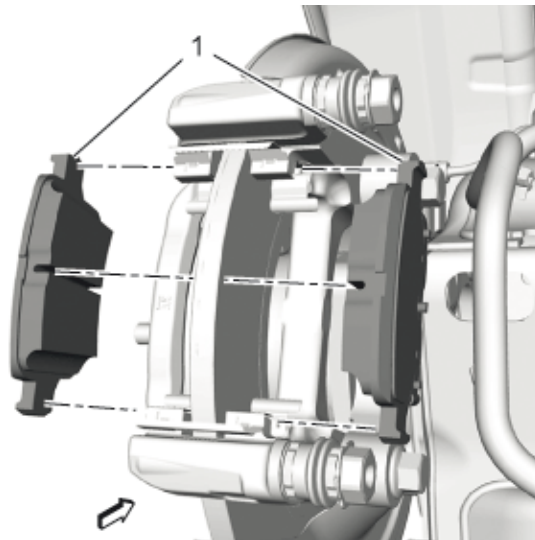


Fig. 74: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: The disc brake pad equipped with wear sensor has to be mounted in lower position on the inner side of the rotor.

2. Install the disc brake pads. (1) (Qty: 2)

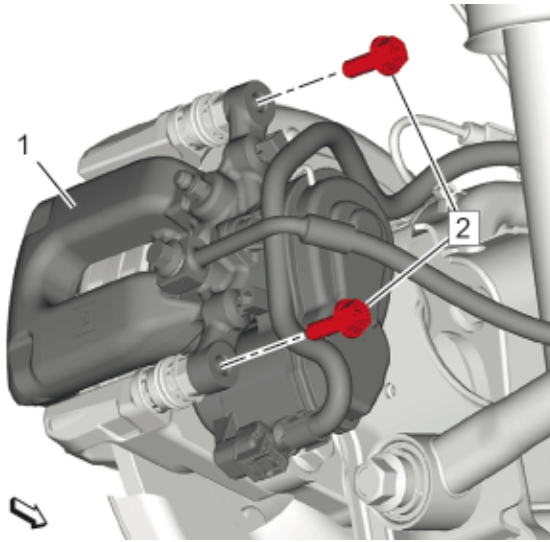


Fig. 75: Brake Caliper And Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install the brake caliper. (1)

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.

4. Install NEW Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1) and tighten to 36 N.m (27 lb ft). Install NEW bolts.
5. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
6. Remove the support and lower the vehicle.
7. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
8. Slowly release the brake pedal.
9. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
10. Inspect the fluid level in the brake master cylinder reservoir.
11. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)

FRONT BRAKE CALIPER BRACKET REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this

vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Refer to [Brake Dust Warning](#) .

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

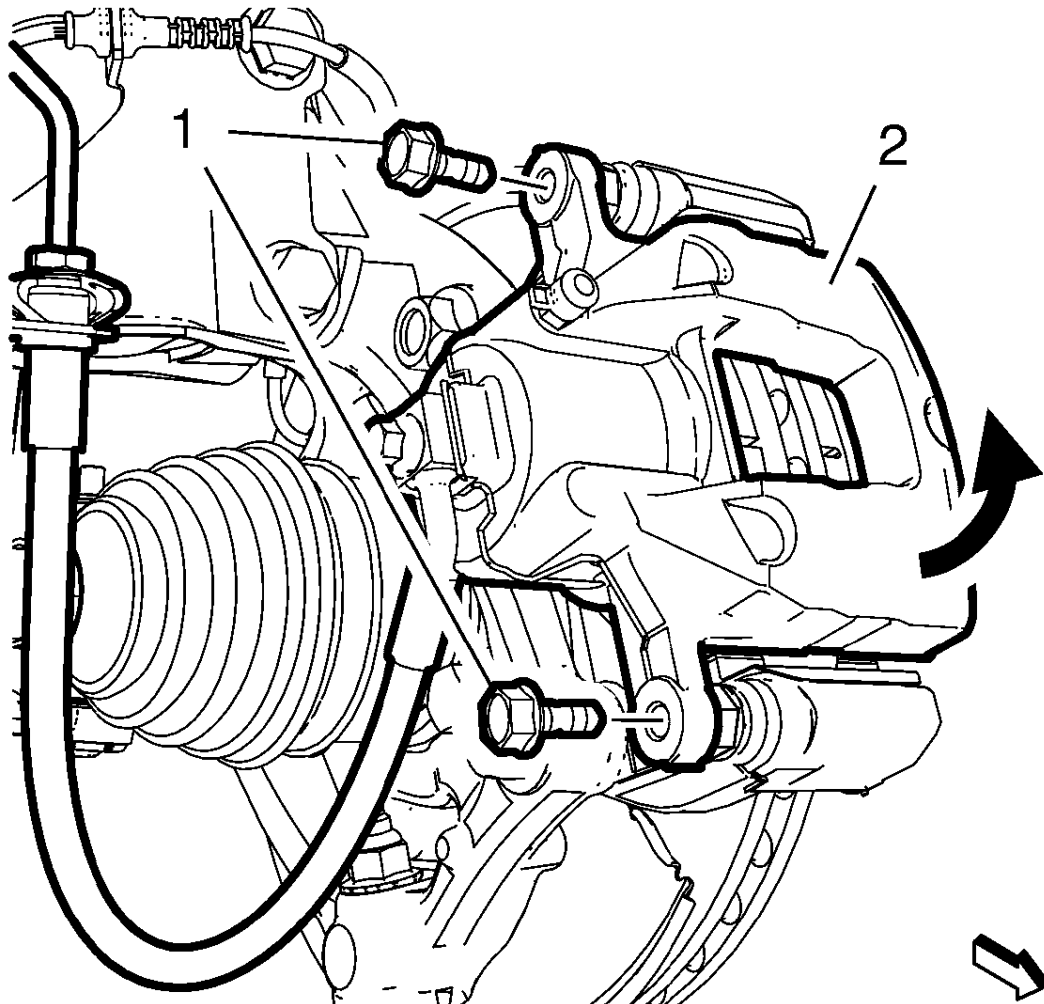


Fig. 76: Front Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

- NOTE:**
- Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.
 - Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

3. Remove and DISCARD Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove Front Brake Caliper

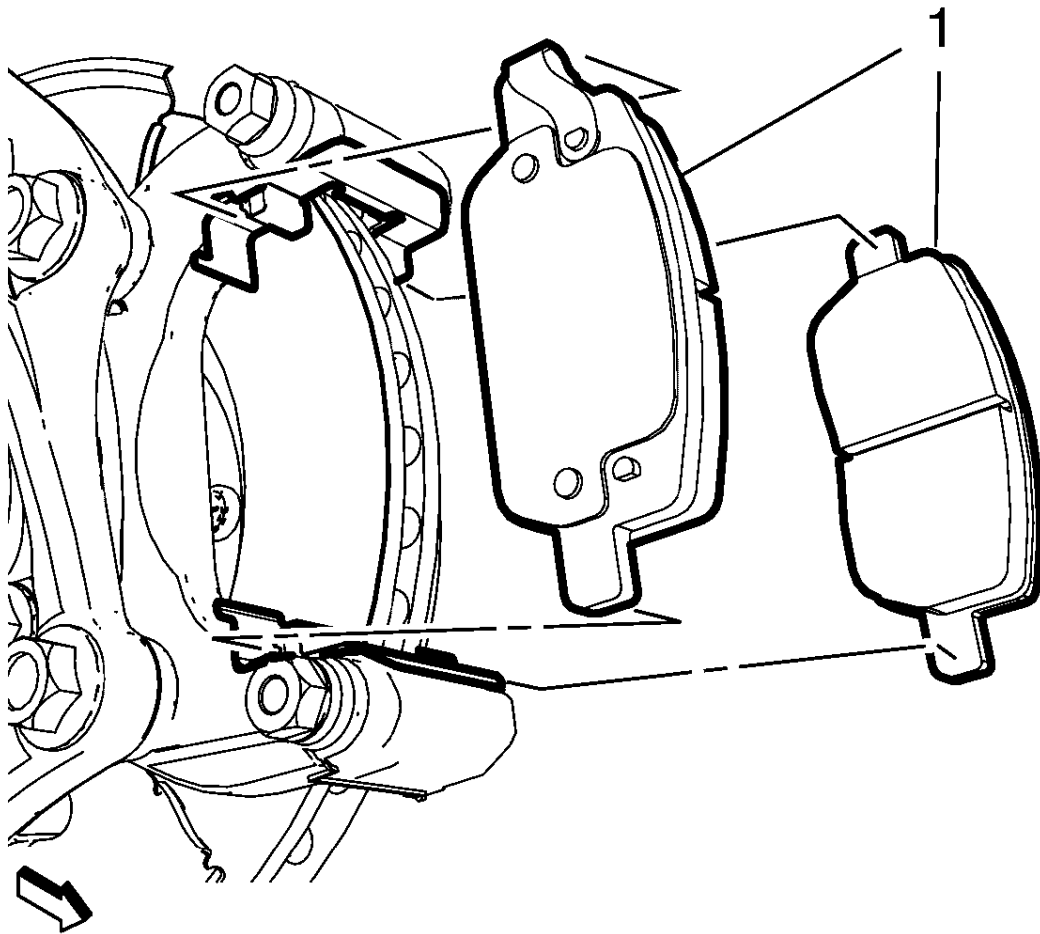


Fig. 77: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

5. Remove the disc brake pads. (1) (Qty: 2)

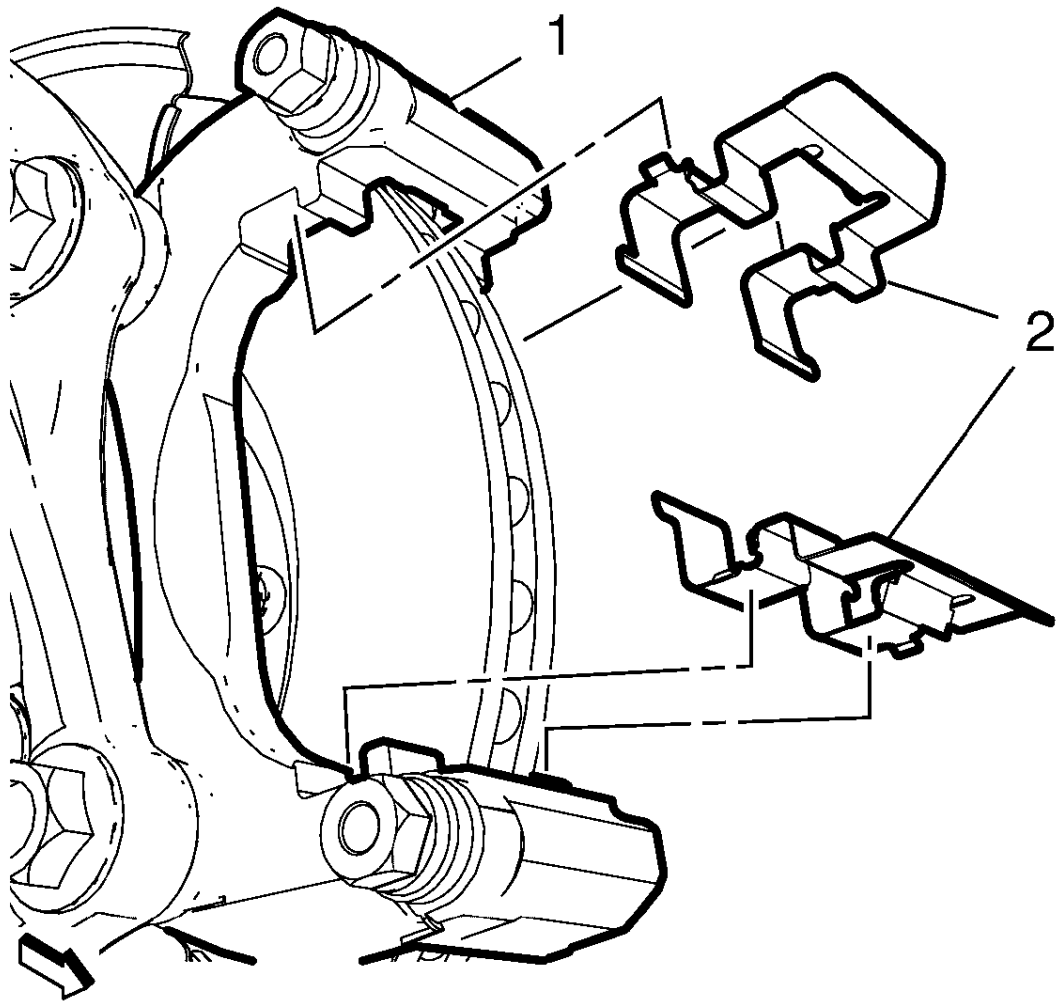


Fig. 78: Brake Pad Springs And Caliper Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Remove Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)

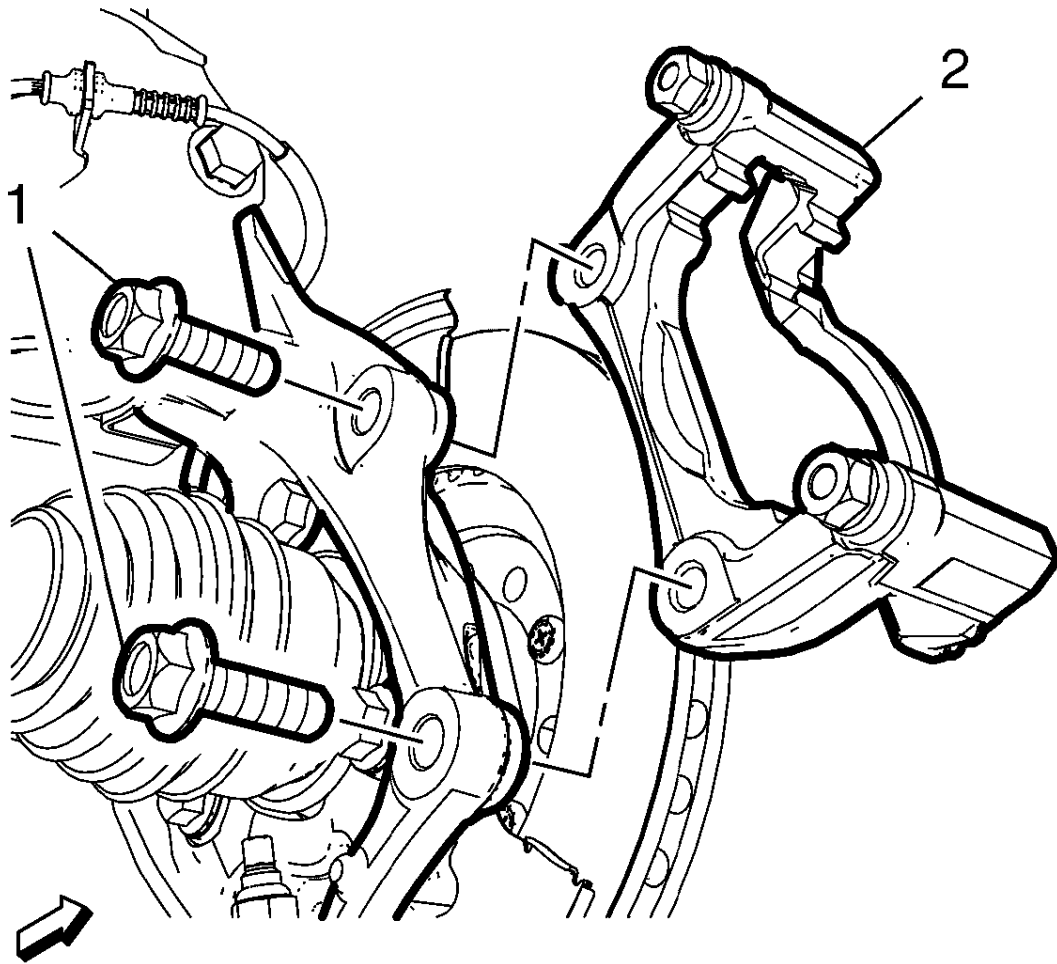


Fig. 79: Brake Caliper Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Remove Bolts (1) (Qty: 2) @ Brake Caliper Bracket (2)
8. Remove Front Brake Caliper Bracket

Installation Procedure

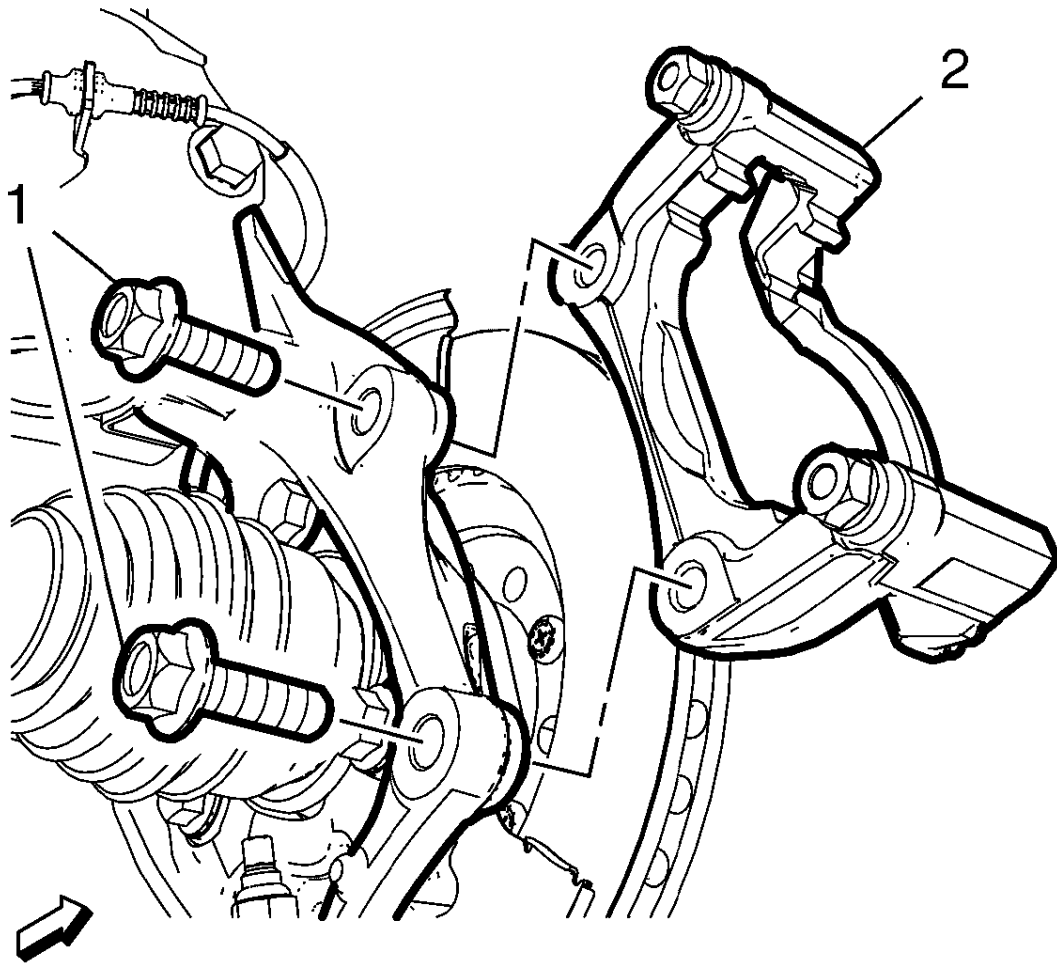


Fig. 80: Brake Caliper Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Caliper Bracket (2)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Bolts (1) (Qty: 2) @ Brake Caliper Bracket (2)
 1. First Pass: 150 N.m (111 lb ft).
 2. Final Pass: 15 - 30 degrees

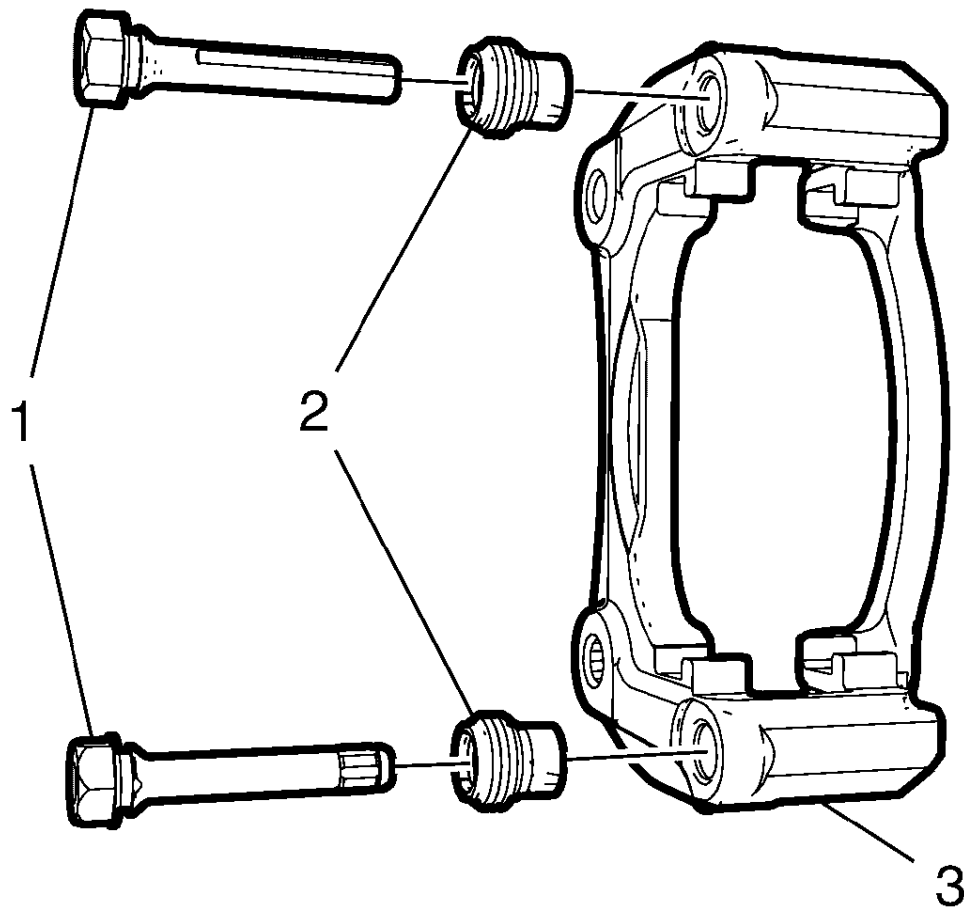


Fig. 81: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Apply a light coating of high temperature, silicone brake lubricant to the brake caliper bracket guide pin bores, the inner portion of the guide pin seals, and the brake caliper guide pins.
4. Seat the brake caliper guide pin seal in the groove of the brake caliper guide pin. (2) (Qty: 2)

NOTE: The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.

5. Install Front Brake Caliper Guide Pins (1) (Qty: 2)
6. Ensure the brake caliper guide pin seal is fully seated in the groove of the brake caliper guide pin and the guide pin slides freely in caliper bracket bore.

NOTE: If reusing the brake caliper guide pins (1) and the guide pin seals (2). Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:

- Restricted caliper guide pin movement
- Looseness in the brake caliper mounting bracket
- Seized or binding caliper guide pins
- Split or torn boots

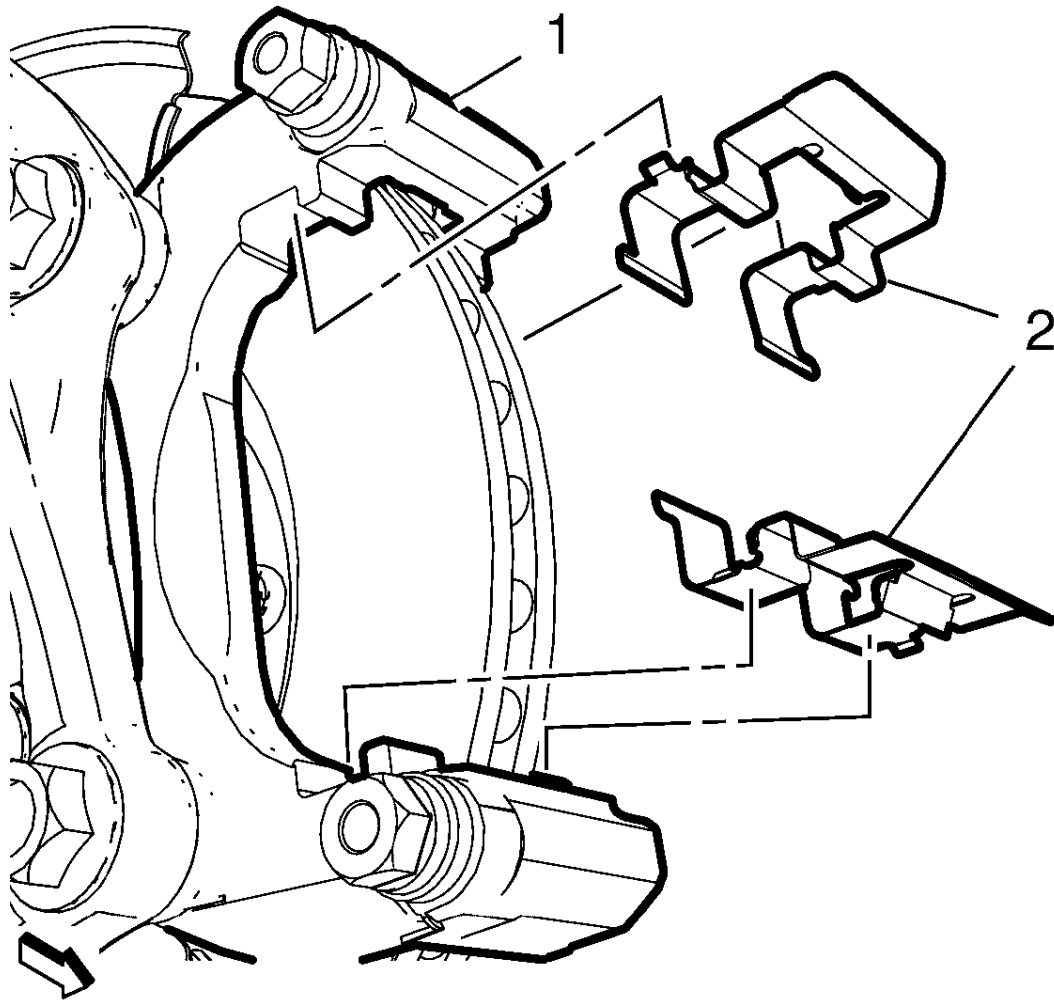


Fig. 82: Brake Pad Springs And Caliper Bracket

Courtesy of GENERAL MOTORS COMPANY

7. Install Brake Pad Springs (2) (Qty: 2) @ Brake Caliper Bracket (1)

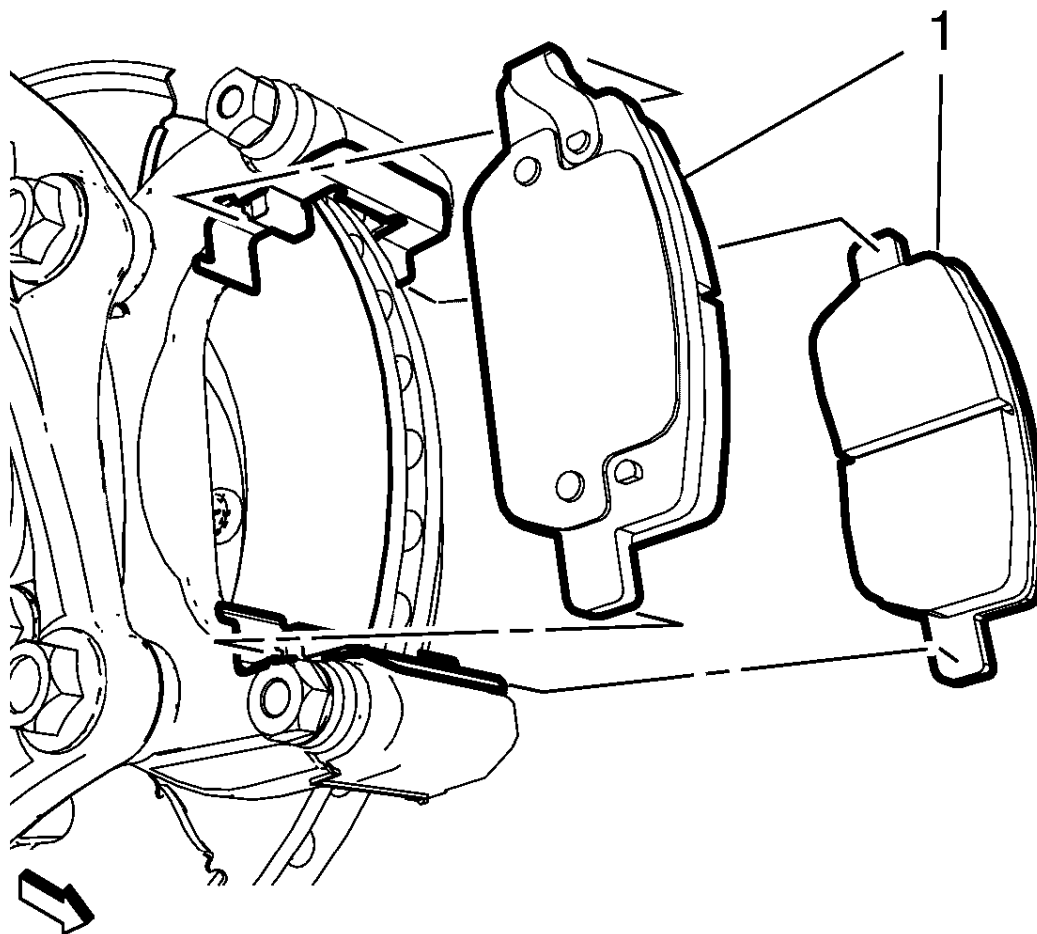


Fig. 83: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: The disc brake pad equipped with wear sensor has to be mounted in upper position on the inner side of the rotor.

8. Install the disc brake pads. (1) (Qty: 2)

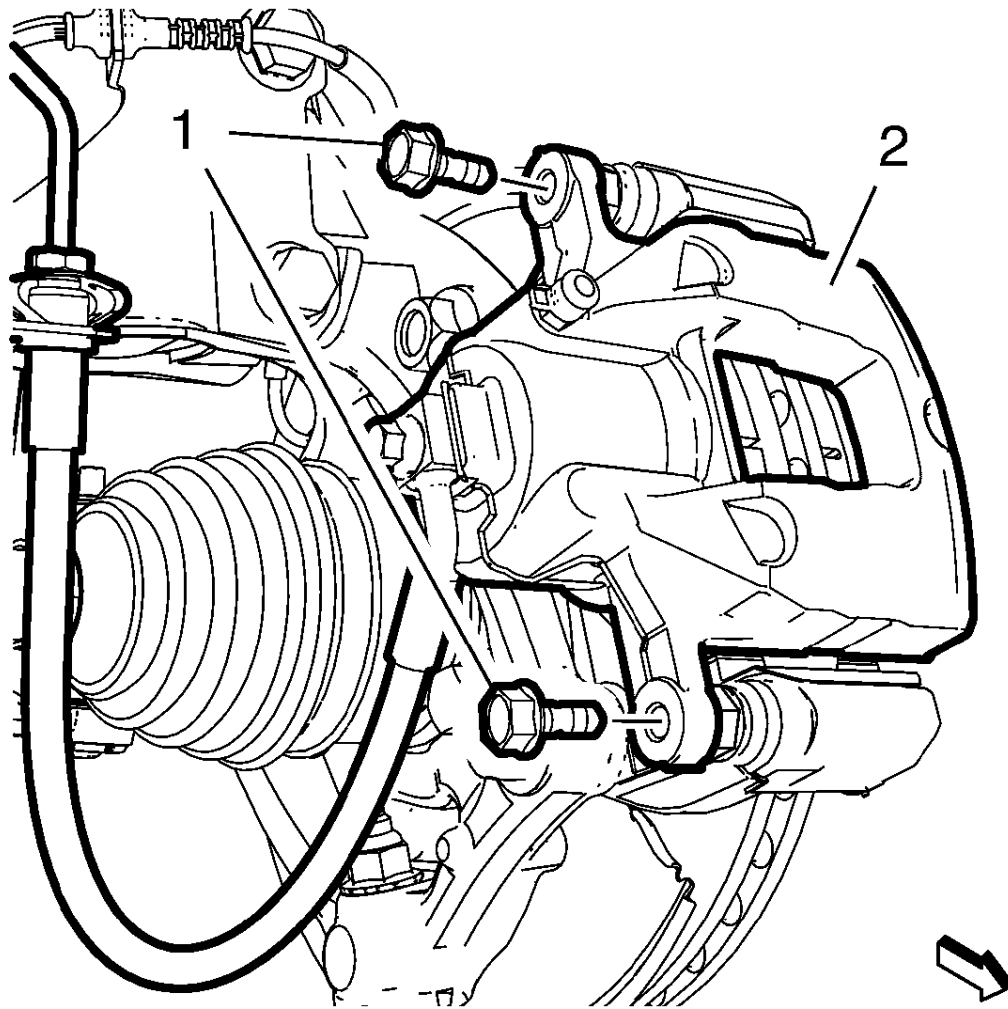


Fig. 84: Front Brake Caliper And Guide Pin Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Install the brake caliper. (2)

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

NOTE: Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.

10. Install and tighten Brake Caliper Guide Pin Bolts (1) (Qty: 2) @ Front Brake Caliper (2) to 40 N.m (30 lb ft)
11. Install the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)
12. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
13. Slowly release the brake pedal.
14. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
15. Inspect the fluid level in the brake master cylinder reservoir.
16. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)

REAR BRAKE CALIPER BRACKET REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Refer to [Brake Dust Warning](#)

1. Set the parking brake in service mode

1. Change the transmission gear in neutral position.
2. Press the electronic park brake switch until the red parking brake status lamp is illuminating in the instrument cluster.

NOTE: Do not press the brake pedal intensely. It is sufficient when the brake lights are illuminated.

3. Press the brake pedal 5 times slightly until the vacuum in the power brake booster is empty.
4. Turn the ignition ON, with the engine OFF.
5. Press the brake pedal slightly and the electronic park brake switch for 15 seconds until the orange brake service lamp is illuminating.
6. By keeping brake pedal applied, release and re-press the electronic park brake switch for 5 seconds.
7. Release the electronic park brake switch and the brake pedal simultaneously. The rear brake calipers are retracting and the orange service brake lamp is flashing.

2. Turn OFF the ignition.

3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

4. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

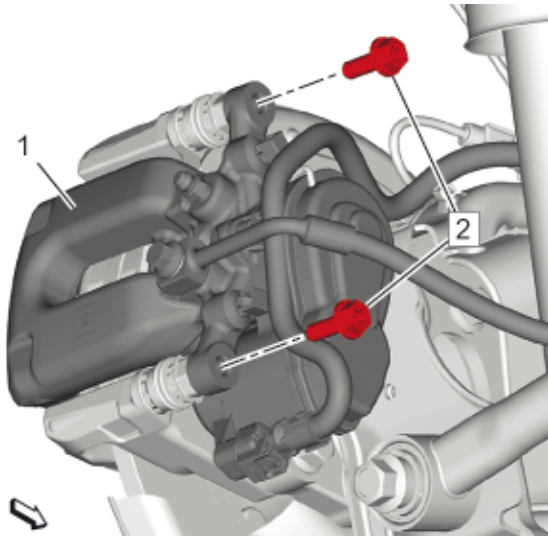


Fig. 85: Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT disconnect the brake hoses from the calipers.

NOTE:

- Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.
- Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt. Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.

5. Remove and DISCARD Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

6. Remove the brake caliper assembly.

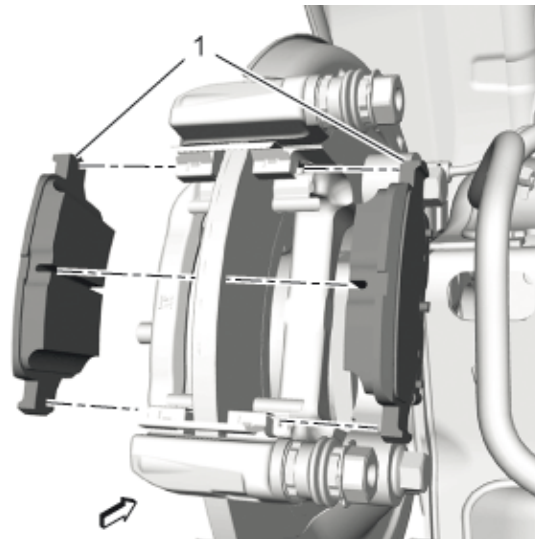


Fig. 86: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

7. Remove the disc brake pads. (1) (Qty: 2)

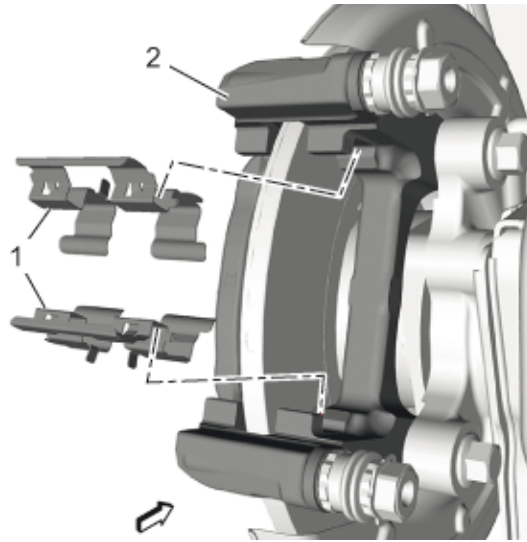


Fig. 87: Brake Caliper Bracket And Brake Pad Springs
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Pad Springs (1) (Qty: 2) @ Brake Caliper Bracket (2)

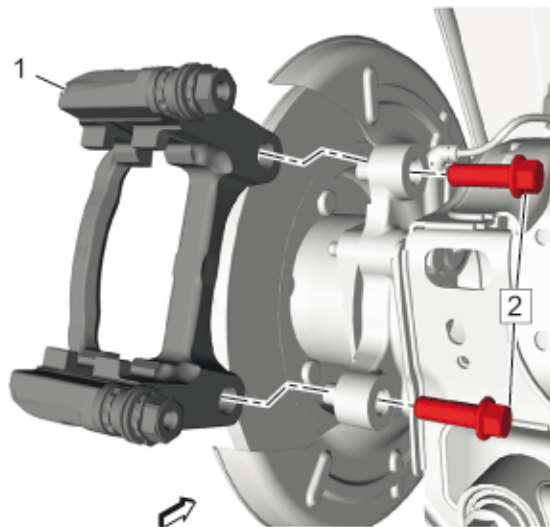


Fig. 88: Rear Brake Caliper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Bolts (2) (Qty: 2) @ Rear Brake Caliper Bracket (1)

10. Remove Rear Brake Caliper Bracket

Installation Procedure

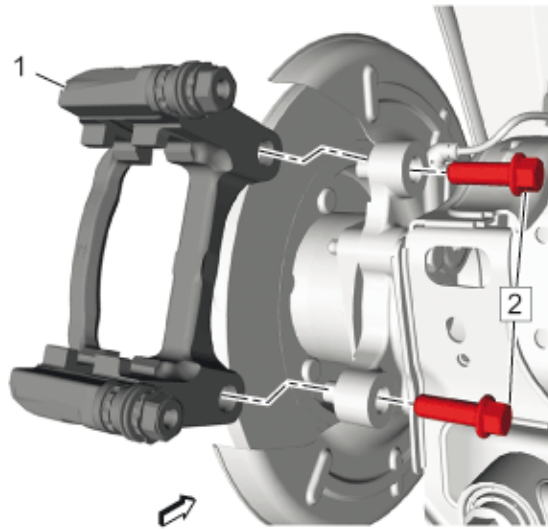


Fig. 89: Rear Brake Caliper Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Caliper Bracket (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Bolts (2) (Qty: 2) @ Brake Caliper Bracket
 1. First Pass: 100 N.m (74 lb ft).
 2. Final Pass: 15 - 30 degrees, using the **EN-45059** meter

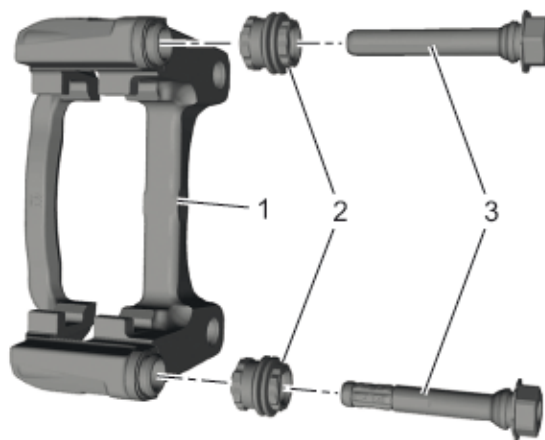


Fig. 90: Brake Caliper Guide Pins, Boots And Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Apply a light coating of high temperature, silicone brake lubricant to the brake caliper bracket guide pin bores, the inner portion of the guide pin seals, and the brake caliper guide pins.
4. Seat the brake caliper guide pin seal in the groove of the brake caliper guide pin. (2) (Qty: 2)

NOTE: The lower brake caliper guide pin is equipped with a bushing and must be installed in the same location.

5. Install Front Brake Caliper Guide Pins (1) (Qty: 2)
6. Ensure the brake caliper guide pin seal is fully seated in the groove of the brake caliper guide pin and the guide pin slides freely in caliper bracket bore.

NOTE: If reusing the brake caliper guide pins (3) and the guide pin seals (2). Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:

- Restricted caliper guide pin movement
- Looseness in the brake caliper mounting bracket
- Seized or binding caliper guide pins
- Split or torn boots

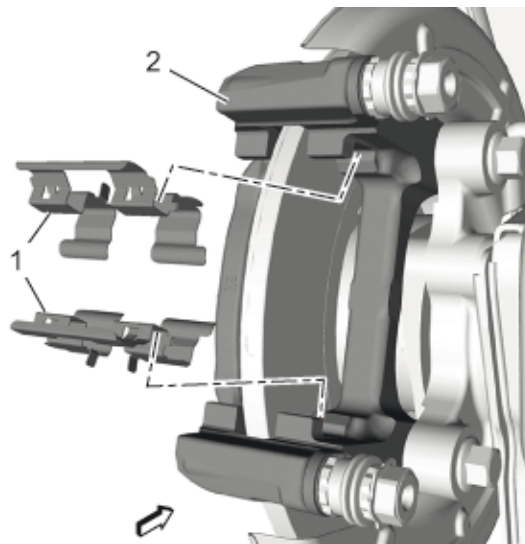


Fig. 91: Brake Caliper Bracket And Brake Pad Springs
Courtesy of GENERAL MOTORS COMPANY

7. Install Brake Pad Springs (1) (Qty: 2) @ Brake Caliper Bracket (2)

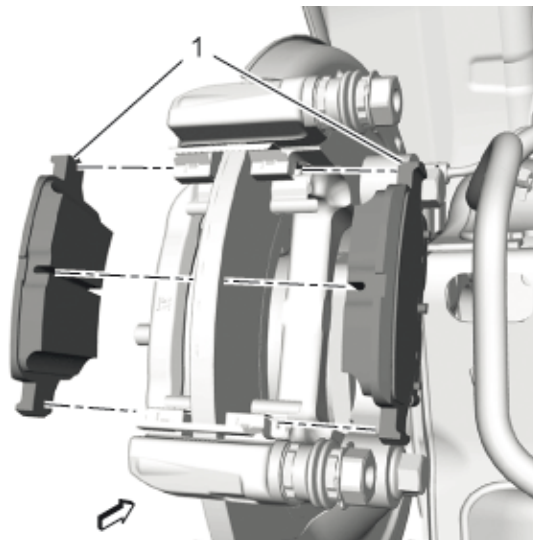


Fig. 92: Disc Brake Pads

Courtesy of GENERAL MOTORS COMPANY

NOTE: The disc brake pad equipped with wear sensor has to be mounted in upper position on the inner side of the rotor.

8. Install the disc brake pads. (1) (Qty: 2)

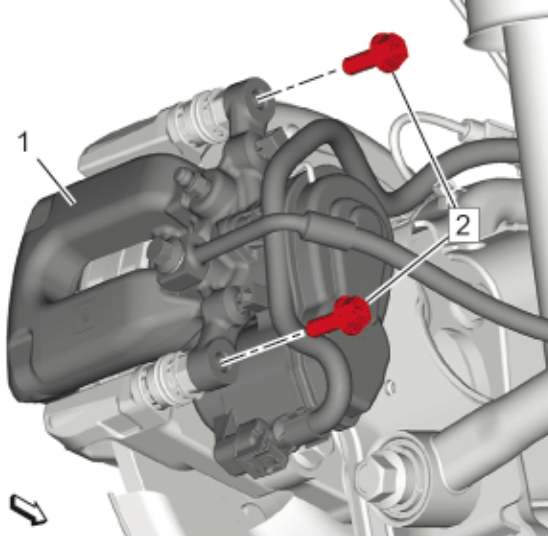


Fig. 93: Brake Caliper And Guide Pin Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Install the brake caliper assembly (1).

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

10. Install and tighten Brake Caliper Guide Pin Bolts (2) (Qty: 2) @ Rear Brake Caliper (1) to 36 N.m (27 lb ft)
11. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
12. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
13. Slowly release the brake pedal.
14. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
15. Inspect the fluid level in the brake master cylinder reservoir.
16. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Master Cylinder Reservoir Filling](#)
17. Activate the electronic parking brake.
 1. Turn the ignition ON, with the engine OFF.
 2. Press the brake pedal slightly and push the electronic parking brake switch for over 5 seconds. The orange service lamp goes off and the red parking brake status lamp is flashing a few times.

FRONT BRAKE ROTOR REPLACEMENT

Special Tools

- CH-41013 Rotor Resurfacing Kit

- CH-42450-A Wheel Hub Resurfacing Kit

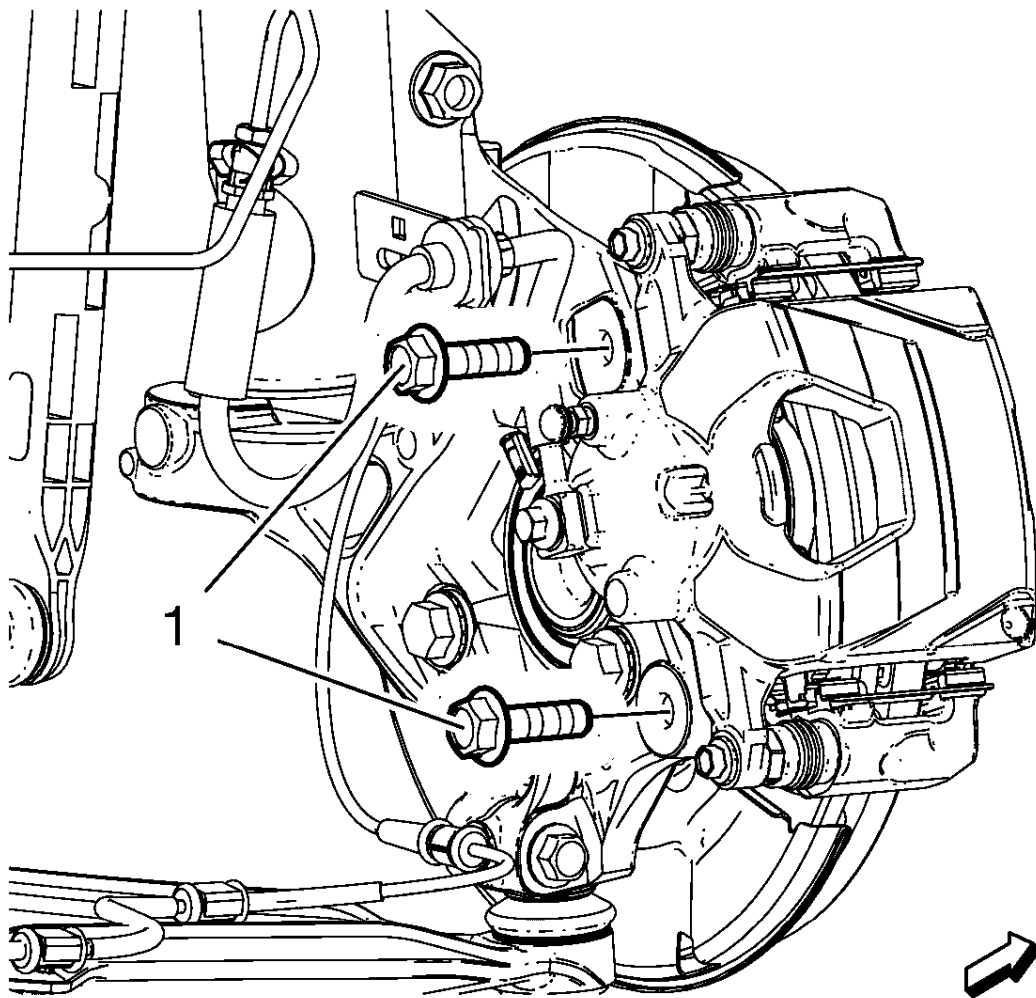
For equivalent regional tools, refer to [Special Tools](#).

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Refer to [Brake Dust Warning](#) .

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .



[Fig. 94: Brake Caliper Bracket Bolts](#)

Courtesy of GENERAL MOTORS COMPANY

3. Remove the brake caliper bracket bolts (1).

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it

is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the brake caliper and bracket as an assembly and support with heavy mechanics wire or equivalent.

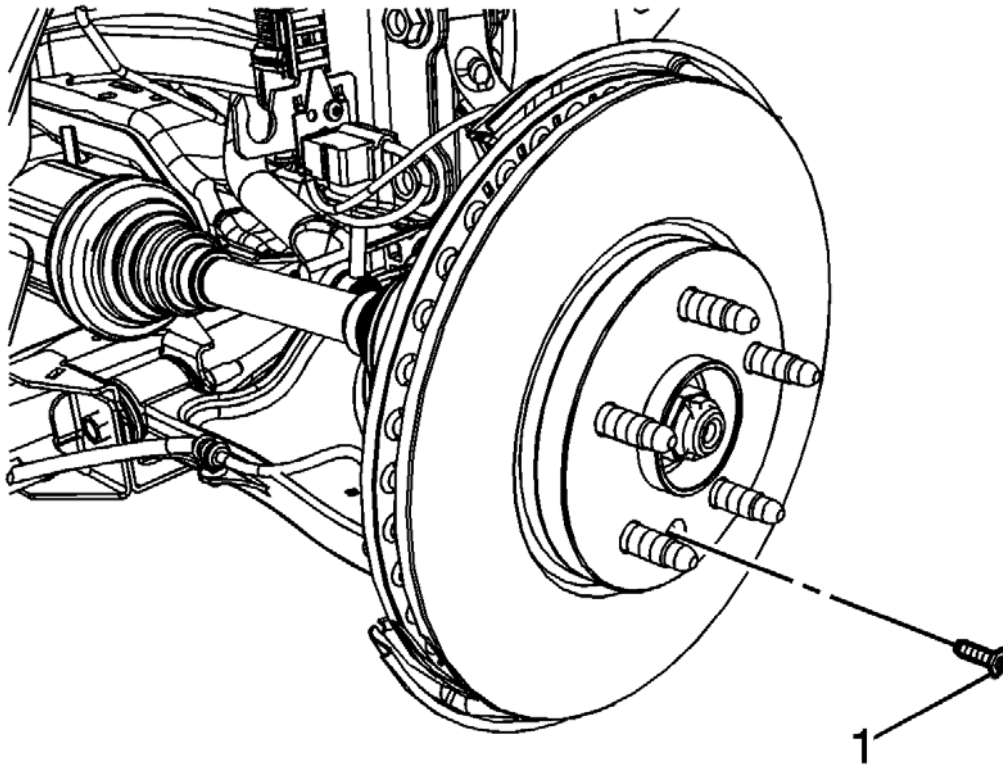


Fig. 95: Brake Rotor Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Remove the brake rotor bolt (1).

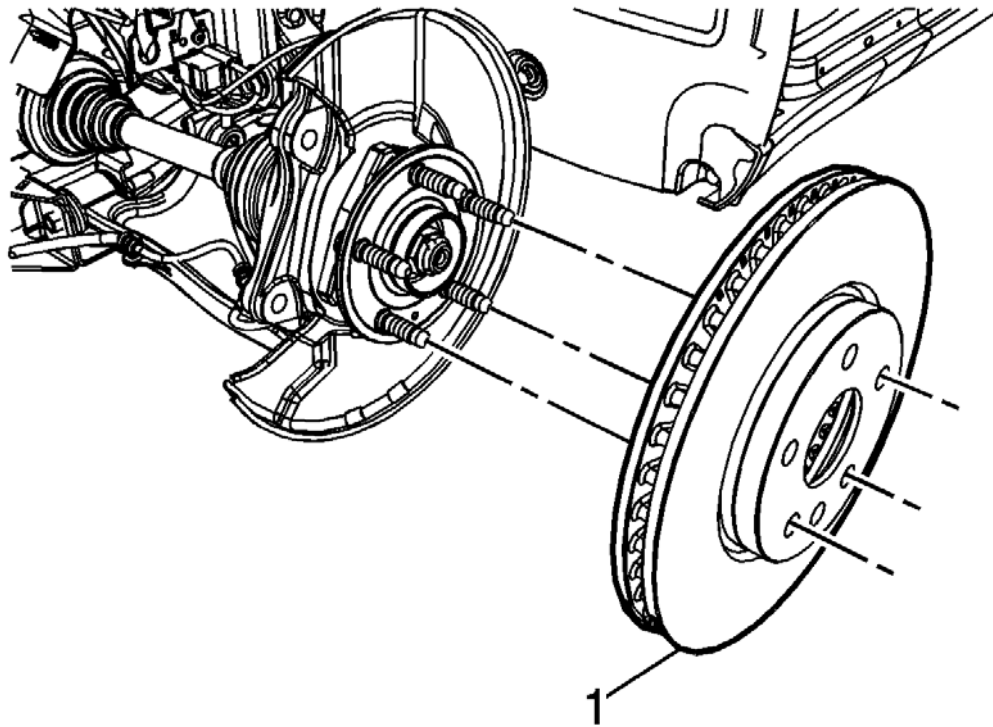


Fig. 96: Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake rotor (1).

Installation Procedure

1. If installing a new brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol or equivalent.
2. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the **CH-41013** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.

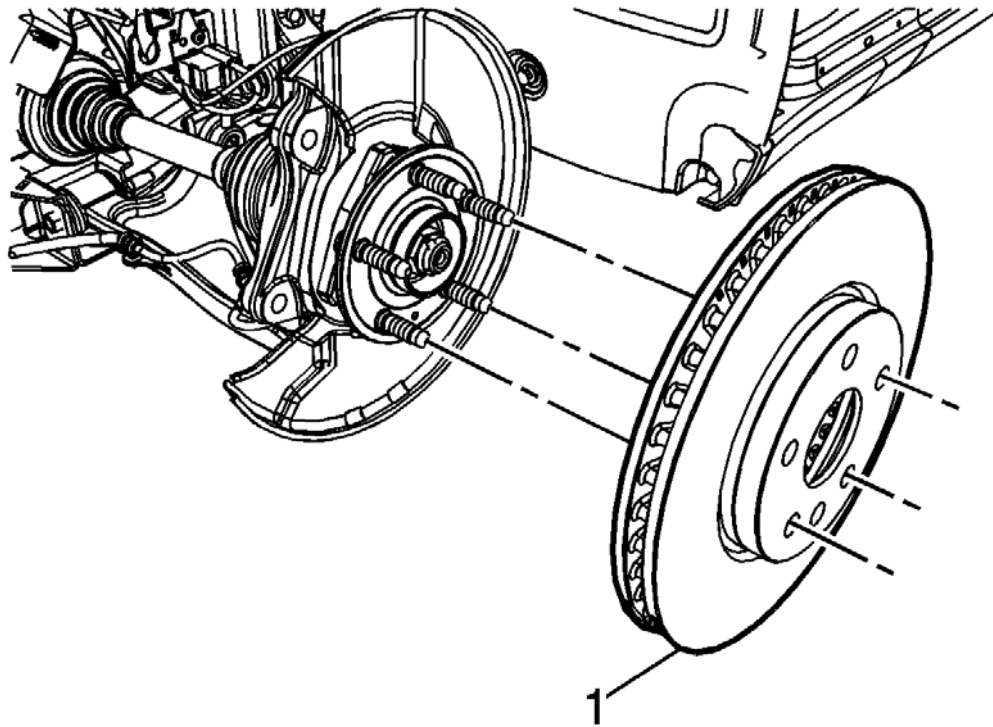


Fig. 97: Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

4. Install the brake rotor (1).

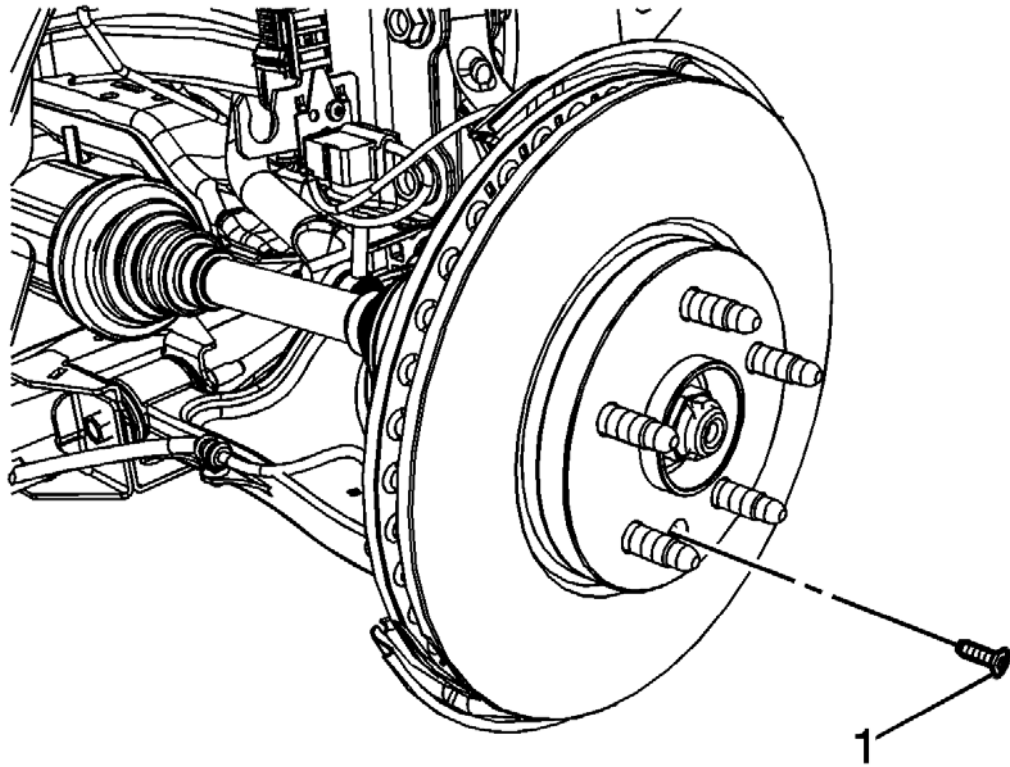


Fig. 98: Brake Rotor Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

5. Install the brake rotor bolt (1) and tighten to 9 N.m (80 lb in).
6. Position the brake caliper and bracket assembly over the brake rotor and to the steering knuckle.

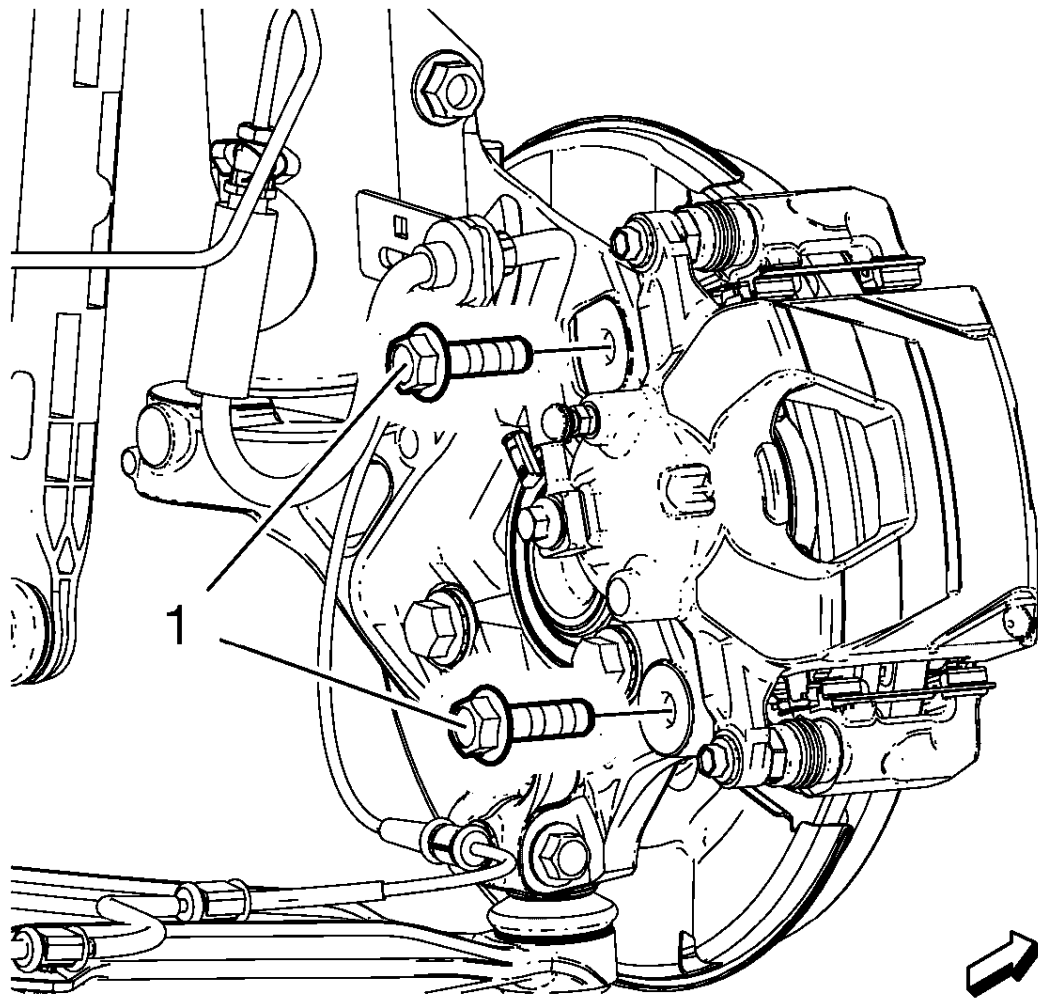


Fig. 99: Brake Caliper Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Install the brake caliper bracket bolts (1).

Tighten

1. First Pass: 150 N.m (111 lb ft)
2. Final Pass: **15-30 degrees**

8. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .

9. Burnish the brake pads and rotors. Refer to [Brake Pad and Rotor Burnishing](#).

REAR BRAKE ROTOR REPLACEMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit
- **CH-45059** Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Refer to [Brake Dust Warning](#)

NOTE: Always replace disc brake rotors in axle sets.

1. Set the electronic parking brake in the service mode.
 1. Change the transmission gear to Neutral position.
 2. Press the electronic park brake switch until the red parking brake status lamp is illuminating in the instrument cluster.
- NOTE:** Do not press the brake pedal intensely. It is sufficient if the brake tail lamps are illuminating.
3. Press the brake pedal 5 times slightly until the vacuum in the power brake booster is empty.
4. Turn the ignition ON, with the engine OFF.
5. Press the brake pedal and the electronic park brake switch for 15 seconds until the orange brake service lamp is illuminating.
6. By keeping brake pedal applied, release and re-press the electronic park brake switch for 5 seconds.
7. Release the electronic park brake switch and the brake pedal simultaneously. The rear brake calipers are retracting and the orange brake service lamp is flashing.
2. Turn OFF the ignition.
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

4. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)

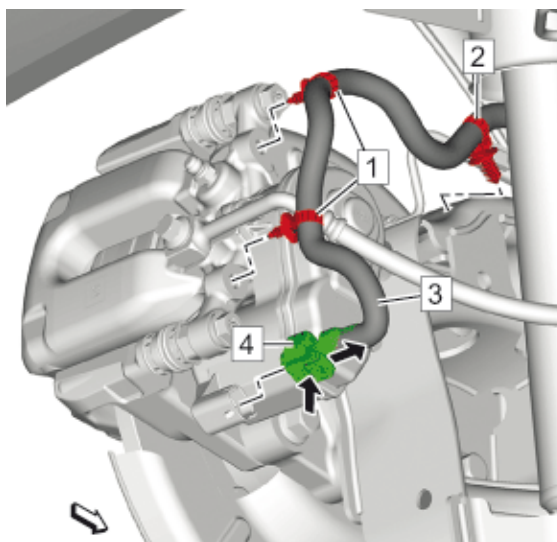


Fig. 100: Electrical Connector, Fasteners And Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (4)

6. Remove Fasteners (1) (Qty: 2)
7. Remove Fastener (2)
8. Remove Wiring Harness (3)

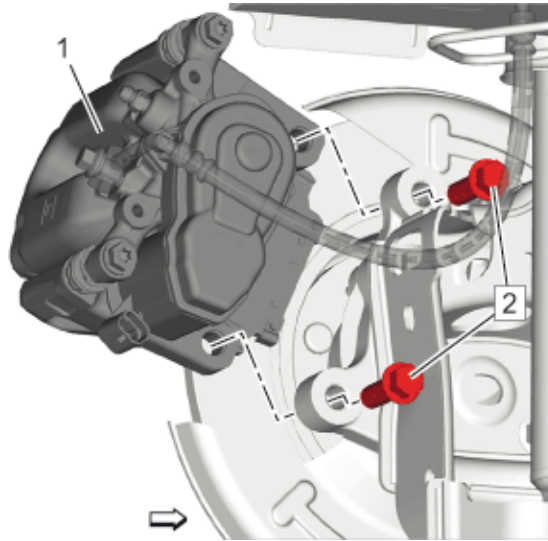


Fig. 101: Brake Caliper And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Rear Brake Caliper Bracket Bolts (2) (Qty: 2)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

10. Remove the brake caliper assembly and support with heavy mechanics wire. (1)

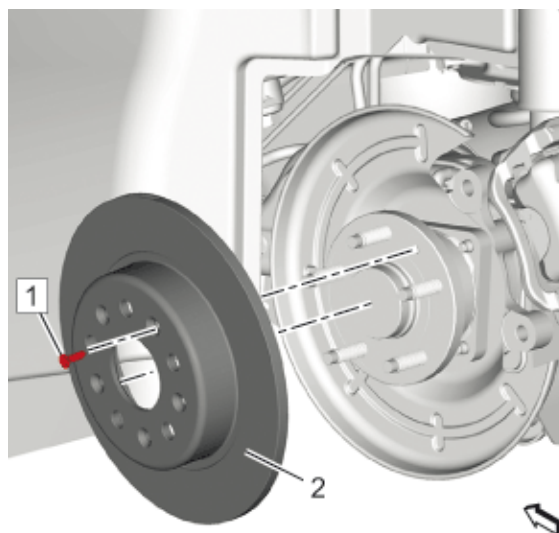


Fig. 102: Rear Brake Rotor And Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Remove Rear Brake Rotor Bolt (1)

12. Remove Rear Brake Rotor (2)

Installation Procedure

1. If installing a NEW brake rotor, clean the friction surfaces of the brake rotor with denatured alcohol.
2. Using the **CH-42450-A** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
3. Using the **CH-41013** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the rotor to the hub/axle flange.

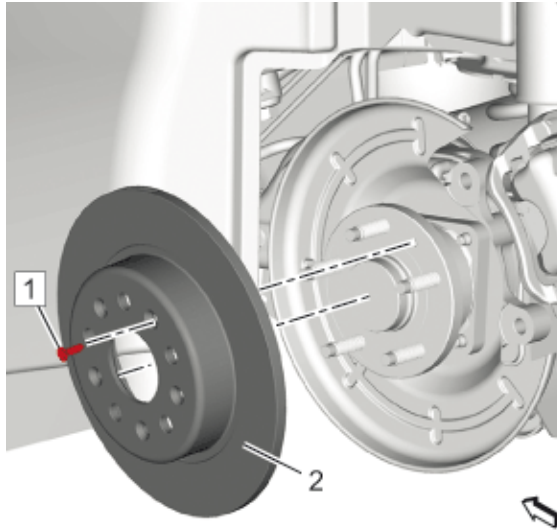


Fig. 103: Rear Brake Rotor And Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Rotor (2)

CAUTION: Refer to [Fastener Caution](#)

5. Install and tighten Rear Brake Rotor Bolt (1) to 9 N.m (80 lb in)

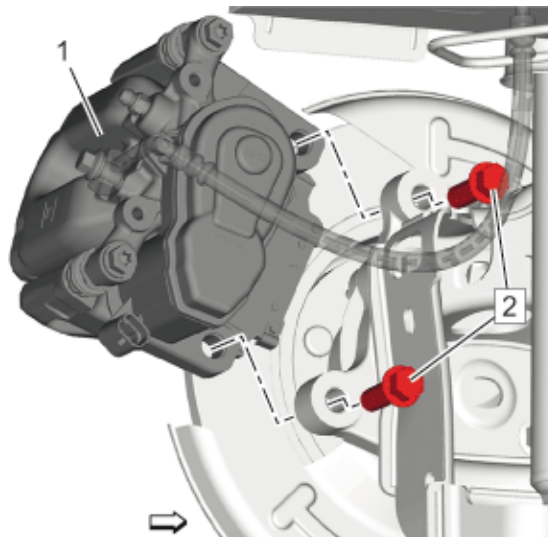


Fig. 104: Brake Caliper And Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Position the rear brake caliper assembly (1).
7. Install and tighten Rear Brake Caliper Bracket Bolts (2) (Qty: 2)
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 15 - 30 degrees

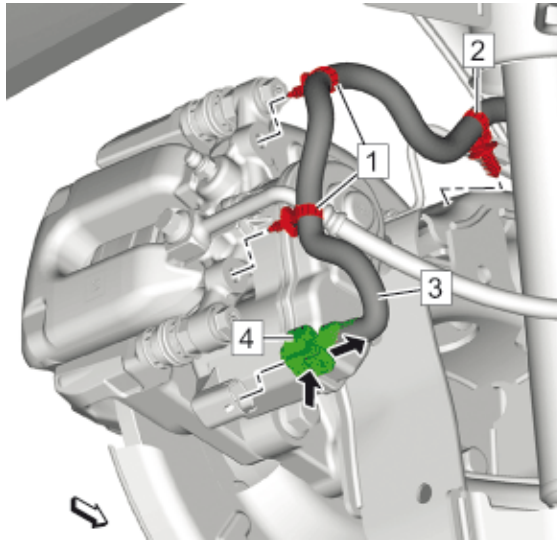


Fig. 105: Electrical Connector, Fasteners And Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

8. Install Wiring Harness (3)
9. Install Fastener (2)
10. Install Fasteners (1) (Qty: 2)
11. Connect Electrical Connector (4)
12. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
13. Lower the vehicle.
14. Activate the electronic parking brake.
 1. Turn the ignition ON, with the engine OFF.
 2. Press the brake pedal and the electronic parking brake switch for over 5 seconds. The orange brake service lamp turns off and the red parking brake status lamp is flashing a few times.
15. Burnish the brake pads and rotors. Refer to [Brake Pad and Rotor Burnishing](#)

FRONT BRAKE SHIELD REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove Front Wheel Bearing and Hub. Refer to [Front Wheel Bearing and Hub Replacement](#)

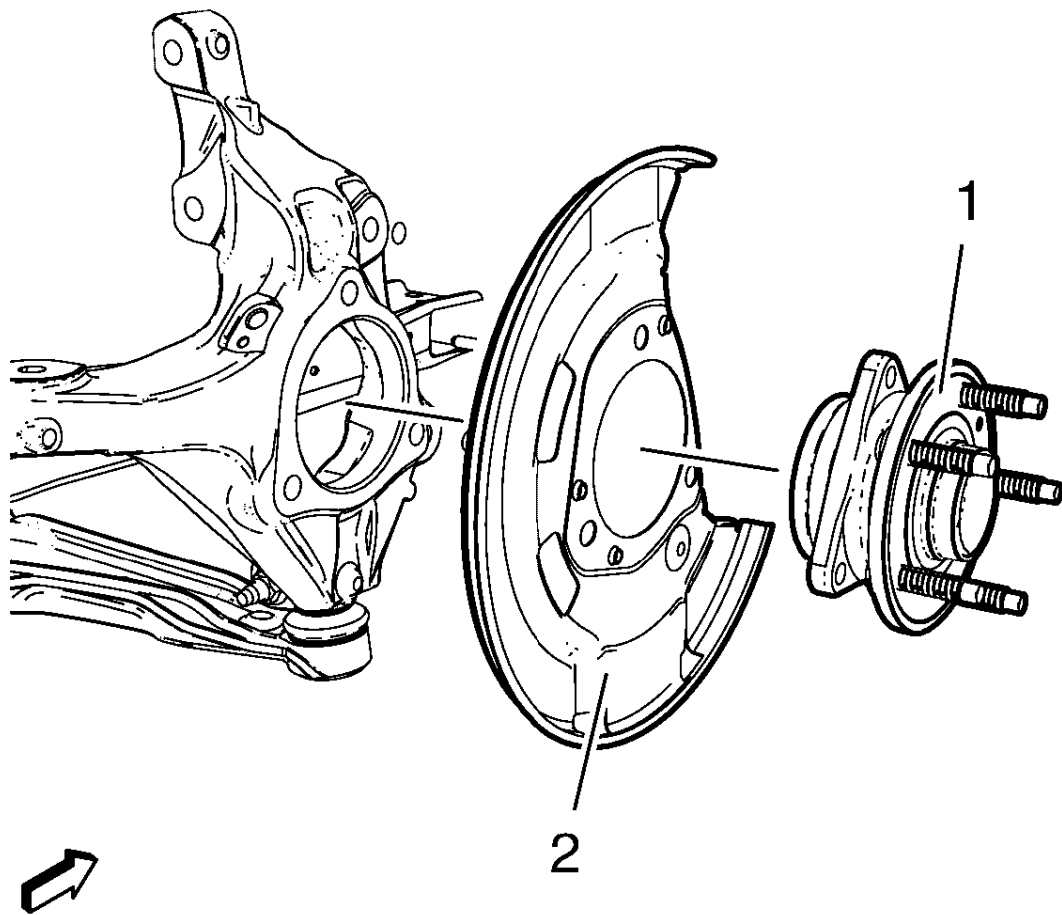


Fig. 106: Wheel Bearing/Hub, Front Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

3. Remove the wheel bearing/hub (1) and front brake shield (2) from the steering knuckle.

Installation Procedure

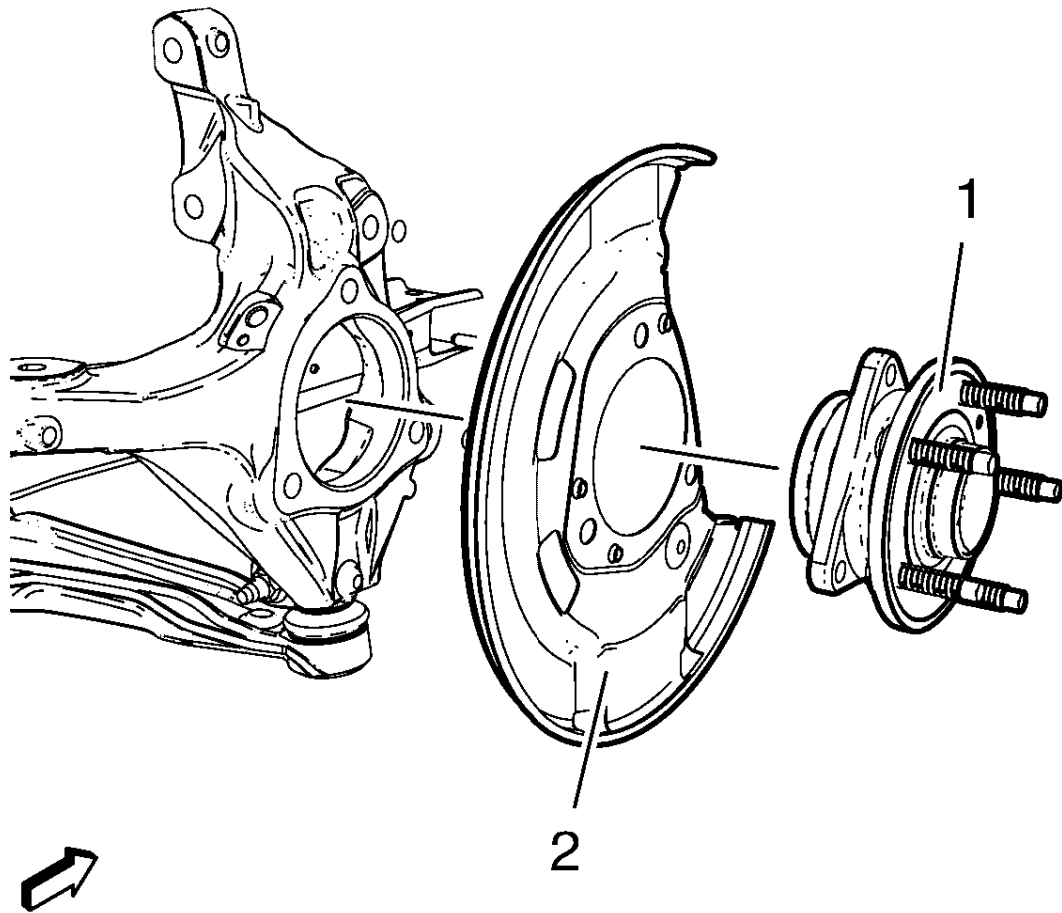


Fig. 107: Wheel Bearing/Hub, Front Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

1. Position the front brake shield (2) and wheel bearing/hub assembly (1) in the steering knuckle.
2. Install Front Wheel Bearing and Hub. Refer to [Front Wheel Bearing and Hub Replacement](#)
3. Remove the support and lower the vehicle.

REAR BRAKE SHIELD REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the rear tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible

brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

2. Remove Rear Brake Rotor. Refer to [Rear Brake Rotor Replacement](#)
3. Remove Rear Wheel Speed Sensor. Refer to [Rear Wheel Speed Sensor Replacement](#)

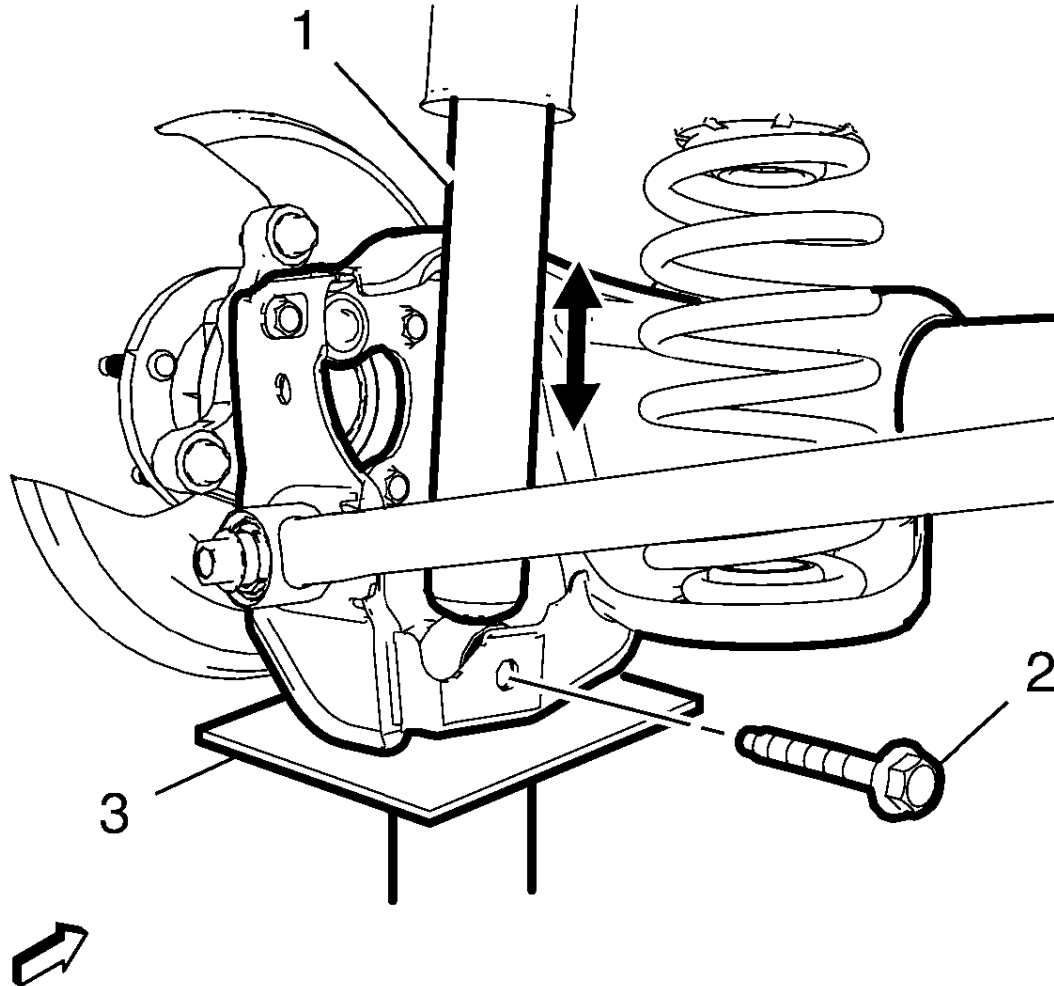


Fig. 108: Rear Shock Absorber, Bolt And Hydraulic Lift
Courtesy of GENERAL MOTORS COMPANY

4. Support the rear axle with a hydraulic lift table. (3)
5. Remove Rear Shock Absorber Bolt (2)
6. Push up to the shock absorber (1) gain access to the rear wheel bearing and hub bolts.

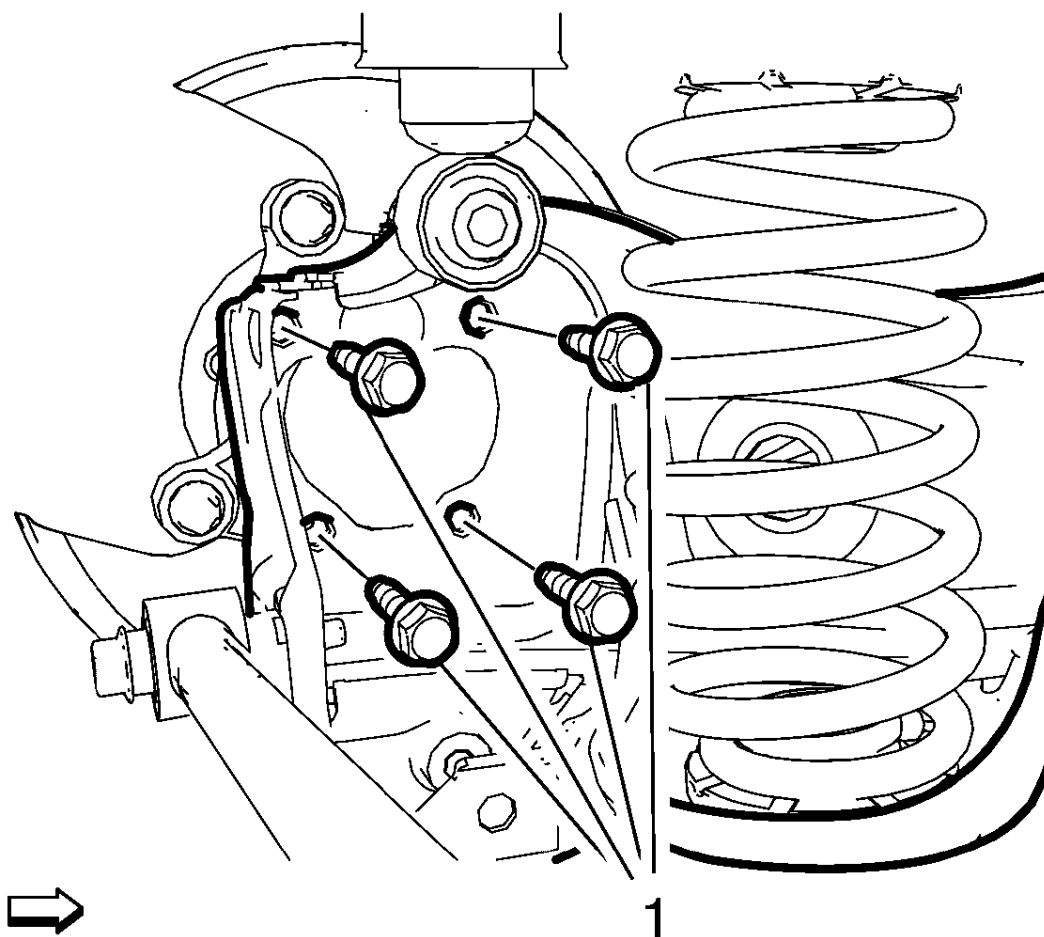


Fig. 109: Rear Wheel Bearing And Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Bolts (1) (Qty: 4)

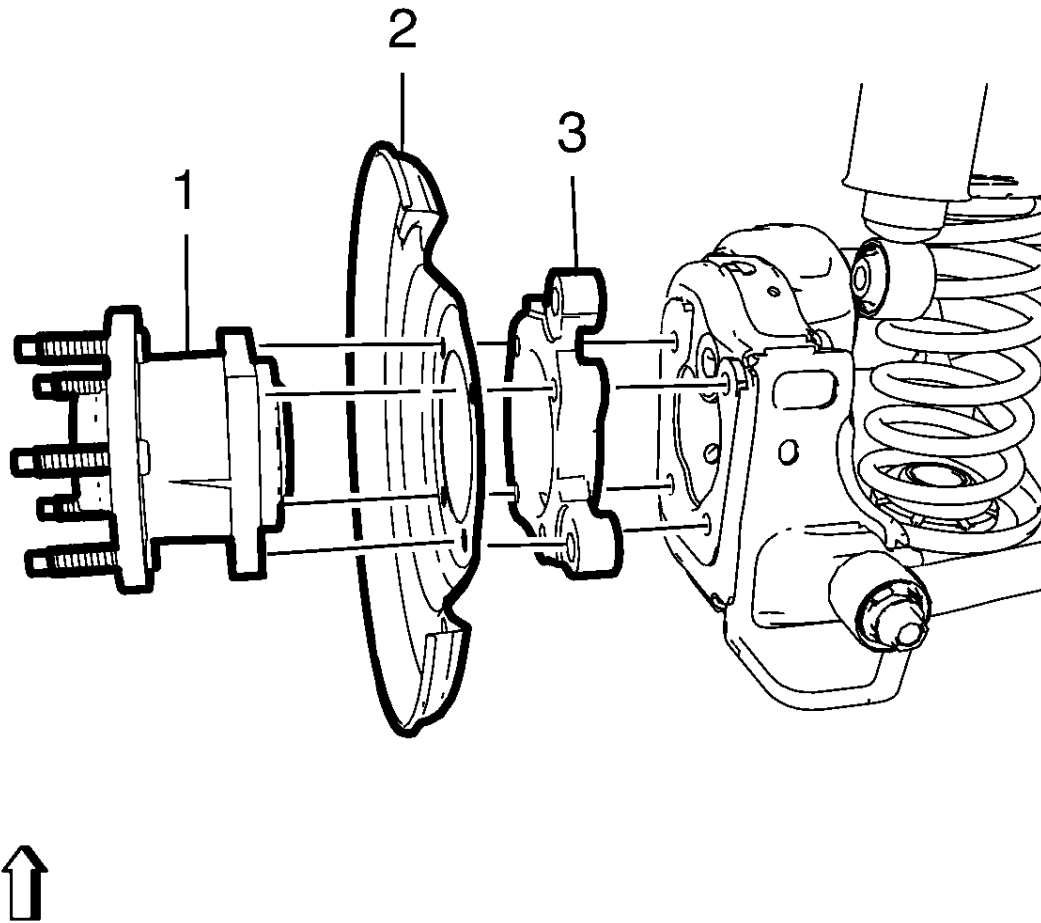


Fig. 110: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Wheel Bearing and Hub Assembly (1)
9. Remove the rear brake shield (2).
10. Remove the rear brake caliper mount plate (3).

Installation Procedure

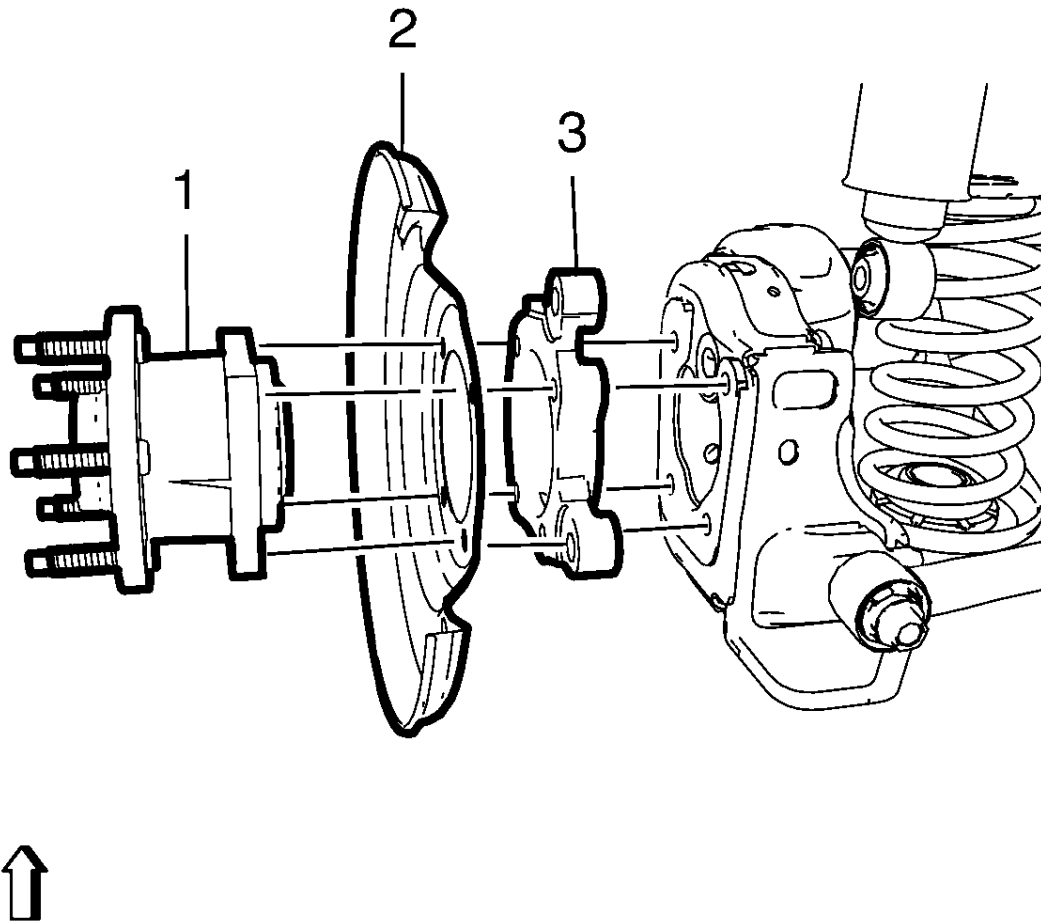


Fig. 111: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the rear brake caliper mount plate (3).
2. Install the rear brake shield (2).
3. Install Rear Wheel Bearing and Hub Assembly (1)

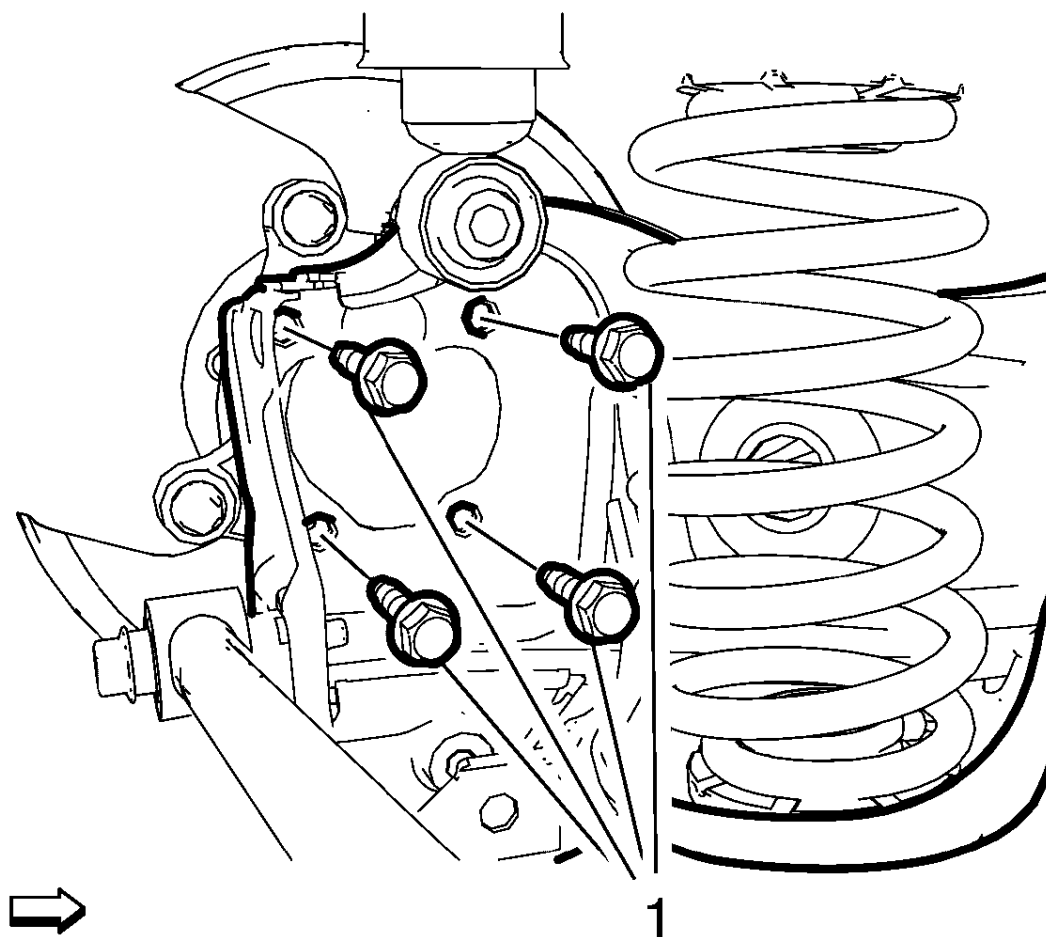


Fig. 112: Rear Wheel Bearing And Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution**

4. Apply thread locking adhesive to the fasteners.
5. Install and tighten Bolts (1) (Qty: 4)
 1. First Pass: 50 Nm. (37 lb ft).
 2. Final Pass: 30 - 45 degrees, use the **EN-45059** meter

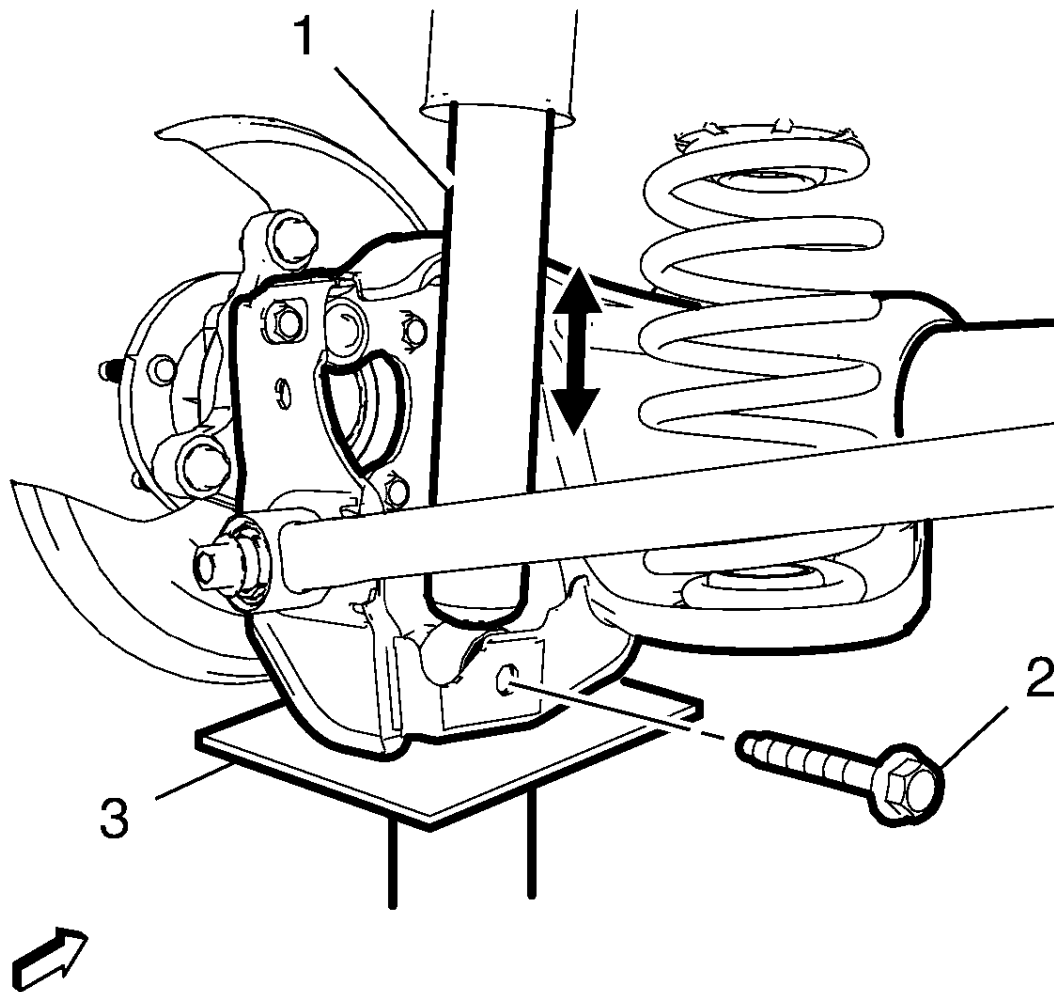


Fig. 113: Rear Shock Absorber, Bolt And Hydraulic Lift

Courtesy of GENERAL MOTORS COMPANY

NOTE: Service may offer bolts without micro-encapsulated thread locking adhesive. If this is the case, apply thread locking adhesive to the bolt.

6. Support the rear axle with a tall jack stand near the shock absorber.
7. Install, but do NOT tighten Rear Shock Absorber Bolt (2)
8. Install Rear Wheel Speed Sensor. Refer to [Rear Wheel Speed Sensor Replacement](#)
9. Install Rear Brake Rotor. Refer to [Rear Brake Rotor Replacement](#) - Install
10. Install Tire and Wheel. Refer to [Tire and Wheel Removal and Installation](#)
11. Lower the vehicle.

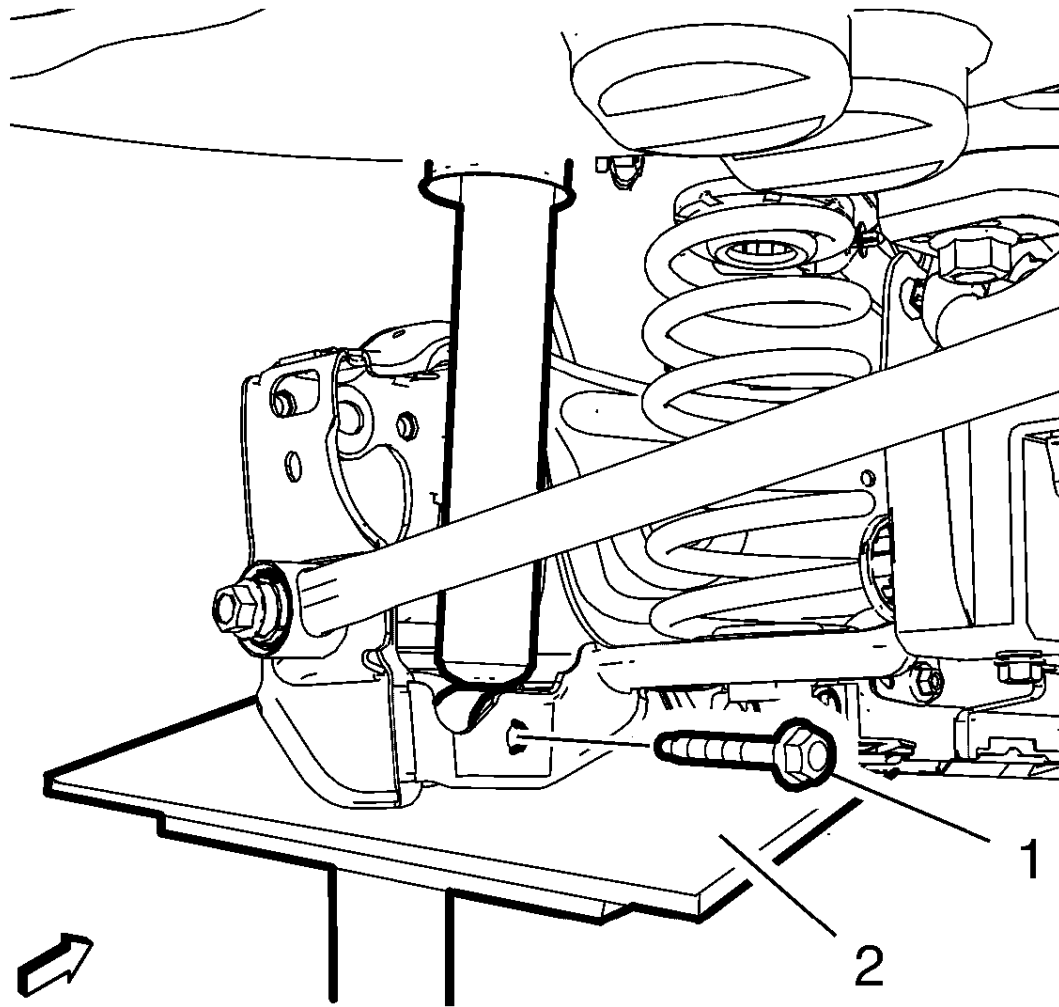


Fig. 114: Rear Shock Absorber Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the bolt with vehicle standing on the ground.

12. Tighten Rear Shock Absorber Bolt (1) to 100 N.m (74 lb ft)

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#)
- Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 - 11300 km (3,000 - 7,000 mi). Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025 - 0.127 mm (0.001 - 0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. Refer to [Brake Rotor Assembled Lateral Runout Correction - Indexing](#)
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. Refer to [Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe](#)

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - INDEXING

NOTE: This Procedure is not used in Europe

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to [Special Tools](#).

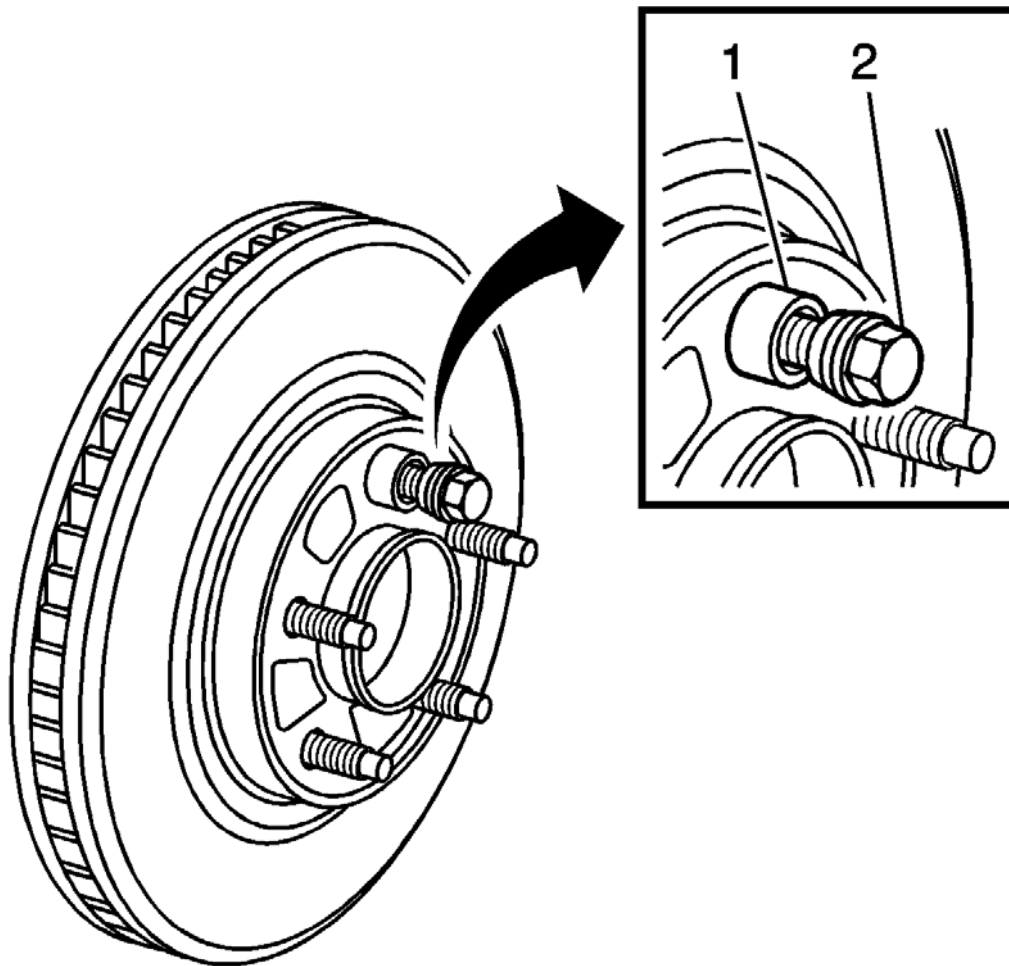


Fig. 115: Conical Brake Rotor Washer And Lug Nut
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Dust Warning](#) .

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#)
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 - 11300 km (3,000 - 7,000 mi). Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)

1. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

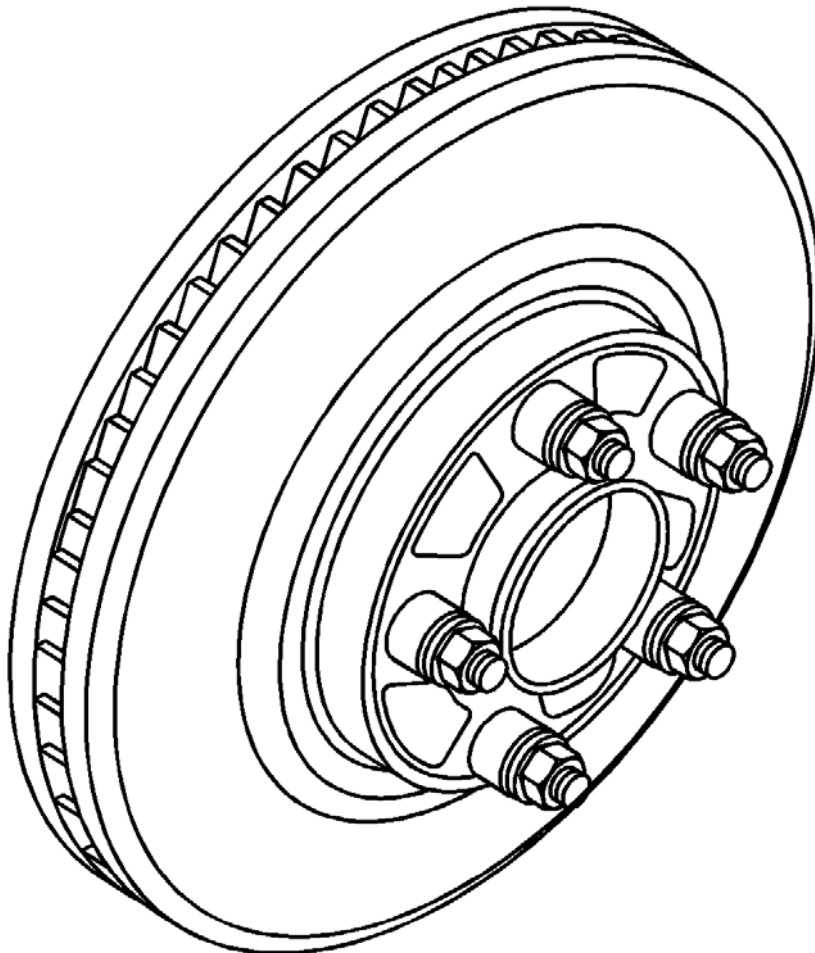


Fig. 116: Conical Brake Rotor Washers And Lug Nuts

Courtesy of GENERAL MOTORS COMPANY

6. Install the remaining **CH-45101-100** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
7. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to [**Tire and Wheel Removal and Installation**](#)
8. Measure the assembled LRO of the brake rotor. Refer to [**Brake Rotor Assembled Lateral Runout Measurement**](#)
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1 - 9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to [**Brake Rotor Assembled Lateral Runout Correction**](#).
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - CORRECTION PLATES

NOTE: This procedure not used in Europe

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to [**Special Tools**](#).

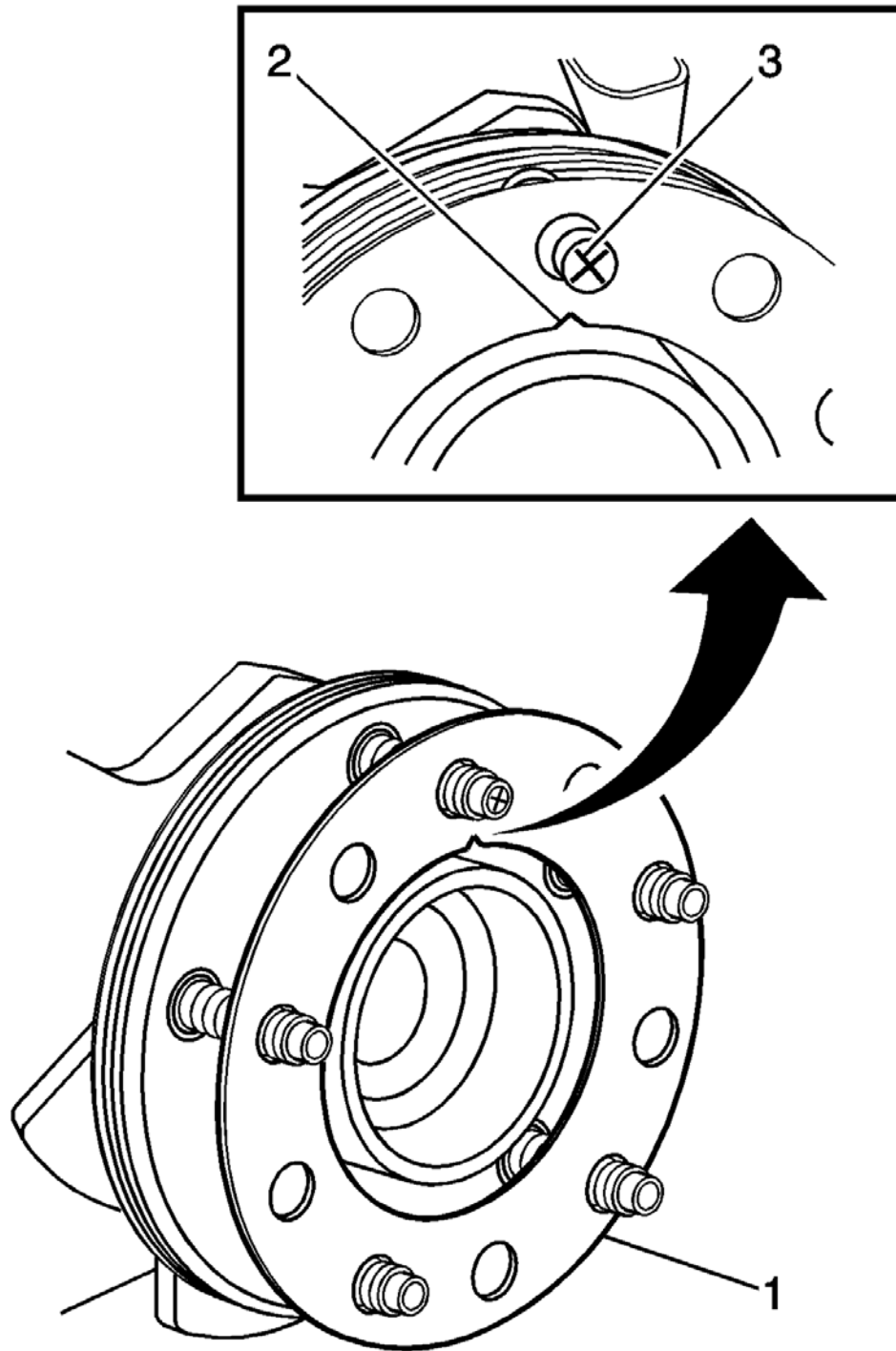


Fig. 117: Correction Plate, High Spot Mark And V-Shaped Notch

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Dust Warning](#) .

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#)

- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 - 11300 km (3,000 - 7,000 mi). Refer to Brake Rotor Assembled Lateral Runout Measurement**

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.

5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

NOTE:

- **Do NOT install used correction plates in an attempt to correct brake rotor assembled LRO.**
- **Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.**

6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.

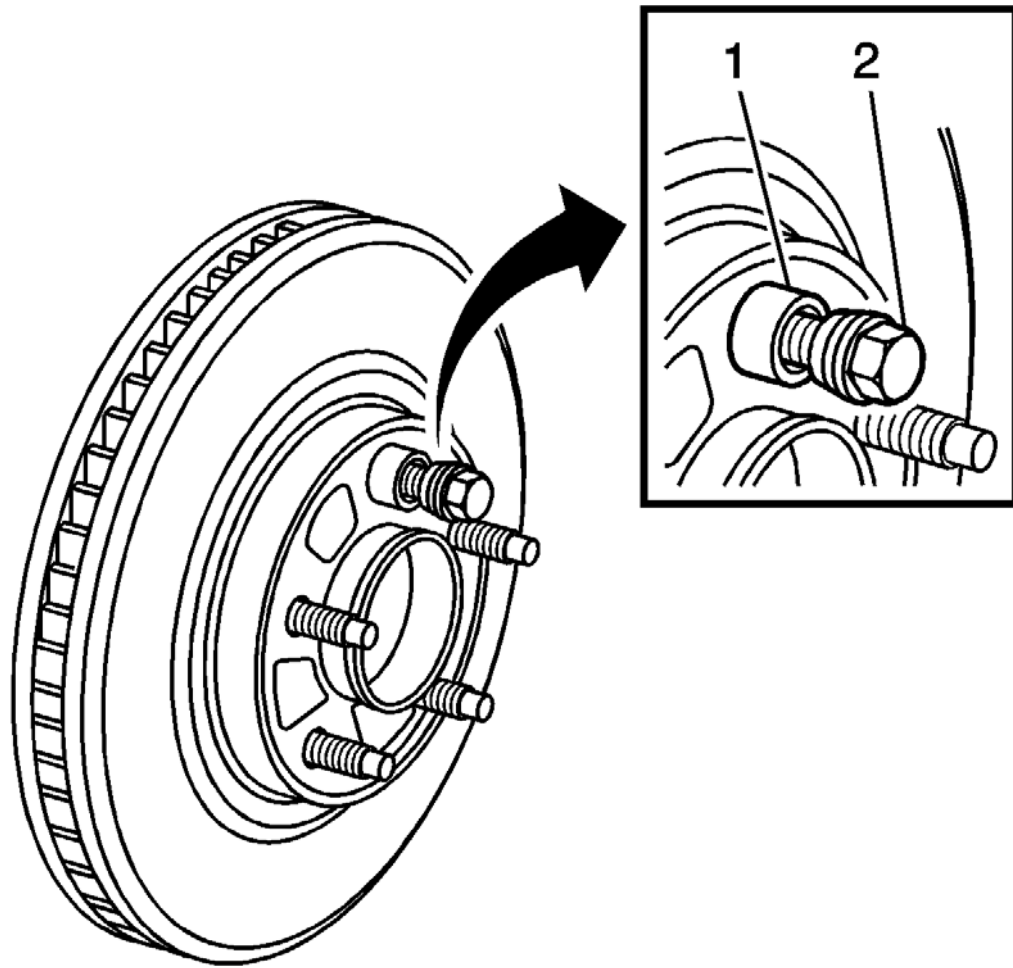


Fig. 118: Conical Brake Rotor Washer And Lug Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
8. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

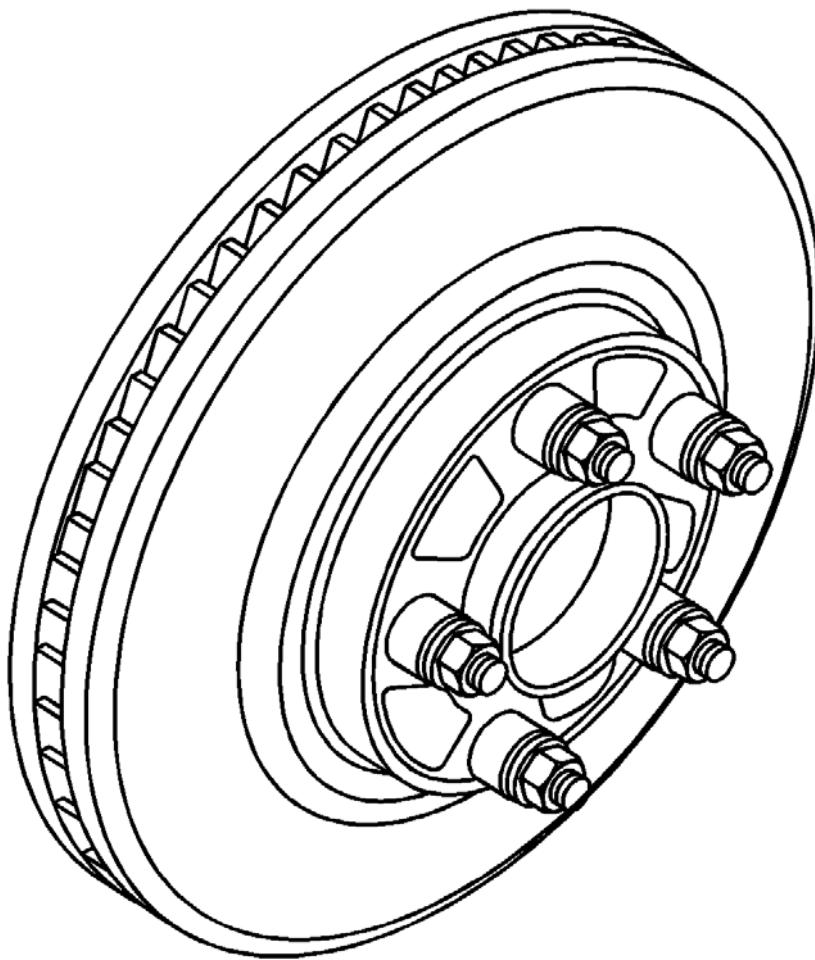


Fig. 119: Conical Brake Rotor Washers And Lug Nuts

Courtesy of GENERAL MOTORS COMPANY

10. Install the remaining **CH-45101-100** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
11. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to [Tire and Wheel Removal and Installation](#)
12. Measure the assembled LRO of the brake rotor. Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to [Brake Rotor Assembled Lateral Runout Correction](#).
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - ON VEHICLE LATHE

NOTE: This procedure is not used in Europe.

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

NOTE:

- Brake rotor thickness variation **MUST** be checked **BEFORE** checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to [Brake Rotor Thickness Variation Measurement](#)
- Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 - 11300 km (3,000 - 7,000 mi). Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. Refer to [Brake Rotor Thickness Measurement](#)
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
 2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
 3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to [Brake Rotor Assembled Lateral Runout Correction](#).
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR REFINISHING

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Dust Warning](#) .

NOTE:

- The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.

Do not refinish disc brake rotors in an attempt to correct the following conditions:

- Brake system noise - squeal, growl, groan
- Uneven and/or premature disc brake pad wear
- Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface
- Scoring of the disc brake rotor friction surface less than the maximum allowable specification
- Before refinishing a brake rotor, the rotor **MUST** first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Refer to [Brake Rotor Thickness Measurement](#)

Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

- Thickness variation in excess of the maximum allowable specification
- Excessive corrosion/rust and/or pitting
- Cracks and/or heat spots
- Excessive blueing discoloration
- Scoring of the disc brake rotor surface in excess of the maximum allowable specification
- Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.

NOTE:

If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.

NOTE:

Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating

surface of the hub/axle flange.

2. Using the **CH-41013** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. Refer to [Brake Rotor Thickness Measurement](#)
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
 1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
 2. Using moderate pressure, apply the non-directional finish:
 - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
 - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.

NOTE: Thoroughly cleaning the brake rotor will prevent the possible transfer of finite metal dust left as a by-product of machining to the brake pad material during the burnishing process, thereby reducing the possibility for brake squeal or other brake noises to occur.

3. After applying a non-directional finish, clean each friction surface of the brake rotor with a solution of mild dish washing detergent and water, or a GM approved brake cleaner and a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. Refer to [Brake Rotor Assembled Lateral Runout Measurement](#)
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. Refer to [Brake Rotor Assembled Lateral Runout Correction](#)

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

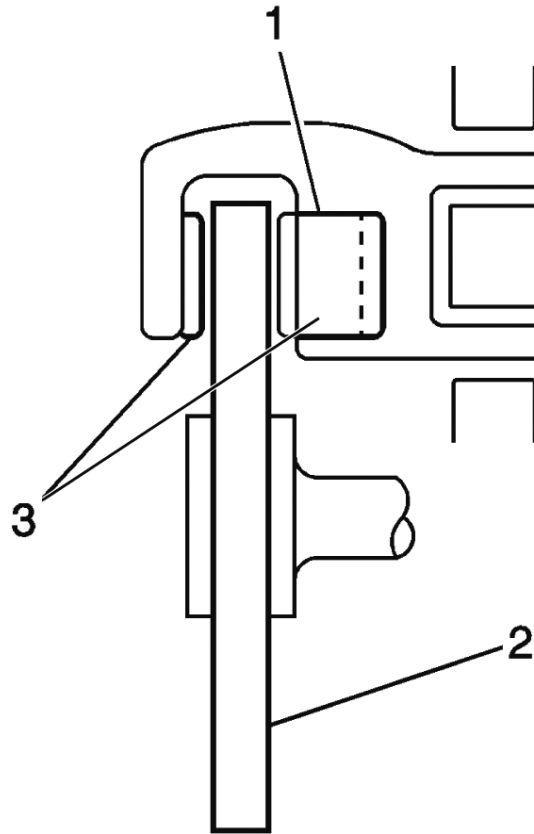


Fig. 120: Brake Caliper Piston, Rotor And Brake Pads

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Brake Caliper Caution](#) .

The brake caliper is single piston type; and is installed on knuckle by two mounting bolts. Brake caliper transforms hydraulic pressure generated by depressing brake pedal into braking force. The braking force evenly acts on the piston (1) and the bottom of brake caliper cylinder bore, and then move the piston outward and slide brake caliper inward so that there generates a clamping effect on brake rotor (2). The clamping effect forces brake pad (3) to attach to brake rotor, and the resulting friction will make vehicles stop.

When maintaining the brake caliper, replace all parts included in repair sets.

- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- Do not apply compressed air to brake parts with workshop with lubricant, otherwise the rubber parts may be damaged.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace whole brake pad (3) according to service parts in the maintenance package.
- The torque values are specified for dry, non-lubricated fasteners.

- Perform the service operations on a clean bench, free from all mineral oil materials.

Gap Calibration

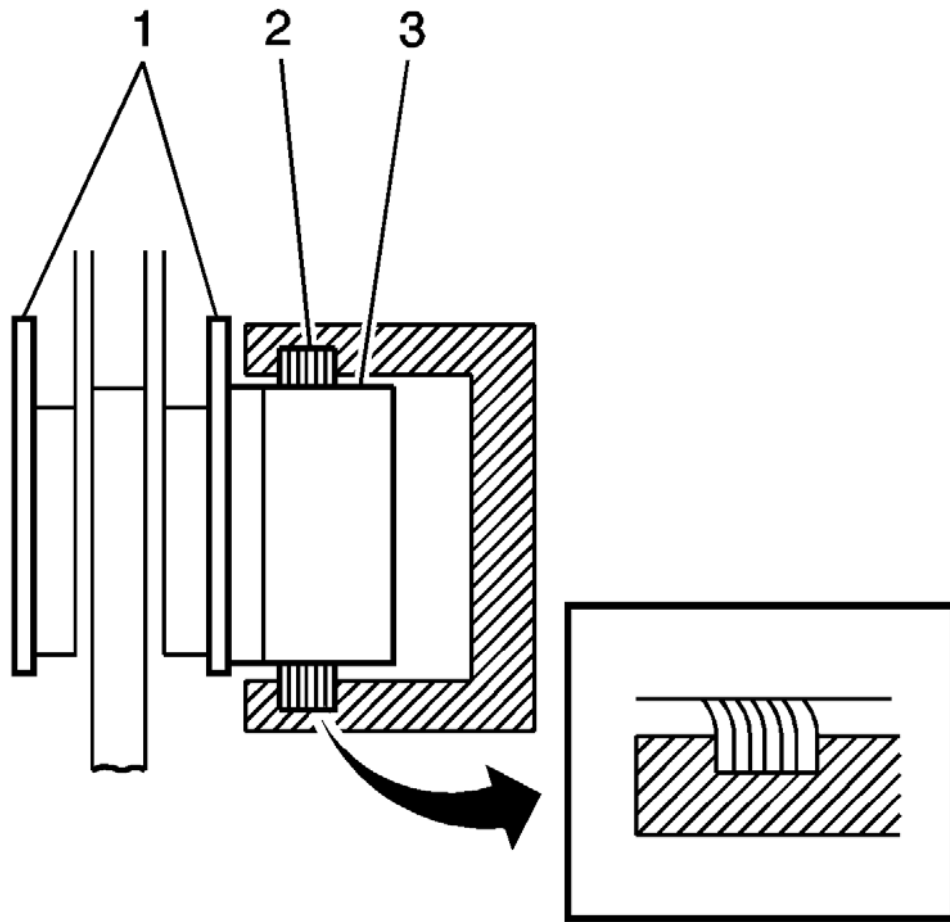


Fig. 121: Sectional View Of Pads, Piston Seal And Piston
Courtesy of GENERAL MOTORS COMPANY

When the hydraulic pressure acts on the piston (3), the piston moves left. The piston seals (2) exert pressure on the piston and move together with the cylinder. However, parts of the piston seals are fixed in the grooves of the cylinder. As shown, the shape of seals deforms toward the direction of piston.

When the pressure on the brake pedal is removed and the hydraulic pressure on the piston is released, there generates recovery elasticity on the seals. The force pushes the piston to the right side and return to its original position.

When the brake pad (1) exhibits wear, and the gap between the brake rotor and brake pad gets much larger, the piston moves farther.

Seals may further deform. Because the end of seals is fixed in the groove of the cylinder, the deformation is limited in the above-mentioned scope. Pistons further move to fill the gap. When the piston returns to the same position, the rubber seals resume original shape, and the gap between brake rotor and brake pad keeps the original level.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

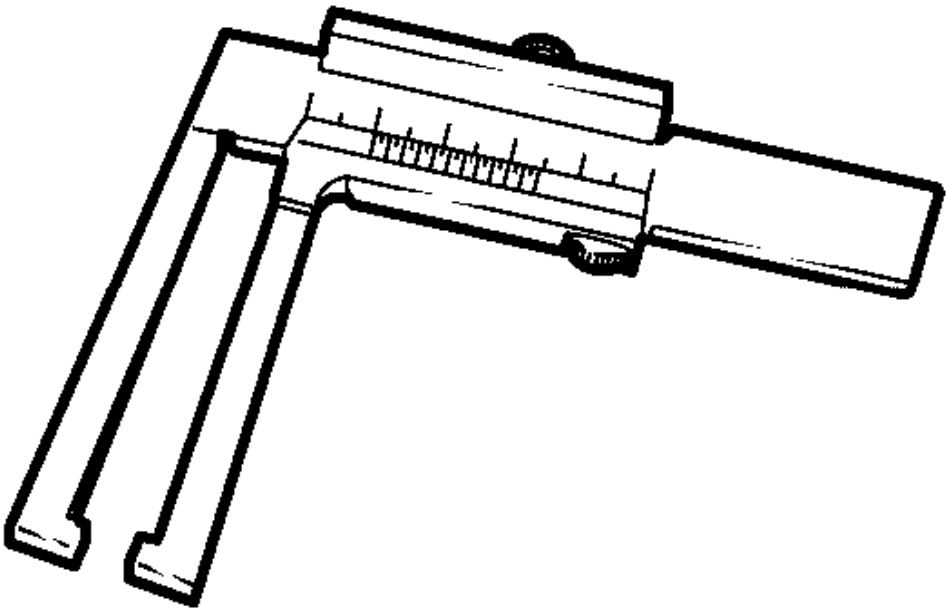
Illustration	Tool Number/Description
	CH-230-A MKM-230-A J-21177-A Disc Gauge

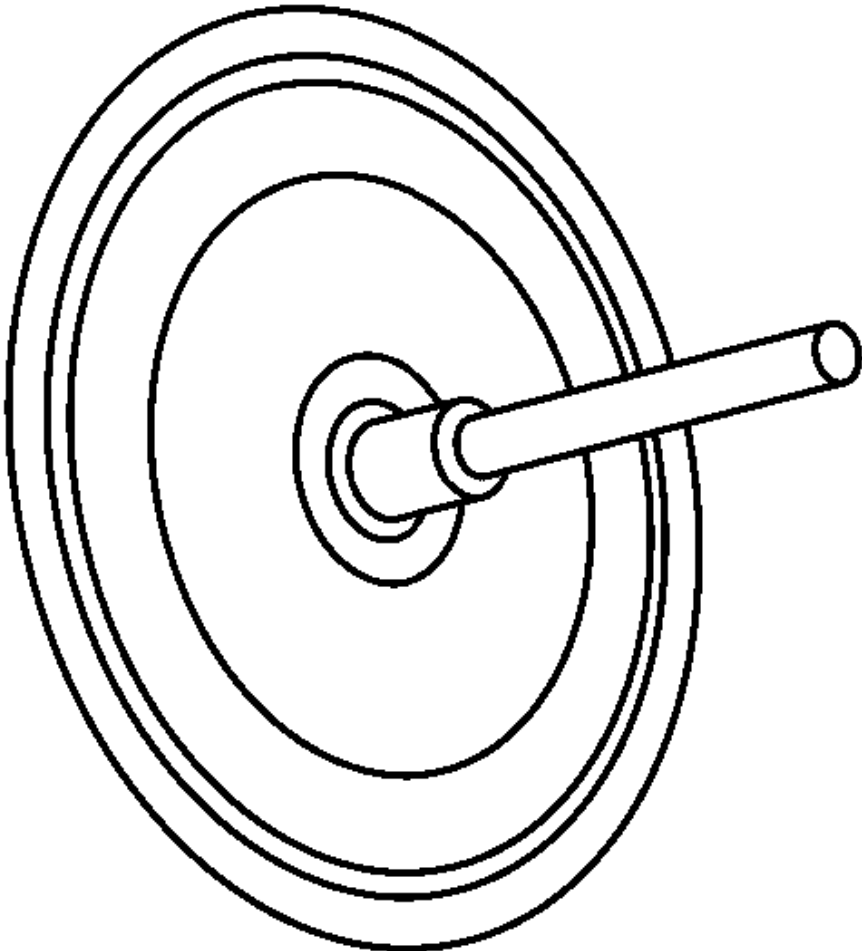
Illustration	Tool Number/Description
	CH-41013 J-41013 Rotor Resurfacing Kit

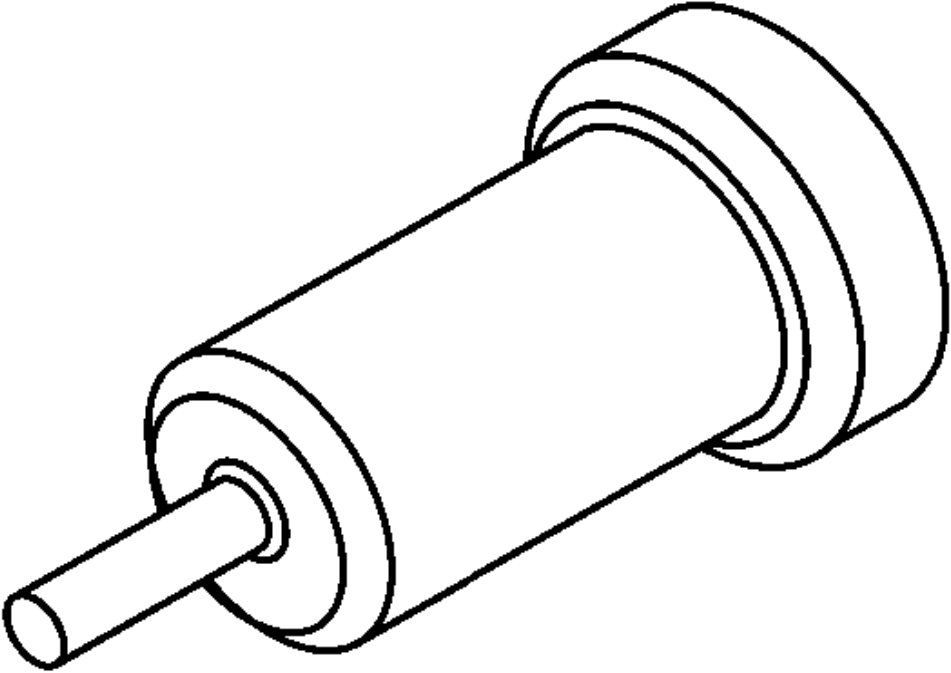
Illustration	Tool Number/Description
	CH-42450-A J-42450-A Wheel Hub Resurfacing Kit

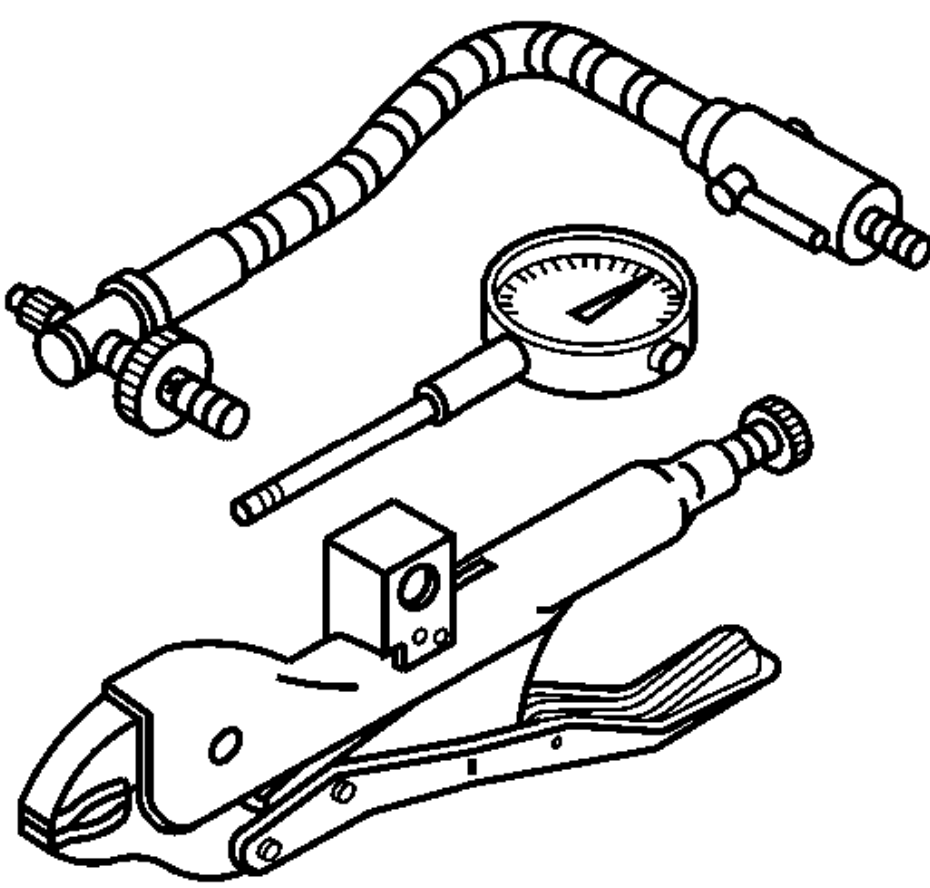
Illustration	Tool Number/Description
	CH-45101 J-45101 Hub and Wheel Runout Gauge

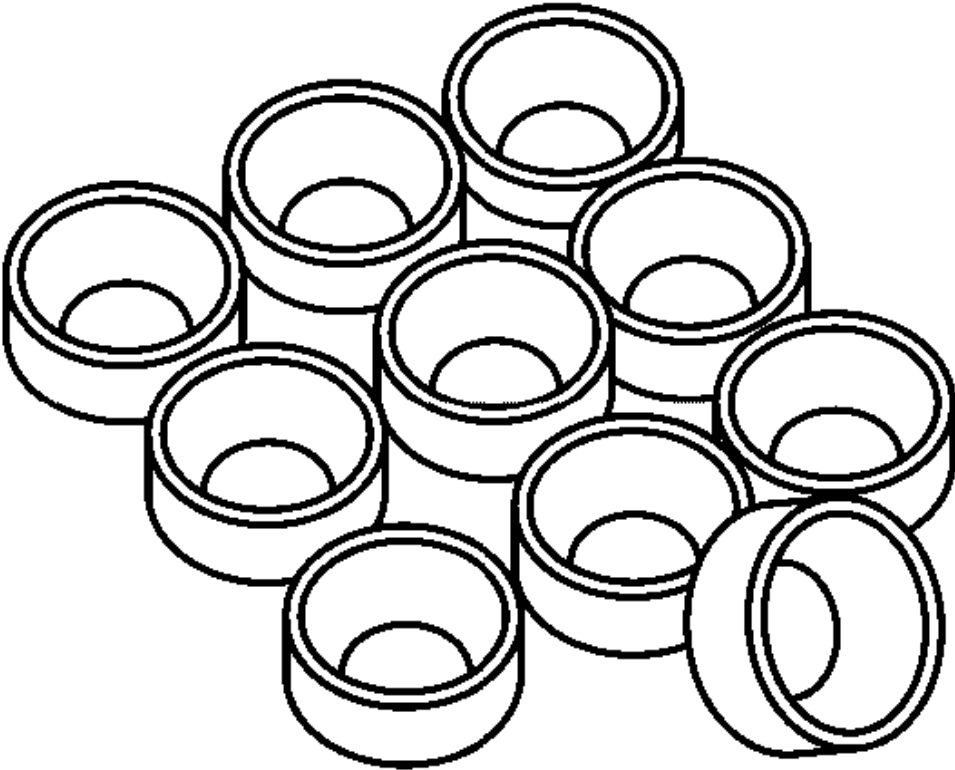
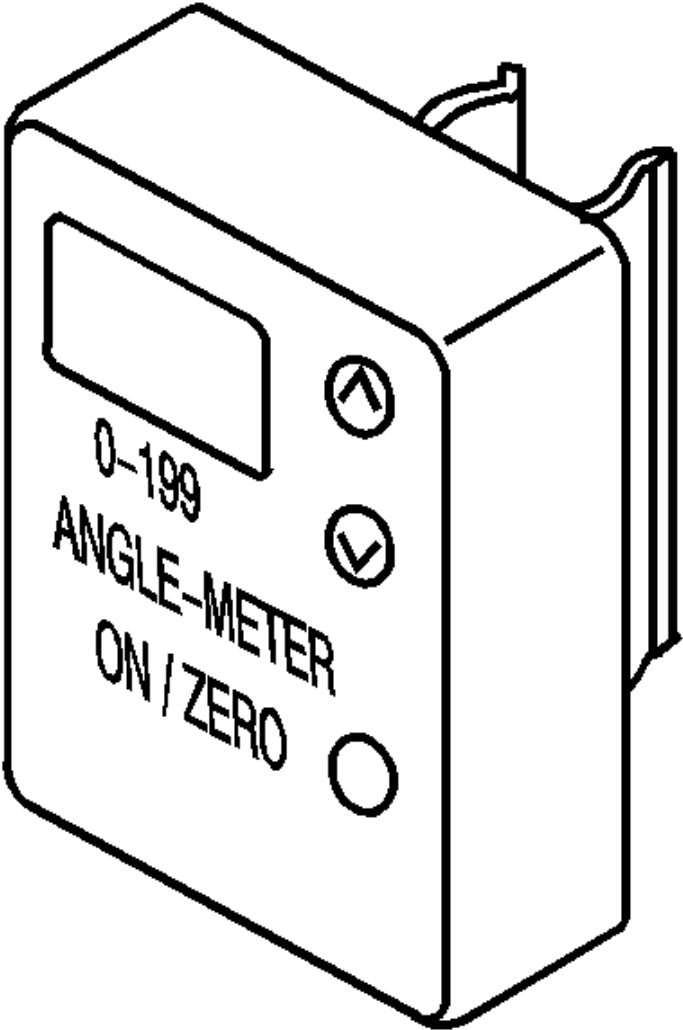
Illustration	Tool Number/Description
 A cluster of 12 conical brake rotor washers. The washers are arranged in a loose, overlapping pile. Each washer is a shallow, conical cup shape with a double-line rim. They are drawn in a simple line-art style with no shading.	CH-45101-100 J-45101-100 Conical Brake Rotor Washers

Illustration	Tool Number/Description
	EN-45059 J-45059 Angle Meter

Article GUID: A00884650

BRAKES

Hydraulic Brakes - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Brake Hose Fitting Gasket
Master Cylinder Primary Piston Assembly
Master Cylinder Primary Piston Retainer
Master Cylinder Secondary Piston Seal
Master Cylinder Secondary Piston Seal Retainer
Power Brake Booster Gasket

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake and Accelerator Pedal Assembly Bolt	20 N.m (15 lb ft)
Brake Hose Fitting Bolt - Front and Rear	40 N.m (30 lb ft)
Brake Master Cylinder Bolt	22 N.m (16 lb ft)
Brake Master Cylinder Reservoir Bolt	2.5 N.m (22 lb in)
Brake Master Cylinder Brake Pipe Fitting	32 N.m (24 lb ft)
Brake Pipe Fitting	20 N.m (15 lb ft)
Brake Pipe Fitting at Brake Pressure Modulator Valve (BPMV)	32 N.m (24 lb ft)
Brake Pressure Modulator Valve Primary Brake Pipe Fitting	32 N.m (24 lb ft)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Brake Pressure Modulator Valve Secondary Brake Pipe Fitting	32 N.m (24 lb ft)
Power Brake Booster Bolt	22 N.m (16 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
Hydraulic Brake System	1 liter	1.06 quarts

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Caliper Bleeder Valve - Front	10 N.m	89 lb in
Brake Caliper Bleeder Valve - Rear	13 N.m	115 lb in

BRAKE SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English
Brake Pedal Travel Maximum specification with 445 N (100 lbs) of force applied to the pedal with the power OFF.	44 mm	1.73 in

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Hydraulic Brake System	DOT 3 Motor Vehicle Brake Fluid	19299818	19299819

SCHEMATIC WIRING DIAGRAMS**HYDRAULIC BRAKE WIRING SCHEMATICS**

Hydraulic Brakes

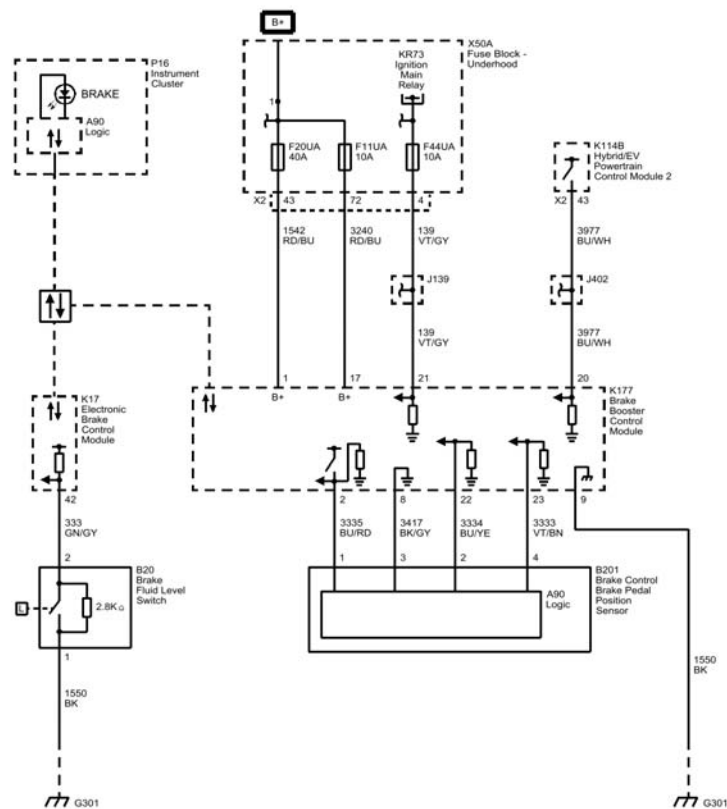


Fig. 1: Hydraulic Brakes

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0075: BRAKE PEDAL POSITION SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0075

Brake Pedal Position Sensor Performance

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Pedal Position Sensor = Out Of Range

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0075 is not set.
 - **If the DTC is set**

Replace the component: K177 Brake Booster Control Module
 - **If the DTC is not set**
3. All OK.

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode

2. Verify DTC C0075 is not set.

- **If the DTC is set**

1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module

2. Verify the DTC does not set.

- If the DTC sets - Replace the component:K177 Brake Booster Control Module

- If the DTC is not set

3. All OK.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0579, C057A, OR C057E: BRAKE BOOSTER CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis:[Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0579

Brake Booster Control Module Temperature Sensor 2 Circuit Low Voltage

DTC C057A

Brake Booster Control Module Temperature Sensor 2 Circuit High Voltage

DTC C057E

Brake Booster Control Module Temperature Sensor 1-2 Correlation

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost= Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0579, C057A, C057E is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, OR C1275-C1277: BRAKE BOOSTER MOTOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C057F

Brake Booster Motor 1 Phase U-V-W Circuit

DTC C0582

Brake Booster Motor 1 Phase U-V-W Circuit Performance

DTC C058A

Brake Booster Motor 1 Position Sensor Circuit Performance

DTC C0590

Brake Booster Motor 1 Phase U-V-W Circuit High Current

DTC C0591

Brake Booster Motor 1 Phase U-V-W Circuit Low Current

DTC C0595

Brake Booster Control Module Internal Driver Performance

DTC C0596

Brake Booster Motor 1 Current Sensor Circuit Performance

DTC C1275

Brake Booster Motor Position Sensor Unexpected Reset

DTC C1276

Brake Booster Motor Position Sensor Message Counter Incorrect

DTC C1277

Brake Booster Motor Position Sensor Configuration Error

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

C057F, C0582, C0590, C0591

- Ignition - On / Vehicle - In Service Mode
- Brake Pedal = Released
- Automatic Braking Event = None - For greater than 5 s

C058A, C0595, C0596, C1275, C1276, C1277

- Vehicle = On

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276, C1277 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C0580 OR C0594: BRAKE BOOSTER MOTOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis:[Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C0580

Brake Pedal Position Sensor Performance

DTC C0594

Brake Pedal Position Sensor Performance

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Pedal Position Sensor = Out Of Range

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Brake System Warning Indicator = On

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0580, C0594 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
3. All OK.

- If the DTC is not set

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C1072: BRAKE FLUID LEVEL SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1072

Brake Fluid Level Sensor Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C1072 05 C111C	C1072 05	C1072 05	-
Ground	-	C1072 05 C111C	-	-

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B20 Brake Fluid Level Switch	The brake fluid level switch is a normally open switch that closes when the brake fluid is below the minimum level. The switch is magnetically actuated by a float.
K17 Electronic Brake Control Module	The electronic brake control module detects a malfunction and sends a serial data message to the instrument cluster

Component	Description
	requesting illumination of the brake warning indicator.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- Ground circuit = open
- Signal circuit = open/Short to Ground

Actions Taken When the DTC Sets

Brake System Warning Indicator = On

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition/Vehicle - Off
2. Verify the condition does not exist: Incorrect fluid level or condition - Refer to: [Master Cylinder Reservoir Filling](#)
 - **If a condition exists**
Repair or replace as necessary.
 - **If no condition exists**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B20 Brake Fluid Level Switch
3. Test for less than 10 ohms between the test points: Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect ground terminal.
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 2 @ Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Brake Fluid Level Sensor = OK
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K17 Electronic Brake Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground
7. Verify the scan tool parameter: Brake Fluid Level Sensor = Low
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K17 Electronic Brake Control Module
- **If the specified state**

8. Test or replace the component: B20 Brake Fluid Level Switch

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C111C: LOW BRAKE FLUID INDICATED

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C111C

Low Brake Fluid Indicated

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C1072 05 C111C	C1072 05	C1072 05	-
Ground	-	C1072 05 C111C	-	-

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B20 Brake Fluid Level Switch	The brake fluid level switch is a normally open switch that closes when the brake fluid is below the minimum level. The switch is magnetically actuated by a float.

Component	Description
K17 Electronic Brake Control Module	The electronic brake control module detects a malfunction and sends a serial data message to the instrument cluster requesting illumination of the brake warning indicator.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- Ground circuit = open
- Signal circuit = open/Short to Ground

Actions Taken When the DTC Sets

Brake System Warning Indicator = On

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition/Vehicle - Off
2. Verify the condition does not exist: Incorrect fluid level or condition - Refer to: Master Cylinder Reservoir Filling
 - If a condition exists

Repair or replace as necessary.

- **If no condition exists**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B20 Brake Fluid Level Switch
3. Test for less than 10 ohms between the test points:Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect ground terminal.
 2. Test for less than 1 ohms between the test points:Ground circuit terminal 2 @Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Brake Fluid Level Sensor = OK
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K17 Electronic Brake Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points:Signal circuit terminal 1 & Ground
7. Verify the scan tool parameter: Brake Fluid Level Sensor= Low
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:Signal circuit terminal 1 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points:Signal circuit terminal 1 @ Component harness & The other end of the circuit @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K17 Electronic Brake Control Module
- **If the specified state**

8. Test or replace the component: B20 Brake Fluid Level Switch

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC C1278 OR C1279: BRAKE SYSTEM DATA 2 MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1278

Brake System Data 1 Message Counter Incorrect

DTC C1279

Brake System Data 2 Message Counter Incorrect

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C1278, C1279 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
 - 3. All OK.
- **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

For control module replacement, programming, and setup refer to: Control Module References

DTC C1449: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis:Strategy Based Diagnosis

- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1449

System Configuration Error

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C1449 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P057B-P057E, P05DC-P05DF, OR P05E0: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P057B

Brake Pedal Position Sensor 1 Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor 1 Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

DTC P05DC

Brake Pedal Position Sensor "B" Circuit Range/Performance

DTC P05DD

Brake Pedal Position Sensor 2 Circuit Low Voltage

DTC P05DE

Brake Pedal Position Sensor 2 Circuit High Voltage

DTC P05DF

Brake Pedal Position Sensor 2 Circuit Erratic

DTC P05E0

Brake Pedal Position Sensors 1-2 Not Plausible

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD	P057C, P05DE	-	-
Brake Pedal Position Sensor Signal 1	P057C	P057C	P057D	P057B, P05E0
Brake Pedal Position Sensor Signal 2	P05DD	P05DE	P05DE	P05DC, P05E0
Low Reference	-	P057C, P05DE	-	-

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The pedal travel sensor is connected to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference, and two signal circuits.

Conditions for Running the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

P057B

The brake pedal position sensor 1 upper and lower and lower range has been exceeded

P057E

Brake pedal position sensor 1 erratic signal

P057C

Brake pedal position sensor 1 signal shorted to ground

P057D

Brake pedal position sensor 1 signal shorted to voltage

P05DC

The brake pedal position sensor 2 upper and lower and lower range has been exceeded

P05DD

Brake pedal position sensor 2 signal shorted to ground

P05DE

Brake pedal position sensor 2 signal shorted to voltage

P05DF

Brake pedal position sensor 2 erratic signal

P05E0

The deviation between Brake pedal position sensor 1 and 2 is too large

Action Taken When the DTC Sets

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

- No boost or blending is available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC P050E may set if the brake pedal is applied for 60 seconds or more while also applying the accelerator pedal.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the harness connector at the K177 Brake Booster Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K177 Brake Booster Control Module.
 - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K177 Brake Booster Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
 - **If between 4.8 - 5.2 V**
5. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
- **If greater than 1 V**
 1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
 - **If less than 1 V**
6. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
7. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
- **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
8. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
9. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
- **If greater than 1 V**
 1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
 - **If less than 1 V**
10. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
11. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
- **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**

12. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

13. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup

DTC P0601, P0603, P0604, P0606, P060B, OR P062F: CONTROL MODULE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0601, P0603, P0604, P0606, P060B, P062F is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
3. All OK.

- If the DTC is not set

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0642, P06A6, OR P06A7: SENSOR REFERENCE VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0642

Sensor Reference Voltage 1 Low Voltage

DTC P06A6

Sensor Reference Voltage 1 Performance

DTC P06A7

Sensor Reference Voltage 2 Performance

For symptom byte information refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD, P06A6, P06A7	P057C, P05DE, P0642	-	P06A6, P06A7

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The pedal travel sensor is attached to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference, and two signal circuits.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Pedal travel sensor voltage supply failure

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON/Vehicle in Service Mode.
3. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF/ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K177 Brake Booster Control Module.
 - **If greater than 5.2 V**
1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K177 Brake Booster Control Module.
 - **If between 4.8 - 5.2 V**
4. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup

DTC P25C6 OR P25C7: BRAKE BOOSTER TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P25C6

Brake Booster Temperature Sensor Circuit Low Voltage

DTC P25C7

Brake Booster Temperature Sensor 1 Circuit High Voltage

Symptom Byte Information: [Symptom Byte List](#)

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Control Module Temperature= Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P25C6, P25C7 is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module:K177 Brake Booster Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component:K177 Brake Booster Control Module
 - If the DTC is not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: [Control Module References](#)

SYMPTOMS - HYDRAULIC BRAKES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform [Diagnostic System Check - Vehicle](#) before using the brake indicator symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control module(s) can communicate via the serial data link.
2. Perform the [Brake System Vehicle Road Test](#) before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
3. Review the system operation in order to familiarize yourself with the system functions.
 - [Power Brake Booster Description and Operation](#)
 - [Brake Warning System Description and Operation](#)
 - [Hydraulic Brake System Description and Operation](#)
 - [Disc Brake System Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the brake warning system. [Checking Aftermarket Accessories](#)
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. [Testing for Intermittent Conditions and Poor Connections](#)

Symptom List

Perform a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Brake Warning Indicator Malfunction](#)
- [Brake Pulsation](#)
- [Brake System Noise](#)
- [Braking Action Uneven - Pulls to One Side](#)
- [Braking Action Uneven - Front to Rear](#)
- [Brake Pedal Excessive Travel](#)
- [Brake Pedal Excessive Effort](#)
- [Brakes Drag](#)
- [Brake System Slow Release](#)
- [Brake Fluid Loss](#)

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC C1072

Brake Fluid Level Sensor Circuit

Symptom Byte Information: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C1072 05 C111C	C1072 05	C1072 05	-
Ground	-	C1072 05 C111C	-	-

Circuit/System Description

For an overview of the component/system, refer to: [Hydraulic Brake System Description and Operation](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B20 Brake Fluid Level Switch	The brake fluid level switch is a normally open switch that closes when the brake fluid is below the minimum level. The switch is magnetically actuated by a float.
K17 Electronic Brake Control Module	The electronic brake control module detects a malfunction and sends a serial data message to the instrument cluster requesting illumination of the brake warning indicator.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- Ground circuit = open

- Signal circuit = open/Short to Ground

Actions Taken When the DTC Sets

Brake System Warning Indicator = On

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition/Vehicle - Off
2. Verify the condition does not exist: Incorrect fluid level or condition - Refer to: **Master Cylinder Reservoir Filling**
 - **If a condition exists**

Repair or replace as necessary.
 - **If no condition exists**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B20 Brake Fluid Level Switch

3. Test for less than 10 ohms between the test points: Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect ground terminal.
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 2 @ Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Brake Fluid Level Sensor = OK
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K17 Electronic Brake Control Module
 - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground
7. Verify the scan tool parameter: Brake Fluid Level Sensor = Low
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K17 Electronic Brake Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K17 Electronic Brake Control Module
 - **If the specified state**
8. Test or replace the component: B20 Brake Fluid Level Switch

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- For control module replacement, programming, and setup refer to: [Control Module References](#)

BRAKE PULSATION

Step	Action	Yes	No
DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	1. Inspect the disc brake system for the following conditions. - Excessive thickness variation of rotor friction surfaces - Excessive assembled lateral runout (LRO) of rotor friction surfaces - Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag - Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation - Loose, damaged or missing caliper or lining hardware - Bent or damaged caliper or mounting component - Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Perform the disc brake system diagnostic procedure. Disc Brake System Diagnosis 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to Step 3	Go to Symptoms - Hydraulic Brakes
3	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM NOISE

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	1. Inspect the disc brake system for the following conditions. • Lining wear indicator contact with rotor • Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings • Contaminated linings • Aftermarket linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Damaged or excessively worn caliper hardware and/or lining hardware • Incorrectly installed, loose or missing caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged splash shield or backing plate • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. <u>Disc Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	1. Inspect the brake apply system for the following conditions. • Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	Inspect the park brake system for proper operation. <u>Park Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to <u>Diagnostic Starting Point - Vehicle</u>
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

5

Steering components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	1. Inspect the hydraulic brake system for the following conditions. • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston	Go to Step 6	Go to Step 3

Step	Action	Yes	No
	• Brake fluid leak 2. Adjust, repair or replace components as necessary. Hydraulic Brake System Diagnosis Did you find and correct a condition?		
3	1. Inspect the disc brake system for the following conditions. • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 6	Go to Step 4
4	1. Inspect the suspension system for the following conditions. • Incorrect tire pressures • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Diagnostic Starting Point - Vehicle Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	1. Inspect the steering system for the following conditions. • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Diagnostic Starting Point - Vehicle	Go to Step 6	Go to Diagnostic Starting Point - Vehicle

Step	Action	Yes	No
	Did you find and correct a condition?		
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Descriptions

The number below refers to the step number on the diagnostic table.

4

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improper operation of dynamic rear proportion (DRP) system 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to Step 3
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings	Go to Step 6	Go to Step 4

Step	Action	Yes	No
	• Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. <u>Disc Brake System Diagnosis</u> Did you find and correct a condition?		
4	1. Inspect the suspension system for the following conditions: • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. <u>Diagnostic Starting Point - Vehicle</u> Did you find and correct a condition?	Go to Step 6	Go to Step 5
5	1. Inspect the brake apply system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Binding, bent or damaged brake pedal • Binding, bent or damaged brake pedal bracket 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 6	Go to <u>Diagnostic Starting Point - Vehicle</u>
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Symptoms - Hydraulic Brakes
2	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Place the Power button in the Service Only mode. 2. Remove one of the Electric Brake Boost fuses from the Engine Compartment Fuse Block. 3. Apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. Did you complete the brake pedal travel and feel inspections?	Go to Step 3	-
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections: • Pedal feel was spongy • Air in hydraulic system • External brake fluid leaks • Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor • External brake fluid leaks • Poor brake fluid quality; low boiling point • Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies • Internal brake fluid leaks; improperly functioning master cylinder • Poor brake fluid quality; low boiling point • Pedal returned to rest slowly after any of the applies • Internally damaged flexible brake	Go to Step 9	Go to Step 4

Step	Action	Yes	No
	hoses; hindering fluid return • Binding caliper pistons • Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?		
4	1. Inspect the disc brake system for the following conditions: • Cracked, excessively worn or damaged linings • Cracked, excessively worn or damaged rotors • Improperly operating, binding or damaged caliper hardware and/or lining hardware • Loose or missing caliper hardware and/or lining hardware • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. <u>Disc Brake System Diagnosis</u> 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to Step 9	Go to Step 5
5	Inspect for proper brake pedal travel. <u>Brake Pedal Travel Measurement and Inspection</u> Is the brake pedal travel distance within the acceptable limits?	Go to Step 8	Go to Step 6

Step	Action	Yes	No
6	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. • Perform the brake pedal pushrod component inspection. Brake Pedal Pushrod Inspection. • Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to Step 9	Go to Step 7
7	1. Replace the brake master cylinder assembly. 2. Inspect the brake pedal travel. Brake Pedal Travel Measurement and Inspection Did you find and correct a condition?	Go to Step 9	Go to Step 8
8	1. Inspect the brake assist system for the following conditions: • Internal fluid leaks and/or restrictions within the brake modulator assembly • Damaged or improperly operating brake modulator assembly 2. Adjust, repair or replace components as necessary. Hydraulic Brake System Diagnosis Did you find and correct a condition?	Go to Step 9	Go to Symptoms - Hydraulic Brakes
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Brake System Vehicle Road Test Is the condition still present?	Go to Step 2	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to Diagnostic Starting Point -

Step	Action	Yes	No
			<u>Vehicle</u>
2	1. Inspect the brake assist system for the following conditions: • Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings • Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 5	Go to Step 3
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 5	Go to Step 4
4	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing	Go to Step 5	Go to <u>Diagnostic Starting Point - Vehicle</u>

Step	Action	Yes	No
	discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. <u>Disc Brake System Diagnosis</u> Did you find and correct a condition?		
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKES DRAG

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to Step 3	Go to Step 4
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to Step 14	Go to Step 4
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to Step 5	Go to Step 7
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to Step 6	Go to Step 7
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system.	Go to Step 14	Go to Step 7

Step	Action	Yes	No
	Did you find and correct a condition?		
7	Inspect the park brake system for proper operation. Park Brake System Diagnosis Did you find and correct a condition?	Go to Step 14	Go to Step 8
8	1. Inspect the disc brake system for the following conditions: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware - Ensure free movement of linings and of caliper, if equipped with sliding type caliper • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Disc Brake System Diagnosis Did you find and correct a condition?	Go to Step 14	Go to Step 9
9	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to Step 11	Go to Step 10
10	1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to Step 14	-
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present.	Go to Step 13	Go to Step 12

Step	Action	Yes	No
	Do the brake corners still exhibit the brake drag condition?		
12	Replace the brake booster assembly. Did you complete the replacement?	Go to Step 14	-
13	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 14	Go to <u>Diagnostic Starting Point - Vehicle</u>
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKE SYSTEM SLOW RELEASE

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	1. Inspect the hydraulic brake and assist system for the following conditions: • Improper operation of caliper pistons • Internally damaged flexible brake hoses; hindering brake release • Contaminated brake fluid • Damaged or improperly operating master cylinder • Damaged or improperly operating hydraulic booster, if equipped • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket	Go to Step 4	Go to Step 3

Step	Action	Yes	No
	2. Adjust, repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?		
3	1. Inspect the disc brake system for the following conditions: • Damaged or excessively worn caliper hardware and/or lining hardware • Distorted or damaged linings • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. <u>Disc Brake System Diagnosis</u> Did you find and correct a condition?	Go to Step 4	Go to <u>Symptoms - Hydraulic Brakes</u>
4	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

BRAKE FLUID LOSS

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimp joints • Brake pipe fittings • Caliper piston seals • Wheel cylinder piston seals, if equipped • Master cylinder reservoir • Master cylinder reservoir low pressure hose, if equipped	Go to Step 8	Go to Step 3

Step	Action	Yes	No
	Brake pressure modulator valve (BPMV) assembly, if equipped 2. Repair or replace components as necessary. <u>Hydraulic Brake System Diagnosis</u> Did you find and correct a condition?		
3	Is the vehicle equipped with a vacuum brake booster?	Go to Step 4	Go to Step 6
4	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to Step 5	Go to <u>Diagnostic Starting Point - Vehicle</u>
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to Step 8	-
6	1. Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. 2. Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to Step 7	Go to <u>Diagnostic Starting Point - Vehicle</u>
7	Replace the brake master cylinder. Did you complete the replacement?	Go to Step 8	-
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. <u>Brake System Vehicle Road Test</u> Is the condition still present?	Go to Step 2	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

The numbers below refer to the step numbers on the diagnostic table:

9

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

10

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

12

Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.

15

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

19

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

22

Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Diagnostic Starting Point - Vehicle</u>
2	Visually inspect the disc brake pads for the following conditions: <u>Brake Pad Inspection</u> • Lining thickness below specifications • Uneven and/or abnormal wear - edge-to-edge and/or side-to-side • Looseness or damage - including pad hardware • Evidence of contamination from an external substance	Go to Step 3	Go to Step 12

Step	Action	Yes	No
	Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?		
3	Are any of the front and/or rear disc brake pads contaminated?	Go to Step 8	Go to Step 4
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to Step 7	Go to Step 5
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to Step 7	Go to Step 6
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. <u>Front Disc Brake Pads Replacement</u> , and/or <u>Rear Disc Brake Pads Replacement</u> Did you complete the inspection and replacement?	Go to Step 12	-
7	CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake	Go to Step 12	-

Step	Action	Yes	No
	hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or from the suspension knuckles and support the calipers. Front Brake Caliper Replacement , and/or Rear Brake Caliper Replacement 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: Front Disc Brake Mounting and Hardware Inspection , and/or Rear Disc Brake Mounting and Hardware Inspection • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures, as required: • Front Brake Caliper Bracket Replacement • Rear Brake Caliper Bracket Replacement 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Front Disc Brake Pads Replacement , and/or Rear Disc Brake Pads Replacement Did you complete the inspection and replacement?		

Step	Action	Yes	No
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: • Front Brake Caliper Replacement • Rear Brake Caliper Replacement • Front Brake Hose Replacement • Rear Brake Hose Replacement • Brake Pipe Replacement Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	Go to Step 9
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	Go to Step 10
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to Step 11	-
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. CAUTION:	Go to Step 12	-

Step	Action	Yes	No
	Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak. NOTE: Do NOT disconnect the hydraulic brake flex hoses from the calipers. 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Front Brake Caliper Replacement , and/or Rear Brake Caliper		

Step	Action	Yes	No
	<u>Replacement</u> 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: <u>Front Disc Brake Mounting and Hardware Inspection</u> , and/or <u>Rear Disc Brake Mounting and Hardware Inspection</u> • Binding or seized hardware • Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. 5. Replace the contaminated disc brake pads as a complete axle set. <u>Front Disc Brake Pads Replacement</u> , and/or <u>Rear Disc Brake Pads Replacement</u> Did you complete the cleaning, inspection and replacement?		
12	Visually inspect each of the rear disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to Step 13	Go to Step 14
13	Repair or replace the disc brake rotor shields/backing plates as required. <u>Front Brake Shield Replacement</u> , or <u>Rear Brake Shield Replacement</u> Did you complete the repair or replacement?	Go to Step 14	-

Step	Action	Yes	No
14	1. Check the thickness of each of the disc brake rotors. NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Brake Rotor Thickness Measurement Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to Step 15	Go to Step 18
15	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Brake Rotor Thickness Variation Measurement Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 17	Go to Step 16
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: Brake Rotor Surface and Wear Inspection • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level	Go to Step 17	Go to Step 22

Step	Action	Yes	No
	NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the determination. Does the brake rotor require REFINISHING?		
17	1. Refinish the brake rotor. <u>Brake Rotor Refinishing</u> 2. Inspect the brake rotor thickness. <u>Brake Rotor Thickness Measurement</u> Were you able to REFINISH the brake rotor within the minimum requirements?	Go to Step 22	Go to Step 21
18	Is the brake rotor at or below the DISCARD requirements?	Go to Step 21	Go to Step 19
19	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. <u>Brake Rotor Thickness Variation Measurement</u> Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to Step 21	Go to Step 20
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: <u>Brake Rotor Surface and Wear Inspection</u> • Heavy rust and/or pitting • Cracks and/or heat spots • Excessive blueing discoloration • Deep or excessive scoring beyond maximum acceptable level	Go to Step 21	Go to Step 22

Step	Action	Yes	No
	NOTE: Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor. 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?		
21	NOTE: Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes. Replace the brake rotor. <u>Front Brake Rotor Replacement</u> , or <u>Rear Brake Rotor Replacement</u> Did you complete the replacement?	Go to Step 24	-
22	NOTE: Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor. Inspect each of the disc brake rotors for assembled LRO that exceeds the maximum acceptable level. <u>Brake Rotor Assembled Lateral Runout Measurement</u> Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to Step 23	Go to Step 24

Step	Action	Yes	No
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. <u>Brake Rotor Assembled Lateral Runout Measurement</u> Did you complete the operation?	Go to Step 24	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to Step 2	Go to <u>Symptoms - Hydraulic Brakes</u>
2	Inspect and adjust the brake fluid level in the brake master cylinder. <u>Master Cylinder Reservoir Filling</u> Was the brake fluid level low?	Go to Step 3	Go to Step 4
3	- Inspect the brake fluid for the following conditions, indicating brake fluid contamination: - Fluid separation, indicating two types of fluid are present - Swirled appearance - oil-based substance - Layered appearance - silicone-based substance - Fluid discoloration - Cloudy appearance - moisture - Dark appearance/ suspended particles in fluid - dirt, rust, corrosion, brake dust - Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to Step 5	Go to Step 6
4	- Inspect the brake fluid for the following conditions, indicating brake fluid contamination: - Fluid separation, indicating two types of	Go to Step 5	Go to Step 12

Step	Action	Yes	No
	fluid are present • Swirled appearance - oil-based substance • Layered appearance - silicone-based substance • Fluid discoloration • Cloudy appearance - moisture • Dark appearance/ suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?		
5	1. Flush the hydraulic brake system. <u>Hydraulic Brake System Flushing</u> 2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated. 1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. 2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent. 3. Dry the brake pipes using non-lubricated, filtered air. 4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated. • Replace the brake master cylinder reservoir cap diaphragm. • <u>Master Cylinder Replacement</u> • Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or	Go to Step 9	-

Step	Action	Yes	No
	equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir. • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Front Brake Caliper Overhaul</u> , <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> • <u>Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement</u> 3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system. 4. Refill and bleed the hydraulic brake system. <u>Hydraulic Brake System Bleeding</u> Did you complete the operation and any required repairs and/or replacements?		
6	1. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: • Brake master cylinder reservoir cap diaphragm • <u>Master Cylinder Replacement</u> • <u>Front Brake Hose Replacement</u> • <u>Rear Brake Hose Replacement</u> • <u>Brake Pipe Replacement</u> • <u>Front Brake Caliper Overhaul</u> , <u>Front Brake Caliper Replacement</u> • <u>Rear Brake Caliper Replacement</u> • <u>Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement</u> 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. <u>Hydraulic Brake System Bleeding</u>	Go to Step 7	Go to Step 12

Step	Action	Yes	No
	While bleeding the hydraulic brake system, observe for the following conditions: • The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced • An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?		
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced?	Go to Step 19	Go to Step 8
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 9	Go to Step 10
9	Inspect the hydraulic function of the brake calipers and/or wheel cylinders, if equipped for proper operation. Hydraulic Brake Component Operation Visual Inspection Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 21	Go to Step 14
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to Step 13	Go to Step 11
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to Step 17	-
12	Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Hydraulic Brake Component Operation Visual Inspection Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to Step 15	Go to Step 13
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Remove the tire and wheel assemblies. Tire and Wheel Removal and Installation 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of	Go to Step 17	Go to Step 14

Step	Action	Yes	No
	brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?		
14	Repair or replace any brake caliper/wheel cylinder that was not operating properly. • Front Brake Caliper Overhaul , Front Brake Caliper Replacement • Rear Brake Caliper Replacement Did you complete the repair and/or replacement?	Go to Step 21	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Hydraulic Brake System Bleeding Was there air in the system?	Go to Step 19	Go to Step 16
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to Step 21	Go to Step 17
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Brake Pipe and Hose Inspection 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. • Front Brake Hose Replacement • Rear Brake Hose Replacement • Brake Pipe Replacement 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to Step 21	Go to Step 18
18	Replace the brake modulator assembly, in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Electronic Brake Control Module with Brake Pressure Modulator Valve	Go to Step 21	-

Step	Action	Yes	No
	<u>Replacement</u> Did you complete the replacement?		
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to Step 21	Go to Step 20
20	1. Inspect the brake master cylinder for internal fluid leaks. <u>Brake System Internal Leak Test</u> 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. <u>Master Cylinder Replacement</u> Did you find and correct a condition?	Go to Step 21	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. **Master Cylinder Reservoir Filling**
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Start the engine and allow it to idle.

2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. **Symptoms - Hydraulic Brakes**
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.
8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side, or front to rear.

A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

21. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test

drive the vehicle until it is repaired.

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

Special Tools

CH-28662 Brake Pedal Effort Gauge

For equivalent regional tools, refer to [Special Tools](#).

1. Perform this procedure with the power OFF and the brakes cool.

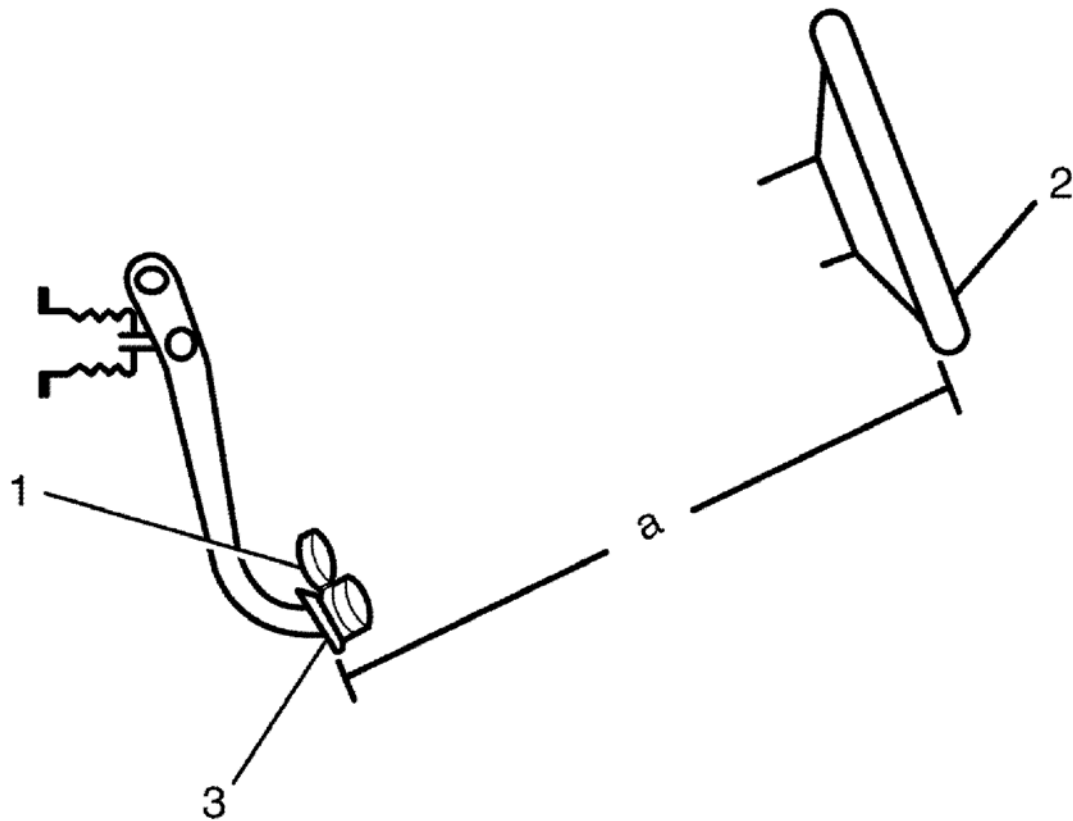


Fig. 2: Steering Wheel, Brake Pedal And Gauge

Courtesy of GENERAL MOTORS COMPANY

2. Install the **CH-28662** gauge (1), or equivalent, to the brake pedal (3).
3. Measure and record the distance (a) from the brake pedal (3) to the rim of the steering wheel (2). Note the points of measurement.

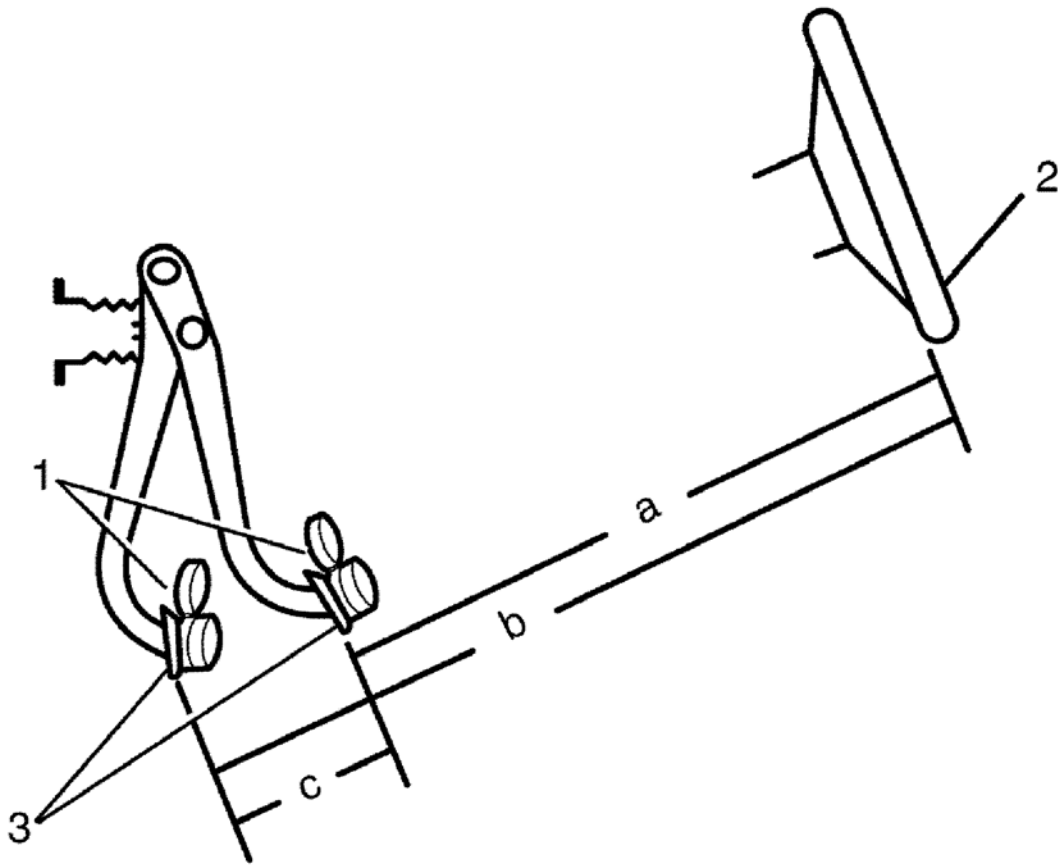


Fig. 3: Brake Pedal Components And Travel Measurement

Courtesy of **GENERAL MOTORS COMPANY**

4. Apply and maintain a force of 445 N (100 lb) to the brake pedal, as indicated on the **CH-28662** gauge (1), or equivalent.
5. While maintaining 445 N (100 lb) of force to the brake pedal (3), measure and record the distance (b) from the same point on the brake pedal (3) to the same point on the rim of the steering wheel (2).
6. Release the brake pedal (3) and repeat steps 4 and 5 to obtain a second measurement. After obtaining a second measurement, proceed to step 7.
7. Average the first and second measurements recorded for the 2 applies of the brakes.
8. Subtract the initial unapplied distance (a), from the average applied distance (b) to obtain the brake pedal travel measurement (c).
9. Compare the measurement obtained with the specification. Refer to **Brake System Specifications**.

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder.

While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

If the fluid level is abnormally low, adjust the brake fluid level. [Master Cylinder Reservoir Filling](#)

2. Start the engine and allow it to idle.
3. Apply constant, moderate foot pressure to the brake pedal.

If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
 - Master cylinder brake pipe fittings
 - All brake pipe connections
 - Brake pipes
 - Brake hoses and connections
 - Brake calipers and/or wheel cylinders, if equipped
6. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

BRAKE SYSTEM INTERNAL LEAK TEST

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Ensure is ignition is OFF for at least 60 seconds to allow the system to depressurize and deplete the power reserve.
2. Apply the brake pedal several times to verify the power reserve is fully depleted.
3. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
4. Release the brake pedal.
5. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
 1. Inspect the brake system for external leaks. [Brake System External Leak Inspection](#)
 2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. [Hydraulic Brake System Bleeding](#)

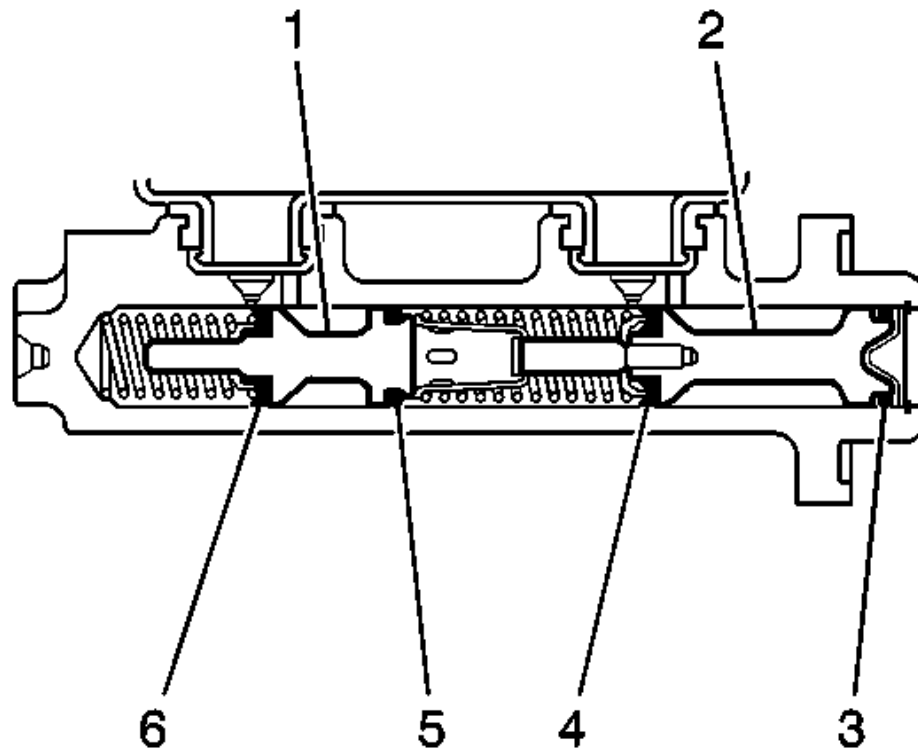


Fig. 4: Identifying Brake Master Cylinder (Cross Sectional View)

Courtesy of GENERAL MOTORS COMPANY

6. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
 1. Loosen the master cylinder-to-adapter mounting nuts.
 2. Carefully pull the master cylinder away from the adapter just enough to inspect the mounting surface of the master cylinder.
 3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
7. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires replacement.
8. If the master cylinder primary piston (2) does not exhibit any leakage, install the master cylinder to the adapter and pressure bleed the brake system. **Hydraulic Brake System Bleeding**
9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires replacement due to an internal leak past a piston seal.
10. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV)

may be leaking internally, and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

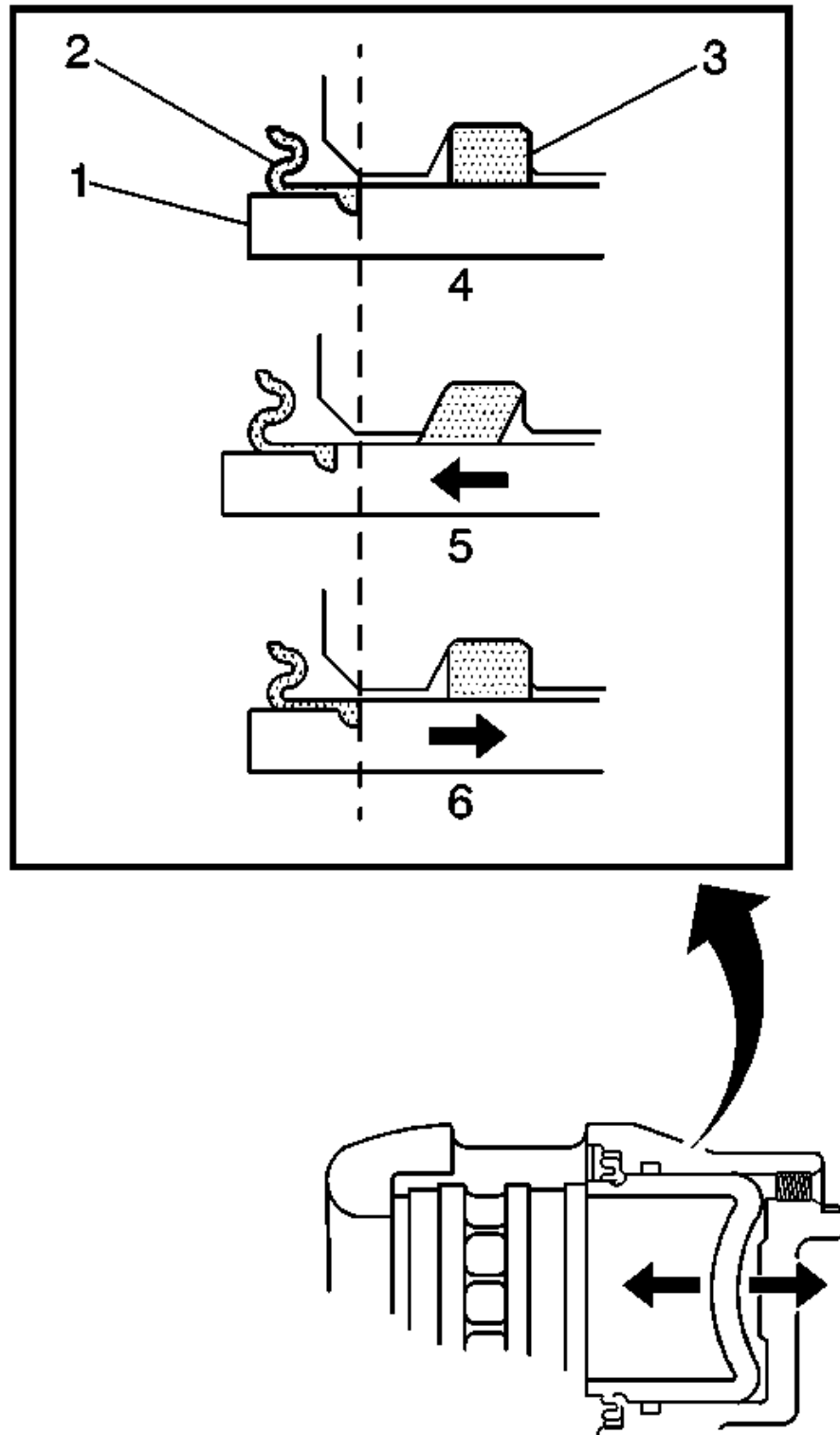


Fig. 5: Identifying Brake Caliper/Pad Inspection Areas

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.
4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
 1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
 2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

BRAKE PIPE AND HOSE INSPECTION

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Visually inspect all of the brake pipes for the following conditions:
 - Kinks, improper routing, missing or damaged retainers, Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

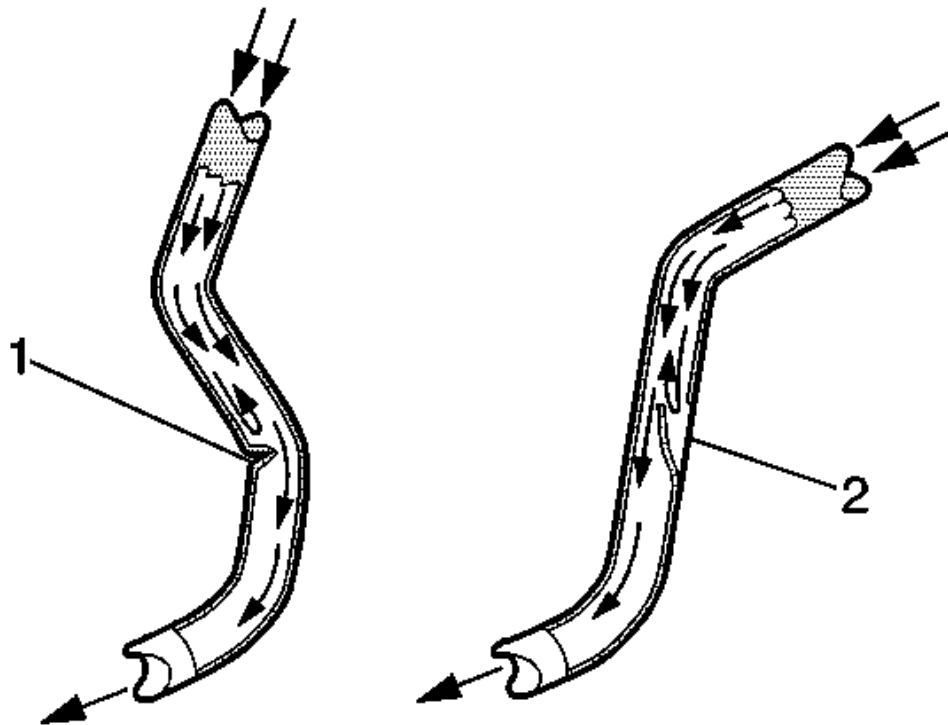


Fig. 6: Identifying Flexible Brake Hose Failure Conditions

Courtesy of GENERAL MOTORS COMPANY

4. Visually inspect all of the flexible brake hoses for the following conditions:
 - Kinks (1), improper routing, twists, chafing, missing or damaged retainers
 - Leaking connections, cracking, dry-rot, blisters, bulges
5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Tightly press the flexible brake hose with fingers to check whether there are any spongy spots (2) (which indicates the existence of interior blocking). Inspect the entire length of each hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

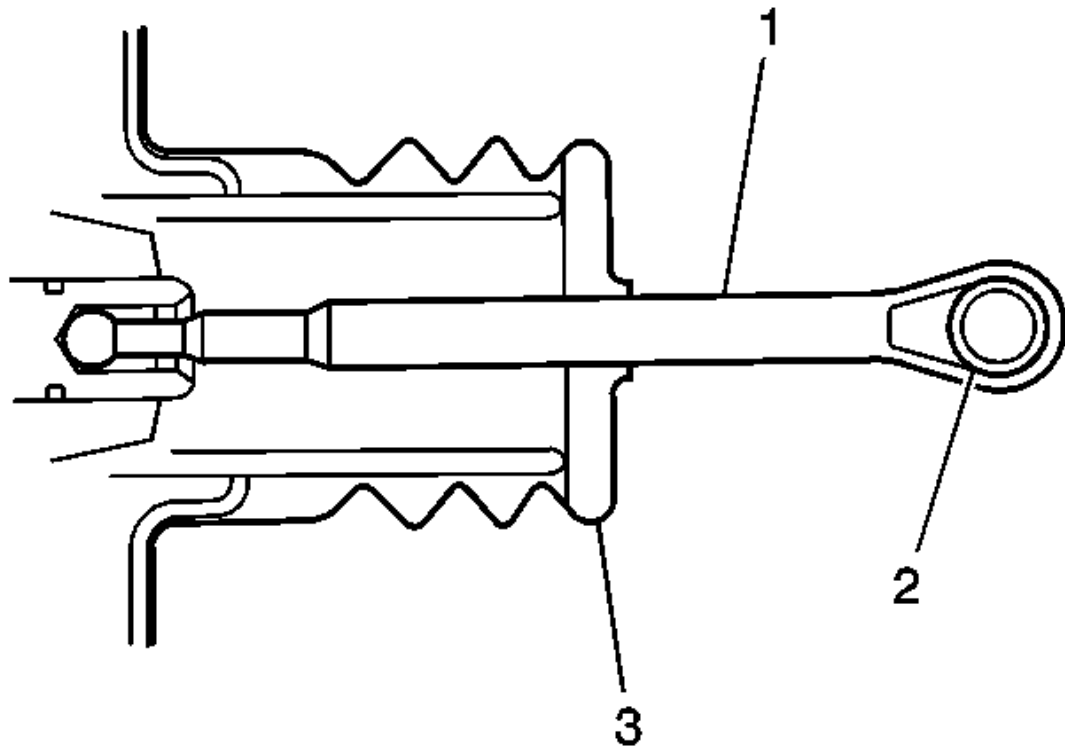


Fig. 7: View of Brake Pedal Pushrod

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the brake pedal pushrod (1) from the brake pedal.
2. Inspect the brake pedal pushrod eyelet bushing (2), if equipped, for cracks and/or excessive wear.
3. Reposition the pedal pushrod boot (3) toward the front of the vehicle to expose as much of the pedal pushrod (1) as possible.
4. Inspect the brake pedal pushrod (1) for straightness.
5. If the brake pedal pushrod eyelet bushing (2) exhibited cracks and/or excessive wear, then the bushing requires replacement.
6. If the brake pedal pushrod (1) is not straight, then the pushrod requires replacement.
7. Return the pedal pushrod boot (3) to its original position on the pedal pushrod (1).
8. Connect the brake pedal pushrod (1) to the brake pedal.

REPAIR INSTRUCTIONS

HYDRAULIC BRAKE FLUID REPLACEMENT

WARNING: [Brake Fluid Irritant Warning](#)

CAUTION: [Brake Fluid Effects on Paint and Electrical Components Caution](#)

CAUTION: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

1. With the engine OFF, apply and release the brake pedal several times until the pedal effort becomes firm to deplete the brake booster power reserve.
2. Clean the outer surface of the master cylinder brake fluid reservoir, on and around the reservoir cap, prior to removing the cap and diaphragm. [Master Cylinder Reservoir Filling](#)
3. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. [Adhesives, Fluids, Lubricants, and Sealers](#)
4. Maintain the brake fluid level in the master cylinder brake fluid reservoir to between the minimum and maximum-fill level during the brake fluid replacement procedure.
5. Following the hydraulic brake system bleeding procedure, bleed each of the hydraulic brake wheel circuits until clean, clear brake fluid is observed coming from each bleeder valve. [Hydraulic Brake System Bleeding](#)
6. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. [Master Cylinder Reservoir Filling](#)
7. Securely install the master cylinder brake fluid reservoir diaphragm and cap.
8. Slowly apply and release the brake pedal, observing the brake pedal feel.
9. If the brake pedal feels spongy, perform the following:
 1. Visually inspect the hydraulic brake system for external leaks. [Brake System External Leak Inspection](#)
 2. Using a scan tool, perform the antilock brake system automated bleed procedure to remove any air that may have become trapped in the brake pressure modulator valve (BPMV). [Antilock Brake System Automated Bleed](#)

MASTER CYLINDER RESERVOIR FILLING

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

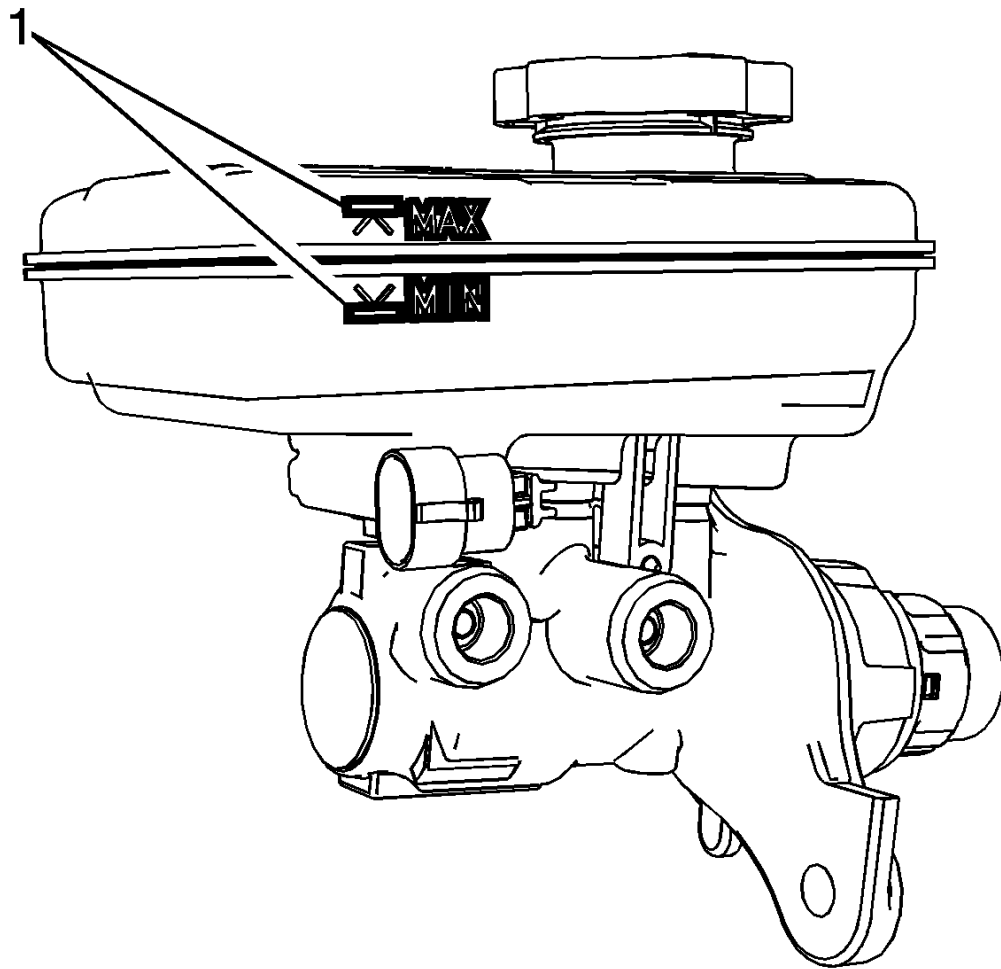


Fig. 8: Inspecting Brake Fluid Level Through Brake Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is half way or less between the MAX and MIN levels (1) in the master cylinder reservoir, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is half way or less between the MAX and MIN levels during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the MAX fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the MAX fill level.
5. If the brake fluid level is above the half way point, adding brake fluid is not recommended under normal conditions.
6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
7. If necessary, add GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

WARNING: Brake Fluid Irritant Warning

WARNING: Use of eye goggles is necessary to prevent personal injury.

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

1. Remove Dash Upper Extension Panel Opening Cover Replacement
2. Using a suitable tool, remove and properly dispose of the brake fluid from the brake master cylinder reservoir.

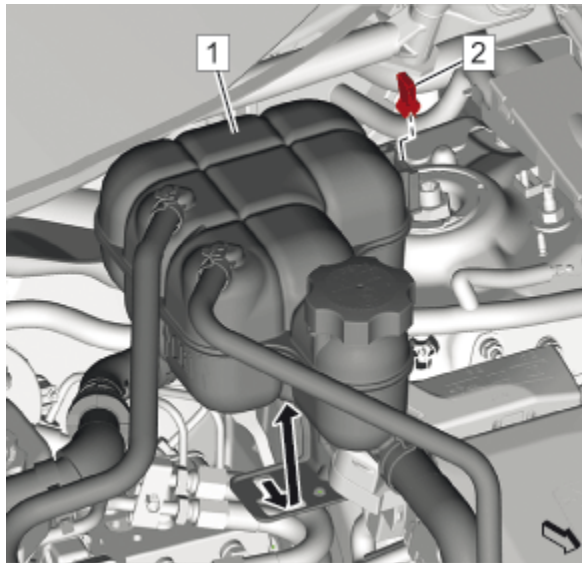


Fig. 9: Radiator Surge Tank And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

3. Remove Clip(2)@Radiator Surge Tank (1)
4. Slide the radiator surge tank forward and lift to remove.

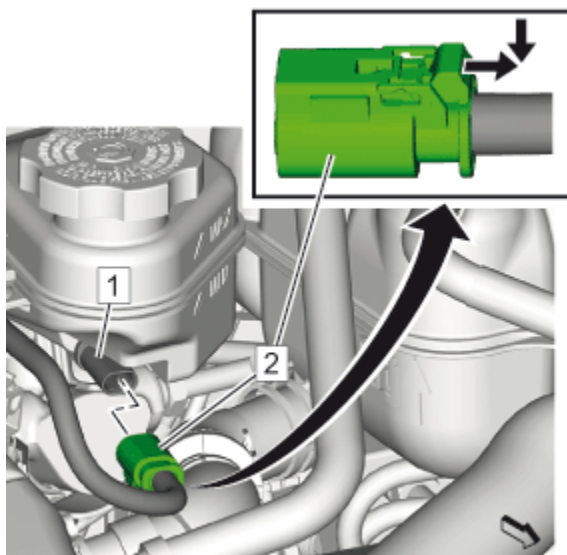


Fig. 10: Electrical Connector And Brake Fluid Level Sensor

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (2) @Brake Fluid Level Sensor (1)

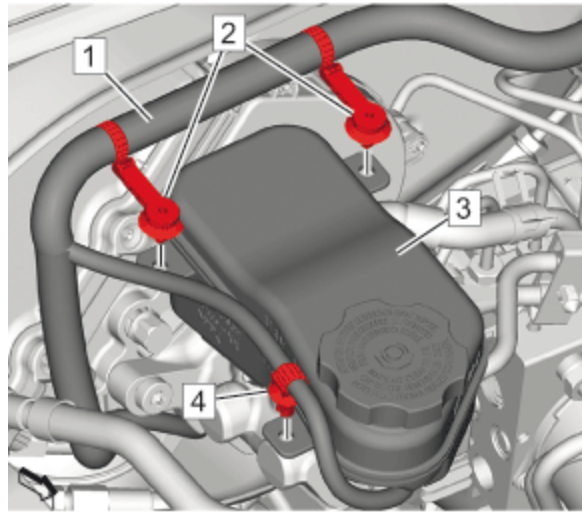


Fig. 11: Brake Master Cylinder Reservoir And Body Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

6. Unclip Clip (2)@Brake Master Cylinder Reservoir (3)
7. Unclip Clip (4) @Brake Master Cylinder Reservoir
8. Body Wiring Harness (1) @Brake Master Cylinder Reservoir

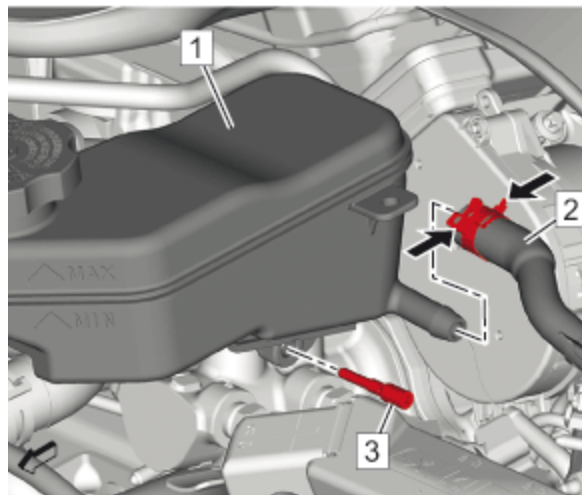


Fig. 12: Brake Master Cylinder Reservoir Hose

Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the opening to prevent contamination.

9. Disconnect Brake Master Cylinder Reservoir Hose (2)

10. Remove Bolt (3) @Brake Master Cylinder Reservoir (1)

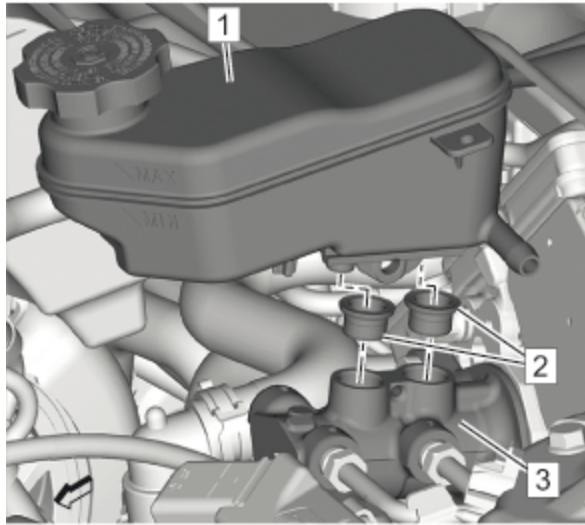


Fig. 13: Brake Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

NOTE: Protect the windshield edge before removing the component.

11. Remove Brake Master Cylinder Reservoir (1) @Brake Master Cylinder (3)
12. Remove Brake Master Cylinder Reservoir Seal (2) @Brake Master Cylinder
13. Remove **Brake Fluid Level Sensor Replacement**

Installation Procedure

1. Install **Brake Fluid Level Sensor Replacement**

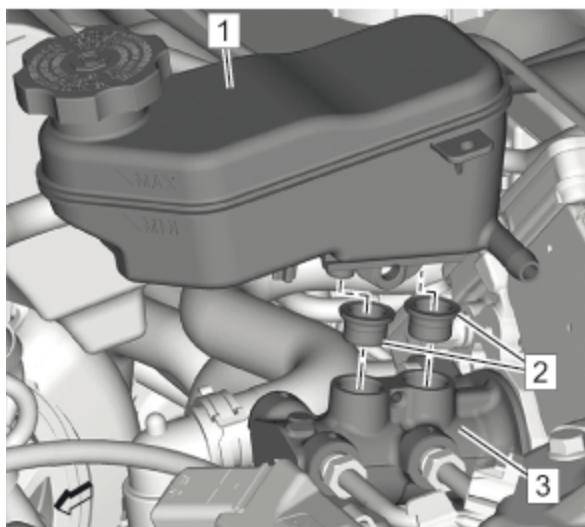


Fig. 14: Brake Master Cylinder Reservoir

Courtesy of GENERAL MOTORS COMPANY

2. Lubricate the brake master cylinder reservoir seals with GM approved brake fluid from a clean, sealed,

brake fluid container. - [Adhesives, Fluids, Lubricants, and Sealers](#)

3. Install Brake Master Cylinder Reservoir Seal (2) @Brake Master Cylinder (3)
4. Install Brake Master Cylinder Reservoir (1) @Brake Master Cylinder

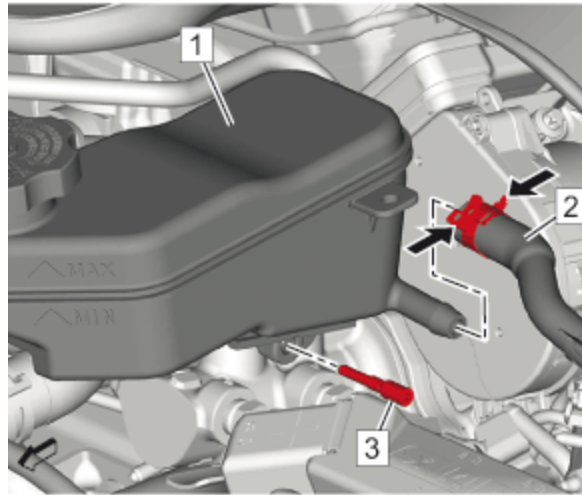


Fig. 15: Brake Master Cylinder Reservoir Hose
Courtesy of GENERAL MOTORS COMPANY

5. Connect Brake Master Cylinder Reservoir Hose (2)

CAUTION: [Fastener Caution](#)

6. Install Bolt (3) @Brake Master Cylinder Reservoir (1) and tighten 2.5 N.m (22 lb in)

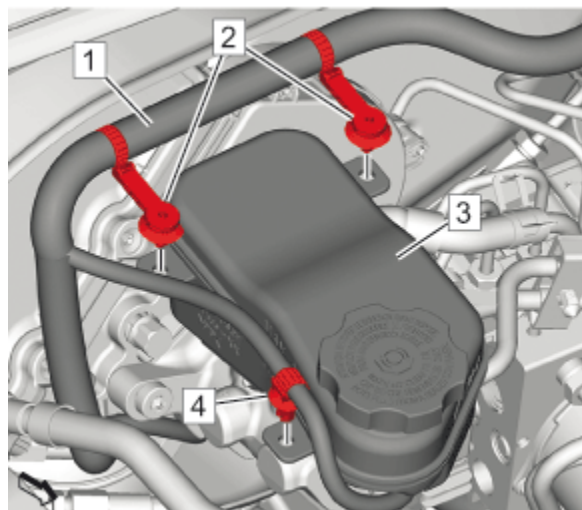


Fig. 16: Brake Master Cylinder Reservoir And Body Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

7. Install Body Wiring Harness (1) @Brake Master Cylinder Reservoir (3)
8. Install Clip (2) @Brake Master Cylinder Reservoir

9. Clip (4) @Brake Master Cylinder Reservoir

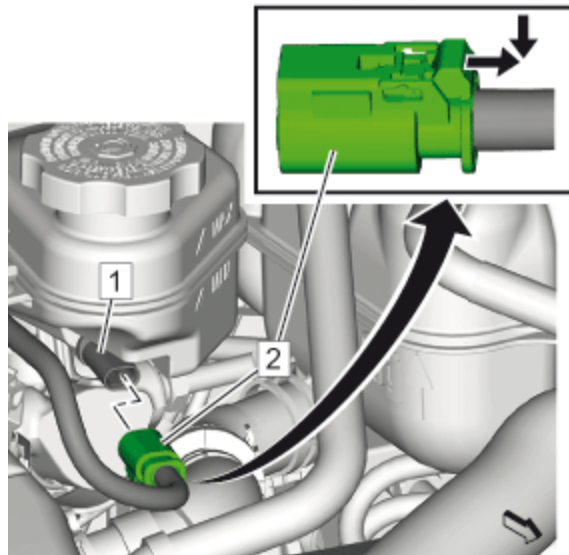


Fig. 17: Electrical Connector And Brake Fluid Level Sensor
Courtesy of GENERAL MOTORS COMPANY

10. Connect Electrical Connector (2) @Brake Fluid Level Sensor (1)

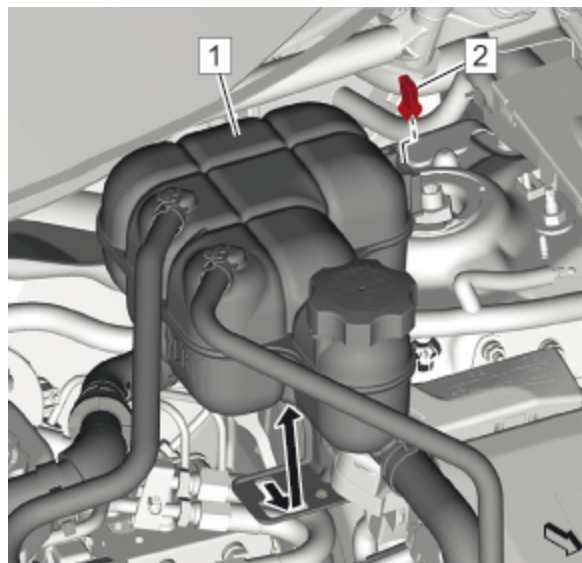


Fig. 18: Radiator Surge Tank And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

11. Install the radiator surge tank into the bracket and slide rearward to secure.(1)
12. Install Clip (2) @Radiator Surge Tank
13. Install **Dash Upper Extension Panel Opening Cover Replacement**
14. Bleed the brake system. **Hydraulic Brake System Bleeding**

MASTER CYLINDER REPLACEMENT

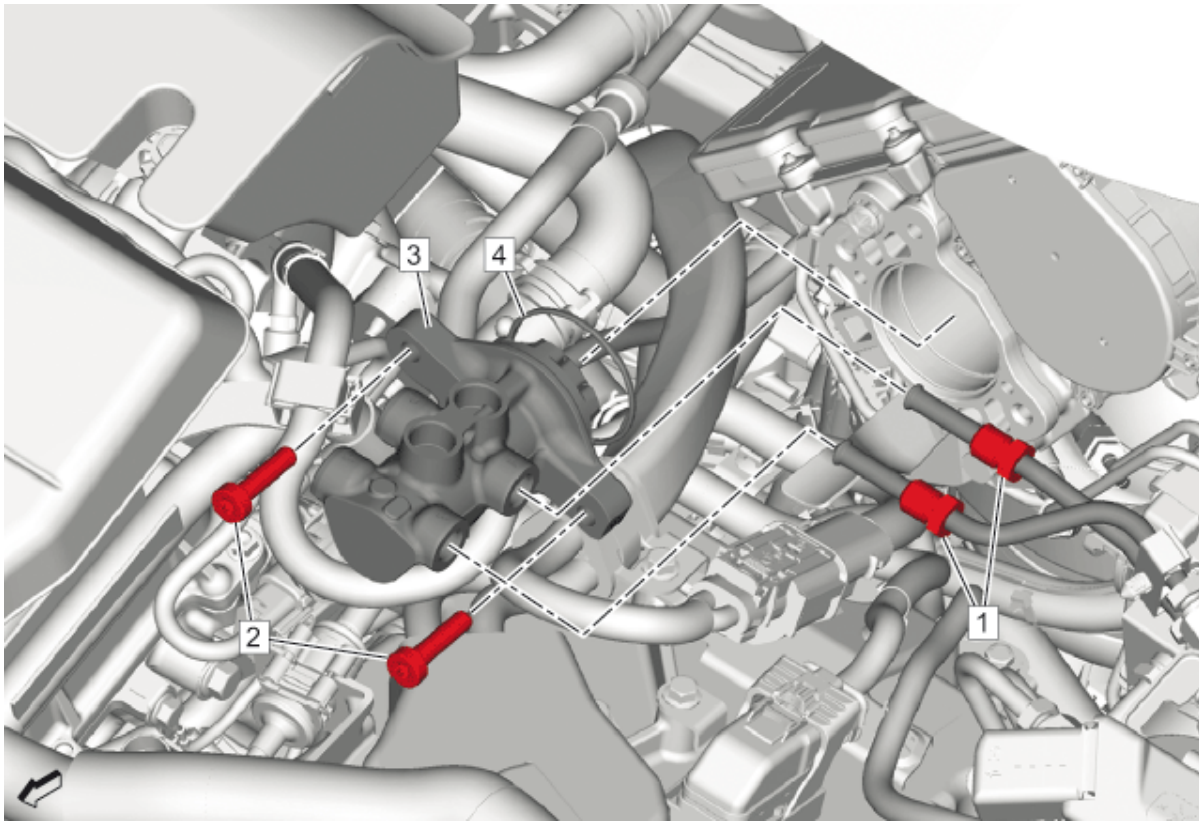


Fig. 19: Master Cylinder
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: <u>Brake Fluid</u> <u>Irritant</u> <u>Warning</u>	
WARNING: <u>Eye</u> <u>Protection</u> <u>Warning</u>	
CAUTION: <u>Brake Fluid</u> <u>Effects on</u> <u>Paint and</u> <u>Electrical</u> <u>Components</u> <u>Caution</u>	
CAUTION: If there is no brake fluid in	

Callout	Component Name
the master cylinder, remove one of the brake booster fuses before applying the brake pedal. Failure to do so may damage the electric brake booster. Preliminary Procedures 1. Remove one of the electric brake booster fuses from the engine compartment fuse block. 2. Dash Upper Extension Panel Opening Cover Replacement 3. Master Cylinder Reservoir Replacement	
1	Brake Pipe Fitting (Qty: 2) CAUTION: Fastener Caution Tighten 32 N.m (24 lb ft)
2	Brake Master Cylinder Bolt Tighten 22 N.m (16 lb ft)
3	Brake Master Cylinder Procedure Replace the power brake booster gasket. NOTE: Protect the windshield edge before removing the component. Cap the brake pipe fitting

Callout	Component Name
	and plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.
4	Brake Master Cylinder Seal Procedure Lubricate the seal with GM approved brake fluid from a clean, sealed, brake fluid container.

MASTER CYLINDER OVERHAUL

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

Disassembly Procedure

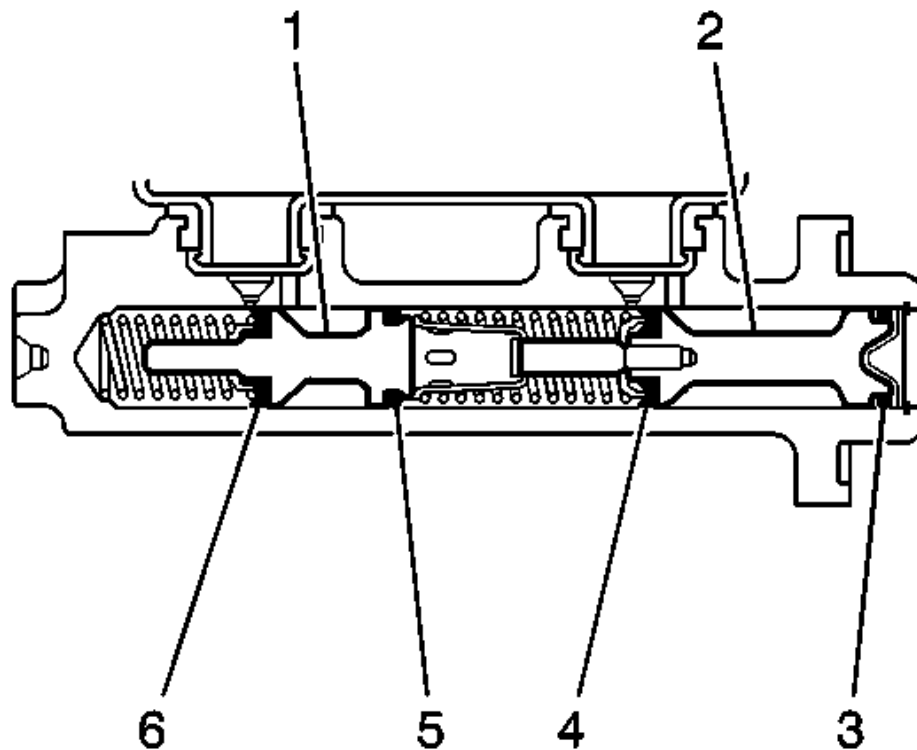


Fig. 20: Identifying Brake Master Cylinder (Cross Sectional View)

Courtesy of GENERAL MOTORS COMPANY

1. Remove the brake master cylinder from the vehicle. Refer to [**Master Cylinder Replacement**](#).
2. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
3. Clean the outside of the master cylinder reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Remove the reservoir cap and diaphragm from the reservoir.
5. Inspect the reservoir cap and diaphragm for the following conditions. If any of these conditions are present, replace the affected components.
 - Cuts or cracks
 - Nicks or deformation
6. Remove the master cylinder reservoir from the master cylinder. Refer to [**Master Cylinder Reservoir Replacement**](#).
7. Using a smooth, round-ended tool, depress the primary piston (2) and remove the piston retainer.
8. Remove the primary piston assembly from the cylinder bore.
9. Plug the cylinder inlet ports and the rear outlet port. Apply low pressure, non-lubricated, filtered air into the front outlet port, in order to remove the secondary piston (1) with the primary (6) and secondary (5) seals, and the return spring.
10. Discard the primary piston assembly, the piston retainer, and the seals and seal retainer from the secondary piston.

Assembly Procedure

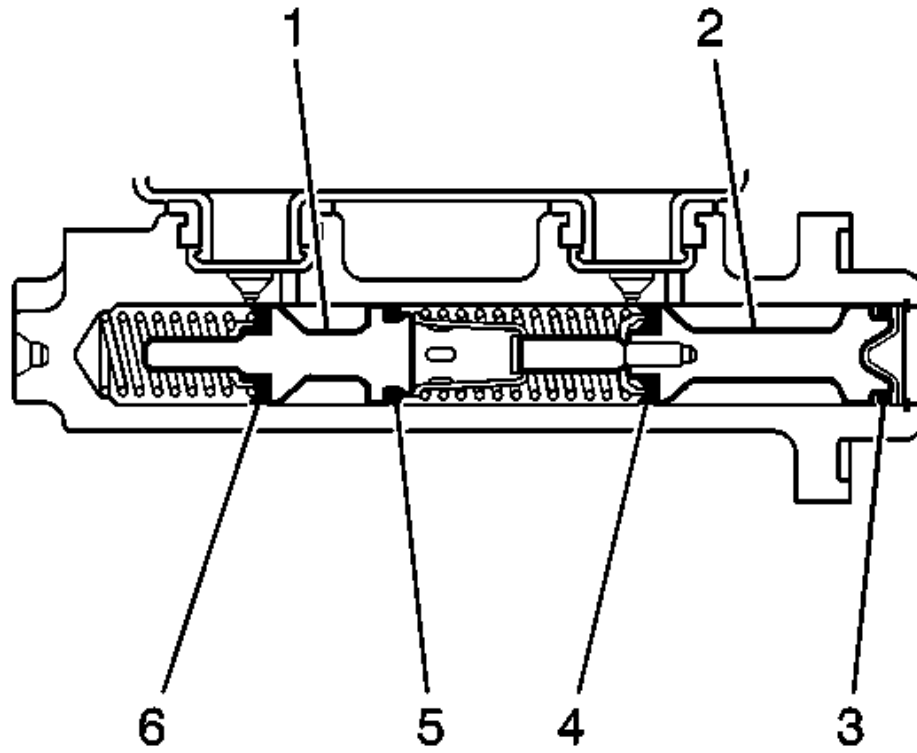


Fig. 21: Identifying Brake Master Cylinder (Cross Sectional View)

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not use abrasives to clean the brake master cylinder bore.

1. Clean the interior and exterior of the master cylinder, the secondary piston (1), and the return spring in denatured alcohol, or equivalent.
2. Inspect the master cylinder bore, inlet and outlet ports, the secondary piston (1), and the return spring for cracks, scoring, pitting, and/or corrosion. Replace the master cylinder if any of these conditions exist.
3. Dry the master cylinder and the individual components with non-lubricated, filtered air.
4. Lubricate the master cylinder bore, the secondary piston (1), the return spring, and all of the individual overhaul components with Delco Supreme 11[®], GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT - 3 brake fluid from a clean, sealed brake fluid container.
5. Assemble the lubricated, new primary seal (6) and retainer, and new secondary seal (5) onto the secondary piston.
6. Install the lubricated return spring and secondary piston assembly (1) into the cylinder bore.
7. Install the lubricated, new primary piston assembly (2) into the cylinder bore.
8. Using a smooth, round-ended tool, depress the primary piston (2) and install the new piston retainer.

9. Install the master cylinder reservoir to the master cylinder. Refer to [Master Cylinder Reservoir Replacement](#).
10. Install the reservoir cap and diaphragm to the reservoir.
11. Install the master cylinder to the vehicle. Refer to [Master Cylinder Replacement](#).

MASTER CYLINDER BENCH BLEEDING

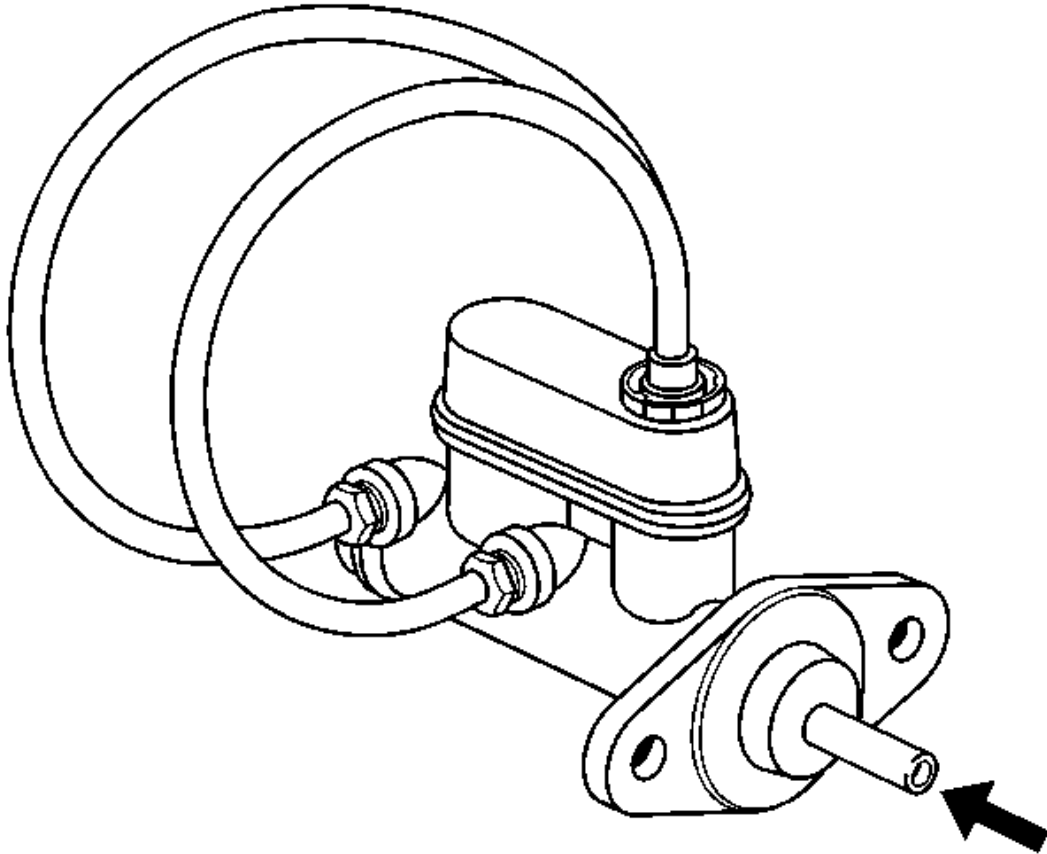


Fig. 22: Bleeding Master Cylinder

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Secure the mounting flange of the brake master cylinder in a bench vise so that the rear of the primary piston is accessible.
2. Remove the master cylinder reservoir cap and diaphragm.
3. Install suitable fittings to the master cylinder ports that match the type of flare seat required and also

provide for hose attachment.

4. Install transparent hoses to the fittings installed to the master cylinder ports, then route the hoses into the master cylinder reservoir.
5. Fill the master cylinder reservoir to at least the half-way point with GM approved brake fluid from a clean, sealed brake fluid container. Adhesives, Fluids, Lubricants, and Sealers
6. Ensure that the ends of the transparent hoses running into the master cylinder reservoir are fully submerged in the brake fluid.
7. Using a smooth, round-ended tool, depress and release the primary piston as far as it will travel, a depth of about 25 mm (1 in), several times. Observe the flow of fluid coming from the ports.

As air is bled from the primary and secondary pistons, the effort required to depress the primary piston will increase and the amount of travel will decrease.

8. Continue to depress and release the primary piston until fluid flows freely from the ports with no evidence of air bubbles.
9. Remove the transparent hoses from the master cylinder reservoir.
10. Install the master cylinder reservoir cap and diaphragm.
11. Remove the fittings with the transparent hoses from the master cylinder ports. Wrap the master cylinder with a clean shop cloth to prevent brake fluid spills.
12. Remove the master cylinder from the vise.

BRAKE MASTER CYLINDER SHIELD REPLACEMENT

Removal Procedure

1. Remove Dash Upper Extension Panel Opening Cover Replacement

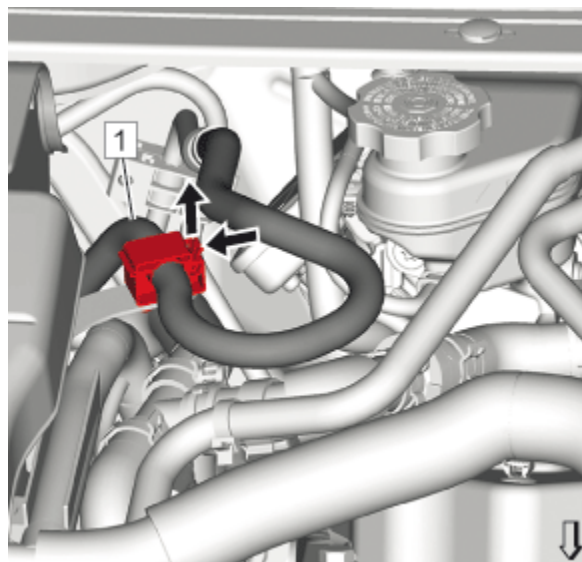


Fig. 23: Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Fuel Feed Hose (1) @Clip

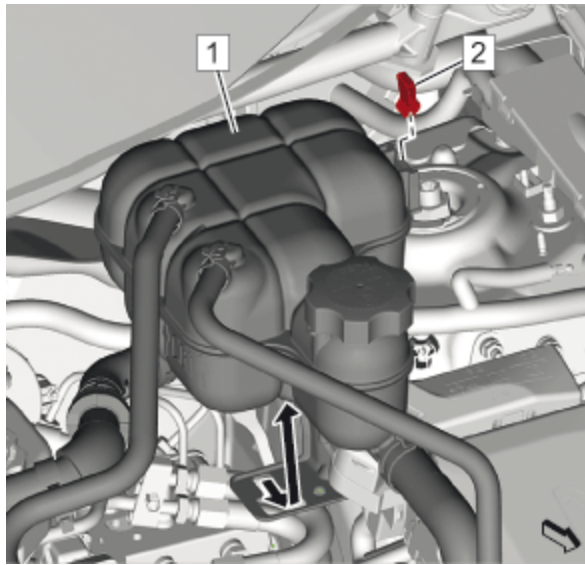


Fig. 24: Radiator Surge Tank And Bracket Clip
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Surge Tank Bracket Clip (2)

NOTE: Do NOT disconnect the engine coolant hoses.

4. Reposition away Radiator Surge Tank (1)

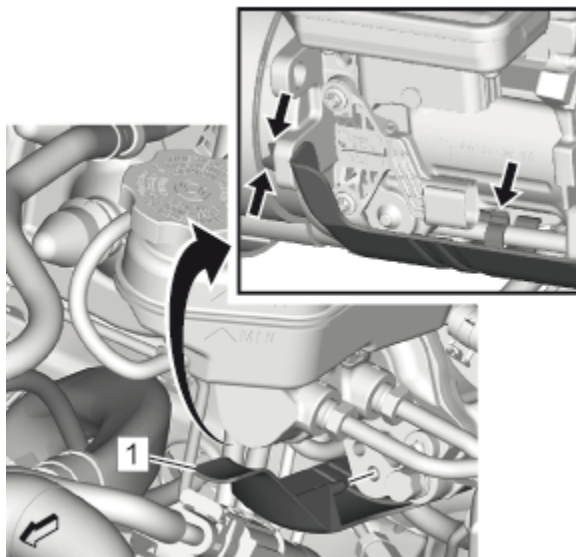


Fig. 25: Brake Master Cylinder Shield
 Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the brake master cylinder shield (1) from the brake master cylinder assembly.

Installation Procedure

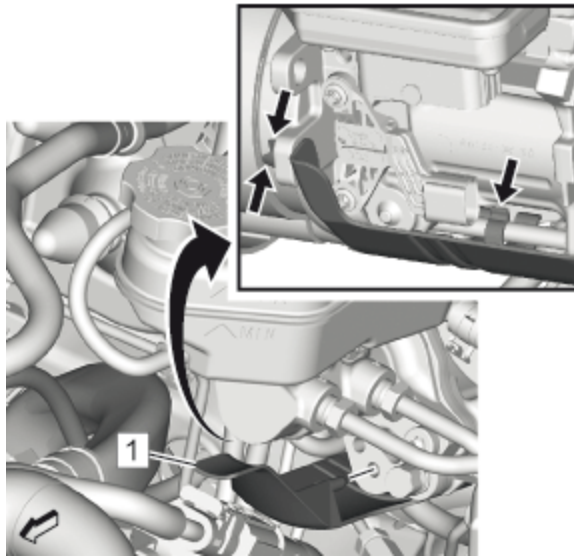


Fig. 26: Brake Master Cylinder Shield

Courtesy of GENERAL MOTORS COMPANY

1. Connect the brake master cylinder shield (1) to the brake master cylinder assembly.

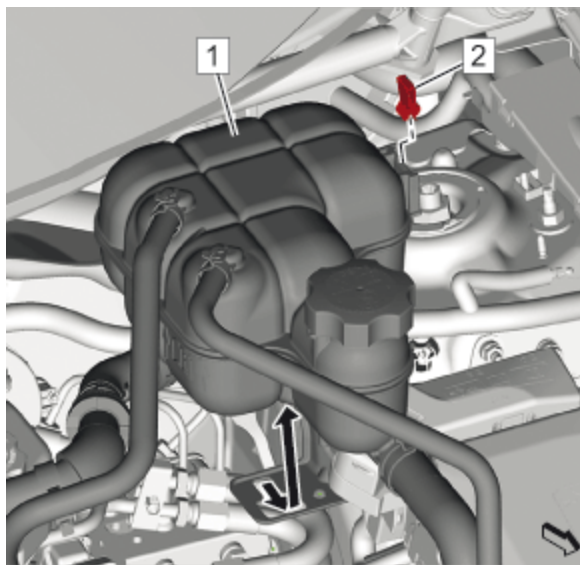


Fig. 27: Radiator Surge Tank And Bracket Clip

Courtesy of GENERAL MOTORS COMPANY

2. Install Radiator Surge Tank (1)
3. Install Radiator Surge Tank Bracket Clip (2)

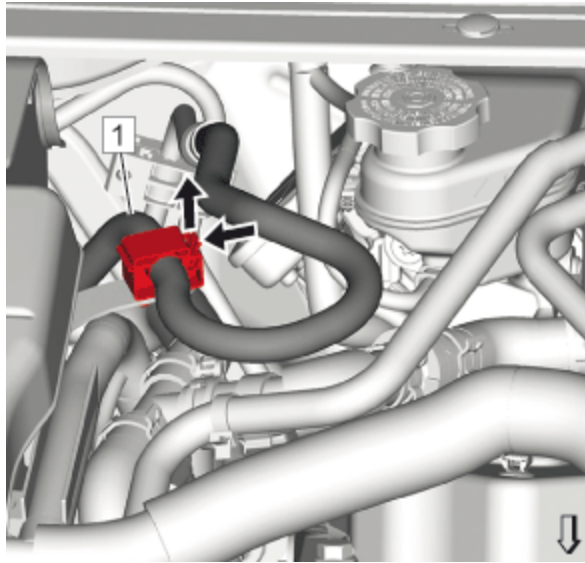


Fig. 28: Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

4. Install Fuel Feed Hose (1) @ Clip
5. Install **Dash Upper Extension Panel Opening Cover Replacement**

BRAKE FLUID LEVEL SENSOR REPLACEMENT

Removal Procedure

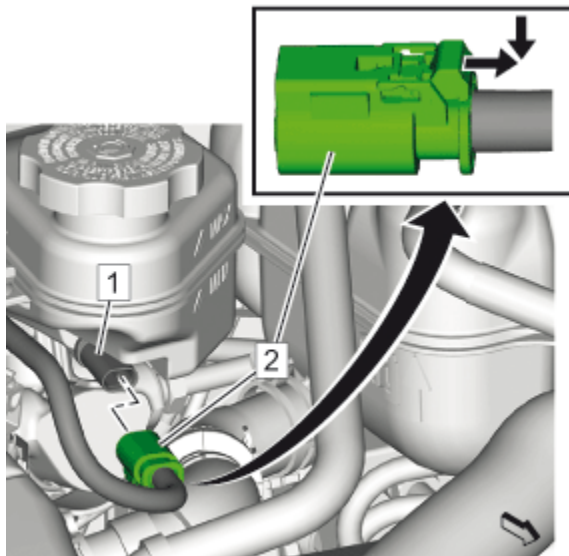


Fig. 29: Electrical Connector And Brake Fluid Level Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect Electrical Connector (2) @Brake Fluid Level Sensor (1)

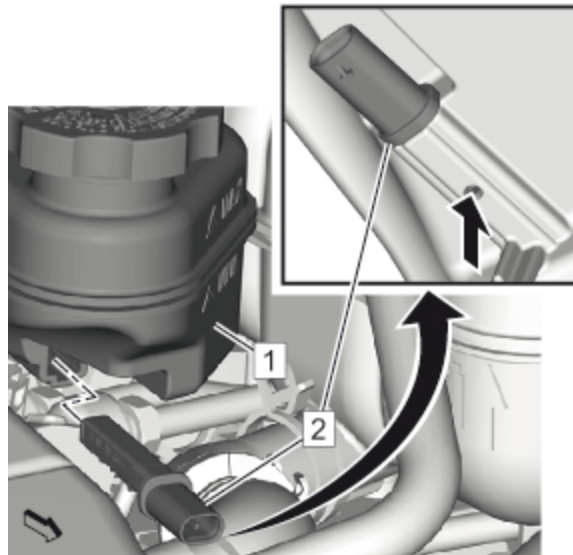


Fig. 30: Brake Fluid Level Sensor And Brake Master Cylinder Reservoir
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Brake Fluid Level Sensor (2) @Brake Master Cylinder Reservoir (1)

Installation Procedure

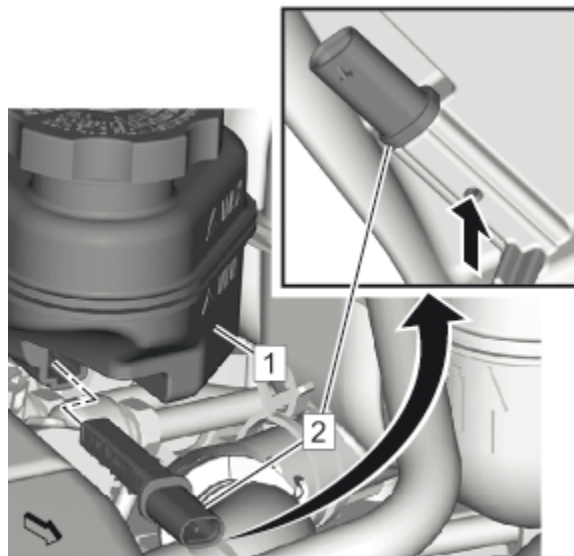


Fig. 31: Brake Fluid Level Sensor And Brake Master Cylinder Reservoir
 Courtesy of GENERAL MOTORS COMPANY

1. Connect Brake Fluid Level Sensor (2) @Brake Master Cylinder Reservoir (1)

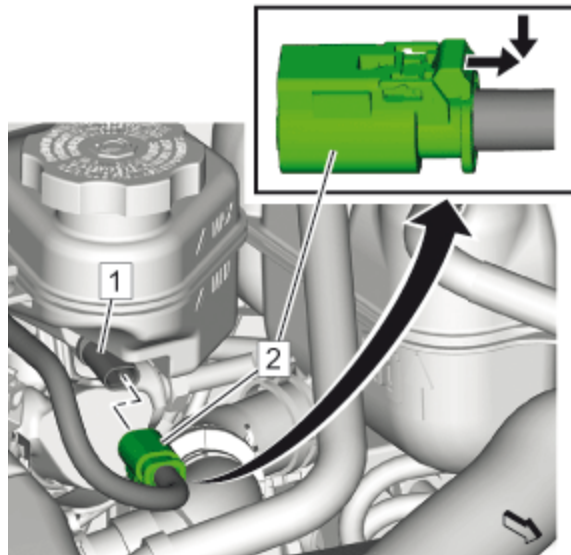


Fig. 32: Electrical Connector And Brake Fluid Level Sensor
 Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connector (2) @Brake Fluid Level Sensor (1)

BRAKE AND ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

1. **High Voltage Disabling**
2. Remove **Accelerator Pedal Replacement**
3. Remove **Power Brake Master Cylinder Booster Assembly Replacement**
4. Remove **Instrument Panel Tie Bar Replacement**

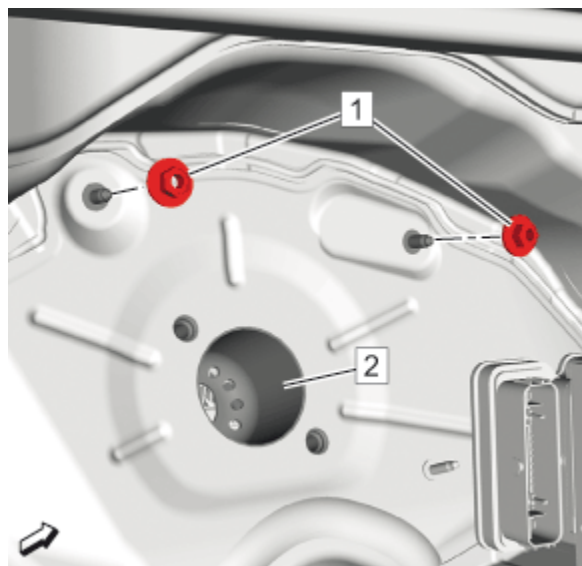


Fig. 33: Brake And Accelerator Pedal Assembly And Nuts
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 brake and accelerator pedal assembly nuts (1) from the brake and accelerator pedal assembly (2).

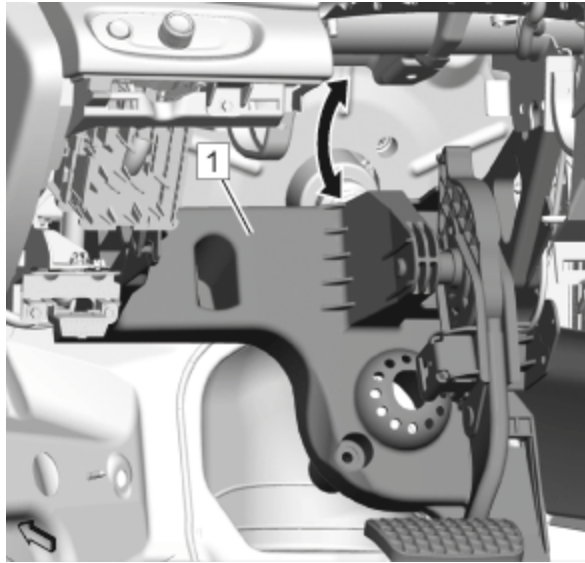


Fig. 34: Brake And Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Remove the brake and accelerator pedal assembly (1) from the vehicle.

Installation Procedure

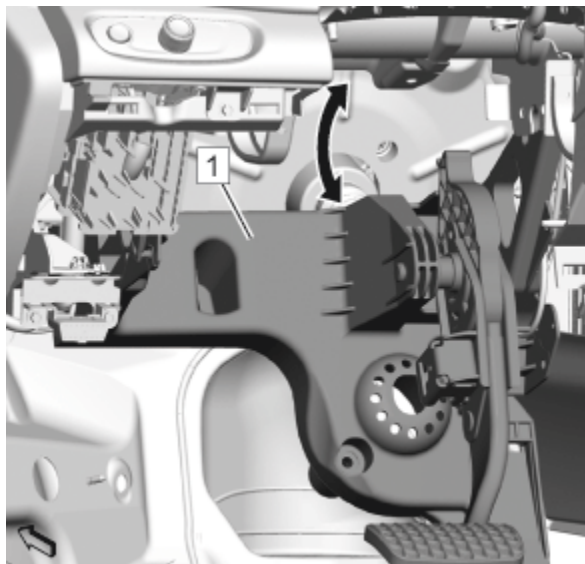


Fig. 35: Brake And Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Install the brake and accelerator pedal assembly (1) to the vehicle.

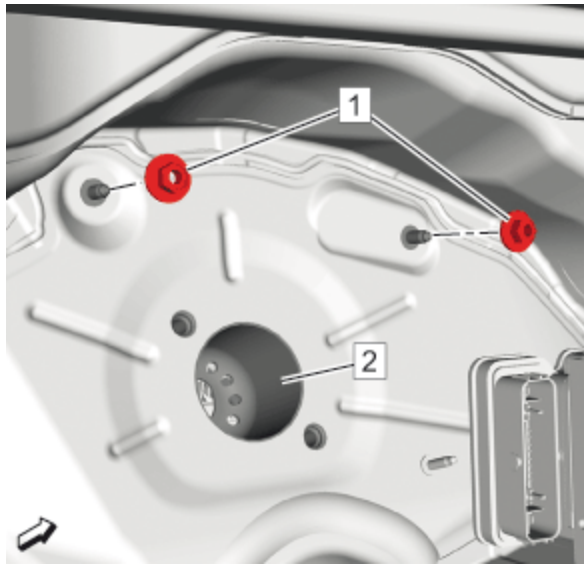


Fig. 36: Brake And Accelerator Pedal Assembly And Nuts

Courtesy of GENERAL MOTORS COMPANY

2. Install the 2 brake and accelerator pedal assembly nuts (1) to the brake and accelerator pedal assembly (2) and tighten to 22 N.m (16 lb ft).
3. Install [Power Brake Master Cylinder Booster Assembly Replacement](#)
4. Install [Instrument Panel Tie Bar Replacement](#)
5. Install [Accelerator Pedal Replacement](#)
6. [High Voltage Enabling](#)

BRAKE PIPE REPLACEMENT

Special Tools

CH-45405 Brake Pipe Flaring Kit

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

WARNING: Always use double walled steel brake pipe when replacing brake pipes. The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

NOTE: When servicing the brake pipes, note the following:

- If sectioning the brake pipe, use replacement pipe of the same type and outside diameter.

- **Use fittings of the appropriate size and type.**
- **Only create flares of the same type or design as originally equipped on the vehicle.**

1. Inspect the area of brake pipe to be repaired or replaced.
2. Remove components as necessary to gain access to the brake pipe to be repaired or replaced.
3. Release the brake pipe to be replaced from the retainers, as required.
4. Select an appropriate location to section the brake pipe, if necessary.
 - Allow adequate clearance in order to maneuver the **CH-45405** Brake Pipe Flaring Kit.
 - Avoid sectioning the brake pipe at bends or mounting points.
5. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
6. Add to the measurement taken the appropriate additional length required for each flare to be created.

Specification

- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe
- 12.67 mm (0.499 in) for 7.94 mm (5/16 in) diameter pipe

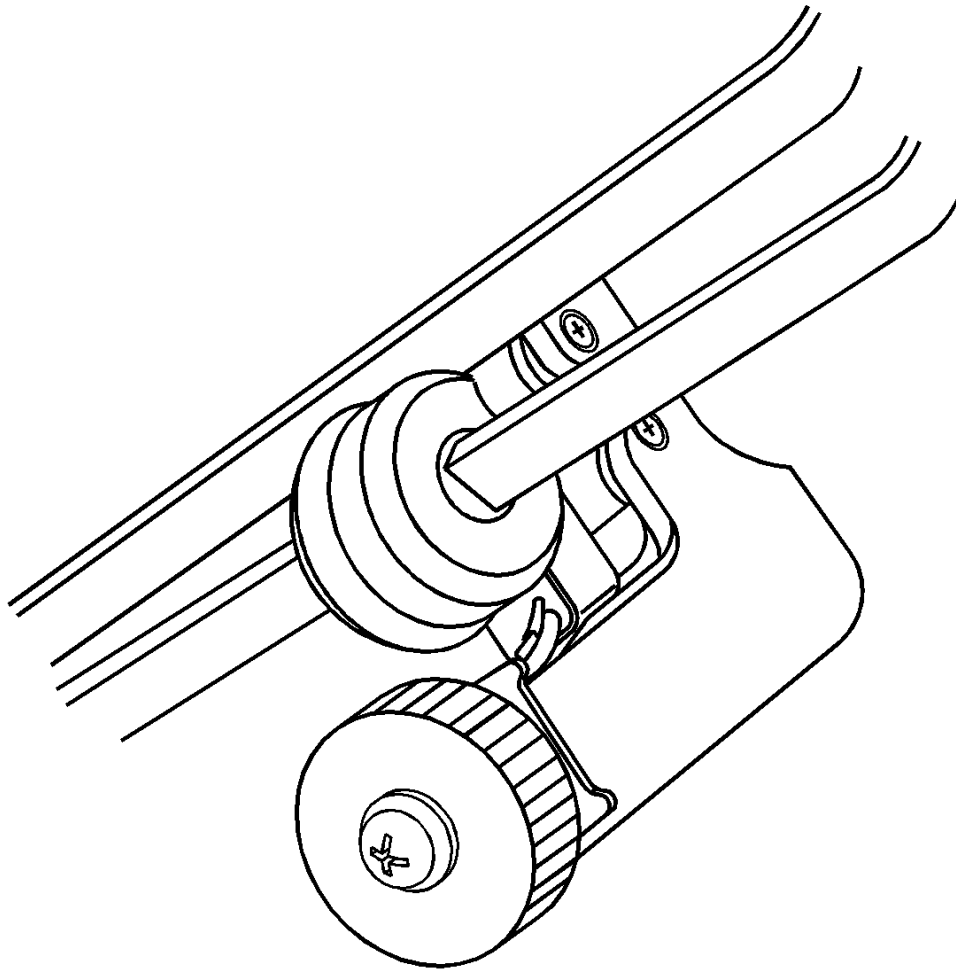


Fig. 37: Sectioning Brake Pipe Using Pipe Cutter

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the brake pipe end to be flared is cut at a square, 90 degree angle to the pipe length.

7. Using the pipe cutter included in the **CH-45405** Brake Pipe Flaring Kit, carefully cut the brake pipe squarely to the measured length.
8. Remove the sectioned brake pipe from the vehicle.
9. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.

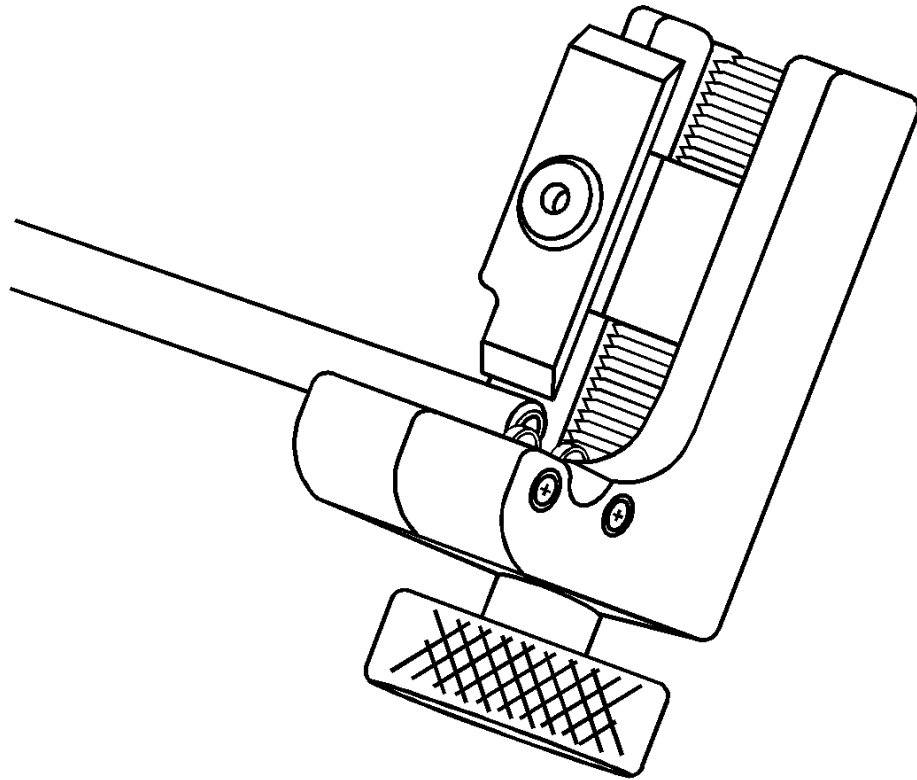


Fig. 38: Stripping Nylon Coating From Brake Pipe Ends

Courtesy of GENERAL MOTORS COMPANY

10. Strip the nylon coating from the brake pipe end to be flared, if necessary.

- Select the appropriate blade on the coating stripping tool included in the **CH-45405** Brake Pipe Flaring Kit, by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers.

Specification

- 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) blade for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe
- Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
- While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

NOTE: Do not gouge the metal surface of the brake pipe.

- Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
- After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe until the metal pipe surface is exposed.
- Loosen the thumbwheel of the tool and remove the brake pipe.

NOTE: Ensure that all loose remnants of the nylon coating have been removed from the brake pipe.

- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

Specification

- 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
- 9.50 mm (0.374 in) for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe

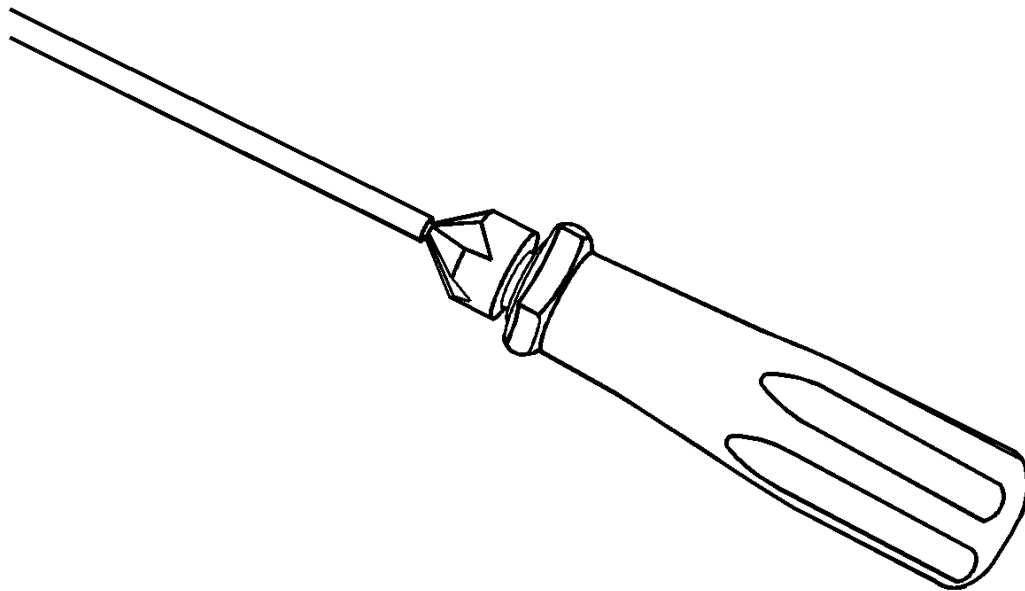


Fig. 39: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS COMPANY

11. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **CH-45405** Brake Pipe Flaring Kit.
12. Install the tube nuts on the brake pipe, noting their orientation.
13. Clean the brake pipe and the **CH-45405** Brake Pipe Flaring Kit of lubricant, contaminants, and debris.

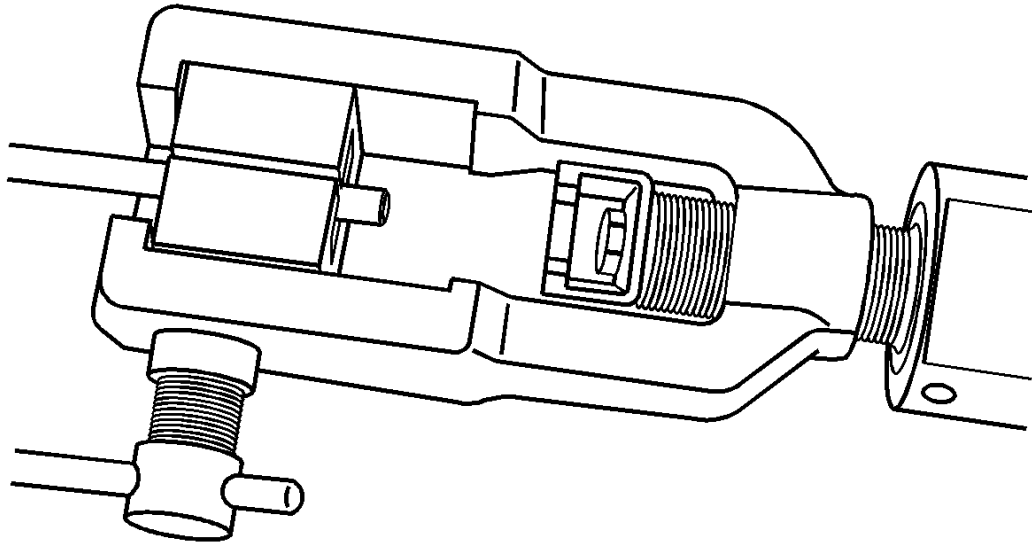


Fig. 40: Installing Die Halves Into Die Cage
Courtesy of GENERAL MOTORS COMPANY

14. Loosen the die clamping screw of the **CH-45405** Brake Pipe Flaring Kit.
15. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

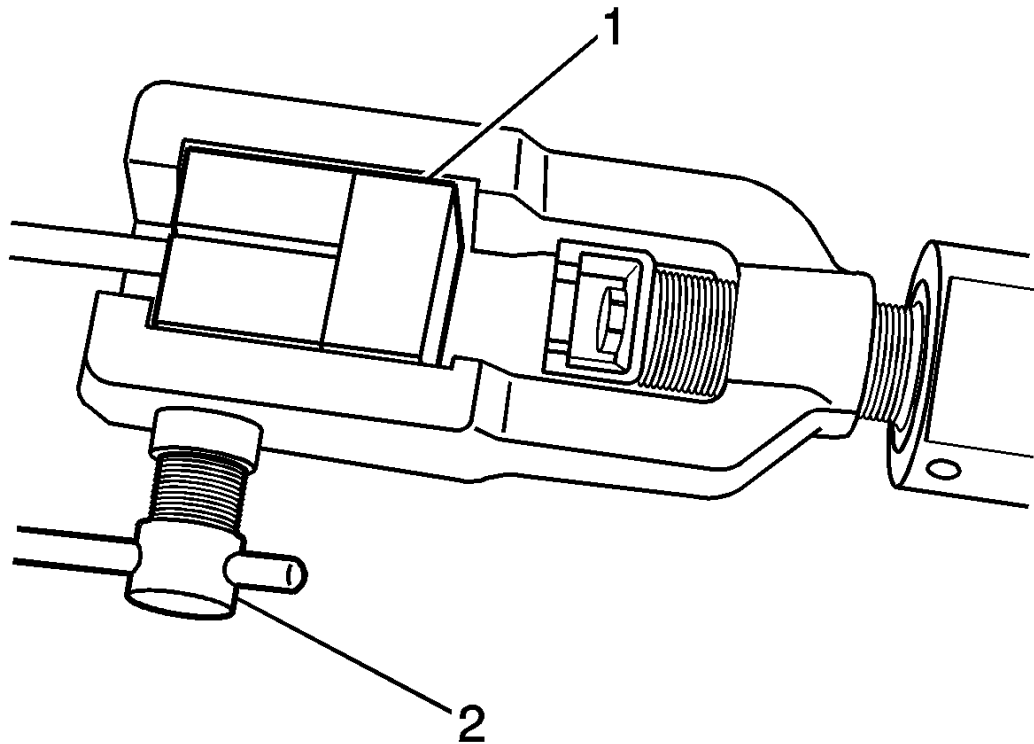


Fig. 41: View Of Clamping Screw & Unused Die
Courtesy of GENERAL MOTORS COMPANY

16. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
17. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
18. Remove the unused die (1).
19. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
20. Firmly hand tighten the clamping screw (2) against the dies.

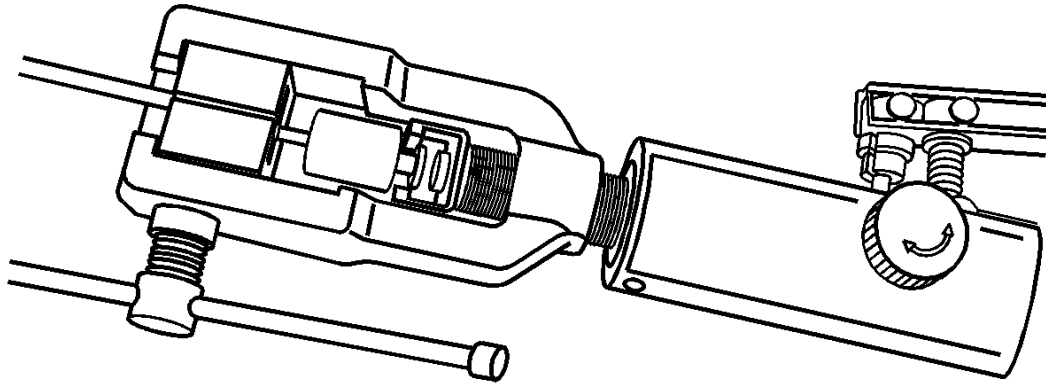


Fig. 42: Rotating J 45405 To Bottom Against Die Cage

Courtesy of GENERAL MOTORS COMPANY

21. Select the appropriate forming mandrel and place into the forming ram.
22. Rotate the hydraulic fluid control valve clockwise to the closed position.
23. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.

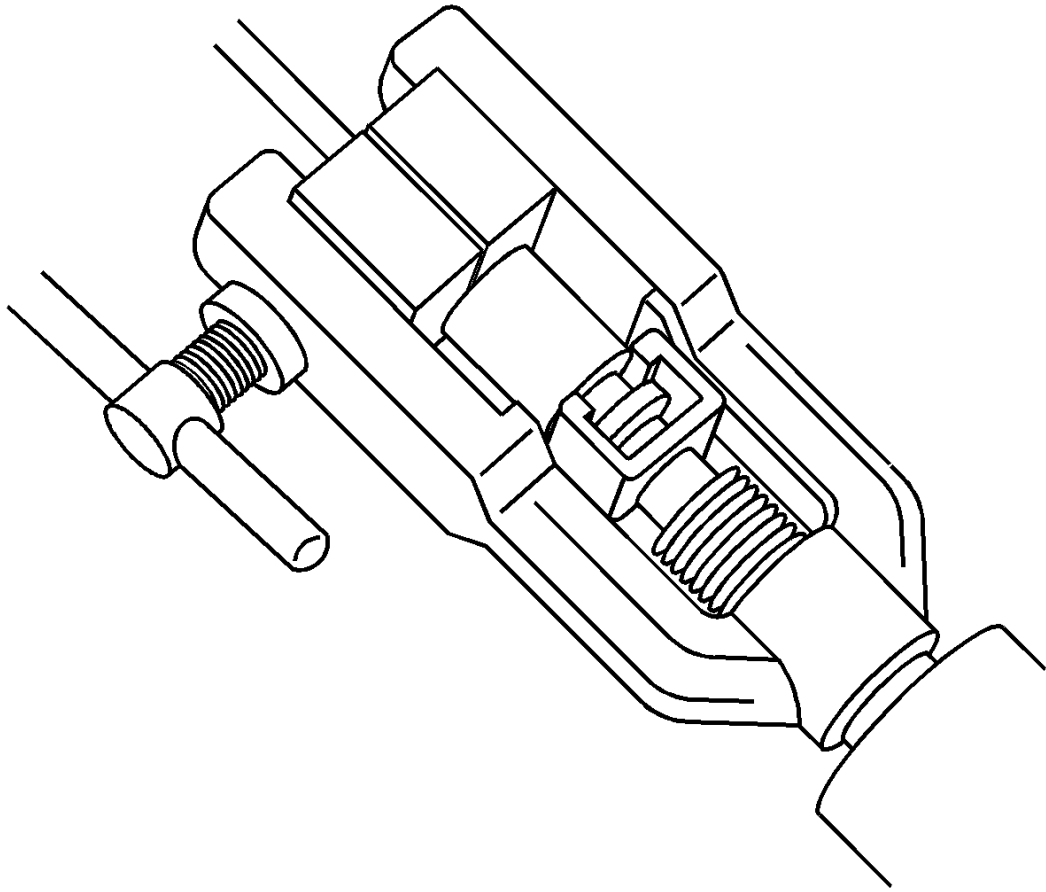


Fig. 43: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS COMPANY

24. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Brake Pipe Flaring Kit until the forming mandrel bottoms against the clamping dies.
25. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.

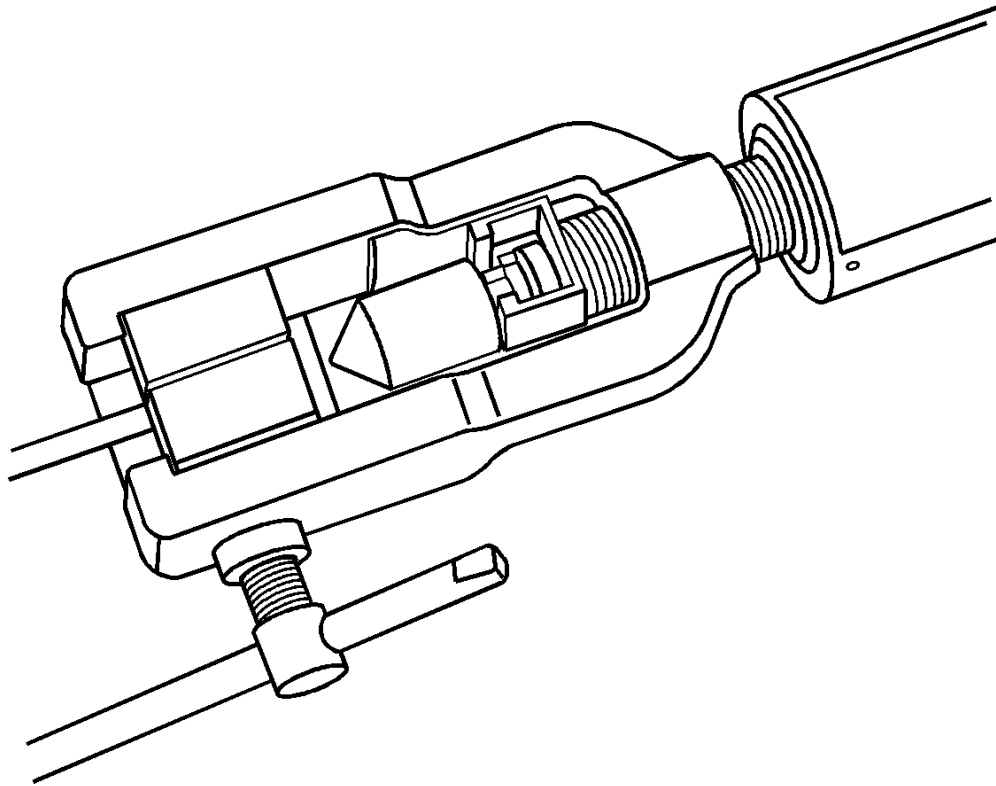


Fig. 44: Using Pipe Flaring Tool

Courtesy of GENERAL MOTORS COMPANY

26. Insert the finishing cone into the forming ram.
27. Rotate the hydraulic fluid control valve clockwise to the closed position.
28. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.
29. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Brake Pipe Flaring Kit until the finishing cone bottoms against the dies.
30. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
31. Loosen the die clamping screw and remove the dies and pipe.
32. If necessary, lightly tap the dies until the die halves separate.

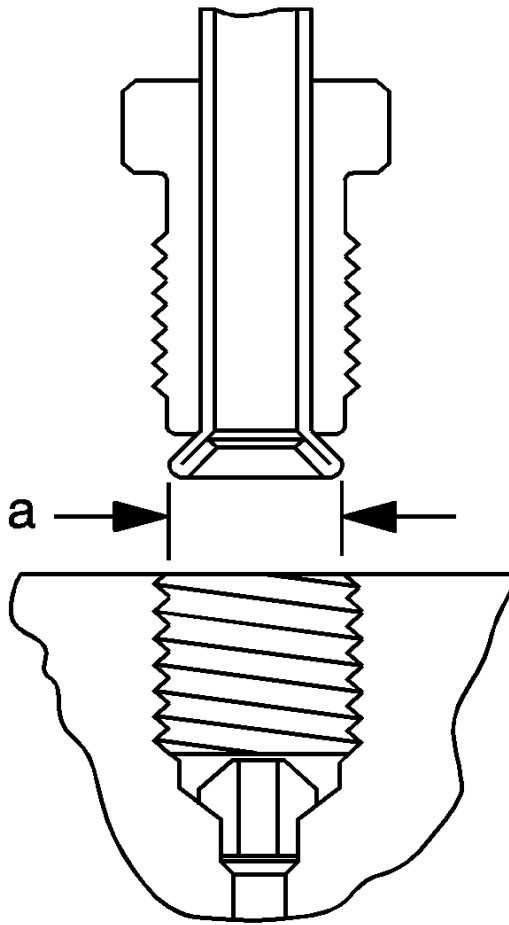


Fig. 45: Identifying Correct Brake Pipe Flare Shape & Diameter

Courtesy of GENERAL MOTORS COMPANY

33. Inspect the brake pipe flare for correct shape and diameter (a).

Specification

- 6.74 - 7.10 mm (0.265 - 0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
- 8.57 - 9.27 mm (0.344 - 0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe
- 10.42 - 10.79 mm (0.410 - 0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe

34. If necessary, using the removed section of brake pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

NOTE: When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.

35. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.

36. If previously released, secure the brake pipe to the retainers.

37. Install any components that may have been removed to gain access to the brake pipe.

38. Bleed the hydraulic brake system. [Hydraulic Brake System Bleeding](#)
39. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

BRAKE MASTER CYLINDER RESERVOIR HOSE REPLACEMENT

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

CAUTION: [Brake Fluid Effects on Paint and Electrical Components Caution](#)

1. Remove [Dash Upper Extension Panel Opening Cover Replacement](#)

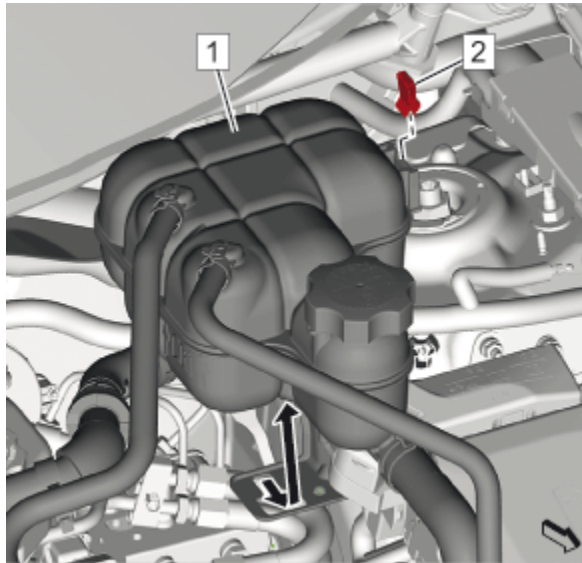


Fig. 46: Radiator Surge Tank And Bracket Clip

Courtesy of GENERAL MOTORS COMPANY

2. Remove Radiator Surge Tank Bracket Clip (2)

NOTE: Do NOT disconnect the engine coolant hoses.

3. Reposition away Radiator Surge Tank (1)

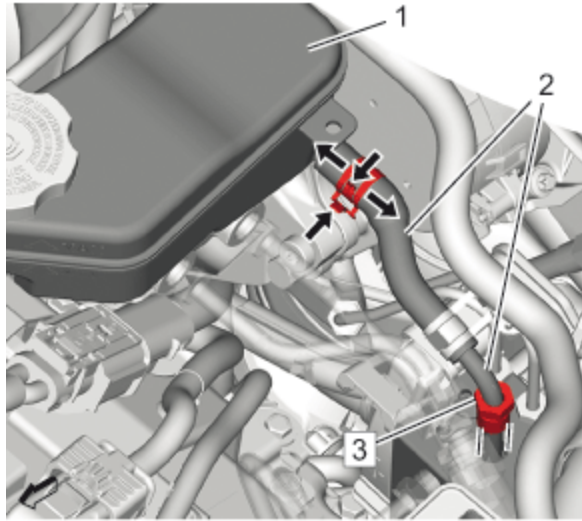


Fig. 47: Brake Master Cylinder Reservoir And Hose

Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the opening to prevent contamination.

4. Disconnect the brake master cylinder reservoir hose (2) from the brake master cylinder reservoir (1).
5. Remove Brake Pipe Fitting (3) @Brake Pressure Modulator Valve
6. Remove the brake master cylinder reservoir hose from the vehicle.

Installation Procedure

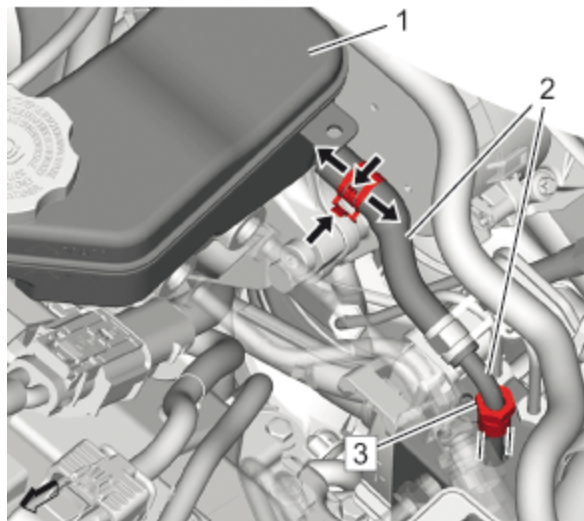


Fig. 48: Brake Master Cylinder Reservoir And Hose

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

1. Install Brake Pipe Fitting (3) @Brake Pressure Modulator Valve and tighten 32 N.m (24 lb ft)
2. Connect the brake master cylinder reservoir hose (2) to the brake master cylinder reservoir (1).

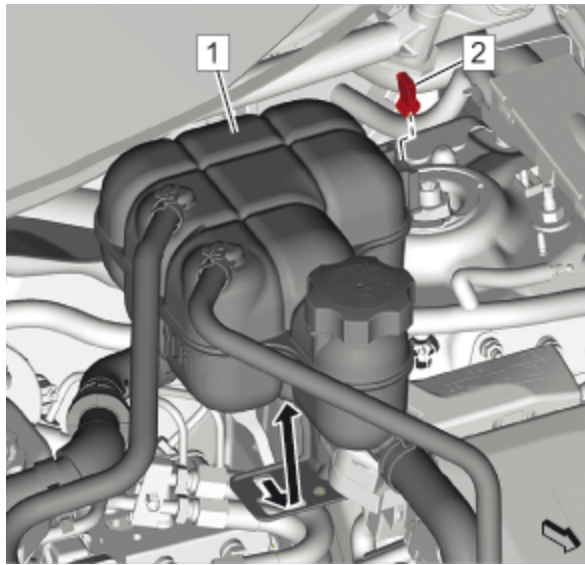


Fig. 49: Radiator Surge Tank And Bracket Clip

Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Surge Tank (1)
4. Install Radiator Surge Tank Bracket Clip (2)
5. Install [Dash Upper Extension Panel Opening Cover Replacement](#)
6. [Hydraulic Brake System Bleeding](#)

FRONT BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

1. Remove [Tire and Wheel Removal and Installation](#)

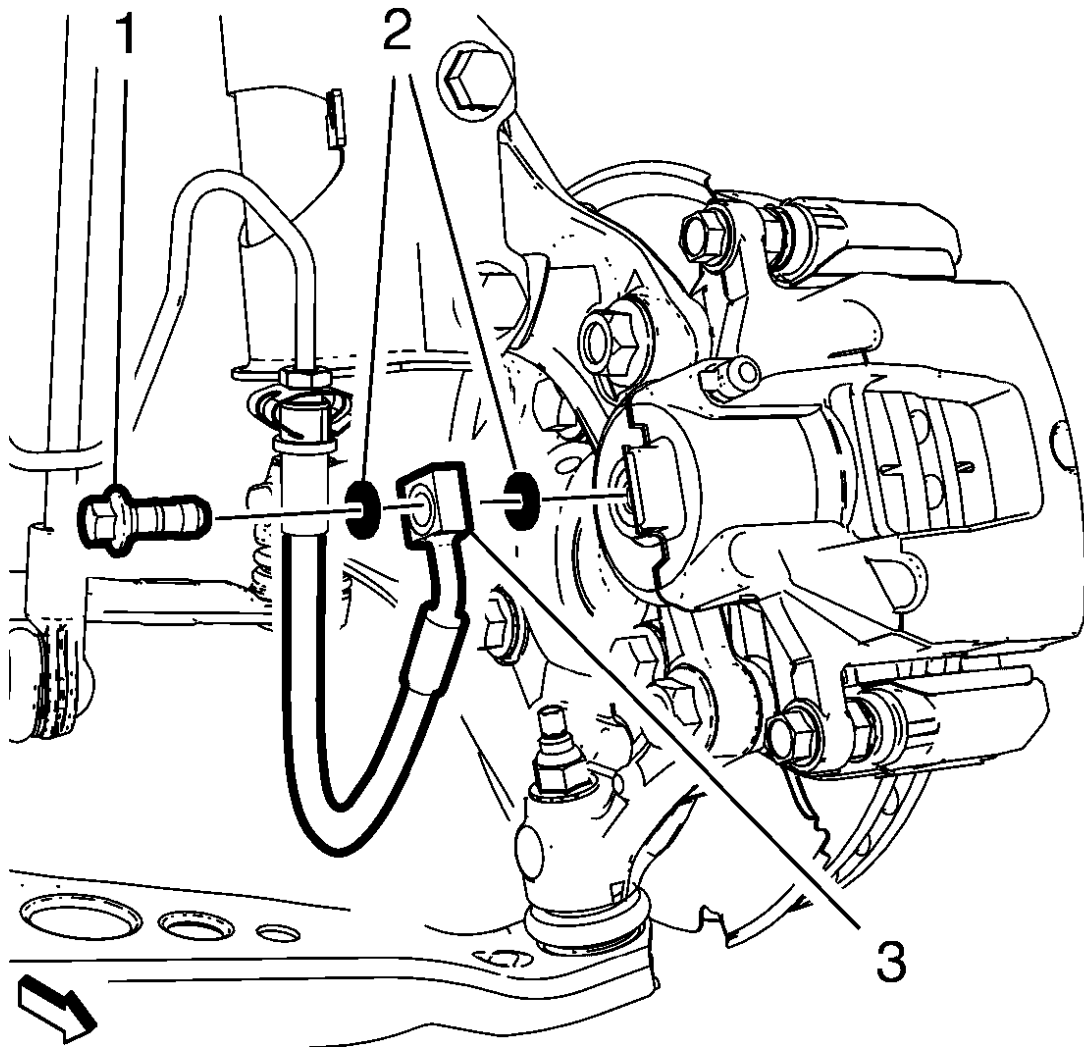


Fig. 50: Front Brake Hose And Brake Hose Fitting Bolt

Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Brake Hose (3) @Brake Hose Fitting Bolt (1)
3. Cap the brake hose fitting to prevent brake fluid loss and contamination.
4. Cap the brake caliper inlet port to prevent brake fluid loss and contamination.
5. DISCARD the brake hose fitting gaskets.(2)

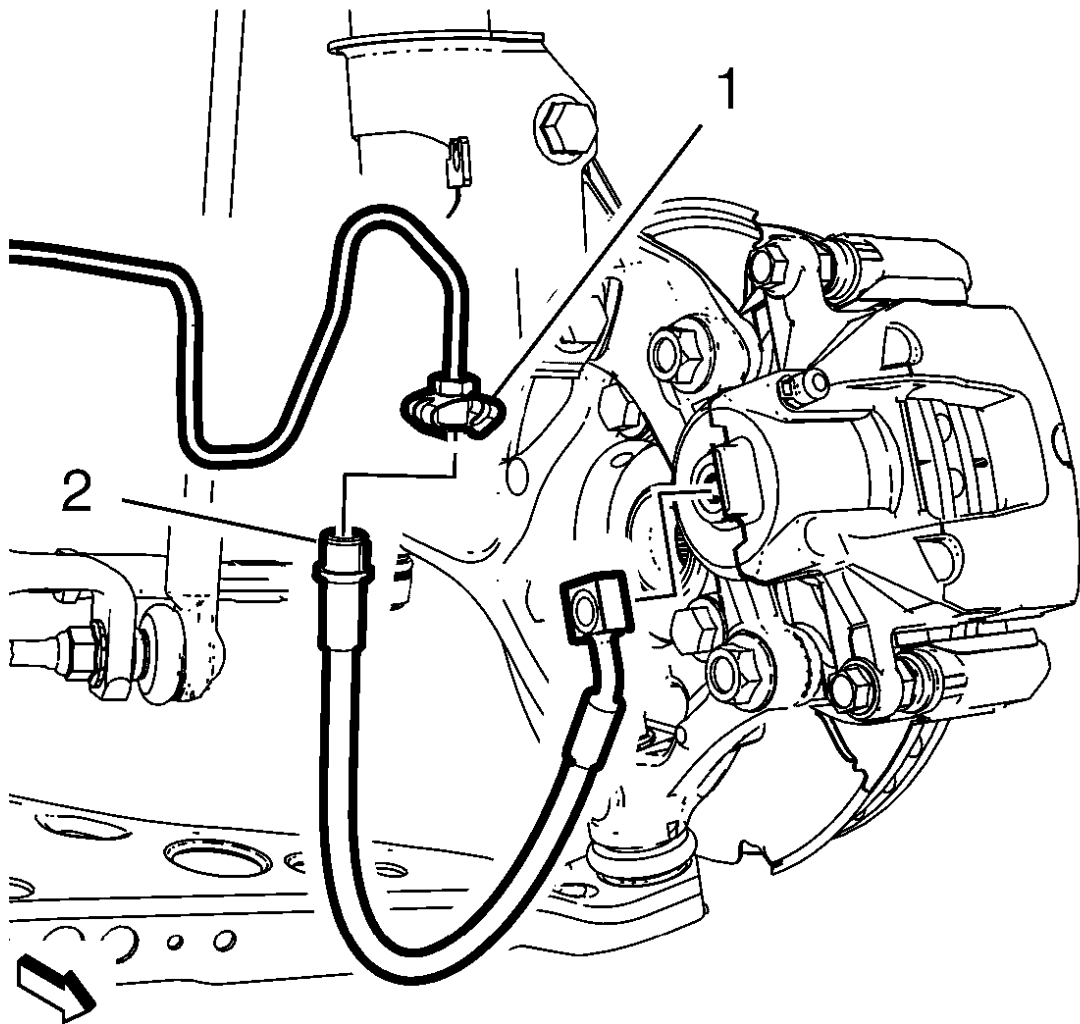


Fig. 51: Front Brake Hose And Front Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Hose (2) @Front Brake Pipe Fitting (1)
7. Cap the brake pipe fitting to prevent brake fluid loss and contamination.
8. Cap the brake hose fitting to prevent brake fluid loss and contamination.

Installation Procedure

1. Remove the caps from brake pipe fitting and the brake hose.

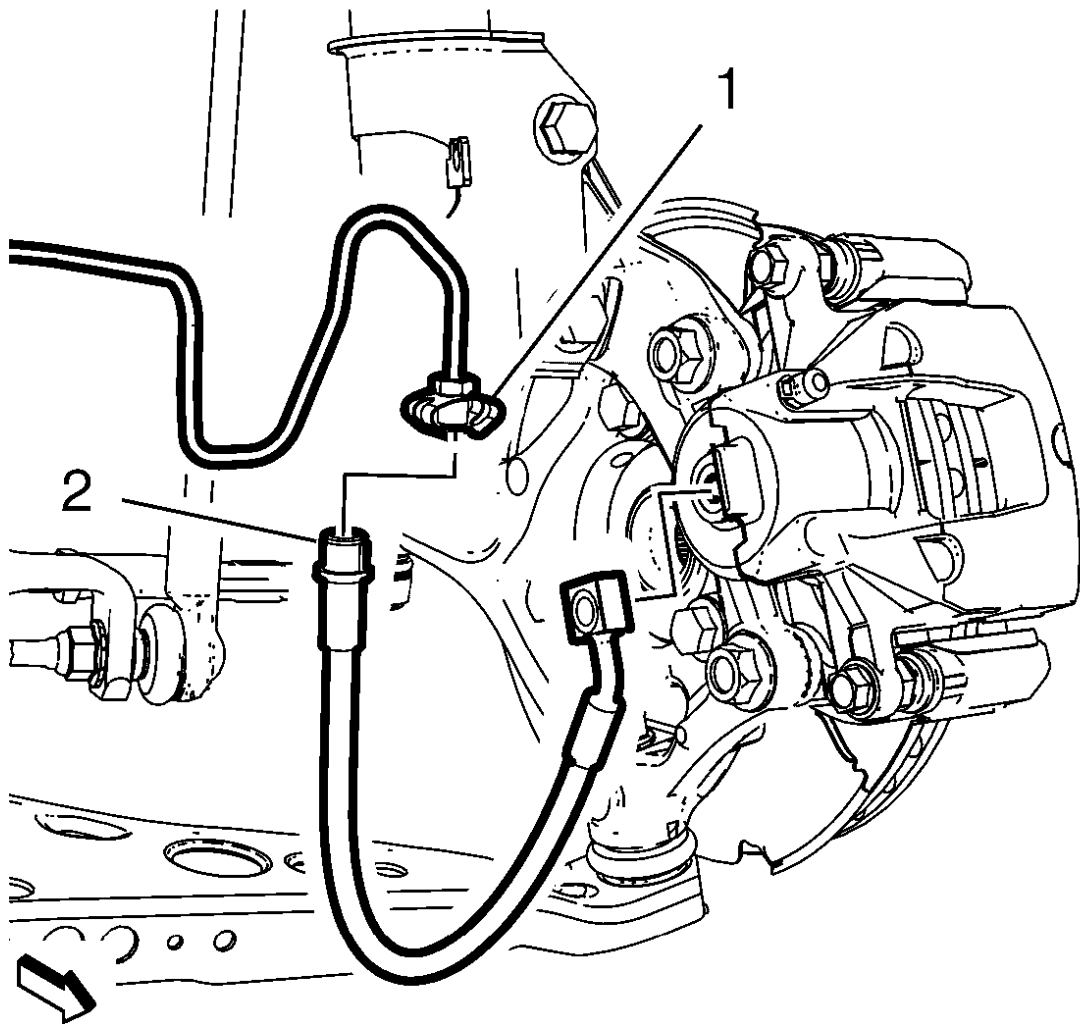


Fig. 52: Front Brake Hose And Front Brake Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

2. Install Front Brake Hose (2) @Front Brake Pipe Fitting (1) and tighten 20 N.m (15 lb ft)
3. Remove the caps from the brake hose and the brake caliper inlet port.

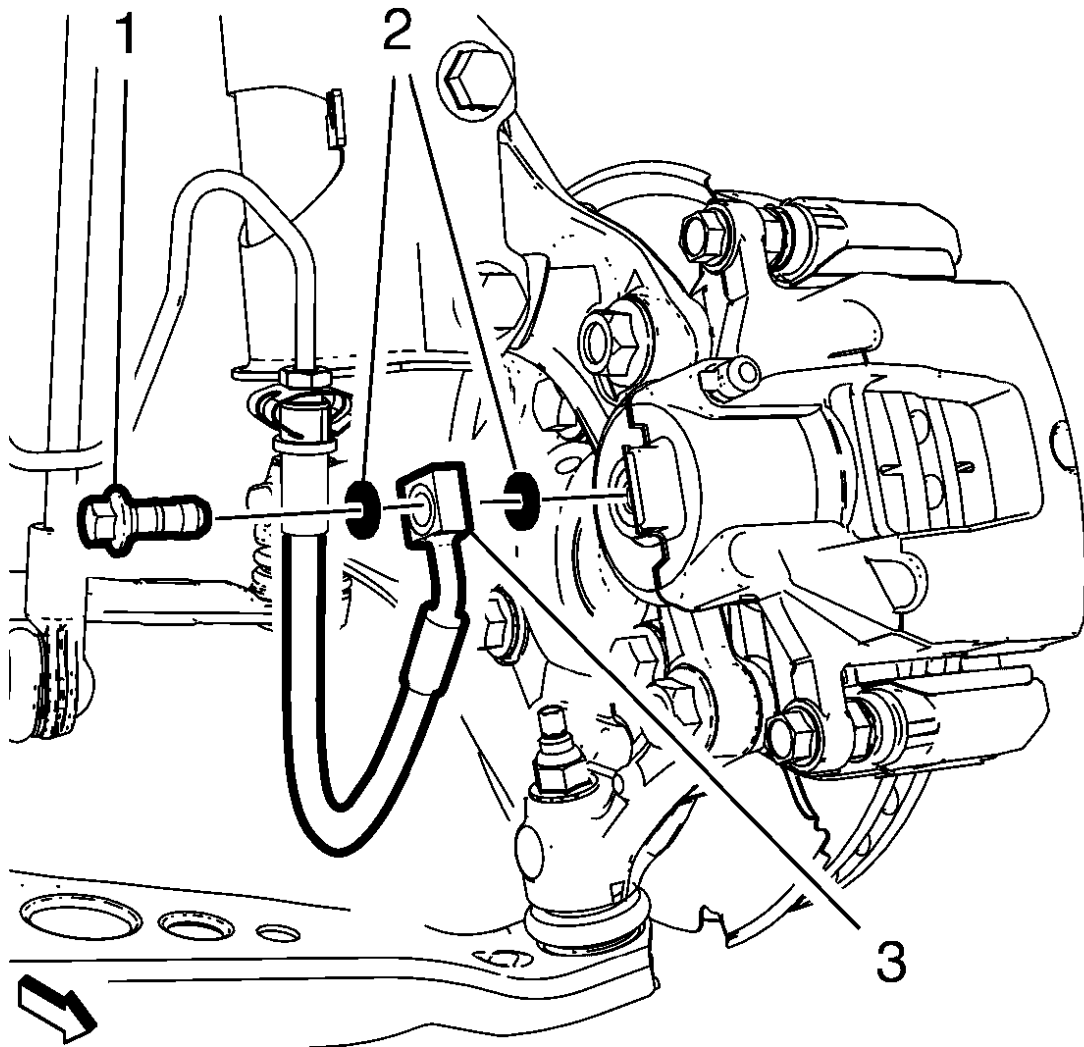


Fig. 53: Front Brake Hose And Brake Hose Fitting Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

4. Install NEW brake hose fitting gaskets.(2)
5. Install Front Brake Hose (3) @Brake Hose Fitting Bolt (1) and tighten 40 N.m (30 lb ft)
6. [Hydraulic Brake System Bleeding](#)
7. Install [Tire and Wheel Removal and Installation](#) - Install

REAR BRAKE HOSE REPLACEMENT

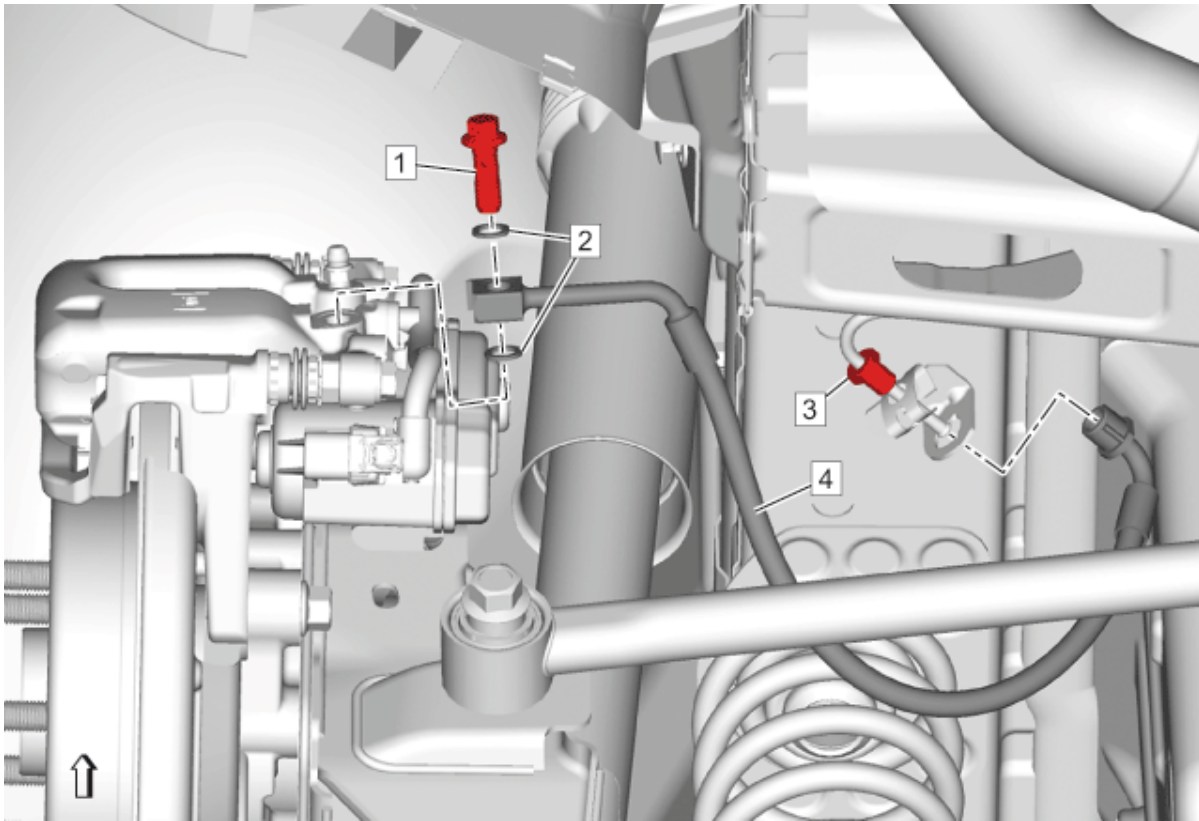


Fig. 54: Rear Brake Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: <u>Brake Fluid</u> <u>Irritant</u> <u>Warning</u> WARNING: <u>Brake Fluid</u> <u>Effects on</u> <u>Paint and</u> <u>Electrical</u> <u>Components</u> <u>Caution</u> Preliminary Procedure <u>Tire and Wheel Removal and Installation</u>	
1	Brake Hose Fitting Bolt CAUTION: <u>Fastener</u> <u>Caution</u> Tighten

Callout	Component Name
	40 N.m (30 lb ft)
2	Brake Hose Fitting Gaskets (Qty: 2) Procedure DISCARD the brake hose fitting gaskets.
3	Brake Pipe Fitting Tighten 20 N.m (15 lb ft)
4	Rear Brake Hose Procedure <u>Hydraulic Brake System Bleeding</u>

HYDRAULIC BRAKE SYSTEM BLEEDING

WARNING: Refer to [Brake Fluid Irritant Warning](#) .

CAUTION: Refer to [Brake Fluid Effects on Paint and Electrical Components Caution](#) .

CAUTION: Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

If hydraulic components were serviced on only one wheel hydraulic circuit, perform the following procedure.

Bleeding a Single Hydraulic Brake Circuit

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#) .

NOTE: The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.

5. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
6. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
7. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
8. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake

hydraulic system.

NOTE: Any brake fluid leaks identified require repair prior to completing this procedure.

9. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
10. Install a proper box-end wrench onto the wheel hydraulic circuit bleeder valve which has been serviced.
11. Install a transparent hose over the end of the bleeder valve.
12. Submerge the open end of the transparent hose into a transparent container partially filled with brake fluid from a clean, sealed brake fluid container.
13. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
14. Allow fluid to flow until air bubbles stop flowing from the bleeder.
15. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.

NOTE: The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

16. Close the brake pressure bleeder fluid tank valve then disconnect the brake pressure bleeder from the master cylinder reservoir bleeder adapter.
17. Remove the master cylinder reservoir bleeder adapter from the master cylinder reservoir.
18. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
19. Slowly press and release the brake pedal. Observe the brake pedal feel.
20. If the brake pedal feels spongy, perform the Bleeding the Complete Brake Hydraulic System procedure:
21. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

NOTE: DO NOT allow the vehicle to be driven until it is diagnosed and repaired.

22. If the brake system warning lamp remains illuminated, refer to [Diagnostic Starting Point - Vehicle](#) .

Bleeding the Complete Brake Hydraulic System

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#) .
5. If the master cylinder was replaced, the master cylinder must be bench bled. Refer to [Master Cylinder Bench Bleeding](#).

NOTE: The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.

6. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
7. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
8. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
9. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake hydraulic system.

NOTE: Any brake fluid leaks identified require repair prior to completing this procedure.

10. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
11. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
12. Install a transparent hose over the end of the bleeder valve.
13. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container.
14. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
15. Allow fluid to flow until air bubbles stop flowing from the bleeder.
16. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.
17. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
18. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
19. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
20. Close the brake pressure bleeder fluid tank valve.

NOTE: The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

21. Remove the brake pressure bleeding equipment from the vehicle.
22. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to [Fluid and Lubricant Recommendations](#).
23. Slowly press and release the brake pedal. Observe the brake pedal feel.
24. If the brake pedal feels spongy, perform the following procedure.

1. If equipped with antilock brakes, install a scan tool and perform the [Antilock Brake System](#)

Automated Bleed to remove air which may be trapped in the BPMV.

2. Inspect the hydraulic brake system for external leaks. Refer to **Brake System External Leak Inspection**.
3. Repeat the Bleeding the Complete Brake Hydraulic System procedure.
25. If the brake pedal still feels spongy, pressure bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding**.
26. Turn the ignition switch ON with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

NOTE: **DO NOT allow the vehicle to be driven until the brake system is diagnosed and repaired.**

27. If the brake system warning lamp remains illuminated, refer to **Diagnostic Starting Point - Vehicle** .

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: Refer to **Brake Fluid Irritant Warning** .

CAUTION: Refer to **Brake Fluid Effects on Paint and Electrical Components Caution** .

CAUTION: **Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.**

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
 - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
 - Swirled appearance - oil-based substance
 - Layered appearance - silicone-based substance
 - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
 - Cloudy appearance - moisture
 - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust
2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
 1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.
 - **Master Cylinder Replacement**

- [Front Brake Hose Replacement](#)
- [Rear Brake Hose Replacement](#)
- [Front Brake Caliper Replacement](#)
- [Rear Brake Caliper Replacement](#)
- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)

2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.
3. Dry the brake pipes using non-lubricated, filtered air.
4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

- [Master Cylinder Replacement](#); also perform the following:

Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. [Master Cylinder Reservoir Replacement](#)

Replace the brake master cylinder reservoir cap.

- [Front Brake Hose Replacement](#)
- [Rear Brake Hose Replacement](#)
- [Front Brake Caliper Overhaul](#) , or [Front Brake Caliper Replacement](#)
- [Rear Brake Caliper Replacement](#)
- [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. [Adhesives, Fluids, Lubricants, and Sealers](#)
6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. [Hydraulic Brake System Bleeding](#)

POWER BRAKE MASTER CYLINDER BOOSTER ASSEMBLY REPLACEMENT

Removal Procedure

WARNING: [Brake Fluid Irritant Warning](#)

CAUTION: [Brake Fluid Effects on Paint and Electrical Components Caution](#)

CAUTION: Do not lift or carry the electric brake booster by the input rod, electrical connectors or master cylinder reservoir. Failure to follow these steps may damage the electric brake booster.

CAUTION: If there is no brake fluid in the master cylinder, remove one of the brake booster fuses before applying the brake pedal. Failure to do so may

damage the electric brake booster.

1. Remove one of the electric brake booster fuses from the engine compartment fuse block.
2. Remove **Dash Upper Extension Panel Opening Cover Replacement**

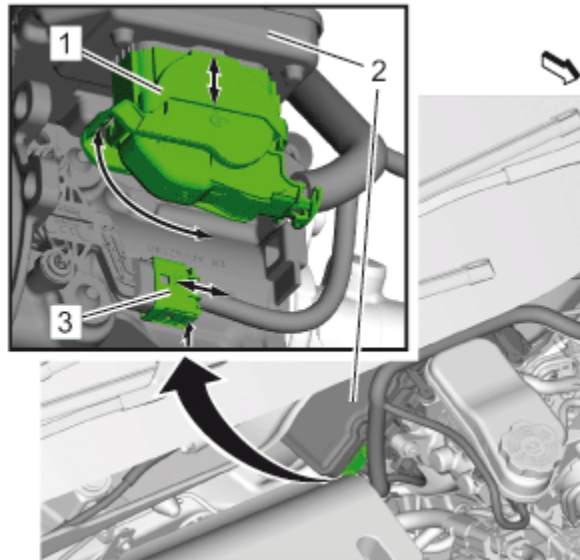


Fig. 55: Electrical Connector And Power Brake Booster

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector (1) @Power Brake Booster (2)
4. Disconnect Electrical Connector (3) @Power Brake Booster (2)

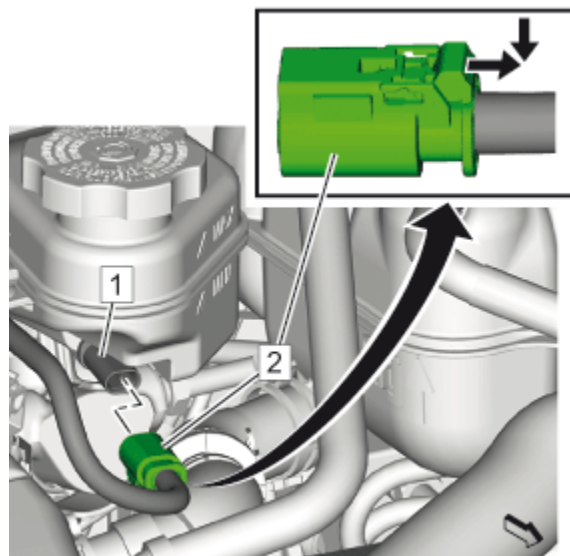


Fig. 56: Electrical Connector And Brake Fluid Level Sensor

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (2) @Brake Fluid Level Sensor (1)

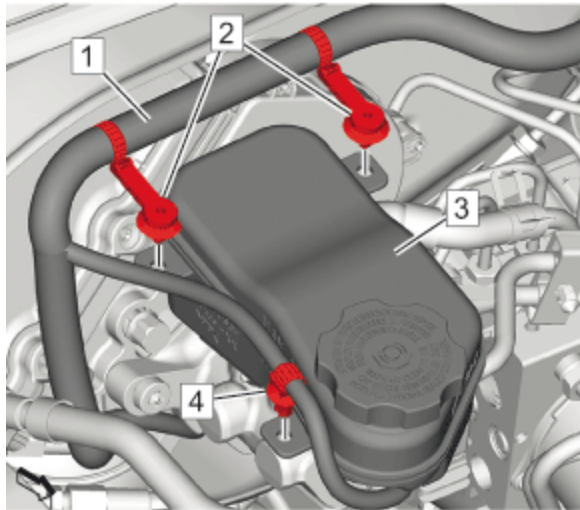


Fig. 57: Brake Master Cylinder Reservoir And Body Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

6. Unclip Clip (2) @Brake Master Cylinder Reservoir (3)
7. Unclip Clip (4) @Brake Master Cylinder Reservoir
8. Remove Body Wiring Harness (1) @Brake Master Cylinder Reservoir

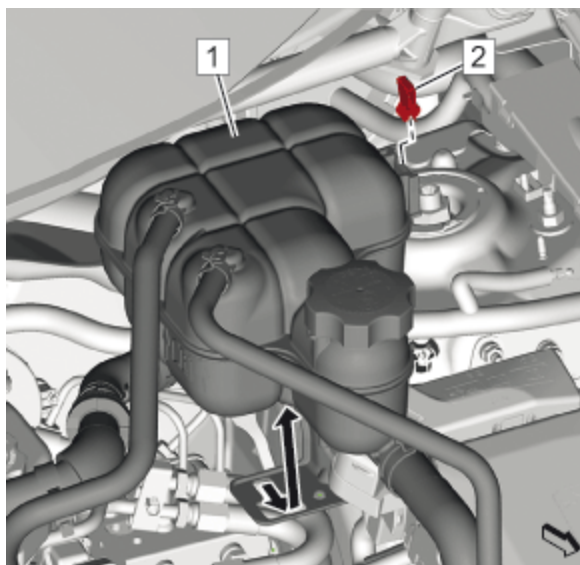


Fig. 58: Radiator Surge Tank And Bracket Clip
 Courtesy of GENERAL MOTORS COMPANY

9. Remove Clip (2) @Radiator Surge Tank (1)

NOTE: Do NOT disconnect the engine coolant hoses.

10. Slide the radiator surge tank forward and lift to remove.

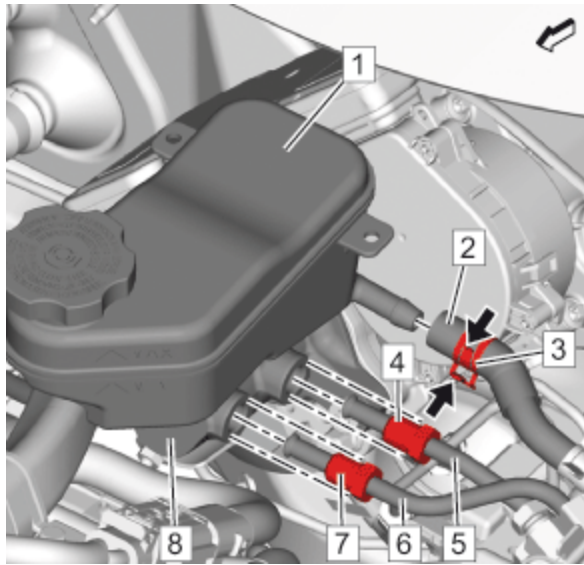


Fig. 59: Brake Master Cylinder Reservoir Hose And Brake Pressure Modulator Valve Secondary Pipe

Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Brake Master Cylinder Reservoir Hose (2) @Brake Master Cylinder Reservoir (1)
12. Remove Brake Pressure Modulator Valve Secondary Pipe Fitting (7) @Brake Master Cylinder (8)
13. Remove Brake Pressure Modulator Valve Secondary Pipe (6) @Brake Master Cylinder
14. Remove Brake Pressure Modulator Valve Primary Pipe Fitting (4) @Brake Master Cylinder
15. Remove Brake Pressure Modulator Valve Primary Pipe (5) @Brake Master Cylinder
16. Remove the master cylinder without removing the master cylinder reservoir. **Master Cylinder Replacement**

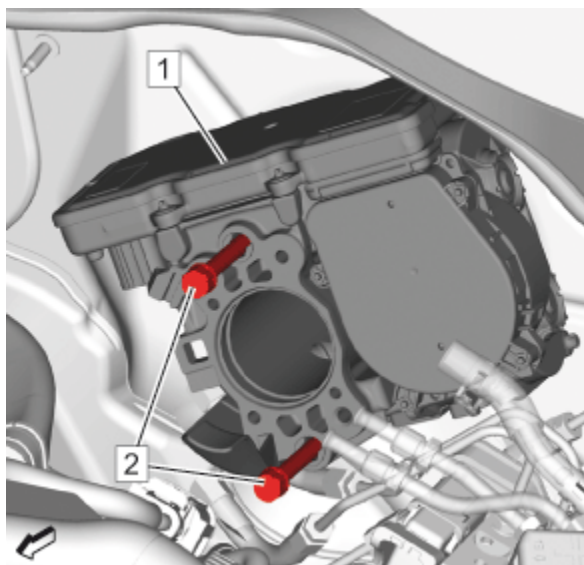


Fig. 60: Power Brake Booster

Courtesy of GENERAL MOTORS COMPANY

17. Loosen Bolt (2) @Power Brake Booster (1)
18. Remove **Brake Pedal Position Sensor Replacement**

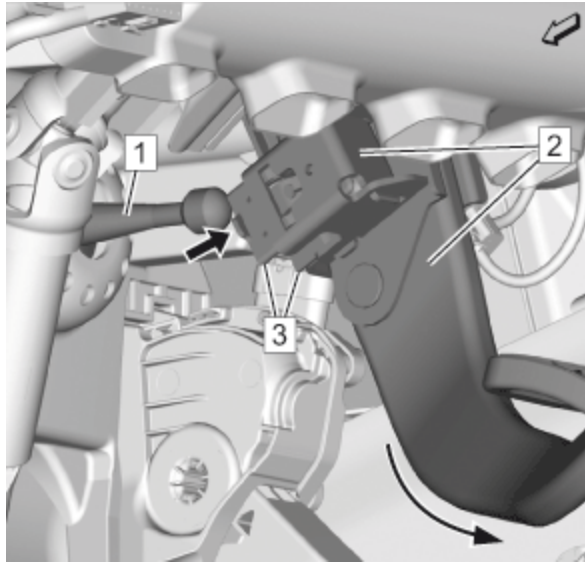


Fig. 61: Brake Pedal Push Rod And Brake Pedal

Courtesy of GENERAL MOTORS COMPANY

19. Disconnect the brake pedal push rod (1) from the brake pedal (2). Press the 2 tabs of the click fit connector (3) together and pull the brake pedal to facilitate the removal.

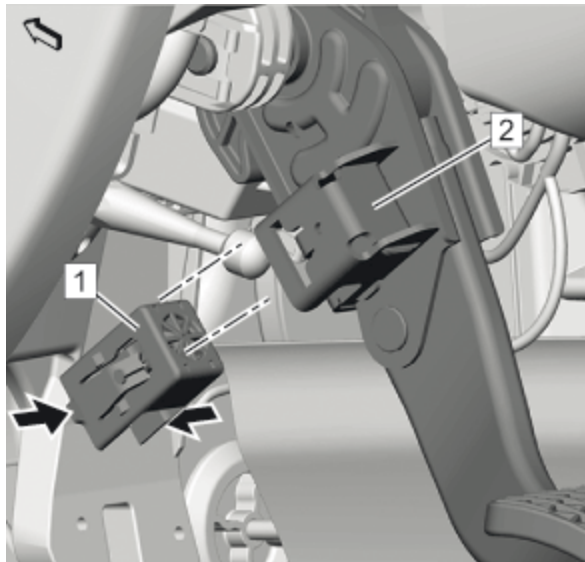


Fig. 62: Brake Pedal

Courtesy of GENERAL MOTORS COMPANY

20. Remove and DISCARD the click fit connector (1) from the brake pedal (2).

NOTE: **Protect the windshield edge before removing the component.**

21. Remove Power Brake Booster@Vehicle

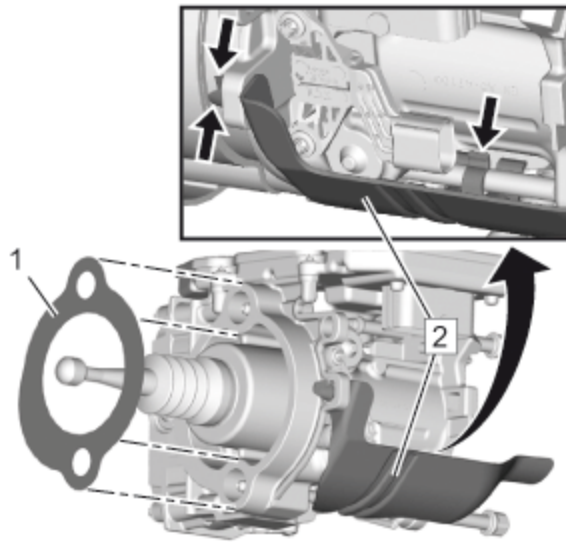


Fig. 63: Power Brake Booster Gasket

Courtesy of GENERAL MOTORS COMPANY

22. Remove and DISCARD the power brake booster gasket (1).
23. Remove the power brake booster heat shield.(2)

Installation Procedure

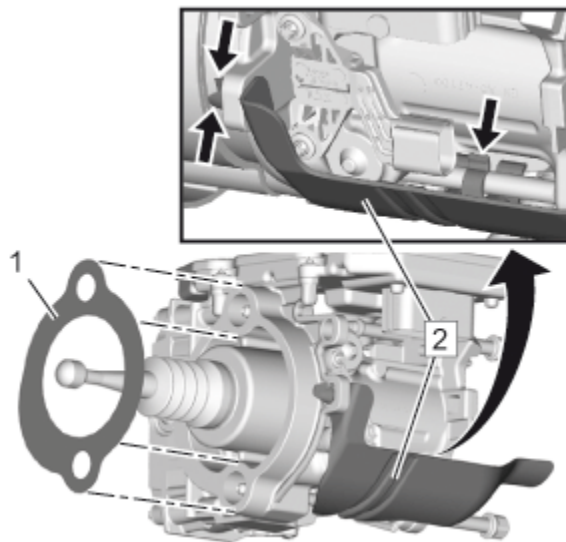


Fig. 64: Power Brake Booster Gasket

Courtesy of GENERAL MOTORS COMPANY

1. Install the power brake booster heat shield (2).

NOTE: Ensure that the old gasket was removed from the vehicle.

2. Install the NEW power brake booster gasket (1).
3. Install Power Brake Booster@Vehicle

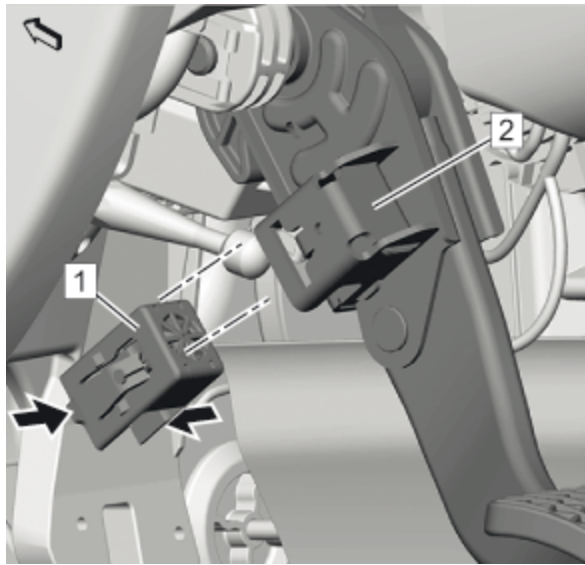


Fig. 65: Brake Pedal

Courtesy of GENERAL MOTORS COMPANY

4. Install the NEW click fit connector (1) to the brake pedal (2).

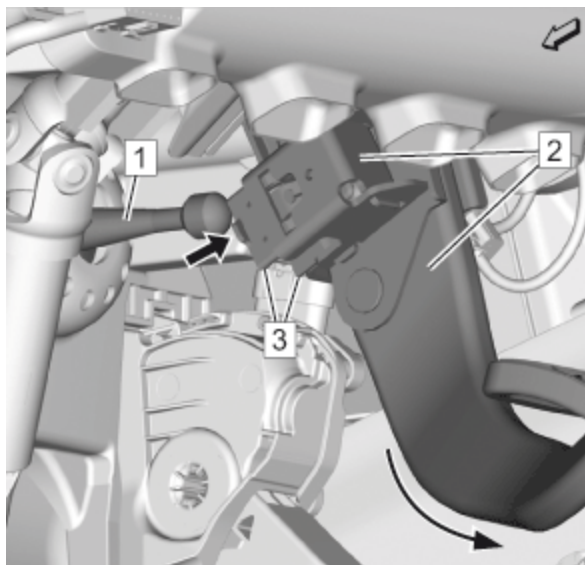


Fig. 66: Brake Pedal Push Rod And Brake Pedal

Courtesy of GENERAL MOTORS COMPANY

5. Connect the brake pedal push rod (1) to the brake pedal (2).
6. Install **Brake Pedal Position Sensor Replacement**

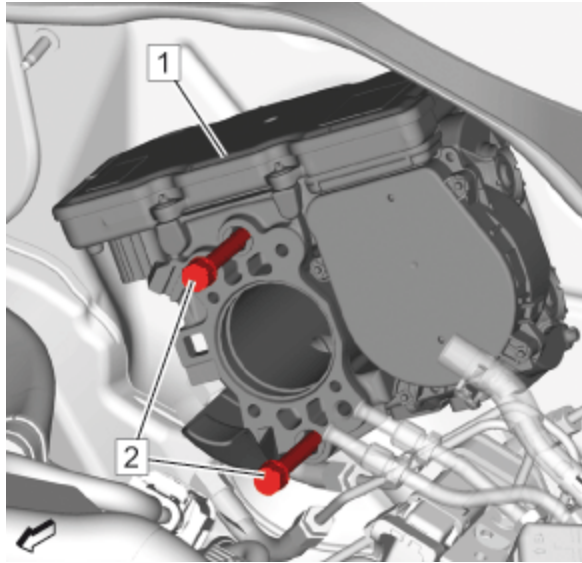


Fig. 67: Power Brake Booster

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

7. Bolt (2) @Power Brake Booster (1) Tighten 22 N.m (16 lb ft)
8. Install the master cylinder with the master cylinder reservoir. Master Cylinder Replacement

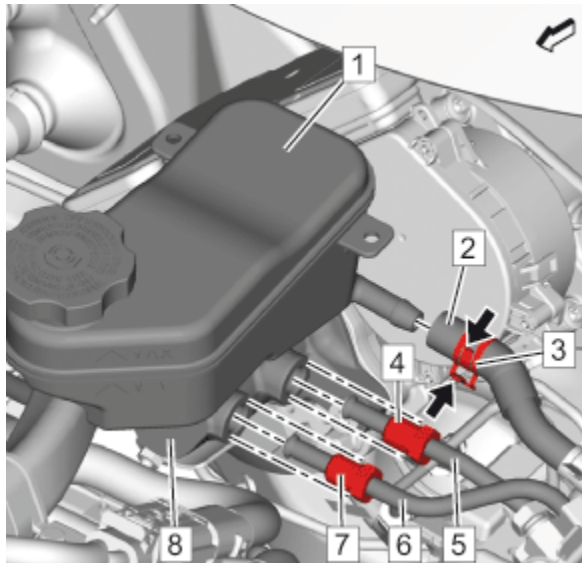


Fig. 68: Brake Master Cylinder Reservoir Hose And Brake Pressure Modulator Valve Secondary Pipe

Courtesy of GENERAL MOTORS COMPANY

9. Install Brake Pressure Modulator Valve Primary Pipe (5) @Brake Master Cylinder (8)
10. Brake Pressure Modulator Valve Primary Pipe Fitting (4)@Brake Master Cylinder - Tighten 32 N.m (24 lb ft)
11. Install Brake Pressure Modulator Valve Secondary Pipe (6) @Brake Master Cylinder
12. Brake Pressure Modulator Valve Secondary Pipe Fitting (7) @Brake Master Cylinder - Tighten 32 N.m

(24 lb ft)

13. Install Brake Master Cylinder Reservoir Hose (2) @Brake Master Cylinder Reservoir (1)

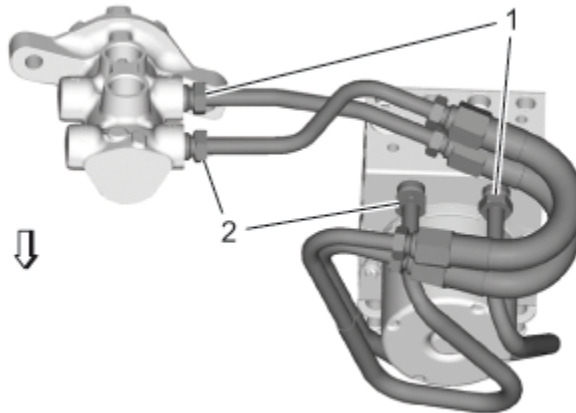


Fig. 69: Brake Pressure Modulator Valve Primary And Secondary Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

14. Ensure the brake pipes are correctly installed.
 1. Brake Pressure Modulator Valve Primary Pipe Fitting (1)
 2. Brake Pressure Modulator Valve Secondary Pipe (2)

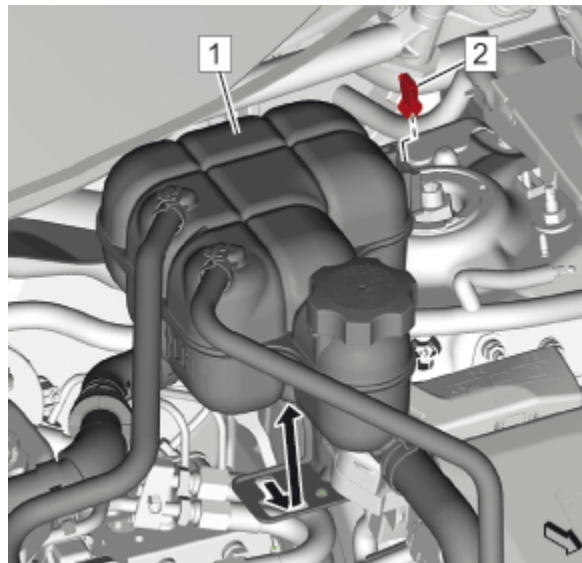


Fig. 70: Radiator Surge Tank And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

15. Install Radiator Surge Tank (1)
16. Install Radiator Surge Tank Bracket Clip (2)

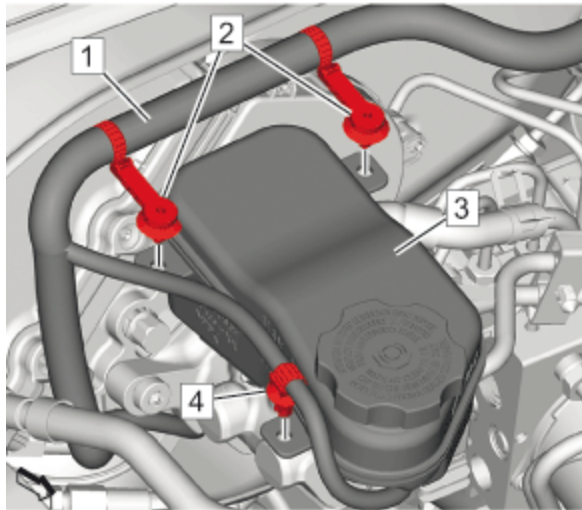


Fig. 71: Brake Master Cylinder Reservoir And Body Wiring Harnes
 Courtesy of GENERAL MOTORS COMPANY

17. Install Body Wiring Harness (1)
18. Install Clip (2) @Brake Master Cylinder Reservoir (3)
19. Install Clip (2) @Brake Master Cylinder Reservoir

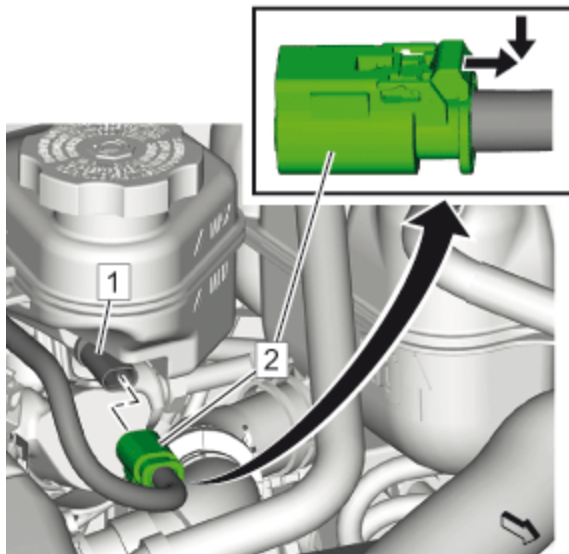


Fig. 72: Electrical Connector And Brake Fluid Level Sensor
 Courtesy of GENERAL MOTORS COMPANY

20. Connect Electrical Connector(2)@Brake Fluid Level Sensor(1)

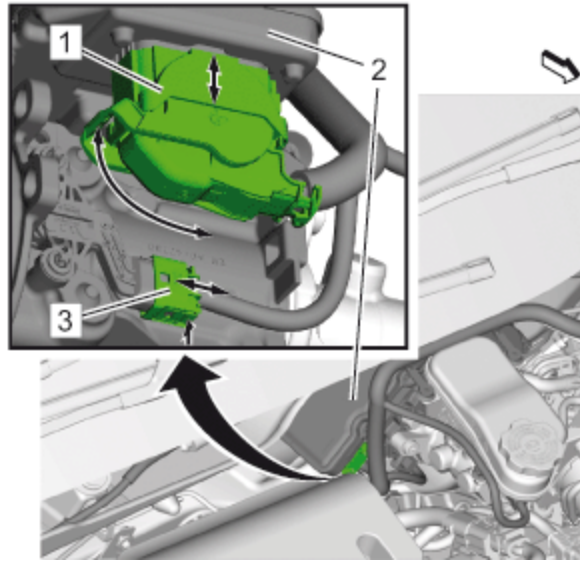


Fig. 73: Electrical Connector And Power Brake Booster
Courtesy of GENERAL MOTORS COMPANY

21. Connect Electrical Connector(1)@Power Brake Booster(2)
22. Connect Electrical Connector(3)@Power Brake Booster
23. Install [Dash Upper Extension Panel Opening Cover Replacement](#)
24. Install the electric brake booster fuse to the engine compartment fuse block.
25. [Hydraulic Brake System Bleeding](#)
26. Program and calibrate the power brake booster control module. Refer to [Control Module References](#) .

DESCRIPTION AND OPERATION

POWER BRAKE BOOSTER DESCRIPTION AND OPERATION

Power Brake Booster Description and Operation

The brake booster is an electromechanical brake booster that replaces a vacuum booster including its vacuum supply. It is designed to make hybrid and electric vehicles more efficient by providing situation-dependent support when a driver initiates braking.

The brake booster unit takes the driver applied brake demand and transforms this into an amplified brake pressure and does not rely on vacuum to function. The brake booster unit is designed to operate together with an electronic stability control module which is normally responsible for ABS, traction control and stability control.

Since the brake booster unit operates electromechanically, it does not require vacuum from the engine and recovers almost all the energy lost in typical braking. It uses electrical current only during braking.

The brake booster unit consists of a PSM motor for force build up, and ECU for the control of the brake booster, a stage gear control to transmit the motor torque to the output pressure in the master cylinder, a vehicle interface to connect the brake booster and the vehicle, a pedal coupling unit to couple the brake booster with the vehicle pedal unit, a pedal travel sensor to detect the driver brake request, TMC to connect the brake booster with the braking system and a reservoir to support the braking system with brake fluid.

For maximum efficiency, a hybrid or EV must recover as much energy as possible when braking. Ideally, a vehicle would be slowed down purely by the electric motor, avoiding the loss of valuable energy through braking. The system recovers almost all the energy lost in typical braking operations by ensuring deceleration rates of up to 0.3 g are achieved using the electric motor alone. If the brakes are applied harder, the brake booster system generates the additional braking pressure needed in the traditional way, using the brake master cylinder.

The brake booster unit is purely electromechanical, without brake fluid, which means it can be rotated flexibly about the longitudinal axis.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

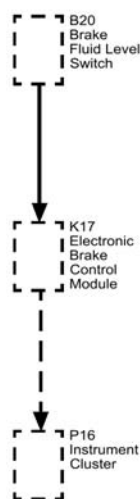


Fig. 74: Brake Warning Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
B20	B20 Brake Fluid Level Switch
K17	K17 Electronic Brake Control Module

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 seconds.
- When the EBCM detects a too low brake fluid level it sets a DTC and sends a serial data message to the instrument cluster, which will illuminate.

Electronic brake control module (EBCM) monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module (EBCM) will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.
Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	-----------------------------

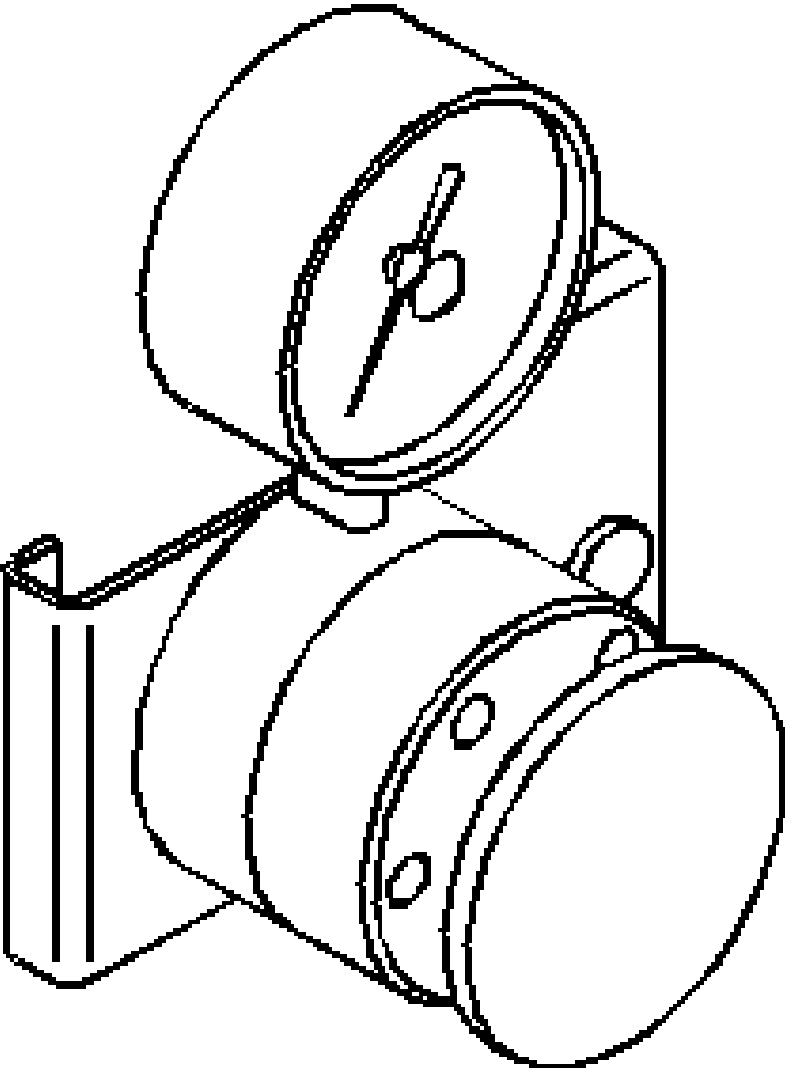
Illustration	Tool Number/ Description
	CH 28662 J 28662 Brake Pedal Effort Gauge

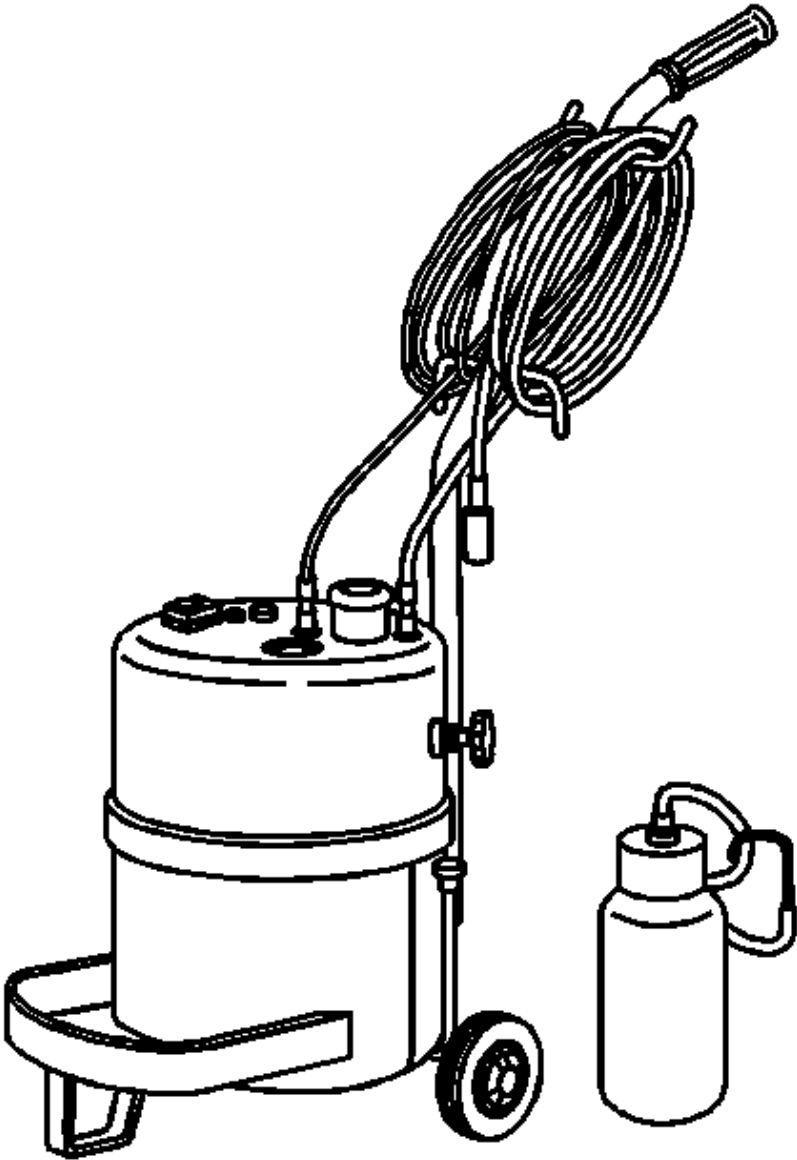
Illustration	Tool Number/ Description
	CH 29532-A J 29532-A Pressure Brake Bleeder

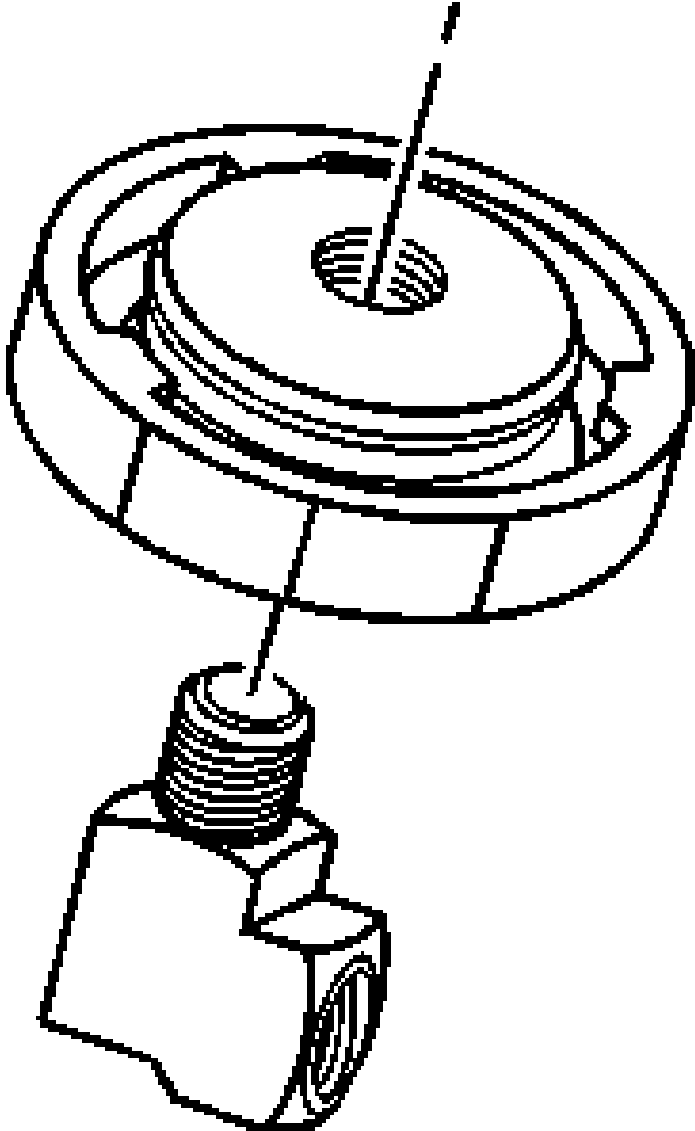
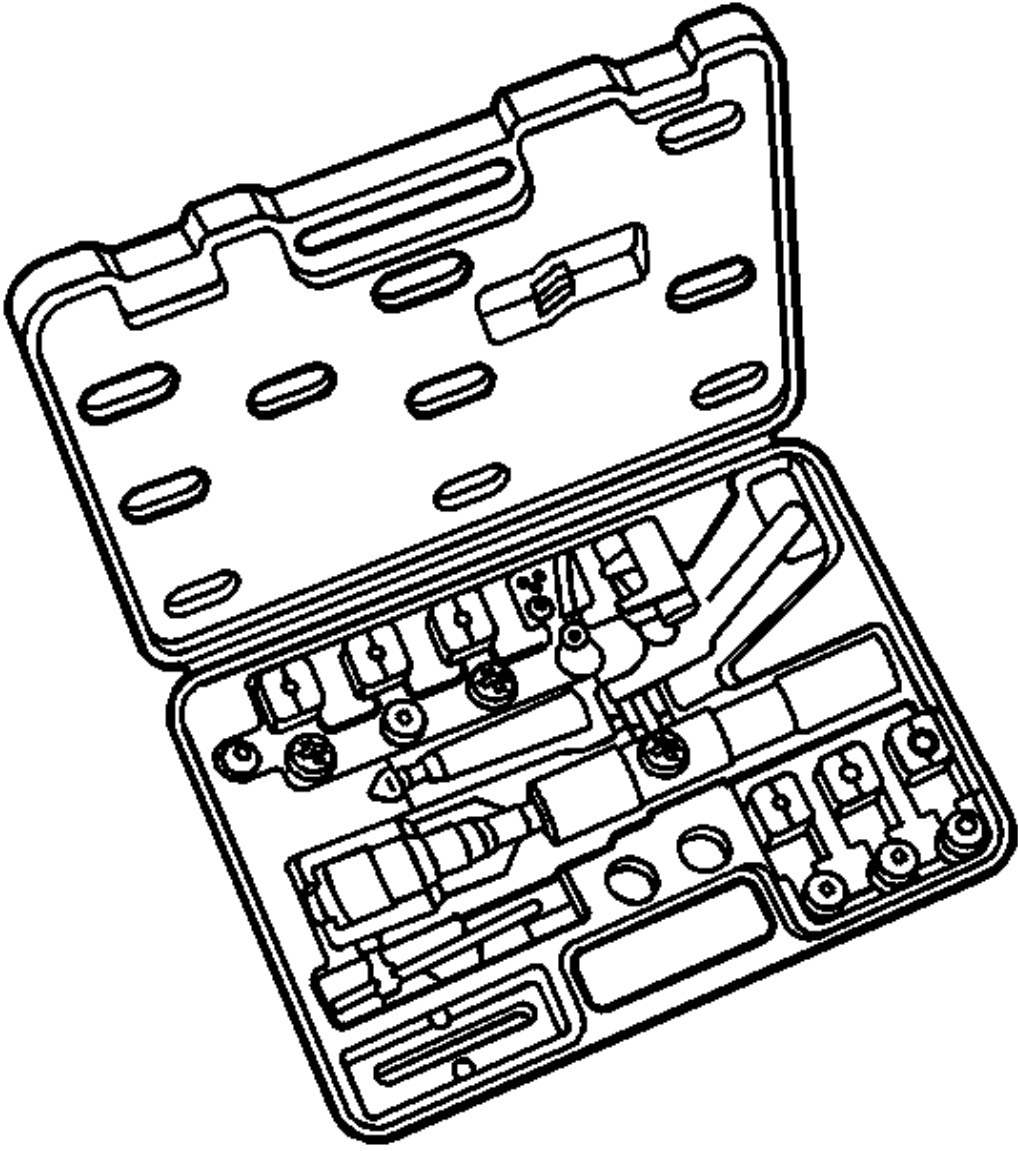
Illustration	Tool Number/ Description
	CH 35589-A J 35589-A Brake Pressure Bleeder Adapter

Illustration	Tool Number/ Description
	CH 45405 J 45405 Brake Pipe Flaring Kit

Article GUID: A00884698

BRAKES

Park Brake - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Brake Hose Fitting Gasket
Rear Parking Brake Actuator Seal Ring

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Parking Brake Actuator Bolt	12 N.m (106 lb in)
Brake Hose Fitting Bolt	40 N.m (30 lb ft)

SCHEMATIC WIRING DIAGRAMS

PARK BRAKE SYSTEM WIRING SCHEMATICS

Park Brake

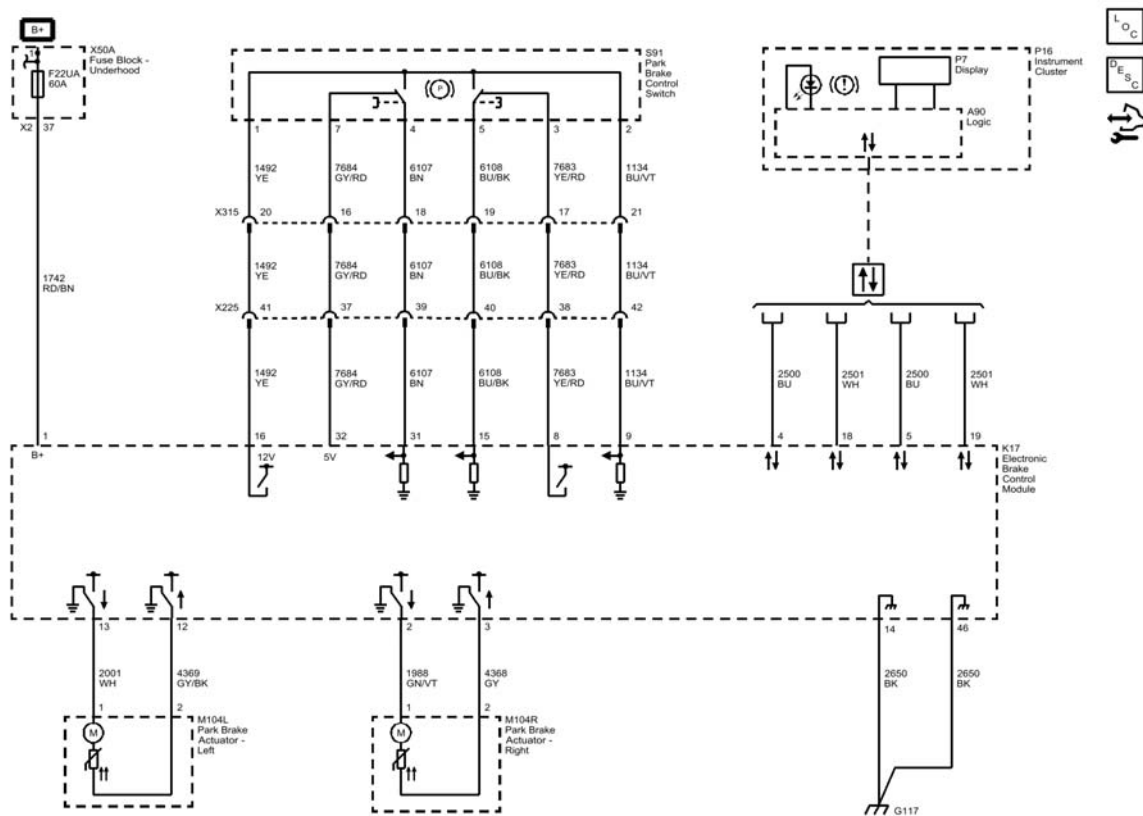


Fig. 1: Park Brake

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C1138: SUPPLY VOLTAGE GOES BELOW 7 V AND ABOVE 16.5 V/SIGNAL PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC C1138 03

Supply Voltage Goes Below 7 V

DTC C1138 07

Supply Voltage Goes Above 16.5 V

DTC C1138 58

Signal Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C1138 03	C1138 03	-	C1138 58
Ground	-	C1138 03	C1138 07	C1138 58

Circuit/System Description

The Electronic Brake Control Module monitors its supply voltage to verify the supply voltage is within the normal operating range

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

DTC C1138 03

The EBCM detects its supply voltage of less than approximately 7 V.

DTC C1138 07

The EBCM detects a supply voltage of more than 16.5 V.

DTC C1138 58

The Park Brake Controller (PBC) loses communication with the EBCM during park brake actuation.

Action Taken When the DTC Sets

- DTC is stored in memory.
- Park brake actuation unavailable.

Conditions for Clearing the DTC

The supply voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the charging system.
- A possible cause of this DTC could be overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

2. Vehicle OFF, measure and record the battery voltage at the battery terminals.

3. Verify the battery voltage stabilizes between 12.4 V and 12.8 V within a few minutes of turning the vehicle OFF.

- **If battery voltage is less than 12.4 V or more than 12.8 V**

Refer to [Battery Inspection/Test](#) .

- **If battery voltage is between 12.4 and 12.8 V**

4. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.

5. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.

- **If the voltage is not at least 1 V greater than the voltage measured in step 2 or is greater than 15 V.**

Refer to [Charging System Test](#) .

- **If the voltage is at least 1 V greater than the voltage measured in step 2, but less than 15 V.**

6. Verify the K17 Electronic Brake Control Module scan tool ignition voltage parameter is within 1 V of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing.

- **If within 1 V of the battery voltage**

7. All OK.

Circuit/System Testing

NOTE:

- You must perform the Circuit/System Verification before Circuit/System Testing.
- Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 5 Ω . In most cases the readings will drop below 20 Ω within 1 min indicating the control module is going to sleep.

DTC C1138 03 or DTC C1138 07

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 46 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K17 Electronic Brake Control Module.
 - **If the test lamp illuminates**
4. Replace the K17 Electronic Brake Control Module.

DTC C1138 58

1. Verify that no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

2. Using the S91 Park Brake Control Switch, apply and release the park brake.
3. Verify that the DTC does not reset.

- **If the DTC resets**

Replace the K17 Electronic Brake Control Module.

- **If the DTC does not reset**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

DTC C1148: LEFT PARK BRAKE ACTUATOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC C1148

Left Park Brake Actuator Circuit

For symptom byte information, refer to: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Park Brake Actuator Apply Control	C1148 0C	C1148 04	C1148 0B	C1148 00 C1148 0F
Left Park Brake Actuator Release Control	C1148 0C	C1148 04	C1148 0B	C1148 00 C1148 0F

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and

right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the left park brake actuator or its circuits.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Diagnostic Aids

After repairing any fault, the DTC will still be set as current and the park brakes will not function. It is necessary to clear the DTC with a scan tool in order to place the DTC in history and regain park brake function.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Circuit/System Verification

1. Verify the M104L Park Brake Actuator - Left apply when pulling the S91 Park Brake Switch.
 - **If the M104L Park Brake Actuator - Left does not apply**

Refer to the Circuit/System Testing.
 - **If the M104L Park Brake Actuator - Left does apply**
2. Verify the M104L Park Brake Actuator - Left release when pressing the S91 Park Brake Switch.
 - **If the M104L Park Brake Actuator - Left does not release**

Refer to the Circuit/System Testing.
 - **If the M104L Park Brake Actuator - Left does release**
3. All OK.

Circuit/System Testing

NOTE: **It is necessary to clear the DTC after any repair is made to regain park brake output control and have the DTC to set as history.**

1. Ignition OFF, disconnect the harness connector at the M104L Park Brake Actuator - Left and the harness connector at the K17 Electronic Brake Control Module. Ignition ON
2. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - Terminal 12
 - Terminal 13
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Ignition OFF.
4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - Terminal 12
 - Terminal 13
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
5. Test for less than 2 Ω between the M104L Park Brake Actuator - Left harness connector terminal 1 and

the K17 Electronic Brake Control Module harness connector terminal 13

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Test for less than 2 Ω between the M104L Park Brake Actuator - Left harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal 12

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

7. Install a 25 A fused jumper wire between one of the control terminals at the M104L Park Brake Actuator - Left and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M104L Park Brake Actuator - Left should perform the apply and release function.

- **If the actuator does not perform the apply and release function**

Replace the M104L Park Brake Actuator - Left.

- **If the actuator performs the apply and release function**

8. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Rear Parking Brake Actuator Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC C114C: PARK BRAKE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC C114C

Park Brake Switch Circuit

For symptom byte information, refer to: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Brake Switch Supply Voltage Terminal 16	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08
Park Brake Apply Switch Voltage Reference Terminal 32	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08
Park Brake Release Switch Voltage Reference Terminal 8	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08
Park Brake Switch Signal Terminal 9	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08
Park Brake Apply Switch Signal Terminal 31	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08
Park Brake Release Switch Signal Terminal 15	C114C 02	C114C 04,	C114C 01,	C114C 00 C114C 08

Circuit/System Description

The parking brake function is integrated into the Electronic Brake Control Module. The Electronic Brake Control Module contains the logic for applying and releasing the parking brake when commanded by the Park Brake Switch. The Electronic Brake Control Module will perform diagnostics on the Park Brake Switch and its wiring harness to verify it is functioning properly.

The Park Brake Switch diagnostic checks for failure conditions in the Park Brake Switch and associated wiring into the Electronic Brake Control Module.

Conditions for Running the DTC

Vehicle ON or in SERVICE MODE.

Conditions for Setting the DTC

The Electronic Brake Control Module detects a short to battery, short to ground, open circuit, or an internal Parking Brake Control Switch malfunction. The Electronic Brake Control Module detects the apply or release button was activated for more than 90 s.

Action Taken When the DTC Sets

- The parking brake is disabled.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive Vehicle on/off cycles with at least one test pass in each Vehicle cycle and no test fail result.
- The condition for the DTC is no longer present.
- The Park Brake Switch button is INACTIVE using the scan tool without the switch being activated.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool Park Brake Switch parameter changes between Released and Apply while pressing and releasing the S91 Park Brake Switch.
 - **If the parameter does not change**

Refer to Circuit/System Test.
 - **If the parameter changes**
3. All OK.

Circuit/System Test

1. Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. Vehicle ON.
2. Test for less than 1 V between each circuit terminals listed below and ground;
 - Terminal 16
 - Terminal 32
 - Terminal 9
 - Terminal 15
 - Terminal 31
 - Terminal 8
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Vehicle OFF.

4. Test for infinite resistance between the circuit terminals listed below and ground;

- Terminal 16
- Terminal 32
- Terminal 9
- Terminal 15
- Terminal 31
- Terminal 8

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Test for less than 5 Ω between the circuit terminal 32 and the circuit terminal 31.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Switch.

2. Test for less than 2 Ω in the circuits end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the S91 Park Brake Switch.

- **If less than 5 Ω**

6. Test for less than 5 Ω between the circuit terminal 8 and the circuit terminal 15.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Switch.

2. Test for less than 2 Ω in the circuits end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the S91 Park Brake Switch.

- **If less than 5 Ω**

7. Test for less than 5 Ω between the circuit terminal 16 and the circuit terminal 9.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the S91 Park Brake Switch.

2. Test for less than 2 Ω in the circuits end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the S91 Park Brake Switch.

- **If less than 5 Ω**

8. Test for less than 5 Ω between the circuit terminal 9 and the circuit terminal 31 while closing the switch.

- **If 5 Ω or greater**

Replace the S91 Park Brake Switch.

- **If less than 5 Ω**

9. Test for less than 5 Ω between the circuit terminal 9 and the circuit terminal 15 while closing the switch.

- **If 5 Ω or greater**

Replace the S91 Park Brake Switch.

- **If less than 5 Ω**

10. Vehicle OFF, all access doors closed, all vehicle systems OFF, disconnect the harness connector at the S91 Park Brake Switch.

11. Test for less than 10 Ω between the ground circuit terminal 8 at the S91 Park Brake Switch and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

12. Replace the S91 Park Brake Switch.

13. Verify that DTC C114C does not set while operating the vehicle within the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K17 Electronic Brake Control Module.

- **If DTC does not set**

14. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Parking Brake Actuator Switch Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC C1586: RIGHT PARK BRAKE ACTUATOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC C1586

Right Park Brake Actuator Circuit

For symptom byte information, refer to: [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Park Brake Actuator Apply Control	C1586 0C	C1586 04	C1586 0B	C1586 00 C1586 0F
Right Park Brake Actuator Release Control	C1586 0C	C1586 04	C1586 0B	C1586 00 C1586 0F

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the right park brake actuator or its circuits.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Diagnostic Aids

After repairing any fault, the DTC will still be set as current and the park brakes will not function. It is necessary to clear the DTC with a scan tool in order to place the DTC in history and regain park brake function.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the M104R Park Brake Actuator - Right apply when pulling the S91 Park Brake Switch.
 - **If the M104R Park Brake Actuator - Right does not apply**
Refer to the Circuit/System Testing.
 - **If the M104R Park Brake Actuator - Right does apply**
2. Verify the M104R Park Brake Actuator - Right release when pressing the S91 Park Brake Switch.
 - **If the M104R Park Brake Actuator - Right does not release**
Refer to the Circuit/System Testing.
 - **If the M104R Park Brake Actuator - Right does release**
3. All OK.

Circuit/System Testing

NOTE: It is necessary to clear the DTC after any repair is made to regain park brake output control and have the DTC to set as history.

1. Ignition OFF, disconnect the harness connector at the M104R Park Brake Actuator - Right and the harness connector at the K17 Electronic Brake Control Module. Ignition ON
2. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
 - Terminal 2

- Terminal 3
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Ignition OFF.

4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:

- Terminal 2
- Terminal 3
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

5. Test for less than 2 Ω between the M104R Park Brake Actuator - Right harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal 2

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

6. Test for less than 2 Ω between the M104R Park Brake Actuator - Right harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal 3

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

7. Install a 25 A fused jumper wire between one of the control terminals at the M104R Park Brake Actuator - Right and 12 V. Momentarily install a jumper wire between the other control terminal and ground.

Reverse the jumper wires at least two times, the M104R Park Brake Actuator - Right should perform the apply and release function.

- **If the actuator does not perform the apply and release function**

Replace the M104R Park Brake Actuator - Right.

- **If the actuator performs the apply and release function**

8. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Rear Parking Brake Actuator Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC C1587: LEFT PARK BRAKE ACTUATOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC C1587

Left Park Brake Actuator

For symptom byte information, refer to: [Symptom Byte List](#)

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the left park brake actuator.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C1587 is not set.
 - **If the DTC is set**
 1. Perform the Park Brake Calibration learn procedure. Refer to **Park Brake Calibration**.
 2. Ignition ON.
 3. Apply and release the park brake.
 4. Verify the DTC is not set.
 - If the DTC is set, replace the M104L Park Brake Actuator - Left.
 - If the DTC is not set
 - 5. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

DTC C1588: RIGHT PARK BRAKE ACTUATOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC C1588

Right Park Brake Actuator

For symptom byte information, refer to: [Symptom Byte List](#)

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the right park brake actuator.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

[Park Brake System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C1588 is not set.
 - **If the DTC is set**
 1. Perform the Park Brake Calibration learn procedure. Refer to **Park Brake Calibration**.
 2. Ignition ON.
 3. Apply and release the park brake.
 4. Verify the DTC is not set.
 - If the DTC is set, replace the M104R Park Brake Actuator - Right.
 - If the DTC is not set
 - 5. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

SYMPTOMS - PARK BRAKE

NOTE: Review the system operation in order to familiarize yourself with the system functions.

Refer to **Park Brake System Diagnosis**.

1. Inspect for aftermarket devices which could affect the operation of the park brake system.
2. Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
3. Listen to working noise in both parking brake actuators during pushing the parking brake indicator switch.

If no noises occur, check the fuse.

4. Perform a test with a scan tool.

PARK BRAKE WILL NOT HOLD OR RELEASE

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom Table?	Go to Step 2	Go to Symptoms - Park Brake
2	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis . Did you find and correct a condition?	Go to Step 4	Go to Step 3
3	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to Step 4	Go to Symptoms - Park Brake
4	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to Step 2	System OK

PARK BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate Symptom Table to go to other brake system diagnostic tables as appropriate.			
1	1. Raise and support the vehicle with the rear axle supported by jack stands. Lifting and Jacking the Vehicle . 2. Shift the transmission into NEUTRAL. 3. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to Step 4	Go to Step 2
2	1. Shift the transmission into NEUTRAL. 2. Apply the park brake. 3. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to Step 4	Go to Step 3

Step	Action	Yes	No
3	Do the electronic park brake actuators working?	Go to Step 10	Go to Step 5
4	Calibrate the park brake. <u>Park Brake Calibration</u> Do the rear brakes have a significant amount of drag?	Go to Step 5	Go to Step 10
5	1. Check the fuse of the electronic park brake. 2. Check visual the electronic park brake actuators, the wiring harness and the electrical connectors. 3. Check visual the electronic brake control module, the wiring harness and the electrical connector. 4. Check the electronic park brake system with a scan tool. Did you find the condition?	Go to Step 6	Go to Step 7
6	• Replace the fuse as necessary. • Replace the wiring harness as necessary. • Replace the park brake actuator switch as necessary. <u>Parking Brake Actuator Switch Replacement</u> • Replace the parking brake actuators as necessary. <u>Rear Parking Brake Actuator Replacement</u> Did you correct the condition?	Go to Step 9	Go to Step 6
7	CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.	Go to Step 8	Go to Step 10

Step	Action	Yes	No
	1. Remove the rear disc brake pads. Rear Disc Brake Pads Replacement . 2. Inspect the disc brake pads for looseness, damaged, broken or missing components. 3. Check the brake caliper piston seals for cracks. 4. Check the brake caliper pistons for movement 5. Check the electronic park brake actuators for a seized condition. Does the park brake hardware and/or the park brake actuators require replacement?		
8	1. Replace the rear brake hardware components as necessary. Rear Disc Brake Pads Replacement 2. Replace the rear brake calipers as necessary. Rear Brake Caliper Replacement Did you complete the replacement?	Go to Step 9	-
9	1. Calibrate the electronic brake system. Park Brake Calibration Did you complete the replacement and adjustment?	Go to Step 10	Go to Symptoms - Park Brake
10	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK	Go to Symptoms - Park Brake

REPAIR INSTRUCTIONS

PARK BRAKE CALIBRATION

1. Block the drive wheels.
2. Install a scan tool to the vehicle.
3. Turn the ignition switch to the ON/RUN position with the engine OFF.
4. Select Configuration/Reset Functions from the electronic brake control module menu.
5. Perform the parking brake calibration procedure.

PARKING BRAKE ACTUATOR SWITCH REPLACEMENT

Removal Procedure

1. Remove [Front Floor Console Accessory Trim Plate Replacement](#)



Fig. 2: Electrical Connector And Parking Brake Switch

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (2) @Parking Brake Switch (1)
3. Remove Parking Brake Switch (1)

Installation Procedure

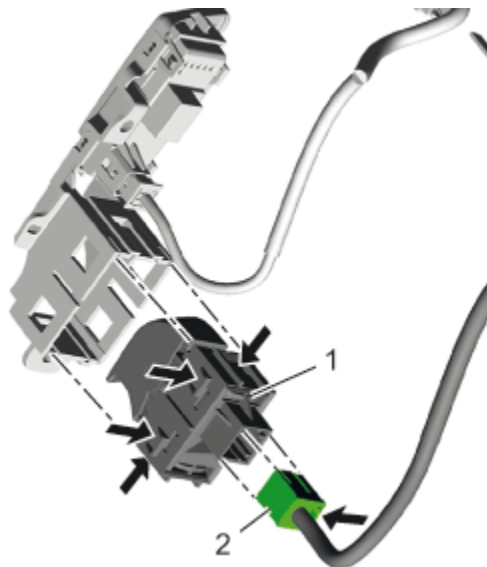


Fig. 3: Electrical Connector And Parking Brake Switch

Courtesy of GENERAL MOTORS COMPANY

1. Install Parking Brake Switch (1)
2. Connect Electrical Connector (2) @Parking Brake Switch (1)
3. Install **Front Floor Console Accessory Trim Plate Replacement**

REAR PARKING BRAKE ACTUATOR REPLACEMENT

Removal Procedure

WARNING: Brake Fluid Irritant Warning

WARNING: Use of eye goggles is necessary to prevent personal injury.

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

1. Set the parking brake in service mode. With Scan Tool.
 1. Connect the scan tool.
 2. Ignition ON, engine OFF.
 3. Select Electronic Brake Control Module.
 4. Select Control Functions.

NOTE: Do not apply any brake pressure during the following step.

5. Select Rear Brake Caliper Piston Retract.
2. Turn OFF the ignition.
3. Raise and support the vehicle. Lifting and Jacking the Vehicle .
4. Remove the rear tire and wheel assemblies. Tire and Wheel Removal and Installation .

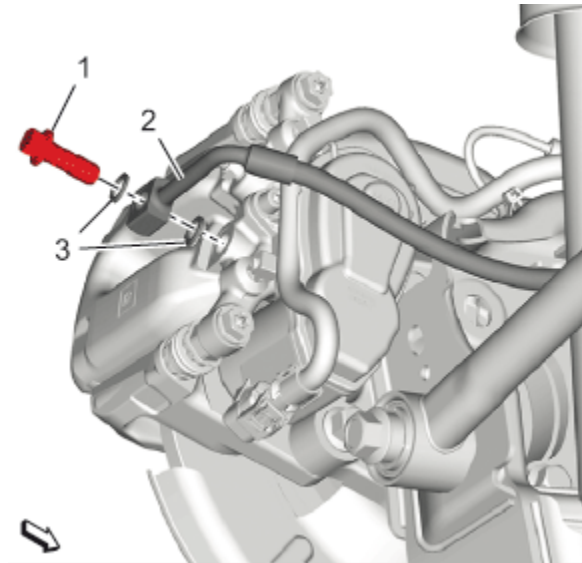


Fig. 4: Brake Hose, Fitting Bolt And Sealing Washers

Courtesy of GENERAL MOTORS COMPANY

5. Remove Brake Hose Fitting Bolt (1) @Rear Brake Caliper
6. Remove Brake Hose (2) @Rear Brake Caliper
7. Cap the brake caliper inlet port to prevent brake fluid loss and contamination.
8. Cap the brake hose fitting to prevent brake fluid loss and contamination.
9. DISCARD the brake hose fitting gaskets. (3)

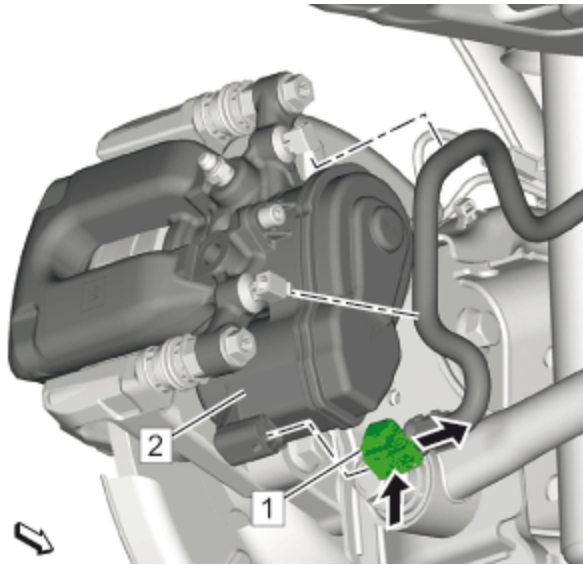


Fig. 5: Brake Caliper Assembly And Lectrical Connector

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the electrical connector (1) and remove the wiring harness from the brake caliper assembly (2).

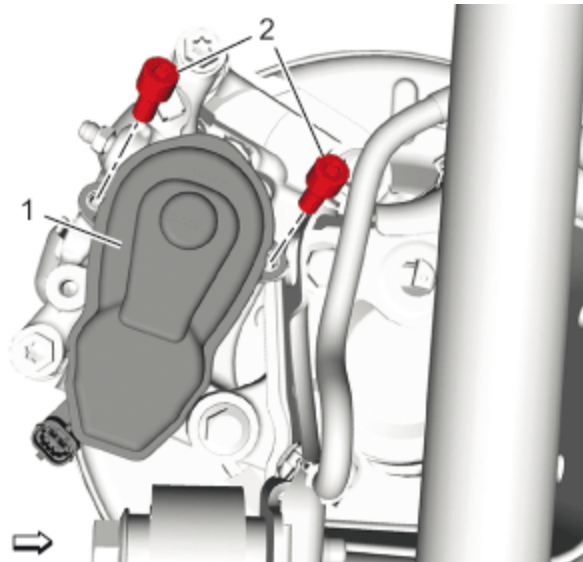


Fig. 6: Parking Brake Actuator

Courtesy of GENERAL MOTORS COMPANY

11. Remove Bolt (2) @Parking Brake Actuator (1)

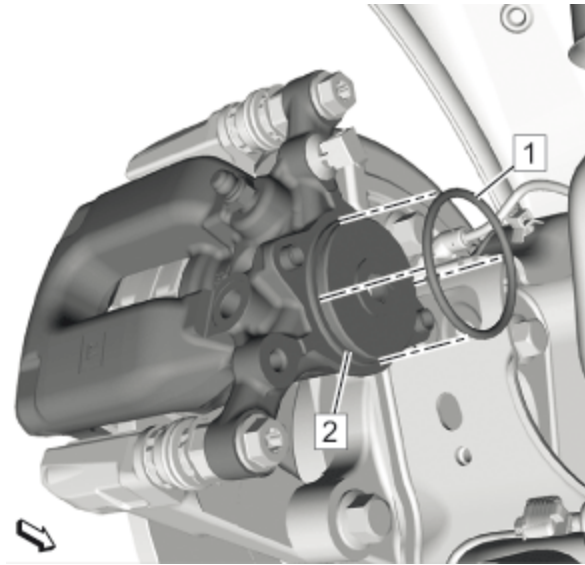


Fig. 7: Seal Ring And Rear Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

12. Remove Seal Ring (1) @Rear Brake Caliper (2) and DISCARD

Installation Procedure

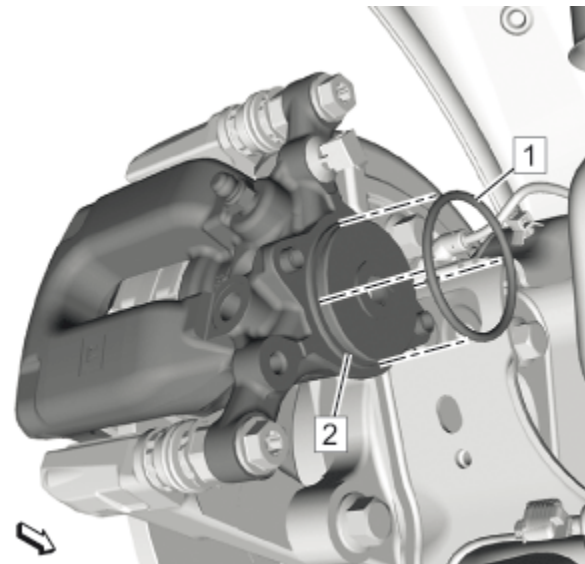


Fig. 8: Seal Ring And Rear Brake Caliper

Courtesy of GENERAL MOTORS COMPANY

NOTE: The seating faces between actuator and housing must be free of scratches and clean.

1. Install a NEW O-ring seal.(1)

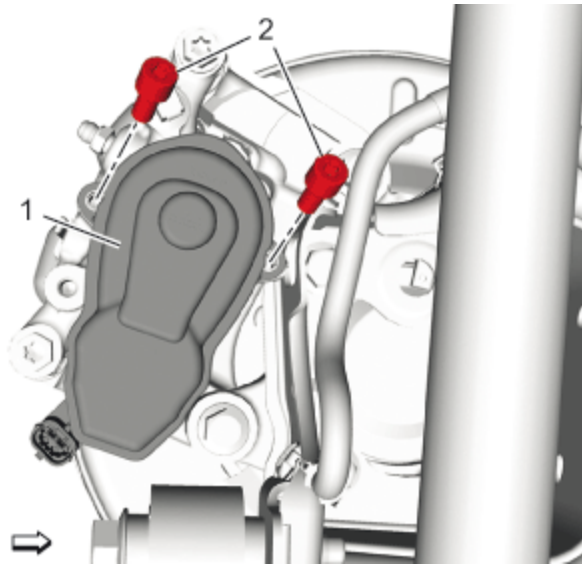


Fig. 9: Parking Brake Actuator

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Install Bolt (2) @Parking Brake Actuator (1) and tighten 12 N.m (106 lb in)

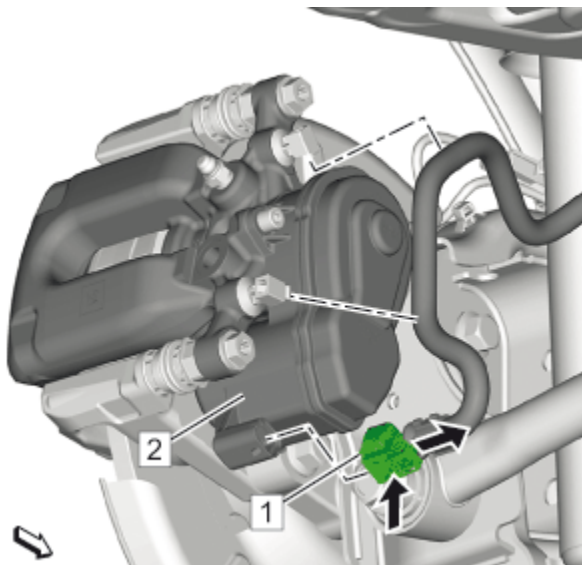


Fig. 10: Brake Caliper Assembly And Lectrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector (1) and fix the wiring harness with 2 cable straps to the brake caliper assembly (2).
4. Remove the caps from the brake caliper opening and the brake hose.

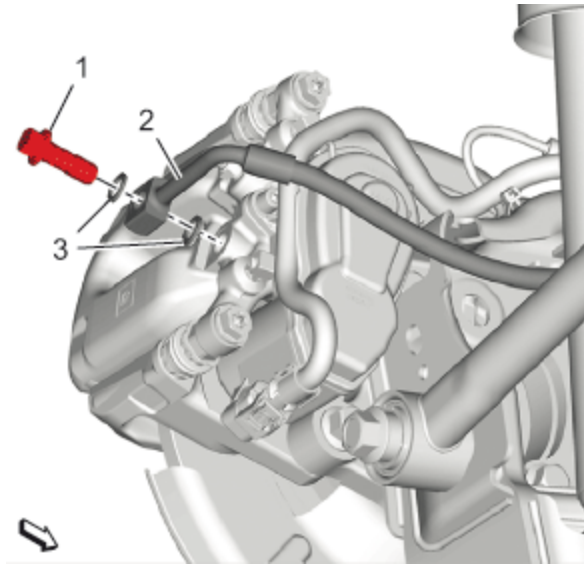


Fig. 11: Brake Hose, Fitting Bolt And Sealing Washers

Courtesy of GENERAL MOTORS COMPANY

5. Install NEW brake hose fitting gaskets. (3)
6. Install Brake Hose Fitting Bolt (1) @Rear Brake Caliper and tighten 40 N.m (30 lb ft)
7. Bleed the brake system. [Hydraulic Brake System Bleeding](#)
8. Install the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#) .
9. Remove the support and lower the vehicle.
10. With the engine OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then repeat step 10 and 11 until a firm brake pedal is obtained.
13. [Park Brake Calibration](#)

REAR PARKING BRAKE SERVICE MODE SELECTION

Rear Parking Brake Actuator Release - Service Mode

Prior to any rear disc brake or parking brake service, the parking brake actuator must be placed in Service Mode.

1. Install a scan tool to the vehicle.
2. Turn the ignition ON with the engine OFF.
3. On the scan tool menu, select Electronic Brake Control Module.
4. Select Control Functions.

NOTE: Do NOT apply any brake pedal pressure during this step.

5. Select Rear Brake Caliper Piston Retract.
6. After the repair is complete, calibrate the park brake. [Park Brake Calibration](#)

Rear Parking Brake Actuator Release - Manual Release

In the event the rear parking brake actuator fails or there is a loss of electrical power, the parking brake may be released manually.

1. Remove the rear parking brake actuator. [Rear Parking Brake Actuator Replacement](#)
2. Insert an appropriate hex tool past the splines of the parking brake actuator piston apply spindle in the brake caliper.
3. Rotate the parking brake actuator piston apply spindle clockwise to release the parking brake.
4. After the repair is complete, calibrate the park brake. [Park Brake Calibration](#)

DESCRIPTION AND OPERATION

ELECTRONIC PARKING BRAKE DESCRIPTION

Vehicles with the electric parking brake have a switch in the center console or on the dash, which takes the place of the manual parking brake system, the foot pedal and release handle. In case of insufficient electrical power, the electric parking brake cannot be applied or released.

Electronic Brake Control Module

The parking brake function is integrated into the Electronic Brake Control Module. The Electronic Brake Control Module contains the logic for applying and releasing the parking brake when commanded by the Park Brake Switch.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

The Park Brake Motor Position Sensor is an internal sensor to the park brake actuator, this sensor is used to monitor the park brake motor position.

Electric Parking Brake Apply

The electric parking brake can be applied any time the vehicle is stopped or in motion. The electric parking brake is applied by momentarily lifting up on the park brake control switch. The red park brake light will momentarily flash while the parking brake is being applied. Once fully applied, the red park brake light will turn on. If the electric parking brake is applied while the vehicle is in motion, a chime will sound, and the message "Release Park Brake Switch" will be displayed.

If the red park brake light is flashing, the electric parking brake is only partially applied or released, or there is a problem with the electric parking brake. The message "Service Park Brake" will be displayed.

The vehicle may automatically apply the electric parking brake in some situations when the vehicle is not moving. This is normal, and is done to periodically check the correct operation of the electric parking brake system.

Electric Parking Brake Release

To release the electric parking brake, turn the ignition switch to the ON or RUN position, apply and hold the brake pedal, and push down momentarily on the park brake control switch. When the electric parking brake is released the red park brake light turns off.

The electric parking brake can be used to prevent roll back for vehicles with a manual transmission taking off on a hill. In a situation where no roll back is desired, an applied electric parking brake will allow both feet to be used for the clutch and accelerator pedals in preparation for starting the vehicle moving in the intended direction. In this situation, perform the normal clutch and accelerator actions required to begin moving the vehicle. There is no need to push the switch to release the electric parking brake. To disable this feature lift and hold the park brake control switch while the vehicle is in motion, this will keep the electric parking brake applied.

PARK BRAKE SYSTEM DESCRIPTION AND OPERATION

Electronic Park Brake System

By pushing the parking brake switch, the actuators on each rear disc brake caliper will be activated and the rear brake caliper pistons apply pressure to the rear disc brake rotors until the rear tire and wheel assemblies are locked. A red brake lamp shows the status of the activated parking brake and is illuminating during the On position of the ignition switch.

By pressing the parking brake switch a second time, the electronic parking brake will release and the red brake lamp go out.

Non mechanical problems with the electronic parking brake system can be localized with a scan tool.

Service

Before a repair service procedure on the rear brakes is carried out, the electronic parking brake system has to be set in a service mode. After the repair service procedure of the rear disc brakes, the electronic parking brake system has to be calibrated before the vehicle can leave the workshop. The rotation of the rear brake caliper piston of a brake caliper equipped with an electronic parking brake system is not allowed. The rear brake caliper piston can be retracted by pressing in the caliper bore with a suitable tool.

Article GUID: A00884723

COMMON SPECS & PROCEDURES

Volt

COMMON SPECS & PROCEDURES INDEX

VOLT - COMMON SPECS & PROCEDURES

System	Specification/Procedure
Air Conditioning	
Service	<u>APPROXIMATE FLUID CAPACITIES</u>
Torque	<u>FASTENER SPECIFICATIONS</u> Automatic: <u>FASTENER SPECIFICATIONS</u>
Front: Wheel Drive Shaft Nut	
First Pass	150 N.m (111 lb ft)
Second Pass	Loosen 45 degrees
Final Pass	250 N.m (184 lb ft)
Rear: Wheel Bearing and Hub Bolts	
First Pass	50 N.m (37 lb ft)
Final Pass	30 - 45 degrees
Battery	<u>BATTERY DESCRIPTION AND OPERATION</u>
Brakes	
Bleeding Sequence	<u>HYDRAULIC BRAKE SYSTEM BLEEDING</u>
Disc Brakes	
Service Specifications	<u>DISC BRAKE COMPONENT SPECIFICATIONS</u>
Torque	<u>FASTENER SPECIFICATIONS</u>
Charging	
Generator	See Drive Motor/Generators under: <u>CHARGING SYSTEM COMPONENTS</u>
Torque	<u>FASTENER SPECIFICATIONS</u>
Drive Belts	
Adjustment	Serpentine Belt Used, Not Adjustable
Drive Belt Routing	N/A
Engine Cooling	
General Service Specifications	<u>SPECIFICATIONS</u>
Radiator Cap Pressure	Pressure Stamped on Cap
Thermostat R & I	
1.5L	<u>ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT</u>
Water Pump R & I	
1.5L	<u>WATER PUMP REPLACEMENT</u>
Engine Mechanical	
1.5L	

System		Specification/Procedure
	Compression	Compression Ratio: 12.5:1 <u>ENGINE COMPRESSION TEST</u>
	Oil Pressure - @ 1500 RPM 100Â°C	200-250 kPa (29-36 psi)
	Overhaul	<u>SPECIFICATIONS</u>
	Torque	<u>FASTENER SPECIFICATIONS</u>
Fluid Specifications		See FLUIDS under MAINTENANCE/FLUIDS tab. From within Manager or Service Writer, click the "30/60/90 Interval" or "Maint." button.
Flywheel/Flex Plate/Drive Plate Torque		First Pass - 30 N.m (22 lb ft) Final Pass - Additional 70Â°
Fuel System		
Pressure Specification		Engine OFF, Pump Commanded ON - 345-650 kPa (50-94 psi) Engine ON Running - 379-427 kPa (55-62 psi) On Scan Tool
	Fuel Pressure Test Procedure	<u>CIRCUIT/SYSTEM VERIFICATION</u>
	Fuel Filter Location	In the fuel tank, part of the Fuel Tank Fuel Pump Module
	Fuel Filter R & I	<u>FUEL TANK FUEL PUMP MODULE REPLACEMENT</u>
Ignition		
Firing Order & Cylinder Identification		See info and graphic for 4 cylinder engine under: <u>FIRING ORDER & CYLINDER IDENTIFICATION</u>
Ignition Wires (Resistance)		Individual Ignition Coils
Ignition Wires (Routing)		
1.5L		Coil on Plug
Spark Plug (Type = Refer to Electronic Parts Catalog)		
Gap		0.60 - 0.70 mm (0.024 - 0.028 in)
Torque		17 N.m (13 lb ft)
Starting		
Starter		<u>STARTING SYSTEM DESCRIPTION AND OPERATION</u>
Torque		<u>FASTENER SPECIFICATIONS</u>
Wheel Alignment		
	Adjustment Specifications	<u>WHEEL ALIGNMENT SPECIFICATIONS</u>
	Torque	<u>FASTENER SPECIFICATIONS</u>
Wheel & Tire		
Wheel Lug Nut Torque		140 N.m (103 lb ft) See graphic at "wheel nut tightening sequence" under: <u>INSTALLATION PROCEDURE</u>

DTC INDEX

Volt

ANTILOCK BRAKE SYSTEM - DTCS

ANTILOCK BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B2745</u>	Traction Control Switch Circuit
<u>DTC C0010, C0019, C001C, or C001D</u>	Inlet Control/Outlet Control
<u>DTC C0051</u>	Steering Wheel Angle Sensor
<u>DTC C006B</u>	Stability System Active Too Long
<u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>	Lateral Acceleration/Longitudinal Acceleration/Yaw Rate Signals
<u>DTC C0500, C0504, C0506-C0510, or C0512-C0516</u>	Wheel Speed Sensors
<u>DTC C052B, C052D, C052F, C055B, or C05AE</u>	ABS Pump Motor
<u>DTC C0552, C10C0, C10C4, or C1251 (Without UGN)</u>	Yaw Rate
<u>DTC C0555, C0558</u>	Wheel Speed Sensor Incorrect Component Installed
<u>DTC C059B or C0560</u>	Front Brake Pressure Sensor Missing Calibration
<u>DTC C0571, C0572, or C0574</u>	Brake Master Cylinder Pressure Sensor 1 Circuit
<u>DTC C0575, C0576, or C0578</u>	Left Rear Brake Pressure Sensor Circuit
<u>DTC C05A3, C05A4, or C10EE</u>	Wheel Speed Sensor Supply Circuit/Wheel Speed Sensor Frequency
<u>DTC C05AD</u>	Brake Blending System Performance
<u>DTC C05B0 or C05B1</u>	ABS Front Hydraulic Circuit Leak Detected/ABS Rear Hydraulic Circuit Leak Detected
<u>DTC C05B2</u>	Steering Wheel Angle Sensor Signal - Yaw Rate Sensor Signal Not Plausible
<u>DTC C106A or C106B</u>	Pump Motor Relay Circuit Low/Pump Motor Relay Circuit High
<u>DTC C106D, C106F or C1070</u>	Valve Relay Circuit
<u>DTC C10AC</u>	Brake System Calculated Component Overheat
<u>DTC C10EA</u>	Powertrain Control Module Indicated Requested Torque
<u>DTC C10EB</u>	Engine Control Module Indicated Traction Control
<u>DTC C112B</u>	Active Brake System Performance
<u>DTC C112F</u>	Isolation Valve Performance
<u>DTC C1200</u>	Powertrain Sensed Brake Pedal Information Message Counter Incorrect
<u>DTC C1203</u>	Invalid Data Received From Integrated Chassis Control Module

DTC	Description
<u>DTC C124C, C124E or C1269</u>	Wheel Speed Sensor Incorrect Mounting
<u>DTC C1259</u>	Powertrain Automatic Braking Request Message Counter Incorrect
<u>DTC C1268</u>	Accelerator Pedal Override Active Message Counter Incorrect
<u>DTC C1284 or C1285</u>	Brake Assist Information 1 Message Counter Incorrect/Brake Assist Information 2 Message Counter Incorrect
<u>DTC C1286</u>	Commanded Axle Torque Message Counter Incorrect
<u>DTC C1287</u>	Regenerative Braking Axle Torque Achieved Message Counter Incorrect
<u>DTC C1288</u>	Autonomous Braking Accelerator Actual Position Status Message Counter Incorrect
<u>DTC C1289</u>	Charging System Park Brake Autonomous Apply Request Message Counter Incorrect
<u>DTC C1445</u>	System Disabled Information Stored Temperature High
<u>DTC C144B</u>	Electronic Control Unit Software
<u>DTC C158F or C1590, C1592</u>	Traction Control Prime Solenoid Valve Circuits/Traction Control Isolation Solenoid Valve Circuits
<u>DTC C1594</u>	Adaptive Cruise Control Braking Request - Accelerator Pedal Position Not Plausible
<u>DTC P0560, P0562, or P0563</u>	System Voltage
<u>DTC P05FF</u>	Brake Pressure Sensor and Brake Pedal Position Sensor Correlation
<u>DTC P0601, P0604, P0606, P060B, or P062F</u>	Control Module (Electronic Brake Control Module)
<u>DTC P0856</u>	Traction Control Torque Request Circuit
<u>DTC P15F8</u>	Automatic Braking Engine Torque Request Signal Message Counter Incorrect
<u>DTC P15FD</u>	Wheel Speed Sensor Message Sequence Incorrect
<u>DTC P1B12</u>	Driver Intended Braking Torque Signal Message Counter Incorrect
<u>DTC P215A</u>	Vehicle Speed-Wheel Speed Correlation
<u>DTC P2299</u>	Brake Pedal Position/Accelerator Pedal Position Incompatible

AUTOMATIC TRANSMISSION - 5ET50 (MKV) - DTCS

AUTOMATIC TRANSMISSION - 5ET50 (MKV) - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0658 or P0659</u>	Actuator High Control Circuit Group 1 Voltage

DTC	Description
<u>DTC P0711, P0713</u>	Transmission Fluid Temperature Sensor
<u>DTC P0721</u>	Output Speed Sensor Performance
<u>DTC P077B, P077D</u>	Output Speed Sensor Circuit
<u>DTC P079A</u>	Transmission Clutch 1 Slip Detected
<u>DTC P079B</u>	Transmission Clutch 2 Slip Detected
<u>DTC P079C</u>	Transmission Clutch 3 Slip Detected
<u>DTC P07A3</u>	Transmission Clutch 1 Stuck On
<u>DTC P07A5</u>	Transmission Clutch 2 Stuck On
<u>DTC P07A7</u>	Transmission Clutch 3 Stuck On
<u>DTC P0960, P0962, or P0963</u>	Transmission Control Solenoid Valve 1 Control Circuit
<u>DTC P0964, P0966, P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730</u>	Transmission Control Solenoid Valve 2 Control Circuit/Transmission Control Solenoid Valve 3 Control Circuit/Transmission Control Solenoid Valve 4 Control Circuit/Transmission Control Solenoid Valve 5 Control Circuit
<u>DTC P152A or P152D</u>	Regenerative Braking Control Switch 1 Circuit/Regenerative Braking Control Switch 1 and 2 Circuit
<u>DTC P152C</u>	Regenerative Braking Control Switch Signal Message Counter Incorrect
<u>DTC P16F7</u>	Control Module Pressure Control Solenoid Command Incorrect
<u>DTC P179C</u>	Transmission Clutch 1 Minor Slip Detected
<u>DTC P179D</u>	Transmission Clutch 2 Minor Slip Detected
<u>DTC P1824, P182A, P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3</u>	Internal Mode Switch
<u>DTC P215B</u>	Vehicle Speed - Output Shaft Speed Not Plausible
<u>DTC P215C</u>	Output Shaft Speed - Wheel Speed Not Plausible
<u>DTC P2670 or P2671</u>	Actuator High Control Circuit Group 2 Voltage
<u>DTC P27A7</u>	Transmission Control Solenoid Valve 1 Calibration Incorrect

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DTCS

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561, P0563, P1A0C, P1A0D, or P1EFC</u>	Device Power Circuit/Battery Voltage/System Voltage/Battery Energy Control Module System
<u>DTC B1516</u>	Battery Current Sensor

DTC	Description
<u>DTC B151A</u>	Low Battery Capacity Detected
<u>DTC B1527</u>	Parasitic Load
<u>DTC P0A8D</u>	14V Power Module System Voltage Low Voltage
<u>DTC P1F5D or P1F5E</u>	14 Volt Power Module L-Terminal Circuit
<u>DTC P1F59, P1F5A, or P1F5B</u>	14 Volt Power Module Status Terminal Circuit
<u>DTC U3001, U3003, U3006, U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>	Battery Voltage/Control Module

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DTCS

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B3006</u>	Hood Ajar Circuit
<u>DTC P257D, P257F</u>	Engine Hood Switch Circuit

BUMPERS AND FASCIAS - DTCS

BUMPERS AND FASCIAS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P059F or P151E</u>	Active Grille Air Shutter

CELLULAR, ENTERTAINMENT, AND NAVIGATION - DTCS

CELLULAR, ENTERTAINMENT, AND NAVIGATION - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0997</u>	Auxiliary Electronic Control Unit Performance
<u>DTC B1024</u>	Circuit Board Temperature Sensor Above Maximum Threshold (Audio Amplifier)
<u>DTC B1024</u>	Circuit Board Temperature Sensor Below Minimum Threshold/Circuit Board Temperature Sensor Above Maximum Threshold (Human Machine Interface Control Module)
<u>DTC B1025, B1135</u>	Audio Output Circuits
<u>DTC B124B</u>	USB 1 Circuit
<u>DTC B124F</u>	Universal Serial Bus (USB) Programming
<u>DTC B125A</u>	Antenna Signal Circuit
<u>DTC B125C</u>	Satellite Antenna Circuit
<u>DTC B1271</u>	Theft Protection Active
<u>DTC B127E</u>	Front Video Display Output Signal
<u>DTC B12A8</u>	Optical Media Drive Theft Locked
<u>DTC B1446 or B1447</u>	Backup Power Source

DTC	Description
<u>DTC B2455</u>	Cellular Phone Microphone Circuit
<u>DTC B2462</u>	Global Positioning System
<u>DTC B2470</u>	Cellular Phone Antenna Circuit Malfunction
<u>DTC B2476 or B2482</u>	Cellular Phone Select Service Switch

CRUISE CONTROL SYSTEM - DTCS

CRUISE CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0571</u>	Cruise Control Brake Switch Circuit
<u>DTC P0572 or P0573</u>	Brake Switch Circuit 1 Low/High Voltage
<u>DTC P0575</u>	Cruise Control Switch Signal Message Counter Incorrect
<u>DTC P0703</u>	Brake Switch Signal Message Counter Incorrect
<u>DTC P158A</u>	Cruise Control Calibration Incorrect

DATA COMMUNICATION SYSTEM - DTCS

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (1 OF 2)

DTC	Description
<u>DTC B1000</u>	Electronic Control Unit
<u>DTC B1001</u>	Option Configuration
<u>DTC B1016</u>	Vehicle Identification Number Information Not Programmed
<u>DTC B101D</u>	Electronic Control Unit Hardware
<u>DTC B101E</u>	Electronic Control Unit Software
<u>DTC C056D</u>	Electronic Control Unit Hardware
<u>DTC C056E</u>	Electronic Control Unit Software
<u>DTC P0601, P0607, P060A-P060C, P062F, P16E9-P16F0, or P262B</u>	Control Module
<u>DTC P06E4</u>	Control Module Wake-Up Circuit Performance (Hybrid/EV Powertrain Control Module 2)
<u>DTC P0A1E, P1A01, P1A05, or P1A06</u>	Battery Energy Control Module
<u>DTC P16B7</u>	Electric A/C Compressor Control Module Wake-Up Circuit Performance
<u>DTC P16B8, P16BA</u>	Electric A/C Compressor Control Module
<u>DTC P1E8E, P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>	Hybrid/EV Battery Interface Control Module
<u>DTC P1EB1</u>	Hybrid/EV Battery Interface Control Module Software Incompatible

DTC	Description
<u>DTC P1EB2, P1EB5, P1FA6-P1FAB, P3030, or P303B</u>	Hybrid/EV Battery Interface Control Module
<u>DTC P1EB9</u>	High Voltage Energy Management Communication Bus Enable Circuit
<u>DTC P1EB9</u>	High Voltage Energy Management Communication Bus Enable Circuit
<u>DTC U0020</u>	Low Speed CAN Bus
<u>DTC U0028</u>	MOST Bus
<u>DTC U0029</u>	MOST Bus Performance
<u>DTC U0073 or U2100</u>	Control Module Communication Bus A Off/CAN Bus Communication
<u>DTC U0074</u>	Control Module Communication Powertrain Expansion CAN Bus Off
<u>DTC U0075</u>	Control Module Communication Object Detection CAN Bus Off
<u>DTC U0077</u>	Control Module Communication Chassis Expansion CAN Bus Off
<u>DTC U0078</u>	Control Module Communication Low Speed CAN Bus Off
<u>DTC U007A</u>	Control Module Communication High Voltage Energy Management CAN Bus Off
<u>DTC U0100, U02FF</u>	Control Module U Code List
<u>DTC U0300, U0336</u>	Control Module U Code List
<u>DTC U0400, U05FF</u>	Control Module U Code List
<u>DTC U1340, U135F</u>	Control Module U Code List
<u>DTC U1500, U15FF</u>	Control Module U Code List
<u>DTC U179A</u>	Lost Communication with Hybrid Powertrain Control Module 2
<u>DTC U179D</u>	Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus
<u>DTC U1803</u>	Lost Communication with Hybrid Powertrain Control Module 2
<u>DTC U1806</u>	Battery Energy Control Module High Voltage Energy Management CAN Bus Off
<u>DTC U180B</u>	Battery Energy Control Module High Speed CAN Bus Off
<u>DTC U1814</u>	Powertrain Wake-Up Communication Circuit

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (2 OF 2)

DTC	Description
<u>DTC U1817</u>	Lost Communication with Hybrid Powertrain Control Module on Powertrain Expansion CAN Bus

DTC	Description
<u>DTC U1818</u>	Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus
<u>DTC U182D</u>	Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus
<u>DTC U182E or U182F</u>	Drive Motor Control Module Lost Communication with Hybrid PCM 2 on Powertrain Expansion Communication Bus
<u>DTC U1833</u>	Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
<u>DTC U183E</u>	Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus
<u>DTC U1845 or U1846</u>	Drive Motor Control Module Lost Communication with Hybrid Powertrain Control Module
<u>DTC U184A</u>	Lost Communication with Body Control Module on Low Speed CAN Bus
<u>DTC U184B</u>	Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus
<u>DTC U184C</u>	Lost Communication with Instrument Cluster on Low Speed CAN Bus
<u>DTC U184D</u>	Lost Communication with Radio on Low Speed CAN Bus
<u>DTC U184E</u>	Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus
<u>DTC U185A</u>	Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus
<u>DTC U185B</u>	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
<u>DTC U1860</u>	Electric A/C Compressor Control Module Lost Communication with Hybrid Powertrain Control Module 2
<u>DTC U1876</u>	Drive Motor Control Module 1 Lost Communication with Engine Control Module
<u>DTC U1879</u>	Drive Motor Control Module 2 Lost Communication with Engine Control Module
<u>DTC U1885</u>	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module

DTC	Description
<u>DTC U18A2</u>	Lost Communication with Fuel Pump Driver Control Module
<u>DTC U18B5</u>	Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus
<u>DTC U18B9, U18BF</u>	Primary/Secondary High Speed CAN Bus Subnet Configuration List
<u>DTC U2098</u>	MOST Communication Enable Circuit
<u>DTC U2099</u>	High Speed Communication Enable Circuit
<u>DTC U2160, U2231</u>	Control Module U Code List
<u>DTC U2401</u>	Battery Energy Control Module Dedicated Bus 1 Off
<u>DTC U2602</u>	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
<u>DTC U2603, U2606 or U2617-U2624</u>	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
<u>DTC U2616</u>	Fuel Pump Driver Control Module Lost Communication with ECM
<u>DTC U3000</u>	Control Module
<u>DTC U3012</u>	Control Module Improper Wake-up Performance

ENGINE CONTROLS / FUEL - 1.5L (L3A) - DTCS

ENGINE CONTROLS / FUEL - 1.5L (L3A) - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (1 OF 2)

DTC	Description
<u>DTC P0010, P0013, or P2088, P2091</u>	Camshaft Position Actuator Solenoid Valve Control
<u>DTC P0011 or P0014</u>	Intake/Exhaust Camshaft Position System Performance
<u>DTC P0016 or P0017</u>	Crankshaft Position
<u>DTC P0030, P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>	HO2S Heater
<u>DTC P0089, P00C6, P228C, or P228D</u>	Fuel Pressure Regulator
<u>DTC P0090, P0092, P00C8, P00C9, or P00CA</u>	Fuel Pressure Regulator
<u>DTC P0096 or P0111</u>	Intake Air Temperature (IAT) Sensor 2 Performance
<u>DTC P0097, P0098, or P0099</u>	Intake Air Temperature (IAT) Sensor 2
<u>DTC P00C7</u>	Intake Air Pressure Measurement System - Multiple Sensors Not Plausible
<u>DTC P00F4, P00F6</u>	Intake Air Humidity Sensor
<u>DTC P00FE, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>	Control Module Requested MIL Illumination
<u>DTC P0101</u>	Mass Air Flow (MAF) Sensor Performance

DTC	Description
<u>DTC P0102 or P0103</u>	Mass Air Flow (MAF) Sensor
<u>DTC P0106</u>	Manifold Absolute Pressure (MAP) Sensor Performance
<u>DTC P0107 or P0108</u>	Manifold Absolute Pressure (MAP) Sensor
<u>DTC P0112, P0113, or P0114</u>	Intake Air Temperature (IAT) Sensor 1
<u>DTC P0117, P0118, or P0119</u>	Engine Coolant Temperature (ECT) Sensor
<u>DTC P0121, P0123, P0222, P0223, P16A0-P16A2, or P2135</u>	Throttle Position Sensor/Sensor Communication Circuit
<u>DTC P0128</u>	Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature
<u>DTC P0131, P0132, P0137, or P0138</u>	HO2S Circuit Low/High Voltage Sensor
<u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>	HO2S Slow/Delayed Response
<u>DTC P0171 or P0172</u>	Fuel Trim System
<u>DTC P0191 or P0192</u>	Fuel Rail Pressure Sensor Performance
<u>DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F</u>	Fuel Temperature Sensor
<u>DTC P018B, P018D</u>	Fuel Pressure Sensor
<u>DTC P0201, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>	Cylinder Injector Control
<u>DTC P0231, P0232, or P023F</u>	Fuel Pump Control
<u>DTC P0300, P0304</u>	Engine/Cylinder Misfire Detected
<u>DTC P0315</u>	Crankshaft Position System Variation Not Learned
<u>DTC P0324, P0326, or P06B6</u>	Knock Sensor System Performance/Control Module Knock Sensor Processor Performance
<u>DTC P0325, P0327, or P0328</u>	Knock Sensor Circuit
<u>DTC P0335 or P0336</u>	Crankshaft Position Sensor
<u>DTC P0340, P0341, P0365, or P0366</u>	Intake/Exhaust Camshaft Position Sensor
<u>DTC P0351, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>	Ignition Coil Control Circuit
<u>DTC P0401</u>	Exhaust Gas Recirculation (EGR) Flow Insufficient
<u>DTC P0403, P0489, or P0490</u>	Exhaust Gas Recirculation (EGR) Control
<u>DTC P0404 or P042E</u>	Exhaust Gas Recirculation Open/Closed Position Performance
<u>DTC P0405 or P0406</u>	Exhaust Gas Recirculation (EGR) Position Sensor
<u>DTC P040B, P040E or P041B-P041E</u>	Exhaust Gas Recirculation (EGR) Temperature Sensor
<u>DTC P0420</u>	Catalyst System Low Efficiency
<u>DTC P043E, P043F, or P145F</u>	Evaporative Emission (EVAP) System Reference
<u>DTC P0442 or P0455</u>	Evaporative Emission (EVAP) System

DTC	Description
<u>DTC P0443, P0458, or P0459</u>	Evaporative Emission (EVAP) Purge Solenoid Valve Control

**ENGINE CONTROLS / FUEL - 1.5L (L3A) - DIAGNOSTIC TROUBLE CODE (DTC)
IDENTIFICATION (2 OF 2)**

DTC	Description
<u>DTC P0446</u>	Evaporative Emission (EVAP) Vent System Performance
<u>DTC P0449, P0498, or P0499</u>	Evaporative Emission (EVAP) Vent Solenoid Valve Control
<u>DTC P0451, P0453</u>	Fuel Tank Pressure Sensor
<u>DTC P0497</u>	Evaporative Emission (EVAP) System No Flow During Purge
<u>DTC P050D</u>	Cold Start Rough Idle
<u>DTC P057B, P057E</u>	Brake Pedal Position Sensor
<u>DTC P0601, P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>	Control Module Performance
<u>DTC P0627, P0629</u>	Fuel Pump Enable Circuit
<u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>	5 V Reference Circuit
<u>DTC P0650, P263A, or P263B</u>	Malfunction Indicator Lamp (MIL) Control
<u>DTC P0685, P0690, P1682, P16A7, P16AF, or P16B3</u>	Engine Controls Ignition Relay/Ignition 1 Switch Circuit 2
<u>DTC P06E4</u>	Control Module Wake-Up Circuit Performance (ECM)
<u>DTC P1101</u>	Intake Air Flow System Performance
<u>DTC P111E</u>	Engine Coolant Temperature Sensor Not Plausible
<u>DTC P1255</u>	Fuel Pump Control Module Driver High Temperature
<u>DTC P127C, P128A, P128D, P128F, P16E4, or P16E5</u>	Fuel Rail Pressure Sensor/Sensor Communication Circuit
<u>DTC P129E or P12A8</u>	Fuel Pump Control Signal Message Counter Incorrect
<u>DTC P129B or P129C</u>	Fuel Pump Driver Control Module System
<u>DTC P129D</u>	Fuel Pump Driver Control Module Ignition On/Start Switch Circuit Low Voltage
<u>DTC P12A6</u>	Fuel Pump Driver Control Module Enable Circuit Performance
<u>DTC P135A</u>	Ignition Coil Supply Voltage Circuit Bank 1
<u>DTC P1400</u>	Cold Start Emission Reduction Control System
<u>DTC P145C or P145D</u>	Evaporative Emission (EVAP) System
<u>DTC P145E</u>	Evaporative Emission (EVAP) System Leak Detection Pump to Vent Solenoid Valve Leak Detected

DTC	Description
<u>DTC P1461</u>	Evaporative Emission (EVAP) System Pressure Incorrect During Fuel Fill Door Open Request
<u>DTC P1462</u>	Evaporative Emission (EVAP) System Reference Orifice Flow Erratic
<u>DTC P1426</u>	Exhaust Gas Recirculation (EGR) Valve Internal Performance
<u>DTC P1427, P142A or P1437</u>	EGR Temperature Sensor
<u>DTC P1516, P2101, P2119, or P2176</u>	Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance
<u>DTC P15F2</u>	Engine Torque Command Signal Message Counter Incorrect
<u>DTC P15F9</u>	Hybrid/EV System Engine Speed Control Intervention Request Type Signal Message Counter Incorrect
<u>DTC P15FB</u>	Brake Pedal Position Sensor Signal Message Counter Incorrect
<u>DTC P162D</u>	Evaporative Emission (EVAP) System Alarm Clock Signal Not Received
<u>DTC P163A</u>	Control Module Fuel Pressure Regulator 1 Control System Circuitry Performance
<u>DTC P2096 or P2097</u>	Post Catalyst Fuel Trim System
<u>DTC P2122, P2123, P2127, P2128, or P2138</u>	Accelerator Pedal Position (APP) Sensor
<u>DTC P2199</u>	Intake Air Temperature (IAT) Sensor 1-2 Not Plausible
<u>DTC P219A</u>	Fuel Trim Cylinder Balance
<u>DTC P2227, P2230</u>	Barometric Pressure (BARO) Sensor
<u>DTC P2400, P2402</u>	Evaporative Emission (EVAP) System Leak Detection Pump
<u>DTC P2418, P2420</u>	Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Control Circuit
<u>DTC P2422</u>	Evaporative Emission (EVAP) Vent Solenoid Valve Stuck Closed
<u>DTC P2450</u>	Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Performance
<u>DTC P2457</u>	Exhaust Gas Recirculation (EGR) Cooler Low Efficiency
<u>DTC P24B9, P24BB</u>	Evaporative Emission (EVAP) System Leak Detection Pump Pressure Sensor
<u>DTC P2618</u>	Crankshaft Position Signal Output Circuit Low Voltage
<u>DTC P2635</u>	Fuel Pump Flow Performance

ENGINE COOLING SYSTEM - DTCS

ENGINE COOLING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P00B3 or P00B4</u>	Radiator Coolant Temperature (RCT) Sensor Circuit Low/High Voltage
<u>DTC P00B7</u>	Engine Coolant Flow Insufficient
<u>DTC P0597, P0599</u>	Engine Coolant Thermostat Heater Control Circuit
<u>DTC P112F</u>	Radiator Coolant Temperature Sensor Not Plausible
<u>DTC P1485, P1487</u>	Cooling Fan Output Circuit
<u>DTC P2181</u>	Engine Cooling System Performance

ENGINE MECHANICAL - 1.5L (L3A) - DTCS

ENGINE MECHANICAL - 1.5L (L3A) - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P06DA, P06DE</u>	Engine Oil Pressure Control Solenoid Valve

FIXED AND MOVEABLE WINDOWS - DTCS

FIXED AND MOVEABLE WINDOWS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0283</u>	Rear Defogger Circuit
<u>DTC B316B, B317A, B318A, or B319A</u>	Window Switch
<u>DTC B3205</u>	Driver Window Motor

HORN SYSTEM - DTCS

HORN SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B010E</u>	Pedestrian Friendly Alert Audio Output Circuit
<u>DTC B274E or B274F</u>	Low Note Horn Relay Control Circuit

HVAC SYSTEM - AUTOMATIC - DTCS

HVAC SYSTEM - AUTOMATIC - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0163</u>	Passenger Compartment Temperature Sensor Circuit
<u>DTC B0173 or B0178</u>	Upper Left Duct Air Temperature Sensor Circuit/Lower Left Duct Air Temperature Sensor Circuit
<u>DTC B018A, B048C, B048F, or B1395</u>	Windshield Temperature Sensor Circuit/Humidity Sensor Humidity Circuit/Humidity Sensor Temperature Circuit/Control Module Voltage Reference Output Circuit Voltage
<u>DTC B0183</u>	Solar Load Sensor Circuit

DTC	Description
<u>DTC B0193</u>	Front Blower Motor Speed Circuit
<u>DTC B0223, B0233, B023A, or B0408</u>	Recirculate Position Command 1 Circuit/Air Flow Control Circuit/HVAC Actuators Supply Voltage/Main Temperature Control Circuit
<u>DTC B048E</u>	Auxiliary Heater System
<u>DTC B3844</u>	Engine Coolant Circulation Pump Circuit
<u>DTC P0531, P0532, or P0533</u>	Air Conditioning (A/C) Refrigerant Pressure Sensor
<u>DTC P0534</u>	Air Conditioning (A/C) Refrigerant Charge Low
<u>DTC P0D69, P0D7F</u>	A/C Compressor Motor Voltage Sensor/Electric A/C Compressor Control Module Internal Temperature Sensor/Electric A/C Compressor Control Module Output Driver Temperature Sensor
<u>DTC P151C or P2516, P2518</u>	Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor
<u>DTC P154F</u>	Electric A/C Compressor motor Input Current-Positive Contactor State Not Plausible
<u>DTC P156A, P156C</u>	Air Conditioning (A/C) Pressure Too High when A/C Off/Air Conditioning (A/C) Pressure Too Low when A/C On
<u>DTC P15C6 or P15C8, P15CB</u>	Electric A/C Compressor Speed Request Signal Message Counter Incorrect/Electric A/C Compressor Data Message Counter Incorrect/Electric A/C Compressor Status Message Counter Incorrect/Electric A/C Compressor Sensors Signal Message Counter Incorrect/Electric A/C Compressor Sensors Status Message Counter Incorrect
<u>DTC P1F0A, P1F0D</u>	A/C Compressor Motor Speed Performance/A/C Compressor Motor Start-Up Current Performance/Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit Voltage
<u>DTC P15C5, P2682, P2683, P26A5, P26A7, P26A9, P26AD, or P26AE</u>	Engine Coolant Bypass Valve Position Sensor/Engine Coolant Bypass Valve Control Circuits

HYBRID / EV CONTROL SYSTEM - DTCS

HYBRID / EV CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0335 or P0336</u>	Crankshaft Position Sensor
<u>DTC P0506 or P0507</u>	Idle Speed Low/High
<u>DTC P0601, P0604, P0606, P062F, P1EB6, or P1EB7</u>	Control Module (Hybrid/EV Powertrain Control Module 1)
<u>DTC P061A or P061B</u>	Control Module Torque System

DTC	Description
<u>DTC P06AF</u>	Torque Management System Performance - Forced Engine Shutdown
<u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>	Sensor Supply Voltage
<u>DTC P0A1B or P0A1C</u>	Drive Motor Control Module Performance
<u>DTC P0A3E, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>	Drive Motor 1 Position Sensor
<u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>	Drive Motor Position Sensor
<u>DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D</u>	Drive Motor Phase
<u>DTC P0A78 or P0A79</u>	Drive Motor Inverter Performance
<u>DTC P0AB9</u>	Hybrid/EV System Performance
<u>DTC P0AEE, P0AEF, P0AF0, P0AF3, P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>	Drive Motor Inverter Temperature Sensor
<u>DTC P0B01, P0B04, or P0B07</u>	Auxiliary Transmission Fluid Pump Low Current
<u>DTC P0BE6, P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>	Drive Motor
<u>DTC P0BFD or P0BFE</u>	Drive Motor Phases U-V-W Not Plausible
<u>DTC P0C01 or P0C04</u>	Drive Motor High Current
<u>DTC P0C0B or P0C0E</u>	Drive Motor Inverter Supply Voltage Circuit
<u>DTC P0C11, P0C16</u>	Drive Motor Inverter Phase
<u>DTC P0C17, P0C18, P1B0E, or P1B10</u>	Drive Motor Position
<u>DTC P0C19</u>	Drive Motor 1 Torque Delivered Performance
<u>DTC P0C1A</u>	Drive Motor 2 Torque Delivered Performance
<u>DTC P0C28</u>	Auxiliary Transmission Fluid Pump High Current
<u>DTC P0C4E</u>	Drive Motor 1 Position Exceeded Learning Limit
<u>DTC P0C4F</u>	Drive Motor 2 Position Exceeded Learning Limit
<u>DTC P0C76</u>	Hybrid/EV Battery System High Voltage Present
<u>DTC P150D or P150E</u>	Supply Voltage Circuit
<u>DTC P15F0</u>	Engine Torque Delivered Signal Message Counter Incorrect
<u>DTC P15F1</u>	Axle Torque Request Signal Message Counter Incorrect
<u>DTC P15F2</u>	Engine Torque Command Signal Message Counter Incorrect
<u>DTC P15FC</u>	Hybrid/EV Battery Contactor Status Message Counter Incorrect
<u>DTC P16E0</u>	Engine Performance - No Torque Detected

DTC	Description
<u>DTC P16F3</u>	Control Module Redundant Memory Performance (Hybrid/EV Powertrain Control Module 1)
<u>DTC P16F4</u>	Control Module Transmission Range Switch (Hybrid/EV Powertrain Control Module 1)
<u>DTC P16F6</u>	Control Module Transmission Range Calculation Performance (Hybrid/EV Powertrain Control Module 1)
<u>DTC P179A</u>	Auxiliary Transmission Fluid Pump Overspeed
<u>DTC P190A, P190F</u>	Drive Motor Inverter Phase
<u>DTC P1A4E, P1A50, P1A54, P1ADC, or P1ADD</u>	Drive Motor Control Module
<u>DTC P1ADE, P1ADF, P1AE0, or P1AE1</u>	Drive Motor Control Module System
<u>DTC P1AEE or P1AEF</u>	Drive Motor Control Module Hybrid/EV Battery System Voltage High Voltage
<u>DTC P1AF0 or P1AF2</u>	Drive Motor Control Module Hybrid/EV Battery Voltage System Isolation Lost
<u>DTC P1AF4, P1AF7</u>	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit
<u>DTC P1B0B or P1B0C</u>	Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit
<u>DTC P1B0D or P1B0E</u>	Drive Motor Control Module Drive Motor Overspeed
<u>DTC P1B15</u>	Regenerative Braking Torque Request Signal Message Counter Incorrect
<u>DTC P1B41 or P1B42</u>	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance
<u>DTC P1B43 or P1B44</u>	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit
<u>DTC P1E0A or P1E0B</u>	Drive Motor Control Module Torque Calculation Performance
<u>DTC P1E1B, P1E1F</u>	Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit
<u>DTC P1E22</u>	Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage System Isolation Lost
<u>DTC P1E29</u>	Auxiliary Transmission Fluid Pump Control Module Calculated Motor Position Performance
<u>DTC P1E2A, P1E2F</u>	Auxiliary Transmission Fluid Pump Phase
<u>DTC P1E34, P1E36</u>	Auxiliary Transmission Fluid Pump Inverter Temperature Sensor
<u>DTC P1E37</u>	Auxiliary Transmission Fluid Pump Inverter High Temperature
<u>DTC P1E38</u>	Auxiliary Transmission Fluid Pump Inverter Supply Voltage Circuit

DTC	Description
<u>DTC P1E39</u>	Auxiliary Transmission Fluid Pump Inverter Performance
<u>DTC P1E3A</u>	Auxiliary Transmission Fluid Pump Motor Torque Delivered Performance
<u>DTC P1E4A or P1E4B</u>	Control Module Redundant Drive Motor 1 Speed Sensing Circuit
<u>DTC P1F00</u>	Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit Erratic
<u>DTC P1F63, P1F65</u>	Hybrid/EV System Voltage Discharge Circuit
<u>DTC P2797</u>	Auxiliary Transmission Fluid Pump Performance
<u>DTC P3260</u>	Internal Control Module Drive Motor Control Performance

HYBRID / EV COOLING SYSTEM - DTCS

HYBRID / EV COOLING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0480</u>	Cooling Fan Relay Control Circuit
<u>DTC P0A7E</u>	Hybrid/EV Battery Pack High Temperature
<u>DTC P0A9C, P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>	Hybrid/EV Battery Temperature Sensor
<u>DTC P0C43, P0C46</u>	Hybrid/EV Battery Pack Coolant Temperature Sensor
<u>DTC P0C47, P1E8C, or P1E8D</u>	Hybrid/EV Battery Pack Coolant Pump
<u>DTC P0CE9, P1F44, or P1F45</u>	Hybrid/EV Electronics Coolant Pump
<u>DTC P0CEE, P0CF2</u>	Hybrid/EV Electronics Coolant Temperature Sensor
<u>DTC P19FA, P19FC</u>	Hybrid/EV Electronics Coolant Pump Feedback
<u>DTC P19FD, P19FF</u>	Hybrid/EV Battery Pack Coolant Pump Feedback Circuit
<u>DTC P148A, P148C</u>	Cooling Fan Signal Circuit
<u>DTC P1EC6</u>	Hybrid/EV Battery Pack Heater Performance
<u>DTC P1FFB, P1FFE</u>	Hybrid/EV Battery Pack Coolant Level
<u>DTC P1FFF</u>	System Isolation/Coolant Level Sensor Fault - Hybrid/EV Battery Charging System Disabled

HYBRID / EV ENERGY STORAGE SYSTEM - DTCS

HYBRID / EV ENERGY STORAGE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0A0C or P0A0D</u>	High Voltage System Interlock Circuit Voltage
<u>DTC P0A7F</u>	Hybrid/EV Battery Pack

DTC	Description
<u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>	Hybrid/EV Battery Positive Contactor/Hybrid/EV Battery Negative Contactor/Hybrid/EV Battery Precharge Contactor/Battery Charging System Positive Contactor/Battery Charging System Contactor(s) Stuck Open/Hybrid/EV Battery System Contactor(s) Stuck Open/Hybrid/EV Battery Pack Heater Transistor Control Circuit
<u>DTC P0AA6 or P1AE6</u>	Hybrid/EV Battery Voltage System Isolation Lost/Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit
<u>DTC P0ABB, P0ABC, or P0ABD</u>	Hybrid/EV Battery Voltage Sensor
<u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>	Hybrid/EV Battery Low Resolution Current Sensor/Hybrid/EV Battery High Resolution Current Sensor
<u>DTC P0AF8</u>	Hybrid System Voltage
<u>DTC P0AFA or P0AFB</u>	Hybrid/EV Battery System Voltage
<u>DTC P0B3B, P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>	Hybrid/EV Battery (1-96) Circuit(s)
<u>DTC P0C78 or P3061</u>	Hybrid/EV Battery System Precharge Time Too Long/Hybrid/EV Battery Precharge High Current
<u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC8, P3035, or P3040</u>	Battery Energy Control Module 5 V Reference Circuit/Hybrid/EV Battery Interface Control Module (1-12) 5 V Reference Circuit(s)
<u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCE, P3036, or P3041</u>	Hybrid/EV Battery Interface Control Module (1-12) Cell Balancing Circuit(s)
<u>DTC P1EAB or P1EAC</u>	Battery Energy Control Module Hybrid/EV Battery Cell High Voltage/Hybrid/EV Battery Cell Overvoltage Signal Circuit Performance
<u>DTC P1FD5, P1FF2, P3038-P303A, or P3043-P3045</u>	Hybrid/EV Battery Interface Control Module (1-12) Voltage Sensor(s)
<u>DTC P1F17</u>	System Isolation / Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

HYBRID PLUG-IN CHARGING - DTCS

HYBRID PLUG-IN CHARGING - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC P0CF4, P0CF6</u>	Control Pilot Circuit
<u>DTC P0CF9 or P0D01</u>	Control Pilot Charging Switch Performance
<u>DTC P0D1F</u>	Control Module Date/Time Synchronization Performance
<u>DTC P0D26</u>	Battery Charger System Precharge Time Too Long
<u>DTC P0D2B or P0D2C</u>	Control Pilot/Status Indicator Control Circuit
<u>DTC P0D3E, P0D40</u>	Battery Charger Input Voltage Sensor

DTC	Description
<u>DTC P0D4D, P0D4F</u>	Battery Charger Hybrid/EV Battery Output Voltage Sensor
<u>DTC P0D58 or P0D59</u>	Proximity Detection Circuit Low/High Voltage
<u>DTC P0D5A</u>	Proximity Detection Circuit Erratic
<u>DTC P0D5C</u>	Battery Charger Hybrid/EV Battery Output Power Performance
<u>DTC P0D5E</u>	Battery Charger System High Voltage Present
<u>DTC P0E61 or P0E65</u>	Battery Charger Enable Circuit
<u>DTC P1EE6</u>	Battery Charger AC Voltage Not Present

HYDRAULIC BRAKE SYSTEM - DTCS

HYDRAULIC BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC C0075</u>	Brake Pedal Position Sensor Performance
<u>DTC C0579, C057A, or C057E</u>	Brake Booster Control Module Temperature Sensor
<u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275, C1277</u>	Brake Booster Motor
<u>DTC C0580 or C0594</u>	Brake Booster Motor
<u>DTC C1072</u>	Brake Fluid Level Sensor Circuit
<u>DTC C111C</u>	Low Brake Fluid Indicated
<u>DTC C1278 or C1279</u>	Brake System Data 2 Message Counter Incorrect
<u>DTC C1449</u>	System Configuration Error
<u>DTC P057B, P057E, P05DC-P05DE, or P05E0</u>	Brake Pedal Position Sensor
<u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>	Control Module
<u>DTC P0642, P06A6, or P06A7</u>	Sensor Reference Voltage
<u>DTC P25C6 or P25C7</u>	Brake Booster Temperature Sensor

IMMOBILIZER SYSTEM - DTCS

IMMOBILIZER SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B2955</u>	Security Sensor Data Circuit Malfunction
<u>DTC B302A</u>	Mobile Telephone Communications Interface Requested Immobilization
<u>DTC B3031</u>	Security Controller In Learn Mode
<u>DTC B3055</u>	No Transponder Modulation or No Transponder
<u>DTC B305C</u>	Immobilizer Transponder of Wrong Type Programmed
<u>DTC B3060</u>	Unprogrammed Transponder Identification Code Received
<u>DTC B3899</u>	Incorrect Immobilizer Identifier Received

DTC	Description
<u>DTC B389A</u>	Environment Identification
<u>DTC B3902</u>	Incorrect Immobilizer Identifier Received
<u>DTC B3924, B3928</u>	Incorrect Environmental Identifier Received
<u>DTC B3935</u>	Transponder Authentication
<u>DTC B3976</u>	Unconfigured Transponder
<u>DTC B3978, B3982</u>	Incorrect Environmental Identifier Received
<u>DTC B3984</u>	Device 1 Environment Identifier Not Programmable
<u>DTC P0513</u>	Immobilizer Key Incorrect
<u>DTC P0633</u>	Immobilizer Key Not Programmed
<u>DTC P162B</u>	Remote Vehicle Speed Limiting Signal Message Counter Incorrect
<u>DTC P1631</u>	Immobilizer Fuel Enable Signal Not Correct
<u>DTC P1649</u>	Immobilizer Security Code Not Programmed

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DTCS

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0158</u>	Ambient Air Temperature Sensor
<u>DTC B0550</u>	Odometer Circuit General Memory Malfunction
<u>DTC B071F</u>	Transmission Range Indicator Internal Malfunction
<u>DTC B124F</u>	MOST Programming Failure
<u>DTC P0071, P0074</u>	Ambient Air Temperature Sensor
<u>DTC P0461, P0464</u>	Fuel Level Sensor
<u>DTC P0521, P0522, or P0523</u>	Engine Oil Pressure Sensor

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DTCS

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B305D</u>	Challenge Active Circuit
<u>DTC B3101</u>	Keyless Entry Data Link Circuit
<u>DTC B3105</u>	Keyless Entry Transmitters
<u>DTC B3106</u>	Keyless Entry Data Link
<u>DTC B3109, B3113</u>	Keyless Entry Transmitter (1-5) Battery
<u>DTC B310D, B310F</u>	Keyless Entry Transmitter (6-8) Battery
<u>DTC B3119</u>	Keyless Entry Antenna 1
<u>DTC B3120</u>	Keyless Entry Antenna 2
<u>DTC B3121</u>	Keyless Entry Antenna 3
<u>DTC B3122</u>	Keyless Entry Antenna 4

DTC	Description
<u>DTC B3123</u>	Keyless Entry Antenna 5
<u>DTC B3124</u>	Keyless Entry Antenna 6

LIGHTING SYSTEM - DTCS

LIGHTING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B1395</u>	Control Module Voltage Reference Output Circuit Voltage
<u>DTC B1480</u>	Battery Rundown Protection Circuit Short to Ground
<u>DTC B2545</u>	Backup Lamps Circuit
<u>DTC B255D</u>	Passenger Compartment Lamp Control 2 Circuit
<u>DTC B2570</u>	Trunk Lamp Control Circuit Short to Ground
<u>DTC B2575 or B2699</u>	Left Headlamp Control Circuit/Right Headlamp Control Circuit
<u>DTC B257A</u>	Headlamp Switch Input Signals Correlation Malfunction
<u>DTC B2580</u>	Headlamp High Beam Control Circuit
<u>DTC B2585 or B3867</u>	Left Park Lamps Control Circuit/Right Park Lamps Control Circuit
<u>DTC B2600 or B2605</u>	Left Daytime Running Lamps Control Circuit Short to Ground/Right Daytime Running Lamps Control Circuit Short to Ground
<u>DTC B2610</u>	Passenger Compartment Dimming 1 Circuit
<u>DTC B2615</u>	Passenger Compartment Dimming 2 Circuit Short to Ground
<u>DTC B2625</u>	Display Dimming Pulse Width Modulation Output Circuit Short to Ground
<u>DTC B3596</u>	Hazard Lamps Request Circuit Malfunction
<u>DTC B3600</u>	Passenger Compartment Dimming Request Signal Circuit Voltage
<u>DTC B3650</u>	High Beam Request Signal Circuit Performance - Signal Invalid
<u>DTC B3806</u>	High Beam and Headlamp Flash Select Circuit Malfunction
<u>DTC B3881 or B3882</u>	Left Tail Lamp Circuit/Right Tail Lamp Circuit
<u>DTC B3883</u>	License Plate Lamp Circuit
<u>DTC B3884</u>	Center High Mounted Stop Lamp Circuit
<u>DTC B3948 or B3949</u>	Left Front Turn Signal Circuit/Right Front Turn Signal Circuit
<u>DTC B3950 or B3951</u>	Left Rear Turn Signal Circuit/Right Rear Turn Signal Circuit

DTC	Description
<u>DTC C0277 or C0890</u>	Brake Pedal Position Sensor Circuit/Control Module Voltage Reference Output 3 Circuit Voltage
<u>DTC C0297</u>	Brake Applied Output Circuit Short to Ground

OBJECT DETECTION SYSTEM - PARK ASSIST SYSTEM - DTCS

OBJECT DETECTION SYSTEM - PARK ASSIST SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B094B or B094C</u>	Left Side Object Detection Control Module/Right Side Object Detection Control Module
<u>DTC B0954, B0955, B0956, or B0957</u>	Parking Assist Front Sensor Circuits
<u>DTC B0958, B0959, B0960, or B0961</u>	Parking Assist Rear Sensor Circuits
<u>DTC B096B</u>	Parking Assist Switch Parallel Parking Circuit
<u>DTC B096C or B096D</u>	Parking Assist Side Sensor Left Front Circuit/Parking Assist Side Sensor Right Front Circuit
<u>DTC B0987</u>	Vehicle Direction Camera Indicator Circuit
<u>DTC B1011</u>	System Disabled Information Stored
<u>DTC B1015</u>	Vehicle Identification Number Information
<u>DTC B101D (DTC set in K109 Frontview Camera Module)</u>	Electronic Control Unit Hardware
<u>DTC B127B</u>	Rearview Camera Input Signal Circuit Missing Reference
<u>DTC B1405</u>	Control Module Voltage Reference Output 2 Circuit
<u>DTC B356A</u>	Vehicle Direction Warning Switch Circuit Short to Ground
<u>DTC B390C</u>	Long Range Radar Sensor Module
<u>DTC B390D</u>	Frontview Camera Module Incorrect Mounting
<u>DTC P15F6</u>	Front Object Detection Control Module Torque Request Signal Message Counter Incorrect

PARKING BRAKE SYSTEM - DTCS

PARKING BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC C1138</u>	Supply Voltage Goes Below 7 V/Above 16.5 V/Signal Performance
<u>DTC C1148</u>	Left Park Brake Actuator Circuit
<u>DTC C114C</u>	Park Brake Switch Circuit
<u>DTC C1586</u>	Right Park Brake Actuator Circuit
<u>DTC C1587</u>	Left Park Brake Actuator
<u>DTC C1588</u>	Right Park Brake Actuator

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DTCS

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B1474 or B3849</u>	Passenger Exterior Door Handle Switch Circuit Short to Ground/Driver Exterior Door Handle Switch Circuit Short to Ground
<u>DTC B1534 or B1535</u>	Left Rear Door Handle Switch Circuit Short to Ground/Right Rear Door Handle Switch Circuit Short to Ground
<u>DTC B297B or B297C</u>	Driver Door Open Switch Circuit Not Plausible
<u>DTC B3125, B3130, or B3135</u>	Driver Door Only Unlock Circuit/All Doors Unlock Circuit/All Doors Lock Circuit
<u>DTC B3140, B3145, B3150, or B3155</u>	Door Unlock Switch Circuits
<u>DTC B3265</u>	Trunk Lid Unlatch Output Circuit Short to Ground
<u>DTC B3618</u>	Exterior Liftgate Unlatch Switch Circuit Malfunction
<u>DTC P0CCC, P0CCE, or P0CCF</u>	Charge Port Door Position Sensor Circuit
<u>DTC P04B6</u>	Fuel Fill Door Stuck Closed
<u>DTC P04B8, P04BA</u>	Fuel Fill Door Position Sensor Circuit
<u>DTC P04BB, P04BC, or P04C0</u>	Fuel Fill Door Lock Control Circuit
<u>DTC P04C8, P04CA, or P04CB</u>	Fuel Fill Door Open Request Switch Circuit
<u>DTC P169D</u>	Fuel Fill Door Open Request Switch Wake-Up Circuit Performance

POWER STEERING SYSTEM - DTCS

POWER STEERING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC C0176</u>	Control Module Temperature Sensor High Temperature
<u>DTC C0460</u>	Steering Wheel Angle Sensor
<u>DTC C0475</u>	Power Steering Motor Circuit Malfunction
<u>DTC C0545</u>	Steering Wheel Torque Sensor
<u>DTC C055C</u>	Steering Gear Performance Malfunction
<u>DTC C0569</u>	Internal Check Sum Error/Calibration Not Programmed/Configuration Not Programmed
<u>DTC C056D</u>	Electronic Control Unit Hardware (Power Steering Control Module)
<u>DTC C056E</u>	Electronic Control Unit Software
<u>DTC C1436</u>	Steering Wheel Angle Signal

SEAT BELT SYSTEM - DTCS

SEAT BELT SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0072 or B0073</u>	Driver/Passenger Seat Belt Switch
<u>DTC B059A</u>	Passenger Seat Belt Indicator Circuit

SEAT HEATING SYSTEM AND SEAT COOLING SYSTEM - DTCS

SEAT HEATING SYSTEM AND SEAT COOLING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B191A or B191B</u>	Front/Rear Heated Seat Module

SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM - DTCS

SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B3622</u>	Steering Wheel Controls Signal Circuit

SHIFT LOCK CONTROL SYSTEM - DTCS

SHIFT LOCK CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B270A</u>	Park Lock Solenoid Control Circuit Short to Battery/Ground

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DTCS

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B0012 or B0013</u>	Driver Steering Wheel Air Bag Deployment Loop Stage 1/Driver Steering Wheel Air Bag Deployment Loop Stage 2
<u>DTC B0014, B0021, B0031, or B0038</u>	Seat Side Air Bag Deployment Loops
<u>DTC B0015, B001A, B001B, or B0022</u>	Seat Belt Retractor Pretensioner Deployment Loops/Seat Belt Anchor Pretensioner Deployment Loops
<u>DTC B0016, B0018, B0023, or B0025</u>	Left Roof Rail Air Bag Deployment Loop/Right Roof Rail Air Bag Deployment Loop
<u>DTC B0017 or B0024</u>	Driver Knee Air Bag Deployment Loop/Passenger Knee Air Bag Deployment Loop
<u>DTC B0019 or B0020</u>	Passenger Instrument Panel Air Bag Deployment Loop Stage 1/Passenger Instrument Panel Air Bag

DTC	Description
	Deployment Loop Stage 2
<u>DTC B0052</u>	Deployment Commanded
<u>DTC B0074</u>	Passenger Presence Sensor
<u>DTC B0081</u>	Passenger Presence Module
<u>DTC B0083 or B0084</u>	Left Front Impact Sensor/Right Front Impact Sensor
<u>DTC B0085 or B0088</u>	Left Front Side Impact Sensor/Right Rear Side Impact Sensor
<u>DTC B0086 or B0087</u>	Right Front Side Impact Sensor/Left Rear Side Impact Sensor
<u>DTC B067F or B0680</u>	Passenger Air Bag On Indicator Circuit/Passenger Air Bag Off Indicator Circuit
<u>DTC B1001</u>	Option Configuration (Inflatable Restraint Sensing and Diagnostic Module)
<u>DTC B1001</u>	Option Configuration Error (Passenger Presence System)
<u>DTC B1019</u>	System Configuration Error

THEFT DETERRENT SYSTEM - DTCS

THEFT DETERRENT SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B291A</u>	Content Theft Deterrent Assembly Internal Malfunction
<u>DTC B291B</u>	Content Theft Deterrent Sensor

TIRE PRESSURE MONITORING SYSTEM - DTCS

TIRE PRESSURE MONITORING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC C0569</u>	System Configuration Malfunction
<u>DTC C0750, C0755, C0760, or C0765</u>	Front Tire Pressure Sensor
<u>DTC C0775</u>	Tire Pressure Monitoring System Sensors Malfunction

WIPER SYSTEM AND WASHER SYSTEM - DTCS

WIPER SYSTEM AND WASHER SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B3715</u>	Windshield Wiper Relay Circuit
<u>DTC B371A</u>	Windshield Wiper Motor Internal Malfunction
<u>DTC B371C</u>	Front Wiper Motor 2

DTC	Description
<u>DTC B3873</u>	Front Washer Relay Circuit

WIRING SYSTEMS AND POWER MANAGEMENT - DTCS

WIRING SYSTEMS AND POWER MANAGEMENT - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
<u>DTC B097B</u>	Power Mode Start Switch Circuit (1 Of 2)
<u>DTC B097B</u>	Power Mode Start Switch Circuit (2 Of 2)
<u>DTC B097C</u>	Power Mode Run/Crank Indicator Circuit Short to Ground
<u>DTC B1370</u>	Control Module Ignition On and Start Circuit (Instrument Cluster)
<u>DTC B144A</u>	Run Power Relay Circuit
<u>DTC B144B</u>	Run/Crank Power Relay Circuit
<u>DTC B1451</u>	Accessory Power Circuit
<u>DTC B305E</u>	Interruptible RAP Relay Circuit
<u>DTC P15B9 or P15BA</u>	Electric A/C Compressor Control Module Ignition On/Start Switch Circuit Voltage
<u>DTC P1A5E or P1A5F</u>	Battery Energy Control Module Ignition On/Start Switch Circuit Low Voltage
<u>DTC P1A60</u>	Battery Energy Control Module Ignition Accessory Switch Circuit Low Voltage
<u>DTC P2534 or P2535</u>	Ignition On/Start Switch Circuit Voltage
<u>DTC P2537</u>	Ignition Accessory Switch Circuit Low Voltage

Article GUID: A00889010

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Electrical Center Identification Views - Volt

ELECTRICAL CENTER IDENTIFICATION VIEWS

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY - FRONT VIEW

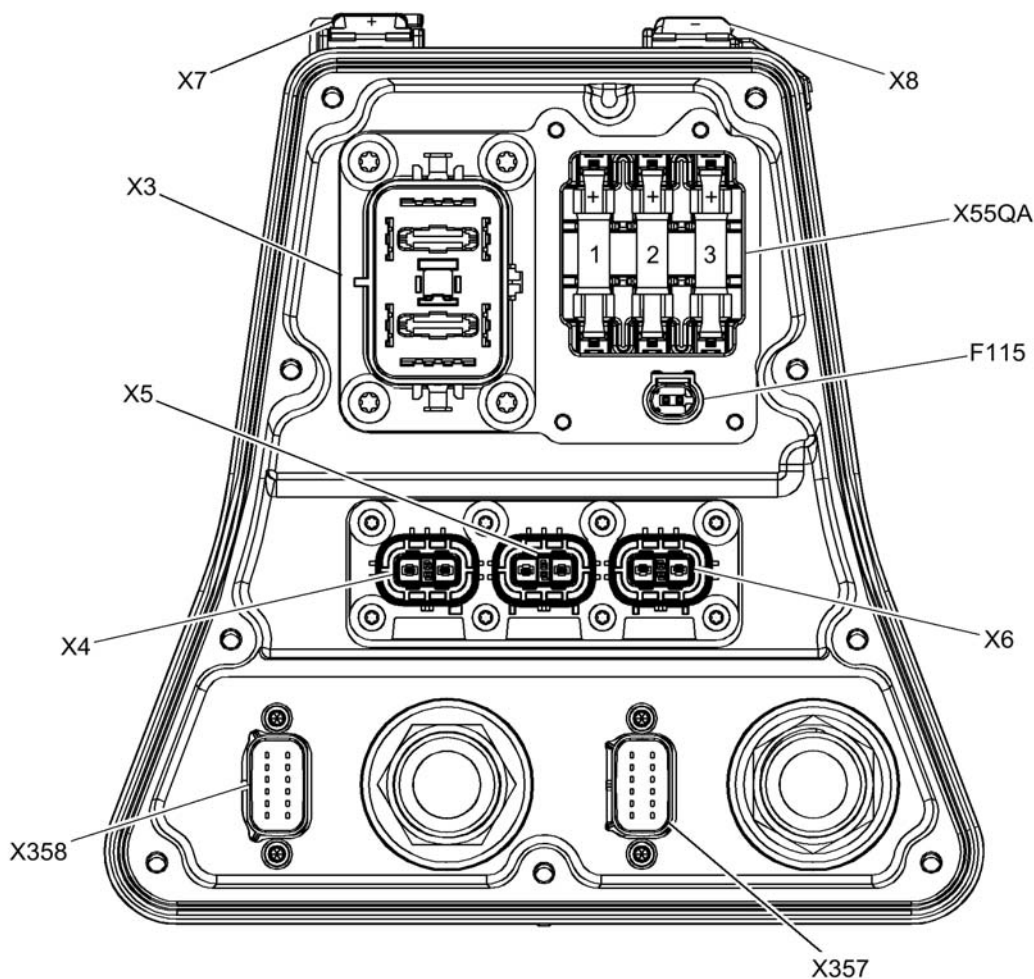


Fig. 1: A28 Hybrid/EV Battery Contactor Assembly - Front View Fuses
Courtesy of GENERAL MOTORS COMPANY

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY FUSE IDENTIFICATION

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
F1	-	F1HA	40A	• G1 A/C Compressor

No.	Device Label Name	Device Assigned Name	Rating	Description
F2	-	F2HA	15A	• K1 14V Power Module • T18 Battery Charger
F3	-	F3HA	30A	• K10 Coolant Heater Control Module

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY - REAR VIEW

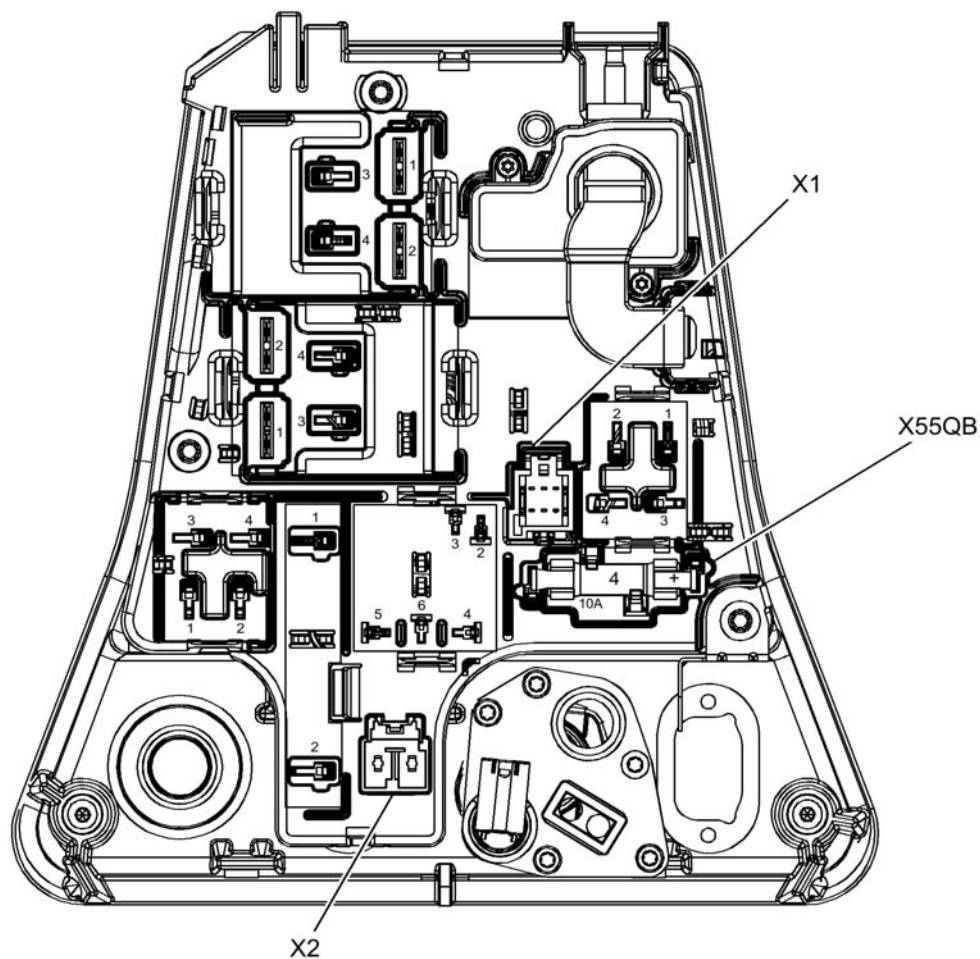


Fig. 2: A28 Hybrid/EV Battery Contactor Assembly - Rear View

Courtesy of GENERAL MOTORS COMPANY

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY FUSE AND RELAY IDENTIFICATION

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				

No.	Device Label Name	Device Assigned Name	Rating	Description
F4	-	F4HA	10A	E54 Hybrid/EV Battery Pack Coolant Heater
Relays				
KR34B	-	KR34B Hybrid/EV Battery Positive Contactor	-	- F1HA - F3HA - T6 Power Inverter Module
KR34A	-	KR34A Hybrid/EV Battery Negative Contactor	-	KR134 Pre-Charge Contactor
KR134	-	KR134 Pre-Charge Contactor	-	KR34A Hybrid/EV Battery Negative Contactor
KR116B	-	KR116B Battery Charging System Positive Contactor	-	F2HA

T6 POWER INVERTER MODULE

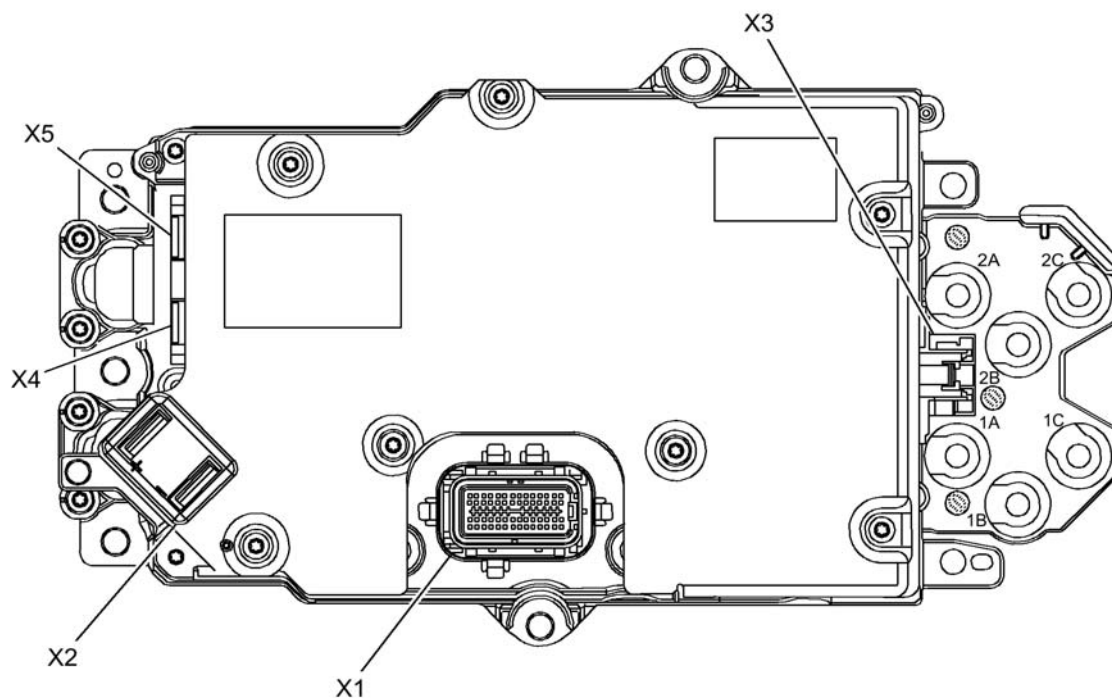


Fig. 3: T6 Power Inverter Module
 Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD LABEL

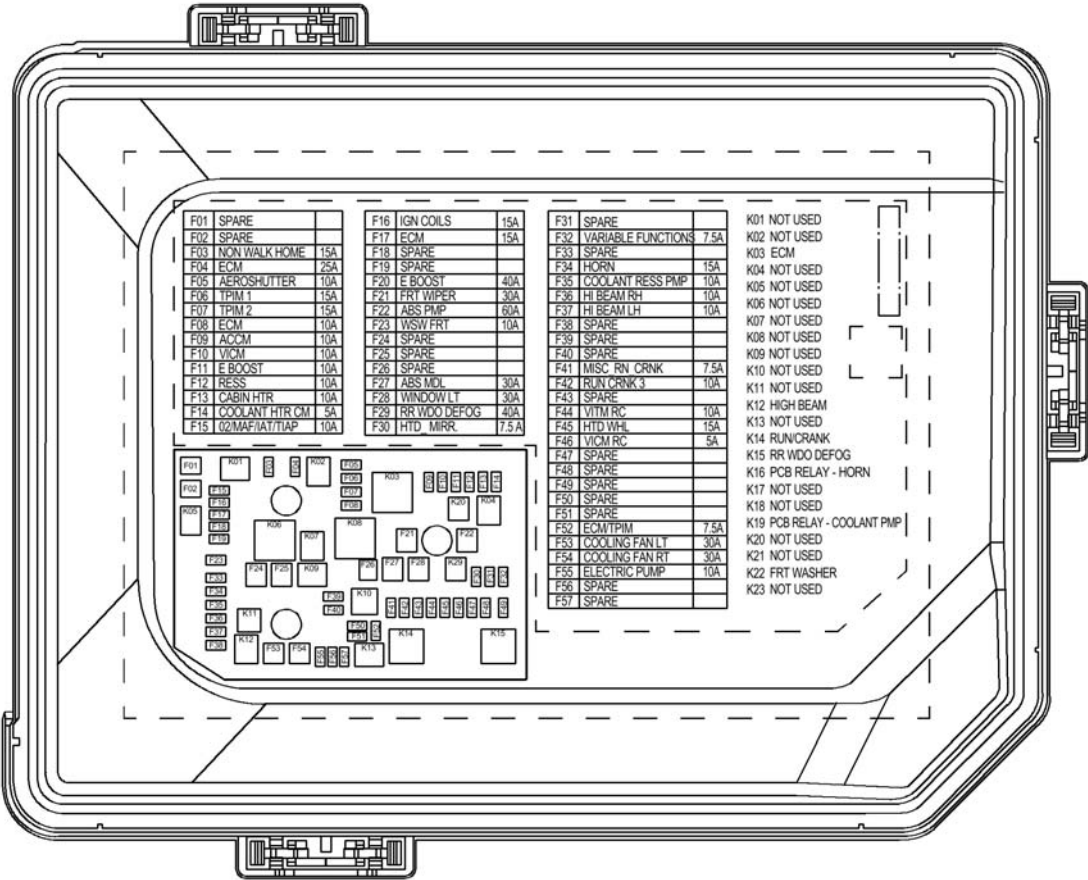


Fig. 4: X50A Fuse Block - Underhood Label
Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD TOP VIEW

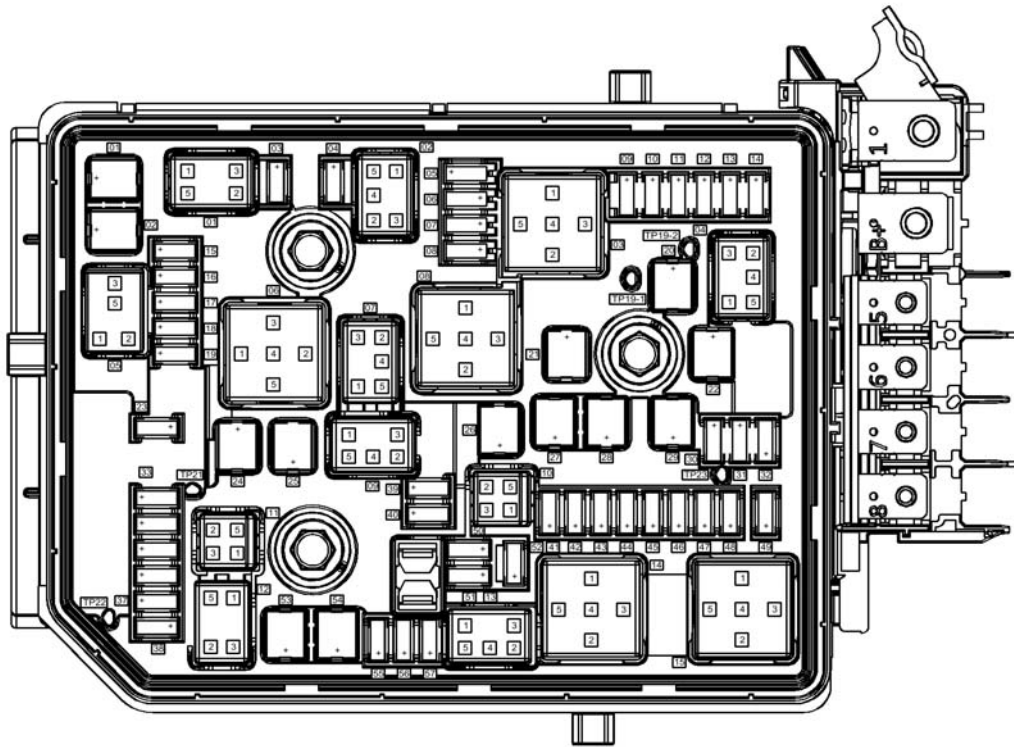


Fig. 5: X50A Fuse Block - Underhood Top View

Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD FUSE AND RELAY IDENTIFICATION LEGEND

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
F01	EMPTY	F1UA	-	• Not Used
F02	EMPTY	F2UA	-	• Not Used
F03	NON WALK HOME	F3UA	15A	• Q44 Engine Oil Pressure Control Solenoid Valve • E41 Engine Coolant Thermostat Heater • Q12 Evaporative Emission Purge Solenoid Valve • Q14 Exhaust Gas Recirculation Valve • B52A Heated Oxygen Sensor 1
F04	ECM	F4UA	25A	• K20 Engine Control Module

No.	Device Label Name	Device Assigned Name	Rating	Description
F05	AEROSHUTTER	F5UA	10A	• M96 Active Grill Air Shutter Actuator
F06	TPIM 1	F6UA	15A	• T6 Power Inverter Module
F07	TPIM 2	F7UA	15A	• T6 Power Inverter Module
F08	ECM	F8UA	10A	• K20 Engine Control Module
F09	ACCM	F9UA	10A	• G1 A/C Compressor
F10	VICM	F10UA	10A	• K114B Hybrid/EV Powertrain Control Module 2
F11	E BOOST	F11UA	10A	• K177 Brake Booster Control Module
F12	RESS	F12UA	10A	• K16 Battery Energy Control Module
F13	CABIN HTR	F13UA	10A	• KR31 Coolant Pump Relay - Auxiliary
F14	COOLANT HTR CM	F14UA	5A	• K10 Coolant Heater Control Module
F15	O2/MAF/IAT/TIAP	F15UA	10A	• B75C Multifunction Intake Air Sensor • B52B Heated Oxygen Sensor 2
F16	IGN COILS	F16UA	15A	• T8A Ignition Coil 1 • T8B Ignition Coil 2 • T8C Ignition Coil 3 • T8D Ignition Coil 4
F17	ECM	F17UA	15A	• K20 Engine Control Module
F18	EMPTY	F18UA	-	• Not Used
F19	EMPTY	F19UA	-	• Not Used
F20	E BOOST	F20UA	40A	• K177 Brake Booster Control Module

X50A FUSE BLOCK - UNDERHOOD BOTTOM VIEW

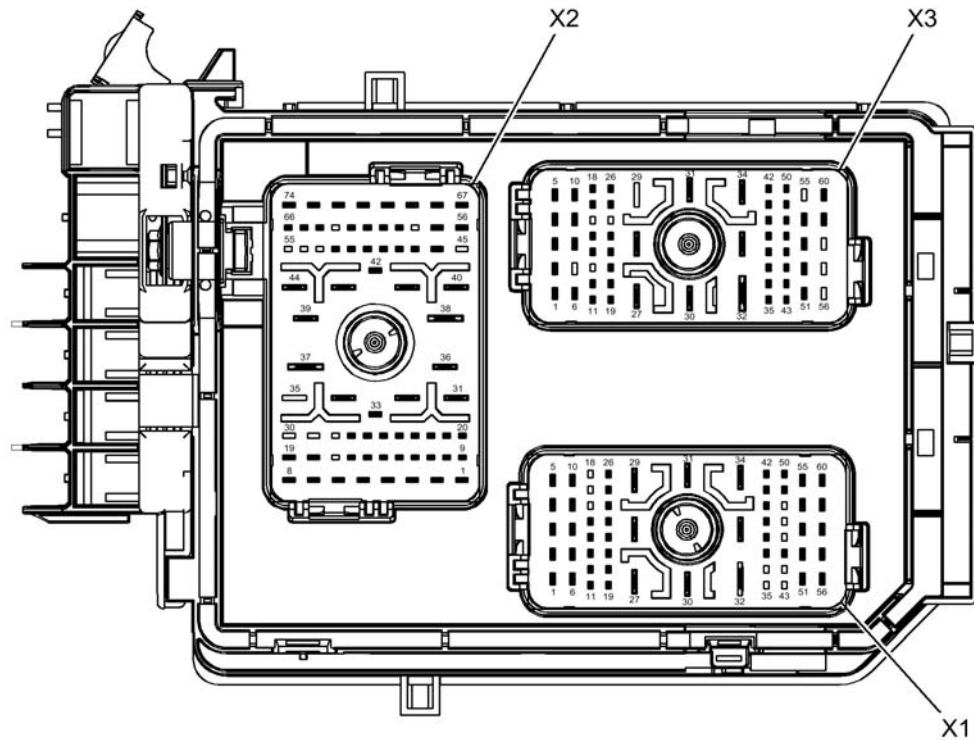
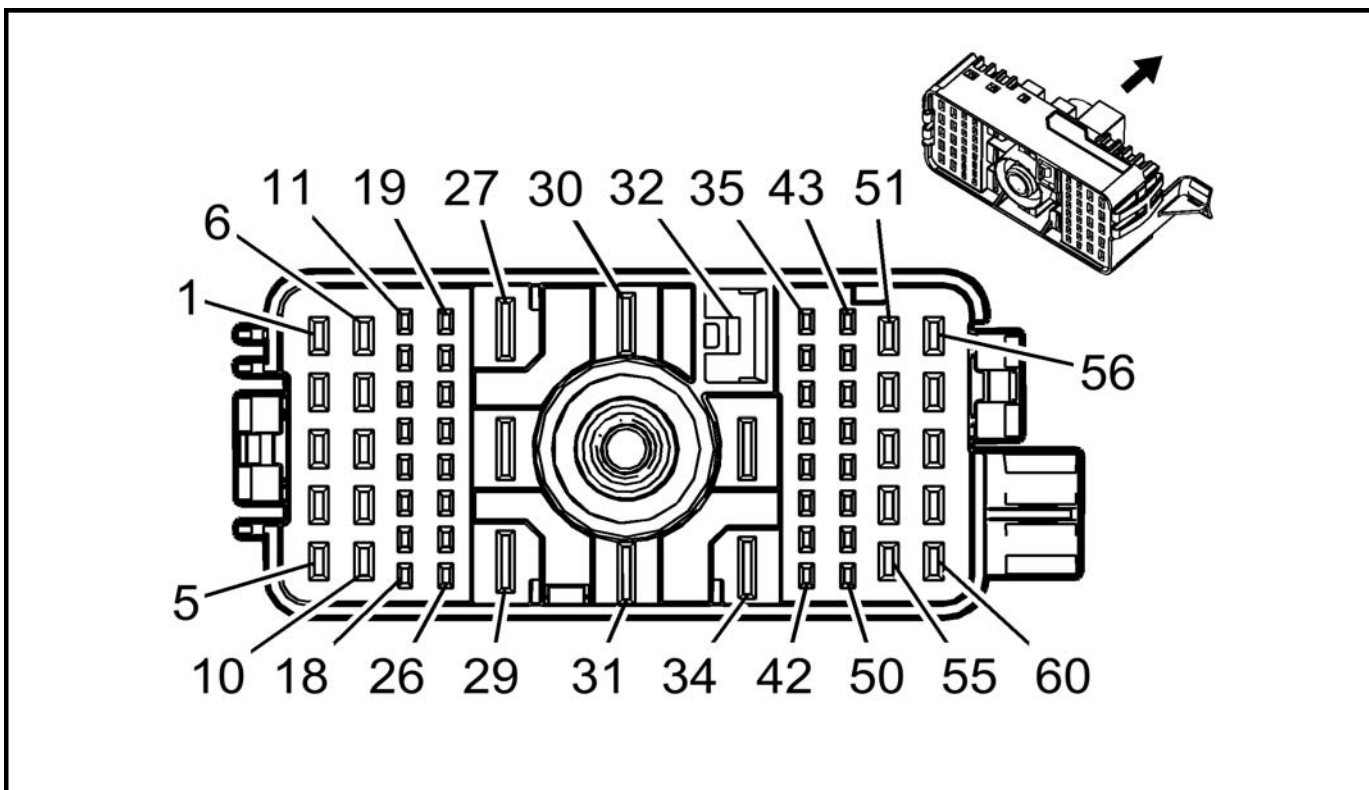


Fig. 6: X50A Fuse Block - Underhood Bottom View
Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD X1



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 13968447
- Service Connector: 19332381
- Description: 60-Way F 1.5, 2.8 CTS, 6.3 MCP Series (BK)

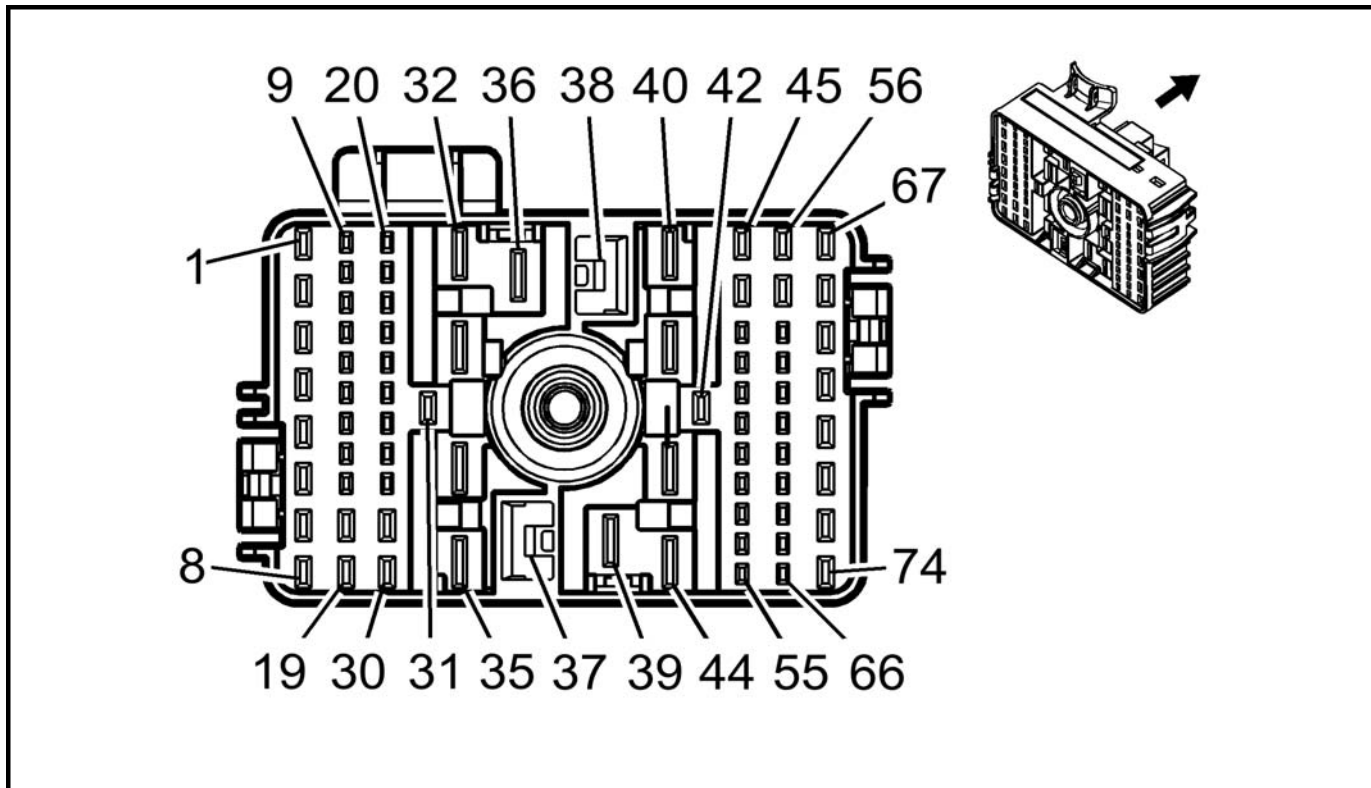
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505347	J-35616-14 (GN)	J-38125-560	1241374-1	Lear 17	E	2
II	13579921	J-35616-40 (BU)	J-38125-556	1241402-1	Lear 28	2	A
III	13579921	J-35616-40 (BU)	J-38125-556	1241406-1	Lear 17	F	G
IV	13582285	J-35616-35 (VT)	J-38125-557	1241388-1	Lear 17	2	4
V	13582285	J-35616-35 (VT)	J-38125-557	1241388-1	Lear 17	E	C
VI	13582286	J-35616-35 (VT)	J-38125-557	1241390-1	Lear 17	C	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 26	-	-	-	Not Occupied	-	-
27	0.75	RD/BU	3940	Battery Positive Voltage	II	-
28 - 29	-	-	-	Not Occupied	-	-
30	3	RD/BU	540	Battery Positive Voltage	III	-
31	-	-	-	Not Occupied	-	-
32	3	RD/WH	140	Battery Positive Voltage	III	-
33 - 38	-	-	-	Not Occupied	-	-
39	0.5	BK/BU	6813	Coolant Temperature Sensor 2 Low Reference	I	-
40 - 41	-	-	-	Not Occupied	-	-
42	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	I	-
43 - 51	-	-	-	Not Occupied	-	-
52	0.5	GY/VT	228	Windshield Washer Pump Control	V	-
53	1	BK	1150	Ground	IV	-
54 - 55	-	-	-	Not Occupied	-	-
56	0.5	WH	711	Left Headlamp High Beam Control	V	-
57	1.5	WH	311	Right Headlamp High Beam Control	VI	-
58	0.75	RD/VT	3340	Battery Positive Voltage	V	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
59	1	BN/GY	29	Horn Control	IV	-
60	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 13968446
- Service Connector: 19332382
- Description: 74-Way F 1.5, 2.8 CTS, 6.3 MCP Series (BK)

Terminal Part Information

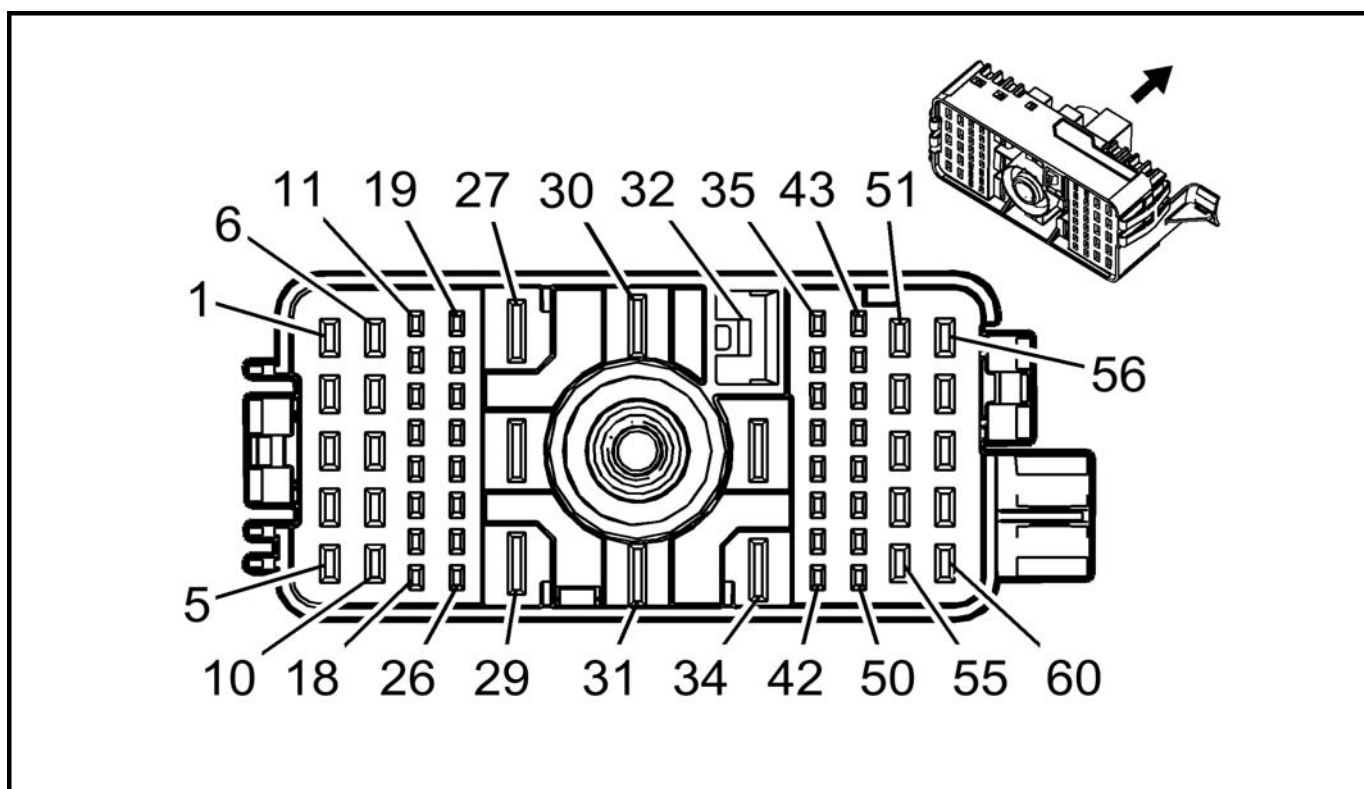
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505347	J-35616-14 (GN)	J-38125-560	1241374-1	Lear 17	E	2
II	13579921	J-35616-40 (BU)	J-38125-556	1241406-1	Lear 17	F	1
III	13579921	J-35616-40 (BU)	J-38125-556	1241408-1	Lear 28	A	B
IV	13582285	J-35616-35 (VT)	J-38125-557	1241388-1	Lear 17	E	C
V	19332365	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
VI	19332366	J-35616-35 (VT)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
VII	19332367	J-35616-35 (VT)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	639	Run/Crank Ignition 1 Voltage	IV	-
2	0.5	VT/GN	439	Run/Crank Ignition 1 Voltage	IV	-
3	-	-	-	Not Occupied	-	-
4	0.5	VT/GY	139	Run/Crank Ignition 1 Voltage	IV	-
5	0.75	VT/GY	539	Run/Crank Ignition 1 Voltage	IV	-
6	0.5	VT/GY	2339	Run/Crank Ignition 1 Voltage	IV	-
7 - 13	-	-	-	Not Occupied	-	-
14	0.75	BN/YE	2267	Mirror Heating Element Control	I	-
15	0.5	GN/VT	5199	Run/Crank Relay Coil Control	I	-
16 - 20	-	-	-	Not Occupied	-	-
21	0.35	BN/VT	1969	Headlamp High Beam Relay Control	V	-
22 - 23	-	-	-	Not Occupied	-	-
24	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
25	0.35	BN/GY	2268	Windshield Washer Relay Control	V	-
26	0.5	BN/VT	193	Rear Defog Relay Control	I	-
27 - 30	-	-	-	Not Occupied	-	-
31	4	RD/WH	342	Battery Positive Voltage	II	-
32	2 2 2.5	RD/BN RD/BN RD/BN	3640 3640 3640	Battery Positive Voltage Battery Positive Voltage Battery Positive Voltage	III	UEC UEC UEC
33	-	-	-	Not Occupied	-	-
34	4	BN/VT	293	Rear Defog Element Control	II	-
35	-	-	-	Not Occupied	-	-
36	2.5	RD/YE	3740	Battery Positive Voltage	III	-
37	4	RD/BN	1742	Battery Positive Voltage	VII	-
38 - 42	-	-	-	Not Occupied	-	-
43	4	RD/BU	1542	Battery Positive Voltage	II	-
44 - 50	-	-	-	Not Occupied	-	-
51	0.35	BN/WH	28	Horn Relay Control	V	-
52 - 65	-	-	-	Not Occupied	-	-
66	0.5	VT/GN	1097	Coolant Pump Motor Control	I	-
67	0.5	VT/BU	5705	Powertrain Main Relay Fused Control 6	IV	-
68	0.5	RD/GY	2140	Battery Positive Voltage	IV	-
69	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
70	0.5	RD/WH	2740	Battery Positive Voltage	IV	-
71	0.75	RD/BU	5240	Battery Positive Voltage	IV	-
72	1.5	RD/BU	3240	Battery Positive Voltage	VI	-
73	0.75	RD/VT	1640	Battery Positive Voltage	IV	-
74	0.5	VT/GN	1097	Coolant Pump Motor Control	IV	-

X50A FUSE BLOCK - UNDERHOOD X3



Connector Part Information

- Harness Type: Engine
- OEM Connector: 13968449
- Service Connector: 19332383
- Description: 60-Way F 1.5 CTS, 2.8 CTS, 6.3 MCP, 9.5 YPT Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505347	J-35616-14 (GN)	J-38125-560	1241374-1	Lear 17	E	2
II	13579921	J-35616-40 (BU)	J-38125-556	1241408-1	Lear 28	A	B
III	13582285	J-35616-35 (VT)	J-38125-557	1241388-1	Lear 17	E	C

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	639	Run/Crank Ignition 1 Voltage	III	-
2	-	-	-	Not Occupied	-	-
3	0.5	RD/BN	440	Battery Positive Voltage	III	-
4	0.75	RD/VT	1940	Battery Positive Voltage	III	-
5	0.75	RD/YE	240	Battery Positive Voltage	III	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.5	VT/BK	339	Run/Crank Ignition 1 Voltage	III	-
9	-	-	-	Not Occupied	-	-
10	0.5	VT/GN	1097	Coolant Pump Motor Control	III	-
11 - 16	-	-	-	Not Occupied	-	-
17	0.5	WH/BN	1089	Coolant Pump Motor Relay Control	I	-
18	0.5	YE	5991	Powertrain Relay Coil Control	I	-
19 - 30	-	-	-	Not Occupied	-	-
31	2	VT/BU	5290	Powertrain Main Relay Fused Supply 1	II	-
32 - 34	-	-	-	Not Occupied	-	-
35	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	I	-
36	-	-	-	Not Occupied	-	-
37	0.5	BK/BU	6813	Coolant Temperature Sensor 2 Low Reference	I	-
38 - 50	-	-	-	Not Occupied	-	-
51	0.75	VT/BU	5292	Powertrain Main Relay Fused Supply 3	III	-
52	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply 2	III	-
53	0.5	VT/BU	5294	Powertrain Main Relay Fused Supply 5	III	-
54	0.75	VT/BU	5293	Powertrain Main Relay Fused Supply 4	III	-
55 - 60	-	-	-	Not Occupied	-	-

X50B FUSE BLOCK - UNDERHOOD AUXILIARY TOP VIEW

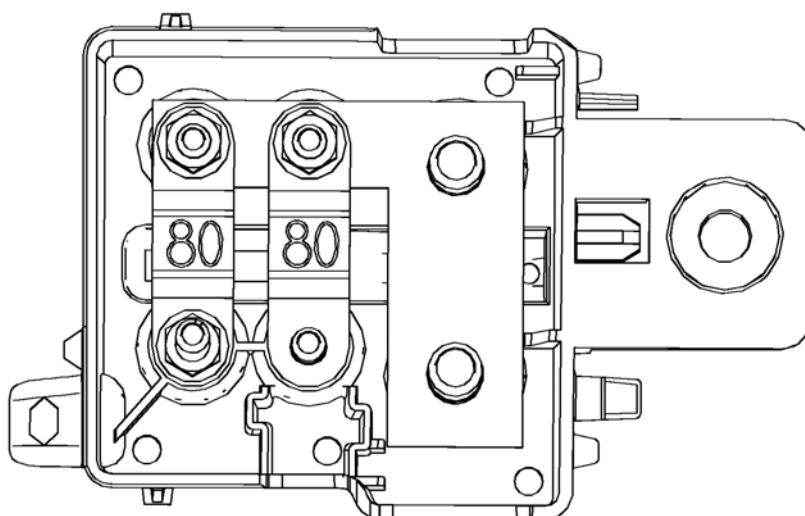


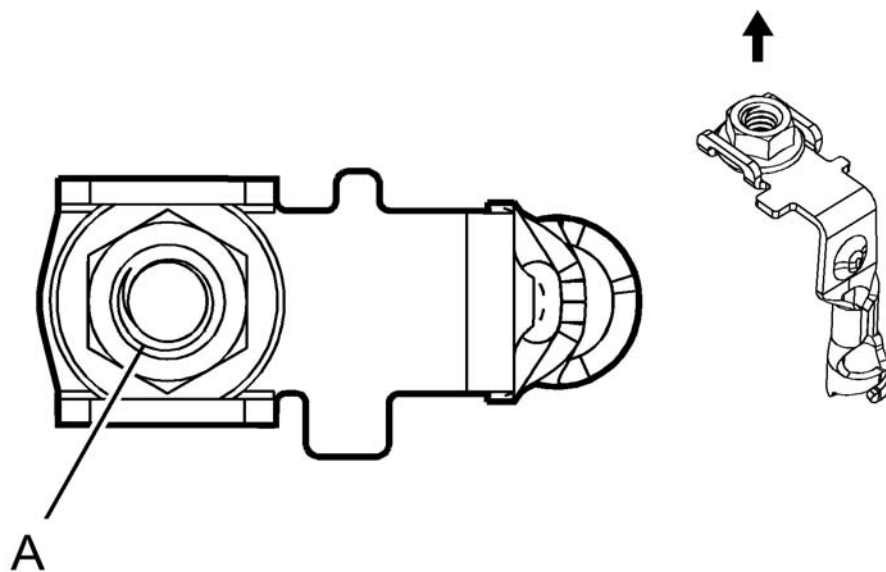
Fig. 7: X50B Fuse Block - Underhood Auxiliary Top View

Courtesy of GENERAL MOTORS COMPANY

X50B FUSE BLOCK - UNDERHOOD AUXILIARY FUSE IDENTIFICATION

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
1	-	F1UB	80A	• Charging Provision
2	-	F2UB	80A	• K43 Power Steering Control Module

X50B FUSE BLOCK - UNDERHOOD AUXILIARY X1



Connector Part Information

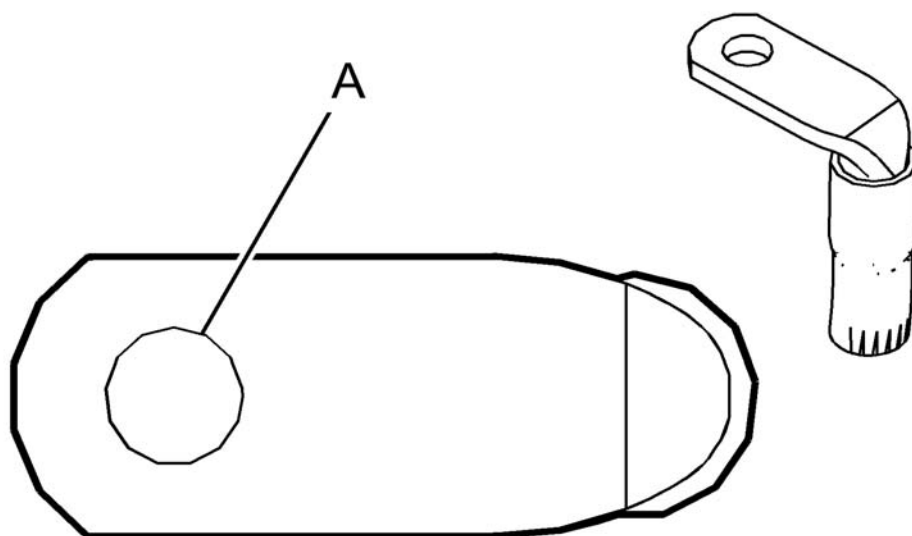
- Harness Type: Body
- OEM Connector: 33183558
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	30	RD	40	Battery Positive Voltage	I	-

X50B FUSE BLOCK - UNDERHOOD AUXILIARY X2



Connector Part Information

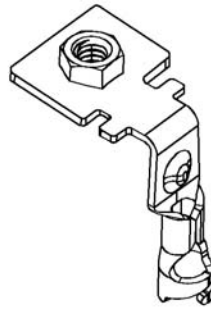
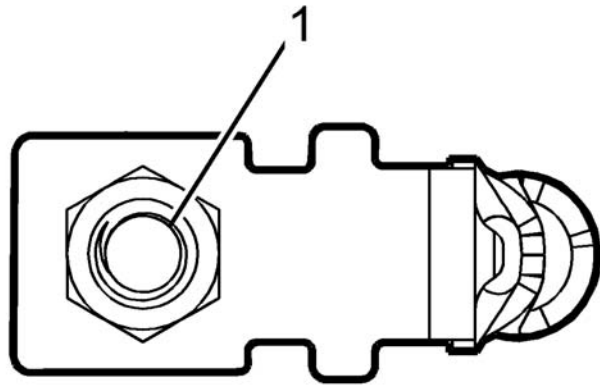
- Harness Type: Battery Cable
- OEM Connector: 33183558
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	30	RD	40	Battery Positive Voltage	I	-

X50B FUSE BLOCK - UNDERHOOD AUXILIARY X3



Connector Part Information

- Harness Type: Engine
- OEM Connector: 33188540
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	10	RD/GN	242	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY TOP VIEW

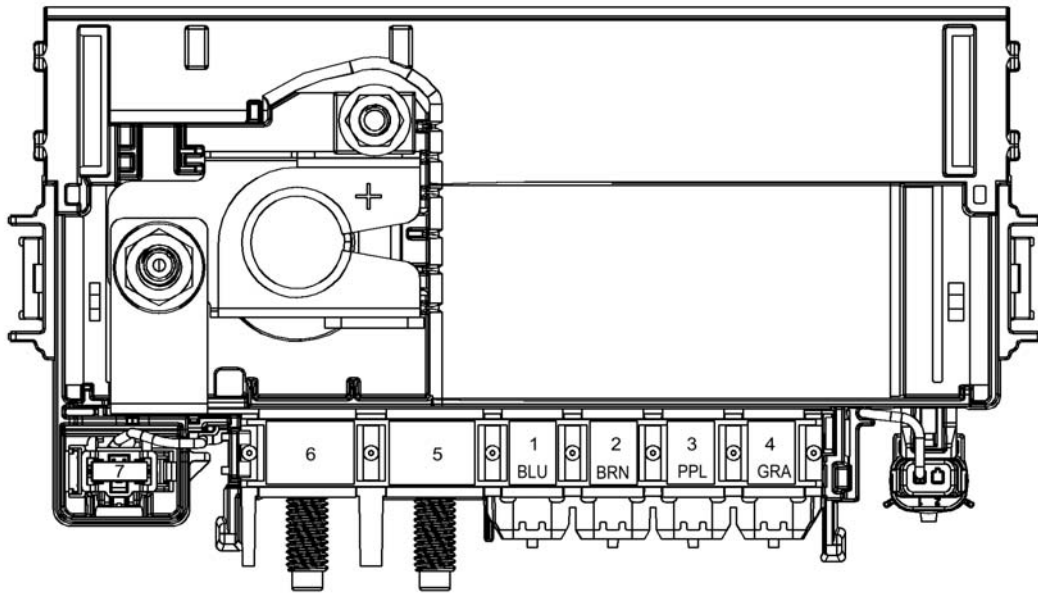


Fig. 8: X50D Fuse Block - Battery Top View
 Courtesy of GENERAL MOTORS COMPANY

X50D FUSE BLOCK - BATTERY FUSE IDENTIFICATION

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
1	IEC1	F1RB	80A	• X51A Fuse Block - Instrument Panel
2	IEC2	F2RB	80A	• X51A Fuse Block - Instrument Panel
3	REC	F3RB	80A	• X53A Fuse Block - Rear Body
4	-	F4RB	100A	• Not Used
5	PRE FUSE UEC	F5RB	175A	• X50B Fuse Block - Underhood Auxiliary
6	APM	F6RB	200A	• K1 14V Power Module
7	BAT SENS	F7RB	5A	• Battery Sense

X50D FUSE BLOCK - BATTERY BOTTOM VIEW

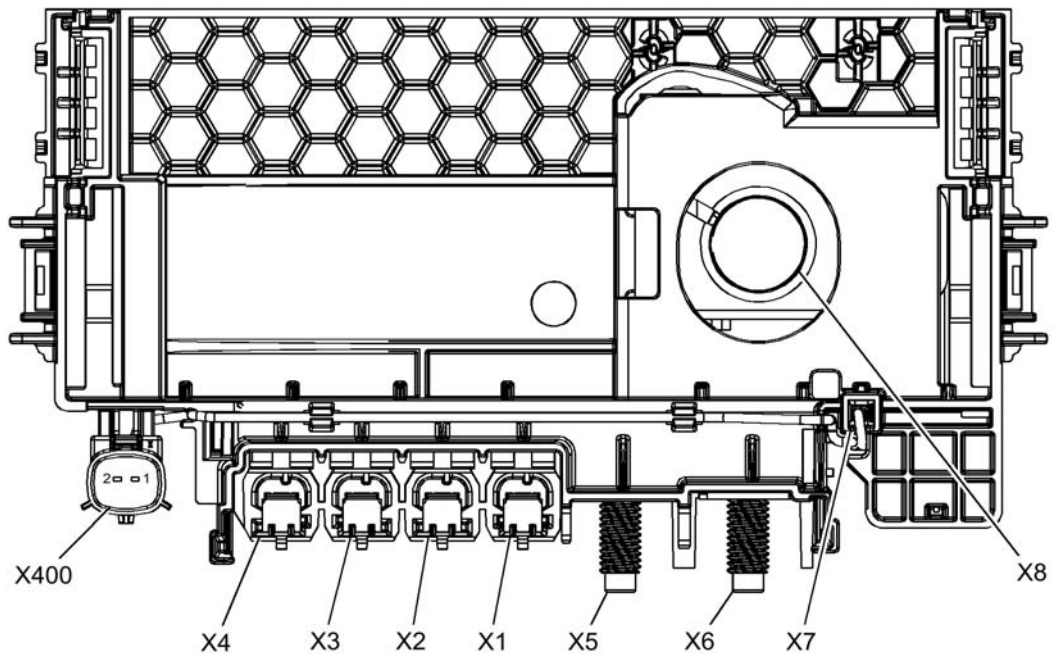
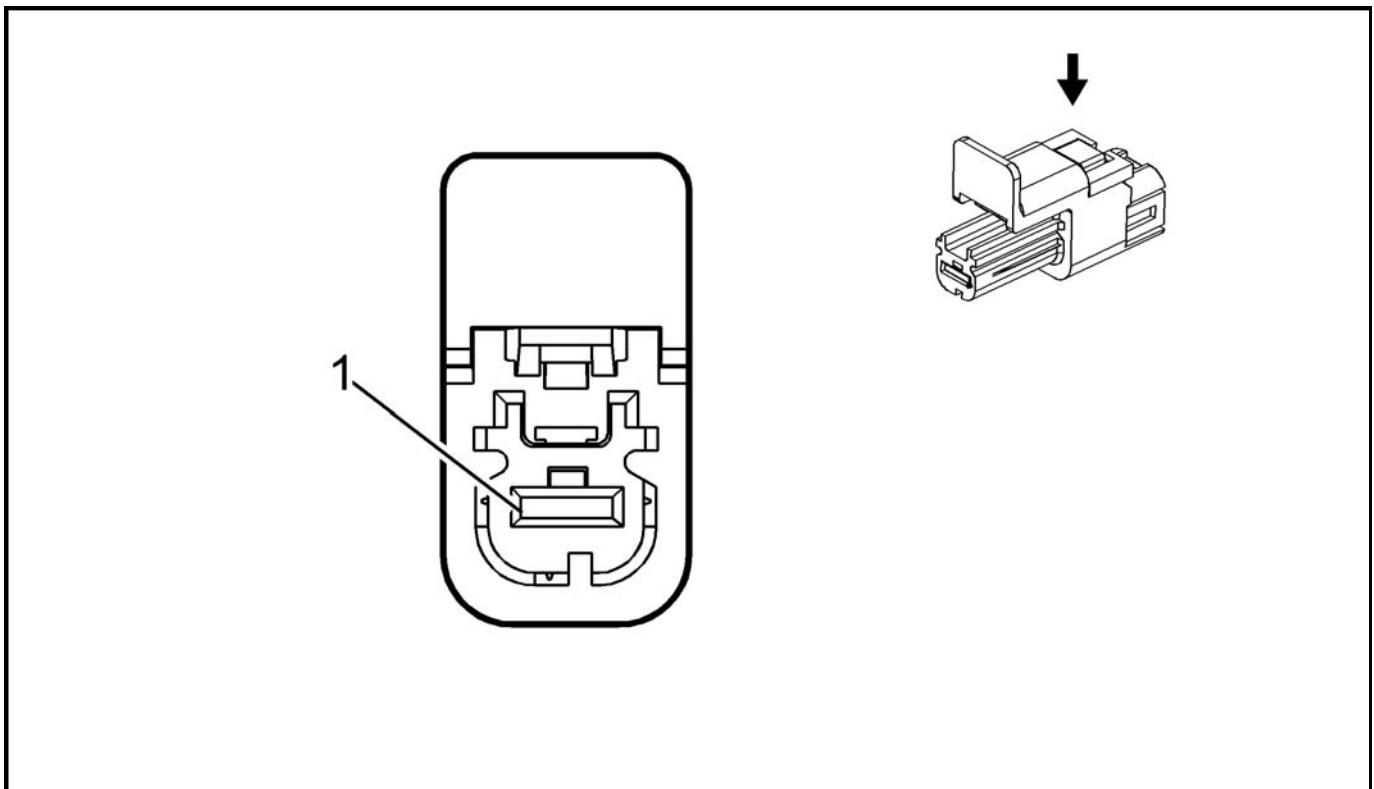


Fig. 9: X50D Fuse Block - Battery Bottom View
 Courtesy of GENERAL MOTORS COMPANY

X50D FUSE BLOCK - BATTERY X1



Connector Part Information

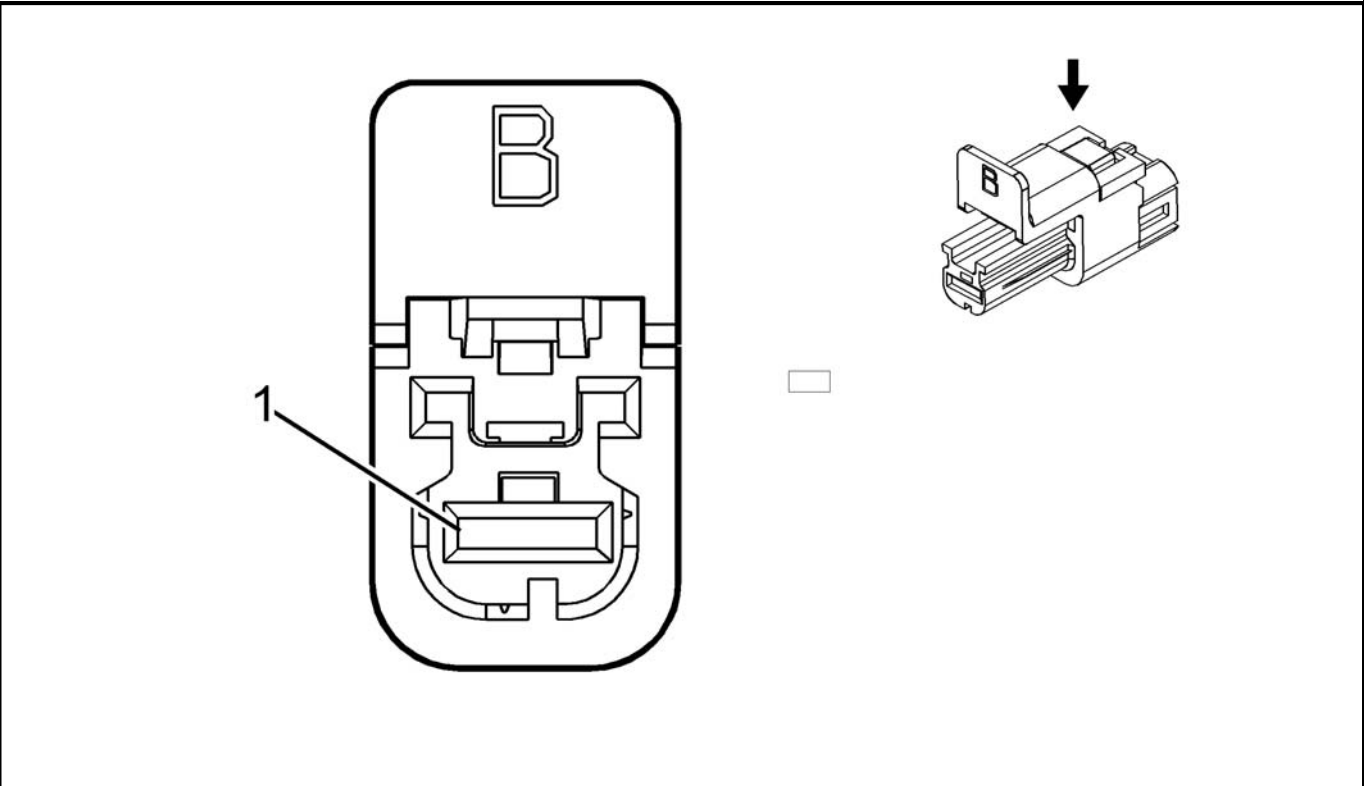
- Harness Type: Body
- OEM Connector: 33121434
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 6.3 Series (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/BU	42	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X2



Connector Part Information

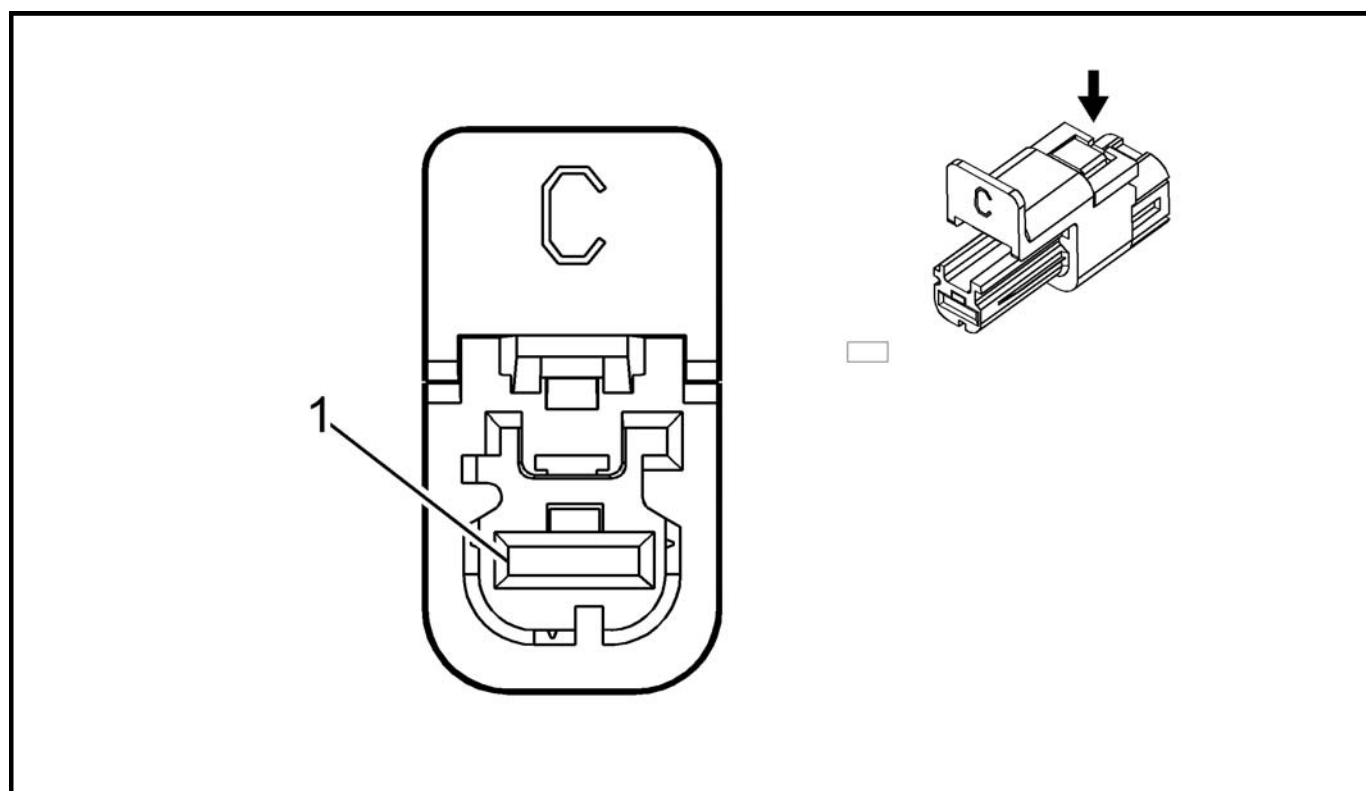
- Harness Type: Body
- OEM Connector: 13596077
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 6.3 Series (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/GY	142	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X3



Connector Part Information

- Harness Type: Body
- OEM Connector: 33121436
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 6.3 Series (VT)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/VT	102	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X5

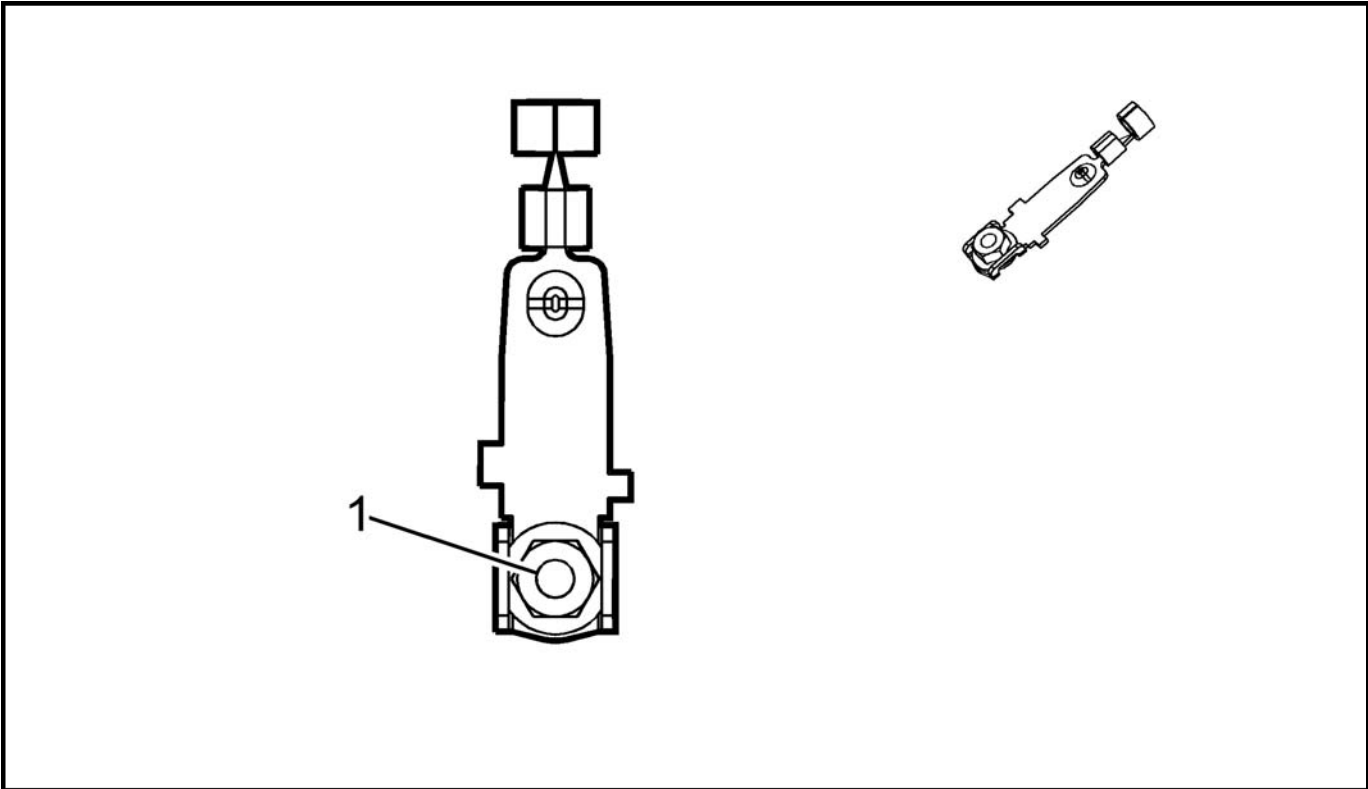
-
Connector Part Information • Harness Type: Body • OEM Connector: 20051 • Service Connector: Not Available • Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	30	RD	40	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X6



Connector Part Information

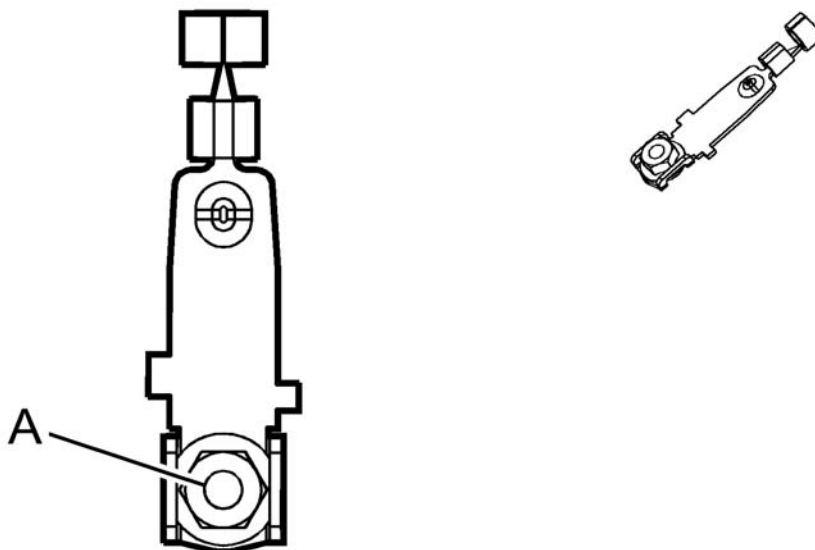
- Harness Type: Battery Cable
- OEM Connector: 33183551
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	25	RD/YE	2	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X7



Connector Part Information

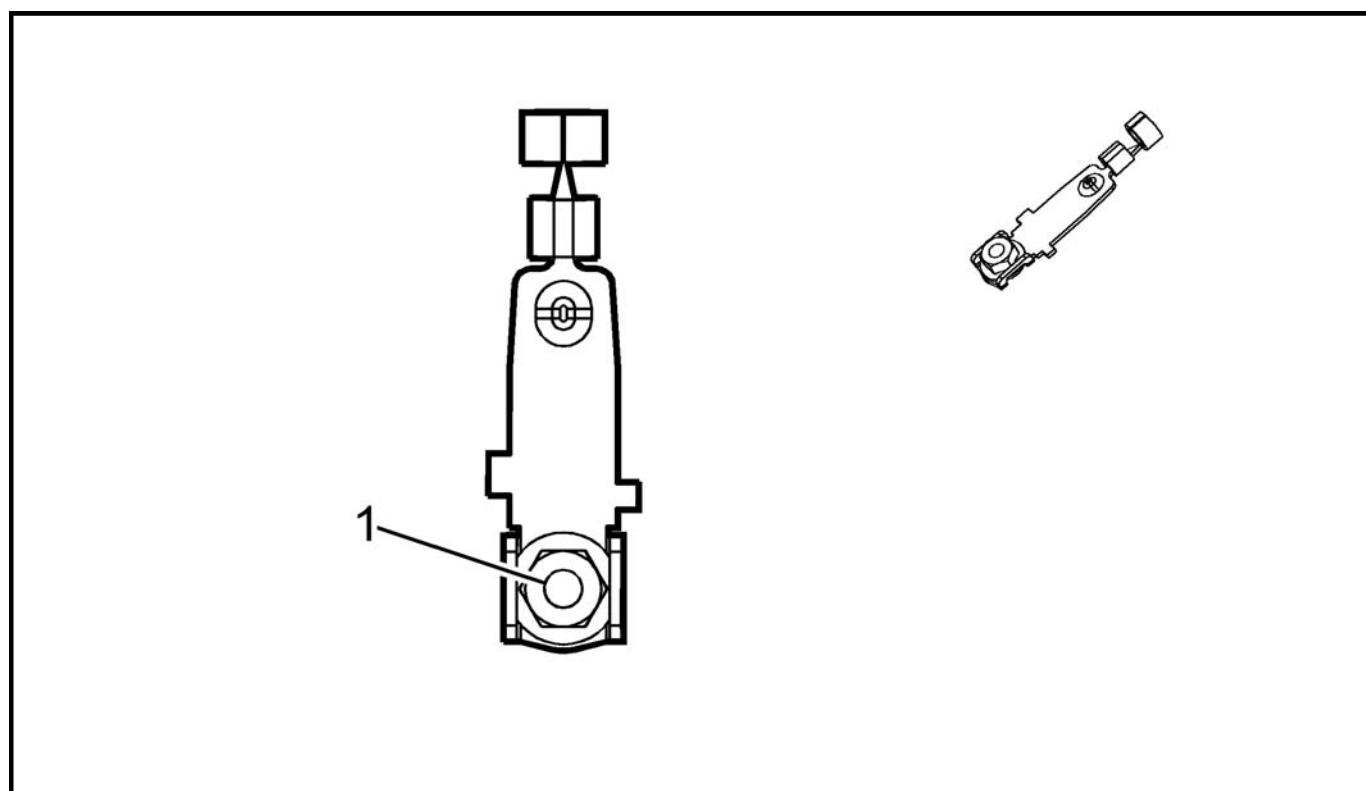
- Harness Type: Battery Sense Pigtail
- OEM Connector: 12103514
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	RD/WH	4740	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X8



Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: 33183557
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	30	RD	40	Battery Positive Voltage	I	-

X51A FUSE BLOCK - INSTRUMENT PANEL LABEL

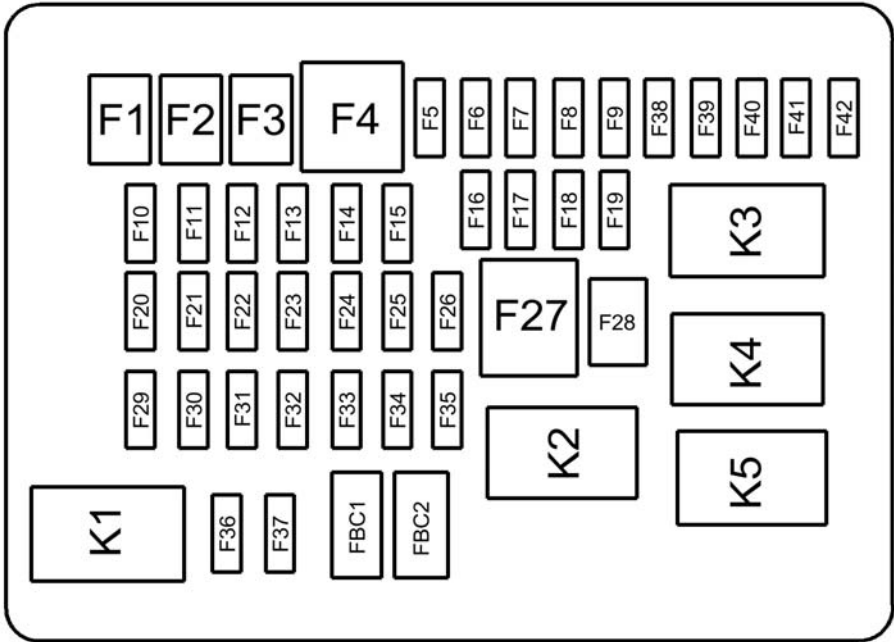


Fig. 10: X51A Fuse Block - Instrument Panel Label

Courtesy of GENERAL MOTORS COMPANY

X51A FUSE BLOCK - INSTRUMENT PANEL FUSE AND RELAY IDENTIFICATION LEGEND

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
F1	EMPTY	F1DA	30A	Not Used
F2	EMPTY	F2DA	30A	Not Used
F3	EMPTY	F3DA	30A	Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
F4	HVAC BLWR	F4DA	40A	• K8 Blower Motor Control Module
F5	BCM 2	F5DA	15A	• K9 Body Control Module
F6	EMPTY	F6DA	25A	• Not Used
F7	EMPTY	F7DA	30A	• Not Used
F8	BCM 3	F8DA	15A	• K9 Body Control Module
F9	FPPM	F9DA	25A	• K111 Fuel Pump Driver Control Module
F10	EMPTY	F10DA	30A	• Not Used
F11	EMPTY	F11DA	30A	• Not Used
F12	EMPTY	F12DA	30A	• Not Used
F13	EMPTY	F13DA	30A	• Not Used
F14	EMPTY	F14DA	15A	• Not Used
F15	EMPTY	F15DA	30A	• Not Used
F16	EMPTY	F16DA	30A	• Not Used
F17	DLC	F17DA	15A	• X84 Data Link Connector
F18	BCM 7	F18DA	15A	• K9 Body Control Module
F19	CLUSTER	F19DA	10A	• P16 Instrument Cluster
F20	BCM 1	F20DA	15A	• K9 Body Control Module
F21	BCM 4	F21DA	15A	• K9 Body Control Module
F22	BCM 6	F22DA	15A	• K9 Body Control Module
F23	ONSTAR	F23DA	10A	• K73 Telematics Communication Interface Control Module

No.	Device Label Name	Device Assigned Name	Rating	Description
F24	AIRBAG	F24DA	10A	• K36 Inflatable Restraint Sensing and Diagnostic Module • K85 Passenger Presence Module
F25	DISPLY	F25DA	7.5A	• A26 HVAC Controls • P17 Info Display Module
F26	INFT	F26DA	10A	• K74 Human Machine Interface Control Module • X83 Auxiliary Audio Input
F27	EMPTY	F27DA	30A	• Not Used
F28	EMPTY	F28DA	30A	• Not Used
F29	OVRHD CNSL	F29DA	7.5A	• S48B Multifunction Switch - Overhead Console
F30	RDO	F30DA	15A	• A11 Radio
F31	SWC	F31DA	2A	• S70L Steering Wheel Controls Switch - Left • S70R Steering Wheel Controls Switch - Right
F32	BCM 8	F32DA	20A	• K9 Body Control Module
F33	HVAC	F33DA	10A	• P36 Battery State of Charge Indicator • K33 HVAC Control Module
F34	PEPS	F34DA	5A	• K84 Keyless Entry Control Module
F35	REAR CLOSR	F35DA	7.5A	• KR95A Liftgate Unlatch Relay
F36	CHARGER	F36DA	5A	• T22 Mobile Device Wireless Charger Module
F37	EMPTY	F37DA	20A	• Not Used
F38	EMPTY	F38DA	-	• Not Used
F39	EMPTY	F39DA	-	• Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
F40	EMPTY	F40DA	-	• Not Used
F41	EMPTY	F41DA	-	• Not Used
F42	EMPTY	F42DA	-	• Not Used
Circuit Breakers				
CB1	APO FRT	CB1DA	15A	• X80H Accessory Power Receptacle - Center Console
CB2	APO RR	CB2DA	15A	• X80L Accessory Power Receptacle - Rear Console
Relays				
K1	-	-	-	• Not Used
K2	RAP/ACCY	KR76 Retained Accessory Power Relay	-	• CB2DA • CB1DA • F36DA
K3	LIFTGATE	KR95A Liftgate Unlatch Relay	-	• A23C Liftgate Latch Assembly
K4	-	-	-	• Not Used

X51A FUSE BLOCK - INSTRUMENT PANEL TOP VIEW

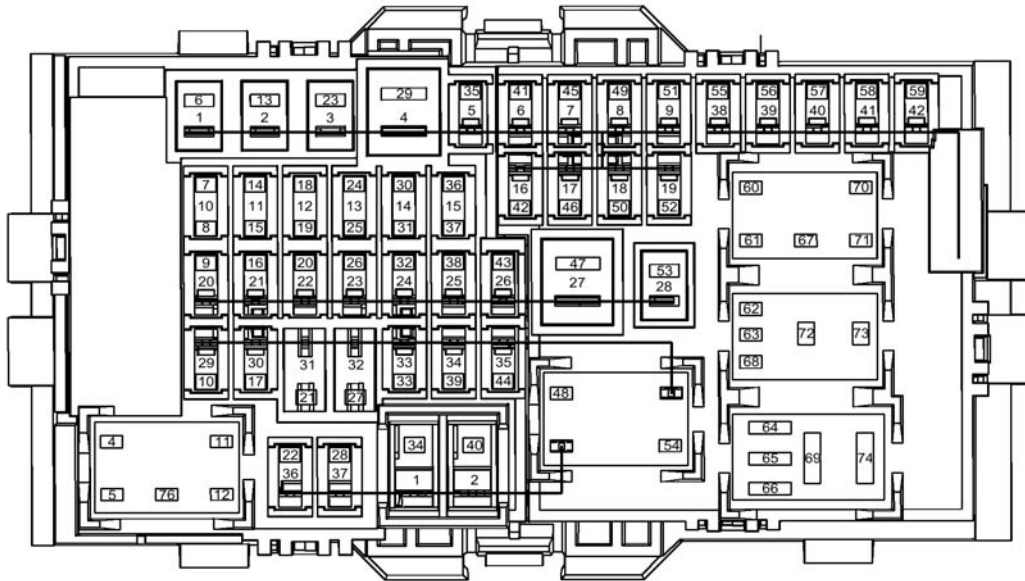
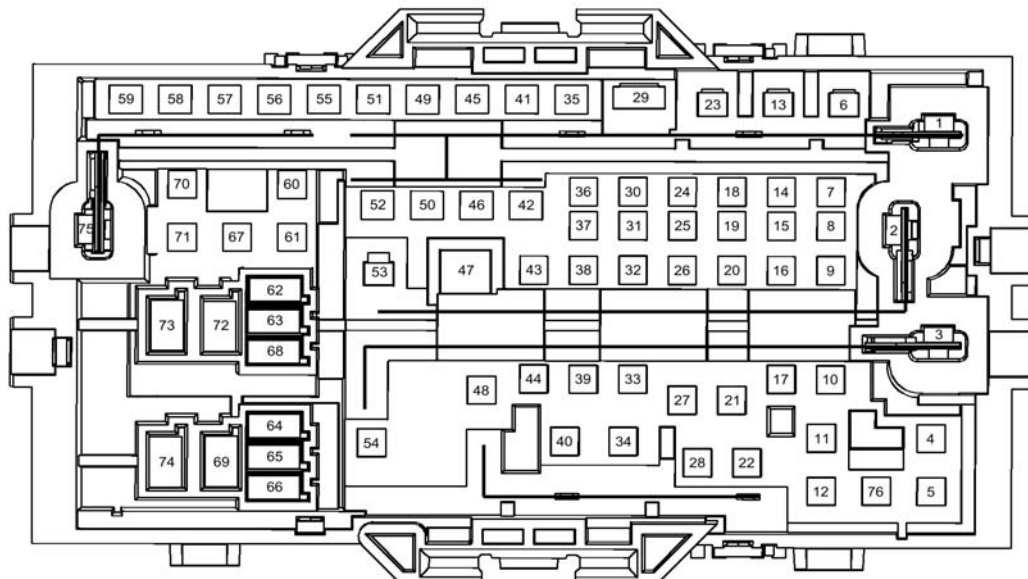


Fig. 11: X51A Fuse Block - Instrument Panel Top View
Courtesy of GENERAL MOTORS COMPANY

X51A FUSE BLOCK - INSTRUMENT PANEL WIRE ENTRY



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 33192630
- Service Connector: Service by Component Assembly - See Part Catalog
- Description: 71-Way F Wire Entry Fuse Block

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13580023	J-35616-43 (RD)	J-38125-11A	Not Required	Not Required	Not Required	Not Required
II	19300649	J-35616-35 (VT)	J-38125-12A	Not Required	Not Required	Not Required	Not Required
III	19301761	J-35616-35 (VT)	J-38125-11A	Not Required	Not Required	Not Required	Not Required
IV	19301761	J-35616-35 (VT)	J-38125-12A	Not Required	Not Required	Not Required	Not Required
V	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/BU	42	Battery Positive Voltage	V	-
2	8	RD/GY	142	Battery Positive Voltage	V	-
3 - 8	-	-	-	Not Occupied	-	-
9	1	RD/BN	4240	Battery Positive Voltage	III	-
10	0.5	RD/GN	2440	Battery Positive Voltage	II	-
11 - 15	-	-	-	Not Occupied	-	-
16	1.5	RD/YE	4340	Battery Positive Voltage	IV	-
17	1	RD/VT	340	Battery Positive Voltage	III	-
18 - 19	-	-	-	Not Occupied	-	-
20	1	RD/GN	4140	Battery Positive Voltage	III	-
21	0.5	RD/WH	5440	Battery Positive Voltage	II	-
22	0.35	VT	4601	Retained Accessory Power Fused Control	II	-
23 - 25	-	-	-	Not Occupied	-	-
26	0.5	RD/VT	2640	Battery Positive Voltage	II	-
27	1	RD/BN	4940	Battery Positive Voltage	III	-
28	-	-	-	Not Occupied	-	-
29	4	RD/VT	542	Battery Positive Voltage	I	-
30 - 31	-	-	-	Not Occupied	-	-
32	0.35 0.5	RD/BK RD/BK	2240 2240	Battery Positive Voltage Battery Positive Voltage	III	- -

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
33	0.35 0.5	RD/WH RD/WH	3440 3440	Battery Positive Voltage Battery Positive Voltage	III	- -
34	1	VT	1301	Retained Accessory Power Fuse Control	III	-
35	1	RD/BU	4540	Battery Positive Voltage	III	-
36 - 37	-	-	-	Not Occupied	-	-
38	0.5	RD/BU	3240	Battery Positive Voltage	III	-
39	0.5	RD/WH	640	Battery Positive Voltage	II	-
40	1	VT/WH	1701	Retained Accessory Power Ignition	III	-
41 - 42	-	-	-	Not Occupied	-	-
43	0.35 0.5	RD/YE RD/YE	5040 5040	Battery Positive Voltage Battery Positive Voltage	III	- -
44	0.5	RD/BU	5240	Battery Positive Voltage	II	-
45	-	-	-	Not Occupied	-	-
46	0.5	RD/GY	1740	Battery Positive Voltage	II	-
47	-	-	-	Not Occupied	-	-
48	0.35	GY/GN	4083	RAP Relay 2 Coil Control	II	-
49	1.5	RD/GN	4440	Battery Positive Voltage	IV	-
50	1	RD/GY	4840	Battery Positive Voltage	III	-
51	2	RD/GN	1540	Battery Positive Voltage	IV	-
52	0.5	RD/GN	502	Battery Positive Voltage	II	-
53	-	-	-	Not Occupied	-	-
54	0.5	BK	2150	Ground	II	-
55 - 59	-	-	-	Not Occupied	-	-
60	0.5	BK	2150	Ground	II	-
61	0.5	RD/BU	5240	Battery Positive Voltage	II	-
62 - 66	-	-	-	Not Occupied	-	-
67	0.5	BK	2150	Ground	III	-
68 - 69	-	-	-	Not Occupied	-	-
70	0.5	BU/YE	6795	Lift Glass/Rear Compartment Lid Motor Release Control 2	II	-
71	0.35	YE	5704	Endgate Latch Relay Coil Control	II	-
72 - 75	-	-	-	Not Occupied	-	-

X53A FUSE BLOCK - REAR BODY LABEL

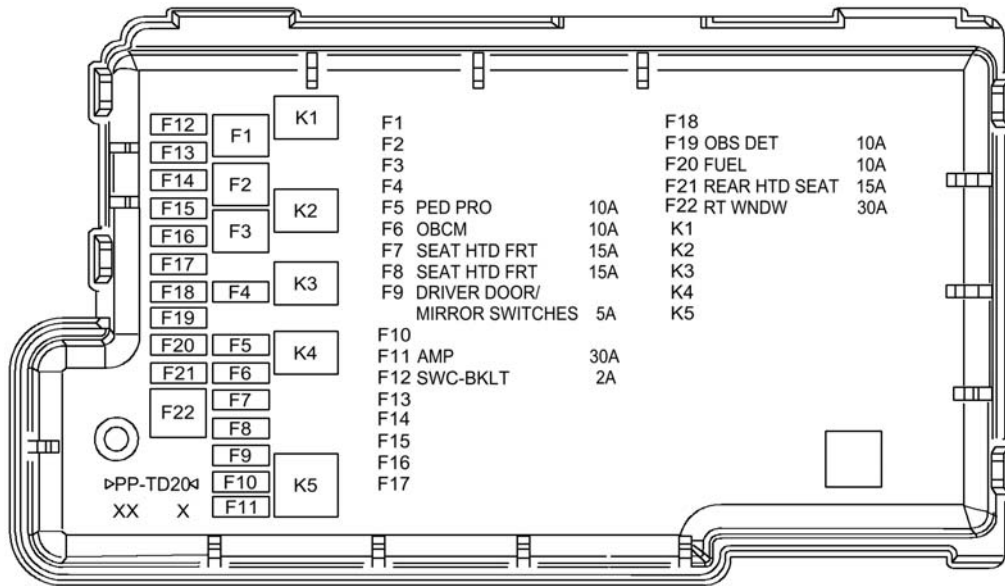


Fig. 12: X53A Fuse Block - Rear Body Label
 Courtesy of GENERAL MOTORS COMPANY

X53A FUSE BLOCK - REAR BODY TOP VIEW

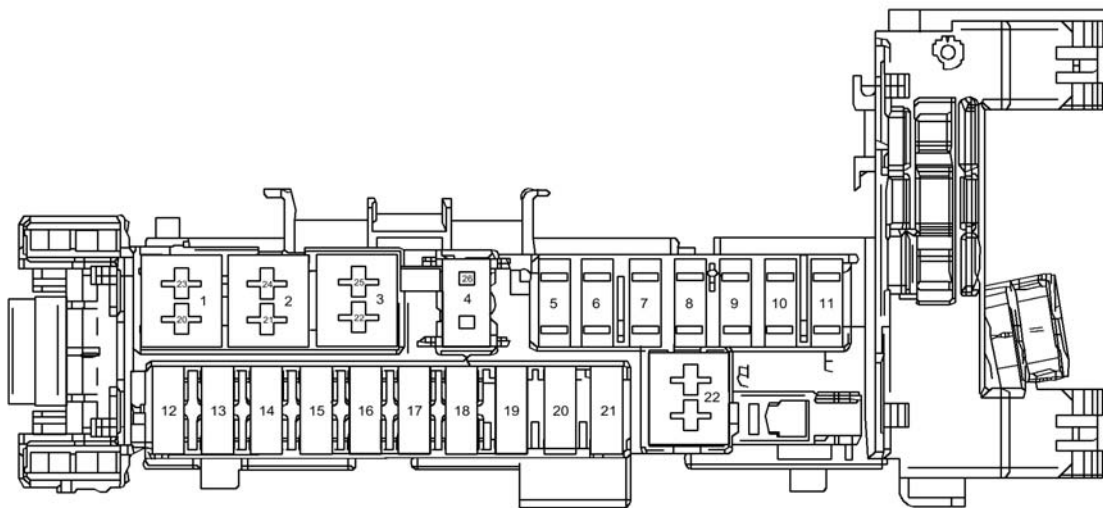
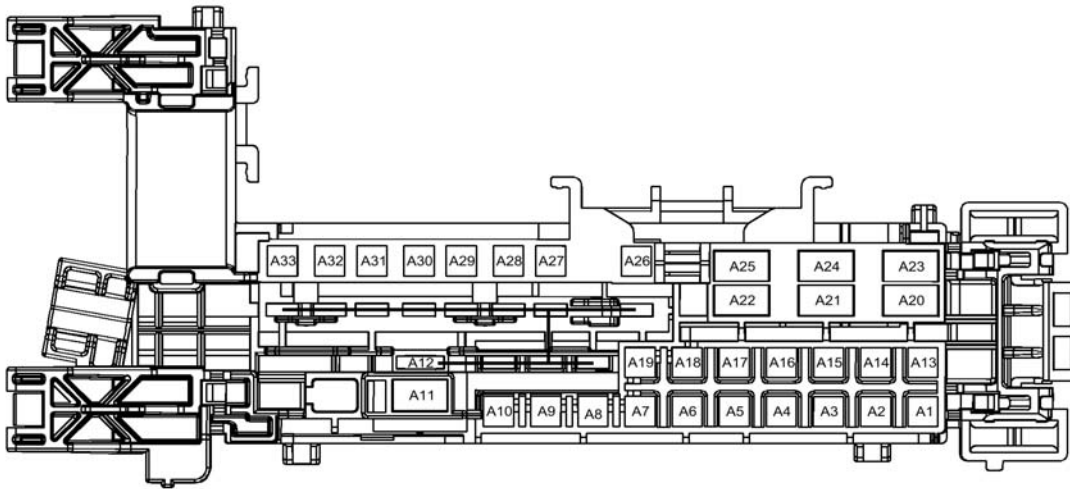


Fig. 13: X53A Fuse Block - Rear Body Top View**Courtesy of GENERAL MOTORS COMPANY****X53A FUSE BLOCK - REAR BODY FUSE IDENTIFICATION**

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
F1	Empty	F1RA	-	• Not Used
F2	Empty	F2RA	-	• Not Used
F3	Empty	F3RA	-	• Not Used
F4	Empty	F4RA	-	• Not Used
F5	PED PRO	F5RA	10A	• K132 Pedestrian Alert Sound Control Module
F6	OBCM	F6RA	10A	• T18 Battery Charger
F7	SEAT HTD FRT	F7RA	15A	• K29F Seat Heating Control Module - Front
F8	SEAT HTD FRT	F8RA	15A	• K29F Seat Heating Control Module - Front
F9	DRVR DOOR SW	F9RA	5A	• S117 Refuel Request Switch • S146 Window/Outside Rearview Mirror Switch - Driver
F10	Empty	F10RA	-	• Not Used
F11	AMP	F11RA	30A	• T3 Audio Amplifier
F12	DIM	F12RA	2A	• S70E Steering Wheel Controls Switch - Radio Presets
F13	Empty	F13RA	-	• Not Used
F14	Empty	F14RA	-	• Not Used
F15	Empty	F15RA	-	• Not Used
F16	Empty	F16RA	-	• Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
F17	Empty	F17RA	-	• Not Used
F18	Empty	F18RA	-	• Not Used
F19	OBS DET	F19RA	10A	• K182 Parking Assist Control Module • K109 Frontview Camera Module • K124 Active Safety Control Module • B218L Side Object Sensor Module - Left • B218R Side Object Sensor Module - Right
F20	FUEL	F20RA	10A	• Q13 Evaporative Emission Vent Solenoid Valve • Q63 Evaporative Emission System Leak Detection Pump Assembly
F21	RR HTD SEAT	F21RA	15A	• K29R Seat Heating Control Module - Rear
F22	RT WNDW	F22RA	30A	• S79P Window Switch - Passenger • S79RR Window Switch - Right Rear
Diodes				
DIODE	Empty	-	-	• Not Used
Relays				
R1	Empty	-	-	• Not Used
R2	Empty	-	-	• Not Used
R3	Empty	-	-	• Not Used
R4	Empty	-	-	• Not Used
R5	Empty	-	-	• Not Used

X53A FUSE BLOCK - REAR BODY WIRE ENTRY



Connector Part Information

- Harness Type: Body
- OEM Connector: 13367496
- Service Connector: Service by Component Assembly - See Part Catalog
- Description: 34-Way F Wire Entry Fuse Block

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575747	J-35616-35 (VT)	J-38125-36	Not Required	Not Required	Not Required	Not Required
II	13575770	J-35616-43 (RD)	J-38125-11A	Not Required	Not Required	Not Required	Not Required
III	19299860	J-35616-35 (VT)	J-38125-36	Not Required	Not Required	Not Required	Not Required
IV	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A1	0.5	YE	6817	LED Backlight Dimming Control	III	-
A2 - A7	-	-	-	Not Occupied	-	-
A8	0.5	RD/GY	2840	Battery Positive Voltage	III	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A9	0.5	RD/WH	1340	Battery Positive Voltage	III	-
A10	1	RD/GN	1840	Battery Positive Voltage	III	-
A11	2	RD/YE	3740	Battery Positive Voltage	II	-
A12	-	-	-	Not Occupied	-	-
A13	0.5	YE	6817	LED Backlight Dimming Control	III	-
A14 - A26	-	-	-	Not Occupied	-	-
A27	0.5	RD/VT	4640	Battery Positive Voltage	III	-
A28	0.5	RD/BU	1240	Battery Positive Voltage	III	-
A29	0.75	RD/GY	1740	Battery Positive Voltage	III	-
A30	0.75	RD/BN	1742	Battery Positive Voltage	III	-
A31	0.5	RD/WH	4740	Battery Positive Voltage	III	-
A32	-	-	-	Not Occupied	-	-
A33	3	RD/BN	1140	Battery Positive Voltage	I	-
A34	8	RD/VT	102	Battery Positive Voltage	IV	-

X55AL FUSE HOLDER - BODY CONTROL MODULE

-
Connector Part Information • Harness Type: Body • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	RD/WH	4740	Battery Positive Voltage	I	-
2	0.75	RD/WH	4740	Battery Positive Voltage	I	-

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Door Component Views - Volt

DOOR COMPONENT VIEWS

DRIVER DOOR COMPONENTS

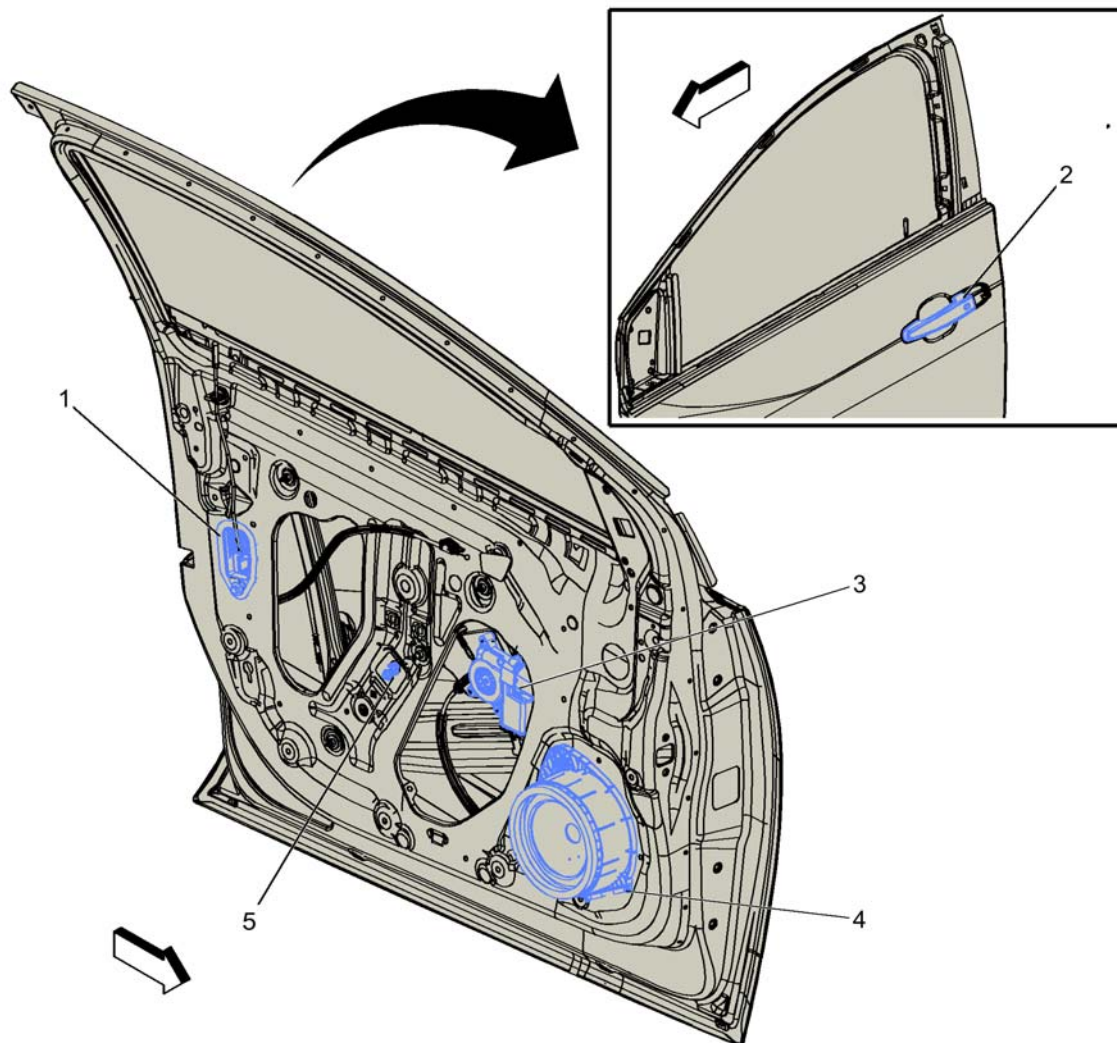


Fig. 1: Driver Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A23D Door Latch Assembly - Driver A23D Door Latch Assembly - Driver
2. A24D Door Handle Assembly - Driver Exterior A24D Door Handle Assembly - Driver Exterior
3. M74D Window Motor - Driver M74D Window Motor - Driver
4. P19AG Speaker - Left Front Door P19AG Speaker - Left Front Door (UQA) P19AG Speaker - Left Front Door (UZ6)
5. B63LF Side Impact Sensor - Left Front B63LF Side Impact Sensor - Left Front

DRIVER DOOR TRIM COMPONENTS

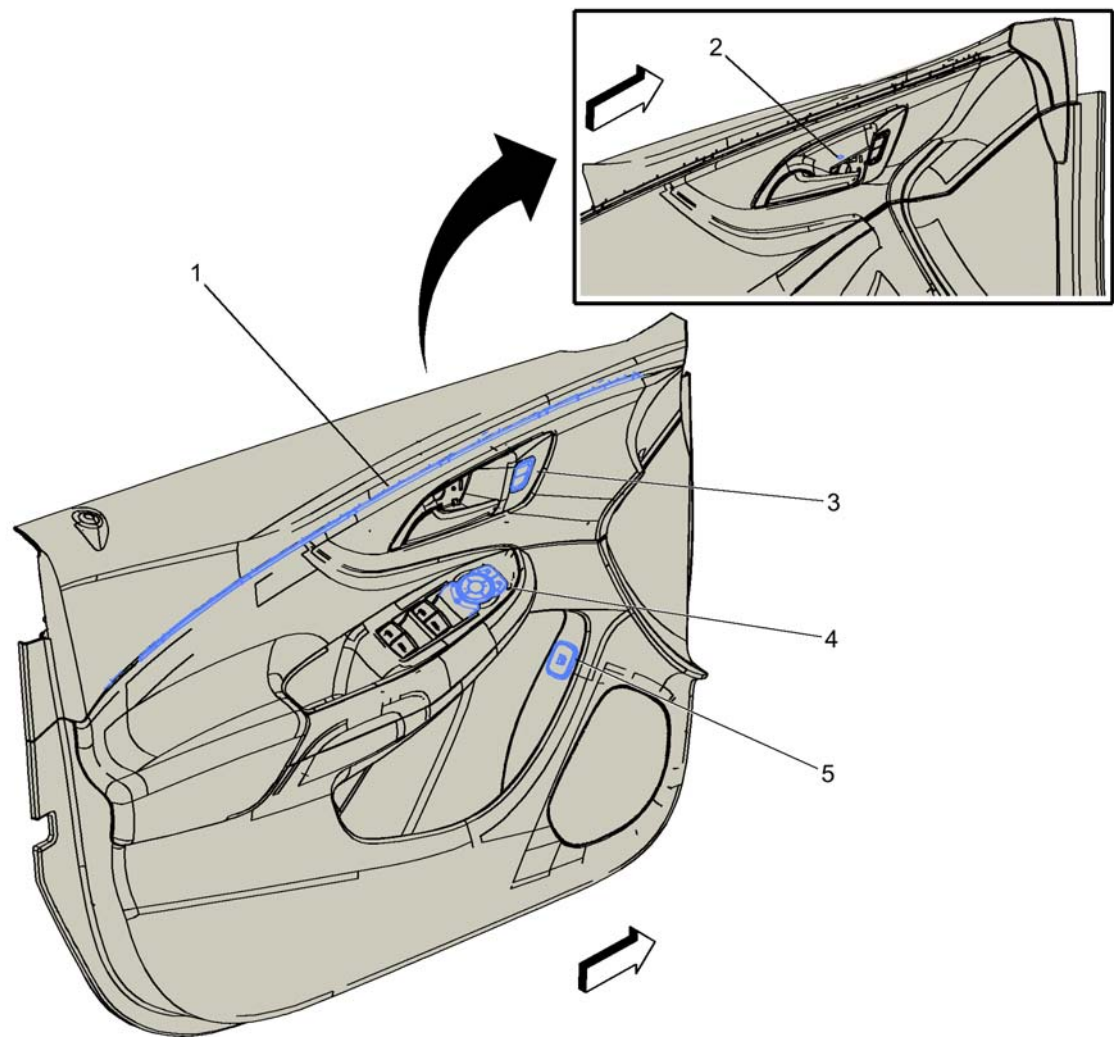


Fig. 2: Driver Door Trim Components
Courtesy of GENERAL MOTORS COMPANY

Items
1. E1D Accent Lamp - Driver Door <u>E1D Accent Lamp - Driver Door</u>
2. E63D Flood Lamp - Driver Door Handle <u>E63D Flood Lamp - Driver Door Handle</u>
3. S13D Door Lock Switch - Driver <u>S13D Door Lock Switch - Driver</u>
4. S146 Window/Outside Rearview Mirror Switch - Driver <u>S146 Window/Outside Rearview Mirror Switch - Driver</u>
5. S117 Refuel Request Switch <u>S117 Refuel Request Switch</u>

PASSENGER DOOR COMPONENTS

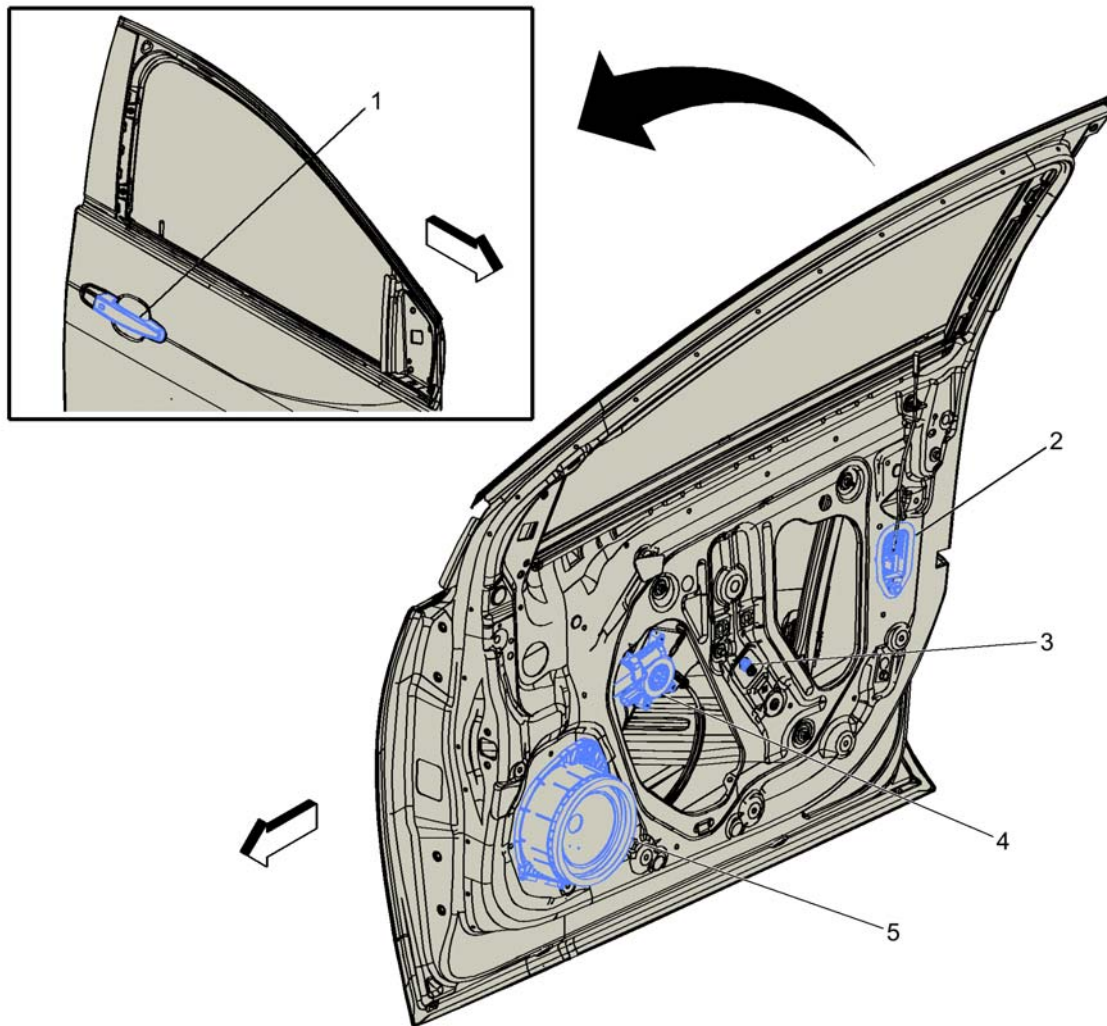


Fig. 3: Passenger Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A24P Door Handle Assembly - Passenger Exterior <u>A24P Door Handle Assembly - Passenger Exterior</u>
2. A23P Door Latch Assembly - Passenger <u>A23P Door Latch Assembly - Passenger</u>
3. B63RF Side Impact Sensor - Right Front <u>B63RF Side Impact Sensor - Right Front</u>
4. M74P Window Motor - Passenger <u>M74P Window Motor - Passenger</u>
5. P19AH Speaker - Right Front Door <u>P19AH Speaker - Right Front Door (UQA)</u>

PASSENGER DOOR TRIM COMPONENTS

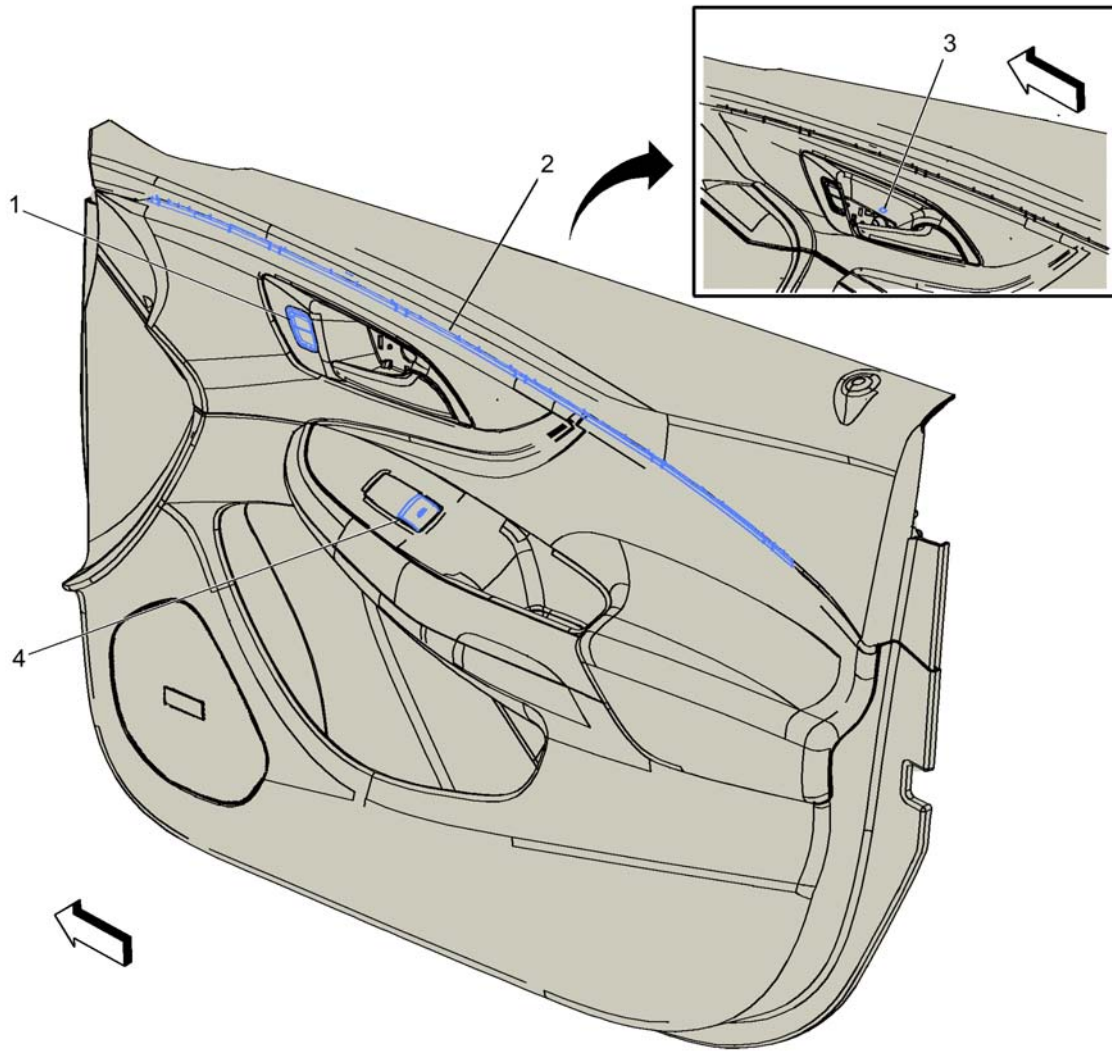


Fig. 4: Passenger Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S13P Door Lock Switch - Passenger <u>S13P Door Lock Switch - Passenger</u>
2. E1P Accent Lamp - Passenger Door <u>E1P Accent Lamp - Passenger Door</u>
3. E63P Flood Lamp - Passenger Door Handle <u>E63P Flood Lamp - Passenger Door Handle</u>
4. S79P Window Switch - Passenger <u>S79P Window Switch - Passenger</u>

LEFT REAR DOOR COMPONENTS

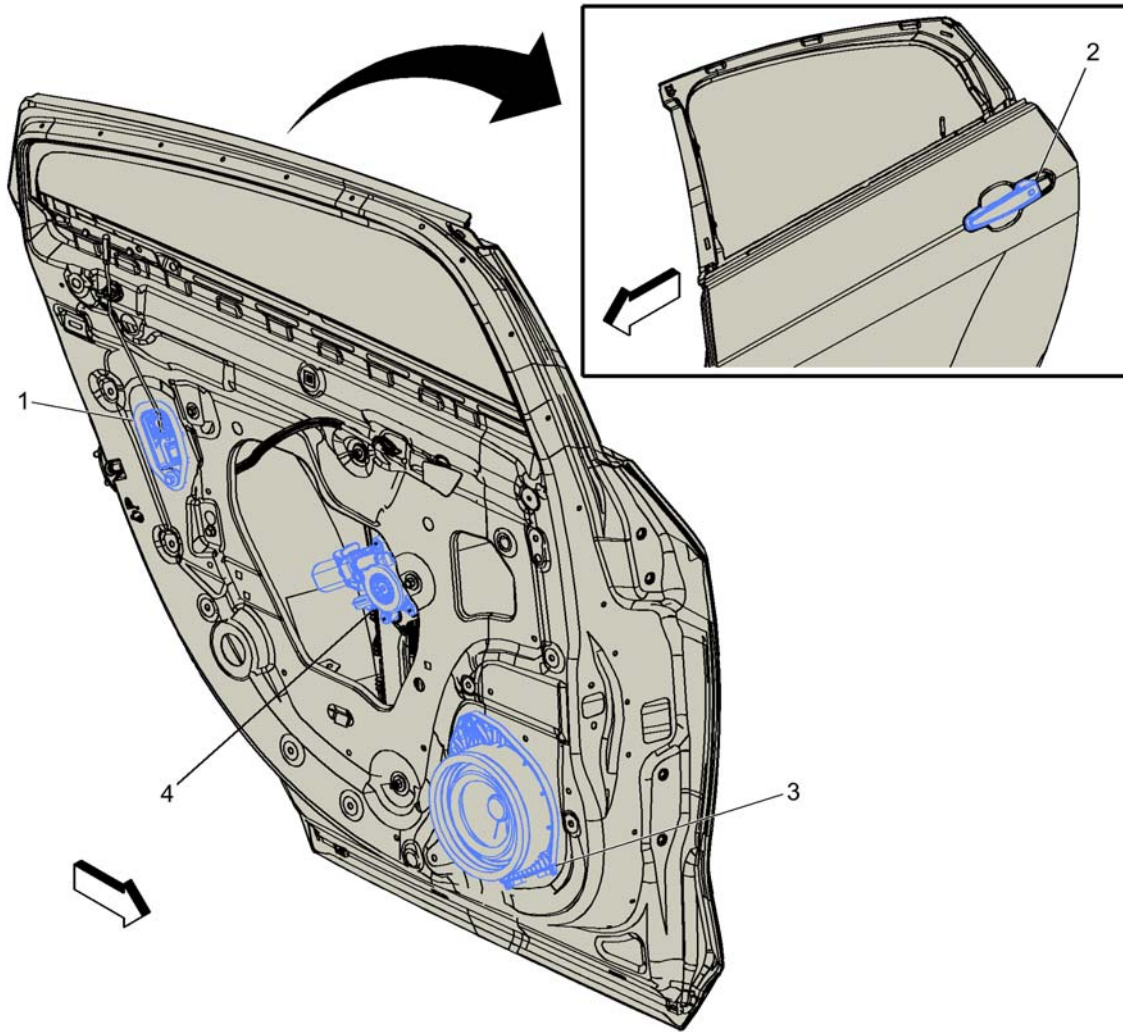


Fig. 5: Left Rear Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A23LR Door Latch Assembly - Left Rear <u>A23LR Door Latch Assembly - Left Rear</u>
2. A24LR Door Handle Assembly - Left Rear Exterior <u>A24LR Door Handle Assembly - Left Rear Exterior</u>
3. P19AL Speaker - Left Rear Door <u>P19AL Speaker - Left Rear Door (UQA)</u> <u>P19AL Speaker - Left Rear Door (UZ6)</u>
4. M74LR Window Motor - Left Rear <u>M74LR Window Motor - Left Rear</u>

LEFT REAR DOOR TRIM COMPONENTS

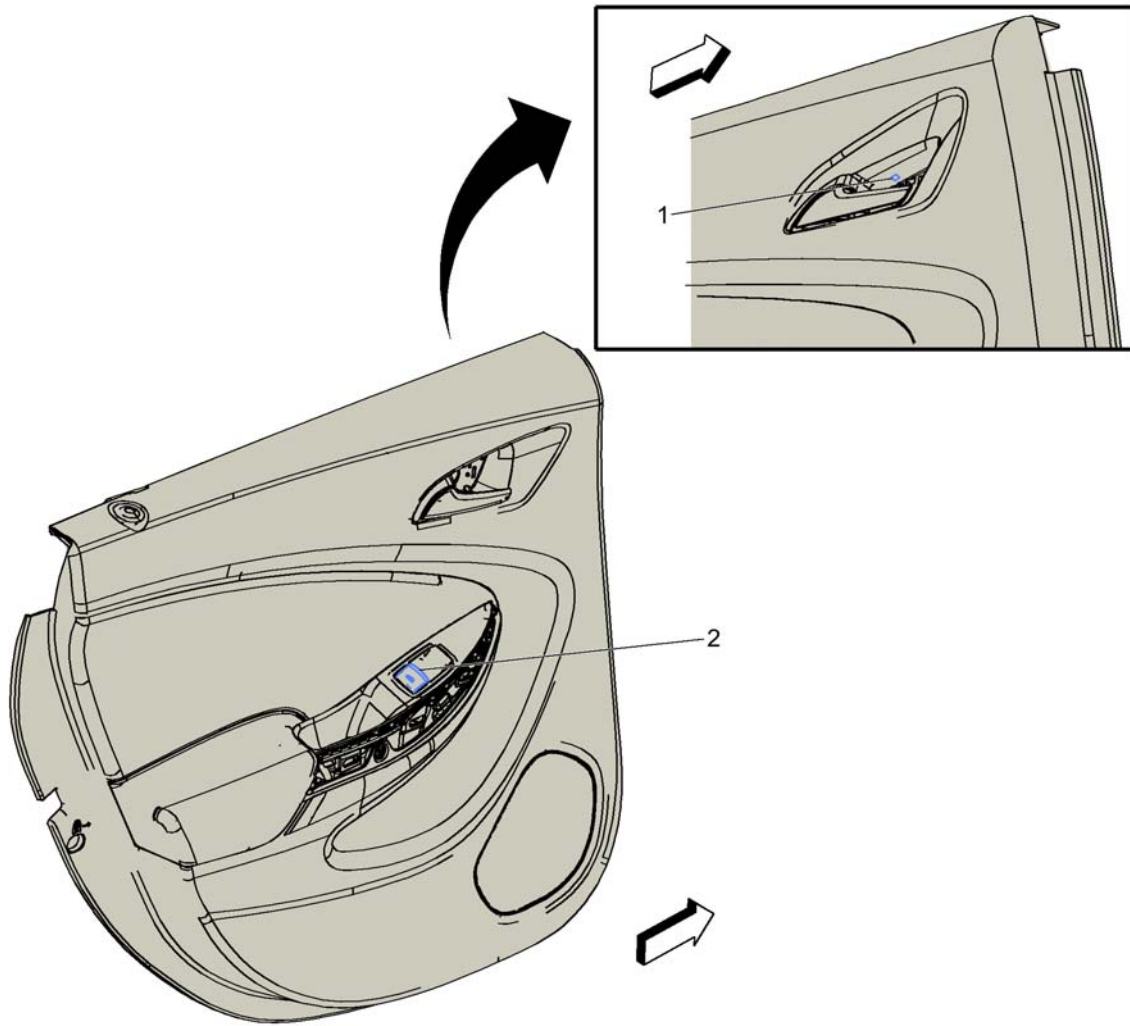


Fig. 6: Left Rear Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. E63LR Flood Lamp - Left Rear Door Handle E63LR Flood Lamp - Left Rear Door Handle
2. S79LR Window Switch - Left Rear S79LR Window Switch - Left Rear

RIGHT REAR DOOR COMPONENTS

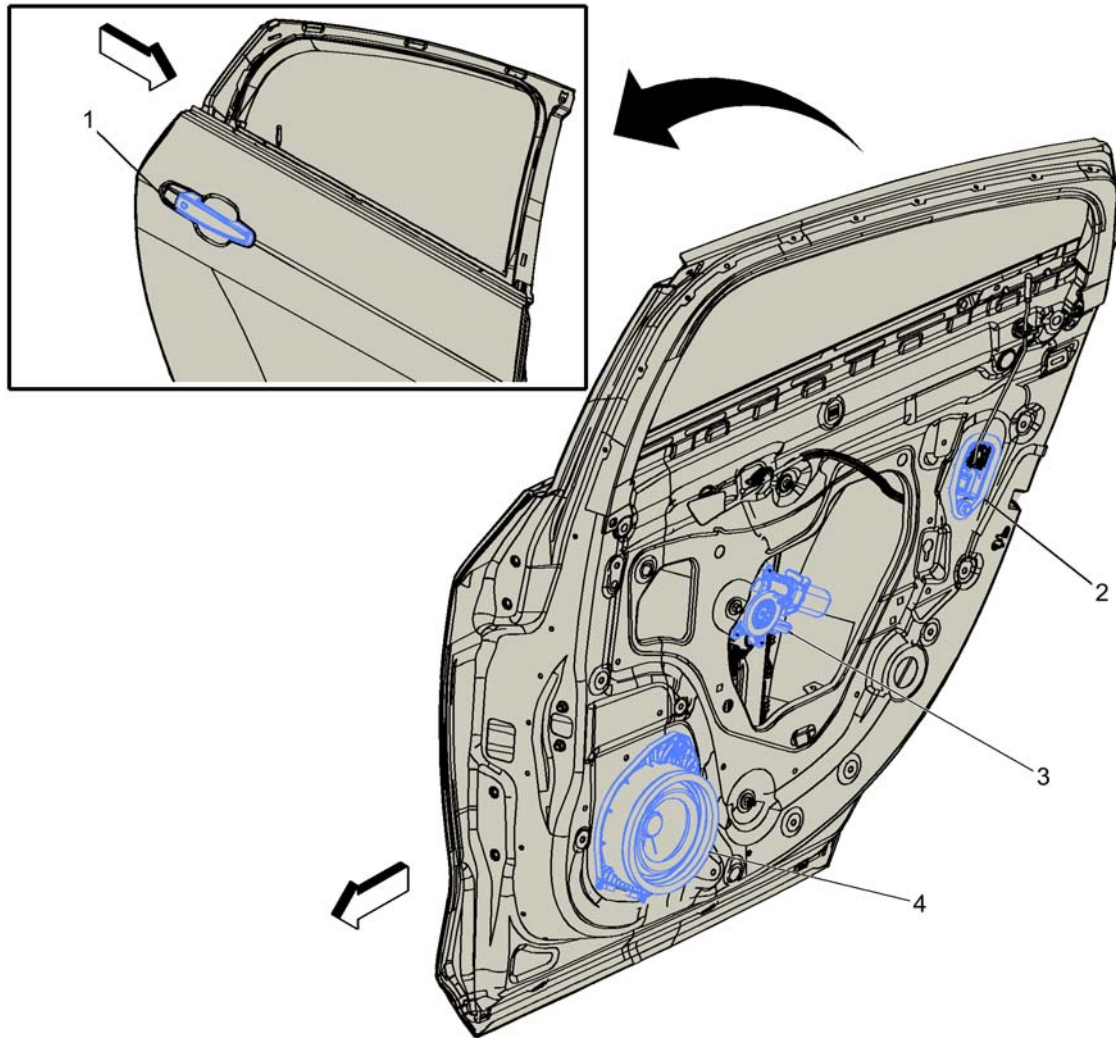


Fig. 7: Right Rear Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A24RR Door Handle Assembly - Right Rear Exterior <u>A24RR Door Handle Assembly - Right Rear Exterior</u>
2. A23RR Door Latch Assembly - Right Rear <u>A23RR Door Latch Assembly - Right Rear</u>
3. M74RR Window Motor - Right Rear <u>M74RR Window Motor - Right Rear</u>
4. P19AM Speaker - Right Rear Door <u>P19AM Speaker - Right Rear Door (UQA)</u> <u>P19AM Speaker - Right Rear Door (UZ6)</u>

RIGHT REAR DOOR TRIM COMPONENTS

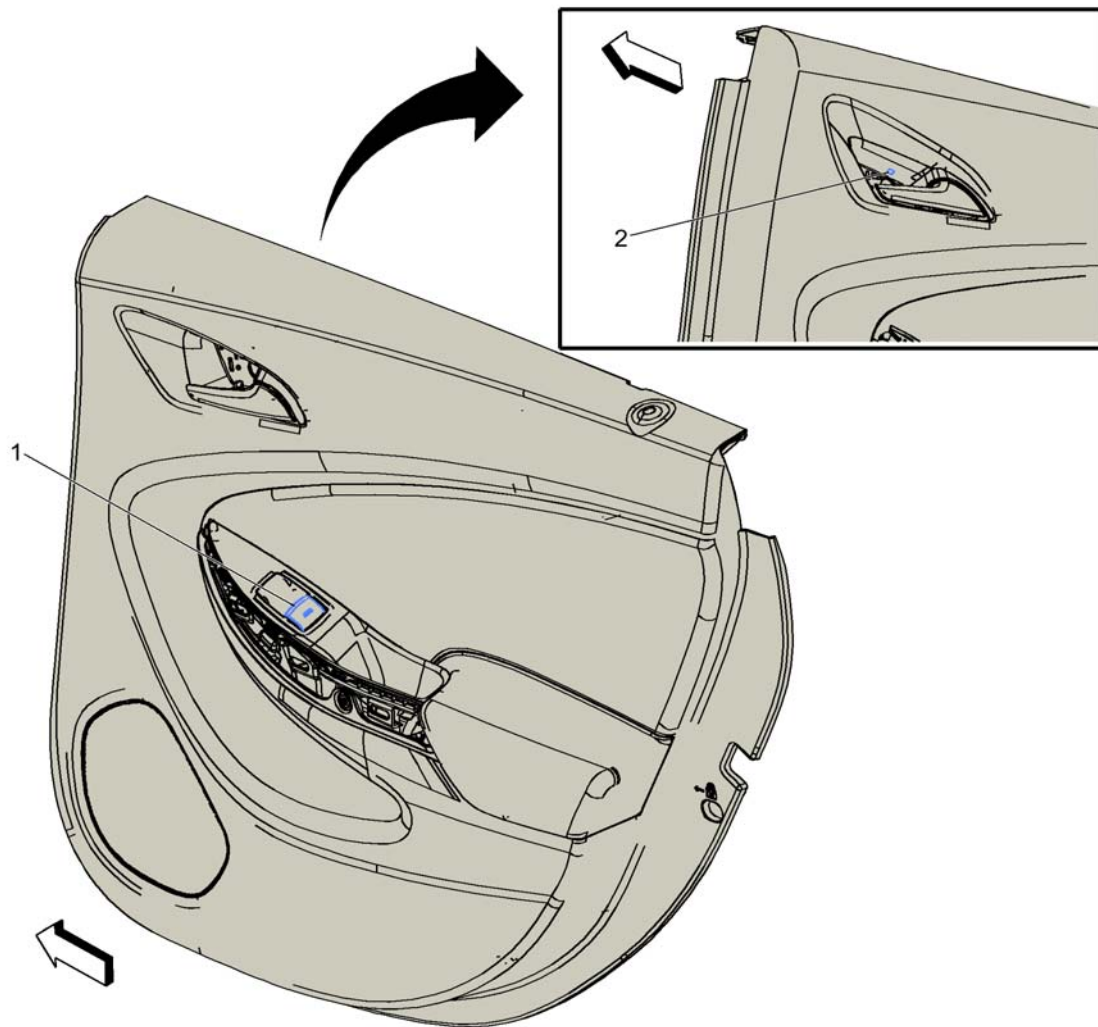


Fig. 8: Right Rear Door Trim Components
 Courtesy of GENERAL MOTORS COMPANY

Items	
1. S79RR Window Switch - Right Rear	S79RR Window Switch - Right Rear
2. E63RR Flood Lamp - Right Rear Door Handle	E63RR Flood Lamp - Right Rear Door Handle

Article GUID: A00884673

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Front of Vehicle/Engine Compartment Component Views - Volt

FRONT OF VEHICLE/ENGINE COMPARTMENT COMPONENT VIEWS

ENGINE COMPARTMENT COMPONENTS

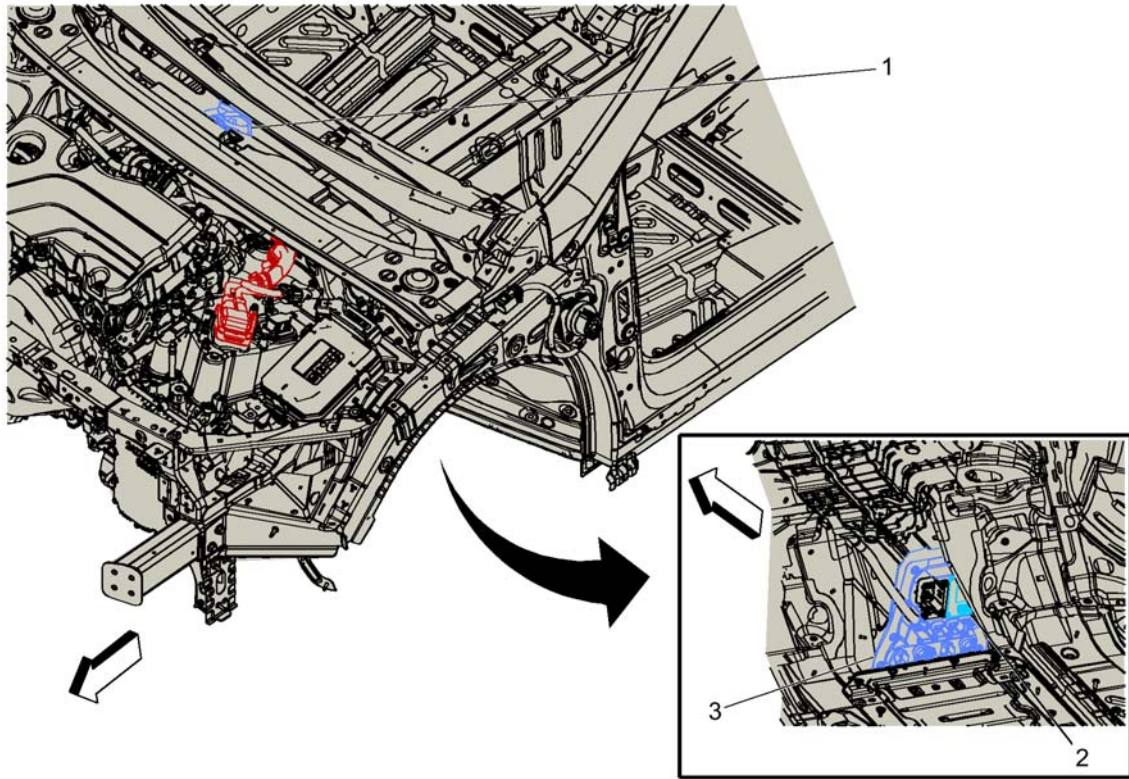


Fig. 1: Engine Compartment Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. M75 Windshield Wiper Motor M75 Windshield Wiper Motor
2. X55QA Fuse Holder 1 - Hybrid/EV Battery Pack
3. A28 Hybrid/EV Battery Contactor Assembly A28 Hybrid/EV Battery Contactor Assembly X3 A28 Hybrid/EV Battery Contactor Assembly X4 A28 Hybrid/EV Battery Contactor Assembly X5 A28 Hybrid/EV Battery Contactor Assembly X6

ENGINE COMPARTMENT COMPONENTS - FRONT (1 OF 4)

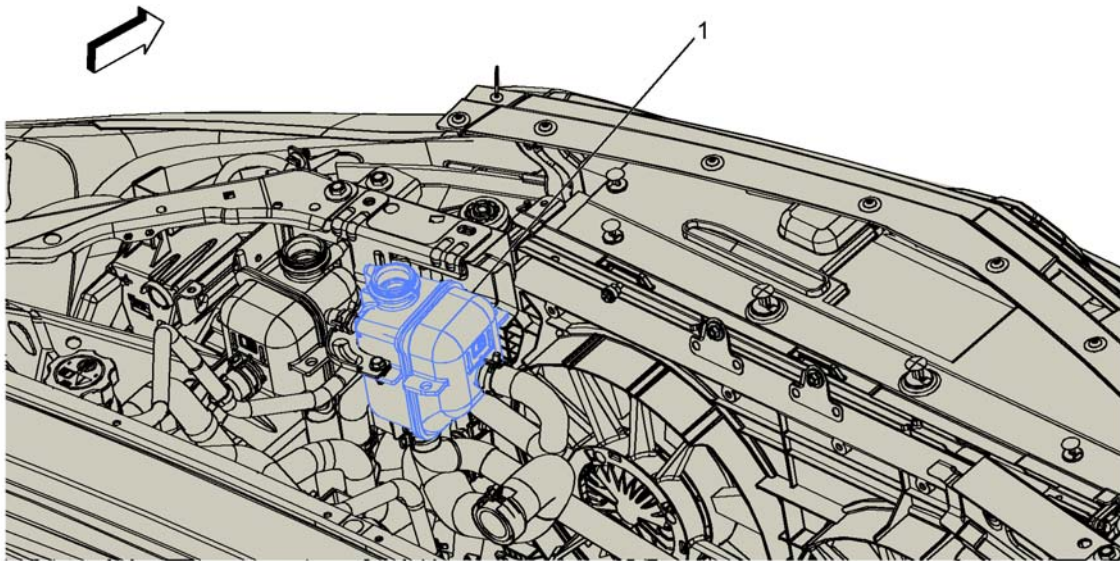


Fig. 2: Engine Compartment Components - Front (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B258 Hybrid/EV Battery Coolant Level Switch B258 Hybrid/EV Battery Coolant Level Switch

ENGINE COMPARTMENT COMPONENTS - FRONT (2 OF 4)

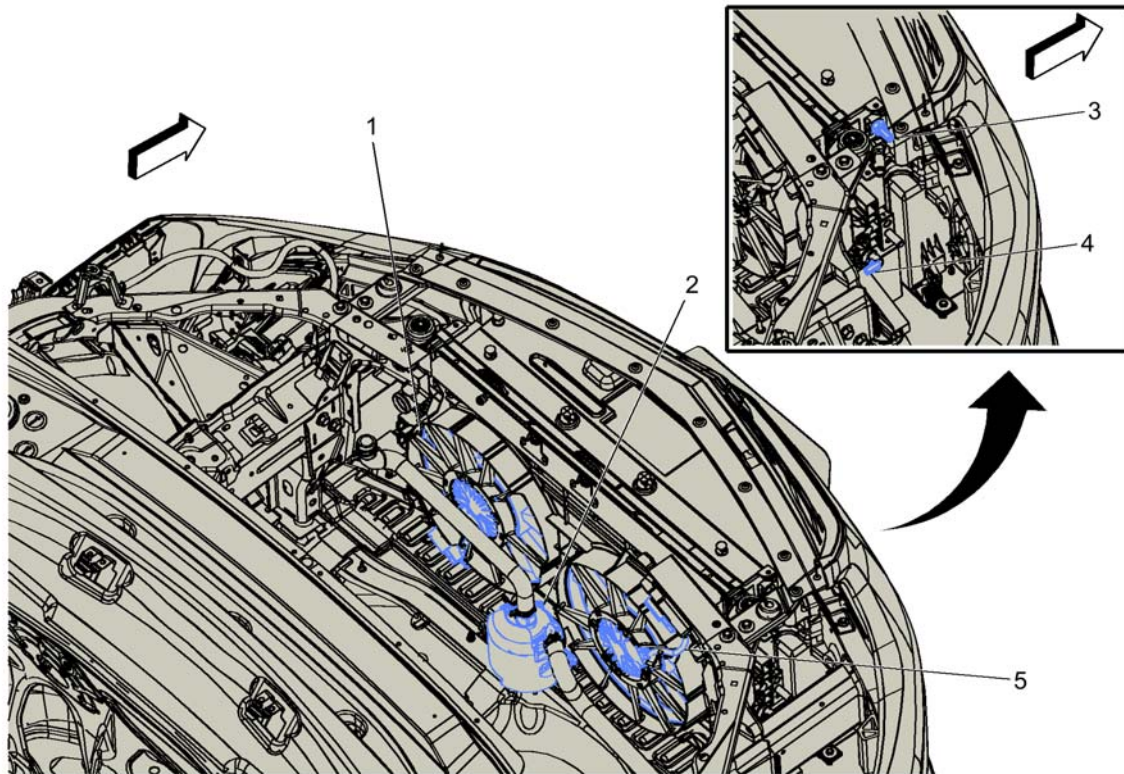


Fig. 3: Engine Compartment Components - Front (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. G10L Cooling Fan Motor - Left <u>G10L Cooling Fan Motor - Left</u>
2. G37 Hybrid/EV Battery Pack Coolant Pump <u>G37 Hybrid/EV Battery Pack Coolant Pump</u>
3. B202 Hybrid/EV Electronics Coolant Temperature Sensor <u>B202 Hybrid/EV Electronics Coolant Temperature Sensor</u>
4. B203 Radiator Coolant Temperature Sensor <u>B203 Engine Coolant Radiator Temperature Sensor</u>
5. G10R Cooling Fan Motor - Right <u>G10R Cooling Fan Motor - Right</u>

ENGINE COMPARTMENT COMPONENTS - FRONT (3 OF 4)

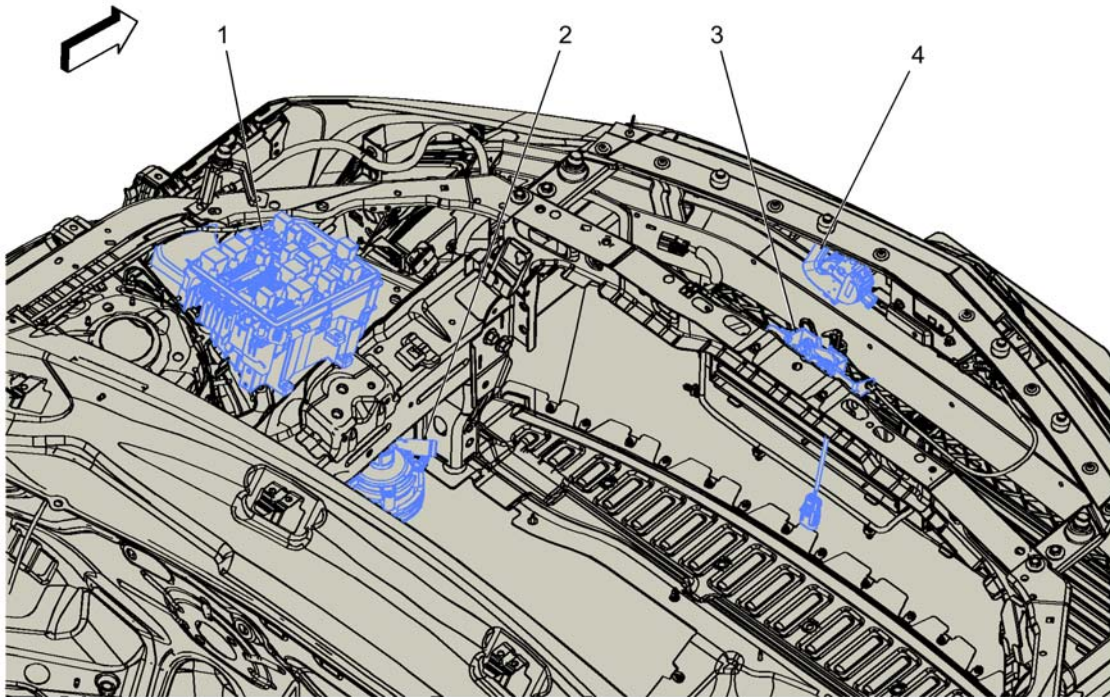


Fig. 4: Engine Compartment Components - Front (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X50A Fuse Block - Underhood <u>X50A Fuse Block - Underhood X1 X50A Fuse Block - Underhood X2 X50A Fuse Block - Underhood X3</u>
2. G35 Hybrid/EV Electronics Coolant Pump <u>G35 Hybrid/EV Electronics Coolant Pump</u>
3. B55 Hood Ajar Switch <u>B55 Engine Hood Switch</u>
4. P48 Pedestrian Alert Sound Speaker <u>P48 Pedestrian Alert Sound Speaker</u>

ENGINE COMPARTMENT COMPONENTS - FRONT (4 OF 4)

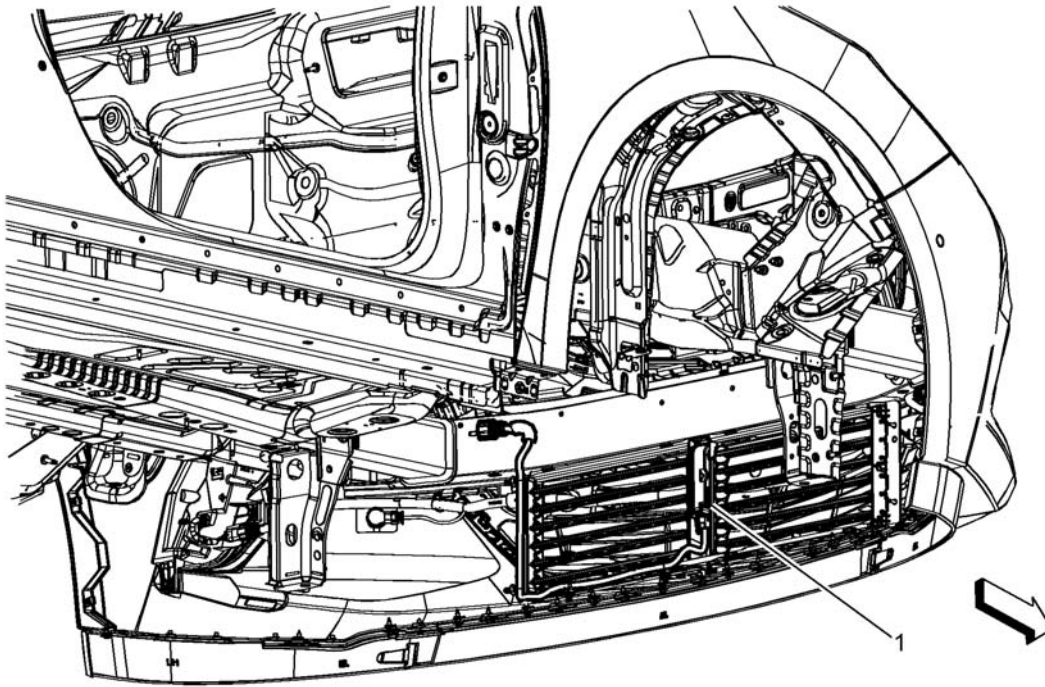


Fig. 5: Engine Compartment Components - Front (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. M96 Active Grille Air Shutter Actuator M96 Active Grille Air Shutter Actuator

ENGINE COMPARTMENT COMPONENTS - LEFT

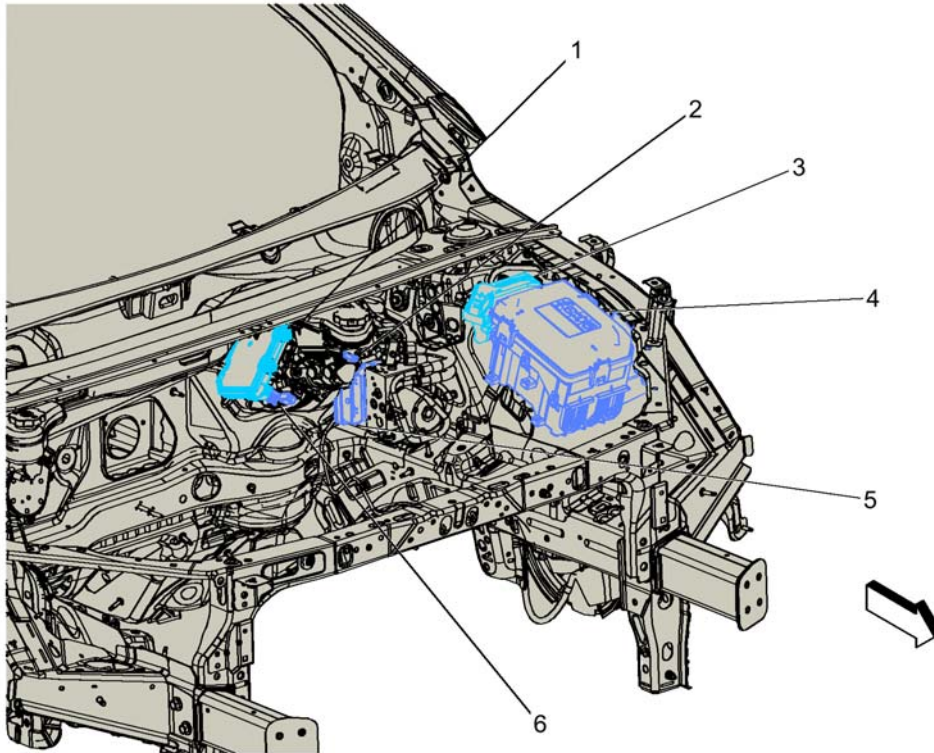


Fig. 6: Engine Compartment Components - Left

Courtesy of GENERAL MOTORS COMPANY

Items
1. K177 Brake Booster Control Module <u>K177 Brake Booster Control Module</u>
2. B20 Brake Fluid Level Switch <u>B20 Brake Fluid Level Switch</u>
3. X50B Fuse Block - Underhood Auxiliary <u>X50B Fuse Block - Underhood Auxiliary X1</u>
4. X50A Fuse Block - Underhood <u>X50A Fuse Block - Underhood X1</u> <u>X50A Fuse Block - Underhood X2</u> <u>X50A Fuse Block - Underhood X3</u>
5. K17 Electronic Brake Control Module <u>K17 Electronic Brake Control Module</u>
6. B201 Brake Control Brake Pedal Position Sensor <u>B201 Brake Control Brake Pedal Position Sensor</u>

ENGINE COMPARTMENT COMPONENTS - RIGHT

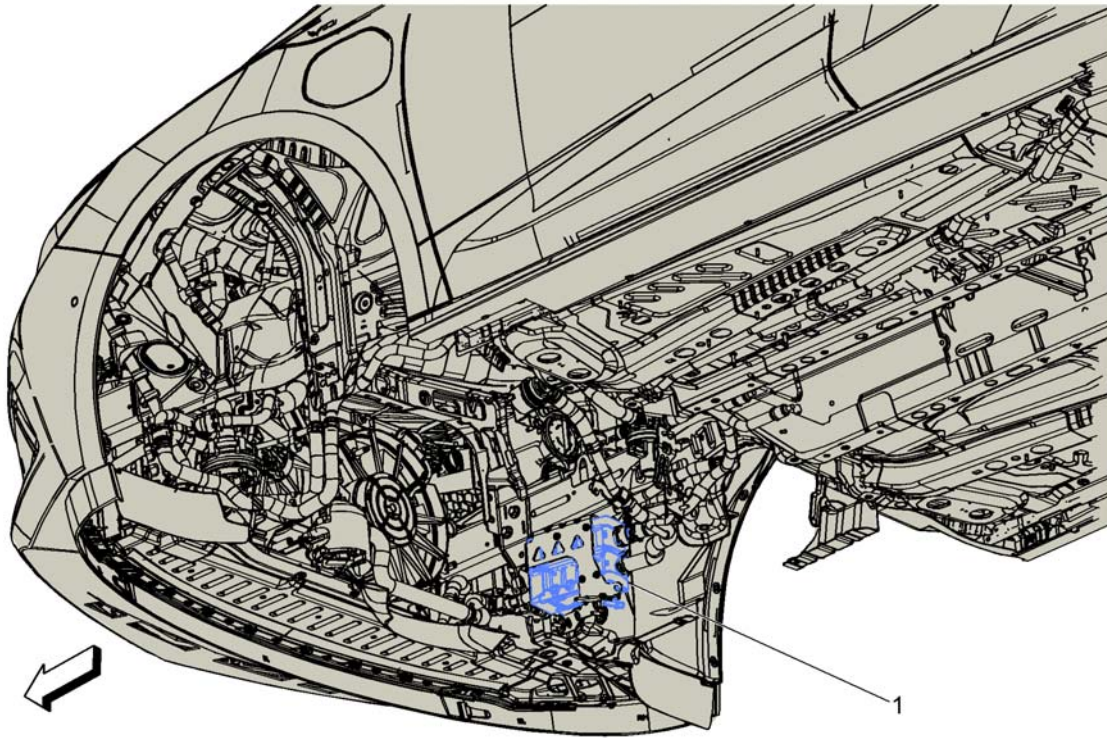


Fig. 7: Engine Compartment Components - Right
Courtesy of GENERAL MOTORS COMPANY

Items
1. K10 Coolant Heater Control Module <u>K10 Coolant Heater Control Module X1</u>

FRONT OF VEHICLE COMPONENTS (1 OF 2)

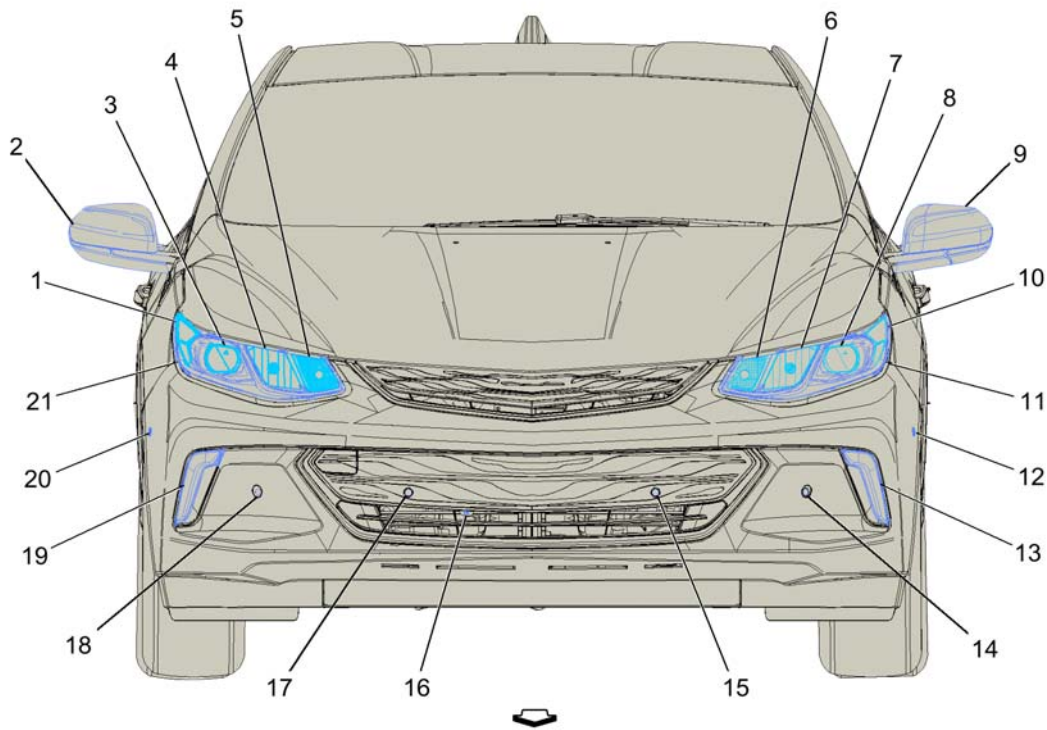


Fig. 8: Front of Vehicle Components (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Items
1. E2RF Side Marker Lamp - Right Front
2. A9B Outside Rearview Mirror - Passenger
3. E4H Headlamp - Right Low Beam
4. E4F Headlamp - Right High Beam <u>E4F Headlamp - Right High Beam</u>
5. E4RF Turn Signal Lamp - Right Front
6. E4LF Turn Signal Lamp - Left Front
7. E4E Headlamp - Left High Beam <u>E4E Headlamp - Left High Beam</u>
8. E4G Headlamp - Left Low Beam
9. A9A Outside Rearview Mirror - Driver
10. E2LF Side Marker Lamp - Left Front
11. E13LA Headlamp Assembly - Left
12. B306K Parking Assist Sensor - Side Left Front (UKC) <u>B306K Parking Assist Sensor - Side Left Front</u>
13. E4AC Park/Daytime Running Lamp - Left <u>E4AC Park/Daytime Running Lamp - Left</u>
14. B306A Parking Assist Sensor - Front Left Outer (UFQ) <u>B306A Parking Assist Sensor - Front Left Outer</u>
15. B306B Parking Assist Sensor - Front Left Middle (UFQ) <u>B306B Parking Assist Sensor - Front Left Middle</u>
16. B9 Ambient Air Temperature Sensor <u>B9 Ambient Air Temperature Sensor</u>

Items
17. B306C Parking Assist Sensor - Front Right Middle (UFQ) B306C Parking Assist Sensor - Front Right Middle
18. B306D Parking Assist Sensor - Front Right Outer (UFQ) B306D Parking Assist Sensor - Front Right Outer
19. E4AD Park/Daytime Running Lamp - Right E4AD Park/Daytime Running Lamp - Right
20. B306L Parking Assist Sensor - Side Right Front (UKC) B306L Parking Assist Sensor - Side Right Front
21. E13RA Headlamp Assembly - Right

FRONT OF VEHICLE COMPONENTS (2 OF 2)

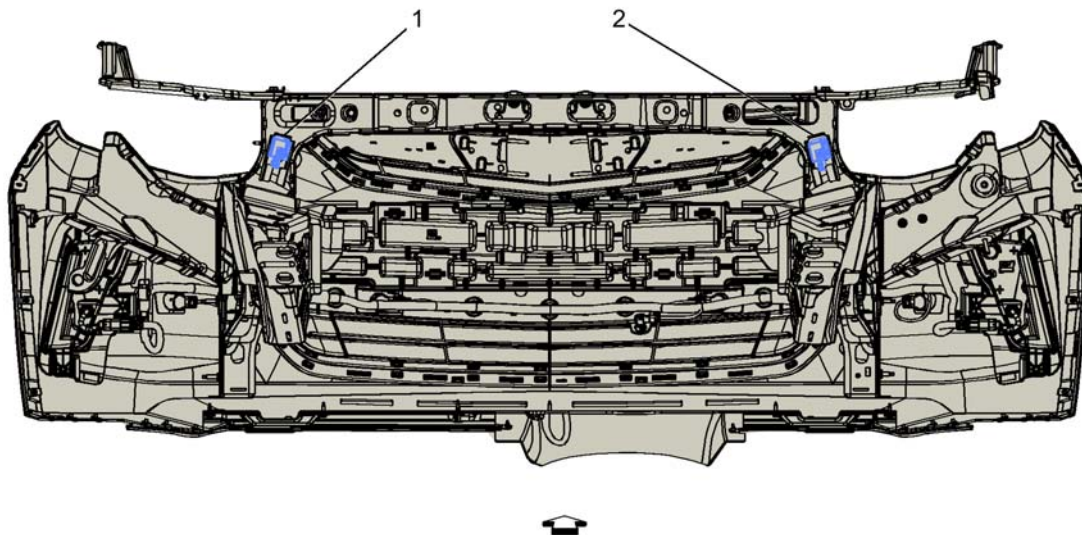


Fig. 9: Front of Vehicle Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B59L Front Impact Sensor - Left B59L Front Impact Sensor - Left
2. B59R Front Impact Sensor - Right B59R Front Impact Sensor - Right

LEFT FRONT OF VEHICLE COMPONENTS (1 OF 2)

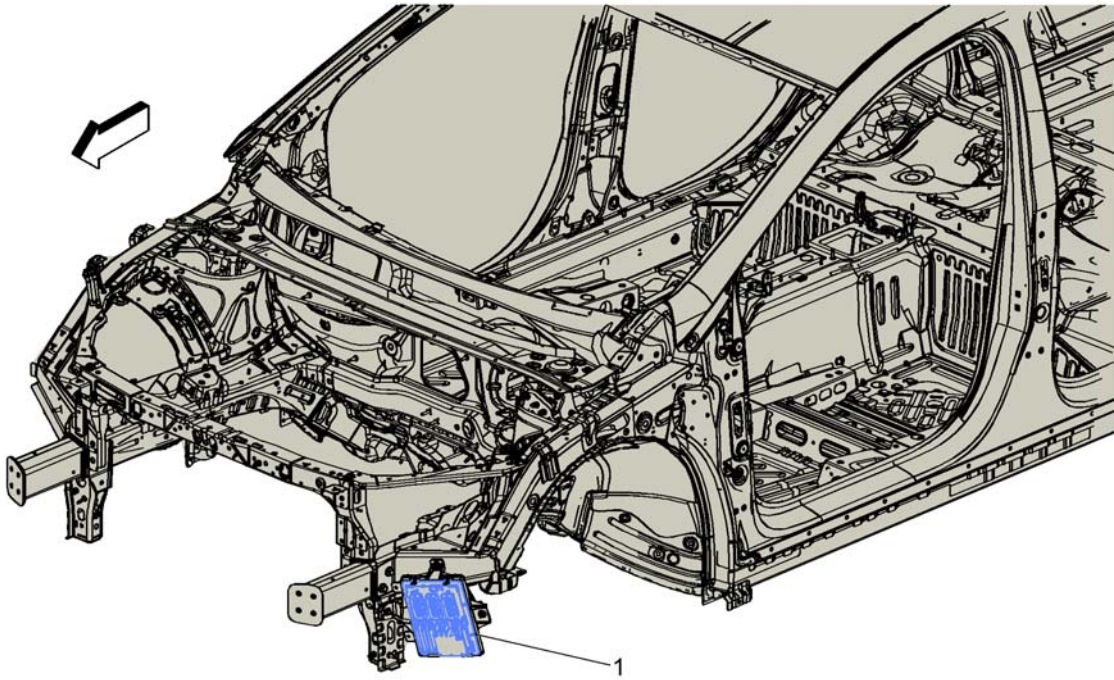


Fig. 10: Left Front of Vehicle Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K20 Engine Control Module <u>K20 Engine Control Module X1</u> <u>K20 Engine Control Module X2</u> <u>K20 Engine Control Module X3</u>

LEFT FRONT OF VEHICLE COMPONENTS (2 OF 2)

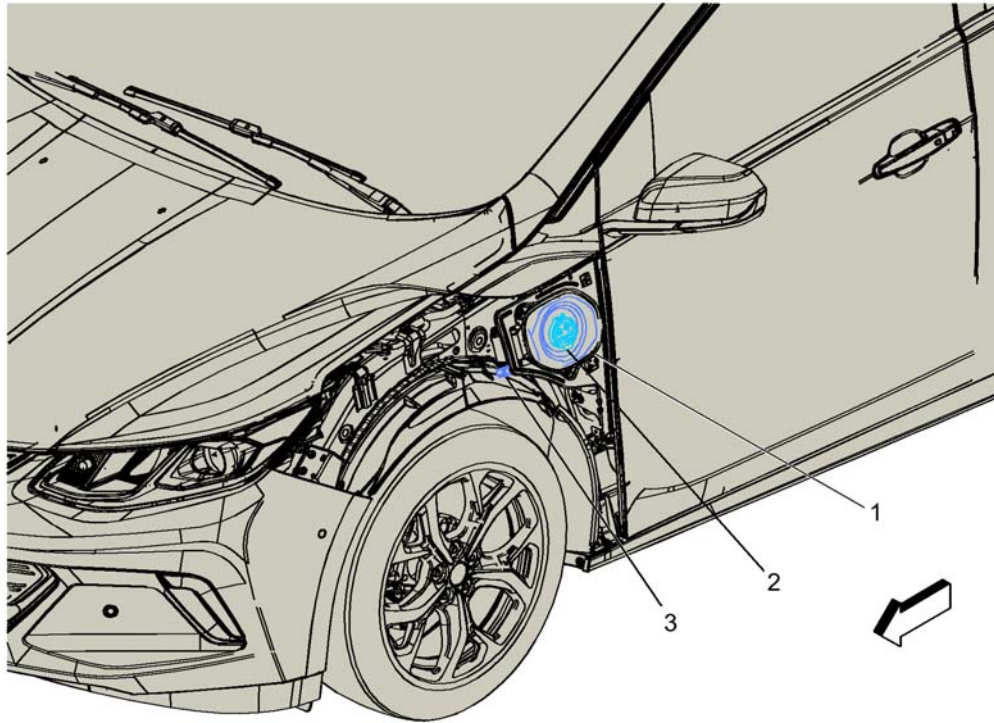


Fig. 11: Left Front of Vehicle Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X98 Hybrid/EV Battery Charger Receptacle <u>X98 Hybrid/EV Battery Charger Receptacle</u>
2. E85 Hybrid/EV Battery Charger Receptacle Accent Lamp
3. B197 Charge Port Door Position Switch <u>B197 Charge Port Door Position Switch</u>

RIGHT FRONT OF VEHICLE COMPONENTS

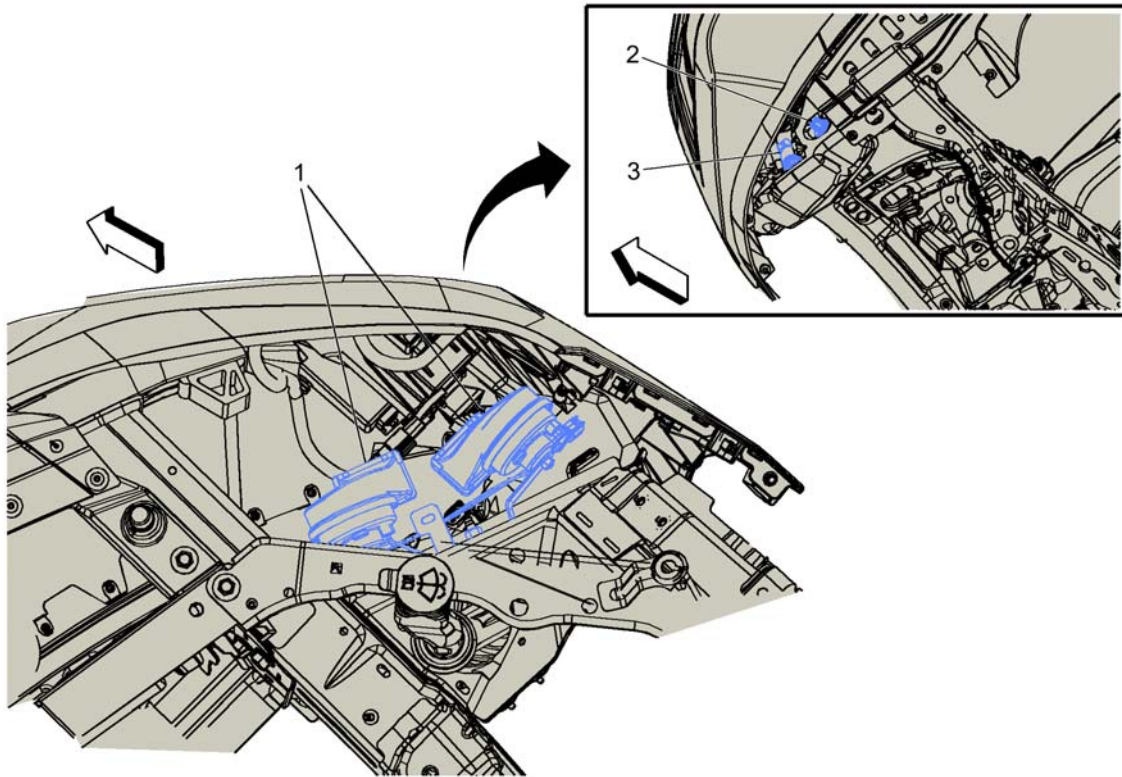


Fig. 12: Right Front of Vehicle Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. P12 Horn P12 Horn
2. B118B Windshield Washer Fluid Level Switch B118B Windshield Washer Fluid Level Switch
3. G24 Windshield Washer Pump G24 Windshield Washer Pump

Article GUID: A00884703

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Ground Views - Volt

GROUND VIEWS

G101

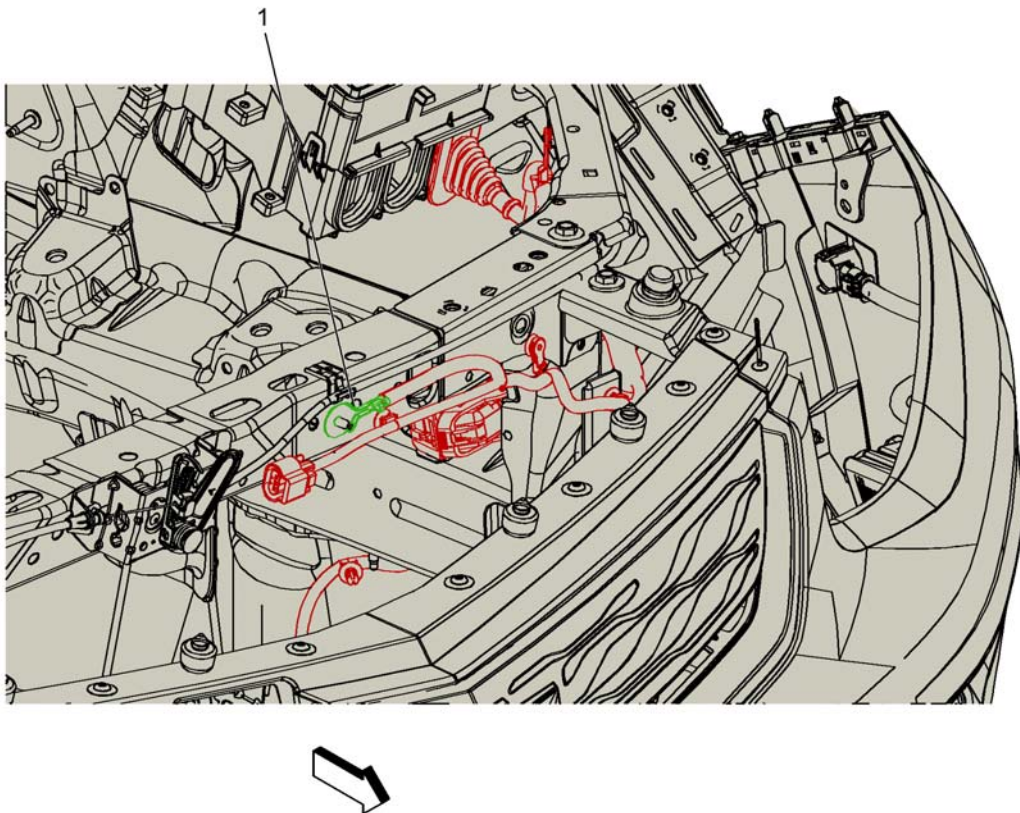


Fig. 1: G101

Courtesy of GENERAL MOTORS COMPANY

Items
1. G101

G102

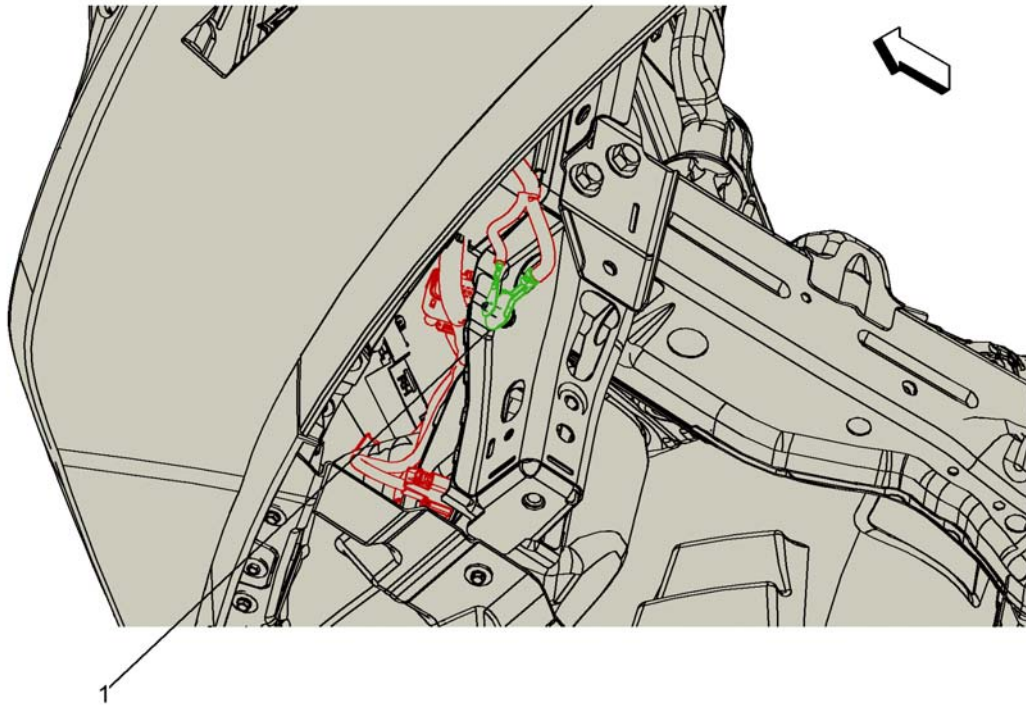


Fig. 2: G102

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G102	

G104 AND G113

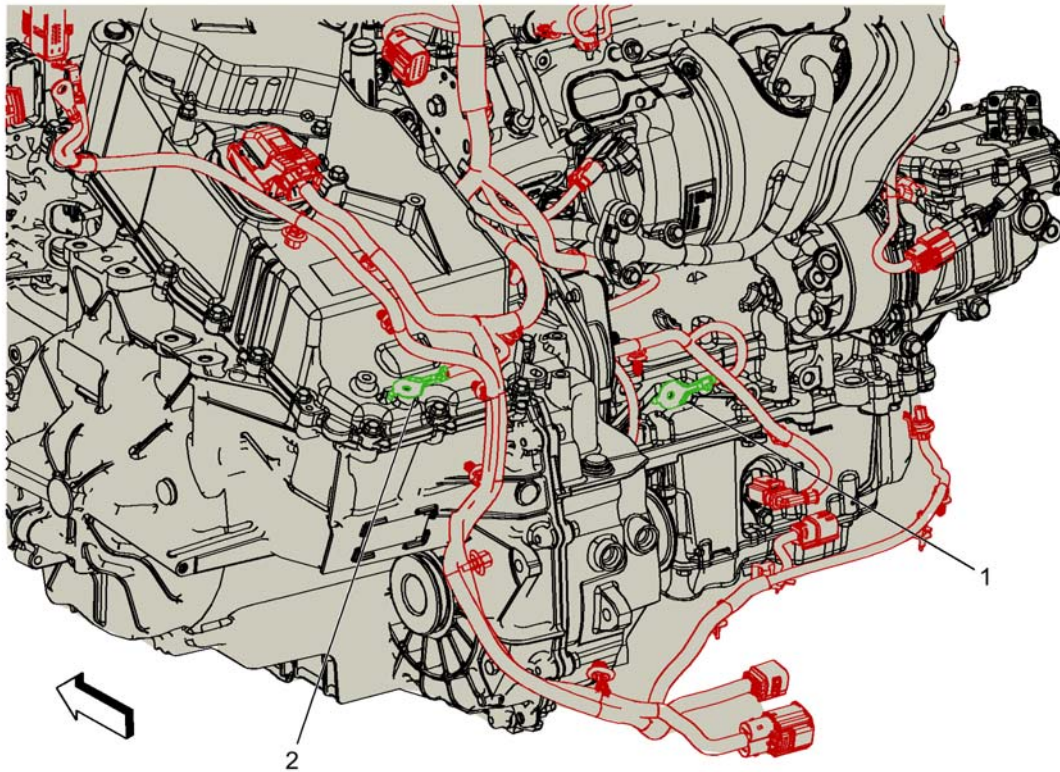


Fig. 3: G104 and G113

Courtesy of GENERAL MOTORS COMPANY

Items	
1.	G104
2.	G113

G105

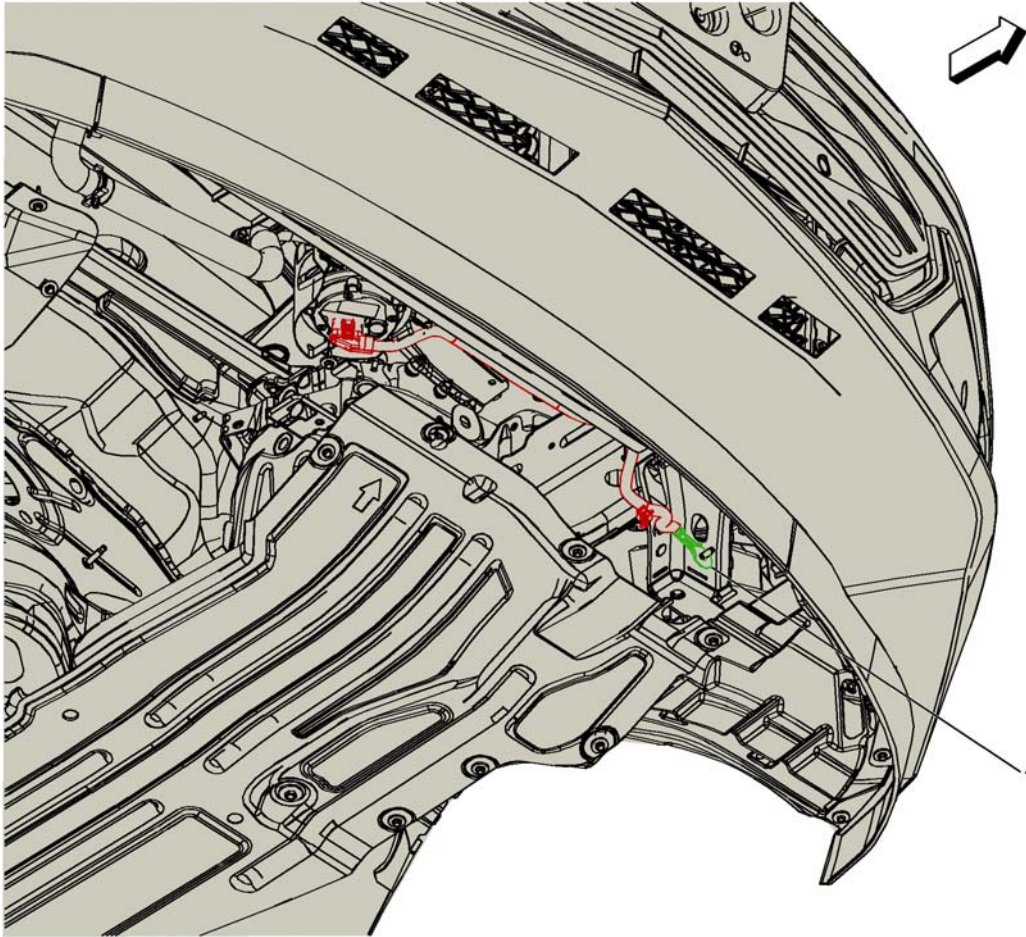


Fig. 4: G105

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G105	

G109

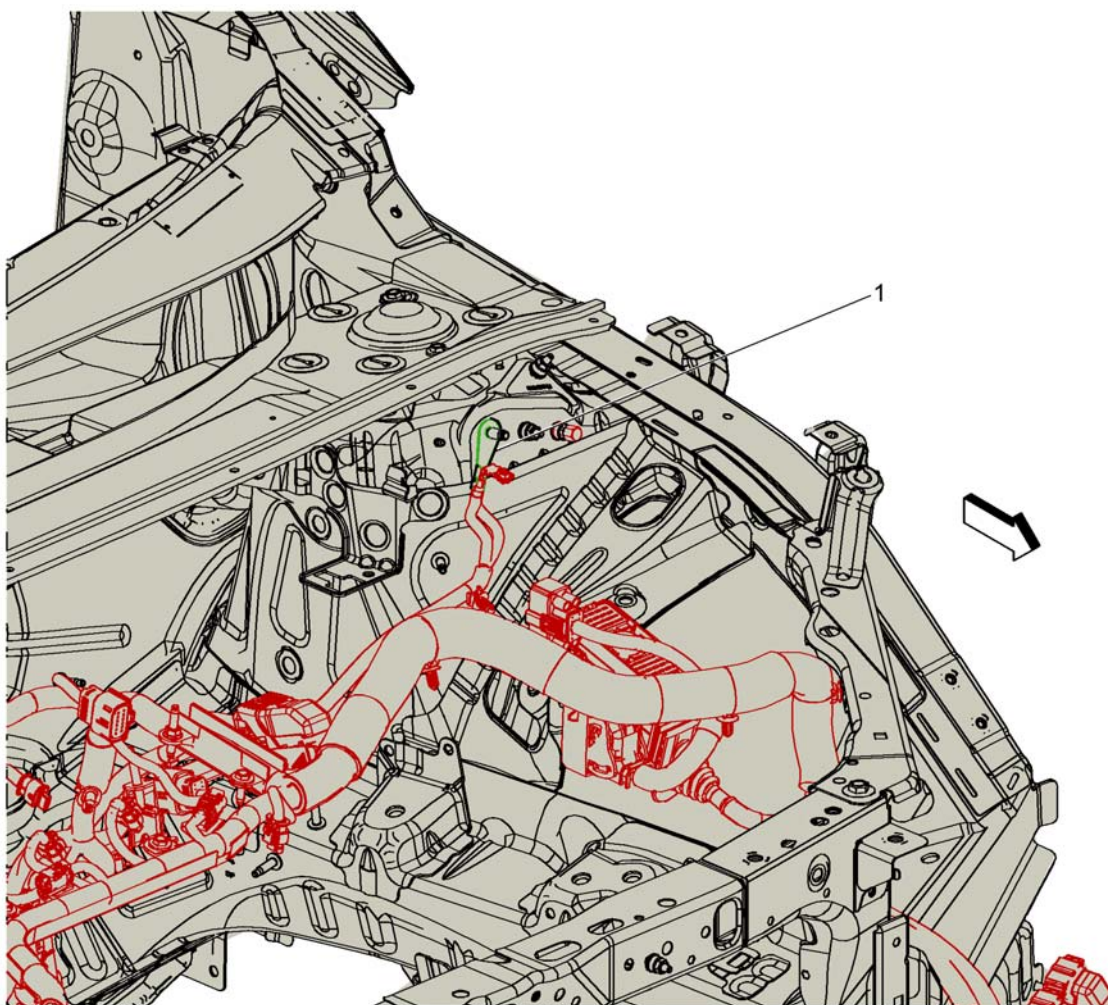


Fig. 5: G109

Courtesy of GENERAL MOTORS COMPANY

Items
1. G109

G110 AND G112

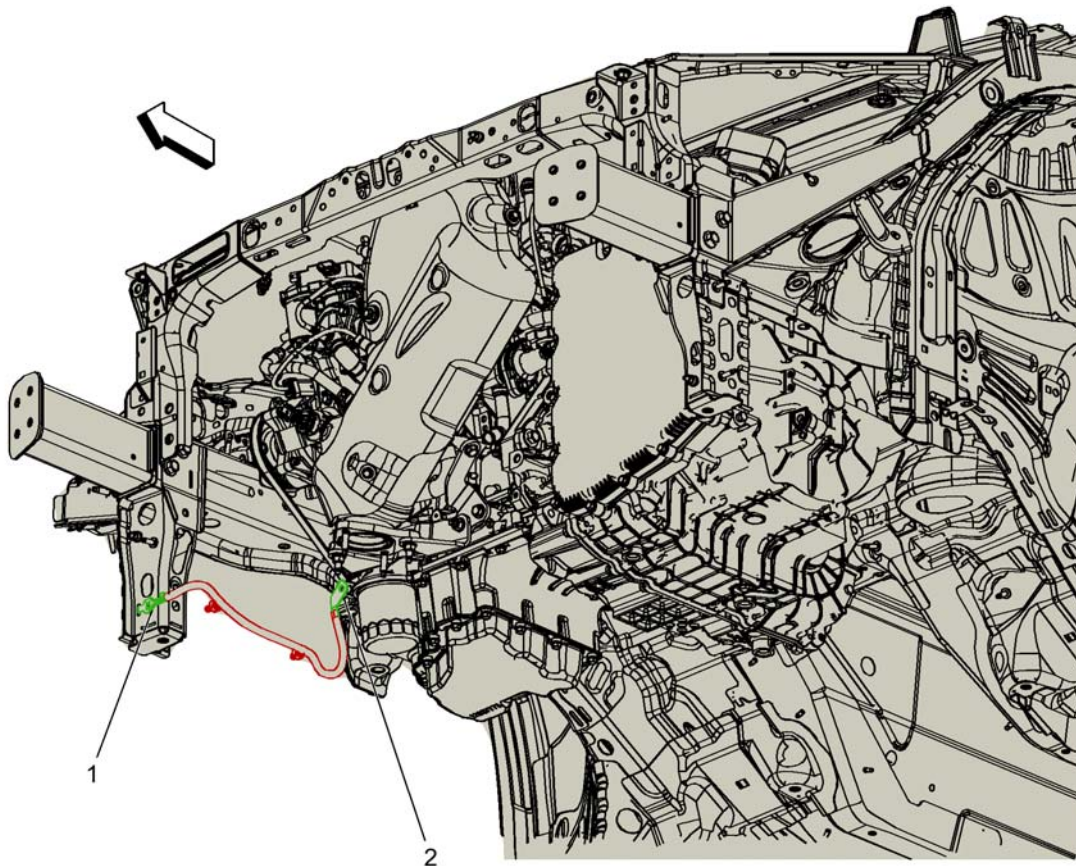


Fig. 6: G110 and G112

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G110	
2. G112	

G117

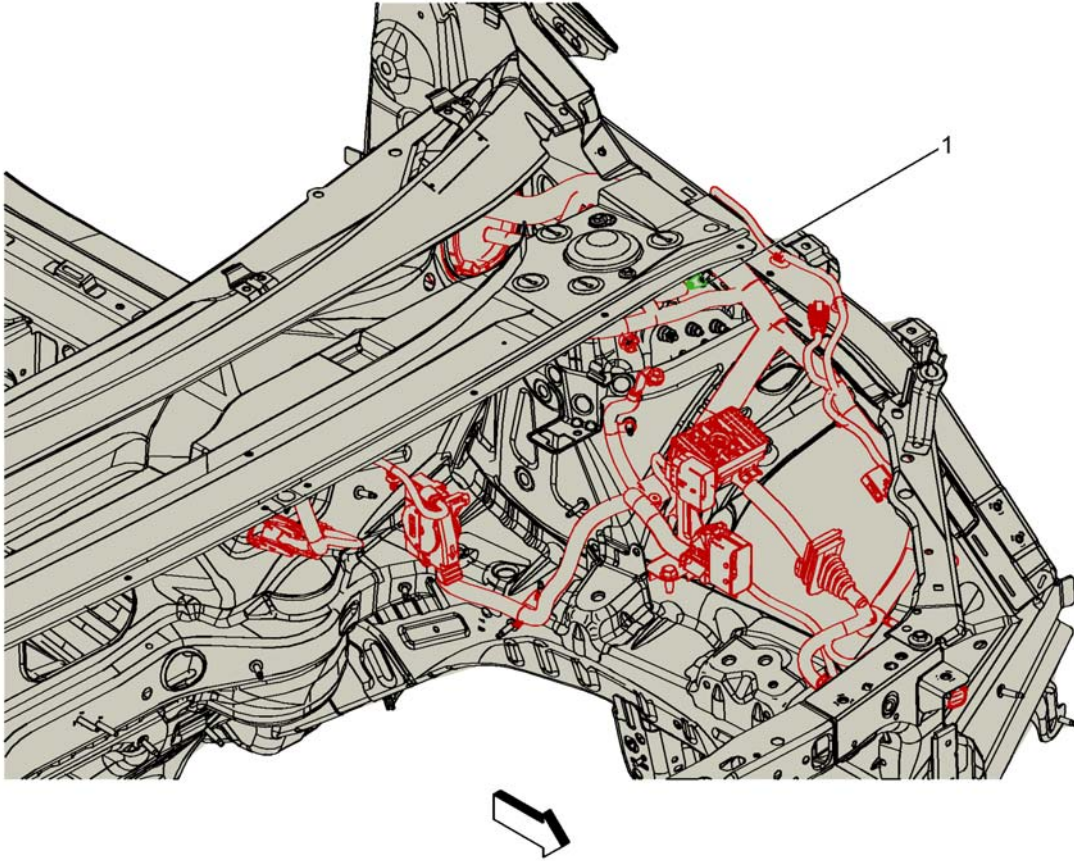


Fig. 7: G117

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G117	

G122

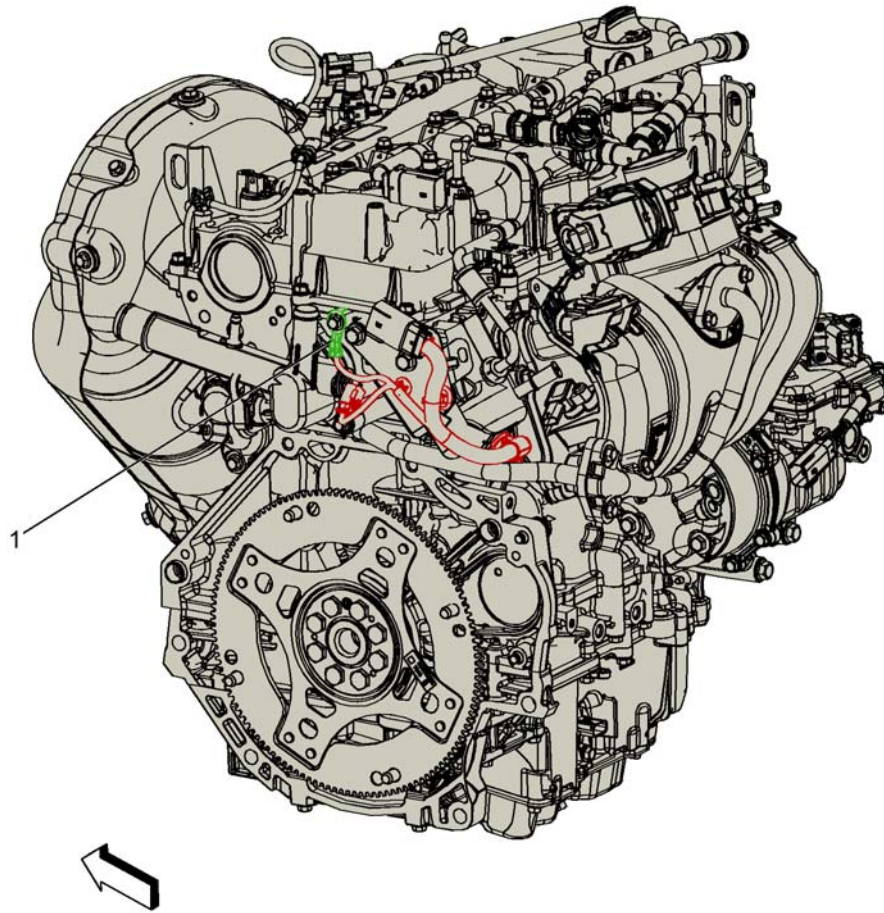


Fig. 8: G122

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G122	

G201 AND G204

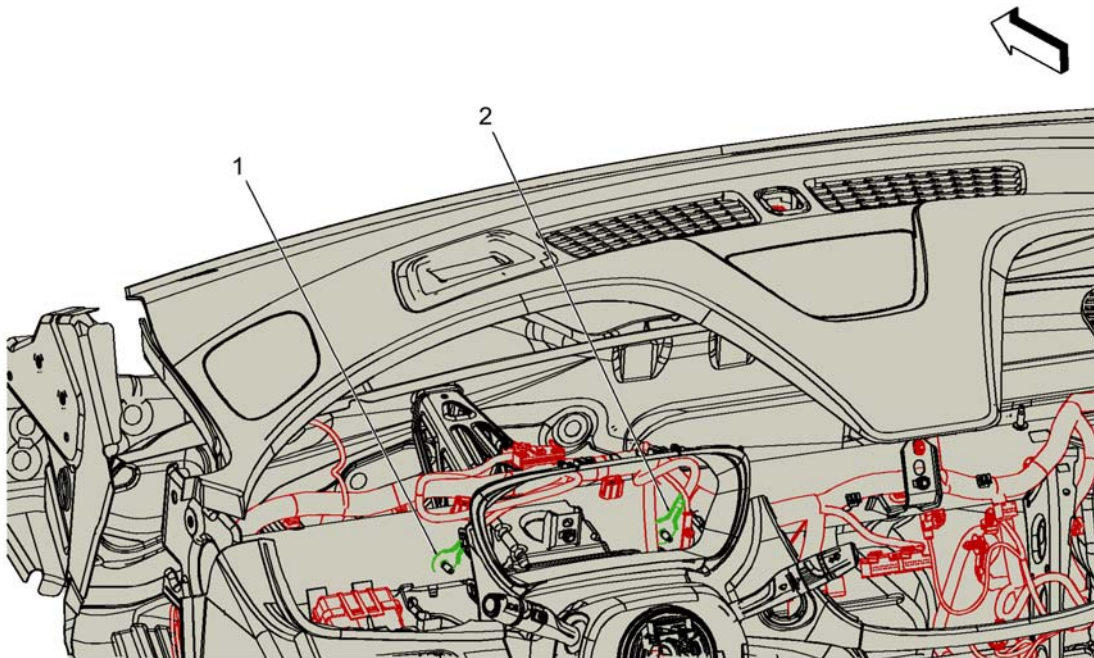


Fig. 9: G201 and G204

Courtesy of GENERAL MOTORS COMPANY

Items
1. G201
2. G204

G202

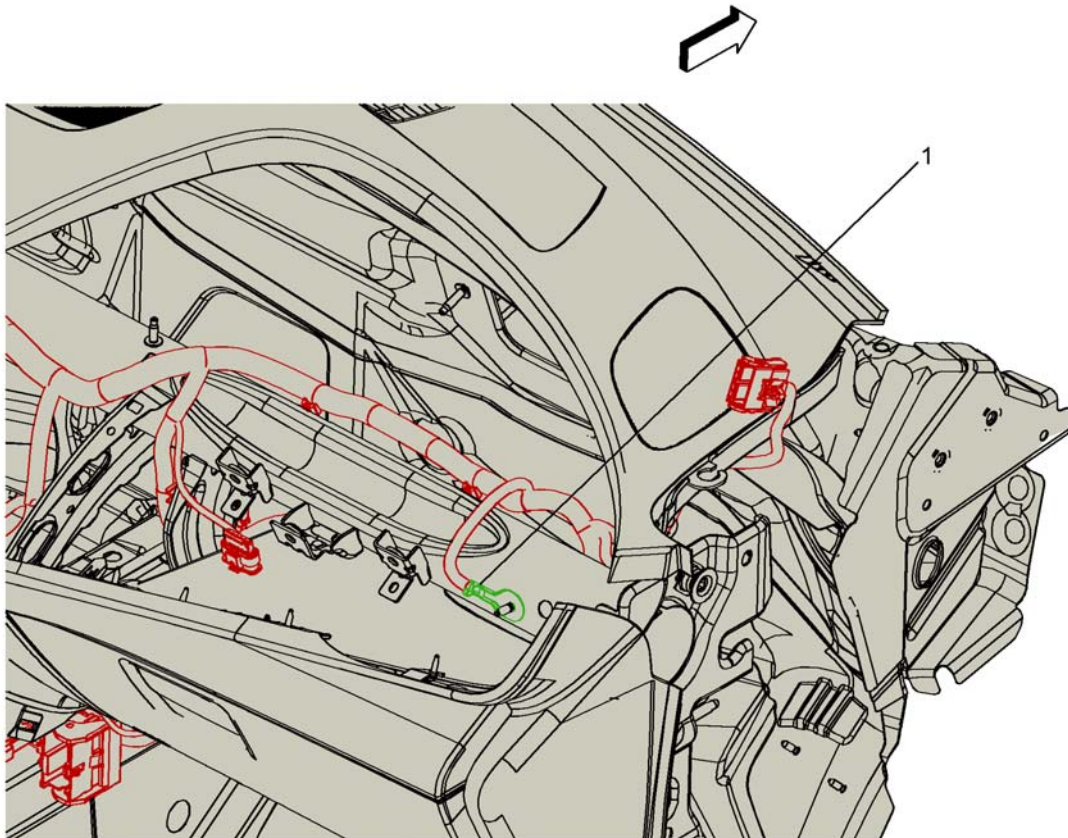


Fig. 10: G202

Courtesy of GENERAL MOTORS COMPANY

Items
1. G202

G205

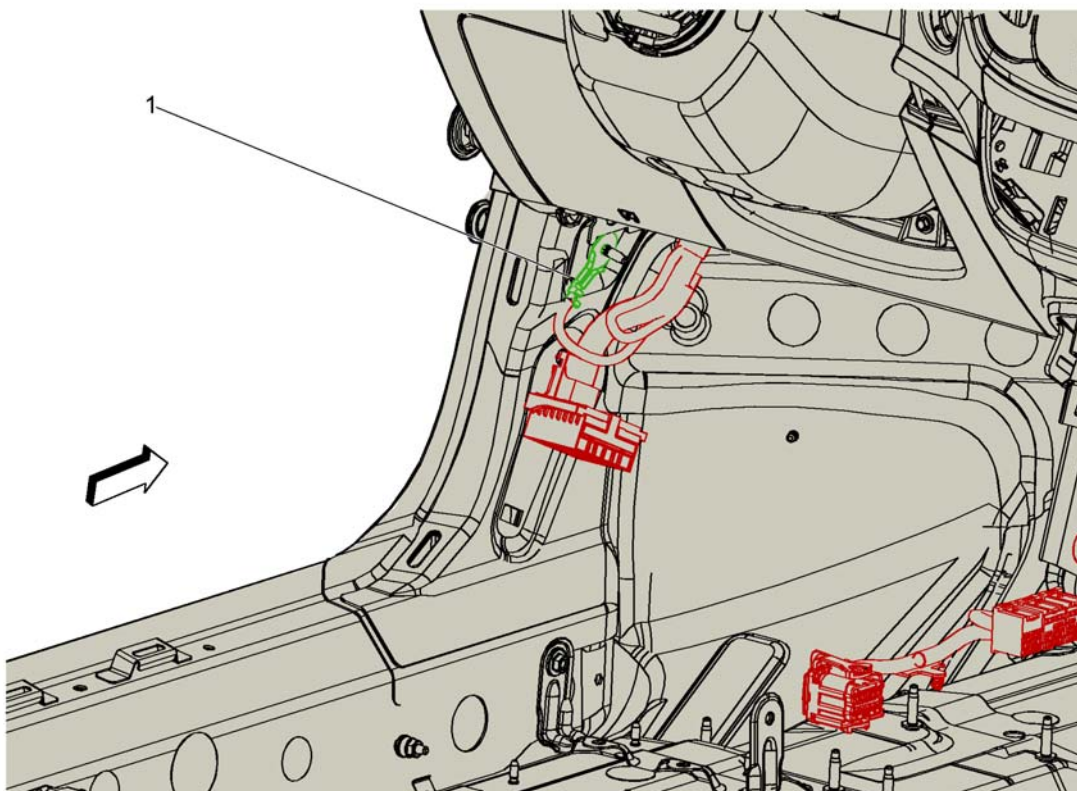


Fig. 11: G205

Courtesy of GENERAL MOTORS COMPANY

Items
1. G205

G301

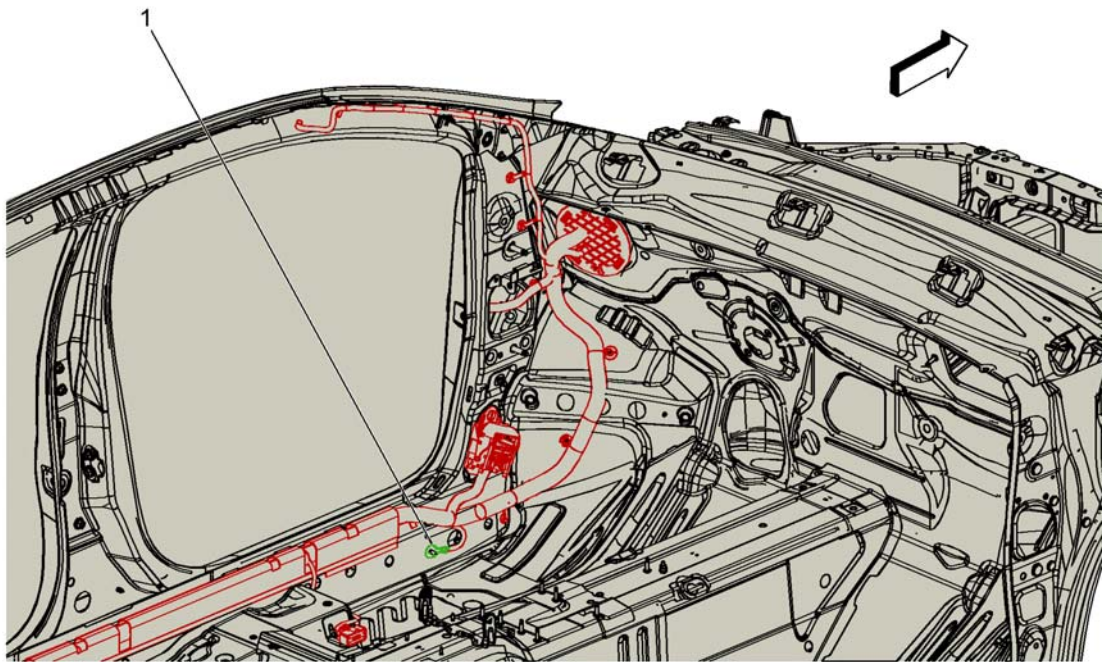


Fig. 12: G301

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G301	

G302

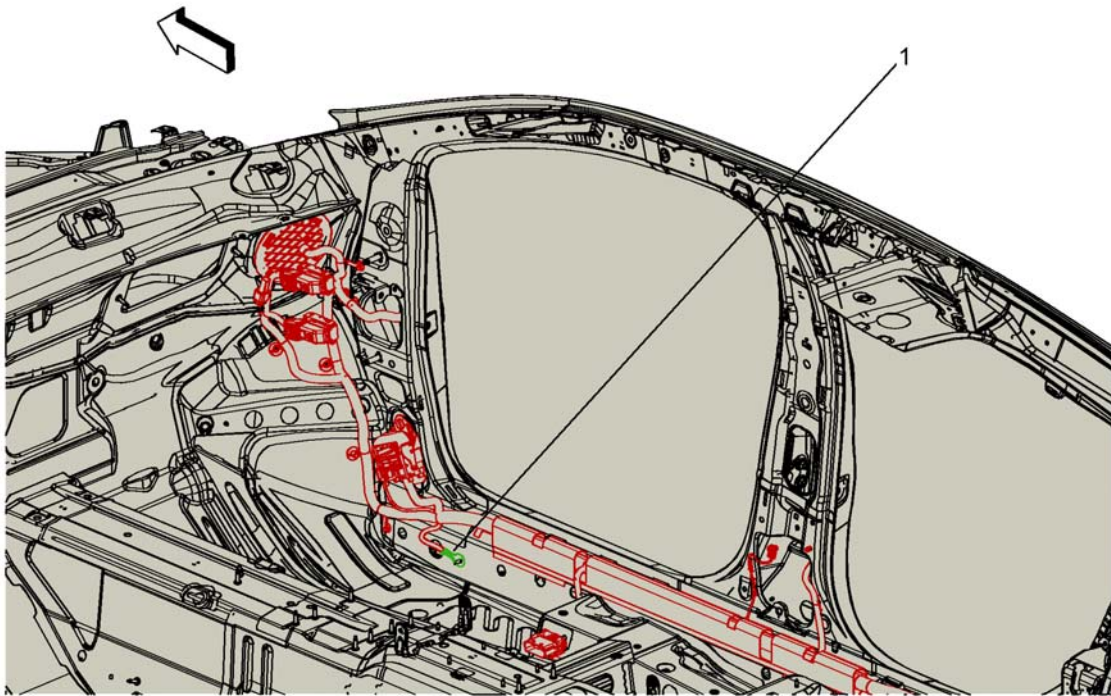


Fig. 13: G302

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G302	

G304

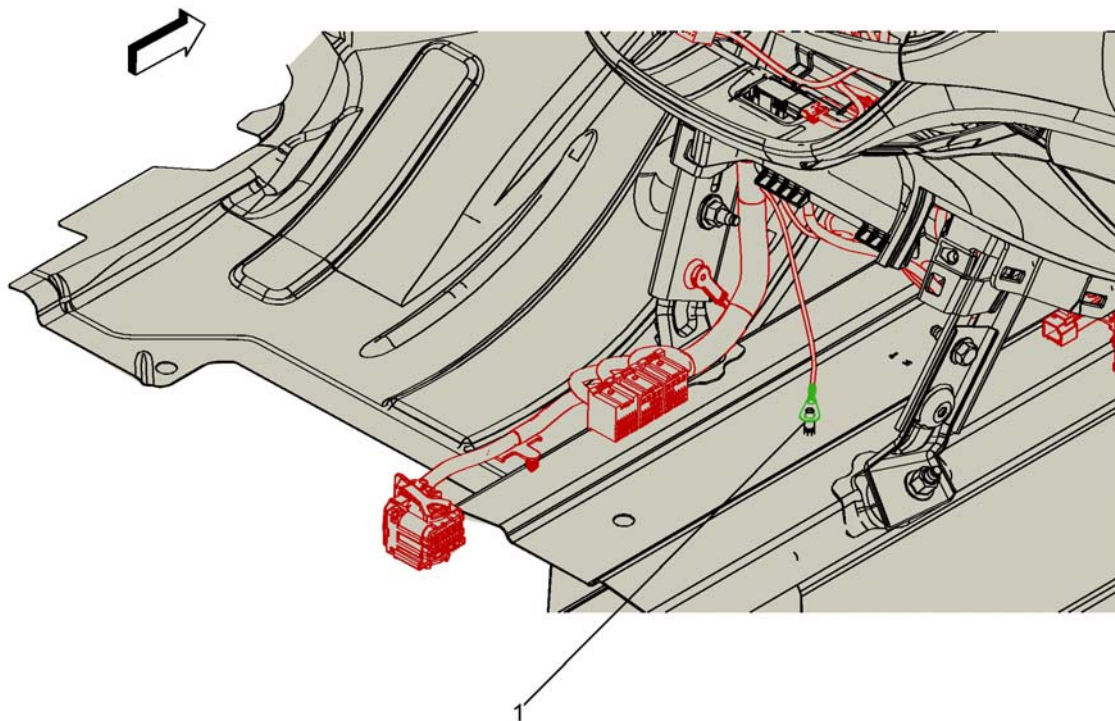


Fig. 14: G304

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G304	

G340 AND G341

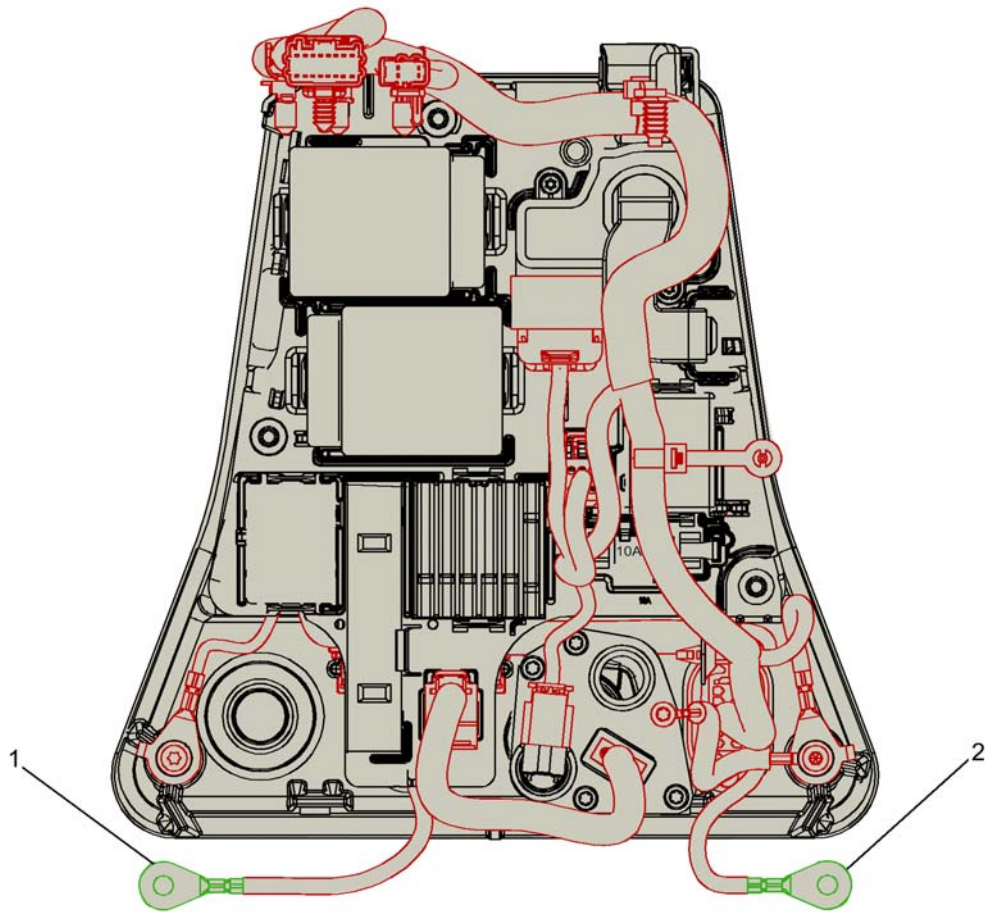


Fig. 15: G340 and G341

Courtesy of GENERAL MOTORS COMPANY

Items	
1.	G340
2.	G341

G403

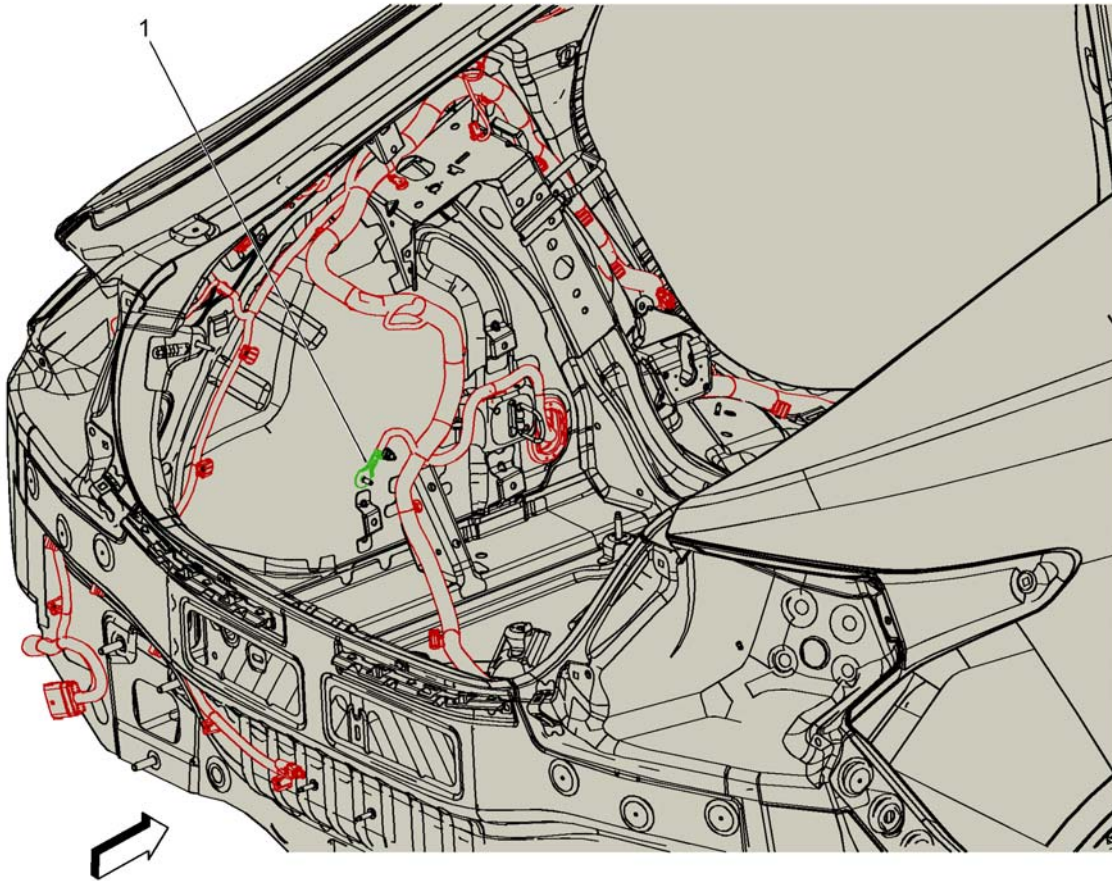


Fig. 16: G403

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G403	

G405

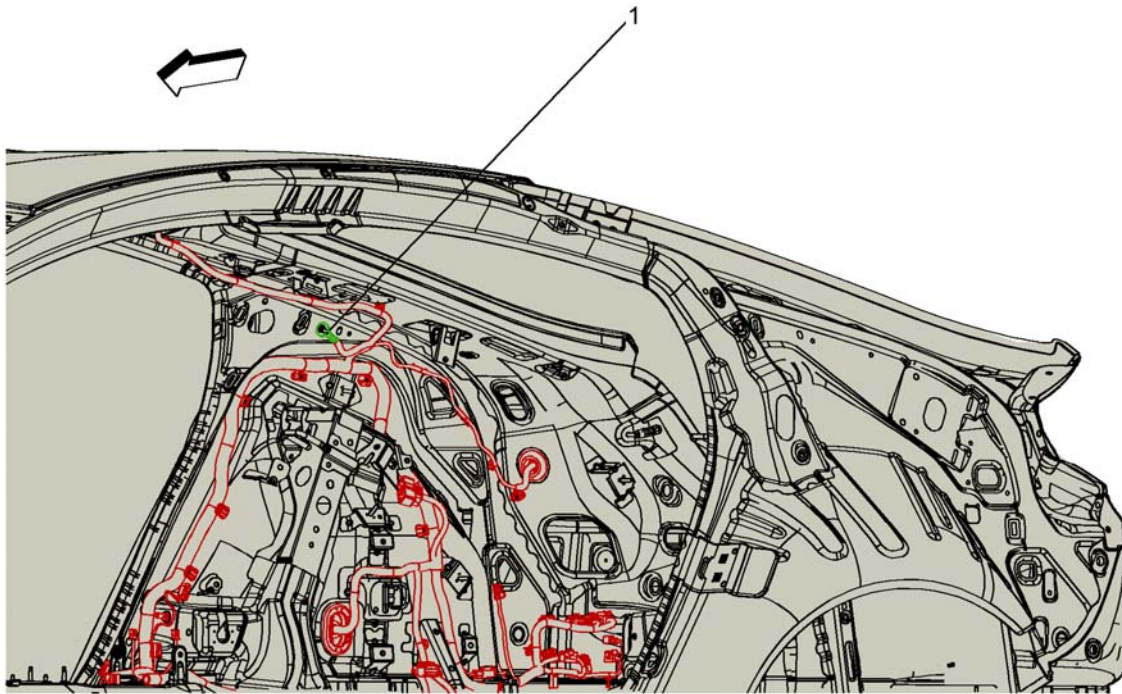


Fig. 17: G405

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G405	

G406

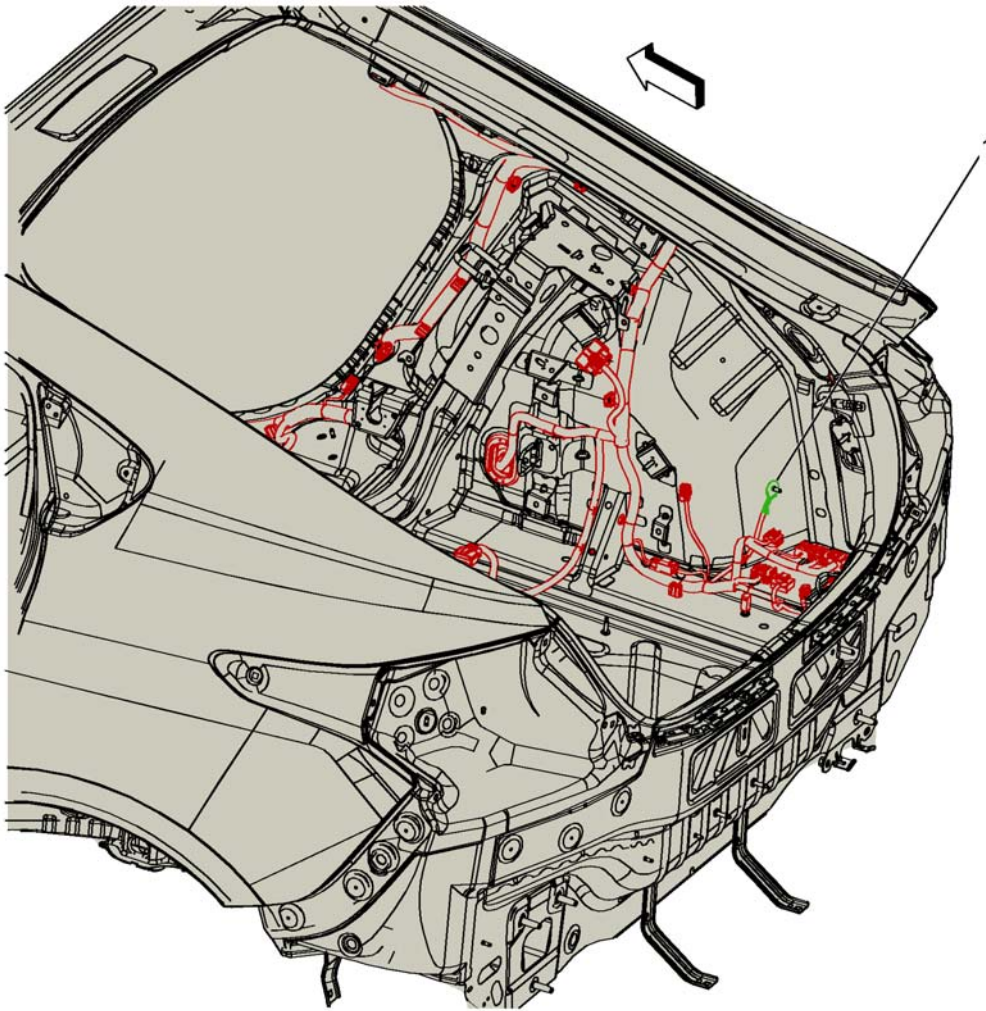


Fig. 18: G406

Courtesy of GENERAL MOTORS COMPANY

Items	
1.	G406

G408 AND G409

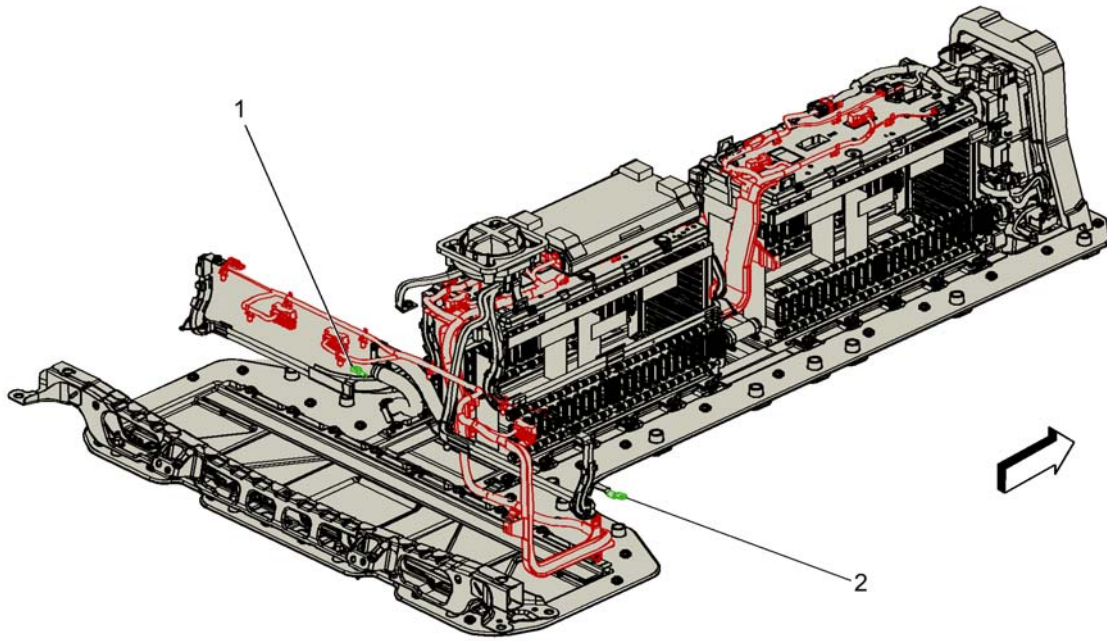


Fig. 19: G408 and G409

Courtesy of GENERAL MOTORS COMPANY

Items
1. G408
2. G409

Article GUID: A00884716

ELECTRICAL
Hybrid/EV Controls - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Accessory DC Power Control Module Bolt	22 N.m (16 lb ft)
Accessory DC Power Control Module Nut	22 N.m (16 lb ft)
Battery Positive and Negative Cable Nut (APM Ground Cable)	22 N.m (16 lb ft)
Battery Positive and Negative Cable Nut (B+ APM Module to Battery Fuse Block)	22 N.m (16 lb ft)

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV CONTROLS WIRING SCHEMATICS

Power, Ground and Data Communication

Fig. 2: Manual Drive Mode Select Interface
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Monitoring

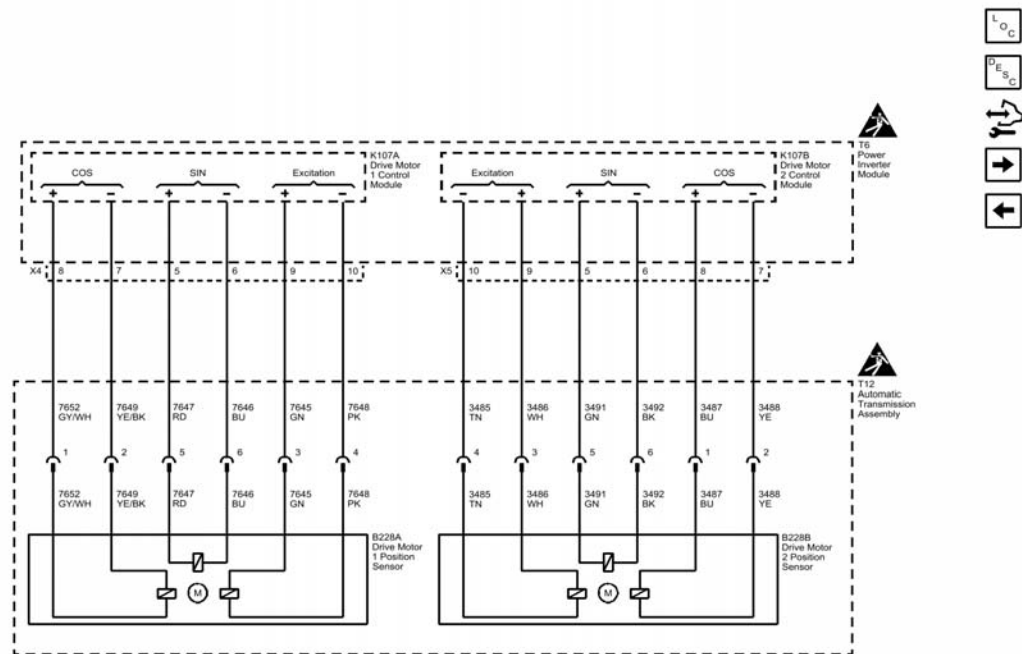


Fig. 3: Drive Motor Monitoring
Courtesy of GENERAL MOTORS COMPANY

Drive Motors and Auxiliary Transmission Fluid Pump Controls

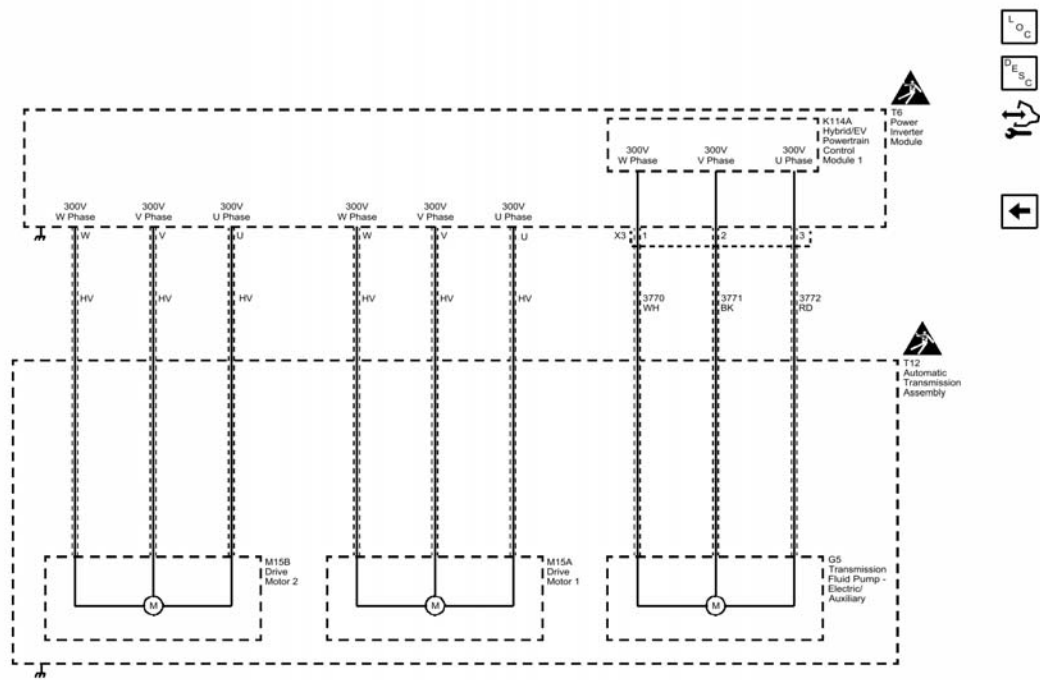


Fig. 4: Drive Motors and Auxiliary Transmission Fluid Pump Controls

Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

HYBRID CONTROLS ELECTRONIC COMPONENT VIEWS

Hybrid Control Electronic Component Views

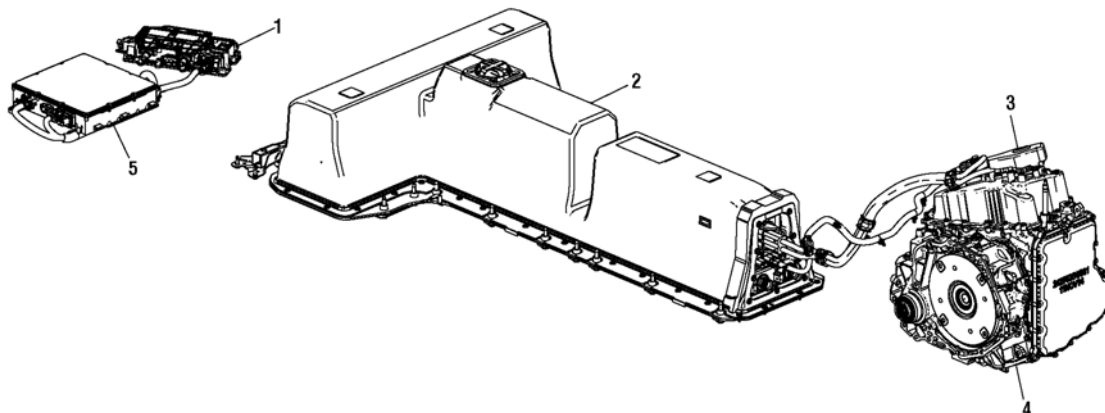


Fig. 5: Hybrid Control Electronic Component Views

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	K1 14 V Power Module

Callout	Component Name
2	High Voltage Battery
3	T6 Power Inverter Module
4	T12 Automatic Transmission Assembly
5	T18 Battery Charger

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0335 OR P0336: CRANKSHAFT POSITION SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Circuit/System Description

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The crankshaft position sensor is a magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of invisible magnetic segments on the edge of the crankshaft position reluctor ring mounted on the crankshaft. Each magnetic segment on the ring is spaced at a 60 segment spacing with 2 missing spaces for a reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency, with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal, which represents an image of the crankshaft reluctor ring, to the ECM as each segment on the ring rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft reluctor ring reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft, to control camshaft phasing, and to detect cylinder misfire.

The ECM also generates and sends a replicated signal over a dedicated line to the hybrid/EV powertrain control module 1.

The hybrid/EV powertrain control module 1 uses crankshaft speed and position to confirm internal combustion engine (ICE) status in various modes; for example to confirm Autostart and Autostop functionality. In addition to the signal sent over the dedicated line, this information is also sent from the ECM to the hybrid/EV powertrain control module 1 over serial data. The serial data status will be used by the hybrid/EV powertrain control module 1 in the event of a failure of this circuit.

Conditions for Running the DTC

P0335 or P0336

The vehicle is ON.

Conditions for Setting the DTC

P0335

No signal from the crank sensor for more than 1.4 seconds.

P0336

The signal from the crank sensor is invalid for more than 1.4 seconds.

OR

15 crankshaft sensor resync events occur in less than 10 seconds.

Action Taken When the DTC Sets

DTCs P0335 and P0336 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0335 and P0336 are Type B DTCs.

Diagnostic Aids

A high resistance ground for either the power inverter module, often referred to as the drive motor generator power inverter module, or the ECM may cause these DTCs to set intermittently. Inspect all grounds for good, secure connections.

Reference Information

Schematic Reference

- [Hybrid/EV Controls Schematics](#)
- [Engine Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-35616** Terminal Test Kit
- **EL-38522** Variable Signal Generator

Equivalent regional tools: Special Tools

Circuit/System Verification

1. Engine Running, observe the hybrid/EV powertrain control module Engine Speed parameter with a scan tool.
2. Verify the Engine Speed parameter displays the current engine speed, matching the tachometer and/or the ECM Engine Speed parameter.
 - **If the hybrid/EV powertrain control module Engine Speed parameter displays a value other than the current engine speed**

Refer to Circuit/System Testing.
 - **If the Engine Speed parameter displays a value matching the current engine speed**
3. All OK

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X2 harness connector at the K20 ECM.
3. Using the **EL 35616** terminal test kit, connect the **EL 38522** variable signal generator red lead to the Crankshaft 60X Sensor Signal circuit terminal 42 at the harness. Connect the **EL 38522** variable signal generator black lead to ground.
4. Set the **EL 38522** variable signal generator SIGNAL to 12 V, FREQUENCY to 30 Hz, and DUTY CYCLE to NORMAL, 50 percent. Plug power cord in to vehicle being tested or another power source.
5. Vehicle ON.

NOTE: **With the variable signal generator set at 30 Hz, the Crankshaft Position Resync Counter should cycle from 0 - 255 in 8.5 seconds.**

6. Verify with a scan tool the hybrid/EV powertrain control module Crankshaft Position Resync Counter parameter displays a constantly changing value.
 - **If parameter does not display a constantly changing value**
 1. Vehicle OFF, disconnect **EL 38522** variable signal generator red and black leads, disconnect the X1 harness connector at the T6 power inverter module, vehicle ON.
 2. Test for less than 1 V between the signal circuit terminal 29 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for infinite resistance between the signal circuit terminal 29 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
5. Test for less than 2 Ω in the signal circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the T6 power inverter module.
 - **If parameter displays a constantly changing value**

7. Replace the K20 ECM.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Refer to [Control Module References](#) for engine control module or T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0506 OR P0507: IDLE SPEED LOW/HIGH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0506

Idle Speed Low

DTC P0507

Idle Speed High

Circuit/System Description

The hybrid/EV powertrain control module 1 determines the engine idling speed which varies based on the hybrid/EV battery pack state of charge. The engine control module (ECM) achieves throttle positioning by providing a pulse width modulated voltage to the throttle actuator motor. The throttle blade is spring loaded in both directions, and the default position is slightly open. The hybrid/EV powertrain control module 1 can detect a condition where the engine is cranking but does not start or has stalled, or if the engine speed does not match the commanded speed.

The throttle actuator control (TAC) motor is controlled by the ECM. The DC motor located in the throttle body drives the throttle blade. In order to decrease engine speed, along with spark and fuel delivery changes the ECM commands the throttle closed reducing air flow into the engine and the engine speed decreases. In order to increase engine speed, the ECM commands the throttle plate open allowing more air to pass the throttle plate. If the hybrid/EV powertrain control module 1 detects the actual engine speed is not within a predetermined range of the commanded engine speed, this DTC sets.

Conditions for Running the DTC

P0506

- DTCs P0722, P077B, P0A3F, P0A40, P0A45, P0A46, P0C52, P0C53, P0C57, P0C58, P0C5C, P0C5D, P0C61, P0C62, P1B03, P1B04, P215C are not set.
- The system voltage is greater than 9 volts.

- The accelerator pedal position is valid.
- The accelerator pedal position is less than 1 percent.
- The engine has been running for greater than 60 seconds.
- The vehicle speed is less than 2 km/h (1.2 mph).
- The engine coolant temperature (ECT) is 60Â°C (140Â°F) or greater.
- The commanded engine speed is steady within 50 RPM.

P0507

- The commanded engine speed is steady within 25 RPM.
- A scan tool output control is not active.
- DTCs P0506 or P0507 run continuously when the above conditions are met for greater than 10 seconds.

Conditions for Setting the DTC

P0506

The actual engine speed is at least 91 RPM less than the commanded engine speed.

P0507

The actual engine speed is at least 182 RPM greater than the commanded engine speed.

Action Taken When the DTC Sets

DTCs P0506 and P0507 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0506 and P0507 are Type B DTCs.

Diagnostic Aids

- A stalling condition can cause DTC P0506 to set.
- An intermittent vehicle speed sensor (VSS) signal can cause DTC P0507 to set.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no other DTCs are set.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**

2. Verify none of the conditions listed below exist:

P0506

- Excess deposits in the Q38 Throttle Body. Refer to Throttle Body Inspection and Cleaning .
- Restricted exhaust
- Mechanical conditions that limit engine speed
- Parasitic load on the engine - For example, a transmission condition, a belt driven accessory condition.
- **If a condition exists**

Repair as necessary.

- **If no condition exists**

3. All OK

P0507

- Vacuum leaks
- A throttle valve that does not close correctly
- Verify the correct operation of the crankcase ventilation system. Inspect for the following conditions:
 - The routing of the positive crankcase ventilation (PCV) system
 - Vacuum leaks in the PCV system
- **If a condition exists**

Repair as necessary.

- **If no condition exists**

4. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P0601-P0604, P0606, P062F, P1EB6, OR P1EB7: CONTROL MODULE (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P1EB6

Drive Motor 1 Control Module Long Term Memory Reset

DTC P1EB7

Drive Motor 2 Control Module Long Term Memory Reset

Circuit/System Description

This is an internal fault detection of the hybrid/EV powertrain control module 1 or drive motor control modules. The hybrid/EV powertrain control module 1 and both drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and not serviced separately. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0601 - P0604, P0606, P061A, P061B, P1EB6, and P1EB7 are Type A DTCs.
- DTC P062F is a Type B DTC.

- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

- DTCs P0601 - P0604, P0606, P061A, P061B, P1EB6, and P1EB7 are Type A DTCs.
- DTC P062F is a Type B DTC.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.

- **If the DTC is set**

Refer to [DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC](#) .

- **If the DTC is not set**

3. Verify DTC P0601, P0602, P0603, P0604, P0606, P061A, P061B, P062F, P1EB6, or P1EB7 is not set.

- **If any of the DTCs are set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P061A OR P061B: CONTROL MODULE TORQUE SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P061A

Control Module Torque System Circuitry Performance

DTC P061B

Control Module Torque Calculation Performance

Circuit/System Description

The hybrid/EV powertrain control module 1 is responsible for vehicle torque management. To accomplish this, the hybrid/EV powertrain control module 1 constantly monitors all aspects of requested and actual delivered torque from involved controllers. If a torque management fault is detected, propulsion power will be reduced or shut down. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the power inverter module and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P061A or P061B are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P061A and P061B are Type A DTCs.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.

- **If the DTC is set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .

- **If the DTC is not set**

3. Verify DTC P061A or P061B is not set.

- **If any of the DTCs are set**

Replace the T6 Power Inverter Module.

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P06AF: TORQUE MANAGEMENT SYSTEM PERFORMANCE - FORCED ENGINE SHUTDOWN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P06AF

Torque Management System Performance - Forced Engine Shutdown

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors a state of health message that the ECM transmits to verify the ECM is functioning properly. The hybrid/EV powertrain control module 1 is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 does not detect a valid state of health message from the ECM.

Action Taken When the DTC Sets

- DTC P06AF is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P06AF is a Type A DTC.

Reference Information

Schematic Reference

- [Hybrid/EV Controls Schematics](#)
- [Engine Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0606 is not set.
 - **If the DTC is set**

Refer to [DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 \(Hybrid/EV Powertrain Control Module 1\)](#).

- **If the DTC is not set**
3. Verify DTC P06AF is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.

- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, continue to Circuit/System Testing.
 - If the DTC does not set.

4. All OK.

- **If the DTC is not set**

4. All OK.

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

1. Vehicle OFF.
2. Disconnect the X1 harness connector at the T6 Power Inverter Module and disconnect the X1 harness at the K20 ECM.
3. Test for less than 2 Ω on the serial data circuits listed below end to end.
 - T6 Power Inverter Module X1 connector terminal 33 to K20 ECM X1 connector terminal 8
 - T6 Power Inverter Module X1 connector terminal 34 to K20 ECM X1 connector terminal 7
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

 - **If less than 2 Ω**
4. Replace the K20 ECM.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Replace the T6 Power Inverter Module.

 - **If the DTC does not set**
7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K20 ECM or T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P06B1, P06B2, P06B4, P06B5, P06E7, OR P06E8: SENSOR SUPPLY VOLTAGE CIRCUIT(S) 1-3 VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P06B1

Sensor Supply Voltage Circuit 1 Low Voltage

DTC P06B2

Sensor Supply Voltage Circuit 1 High Voltage

DTC P06B4

Sensor Supply Voltage Circuit 2 Low Voltage

DTC P06B5

Sensor Supply Voltage Circuit 2 High Voltage

DTC P06E7

Sensor Supply Voltage Circuit 3 Low Voltage

DTC P06E8

Sensor Supply Voltage Circuit 3 High Voltage

Circuit/System Description

The Hybrid/EV powertrain control module 1 and motor control modules share an internal 15 V reference power supply in order to operate the drive motor sensors processors. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved. The control modules listed below are part of the power inverter module and are not serviced separately:

- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8 - 18 V.

Conditions for Setting the DTC

P06B1, P06B4, or P06E7

The reference voltage is less than 12 V for 1 s.

P06B2, P06B5, or P06E8

The reference voltage is greater than 22 V for 1 s.

Actions Taken When the DTC Sets

- DTCs P06B1, P06B2, P06B4, P06B5, P06E7, and P06E8 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Actions Taken When the DTC Sets

DTCs P06B1, P06B2, P06B4, P06B5, P06E7, and P06E8 are Type A DTCs.

Diagnostic Aids

This DTC may set due to low 12 V system voltage.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8 is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK
 - **If none of the DTCs are set**

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A1B OR P0A1C: DRIVE MOTOR 1-2 CONTROL MODULE PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A1B

Drive Motor 1 Control Module Performance

DTC P0A1C

Drive Motor 2 Control Module Performance

Circuit/System Description

The power inverter module is often referred to as the drive motor generator power inverter module. This is a fault detection of the power inverter module's internal motor control modules. This fault is handled inside the power inverter module; no external circuits are involved. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0A1B and P0A1C are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0A1B and P0A1C are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A1B or P0A1C is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 3. All OK
 - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, OR P1B03: DRIVE MOTOR 1 POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A3F

Drive Motor 1 Position Sensor Circuit

DTC P0A40

Drive Motor 1 Position Sensor Performance

DTC P0C52

Drive Motor 1 Position Sensor Circuit 1 Low Voltage

DTC P0C53

Drive Motor 1 Position Sensor Circuit 1 High Voltage

DTC P0C5C

Drive Motor 1 Position Sensor Circuit 2 Low Voltage

DTC P0C5D

Drive Motor 1 Position Sensor Circuit 2 High Voltage

DTC P1B03

Drive Motor 1 Position Sensor Circuit Tracking Lost

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Excitation Reference Circuit*	P0A3F	P0A3F	P0A3F	P0A40, P1B03
COS Signal* - Circuit	P0A3F, P0C52	P0A3F	P0A3F, P0C53	P0A40, P1B03
SIN Signal* - Circuit	P0A3F, P0C5C	P0A3F	P0A3F, P0C5D	P0A40, P1B03
*Represents a differential circuit consisting of a pair of wires. See Circuit/System Description and schematic for detailed description.				

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils, and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for return signals, often referred to as Sine and Cosine waveforms, abbreviated SIN and COS. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coil signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor. The drive motor 1 position sensor is serviceable separately from the drive motor assembly.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P0C52, P0C5C

Circuit voltage is less than 0.5 V.

P0C53, P0C5D

Circuit voltage is greater than 4.5 V.

P0A3F

SIN or COS signal is less than 2.3 V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A40

SIN or COS signal is greater than 4 V. The motor control module detects a degraded motor position sensor signal.

P1B03

The motor control module is unable to track the motor position based upon the sensor signals.

Action Taken When the DTC Sets

P0A3F, P0A40, P1B03

- DTCs P0A3F, P0A40, and P1B03 are Type A DTCs.
- Vehicle propulsion will be disabled.

P0C52, P0C53, P0C5C, P0C5D

DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0A3F, P0A40, and P1B03 are Type A DTCs.
- DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Diagnostic Aids

The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.

In the case of intermittent concerns, clearing DTC information and returning the vehicle to the customer without a repair is not appropriate. Contact technical assistance when the cause of an intermittent concern cannot be identified.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

DT-44152 Jumper Harness

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury

or death.

NOTE: If the position sensor or wiring harness circuits fail the circuit tests, replace the component; do not repair.

1. Disable High Voltage, refer to [High Voltage Disabling](#) .
2. Remove the Drive Motor Power Inverter Module Cover, refer to [Drive Motor Power Inverter Module Cover Replacement](#) .
3. Vehicle OFF, disconnect the X4 harness connector at the T6 Power Inverter Module.
4. Test for greater than 10,000 Ω between the terminals listed below and ground:
 - Excitation Reference circuit terminal 9 X4
 - Excitation Reference circuit terminal 10 X4
 - SIN Signal circuit terminal 5 X4
 - SIN Signal circuit terminal 6 X4
 - COS Signal circuit terminal 7 X4
 - COS Signal circuit terminal 8 X4
 - **If less than 10,000 Ω**
 1. Remove the transmission, refer to [Transmission Replacement](#) .
 2. Disconnect the connector at the B228B Drive Motor 1 Position Sensor, refer to [Drive Motor Removal - 1st Position](#) .
 3. Test for less than 10,000 Ω between the appropriate harness terminal and ground.
 - If less than 10,000 Ω , replace the transmission wiring harness assembly.
 - If greater than 10,000 Ω , replace the B228B Drive Motor 1 Position Sensor.
 - **If greater than 10,000 Ω**
5. Test for 4.0 - 25 Ω between the terminals listed below:
 - Excitation Reference circuit terminal 10 and Reference circuit terminal 9
 - COS Signal circuit 1 terminal 7 and Signal circuit 1 terminal 8
 - SIN Signal circuit 2 terminal 5 and Signal circuit 2 terminal 6
 - **If not within the specified range**
 1. Disconnect the connector at the B228B Drive Motor 1 Position Sensor.
 2. Test for 4.0 - 25 Ω between the connector terminals listed below:
 - Excitation Reference circuit terminal 3 and Excitation Reference circuit terminal 4
 - COS Signal circuit terminal 1 and COS Signal circuit terminal 2
 - SIN Signal circuit terminal 5 and SIN Signal circuit terminal 6
 - If within the specified range, replace the transmission wiring harness assembly.
 - If not within the specified range, replace the B228B Drive Motor 1 Position Sensor.
 - **If within the specified range**
6. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Power Inverter Module Cover Replacement](#)
- Refer to [Drive Motor Disassemble - 1st Position](#) for B228A Drive Motor 1 Position Sensor replacement

- Refer to [Automatic Transmission Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup

DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, OR P1B04: DRIVE MOTOR 2 POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A45

Drive Motor 2 Position Sensor Circuit

DTC P0A46

Drive Motor 2 Position Sensor Performance

DTC P0C57

Drive Motor 2 Position Sensor Circuit 1 Low Voltage

DTC P0C58

Drive Motor 2 Position Sensor Circuit 1 High Voltage

DTC P0C61

Drive Motor 2 Position Sensor Circuit 2 Low Voltage

DTC P0C62

Drive Motor 2 Position Sensor Circuit 2 High Voltage

DTC P1B04

Drive Motor 2 Position Sensor Circuit Tracking Lost

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Excitation Reference*	P0A45	P0A45	P0A45	P0A46, P1B04
COS Signal* - Circuit	P0A45, P0C57	P0A45	P0A45, P0C58	P0A46, P1B04
SIN Signal* - Circuit	P0A45, P0C61	P0A45	P0A45, P0C62	P0A46, P1B04
*Represents a differential circuit consisting of a pair of wires. See Circuit/System Description and schematic for detailed description.				

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for return signals, often referred to as Sine and Cosine waveforms, abbreviated SIN and COS. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor. The drive motor 2 position sensor is serviceable separately from the drive motor assembly.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P0C57 or P0C61

Circuit voltage is less than 0.5 V.

P0C58 or P0C62

Circuit voltage is greater than 4.5 V.

P0A45

SIN or COS signal is less than 2.3 V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A46

SIN or COS signal is greater than 4 V. The motor control module detects a degraded motor position sensor signal.

P1B04

The motor control module is unable to track the motor position based upon the sensor signals.

Action Taken When the DTC Sets

P0A45, P0A46, P1B04

- DTCs P0A45, P0A46, and P1B04 are Type A DTCs.
- Vehicle propulsion will be disabled.

P0C57, P0C58, P0C61, P0C62

DTCs P0C57, P0C58, P0C61, and P0C62 are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0A45, P0A46, and P1B04 are Type A DTCs.
- DTCs P0C57, P0C58, P0C61, and P0C62 are Type B DTCs.

Diagnostic Aids

The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.

In the case of intermittent concerns, clearing DTC information and returning the vehicle to the customer without a repair is not appropriate. Contact technical assistance when the cause of an intermittent concern cannot be identified.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: If the position sensor or wiring harness circuits fail the circuit tests, replace the component; do not repair.

1. Disable High Voltage, refer to [High Voltage Disabling](#) .

2. Remove the Drive Motor Power Inverter Module Cover, refer to [Drive Motor Power Inverter Module Cover Replacement](#).
3. Vehicle OFF, disconnect the X5 harness connector at the T6 Power Inverter Module.
4. Test for greater than 10,000 Ω between the terminals listed below and ground:
 - Excitation Reference circuit terminal 9 X5
 - Excitation Reference circuit terminal 10 X5
 - SIN Signal circuit terminal 5 X5
 - SIN Signal circuit terminal 6 X5
 - COS Signal circuit terminal 7 X5
 - COS Signal circuit terminal 8 X5
 - **If less than 10,000 Ω**
 1. Remove the transmission, refer to [Transmission Replacement](#).
 2. Disconnect the connector at the B228B Drive Motor 2 Position Sensor, refer to [Drive Motor Removal - 2nd Position](#).
 3. Test for less than 10,000 Ω between the appropriate harness terminal and ground.
 - If less than 10,000 Ω , replace the transmission wiring harness assembly.
 - If greater than 10,000 Ω , replace the B228B Drive Motor 2 Position Sensor.
 - **If greater than 10,000 Ω**
5. Test for 4.0 - 25 Ω between the terminals listed below:
 - Excitation Reference circuit terminal 10 and Reference circuit terminal 9
 - COS Signal circuit 1 terminal 7 and Signal circuit 1 terminal 8
 - SIN Signal circuit 2 terminal 5 and Signal circuit 2 terminal 6
 - **If not within the specified range**
 1. Disconnect the connector at the B228B Drive Motor 2 Position Sensor.
 2. Test for 4.0 - 25 Ω between the connector terminals listed below:
 - Excitation Reference circuit terminal 3 and Excitation Reference circuit terminal 4
 - COS Signal circuit terminal 1 and COS Signal circuit terminal 2
 - SIN Signal circuit terminal 5 and SIN Signal circuit terminal 6
 - If within the specified range, replace the transmission wiring harness assembly.
 - If not within the specified range, replace the B228B Drive Motor 2 Position Sensor.
 - **If within the specified range**
6. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Power Inverter Module Cover Replacement](#)
- Refer to [Drive Motor Disassemble - 2nd Position](#) for B228B Drive Motor 2 Position Sensor replacement
- Refer to [Automatic Transmission Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, OR P0A6D: DRIVE MOTOR 1-2 PHASE U, V OR W LOW CURRENT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A5E

Drive Motor 1 Phase U Low Current

DTC P0A61

Drive Motor 1 Phase V Low Current

DTC P0A64

Drive Motor 1 Phase W Low Current

DTC P0A67

Drive Motor 2 Phase U Low Current

DTC P0A6A

Drive Motor 2 Phase V Low Current

DTC P0A6D

Drive Motor 2 Phase W Low Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module fault conditions.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

One or more phase currents are less than 1.0 A.

Action Taken When the DTC Sets

DTCs P0A5E, P0A61, P0A64, P0A67, P0A6A, and P0A6D are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0A5E, P0A61, P0A64, P0A67, P0A6A, and P0A6D are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, and P0A6D is not set.
 - **If any of the DTCs are set**
 1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, continue to Circuit/System Testing.
 - If the DTC does not set
 - **If none of the DTCs are set**
3. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W

Drive Motor 2

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W
- **If less than infinite resistance**

Replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Test for less than 1 Ω between the AC circuit terminals listed below:

- Terminal 3 phase U to terminal 2 phase V
- Terminal 3 phase U to terminal 1 phase W
- Terminal 2 phase V to terminal 1 phase W
- **If 1 Ω or greater**

Replace the M15 Drive Motor.

- **If less than 1 Ω**

5. Verify the DTC does not set.

- **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.

- Replace the T6 Power Inverter Module.
- Replace the M15 Drive Motor.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Repeat the DTC check.

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Drive Motor Removal - 1st Position](#) for Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for Drive Motor 2 replacement
- Refer to [Control Module References](#) for Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0A78 OR P0A79: DRIVE MOTOR 1-2 INVERTER PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0A78

Drive Motor 1 Inverter Performance

DTC P0A79

Drive Motor 2 Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

The high voltage contactor relays are closed.

Conditions for Setting the DTC

The motor control module detects excessive current flow through the switched portion of the insulated gate bipolar transistor.

Actions Taken When the DTC Sets

- DTCs P0A78 and P0A79 are Type A DTCs.
- The power inverter module requests hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0A78 and P0A79 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A78 or P0A79 is not set.
 - **If any of the DTCs are set**
 1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, continue to Circuit/System Testing.
 - If the DTC does not set.
 - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury

or death.

1. Perform the [High Voltage Disabling](#) procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the T6 Power Inverter Module. Refer to [Drive Motor Generator Power Inverter Module Replacement](#).
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W

Drive Motor 2

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W
- **If less than infinite resistance**

Replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

1. Perform each of the operations listed below one at a time until the fault is corrected.
 1. Replace the T6 Power Inverter Module.
 2. Replace the M15 Drive Motor.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.
 - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Removal - 1st Position](#) for Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for Drive Motor 2 replacement
- Refer to [Control Module References](#) for Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0AB9: HYBRID/EV SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0AB9

Hybrid/EV System Performance

Circuit/System Description

This vehicle does not use a 12 V starter motor to crank the internal combustion engine. A much more powerful 300 V motor located within the transmission is utilized to crank the engine. This motor, drive motor 1, can rotate the engine to operating speed within just a few hundred milliseconds. The hybrid/EV powertrain control module 1 can detect a condition where the engine is cranking but does not start or has stalled.

Conditions for Running the DTC

Drive motor 1 is cranking the engine.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects that crankshaft position sensor engine speed has not risen above the commanded cranking speed indicating the engine has failed to start, or the hybrid/EV powertrain control module 1 detects crankshaft position sensor engine speed has fallen below a specific minimum speed indicating the engine has stalled.

Actions Taken When the DTC Sets

DTC P0AB9 is a Type A DTC.

Cranks But Does Not Start

When system commands engine Crank, the hybrid/EV powertrain control module 1 will command drive motor 1 to rotate the engine. The drive motor will continue to rotate the engine at a specific RPM until the engine starts and causes increased engine RPM. The hybrid/EV powertrain control module 1 will cease engine rotation if an increase in engine RPM is not observed after several seconds. This function may have the appearance of a start/stall condition.

- Commanded engine torque is greater than 20 N.m (15 lb ft)
- Low fuel level condition not set
- Fuel level sensors DTCs not set
- Engine CMP or CKP sensor DTCs not set
- DTC P16E0 not set

Engine Stall

If a stall occurs after a successful engine start, the hybrid/EV powertrain control module 1 will recognize the drop in engine RPM and command drive motor 1 to maintain engine RPM in an attempt to restart the engine. Drive motor 1 will continue to rotate the engine until the hybrid/EV powertrain control module 1 commands it to stop. The engine may be rotated for many minutes after the actual engine stall condition occurred and is typically stopped only after the hybrid/EV battery state of charge gets too low. This function may have the appearance of a running engine.

- Engine is running
- Low fuel level condition not set
- Fuel level sensors DTCs not set

- Engine CMP or CKP sensor DTCs not set
- DTC P16E0 not set

Conditions for Clearing the DTC

DTC P0AB9 is a Type A DTC.

Diagnostic Aids

Any condition that causes the engine to stall and/or not start may set this DTC. Possible conditions include:

- Fuel conditions such as low level, low pressure, or contamination
- Engine conditions such as low compression
- Restricted exhaust or air intake systems
- Loose or disconnected grounds

Always inspect for DTCs that would cause an engine stall and/or no start condition.

This DTC may set if the vehicle is powered off while driving.

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. Under normal operation, the engine should start and run.
2. Verify the engine starts and runs for at least 20 seconds.

- **If the engine fails to start and run for at least 20 seconds**

Diagnose the engine and transmission systems. Perform Line Pressure Check. Refer to [Line Pressure Check](#).

- **If the engine starts and runs for at least 20 seconds**

3. Verify DTC P0AB9 is not set.

- **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, OR P0BE1-P0BE3: DRIVE MOTOR INVERTER TEMPERATURE SENSOR(S) 1-6

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0AEE

Drive Motor Inverter Temperature Sensor 1 Performance

DTC P0AEF

Drive Motor Inverter Temperature Sensor 1 Circuit Low Voltage

DTC P0AF0

Drive Motor Inverter Temperature Sensor 1 Circuit High Voltage

DTC P0AF3

Drive Motor Inverter Temperature Sensor 2 Performance

DTC P0AF4

Drive Motor Inverter Temperature Sensor 2 Circuit Low Voltage

DTC P0AF5

Drive Motor Inverter Temperature Sensor 2 Circuit High Voltage

DTC P0BD2

Drive Motor Inverter Temperature Sensor 3 Performance

DTC P0BD3

Drive Motor Inverter Temperature Sensor 3 Circuit Low Voltage

DTC P0BD4

Drive Motor Inverter Temperature Sensor 3 Circuit High Voltage

DTC P0BD7

Drive Motor Inverter Temperature Sensor 4 Performance

DTC P0BD8

Drive Motor Inverter Temperature Sensor 4 Circuit Low Voltage

DTC P0BD9

Drive Motor Inverter Temperature Sensor 4 Circuit High Voltage

DTC P0BDC

Drive Motor Inverter Temperature Sensor 5 Performance

DTC P0BDD

Drive Motor Inverter Temperature Sensor 5 Circuit Low Voltage

DTC P0BDE

Drive Motor Inverter Temperature Sensor 5 Circuit High Voltage

DTC P0BE1

Drive Motor Inverter Temperature Sensor 6 Performance

DTC P0BE2

Drive Motor Inverter Temperature Sensor 6 Circuit Low Voltage

DTC P0BE3

Drive Motor Inverter Temperature Sensor 6 Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

P0AEE, P0AF3, P0BD2, P0BD7, P0BDC, and P0BE1

- Vehicle ON after the vehicle has been OFF for 6 hours.
- Temperature average of the inverter phase temperature sensors is greater than -20°C (-4°F).
- DTCs P0AEF, P0AF0, P0AF4, P0AF5, P0BD3, P0BD4, P0BD8, P0BD9, P0BDD, P0BDE, P0BE2, and P0BE3 are not set.

P0AEF, P0AF4, P0BD3, P0BD8, P0BDD, and P0BE2

The vehicle is ON.

P0AF0, P0AF5, P0BD4, P0BD9, P0BDE, and P0BE3

- The vehicle is ON.
- Inverter warmup time is 90 s or greater.

Conditions for Setting the DTC

P0AEE, P0AF3, P0BD2, P0BD7, P0BDC, and P0BE1

A 20°C (36°F) difference is observed between the individual inverter phase temperature sensor and the average of the power electronics coolant and transmission fluid temperatures, at vehicle ON after a cold soak.

P0AEF, P0AF4, P0BD3, P0BD8, P0BDD, and P0BE2

The inverter phase temperature sensor is greater than 170°C (338°F) for 3 s.

P0AF0, P0AF5, P0BD4, P0BD9, P0BDE, and P0BE3

The inverter phase temperature sensor is less than -50°C (-58°F) for 2.6 s.

Actions Taken When the DTC Sets

DTCs P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2 and P0BE3 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2 and P0BE3 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AEE, P0AEF, P0AF0, P0AF3, P0AF4, P0AF5, P0BD2, P0BD3, P0BD4, P0BD7, P0BD8, P0BD9, P0BDC, P0BDD, P0BDE, P0BE1, P0BE2, or P0BE3 is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 3. All OK.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup

DTC P0B01, P0B04, OR P0B07: AUXILIARY TRANSMISSION FLUID PUMP LOW CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0B01

Auxiliary Transmission Fluid Pump Low Current

DTC P0B04

Auxiliary Transmission Fluid Pump Low Current

DTC P0B07

Auxiliary Transmission Fluid Pump Low Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The pump motor utilizes 3 phase AC electricity. The motor stator coil is comprised of three phase circuits. The phase circuits are identified as phase U, phase V, and phase W. The U-V-W phase circuits are connected in a wye configuration. This means each phase is connected at a single, central point. The motor control modules monitor a current sensor connected to each motor phase. The current sensor is part of the power inverter module assembly and is not serviced separately. The hybrid/EV powertrain control module 1 is part of the power inverter module and is not serviced separately.

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

One or more phase currents are less than 1 A.

Action Taken When the DTC Sets

- DTCs P0B01, P0B04, and P0B07 are Type A DTCs.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0B01, P0B04, and P0B07 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

[Circuit/System Testing](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the [High Voltage Disabling](#) procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the T6 Power Inverter Module cover. Refer to [Drive Motor Power Inverter Module Cover Replacement](#).
3. Disconnect the G5 transmission fluid pump high voltage AC 3 phase circuit harness connector at the rear of the T6 Power Inverter Module.
4. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the G5 Transmission Fluid Pump - Electric/Auxiliary:
 - Terminal 3 phase U
 - Terminal 2 phase V
 - Terminal 1 phase W
 - **If less than infinite resistance**
 Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.
 - **If infinite resistance**
5. With the pump at 25°C (77°F), test for 2.4 - 2.8 Ω between the AC circuit terminals listed below:
 - Terminal 3 phase U to terminal 2 phase V
 - Terminal 3 phase U to terminal 1 phase W
 - Terminal 2 phase V to terminal 1 phase W
 - **If not within the specified range**
 Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.
 - **If within the specified range**
6. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) for G5 Transmission Fluid Pump - Electric/Auxiliary, often referred to as the A/Trans Fluid Pump Motor, replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, OR P0BFA-P0BFC: DRIVE MOTOR 1-2 PHASE U, V OR W CURRENT SENSOR(S)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0BE6

Drive Motor 1 Phase U Current Sensor Performance

DTC P0BE7

Drive Motor 1 Phase U Current Sensor Circuit Low Voltage

DTC P0BE8

Drive Motor 1 Phase U Current Sensor Circuit High Voltage

DTC P0BEA

Drive Motor 1 Phase V Current Sensor Performance

DTC P0BEB

Drive Motor 1 Phase V Current Sensor Circuit Low Voltage

DTC P0BEC

Drive Motor 1 Phase V Current Sensor Circuit High Voltage

DTC P0BEE

Drive Motor 1 Phase W Current Sensor Performance

DTC P0BEF

Drive Motor 1 Phase W Current Sensor Circuit Low Voltage

DTC P0BF0

Drive Motor 1 Phase W Current Sensor Circuit High Voltage

DTC P0BF2

Drive Motor 2 Phase U Current Sensor Performance

DTC P0BF3

Drive Motor 2 Phase U Current Sensor Circuit Low Voltage

DTC P0BF4

Drive Motor 2 Phase U Current Sensor Circuit High Voltage

DTC P0BF6

Drive Motor 2 Phase V Current Sensor Performance

DTC P0BF7

Drive Motor 2 Phase V Current Sensor Circuit Low Voltage

DTC P0BF8

Drive Motor 2 Phase V Current Sensor Circuit High Voltage

DTC P0BFA

Drive Motor 2 Phase W Current Sensor Performance

DTC P0BFB

Drive Motor 2 Phase W Current Sensor Circuit Low Voltage

DTC P0BFC

Drive Motor 2 Phase W Current Sensor Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

Conditions for Running the DTC

The control module runs the program to detect an internal fault when the Hybrid wake-up circuit is active.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB and P0BFC are Type A DTCs.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB and P0BFC are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0, P0BF2, P0BF3, P0BF4, P0BF6, P0BF7, P0BF8, P0BFA, P0BFB or P0BFC is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK
 - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0BFD OR P0BFE: DRIVE MOTOR 1-2 PHASES U-V-W NOT PLAUSIBLE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0BFD

Drive Motor 1 Phases U-V-W Not Plausible

DTC P0BFE

Drive Motor 2 Phases U-V-W Not Plausible

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Because all the motor generator phase circuits are electrically joined together, they should each flow about the same amount of current. The motor control modules perform a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

- The vehicle is ON.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

The sum of the 3 phase current sensors is 110 A or greater.

Actions Taken When the DTC Sets

- DTCs P0BFD and P0BFE are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0BFD and P0BFE are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.

2. Verify DTC P0BFD or P0BFE is not set.

- **If any of the DTCs are set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Verify the DTC does not set.

- If the DTC sets, continue to Circuit/System Testing.
- If the DTC does not set.

4. All OK.

- **If none of the DTCs are set**

3. All OK.

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module cable connections.
2. Remove the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 1B phase U
- Terminal 1A phase V
- Terminal 1C phase W

Drive Motor 2

- Terminal 2B phase U

- Terminal 2A phase V
- Terminal 2C phase W
- **If less than infinite resistance**

Replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Perform each of the operations listed below one at a time until the fault is corrected.

1. Replace the T6 Power Inverter Module.
2. Replace the M15 Drive Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Removal - 1st Position](#) for Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for Drive Motor 2 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C01 OR P0C04: DRIVE MOTOR 1-2 HIGH CURRENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C01

Drive Motor 1 High Current

DTC P0C04

Drive Motor 2 High Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

The hybrid wakeup circuit is active.

Conditions for Setting the DTC

One or more phase currents are greater than 600 A.

Actions Taken When the DTC Sets

- DTCs P0C01 and P0C04 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0C01 and P0C04 are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C01 or P0C04 is not set.
 - **If any of the DTCs are set**
 1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - 3. Verify the DTC does not set.
 - If the DTC sets, continue to Circuit/System Testing.
 - If the DTC does not set.
 - 4. All OK
 - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the T6 Power Inverter Module. Refer to **Drive Motor Generator Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W

Drive Motor 2

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W
- **If less than infinite resistance**

Replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.

- **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration
 2. Replace the T6 Power Inverter Module.
 3. Replace the M15 Drive Motor.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.
 - **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Removal - 1st Position](#) for Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for Drive Motor 2 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C0B OR P0C0E: DRIVE MOTOR 1-2 INVERTER SUPPLY VOLTAGE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C0B

Drive Motor 1 Inverter Supply Voltage Circuit

DTC P0C0E

Drive Motor 2 Inverter Supply Voltage Circuit

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- High voltage is greater than 100 V.

Conditions for Setting the DTC

The control module does not detect voltage at the insulated gate bi-polar transistor bias supply.

Actions Taken When the DTC Sets

- DTCs P0C0B and P0C0E are Type A DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0C0B and P0C0E are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C0B or P0C0E is not set.
 - **If any of the DTCs are set**
 1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, continue to Circuit/System Testing.
 - If the DTC does not set.
 - 4. All OK
 - **If none of the DTCs are set**
3. All OK

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the [High Voltage Disabling](#) procedure for servicing the T6 Power Inverter Module cable connections.
2. Remove the T6 Power Inverter Module. Refer to [Drive Motor Generator Power Inverter Module Replacement](#).
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W

Drive Motor 2

- Terminal 3 phase U
- Terminal 2 phase V
- Terminal 1 phase W
- **If less than infinite resistance**

Replace the M15 Drive Motor.

- **If infinite resistance for all AC circuits**

4. Verify the DTC does not set.

- **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration

2. Replace the T6 Power Inverter Module.

3. Replace the applicable M15 Drive Motor.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Repeat the DTC check.

- **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Removal - 1st Position](#) for M15A Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for M15B Drive Motor 2 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C11-P0C16: DRIVE MOTOR 1-2 INVERTER PHASE U, V OR W HIGH TEMPERATURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C11

Drive Motor 1 Inverter Phase U High Temperature

DTC P0C12

Drive Motor 1 Inverter Phase V High Temperature

DTC P0C13

Drive Motor 1 Inverter Phase W High Temperature

DTC P0C14

Drive Motor 2 Inverter Phase U High Temperature

DTC P0C15

Drive Motor 2 Inverter Phase V High Temperature

DTC P0C16

Drive Motor 2 Inverter Phase W High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two drive motor control modules and the hybrid/EV powertrain control module 1. Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction and output torque of its respective drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3 phase AC. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. Each motor control module monitors the temperature of each phase in order to detect power inverter module over-temperature conditions.

Conditions for Running the DTC

P0C11 - P0C16

Vehicle ON.

Conditions for Setting the DTC

The phase temperature has exceeded 131Â°C (268Â°F) for 5 seconds.

Action Taken When the DTC Sets

- DTCs P0C11, P0C12, P0C13, P0C14, P0C15 and P0C16 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0C11, P0C12, P0C13, P0C14, P0C15 and P0C16 are Type A DTCs.

Reference Information

Description and Operation

- [Drive Motor Power Inverter Module Description and Operation](#)
- [Hybrid/EV Cooling System Description and Operation](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Vehicle ON, observe the scan tool ECM Engine Coolant Temperature (ECT) parameter in freeze frame data.
2. Verify the Engine Coolant Temperature parameter was below 125°C (257°F) when the DTC set.
 - **If the ECT was 125°C (257°F) or greater when the DTC set**
 Refer to [Symptoms - Engine Cooling](#) and correct that concern first.
 - **If the ECT was below 125°C (257°F) when the DTC set**
3. Inspect for proper coolant level in the hybrid cooling system reservoir.
 - **If coolant level is low**
 Refer to [Hybrid Cooling System Loss of Coolant \(Power Electronics\)](#) [Hybrid Cooling System Loss of Coolant \(Battery\)](#) .
 - **If coolant level is OK**
4. Inspect the hybrid/EV cooling system radiator for debris or obstruction.
 - **If a concern is found**
 Repair or replace the restricted or damaged components as necessary.
 - **If no concern is found**
5. Inspect for proper operation of all hybrid/EV system coolant pumps. Refer [Hybrid/EV Electronics Cooling Diagnostic](#) .
 - **If a concern is found**
 Repair or replace the coolant pumps as necessary.
 - **If no concern is found**
6. Command the cooling fans through all operating speeds.
 - **If the cooling fans do not operate in all speeds**
 Refer to [Hybrid/EV Electronics Cooling Diagnostic](#) .

- If the cooling fans operate in all speeds

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C17, P0C18, P1B0F, OR P1B10: DRIVE MOTOR 1-2 POSITION NOT LEARNED/LEARN INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C17

Drive Motor 1 Position Not Learned

DTC P0C18

Drive Motor 2 Position Not Learned

DTC P1B0F

Drive Motor 1 Position Learn Incorrect

DTC P1B10

Drive Motor 2 Position Learn Incorrect

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The motor control module will attempt to learn the position at vehicle OFF. The non-learned condition would

normally occur only after a motor control module reprogramming event. The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

P0C17, P0C18

- Vehicle is cycled from ON to OFF.
- The motor control module has no valid drive motor position sensor offset value in memory.

P1B0F, P1B10

- Vehicle is cycled from ON to OFF.
- The motor control module has learned a valid drive motor position sensor offset value at least once.

Conditions for Setting the DTC

Condition 1

Position sensor offset value not learned because drive motor speed is greater than 50 RPM.

Condition 2

Position sensor offset value not learned because hybrid battery voltage as observed at the motor control module is less than 200 V.

Condition 3

- Position sensor offset value not learned because drive motor phase to phase current difference is less than 30 A.
- P1B0F or P1B10 failed to learn for 15 consecutive key cycle learn attempts.

Actions Taken When the DTC Sets

P0C17, P0C18

DTCs P0C17 and P0C18 are Type A DTCs.

P1B0F, P1B10

- DTCs P1B0F and P1B10 are Type B DTCs.
- The motor control module operates the drive motor generator using the last valid learned offset.

Conditions for Clearing the DTC

- DTCs P0C17 and P0C18 are Type A DTCs.
- DTCs P1B0F and P1B10 are Type B DTCs.

Diagnostic Aids

- If the vehicle is powered off while driving, DTC P1B0F or P1B10 may set.
- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 for drive motor 1 or DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 for drive motor 2 suggests intermittent position sensor circuit or connector problems.

Reference Information

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTCs P0A3F, P0A40, P0A45, P0A46, P0A78, P0A79, P0C01, P0C04, P0C0B, P0C0E, P0C4E, P0C4F, P0C52, P0C53, P0C57, P0C58, P0C5C, P0C5D, P0C61, P0C62, P1B03, P1B04, P1B0D, or P1B0E is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

NOTE: **When turning vehicle OFF, open and close the driver door and wait 2 minutes to allow all modules to shut down.**

3. Cycle vehicle power 4 times, using a scan tool to monitor the state of the appropriate Drive Motor Position Sensor Offset Learn Status.

- **If Drive Motor Position Sensor Offset Learn Status showed Motor Current Incorrect all 4 cycles**

Refer to Circuit/System Testing.

- **If Drive Motor Position Sensor Offset Learn Status did not show Motor Current Incorrect all 4 cycles**

4. Vehicle ON.
5. Verify DTC P0C17, P0C18, P1B0F, or P1B10 is not set.

- **If any of the DTCs are set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Cycle vehicle power 4 times, using a scan tool to monitor the state of the appropriate Drive Motor Position Sensor Offset Learn Status.

3. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set

4. All OK.

- If none of the DTCs are set

6. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the High Voltage Disabling procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the T6 Power Inverter Module. Refer to Drive Motor Generator Power Inverter Module Replacement.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the appropriate M15 Drive Motor:

Drive Motor 1

- Terminal 1B phase U
- Terminal 1A phase V
- Terminal 1C phase W

Drive Motor 2

- Terminal 2B phase U
- Terminal 2A phase V
- Terminal 2C phase W
- If less than infinite resistance

Replace the M15 Drive Motor.

- If infinite resistance for all AC circuits

4. Verify the DTC does not set.

- If the DTC sets

1. Perform each of the operations listed below one at a time until the fault is corrected.
 1. Replace the T6 Power Inverter Module.
 2. Replace the appropriate M15 Drive Motor.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Repeat the DTC check.

- **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Drive Motor Removal - 1st Position](#) for K107A Drive Motor 1 replacement
- Refer to [Drive Motor Removal - 2nd Position](#) for K107B Drive Motor 2 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C19: DRIVE MOTOR 1 TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C19

Drive Motor 1 Torque Delivered Performance

Circuit/System Description

Each drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of its respective drive motor. The motor control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- DTCs P0A3F, P0A40, P1AF5, P0BFD, P1B03, P1B0C or P16EB is not set.
- Vehicle ON.
- Drive motor 1 is commanded to develop torque.

Conditions for Setting the DTC

The motor control module has detected that difference between drive motor delivered and commanded torque is greater than 123 N.m (91 lb ft).

Actions Taken When the DTC Sets

- DTC P0C19 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P0C19 is a Type A DTC.

Diagnostic Aids

Because the engine and drive motor 1 are mechanically connected through a planetary gear set, an engine condition that requires drive motor 1 to consume excessive current while trying to rotate the engine may cause this DTC to set such as:

- Extreme braking during regeneration may cause this DTC to be set in history.
- Seized or binding engine
- Seized or binding accessory drive belt

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. The engine should start and run.
2. Verify the engine is not seized or binding.
 - **If the engine is seized or binding**
Refer to [Symptoms - Engine Mechanical](#) .
 - **If the engine is not seized or binding**
3. Verify DTC P0C19 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 3. All OK
 - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C1A: DRIVE MOTOR 2 TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C1A

Drive Motor 2 Torque Delivered Performance

Circuit/System Description

Each drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of its respective drive motor. The motor control module is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- Vehicle ON.
- DTCs P0A3F, P0A40, P1AF5, P0BFD, P1B03, P1B0C, P1B41, or P16EB is not set.
- Drive motor 2 is commanded to develop torque.

Conditions for Setting the DTC

The motor control module has detected that difference between drive motor delivered and commanded torque is greater than 132 N.m (97 lb ft).

Actions Taken When the DTC Sets

- DTC P0C1A is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P0C1A is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C1A is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
4. All OK
 - **If the DTC is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C28: AUXILIARY TRANSMISSION FLUID PUMP HIGH CURRENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C28

Auxiliary Transmission Fluid Pump High Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motors utilize 3 phase AC electricity. The motor stator coil is comprised of three phase circuits. The phase circuits are identified as phase U, phase V, and phase W. The U-V-W phase circuits are connected in a wye configuration. This means each phase is connected at a single, central point. The motor control modules monitor a current sensor connected to each motor phase. The current sensor is part of the motor assembly and is not serviced separately. The hybrid/EV powertrain control module 1 is part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

One or more phase currents are greater than 35 A.

Actions Taken When the DTC Sets

- DTC P0C28 is a Type A DTC.

- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

DTC P0C28 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the High Voltage Disabling procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Disconnect the X8 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the G5 Transmission Fluid Pump - Electric/Auxiliary:
 - Terminal 3 phase U
 - Terminal 2 phase V
 - Terminal 1 phase W
 - **If less than infinite resistance**

Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.

- **If infinite resistance**

4. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) for G5 Transmission Fluid Pump - Electric/Auxiliary replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C4E: DRIVE MOTOR 1 POSITION EXCEEDED LEARNING LIMIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C4E

Drive Motor 1 Position Exceeded Learning Limit

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is cycled OFF.

- Offset Learn has completed.

Conditions for Setting the DTC

- The position sensor total offset exceeds 30 degrees during the learning process.

OR

- The current learned value differs from the previous learned value by greater than 10 degrees.

Actions Taken When the DTC Sets

DTC P0C4E is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C4E is a Type A DTC.

Diagnostic Aids

This DTC sets when the drive motor control module is unable to learn the position of the drive motor. When this DTC sets, or after replacement of a drive motor position sensor, drive motor, or power inverter module, it is possible that a special wide angle learn needs to occur. This wide angle learn occurs when the drive motor control module sees a programming event on the High Speed GMLAN bus.

For intermittent appearance of DTCs:

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.
- Drive motor control modules 1 and 2 monitor and report their respective Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating, and possibly intermittent, appearance of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.

Drive Motor 1/2 Position Sensor Offset Learn Status Parameter Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	Not Applicable
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	Not Applicable
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor or power inverter module

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03](#).

- **If none of the DTCs are set**
3. Verify DTC P0C4E is not set.
 - **If the DTC sets**

NOTE:

A current DTC indicates that the Motor Control Module cannot learn the motor position. Programming any module on the High Speed GMLAN bus will initiate a Motor Control Module wide angle learn. If current T6 Power Inverter Module software is already up-to-date, then programming will not take place and the wide angle learn will not be initiated. Program a different module, such as the ECM, to initiate the wide angle learn. If necessary, the majority of modules can be forced to reprogram using the SPS Replace and Program option.

1. Perform each of the operations listed below one at a time until the fault is corrected.
 1. Program the T6 Power Inverter Module or another High Speed GMLAN module if software is already up-to-date.

NOTE:

Check for physical damage on the position sensor and drive motor

rotor and replace any damaged component first.

2. Replace the B228A Drive Motor 1 Position Sensor, and if the DTC still sets, program a module to initiate wide angle learn.
3. Replace the M15A Drive Motor 1, and if the DTC still sets, program a module to initiate wide angle learn.
4. Replace and program the T6 Power Inverter Module.

2. Repeat the DTC check in step 3.

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Disassemble - 1st Position](#) for B228A Drive Motor 1 Position Sensor, often referred to as the Generator Position Sensor Stator (Unit A), replacement
- Refer to [Drive Motor Removal - 1st Position](#) , and [Drive Motor Installation - 1st Position](#) for Drive Motor 1 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C4F: DRIVE MOTOR 2 POSITION EXCEEDED LEARNING LIMIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C4F

Drive Motor 2 Position Exceeded Learning Limit

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The control modules listed below are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately:

- Auxiliary transmission fluid pump control module
- Drive motor 1 control module
- Drive motor 2 control module
- Hybrid/EV powertrain control module 1

Conditions for Running the DTC

- The vehicle is cycled OFF.
- Offset learn has completed.

Conditions for Setting the DTC

- The position sensor offset total exceeds 30 degrees during the learning process.

OR

- The current learned value differs from the previous learned value by greater than 10 degrees.

Actions Taken When the DTC Sets

DTC P0C4F is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C4F is a Type A DTC.

Diagnostic Aids

This DTC sets when the drive motor control module is unable to learn the position of the drive motor. When this DTC sets, or after replacement of a drive motor position sensor, drive motor, or power inverter module, it is possible that a special wide angle learn needs to occur. This wide angle learn occurs when the drive motor control module sees a programming event on the High Speed GMLAN bus.

For intermittent appearance of DTCs:

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- Intermittent appearance of DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 suggests intermittent position sensor circuit or connector problems.
- Drive motor control modules 1 and 2 monitor and report their respective Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating or intermittent display of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.

Drive Motor 1/2 Position Sensor Offset Learn Status Parameter Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
---	-------------	------------------

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	Not Applicable
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	Not Applicable
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor or power inverter module

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04.](#)

- **If none of the DTCs are set**
3. Verify DTC P0C4F is not set.
 - **If the DTC sets**

NOTE:

A current DTC indicates that the Motor Control Module cannot learn the motor position. Programming any module on the High Speed GMLAN bus will initiate a Motor Control Module wide angle learn. If current T6 Power

Inverter Module software is already up-to-date, then programming will not take place and the wide angle learn will not be initiated. Program a different module, such as the ECM, to initiate the wide angle learn. If necessary, the majority of modules can be forced to reprogram using the SPS Replace and Program option.

1. Perform each of the operations listed below one at a time until the fault is corrected.

1. Program the T6 Power Inverter Module or another High Speed GMLAN module if software is already up-to-date.

NOTE: Check for physical damage on the position sensor and drive motor rotor and replace any damaged component first.

2. Replace the B228B Drive Motor 2 Position Sensor, and if the DTC still sets, program a module to initiate wide angle learn.
3. Replace the M15B Drive Motor 2, and if the DTC still sets, program a module to initiate wide angle learn.
4. Replace and program the T6 Power Inverter Module.

2. Repeat the DTC check in step 3.

- If the DTC does not set

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Disassemble - 2nd Position](#) for B228B Drive Motor 2 Position Sensor replacement
- Refer to [Drive Motor Removal - 2nd Position](#) , and [Drive Motor Installation - 2nd Position](#) for Drive Motor 2 replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C76: HYBRID/EV BATTERY SYSTEM HIGH VOLTAGE PRESENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C76

Hybrid/EV Battery System High Voltage Present

Circuit/System Description

The hybrid/EV battery pack contains 4 high voltage contactors and 1 solid state relay (transistor). The high voltage contactors allow the high voltage DC to be connected to the vehicle or safely contained within the hybrid/EV battery pack. The 4 high voltage contactors are a main positive high voltage contactor, main negative high voltage contactor,

charge positive high voltage contactor, and a precharge negative high voltage contactor. The transistor controls the battery heater high voltage positive circuit.

Conditions for Running the DTC

- High voltage contactors are commanded open.
- The system voltage is at least 10 V.

Conditions for Setting the DTC

The high voltage bus voltage is greater than 200 V 3.5 seconds after the contactors have been commanded open.

Action Taken When the DTC Sets

DTC P0C76 is a Type A DTC.

Conditions for Clearing the DTC

- DTC P0C76 is a Type A DTC.
- The Clear Secured High Voltage DTCs reset function must be performed to prevent resetting the DTC.

Reference Information

Schematic Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify the contactors are operating normally.
 - **If the contactors are not operating properly**
Repair as necessary.
 - **If the contactors are operating properly**
2. Vehicle ON.
3. With a scan tool, perform the Clear Secured High Voltage DTCs reset function.
4. Verify DTC P0C76 is not set.
 - **If the DTC is set**
Replace the T6 Power Inverter Module.
 - **If the DTC is not set**
5. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P150D OR P150E: SUPPLY VOLTAGE CIRCUIT(S) 1-2 LOW VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P150D

Supply Voltage Circuit 2 Low Voltage

DTC P150E

Supply Voltage Circuit 1 Low Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P150D

Battery voltage on circuit 2 is less than 8.0 V for more than 2.5 s.

P150E

Battery voltage on circuit 1 is less than 8.0 V for more than 2.5 s.

Action Taken When the DTC Sets

DTC P150D and P150E are Type C DTCs.

Conditions for Clearing the DTC

DTC P150D and P150E are Type C DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

[Circuit/System Testing](#)

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.

- **If any of the DTCs are set**

Refer to [DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC](#).

- **If none of the DTCs are set**

3. Verify DTC P150D or P150E is not set.

- **If DTC P150D is set**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
2. Verify a test lamp illuminates between the B+ circuit terminal 50 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the T6 Power Inverter Module.

- **If the test lamp illuminates**

3. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

4. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set

5. All OK.

- **If DTC P150E is set**

1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
1. Remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the T6 Power Inverter Module.
 - **If the test lamp illuminates**
3. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
4. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set
5. All OK.
- **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F0: ENGINE TORQUE DELIVERED SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F0

Engine Torque Delivered Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated engine torque delivered calculation is correct.

Conditions for Running the DTC

- Vehicle is ON.
- Run/Crank is 9.5 V or greater.

OR

Ignition Run/Crank is 11 V or greater.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F0 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F0 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15F0 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F1: AXLE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F1

Axle Torque Request Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated axle torque requested calculation is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The run/crank voltage is 9.5 V or greater.

OR

The ignition run/crank voltage is 11 V or greater.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F1 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F1 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15F1 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
2. Verify the DTC does not set.
- If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
3. All OK
- **If the DTC is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F2: ENGINE TORQUE COMMAND SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F2

Engine Torque Command Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 sends an engine torque requested message to the ECM over the serial data circuits. The ECM monitors the data to verify the indicated engine torque requested calculation is correct. The ECM processor monitors the data to verify that the engine torque command is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is 8 - 18 V.
- DTC U1817 is not set.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F2 is a Type A DTC.

- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F2 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: Diagnose and repair any communication DTCs prior to performing this testing.

1. Vehicle ON.
2. Verify DTC P15F2 is not set.
 - **If the DTC is set**
 1. Verify the K20 ECM has the latest calibration in Calibration Information.
 - If the K20 ECM does not have the latest calibration, program the K20 ECM.
 - If the K20 ECM has the latest calibration, replace the K20 ECM.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K20 ECM.
 - If the DTC does not set.
 3. All OK
 - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for K20 ECM replacement, programming, and setup

DTC P15FC: HYBRID/EV BATTERY CONTACTOR STATUS MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P15FC

Hybrid/EV Battery Contactor Status Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated contactor closure status is correct.

Conditions for Running the DTC

The vehicle is ON for 1 second.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Actions Taken When the DTC Sets

- DTC P15FC is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15FC is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15FC is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK
 - **If the DTC is not set**

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P16E0: ENGINE PERFORMANCE - NO TORQUE DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16E0

Engine Performance - No Torque Detected

Circuit/System Description

This vehicle does not use a 12 V starter motor to crank the internal combustion engine. A much more powerful 300 V motor located within the transmission is utilized to crank the engine. This motor, drive motor 1, can rotate the engine to operating speed within just a few hundred milliseconds. The hybrid/EV powertrain control module 1 can detect a condition where the engine is cranking but does not start or has stalled.

Conditions for Running the DTC

- The vehicle is ON.
- DTC U0100 is not set.
- Engine running.
- Fuel Level is NOT Low.
- No Fuel Level sensor DTCs set.
- Commanded engine torque is 50 or greater.

Conditions for Setting the DTC

The difference between commanded engine torque and delivered engine torque is 50 or greater for 3.5 seconds out of a 4 second window.

Action Taken When the DTC Sets

DTC P16E0 is a Type A DTC.

Conditions for Clearing the DTC

DTC P16E0 is a Type A DTC.

Diagnostic Aids

Any condition that causes the engine to stall and/or not start may set this DTC. Possible conditions include:

- Fuel conditions such as low pressure or contamination.
- Engine conditions such as low compression.
- Restricted exhaust or air intake systems.

Always inspect for DTCs that would cause an engine stall and/or no start condition.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Vehicle ON. Operate the hood release to open the hood. The engine should start and run.
2. Verify the engine starts.
 - **If the engine fails to start**

Diagnose the engine system. Refer to [Engine Cranks But Does Not Run](#) .

- **If the engine starts**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P16F3: CONTROL MODULE REDUNDANT MEMORY PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16F3

Control Module Redundant Memory Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor stores identical data in two locations and compares the data to verify that the stored data is correct.

Conditions for Running the DTC

The system voltage is 11 V or greater.

Conditions for Setting the DTC

The control module has detected that data identical when stored is not the same when retrieved.

Action Taken When the DTC Sets

- DTC P16F3 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F3 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0335 or any communication U-code DTC is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
3. Verify DTC P16F3 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 3. All OK
 - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P16F4: CONTROL MODULE TRANSMISSION RANGE SWITCH INPUT CIRCUITRY PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16F4

Control Module Transmission Range Switch Input Circuitry Performance

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, is a hall-effect switch attached to the transmission case within the transmission. The 5 outputs from the switch indicate which position is selected by the transmission manual shaft. Five outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P/S. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C, and signal P signal S. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected the commanded transmission range state is not correct based upon internal calculations or by a comparison to input or output torque conditions.

Action Taken When the DTC Sets

- DTC P16F4 is a Type A DTC.
- Vehicle propulsion will be disabled. The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F4 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify DTC P1824, P182A - P182F, P1838 - P1841, P18B5 - P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3 is not set.

- **If any of the DTCs are set**

Refer to [DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3](#).

- **If none of the DTCs are set**

2. Verify that DTC P16F4 is not set.

- **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set

4. All OK

- **If the DTC is not set**

3. All OK

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P16F6: CONTROL MODULE TRANSMISSION RANGE CALCULATION PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 1)

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

[DTC Descriptor](#)

DTC P16F6

Control Module Transmission Range Calculation Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the commanded range state calculation is correct.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected the commanded transmission range state is not correct based upon internal calculations or by a comparison to input or output torque conditions.

Action Taken When the DTC Sets

- DTC P16F6 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F6 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P16F6 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
3. All OK
 - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming

DTC P179A: AUXILIARY TRANSMISSION FLUID PUMP OVERSPEED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P179A

Auxiliary Transmission Fluid Pump Overspeed

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The motor control modules operate their respective drive motor generator based upon drive motor generator power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump motor. The hybrid powertrain control module and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The vehicle is ON or the power inverter module is awake.

Conditions for Setting the DTC

An auxiliary transmission fluid pump motor speed of greater than 6500 RPM has been detected.

Action Taken When the DTC Sets

DTC P179A is a Type A DTC.

Conditions for Clearing the DTC

DTC P179A is a Type A DTC.

Reference Information

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P179A is not set.
 - **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
3. All OK
 - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P190A-P190F: DRIVE MOTOR 1-2 INVERTER PHASE U, V OR W TEMPERATURE ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P190A

Drive Motor 1 Inverter Phase U Temperature Erratic

DTC P190B

Drive Motor 1 Inverter Phase V Temperature Erratic

DTC P190C

Drive Motor 1 Inverter Phase W Temperature Erratic

DTC P190D

Drive Motor 2 Inverter Phase U Temperature Erratic

DTC P190E

Drive Motor 2 Inverter Phase V Temperature Erratic

DTC P190F

Drive Motor 2 Inverter Phase W Temperature Erratic

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The inverter phase temperature is intermittent.

Actions Taken When the DTC Sets

DTCs P190A-P190F are Type B DTCs.

Conditions for Clearing the DTC

DTCs P190A-P190F are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTCs P190A-P190F are not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set
 3. All OK.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup

DTC P1A4F, P1A50-P1A54, P1ADC, OR P1ADD: DRIVE MOTOR 1-2 CONTROL MODULE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1A4F

Drive Motor 1 Control Module Not Programmed

DTC P1A50

Drive Motor 1 Control Module Random Access Memory

DTC P1A51

Drive Motor 1 Control Module Read Only Memory

DTC P1A52

Drive Motor 2 Control Module Not Programmed

DTC P1A53

Drive Motor 2 Control Module Random Access Memory

DTC P1A54

Drive Motor 2 Control Module Read Only Memory

DTC P1ADC

Drive Motor 1 Control Module Long Term Memory Performance

DTC P1ADD

Drive Motor 2 Control Module Long Term Memory Performance

Circuit/System Description

The drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately. This fault is handled inside the drive motor control modules and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is 8 - 18 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction or a service module has been installed but not yet programmed.

Actions Taken When the DTC Sets

- DTCs P1A4F, P1A50, P1A51, P1A52, P1A53, and P1A54 are Type A DTCs.
- P1ADC and P1ADD are Type B DTCs.

- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

- DTCs P1A4F, P1A50, P1A51, P1A52, P1A53, and P1A54 are Type A DTCs.
- P1ADC and P1ADD are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1A4F, P1A50, P1A51, P1A52, P1A53, P1A54, P1ADC and P1ADD is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1ADE, P1ADF, P1AE0, OR P1AE1: DRIVE MOTOR 1-2 CONTROL MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P1ADE

Drive Motor 1 Control Module System Voltage Low Voltage

DTC P1ADF

Drive Motor 1 Control Module System Voltage High Voltage

DTC P1AE0

Drive Motor 2 Control Module System Voltage Low Voltage

DTC P1AE1

Drive Motor 2 Control Module System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

The Vehicle is ON.

Conditions for Setting the DTC

DTCs P1ADE and P1AE0

Motor control module ignition-voltage is less than or equal to 10 V for 5 s.

DTCs P1ADF and P1AE1

Motor control module ignition voltage is greater than 16 V for 5 s.

Actions Taken When the DTC Sets

DTCs P1ADE, P1ADF, P1AE0 and P1AE1 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1ADE, P1ADF, P1AE0 and P1AE1 are Type C DTCs.

Diagnostic Aids

A battery charger or vehicle jump start may have set DTCs P1ADF or P1AE1.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.

- **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C,**

P1A0D, or P1EFC .

- **If none of the DTCs are set**

3. Verify DTC P1ADE, P1ADF, P1AE0, or P1AE1 is not set.

- **If any of the DTCs are set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1AEE OR P1AEF: DRIVE MOTOR 1-2 CONTROL MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1AEE

Drive Motor 1 Control Module Hybrid/EV Battery System Voltage High Voltage

DTC P1AEF

Drive Motor 2 Control Module Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module contains two drive motor control modules. Each motor control module measures hybrid battery high voltage with several internal sensors.

The motor control modules monitors for high voltage that is greater than the system allows during normal operation.

Conditions for Running the DTC

- The hybrid/EV battery system contactor relays are closed.
- Ignition voltage is greater than 8 V and no more than 18 V.

Conditions for Setting the DTC

Greater than 450 V on the high voltage circuit is detected by the motor control module.

OR

The motor control module has detected an internal fault.

Actions Taken When the DTC Sets

- DTCs P1AEE and P1AEF are Type A DTCs.
- The power inverter module disables propulsion during the current ignition cycle.

Conditions for Clearing the DTC

DTCs P1AEE and P1AEF are Type A DTCs.

Diagnostic Aids

If the high voltage contactor relays open while high current is present a large voltage surge may be created. The resultant voltage surge may set DTC P1AEE or P1AEF. Always check for other DTCs or conditions such as loss of isolation, contactor control, etc. that could result in a vehicle shutdown/stall.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0ABB, P0ABC, or P0ABD is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

 - **If none of the DTCs are set**
3. Verify DTC P1AF0, P1AF2, P1AF4, P1AF6, P1B0B, P1B43, P1E1C, or P1E1E is not set.
 - **If any of the DTCs are set**

NOTE: The loss of isolation may be intermittent and internal to the transmission.

Inspect the vehicle for a loss of isolation condition. Refer to [Loss of Isolation on the High Voltage Main Bus](#) .

- **If none of the DTCs are set**
4. Verify no other DTCs are set.
 - **If any DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

5. Verify DTC P1AEE or P1AEF is not set.

- **If any of the DTCs are set**

Replace the T6 Power Inverter Module.

- **If none of the DTCs are set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1AF0 OR P1AF2: DRIVE MOTOR 1-2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SYSTEM ISOLATION LOST

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1AF0

Drive Motor 1 Control Module Hybrid/EV Battery Voltage System Isolation Lost

DTC P1AF2

Drive Motor 2 Control Module Hybrid/EV Battery Voltage System Isolation Lost

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

If the motor control modules detect an isolation loss on either the positive or negative high voltage bus, the hybrid/EV powertrain control module 1 reports a fault. The isolation loss may be caused by any component in the high voltage system.

Conditions for Running the DTC

- DTCs P1AE8, P1AE9, P1AEC, or are not set.
- The high voltage contactor relays are closed.
- High voltage is greater than 50 V.
- Ignition voltage is 8 - 18 V.

Conditions for Setting the DTC

The ratio between Negative Supply Isolation Voltage and Positive Supply Isolation Voltage is greater than 4.53 or less than 0.21 for greater than 2.5 s in a 5 s window.

Actions Taken When the DTC Sets

DTCs P1AF0 and P1AF2 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1AF0 and P1AF2 are Type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 or P1AE6 is not set.
 - **If any of the DTCs are set**
Refer to [DTC P0AA6 or P1AE6](#) .
 - **If none of the DTCs are set**
3. Verify DTC P0A78, P0A79, P0BFD, P0BFE, P0C01, or P0C04 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
4. Verify DTC P1AF0 or P1AF2 is not set.
 - **If any of the DTCs are set**

Refer to [Loss of Isolation on the High Voltage Main Bus](#) .

- If none of the DTCs are set

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1AF4-P1AF7: DRIVE MOTOR 1-2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 1 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1AF4

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1AF5

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

DTC P1AF6

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1AF7

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

P1AF4 and P1AF6

- The Vehicle is ON.
- The hybrid/EV contactors are closed.

P1AF5 and P1AF7

The Vehicle is ON.

Conditions for Setting the DTC

P1AF4 and P1AF6

The motor control module detects Positive Supply Isolation sensor voltage less than 20 V.

P1AF5 and P1AF7

The motor control module detects the value of the Positive Supply Isolation voltage subtracted from the pack voltage is greater than 60 V.

Actions Taken When the DTC Sets

- DTCs P1AF4, P1AF5, P1AF6 and P1AF7 are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1AF4, P1AF5, P1AF6 and P1AF7 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 is not set.
 - **If the DTC is set**
Refer to **DTC P0AA6 or P1AE6** .
 - **If the DTC is not set**
3. Verify DTC P1AF4, P1AF5, P1AF6, or P1AF7 is not set.
 - **If any of the DTCs are set**
Refer to **Loss of Isolation on the High Voltage Main Bus** .
 - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1B0B OR P1B0C: DRIVE MOTOR 1 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check -**

Vehicle

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1B0B

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1B0C

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

- The vehicle is ON.
- Contactors are closed.

Conditions for Setting the DTC

P1B0B

The motor control module detects Negative Supply Isolation sensor voltage less than 20 V.

P1B0C

The motor control module detects Negative Supply Isolation sensor voltage greater than 60 V.

Actions Taken When the DTC Sets

- DTCs P1B0B and P1B0C are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B0B and P1B0C are Type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1BOB or P1B0C is not set.

- **If any of the DTCs are set**

Refer to **Loss of Isolation on the High Voltage Main Bus** .

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1B0D OR P1B0E: DRIVE MOTOR 1-2 CONTROL MODULE DRIVE MOTOR 1-2 OVERSPEED

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1B0D

Drive Motor 1 Control Module Drive Motor 1 Overspeed

DTC P1B0E

Drive Motor 2 Control Module Drive Motor 2 Overspeed

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The drive motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the drive motor control module to determine the exact position, speed and direction of the drive motor. The motor control modules are part of the power inverter module, often referred to as the drive motor generator power inverter module, and are not serviced separately.

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

Drive motor speed is greater than 12,700 RPM.

Actions Taken When the DTC Sets

- DTCs P1B0D and P1B0E are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B0D and P1B0E are Type A DTCs.

Diagnostic Aids

- A transmission mechanical failure that occurs during high drive motor generator torque may cause these DTCs to set.
- Repeated drive motor operation at speeds in excess of the DTC limits may cause deterioration of the drive motor rotor magnets.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no other Hybrid Transmission DTCs are set.
 - **If other Hybrid Transmission DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **If no other Hybrid Transmission DTCs are set**
3. Verify DTC P1B0D or P1B0E is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

3. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

4. All OK

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B15: REGENERATIVE BRAKING TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1B15

Regenerative Braking Torque Request Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated brake torque request calculation is correct.

Conditions for Running the DTC

- The vehicle is ON for 1 second.
- The Run/Crank system voltage is 9.5 V or greater

OR

The ignition/Run/Crank voltage is 11 V or greater.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Actions Taken When the DTC Sets

- DTC P1B15 is a Type A DTC.

- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P1B15 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B15 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK
 - **If the DTC is not set**

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B41 OR P1B42: DRIVE MOTOR 1-2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P1B41

Drive Motor 1 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

DTC P1B42

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

- The vehicle is ON.
- The high voltage contactor relays are closed.

P1B41

DTC P1AE8, P1AE9, P1B0B, or P1B0C is not set.

P1B42

DTC P1AEA, P1AEB, P1B43, or P1B44 is not set.

Conditions for Setting the DTC

The difference between the Isolation Supply voltage sensed and hybrid battery voltage is greater than 70 V.

And

The difference between the Isolation Supply voltage sensed and the high voltage measured is greater than 70 V.

Actions Taken When the DTC Sets

- DTCs P1B41 and P1B42 are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B41 and P1B42 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B41 or P1B42 is not set.
 - If any of the DTCs are set

Refer to [Loss of Isolation on the High Voltage Main Bus](#).

- If none of the DTCs are set

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1B43 OR P1B44: DRIVE MOTOR 2 CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1B43

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1B44

Drive Motor 2 Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

- The vehicle is ON.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1B43

The drive motor control module detects Negative Supply Isolation sensor voltage less than 20 V for 1 s.

P1B44

The drive motor control module detects Negative Supply Isolation sensor voltage greater than 60 V for 1 s.

Actions Taken When the DTC Sets

- DTCs P1B43 and P1B44 are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1B43 and P1B44 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1B43 or P1B44 is not set.

- **If any of the DTCs are set**

Refer to [Loss of Isolation on the High Voltage Main Bus](#) .

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1E0A OR P1E0B: DRIVE MOTOR 1-2 CONTROL MODULE TORQUE CALCULATION PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E0A

Drive Motor 1 Control Module Torque Calculation Performance

DTC P1E0B

Drive Motor 2 Control Module Torque Calculation Performance

Circuit/System Description

The motor control modules perform redundant calculations of desired and achieved torque values. These values are continuously compared and should always be the same.

Conditions for Running the DTC

Ignition voltage is 8 - 18 V.

Conditions for Setting the DTC

The redundant torque calculation does not match the primary calculation.

Action Taken When the DTC Sets

- DTCs P1E0A and P1E0B are Type A DTCs.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1E0A and P1E0B are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no transmission or motor control module DTCs are set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
3. Verify DTC P1E0A or P1E0B is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E1B-P1E1F: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE HYBRID/EV

BATTERY VOLTAGE ISOLATION SENSING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E1B

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

DTC P1E1C

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1E1D

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

DTC P1E1E

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1E1F

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

P1E1B

The motor control module detects a correlation difference between the Isolation Supply sensor and overall pack

voltage.

P1E1C and P1E1E

The motor control module detects Isolation Supply sensor voltage less than 20 V.

P1E1D and P1E1F

The motor control module detects Isolation Supply sensor voltage greater than 40 V.

Action Taken When the DTC Sets

DTCs P1E1B, P1E15C, P1E1D, P1E1E, and P1E1F are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1E1B, P1E15C, P1E1D, P1E1E, and P1E1F are Type B DTCs.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E1B, P1E1C, P1E1D, P1E1E, or P1E1F is not set.
 - **If any of the DTCs are set**

Refer to [Loss of Isolation on the High Voltage Main Bus](#) .
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P1E22: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SYSTEM ISOLATION LOST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E22

Auxiliary Transmission Fluid Pump Control Module Hybrid/EV Battery Voltage System Isolation Lost

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. Each drive motor control module monitors its internal high voltage sensor for correct operation; no external circuits are involved. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The motor control modules test for isolation between each high voltage bus and vehicle chassis whenever high voltage is present at the power inverter module.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is 8 - 18 V.
- The high voltage contactor relays are closed.
- DTCs P1AE8, P1AE9, or P1AEC are not set.

Conditions for Setting the DTC

The drive motor control module detects an isolation fault between the battery pack and chassis ground.

Action Taken When the DTC Sets

DTC P1E22 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1E22 is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E22 is not set.

- **If the DTC is set**

Refer to [Loss of Isolation on the High Voltage Main Bus](#) .

- **If the DTC is not set**

3. All OK

DTC P1E29: AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE CALCULATED

MOTOR POSITION PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E29

Auxiliary Transmission Fluid Pump Control Module Calculated Motor Position Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

The auxiliary transmission fluid pump control module uses sensorless control to estimate motor speed and position from the phase current sensors.

Conditions for Running the DTC

The vehicle is ON or the power inverter module is awake.

Conditions for Setting the DTC

The auxiliary transmission fluid pump control module detects a fault.

Actions Taken When the DTC Sets

DTC P1E29 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1E29 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P179A, P1E20, P1E21, P1E22, P1E27, P1E28, P1E1C, P1E1D, P1E1E, P1E1F, P1E1B, P1E29, P1E34, P1E35, or P1E36 is not set.
 - If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Verify DTC P1E29 is not set.

- **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1E2A-P1E2F: AUXILIARY TRANSMISSION FLUID PUMP PHASE U-V CURRENT SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E2A

Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit Low Voltage

DTC P1E2B

Auxiliary Transmission Fluid Pump Phase U Current Sensor Circuit High Voltage

DTC P1E2C

Auxiliary Transmission Fluid Pump Phase U Current Sensor Performance

DTC P1E2D

Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit Low Voltage

DTC P1E2E

Auxiliary Transmission Fluid Pump Phase V Current Sensor Circuit High Voltage

DTC P1E2F

Auxiliary Transmission Fluid Pump Phase V Current Sensor Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor generator based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. This is an internal fault detection of the power inverter module. This fault is handled inside the power inverter module and no external circuits are involved.

Each motor control module operates its respective drive motor based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls its respective motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each motor operates utilizing 3-phase alternating current AC electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor generator. Each phase is individually identified as U, V, and W. Each motor control module monitors the current of each phase in order to detect out of range current conditions.

Because each individual motor's phase circuits are electrically joined together, the phases normally flow about the same amount of current. The motor control module performs a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

The vehicle is ON or the module is awake.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Actions Taken When the DTC Sets

- DTCs P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F, are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F, are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E2A, P1E2B, P1E2C, P1E2D, P1E2E, P1E2F is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power

inverter module.

- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E34-P1E36: AUXILIARY TRANSMISSION FLUID PUMP INVERTER TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E34

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit High Voltage

DTC P1E35

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit Low Voltage

DTC P1E36

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Performance

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON or the module is awake.
- Motor temperature is greater than -20°C (-4°F). If motor temperature is less than -20°C (-4°F) at vehicle ON, the drive motor must operate at greater than 20 N.m (14.75 lb ft) for a cumulative time of 1.5 minutes before the DTC will run.

P1E34

- The vehicle is ON or the module is awake for more than 10 minutes.

- The drive motor(s) have been operating.

P1E35

The vehicle is ON or the module is awake.

P1E36

- The inverter temperature is greater than -20°C (-4°F).
- P0AF0 and P0AEF are not present.

Conditions for Setting the DTC

P1E34

The inverter phase temperature sensor is less than -50°C (-58°F) for 3 seconds. If the fault is detected at the start of a drive cycle the DTC will set after 600 s.

P1E35

The inverter phase temperature sensor is greater than 170°C (338°F) for 3 s.

P1E36

A 20°C (36°F) difference is observed between the individual inverter phase temperature sensor and the average of the Hybrid Electronics Coolant Temperature and the Transmission Fluid Temperature.

Actions Taken When the DTC Sets

DTCs P1E34, P1E35, and P1E36 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1E34, P1E35, and P1E36 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E34, P1E35, or P1E36 is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set.

4. All OK

- **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1E37: AUXILIARY TRANSMISSION FLUID PUMP INVERTER HIGH TEMPERATURE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E37

Auxiliary Transmission Fluid Pump Inverter High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The inverter temperature sensor is part of the power inverter module and is not serviced separately.

Conditions for Setting the DTC

The pump inverter temperature sensor is greater than 122Â°C (252Â°F).

Actions Taken When the DTC Sets

- DTC P1E37 is a Type A DTC.
- The hybrid/EV powertrain control module 1 may command the engine into derate mode.

Conditions for Clearing the DTC

DTC P1E37 is a Type A DTC.

Diagnostic Aids

- Ask about the customer's driving habits, trailer towing, etc.
- Ensure the engine cooling system is functioning normally.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1E36 is not set.
 - **If the DTC is set**
Refer to DTC P1E34-P1E36.
 - **If the DTC is not set**
3. Verify that DTC P0C11, P0C12, P0C13, P0C14, P0C15, or P0C16 is not set.
 - **If any of the DTCs are set**
Refer to DTC P0C11-P0C16.
 - **If none of the DTCs are set**
4. Verify DTC P1E37 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 4. All OK
 - **If the DTC is not set**
5. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1E38: AUXILIARY TRANSMISSION FLUID PUMP INVERTER SUPPLY VOLTAGE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E38

Auxiliary Transmission Fluid Pump Inverter Supply Voltage Circuit

Circuit/System Description

The power inverter motor, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

Vehicle is ON or module is awake.

Conditions for Setting the DTC

The control module does not detect voltage at the insulated gate bi-polar transistor bias power supply.

Actions Taken When the DTC Sets

- DTC P1E38 is a Type A DTC.
- Propulsion is disabled.

Conditions for Clearing the DTC

DTC P1E38 is a Type A DTC.

Diagnostic Aids

To assist in troubleshooting and duplicating intermittent failure conditions, observe the Freeze Frame/Failure Records data. This is especially important to do before programming or replacing the power inverter module.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or the T12 Transmission.
2. Disconnect the X4 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the each of the AC circuit terminals listed below and ground for each phase of the G5 Transmission Fluid Pump - Electric/Auxiliary:
 - X4 terminal 3 phase U
 - X4 terminal 2 phase V
 - X4 terminal 1 phase W
 - **If less than infinite resistance**

Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.

- **If infinite resistance**

4. Verify DTC P1E38 does not set.

- **If the DTC sets**

1. Perform each of the operations listed below one at a time until the fault is corrected.

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration

2. Replace the T6 Power Inverter Module.

3. Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.

2. Repeat the DTC check.

- **If the DTC does not set**

5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) for G5 Transmission Fluid Pump - Electric/Auxiliary, often referred to as the A/Trans Fluid Pump Motor, replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E39: AUXILIARY TRANSMISSION FLUID PUMP INVERTER PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E39

Auxiliary Transmission Fluid Pump Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. Each motor control module controls its respective motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each insulated gate bipolar transistor assembly is monitored for fault conditions. The motor control modules are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

Vehicle is ON or Charge Mode is active.

Conditions for Setting the DTC

The motor control module detects excessive current flow through the switched portion of the insulated gate bipolar transistor.

Actions Taken When the DTC Sets

- DTC P1E39 is a Type A DTC.
- Propulsion is disabled.

Conditions for Clearing the DTC

DTC P1E39 is a Type A DTC.

Diagnostic Aids

To assist in troubleshooting and duplicating intermittent failure conditions, observe the Freeze Frame/Failure Records data. This is especially important to do before programming or replacing the power inverter module.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the [High Voltage Disabling](#) procedure for servicing the T6 Power Inverter Module or the T12 Transmission.
2. Disconnect the X4 harness connector at the T6 Power Inverter Module.
3. Test for infinite resistance between the each of the AC circuit terminals listed below and ground for each phase of the G5 Transmission Fluid Pump - Electric/Auxiliary:
 - Terminal 3 phase U
 - Terminal 2 phase V
 - Terminal 1 phase W
 - **If less than infinite resistance**

Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.
 - **If infinite resistance**
4. Verify DTC P1E39 does not set.
 - **If the DTC sets**
 1. Perform each of the operations listed below one at a time until the fault is corrected.

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration
2. Replace the T6 Power Inverter Module.
3. Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.

2. Repeat the DTC check.

- **If the DTC does not set**

5. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) for G5 Transmission Fluid Pump - Electric/Auxiliary, often referred to as the A/Trans Fluid Pump Motor, replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E3A: AUXILIARY TRANSMISSION FLUID PUMP MOTOR TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E3A

Auxiliary Transmission Fluid Pump Motor Torque Delivered Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains two motor control modules and the hybrid/EV powertrain control module 1. The two motor control modules operate their respective drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is between 11.0 - 16.0 V.
- Auxiliary transmission fluid pump torque command is greater than 6.5 N.m (4.8 lb ft).

Conditions for Setting the DTC

The actual auxiliary transmission fluid pump speed is more than 200 RPM different from the commanded speed.

Actions Taken When the DTC Sets

DTC P1E3A is a Type A DTC.

Conditions for Clearing the DTC

DTC P1E3A is a Type A DTC.

Diagnostic Aids

There should always be other hybrid/EV powertrain or motor control module DTCs set along with DTC P1E3A. Always diagnose other DTCs before addressing this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify that no other hybrid/EV powertrain or motor control module DTC is set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
2. Verify DTC P1E3A is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets.
 1. Replace the G5 Automatic Transmission Fluid Pump.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set
 3. All OK
 - If the DTC is not set.
 - 3. All OK
 - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) for G5 Automatic Transmission Fluid Pump, often referred to as the A/Trans Fluid Pump Motor, replacement

- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1E4A OR P1E4B: CONTROL MODULE REDUNDANT DRIVE MOTOR 1-2 SPEED SENSING CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E4A

Control Module Redundant Drive Motor 1 Speed Sensing Circuit

DTC P1E4B

Control Module Redundant Drive Motor 2 Speed Sensing Circuit

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the motor control module to determine the exact position, speed and direction of the drive motor. The hybrid/EV powertrain control module 1 also calculates motor speed. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- This diagnostic runs one time at vehicle ON.
- System voltage is greater than 11 V.
- No serial data communication faults.

Conditions for Setting the DTC

The calculated motor speed is greater than 400 RPM different from the measured speed for 3 s within a 5 s window.

Actions Taken When the DTC Sets

- DTC P1E4A is a Type A DTC.
- DTC P1E4B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC P1E4A is a Type A DTC.
- DTC P1E4B is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
 - **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .
 - **If none of the DTCs are set**
3. Verify DTC P1E4A or P1E4B is not set.
 - **If any of the DTCs are set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set.
 - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1F00: AUXILIARY TRANSMISSION FLUID PUMP INVERTER TEMPERATURE SENSOR CIRCUIT ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1F00

Auxiliary Transmission Fluid Pump Inverter Temperature Sensor Circuit Erratic

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON or the module is awake.
- The module has been awake for more than 10 minutes.

Conditions for Setting the DTC

The inverter phase temperature sensor signal is intermittent.

Actions Taken When the DTC Sets

DTC P1F00 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1F00 is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1F00 is not set.
 - **If the DTC is set**
 1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set
 4. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1F63-P1F65: HYBRID/EV SYSTEM VOLTAGE DISCHARGE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1F63

Hybrid/EV System Voltage Discharge Circuit Performance

DTC P1F64

Hybrid/EV System Voltage Discharge Circuit Low Voltage

DTC P1F65

Hybrid/EV System Voltage Discharge Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

P1F63

- High voltage as measured by the power inverter module prior to commanding discharge is greater than 330 V.
- The high voltage main contactors are commanded OPEN.
- High voltage as measured by the power inverter module after discharge completes is less than 200 V.
- Drive motor speeds are less than 200 RPM.

P1F64 or P1F65

The vehicle is ON or the module is awake.

Conditions for Setting the DTC

DTC P1F63

The high voltage as measured by the power inverter module does not decrease by 20 V or greater within 0.1 seconds of commanding the discharge circuit ON.

DTC P1F64

The module internal diagnostic circuit detects the discharge resistor circuit is OPEN.

DTC P1F65

The module internal diagnostic circuit detects the discharge resistor circuit is shorted.

Actions Taken When the DTC Sets

DTCs P1F63, P1F64, and P1F65 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P1F63, P1F64, and P1F65 are Type A DTCs.

Diagnostic Aids

Low 12 V system voltage may cause one or more of these DTCs to set.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC is not set.

- **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .

- **If none of the DTCs are set**

3. Verify DTC P1F63, P1F64, or P1F65 is not set.

- **If any of the DTCs are set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.
 - If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
 - If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
 - If the DTC sets, replace the T6 Power Inverter Module.
 - If the DTC does not set

4. All OK.

- **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P2797: AUXILIARY TRANSMISSION FLUID PUMP PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2797

Auxiliary Transmission Fluid Pump Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains three motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motor based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9 V.
- Auxiliary transmission fluid pump speed is greater than 5 RPM.

Conditions for Setting the DTC

The actual auxiliary transmission fluid pump speed is not within a calibrated threshold of the commanded speed.

Action Taken When the DTC Sets

- DTC P2797 is a Type A DTC.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P2797 is a Type A DTC.

Diagnostic Aids

- Usually, other hybrid/EV powertrain or motor control module DTCs set along with DTC P2797. Always diagnose other DTCs before addressing this DTC.
- This DTC may set if the vehicle is run out of fuel while driving.
- This DTC may be set if the high voltage contactors open while the Auxiliary Transmission Fluid Pump has been commanded on using the Scan Tool.
- This DTC may be set if the transmission fluid gets too hot. Causes of transmission overheating include transmission fluid level that is either too low or too high.

Reference Information

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Verify that no other hybrid/EV powertrain or motor control module DTC is set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

NOTE: Fluid level that is either too high or too low can result in overheating.

2. Verify the transmission fluid level and condition is correct and inspect for other causes of transmission overheating. Refer to [Transmission Fluid Level and Condition Check](#) , and [Transmission Overheats](#) .

- **If a condition was found**

Repair as necessary.

- **If a condition was not found**

3. Verify DTC P2797 is not set.

- **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

2. Verify the DTC does not set.

- If the DTC sets.

1. Replace the G5 Transmission Fluid Pump - Electric/Auxiliary.

2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.

- **If the DTC is not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#) G5 Transmission Fluid Pump - Electric/Auxiliary, often referred to as the A/Trans Aux Fluid Pump Motor, replacement
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P3260: INTERNAL CONTROL MODULE DRIVE MOTOR CONTROL PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P3260

Internal Control Module Drive Motor Control Performance

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors for the engine speed and drive motor torque to go below calibrated limits when the transmission is shifted into Neutral. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Automatic transmission manual shift shaft is in Neutral.
- No Vehicle Speed DTCs or P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3 internal mode switch DTCs are set.
- Vehicle speed is less than 3 MPH (5 km/h).

Conditions for Setting the DTC

NOTE: There is a running calibration change for model year and a service release for model year 2016. Re-program the controller first and then check the following conditions.

Either of the following conditions is detected 33 seconds after the Conditions for Running the DTC have been met:

- Drive Motor A torque is greater than 4.
- OR
- Engine speed is greater than 200 RPM.

Action Taken When the DTC Sets

DTC P3260 is a Type A DTC.

Conditions for Clearing the DTC

DTC P3260 is a Type A DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify DTCs that inhibit Autostop operation, or stuck clutch DTCs P07A3 or P07A5, or pressure controls solenoid DTCs P0960, P0962, or P0963 are not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

2. Verify DTC P3260 is not set.

- **If the DTC is set**

1. Verify the T6 Power Inverter Module has the latest calibration in Calibration Information.

- If the T6 Power Inverter Module does not have the latest calibration, program the T6 power inverter module.
- If the T6 Power Inverter Module has the latest calibration, replace the T6 Power Inverter Module.

NOTE: **The transmission must be in Neutral for greater than 33 seconds.**

2. Vehicle ON, verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC is not set

3. All OK.

- **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup

SYMPTOMS - HYBRID CONTROLS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions.

Refer to the following procedures:

- **Drive Motor Power Inverter Module Description and Operation**

- [High Voltage Monitoring Systems Description](#)
- [Hybrid Modes of Operation Description](#)
- [Drive Motor Battery System Description](#)
- [Transmission General Description](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Hybrid System. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [DC Power Conversion Test](#)
- [Drive Mode Select Switch Malfunction](#)

DRIVE MODE SELECT SWITCH MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	Stuck in Normal Mode	Stuck in Normal Mode	-	P1762
Ground	-	Stuck in Normal Mode	-	P1762

Circuit/System Description

The body control module (BCM) monitors the state of the drive mode select switch. The BCM sends the drive mode select switch signal message to the ECM over the serial data circuits. The ECM uses this message to determine the following driver selected mode of operation:

- Normal
- Sport
- Mountain
- Hold, some models

Diagnostic Aids

- Under normal operation, when the DRIVE MODE button is pressed, the drive mode select switch closes and the scan tool BCM Drive Mode Select Switch parameter displays Active. When the DRIVE MODE button is released, the switch opens, the parameter displays Inactive, and the driver information center display is updated.
- When attempting to run or set ECM serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete ECM shutdown.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify the scan tool BCM Drive Mode Select Switch parameter displays Inactive when DRIVE MODE button is not pressed and Active when pressed and held.

- **If the BCM Drive Mode Select Switch parameter does not indicate the correct status**

Refer to Circuit/System Testing.

- **If the BCM Drive Mode Select Switch parameter indicates the correct status**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S126 Drive Mode Select Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**

3. Vehicle ON.
4. Verify the scan tool BCM Drive Mode Select Switch parameter displays Inactive.
 - **If the parameter does not display Inactive**
 1. Vehicle OFF, disconnect the X6 harness connector at the K9 BCM.
 2. Test for infinite resistance between the signal circuit terminal 22 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 BCM.
 - **If the parameter displays Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 4.
6. Verify the scan tool BCM Drive Mode Select Switch parameter displays Active.
 - **If the parameter does not display Active**
 1. Vehicle OFF, remove the jumper wire, disconnect the X6 harness connector at the K9 BCM.
 2. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 BCM.
 - **If the parameter displays Active**
7. Test or replace the S126 Drive Mode Select Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S126 Drive Mode Select Switch.
2. Test for infinite resistance between the signal terminal 1 and the ground terminal 4 with the switch in the open position.
 - **If less than infinite resistance**

Replace the S126 Drive Mode Select Switch.
 - **If infinite resistance**
3. Test for less than 2 Ω between the signal terminal 1 and the ground terminal 4 with the switch in the closed position.
 - **If 2 Ω or greater**

Replace the S126 Drive Mode Select Switch.
 - **If less than 2 Ω**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for K9 Body Control Module replacement, programming, and setup
- Refer to [Radio Control Assembly Replacement](#) for S126 Drive Mode Select Switch replacement

DC POWER CONVERSION TEST

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

The 14 V power module, often referred to as the accessory DC power control module, supplies the energy that flows between the high voltage (360 V) direct current (DC) and low voltage (14 V) DC to charge the 12 V battery and to operate the power accessories. The ECM controls the 14 V power module by supplying 5 V pulse width modulated (PWM) signal through a control circuit. The 14 V power module sends 5 V PWM feedback signal to the ECM through the feedback circuit. The 14 V power module generates more power as the commanded duty cycle increases.

Diagnostic Aids

Using a carbon pile tester is the preferred method to test the 14 V power module. The carbon pile tester can put an increasing load on the system to reach a target current level. If a carbon pile tester is not available, the alternative method is using the scan tool 14 V power module setpoint.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle OFF.
2. Measure and record the C1 battery voltage at the C1 battery terminals. The C1 battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the vehicle OFF.
 - **If not within the specified range**
 Refer to [Battery Inspection/Test](#) .
 - **If within the specified range**
3. Vehicle ON, accessories OFF.
4. Measure and record the C1 battery voltage at the C1 battery terminals. The voltage should be at least 1 V greater than the voltage measured in step 1 but less than 15.6 V.
 - **If not within the specified range**

Refer to Circuit/System Testing.

- **If within the specified range**

5. All OK.

Circuit/System Testing

NOTE: If a carbon pile tester is available, refer to With Carbon Pile Tester section. Otherwise, refer to Without Carbon Pile Tester section.

With Carbon Pile Tester

1. Vehicle ON.
2. Verify that no K1 14 V Power Module or B18 Battery Current Sensor DTCs are set that would cause a charging system concern.

- **If an applicable DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no applicable DTCs are set**

3. Vehicle OFF.
4. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.

- **If not within the specified range**

Refer to [Battery Inspection/Test](#) .

- **If within the specified range**

5. Connect a carbon pile tester to the C1 Battery.
6. Vehicle ON, turn all accessories off. Observe the voltage reading on the tester. The voltage should read between 12.6 - 15.5 V.
7. Adjust the carbon pile tester so that the Low - Voltage Battery Current parameter on the 14 V Power Module data list of the Engine Control Module is reading 160 amps.
8. Verify the voltage reading remains between 12.6 - 15.5 V.

- **If not within the specified range**

Replace the K1 14 V Power Module.

- **If within the specified range**

9. All OK.

Without Carbon Pile Tester

1. Vehicle ON.
2. Verify that no K1 14 V Power Module or B18 Battery Current Sensor DTCs are set that would cause a charging system concern.

- **If an applicable DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no applicable DTCs are set**

3. Vehicle OFF.

4. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.

- **If not within the specified range**

Refer to [Battery Inspection/Test](#) .

- **If within the specified range**

5. Vehicle ON.

6. Verify the scan tool Engine Control Module Ignition 1 Signal parameter continually increases when controlling the Engine Control Module 14 V Power Module Setpoint from 10 - 80% with a scan tool. It may take up to 10 s for the battery voltage to stabilize between each setpoint change.

- **If the battery voltage does not continually increase**

Replace the K1 14 V Power Module.

- **If the battery voltage continually increases**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K1 14 V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup

REPAIR INSTRUCTIONS

ACCESSORY DC POWER CONTROL MODULE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Rear Compartment Floor Stowage Trim Compartment. Refer to [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

3. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
4. Drain the cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

CAUTION: Ensure the cooling system is drained, and hoses are removed prior to disconnecting any electrical connections. Failure to do this may result in damage to the electrical connectors or components. Any damaged electrical connectors or components must be replaced.

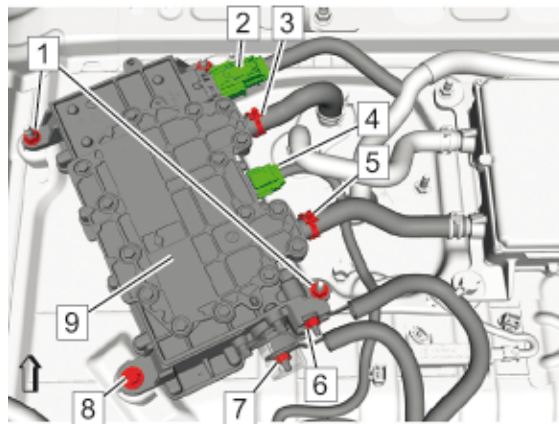


Fig. 6: Accessory DC Power Control Module, Bolt, Nuts, Coolant Hoses, Clamps And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

5. Loosen Clamps (3, 5) (Qty: 2) using **BO-38185** pliers
6. Remove Coolant Hoses (Qty: 2)
7. Disconnect Electrical Connectors (2, 4)
8. Remove the battery positive and negative cable nut (APM ground cable) (6).
9. Remove the battery positive and negative cable nut (B+ APM Module to Battery Fuse Block) (7).
10. Remove 2 the accessory dc power control module nuts (1).
11. Remove the accessory dc power control module bolt (8).
12. Remove the accessory dc power control module (9).

Installation Procedure

CAUTION: Ensure that all electrical connections are made before the hoses are connected, and the cooling system is filled. Failure to do this may result in damage to the electrical connectors or components. Any damaged electrical connectors or components must be replaced.

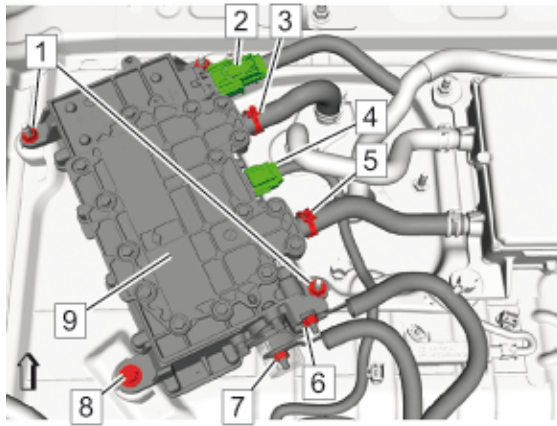


Fig. 7: Accessory DC Power Control Module, Bolt, Nuts, Coolant Hoses, Clamps And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

1. Install the accessory dc power control module (9).

CAUTION: Refer to [Fastener Caution](#)

2. Install the accessory dc power control module bolt (8) and tighten to 22 N.m (16 lb ft).
3. Install 2 the accessory dc power control module nuts (1) and tighten to 22 N.m (16 lb ft).
4. Install the battery positive and negative cable nuts (B+ APM Module to Battery Fuse Block) (7) and tighten to 22 N.m (16 lb ft).
5. Install the battery positive and negative cable nut (APM ground cable) (6) and tighten to 22 N.m (16 lb ft).
6. Connect Electrical Connectors (2, 4)
7. Install Coolant Hoses (Qty: 2)
8. Install Clamps (3, 5) (Qty: 2) using **BO-38185** pliers
9. Fill the cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
10. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
11. Install Rear Compartment Floor Stowage Trim Compartment. Refer to [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
12. Enable high voltage system. Refer to [High Voltage Enabling](#)

DESCRIPTION AND OPERATION

ACCESSORY DC POWER CONTROL MODULE DESCRIPTION AND OPERATION

Location

The 14 V power module, also called the accessory DC power control module, is located in the rear trunk compartment underneath the floor stowage trim panel. It is attached to the chassis with four fasteners. The 14 V power module is cooled with pre-mixed Dexcool® circulating through a cooling system that is separate from the engine cooling system.

The 14 V power module is an electronic device that takes the place of the generator on a traditional vehicle. On a

hybrid or electric vehicle the 14 V power module converts high voltage (300 V) direct current (DC) to low voltage (12 V) DC for accessory electrical operation and to charge the 12 V battery.

Normally, the 14 V power module only supplies 12 V DC when the vehicle is under a normal drive cycle. However there are certain instances when the vehicle is being charged through a standard wall socket where the 14 V power module operation is required to sustain the 12 V battery.

The 14 V power module is capable of supplying up to 130 Amps of 12 V DC.

Communication and Hosted Diagnostics

The 14 V power module has no internal diagnostic tests and does not communicate over serial data. The engine control module (ECM) monitors and controls the 14 V power module and will report DTCs if a fault is detected.

Circuit Inputs

Inputs to the 14 V power module include the high voltage and 12 V circuits. The 14 V power module also has a pulse width modulated set point input from the engine control module (ECM). This input enables conversion of voltage from high to the desired 12 V output level.

For more information on the 12 V Battery Charging System, refer to [**Charging System Description and Operation**](#).

Circuit Outputs

Outputs

The only outputs supported by the 14 V power module are the status feedback circuit to the engine control module (ECM) and 12 V DC which powers the 12 V components in the vehicle and charges the 12 V battery.

Low voltage 12 V cables on the hybrid/EV vehicle do not require unique coloring or servicing procedures.

DRIVE MOTOR POWER INVERTER MODULE DESCRIPTION AND OPERATION

Overview

The power inverter module, often referred to as the drive motor generator power inverter module, converts high voltage direct current (DC) electrical energy to 3-phase alternating current (AC) electrical energy. It is mounted directly to the transmission and is cooled with pre-mixed DEX-COOLÂ® circulating through a cooling system that is separate from the engine cooling system. The hybrid cooling system utilizes a heat exchanger at the front of the vehicle and electric pumps to circulate the coolant. Refer to [**Hybrid/EV Cooling System Description and Operation**](#).

High Voltage Circuits

Direct Current (DC)

The power inverter module is connected to the positive and negative terminals of the high voltage DC hybrid/EV battery pack. Both of the negative and positive high voltage DC battery poles are electrically isolated from the vehicle chassis by a specific amount of resistance. Each high voltage DC bus is switched ON or OFF by a high voltage, high current contactor relay contained within the hybrid/EV battery pack. All high voltage DC negative and positive DC cables are individually shielded and orange in color to alert the technician to the potential presence of high voltage.

Three Phase Alternating Current (AC)

There two 3-phase motors in the transmission, connected directly to the power inverter module via ring terminals and

A/C connector rods. A single shielded cable connects the auxiliary transmission fluid pump to the power inverter module. This cable contains 3 individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump. The cable is orange in color to alert the technician to the potential presence of high voltage.

Drive Motor Generator Power Inverter Module

Overview

The power inverter module contains 2 motor control modules and the hybrid/EV powertrain control module 1. Two of the motor control modules operate their respective drive motors based upon power inverter module commands. The third motor control module controls the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. All four modules are flash-programmable microprocessors.

Hybrid Powertrain Control Module

Location

The hybrid/EV powertrain control module 1 is a non-serviceable, flash-programmable microprocessor contained within the power inverter module.

Operating Functions

The hybrid/EV powertrain control module 1 is the main controller of powertrain operation. The hybrid/EV powertrain control module 1 determines when to perform normal operating modes such as electric mode, extended range mode, and regenerative braking. The hybrid/EV powertrain control module 1 also operates in conjunction with the hybrid/EV powertrain control module 2 to determine when to enable and disable the DC high voltage circuits. Each motor control module operates the applicable motor based upon hybrid/EV powertrain control module 1 commands.

Communication and Hosted Diagnostics

The hybrid/EV powertrain control module 1 is the host controller for DTC information for the following control modules:

- Drive motor 1 control module
- Drive motor 2 control module
- Auxiliary transmission fluid pump control module

These modules diagnose their own operation and determine when a fault condition is present.

The motor control modules and the hybrid/EV powertrain control module 1 exchange information and commands on a serial peripheral interface bus internal communication circuit as well as the hi-speed GMLAN communication circuit.

In the event a hosted module communicates a fault condition, the hybrid/EV powertrain control module 1 will determine if one or more operating modes are affected and notify the vehicle operator by requesting the MIL illuminate and/or by displaying a message in the Driver Information Center. In addition, the hybrid/EV powertrain control module 1 will store the associated DTC information for retrieval by a scan tool. Some hosted modules may require an ignition cycle to clear certain DTCs from the hybrid/EV powertrain control module 1.

Circuit Inputs

In addition to data parameters, the hybrid/EV powertrain control module 1 directly monitors the following signal circuits:

- Transmission internal mode switch direction and Park/Neutral switch signals
- Crankshaft position sensor signal

Motor Control Modules

Location

Both of the drive motors and the auxiliary transmission fluid pump motor are located within the transmission. They are each controlled by their own motor control module; each module is a flash-programmable micro-processor. Each motor control module is contained within the power inverter module. Also contained within the power inverter module is the hybrid/EV powertrain control module 1 micro-processor.

Operating Functions

The motor control modules operate their respective motors based upon hybrid/EV powertrain control module 1 commands. Each motor control module controls the speed, direction, and output torque of its respective drive motor or the auxiliary transmission fluid pump through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors.

Communication and Hosted Diagnostics

In addition to the internal serial peripheral interface bus communication circuit that the hybrid/EV powertrain control module 1 and each motor control module control use to communicate, the motor control modules also communicate on the hi-speed and hybrid serial data circuits. The motor control modules do not store their own Diagnostic Trouble Code (DTC) information. The hybrid/EV powertrain control module 1 will store motor control module associated DTC information for retrieval by a scan tool. The scan tool can communicate directly with each motor control module in order to retrieve data parameters only.

Circuit Inputs

In addition to data parameters, each motor control module monitors its respective motor for voltage, current, speed, direction and temperature. Additionally, the motor control module monitors the insulated gate bipolar transistor components for temperature and proper operation. Some of the motor control module operation data is shared with the hybrid/EV powertrain control module 1.

Circuit Outputs

Each motor control module controls its respective insulated gate bipolar transistor driver board that in-turn controls each motor. The motors operate using 3 - phase AC electricity, and are connected directly to the power inverter module via ring terminals and A/C connector rods. A single shielded cable connects the auxiliary transmission fluid pump to the power inverter module. This cable contains 3 individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump. The cable is orange in color to alert the technician to the potential presence of high voltage.

ELECTROMAGNETIC COMPATIBILITY DESCRIPTION

Overview

Vehicles are typically subject to certain legal requirements that limit the amount of electromagnetic interference (EMI) that can be generated by the vehicles electronic devices. Additionally, the electronic devices within the vehicle must be able to withstand a certain amount of EMI without affecting their operation. EMI is generated whenever electrical current flows through a circuit. The amount of EMI generated, or amplitude, is usually dependent upon the amount of current flow, amperage, and the on-off pattern of current flow through the circuit, frequency. The EMI requirements are generally referred to as electromagnetic compatibility.

There are many ways of ensuring the vehicle meets electromagnetic compatibility requirements. These include:

- Adding capacitors and resistors to certain electrical circuits
- Regulating the frequency at which a component may operate
- Shielding the wires, cables and components

Circuit Design

The power inverter module, often referred to as the drive motor generator power inverter module, and the 14 V power module, often referred to as the accessory DC power control module, each contain filter capacitors connected to the high voltage circuits. These capacitors are necessary to reduce the voltage spikes that occur as a result of the switching of current On and Off. Reducing voltage spikes reduces EMI. The frequency of current switching is also closely regulated. Too high a frequency can cause an increase in EMI generation.

Wiring/Cable Design

Different types of wire/cable shielding methods are utilized in the vehicle. Common types of circuit shielding include twisted-pair and internal braid or foil. Twisted pair is typically used in circuits such as serial data circuits. The wire pair is twisted together at a particular turns-per-length ratio. Shielded cable is utilized for all other circuits requiring either protection from external EMI or to reduce EMI radiation of the cable itself into other nearby components or circuits.

High Voltage Cable

- 300-Volt Battery Positive and Negative Cable
- Air Conditioning and Drive Motor Battery Cooling Compressor

The high voltage cables utilize internal braid shielding. Typically, both ends of the internal braid shield are attached to chassis ground. All of the high voltage, internally shielded cables are grounded at their cable end attachment points. Mounting blocks, where used, perform the shield to chassis ground connection. Connection points not serviced with a mounting block utilize a separate ring terminal.

Low and Intermediate Voltage Wiring

The signal circuits for the transmission sensors utilize shielding protection. The drive motor position sensor circuits utilize internal foil shielding. The wiring harness external of the transmission assembly is connected to chassis ground with ring terminals at the power inverter module. The internal transmission wiring harness is attached to chassis ground with a ring terminal at the valve body assembly.

The auxiliary transmission fluid pump 3 phase cables utilize internal foil shielding. The wiring harness shield is connected to chassis ground within the power inverter module.

Component Shielding

Certain components utilize their structure to effectively shield EMI. Metal covers, chassis grounded metal cases and electro-magnetically conductive gaskets may all be part of a components electromagnetic compatibility design.

Shielding Loss

A loss of proper shielding may result in poor AM band radio reception and/or incorrect sensor circuit readings depending upon the location of the shield loss. Damage that has penetrated to the insulated conductor of high voltage cables is not repairable. Certain Low and Intermediate voltage shielded wiring harnesses may be repairable. Refer to [Wiring Repairs](#) , and [Splicing Twisted or Shielded Cable](#) .

HIGH VOLTAGE MONITORING SYSTEMS DESCRIPTION

The hybrid/EV system monitors several high voltage components for attempted access. Additionally, a minimum amount of isolation resistance is maintained at all times between both negative and positive poles of the hybrid/EV battery and the vehicle chassis. Microprocessors internal to the power inverter module, often referred to as the drive motor generator power inverter module, and the hybrid/EV powertrain control module 2 monitor the hybrid/EV system for access and loss of isolation.

High Voltage Interlock Circuit

The high voltage interlock circuit is a wire loop that passes through certain high voltage components. The high voltage interlock circuit is used to determine if access to high voltage components is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV system may react to the loss of high voltage interlock circuit continuity by opening the high voltage contactor relays and discharging the high voltage capacitors. The high voltage interlock circuit signal is generated by the hybrid/EV powertrain control module 2. The high voltage interlock circuit status is monitored by the hybrid/EV powertrain control module 2.

High Voltage DC Chassis Isolation

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set. Additional information can be found in [Hybrid/EV System High Voltage Isolation Description](#).

HYBRID MODES OF OPERATION DESCRIPTION

Vehicle Operating Modes Description

This vehicle is an Extended Range Electric Vehicle. It uses an electric propulsion system to drive the vehicle at all times. Electricity is the vehicle's primary source of energy, while gasoline is the secondary source.

The vehicle has two modes of operation - Electric and Extended Range. In both modes, the vehicle is propelled by the electric motors that are internal to the transmission. Electrical energy is converted into mechanical energy to drive the wheels and propel the vehicle. The vehicle's performance remains the same in either mode.

This overview is not a comprehensive list of all aspects of the Extended Range Electric Vehicle. Refer to Automatic Transmission 5ET50 [Electronic Component Description](#) for information regarding transmission operation. More detailed and comprehensive information is also available through the dealer training program.

Electric Mode

Electric Mode is the primary mode of operation for this vehicle. While in Electric mode, the vehicle is powered by electrical energy stored in the high voltage hybrid/EV battery pack. The vehicle can operate in this mode for a range of up to 40 - 80 km (25 - 50 miles) until the battery has reached a low state of charge.

Extended Range Mode

When the vehicle reaches the end of its electric range, it switches to Extended Range Mode. In this mode, electricity is produced by the drive motor, which is driven by the internal combustion engine (ICE). This secondary source of electric power extends the vehicle range. Operation will continue in extended range mode until the vehicle can be plugged in to recharge the hybrid/EV battery pack and restore electric mode.

The hybrid/EV battery pack will continue to provide some power and work together with the ICE to provide peak performance when it is required, such as driving up a steep incline or during high acceleration. The hybrid/EV battery pack will not be recharged while in extended range mode.

Internal Combustion Engine (ICE) Starting

This vehicle does not use a 12 V starter motor to crank the ICE. A much more powerful 300 V motor, drive motor 1, located within the transmission is utilized to crank the ICE. Drive motor 1 can rotate the ICE to operating speed within just a few hundred milliseconds. This allows near-instant starting of the ICE.

The vehicle's on-board computers determine when the ICE needs to run. Some of the normal vehicle conditions that force the ICE to run are:

- The hybrid/EV battery pack has a low state of charge
- The hood is open or not completely latched
- The ICE is needed to maintain the hybrid/EV battery pack temperature
- The ICE needs to run for maintenance
- Extremely low ambient temperatures

When the hood is open, the ICE will run without turning off. The hybrid/EV battery pack is neither charged nor discharged when this occurs.

Some hybrid/EV battery pack faults will cause the ICE to run without turning off.

Service Mode

Service Mode is available for service and diagnostics and to verify the proper operation of the MIL and may be required for emission inspection purposes. With vehicle OFF, and the brake pedal not applied, pressing and holding the POWER button for more than 5 seconds will place the vehicle in Service Mode. The instruments and audio systems will operate as they do in ON, but the vehicle will not be able to be driven. The propulsion system will not start in Service Mode.

Engine Unavailable

If the vehicle runs out of fuel, or the power inverter module has detected the ICE will not start due to a malfunction, the vehicle can continue to be driven in Electric Mode.

Propulsion Power is Reduced

This message comes on any time the battery is reporting less than 35 kW of power available for any reason. This message will NOT require service by a dealer unless the Propulsion Power Reduced message is accompanied by a Malfunction Indicator Lamp.

- This message may appear while severe highway grades, even in Mountain Mode.
- This message may appear on start up if the battery is at or below -15°C (5°F), possibly from the vehicle sitting outside unplugged in the winter.
- This message may appear in Normal or Sport mode in non-mountainous terrain, typically with aggressive driving. When this message appears with aggressive driving, the battery reserve has been depleted.

Maintenance Modes

Engine Maintenance Mode

Engine Maintenance Mode runs the engine to keep it in good working condition when the vehicle has been operated in Electric Mode only for a prolonged period. Engine Maintenance Mode will run the ICE, even if the hybrid/EV battery pack state of charge is sufficient to operate the vehicle in Electric Mode.

Fuel Maintenance Mode

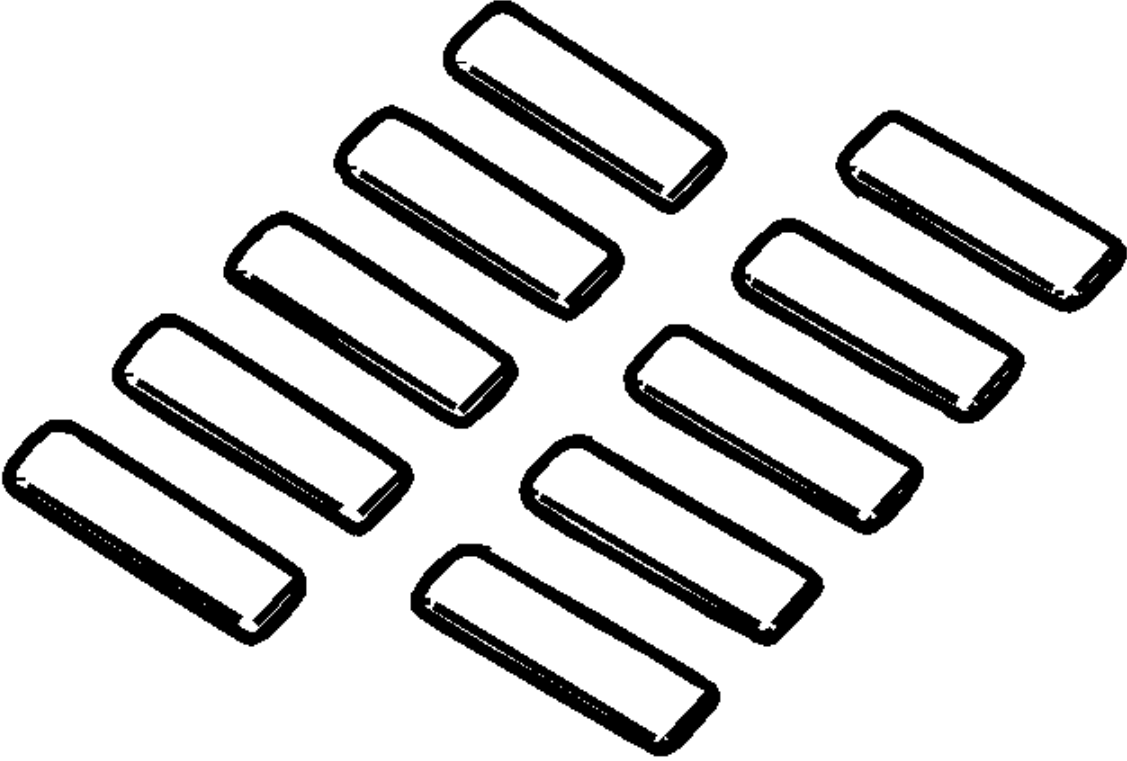
When only Electric Mode is used for a prolonged period, Fuel Maintenance Mode will run the ICE to use up old fuel. The ICE will run until enough fresh fuel is added or a low fuel level is detected. During Fuel Maintenance Mode the ICE may cycle on and off.

Regenerative Braking

When the vehicle is coasting or braking the power inverter module may operate the drive motor as a generator in an Electrical Generation Mode. Operating as an electrical generator, the drive motor exerts a driveline load that helps to slow the vehicle. The electrical energy that the drive motor creates is transferred by the power inverter module to the hybrid/EV battery pack. Constant communication between the power inverter module and the electronic brake control module allows the blending of regenerative braking force with hydraulic braking force.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	EL-48569 Terminal Covers

ELECTRICAL

Hybrid/EV Energy Storage - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
300 - Volt Battery Positive and Negative Cable Fastener	9 N.m (80 lb in)
300 - Volt Battery Positive and Negative Cable Retainer Fastener	9 N.m (80 lb in)
Auxiliary Generator Battery Jumper Cable Bolt	9 N.m (80 lb in)
Auxiliary Generator Battery Jumper Cable Fastener	9 N.m (80 lb in)
Battery Cooling Plate Hose Clamp	2.1 N.m (19 lb in)
Battery Hold Down Retainer Fastener	9 N.m (80 lb in)
Battery Tray Front Brace Fastener	9 N.m (80 lb in)
Battery Tray Front-Rear Brace Fastener	9 N.m (80 lb in)
Cell Battery Cooling Manifold Inlet Hose Clamp	2.5 N.m (22 lb in)
Cell Battery Cooling Manifold Outlet Hose Clamp	2.5 N.m (22 lb in)
Drive Motor Battery Tray Bolt	58 N.m (43 lb ft)
Drive Motor Battery Tray Bolt (Rear Cross-Bar)	22 N.m (16 lb ft)
Engine Wiring Harness Ground Nut	9 N.m (80 lb in)
Fuse Block Cover Fastener	2.5 N.m (22 lb in)
Generator Battery Current Sensor Fastener	9 N.m (80 lb in)
Ground Cable Nut	9 N.m (80 lb in)
Ground Strap Nut	9 N.m (80 lb in)
High Voltage Battery Cover Fastener	9 N.m (80 lb in)
High Voltage Battery High Voltage Manual Disconnect Connector Fastener	9 N.m (80 lb in)
High Voltage Battery Positive Cable Fastener	9 N.m (80 lb in)
High Voltage Battery Positive Cable Bracket Fastener	9 N.m (80 lb in)
Inspection Plug Fastener	9 N.m (80 lb in)
Pass-Through Grommet Fastener	9 N.m (80 lb in)
Power Inverter Module Connector Cover Bolt	9 N.m (80 lb in)
Power Inverter Module Connector Cover Nut	9 N.m (80 lb in)
Power Inverter Module High Voltage Cable Cover Bolt	9 N.m (80 lb in)
T6 Power Inverter Module Cable Retainer Fastener	9 N.m (80 lb in)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
High Voltage Battery Cover Fasteners	Threadlocker	12345382	10953489

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV ENERGY STORAGE WIRING SCHEMATICS

Battery Energy Control Module Power, Ground and Data Communication

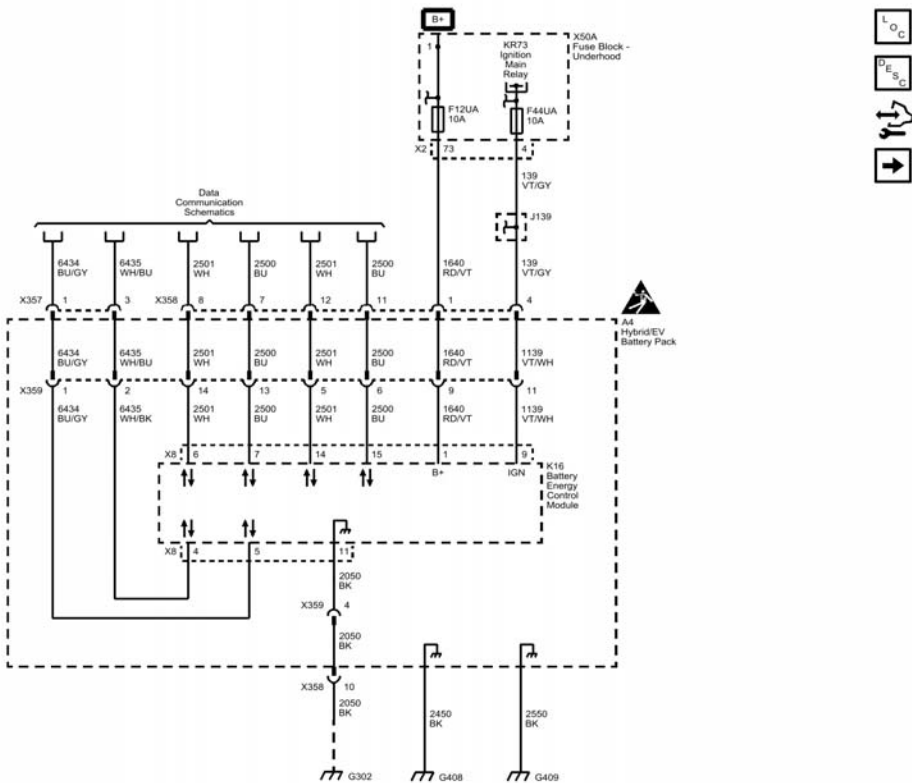


Fig. 1: Battery Energy Control Module Power, Ground and Data Communication
 Courtesy of GENERAL MOTORS COMPANY

K114B Hybrid Powertrain Control Module 2 Power, Ground, and Internal Battery Communication

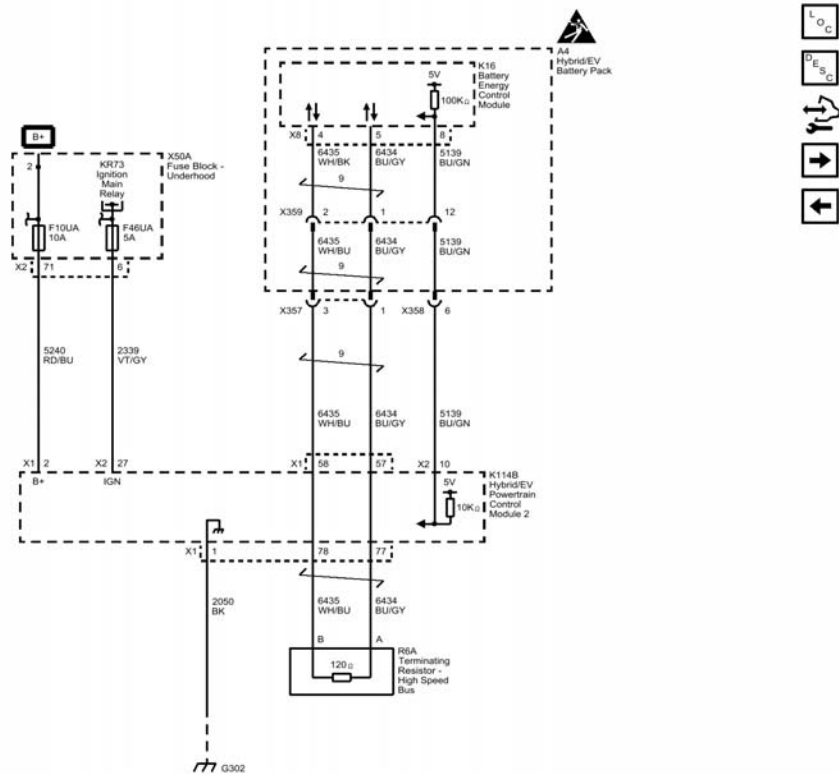


Fig. 2: K114B Hybrid Powertrain Control Module 2 Power, Ground, and Internal Battery Communication
 Courtesy of GENERAL MOTORS COMPANY

High Voltage Interlock Loop - Main

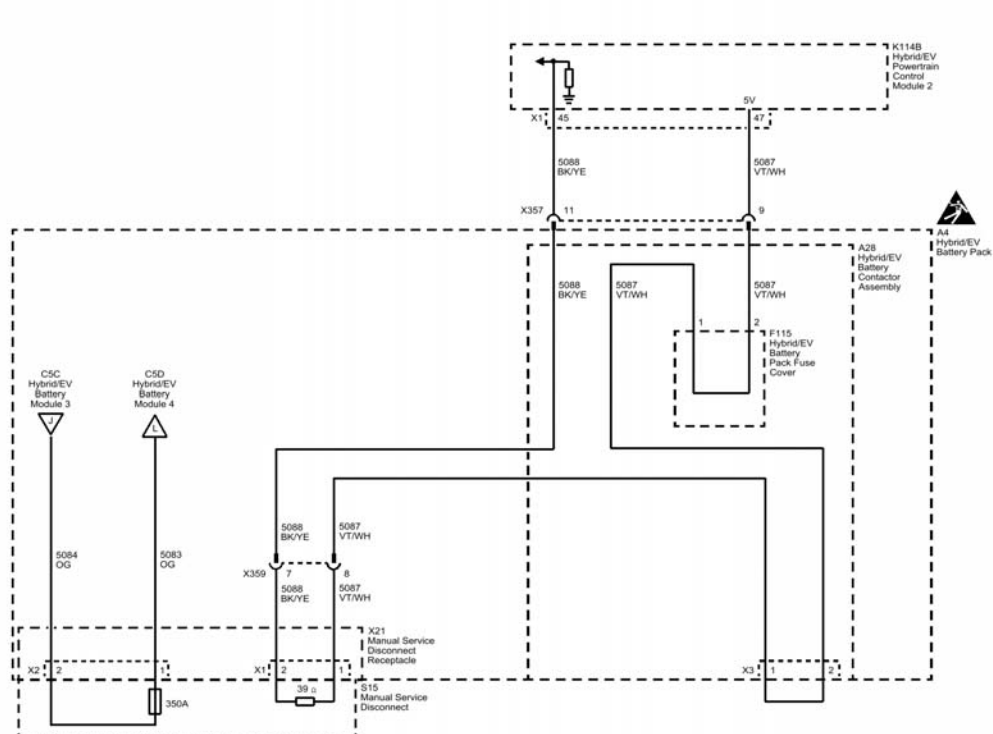


Fig. 3: High Voltage Interlock Loop - Main
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - Control

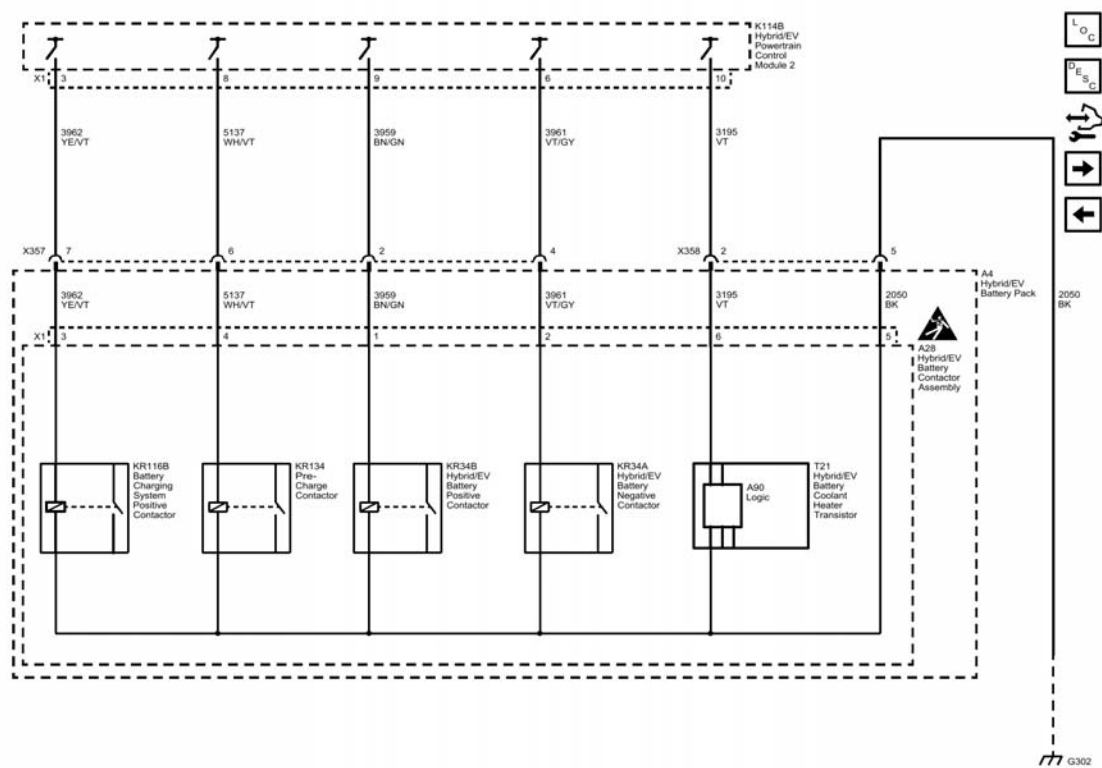


Fig. 4: High Voltage Contactors - Control
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors

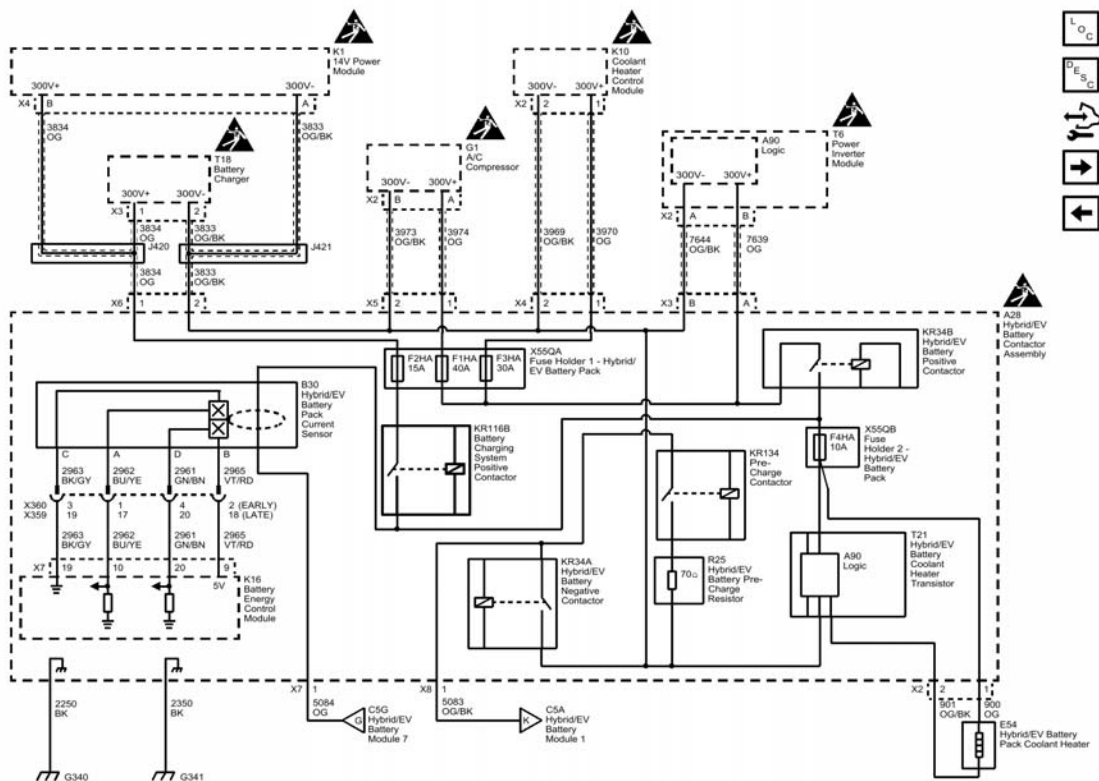


Fig. 5: High Voltage Contactors
 Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Section 1

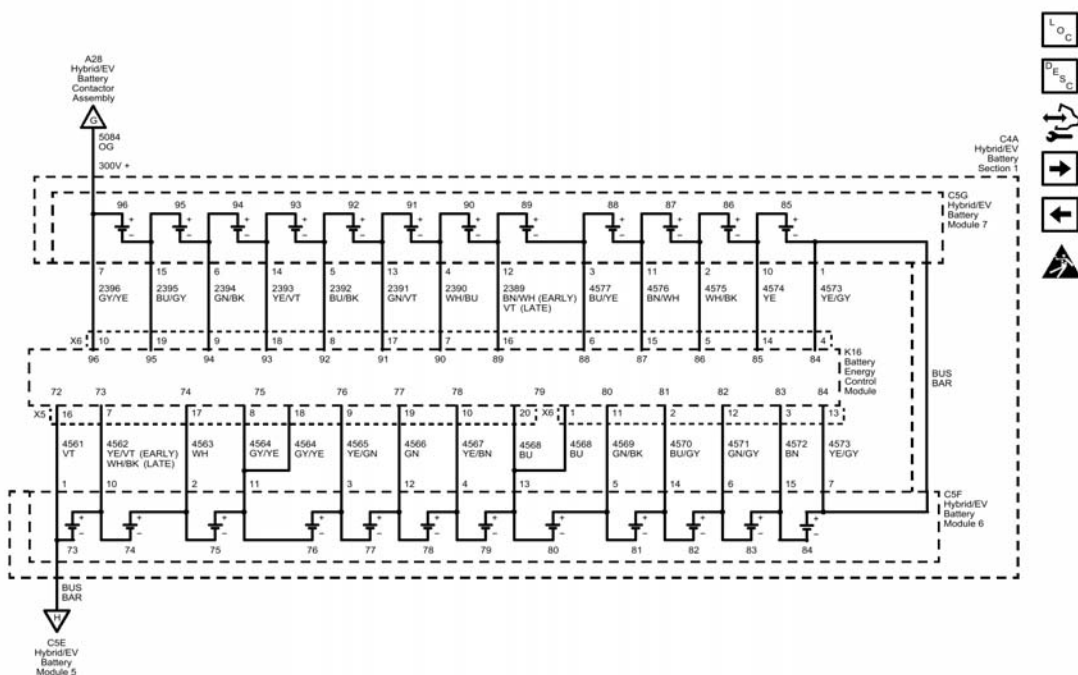


Fig. 6: Hybrid/EV Battery Section 1
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Section 2

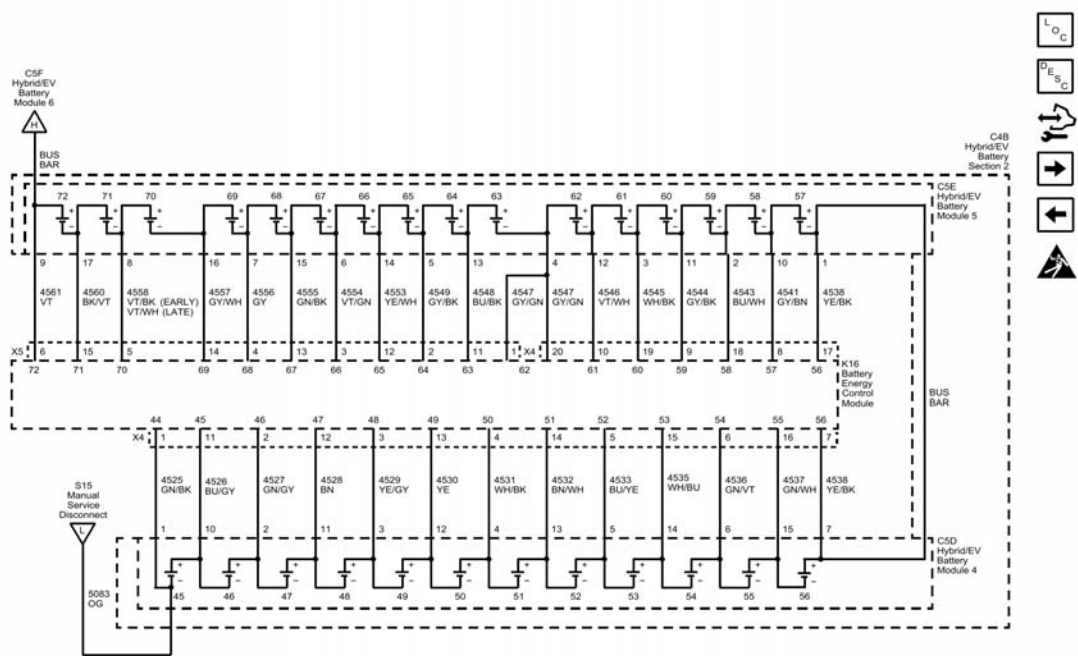


Fig. 7: Hybrid/EV Battery Section 2
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Section 3

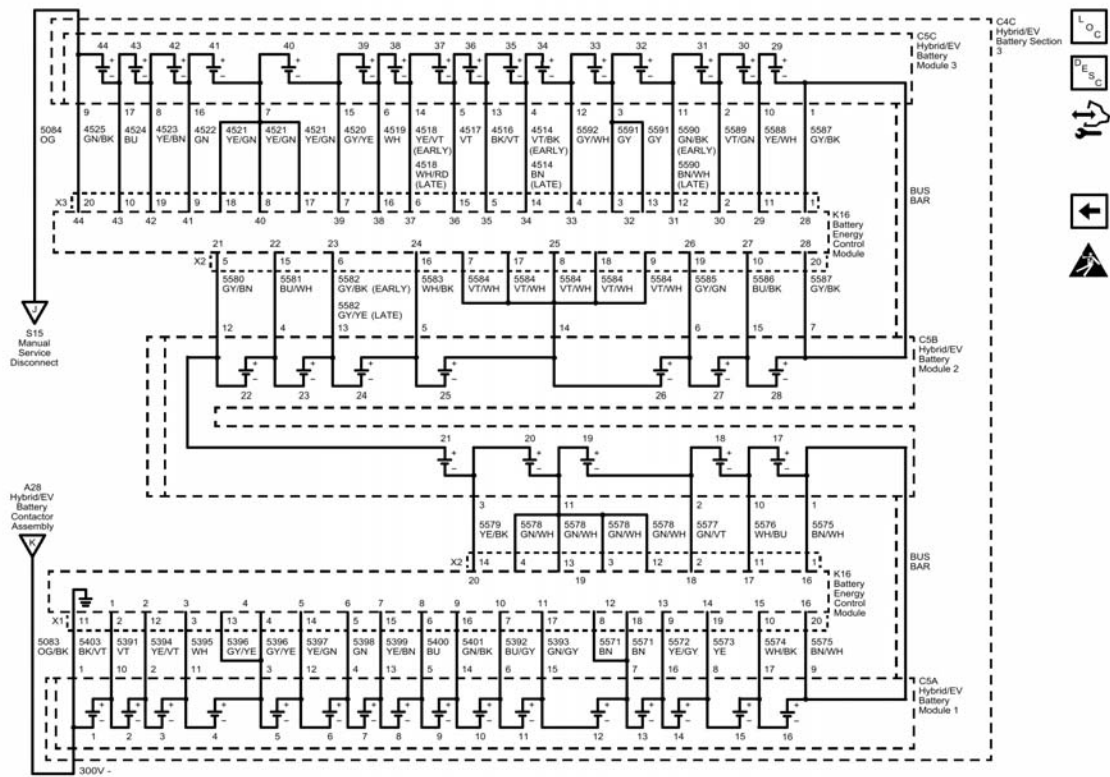


Fig. 8: Hybrid/EV Battery Section 3
 Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Battery Cover Assembly

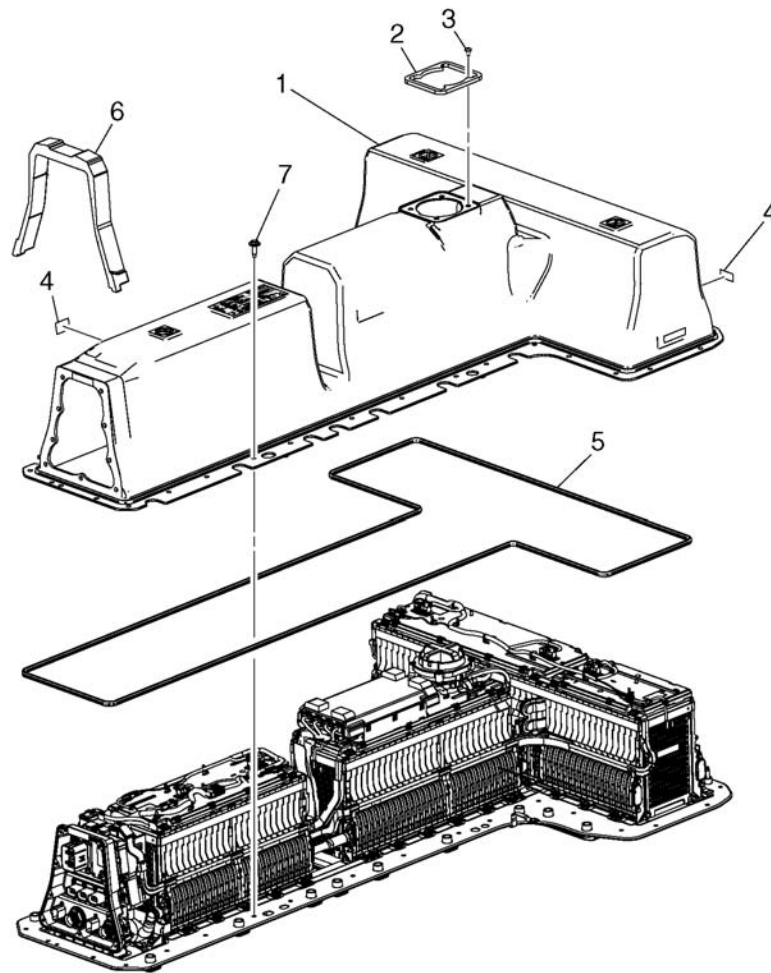


Fig. 9: Battery Cover Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Cover
2	High Voltage Battery Cover Seal Adhesive
3	Battery Tray Bolt
4	Vent Valve
5	High Voltage Battery Cover Seal
6	Battery Insulator
7	Bolt

Battery Cable Assembly

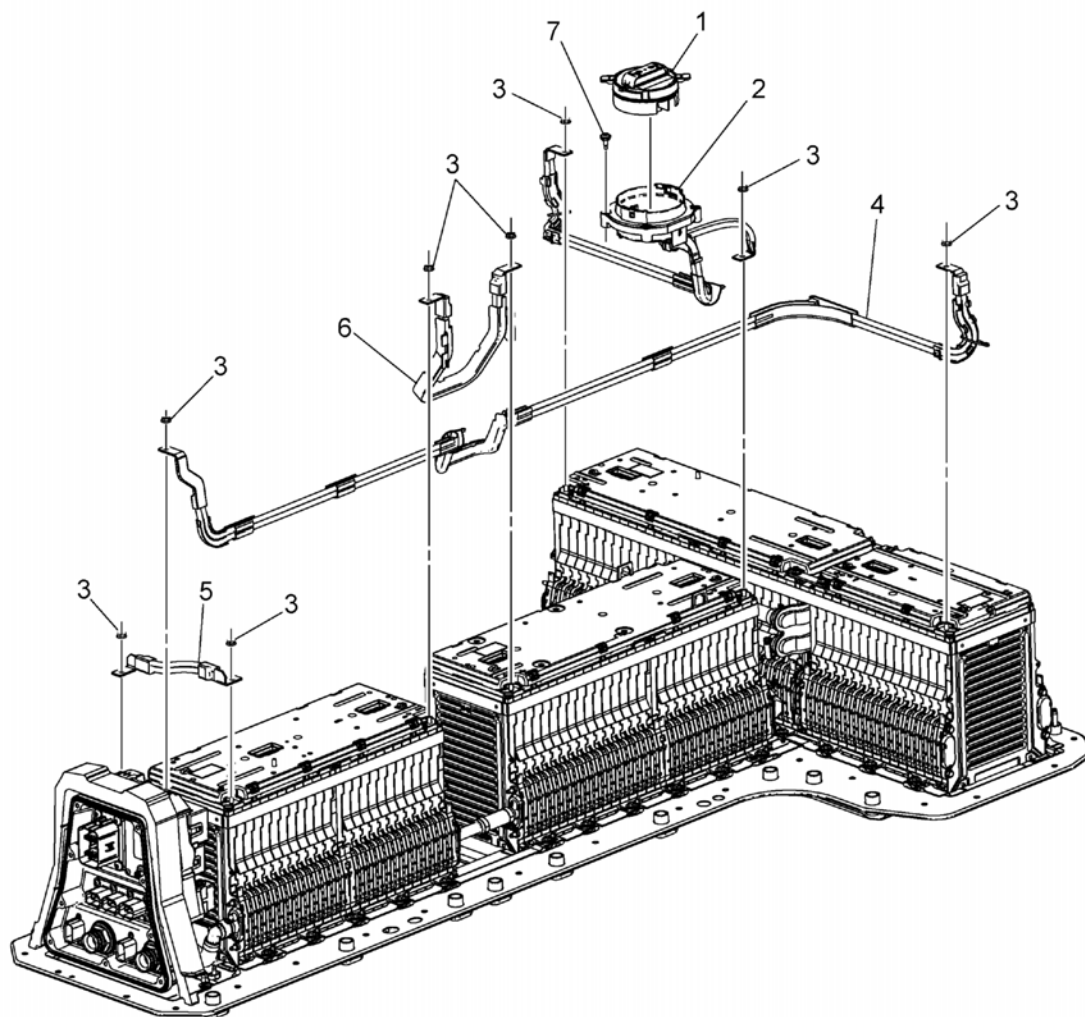


Fig. 10: Battery Cable Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Manual Disconnect Lever
2	High Voltage Battery Positive Cable
3	Battery Positive and Negative Cable Nut
4	High Voltage Battery Positive Cable
5	High Voltage Battery Positive Cable
6	High Voltage Battery Positive Cable
7	Battery Tray Bolt

Battery Harness Module Assembly

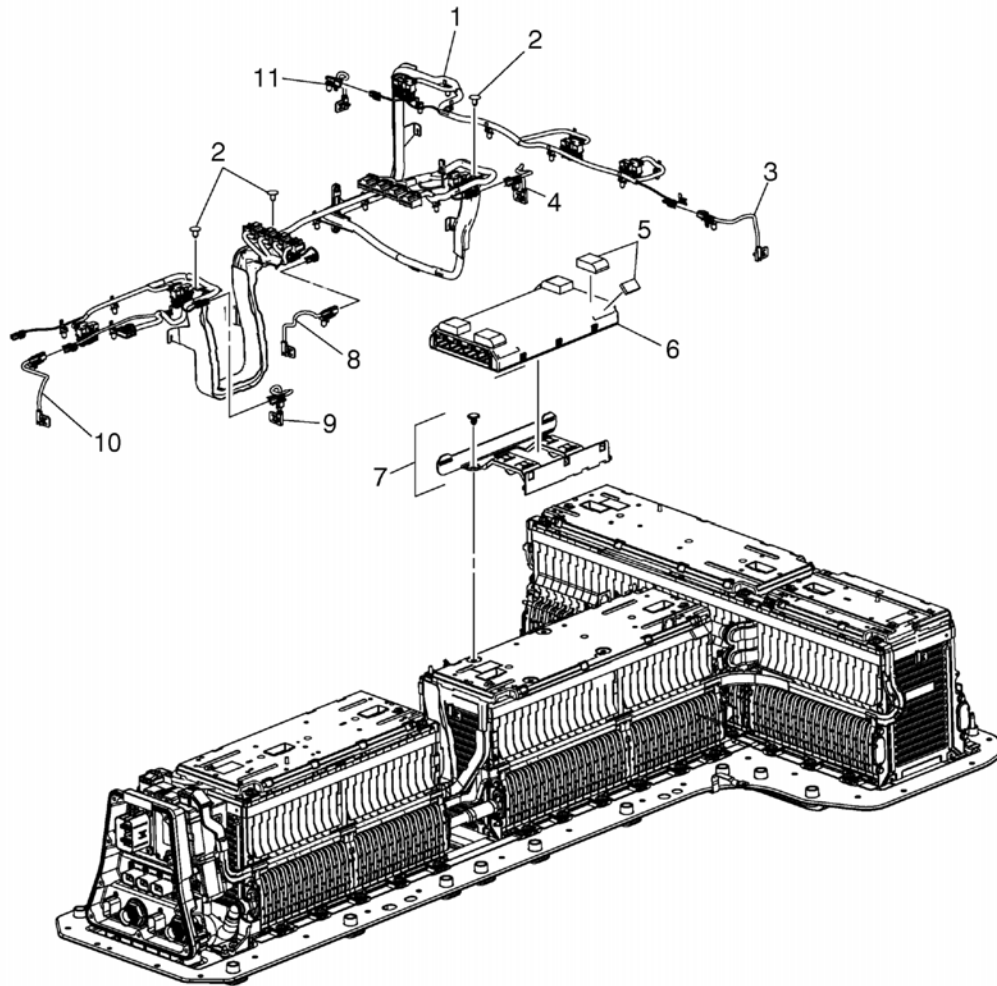


Fig. 11: Battery Harness Module Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Auxiliary Battery Wiring Harness
2	Retainer
3	Battery Cell Temperature Sensor
4	Battery Cell Temperature Sensor
5	High Voltage Battery Cover Seal Adhesive
6	Battery Energy Control Module
7	Interface Control Module Bracket
8	Battery Cell Temperature Sensor
9	Battery Cell Temperature Sensor
10	Battery Cell Temperature Sensor
11	Battery Cell Temperature Sensor

Battery Cell Assembly

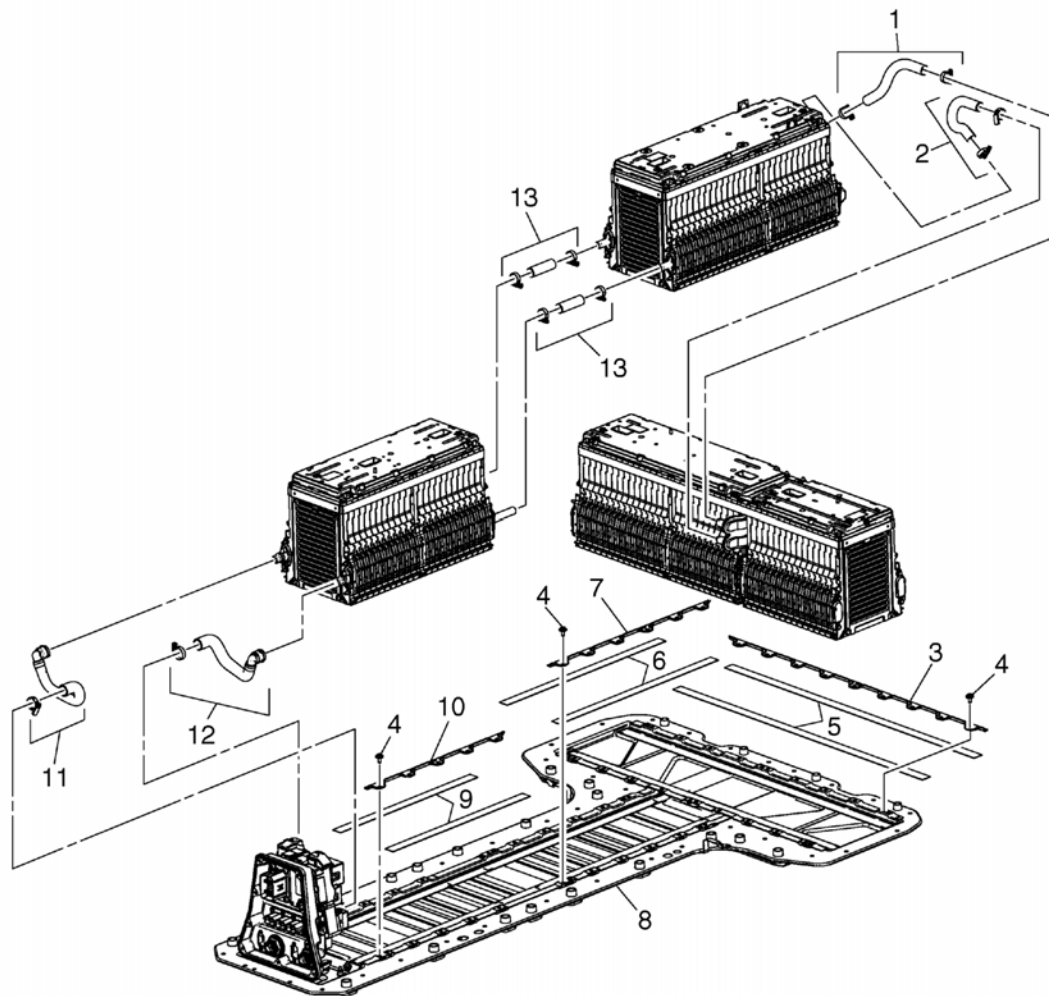


Fig. 12: Battery Cell Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Cooling Manifold Outlet Hose
2	High Voltage Battery Cooling Manifold Inlet Hose
3	Battery Hold Down Retainer
4	Battery Tray Bolt
5	High Voltage Battery Tray Spacer
6	High Voltage Battery Tray Spacer
7	Battery Hold Down Retainer
8	High Voltage Battery Tray
9	High Voltage Battery Tray Spacer
10	Battery Hold Down Retainer
11	High Voltage Battery Cooling Manifold Inlet Hose
12	High Voltage Battery Cooling Manifold Outlet Hose
13	High Voltage Battery Cooling Plate Hose

Battery Relay Mounting Assembly

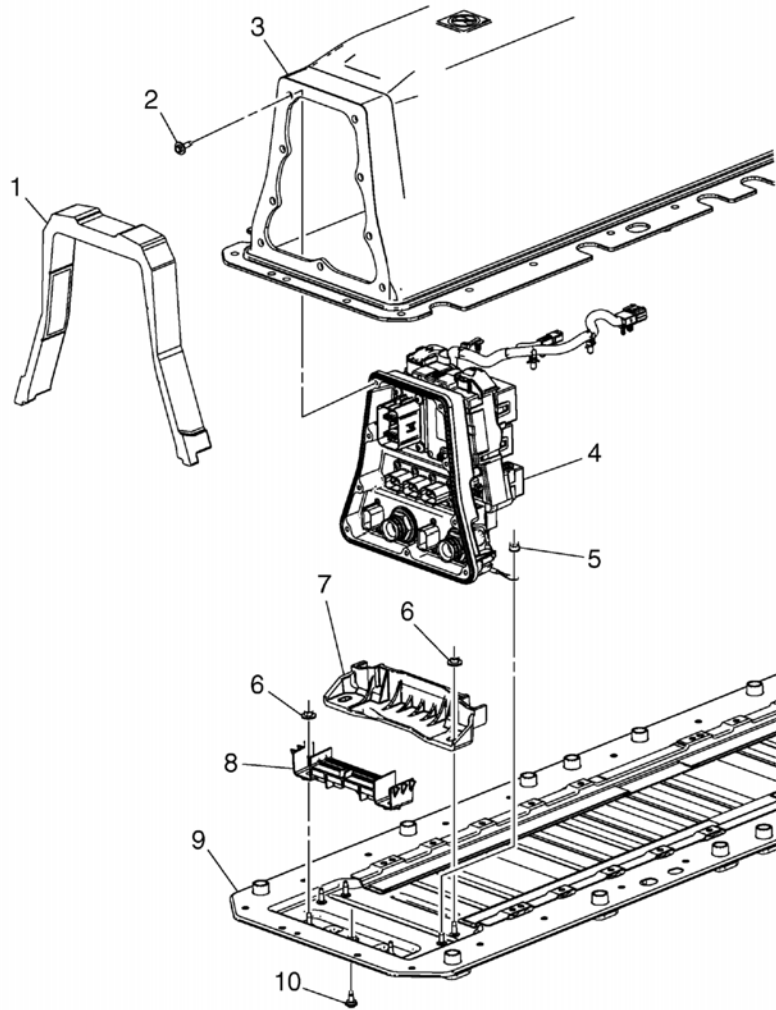


Fig. 13: Battery Relay Mounting Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Battery Insulator
2	Bolt
3	High Voltage Battery Cover
4	Generator Battery Disconnect Relay
5	Nut
6	Heater and Air Conditioning Evaporator and Blower Module Nut
7	Battery Tray Front Brace
8	Battery Tray Front Brace
9	High Voltage Battery Tray
10	Battery Tray Bolt

Battery Relay Assembly

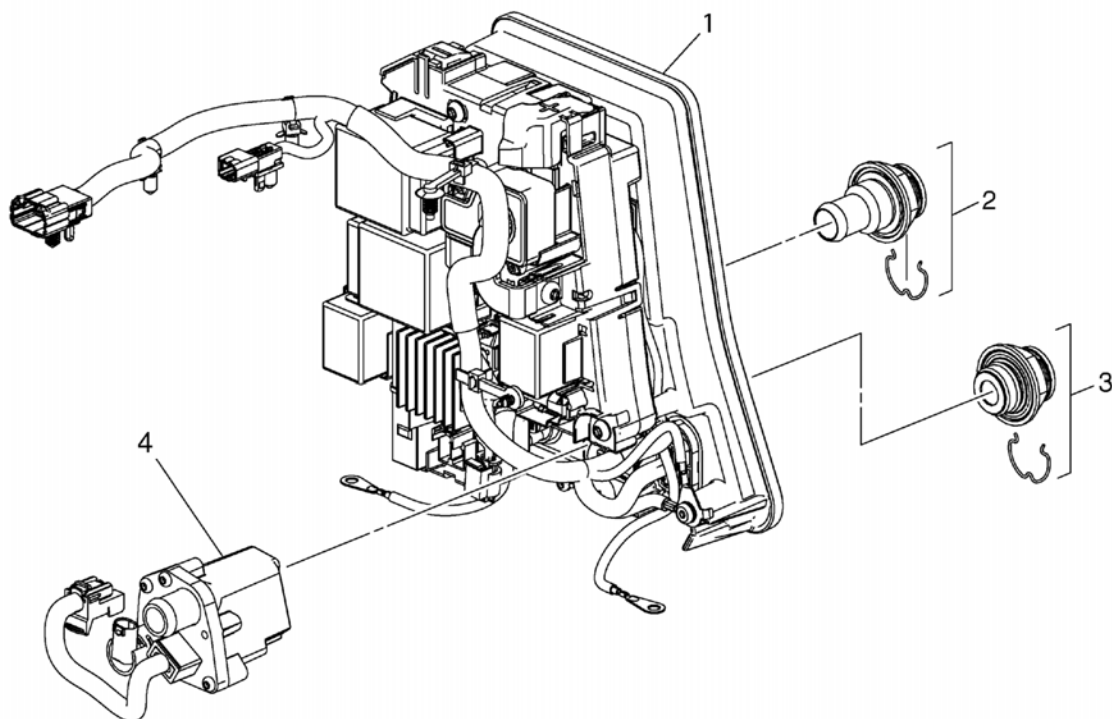


Fig. 14: Battery Relay Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Generator Battery Disconnect Relay
2	Heater Outlet Hose Bolt
3	Heater Outlet Hose Bolt
4	High Voltage Battery Heater

HIGH VOLTAGE BATTERY IDENTIFICATION

Battery Label with Smart Number

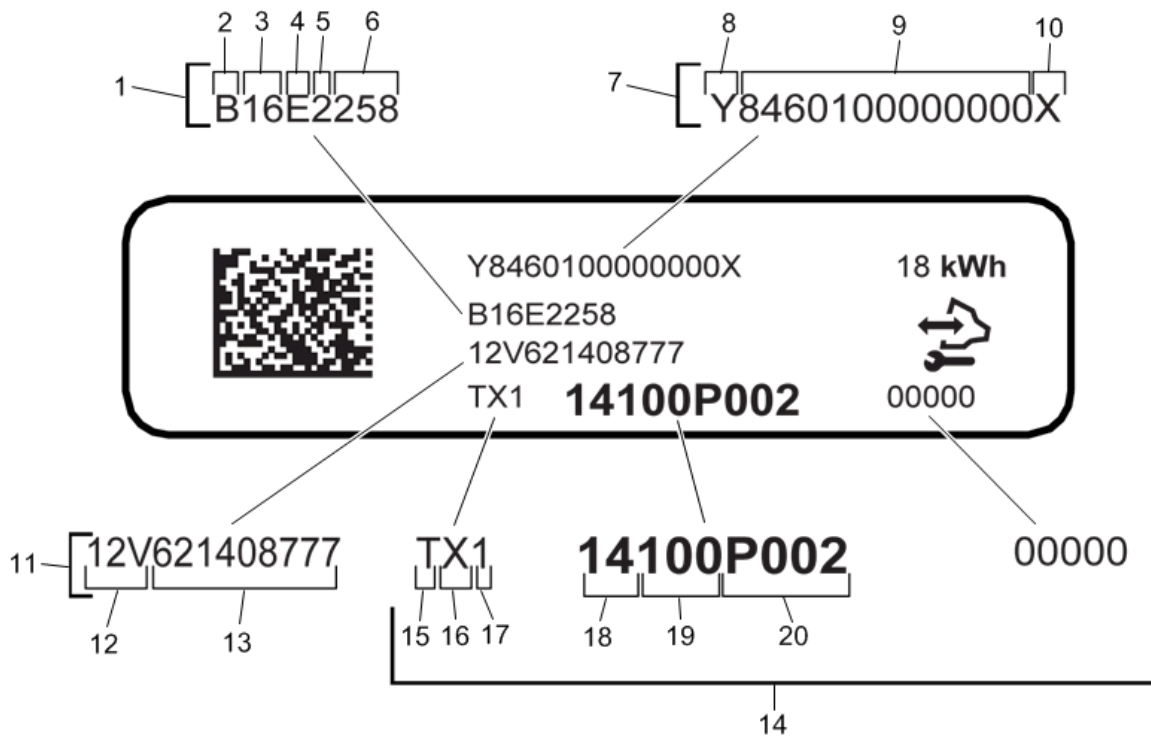


Fig. 15: Battery Label with Smart Number

Courtesy of GENERAL MOTORS COMPANY

1. Smart Number
2. GM Assigned Part Number Identifier
3. Model Year
4. Technology Type: Energy, BAS, or HEV
5. Generation
6. Serial Number
7. VPPS Code
8. VPPS Identifier
9. VPPS: GM Compressed Vehicle Partitioning and Product Structure Code
10. Vehicle Mounting Location
11. DUNS Code
12. DUNS Identifier
13. Supplier Manufacturing/Assembly Site
14. Trace Code
15. Trace Code Identifier
16. Line/Machine
17. Shift
18. Manufactured/Assembled Year
19. Julian Day of Manufacture/Assembly
20. Daily Sequence

Battery Label with Part Number

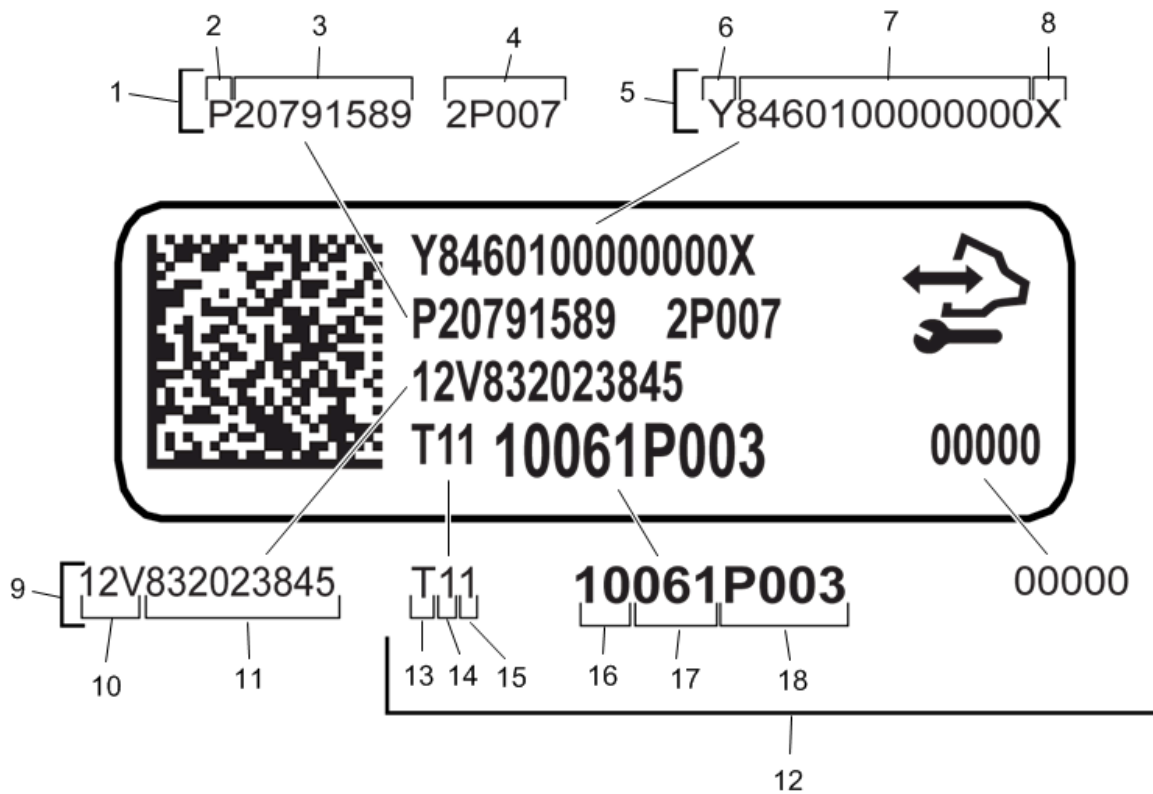


Fig. 16: Battery Label with Part Number
Courtesy of GENERAL MOTORS COMPANY

1. GM Part Number
2. GM Assigned Part Number Identifier
3. GM 8-Digit P/N
4. Revision Level
5. VPPS Code
6. VPPS Identifier
7. VPPS: GM Compressed Vehicle Partitioning and Product Structure Code
8. Vehicle Mounting Location
9. DUNS Code
10. DUNS Identifier
11. Supplier Manufacturing/Assembly Site
12. Trace Code
13. Trace Code Identifier
14. Line/Machine
15. Shift
16. Manufactured/Assembled Year
17. Julian Day of Manufacture/Assembly
18. Daily Sequence

DIAGNOSTIC INFORMATION AND PROCEDURES

HIGH VOLTAGE SAFETY

The High Voltage Safety procedure will perform the following tasks:

- Identify precautions when performing service or inspections.
- Identify labels for components, wire harness, and connectors.
- Identify high voltage insulation glove inspection procedure.

When applicable, additional region-specific high voltage service requirements and/or Dangers will be located in the General Information, Safety Regulations service category and take precedence over the information presented here.

General High Voltage Dangers

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: For European Region, a face shield is required in place of safety glasses.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

NOTE: For European Region, a special voltage tester such as the EL-52229 may be required. A multimeter that can measure current is prohibited.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

Precautions when Performing Service or Inspections

- Always verify that the high voltage has been disabled before working on or around high voltage components, wires, cables, or harnesses.
- Remove all metal objects such as rings and watches.
- The **EL-48900** HEV safety kit contains safety cones. Place the safety cones around the vehicle to alert other technicians that you are working on the high voltage system.
- Remove all keyless entry transmitters and the manual service disconnect from the vehicle and secure in a place outside the vehicle.
- Always wear certified and tested high voltage insulation gloves when inspecting or testing any high voltage wires and components.
- Use the "One Hand" rule whenever possible:
 - Work with only one hand.
 - Keep the other hand behind your back.
- DO NOT carry any metal objects such as a mechanical pencil or a measuring tape that could fall and cause a short circuit.
- After removing ring-terminal style high voltage wires, protect and insulate the terminal ends immediately with the **EL-50209** high voltage terminal cover and UL® Listed or equivalent insulation tape rated at a minimum of 600 V.
- Always tighten the high voltage terminal fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.
- After finishing work on the high voltage systems and before reinstalling the high voltage manual disconnect, inspect for the following:
 - Verify high voltage system integrity and that all connectors are installed.
 - Verify that all tools or loose components have been removed.

Labels for Components, Wire Harness, and Connectors

The wire harnesses and cables for high voltage circuits are encased in an orange colored covering. In addition, high voltage components such as the Energy Storage System and high voltage cables are affixed with "High Voltage" red danger and orange warning labels.

High Voltage Insulation Glove Inspection Procedure

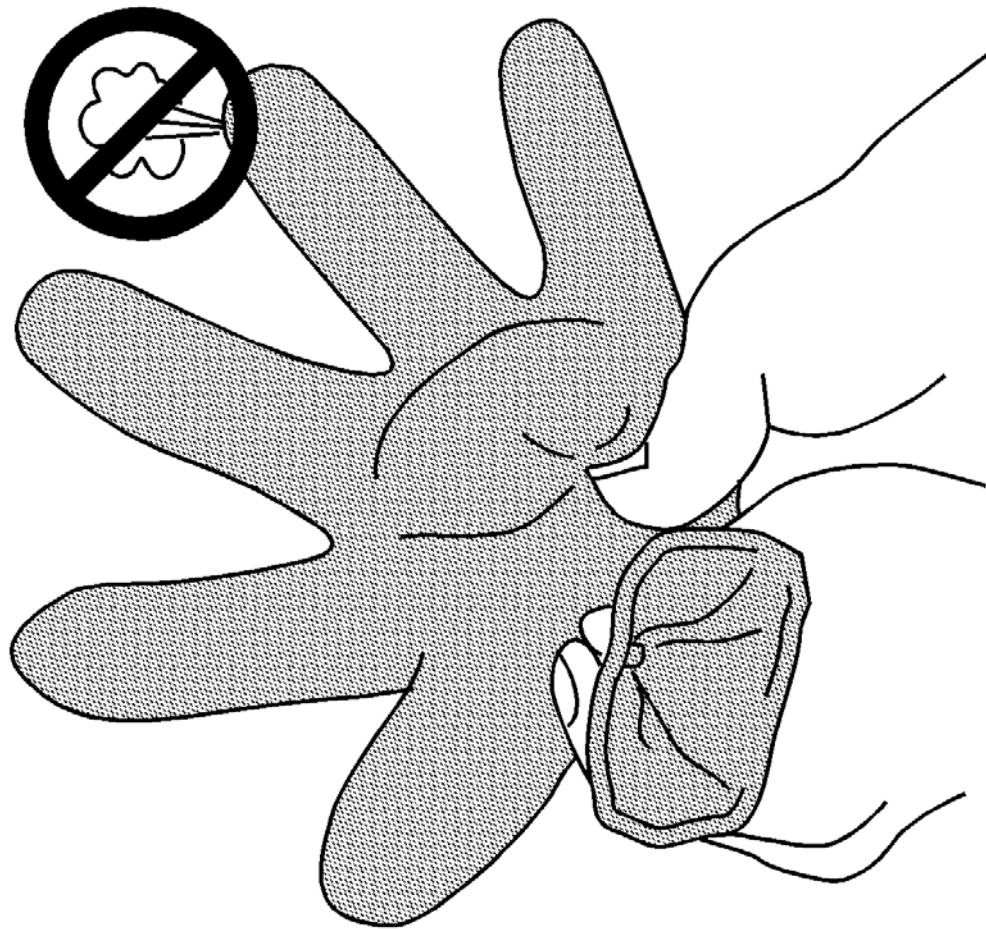


Fig. 17: Glove Inspection Procedure

Courtesy of GENERAL MOTORS COMPANY

The following procedure visually and functionally inspects the insulation gloves to be used while performing service on high voltage systems. This inspection procedure should be performed prior to any procedure that requires the use of class "0" insulation gloves rated at 1000 V.

1. Remove glove from leather protector.
2. Trap air in the glove and seal opening. Pinch or roll the opening closed tightly to prevent any air loss.
3. Press glove to increase pressure.
4. Inspect for the following conditions:
 - Pin holes
 - Air leaks
 - Wear, tears, or abrasions
 - Damp or wet material
 - Expired certification
 - **If any of the above conditions are met**

Do not use the gloves.

- **If none of the above conditions are met**

5. All OK. Gloves are OK to use.

HIGH VOLTAGE DISABLING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure utilizes two possible methods to disable high voltage:

NOTE: **The High Voltage Disable procedure, regardless of the method, only de-energizes the high voltage circuits and components outside of the Hybrid/EV battery pack, dangerous voltage levels always exist within the Hybrid/EV battery pack.**

1. Scan Tool Method: The on-vehicle control module software, initiated by the GDS2 scan tool, disables and discharges high voltage outside of the Hybrid/EV battery pack.
2. DMM Method: If the GDS2 Scan Tool Method does not complete or cannot be implemented, A DMM-based physical measurement method is performed at certain high voltage connectors.

A successful GDS2 Scan Tool High Voltage Disable Procedure will:

1. Perform an analysis of the vehicle condition by verifying specific DTCs have run and passed.
2. Calculate the high voltage isolation resistance to the vehicle chassis.
3. Open the high voltage contactor relays and discharge the high voltage system by setting a crash event lockout. When this stage is reached the Clear Secured High Voltage DTCs procedure will have to be performed to enable the system again.
4. Latch a Service Lockout condition to prevent unintended enabling of the high voltage system.
5. Instruct you when to remove the manual service disconnect.
6. Indicate successful high voltage disabling by:
 - Displaying a PROCEDURE COMPLETE message on the scan tool
 - Displaying a CHECK VEHICLE'S HIGH VOLTAGE STATUS message on the scan tool which will require you to verify:
 - Vehicle is displaying an Instrument Cluster DIC message
 - Vehicle is sounding a continuous audible response from the vehicle Pedestrian Alert alarm
 - High Voltage Inverter Voltage parameter on scan tool indicates system high voltage has been lowered to a safe level

An Unsuccessful GDS2 Scan Tool High Voltage Disable Procedure:

If vehicle conditions DO NOT permit the GDS2 scan tool procedure to complete, you will have to verify high voltage disabling by measuring the applicable connectors for safe voltage level with a DMM.

Diagnostic Aids

Review the [High Voltage Connectors](#) information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Drive Motor Battery System Description](#)

Electrical Information Reference

[Circuit Testing](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information. Refer to [High Voltage Safety](#).

NOTE: Ensure the 12V battery is fully charged and tested prior to continuing.

2. Disconnect and remove all 12 V Battery Chargers and the Charge Cable from the X98 Hybrid Battery Charger Receptacle.

NOTE: If vehicle conditions do not allow for GDS2 scan tool usage, proceed to GDS2 Scan Tool Procedure Unsuccessful below.

3. Access the GDS2 scan tool High Voltage Disable Procedure located under HPCM2 Control Functions.
4. Perform the actions as specified within the GDS2 scan tool procedure.

NOTE: If at any point the GDS2 scan tool displays a "PROCEDURE UNSUCCESSFUL" warning message or you lose communication, stop the GDS2 procedure and proceed to GDS2 Scan Tool Procedure Unsuccessful below.

5. WHEN INSTRUCTED by the GDS2 procedure, remove the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#). Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with UL listed, or equivalent, insulation tape rated at a minimum of 600 V.
6. Verify the GDS2 scan tool procedure completed successfully by observing a GDS2 scan tool "PROCEDURE COMPLETE" message followed by a "CHECK VEHICLE'S HIGH VOLTAGE STATUS" message. Verify these messages are combined with ALL the following conditions:
 - Continuous Audible Vehicle Response of the Pedestrian Alert alarm
 - DIC message
 - High Voltage Inverter Voltage parameter on scan tool indicates system high voltage is less than 10 volts
 - If the procedure was unsuccessful

Proceed to GDS2 Scan Tool Procedure Unsuccessful below.

- If the procedure successfully completed

1. Turn the vehicle power mode to OFF.
2. Disconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#) . Note: Disconnecting the 12 V battery is the only method to deactivate the audible vehicle response. The audible response will not resume when the 12 V battery is reconnected.

NOTE: You will have to perform the Clear Secured High Voltage DTCs GDS2 scan tool procedure in order to re-enable the high voltage system upon completion of the required vehicle servicing.

3. The high voltage circuits and components OUTSIDE of the Hybrid/EV battery pack are now disabled/discharged.

NOTE: Print the High Voltage Disable Confirmation table if necessary. Circle Steps Completed to identify which components have been disabled.

High Voltage Disable Confirmation Table

Was the GDS2 Scan Tool Procedure SUCCESSFUL?	Circle One:	NO	YES
--	-------------	----	-----

If YES, all high voltage external of the A4 Hybrid/EV Battery Pack is now disabled. Fill-out and Print form as necessary. If NO, perform GDS2 Scan Tool Procedure Unsuccessful steps as required			
Confirm GDS2 Scan Tool Procedure Unsuccessful Steps Completed Below			
High Voltage Components you wish to Disable	GDS2 Scan Tool Procedure Unsuccessful Steps that must be completed	Steps Completed	
• General Vehicle Servicing around or near but not directly at high voltage components • T6 Power Inverter Module and connectors • T12 Transmission and connectors	Steps 1 - 14	NO	YES
• A4 Hybrid/EV Battery Pack - external • 300V cable - A4 Hybrid/EV Battery Pack to T6 Power Inverter Module	Steps 1 - 28	NO	YES
K1 14V Power Module	Steps 1 - 33*	NO	YES
T18 Battery Charger	Steps 1 - 33*	NO	YES
300V cable - A4 Hybrid/EV Battery Pack to K1 14V Power Module and T18 Battery Charger	Steps 1 - 33*	NO	YES
K10 Heater	Steps 1 - 33*	NO	YES
300V cable - A4 Hybrid/EV Battery Pack to K10 Heater	Steps 1 - 33*	NO	YES
G1 A/C Compressor	Steps 1 - 33*	NO	YES
300V cable - A4 Hybrid/EV Battery Pack to G1 A/C Compressor	Steps 1 - 33*	NO	YES
*Perform testing at each component as applicable			
Technician:			
VIN:			
License Plate:			

GDS2 Scan Tool Procedure Unsuccessful

NOTE: If the GDS2 Scan Tool Procedure was unsuccessful, follow the steps below as applicable.

1. Turn the vehicle power mode to OFF. Remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Attempt to start the vehicle with the Ignition Mode Switch.

- If the vehicle enters Propulsion System Active mode or the engine starts

Locate and remove all keyless entry transmitters from within the vehicle and return to the beginning of the GDS2 Scan Tool Procedure Unsuccessful procedure.

- If the vehicle did not enter Propulsion System Active mode and the engine did not start

NOTE: The 12 V battery must be disconnected to ensure proper test results.

3. Disconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#)
4. Remove the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#). Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.

NOTE: **5 min must elapse before removing any high voltage connectors. Removal of non high voltage components is allowed during this wait time.**

5. Wait 5 min before continuing, to allow the high voltage capacitors to discharge.

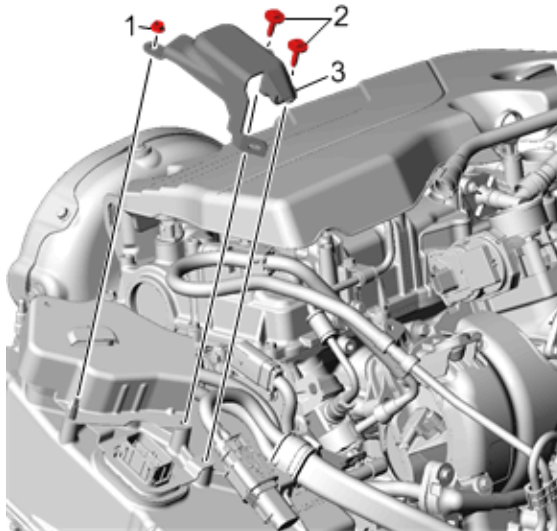


Fig. 18: T6 Power Inverter Module X1 56-Way Connector Cover, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the T6 Power Inverter Module X1 56-way connector cover nut (1) and bolts (2). Remove the cover (3).
7. Disconnect the T6 Power Inverter Module X1 56-way connector.

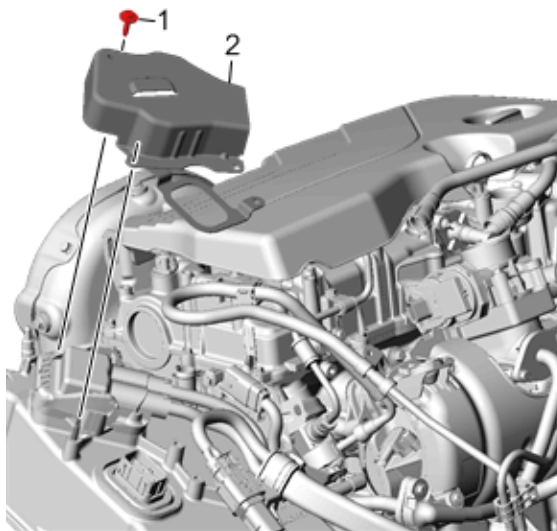


Fig. 19: T6 Power Inverter Module X2 HV Cable Cover And Remaining Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the T6 Power Inverter Module X2 HV cable cover remaining bolt (1) and HV cable cover (2).

NOTE: A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.

9. Verify the test DMM by measuring a known good 9 to 12 V battery.

- If the DMM does not properly measure the test battery

Repair or replace the DMM and repeat all voltage measurements.

- If the DMM properly measures the test battery

NOTE:

- Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.
- Inspect the High Voltage DC connection seal for deformation or damage. Inspect the High Voltage DC connector for seal residue or debris. Always replace damaged seals and clean seal remnants from the connector with a non-marring tool.

10. Disconnect the T6 Power Inverter Module X2 high voltage harness connector which connects to the A4 Hybrid/EV Battery Pack.

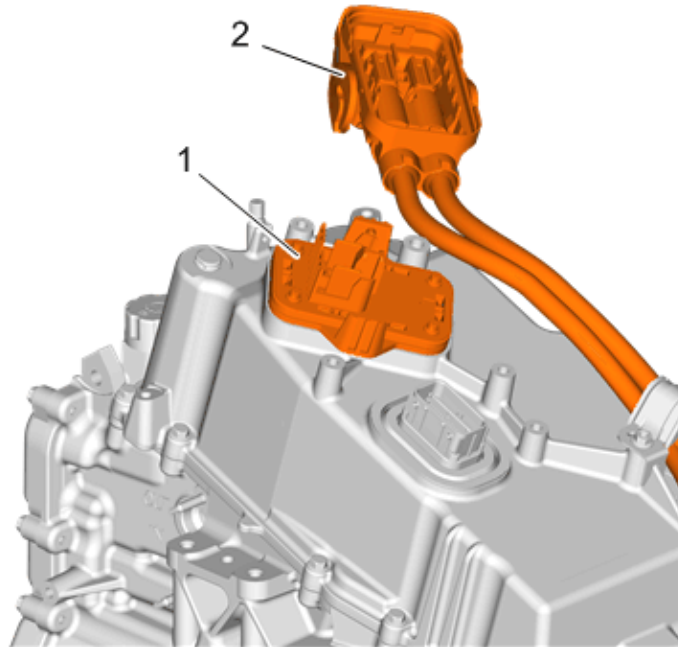


Fig. 20: T6 Power Inverter Module X2 Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE:

5 min must have elapsed since removing the S15 Manual Service Disconnect before continuing to allow the high voltage capacitors to discharge and ensure proper test results.

11. Verify the voltage measures less than 3 V at the T6 Power Inverter Module X2 connector (1) at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- If 3 V or greater

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

12. Verify the voltage measures less than 3 V at the HV DC harness connector (2) to the T6 Power Inverter Module X2 at the following points:

- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
- **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present.](#)

- **If less than 3 V**

13. Verify the test DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM properly measures the test battery**

14. The T6 Power Inverter Module is now discharged. You may perform T6 Power Inverter Module, T12 Transmission or General vehicle service and exit the High Voltage Disabling procedure at this time but you **MUST** continue if additional high voltage component service is required.

- **If you do not need to perform additional high voltage component service**

HV Disable for T6 power inverter module and/or T12 Transmission is complete.

- **If you need to perform additional high voltage component service**

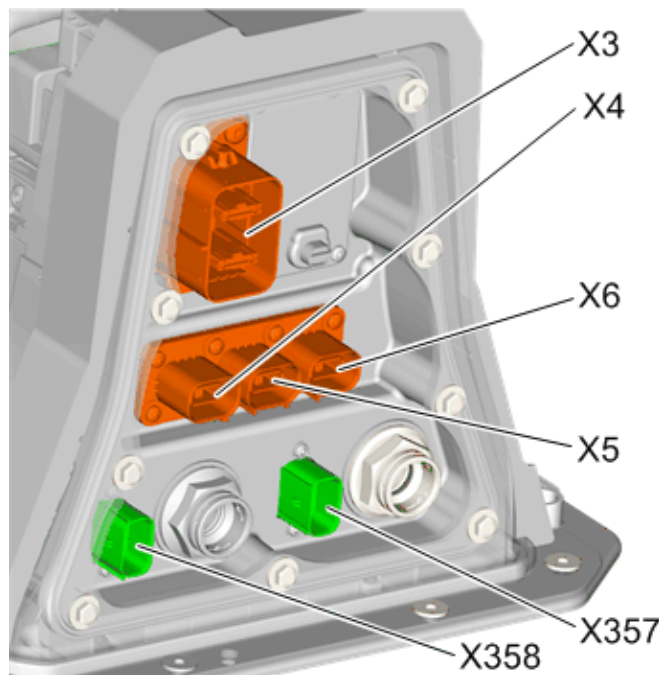


Fig. 21: A28 Hybrid/EV Battery Contactor Assembly Connectors
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect the low voltage harness connectors X357 and X358 at the A28 Hybrid/EV Battery Contactor Assembly.
16. Disconnect the T18 Battery Charger harness connector at the A28 Hybrid/EV Battery Contactor Assembly X6.
17. Verify the voltage measures less than 3 V at the A28 Hybrid/EV Battery Contactor Assembly connector X6 at the following points:
 - High voltage DC (-360 V) negative terminal 2 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 and high voltage DC (-360 V) negative terminal 2.
 - **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present](#).

- **If less than 3 V**

18. Verify the voltage measures less than 3V at the A28 Hybrid/EV Battery Contactor Assembly connector X6 at the T18 Battery Charger harness side at the following points:
 - High voltage DC (-360 V) negative terminal 2 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 and high voltage DC (-360 V) negative terminal 2.
 - **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

19. Disconnect the G1 A/C Compressor harness connector at the A28 Hybrid/EV Battery Contactor Assembly X5.
20. Verify the voltage measures less than 3 V at the A28 Hybrid/EV Battery Contactor Assembly connector X5 at the following points:
 - High voltage DC (-360 V) negative terminal 2 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 and high voltage DC (-360 V) negative terminal 2.
 - **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present](#).

- **If less than 3 V**

21. Verify the voltage measures less than 3V at the A28 Hybrid/EV Battery Contactor Assembly connector X5 at the G1 A/C Compressor harness side at the following points:
 - High voltage DC (-360 V) negative terminal 2 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 and high voltage DC (-360 V) negative terminal 2.
 - **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

22. Disconnect the K10 Cabin Heater Control Module harness connector at the A28 Hybrid/EV Battery Contactor Assembly connector X4.
23. Verify the voltage measures less than 3 V at the A28 Hybrid/EV Battery Contactor Assembly connector X4 at the following points:
- High voltage DC (-360 V) negative terminal 2 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal 1 and high voltage DC (-360 V) negative terminal 2.
 - **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present.](#)

- **If less than 3 V**

24. Verify the voltage measures less than 3 V at the A28 Hybrid/EV Battery Contactor Assembly connector X4 at the K10 Cabin Heater Control Module harness side at the following points:
- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
 - **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

25. Disconnect the T6 Power Inverter Module harness connector at the A28 Hybrid/EV Battery Contactor Assembly X3.
26. Verify the voltage measures less than 3 V at the A28 Hybrid/EV Battery Contactor Assembly connector X3 at the following points:
- High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
 - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
 - **If 3 V or greater**

There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to [Hybrid/EV Battery Voltage Present.](#)

- **If less than 3 V**

NOTE: Discard any 300 V Battery Positive and Negative cable connector seal that may be deformed or damaged. Replace any seal that is deformed, missing, or damaged.

NOTE: A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.

27. Verify the test DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM properly measures the test battery**

28. The high voltage connectors at the A4 Hybrid/EV battery pack are now discharged. You may perform A4 Hybrid/EV battery pack removal and exit the High Voltage Disabling procedure at this time but you **MUST** continue if additional high voltage component service is required.

- **If you do not need to perform additional high voltage component service**

HV Disable for T6 power inverter module, T12 Transmission and A4 Hybrid battery pack is complete.

- **If you need to perform additional high voltage component service**

29. Disconnect the high voltage connector(s) at the component(s) to be serviced.

30. Verify the voltage measures less than 3 V at the Module connector at the following points:

- High voltage DC (-360 V) negative terminal B or 2 to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A or 1 to vehicle chassis ground.
- High voltage DC (+360 V) positive terminal A or 1 and high voltage DC (-360 V) negative terminal B or 2.
- **If 3 V or greater**

Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

31. Repeat the previous step at all high voltage module connectors for any additional high voltage components requiring service.

32. Verify the test DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM properly measures the test battery**

33. High voltage is disabled/discharged at all TESTED modules.

HIGH VOLTAGE ENABLING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The High Voltage Enabling procedure will perform the following tasks:

- Identify how to enable high voltage.
- Verify high voltage system integrity and that all connectors are installed.

Diagnostic Aids

Review the [High Voltage Connectors](#) information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information prior to performing the High Voltage Enabling procedure. Refer to High Voltage Safety
2. Ensure that the 12 V battery is disconnected. Refer to Battery Negative Cable Disconnection and Connection

NOTE:

- Always tighten the high voltage fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.
- The high voltage connectors that have been disconnected do not require a specific sequence when connecting.

3. After finishing work on the high voltage systems and before installing the S15 Manual Service Disconnect, inspect for the following:
 - Verify that all tools or loose components have been removed.
 - Inspect any disconnected 300 V Battery Positive and Negative cable seals for being deformed, missing, or damaged. Replace any seals that are deformed, missing, or damaged.
 - Verify high voltage system integrity and that all connectors are installed.
 - Verify that all high voltage interlock circuit connectors and covers are installed.
 - Install any components or connectors that have been removed or replaced during diagnosis.
4. Install the S15 Manual Service Disconnect (1). Refer to [**Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**](#)
5. Connect the 12 V battery. Refer to [**Battery Negative Cable Disconnection and Connection**](#).
6. Vehicle in Service Mode.
7. Verify if the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced.
 - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced**

Program the K16 Battery Energy Control Module. Refer to [**Battery Energy Control Module Programming and Setup**](#). Continue to the next step once programming is complete.
 - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has not been replaced**
8. Verify if the [**High Voltage Disabling**](#) procedure performed prior to vehicle repair utilized the GDS2 scan tool method.
 - **If the GDS2 scan tool high voltage disabling procedure was performed, the high voltage contactor relays are in a lockout state.**

Perform the [**Clear Secured High Voltage DTCs**](#) procedure and return to the next step.
 - **If the DMM Method high voltage disabling procedure was performed**
9. Vehicle in Service Mode, perform the driver window express learn and clear all DTC Information with a scan tool. Refer to [**Window Motor Programming - Express Function**](#).
10. Vehicle OFF and all vehicle systems OFF. It may take up to 5 min for all vehicle systems to power down.
11. Vehicle in Service Mode.
12. Verify with a scan tool no DTCs are set.
 - **If any DTCs are set**

Refer to [**Diagnostic Trouble Code \(DTC\) List - Vehicle**](#).
 - **If no DTCs are set**
13. Vehicle ON. Open the hood to start and idle the engine for 2 min.
14. Vehicle OFF and wait 5 min.
15. Vehicle in Service Mode. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the following DTCs have Ran Since Code Clear and have not set:
 - Motor position sensor learn DTCs P0C17 and P0C18.
 - Contactor DTCs P0AD9, P0ADD, P0D0A, and P1EBD.
 - Discharge and Pre-charge DTCs P0C76, P0C77, P0C78 and P0AFB.
 - High voltage loss of isolation DTCs P0AA6, P1AE6, P1AF0 and P1AF2.

- If any DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If the DTCs have Not Ran Since Code Clear

1. Review and operate the vehicle according to the applicable DTC Conditions for Running and ensure the DTCs run and pass.
2. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the specified DTCs have Ran Since Code Clear and have not set:

- If any DTCs are set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
- If the DTCs have Ran and Passed

3. Test drive the vehicle and verify no DTCs are set.

- If the DTCs have Ran and Passed

16. Test drive the vehicle and verify no DTCs are set.

EL-48571 HIGH VOLTAGE BATTERY PIN OUT BOX REFERENCE

Special Tools

EL-48571-55 Battery Pin Out Box Adapter

For regional equivalent tools, refer to [Special Tools](#).

Battery Section 1				
Connector ID	Battery Module 7		Battery Module 6	
Selector Switch Position	Switch Number	Test Cells 85 - 96	Switch Number	Test Cells 73 - 84
A	1	85	1	73
	2	86	2	74
	3	87	3	75
	4	88	4	76
	5	89	5	77
	6	90	6	78
B	7	91	7	79
	8	92	8	80
	9	93	9	81
	10	94	10	82
	11	95	11	83
	12	96	12	84

Battery Section 2				
Connector ID	Battery Module 5		Battery Module 4	
Selector Switch Position	Switch Number	Test Cells 57 - 72	Switch Number	Test Cells 45 - 56
A	1	57	1	45
	2	58	2	46
	3	59	3	47
	4	60	4	48

Battery Section 2				
Connector ID	Battery Module 5		Battery Module 4	
Selector Switch Position	Switch Number	Test Cells 57 - 72	Switch Number	Test Cells 45 - 56
	5	61	5	49
	6	62	6	50
B	7	63	7	51
	8	64	8	52
	9	65	9	53
	10	66	10	54
	11	67	11	55
	12	68	12	56
C	13	69	-	-
	14	70	-	-
	15	71	-	-
	16	72	-	-

Battery Section 3						
Connector ID	Battery Module 3		Battery Module 2		Battery Module 1	
Selector Switch Position	Switch Number	Test Cells 29 - 44	Switch Number	Test Cells 17 - 28	Switch Number	Test Cells 1 - 16
A	1	29	1	17	1	1
	2	30	2	18	2	2
	3	31	3	19	3	3
	4	32	4	20	4	4
	5	33	5	21	5	5
	6	34	6	22	6	6
B	7	35	7	23	7	7
	8	36	8	24	8	8
	9	37	9	25	9	9
	10	38	10	26	10	10
	11	39	11	27	11	11
	12	40	12	28	12	12
C	13	41	-	-	13	13
	14	42	-	-	14	14
	15	43	-	-	15	15
	16	44	-	-	16	16

HIGH VOLTAGE CONNECTORS

Connector Type Identification

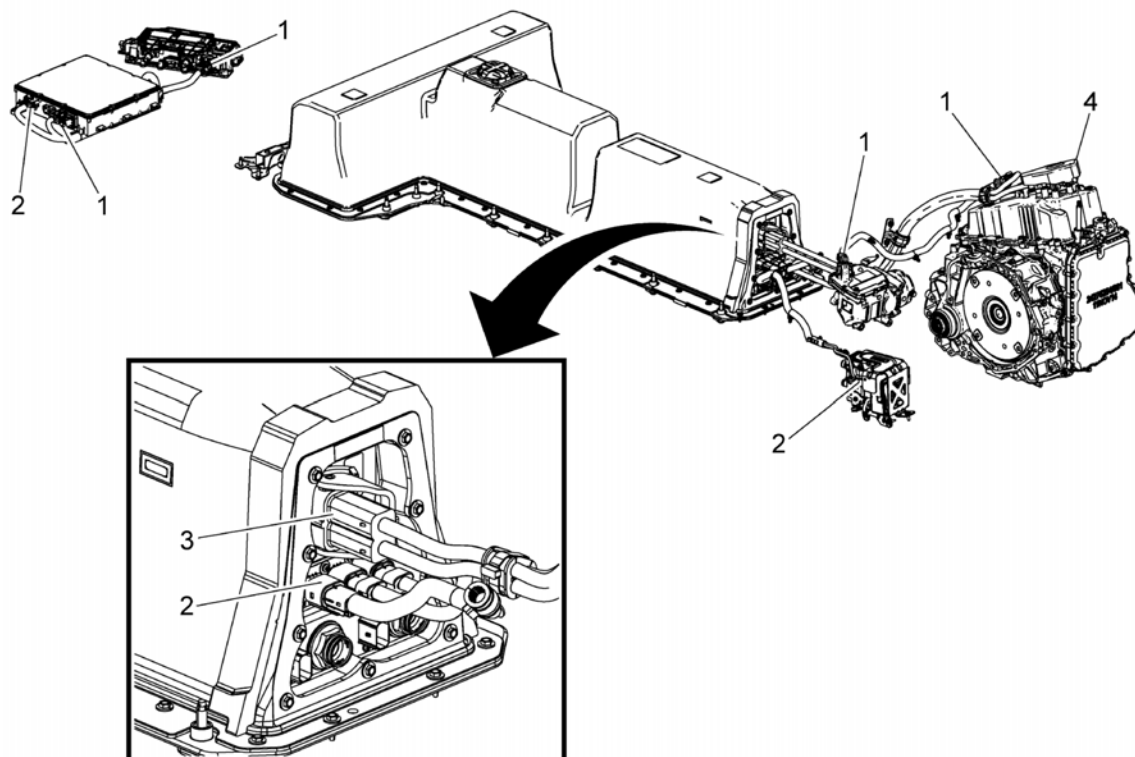


Fig. 22: Connector Type Identification

Courtesy of GENERAL MOTORS COMPANY

Connector Type		Connector Location						
		T6 Power Inverter Module	A28 Hybrid/EV Battery Contactor Assembly	G1 A/C Compressor	K10 Coolant Heater Control Module	K1 14V Power Module	T18 Battery Charger	X98 Hybrid/EV Battery Charger Receptacle
Callout	Connector							
1	HV280	-	-	X130, X2	-	X4	X2	X1
2	AMP+HVA280	-	X4, X5, X6	-	X2	-	X3	-
3	PP2000 Axial	-	X3	-	-	-	-	-
4	PP2000 90 NFS	X2	-	-	-	-	-	-

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the

procedure exactly as written may result in serious injury or death.

Review the high voltage safety information. Refer to [High Voltage Safety](#).

HV280 Connector Procedure

HV280 Disconnect Procedure

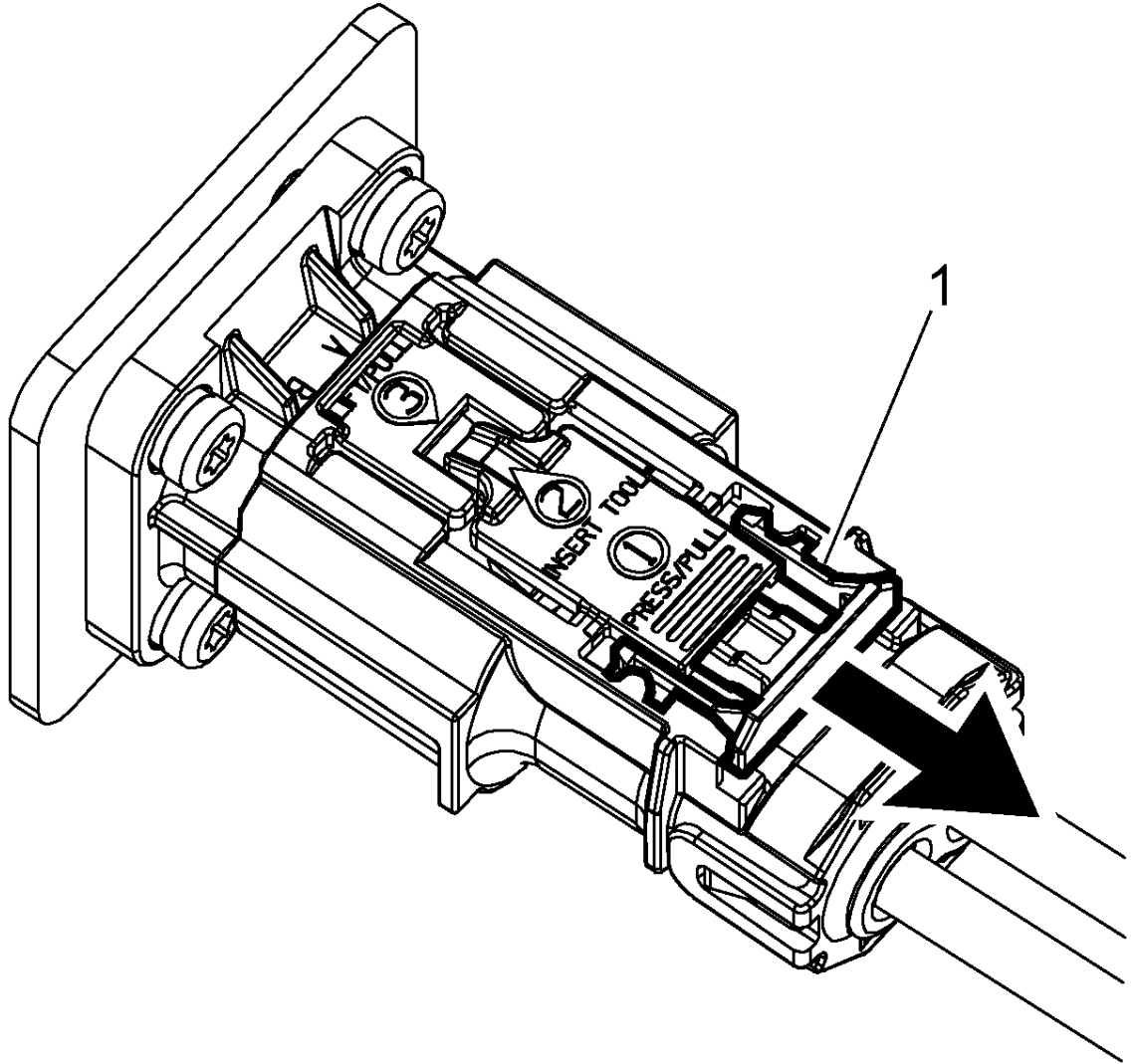


Fig. 23: Connector Position Assurance (CPA) Tab

Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

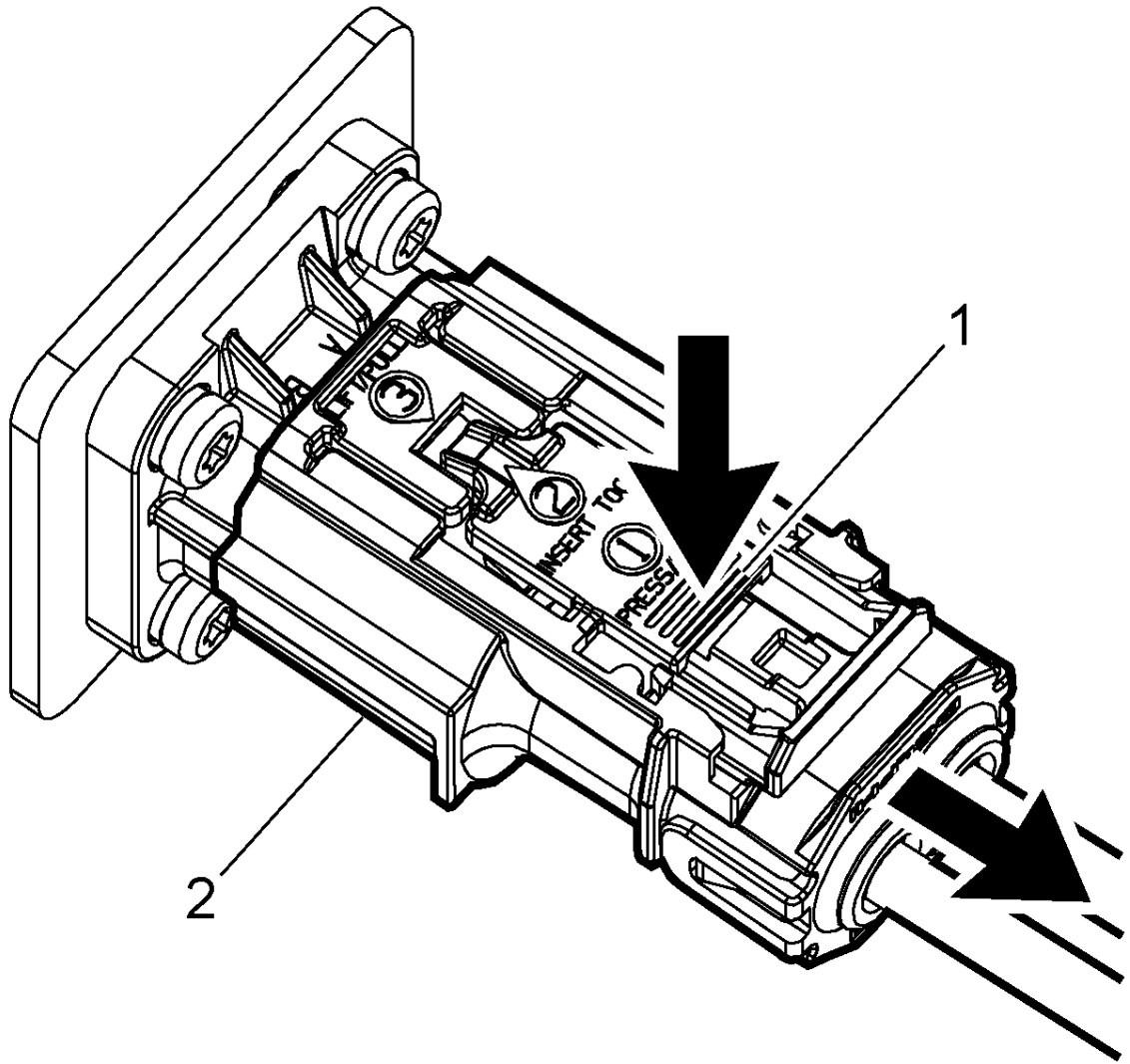


Fig. 24: Female Connector And Female Connector Lock
Courtesy of GENERAL MOTORS COMPANY

NOTE: Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

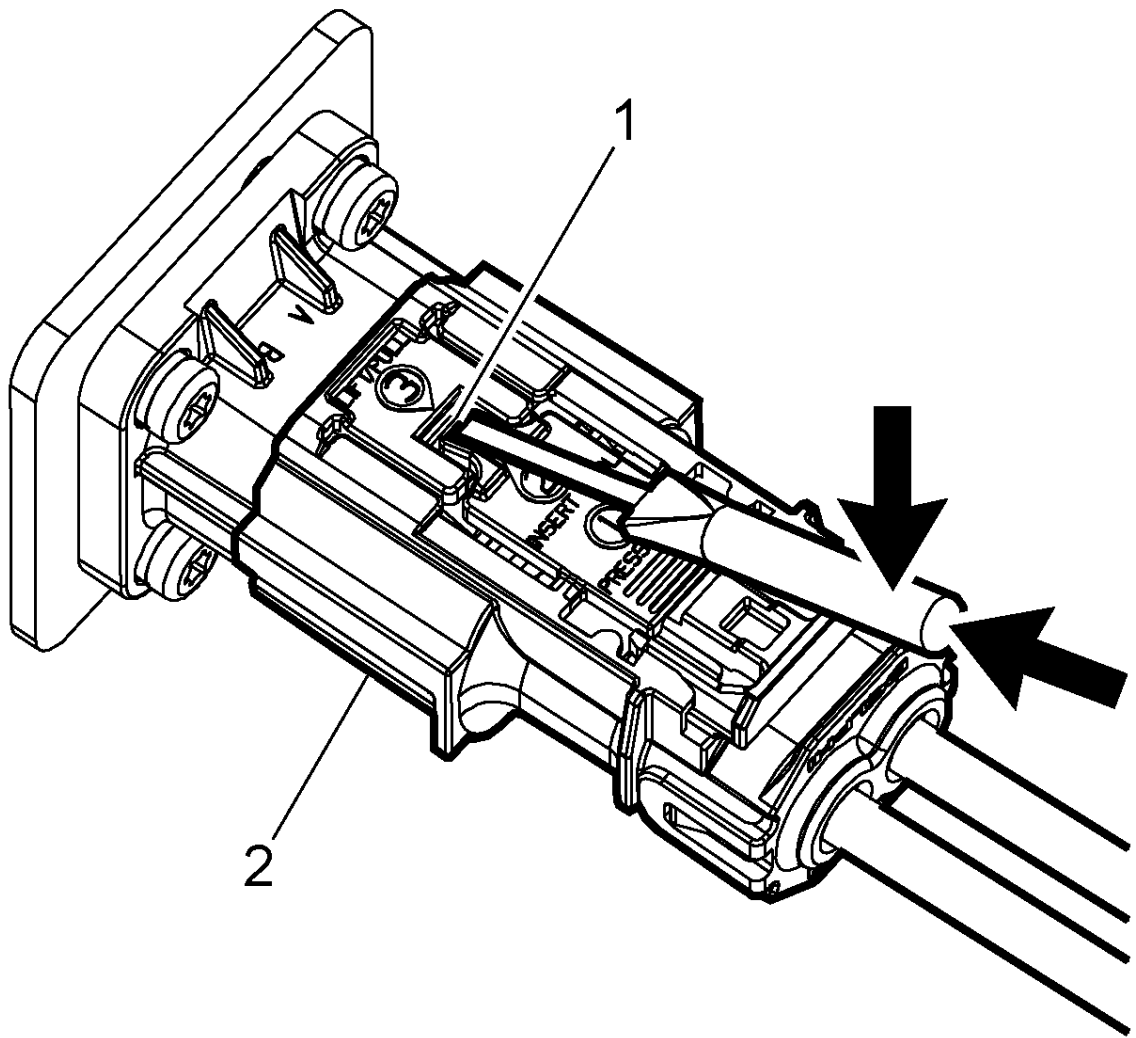


Fig. 25: Second Connector Lock And Female Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the connector does not separate easily when pulled after the second connector lock is released, check that both sides of the second connector lock have been released.

3. Insert a suitable tool into the slot under the second connector lock (1). Using the tool as a lever, release the female connector by gently raising the second connector lock. An audible click or clicks will be heard on both sides of the connector as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

HV280 Connect Procedure

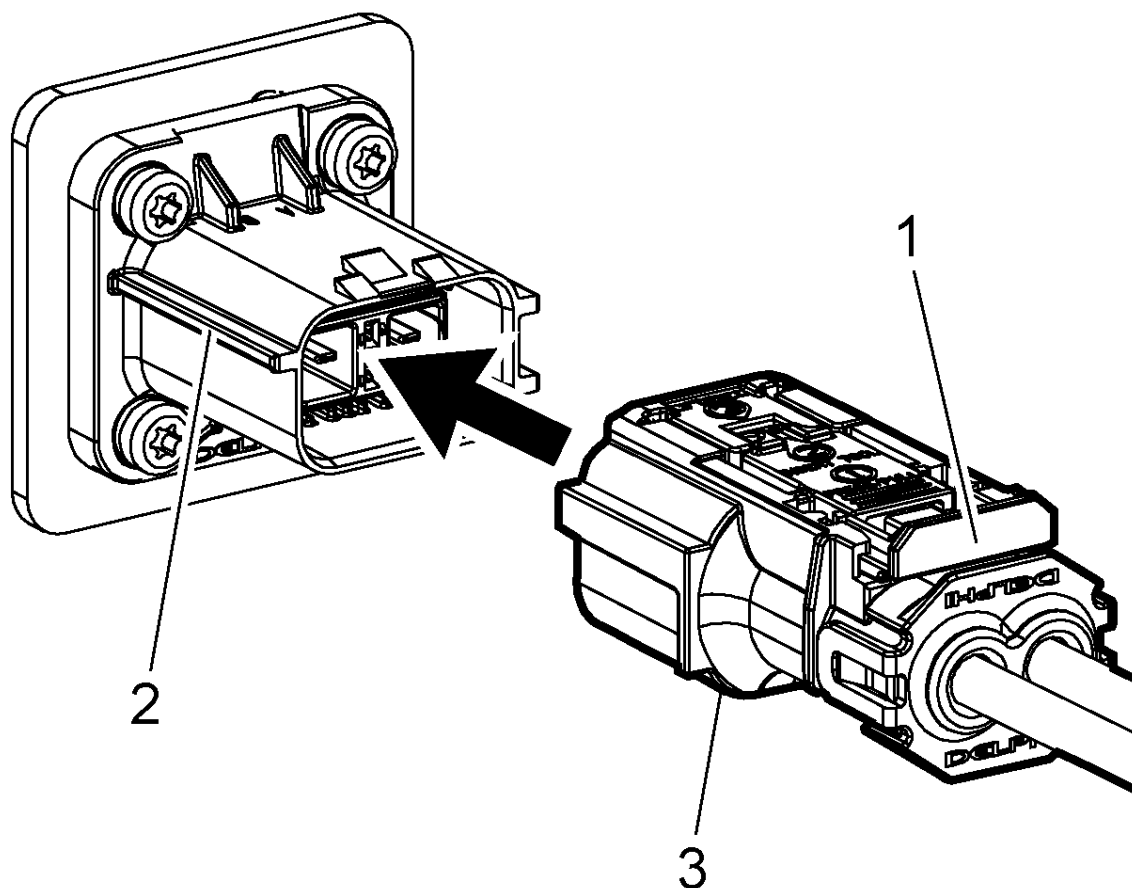


Fig. 26: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the CPA tab (1) is in the pre-stage position.
- The connector will be fully mated when a series of 2 audible clicks is heard.

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).

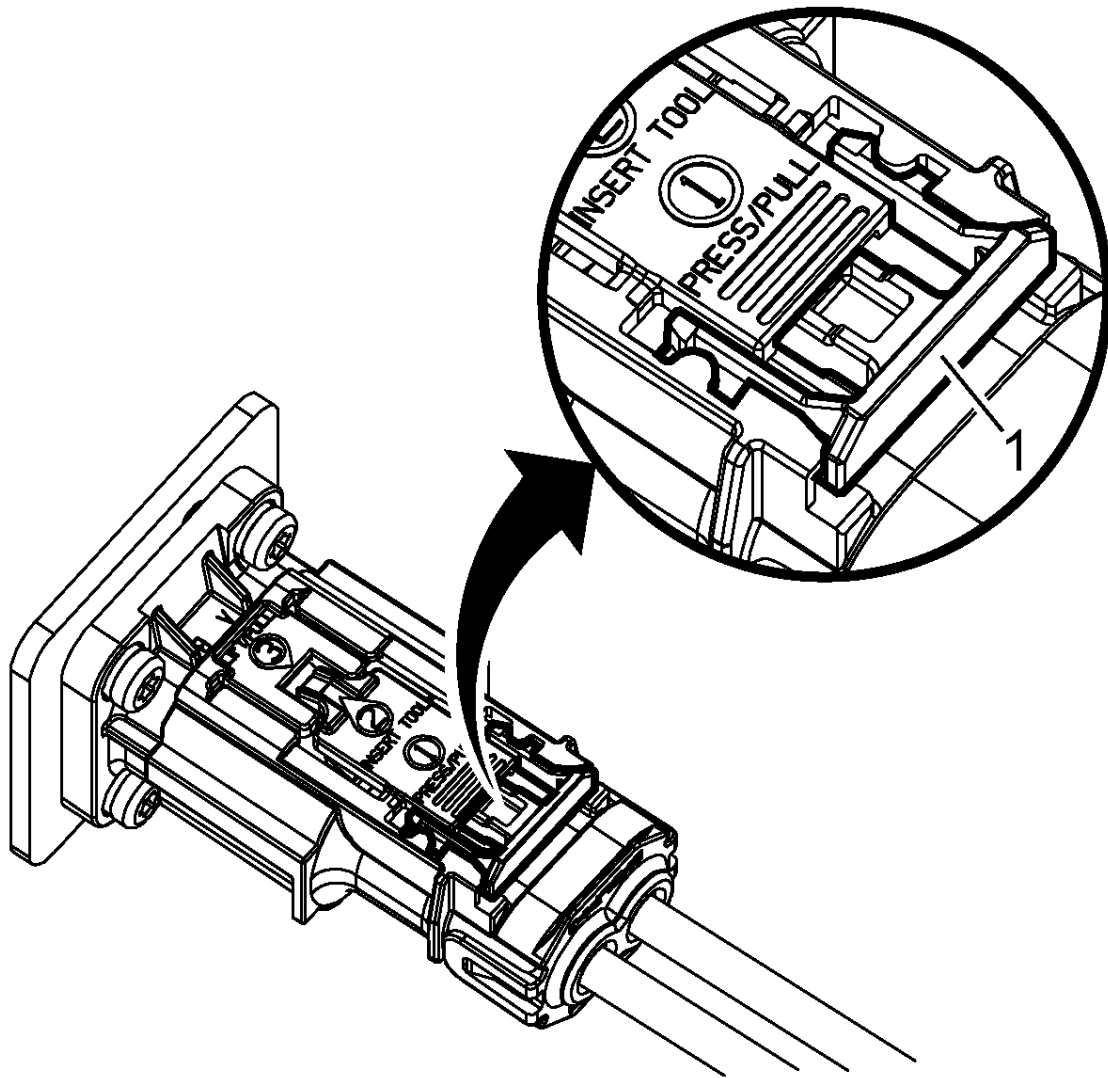


Fig. 27: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

NOTE: There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

AMP+HVA280 Connector Procedure

AMP+HVA280 Disconnect Procedure

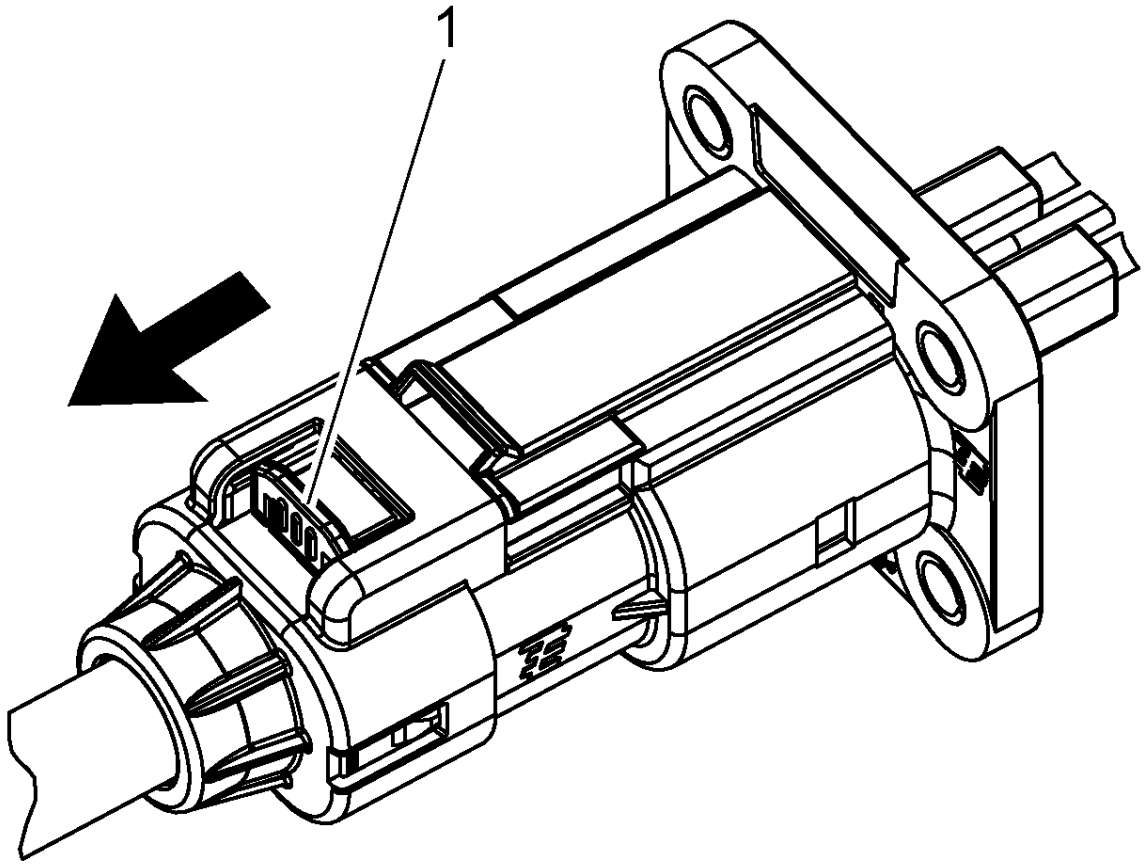


Fig. 28: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

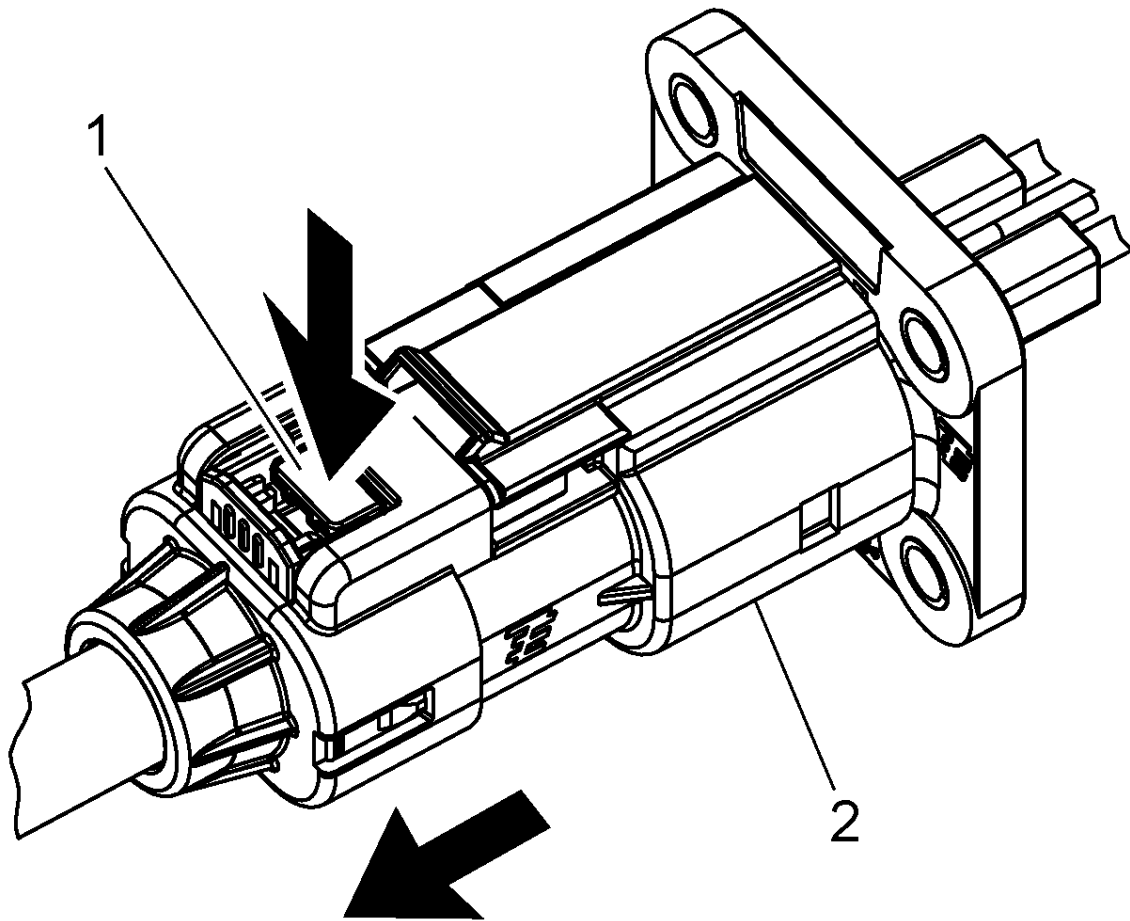


Fig. 29: Female Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

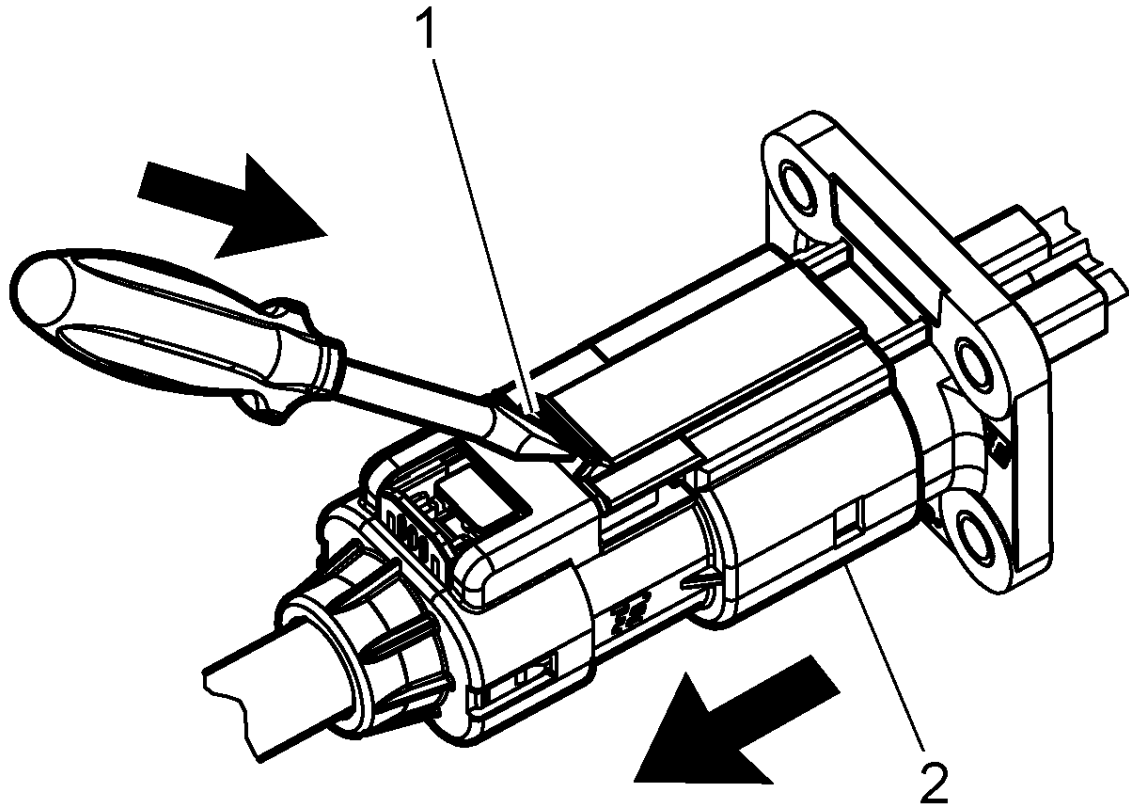


Fig. 30: Depressing Second Connector Lock To Disconnect Female Connector
Courtesy of GENERAL MOTORS COMPANY

3. Insert a suitable tool into the slot (1) and depress the second connector lock. An audible click will be heard as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

AMP+HVA280 Connect Procedure

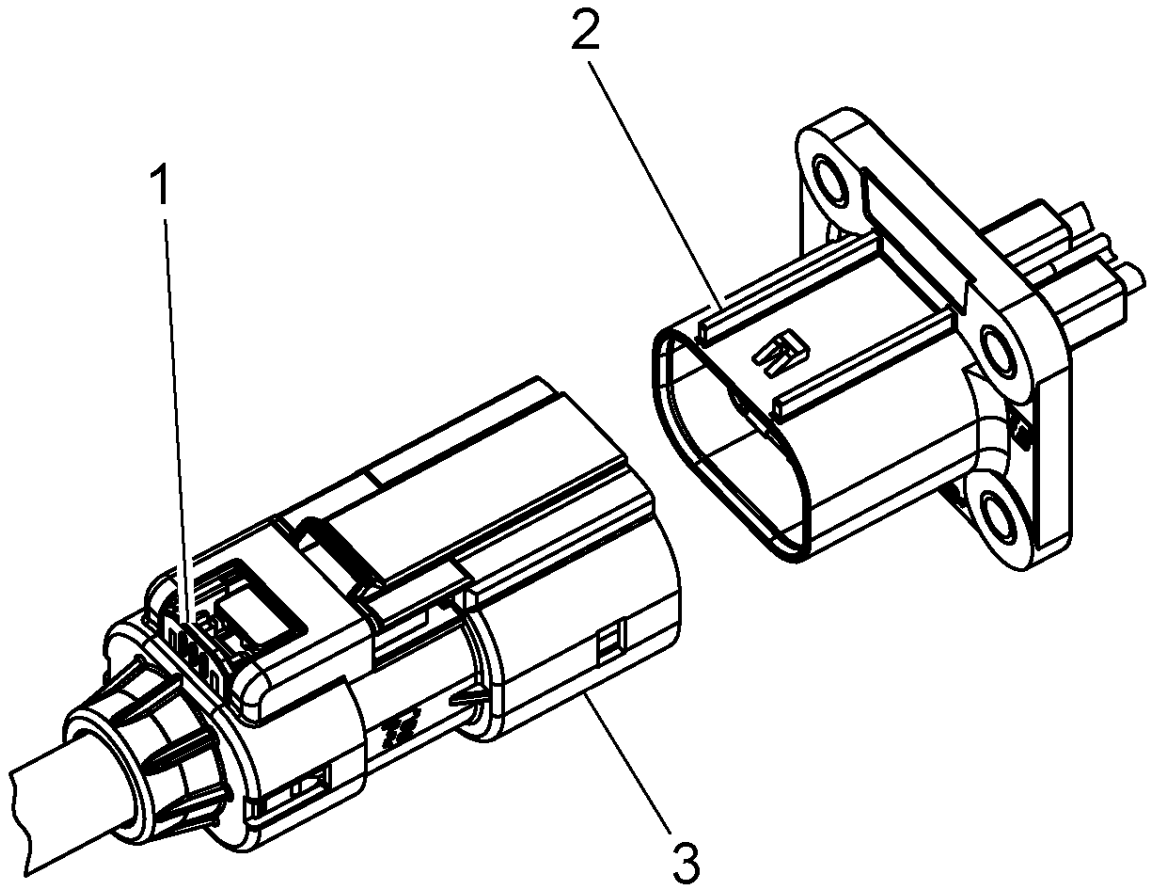


Fig. 31: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the CPA tab (1) is in the pre-stage position.
- The connector will be fully mated when a series of two audible clicks is heard.

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).

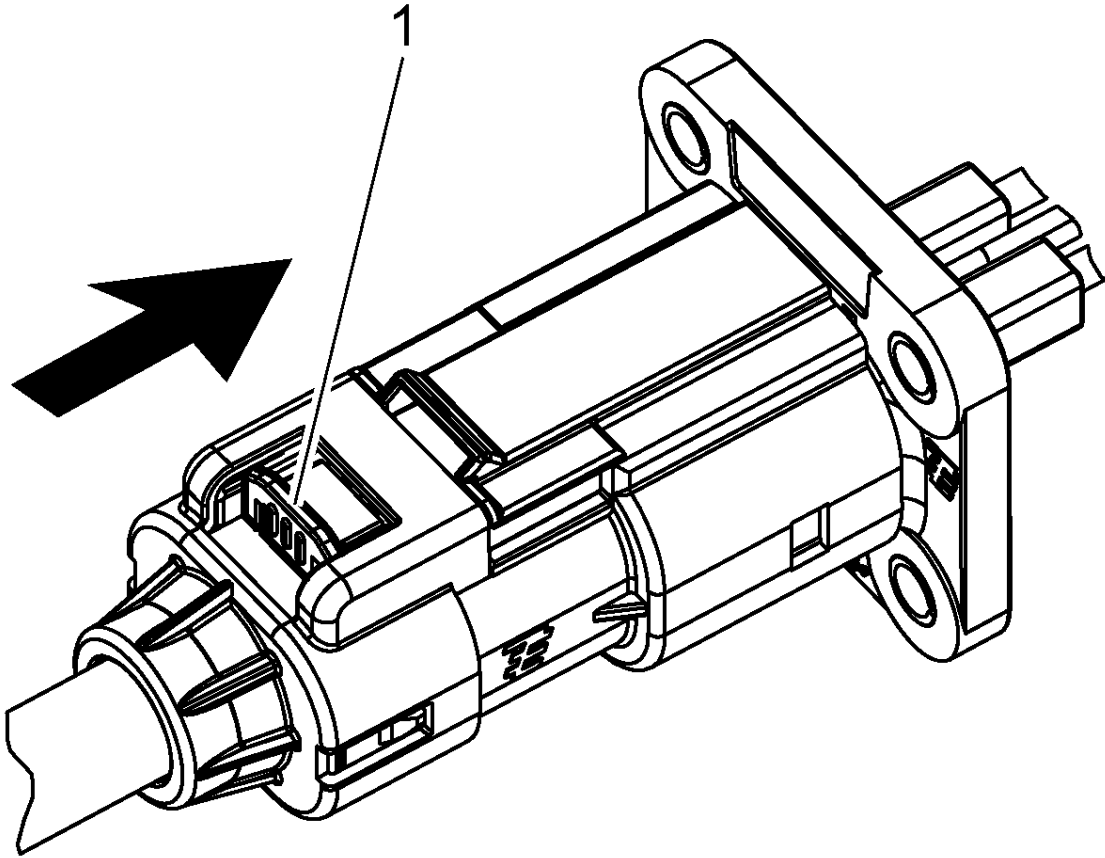


Fig. 32: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

NOTE: There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

PP2000 Axial Connector Procedure

PP2000 Axial Disconnect Procedure

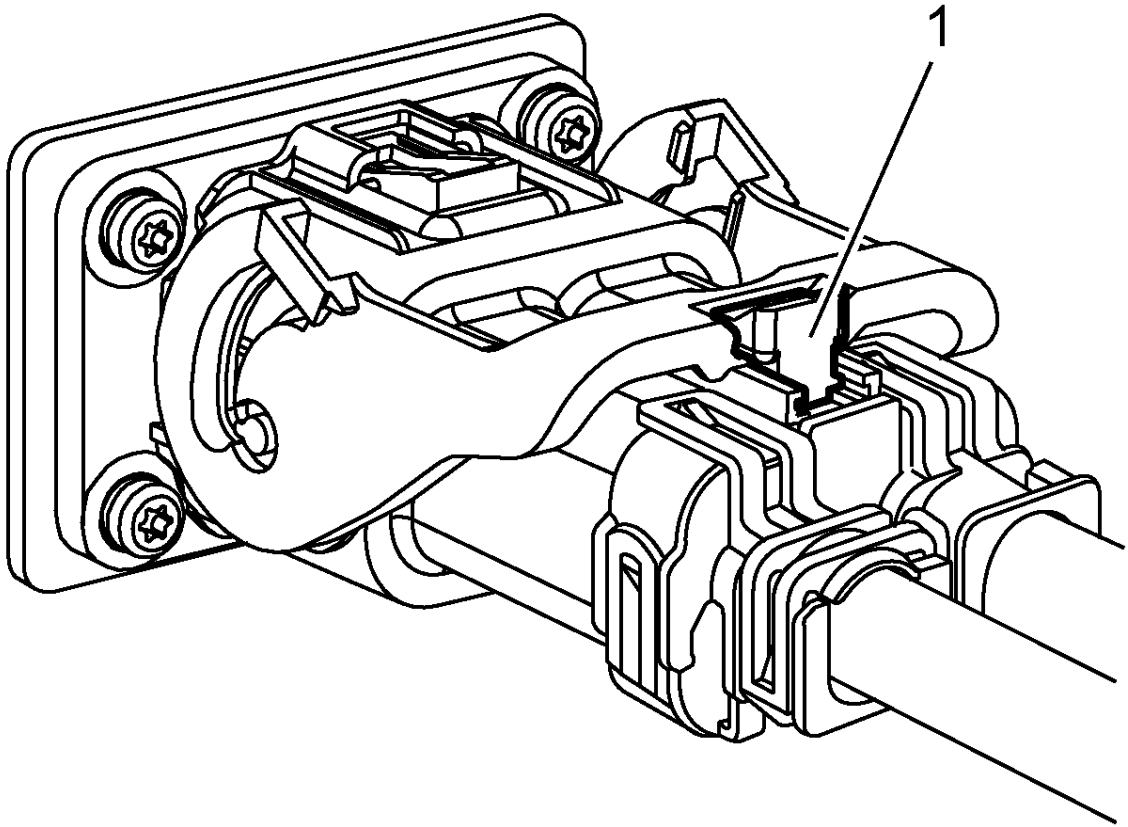


Fig. 33: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) tab (1) back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

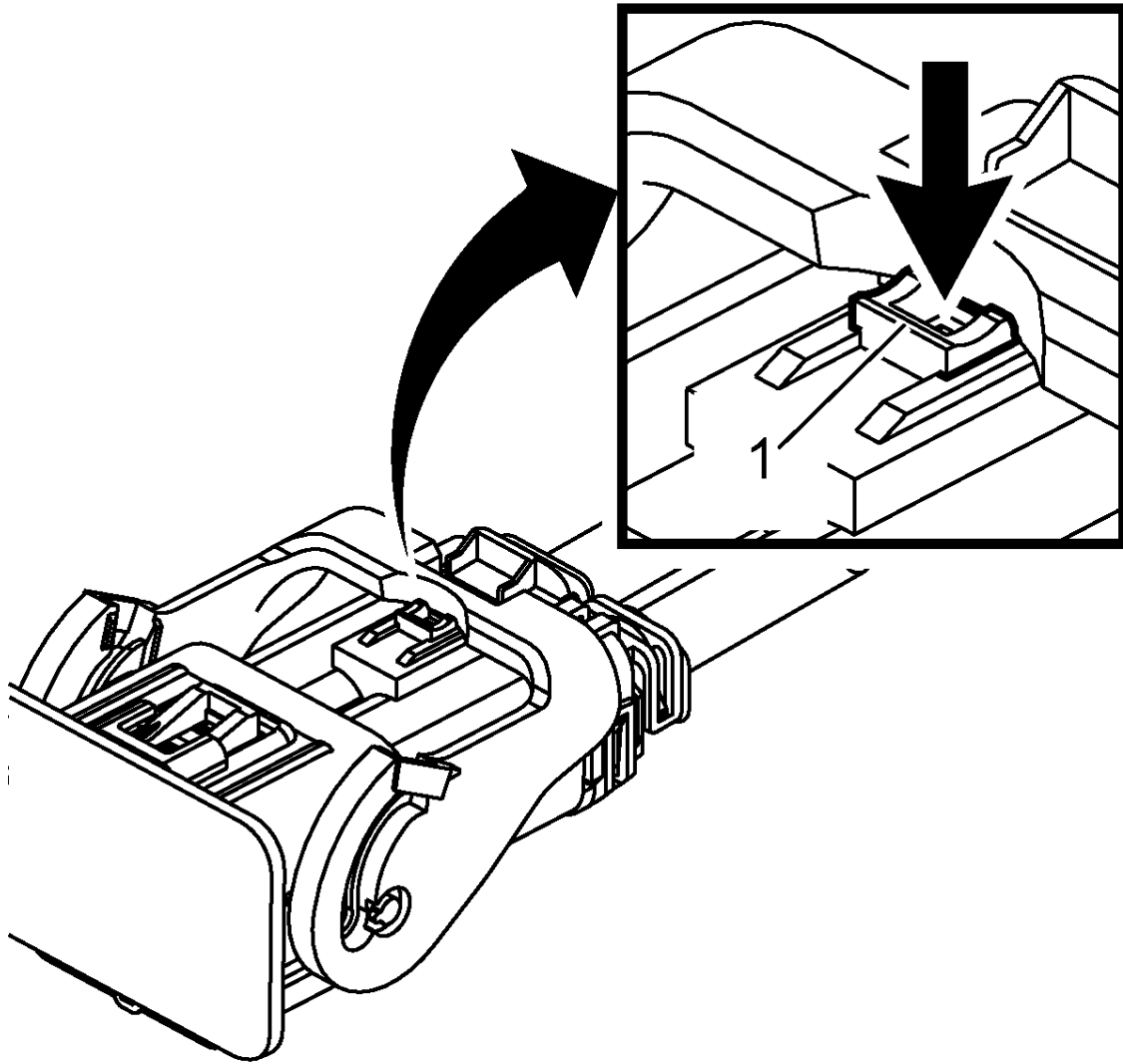


Fig. 34: Primary Lock Feature

Courtesy of GENERAL MOTORS COMPANY

2. Depress the primary lock feature (1) to release the lever.

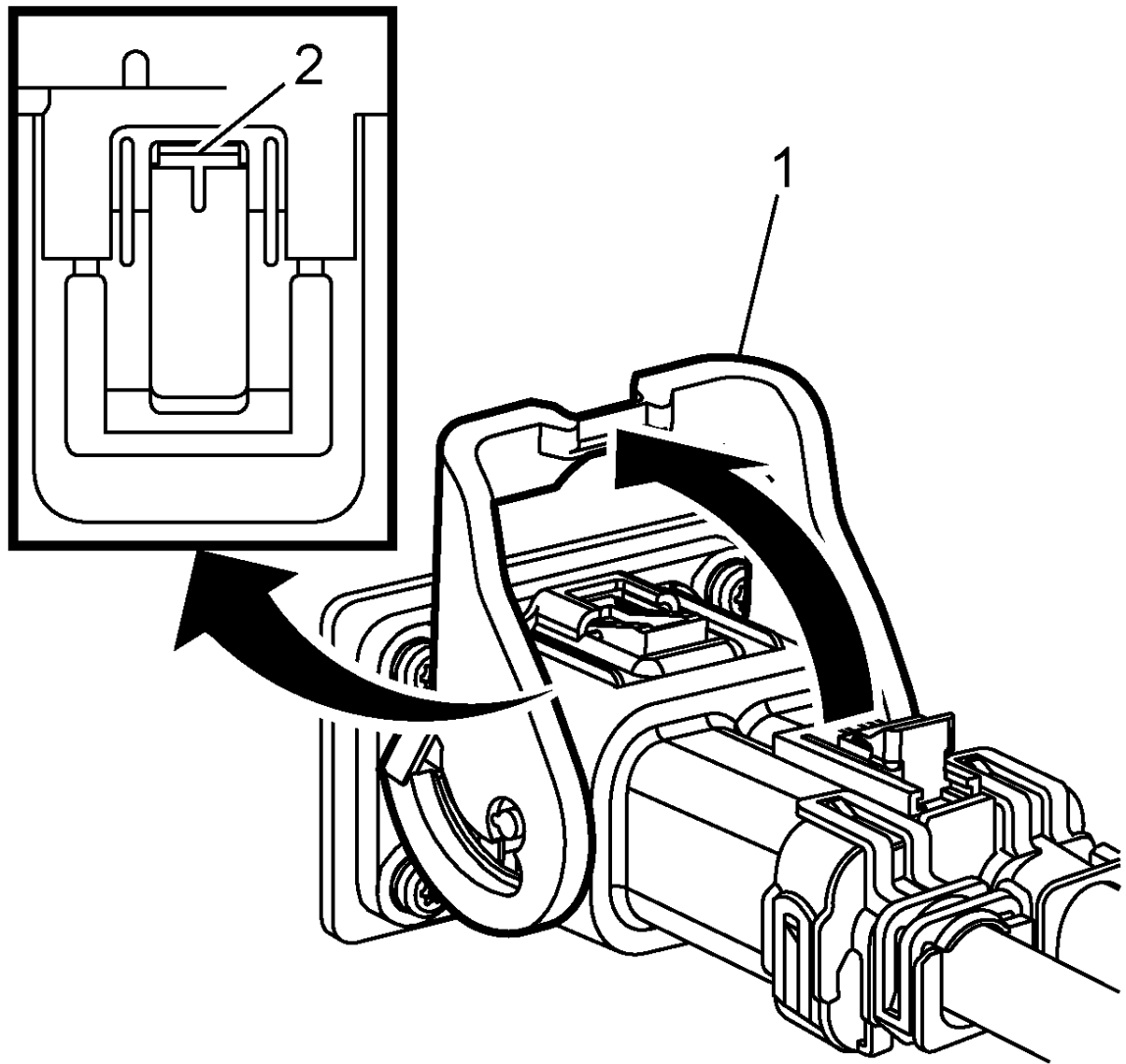


Fig. 35: Lift And Rotate Lever

Courtesy of GENERAL MOTORS COMPANY

NOTE: Only rotate the lever until the locks contact each other at the top of the connector (2).

3. Lift and rotate the lever (1) to place the connector in the partial-mate position.

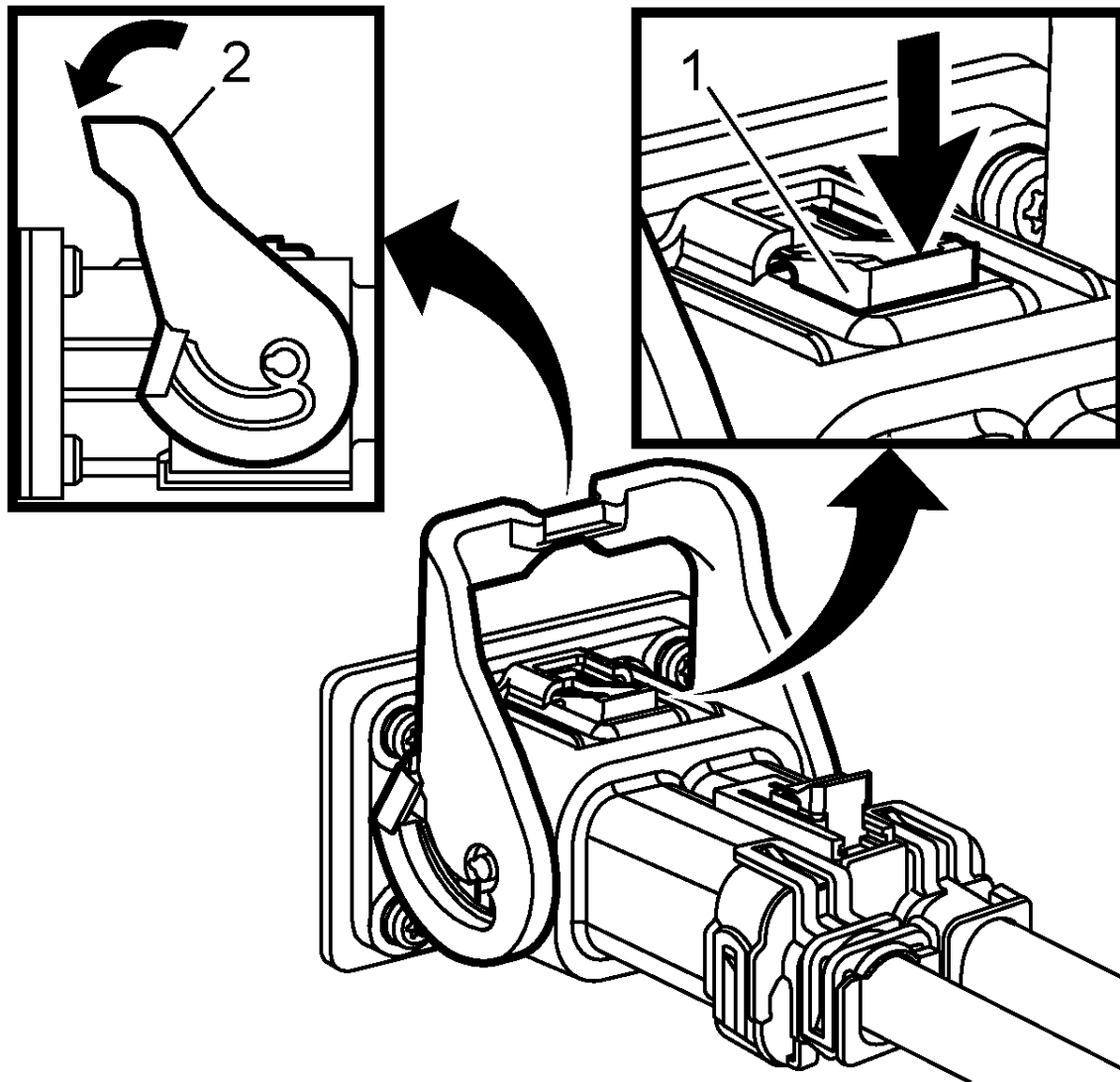


Fig. 36: Connector Lock And Lever

Courtesy of GENERAL MOTORS COMPANY

4. Depress the connector lock (1). Keep the lock depressed and rotate the lever (2) forward to the pre-stage position. There will be an audible click sound when the connector lock disengages.
5. Pull back on the female connector to disconnect the connector completely.

PP2000 Axial Connect Procedure

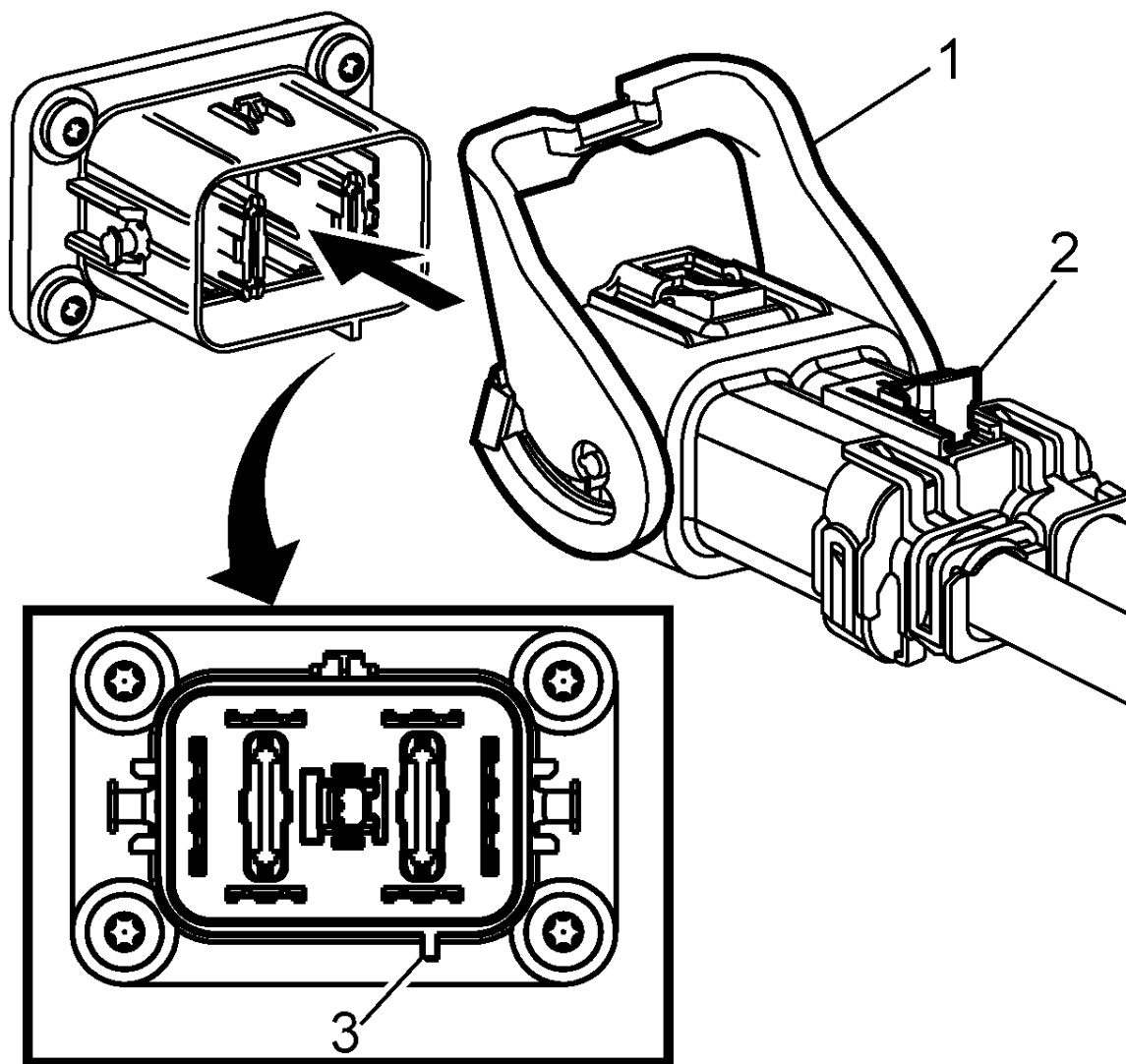


Fig. 37: Lever, Connector Position Assurance (CPA) Tab And Index Guide

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Using the connector lever to draw the connectors together during the pre-stage position may damage the connector lever pivots. Initial mating of the connector halves **MUST** be performed without the use of the connector lever. Engage the harness connector to the header connector by hand and allow the connector lever to freely rotate from the pre-stage position. Use the lever to fully mate the connector halves only when lever has rotated beyond the pre-stage position.

NOTE: Ensure the lever (1) and CPA tab (2) are in the pre-stage position.

1. Align the connector with the index features (3) and install the connector to the pre-locking position. The lever will be released from its pre-stage position with a short movement.

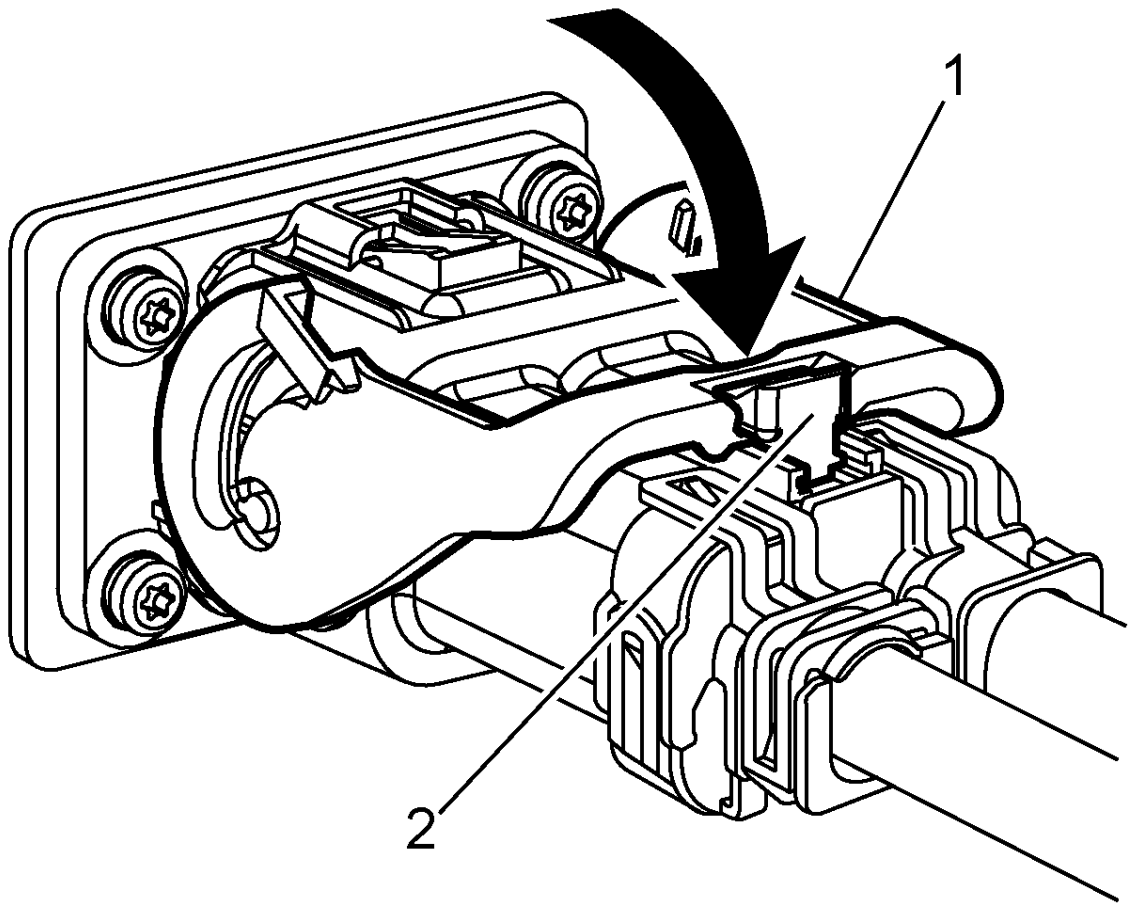


Fig. 38: Lever And Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

2. Close the lever (1) to the full-stage position. There will be a very audible click sound.
3. Push the CPA tab (2) to lock the connector in the full-stage position. There will be a very audible click sound when the connector is secured.

PP2000 90 NFS Connector Procedure

PP2000 90 NFS Disconnect Procedure

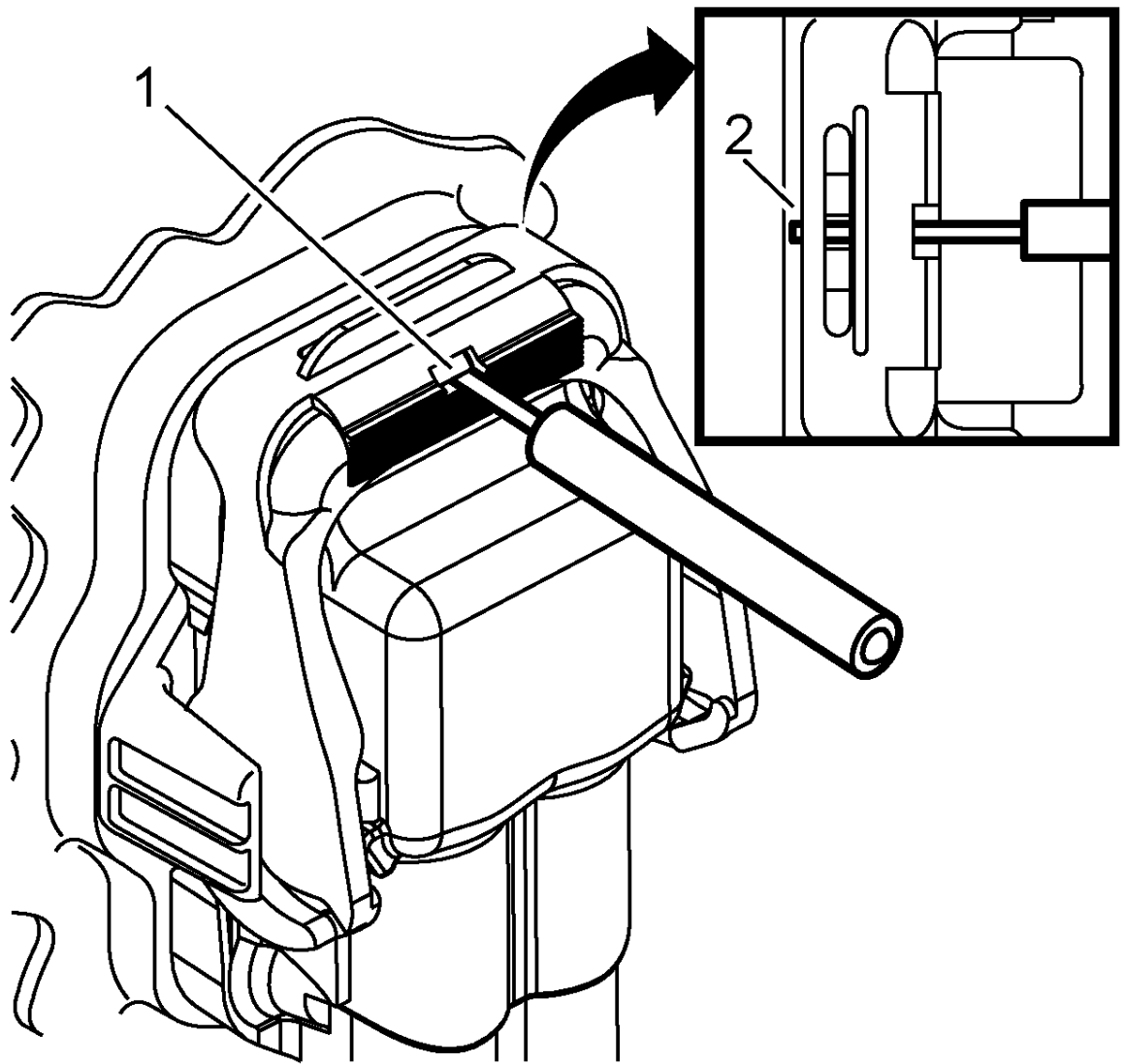


Fig. 39: Using Tool Through Opening To Unlock Lever
Courtesy of GENERAL MOTORS COMPANY

1. Place a suitable tool, such as a small flat-blade screwdriver, through the opening (1) at the front of the lever, and extend the tip down to near the base of the connector (2).
2. Rotate the tool slightly in either direction to unlock the lever.

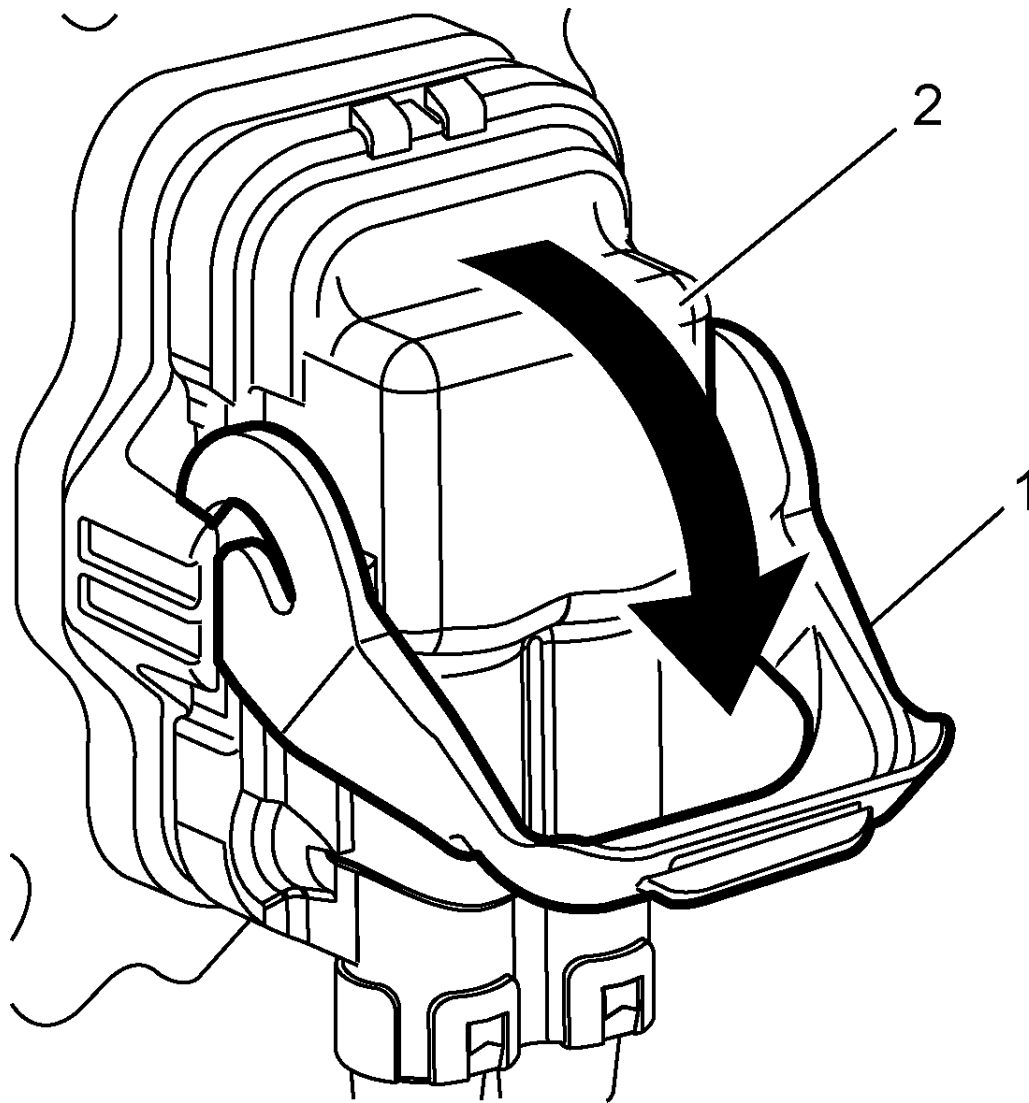


Fig. 40: Lever And Female Connector

Courtesy of GENERAL MOTORS COMPANY

3. Rotate the lever (1) to place the connector in a partial-mate position.
4. Remove the female connector (2) to complete the disconnection.

NOTE: **Always clean seal remnants from the connector with a non-marring tool.**

5. Inspect the High Voltage DC harness connector for seal residue or debris. Clean as necessary.
6. Inspect the High Voltage DC header connector seal for deformation or damage. Replace the DC connector header when seal damage is observed.

PP2000 90 NFS Connect Procedure

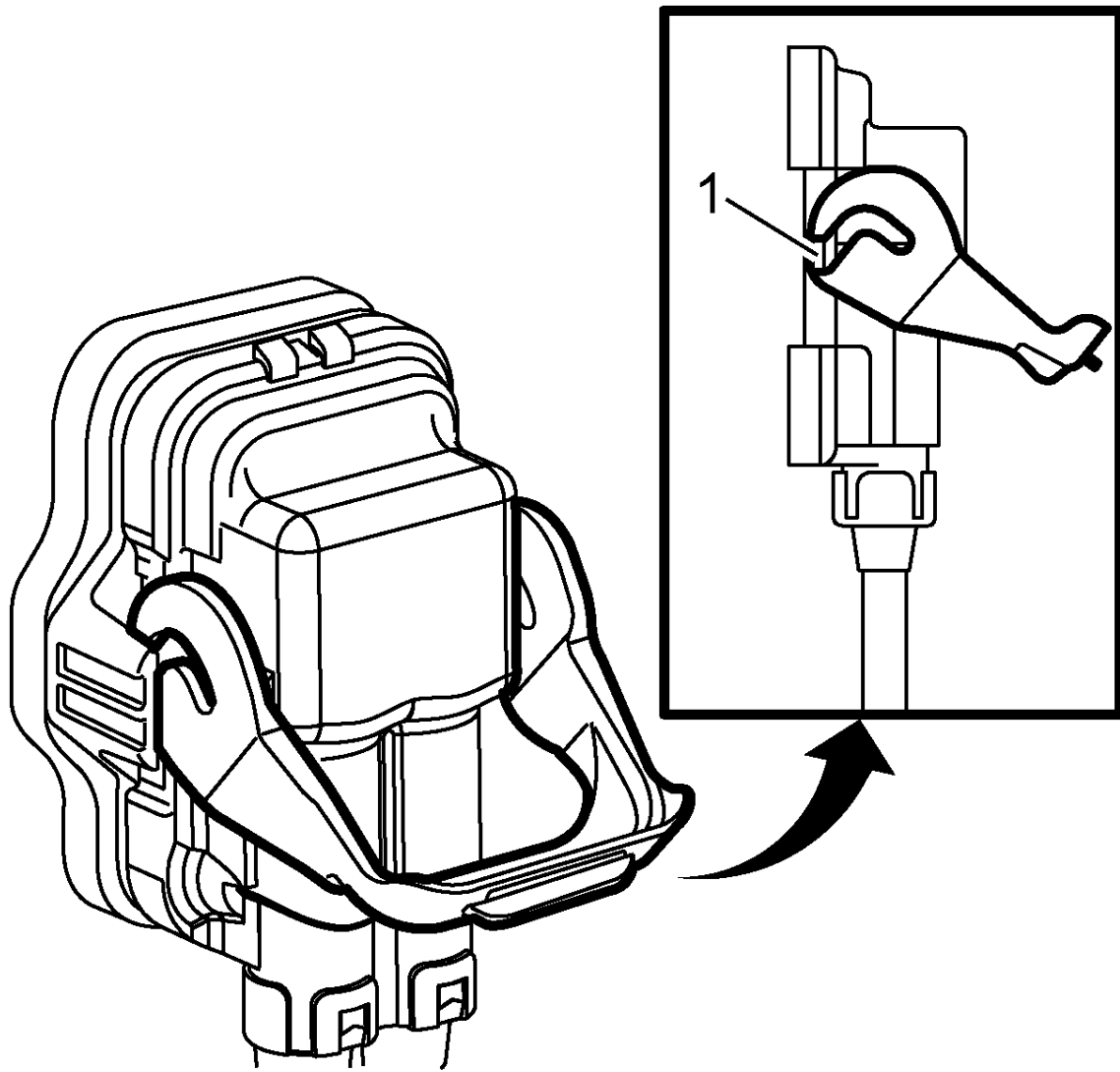


Fig. 41: Lever In Pre-Stage Assembly Position
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the lever is in the pre-stage assembly position (1).

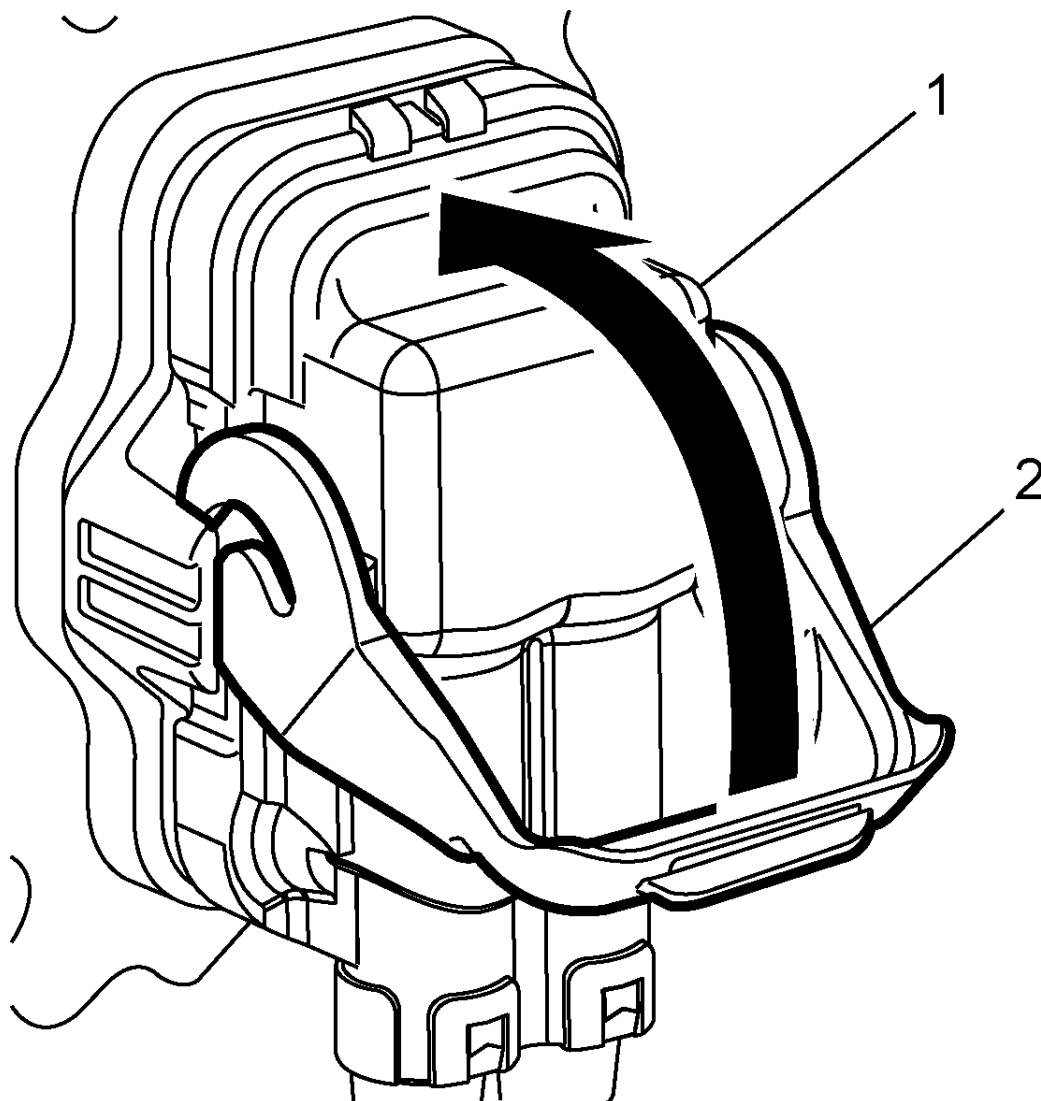


Fig. 42: Female Connector And Lever

Courtesy of GENERAL MOTORS COMPANY

2. Install the female connector (1) in the partial-mate position.
3. Rotate the lever (2) to place the connector in the full-mate position. There will be a very audible click sound when the lever locks in the full-stage position.

DTC P0A0C OR P0A0D: HIGH VOLTAGE SYSTEM INTERLOCK CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0A0C

High Voltage System Interlock Circuit Low Voltage

DTC P0A0D

High Voltage System Interlock Circuit High Voltage

Circuit/System Description

The main high voltage interlock circuit loop is used to determine if access to high voltage components is being attempted. Attempting to gain access to these high voltage components causes the main high voltage interlock circuit to open. The hybrid/EV powertrain control module 2 sources 5 V on the main high voltage interlock circuit loop and monitors the return voltage. A resistor in the manual service disconnect allows the hybrid/EV powertrain control module 2 to detect improper main high voltage interlock circuit voltage, such as open or shorted circuits.

Conditions for Running the DTC

P0A0C

- The 12 V battery voltage is greater than 10.2 V.
- The high voltage contactors are closed.

P0A0D

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is awake and communicating.

Conditions for Setting the DTC

P0A0C

The hybrid/EV powertrain control module 2 detects main high voltage interlock circuit loop voltage is less than 1.5 V.

P0A0D

- The hybrid/EV powertrain control module 2 detects main high voltage interlock circuit loop voltage is greater than 1.2 V when the circuit is inactive.

OR

- The hybrid/EV powertrain control module 2 detects main high voltage interlock circuit loop voltage is greater than 2.2 V when the circuit is active.

Actions Taken When the DTC Sets

- DTCs P0A0C and P0A0D are Type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTCs P0A0C and P0A0D are Type A DTCs.

Diagnostic Aids

- Test for a fully engaged hybrid battery pack high voltage manual disconnect whenever an open high voltage interlock circuit condition is observed. The hybrid battery pack high voltage manual disconnect must be pressed down fully in order to engage the high voltage interlock circuit terminals.
- The main high voltage interlock circuit is also routed through several inline connectors.

- The hybrid powertrain control module 2 scan tool parameter High Voltage Interlock Circuit Status will indicate Open Circuit whenever improper interlock circuit voltage is observed. Manipulating connections while monitoring the parameter for a change from Closed Circuit to Open Circuit may help locate intermittent connections.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode.
2. With a scan tool, observe the hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter.
 - **The parameter indicates an OPEN CIRCUIT condition.**Refer to Circuit/System Testing
 - **The parameter indicates a CLOSED CIRCUIT condition.**
3. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: The main high voltage interlock circuit is routed through several inline connectors and the S15 Manual Service Disconnect. The following steps assume the S15 manual service disconnect and the appropriate inline connectors are connected.

1. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
2. Vehicle in Service Mode. Test for 4.8V or greater between the 5 V reference circuit terminal 9 and ground.
 - If less than 4.8V
 1. Vehicle OFF, disconnect the X1 connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the 5 V reference circuit terminal 47, X1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit terminal 47 end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω replace the K114B Hybrid/EV Powertrain Control Module 2.
 - If 4.8V or greater

NOTE: Installing a 35 - 50 Ω resistor in place of a jumper should result in a constant Closed Circuit parameter indication.

3. With a scan tool, observe the hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter while momentarily installing a jumper between the 5V reference circuit terminal 9 and the signal circuit terminal 11, X357. Verify the parameter momentarily indicates a Closed Circuit whenever the jumper is first connected.

- **If the parameter never indicates a Closed Circuit condition**

1. Vehicle OFF, disconnect the X1 connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the signal circuit terminal 45 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit terminal 45 end to end.
 - If 2 Ω or greater, repair the open/high resistance on the circuit.
 - If less than 2 Ω replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the parameter will indicate a Closed Circuit condition**

4. Vehicle OFF. Test for 35 - 50 Ω between the 5 V reference circuit terminal 9 and the signal circuit terminal 11, X357 at the A4 Hybrid/EV battery pack.

- **If within the specified range**

All OK.

- **If not within the specified range**

5. Disable the high voltage for servicing at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
6. Disconnect the S15 Manual Service Disconnect.
7. Test for 35 - 45 Ω between the high voltage interlock circuit terminals of the S15 Manual Service Disconnect lever, terminal 1 and terminal 2.

- **If not within the specified range**

Replace the S15 Manual Service Disconnect.

- **If within the specified range**

8. Disconnect A4 Hybrid/EV battery pack connector X3.
9. Test for less than 2 Ω between the high voltage interlock circuit terminals of the 300V Battery Positive and Negative Cable.

- **If 2 Ω or greater**

Replace the 300V Battery Positive and Negative Cable assembly.

- **If less than 2 Ω**

10. Replace the A4 Hybrid/EV battery pack.

Component Testing

1. Disconnect the S15 Manual Service Disconnect.
2. Test for 35 - 45 Ω between the following terminals of the S15 Manual Service Disconnect, Terminal 1 and terminal 2.

- **If not within the specified range**

Replace the S15 Manual Service Disconnect.

- **If within the specified range**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#) for S15 Manual Service Disconnect replacement.
- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#) for A4 Hybrid/EV battery pack replacement.
- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Power Inverter Module and A/C Compressor](#)
- Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0A7F: HYBRID/EV BATTERY PACK

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0A7F

Hybrid/EV Battery Pack

Circuit/System Description

The hybrid/EV powertrain control module 2 calculates the high voltage battery pack capability and determines the high voltage battery pack end of life.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 10.2 V.
- Hybrid battery temperature is greater than 20Â° C (68Â° F).
- Hybrid battery temperature is less than 50Â° C (122Â° F).
- Hybrid battery state of charge is between 15% and 100%.
- When the hybrid/EV powertrain control module 2 calculates the actual battery power has exceeded the power limits multiplied by seconds of duration is greater than 80%.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0ABB, P0ABC, P0ABD, P0AC1, P0AC2, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0AF8, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, P0C7D, P0C7E, P0C7F, P0C82, P0C83, P0C84, P0C89, P0C8A, P0C8B, P0C8E, P0C8F, P0C90, P0C93, P0C94, P0C95, P0C98, P0C99, P0C9A, P0CA9, P0CAA, P0CAB, P0CAE, P0CAF, P0CB0, P0CB3, P0CB4, P0CB5, P0CB8, P0CB9, P0CBA, P1A07, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1EBA, P1EBB, U0111, U185A, U2401, U2603, U2604, U2605, or U2606.

Conditions for Setting the DTC

- Battery voltage and current is varying. Requires more than 10 minutes of city driving.
- The hybrid/EV powertrain control module 2 calculates the power limits is less than the KW end of life power threshold.

Action Taken When the DTC Sets

DTC P0A7F is a type B DTC.

Conditions for Clearing the DTC

DTC P0A7F is a type B DTC.

Diagnostic Aids

Removing the manual service disconnect before disconnecting the 12 V battery may cause a DTC P0A7F to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

NOTE: Removing the manual service disconnect before disconnecting the 12 V battery may cause a DTC P0A7F to set. Incorrectly performing the High Voltage Disabling procedure steps will cause false DTCs to set and result in misdiagnosis of vehicle components.

1. Record the freeze frame/failure records.
2. Verify that no other DTCs are set.

- If any other DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- No other DTCs are set

3. Verify DTC P0A7F is set.

- If DTC P0A7F is set

1. Vehicle OFF, disconnect the 12 V battery. Wait 30 seconds, reconnect the 12 V battery. Refer to [Battery Negative Cable Disconnection and Connection](#).
2. Review and operate the vehicle according to the DTC Conditions for Running. Operate the vehicle for more than 10 minutes of city driving.
3. Verify that DTC P0A7F does not reset.
 - If DTC P0A7F resets
 1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
 2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#).
 3. Inspect all internal high voltage busbar/cable terminals for arc-flash damage.
 - If high voltage terminal damage is present, replace the effected components.
 - If high voltage terminal damage is not present, replace the A4 hybrid/EV battery pack.
 - If DTC P0A7F does not reset
4. All OK.

- If DTC P0A7F is not set

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
- Refer to [Control Module References](#) for battery energy control module and hybrid battery interface control modules replacement, programming and setup.

DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, OR P1EC3: HYBRID/EV BATTERY & BATTERY CHARGING SYSTEM

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0AA1

Hybrid/EV Battery Positive Contactor Circuit Stuck Closed

DTC P0AA4

Hybrid/EV Battery Negative Contactor Circuit Stuck Closed

DTC P0AD9

Hybrid/EV Battery Positive Contactor Control Circuit

DTC P0ADD

Hybrid/EV Battery Negative Contactor Control Circuit

DTC P0AE3

Hybrid/EV Battery Precharge Contactor Circuit Stuck Open

DTC P0AE4

Hybrid/EV Battery Precharge Contactor Control Circuit

DTC P0D0A

Battery Charging System Positive Contactor Control Circuit

DTC P0D09

Battery Charging System Positive Contactor Stuck Open

DTC P1EBD

Battery Charging System Contactor(s) Stuck Open

DTC P1EC0

Hybrid/EV Battery System Contactor(s) Stuck Open

DTC P1EC3

Hybrid/EV Battery Pack Heater Transistor Control Circuit

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors and 1 solid state relay (transistor). The high voltage contactors and transistor allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The transistor controls the battery heater high voltage positive circuit. The contactors and transistor close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor/transistor. Ground is provided through a vehicle ground external of the high voltage battery.

Conditions for Running the DTC

P0AA1

- The 12 V battery voltage is greater than 10.2 V.
- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P0AF8, P1A07, P1AE8, P1AE9, or P1AEC.

P0AA4

- The 12 V battery voltage is greater than 10.2 V.
- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.
- Active battery heating is not enabled.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P0AF8, P1A07, P1AE8, P1AE9, or P1AEC.

P0AD9, P0ADD, P0AE4, P0D0A, P1EC3 and P1EBD

The 12 V battery voltage is greater than 10.2 V.

P0AE3

- During precharge mode.
- The negative contactor is open.
- Battery heating is not enabled.

P0D09

- During precharge mode.

- The negative contactor is open.
- The charger contactor is closed.
- Negative bus voltage is greater than 40 V.

P1EC0

- The 12 V battery voltage is greater than 10.2 V.
- The main positive and negative contactors have been closed for more than 1 second.
- The charger positive contactor is closed.
- None of the following DTCs are set; P1AE8, P1AE9, or P1AEC.

Conditions for Setting the DTC

P0AA1

The positive bus voltage is greater than 30 V.

P0AA4

The negative bus voltage is greater than 30 V.

P0AD9, P0ADD and P0D0A

The hybrid/EV powertrain control module 2 has detected an open or short to voltage in the control circuit for the corresponding contactor.

P0AE3

The negative bus voltage is less than 5 V.

P0AE4

The hybrid/EV powertrain control module 2 has detected a short to voltage in the control circuit.

P0D09

The battery charger sensed voltage is less than 10 V.

P1EBD

The battery charger sensed voltage is less than 80% of hybrid/EV battery voltage.

P1EC0

The main bus voltage is less than 80% of hybrid/EV battery voltage.

P1EC3

The hybrid/EV powertrain control module 2 has detected an open, short to ground or short to voltage in the heater transistor control circuit.

Actions Taken When the DTC Sets

- DTCs P0AE3, P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Conditions for Clearing the DTC

- DTCs P0AE3, P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Diagnostic Aids

DTC P1EC3 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25°C (-13°F).

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
 - **If any of the DTCs are set**
Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
3. Verify that DTC P0AA1 and/or P0AA4 is set without any of the above contactor Control Circuit DTCs.
 - **If the DTC is set**
Replace the A28 Hybrid/EV Battery Contactor Assembly.
 - **If the DTC is not set**

4. Connect the drive motor battery charger cable. Verify DTC P0D26 is not set and the vehicle will charge.

- **If the DTC is set and the vehicle will not charge**

Refer to [**DTC P0D26**](#) .

- **If the DTC is not set and the vehicle charges**

5. Verify that DTC P0C78 is not set.

- **If the DTC is set**

Refer to [**DTC P0C78 or P3061**](#).

- **If the DTC is not set**

NOTE: **The following setup steps must be performed exactly in order to exercise the contactors.**

6. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.

7. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: **The brake pedal must remain depressed throughout the remainder of the contactor steps.**

8. PRESS and HOLD the brake pedal.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode.**

9. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.

10. Disconnect the S15 Manual Service Disconnect.

NOTE: **DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.**

11. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

12. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.

- **If the Hybrid/EV Battery Negative Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Negative Contactor does open and close**

13. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

14. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.

- **If the Hybrid/EV Battery Positive Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Positive Contactor does open and close**

15. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

16. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Precharge Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Precharge Contactor does open and close**

17. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

18. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Charger Contactor does not open and close**

Refer to Circuit/System Testing.

- **If the Hybrid/EV Battery Charger Contactor does open and close**

19. All OK.

Circuit/System Testing

NOTE: You must perform Circuit/System Verification before proceeding.

DTC P0AD9, P0ADD, P0AE4, or P0D0A Contactor Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If more than 10 Ω**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K16 Battery Energy Control Module and A28 Hybrid/EV Battery Contactor Assembly.

- **If the test lamp illuminates**

5. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode.

6. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control

circuit terminals listed below and ground:

- Terminal 2 X357
- Terminal 4 X357
- Terminal 6 X357
- Terminal 7 X357
- **If the test lamp illuminates on any circuit**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If the test lamp does not illuminate on all circuits**

7. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
8. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:

- Terminal 2 X357
- Terminal 4 X357
- Terminal 6 X357
- Terminal 7 X357
- **If less than infinite resistance on either circuit**

Repair the short to ground on the circuit.

- **If infinite resistance on both circuits**

9. Test for less than 2 Ω between the harness connector terminals listed below:
 - Terminal 2 X357 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2
 - Terminal 4 X357 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
 - Terminal 6 X357 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
 - Terminal 7 X357 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2
 - **If 2 Ω or greater on any circuit**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω on all circuits**

10. Replace the A28 Hybrid/EV Battery Contactor Assembly.
11. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

12. All OK.

DTC P1EC3 - Hybrid/EV Battery Pack Heater Transistor Diagnosis

1. Vehicle in Service Mode.
2. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D0A, P0D09, P1EBD, or P1EC0, is not set.
 - **If any contactor DTC is set**

Refer to the appropriate contactor Circuit/System Testing.
 - **If no contactor DTC is set**
3. Vehicle OFF, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
4. Vehicle in Service Mode.
5. Verify that a test lamp does not illuminate between the A4 Hybrid/EV Battery Pack harness control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
 - **If the test lamp does not illuminate**
6. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
7. Test for infinite resistance between the A4 Hybrid/EV Battery Pack harness control circuit terminal 2 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**

Test for less than 2 Ω in the control circuit end to end.
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
8. Perform the [High Voltage Disabling](#) procedure and replace the A28 Hybrid/EV Battery Contactor Assembly.
9. Verify that DTC P1EC3 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC is set**

Replace the K114B Hybrid Powertrain Control Module 2.
 - **If the DTC is not set**
10. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor

Assembly replacement.

- Refer to [Control Module References](#) for battery energy control module and hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0AA6 OR P1AE6: HYBRID/EV BATTERY VOLTAGE SYSTEM ISOLATION LOST & BATTERY ENERGY CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0AA6

Hybrid/EV Battery Voltage System Isolation Lost

DTC P1AE6

Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit

Circuit/System Description

The vehicle is equipped with a high voltage isolation monitor feature. The purpose of the battery energy control module high voltage isolation monitor circuit is to test the resistance between the high voltage positive and negative direct current (DC) bus and chassis ground. The battery energy control module isolation monitoring method is sometimes referred to as the active isolation monitor. The hybrid powertrain control module 2 requests the battery energy control module to perform this test. Measurement values are reported to the hybrid powertrain control module 2, which makes the determination of an isolation fault.

The isolation check for P0AA6 Hybrid Battery Voltage System Isolation Lost runs when all the contactors are open. This check monitors isolation in the battery system. This check runs only once during the time that the hybrid powertrain control module 2 is awake and runs after the contactors have been open for 35 seconds. This monitor typically runs when the vehicle is turned off after a drive. It could also run when the vehicle is first started, if there is a long enough period between the hybrid powertrain control module 2 waking up and the main contactors closing.

The battery energy control module runs an internal self check of this sensor circuit. When this test fails, DTC P1AE6 will be set.

Conditions for Running the DTC

P0AA6

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating
- All the contactors have been open for 35 seconds.

P1AE6

- The 12 V battery voltage is greater than 11 V.
- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- The hybrid powertrain control module 2 has requested the battery energy control module to run the isolation test.

- The main contactors are open.
- DTC U185B is not set.

Conditions for Setting the DTC

P0AA6

- The battery energy control module has detected active isolation resistance is less than 300K Ω if P0AA6 has not failed, or less than 350K Ω if P0AA6 has failed at least once.
- 5 out of 10 tests have failed.

P1AE6

The battery energy control module has detected a fault with the active isolation sensing circuits.

Actions Taken When the DTC Sets

P0AA6 and P1AE6 are Type A DTCs.

Conditions for Clearing the DTC

- P0AA6 and P1AE6 are Type A DTCs.
- P0AA6 requires one passing test at greater than 350K Ω resistance.

Diagnostic Aids

- A single high voltage contactor stuck closed may set this DTC.
- Condensation or water intrusion into the hybrid/EV battery pack may cause P0AA6 or P1AE6 to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

[Control Module References](#) for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Verify that DTC P0A7E, P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0C32, P0D0A, P0D09, P1EBD, P1EC0 or P1EC3 is not set.

- **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

2. Verify that DTC P1AE6 is set and P0AA6 is not set.

- **If DTC P1AE6 is set without DTC P0AA6**

Replace the K16 Battery Energy Control Module.

- **If both DTCs are set, or only DTC P0AA6 is set**

3. Verify with a scan tool the hybrid powertrain control module 2, Isolation Test Resistance parameter is greater than 350k Ω .

- **If the parameter is 350k Ω or less**

Refer to Circuit/System Testing.

- **If the parameter is greater than 350k Ω**

4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.

- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Remove the Drive Motor Battery Cover. Refer to [High Voltage Battery Cover Replacement](#).
3. Disconnect the harness connector at the E54 Hybrid/EV Battery Pack Coolant Heater.
4. Test for 61 - 75 Ω between terminal A and terminal B at the E54 Hybrid/EV Battery Pack Coolant Heater.

- **If not within the specified range**

Verify that the heater fuse is not blown. Replace the heater fuse if it is blown and the E54 Hybrid/EV Battery Pack Coolant Heater.

- **If within the specified range**

NOTE: Only perform the following continuity tests with the EL-50772 Insulation Multimeter or equivalent.

5. Ensure only the EL-50772 insulation multimeter or equivalent is used with this procedure. Select the Isolation Test setting, then select the 500 V range. Refer to [Troubleshooting With an Insulation Multimeter](#) for important usage instructions.
6. Test for 550M Ω between the E54 Hybrid/EV Battery Pack Coolant Heater terminals listed below and battery tray ground:

- Terminal A
- Terminal B
- **If less than 550M Ω**

Verify that the heater fuse is not blown. Replace the heater fuse if it is blown and the E54 Hybrid/EV Battery Pack Coolant Heater.

- **If 550M Ω or greater**

7. Replace the A4 Hybrid/EV Battery Pack.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Voltage Battery Heater Replacement](#)
- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid Battery Contactor Assembly replacement
- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0ABB, P0ABC, OR P0ABD: HYBRID/EV BATTERY VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0ABB

Hybrid/EV Battery Voltage Sensor Performance

DTC P0ABC

Hybrid/EV Battery Voltage Sensor Circuit Low Voltage

DTC P0ABD

Hybrid/EV Battery Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors individual cell voltage readings from the battery energy control module. The battery energy control module monitors the voltage of the 96 battery cell groups. Voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

Conditions for Running the DTC

P0ABB

- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.
- DTC U0111 or U185A is not set.

P0ABC and P0ABD

- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.
- The 12 V battery voltage is greater than 10.2 V.
- DTC P1A07 is not set.

Conditions for Setting the DTC

P0ABB

The hybrid/EV powertrain control module 2 detects difference of 12 V between the average cell group voltage multiplied by 96 and the voltage measured at battery side of the main contactors.

P0ABC

The battery energy control module detects the terminal voltage is less than 24 V on the battery side of the main contactors.

P0ABD

The battery energy control module detects the terminal voltage is greater than 479 V on the battery side of the main

contactors.

Actions Taken When the DTC Sets

- DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.
- The vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.

Diagnostic Aids

- The hybrid/EV battery pack high voltage manual service disconnect is out, not installed correctly, or a blown manual service disconnect fuse may cause P0ABB and/or P0ABC to set.
- The hybrid/EV battery pack high voltage manual service disconnect was removed, out of sequence, or was out during a service procedure with the 12 V battery connected may cause P0ABB and/or P0ABC to set.

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

- The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-55** Battery Pin Out Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.
 - **If any DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If no other DTCs are set**
3. Verify and record with a scan tool, the battery energy control module Hybrid Battery Pack Terminal 1 Voltage parameter and the hybrid/EV powertrain control module 2 Hybrid Battery Pack Voltage parameters are between 205 - 419 V and within 12 V of each other.
 - **If not within the specified range and not within 12 V of each other**

Refer to Circuit/System Testing.

- **If within the specified range and within 12 V of each other**
4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.

- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Remove the S15 Manual Service Disconnect.
3. Test for less than 10 Ω across the S15 Manual Service Disconnect fuse terminals.

- **If 10 Ω or greater**

Replace the S15 Manual Service Disconnect.

- **If less than 10 Ω**

4. Remove the A4 hybrid/EV battery pack cover. Refer to [High Voltage Battery Cover Replacement](#).

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

5. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

6. Inspect the harness connectors and the 16 battery energy control module connectors for corrosion.

- **If corrosion is present**

Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

- **If corrosion is not present**

NOTE: The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.

7. Disconnect the harness connectors at the C5A Hybrid/EV Battery Module 1 and the C5G Hybrid/EV Battery Module 7.

8. Inspect the harness connector and the appropriate C5 Hybrid/EV Battery Module connector for corrosion.

- **If corrosion is present**

Replace the A4 Hybrid/EV Battery Pack Internal Harness and the C4 Hybrid/EV Battery Section as

applicable.

- **If corrosion is not present**

9. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-55** Battery Pin Out Box Adapter to the appropriate battery module.
10. Insert the DMM probes into the **EL-48571** High Voltage Battery Pin Out Box test cavities.
11. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** High Voltage Battery Pin Out Box through each of the switch positions. Refer to [**EL-48571 High Voltage Battery Pin Out Box Reference**](#).
12. Verify each cell group voltage reading is between 3.45-4.05 V.

- **If not within the specified range**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If within the specified range**

13. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If 0.03 V or less**

NOTE: If DTC P0ABC or P0ABD are set, only voltage sense circuits 1 or 96 require testing. Perform the following testing at the hybrid/EV battery pack internal wiring harness connector.

14. Test for infinite resistance between each appropriate voltage sense circuit terminals and ground.

- **If less than infinite resistance**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If infinite resistance**

NOTE: If DTC P0ABC or P0ABD are set, only voltage sense circuits 1 or 96 require testing.

15. Test for less than 2Ω in each appropriate voltage sense circuits end to end.

- **If 2Ω or greater**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If less than 2Ω**

16. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

- Refer to [**Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**](#) for S15 manual service disconnect replacement.
- Refer to [**High Voltage Section Battery Replacement \(Battery Section 1\)High Voltage Section Battery Replacement \(Battery Section 2\)High Voltage Section Battery Replacement \(Battery Section 3\)**](#)

- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
- Refer to [Auxiliary Battery Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, OR P1EBB: HYBRID/EV BATTERY LOW RESOLUTION CURRENT SENSOR & HYBRID/EV BATTERY HIGH RESOLUTION CURRENT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AC1

Hybrid/EV Battery Low Resolution Current Sensor Circuit Low Voltage

DTC P0AC2

Hybrid/EV Battery Low Resolution Current Sensor Circuit High Voltage

DTC P0B10

Hybrid/EV Battery High Resolution Current Sensor Circuit Low Voltage

DTC P0B11

Hybrid/EV Battery High Resolution Current Sensor Circuit High Voltage

DTC P0B13

Hybrid/EV Battery Low Resolution Current Sensor - High Resolution Current Sensor Not Plausible

DTC P1EBA

Hybrid/EV Battery Low Resolution Current Sensor Exceeded Learning Limit

DTC P1EBB

Hybrid/EV Battery High Resolution Current Sensor Exceeded Learning Limit

Circuit/System Description

The hybrid/EV battery current sensor is mounted inside the hybrid/EV battery pack. The positive high voltage cable that goes to the positive contactor relay passes through the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor detects the amperage that flows in and out of the hybrid/EV batteries. The battery energy control module supplies and monitors a 5 V reference signal to the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor returns a signal between 0 and 5 V to the battery energy control module. The hybrid/EV battery pack current sensor signal is in proportion to the amperage going in and out of the hybrid/EV battery pack. The hybrid/EV battery pack current sensor has 2 measurement ranges in order to maintain accuracy. The ranges are low resolution and high resolution. The measurement ranges of the hybrid/EV battery pack current

sensor have some overlap with each other. A signal voltage of the high resolution hybrid/EV battery pack current sensor greater than 2.5 V indicates that the hybrid/EV battery is being charged, and a signal voltage less than 2.5 V indicates discharging. A signal voltage of the low resolution hybrid/EV battery pack current sensor greater than 3.24 V indicates that the hybrid/EV battery is being charged and a signal voltage less than 3.24 V indicates discharging. The high resolution measures from -20 to +20 A. The low resolution measures from -500 to +230 A.

Conditions for Running the DTC

P0AC1, P0AC2, P0B10, and P0B11

- The 12 V battery voltage is greater than 10.2 V.
- The battery energy control module is awake and communicating.

P0B13

- The hybrid/EV battery low resolution current sensor or the hybrid/EV battery high resolution current sensor value is between -20 and +20 A.
- None of the following DTCs are set: P0AC1, P0AC2, P1EBA, P1A07, P0B10, P0B11, P0B13, P1EBB, U0111, U185A.

P1EBA and P1EBB

- Runs during battery energy control module initialization.
- The 12 V battery voltage is greater than 10.2 V.
- The high voltage main and charger contactors are open (during wake-up).
- DTC P1A07 is not set.

Conditions for Setting the DTC

P0AC1

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is less than -555 A.

P0AC2

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is greater than +285 A.

P0B10

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is less than -23 A.

P0B11

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is greater than +23 A.

P0B13

The difference between the Hybrid/EV Battery's low resolution current sensor value and its high resolution current sensor value is greater than 10 A.

P1EBA

The battery energy control module detects that the Pack Current Low Resolution Offset is greater than the calibration Low Resolution Offset of 8 A.

P1EBB

The battery energy control module detects that the Pack Current High Resolution Offset is greater than the calibration High Resolution Offset of 2.5 A.

Action Taken When the DTC Sets

- DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.
- The vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Vehicle in Service Mode, all accessories OFF.

NOTE: Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.

2. Verify the scan tool battery energy control module Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is between -555 A and +285 A and changes with the amount of current draw on the hybrid/EV battery pack.
 - If not within the specified range
Refer to Circuit/System Testing.
 - If within the specified range

NOTE: Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.

3. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is between -23 A and +23 A, and changes with the amount of current draw on the hybrid/EV battery pack.
 - If not within the specified range
Refer to Circuit/System Testing.
 - If within the specified range

4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal

Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)
3. Disconnect the X7 harness connector at the K16 Battery Energy Control Module.

NOTE: **2016 model year and early model year vehicles have an inline 4-wire harness connector, late model and newer vehicles have a 20-wire connector.**

4. Disconnect the A28 Hybrid/EV Battery Contactor Assembly inline connector that contains the B30 Hybrid/EV Battery Pack Current Sensor circuits.

5. Test for less than 2 Ω in the low reference circuit end to end.

- **If 2 Ω or greater**

Replace the Auxiliary Battery Wiring Harness.

- **If less than 2 Ω**

6. Test for less than 2 Ω in the 5V reference circuit end to end.

- **If 2 Ω or greater**

Replace the Auxiliary Battery Wiring Harness.

- **If less than 2 Ω**

7. Test for less than 2 Ω in the low resolution signal circuit end to end.

- **If 2 Ω or greater**

Replace the Auxiliary Battery Wiring Harness.

- **If less than 2 Ω**

8. Test for less than 2 Ω in the high resolution signal circuit end to end.

- **If 2 Ω or greater**

Replace the Auxiliary Battery Wiring Harness.

- **If less than 2 Ω**

9. Test for infinite resistance between the 5 V reference circuit terminal and ground.

- **If less than infinite resistance**

Replace the Auxiliary Battery Wiring Harness.

- **If infinite resistance**

10. Test for infinite resistance between the low resolution signal circuit terminal and ground.

- **If less than infinite resistance**

Replace the Auxiliary Battery Wiring Harness.

- **If infinite resistance**

11. Test for infinite resistance between the high resolution signal circuit terminal and ground.

- **If less than infinite resistance**

Replace the Auxiliary Battery Wiring Harness.

- **If infinite resistance**

NOTE: The B30 Hybrid/EV Battery Pack Current Sensor is not serviced separately.

12. Replace the A28 Hybrid/EV Battery Contactor Assembly.

13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

14. Verify the DTC does not set.

- **If the DTC sets**

Replace the K16 battery energy control module.

- **If the DTC does not set**

15. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Generator Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor Assembly replacement
- Refer to [Auxiliary Battery Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming, and setup.

DTC P0AF8: HYBRID SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AF8

Hybrid System Voltage

Circuit/System Description

The hybrid battery contains 192 individual cells. Two cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.7 V, for a nominal system voltage of 355 V direct current. The battery cell groups are joined to form 3 distinct sections. The first 24 battery cell groups make up battery section 1. This section is adjacent to the cowl and contains battery cell groups 73 through 96. The next 28 battery cell groups make up battery section 2. This section is located behind section 1 and contains battery cell groups 45 through 72. The transverse battery section is section number 3 and it contains the remaining 44 battery cell groups 1 through 44. The battery sections also contain two temperature sensors, with one sensor located at each end of the section.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

- The hybrid/EV battery main contactors are closed.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P1A07, P1AE8, P1AE9, P1AEA, P1AEB, P1AEC, P1AED, P1E20, P1E21, P1E28, or U1817.

OR

- Battery charging is active.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P0D4E, P0D4F, P0D5C, P16C5, P1A07, P1EEB, P1EEC, P1ECE, or U1838.

Conditions for Setting the DTC

- The difference between the Hybrid/EV Battery pack voltage and the hybrid/EV powertrain control module 1 bus voltage is greater than 16 V.

OR

- The difference between the Hybrid/EV Battery pack voltage and the charger module's bus voltage is greater than 16 V.

Action Taken When the DTC Sets

- DTC P0AF8 is a type A DTC.
- The vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTC P0AF8 is a type A DTC.

Diagnostic Aids

- An open charger fuse may cause DTC P0AF8 to set.
- DTC P1EC0 may set a DTC P0AF8 if the vehicle is ON or vehicle in service mode while the contactors are stuck OPEN

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Verify that no other DTCs are set.

- **If any DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If no DTCs are set**

2. Ensure the battery charge cord is not connected.

3. Vehicle ON.

NOTE: **The contactors must be closed.**

4. Verify with a scan tool, the hybrid/EV powertrain control module 1 High Voltage Circuit and the battery energy control module Hybrid Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.

- **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

Refer to Circuit/System Testing, Battery Main Bus Diagnostics.

- **If the parameters are within 16 V of each other and DTC P0AF8 is not set**

5. Connect the battery charge cord.
6. Verify with a scan tool, the hybrid/EV powertrain control module 2 Battery Charger High Output and the battery energy control module Hybrid Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.

- **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

Refer to Circuit/System Testing, Battery Charger Bus Diagnostics.

- **If the parameters are within 16 V of each other and DTC P0AF8 is not set**

7. All OK

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Battery Charger Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to [High Voltage Disabling](#).
2. Disconnect the T18 Battery Charger high voltage DC connector.
3. Disconnect the K1 14V Power Module high voltage connector.

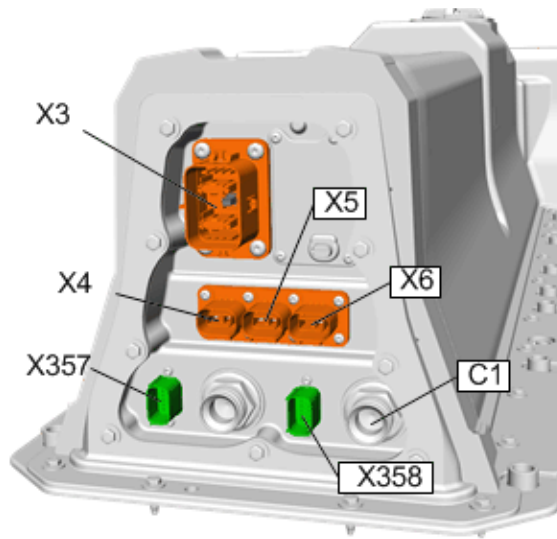


Fig. 43: A4 Hybrid/EV Battery Pack Connector Identification
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the X6 harness connector at the A4 Hybrid/EV Battery Pack.
5. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X6 harness connector.
 - **If less than infinite resistance**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.
 - **If infinite resistance**
6. Test for less than 10 Ω between the terminals listed below:
 - High voltage DC (-360 V) negative terminal B harness connector at the T18 Battery Charger and the high voltage DC (-360 V) negative terminal B X6 harness connector at the A4 Hybrid/EV Battery Pack.
 - High voltage DC (+360 V) positive terminal A harness connector at the T18 Battery Charger and the high voltage DC (+360 V) negative terminal A X6 harness connector at the A4 Hybrid/EV Battery Pack.
 - **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.
 - **If less than 10 Ω**
7. Replace the T18 Battery Charger and the fuse, if open.
8. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If DTC P0AF8 sets**

Replace the K1 14V Power Module and the fuse, if open.
 - **If DTC P0AF8 does not set**
9. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If DTC P0AF8 sets**

Replace the high voltage battery disconnect relay assembly.
 - **If DTC P0AF8 does not set**

10. All OK.

Battery Main Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Disconnect the X3 harness connector at the A4 Hybrid/EV Battery Pack.
3. Disconnect the high voltage connector at the T6 power inverter module.
4. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X3 harness connector.

- **If less than infinite resistance**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If infinite resistance**

5. Test for less than 10 Ω between the terminals listed below:

- High voltage DC (-360 V) negative terminal B X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (-360 V) negative terminal B harness connector at the T6 Power Inverter Module.
- High voltage DC (+360 V) positive terminal A X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (+360 V) negative terminal A harness connector at the T6 Power Inverter Module.

- **If 10 Ω or greater**

Replace the high voltage DC cables. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If less than 10 Ω**

6. Replace the T6 Power Inverter Module.
7. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0AF8 sets**

Replace the high voltage battery disconnect relay assembly.

- **If DTC P0AF8 does not set**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Power Inverter Module and A/C Compressor](#)
- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Charger Receptacle, Accessory DC Power Control Module, and Drive Motor Battery Charger](#)
- Refer to [Drive Motor Battery Charger Replacement](#) for T18 Battery Charger replacement.
- Refer to [Accessory DC Power Control Module Replacement](#) for K1 14V Power Module replacement.
- Refer to [High Voltage Battery Disconnect Relay Fuse Replacement \(Front - BDU\)High Voltage Battery Disconnect Relay Fuse Replacement \(Rear - BDU\)](#)
- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for high voltage battery disconnect relay

assembly.

- Refer to [Control Module References](#) for battery charger, power inverter module replacement, programming and setup.

DTC P0AFA OR P0AFB: HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AFA

Hybrid/EV Battery System Voltage Low Voltage

DTC P0AFB

Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The battery energy control module will diagnose its own systems and determine when a fault condition is present. Diagnostics and system status is communicated from the battery energy control module to the hybrid/EV powertrain control module 2 through serial data. The hybrid/EV powertrain control module 2 is the host controller for diagnostic trouble code (DTC) information. The battery energy control module monitors the hybrid/EV battery voltage at the battery side of the high voltage main contactors.

Conditions for Running the DTC

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; P0ABC, P0ABD, P1A07, P0AF8, P0ABB, U0111, U185A.

Conditions for Setting the DTC

P0AFA

The Hybrid Battery Pack Voltage initially is less than 148.9 V and does not exceed 164.9 V.

OR

The Minimum Hybrid Battery Cell Group Voltage in the hybrid battery initially is less than 1.55 V and does not exceed 1.72 V.

P0AFB

The Hybrid Battery Pack Voltage is greater than 438 V.

OR

The Maximum Hybrid Battery Cell Group Voltage in the hybrid battery is greater than 4.56 V.

Action Taken When the DTC Sets

- DTCs P0AFA and P0AFB are type A DTCs.
- The vehicle will operate in a reduced power mode and the extended range mode.
- Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTCs P0AFA and P0AFB are type A DTCs.
- The Clear Secured High Voltage DTCs reset function must be performed with a scan tool before clear codes.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

The hybrid/EV battery pack high voltage manual service disconnect is not installed correctly, or a blown manual service disconnect fuse will cause P0AFA to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-55** Battery Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Record the freeze frame/failure records.

NOTE: An intermittent condition is more likely to be present with a low state of charge. **DO NOT** plug in the vehicle to charge the hybrid/EV battery pack.

2. Vehicle in Service Mode.
3. Verify that DTC P0AA1, P0AD9, P0ADD, P0AE2, P0AE4, P0B3B, P0B3C, P0B3D, P0B3E, P0B40, P0B41, P0B42, P0B43, P0B45, P0B46, P0B47, P0B48, P0B4A, P0B4B, P0B4D, P0B4C, P0B4F, P0B50, P0B51, P0B52, P0B54, P0B55, P0B56, P0B57, P0B59, P0B5A, P0B5B, P0B5C, P0B5E, P0B60, P0B5F, P0B61, P0B63, P0B64, P0B65, P0B66, P0B69, P0B68, P0B6A, P0B6D, P0B6B, P0B6E, P0B70, P0B6F, P0B72, P0B74, P0B73, P0B75, P0B77, P0B78, P0B79, P0B7A, P0B7D, P0B7C, P0B7E, P0B7F, P0B81, P0B82, P0B83, P0B84, P0B86, P0B87, P0B88, P0B89, P0B8B, P0B8C, P0B8D, P0B8E, P0B90, P0B91, P0B92, P0B93, P0B95, P0B96, P0B97, P0B98, P0B9A, P0B9B, P0B9C, P0B9D, P0B9F, P0BA1, P0BA0, P0BA2, P0BA4, P0BA5, P0BA6, P0BA7, P0BA9, P0BAA, P0BAB, P0BAC, P0BAE, P0BAF, P0BB0, P0BB1, P0BB3, P0BB4, P0BB5, P0BB6, P0BB8, P0BB9, P0BBA, P0BBB, P0D0A, P0D11, P1B16, P1B17, P1B18, P1B19, P1B1A, P1B1B, P1B1C, P1B1D, P1B1E, P1B1F, P1B20, P1B21, P1B22, P1B23, P1B24, P1B25, P1B26, P1B27, P1B28, P1B29, P1B2B, P1B2A, P1B2C, P1B2D, P1B45, P1B46, P1B47, P1B48, P1B49, P1B4A, P1B4B, P1B4C, P1B4D, P1B4E, P1B4F, P1B50, P1B51, P1B52, P1B53, P1B54, P1B55, P1B56, P1B57, P1B58, P1B59, P1B5A, P1B5B, P1B5C, P1B5D, P1B5E, P1B5F, P1B60, P1B61, P1B62, P1B63, P1B64, P1B65, P1B66, P1B67, P1B68, P1B69, P1B6A, P1B6B, P1B6C, P1B6D, P1B6E, P1B6F, P1B70, P1B71, P1B72, P1B73, P1B74, P1B75, P1B76, P1B77, P1B78, P1B79, P1B7A, P1B7B, P1B7C, P1B7D, P1B7F, P1B7E, P1B80, P1B81, P1B82, P1B83, P1B84, P1B85, P1B86, P1B87, P1B88, P1B89, P1B8A, P1B8B, P1B8C, P1B8D, P1B8E, P1B8F, P1B90, P1B91, P1B92, P1B93, P1B94, P1B95, P1B97, P1B96, P1B98, P1B99, P1B9A, P1B9B, P1B9C, P1B9D, P1B9E, P1B9F, P1BA0, P1BA1, P1BA2, P1BA3, P1BA4, P1BA5, P1BA6, P1BA7, P1BA8, P1BA9, P1BAB, P1BAA, P1BAC, P1BAD, P1BAE, P1BAF, P1BB0, P1BB1, P1BB2, P1BB3, P1BB4, P1BB5, P1BB6, P1BB7, P1BB8, P1BB9, P1BBA, P1BBB, P1BBC, P1BBD, P1BBE, P1BBF, P1BC0, P1BC1, P1BC2, P1BC3, P1BC4, P1BC5, P1BC6, P1BC7, P1BC8, P1BC9, P1BCA, P1BCB, P1BCC, P1BCE, P1BCD, P1BCF, P1BD0, P1BD2, P1BD1, P1BD3, P1BD4, P1BD5, P1BD6, P1BD7, P1BD8, P1BD9, P1BDA, P1BDB, P1BDD, P1BDC, P1BDE, P1BDF, P1BE1, P1BE0, P1BE3, P1BE2, P1BE4, P1BE5, P1BE6, P1BE7, P1BE8, P1BE9, P1BEA, P1BEB, P1BEC, P1BED, P1BEE, P1BF0, P1BEF, P1BF1, P1BF2, P1BF4, P1BF3, P1BF5, P1BF4, P1BF7, P1BF8, P1BF9, P1BFA, P1BFB, P1BFC, P1BFD, P1BFE, P1E01, P1E02, P1E03, P1E04, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E62, P1E61, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6D, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E76, P1E75, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1EBC, P1EBF, P1EC0, P1EC3, P1EC4, P1EC5, U2603, U2604, U2605, U2606, or U2401 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

4. Verify the scan tool Hybrid/EV Battery Pack Terminal 1 Voltage is between 164.9 - 438 V.

- **If not within the specified range**

Refer to Circuit/System Testing, Hybrid Battery Pack Voltage Diagnosis.

- **If within the specified range**

5. Verify the scan tool Hybrid/EV Battery 1 - 96 voltages are between 3.45-4.56 V and all readings are within 0.03 V of each other.

- **If not between 3.45-4.56 V or not within 0.03 V of each other**

Refer to Circuit/System Testing, Hybrid Battery 1 - 96 Cell Group Diagnosis.

- **If between 3.45-4.56 V and within 0.03 V of each other**

NOTE: If the freeze frame/failure records were not initially stored, operate the vehicle under high hybrid/EV battery load conditions, such as hard acceleration, and attempt to set the DTC.

6. Review the freeze frame/failure records. Verify the stored Hybrid/EV Battery 1 - 96 voltages were all between 3.45 - 4.56 V and all readings were within 0.03 V of each other at the time the DTC set.

- **If not between 3.45 - 4.56 V or not within 0.03 V of each other**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If between 3.45 - 4.56 V and within 0.03 V of each other**

7. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Hybrid Battery Pack Voltage Diagnosis

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Remove the S15 manual service disconnect.
3. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.

- **If 10 Ω or greater**

Replace the S15 manual service disconnect and repeat Circuit/System Verification.

- **If less than 10 Ω**

4. Remove the A4 hybrid/EV battery pack cover. Refer to [High Voltage Battery Cover Replacement](#)
5. Install a known good S15 manual service disconnect.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

NOTE: You are testing high voltage.

6. Test for 164.9 - 438 V between the negative (300 V) C5A and positive (300 V) C5G at the A28 Hybrid/EV Battery Contactor Assembly.

- **If not within the specified range**

Replace the A4 Hybrid/EV Battery Pack. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

- **If within the specified range**

7. Replace the K16 Battery Energy Control Module. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

Hybrid Battery 1 - 96 Cell Group Diagnosis

1. Vehicle OFF, disable the high voltage at the A4 hybrid/EV battery pack. Refer to [High Voltage Disabling](#).
2. Remove the A4 hybrid/EV battery pack cover. Refer to [High Voltage Battery Cover Replacement](#)

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

3. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

NOTE: The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

4. Disconnect the harness connector at the appropriate C4 Hybrid/EV Battery Section connector.
5. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-55** Battery Pinout Box Adapter to the appropriate battery section.
6. Insert the DMM probes into the **EL-48571** test cavities.
7. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** through each of the switch positions. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#)
8. Verify each cell group voltage reading is between 3.45-4.05 V.

- **If not within the specified range**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If within the specified range**

9. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the appropriate C4 hybrid/EV battery section.

- **If 0.03 V or less**

10. Test for infinite resistance between each appropriate voltage sense circuit terminals and ground.

- **If less than infinite resistance**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If infinite resistance**

11. Test for less than 2 Ω in each appropriate voltage sense circuits end to end.

- **If 2 Ω or greater**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If less than 2 Ω**

12. Replace the K16 Battery Energy Control Module. After the repair is complete with a scan tool, the [Clear Secured High Voltage DTCs](#) reset function must be performed.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#) for S15 manual service disconnect replacement.
- Refer to [High Voltage Section Battery Replacement \(Battery Section 1\)High Voltage Section Battery Replacement \(Battery Section 2\)High Voltage Section Battery Replacement \(Battery Section 3\)](#)
- Refer to [Auxiliary Battery Wiring Harness Replacement](#) for Hybrid/EV Battery Pack Internal Harness replacement
- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

- Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, OR P1E4C-P1E8B: HYBRID/EV BATTERY CIRCUITS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0B3B

Hybrid/EV Battery 1 Circuit

DTC P0B3C

Hybrid/EV Battery 1 Circuit Performance

DTC P0B3D

Hybrid/EV Battery 1 Circuit Low Voltage

DTC P0B3E

Hybrid/EV Battery 1 Circuit High Voltage

DTC P0B40

Hybrid/EV Battery 2 Circuit

DTC P0B41

Hybrid/EV Battery 2 Circuit Performance

DTC P0B42

Hybrid/EV Battery 2 Circuit Low Voltage

DTC P0B43

Hybrid/EV Battery 2 Circuit High Voltage

DTC P0B45

Hybrid/EV Battery 3 Circuit

DTC P0B46

Hybrid/EV Battery 3 Circuit Performance

DTC P0B47

Hybrid/EV Battery 3 Circuit Low Voltage

DTC P0B48

Hybrid/EV Battery 3 Circuit High Voltage

DTC P0B4A

Hybrid/EV Battery 4 Circuit

DTC P0B4B

Hybrid/EV Battery 4 Circuit Performance

DTC P0B4C

Hybrid/EV Battery 4 Circuit Low Voltage

DTC P0B4D

Hybrid/EV Battery 4 Circuit High Voltage

DTC P0B4F

Hybrid/EV Battery 5 Circuit

DTC P0B50

Hybrid/EV Battery 5 Circuit Performance

DTC P0B51

Hybrid/EV Battery 5 Circuit Low Voltage

DTC P0B52

Hybrid/EV Battery 5 Circuit High Voltage

DTC P0B54

Hybrid/EV Battery 6 Circuit

DTC P0B55

Hybrid/EV Battery 6 Circuit Performance

DTC P0B56

Hybrid/EV Battery 6 Circuit Low Voltage

DTC P0B57

Hybrid/EV Battery 6 Circuit High Voltage

DTC P0B59

Hybrid/EV Battery 7 Circuit

DTC P0B5A

Hybrid/EV Battery 7 Circuit Performance

DTC P0B5B

Hybrid/EV Battery 7 Circuit Low Voltage

DTC P0B5C

Hybrid/EV Battery 7 Circuit High Voltage

DTC P0B5E

Hybrid/EV Battery 8 Circuit

DTC P0B5F

Hybrid/EV Battery 8 Circuit Performance

DTC P0B60

Hybrid/EV Battery 8 Circuit Low Voltage

DTC P0B61

Hybrid/EV Battery 8 Circuit High Voltage

DTC P0B63

Hybrid/EV Battery 9 Circuit

DTC P0B64

Hybrid/EV Battery 9 Circuit Performance

DTC P0B65

Hybrid/EV Battery 9 Circuit Low Voltage

DTC P0B66

Hybrid/EV Battery 9 Circuit High Voltage

DTC P0B68

Hybrid/EV Battery 10 Circuit

DTC P0B69

Hybrid/EV Battery 10 Circuit Performance

DTC P0B6A

Hybrid/EV Battery 10 Circuit Low Voltage

DTC P0B6B

Hybrid/EV Battery 10 Circuit High Voltage

DTC P0B6D

Hybrid/EV Battery 11 Circuit

DTC P0B6E

Hybrid/EV Battery 11 Circuit Performance

DTC P0B6F

Hybrid/EV Battery 11 Circuit Low Voltage

DTC P0B70

Hybrid/EV Battery 11 Circuit High Voltage

DTC P0B72

Hybrid/EV Battery 12 Circuit

DTC P0B73

Hybrid/EV Battery 12 Circuit Performance

DTC P0B74

Hybrid/EV Battery 12 Circuit Low Voltage

DTC P0B75

Hybrid/EV Battery 12 Circuit High Voltage

DTC P0B77

Hybrid/EV Battery 13 Circuit

DTC P0B78

Hybrid/EV Battery 13 Circuit Performance

DTC P0B79

Hybrid/EV Battery 13 Circuit Low Voltage

DTC P0B7A

Hybrid/EV Battery 13 Circuit High Voltage

DTC P0B7C

Hybrid/EV Battery 14 Circuit

DTC P0B7D

Hybrid/EV Battery 14 Circuit Performance

DTC P0B7E

Hybrid/EV Battery 14 Circuit Low Voltage

DTC P0B7F

Hybrid/EV Battery 14 Circuit High Voltage

DTC P0B81

Hybrid/EV Battery 15 Circuit

DTC P0B82

Hybrid/EV Battery 15 Circuit Performance

DTC P0B83

Hybrid/EV Battery 15 Circuit Low Voltage

DTC P0B84

Hybrid/EV Battery 15 Circuit High Voltage

DTC P0B86

Hybrid/EV Battery 16 Circuit

DTC P0B87

Hybrid/EV Battery 16 Circuit Performance

DTC P0B88

Hybrid/EV Battery 16 Circuit Low Voltage

DTC P0B89

Hybrid/EV Battery 16 Circuit High Voltage

DTC P0B8B

Hybrid/EV Battery 17 Circuit

DTC P0B8C

Hybrid/EV Battery 17 Circuit Performance

DTC P0B8D

Hybrid/EV Battery 17 Circuit Low Voltage

DTC P0B8E

Hybrid/EV Battery 17 Circuit High Voltage

DTC P0B90

Hybrid/EV Battery 18 Circuit

DTC P0B91

Hybrid/EV Battery 18 Circuit Performance

DTC P0B92

Hybrid/EV Battery 18 Circuit Low Voltage

DTC P0B93

Hybrid/EV Battery 18 Circuit High Voltage

DTC P0B95

Hybrid/EV Battery 19 Circuit

DTC P0B96

Hybrid/EV Battery 19 Circuit Performance

DTC P0B97

Hybrid/EV Battery 19 Circuit Low Voltage

DTC P0B98

Hybrid/EV Battery 19 Circuit High Voltage

DTC P0B9A

Hybrid/EV Battery 20 Circuit

DTC P0B9B

Hybrid/EV Battery 20 Circuit Performance

DTC P0B9C

Hybrid/EV Battery 20 Circuit Low Voltage

DTC P0B9D

Hybrid/EV Battery 20 Circuit High Voltage

DTC P0B9F

Hybrid/EV Battery 21 Circuit

DTC P0BA0

Hybrid/EV Battery 21 Circuit Performance

DTC P0BA1

Hybrid/EV Battery 21 Circuit Low Voltage

DTC P0BA2

Hybrid/EV Battery 21 Circuit High Voltage

DTC P0BA4

Hybrid/EV Battery 22 Circuit

DTC P0BA5

Hybrid/EV Battery 22 Circuit Performance

DTC P0BA6

Hybrid/EV Battery 22 Circuit Low Voltage

DTC P0BA7

Hybrid/EV Battery 22 Circuit High Voltage

DTC P0BA9

Hybrid/EV Battery 23 Circuit

DTC P0BAA

Hybrid/EV Battery 23 Circuit Performance

DTC P0BAB

Hybrid/EV Battery 23 Circuit Low Voltage

DTC P0BAC

Hybrid/EV Battery 23 Circuit High Voltage

DTC P0BAE

Hybrid/EV Battery 24 Circuit

DTC P0BAF

Hybrid/EV Battery 24 Circuit Performance

DTC P0BB0

Hybrid/EV Battery 24 Circuit Low Voltage

DTC P0BB1

Hybrid/EV Battery 24 Circuit High Voltage

DTC P0BB3

Hybrid/EV Battery 25 Circuit

DTC P0BB4

Hybrid/EV Battery 25 Circuit Performance

DTC P0BB5

Hybrid/EV Battery 25 Circuit Low Voltage

DTC P0BB6

Hybrid/EV Battery 25 Circuit High Voltage

DTC P0BB8

Hybrid/EV Battery 26 Circuit

DTC P0BB9

Hybrid/EV Battery 26 Circuit Performance

DTC P0BBA

Hybrid/EV Battery 26 Circuit Low Voltage

DTC P0BBB

Hybrid/EV Battery 26 Circuit High Voltage

DTC P1B16

Hybrid/EV Battery 27 Circuit Performance

DTC P1B17

Hybrid/EV Battery 27 Circuit Low Voltage

DTC P1B18

Hybrid/EV Battery 27 Circuit High Voltage

DTC P1B19

Hybrid/EV Battery 28 Circuit Performance

DTC P1B1A

Hybrid/EV Battery 28 Circuit Low Voltage

DTC P1B1B

Hybrid/EV Battery 28 Circuit High Voltage

DTC P1B1C

Hybrid/EV Battery 29 Circuit Performance

DTC P1B1D

Hybrid/EV Battery 29 Circuit Low Voltage

DTC P1B1E

Hybrid/EV Battery 29 Circuit High Voltage

DTC P1B1F

Hybrid/EV Battery 30 Circuit Performance

DTC P1B20

Hybrid/EV Battery 30 Circuit Low Voltage

DTC P1B21

Hybrid/EV Battery 30 Circuit High Voltage

DTC P1B22

Hybrid/EV Battery 31 Circuit Performance

DTC P1B23

Hybrid/EV Battery 31 Circuit Low Voltage

DTC P1B24

Hybrid/EV Battery 31 Circuit High Voltage

DTC P1B25

Hybrid/EV Battery 32 Circuit Performance

DTC P1B26

Hybrid/EV Battery 32 Circuit Low Voltage

DTC P1B27

Hybrid/EV Battery 32 Circuit High Voltage

DTC P1B28

Hybrid/EV Battery 27 Circuit

DTC P1B29

Hybrid/EV Battery 28 Circuit

DTC P1B2A

Hybrid/EV Battery 29 Circuit

DTC P1B2B

Hybrid/EV Battery 30 Circuit

DTC P1B2C

Hybrid/EV Battery 31 Circuit

DTC P1B2D

Hybrid/EV Battery 32 Circuit

DTC P1B45

Hybrid/EV Battery 33 Circuit Performance

DTC P1B46

Hybrid/EV Battery 33 Circuit Low Voltage

DTC P1B47

Hybrid/EV Battery 33 Circuit High Voltage

DTC P1B48

Hybrid/EV Battery 34 Circuit Performance

DTC P1B49

Hybrid/EV Battery 34 Circuit Low Voltage

DTC P1B4A

Hybrid/EV Battery 34 Circuit High Voltage

DTC P1B4B

Hybrid/EV Battery 35 Circuit Performance

DTC P1B4C

Hybrid/EV Battery 35 Circuit Low Voltage

DTC P1B4D

Hybrid/EV Battery 35 Circuit High Voltage

DTC P1B4E

Hybrid/EV Battery 36 Circuit Performance

DTC P1B4F

Hybrid/EV Battery 36 Circuit Low Voltage

DTC P1B50

Hybrid/EV Battery 36 Circuit High Voltage

DTC P1B51

Hybrid/EV Battery 37 Circuit Performance

DTC P1B52

Hybrid/EV Battery 37 Circuit Low Voltage

DTC P1B53

Hybrid/EV Battery 37 Circuit High Voltage

DTC P1B54

Hybrid/EV Battery 38 Circuit Performance

DTC P1B55

Hybrid/EV Battery 38 Circuit Low Voltage

DTC P1B56

Hybrid/EV Battery 38 Circuit High Voltage

DTC P1B57

Hybrid/EV Battery 39 Circuit Performance

DTC P1B58

Hybrid/EV Battery 39 Circuit Low Voltage

DTC P1B59

Hybrid/EV Battery 39 Circuit High Voltage

DTC P1B5A

Hybrid/EV Battery 40 Circuit Performance

DTC P1B5B

Hybrid/EV Battery 40 Circuit Low Voltage

DTC P1B5C

Hybrid/EV Battery 40 Circuit High Voltage

DTC P1B5D

Hybrid/EV Battery 41 Circuit Performance

DTC P1B5E

Hybrid/EV Battery 41 Circuit Low Voltage

DTC P1B5F

Hybrid/EV Battery 41 Circuit High Voltage

DTC P1B60

Hybrid/EV Battery 42 Circuit Performance

DTC P1B61

Hybrid/EV Battery 42 Circuit Low Voltage

DTC P1B62

Hybrid/EV Battery 42 Circuit High Voltage

DTC P1B63

Hybrid/EV Battery 43 Circuit Performance

DTC P1B64

Hybrid/EV Battery 43 Circuit Low Voltage

DTC P1B65

Hybrid/EV Battery 43 Circuit High Voltage

DTC P1B66

Hybrid/EV Battery 44 Circuit Performance

DTC P1B67

Hybrid/EV Battery 44 Circuit Low Voltage

DTC P1B68

Hybrid/EV Battery 44 Circuit High Voltage

DTC P1B69

Hybrid/EV Battery 45 Circuit Performance

DTC P1B6A

Hybrid/EV Battery 45 Circuit Low Voltage

DTC P1B6B

Hybrid/EV Battery 45 Circuit High Voltage

DTC P1B6C

Hybrid/EV Battery 46 Circuit Performance

DTC P1B6D

Hybrid/EV Battery 46 Circuit Low Voltage

DTC P1B6E

Hybrid/EV Battery 46 Circuit High Voltage

DTC P1B6F

Hybrid/EV Battery 47 Circuit Performance

DTC P1B70

Hybrid/EV Battery 47 Circuit Low Voltage

DTC P1B71

Hybrid/EV Battery 47 Circuit High Voltage

DTC P1B72

Hybrid/EV Battery 48 Circuit Performance

DTC P1B73

Hybrid/EV Battery 48 Circuit Low Voltage

DTC P1B74

Hybrid/EV Battery 48 Circuit High Voltage

DTC P1B75

Hybrid/EV Battery 49 Circuit Performance

DTC P1B76

Hybrid/EV Battery 49 Circuit Low Voltage

DTC P1B77

Hybrid/EV Battery 49 Circuit High Voltage

DTC P1B78

Hybrid/EV Battery 50 Circuit Performance

DTC P1B79

Hybrid/EV Battery 50 Circuit Low Voltage

DTC P1B7A

Hybrid/EV Battery 50 Circuit High Voltage

DTC P1B7B

Hybrid/EV Battery 51 Circuit Performance

DTC P1B7C

Hybrid/EV Battery 51 Circuit Low Voltage

DTC P1B7D

Hybrid/EV Battery 51 Circuit High Voltage

DTC P1B7E

Hybrid/EV Battery 52 Circuit Performance

DTC P1B7F

Hybrid/EV Battery 52 Circuit Low Voltage

DTC P1B80

Hybrid/EV Battery 52 Circuit High Voltage

DTC P1B81

Hybrid/EV Battery 53 Circuit Performance

DTC P1B82

Hybrid/EV Battery 53 Circuit Low Voltage

DTC P1B83

Hybrid/EV Battery 53 Circuit High Voltage

DTC P1B84

Hybrid/EV Battery 54 Circuit Performance

DTC P1B85

Hybrid/EV Battery 54 Circuit Low Voltage

DTC P1B86

Hybrid/EV Battery 54 Circuit High Voltage

DTC P1B87

Hybrid/EV Battery 55 Circuit Performance

DTC P1B88

Hybrid/EV Battery 55 Circuit Low Voltage

DTC P1B89

Hybrid/EV Battery 55 Circuit High Voltage

DTC P1B8A

Hybrid/EV Battery 56 Circuit Performance

DTC P1B8B

Hybrid/EV Battery 56 Circuit Low Voltage

DTC P1B8C

Hybrid/EV Battery 56 Circuit High Voltage

DTC P1B8D

Hybrid/EV Battery 57 Circuit Performance

DTC P1B8E

Hybrid/EV Battery 57 Circuit Low Voltage

DTC P1B8F

Hybrid/EV Battery 57 Circuit High Voltage

DTC P1B90

Hybrid/EV Battery 58 Circuit Performance

DTC P1B91

Hybrid/EV Battery 58 Circuit Low Voltage

DTC P1B92

Hybrid/EV Battery 58 Circuit High Voltage

DTC P1B93

Hybrid/EV Battery 59 Circuit Performance

DTC P1B94

Hybrid/EV Battery 59 Circuit Low Voltage

DTC P1B95

Hybrid/EV Battery 59 Circuit High Voltage

DTC P1B96

Hybrid/EV Battery 60 Circuit Performance

DTC P1B97

Hybrid/EV Battery 60 Circuit Low Voltage

DTC P1B98

Hybrid/EV Battery 60 Circuit High Voltage

DTC P1B99

Hybrid/EV Battery 61 Circuit Performance

DTC P1B9A

Hybrid/EV Battery 61 Circuit Low Voltage

DTC P1B9B

Hybrid/EV Battery 61 Circuit High Voltage

DTC P1B9C

Hybrid/EV Battery 62 Circuit Performance

DTC P1B9D

Hybrid/EV Battery 62 Circuit Low Voltage

DTC P1B9E

Hybrid/EV Battery 62 Circuit High Voltage

DTC P1B9F

Hybrid/EV Battery 63 Circuit Performance

DTC P1BA0

Hybrid/EV Battery 63 Circuit Low Voltage

DTC P1BA1

Hybrid/EV Battery 63 Circuit High Voltage

DTC P1BA2

Hybrid/EV Battery 64 Circuit Performance

DTC P1BA3

Hybrid/EV Battery 64 Circuit Low Voltage

DTC P1BA4

Hybrid/EV Battery 64 Circuit High Voltage

DTC P1BA5

Hybrid/EV Battery 65 Circuit Performance

DTC P1BA6

Hybrid/EV Battery 65 Circuit Low Voltage

DTC P1BA7

Hybrid/EV Battery 65 Circuit High Voltage

DTC P1BA8

Hybrid/EV Battery 66 Circuit Performance

DTC P1BA9

Hybrid/EV Battery 66 Circuit Low Voltage

DTC P1BAA

Hybrid/EV Battery 66 Circuit High Voltage

DTC P1BAB

Hybrid/EV Battery 67 Circuit Performance

DTC P1BAC

Hybrid/EV Battery 67 Circuit Low Voltage

DTC P1BAD

Hybrid/EV Battery 67 Circuit High Voltage

DTC P1BAE

Hybrid/EV Battery 68 Circuit Performance

DTC P1BAF

Hybrid/EV Battery 68 Circuit Low Voltage

DTC P1BB0

Hybrid/EV Battery 68 Circuit High Voltage

DTC P1BB1

Hybrid/EV Battery 69 Circuit Performance

DTC P1BB2

Hybrid/EV Battery 69 Circuit Low Voltage

DTC P1BB3

Hybrid/EV Battery 69 Circuit High Voltage

DTC P1BB4

Hybrid/EV Battery 70 Circuit Performance

DTC P1BB5

Hybrid/EV Battery 70 Circuit Low Voltage

DTC P1BB6

Hybrid/EV Battery 70 Circuit High Voltage

DTC P1BB7

Hybrid/EV Battery 71 Circuit Performance

DTC P1BB8

Hybrid/EV Battery 71 Circuit Low Voltage

DTC P1BB9

Hybrid/EV Battery 71 Circuit High Voltage

DTC P1BBA

Hybrid/EV Battery 72 Circuit Performance

DTC P1BBB

Hybrid/EV Battery 72 Circuit Low Voltage

DTC P1BBC

Hybrid/EV Battery 72 Circuit High Voltage

DTC P1BBD

Hybrid/EV Battery 73 Circuit Performance

DTC P1BBE

Hybrid/EV Battery 73 Circuit Low Voltage

DTC P1BBF

Hybrid/EV Battery 73 Circuit High Voltage

DTC P1BC0

Hybrid/EV Battery 74 Circuit Performance

DTC P1BC1

Hybrid/EV Battery 74 Circuit Low Voltage

DTC P1BC2

Hybrid/EV Battery 74 Circuit High Voltage

DTC P1BC3

Hybrid/EV Battery 75 Circuit Performance

DTC P1BC4

Hybrid/EV Battery 75 Circuit Low Voltage

DTC P1BC5

Hybrid/EV Battery 75 Circuit High Voltage

DTC P1BC6

Hybrid/EV Battery 76 Circuit Performance

DTC P1BC7

Hybrid/EV Battery 76 Circuit Low Voltage

DTC P1BC8

Hybrid/EV Battery 76 Circuit High Voltage

DTC P1BC9

Hybrid/EV Battery 77 Circuit Performance

DTC P1BCA

Hybrid/EV Battery 77 Circuit Low Voltage

DTC P1BCB

Hybrid/EV Battery 77 Circuit High Voltage

DTC P1BCC

Hybrid/EV Battery 78 Circuit Performance

DTC P1BCD

Hybrid/EV Battery 78 Circuit Low Voltage

DTC P1BCE

Hybrid/EV Battery 78 Circuit High Voltage

DTC P1BCF

Hybrid/EV Battery 79 Circuit Performance

DTC P1BD0

Hybrid/EV Battery 79 Circuit Low Voltage

DTC P1BD1

Hybrid/EV Battery 79 Circuit High Voltage

DTC P1BD2

Hybrid/EV Battery 80 Circuit Performance

DTC P1BD3

Hybrid/EV Battery 80 Circuit Low Voltage

DTC P1BD4

Hybrid/EV Battery 80 Circuit High Voltage

DTC P1BD5

Hybrid/EV Battery 81 Circuit Performance

DTC P1BD6

Hybrid/EV Battery 81 Circuit Low Voltage

DTC P1BD7

Hybrid/EV Battery 81 Circuit High Voltage

DTC P1BD8

Hybrid/EV Battery 82 Circuit Performance

DTC P1BD9

Hybrid/EV Battery 82 Circuit Low Voltage

DTC P1BDA

Hybrid/EV Battery 82 Circuit High Voltage

DTC P1BDB

Hybrid/EV Battery 83 Circuit Performance

DTC P1BDC

Hybrid/EV Battery 83 Circuit Low Voltage

DTC P1BDD

Hybrid/EV Battery 83 Circuit High Voltage

DTC P1BDE

Hybrid/EV Battery 84 Circuit Performance

DTC P1BDF

Hybrid/EV Battery 84 Circuit Low Voltage

DTC P1BE0

Hybrid/EV Battery 84 Circuit High Voltage

DTC P1BE1

Hybrid/EV Battery 85 Circuit Performance

DTC P1BE2

Hybrid/EV Battery 85 Circuit Low Voltage

DTC P1BE3

Hybrid/EV Battery 85 Circuit High Voltage

DTC P1BE4

Hybrid/EV Battery 86 Circuit Performance

DTC P1BE5

Hybrid/EV Battery 86 Circuit Low Voltage

DTC P1BE6

Hybrid/EV Battery 86 Circuit High Voltage

DTC P1BE7

Hybrid/EV Battery 87 Circuit Performance

DTC P1BE8

Hybrid/EV Battery 87 Circuit Low Voltage

DTC P1BE9

Hybrid/EV Battery 87 Circuit High Voltage

DTC P1BEA

Hybrid/EV Battery 88 Circuit Performance

DTC P1BEB

Hybrid/EV Battery 88 Circuit Low Voltage

DTC P1BEC

Hybrid/EV Battery 88 Circuit High Voltage

DTC P1BED

Hybrid/EV Battery 89 Circuit Performance

DTC P1BEE

Hybrid/EV Battery 89 Circuit Low Voltage

DTC P1BEF

Hybrid/EV Battery 89 Circuit High Voltage

DTC P1BF0

Hybrid/EV Battery 90 Circuit Performance

DTC P1BF1

Hybrid/EV Battery 90 Circuit Low Voltage

DTC P1BF2

Hybrid/EV Battery 90 Circuit High Voltage

DTC P1BF3

Hybrid/EV Battery 91 Circuit Performance

DTC P1BF4

Hybrid/EV Battery 91 Circuit Low Voltage

DTC P1BF5

Hybrid/EV Battery 91 Circuit High Voltage

DTC P1BF6

Hybrid/EV Battery 92 Circuit Performance

DTC P1BF7

Hybrid/EV Battery 92 Circuit Low Voltage

DTC P1BF8

Hybrid/EV Battery 92 Circuit High Voltage

DTC P1BF9

Hybrid/EV Battery 93 Circuit Performance

DTC P1BFA

Hybrid/EV Battery 93 Circuit Low Voltage

DTC P1BFB

Hybrid/EV Battery 93 Circuit High Voltage

DTC P1BFC

Hybrid/EV Battery 94 Circuit Performance

DTC P1BFD

Hybrid/EV Battery 94 Circuit Low Voltage

DTC P1BFE

Hybrid/EV Battery 94 Circuit High Voltage

DTC P1E01

Hybrid/EV Battery 95 Circuit Performance

DTC P1E02

Hybrid/EV Battery 95 Circuit Low Voltage

DTC P1E03

Hybrid/EV Battery 95 Circuit High Voltage

DTC P1E04

Hybrid/EV Battery 96 Circuit Performance

DTC P1E05

Hybrid/EV Battery 96 Circuit Low Voltage

DTC P1E06

Hybrid/EV Battery 96 Circuit High Voltage

DTC P1E4C

Hybrid/EV Battery 33 Circuit

DTC P1E4D

Hybrid/EV Battery 34 Circuit

DTC P1E4E

Hybrid/EV Battery 35 Circuit

DTC P1E4F

Hybrid/EV Battery 36 Circuit

DTC P1E50

Hybrid/EV Battery 37 Circuit

DTC P1E51

Hybrid/EV Battery 38 Circuit

DTC P1E52

Hybrid/EV Battery 39 Circuit

DTC P1E53

Hybrid/EV Battery 40 Circuit

DTC P1E54

Hybrid/EV Battery 41 Circuit

DTC P1E55

Hybrid/EV Battery 42 Circuit

DTC P1E56

Hybrid/EV Battery 43 Circuit

DTC P1E57

Hybrid/EV Battery 44 Circuit

DTC P1E58

Hybrid/EV Battery 45 Circuit

DTC P1E59

Hybrid/EV Battery 46 Circuit

DTC P1E5A

Hybrid/EV Battery 47 Circuit

DTC P1E5B

Hybrid/EV Battery 48 Circuit

DTC P1E5C

Hybrid/EV Battery 49 Circuit

DTC P1E5D

Hybrid/EV Battery 50 Circuit

DTC P1E5E

Hybrid/EV Battery 51 Circuit

DTC P1E5F

Hybrid/EV Battery 52 Circuit

DTC P1E60

Hybrid/EV Battery 53 Circuit

DTC P1E61

Hybrid/EV Battery 54 Circuit

DTC P1E62

Hybrid/EV Battery 55 Circuit

DTC P1E63

Hybrid/EV Battery 56 Circuit

DTC P1E64

Hybrid/EV Battery 57 Circuit

DTC P1E65

Hybrid/EV Battery 58 Circuit

DTC P1E66

Hybrid/EV Battery 59 Circuit

DTC P1E67

Hybrid/EV Battery 60 Circuit

DTC P1E68

Hybrid/EV Battery 61 Circuit

DTC P1E69

Hybrid/EV Battery 62 Circuit

DTC P1E6A

Hybrid/EV Battery 63 Circuit

DTC P1E6B

Hybrid/EV Battery 64 Circuit

DTC P1E6C

Hybrid/EV Battery 65 Circuit

DTC P1E6D

Hybrid/EV Battery 66 Circuit

DTC P1E6E

Hybrid/EV Battery 67 Circuit

DTC P1E6F

Hybrid/EV Battery 68 Circuit

DTC P1E70

Hybrid/EV Battery 69 Circuit

DTC P1E71

Hybrid/EV Battery 70 Circuit

DTC P1E72

Hybrid/EV Battery 71 Circuit

DTC P1E73

Hybrid/EV Battery 72 Circuit

DTC P1E74

Hybrid/EV Battery 73 Circuit

DTC P1E75

Hybrid/EV Battery 74 Circuit

DTC P1E76

Hybrid/EV Battery 75 Circuit

DTC P1E77

Hybrid/EV Battery 76 Circuit

DTC P1E78

Hybrid/EV Battery 77 Circuit

DTC P1E79

Hybrid/EV Battery 78 Circuit

DTC P1E7A

Hybrid/EV Battery 79 Circuit

DTC P1E7B

Hybrid/EV Battery 80 Circuit

DTC P1E7C

Hybrid/EV Battery 81 Circuit

DTC P1E7D

Hybrid/EV Battery 82 Circuit

DTC P1E7E

Hybrid/EV Battery 83 Circuit

DTC P1E7F

Hybrid/EV Battery 84 Circuit

DTC P1E80

Hybrid/EV Battery 85 Circuit

DTC P1E81

Hybrid/EV Battery 86 Circuit

DTC P1E82

Hybrid/EV Battery 87 Circuit

DTC P1E83

Hybrid/EV Battery 88 Circuit

DTC P1E84

Hybrid/EV Battery 89 Circuit

DTC P1E85

Hybrid/EV Battery 90 Circuit

DTC P1E86

Hybrid/EV Battery 91 Circuit

DTC P1E87

Hybrid/EV Battery 92 Circuit

DTC P1E88

Hybrid/EV Battery 93 Circuit

DTC P1E89

Hybrid/EV Battery 94 Circuit

DTC P1E8A

Hybrid/EV Battery 95 Circuit

DTC P1E8B

Hybrid/EV Battery 96 Circuit

Circuit/System Description

The hybrid battery contains 192 individual cells. Two cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.7 V, for a nominal system voltage of 355 V direct current. The battery cell groups are joined to form 3 distinct sections. The first 24 battery cell groups make up battery section 1. This section is adjacent to the cowl and contains battery cell groups 73 through 96. The next 28 battery cell groups make up battery section 2. This section is located behind section 1 and contains battery cell groups 45 through 72. The transverse battery section is section number 3 and it contains the remaining 44 battery cell groups 1 through 44. The battery sections also contain two temperature sensors, with one sensor located at each end of the section.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

DTC P0B3B, P0B3D, P0B3E, P0B40, P0B42, P0B43, P0B45, P0B47, P0B48, P0B4A, P0B4C, P0B4D, P0B4F, P0B51, P0B54, P0B52, P0B56, P0B57, P0B59, P0B5B, P0B5C, P0B5E, P0B60, P0B61, P0B63, P0B65, P0B66, P0B68, P0B6A, P0B6B, P0B6D, P0B6F, P0B70, P0B72, P0B74, P0B75, P0B77, P0B79, P0B7A, P0B7C, P0B7E, P0B7F, P0B81, P0B83, P0B84, P0B86, P0B88, P0B89, P0B8B, P0B8D, P0B8E, P0B90, P0B92, P0B93, P0B95, P0B97, P0B98, P0B9A, P0B9C, P0B9D, P0B9F, P0BA1, P0BA2, P0BA4, P0BA6, P0BA7, P0BA9, P0BAB, P0BAC, P0BAE, P0BB0, P0BB1, P0BB3, P0BB5, P0BB6, P0BB8, P0BBA, P0BBB, P1B17, P1B18, P1B1A, P1B1B, P1B1D, P1B1E, P1B20, P1B21, P1B23, P1B24, P1B26, P1B27, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1B46, P1B47, P1B4A, P1B4C, P1B4D, P1B4F, P1B50, P1B52, P1B53, P1B55, P1B56, P1B58, P1B59, P1B5B, P1B5C, P1B5E, P1B5F, P1B61, P1B64, P1B62, P1B65, P1B67, P1B68, P1B6A, P1B6B, P1B6D, P1B6E, P1B70, P1B71, P1B73, P1B74, P1B76, P1B77, P1B79, P1B7A, P1B7C, P1B7D, P1B7F, P1B80, P1B82, P1B83, P1B85, P1B86, P1B88, P1B89, P1B8B, P1B8C, P1B8E, P1B8F, P1B91, P1B92, P1B94, P1B95, P1B97, P1B98, P1B9A, P1B9B, P1B9D, P1B9E, P1BA0, P1BA1, P1BA3, P1BA4, P1BA6, P1BA7, P1BA9, P1BAA, P1BAC, P1BAD, P1BAF, P1BB0, P1BB2, P1BB3, P1BB5, P1BB6, P1BB8, P1BB9, P1BBB, P1BBC, P1BBE, P1BBF, P1BC1, P1BC2, P1BC4, P1BC5, P1BC7, P1BC8, P1BCA, P1BCB, P1BCD, P1BCE, P1BD0, P1BD1, P1BD3, P1BD4, P1BD6, P1BD7, P1BD9, P1BDA, P1BDC, P1BDD, P1BDF, P1BE0, P1BE2, P1BE3, P1BE5, P1BE6, P1BE8, P1BE9, P1BEB, P1BEC, P1BEE, P1BEF, P1BF1, P1BF2, P1BF4, P1BF5, P1BF7, P1BF8, P1BFA, P1BFB, P1BFD, P1BFE, P1E02, P1E03, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B

All of the following conditions exist:

- Vehicle in Service Mode, Vehicle ON or Engine Running.
- The hybrid/EV battery energy control module is awake and communicating.
- None of the following DTCs are set; P1A07, P1E8E, P1E8F, P1E90, P1E91, P1E92, P1E93, P1E94, P1E95, P1E96, P1E97, P1E98, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9E, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA4, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, U2402, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624.

DTC P0B3C, P0B41, P0B46, P0B4B, P0B50, P0B55, P0B5A, P0B5F, P0B64, P0B69, P0B6E, P0B73, P0B78, P0B7D, P0B82, P0B87, P0B8C, P0B91, P0B96, P0B9B, P0BA0, P0BA5, P0BAA, P0BAF, P0BB4, P0BB9, P1B19, P1B1F, P1B25, P1B45, P1B48, P1B4B, P1B4E, P1B51, P1B54, P1B57, P1B5A, P1B5D, P1B60, P1B63, P1B66, P1B69, P1B6C, P1B6F, P1B72, P1B75, P1B78, P1B7B, P1B7E, P1B81, P1B84, P1B87, P1B8A, P1B8D, P1B90, P1B93, P1B96, P1B99, P1B9C, P1B9F, P1BA2, P1BA5, P1BA8, P1BAB, P1BAE, P1BB1, P1BB4, P1BB7, P1BBA, P1BBD, P1BC0, P1BC3, P1BC6, P1BC9, P1BCC, P1BCF, P1BD2, P1BD5, P1BD8, P1BDB, P1BDE, P1BE1, P1BE4, P1BE7, P1BEA, P1BED, P1BF0, P1BF3, P1BF6, P1BF9, P1BFC, P1E01, P1E04

All of the following conditions exist:

- Vehicle ON.
- Vehicle speed is greater than 0.
- There is a change in the Voltage and Current readings.
- DTC U185A is not set.

Conditions for Setting the DTC

Battery Circuit

- P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B are Type A DTCs.
- The hybrid/EV battery energy control module detects high resistance on the circuit.

Circuit Performance

- P0B3C, P0B41, P0B46, P0B4B, P0B50, P0B55, P0B5A, P0B5F, P0B64, P0B69, P0B6E, P0B73, P0B78, P0B7D, P0B82, P0B87, P0B8C, P0B91, P0B96, P0B9B, P0BA0, P0BA5, P0BAA, P0BAF, P0BB4, P0BB9, P1B19, P1B1F, P1B25, P1B45, P1B48, P1B4B, P1B4E, P1B51, P1B54, P1B57, P1B5A, P1B5D, P1B60, P1B63, P1B66, P1B69, P1B6C, P1B6F, P1B72, P1B75, P1B78, P1B7B, P1B7E, P1B81, P1B84, P1B87, P1B8A, P1B8D, P1B90, P1B93, P1B96, P1B99, P1B9C, P1B9F, P1BA2, P1BA5, P1BA8, P1BAB, P1BAE, P1BB1, P1BB4, P1BB7, P1BBA, P1BBD, P1BC0, P1BC3, P1BC6, P1BC9, P1BCC, P1BCF, P1BD2, P1BD5, P1BD8, P1BDB, P1BDE, P1BE1, P1BE4, P1BE7, P1BEA, P1BED, P1BF0, P1BF3, P1BF6, P1BF9, P1BFC, P1E01, P1E04 are Type A DTCs.
- The faulted cell group does not change voltage.

Low Voltage

- P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05 are Type A DTCs.
- Any hybrid/EV battery voltage signal is less than 0.2 V.

High Voltage

- P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8, P1BFB, P1BFE, P1E03, P1E06 are Type A DTCs.
- Any hybrid/EV battery voltage signal is greater than 4.8 V.

Action Taken When the DTC Sets

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- If any of these DTCs are set, the vehicle will operate in a reduced power mode and the extended range mode.

- Battery Circuit, Low Voltage or High Voltage DTCs set: Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- Vehicle must be cycled from ON to OFF.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-55** Battery Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Record the freeze frame/failure records.
2. Vehicle in Service Mode.
3. Verify the scan tool Hybrid/EV Battery 1 - 96 voltages are between 3.45-4.05 V and all readings are within 0.03 V of each other.

- **If not between 3.45-4.05 V or not within 0.03 V of each other**

Refer to Circuit/System Testing.

- **If between 3.45-4.05 V and within 0.03 V of each other**

4. Clear the DTC and perform the [Clear Secured High Voltage DTCs](#) procedure.
5. Review and operate the vehicle according to the DTC Conditions for Running. Operate the vehicle for more than 10 minutes of city driving.
6. Verify the DTC does not reset.

- **If the DTC resets**

Refer to Circuit/System Testing.

- **If the DTC does not reset**

7. Plug-in the vehicle and charge the A4 Hybrid/EV Battery Pack.
8. Verify the DTC does not reset.

- **If the DTC resets**

Refer to Circuit/System Testing.

- **If the DTC does not reset**

9. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal

Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable high voltage at the A4 hybrid/EV battery pack. Refer to [High Voltage Disabling](#)
2. Remove the A4 hybrid/EV battery pack cover. Refer to [High Voltage Battery Cover Replacement](#)

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
 2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
 3. Disconnect and reconnect the battery energy control module connectors **ONLY** in the sequence provided in Repair Instructions.
3. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).
 4. Inspect the harness connectors and the K16 battery energy control module connectors for corrosion.

- If corrosion is present

Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

- If corrosion is not present

NOTE: The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

5. Disconnect the harness connector at the appropriate C4 Hybrid/EV Battery Section harness connector as indicated by the voltages or DTCs observed during Circuit/System Verification.
6. Inspect the harness connector and the appropriate C4 Hybrid/EV Battery Section connector for corrosion.

- If corrosion is present

Replace the Hybrid/EV Battery Pack Internal Harness and the C4 Hybrid/EV Battery Section, as applicable.

- If corrosion is not present

7. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-55** Battery Pinout Box Adapter to the appropriate battery section.
8. Insert the DMM probes into the **EL-48571** test cavities.
9. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** through each of the switch positions. Refer to [EL-48571 High Voltage Battery Pin Out Box Reference](#)
10. Verify each cell group voltage reading is between 3.45-4.05 V.

- **If not within the specified range**

Replace the appropriate C4 Hybrid/EV Battery Section.

- **If within the specified range**

11. Verify each cell group voltage reading is within 0.03 V of each other.

- **If greater than 0.03 V**

Replace the appropriate C4 hybrid/EV battery section.

- **If 0.03 V or less**

NOTE: Perform the following testing at the hybrid/EV battery pack internal wiring harness connector.

12. Test for infinite resistance between each appropriate voltage sense circuit terminals and ground.

- **If less than infinite resistance**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If infinite resistance**

13. Test for less than 2 Ω in each appropriate voltage sense circuits end to end.

- **If 2 Ω or greater**

Replace the Hybrid/EV Battery Pack Internal Harness.

- **If less than 2 Ω**

14. Replace the appropriate C4 hybrid/EV battery section. Operate the vehicle and verify the DTC does not reset.

- **If the DTC resets**

Replace the K16 Battery Energy Control Module.

- **If the DTC does not reset**

15. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Voltage Section Battery Replacement \(Battery Section 1\)](#)[High Voltage Section Battery Replacement \(Battery Section 2\)](#)[High Voltage Section Battery Replacement \(Battery Section 3\)](#)
- Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
- Refer to [Auxiliary Battery Wiring Harness Replacement](#)
- Refer to [Control Module References](#) for hybrid/EV battery energy control module replacement, programming and setup.

DTC P0C78 OR P3061: HYBRID/EV BATTERY SYSTEM PRECHARGE TIME TOO LONG & HYBRID/EV BATTERY PRECHARGE HIGH CURRENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0C78

Hybrid/EV Battery System Precharge Time Too Long

DTC P3061

Hybrid/EV Battery Precharge High Current

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors and 1 solid state relay (transistor). The high voltage contactors and transistor allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The transistor controls the battery heater high voltage positive circuit. The contactors and transistor close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/transistors. Ground is provided through the case ground.

In order to prevent large in-rush current, system bus high voltage is routed through a pre-charge resistor whenever high voltage is commanded ON. The hybrid/EV powertrain control module 2 monitors the time and current it takes the system bus voltage to attain the same level as the battery pack voltage. If it takes too long, or too much current flows, a DTC is set.

Conditions for Running the DTC

P0C78

- Battery voltage sensor has not failed.
- Bus voltage sensor has not failed.

P3061

- Battery voltage sensor has not failed.
- Battery current sensor has not failed.
- Precharge is active.

Conditions for Setting the DTC

P0C78

The bus voltage has not reached 95% of battery voltage within 700 ms of the contactors closing.

P3061

The bus current is greater than 3 amps for 88 ms during precharge.

Actions Taken When the DTC Sets

- DTC P0C78 and P3061 are type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTC P0C78 and P3061 are type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Record the freeze frame/failure records.
2. Vehicle in Service Mode.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

NOTE: The following setup steps must be performed exactly in order to exercise the contactors.

4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: The brake pedal must remain depressed throughout the remainder of the contactor steps.

6. PRESS and HOLD the brake pedal.

NOTE: DO NOT press the power button and enter Vehicle in Service Mode.

7. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
8. Disconnect the S15 Manual Service Disconnect.

NOTE: DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.

9. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

NOTE: It is normal for the contactor to make noise only when opening.

10. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.

- If the Hybrid/EV Battery Negative Contactor does not open and close

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- If the Hybrid/EV Battery Negative Contactor does open and close

11. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

NOTE: It is normal for the contactor to make noise only when opening.

12. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.

- If the Hybrid/EV Battery Positive Contactor does not open and close

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- If the Hybrid/EV Battery Positive Contactor does open and close

13. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

NOTE: It is normal for the contactor to make noise only when opening.

14. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.

- If the Hybrid/EV Battery Precharge Contactor does not open and close

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- **If the Hybrid/EV Battery Precharge Contactor does open and close**

15. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

NOTE: It is normal for the contactor to make noise only when opening.

16. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.

- **If the Hybrid/EV Battery Charger Contactor does not open and close**

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- **If the Hybrid/EV Battery Charger Contactor does open and close**

17. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.

- **If 10 Ω or greater**

Obtain a new S15 manual service disconnect and Refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.

- **If less than 10 Ω**

18. Vehicle OFF.

19. Install the S15 Manual Service Disconnect.

20. Clear the DTC Information. Vehicle OFF and wait 5 minutes. Vehicle ON, verify DTC P0C78 or P3061 do not set.

- **If any of the DTCs are set**

NOTE: The vehicle must remain OFF to prevent DTC P0C78 and P3061 from running.

1. Vehicle OFF.

2. Wait 5 minutes.

3. Connect the drive motor battery charger cable.

4. Verify DTC P0D26 is not set and the vehicle will charge.

- If the DTC is set and the vehicle will not charge, refer to Circuit/System Testing, High Voltage System Bus Diagnosis with DTC P0D26.
- If the DTC is not set and the vehicle charges, refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.

- **If none of the DTCs are set**

21. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal

protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Contactor Function Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If more than 10 Ω**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K16 Battery Energy Control Module and A28 Hybrid/EV Battery Contactor Assembly.
 - **If the test lamp illuminates**
5. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode.
6. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
 - Terminal 2 X357
 - Terminal 4 X357

- Terminal 6 X357

- Terminal 7 X357

- **If the test lamp illuminates on any circuit**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If the test lamp does not illuminate on all circuits**

7. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.

8. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:

- Terminal 2 X357
- Terminal 4 X357
- Terminal 6 X357
- Terminal 7 X357

- **If less than infinite resistance on either circuit**

Repair the short to ground on the circuit.

- **If infinite resistance on both circuits**

9. Test for less than 2 Ω between the harness connector terminals listed below:

- Terminal 2 X357 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 4 X357 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 6 X357 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 7 X357 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2

- **If 2 Ω or greater on any circuit**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω on all circuits**

10. Replace the A28 Hybrid/EV Battery Contactor Assembly.

11. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

12. All OK.

High Voltage System Bus Diagnosis with P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, K1 14V Power Module and the T18 Battery

Charger. Refer to [High Voltage Disabling](#).

2. Disconnect the X3 connector at the T18 Battery Charger and the X4 connector at the K1 14V Power Module.
3. Verify that all HV harness connector and mating module connector terminals are free from moisture, corrosion and arc flash damage.

- **If any terminals show signs of damage**

Replace the HV wiring harness and effected modules as necessary.

- **If no arc flash damage, moisture, or corrosion is found**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

4. Test the K1 14 V Power Module X4 terminals for greater than 10K Ω , X4-A to X4-B.

- **If 10K Ω or less**

1. Replace the K1 14V Power Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

5. Test the T18 Battery Charger terminals for greater than 10K Ω , X3-1 to X3-2.

- **If 10K Ω or less**

1. Replace the T18 Battery Charger.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

6. Remove and open the A4 Battery Pack. Refer to [High Voltage Battery Cover Replacement](#).

7. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.

- **If a terminal concern is found**

Replace all affected components.

- **If no internal concerns are observed**

8. Replace the A28 Hybrid/EV Battery Contactor Assembly.

9. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running

the DTC.

- **If DTC P0C78 or P3061 sets**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If DTC P0C78 or P3061 does not set**

10. All OK.

High Voltage System Bus Diagnosis without P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, G1 A/C Compressor, T6 Power Inverter Module and the K10 Coolant Heater. Refer to [High Voltage Disabling](#).
2. Disconnect the X2 connector at the T6 Power Inverter Module, the X3, X4 and X5 connectors at the A4 Battery Pack, the X2 connector at the K10 Coolant Heater and the X2 connector at the G1 A/C Compressor.
3. Verify that all HV harness connector and mating module connector terminals are free from moisture, corrosion and arc flash damage.

- **If any terminals show signs of damage**

Replace the HV wiring harness and effected modules as necessary.

- **If no arc flash damage, moisture, or corrosion is found**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

4. Test the T6 Power Inverter Module X2 terminals for greater than 10K Ω , X2-A to X2-B.

- **If 10K Ω or less**

1. Replace the T6 Power Inverter Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If DTC P0C78 or P3061 does not set

3. All OK.

- **If greater than 10K Ω**

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

5. Test the K10 Coolant Heater X2 terminals for greater than 10K Ω , X2-1 to X2-2.

- **If 10K Ω or less**

1. Replace the K10 Coolant Heater Control Module.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If DTC P0C78 or P3061 does not set

3. All OK.

- If greater than 10K Ω

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.

6. Test the G1 A/C Compressor X2 terminals for greater than 10K Ω , X2-A to X2-B.

- If 10K Ω or less

1. Replace the G1 A/C Compressor.

2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If DTC P0C78 or P3061 does not set

3. All OK.

- If greater than 10K Ω

7. Remove and open the A4 Battery Pack. Refer to [High Voltage Battery Cover Replacement](#).

8. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.

- If a terminal concern is found

Replace all affected components.

- If no internal concerns are observed

9. Replace the A28 Hybrid/EV Battery Contactor Assembly and the K16 Battery Energy Control Module.

10. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC P0C78 or P3061 sets

Replace the K114B Hybrid Powertrain Control Module 2.

- If DTC P0C78 or P3061 does not set

11. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor Assembly
- Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#) for G1 A/C compressor
- Refer to [Heater Coolant Heater Replacement](#) for K10 Coolant Heater
- Refer to [Control Module References](#) for T6 power inverter module, K1 14V Power Module, T18 battery charger, battery energy control module, or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, OR P3040: BATTERY ENERGY CONTROL MODULE 5 V REFERENCE CIRCUIT & HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 5 V REFERENCE CIRCUIT(S)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1A07

Battery Energy Control Module 5 V Reference Circuit

DTC P1E93

Hybrid/EV Battery Interface Control Module 1 5 V Reference Circuit

DTC P1E99

Hybrid/EV Battery Interface Control Module 2 5 V Reference Circuit

DTC P1E9F

Hybrid/EV Battery Interface Control Module 3 5 V Reference Circuit

DTC P1EA5

Hybrid/EV Battery Interface Control Module 4 5 V Reference Circuit

DTC P1FC3

Hybrid/EV Battery Interface Control Module 5 5 V Reference Circuit

DTC P1FC4

Hybrid/EV Battery Interface Control Module 6 5 V Reference Circuit

DTC P1FC5

Hybrid/EV Battery Interface Control Module 7 5 V Reference Circuit

DTC P1FC6

Hybrid/EV Battery Interface Control Module 8 5 V Reference Circuit

DTC P1FC7

Hybrid/EV Battery Interface Control Module 9 5 V Reference Circuit

DTC P1FC8

Hybrid/EV Battery Interface Control Module 10 5 V Reference Circuit

DTC P3035

Hybrid/EV Battery Interface Control Module 11 5 V Reference Circuit

DTC P3040

Hybrid/EV Battery Interface Control Module 12.5 V Reference Circuit

Circuit/System Description

The hybrid battery contains 192 individual cells. Two cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.7 V, for a nominal system voltage of 355 V direct current. The battery cell groups are joined to form 3 distinct sections. The first 24 battery cell groups make up battery section 1. This section is adjacent to the cowl and contains battery cell groups 73 through 96. The next 28 battery cell groups make up battery section 2. This section is located behind section 1 and contains battery cell groups 45 through 72. The transverse battery section is section number 3 and it contains the remaining 44 battery cell groups 1 through 44. The battery sections also contain two temperature sensors, with one sensor located at each end of the section.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1A07

- The battery energy control module is awake and communicating.
- The 12 V battery voltage greater than or equal to 9 V.

P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624

Conditions for Setting the DTC

P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

The battery energy control module has detected an internal 5V reference circuit voltage is less than 2.8 V or greater than 3.2 V.

Actions Taken When the DTC Sets

- DTCs P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.
- The vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTCs P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is not set.
 - If DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is set
 1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to High Voltage Disabling.
 2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to Battery Energy Control Module Replacement.
 - If none of the DTCs are set
2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for battery energy control module programming and setup.

DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, OR P3041: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 CELL BALANCING CIRCUIT(S)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1E92

Hybrid/EV Battery Interface Control Module 1 Cell Balancing Circuit

DTC P1E98

Hybrid/EV Battery Interface Control Module 2 Cell Balancing Circuit

DTC P1E9E

Hybrid/EV Battery Interface Control Module 3 Cell Balancing Circuit

DTC P1EA4

Hybrid/EV Battery Interface Control Module 4 Cell Balancing Circuit

DTC P1FC9

Hybrid/EV Battery Interface Control Module 5 Cell Balancing Circuit

DTC P1FCA

Hybrid/EV Battery Interface Control Module 6 Cell Balancing Circuit

DTC P1FCB

Hybrid/EV Battery Interface Control Module 7 Cell Balancing Circuit

DTC P1FCC

Hybrid/EV Battery Interface Control Module 8 Cell Balancing Circuit

DTC P1FCD

Hybrid/EV Battery Interface Control Module 9 Cell Balancing Circuit

DTC P1FCE

Hybrid/EV Battery Interface Control Module 10 Cell Balancing Circuit

DTC P3036

Hybrid/EV Battery Interface Control Module 11 Cell Balancing Circuit

DTC P3041

Hybrid/EV Battery Interface Control Module 12 Cell Balancing Circuit

Circuit/System Description

To maintain a similar state of charge on the cell groups, the hybrid/EV powertrain control module 2 looks at the cell group voltages and determines which cell groups need energy removed in order to maintain the battery groups at a similar state of charge. This is known as cell balancing. There is a transistor switched resistor wired in parallel with the cell group internal to the hybrid/EV battery interface control module portion of the battery energy control module. The hybrid/EV powertrain control module 2 sends a command to the hybrid/EV battery energy control module to begin cell balancing.

Conditions for Running the DTC

- The hybrid/EV battery energy control module is awake and communicating.
- The high voltage fault circuit diagnostic is not running.
- The cell balancing circuit is greater than 3.0 V.
- None of the following DTCs are set, P1E8E, P1E94, P1E9A, P1EA0, P1FBD, P1FBE, P1FBF, P1FC0, P1FC1, P1FC2, P3037, P3042, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624.

Conditions for Setting the DTC

The battery energy control module has detected an internal cell balancing switch fault.

Actions Taken When the DTC Sets

- DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.
- Cell balancing is disabled.
- The vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that no other DTCs are set.

- If any other DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If no other DTCs are set

2. Verify that DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, or P3041 is set.

- DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036 or P3041 is set

1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).

2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- If none of the DTCs are set

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for battery energy control module replacement, programming and setup.

DTC P1EAB OR P1EAC: BATTERY ENERGY CONTROL MODULE HYBRID/EV BATTERY CELL HIGH VOLTAGE & HYBRID/EV BATTERY CELL OVERVOLTAGE SIGNAL CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1EAB

Battery Energy Control Module Hybrid/EV Battery Cell High Voltage

DTC P1EAC

Circuit/System Description

The 2nd protection is a redundant method to monitor cell group overvoltage. The 2nd protection circuit is the actual hardware signal from the hybrid/EV battery energy control module to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 monitors this line to determine when a cell group overvoltage condition exists, independently of the cell group diagnostic trouble codes transmitted via serial data from the battery energy control module to the hybrid powertrain control module 2.

The 2nd protection self test diagnostic is used to check the signal circuit. The hybrid/EV battery energy control module performs this test, once, every power up cycle. When run/crank input signal transitions high and after a calibrated delay, the hybrid/EV battery energy control module informs the hybrid/EV powertrain control module 2, via serial data communication bus that it is about to run the diagnostics on the 2nd protection circuit. The hybrid/EV battery energy control module then proceeds to command, via internal serial data, each of its internal hybrid/EV battery interface control modules to run the check on its hardware output. Each of the four hybrid/EV battery interface control modules pulls the signal circuit low and releases it, in sequence. If any pulses are missing, the hybrid/EV battery energy control module sets a related fault, and sends this information to the hybrid/EV powertrain control module 2 on the serial data. Additionally, the hybrid powertrain control module 2 monitors the 2nd protection circuit for opens, shorts to ground and shorts to voltage.

Conditions for Running the DTC

P1EAB

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B49, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05, P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8, P1BFB, P1BFE, P1E03, P1E06, P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, P303B, U0111, or U185A is not set
- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.

- Vehicle is ON for greater than 5 seconds.
- Hybrid powertrain control module 1 detects high voltage bus is greater than 312 V.
- Battery charging is not active.

P1EAC

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC U0111 or U185A is not set.
- The 12 V battery voltage greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.
- Vehicle is ON for greater than 5 seconds.

Conditions for Setting the DTC

P1EAB

A cell group voltage of greater than 4.5 V is detected.

OR

The hybrid powertrain control module 2 has detected a fault with the 2nd protection circuit.

P1EAC

The hybrid/EV powertrain control module 2 has detected a fault with the 2nd protection circuit.

Action Taken When the DTC Sets

- DTCs P1EAB and P1EAC are type A DTCs.
- If any of these DTCs are set, the vehicle will operate in a reduced power mode and the extended range mode.

P1EAB

Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTCs P1EAB and P1EAC are type A DTCs.
- Vehicle Power cycled from ON to OFF after code clear.

P1EAB

After the repair for DTC P1EAB, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

Diagnostic Aids

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50211** Low Voltage Jumper Harness Extension

Equivalent regional tools: **Special Tools**.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0B3B, P0B3D, P0B3E, P0B40, P0B42, P0B43, P0B45, P0B47, P0B48, P0B4A, P0B4C, P0B4D, P0B4F, P0B51, P0B54, P0B52, P0B56, P0B57, P0B59, P0B5B, P0B5C, P0B5E, P0B60, P0B61, P0B63, P0B65, P0B66, P0B68, P0B6A, P0B6B, P0B6D, P0B6F, P0B70, P0B72, P0B74, P0B75, P0B77,

P0B79, P0B7A, P0B7C, P0B7E, P0B7F, P0B81, P0B83, P0B84, P0B86, P0B88, P0B89, P0B8B, P0B8D, P0B8E, P0B90, P0B92, P0B93, P0B95, P0B97, P0B98, P0B9A, P0B9C, P0B9D, P0B9F, P0BA1, P0BA2, P0BA4, P0BA6, P0BA7, P0BA9, P0BAB, P0BAC, P0BAE, P0BB0, P0BB1, P0BB3, P0BB5, P0BB6, P0BB8, P0BBA, P0BBB, P1B17, P1B18, P1B1A, P1B1B, P1B1D, P1B1E, P1B20, P1B21, P1B23, P1B24, P1B26, P1B27, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1B46, P1B47, P1B4A, P1B4C, P1B4D, P1B4F, P1B50, P1B52, P1B53, P1B55, P1B56, P1B58, P1B59, P1B5B, P1B5C, P1B5E, P1B5F, P1B61, P1B64, P1B62, P1B65, P1B67, P1B68, P1B6A, P1B6B, P1B6D, P1B6E, P1B70, P1B71, P1B73, P1B74, P1B76, P1B77, P1B79, P1B7A, P1B7C, P1B7D, P1B7F, P1B80, P1B82, P1B83, P1B85, P1B86, P1B88, P1B89, P1B8B, P1B8C, P1B8E, P1B8F, P1B91, P1B92, P1B94, P1B95, P1B97, P1B98, P1B9A, P1B9B, P1B9D, P1B9E, P1BA0, P1BA1, P1BA3, P1BA4, P1BA6, P1BA7, P1BA9, P1BAA, P1BAC, P1BAD, P1BAF, P1BB0, P1BB2, P1BB3, P1BB5, P1BB6, P1BB8, P1BB9, P1BBB, P1BBC, P1BBE, P1BBF, P1BC1, P1BC2, P1BC4, P1BC5, P1BC7, P1BC8, P1BCA, P1BCB, P1BCD, P1BCE, P1BD0, P1BD1, P1BD3, P1BD4, P1BD6, P1BD7, P1BD9, P1BDA, P1BDC, P1BDD, P1BDF, P1BE0, P1BE2, P1BE3, P1BE5, P1BE6, P1BE8, P1BE9, P1BEB, P1BEC, P1BEE, P1BEF, P1BF1, P1BF2, P1BF4, P1BF5, P1BF7, P1BF8, P1BFA, P1BFB, P1BFD, P1BFE, P1E02, P1E03, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, or U2606 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- If none of the DTCs are set

3. Verify that DTC P1EAB or P1EAC is not set.

- If DTC P1EAB or P1EAC is set

Refer to Circuit/System Testing

- If DTC P1EAB or P1EAC is not set

4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify the hybrid/EV powertrain control module 2 scan tool Maximum Hybrid/EV Battery Module Voltage parameter is 4.5 V or less.

- **If greater than 4.5 V**

Perform the applicable DTC diagnosis for the battery module indicating high voltage. Refer to [DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B.](#)

- **If 4.5 V or less**

3. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling.](#)

NOTE: Connecting the 12 V battery with the manual service disconnect removed will set DTCs.

4. Connect the 12 V battery. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode.

5. Test for 4.8 - 5.2 V between the signal circuit terminal 6 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.

- **If 5.2 V or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.

- **If between 4.8 - 5.2 V**

6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack Cover. Refer to [High Voltage Battery Cover Replacement.](#)
7. Connect **EL-50211** Low Voltage Jumper Harness Extension. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. Vehicle in Service Mode.
8. Test for 4.8 - 5.2 V between the signal circuit terminal 8 and ground.

- **If not within the specified range**

Repair or replace the Hybrid/EV Battery Pack Internal Harness. After the repair, with a scan tool, perform the [Clear Secured High Voltage DTCs](#) repair instruction.

- **If within the specified range**

9. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Auxiliary Battery Wiring Harness Replacement](#) for Hybrid/EV Battery Pack Internal Harness replacement
- Refer to [Control Module References](#) for battery energy control module or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1FD5-P1FF2, P3038-P303A, OR P3043-P3045: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 VOLTAGE SENSOR(S)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1FD5

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit Low Voltage

DTC P1FD6

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit Low Voltage

DTC P1FD7

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit Low Voltage

DTC P1FD8

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit Low Voltage

DTC P1FD9

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit Low Voltage

DTC P1FDA

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit Low Voltage

DTC P1FDB

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit Low Voltage

DTC P1FDC

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit Low Voltage

DTC P1FDD

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit Low Voltage

DTC P1FDE

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit Low Voltage

DTC P1FDF

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit High Voltage

DTC P1FE0

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit High Voltage

DTC P1FE1

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit High Voltage

DTC P1FE2

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit High Voltage

DTC P1FE3

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit High Voltage

DTC P1FE4

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit High Voltage

DTC P1FE5

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit High Voltage

DTC P1FE6

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit High Voltage

DTC P1FE7

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit High Voltage

DTC P1FE8

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit High Voltage

DTC P1FE9

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Performance

DTC P1FEA

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Performance

DTC P1FEB

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Performance

DTC P1FEC

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Performance

DTC P1FED

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Performance

DTC P1FEE

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Performance

DTC P1FEF

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Performance

DTC P1FF0

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Performance

DTC P1FF1

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Performance

DTC P1FF2

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Performance

DTC P3038

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit Low Voltage

DTC P3039

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit High Voltage

DTC P303A

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit Performance

DTC P3043

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Low Voltage

DTC P3044

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit High Voltage

DTC P3045

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Performance

Circuit/System Description

The hybrid battery contains 192 individual cells. Two cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.7 V, for a nominal system voltage of 355 V direct current. The battery cell groups are joined to form 3 distinct sections. The first 24 battery cell groups make up battery section 1. This section is adjacent to the cowl and contains battery cell groups 73 through 96. The next 28 battery cell groups make up battery section 2. This section is located behind section 1 and contains battery cell groups 45 through 72. The transverse battery section is section number 3 and it contains the remaining 44 battery cell groups 1 through 44. The battery sections also contain two temperature sensors, with one sensor located at each end of the section.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3038, P3039, P3043, and P3044

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit low voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit high voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit DTCs are set.

Conditions for Setting the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P3038, and P3043

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are less than 1.5 V.

P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3039, and P3044

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are greater than 48.5 V.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

A hybrid/EV battery interface control module has detected a deviation between the module voltage sum of a half section minus the voltage sum of 8 individual cell groups in a section is greater than 0.6 V

Actions Taken When the DTC Sets

- DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.
- The vehicle will operate in a reduced power mode and the extended range mode.
- Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is not set.

- If DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is set

1. Vehicle OFF, disable high voltage. Refer to [High Voltage Disabling](#).
2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- If none of the DTCs are set

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P1F17: SYSTEM ISOLATION/IMPACT SENSOR FAULT - HYBRID/EV BATTERY SYSTEM CONTACTORS OPEN

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F17

System Isolation/Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

Circuit/System Description

The hybrid/EV powertrain control module 2 will set DTC P1F17 if the hybrid/EV powertrain control module 1 has detected a passive loss of isolation in combination with the supplemental inflatable restraint sensors are not working or has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

- DTC P1AF0, P1AF2 or P1E22 is set in the hybrid/EV powertrain control module 1.

AND

- DTCs B0083-B0088 are set in the supplemental inflatable restraint module.

OR

- DTC P1AF0, P1AF2 or P1E22 is set in the hybrid/EV powertrain control module 1.

AND

- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

AND

- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1.

AND

- DTCs B0083-B0088 are set in the supplemental inflatable restraint module.

Action Taken When the DTC Sets

- DTC P1F17 is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

- DTC P1F17 is a type A DTC.
- The **Clear Secured High Voltage DTCs** reset function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**
3. Verify that DTC P1F17 is not set.
 - **If DTC P1F17 is set**
 1. Verify the K36 Inflatable Restraint Sensing And Diagnostic Module is programmed with the correct software calibration.
 - If the correct software is not installed, program the K36 Inflatable Restraint Sensing And Diagnostic Module.
 - If the correct software is installed
 2. Perform the [Clear Secured High Voltage DTCs](#) repair instruction.
 3. Verify that DTC P1F17 does not set while operating the vehicle within the Conditions for Running the DTC.
 - If DTC P1F17 is set, replace the K114B Hybrid Powertrain Control Module 2.
 - If DTC P1F17 is not set
 4. All OK.
 - **If DTC P1F17 is not set**
 4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 and inflatable restraint sensing and diagnostic module replacement, programming and setup.

LOSS OF ISOLATION ON THE HIGH VOLTAGE MAIN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

Vehicles equipped with high voltage energy storage are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

The vehicle utilizes Passive and Active isolation testing to determine the amount of isolation between the high voltage and the chassis.

Passive isolation testing is performed within the power inverter module and tests whenever the high voltage main contactors are closed. Utilizing a high impedance resistor network, passive isolation detection monitors all high

voltage components including the hybrid/EV battery pack and isolation loss results in DTCs P1AF0, P1AF2 and/or P1E22. Real-time status of passive isolation detection can be determined by observing the delta between the Positive Supply Isolation Voltage and Negative Supply Isolation Voltage scan tool parameters. The parameters are displayed by any of the Motor Control Modules.

Active isolation testing is performed by the hybrid powertrain control module 2 and tests after the high voltage main contactors open. Utilizing a switched resistance, active isolation detection monitors the internal Hybrid/EV battery pack as well as the charging system direct current (DC) high voltage circuits and isolation loss results in DTC P0AA6. Status for the prior active isolation detection event can be determined by observing the hybrid powertrain control module 2 Isolation Test Resistance scan tool parameter. Real-time status observation requires the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test.

Diagnosis for isolation requires testing with high voltage potential. Special insulation testing multimeters such as the EL-50772 utilize their own internal high voltage and must be used to test the isolation capability of high voltage components and circuits. Refer to [Troubleshooting With an Insulation Multimeter](#).

Diagnostic Aids

Prior to disabling high voltage:

Monitoring certain scan tool parameters when high voltage is active may help to identify which high voltage components and circuits have lost their chassis isolation. The Vehicle Information selection within the HPCM2 scan tool Data Display contains many parameters related to isolation diagnosis. The Drive Motor 1 Control Module Positive Supply Isolation Voltage and Drive Motor 1 Control Module Negative Supply Isolation Voltage parameters provide a real-time indication of isolation status. The parameters will shift in respect to one another relative to the level of isolation loss. The greater the delta, or difference, between parameters, the less isolation exists between high voltage and the vehicle chassis.

Isolation Loss between HV Components and Chassis, Positive Side*

Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate Passive Isolation DTC set point	100K	None - Direct Short
Positive Isolation Parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation Parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Delta Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V
*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.								

Certain isolation loss concerns may only appear during high moisture environmental conditions. Drive the vehicle thru an underbody spraying-style car wash while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

Isolation loss might only occur when a high voltage device is active. Use the High Voltage Component Test Method table and operate each HV component while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

High Voltage Component Test Methods

HV Component	Scan Tool Parameter	Most Complete Test Method
G1 Electric A/C Compressor	Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and Monitor Isolation Voltage Parameter Delta
K10 Coolant Heater	Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and Monitor Isolation Voltage Parameter Delta
E54 Battery Heater*	Hybrid/EV Battery Pack Heater Power Command (HPCM2)	Hybrid/EV Battery Pack Heater Power GDS2 Scan Tool Control Function (HPCM2) and Monitor Isolation Voltage Parameter Delta*
		Review the DTC P1EC6 Conditions for Running and Monitor Isolation Voltage Parameter Delta while heater is commanded ON*
T18 Battery Charger	Active During Charge	Insulation Multimeter
K1 14V Power Module	14V Module High Voltage Circuit Current (HPCM1)	Insulation Multimeter
T6 Power Inverter Module	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
M15A, M15B Drive Motors	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
G5 Transmission Fluid Pump	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
A4 Battery Pack - Internal Side of Contactors	Isolation Concern Results in DTC P0AA6	
*Because the E54 Battery Heater is always connected to the positive bus, an isolation fault may result in a delta decrease when commanded ON.		

After disabling high voltage:

High Voltage cables disconnected at each end from their respective modules must be tested with the insulation meter connected to their shield circuit and not to vehicle chassis.

The **EL-50772** insulation meter, when set to the 500V scale, indicates 550M Ω when measuring infinite or open circuit conditions. An equivalent meter may display 'infinite' value in a different manner.

Reference Information

Schematic Reference

- [Hybrid/EV Energy Storage Schematics](#)
- [Hybrid/EV Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

[Hybrid/EV System High Voltage Isolation Description](#) for:

- Passive Isolation circuit detail
- Active Isolation circuit detail
- Complete High Voltage system schematic

Electrical Information Reference

Troubleshooting With an Insulation Multimeter

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Remove all vehicle chargers.
2. Vehicle ON.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3 is not set.
 - **If any DTC is set**
 Refer to **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3.**
 - **If none of the DTCs are set**
4. Verify that DTC P0AA6 or P1AE6 is not set.
 - **If any DTC is set**
 Refer to **DTC P0AA6 or P1AE6.**
 - **If none of the DTCs are set**

NOTE: High voltage must be enabled to obtain accurate results.

5. Vehicle ON, observe the scan tool Drive Motor 1 Positive Supply Isolation Voltage and the Drive Motor 1 Negative Supply Isolation Voltage scan tool parameters.
6. Is the delta, or difference, between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?
 - **If the delta is greater than 15 volts**
 Using the High Voltage Component Test Methods table as a guide, observe and record which components are active. Refer to Circuit/System Testing.
 - **If the delta is 15 volts or less**
7. Using the High Voltage Component Test Method table as a guide, turn ON devices one at a time while monitoring the isolation voltage delta.

8. Is the delta between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts when a component is active?

- **If the delta is greater than 15 volts**

Observe and record which components are active. Refer to Circuit/System Testing.

- **If the delta is 15 volts or less**

9. Turn the vehicle OFF, open and close the drivers door and wait two minutes.

10. PRESS and HOLD the brake pedal and activate the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test. The battery pack isolation test will complete in less than a minute. Verify the Isolation Test Resistance parameter when the test is complete is greater than 350K ohms.

- **If the resistance is 350K or less**

Refer to **DTC P0AA6 or P1AE6**.

- **If the resistance is greater than 350K ohms**

11. Vehicle OFF. Connect the vehicle charge cord. Ensure charge mode is active.

12. With charge mode already active, Vehicle ON and observe the scan tool Drive Motor 1 Positive Supply Isolation Voltage and the Drive Motor 1 Negative Supply Isolation Voltage scan tool parameters.

13. Is the delta between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?

- **If the delta is greater than 15 volts**

Refer to Circuit/System Testing.

- **If the delta is less than 15 volts**

14. All OK, review Diagnostic Aids.

Circuit/System Testing

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

NOTE: **Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.**

1. Disable the high voltage for servicing at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Disconnect the A4 Hybrid/EV Battery pack high voltage harness connector at the T6 Power Inverter Module if not already disconnected during the High Voltage Disabling procedure.
3. Disconnect the G1 Air Conditioning Compressor high voltage harness connector located above the transmission if not already disconnected during the High Voltage Disabling procedure.
4. Disconnect all HV connectors at the A4 Hybrid/EV Battery Pack if not already disconnected during the High Voltage Disabling procedure.

NOTE: **Only perform the following continuity tests using the EL-50772 Insulation Multimeter or equivalent.**

5. Ensure only the **EL-50772** Insulation Multimeter or equivalent is used with this procedure. Select the Isolation Test setting, then select the 500V range. Refer to [Troubleshooting With an Insulation Multimeter](#) for important usage instructions.
6. Test for 550M Ω between the circuit terminals listed below and cable shield, using the **EL-50772** Insulation Multimeter :
 - T18 Battery Charger/K1 14V Power Module harness connector terminal A +300V, at the A4 Hybrid/EV Battery Pack.
 - T18 Battery Charger/K1 14V Power Module harness connector terminal B -300V, at the A4 Hybrid/EV Battery Pack.
 - **If less than 550M Ω**
 1. Disconnect the high voltage harness connector at the K1 14V Power Module.
 2. Test for 550M Ω between the circuit terminals listed below and chassis ground:
 - K1 14V Power Module connector terminal A +300V
 - K1 14V Power Module connector terminal B -300V
 - If less than 550M Ω , replace the K1 14V Power Module.
 - If 550M Ω
 3. Disconnect the high voltage direct current (DC) harness connector at the T18 Battery Charger.
 - 4. Test for 550M Ω between the circuit terminals listed below and chassis ground:
 - T18 Battery Charger module connector terminal A +300V
 - T18 Battery Charger module connector terminal B -300V
 - If less than 550M Ω , replace the T18 Battery Charger.
 - If 550M Ω , replace the 300V DC cable assembly.
 - **If 550M Ω**
7. Test for 550M Ω between the circuit terminals listed below and chassis ground:
 - K10 Heater module harness connector Terminal A +300V at the A4 Hybrid/EV Battery Pack
 - K10 Heater module harness connector Terminal B -300V at the A4 Hybrid/EV Battery Pack
 - **If less than 550M Ω**
 1. Disconnect the high voltage connector at the K10 Heater module.
 2. Retest for 550M Ω between the circuit terminals listed below and chassis ground:

- K10 Heater module harness connector Terminal A +300V at the A4 Hybrid/EV Battery Pack
- K10 Heater module harness connector Terminal B -300V at the A4 Hybrid/EV Battery Pack
- If 550M Ω , replace the K10 Heater module.
- If less than 550M Ω , replace the 300V DC cable assembly.

- **If 550M Ω**

8. Test for 550M Ω between the circuit terminals listed below and chassis ground:

- G1 A/C Compressor module harness connector Terminal A +300V at the A4 Hybrid/EV Battery Pack
- G1 A/C Compressor module harness connector Terminal B -300V at the A4 Hybrid/EV Battery Pack
- If less than 550M Ω , replace the 300V DC cable assembly.

- **If 550M Ω**

9. Test for 550M Ω between the circuit terminals listed below and chassis ground:

- T6 Power Inverter Module harness connector Terminal A +300V at the A4 Hybrid/EV Battery Pack
- T6 Power Inverter Module harness connector Terminal B -300V at the A4 Hybrid/EV Battery Pack
- If less than 550M Ω , replace the 300V DC cable assembly.

- **If 550M Ω**

NOTE: There may be up to a 5 second delay for proper test results to be displayed, always Press and Hold the EL-50772 test button until maximum measurement values are observed.

10. Test for 550M Ω between the circuit terminals listed below and chassis ground:

- G1 A/C Compressor module harness connector Terminal A +300V, located above the transmission
- G1 A/C Compressor module harness connector Terminal B -300V, located above the transmission
- **If less than 550M Ω**

1. Disconnect the high voltage connector at the G1 A/C Compressor module.

2. Retest for 550M Ω between the circuit terminals listed below and chassis ground:

- G1 A/C Compressor module harness connector Terminal A +300V, located above the transmission
- G1 A/C Compressor module harness connector Terminal B -300V, located above the transmission
- If 550M Ω , replace the G1 A/C Compressor module.
- If less than 550M Ω , replace the 300V DC cable assembly.

- **If 550M Ω**

NOTE: Testing of the drive motors and transmission fluid pump motor cannot be performed while connected to the T6 Power Inverter Module.

11. Remove the T6 Power Inverter Module from the transmission. Refer to [Drive Motor Power Inverter Module Removal](#).

NOTE: There may be up to a 5 second delay for proper test results to be displayed, always Press and Hold the EL-50772 test button until maximum measurement values are observed.

12. Test for 550M Ω between each M15B Drive Motor 2, 3 phase buss bar terminal and the transmission case:

- Terminal U 300V
- Terminal V 300V
- Terminal W 300V

- **If less than 550M Ω**

Replace the M15B Drive Motor 2 and the 3 phase connector assembly.

- **If 550M Ω**

13. Test for 550M Ω between each M15A Drive Motor 1, 3 phase buss bar terminal and the transmission case:

- Terminal U 300V
- Terminal V 300V
- Terminal W 300V

- **If less than 550M Ω**

Replace the M15A Drive Motor 1 and the 3 phase connector assembly.

- **If 550M Ω**

14. Test for 550M Ω between the G5 Transmission Fluid Pump 3 phase cable harness circuit terminals listed below and chassis ground:

- Terminal 1 300V
- Terminal 2 300V
- Terminal 3 300V

- **If less than 550M Ω**

Replace the G5 Transmission Fluid Pump.

- **If 550M Ω**

15. Test for 1.1M Ω or greater between each T6 Power Inverter Module high voltage circuit terminal and the chassis of the power inverter module.

- **If less than 1.1M Ω**

Replace the T6 Power Inverter Module.

- **If 1.1M Ω or greater**

16. All OK, review Diagnostic Aids.

Component Testing

1. Perform component testing only after high voltage is disabled.
2. Testing of the Battery Heater must be performed after the A28 Hybrid/EV Battery Contactor Assembly is removed from the Hybrid/EV Battery Pack assembly.
3. Testing of the drive motors and transmission fluid pump must be performed disconnected from the power inverter module.
4. Test with the **EL-50772** insulation multimeter or equivalent, set only at 500V.

HV Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results
G1 Electric A/C Compressor	None	1. HV Pos+ terminal to compressor housing/HV Neg- terminal to compressor housing 2. Test continuously for several seconds until	550M Ω

HV Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results
		maximum measurement is obtained.	
K10 Coolant Heater	Plug one coolant port and fill with coolant	HV Pos+ terminal to cable shield/HV Neg- terminal to cable shield	550M Ω
E54 Battery Heater	1. Remove from Hybrid/EV Battery Pack. 2. Plug one coolant port and fill with coolant.	HV Pos+ terminal to heater housing/HV Neg- terminal to heater housing	550M Ω
T18 Battery Charger	None	HV DC Pos+ terminal to module housing/HV DC Neg- terminal to module housing	550M Ω
K1 14V Power Module	None	HV Pos+ terminal to module housing/HV Neg- terminal to module housing	550M Ω
T6 Power Inverter Module	Must be removed from transmission	1. Each HV terminal, both AC and DC, to module housing. 2. Test continuously for several seconds until maximum measurement is obtained.	1.1 to 1.2M Ω
M15A, M15B Drive Motors	Must be electrically disconnected from T6 Power Inverter Module during test	1. Any HV 3 phase terminal to stator ground. 2. Test continuously for several seconds until maximum measurement is obtained.	550M Ω
G5 Transmission Fluid Pump	Disconnect cable from T6 Power Inverter Module	1. Any HV 3 phase terminal to stator ground. 2. Test continuously for several seconds until maximum measurement is obtained.	550M Ω
300-V Battery Positive and Negative Cables	Disconnect cables at both ends	HV Pos+ terminal to cable shield/HV Neg- terminal to cable shield	550M Ω

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Power Inverter Module and A/C Compressor](#)
- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Heater Coolant Heater](#)
- Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Charger Receptacle, Accessory DC Power Control Module, and Drive Motor Battery Charger](#)
- Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#)
- Refer to [Heater Coolant Heater Replacement](#)
- Refer to [Accessory DC Power Control Module Replacement](#)
- Refer to [Drive Motor Disassemble - 1st Position](#)
- Refer to [Drive Motor Disassemble - 2nd Position](#)
- Refer to [Automatic Transmission Fluid Pump and Fluid Filter Removal](#)
- Refer to [High Voltage Battery Heater Replacement](#)
- Refer to [Control Module References](#) for the T6 power inverter module replacement, programming and setup.

HYBRID/EV BATTERY VOLTAGE PRESENT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors and 1 transistor. The high voltage contactors and transistor allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and precharge negative high voltage contactor. The transistor controls the battery heater. The contactors and transistor close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor/transistor. Ground is provided through a vehicle ground external of the high voltage battery.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

[Circuit/System Testing](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information prior to performing the High Voltage Disabling procedure. Refer to [High Voltage Safety](#)
2. Verify the High Voltage Disabling procedure has been performed and the S15 manual service disconnect has been removed.

- **The procedure has not been performed**

Refer to [High Voltage Disabling](#) before continuing to the next step.

- **The procedure has been performed**

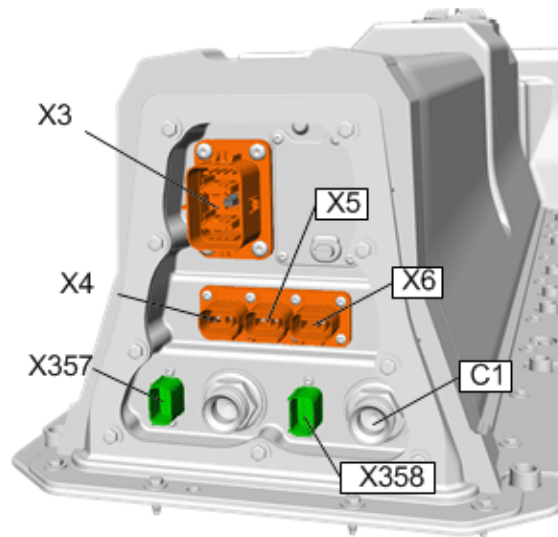


Fig. 44: A4 Hybrid/EV Battery Pack Connector Identification

Courtesy of GENERAL MOTORS COMPANY

NOTE: Connecting the 12 V battery while leaving the S15 manual service disconnect out will set DTCs. Clear these DTCs after all repairs are complete.

3. Disconnect the low voltage (X357) and (X358) harness connectors at the A4 Hybrid/EV Battery Pack. Connect the 12 V battery. Vehicle in Service Mode.
4. Test for less than 9.5 V at the following points and ground:
 - X357, Terminal 2
 - X357, Terminal 4
 - X357, Terminal 6
 - X357, Terminal 7
 - **If 9.5 V or greater**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
 - **If less than 9.5 V**
5. Vehicle OFF.

NOTE:

- **Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.**

- **A 9 V battery or the vehicles 12 V battery can be used to test the DMM.**

6. Test the DMM by measuring a known good 9 to 12 V battery.

- **If the DMM does not properly measure the test battery**

Repair or replace the DMM and repeat all voltage measurements.

- **If the DMM does properly measure the test battery**

7. Replace the A4 Hybrid/EV Battery Pack. There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

TROUBLESHOOTING WITH AN INSULATION MULTIMETER

Special Tools

EL-50772 Insulation Multimeter

For regional equivalent tools, refer to [Special Tools](#)

Diagnosis for isolation loss requires insulation testing with high voltage potential. Special multimeters that utilize their own built-in high voltage, such as the **EL-50772** Insulation Multimeter, test the isolation capability of high voltage components and circuits. Understanding an insulation multimeter and how it functions is necessary to obtain proper test results.

How to Use the Insulation Multimeter

1. Read all instructions and warnings that came with your insulation multimeter.

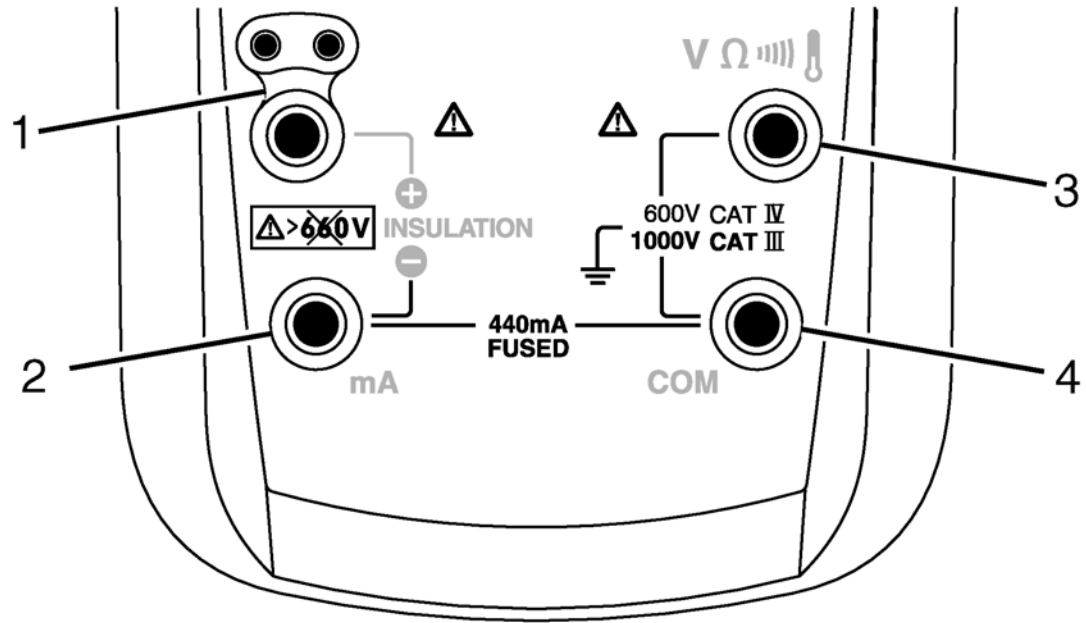


Fig. 45: Ports

Courtesy of GENERAL MOTORS COMPANY

2. Plug into the correct ports (1, 2) for insulation testing. This is easy to get wrong especially if you use the **EL-50772** for standard DMM testing too. Do NOT use ports (3, 4) for insulation testing.
3. Always test at the 500V range.

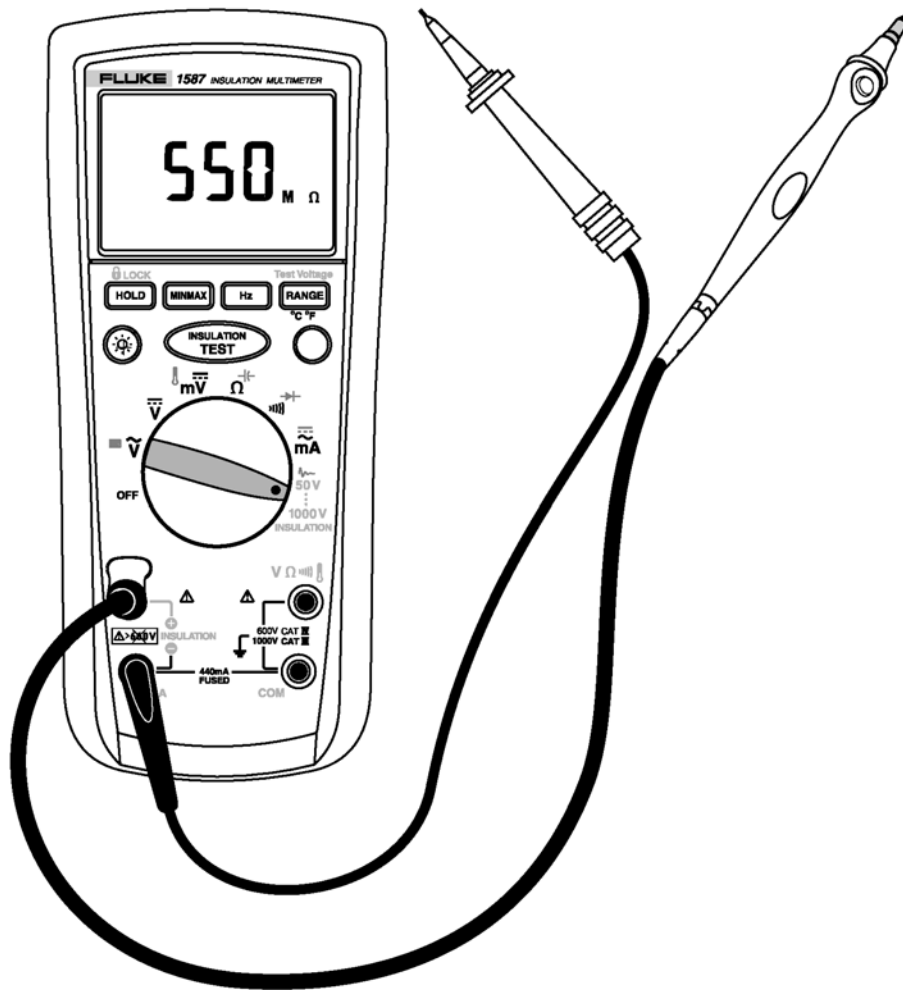


Fig. 46: Insulation Multimeter (550)

Courtesy of GENERAL MOTORS COMPANY

4. With the test leads not connected to anything, press and hold test button to know how your meter displays an infinite measurement. The **EL-50772** will display 550M Ω when measuring an open circuit while set to the 500V range.

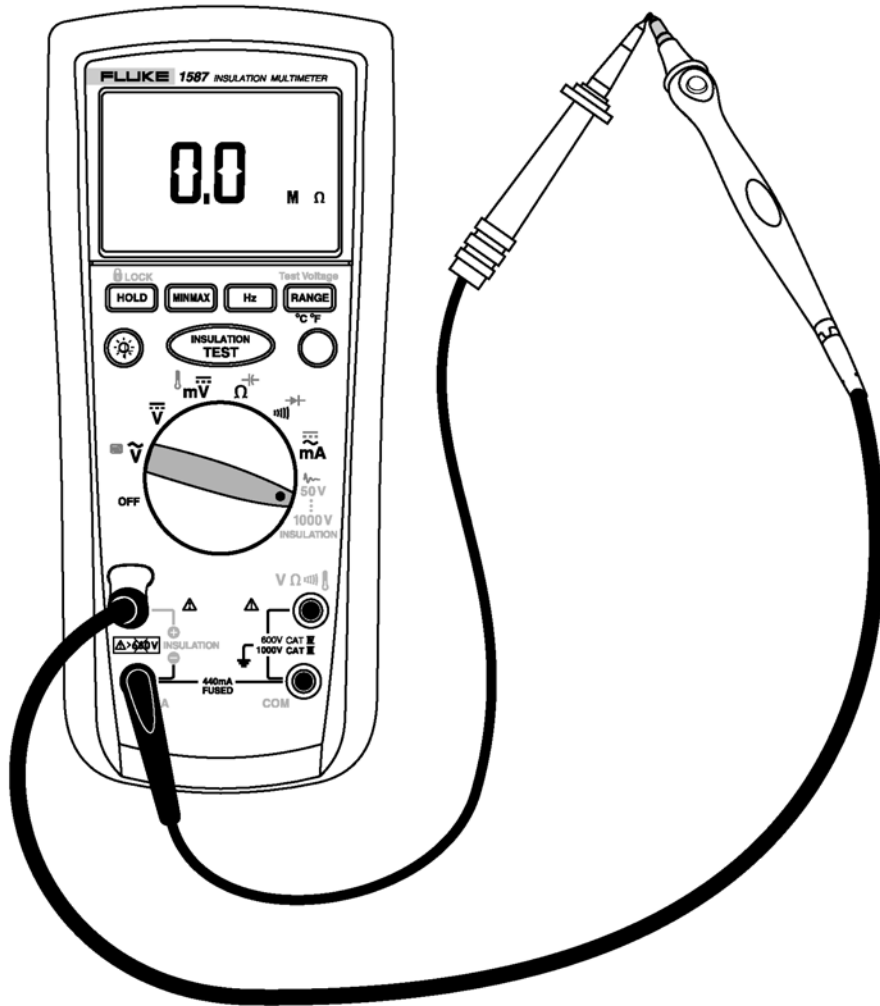


Fig. 47: Insulation Multimeter (0.0)

Courtesy of GENERAL MOTORS COMPANY

5. With the test leads connected together, press and hold test button to know how your meter displays continuity. The **EL-50772** will display 0.0 Ω .

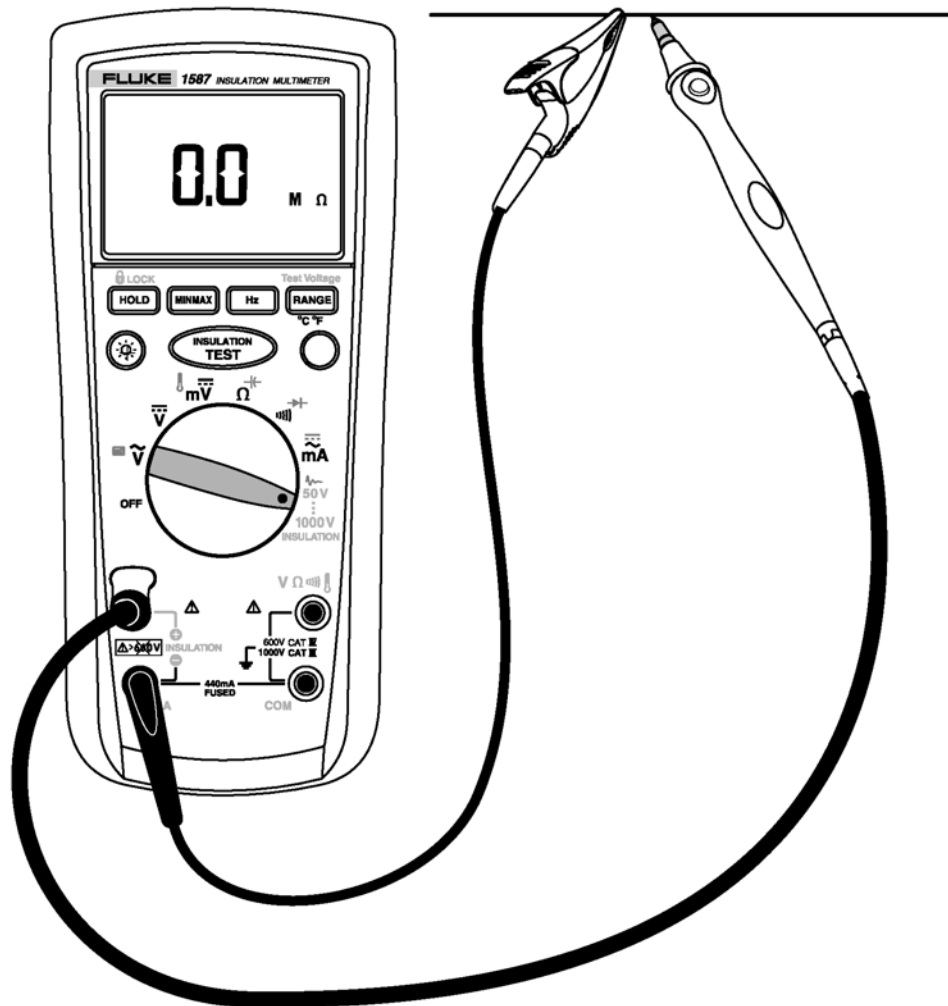


Fig. 48: Insulation Multimeter (0.0)
Courtesy of GENERAL MOTORS COMPANY

6. When performing insulation testing you need a good ground reference. When possible use an alligator clamp to attach the ground lead. Typically, the reference point will be to vehicle chassis except cable testing which requires connection to the cable shield termination at the connector and not to the chassis.
7. Verify your ground connection prior to every test measurement at a suitable ground location near your test point. The **EL-50772** should display 0.0 Ω, indicating continuity.
8. When testing components with large capacitance or inductance, such as certain modules and larger motor stators, it may be necessary to hold the test for a few seconds until the maximum resistance value is displayed.

RECHARGEABLE ENERGY STORAGE SYSTEM SMOKE TEST

Special Tools

- **EL-50812** Volt Battery Smoke Test Leak Adapters
- **EL-51753** Volt Battery Smoke Test Leak Adapters
- **GE 41413-A** Evaporative Emissions System Tester (EEST)

Equivalent regional tools: **Special Tools**

1. Remove Drive Motor Battery. Refer to **Drive Motor Battery Replacement and Shipping Preparation**

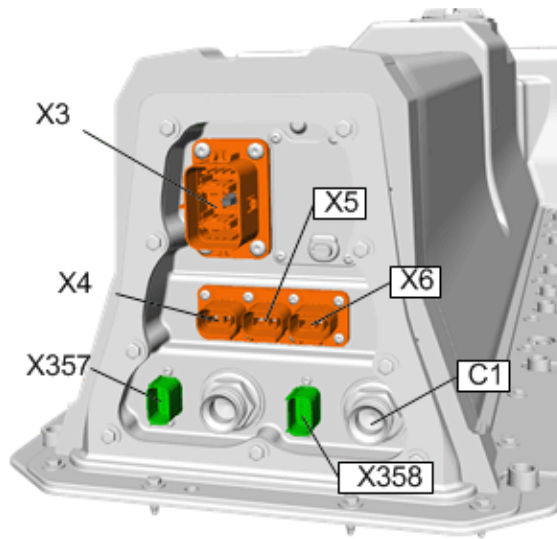


Fig. 49: A4 Hybrid/EV Battery Pack Connector Identification
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Adapters for connectors X4, X5 and X6 have to be positioned downward approximately 45 degrees, then pushed upward to lock in place.

2. Install the **EL-51753** Drive Motor Battery smoke test leak adapters to the following Drive Motor Battery Connectors:
 - X3
 - X4
 - X5
3. Install the **EL-50812** Drive Motor Battery smoke test leak adapters to the following Drive Motor Battery Connectors:
 - X357
 - X358
4. Cap or apply duct tape to coolant connector (C1).
5. Reinstall the S15 manual service disconnect lever.

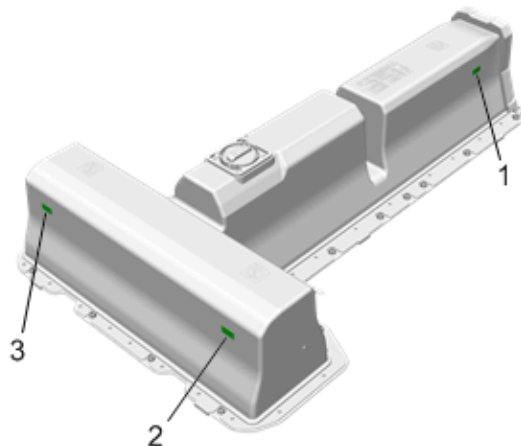


Fig. 50: Gore Patches

Courtesy of GENERAL MOTORS COMPANY

NOTE: Duct tape is not recommended because of damage to the Gore patches when removing.

6. Cover all gore patches (1, 2 and 3) with tape.
7. Create a pencil size hole through the duct tape and vent patch (2) to allow a full soak of the smoke into the Drive Motor Battery.

NOTE: It is not recommended to use the tester in an outside repair bay area because wind and sunlight may affect temperature and your ability to see the smoke.

8. Turn OFF any fans that may cause air movement around or near the Drive Motor Battery.

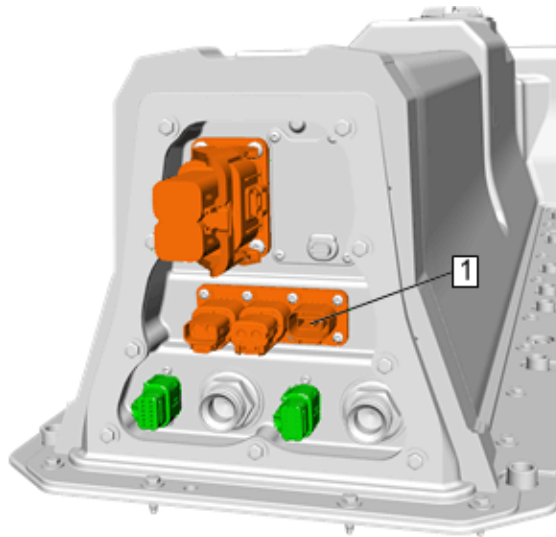


Fig. 51: Connector

Courtesy of GENERAL MOTORS COMPANY

9. Install the GE 41413-A Evaporative Emissions System Tester (EEST) to connector (1).

NOTE: Completely unwind the smoke hose from the bracket for optimal tester performance.

10. Turn the nitrogen/smoke valve on the control panel to smoke.

NOTE: The remote switch operates in a push ON, push OFF fashion.

11. Press and release the remote switch to activate the tester and inject smoke into the Drive Motor Battery.

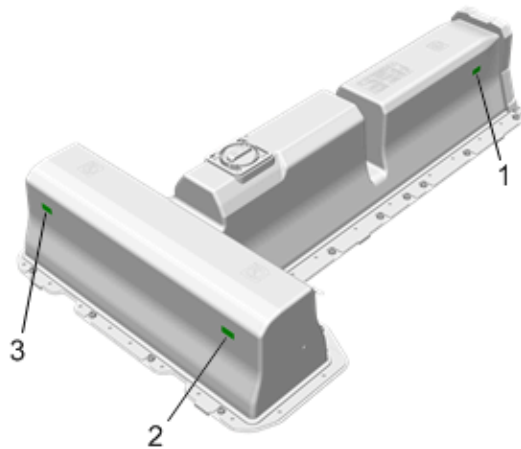


Fig. 52: Gore Patches

Courtesy of GENERAL MOTORS COMPANY

12. Soak/Fill the RESS with smoke for FIVE MINUTES until smoke is observed from the hole in vent (2).
13. Once smoke is observed from the hole, press and release the remote switch to deactivate the tester to relieve the pressure within the Drive Motor Battery.
14. Seal the hole in vent (2) with masking tape.

NOTE: For optimal visual smoke performance, deactivate the smoke flow and allow the system pressure to drop. Allowing the smoke to exit through small holes at a low flow rate greatly enhances visibility.

15. Introduce smoke into the Drive Motor Battery for THREE MINUTES. Using a high-intensity white light, look for any visible smoke emitting anywhere from the Drive Motor Battery.
16. Press and release the remote switch to deactivate the tester.
17. Repair any visible leaks by retightening the fasteners or by resealing any areas.
18. Retest the Drive Motor Battery, to ensure repair has been completed.
19. Remove the masking tape from the gore patches (1 and 3).
20. Remove the masking tape from rear vent (2).
21. Open the nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to Nitrogen.
22. Press and release the remote switch to activate the tester and inject nitrogen into the Drive Motor Battery for FIVE MINUTES, verify no smoke is coming from the vent.
23. Remove all old vents from the Drive Motor Battery.
24. Install NEW Gore patches (P/N 20791600), replacing the old vents.
25. Disconnect the tester and remove the adapters from the Drive Motor Battery.
26. Remove the S15 manual service disconnect lever.
27. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#).

REPAIR INSTRUCTIONS

HIGH VOLTAGE SYSTEM INSPECTION

Circuit/System Description

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

The Inspection Process

The high voltage system and Hybrid/EV battery pack inspection process consists of two levels of inspection:

1. Component Initial Inspection
2. High Voltage Operation Inspection

Results of the inspection processes may result in:

- Hybrid/EV Battery Depower
- Repair, or replacement and recycling of the Hybrid/EV Battery
- Replacement of high voltage components

Vehicle Collision Detection/High Voltage Lockout

The supplemental inflatable restraint system supplements the protection offered by the seat belts. The supplemental inflatable restraint sensing and diagnostic module determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. The hybrid/EV powertrain control module 2 will open the high voltage contactor relays, placing the vehicle in a high voltage lockout state and disabling the vehicle whenever a crash event of sufficient intensity has been detected.

The supplemental inflatable restraint module transmits through serial data to the hybrid/EV powertrain control module 2 both the crash event status and whenever a sensor fault is detected.

NOTE: The Crash Event Detected/Air Bag Deployed high voltage lockout state will remain active until cleared by the Clear Secured High Voltage DTCs procedure.

A complete inspection of the high voltage system must be performed if the vehicle has been involved in a collision.

High Voltage Battery Moisture Exposure

The Lithium Ion hybrid/EV battery pack should be depowered whenever internal components have been exposed to moisture, whether due to vehicle flood, coolant leakage within the hybrid/EV battery pack assembly, etc.

Reference Information

Schematic Reference

- [Hybrid/EV Energy Storage Schematics](#)
- [Hybrid/EV Controls Schematics](#)
- [Plug-In Charging Schematics](#)

Description and Operation

Drive Motor Battery System Description

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50332** EV/HEV Battery Service Tool
- **J-35616-35** Test Probes

Equivalent regional tools: Special Tools.

Component Initial Inspection

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or

death.

1. Disconnect the 12V battery.
2. Wear personal protection equipment - high voltage gloves, safety glasses or face shield, and remove the S15 Manual Service Disconnect. If vehicle damage does not allow for access to the S15 Manual Service Disconnect, remove the damaged portion of the vehicle until such time as the S15 Manual Service Disconnect can be removed. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#).
3. Inspect the Hybrid/EV battery pack for evidence of exposure to fire, either directly or in close proximity.

- **If exposure to fire is evident**

1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
3. Continue with inspection.

- **If not exposed to fire**

4. Inspect the Hybrid/EV battery pack enclosure for damage including foreign object intrusion.

- **If damage is evident**

1. Depowering of the Hybrid/EV battery pack and/or damaged module section is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
3. Continue with inspection.

- **If not damaged**

5. Inspect the vehicle for exposure to water at a level higher than the vehicle rocker panel.

- **If the vehicle was exposed to flood**

1. Remove the battery drain plug, capture and discard any drained fluid.
2. Lift the vehicle rear slightly to assist in fluid extraction.

- **If fluid is present**

1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.

3. Continue with inspection.

- If fluid was not present

Install a new drain plug and continue with inspection.

- **If the vehicle was not flooded**

6. Inspect the battery coolant system for proper level.

- **If battery coolant level is low**

1. Verify if the low coolant is the result of system damage external of the A4 Hybrid/EV battery pack.

- If the cooling system external of the A4 Hybrid/EV Battery Pack is not damaged and/or leaking

1. Remove the battery drain plug, capture and discard any drained fluid.

2. Lift the vehicle rear slightly to assist in fluid extraction.

- If fluid is present

3. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

4. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.

5. Continue with inspection.

- If fluid is not present

6. Install a new drain plug and continue with inspection.

- If the cooling system external of the A4 Hybrid/EV Battery Pack is damaged and/or leaking

2. Continue with inspection.

- **If the battery coolant system is at the proper level**

NOTE: **Post-crash 50 foot vehicle isolation is no longer required if the Hybrid/EV battery pack did not exhibit damage assessed in the steps above.**

7. Inspect each high voltage component listed below for visible damage. Record the results on the High Voltage Component Inspection Table below.

- G1 Electric A/C Compressor
- K1 14V Power Module
- K10 Coolant Heater
- T6 Power Inverter Module
- T18 Battery Charger
- Transmission case
- X98 Hybrid/EV Battery Charger Receptacle
- All High voltage orange cables
- **If any high voltage component inspection failed and Hybrid/EV battery Depower is recommended**

Disconnect the damaged components from the high voltage bus before attempting in-vehicle depowering of the Hybrid/EV battery pack. In extreme cases depowering may need to occur by connecting directly within the Hybrid/EV battery pack with the cover removed. See Battery Depower below.

- **If any high voltage component inspection failed and Hybrid/EV battery Depower is NOT recommended**
- 1. Perform the [High Voltage Disabling](#) procedure and replace the damaged components before attempting to operate the vehicle
- 2. Once you have confirmed or repaired all high voltage component visual integrity, perform High Voltage Operation Inspection below.
- **If all high voltage component inspection passed**

Perform High Voltage Operation Inspection below.

High Voltage Component Inspection Table

High Voltage Component	Inspection (passed/failed)
G1 Electric A/C Compressor	Â
K1 14V Power Module	Â
K10 Coolant Heater	Â
T6 Power Inverter Module	Â
T18 Battery Charger	Â
Transmission case	Â
X98 Hybrid/EV Battery Charger Receptacle	Â
All High voltage orange cables	Â

High Voltage Operation Inspection

NOTE: The vehicle must have a functioning 12V system and serial data communications to continue.

1. Verify you have successfully passed the Component Initial Inspection.
 - **If the Component Initial Inspection has failed or not been performed**
DO NOT CONTINUE. Restart the Inspection procedure.
 - **If the Component Initial Inspection has passed**
2. Verify the S15 Manual Service Disconnect is installed.
 - **If the S15 Manual Service Disconnect is not installed**
 1. Wear personal protection equipment - high voltage gloves, safety glasses or face shield.
 2. Install the S15 Manual Service Disconnect. Refer to [Drive Motor Battery High Voltage Manual Disconnect Lever Replacement](#).
 3. Proceed to step 3.
 - **If the S15 Manual Service Disconnect is installed**
3. Connect the 12V battery.
4. Vehicle in Service Mode. With a scan tool select the Hybrid/EV powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
 - **If either parameter displays YES**
The high voltage contactors may be prevented from closing. The vehicle will not start. Perform the Clear Secured High Voltage DTCs procedure and proceed to the next step.
 - **If BOTH parameters indicate NO**

5. Vehicle ON. With a scan tool check for the following HV system DTCs: Contactor DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE1, P0AE3, P0D0A, P0D09, P1EBD, P1EC0, P1EC3, Isolation DTCs P0AA6, P1AE6, P1AF0, or P1AF2, Precharge DTCs P0C76, P0C78 or P3061.

- **If any DTCs are set**

Repair these DTCs first. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

6. Verify collision repairs are necessary.

- **If collision repairs are not necessary**

High Voltage System Inspection passed.

- **If collision repairs are necessary**

7. Verify High Voltage Disabling is necessary prior to carrying out the collision repairs.

- **If High Voltage Disabling is necessary**

Perform the [High Voltage Disabling](#) before carrying out the collision repairs.

- **If High Voltage Disabling is not necessary**

8. High Voltage System Inspection passed.

Battery Depower

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Store the vehicle with hybrid/EV battery pack installed or the hybrid/EV battery pack assembly outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture until the hybrid/EV battery pack has been discharged. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL® listed, or equivalent, insulation tape rated at a minimum of 600 V. Contact the GM Technical Assistance Center for discharge instructions prior to storage and shipping of the hybrid/EV battery pack.

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: Depowering of the battery:

- Will NOT reduce battery voltage to a safe level. The battery will contain high voltage after depower procedure is complete.
- Reduces the state of charge to the lowest level thus reducing the likelihood of a battery fire.
- Requires special tool EL-50332 battery service tool.
- Allows for future recovery of the battery after an internal battery inspection and/or repair is completed.

NOTE: Depowering is not required if TOTAL hybrid/EV battery pack voltage is 285 volts or less as monitored by either:

- hybrid/EV powertrain control module 2 scan tool Hybrid/EV Battery Pack Voltage parameter

OR

- A DMM directly at the battery sections

Depowering can occur with the Hybrid/EV battery pack in or out of the vehicle. You can configure the **EL-50332** high voltage connections to the Hybrid/EV battery pack at any of the following locations:

- High Voltage power inverter module connection under hood with **EL-50332-255 ***
- High Voltage 12V Power Module connection in rear cargo area with **EL-50332-265 ***
- High Voltage connection at Hybrid/EV Battery Pack with **EL-50332-260 ***
- Directly at battery section terminals with **EL-50332-170**

*Also requires connection to the contactor relay control circuits with **EL-50332-115** and **EL-50332-270** and two **J-35616-35** test probes.

In-Vehicle or Hybrid/EV Battery Pack Cover Installed Depower Instructions

NOTE:

- The **EL-50332** will close the Hybrid/EV battery pack contactors. You must verify the vehicles high voltage system integrity prior to enabling high voltage. Disconnect visually damaged high voltage components/cables from the high voltage system before attempting in-vehicle depowering.
- You must be able to connect to the hybrid/EV powertrain control module 2 vehicle harness connectors or the hybrid/EV battery pack low voltage connectors.
- Wear your Personal Protective Equipment for the duration of the battery depower event.

1. Ensure the integrity of the vehicles high voltage system.
2. Connect to the Hybrid/EV battery pack contactor control circuits with one of the two methods below:

Method 1: Connecting at Hybrid/EV Powertrain Control Module 2 Connectors

NOTE:

In this configuration the **EL-50332** will supply 12V+ power to the battery energy control module via the vehicle wiring and under hood fuse relay center. Because the **EL-50332** has limited 12V+ capacity it will be necessary to jumper the circuits such that only the battery energy control module is supplied with 12V+ power.

1. Connect the **EL-50332** to the contactor control circuits at the hybrid/EV powertrain control module 2 connectors with the **EL-50332-270** interface module and **50332-115** harness.
2. Remove the hybrid/EV powertrain control module 2 fuse F10 and the battery energy control module fuse F12 from the underhood electrical center.

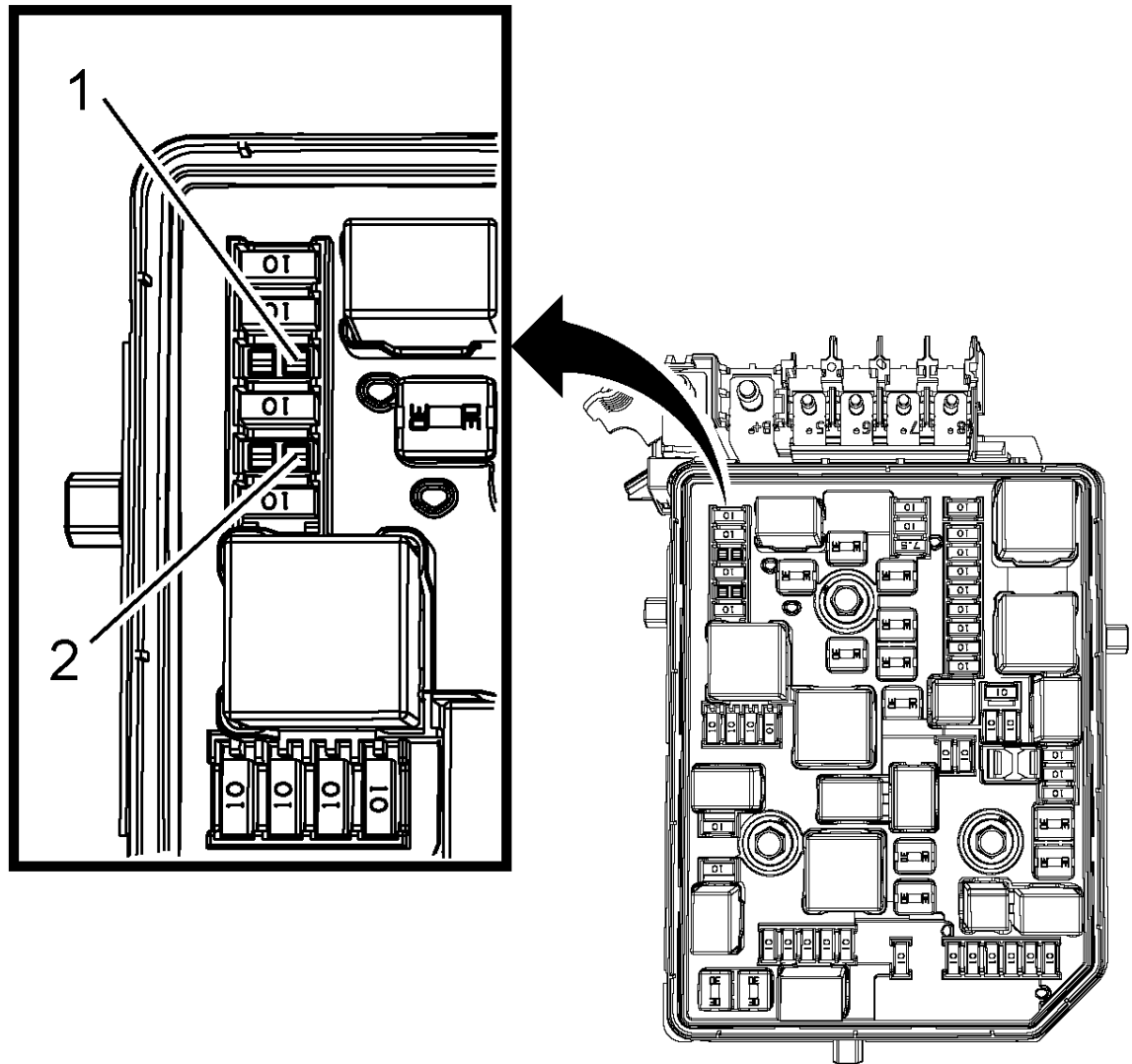


Fig. 53: Fuse Load Circuits

Courtesy of GENERAL MOTORS COMPANY

3. Jumper the fuse load circuits together (1, 2) using two **J-35616-35** test probes and a 10A maximum fused jumper.

Method 2: Connecting at Hybrid/EV Battery Pack Connectors

1. Connect the **EL-50332** to the contactor control circuits at the hybrid/EV battery pack low voltage connectors with the **EL-50332-270** interface module and **50332-115** harness.
3. Connect the **EL-50332** to the applicable high voltage connector.
4. Install the manual service disconnect lever.
5. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.

6. Remove the manual service disconnect lever.

NOTE: Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).

7. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
8. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
9. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

Hybrid/EV Battery Pack Removed Depower Instructions

1. Connect the **EL-50332-260** harness to the applicable battery section terminals. If depowering all battery sections install the manual service disconnect lever.
2. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: **Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.**

3. Remove the manual service disconnect lever.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

4. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
5. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
6. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

DRIVE MOTOR BATTERY HIGH VOLTAGE MANUAL DISCONNECT LEVER REPLACEMENT

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Removal Procedure

1. Remove Front Floor Console Compartment Divider. Refer to [Front Floor Console Compartment Divider Replacement](#)

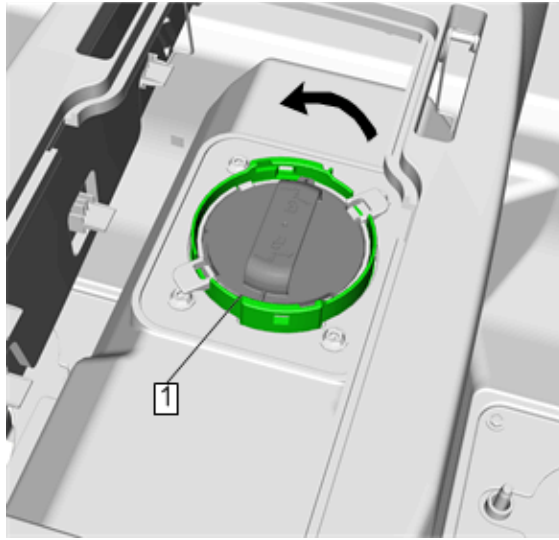


Fig. 54: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

2. Rotate Drive Motor Battery High Voltage Manual Disconnect Lever (1) Left

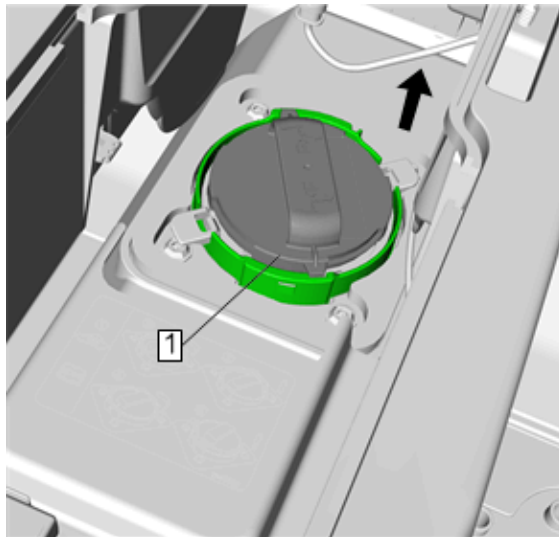


Fig. 55: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

3. Lift Drive Motor Battery High Voltage Manual Disconnect Lever (1) Upwards

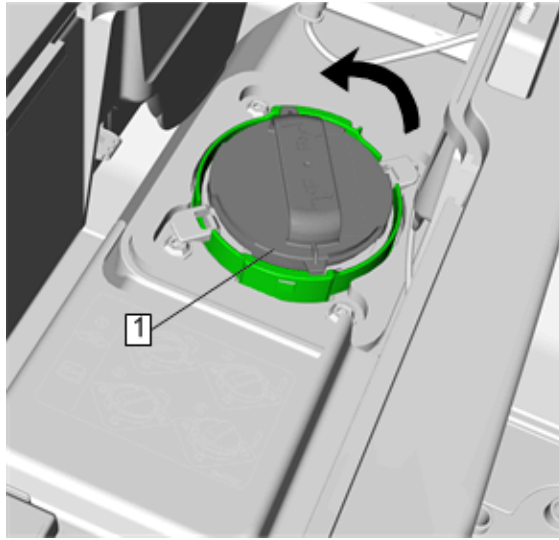


Fig. 56: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

4. Rotate Drive Motor Battery High Voltage Manual Disconnect Lever (1) Left

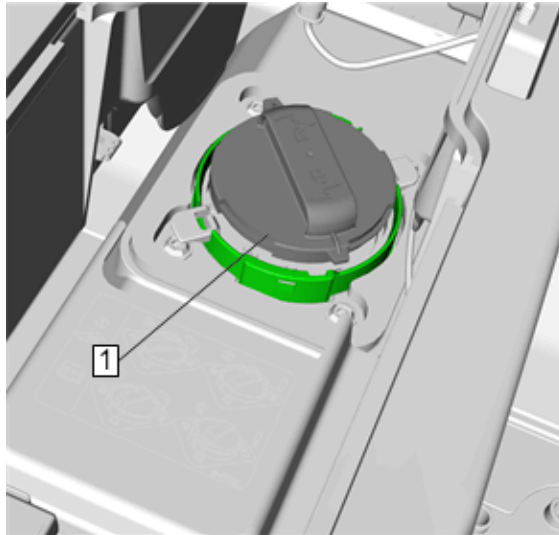


Fig. 57: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

5. Remove Drive Motor Battery High Voltage Manual Disconnect Lever (1)

Installation Procedure

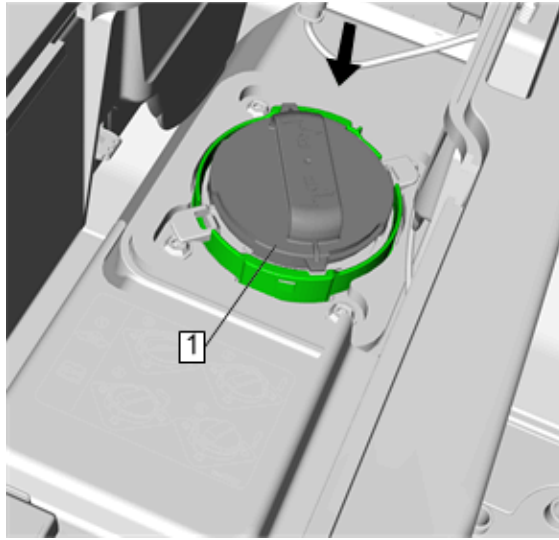


Fig. 58: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery High Voltage Manual Disconnect Lever (1)

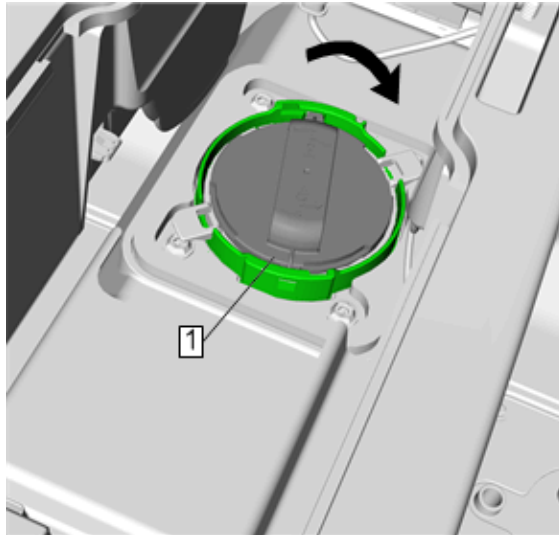


Fig. 59: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

2. Rotate Drive Motor Battery High Voltage Manual Disconnect Lever (1) Right

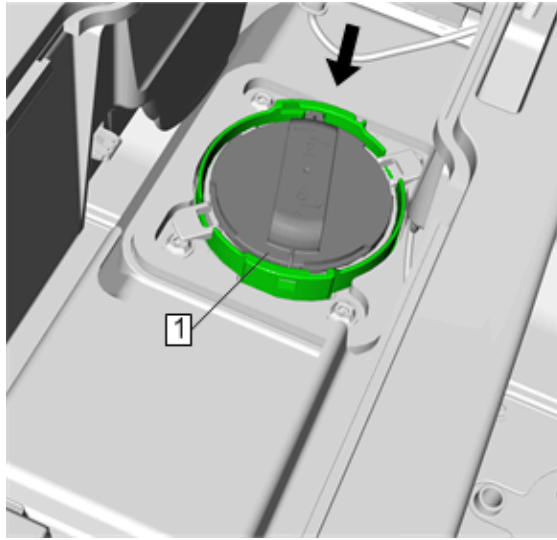


Fig. 60: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

3. Push Drive Motor Battery High Voltage Manual Disconnect Lever (1) Downwards

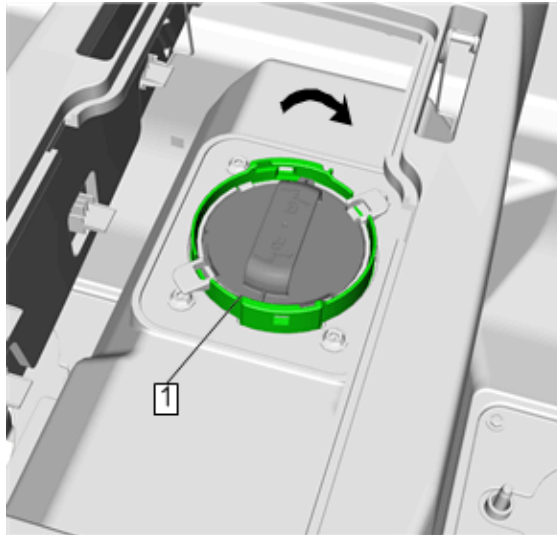


Fig. 61: Drive Motor High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

4. Rotate Drive Motor Battery High Voltage Manual Disconnect Lever (1) Right
5. Pull up on the handle to ensure the lever is in the locked position.
6. Install Front Floor Console Compartment Divider. Refer to [Front Floor Console Compartment Divider Replacement](#)

HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT CONNECTOR REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle,

either indoors or outdoors

- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

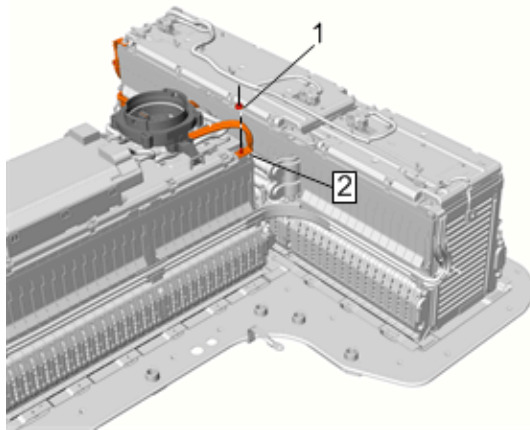


Fig. 62: High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

2. Remove High Voltage Battery Positive Cable Fastener (1)
3. Remove High Voltage Battery Positive Cable (2)

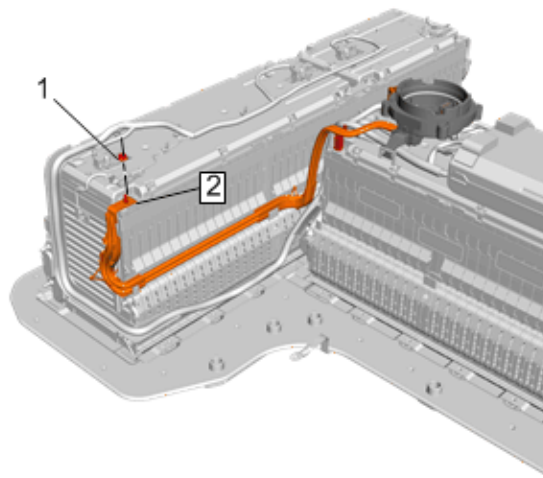


Fig. 63: High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Remove High Voltage Battery Positive Cable Fastener (1)
5. Remove High Voltage Battery Positive Cable (2)

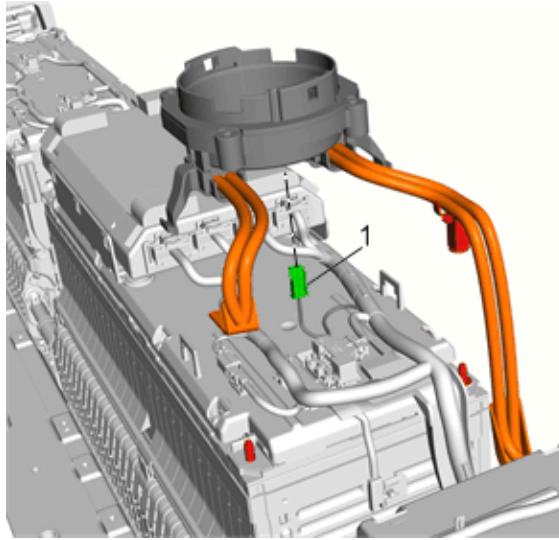


Fig. 64: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Electrical Connector (1)

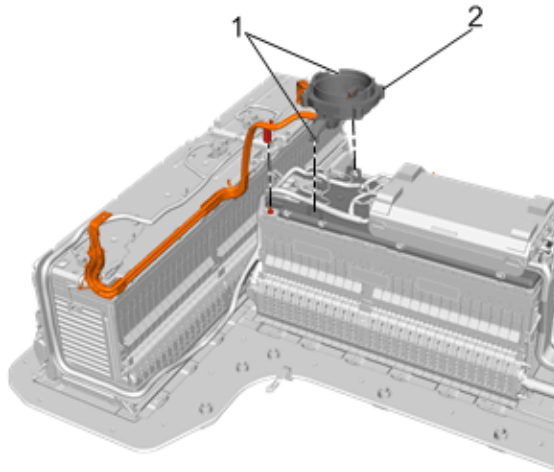


Fig. 65: High Voltage Battery High Voltage Manual Disconnect Connector And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Retaining Tabs (1) (Qty: 2)
8. Remove High Voltage Battery High Voltage Manual Disconnect Connector (2)

Installation Procedure

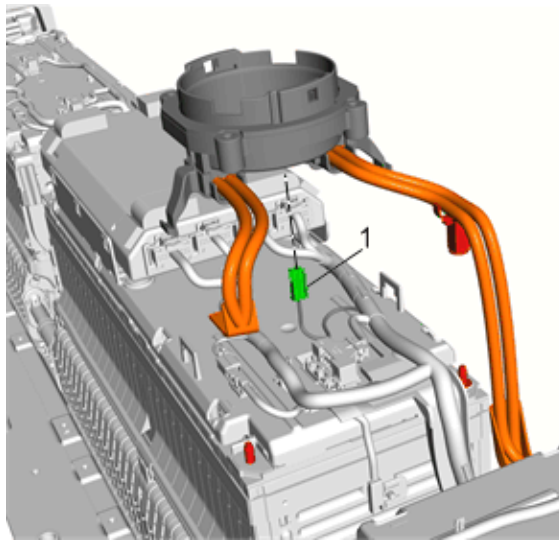


Fig. 66: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

1. Connect Electrical Connector (1)

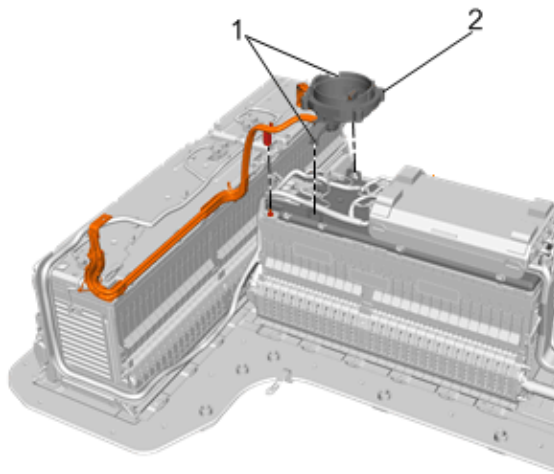


Fig. 67: High Voltage Battery High Voltage Manual Disconnect Connector And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

2. Install High Voltage Battery High Voltage Manual Disconnect Connector (2)

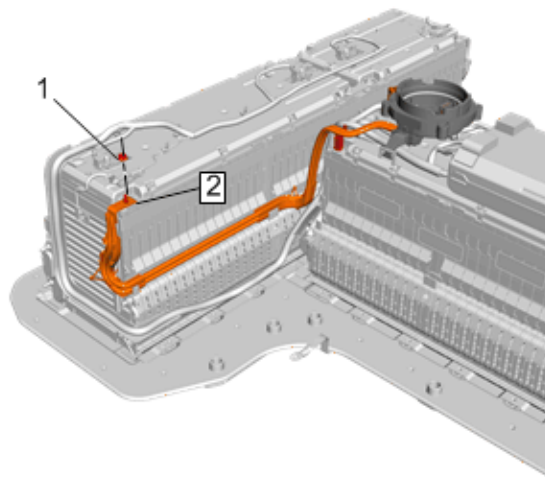


Fig. 68: High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Install High Voltage Battery Positive Cable (2)

CAUTION: Refer to [Fastener Caution](#) .

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

4. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

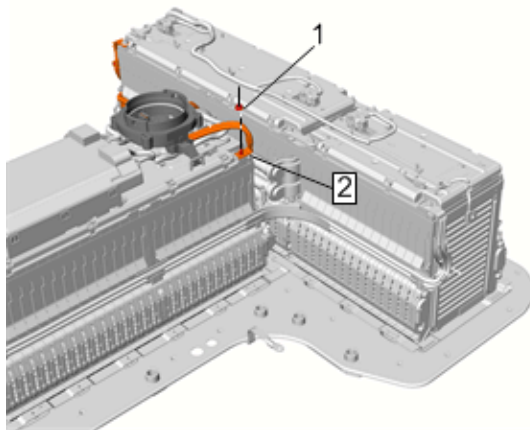


Fig. 69: High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

- 6.

7. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)
8. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
9. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#) - Install

HIGH VOLTAGE BATTERY COVER REPLACEMENT

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

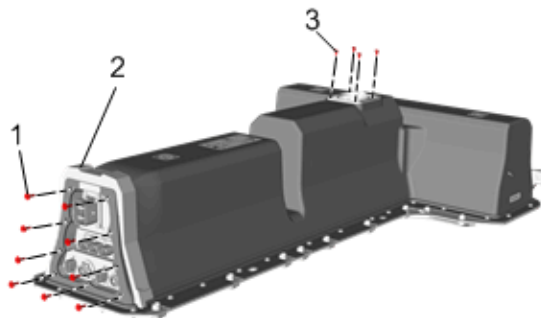


Fig. 70: High Voltage Battery High Voltage Manual Disconnect Connector Fasteners And High Voltage

Battery Cover Fasteners

Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD High Voltage Battery High Voltage Manual Disconnect Connector Fasteners (3) (Qty: 4). Remove and DISCARD the fasteners.
4. Remove High Voltage Battery Cover Fasteners (1) (Qty: 9)

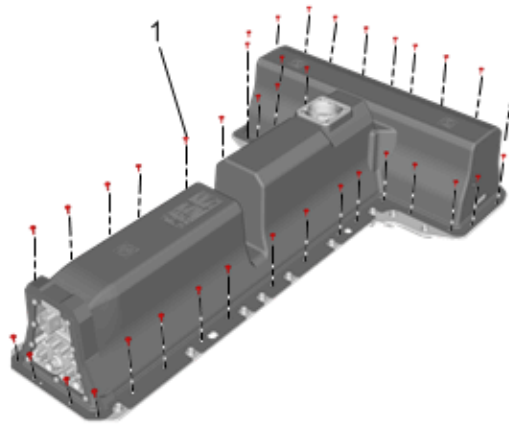


Fig. 71: High Voltage Battery Cover Fasteners

Courtesy of GENERAL MOTORS COMPANY

5. Remove High Voltage Battery Cover Fasteners (1) (Qty: 38)

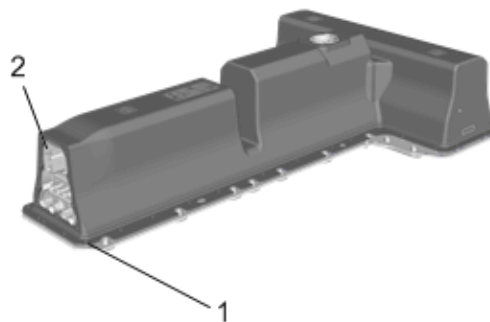


Fig. 72: High Voltage Battery Cover And Drive Motor Battery Wire Junction Block Relay

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use insulated tools when servicing components beneath the drive motor generator cover.

NOTE: Prying cover off with tools can crack the cover.

6. Carefully lift the corner of the high voltage battery cover (1), where it contacts the drive motor battery wire junction block relay (2) and gently lift the front cover up.

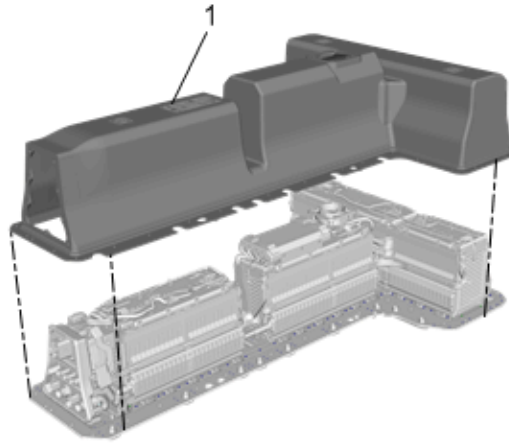


Fig. 73: High Voltage Battery Cover
Courtesy of GENERAL MOTORS COMPANY

7. Remove High Voltage Battery Cover (1)

Installation Procedure

1. Perform the Hybrid/EV Battery System verification. Refer to [Hybrid/EV Battery System Verification](#)

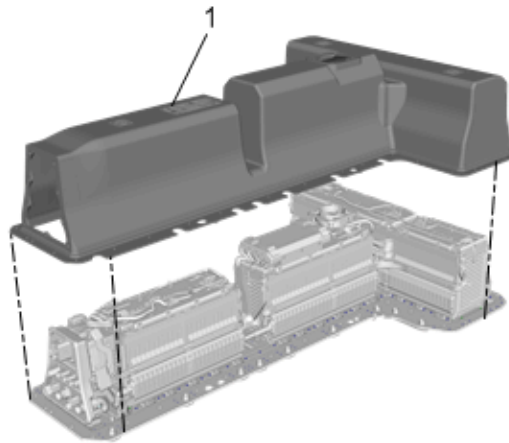


Fig. 74: High Voltage Battery Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Inspect the cover for cracks.**

2. Install the high voltage battery cover (1) by aligning the manual service disconnect (MSD) housing with the high voltage cover opening and gently push the front of the cover down against the drive motor battery wire junction block relay.

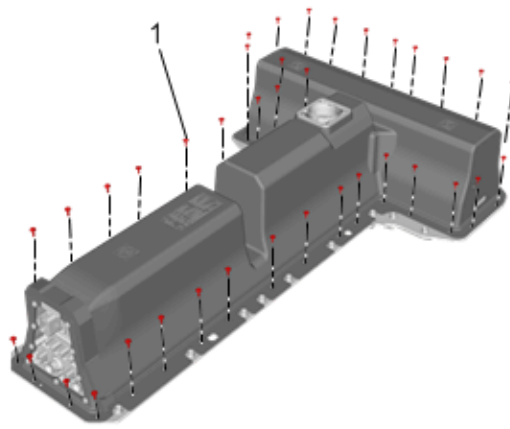


Fig. 75: High Voltage Battery Cover Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Loosely install High Voltage Battery Cover Fasteners (1) (Qty: 38)

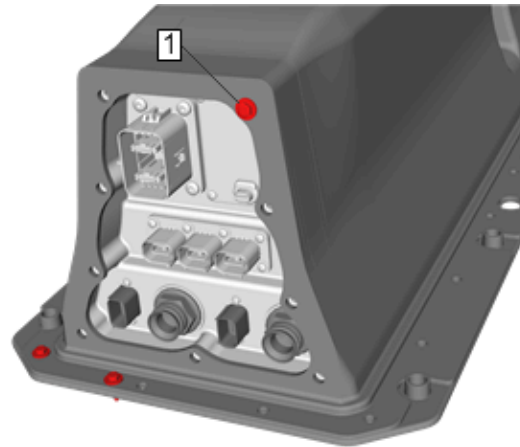


Fig. 76: High Voltage Battery Cover Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Loosely install High Voltage Battery Cover Fastener (1)

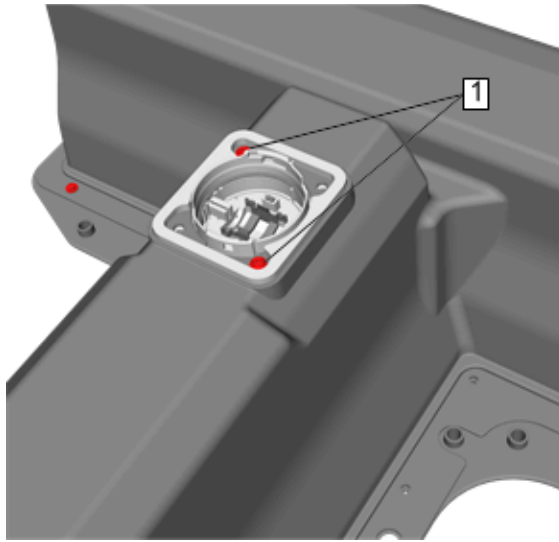


Fig. 77: New Fasteners

Courtesy of GENERAL MOTORS COMPANY

5. Loosely install NEW fasteners. (1)

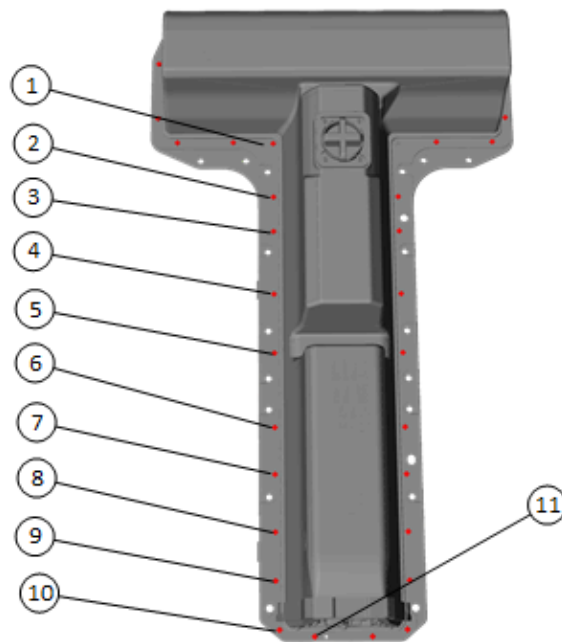


Fig. 78: High Voltage Battery Cover Fastener Tightening Sequence (1 Of 3)

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

6. Tighten High Voltage Battery Cover Fasteners in sequence to 9 N.m (80 lb in)

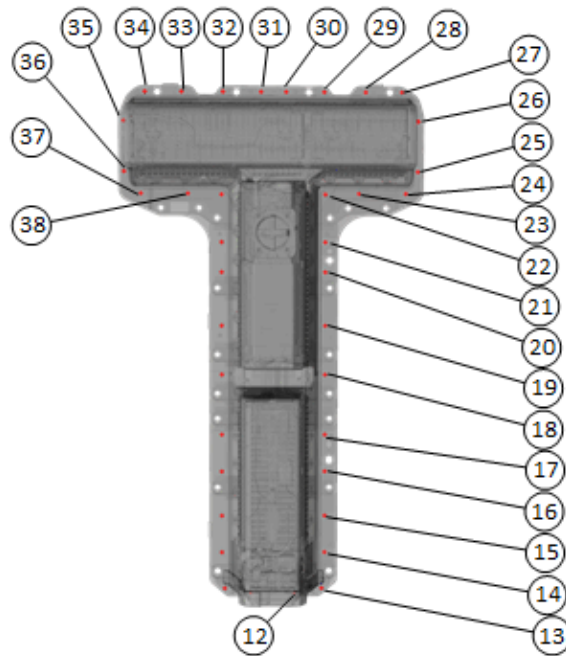


Fig. 79: High Voltage Battery Cover Fastener Tightening Sequence (2 Of 3)
 Courtesy of GENERAL MOTORS COMPANY

7. Tighten High Voltage Battery Cover Fasteners in sequence to 9 N.m (80 lb in)

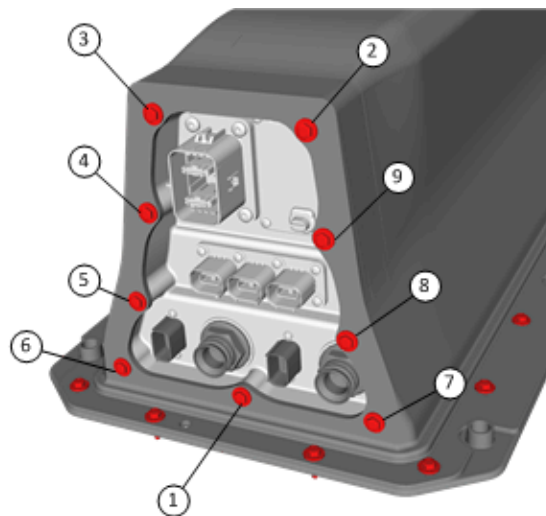


Fig. 80: High Voltage Battery Cover Fastener Tightening Sequence (3 Of 3)
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean all high voltage cover fasteners (1) and apply a medium strength thread-locker to the threads.

8. Tighten High Voltage Battery Cover Fasteners in sequence to 9 N.m (80 lb in)

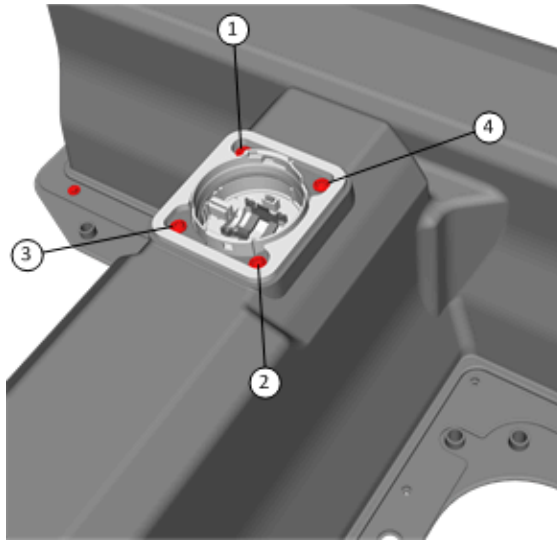


Fig. 81: High Voltage Battery High Voltage Manual Disconnect Connector Fastener Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

9. Tighten NEW fasteners in sequence to 9 N.m (80 lb in)
10. Perform a smoke test on the rechargeable energy storage system. Refer to [Rechargeable Energy Storage System Smoke Test](#)
11. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
12. Enable the high voltage system. Refer to [High Voltage Enabling](#)

HIGH VOLTAGE BATTERY TRAY REPLACEMENT

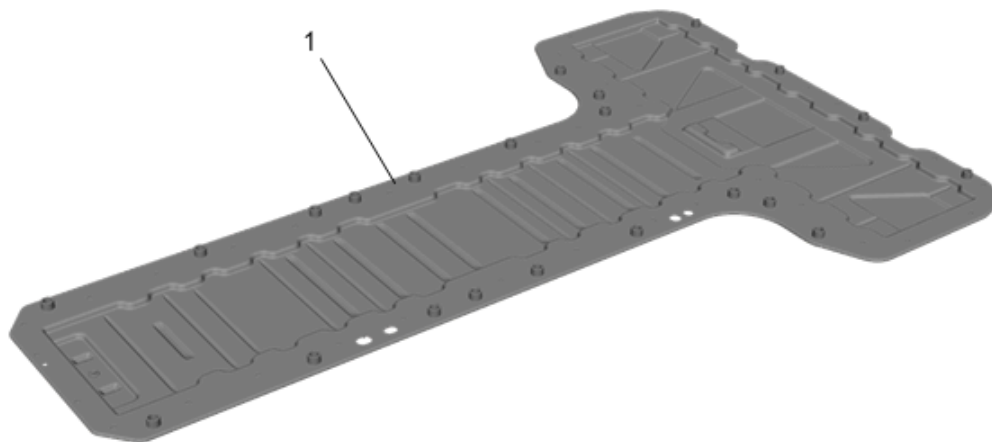


Fig. 82: High Voltage Battery Tray

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove High Voltage Battery Disconnect Relay. Refer to High Voltage Battery Disconnect Relay Replacement 2. Remove High Voltage Section Battery. Refer to High Voltage Section Battery Replacement (Battery Section 1)High Voltage Section Battery Replacement (Battery Section 2)High Voltage Section Battery Replacement (Battery Section 3) 3. Remove Battery Tray Front Brace. Refer to Battery Tray Front Brace Replacement	
1	Battery Tray

HIGH VOLTAGE BATTERY TRAY SPACER REPLACEMENT

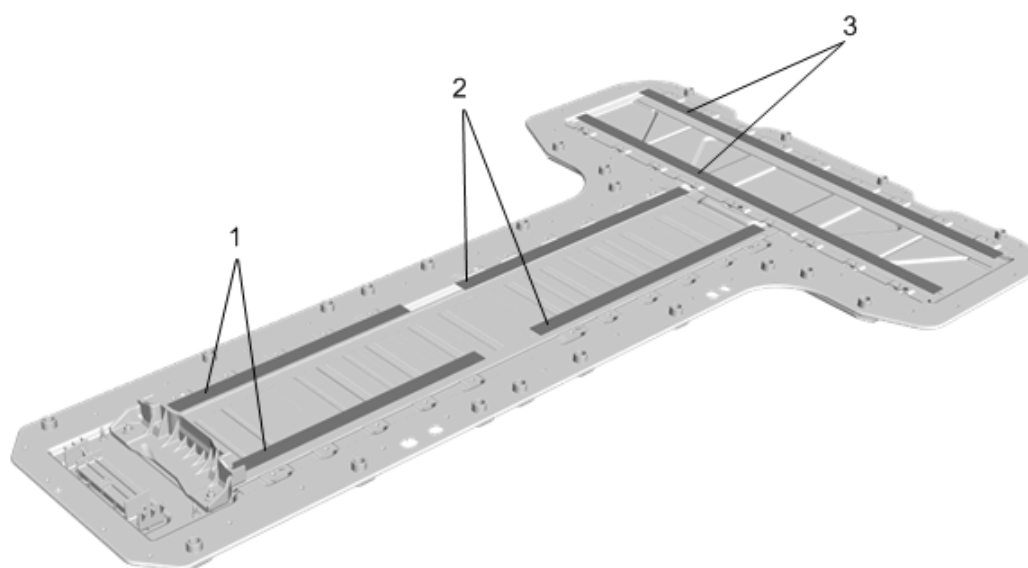


Fig. 83: High Voltage Battery Tray Spacer
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement 2. Remove High Voltage Section Battery. Refer to High Voltage Section Battery Replacement (Battery Section 1)High Voltage Section Battery Replacement (Battery Section 2)High Voltage Section Battery Replacement (Battery Section 3)	
1	High Voltage Battery Tray Spacer - Battery Section 1
2	High Voltage Battery Tray Spacer - Battery Section 2
3	High Voltage Battery Tray Spacer - Battery Section 3

BATTERY COVER SEAL REPLACEMENT

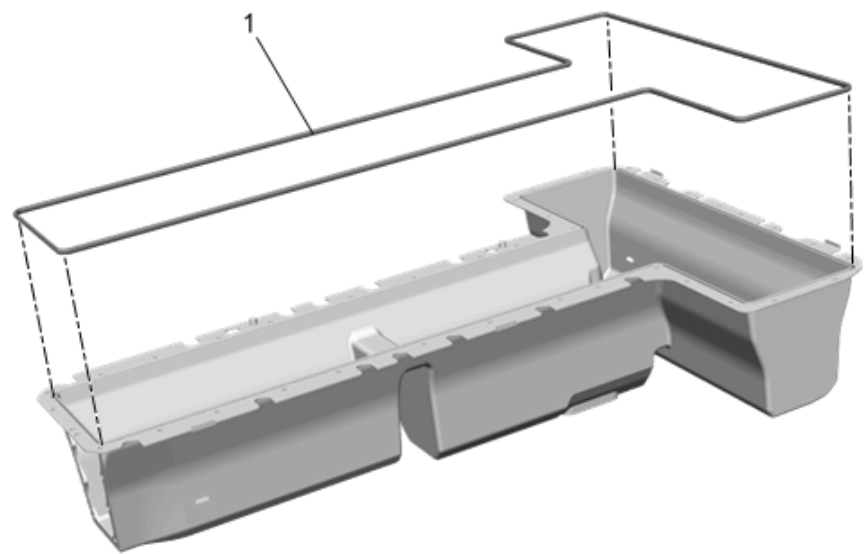


Fig. 84: Battery Cover Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors	

Callout	Component Name
• Visually and functionally inspect the gloves before use. • Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. Preliminary Procedures 1. Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement 2. Clean the sealing surface using acetone, toluene or methyl ethyl ketone.	
1	Drive Motor Battery Seal

BATTERY ENERGY CONTROL MODULE REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

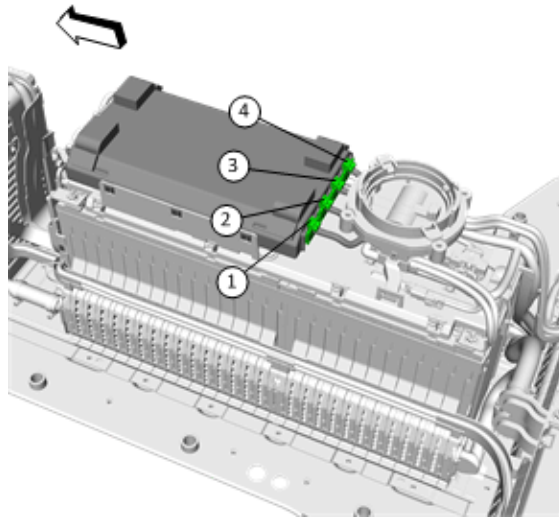


Fig. 85: Battery Energy Control Module Connector Disconnect Sequence (1 Of 2)

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

2. Disconnect the battery energy control module connectors in the sequence shown above.

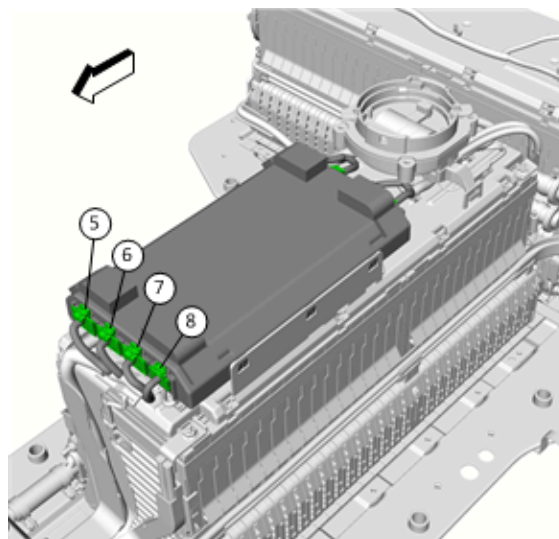


Fig. 86: Battery Energy Control Module Connector Disconnect Sequence (2 Of 2)

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the battery energy control module connectors in the sequence shown above.

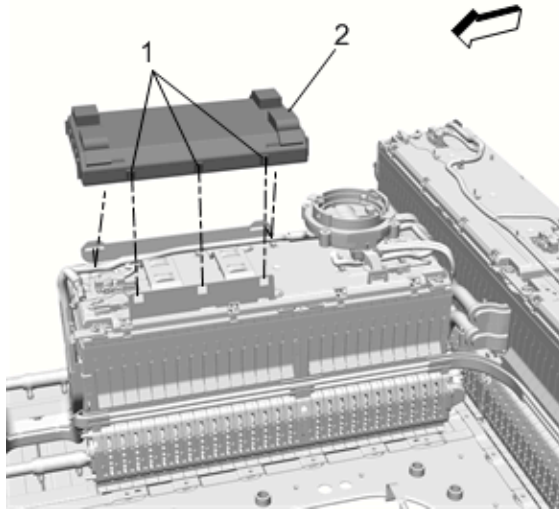


Fig. 87: Battery Energy Control Module And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Retaining Tabs (1) (Qty: 3)
5. Remove Battery Energy Control Module (2)

Installation Procedure

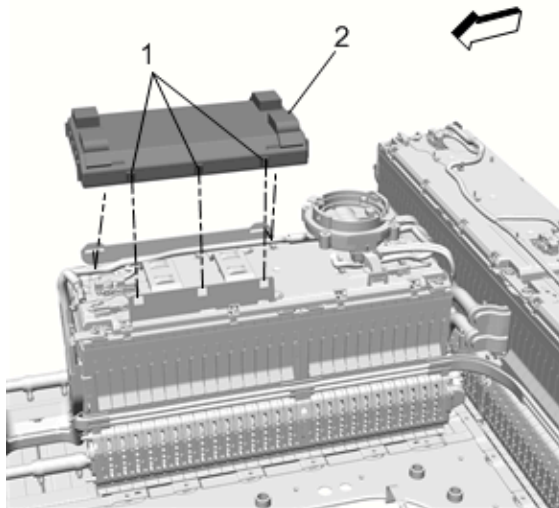


Fig. 88: Battery Energy Control Module And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Energy Control Module (2)

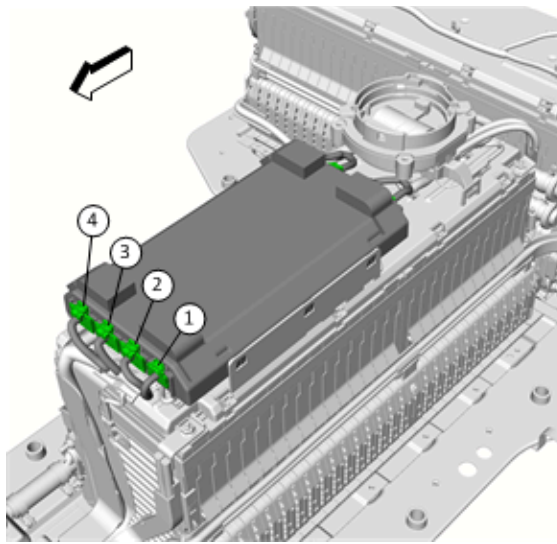


Fig. 89: Battery Energy Control Module Connector Reconnection Sequence (1 Of 2)
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

2. Connect the battery energy control module connectors in the sequence shown above.

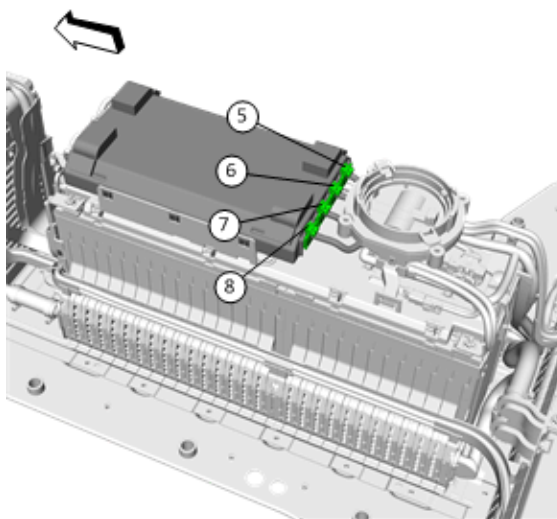


Fig. 90: Battery Energy Control Module Connector Reconnection Sequence (2 Of 2)
 Courtesy of GENERAL MOTORS COMPANY

3. Connect the battery energy control module connectors in the sequence shown above.

4. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
5. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

NOTE: Service replacement module requires programming.

6. Program the battery energy control module. Refer to [Control Module References](#)

HIGH VOLTAGE BATTERY POSITIVE CABLE REPLACEMENT (BATTERY SECTION 1 TO BATTERY SECTION 2)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

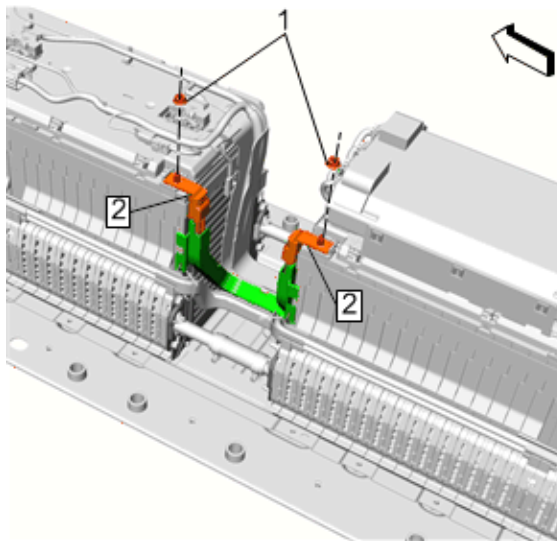


Fig. 91: High Voltage Battery Positive Cable And Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove High Voltage Battery Positive Cable Fasteners (1) (Qty: 2)
3. Remove High Voltage Battery Positive Cable (2) (Qty: 2)

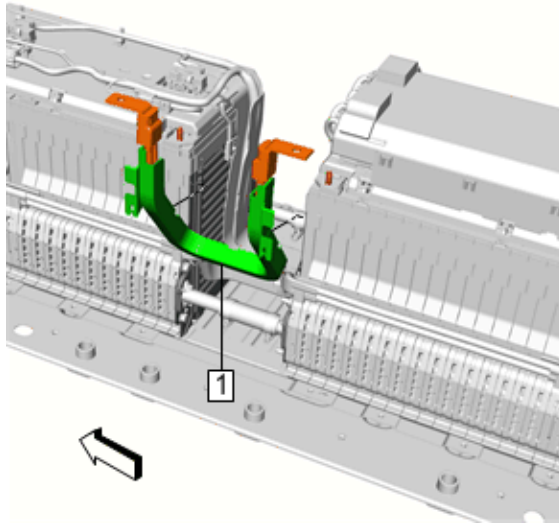


Fig. 92: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove High Voltage Battery Positive Cable (1)

Installation Procedure

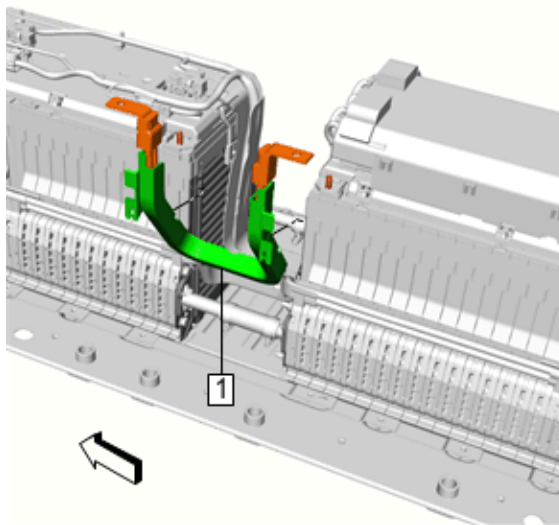


Fig. 93: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Positive Cable (1)

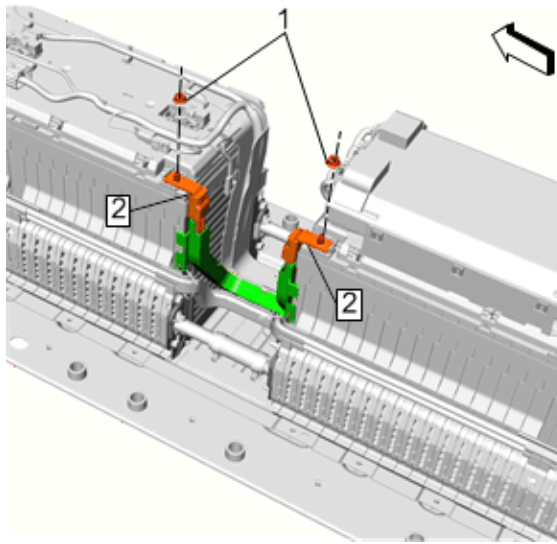


Fig. 94: High Voltage Battery Positive Cable And Fasteners

Courtesy of GENERAL MOTORS COMPANY

2. Install High Voltage Battery Positive Cable (2) (Qty: 2)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

3. Install and tighten High Voltage Battery Positive Cable Fasteners (1) (Qty: 2) to 9 N.m (80 lb in)
4. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
5. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

HIGH VOLTAGE BATTERY POSITIVE CABLE REPLACEMENT (GENERATOR BATTERY DISCONNECTOR RELAY TO BATTERY SECTION 3)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

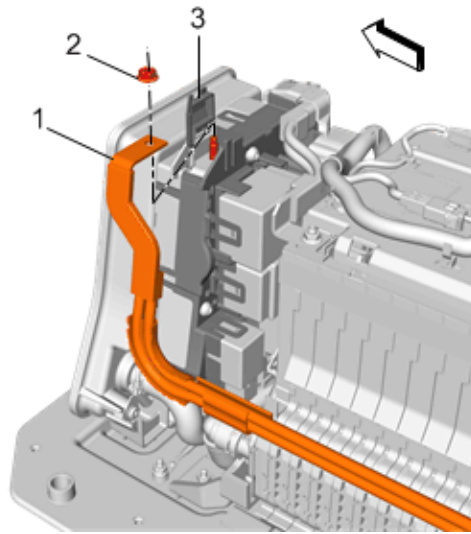


Fig. 95: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

2. Open Terminal Cover (3)
3. Remove High Voltage Battery Positive Cable Fastener (2)
4. Remove High Voltage Battery Positive Cable (1)

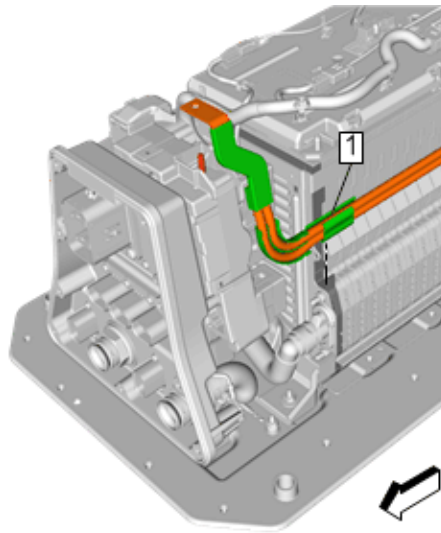


Fig. 96: Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Retainer (1)

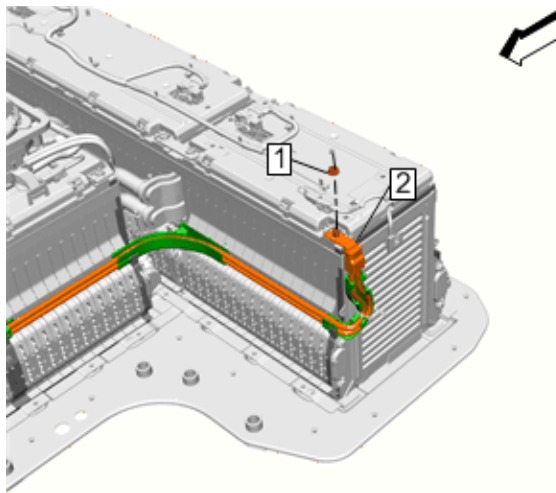


Fig. 97: High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Remove High Voltage Battery Positive Cable Fastener (1)
7. Remove High Voltage Battery Positive Cable (2)

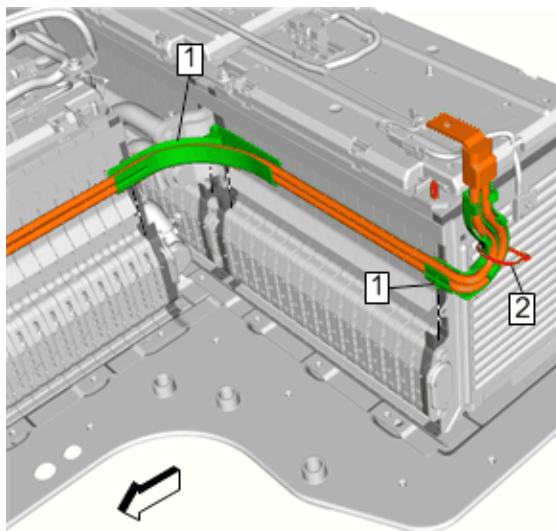


Fig. 98: Retainers And Cable Tie
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Retainers (1) (Qty: 2)
9. Remove Cable Tie (2)

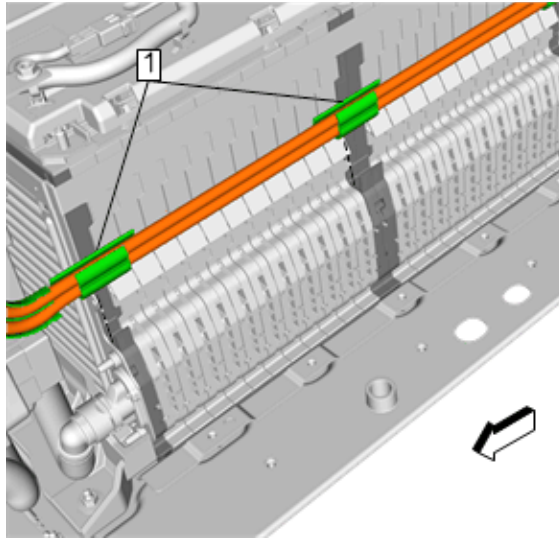


Fig. 99: Retainers

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Retainers (1) (Qty: 2)

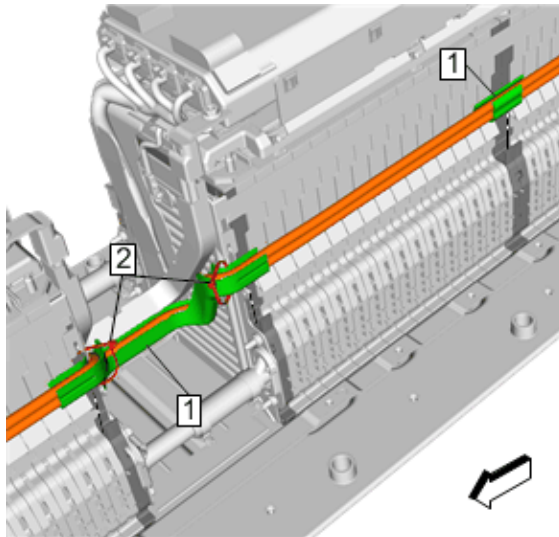


Fig. 100: Retainers And Cable Ties

Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Retainers (1) (Qty: 2)

12. Remove Cable Ties (2) (Qty: 2)

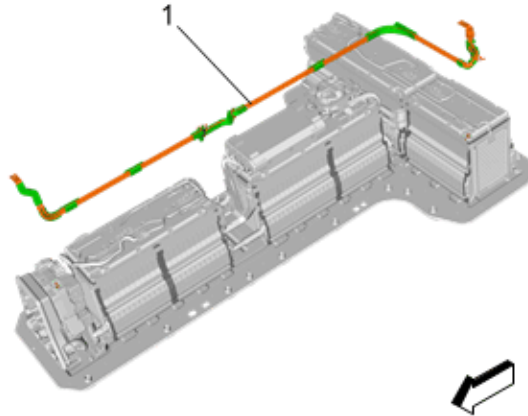


Fig. 101: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

13. Remove High Voltage Battery Positive Cable (1)

Installation Procedure

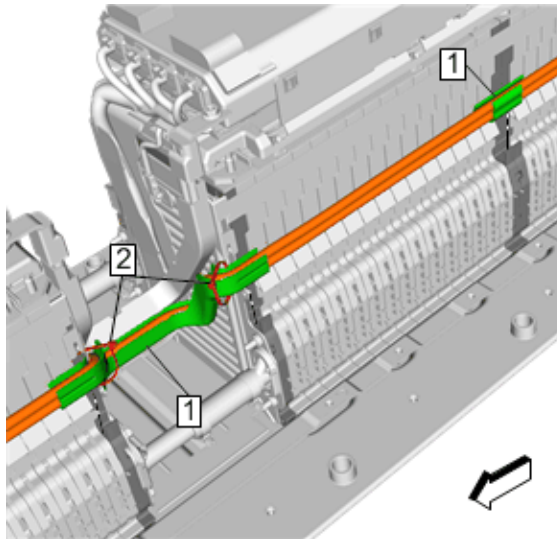


Fig. 102: Retainers And Cable Ties
Courtesy of GENERAL MOTORS COMPANY

1. Install Retainers (1) (Qty: 2)
2. Install Cable Ties (2) (Qty: 2)

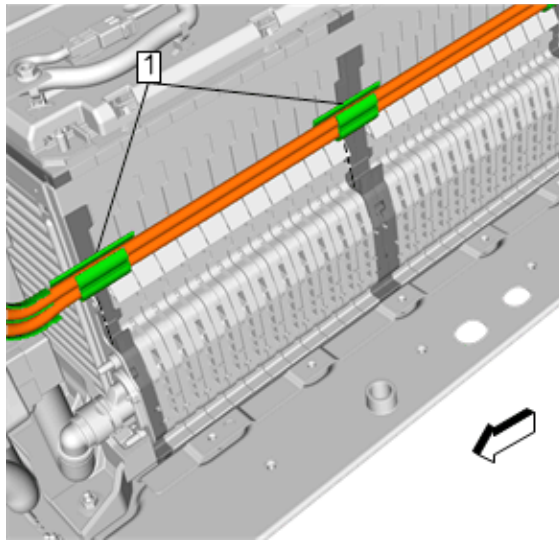


Fig. 103: Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Install Retainers (1) (Qty: 2)

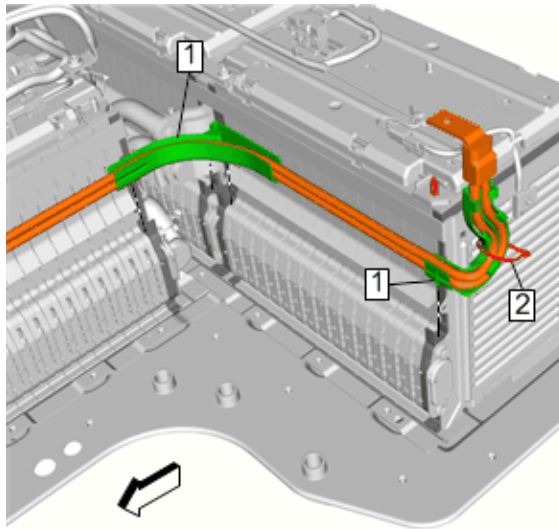


Fig. 104: Retainers And Cable Tie

Courtesy of GENERAL MOTORS COMPANY

4. Install Retainers (1) (Qty: 2)
5. Install Cable Tie (2)

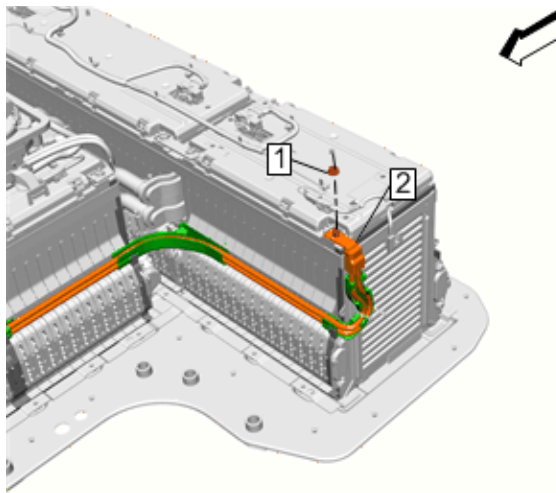


Fig. 105: High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery Positive Cable (2)

CAUTION: Refer to Fastener Caution

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

7. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

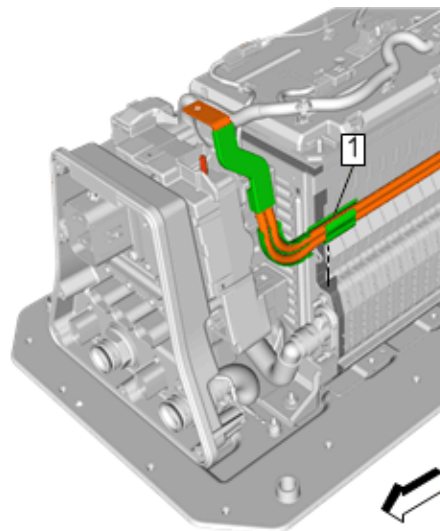


Fig. 106: Retainer
 Courtesy of GENERAL MOTORS COMPANY

8. Install Retainer (1)

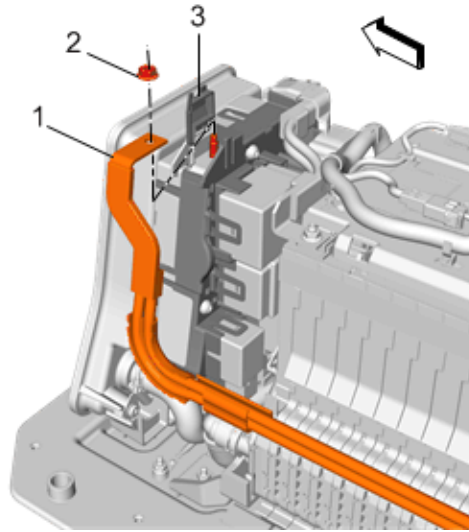


Fig. 107: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

9. Install High Voltage Battery Positive Cable (1)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

10. Install and tighten High Voltage Battery Positive Cable Fastener (2) to 9 N.m (80 lb in)
11. Close Terminal Cover (3)
12. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
13. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

HIGH VOLTAGE BATTERY POSITIVE CABLE REPLACEMENT (GENERATOR BATTERY DISCONNECTOR RELAY TO BATTERY SECTION 1)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

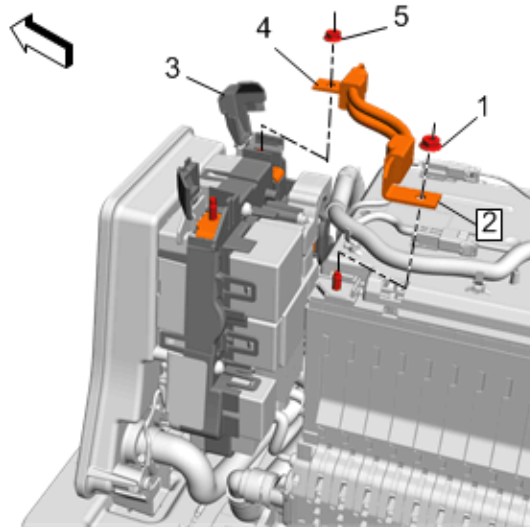


Fig. 108: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
 Courtesy of GENERAL MOTORS COMPANY

2. Remove High Voltage Battery Positive Cable Fastener (1)
3. Remove High Voltage Battery Positive Cable (2)
4. Open Terminal Cover (3)
5. Remove High Voltage Battery Positive Cable Fastener (5)
6. Remove High Voltage Battery Positive Cable (4)

Installation Procedure

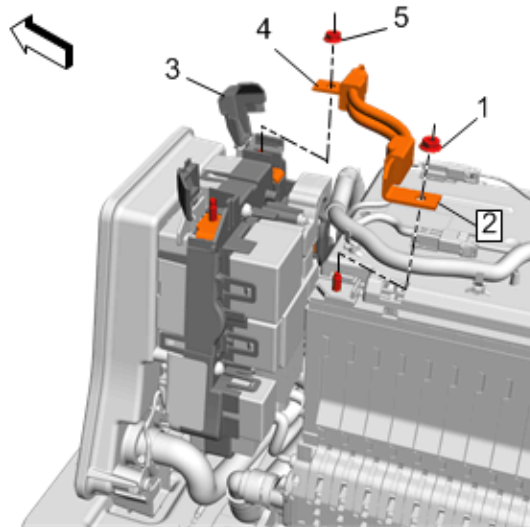


Fig. 109: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
 Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Positive Cable (2)

CAUTION: Refer to [Fastener Caution](#)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

2. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)
3. Install High Voltage Battery Positive Cable (4)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

4. Install and tighten High Voltage Battery Positive Cable Fastener (5) to 9 N.m (80 lb in)
5. Close Terminal Cover (3)
6. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
7. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

GENERATOR BATTERY CURRENT SENSOR REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
2. Remove High Voltage Battery Disconnect Relay. Refer to [High Voltage Battery Disconnect Relay Replacement](#)

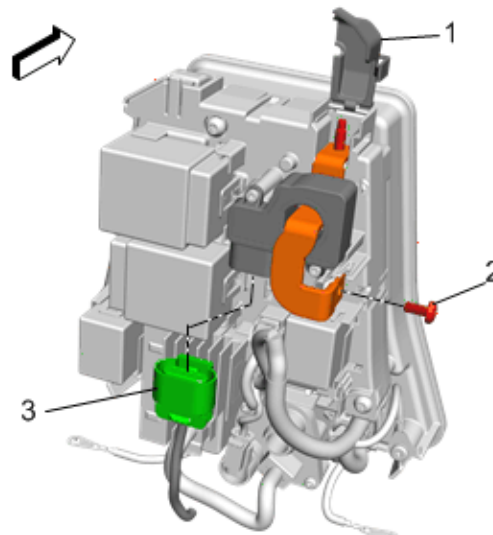


Fig. 110: Terminal Cover, Fastener And Battery Current Sensor Connector
Courtesy of GENERAL MOTORS COMPANY

3. Open Terminal Cover (1)
4. Remove Fastener (2)
5. Disconnect Battery Current Sensor Connector (3)

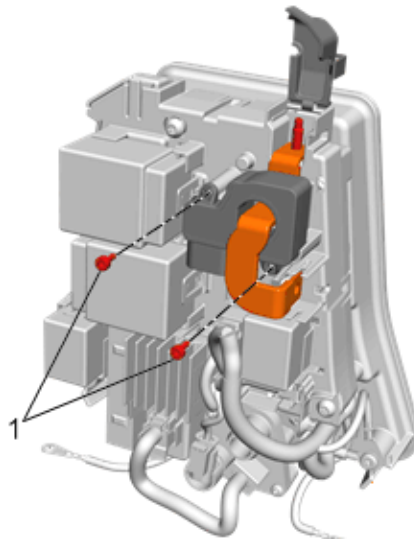


Fig. 111: Fasteners

Courtesy of GENERAL MOTORS COMPANY

6. Remove Fasteners (1) (Qty: 2)

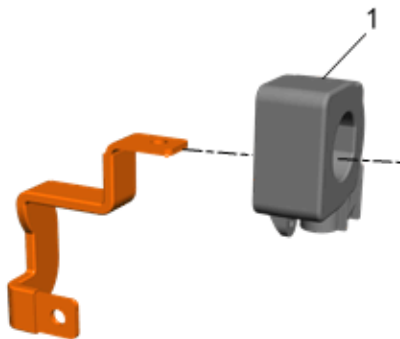


Fig. 112: Battery Current Sensor

Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Current Sensor (1)

Installation Procedure

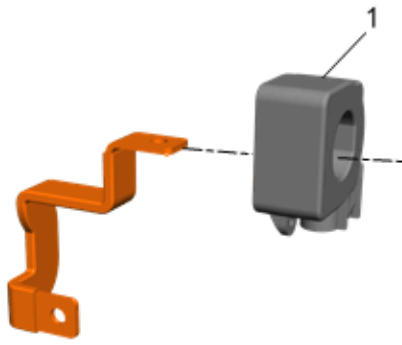


Fig. 113: Battery Current Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Current Sensor (1)

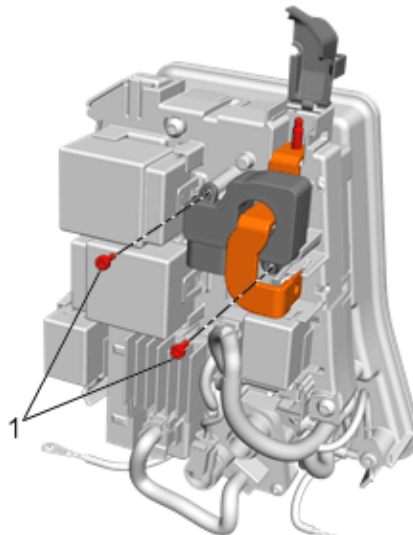


Fig. 114: Fasteners

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

2. Install and tighten Fasteners (1) (Qty: 2) to 9 N.m (80 lb in)

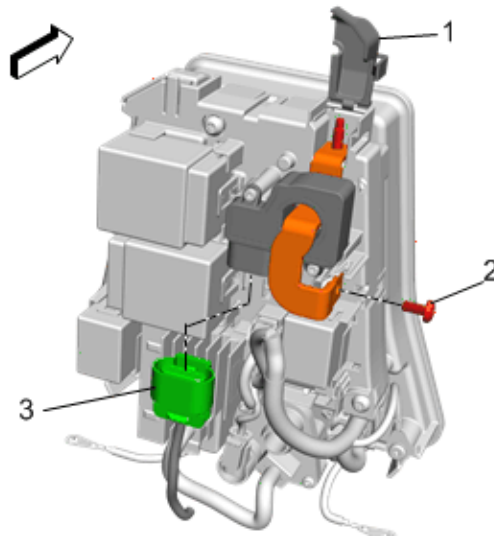


Fig. 115: Terminal Cover, Fastener And Battery Current Sensor Connector
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

3. Install and tighten Fastener (2) to 9 N.m (80 lb in)
4. Connect Battery Current Sensor Connector (3)
5. Close Terminal Cover (1)
6. Install High Voltage Battery Disconnect Relay. Refer to [High Voltage Battery Disconnect Relay Replacement](#)
7. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
8. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
9. Lower the vehicle.
10. Fill the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

GENERATOR BATTERY DISCONNECTOR RELAY REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#) - Remove

2. Drain the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

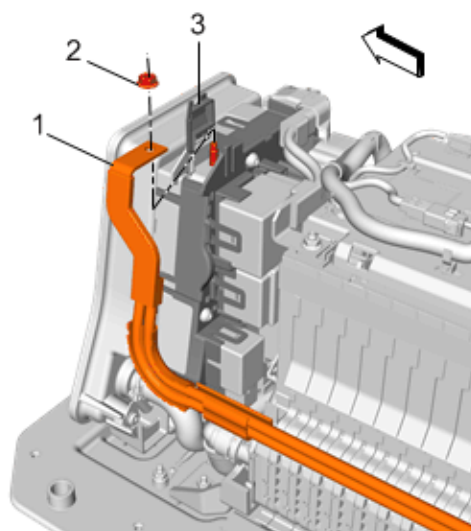


Fig. 116: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Open Terminal Cover (3)

4. Remove High Voltage Battery Positive Cable Fastener (2)

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

5. Remove High Voltage Battery Positive Cable (1)

NOTE: Cover exposed terminal with approved high voltage insulated tape.

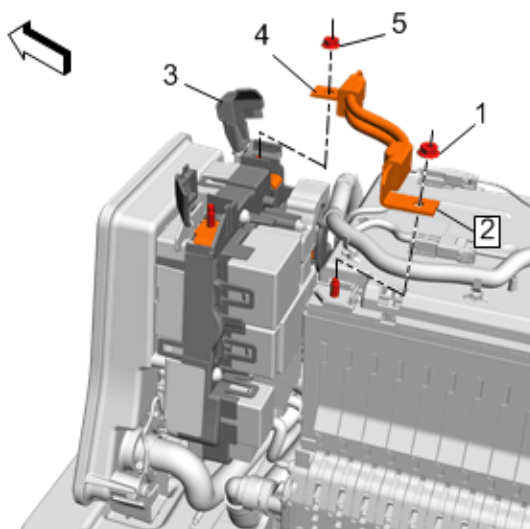


Fig. 117: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

6. Remove High Voltage Battery Positive Cable Fastener (1)

7. Remove High Voltage Battery Positive Cable (2)

8. Open Terminal Cover (3)
9. Remove High Voltage Battery Positive Cable Fastener (5)

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

10. Remove High Voltage Battery Positive Cable (4)

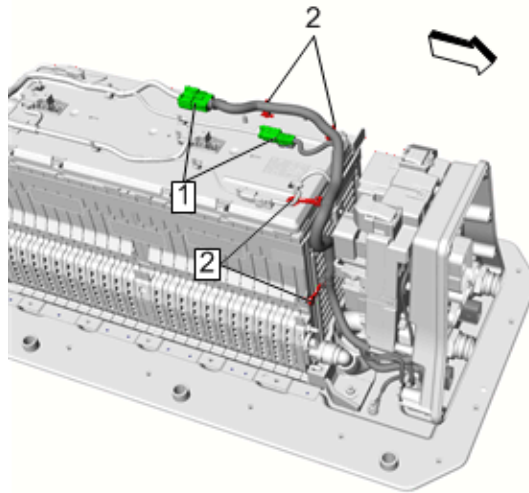


Fig. 118: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Electrical Connectors (1) (Qty: 2)
12. Release Retainers (2) (Qty: 4)

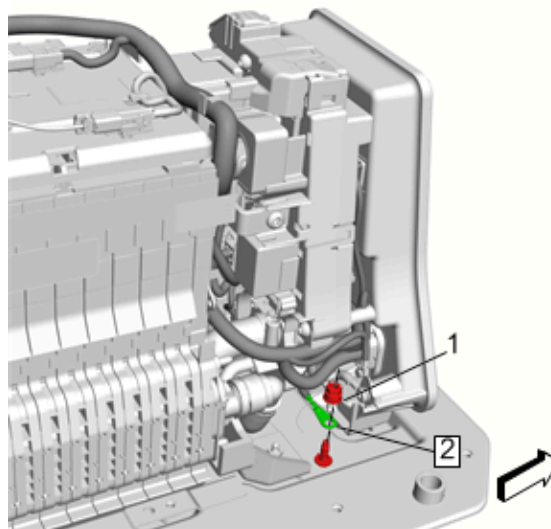


Fig. 119: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

13. Remove Ground Nut (1)
14. Remove Ground Cable (2)

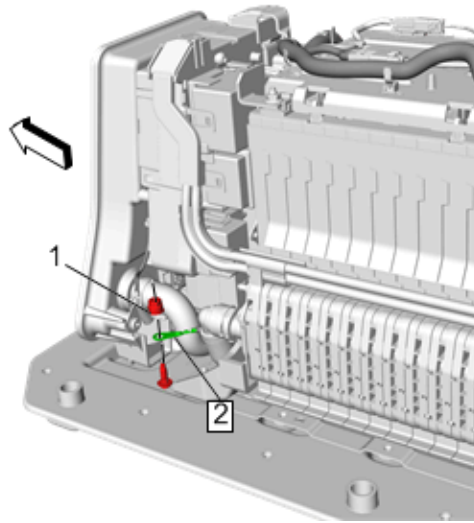


Fig. 120: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

15. Remove Ground Nut (1)
16. Remove Ground Cable (2)

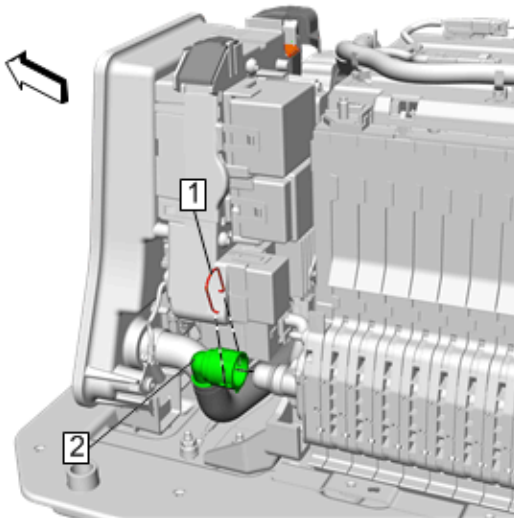


Fig. 121: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

17. Unclip the hose retainer. (1)
18. Remove High Voltage Battery Cooling Manifold Outlet Hose (2)

NOTE: **Coolant must be drained before removing hoses.**

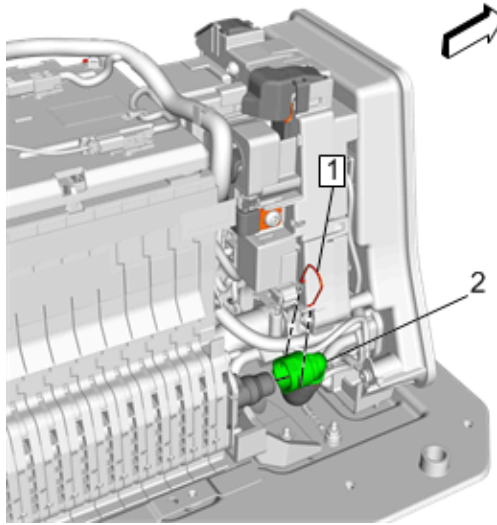


Fig. 122: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

19. Unclip the hose retainer. (1)
20. Remove High Voltage Battery Cooling Manifold Inlet Hose (2)

NOTE: Coolant must be drained before removing hoses.

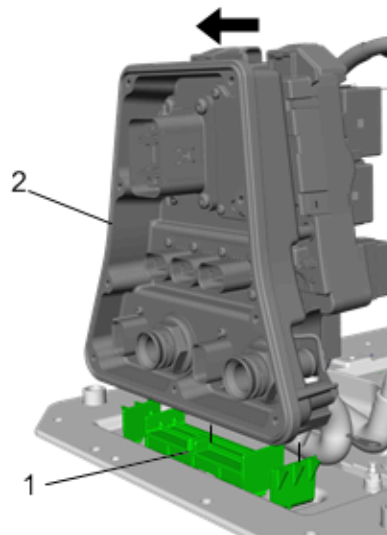


Fig. 123: High Voltage Battery Disconnect Relay And Battery Tray Front Brace
 Courtesy of GENERAL MOTORS COMPANY

21. Disengage High Voltage Battery Disconnect Relay (2) @ Battery Tray Front Brace (1)
22. Remove High Voltage Battery Disconnect Relay (2)
23. Transfer components as necessary.

Installation Procedure

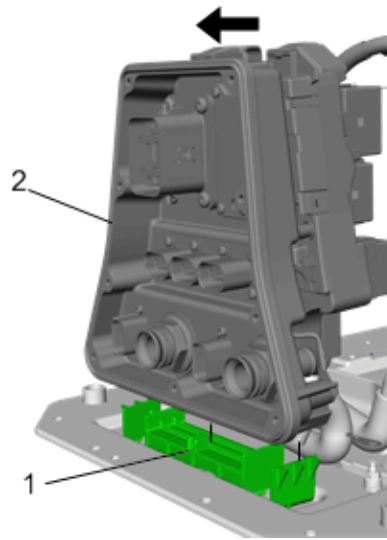


Fig. 124: High Voltage Battery Disconnect Relay And Battery Tray Front Brace
Courtesy of GENERAL MOTORS COMPANY

1. Engage High Voltage Battery Disconnect Relay (2) @ Battery Tray Front Brace (1)

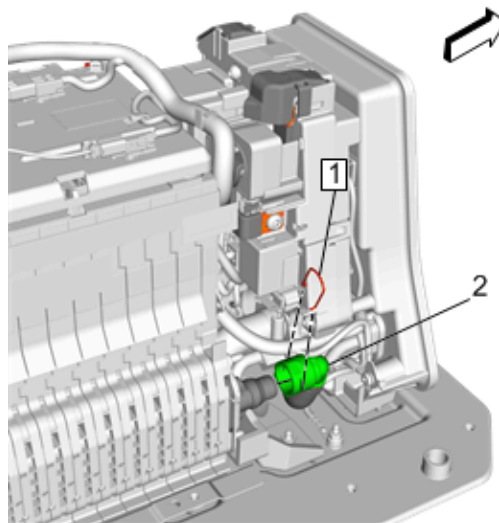


Fig. 125: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Install High Voltage Battery Cooling Manifold Inlet Hose (2)
3. Install the retainer. (1)

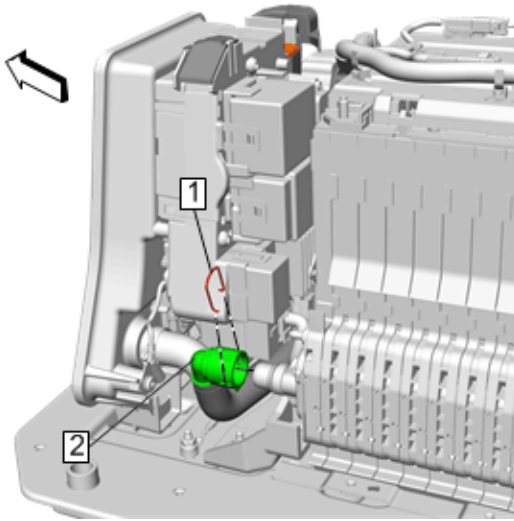


Fig. 126: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install High Voltage Battery Cooling Manifold Outlet Hose (2)
5. Install the retainer. (1)

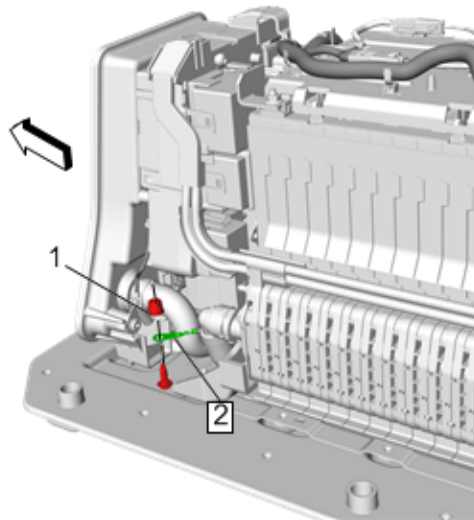


Fig. 127: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

6. Install Ground Cable (2)

CAUTION: Refer to **Fastener Caution**

7. Install and tighten Ground Nut (1) to 9 N.m (80 lb in)

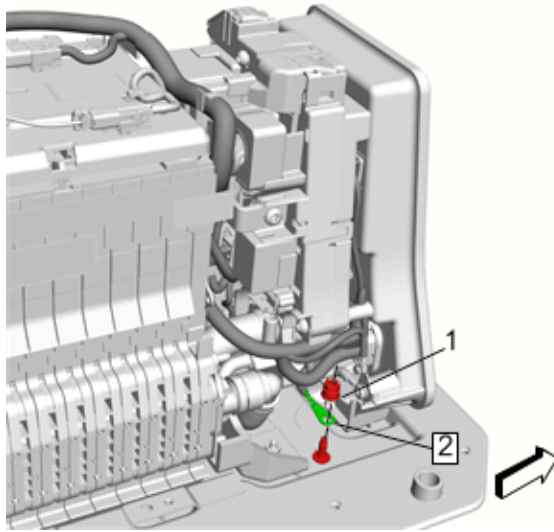


Fig. 128: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install Ground Cable (2)
9. Install and tighten Ground Nut (1) to 9 N.m (80 lb in)

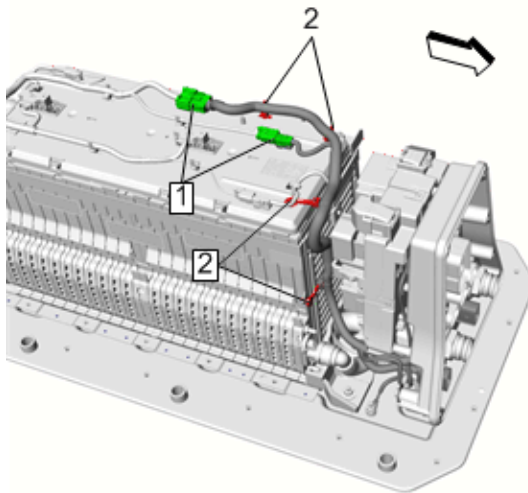


Fig. 129: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

10. Connect Electrical Connectors (1) (Qty: 2)
11. Install Retainers (2) (Qty: 4)

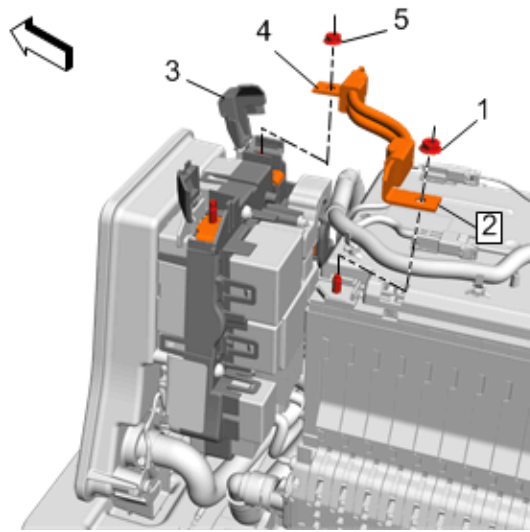


Fig. 130: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
 Courtesy of GENERAL MOTORS COMPANY

12. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

13. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

14. Install High Voltage Battery Positive Cable (4)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

15. Install and tighten High Voltage Battery Positive Cable Fastener (5) to 9 N.m (80 lb in)

16. Close Terminal Cover (3)

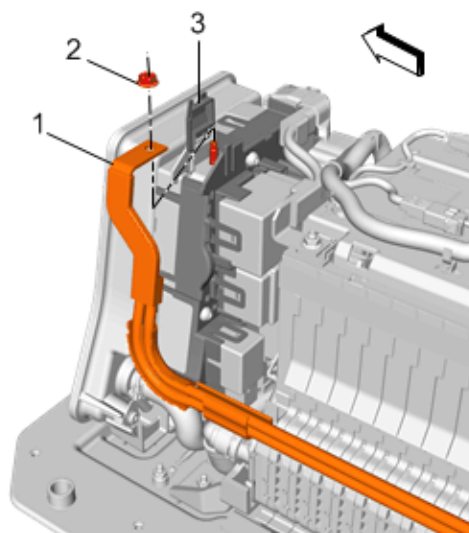


Fig. 131: Terminal Cover, High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

17. Install High Voltage Battery Positive Cable (1)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

18. Install and tighten High Voltage Battery Positive Cable Fastener (2) to 9 N.m (80 lb in)
19. Close Terminal Cover (3)
20. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
21. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
22. Fill the cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
23. Perform Hybrid Cooling System Leak Test. Refer to [Hybrid Cooling System Leak Test](#)

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 6)

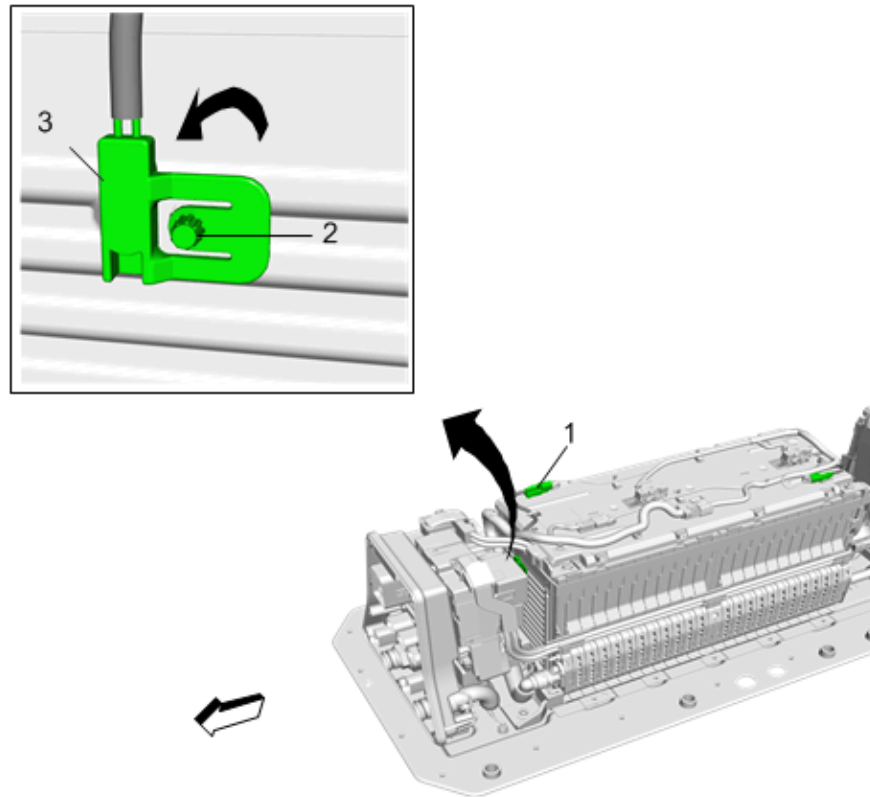


Fig. 132: Cell Battery High Voltage Sensor (Thermistor 6)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 6
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 4)

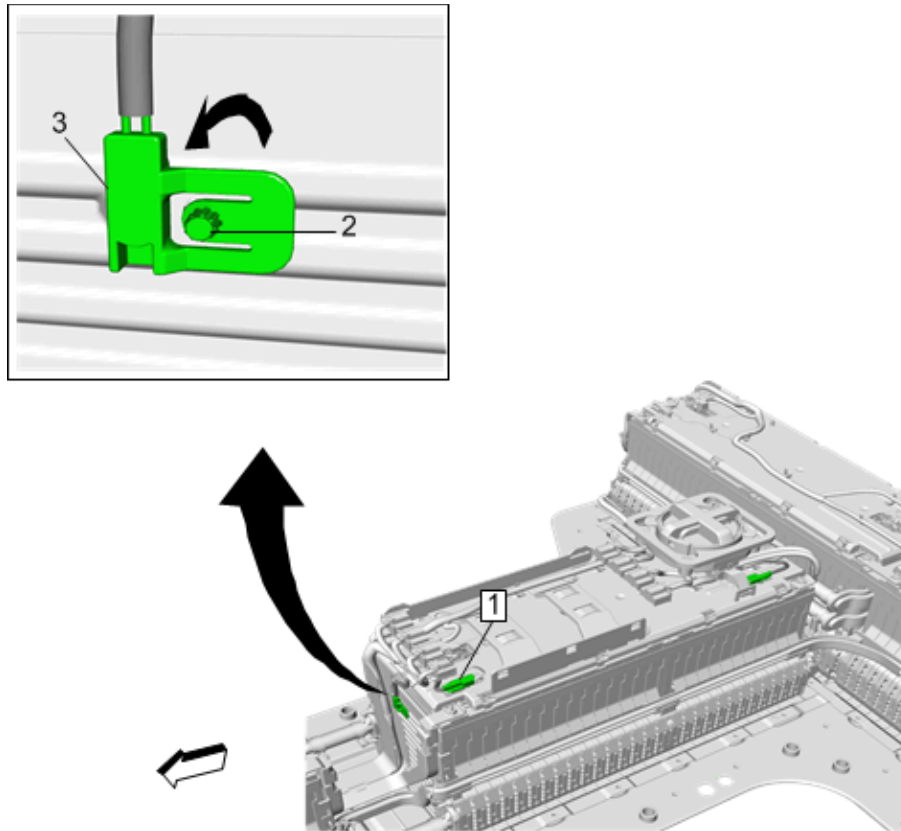


Fig. 133: Cell Battery High Voltage Sensor (Thermistor 4)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 4
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 1)

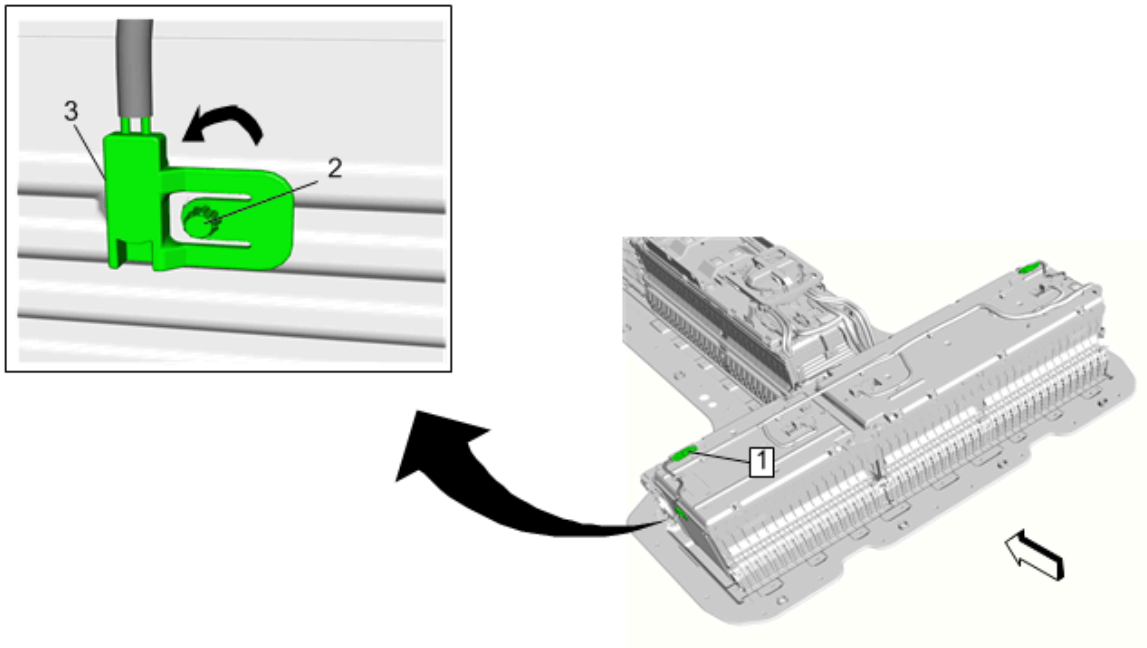


Fig. 134: Cell Battery High Voltage Sensor (Thermistor 1)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 1
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 5)

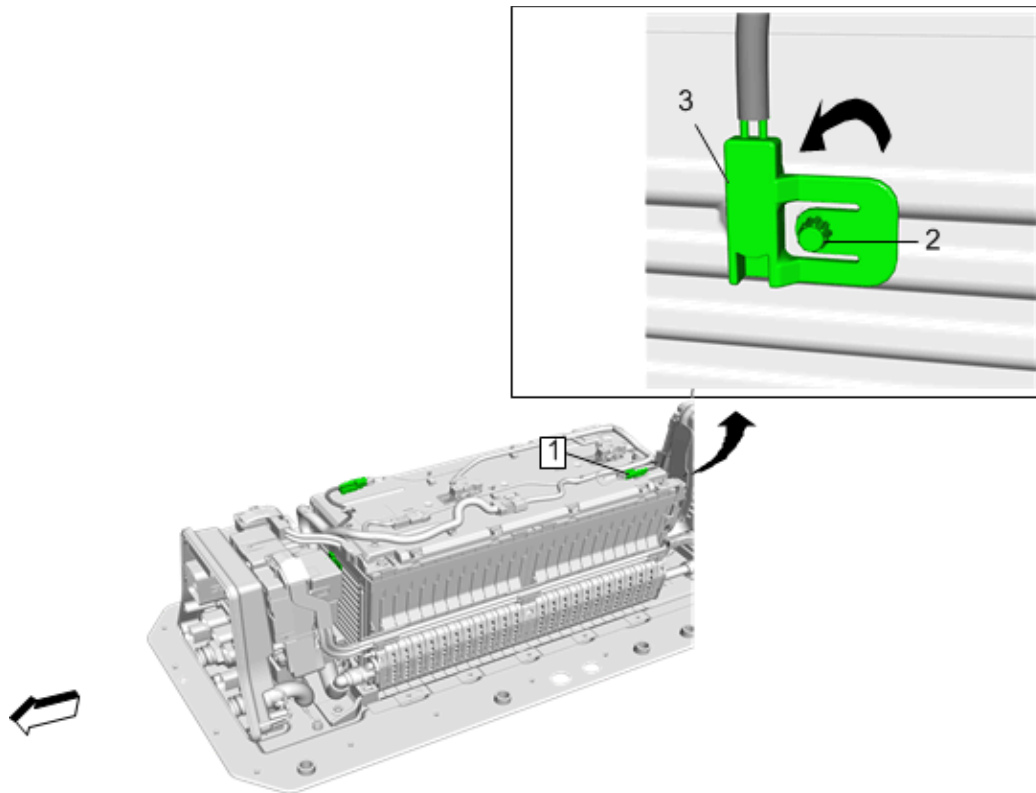


Fig. 135: Cell Battery High Voltage Sensor (Thermistor 5)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 5
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 3)

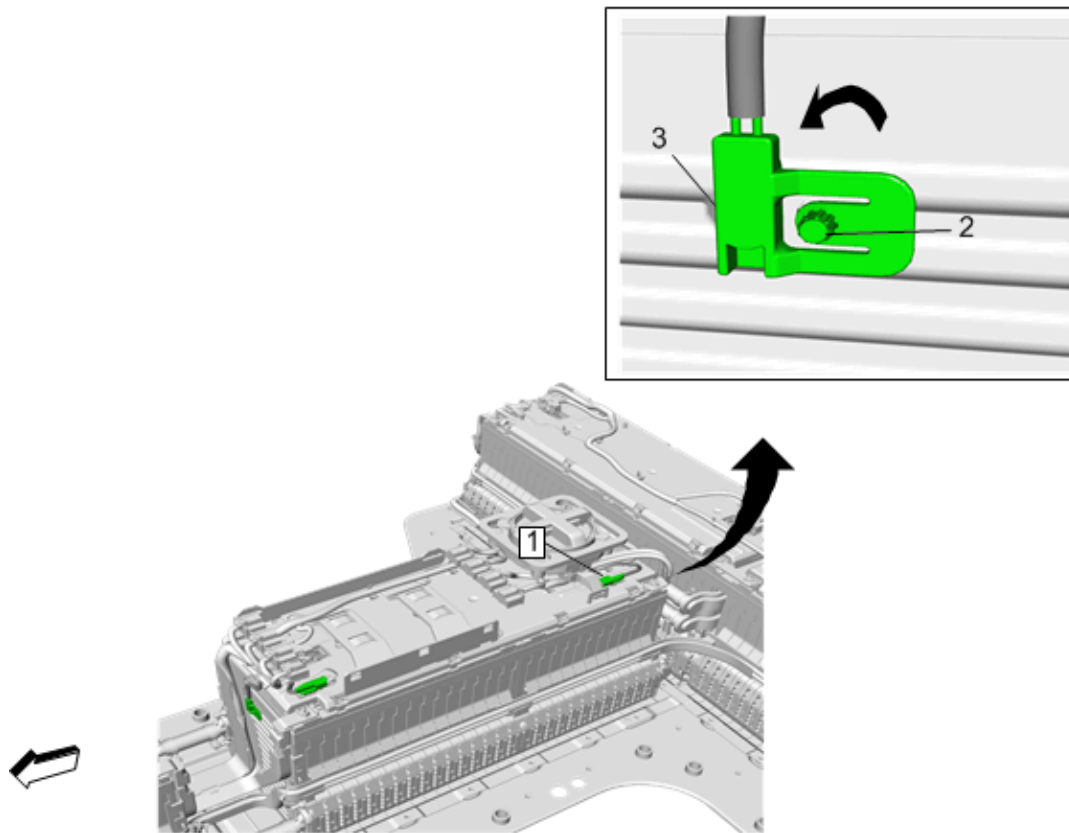


Fig. 136: Cell Battery High Voltage Sensor (Thermistor 3)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 3
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

CELL BATTERY HIGH VOLTAGE SENSOR REPLACEMENT (THERMISTOR 2)

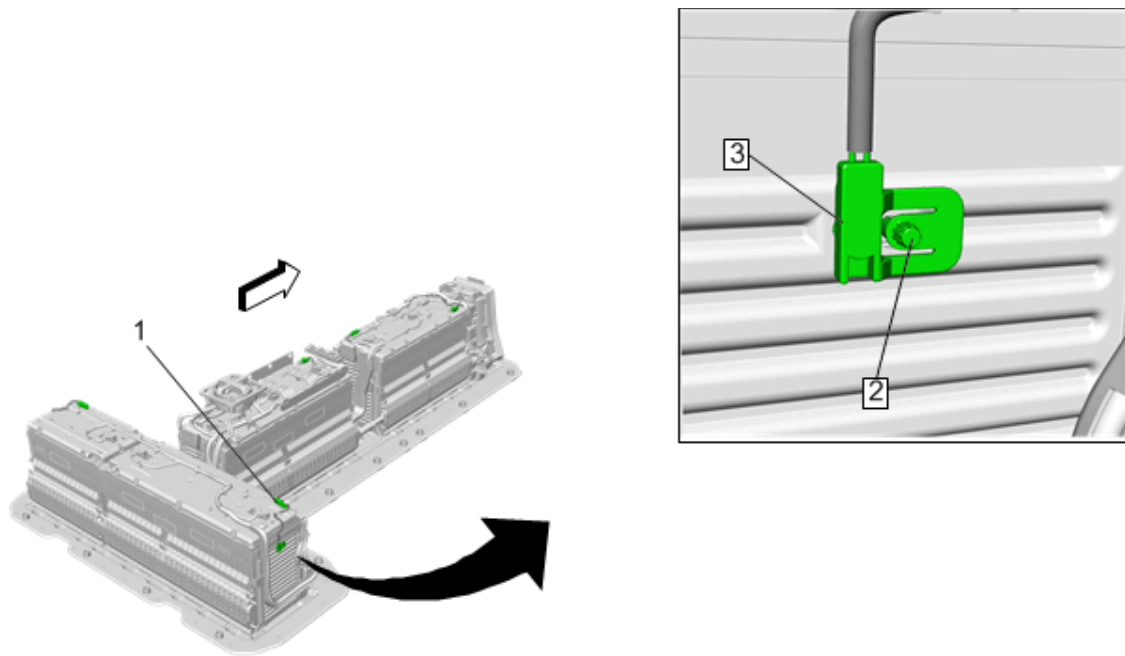


Fig. 137: Cell Battery High Voltage Sensor (Thermistor 2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	Cell Battery High Voltage Sensor Connector
2	Fastener
3	Cell Battery High Voltage Sensor 2
Procedure	
Gently pull up on the tab (2) and rotate 90 Degrees.	

HIGH VOLTAGE SECTION BATTERY REPLACEMENT (BATTERY SECTION 1)

Removal Procedure

Special Tools

- EL-51763 High Voltage Battery Section Covers
- EL-50115 Battery Section Lifting Adapters
- EL-48264 Battery Pack Lifting Adapter

Equivalent regional tools: [Special Tools](#)

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

2. Disconnect the Battery Energy Control Module Connectors. Refer to [Battery Energy Control Module Replacement](#)
3. Drain the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

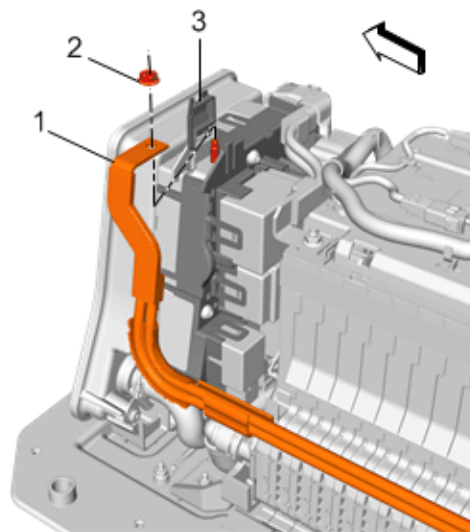


Fig. 138: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Open Battery Terminal Cover (3)
5. Remove High Voltage Battery Positive Cable Fastener (2)
6. Remove High Voltage Battery Positive Cable (1)

NOTE: Cover exposed terminal with high voltage tape.

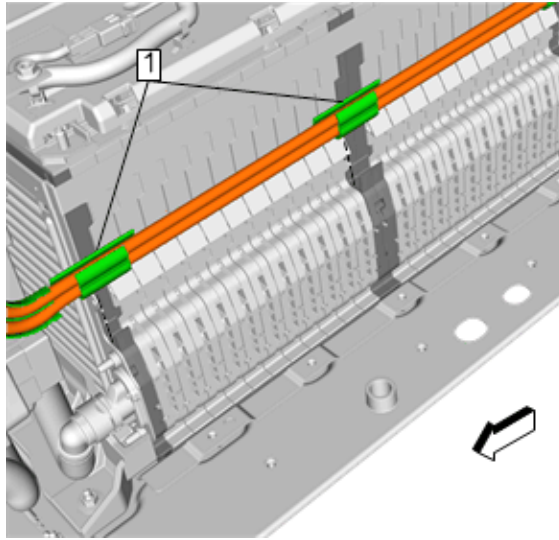


Fig. 139: Retainers

Courtesy of GENERAL MOTORS COMPANY

7. Disengage Retainers (1) (Qty: 2)

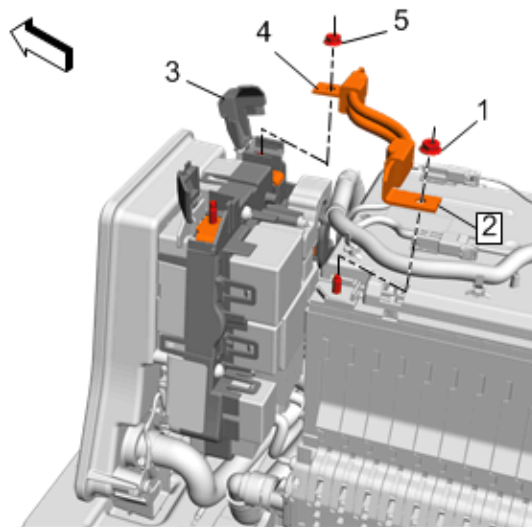


Fig. 140: High Voltage Battery Positive Cable, Fasteners And Terminal Cover

Courtesy of GENERAL MOTORS COMPANY

8. Remove High Voltage Battery Positive Cable Fastener (1)
9. Remove High Voltage Battery Positive Cable (2)
10. Open Battery Terminal Cover (3)
11. Remove High Voltage Battery Positive Cable Fastener (5)
12. Remove High Voltage Battery Positive Cable (4)

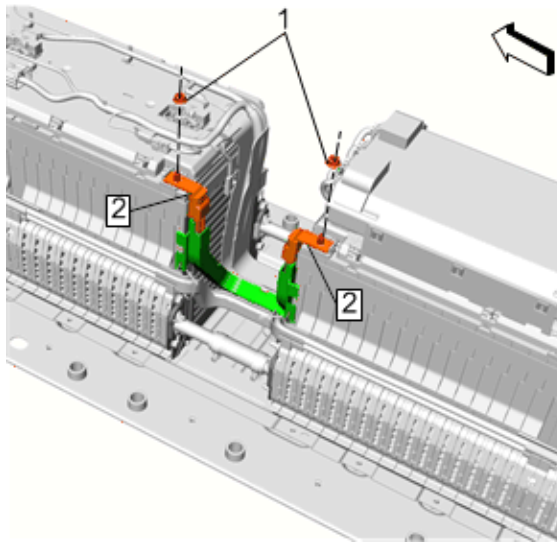


Fig. 141: High Voltage Battery Positive Cable And Fasteners
Courtesy of GENERAL MOTORS COMPANY

13. Remove High Voltage Battery Positive Cable Fasteners (1) (Qty: 2)
14. Remove High Voltage Battery Positive Cable (2) (Qty: 2)

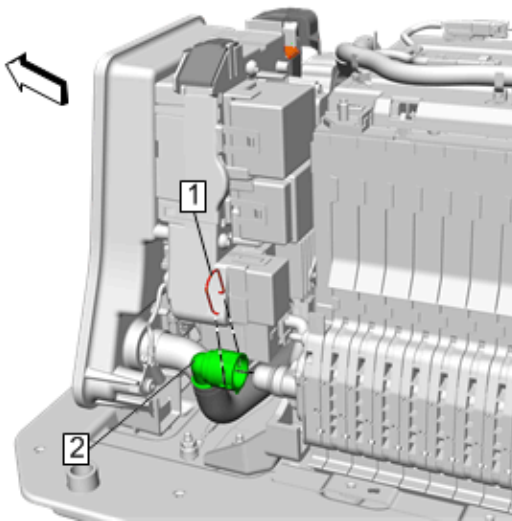


Fig. 142: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

15. Unclip the hose retainer. (1)
16. Remove Cell Battery Cooling Manifold Outlet Hose (2)

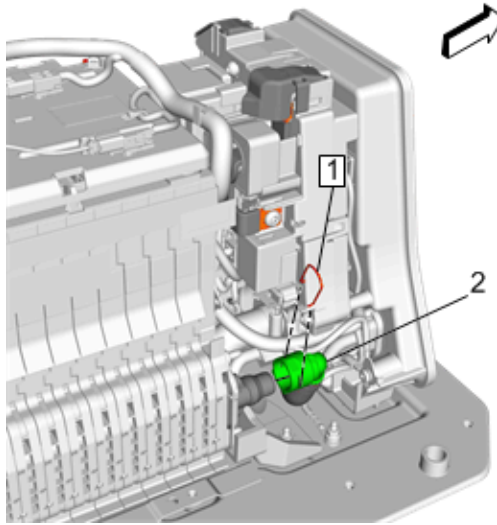


Fig. 143: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

17. Unclip the hose retainer. (1)
18. Remove Cell Battery Cooling Manifold Inlet Hose (2)

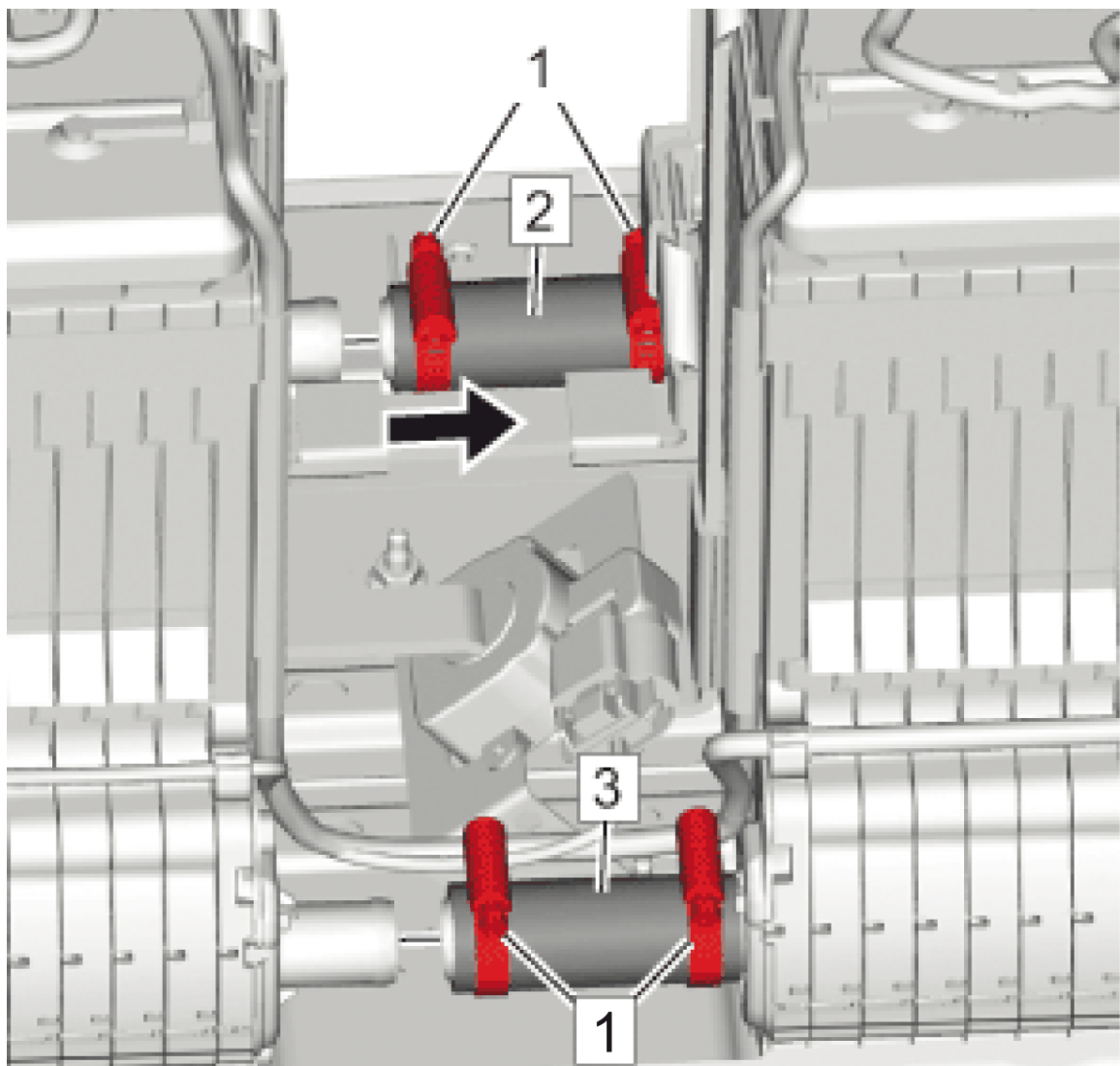


Fig. 144: Cell Battery Cooling Plate Hoses And Clamps

Courtesy of GENERAL MOTORS COMPANY

19. Loosen the clamps (1) (Qty: 4)
20. Move the 2 cell battery cooling plate hoses (2, 3) in direction of arrow.

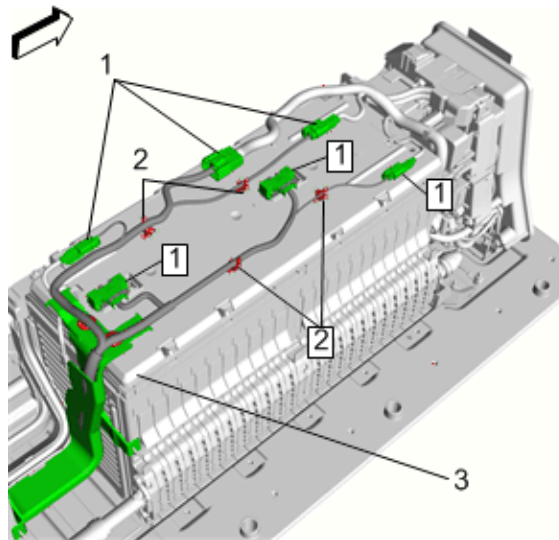


Fig. 145: Electrical Connectors And Retainers

Courtesy of GENERAL MOTORS COMPANY

21. Disconnect Electrical Connectors (1) (Qty: 6) @ Battery Section 1
22. Disengage Retainers (2) (Qty: 4)
23. Disengage any harness retainers attached to battery section 1 and set aside the harnesses.

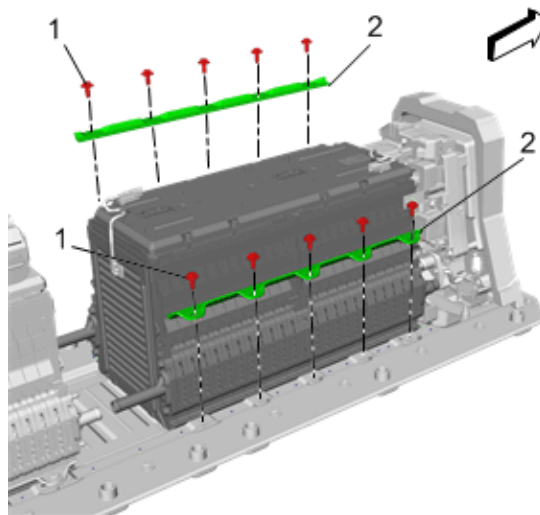


Fig. 146: Battery Hold Down Retainers And Fasteners

Courtesy of GENERAL MOTORS COMPANY

24. Remove Fasteners (1) (Qty: 10)
25. Remove Battery Hold Down Retainers (2) (Qty: 2)

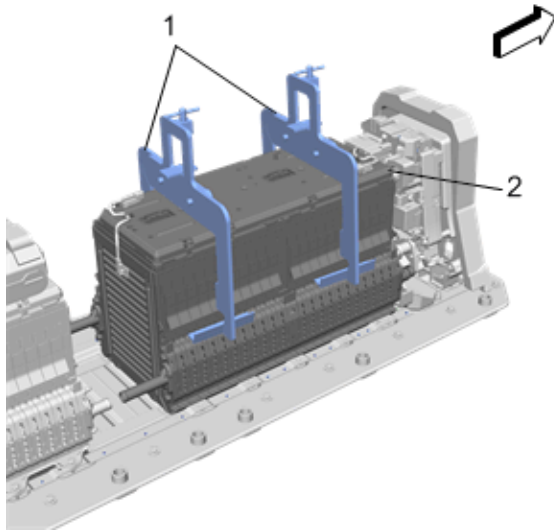


Fig. 147: Battery Section Lifting Adapters And Battery Section 1
Courtesy of GENERAL MOTORS COMPANY

26. Install **EL-50115** Battery Section Lifting Adapters (1) (Qty: 2) @ Battery Section 1 (2)

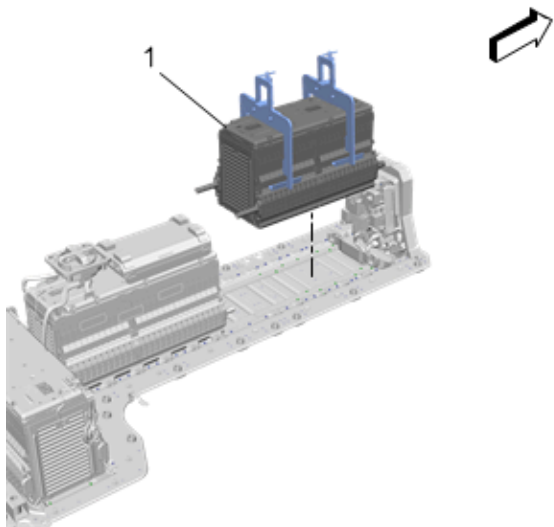


Fig. 148: Battery Section 1
Courtesy of GENERAL MOTORS COMPANY

27. Remove Battery Section 1 (1)

Installation Procedure

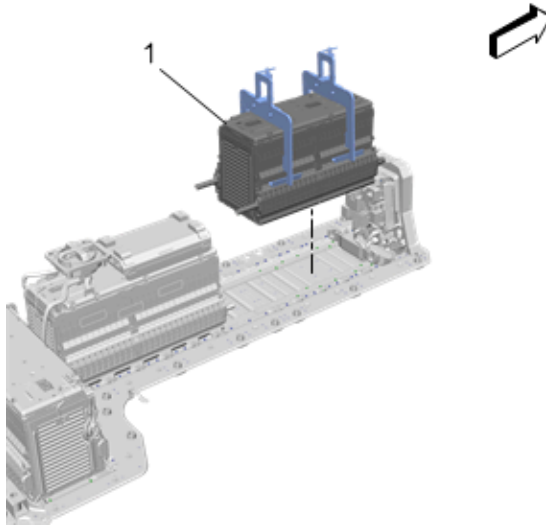


Fig. 149: Battery Section 1

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Section 1 (1)

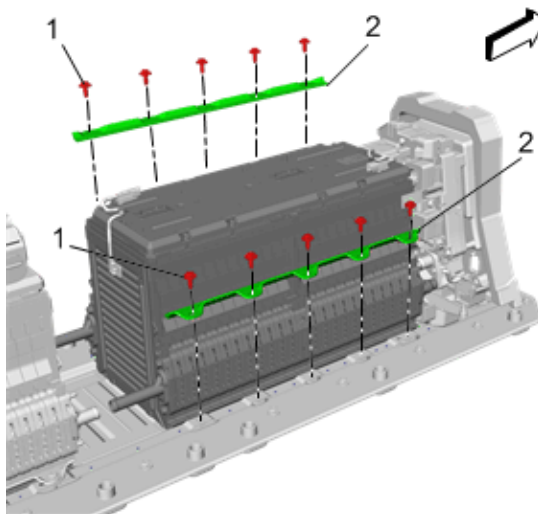


Fig. 150: Battery Hold Down Retainers And Fasteners

Courtesy of GENERAL MOTORS COMPANY

2. Install Battery Hold Down Retainers (2) (Qty: 2)
3. Push and hold battery section 1 firmly against the front brace, before tightening fasteners. (1)

CAUTION: Refer to **Fastener Caution**

4. Install and tighten Fasteners (1) (Qty: 10) to 9 N.m (80 lb in)

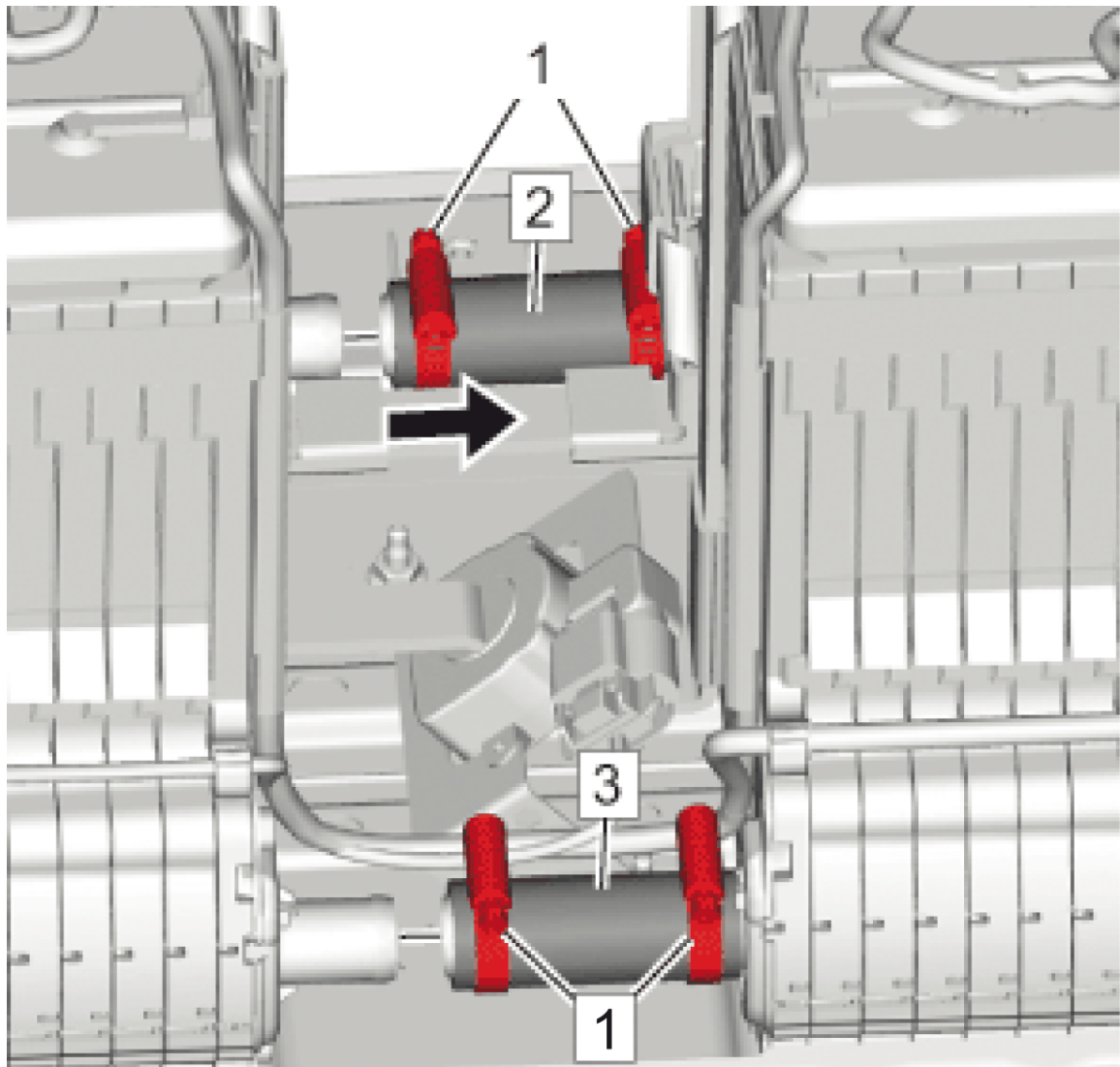


Fig. 151: Cell Battery Cooling Plate Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

5. Move the 2 cell battery cooling plate hoses (2, 3) against direction of arrow.
6. Tighten Clamps (1) (Qty: 4) to 2.1 N.m (19 lb in)

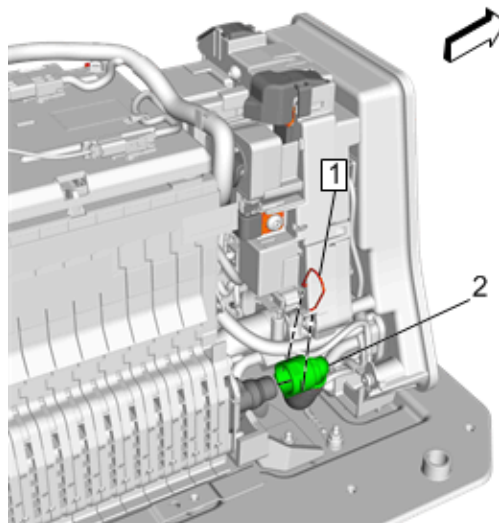


Fig. 152: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Install Cell Battery Cooling Manifold Inlet Hose (2)
8. Install the retainer. (1)

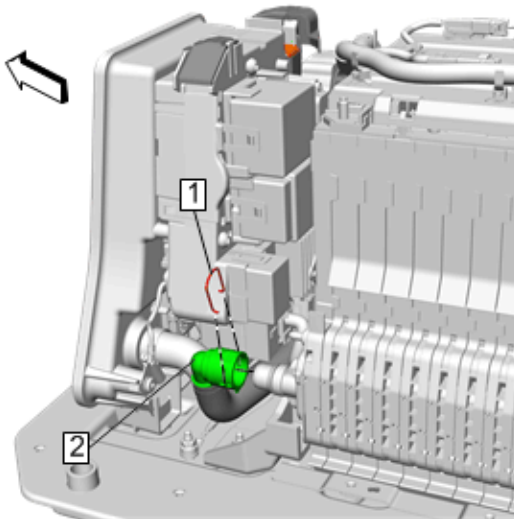


Fig. 153: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Install Cell Battery Cooling Manifold Outlet Hose (2)
10. Install the retainer. (1)

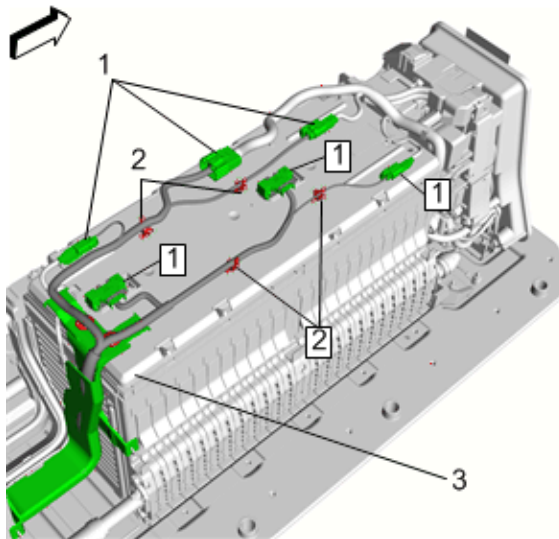


Fig. 154: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Connect Electrical Connectors (1) (Qty: 6) @ Battery Section 1 (3)
12. Engage Retainers (2) (Qty: 4)

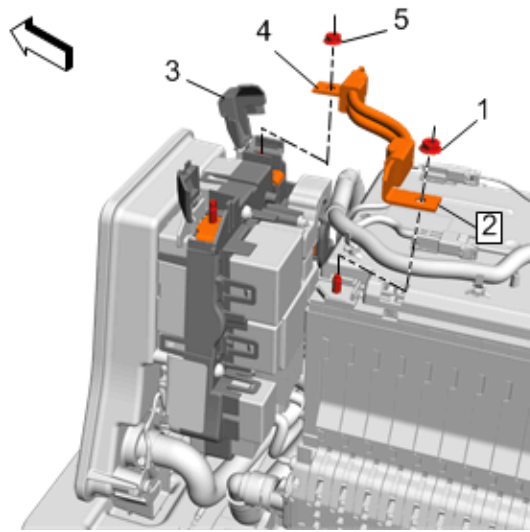


Fig. 155: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
 Courtesy of GENERAL MOTORS COMPANY

13. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

14. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

15. Install High Voltage Battery Positive Cable (4)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

16. Install and tighten High Voltage Battery Positive Cable Fastener (5) to 9 N.m (80 lb in)

17. Close Battery Terminal Cover (3)

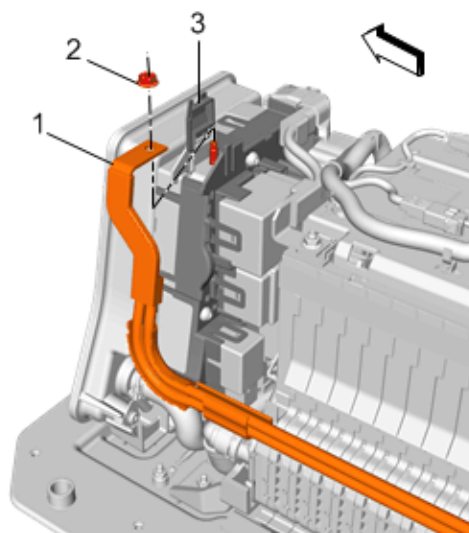


Fig. 156: Terminal Cover, High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

18. Install High Voltage Battery Positive Cable (1)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

19. Install and tighten High Voltage Battery Positive Cable Fastener (2) to 9 N.m (80 lb in)
20. Close Battery Terminal Cover (3)

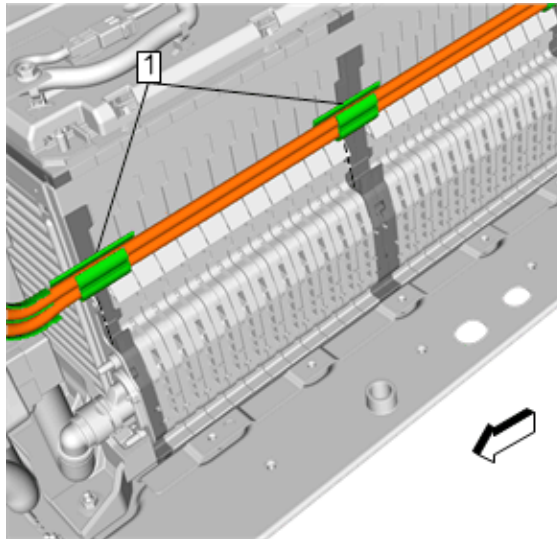


Fig. 157: Retainers

Courtesy of GENERAL MOTORS COMPANY

21. Engage Retainers (1) (Qty: 2)
22. Connect the Battery Energy Control Module Connectors in sequence. Refer to [Battery Energy Control Module Replacement](#)
23. Perform the Hybrid/EV battery cell balancing procedure. Refer to [Hybrid/EV Battery Cell Balancing](#)
24. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
25. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
26. Fill the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

HIGH VOLTAGE SECTION BATTERY REPLACEMENT (BATTERY SECTION 2)

Removal Procedure

Special Tools

- EL-51763 High Voltage Battery Section Covers
- EL-50115 Battery Section Lifting Adapters
- EL-48264 Battery Pack Lifting Adapter

Equivalent regional tools: [Special Tools](#)

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
2. Drain the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)
3. Remove High Voltage Battery Positive Cable. Refer to [High Voltage Battery Positive Cable Replacement \(Battery Section 1 to Battery Section 2\)](#)
4. Remove High Voltage Battery High Voltage Manual Disconnect Connector. Refer to [High Voltage Battery High Voltage Manual Disconnect Connector Replacement](#)

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

5. Remove Battery Energy Control Module. Refer to [Battery Energy Control Module Replacement](#)

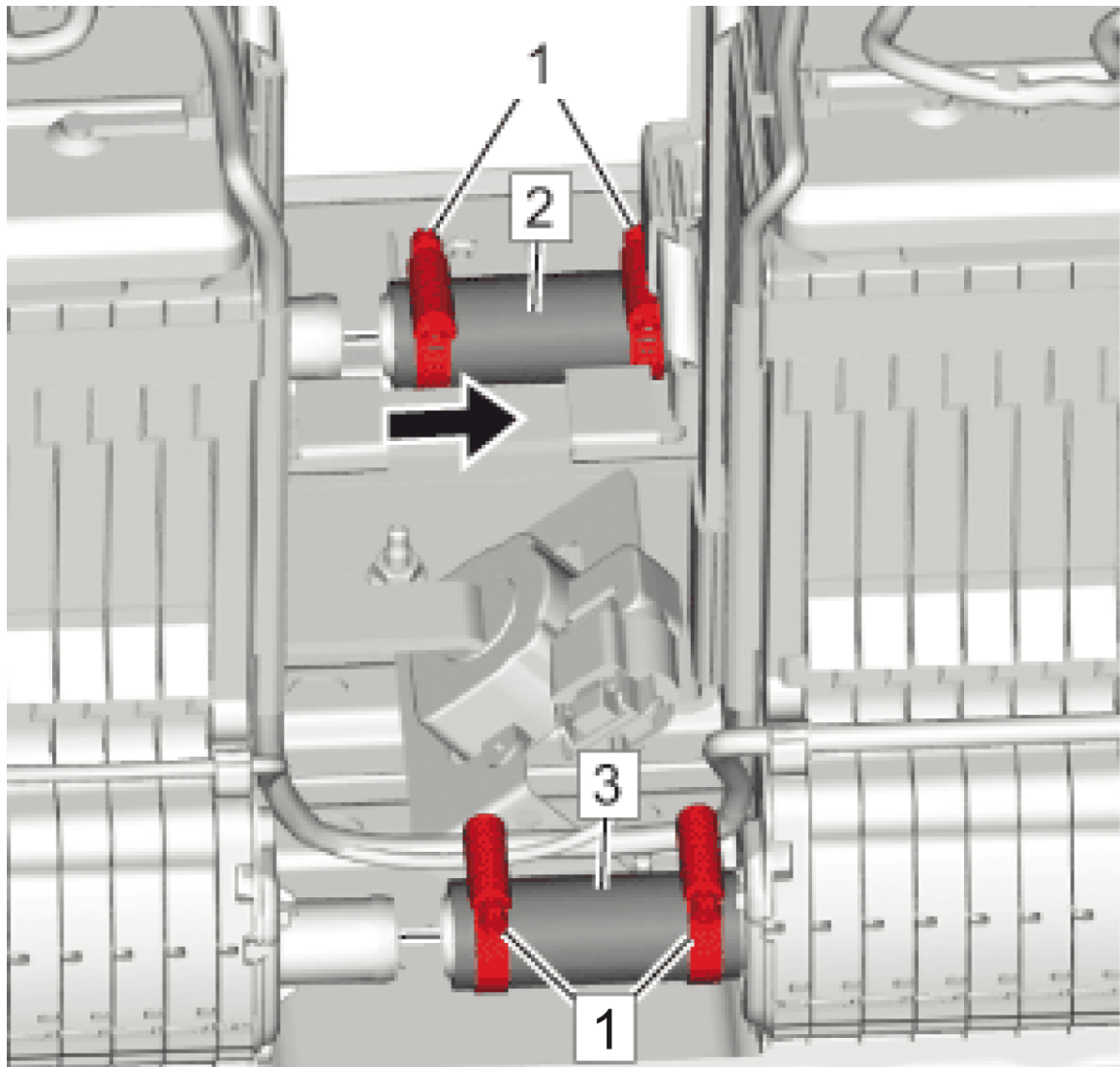


Fig. 158: Cell Battery Cooling Plate Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

6. Loosen the clamps. (1) (Qty: 4)
7. Move the 2 cell battery cooling plate hoses (2, 3) in direction of arrow.

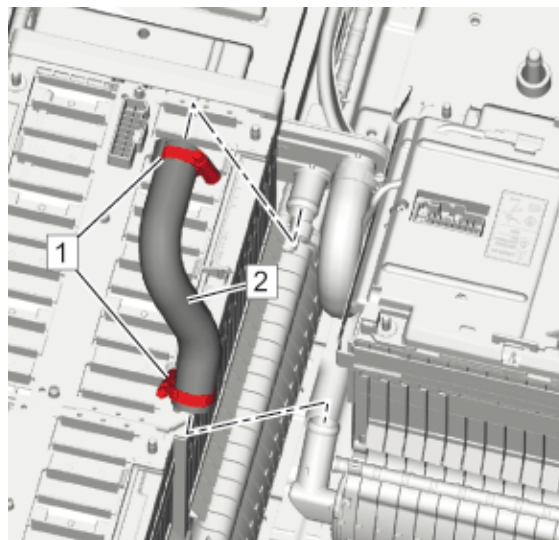


Fig. 159: High Voltage Battery Cooling Manifold Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

8. Loosen the clamps. (1) (Qty: 2)
9. Remove the cell battery cooling manifold inlet hose (2).

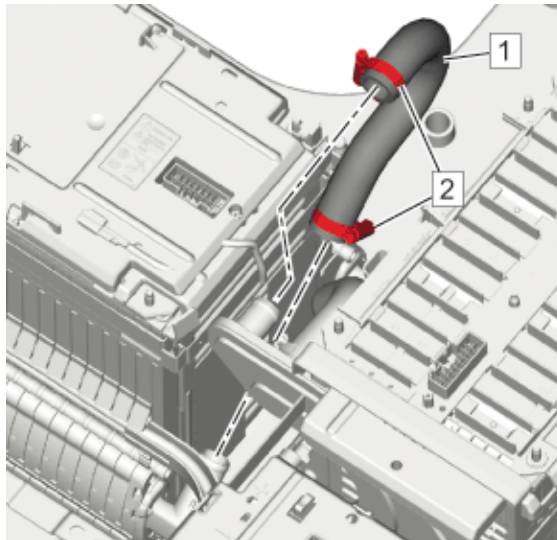


Fig. 160: High Voltage Battery Cooling Manifold Outlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

10. Loosen the clamps. (2) (Qty: 2)
11. Remove the cell battery cooling manifold outlet hose (1).

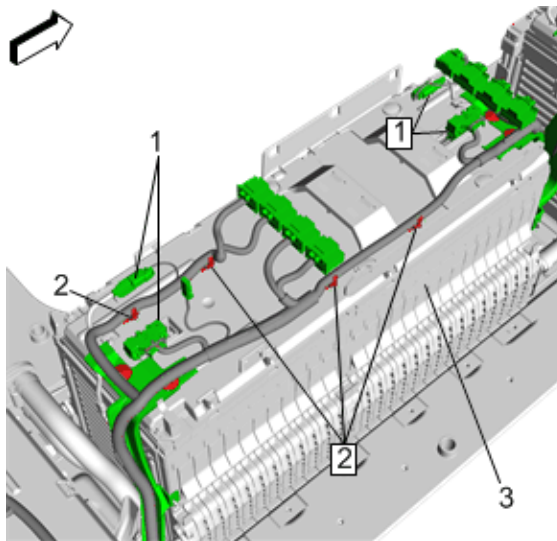


Fig. 161: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

12. Disconnect Electrical Connectors (1) (Qty: 4) @ Battery Section 2 (3)
13. Disengage Retainers (2) (Qty: 4)
14. Disengage any harness retainers attached to battery section 2 and set aside the harnesses.

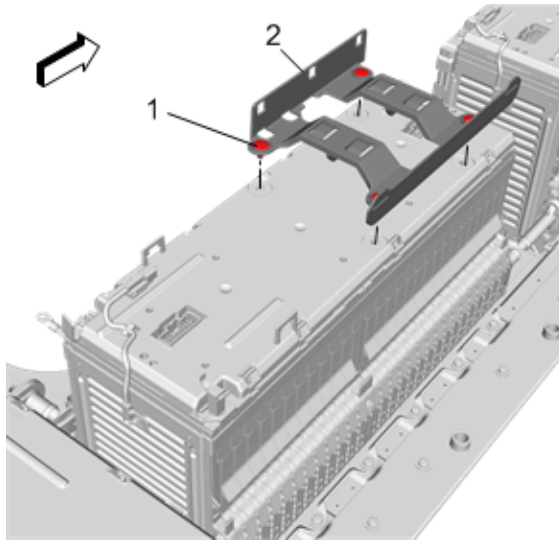


Fig. 162: Battery Energy Control Module Bracket And Retainers
Courtesy of GENERAL MOTORS COMPANY

15. Disengage Retainers (1) (Qty: 4)
16. Remove Battery Energy Control Module Bracket (2)

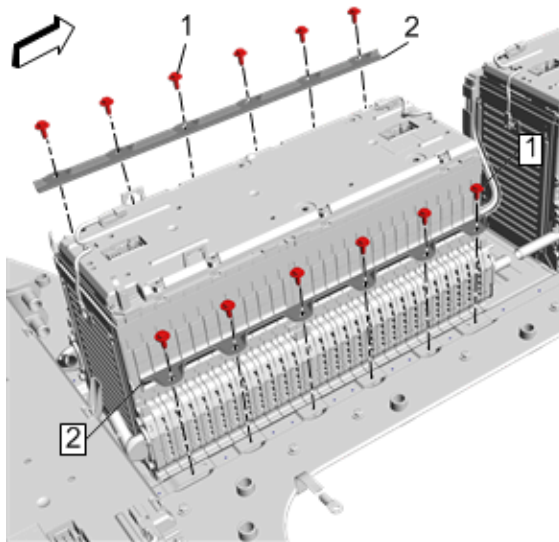


Fig. 163: Battery Hold Down Retainers And Fasteners
Courtesy of GENERAL MOTORS COMPANY

17. Remove Fasteners (1) (Qty: 12)
18. Remove Battery Hold Down Retainers (2) (Qty: 2)

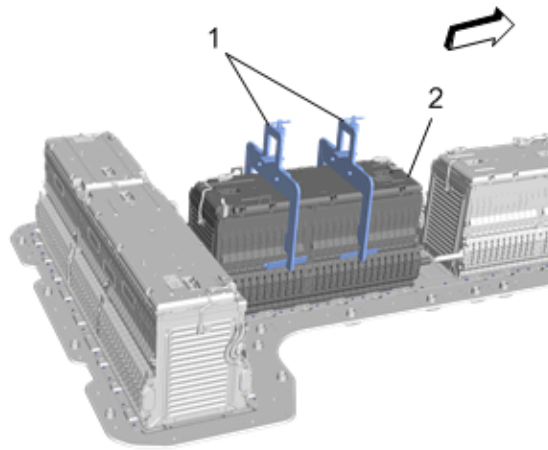


Fig. 164: Battery Section Lifting Adapters And Battery Section 2
Courtesy of GENERAL MOTORS COMPANY

19. Install **EL-50115** Battery Section Lifting Adapters (1) (Qty: 2) @ Battery Section 2 (2)

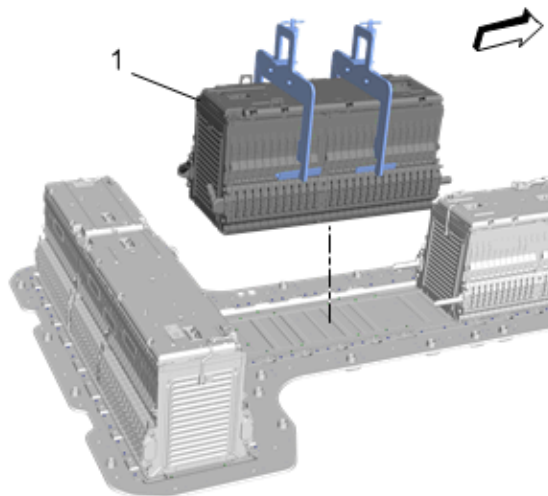


Fig. 165: Battery Section 2
Courtesy of GENERAL MOTORS COMPANY

20. Remove Battery Section 2 (1)

Installation Procedure

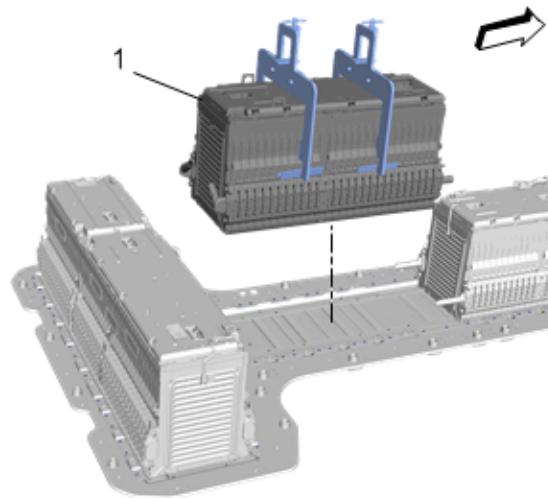


Fig. 166: Battery Section 2

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Section 2 (1)

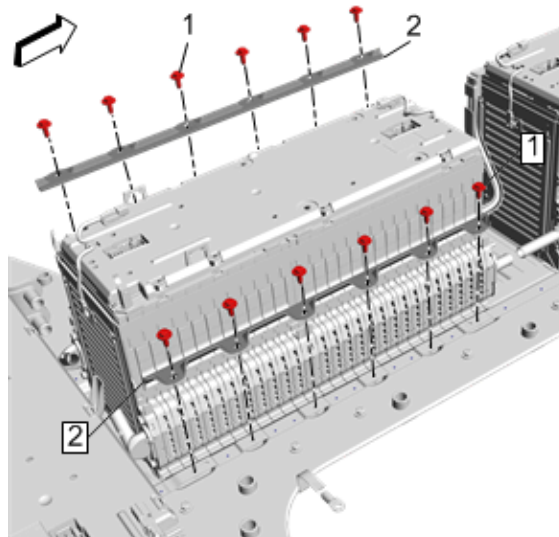


Fig. 167: Battery Hold Down Retainers And Fasteners

Courtesy of GENERAL MOTORS COMPANY

2. Install Battery Hold Down Retainers (2) (Qty: 2)

CAUTION: Refer to [Fastener Caution](#)

3. Install and tighten Fasteners (1) (Qty: 12) to 9 N.m (80 lb in)

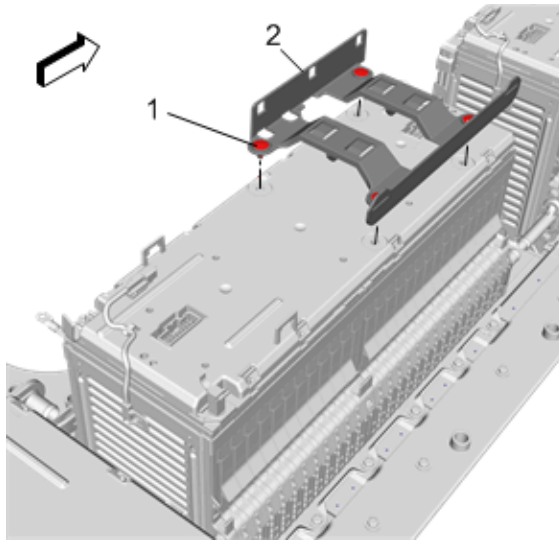


Fig. 168: Battery Energy Control Module Bracket And Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Install Battery Energy Control Module Bracket (2)
5. Engage Retainers (1) (Qty: 4)

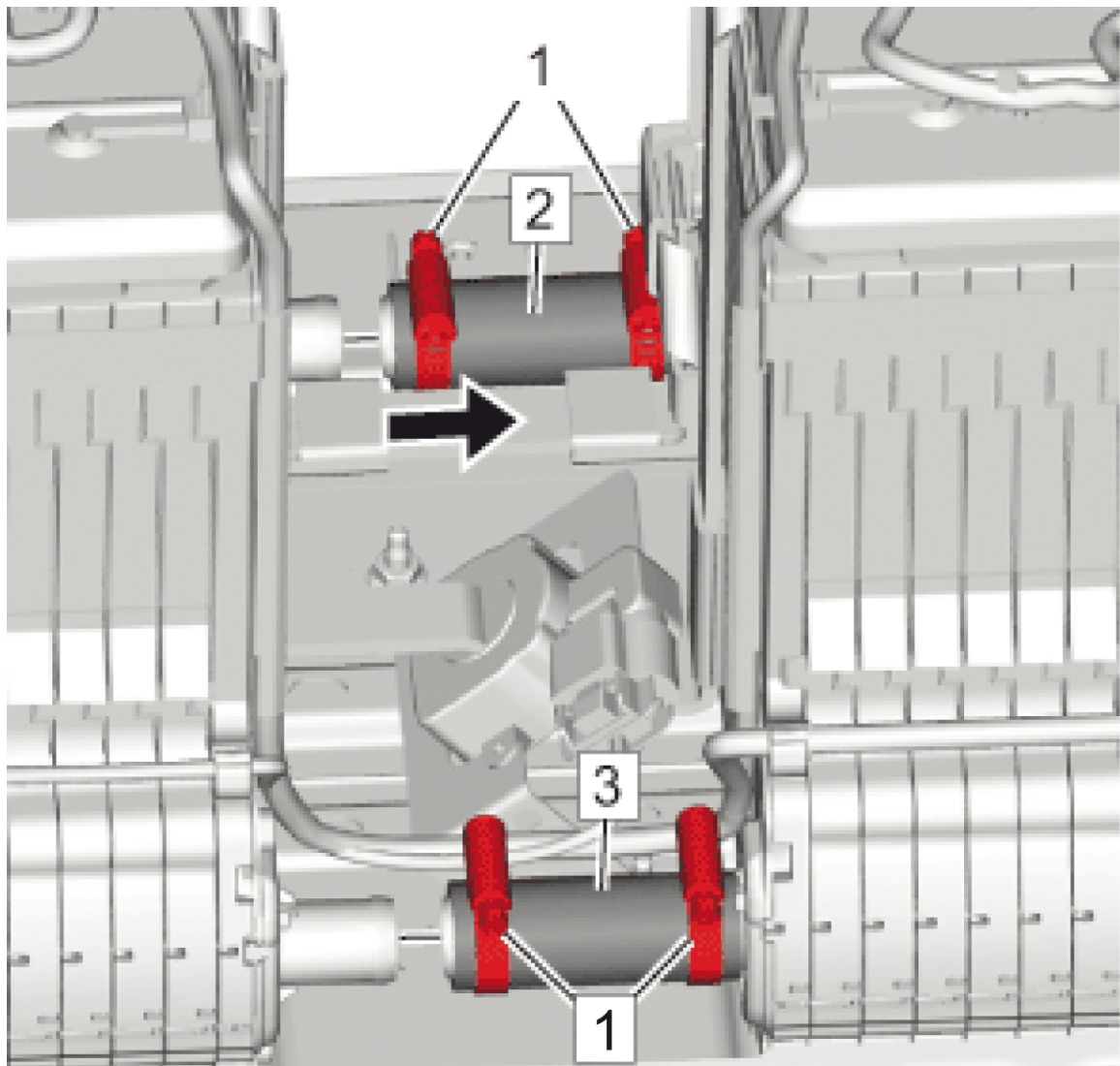


Fig. 169: Cell Battery Cooling Plate Hoses And Clamps

Courtesy of GENERAL MOTORS COMPANY

6. Move the 2 cell battery cooling plate hoses (2, 3) against direction of arrow.
7. Tighten Clamps (1) (Qty: 4) to 2.1 N.m (19 lb in)

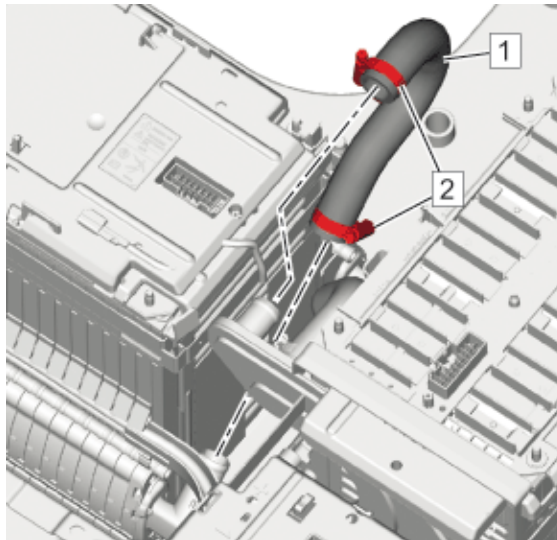


Fig. 170: High Voltage Battery Cooling Manifold Outlet Hose And Clamps

Courtesy of GENERAL MOTORS COMPANY

8. Install the cell battery cooling manifold outlet hose (1).
9. Tighten Clamps (2) (Qty: 2) to 2.1 N.m (19 lb in)

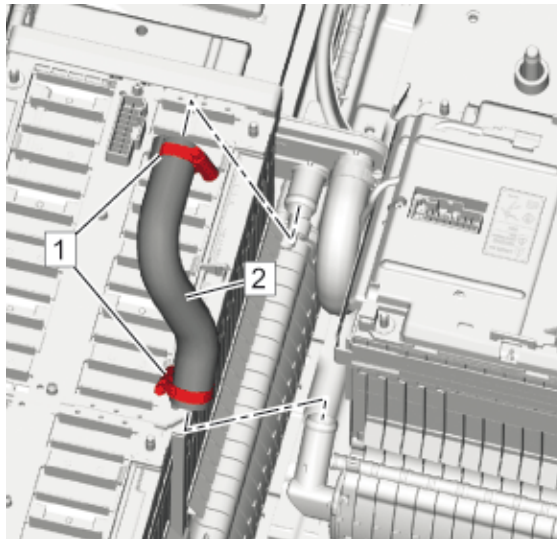


Fig. 171: High Voltage Battery Cooling Manifold Inlet Hose And Clamps

Courtesy of GENERAL MOTORS COMPANY

10. Install the cell battery cooling manifold inlet hose (2).
11. Tighten Clamps (1) (Qty: 2) to 2.1 N.m (19 lb in)

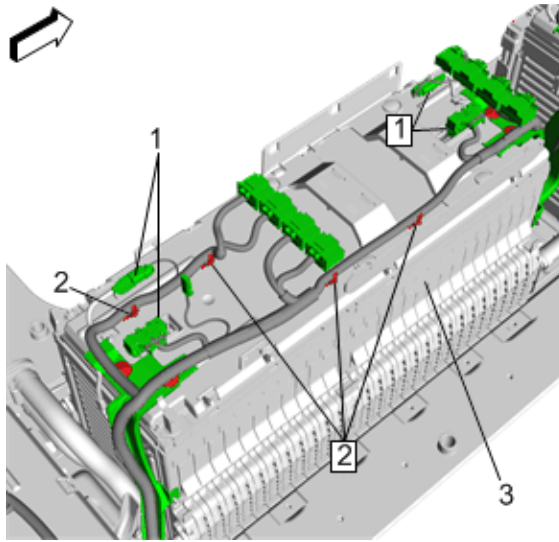


Fig. 172: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

- 12. Connect Electrical Connectors (1) (Qty: 4) @ Battery Section 2 (3)
- 13. Engage Retainers (2) (Qty: 4)

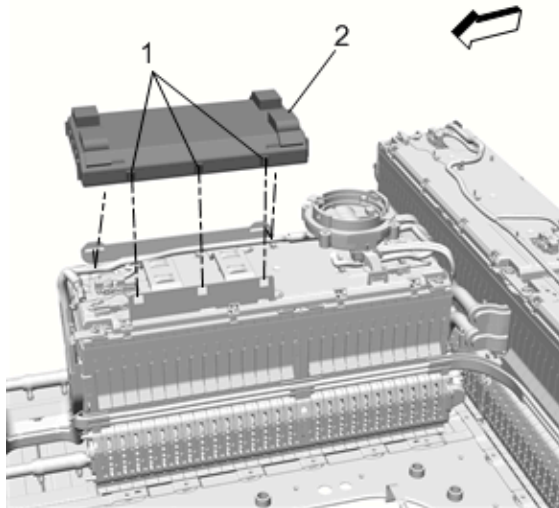


Fig. 173: Battery Energy Control Module And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

- 14. Install Battery Energy Control Module (2)

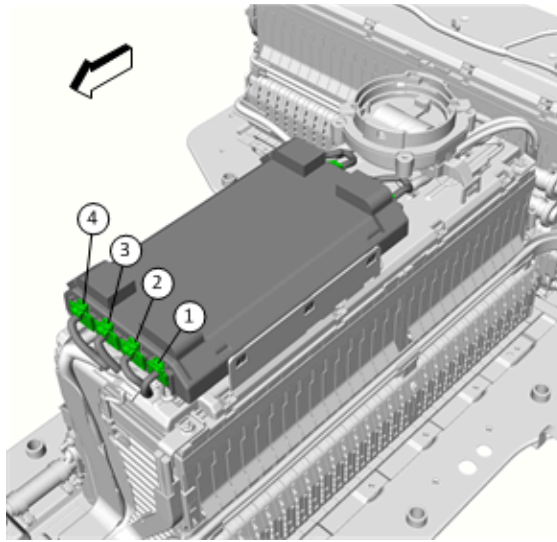


Fig. 174: Battery Energy Control Module Connector Reconnection Sequence (1 Of 2)
Courtesy of GENERAL MOTORS COMPANY

15. Install connectors in the sequence shown @ Battery Energy Control Module

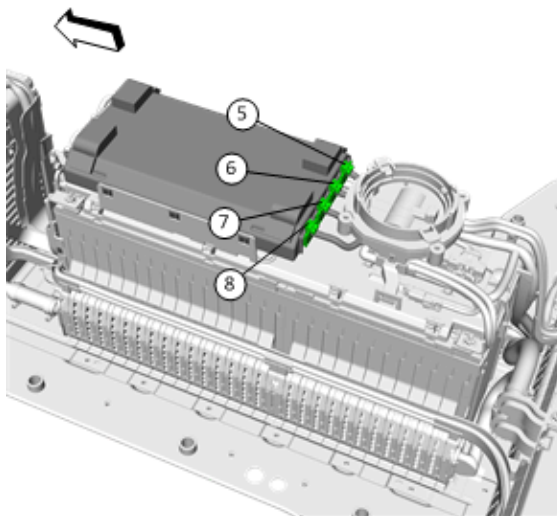


Fig. 175: Battery Energy Control Module Connector Reconnection Sequence (2 Of 2)
Courtesy of GENERAL MOTORS COMPANY

16. Install connectors in the sequence shown @ Battery Energy Control Module
17. Install High Voltage Battery High Voltage Manual Disconnect Connector. Refer to [High Voltage Battery High Voltage Manual Disconnect Connector Replacement](#)
18. Install High Voltage Battery Positive Cable. Refer to [High Voltage Battery Positive Cable Replacement \(Battery Section 1 to Battery Section 2\)](#)
19. Perform the Hybrid/EV battery cell balancing procedure. Refer to [Hybrid/EV Battery Cell Balancing](#)
20. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
21. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
22. Fill the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

HIGH VOLTAGE SECTION BATTERY REPLACEMENT (BATTERY SECTION 3)

Removal Procedure

Special Tools

- **EL-51763** High Voltage Battery Section Covers
- **EL-50115** Battery Section Lifting Adapters
- **EL-48264** Battery Pack Lifting Adapter

Equivalent regional tools: [Special Tools](#)

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

2. Disconnect the electrical connectors at the Battery Energy Control Module. Refer to [Battery Energy Control Module Replacement](#)
3. Drain the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

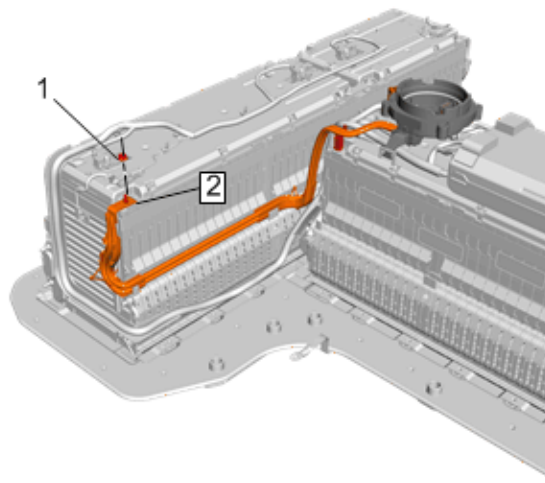


Fig. 176: High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

4. Remove High Voltage Battery Positive Cable Fastener (1)
5. Remove High Voltage Battery Positive Cable (2)

NOTE: Cover the High Voltage Positive Cable Terminal with approved high voltage insulating tape.

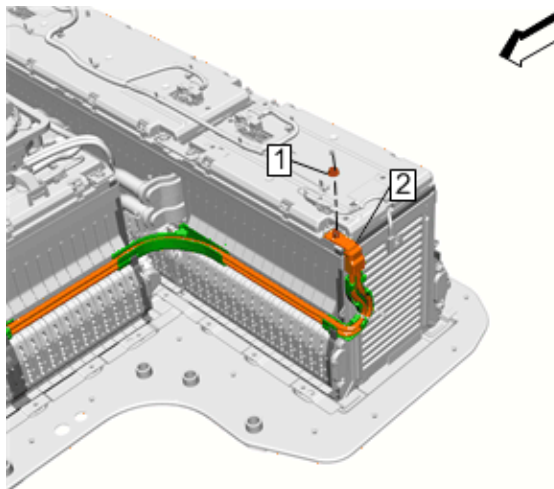


Fig. 177: High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

6. Remove High Voltage Battery Positive Cable Fastener (1)
7. Remove High Voltage Battery Positive Cable (2)

NOTE: Cover the High Voltage Positive Cable Terminal with approved high voltage insulated tape.

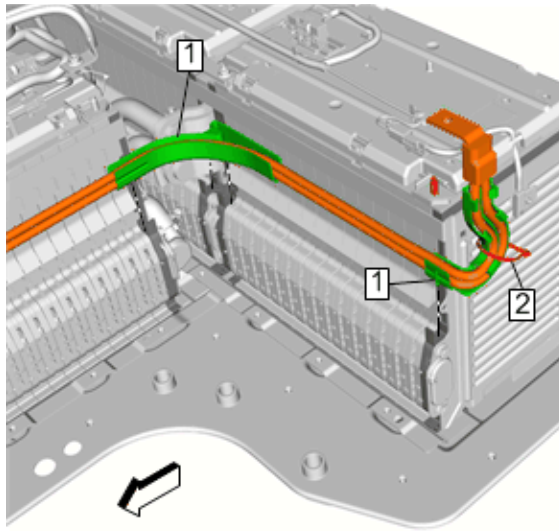


Fig. 178: Retainers And Cable Tie
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Retainers (1) (Qty: 2)
9. Remove Cable Tie (2)

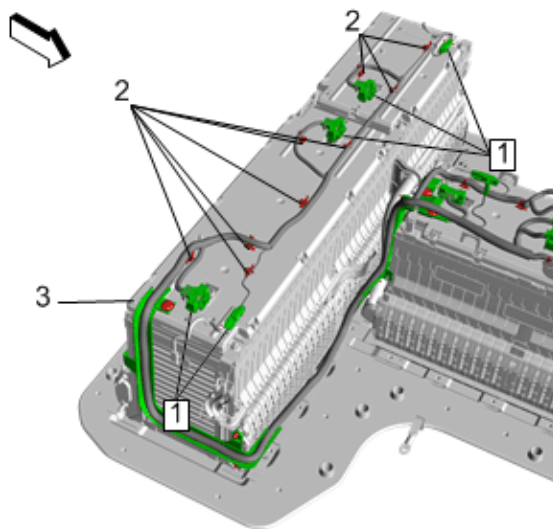


Fig. 179: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Electrical Connectors (1) (Qty: 5) @ Battery Section 3
11. Disengage Retainers (2) (Qty: 9)
12. Disconnect any harness retainers attached to battery section 3.

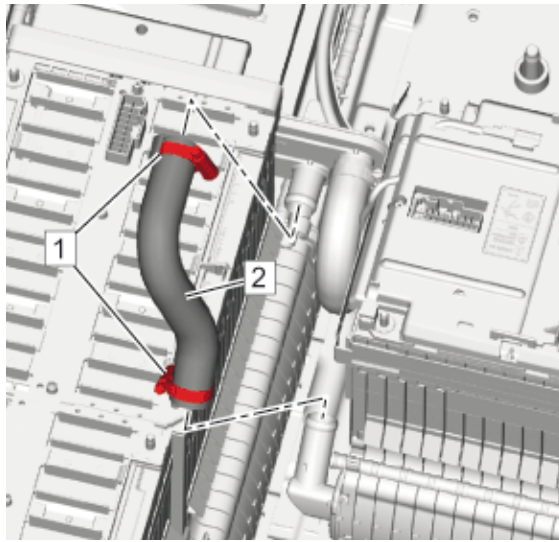


Fig. 180: High Voltage Battery Cooling Manifold Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

13. Loosen the clamps. (1) (Qty: 2)
14. Remove the cell battery cooling manifold inlet hose (2).

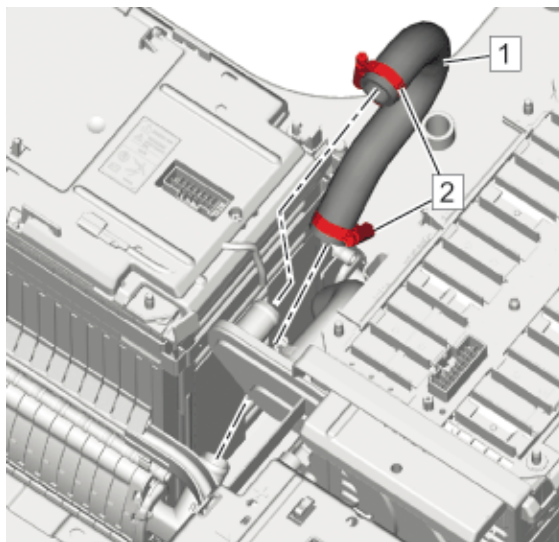


Fig. 181: High Voltage Battery Cooling Manifold Outlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

15. Loosen the clamps. (2) (Qty: 2)
16. Remove the cell battery cooling manifold outlet hose (1).

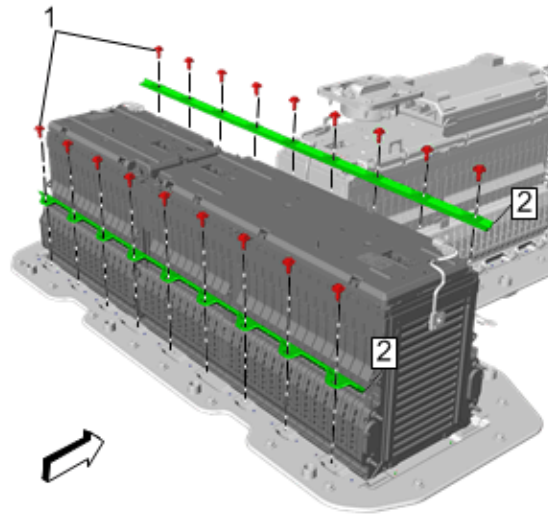


Fig. 182: Battery Hold Down Retainers And Fasteners
Courtesy of GENERAL MOTORS COMPANY

17. Remove Fasteners (1) (Qty: 18)
18. Remove Battery Hold Down Retainers (2) (Qty: 2)

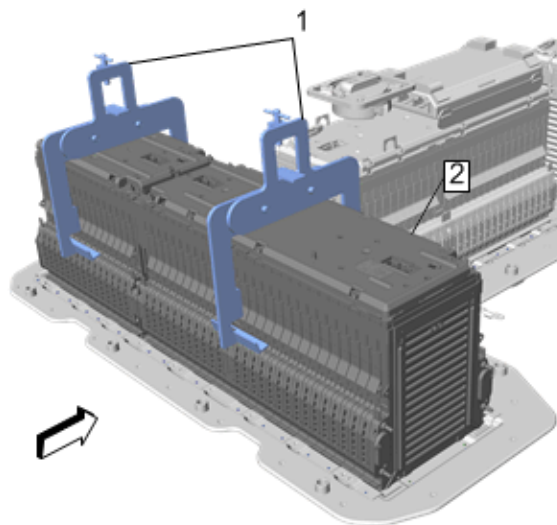


Fig. 183: Battery Section Lifting Adapters And Battery Section 3
Courtesy of GENERAL MOTORS COMPANY

19. Install EL-50115 Battery Section Lifting Adapters (1) (Qty: 2) @ Battery Section 3 (2)

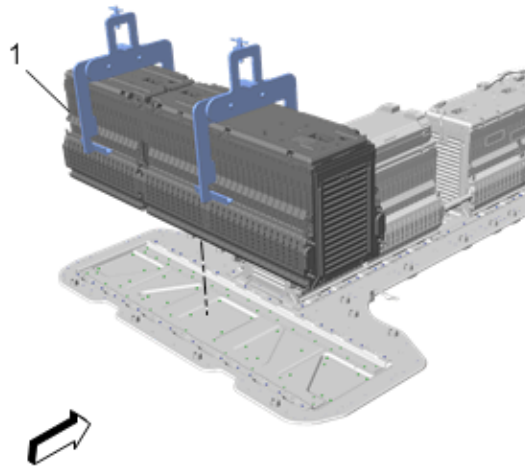


Fig. 184: Battery Section 3
Courtesy of GENERAL MOTORS COMPANY

20. Remove Battery Section 3 (1)

Installation Procedure

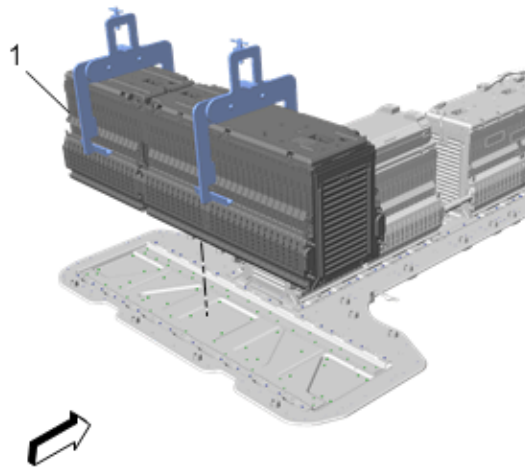


Fig. 185: Battery Section 3
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Section 3 (1)

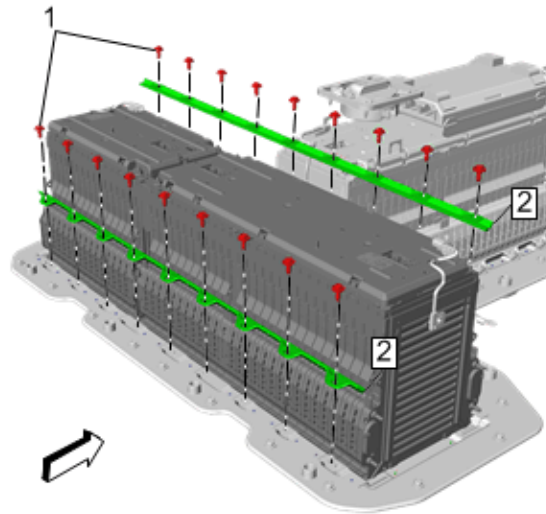


Fig. 186: Battery Hold Down Retainers And Fasteners
 Courtesy of GENERAL MOTORS COMPANY

2. Install Battery Hold Down Retainers (2) (Qty: 2)

CAUTION: Refer to Fastener Caution

3. Install and tighten Fasteners (1) (Qty: 18) to 9 N.m (80 lb in)

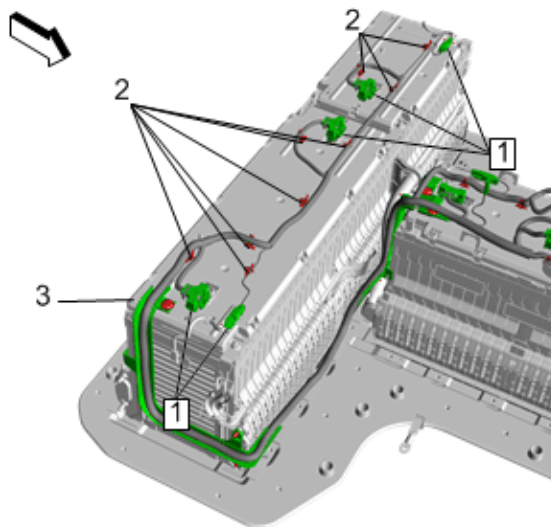


Fig. 187: Electrical Connectors And Retainers
 Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connectors (1) (Qty: 5) @ Battery Section 3 (3)
5. Connect Retainers (2) (Qty: 9)

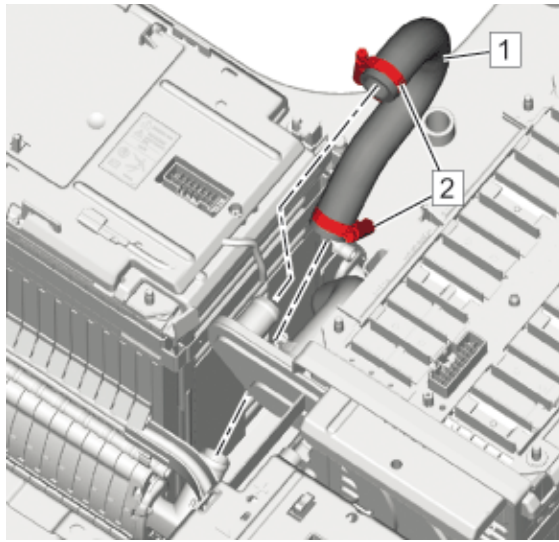


Fig. 188: High Voltage Battery Cooling Manifold Outlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

6. Install the cell battery cooling manifold outlet hose (1).
7. Tighten Clamps (2) (Qty: 2) to 2.1 N.m (19 lb in)

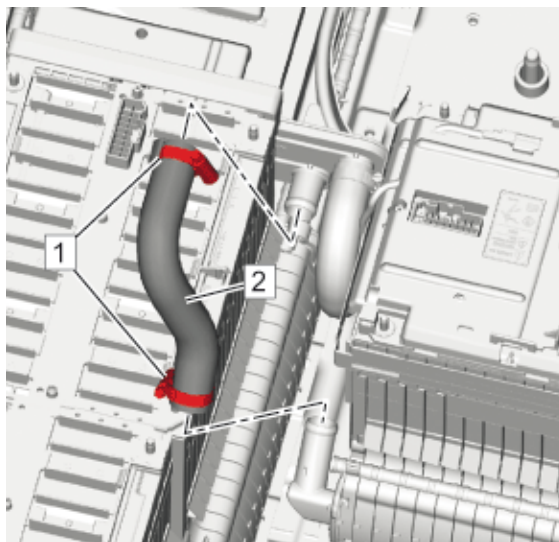


Fig. 189: High Voltage Battery Cooling Manifold Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

8. Install the cell battery cooling manifold inlet hose (2).
9. Tighten Clamps (1) (Qty: 2) to 2.1 N.m (19 lb in)

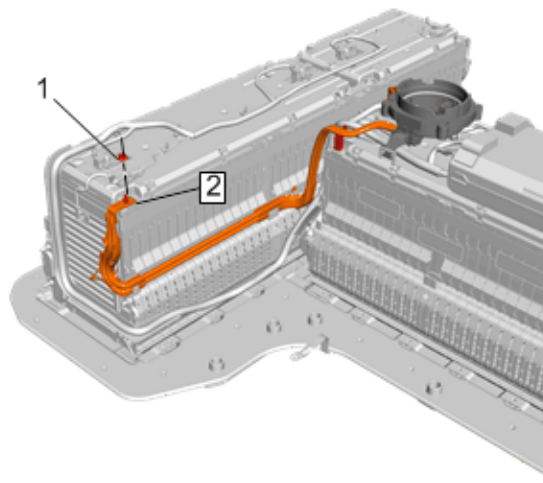


Fig. 190: High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

10. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

11. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

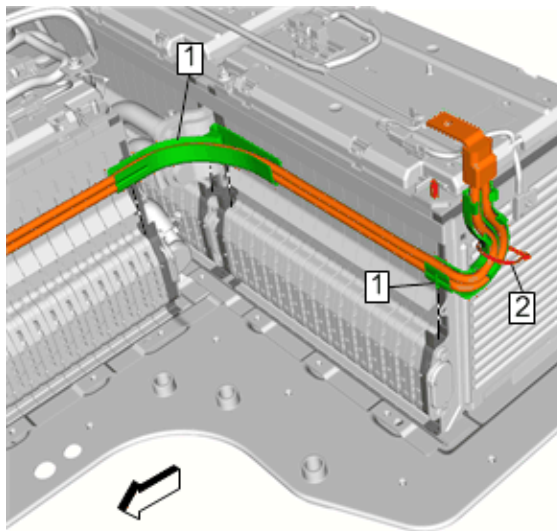


Fig. 191: Retainers And Cable Tie
 Courtesy of GENERAL MOTORS COMPANY

12. Install Retainers (1) (Qty: 2)

13. Install Cable Tie (2)

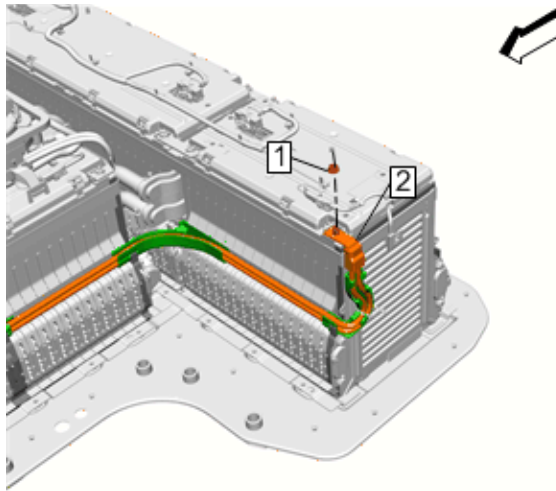


Fig. 192: High Voltage Battery Positive Cable And Fastener
 Courtesy of GENERAL MOTORS COMPANY

14. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

15. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)

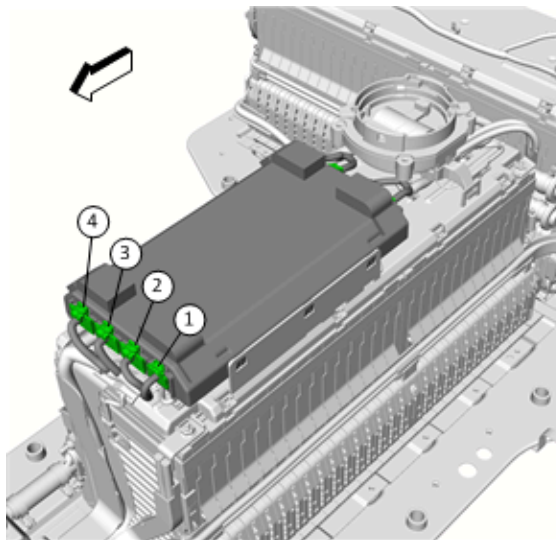


Fig. 193: Battery Energy Control Module Connector Reconnection Sequence (1 Of 2)
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to

reconnecting the battery energy control module connectors.

3. Disconnect and reconnect the battery energy control module connectors **ONLY** in the sequence provided in Repair Instructions.

16. Connect the connectors in the sequence shown @ Battery Energy Control Module

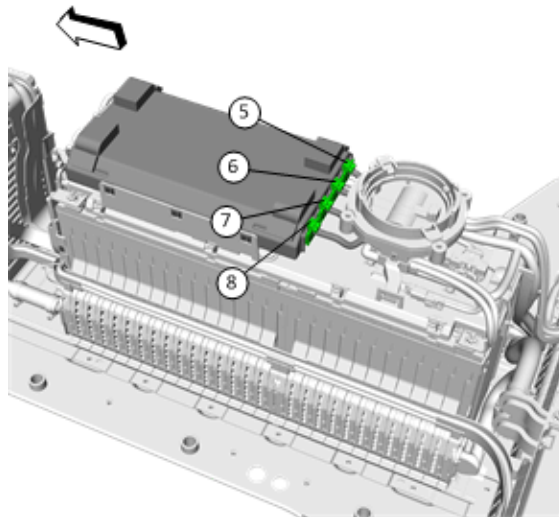


Fig. 194: Battery Energy Control Module Connector Reconnection Sequence (2 Of 2)

Courtesy of GENERAL MOTORS COMPANY

17. Connect the connectors in the sequence shown @ Battery Energy Control Module
18. Install High Voltage Battery Positive Cable. Refer to [High Voltage Battery Positive Cable Replacement \(Generator Battery Disconnect Relay to Battery Section 3\)](#)
19. Perform the Hybrid/EV battery cell balancing procedure. Refer to [Hybrid/EV Battery Cell Balancing](#)
20. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
21. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
22. Fill the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

HIGH VOLTAGE BATTERY DISCONNECT RELAY REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

2. Drain the cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)

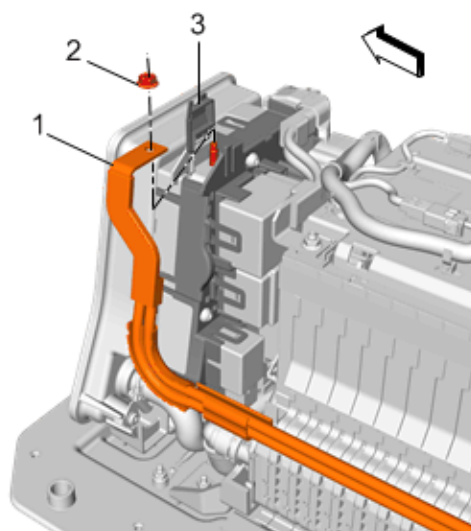


Fig. 195: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Open Terminal Cover (3)

4. Remove High Voltage Battery Positive Cable Fastener (2)

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

5. Remove High Voltage Battery Positive Cable (1)

NOTE: Cover exposed terminal with approved high voltage insulated tape.

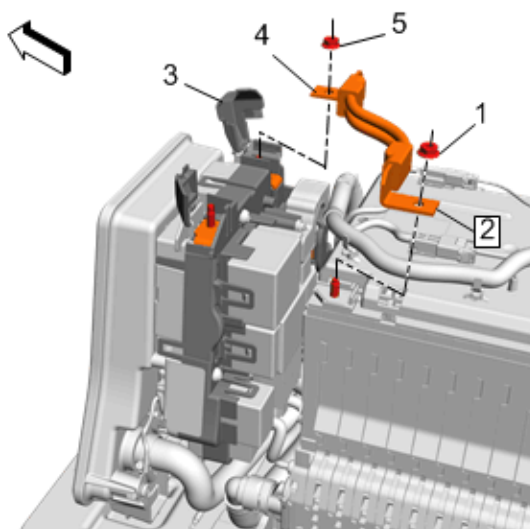


Fig. 196: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

6. Remove High Voltage Battery Positive Cable Fastener (1)

7. Remove High Voltage Battery Positive Cable (2)

8. Open Terminal Cover (3)
9. Remove High Voltage Battery Positive Cable Fastener (5)

NOTE: Do not use air tools to remove fasteners. Damage to the stud may result.

10. Remove High Voltage Battery Positive Cable (4)

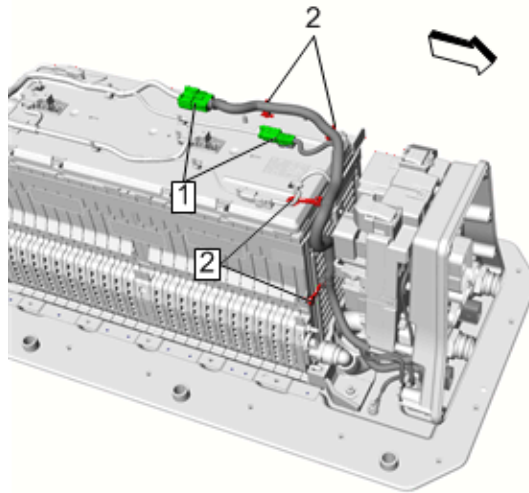


Fig. 197: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Electrical Connectors (1) (Qty: 2)
12. Release Retainers (2) (Qty: 4)

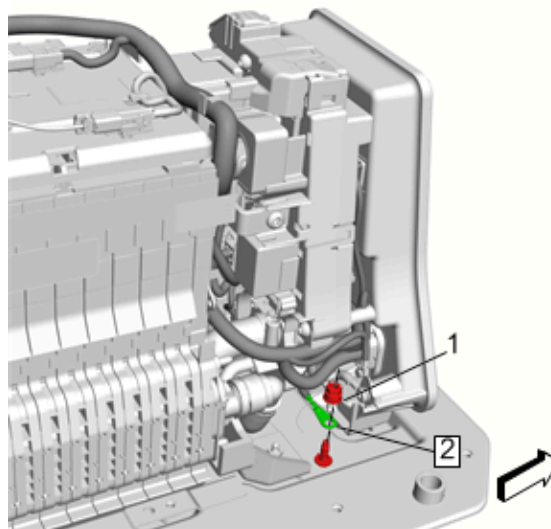


Fig. 198: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

13. Remove Ground Nut (1)
14. Remove Ground Cable (2)

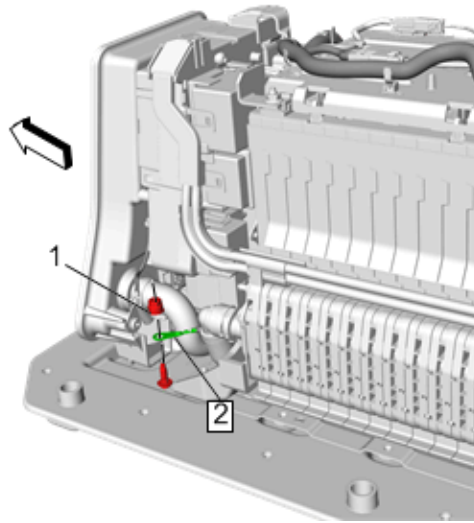


Fig. 199: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

15. Remove Ground Nut (1)
16. Remove Ground Cable (2)

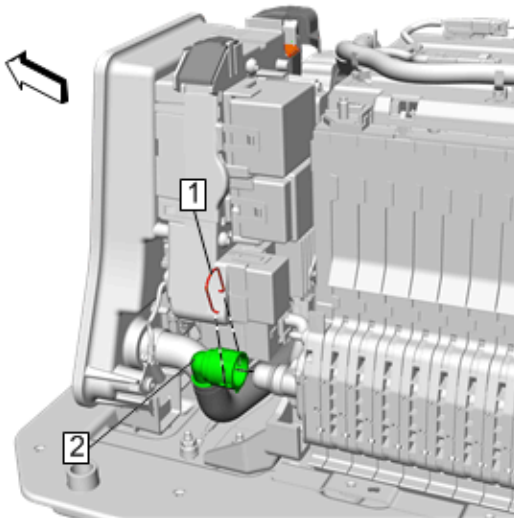


Fig. 200: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

17. Unclip the hose retainer. (1)
18. Remove High Voltage Battery Cooling Manifold Outlet Hose (2)

NOTE: Coolant must be drained before removing hoses.

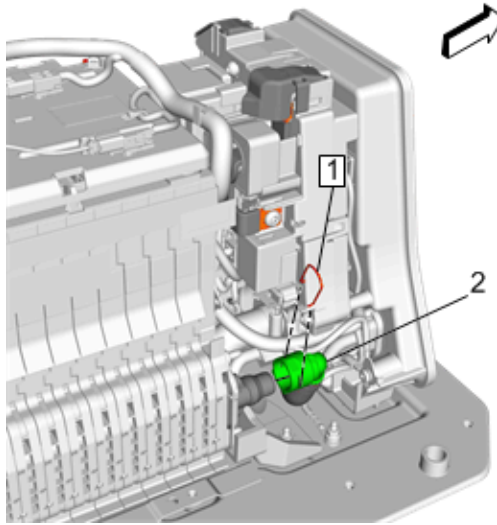


Fig. 201: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

19. Unclip the hose retainer. (1)
20. Remove High Voltage Battery Cooling Manifold Inlet Hose (2)

NOTE: Coolant must be drained before removing hoses.

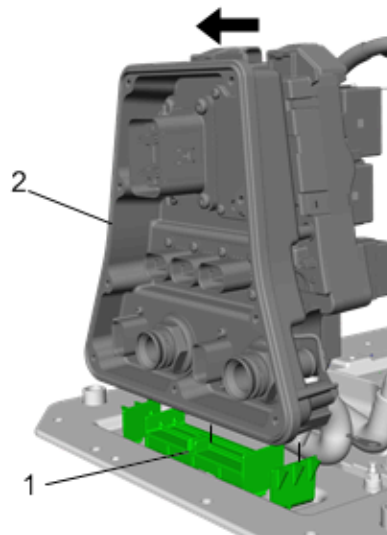


Fig. 202: High Voltage Battery Disconnect Relay And Battery Tray Front Brace
Courtesy of GENERAL MOTORS COMPANY

21. Disengage High Voltage Battery Disconnect Relay (2) @ Battery Tray Front Brace (1)
22. Remove High Voltage Battery Disconnect Relay (2)

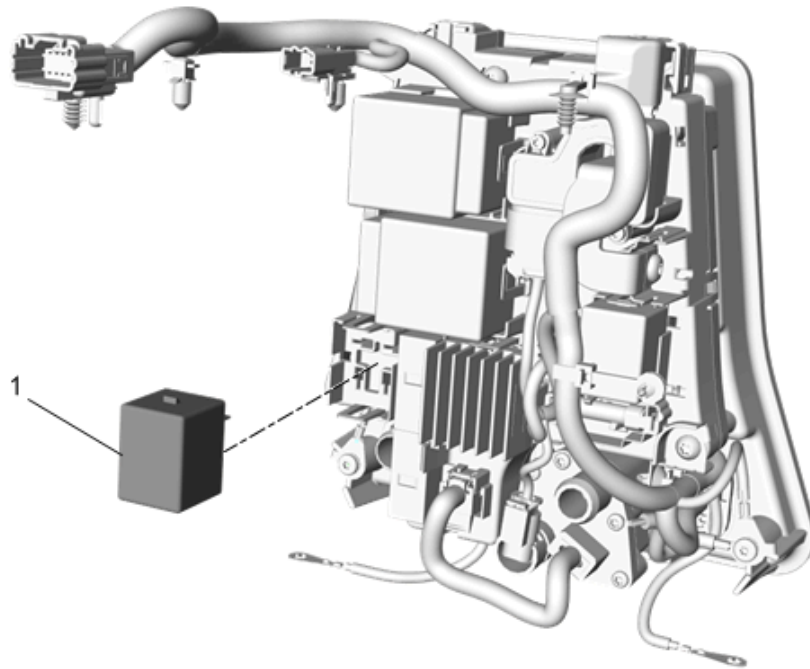


Fig. 203: High Voltage Battery Disconnect Relay - Pre-Charge Contactor
Courtesy of GENERAL MOTORS COMPANY

23. Remove High Voltage Battery Disconnect Relay - Pre-Charge Contactor (1)

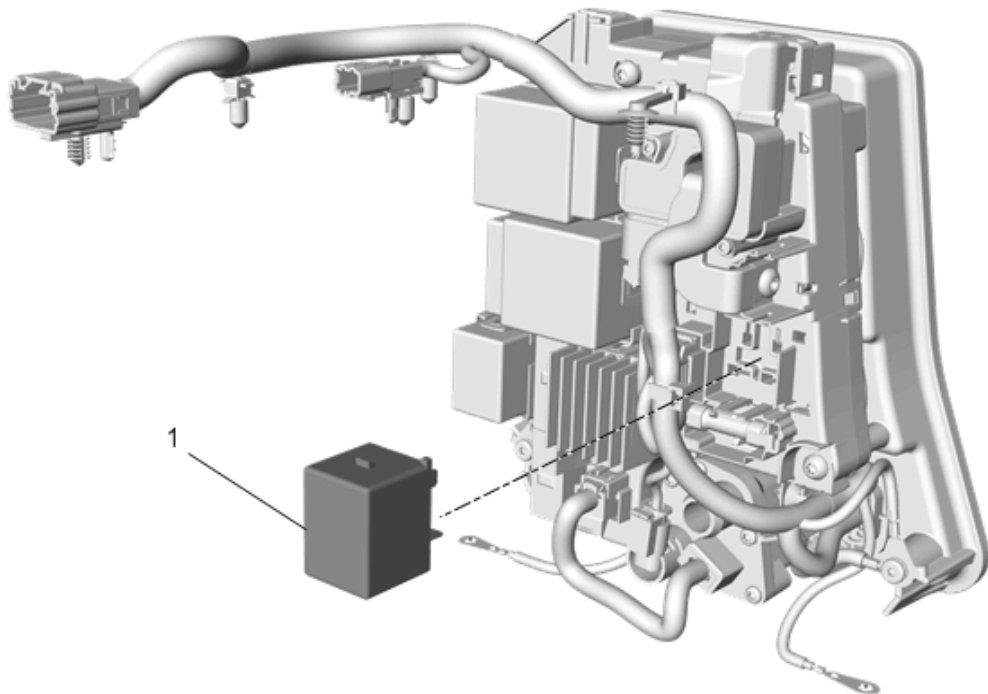


Fig. 204: High Voltage Battery Disconnect Relay - Charge Contactor
Courtesy of GENERAL MOTORS COMPANY

24. Remove High Voltage Battery Disconnect Relay - Charge Contactor (1)
25. Transfer components as necessary.

Installation Procedure

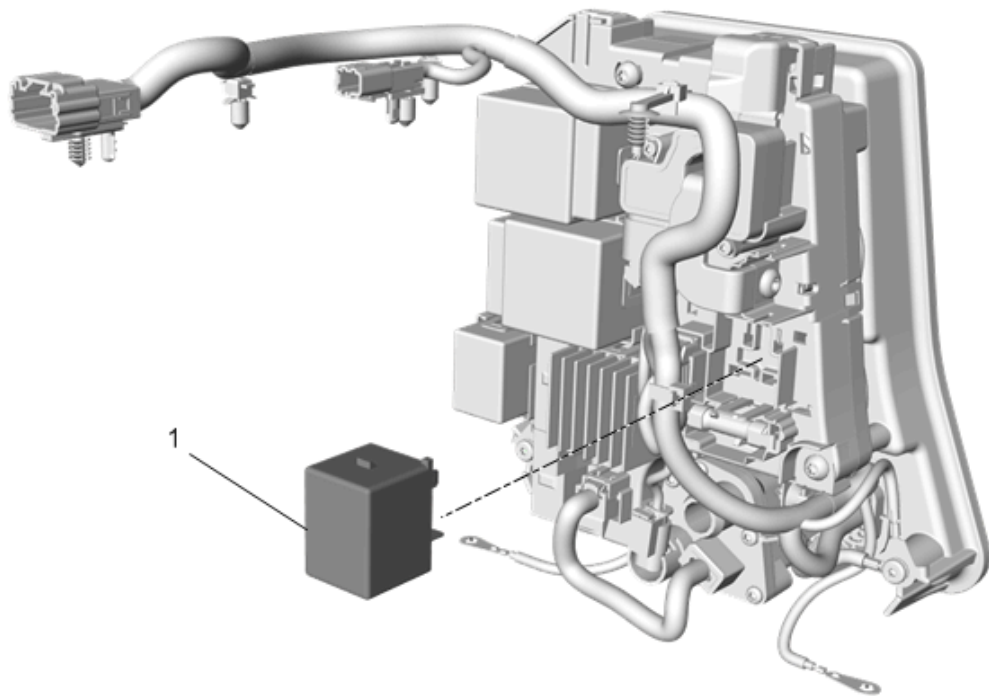


Fig. 205: High Voltage Battery Disconnect Relay - Charge Contactor
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Disconnect Relay - Charge Contactor (1)

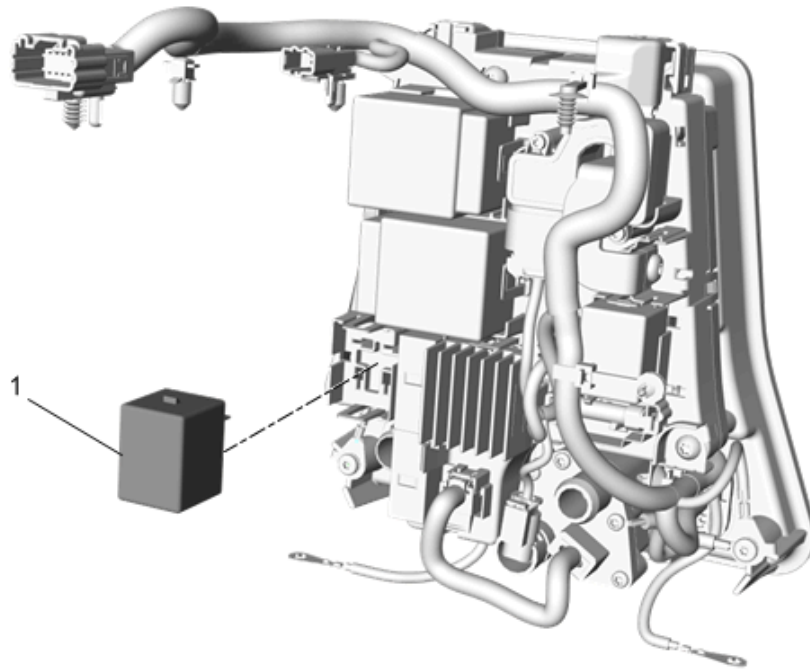


Fig. 206: High Voltage Battery Disconnect Relay - Pre-Charge Contactor
Courtesy of GENERAL MOTORS COMPANY

2. Install High Voltage Battery Disconnect Relay - Pre-Charge Contactor (1)

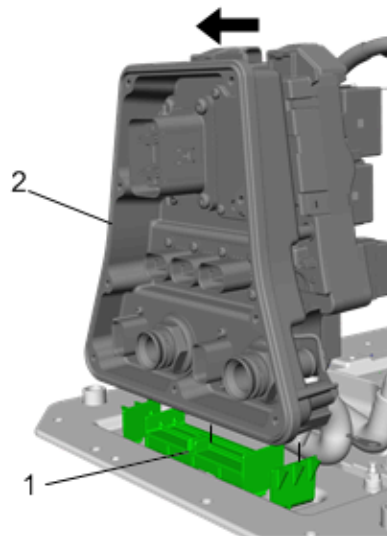


Fig. 207: High Voltage Battery Disconnect Relay And Battery Tray Front Brace
Courtesy of GENERAL MOTORS COMPANY

3. Engage High Voltage Battery Disconnect Relay (2) @ Battery Tray Front Brace (1)

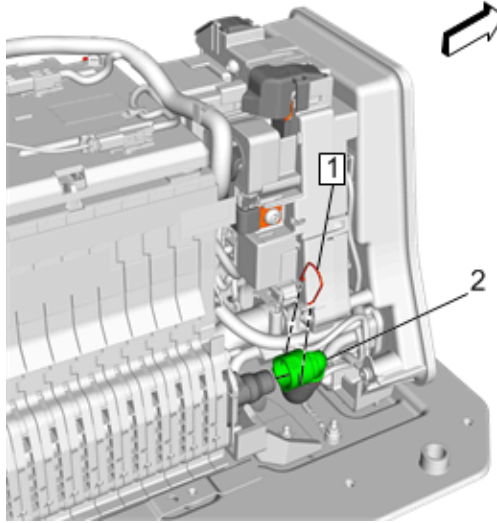


Fig. 208: High Voltage Battery Cooling Manifold Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install High Voltage Battery Cooling Manifold Inlet Hose (2)
5. Install the retainer. (1)

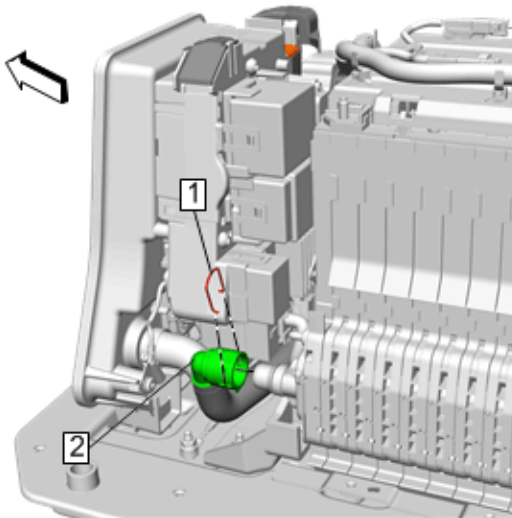


Fig. 209: High Voltage Battery Cooling Manifold Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery Cooling Manifold Outlet Hose (2)
7. Install the retainer. (1)

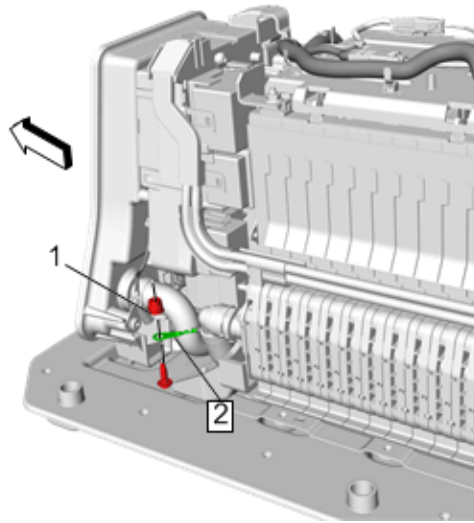


Fig. 210: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install Ground Cable (2)

CAUTION: Refer to **Fastener Caution**

9. Install and tighten Ground Nut (1) to 9 N.m (80 lb in)

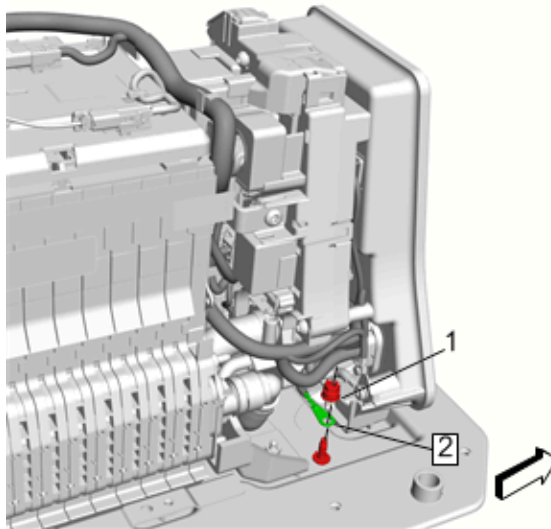


Fig. 211: Ground Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

10. Install Ground Cable (2)

11. Install and tighten Ground Nut (1) to 9 N.m (80 lb in)

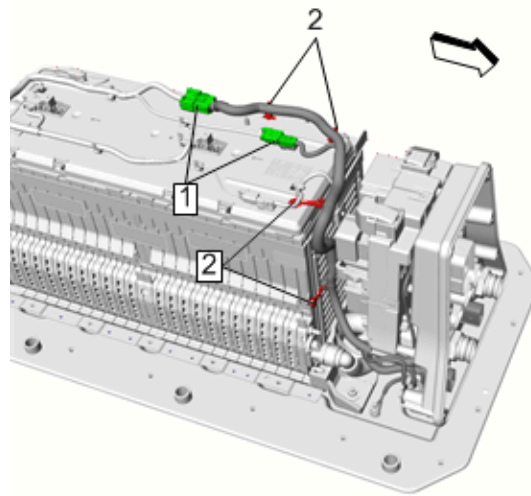


Fig. 212: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

12. Connect Electrical Connectors (1) (Qty: 2)
13. Install Retainers (2) (Qty: 4)

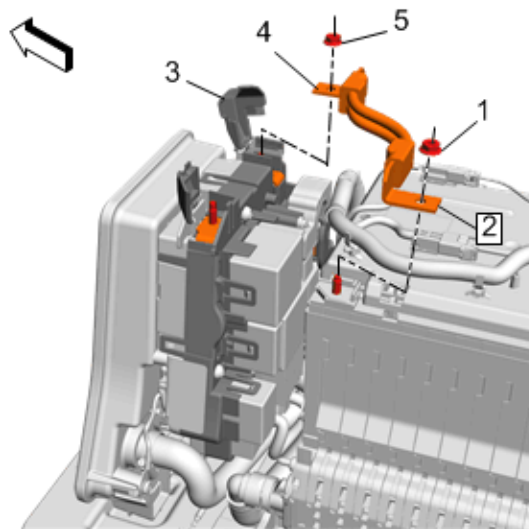


Fig. 213: High Voltage Battery Positive Cable, Fasteners And Terminal Cover
Courtesy of GENERAL MOTORS COMPANY

14. Install High Voltage Battery Positive Cable (2)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

15. Install and tighten High Voltage Battery Positive Cable Fastener (1) to 9 N.m (80 lb in)
16. Install High Voltage Battery Positive Cable (4)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

17. Install and tighten High Voltage Battery Positive Cable Fastener (5) to 9 N.m (80 lb in)

18. Close Terminal Cover (3)

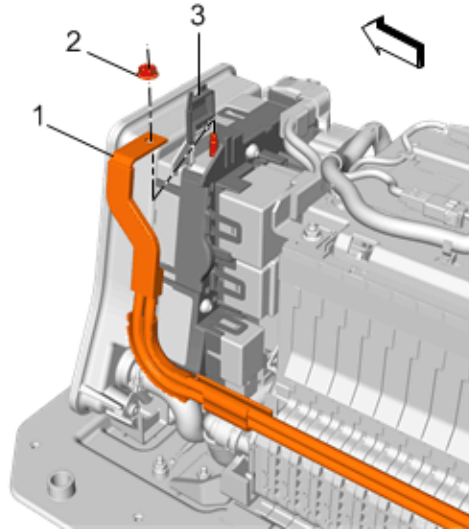


Fig. 214: Terminal Cover, High Voltage Battery Positive Cable And Fastener
Courtesy of GENERAL MOTORS COMPANY

19. Install High Voltage Battery Positive Cable (1)

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

20. Install and tighten High Voltage Battery Positive Cable Fastener (2) to 9 N.m (80 lb in)

21. Close Terminal Cover (3)

22. Perform a smoke test on the rechargeable energy storage system. Refer to [Rechargeable Energy Storage System Smoke Test](#)

23. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)

24. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

25. Fill the cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

HIGH VOLTAGE BATTERY DISCONNECT RELAY SEAL REPLACEMENT

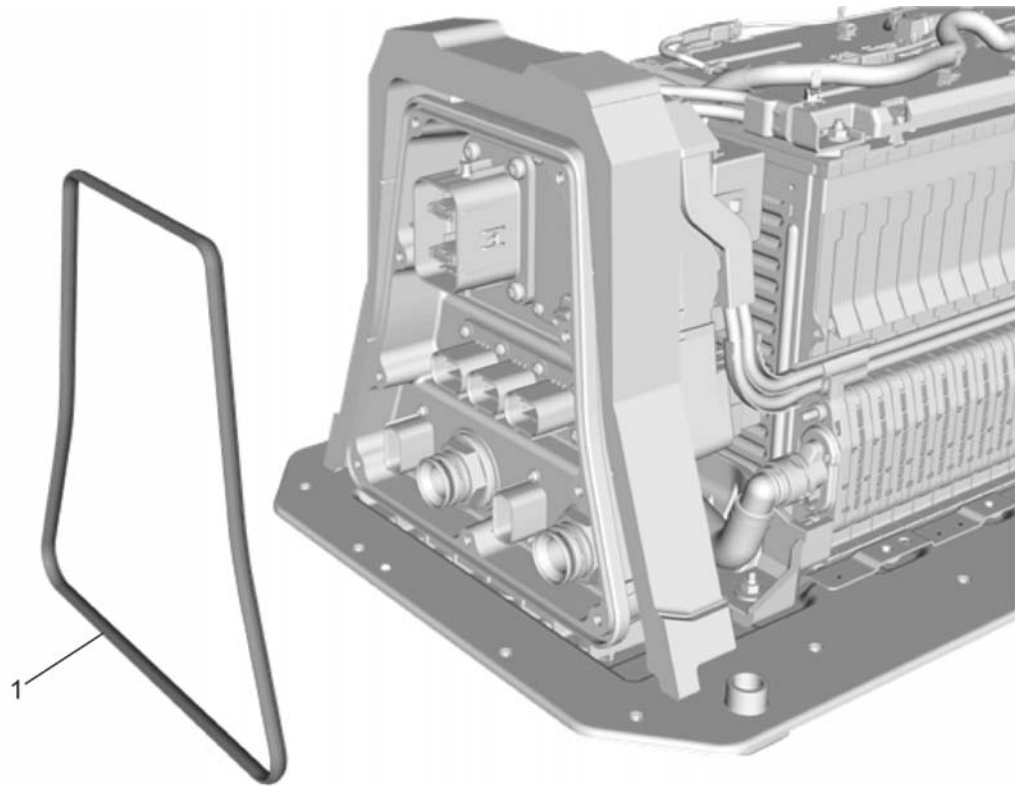


Fig. 215: High Voltage Battery Disconnect Relay Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	High Voltage Battery Disconnect Relay Seal

HIGH VOLTAGE BATTERY DISCONNECT RELAY FUSE REPLACEMENT (FRONT - BDU)

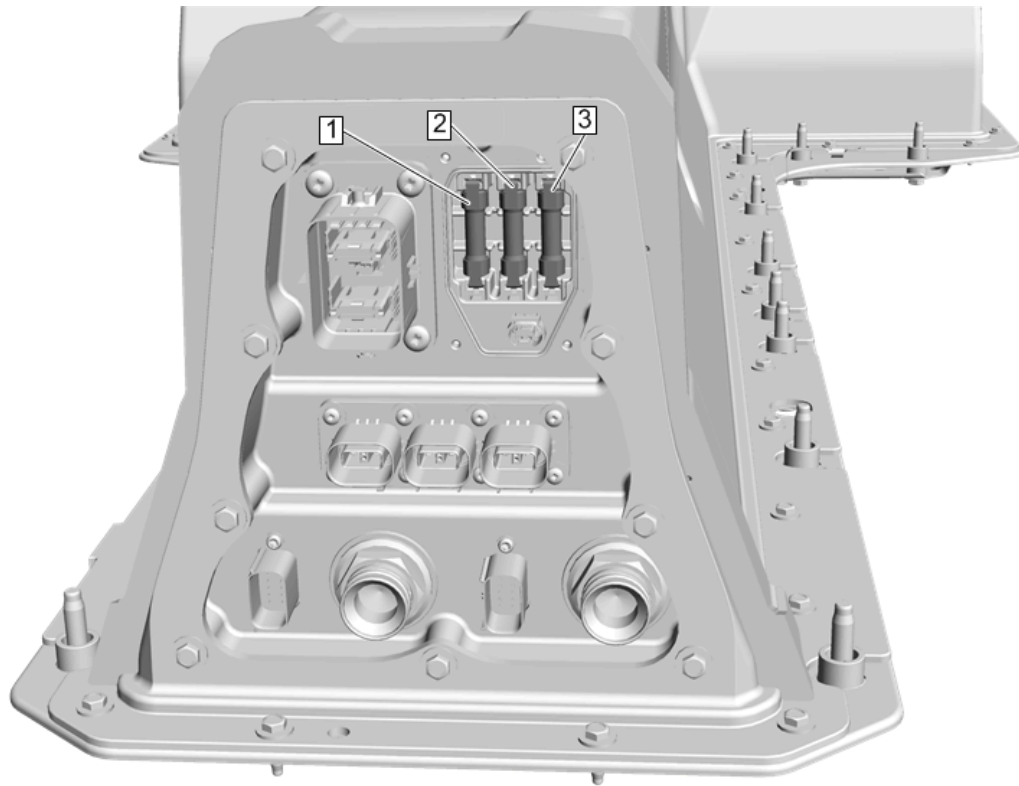


Fig. 216: High Voltage Battery Disconnect Relay Fuse (Front - BDU)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high	

Callout	Component Name
	voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the

Callout	Component Name
	high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. 1. Disable the high voltage system. Refer to High Voltage Disabling 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle 3. Remove Fuse Block Cover. Refer to Fuse Block Cover Replacement
1	40 Amp Fuse - ACCM
2	15 Amp Fuse - OBCM
3	30 Amp Fuse - CHCM

HIGH VOLTAGE BATTERY DISCONNECT RELAY FUSE REPLACEMENT (REAR - BDU)

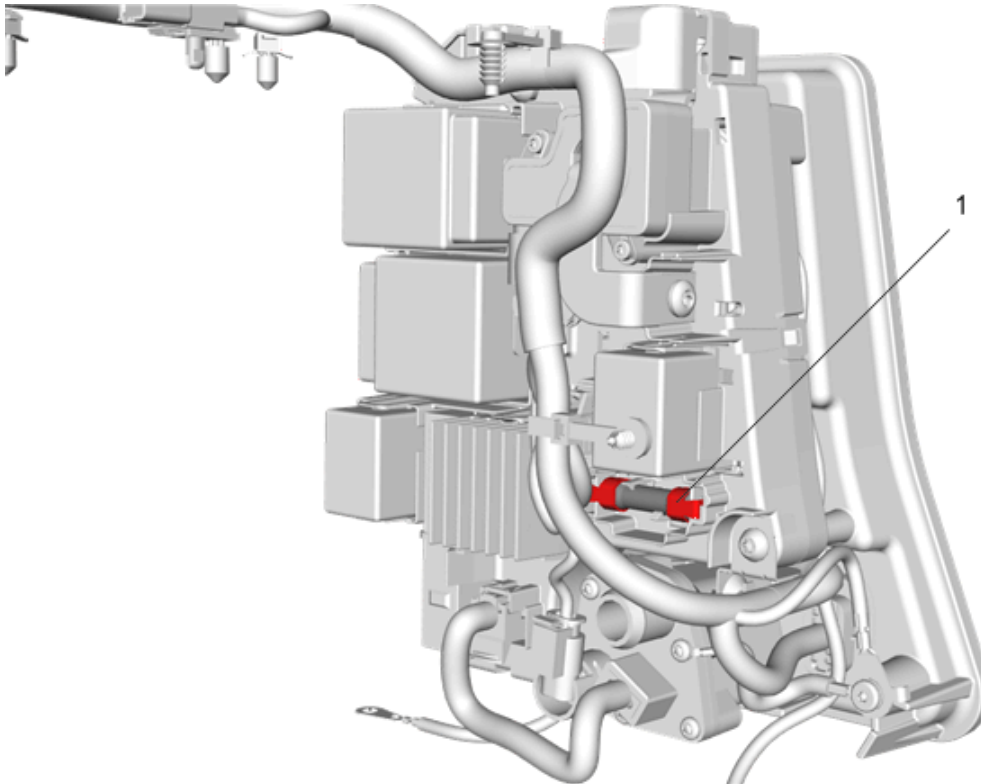


Fig. 217: High Voltage Battery Disconnect Relay Fuse (Rear - BDU)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle 2. Remove Drive Motor Battery. Refer to Drive Motor Battery Replacement and Shipping Preparation 3. Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement	
1	10 Amp Heater Fuse

HIGH VOLTAGE BATTERY PRECHARGE RESISTOR REPLACEMENT

Removal Procedure

1. Remove High Voltage Battery Disconnect Relay. Refer to [High Voltage Battery Disconnect Relay Replacement](#)

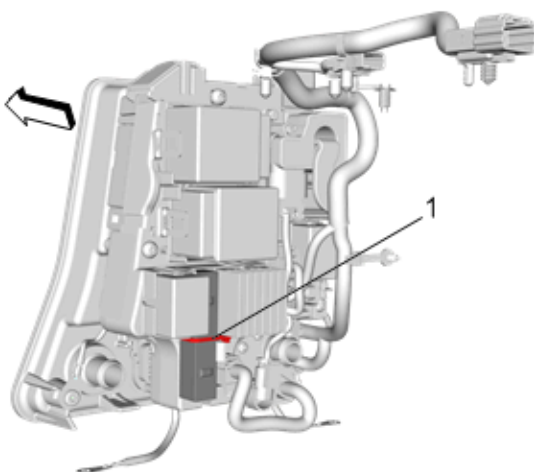


Fig. 218: Tie-Wrap

Courtesy of GENERAL MOTORS COMPANY

2. Remove Tie-Wrap (1)

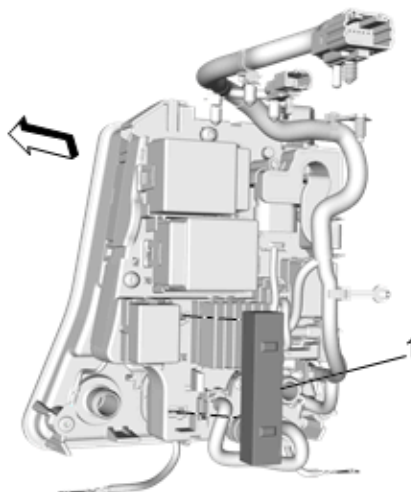


Fig. 219: High Voltage Battery Pre-Charge Resistor

Courtesy of GENERAL MOTORS COMPANY

3. Remove High Voltage Battery Pre-Charge Resistor (1)

Installation Procedure

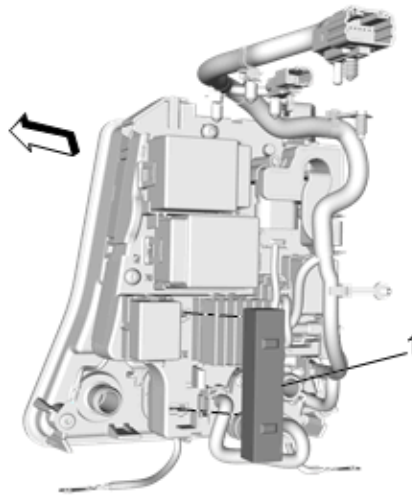


Fig. 220: High Voltage Battery Pre-Charge Resistor

Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Pre-Charge Resistor (1)

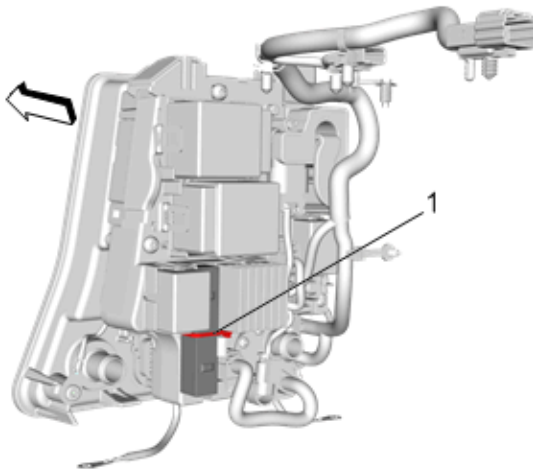


Fig. 221: Tie-Wrap

Courtesy of GENERAL MOTORS COMPANY

2. Install Tie-Wrap (1)
3. Install High Voltage Battery Disconnect Relay. Refer to [High Voltage Battery Disconnect Relay Replacement](#)

FUSE BLOCK COVER REPLACEMENT

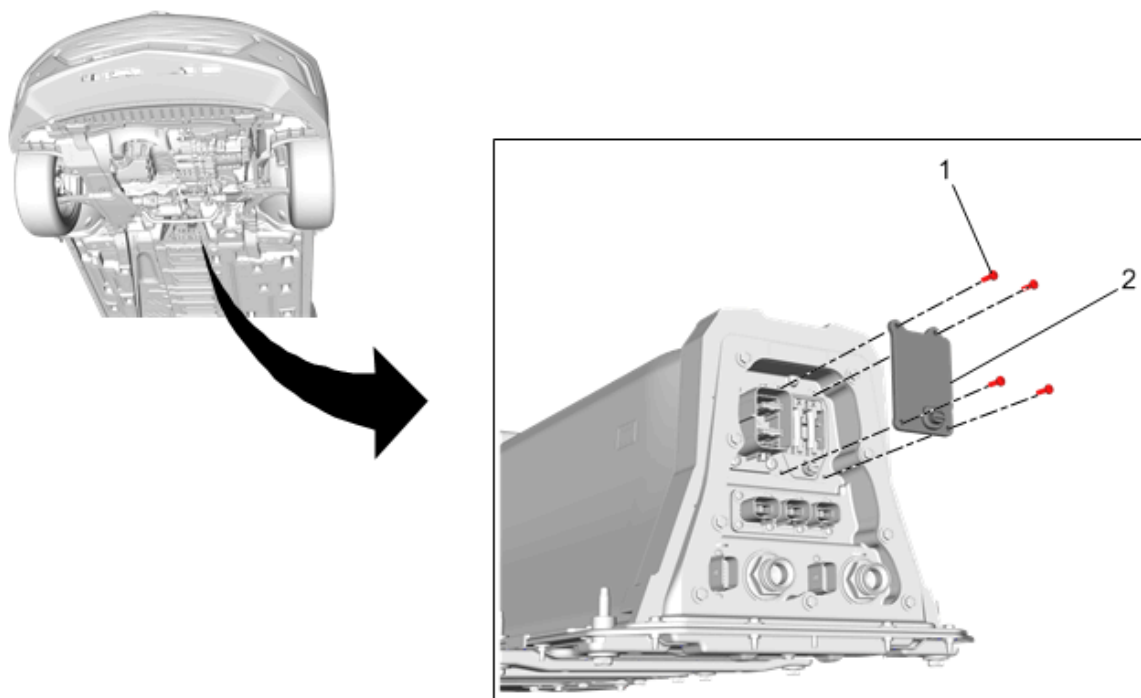


Fig. 222: Fuse Block Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high	

Callout	Component Name
	voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the

Callout	Component Name
	high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. 1. Disable the high voltage system. Refer to High Voltage Disabling 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
1	Fastener (Qty: 4) CAUTION: Refer to Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Fuse Block Cover

DRIVE MOTOR BATTERY NEGATIVE HIGH VOLTAGE CONTACTOR RELAY REPLACEMENT

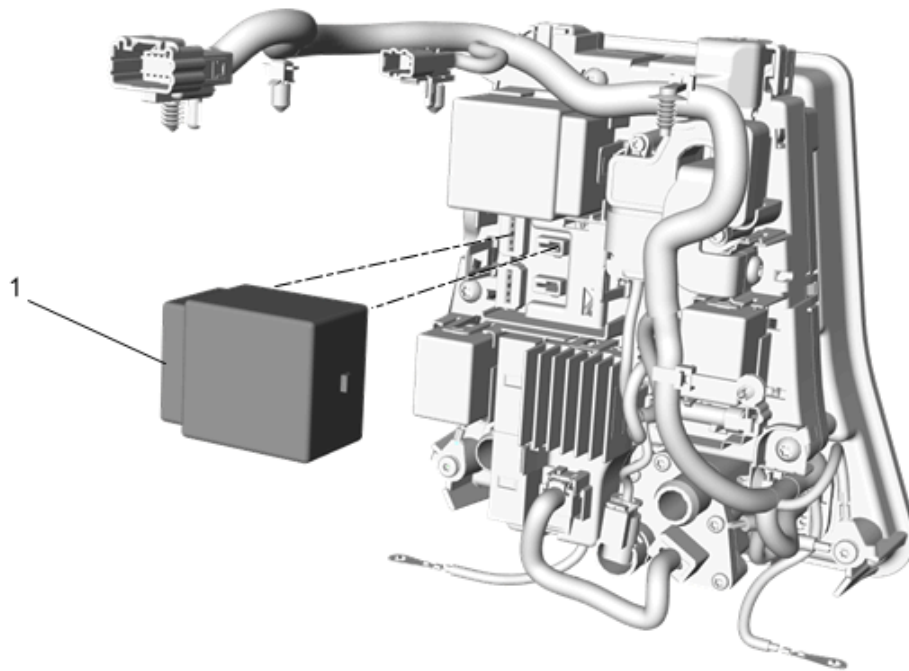


Fig. 223: Drive Motor Battery Negative High Voltage Contactor Relay
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove High Voltage Battery Disconnect Relay. Refer to High Voltage Battery Disconnect Relay Replacement	
1	Drive Motor Battery Negative High Voltage Contactor Relay

DRIVE MOTOR BATTERY POSITIVE HIGH VOLTAGE CONTACTOR RELAY REPLACEMENT

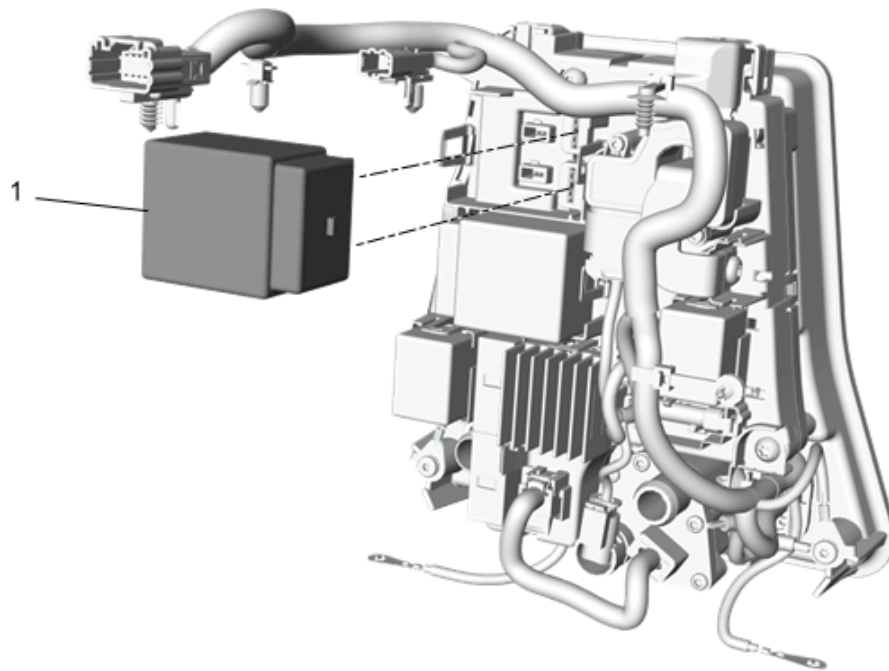


Fig. 224: Drive Motor Battery Positive High Voltage Contactor Relay

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove High Voltage Battery Disconnect Relay. Refer to High Voltage Battery Disconnect Relay Replacement	
1	Drive Motor Battery Positive High Voltage Contactor Relay

BATTERY 300-VOLT POSITIVE AND NEGATIVE CABLE REPLACEMENT - HIGH VOLTAGE BATTERY TO POWER INVERTER MODULE AND A/C COMPRESSOR

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.

- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

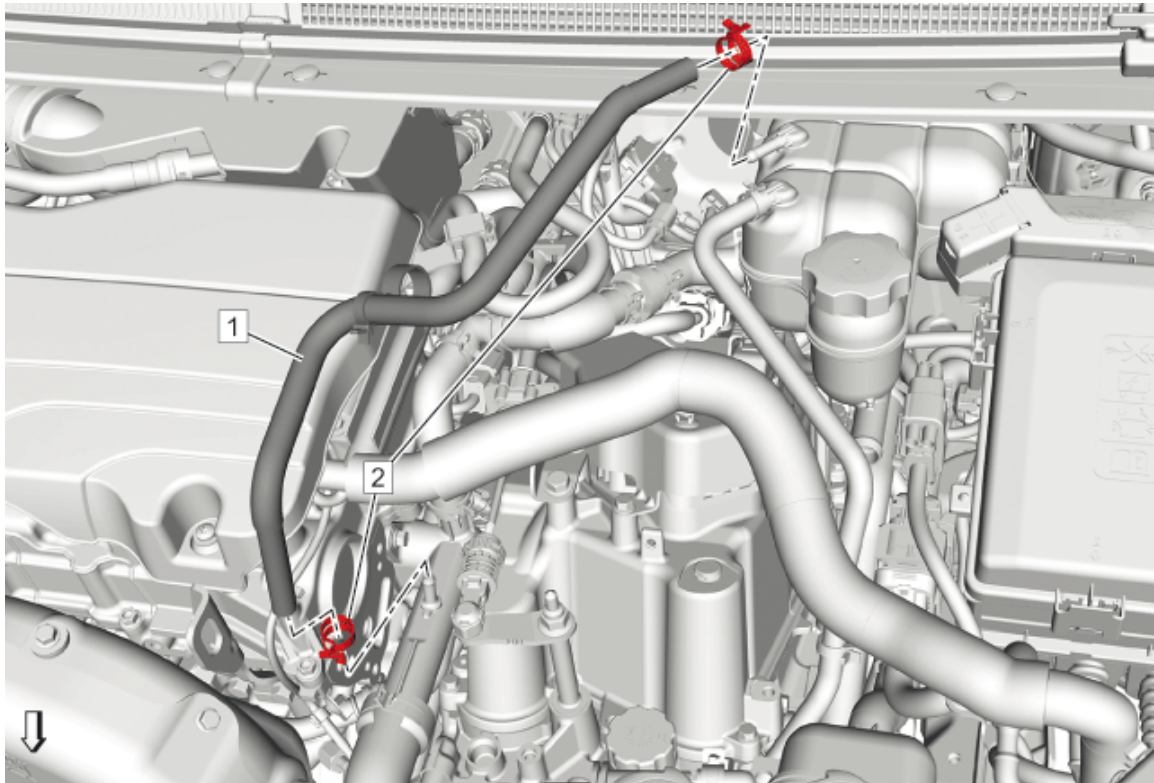


Fig. 225: Heater Outlet Hose Vapor Vent Hose
Courtesy of GENERAL MOTORS COMPANY

2. Remove Heater Outlet Hose Vapor Vent Hose (1). Refer to [Heater Outlet Hose Vapor Vent Hose Replacement](#)

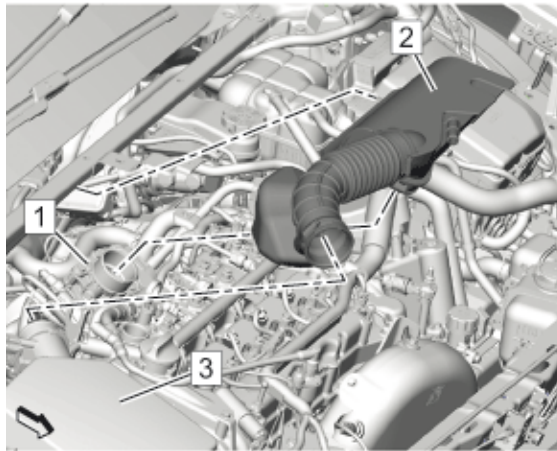


Fig. 226: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body
Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Cleaner Outlet Duct (2). Refer to [Air Cleaner Outlet Duct Replacement](#)

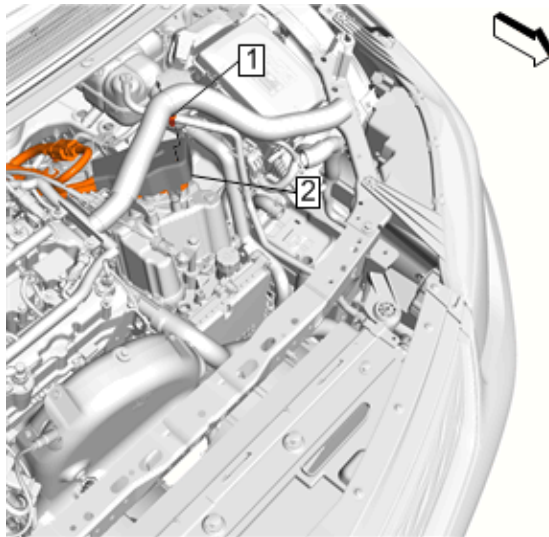


Fig. 227: Engine Wiring Harness Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Engine Wiring Harness Retainer (1)

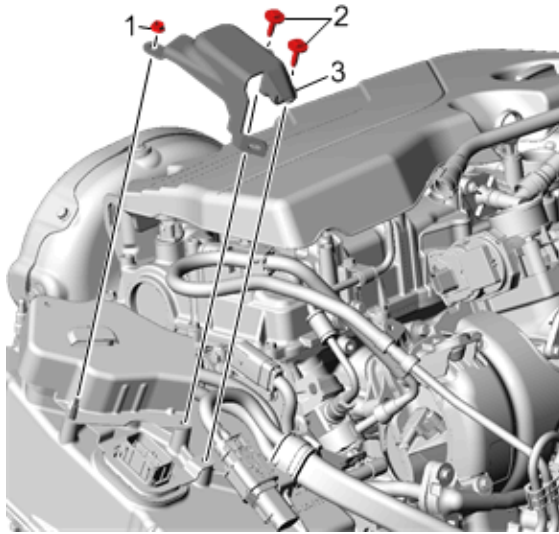


Fig. 228: T6 Power Inverter Module X1 56-Way Connector Cover, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove Power Inverter Module Connector Cover Nut (1)
6. Remove Power Inverter Module Connector Cover Bolts (2) (Qty: 2)
7. Remove Power Inverter Module Connector Cover (3)

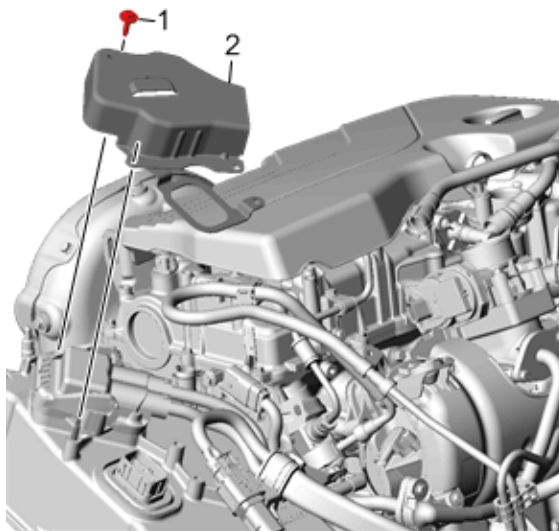


Fig. 229: T6 Power Inverter Module X2 HV Cable Cover And Remaining Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Power Inverter Module High Voltage Cable Cover Bolt (1)
9. Remove Power Inverter Module High Voltage Cable Cover (2)

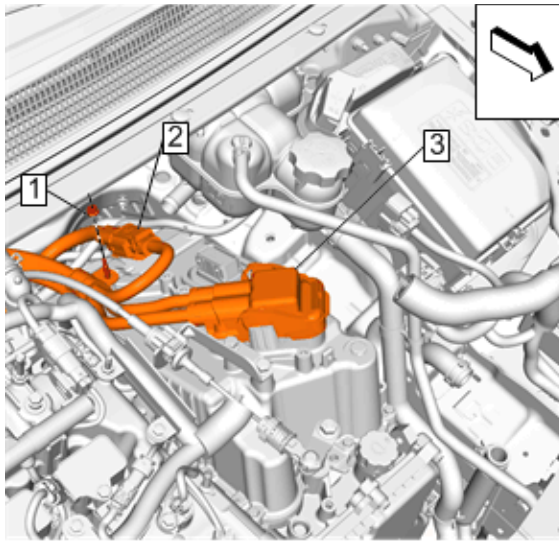


Fig. 230: Electrical Connectors And Fastener
Courtesy of GENERAL MOTORS COMPANY

10. Remove Fastener (1)
11. Disconnect Electrical Connector (2)
12. Disconnect Electrical Connector (3)

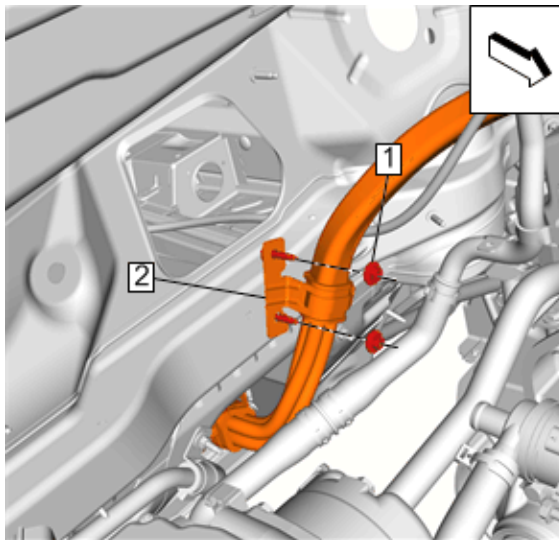


Fig. 231: Cable Bracket And Fasteners
Courtesy of GENERAL MOTORS COMPANY

13. Remove Fasteners (1) (Qty: 2)
14. Remove Cable Bracket (2)
15. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
16. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)

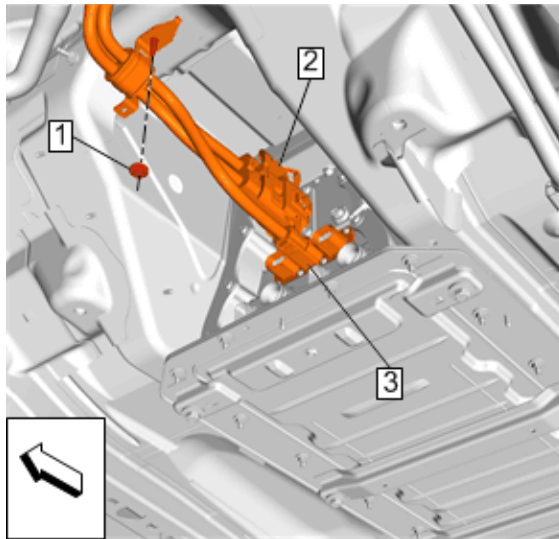


Fig. 232: Electrical Connectors And Fastener
Courtesy of GENERAL MOTORS COMPANY

17. Remove Fastener (1)
18. Disconnect Electrical Connector (2)
19. Disconnect Electrical Connector (3)

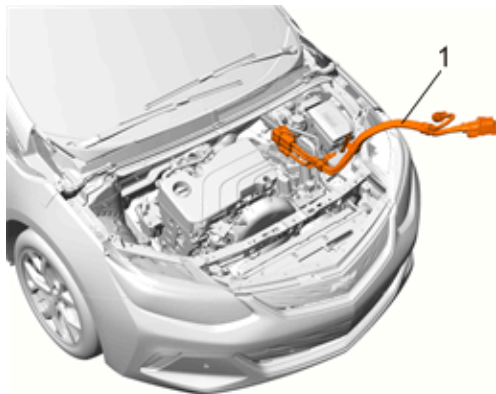


Fig. 233: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

20. Remove High Voltage Battery Positive Cable (1)

Installation Procedure



Fig. 234: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Positive Cable (1)

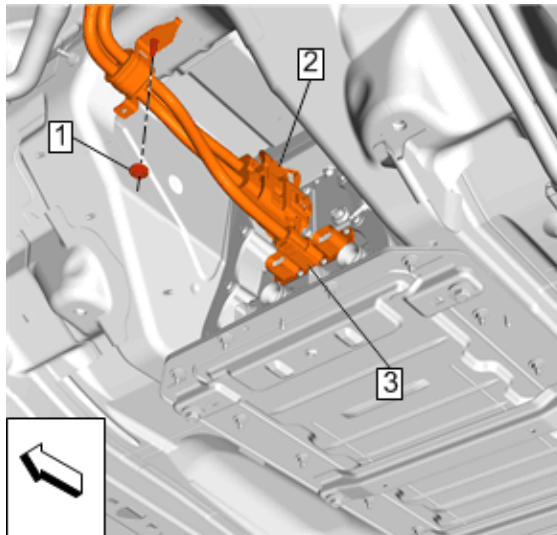


Fig. 235: Electrical Connectors And Fastener
Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connector (3)
3. Connect Electrical Connector (2)
4. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)

CAUTION: Refer to [Fastener Caution](#)

5. Install and tighten Fastener (1) to 9 N.m (80 lb in)

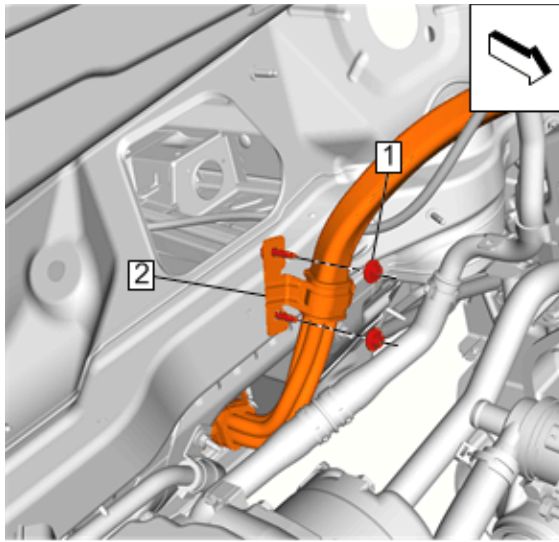


Fig. 236: Cable Bracket And Fasteners

Courtesy of GENERAL MOTORS COMPANY

6. Install Cable Bracket (2)
7. Install and tighten Fasteners (1) (Qty: 2) to 9 N.m (80 lb in)

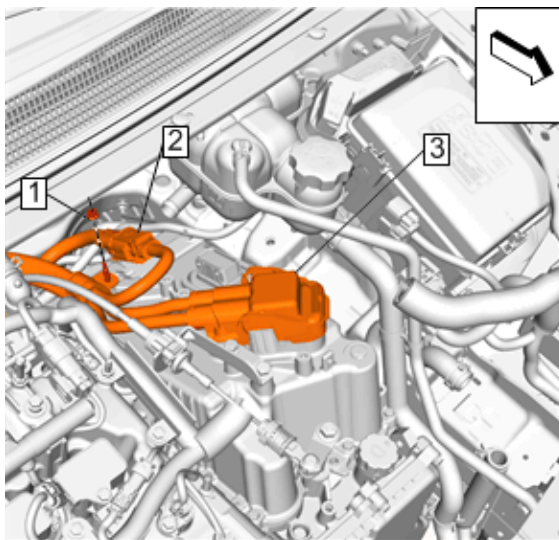


Fig. 237: Electrical Connectors And Fastener

Courtesy of GENERAL MOTORS COMPANY

8. Connect Electrical Connector (3)
9. Connect Electrical Connector (2)
10. Install and tighten Fastener (1) to 9 N.m (80 lb in)

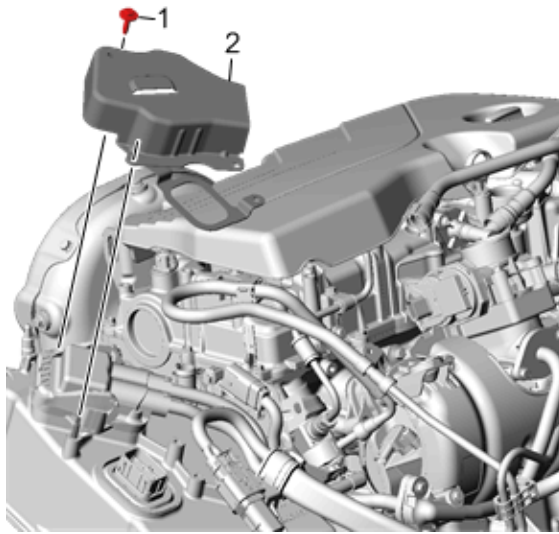


Fig. 238: T6 Power Inverter Module X2 HV Cable Cover And Remaining Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Install Power Inverter Module High Voltage Cable Cover (2)
12. Install and tighten Power Inverter Module High Voltage Cable Cover Bolt (1) to 9 N.m (80 lb in)

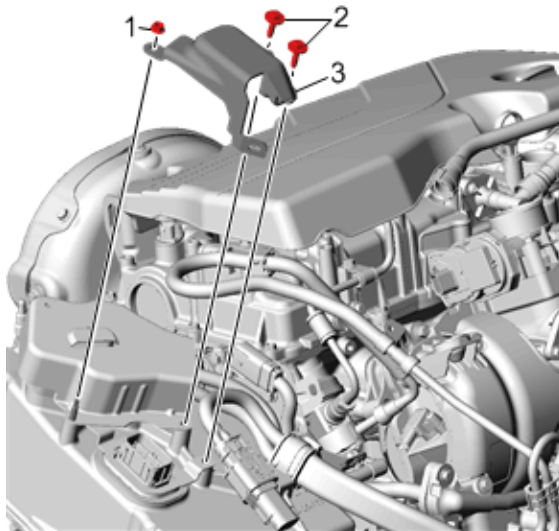


Fig. 239: T6 Power Inverter Module X1 56-Way Connector Cover, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install Power Inverter Module Connector Cover (3)
14. Install and tighten Power Inverter Module Connector Cover Bolts (2) (Qty: 2) to 9 N.m (80 lb in)
15. Install and tighten Power Inverter Module Connector Cover Nut (1) to 9 N.m (80 lb in)

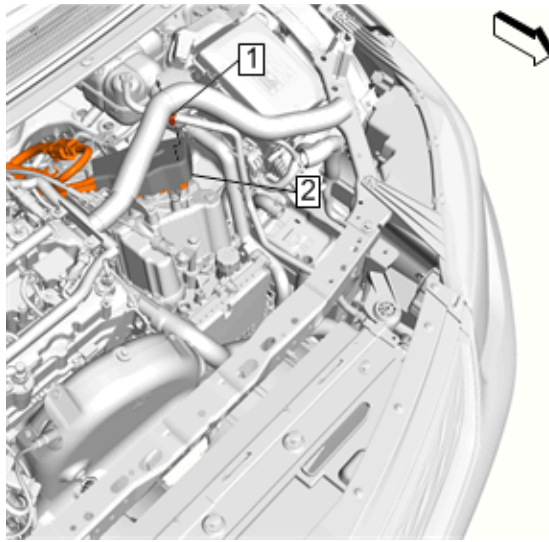


Fig. 240: Engine Wiring Harness Retainer
Courtesy of GENERAL MOTORS COMPANY

16. Engage Engine Wiring Harness Retainer (1)

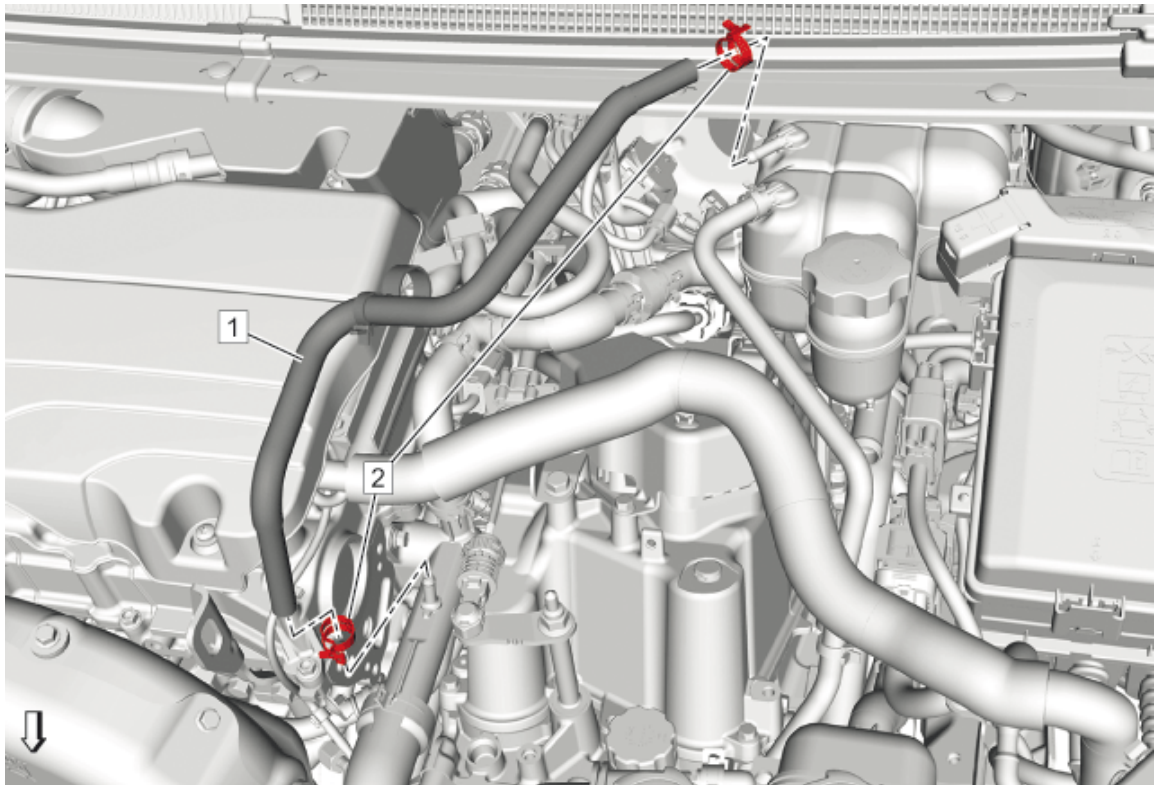


Fig. 241: Heater Outlet Hose Vapor Vent Hose
Courtesy of GENERAL MOTORS COMPANY

17. Install Heater Outlet Hose Vapor Vent Hose (1). Refer to [Heater Outlet Hose Vapor Vent Hose Replacement](#)

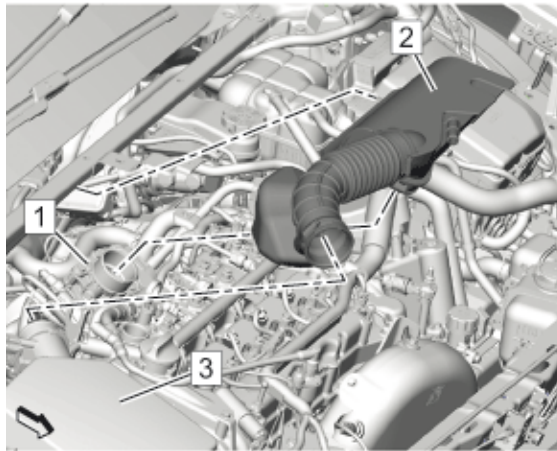


Fig. 242: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body
 Courtesy of GENERAL MOTORS COMPANY

18. Install Air Cleaner Outlet Duct (2). Refer to [Air Cleaner Outlet Duct Replacement](#)

19. Enable High Voltage System. Refer to [High Voltage Enabling](#)

BATTERY 300-VOLT POSITIVE AND NEGATIVE CABLE REPLACEMENT - HIGH VOLTAGE BATTERY TO HEATER COOLANT HEATER

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
4. Remove Front Compartment Air Deflector. Refer to [Front Compartment Air Deflector Replacement](#)
5. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)

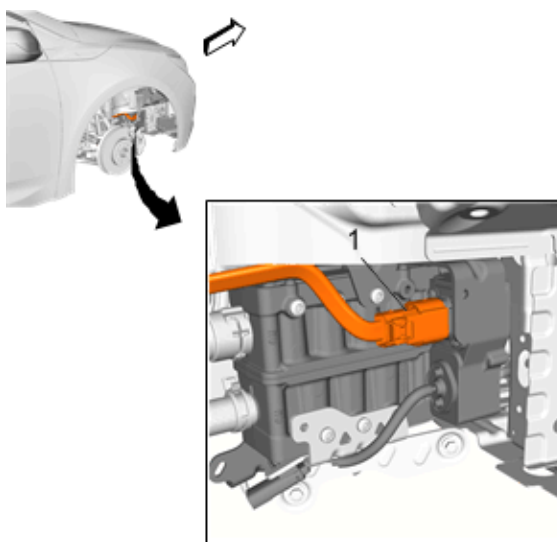


Fig. 243: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Electrical Connector (1)

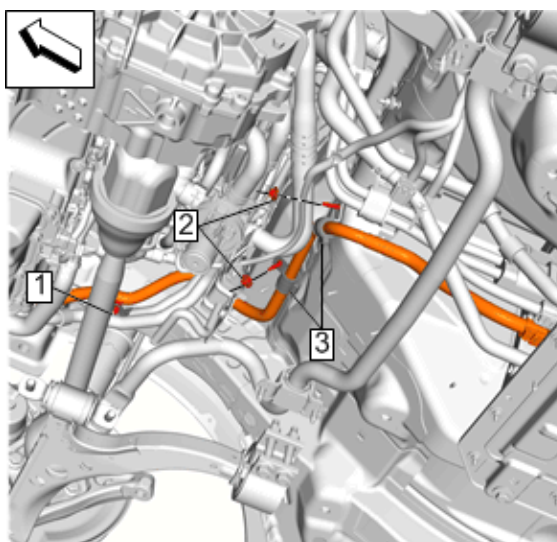


Fig. 244: Cable Brackets, Retainer And Fasteners

Courtesy of GENERAL MOTORS COMPANY

7. Disengage Retainer (1)
8. Remove Fasteners (2) (Qty: 2)
9. Remove Cable Brackets (3) (Qty: 2)

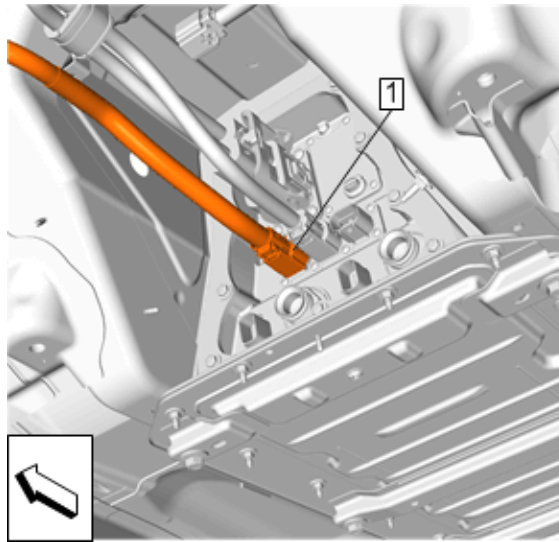


Fig. 245: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Electrical Connector (1)

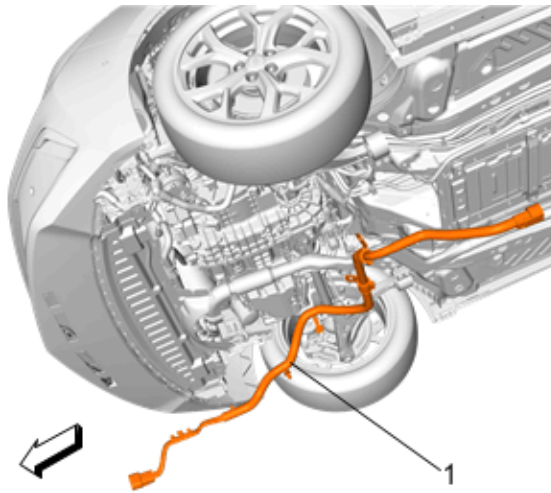


Fig. 246: High Voltage Battery Positive Cable

Courtesy of GENERAL MOTORS COMPANY

11. Remove High Voltage Battery Positive Cable (1)

Installation Procedure

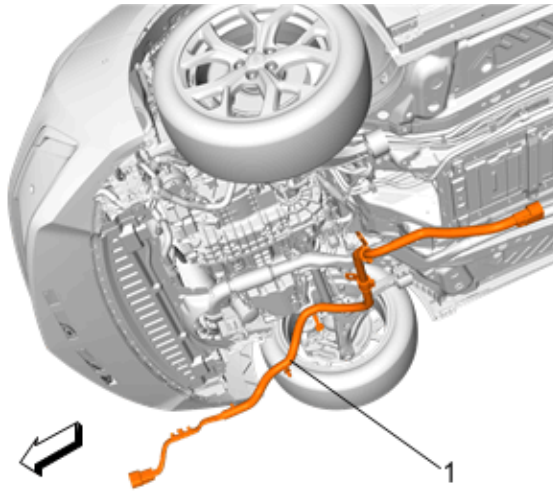


Fig. 247: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Positive Cable (1)

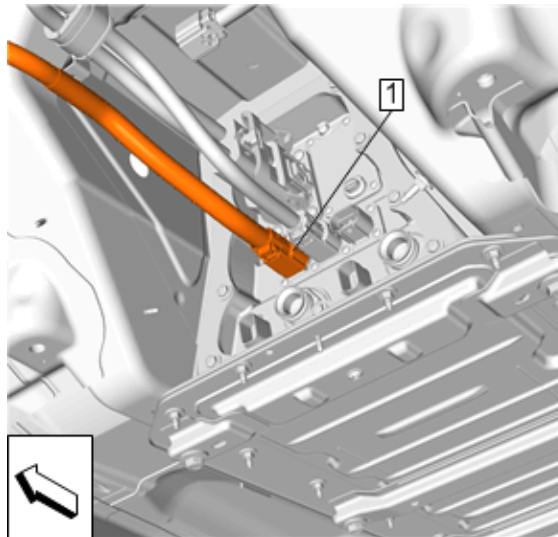


Fig. 248: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connector (1)

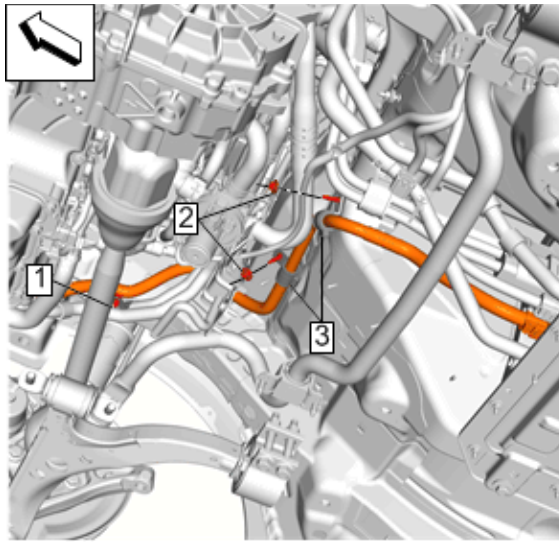


Fig. 249: Cable Brackets, Retainer And Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Install Cable Brackets (3) (Qty: 2)
4. Install and tighten Fasteners (2) (Qty: 2) to 9 N.m (80 lb in)
5. Engage Retainer (1)

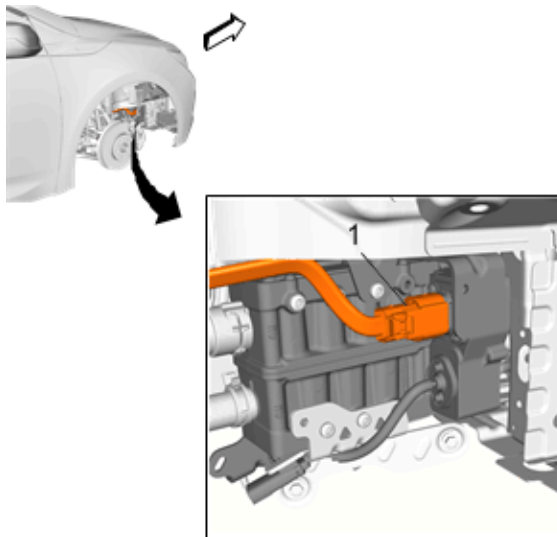


Fig. 250: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Connect Electrical Connector (1)
7. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
8. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
9. Install Front Compartment Air Deflector. Refer to [Front Compartment Air Deflector Replacement](#)
10. Lower the vehicle.
11. Enable high voltage system. Refer to [High Voltage Enabling](#)

BATTERY 300-VOLT POSITIVE AND NEGATIVE CABLE REPLACEMENT - HIGH VOLTAGE BATTERY TO CHARGER RECEPTACLE, ACCESSORY DC POWER CONTROL MODULE, AND DRIVE MOTOR BATTERY CHARGER

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Rear Compartment Floor Stowage Trim Compartment. Refer to [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
4. Remove Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

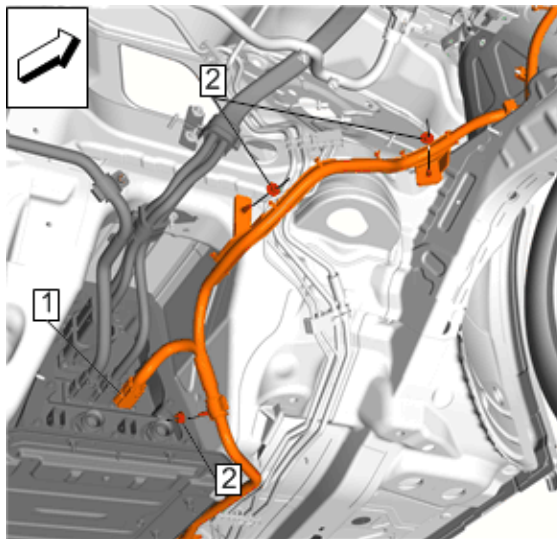


Fig. 251: Drive Motor Battery Electrical Connector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @ Drive Motor Battery
6. Remove Fasteners (2) (Qty: 3)

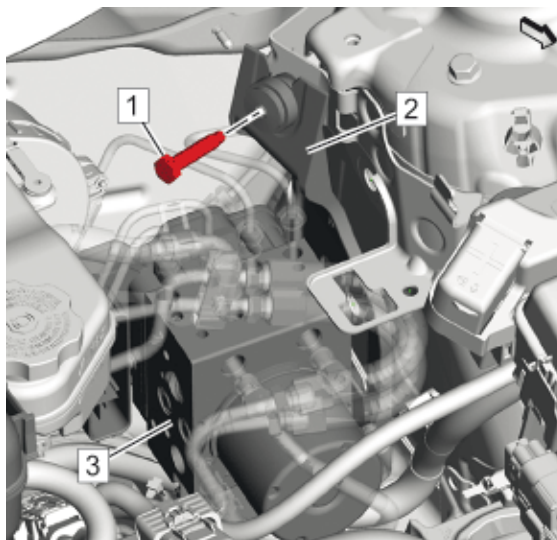


Fig. 252: Brake Pressure Modulator Valve, Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Reposition the brake pressure modulator valve (3) without disconnecting the brake lines. Refer to [**Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement**](#)

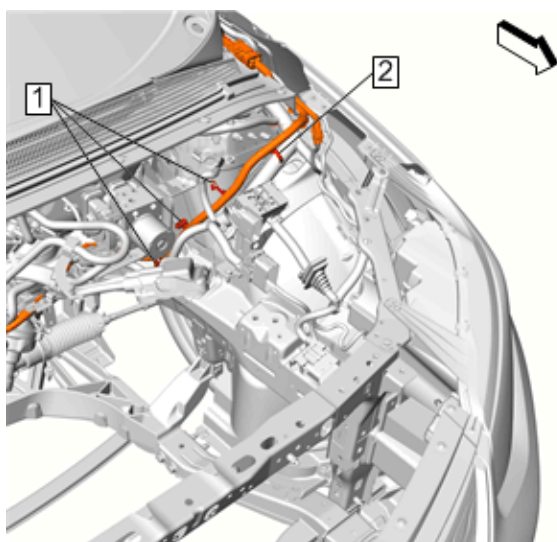


Fig. 253: Retainers And Clip
Courtesy of GENERAL MOTORS COMPANY

8. Disengage Retainers (1) (Qty: 3)
9. Disengage Clip (2)

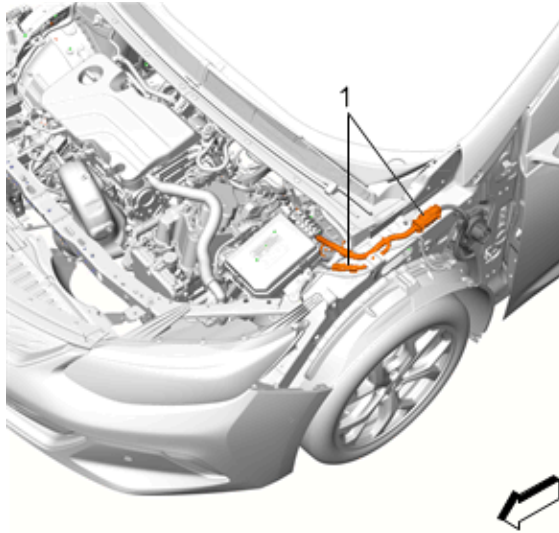


Fig. 254: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Electrical Connectors (1) (Qty: 2)

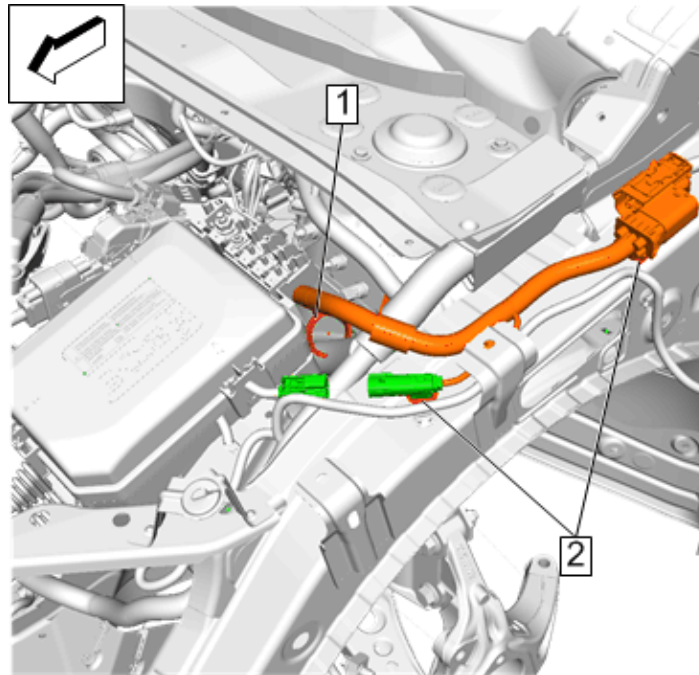


Fig. 255: Retainer Clip And Retainers

Courtesy of GENERAL MOTORS COMPANY

11. Disengage Retainer Clip (1)
12. Disengage Retainers (2) (Qty: 2)

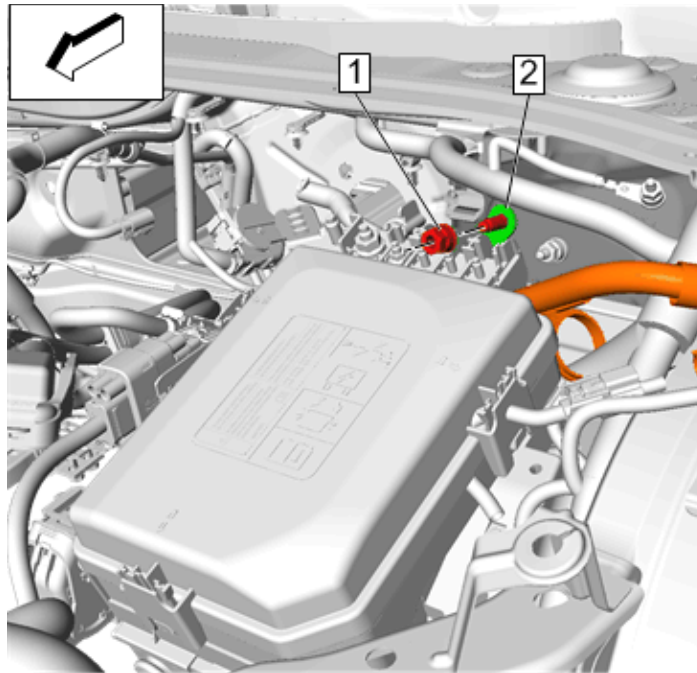


Fig. 256: Engine Wiring Harness And Ground Nut
Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Wiring Harness Ground Nut (1)
14. Reposition Engine Wiring Harness (2) away

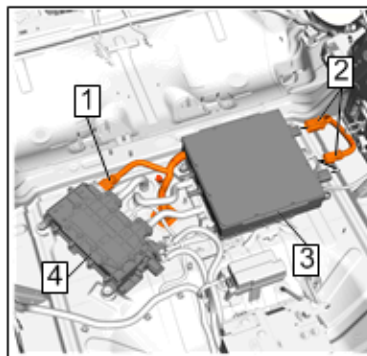


Fig. 257: Accessory DC Power Control Module, Drive Motor Battery Charger And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect Electrical Connector (1) @ Accessory DC Power Control Module (4)
16. Disconnect Electrical Connectors (2) (Qty: 2) @ Drive Motor Battery Charger (3)

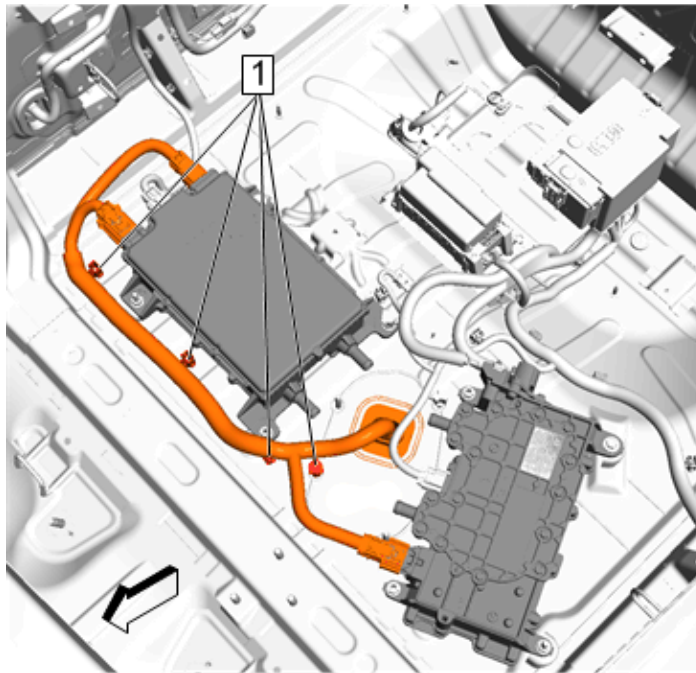


Fig. 258: Retainers

Courtesy of GENERAL MOTORS COMPANY

17. Disengage Retainers (1) (Qty: 4)
18. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

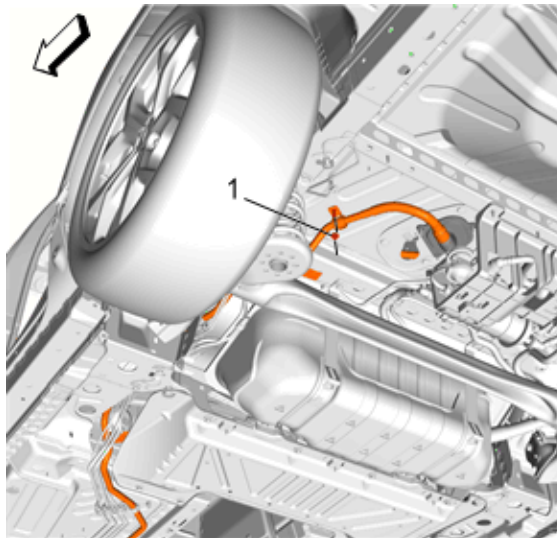


Fig. 259: Fastener

Courtesy of GENERAL MOTORS COMPANY

19. Remove Fastener (1)

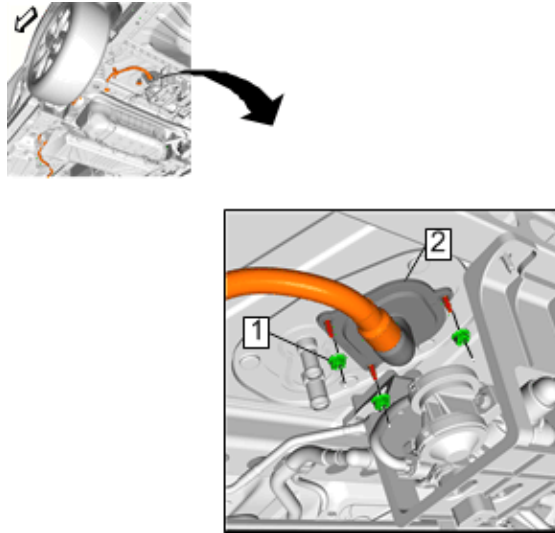


Fig. 260: Pass-Through Grommet And Fasteners
Courtesy of GENERAL MOTORS COMPANY

20. Remove Fasteners (1) (Qty: 3)
21. Remove Pass-Through Grommet (2)

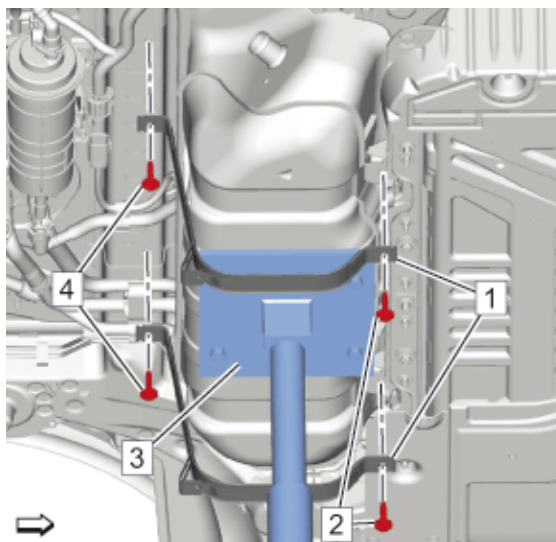


Fig. 261: Fuel Tank Straps
Courtesy of GENERAL MOTORS COMPANY

22. Support the fuel tank and only remove the fuel tank straps (1). Refer to [Fuel Tank Replacement](#)
23. Support the drive motor battery.

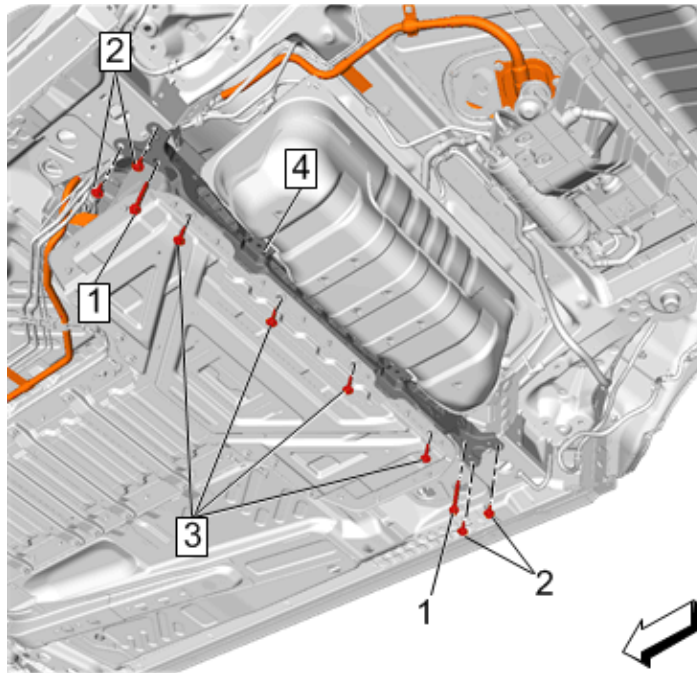


Fig. 262: Drive Motor Battery Tray Fasteners And Floor Panel Bar
 Courtesy of GENERAL MOTORS COMPANY

- 24. Remove Drive Motor Battery Tray Fasteners (1) (Qty: 2)
- 25. Remove Drive Motor Battery Tray Fasteners (2) (Qty: 4)
- 26. Remove Drive Motor Battery Tray Fasteners (3) (Qty: 4)
- 27. Remove Floor Panel Bar (4)

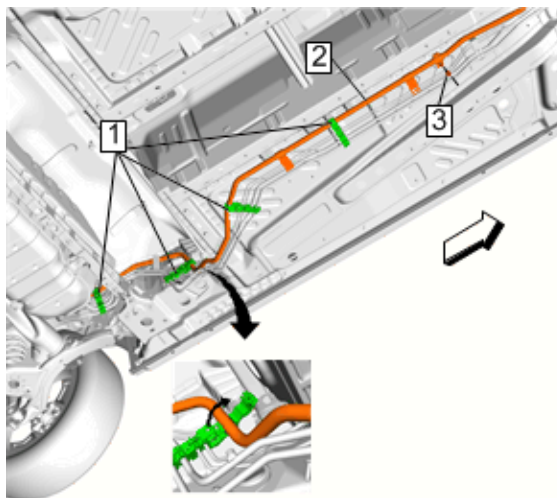


Fig. 263: Retainer Clips And Fastener
 Courtesy of GENERAL MOTORS COMPANY

- 28. Disengage Retainer Clips (1) (Qty: 4)
- 29. Remove Fastener (3)

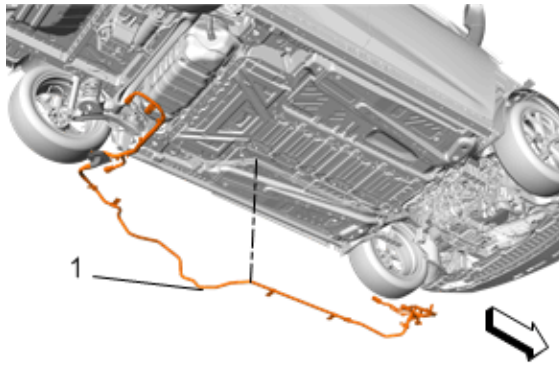


Fig. 264: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

30. Remove High Voltage Battery Positive Cable (1)

Installation Procedure

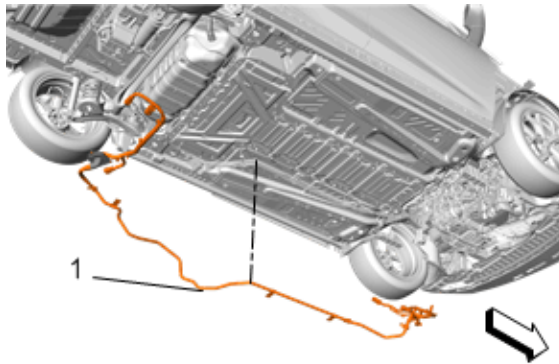


Fig. 265: High Voltage Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Positive Cable (1)

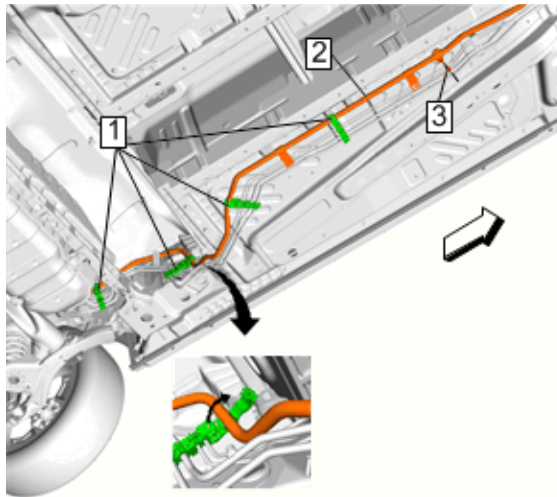


Fig. 266: Retainer Clips And Fastener

Courtesy of GENERAL MOTORS COMPANY

2. Install High Voltage Battery Positive Cable (2) @ Retainer Clips (1) (Qty: 4)
3. Engage Retainer Clips (1) (Qty: 4)

CAUTION: Refer to Fastener Caution

4. Install and tighten Fastener (3) to 9 N.m (80 lb in)

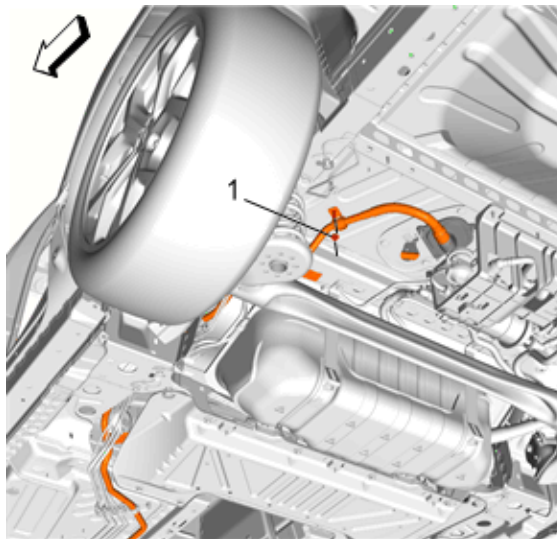


Fig. 267: Fastener

Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Fastener (1) to 9 N.m (80 lb in)

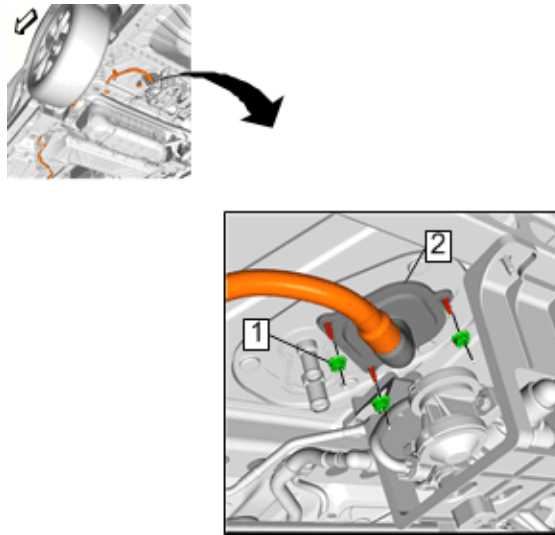


Fig. 268: Pass-Through Grommet And Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Install Pass-Through Grommet (2)
7. Install and tighten Fasteners (1) (Qty: 3) to 9 N.m (80 lb in)

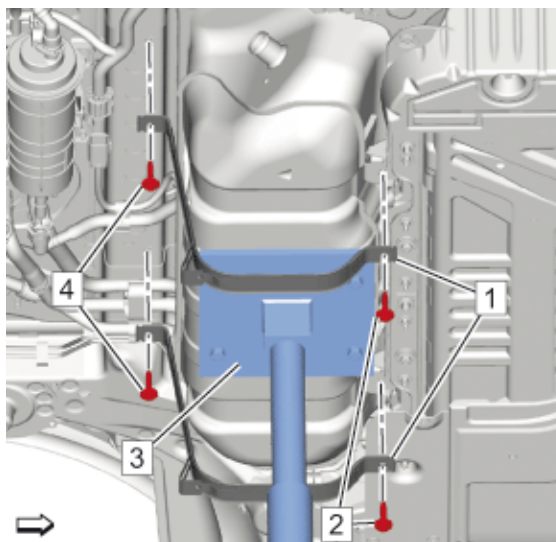


Fig. 269: Fuel Tank Straps
Courtesy of GENERAL MOTORS COMPANY

8. Install the fuel tank straps (1). Refer to [Fuel Tank Replacement](#)

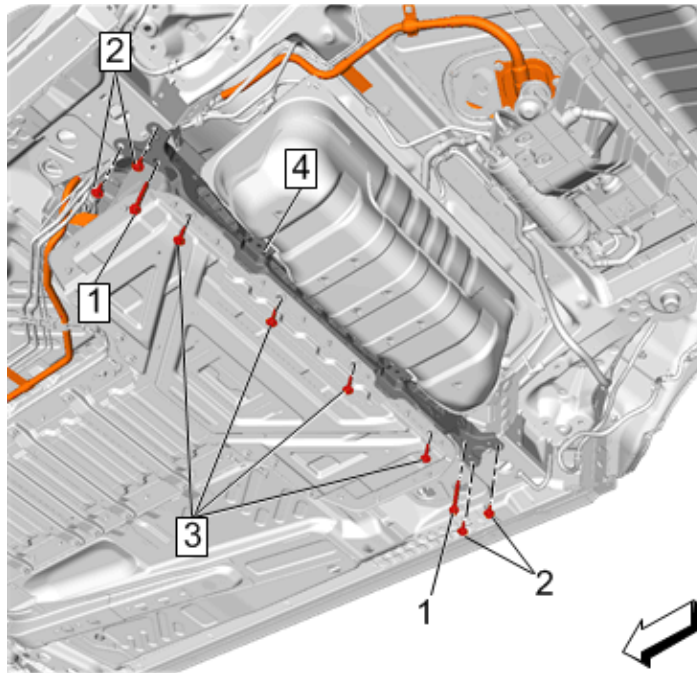


Fig. 270: Drive Motor Battery Tray Fasteners And Floor Panel Bar
Courtesy of GENERAL MOTORS COMPANY

9. Install Floor Panel Bar (4)
10. Install and tighten Drive Motor Battery Tray Fasteners (2) (Qty: 4) to 22 N.m (16 lb ft)
11. Install and tighten Drive Motor Battery Tray Fasteners (3) (Qty: 4) to 22 N.m (16 lb ft)
12. Install and tighten Drive Motor Battery Tray Fasteners (1) (Qty: 2) to 58 N.m (43 lb ft)
13. Lower the vehicle.

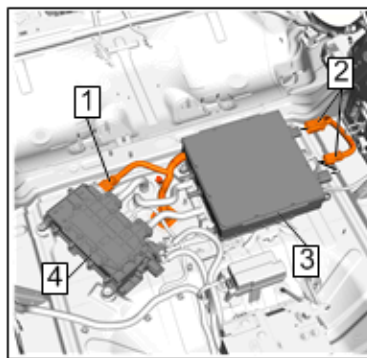


Fig. 271: Accessory DC Power Control Module, Drive Motor Battery Charger And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

14. Connect Electrical Connector (1) @ Accessory DC Power Control Module (4)
15. Connect Electrical Connectors (2) (Qty: 2) @ Drive Motor Battery Charger (3)

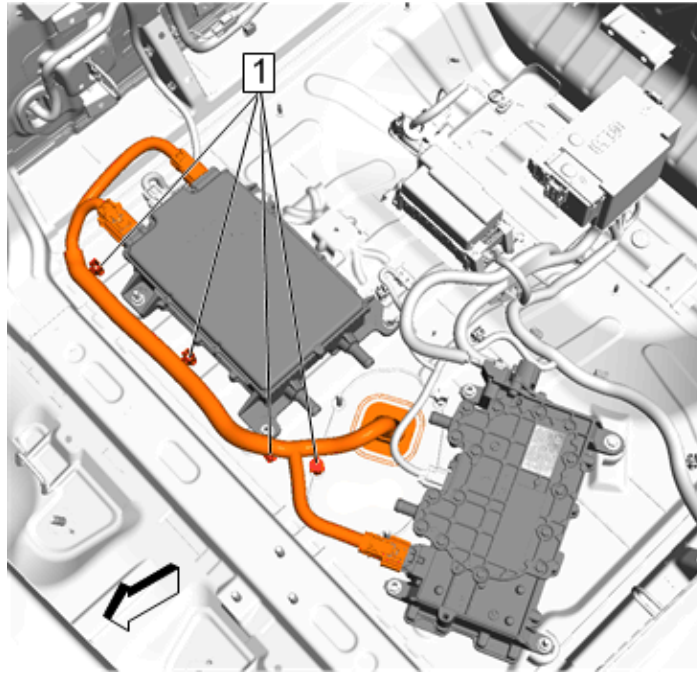


Fig. 272: Retainers

Courtesy of GENERAL MOTORS COMPANY

16. Engage Retainers (1) (Qty: 4)
17. Install Rear Compartment Floor Stowage Trim Compartment. Refer to [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

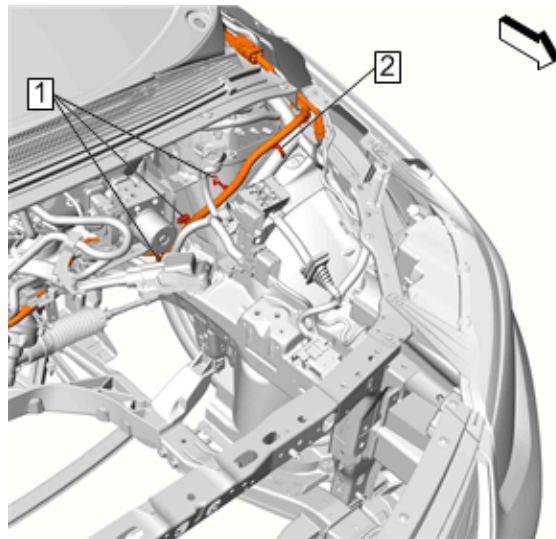


Fig. 273: Retainers And Clip

Courtesy of GENERAL MOTORS COMPANY

18. Engage Retainers (1) (Qty: 3)
19. Engage Clip (2)

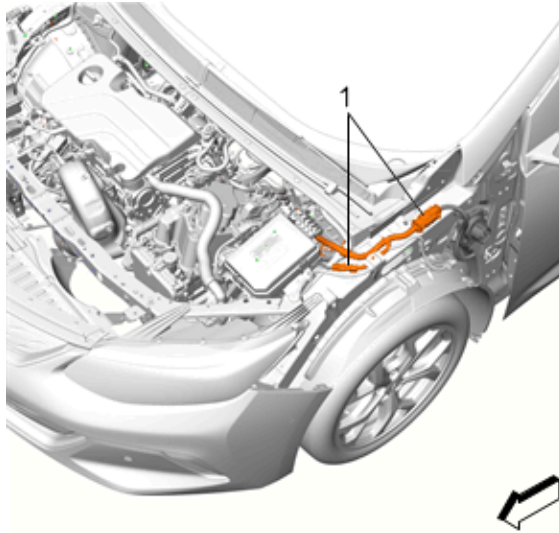


Fig. 274: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

20. Connect Electrical Connectors (1) (Qty: 2)

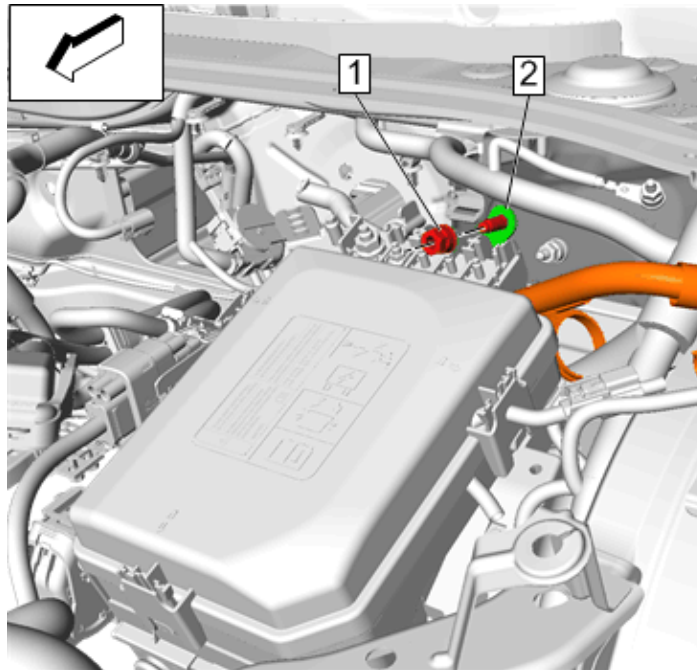


Fig. 275: Engine Wiring Harness And Ground Nut

Courtesy of GENERAL MOTORS COMPANY

21. Install Engine Wiring Harness (2)

22. Install and tighten Engine Wiring Harness Ground Nut (1) to 9 N.m (80 lb in)

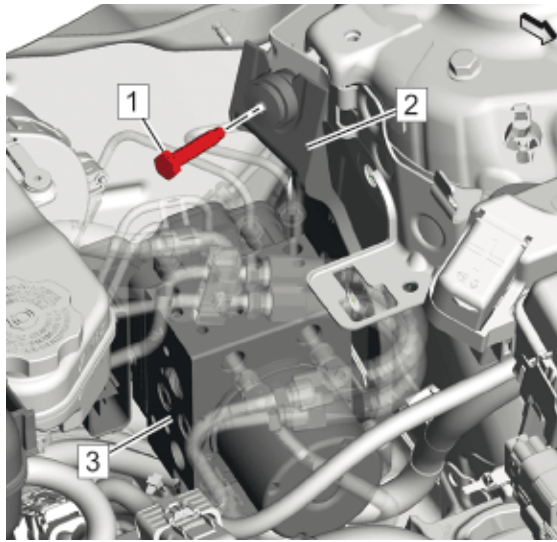


Fig. 276: Brake Pressure Modulator Valve, Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

23. Install the brake pressure modulator valve (3). Refer to [Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement](#)

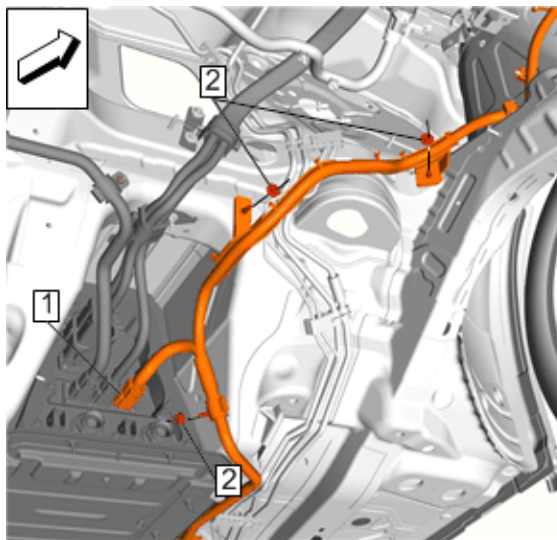


Fig. 277: Drive Motor Battery Electrical Connector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

24. Install and tighten Fasteners (2) (Qty: 3) to 9 N.m (80 lb in)
25. Connect Electrical Connector (1)
26. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)
27. Lower the vehicle.
28. Enable the high voltage system. Refer to [High Voltage Enabling](#)

BATTERY TRAY FRONT BRACE REPLACEMENT

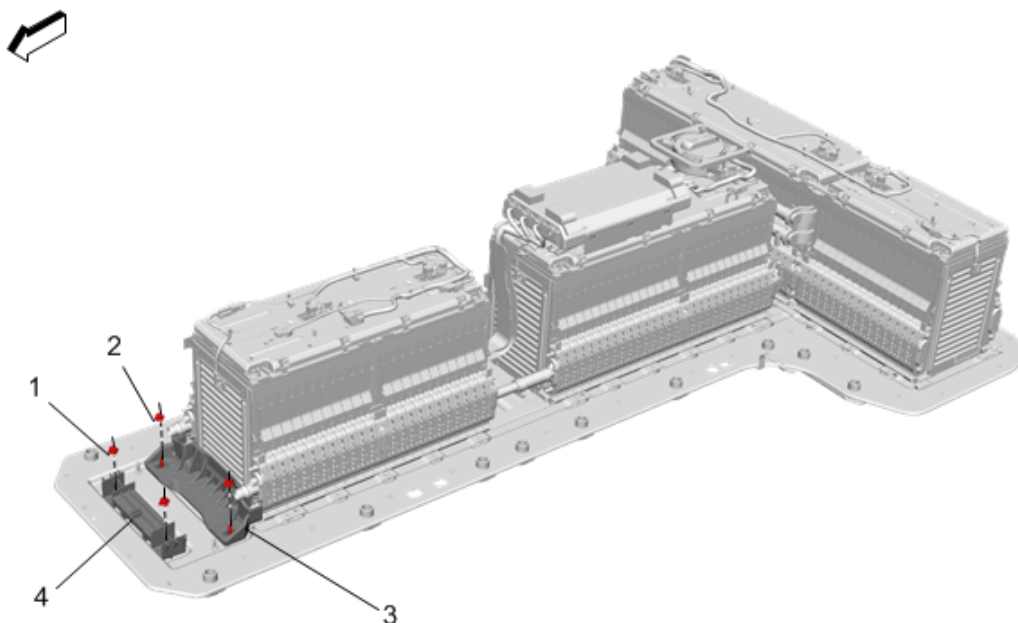


Fig. 278: Battery Tray Front Brace

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove High Voltage Battery Cover. Refer to High Voltage Battery Cover Replacement 2. Remove High Voltage Battery Disconnect Relay. Refer to High Voltage Battery Disconnect Relay Replacement	
1	Battery Tray Front Brace Fastener (Qty: 2) CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Battery Tray Front-Rear Brace Fastener (Qty: 2) Tighten 9 N.m (80 lb in)
3	Battery Tray Front-Rear Brace Procedure Push the rear brace firmly against battery section 1 and hold firmly in place when installing the bolts.
4	Battery Tray Front Brace

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION

Special Tools

EL 49976 Drive Motor Battery Lifting Fixture

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
3. Remove Underbody Front Air Deflector-Left Side. Refer to [Underbody Front Air Deflector Replacement - Left Side](#)
4. Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement](#)
5. Remove the drive motor battery radiator surge tank cap. Refer to [Drive Motor Battery Radiator Surge Tank Cap Replacement](#)

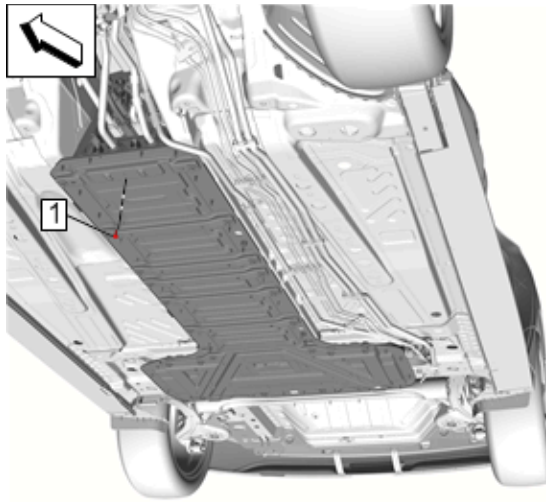


Fig. 279: Inspection Plug

Courtesy of GENERAL MOTORS COMPANY

6. Place a drain pan under the vehicle.
7. Remove and DISCARD Inspection Plug (1)

NOTE: Document the color of the fluid and the quantity of fluid drained.

NOTE: If there is any coolant residue present, contact the technical assistant center (TAC).

8. Collect any fluid present in the drain pan and if no fluid is present, insert a clean white cloth or cotton swab through the inspection plug opening, looking for any evidence of coolant residue.

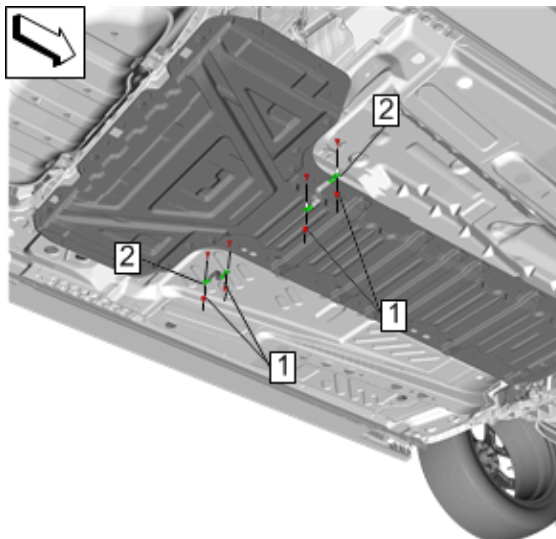


Fig. 280: Ground Straps And Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Remove Ground Strap Nuts (1) (Qty: 4)
10. Remove Ground Straps (2) (Qty: 2)

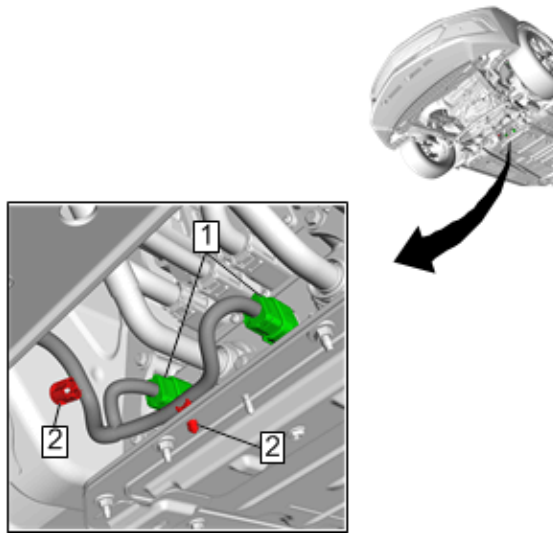


Fig. 281: Electrical Connectors And Retainers
 Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Electrical Connectors (1) (Qty: 2)
12. Release Retainers (2) (Qty: 2)

NOTE: Cover electrical connectors so contamination of coolant fluid will not happen.

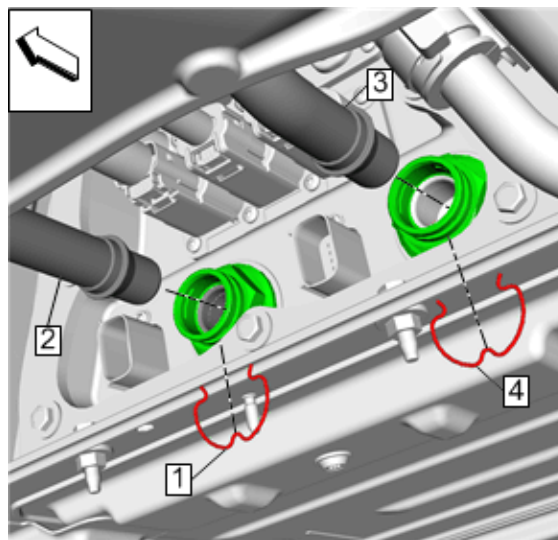


Fig. 282: Drive Motor Battery Coolant Cooler Inlet Hose, Outlet Hose And Retainers
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure all the fluid is drained and use the smoke test plugs so the electrical connectors do not get contaminated with splashed fluid.

13. Place a drain pan under the vehicle.
14. Release Retainer (4)
15. Reposition Drive Motor Battery Coolant Cooler Outlet Hose (3)
16. Release Retainer (1)
17. Reposition Drive Motor Battery Coolant Cooler Inlet Hose (2)

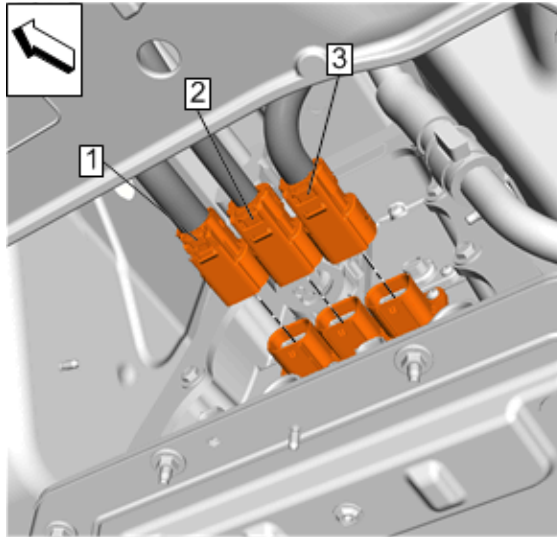


Fig. 283: Cabin Heater Control Module Harness Connector, A/C Compressor Harness Connector And Battery Charger Harness Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: Wrap exposed electrical connections with electrical tape to keep coolant out of the electrical connections.

18. Disconnect the following:

NOTE: Pull back the red CPA, release the orange tab and pull the connector back approximately 1/4 inch. Depress green tab and disconnect.

- Disconnect K10 Cabin Heater Control Module Harness Connector (1)
- Disconnect G1 Air Conditioning Compressor Harness Connector (2)
- Disconnect T18 Battery Charger Harness Connector (3)

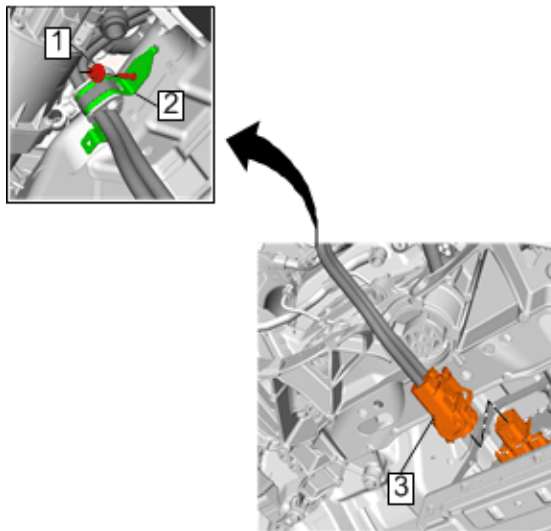


Fig. 284: T6 Power Inverter Module Connector, Cable Retainer And Fastener

Courtesy of GENERAL MOTORS COMPANY

19. Remove Fastener (1)

20. Remove Cable Retainer (2)

NOTE: Release the green CPA, pull on the gray lever and depress the orange tab.

21. Disconnect T6 Power Inverter Module Connector (3)
22. Wrap exposed electrical connections with electrical tape to keep coolant out of electrical connections.

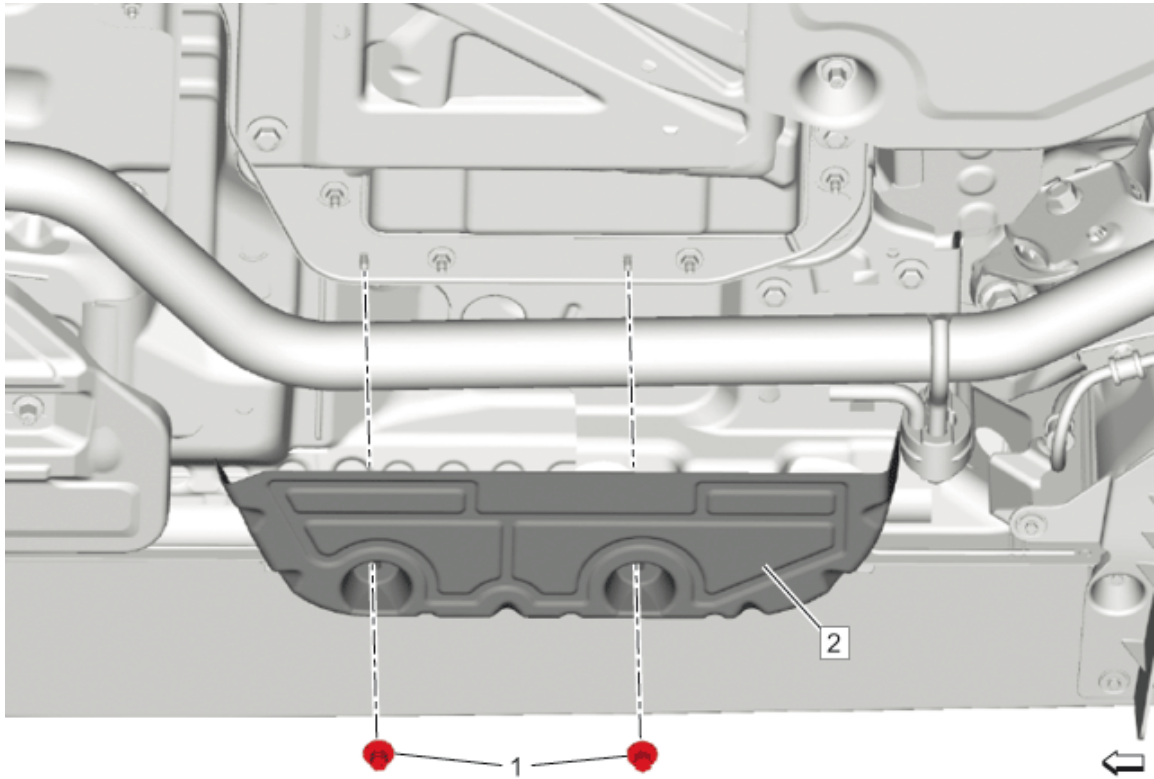


Fig. 285: Rear Body Exhaust Heat Shield
Courtesy of GENERAL MOTORS COMPANY

23. Remove Rear Body Exhaust Heat Shield (2). Refer to [Rear Body Exhaust Heat Shield Replacement](#)

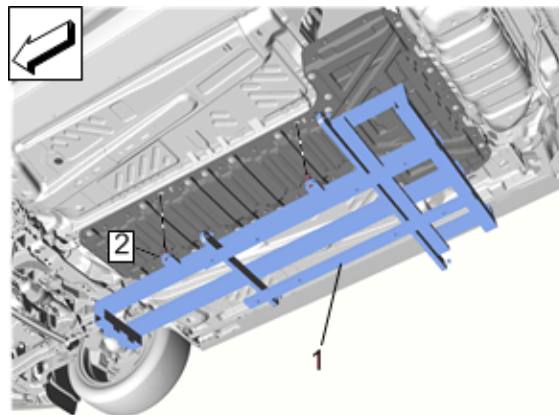


Fig. 286: Drive Motor Battery Support Fixture And Locating Pins
Courtesy of GENERAL MOTORS COMPANY

NOTE: The drive motor battery mass is approximately 204 kg (450 lbs).

24. Mount the **EL 49976** Drive Motor Battery Support Fixture, to a lift table with 4 fasteners.
25. Ensure the long axis of the drive motor battery support fixture (1) is mounted to the long side of the lift table.

NOTE: This must be performed prior to raising the fixture up against the battery tray.

26. Insert the locating pins (2) into the drive motor battery locating holes.

NOTE: The 2 locator pins must not be inserted into the tray/underbody until the alignment is completed.

27. Adjust the angle of the table/lifting fixture until it is parallel to the battery tray/aero shield.

NOTE: There can be no gaps in excess of 5 mm around the perimeter of the lifting fixture. If the gap is in excess of 5 mm, lower the fixture and adjust the alignment.

28. Raise the fixture until it is firmly resting against the tray along the entire perimeter of the fixture.

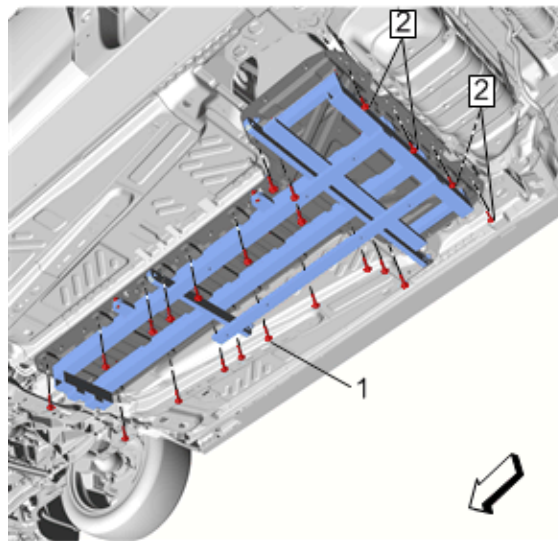


Fig. 287: Drive Motor Battery Tray Fasteners
Courtesy of GENERAL MOTORS COMPANY

29. Remove Drive Motor Battery Tray Fasteners (1) (Qty: 18)
30. Remove Drive Motor Battery Tray Fasteners (2) (Qty: 4)

NOTE: Ensure all fasteners are removed before lowering the fixture with the drive motor battery.

31. Remove the drive motor battery and the **EL-49976** drive motor battery support fixture from the lift table and set aside.
32. Remove the replacement drive motor battery and the replacement **EL-49976** drive motor battery support fixture from the container and mount to the lift table.
33. Ensure that tape covers the manual disconnect terminals on the drive motor battery.
34. If the drive motor battery is being returned, prepare the drive motor battery for safe shipping by performing the following:

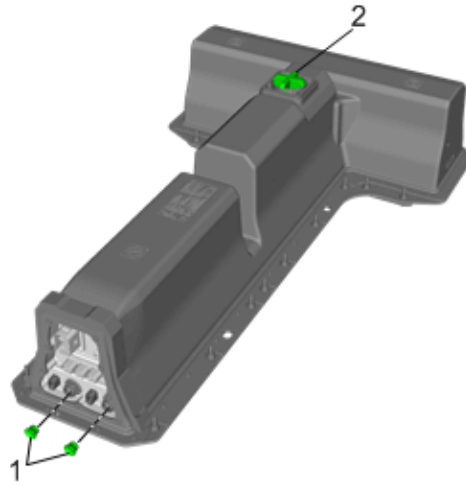


Fig. 288: Coolant Plugs And S15 Manual Service Disconnect (MSD) Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: As part of the battery removal process, all coolant should be drained from the battery pack.

1. Install coolant plugs (1) in the coolant lines. Coolant plugs can be removed from the new service battery assembly and installed in the returned battery. Additional coolant plugs (GM p/n 22770854) can be ordered if they are needed.

NOTE: The MSD lever should remain with the vehicle and not be returned with the battery assembly.

2. Install the S15 Manual Service Disconnect (MSD) Cover (2). The MSD cover can be removed from the new service battery assembly and installed in the returned battery. Additional MSD covers (GM p/n 22770856) can be ordered if they are needed.

NOTE: The failed battery must be removed and returned with a battery assembly lifting fixture (GM Special Tool EL-49976). This lifting fixture will be attached to the failed battery and placed in the shipping container. Each new service battery will come with a battery assembly lifting fixture for use during installation. You will keep this fixture for servicing future battery removals.

3. Install the High Voltage Connector Cover. The high voltage connector cover can be removed from the service battery and installed on the returned battery. If the service battery assembly did not come with a high voltage connector cover, additional covers can be ordered by calling 1-800 GM TOOLS.

Installation Procedure

1. Mount the lifting table to the EL 49976 drive motor battery support fixture with 4 fasteners.

NOTE: Ensure the long axis of the lifting fixture is mounted and parallel to the long side of the lift table.

2. Install the drive motor battery, with the EL 49976 drive motor battery support fixture to the lift table.

NOTE: Make sure there is no gap around the perimeter more than 5 mm. If there is a gap of 5 mm or greater, realign the EL 49976 drive motor battery support fixture to the drive motor battery.

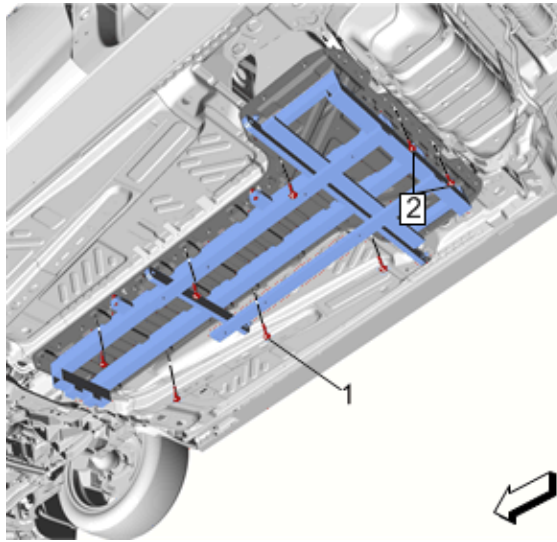


Fig. 289: Drive Motor Battery Tray Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution**

3. Install and tighten Drive Motor Battery Tray Fasteners (1) (Qty: 6) to 58 N.m (43 lb ft)
4. Install and tighten Drive Motor Battery Tray Fasteners (2) (Qty: 2) to 22 N.m (16 lb ft)

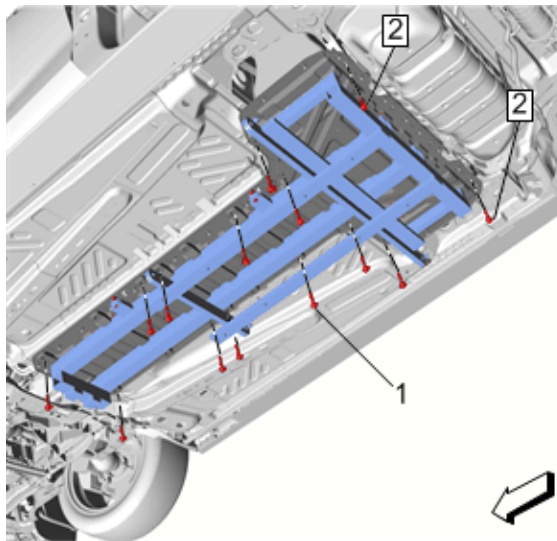


Fig. 290: Drive Motor Battery Tray Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Drive Motor Battery Tray Fasteners (1) (Qty: 12) to 58 N.m (43 lb ft)
6. Install and tighten Drive Motor Battery Tray Fasteners (2) (Qty: 2) to 22 N.m (16 lb ft)

NOTE: Ensure all the drive motor generator battery fasteners are installed and torqued prior to lowering the lift table.

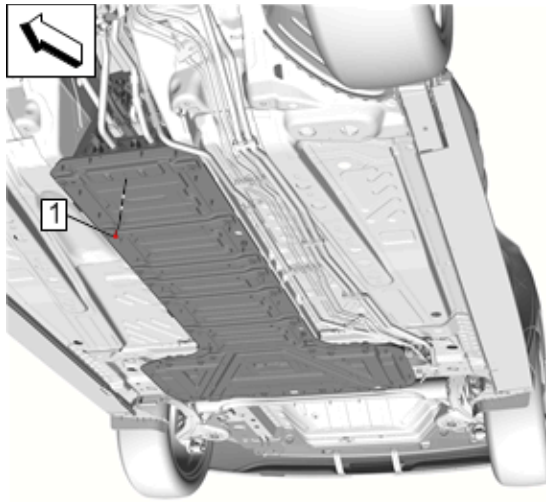


Fig. 291: Inspection Plug

Courtesy of GENERAL MOTORS COMPANY

7. Install and tighten the NEW Inspection Plug (1) to 9 N.m (80 lb in)

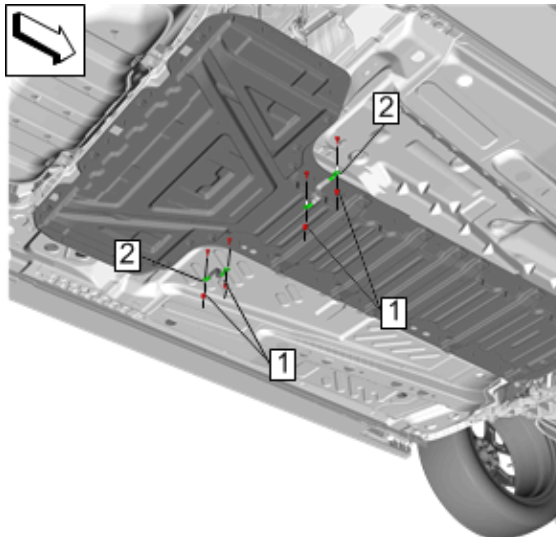


Fig. 292: Ground Straps And Nuts

Courtesy of GENERAL MOTORS COMPANY

8. Install Ground Straps (2) (Qty: 2)
9. Install and tighten Ground Strap Nuts (1) (Qty: 4) to 9 N.m (80 lb in)

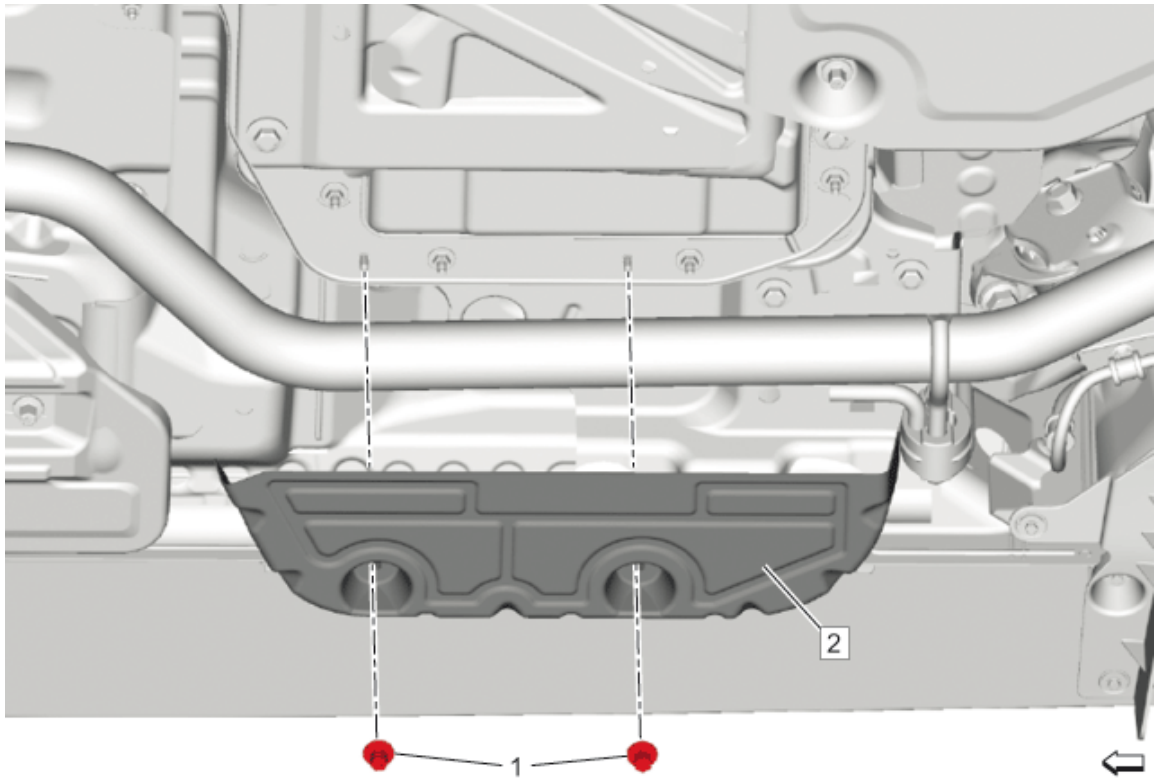


Fig. 293: Rear Body Exhaust Heat Shield
Courtesy of GENERAL MOTORS COMPANY

10. Install Rear Body Exhaust Heat Shield (2). Refer to [Rear Body Exhaust Heat Shield Replacement](#)

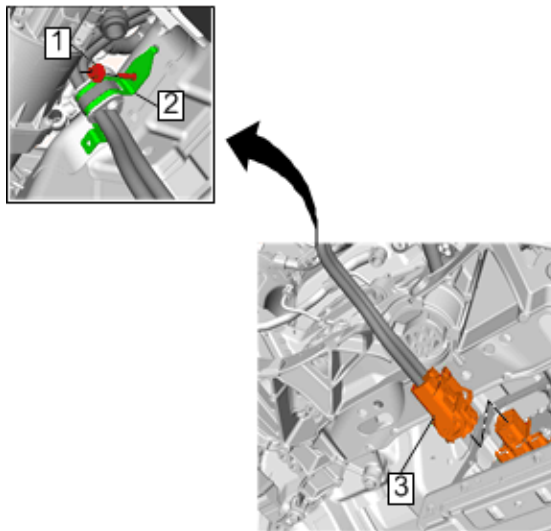


Fig. 294: T6 Power Inverter Module Connector, Cable Retainer And Fastener
Courtesy of GENERAL MOTORS COMPANY

11. Connect T6 Power Inverter Module Connector (3)
12. Install Cable Retainer (2)
13. Install and tighten Fastener (1) to 9 N.m (80 lb in)

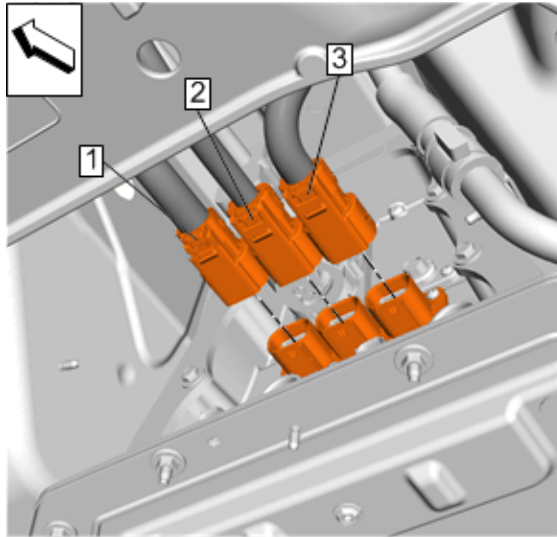


Fig. 295: Cabin Heater Control Module Harness Connector, A/C Compressor Harness Connector And Battery Charger Harness Connector

Courtesy of GENERAL MOTORS COMPANY

14. Connect the following:

- Connect K10 Cabin Heater Control Module Harness Connector (1)
- Connect G1 Air Conditioning Compressor Harness Connector (2)
- Connect T18 Battery Charger Harness Connector (3)

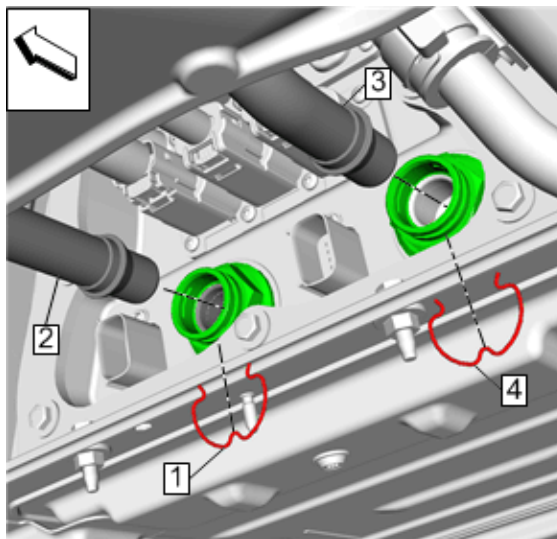


Fig. 296: Drive Motor Battery Coolant Cooler Inlet Hose, Outlet Hose And Retainers

Courtesy of GENERAL MOTORS COMPANY

15. Install Drive Motor Battery Coolant Cooler Outlet Hose (3)
16. Install Retainer (4)
17. Install Drive Motor Battery Coolant Cooler Inlet Hose (2)
18. Retainer (1)

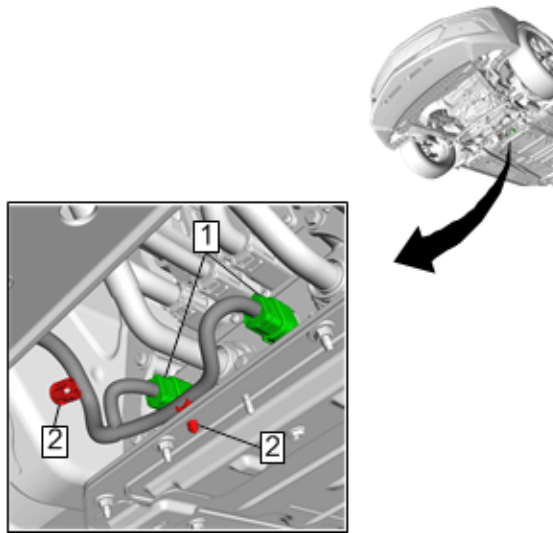


Fig. 297: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

19. Connect Electrical Connectors (1) (Qty: 2)
20. Install Retainers (2) (Qty: 2)
21. Fill the drive motor battery with coolant. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)
22. Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement](#)
23. Install Underbody Front Air Deflector-Left Side. Refer to [Underbody Front Air Deflector Replacement - Left Side](#)
24. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
25. Install the drive motor battery radiator surge tank cap. Refer to [Drive Motor Battery Radiator Surge Tank Cap Replacement](#)
26. Enable the high voltage system. Refer to [High Voltage Enabling](#)
27. Check the battery pack cooling system for leaks. Refer to [Hybrid Cooling System Leak Test](#)
28. Reprogram the battery energy control module. Refer to [Control Module References](#)
29. Reprogram the HPCM2. Refer to [Control Module References](#)
30. Clear the secured high voltage DTC's. Refer to [Clear Secured High Voltage DTCs](#)
31. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Refer to [Hybrid/EV Battery Pack Capacity Learn](#)

NOTE: Refer to Diagnostic Aids to determine when, if required procedure should be performed.

AUXILIARY BATTERY WIRING HARNESS REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
2. Remove Battery Energy Control Module. Refer to [Battery Energy Control Module Replacement](#)
3. Remove High Voltage Battery High Voltage Manual Disconnect Connector. Refer to [High Voltage Battery High Voltage Manual Disconnect Connector Replacement](#)

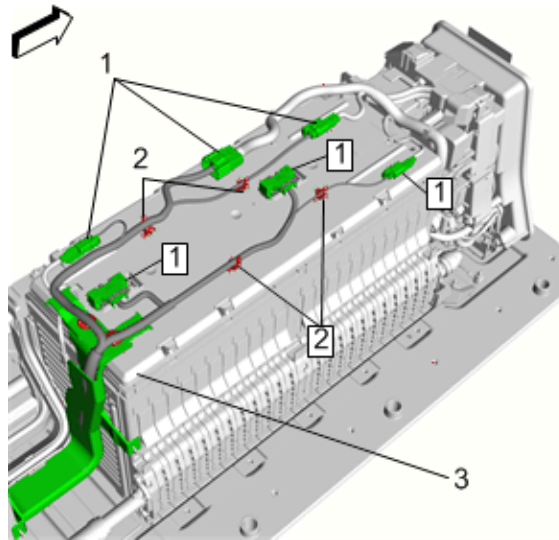


Fig. 298: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connectors (1) (Qty: 6) @ High Voltage Battery Section 1
5. Disengage Retainers (2) (Qty: 4)

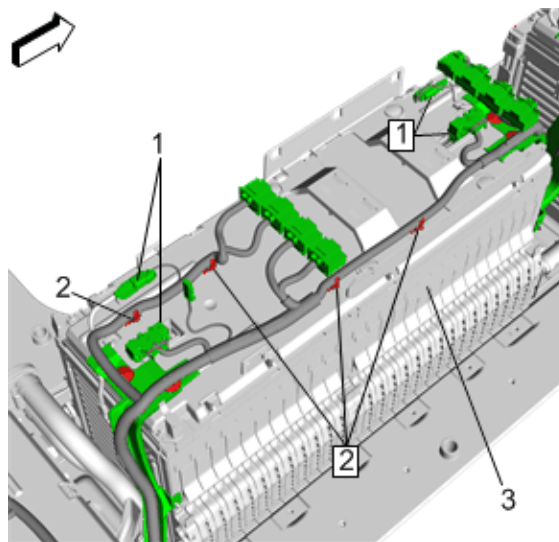


Fig. 299: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Electrical Connectors (1) (Qty: 4) @ High Voltage Battery Section 2
7. Disengage Retainers (2) (Qty: 4)

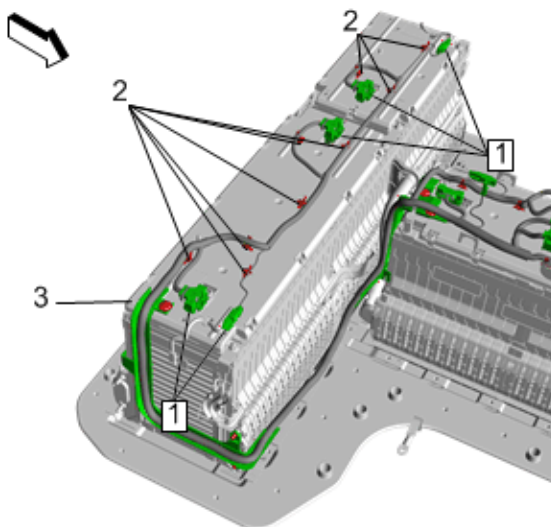


Fig. 300: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Electrical Connectors (1) (5) @ High Voltage Battery Section 3
9. Disengage Retainers (2) (Qty: 9)

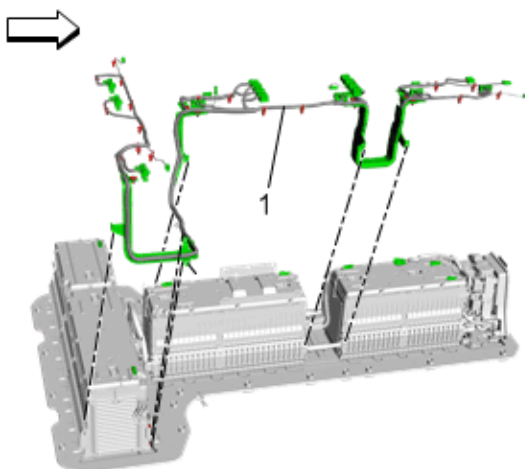


Fig. 301: Auxiliary Battery Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Remove Auxiliary Battery Wiring Harness (1)

Installation Procedure

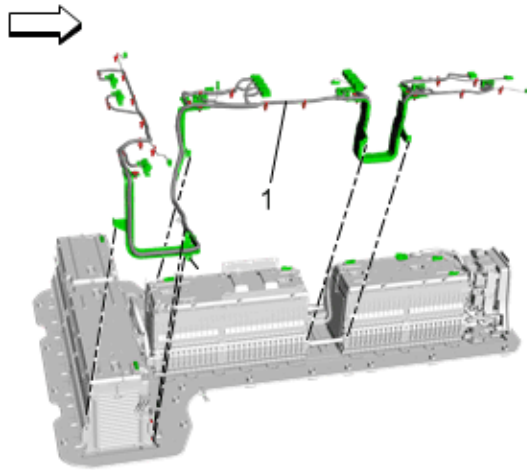


Fig. 302: Auxiliary Battery Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Battery Wiring Harness (1)

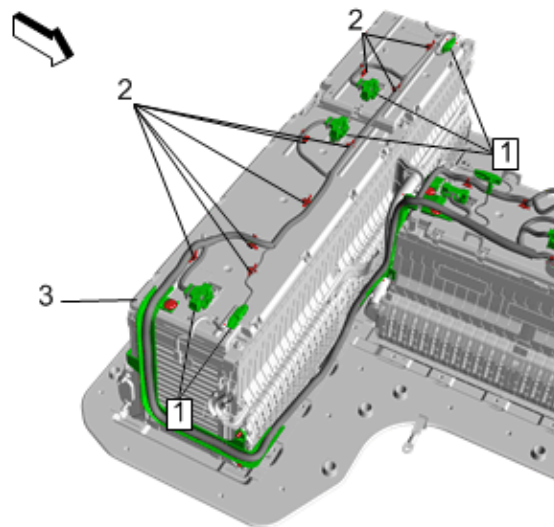


Fig. 303: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connectors (1) (Qty: 5) @ High Voltage Battery Section 3
3. Connect Retainers (2) (Qty: 9)

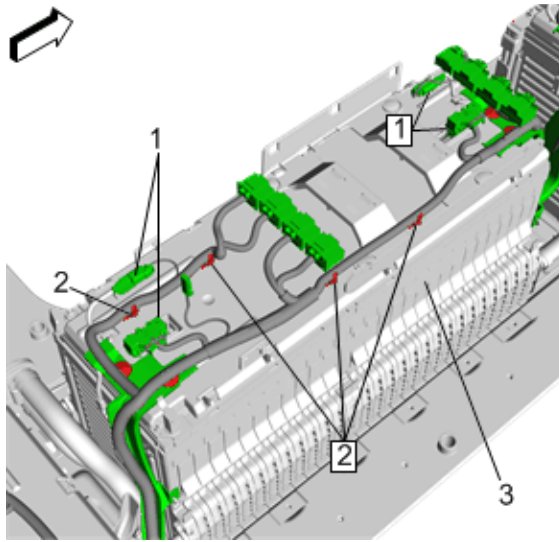


Fig. 304: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connectors (1) (Qty: 4) @ High Voltage Battery Section 2
5. Connect Retainers (2) (Qty: 4)

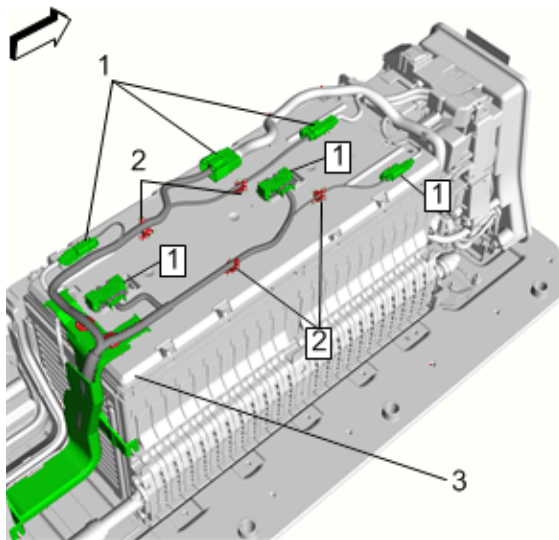


Fig. 305: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Connect Electrical Connectors (1) (Qty: 6) @ High Voltage Battery Section 1
7. Connect Retainers (2) (Qty: 4)
8. Install Battery Energy Control Module. Refer to [Battery Energy Control Module Replacement](#)
9. Install High Voltage Battery High Voltage Manual Disconnect Connector. Refer to [High Voltage Battery High Voltage Manual Disconnect Connector Replacement](#)
10. Install High Voltage Battery Cover. Refer to [High Voltage Battery Cover Replacement](#)
11. Install Drive Motor Battery. Refer to [Drive Motor Battery Replacement and Shipping Preparation](#)

CLEAR SECURED HIGH VOLTAGE DTCS

Circuit/System Description

The hybrid powertrain control modules 1 and 2 independently monitor for high voltage safety conditions such as airbag deploy events and certain high voltage system faults. When either module identifies one of these conditions, a DTC may set and the vehicle is placed into a 'high voltage lockout' state. While in the lockout state, the high voltage contactor relays are prevented from closing.

The purpose of the high voltage lockout state is to allow for high voltage system inspection prior to re-enabling. A complete inspection of the high voltage system and components must be performed if the vehicle has been involved in a collision. Perform the [High Voltage System Inspection](#) procedure, if necessary, prior to clearing a Secured High Voltage DTCs/lockout state.

Diagnostic Aids

- The following conditions may result in a HV lockout state without a corresponding DTC:
 - High voltage component replacement
 - Low 12 V battery event
 - SPS programming event
 - Airbag deployment/crash event detected: The Inflatable Restraint Sensing and Diagnostic Module may or may not set a DTC but will continue to broadcast a crash event status until reset.
- Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout.
- Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.
- The Clear Secured High Voltage DTCs procedure must be completed when the following components, as applicable, are replaced:
 - K16 Hybrid/EV Battery Energy Control Module
 - K112A - K112H Hybrid/EV Battery Interface Control Module
 - A4 Hybrid/EV Battery Pack
 - K114A Hybrid/EV Powertrain Control Module 1
 - K114B Hybrid/EV Powertrain Control Module 2

Contactor Open Reasons Reset

The hybrid/EV powertrain control module 2, Hybrid/EV Battery Contactor Open Reasons scan tool parameter list identifies all past events that commanded contactors open. The parameters can only be reset by either reprogramming the hybrid/EV powertrain control module 2 or by performing the scan tool Hybrid/EV Battery Contactor Open Reasons Reset function. To aid in possible future intermittent diagnosis, the parameters should be reset to NO once all diagnostic procedures are successfully completed.

Scan Tool Hybrid/EV Battery Contactor Open Reasons Reset Function

NOTE: **The hybrid/EV system must be able to enter a Propulsion Active state.**

1. Complete the Circuit System Verification and Testing as necessary.
2. Remove any chargers and as applicable, the charge cord.
3. Vehicle OFF, wait 5 minutes.

NOTE: **It is not necessary to completely remove the S15 Manual Service Disconnect.**

4. Disengage the S15 Manual Service Disconnect to the first position to open the high voltage interlock loop circuit.
5. Service Mode, enable the scan tool reset function.

6. Vehicle OFF, wait 5 minutes.
7. Fully engage the S15 Manual Service Disconnect.
8. Start the vehicle and Clear Vehicle DTCs.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle ON.
2. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 parameters Hybrid/EV Battery Positive Contactor Command and Hybrid/EV Battery Negative Contactor Command each indicate Closed.
 - **If the contactors are not commanded Closed**

Refer to Circuit/System Testing.
 - **If the contactors are commanded Closed**
3. A Secured High Voltage DTC HV lockout state is not present. All OK.

Circuit/System Testing

The Clear Secured High Voltage DTCs reset process requires scan tool interaction with **two or three different control modules in sequence** and can be completed using the following steps:

1. Install **EL-49642** SPS programming support tool.
2. Vehicle in Service Mode. With a scan tool select the Hybrid/EV Powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
 - **If either parameter displays YES**
 1. Perform the [High Voltage System Inspection](#) procedure.
 2. If the results of the inspection procedure support enabling of the high voltage system, perform the Inflatable Restraint and Sensing Diagnostic Module function Reset High Voltage Disable Request After Crash Event Detected.
 3. Turn the vehicle OFF for 5 minutes.
 4. Proceed to next step.
 - **If BOTH parameters indicate NO**
3. Vehicle in Service Mode. With a scan tool, clear All DTCs.

NOTE: **A command reject may appear on the scan tool after the first Clear Secured High Voltage DTCs request. If this occurs, ignore this command reject and continue to the next step.**

4. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions waiting 45 seconds before exiting the screen.
5. With a scan tool, select Hybrid/EV Powertrain Control Module Control Functions list. Select Clear Secured High Voltage DTCs. Select Continue button waiting 45 seconds before exiting the screen.

6. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions.
7. With a scan tool, clear All DTCs.
8. Allow the Hybrid/EV powertrain Control Modules to enter sleep mode by performing the following:
 1. Turn the vehicle OFF.
 2. Ensure the scan tool is not communicating with any control modules by returning to the Home screen.
 3. Ensure the scan tool is accessible without having to open doors or otherwise cause control module wake-up.
 4. Shut all doors. Do NOT depress the brake pedal or activate any vehicle controls such as the parking lights, fuel door release, etc.

NOTE: Sleep mode is usually entered within two minutes after shutting off the vehicle. However, activating vehicle features such as Refuel Mode may extend this time up to 30 minutes.

5. Wait 5 minutes with the vehicle in the prescribed condition so that the modules may enter sleep mode.
9. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 has gone to sleep by ensuring communication is not present.
 - **If communication is present**

Repeat the previous step.
 - **If communication is not present**
10. Start the vehicle.
11. Verify that no DTCs are set.
 - **If any DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no DTCs are set**
12. All OK.

HYBRID/EV BATTERY PACK CAPACITY LEARN

Circuit/System Description

The Hybrid Powertrain Control Module 2 learns the battery capacity as the Hybrid/EV battery pack is discharged and charged. Once learned, the capacity value is allowed to change over a long period of time, as the battery ages.

Replacement of the battery pack, all battery sections or the Hybrid Powertrain Control Module 2 requires capacity learning at a faster rate than normal.

To enable hardware replacement, the Hybrid Powertrain Control Module 2 can be placed into a fast learn mode with the scan tool.

Activating the fast Capacity Learn mode will reset the battery capacity to a much lower value and subsequent charge/discharge cycles will then learn the capacity back up to the proper value. Initially this may have a noticeable effect on EV range until the capacity learning for the new hardware begins. It may take several battery pack depletions and charges for a maximum EV range to be learned/displayed.

Diagnostic Aids

The Hybrid/EV Battery Pack Capacity Learn procedure must be completed when the following components are replaced:

- Hybrid Powertrain Control Module 2
- Hybrid/EV Battery Pack
- All battery sections

Whenever the Hybrid/EV Battery Pack Capacity Learn is activated the vehicle needs to be operated in a normal manner in order to learn an accurate battery capacity value.

NEVER disconnect the 12V battery supply to the vehicle or the Hybrid Powertrain Control Module 2 after initially activating the Hybrid/EV Battery Pack Capacity Learn. Loss of 12V power will force the Hybrid Powertrain Control Module 2 to store the current capacity value as accurate and will also disable fast learning. The process needs to complete without 12V battery interruption for the best results. Repeat the Hybrid/EV Battery Pack Capacity Learn any time 12V battery interruption occurs prior to operating the vehicle by driving and/or charging. It is possible to observe whether an update has occurred by looking at the battery capacity after charging and/or driving the vehicle.

Hybrid/EV Battery Pack Capacity Learn

NOTE: Hybrid/EV Battery Pack Capacity Learn should **ONLY** be activated when the battery pack, **ALL** battery sections or the Hybrid Powertrain Control Module 2 has been replaced.

The Hybrid/EV Battery Pack Capacity Learn procedure can be activated with a scan tool using the following steps:

1. Vehicle On
2. With a scan tool, select Hybrid Powertrain Control Module 2 Configuration/Reset Functions. Select the Learn Functions - Hybrid/EV Battery Pack Capacity Learn and command a Learn.
3. Observe and record the alphanumeric value in the Hybrid/EV Battery Pack Capacity scan tool parameter.
4. Connect the vehicle charge cord and completely charge the hybrid/EV battery pack.
5. The vehicle is OK to return to the customer. Inform the customer that their EV range will continue to learn as the vehicle is operated normally. Longer drive trips followed by full charging will allow the fastest learn.
6. If the customer returns with an EV Range concern, contact technical assistance.

HYBRID/EV BATTERY CELL BALANCING

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

Hybrid/EV Battery Cell Balancing

The **EL-50332** Hybrid/EV Battery Service Tool is used to match the voltage level of a replacement battery section to the existing battery sections following a service event. The tool will charge or discharge the replacement section, as required, based on measured cell group voltage data. The EL-50332 requires feedback from the battery energy control module during the balancing process. Communication is through the A4 Hybrid/EV Battery Pack X357 and X358 connectors and a low voltage interface harness provided with the EL-50332 Hybrid/EV Battery Service Tool. The charging and discharging is performed by direct connection to the replacement battery section positive and negative terminals.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

Testing for Intermittent Conditions and Poor Connections

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- EL-50332 Hybrid/EV Battery Service Tool
- EL-50332-105 Universal Fuse Box
- EL-50332-120 High Voltage Interface Cable
- EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable
- EL-50332-135 Hybrid/EV Battery Contactor Assembly Interface Cable
- EL-50332-145 Black Banana Jack Cable
- EL-50332-150 Red Banana Jack Cable
- EL-50332-155 Green Banana Jack Cable
- EL-50332-170 High Voltage Alligator Clamps
- EL-50332-175 120 V Power Cable
- EL-50332-175 120 V Power Cable - EU
- EL-50332-180 250 V Power Cable - AUS
- EL-50332-270 Vehicle Interface Module 2

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL® listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

Inspection Procedure

NOTE: Before balancing a battery section, make sure all of the external EL-50332 components and cables are in good condition and working order.

1. Connect the EL-50332-145 Black Banana Jack Cable, EL-50332-150 Red Banana Jack Cable, and EL-50332-155 Green Banana Jack Cable to the EL-50332-105 Universal Fuse Box.
2. Connect the EL-50332-120 High Voltage Interface Cable to the EL-50332-105 Universal Fuse Box.

3. Connect the **EL-50332-120** High Voltage Interface Cable to the **EL - 50332** Hybrid/EV Battery Service Tool.
4. Connect the **EL-50332-135** Hybrid/EV Battery Contactor Assembly Interface Cable to the **EL-50332-270** Vehicle Interface Module 2.
5. Connect the **EL-50332-125** Vehicle Interface Module Low Voltage 24-Pin Cable to the **EL-50332-270** Vehicle Interface Module 2.
6. Connect the **EL-50332-125** Vehicle Interface Module Low Voltage 24-Pin Cable to the **EL-50332** Hybrid/EV Battery Service Tool.

NOTE: **Refer to the Special Tools for the correct regional power cord.**

7. Connect the appropriate regional power cord to the **EL-50332** Hybrid/EV Battery Service Tool.
8. Connect the appropriate regional power cord into a known good power outlet.
9. Turn ON the **EL - 50332** Hybrid/EV Battery Service Tool using the power switch.
10. At the MAIN MENU, select SECTION BALANCE, press the SELECT soft key.
11. At the TYPE menu, select VOLTEC, press the NEXT soft key.
12. At the TARGET menu, select appropriate section to be balanced, press the NEXT soft key.
13. Connect the **EL-50332-155** Green Banana Jack Cable to the A4 Hybrid/EV Battery Pack ground stud.
14. Connect the **EL-50332-145** Black Banana Jack Cable to the appropriate section negative stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Section 1, Hybrid Battery Section 2, or Hybrid Battery Section 3.
15. Connect the **EL-50332-150** Red Banana Jack Cable to the appropriate section positive stud to be balanced. Refer to [Hybrid/EV Energy Storage Schematics](#) for Hybrid Battery Section 1, Hybrid Battery Section 2, or Hybrid Battery Section 3.
16. Press the NEXT soft key.
17. Connect the **EL-50332-135** Hybrid/EV Battery Contactor Assembly Interface Cable to the A4 Hybrid/EV Battery Pack.

NOTE: **Depending on the charge condition of the battery pack and the section being balanced, this process may take up to 4 hours to complete.**

18. Press the NEXT soft key.

NOTE: **The EL-50332 will now balance the selected section by charging/discharging, as appropriate. Target voltage varies based on measured pack cell group voltages. Initial balancing will be in a constant current mode (max 5 amp charge, 7.5 amp discharge). The tool will transition to a constant voltage mode (decreasing current) near the end of the event. A warranty code and pack voltage current data will be displayed at the conclusion of the balancing event.**

19. An audible tone will sound at the end of balancing or in the event of a fault condition.

- **A fault condition was detected**

Refer to the **EL - 50332** Hybrid/EV Battery Service Tool Instruction Manual.

- **Section balancing completed successfully**

20. At the Completed menu, press the NEXT soft key. Record warranty code. Press the EXIT soft key.
21. Disconnect the **EL - 50332** Hybrid/EV Battery Service Tool from the Hybrid/EV Battery Pack.
22. All OK.

HYBRID/EV BATTERY SYSTEM VERIFICATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

Hybrid/EV Battery System Verification

After major internal A4 Hybrid/EV Battery Pack repairs the technician may use the **EL-50332** Hybrid/EV Battery Service Tool to verify proper cell group voltage and temperature connection/operation prior to installing the battery pack cover and/or installing the battery pack into the vehicle.

The **EL-50332** Hybrid/EV Battery Service Tool communicates with the battery energy control module through the A4 Hybrid/EV Battery Pack low voltage connectors. The tool displays battery cell group voltages for the 96 battery cell groups along with the calculated voltage difference between the highest and lowest readings. The tool also displays the temperatures read by the thermistors located within the battery sections.

Diagnostic Aids

Hybrid/EV Battery System Verification requires that the battery pack is removed from the vehicle and that the battery energy control module contains software. If you are installing a service replacement battery energy control module, connect the battery pack to the vehicle with the **EL-50211** Low Voltage Jumper Harness Extension and program the battery energy control module prior to performing Hybrid/EV Battery System Verification. Perform the [Clear Secured High Voltage DTCs](#) procedure after successfully programming the service replacement battery energy control module.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

[Testing for Intermittent Conditions and Poor Connections](#)

Description and Operation

[Drive Motor Battery System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

[Control Module References](#) for scan tool information

Special Tools

- **EL-50211** Low Voltage Jumper Harness Extension
- **EL-50332** Hybrid/EV Battery Service Tool
- **EL-50332-10** 220V Power Cable - China
- **EL-50332-125** Vehicle Interface Module Low Voltage 24-Pin Cable
- **EL-50332-135** Hybrid/EV Battery Contactor Assembly Interface Cable
- **EL-50332-175** 120 V Power Cable
- **EL-50332-175** 120 V Power Cable - EU
- **EL-50332-180** 250 V Power Cable - AUS
- **EL-50332-270** Vehicle Interface Module 2

For equivalent regional tools, refer to [Special Tools](#)

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

WARNING: This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high

voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with UL[®] listed, or equivalent, insulation tape rated at a minimum of 600 V.

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: Before performing the Hybrid/EV Battery System Verification, make sure all of the external EL-50332 components are in good condition and working order.

1. Connect the **EL-50332-125** to the **EL-50332-270** .
2. Connect the **EL-50332-125** to the **EL-50332** .
3. Connect the appropriate regional power cord to the **EL-50332** .
4. Connect the power cord into a known good power outlet.
5. Turn ON the **EL-50332** using the power switch.
6. At the MAIN MENU, select PACK INFO, press the SELECT soft key.

NOTE: Selecting One-shot will take and display a single snapshot of the battery parameters, selecting Continuous will display live parameter values.

7. At the PACK INFO TYPE menu, select ONE-SHOT, press the NEXT soft key.
8. At the MANUFACTURER menu, select correct BRAND, press the NEXT soft key.
9. At the MODEL menu, select correct MODEL, press the NEXT soft key.
10. At the COMM CONNECTION menu, select HYBRID BATTERY CONTACTOR ASSEMBLY, press the NEXT soft key.
11. Connect the **EL-50332-135** to the A4 Hybrid/EV Battery Pack.
12. Connect the **EL-50332-135** to the **EL-50332-270** , press the NEXT soft key.
13. At the PACK INFO menu, scroll down to the DELTA VCELL parameter. Record and verify the DELTA VCELL is less than 0.1 V.

- **If the DELTA VCELL is 0.1 V or greater**

There is an internal battery pack concern. Inspect for conditions such as improper internal wiring connections or improper cell balancing service procedures.

- **The DELTA VCELL is less than 0.1 V**

14. Record and verify all of the battery temperature sensor readings are within 6[°]C (10.8[°]F) of each other.
- **If any of the battery temperature sensor readings are 6[°]C (10.8[°]F) or greater of each other**

There is an internal battery pack concern. Inspect for conditions such as improper internal wiring

connections or damaged components.

- The battery temperature sensor readings are within 6Â° C (10.8Â° F) of each other

15. All OK.

DESCRIPTION AND OPERATION

DRIVE MOTOR BATTERY SYSTEM DESCRIPTION

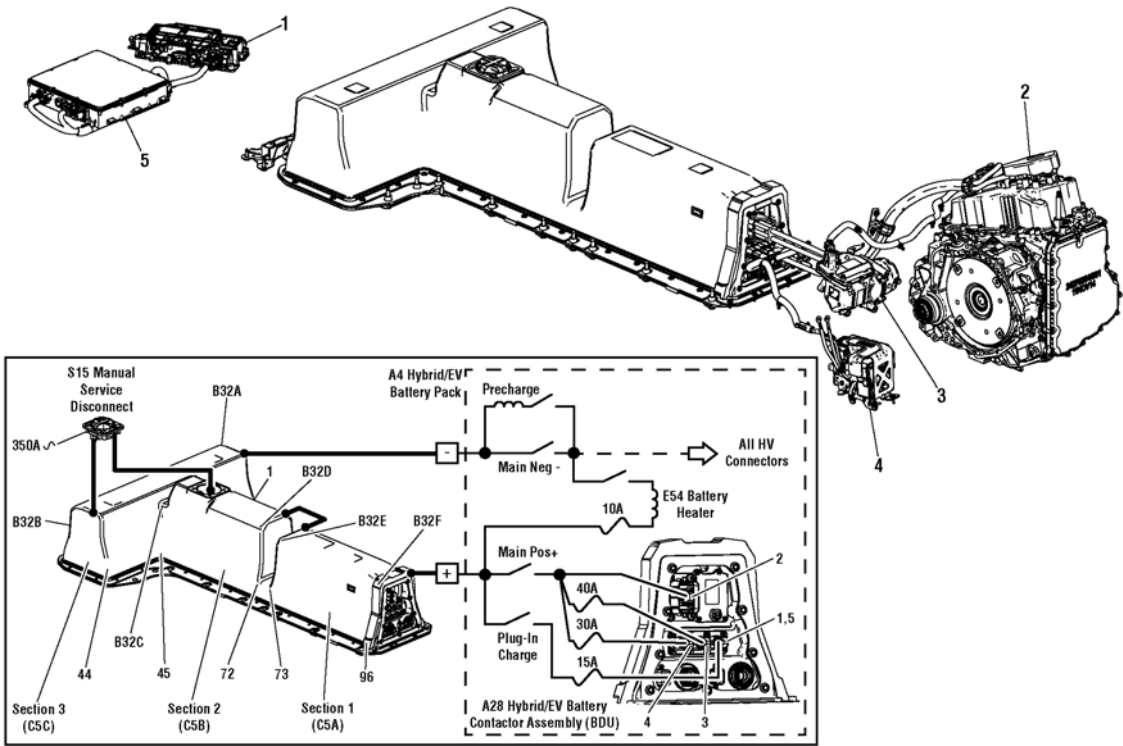


Fig. 306: Drive Motor Battery System
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	K1 14V Power Module
2	T6 Power Inverter Module
3	G1 A/C Compressor
4	K10 Cabin Heater
5	T18 Battery Charger

Overview

The high voltage hybrid/EV battery contains 192 individual lithium-ion cells. Two cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.7 V, for a nominal system voltage of 355 V direct current. The battery cell groups are joined to form 3 distinct sections. The first 24 battery cell groups make up battery section 1. This section is adjacent to the cowl and contains battery cell groups 73 through 96. The next 28 battery cell groups make up battery section 2. This section is located behind section 1 and contains battery cell groups 45 through 72. The transverse battery section is section number 3 and it contains the remaining 44 battery cell groups 1 through 44. The battery sections also contain two temperature sensors, with one sensor located at each end of the section for a Hybrid/EV battery pack total of six temperature sensors.

Located within the high voltage Hybrid/EV battery pack, the battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the top surface of the battery section. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for battery energy control module diagnostic trouble code information.

Location

The high voltage hybrid/EV battery is located beneath the vehicle. The battery energy control module, current sensor, and high voltage contactors are located within the hybrid battery assembly. The hybrid powertrain control module 2 is located behind the front passenger seat instrument panel.

High Voltage Control

The hybrid/EV battery contains 4 high voltage contactors and 1 solid state relay (transistor). The high voltage contactors and transistor allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The transistor controls the battery heater high voltage negative circuit.

In order to prevent large in-rush current to capacitors located in the vehicles high voltage components, the contactors close in a specific precharge sequence controlled by the hybrid/EV powertrain control module 2.

Contactor Close Sequence (Precharge)

1. Plug-In Charge Positive Contactor
2. Main Positive Contactor
3. Precharge Negative Contactor

NOTE: **Wait for bus high voltage to attain almost the same level as hybrid/EV battery voltage.**

4. Main Negative Contactor
5. The precharge contactor opens when bus voltage and hybrid/EV battery voltage are equal.

Thermal Management

The hybrid/EV battery is cooled and heated with pre-mixed DEX-COOLÂ®, which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. A refrigerant/coolant heat exchanger (chiller) and the electric A/C compressor motor control module assembly cools down the high voltage hybrid/EV battery. A high voltage heater inside the hybrid/EV battery can also heat the coolant entering the hybrid/EV battery when needed. Refer to [Hybrid/EV Cooling System Description and Operation](#) .

HYBRID/EV SYSTEM HIGH VOLTAGE ISOLATION DESCRIPTION

Loss of Isolation Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

Similar to typical 12V vehicle systems, loss of isolation can be as simple as a direct conductor-to-chassis short. Unlike 12V systems however, the potential within high voltage systems means that insulation breakdown is also a cause for loss of isolation. Therefore diagnosis for isolation loss requires testing with high voltage potential. Special multi-meters that utilize their own built-in high voltage, such as the **EL-50772** Insulation Multimeter, are used to test the isolation capability of high voltage components and circuits. Additionally, monitoring certain scan tool parameters when high voltage is active may also help to identify which high voltage components and circuits may have lost their chassis isolation.

Vehicle Loss of Isolation Detection

The vehicle performs two independent tests for isolation:

1. Passive isolation testing which is performed within the power inverter module by the hybrid powertrain control module 1.
2. Active isolation testing which is performed within the Hybrid/EV battery pack by the hybrid powertrain control module 2.

Passive Isolation Testing

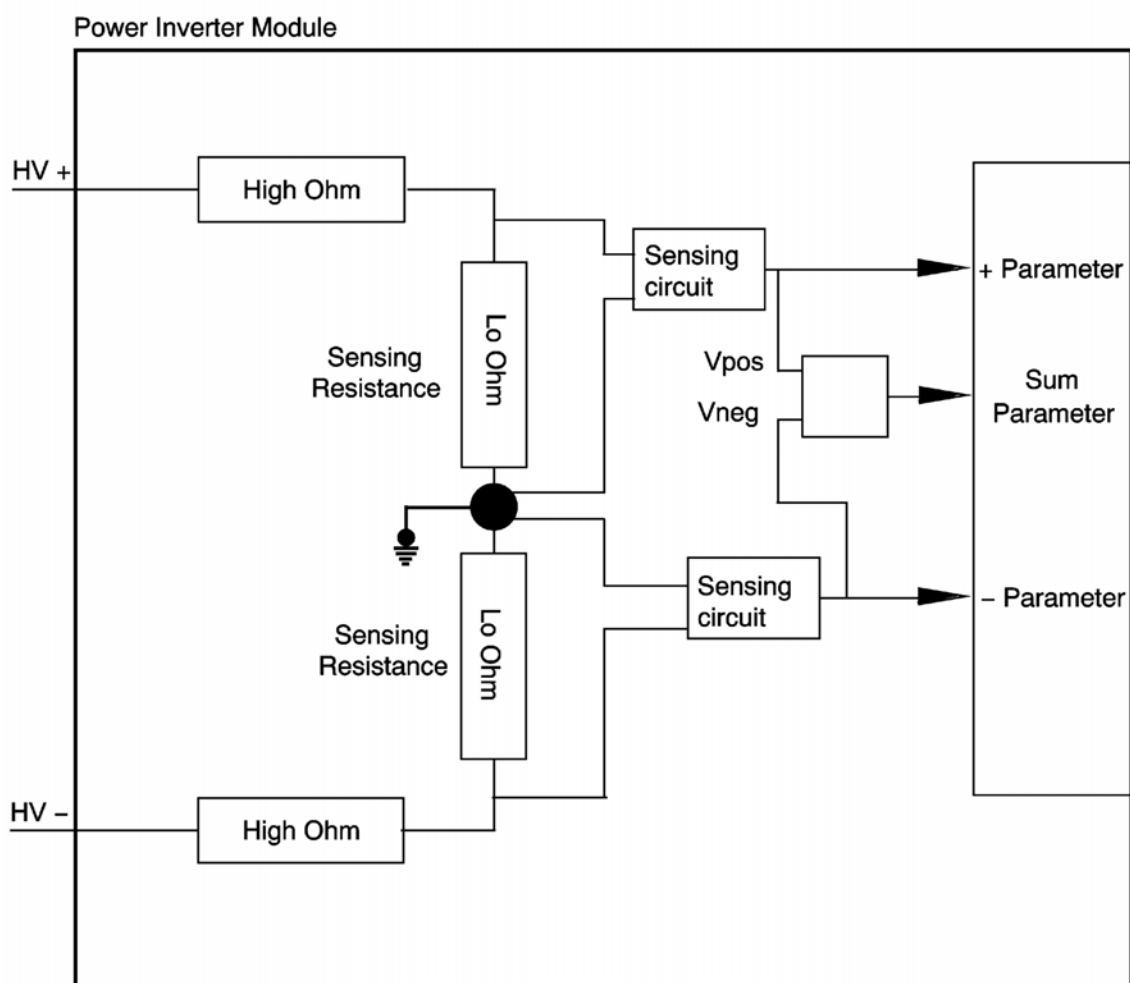


Fig. 307: Power Inverter Module Operation Graph
 Courtesy of GENERAL MOTORS COMPANY

The power inverter module continuously performs isolation testing whenever high voltage to the module is present. The power inverter module has one isolation sensing circuit although the drive motor and aux pump control modules monitor and display the sensor data redundantly. The Positive Supply Isolation Voltage and the Negative Supply

Isolation Voltage scan tool parameters give a real-time indication of Isolation status. Under normal operating conditions each of the parameters will indicate about half of the total Hybrid/EV battery pack high voltage potential. When a loss of isolation condition is observed, the Voltage scan tool parameter values will shift in respect to each other. When the voltage shift exceeds a set ratio, DTCs P1AF0, P1AF2, or P1E22 will set.

NOTE: Some high voltage components contain internal switching or inverter circuits that can interrupt a portion of their high voltage circuitry. If such a component, for example the passenger cabin heater, is OFF its complete internal circuitry is not being monitored. Likewise, these internally switched components cannot be fully tested off-vehicle with the EL-50772 Insulation Multimeter, or equivalent.

Scan Tool Parameters

- Drive Motor 1 Positive Supply Isolation Voltage
- Drive Motor 1 Negative Supply Isolation Voltage
- Drive Motor 2 Positive Supply Isolation Voltage
- Drive Motor 2 Negative Supply Isolation Voltage
- Aux Trans Fluid Pump Positive Supply Isolation Voltage
- Aux Trans Fluid Pump Negative Supply Isolation Voltage

The power inverter module isolation sensing circuit communicates one value, which is displayed redundantly by three different modules. The data within the parameters for each module is identical.

Isolation Loss between HV Components and Chassis, Positive Side*

Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate DTC set	100K	None - Direct Short
Positive Isolation parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Difference Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V
*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.								

Active Isolation Testing

Active isolation testing is dedicated to monitoring the internal Hybrid/EV battery pack HV circuits. The battery energy control module switches fixed resistors between the high voltage system and vehicle chassis. The difference between the switched-to-chassis state and the unswitched state is used to calculate a resistance-to-chassis value. When resistance-to-chassis decreases below a set value, DTC P0AA6 will set.

Active isolation testing occurs when the main high voltage contactor relays are open. For this reason most testing of the Hybrid/EV battery pack occurs just after the vehicle is shut off following a drive trip. The Isolation Test Resistance scan tool parameter indicates the resistance-to-chassis calculation determined when the last Active isolation test was performed.

High Voltage System

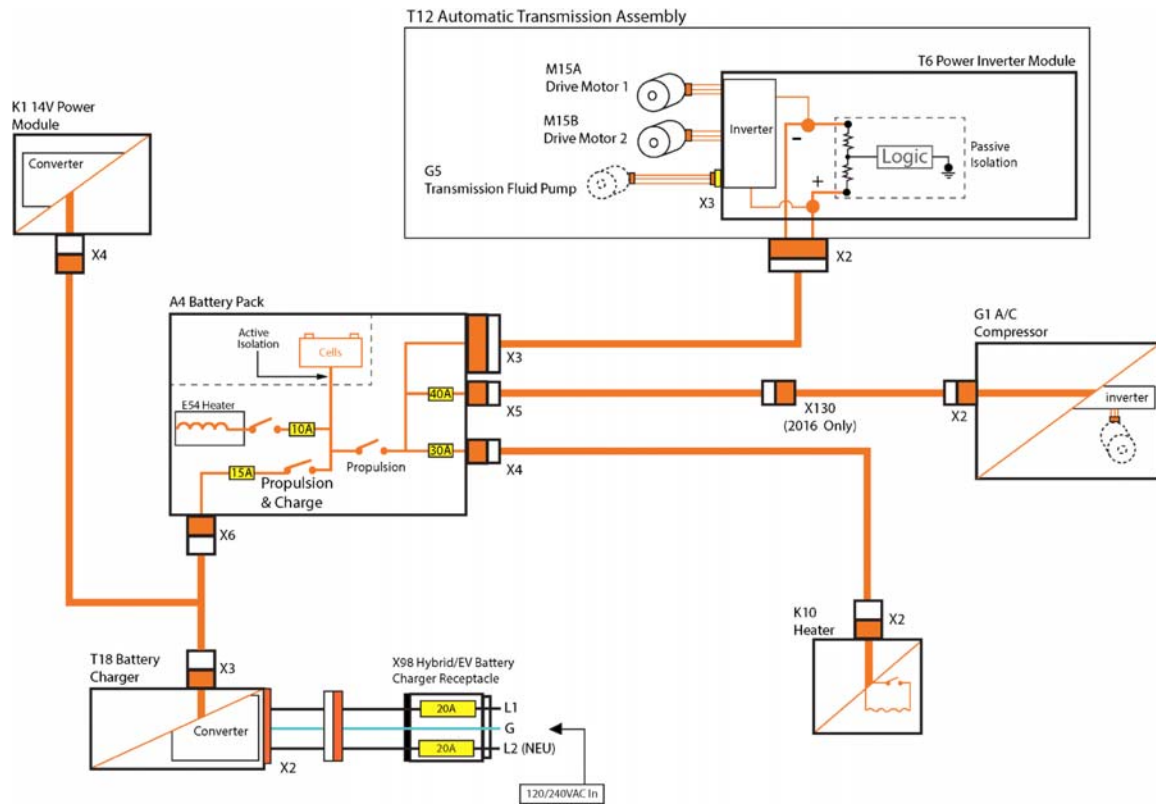


Fig. 308: High Voltage System

Courtesy of GENERAL MOTORS COMPANY

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

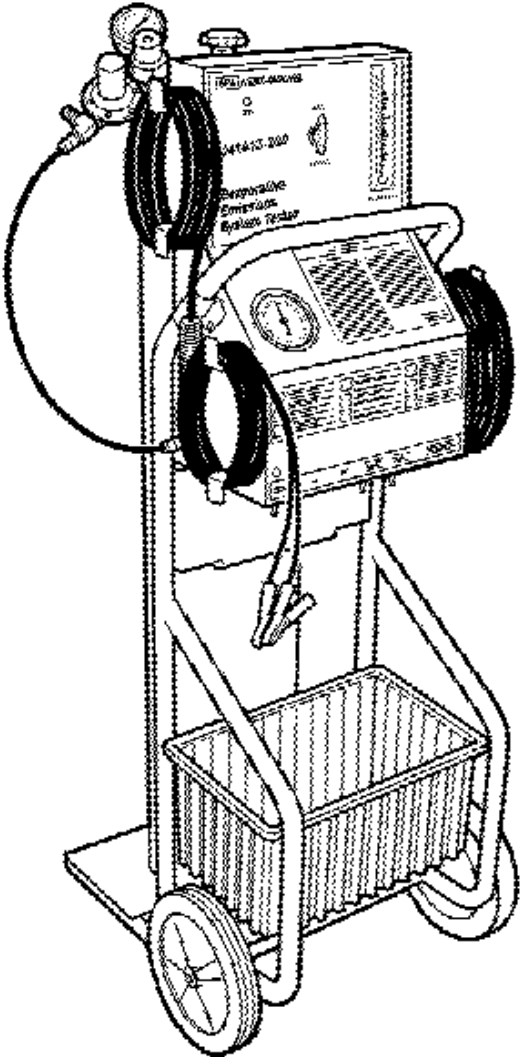
Illustration	Tool Number/Description
	GE-41413-A J-41413-A Evaporative Emissions System Tester

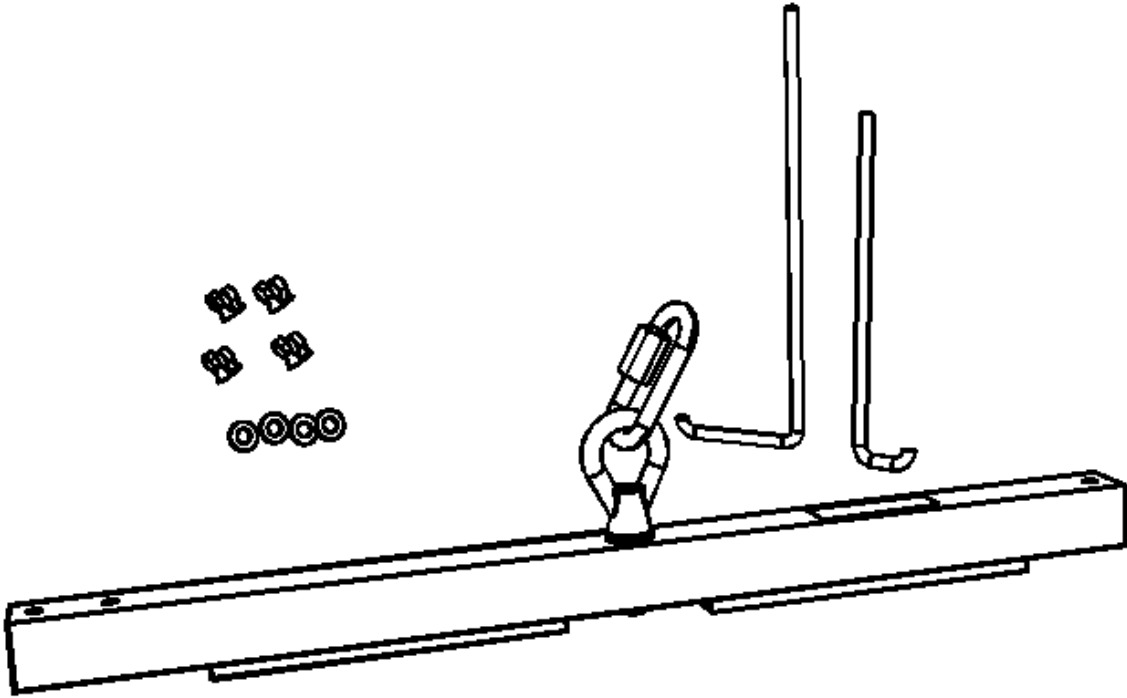
Illustration	Tool Number/Description
	EL-48264 Battery Pack Lifting Adapter

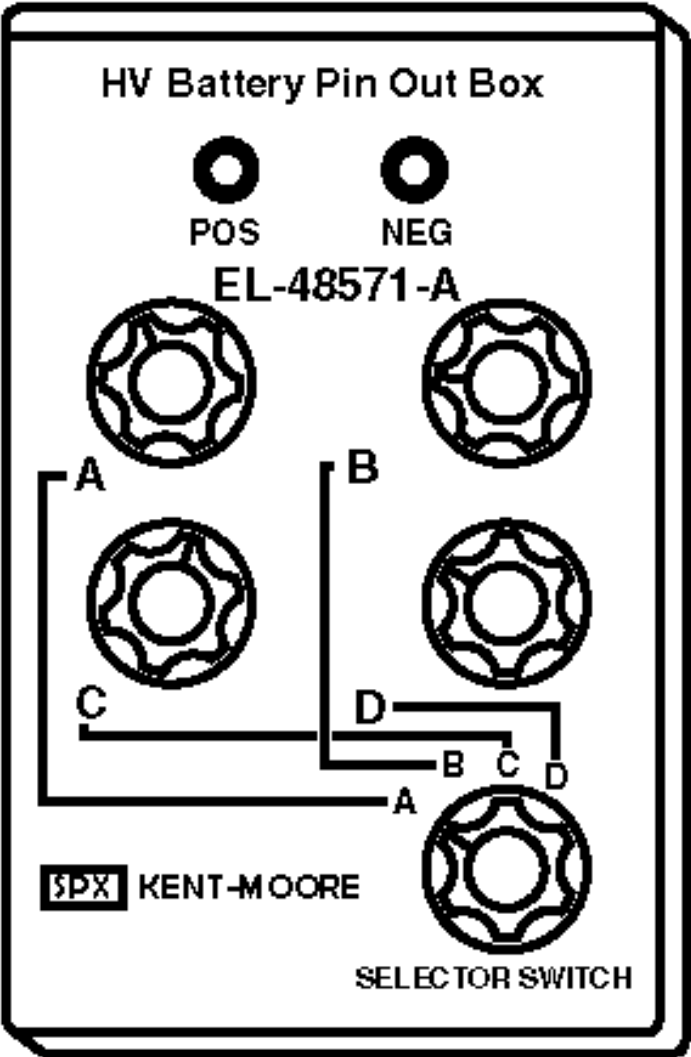
Illustration	Tool Number/Description
 The diagram illustrates the internal wiring of the HV Battery Pin Out Box (EL-48571-A). At the top, two terminals are labeled POS and NEG. Below them, the model number EL-48571-A is printed. The box contains four circular components, each with a star-like internal pattern. Wires connect these components to a selector switch at the bottom. The wiring is labeled with letters A, B, C, and D. A legend at the bottom left shows a box with 'SPX' and the text 'KENT-MOORE'. The selector switch is labeled 'SELECTOR SWITCH'.	EL-48571 High Voltage Battery Pin Out Box

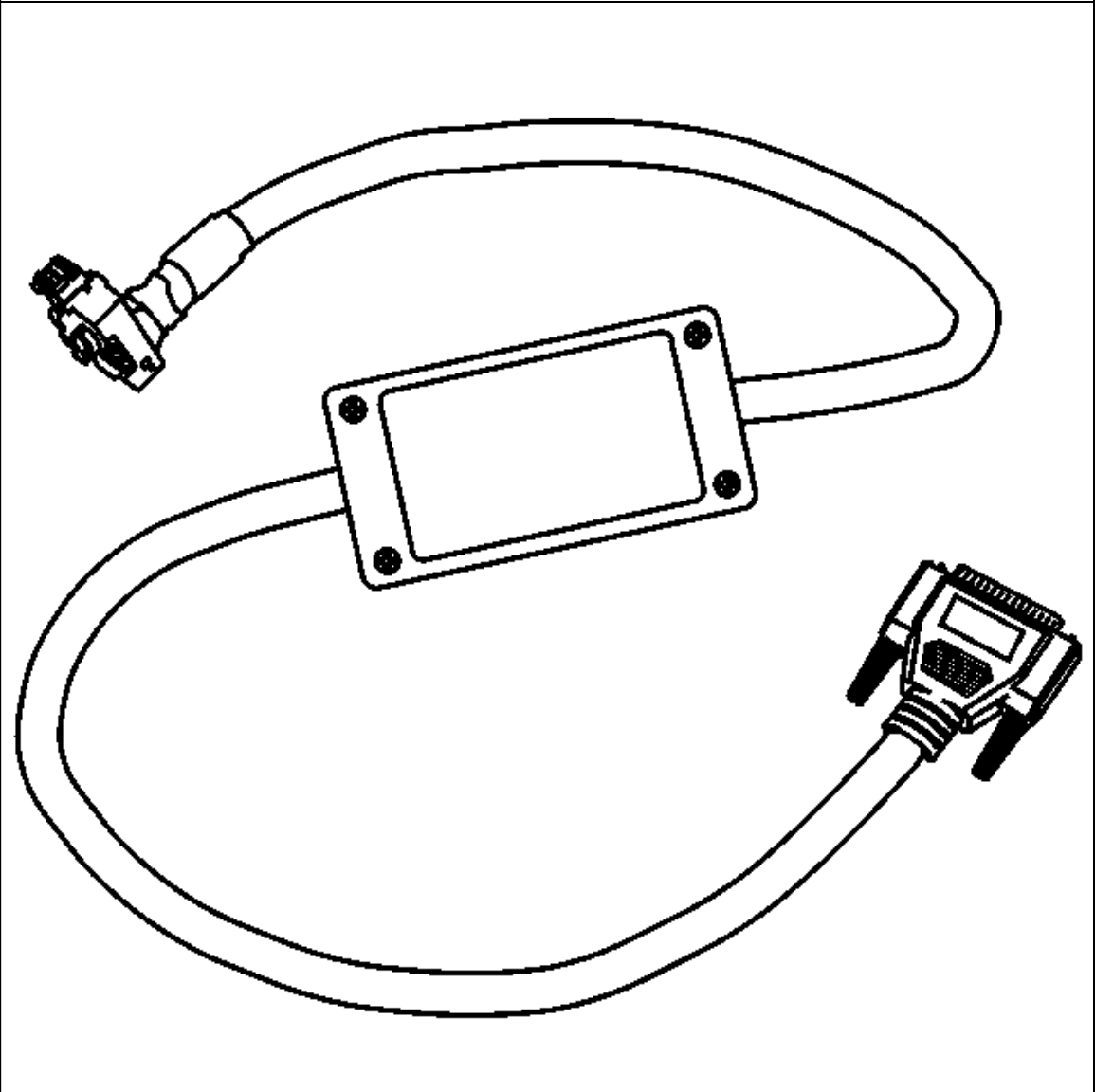
Illustration	Tool Number/Description
 A line drawing of a cable. In the center is a rectangular box with four screws, one on each side. A cable extends from the top-left of the box, ending in a multi-pin connector. Another cable extends from the bottom-right of the box, ending in a different multi-pin connector. The entire assembly is shown in a looped configuration.	EL-48571-55 Battery Pin Out Box Adapter

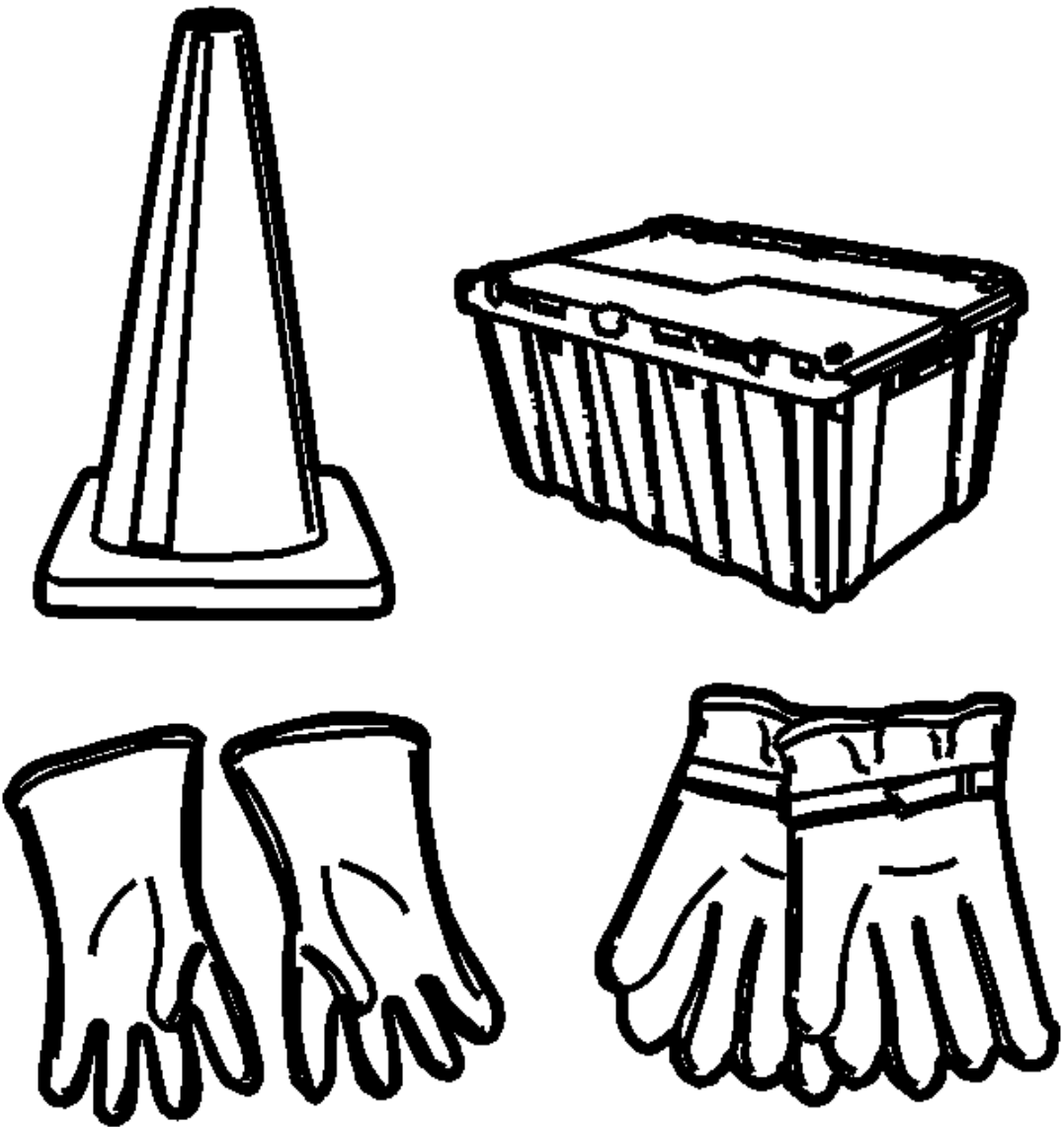
Illustration	Tool Number/Description
 The illustration shows three items: a traffic cone on the left, a rectangular storage bin with vertical ridges in the upper right, and two pairs of gloves at the bottom. The pair on the left has a textured, wavy pattern on the palm side, while the pair on the right is smooth with visible stitching at the wrist and fingers.	EL-48900 HEV Safety Kit

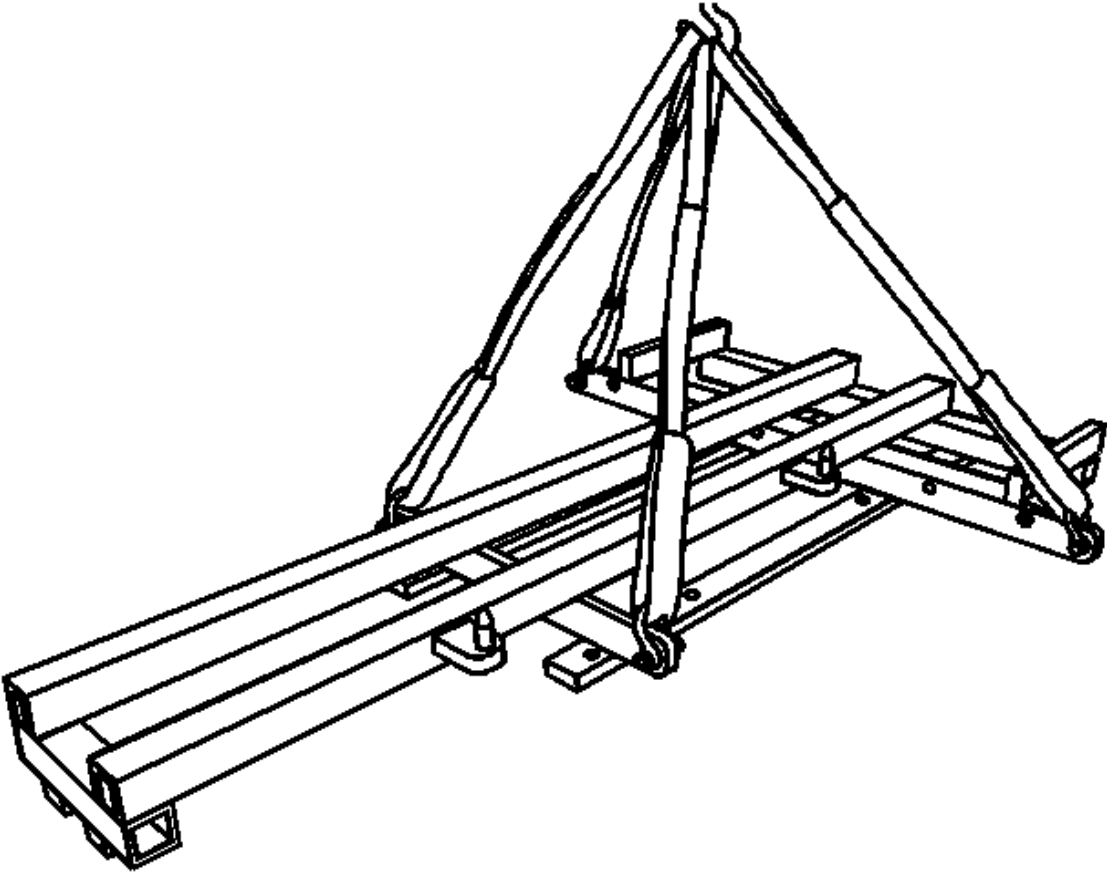
Illustration	Tool Number/Description
	EL-49976 Hybrid/EV Battery Lifting Fixture

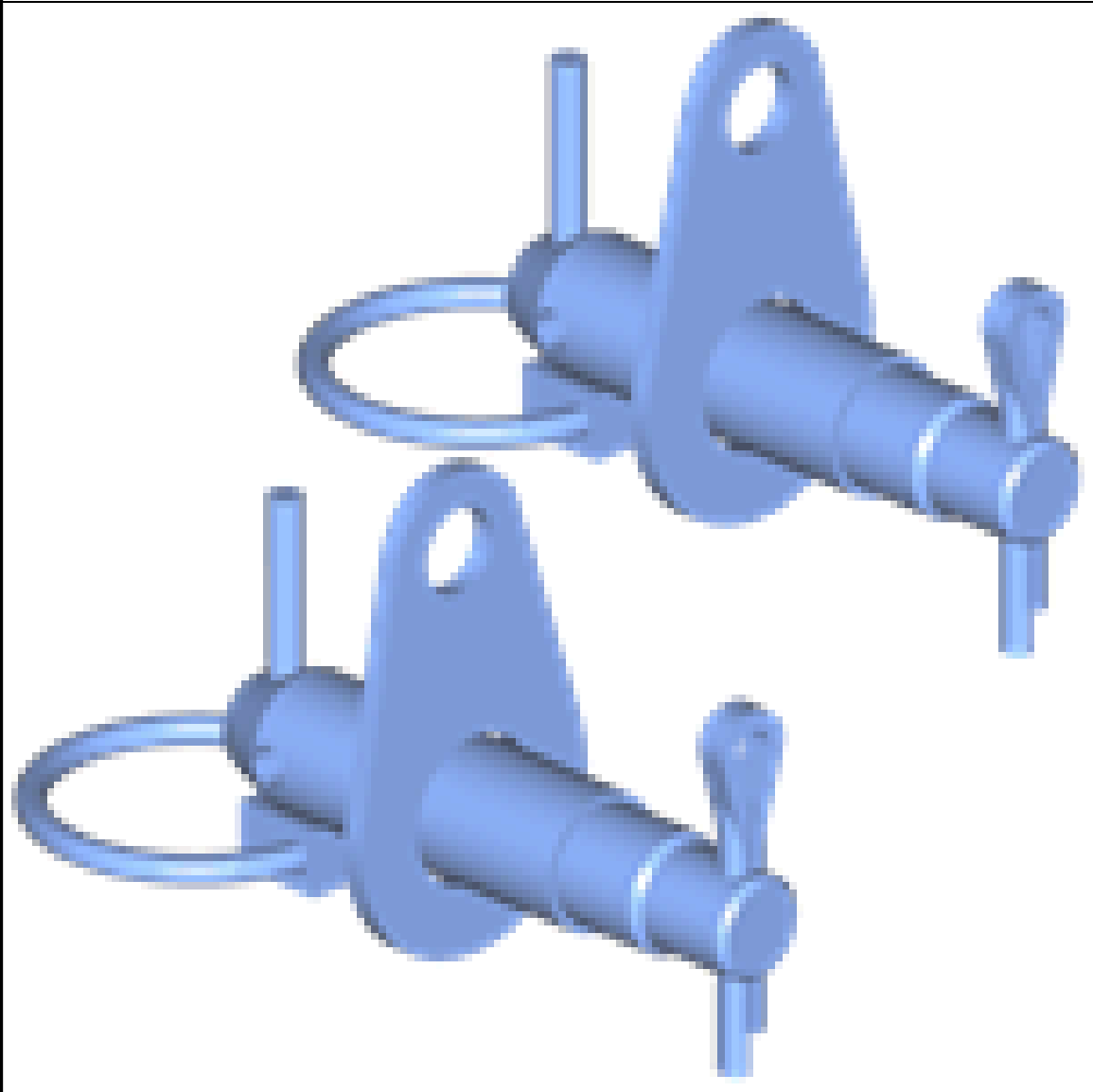
Illustration	Tool Number/Description
	EL-49976-50 Battery Lifting Fixture Alignment Pins

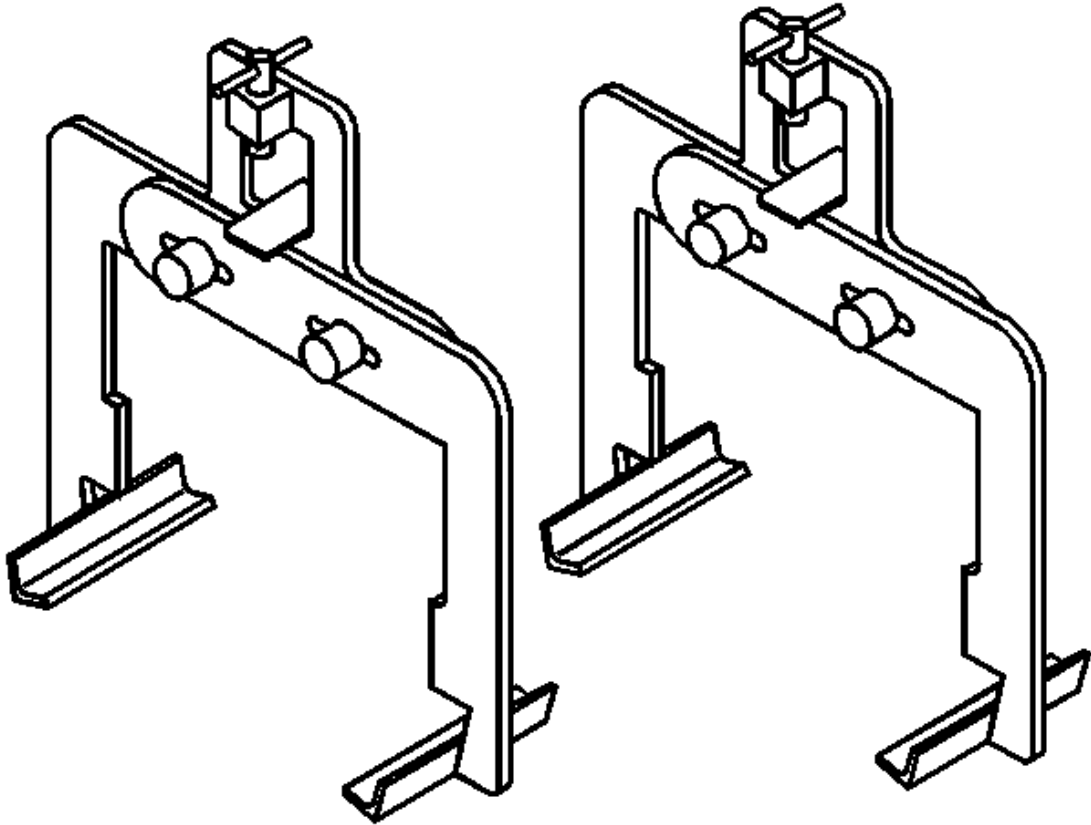
Illustration	Tool Number/Description
	EL-50115 Battery Section Lifting Adapter

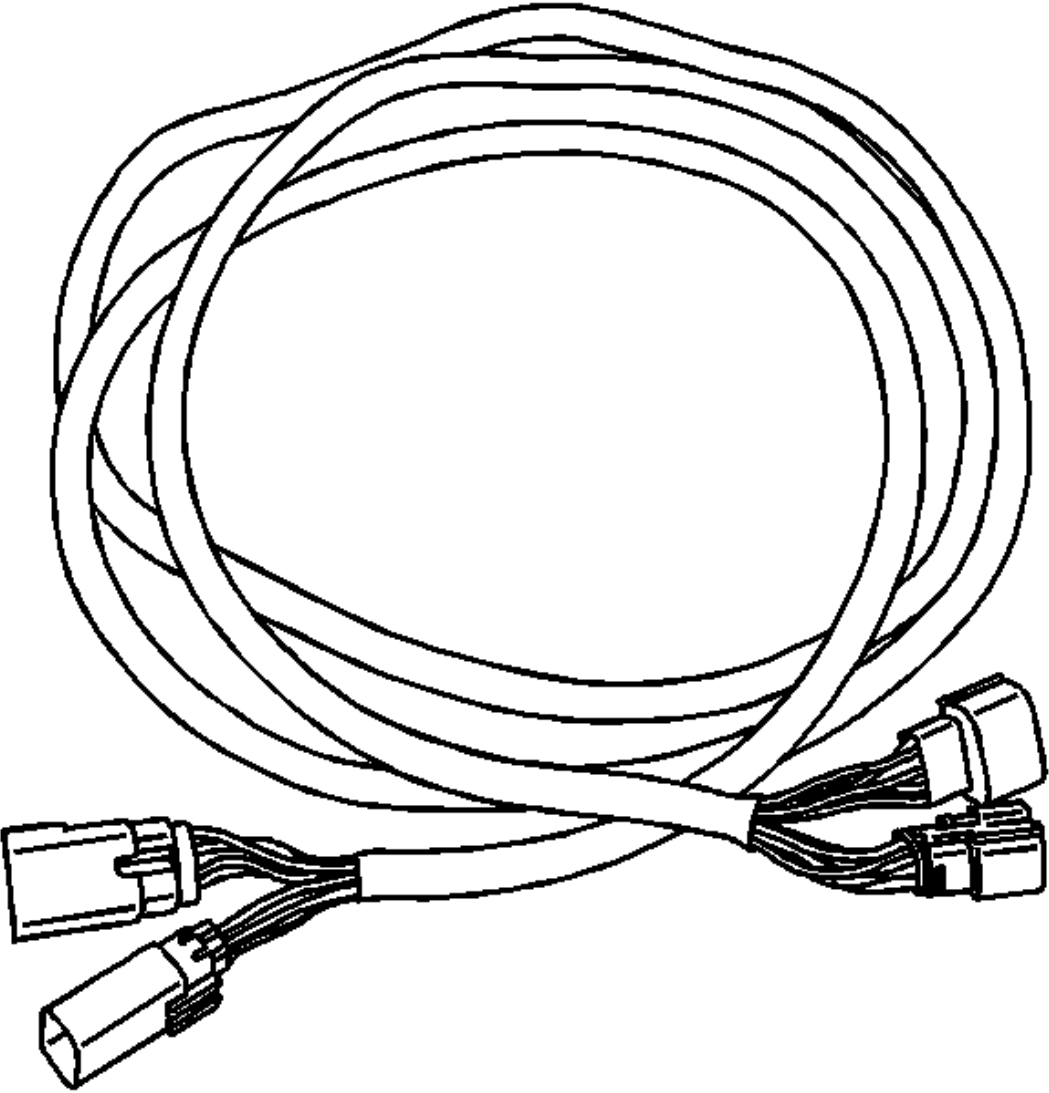
Illustration	Tool Number/Description
	EL-50211 Low Voltage Jumper Harness

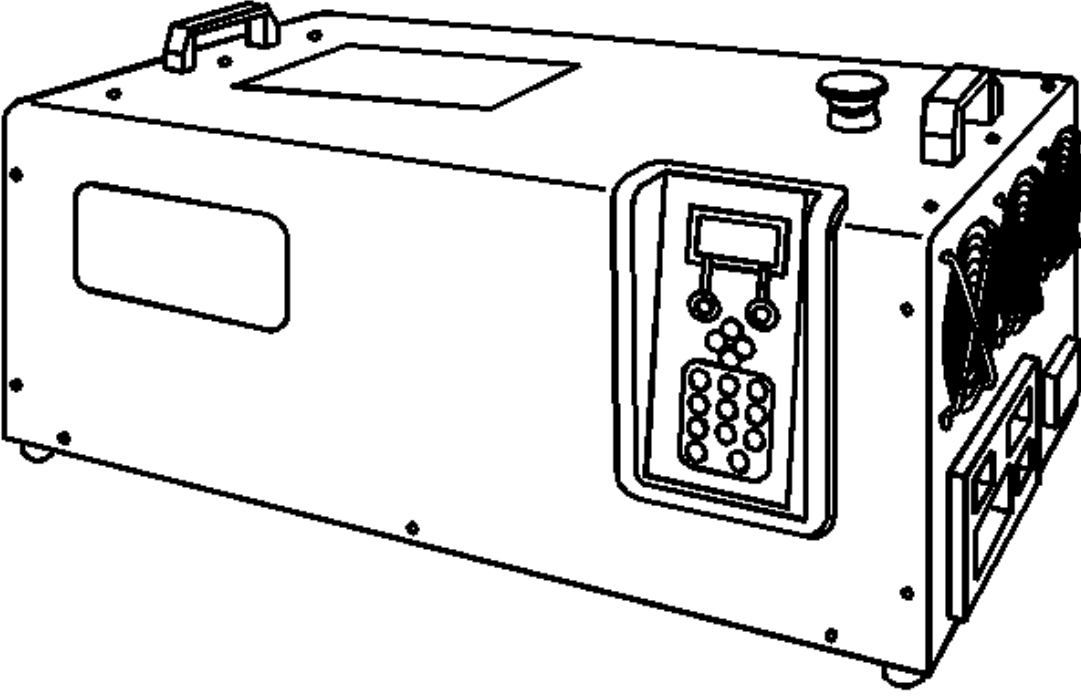
Illustration	Tool Number/Description
	EL-50332 Hybrid/EV Battery Service Tool

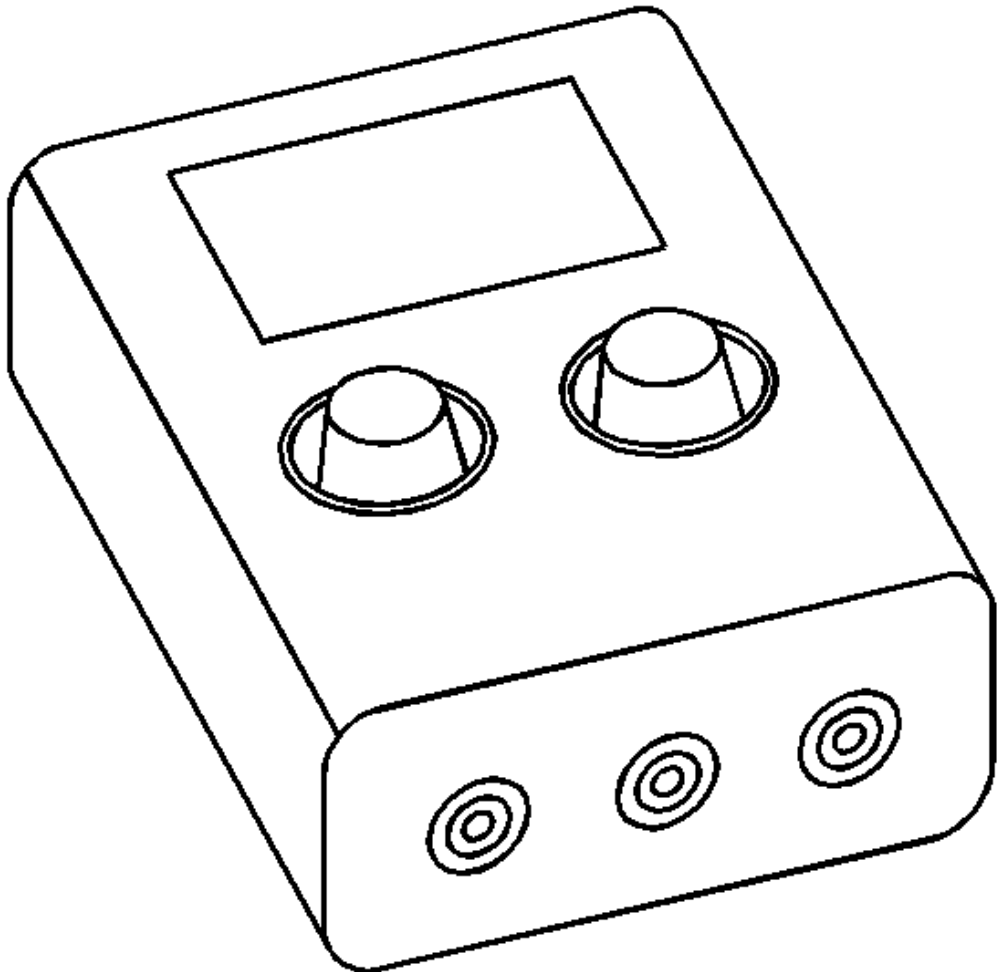
Illustration	Tool Number/Description
	EL-50332-105 Universal Fuse Box

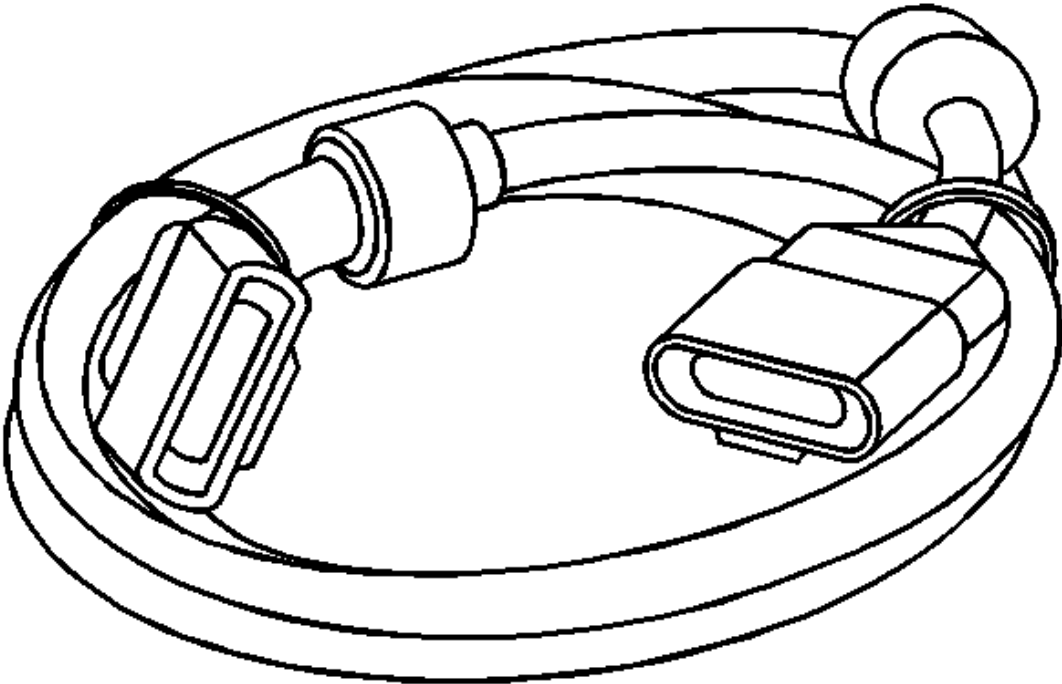
Illustration	Tool Number/Description
	EL-50332-120 High Voltage Interface Cable

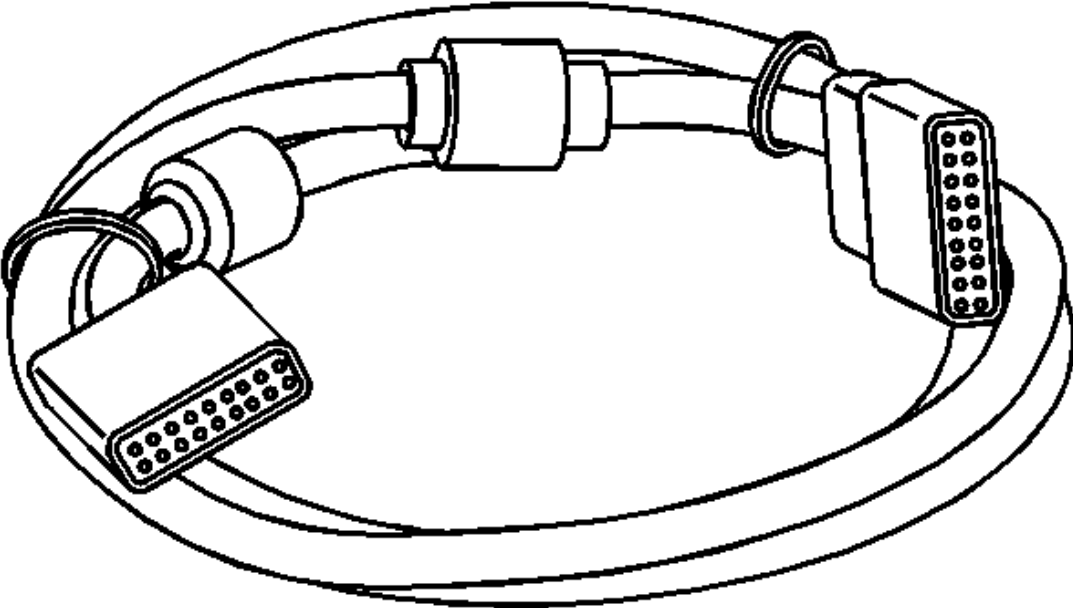
Illustration	Tool Number/Description
	EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable

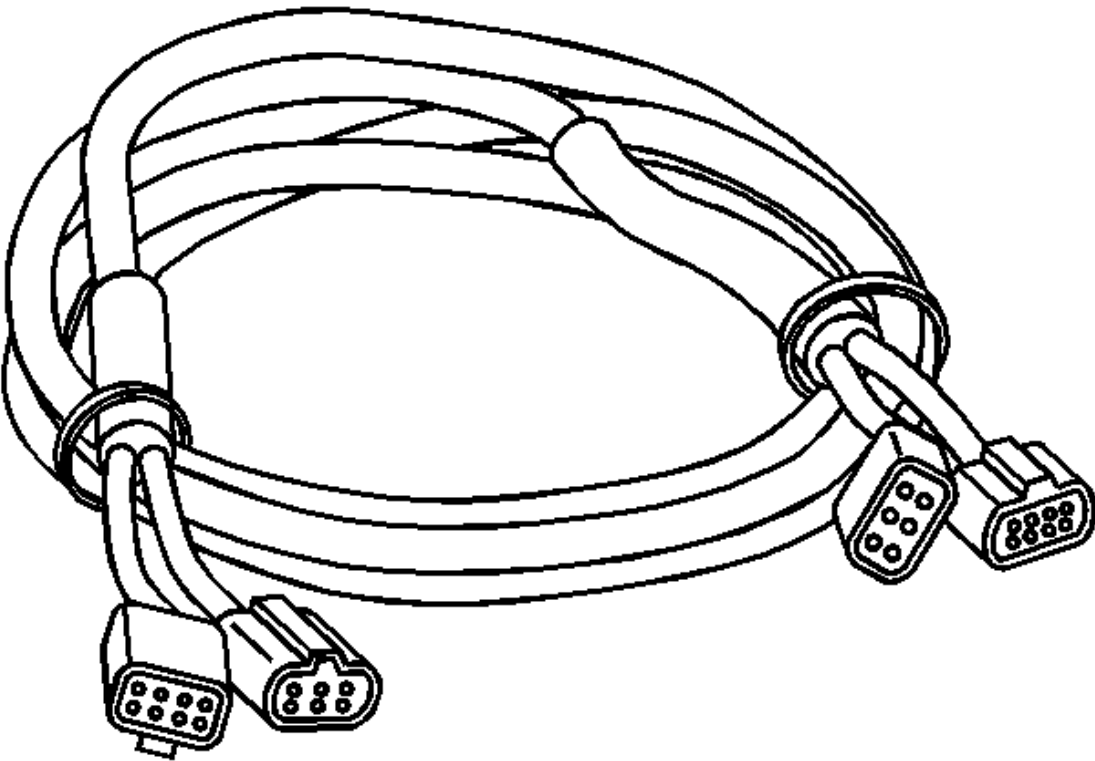
Illustration	Tool Number/Description
	EL-50332-135 Hybrid/EV Battery Contactor Assembly Interface Cable

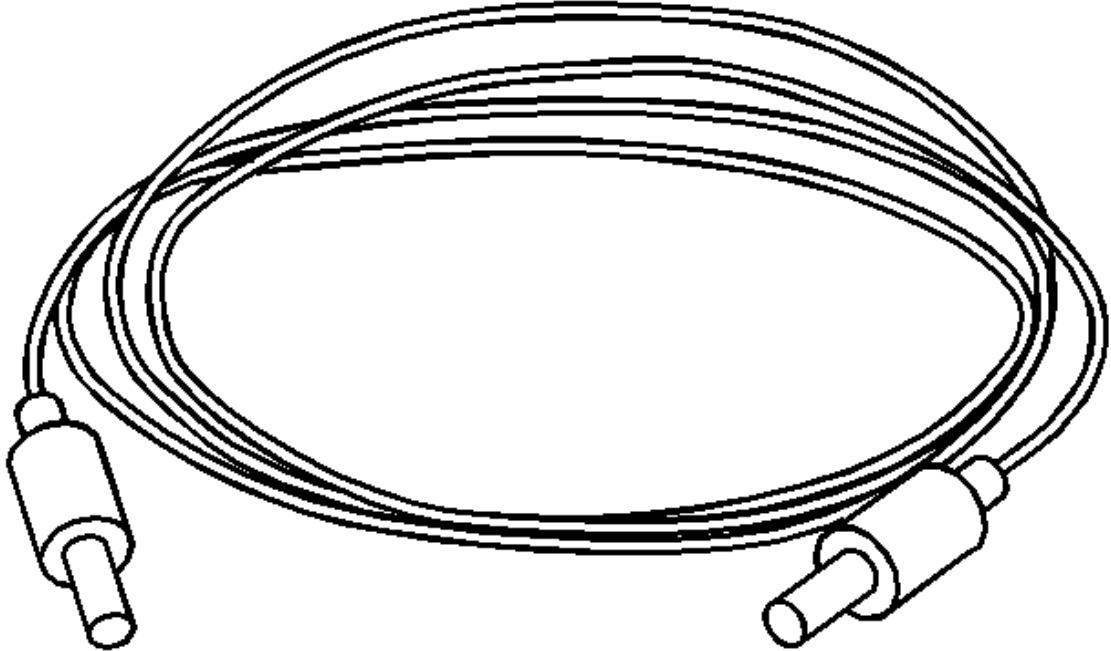
Illustration	Tool Number/Description
	EL-50332-145 Black Banana Jack Cable

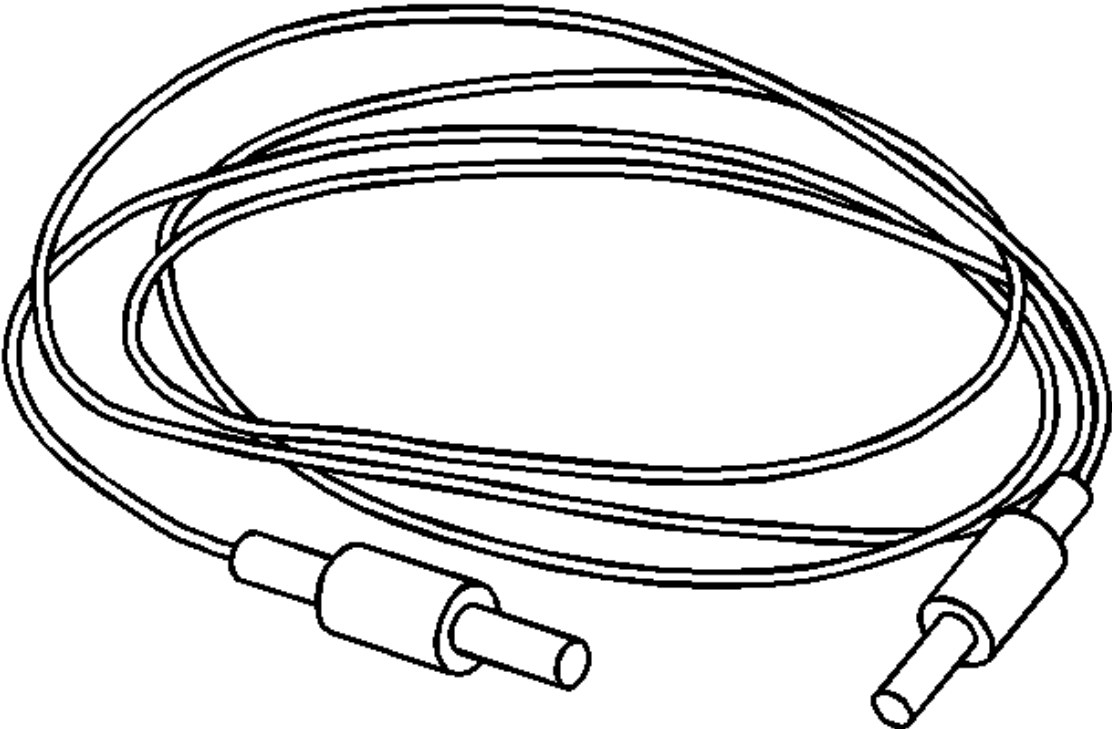
Illustration	Tool Number/Description
	EL-50332-150 Red Banana Jack Cable

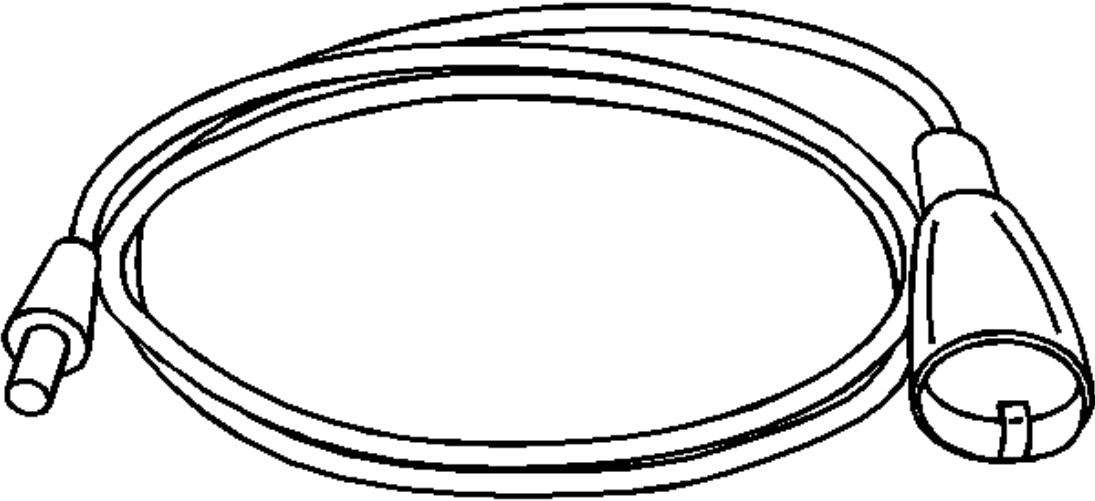
Illustration	Tool Number/Description
	EL-50332-155 Green Banana Jack Cable

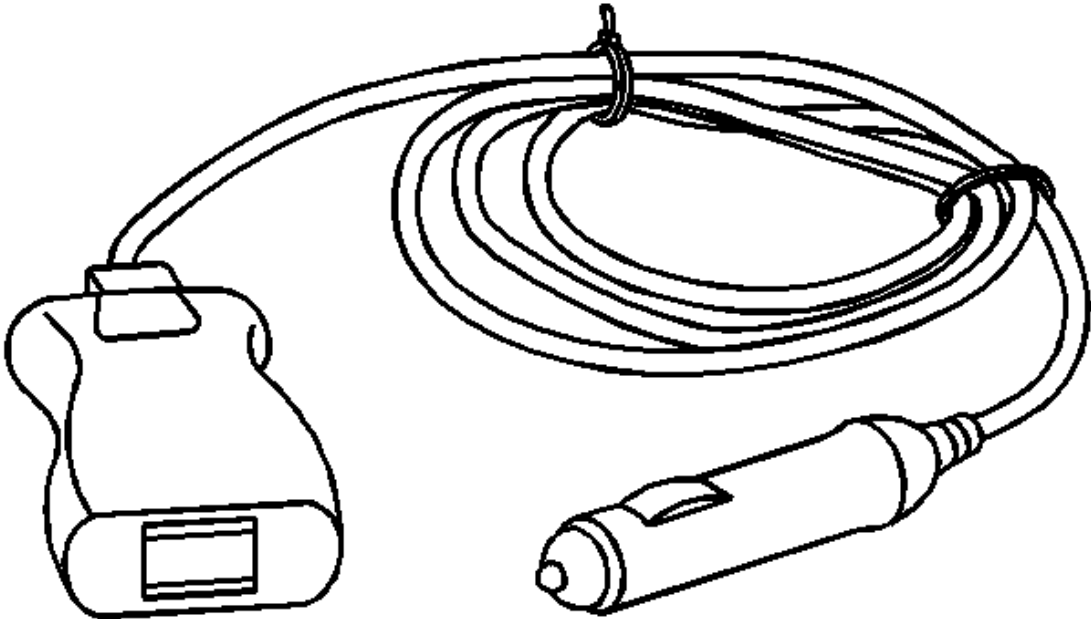
Illustration	Tool Number/Description
	EL-50332-160 12 V Auxiliary Power Cable

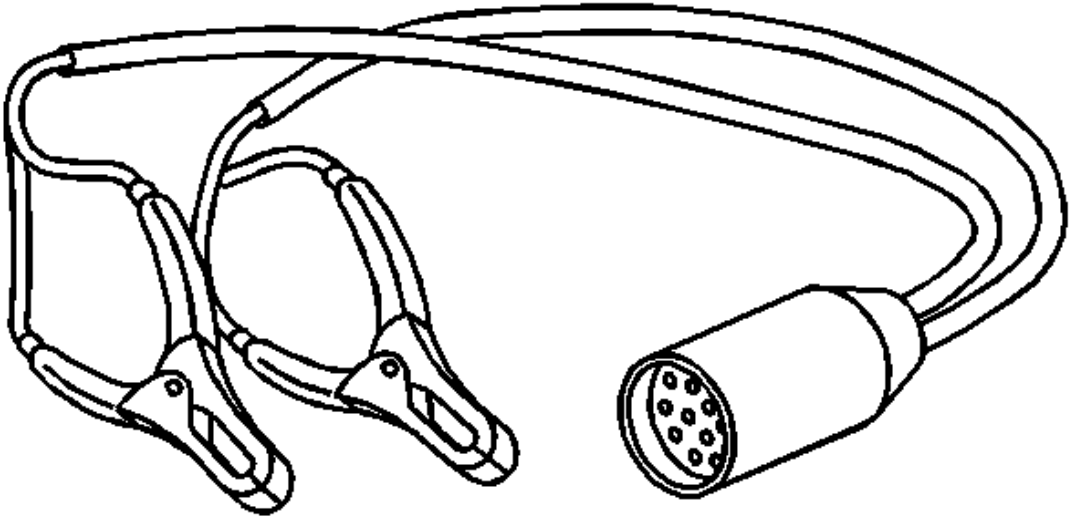
Illustration	Tool Number/Description
	EL-50332-165 12 V Auxiliary Clamps Adapter Cable

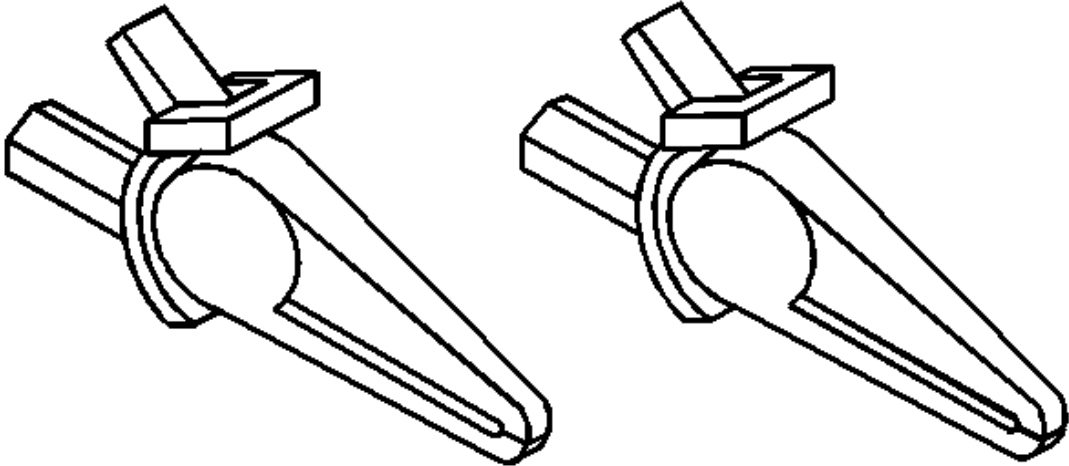
Illustration	Tool Number/Description
 The illustration shows two identical high-voltage alligator clamps. Each clamp consists of a long, tapered metal body with a pointed end. A circular contact point is located near the base of the jaws. A rectangular metal plate is attached to the top of the handle, and a small, rectangular metal tab extends from the top of the handle. The clamps are shown from a perspective view, one slightly behind the other.	EL-50332-170 High Voltage Alligator Clamps

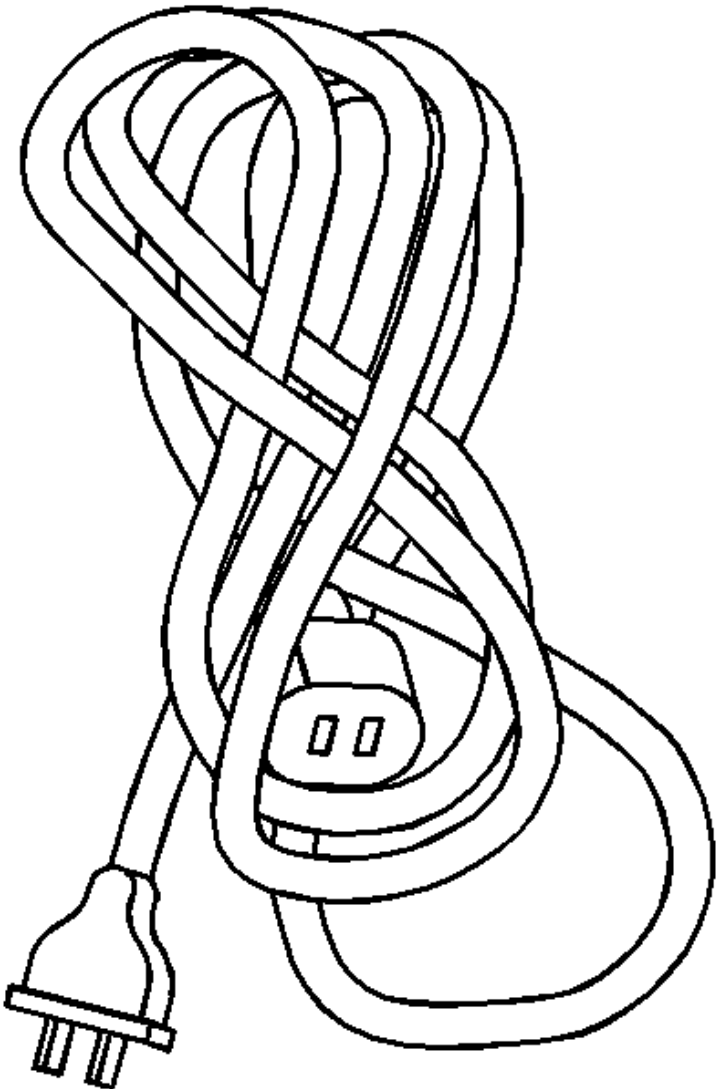
Illustration	Tool Number/Description
	EL-50332-175 120 V Power Cable

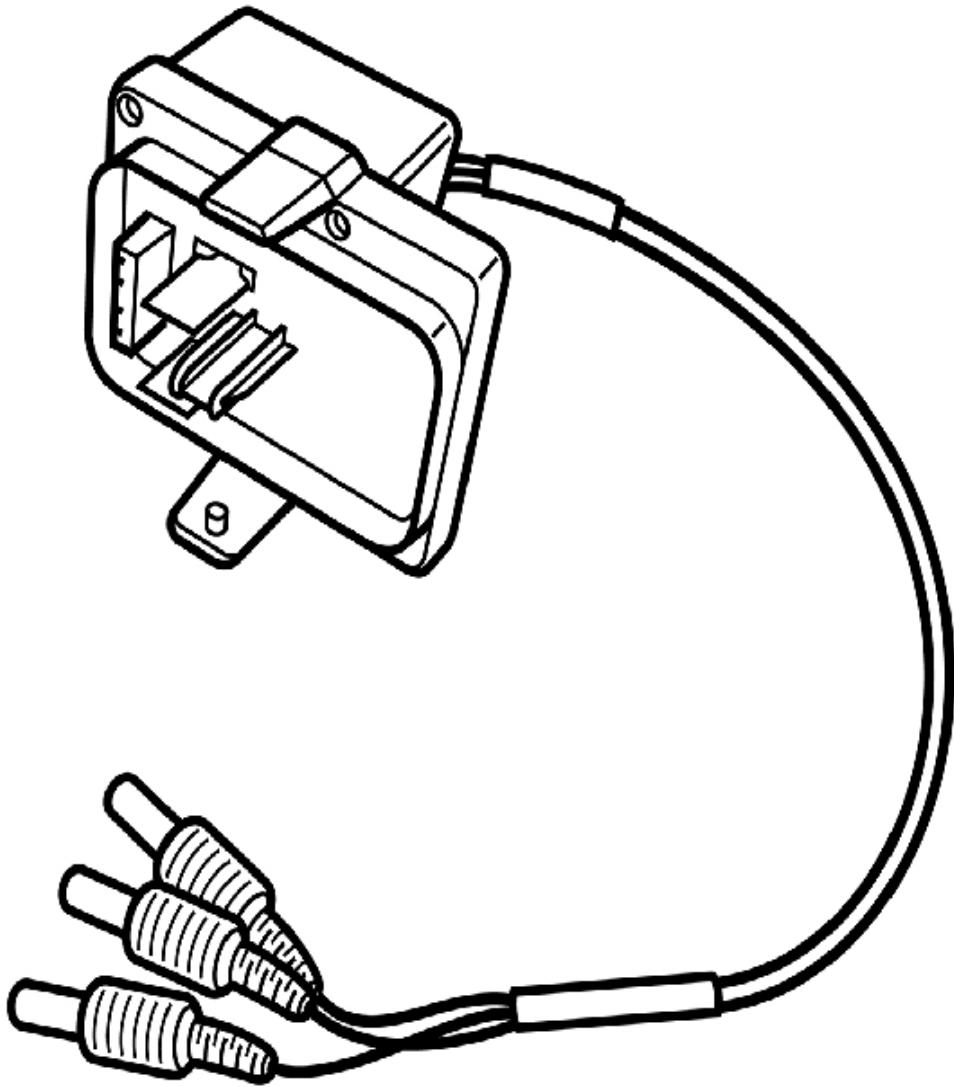
Illustration	Tool Number/Description
	EL-50332-255 Power Inverter Module High Voltage Interface Cable

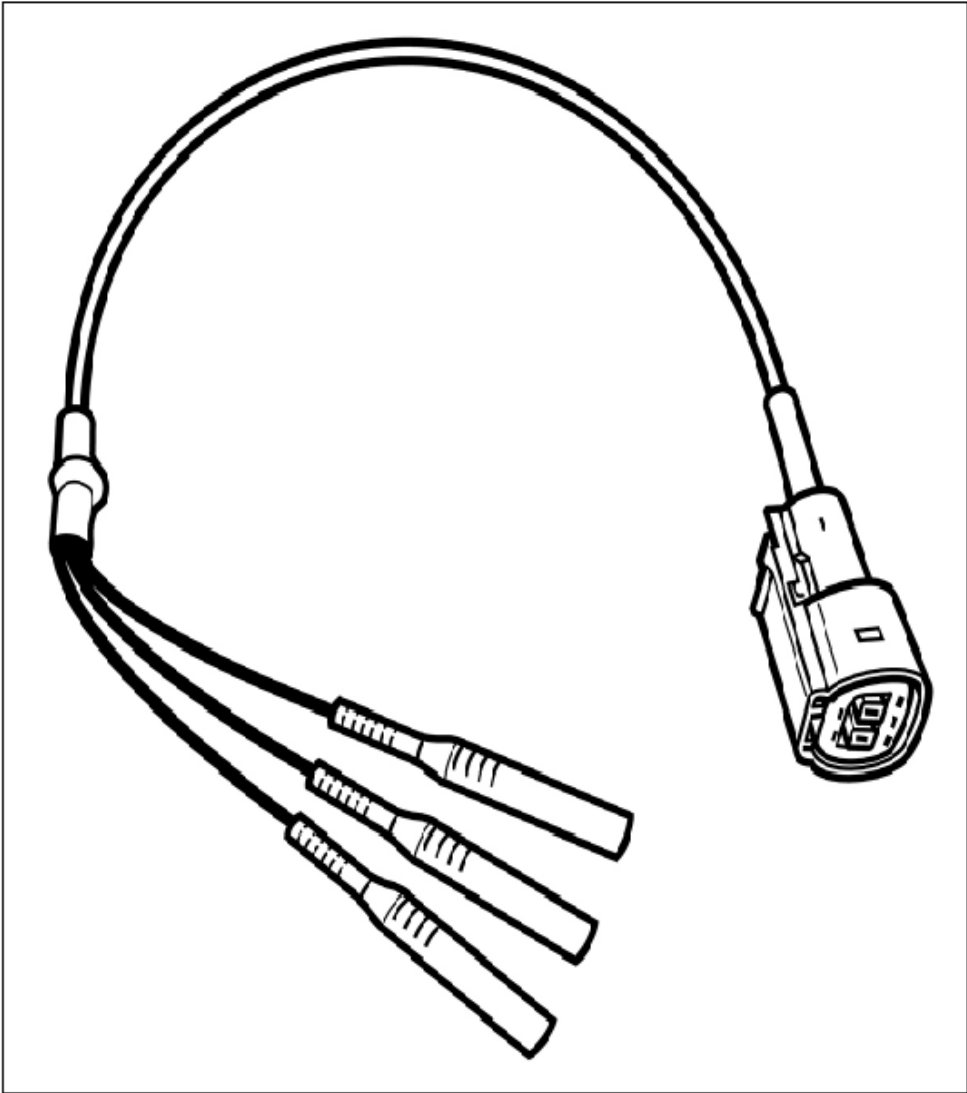
Illustration	Tool Number/Description
	EL-50332-260 High Voltage Battery Bulkhead Interface Cable

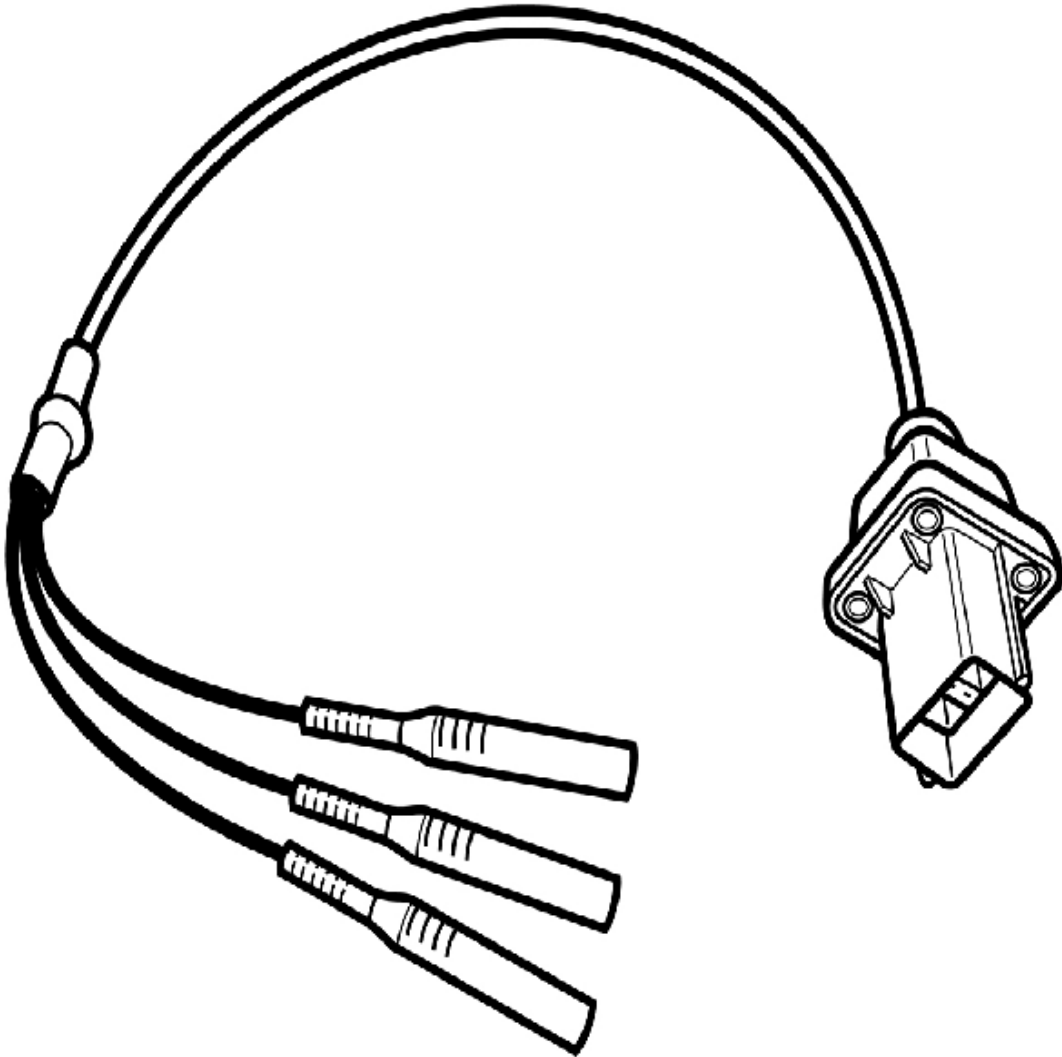
Illustration	Tool Number/Description
	EL-50332-265 14 V Accessory Power Module Harness Interface Cable

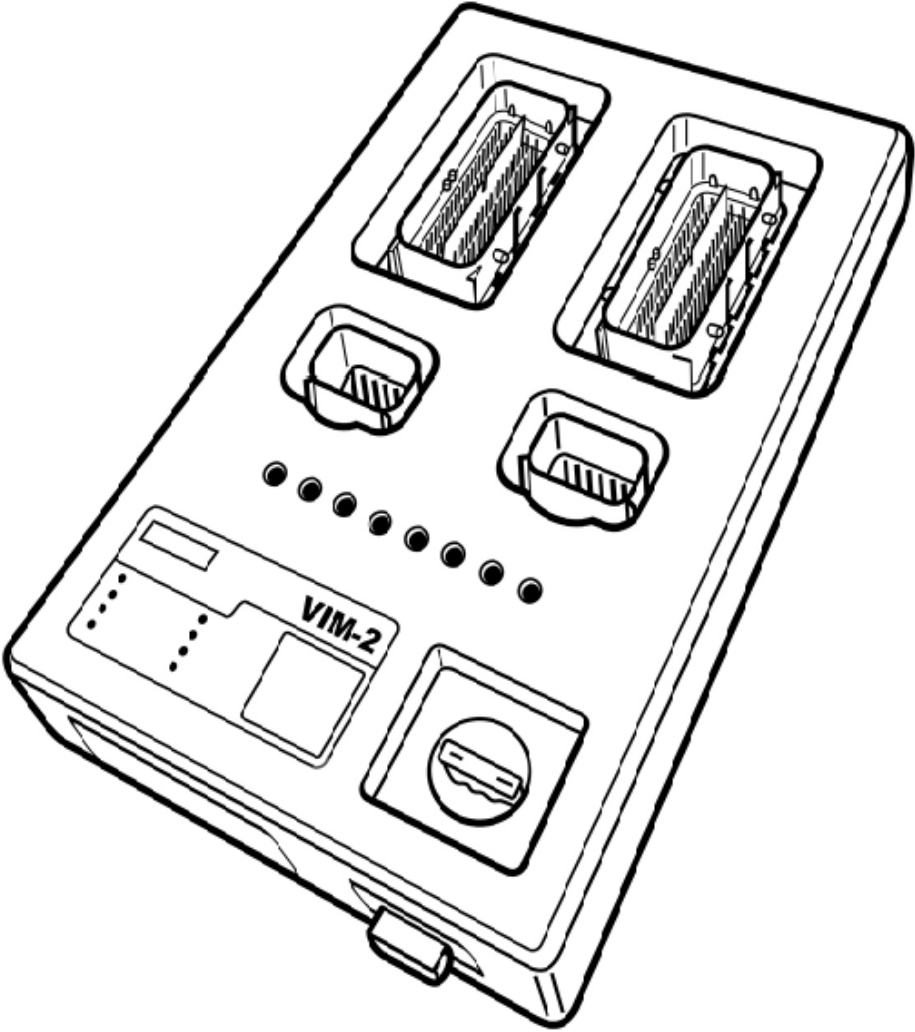
Illustration	Tool Number/Description
	EL-50332-270 Vehicle Interface Module 2

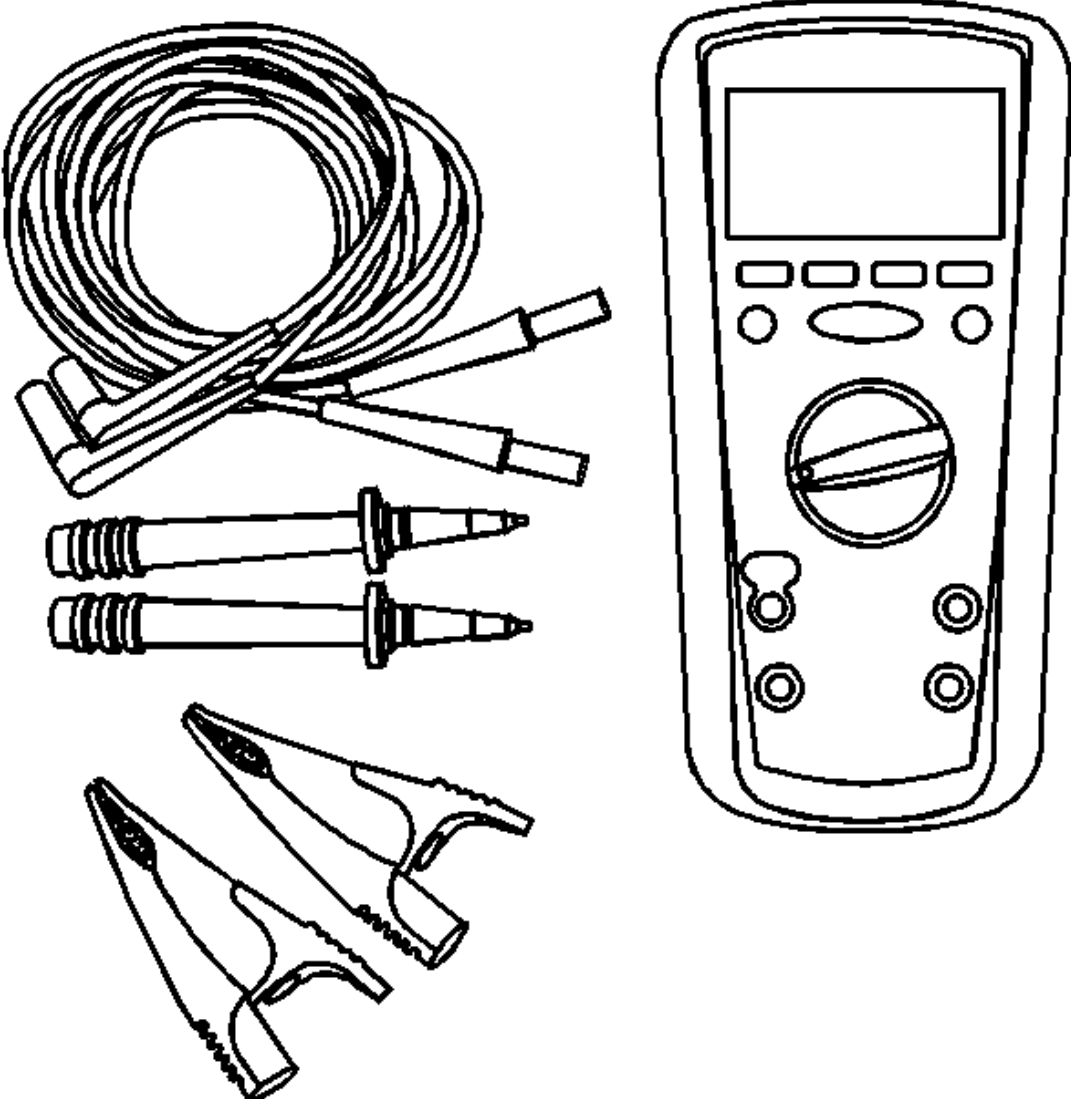
Illustration	Tool Number/Description
 The illustration shows an Insulation Multimeter (EL-50772) and its accessories. The multimeter is a handheld device with a rectangular body. It features a large rectangular LCD screen at the top. Below the screen are four small rectangular buttons and two circular buttons. A large circular rotary selector switch is positioned in the center of the face. At the bottom, there are four circular ports for test leads. The accessories include a coiled cable with two test leads, two individual test leads with pointed probes, and two alligator clips.	EL-50772 Insulation Multimeter

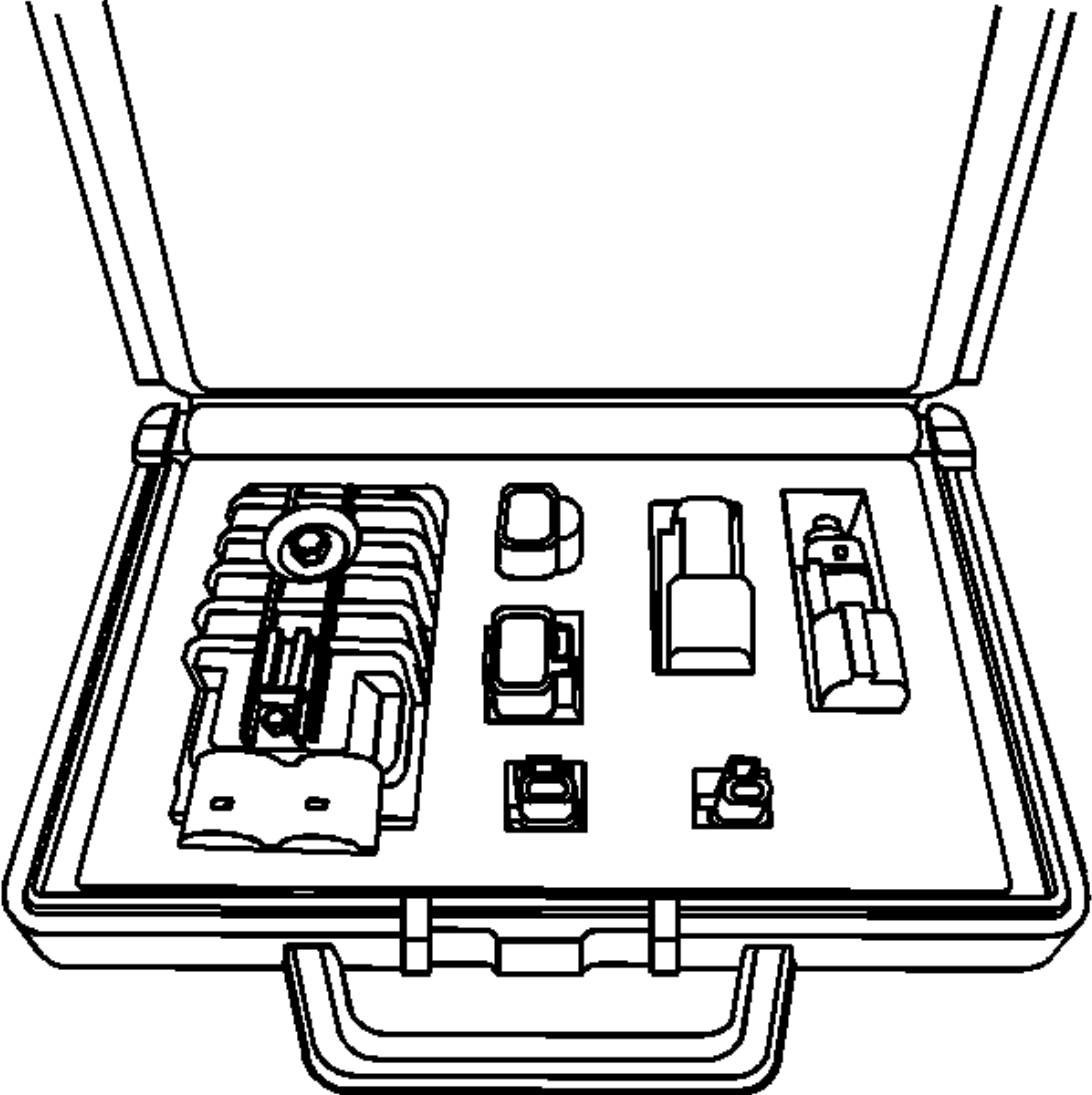
Illustration	Tool Number/Description
	EL-50812 Battery Smoke Test Leak Adapters

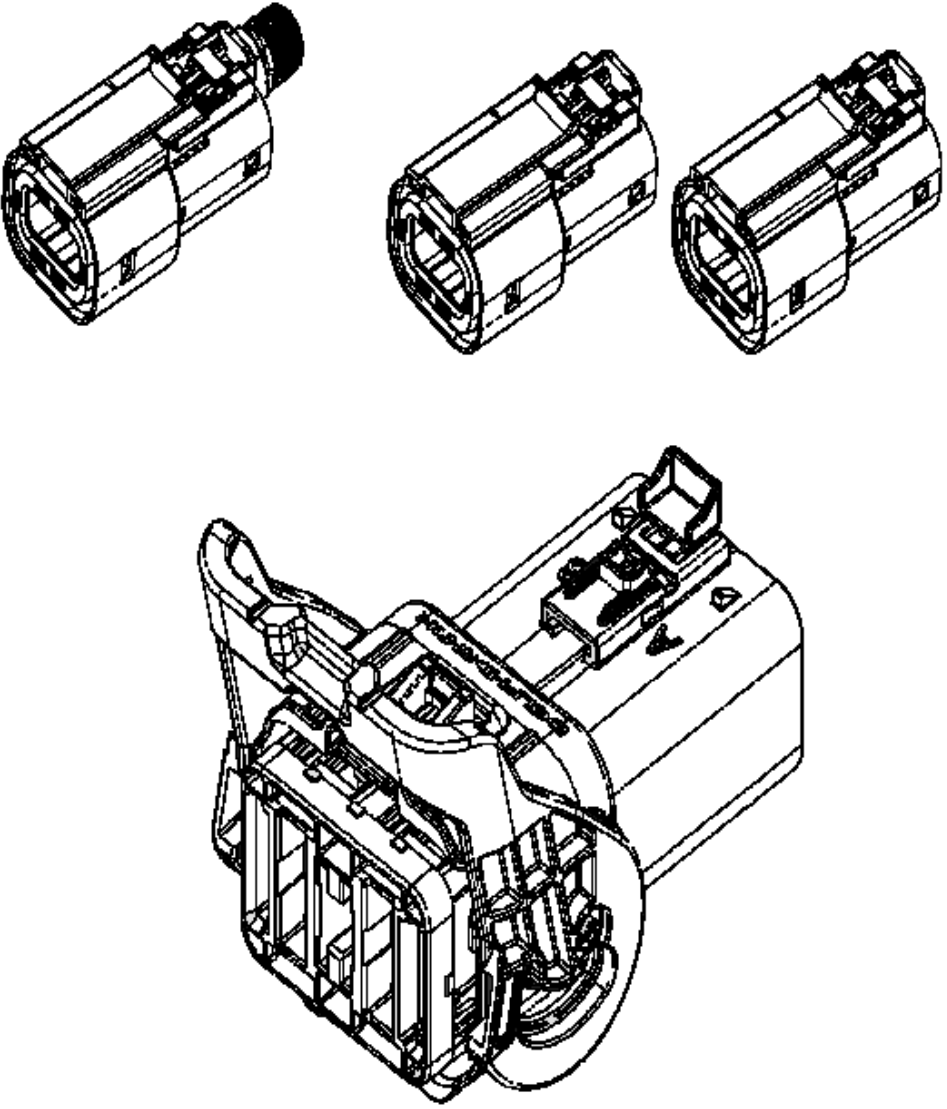
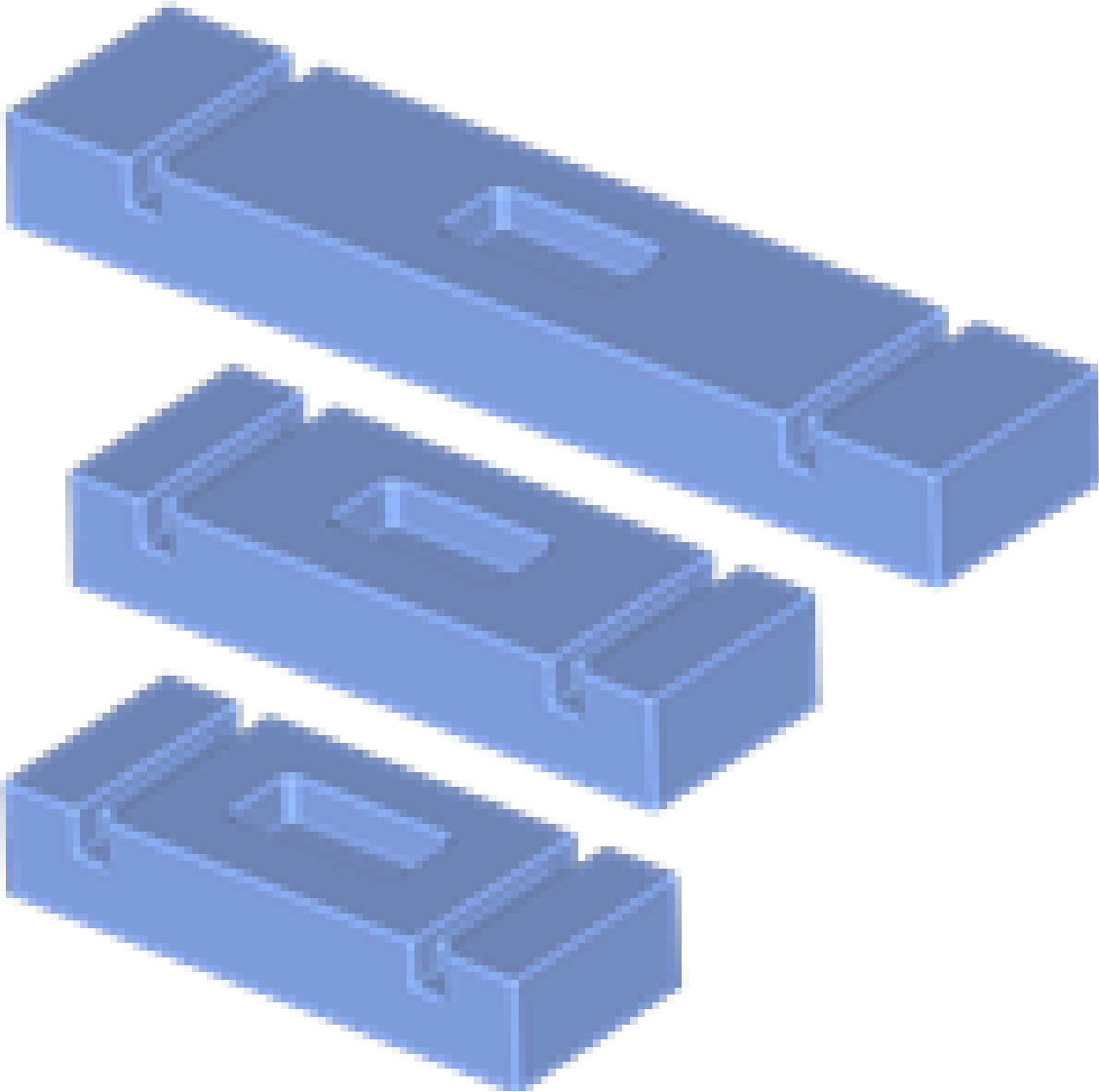
Illustration	Tool Number/Description
 The illustration contains four technical line drawings. At the top, there are three identical cylindrical components, each with a flange at one end and a threaded cap at the other. Below these, there is a larger, more complex assembly consisting of a rectangular base with a grid-like structure on top, and a cylindrical component attached to the side.	EL-51753 High Voltage Battery Smoke Test Adapters

Illustration	Tool Number/Description
	EL-51763 High Voltage Battery Section Covers

Article GUID: A00884664

ELECTRICAL

Hybrid/EV System Heating and Cooling - Volt

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

B204 Hybrid/EV Battery Pack Coolant Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	75.5
-20Â°C (-4Â°F)	21.6
0Â°C (32Â°F)	7.2
20Â°C (68Â°F)	2.7
40Â°C (104Â°F)	1.2
60Â°C (140Â°F)	0.550
80Â°C (176Â°F)	0.280
100Â°C (212Â°F)	0.155
140Â°C (284Â°F)	0.054
*Part # 55591401	

B32 Hybrid/EV Battery Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	202
-20Â°C (-4Â°F)	71.2
0Â°C (32Â°F)	27.8
20Â°C (68Â°F)	12.1
40Â°C (104Â°F)	5.8
60Â°C (140Â°F)	3
80Â°C (176Â°F)	1.7
90Â°C (194Â°F)	1.2
*Part # 23348948	

B202 Hybrid/EV Electronics Coolant Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	45
-20Â°C (-4Â°F)	15
0Â°C (32Â°F)	5.8
20Â°C (68Â°F)	2.5
40Â°C (104Â°F)	1.2
60Â°C (140Â°F)	0.595
80Â°C (176Â°F)	0.323
100Â°C (212Â°F)	0.187
150Â°C (302Â°F)	0.057
*Part # 25186240	

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Drive Motor Generator Control Module Cooling Outlet Hose Seal
Heater Outlet Hose Fitting O-Ring Seal

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Air Conditioning Evaporator Hose Nut	22 N.m (16 lb ft)
Battery Positive and Negative Cable Bracket Nut	9 N.m (80 lb in)
Coolant Temperature Sensor	33 N.m (24 lb ft)
Drive Motor Battery Coolant Cooler Inlet Hose Nut	9 N.m (80 lb in)
Drive Motor Battery Coolant Cooler Nut	9 N.m (80 lb in)
Drive Motor Battery Coolant Pump Bracket Stud	9 N.m (80 lb in)
Drive Motor Battery Radiator Outlet Hose Bracket Nut	9 N.m (80 lb in)
Drive Motor Generator Control Module Cooling Outlet Hose Nut	9 N.m (80 lb in)
Drive Motor Generator Control Module Cooling Outlet Hose Bolt	9 N.m (80 lb in)
Generator Control Module Coolant Pump Bracket Nut	9 N.m (80 lb in)
Heat Shield Nut	9 N.m (80 lb in)
Heater Outlet Hose Fitting	45 N.m (33 lb ft)
High Voltage Battery Cooling Manifold Inlet Hose Clamp	2.1 N.m (19lb in)
High Voltage Battery Cooling Manifold Outlet Hose Clamp	2.1 N.m (19lb in)
High Voltage Battery Cooling Plate Hose Clamp	2.1 N.m (19lb in)
Radiator Surge Tank Bolt	9 N.m (80 lb in)
Radiator Surge Tank Bracket Bolt	22 N.m (16 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System Filling		
High Voltage Battery Pack Cooling	3.8 liters	4.0 Quarts
Power Electronics Cooling	4.2 liters	4.4 Quarts

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
DEX-COOLÂ® (Premix 50/50 with De-Ionized Water)	Engine Coolant	12378390	10953456

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV COOLING WIRING SCHEMATICS

Hybrid/EV Battery Modules - Temperature Sensors 1 through 6

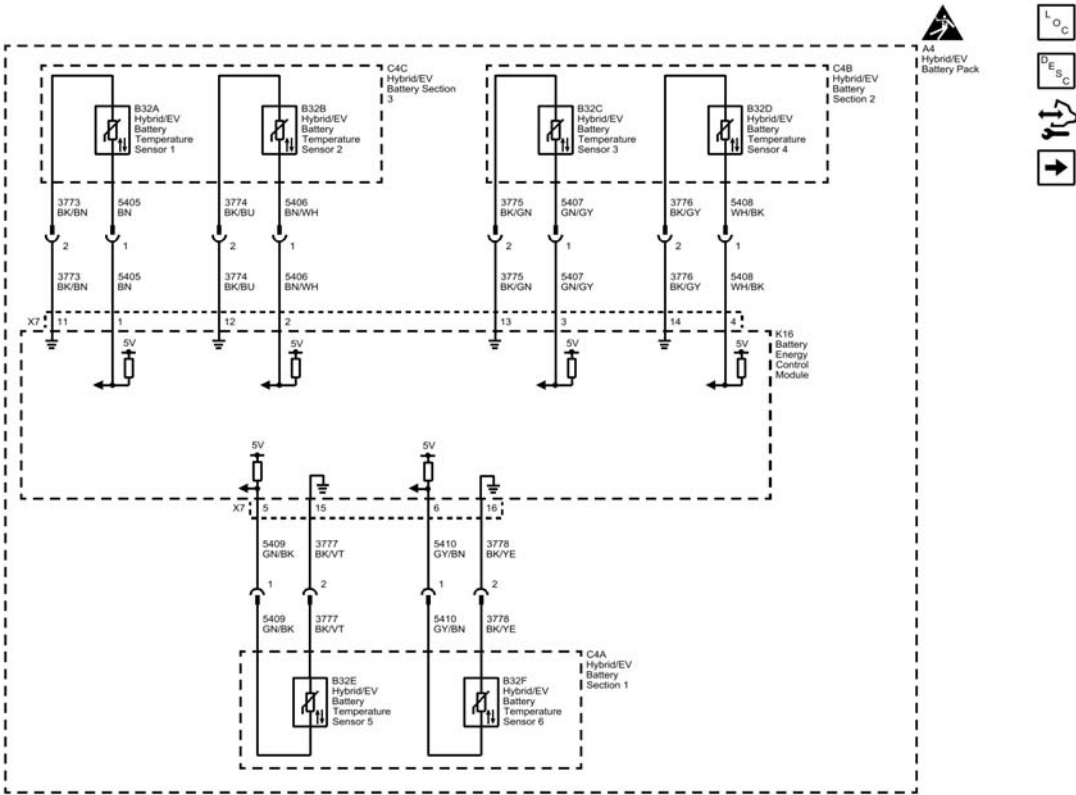


Fig. 1: Hybrid/EV Battery Modules - Temperature Sensors 1 through 6
 Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Pack Cooling

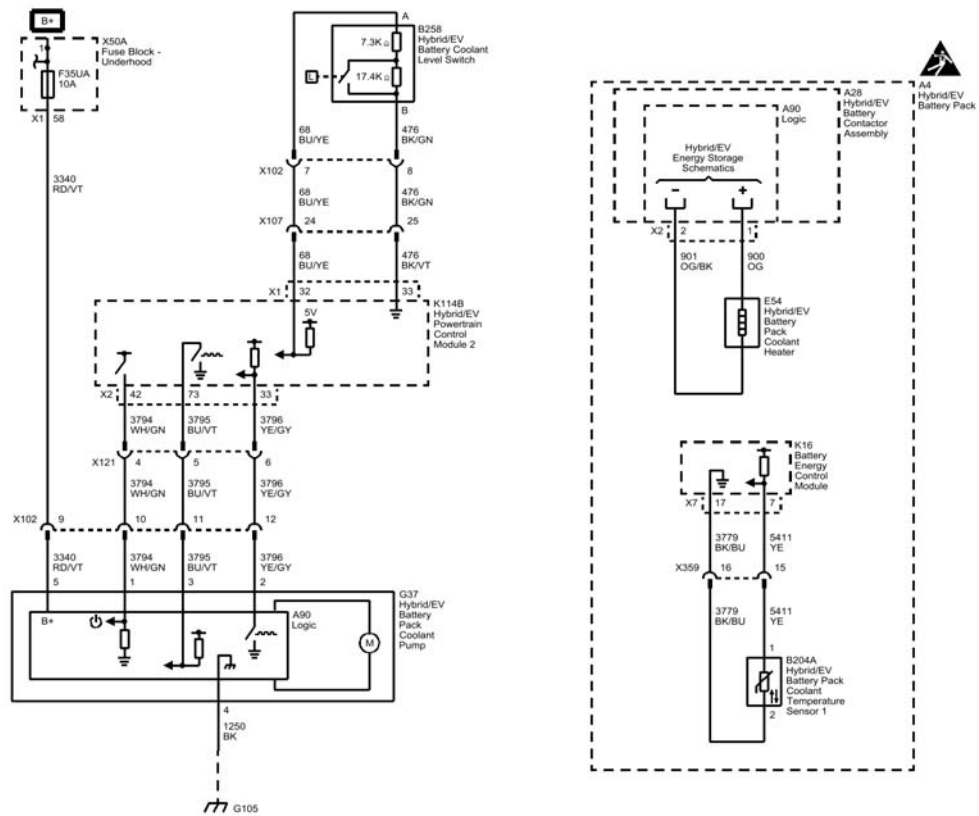


Fig. 2: Hybrid/EV Battery Pack Cooling
 Courtesy of GENERAL MOTORS COMPANY

Cooling Fans

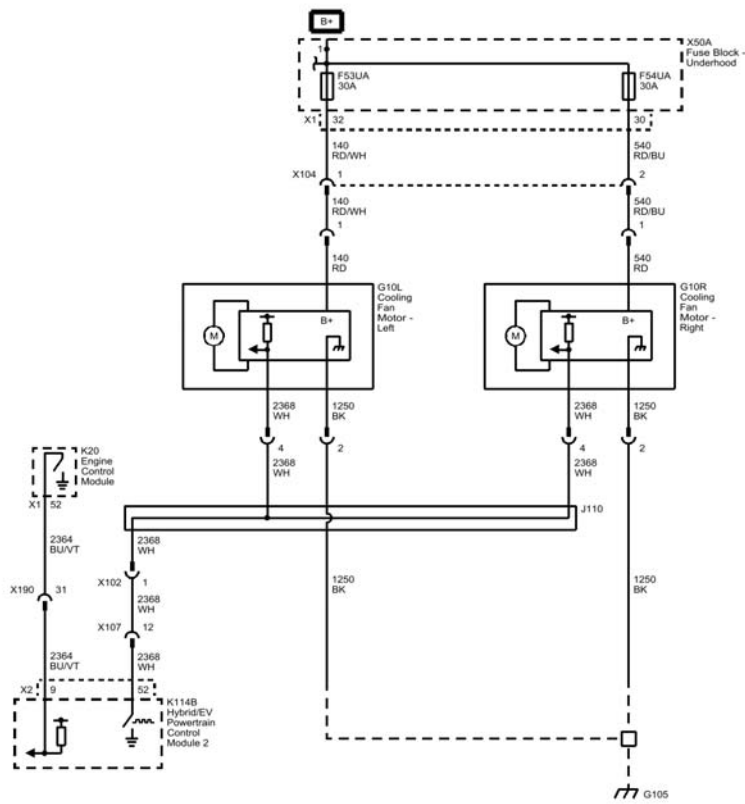


Fig. 3: Cooling Fans
 Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Electronics Cooling

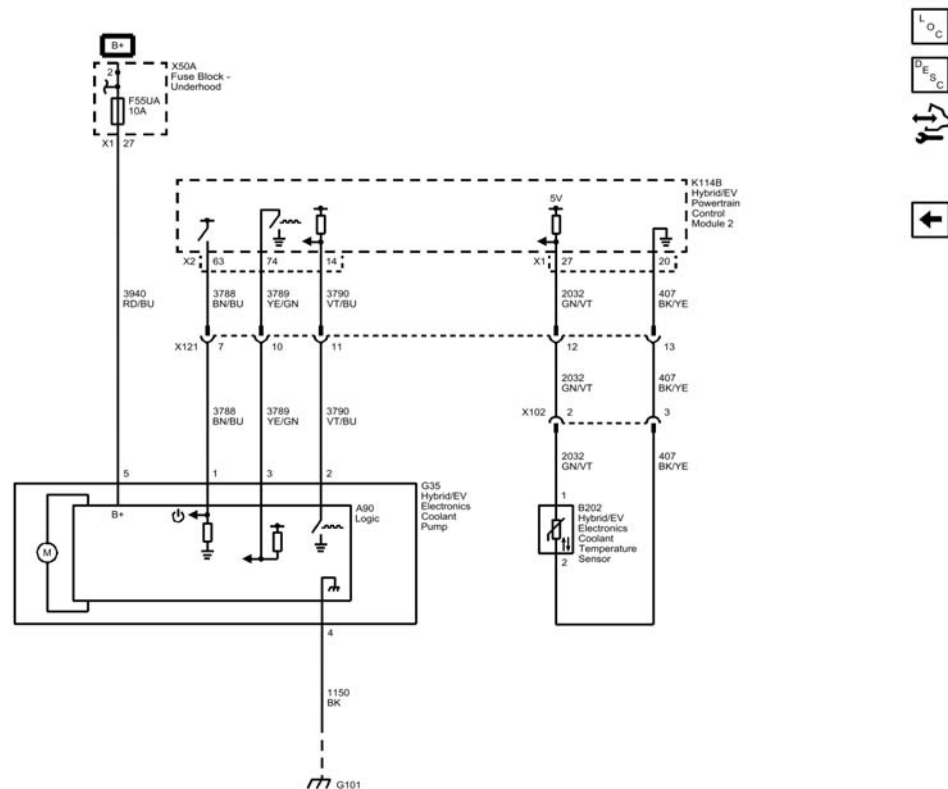


Fig. 4: Hybrid/EV Electronics Cooling
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0480: COOLING FAN RELAY CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0480

Cooling Fan Relay Control Circuit

Circuit/System Description

The radiator cooling fans are controlled as a pair with a pulse width modulated (PWM) signal on the cooling fan relay control circuit from the hybrid/EV powertrain control module 2. Although the hybrid/EV powertrain control module 2 is directly connected to the cooling fans, the ECM is considered the master controller. The ECM sends a fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan signal hardwire circuit. The hybrid/EV powertrain control module 2 operates in a pass-through mode for any ECM-derived fan request. The higher the duty cycle the higher the cooling fan speed. The right side fan

operates at a maximum speed of 3200 RPM while the left side fan operates at a maximum speed of 2900 RPM.

When the ECM is awake and there are no faults, the hybrid/EV powertrain control module 2 sends its cooling fan requests to the ECM via serial data. The ECM uses this request and other vehicle inputs to decide if and what speed the cooling fans should operate. The ECM sends the cooling fan signal command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the fan relay control signal to the cooling fans to operate and at what speed.

If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will directly control the cooling fans. If active cooling is needed, the ECM wakes up to operate the air conditioning control module and then the ECM is the master controller for the fans.

Conditions for Running the DTC

The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 has detected an open, short to ground or short to voltage fault on the fan relay control circuit.

Action Taken When the DTC Sets

DTC P0480 is a type B DTC.

Conditions for Clearing the DTC

DTC P0480 is a type B DTC.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that both the cooling fans are operating at a high speed when commanding the Cooling Fan Motor Command to 90% with a scan tool.
 - **If either or both cooling fans are not operating at a high speed**
Refer to Circuit/System Testing.
 - **If the cooling fans are operating as commanded**
3. Verify that both the cooling fans are operating at a low speed when commanding the Cooling Fan Motor Command to 10% with a scan tool.
 - **If either or both cooling fans are not operating at a low speed**
Refer to Circuit/System Testing.
 - **If the cooling fans are operating as commanded**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate G10 Cooling Fan Motor.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
Repair the open/high resistance in the circuit.
 - **If less than 10 Ω**
3. Connect a test lamp between the B+ circuit terminal 1 and ground.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the G10 Cooling Fan Motor and the fuse.
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.
6. Vehicle in service mode, verify the test lamp changes between dim (10%) and bright (90%) when

commanding the Cooling Fan Motor Command ON between 10% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp changes illumination between bright (90%) and dim (10%)**

7. Replace the G10 cooling fan motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Fan Shroud Replacement](#) for G10 cooling fan motor replacement
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0A7E: HYBRID/EV BATTERY PACK HIGH TEMPERATURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A7E

Hybrid/EV Battery Pack High Temperature

Circuit/System Description

The hybrid/EV battery pack has 6 hybrid/EV battery module temperature sensors. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to determine the hybrid/EV battery module temperature to control the energy storage cooling system operation.

The energy storage system cooling system uses a 12 V hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the electric A/C compressor motor control module assembly to cool down the high voltage hybrid/EV battery.

Conditions for Running the DTC

- The hybrid/EV powertrain control module 2 and hybrid/EV battery energy control module are awake and communicating.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, or U179C.

Conditions for Setting the DTC

The maximum sensed temperature in the hybrid/EV battery is greater than 73.5°C (164.3°F).

Action Taken When the DTC Sets

- DTC P0A7E is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTC P0A7E is a type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0480, P0534, P0C47, P148A-P148C, P1EC6, P1E8C or P1E8D is not set.

- **If any DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- If none of the DTCs are set

WARNING: Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.

3. Test for proper coolant level and operation of the hybrid/EV battery coolant system, refrigerant system and coolant fan system. Refer to [Hybrid/EV Battery Cooling Diagnostic](#).

DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, OR P0C34-P0C36: HYBRID/EV BATTERY TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A9C

Hybrid/EV Battery Temperature Sensor 1 Performance

DTC P0A9D

Hybrid/EV Battery Temperature Sensor 1 Circuit Low Voltage

DTC P0A9E

Hybrid/EV Battery Temperature Sensor 1 Circuit High Voltage

DTC P0AC6

Hybrid/EV Battery Temperature Sensor 2 Performance

DTC P0AC7

Hybrid/EV Battery Temperature Sensor 2 Circuit Low Voltage

DTC P0AC8

Hybrid/EV Battery Temperature Sensor 2 Circuit High Voltage

DTC P0ACB

Hybrid/EV Battery Temperature Sensor 3 Performance

DTC P0ACC

Hybrid/EV Battery Temperature Sensor 3 Circuit Low Voltage

DTC P0ACD

Hybrid/EV Battery Temperature Sensor 3 Circuit High Voltage

DTC P0AE9

Hybrid/EV Battery Temperature Sensor 4 Performance

DTC P0AEA

Hybrid/EV Battery Temperature Sensor 4 Circuit Low Voltage

DTC P0AEB

Hybrid/EV Battery Temperature Sensor 4 Circuit High Voltage

DTC P0BC3

Hybrid/EV Battery Temperature Sensor 5 Performance

DTC P0BC4

Hybrid/EV Battery Temperature Sensor 5 Circuit Low Voltage

DTC P0BC5

Hybrid/EV Battery Temperature Sensor 5 Circuit High Voltage

DTC P0C34

Hybrid/EV Battery Temperature Sensor 6 Performance

DTC P0C35

Hybrid/EV Battery Temperature Sensor 6 Circuit Low Voltage

DTC P0C36

Hybrid/EV Battery Temperature Sensor 6 Circuit High Voltage

Circuit/System Description

The hybrid/EV battery temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery cell groups. The hybrid/EV battery interface control module supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery temperature sensor resistance changes with battery temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to control the battery cooling system operation.

Conditions for Running the DTC

P0A9D, P0A9E, P0AC7, P0AC8, P0ACC, P0ACD, P0AEA, P0AEB, P0BC4, P0BC5, P0C35, P0C36 and P0C7E

- The 12 V battery voltage is greater than 9 V.

- Hybrid/EV powertrain control module 2 and hybrid/EV battery energy control module are awake and communicating
- None of the following DTCs are set: P1E93, P1E99, P1E9F, P1EA5, P1E8E, P1E94, P1E9A, or P1EA0

P0A9C, P0AC6, P0ACB, P0AE9, P0BC3 and P0C34

None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, U2401, U2603, U2604, U2605, U2606.

Conditions for Setting the DTC

P0A9C, P0AC6, P0ACB, P0AE9, P0BC3 and P0C34

The difference between a hybrid/EV battery temperature sensor and the average of all the other hybrid/EV battery temperature sensors is greater than 20Â°C (36Â°F).

P0A9D, P0AC7, P0ACC, P0AEA, P0BC4 and P0C35

The hybrid/EV battery temperature sensor is greater than 80Â°C (176Â°F).

P0A9E, P0AC8, P0ACD, P0AEB, P0BC5 and P0C36

The hybrid/EV battery temperature sensor is -40Â°C (-40Â°F).

Action Taken When the DTC Sets

- DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35 and P0C36 are type B DTCs.
- If all sensors fail, the vehicle will operate in a reduced power mode and the extended range mode.

Conditions for Clearing the DTC

DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35 and P0C36 are type B DTCs.

Diagnostic Aids

Low or no coolant or refrigerant in the system may set a DTC P0A9D, P0AC7, P0ACC, P0AEA, P0BC4 or P0C35.

Reference Information

Schematic Reference

- [Hybrid/EV Cooling Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50211** Low Voltage Harness

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0C47, P1E8C or P1EC6 is not set.

- **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

3. Observe the scan tool Hybrid Battery 1 - 6 temperature parameters. The sensor readings should be between -39 and +80°C (-38.2 and + 176°F) with less than a 20°C (36°F) difference between any of the temperature sensor readings. Refer to [Temperature Versus Resistance](#)

- **If not within the specified range**

Refer to Circuit/System Testing.

- **If within the specified range**

4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#) . Remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)
2. Disconnect the harness connector at the appropriate B32 Hybrid/EV Battery Temperature Sensor.
3. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the appropriate harness connector at the K16 Battery Energy Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, replace the Hybrid/EV Battery Pack internal wiring harness.
 - If less than 2 Ω , replace the K16 Battery Energy Control Module.
 - **If less than 10 Ω**

NOTE: With the S15 manual service disconnect removed the 12 V battery connected and the Vehicle in Service Mode, may cause additional DTCs to set. Continue with diagnostics and clear any additional DTCs when repairs are complete.

4. Connect the EL-50211 Low Voltage Jumper Harness Extension. Connect the 12 V battery. Vehicle in Service Mode.
5. Verify with the scan tool the appropriate Hybrid/EV Battery Temperature Sensor is less than -35°C (-38.2°F).
 - **If -35°C (-38.2°F) or greater**
 1. Vehicle OFF, disconnect the appropriate harness connector at the K16 Battery Energy Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, replace the Hybrid/EV Battery Pack internal wiring harness.
 - If infinite resistance, replace the K16 Battery Energy Control Module.
 - **If less than -35°C (-38.2°F)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2. Verify with the scan tool the appropriate Hybrid/EV Battery Temperature Sensor is greater than 80°C (176°F).
 - **If less than 80°C (176°F)**
 1. Vehicle OFF, disconnect the appropriate harness connector at the K16 Battery Energy Control Module. Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit terminal and ground.
 - If 1 V or greater, replace the Hybrid/EV Battery Pack internal wiring harness.
 - If less than 1 V
3. Vehicle Off.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, replace the Hybrid/EV Battery Pack internal wiring harness.
 - If less than 2 Ω , replace the K16 Battery Energy Control Module.
- **If 80 $^{\circ}$ C (176 $^{\circ}$ F) or greater**
7. Test or replace the appropriate B32 Hybrid/EV Battery Temperature Sensor.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate B32 Hybrid/EV Battery Temperature Sensor.
2. Test for 9.9 - 13.4 k Ω at approximately 21.11 $^{\circ}$ C (70 $^{\circ}$ F) between the signal terminal and the low reference terminal. Refer to [Temperature Versus Resistance](#) for Hybrid/EV Battery Temperature Sensor.
 - **If not within the specified range**

Replace the appropriate B32 Hybrid/EV Battery Temperature Sensor.
 - **If within the specified range**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Cell Battery High Voltage Sensor Replacement \(Thermistor 6\)](#) [Cell Battery High Voltage Sensor Replacement \(Thermistor 4\)](#) [Cell Battery High Voltage Sensor Replacement \(Thermistor 1\)](#) [Cell Battery High Voltage Sensor Replacement \(Thermistor 5\)](#) [Cell Battery High Voltage Sensor Replacement \(Thermistor 3\)](#) [Cell Battery High Voltage Sensor Replacement \(Thermistor 2\)](#) for B32 Hybrid/EV Battery Temperature Sensor replacement.
- [Control Module References](#) for K16 battery energy control module replacement, programming and setup.

DTC P0C43-P0C46: HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C43

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Performance

DTC P0C44

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Low Voltage

DTC P0C45

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit High Voltage

DTC P0C46

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Erratic

Circuit/System Description

The hybrid/EV battery pack coolant temperature sensor is located in the coolant inlet of the hybrid/EV battery. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery coolant. The hybrid/EV battery pack coolant temperature sensor resistance changes with battery coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The battery energy control module uses the hybrid/EV battery temperature sensor to determine the hybrid/EV battery pack temperature to control the battery cooling and heating operations.

Conditions for Running the DTC

P0C43

- Vehicle ON after all high voltage contactor relays had been Open for 4 hours.
- The 12 V battery voltage is greater than 10.2 V.
- None of the following DTCs are set: P0C44, P0C45, P0C46, P0C47, P0A9C, P0A9D, P0A9E, P1E8C, P1E8D, P19FD, P19FE, P19FF, or U0111.

P0C44

- The 12 V battery voltage is greater than 10.2 V.
- Battery energy control module is awake and communicating.
- DTC P1A07 is not set.

P0C45

- The 12 V battery voltage is greater than 10.2 V.
- Battery energy control module is awake and communicating.
- DTC P1A07 is not set.

P0C46

- The 12 V battery voltage is greater than 10.2 V.
- Battery energy control module is awake and communicating.
- None of the following DTCs are set: DTC P0C44, P0C45 or U185A.

Conditions for Setting the DTC

P0C43

The hybrid/EV battery pack coolant temperature sensor reading is not within 22Â°C (40Â°F) of the outside air temperature AND is not within 23Â°C (41Â°F) of the Average Hybrid Battery Pack Temperature.

P0C44

The hybrid/EV battery pack coolant temperature sensor 1 is greater than 87.5°C (189.5°F).

P0C45

The hybrid/EV battery pack coolant temperature sensor 1 is less than or equal to -40°C (-40°F).

P0C46

The hybrid/EV battery pack coolant temperature sensor is intermittent or has changed by 64°C (115°F) or greater within 4 seconds.

Action Taken When the DTC Sets

- DTC P0C43 - P0C46 are type B DTCs.
- The active heating mode is disabled.

Conditions for Clearing the DTC

DTC P0C43 - P0C46 are type B DTCs.

Diagnostic Aids

- Low or no coolant or refrigerant in the system may set a DTC P0C43.
- DTC P0C43 - P0C46 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25°C (-13°F).

Reference Information

Schematic Reference

- [Hybrid/EV Cooling Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Hybrid/EV Cooling System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AC1 or P0B10 is not set.
 - **If any DTC is set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **If none of the DTCs are set**
3. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 parameter is between -39 and +87.5Â°C (-38.2 and +189.5Â°F).
 - **If not within the specified range**
Refer to Circuit/System Testing.
 - **If within the specified range**
4. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor and Outside Air Temperature Sensor parameters are within 22Â°C (40Â°F) of each other after the vehicle has been OFF and not charging for 4 hours or greater.
 - **If not within the specified range**
Refer to Circuit/System Testing.
 - **If within the specified range**
5. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#) . Remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#) . Disconnect the harness connector at the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K16 Battery Energy Control Module.

- **If less than 10 Ω**

NOTE: With the S15 Manual Service Disconnect removed, the 12 V battery connected, and the Vehicle in Service Mode, may cause additional DTCs to set. Continue with diagnostics and clear any additional DTCs when repairs are complete.

3. Connect the **EL-50211** Low Voltage Jumper Harness Extension. Connect the 12 V battery. Vehicle in Service Mode.

4. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor is less than -35°C (-38.2°F).

- **If greater than -35°C (-38.2°F)**

1. Vehicle OFF, test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K16 Battery Energy Control Module.

- **If less than -35°C (-38.2°F)**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.

6. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor is greater than 87.5°C (189.5°F).

- **If less than 87.5°C (189.5°F)**

1. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V
2. Vehicle OFF, test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K16 Battery Energy Control Module.
- **If 87.5 $^{\circ}$ C (189.5 $^{\circ}$ F) or greater**
7. Replace the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor.
2. Test for 2.2 - 3.0K Ω at approximately 21 $^{\circ}$ C (70 $^{\circ}$ F) between the signal terminal and the low reference terminal. Refer to [Temperature Versus Resistance](#) for Hybrid/EV Battery Pack Coolant Temperature Sensor.

- **If not within the specified range**

Replace the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor.

- **If within the specified range**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Temperature Sensor Replacement](#) for B204A Hybrid/EV battery pack coolant temperature sensor.
- [Control Module References](#) for battery energy control module replacement, programming and setup.

DTC P0C47, P1E8C, OR P1E8D: HYBRID/EV BATTERY PACK COOLANT PUMP

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0C47

Hybrid/EV Battery Pack Coolant Pump Control Circuit

DTC P1E8C

Hybrid/EV Battery Pack Coolant Pump Enable Circuit Low Voltage

DTC P1E8D

Hybrid/EV Battery Pack Coolant Pump Enable Circuit High Voltage

Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P0C47

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 5 - 95%.

P1E8C

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.

P1E8D

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled.

Conditions for Setting the DTC

P0C47

The hybrid/EV powertrain control module 2 detects the Coolant Pump Control circuit is open, shorted to voltage or shorted to ground.

P1E8C

The hybrid/EV powertrain control module 2 detects the Coolant Pump Enable circuit is shorted to ground.

P1E8D

The hybrid/EV powertrain control module 2 detects the Coolant Pump Enable circuit is open or shorted to voltage.

Action Taken When the DTC Sets

- DTCs P0C47, P1E8C and P1E8D are type B DTCs.
- Hybrid/EV battery pack active heating is disabled.

Conditions for Clearing the DTC

DTCs P0C47, P1E8C and P1E8D are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is On*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B, or U2602 is not set.

- **If any DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.

- Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
- Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
- Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

- **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**

3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20 - 90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the pump enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **The test lamp changes illumination between bright (20%) and dim (90%)**
10. Remove the test lamp.
 11. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.
 - **If greater than 0%**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 0%**
 12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
 13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the feedback circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the feedback circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
 14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0CE9, P1F44, OR P1F45: HYBRID/EV ELECTRONICS COOLANT PUMP

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0CE9

Hybrid/EV Electronics Coolant Pump Control Circuit

DTC P1F44

Hybrid/EV Electronics Coolant Pump Enable Circuit Low Voltage

DTC P1F45

Hybrid/EV Electronics Coolant Pump Enable Circuit High Voltage

Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger, and the 14 V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P0CE9

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV electronics coolant pump is enabled.
- The hybrid/EV electronics coolant pump is commanded between 5% and 95%.

P1F44

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV electronics coolant pump is enabled.

P1F45

- The 12 V battery voltage is greater than 10.2 V.
- The Hybrid/EV electronics coolant pump is disabled.

Conditions for Setting the DTC

P0CE9

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Control circuit is open, shorted to voltage or shorted to ground.

P1F44

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Enable circuit is shorted to ground.

P1F45

The Hybrid/EV Powertrain Control Module 2 detects the Coolant Pump Enable circuit is open or shorted to voltage.

Action Taken When the DTC Sets

DTCs P0CE9, P1F44, and P1F45 are a Type B DTCs.

Conditions for Clearing the DTC

DTCs P0CE9, P1F44, and P1F45 are a Type B DTCs.

Diagnostic Aids

- DTC P1F44, and P1F45 may cause DTC P0CE9 to set.
- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37°C (-34°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is On*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P0C47, or P1EC6 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.
 - Hybrid/EV Electronics Coolant Pump Command to be 10% or greater
 - Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%
 - Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
 - **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified range**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
 - **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**
3. Vehicle On.
 4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown

3. Replace the G35 Hybrid/EV Electronics Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV electronics coolant pump ON (20 - 90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the pump enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify the test lamp changes illumination between bright (20%) and dim (90%) when commanding the hybrid/EV electronics coolant pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always bright**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **The test lamp changes illumination between bright (20%) and dim (90%)**
10. Remove the test lamp.
11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.
 - **If greater than 0%**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool, Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the feedback circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the feedback circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
14. Replace the G35 Hybrid/EV Electronics Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Control Module Coolant Pump Replacement** for Hybrid/EV electronics coolant pump replacement

- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0CEF-P0CF2: HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0CEF

Hybrid/EV Electronics Coolant Temperature Sensor Performance

DTC P0CF0

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Low Voltage

DTC P0CF1

Hybrid/EV Electronics Coolant Temperature Sensor Circuit High Voltage

DTC P0CF2

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Erratic

Circuit/System Description

The hybrid/EV electronics coolant temperature sensor is located in the combined electronics coolant radiator/air conditioning condenser assembly. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV electronics coolant. The hybrid/EV electronics coolant temperature sensor resistance changes with coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The hybrid/EV powertrain control module 2 uses the hybrid/EV electronics coolant temperature sensor to determine the hybrid/EV electronics temperature to control the hybrid/EV electronics cooling operation.

Conditions for Running the DTC

P0CEF

- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle ON for less than 20 seconds.
- Propulsion system inactive time is greater than 5 hours.
- Hybrid/EV electronics coolant pump off soak time is greater than 1 hour.
- Air Conditioning compressor off soak time is greater than 1 hour.
- On Board Charger module off soak time is greater than 1 hour.
- None of the following DTCs are set; P0071-P0074, P0532, P0533, P0606, P0711-P0713, P0CF0, P0CF1, P0CE9, P0A2B, P0A2C, P0A2D, P1F44, or P1F45.

P0CF0, P0CF1 and P0CF2

- Vehicle ON.
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0CEF

- The hybrid/EV electronics coolant temperature does not fall within 27Â°C (48.6Â°F) of the outside air temperature.

AND

- The hybrid/EV electronics coolant temperature does not fall within 27Â°C (48.6Â°F) of the transmission fluid temperature.

AND

- The hybrid/EV electronics coolant temperature does not fall within 28Â°C (50Â°F) of the air condition high side pressure, converted to temperature.

P0CF0

The hybrid/EV electronics coolant temperature is greater than 100Â°C (212Â°F) indicating a circuit voltage less than 0.20 V.

P0CF1

The hybrid/EV electronics coolant temperature is less than -40Â°C (-40Â°F) indicating a circuit voltage greater than 4.90 V.

P0CF2

- The hybrid/EV electronics coolant temperature is intermittent or has changed greater than 90Â°C (162Â°F).
- Condition exists for 4 seconds or more.

Actions Taken When the DTC Sets

- P0CEF-P0CF2 are type B DTCs.
- The Hybrid/EV Electronics Coolant Pump is commanded to a fixed speed.

Conditions for Clearing the DTC

P0CEF-P0CF2 are type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, verify that DTC P0CE9 is not set.

- **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

2. Verify the Hybrid Electronics Coolant Temperature is between -39 and +99°C (-38.2 and +210°F) with a scan tool.

- **If not within the specified range**

Refer to Circuit/System Testing.

- **If within the specified range**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Hybrid Electronics Coolant Temperature is less than -35°C (-38.2°F).
 - **If -35°C (-38.2°F) or greater**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the signal circuit and the circuits listed below:
 - Low reference circuit
 - Chassis ground
 - If less than infinite resistance, repair the appropriate short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than -35°C (-38.2°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Hybrid Electronics Coolant Temperature is greater than 99°C (210°F).
 - **If less than 99°C (210°F)**
 1. Vehicle OFF, remove the jumper wire, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF, test for less than $2\ \Omega$ in the signal circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 99°C (210°F) or greater**
7. Replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
2. Test for 2 - $2.5\text{k}\ \Omega$ at approximately 21.11°C (70°F) between the signal terminal and the low reference terminal. Refer to [Temperature Versus Resistance](#) for Hybrid/EV Electronics Coolant Temperature Sensor.
 - **If not within the specified range**

Replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
 - **If within the specified range**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Coolant Temperature Sensor Replacement](#)

- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P19FA-P19FC: HYBRID/EV ELECTRONICS COOLANT PUMP FEEDBACK

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P19FA

Hybrid/EV Electronics Coolant Pump Feedback Circuit High Frequency

DTC P19FB

Hybrid/EV Electronics Coolant Pump Feedback Circuit Low Frequency

DTC P19FC

Hybrid/EV Electronics Coolant Pump Feedback Circuit Performance

Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger, and the 14 V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P19FA and P19FB

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 90%.
- All above conditions met for at least 3 seconds.

P19FC

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled for at least 10 seconds.
- DTC P19FC has not already failed when coolant pump was enabled.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 90%.
- Hybrid/EV electronics coolant temperature sensor is greater than -20°C (-4°F).
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0CE9, P0CEF, P0CF0, P0CF1, P0CF2, P1F44, or P1F45.

Conditions for Setting the DTC

P19FA

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

P19FB

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

P19FC

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 250 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11 - 90% PWM.

Action Taken When the DTC Sets

DTCs P19FA, P19FB and P19FC are type B DTCs.

Conditions for Clearing the DTC

DTCs P19FA, P19FB and P19FC are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37°C (-34°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%.

Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is On*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, or P0C47 is not set.
 - If any DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.

- Hybrid/EV Electronics Coolant Pump Command to be 10% or greater.
- Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%.
- Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.

2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

- **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**

3. Vehicle On.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown

3. Replace the G35 Hybrid/EV Electronics Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Electronics Coolant Pump ON (20 - 90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the pump enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Electronics Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (90%)**

10. Remove the test lamp.

11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the feedback circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.

13. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the feedback circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Replace the G35 Hybrid/EV Electronics Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Control Module Coolant Pump Replacement** for Hybrid/EV electronics coolant pump replacement.
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P19FD-P19FF: HYBRID/EV BATTERY PACK COOLANT PUMP FEEDBACK CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P19FD

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit High Frequency

DTC P19FE

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Low Frequency

DTC P19FF

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Performance

Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P19FD and P19FE

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 90%.
- All above conditions met for at least 3 seconds.

P19FF

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is disabled for at least 10 seconds.
- DTC P19FF has not already failed when coolant pump was enabled.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 90%.
- Hybrid/EV battery pack coolant inlet temperature sensor is greater than -20°C (-4°F).
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0C43, P0C44, P0C45, P0C47, P1E8C, P1E8D, P19FD or P19FE.

Conditions for Setting the DTC

P19FD

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

P19FE

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

P19FF

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 250 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11 - 90% PWM.

Action Taken When the DTC Sets

- DTCs P19FD, P19FE and P19FF are type B DTCs.
- Hybrid/EV battery pack active heating and active cooling are disabled.

Conditions for Clearing the DTC

DTCs P19FD, P19FE and P19FF are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is in Service Mode*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B, or U2602 is not set.
 - **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.
 - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
 - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
 - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
 - **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
 - **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown

3. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle ON. Verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20 - 90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the pump enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.

9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.

- **If the test lamp is always dim or does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always bright**
1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **The test lamp changes illumination between bright (20%) and dim (90%)**
10. Remove the test lamp.
11. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.
 - **If greater than 0%**
1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.
 - **If 90% or less**
1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the feedback circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P148A-P148C: COOLING FAN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P148A

Cooling Fan Signal Circuit Performance

DTC P148B

Cooling Fan Signal Circuit Low Voltage

DTC P148C

Cooling Fan Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Speed Signal Circuit	P148B, P1486	P148A, P1485	P148C, P1487	-
Fans operate at 90% with all malfunctions				

Circuit/System Description

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. When propulsion is active, the engine control module (ECM) processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The ECM decides if and at what speed the cooling fans should operate. The ECM sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans without ECM intervention.

The ECM communicates the fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan speed signal circuit/hardware circuit and also sends a redundant serial data signal. Since the hardware circuit is an output from the ECM but an input to the hybrid/EV powertrain control module 2, each module has unique DTCs to monitor the same circuit.

Conditions for Running the DTC

P148A

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is active for more than 43 seconds.
- The cooling fan speed request has not changed by greater than 5% for at least 43 seconds.
- None of the following DTCs are set: P148B, P148C, or U0293.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fans are enabled for more than 43 seconds.
- The cooling fan speed request has not changed by greater than 5% for at least 43 seconds.
- None of the following DTCs are set: P148B, P148C, or U0293.

P148B

The 12 V battery voltage is greater than or equal to 10.2 V.

P148C

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is active for more than 43 seconds.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fans are enabled for more than 43 seconds.

Conditions for Setting the DTC

P148A

The PWM cooling fan signal circuit duty cycle request from engine control module (Hardwire) is not within 30% of the redundant engine cooling fan speed sent to the hybrid/EV powertrain control module 2 via serial data.

P148B

The hybrid/EV powertrain control module 2 has detected a duty cycle of less than 3% from the engine control module.

P148C

The hybrid/EV powertrain control module 2 has detected a duty cycle of greater than 97% from the engine control module.

Action Taken When the DTC Sets

DTCs P148A, P148B and P148C are type B DTCs.

Conditions for Clearing the DTC

DTCs P148A, P148B and P148C are type B DTCs.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1485, P1486, P1487, P148A, P148B, or P148C is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module
- 2, vehicle in Service Mode.

NOTE: The cooling fan circuit is pulled up to a voltage within the ECM. 3 - 4 V measured on this circuit with the hybrid/EV powertrain control module 2 disconnected is normal.

2. Test for 3 - 4 V between the cooling fan circuit terminal 9 and ground.

- **If less than 3 V**

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the cooling fan circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If 4V or greater**

1. Vehicle OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the cooling fan circuit and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If 1 V or less, replace the K20 Engine Control Module.

- **If 3 - 4 V**

3. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.

4. Reconnect the K114B Hybrid/EV Powertrain Control Module 2 connector X2.

5. Vehicle in Service Mode. Test for greater than 10 V between the signal circuit and ground.

- **If 10 V or less**

Replace the Hybrid/EV Powertrain Control Module 2.

- **If greater than 10 V**

6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for engine control module or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1EC6: HYBRID/EV BATTERY PACK HEATER PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EC6

Hybrid/EV Battery Pack Heater Performance

Circuit/System Description

The hybrid/EV battery pack coolant heater is mounted to the coolant inlet on the back side of the hybrid/EV battery contactor assembly. The hybrid/EV battery pack coolant heater uses the hybrid/EV battery high voltage as its power source. The hybrid/EV battery pack heater high voltage is controlled by a solid state relay/transistor. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage solid state relay/transistor. The hybrid/EV battery pack coolant heater high voltage circuit is fuse protected.

When the Conditions for Running the DTC are met, the hybrid/EV battery pack coolant heater is commanded ON. The hybrid/EV powertrain control module 2 then monitors for a temperature change at the hybrid/EV battery pack coolant temperature sensor 1 to determine if the hybrid/EV battery pack coolant heater is functioning properly.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV battery pack coolant temperature sensor is less than 20°C (68°F).
- Runs once per drive cycle, either in propulsion system active or in Charge Mode.
- Hybrid/EV battery pack state of charge is greater than 5%.
- Hybrid/EV battery pack voltage is greater than 280 V.
- None of the following DTCs are set; P0C43, P0C44, P0C45, P0C47, P19FD, P19FE, P19FF, P1EC3, P1E8C, P1E8D, P1FFB, P1FFC, P1FFD, or P1FFE.

Conditions for Setting the DTC

- The hybrid/EV powertrain control module 2 commands the hybrid/EV battery pack coolant pump to 7% and the battery heater to 100% for 4 seconds, then varies battery heater output in relation to battery voltage for a maximum of 3 minutes.
- The hybrid/EV powertrain control module 2 did not see the battery pack coolant temperature rise more than 3°C (5.4°F) within 60 seconds of commanding the battery heater OFF.

Action Taken When the DTC Sets

- DTC P1EC6 is a type B DTC.
- Hybrid/EV battery pack active heating is disabled.

Conditions for Clearing the DTC

DTC P1EC6 is a type B DTC.

Diagnostic Aids

P1EC6 will prevent battery heating and the vehicle will be unable to start in cold weather if battery temperature drops below -25°C (-13°F).

Reference Information

Schematic Reference

[Hybrid/EV Cooling Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Hybrid/EV Cooling System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE1, P0AE3, P0D0A, P0D09, P1EBD, P1EC0, or P1EC3 is not set.
 - **If any DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

NOTE: **Other DTCs will set.**

3. Vehicle OFF. Remove the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Set the vehicle Charge Mode to IMMEDIATE. Connect the charge cord set. With the vehicle in Charge Mode, Vehicle in Service Mode.
4. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor parameter increases 3Â° C (5.4Â° F) within 120 s when command the hybrid/EV battery pack coolant heater ON with a scan tool.

- If the Hybrid/EV Battery Pack Coolant Temperature Sensor did not increase 3Â° C (5.4Â° F) within 120 s

Refer to Circuit/System Testing.

- If the Hybrid/EV Battery Pack Coolant Temperature Sensor did increase 3Â° C (5.4Â° F) within 120 s

5. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Remove the Drive Motor Battery Cover. Refer to [High Voltage Battery Cover Replacement](#). Disconnect the E54 Hybrid/EV Battery Pack Coolant Heater harness connector at the A28 Hybrid/EV Battery Contactor Assembly.

NOTE: The following continuity tests must be performed using the Ohm setting.

3. Test for 61 - 75 Ω between terminal 1 and terminal 2 at the E54 Hybrid/EV Battery Pack Coolant Heater.
 - If not within the specified range

Verify that the battery pack coolant heater fuse is not blown. Replace the fuse if it is blown and the E54 Hybrid/EV Battery Pack Coolant Heater.

- If within the specified range

NOTE: The following continuity tests must be performed using an EL-50772 Insulation Multimeter.

4. Select the Isolation test setting, then select the 500 V range. Refer to [Troubleshooting With an Insulation Multimeter](#) . Test for greater than 550M Ω between the E54 Hybrid/EV Battery Pack Coolant Heater terminals listed below and battery tray ground with the **EL-50772** , set on the Isolation test setting:
 - Terminal 1
 - Terminal 2
 - If less than 550M Ω

NOTE: Also verify that the battery pack coolant heater fuse is not blown.

Replace the E54 Hybrid/EV Battery Pack Coolant Heater.

- If 550M Ω or greater

5. Replace the A28 Hybrid/EV Battery Contactor Assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [High Voltage Battery Heater Replacement](#)
- [High Voltage Battery Disconnect Relay Fuse Replacement \(Front - BDU\)](#) [High Voltage Battery Disconnect Relay Fuse Replacement \(Rear - BDU\)](#) for Battery Heater Fuse Replacement
- [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor Assembly replacement

DTC P1FFB-P1FFE: HYBRID/EV BATTERY PACK COOLANT LEVEL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1FFB

Hybrid/EV Battery Pack Coolant Level Sensor Circuit

DTC P1FFC

Hybrid/EV Battery Pack Coolant Level Sensor Circuit Low Voltage

DTC P1FFD

Hybrid/EV Battery Pack Coolant Level Sensor Circuit High Voltage

DTC P1FFE

Hybrid/EV Battery Pack Coolant Level Low

Circuit/System Description

The hybrid/EV battery pack coolant system has a level sensor. The hybrid/EV battery pack coolant level sensor is attached to the coolant surge tank. The level sensor is a 2 state bi-metallic reed switch which changes state when the switch reed is exposed to magnetism. The level of the hybrid/EV battery pack coolant in the surge tank causes a magnet-equipped float to move towards and away from the sensor as coolant level decreases or increases. The hybrid/EV powertrain control module 2 supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery pack coolant level sensor resistance decreases when the battery coolant level in the surge tank gets low. The hybrid/EV powertrain control module 2 uses the hybrid/EV battery pack coolant level sensor to determine if the hybrid/EV battery pack coolant system is low on coolant.

Conditions for Running the DTC

P1FFB, P1FFC, and P1FFD

The 12 V battery voltage is greater than 10.2 V.

P1FFE

- The vehicle speed is zero for more than 30 seconds
- The battery pack temperature is between 0Â°C (32Â°F) and 120Â°C (248Â°F)
- None of the following DTCs are set: P0721, P077B, P215C, P2610, U0100 or U0101
- Once set, the DTC will not run again until a scan tool clear code command is sent.

Conditions for Setting the DTC

P1FFB

The hybrid/EV battery pack coolant level sensor voltage is between 2.8 V - 3.1 V

P1FFC

The hybrid/EV battery pack coolant level sensor voltage is below 1.37 V

P1FFD

The hybrid/EV battery pack coolant level sensor voltage is above 4.0 V

P1FFE

The hybrid/EV battery pack coolant level sensor voltage is between 1.38 - 2.84 V for more than 2 consecutive key cycles

Action Taken When the DTC Sets

- DTC P1FFB, P1FFC, P1FFD, and P1FFE are type A DTCs.
- The driver information center (DIC) displays the SERVICE HIGH VOLTAGE CHARGING SYSTEM message.
- Hybrid/EV battery pack charging is disabled.

- Hybrid/EV battery pack active heating and active cooling are disabled.
- DTC P1FFF is set.

Conditions for Clearing the DTC

- DTC P1FFB, P1FFC, and P1FFD are type A DTCs.
- DTC P1FFE is a type A DTC but will only clear with a scan tool clear code command.

Diagnostic Aids

- Parking the vehicle on a steep incline may set DTC P1FFE.
- DTC P1FFE will not clear or go to history with ignition cycles once DTC is set. DTC P1FFE will only clear with a scan tool clear code command.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the vehicle hybrid/EV battery cooling system is full.
 - If the hybrid/EV battery cooling system is low

WARNING: Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can

cause severe injury or death.

Refer to Hybrid Cooling System Loss of Coolant (Battery), **Hybrid Cooling System Loss of Coolant (Power Electronics)Hybrid Cooling System Loss of Coolant (Battery)**

- **If the hybrid/EV battery cooling system is full**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B258 Hybrid/EV Battery Coolant Level Sensor.

2. Test for less than 10 Ω between the low reference circuit terminal B and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V signal circuit terminal A and ground.

- **If 4.8 V or less**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 5.2 V or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If within the specified range**

5. Vehicle OFF, remove the B258 Hybrid/EV Battery Coolant Level Sensor from the coolant surge tank.

NOTE: **The coolant sensor must be removed from the coolant surge tank to ensure the coolant float magnet does not close the internal reed switch.**

6. Test for 24 - 25.4k Ω between the signal terminal A and the low reference terminal B.

- **If not within the specified range**

Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

- **If within the specified range**

NOTE: Moving the magnet slightly along the bottom of the sensor will assist closing the internal switch.

7. Using a magnet, place the magnet off center of the B258 Hybrid/EV Battery Coolant Level Sensor, opposite of the terminals on the epoxy side to close the internal reed switch.

8. Test for 7.1 - 7.54k Ω between the signal terminal A and the low reference terminal B.

- **If not within the specified range**

Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

- **If within the specified range**

9. Replace the coolant surge tank.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Radiator Surge Tank Replacement \(Drive Motor Battery Radiator Surge Tank\)](#)[Radiator Surge Tank Replacement \(Drive Motor Generator Power Inverter Module Surge Tank\)](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1FFF: SYSTEM ISOLATION/COOLANT LEVEL SENSOR FAULT - HYBRID/EV BATTERY CHARGING SYSTEM DISABLED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1FFF

System Isolation/Coolant Level Sensor Fault - Hybrid/EV Battery Charging System Disabled

Circuit/System Description

This diagnostic is an indicator that hybrid/EV battery pack charging is disabled because the hybrid/EV powertrain control module 2 detected one of the following conditions:

WARNING: Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.

- A loss of isolation between the hybrid/EV battery pack high voltage circuits and vehicle chassis
- A low coolant condition of the hybrid/EV battery pack coolant system
- A fault in the hybrid/EV battery pack coolant level sensor/circuit

Conditions for Running the DTC

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- Once set, the DTC will not run again until a scan tool clear code command is sent.

Conditions for Setting the DTC

NOTE: DTC P1FFF will never set alone.

When DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD, or P1FFE is set, DTC P1FFF will also be set.

Action Taken When the DTC Sets

- DTC P1FFF is a type A DTC.
- The driver information center (DIC) displays the SERVICE HIGH VOLTAGE CHARGING SYSTEM message.
- Hybrid/EV battery pack charging is disabled.
- Hybrid/EV battery pack active cooling is disabled.

Conditions for Clearing the DTC

DTC P1FFF is a type A DTC but will only clear with a scan tool clear code command.

Diagnostic Aids

- DTC P1FFF will not clear or go to history with ignition cycles once DTC is set.
- DTC P1FFF will only clear with a scan tool clear code command.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify that DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD, or P1FFE are not set.

- If DTC P0AA6 or P1AE6 is set

Refer to [DTC P0AA6 or P1AE6](#) .

- If DTC P1FFB, P1FFC, P1FFD, or P1FFE is set

Refer to [DTC P1FFB-P1FFE](#).

- If none of the DTCs are set

NOTE: In order to clear P1FFF, the K114B Hybrid/EV Powertrain Control Module 2 may have to be programmed or replaced if the module contains the current calibration level.

2. Clear Codes. Verify DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD, or P1FFE does not set.

- If any DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If none of the DTCs are set

3. All OK.

HYBRID/EV ELECTRONICS COOLING DIAGNOSTIC

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	WARNING: Refer to Moving Parts and Hot Surfaces Warning . WARNING:	Go to Step 3	Go to Step 17

Step	Action	Yes	No
	Wear safety glasses in order to avoid eye damage. 1. Add coolant to the coolant surge tank as needed. <u>Drive Motor Generator Power Inverter Module Cooling System Draining and Filling</u> 2. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 3. Quickly remove and install the drive motor generator control module coolant pump hose from the generator control module coolant pump. <u>Drive Motor Generator Control Module Coolant Pump Hose Replacement</u> Is there coolant flowing out of the drive motor control module coolant pump hose?		
3	Quickly remove and install the drive motor control module radiator inlet hose from the generator control module coolant pump. <u>Drive Motor Control Module Radiator Inlet Hose Replacement</u> Is there coolant flowing out of the drive motor control module radiator inlet hose?	Go to Step 4	Go to Step 18
4	Quickly remove and install the drive motor control module radiator inlet hose from the air conditioning condenser. <u>Drive Motor Control Module Radiator Inlet Hose Replacement</u> Is there coolant flowing out of the drive motor control module radiator inlet hose?	Go to Step 5	Go to Step 19
5	Quickly remove and install the drive motor control module radiator outlet hose from the air conditioning condenser. Refer to <u>Drive Motor Control Module Radiator Outlet Hose Replacement</u> Is there coolant flowing out of the air conditioning condenser?	Go to Step 6	Go to Step 20
6	Quickly remove and install the drive motor generator control module radiator outlet hose from drive motor generator control module cooling outlet hose-underbody line assembly. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line) Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module Inlet)</u> Is there coolant flowing out of the drive motor generator control module radiator outlet hose?	Go to Step 7	Go to Step 21

Step	Action	Yes	No
7	Quickly remove and install the drive motor generator control module cooling outlet hose-underbody line assembly from the drive motor generator control module bracket flange. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module Inlet)</u> Is there coolant flowing out of the drive motor generator control module cooling outlet hose - underbody line assembly?	Go to Step 8	Go to Step 22
8	Quickly remove and install the generator control module coolant radiator hose from the drive motor generator control module bracket flange. <u>Generator Control Module Coolant Radiator Hose Replacement</u> Is there coolant flowing out of the drive motor generator control module bracket flange?	Go to Step 9	Go to Step 23
9	Quickly remove and install the generator control module coolant radiator hose from the accessory DC power control module. <u>Generator Control Module Coolant Radiator Hose Replacement</u> Is there coolant flowing out of the generator control module coolant radiator hose?	Go to Step 10	Go to Step 24
10	Quickly remove and install the generator control module coolant hose from the accessory DC power control module. <u>Generator Control Module Coolant Hose Replacement</u> Is there coolant flowing out of the accessory DC power control module?	Go to Step 11	Go to Step 25
11	Quickly remove and install the generator control module coolant hose from the drive motor battery charger. <u>Generator Control Module Coolant Hose Replacement</u> Is there coolant flowing out of the generator control module coolant hose?	Go to Step 12	Go to Step 26
12	Quickly remove and install the generator control module coolant tank hose from the drive motor battery charger. <u>Generator Control Module Coolant Tank Hose Replacement</u> Is there coolant flowing out of the drive motor battery charger?	Go to Step 13	Go to Step 27
13	Quickly remove and install the generator control module coolant tank hose from the drive motor generator control module bracket flange. <u>Generator Control Module Coolant Tank Hose Replacement</u> Is there coolant flowing out of the generator control module coolant tank hose?	Go to Step 14	Go to Step 28

Step	Action	Yes	No
14	Quickly remove and install the drive motor generator control module cooling outlet hose - underbody line assembly from the drive motor generator control module bracket flange. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)</u> Is there coolant flowing out of the drive motor generator control module bracket flange?	Go to Step 15	Go to Step 23
15	Quickly remove and install the drive motor generator control module cooling outlet hose-underbody line assembly from the drive motor generator control module cooling outlet hose. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)</u> Is there coolant flowing out of the drive motor generator control module cooling outlet hose - underbody line assembly?	Go to Step 16	Go to Step 22
16	Quickly remove and install the drive motor generator control module cooling outlet hose from the radiator surge tank - TPIM. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)</u> Is there coolant flowing out of the drive motor generator control module cooling outlet hose?	Go to Step 30	Go to Step 22
17	Replace the drive motor generator control module coolant pump hose. <u>Drive Motor Generator Control Module Coolant Pump Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
18	Replace the generator control module coolant pump. <u>Generator Control Module Coolant Pump Replacement.</u> Is the repair complete?	Go to Step 30	Go to Step 1
19	Replace the drive motor control module radiator inlet hose. <u>Drive Motor Control Module Radiator Inlet Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
20	Replace the air conditioning condenser. <u>Air Conditioning Condenser Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1

Step	Action	Yes	No
21	Replace the drive motor control module radiator outlet hose. <u>Drive Motor Control Module Radiator Outlet Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
22	Replace the drive motor generator control module cooling outlet hose-underbody line assembly. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module Inlet)</u> Is the repair complete?	Go to Step 30	Go to Step 1
23	Replace the drive motor generator control module bracket. Is the repair complete?	Go to Step 30	Go to Step 1
24	Replace the generator control module coolant radiator hose. <u>Generator Control Module Coolant Radiator Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
25	Replace the accessory DC power control module. <u>Accessory DC Power Control Module Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
26	Replace the generator control module coolant hose. <u>Generator Control Module Coolant Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
27	Replace the drive motor battery charger. <u>Drive Motor Battery Charger Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
28	Replace the generator control module coolant tank hose. <u>Generator Control Module Coolant Tank Hose Replacement</u> Is the repair complete?	Go to Step 30	Go to Step 1
29	Replace the drive motor generator control module cooling outlet hose. <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module Inlet)</u> Is the repair complete?	Go to Step 1	Go to Step 1
30	1. Add coolant to the coolant surge tank as needed. <u>Drive Motor Generator Power Inverter Module Cooling System Draining and Filling</u> 2. Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 1

HYBRID/EV BATTERY COOLING DIAGNOSTIC

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	WARNING: Refer to <u>Moving Parts and Hot Surfaces Warning</u> . WARNING: Wear safety glasses in order to avoid eye damage. 1. Add coolant to the coolant surge tank as needed. Refer to <u>Drive Motor Battery Cooling System Draining and Filling</u>. 2. Using GDS, turn on the drive motor battery coolant pump. 3. Quickly remove and install the coolant hose from the drive motor battery coolant pump. Refer to <u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump Outlet to Chiller Inlet)</u><u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Tube Assembly to Chiller)</u> (pump outlet to tube). Is there coolant flowing out of the drive motor battery coolant pump?	Go to Step 3	Go to Step 1
3	Quickly remove and install the drive motor battery coolant cooler inlet hose (pump outlet to tube) from the drive motor battery coolant cooler inlet hose (tube to cooler inlet). Refer to <u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump Outlet to Chiller Inlet)</u><u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Tube Assembly to Chiller)</u> (pump outlet to tube). Is there coolant flowing out of the drive motor battery coolant cooler inlet hose (pump outlet to tube)?	Go to Step 4	Go to Step 11
4	Quickly remove and install the drive motor battery coolant cooler inlet hose (tube to cooler inlet) from the coolant cooler. Refer to <u>Drive Motor Battery</u>	Go to Step 5	Go to Step 12

Step	Action	Yes	No
	<u>Coolant Cooler Inlet Hose Replacement (Pump Outlet to Chiller Inlet)</u><u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Tube Assembly to Chiller)</u> (tube to cooler inlet). Is there coolant flowing out of the drive motor battery coolant cooler inlet hose (tube to cooler inlet)?		
5	Quickly remove and install the drive motor battery coolant inlet hose from the coolant cooler. Refer to <u>Drive Motor Battery Coolant Inlet Hose Replacement</u>. Is there coolant flowing out of the drive motor battery coolant cooler?	Go to Step 6	Go to Step 13
6	Quickly remove and install the drive motor battery coolant inlet hose from the drive motor battery. Refer to <u>Drive Motor Battery Coolant Inlet Hose Replacement</u>. Is there coolant flowing out of the drive motor battery inlet hose?	Go to Step 7	Go to Step 14
7	Quickly remove and install the drive motor battery coolant outlet hose from the drive motor battery. Refer to <u>Drive Motor Battery Coolant Outlet Hose Replacement (Drive Motor Battery to Tube)</u><u>Drive Motor Battery Coolant Outlet Hose Replacement (Tube to Drive Motor Battery Reservoir)</u>. Is there coolant flowing out of the drive motor battery?	Go to Step 8	Go to Step 15
8	Quickly remove and install the drive motor battery coolant outlet hose (drive motor battery to tube) from the drive motor battery coolant outlet hose (tube to drive motor battery reservoir). Refer to <u>Drive Motor Battery Coolant Outlet Hose Replacement (Drive Motor Battery to Tube)</u><u>Drive Motor Battery Coolant Outlet Hose Replacement (Tube to Drive Motor Battery Reservoir)</u>. Is there coolant flowing out of the drive motor battery outlet hose (drive motor battery to tube)?	Go to Step 9	Go to Step 16
9	Quickly remove and install the drive motor battery coolant outlet hose (tube to drive motor battery reservoir) from the radiator surge tank. Refer to <u>Drive Motor Battery Coolant Outlet Hose Replacement (Drive Motor Battery to Tube)</u><u>Drive Motor Battery Coolant Outlet Hose Replacement (Tube to Drive Motor Battery Reservoir)</u>. Is there coolant flowing out of the drive motor battery coolant outlet hose (tube to drive motor battery reservoir)?	Go to Step 10	Go to Step 17
10	Quickly remove and install the drive motor battery coolant pump inlet hose from the drive motor battery coolant pump. Refer to <u>Drive Motor Battery Coolant</u>	Go to Step 19	Go to Step 18

Step	Action	Yes	No
	<u>Pump Inlet Hose Replacement.</u> Is there coolant flowing out of the drive motor battery coolant pump inlet hose?		
11	Replace the drive motor battery coolant cooler inlet hose. Refer to <u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump Outlet to Chiller Inlet)Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Tube Assembly to Chiller)</u> (pump outlet to tube). Is the repair complete?	Go to Step 19	Go to Step 1
12	Replace the drive motor battery coolant cooler inlet hose. Refer to <u>Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump Outlet to Chiller Inlet)Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Tube Assembly to Chiller)</u> (tube to cooler inlet). Is the repair complete?	Go to Step 19	Go to Step 1
13	Replace the drive motor battery coolant cooler. Refer to <u>Drive Motor Battery Coolant Cooler Replacement.</u> Is the repair complete?	Go to Step 19	Go to Step 1
14	Replace the drive motor battery coolant inlet hose. Refer to <u>Drive Motor Battery Coolant Inlet Hose Replacement.</u> Is the repair complete?	Go to Step 19	Go to Step 1
15	Replace the drive motor battery. Refer to <u>Drive Motor Battery Replacement and Shipping Preparation .</u> Is the repair complete?	Go to Step 19	Go to Step 1
16	Replace the drive motor battery coolant outlet hose. Refer to <u>Drive Motor Battery Coolant Outlet Hose Replacement (Drive Motor Battery to Tube)Drive Motor Battery Coolant Outlet Hose Replacement (Tube to Drive Motor Battery Reservoir).</u> Is the repair complete?	Go to Step 19	Go to Step 1
17	Replace the drive motor battery coolant outlet hose (tube to drive motor battery reservoir). Refer to <u>Drive Motor Battery Coolant Outlet Hose Replacement (Drive Motor Battery to Tube)Drive Motor Battery Coolant Outlet Hose Replacement (Tube to Drive Motor Battery Reservoir).</u> Is the repair complete?	Go to Step 19	Go to Step 1
18	Replace the drive motor battery coolant pump inlet hose. Refer to <u>Drive Motor Battery Coolant Pump Inlet Hose Replacement.</u> Is the repair complete?	Go to Step 19	Go to Step 1
19	1. Add coolant to the coolant surge tank as needed. Refer to <u>Drive Motor Battery Cooling System Draining and Filling.</u>	System OK	Go to Step 1

Step	Action	Yes	No
	2. Operate the system in order to verify the repair.		
	Did you find and correct the condition?		

HYBRID/EV BATTERY PACK COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37°C (-34°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is On*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*

Displayed PWM Value	Pump Self-Diagnostic Indication
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C47, P1E8C, P1E8D, P19FD, P19FE, or P19FF is not set.
 - **If any DTC is set**
 Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - **If none of the DTCs are set**
3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 90% with a scan tool.
 - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
 - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
 - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
 - **The scan tool parameters listed are not within the specified ranges**
 Refer to Circuit/System Testing.
 - **The scan tool parameters listed are within the specified ranges**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

- **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**

3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown

3. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Replace the K114B hybrid/EV powertrain control module 2.

- **If the test lamp is OFF**

7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Battery Pack Coolant Pump ON (20 - 90%) with a scan tool if necessary.

- **If the test lamp is OFF**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the pump enable circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the pump enable circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is ON**

8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Battery Pack Coolant Pump ON between 20% and 90% with a scan tool.
 - **If the test lamp is always dim or does not illuminate**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always bright**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **The test lamp changes illumination between bright (20%) and dim (90%)**
10. Remove the test lamp.
11. Verify the scan tool Hybrid/EV Battery Pack Coolant Pump Feedback parameter is 0%.
 - **If greater than 0%**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid/EV Battery Pack Coolant Pump Feedback parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the feedback circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Connect the G37 Hybrid/EV Battery Pack Coolant Pump.

15. Vehicle On.

16. Place your hand on the coolant pump and verify that pump operation is felt when commanding the Hybrid/EV Battery Pack Coolant Pump ON to 90% with a scan tool.

- **If pump operation cannot be felt at 90%**

Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

- **If pump operation is felt at 90%**

17. All OK. Refer to [Hybrid/EV Battery Cooling Diagnostic](#) to verify for proper flow of the coolant pump and system.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Coolant Pump Replacement](#)
- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

HYBRID/EV ELECTRONICS COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, drive motor generator power inverter module, the battery charger, and the 14V accessory power module to control the temperature of these modules.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is On*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle On.

2. Verify that DTC P0CE9, P1F44, P1F45, P19FA, P19FB, or P19FC is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

3. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 90% with a scan tool.

- Hybrid/EV Electronics Coolant Pump Command to be 10% or greater.
- Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%.
- Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified ranges**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.

2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

- **If 5 Ω or greater**

Repair the open/high resistance on the ground circuit.

- **If less than 5 Ω**

3. Vehicle On.

4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.

- **If less than B+**

1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω and the fuse is blown

3. Replace the G35 Hybrid/EV Electronics Coolant Pump.

- **If B+**

5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.

6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.

- **If the test lamp is ON**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 1 V between the pump enable circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V
3. Replace the K114B hybrid/EV powertrain control module 2.
 - **If the test lamp is OFF**
7. Vehicle On. Verify the test lamp illuminates. Command the Hybrid/EV Electronics Coolant Pump ON (20 - 90%) with a scan tool if necessary.
 - **If the test lamp is OFF**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the pump enable circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the pump enable circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is ON**
 8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
 9. Verify that a test lamp changes illumination between bright (20%) and dim (90%) when commanding the Hybrid/EV Electronics Coolant Pump ON between 20% and 90% with a scan tool.
 - **If the test lamp is always dim or does not illuminate**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always bright**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **The test lamp changes illumination between bright (20%) and dim (90%)**
 10. Remove the test lamp.
 11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.
 - **If greater than 0%**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the feedback circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the feedback circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
14. Connect the G35 Hybrid/EV Electronics Coolant Pump.
15. Vehicle On.
16. Place your hand on the coolant pump and verify that pump operation is felt when commanding the Hybrid/EV Electronics Coolant Pump ON to 90% with a scan tool.
 - **If pump operation cannot be felt at 90%**

Replace the G35 Hybrid/EV Electronics Coolant Pump.

 - **If pump operation is felt at 90%**
17. Electronic control of the pump is OK. Verify for proper flow of the coolant pump and system.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Generator Control Module Coolant Pump Replacement** for Hybrid/EV electronics coolant pump replacement.
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

HYBRID COOLING SYSTEM LOSS OF COOLANT (POWER ELECTRONICS)

Step	Action	Yes	No
1	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 13	Go to Step 2
2	Fill the cooling system to the proper level. Refer to <u>Drive Motor Generator Power Inverter Module Cooling System Draining and Filling.</u>	Go to Step 3	-

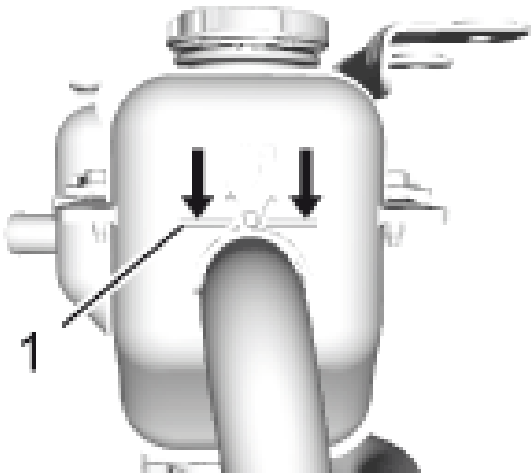
Step	Action	Yes	No
	Is the action complete?		
3	Overheating can cause a loss of coolant. Is the Hybrid/EV Electronics Cooling Diagnostic overheating?	Go to Step 11	Go to Step 4
4	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to Step 12	Go to Step 5
5	Visually inspect the following components: • Coolant surge tank • Coolant hoses and pipes • Generator control module coolant Pump • Air conditioning condenser • Accessory DC power control module • Drive motor battery charger Are any of the listed components leaking?	Go to Step 12	Go to Step 6
6	1. Pressure test the cooling system. Refer to Hybrid Cooling System Leak Test . 2. With the cooling system pressurized, visually inspect the components listed in step 5. Are any leaks present?	Go to Step 12	Go to Step 7
7	Pressure test the coolant pressure cap. Refer to Hybrid Cooling System Pressure Cap Testing . Does the coolant pressure cap hold pressure?	Go to Step 9	Go to Step 8
8	Replace the coolant pressure cap. Is the repair complete?	Go to Step 13	-
9	1. Pressure test the cooling system. Refer to Hybrid Cooling System Leak Test . 2. With the cooling system pressurized, remove the engine cooling system pressure cap. Does the hybrid cooling system hold pressure?	-	Go to Step 10
10	Replace the surge tank-drive motor generator power inverter module. Refer to Radiator Surge Tank Replacement (Drive Motor Battery Radiator Surge Tank) Radiator Surge Tank Replacement (Drive Motor Generator Power Inverter Module Surge Tank) . Is the repair complete?	Go to Step 13	-
11	Repair the hybrid cooling system overheating condition. Refer to Hybrid/EV Battery Cooling Diagnostic . Is the repair complete?	Go to Step 13	-
12	Repair or replace the leaking component. Refer to the appropriate repair.	Go to Step 13	-

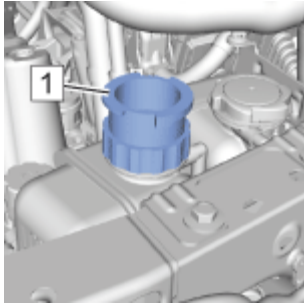
Step	Action	Yes	No
	Is the repair complete?		
13	Operate the system in order to verify the repair. NOTE: Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized) Did you find and correct the condition?	System OK	Go to Step 2

HYBRID COOLING SYSTEM LOSS OF COOLANT (BATTERY)

Step	Action	Yes	No
DEFINITION: Perform this procedure in conjunction with a high-voltage battery overheating condition, low coolant in the high-voltage battery surge tank, or when instructed to by DTC P1FFE, P1AE6, or P0AA6 diagnostic procedures. WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather			

Step	Action	Yes	No
	protectors • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedure exactly as written may result in serious injury or death. WARNING: Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly.		

Step	Action	Yes	No
Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.			
1	Raise and support the hood with prop rod. Was the hood raised and supported with the prop rod?	Go to Step 2	Go to Step 1
2	 Visually inspect the coolant level in the high-voltage battery surge tank. Is the coolant level at the fill line (1)?	Go to Step 3	Go to Step 4
3	Are any of the following DTCs present? • P0AA6 (Hybrid/EV Battery Voltage System Isolation Lost) • P1AE6 (Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit) • P1FFE (Hybrid/EV Battery Pack Coolant Level Low)	Perform DTC Diagnostics.	Go to Step 4
4	Inspect the HV battery for internal coolant leakage. Did coolant flow from drive motor battery?	Then Go to Step 5	Go to Step 6
5	Call the GM Technical Assistance Center (TAC) for further instructions. DO NOT ATTEMPT TO REPAIR VEHICLE WITHOUT CALLING TAC. Was TAC called?	Go to Step 6	Go to Step 5
6	Inspect the coolant cap for proper seat. Was the coolant cap loosen?	Go to Step 7	Go to Step 6

Step	Action	Yes	No
7	Special Tools:  <u>Fig. 5: Radiator Cap And Surge Tank Test Adapter</u> • EN-24460-A cooling system pressure tester • GE-46143 radiator cap and surge tank test adapter (1) Pressure test high-voltage battery cooling loop and pressure cap to 34.4 kPa (5 psi). Does the system hold pressure for at least five minutes?	Go to Step 9	Go to Step 8
8	NOTE: When raising vehicle on hoist, vehicle must be level. Visually inspect the following components-Also inspect their hoses, clamps, and hose connections for coolant leaks: • Coolant surge tank • Air separator • HV battery radiator • HV battery coolant pump • HV battery chiller • HV battery assembly Was a coolant leak found?	Replace component(s), hose(s), or clamp(s) that is/are leaking. Refer to appropriate procedure(s). Validate repair with additional pressure test. Then Go to Step 9	Go to Step 9
9	Special Tools: • GE-26568 Coolant and Battery Tester • GE-47716-A Vac-N-Fill Coolant Refill Tool • GE-46143 Radiator Cap and Surge Tank Test Adapter Fill and adjust high-voltage battery cooling system level at the surge tank. Refer to <u>Drive Motor Battery Cooling</u>	Go to Step 10	Go to Step 9

Step	Action	Yes	No
	<u>System Draining and Filling.</u> Was the high-voltage battery cooling system level filled and adjusted at the surge tank?		
10	Verify the following before returning vehicle to customer: • Coolant level is at the top of the full line of the high-voltage battery surge tank. • Coolant Cap is reinstalled. • DTC P1FFE (Hybrid/EV Battery Pack Coolant Level Low) is cleared from ECU. Did you find and correct the condition?	System OK	Go to Step 1

HYBRID COOLING SYSTEM PRESSURE CAP TESTING

Special Tools

- **GE-46143** Radiator Cap and Surge Tank Test Adapter
- **EN-24460-A** Cooling System Pressure Tester

For equivalent regional tools, Refer to [Special Tools](#)

Pressure Cap Testing

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

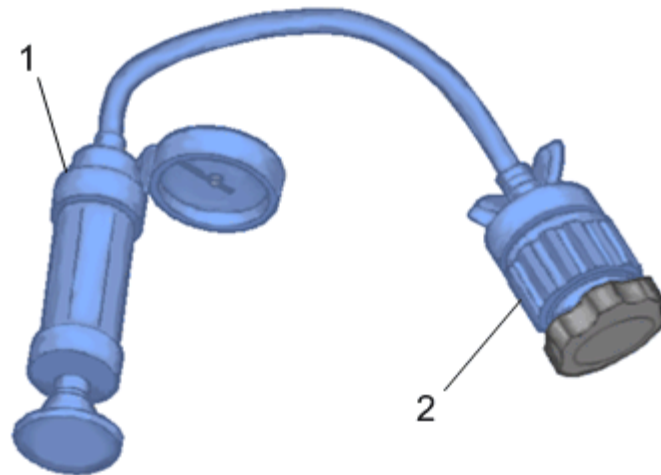


Fig. 6: Identifying Pressure Cap Tester

Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate GE-46143 Radiator Cap and Surge Tank Test Adapter and pressure cap O-rings with coolant and press cap to seat O-ring on GE-46143 Radiator Cap and Surge Tank Test Adapter before turning to engage threads.

3. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **GE-46143** Radiator Cap and Surge Tank Test Adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
 - Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
 - Maintain the rated pressure for at least 10 seconds.

Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:
 - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
 - The pressure cap does not hold the rated pressure.

HYBRID COOLING SYSTEM LEAK TEST

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-46143** Radiator Cap and Surge Tank Test Adapter

For equivalent regional tools, Refer to [Special Tools](#)

WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

WARNING: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to [Hybrid Cooling System Pressure Cap Testing](#).
3. Wash the pressure cap mating surface with water.

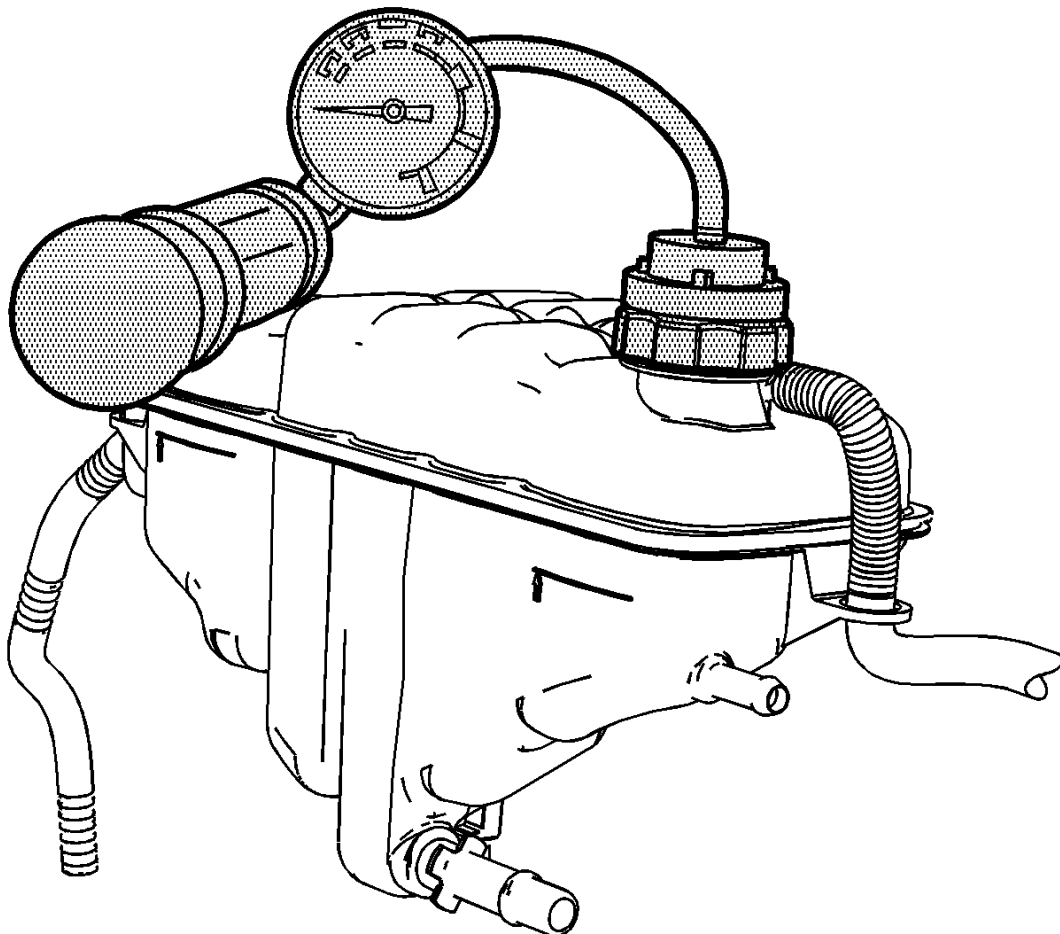


Fig. 7: Cooling System Pressure Tester Components

Courtesy of GENERAL MOTORS COMPANY

4. Use the **EN-24460-A** Cooling System Pressure Tester with the **GE-46143** Radiator Cap and Surge Tank Test Adapter in order to apply pressure to the cooling system.

Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

Observe the gauge for any pressure loss.

NOTE: Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized)

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

DRIVE MOTOR BATTERY COOLING SYSTEM DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-46143** Cooling System Adapter
- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **GE-50385** Battery Pack Coolant Adapters
- **EL-51753** Battery Leak Test Kit
- **EL-50812** Battery Leak Test Kit

Equivalent regional tools: [Special Tools](#).

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

NOTE: If system is being drained to perform internal service or replacement of the high-voltage battery, it is necessary to purge the high-voltage battery of any residual coolant. Refer to the High-Voltage Battery Coolant Purge procedure at the end of this procedure.

Drain Points

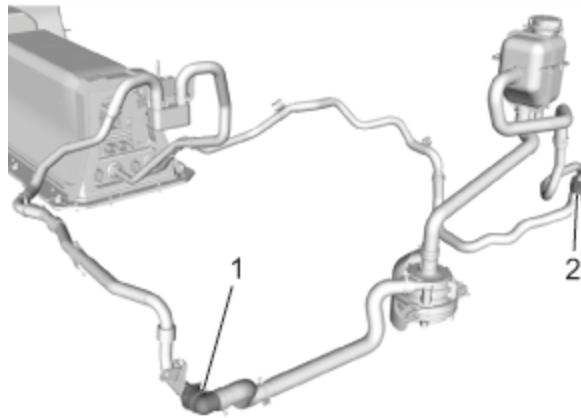


Fig. 8: Battery Inlet And Outlet Branch Drain Point
Courtesy of GENERAL MOTORS COMPANY

1. The graphic shows the 2 draining points:
 1. Battery Inlet Branch Drain Point (1)
 2. Battery Outlet Branch Drain Point (2)

Draining Procedure

NOTE:

- Draining of the cooling system or replacement of any drive motor battery cooling system parts requires the actuation of the Hybrid/EV Battery Pack Coolant Pump Bleed Procedure in the GDS tool.
- To completely drain the high-voltage battery cooling system, coolant must be drained from three locations: The inlet branch quick connect, the outlet branch quick connect, and the inlet & outlet pipes at the high-voltage battery.
- If draining the system for high-voltage battery internal service or replacement, it is necessary to purge all coolant from the battery using an additional procedure. Go to Purging & Remove of Coolant from Battery .

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain battery coolant inlet branch. Disconnect the battery coolant pump outlet hose at the chiller inlet pipe at the right frame rail. [Drive Motor Battery Coolant Cooler Inlet Hose Replacement \(Pump Outlet to Chiller Inlet\)](#)[Drive Motor Battery Coolant Cooler Inlet Hose Replacement \(Tube Assembly to Chiller\)](#) (Tube Assembly to Chiller).
3. Drain battery coolant outlet branch. Disconnect the high-voltage battery outlet pipe at the surge tank inlet hose quick connect near the left frame rail. [Drive Motor Control Module Radiator Outlet Hose Replacement](#).
4. Drain the inlet and outlet branch at the battery. Disconnect high-voltage battery inlet pipe and outlet pipe. Refer to [Drive Motor Control Module Radiator Inlet Hose Replacement](#) (Drive Motor Battery to Tube).

Vac-N-Fill Procedure

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

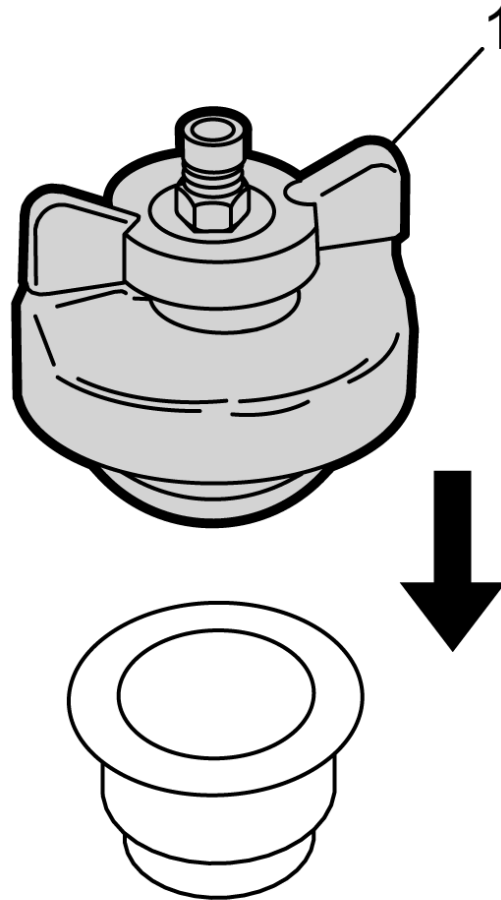


Fig. 9: Radiator Cap & Surge Tank Test Adapter

Courtesy of GENERAL MOTORS COMPANY

NOTE: To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

2. Install **GE-46143** adapter.
3. Attach the Van-N-Fill cap (1) to **GE-46143** adapter.

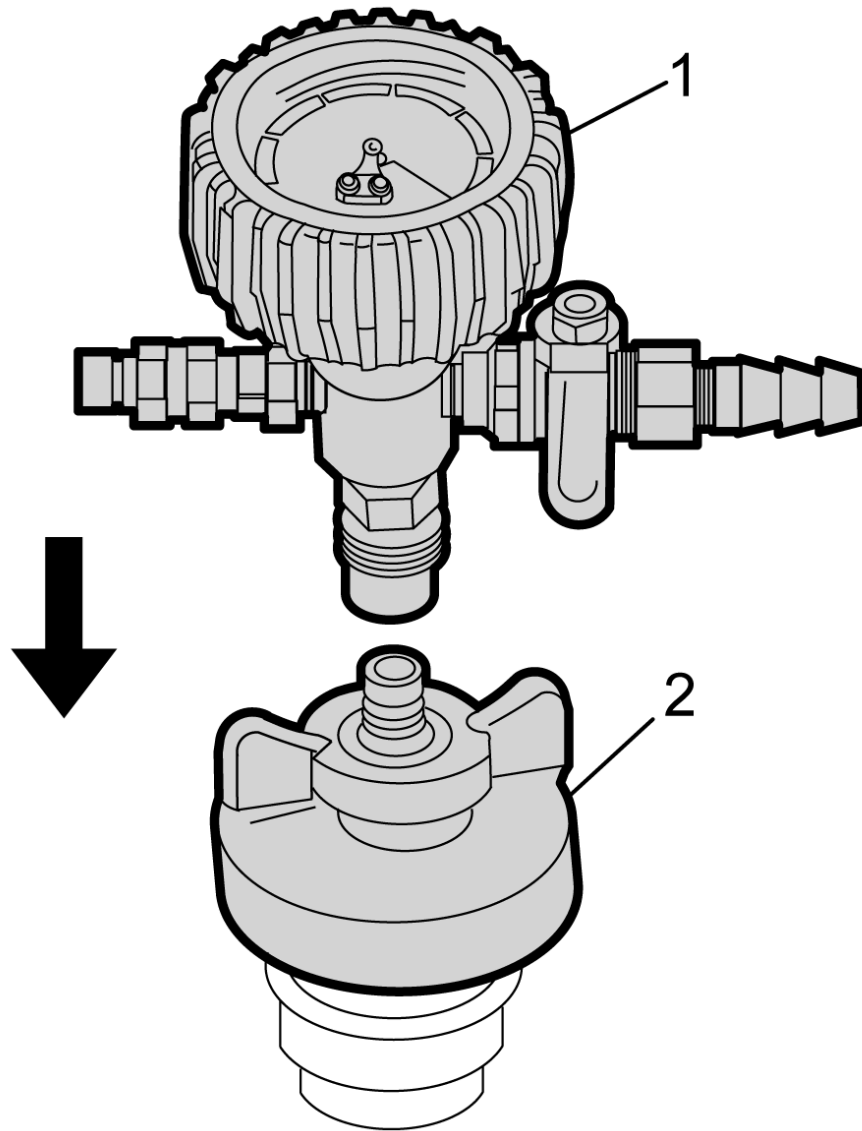


Fig. 10: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

4. Attach the vacuum gauge assembly (1) to the Vac-N-Fill cap (2).

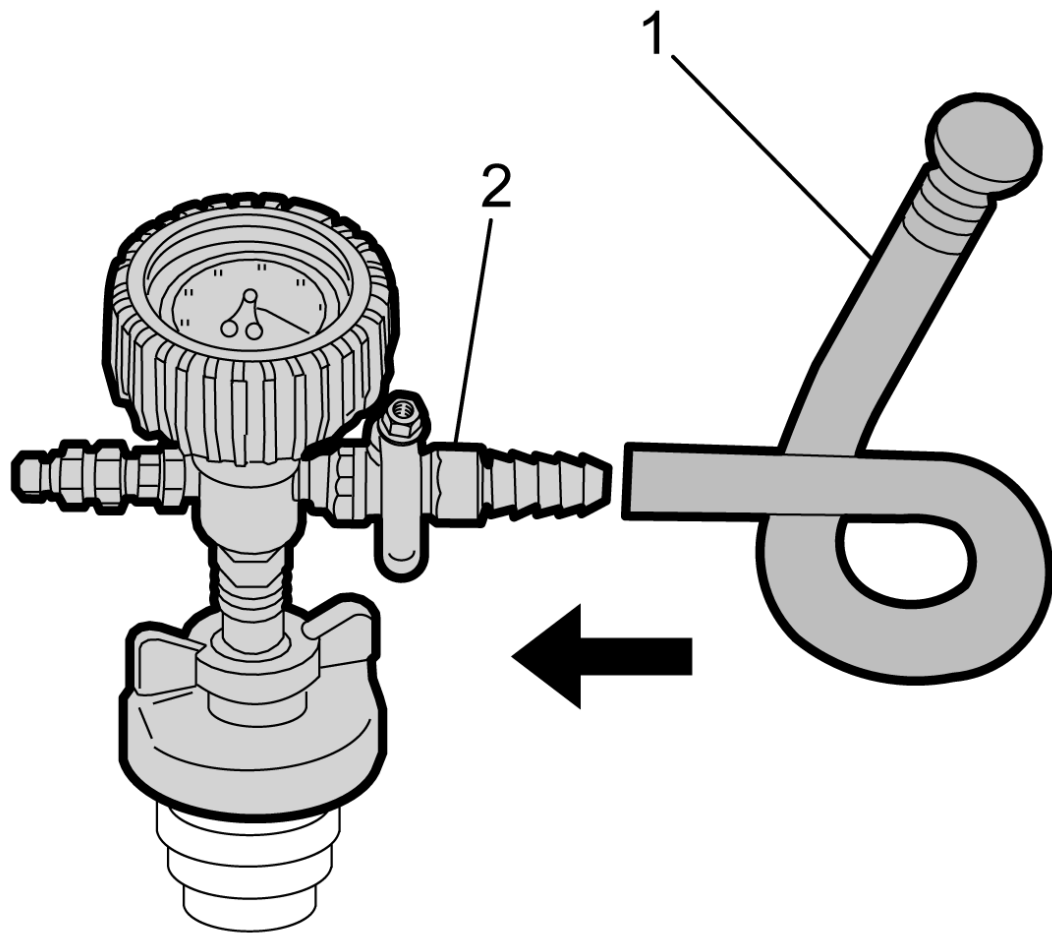


Fig. 11: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

5. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).

Ensure that the valve is closed.

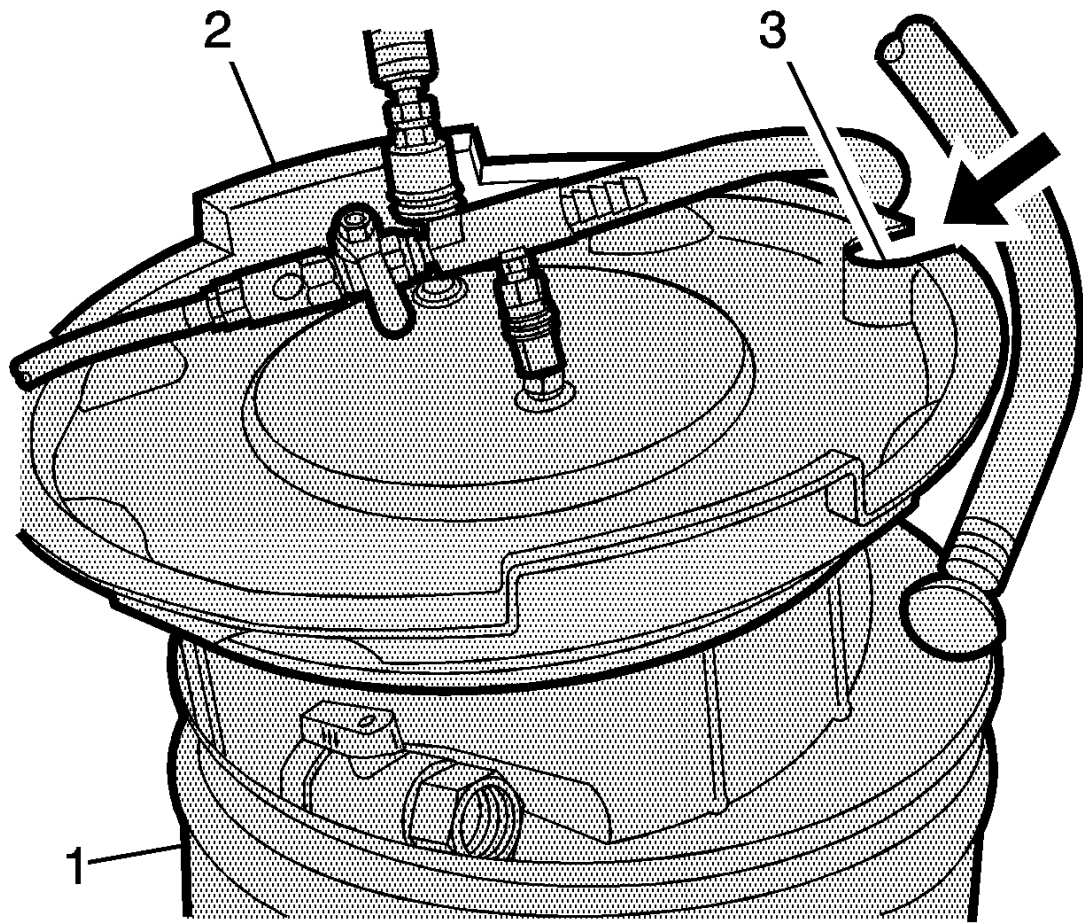


Fig. 12: Graduated Reservoir, Vacuum Tank & Cut-Out Area

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a Pre-mixed DEXCOOLÂ® (50/50 mixture of DEXCOOLÂ® and deionized water). Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

6. Pour the coolant mixture into the graduated reservoir (1).
7. Place the fill hose in the graduated reservoir (1).

NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

8. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

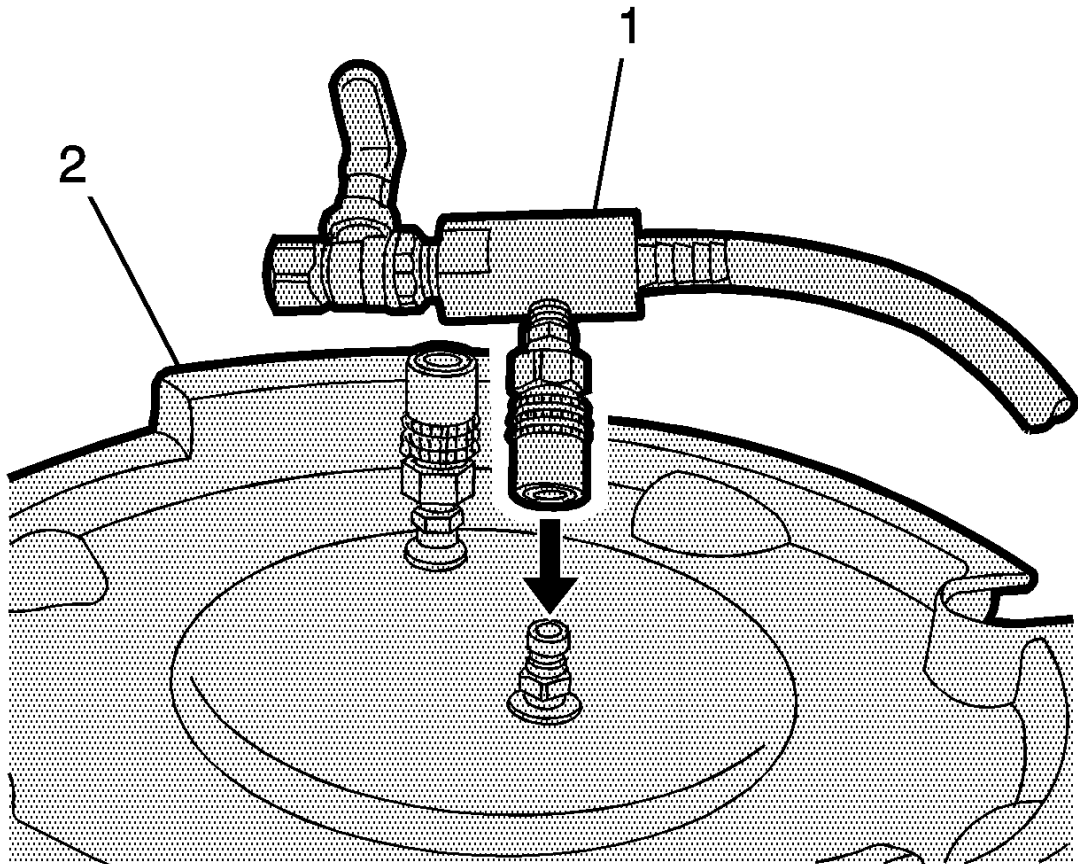


Fig. 13: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly (1) to the vacuum tank (2).

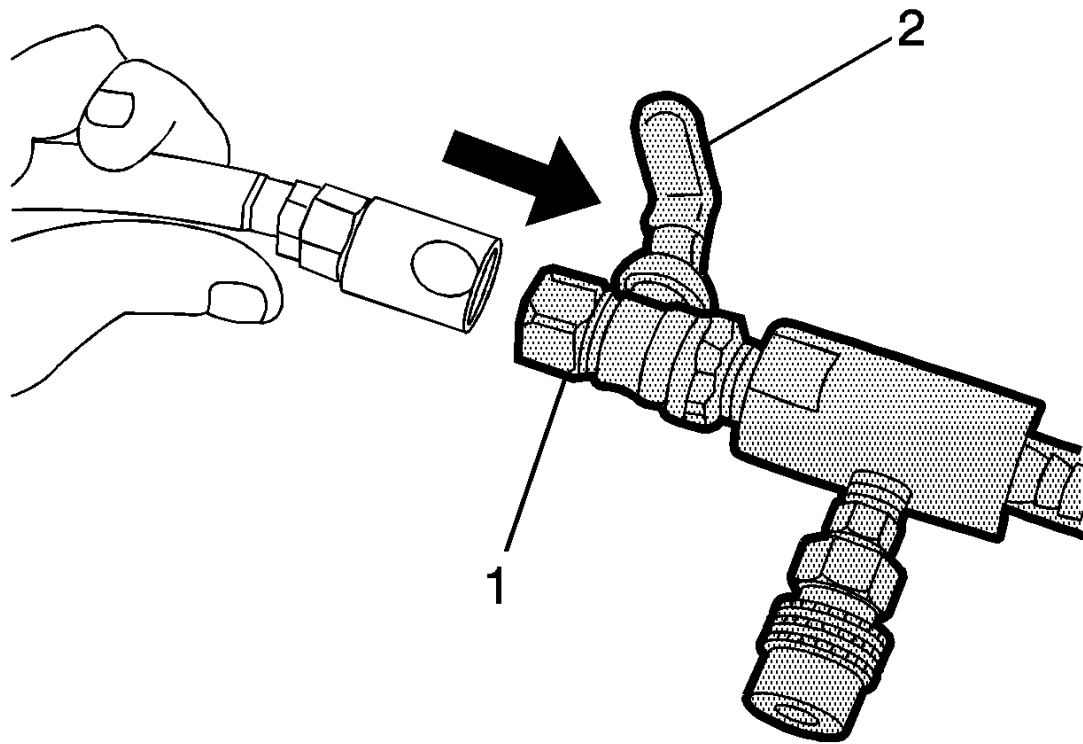


Fig. 14: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

10. Attach a shop air hose to the venturi assembly (1).

Ensure the valve (2) on the venturi assembly is closed.

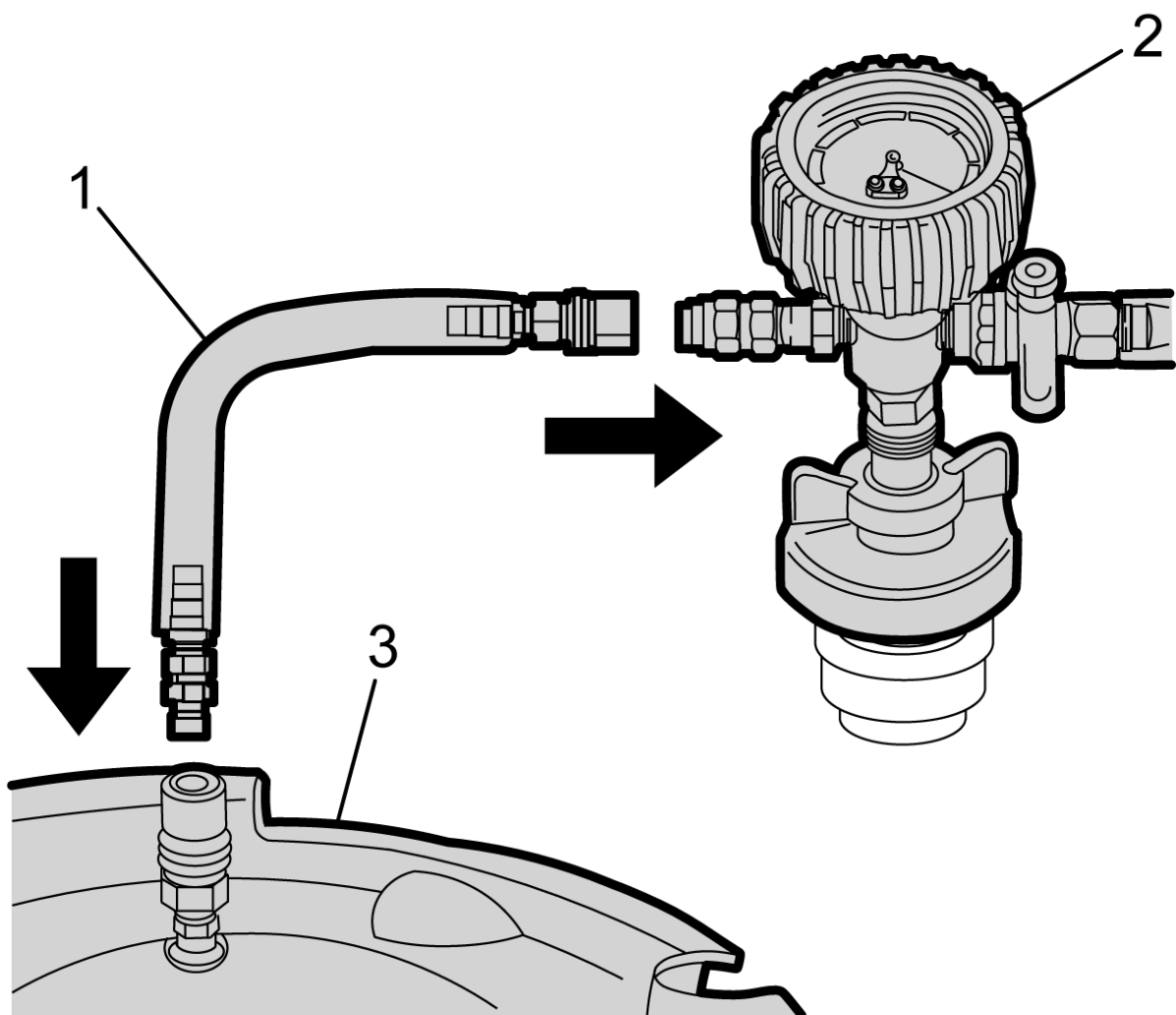


Fig. 15: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

11. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

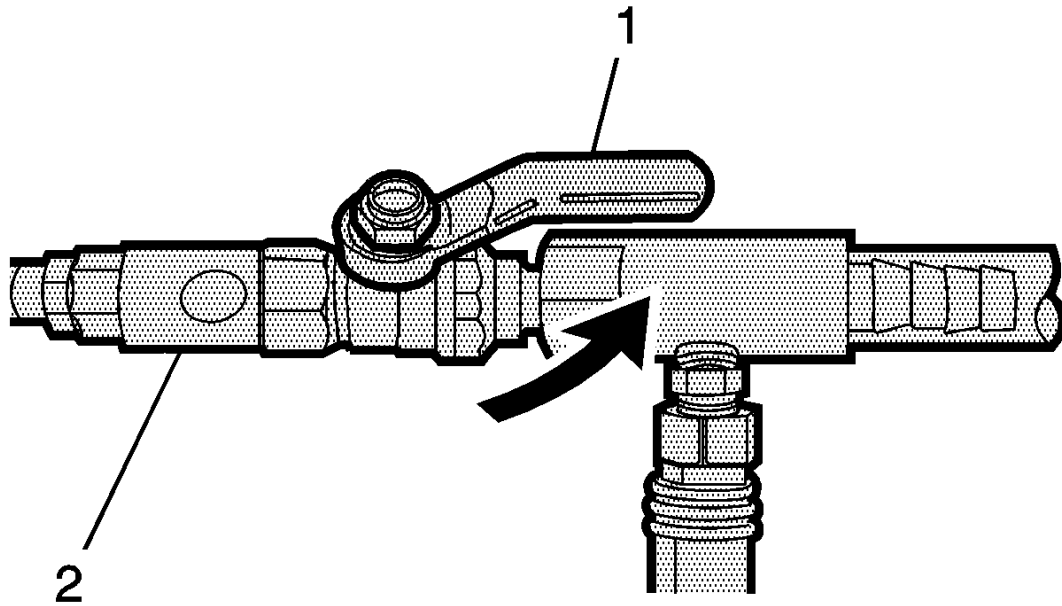


Fig. 16: Valve & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

12. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

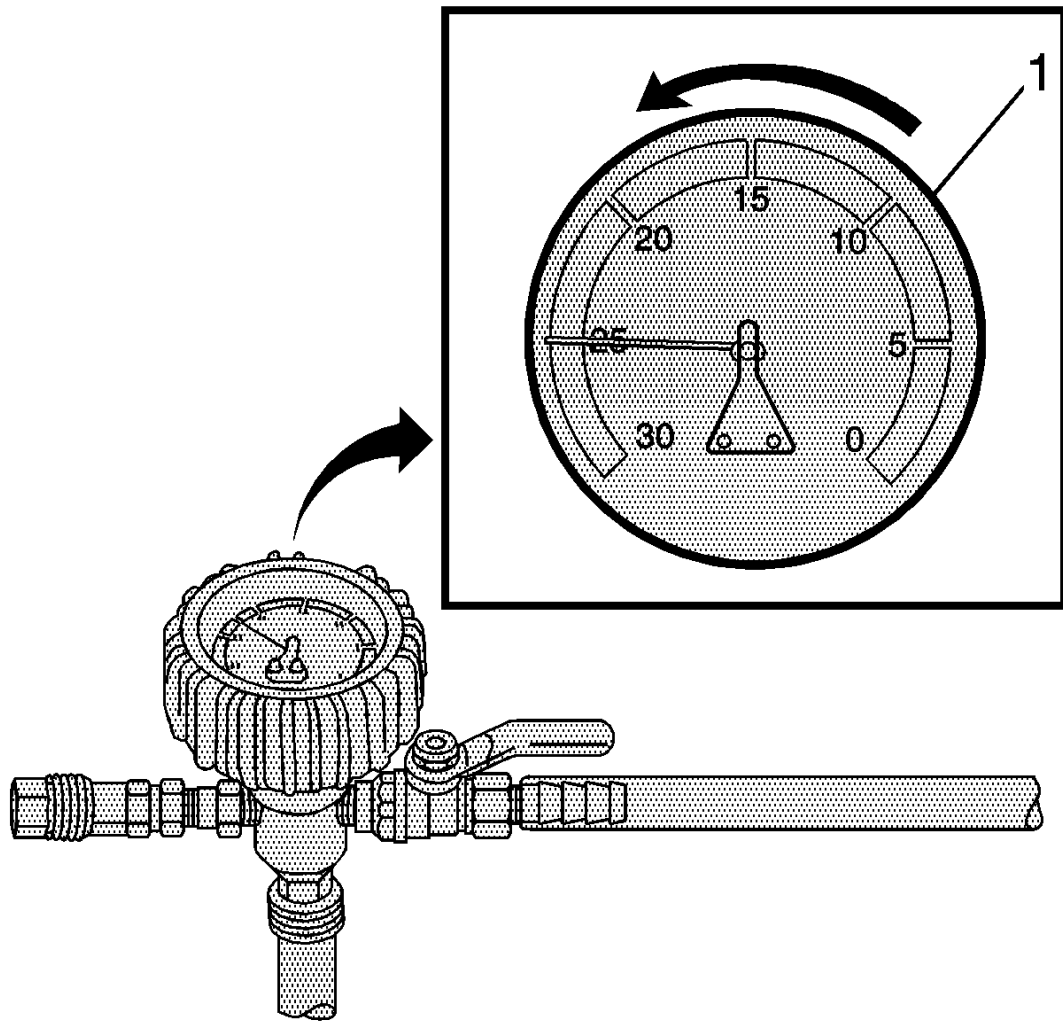


Fig. 17: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

13. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).

Cooling hoses may start to collapse. This is normal due to vacuum draw.

14. To aid in the fill process, position the graduated reservoir above the coolant fill port.

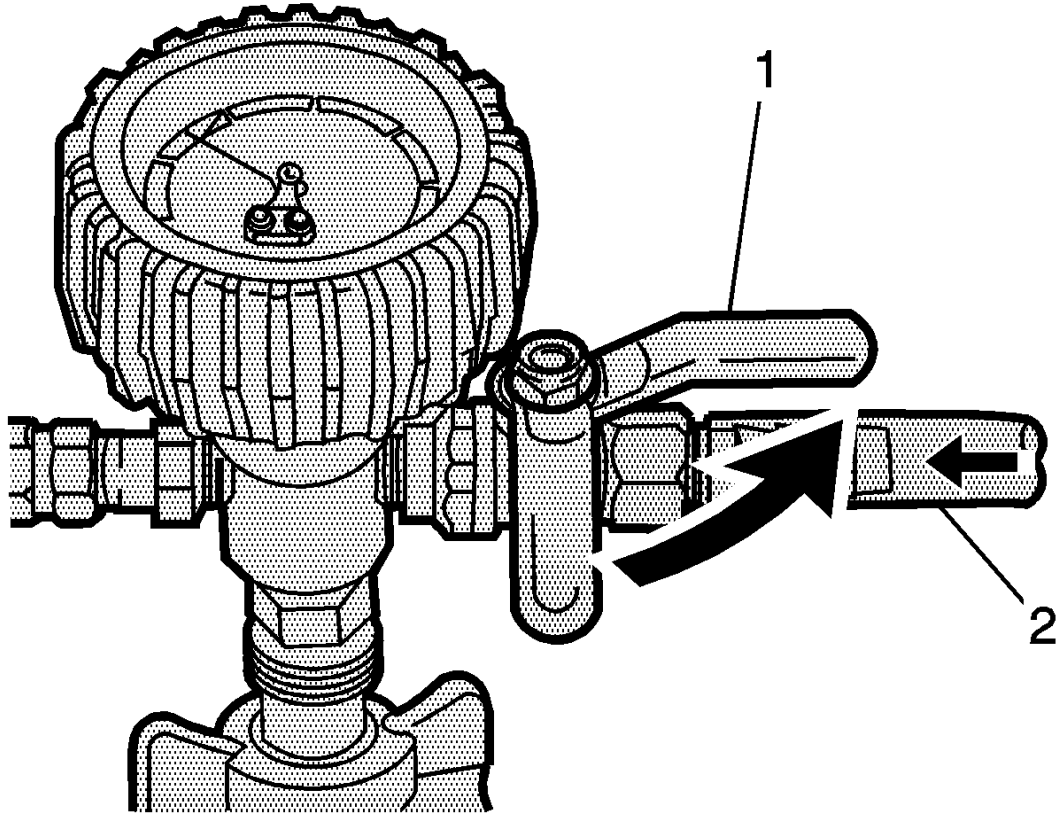


Fig. 18: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

15. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
16. Close the valve on the venturi assembly.
17. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

If vacuum loss is observed, refer to [Hybrid Cooling System Loss of Coolant \(Power Electronics\)](#)[Hybrid Cooling System Loss of Coolant \(Battery\)](#).

18. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

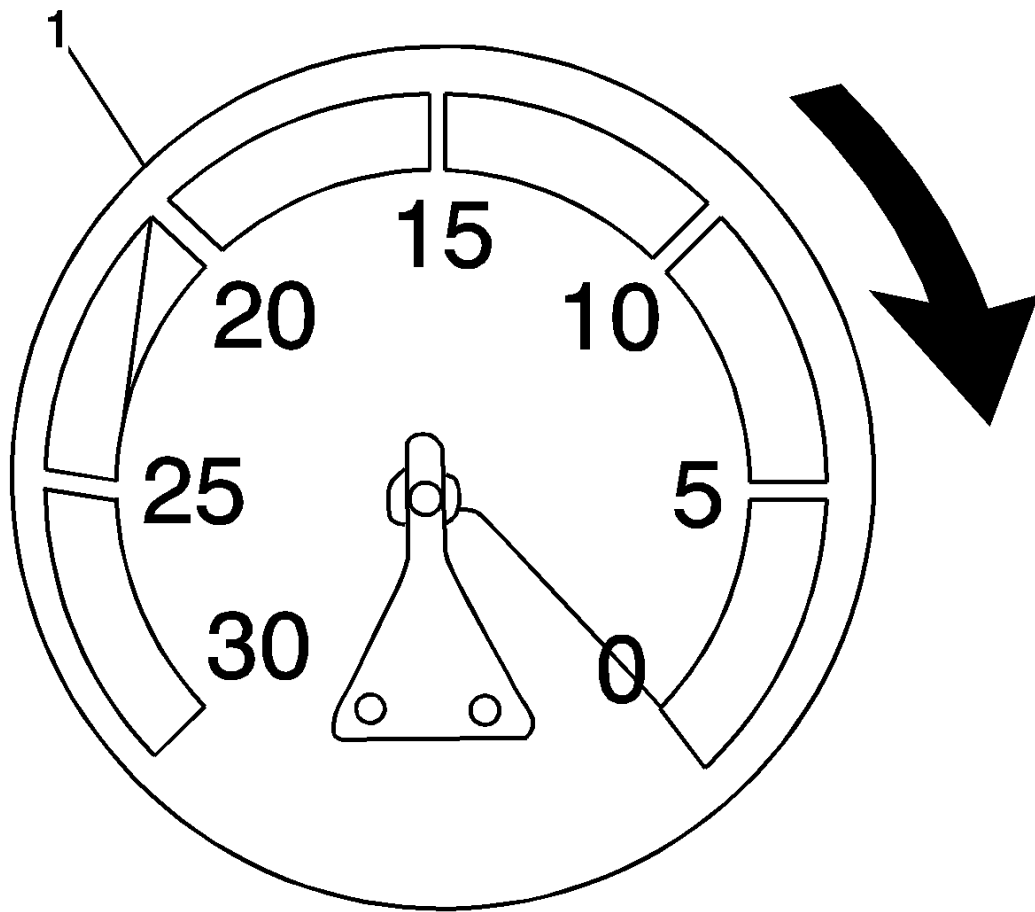


Fig. 19: Vacuum Gauge

Courtesy of GENERAL MOTORS COMPANY

19. Once the vacuum gauge (1) reaches zero, close the valve on the vacuum gauge assembly and repeat steps 12 - 18.
20. Place vehicle in Service Mode. With the GDS scan tool, activate the hybrid/EV battery pack coolant pump for 5 minutes while maintaining 381 mm (15 in Hg) vacuum throughout the process. The pump can be activated by navigating to the following location:
 1. Module Diagnostics
 2. Hybrid Powertrain Control Module 2
 3. Control Functions
 4. Hybrid/EV Battery Pack Coolant Pump
 5. Command Pump to 80%
21. Detach the Vac-N-Fill cap from the **GE-46143** adapter.
22. Remove **GE-46143** adapter from the surge tank fill neck.

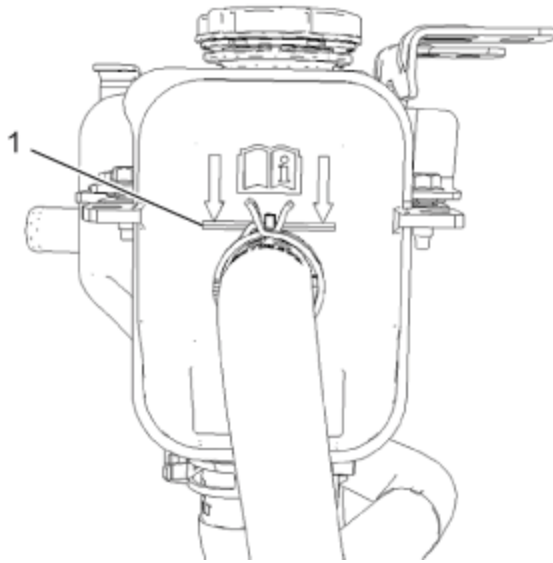


Fig. 20: Surge Tank

Courtesy of GENERAL MOTORS COMPANY

23. Upon completion of the hybrid/EV battery pack coolant pump activation, adjust the surge tank coolant level to the FULL COLD line on the side of the surge tank (1).
24. Inspect the concentration of the coolant mixture using **GE-26568** tester.

REMOVING EXCESS COOLANT FROM SYSTEM

NOTE: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

1. Detach the vacuum hose from the vacuum gauge assembly.

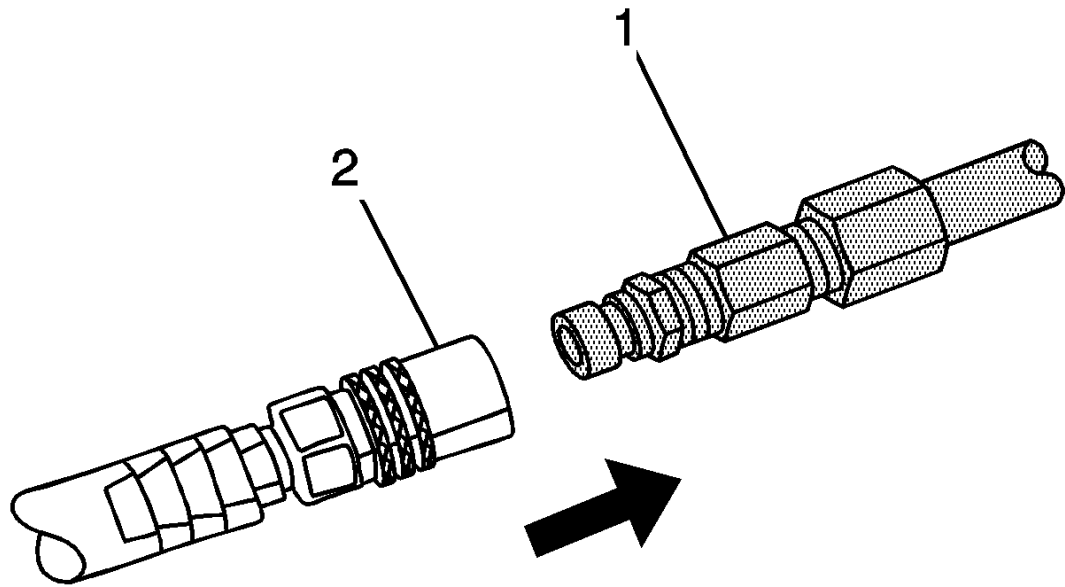


Fig. 21: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

2. Attach the extraction hose (1) to the vacuum hose (2).

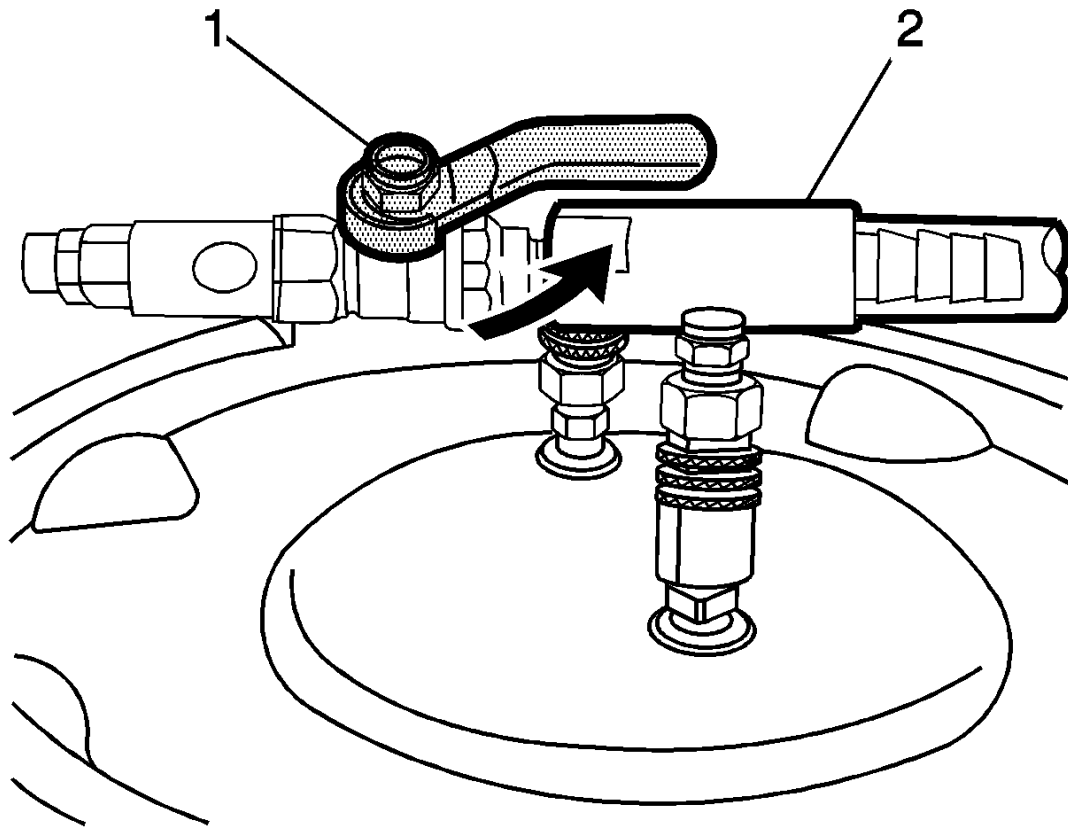


Fig. 22: Venturi Assembly & Valve

Courtesy of GENERAL MOTORS COMPANY

3. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

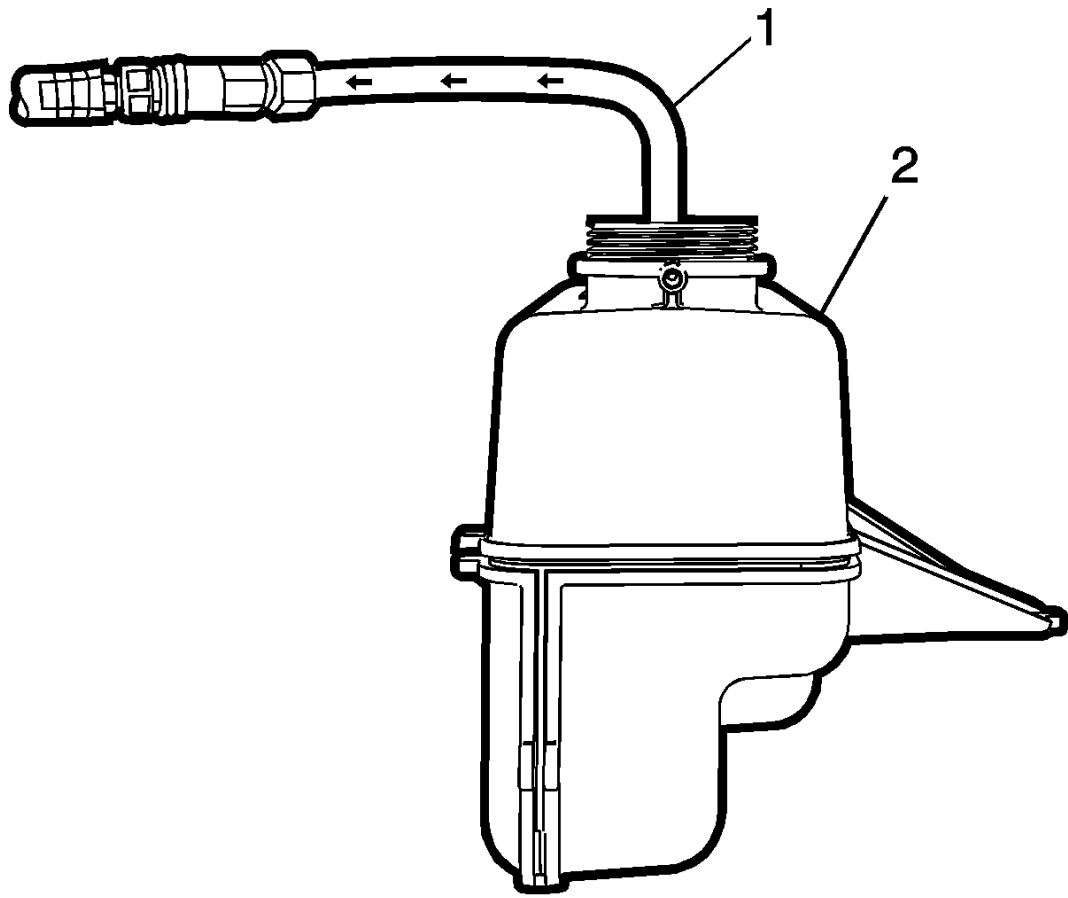


Fig. 23: Extraction Hose And Surge Tank
Courtesy of GENERAL MOTORS COMPANY

4. Assemble the extraction hose (1) and insert into the surge tank (2).

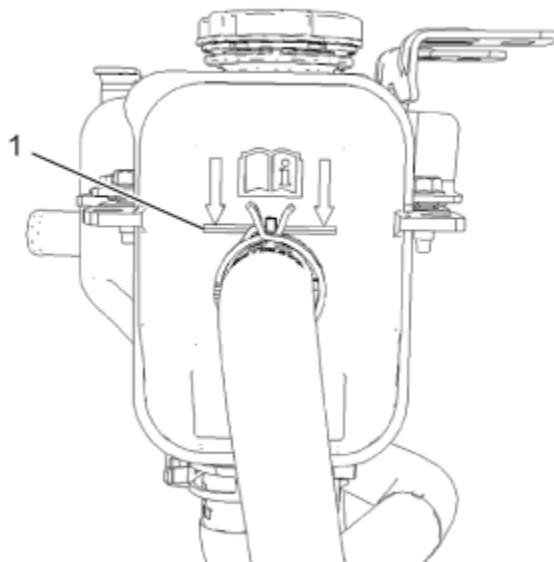


Fig. 24: Surge Tank

Courtesy of GENERAL MOTORS COMPANY

5. Adjust the surge tank coolant level to the FULL COLD line on the side of the surge tank (1).
6. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

PURGING & REMOVAL OF COOLANT FROM BATTERY

NOTE: Prior to performing high-voltage battery internal service, it is necessary to purge any residual coolant inside the battery that is left over from the cooling system draining procedure. Similarly, coolant must be removed from the battery prior to return shipping. This procedure must also be used when purging complete system of contaminated coolant.

NOTE: This procedure can be performed in vehicle, or with battery removed from vehicle.

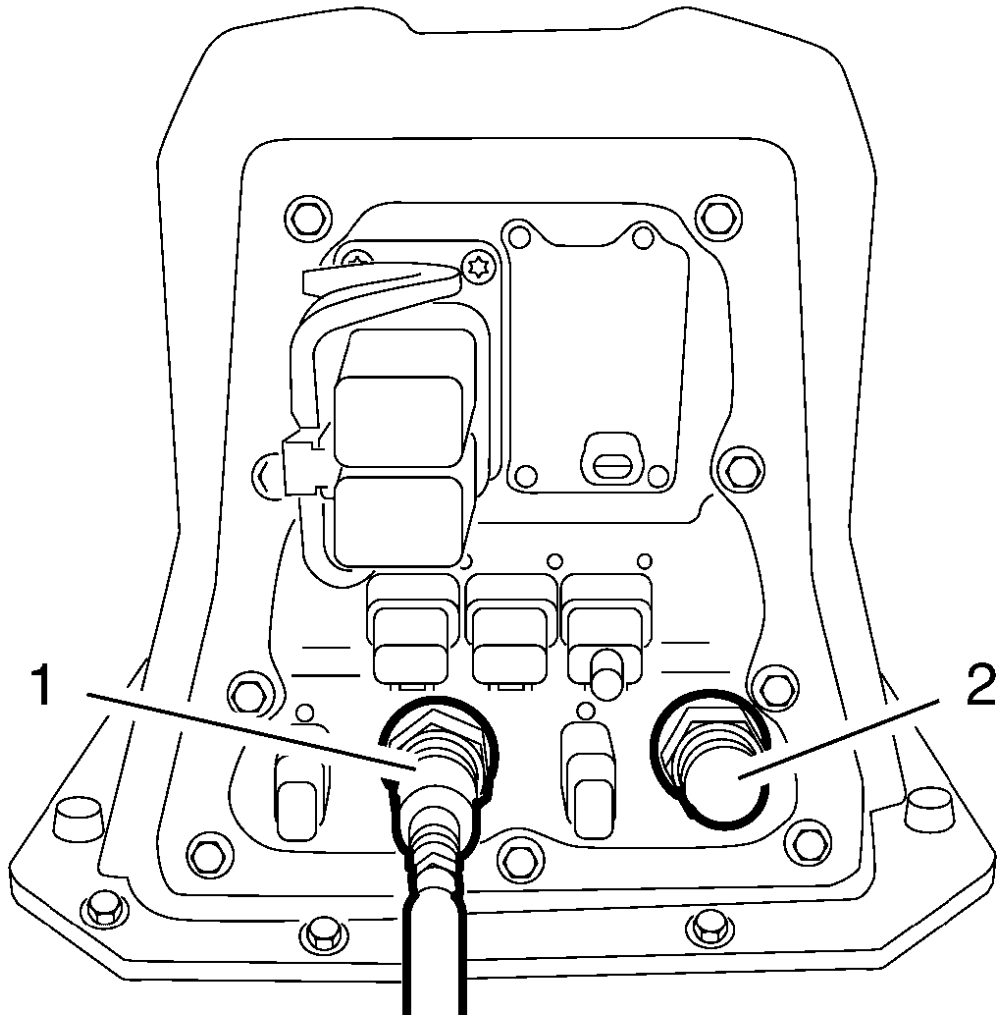


Fig. 25: Plugs From Battery Leak Test Kits

Courtesy of GENERAL MOTORS COMPANY

1. Install necessary plugs from **EL-50812** & **EL-51753** Battery Leak Test Kits (1, 2).
2. Install **GE-50385** Battery Pack Coolant Adapters to the battery coolant ports.
3. Connect the **GE-47716** Vac N Fill vacuum hose to the **GE-50385** adapter with thru-port.

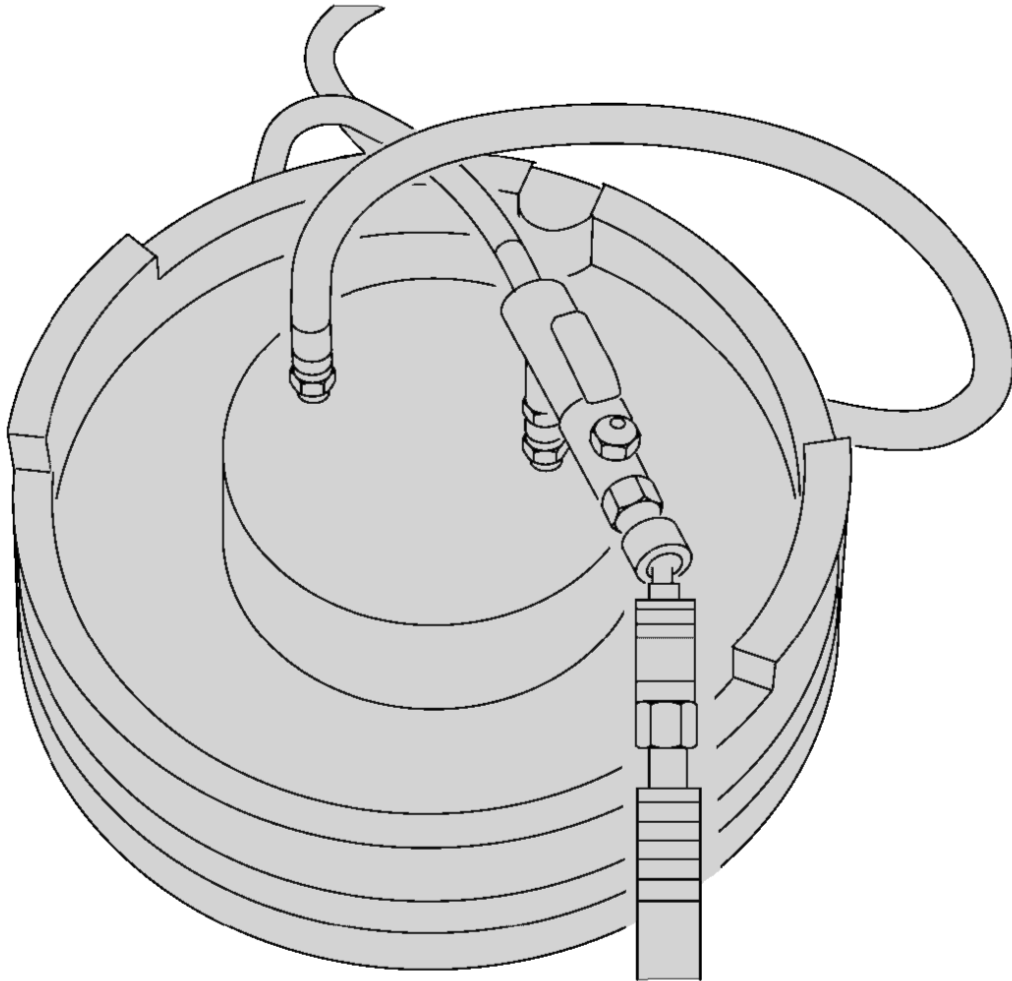


Fig. 26: Connect Other End Of Vacuum Hose to Vac N Fill Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

4. Connect other end of vacuum hose to the Vac N Fill vacuum tank.
5. Install the venturi assembly to the vacuum tank with valve closed.
6. Attached regulated shop air supply hose to venturi assembly.
7. Open valve on venturi assembly to apply vacuum to high-voltage battery internal coolant loop.
8. Build vacuum for at least one minute.

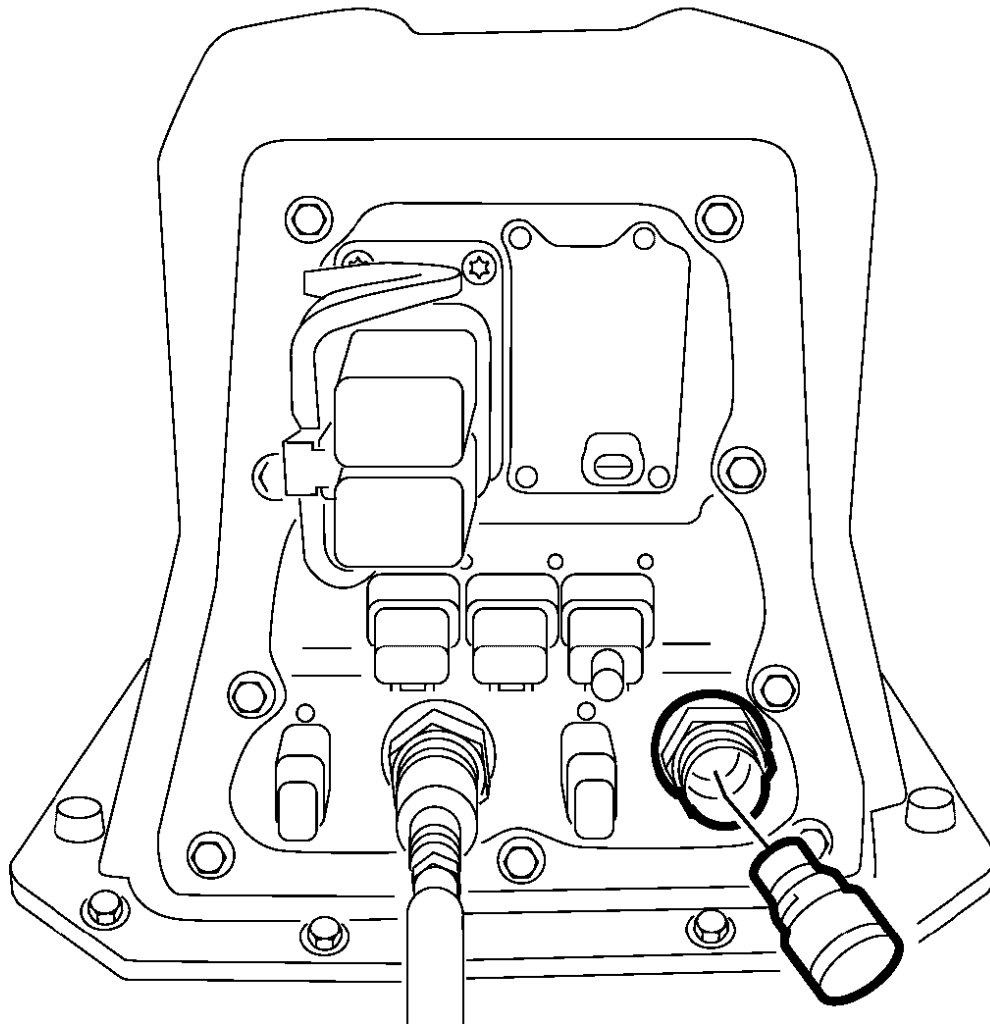


Fig. 27: GE-50385 Plug to Break Vacuum And Purge Battery Of Coolant
Courtesy of GENERAL MOTORS COMPANY

9. Temporarily remove **GE-50385** plug to break vacuum and purge battery of coolant.
10. Install plug to build vacuum again.
11. Repeat step 7-9 several times until no more coolant can be extracted.

DRIVE MOTOR GENERATOR POWER INVERTER MODULE COOLING SYSTEM DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **BO-38185** Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

WARNING: Before conducting any repair to this high voltage cooling system, it is

necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

Draining Procedure

1. Turn Vehicle Power Off and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

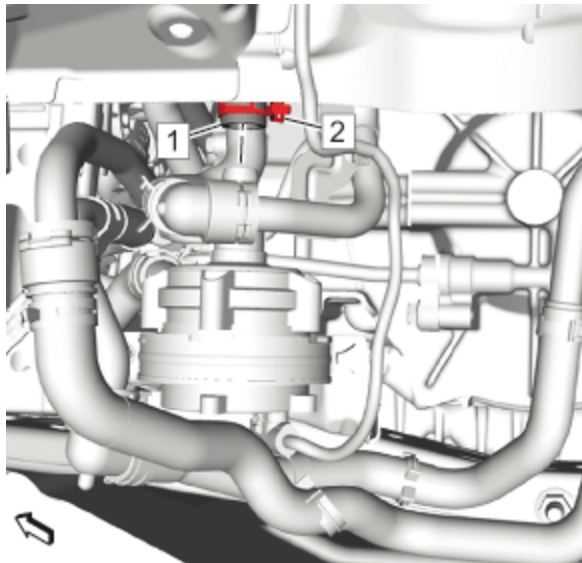


Fig. 28: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (2) **BO-38185** pliers
5. Remove Coolant Hose (1)
6. Lower the vehicle.

Vac-N-Fill Procedure

1. Turn Vehicle Power Off and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

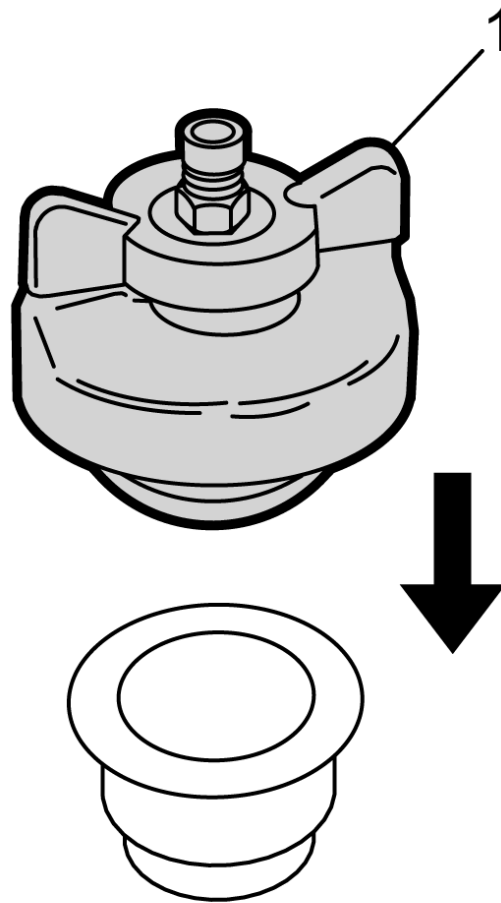


Fig. 29: Radiator Cap & Surge Tank Test Adapter
Courtesy of GENERAL MOTORS COMPANY

NOTE: To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

2. Install **GE-46143** cooling system adapter
3. Attach the Vac-N-Fill cap (1) to **GE-46143** cooling system adapter.

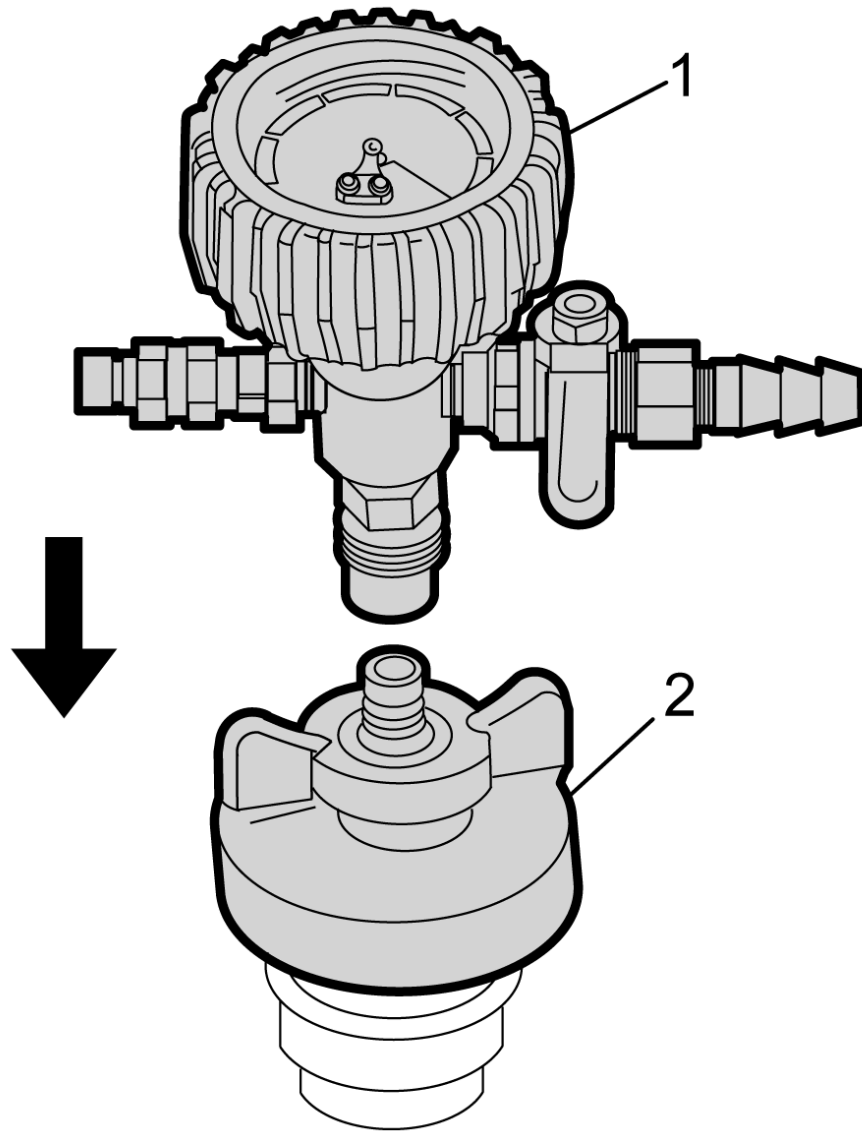


Fig. 30: Vacuum Gauge Assembly & Vac N Fill Cap
Courtesy of GENERAL MOTORS COMPANY

4. Attach the vacuum gauge assembly (1) to the Vac-N-Fill cap (2).

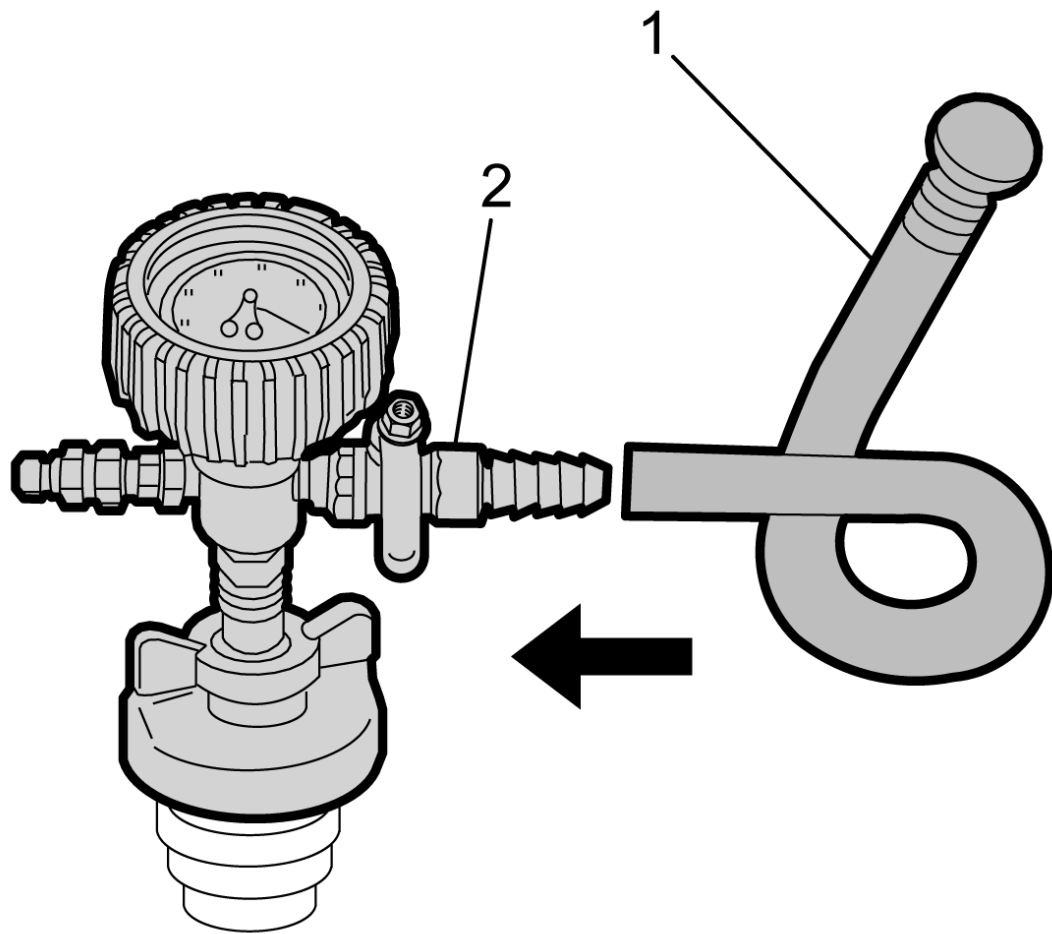


Fig. 31: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

5. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly (2).

Ensure that the valve is closed.

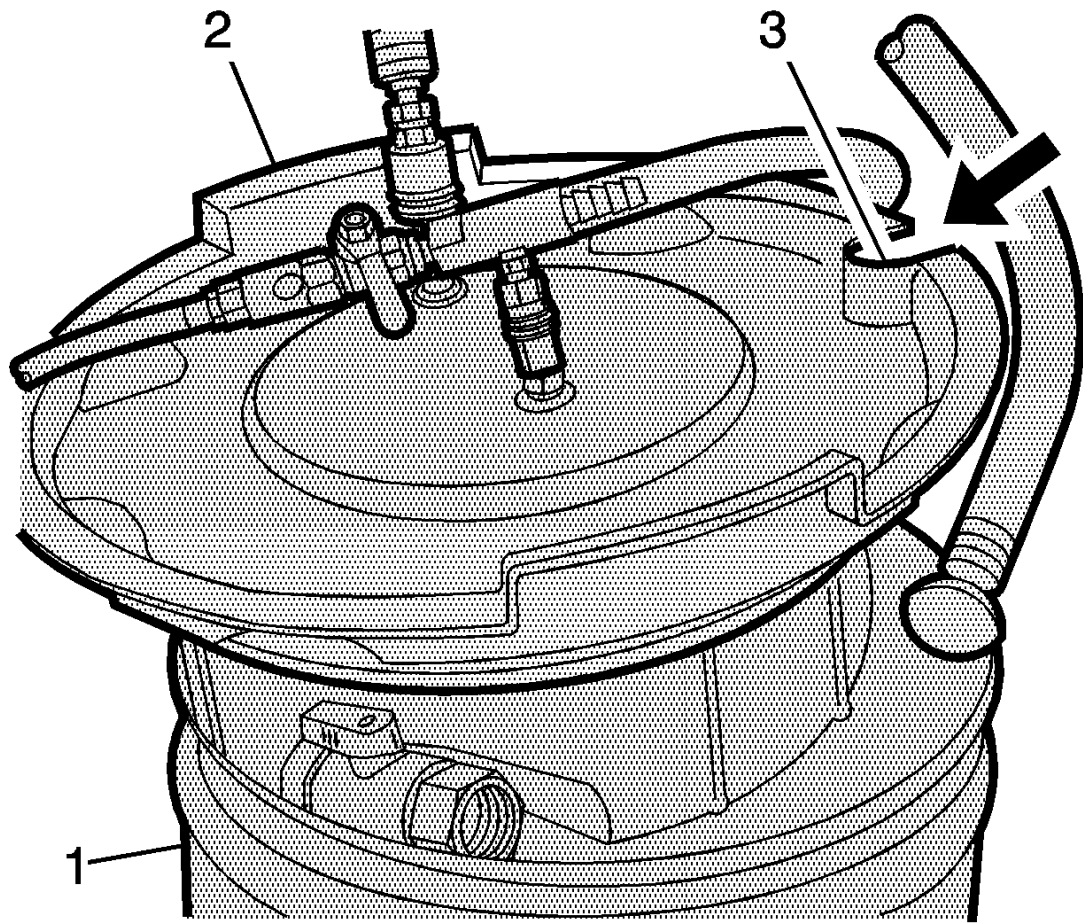


Fig. 32: Graduated Reservoir, Vacuum Tank & Cut-Out Area

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a Pre-mixed DEXCOOLÂ® (50/50 mixture of DEXCOOLÂ® and deionized water). Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

6. Pour the coolant mixture into the graduated reservoir (1).

7. Place the fill hose in the graduated reservoir (1).

NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

8. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

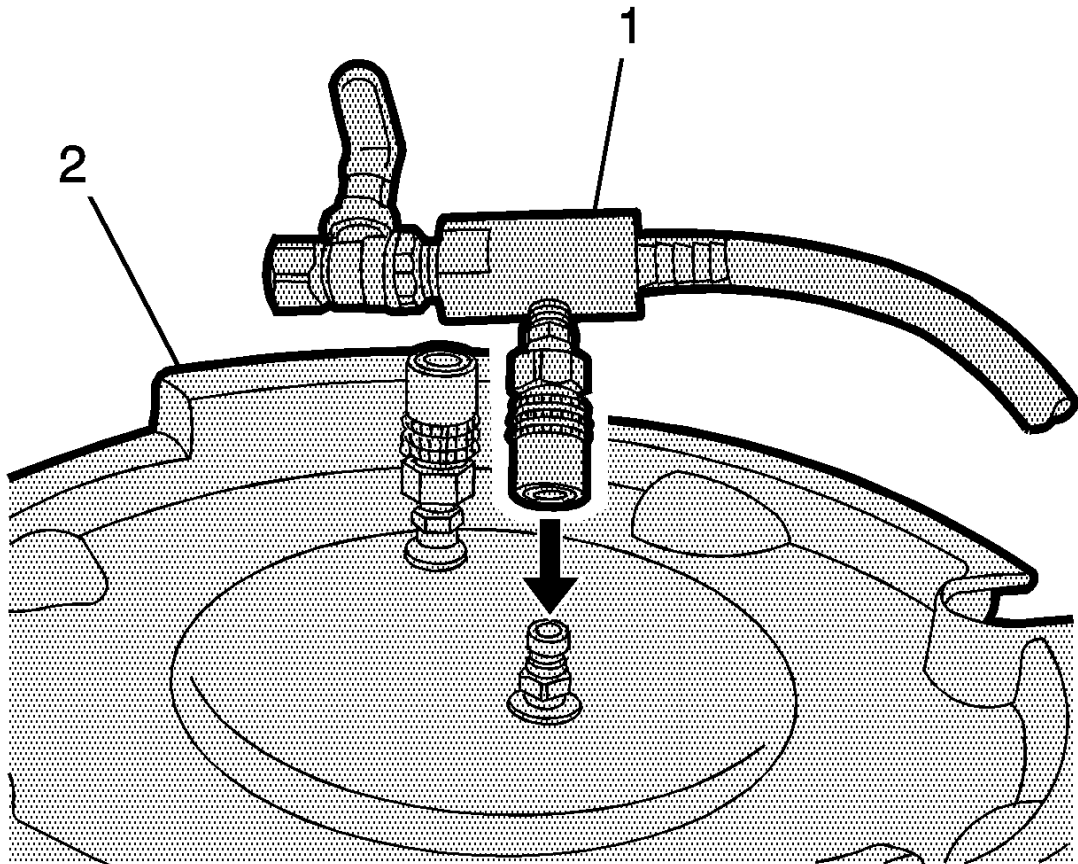


Fig. 33: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly (1) to the vacuum tank (2).

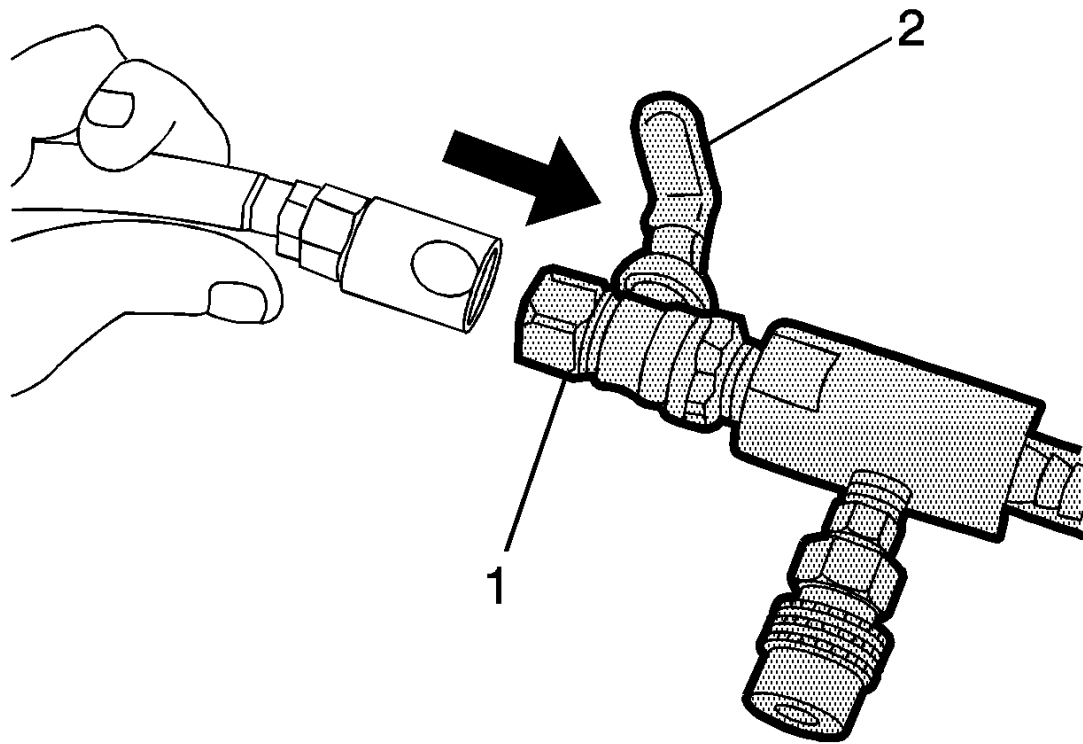


Fig. 34: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

10. Attach a shop air hose to the venturi assembly (1).

Ensure the valve (2) on the venturi assembly is closed.

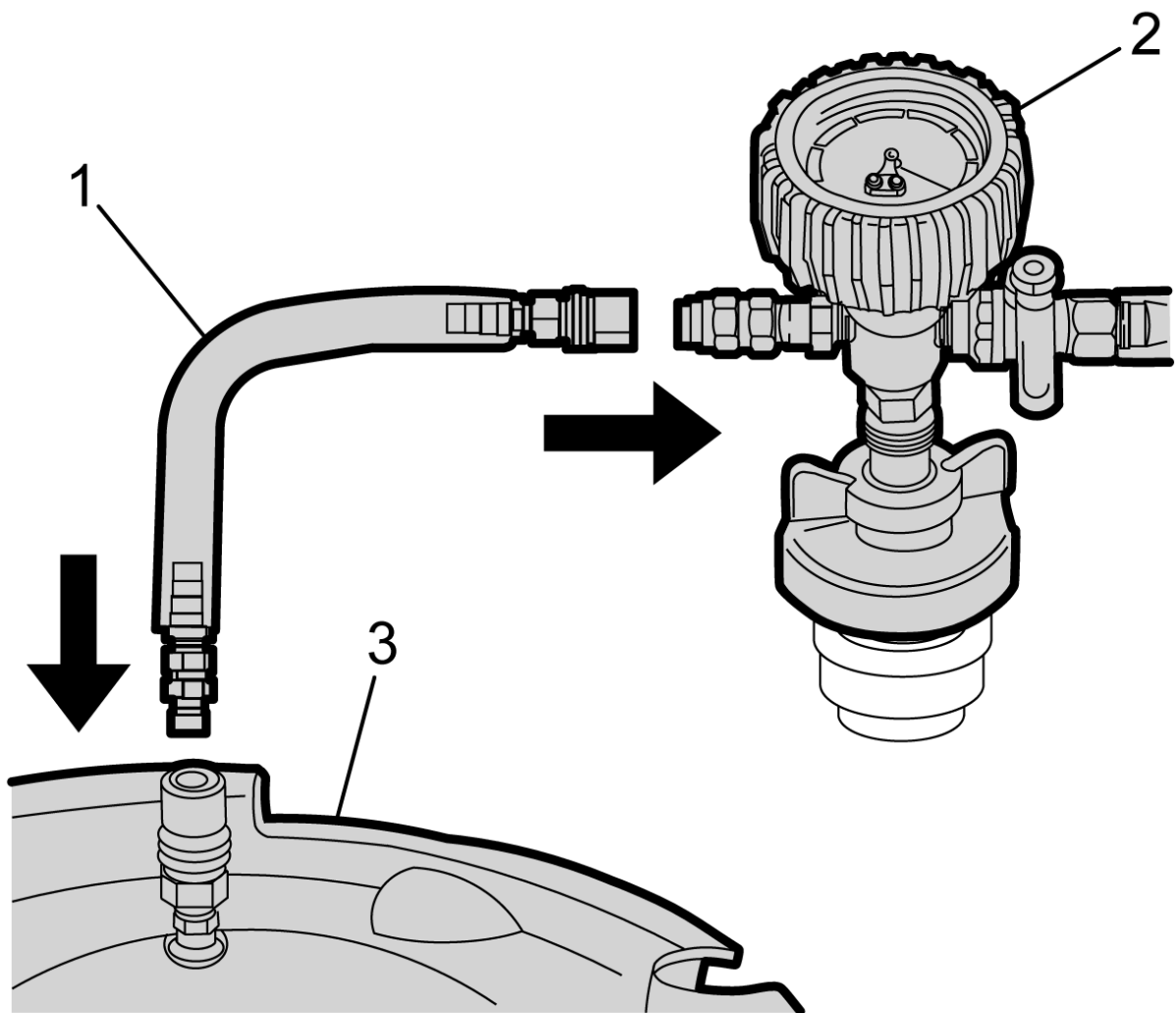


Fig. 35: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

11. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

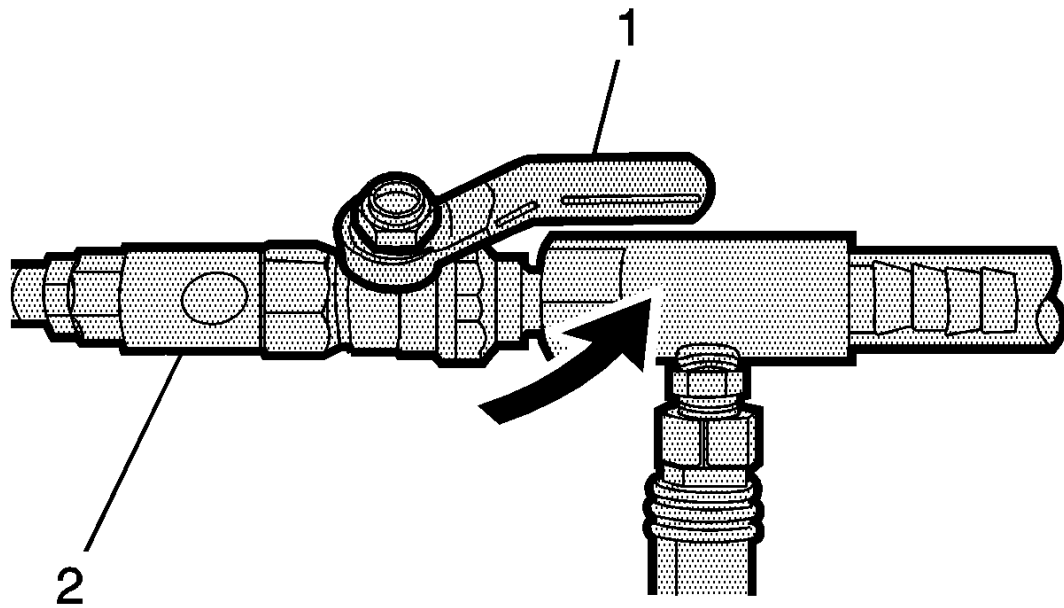


Fig. 36: Valve & Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

12. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

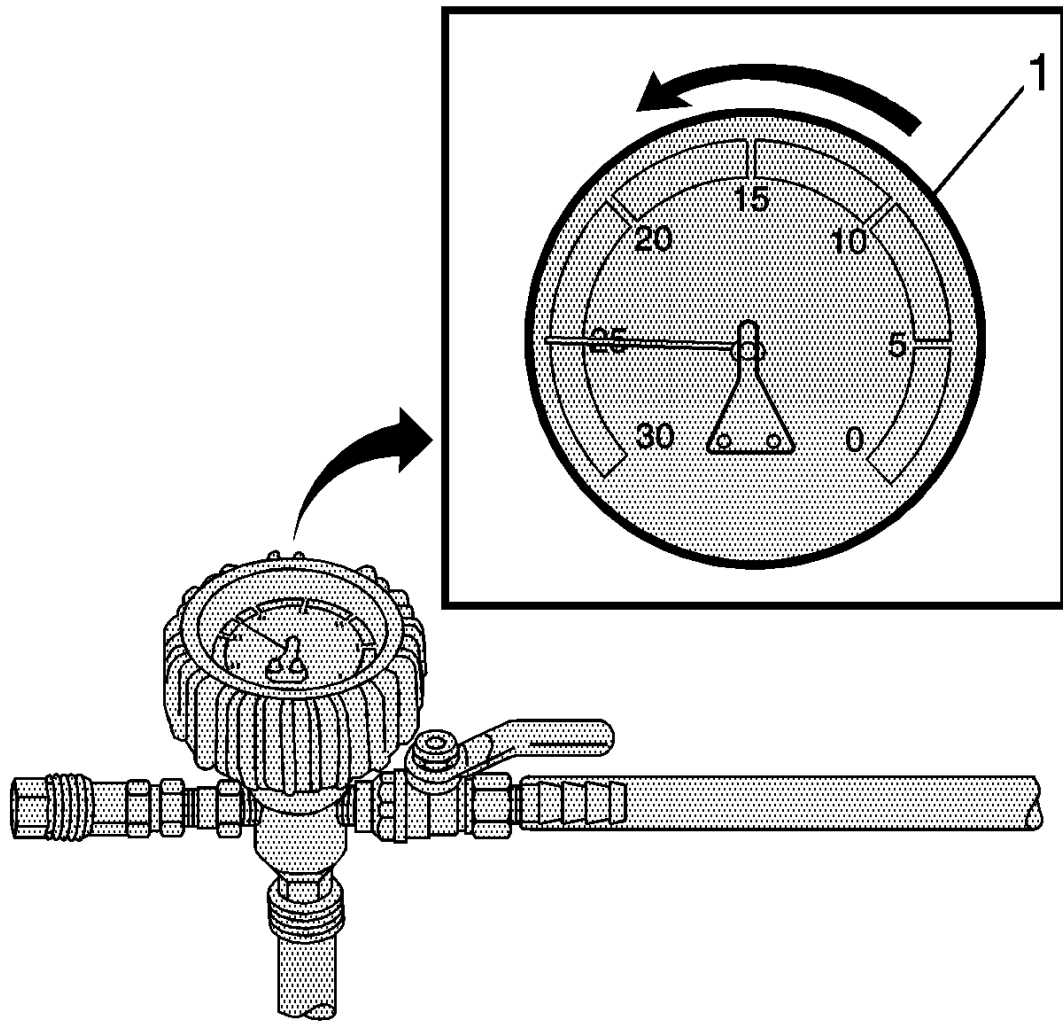


Fig. 37: Vacuum Gauge Needle

Courtesy of GENERAL MOTORS COMPANY

13. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).

Cooling hoses may start to collapse. This is normal due to vacuum draw.

14. To aid in the fill process, position the graduated reservoir above the coolant fill port.

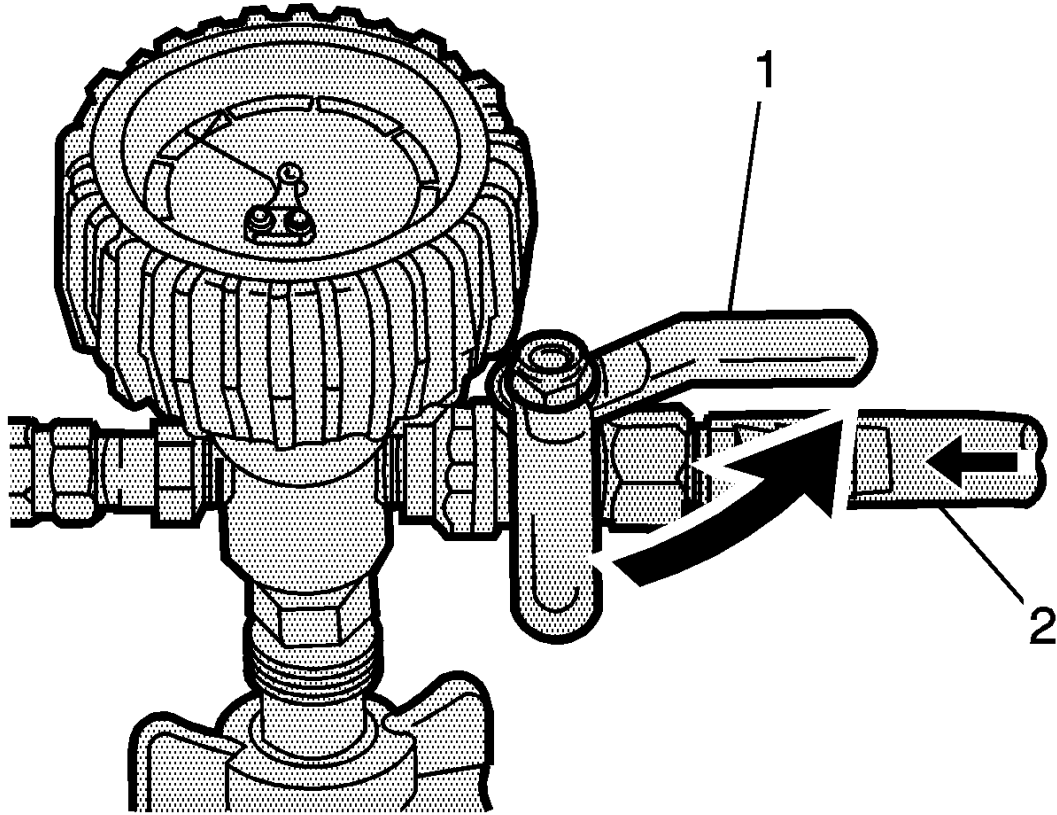


Fig. 38: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

15. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
16. Close the valve on the venturi assembly.
17. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

If vacuum loss is observed, refer to [Loss of Coolant](#) .

18. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

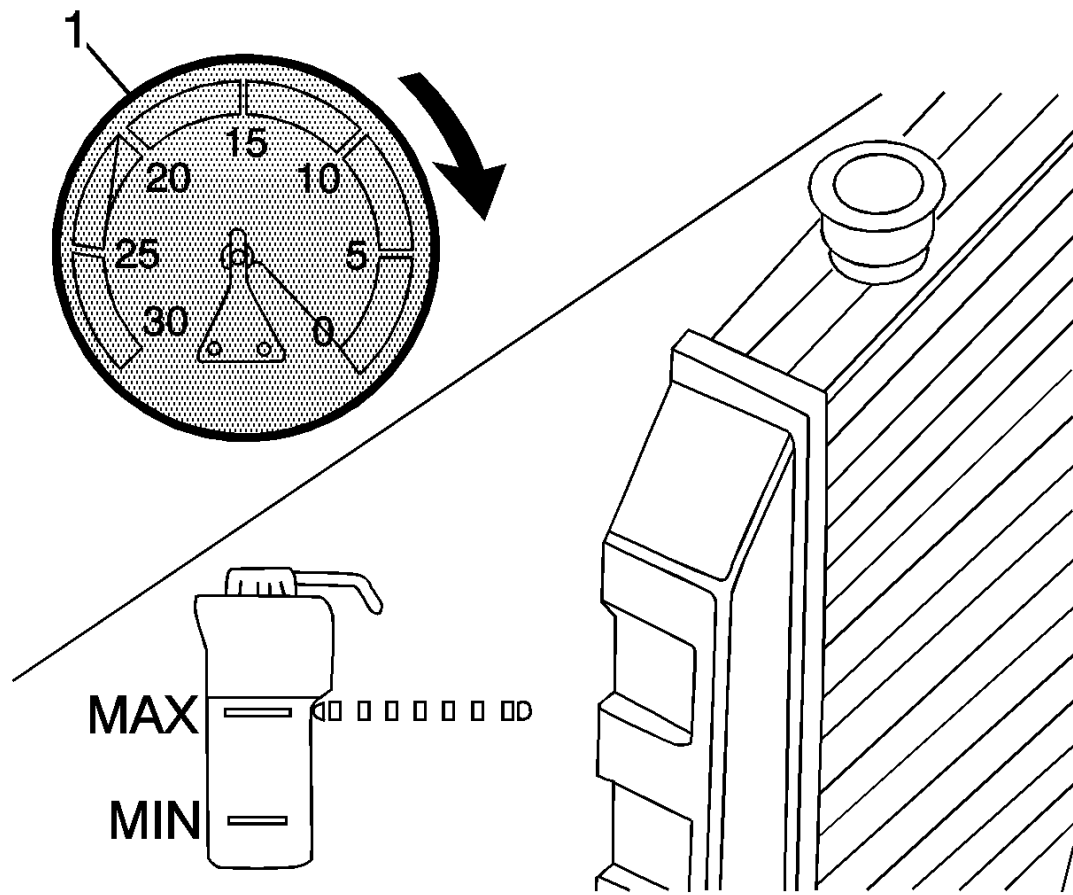


Fig. 39: Vacuum Gauge At Zero

Courtesy of GENERAL MOTORS COMPANY

19. Once the vacuum gauge reaches zero (1), close the valve on the vacuum gauge assembly and repeat steps 12 - 18.
20. Detach the Vac-N-Fill cap from the **GE-46143** adapter.
21. Remove **GE-46143** adapter from the surge tank fill neck.
22. Add coolant to the system as necessary.
23. Inspect the concentration of the coolant mixture using **GE-26568** tester.

NOTE: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

24. Detach the vacuum hose from the vacuum gauge assembly.

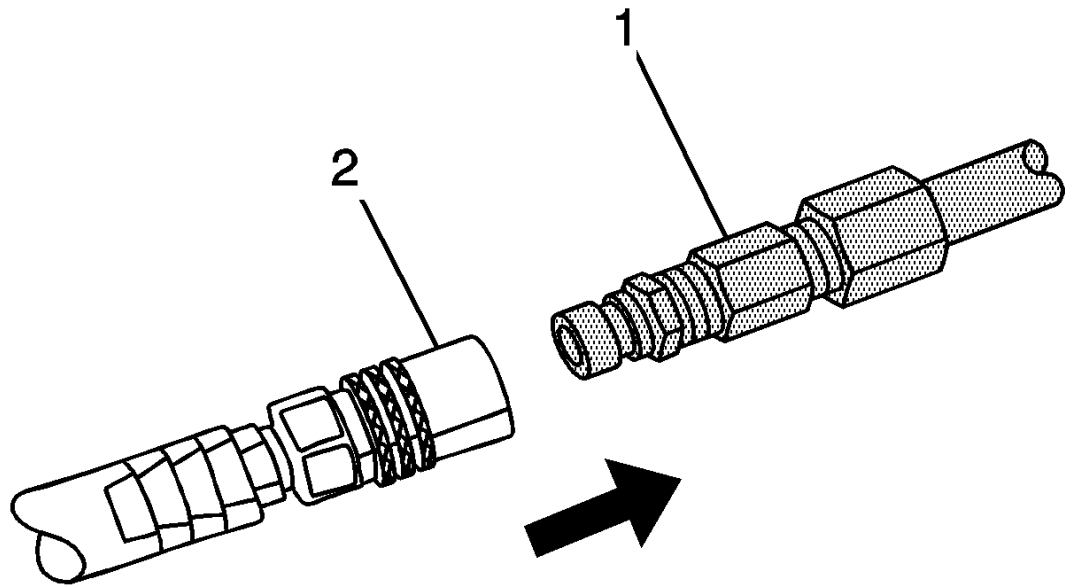


Fig. 40: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

25. Attach the extraction hose (1) to the vacuum hose (2).

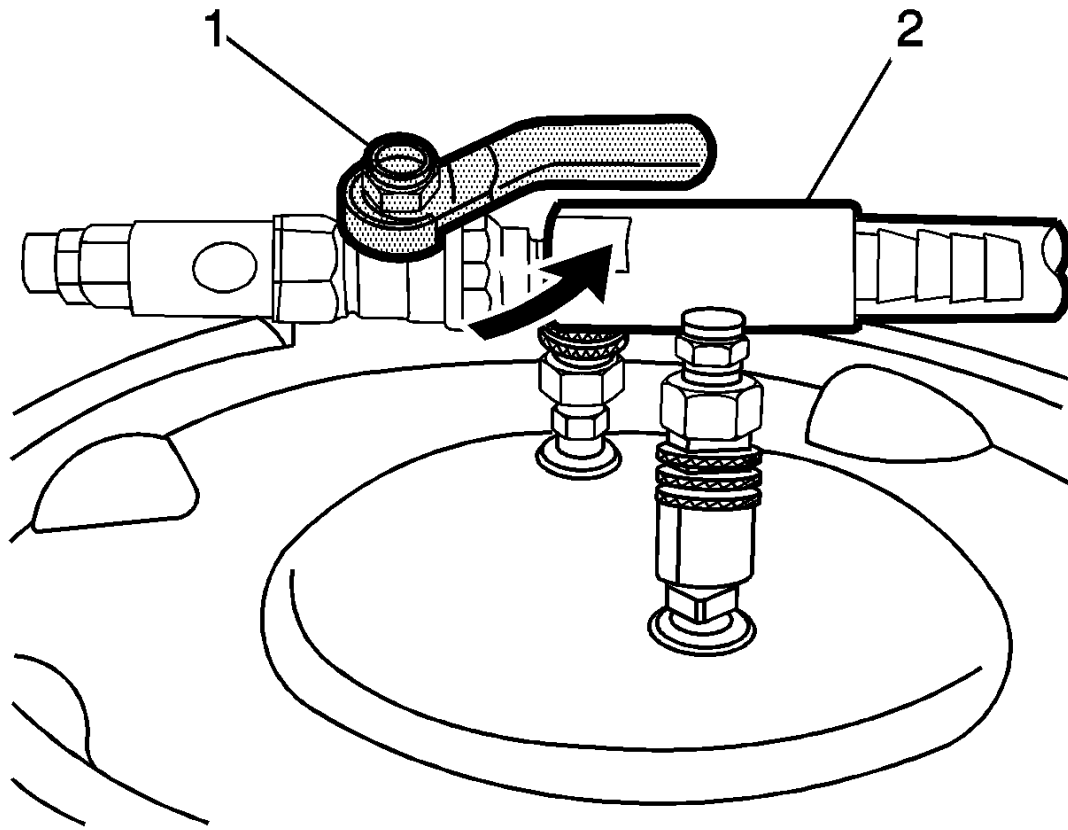


Fig. 41: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

26. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

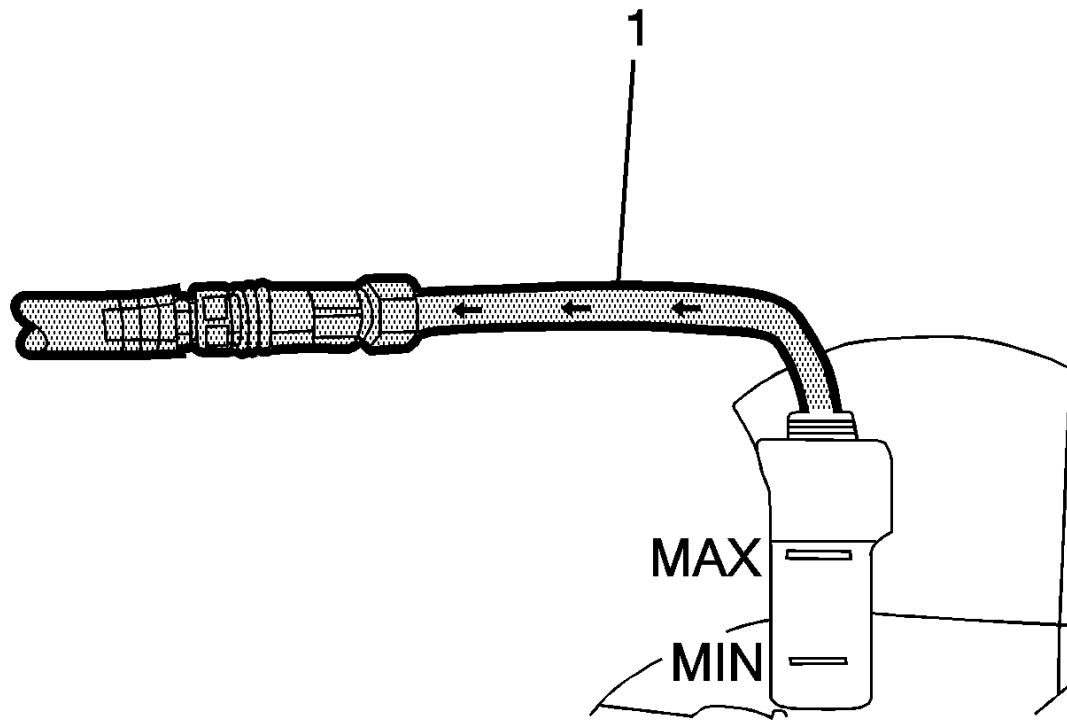


Fig. 42: Coolant Extraction Hose

Courtesy of GENERAL MOTORS COMPANY

27. Use the extraction hose (1) to draw out coolant to the proper level.
28. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

COOLANT TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining**

and Filling

3. Remove [Front Bumper Fascia Center Support Replacement](#)
4. Remove [Pedestrian Sound Alert Speaker Replacement](#)

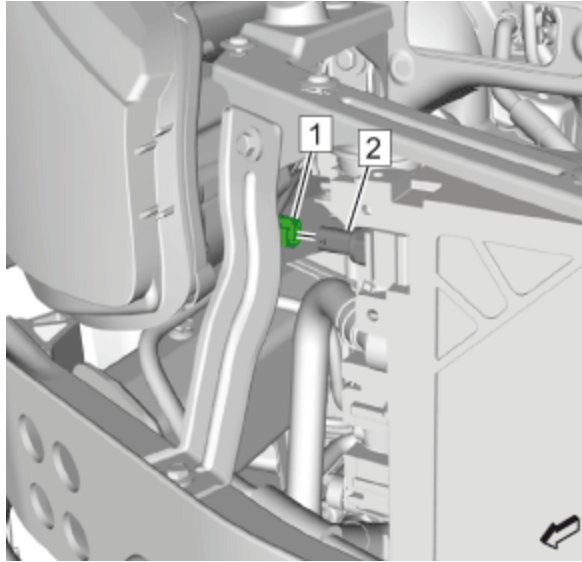


Fig. 43: Electrical Connector And Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1).
6. Remove the coolant temperature sensor (2).

Installation Procedure

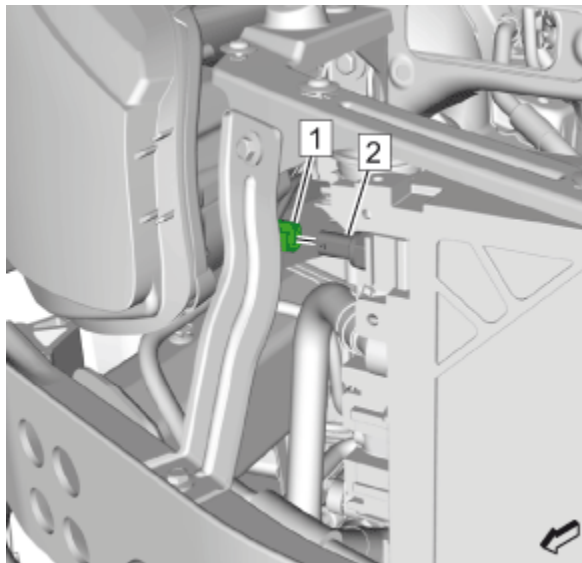


Fig. 44: Electrical Connector And Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

1. Install the coolant temperature sensor (2) and tighten to 33 N.m (24 lb ft).
2. Connect Electrical Connector (1)

3. Install [Front Bumper Fascia Center Support Replacement](#)
4. Install [Pedestrian Sound Alert Speaker Replacement](#)
5. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove [High Voltage Battery Cover Replacement](#)
2. Remove [High Voltage Battery Disconnect Relay Replacement](#)

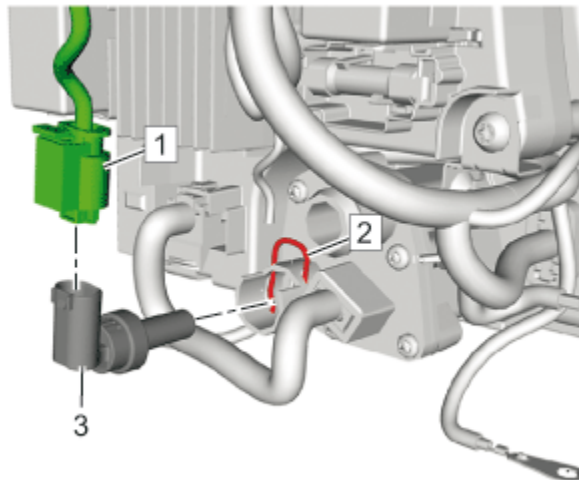


Fig. 45: Electrical Connector And Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector(1).
4. Loosen Clamp(2).

5. Remove Engine Coolant Temperature Sensor(3).

Installation Procedure

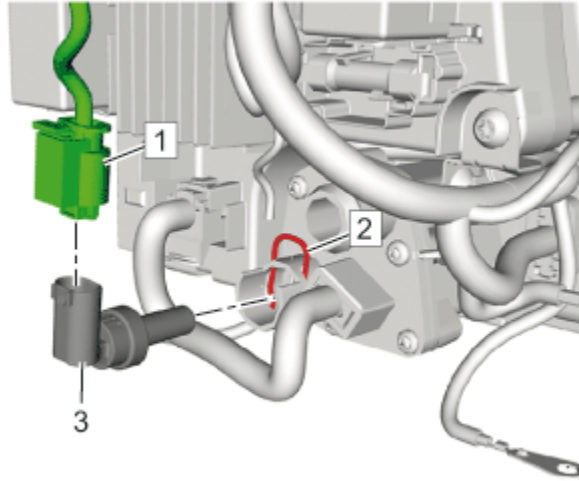


Fig. 46: Electrical Connector And Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Coolant Temperature Sensor(3).
2. Install Clamp(2).
3. Connect Electrical Connector(1).
4. Install [High Voltage Battery Disconnect Relay Replacement](#)
5. Install [High Voltage Battery Cover Replacement](#)

DRIVE MOTOR CONTROL MODULE RADIATOR INLET HOSE REPLACEMENT

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement](#)

(Right Side)

5. Remove Headlamp Replacement

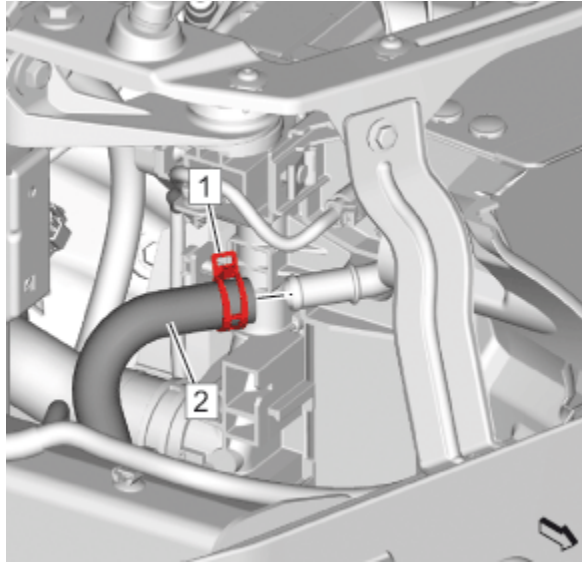


Fig. 47: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

6. Disengage Clamp(1) Hose Clamp Replacement Guidelines - Spring Type

7. Remove Coolant Hose(2)

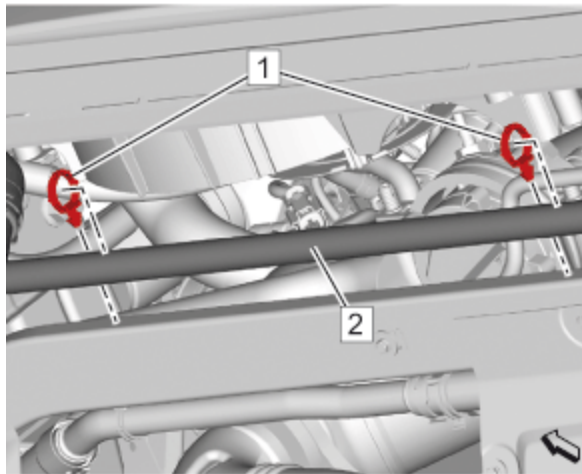


Fig. 48: Coolant Hose And Clip

Courtesy of GENERAL MOTORS COMPANY

8. Remove Coolant Hose(2).

9. Remove Clip(1).

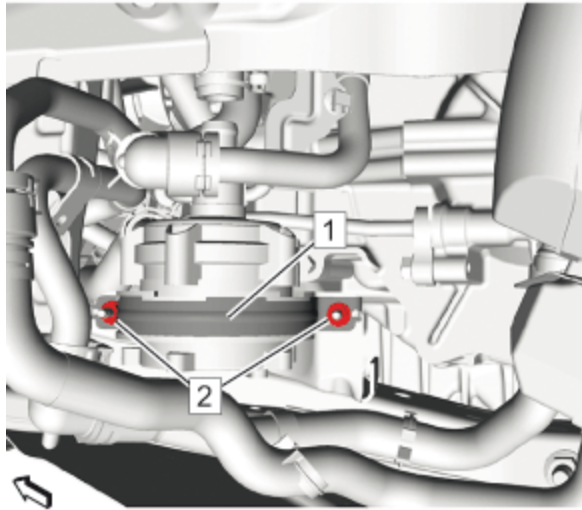


Fig. 49: Generator Control Module Coolant Pump Bracket And Nuts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the position of the pump and the bracket.

10. Remove the 2 generator control module coolant pump bracket nuts (2).
11. Remove the generator control module coolant pump bracket (1).

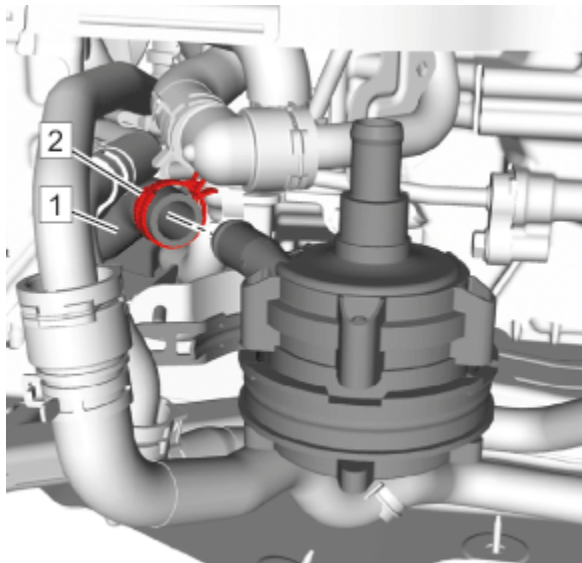


Fig. 50: Clamp And Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

12. Disengage Clamp(2) [Hose Clamp Replacement Guidelines - Spring Type](#)
13. Remove Coolant Hose(1)
14. Remove the drive motor control module radiator inlet hose from the vehicle.

Installation Procedure

1. Install the drive motor control module radiator inlet hose to the vehicle.

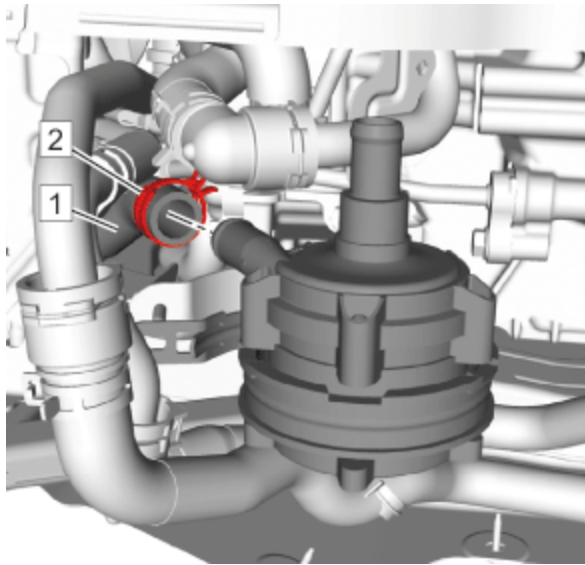


Fig. 51: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

2. Install Coolant Hose(1)
3. Engage Clamp(2) [Hose Clamp Replacement Guidelines - Spring Type](#)

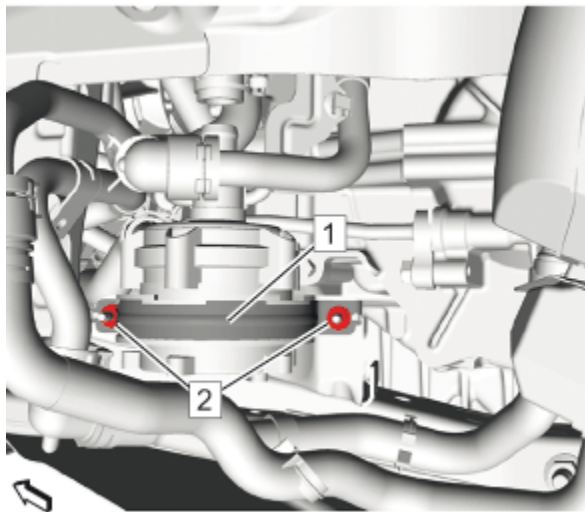


Fig. 52: Generator Control Module Coolant Pump Bracket And Nuts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Check the pump and the bracket for the correct original position.

4. Install the generator control module coolant pump bracket (1).

CAUTION: [Fastener Caution](#)

5. Install the 2 generator control module coolant pump bracket nuts (2) and tighten to 9 N.m (80 lb in).

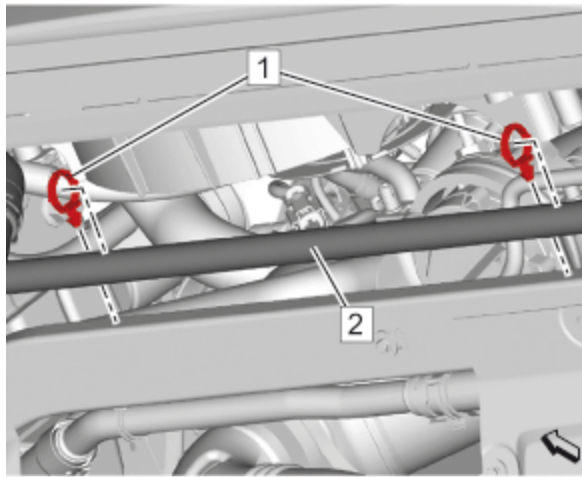


Fig. 53: Coolant Hose And Clip

Courtesy of GENERAL MOTORS COMPANY

6. Install Clip (1)
7. Install Coolant Hose(2)

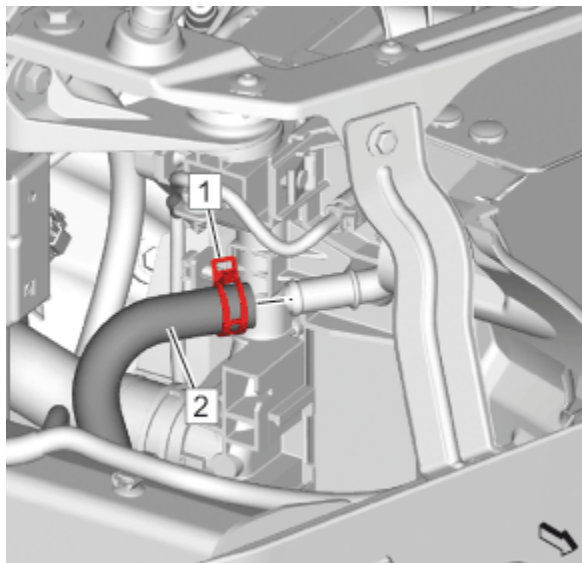


Fig. 54: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

8. Install Coolant Hose(2)
9. Engage Clamp(1) [Hose Clamp Replacement Guidelines - Spring Type](#)
10. Install [Headlamp Replacement](#)
11. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
12. Lower the vehicle.
13. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

DRIVE MOTOR CONTROL MODULE RADIATOR OUTLET HOSE REPLACEMENT

Overview

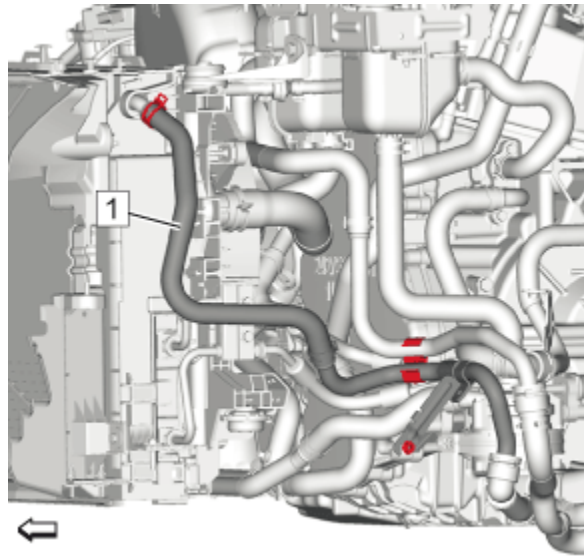


Fig. 55: Drive Motor Control Module Radiator Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor control module radiator outlet hose (1) without the body.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Remove [Headlamp Replacement](#)

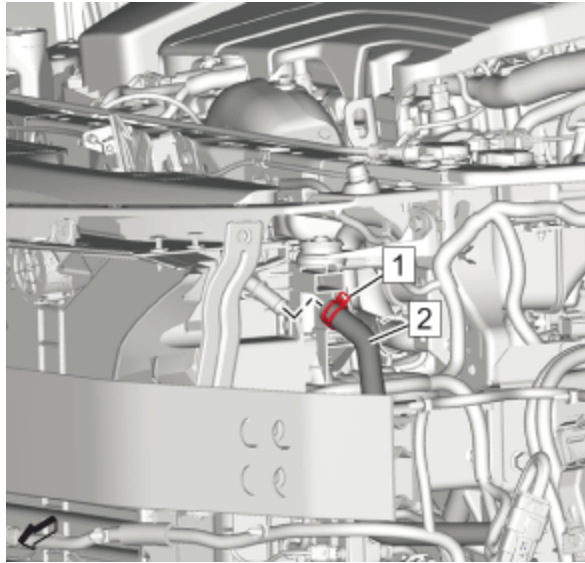


Fig. 56: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp(1). [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Remove Coolant Hose(2).
6. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
7. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

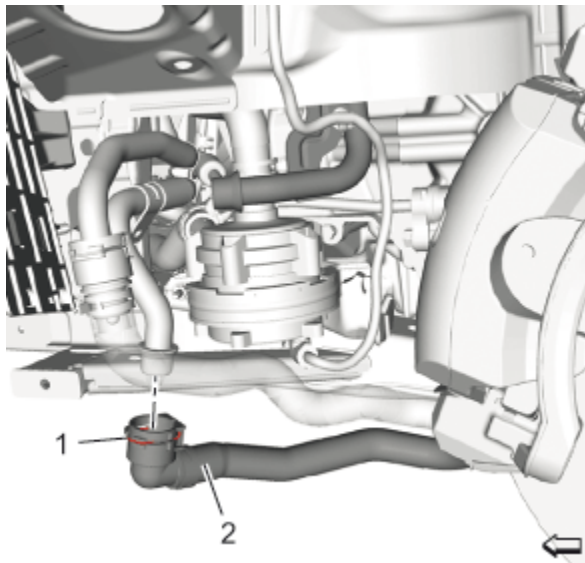


Fig. 57: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Disengage Clamp(1)
9. Remove Coolant Hose(2)

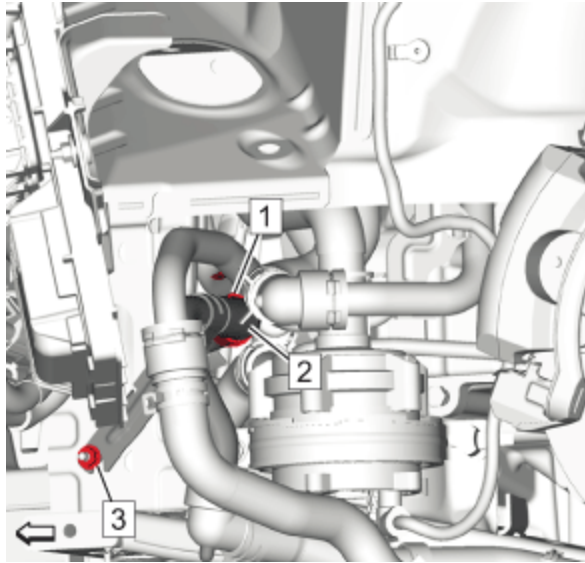


Fig. 58: Drive Motor Control Module Radiator Outlet Hose Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

10. Loosen Drive motor control module radiator outlet hose bracket nut (3)
11. Unclip Retainer(1)
12. Remove the drive motor control module radiator outlet hose (2).

Installation Procedure

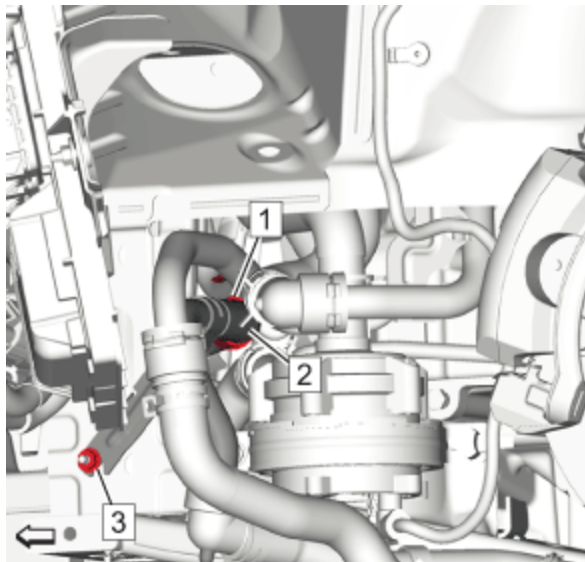


Fig. 59: Drive Motor Control Module Radiator Outlet Hose Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor control module radiator outlet hose (2).
2. Install Retainer (1)

CAUTION: **Fastener Caution**

3. Drive motor control module radiator outlet hose bracket nut (3) - Tighten 9 N.m (80 lb in)

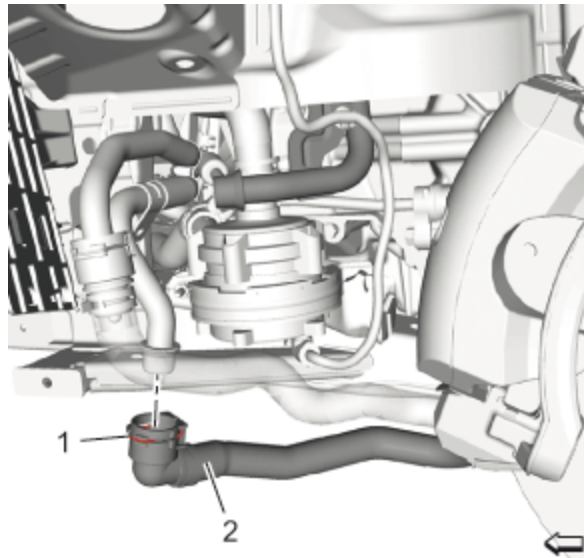


Fig. 60: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Install Coolant Hose (2)
5. Engage Clamp (1)
6. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
7. Lower the vehicle.

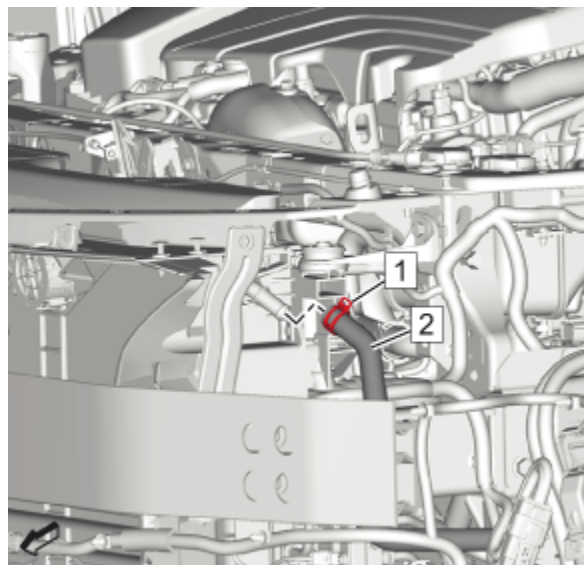


Fig. 61: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Install Coolant Hose (2)
9. Engage Clamp (1)[Hose Clamp Replacement Guidelines - Spring Type](#)
10. Install [Headlamp Replacement](#)
11. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

GENERATOR CONTROL MODULE COOLANT TANK HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Remove [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

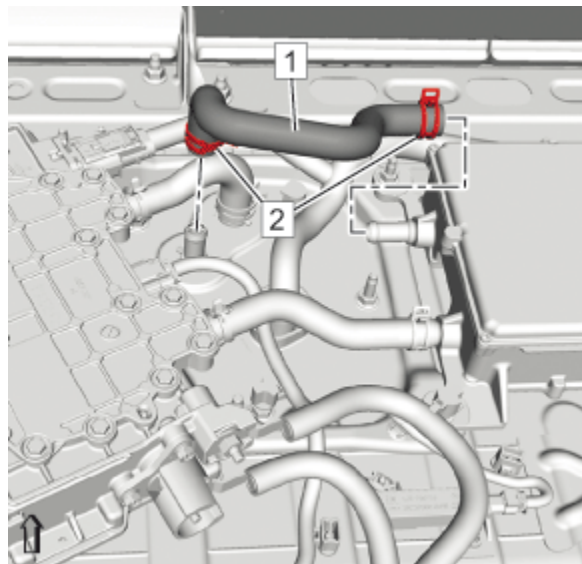


Fig. 62: Clamp And Generator Control Module Coolant Tank Hose
Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (2) **BO-38185** pliers
5. Remove Generator Control Module Coolant Tank Hose (1)

Installation Procedure

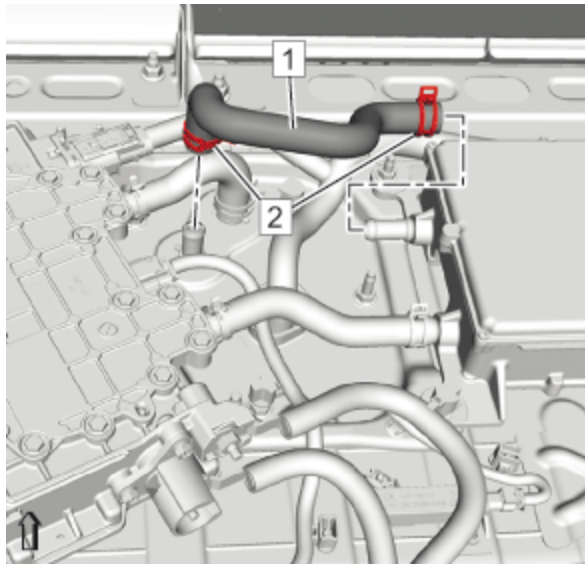


Fig. 63: Clamp And Generator Control Module Coolant Tank Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Control Module Coolant Tank Hose (1).
2. Install Clamp (2) **BO-38185** pliers
3. Install [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
4. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

RADIATOR SURGE TANK REPLACEMENT (DRIVE MOTOR BATTERY RADIATOR SURGE TANK)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

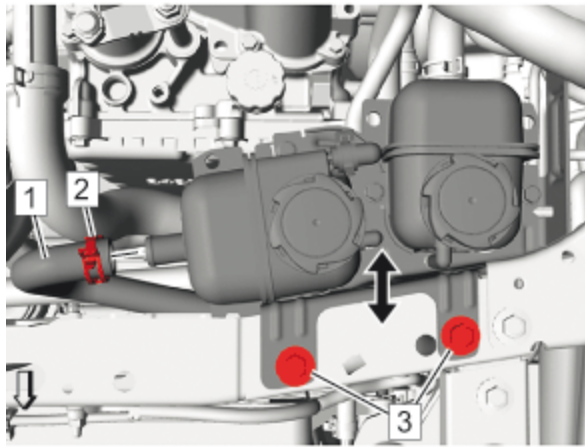


Fig. 64: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

3. Loosen Clamp (2) **BO-38185** pliers
4. Remove Coolant Hose (1)
5. Remove the 2 radiator surge tank bracket bolts (3).

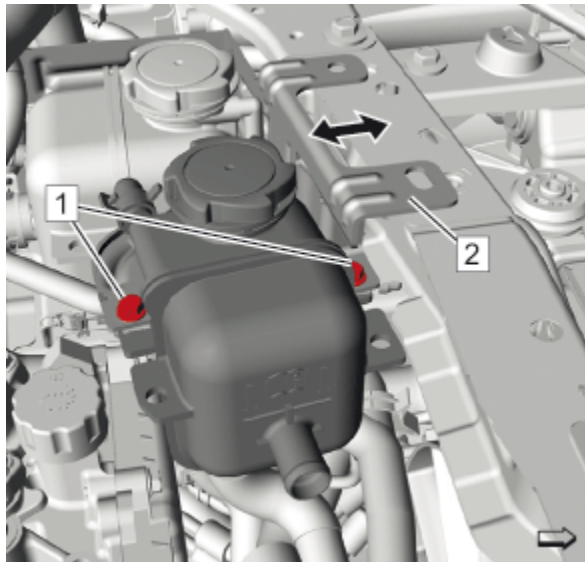


Fig. 65: Radiator Surge Tank Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Move the radiator surge tank bracket (2) in engine direction (arrow) until the front bolt is accessible.
7. Remove Radiator Surge Tank Bolt (1)

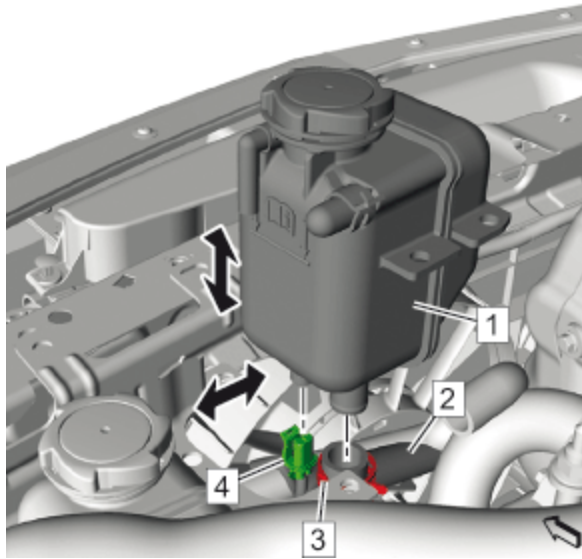


Fig. 66: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

8. Move the radiator surge tank (1) in the right direction (arrow) and in top direction until the lower hose and the electrical connector is accessible.
9. Disconnect Electrical Connector (4)
10. Loosen Clamp (3) **BO-38185** pliers
11. Remove Coolant Hose (2)
12. Remove Radiator Surge Tank (1)

Installation Procedure

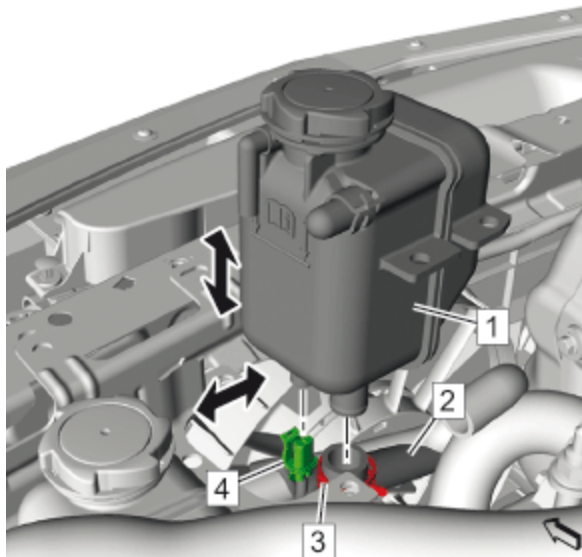


Fig. 67: Radiator Surge Tank

Courtesy of GENERAL MOTORS COMPANY

1. Install Coolant Hose (2).
2. Install Clamp (3) **BO-38185** pliers
3. Connect Electrical Connector (4)

4. Move the radiator surge tank (1) in the left direction (arrow) to the original position.

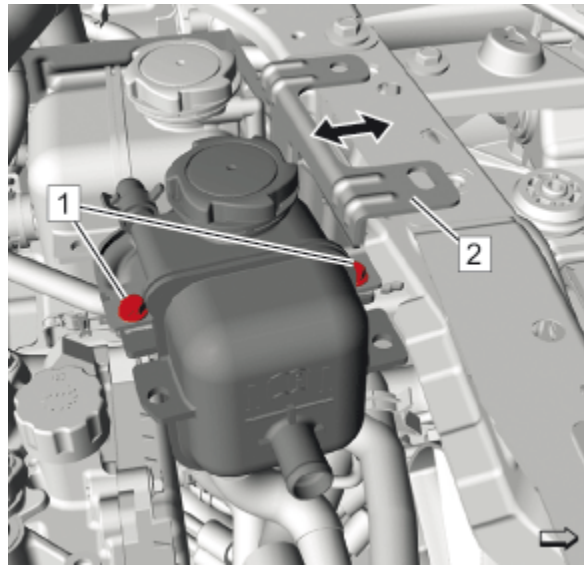


Fig. 68: Radiator Surge Tank Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Install Radiator Surge Tank Bolt (1) - Install and tighten 9 N.m (80 lb in)
6. Position the radiator surge tank bracket (2) in front direction (arrow) to the original position.

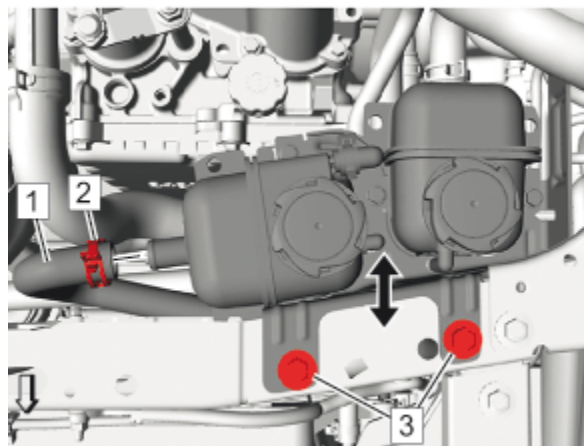


Fig. 69: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install the 2 radiator surge tank bracket bolt (3) and tighten to 22 N.m (16 lb ft).
8. Install Coolant Hose(1)
9. Clamp (2) - Tighten - **BO-38185** pliers
10. Fill the cooling system. Drive Motor Battery Cooling System Draining and Filling

RADIATOR SURGE TANK REPLACEMENT (DRIVE MOTOR GENERATOR POWER INVERTER)

MODULE SURGE TANK)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

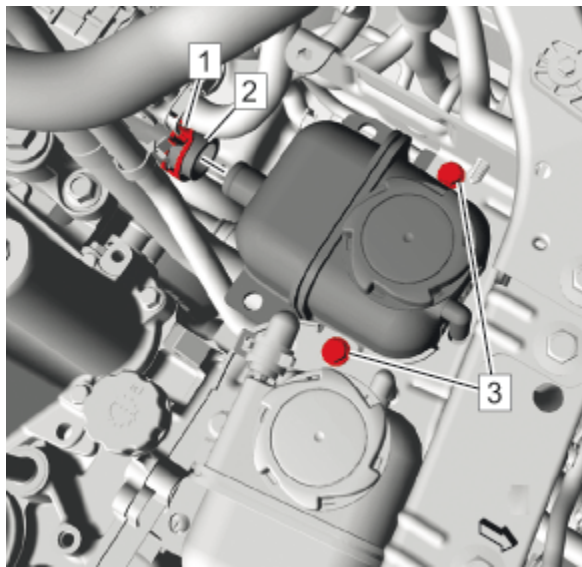


Fig. 70: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

3. Loosen Clamp (1) **BO-38185** pliers
4. Remove Coolant Hose (2)
5. Remove Radiator Surge Tank Bolt (3)

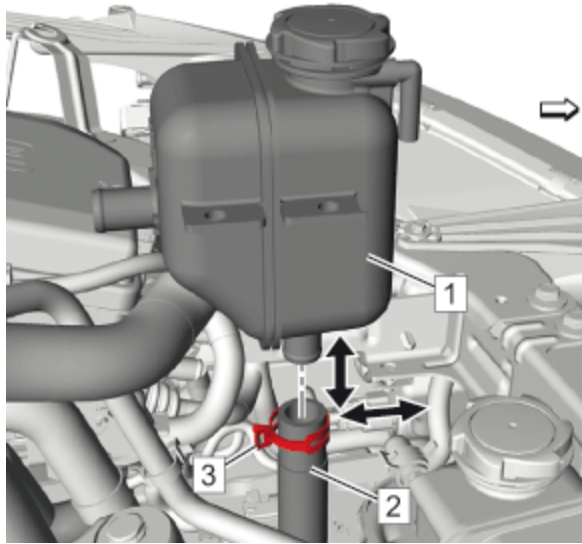


Fig. 71: Radiator Surge Tank And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

6. Move the radiator surge tank (1) in engine direction (arrow) and in top direction until the lower hose is accessible.
7. Loosen Clamp (3) **BO-38185** pliers
8. Remove Coolant Hose (2)
9. Remove Radiator Surge Tank (1)

Installation Procedure

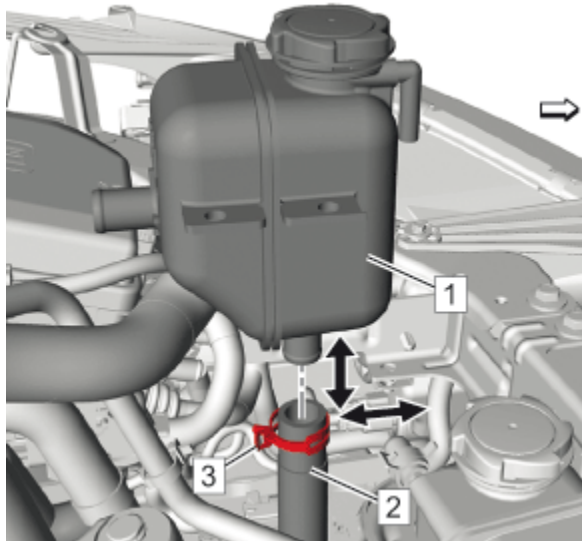


Fig. 72: Radiator Surge Tank And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Coolant Hose (2)
2. Install Clamp (3) **BO-38185** pliers
3. Move the radiator surge tank (1) in front direction (arrow) to their original position.

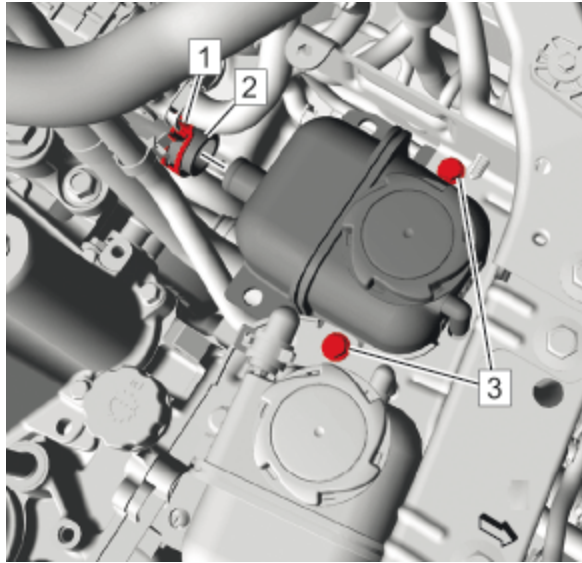


Fig. 73: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install Radiator Surge Tank Bolt (3) and tighten 9 N.m (80 lb in)
5. Install Coolant Hose (2)
6. Clamp (1) - Tighten **BO-38185** pliers
7. Fill the cooling system. Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

DRIVE MOTOR GENERATOR CONTROL MODULE COOLANT PUMP HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: Special Tools

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
3. Raise and support the vehicle. Lifting and Jacking the Vehicle
4. Remove Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement

(Right Side)

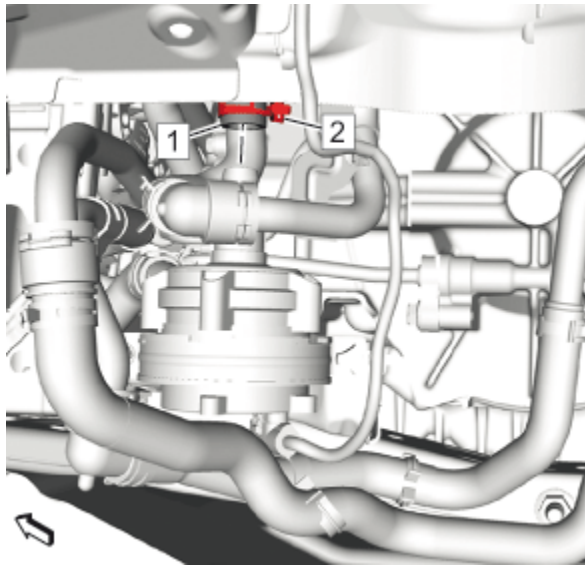


Fig. 74: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

5. Loosen Clamp (2) **BO-38185** pliers
6. Remove Coolant Hose(1)
7. Lower the vehicle.

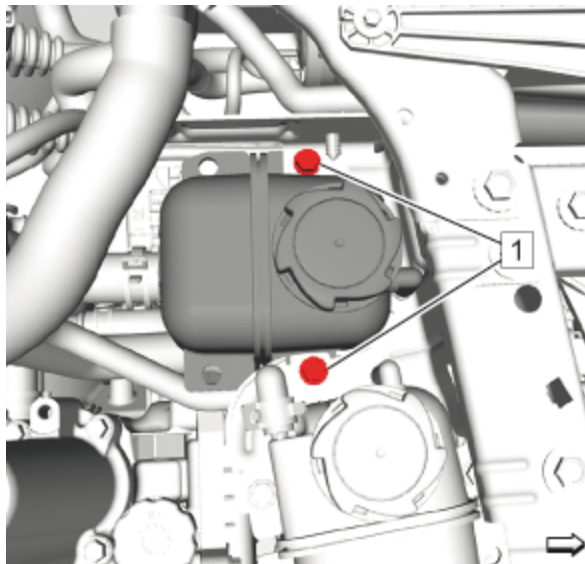


Fig. 75: Surge Tank Bolt

Courtesy of GENERAL MOTORS COMPANY

8. Remove Radiator Surge Tank Bolt (1)

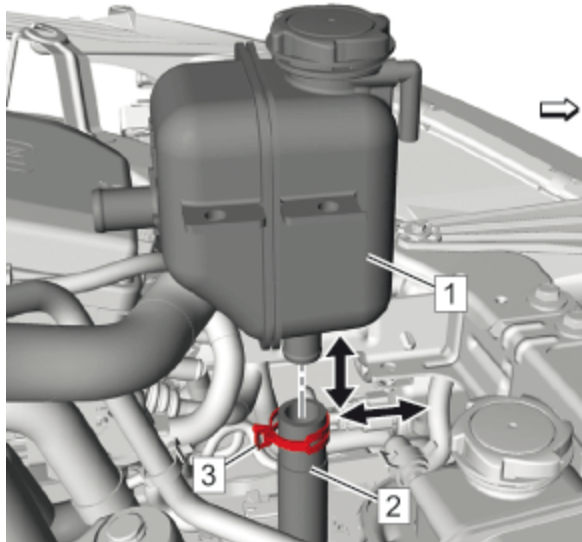


Fig. 76: Radiator Surge Tank And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

9. Move the radiator surge tank (1) in engine direction (arrow) and in top direction until the lower hose is accessible.
10. Loosen Clamp (3) **BO-38185** pliers
11. Remove Coolant Hose (2)

Installation Procedure

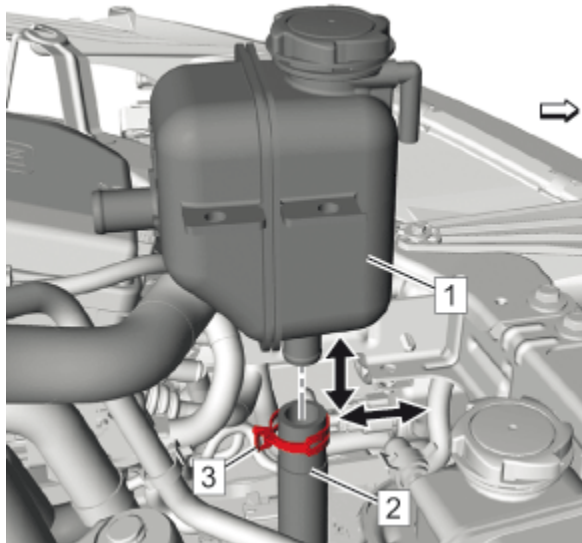


Fig. 77: Radiator Surge Tank And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Coolant Hose (2)
2. Install Clamp (3) **BO-38185** pliers
3. Move the radiator surge tank (1) in front direction (arrow) to their original position.

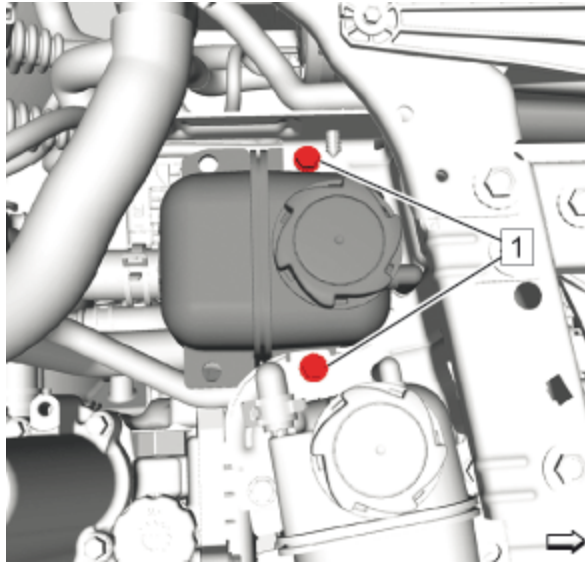


Fig. 78: Surge Tank Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install Radiator Surge Tank Bolt (1) -and tighten 9 N.m (80 lb in)
5. Raise the vehicle.

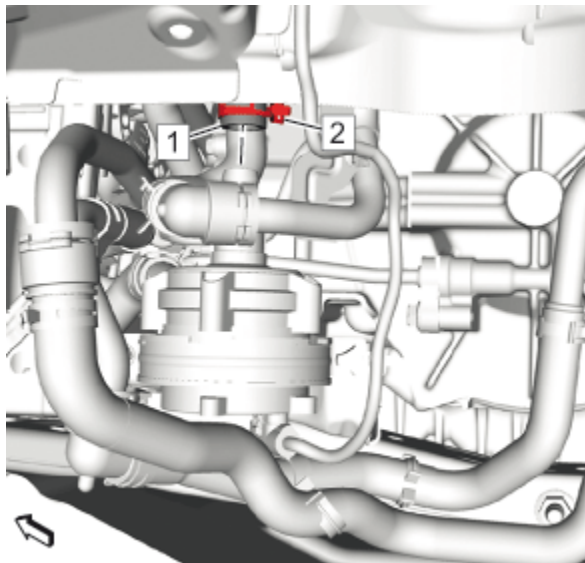


Fig. 79: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

6. Install Coolant Hose (1)
7. Install Clamp (2) **BO-38185** pliers
8. Install Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)
9. Lower the vehicle.
10. Fill the cooling system. Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

DRIVE MOTOR GENERATOR CONTROL MODULE COOLING OUTLET HOSE REPLACEMENT (UNDERBODY LINE)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Overview

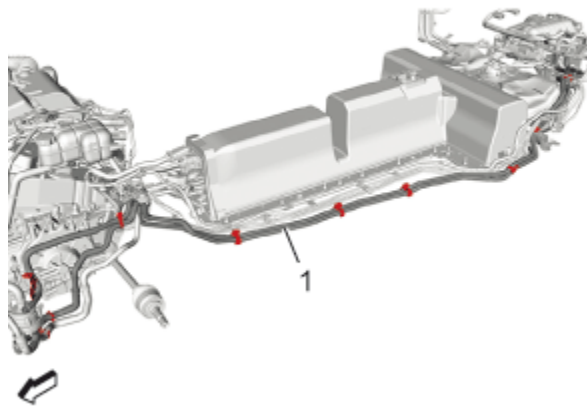


Fig. 80: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor generator control module cooling outlet hose (1) without the body.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Remove the floor panel number 4 cross bar. [Floor Panel Number 4 Cross Bar Replacement](#)
3. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
4. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

5. Remove Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)
6. Remove Drivetrain and Front Suspension Cradle Replacement
7. Remove Front Wheel Drive Shaft Replacement

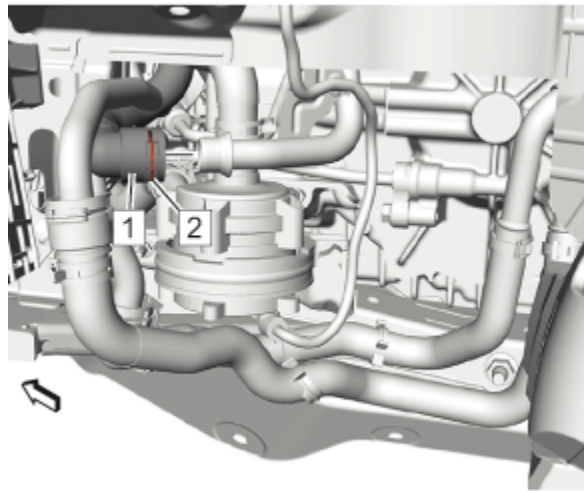


Fig. 81: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Loosen Clamp (2)
9. Remove Coolant Hose (1)

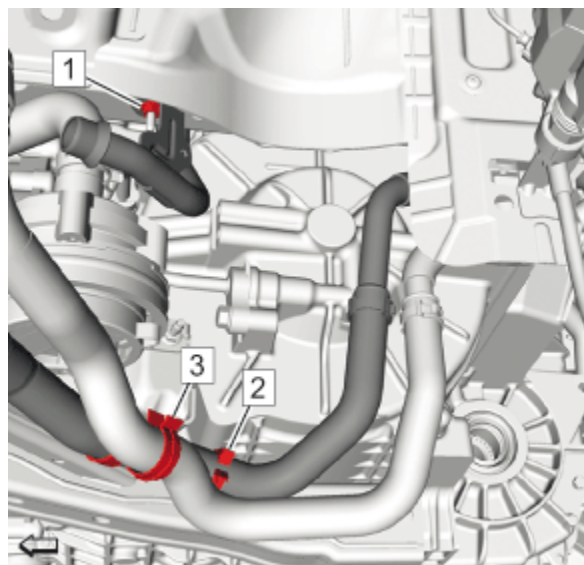


Fig. 82: Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Unclip Retainer(2, 3)

NOTE: Unclip the wiring harness.

11. Remove Drive Motor Generator Control Module Cooling Outlet Hose Nut (1)

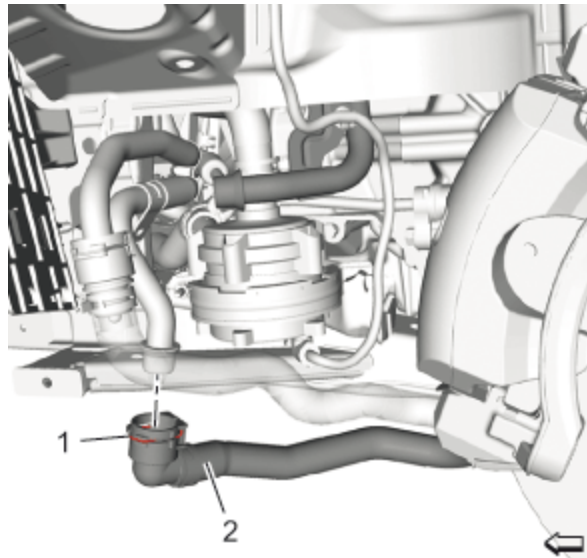


Fig. 83: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

12. Loosen Clamp (1)
13. Remove Coolant Hose (2)

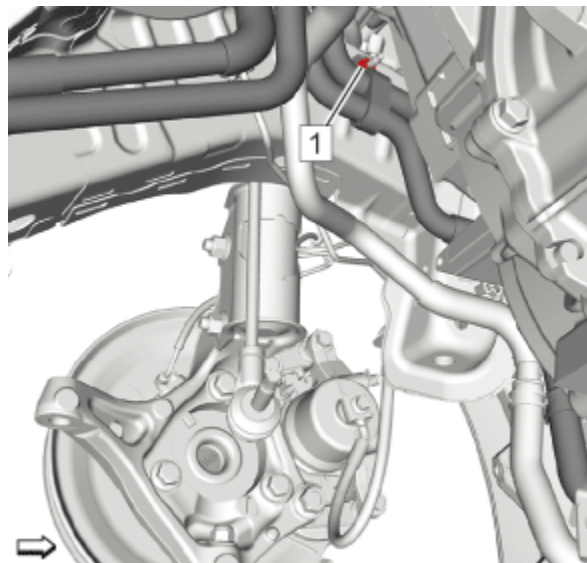


Fig. 84: Drive Motor Generator Control Module Cooling Outlet Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

14. Remove Drive Motor Generator Control Module Cooling Outlet Hose Nut (1)

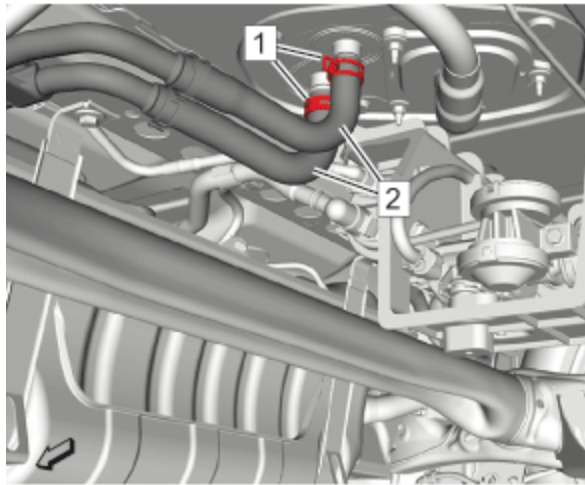


Fig. 85: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

15. Loosen Clamp (1) **BO-38185** pliers
16. Remove Coolant Hose (2)

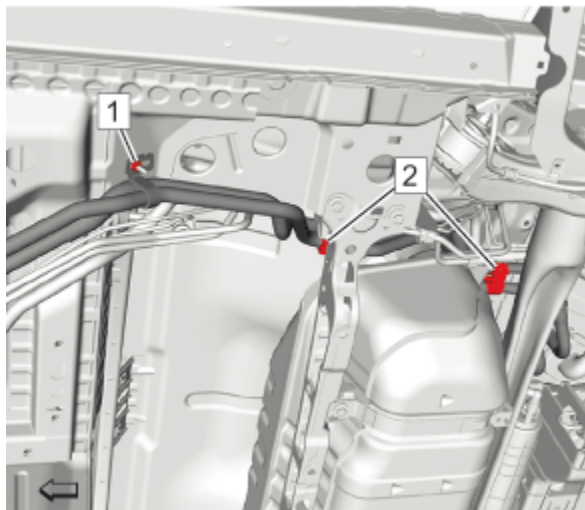


Fig. 86: Drive Motor Generator Control Module Cooling Outlet Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

17. Remove Drive Motor Generator Control Module Cooling Outlet Hose Nut (1)
18. Unclip Retainer (2)

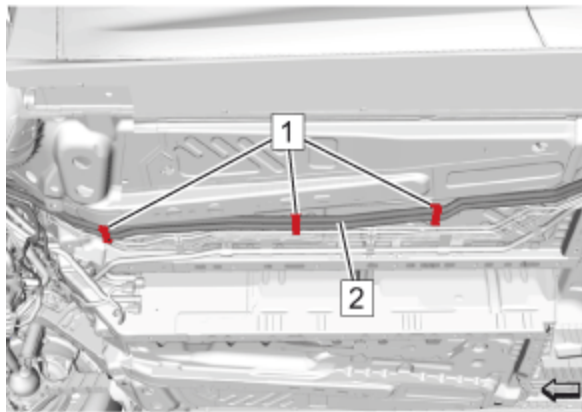


Fig. 87: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

19. Unclip Retainer (1)
20. Remove Drive Motor Generator Control Module Cooling Outlet Hose (2)

Installation Procedure

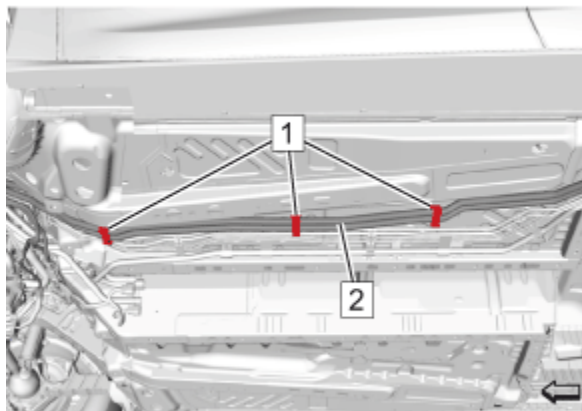


Fig. 88: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Cooling Outlet Hose (2)
2. Install Retainer (1)

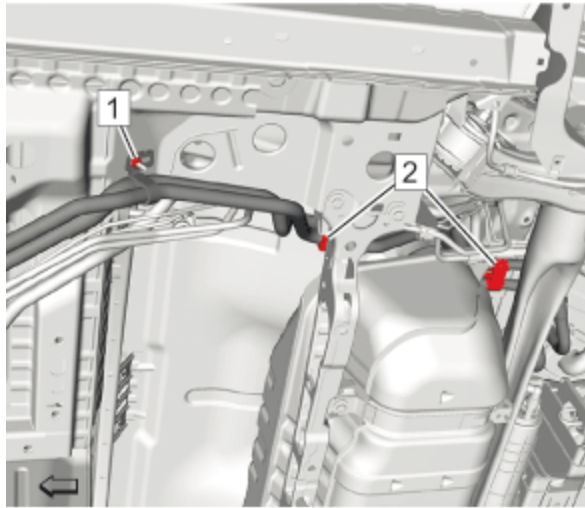


Fig. 89: Drive Motor Generator Control Module Cooling Outlet Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install Retainer(2)

CAUTION: **Fastener Caution**

4. Install Drive Motor Generator Control Module Cooling Outlet Hose Nut (1) and tighten 9 N.m (80 lb in)

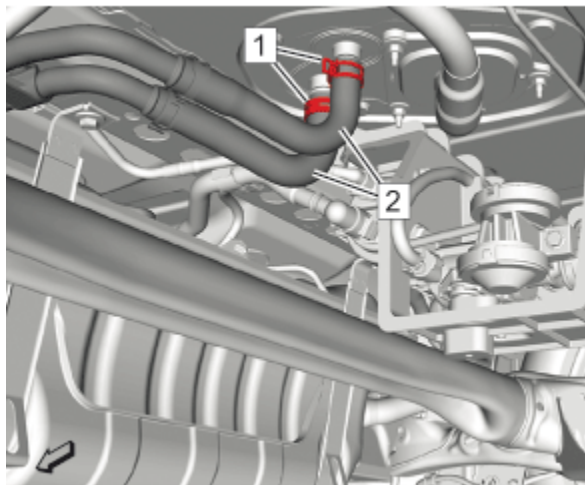


Fig. 90: Coolant Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Coolant Hose (2)
6. Install Clamp (1) **BO-38185** pliers

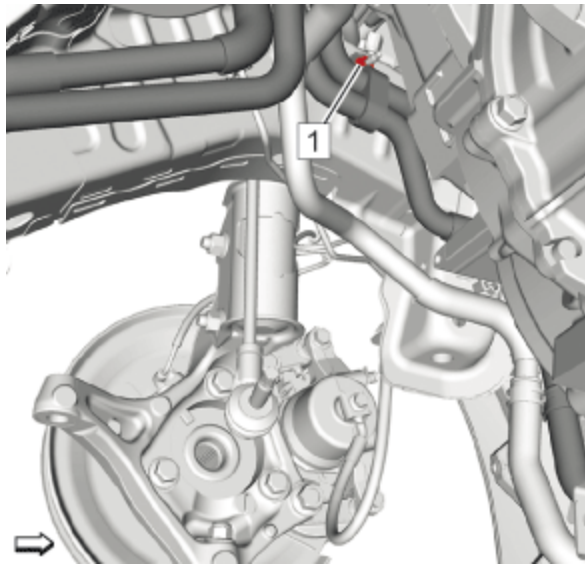


Fig. 91: Drive Motor Generator Control Module Cooling Outlet Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install Drive Motor Generator Control Module Cooling Outlet Hose Nut (1) and tighten 9 N.m (80 lb in)

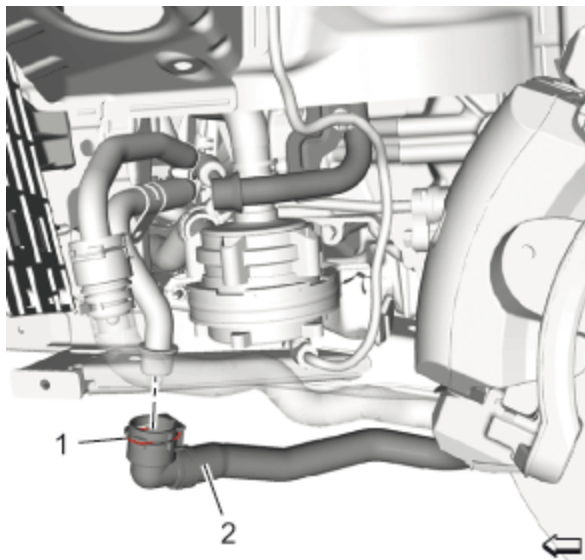


Fig. 92: Coolant Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Install Coolant Hose (2)
9. Install Clamp (1)

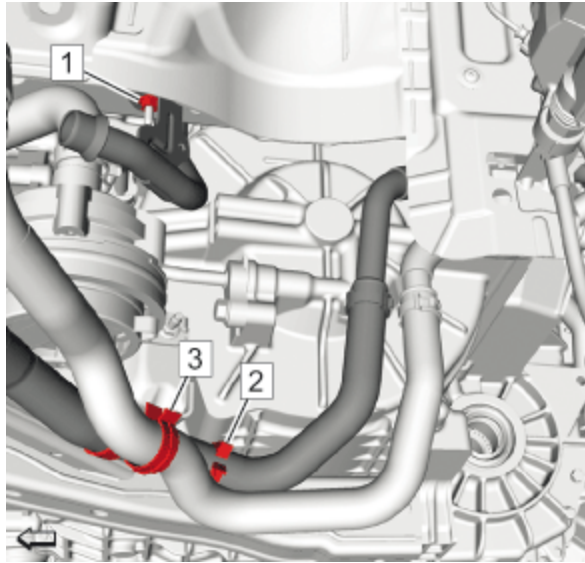


Fig. 93: Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install the wiring harness.

10. Install Drive Motor Generator Control Module Cooling Outlet Hose Nut (1) and tighten 90 N.m (80 lb in)
11. Install Retainer(2, 3)

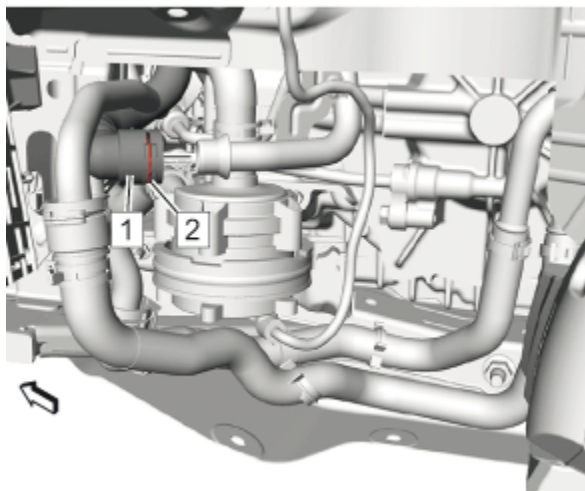


Fig. 94: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

12. Install Coolant Hose (1)
13. Install Clamp(2)
14. Install [Front Wheel Drive Shaft Replacement](#)
15. Install [Drivetrain and Front Suspension Cradle Replacement](#)
16. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
17. Install the floor panel number 4 cross bar. [Floor Panel Number 4 Cross Bar Replacement](#)

18. Lower the vehicle.

19. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

DRIVE MOTOR GENERATOR CONTROL MODULE COOLING OUTLET HOSE REPLACEMENT (UNDERBODY LINE TO TRACTION POWER INVERTER MODULE INLET)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Overview

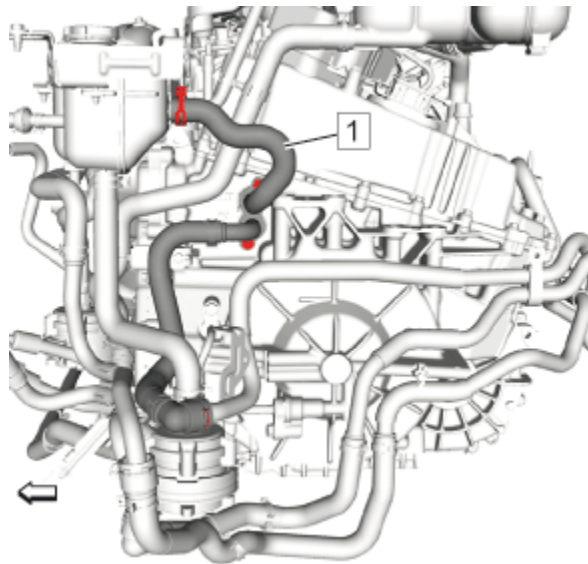


Fig. 95: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor generator control module cooling outlet hose (1) without the engine.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

2. Drain the cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

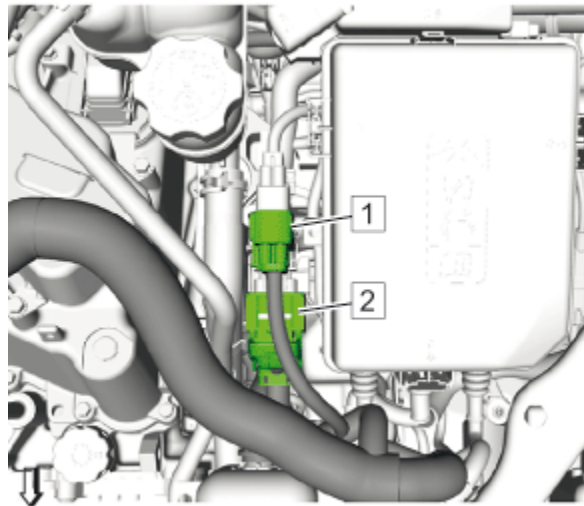


Fig. 96: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector(1, 2)

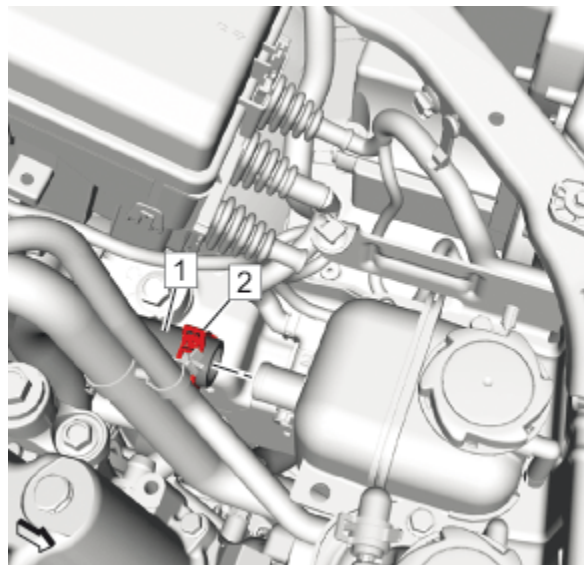


Fig. 97: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (2) **BO-38185** pliers
5. Remove Coolant Hose (1)

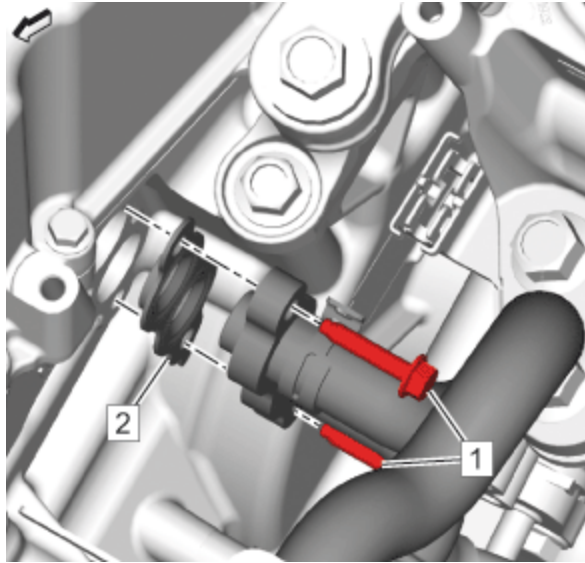


Fig. 98: Drive Motor Generator Control Module Cooling Outlet Hose And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Generator Control Module Cooling Outlet Hose Bolt (1)
7. Remove Seal (2) and DISCARD
8. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
9. Remove **Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)** - Remove

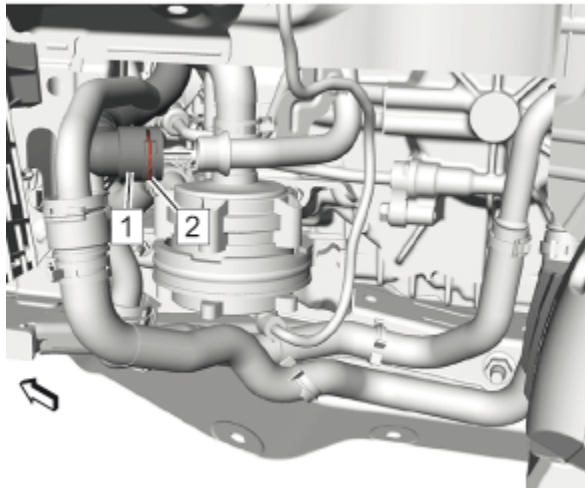


Fig. 99: Coolant Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

10. Loosen Clamp (2)
11. Remove Drive Motor Generator Control Module Cooling Outlet Hose (1)

Installation Procedure

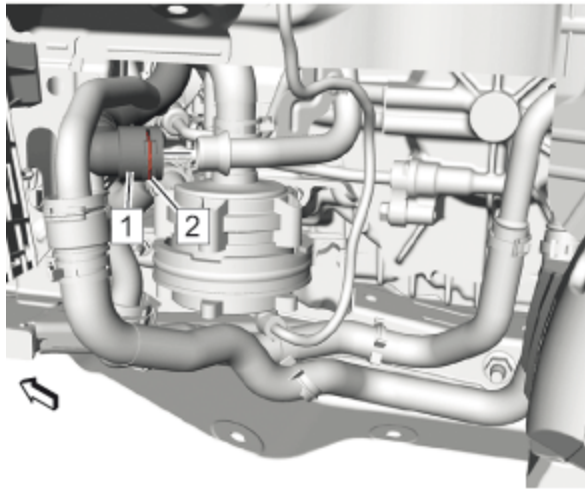


Fig. 100: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Cooling Outlet Hose (1)
2. Install Clamp (2)
3. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
4. Lower the vehicle.

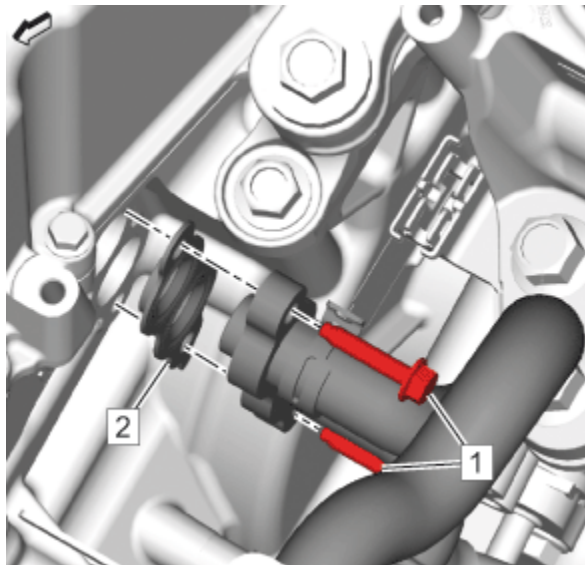


Fig. 101: Drive Motor Generator Control Module Cooling Outlet Hose And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install a NEW seal.(2)

CAUTION: [Fastener Caution](#)

6. Install Drive Motor Generator Control Module Cooling Outlet Hose Bolt(1) and tighten 9 N.m (80 lb in)

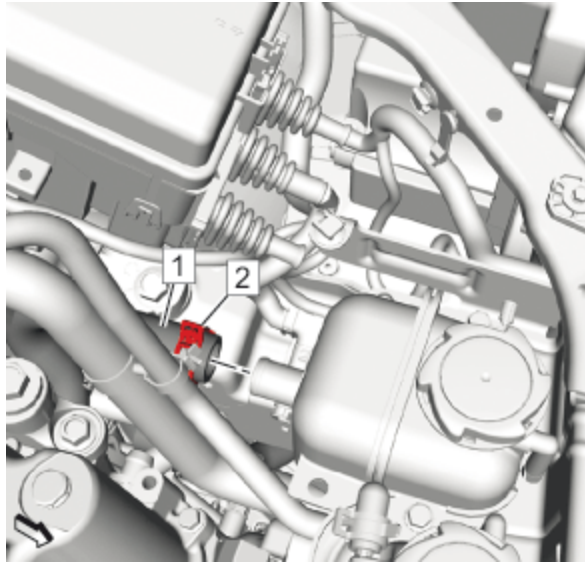


Fig. 102: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install Coolant Hose (1)
8. Install Clamp (2) **BO-38185** pliers

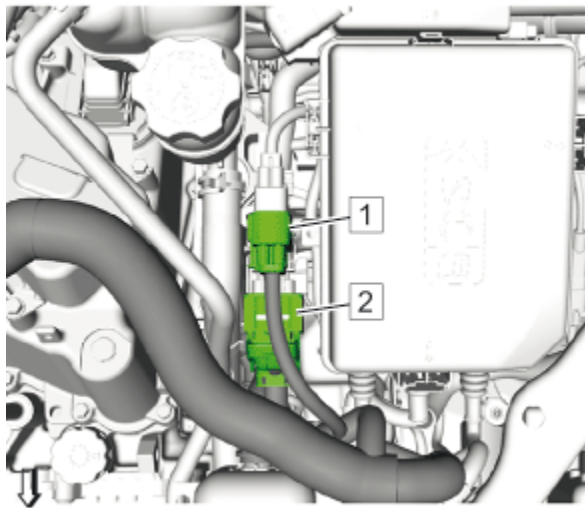


Fig. 103: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

9. Connect Electrical Connector (1, 2)
10. Fill the cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

GENERATOR CONTROL MODULE COOLANT RADIATOR HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Remove [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

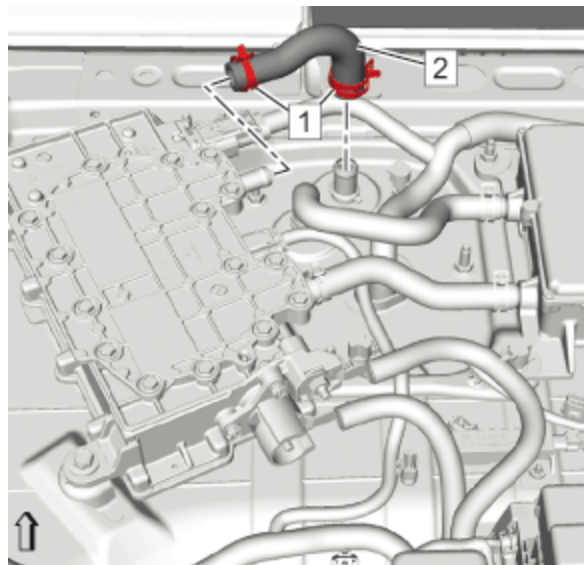


Fig. 104: Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (1) **BO-38185** pliers
5. Remove the generator control module coolant radiator hose (2).

Installation Procedure

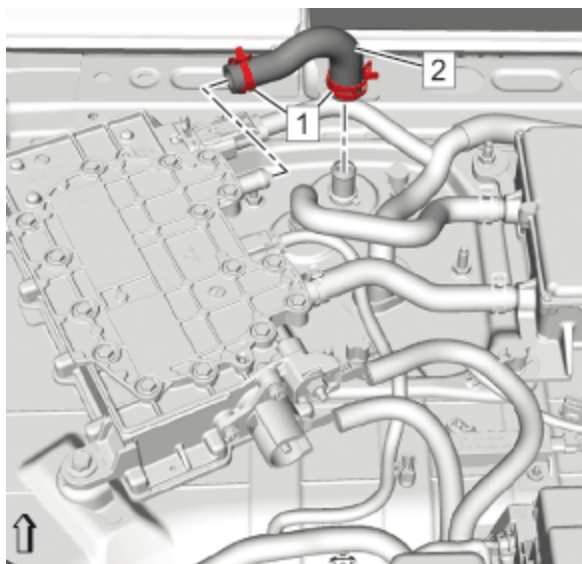


Fig. 105: Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Install the generator control module coolant radiator hose (2).
2. Install Clamp (1) **BO-38185** pliers
3. Install [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
4. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

GENERATOR CONTROL MODULE COOLANT HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Remove [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

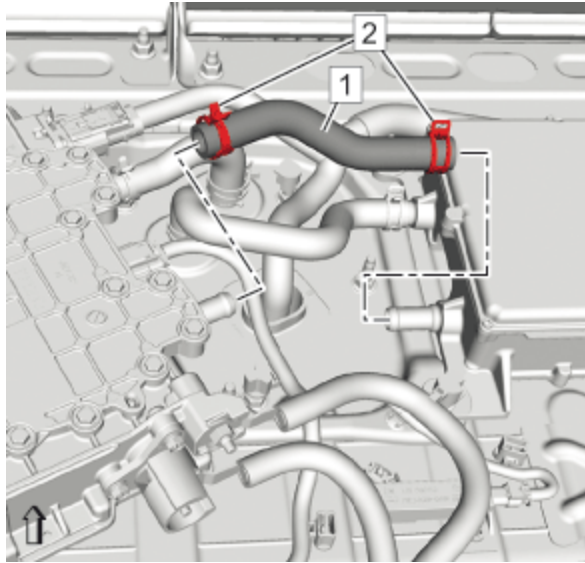


Fig. 106: Generator Control Module Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (2) **BO-38185** pliers
5. Remove the generator control module coolant hose (1).

Installation Procedure

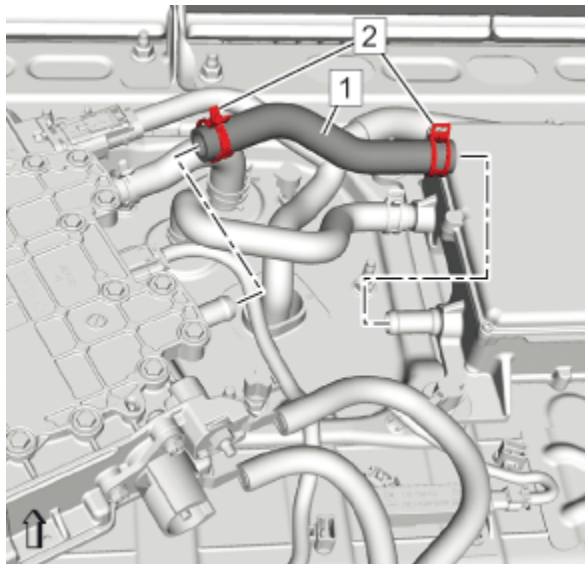


Fig. 107: Generator Control Module Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install the generator control module coolant hose (1).
2. Install Clamp (2) **BO-38185** pliers
3. Install **Rear Compartment Floor Stowage Trim Compartment Replacement**
4. Fill the cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

GENERATOR CONTROL MODULE COOLANT PUMP REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

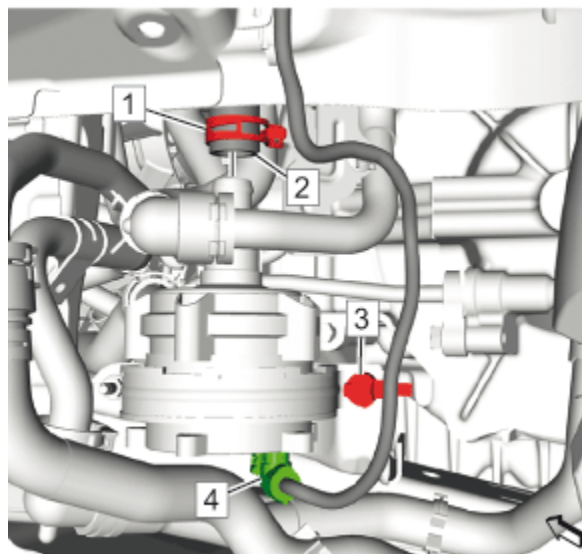


Fig. 108: Coolant Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (4)
6. Unclip Retainer (3)
7. Loosen Clamp (1) **BO-38185** pliers
8. Remove Coolant Hose (2)

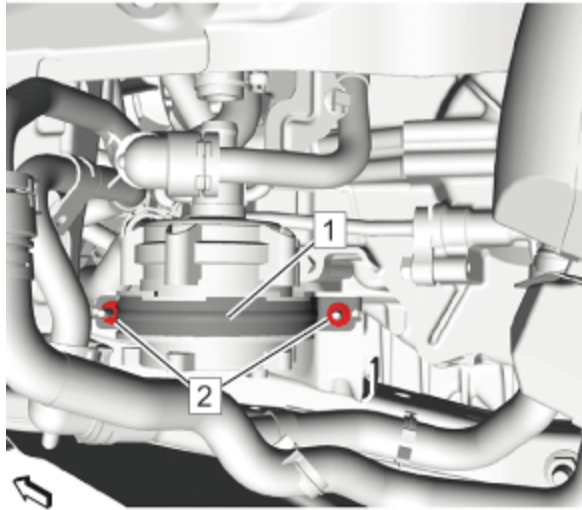


Fig. 109: Generator Control Module Coolant Pump Bracket And Nuts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the position of the pump and the bracket.

9. Remove the 2 generator control module coolant pump bracket nuts (2).
10. Remove the front half generator control module coolant pump bracket (1).

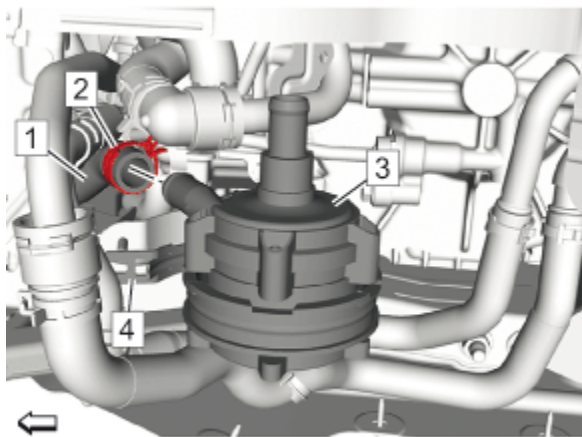


Fig. 110: Clamp And Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

11. Loosen Clamp (2) **BO-38185** pliers
12. Remove Coolant Hose (1)
13. Remove the generator control module coolant pump (3).
14. Remove the rear half of the generator control module coolant pump bracket (4).

Installation Procedure

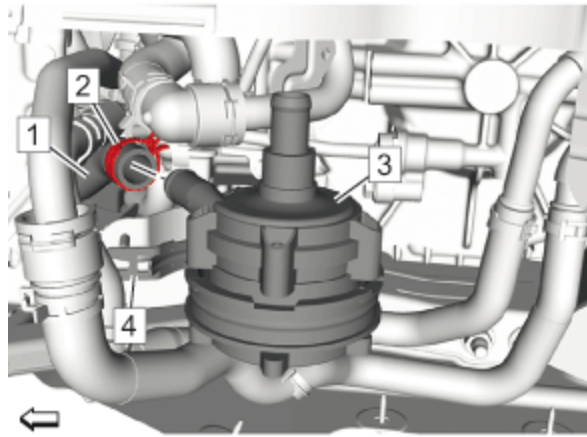


Fig. 111: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install Coolant Hose (1)
2. Install Clamp (2) **BO-38185** pliers
3. Install the rear half of the generator control module coolant pump bracket (4).
4. Install the generator control module coolant pump (3).

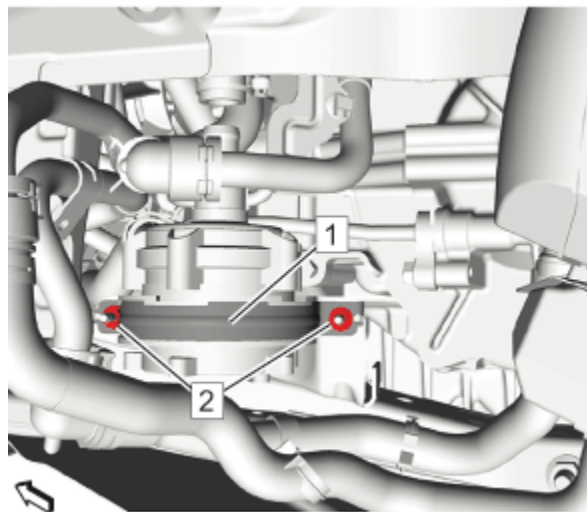


Fig. 112: Generator Control Module Coolant Pump Bracket And Nuts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Check the pump and the bracket for the correct original position.

5. Install the front half of the generator control module coolant pump bracket (1).

CAUTION: Fastener Caution

6. Install the 2 generator control module coolant pump bracket nuts (2) and tighten to 9 N.m (80 lb in).

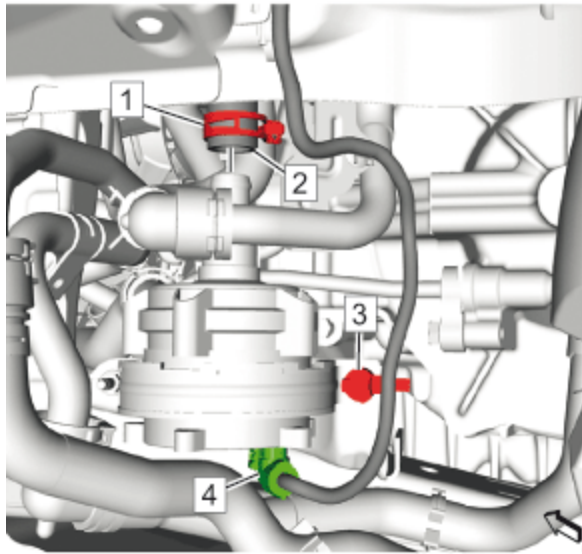


Fig. 113: Coolant Hose And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Coolant Hose (2)
8. Install Clamp (1) **BO-38185** pliers
9. Install Retainer (3)
10. Connect Electrical Connector (4)
11. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
12. Lower the vehicle.
13. Fill the cooling system. [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

HIGH VOLTAGE BATTERY HEATER REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove [High Voltage Battery Cover Replacement](#)
2. Remove [High Voltage Battery Disconnect Relay Replacement](#)

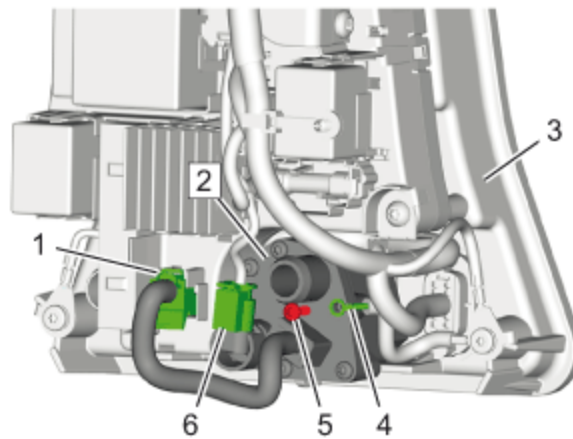


Fig. 114: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connectors.(1, 6)
4. Remove the high voltage battery heater ground cable bolt (5).
5. Hang the high voltage battery heater ground cable (4) aside.
6. Use a paint pen and place match marks on the high voltage battery heater (2) and the drive motor battery wire junction block relay (3) to ensure proper realignment during installation.

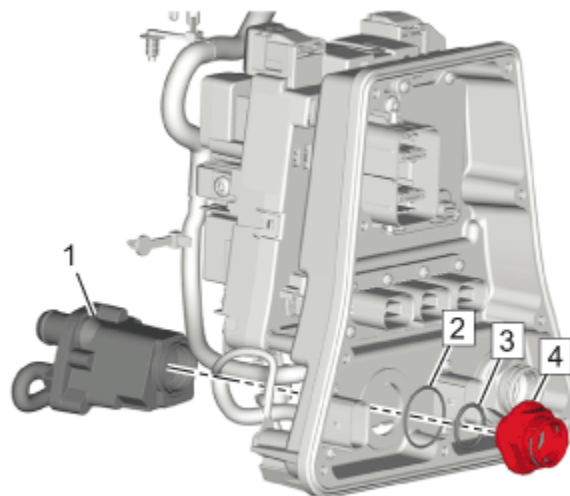


Fig. 115: High Voltage Battery Heater And High Voltage Heater Outlet Hose Fitting

Courtesy of GENERAL MOTORS COMPANY

7. Remove High Voltage Heater Outlet Hose Fitting(4)
8. Remove High Voltage Battery Heater(1)
9. Remove and DISCARD the 2 heater outlet hose fitting O-ring seals (2, 3)

Installation Procedure

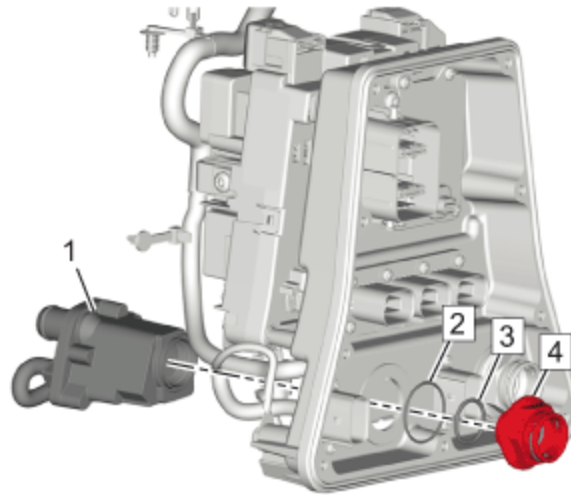


Fig. 116: High Voltage Battery Heater And High Voltage Heater Outlet Hose Fitting
Courtesy of GENERAL MOTORS COMPANY

1. Install the 2 NEW heater outlet hose fitting O-ring seals (2, 3)
2. Position the high voltage battery heater (1) to the drive motor battery wire junction block relay ensuring to align the match marks.
3. Install High Voltage Heater Outlet Hose Fitting(4)

CAUTION: Fastener Caution

NOTE: **Ensure that the high voltage battery heater (1) is correctly aligned.**

4. Hold the high voltage battery heater (1) and tighten the heater outlet hose fitting (4) to 45 N.m (33 lb ft).

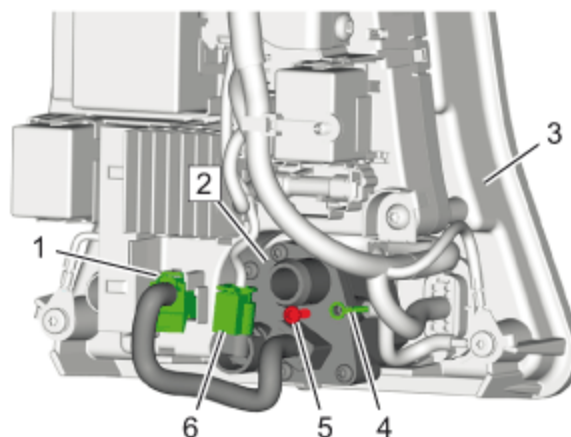


Fig. 117: Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the high voltage battery heater ground cable (4) to the high voltage battery heater (1).
6. Install the high voltage battery heater ground cable bolt (5).

7. Connect the electrical connectors.(1, 6)
8. Install [High Voltage Battery Disconnect Relay Replacement](#)
9. Install [High Voltage Battery Cover Replacement](#)

DRIVE MOTOR BATTERY RADIATOR SURGE TANK CAP REPLACEMENT

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

NOTE: The tamper-resistant coolant cap has a one-way mechanism to deter the service of cooling systems by unqualified individuals.

Removal Procedure

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

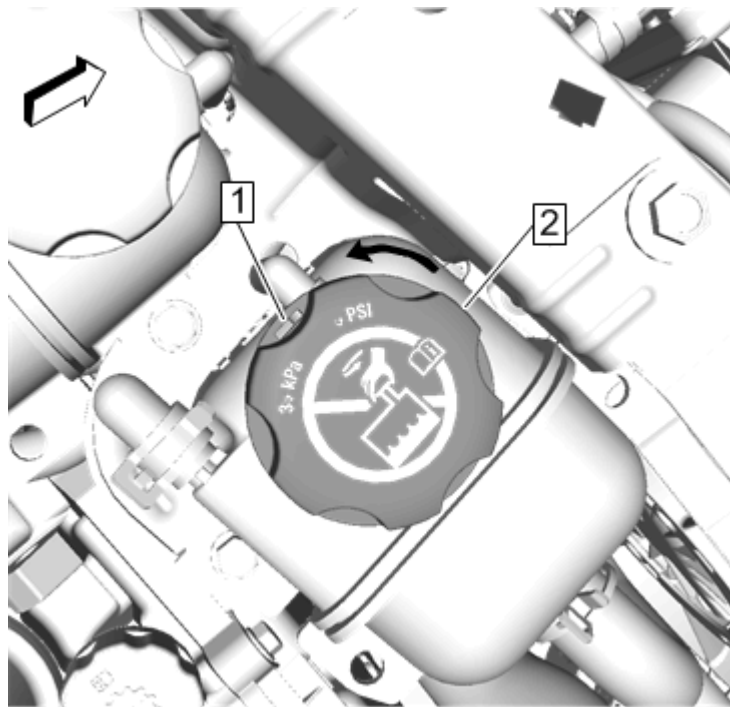


Fig. 118: Cap Cover And Cap Body

Courtesy of GENERAL MOTORS COMPANY

2. Rotate the cap upper cover counter-clockwise to align the slot in the cap cover (1) with the slot in the cap body (2).

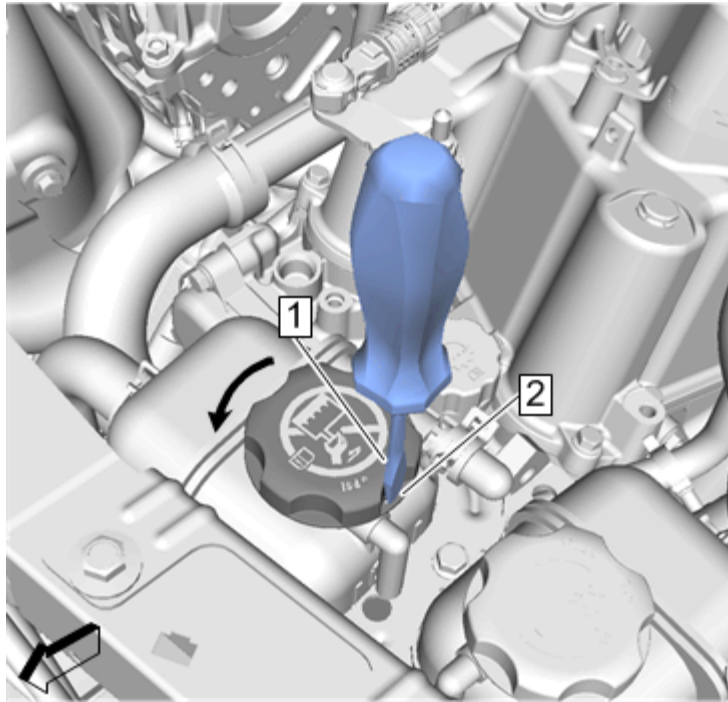


Fig. 119: Flat Bladed Screwdriver And Slot
Courtesy of GENERAL MOTORS COMPANY

3. Insert a flat bladed screwdriver (1) into the slot (2), no wider than 8 mm (5/16").

NOTE: Do not use the flat bladed screwdriver to loosen the cap.

4. With the cap sections engaged, rotate the cap counter-clockwise by hand to loosen and remove from the surge tank.

Installation Procedure

1. Install and rotate cap clockwise until it is tight, and the detent in cap engages to the rib in the surge tank.

DRIVE MOTOR BATTERY COOLANT COOLER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the

vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Remove [Air Cleaner Outlet Duct Replacement](#)
3. Recover the refrigerant. [Refrigerant Recovery and Recharging](#)
4. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
5. Disconnect the evaporative emission pipe from the evaporative emission canister purge solenoid valve and reposition. [Plastic Collar Quick Connect Fitting Service](#)
6. Disconnect the air conditioning evaporator hose assembly from the thermal expansion valve and reposition. [Air Conditioning Evaporator Hose Assembly Replacement](#)

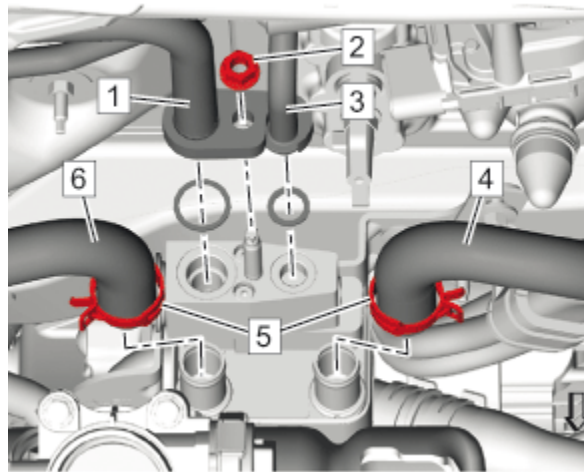


Fig. 120: Air Conditioning Evaporator Hose Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the air conditioning evaporator hose nut (2).
8. Remove the air conditioning evaporator hose (1).
9. Remove Air Conditioning Condenser Tube(3)
10. Loosen Clamp (5) **BO-38185** pliers
11. Remove Coolant Hose (4, 5)

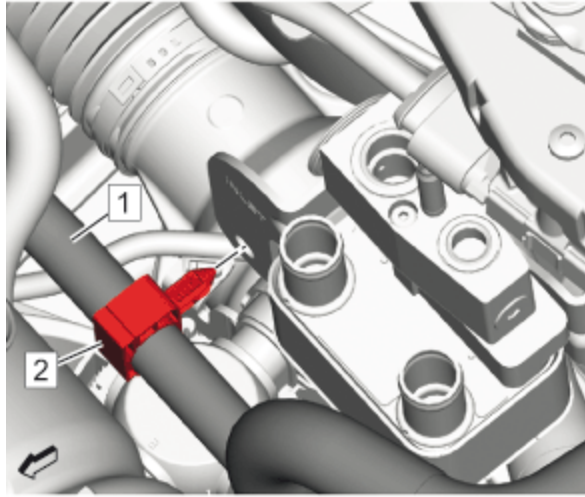


Fig. 121: Clip And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

12. Remove the clip (2) along with the coolant hose (1).

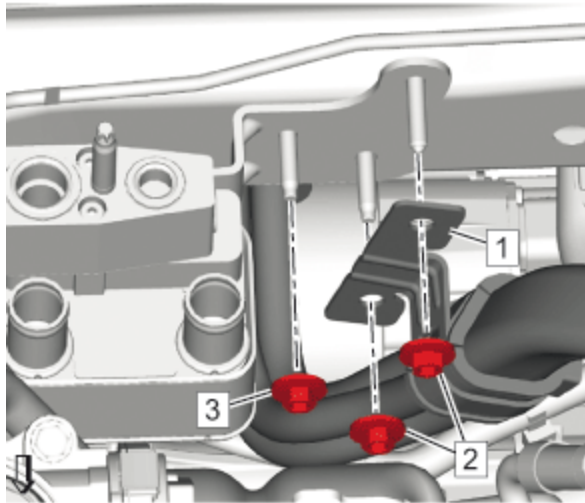


Fig. 122: Battery Positive And Negative Cable Bracket Nuts

Courtesy of GENERAL MOTORS COMPANY

13. Remove the 2 battery positive and negative cable bracket nuts (2).
14. Remove Battery Positive and Negative Cable(2)
15. Remove the drive motor battery coolant cooler nut (3).

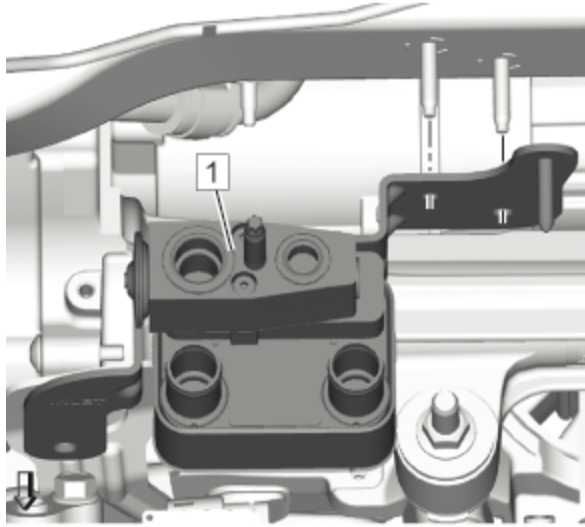


Fig. 123: Drive Motor Battery Coolant Cooler
Courtesy of GENERAL MOTORS COMPANY

16. Remove the drive motor battery coolant cooler (1).

Installation Procedure

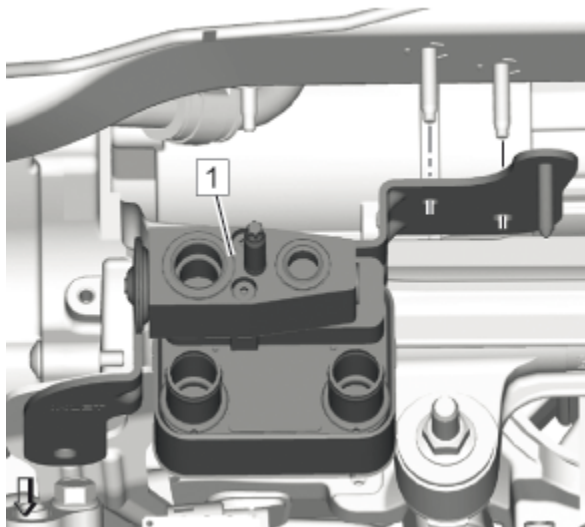


Fig. 124: Drive Motor Battery Coolant Cooler
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery coolant cooler (1).

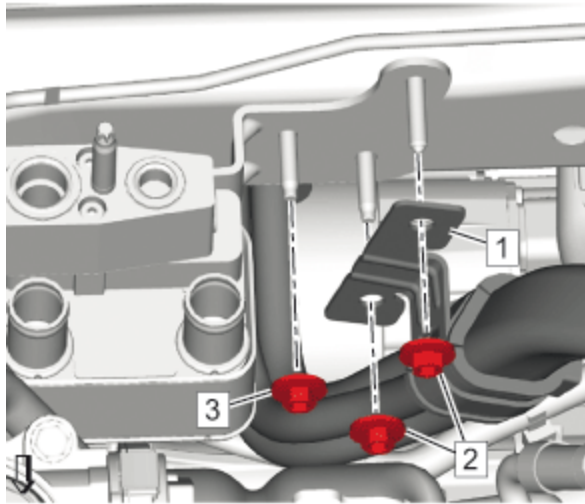


Fig. 125: Battery Positive And Negative Cable Bracket Nuts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Install the drive motor battery coolant cooler nut (3) and tighten to 9 N.m (80 lb in).
3. Install Battery Positive and Negative Cable (3)
4. Install the 2 battery positive and negative cable bracket nuts (2) and tighten to 9 N.m (80 lb in).

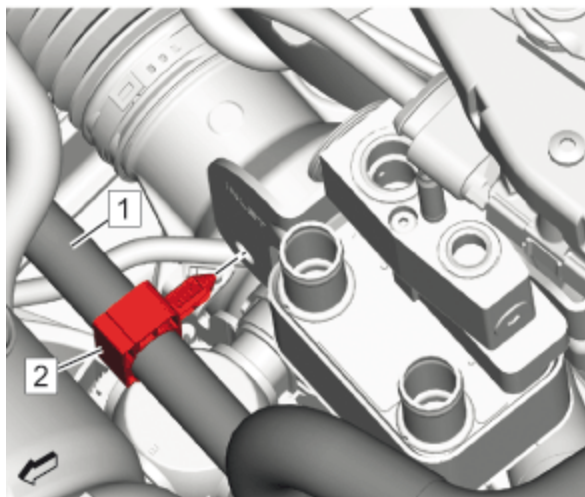


Fig. 126: Clip And Coolant Hose
 Courtesy of GENERAL MOTORS COMPANY

5. Install the clip (2) along with the coolant hose (1).

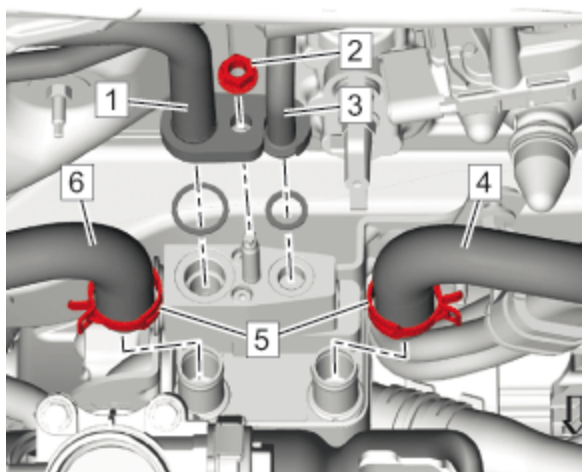


Fig. 127: Air Conditioning Evaporator Hose Nut

Courtesy of GENERAL MOTORS COMPANY

6. Install Coolant Hose (4, 6)
7. Install Clamp (3) **BO-38185** pliers
8. Install Air Conditioning Condenser Tube (3)
9. Install the air conditioning evaporator hose (1).
10. Install the air conditioning evaporator hose nut (2) and tighten to 22 N.m (16 lb ft).
11. Lower the vehicle.
12. Connect the air conditioning evaporator hose assembly to the thermal expansion valve and reposition. [Air Conditioning Evaporator Hose Assembly Replacement](#)
13. Connect the evaporative emission pipe to the evaporative emission canister purge solenoid valve and reposition. [Plastic Collar Quick Connect Fitting Service](#)
14. Install [Air Cleaner Outlet Duct Replacement](#)
15. Fill the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
16. Evacuate and charge the refrigerant system. [Refrigerant Recovery and Recharging](#)

DRIVE MOTOR BATTERY COOLANT PUMP REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Exhaust Front Pipe Replacement](#)

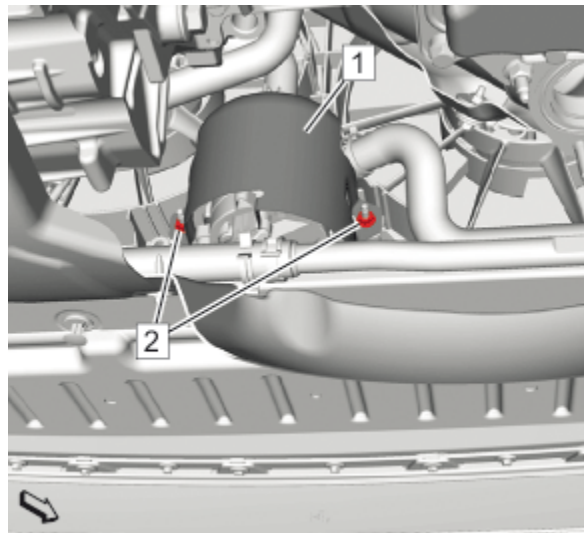


Fig. 128: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

5. Remove Heat Shield Nut (2)
6. Remove Heat Shield (1)

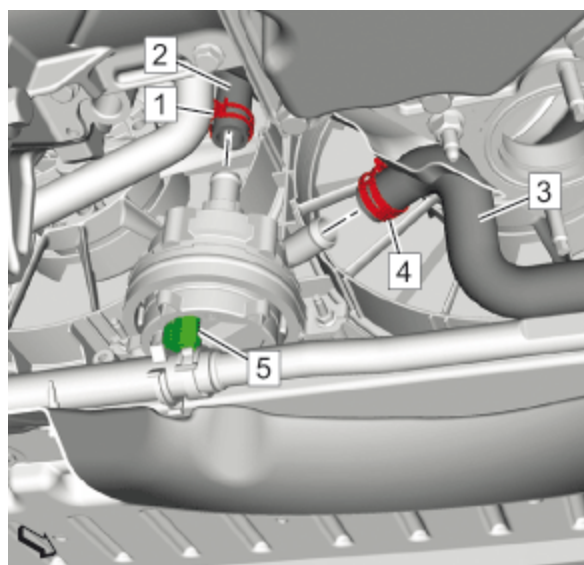


Fig. 129: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector(5)
8. Loosen Clamp(1, 4) **BO-38185** pliers
9. Remove Coolant Hose(2, 3)

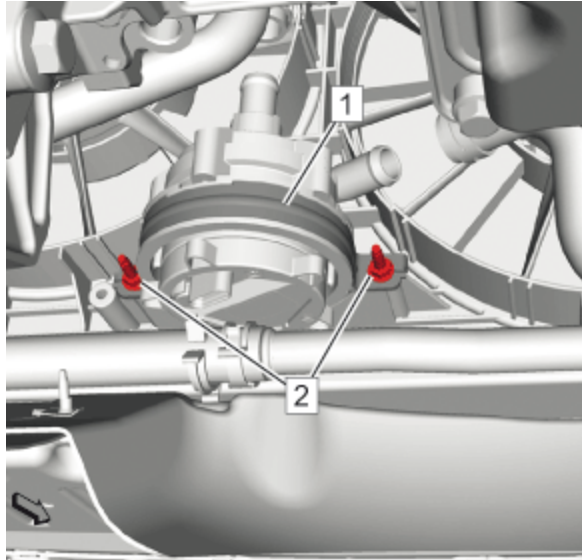


Fig. 130: Drive Motor Battery Coolant Pump Bracket Stud
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the position of the pump and the bracket.

10. Remove Drive Motor Battery Coolant Pump Bracket Stud (2)
11. Remove Drive Motor Battery Coolant Pump Bracket (1)

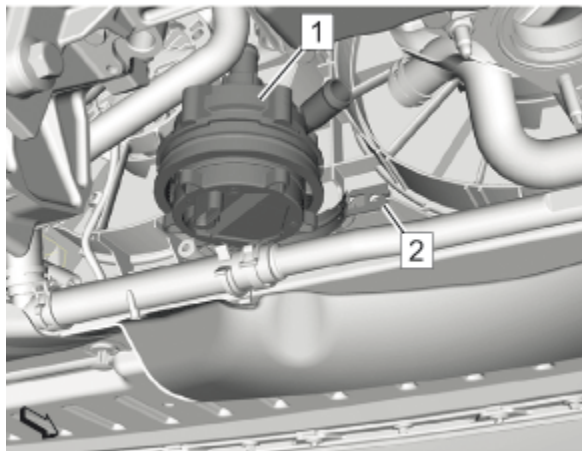


Fig. 131: Drive Motor Battery Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

12. Remove Drive Motor Battery Coolant Pump (1)
13. Remove Drive Motor Battery Coolant Pump Bracket (2)

Installation Procedure

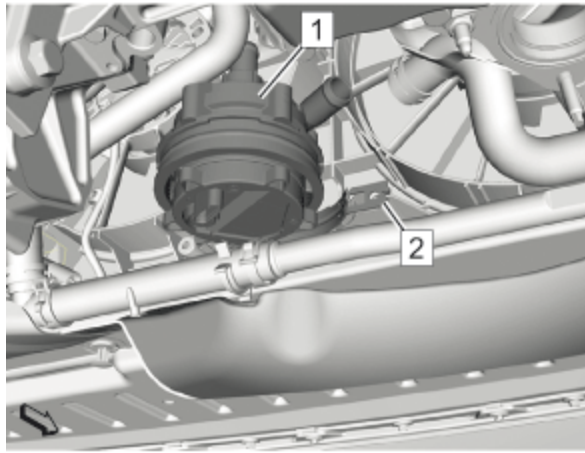


Fig. 132: Drive Motor Battery Coolant Pump
 Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Pump Bracket (2)
2. Install Drive Motor Battery Coolant Pump (1)

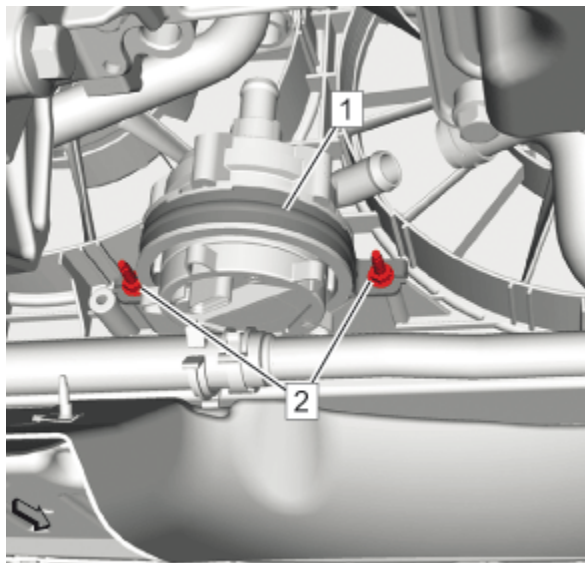


Fig. 133: Drive Motor Battery Coolant Pump Bracket Stud
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Check the pump and the bracket for the correct original position.

3. Install Drive Motor Battery Coolant Pump Bracket (1)

CAUTION: Fastener Caution

4. Install Drive Motor Battery Coolant Pump Bracket Stud (2) and tighten 9 N.m (80 lb in)

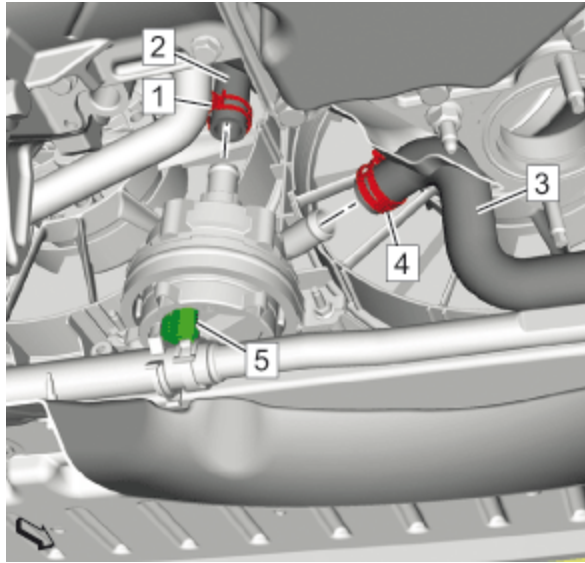


Fig. 134: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

5. Install Coolant Hose (2)
6. Install Clamp (1, 4) **BO-38185** pliers
7. Connect Electrical Connector (5)

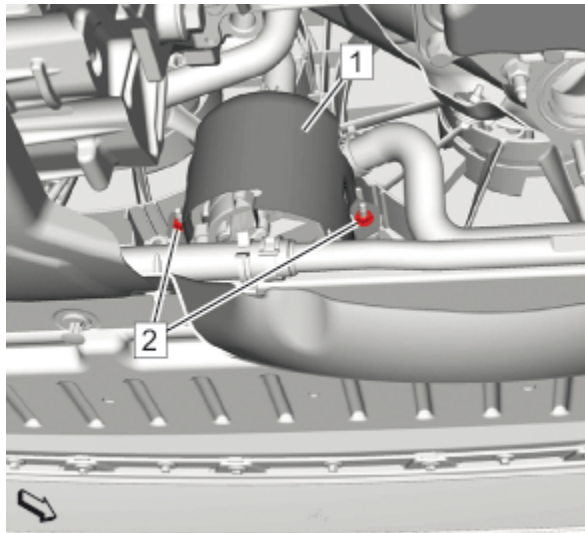


Fig. 135: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

8. Install Heat Shield (1)
9. Install Heat Shield Nut (2) and tighten 9 N.m (80 lb in)
10. Install **Exhaust Front Pipe Replacement**
11. Lower the vehicle.
12. Fill the cooling system. **Drive Motor Battery Cooling System Draining and Filling**

DRIVE MOTOR BATTERY COOLANT PUMP INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Exhaust Front Pipe Replacement](#)

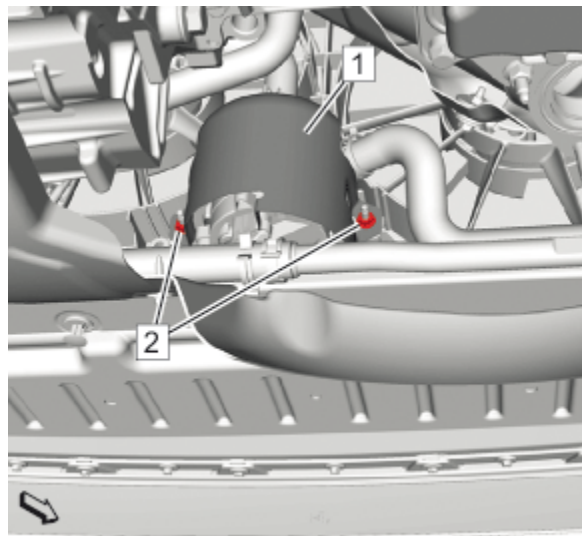


Fig. 136: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

5. Remove Heat Shield Nut (2)
6. Remove Heat Shield (1)

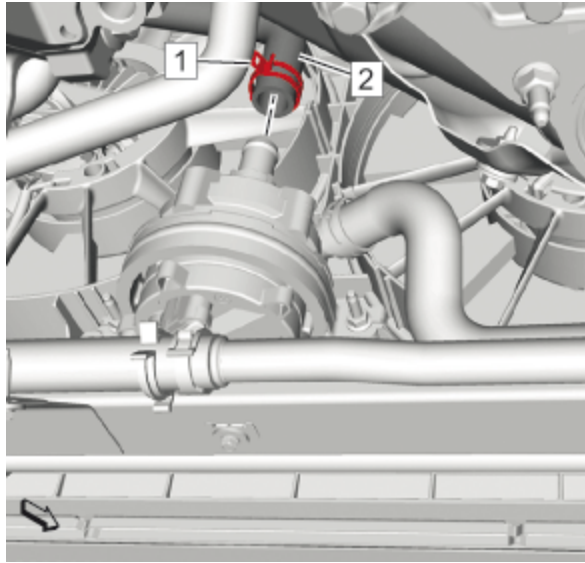


Fig. 137: Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

7. Loosen Clamp (1) **BO-38185** pliers
8. Remove Coolant Hose (2)
9. Lower the vehicle.

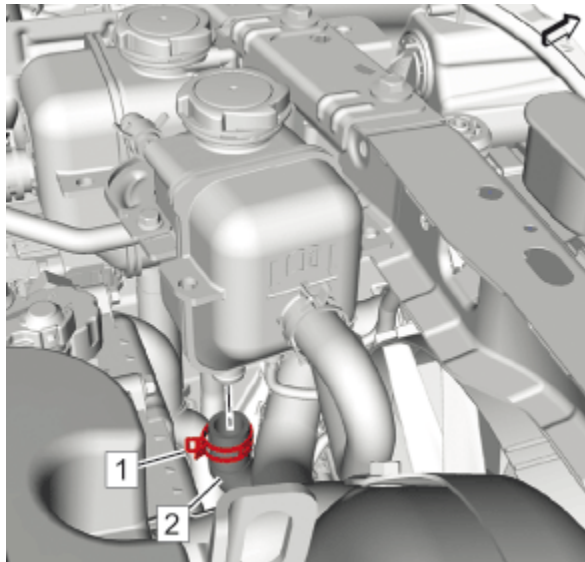


Fig. 138: Drive Motor Battery Coolant Pump Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

10. Loosen Clamp (1) - **BO-38185** pliers
11. Remove Drive Motor Battery Coolant Pump Inlet Hose (2)

Installation Procedure

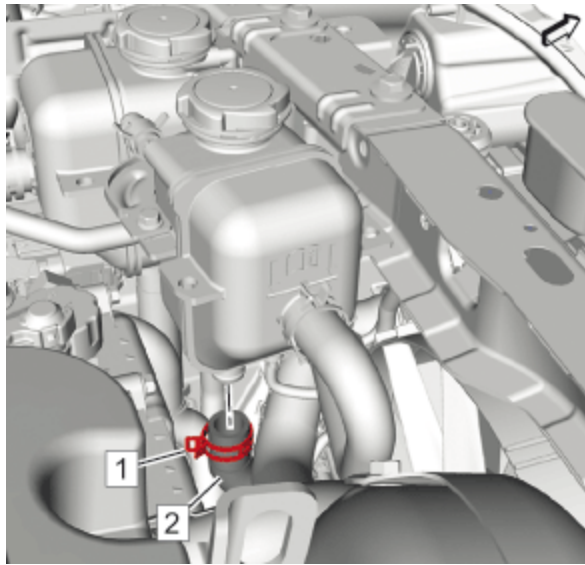


Fig. 139: Drive Motor Battery Coolant Pump Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Pump Inlet Hose (2)
2. Install Clamp (1) **BO-38185** pliers
3. Raise the vehicle.

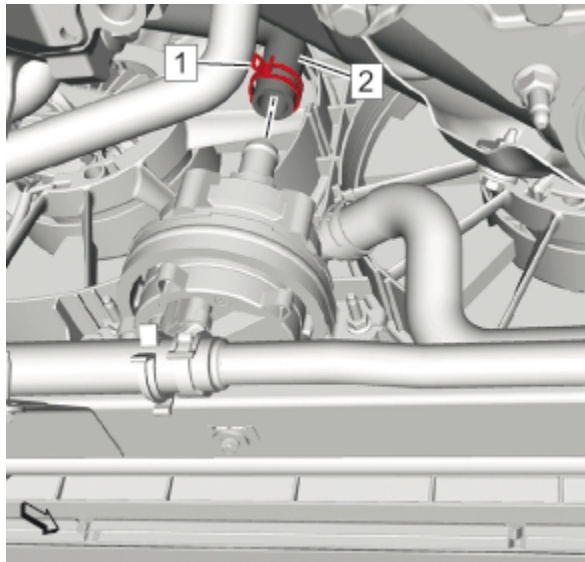


Fig. 140: Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

4. Install Coolant Hose (2)
5. Install Clamp (1) **BO-38185** pliers

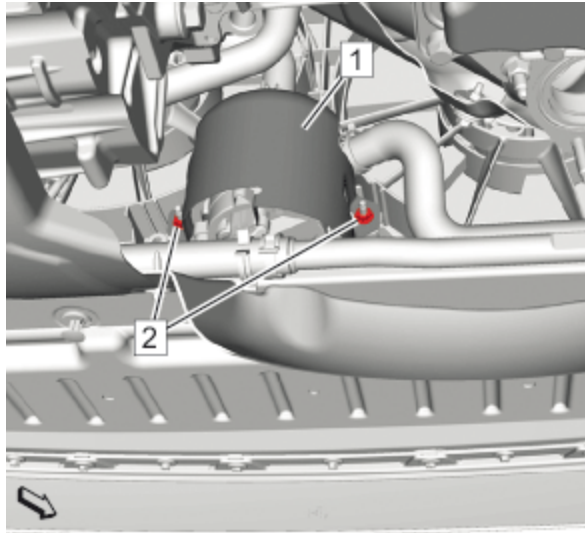


Fig. 141: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

6. Install Heat Shield (1)

CAUTION: **Fastener Caution**

7. Install Heat Shield Nut (2) and tighten 9 N.m (80 lb in)
8. Install **Exhaust Front Pipe Replacement**
9. Lower the vehicle.
10. Fill the cooling system. **Drive Motor Battery Cooling System Draining and Filling**

DRIVE MOTOR BATTERY COOLANT INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

Overview

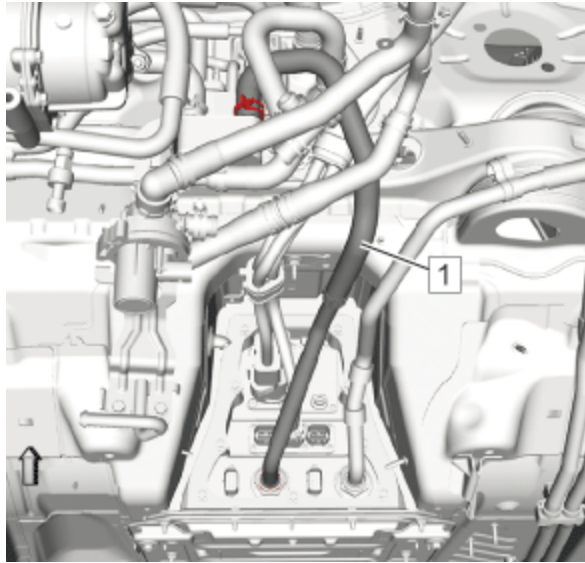


Fig. 142: Drive Motor Battery Coolant Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor battery coolant inlet hose (1) without the engine.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. **Drive Motor Battery Cooling System Draining and Filling**
3. Remove **Air Cleaner Outlet Duct Replacement**

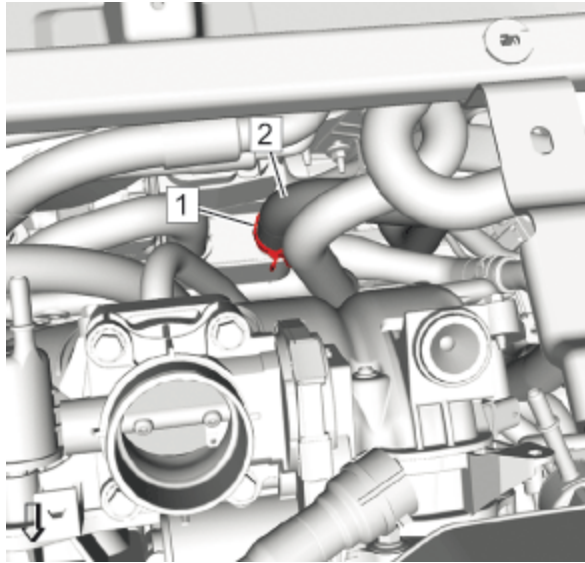


Fig. 143: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (1) **BO-38185** pliers
5. Remove Coolant Hose (2)
6. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
7. Remove [Front Compartment Splash Shield Replacement](#)

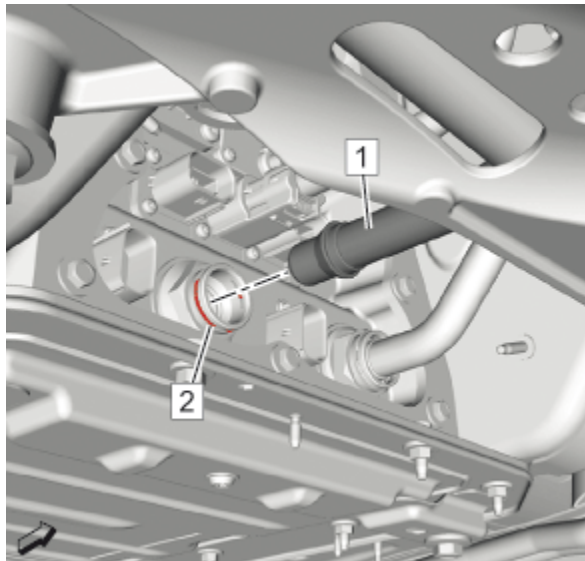


Fig. 144: Retainer And Drive Motor Battery Coolant Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

8. Remove Retainer (2)
9. Remove Drive Motor Battery Coolant Inlet Hose (1)

Installation Procedure

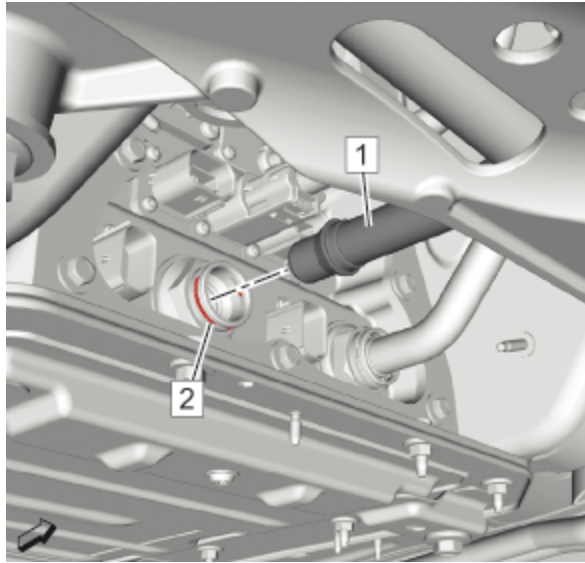


Fig. 145: Retainer And Drive Motor Battery Coolant Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install the retainer (2) to the fitting.
2. Install Drive Motor Battery Coolant Inlet Hose (1)
3. Install [Front Compartment Splash Shield Replacement](#)
4. Lower the vehicle.

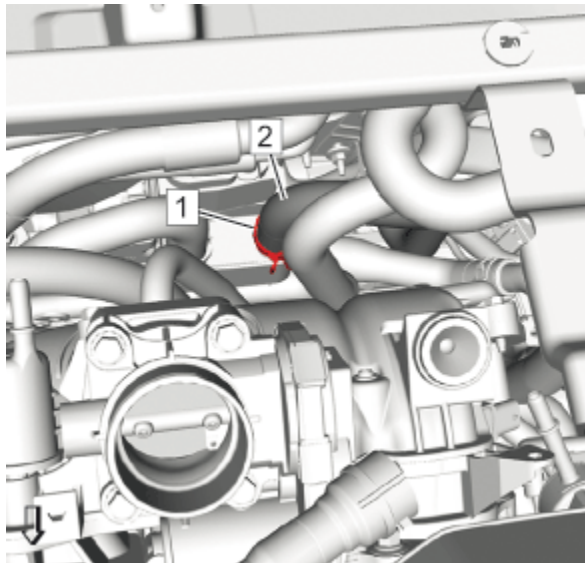


Fig. 146: Clamp And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install Coolant Hose (2)
6. Install Clamp (1) **BO-38185** pliers
7. Install [Air Cleaner Outlet Duct Replacement](#)
8. Fill the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

DRIVE MOTOR BATTERY COOLANT OUTLET HOSE REPLACEMENT (DRIVE MOTOR BATTERY TO TUBE)

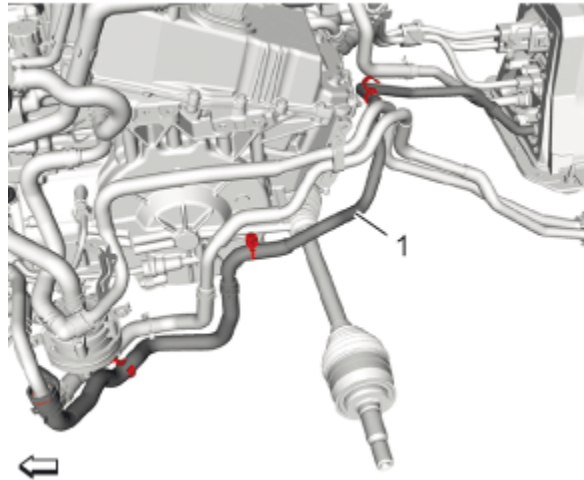


Fig. 147: Drive Motor Battery Coolant Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor battery coolant outlet hose (1) without the body.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
5. Remove [Drivetrain and Front Suspension Cradle Replacement](#)

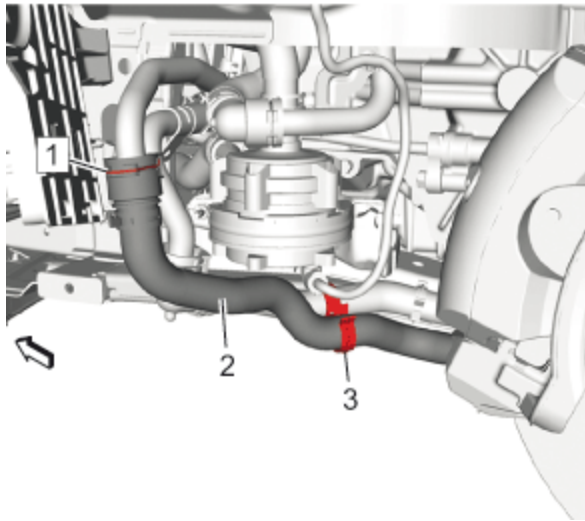


Fig. 148: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Unclip Retainer (3)
7. Loosen Clamp (1)
8. Remove Coolant Hose (2)

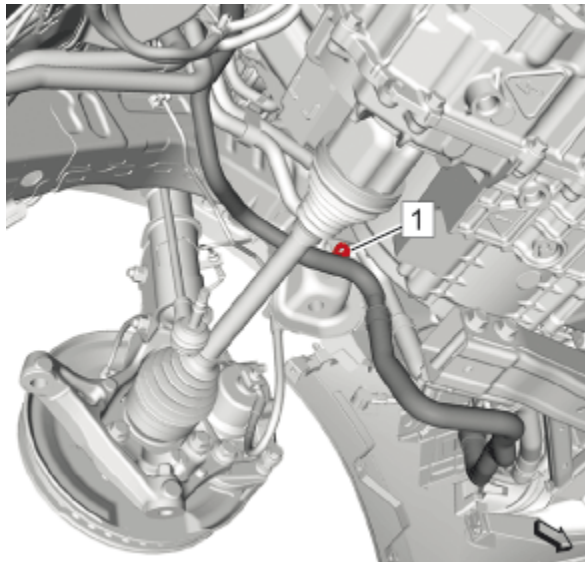


Fig. 149: Retainer

Courtesy of GENERAL MOTORS COMPANY

9. Unclip Retainer (1)

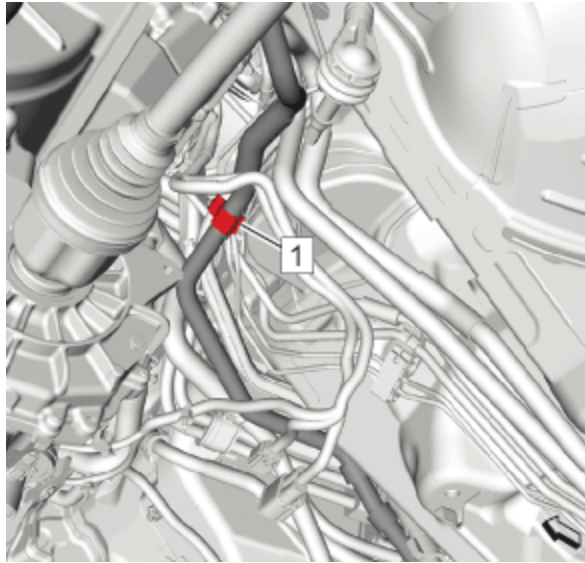


Fig. 150: Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Unclip Retainer (1)

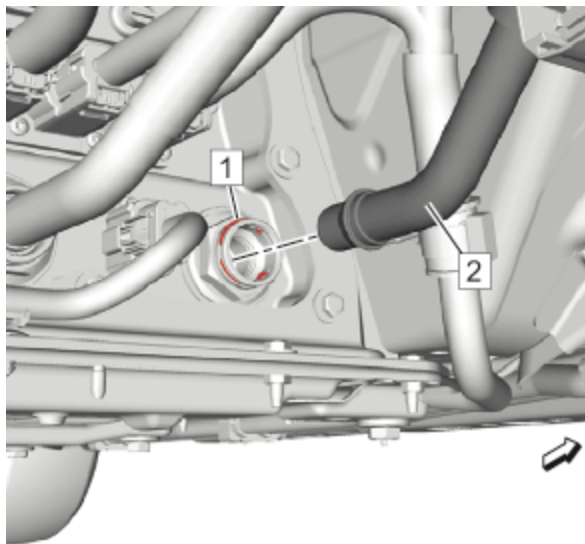


Fig. 151: Clamp And Drive Motor Battery Coolant Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

11. Loosen Clamp (1)

12. Remove Drive Motor Battery Coolant Outlet Hose (2)

Installation Procedure

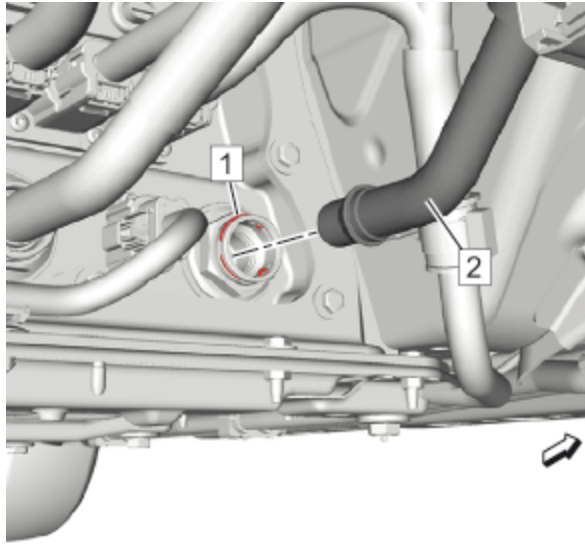


Fig. 152: Clamp And Drive Motor Battery Coolant Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Outlet Hose (2)
2. Install Clamp (1)

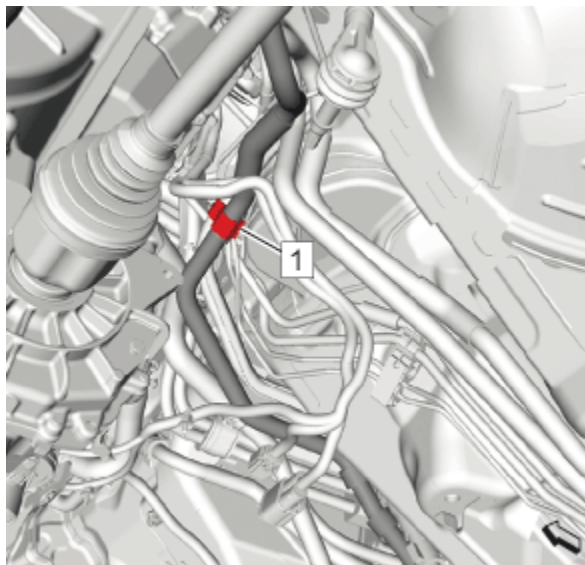


Fig. 153: Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Install Retainer (1)

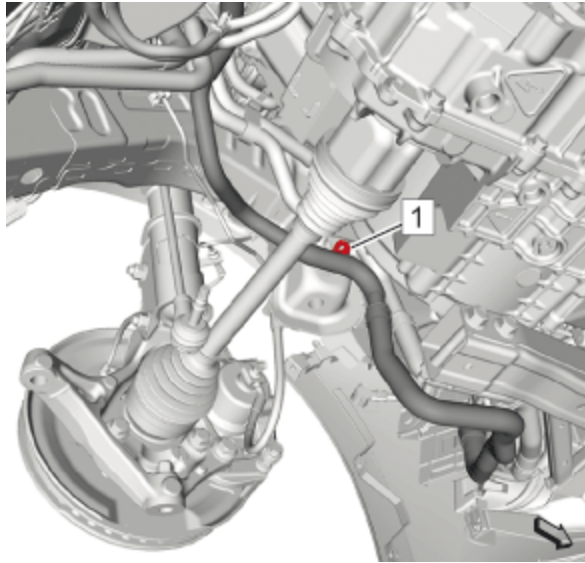


Fig. 154: Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install Retainer (1)

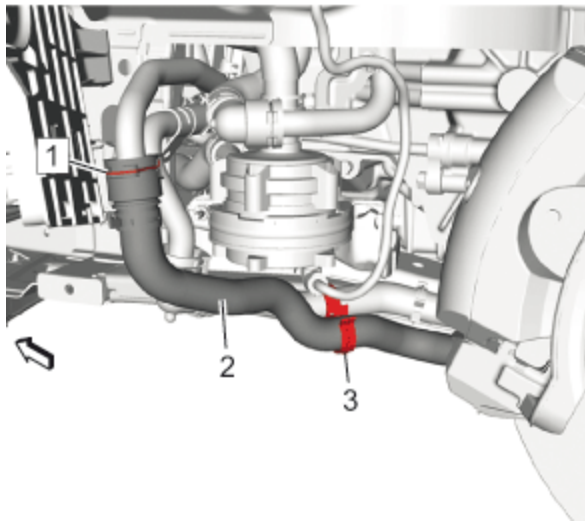


Fig. 155: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Install Coolant Hose (2)
6. Install Clamp (2)
7. Install Retainer (3)
8. Install **Drivetrain and Front Suspension Cradle Replacement**
9. Install **Front Wheelhouse Liner Replacement (Left Side)** **Front Wheelhouse Liner Replacement (Right Side)**
10. Lower the vehicle.
11. Fill the cooling system. **Drive Motor Battery Cooling System Draining and Filling**

DRIVE MOTOR BATTERY COOLANT OUTLET HOSE REPLACEMENT (TUBE TO DRIVE

MOTOR BATTERY RESERVOIR)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Overview

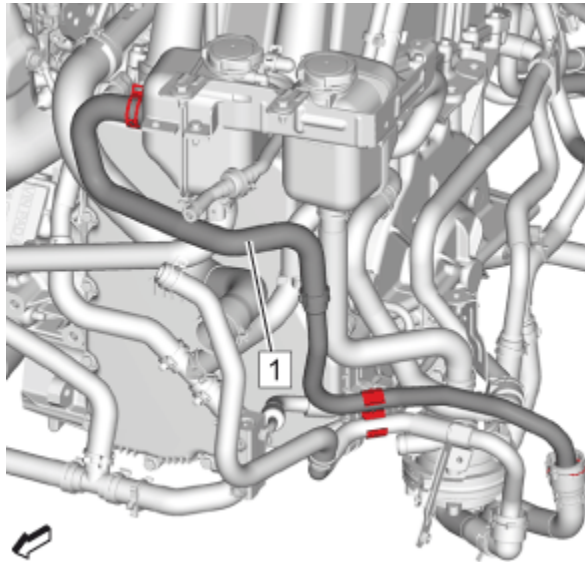


Fig. 156: Drive Motor Battery Coolant Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor battery coolant outlet hose (1) without the body and the radiator.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

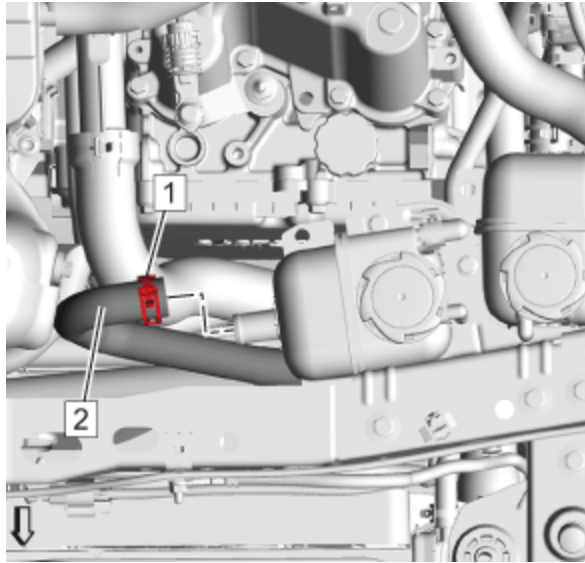


Fig. 157: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

3. Loosen Clamp (1) **BO-38185** pliers
4. Remove Coolant Hose (2)
5. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
6. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

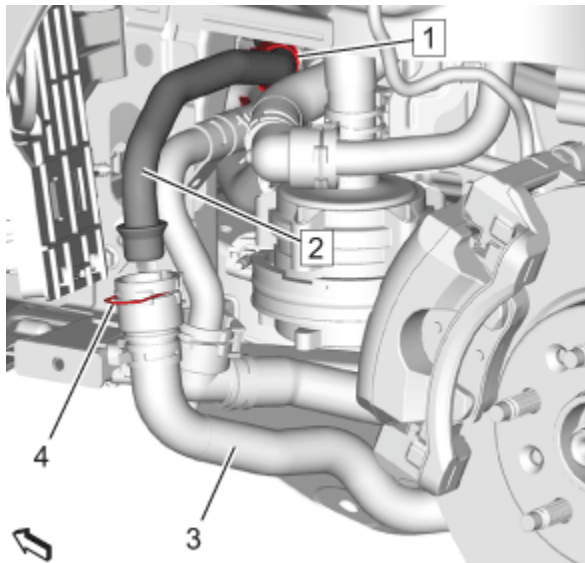


Fig. 158: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

7. Loosen Clamp (4)
8. Remove coolant Hose (3)
9. Unclip Retainer (1)
10. Remove the drive motor battery coolant outlet hose (2).

Installation Procedure

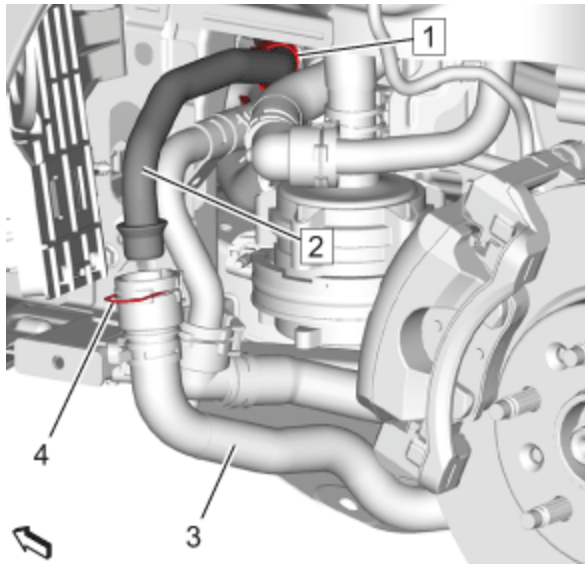


Fig. 159: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery coolant outlet hose (2).
2. Install Retainer (1)
3. Install Coolant Hose (3)
4. Clamp (4)
5. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
6. Lower the vehicle.

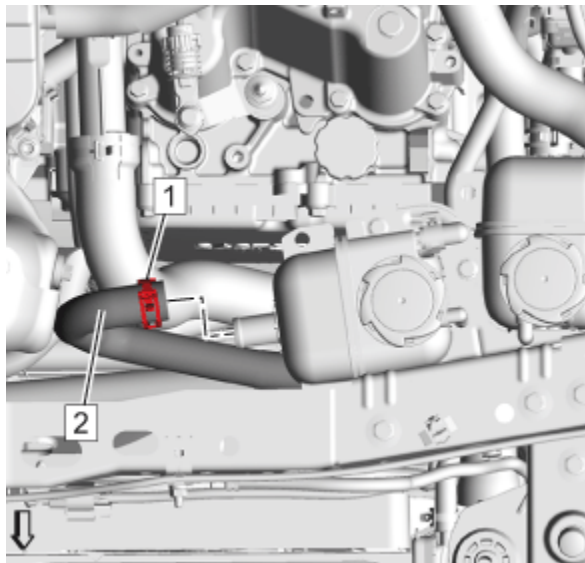


Fig. 160: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

7. Install Coolant Hose (2)
8. Install Clamp (1) **BO-38185** pliers
9. Fill the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

DRIVE MOTOR BATTERY COOLANT COOLER INLET HOSE REPLACEMENT (PUMP OUTLET TO CHILLER INLET)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

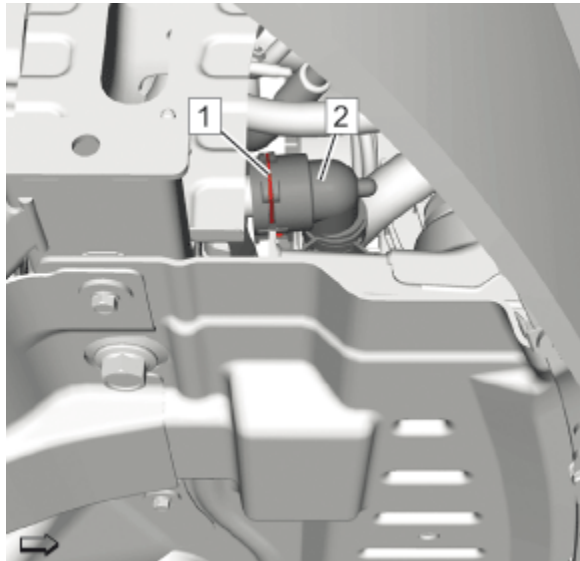


Fig. 161: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

5. Loosen Clamp(1)
6. Remove Coolant Hose(2)
7. Remove [Exhaust Front Pipe Replacement](#)

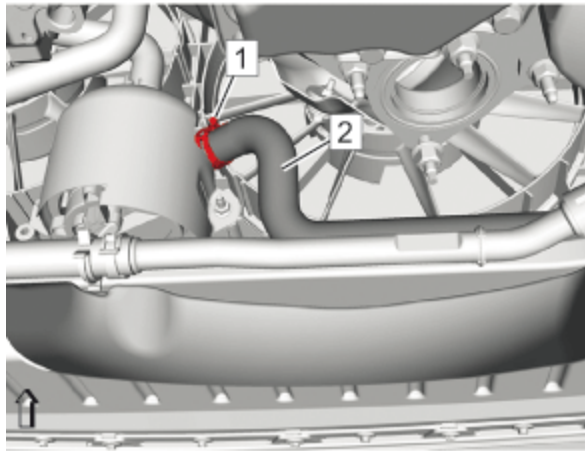


Fig. 162: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

8. Loosen Clamp(1) **BO-38185** pliers
9. Remove Coolant Hose(2)

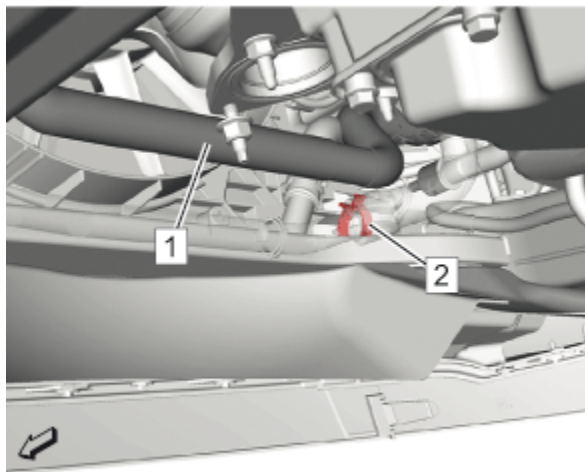


Fig. 163: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Remove the drive motor battery coolant cooler inlet hose (1) from the retainer (2).

Installation Procedure

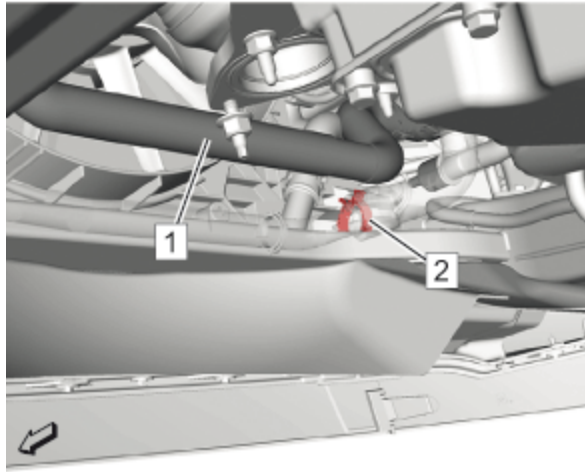


Fig. 164: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery coolant cooler inlet hose (1) to the retainer (2).

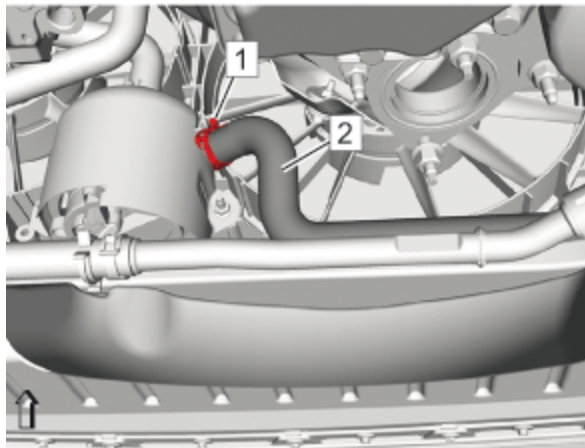


Fig. 165: Clamp And Coolant Hose
Courtesy of GENERAL MOTORS COMPANY

2. Install Coolant Hose (2)
3. Install Clamp (1) **BO-38185** pliers
4. Install **Exhaust Front Pipe Replacement**

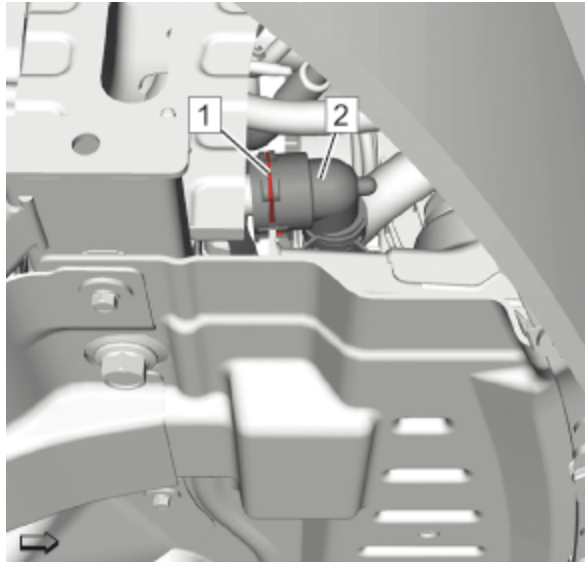


Fig. 166: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

5. Install Coolant Hose (2)
6. Install Clamp(1)
7. Install **Front Wheelhouse Liner Replacement (Left Side)** **Front Wheelhouse Liner Replacement (Right Side)**
8. Lower the vehicle.
9. Fill the cooling system. **Drive Motor Battery Cooling System Draining and Filling**

DRIVE MOTOR BATTERY COOLANT COOLER INLET HOSE REPLACEMENT (TUBE ASSEMBLY TO CHILLER)

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: **Special Tools**

Overview

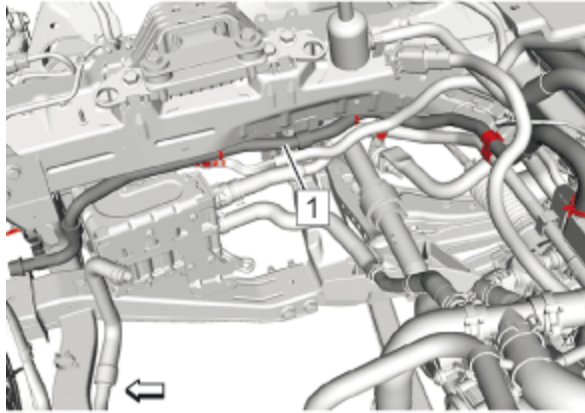


Fig. 167: Drive Motor Battery Coolant Cooler Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Routing and the fixations of the drive motor battery coolant cooler inlet hose (1) without the engine.

Removal Procedure

WARNING: Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Turn the Vehicle Power Off, remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the cooling system. **Drive Motor Battery Cooling System Draining and Filling**
3. Remove **Air Cleaner Outlet Duct Replacement**

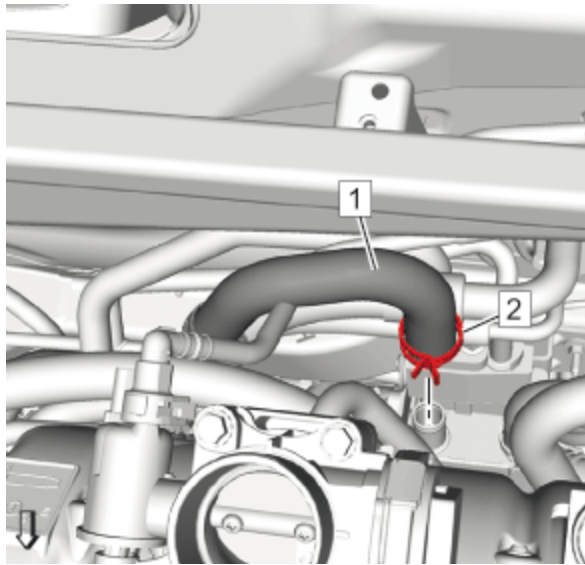


Fig. 168: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Clamp (2)
5. Remove Coolant Hose (1) **BO-38185** pliers

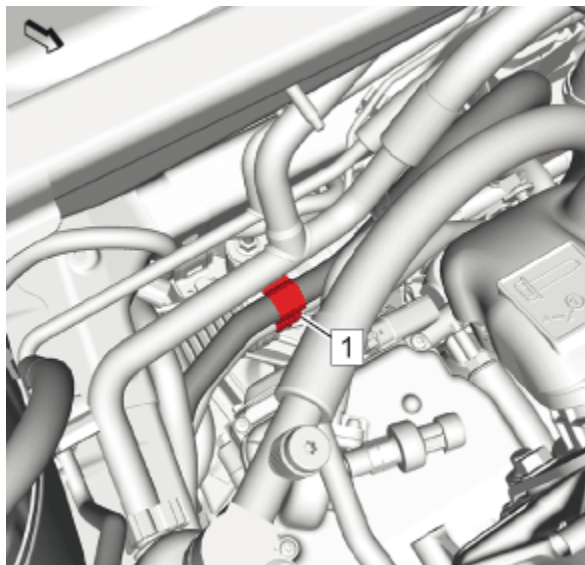


Fig. 169: Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Unclip Retainer (1)
7. Raise and support the vehicle. **Lifting and Jacking the Vehicle**

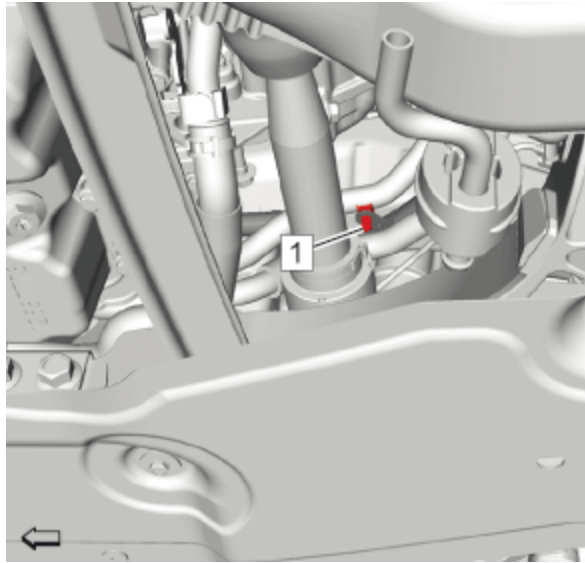


Fig. 170: Retainer

Courtesy of GENERAL MOTORS COMPANY

8. Unclip Retainer (1)

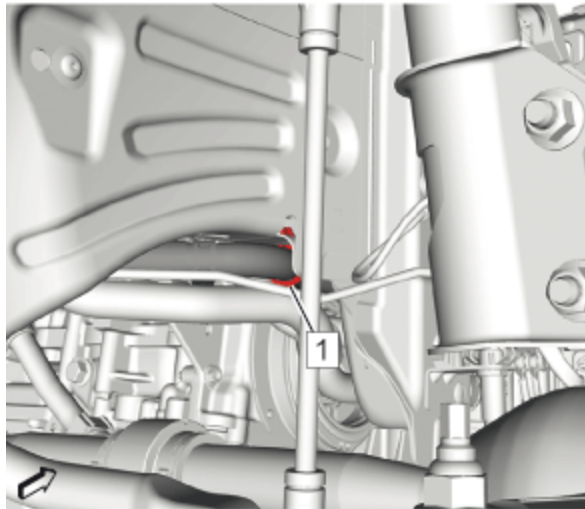


Fig. 171: Retainer

Courtesy of GENERAL MOTORS COMPANY

9. Unclip Retainer (1)
10. Remove **Front Underbody Air Deflector Replacement**

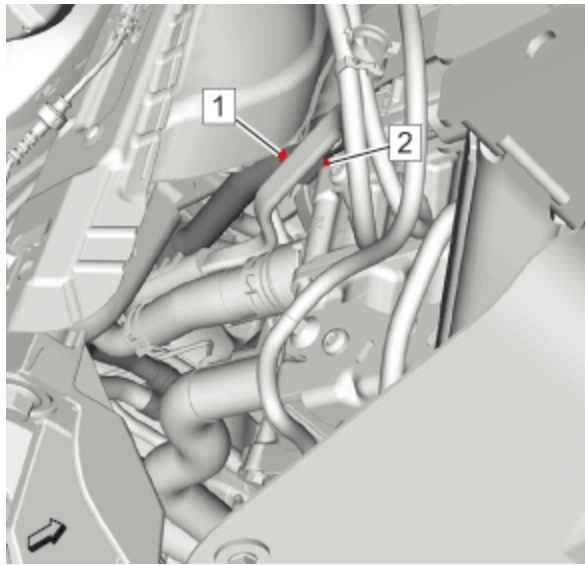


Fig. 172: Retainer

Courtesy of GENERAL MOTORS COMPANY

11. Unclip Retainer (1, 2)

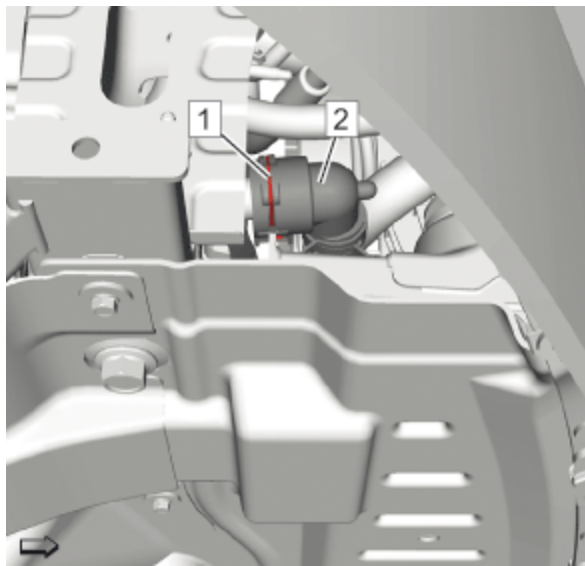


Fig. 173: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

12. Loosen Clamp(1)

13. Remove Coolant Hose(2)

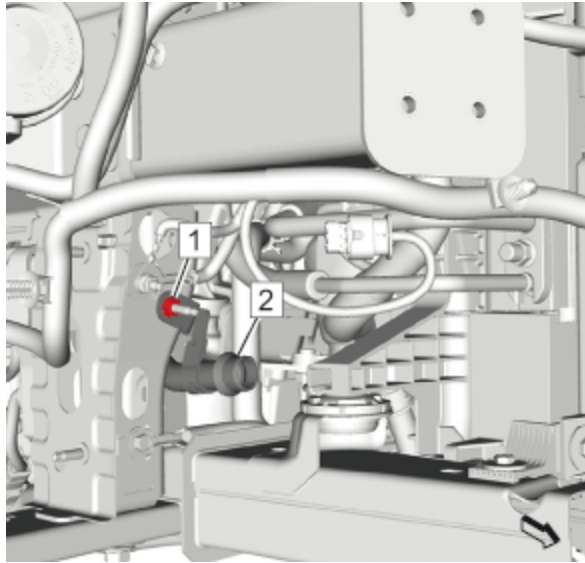


Fig. 174: Drive Motor Battery Coolant Cooler Inlet Hose Nut
Courtesy of GENERAL MOTORS COMPANY

14. Remove the drive motor battery coolant cooler inlet hose nut (1).

NOTE: Turn the hose during the removal.

15. Remove the drive motor battery coolant cooler inlet hose (2) in the front direction.

Installation Procedure

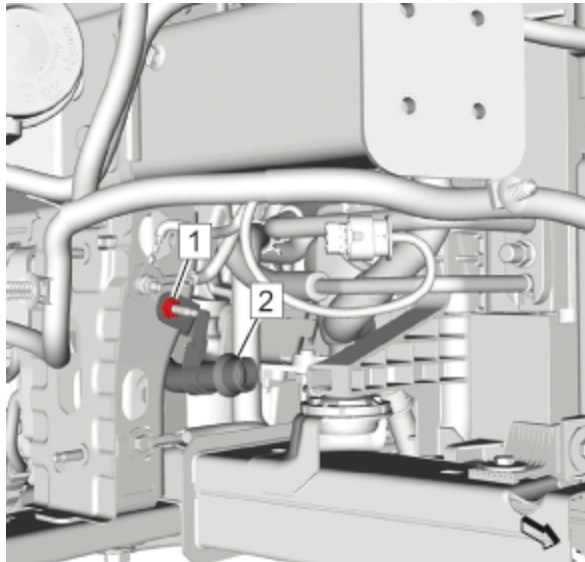


Fig. 175: Drive Motor Battery Coolant Cooler Inlet Hose Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Turn the hose during the installation.

1. Install the drive motor battery coolant cooler inlet hose (2).

CAUTION: Fastener Caution

2. Install the drive motor battery coolant cooler inlet hose nut (1) and tighten to 9 N.m (80 lb in).

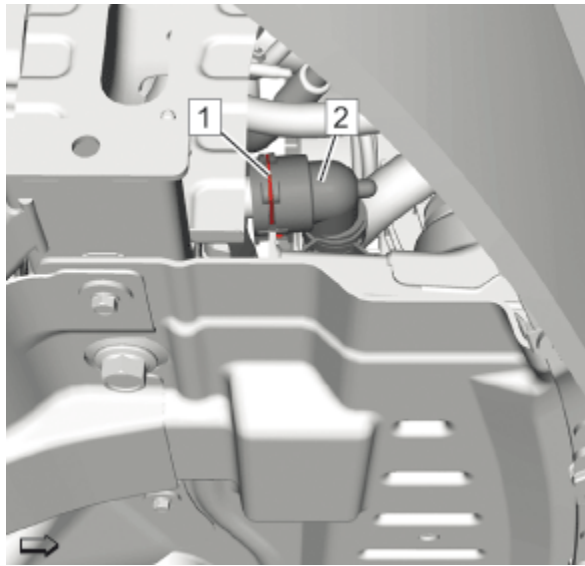


Fig. 176: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

3. Install Coolant Hose (2)
4. Install Clamp (1)

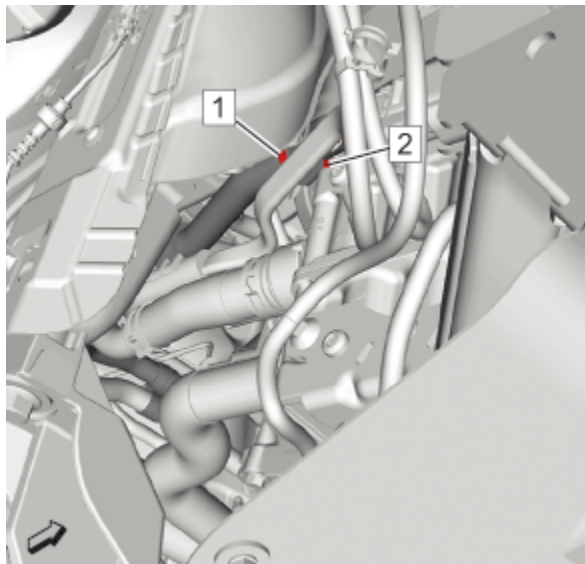


Fig. 177: Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Install Retainer (1, 2)
6. Install **Front Underbody Air Deflector Replacement**

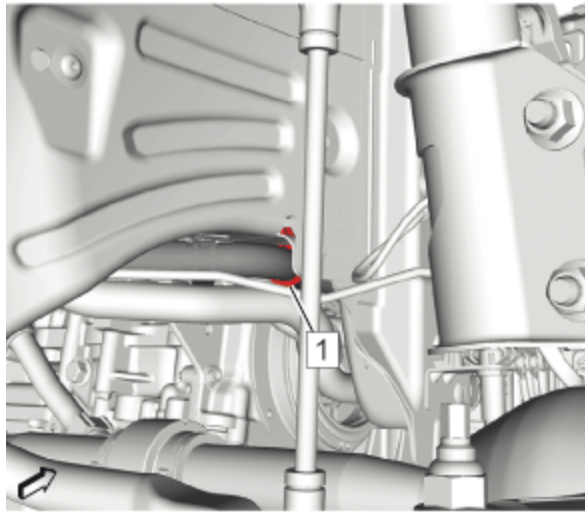


Fig. 178: Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Retainer(1)

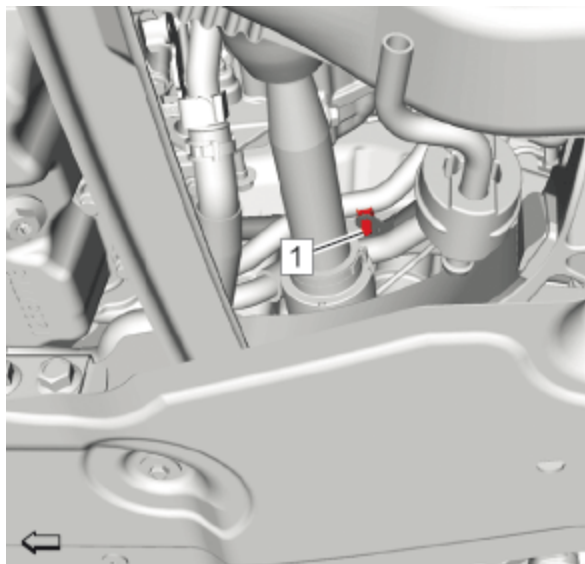


Fig. 179: Retainer

Courtesy of GENERAL MOTORS COMPANY

8. Install Retainer (1)

9. Lower the vehicle.

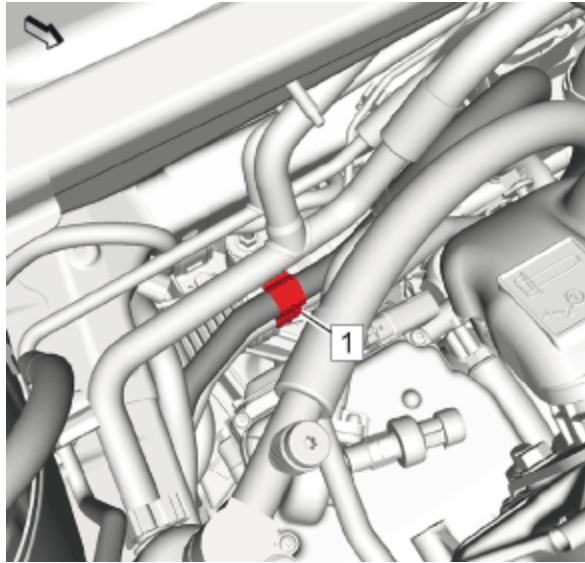


Fig. 180: Retainer

Courtesy of GENERAL MOTORS COMPANY

10. Install Retainer (1)

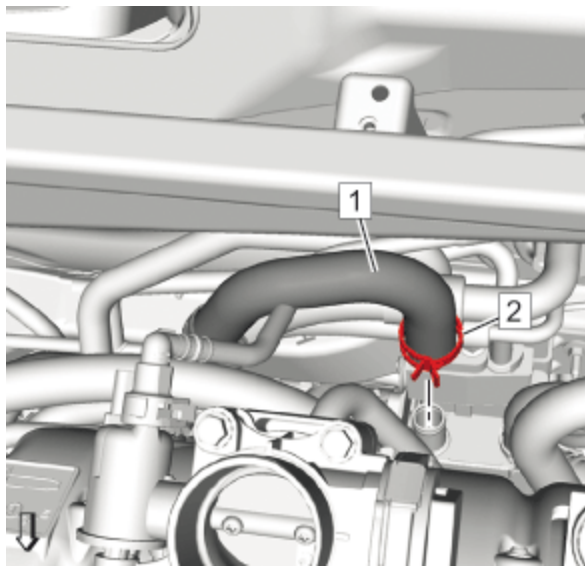


Fig. 181: Clamp And Coolant Hose

Courtesy of GENERAL MOTORS COMPANY

11. Install Coolant Hose (1)
12. Install Clamp (2) **BO-38185** pliers
13. Install [Air Cleaner Outlet Duct Replacement](#)
14. Fill the cooling system. [Drive Motor Battery Cooling System Draining and Filling](#)

HIGH VOLTAGE BATTERY COOLING MANIFOLD INLET HOSE REPLACEMENT (JUNCTION BLOCK TO SECTION 1)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove [High Voltage Battery Cover Replacement](#)
2. Remove [High Voltage Battery Disconnect Relay Replacement](#)

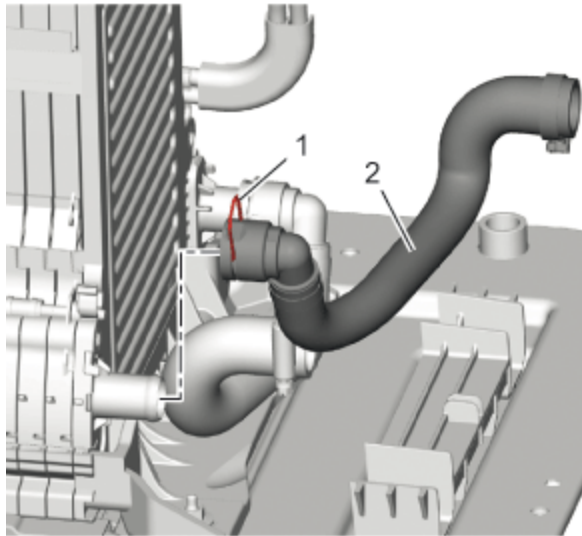


Fig. 182: Cell Battery Cooling Manifold Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Loosen the clamp.(1)
4. Remove the cell battery cooling manifold inlet hose (2).

Installation Procedure

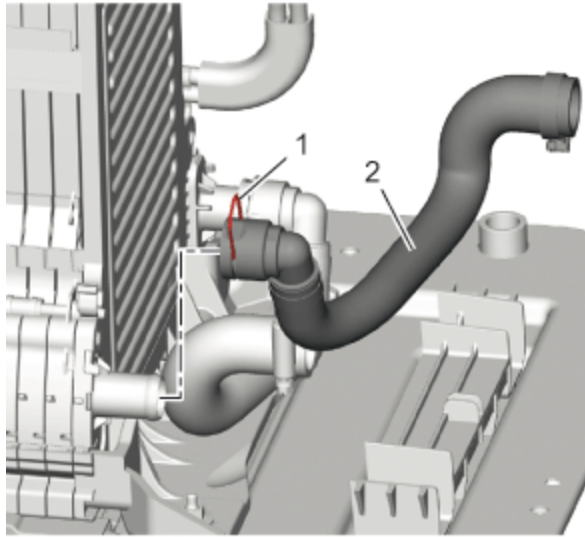


Fig. 183: Cell Battery Cooling Manifold Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

1. Install the cell battery cooling manifold inlet hose (2).
2. Install Clamp (1)
3. Install [High Voltage Battery Disconnect Relay Replacement](#)
4. Install [High Voltage Battery Cover Replacement](#)

HIGH VOLTAGE BATTERY COOLING MANIFOLD INLET HOSE REPLACEMENT (SECTION 2 TO REAR SECTION)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Install [High Voltage Battery Cover Replacement](#)

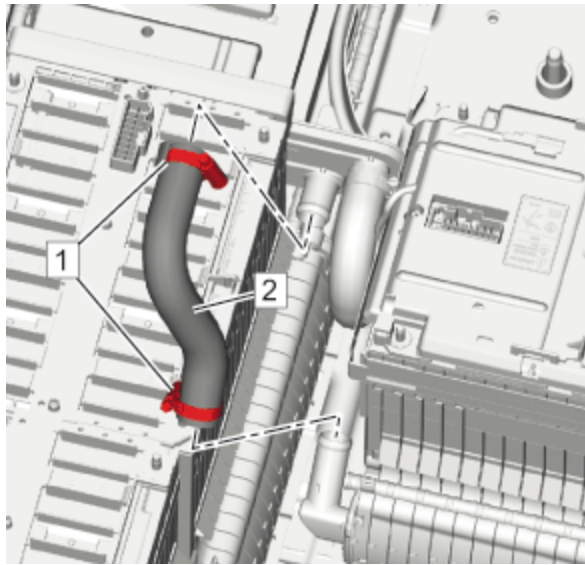


Fig. 184: High Voltage Battery Cooling Manifold Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Loosen High Voltage Battery Cooling Manifold Inlet Hose Clamp (1)
3. Remove the cell battery cooling manifold inlet hose (2).

Installation Procedure

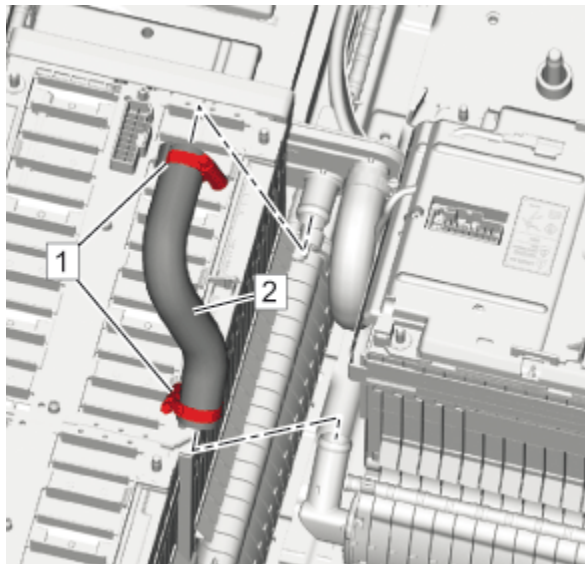


Fig. 185: High Voltage Battery Cooling Manifold Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the cell battery cooling manifold inlet hose (2).

CAUTION: Fastener Caution

2. High Voltage Battery Cooling Manifold Inlet Hose Clamp (1) Tighten 2.1 N.m (19 lb in)
3. Install **High Voltage Battery Cover Replacement**

HIGH VOLTAGE BATTERY COOLING PLATE HOSE REPLACEMENT

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover Replacement

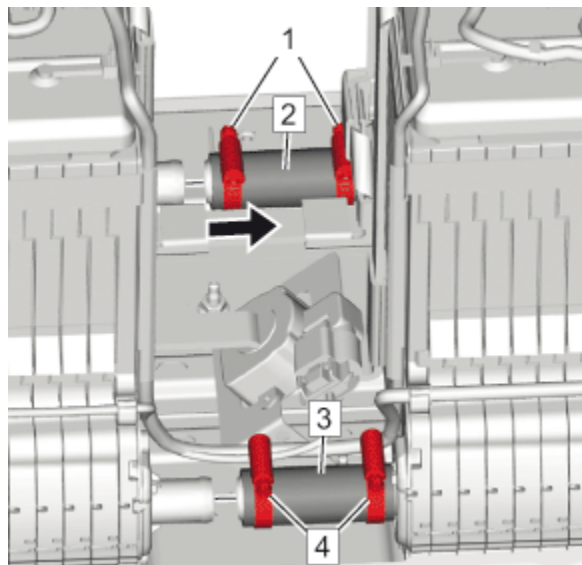


Fig. 186: High Voltage Battery Cooling Plate Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Loosen High Voltage Battery Cooling Plate Hose Clamp (1, 4)
3. Move the 2 high voltage battery cooling plate hoses (2, 3) in direction of arrow.

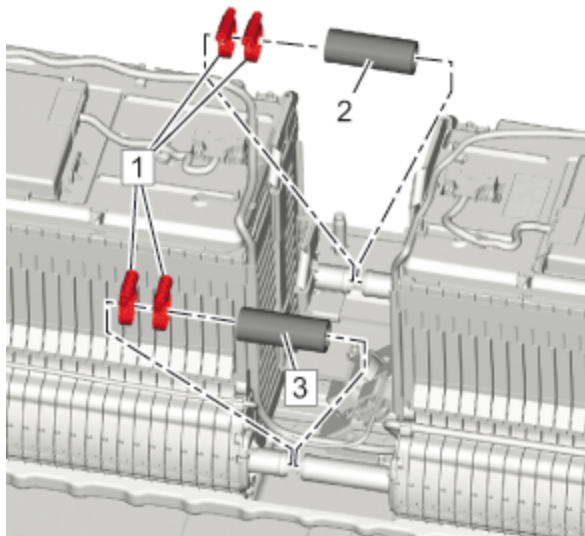


Fig. 187: High Voltage Battery Cooling Plate Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. High Voltage Battery Cooling Plate Hose Clamp (1)
5. High Voltage Battery Cooling Plate Hose (2, 3)

Installation Procedure

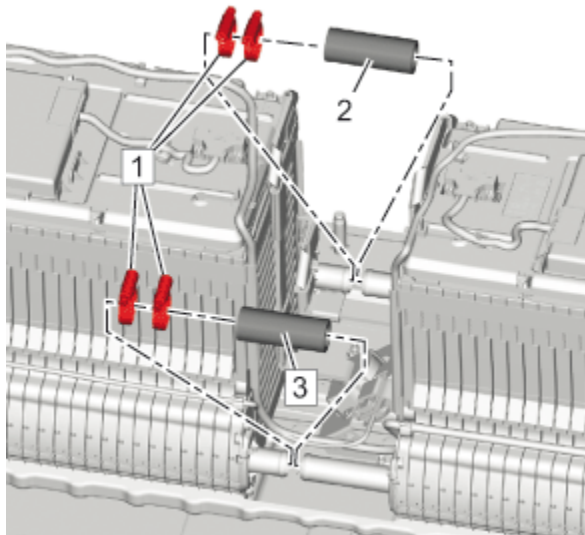


Fig. 188: High Voltage Battery Cooling Plate Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install High Voltage Battery Cooling Plate Hose (2, 3)
2. Install High Voltage Battery Cooling Plate Hose Clamp (1)

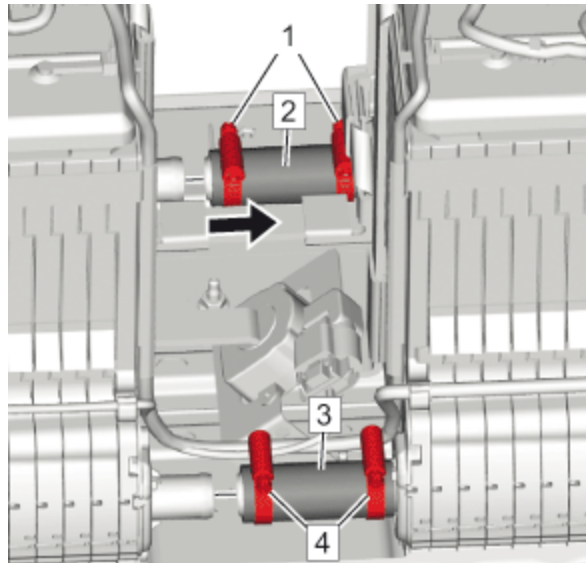


Fig. 189: High Voltage Battery Cooling Plate Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

3. Move the 2 cell battery cooling plate hoses (2, 3) against direction of arrow.

CAUTION: Fastener Caution

4. High Voltage Battery Cooling Plate Hose Clamp (1) - Tighten 2.1 N.m (19 lb in)
5. Install High Voltage Battery Cover Replacement

HIGH VOLTAGE BATTERY COOLING MANIFOLD OUTLET HOSE REPLACEMENT (JUNCTION BLOCK TO SECTION 1)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover Replacement
2. Remove High Voltage Battery Disconnect Relay Replacement

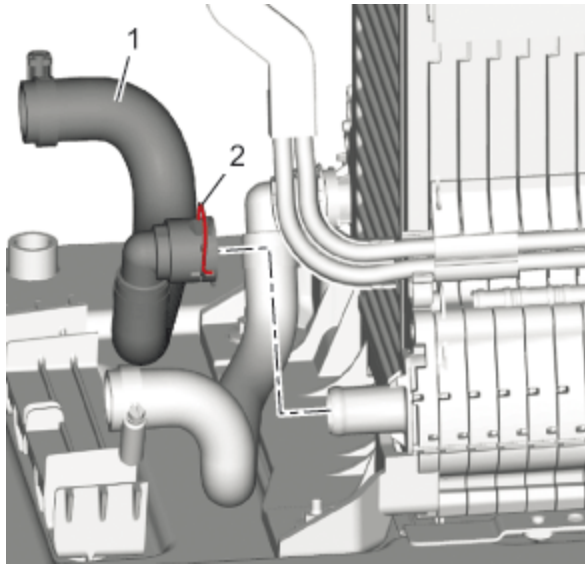


Fig. 190: Clamp And Cell Battery Cooling Manifold Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Loosen the clamp.(2)
4. Remove the cell battery cooling manifold outlet hose (1).

Installation Procedure

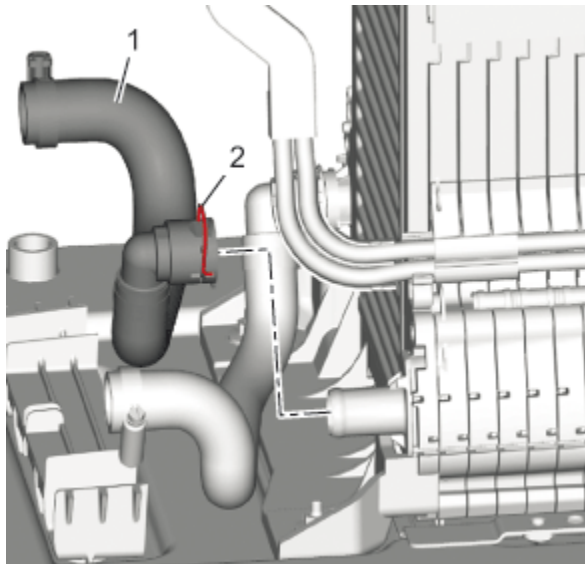


Fig. 191: Clamp And Cell Battery Cooling Manifold Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install the cell battery cooling manifold outlet hose (1).
2. Install Clamp (2)
3. Install [High Voltage Battery Disconnect Relay Replacement](#)
4. Install [High Voltage Battery Cover Replacement](#)

HIGH VOLTAGE BATTERY COOLING MANIFOLD OUTLET HOSE REPLACEMENT (SECTION 2 TO REAR SECTION)

Removal Procedure

WARNING: Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Remove High Voltage Battery Cover Replacement

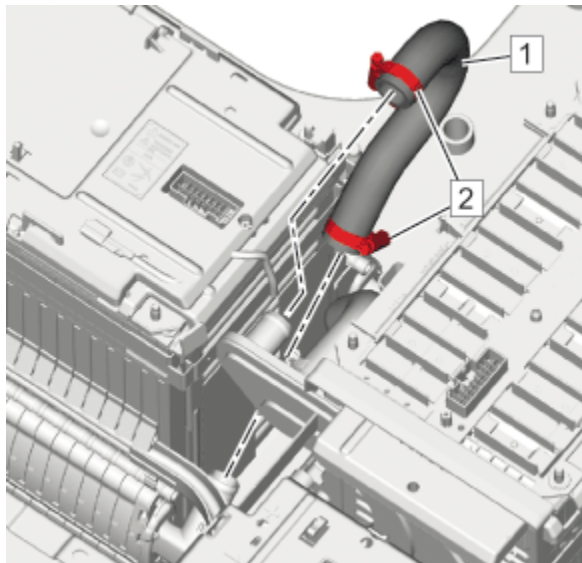


Fig. 192: High Voltage Battery Cooling Manifold Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Loosen High Voltage Battery Cooling Manifold Outlet Hose Clamp (2)
3. Remove the high voltage battery cooling manifold outlet hose (1).

Installation Procedure

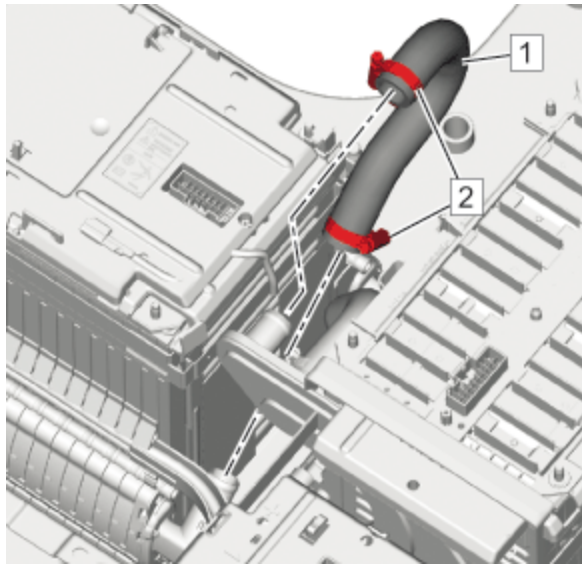


Fig. 193: High Voltage Battery Cooling Manifold Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the high voltage battery cooling manifold outlet hose (1).

CAUTION: Fastener Caution

2. High Voltage Battery Cooling Manifold Outlet Hose Clamp (2) - Tighten 2.1 N.m (19 lb in)
3. Install High Voltage Battery Cover Replacement

DESCRIPTION AND OPERATION

HYBRID/EV COOLING SYSTEM DESCRIPTION AND OPERATION

This vehicle is equipped with three fully independent cooling systems.

1. The hybrid/EV electronics cooling system is dedicated to cooling the following components:
 - 14V accessory power module
 - battery charger
 - drive motor generator power inverter module
2. The hybrid/EV battery pack cooling system is dedicated to cooling and heating the high voltage hybrid/EV battery.
3. The engine cooling system is dedicated to:
 - cooling the engine
 - providing heat to the passenger compartment

Hybrid Electronics Cooling System Description and Operation

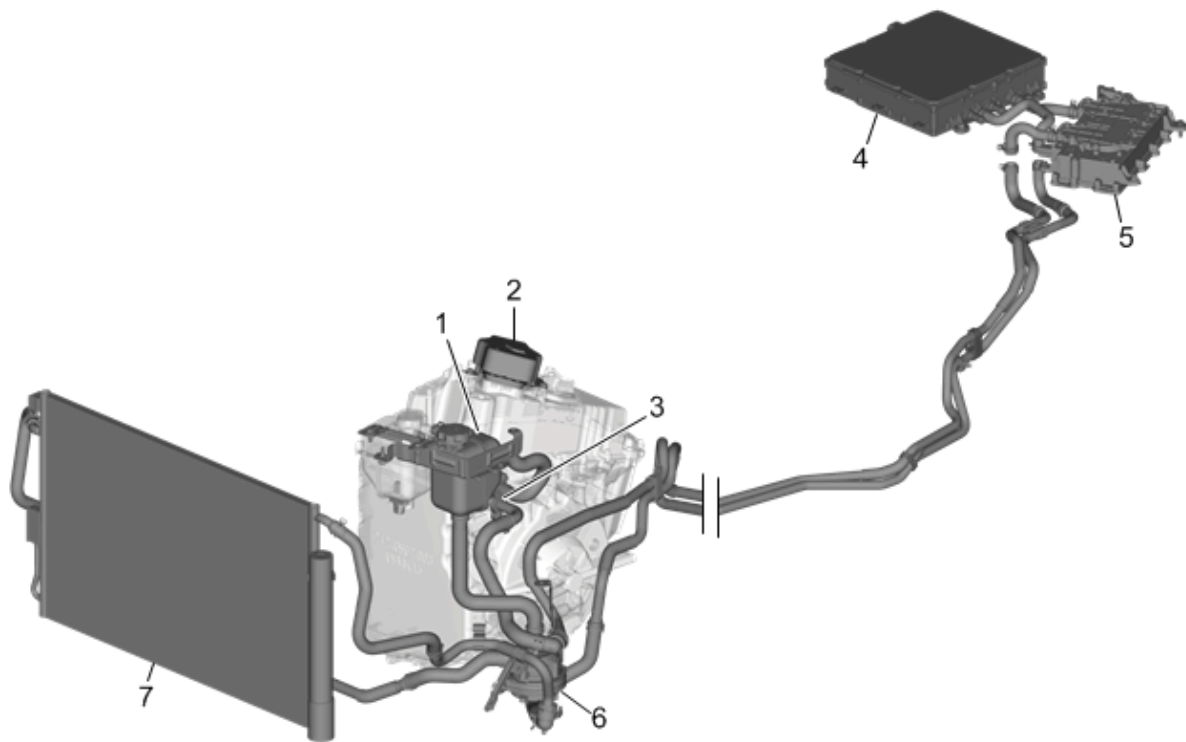


Fig. 194: Hybrid Electronics Cooling System Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Electronics Coolant Reservoir
2	Drive Motor Generator Power Inverter Module
3	Transmission Coolant Inlet and Outlet Ports
4	Battery Charger
5	14 V Accessory Power Module
6	12 V Hybrid/EV Coolant Pump
7	Hybrid/EV Radiator

The primary purpose of the hybrid/EV electronics cooling loop is to cool the drive motor generator power inverter module, battery charger, and the 14V accessory power module. The hybrid/EV electronics cooling system uses the hybrid/EV electronics radiator, engine control module inputs, two 12 V pulse width modulated (PWM) radiator fans and a 12 V hybrid/EV electronics coolant pump to circulate coolant through the system. The hybrid/EV powertrain control module 2 activates the hybrid/EV electronics coolant pump and monitors a temperature sensor in the hybrid/EV electronics radiator. The hybrid/EV electronics coolant pump will be activated when the vehicle is on and during charging.

The hybrid/EV electronics cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the hybrid/EV electronics coolant system.

Hybrid/EV Battery Pack Cooling System Description and Operation

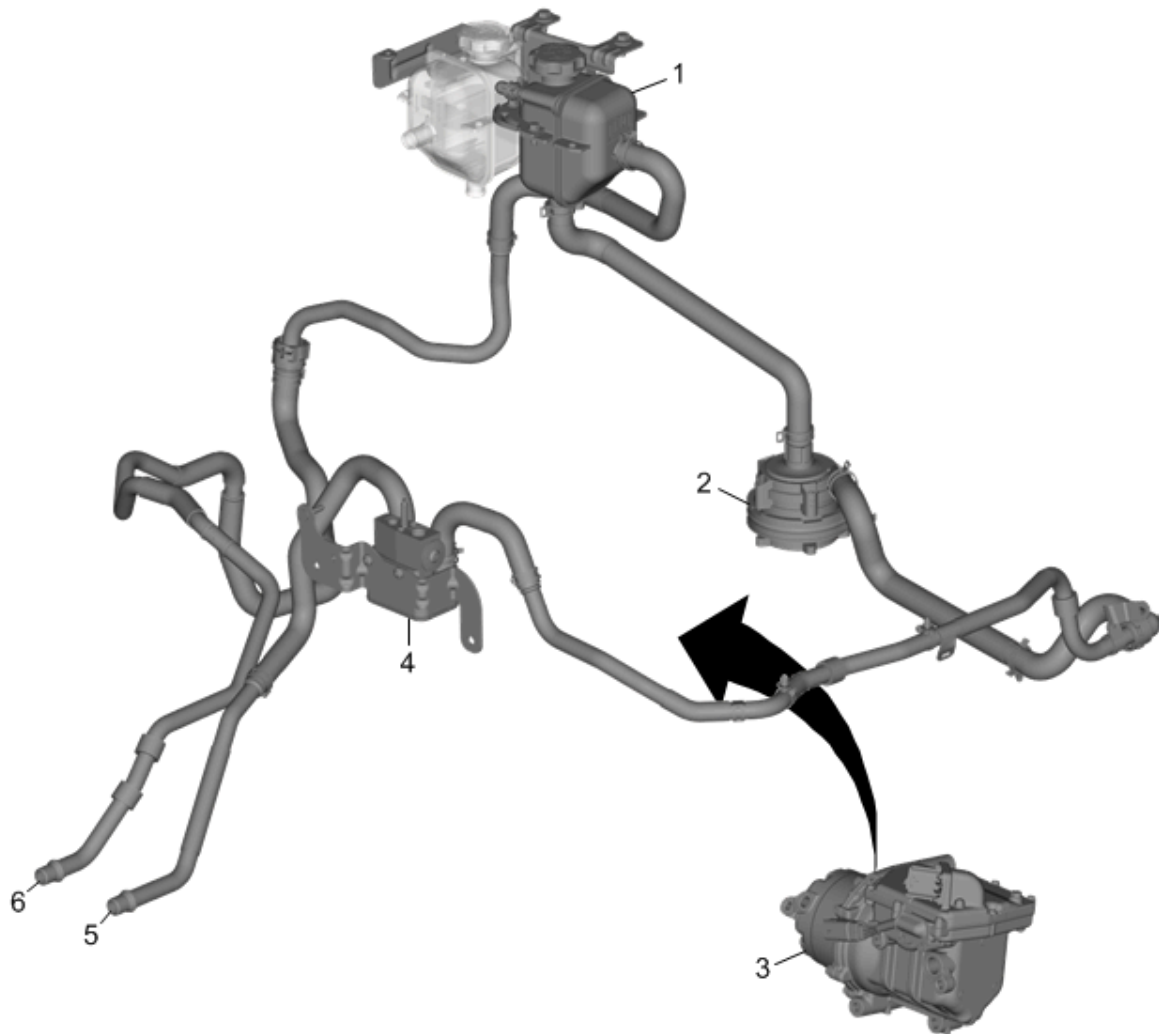


Fig. 195: Hybrid/EV Battery Pack Cooling System Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Coolant Surge Tank
2	12 V Hybrid/EV Battery Pack Coolant Pump
3	A/C Compressor
4	Refrigerant/Coolant Heat Exchanger
5	Hybrid/EV Battery Coolant Inlet
6	Hybrid/EV Battery Coolant Outlet

The energy storage system cooling system uses a 12 V hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the electric A/C compressor motor control module assembly to cool down the high voltage hybrid/EV battery. There is also a high voltage heater inside the hybrid/EV battery to heat the coolant entering the hybrid/EV battery when needed. The hybrid/EV powertrain control module 2 monitors the hybrid/EV battery coolant temperature, hybrid/EV battery cell temperature, refrigerant temperature, refrigerant pressure, and Coolant Level Sensor. The hybrid/EV powertrain control module 2 determines how much hybrid/EV battery cooling or heating is required and turns on the hybrid/EV battery pack coolant pump. Depending on what is required, it will operate the radiator fans and request the A/C Compressor Module to turn on the high voltage A/C compressor, or turn on the high voltage hybrid/EV battery pack heater.

The hybrid/EV battery pack cooling system could be activated when the vehicle is operating, during charging, or when the vehicle is OFF and maintaining the hybrid/EV battery pack temperature. Refer to [Automatic HVAC Description and Operation](#) .

The hybrid/EV battery pack coolant level sensor is attached to the coolant surge tank. The level sensor is a 2 state switch which changes state when the level in the surge tank gets low. The hybrid/EV powertrain control module 2 uses the hybrid/EV battery pack coolant level sensor to determine if disabling the hybrid/EV battery pack charging operation is necessary due to a loss of coolant.

The hybrid/EV battery pack cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the battery coolant system.

Passenger Compartment Heater System Description and Operation

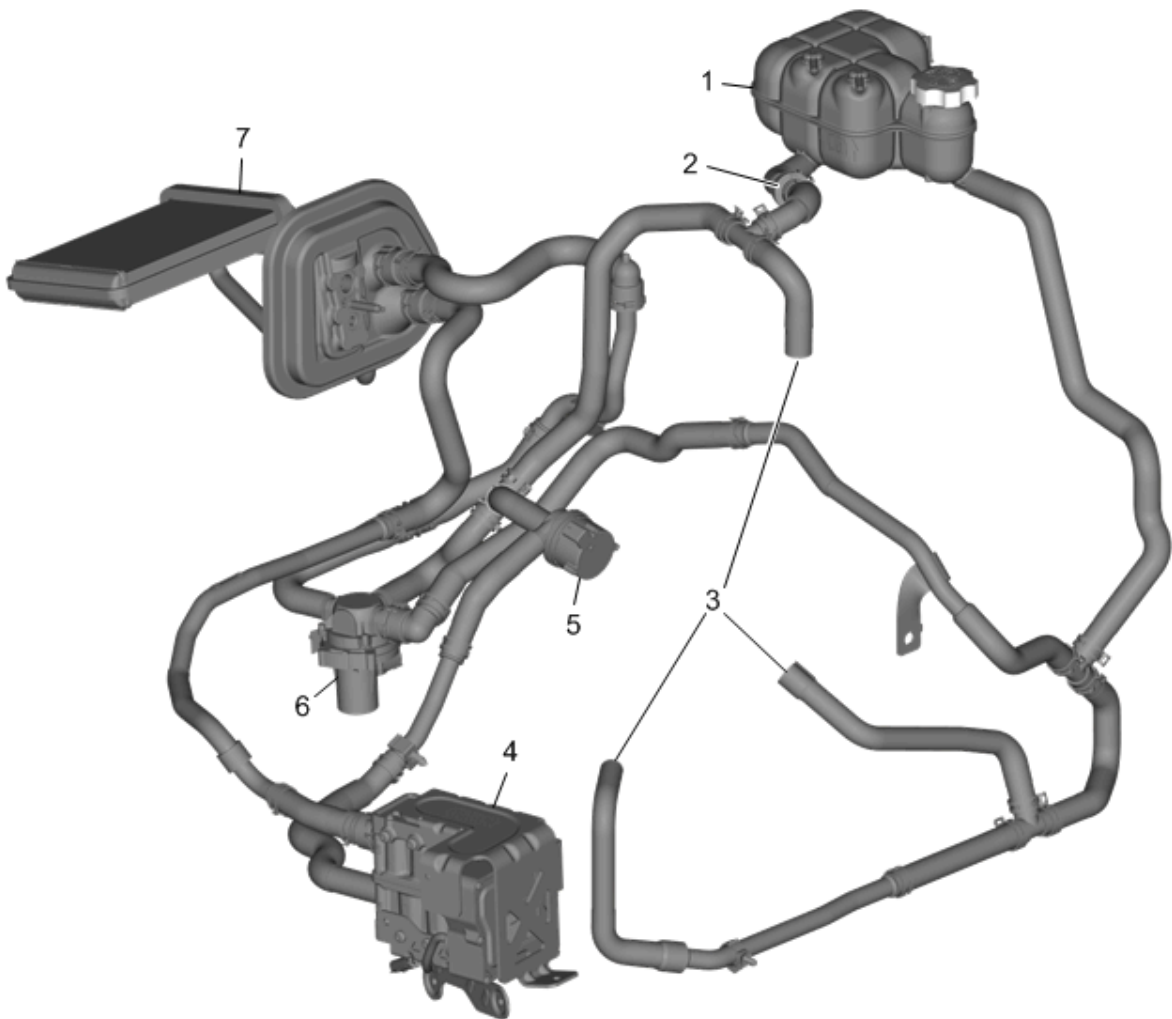


Fig. 196: Passenger Compartment Heater System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Coolant Surge Tank

Callout	Component Name
2	Check Valve
3	Engine Connection
4	High Voltage Heater Control Module
5	12 V Auxiliary Heater Coolant Pump
6	Passenger Compartment Heater Coolant Control Valve
7	Heater Core

The passenger compartment heater system uses the engine radiator, a 12 V auxiliary heater coolant pump, a passenger compartment heater coolant control valve, a high voltage coolant heater control module and a heater core.

The passenger compartment heater coolant control valve has two positions. When commanded in bypass mode, as when the engine is OFF, the passenger compartment heater coolant control valve separates the engine and the high voltage coolant heater control module coolant loops to prevent heat generated by the high voltage heater from dissipating into the engine coolant loop. After the engine starts up and has attained sufficient warmth, the passenger compartment heater coolant control valve is commanded to normal mode and the two coolant loops are linked. Linking allows excess engine heat to assist the high voltage coolant heater control module in heating the passenger compartment. The passenger compartment heater control valve contains an internal position sensor that the hybrid powertrain control module 2 monitors. When the engine coolant temperature heats up, a valve position learn procedure takes place.

The HVAC control module turns on the auxiliary heater coolant pump and monitors the temperature sensors in the passenger compartment and coolant loop to determine if high voltage coolant heater control module operation is needed. Passenger compartment heat is provided by air flowing through the heater core. When operating the vehicle in cold temperatures, the engine may run for short periods to assist in maximizing heat efficiency to the passenger compartment depending on the outside temperature and the amount of passenger compartment heat requested by the vehicle operator.

The hybrid/EV powertrain control module 2 will command the passenger compartment heater coolant control valve into bypass mode when the module goes to sleep, at controller wake-up, and during other times except:

- During learn, after extended loss of 12 V power to the controller
- When the scan tool is sending a command.
- If the valve is stuck in an intermediate position, between two end positions, due to failure or debris.

The engine/passenger compartment heater cooling system circulates a 50/50 mixture of DEX-COOLÂ® and deionized water.

Radiator Cooling Fan Operation

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. The engine control module processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The engine control module decides if and at what speed the cooling fans should operate. The engine control module sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. The hybrid/EV electronics coolant pump and radiator cooling fans may also be enabled during an after-run event, determined by coolant loop temperature.

If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the engine control module is not awake, the hybrid/EV powertrain control module 2 will control the

cooling fans. If active cooling of the Hybrid/EV Battery Pack is needed, the engine control module wakes up to operate the air conditioning control module and then the engine control module is the master controller for the fans.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

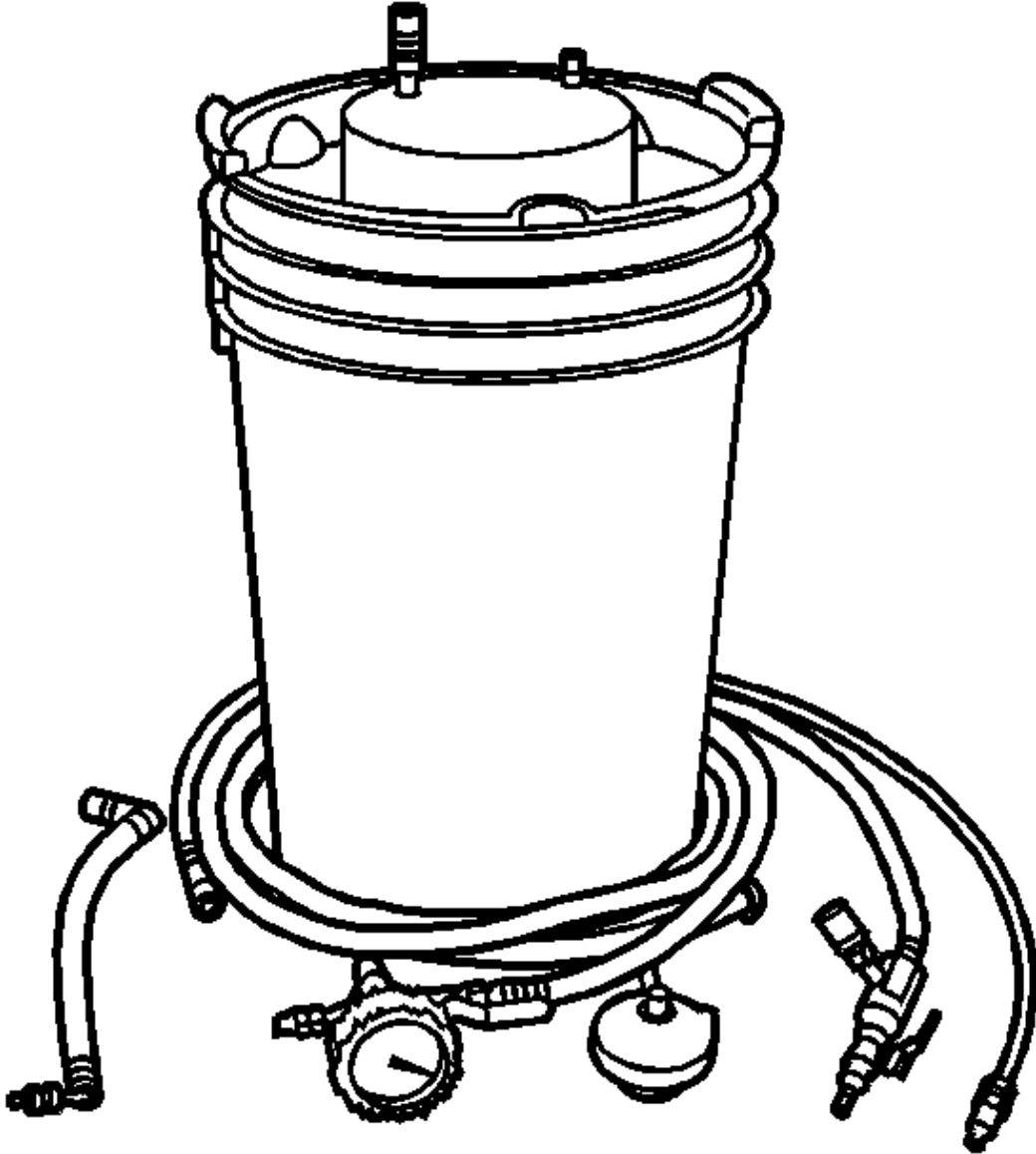
Illustration	Tool Number/ Description
	GE 47716 Vac-N-Fill Coolant Refill Tool

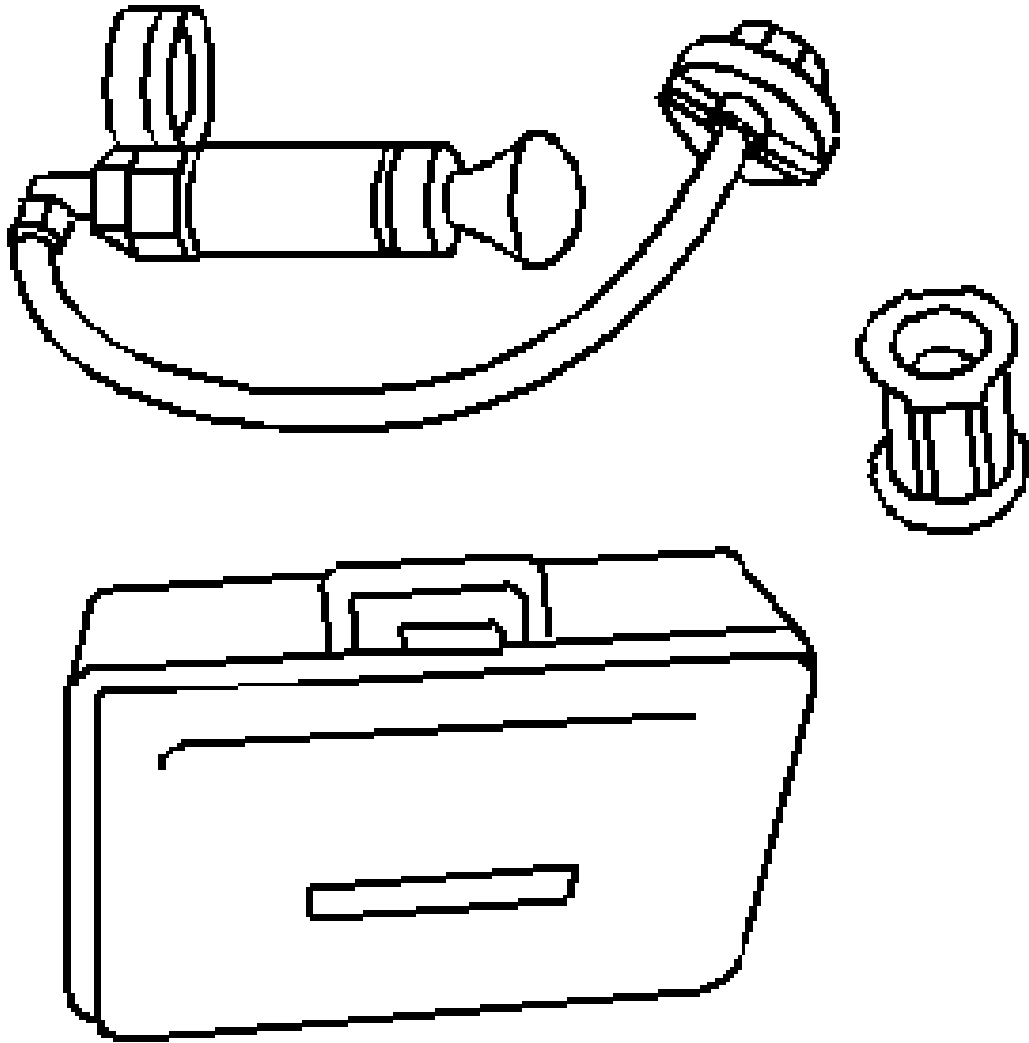
Illustration	Tool Number/ Description
	EN 24460-A J 24460-A Cooling System Pressure Tester

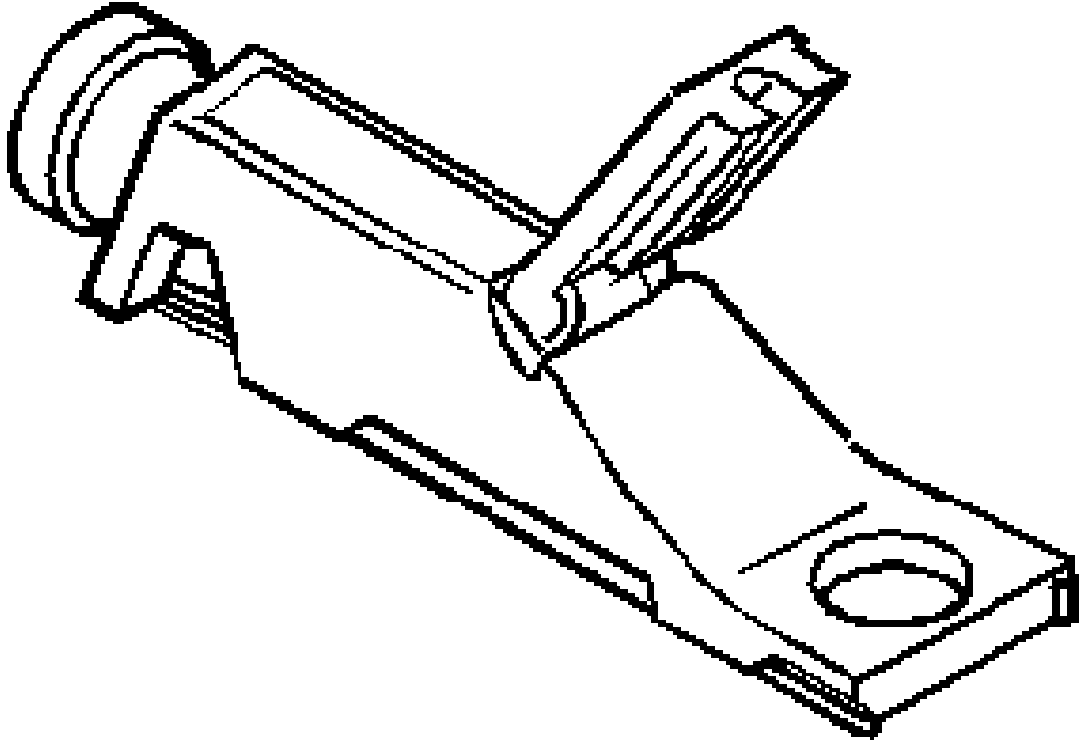
Illustration	Tool Number/ Description
	GE 26568 J 26568 Coolant and Battery Tester

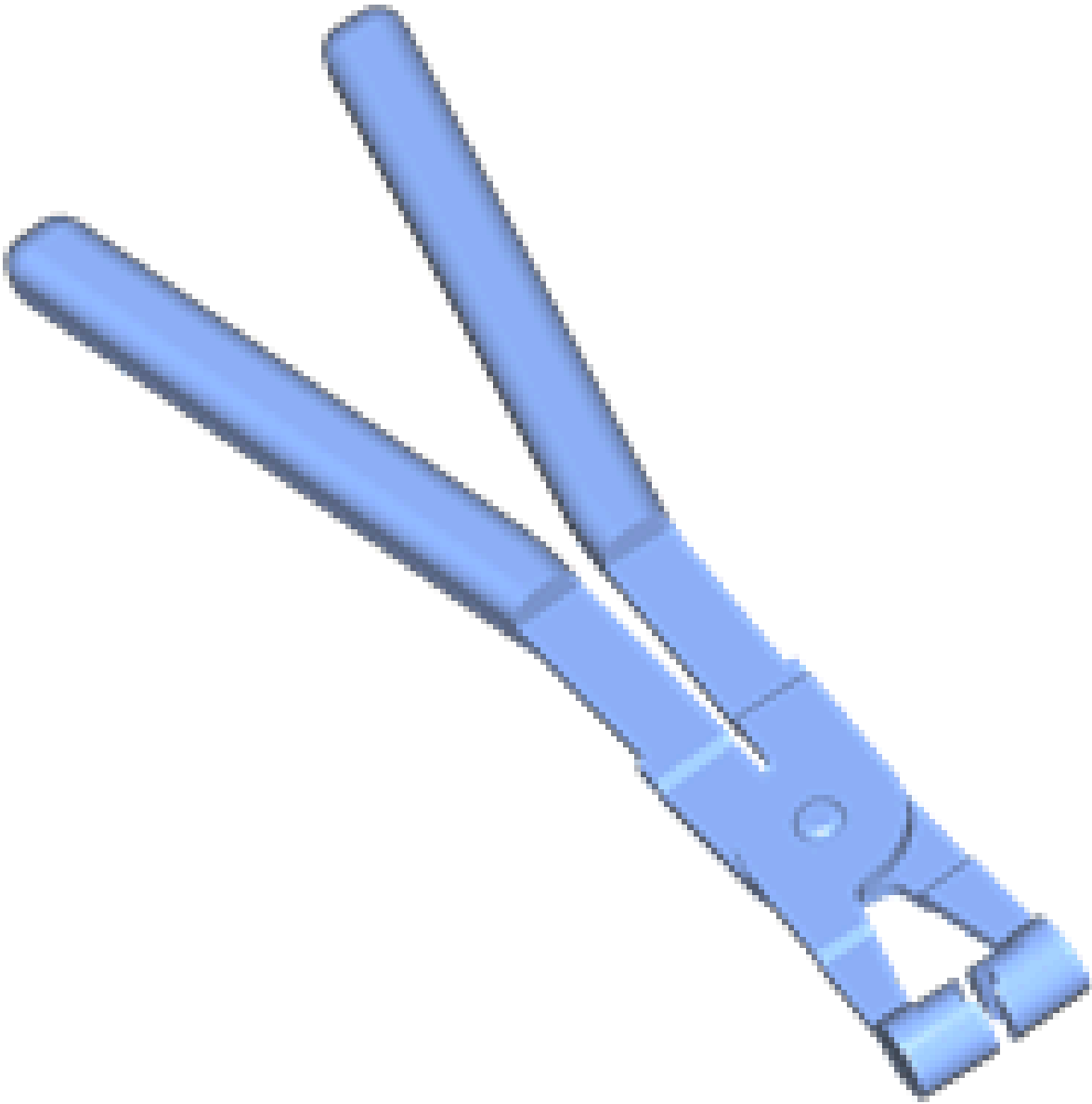
Illustration	Tool Number/ Description
 A 3D illustration of a pair of blue hose clamp pliers. The tool consists of two long, tapered handles that meet at a central pivot point. The handles are made of a solid material, likely metal or high-strength plastic, and have a smooth, slightly curved surface. The jaws of the pliers are located at the ends of the handles, near the pivot. They are designed with a specific shape to grip and manipulate hose clamps. The entire tool is rendered in a uniform blue color with some shading to give it a three-dimensional appearance.	BO 38185 J 38185 Hose Clamp Pliers

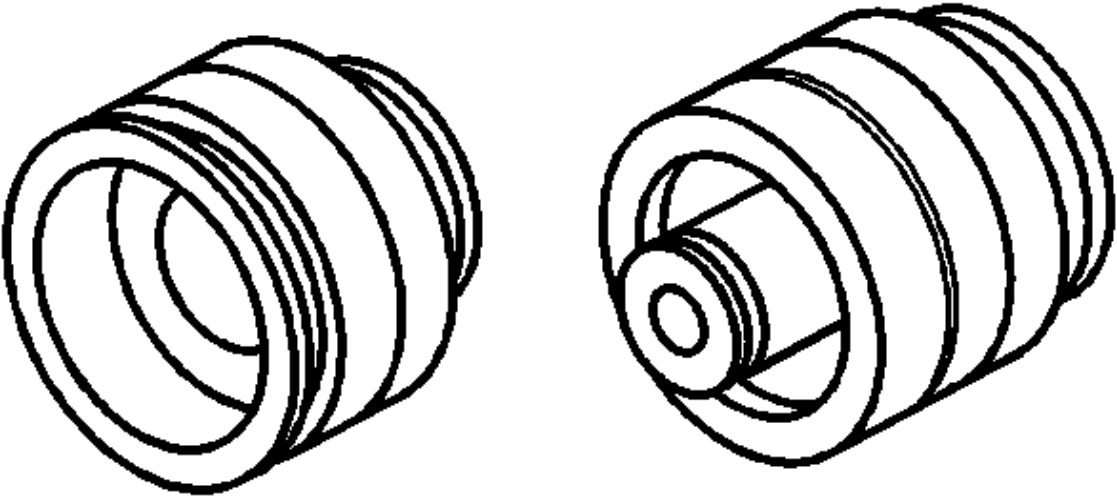
Illustration	Tool Number/ Description
	GE 46143 J 46143 Cooling System Adapter

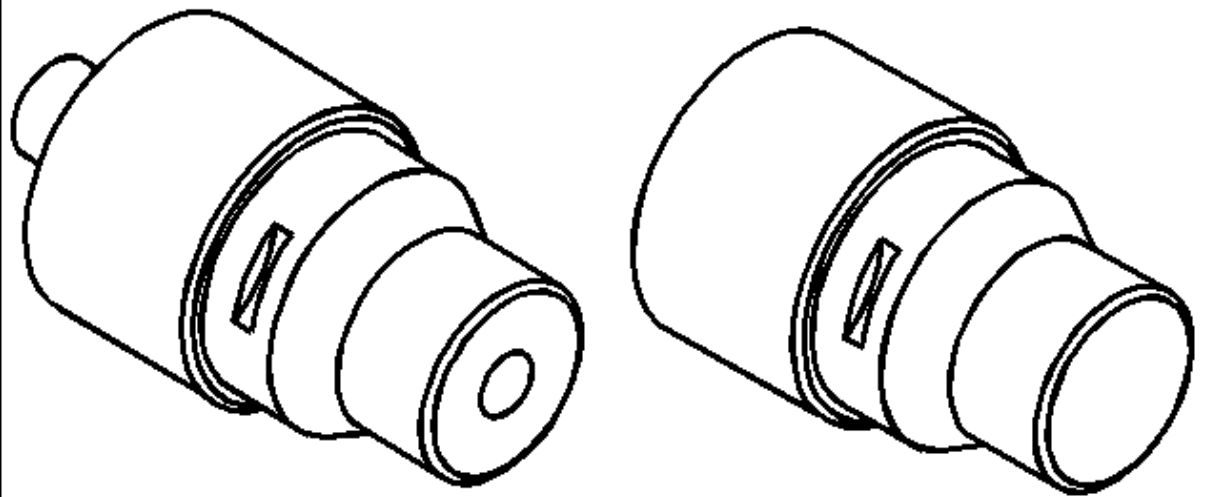
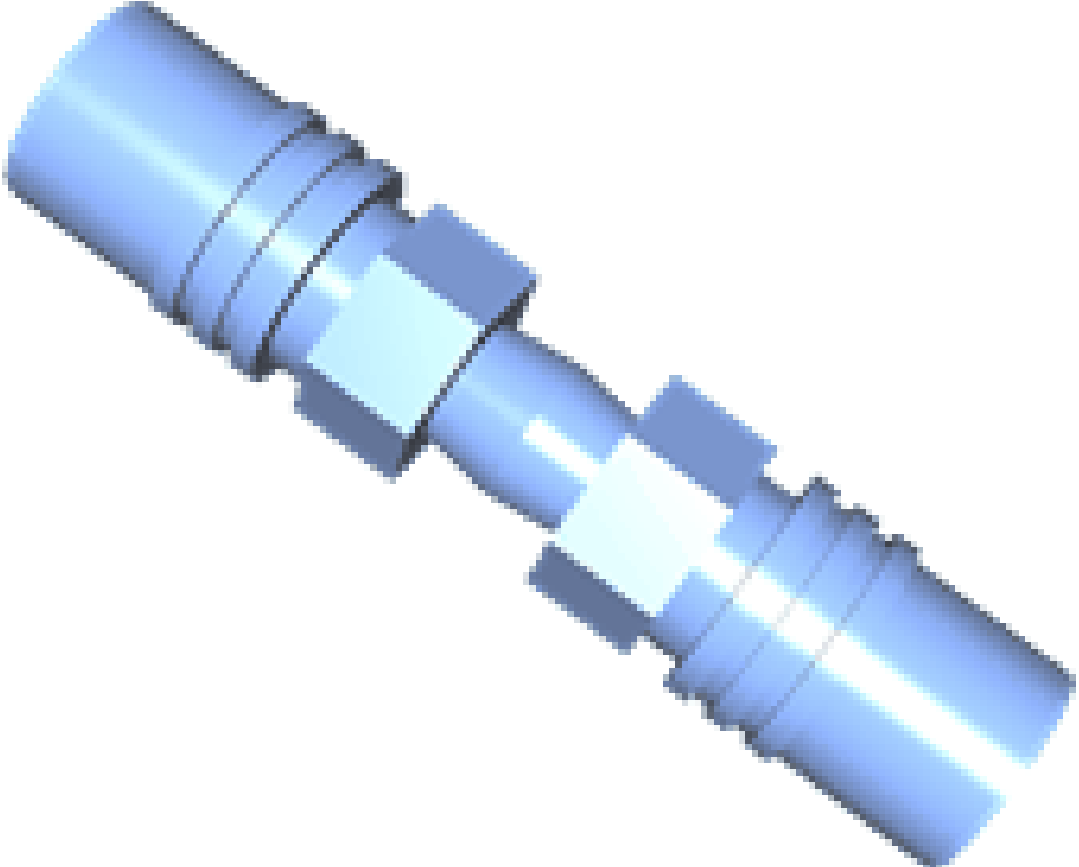
Illustration	Tool Number/ Description
	GE-50385 Battery Pack Coolant Passage Pressure Test Adapter

Illustration	Tool Number/ Description
	GE-50389 Coolant Pressure Test Quick Connector

Article GUID: A00884668

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Instrument Panel/Center Console Component Views - Volt

INSTRUMENT PANEL/CENTER CONSOLE COMPONENT VIEWS

INSTRUMENT PANEL COMPONENTS (1 OF 4)

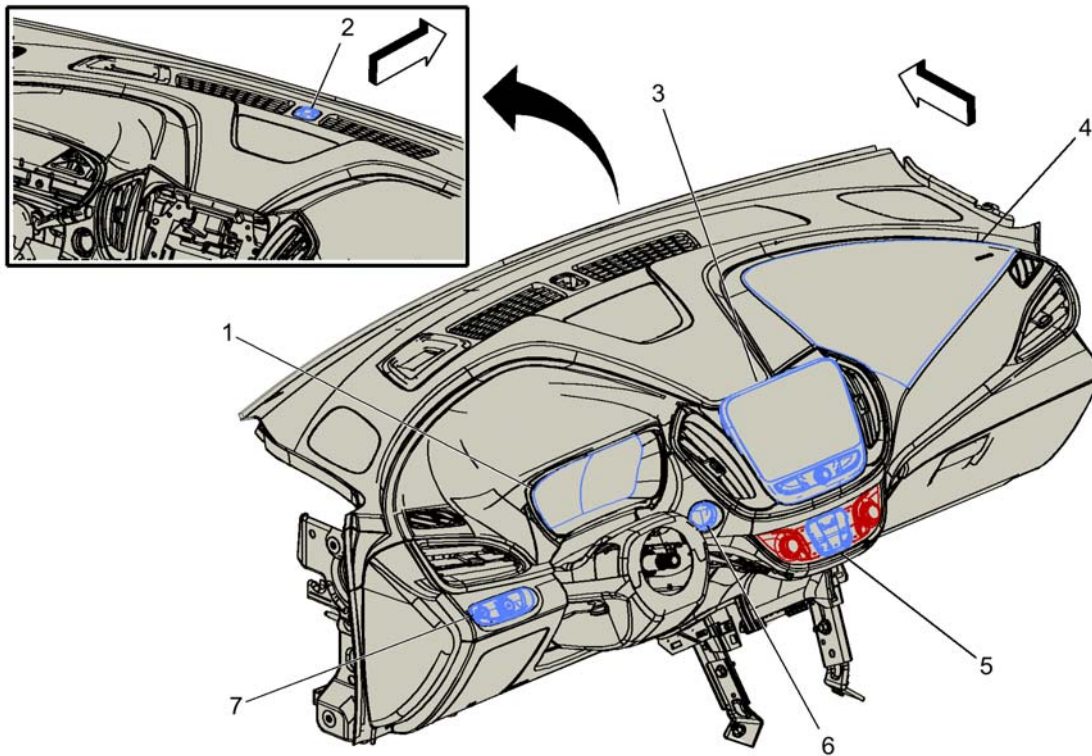


Fig. 1: Instrument Panel Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. P16 Instrument Cluster P16 Instrument Cluster
2. B305 B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator
3. P17 Info Display Module P17 Info Display Module X1
4. F101 Passenger Instrument Panel Air Bag F101 Passenger Instrument Panel Air Bag X1 F101 Passenger Instrument Panel Air Bag X2
5. A26 HVAC Controls A26 HVAC Controls
6. S83 Vehicle On/Off Switch S83 Vehicle On/Off Switch
7. S30 Headlamp Switch S30 Headlamp Switch

INSTRUMENT PANEL COMPONENTS (2 OF 4)

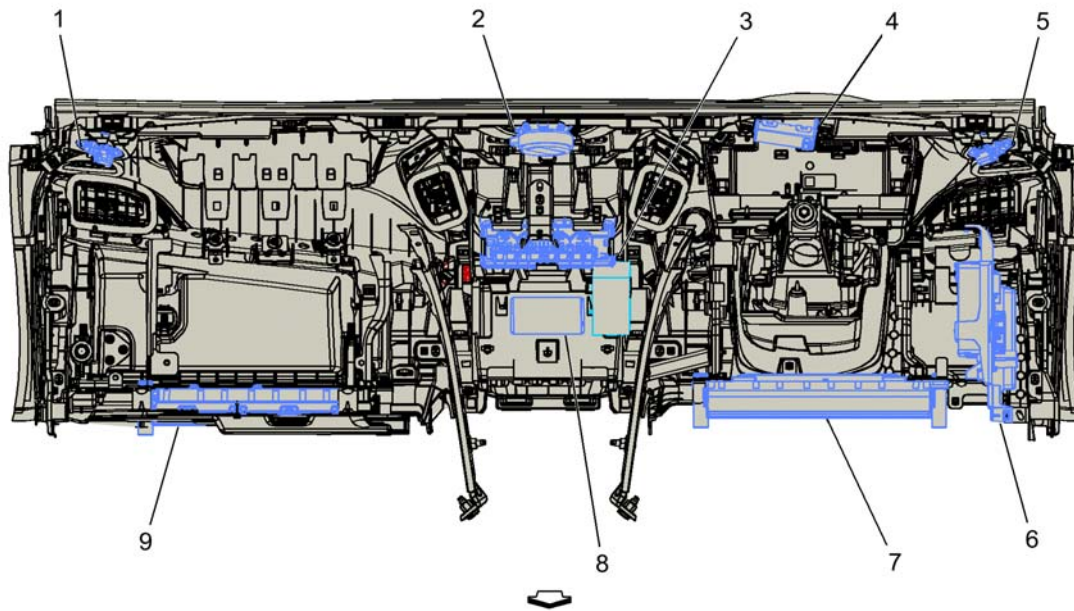


Fig. 2: Instrument Panel Components (2 of 4)
 Courtesy of GENERAL MOTORS COMPANY

Items
1. P19V Speaker - Right Front Tweeter P19V Speaker - Right Front Tweeter
2. P19B Speaker - Center Instrument Panel P19B Speaker - Center Instrument Panel (UQA)
3. K33 HVAC Control Module K33 HVAC Control Module X1 K33 HVAC Control Module X2 K33 HVAC Control Module X3
4. P43 Collision Alert Indicators P43 Collision Alert Indicators
5. P19H Speaker - Left Front Tweeter P19H Speaker - Left Front Tweeter
6. K73 Telematics Communication Interface Control Module (UE1) K73 Telematics Communication Interface Control Module X1 K73 Telematics Communication Interface Control Module X2
7. F114D Knee Air Bag - Driver F114D Knee Air Bag - Driver
8. K74 Human Machine Interface Control Module K74 Human Machine Interface Control Module X1 K74 Human Machine Interface Control Module X2 K74 Human Machine Interface Control Module X3 K74 Human Machine Interface Control Module X5 K74 Human Machine Interface Control Module X7
9. F114P Knee Air Bag - Passenger F114P Knee Air Bag - Passenger

INSTRUMENT PANEL COMPONENTS (3 OF 4)

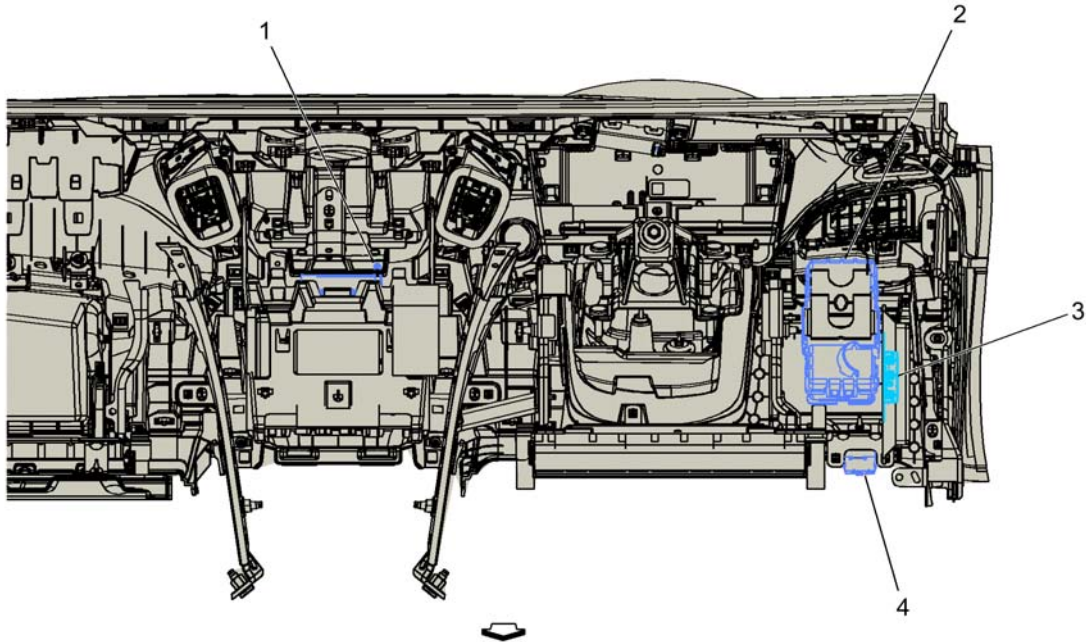


Fig. 3: Instrument Panel Components (3 of 4)
Courtesy of GENERAL MOTORS COMPANY

Items
1. T10B Keyless Entry Antenna - Instrument Panel Compartment <u>T10B Keyless Entry Antenna - Instrument Panel Compartment</u>
2. X51A Fuse Block - Instrument Panel
3. X84 Data Link Connector <u>X84 Data Link Connector</u>
4. T15 Navigation Antenna Signal Splitter <u>T15 Navigation Antenna Signal Splitter X1</u> <u>T15 Navigation Antenna Signal Splitter X2</u> <u>T15 Navigation Antenna Signal Splitter X3</u>

INSTRUMENT PANEL COMPONENTS (4 OF 4)

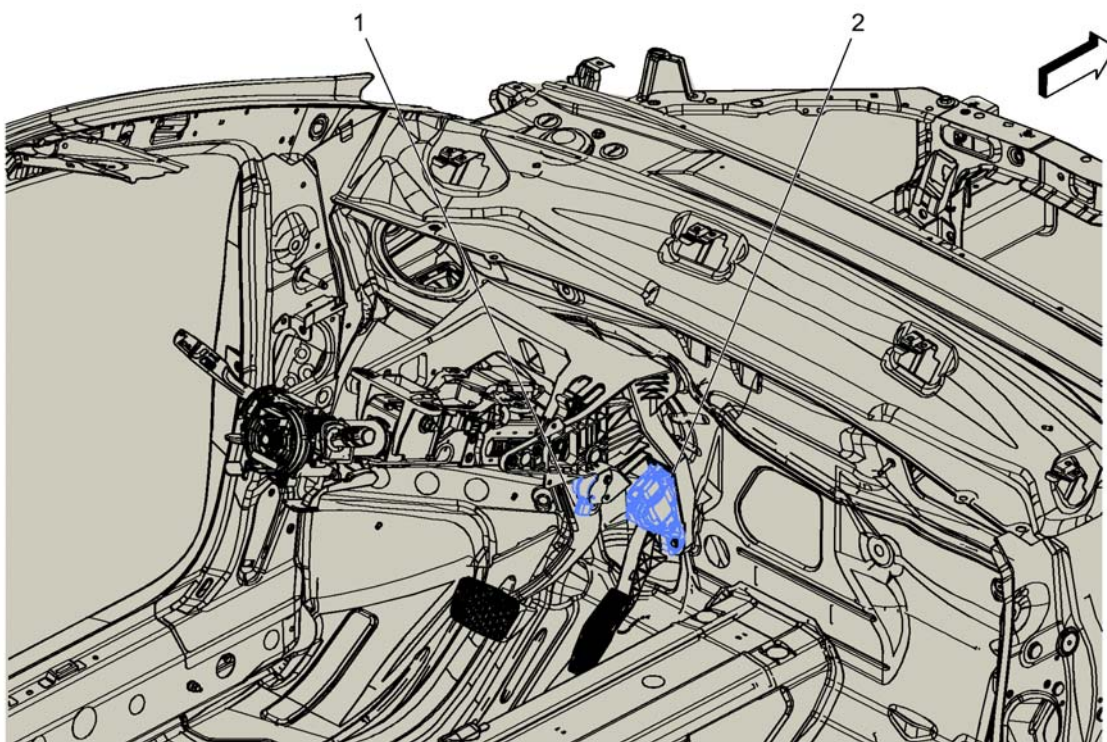


Fig. 4: Instrument Panel Components (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B22 Brake Pedal Position Sensor <u>B22 Brake Pedal Position Sensor</u>
2. B107 Accelerator Pedal Position Sensor <u>B107 Accelerator Pedal Position Sensor</u>

INSTRUMENT PANEL - BOTTOM

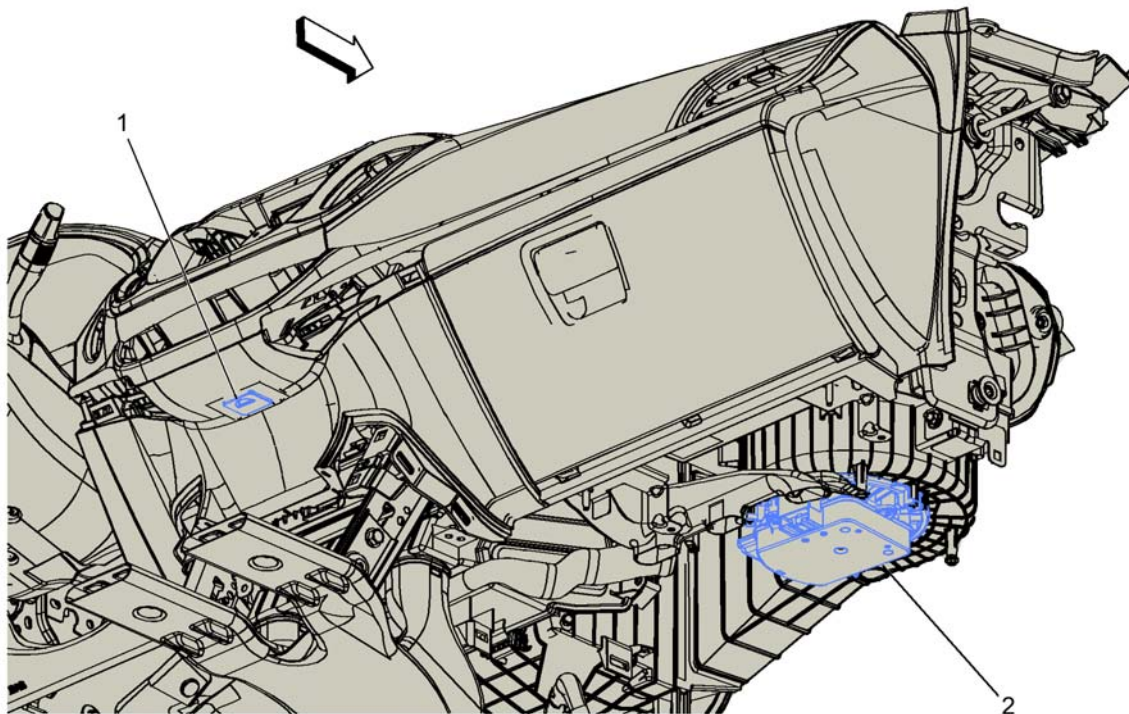


Fig. 5: Instrument Panel - Bottom

Courtesy of GENERAL MOTORS COMPANY

Items
1. E88 <u>E1W Accent Lamp - Instrument Panel</u>
2. M8 Blower Motor <u>M8 Blower Motor</u>

CENTER CONSOLE COMPONENTS (1 OF 3)

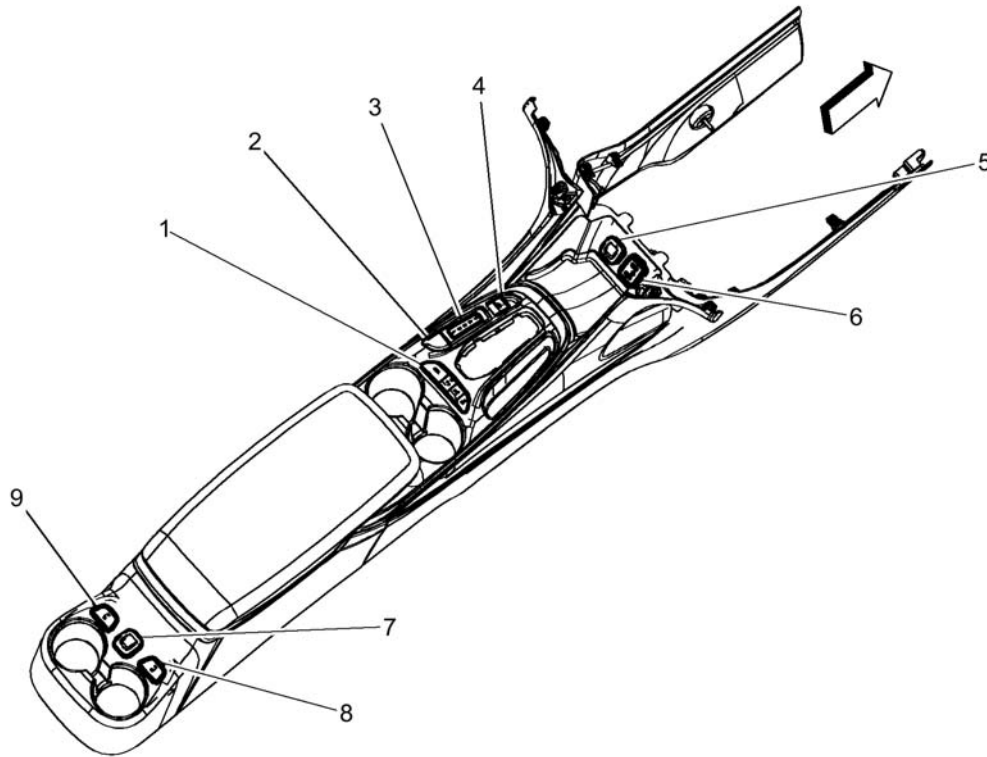


Fig. 6: Center Console Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S48E Multifunction Switch - Center Console <u>S48E Multifunction Switch - Center Console</u>
2. S26 Hazard Warning Switch <u>S26 Hazard Warning Switch</u>
3. P2 Transmission Shift Lever Position Indicator <u>P2 Transmission Shift Lever Position Indicator</u>
4. S91 Park Brake Control Switch <u>S91 Park Brake Control Switch</u>
5. X80H Accessory Power Receptacle - Center Console <u>X80H Accessory Power Receptacle - Center Console</u>
6. X83 Auxiliary Audio Input <u>X83 Auxiliary Audio Input X1</u> <u>X83 Auxiliary Audio Input X2</u>
7. X80L Accessory Power Receptacle - Center Console Rear <u>X80L Accessory Power Receptacle - Center Console Rear</u>
8. S32RR Seat Heating Switch - Right Rear (KA6) <u>S32RR Seat Heating Switch - Right Rear</u>
9. S32LR Seat Heating Switch - Left Rear (KA6) <u>S32LR Seat Heating Switch - Left Rear</u>

CENTER CONSOLE COMPONENTS (2 OF 3)

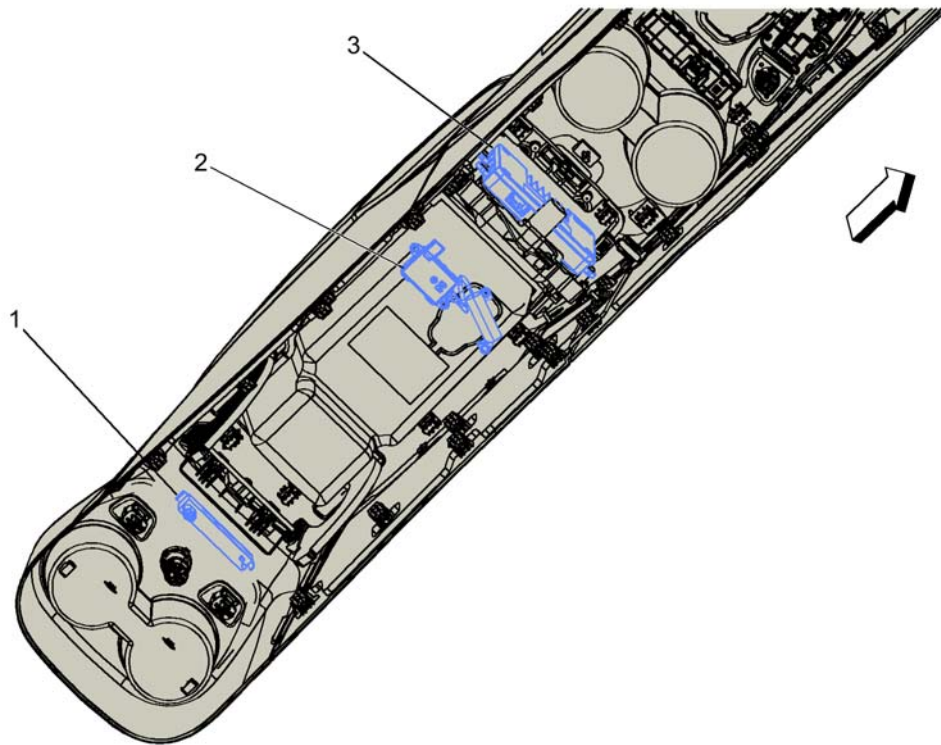


Fig. 7: Center Console Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. T10K Keyless Entry Antenna - Center Console Rear <u>T10K Keyless Entry Antenna - Center Console Rear</u>
2. K89 Immobilizer Control Module <u>K89 Immobilizer Control Module</u>
3. T22 Mobile Device Wireless Charger Module <u>T22 Mobile Device Wireless Charger Module</u>

CENTER CONSOLE COMPONENTS (3 OF 3)

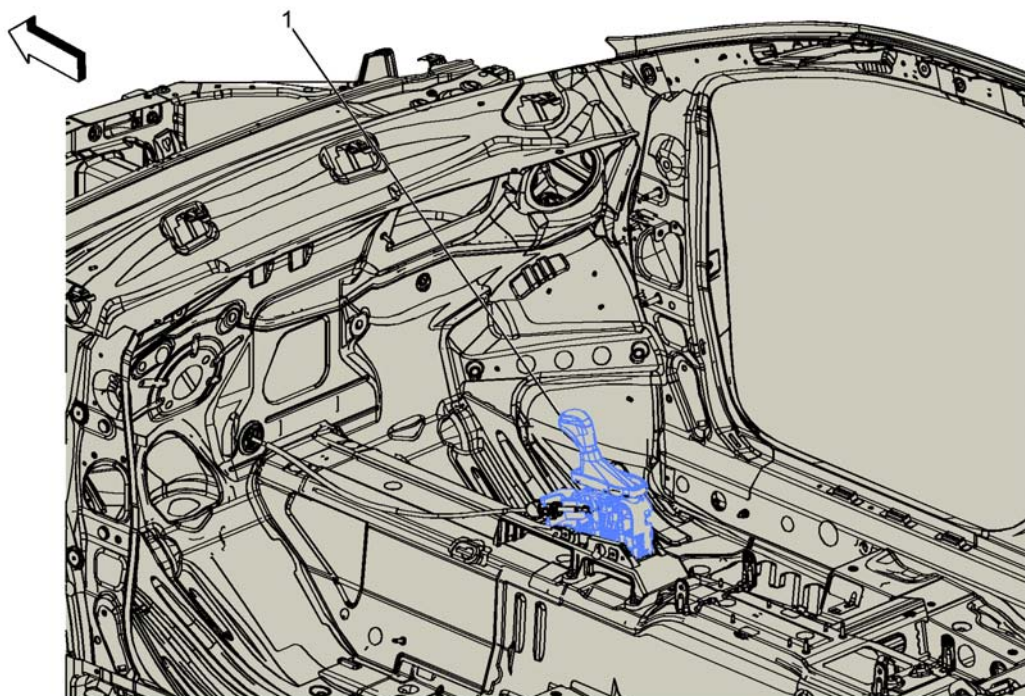


Fig. 8: Center Console Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S3 Transmission Shift Lever <u>S3 Transmission Shift Lever</u>

STEERING WHEEL COMPONENTS

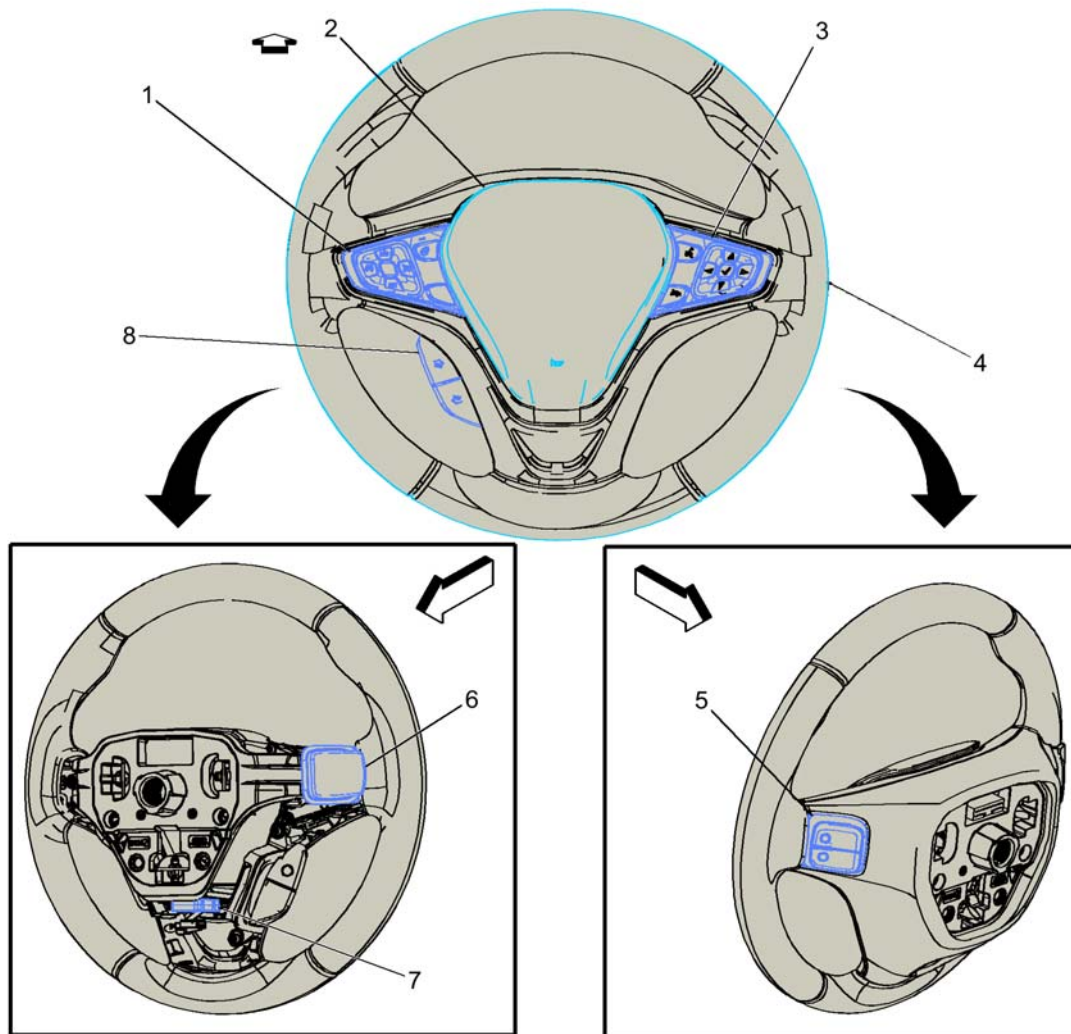


Fig. 9: Steering Wheel Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S70L Steering Wheel Controls Switch - Left S70L Steering Wheel Controls Switch - Left
2. F107 Steering Wheel Air Bag F107 Steering Wheel Air Bag X1 F107 Steering Wheel Air Bag X2
3. S70R Steering Wheel Controls Switch - Right S70R Steering Wheel Controls Switch - Right
4. E15 Steering Wheel Heater (UVD)
5. S70F Steering Wheel Controls Switch - Radio Volume S70F Steering Wheel Controls Switch - Radio Volume
6. S2L Transmission Manual Shift Switch - Left S151 Regenerative Braking On-Demand Switch
7. K32 Steering Wheel Heating Control Module K32 Steering Wheel Heating Control Module X1 K32 Steering Wheel Heating Control Module X2 (UVD)
8. S70E Steering Wheel Controls Switch - Radio Presets S70E Steering Wheel Controls Switch - Radio Presets

STEERING COLUMN COMPONENTS

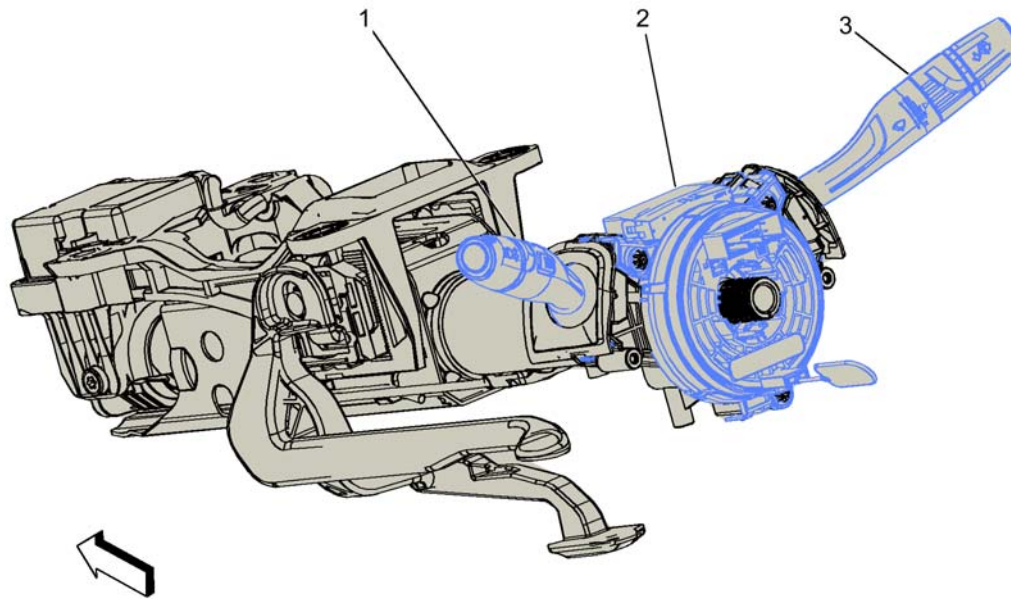


Fig. 10: Steering Column Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S78 Turn Signal/Multifunction Switch S78 Turn Signal/Multifunction Switch
2. X85 Steering Wheel Air Bag Coil X85 Steering Wheel Air Bag Coil X1
3. S82 Windshield Wiper/Washer Switch S82 Windshield Wiper/Washer Switch

Article GUID: A00884683

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Luggage Compartment/Rear of Vehicle Component Views - Volt

LUGGAGE COMPARTMENT/REAR OF VEHICLE COMPONENT VIEWS

LUGGAGE COMPARTMENT COMPONENTS (1 OF 2)

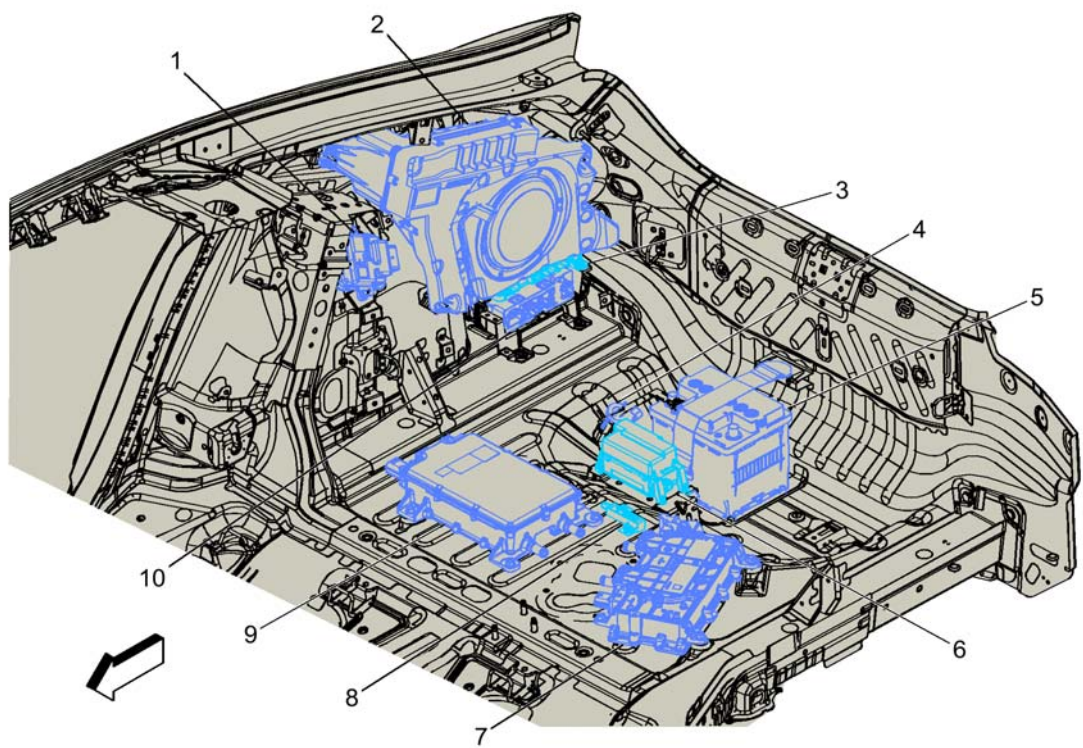


Fig. 1: Luggage Compartment Components (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Items
1. K111 Fuel Pump Driver Control Module K111 Fuel Pump Driver Control Module
2. P19AC Speaker - Subwoofer P19AC Speaker - Subwoofer (UQA)
3. T3 Audio Amplifier (UQA) T3 Audio Amplifier X1 T3 Audio Amplifier X2 T3 Audio Amplifier X3 T3 Audio Amplifier X4
4. B18 Battery Current Sensor B18 Battery Current Sensor
5. C1 Battery C1 Battery
6. X53A Fuse Block - Rear Body X53A Fuse Block - Rear Body Wire Entry
7. K1 14V Power Module K1 14V Power Module X1 K1 14V Power Module X2 K1 14V Power Module X3 K1 14V Power Module X4
8. T10E Keyless Entry Antenna - Rear Compartment T10E Keyless Entry Antenna - Rear Compartment
9. T18 Battery Charger T18 Battery Charger X1

Items
10. A11 Radio A11 Radio X1 A11 Radio X2 A11 Radio X3 A11 Radio X4 A11 Radio X6

LUGGAGE COMPARTMENT COMPONENTS (2 OF 2)

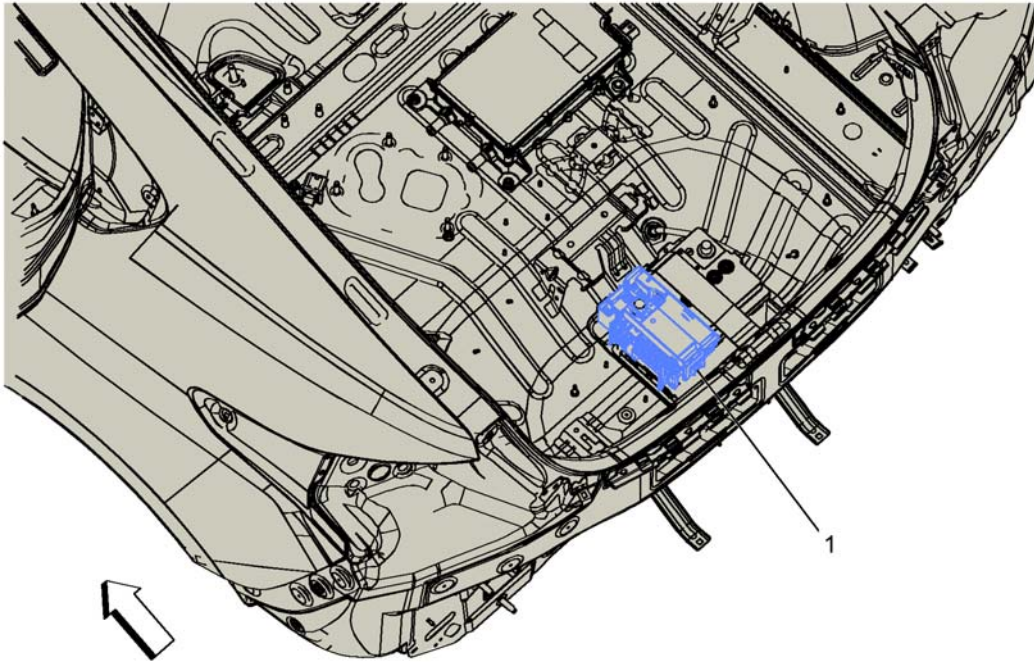


Fig. 2: Luggage Compartment Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X50D Fuse Block - Battery X50D Fuse Block - Battery X1 X50D Fuse Block - Battery X2 X50D Fuse Block - Battery X3 X50D Fuse Block - Battery X5 X50D Fuse Block - Battery X6 X50D Fuse Block - Battery X8

LIFTGATE COMPONENTS (1 OF 2)

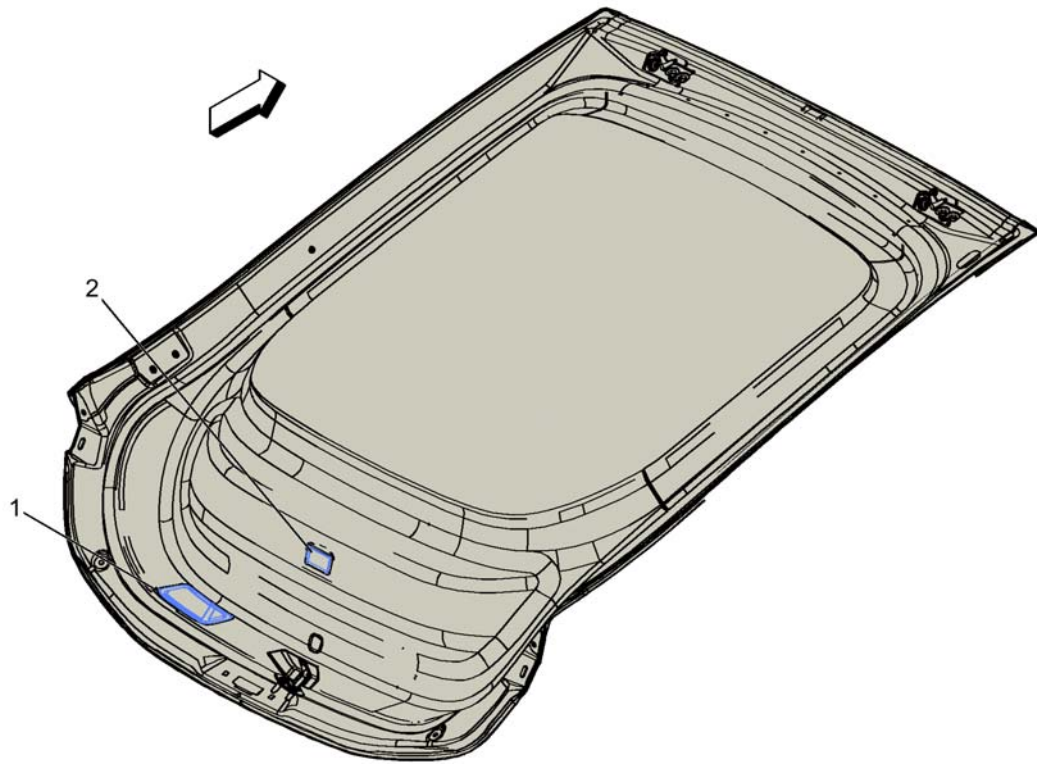


Fig. 3: Liftgate Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S46 Liftgate Handle Switch S46 Liftgate Handle Switch
2. E33 Cargo Lamp E33 Cargo Lamp

LIFTGATE COMPONENTS (2 OF 2)

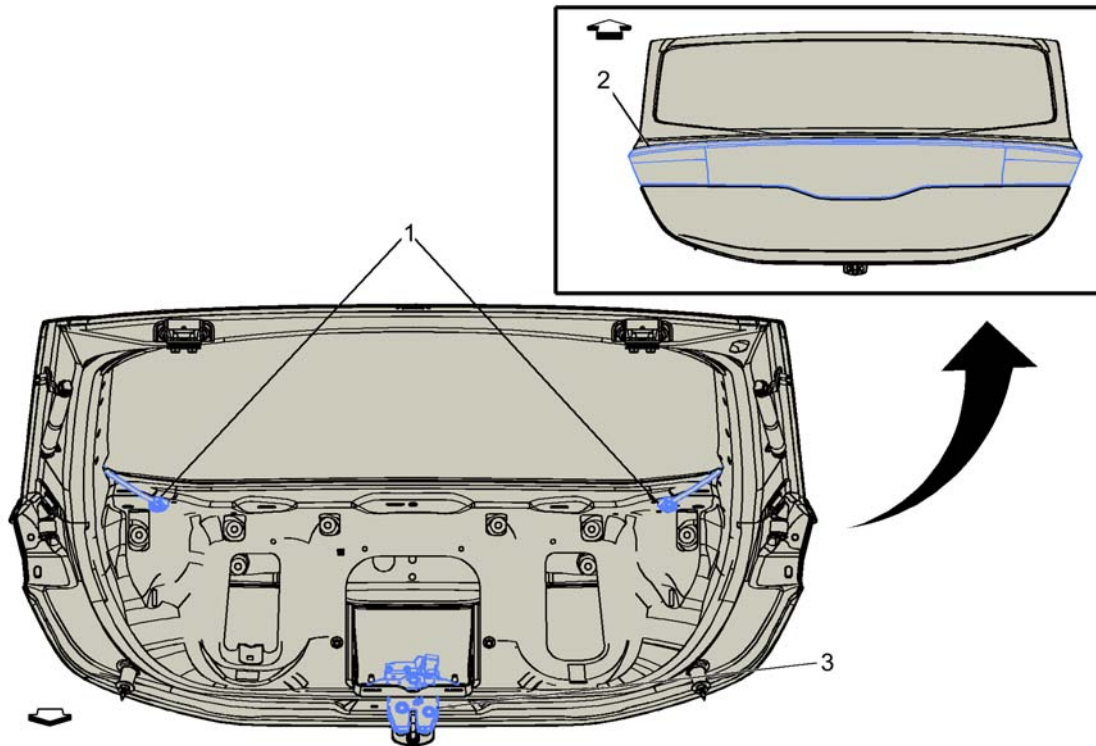


Fig. 4: Liftgate Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E18 Rear Defogger Grid E18 Rear Defogger Grid X1 E18 Rear Defogger Grid X2
2. E6 Center High Mounted Stop Lamp E6 Center High Mounted Stop Lamp
3. A23C Liftgate Latch Assembly A23C Liftgate Latch Assembly

REAR OF VEHICLE COMPONENTS (1 OF 3)

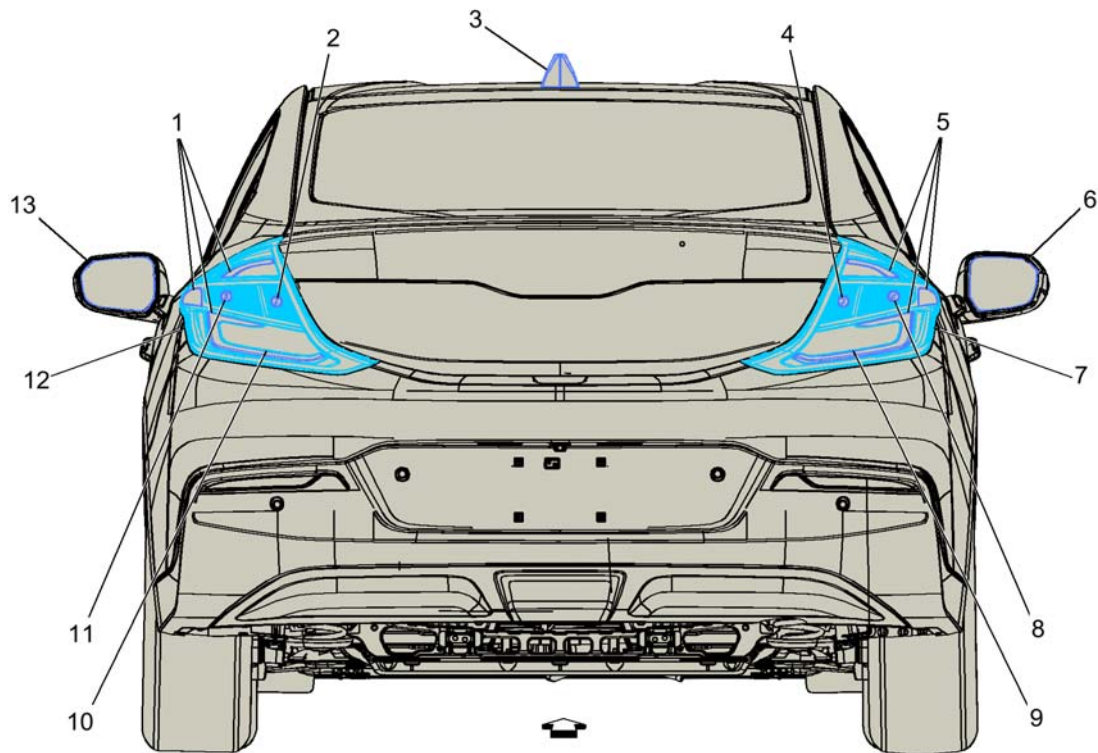


Fig. 5: Rear of Vehicle Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E5E Tail Lamp - Left
2. E5A Backup Lamp - Left <u>E5A Backup Lamp - Left</u>
3. T2RR Antenna - Roof Rear <u>T2RR Antenna - Roof Rear X1 T2RR Antenna - Roof Rear X2</u>
4. E5B Backup Lamp - Right <u>E5B Backup Lamp - Right</u>
5. E5F Tail Lamp - Right
6. E17P Outside Rearview Mirror Glass - Passenger <u>E17P Outside Rearview Mirror Glass - Passenger X1 E17P Outside Rearview Mirror Glass - Passenger X2</u>
7. E42R Tail Lamp Assembly - Right <u>E42R Tail Lamp Assembly - Right</u>
8. E4RR Turn Signal Lamp - Right Rear <u>E4RR Turn Signal Lamp - Right Rear</u>
9. E5R Stop Lamp - Right <u>E5R Stop Lamp - Right</u>
10. E5L Stop Lamp - Left <u>E5L Stop Lamp - Left</u>
11. E4LR Turn Signal Lamp - Left Rear <u>E4LR Turn Signal Lamp - Left Rear</u>
12. E42L Tail Lamp Assembly - Left <u>E42L Tail Lamp Assembly - Left</u>
13. E17D Outside Rearview Mirror Glass - Driver <u>E17D Outside Rearview Mirror Glass - Driver X1 E17D Outside Rearview Mirror Glass - Driver X2</u>

REAR OF VEHICLE COMPONENTS (2 OF 3)

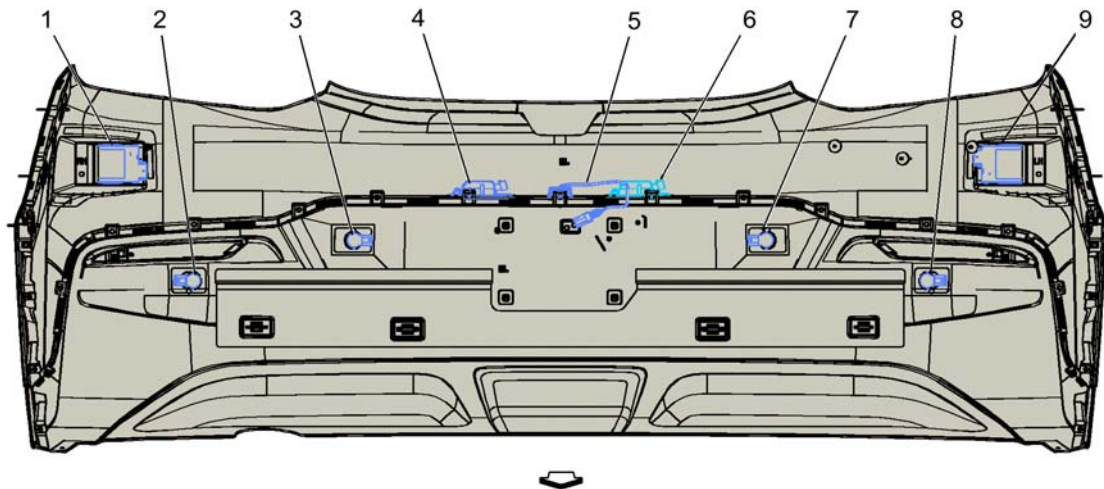


Fig. 6: Rear of Vehicle Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B218R Side Object Sensor Module - Right (UFG) <u>B218R Side Object Sensor Module - Right</u>
2. B306H Parking Assist Sensor - Rear Right Outer (UD7) <u>B306H Parking Assist Sensor - Rear Right Outer</u>
3. B306G Parking Assist Sensor - Rear Right Middle (UD7) <u>B306G Parking Assist Sensor - Rear Right Middle</u>
4. E7R License Plate Lamp - Right <u>E7R License Plate Lamp - Right</u>
5. B87 Rearview Camera (UVC) <u>B87 Rearview Camera</u>
6. E7L License Plate Lamp - Left <u>E7L License Plate Lamp - Left</u>
7. B306F Parking Assist Sensor - Rear Left Middle (UD7) <u>B306F Parking Assist Sensor - Rear Left Middle</u>
8. B306E Parking Assist Sensor - Rear Left Outer (UD7) <u>B306E Parking Assist Sensor - Rear Left Outer</u>
9. B218L Side Object Sensor Module - Left (UFG) <u>B218L Side Object Sensor Module - Left</u>

REAR OF VEHICLE COMPONENTS (3 OF 3)

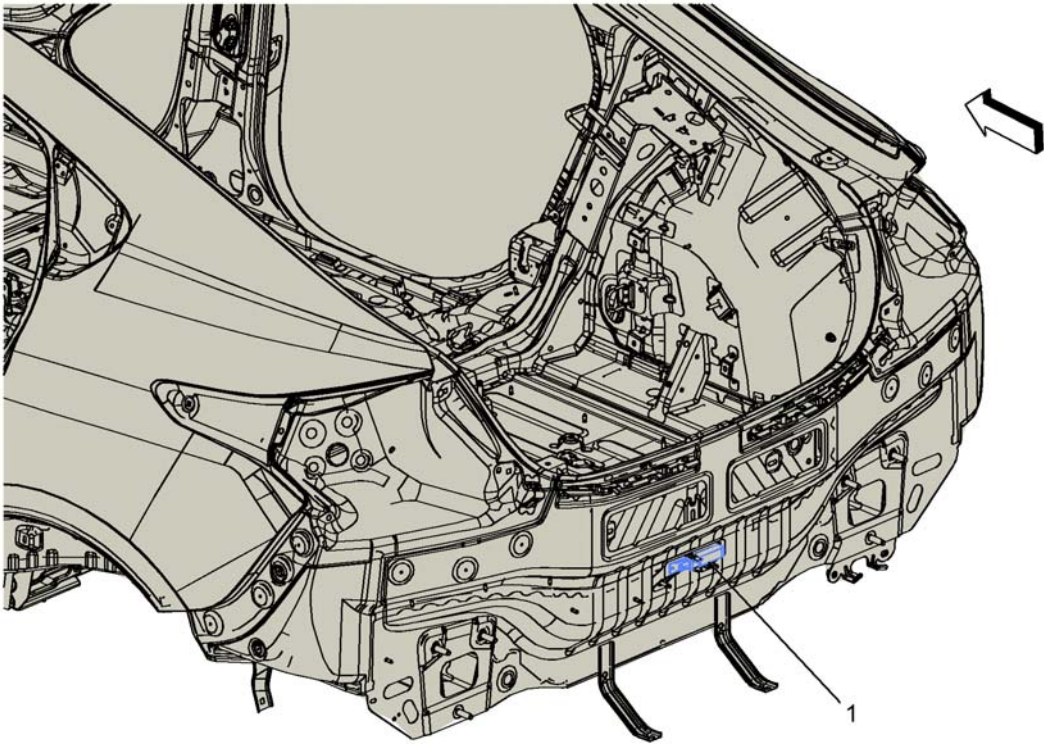


Fig. 7: Rear of Vehicle Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. T10G Keyless Entry Antenna - Rear Fascia <u>T10G Keyless Entry Antenna - Rear Fascia</u>

Article GUID: A00884714

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Master Electrical Component List - Volt

MASTER ELECTRICAL COMPONENT LIST

Code	Name	Option	Location	Locator View	Connector End View
A4	Hybrid/EV Battery Pack	-	Under the center of the vehicle	-	-
A7	Fuel Pump and Level Sensor Assembly	-	Under the vehicle, in the fuel tank	-	<u>A7 Fuel Pump and Level Sensor Assembly</u>
A9A	Outside Rearview Mirror - Driver	-	Outside the vehicle, at the front of the driver door	<u>Front of Vehicle Components (1 of 2)</u>	-
A9B	Outside Rearview Mirror - Passenger	-	Outside the vehicle, at the front of the passenger door	<u>Front of Vehicle Components (1 of 2)</u>	-
A10	Inside Rearview Mirror	-	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>A10 Inside Rearview Mirror</u>
A11	Radio	-	In the right side of luggage compartment, behind the trim panel, below the subwoofer	<u>Luggage Compartment Components (1 of 2)</u>	<u>A11 Radio X1</u> <u>A11 Radio X2</u> <u>A11 Radio X3</u> <u>A11 Radio X4</u> <u>A11 Radio X6</u>
A22	Radio Controls	-	Internal to the info display module	-	-
A23C	Liftgate Latch Assembly	-	At the rear center of the vehicle, in the liftgate	<u>Liftgate Components (2 of 2)</u>	<u>A23C Liftgate Latch Assembly</u>
A23D	Door Latch Assembly - Driver	-	In the passenger compartment, in the rear middle of the driver door	<u>Driver Door Components</u>	<u>A23D Door Latch Assembly - Driver</u>
A23LR	Door Latch Assembly - Left Rear	-	In the passenger compartment, in	<u>Left Rear Door Components</u>	<u>A23LR Door Latch Assembly - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			the rear middle of the left rear door		
A23P	Door Latch Assembly - Passenger	-	In the passenger compartment, in the rear middle of the passenger door	<u>Passenger Door Components</u>	<u>A23P Door Latch Assembly - Passenger</u>
A23RR	Door Latch Assembly - Right Rear	-	In the passenger compartment, in the rear middle of the right rear door	<u>Right Rear Door Components</u>	<u>A23RR Door Latch Assembly - Right Rear</u>
A24D	Door Handle Assembly - Driver Exterior	-	In the passenger compartment, in the driver door handle	<u>Driver Door Components</u>	<u>A24D Door Handle Assembly - Driver Exterior</u>
A24LR	Door Handle Assembly - Left Rear Exterior	-	In the passenger compartment, in the left rear door handle	<u>Left Rear Door Components</u>	<u>A24LR Door Handle Assembly - Left Rear Exterior</u>
A24P	Door Handle Assembly - Passenger Exterior	-	In the passenger compartment, in the passenger door handle	<u>Passenger Door Components</u>	<u>A24P Door Handle Assembly - Passenger Exterior</u>
A24RR	Door Handle Assembly - Right Rear Exterior	-	In the passenger compartment, in the right rear door handle	<u>Right Rear Door Components</u>	<u>A24RR Door Handle Assembly - Right Rear Exterior</u>
A26	HVAC Controls	-	In the passenger compartment, at the center of the instrument panel, below the info display module	<u>Instrument Panel Components (1 of 4)</u>	<u>A26 HVAC Controls</u>
A28	Hybrid/EV Battery Contactor Assembly	-	Under the vehicle, part of the hybrid/EV battery assembly	<u>Engine Compartment Components</u>	• <u>A28 Hybrid/EV Battery Contactor Assembly X1</u> • <u>A28 Hybrid/EV Battery Contactor Assembly X2</u> • <u>A28 Hybrid/EV</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>Battery</u> <u>Contactor</u> <u>Assembly X3</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X4</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X5</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X6</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X7</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X8</u>
B1	A/C Refrigerant Pressure Sensor	-	In the engine compartment, at the right rear top of engine, in the high pressure A/C line	<u>Right Rear of Engine Components</u>	<u>B1 A/C Refrigerant Pressure Sensor</u>
B1C	A/C Low Side Pressure Sensor	-	In the engine compartment, at the rear center of the engine, in the low pressure A/C line	<u>Right Rear of Engine Components</u>	<u>B1C A/C Low Side Pressure Sensor</u>
B5LF	Wheel Speed Sensor - Left Front	-	Under the vehicle, mounted to the left front steering knuckle, near the wheel bearing	<u>Underbody - Wheel Components (3 of 4)</u>	<u>B5LF Wheel Speed Sensor - Left Front</u>

Code	Name	Option	Location	Locator View	Connector End View
B5LR	Wheel Speed Sensor - Left Rear	-	Under the vehicle, mounted to the left rear suspension, near the wheel bearing	<u>Underbody - Wheel Components (2 of 4)</u>	<u>B5LR Wheel Speed Sensor - Left Rear</u>
B5RF	Wheel Speed Sensor - Right Front	-	Under the vehicle, mounted to the right front steering knuckle, near the wheel bearing	<u>Underbody - Wheel Components (1 of 4)</u>	<u>B5RF Wheel Speed Sensor - Right Front</u>
B5RR	Wheel Speed Sensor - Right Rear	-	Under the vehicle, mounted to the right rear suspension, near the wheel bearing	<u>Underbody - Wheel Components (4 of 4)</u>	<u>B5RR Wheel Speed Sensor - Right Rear</u>
B7D	Air Temperature Sensor - Duct Left Lower	-	In the passenger compartment, front, left of center within the instrument panel, on lower duct	-	<u>B7D Air Temperature Sensor - Duct Left Lower</u>
B7H	Air Temperature Sensor - Duct Left Upper	-	In the passenger compartment, front, left of center within the instrument panel, on upper duct	-	<u>B7H Air Temperature Sensor - Duct Left Upper</u>
B9	Ambient Air Temperature Sensor	-	At the right front corner of the vehicle, behind the right side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B9 Ambient Air Temperature Sensor</u>
B13	Transmission Fluid Temperature Sensor	-	In the engine compartment, internal to the transmission	-	-

Code	Name	Option	Location	Locator View	Connector End View
			control solenoid valve assembly		
B14A	Transmission Output Shaft Speed Sensor	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>B14A Transmission Output Shaft Speed Sensor</u>
B15	Transmission Internal Mode Switch	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>B15 Transmission Internal Mode Switch</u>
B18	Battery Current Sensor	-	In the luggage compartment, under the storage compartment floor, on the negative battery cable	<u>Luggage Compartment Components (1 of 2)</u>	<u>B18 Battery Current Sensor</u>
B20	Brake Fluid Level Switch	-	In the left rear of the engine compartment, at the bottom of the brake fluid reservoir	<u>Engine Compartment Components - Left</u>	<u>B20 Brake Fluid Level Switch</u>
B22	Brake Pedal Position Sensor	-	In the passenger compartment, under the driver side of the instrument panel, connected to the brake pedal	<u>Instrument Panel Components (4 of 4)</u>	<u>B22 Brake Pedal Position Sensor</u>
B23E	Camshaft Position Sensor - Exhaust	-	In the left front of the engine, on the left front of the cylinder head	<u>Left Rear of Engine Components</u>	<u>B23E Camshaft Position Sensor - Exhaust</u>
B23F	Camshaft Position Sensor - Intake	-	In the left rear of the engine, on the left rear of the cylinder head	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>B23F Camshaft Position Sensor - Intake</u>
B24	Cellular Phone Microphone	-	In the passenger compartment, at the front center	<u>Headliner Components (2 of 4)</u>	<u>B24 Mobile Telephone Microphone</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the headliner, in the overhead console		
B26	Crankshaft Position Sensor	-	In the left rear of the engine compartment, in the left rear of the engine block, above the oil pan	<u>Right Rear of Engine Components</u>	<u>B26 Crankshaft Position Sensor</u>
B27D	Door Handle Switch - Driver Exterior	-	In the driver door, part of the driver exterior door handle assembly	-	-
B27LR	Door Handle Switch - Left Rear Exterior	-	In the left rear door, part of the left rear exterior door handle assembly	-	-
B27P	Door Handle Switch - Passenger Exterior	-	In the passenger door, part of the passenger exterior door handle assembly	-	-
B27RR	Door Handle Switch - Right Rear Exterior	-	In the right rear door, part of the right rear exterior door handle assembly	-	-
B30	Hybrid/EV Battery Pack Current Sensor	-	Under the vehicle, in the Hybrid/EV battery pack, on the rear of the A28 Hybrid/EV Battery Contactor Assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	<u>B30 Hybrid/EV Battery Pack Current Sensor</u>
B32A	Hybrid/EV Battery Temperature Sensor 1	-	Under the vehicle, in the Hybrid/EV battery section 3, part of Hybrid/EV battery module	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32A Hybrid/EV Battery Temperature Sensor 1</u>

Code	Name	Option	Location	Locator View	Connector End View
			1		
B32B	Hybrid/EV Battery Temperature Sensor 2	-	Under the vehicle, in the Hybrid/EV battery section 3, part of Hybrid/EV battery module 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32B Hybrid/EV Battery Temperature Sensor 2</u>
B32C	Hybrid/EV Battery Temperature Sensor 3	-	Under the vehicle, in the Hybrid/EV battery section 2, part of Hybrid/EV battery module 4	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32C Hybrid/EV Battery Temperature Sensor 3</u>
B32D	Hybrid/EV Battery Temperature Sensor 4	-	Under the vehicle, in the Hybrid/EV battery section 2, part of Hybrid/EV battery module 5	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32D Hybrid/EV Battery Temperature Sensor 4</u>
B32E	Hybrid/EV Battery Temperature Sensor 5	-	Under the vehicle, in the Hybrid/EV battery section 1, part of Hybrid/EV battery module 6	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32E Hybrid/EV Battery Temperature Sensor 5</u>
B32F	Hybrid/EV Battery Temperature Sensor 6	-	Under the vehicle, in the Hybrid/EV battery section 1, part of Hybrid/EV battery module 7	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32F Hybrid/EV Battery Temperature Sensor 6</u>
B34	Engine Coolant Temperature Sensor	-	In the engine compartment, at the left end of the cylinder head, mounted	<u>Left Rear of Engine Components</u>	<u>B34 Engine Coolant Temperature Sensor</u>

Code	Name	Option	Location	Locator View	Connector End View
			in the coolant outlet housing		
B37B	Engine Oil Pressure Sensor	-	In the rear of the engine, below the high pressure fuel pump	<u>Left Rear of Engine Components</u>	<u>B37B Engine Oil Pressure Sensor</u>
B46	Fuel Level Sensor	-	Under the vehicle, in the fuel tank, part of the fuel pump and level sensor assembly	-	-
B47	Fuel Pressure Sensor	-	Under the vehicle, at the right of the fuel tank, in the fuel feed line	<u>Underbody - Fuel System Components (2 of 2)</u>	<u>B47 Fuel Pressure Sensor</u>
B52A	Heated Oxygen Sensor 1	-	In the front of the engine compartment, at the top of the catalytic converter	<u>Right Front of Engine Components (2 of 2)</u>	<u>B52A Heated Oxygen Sensor 1</u>
B52B	Heated Oxygen Sensor 2	-	In the front of the engine compartment, in the exhaust pipe, downstream of the catalytic converter	<u>Right Front of Engine Components (2 of 2)</u>	<u>B52B Heated Oxygen Sensor 2</u>
B55	Hood Ajar Switch	-	At the front center of the vehicle, part of the hood latch	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>B55 Engine Hood Switch</u>
B59L	Front Impact Sensor - Left	-	At the front of the vehicle, mounted to the top left of the radiator core support	<u>Front of Vehicle Components (2 of 2)</u>	<u>B59L Front Impact Sensor - Left</u>
B59R	Front Impact Sensor - Right	-	At the front of the vehicle, mounted to the top right of the	<u>Front of Vehicle Components (2 of 2)</u>	<u>B59R Front Impact Sensor - Right</u>

Code	Name	Option	Location	Locator View	Connector End View
			radiator core support		
B63LF	Side Impact Sensor - Left Front	-	In the passenger compartment, in the center of the left front door	<u>Driver Door Components</u>	<u>B63LF Side Impact Sensor - Left Front</u>
B63LR	Side Impact Sensor - Left Rear	-	In the passenger compartment, in the center of the left rear door	<u>Rear Seat Components (2 of 3)</u>	<u>B63LR Side Impact Sensor - Left Rear</u>
B63RF	Side Impact Sensor - Right Front	-	In the passenger compartment, in the center of the right front door	<u>Passenger Door Components</u>	<u>B63RF Side Impact Sensor - Right Front</u>
B63RR	Side Impact Sensor - Right Rear	-	In the passenger compartment, in the center of the right rear door	<u>Rear Seat Components (3 of 3)</u>	<u>B63RR Side Impact Sensor - Right Rear</u>
B68	Knock Sensor	-	In the engine compartment, at the rear of the engine block, in the center, under the intake manifold	<u>Left Front of Engine Components</u>	<u>B68 Knock Sensor</u>
B74	Manifold Absolute Pressure Sensor	-	In the engine compartment, mounted in the left side of the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>B74 Manifold Absolute Pressure Sensor</u>
B75C	Multifunction Intake Air Sensor	-	At the right rear of the engine, in the intake air snorkel	<u>Right Front of Engine Components (1 of 2)</u>	<u>B75C Multifunction Intake Air Sensor</u>
B81B	Park Position Switch	-	In the passenger compartment, part of the automatic transmission shift lever assembly	-	<u>B81B Park Position Switch</u>
B87	Rearview Camera	UVC	At the rear of the vehicle, between the license plate	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B87 Rearview Camera</u>

Code	Name	Option	Location	Locator View	Connector End View
			lamps, in the center of the fascia		
B88D	Seat Belt Switch - Driver	-	In the passenger compartment, part of the driver seat belt buckle	-	<u>B88D Seat Belt Switch - Driver</u>
B88P	Seat Belt Switch - Passenger	-	In the passenger compartment, part of the passenger seat belt buckle	-	<u>B88P Seat Belt Switch - Passenger</u>
B101	Immobilizer Antenna	-	In the passenger compartment, behind the center of the instrument panel, above the HVAC control module, part of the immobilizer control module	-	-
B107	Accelerator Pedal Position Sensor	-	In the passenger compartment, under the driver side of the instrument panel, part of the accelerator pedal	<u>Instrument Panel Components (4 of 4)</u>	<u>B107 Accelerator Pedal Position Sensor</u>
B118B	Windshield Washer Fluid Level Switch	-	At the left front of the vehicle, behind the left side of the fascia, in the bottom washer solvent bottle	<u>Right Front of Vehicle Components</u>	<u>B118B Windshield Washer Fluid Level Switch</u>
B130A	Exhaust Gas Recirculation Temperature Sensor 1	-	On the right front top of the engine, on the EGR valve	<u>Right Front of Engine Components (2 of 2)</u>	<u>B130A Exhaust Gas Recirculation Temperature Sensor 1</u>
B130B	Exhaust Gas Recirculation Temperature Sensor 2	-	On the engine, behind the left front side of the exhaust	<u>Right Front of Engine Components (2 of 2)</u>	<u>B130B Exhaust Gas Recirculation Temperature Sensor 2</u>

Code	Name	Option	Location	Locator View	Connector End View
			manifold, near cylinder 4		
B150	Fuel Tank Pressure Sensor	-	Under the vehicle, rear of the fuel tank, mounted on the evaporative emission canister	-	<u>B150 Fuel Tank Pressure Sensor</u>
B153D	Seat Belt Buckle - Driver	-	In the passenger compartment, on the inboard side of the driver seat	-	-
B153P	Seat Belt Buckle - Passenger	-	In the passenger compartment, on the inboard side of the passenger seat	-	-
B160	Windshield Temperature and Inside Moisture Sensor	-	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>B160 Windshield Temperature and Inside Moisture Sensor</u>
B197	Charge Port Door Position Switch	-	At the left front of the vehicle, behind the rear of the left front fender	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>B197 Charge Port Door Position Switch</u>
B201	Brake Control Brake Pedal Position Sensor	-	In the engine compartment, below the master cylinder	<u>Engine Compartment Components - Left</u>	<u>B201 Brake Control Brake Pedal Position Sensor</u>
B202	Hybrid/EV Electronics Coolant Temperature Sensor	-	At the right front of the engine compartment, mounted in the top right of the Hybrid/EV electronics radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>B202 Hybrid/EV Electronics Coolant Temperature Sensor</u>
B203	Radiator Coolant Temperature Sensor	-	At the right front of the engine compartment, mounted in the	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>B203 Engine Coolant Radiator Temperature Sensor</u>

Code	Name	Option	Location	Locator View	Connector End View
			right center of the engine radiator side tank		
B204A	Hybrid/EV Battery Pack Coolant Temperature Sensor 1	-	Under the vehicle, inside the hybrid/EV battery pack, in the coolant inlet tube	-	<u>B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1</u>
B208	Fuel Fill Door Status Switch Assembly	-	At the right rear of the vehicle, behind the right rear quarter panel	<u>Underbody - Fuel System Components (1 of 2)</u>	<u>B208 Fuel Fill Door Status Switch Assembly</u>
B218L	Side Object Sensor Module - Left	UFG	At the right rear of the vehicle, behind the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B218L Side Object Sensor Module - Left</u>
B218R	Side Object Sensor Module - Right	UFG	At the left rear of the vehicle, behind the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B218R Side Object Sensor Module - Right</u>
B228A	Drive Motor 1 Position Sensor	-	In the engine compartment, internal to the automatic transmission, part of drive motor 1	<u>Transmission Components</u>	<u>B228A Drive Motor 1 Position Sensor</u>
B228B	Drive Motor 2 Position Sensor	-	In the engine compartment, internal to the automatic transmission, part of drive motor 2	<u>Transmission Components</u>	<u>B228B Drive Motor 2 Position Sensor</u>
B233B	Radar Sensor Module - Long Range	UGN	In the engine compartment, behind the grill, next to the left headlamp assembly	-	<u>B233B Radar Sensor Module - Long Range</u>
B258	Hybrid/EV Battery Coolant Level Switch	-	In the front middle of the engine	<u>Engine Compartment Components - Front (1 of 4)</u>	<u>B258 Hybrid/EV Battery Coolant Level Switch</u>

Code	Name	Option	Location	Locator View	Connector End View
			compartment, in the Hybrid/EV Battery Coolant Surge Tank		
B284	Vehicle Dynamic Sensor	-	In the passenger compartment, under the center console, at the rear	<u>Passenger Compartment Components (3 of 3)</u>	<u>B284 Vehicle Dynamic Sensor</u>
B305	Ambient Light/Sunload Sensor and Battery State of Charge Indicator	-	In the passenger compartment, at the top center of the instrument panel, in the windshield defog vent	<u>Instrument Panel Components (1 of 4)</u>	<u>B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator</u>
B306A	Parking Assist Sensor - Front Left Outer	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306A Parking Assist Sensor - Front Left Outer</u>
B306B	Parking Assist Sensor - Front Left Middle	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306B Parking Assist Sensor - Front Left Middle</u>
B306C	Parking Assist Sensor - Front Right Middle	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306C Parking Assist Sensor - Front Right Middle</u>
B306D	Parking Assist Sensor - Front Right Outer	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306D Parking Assist Sensor - Front Right Outer</u>
B306E	Parking Assist Sensor - Rear Left Outer	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306E Parking Assist Sensor - Rear Left Outer</u>
B306F	Parking Assist Sensor - Rear Left Middle	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306F Parking Assist Sensor - Rear Left Middle</u>
B306G	Parking Assist Sensor - Rear Right Middle	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306G Parking Assist Sensor - Rear Right Middle</u>

Code	Name	Option	Location	Locator View	Connector End View
B306H	Parking Assist Sensor - Rear Right Outer	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306H Parking Assist Sensor - Rear Right Outer</u>
B306K	Parking Assist Sensor - Side Left Front	UKC	At the front of the vehicle, mounted in the left side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306K Parking Assist Sensor - Side Left Front</u>
B306L	Parking Assist Sensor - Side Right Front	UKC	At the front of the vehicle, mounted in the right side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306L Parking Assist Sensor - Side Right Front</u>
B310	Fuel Pressure/Temperature Sensor	-	On the top of the engine, mounted to the center of the fuel rail	<u>Right Front of Engine Components (2 of 2)</u>	<u>B310 Fuel Pressure/Temperature Sensor</u>
C1	Battery	-	In the luggage compartment, under the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	<u>C1 Battery</u>
C4A	Hybrid/EV Battery Section 1	-	Under the vehicle, in the Hybrid/EV battery pack, forward section	-	-
C4B	Hybrid/EV Battery Section 2	-	Under the vehicle, in the Hybrid/EV battery pack, middle section	-	-
C4C	Hybrid/EV Battery Section 3	-	Under the vehicle, in the Hybrid/EV battery pack, rear section	-	-
C5A	Hybrid/EV Battery Module 1	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5A Hybrid/EV Battery Module 1</u>

Code	Name	Option	Location	Locator View	Connector End View
			battery section 3		
C5B	Hybrid/EV Battery Module 2	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5B Hybrid/EV Battery Module 2</u>
C5C	Hybrid/EV Battery Module 3	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5C Hybrid/EV Battery Module 3</u>
C5D	Hybrid/EV Battery Module 4	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 2	-	<u>C5D Hybrid/EV Battery Module 4</u>
C5E	Hybrid/EV Battery Module 5	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 2	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5E Hybrid/EV Battery Module 5</u>
C5F	Hybrid/EV Battery Module 6	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 1	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5F Hybrid/EV Battery Module 6</u>
C5G	Hybrid/EV Battery Module 7	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 1	-	<u>C5G Hybrid/EV Battery Module 7</u>
E1D	Accent Lamp - Driver Door	-	In the passenger compartment, in the driver door	<u>Driver Door Trim Components</u>	<u>E1D Accent Lamp - Driver Door</u>

Code	Name	Option	Location	Locator View	Connector End View
			trim		
E1P	Accent Lamp - Passenger Door	-	In the passenger compartment, in the passenger door trim	<u>Passenger Door Trim Components</u>	<u>E1P Accent Lamp - Passenger Door</u>
E2LF	Side Marker Lamp - Left Front	-	At left side, front of vehicle, part of the left headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E2LF Side Marker Lamp - Left Front</u>
E2RF	Side Marker Lamp - Right Front	-	At right side, front of vehicle, part of the right headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E2RF Side Marker Lamp - Right Front</u>
E4AC	Park/Daytime Running Lamp - Left	-	At the left front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4AC Park/Daytime Running Lamp - Left</u>
E4AD	Park/Daytime Running Lamp - Right	-	At the right front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4AD Park/Daytime Running Lamp - Right</u>
E4E	Headlamp - Left High Beam	-	At the left front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4E Headlamp - Left High Beam</u>
E4F	Headlamp - Right High Beam	-	At the right front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4F Headlamp - Right High Beam</u>
E4G	Headlamp - Left Low Beam	-	At the left front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4G Headlamp - Left Low Beam</u>
E4H	Headlamp - Right Low Beam	-	At the right front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4H Headlamp - Right Low Beam</u>

Code	Name	Option	Location	Locator View	Connector End View
E4LF	Turn Signal Lamp - Left Front	-	At the left front of the vehicle, part of the left headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4LF Turn Signal Lamp - Left Front</u>
E4LR	Turn Signal Lamp - Left Rear	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E4LR Turn Signal Lamp - Left Rear</u>
E4RF	Turn Signal Lamp - Right Front	-	At the right front of the vehicle, part of the right headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4RF Turn Signal Lamp - Right Front</u>
E4RR	Turn Signal Lamp - Right Rear	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E4RR Turn Signal Lamp - Right Rear</u>
E5A	Backup Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5A Backup Lamp - Left</u>
E5B	Backup Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5B Backup Lamp - Right</u>
E5E	Tail Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	-
E5F	Tail Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	-
E5L	Stop Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5L Stop Lamp - Left</u>

Code	Name	Option	Location	Locator View	Connector End View
E5R	Stop Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5R Stop Lamp - Right</u>
E6	Center High Mounted Stop Lamp	-	At the rear of the vehicle, in the center of the liftgate assembly, above the lower glass	<u>Liftgate Components (2 of 2)</u>	<u>E6 Center High Mounted Stop Lamp</u>
E7L	License Plate Lamp - Left	-	At the rear of the vehicle, above the license plate pocket, in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>E7L License Plate Lamp - Left</u>
E7R	License Plate Lamp - Right	-	At the rear of the vehicle, above the license plate pocket, in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>E7R License Plate Lamp - Right</u>
E13LA	Headlamp Assembly - Left	-	At the left front corner of the vehicle	<u>Front of Vehicle Components (1 of 2)</u>	-
E13RA	Headlamp Assembly - Right	-	At the right front corner of the vehicle	<u>Front of Vehicle Components (1 of 2)</u>	-
E14A	Seat Heating Element - Driver Back	KA1	In the passenger compartment, part of the driver seat back	-	<u>E14A Seat Heating Element - Driver Back</u>
E14B	Seat Heating Element - Driver Cushion	KA1	In the passenger compartment, part of the driver seat cushion assembly	-	<u>E14B Seat Heating Element - Driver Cushion</u>
E14C	Seat Heating Element - Passenger Back	KA1	In the passenger compartment, part of the passenger seat back	-	<u>E14C Seat Heating Element - Passenger Back</u>

Code	Name	Option	Location	Locator View	Connector End View
E14D	Seat Heating Element - Passenger Cushion	KA1	In the passenger compartment, part of the passenger seat cushion assembly	-	<u>E14D Seat Heating Element - Passenger Cushion</u>
E14F	Seat Heating Element - Left Rear Cushion	KA6	In the passenger compartment, part of the left rear seat cushion	-	<u>E14F Seat Heating Element - Left Rear Cushion</u>
E14H	Seat Heating Element - Right Rear Cushion	KA6	In the passenger compartment, part of the right rear seat cushion	-	<u>E14H Seat Heating Element - Right Rear Cushion</u>
E15	Steering Wheel Heater	UVD	In the passenger compartment, left front, within the steering wheel rim	<u>Steering Wheel Components</u>	-
E17D	Outside Rearview Mirror Glass - Driver	-	Outside the vehicle, at the front of the driver door, part of the outside rearview mirror assembly	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>E17D Outside Rearview Mirror Glass - Driver X1</u> • <u>E17D Outside Rearview Mirror Glass - Driver X2</u>
E17P	Outside Rearview Mirror Glass - Passenger	-	Outside the vehicle, at the front of the passenger door, part of the outside rearview mirror assembly	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>E17P Outside Rearview Mirror Glass - Passenger X1</u> • <u>E17P Outside Rearview Mirror Glass - Passenger X2</u>
E18	Rear Defogger Grid	-	In the passenger compartment, part of the rear glass	• <u>Passenger Compartment/Roof Component Views</u> • <u>Liftgate Components (2 of 2)</u>	• <u>E18 Rear Defogger Grid X1</u> • <u>E18 Rear Defogger Grid X2</u>
E31L	Sunshade Mirror Lamp - Left	-	In the passenger compartment, at the front left of the headliner,	<u>Headliner Components (1 of 4)</u>	<u>E31L Sunshade Mirror Lamp - Left</u>

Code	Name	Option	Location	Locator View	Connector End View
			part of the sunshade assembly		
E31R	Sunshade Mirror Lamp - Right	-	In the passenger compartment, at the right front of the headliner, part of the sunshade assembly	<u>Headliner Components (1 of 4)</u>	<u>E31R Sunshade Mirror Lamp - Right</u>
E33	Cargo Lamp	-	In the luggage compartment, at the left	<u>Liftgate Components (1 of 2)</u>	<u>E33 Cargo Lamp</u>
E37F	Dome/Reading Lamps - Front	-	In the passenger compartment, at the front center of the headliner	<u>Headliner Components (1 of 4)</u>	-
E37R	Dome/Reading Lamps - Rear	-	In the passenger compartment, at the rear center of the headliner	<u>Headliner Components (1 of 4)</u>	<u>E37R Dome/Reading Lamps - Rear</u>
E41	Engine Coolant Thermostat Heater	-	In the engine compartment, at the right front of the cylinder head, part of the thermostat housing	<u>Right Front of Engine Components (2 of 2)</u>	<u>E41 Engine Coolant Thermostat Heater</u>
E42L	Tail Lamp Assembly - Left	-	At the left rear corner of the vehicle	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E42L Tail Lamp Assembly - Left</u>
E42R	Tail Lamp Assembly - Right	-	At the right rear corner of the vehicle	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E42R Tail Lamp Assembly - Right</u>
E54	Hybrid/EV Battery Pack Coolant Heater	-	Under the vehicle, inside the hybrid/EV battery pack in the coolant inlet tube	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
E63D	Flood Lamp - Driver Door Handle	-	In the passenger compartment, in the driver door trim	<u>Driver Door Trim Components</u>	<u>E63D Flood Lamp - Driver Door Handle</u>

Code	Name	Option	Location	Locator View	Connector End View
E63LR	Flood Lamp - Left Rear Door Handle	-	In the passenger compartment, in the left rear door trim	<u>Left Rear Door Trim Components</u>	<u>E63LR Flood Lamp - Left Rear Door Handle</u>
E63P	Flood Lamp - Passenger Door Handle	-	In the passenger compartment, in the passenger door trim	<u>Passenger Door Trim Components</u>	<u>E63P Flood Lamp - Passenger Door Handle</u>
E63RR	Flood Lamp - Right Rear Door Handle	-	In the passenger compartment, in the right rear door trim	<u>Right Rear Door Trim Components</u>	<u>E63RR Flood Lamp - Right Rear Door Handle</u>
E85	Hybrid/EV Battery Charger Receptacle Accent Lamp	-	In the left fender, behind the charge port door	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>E85 Hybrid/EV Battery Charger Receptacle Accent Lamp</u>
E88	Front Floor Console Bin Lamp	-	In center of instrument panel, under the HVAC control panel	<u>Instrument Panel - Bottom</u>	<u>E1W Accent Lamp - Instrument Panel</u>
F101	Passenger Instrument Panel Air Bag	-	In the passenger compartment, mounted in the passenger side of the instrument panel	<u>Instrument Panel Components (1 of 4)</u>	• <u>F101 Passenger Instrument Panel Air Bag X1</u> • <u>F101 Passenger Instrument Panel Air Bag X2</u> • <u>F101 Passenger Instrument Panel Air Bag X3</u>
F105L	Roof Rail Air Bag - Left	-	In the passenger compartment, along the left roof rail	<u>Passenger Compartment Components (2 of 3)</u>	<u>F105L Roof Rail Air Bag - Left</u>
F105R	Roof Rail Air Bag - Right	-	In the passenger compartment, along the right roof rail	<u>Passenger Compartment Components (3 of 3)</u>	<u>F105R Roof Rail Air Bag - Right</u>
F106LF	Seat Side Air Bag - Left Front	-	In the passenger compartment, mounted in the outboard side of the left front seat back	-	<u>F106LF Seat Side Air Bag - Left Front</u>

Code	Name	Option	Location	Locator View	Connector End View
F106LR	Seat Side Air Bag - Left Rear	-	In the passenger compartment, mounted in the left, outboard side of the rear seat back	<u>Rear Seat Components (1 of 3)</u>	<u>F106LR Seat Side Air Bag - Left Rear</u>
F106RF	Seat Side Air Bag - Right Front	-	In the passenger compartment, mounted in the outboard side of the right front seat back	-	<u>F106RF Seat Side Air Bag - Right Front</u>
F106RR	Seat Side Air Bag - Right Rear	-	In the passenger compartment, mounted in the right, outboard side of the rear seat back	<u>Rear Seat Components (1 of 3)</u>	<u>F106RR Seat Side Air Bag - Right Rear</u>
F107	Steering Wheel Air Bag	-	In the passenger compartment, mounted in the center of the steering wheel	<u>Steering Wheel Components</u>	• <u>F107 Steering Wheel Air Bag X1</u> • <u>F107 Steering Wheel Air Bag X2</u>
F112D	Seat Belt Retractor Pretensioner - Driver	-	In the passenger compartment, at the base of the driver B-pillar	<u>Passenger Compartment Components (2 of 3)</u>	<u>F112D Seat Belt Retractor Pretensioner - Driver</u>
F112P	Seat Belt Retractor Pretensioner - Passenger	-	In the passenger compartment, at the base of the passenger B-pillar	<u>Passenger Compartment Components (3 of 3)</u>	<u>F112P Seat Belt Retractor Pretensioner - Passenger</u>
F113D	Seat Belt Anchor Pretensioner - Driver	-	In the passenger compartment, under the outboard side of the driver seat cushion	-	<u>F113D Seat Belt Anchor Pretensioner - Driver</u>
F113P	Seat Belt Anchor Pretensioner - Passenger	-	In the passenger compartment, under the outboard side of the passenger seat cushion	-	<u>F113P Seat Belt Anchor Pretensioner - Passenger</u>

Code	Name	Option	Location	Locator View	Connector End View
F114D	Knee Air Bag - Driver	-	In the passenger compartment, at the bottom of the driver side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>F114D Knee Air Bag - Driver</u>
F114P	Knee Air Bag - Passenger	-	In the passenger compartment, at the bottom of the passenger side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>F114P Knee Air Bag - Passenger</u>
F115	Hybrid/EV Battery Pack Fuse Cover	-	Under the vehicle, at the front of the Hybrid/EV battery pack	-	<u>F115 Hybrid/EV Battery Pack Fuse Cover</u>
G1	A/C Compressor	-	In the engine compartment, mounted to the right rear of the engine	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	• <u>G1 A/C Compressor X1</u> • <u>G1 A/C Compressor X2</u>
G5	Transmission Fluid Pump - Electric/Auxiliary	-	In the engine compartment, internal to the transmission assembly	-	-
G10L	Cooling Fan Motor - Left	-	At the front of the engine compartment, rear of the left side of the radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G10L Cooling Fan Motor - Left</u>
G10R	Cooling Fan Motor - Right	-	At the front of the engine compartment, rear of the right side of the radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G10R Cooling Fan Motor - Right</u>
G12	Fuel Pump	-	Under the rear of the vehicle, in the fuel tank, part of the fuel pump and level sensor assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
G18	High Pressure Fuel Pump	-	In the fuel system, mounted in-line to the high pressure fuel line, at the top left rear of the engine	<u>Left Front of Engine Components</u>	<u>G18 High Pressure Fuel Pump</u>
G24	Windshield Washer Pump	-	At the left front of the vehicle, behind the left side of the fascia, in the washer solvent bottle	<u>Right Front of Vehicle Components</u>	<u>G24 Windshield Washer Pump</u>
G35	Hybrid/EV Electronics Coolant Pump	-	At the left front of the engine compartment, mounted to the left side of the lower radiator support	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>G35 Hybrid/EV Electronics Coolant Pump</u>
G36	Auxiliary Heater Coolant Pump	-	At the rear of the engine compartment, mounted to the suspension cradle	<u>Right Rear of Engine Components</u>	<u>G36 Auxiliary Heater Coolant Pump</u>
G37	Hybrid/EV Battery Pack Coolant Pump	-	At the front of the engine compartment, mounted to the center of the lower radiator support	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G37 Hybrid/EV Battery Pack Coolant Pump</u>
K1	14V Power Module	-	In the luggage compartment, under the left side of the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	• <u>K1 14V Power Module X1</u> • <u>K1 14V Power Module X2</u> • <u>K1 14V Power Module X3</u> • <u>K1 14V Power Module X4</u>

Code	Name	Option	Location	Locator View	Connector End View
K9	Body Control Module	-	In the passenger compartment, under the center console	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K9 Body Control Module X1</u> • <u>K9 Body Control Module X2</u> • <u>K9 Body Control Module X3</u> • <u>K9 Body Control Module X4</u> • <u>K9 Body Control Module X5</u> • <u>K9 Body Control Module X6</u> • <u>K9 Body Control Module X7</u>
K10	Coolant Heater Control Module	-	At the right side of the engine compartment, near the engine crankshaft pulley	<u>Engine Compartment Components - Right</u>	• <u>K10 Coolant Heater Control Module X1</u> • <u>K10 Coolant Heater Control Module X2</u>
K16	Battery Energy Control Module	-	Under the vehicle, part of the hybrid/EV battery pack	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	• <u>K16 Battery Energy Control Module X1</u> • <u>K16 Battery Energy Control Module X2</u> • <u>K16 Battery Energy Control Module X3</u> • <u>K16 Battery Energy Control Module X4</u> • <u>K16 Battery Energy Control Module X5</u> • <u>K16 Battery Energy Control Module X6</u> • <u>K16 Battery Energy Control Module X7</u>

Code	Name	Option	Location	Locator View	Connector End View
					• <u>K16 Battery Energy Control Module X8</u>
K17	Electronic Brake Control Module	-	At the left rear of the engine compartment, part of the master cylinder assembly	<u>Engine Compartment Components - Left</u>	<u>K17 Electronic Brake Control Module</u>
K20	Engine Control Module	-	At the left front corner of the vehicle, behind the left side of the front fascia, below the left headlamp	<u>Left Front of Vehicle Components (1 of 2)</u>	• <u>K20 Engine Control Module X1</u> • <u>K20 Engine Control Module X2</u> • <u>K20 Engine Control Module X3</u>
K29F	Seat Heating Control Module - Front	KA1	In the passenger compartment, under the passenger seat cushion	-	• <u>K29F Seat Heating Control Module - Front X1 (KA1)</u> • <u>K29F Seat Heating Control Module - Front X2 (KA1)</u>
K29R	Seat Heating Control Module - Rear	KA6	In the passenger compartment, under the center of the rear seat cushion	-	• <u>K29R Seat Heating Control Module - Rear X1 (KA6)</u> • <u>K29R Seat Heating Control Module - Rear X2 (KA6)</u>
K32	Steering Wheel Heating Control Module	-	In the passenger compartment, attached to the lower portion of the steering wheel	<u>Steering Wheel Components</u>	• <u>K32 Steering Wheel Heating Control Module X1</u> • <u>K32 Steering Wheel Heating Control Module</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>X2</u>
K33	HVAC Control Module	-	In the passenger compartment, behind the center of the instrument panel, above the human interface module	<u>Instrument Panel Components (2 of 4)</u>	• <u>K33 HVAC Control Module X1</u> • <u>K33 HVAC Control Module X2</u> • <u>K33 HVAC Control Module X3</u>
K36	Inflatable Restraint Sensing and Diagnostic Module	-	In the passenger compartment, between the front seats, under the center console	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K36 Inflatable Restraint Sensing and Diagnostic Module X1</u> • <u>K36 Inflatable Restraint Sensing and Diagnostic Module X2</u>
K43	Power Steering Control Module	-	Under the vehicle, at the rear of the engine cradle, part of the steering gear assembly	<u>Underbody - Steering Components</u>	• <u>K43 Power Steering Control Module X1</u> • <u>K43 Power Steering Control Module X2</u>
K57	Battery Charger Control Module	-	In the luggage compartment, under trim panel, on the right side floor, part of the battery charger	-	-
K73	Telematics Communication Interface Control Module	UE1	In the passenger compartment, behind the left side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	• <u>K73 Telematics Communication Interface Control Module X1</u> • <u>K73 Telematics Communication Interface Control Module X2</u> • <u>K73 Telematics Communication</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>Interface Control Module X5</u> • <u>K73 Telematics Communication Interface Control Module X7</u>
K74	Human Machine Interface Control Module	-	In the passenger compartment, within the center of the instrument panel, below the HVAC control module	<u>Instrument Panel Components (2 of 4)</u>	• <u>K74 Human Machine Interface Control Module X1</u> • <u>K74 Human Machine Interface Control Module X2</u> • <u>K74 Human Machine Interface Control Module X3</u> • <u>K74 Human Machine Interface Control Module X5</u> • <u>K74 Human Machine Interface Control Module X7</u>
K77	Remote Control Door Lock Receiver	-	In the luggage compartment, behind the left side trim panel	<u>Passenger Compartment Components (1 of 3)</u>	<u>K77 Remote Control Door Lock Receiver</u>
K84	Keyless Entry Control Module	-	In the luggage compartment, behind the left side trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K84 Keyless Entry Control Module X1</u> • <u>K84 Keyless Entry Control Module X2</u>
K85	Passenger Presence Module	-	In the passenger compartment, under the passenger seat	-	<u>K85 Passenger Presence Module</u>
K89	Immobilizer Control Module	-	In the passenger compartment,	<u>Center Console Components (2 of 3)</u>	<u>K89 Immobilizer Control Module</u>

Code	Name	Option	Location	Locator View	Connector End View
			under the center console		
K107A	Drive Motor 1 Control Module	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K107B	Drive Motor 2 Control Module	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K109	Frontview Camera Module	UHY	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>K109 Frontview Camera Module</u>
K111	Fuel Pump Driver Control Module	-	In the luggage compartment, behind the right side trim panel	<u>Luggage Compartment Components (1 of 2)</u>	<u>K111 Fuel Pump Driver Control Module</u>
K114A	Hybrid/EV Powertrain Control Module 1	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K114B	Hybrid/EV Powertrain Control Module 2	-	In the passenger compartment, behind the right side of the instrument panel	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K114B Hybrid/EV Powertrain Control Module 2 X1</u> • <u>K114B Hybrid/EV Powertrain Control Module 2 X2</u>
K118	Electric A/C Compressor Control Module	-	In the engine compartment, part of the A/C Compressor	-	-

Code	Name	Option	Location	Locator View	Connector End View
K124	Active Safety Control Module	UGN	In the left rear corner of the luggage compartment, behind the trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K124 Active Safety Control Module X1</u> • <u>K124 Active Safety Control Module X2</u>
K132	Pedestrian Alert Sound Control Module	-	In the passenger compartment, under the passenger seat, on the floor	<u>Passenger Compartment Components (2 of 3)</u>	<u>K132 Pedestrian Alert Sound Control Module</u>
K177	Brake Booster Control Module	-	In the engine compartment, under the left side of the front cowl	<u>Engine Compartment Components - Left</u>	<u>K177 Brake Booster Control Module</u>
K182	Parking Assist Control Module	UFQ	In the left rear corner of the luggage compartment, behind the trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K182 Parking Assist Control Module X1</u> • <u>K182 Parking Assist Control Module X2</u> • <u>K182 Parking Assist Control Module X3</u>
M6	Air Temperature Door Actuator	-	In the passenger compartment, under the driver side of the instrument panel, mounted to the HVAC module assembly	-	<u>M6 Air Temperature Door Actuator</u>
M7	Transmission Shift Lock Control Solenoid Actuator	-	In the passenger compartment, part of the automatic transmission shift lever assembly	-	<u>M7 Transmission Shift Lock Control Solenoid Actuator</u>
M8	Blower Motor	-	In the passenger compartment, under the	<u>Instrument Panel - Bottom</u>	<u>M8 Blower Motor</u>

Code	Name	Option	Location	Locator View	Connector End View
			passenger side of the instrument panel, mounted to the HVAC module assembly		
M15A	Drive Motor 1	-	In the engine compartment, internal to the automatic transmission	<u>Transmission Components</u>	-
M15B	Drive Motor 2	-	In the engine compartment, internal to the automatic transmission	<u>Transmission Components</u>	-
M37	Mode Door Actuator	-	In the passenger compartment, under the driver side of the instrument panel, mounted to the HVAC module assembly	-	<u>M37 Mode Door Actuator</u>
M46	Air Recirculation Door Actuator	-	In the passenger compartment, under the passenger side of the instrument panel, mounted to the HVAC module assembly, above the blower motor	-	<u>M46 Air Recirculation Door Actuator</u>
M74D	Window Motor - Driver	-	In the passenger compartment, behind the driver door panel	<u>Driver Door Components</u>	<u>M74D Window Motor - Driver</u>
M74LR	Window Motor - Left Rear	-	In the passenger compartment, behind the left	<u>Left Rear Door Components</u>	<u>M74LR Window Motor - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			rear door panel		
M74P	Window Motor - Passenger	-	In the passenger compartment, behind the passenger door panel	<u>Passenger Door Components</u>	<u>M74P Window Motor - Passenger</u>
M74RR	Window Motor - Right Rear	-	In the passenger compartment, behind the right rear door panel	<u>Right Rear Door Components</u>	<u>M74RR Window Motor - Right Rear</u>
M75	Windshield Wiper Motor	-	At the rear of the engine compartment, below the center on the windshield	<u>Engine Compartment Components</u>	<u>M75 Windshield Wiper Motor</u>
M77D	Outside Rearview Mirror Motor - Driver	-	At the front of the driver door, part of the outside rearview mirror assembly	-	<u>M77D Outside Rearview Mirror Motor - Driver</u>
M77P	Outside Rearview Mirror Motor - Passenger	-	At the front of the passenger door, part of the outside rearview mirror assembly	-	<u>M77P Outside Rearview Mirror Motor - Passenger</u>
M96	Active Grille Air Shutter Actuator	-	At front of vehicle, center, behind upper grille	<u>Engine Compartment Components - Front (4 of 4)</u>	<u>M96 Active Grille Air Shutter Actuator</u>
M97	Fuel Fill Door Lock Actuator	-	At the right rear of the vehicle, behind the right rear quarter panel	<u>Underbody - Fuel System Components (1 of 2)</u>	<u>M97 Fuel Fill Door Lock Actuator</u>
M104L	Park Brake Actuator - Left	-	Behind the left rear wheel, mounted to the brake caliper assembly	<u>Underbody - Wheel Components (2 of 4)</u>	<u>M104L Park Brake Actuator - Left</u>
M104R	Park Brake Actuator - Right	-	Behind the right rear wheel, mounted to the brake caliper assembly	<u>Underbody - Wheel Components (4 of 4)</u>	<u>M104R Park Brake Actuator - Right</u>

Code	Name	Option	Location	Locator View	Connector End View
P2	Transmission Shift Lever Position Indicator	-	In the passenger compartment, under the center console	<u>Center Console Components (1 of 3)</u>	<u>P2 Transmission Shift Lever Position Indicator</u>
P12	Horn	-	At right front corner of vehicle, behind right headlamp	<u>Right Front of Vehicle Components</u>	<u>P12 Horn</u>
P16	Instrument Cluster	-	In the passenger compartment, at the top of the driver side of the instrument panel, above the steering column	<u>Instrument Panel Components (1 of 4)</u>	<u>P16 Instrument Cluster</u>
P17	Info Display Module	-	In the passenger compartment, at the top center of the instrument panel, above the radio/HVAC control	<u>Instrument Panel Components (1 of 4)</u>	• <u>P17 Info Display Module X1</u> • <u>P17 Info Display Module X2</u>
P19AC	Speaker - Subwoofer	-	In the luggage compartment, behind the right side trim panel	<u>Luggage Compartment Components (1 of 2)</u>	<u>P19AC Speaker - Subwoofer (UQA)</u>
P19AG	Speaker - Left Front Door	-	In the passenger compartment, behind the left front door panel	<u>Driver Door Components</u>	• <u>P19AG Speaker - Left Front Door (UQA)</u> • <u>P19AG Speaker - Left Front Door (UZ6)</u>
P19AH	Speaker - Right Front Door	-	In the passenger compartment, behind the right front door panel	<u>Passenger Door Components</u>	• <u>P19AH Speaker - Right Front Door (UQA)</u> • <u>P19AH Speaker - Right Front Door (UZ6)</u>
P19AL	Speaker - Left Rear Door	-	In the passenger compartment, behind the left rear door panel	<u>Left Rear Door Components</u>	• <u>P19AL Speaker - Left Rear Door (UQA)</u> • <u>P19AL Speaker - Left Rear Door</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>(UZ6)</u>
P19AM	Speaker - Right Rear Door	-	In the passenger compartment, behind the right rear door panel	<u>Right Rear Door Components</u>	• <u>P19AM Speaker - Right Rear Door (UQA)</u> • <u>P19AM Speaker - Right Rear Door (UZ6)</u>
P19B	Speaker - Center Instrument Panel	-	In the passenger compartment, at the top center of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>P19B Speaker - Center Instrument Panel (UQA)</u>
P19H	Speaker - Left Front Tweeter	-	In the passenger compartment, at the base of the left A-pillar molding	<u>Instrument Panel Components (2 of 4)</u>	<u>P19H Speaker - Left Front Tweeter</u>
P19V	Speaker - Right Front Tweeter	-	In the passenger compartment, at the base of the right A-pillar molding	<u>Instrument Panel Components (2 of 4)</u>	<u>P19V Speaker - Right Front Tweeter</u>
P34D	Side Object Detection Indicator - Driver	-	Outside the vehicle, at the front of the driver door, part of the outside rear view mirror glass	-	-
P34P	Side Object Detection Indicator - Passenger	-	Outside the vehicle, at the front of the passenger door, part of the outside rear view mirror glass	-	-
P43	Collision Alert Indicators	-	In the passenger compartment, left front, mounted to instrument panel, forward of instrument	<u>Instrument Panel Components (2 of 4)</u>	<u>P43 Collision Alert Indicators</u>

Code	Name	Option	Location	Locator View	Connector End View
			cluster		
P48	Pedestrian Alert Sound Speaker	-	At the front of the vehicle, behind the upper grille	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>P48 Pedestrian Alert Sound Speaker</u>
Q5	Brake Pressure Modulator	-	At the left rear of the engine compartment, part of the electronic brake control module	-	-
Q6E	Camshaft Position Actuator Solenoid Valve - Exhaust	-	At the right front of the engine, in the top right front of the cylinder head	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q6E Camshaft Position Actuator Solenoid Valve - Exhaust</u>
Q6F	Camshaft Position Actuator Solenoid Valve - Intake	-	At the right rear of the engine, in the top right rear of the cylinder head	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q6F Camshaft Position Actuator Solenoid Valve - Intake</u>
Q8	Control Solenoid Valve Assembly	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>Q8 Control Solenoid Valve Assembly</u>
Q12	Evaporative Emission Purge Solenoid Valve	-	In the engine compartment, at the top rear center of the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>Q12 Evaporative Emission Purge Solenoid Valve</u>
Q13	Evaporative Emission Vent Solenoid Valve	-	Under the vehicle, rear of the fuel tank, near the evaporative emission canister	-	<u>Q13 Evaporative Emission Vent Solenoid Valve</u>
Q14	Exhaust Gas Recirculation Valve	-	On the front of the engine, mounted at the right of the exhaust manifold	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q14 Exhaust Gas Recirculation Valve</u>

Code	Name	Option	Location	Locator View	Connector End View
Q17A	Fuel Injector 1	-	In the engine compartment, at the top of the engine, next to spark plug 1	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17A Fuel Injector 1</u>
Q17B	Fuel Injector 2	-	In the engine compartment, at the top of the engine, next to spark plug 2	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17B Fuel Injector 2</u>
Q17C	Fuel Injector 3	-	In the engine compartment, at the top of the engine, next to spark plug 3	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17C Fuel Injector 3</u>
Q17D	Fuel Injector 4	-	In the engine compartment, at the top of the engine, next to spark plug 4	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17D Fuel Injector 4</u>
Q23	Line Pressure Control Solenoid Valve	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>Q23 Line Pressure Control Solenoid Valve</u>
Q27B	Pressure Control Solenoid Valve 2	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27C	Pressure Control Solenoid Valve 3	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27D	Pressure Control Solenoid Valve 4	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27E	Pressure Control Solenoid Valve 5	-	In the engine compartment, internal to the transmission	-	-

Code	Name	Option	Location	Locator View	Connector End View
			control solenoid valve assembly		
Q38	Throttle Body	-	In the engine compartment, at the right rear of the engine at the inlet for the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>Q38 Throttle Body</u>
Q44	Engine Oil Pressure Control Solenoid Valve	-	In the engine compartment, mounted to the rear lower portion of the engine	<u>Left Rear of Engine/Transmission Components</u>	<u>Q44 Engine Oil Pressure Control Solenoid Valve</u>
Q63	Evaporative Emission System Leak Detection Pump Assembly	-	Under the vehicle, to the rear of the fuel tank	-	<u>Q63 Evaporative Emission System Leak Detection Pump Assembly</u>
Q66	Passenger Compartment Heater Coolant Control Valve	-	In the rear middle of the engine compartment, mounted to the bulkhead	<u>Right Rear of Engine Components</u>	<u>Q66 Passenger Compartment Heater Coolant Control Valve</u>
R6A	Terminating Resistor - High Speed Bus	-	In the passenger compartment, behind the right side of the instrument panel, taped to the hybrid/ev powertrain control module 2 harness	<u>Passenger Compartment Components (3 of 3)</u>	<u>R6A Terminating Resistor - High Speed Bus</u>
R25	Hybrid/EV Battery Pre-Charge Resistor	-	Under the vehicle, part of the hybrid/EV battery assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
S3	Transmission Shift Lever	-	In the passenger compartment, at the front of the center console	<u>Center Console Components (3 of 3)</u>	<u>S3 Transmission Shift Lever</u>
S13D	Door Lock Switch - Driver	-	In the passenger compartment, at the upper front	<u>Driver Door Trim Components</u>	<u>S13D Door Lock Switch - Driver</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the driver door panel		
S13P	Door Lock Switch - Passenger	-	In the passenger compartment, at the upper front of the passenger door panel	<u>Passenger Door Trim Components</u>	<u>S13P Door Lock Switch - Passenger</u>
S15	Manual Service Disconnect	-	Under the vehicle at the top of the Hybrid/EV battery, accessed by removing the storage compartment in the rear of the center console	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	-
S26	Hazard Warning Switch	-	In the passenger compartment, on top of the center console, rear of the transmission shift lever position indicator	<u>Center Console Components (1 of 3)</u>	<u>S26 Hazard Warning Switch</u>
S30	Headlamp Switch	-	In the instrument panel, to the left of the steering wheel, under the vent	<u>Instrument Panel Components (1 of 4)</u>	<u>S30 Headlamp Switch</u>
S32LR	Seat Heating Switch - Left Rear	KA6	In the center console, in front of the rear cup holders	<u>Center Console Components (1 of 3)</u>	<u>S32LR Seat Heating Switch - Left Rear</u>
S32RR	Seat Heating Switch - Right Rear	KA6	In the center console, in front of the rear cup holders	<u>Center Console Components (1 of 3)</u>	<u>S32RR Seat Heating Switch - Right Rear</u>
S33	Horn Switch	-	In the passenger compartment, in the center of the steering wheel, behind the driver side air	-	• <u>S33 Horn Switch X1</u> • <u>S33 Horn Switch X2</u>

Code	Name	Option	Location	Locator View	Connector End View
			bag		
S46	Liftgate Handle Switch	-	At the rear of the vehicle, in the lower center of the liftgate	<u>Liftgate Components (1 of 2)</u>	<u>S46 Liftgate Handle Switch</u>
S48B	Multifunction Switch - Overhead Console	-	In the passenger compartment, at the front center of the headliner	<u>Headliner Components (2 of 4)</u>	<u>S48B Multifunction Switch - Overhead Console</u>
S48E	Multifunction Switch - Center Console	-	In the passenger compartment, at the front of the center console, rear of transmission shift lever	<u>Center Console Components (1 of 3)</u>	<u>S48E Multifunction Switch - Center Console</u>
S70E	Steering Wheel Controls Switch - Radio Presets	-	In the passenger compartment, on the left side bottom of the steering wheel	<u>Steering Wheel Components</u>	<u>S70E Steering Wheel Controls Switch - Radio Presets</u>
S70F	Steering Wheel Controls Switch - Radio Volume	-	In the passenger compartment, on the steering wheel	<u>Steering Wheel Components</u>	<u>S70F Steering Wheel Controls Switch - Radio Volume</u>
S70L	Steering Wheel Controls Switch - Left	-	In the passenger compartment, on the left side of the steering wheel	<u>Steering Wheel Components</u>	<u>S70L Steering Wheel Controls Switch - Left</u>
S70R	Steering Wheel Controls Switch - Right	-	In the passenger compartment, on the right side of the steering wheel	<u>Steering Wheel Components</u>	<u>S70R Steering Wheel Controls Switch - Right</u>
S78	Turn Signal/Multifunction Switch	-	In the passenger compartment, on the left side of the steering column	<u>Steering Column Components</u>	<u>S78 Turn Signal/Multifunction Switch</u>
S79LR	Window Switch - Left Rear	-	In the passenger compartment, at the center of the left rear door panel	<u>Left Rear Door Trim Components</u>	<u>S79LR Window Switch - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
S79P	Window Switch - Passenger	-	In the passenger compartment, at the center of the passenger door panel	<u>Passenger Door Trim Components</u>	<u>S79P Window Switch - Passenger</u>
S79RR	Window Switch - Right Rear	-	In the passenger compartment at the center of the right rear door panel	<u>Right Rear Door Trim Components</u>	<u>S79RR Window Switch - Right Rear</u>
S82	Windshield Wiper/Washer Switch	-	In the passenger compartment, on the right side of the steering column	<u>Steering Column Components</u>	<u>S82 Windshield Wiper/Washer Switch</u>
S83	Vehicle On/Off Switch	-	In the passenger compartment, in the center of the instrument panel, to the right side of the steering wheel	<u>Instrument Panel Components (1 of 4)</u>	<u>S83 Vehicle On/Off Switch</u>
S91	Park Brake Control Switch	-	In the passenger compartment, in the center console, forward of the transmission shift lever position indicator	<u>Center Console Components (1 of 3)</u>	<u>S91 Park Brake Control Switch</u>
S117	Refuel Request Switch	-	In the passenger compartment, on the driver door panel, above the storage compartment	<u>Driver Door Trim Components</u>	<u>S117 Refuel Request Switch</u>
S146	Window/Outside Rearview Mirror Switch - Driver	-	In the passenger compartment, at the front of the driver door panel	<u>Driver Door Trim Components</u>	<u>S146 Window/Outside Rearview Mirror Switch - Driver</u>
S151	Regenerative Braking On-Demand Switch	-	In the passenger compartment, left front, in the	<u>Steering Wheel Components</u>	<u>S151 Regenerative Braking On-Demand Switch</u>

Code	Name	Option	Location	Locator View	Connector End View
			steering wheel on rear of left spoke		
T2RR	Antenna - Roof Rear	-	Outside the vehicle, at the rear center of the roof	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>T2RR Antenna - Roof Rear X1</u> • <u>T2RR Antenna - Roof Rear X2</u>
T3	Audio Amplifier	UQA	In the luggage compartment, behind the right side trim panel, under the subwoofer	<u>Luggage Compartment Components (1 of 2)</u>	• <u>T3 Audio Amplifier X1</u> • <u>T3 Audio Amplifier X2</u> • <u>T3 Audio Amplifier X3</u> • <u>T3 Audio Amplifier X4</u>
T6	Power Inverter Module	-	In the engine compartment, to the left of the engine, on top of the transmission	• <u>Left Rear of Engine/Transmission Components</u> • <u>Transmission Components</u>	• <u>T6 Power Inverter Module X1</u> • <u>T6 Power Inverter Module X2</u> • <u>G5 Transmission Fluid Pump - Electric/Auxiliary</u> • <u>T6 Power Inverter Module X4</u> • <u>T6 Power Inverter Module X5</u>
T8A	Ignition Coil 1	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 1	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8A Ignition Coil 1</u>
T8B	Ignition Coil 2	-	In the engine compartment, on the top of the cylinder head,	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8B Ignition Coil 2</u>

Code	Name	Option	Location	Locator View	Connector End View
			between the camshafts, at cylinder 2		
T8C	Ignition Coil 3	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 3	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8C Ignition Coil 3</u>
T8D	Ignition Coil 4	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 4	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8D Ignition Coil 4</u>
T10B	Keyless Entry Antenna - Instrument Panel Compartment	-	In the passenger compartment, behind the center of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>T10B Keyless Entry Antenna - Instrument Panel Compartment</u>
T10C	Keyless Entry Antenna - Left Front Door Handle	-	In the driver door, part of the driver exterior door handle assembly	-	-
T10D	Keyless Entry Antenna - Right Front Door Handle	-	In the passenger door, part of the passenger exterior door handle assembly	-	-
T10E	Keyless Entry Antenna - Rear Compartment	-	In the passenger compartment, behind the rear seat, in luggage compartment center of seat back	<u>Luggage Compartment Components (1 of 2)</u>	<u>T10E Keyless Entry Antenna - Rear Compartment</u>
T10G	Keyless Entry Antenna - Rear Fascia	-	On the vehicle exterior, behind the center of the rear fascia	<u>Rear of Vehicle Components (3 of 3)</u>	<u>T10G Keyless Entry Antenna - Rear Fascia</u>
T10K	Keyless Entry Antenna - Center Console Rear	-	In the passenger compartment, under the center	<u>Center Console Components (2 of 3)</u>	<u>T10K Keyless Entry Antenna - Center Console Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			console - rear		
T12	Automatic Transmission Assembly	-	In the engine compartment, to the left of the engine	<u>Left Rear of Engine/Transmission Components</u>	-
T15	Navigation Antenna Signal Splitter	-	In the passenger compartment, behind the glove box, mounted to the telematics communication interface control module bracket	<u>Instrument Panel Components (3 of 4)</u>	• <u>T15 Navigation Antenna Signal Splitter X1</u> • <u>T15 Navigation Antenna Signal Splitter X2</u> • <u>T15 Navigation Antenna Signal Splitter X3</u>
T18	Battery Charger	-	In the luggage compartment, under the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	• <u>T18 Battery Charger X1</u> • <u>T18 Battery Charger X2</u> • <u>T18 Battery Charger X3</u>
T21	Hybrid/EV Battery Coolant Heater Transistor	-	Under the vehicle, part of the hybrid/EV battery contactor assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
T22	Mobile Device Wireless Charger Module	-	In the passenger compartment, inside the center console	<u>Center Console Components (2 of 3)</u>	<u>T22 Mobile Device Wireless Charger Module</u>
X21	Manual Service Disconnect Receptacle	-	At the top of the Hybrid/EV battery, under the battery cover at the top rear of section 2, under the manual service disconnect	-	• <u>X21 Manual Service Disconnect Receptacle</u> • <u>X21 Manual Service Disconnect Receptacle X2</u>
X50A	Fuse Block - Underhood	-	In the left side of the engine compartment, next to the	• <u>Engine Compartment Components - Front (3 of 4)</u>	<u>Electrical Center Identification Views</u>

Code	Name	Option	Location	Locator View	Connector End View
			power inverter module assembly	<u>Engine Compartment Components - Left</u>	
X50B	Fuse Block - Underhood Auxiliary	-	In the left rear of the engine compartment, to the rear of the fuse block - underhood	<u>Engine Compartment Components - Left</u>	<u>Electrical Center Identification Views</u>
X50D	Fuse Block - Battery	-	In the luggage compartment, under the storage compartment floor, attached to the positive battery post	<u>Luggage Compartment Components (2 of 2)</u>	<u>Electrical Center Identification Views</u>
X51A	Fuse Block - Instrument Panel	-	At the left side of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>Electrical Center Identification Views</u>
X53A	Fuse Block - Rear Body	-	In the luggage compartment, under the storage compartment floor, at the front of the battery	<u>Luggage Compartment Components (1 of 2)</u>	<u>Electrical Center Identification Views</u>
X55AL	Fuse Holder - Body Control Module	-	In the luggage compartment, on the positive battery cable, near the positive battery post	-	<u>Electrical Center Identification Views</u>
X55QA	Fuse Holder 1 - Hybrid/EV Battery Pack	-	In the hybrid/EV battery pack, on the front of the contactor assembly	<u>Engine Compartment Components</u>	<u>Electrical Center Identification Views</u>
X55QB	Fuse Holder 2 - Hybrid/EV Battery Pack	-	In the hybrid/EV battery pack, on the back of the contactor	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	<u>Electrical Center Identification Views</u>

Code	Name	Option	Location	Locator View	Connector End View
			assembly		
X80H	Accessory Power Receptacle - Center Console	-	In the passenger compartment, in the center console storage compartment	<u>Center Console Components (1 of 3)</u>	<u>X80H Accessory Power Receptacle - Center Console</u>
X80L	Accessory Power Receptacle - Center Console Rear	-	In the passenger compartment, at the rear of the center console	<u>Center Console Components (1 of 3)</u>	<u>X80L Accessory Power Receptacle - Center Console Rear</u>
X83	Auxiliary Audio Input	-	In the passenger compartment, in the center console storage compartment	<u>Center Console Components (1 of 3)</u>	• <u>X83 Auxiliary Audio Input X1</u> • <u>X83 Auxiliary Audio Input X2</u>
X84	Data Link Connector	-	In the passenger compartment, at the bottom of the driver side of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>X84 Data Link Connector</u>
X85	Steering Wheel Air Bag Coil	-	In the passenger compartment, behind the steering wheel	<u>Steering Column Components</u>	• <u>X85 Steering Wheel Air Bag Coil X1</u> • <u>X85 Steering Wheel Air Bag Coil X2</u>
X98	Hybrid/EV Battery Charger Receptacle	-	At the left front of the vehicle, behind the charging port door	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>X98 Hybrid/EV Battery Charger Receptacle</u>
X100	Forward Lamp Harness to Front Fascia Harness (16 cavities)	-	• (UFQ) At the left front corner of the vehicle, behind the left side of the front fascia • (-UFQ)	• <u>Forward Lamp Harness Routing</u> • <u>Front Fascia Harness Routing</u>	• <u>X100 Forward Lamp Harness to Front Fascia Harness (UFQ)</u> • <u>X100 Forward Lamp Harness to Front Fascia Harness (-UFQ)</u>

Code	Name	Option	Location	Locator View	Connector End View
			At the left front corner of the vehicle, behind the left side of the front fascia		
X102	Forward Lamp Harness to Engine Cooling Fan Harness	-	In the engine compartment, at the lower left of the cooling fan housing	• <u>Forward Lamp Harness Routing</u> • <u>Front of Engine Compartment Harness Routing</u>	<u>X102 Forward Lamp Harness to Cooling Fan Harness</u>
X104	Engine Cooling Fan Harness to Forward Lamp Harness (2 cavities)	-	In the engine compartment, at the lower left of the cooling fan housing	• <u>Forward Lamp Harness Routing</u> • <u>Front of Engine Compartment Harness Routing</u>	<u>X104 Cooling Fan Harness to Forward Lamp Harness</u>
X105	Body Harness to Battery Pack Charge Harness (2 cavities)	-	In the right rear of the engine compartment, at the top of the strut tower, left of the underhood fuse block	-	<u>X105 Body Harness to Battery Cable Harness</u>
X106	Forward Lamp Extension Harness to Forward Lamp Harness (3 cavities)	-	In the engine compartment, behind the left side of the front bumper bar	-	<u>X106 Forward Lamp Extension Harness to Forward Lamp Harness</u>
X107	Forward Lamp Harness to Body Harness (40 cavities)	-	In the left front of the engine compartment, at the top of the left frame rail	• <u>Forward Lamp Harness Routing</u> • <u>Left Side of Engine Compartment Harness Routing</u>	<u>X107 Forward Lamp Harness to Body Harness</u>
X110	Body Harness to Left Headlamp Harness (8 cavities)	-	In the engine compartment, at the rear of the left headlamp	<u>Forward Lamp Harness Routing</u>	<u>X110 Body Harness to Left Headlamp Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			assembly		
X120	Body Harness to Right Headlamp Harness (8 cavities)	-	In the engine compartment, at the rear of the right headlamp assembly	• <u>Forward Lamp Harness Routing</u> • <u>Right Side of Engine Compartment Harness Routing</u>	<u>X120 Body Harness to Right Headlamp Harness</u>
X121	Forward Lamp Harness to Body Harness (16 cavities)	-	In the engine compartment, under the right headlamp	<u>Right Side of Engine Compartment Harness Routing</u>	<u>X121 Forward Lamp Harness to Body Harness</u>
X130	Battery Cable Harness to Battery Cable Harness (4 cavities)	-	In the left rear of the engine compartment, at the top rear of the Power Inverter Module	<u>Left of Engine Compartment Harness Routing</u>	<u>X130 Battery Cable Harness to Battery Cable Harness</u>
X149	Engine Harness to Engine Jumper Harness (6 cavities)	-	At the rear lower center portion of the engine	-	<u>X149 Engine Harness to Engine Oil Level Sensor Harness</u>
X150	Engine Harness to Engine Jumper Harness (12 cavities)	-	In the engine compartment, at the left side of the cylinder head	<u>Right Side of Engine Harness Routing</u>	<u>X150 Engine Harness to Engine Jumper Harness</u>
X155	Body Harness to Engine Harness (16 cavities)	-	In the left side of the engine compartment, above the Transmission	• <u>Engine Harness Routing</u> • <u>Left Side of Engine Compartment Harness Routing</u>	<u>X155 Engine Harness to Body Harness</u>
X160	Engine Harness to Fuel System Harness (12 cavities)	-	At the left top side of the engine, near fuel rail injector 4	-	<u>X160 Engine Harness to Fuel System Harness</u>
X190	Engine Harness to Body Harness (40 cavities)	-	In the left side of the engine compartment, on the side of underhood fuse block	<u>Left Side of Engine Compartment Harness Routing</u>	<u>X190 Engine Harness to Body Harness</u>
X211	Body Harness to Instrument Panel Harness (2 cavities)	-	In the passenger compartment right front	<u>Right Side of Passenger Compartment Harness Routing</u>	<u>X211 Body Harness to Instrument Panel Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			footwell, behind the kick panel		
X225	Instrument Panel Harness to Body Harness (102 cavities)	-	In the passenger compartment left front footwell, behind the kick panel	<u>Instrument Panel Harness Routing</u>	<u>X225 Instrument Panel Harness to Body Harness</u>
X252	Instrument Panel Harness to HVAC System Harness (2 cavities)	-	In the passenger compartment, behind the center of the instrument panel, behind the human interface control panel, on HVAC case	-	<u>X252 Instrument Panel Harness to HVAC System Harness</u>
X275	Instrument Panel Harness to Body Harness (102 cavities)	-	In the passenger compartment, in the right front footwell, behind the kick panel	• <u>Instrument Panel Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X275 Instrument Panel Harness to Body Harness</u>
X302	Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness (6 cavities)	-	Behind the right side of the instrument panel, on instrument panel cross beam	-	<u>X302 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness</u>
X310	Body Harness to Driver Seat Harness (16 cavities)	-	In the passenger compartment, under the driver seat	<u>Left Side of Passenger Compartment Harness Routing</u>	<u>X310 Body Harness to Driver Seat Harness</u>
X315	Floor Console Harness to Instrument Panel Harness (48 cavities)	-	In the passenger compartment, under the front of the center console	• <u>Center Console Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X315 Floor Console Harness to Instrument Panel Harness</u>
X316	Instrument Panel Harness to Floor Console Harness (USB)	-	In the passenger compartment, under the front of the center console	• <u>Center Console Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X316 Instrument Panel Harness to Floor Console Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
X320	Driver Seat Harness to Body Harness (23 cavities)	-	In the passenger compartment, under the passenger seat	<u>Right Side of Passenger Compartment Harness Routing</u>	<u>X320 Driver Seat Harness to Body Harness</u>
X325	Headliner Harness to Instrument Panel Harness (22 cavities)	-	In the passenger compartment, at the base of the right side A-pillar trim	• <u>Headliner Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X325 Headliner Harness to Instrument Panel Harness</u>
X340	Body Harness to Rear Seat Harness (4 cavities)	KA6	Under the right side of the rear seat cushion	-	<u>X340 Body Harness to Rear Seat Harness</u>
X350	Body Harness to Fuel System Harness (16 cavities)	-	Under the vehicle, to the right rear of the fuel tank	<u>Right Rear of Vehicle Harness Routing</u>	<u>X350 Body Harness to Fuel System Harness</u>
X351	Body Harness to Fuel System Harness (8 cavities)	-	Under the vehicle, near the right rear wheel well	<u>Right Rear of Vehicle Harness Routing</u>	<u>X351 Body Harness to Fuel System Harness</u>
X354	Fuel Tank Jumper to Fuel Jumper (6 cavities)	-	Under the vehicle, to the rear of the fuel tank, between the EVAP system and the fuel tank	-	<u>X354 Body Harness to Fuel Tank Harness</u>
X357	Body Harness to Battery Pack Jumper Harness (12 cavities)	-	Under the vehicle, at the front of the hybrid/EV battery pack	-	<u>X357 Body Harness to Battery Pack Jumper Harness</u>
X358	Body Harness to Battery Pack Jumper Harness (12 cavities)	-	Under the vehicle, at the front of the hybrid/EV battery pack	-	<u>X358 Body Harness to Battery Pack Jumper Harness</u>
X359	Auxiliary Battery Cable Harness to Battery Pack Jumper Harness (16 cavities)	-	• (EARLY) Beneath the hybrid/EV battery pack cover, at the top of the	<u>Hybrid/EV Battery Pack Harness Routing</u>	• <u>X359 Auxiliary Battery Cable Harness to Battery Pack Jumper Harness</u> • <u>X359 Battery Cable - High Voltage Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			forward most energy storage module. • (LATE) Beneath the hybrid/EV battery pack cover, at the top of the forward most energy storage module.		<u>to Hybrid/EV Powertrain Control Module Harness (LATE)</u>
X360	Body Harness to Battery Fuse Block Harness (4 cavities)	EARLY	Beneath the hybrid/EV battery pack cover, at the top of the forward most energy storage module.	<u>Hybrid/EV Battery Pack Harness Routing</u>	<u>X360 Auxiliary Battery Cable Harness to Battery Fuse Block Harness</u>
X400	Body Harness to Battery Fuse Block Harness (2 cavities)	-	In the luggage compartment, at the positive battery cable of the battery fuse block	-	<u>X400 Body Harness to Battery Fuse Block Harness</u>
X406	Body Harness to Body Harness (2 cavities)	-	In the luggage compartment, under the storage compartment floor, on the right side	<u>Right Rear of Passenger Compartment Harness Routing</u>	<u>X406 Body Harness to Body Harness</u>
X450	Rear Fascia Harness to Body Harness (20 cavities)	-	• (UFQ) At the rear of the vehicle, behind the left side	• <u>Left Rear of Vehicle Harness Routing</u> • <u>Rear Fascia Harness Routing</u>	• <u>X450 Rear Lamp Harness to Body Harness (UFQ)</u> • <u>X450 Rear Lamp Harness to Body Harness (-UFQ)</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the rear fascia • (-UFQ) At the rear of the vehicle, behind the left side of the rear fascia		
X452	Body Harness to Negative Battery Cable Harness (2 cavities)	-	In the luggage compartment, under the storage compartment floor, near the battery current sensor	• <u>12V Battery Negative Harness Routing</u> • <u>Left Rear of Passenger Compartment Harness Routing</u>	<u>X452 Body Harness to Battery Cable Harness</u>
X500	Driver Door Harness to Body Harness (41 cavities)	-	In the passenger compartment, on the left side of the body, between the door hinges	• <u>Left Front Door Harness Routing</u> • <u>Left Side of Passenger Compartment Harness Routing</u>	<u>X500 Driver Door Harness to Body Harness</u>
X505	Driver Door Harness to Driver Door Trim Harness (22 cavities)	-	In the passenger compartment, behind the driver door panel	• <u>Left Front Door Harness Routing</u> • <u>Left Front Door Trim Harness Routing</u>	<u>X505 Driver Door Harness to Driver Door Trim Harness</u>
X510	Driver Door Harness to Outside Rear View Mirror Harness (12 cavities)	-	In the passenger compartment, behind the driver door panel	<u>Left Front Door Harness Routing</u>	<u>X510 Driver Door Harness to Outside Rear View Mirror Harness</u>
X600	Passenger Door Harness to Body Harness (41 cavities)	-	In the passenger compartment, on the right side of the body, between the door hinges	• <u>Right Front Door Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X600 Passenger Door Harness to Body Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
X605	Passenger Door Harness to Passenger Door Trim Harness (14 cavities)	-	In the passenger compartment, behind the passenger door panel	• <u>Right Front Door Harness Routing</u> • <u>Right Front Door Trim Harness Routing</u>	<u>X605 Passenger Door Harness to Passenger Door Trim Harness</u>
X610	Passenger Door Harness to Outside Rear View Mirror Harness (12 cavities)	-	In the passenger compartment, behind the passenger door panel	<u>Right Front Door Harness Routing</u>	<u>X610 Passenger Door Harness to Outside Rear View Mirror Harness</u>
X700	Left Rear Door Harness to Body Harness (20 cavities)	-	In the passenger compartment, behind the left B-pillar, between the door hinges	• <u>Left Rear Door Harness Routing</u> • <u>Left Side of Passenger Compartment Harness Routing</u>	<u>X700 Left Rear Door Harness to Body Harness</u>
X800	Right Rear Door Harness to Body Harness (20 cavities)	-	In the passenger compartment, behind the right B-pillar, between the door hinges	• <u>Right Rear Door Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X800 Right Rear Door Harness to Body Harness</u>
X900	Liftgate Jumper Harness to Body Harness (8 cavities)	-	In the passenger compartment, above the rear of the headliner, between the hinges	<u>Roof Airbag Harness Routing</u>	<u>X900 Liftgate Jumper Harness to Body Harness</u>
X901	Liftgate Jumper Harness to Body Harness (2 cavities)	-	In the passenger compartment, above the rear of the headliner, between the hinges	-	<u>X901 Liftgate Jumper Harness to Body Harness</u>
X905	Liftgate Jumper Harness to Liftgate Harness (8 cavities)	-	In the liftgate, on the right side, behind the trim, near the glass	<u>Liftgate Harness Routing</u>	<u>X905 Liftgate Jumper Harness to Liftgate Harness</u>
X906	Liftgate Jumper Harness to Liftgate Harness (2 cavities)	-	In the liftgate, on the right side, behind the	<u>Liftgate Harness Routing</u>	<u>X906 Liftgate Jumper Harness to Liftgate Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			trim, near the glass		
G101	Forward Lamp Harness	-	In the engine compartment, on the front of the left frame rail, forward of G103	<u>G101</u>	-
G102	Forward Lamp Harness	-	In the engine compartment, on the front of the right frame rail, forward of G104	<u>G102</u>	-
G104	Forward Lamp Harness	-	In the engine compartment, on the front of the right frame rail, rear of G102	<u>G104 and G113</u>	-
G105	Cooling Fan Jumper Harness	-	In the engine compartment, on the front of the right frame rail, below the right front headlamp assembly	<u>G105</u>	-
G109	Engine Harness	-	In the engine compartment, above the left frame rail, on the left strut tower	<u>G109</u>	-
G110	Engine Harness	-	In the engine compartment, on the front of the right core support	<u>G110 and G112</u>	-
G112	Engine Harness	-	In the engine compartment, on the front right of the engine	<u>G110 and G112</u>	-
G113	Engine Harness	-	In the engine compartment,	<u>G104 and G113</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			on the rear of the transmission assembly		
G117	Body Harness	-	In the engine compartment, at the front of the left strut tower	<u>G117</u>	-
G122	Engine Extension Harness	-	In the engine compartment, on the engine, at the left side of the cylinder head	<u>G122</u>	-
G201	Instrument Panel Harness	-	In the passenger compartment, behind the instrument panel, above the brake pedal, on the instrument panel support	<u>G201 and G204</u>	-
G202	Instrument Panel Harness	-	In the passenger compartment, behind the right side of the instrument panel, above the glove box, on the instrument panel support	<u>G202</u>	-
G204	Instrument Panel Harness	-	In the passenger compartment, behind the center of the instrument panel, on the instrument panel support	<u>G201 and G204</u>	-
G205	Instrument Panel Harness	-	In the passenger compartment, behind the left side of the instrument panel, ground strap from body to instrument	<u>G205</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			panel support		
G301	Body Harness	-	In the passenger compartment, under the left front door sill trim	<u>G301</u>	-
G302	Body Harness	-	In the passenger compartment, under the right front door sill trim	<u>G302</u>	-
G304	Instrument Panel Harness	-	In the passenger compartment, under the center console, to the rear of the shifter	<u>G304</u>	-
G340	Hybrid/EV Battery Pack Contactor Harness	-	Under the vehicle, at the bottom of the hybrid/EV battery pack contactor assembly	<u>G340 and G341</u>	-
G341	Hybrid/EV Battery Pack Contactor Harness	-	Under the vehicle, at the bottom of the hybrid/EV battery pack contactor assembly	<u>G340 and G341</u>	-
G401	14V Power Module Harness	-	In the luggage compartment	-	-
G403	Body Harness	-	In the luggage compartment, behind the left trim panel below the fuse block - rear	<u>G403</u>	-
G404	Body Harness	-	In the luggage compartment, near the battery	-	-
G405	Body Harness	-	In the luggage compartment, behind the right trim panel	<u>G405</u>	-

Code	Name	Option	Location	Locator View	Connector End View
G406	Body Harness	-	In the luggage compartment, behind the right trim panel	<u>G406</u>	-
G408	Hybrid/EV Battery Pack	-	Under the vehicle, at the bottom rear of the hybrid/EV battery pack assembly	<u>G408 and G409</u>	-
G409	Hybrid/EV Battery Pack	-	Under the vehicle, at the bottom rear of the hybrid/EV battery pack assembly	<u>G408 and G409</u>	-
J100	Front Fascia Harness	-	In the front fascia harness approximately 13.6 cm (5.35 in) from the X100 and X101 breakout	<u>Front Fascia Harness Routing</u>	-
J101	Front Fascia Harness	-	In the front fascia harness approximately 21 cm (8.26 in) from the X100 and X101 breakout	<u>Front Fascia Harness Routing</u>	-
J102	Front Fascia Harness	TR6	In the front fascia harness approximately 11 cm (4.33 in) from the front object sensor - left middle connector breakout	-	-
J103	Left Headlamp Harness	TR6	In the left headlamp assembly	-	-
J104	Right Headlamp Harness	-	In the right headlamp assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
J110	Cooling Fan Jumper Harness	-	In the cooling fan jumper harness approximately 4.5 cm (1.77 in) from the X103 breakout	<u>Front of Engine Compartment Harness Routing</u>	-
J115	Left Headlamp Assembly Harness	-	In the left headlamp assembly jumper harness, ground splice for the lamps	<u>Front Fascia Harness Routing</u>	-
J116	Body Harness	-	In the passenger compartment, under the left front door sill trim	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J117	Body Harness	-	In the passenger compartment, under the right front door sill trim	<u>Right Side of Passenger Compartment Harness Routing</u>	-
J121	Right Headlamp Assembly Harness	-	In the right headlamp assembly jumper harness, ground splice for the lamps	-	-
J125	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) from the engine coolant temperature sensor breakout	<u>Engine Harness Routing</u>	-
J127	Engine Harness	-	In the engine harness, between J125 and J131	<u>Engine Harness Routing</u>	-
J128	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) from the power	<u>Engine Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			inverter module assembly cover connector breakout		
J129	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) in to the power inverter module assembly connector breakout	Engine Harness Routing	-
J131	Engine Harness	-	In the engine harness on the secondary air injection solenoid valve breakout approximately 10 cm (3.94 in) from secondary air injection solenoid valve connector	Engine Harness Routing	-
J133	Transmission Harness	-	Internal to the transmission, between the power inverter X4 connector and the drive motor 1 position sensor, approximately 4 cm (1.5 in) from the drive motor 1 position sensor breakout	-	-
J135	Engine Harness	-	In back of engine control module harness connector X1	Engine Harness Routing	-
J136	Engine Harness	-	In back of engine control module harness connector X2	Engine Harness Routing	-

Code	Name	Option	Location	Locator View	Connector End View
J137	Engine Harness	-	In back of engine control module harness connector X3	<u>Engine Harness Routing</u>	-
J139	Body Harness	-	In the engine compartment, near the left strut tower, approximately 11.8 cm (4.6 in) from the electronic brake control module X1 breakout	<u>Left Side of Engine Compartment Harness Routing</u>	-
J150	HVAC Harness	-	In the HVAC harness approximately 5 cm (1.96 in) from the HVAC control module X3 connector breakout	-	-
J200	Instrument Panel Harness	-	In the instrument panel harness, near the hood release handle, approximately 15 cm (5.9 in) from headlamp switch breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J201	Instrument Panel Harness	-	In the instrument panel harness, near the instrument panel fuse block	-	-
J218	Instrument Panel Harness	UQA	In the instrument panel harness, approximately 14.8 cm (5.83 in) from the blower motor connector breakout	-	-

Code	Name	Option	Location	Locator View	Connector End View
J220	Body Harness	-	In the body harness, approximately 8.9 cm (3.5 in) from the pedestrian alert sound control module connector breakout	-	-
J221	Instrument Panel Harness	KA1/KA6	In the instrument panel harness approximately 5 cm (1.96 in) from passenger instrument panel air bag breakout	<u>Instrument Panel Harness Routing</u>	-
J222	Body Harness	-	At the rear of the hybrid/EV battery pack compartment, on the left	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J223	Steering Wheel Harness	UVD	In the steering wheel harness, behind the driver airbag	-	-
J225	Steering Wheel Heater Harness	-	In the steering wheel harness, behind the driver airbag	-	-
J227	Instrument Panel Harness	-	In the instrument panel harness approximately 4.6 cm (1.81 in) in to the telematics communication interface control module connector breakout	-	-
J228	Instrument Panel Harness	UGN	In the instrument panel harness	-	-

Code	Name	Option	Location	Locator View	Connector End View
			approximately 4.6 cm (1.81 in) in to the telematics communication interface control module connector breakout		
J230	Body Harness	-	In the body harness, near the windshield wiper motor	-	-
J232	Instrument Panel Harness	-	In the instrument panel harness approximately 9.6 cm (3.77 in) from the G202 breakout	<u>Instrument Panel Harness Routing</u>	-
J233	Steering Wheel Harness	-	In the steering wheel harness	-	-
J234	Instrument Panel Harness	-	In the instrument panel harness approximately 50 cm (19.67 in) from the G204 breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J255	HVAC Harness	-	In the HVAC harness approximately 29 cm (11.4 in) from the HVAC control module X3 connector	-	-
J301	Body Harness	-	In the body harness approximately 23 cm (119.05 in) from the X500 breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J303	Body Harness	-	In the body harness approximately 15.7 cm (6.18	<u>Instrument Panel Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			in) from the X600 breakout		
J308	Body Harness	-	In the body harness approximately 28 cm (11.02 in) from the X700 breakout	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J310	Body Harness	-	In the body harness approximately 8.5 cm (3.34 in) from the X700 breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J314	Headliner Harness	-	In the headliner harness approximately 5 cm (1.96 in) from the breakout for the passenger air bag disable indicator breakout	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J316	Transmission Shift Lever Harness	-	Inside the transmission shift lever	-	-
J325	Instrument Panel Harness	-	In the instrument panel harness approximately 5 cm (1.96 in) from the X252 breakout	-	-
J326	Body Harness	-	In the body harness approximately 112 cm (44 in) from the transmission shift lever breakout	-	-
J328	Body Harness	-	In the passenger compartment, at the bottom of the left B-pillar	<u>Left Side of Passenger Compartment Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
J330	Passenger Seat Harness	-	In the passenger seat harness	-	-
J331	Passenger Seat Harness	-	In the passenger seat harness	-	-
J333	Body Harness	-	In the passenger compartment, under the left rear door sill trim	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J335	Driver Seat Harness	-	In the driver seat harness	-	-
J336	Driver Seat Harness	-	In the driver seat harness	-	-
J337	Driver Seat Harness	-	In the driver seat harness	-	-
J340	Rear Seat Harness	-	In the rear seat harness	-	-
J341	Rear Seat Harness	-	In the rear seat harness	-	-
J350	Headliner Harness	-	In the headliner harness approximately 5 cm (1.96 in) from the breakout for overhead console connectors	<u>Center Console Harness Routing</u>	-
J351	Headliner Harness	-	In the headliner harness approximately 6.3 cm (2.48 in) in to the breakout for the overhead console connectors	<u>Headliner Harness Routing</u>	-
J352	Headliner Harness	-	In the headliner harness approximately 16.2 cm (6.37 in) from the sunshade mirror lamp - right breakout	<u>Headliner Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
J353	Headliner Harness	-	In the headliner harness approximately 35.4 cm (13.93 in) from the sunshade mirror lamp - right breakout	<u>Headliner Harness Routing</u>	-
J354	Headliner Harness	-	In the headliner harness approximately 45.4 cm (17.87 in) from the sunshade mirror lamp - Right breakout	<u>Headliner Harness Routing</u>	-
J355	Body Harness	-	In the body harness approximately 45 cm (18.89 in) from the G302 breakout	-	-
J376	Body Harness	-	In the body harness, approximately 31 cm (12.20 in) from the terminating resistor - high speed bus breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J377	Body Harness	-	In the body harness, approximately 35.6 cm (14.02 in) from the terminating resistor - high speed bus breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J400	Body Harness	-	In the luggage compartment, on the body harness approximately 38.9 cm (15.31 in) from the	<u>Left Side of Luggage Compartment Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			G403 breakout		
J402	Body Harness	-	In the body harness approximately 32 cm (12.59 in) from the seat belt switch - left rear	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J407	Body Harness	UKC	In the passenger compartment, at the left C-pillar	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J409	Rear Fascia Harness	-	Behind the left side of the rear bumper cover	<u>Rear Fascia Harness Routing</u>	-
J420	High Voltage Battery Charger Harness	-	In the high voltage battery charger harness, in the luggage compartment, approximately 18.3 cm (7.2 in) from the battery charger X2 and X3 connector breakout	-	-
J421	High Voltage Battery Charger Harness	-	In the high voltage battery charger harness, in the luggage compartment, approximately 28.3 cm (11.14 in) from the battery charger X2 and X3 connector breakout	-	-
J450	Left Tail Lamp Harness	-	In the left tail lamp harness	-	-
J451	Rear Fascia Harness	-	In the rear fascia harness approximately 22.8 cm (8.97 in) in to the backup lamp connector	<u>Rear Fascia Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			breakout		
J452	Rear Fascia Harness	-	In the rear fascia harness in the X450 and X451 breakout approximately 5 cm (1.96 in) from X451	-	-
J453	Rear Fascia Harness	-	In the rear fascia harness approximately 9 cm (3.54 in) from rear object sensor - left middle connector breakout	<u>Rear Fascia Harness Routing</u>	-
J455	Rear Fascia Harness	-	In the rear fascia harness approximately 5 cm (1.96 in) from the license plate lamp - left connector breakout	<u>Rear Fascia Harness Routing</u>	-
J456	Rear Fascia Harness	-	In the rear fascia harness approximately 7.5 cm (2.95 in) from the rearview camera connector breakout	<u>Rear Fascia Harness Routing</u>	-
J505	Driver Door Trim Harness	UKC	In the driver door trim harness approximately 7.1 cm (2.79 in) from driver door handle flood lamp connector	-	-
J510	Driver Outside Rearview Mirror Harness	-	In the driver outside rearview mirror harness	-	-
J514	Driver Door Harness	-	In the left front door harness	<u>Left Front Door Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			approximately 8.3 cm (3.26 in) from the X510 connector breakout		
J515	Driver Door Harness	-	In the left front door harness approximately 8.3 cm (3.26 in) from the X510 connector breakout	<u>Left Front Door Harness Routing</u>	-
J516	Driver Door Harness	-	In the left front door harness approximately 3.5 cm (1.38 in) from the X510 connector breakout	-	-
J517	Driver Door Trim Harness	-	In the left door trim harness approximately 12.3 cm (4.84 in) from X505 connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J518	Driver Door Trim Harness	-	In the left door trim harness approximately 16.3 cm (6.41 in) from X505 connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J519	Driver Door Trim Harness	-	In the left door trim harness approximately 6.5 cm (2.55 in) from the outside rearview mirror switch connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J520	Body Harness	-	In the body harness, approximately 45 cm (17.72 in)	-	-

Code	Name	Option	Location	Locator View	Connector End View
			from the transmission shift lever connector breakout		
J605	Passenger Door Trim Harness	UKC	In the passenger door trim harness approximately 5.1 cm (2 in) from the X605 connector	-	-
J610	Passenger Outside Rearview Mirror Harness	-	In the passenger outside rearview mirror harness	-	-
J611	Passenger Door Harness	-	In the right front door harness approximately 24.4 cm (9.60 in) from the X610 connector breakout	<u>Right Front Door Harness Routing</u>	-
J615	Passenger Door Harness	-	In the right front door harness approximately 12.2 cm (4.80 in) from the X610 connector breakout	<u>Right Front Door Harness Routing</u>	-
J618	Passenger Door Trim Harness	-	In the passenger door trim harness approximately 8.8 cm (3.46 in) from the passenger door lock switch connector	-	-
J720	Left Rear Door Harness	-	In the left rear door trim harness approximately 34.3 cm (13.5 in) from the left rear window switch breakout	-	-

Code	Name	Option	Location	Locator View	Connector End View
J820	Right Rear Door Harness	-	In the right rear door trim harness approximately 34.3 cm (13.5 in) from the right rear window switch breakout	-	-
J902	Liftgate Harness	-	In the liftgate harness approximately 11.4 cm (4.48 in) from the rear defogger grid connector breakout	<u>Liftgate Harness Routing</u>	-
J908	Rear Fascia Harness	-	Behind the left side of the rear bumper cover	<u>Rear Fascia Harness Routing</u>	-
J920	Right Tail Lamp Harness	-	In the right tail lamp harness	-	-

Article GUID: A00884676

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Passenger Compartment/Roof Component Views - Volt

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

PASSENGER COMPARTMENT COMPONENTS (1 OF 3)

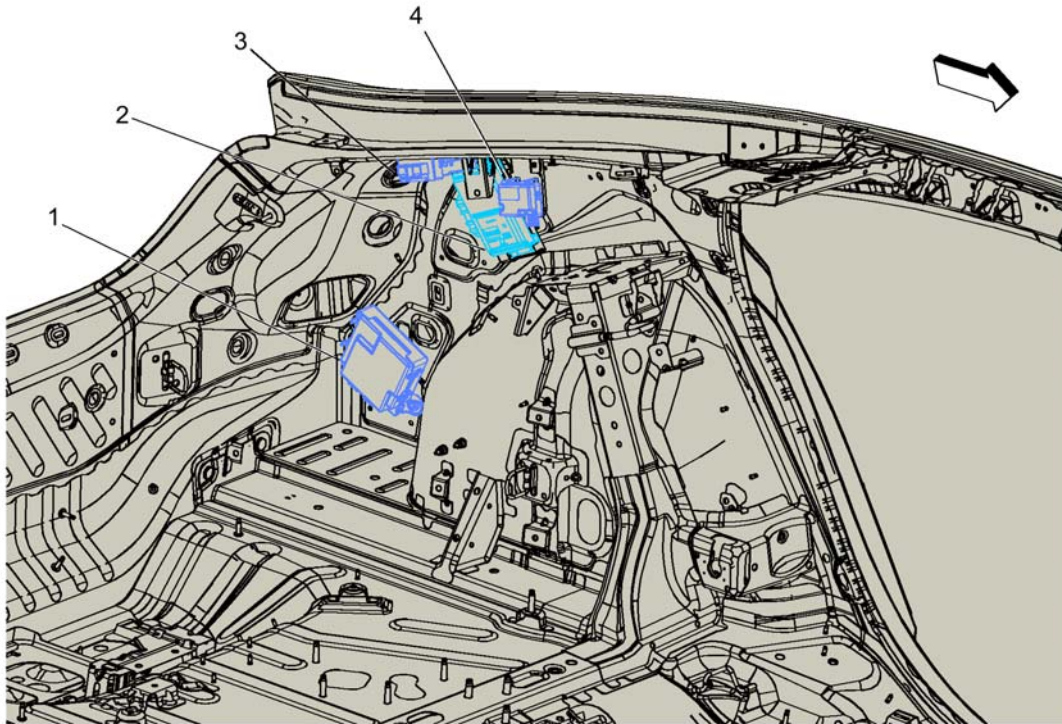


Fig. 1: Passenger Compartment Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K84 Keyless Entry Control Module K84 Keyless Entry Control Module X1 K84 Keyless Entry Control Module X2
2. K124 Active Safety Control Module (UGN) K124 Active Safety Control Module X1 K124 Active Safety Control Module X2
3. K182 Parking Assist Control Module (UFQ) K182 Parking Assist Control Module X1 K182 Parking Assist Control Module X2 K182 Parking Assist Control Module X3
4. K77 Remote Control Door Lock Receiver K77 Remote Control Door Lock Receiver

PASSENGER COMPARTMENT COMPONENTS (2 OF 3)

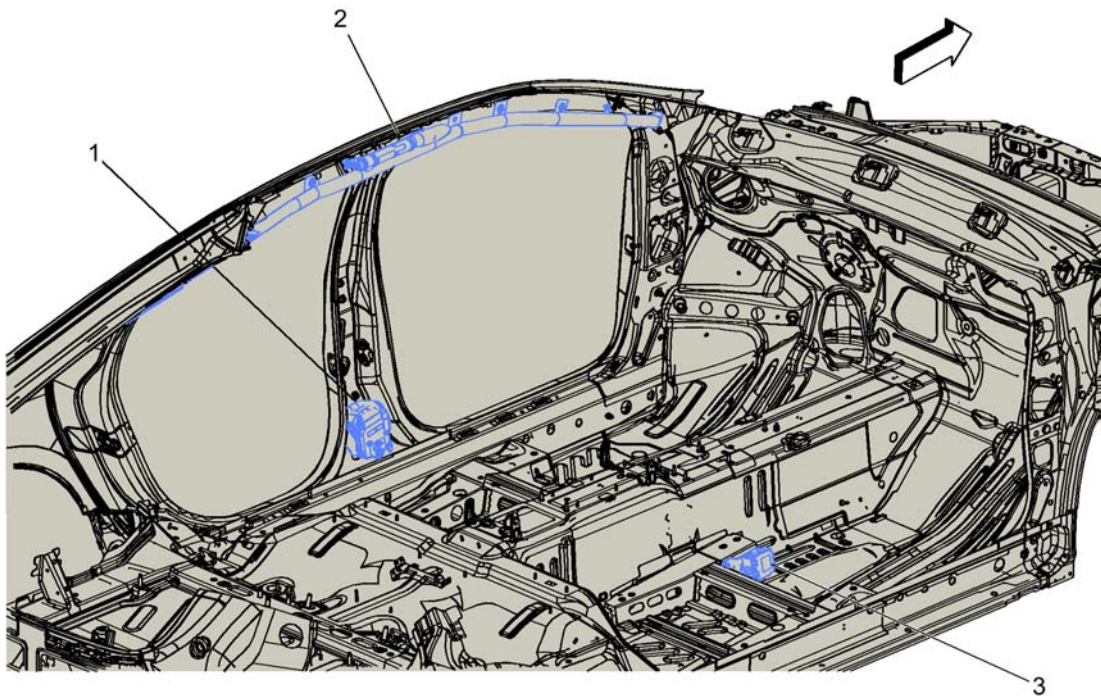


Fig. 2: Passenger Compartment Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. F112D Seat Belt Retractor Pretensioner - Driver <u>F112D Seat Belt Retractor Pretensioner - Driver</u>
2. F105L Roof Rail Air Bag - Left <u>F105L Roof Rail Air Bag - Left</u>
3. K132 Pedestrian Alert Sound Control Module <u>K132 Pedestrian Alert Sound Control Module</u>

PASSENGER COMPARTMENT COMPONENTS (3 OF 3)

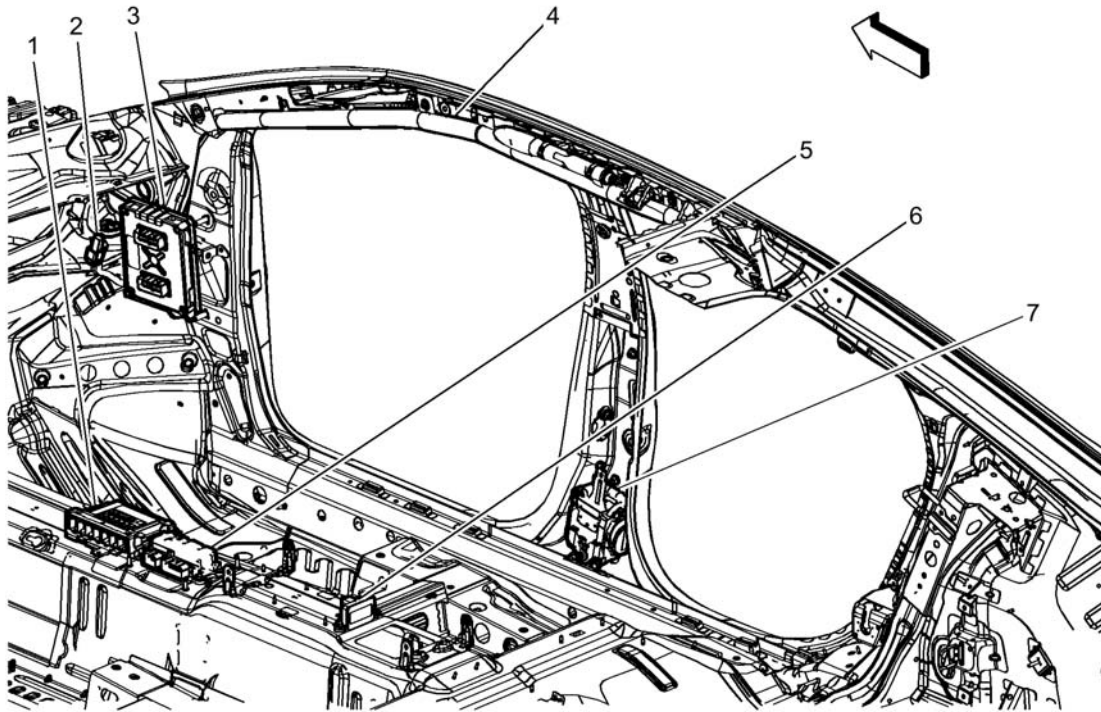


Fig. 3: Passenger Compartment Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K9 Body Control Module <u>K9 Body Control Module X1</u> <u>K9 Body Control Module X2</u> <u>K9 Body Control Module X3</u> <u>K9 Body Control Module X4</u> <u>K9 Body Control Module X5</u> <u>K9 Body Control Module X6</u> <u>K9 Body Control Module X7</u>
2. R6A Terminating Resistor - High Speed Bus <u>R6A Terminating Resistor - High Speed Bus</u>
3. K114B Hybrid/EV Powertrain Control Module 2 <u>K114B Hybrid/EV Powertrain Control Module 2 X1</u> <u>K114B Hybrid/EV Powertrain Control Module 2 X2</u>
4. F105R Roof Rail Air Bag - Right <u>F105R Roof Rail Air Bag - Right</u>
5. K36 Inflatable Restraint Sensing and Diagnostic Module <u>K36 Inflatable Restraint Sensing and Diagnostic Module X1</u> <u>K36 Inflatable Restraint Sensing and Diagnostic Module X2</u>
6. B284 Vehicle Dynamic Sensor <u>B284 Vehicle Dynamic Sensor</u>
7. F112P Seat Belt Retractor Pretensioner - Passenger <u>F112P Seat Belt Retractor Pretensioner - Passenger</u>

HEADLINER COMPONENTS (1 OF 4)

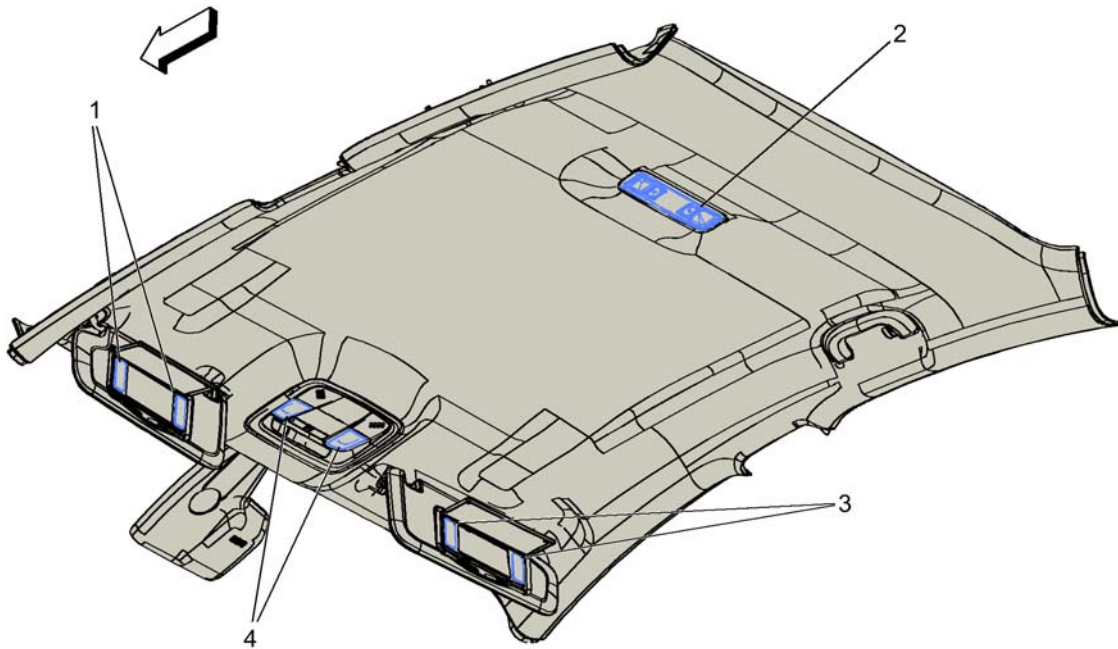


Fig. 4: Headliner Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items	
1. E31L Sunshade Mirror Lamp - Left	<u>E31L Sunshade Mirror Lamp - Left</u>
2. E37R Dome/Reading Lamps - Rear	<u>E37R Dome/Reading Lamps - Rear</u>
3. E31R Sunshade Mirror Lamp - Right	<u>E31R Sunshade Mirror Lamp - Right</u>
4. E37F Dome/Reading Lamps - Front	

HEADLINER COMPONENTS (2 OF 4)

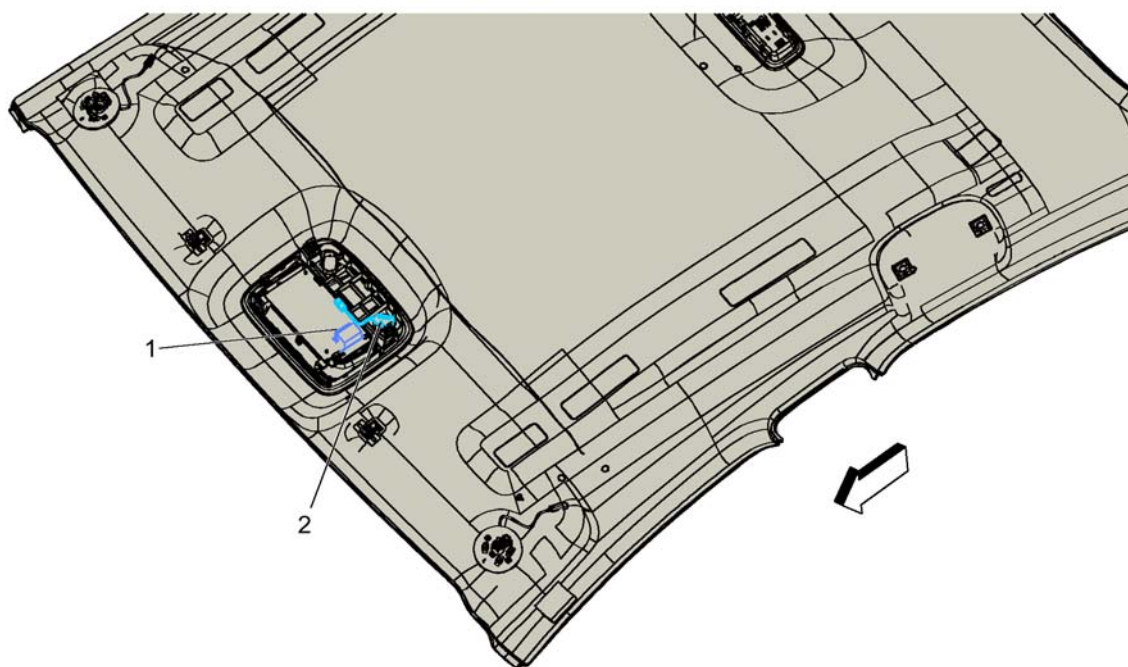


Fig. 5: Headliner Components (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S48B Multifunction Switch - Overhead Console <u>S48B Multifunction Switch - Overhead Console</u>
2. B24 Cellular Phone Microphone <u>B24 Mobile Telephone Microphone</u>

HEADLINER COMPONENTS (3 OF 4)

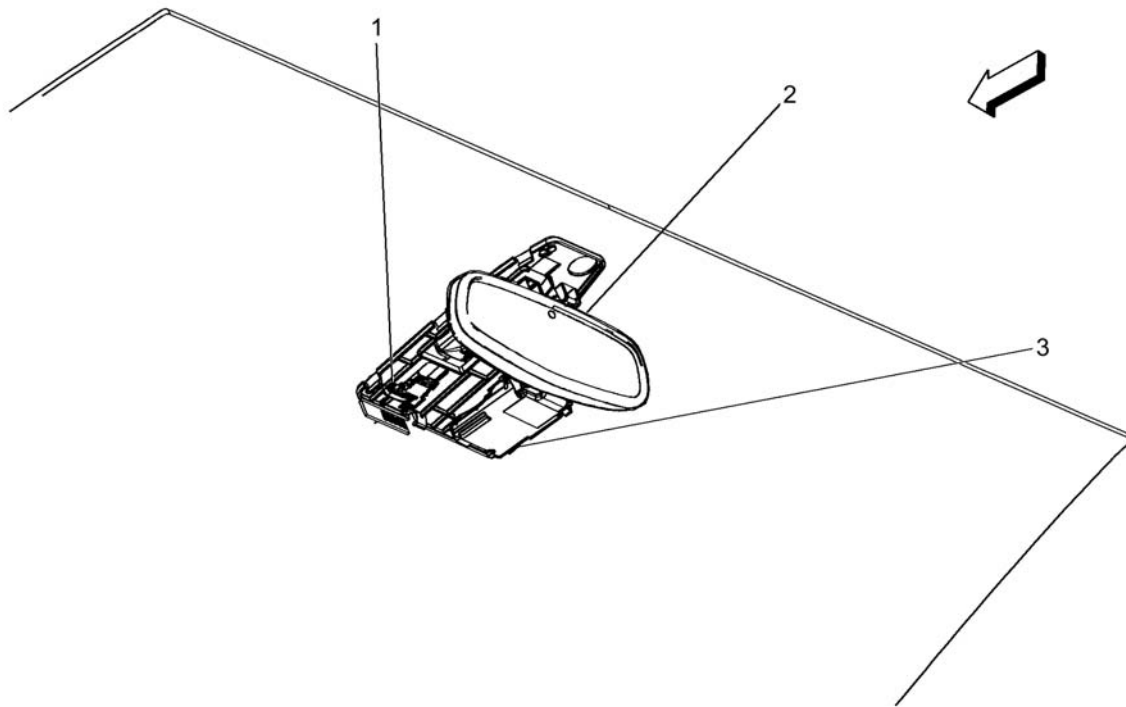


Fig. 6: Headliner Components (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B160 Windshield Temperature and Inside Moisture Sensor <u>B160 Windshield Temperature and Inside Moisture Sensor</u>
2. A10 Inside Rearview Mirror <u>A10 Inside Rearview Mirror</u>
3. K109 Frontview Camera Module (UHY) <u>K109 Frontview Camera Module</u>

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

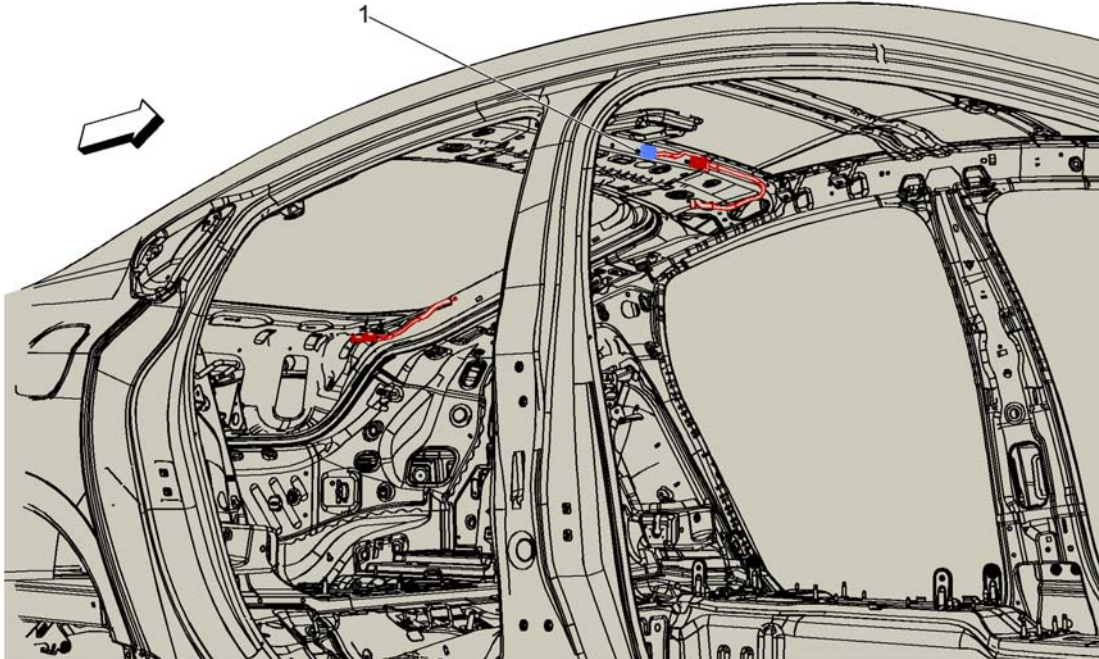


Fig. 7: Headliner Components (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E18 Rear Defogger Grid <u>E18 Rear Defogger Grid X1</u> <u>E18 Rear Defogger Grid X2</u>

REAR SEAT COMPONENTS (1 OF 3)

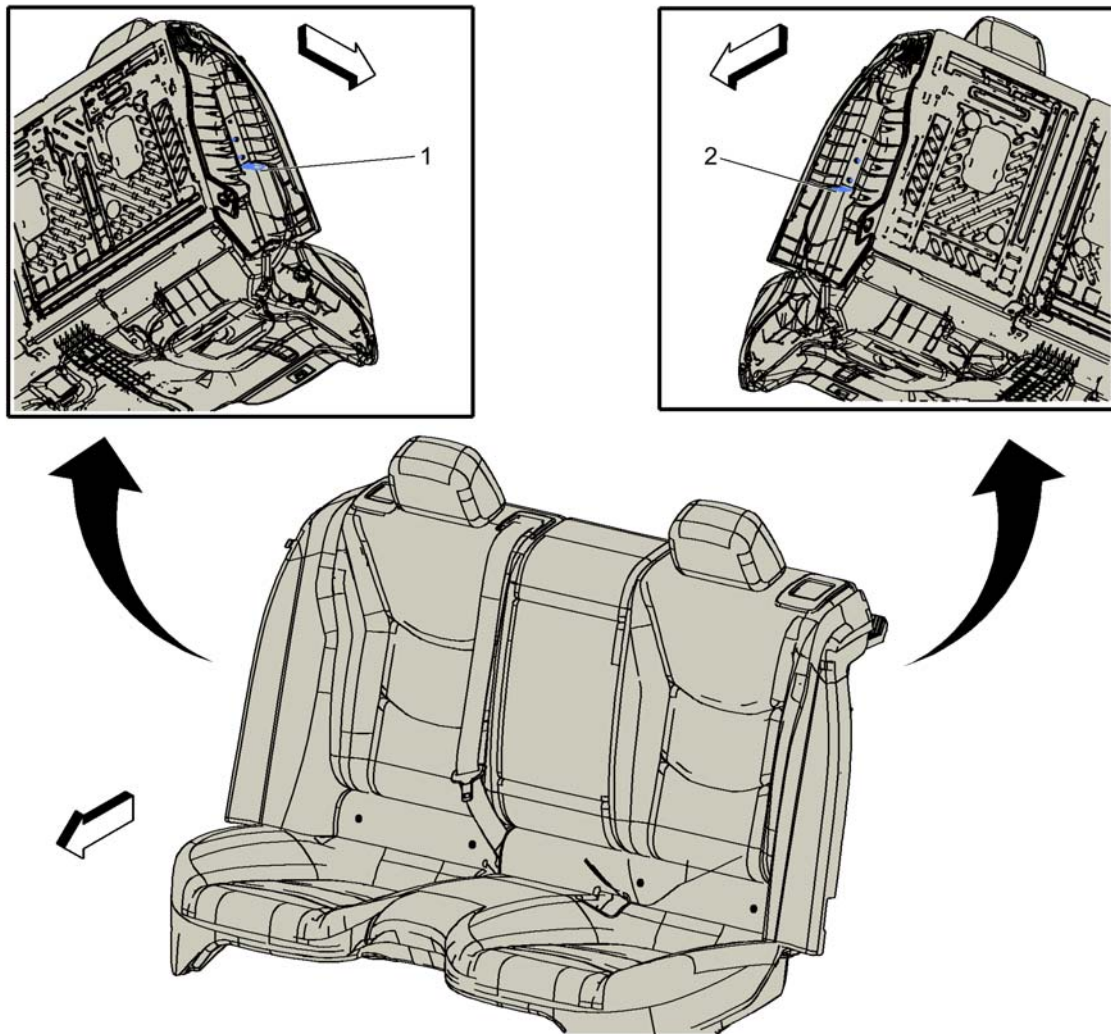


Fig. 8: Rear Seat Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. F106RR Seat Side Air Bag - Right Rear F106RR Seat Side Air Bag - Right Rear
2. F106LR Seat Side Air Bag - Left Rear F106LR Seat Side Air Bag - Left Rear

REAR SEAT COMPONENTS (2 OF 3)

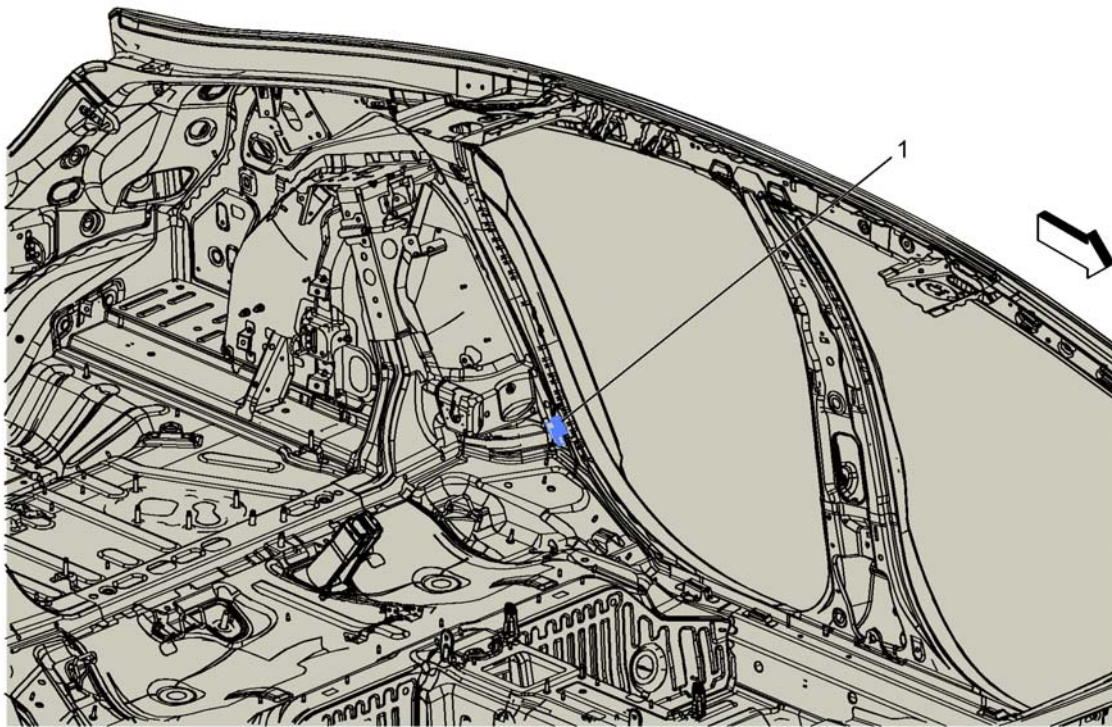


Fig. 9: Rear Seat Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B63LR Side Impact Sensor - Left Rear <u>B63LR Side Impact Sensor - Left Rear</u>

REAR SEAT COMPONENTS (3 OF 3)

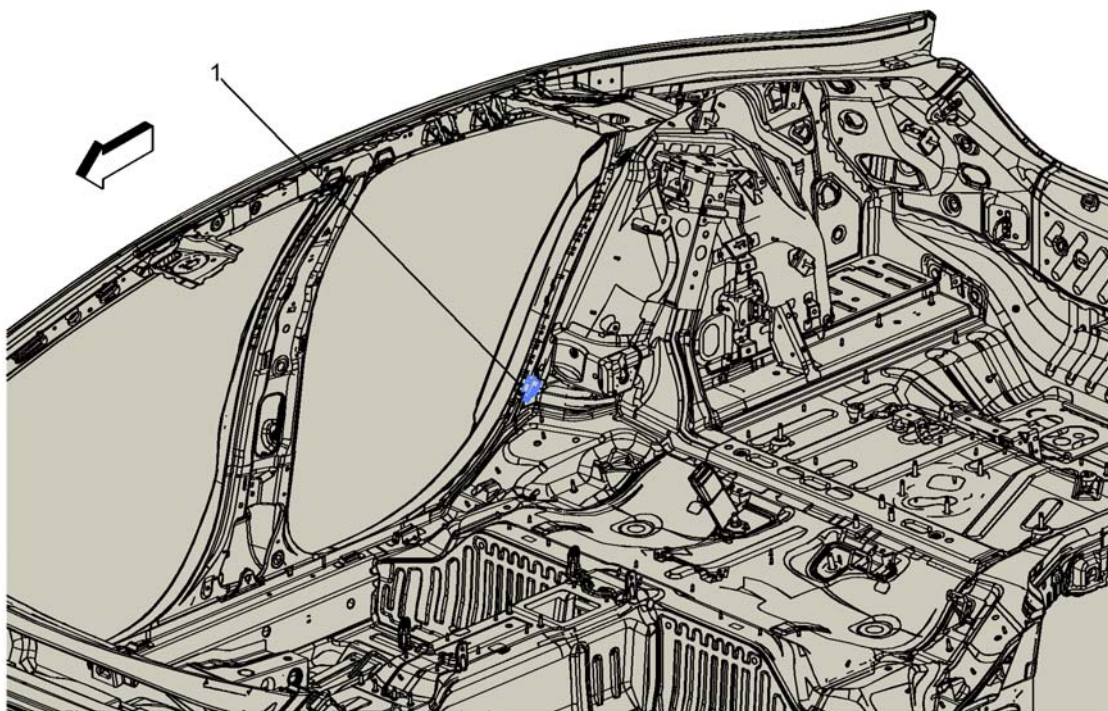


Fig. 10: Rear Seat Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B63RR Side Impact Sensor - Right Rear <u>B63RR Side Impact Sensor - Right Rear</u>

Article GUID: A00884713

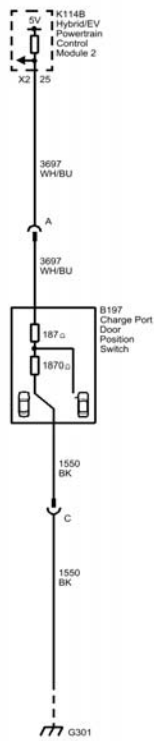


Fig. 2: Charging Port Door
Courtesy of GENERAL MOTORS COMPANY

Battery Charger

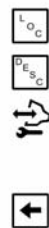
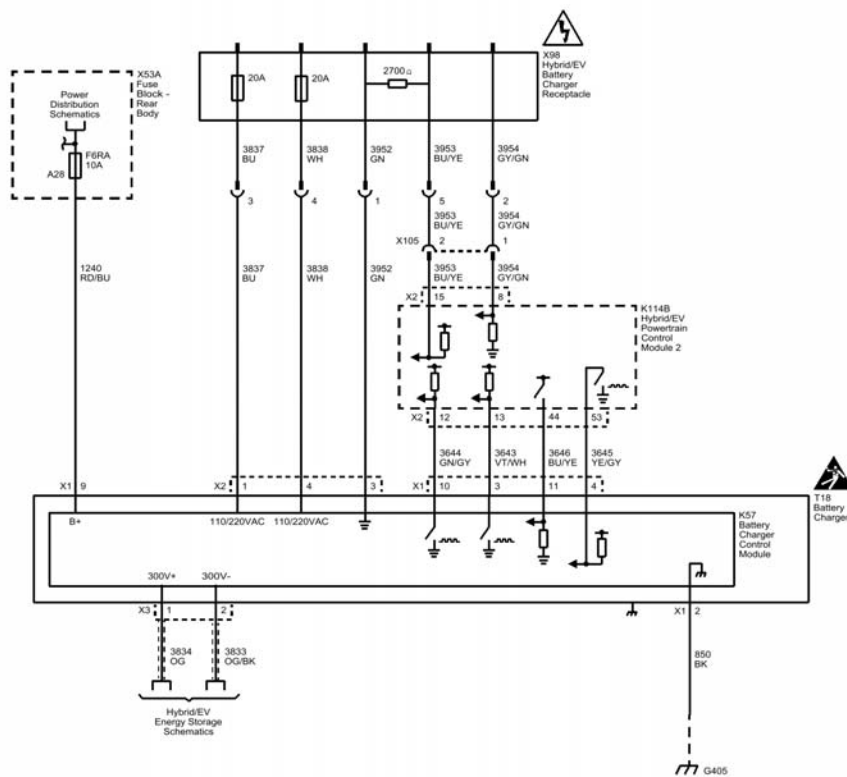


Fig. 3: Battery Charger

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0CF4-P0CF6: CONTROL PILOT CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0CF4

Control Pilot Circuit Performance

DTC P0CF5

Control Pilot Circuit Low Voltage

DTC P0CF6

Control Pilot Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
110/120 A/C Line 1	1	P0D3F, P1EE6	1	-
110/120 A/C Line 2	1	P1EE6	1	-
110/120 A/C Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors a pilot signal from the drive motor battery charger cable. The hybrid/EV powertrain control module 2 utilizes this signal to manage the charging process between the drive motor battery charger cable and the hybrid/EV powertrain control module 2.

Under normal charging conditions the control pilot signal is generated by the drive motor battery charger cable. This diagnostic runs with the drive motor battery charger cable disconnected to verify the vehicle side circuit integrity. The diagnostic signal is generated internally by the hybrid/EV powertrain control module 2.

Conditions for Running the DTC

DTC P0CF4

- The vehicle 12 V battery system voltage is 10.2 V or greater.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- The vehicle needs to be driven above 8 km/h (5 mph).

DTC P0CF5

- The vehicle 12 V battery system voltage is 10.2 V or greater.
- The drive motor battery charger cable is disconnected and the charge port door is closed.

DTC P0CF6

- The vehicle 12 V battery system voltage is 10.2 V or greater.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- The vehicle needs to be driven above 8 km/h (5 mph).

Conditions for Setting the DTC

DTC P0CF4

The control pilot circuit is not meeting its internal range requirements for 5 seconds. This can only be set internal to the hybrid/EV powertrain control module 2. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

DTC P0CF5

The control pilot circuit voltage divided by the system voltage is less than 0.03 V for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

DTC P0CF6

The control pilot circuit voltage divided by the system voltage is greater than 0.55 V for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

Actions Taken When the DTC Sets

- DTC P0CF4-P0CF6 are type A DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0CF4-P0CF6 are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to [High Voltage Disabling](#) .
Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

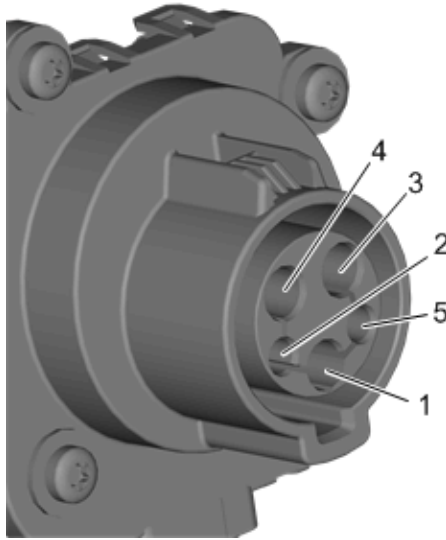


Fig. 4: Hybrid/EV Battery Charger Receptacle And Terminals
 Courtesy of GENERAL MOTORS COMPANY

NOTE: The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.

2. Test for infinite resistance between control pilot signal circuit terminal 2 of the X98 Hybrid/EV Battery Charger Receptacle and the terminals listed below:

- Terminal 4
- Terminal 1
- Terminal 5
- Terminal 3
- **If less than infinite resistance**

1. Disconnect the harness connector from the X98 Hybrid/EV Battery Charger Receptacle.

NOTE: This test is performed on the vehicle side of the harness connector.

2. Test for infinite resistance between the harness connector control pilot signal circuit terminal 2 and the terminals listed below:

- Terminal 4
- Terminal 1
- Terminal 5
- Terminal 3
- If less than infinite resistance, repair the short between the circuits.
- If infinite resistance, replace the X98 Hybrid/EV Battery Charger Receptacle.
- **If infinite resistance**

3. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement**

- [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0CF9 OR P0D01: CONTROL PILOT CHARGING SWITCH PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0CF9

Control Pilot Charging Switch Performance

DTC P0D01

Control Pilot Charging Ventilation Switch Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
110/120 A/C Line 1	1	P0D3F, P1EE6	1	-
110/120 A/C Line 2	1	P1EE6	1	-
110/120 A/C Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid/EV powertrain control module 2 has two internal switches used to modify the control pilot signal. The first internal switch modifies the control pilot signal to indicate to the drive motor battery charger cable that the vehicle is either ready or not ready to accept energy. The second internal switch modifies the control pilot signal to indicate to some drive motor battery charger cables (currently not used) if indoor ventilation is required.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- The diagnostics for DTC P0CF4-P0CF6 must have passed before these will run.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 measures a pilot signal voltage out of range for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

Actions Taken When the DTC Sets

- DTC P0CF9 and P0D01 are type A DTCs
- Disables the high voltage battery charging.

Conditions for Clearing the DTC

DTC P0CF9 and P0D01 are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0CF9 or P0D01 is not set.
 - **If either of the DTCs are set**
 Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D1F: CONTROL MODULE DATE/TIME SYNCHRONIZATION PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D1F

Control Module Date/Time Synchronization Performance

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the date and time data it receives from the radio. This time information is used to ensure the module's internal clock is synchronized to the customer's local time. The Time of Day Charging feature utilizes this internal clock to keep track of time and alarms for delayed charging modes. If this radio time data is received during a drive cycle, the system is considered synchronized.

Conditions for Running the DTC

The vehicle needs to go from Vehicle OFF to Vehicle in Service Mode to start the diagnostic.

Conditions for Setting the DTC

The vehicle is driven for more than 5 consecutive drive cycles where trip distance exceeds 15 Km (9.3 mi), and the date and time were unavailable from the OnStar Module.

Actions Taken When the DTC Sets

- DTC P0D1F is a type C DTC.
- On the Navigation screen "Default Charge Mode: Immediately" is displayed.
- The battery charger Time Of Day charging option is disabled, and charging mode is set to IMMEDIATE.

Conditions for Clearing the DTC

DTC P0D1F is a type C DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle in Service Mode, verify no radio DTC's are set.

- **If any radio DTC's are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no radio DTC's are set**

2. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D26: BATTERY CHARGER SYSTEM PRECHARGE TIME TOO LONG

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D26

Battery Charger System Precharge Time Too Long

Circuit/System Description

In order to prevent large in-rush current, battery charger bus high voltage is routed through a pre-charge resistor whenever high voltage charging is commanded ON. The hybrid/EV powertrain control module 2 monitors the time it takes the battery charger bus voltage to attain the same level as the battery pack voltage. If it takes too long, a DTC is set.

Conditions for Running the DTC

- Battery charger must go from disconnected to connected.
- Drive motor battery charger cable must be connected and vehicle receiving power.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 determines the battery charger does not reach its pre-charge voltage within 1 second.

Actions Taken When the DTC Sets

- DTC P0D26 is a Type A DTC.
- Disables the high voltage battery charging.
- Disables 12V battery charging.

Conditions for Clearing the DTC

DTC P0D26 is a Type A DTC.

Reference Information

Schematic Reference

- [Plug-In Charging Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTC P0C78 is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If the DTC is not set**

2. Verify DTC P0CF4, P0CF5, P0CF6, P0D4E, P0D4F, P0D58, or P0D59 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Connect the drive motor battery charger cable. Verify DTC P0D26 is not set and the vehicle will charge.

- **If the DTC is set and the vehicle will not charge**

Refer to Circuit/System Testing.

- **If the DTC is not set and the vehicle charges**

4. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage for servicing at the A4 Battery Pack, K1 14V Power Module and the T18 Battery Charger. Refer to [High Voltage Disabling](#) .
2. Disconnect the X3 connector at the T18 Battery Charger, the X4 connector at the K1 14V Power Module and the X6 connector at the A4 Battery Pack.
3. Verify that all HV harness connector and mating module connector terminals are free from moisture, corrosion and arc flash damage.
 - **If any terminals show signs of damage**

Replace the HV wiring harness and effected modules as necessary.

- **If no arc flash damage, moisture, or corrosion is found**

4. Test the following HV harness terminals for less than 2 Ω end to end:

- X6-1 to X3-1

- X6-1 to X4-B
- X6-2 to X3-2
- X6-2 to X4-A
- **If 2 Ω or greater**

Replace the HV wiring harness.

- **If less than 2 Ω**

5. Remove the T18 Battery Charger 15A fuse from the A4 Battery Pack. Refer to [High Voltage Battery Disconnect Relay Fuse Replacement \(Front - BDU\)](#) [High Voltage Battery Disconnect Relay Fuse Replacement \(Rear - BDU\)](#) for Front-BDU.

6. Test the battery charger 15A fuse for an open condition.

- **If the fuse is open**

NOTE: The HV harness must remain disconnected from all modules.

1. Test the HV harness terminals X6-1 to X6-2 for infinite resistance.

- If less than infinite resistance, replace the fuse and the HV wiring harness.
- If infinite resistance

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value.

2. Test the K1 14 V Power Module X4 terminals for greater than 10K Ω , X4-A to X4-B.

- If 10K Ω or less, replace the K1 14V Power Module and the fuse.
- If greater than 10 K Ω

NOTE: This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value.

3. Test the T18 Battery Charger terminals for greater than 10K Ω , X3-1 to X3-2.

- If 10K Ω or less, replace the T18 Battery Charger and the fuse.
- If greater than 10 K Ω

4. Replace the T18 Battery Charger and the fuse, reassemble the vehicle, clear DTCs and repeat Circuit/System Verification.

- If Circuit/System Verification is not OK, replace the A28 Hybrid/EV Battery Contactor Assembly.
- If Circuit/System Verification is OK, all OK.

- **If the fuse is OK**

7. Reinstall the fuse. Replace the T18 Battery Charger, reassemble the vehicle, clear DTCs and repeat Circuit/System Verification.

- **If Circuit/System Verification is not OK**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If Circuit/System Verification is OK**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Charger Receptacle, Accessory DC Power Control Module, and Drive Motor Battery Charger](#) for HV wiring harness
- [Generator Battery Disconnecter Relay Replacement](#) for A28 hybrid/EV battery contactor assembly
- [Control Module References](#) for T18 Battery Charger, often referred to as the Drive Motor Battery Charger, or K1 14V Power Module replacement, programming and setup

DTC P0D2B OR P0D2C: CONTROL PILOT/STATUS INDICATOR CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D2B

Control Pilot Indicator Control Circuit

DTC P0D2C

Charge Status Indicator Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Charge Pilot Indicator Control	P0D2B	P0D2B	P0D2B	-
Charge Status Indicator Control	P0D2C	P0D2C, 1	P0D2C	-
Charge Complete Indicator Control	1	1	1	-
Low Reference	-	P0D2C, P0D2B	-	-
1. Plug In Charging Indicator Malfunction				

Circuit/System Description

The status of charging events (including delays) is communicated to the user through a charge status indicator and audio tones. The battery state of charge indicator, located on the top middle of the instrument panel, will be solid lit green when the vehicle is charging under automatic control. It will have a fast flash green if the charging is delayed and will begin later. It will have a slow flash green when charging is complete. A solid lit yellow indicator means the vehicle is not able to accept a charge. And if there is no indicator lit it means the electronic vehicle supply equipment is not working properly or connected.

Conditions for Running the DTC

Both conditions need to run for diagnostic to pass.

Condition 1

- The 12 V battery voltage is greater than 10.2 V.
- Vehicle in Service Mode.
- The drive motor battery charger cable is disconnected (charge status indicator commanded OFF).

Condition 2

- The 12 V battery voltage is greater than 10.2 V.
- Vehicle in Service Mode.
- The vehicle is connected to an AC supply and the battery charger is charging the vehicle (charge status indicator commanded ON).

Conditions for Setting the DTC

- Charge status indicator Commanded OFF, The hybrid/EV powertrain control module 2 detects a short to battery for about 4 s.
- Charge status indicator Commanded ON, The hybrid/EV powertrain control module 2 detects a short to ground or an open/high resistance for 4 s.

Actions Taken When the DTC Sets

DTC P0D2B and P0D2C are type C DTCs.

Conditions for Clearing the DTC

DTC P0D2B and P0D2C are type C DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X1 harness connector at the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.
2. Test for less than 10 Ω between the low reference terminal 1 and ground.

- If 10 Ω or greater

Repair the open/high resistance in the circuit.

- If less than 10 Ω

NOTE: If the drive motor battery charger cable is connected. The drive motor battery charger cable must be disconnected for more than 10 seconds before performing the next step.

3. Connect a test lamp between the control circuit terminal 4 and ground.
4. Verify the test lamp does not illuminate.

- If the test lamp does illuminate

1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp does not illuminate**
5. Connect the drive motor battery charger cable.
 6. Verify that the test lamp illuminates within the first 5 seconds of connecting the drive motor battery charger cable.
 - **If the test lamp does not illuminate**
 1. Disconnect the drive motor battery charger cable. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp does illuminate**
 7. Disconnect the drive motor battery charger cable for at least 10 seconds. Connect a test lamp between the control circuit terminal 3 and ground.
 8. Verify the test lamp does not illuminate.
 - **If the test lamp does illuminate**
 1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp does not illuminate**
 9. Connect the drive motor battery charger cable.
 10. Verify that the test lamp illuminates within 25 seconds of connecting the drive motor battery charger cable.
 - **If the test lamp does not illuminate**
 1. Disconnect the drive motor battery charger cable. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the control circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp does illuminate**
 11. Replace the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Replacement](#) for B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator replacement.

- [Control Module References](#) for battery charger replacement, programming and setup.

DTC P0D3E-P0D40: BATTERY CHARGER INPUT VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D3E

Battery Charger Input Voltage Sensor Performance

DTC P0D3F

Battery Charger Input Voltage Sensor Circuit Low Voltage

DTC P0D40

Battery Charger Input Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the AC voltage sensor inside the battery charger. The signal is pulse-width modulated and the duty cycle increases as the AC voltage increases. The duty cycle equals 10% when the AC voltage sensor reports less than 60 V. The duty cycle equals 90% when the AC voltage sensor reports more than 280 V. Therefore, during normal operation the duty cycle is between 10% and 90%.

Conditions for Running the DTC

P0D3E

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is driven above 6 km/h (4 mph).

P0D3F and P0D40

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is connected to an AC supply and the battery charger is charging the vehicle.

Conditions for Setting the DTC

DTC P0D3E

The battery charger AC input duty cycle is greater than 12% or less than 8%.

DTC P0D3F

The battery charger AC input duty cycle is between 1% and 8%.

OR

The battery charger AC input duty cycle equals 100%.

DTC P0D40

The battery charger AC input duty cycle is between 92% and 99%.

OR

The battery charger AC input duty cycle equals 0%.

Actions Taken When the DTC Sets

- DTC P0D3E, P0D3F and P0D40 are type B DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D3E, P0D3F and P0D40 are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Drive the vehicle above 6 km/h (4 mph).
2. Vehicle OFF. Connect the vehicle to an AC supply to begin charging.
3. Vehicle in Service Mode.
4. Verify that P0D3E, P0D3F, or P0D40 is not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs are set**

5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the T18 Battery Charger. Vehicle in Service Mode.
2. Verify the scan tool High Voltage Battery Charger AC Input Duty Cycle parameter is less than 10%.
 - **If 10% or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the AC voltage sensor circuit terminal 10 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 10%**
3. Install a 3 A fused jumper wire between the AC voltage sensor circuit terminal 10 and the ground circuit terminal 2.
4. Verify the scan tool Battery Charger AC Input Status Duty Cycle parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the AC voltage sensor circuit terminal 10 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for less than 2 Ω in the AC voltage sensor circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
5. Replace the T18 Battery Charger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K114B Hybrid/EV Powertrain Control Module 2 or T18 Battery Charger replacement, programming and setup

DTC P0D4D-P0D4F: BATTERY CHARGER HYBRID/EV BATTERY OUTPUT VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D4D

Battery Charger Hybrid/EV Battery Output Voltage Sensor Performance

DTC P0D4E

Battery Charger Hybrid/EV Battery Output Voltage Sensor Circuit Low Voltage

DTC P0D4F

Battery Charger Hybrid/EV Battery Output Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the DC voltage sensor inside the battery charger. The signal is pulse-width modulated and the duty cycle increases as the DC voltage increases. The duty cycle equals 10% when the DC voltage sensor reports less than 0 V. The duty cycle equals 90% when the DC voltage sensor reports more than 500 V. Therefore, during normal operation the duty cycle is between 10% and 90%.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is connected to an AC supply and the battery charger is charging the vehicle.

Conditions for Setting the DTC

DTC P0D4D

The difference between the battery charger DC output voltage and hybrid/EV battery DC input voltage is greater than 30 V.

DTC P0D4E

The battery charger DC output duty cycle is between 1% and 8%.

OR

The battery charger DC output duty cycle equals 100%.

DTC P0D4F

The battery charger DC output duty cycle is between 92% and 99%.

OR

The battery charger DC output duty cycle equals 0%.

Actions Taken When the DTC Sets

- DTC P0D4D, P0D4E and P0D4F are type B DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D4D, P0D4E and P0D4F are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0D4E or P0D4F is not set.
 - **If any of the DTCs are set**
Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
2. Connect the vehicle to an AC supply to begin charging. Vehicle in Service Mode.
3. Verify that DTC P0D26 is not set.
 - **If the DTC is set**
Refer to DTC P0D26.
 - **If the DTC is not set**
4. Verify that DTC P0D4D is not set.
 - **If the DTC is set**
Refer to Circuit/System Testing.
 - **If the DTC is not set**
5. All OK.

Circuit/System Testing

NOTE: You must perform Circuit/System Verification first.

1. Vehicle OFF, disconnect the X1 harness connector at the T18 Battery Charger. Vehicle in Service Mode.
2. Verify the scan tool High Voltage Battery Charger Output Duty Cycle parameter is less than 10%.
 - **If 10% or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module
 2. Test for infinite resistance between the DC voltage sensor circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 10%**
3. Install a 3 A fused jumper wire between the DC voltage sensor circuit terminal 3 and the ground circuit terminal 2.
4. Verify the scan tool Battery Charger DC Output Status Duty Cycle parameter is greater than 90%.
 - **If 90% or less**
 1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module
 2. Vehicle in Service Mode.
 2. Test for less than 1 V between the DC voltage sensor circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for less than 2 Ω in the DC voltage sensor circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 90%**
5. Replace the T18 Battery Charger.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for K114B Hybrid/EV Powertrain Control Module 2 or T18 Battery Charger replacement, programming and setup.

DTC P0D58 OR P0D59: PROXIMITY DETECTION CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D58

Proximity Detection Circuit Low Voltage

DTC P0D59

Proximity Detection Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
AC Voltage Line 1	P1EE6	P1EE6	-	-
AC Voltage Line 2	P1EE6	P1EE6	-	-
AC Voltage Ground	1	P0D59	1	-
Control Pilot Signal	1	1	1	-
Proximity Signal	P0D58	P0D59	P0D59	-
1. Plug In Charging Indicator Malfunction				

Circuit/System Description

The proximity detection circuit prevents movement of the vehicle while the drive motor battery charger cable is connected. This diagnostic runs with the drive motor battery charger cable disconnected to verify the vehicle side circuit integrity.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle speed is greater than 20 km/h (15 mph) for more than 5 seconds.
- No vehicle speed DTCs are set.

Conditions for Setting the DTC

DTC P0D58

The hybrid/EV powertrain control module 2 measures a voltage less than 4.2 V for 5 seconds.

DTC P0D59

The hybrid/EV powertrain control module 2 measures a voltage greater than 4.8 V for 5 seconds.

Actions Taken When the DTC Sets

- DTC P0D58 and P0D59 are type A DTCs.
- Disable the high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D58 and P0D59 are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to [High Voltage Disabling](#) .
Reconnect the X2 harness connector at the T18 Battery Charger.

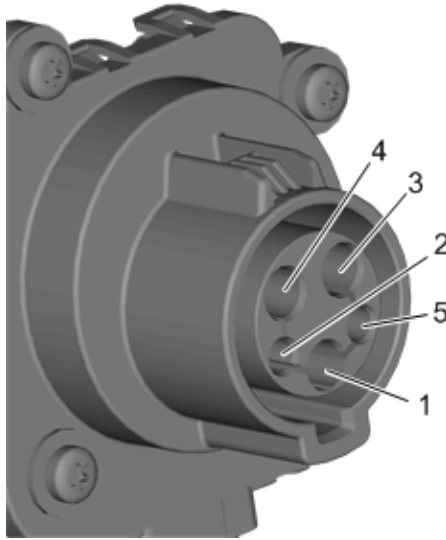


Fig. 5: Hybrid/Ev Battery Charger Receptacle And Terminals
 Courtesy of GENERAL MOTORS COMPANY

NOTE: The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.

2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the X2 harness connector at the T18 Battery Charger.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the T18 Battery Charger.
 - **If less than 10 Ω**
3. Connect the 12 V battery. Vehicle in Service Mode.

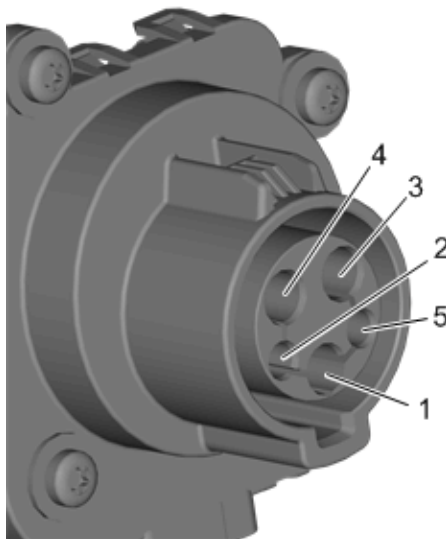


Fig. 6: Hybrid/Ev Battery Charger Receptacle And Terminals
 Courtesy of GENERAL MOTORS COMPANY

4. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.

- **If less than 4.2 V**

1. Vehicle OFF, disconnect the harness connector to the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

NOTE: The following tests are performed at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.

2. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.
 - If less than 4.2 V
 3. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 4. Test for infinite resistance between the signal circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 5. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If greater than 4.8 V**
1. Vehicle OFF, disconnect the X2 harness connector at the T18 Battery Charger. Disconnect the harness connector to the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

NOTE: The following tests are performed at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.

2. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.
 - If greater than 4.8 V
 3. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 4. Test for less than 1 V between the signal circuit terminal 5 and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V
 5. Test for 2.565 - 2.835K Ω between the signal circuit terminal 5 and the low reference circuit terminal 1.
 - If not within the specified range, replace the X98 Hybrid/EV Battery Charger Receptacle.
 - If within the specified range, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If within 4.2 - 4.8 V**
5. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Drive Motor Battery Charger Receptacle Replacement
- Control Module References for battery charger or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D5A: PROXIMITY DETECTION CIRCUIT ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check -

Vehicle

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D5A

Proximity Detection Circuit Erratic

Circuit/System Description

This diagnostic runs with the drive motor battery charger cable connected. The hybrid/EV powertrain control module 2 uses a 5 V regulated signal through a 2700 Ω resistor to a low reference circuit in the battery charger to detect if the drive motor battery charger cable is attached.

Conditions for Running the DTC

The drive motor battery charger cable is connected.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 determines the proximity signal voltage is erratic for 40 seconds.

Actions Taken When the DTC Sets

DTC P0D5A is a type C DTC.

Conditions for Clearing the DTC

DTC P0D5A is a type C DTC.

Diagnostic Aids

The proximity status circuit is susceptible to moisture intrusion. If signs of moisture intrusion are observed in the hybrid/EV battery charger receptacle harness connector, the hybrid/EV battery charger receptacle should be replaced. If moisture is detected on one connector, always be sure to inspect the mating connector as well.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Connect the drive motor battery charger cable.
2. Verify DTC P0D5A is not set.
 - **If the DTC is set**
 Replace the X98 Hybrid/EV Battery Charger Receptacle.
 - **If the DTC is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Drive Motor Battery Charger Receptacle Replacement](#)

DTC P0D5C: BATTERY CHARGER HYBRID/EV BATTERY OUTPUT POWER PERFORMANCE

[Diagnostic Instructions](#)

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

[DTC Descriptor](#)

DTC P0D5C

Battery Charger Hybrid/EV Battery Output Power Performance

[Circuit/System Description](#)

The hybrid/EV powertrain control module 2 monitors the hybrid/EV battery pack voltage and current sensors to determine battery charger output power efficiency.

[Conditions for Running the DTC](#)

- The vehicle 12 V battery system voltage needs to be above 10 V.
- There cannot be any high voltage or current sensor faults present.
- Drive motor battery charger cable must be connected and vehicle receiving power.

[Conditions for Setting the DTC](#)

- Battery charger output power efficiency is less than 67% of nominal value for 10 seconds.
- Hybrid/EV electronics coolant temperature is between -12Â°C (10Â°F) and 65Â°C (149Â°F).

Actions Taken When the DTC Sets

- DTC P0D5C is a type B DTC.
- Disables the high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D5C is a type B DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Connect the drive motor battery charger cable.
2. Verify DTC P0D5C is not set.
 - **If the DTC is set**
 Replace the T18 Battery Charger.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

[Control Module References](#) for T18 Battery Charger, often referred to as the Drive Motor Battery Charger, replacement, programming, and setup

DTC P0D5E: BATTERY CHARGER SYSTEM HIGH VOLTAGE PRESENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0D5E

Battery Charger System High Voltage Present

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors and 1 transistor. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors are a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor, and precharge high voltage contactor. The 1 transistor is the heater transistor. These contactors/transistors close and open in sequence and are controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/transistors. Ground is provided through the case ground.

Conditions for Running the DTC

- All contactors are commanded open.
- Runs once per charger contacts discharge event.
- None of the following DTCs are set: P0D4D, P0D4E or P0D4F.

Conditions for Setting the DTC

High voltage bus does not discharge to below 60 V within 4 seconds of the charger contactors being commanded open.

Actions Taken When the DTC Sets

- DTC P0D5E is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

- DTC P0D5E is a type A DTC.
- The [Clear Secured High Voltage DTCs](#) reset function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

[Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Drive Motor Battery System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: The following setup steps must be performed exactly in order to exercise the contactors.

1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: The brake pedal must remain depressed throughout the remainder of the contactor steps.

3. PRESS and HOLD the brake pedal.

NOTE: DO NOT press the power button and enter Vehicle in Service Mode.

4. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
5. Disconnect the S15 Manual Service Disconnect.

NOTE: DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.

6. Command the Battery Charging System Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open. The KR116B Battery Charging System Positive Contactor should be heard closing and opening.

- If the Battery Charging System Positive Contactor does not open and close

Refer to Circuit/System Testing.

- **If the Battery Charging System Positive Contactor does open and close**

7. Replace the T18 Battery Charger.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X358 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the A28 Hybrid/EV Battery Contactor Assembly and K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to [Battery Energy Control Module Replacement](#).

- **If the test lamp illuminates**

4. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode.
5. Verify that a test lamp does not illuminate between the A4 Hybrid/EV Battery Pack harness control circuit terminal 7 X357 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If the test lamp does not illuminate**

6. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
7. Test for infinite resistance between the A4 Hybrid/EV Battery Pack harness control circuit terminal 7 X357 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Test for less than 2 Ω in the control circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

9. Replace the K114B Hybrid Powertrain Control Module 2.
10. Verify that DTC P0D5E does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC P0D5E is set**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If DTC P0D5E is not set**

11. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [High Voltage Battery Disconnect Relay Replacement](#) for A28 Hybrid/EV Battery Contactor Assembly.
- [Control Module References](#) for battery charger, battery energy control module or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0E61 OR P0E65: BATTERY CHARGER ENABLE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0E61

Battery Charger Enable Circuit

DTC P0E65

Battery Charger Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Charger Enable	P0E61	P0E61	P0E61	-
Battery Charger Control	P0E65	P0E65	P0E65	-

Circuit/System Description

The battery charger is controlled with a charger enable signal and a pulse width modulated (PWM) charger control circuit from the hybrid/EV powertrain control module 2. The charger enable signal is set to 12 V when the hybrid/EV powertrain control module 2 is awake. This allows the battery charger to operate while driving to allow DC voltage sensor operation.

Conditions for Running the DTC

DTC P0E61

The 12 V battery voltage is greater than 10.2 V.

DTC P0E65

- The 12 V battery voltage is greater than 10.2 V.
- Vehicle in Service Mode or the drive motor battery charger cable is connected.

Conditions for Setting the DTC

DTC P0E61

The hybrid/EV powertrain control module 2 detects an open, short to ground, or short to voltage on battery charger enable circuit for 1 second.

DTC P0E65

The hybrid/EV powertrain control module 2 detects an open, short to ground, or short to voltage on battery charger control circuit for 1 second.

Actions Taken When the DTC Sets

- DTC P0E61 and P0E65 are type B DTCs.

- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0E61 and P0E65 are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Disconnect the X1 harness connector at the T18 Battery Charger.
2. Test for infinite resistance between the terminals listed below at the T18 Battery Charger X1 harness connector:
 - Battery charger enable terminal 11 and B+ terminal 9
 - Battery charger enable terminal 11 and ground terminal 2
 - Battery charger control terminal 4 and B+ terminal 9
 - Battery charger control terminal 4 and ground terminal 2
 - **If less than infinite resistance**
Repair the short between the circuits.
 - **If infinite resistance**
3. Test for less than 2 Ω between the terminals listed below end to end:
 - T18 Battery Charger terminal 11 X1 and K114B Hybrid/EV Powertrain Control Module 2 terminal 44 X2

- T18 Battery Charger terminal 4 X1 and K114B Hybrid/EV Powertrain Control Module 2 terminal 53 X2
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

5. Verify P0E61 or P0E65 is not set.

- **If any of the DTCs are set**

Replace the T18 Battery Charger.

- **If none of the DTCs are set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for battery charger or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1EE6: BATTERY CHARGER AC VOLTAGE NOT PRESENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1EE6

Battery Charger AC Voltage Not Present

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
AC Voltage Line 1	P1EE6	P1EE6	-	-
AC Voltage Line 2	P1EE6	P1EE6	-	-
AC Voltage Ground	-	P1EE6	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid battery charger receptacle is connected to the battery charger through two 110/220 V AC circuits and one ground circuit. When the battery charger has been enabled by the hybrid/EV powertrain control module 2, the battery charger will provide an AC voltage measurement to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 allows charging to occur if proper AC voltage is present.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The drive motor battery charger cable is connected.
- DTCs P0D3E, P0D3F, P0D40, or P0D5C is not set.

Conditions for Setting the DTC

The battery charger AC input voltage is below 5 V.

Actions Taken When the DTC Sets

- DTC P1EE6 is a type C DTC.
- Disables the vehicle high voltage battery charging.

Conditions for Clearing the DTC

DTC P1EE6 is a type C DTC.

Diagnostic Aids

The hybrid/EV battery charger receptacle contains internal fuses on Voltage AC Line 1 and Voltage AC Neutral Line 2 circuits. A battery charger internal failure may cause these fuses to blow. If an open circuit is found in the hybrid/EV battery charger receptacle, the battery charger may also need to be replaced.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Clear DTC, connect a known good drive motor battery charger cable to vehicle and household supply voltage.
2. Verify DTC P1EE6 is set.

- **If DTC P1EE6 is not set**

Replace customer's drive motor battery charger cable.

- **If DTC P1EE6 is set**

3. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to [High Voltage Disabling](#)

4. Disconnect the X2 harness connector at the T18 Battery Charger.

5. Test into the harness for infinite resistance between the 110/220 V AC circuit terminals listed below and ground:

- T18 Battery Charger terminal 1 X2
- T18 Battery Charger terminal 4 X2

- **If less than infinite resistance**

1. Disconnect the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.
2. Test into the harness for infinite resistance between the appropriate 110/220 V AC circuit terminal and ground.

- If less than infinite resistance, repair the short to ground in the circuit.
- If infinite resistance, replace the X98 Hybrid/EV Battery Charger Receptacle.

- **If infinite resistance**

6. Test into the harness for infinite resistance between all the 110/220 V AC circuit terminals listed below:

- T18 Battery Charger terminal 1 X2
- T18 Battery Charger terminal 3 X2
- T18 Battery Charger terminal 4 X2
- **If less than infinite resistance**

1. Disconnect the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.
 2. Test into the harness for infinite resistance between the three 110/220 V AC circuit terminals.
 - If less than infinite resistance, repair the short between the circuits.
 - If infinite resistance, replace the X98 Hybrid/EV Battery Charger Receptacle.
- **If infinite resistance**

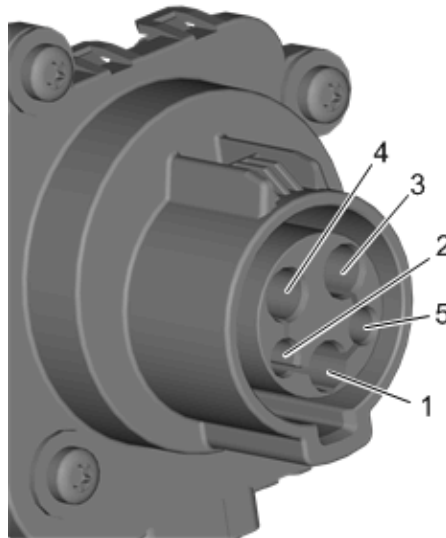


Fig. 7: Hybrid/Ev Battery Charger Receptacle And Terminals

Courtesy of GENERAL MOTORS COMPANY

7. Test for less than 10 Ω between the 110/220 V AC circuit terminals listed below:

- T18 Battery Charger terminal 1 X2 and X98 Hybrid/EV Battery Charger Receptacle 3
- T18 Battery Charger terminal 3 X2 and X98 Hybrid/EV Battery Charger Receptacle 1
- T18 Battery Charger terminal 4 X2 and X98 Hybrid/EV Battery Charger Receptacle 4
- **If 10 Ω or greater**

1. Disconnect the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.
 2. Test for less than 2 Ω in the 110/220 V AC circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 3. Replace the X98 Hybrid/EV Battery Charger Receptacle.
 4. Verify the DTC does not set.
 - If the DTC sets, replace the T18 Battery Charger and X98 Hybrid/EV Battery Charger Receptacle.
 - If the DTC does not set
 5. All OK.
- **If less than 10 Ω**

8. Replace the T18 Battery Charger.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Charger Receptacle Replacement](#)
- [Control Module References](#) for battery charger replacement, programming and setup.

PLUG-IN CHARGING MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
110/120 A/C Line 1	1	P0D3F, P1EE6	1	-
110/120 A/C Line 2	1	P1EE6	1	-
110/120 A/C Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The drive motor battery charger cable allows the vehicle to be charged using a common household power outlet. The drive motor battery charger cable contains LEDs that indicate the status of the drive motor battery charger cable. The drive motor battery charger cable automatically prohibits voltage transfer to the hybrid/EV battery charger receptacle and the Fault Indicator is illuminated red if it senses internal faults or inadequate household voltage. If the drive motor battery charger cable senses no faults the AC Present Indicator is illuminated solid green.

When the hybrid/EV powertrain control module 2 senses the drive motor battery charger cable is connected to the vehicle charge receptacle, it will communicate with the off-vehicle charge equipment to ensure compatibility and proper function. The hybrid/EV powertrain control module 2 will then indicate the status of charging events (including user-programmable delays) to the user via instrument panel mounted plug-in charging status indicator LEDs and audio tones.

Diagnostic Aids

If the drive motor battery charger cable Fault Indicator is illuminated solid red or flashing red before plugging into the vehicle, the charger cable will need to be diagnosed first.

Reference Information

Schematic Reference

[Plug-In Charging Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle ON, verify no DTCs are set.

- **If DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**

2. With the charge cord NOT connected to the vehicle battery charger receptacle, verify the vehicle plug-in charging status indicators are OFF.

- **If the vehicle plug-in charging status indicators are not OFF with the charge cord disconnected from the vehicle**

Refer to **Plug-In Charging Indicator Malfunction**.

- **If the vehicle plug-in charging status indicators are OFF**

3. Vehicle OFF and connect the charge cord to the vehicle battery charger receptacle.

4. Verify the vehicle charge status indicators are operating properly.

- **If the vehicle charge status indicator is solid yellow**

Refer to Circuit/System Testing.

- **If the vehicle charge status indicator is not illuminated**

1. Vehicle ON.

NOTE: **Vehicle must be ON and not in Service Mode for message operation.**

2. Verify the Charge Cord Connected message is displayed in the instrument panel/message center.
 - If the Charge Cord Connected message is displayed, refer to **Plug-In Charging Indicator Malfunction**.
 - If the Charge Cord Connected message is NOT displayed, refer to Circuit/System Testing.
- **If the vehicle charge status indicator is operating properly**

5. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Connect the customer's drive motor battery charger cable to household power outlet, but not the vehicle battery charger receptacle.
2. After 25 seconds, verify drive motor battery charger cable AC Present Indicator illuminates solid green.
 - **If drive motor battery charger cable AC Present Indicator does not illuminate solid green**
 1. Connect a known good drive motor battery charger cable to the same household power outlet.
 - If known good drive motor battery charger cable AC Present Indicator illuminates solid green, replace the customer's drive motor battery charger cable.
 - If known good drive motor battery charger cable AC Present Indicator does not illuminate solid green, have the service provider inspect the household power outlet for insufficient voltage, high frequency noise, or open/high resistance.
 - **If drive motor battery charger cable AC Present Indicator does illuminate solid green**

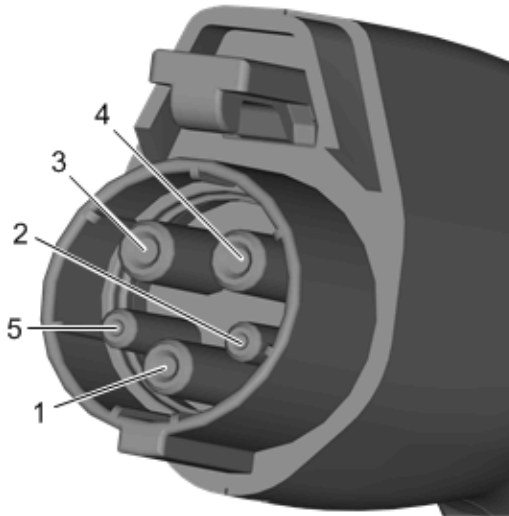


Fig. 8: Drive Motor Battery Charger Cable Terminals
 Courtesy of GENERAL MOTORS COMPANY

3. Test for greater than 1 V between the low voltage circuits listed below on drive motor battery charger cable.

- Proximity status signal circuit terminal 5
- Control pilot signal circuit terminal 2
- **If less than 1 V**

Replace drive motor battery charger cable.

- **If greater than 1 V**

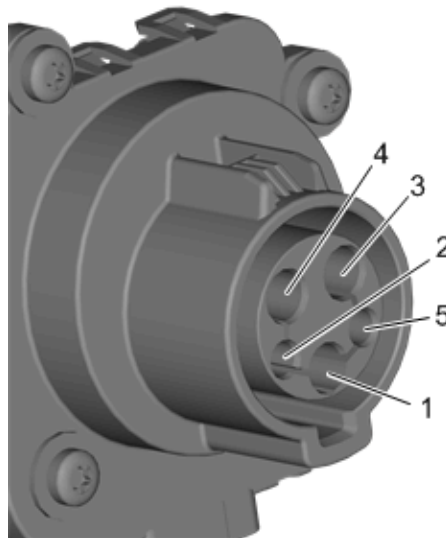


Fig. 9: Hybrid/Ev Battery Charger Receptacle And Terminals
 Courtesy of GENERAL MOTORS COMPANY

NOTE: The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.

NOTE: When measuring resistance observe proper meter polarity by connecting the common/ground meter probe to ground/vehicle chassis.

NOTE: You must measure with a high-impedance Digital Multimeter (DMM) such as the EL-39200 or equivalent.

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for 100k Ω - 4M Ω between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.

- **If 4M Ω or greater**

1. Disconnect the X2 harness connector from K114B Hybrid/EV Powertrain Control Module 2
2. Test for 2 Ω in the control pilot signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 100k Ω**

1. Disconnect the X2 harness connector from K114B Hybrid/EV Powertrain Control Module 2
2. Test for infinite resistance between the control pilot signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If within the specified range**

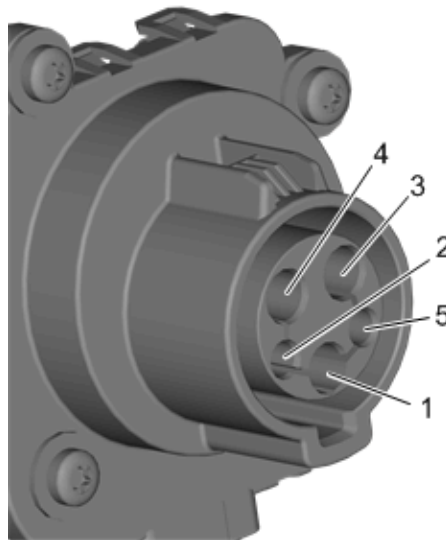


Fig. 10: Hybrid/Ev Battery Charger Receptacle And Terminals

Courtesy of GENERAL MOTORS COMPANY

5. Test for less than 1 V between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.

- **If greater than 1 V**

1. Disconnect the X2 harness connector from K114B Hybrid/EV Powertrain Control Module 2
2. Test for less than 1 V between the control pilot signal circuit and ground.
 - If greater than 1 V, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 1 V**

6. Vehicle in Service Mode.

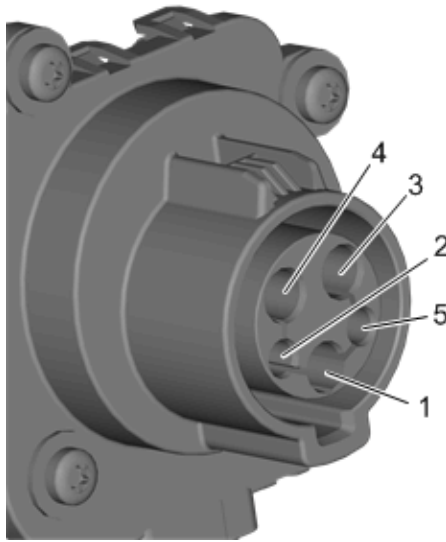


Fig. 11: Hybrid/Ev Battery Charger Receptacle And Terminals
Courtesy of GENERAL MOTORS COMPANY

7. Test for 4.2 - 4.8 V between the proximity status signal terminal 5 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
 - **If less than 4.2 V**
 1. Vehicle OFF, test for infinite resistance between the proximity status signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 2. Disconnect the X2 harness connector from K114B Hybrid/EV Powertrain Control Module 2.
 3. Test for less than 2 Ω in the proximity status signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 4.8 V**
 1. Disconnect the X2 harness connector from K114B Hybrid/EV Powertrain Control Module 2
 2. Test for 0 V between the proximity status signal circuit and ground.
 - If greater than 0 V, repair the short to voltage in the circuit.
 - If 0 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If within the specified range**
8. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the X2 harness connector from T18 Battery Charger and the X2 harness connector from the K114B Hybrid/EV Powertrain Control Module 2.

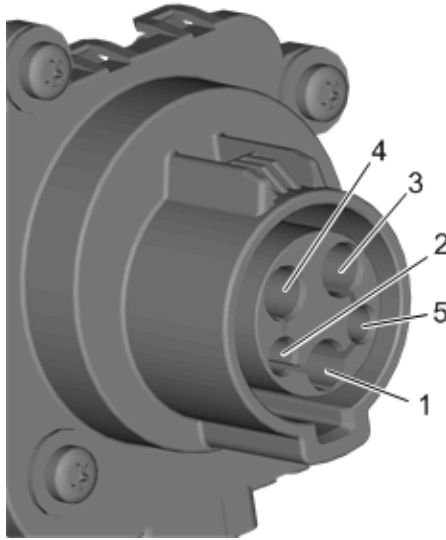


Fig. 12: Hybrid/Ev Battery Charger Receptacle And Terminals
Courtesy of GENERAL MOTORS COMPANY

9. Test for infinite resistance between the terminals listed below at the X98 Hybrid/EV Battery Charger Receptacle:

- 110/220 V A/C Line 1 terminal 3 and 110/220 V A/C Neutral Line 2 terminal 4
- 110/220 V A/C Line 1 terminal 3 and 110/220 V A/C Ground terminal 1
- 110/220 V A/C Line 1 terminal 3 and Control pilot signal circuit terminal 2
- 110/220 V A/C Line 1 terminal 3 and Proximity status signal circuit terminal 5
- 110/220 V A/C Neutral Line 2 terminal 4 and 110/220 V A/C Ground terminal 1
- 110/220 V A/C Neutral Line 2 terminal 4 and Control pilot signal circuit terminal 2
- 110/220 V A/C Neutral Line 2 terminal 4 and Proximity status signal circuit terminal 5
- 110/220 V A/C Ground terminal 1 and Control pilot signal circuit terminal 2
- Control pilot signal circuit terminal 2 and Proximity status signal circuit terminal 5

- **If less than infinite resistance**

Repair the short between the circuits.

- **If infinite resistance**

10. Disconnect the harness connector from the X98 Hybrid/EV Battery Charger Receptacle.

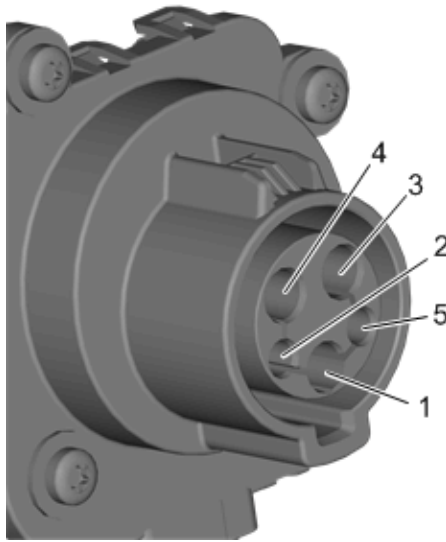


Fig. 13: Hybrid/Ev Battery Charger Receptacle And Terminals
Courtesy of GENERAL MOTORS COMPANY

11. Test for 2.56 - 2.84k Ω between the 110/220 V A/C Ground terminal 1 and Proximity status signal circuit terminal 5 at the X98 Hybrid/EV Battery Charger Receptacle.

- **If not within the specified range**

Replace the X98 Hybrid/EV Battery Charger Receptacle.

- **If within the specified range**

NOTE: This test is performed on the vehicle side of the harness connector.

12. Test for infinite resistance between the 110/220 V A/C Ground terminal 1 and Proximity status signal circuit terminal 5 of the harness connector.

- **If less than infinite resistance**

Repair the short between the circuits.

- **If infinite resistance**

13. Replace and program the K114B Hybrid/EV Powertrain Control Module 2.

14. Repeat Circuit/System Verification and confirm vehicle is All OK.

- **If Circuit/System Verification was not All OK**

Replace the T18 Battery Charger.

- **If Circuit/System Verification was All OK**

15. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Drive Motor Battery Charger Receptacle Replacement](#)
- [Control Module References](#) for T18 battery charger, or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

PLUG-IN CHARGING INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Charge Pilot Indicator Control	P0D2B	P0D2B	P0D2B	-
Charge Status Indicator Control	P0D2C	P0D2C, 1	P0D2C	-
Charge Complete Indicator Control	1	1	1	-
Low Reference	-	P0D2C, P0D2B	-	-
1. Plug In Charging Indicator Malfunction				

Circuit/System Description

The status of charging events (including delays) is communicated to the user through a vehicle plug-in charge status indicator and audio tones. The vehicle plug-in charge status indicator, located on the top middle of the instrument panel, contains a green LED (charge status indicator) and yellow LED (charge pilot indicator) controlled by the Hybrid Powertrain Control Module 2 and a second green LED (charge complete indicator) controlled by the BCM. The indicator will have a short flash green when the vehicle is charging under automatic control. The flash rate increases from one to four as the battery charges. It will have a long flash green if the charging is delayed and will begin later. It will be illuminated solid green when charging is complete. A solid lit yellow indicator means the vehicle is not able to accept a charge.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U135B is not set.

- **If DTC U135B is set**

Refer to DTC U1340-U135F .

- **If DTC U135B is not set**

3. Verify no other hybrid/EV battery-related DTCs are set.

- **If any hybrid/EV battery-related DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **If no hybrid/EV battery-related DTCs are set**

4. Vehicle OFF. Ensure the charge cord is not connected to the vehicle.

5. Verify the vehicle charge indicator is OFF.

- **If the vehicle charge indicator is not OFF**

Refer to Circuit/System Testing.

- **If the vehicle charge indicator is OFF**

6. Connect the charge cord.

7. Verify the vehicle charge indicator is operating properly.

- **If the vehicle charge indicator is solid yellow**

Refer to Plug-In Charging Malfunction

- **If the vehicle charge indicator is OFF**

1. Vehicle ON.

NOTE: **Vehicle must be ON and not in Service Mode for message operation.**

2. Verify the Charge Cord Connected message is displayed in the instrument panel/message center.

- If the Charge Cord Connected message is displayed, refer to Circuit/System Testing.
- If the Charge Cord Connected message is NOT displayed, refer to Plug-In Charging Malfunction.

- **If the vehicle charge indicator is operating properly**

8. All OK.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X1 harness connector at the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.
2. Test for less than 10 Ω between the low reference terminal 1 and ground.

- If 10 Ω or greater

Repair the open/high resistance in the circuit.

- If less than 10 Ω

NOTE: If the drive motor battery charger cable is connected. The drive motor battery charger cable must be disconnected for more than 10 s before performing the next step.

3. Connect a test lamp between the yellow LED control circuit terminal 4 and ground.
4. Verify the test lamp does not illuminate.

- If the test lamp illuminates

1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
- If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- If the test lamp does not illuminate

5. Connect the drive motor battery charger cable.
6. Verify that the test lamp illuminates or flashes in the first 5 s of connecting the drive motor battery charger

cable.

- **If the test lamp does not illuminate**

1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

7. Disconnect the drive motor battery charger cable for at least 10 s. Connect a test lamp between the green LED control circuit terminal 3 and ground.

8. Verify test lamp does not illuminate.

- **If the test lamp illuminates**

1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
- If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp does not illuminate**

9. Connect the drive motor battery charger cable.

10. Verify that the test lamp illuminates or flashes within 25 s of connecting the drive motor battery charger cable.

- **If the test lamp does not illuminate**

1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

11. Replace the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Replacement](#) for B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator replacement.
- [Control Module References](#) for T18 battery charger, or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

REPAIR INSTRUCTIONS

CHARGE PORT HOUSING BEZEL REPLACEMENT

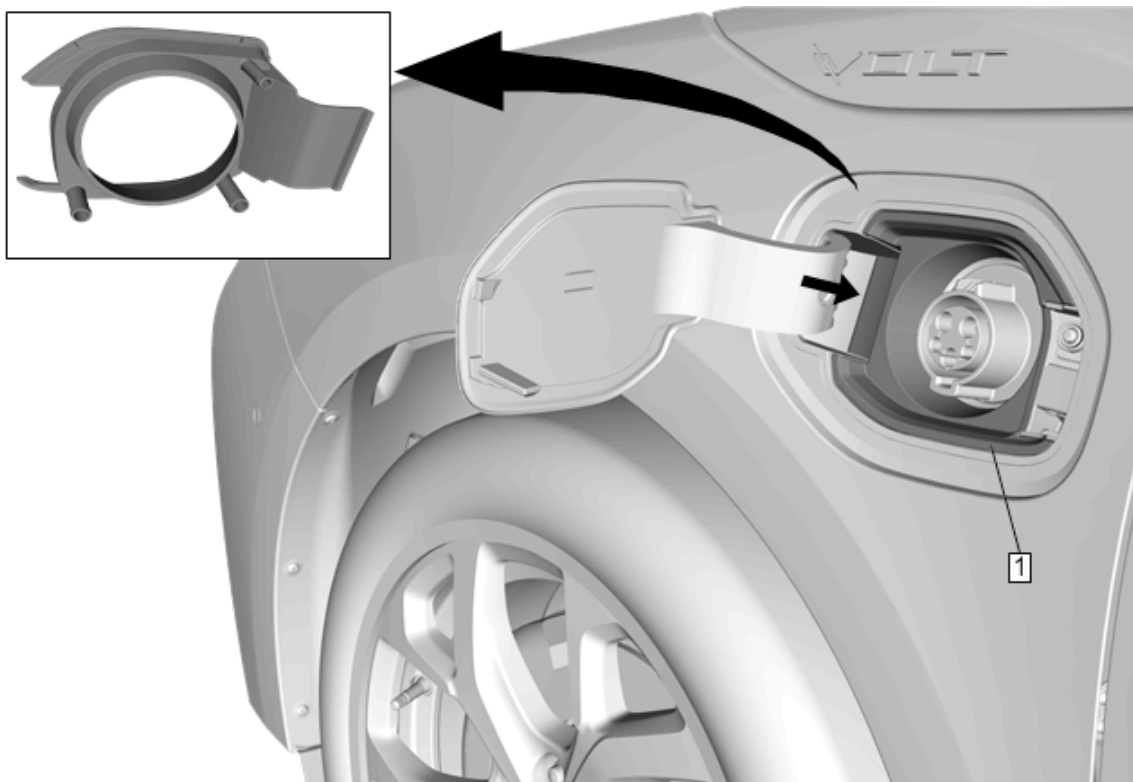


Fig. 14: Charge Port Housing Bezel

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage.	

Callout	Component Name
	• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high

Callout	Component Name
voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Open the charge port door. 2. <u>High Voltage Disabling</u>	
1	Charge Port Housing Bezel Procedure 1. Insert a plastic wedge type-tool between the hinge assembly and housing bezel. 2. Gently apply pressure to the bezel outward and disengage the bezel from the charge port housing assembly. 3. Remove the charge port housing bezel. 4. <u>High Voltage Enabling</u>

CHARGE PORT DOOR REPLACEMENT

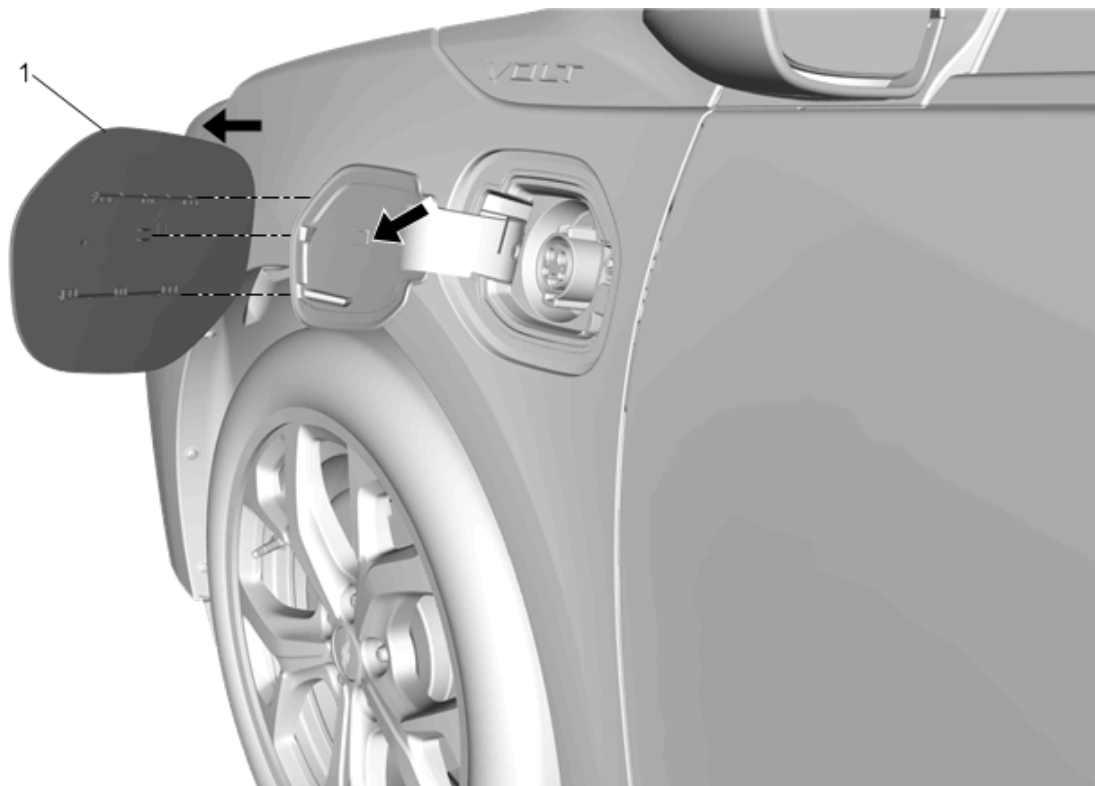


Fig. 15: Charge Port Door

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Open the charge port door. 2. <u>High Voltage Disabling</u>	
1	Charge Port Door Procedure 1. Using a flat-bladed driver, lift slightly upward on the tab at the center of the hinge in order to release the door from the hinge assembly. 2. Slide the door outward, away from the hinge and remove. 3. <u>High Voltage Enabling</u>

CHARGE PORT HOUSING REPLACEMENT

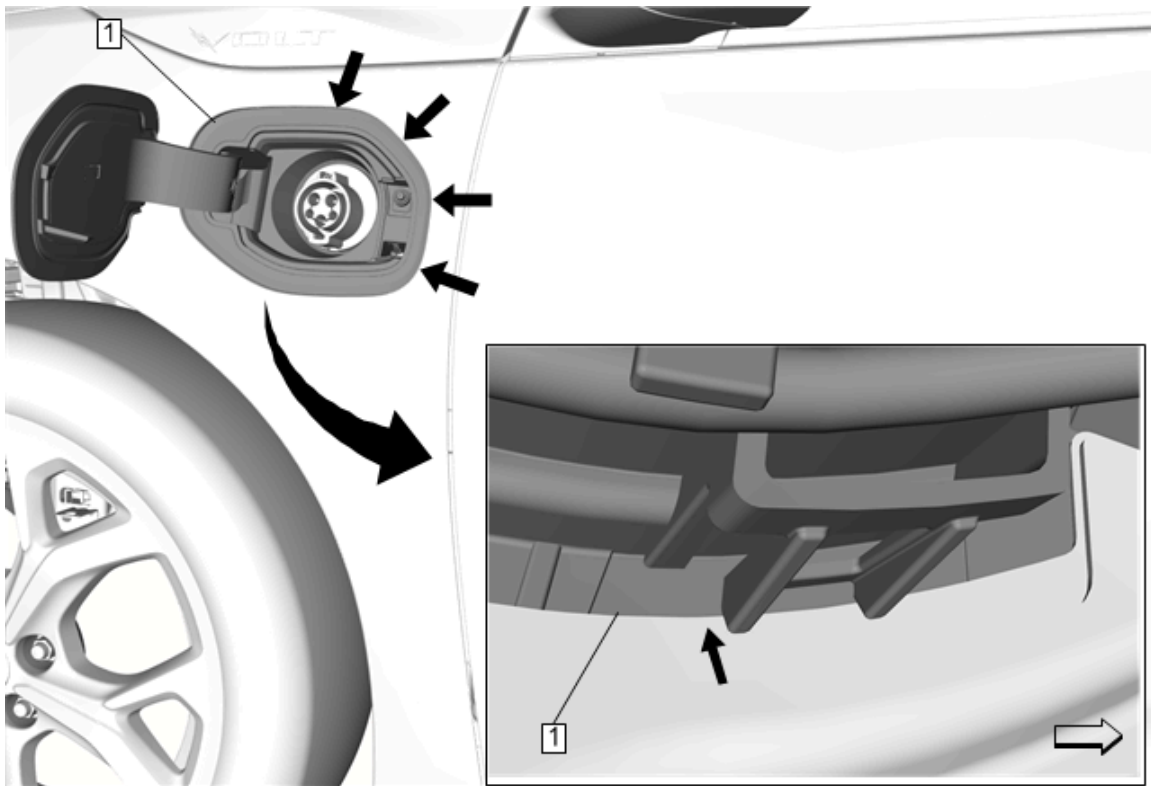


Fig. 16: Charge Port Housing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage.	

Callout	Component Name
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: - Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. - Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. - Visually and functionally inspect the gloves before use. - Wear the Insulation gloves with leather protectors at all times when working with the high	

Callout	Component Name
	voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. <u>High Voltage Disabling</u> 2. <u>Front Wheelhouse Liner Replacement (Left Side)</u> <u>Front Wheelhouse Liner Replacement (Right Side)</u> 3. <u>Charge Port Door Replacement</u> 4. Disconnect the electrical connector.
1	Charge Port Housing CAUTION: Refer to <u>Exterior Trim Emblem Removal Caution</u> . Procedure 1. From inside the fender, release the lower tab to the charge port housing assembly. 2. Push outward on the assembly housing. 3. Using a plastic trim-type stick, gently pry outward while pulling outward on the rear edge of the housing. 4. <u>High Voltage Enabling</u>

CHARGE PORT DOOR AJAR INDICATOR SWITCH REPLACEMENT

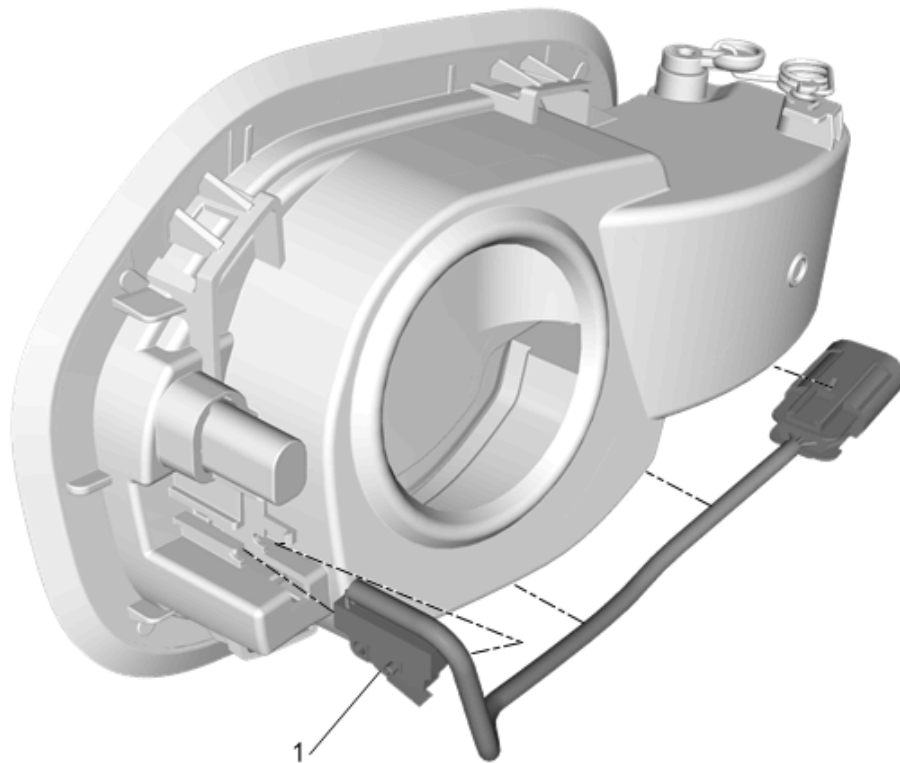


Fig. 17: Charge Port Door Ajar Indicator Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage.	

Callout	Component Name
• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high	

Callout	Component Name
voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. <u>High Voltage Disabling</u> 2. <u>Charge Port Housing Replacement</u>	
1	Charge Port Door Ajar Switch Procedure 1. Release the charge port door ajar indicator switch and connector from the charge port housing cavity. 2. <u>High Voltage Enabling</u>

DRIVE MOTOR BATTERY CHARGER REPLACEMENT

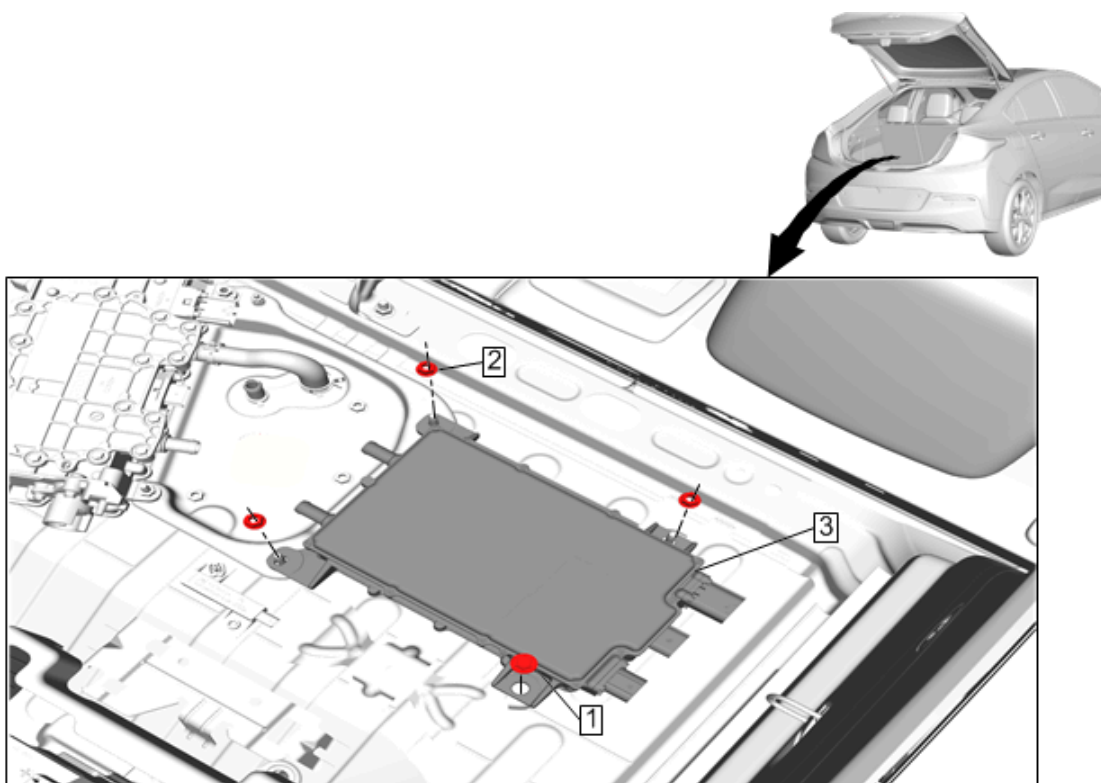


Fig. 18: Drive Motor Battery Charger

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields	

Callout	Component Name
	when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. <u>High Voltage Disabling</u> 2. <u>Drive Motor Generator Power Inverter Module Cooling System Draining and Filling</u> 3. Disconnect all electrical connectors. NOTE:

Callout	Component Name
	Add a protective bag or enclosure to the harness side connector to prevent inadvertent liquid spills during rework. Corrosion will form if this procedure is not followed properly. 4. <u>Generator Control Module Coolant Radiator Hose Replacement</u> , and <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line)</u> <u>Drive Motor Generator Control Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module Inlet)</u>
1	Drive Motor Battery Charger Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Drive Motor Battery Charger Fastener (Qty: 3) Tighten 22 N.m (16 lb ft)
3	Drive Motor Battery Charger Procedure 1. <u>High Voltage Enabling</u> 2. <u>Battery Charger Programming and Setup</u>

DRIVE MOTOR BATTERY CHARGER RECEPTACLE REPLACEMENT

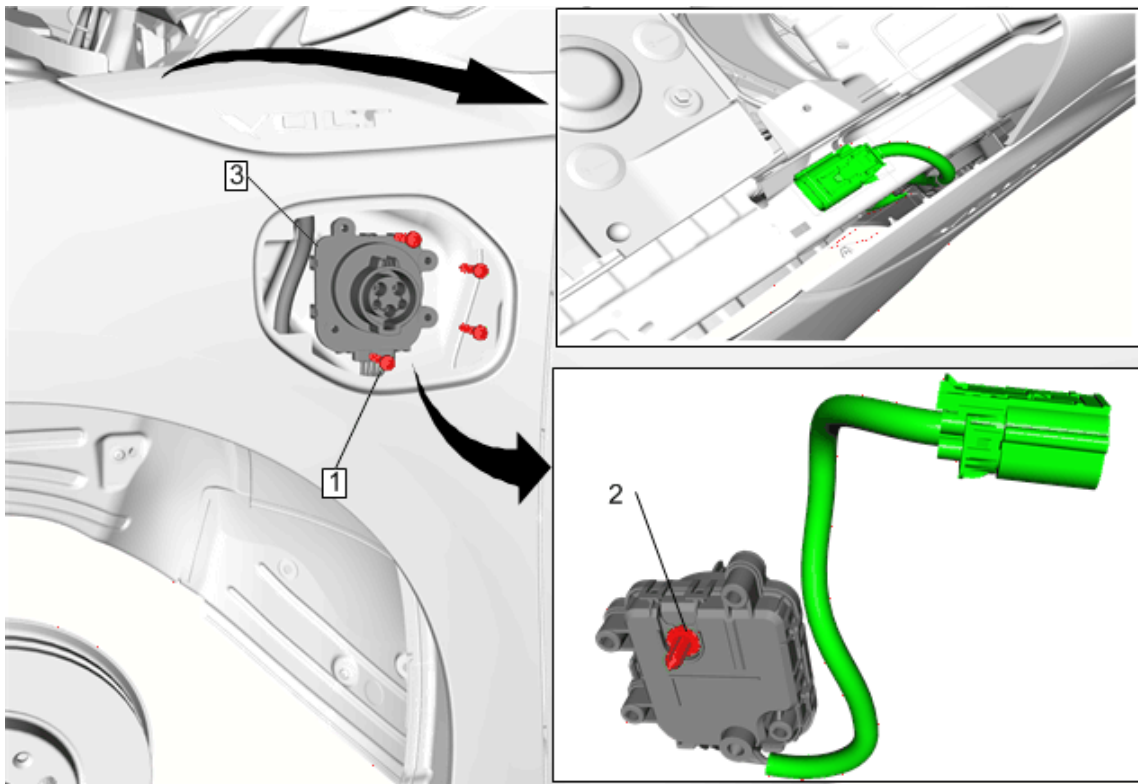


Fig. 19: Drive Motor Battery Charger Receptacle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage.	

Callout	Component Name
• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high	

Callout	Component Name
voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Remove the electric vehicle supply equipment (EVSE) charge cord plug handle from the charger receptacle. 2. <u>High Voltage Disabling</u> 3. <u>Charge Port Housing Replacement</u>	
1	Drive Motor Battery Charger Receptacle Fastener (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 12 N.m (106 lb in)
2	Drive Motor Battery Charger Receptacle Retainer Procedure Using a trim type tool, release the retainer.
3	Drive Motor Battery Charger Receptacle Procedure 1. Open the hood. 2. Disconnect the electrical connector. 3. Unclip the charger receptacle harness retainer. 4. <u>High Voltage Enabling</u>

DESCRIPTION AND OPERATION

PLUG-IN CHARGING SYSTEM DESCRIPTION AND OPERATION

Plug-In Charging System Components

The high voltage battery charging system consists of four main components:

1. The off-vehicle charging equipment:

- Drive motor battery charger cable, often referred to as the travel cord set
- Optional, permanent 230/240 V charge station

2. The hybrid/EV battery charger receptacle, often referred to as the drive motor battery charger receptacle.

3. The battery charger, often referred to as the drive motor battery charger.

4. The hybrid/EV battery pack.

A variety of mechanical, visual, and audio indicators/devices are used to communicate with the user of the charging equipment.

Drive Motor Battery Charger Cable/Charge Station

The drive motor battery charger cable provided with the vehicle features a standard household electrical plug on one end and a plug designed to interface with the vehicles hybrid/EV battery charger receptacle on the other end. The drive motor battery charger cable features a charge current interrupt device with AC power and fault indicators, and it is stored in the vehicle's cargo area. An optional charge station is available for customers who want to reduce the amount of time needed to recharge. The optional charge station, if available, is hard-wired to a 230/240 V power supply and must be permanently mounted at the customer's location. The optional charge station features the same plug on the vehicle end as the drive motor battery charger cable.

The Drive Motor Battery Charger Cable Indicators and the Vehicle Indicators

The drive motor battery charger cable has two indicators, the AC Present Indicator and the Fault Indicator, which display its status.

- Solid green AC Present Indicator means AC voltage is present at the wall plug and there are no faults.
- Flashing green AC Present Indicator and solid red Fault Indicator means the electrical outlet or plug is faulty or overheated.
- Solid red Fault Indicator means the AC outlet does not have a proper ground and charging is not permitted for safety reasons.
- Flashing red Fault Indicator means there is a vehicle fault and the charger cable ground-fault circuit interrupter (GFCI) has tripped.
- Solid green AC Present Indicator and flashing red Fault Indicator means the charger cable has failed self-check.

The off-vehicle battery charging equipment is supervised and controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 is the primary controller, and all diagnostic trouble codes will set in that module even though some of the diagnostics are actually run within the battery charger. Charging events can be delayed at customer request to take advantage of lower rates during non-peak hours. The status of charging events, including delays, is communicated to the user through visual indications, instrument panel mounted charge status indicator, and audio tones. The vehicle charge status indicator, located on the top middle of the instrument panel, will be short flashing green when the vehicle is charging under automatic control. The flash rate increases from one to four as the battery charges. It will be long flashing green if the charging is delayed and will begin later. It will be solid green when charging is complete. A solid yellow indicator means the vehicle is not able to accept a charge. If there is no indicator, the drive motor battery charger cable is not working properly or not connected.

Vehicle Receptacle

The vehicle receptacle, or hybrid/EV battery charger receptacle, is located behind the charging port door on the driver's side front fender. The receptacle is accessed by depressing and opening the receptacle door. The vehicle may be equipped with a secondary charge status indicator at the receptacle.

Battery Charger

The battery charger is a serviceable assembly containing several micro-processors and two separate high voltage chargers. One of the high voltage chargers is used while charging with a 120 V charge source, and both are used with a 230/240 V charge source. The battery charger is mounted beneath the vehicle cargo load floor. DEX-COOLÂ® coolant is used to ensure that the charger does not exceed its maximum designed operating temperature. The battery charger, along with the 14 V power module and the drive motor generator power inverter module, are cooled by a power electronics cooling loop, which is separate from other cooling systems.

12 V Battery Maintenance Mode

Battery Maintenance Mode is an automatic function that prevents deep discharge of the 12 V battery in specific circumstances. It is enabled when the drive motor battery charger cable is plugged into the hybrid/EV battery charger receptacle and the hybrid/EV battery pack is not being charged. Operation differs depending on whether the power mode is Vehicle Off or Vehicle in Service Mode.

With Vehicle Off, the 12 V battery is monitored at periodic intervals up to a maximum of 30 days. With Vehicle in Service Mode, the 12 V battery is monitored at periodic intervals up to a maximum of 60 hours. If voltage is low, the 12 V battery is charged by the 14 V power module using external power for up to four hours. This function is only intended to prevent a dead 12 V battery and does not provide a full charge. This is more efficient than continuously trickle charging, thus minimizing the usage of external power.

Under normal circumstances, with a 12 V battery that is charged when the vehicle is parked, Battery Maintenance Mode will simply monitor the voltage level, and no charging will be necessary. With Vehicle Off, Battery Maintenance Mode will maintain the 12 V battery for up to 30 days. For longer periods, refer to Owner Manual for instructions.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

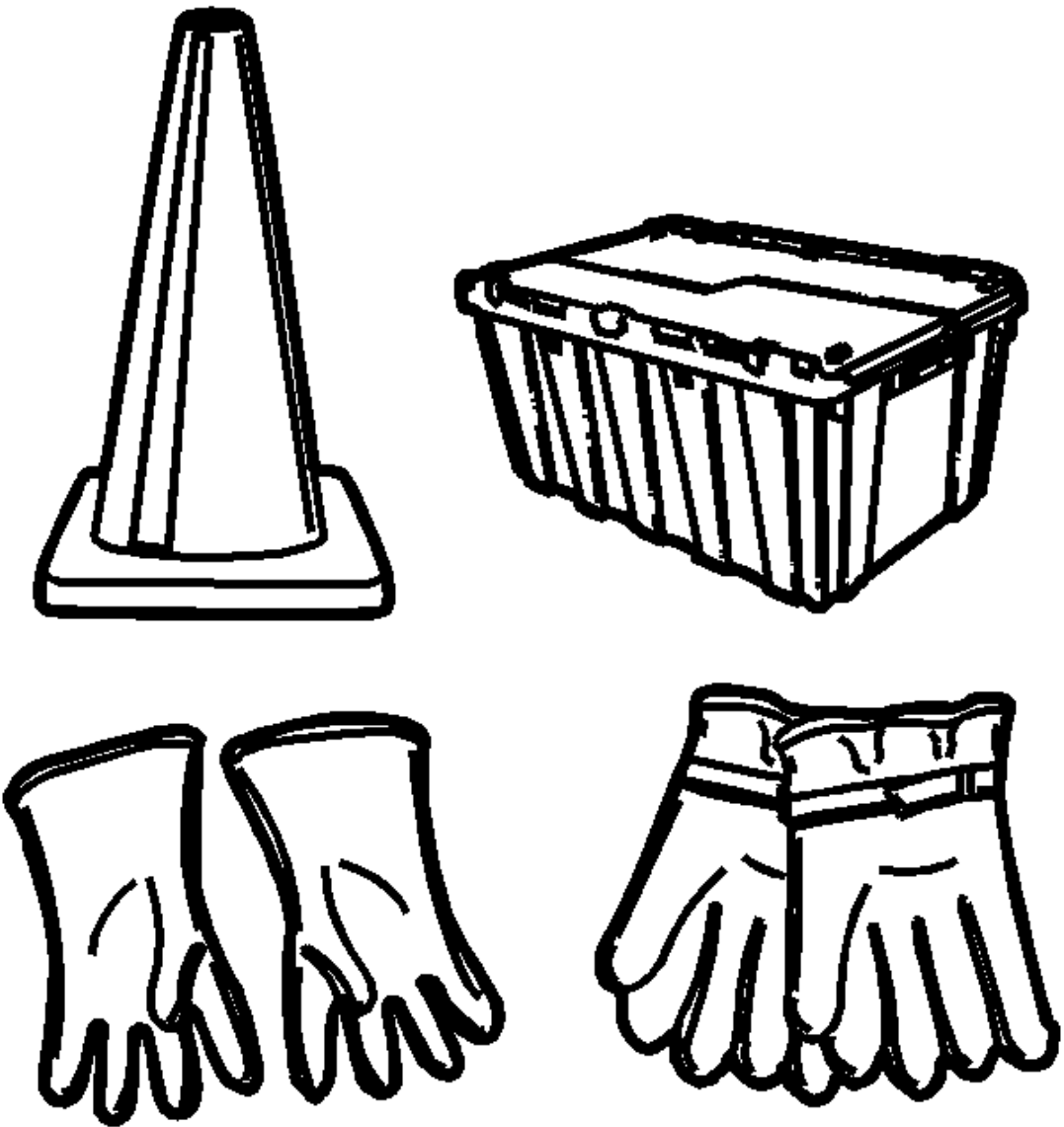
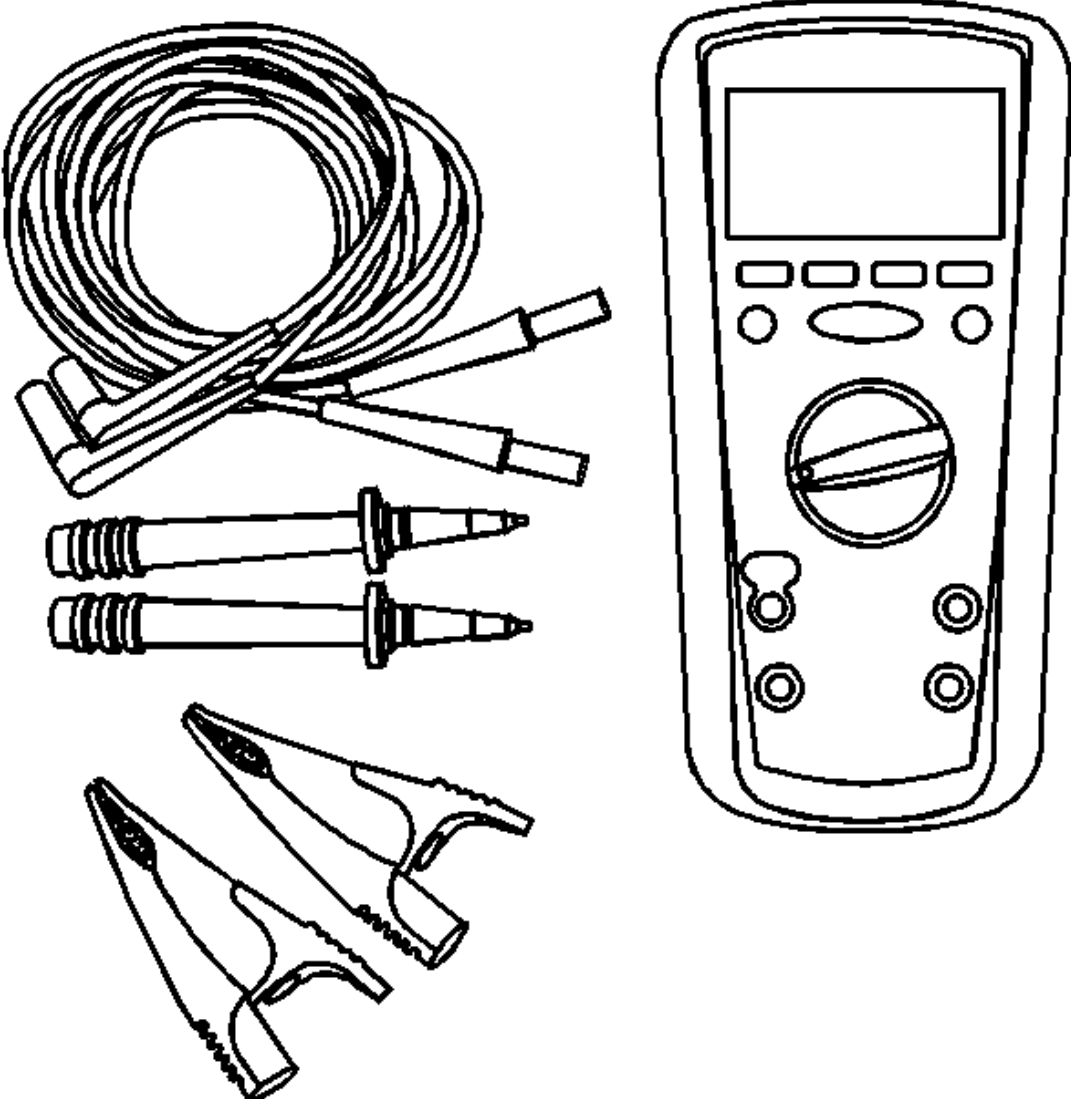
Illustration	Tool Number/Description
 The illustration shows three items: a traffic cone on the left, a rectangular plastic storage bin in the upper right, and two pairs of work gloves at the bottom. One pair of gloves has a textured, wavy pattern on the palms, while the other pair has a smoother surface with visible stitching.	EL-48900 HEV Safety Kit or equivalent Dealer Equipment

Illustration	Tool Number/Description
 A line drawing of a digital multimeter and its accessories. On the left, there is a coiled test lead with two probes, two individual probes with banana plugs, and two alligator clips. On the right is the multimeter itself, which has a rectangular LCD screen at the top, a row of four small function buttons below it, a large circular rotary selector switch in the center, and four input jacks at the bottom. The entire illustration is contained within the 'Illustration' column of the table.	EL-50774 Low/High Resistance Meter

Article GUID: A00884693

ELECTRICAL

Power Outlets - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

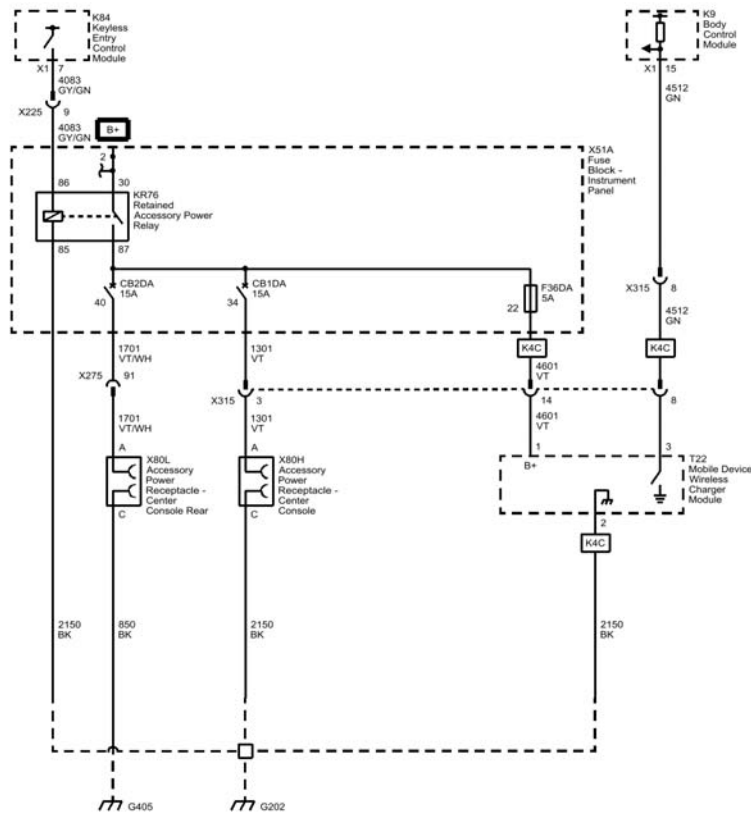
All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Front Floor Console Bracket Bolt	1 N.m (9 lb in)

SCHEMATIC WIRING DIAGRAMS

CIGAR LIGHTER/POWER OUTLET WIRING SCHEMATICS

Cigar Lighter/Power Outlets



DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - MOBILE DEVICE WIRELESS CHARGER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Mobile Device Wireless Charger Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the power outlets. Refer to **Checking Aftermarket Accessories**
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Refer to **Mobile Device Wireless Charger Malfunction (with EL-51755)** in order to diagnose the system.

SYMPTOMS - POWER OUTLETS

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the power outlets. Refer to **Checking Aftermarket Accessories** .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Power Outlet Receptacle Malfunction** in order to diagnose the system.

MOBILE DEVICE WIRELESS CHARGER MALFUNCTION (WITH EL-51755)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Signal	3	2	-	-
Ground	-	1	-	-
1. T22 Mobile Device Wireless Charger Module=Inoperative 2. Wireless Charging Indicator=Off 3. Wireless Charging Indicator=On				

Circuit/System Description

For an overview of the component/system, refer to: [Mobile Device Wireless Charger Description and Operation](#)

Circuit	Description
Ignition	Supplied from a relay.
Signal	The control module input circuit has an internal resistance connected to 12 V. When the switch is closed it will pull the signal voltage low.
Ground	Chassis Ground

Component	Description
T22 Mobile Device Wireless Charger Module	Inductive charging, also known as "wireless charging", uses a magnetic field to transfer energy between two objects. The wireless charger has an induction coil to create an alternating magnetic field. A second induction coil in a portable device takes power from the magnetic field and converts it back into electric current to charge the battery. The two induction coils in proximity work similar as an electrical transformer.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc. The control module also reads various switches and sensors and makes their values available via serial data.

The T22 Mobile Device Wireless Charger Module is controlled by an ignition operated relay and is operational when the ignition is in the Accessory or On position. When a wireless charging device is placed on the charging pad/pocket the charging of the device battery will start. The K9 Body Control Module detects the device battery is charging and sends a serial data message to the P17 Info Display Module which illuminates the charge indicator.

Diagnostic Aids

- Verify the mobile device can be charged with the proper wireless charging adapter. To check for phone or other device compatibility, refer to GM Total Connect website.
- Verify the charging pad/pocket is free from debris or any obstruction that may impede charging.
- The component T22 contains an internal temperature switch that will open if it exceeds 85 °C (185 °F).
- The ambient operating temperature is between -20 and 60 °C (-4 and 140 °F) for the charging system and between 0 and 35 °C (32 and 95 °F) for the mobile device. If the mobile device temperature exceeds 35 °C (95 °F) the mobile device may stop accepting a charge (this may vary with different mobile devices).
- Verify the mobile device is positioned correctly on the charging pad/pocket and there are no foreign objects between the mat and the mobile device. It may be necessary to move the device around slightly or rotate 180 degrees to properly align it on the charging pad/pocket until the device starts to charge. The use of a protective case may require more precise device placement to allow charging or may inhibit charging. Try removing the protective case.
- The mobile device may not charge if the charge mat is NOT completely flat or has an air gap which can be verified by a finger push at the target graphic located at the center of the mat. If the charge mat is NOT flat, replace the charge mat/rubber liner.
- While operating the vehicle in rough conditions, it is possible for the device to move out of position, repositioning of the device may be necessary.
- If the mobile device battery is fully charged, the charge indicator on the P17 Info Display Module may not illuminate.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Mobile Device Wireless Charger Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Special Tools

EL-51755 Inductive Charging Test Tool

Equivalent regional tools: [Special Tools](#)

Circuit/System Verification

WARNING: Remove all objects from the charging pad before charging your mobile device. Objects, such as coins, keys, rings, paper clips, or cards, between the phone and charging pad will become very hot. On the rare occasion that the charging system does not detect an object, and the object gets wedged between the phone and charger, remove the phone and allow the object to cool before removing it from the charging pad, to prevent burns.

1. Ignition - On / Vehicle - In Service Mode
2. Verify the charging pad is clear of any wireless device.

Verify the function: Wireless Charging Indicator=Off

- If the indicator is On

Refer to: Circuit/System Testing

- If the indicator is Off

NOTE: There is a charging coil located in the center of the Charging Pad/Pocket. The EL-51755 Inductive Charging Test Tool has a charging coil in the center of the tool. These coils must be aligned in order for the test tool to illuminate.

To complete successfully, the procedure may need to be repeated 5 times. Between each attempt, remove the tool and wait 3 s.

On a charging pad, align the EL-51755 Inductive Charging Test Tool against the alignment rib. In a pocket, insert the EL-51755 Inductive Charging Test Tool until it stops. For both the pad and pocket, ensure that the flat side (non-LED side) of the EL-51755 Inductive Charging Test Tool aligns against the flat charging surface.

3. Install the special tool: EL-51755 Inductive Charging Test Tool @ Charging Pad/Pocket

Verify the function: Special Tools LED (Light Emitting Diode) = On

- If the special tool is Off

Refer to: Circuit/System Testing

- If the special tool is On

4. Verify the function: Wireless Charging Indicator = On

- If the indicator is Off

Refer to: Circuit/System Testing

- If the indicator is On

NOTE: The customer's device may not be compatible or is defective.

5. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: T22 Mobile Device Wireless Charger Module
3. Test for less than 10 ohms between the test points: Ground circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect ground terminal.
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 1 @ Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: Ignition circuit terminal 1 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Remove - Test Lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 1 & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms Refer to: **Retained Accessory Power Malfunction**
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Remove - Test Lamp
 2. Test for infinite resistance between the test points: Ignition circuit terminal 1 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: T22 Mobile Device Wireless Charger Module.
 - **If the test lamp turns On**
6. Verify the function: Wireless Charging Indicator = Off
 - **If the indicator is On**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K9 Body Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K9 Body Control Module
 - **If the indicator is Off**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 2
8. Verify the function: Wireless Charging Indicator = On

- **If the indicator is Off**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: K9 Body Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K9 Body Control Module

- **If the indicator is On**

9. Test or replace the component: T22 Mobile Device Wireless Charger Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

[Wireless Charging System Module Replacement](#) - T22 Mobile Device Wireless Charger Module

POWER OUTLET RECEPTACLE MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Ground	-	1	-	-
1. Accessory Power Receptacle Malfunction				

Circuit/System Description

The vehicle is fitted with a 12 V accessory power receptacle. The accessory power outlets are controlled by an ignition operated relay. The accessory power receptacle is operational when Vehicle in Service Mode or Vehicle ON.

Diagnostic Aids

It may be helpful to discuss with the customer the usage of any device that may have drawn too much current and caused an open fuse.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Outlets Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Vehicle in Service Mode, connect an appropriate device to the X80 Accessory Power Receptacle.
2. Verify the device is powered by the X80 Accessory Power Receptacle.

- **If the device is not powered**

Refer to Circuit/System Testing

- **If the device is powered**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate X80 Accessory Power Receptacle or E32 Cigarette Lighter Receptacle.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.

- **If greater than 10 Ω**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the control circuit terminal A and ground.
 - **If the test lamp does not illuminate and the circuit fuse/circuit breaker is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the control circuit end to end.

- If greater than 2 Ω , repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse/circuit breaker is not open and there is voltage at the fuse/circuit breaker. Refer to [Retained Accessory Power Malfunction](#).
- **If the test lamp does not illuminate and the circuit fuse/circuit breaker is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the control circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate X80 Accessory Power Receptacle.
 - **If the test lamp illuminates**
- 5. Replace the appropriate X80 Accessory Power Receptacle or E32 Cigarette Lighter Receptacle.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

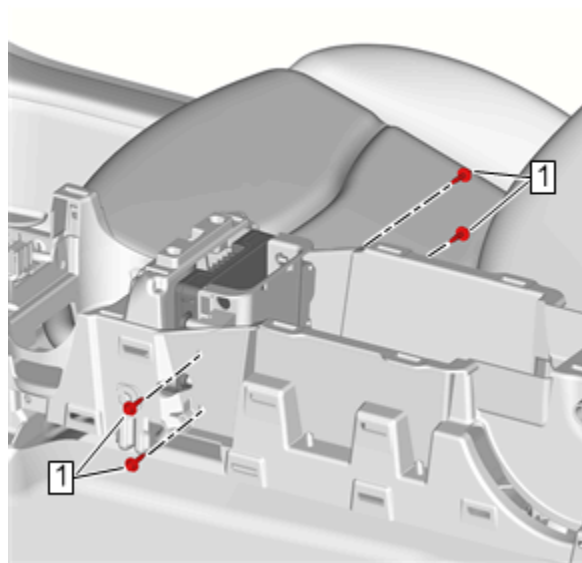
[Accessory Power Receptacle Replacement](#)

REPAIR INSTRUCTIONS

WIRELESS CHARGING SYSTEM MODULE REPLACEMENT

Removal Procedure

1. Remove [Front Floor Rear Console Side Trim Panel Replacement - Left Side](#)
2. Remove [Front Floor Rear Console Side Trim Panel Replacement - Right Side](#)



[Fig. 2: Front Floor Console Bracket Bolts](#)
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Floor Console Bracket Bolt (1)

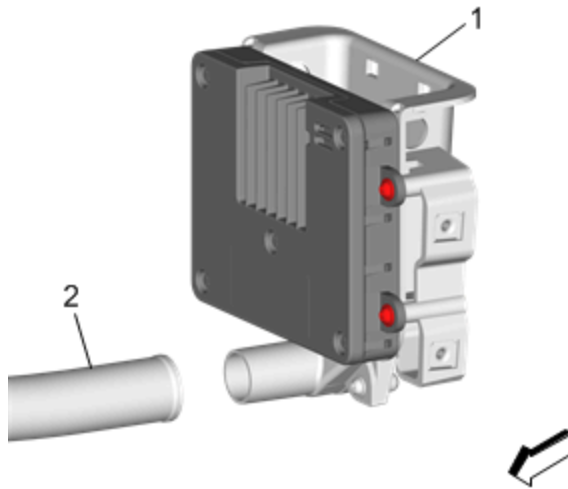


Fig. 3: Front Floor Console Housing Assembly And Radio Cooling Duct
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the Front Floor Console Housing Assembly (1) from the Radio Cooling Duct (2).
5. Disconnect the electrical connector.
6. Remove the Front Floor Console Housing Assembly (1) from the Front Floor Console Assembly.

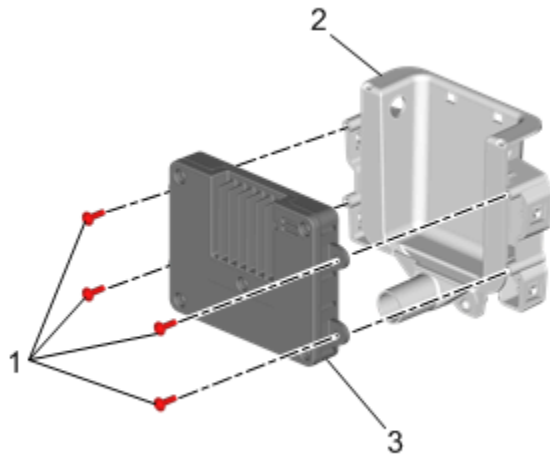


Fig. 4: Front Floor Console Accessory Bracket, Wireless Charging System Module And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Floor Console Bracket Bolt (1)
8. Separate the Front Floor Console Accessory Bracket (2) from the Wireless Charging System Module (3).
9. Transfer components as necessary.

Installation Procedure

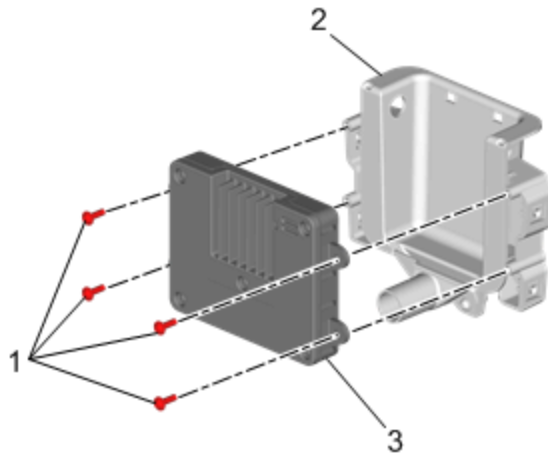


Fig. 5: Front Floor Console Accessory Bracket, Wireless Charging System Module And Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Assemble the Front Floor Console Accessory Bracket (2) to the Wireless Charging System Module (3).
2. Install Front Floor Console Bracket Bolt (1) and tighten 1 N.m (9 lb in)

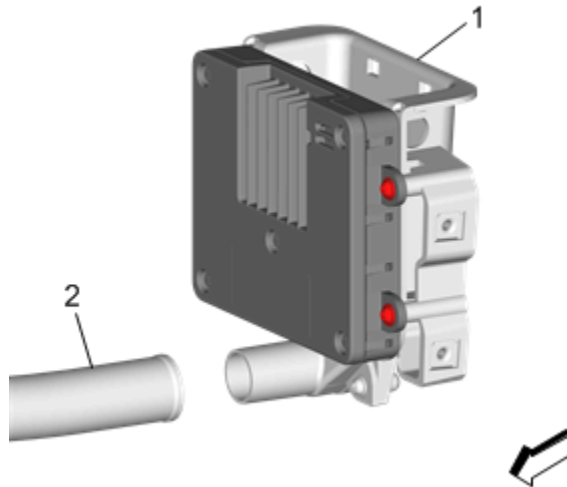


Fig. 6: Front Floor Console Housing Assembly And Radio Cooling Duct

Courtesy of GENERAL MOTORS COMPANY

3. Connect the Front Floor Console Housing Assembly (1) to the Radio Cooling Duct (2).
4. Connect the electrical connector.

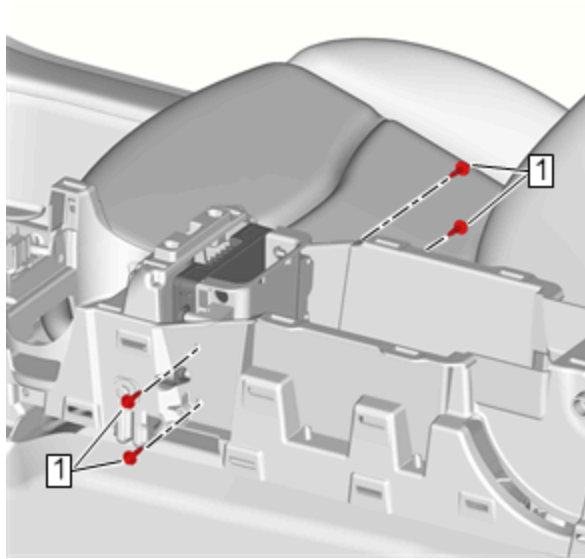


Fig. 7: Front Floor Console Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install Front Floor Console Bracket Bolt (1) and tighten 2.5 N.m (22 lb in)
6. Install **Front Floor Rear Console Side Trim Panel Replacement - Right Side**
7. Install **Front Floor Rear Console Side Trim Panel Replacement - Left Side**

ACCESSORY POWER RECEPTACLE REPLACEMENT

Special Tools

EL-42059 Cigar Lighter Socket Remover

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

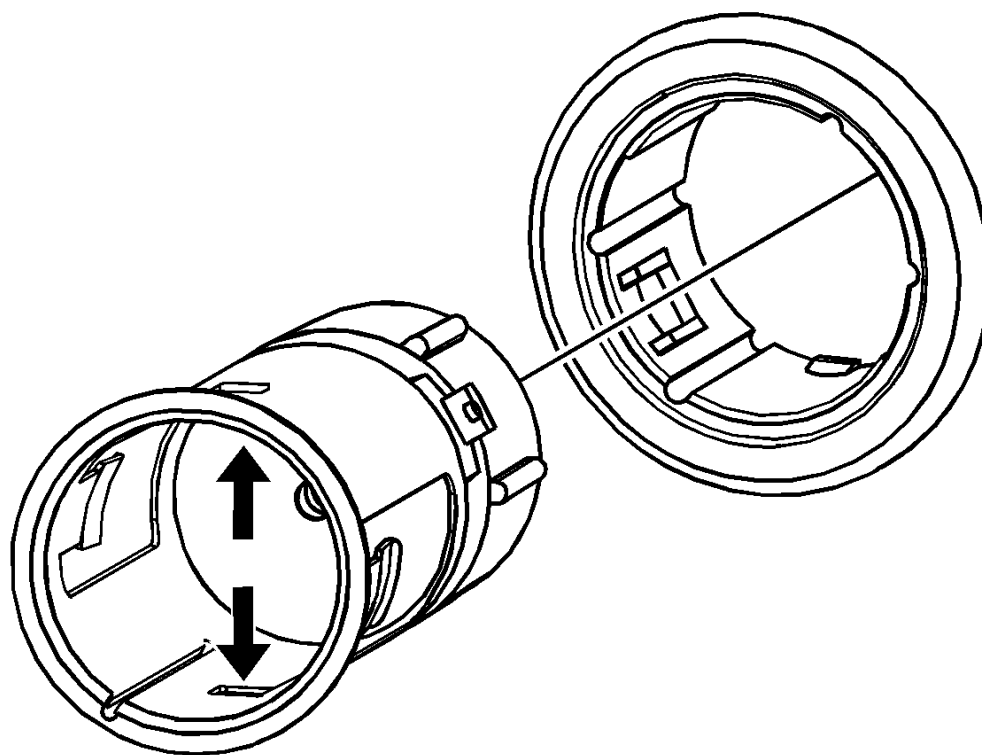


Fig. 8: View Of Cigar Lighter Socket/Accessory Power Outlet
Courtesy of GENERAL MOTORS COMPANY

1. Remove the auxiliary power outlet fuse from the fuse block.
2. Remove the receptacle:
 1. Look into the receptacle. There are two 3 mm (0.11 in) tab windows 12 mm (0.47 in) from the front of the receptacle. The **EL-42059** remover pushes the plastic latches from these tab windows and the receptacle can be pulled straight out.
 2. Place one side of the "T" portion of the **EL-42059** remover into the tab window. The **EL-42059** remover will not fit straight into the receptacle. Angle the slightly for insertion into the receptacle.
 3. Insert the other side of the "T" into the opposite tab window.

You must move the **EL-42059** remover handle toward horizontal to engage the other tab window.

4. Use the **EL-42059** remover to pull the receptacle straight out.

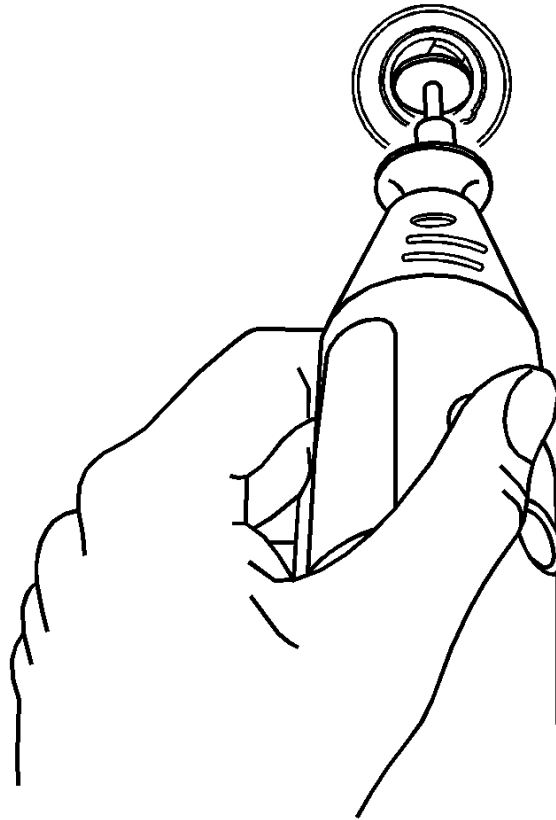


Fig. 9: Removing Cigar Housing Using Grinding Tool

Courtesy of GENERAL MOTORS COMPANY

3. If **EL-42059** remover tool fails to release the lighter socket from the retainer, perform the following alternate method:
 1. Insert a small grinding tool with a cutoff wheel into the socket.
 2. Remove the plastic latches in the 3 mm (0.11 in) square windows.
 3. Use the **EL-42059** remover as directed above to remove the socket.

Installation Procedure

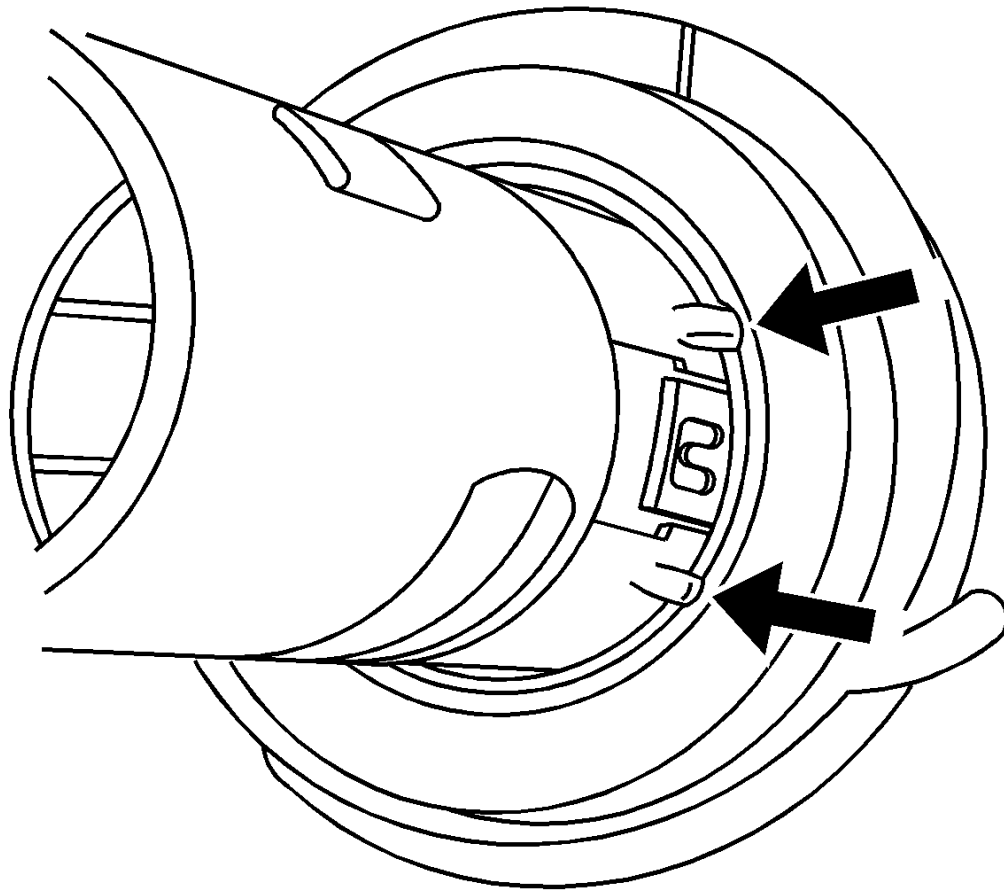


Fig. 10: View Of Receptacle Tabs & Retainer Slots

Courtesy of GENERAL MOTORS COMPANY

1. Route the connector through the retainer. Align the accessory power receptacle retainer to the slot in the opening.
2. Install the retainer by pressing into place fully seated.
3. Connect the electrical connector to the receptacle.
4. Align the tabs on the receptacle to the slots in the retainer. Install the accessory power receptacle by pressing into place until fully seated.
5. Install the accessory power receptacle fuse.

DESCRIPTION AND OPERATION

MOBILE DEVICE WIRELESS CHARGER DESCRIPTION AND OPERATION

Mobile Device Wireless Charging System

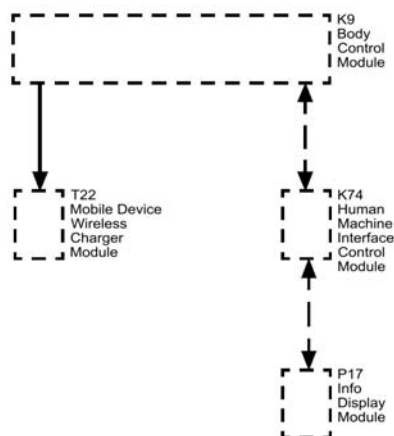


Fig. 11: Mobile Device Wireless Charging System Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K9	K9 Body Control Module
T22	Mobile Device Wireless Charger Module
K74	Human Machine Interface Control Module
P17	P17 Info Display Module

The Mobile Device Wireless Charging System (WCS) is an system for wirelessly charging mobile devices. It is capable of charging the batteries of compatible mobile devices. A compatible device is one that is compliant with Power Matters Alliance (PMA) or Wireless Power Consortium (WPC) Standard, meaning that it is equipped with a PMA or WPC wireless charge "receiver" that will work with the charge "transmitter" installed in the vehicle. The devices may utilize built-in charging circuitry or an adapter (external plug-in device which contains the charging circuitry). To check for phone or other device compatibility, refer to GM Total Connect.

WARNING: Remove all objects from the charging pad before charging your mobile device. Objects, such as coins, keys, rings, paper clips, or cards, between the phone and charging pad will become very hot. On the rare occasion that the charging system does not detect an object, and the object gets wedged between the phone and charger, remove the phone and allow the object to cool before removing it from the charging pad, to prevent burns.

Charging

To charge a device, place it on the charging surface in the vehicle. There is a charging coil located in the center of the charging surface. The device has a charging coil typically near the center of the device. These coils must

be lined up in order for charging to proceed. When the interruptible retained accessory power (IRAP) relay is closed (this is true typically when vehicle ignition is in Run or Accessory position), the WCS will detect the device, establish communications with the device to confirm it is a compatible device, and then deliver charging power to the device via wireless interface. The WCS will be able to deliver up to 5W of power to compatible devices. It shall only enter a charging state if communication is established and a compatible device is identified.

The WCS shall not enter a charging state if there is no communication established with a compatible device. If a non-compatible device or metallic foreign object is detected, the WCS will not transfer power. The charger monitors its internal temperature and will shut down if the charger temperature exceeds 185F (85C).

Indicator

The body control module will detect the device battery is charging and send a serial data message on the GMLAN bus to the radio display. The radio display will indicate a device is currently charging. When the indicator is toggling on and off this indicates a thermal limit has been reached and the device will not charge. For more information refer to the infotainment owners manual.

POWER OUTLETS DESCRIPTION AND OPERATION

12 Volt Power Outlet Receptacle Description and Operation

The accessory power receptacles and cigarette lighter receptacle are supplied with 12 V when the vehicle is in Service Mode or in Vehicle ON Mode.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	--------------------------------

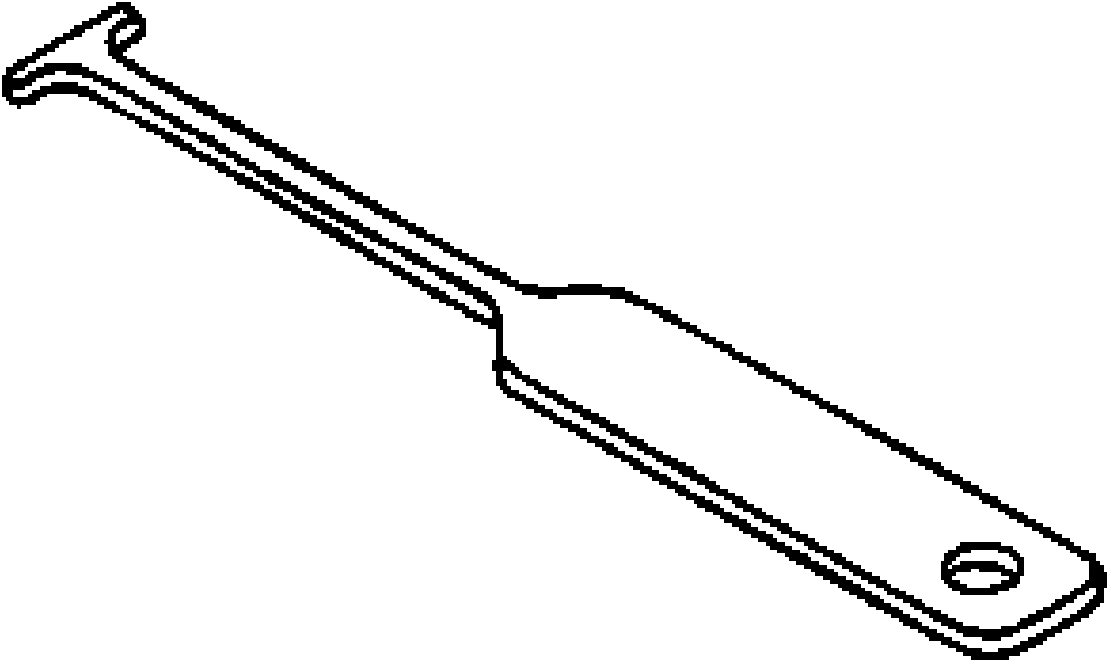
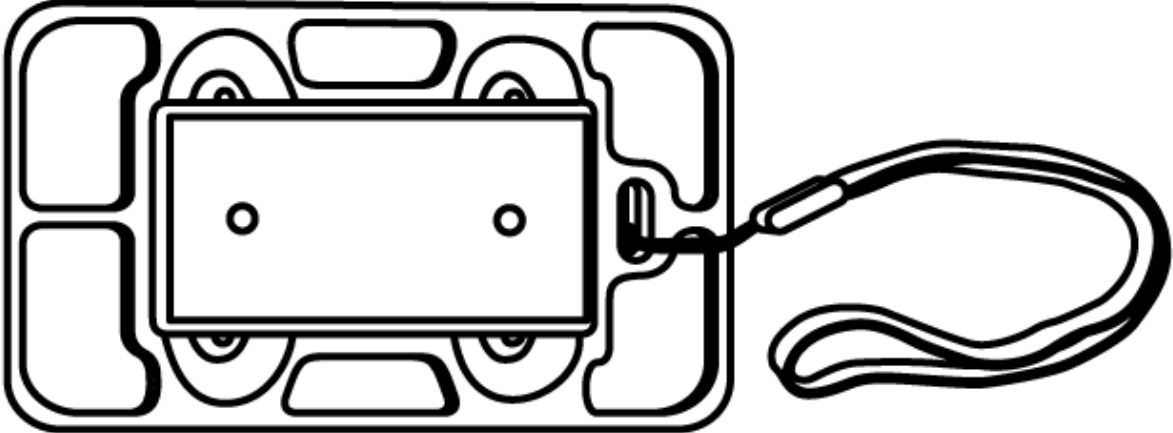
Illustration	Tool Number/ Description
	EL 42059 J 42059 Cigar Lighter Socket Remover

Illustration	Tool Number/ Description
	EL 51755 Inductive Charging Test Tool

Article GUID: A00884646

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Powertrain Component Views - Volt

POWERTRAIN COMPONENT VIEWS

RIGHT FRONT OF ENGINE COMPONENTS (1 OF 2)

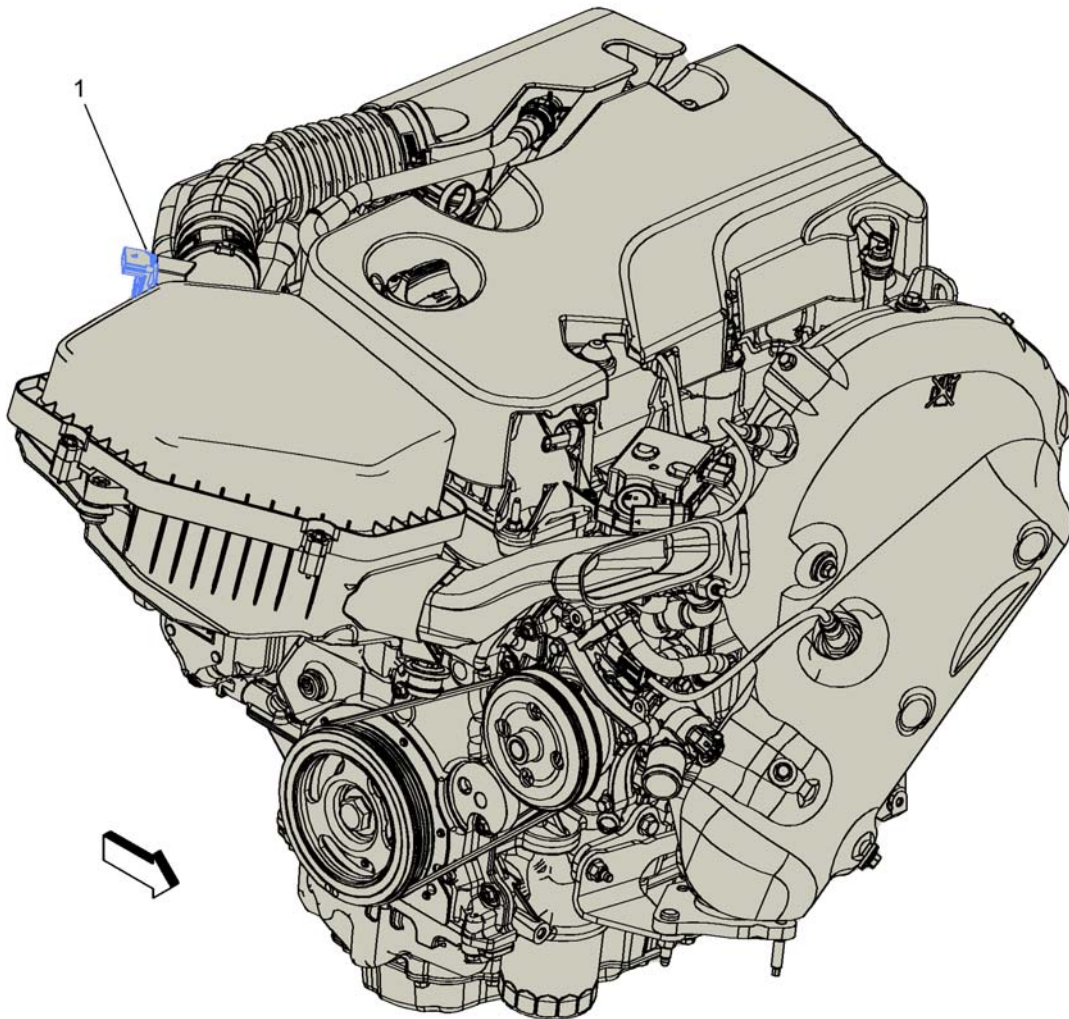


Fig. 1: Right Front of Engine Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B75C Multifunction Intake Air Sensor B75C Multifunction Intake Air Sensor

RIGHT FRONT OF ENGINE COMPONENTS (2 OF 2)

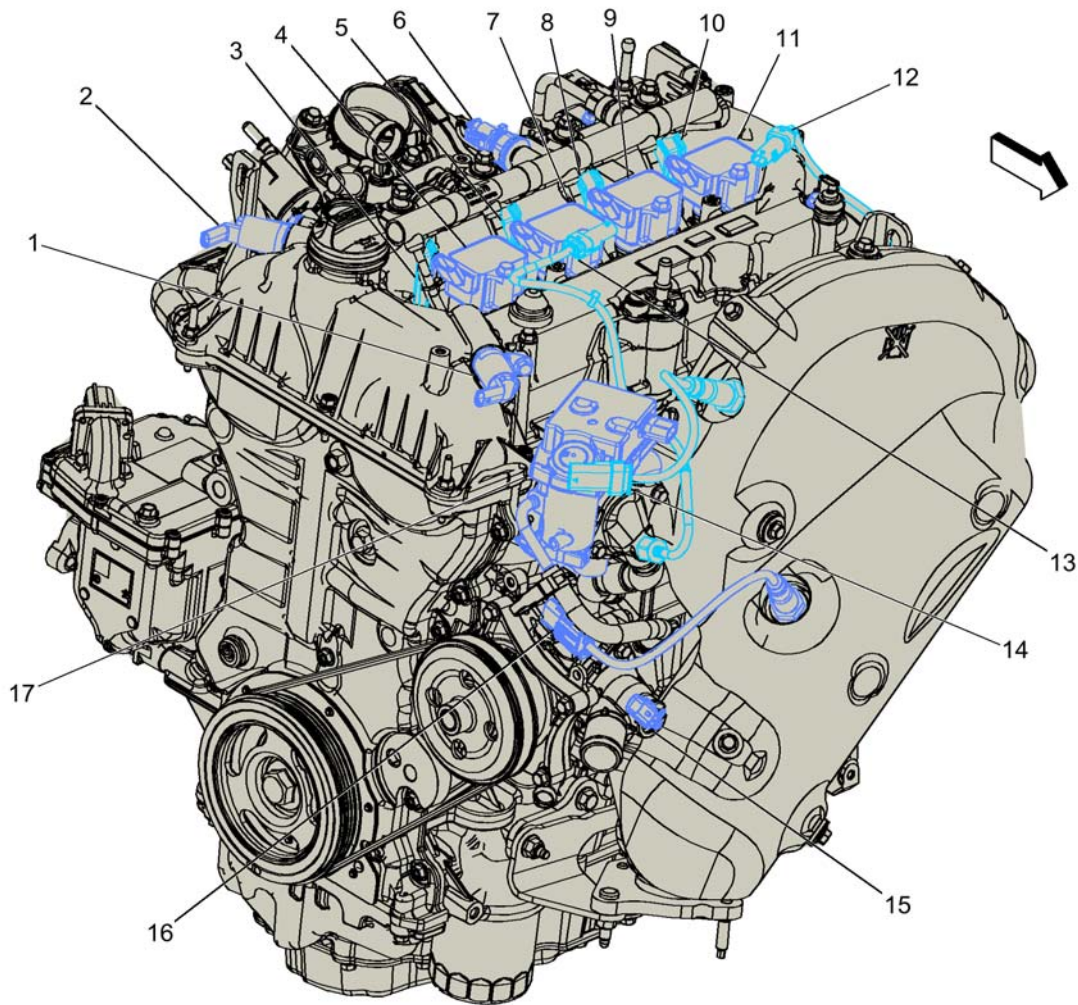


Fig. 2: Right Front of Engine Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. Q6E Camshaft Position Actuator Solenoid Valve - Exhaust <u>Q6E Camshaft Position Actuator Solenoid Valve - Exhaust</u>
2. Q6F Camshaft Position Actuator Solenoid Valve - Intake <u>Q6F Camshaft Position Actuator Solenoid Valve - Intake</u>
3. Q17A Fuel Injector 1 <u>Q17A Fuel Injector 1</u>
4. T8A Ignition Coil 1 <u>T8A Ignition Coil 1</u>
5. Q17B Fuel Injector 2 <u>Q17B Fuel Injector 2</u>
6. B310 Fuel Pressure/Temperature Sensor <u>B310 Fuel Pressure/Temperature Sensor</u>
7. T8B Ignition Coil 2 <u>T8B Ignition Coil 2</u>
8. Q17C Fuel Injector 3 <u>Q17C Fuel Injector 3</u>
9. T8C Ignition Coil 3 <u>T8C Ignition Coil 3</u>
10. Q17D Fuel Injector 4 <u>Q17D Fuel Injector 4</u>
11. T8D Ignition Coil 4 <u>T8D Ignition Coil 4</u>

Items
12. B130B Exhaust Gas Recirculation Temperature Sensor 2 B130B Exhaust Gas Recirculation Temperature Sensor 2
13. B130A Exhaust Gas Recirculation Temperature Sensor 1 B130A Exhaust Gas Recirculation Temperature Sensor 1
14. B52A Heated Oxygen Sensor 1 B52A Heated Oxygen Sensor 1
15. E41 Engine Coolant Thermostat Heater E41 Engine Coolant Thermostat Heater
16. B52B Heated Oxygen Sensor 2 B52B Heated Oxygen Sensor 2
17. Q14 Exhaust Gas Recirculation Valve Q14 Exhaust Gas Recirculation Valve

LEFT FRONT OF ENGINE COMPONENTS

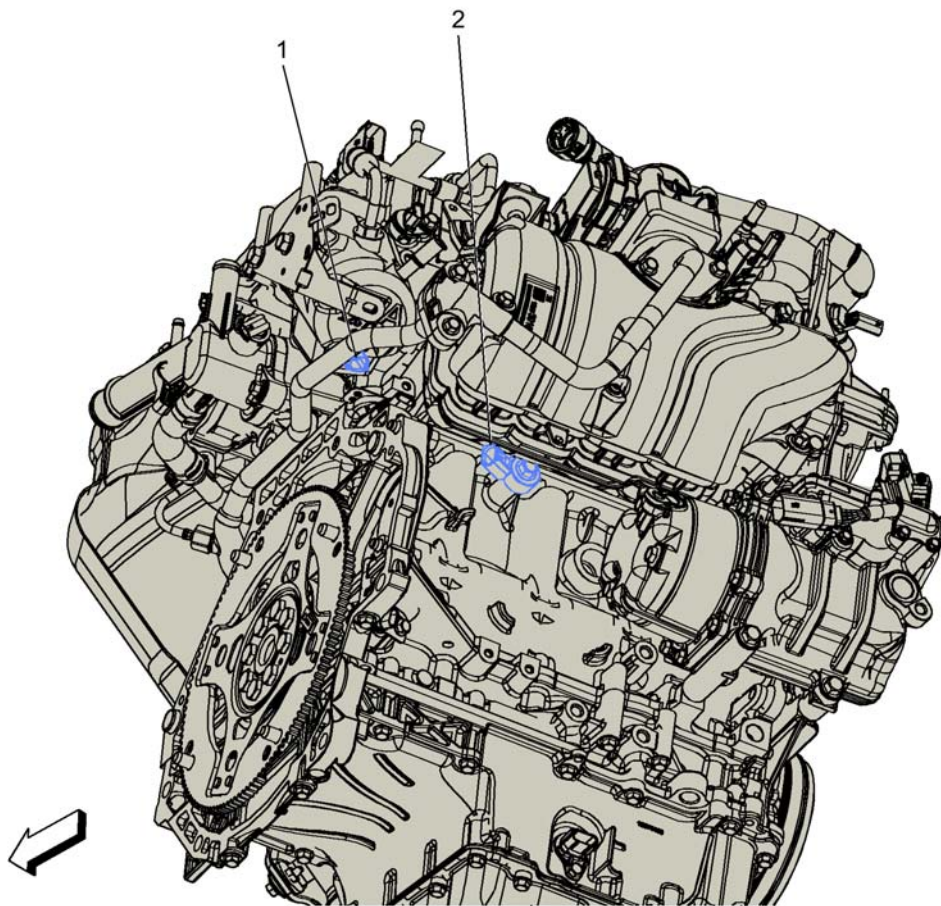


Fig. 3: Left Front of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. G18 High Pressure Fuel Pump G18 High Pressure Fuel Pump
2. B68 Knock Sensor B68 Knock Sensor

RIGHT REAR OF ENGINE COMPONENTS

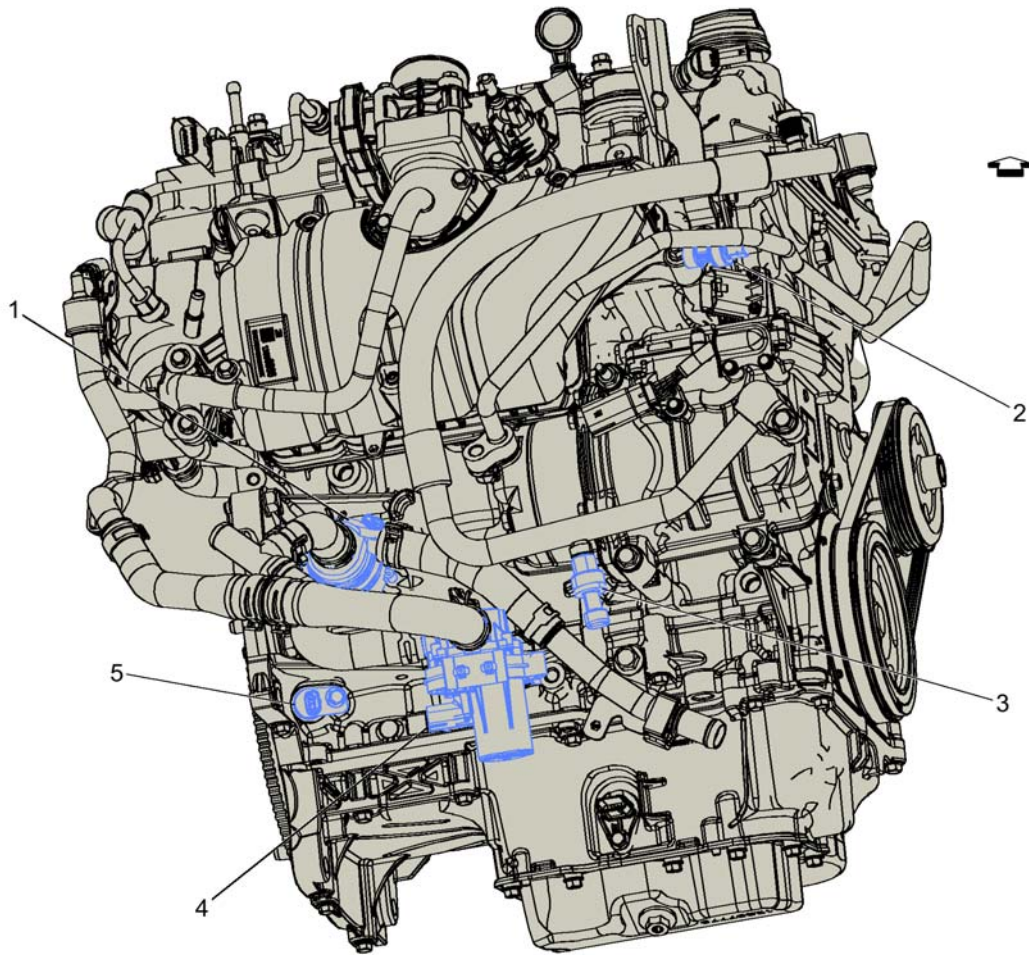


Fig. 4: Right Rear of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. G36 Auxiliary Heater Coolant Pump <u>G36 Auxiliary Heater Coolant Pump</u>
2. B1 A/C Refrigerant Pressure Sensor <u>B1 A/C Refrigerant Pressure Sensor</u>
3. B1C A/C Low Side Pressure Sensor <u>B1C A/C Low Side Pressure Sensor</u>
4. Q66 Passenger Compartment Heater Coolant Control Valve <u>Q66 Passenger Compartment Heater Coolant Control Valve</u>
5. B26 Crankshaft Position Sensor <u>B26 Crankshaft Position Sensor</u>

LEFT REAR OF ENGINE COMPONENTS

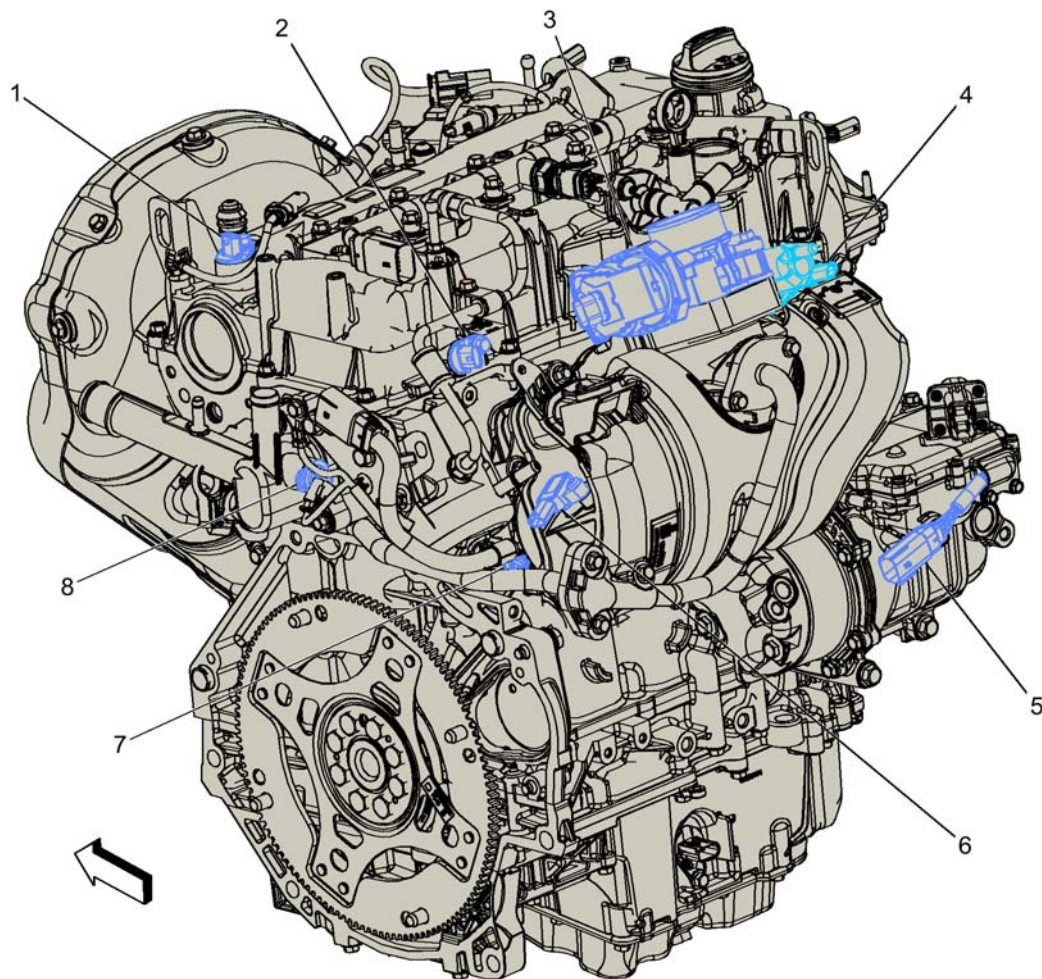


Fig. 5: Left Rear of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. B23E Camshaft Position Sensor - Exhaust <u>B23E Camshaft Position Sensor - Exhaust</u>
2. B23F Camshaft Position Sensor - Intake <u>B23F Camshaft Position Sensor - Intake</u>
3. Q38 Throttle Body <u>Q38 Throttle Body</u>
4. Q12 Evaporative Emission Purge Solenoid Valve <u>Q12 Evaporative Emission Purge Solenoid Valve</u>
5. G1 A/C Compressor <u>G1 A/C Compressor X1</u> <u>G1 A/C Compressor X2</u>
6. B74 Manifold Absolute Pressure Sensor <u>B74 Manifold Absolute Pressure Sensor</u>
7. B37B Engine Oil Pressure Sensor <u>B37B Engine Oil Pressure Sensor</u>
8. B34 Engine Coolant Temperature Sensor <u>B34 Engine Coolant Temperature Sensor</u>

LEFT REAR OF ENGINE/TRANSMISSION COMPONENTS

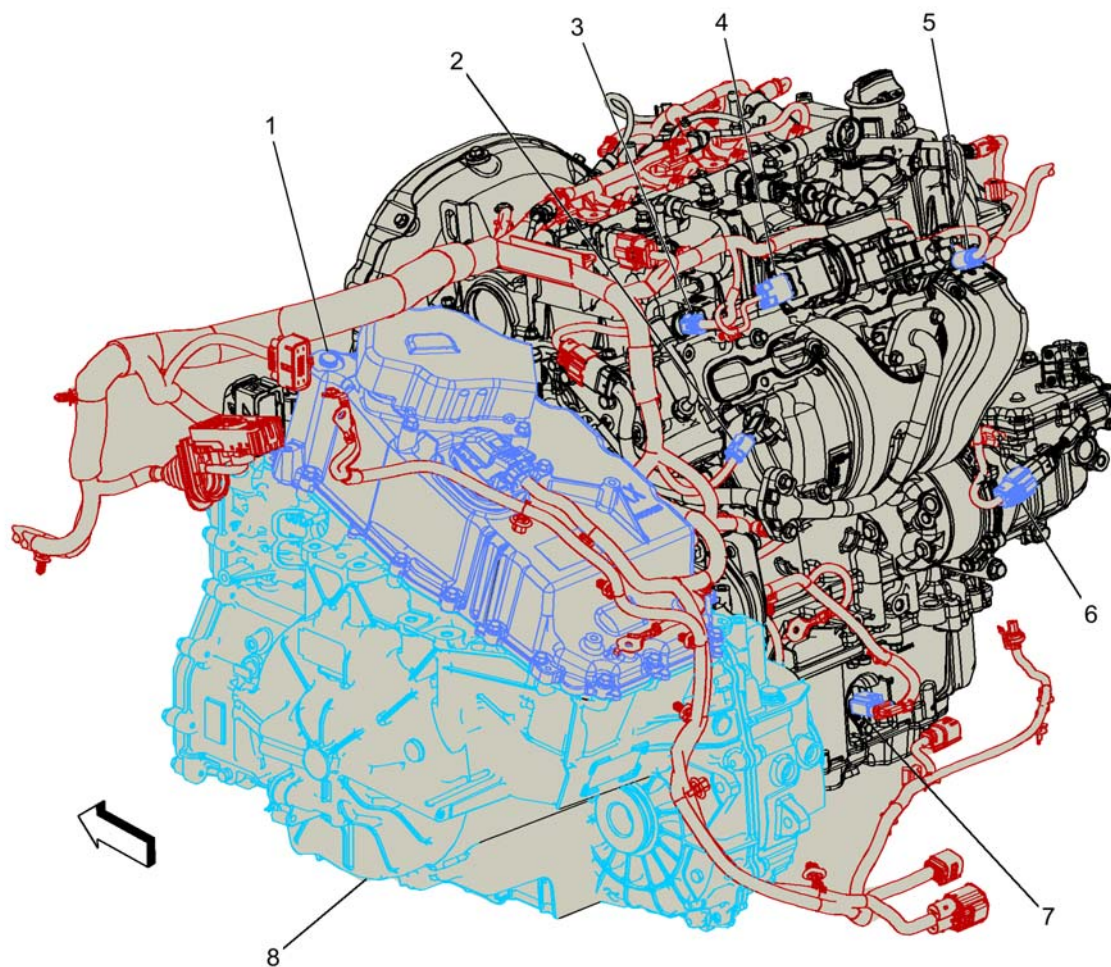


Fig. 6: Left Rear of Engine/Transmission Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. T6 Power Inverter Module <u>T6 Power Inverter Module X1</u> <u>T6 Power Inverter Module X2</u> <u>G5 Transmission Fluid Pump - Electric/Auxiliary</u> <u>T6 Power Inverter Module X4</u>
2. B74 Manifold Absolute Pressure Sensor <u>B74 Manifold Absolute Pressure Sensor</u>
3. B23F Camshaft Position Sensor - Intake <u>B23F Camshaft Position Sensor - Intake</u>
4. Q38 Throttle Body <u>Q38 Throttle Body</u>
5. Q12 Evaporative Emission Purge Solenoid Valve <u>Q12 Evaporative Emission Purge Solenoid Valve</u>
6. G1 A/C Compressor <u>G1 A/C Compressor X1</u> <u>G1 A/C Compressor X2</u>
7. Q44 Engine Oil Pressure Control Solenoid Valve <u>Q44 Engine Oil Pressure Control Solenoid Valve</u>
8. T12 Automatic Transmission Assembly

TRANSMISSION COMPONENTS

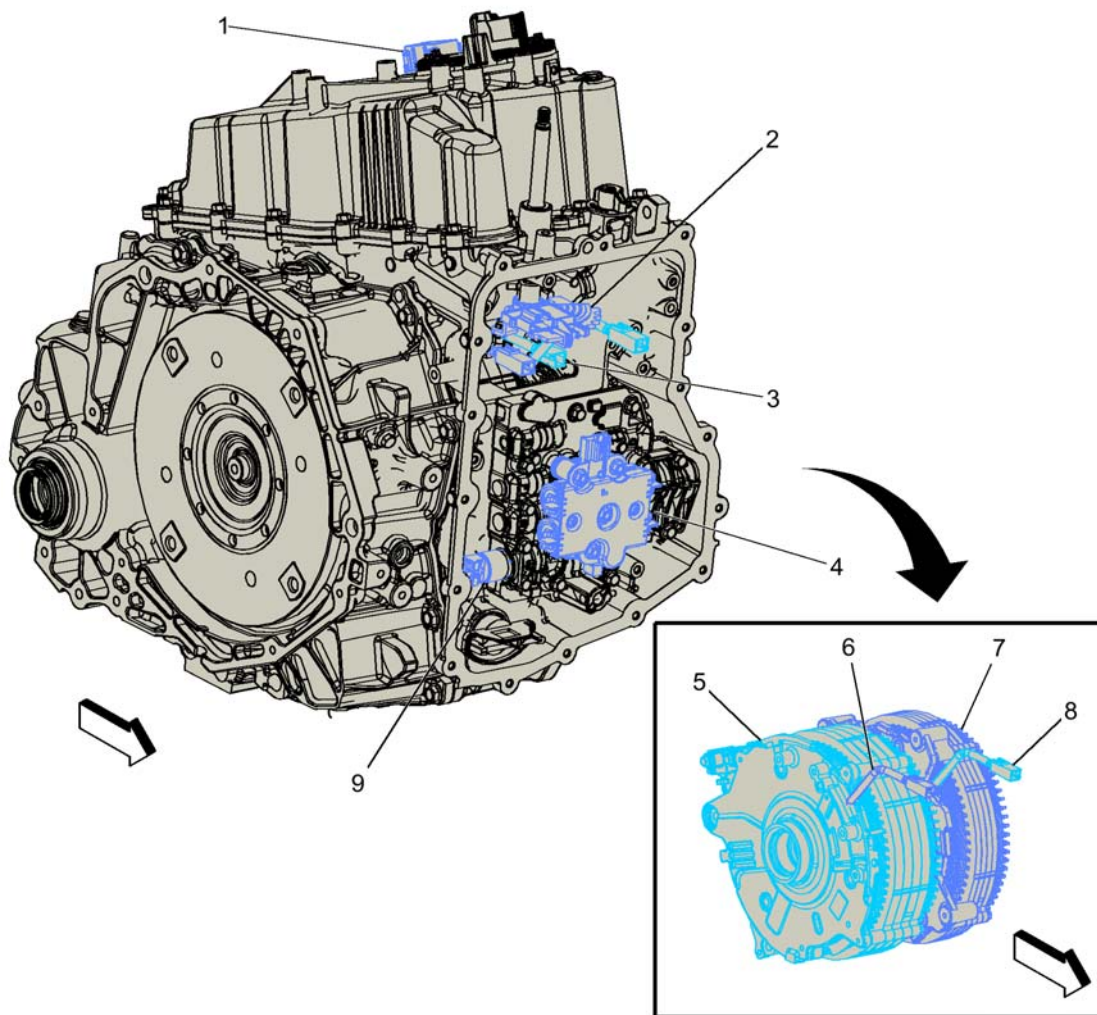


Fig. 7: Transmission Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. T6 Power Inverter Module T6 Power Inverter Module X1 T6 Power Inverter Module X2 G5 Transmission Fluid Pump - Electric/Auxiliary T6 Power Inverter Module X4
2. B15 Transmission Internal Mode Switch B15 Transmission Internal Mode Switch
3. B14A Transmission Output Shaft Speed Sensor B14A Transmission Output Shaft Speed Sensor
4. Q8 Control Solenoid Valve Assembly Q8 Control Solenoid Valve Assembly
5. M15B Drive Motor 2
6. B228B Drive Motor 2 Position Sensor B228B Drive Motor 2 Position Sensor
7. M15A Drive Motor 1
8. B228A Drive Motor 1 Position Sensor B228A Drive Motor 1 Position Sensor
9. Q23 Line Pressure Control Solenoid Valve Q23 Line Pressure Control Solenoid Valve

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Wheels/Vehicle Underbody Component Views - Volt

WHEELS/VEHICLE UNDERBODY COMPONENT VIEWS

UNDERBODY - HYBRID/EV BATTERY PACK INTERNALS

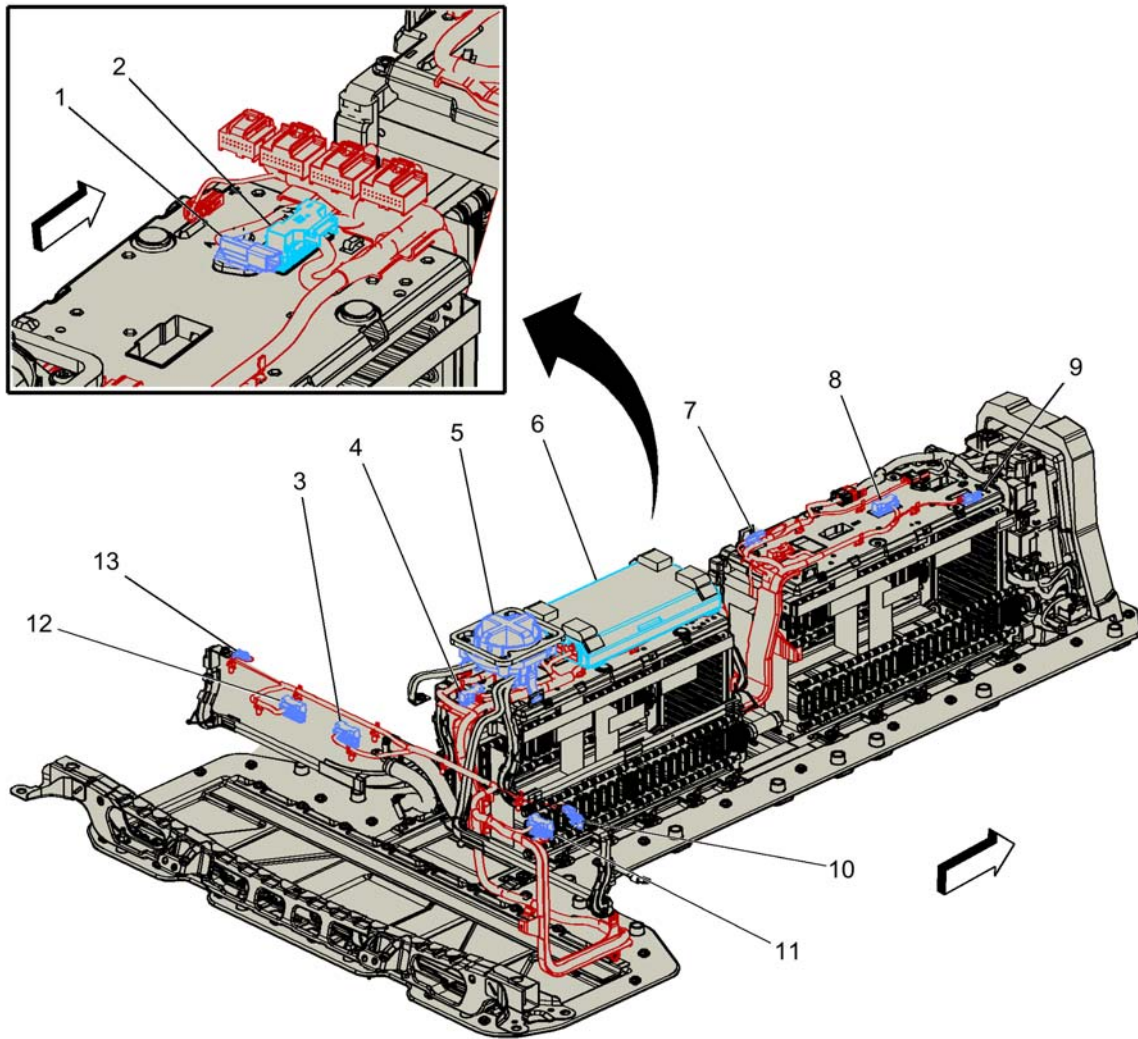


Fig. 1: Underbody - Hybrid/EV Battery Pack Internals

Courtesy of GENERAL MOTORS COMPANY

Items
1. B32D Hybrid/EV Battery Temperature Sensor 4 B32D Hybrid/EV Battery Temperature Sensor 4
2. C5E Hybrid/EV Battery Module 5 C5E Hybrid/EV Battery Module 5
3. C5B Hybrid/EV Battery Module 2 C5B Hybrid/EV Battery Module 2
4. B32C Hybrid/EV Battery Temperature Sensor 3 B32C Hybrid/EV Battery Temperature Sensor 3
5. S15 Manual Service Disconnect

Items
6. K16 Battery Energy Control Module <u>K16 Battery Energy Control Module X1</u> <u>K16 Battery Energy Control Module X2</u> <u>K16 Battery Energy Control Module X3</u> <u>K16 Battery Energy Control Module X4</u> <u>K16 Battery Energy Control Module X5</u> <u>K16 Battery Energy Control Module X6</u> <u>K16 Battery Energy Control Module X7</u> <u>K16 Battery Energy Control Module X8</u>
7. B32E Hybrid/EV Battery Temperature Sensor 5 <u>B32E Hybrid/EV Battery Temperature Sensor 5</u>
8. C5F Hybrid/EV Battery Module 6 <u>C5F Hybrid/EV Battery Module 6</u>
9. B32F Hybrid/EV Battery Temperature Sensor 6 <u>B32F Hybrid/EV Battery Temperature Sensor 6</u>
10. C5C Hybrid/EV Battery Module 3 <u>C5C Hybrid/EV Battery Module 3</u>
11. B32B Hybrid/EV Battery Temperature Sensor 2 <u>B32B Hybrid/EV Battery Temperature Sensor 2</u>
12. C5A Hybrid/EV Battery Module 1 <u>C5A Hybrid/EV Battery Module 1</u>
13. B32A Hybrid/EV Battery Temperature Sensor 1 <u>B32A Hybrid/EV Battery Temperature Sensor 1</u>

UNDERBODY - HYBRID/EV BATTERY PACK CONTACTOR ASSEMBLY COMPONENTS

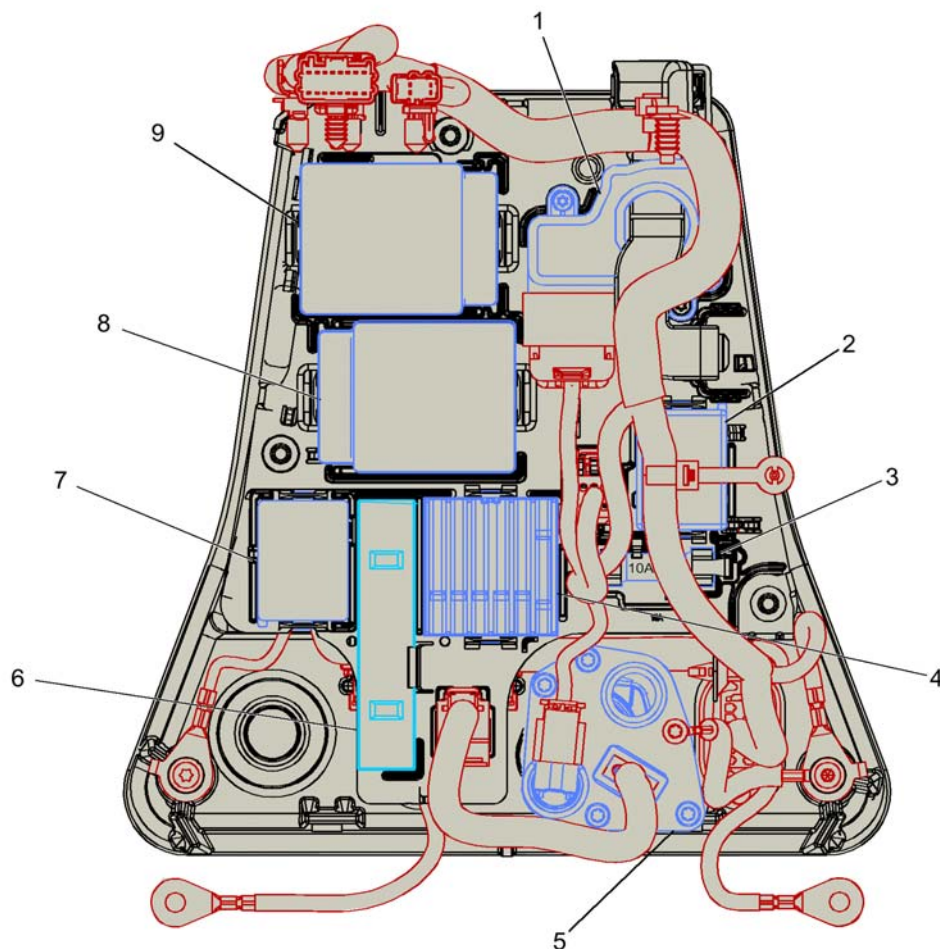


Fig. 2: Underbody - Hybrid/EV Battery Pack Contactor Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

Items
1. B30 Hybrid/EV Battery Pack Current Sensor B30 Hybrid/EV Battery Pack Current Sensor ()
2. KR116B Battery Charging System Positive Contactor
3. X55QB Fuse Holder 2 - Hybrid/EV Battery Pack
4. T21 Hybrid/EV Battery Coolant Heater Transistor
5. E54 Hybrid/EV Battery Pack Coolant Heater
6. R25 Hybrid/EV Battery Pre-Charge Resistor
7. KR134 Pre-Charge Contactor
8. KR34A Drive Motor Battery Negative High Voltage Contactor Relay
9. KR34B Drive Motor Battery Positive High Voltage Contactor Relay

UNDERBODY - FUEL SYSTEM COMPONENTS (1 OF 2)

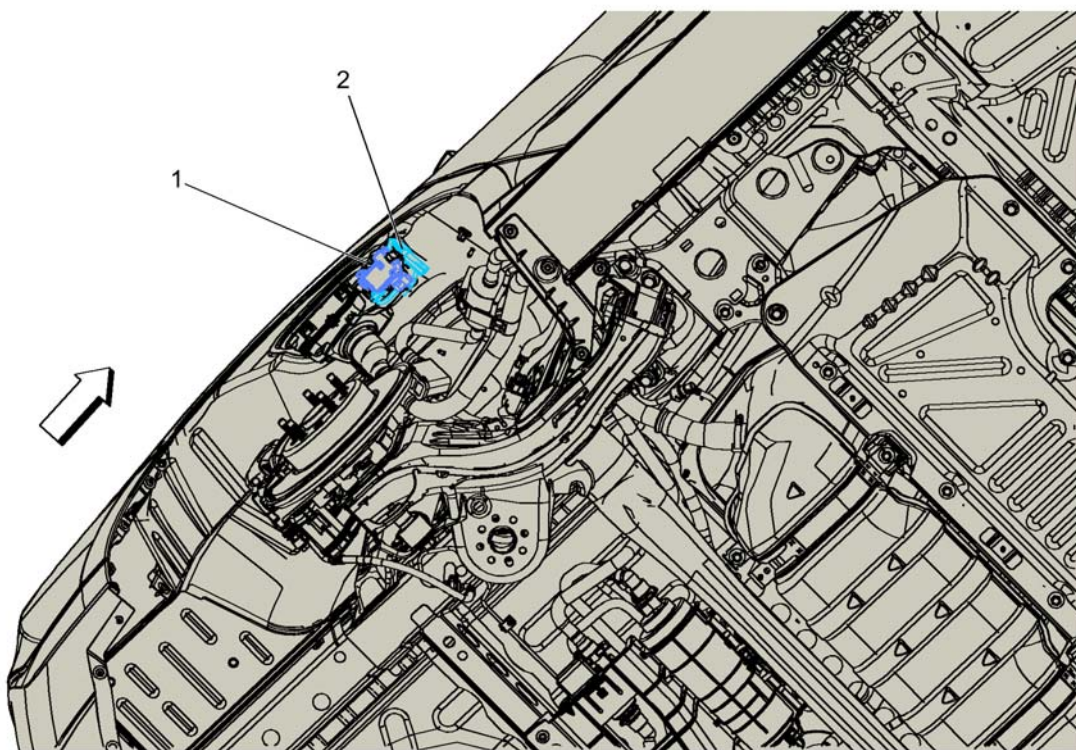


Fig. 3: Underbody - Fuel System Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. M97 Fuel Fill Door Lock Actuator M97 Fuel Fill Door Lock Actuator
2. B208 Fuel Fill Door Status Switch Assembly B208 Fuel Fill Door Status Switch Assembly

UNDERBODY - FUEL SYSTEM COMPONENTS (2 OF 2)

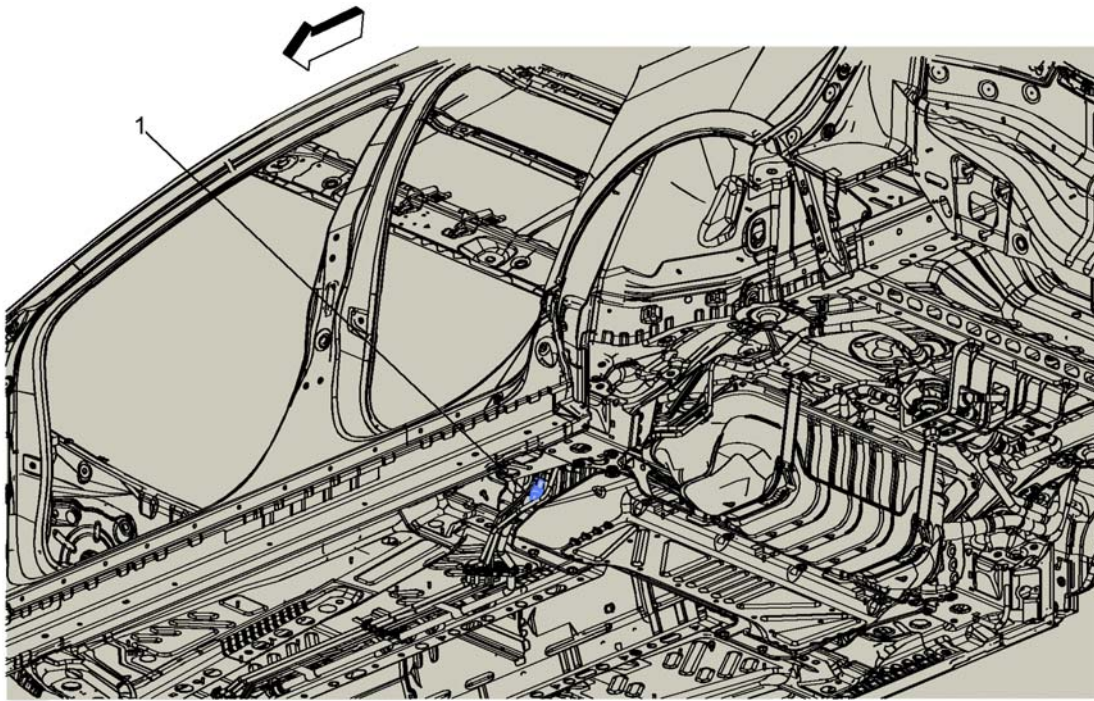


Fig. 4: Underbody - Fuel System Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B47 Fuel Pressure Sensor <u>B47 Fuel Pressure Sensor</u>

UNDERBODY - STEERING COMPONENTS

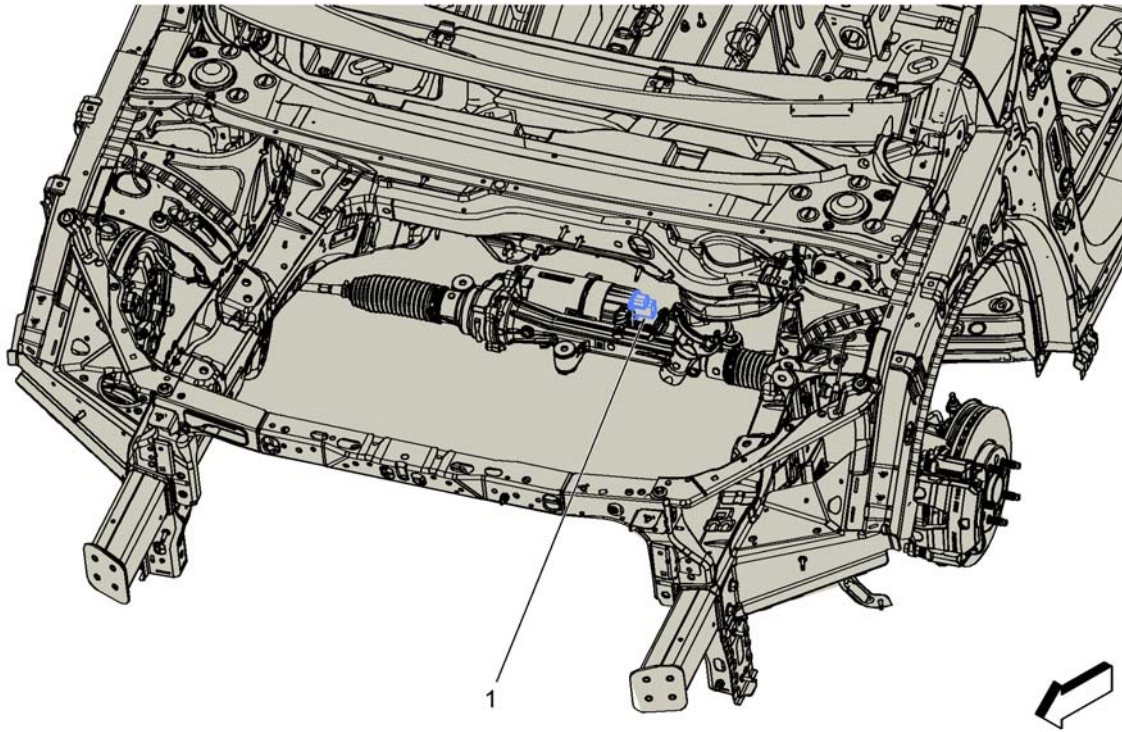


Fig. 5: Underbody - Steering Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. K43 Power Steering Control Module K43 Power Steering Control Module X1 K43 Power Steering Control Module X2

UNDERBODY - WHEEL COMPONENTS (1 OF 4)

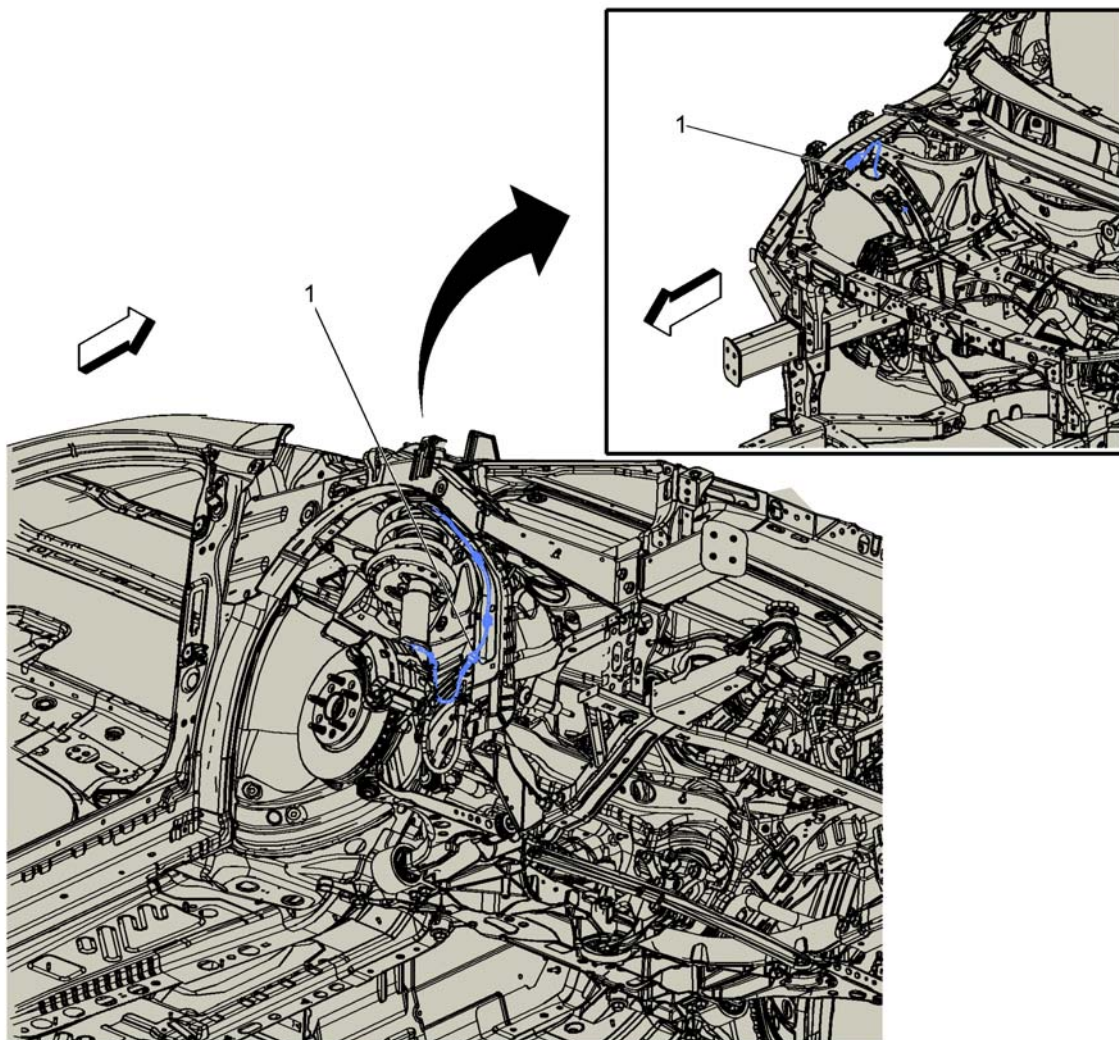


Fig. 6: Underbody - Wheel Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5RF Wheel Speed Sensor - Right Front <u>B5RF Wheel Speed Sensor - Right Front</u>

UNDERBODY - WHEEL COMPONENTS (2 OF 4)

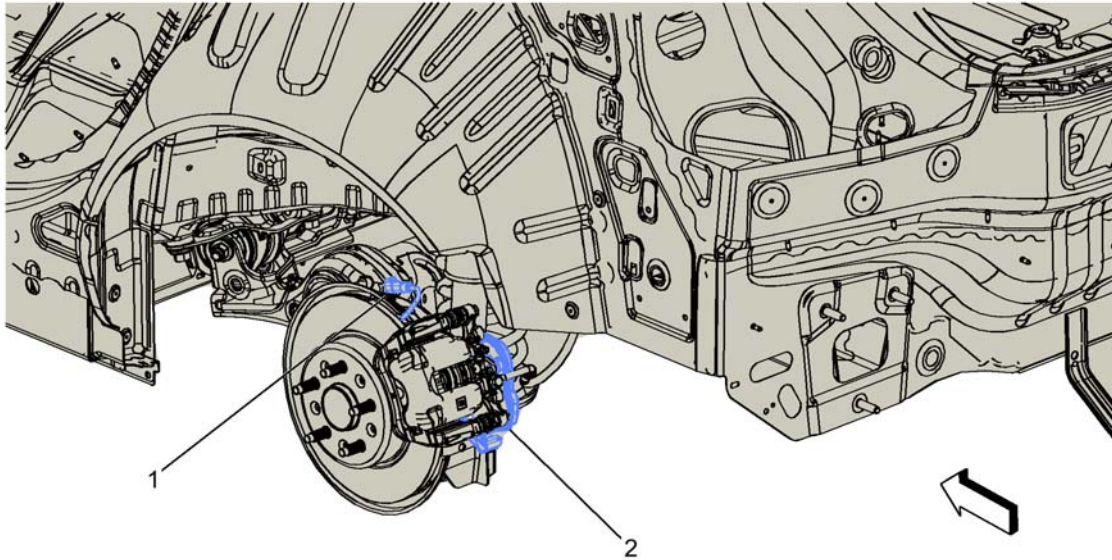


Fig. 7: Underbody - Wheel Components (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5LR Wheel Speed Sensor - Left Rear B5LR Wheel Speed Sensor - Left Rear
2. M104L Park Brake Actuator - Left M104L Park Brake Actuator - Left

UNDERBODY - WHEEL COMPONENTS (3 OF 4)

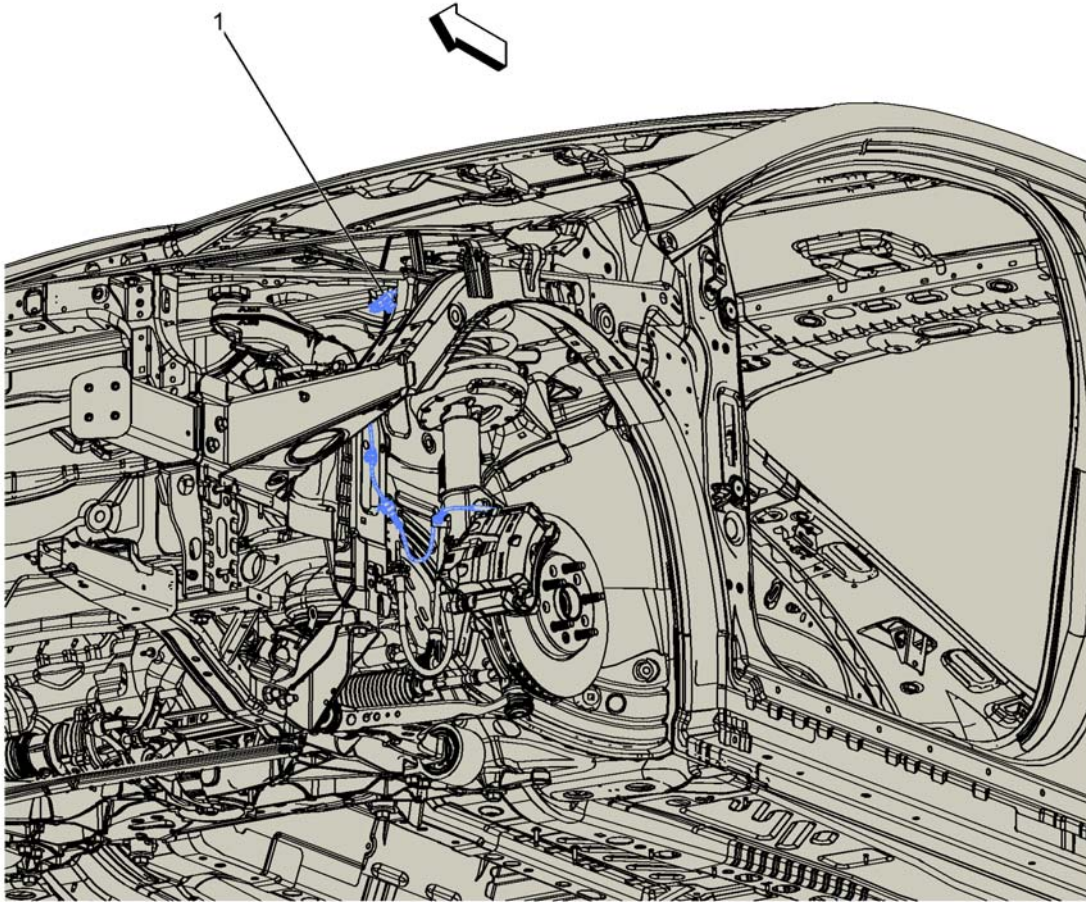


Fig. 8: Underbody - Wheel Components (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5LF Wheel Speed Sensor - Left Front <u>B5LF Wheel Speed Sensor - Left Front</u>

UNDERBODY - WHEEL COMPONENTS (4 OF 4)

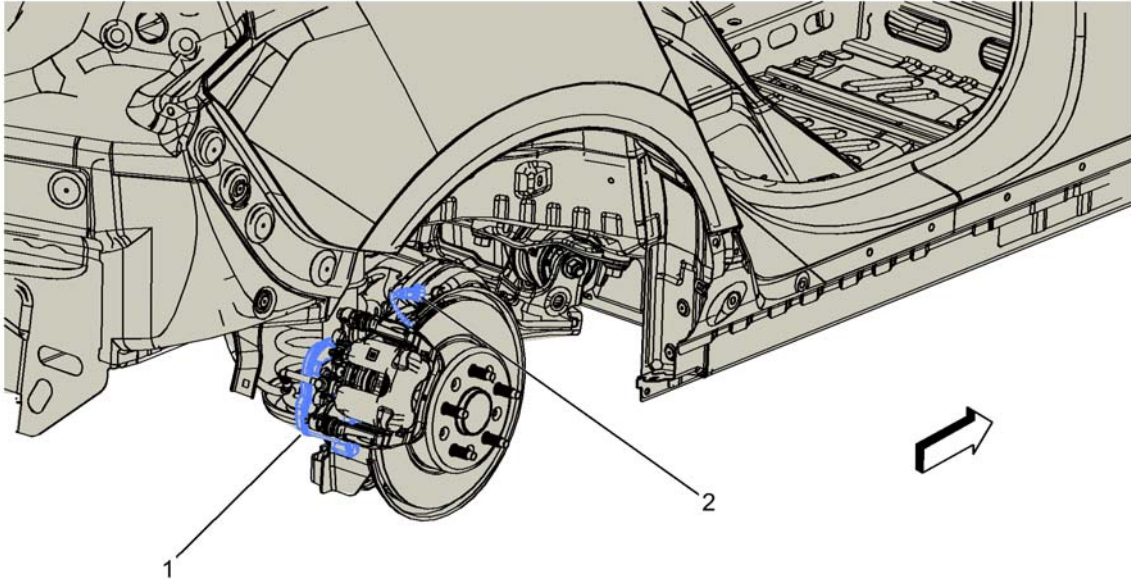


Fig. 9: Underbody - Wheel Components (4 of 4)
Courtesy of GENERAL MOTORS COMPANY

Items
1. M104R Park Brake Actuator - Right M104R Park Brake Actuator - Right
2. B5RR Wheel Speed Sensor - Right Rear B5RR Wheel Speed Sensor - Right Rear

Article GUID: A00884715

ELECTRICAL

Wiring Systems And Power Management - Component Connector End Views - Miscellaneous - Volt

COMPONENT CONNECTOR END VIEWS - MISCELLANEOUS

E4LR TURN SIGNAL LAMP - LEFT REAR

-
Connector Part Information
• Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	YE/BN	618	Left Rear Turn Signal Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E4RR TURN SIGNAL LAMP - RIGHT REAR

-
Connector Part Information
• Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	GN/VT	619	Right Rear Turn Signal Lamp Control	I	-
B	0.8	BK	850	Ground	I	-

E5A BACKUP LAMP - LEFT

-
Connector Part Information • Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.8	GN/WH	1324	Backup Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E5B BACKUP LAMP - RIGHT

-
Connector Part Information • Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
A	0.8	GN/WH	1324	Backup Lamp Control	I	-
B	0.8	BK	850	Ground	I	-

E5L STOP LAMP - LEFT

-
Connector Part Information • Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	GY/YE	7542	Left Rear Stop Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E5R STOP LAMP - RIGHT

-
Connector Part Information • Harness Type: TAIL LAMP • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

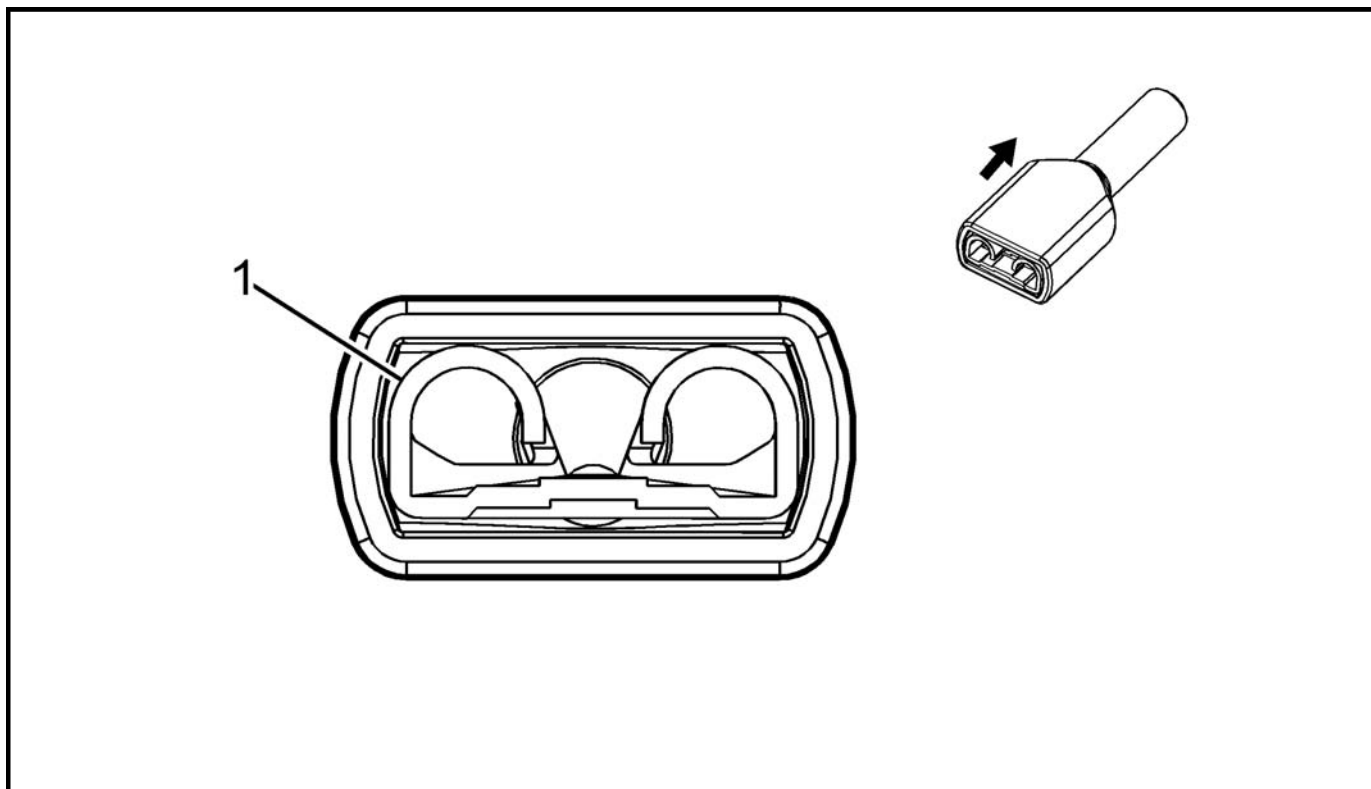
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/YE	7541	Right Rear Stop Lamp Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
B	0.8	BK	850	Ground	I	-

E17D OUTSIDE REARVIEW MIRROR GLASS - DRIVER X1



Connector Part Information

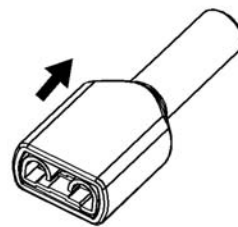
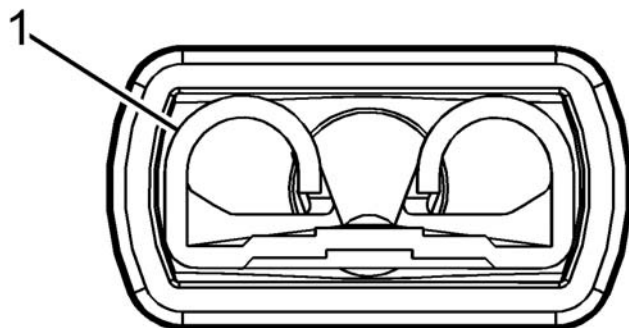
- Harness Type: OSRVM
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/GY	2267	Mirror Heating Element Control	I	-

E17D OUTSIDE REARVIEW MIRROR GLASS - DRIVER X2



Connector Part Information

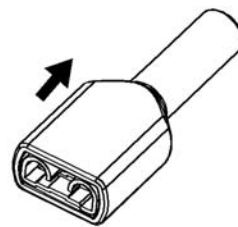
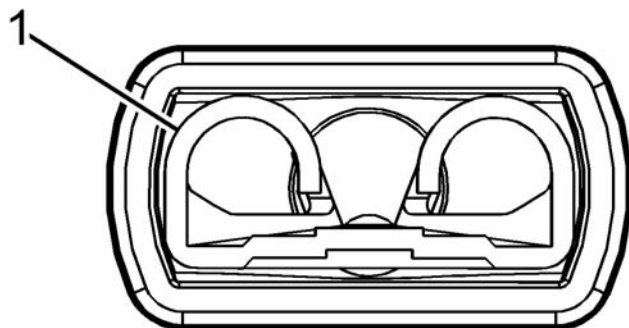
- Harness Type: OSRVM
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1550	Ground	I	-

E17P OUTSIDE REARVIEW MIRROR GLASS - PASSENGER X1



Connector Part Information

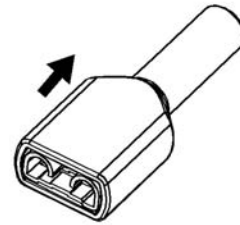
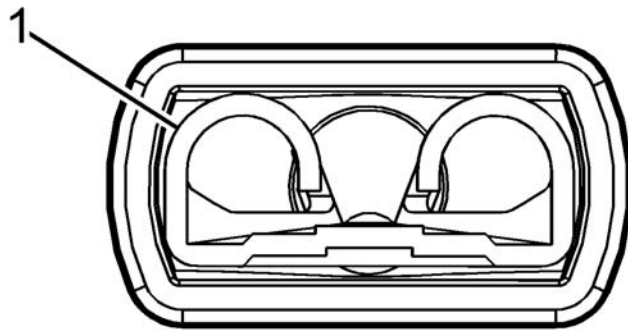
- Harness Type: OSRVM
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/GY	2267	Mirror Heating Element Control	I	-

E17P OUTSIDE REARVIEW MIRROR GLASS - PASSENGER X2



Connector Part Information

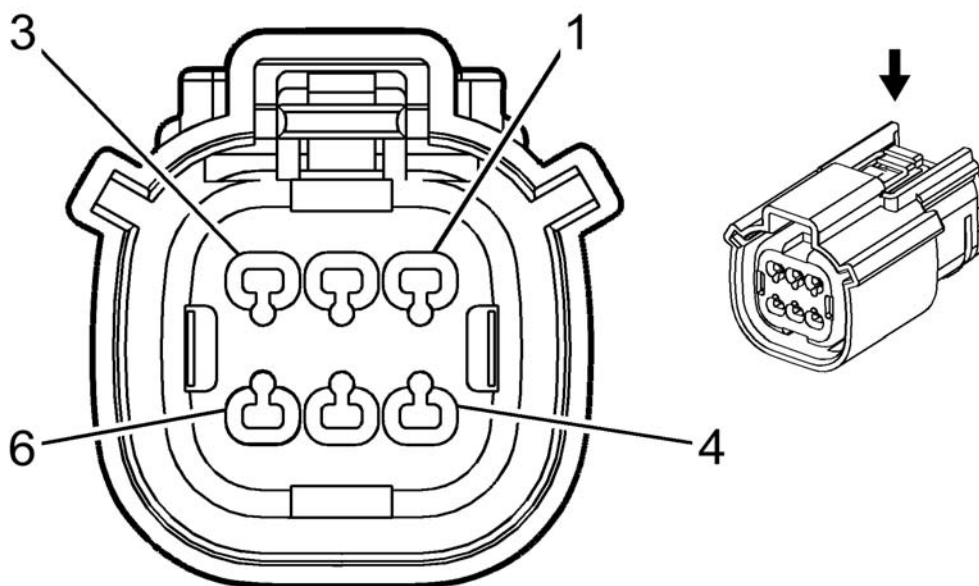
- Harness Type: OSRVM
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	2050	Ground	I	-

E42L TAIL LAMP ASSEMBLY - LEFT



Connector Part Information

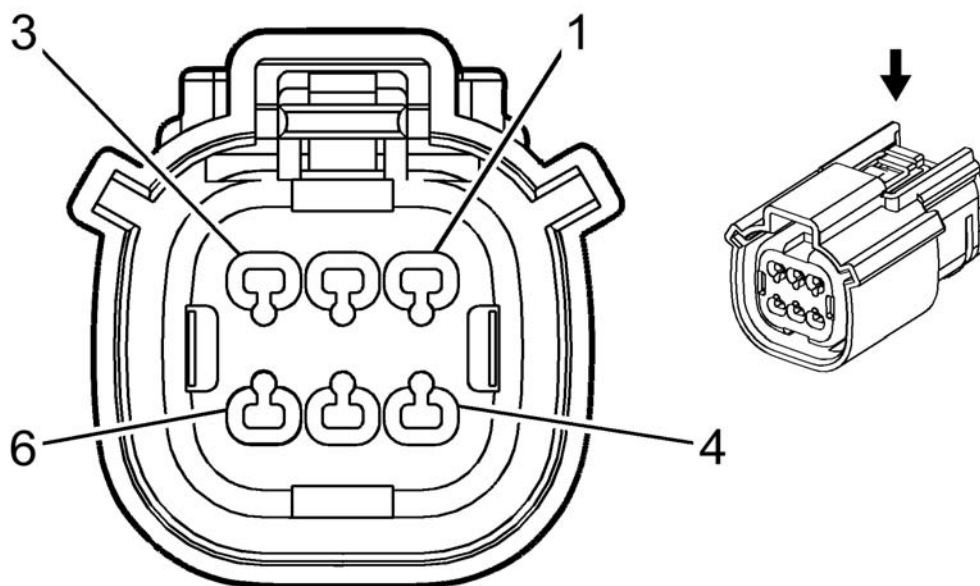
- Harness Type: Body
- OEM Connector: 33472-0606
- Service Connector: 13578533
- Description: 6-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	650	Ground	I	-
2	0.5	WH/YE	1204	Left Park Lamp Control	I	-
3	0.5	GY/YE	7542	Left Rear Stop Lamp Control	I	-
4	0.5	YE/BN	618	Left Rear Turn Signal Lamp Control	I	-
5	0.5	GN/WH	1324	Backup Lamp Control	I	-
6	0.5	BK	650	Ground	I	-

E42R TAIL LAMP ASSEMBLY - RIGHT



Connector Part Information

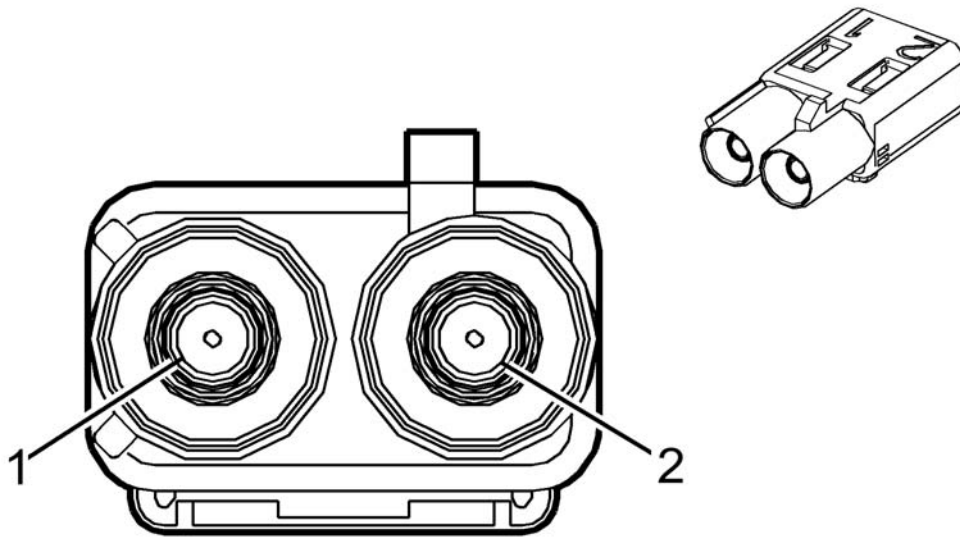
- Harness Type: Body
- OEM Connector: 33472-0606
- Service Connector: 13578533
- Description: 6-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	850	Ground	I	-
2	0.5	VT	1203	Right Park Lamp Control	I	-
3	0.5	WH/YE	7541	Right Rear Stop Lamp Control	I	-
4	0.5	GN/VT	619	Right Rear Turn Signal Lamp Control	I	-
5	0.5	GN/WH	1324	Backup Lamp Control	I	-
6	0.5	BK	850	Ground	I	-

T2RR ANTENNA - ROOF REAR X1



Connector Part Information

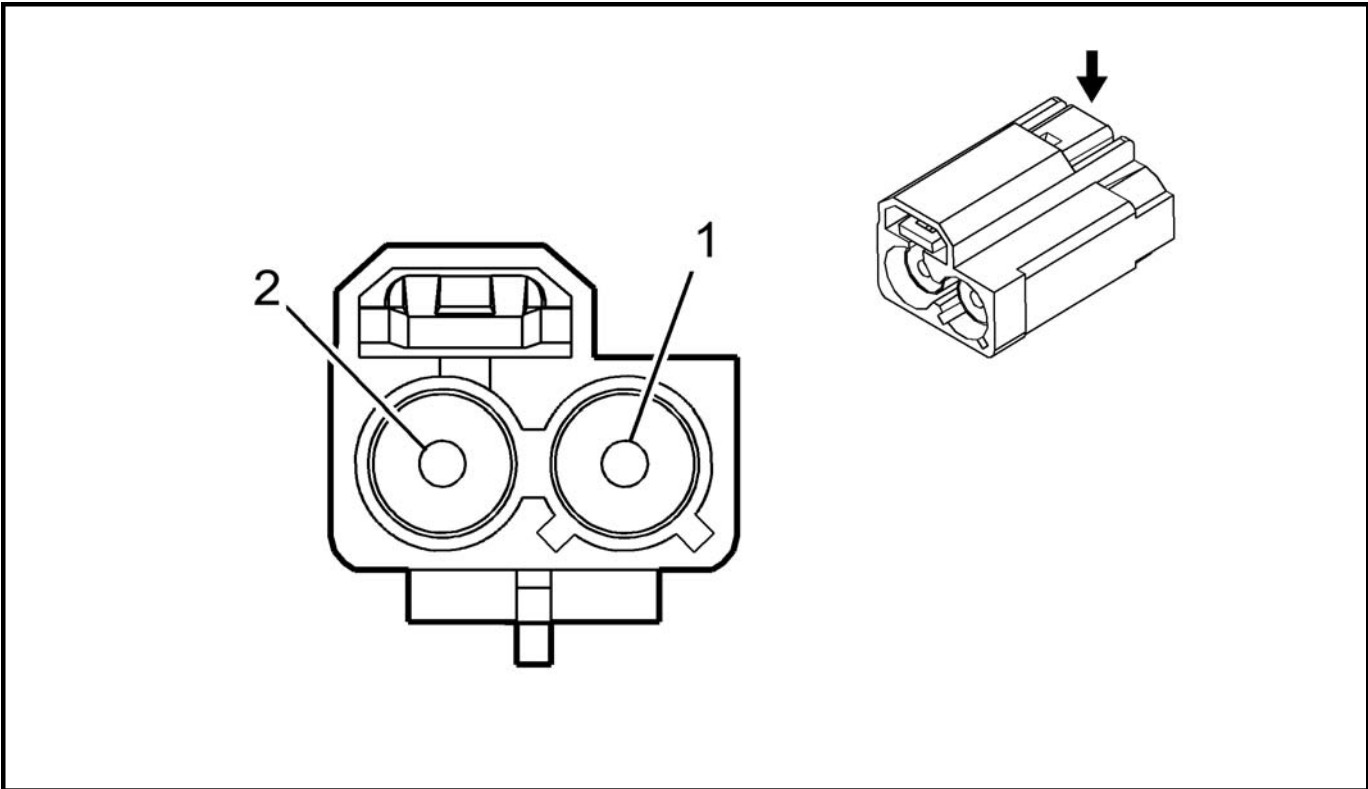
- Harness Type: Body COAX
- OEM Connector: CCEND
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: -

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS/Cell) Coaxial Antenna Cell/GPS combined Signal	I	-

T2RR ANTENNA - ROOF REAR X2



Connector Part Information

Terminal Part Information

• Harness Type: Body • OEM Connector: CCEND • Service Connector: Service by Cable Assembly • IDescription	• Terminated Lead	COAX Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
	No Tool Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

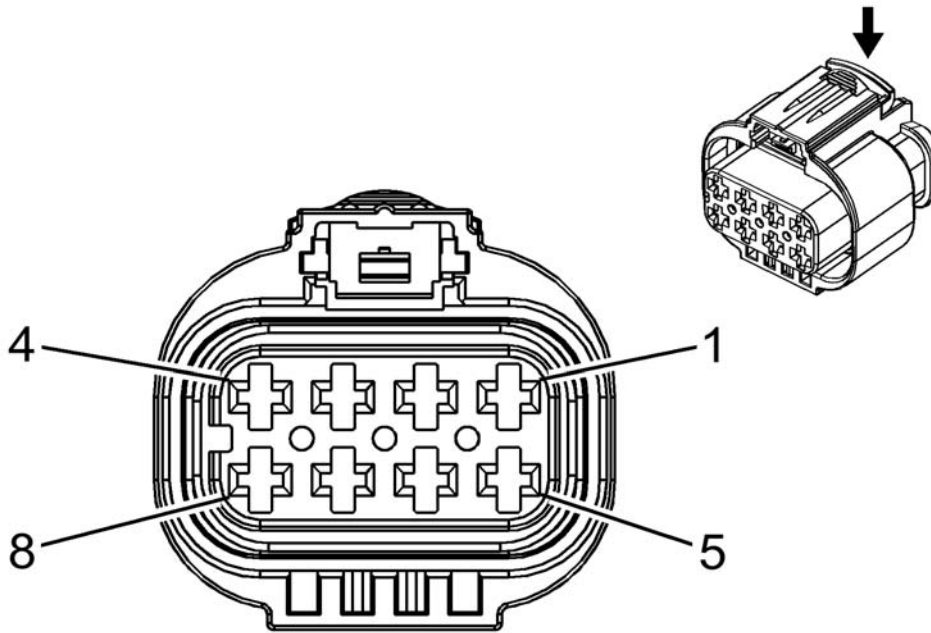
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(XM +/-HD) Coaxial Antenna XM Signal	I	-

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Volt

COMPONENT CONNECTOR END VIEWS

A7 FUEL PUMP AND LEVEL SENSOR ASSEMBLY



Connector Part Information

- Harness Type: Fuel Tank
- OEM Connector: 2109441-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 2.8 Series, Sealed (BK)

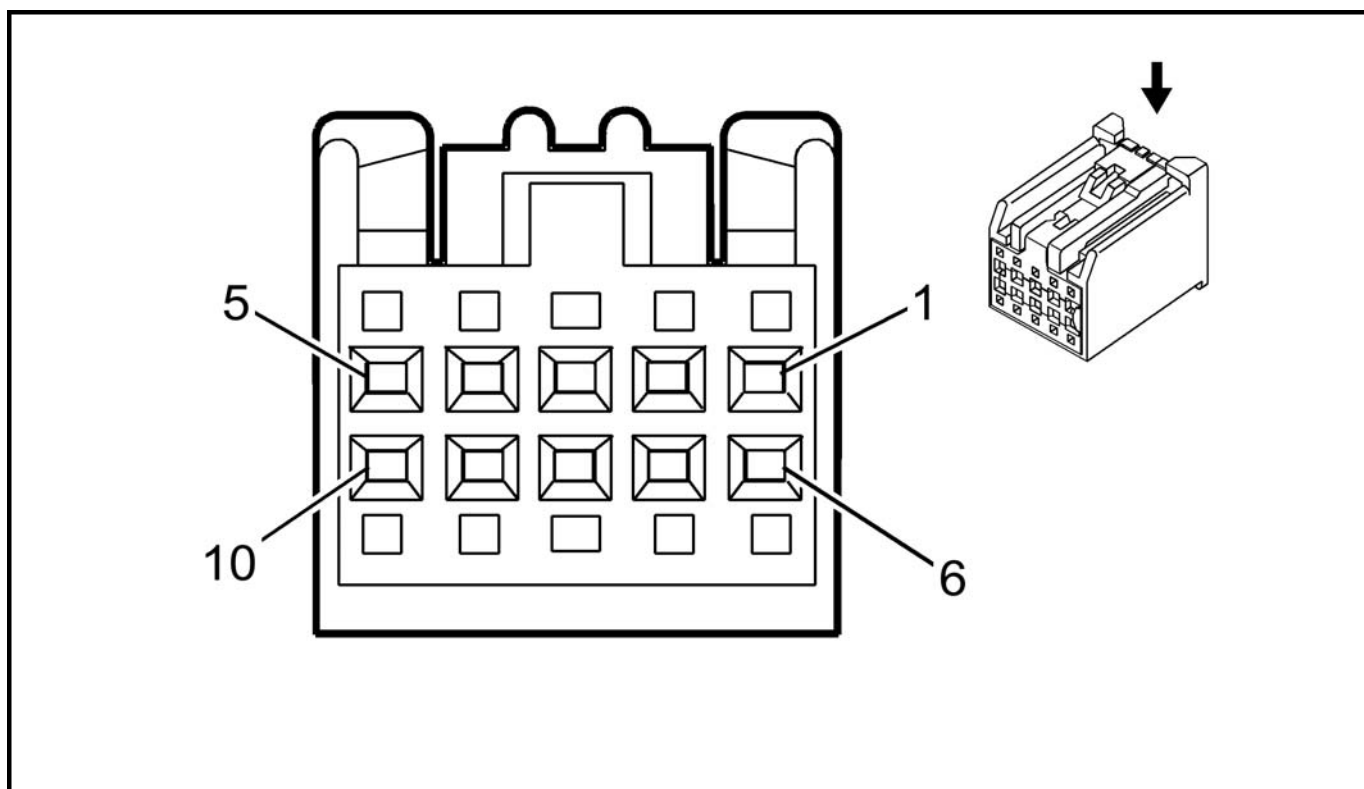
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	2	GY	120	Fuel Pump Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	2	BK/GN	1580	Fuel Pump Low Reference	I	-
5	0.5	BU/VT	1589	Primary Fuel Level Sensor Signal	I	-
6	0.5	BK/GN	6281	Fuel Level Sensor Low Reference	I	-
7 - 8	-	-	-	Not Occupied	-	-

A10 INSIDE REARVIEW MIRROR



Connector Part Information

- Harness Type: Body
- OEM Connector: 13577390
- Service Connector: 13577390
- Description: 10-Way F 0.64 Kaizen Series (BK)

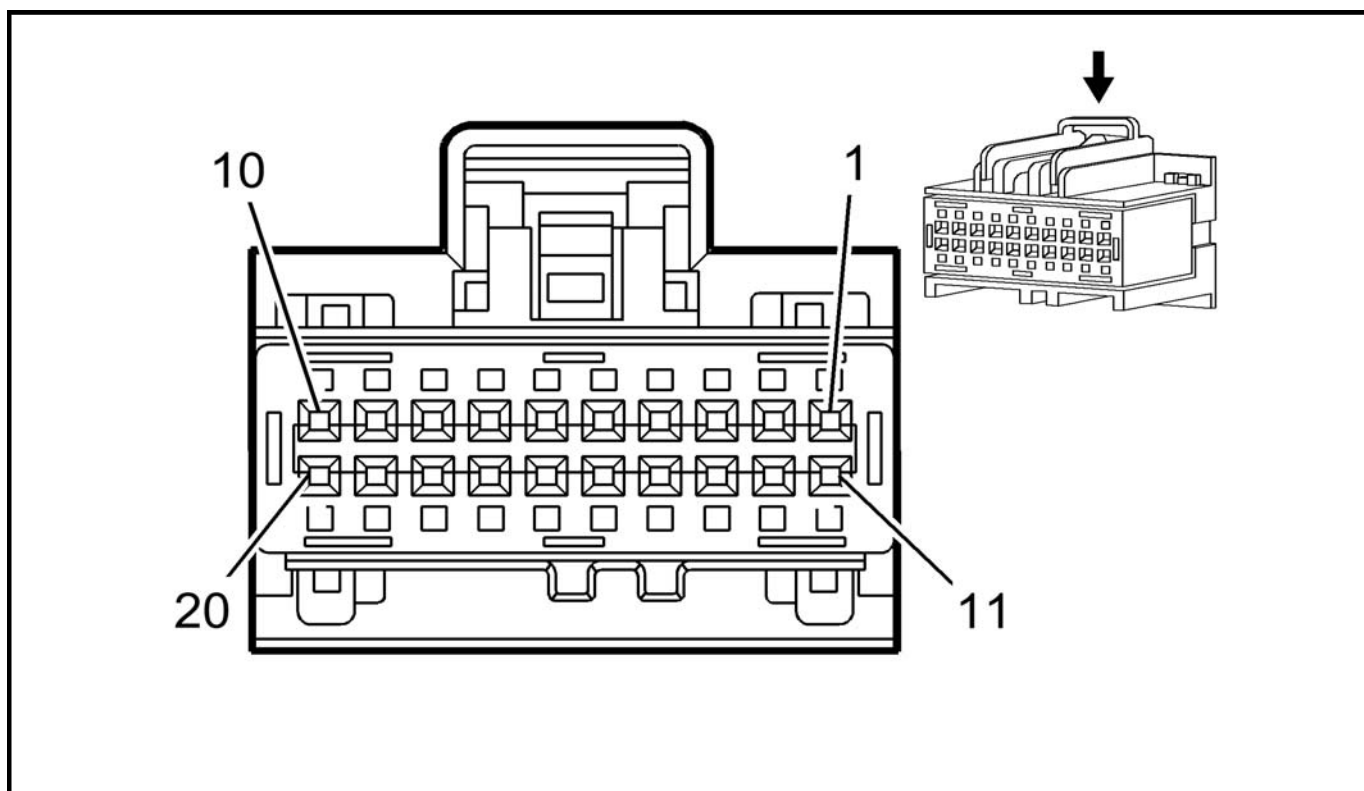
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/WH	1324	Backup Lamp Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	1550	Ground	I	-
6 - 10	-	-	-	Not Occupied	-	-

A11 RADIO X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1201
- Service Connector: 15126710
- Description: 20-Way F 64 Series, Sealed (GY)

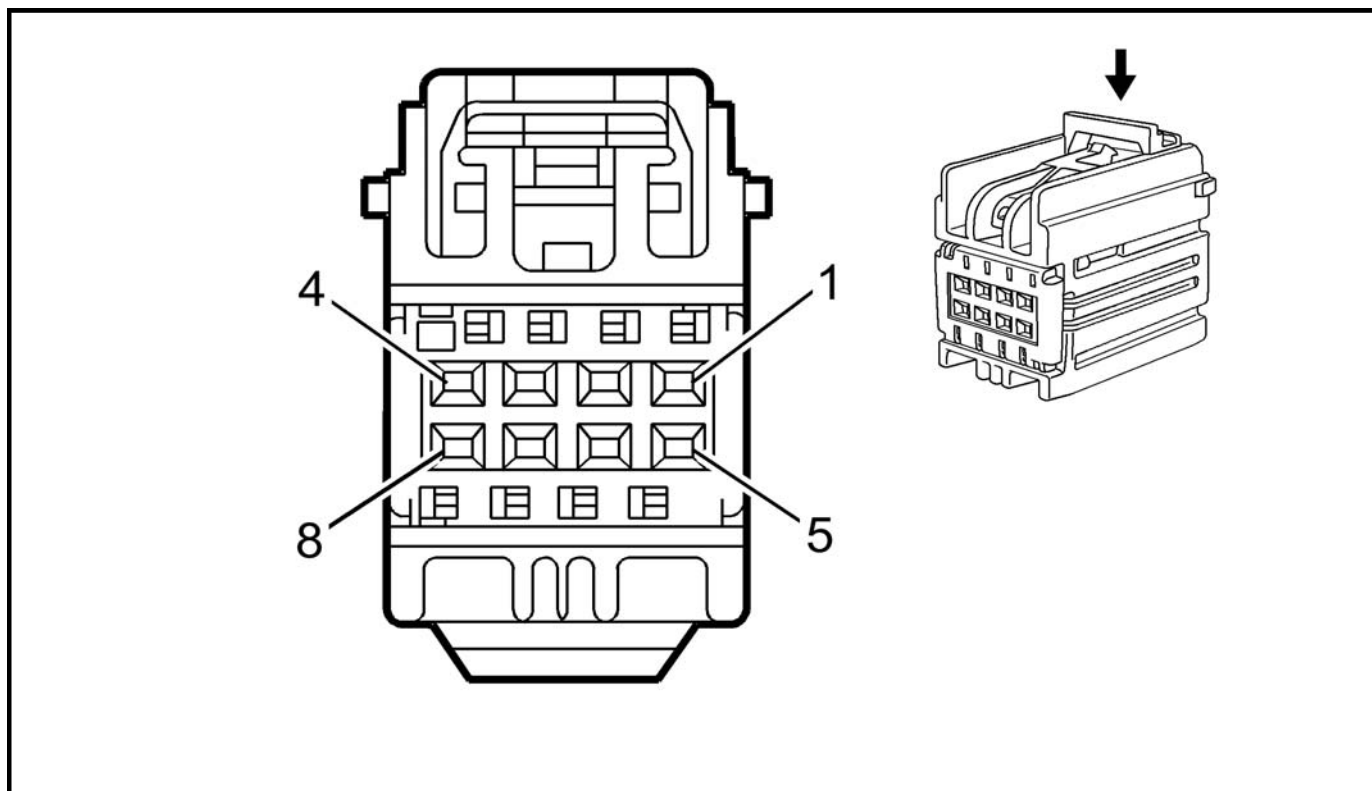
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	RD/VT	340	Battery Positive Voltage	I	-
2 - 10	-	-	-	Not Occupied	-	-
11	0.75	BK	1450	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	-	-	-	Not Occupied	-	-
13	0.35	GN/BU	7532	Local Interconnect Network Serial Data Bus 10	I	-
14	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
15 - 18	-	-	-	Not Occupied	-	-
19	0.35	BK/YE	659	Cellular Telephone Voice Low Reference	I	-
20	0.35	YE	658	Cellular Telephone Voice Signal	I	-

A11 RADIO X2



Connector Part Information

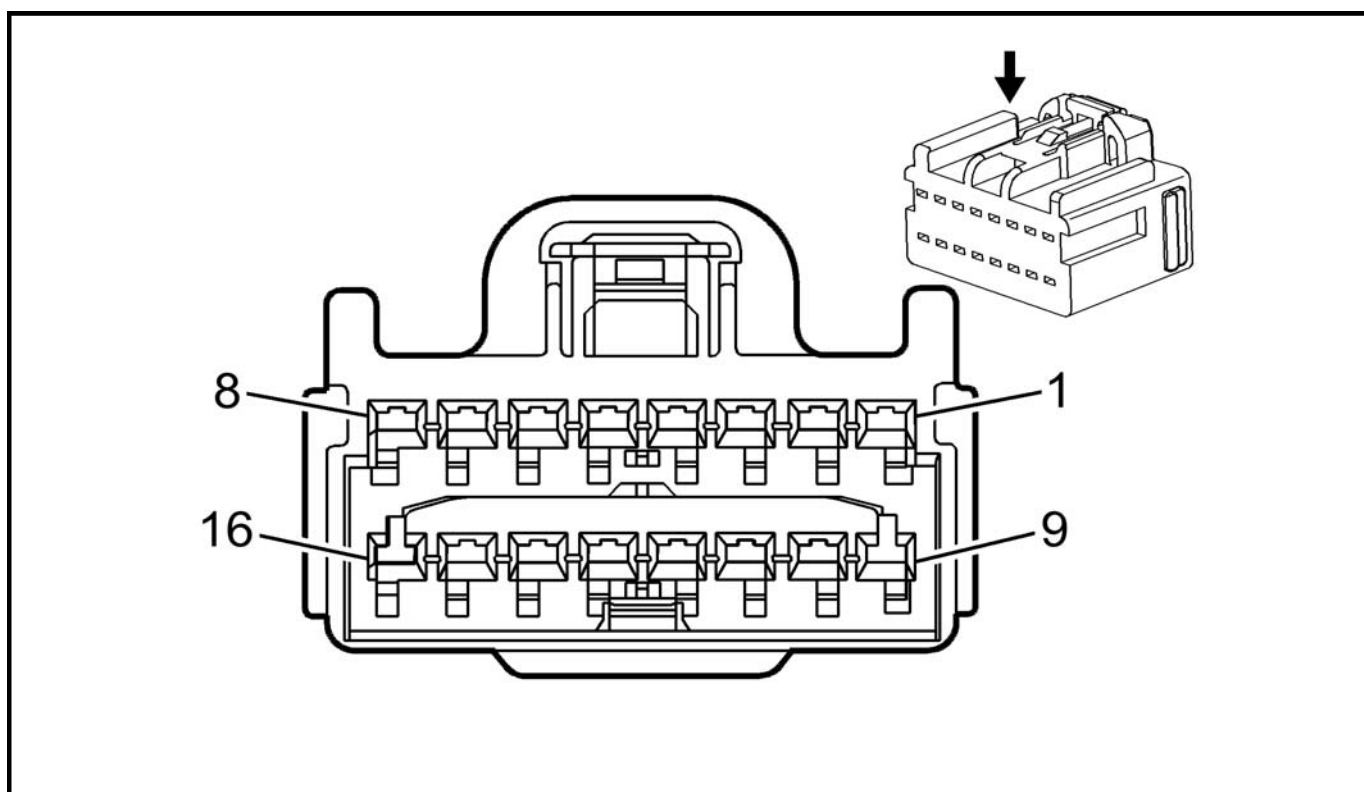
- Harness Type: Body
- OEM Connector: 7283-9029-40
- Service Connector: 19115653
- Description: 8-Way F YESC Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
2	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
3	0.5	WH/GN	3997	MOST Serial Data (-)	I	-
4	0.5	GY/VT	3998	MOST Serial Data (+)	I	-
5 - 6	-	-	-	Not Occupied	-	-
7	0.35	WH/VT	3999	MOST Control	I	-
8	-	-	-	Not Occupied	-	-

A11 RADIO X3 (UZ6)



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-6453-60
- Service Connector: 89047090
- Description: 16-Way F 1.5 Kaizen Series (GN)

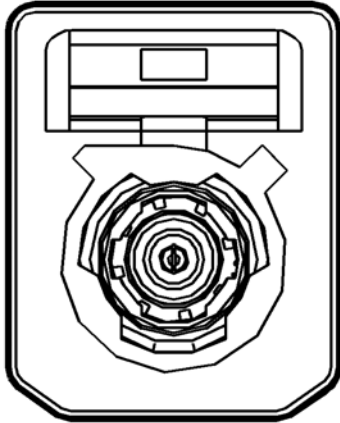
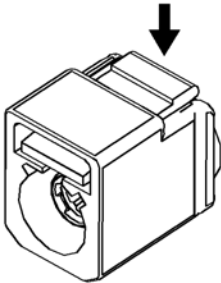
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575829	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-----	------	-------	---------	----------	------------------	--------

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU	201	Left Front Speaker Control (+) 1	I	-
2	1	YE	200	Right Front Speaker Control (+) 1	I	-
3	0.75	GN	199	Left Rear Speaker Control (+)	I	-
4	0.75	WH	46	Right Rear Speaker Control (+)	I	-
5 - 8	-	-	-	Not Occupied	-	-
9	0.75	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
10	1	BN/YE	117	Right Front Speaker Signal (-) 1	I	-
11	0.75	BN/GN	116	Left Rear Speaker Signal (-)	I	-
12	0.75	WH/BN	115	Right Rear Speaker Signal (-)	I	-
13 - 16	-	-	-	Not Occupied	-	-

A11 RADIO X4

Connector Part Information

- Harness Type: Body
- OEM Connector: 13591267
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BK)

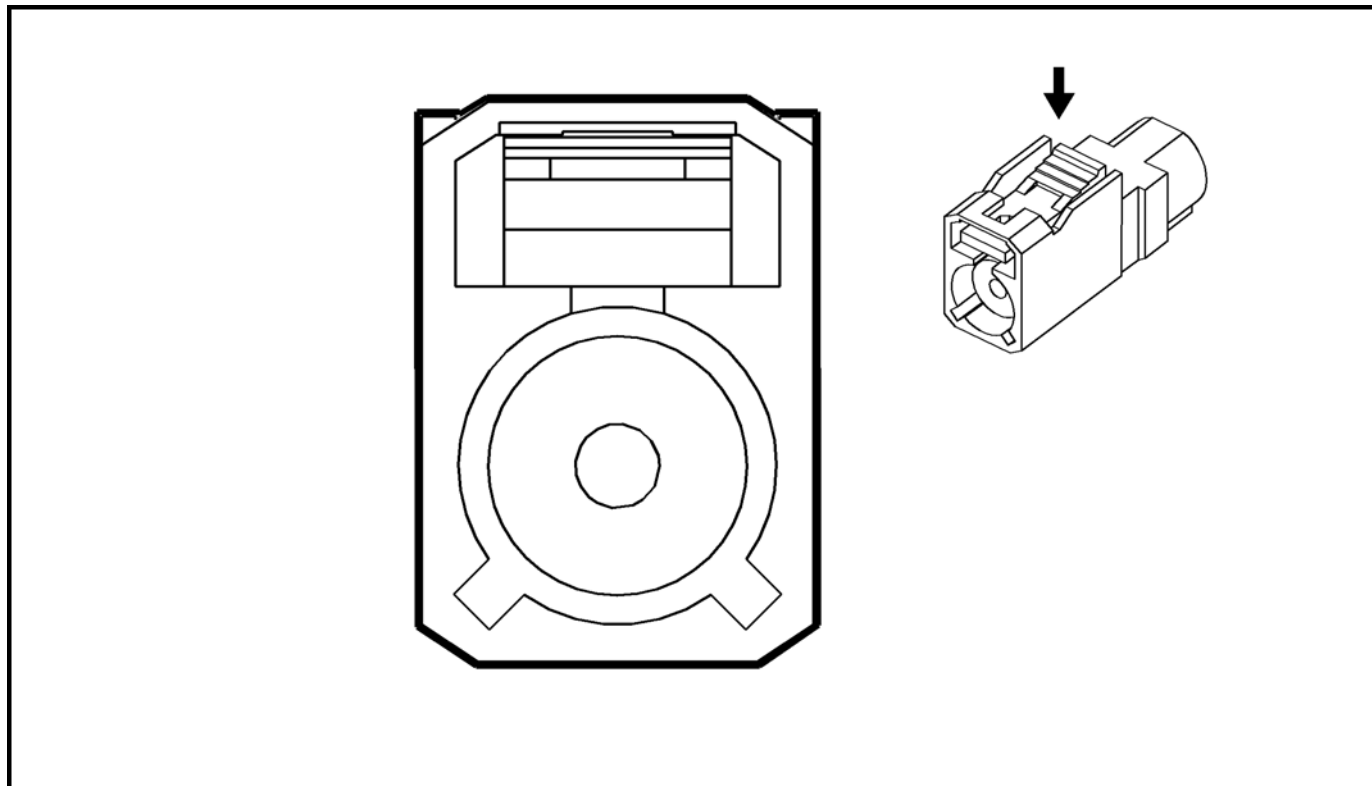
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(AM/FM) Antenna RF Signal	I	-

A11 RADIO X6



Connector Part Information

- Harness Type: Body
- OEM Connector: 13585516
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (YE)

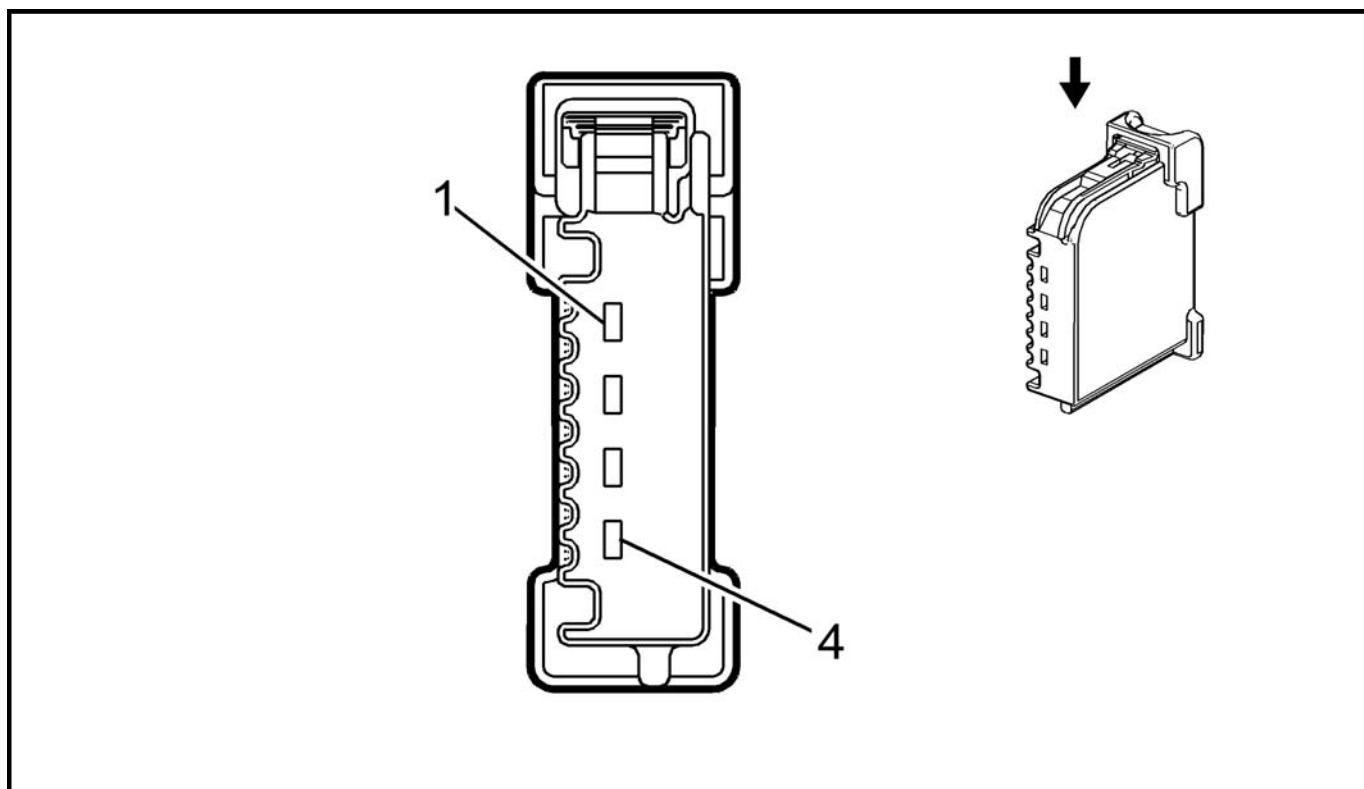
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
-	-	Coax	-	(XM +/-HD) Coaxial Antenna XM Signal	I	-

A23C LIFTGATE LATCH ASSEMBLY



Connector Part Information

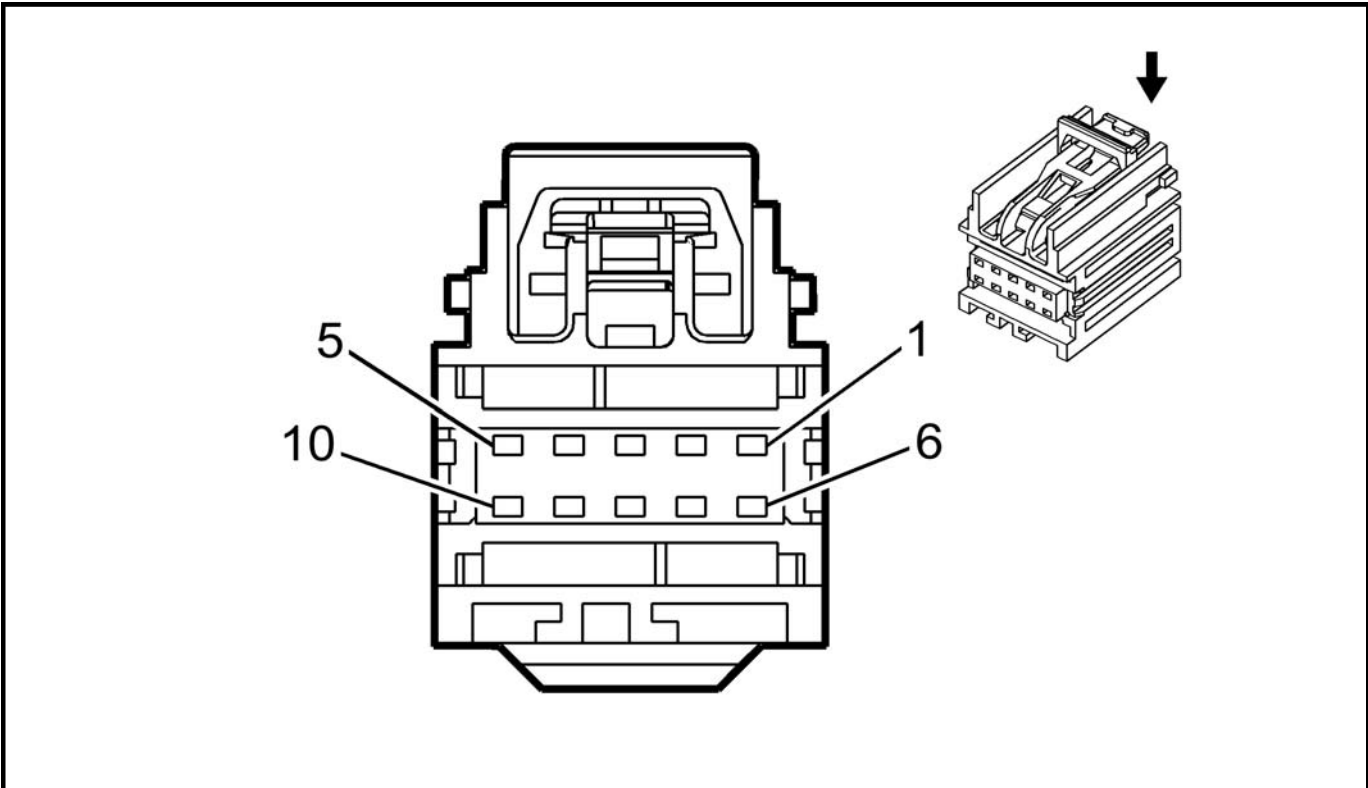
- Harness Type: Liftgate
- OEM Connector: 6098-5516
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.5 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	850	Ground	I	-
2	0.5	VT/GY	1303	Lift Gate Ajar Switch Signal 1	I	-
3	0.5	BU/YE	6795	Lift Glass/Rear Compartment Lid Motor Release Control 2	I	-
4	-	-	-	Not Occupied	-	-

A23D DOOR LATCH ASSEMBLY - DRIVER



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

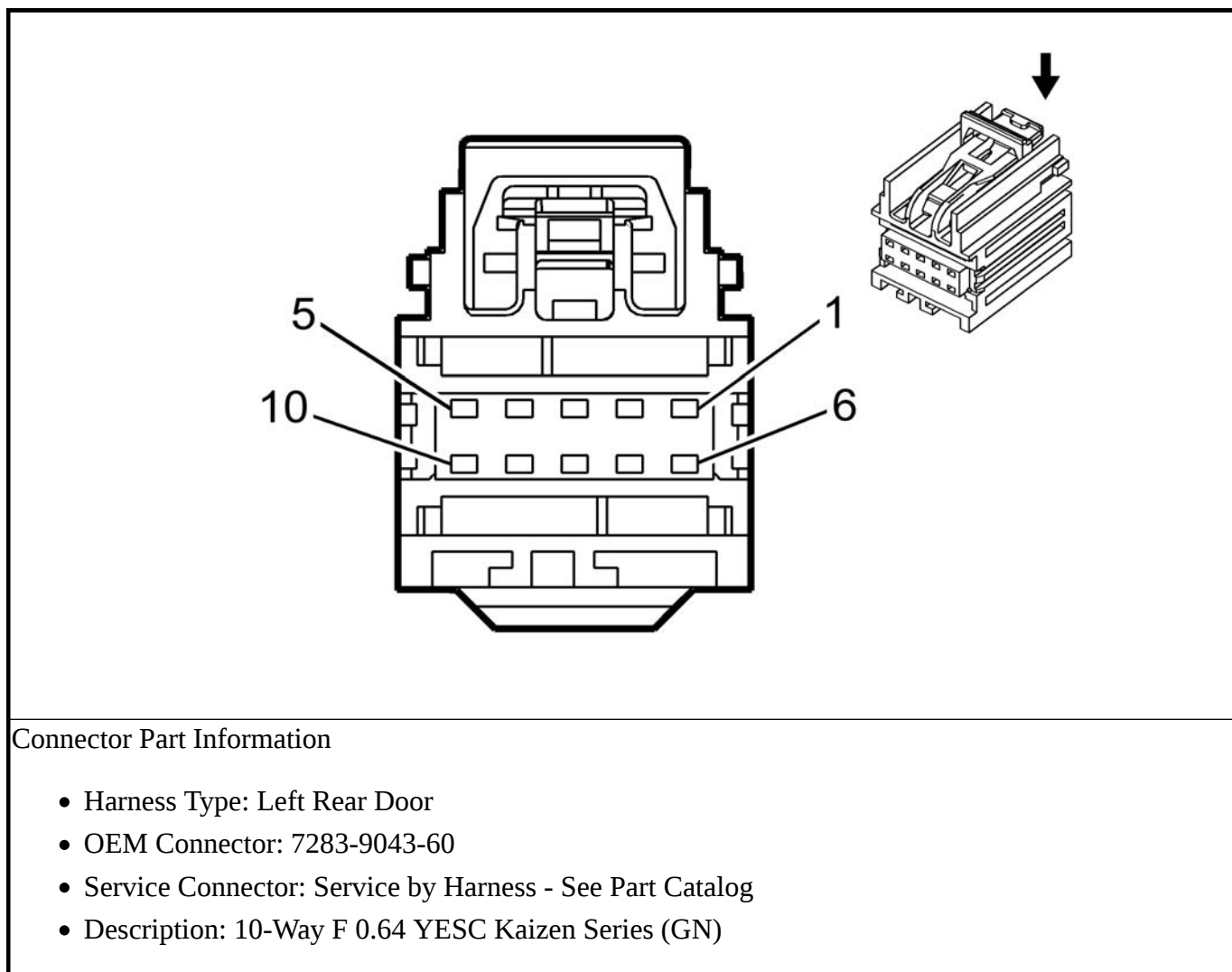
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/BK	745	Left Front Door Ajar Switch Signal	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BK	1550	Ground	I	-
4	0.35	BN/GN	3270	Driver Door Lock Motor Status Signal	I	-
5	0.35	BN/WH	1124	Door Lock Key Switch Unlock Signal	I	-
6	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7	0.75	GY	5911	Door Lock Actuator Lock Control 2	I	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9 - 10	-	-	-	Not Occupied	-	-

A23LR DOOR LATCH ASSEMBLY - LEFT REAR



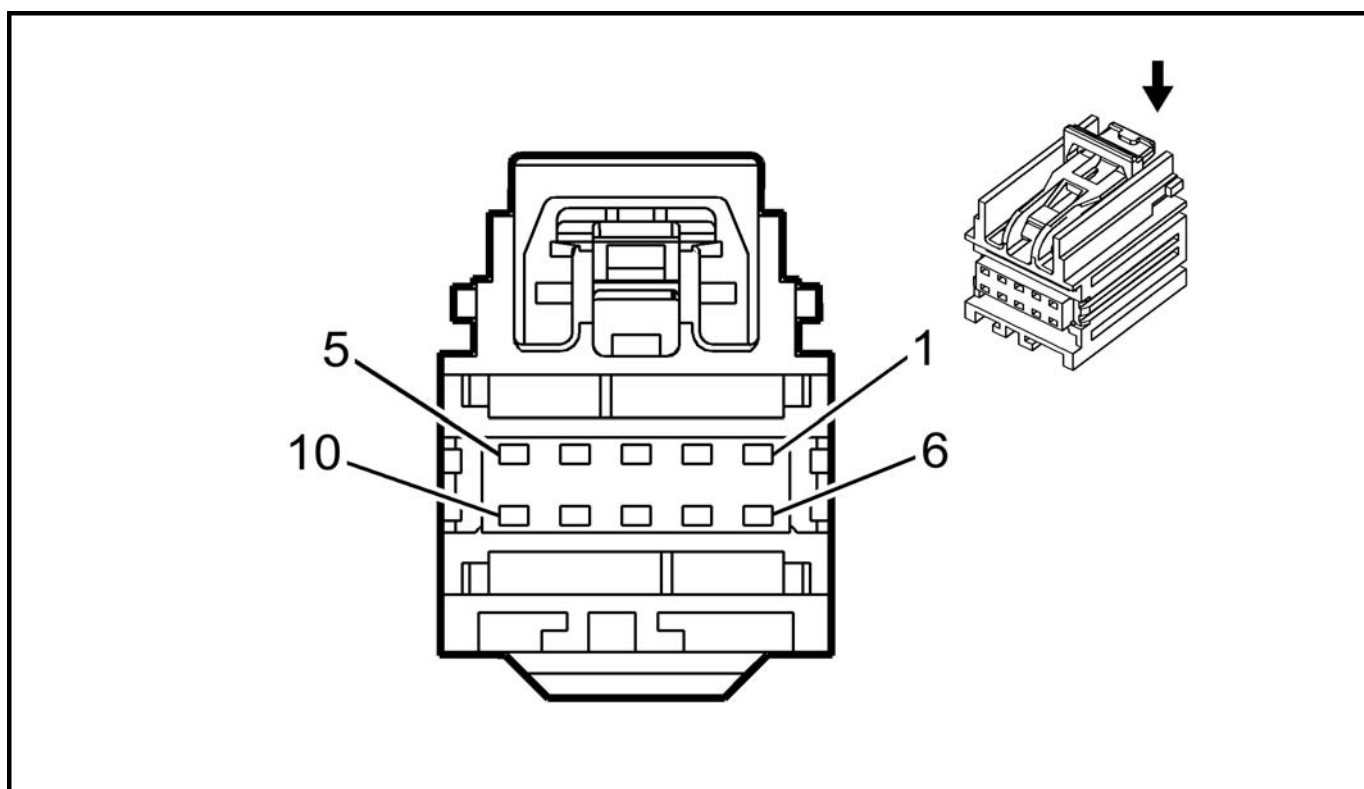
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	747	Left Rear Door Ajar Switch	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
				Signal		
2	-	-	-	Not Occupied	-	-
3	0.5	BK	650	Ground	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	0.75	GY	295	Door Lock Actuator Lock Control	I	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9 - 10	-	-	-	Not Occupied	-	-

A23P DOOR LATCH ASSEMBLY - PASSENGER



Connector Part Information

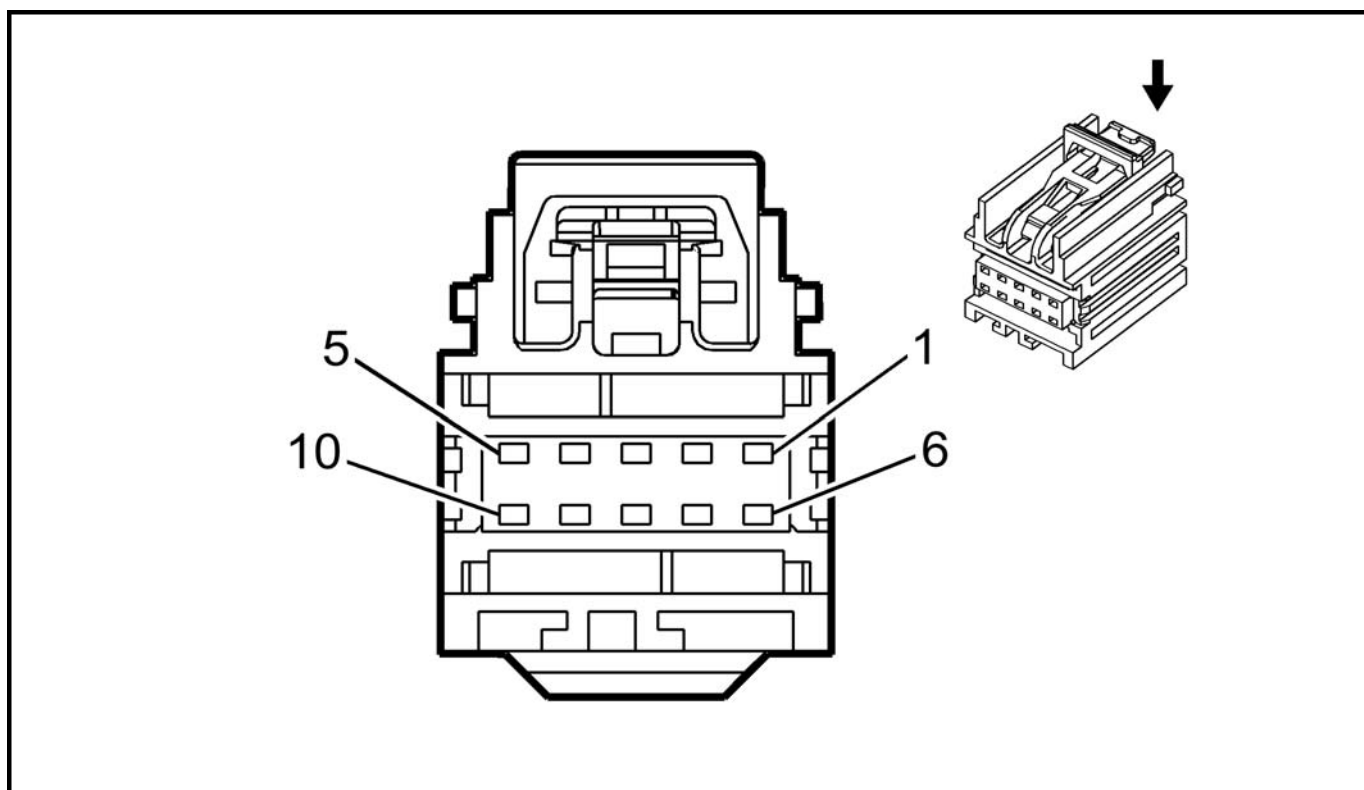
- Harness Type: Passenger Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	BK	2050	Ground	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GY	746	Right Front Door Ajar Switch Signal	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9	0.75	GY	295	Door Lock Actuator Lock Control	I	-
10	-	-	-	Not Occupied	-	-

A23RR DOOR LATCH ASSEMBLY - RIGHT REAR



Connector Part Information

- Harness Type: Right Rear Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

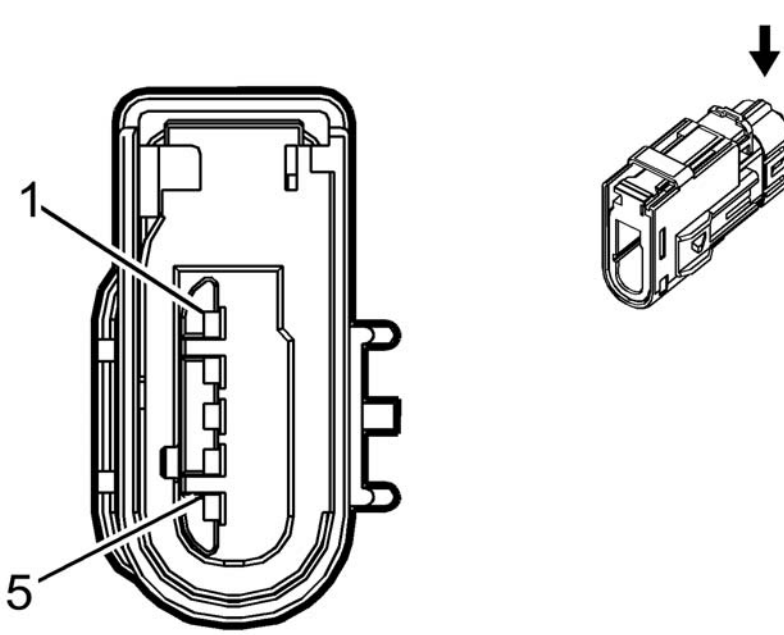
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	BK	850	Ground	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GY	748	Right Rear Door Ajar Switch Signal	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9	0.75	GY	295	Door Lock Actuator Lock Control	I	-
10	-	-	-	Not Occupied	-	-

A24D DOOR HANDLE ASSEMBLY - DRIVER EXTERIOR



Connector Part Information

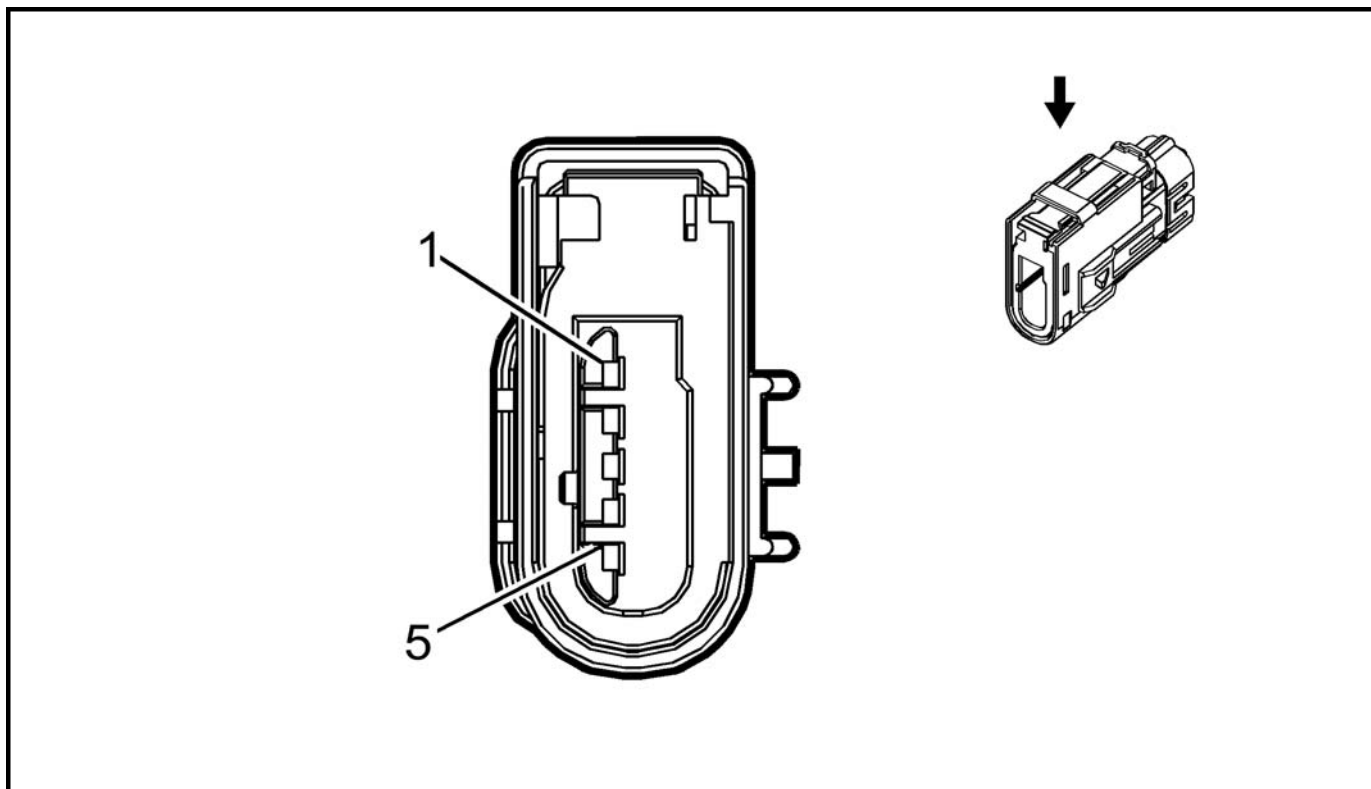
- Harness Type: Driver Door
- OEM Connector: SRVWSB-04-BS
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/WH	3570	Driver Door Handle Switch Signal	I	-
2	0.5	VT	3560	Passive Entry Driver Door Antenna Signal Hi	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	VT/GY	3561	Passive Entry Driver Door Antenna Signal Lo	I	-
5	0.5	BK	1550	Ground	I	-

A24LR DOOR HANDLE ASSEMBLY - LEFT REAR EXTERIOR



Connector Part Information

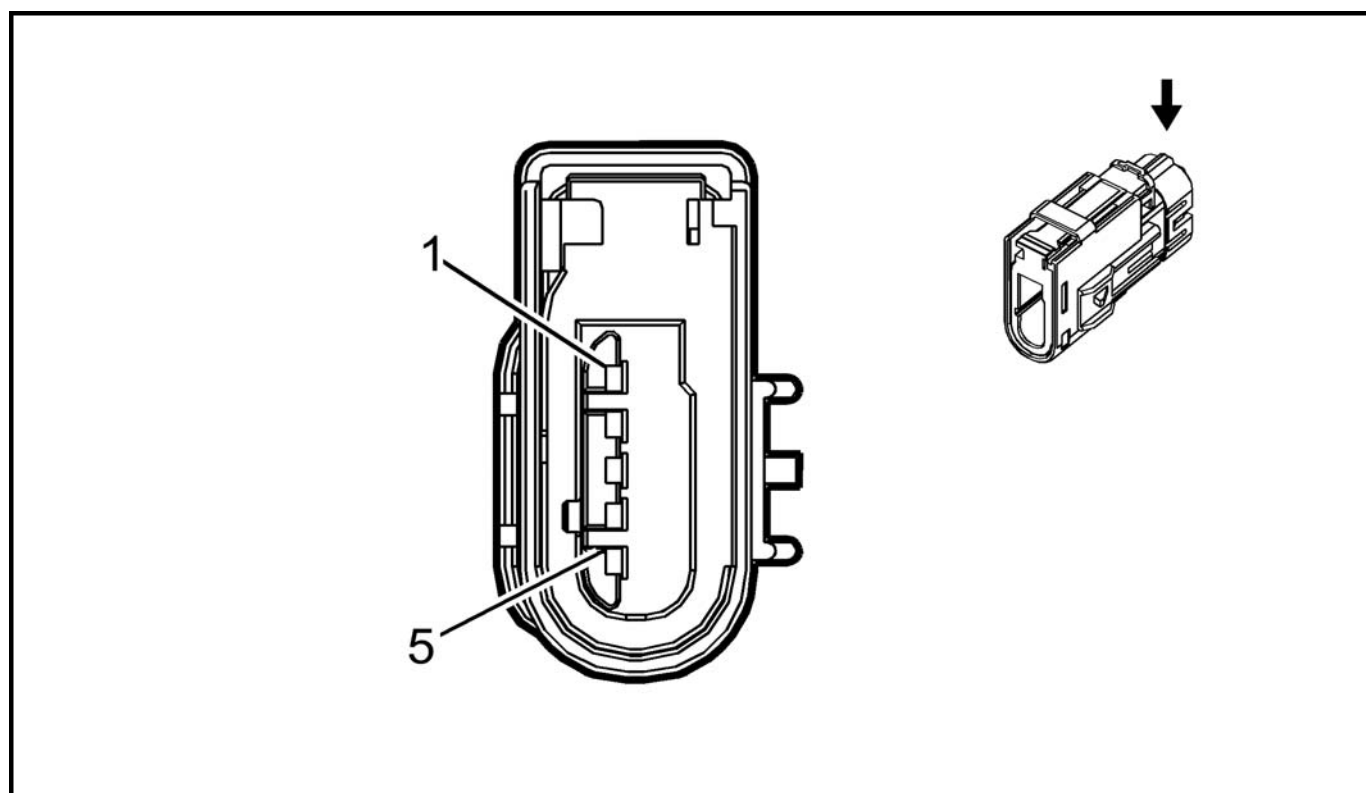
- Harness Type: Left Rear Door
- OEM Connector: SRVWSB-02-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/YE	6157	Left Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	650	Ground	I	-

A24P DOOR HANDLE ASSEMBLY - PASSENGER EXTERIOR



Connector Part Information

- Harness Type: Passenger Door
- OEM Connector: SRVWSB-04-BS
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

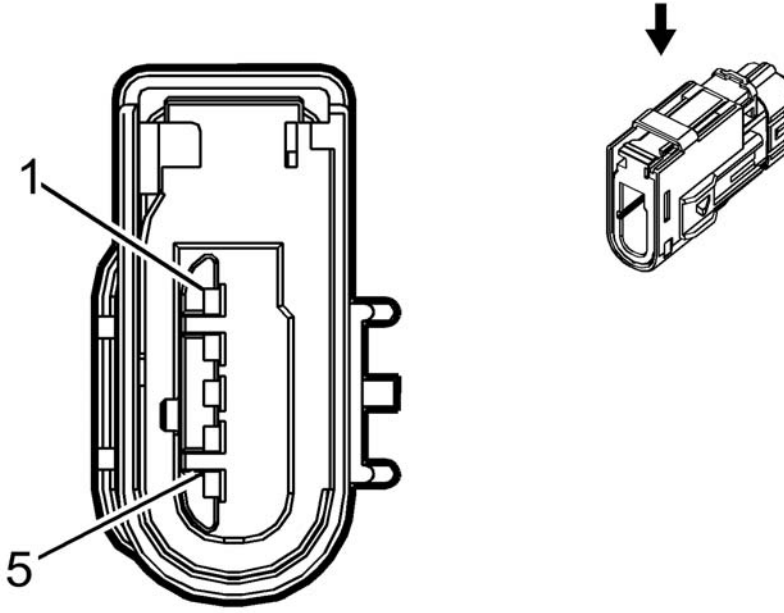
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	3571	Passenger Door Handle Switch Signal	I	-
2	0.5	GN/YE	3562	Passive Entry Passenger Door Antenna Signal Hi	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	GN/BK	3563	Passive Entry Passenger Door Antenna Signal Lo	I	-
5	0.5	BK	2050	Ground	I	-

A24RR DOOR HANDLE ASSEMBLY - RIGHT REAR EXTERIOR



The diagram illustrates the internal wiring of the A24RR Door Handle Assembly. A callout shows the connector being inserted into the handle assembly.

Connector Part Information

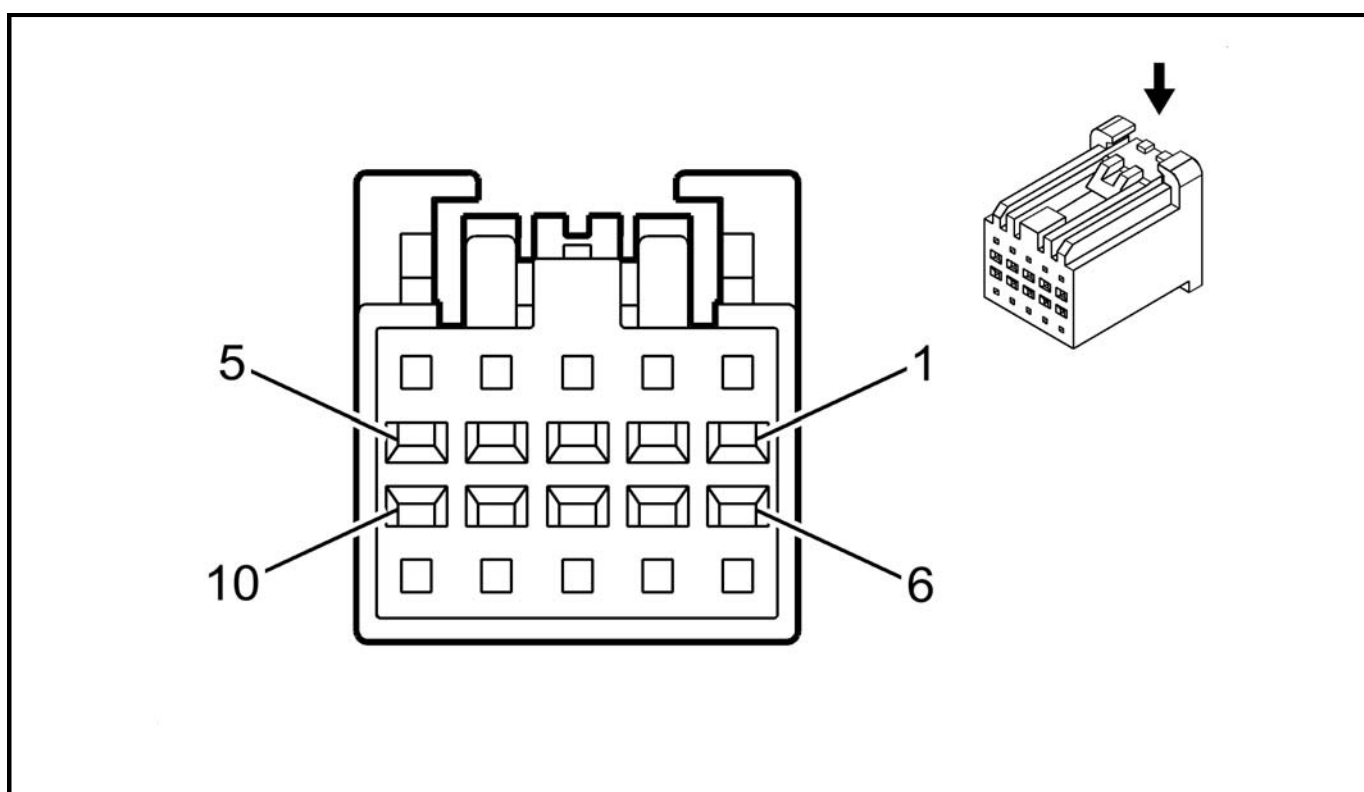
- Harness Type: Right Rear Door
- OEM Connector: SRVWSB-02-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/GY	6158	Right Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	850	Ground	I	-

A26 HVAC CONTROLS



Connector Part Information

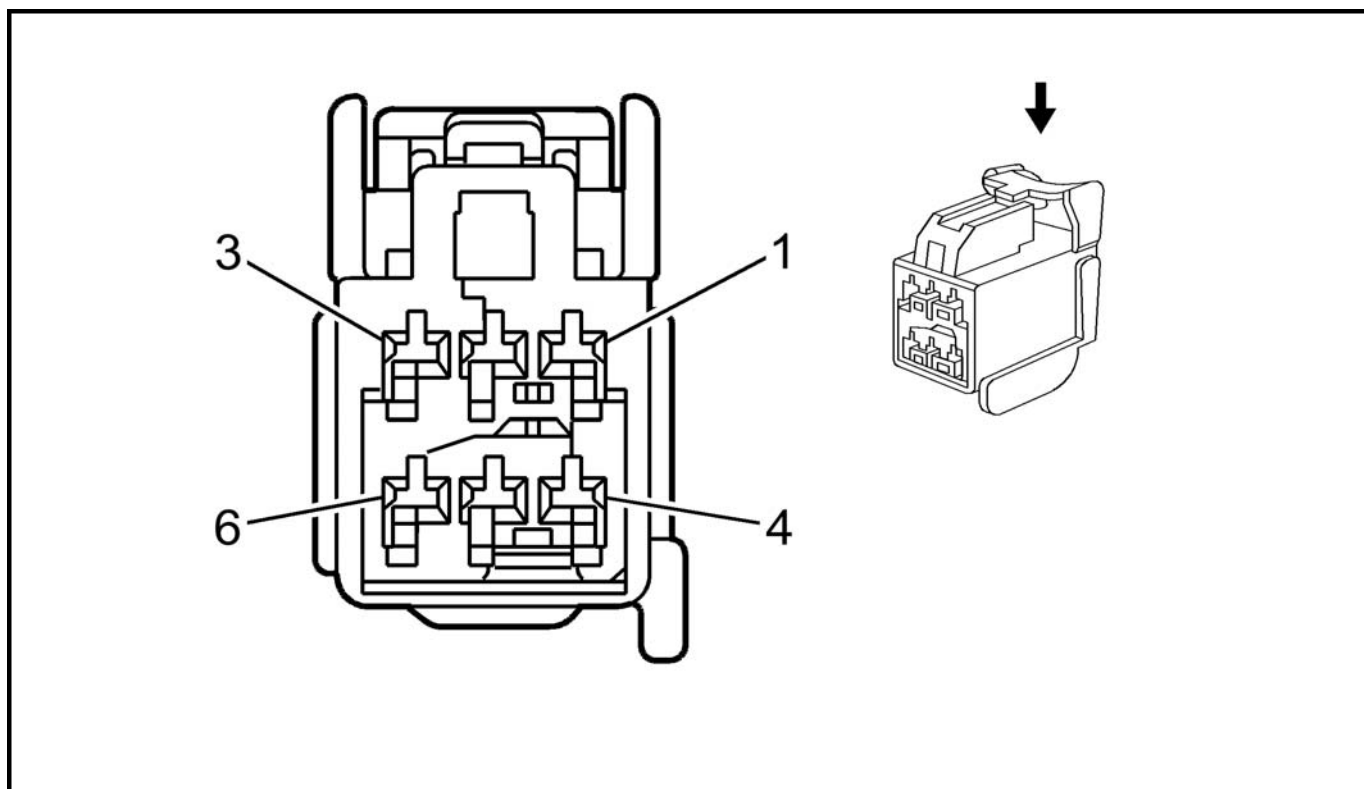
- Harness Type: Instrument Panel
- OEM Connector: AIT2PB-10P-2BH
- Service Connector: 13581139
- Description: 10-Way F 0.64 Kaizen Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	3240	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
4 - 8	-	-	-	Not Occupied	-	-
9	0.35	GN/YE	7531	Local Interconnect Network Serial Data Bus 9	I	-
10	0.5	BK	1650	Ground	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X1



Connector Part Information

- Harness Type: Battery Disconnect
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

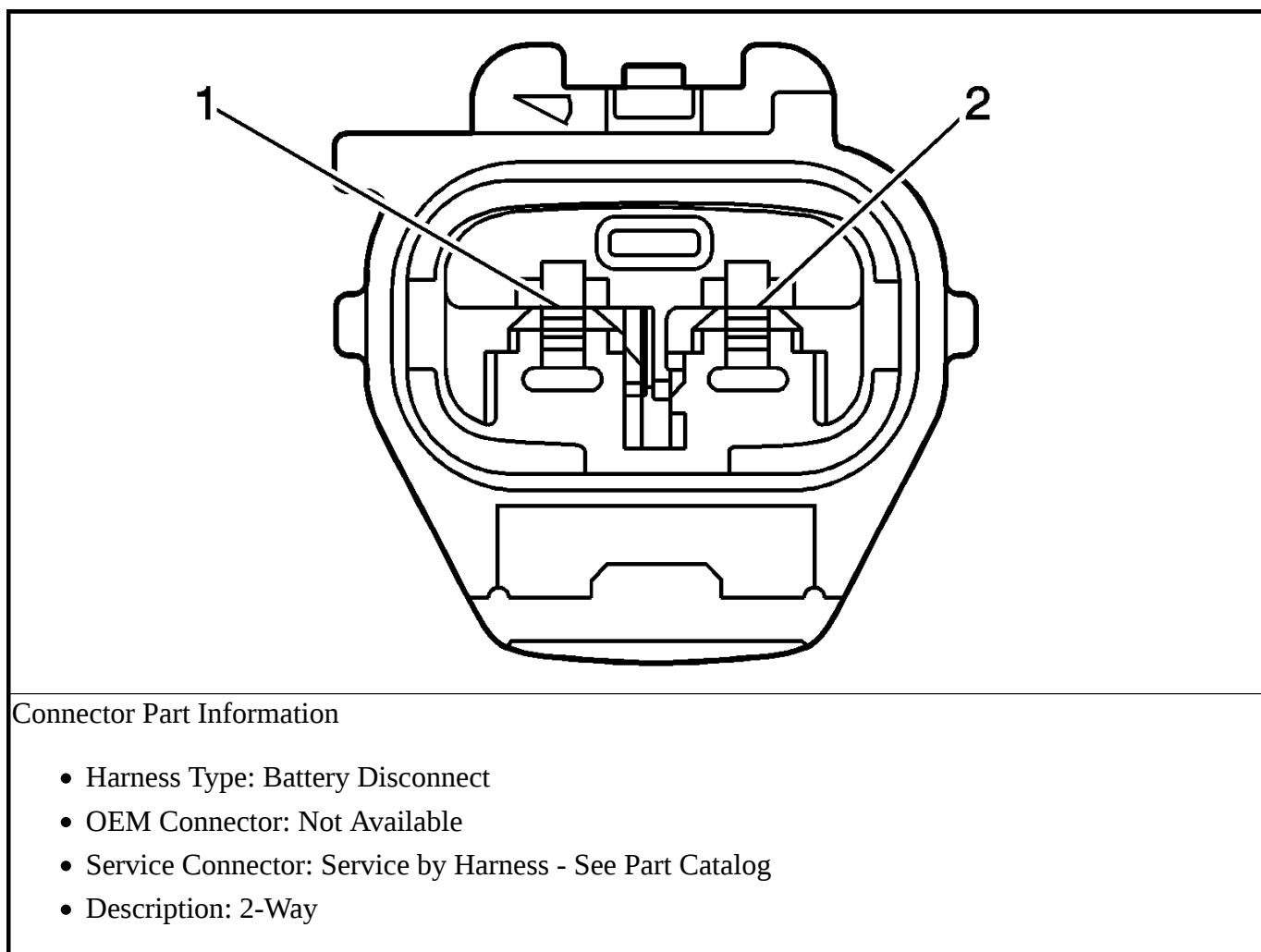
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.5	BN/GN	3959	High Voltage Battery 1 (+) Relay Control	I	-
2	0.5	VT/GY	3961	High Voltage Battery (-) Relay Control	I	-
3	0.5	YE/VT	3962	High Voltage Battery 3 (+) Relay Control	I	-
4	0.5	WH/VT	5137	Precharge Relay PWM Signal	I	-
5	0.5	BK	2050	Ground	I	-
6	0.5	VT	3195	Auxiliary Heater Control	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X2



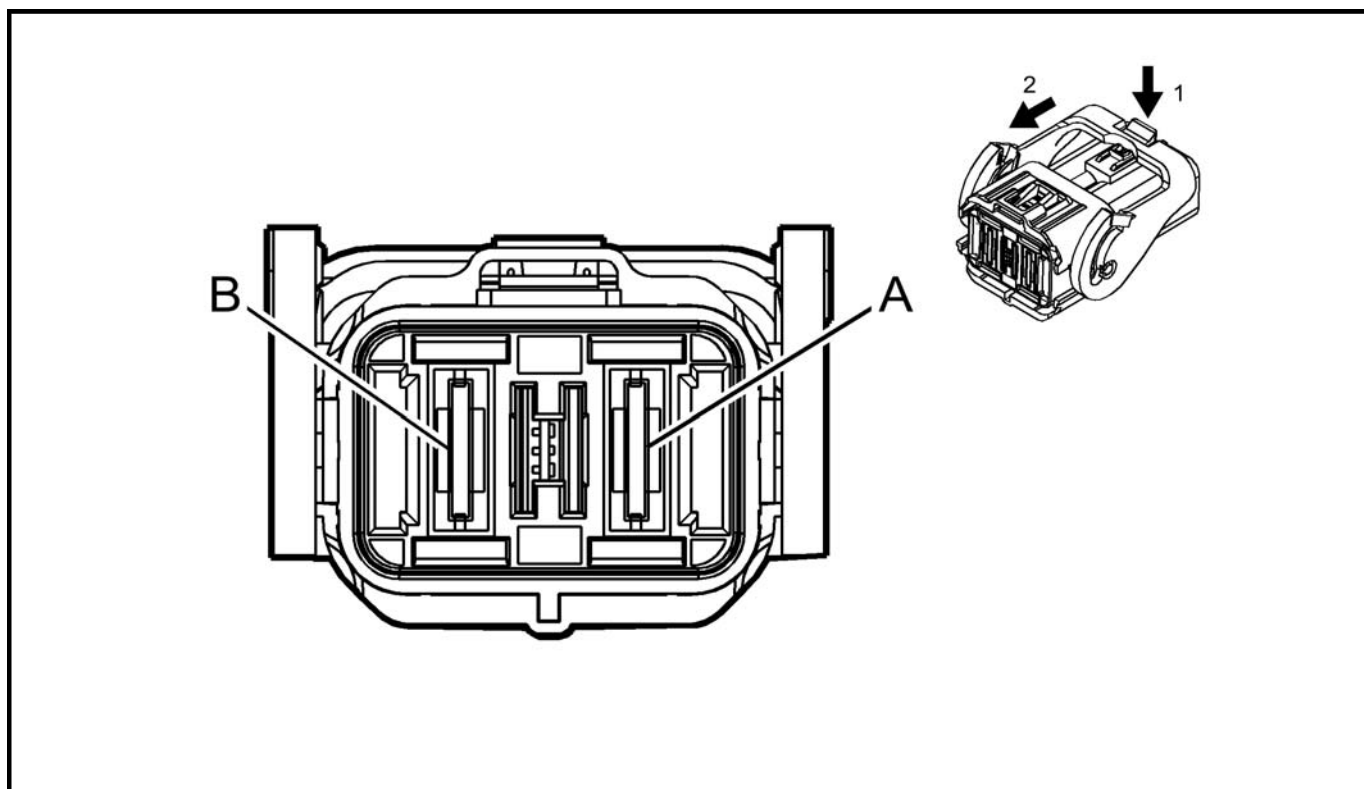
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	1	OG	900	Battery Pack Coolant Heater Power	I	-
2	1	OG/BK	901	Battery Pack Coolant Heater Ground	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X3



Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: 33201523
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000 Series, Sealed (OG)

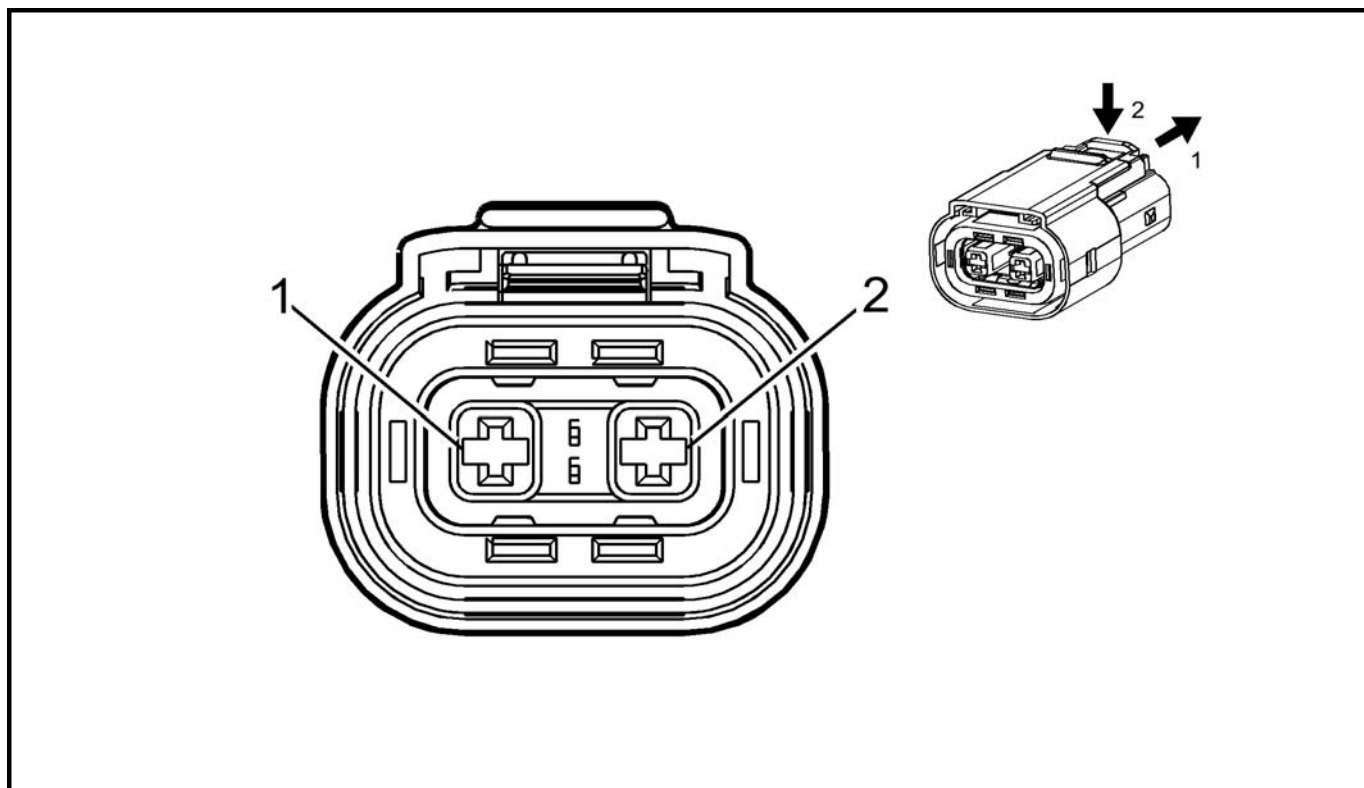
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	35	OG	7639	High Voltage Battery Pack Traction Power Inverter Module Positive Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
B	35	OG/BK	7644	High Voltage Battery Pack Traction Power Inverter Module Negative Control	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X4



Connector Part Information

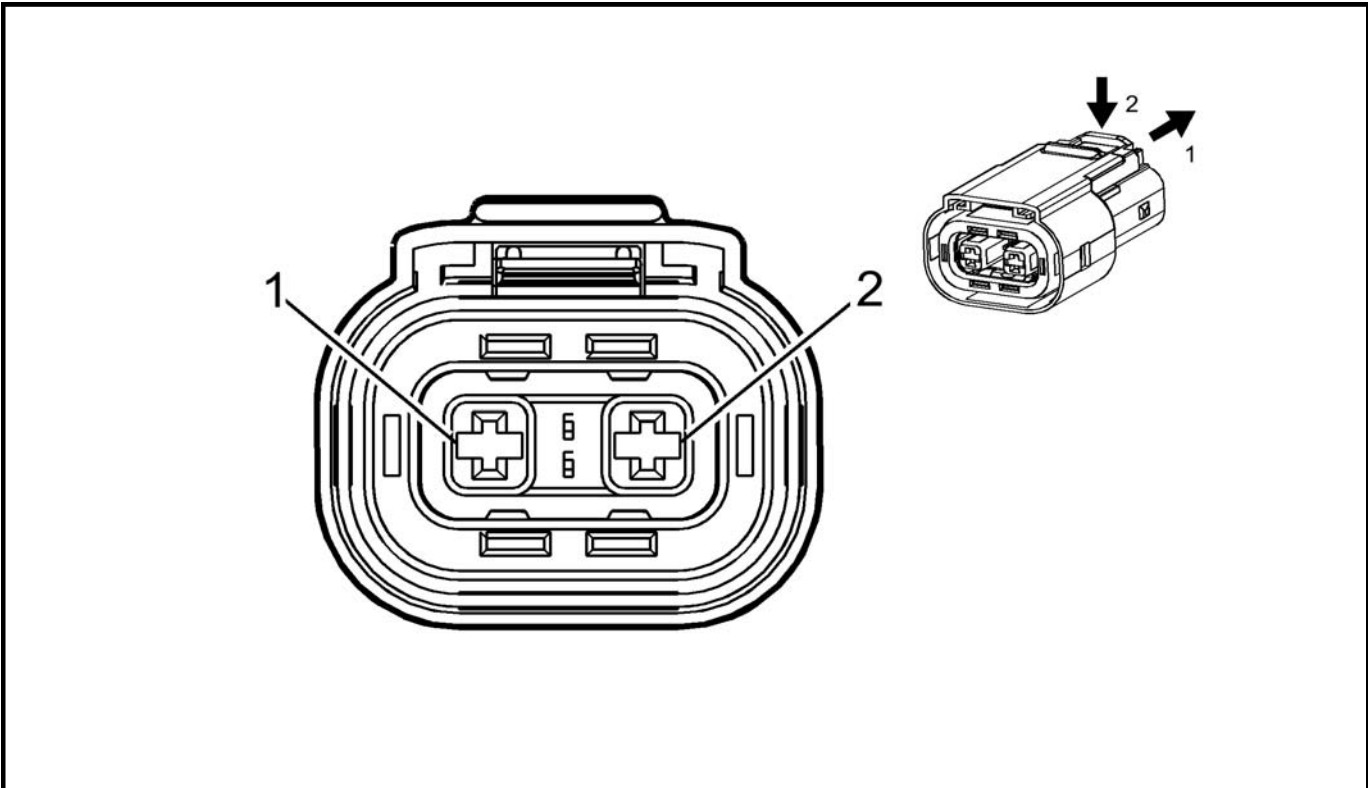
- Harness Type: Battery Cable
- OEM Connector: 33184733
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	5	OG	3970	High Voltage Battery 4 (+)	I	-
2	5	OG/BK	3969	High Voltage Battery 4 (-)	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X5



Connector Part Information

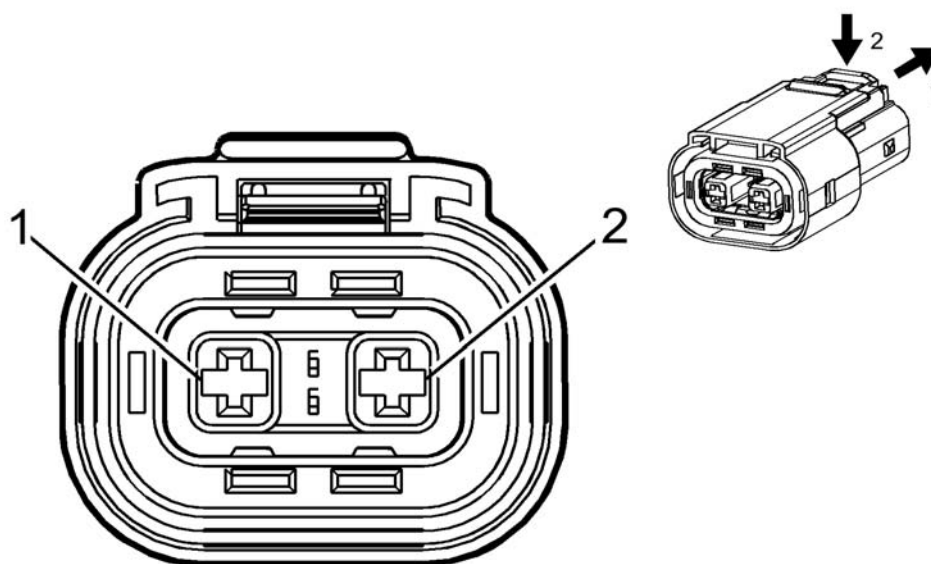
- Harness Type: Battery Cable
- OEM Connector: 33156861
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	5	OG	3974	High Voltage Battery 5 (+)	I	-
2	5	OG/BK	3973	High Voltage Battery 5 (-)	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X6



Connector Part Information

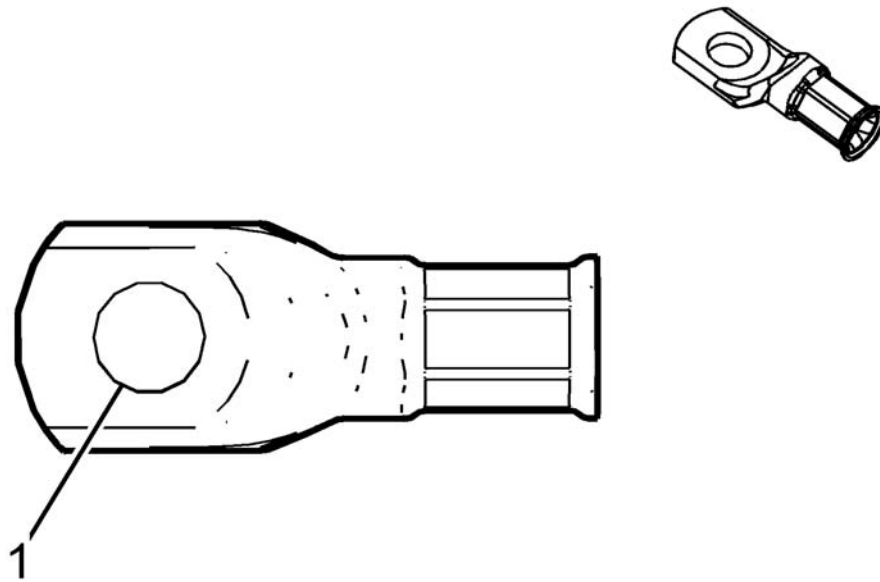
- Harness Type: Battery Cable
- OEM Connector: 33184905
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	OG	3834	High Voltage Battery 2 (+)	I	-
2	3	OG/BK	3833	High Voltage Battery 2 (-)	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X7



Connector Part Information

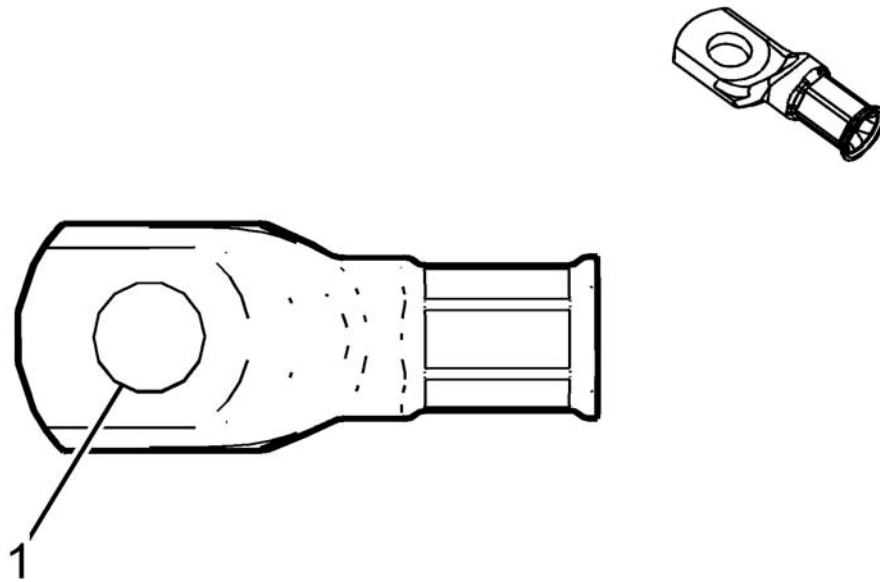
- Harness Type: HV Energy Storage
- OEM Connector: Not Available
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	20	OG	5084	High Voltage Battery (+)	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X8



Connector Part Information

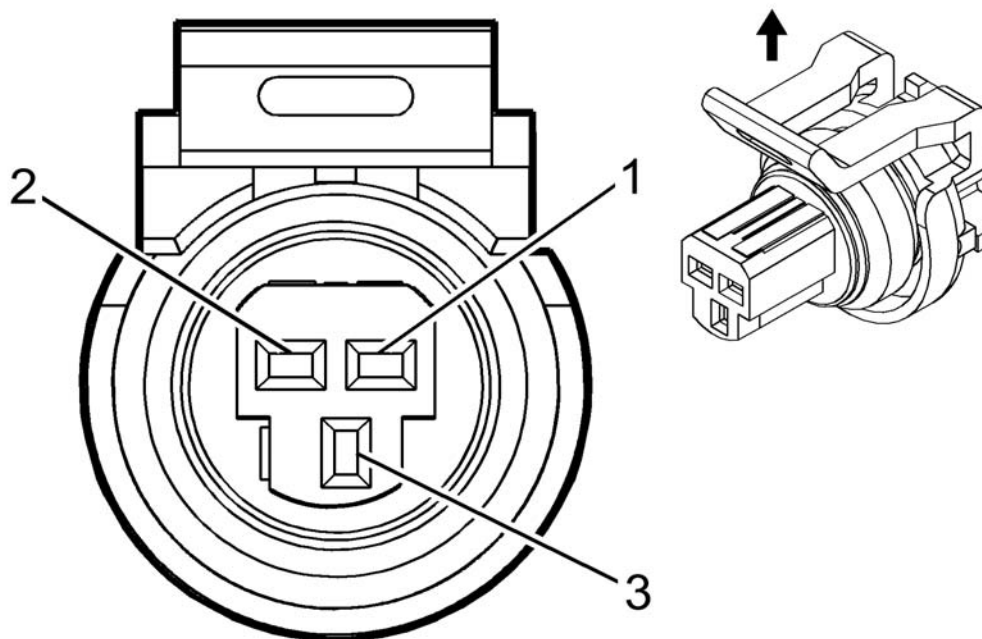
- Harness Type: HV Energy Storage
- OEM Connector: Not Available
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	20	OG/BK	5083	High Voltage Battery (-)	I	-

B1 A/C REFRIGERANT PRESSURE SENSOR



Connector Part Information

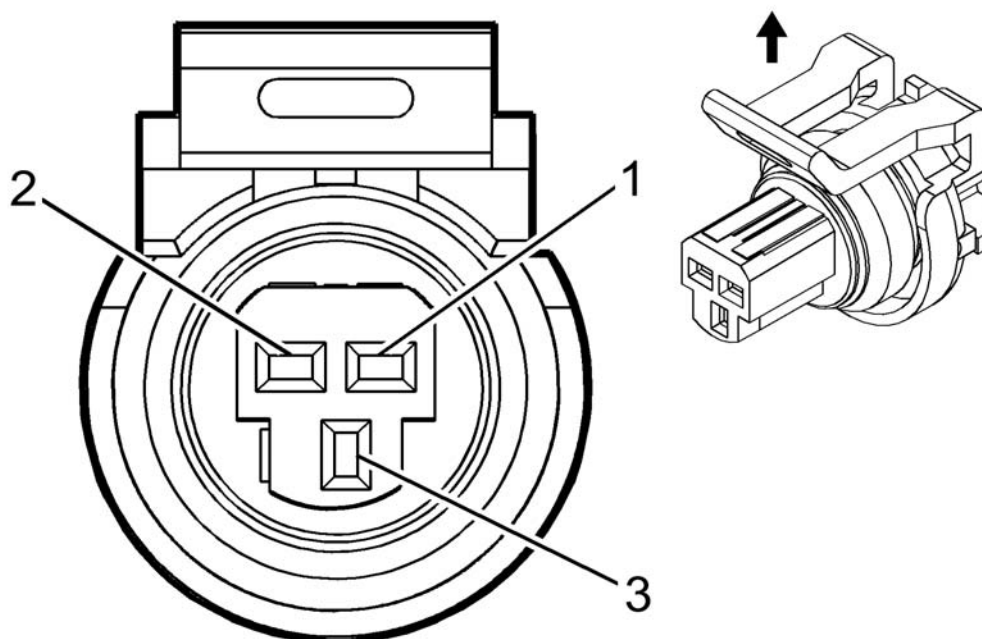
- Harness Type: Engine
- OEM Connector: 13602480
- Service Connector: 88988301
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/WH	2151	Signal Ground	I	E80
2	0.5	BN/RD	2700	A/C Pressure Sensor 5V Reference	I	E80
3	0.5	GN	380	A/C Refrigerant Pressure Sensor Signal	I	E80

B1C A/C LOW SIDE PRESSURE SENSOR



Connector Part Information

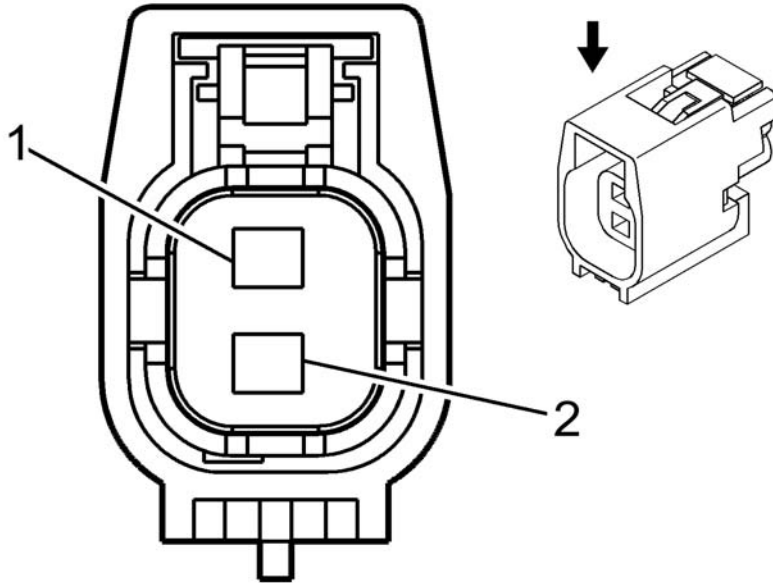
- Harness Type: Engine
- OEM Connector: 13602480
- Service Connector: 88988301
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/GN	476	Sensor Low Reference	I	-
2	0.5	BU/RD	474	5V Reference	I	-
3	0.5	BU	204	A/C Low Pressure Sensor Signal	I	-

B5LF WHEEL SPEED SENSOR - LEFT FRONT



Connector Part Information

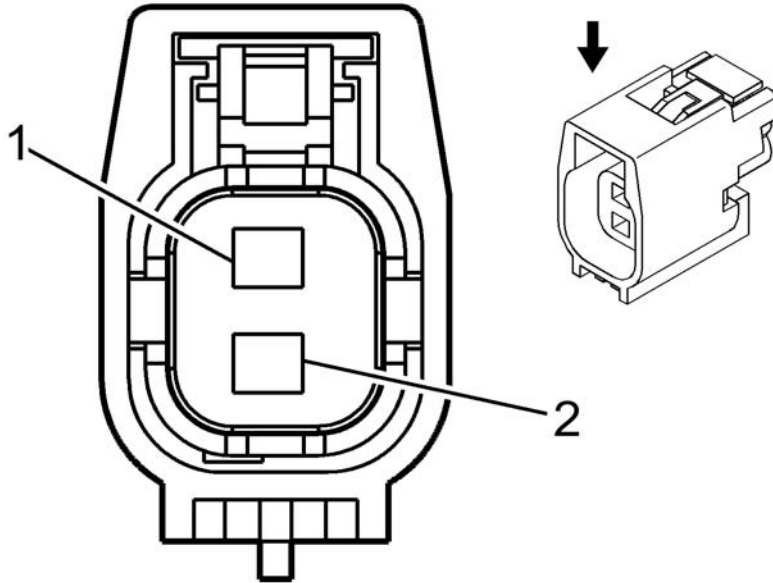
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/WH	7064	Wheel Speed Sensor Control Left Front	I	-
2	0.5	GY	830	Wheel Speed Sensor Signal Left Front	I	-

B5LR WHEEL SPEED SENSOR - LEFT REAR



Connector Part Information

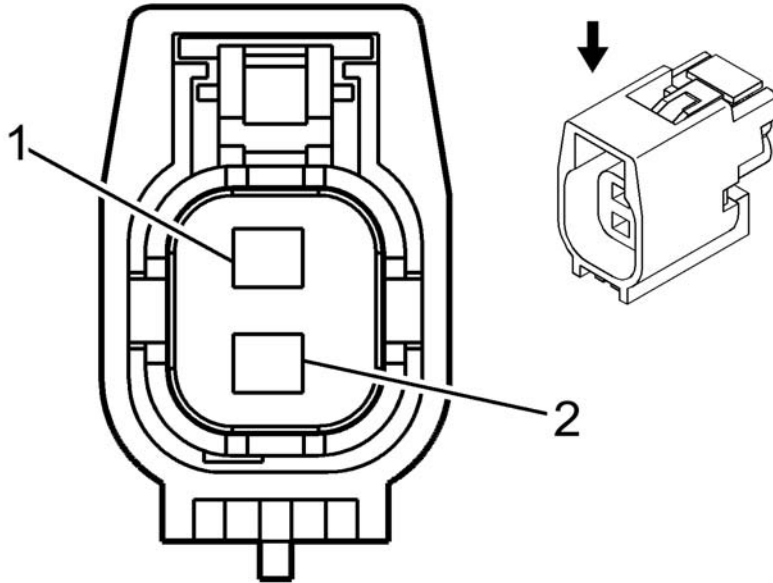
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BK	7127	Wheel Speed Sensor Control Left Rear	I	-
2	0.5	BU	884	Wheel Speed Sensor Signal Left Rear	I	-

B5RF WHEEL SPEED SENSOR - RIGHT FRONT



Connector Part Information

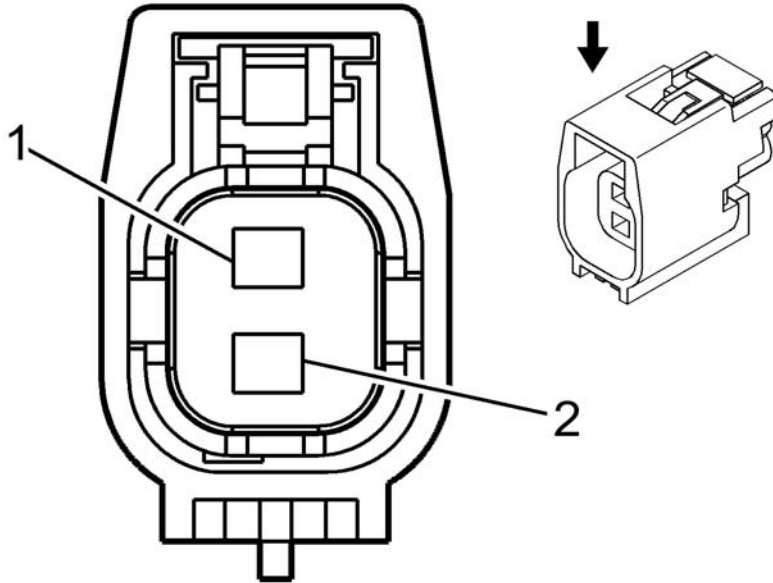
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BN	7065	Wheel Speed Sensor Control Right Front	I	-
2	0.5	YE	872	Wheel Speed Sensor Signal Right Front	I	-

B5RR WHEEL SPEED SENSOR - RIGHT REAR



Connector Part Information

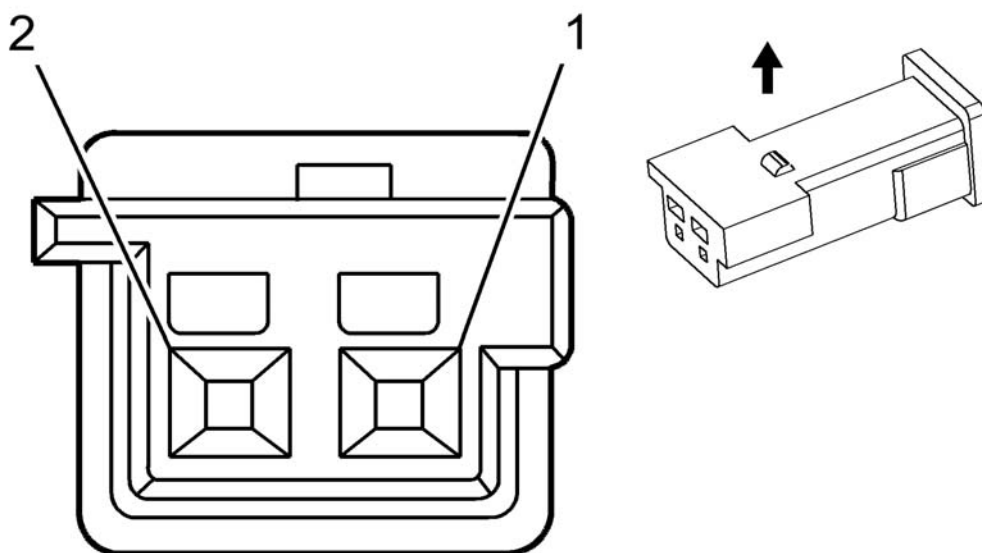
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/YE	7128	Wheel Speed Sensor Control Right Rear	I	-
2	0.5	VT	882	Wheel Speed Sensor Signal Right Rear	I	-

B7D AIR TEMPERATURE SENSOR - DUCT LEFT LOWER



Connector Part Information

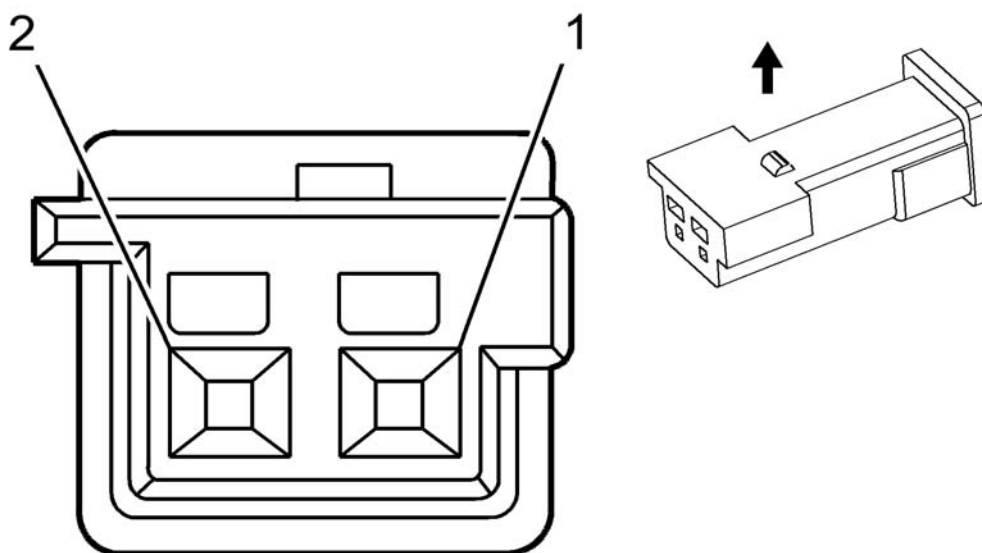
- Harness Type: HVAC
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN	518	Lower Left Air Temperature Sensor Signal	I	-
2	0.35	BK	407	Sensor Low Reference	I	-

B7H AIR TEMPERATURE SENSOR - DUCT LEFT UPPER



Connector Part Information

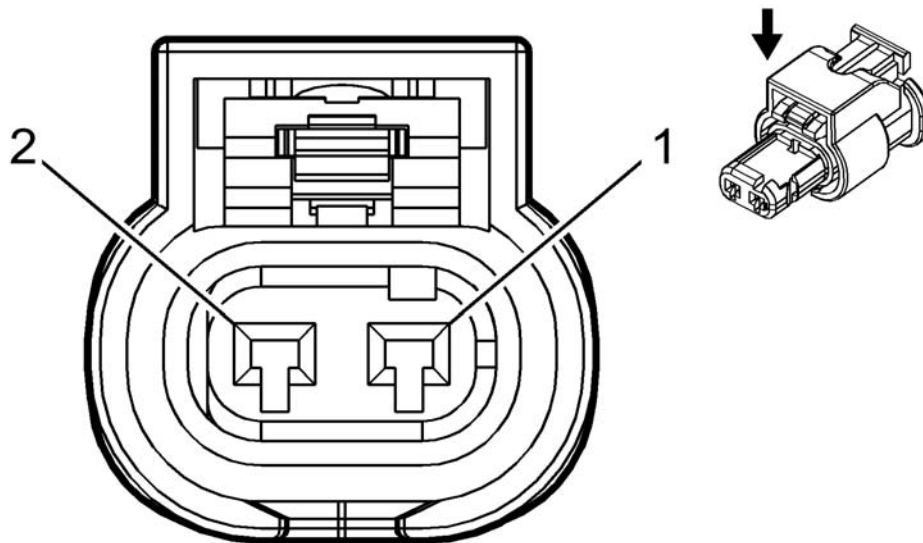
- Harness Type: HVAC
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT	516	Upper Left Air Temperature Sensor Signal	I	-
2	0.35	BK	407	Sensor Low Reference	I	-

B9 AMBIENT AIR TEMPERATURE SENSOR



Connector Part Information

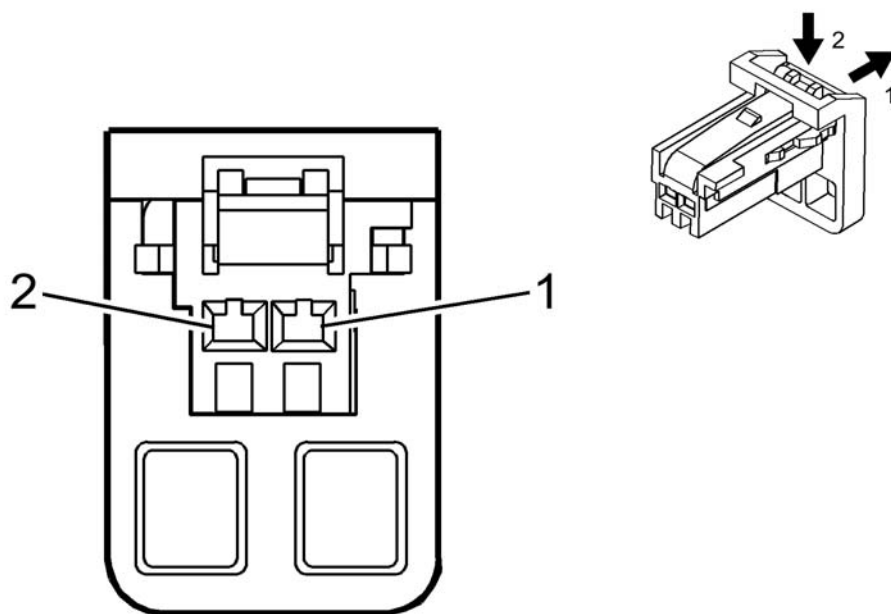
- Harness Type: Front Fascia
- OEM Connector: 1-1718643-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/GY	636	Outside Ambient Air Temperature Sensor Signal	I	-
2	0.5	BK/BU	61	Outside Ambient Temperature Sensor Low Reference	I	-

B14A TRANSMISSION OUTPUT SHAFT SPEED SENSOR



Connector Part Information

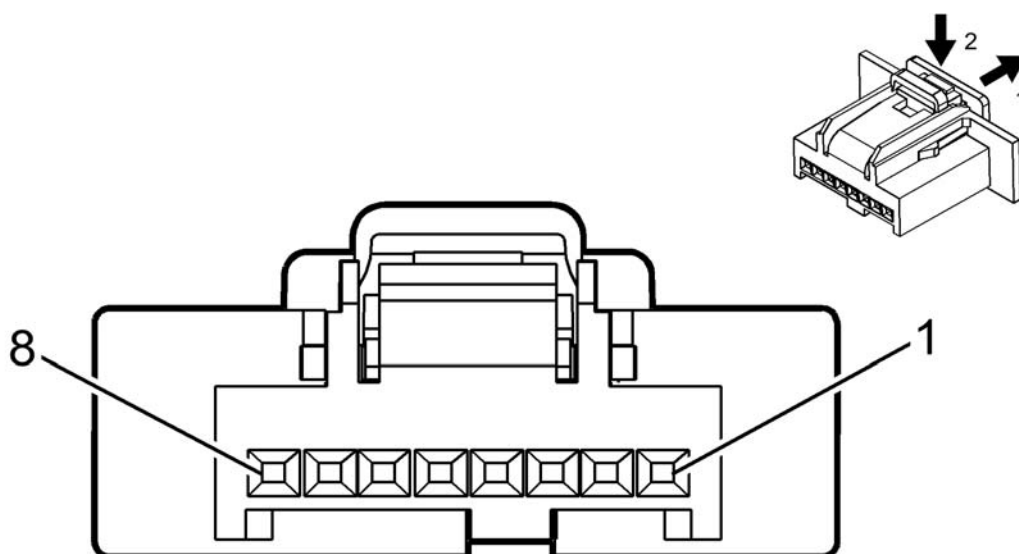
- Harness Type: Transmission
- OEM Connector: 33145080
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 OCS Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT	3604	Transmission Output Speed Sensor Supply	I	-
2	0.5	RD	3098	Output Speed (Digital) Signal	I	-

B15 TRANSMISSION INTERNAL MODE SWITCH



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 13960977
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 II Series (GY)

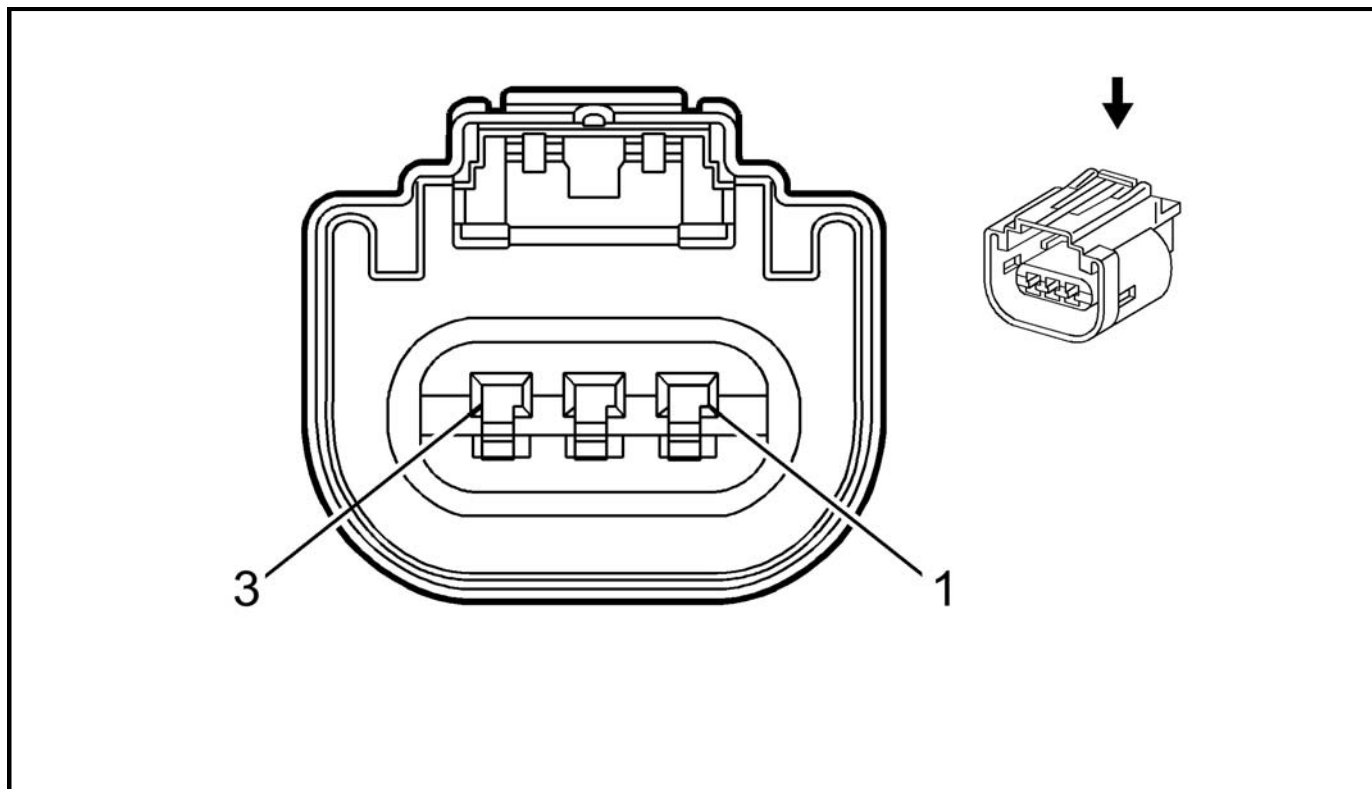
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	PK	3992	Internal Mode Switch Voltage Supply A	I	-
2	0.5	BK	3494	Transmission IMS Mode Switch R1 bit Signal	I	-
3	0.5	BN	3496	Transmission IMS Mode Switch D1 bit Signal	I	-
4	-	-	-	Not Occupied	-	-
5	0.5	GN	3493	Transmission IMS Mode Switch S bit Signal	I	-
6	0.5	BU	3495	Transmission IMS Mode Switch R2 bit Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7	0.5	GY	3497	Transmission IMS Mode Switch D2 bit Signal	I	-
8	0.5	OG	3991	Internal Mode Switch Voltage Supply B	I	-

B18 BATTERY CURRENT SENSOR



Connector Part Information

- Harness Type: Body
- OEM Connector: 34250-3001
- Service Connector: 19179750
- Description: 3-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/VT	5076	Current Sensor Control	I	-
2	0.35	BK/VT	5077	Current Sensor Low Reference	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	WH/YE	5075	Current Sensor Signal	I	-

B20 BRAKE FLUID LEVEL SWITCH

Connector Part Information

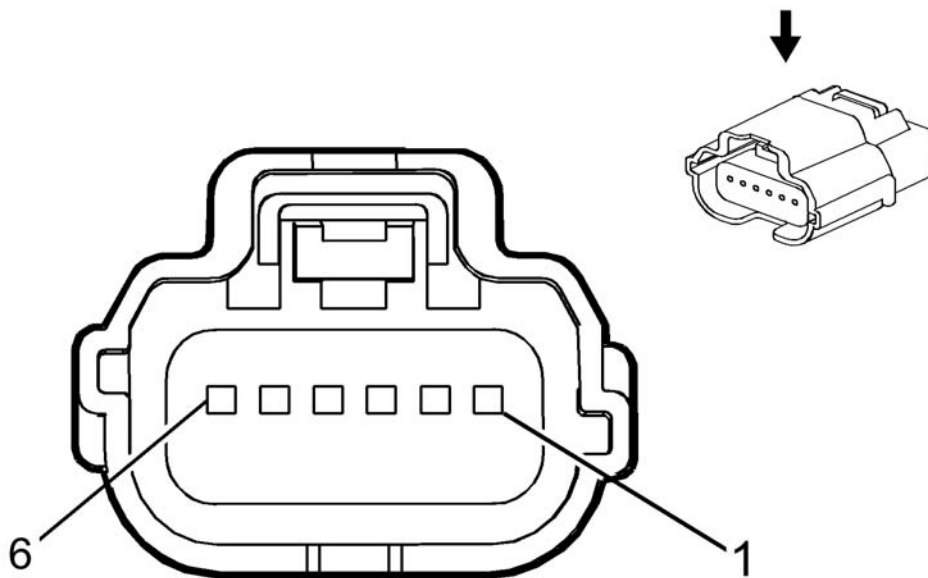
- Harness Type: Body
- OEM Connector: 10010337
- Service Connector: 13587326
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1550	Ground	I	-
2	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	I	-

B22 BRAKE PEDAL POSITION SENSOR



Connector Part Information

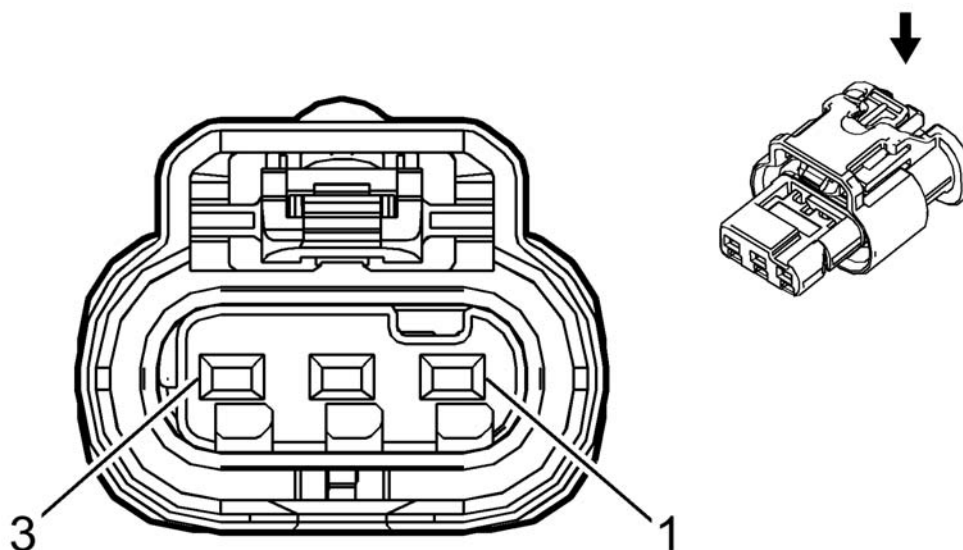
- Harness Type: Instrument Panel
- OEM Connector: 31404-6810
- Service Connector: 19304011
- Description: 6-Way F 64 Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH	5359	Brake Apply Sensor Control	I	-
2	0.35	BK/BN	5360	Brake Apply Sensor Low Reference	I	-
3	0.35	BU/YE	5361	Brake Apply Sensor Signal	I	-
4	0.35	WH/GN	5380	Brake Position Sensor Signal	I	-
5	0.35	WH/RD	5381	Brake Position Sensor 5V Reference	I	-
6	0.35	BK/YE	5382	Brake Position Sensor Low Reference	I	-

B23E CAMSHAFT POSITION SENSOR - EXHAUST



Connector Part Information

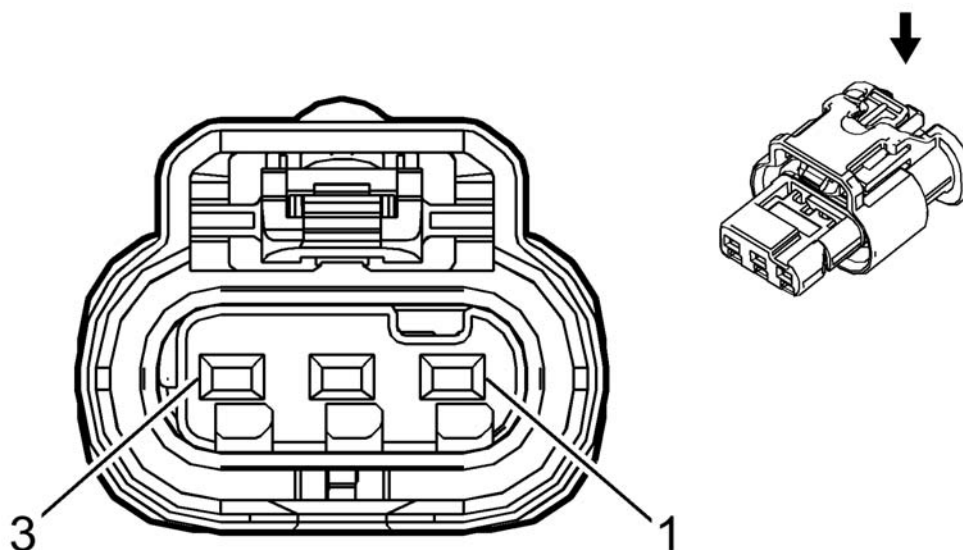
- Harness Type: Engine
- OEM Connector: 2098541-5
- Service Connector: 19329387
- Description: 3-Way F 1.2 MCP Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/YE	5297	Camshaft Position Exhaust Sensor Control 1	I	-
2	0.5	BK/GY	5296	Camshaft Position Exhaust Sensor Low Reference 1	I	-
3	0.5	VT/BK	5273	Camshaft Position Exhaust Sensor 1	I	-

B23F CAMSHAFT POSITION SENSOR - INTAKE



Connector Part Information

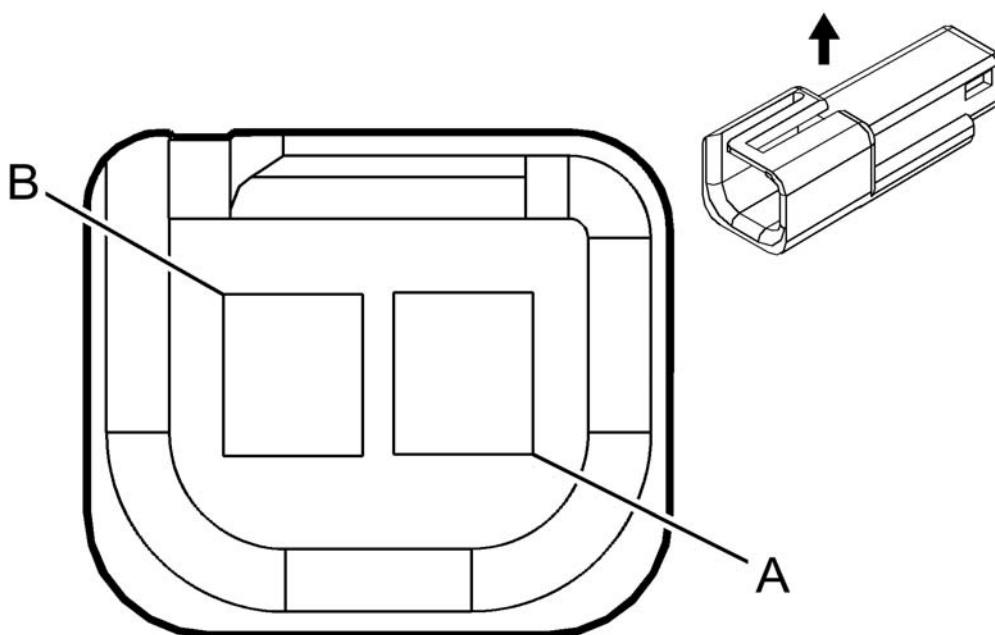
- Harness Type: Engine
- OEM Connector: 2098541-5
- Service Connector: 19329387
- Description: 3-Way F 1.2 MCP Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BU	5300	Camshaft Position Intake Sensor Control 1	I	-
2	0.5	BK/GN	5301	Camshaft Position Intake Sensor Low Reference 1	I	-
3	0.5	YE/VT	5275	Camshaft Position Intake Sensor 1	I	-

B24 MOBILE TELEPHONE MICROPHONE



Connector Part Information

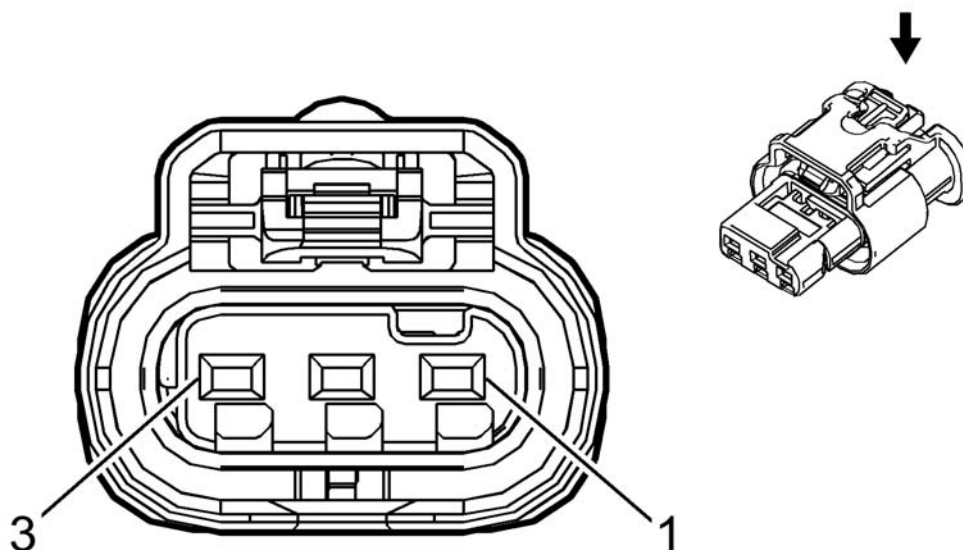
- Harness Type: Headliner
- OEM Connector: 12047663
- Service Connector: 13584278
- Description: 2-Way M 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	BK/BN	654	Cellular Telephone Microphone Low Reference	I	-
B	0.5	BU	655	Cellular Telephone Microphone Signal	I	-

B26 CRANKSHAFT POSITION SENSOR



Connector Part Information

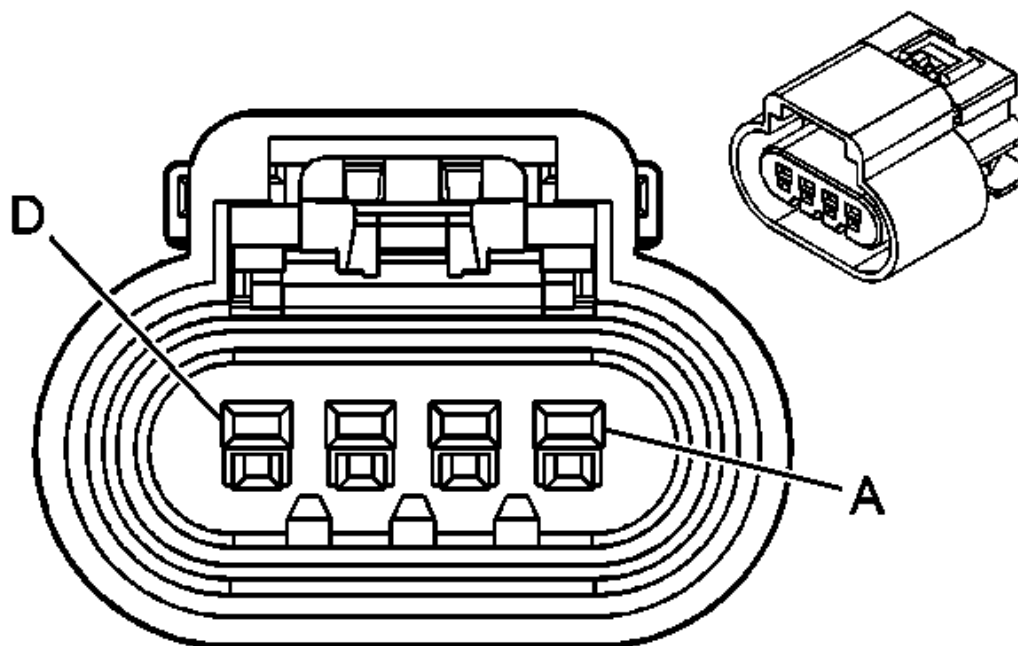
- Harness Type: Engine
- OEM Connector: 2098541-5
- Service Connector: 19329387
- Description: 3-Way F 1.2 MCP Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	6270	Crankshaft 60X Sensor 5V Reference	I	-
2	0.5	BK/VT	6272	Crankshaft 60X Sensor Low Reference	I	-
3	0.5	GN	6271	Crankshaft 60X Sensor Signal	I	-

B30 HYBRID/EV BATTERY PACK CURRENT SENSOR



Connector Part Information

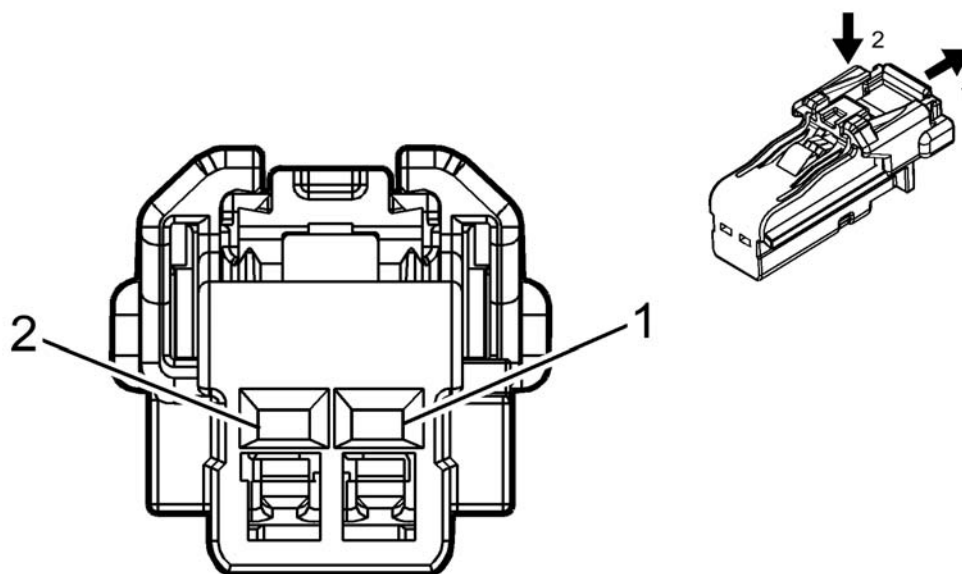
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33124854
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	BU/YE	2962	High Voltage Battery Current Sensor Course Signal	I	-
B	0.5	VT/RD	2965	High Voltage Battery Current Sensor Voltage Reference	I	-
C	0.5	BK/GY	2963	High Voltage Battery Current Sensor Low Reference	I	-
D	0.5	GN/BN	2961	High Voltage Battery Current Sensor Fine Signal	I	-

B32A HYBRID/EV BATTERY TEMPERATURE SENSOR 1



Connector Part Information

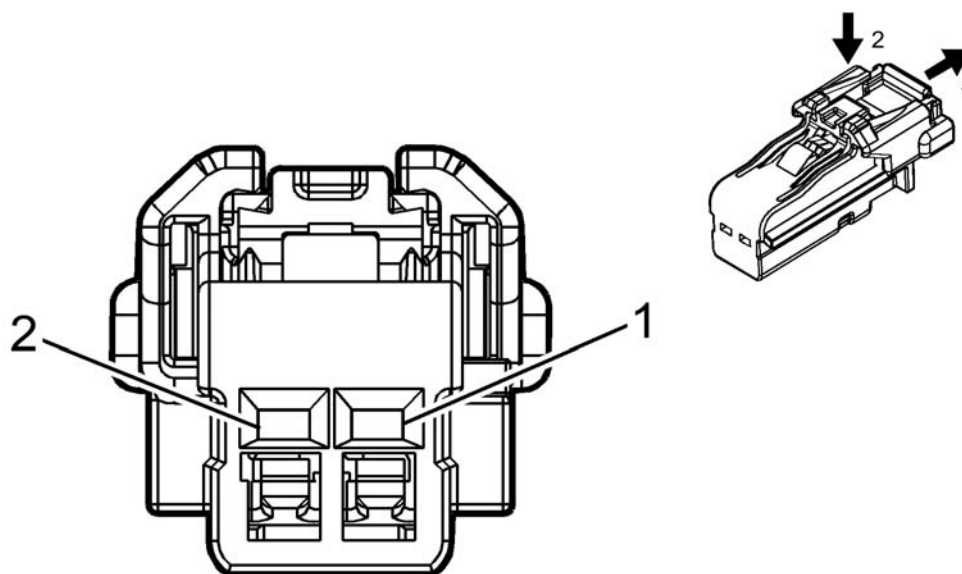
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	5405	Battery Module Temperature Signal 1	I	-
2	0.35	BK/BN	3773	Battery Module Temperature Sensor Low Reference 1	I	-

B32B HYBRID/EV BATTERY TEMPERATURE SENSOR 2



Connector Part Information

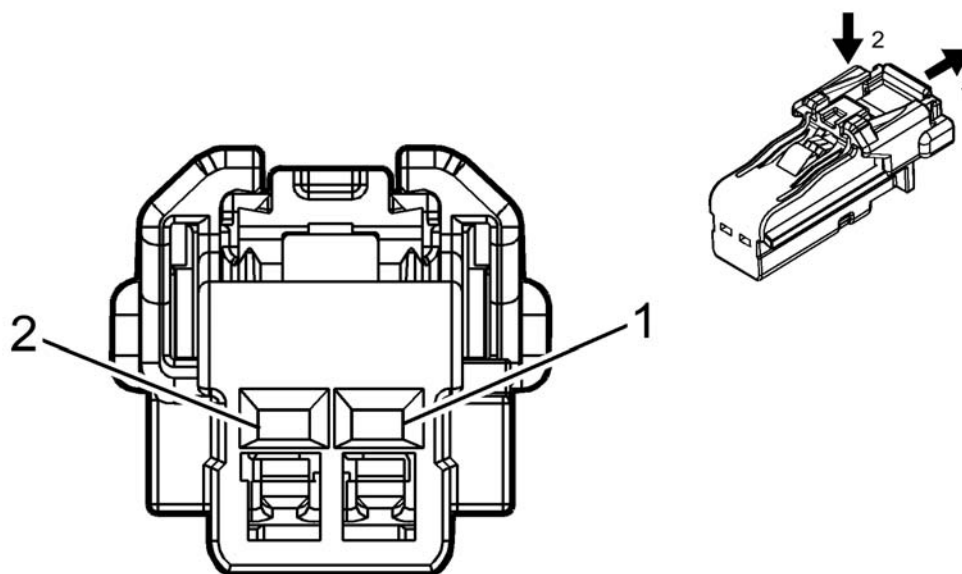
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	5406	Battery Module Temperature Signal 2	I	-
2	0.35	BK/BU	3774	Battery Module Temperature Sensor Low Reference 2	I	-

B32C HYBRID/EV BATTERY TEMPERATURE SENSOR 3



Connector Part Information

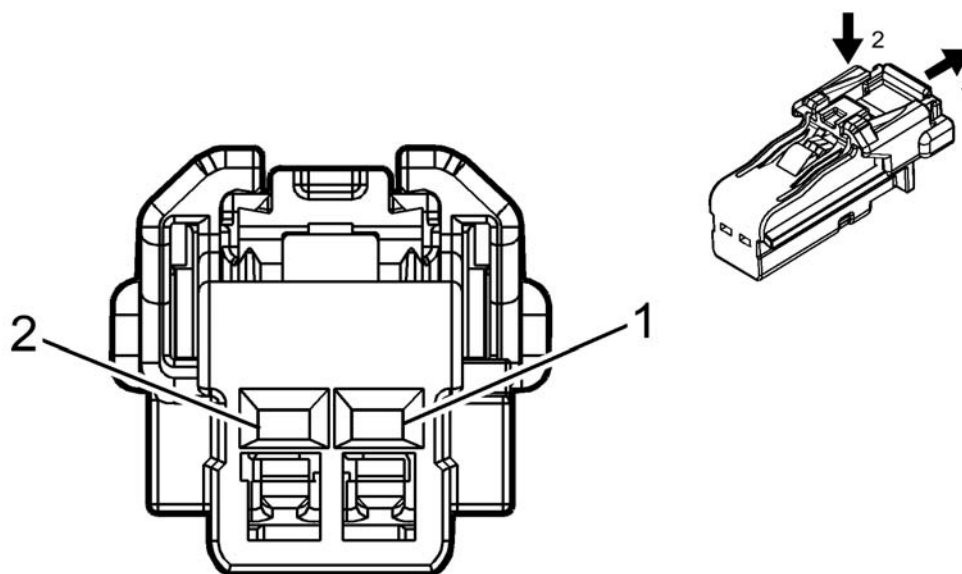
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/GY	5407	Battery Module Temperature Signal 3	I	-
2	0.35	BK/GN	3775	Battery Module Temperature Sensor Low Reference 3	I	-

B32D HYBRID/EV BATTERY TEMPERATURE SENSOR 4



Connector Part Information

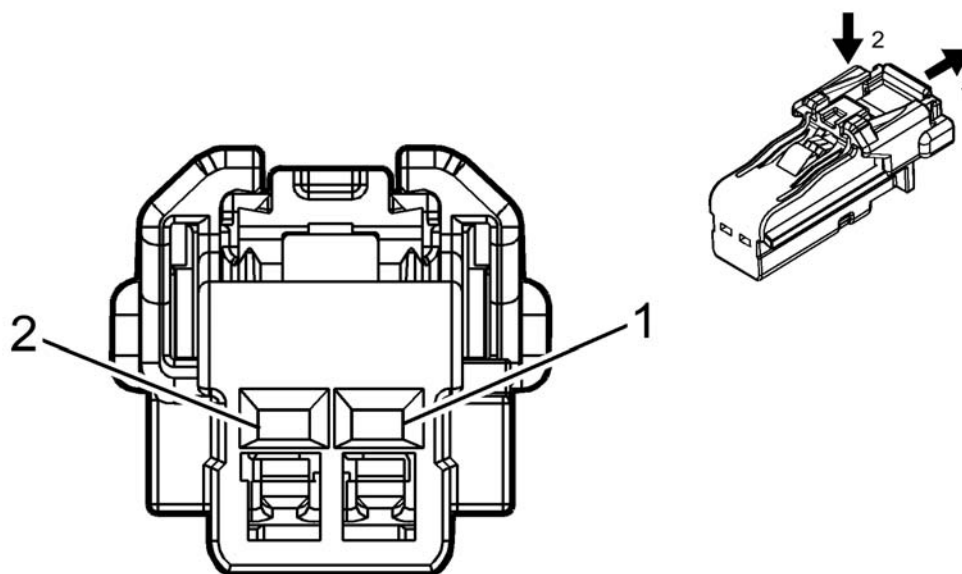
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/BK	5408	Battery Module Temperature Signal 4	I	-
2	0.35	BK/GY	3776	Battery Module Temperature Sensor Low Reference 4	I	-

B32E HYBRID/EV BATTERY TEMPERATURE SENSOR 5



Connector Part Information

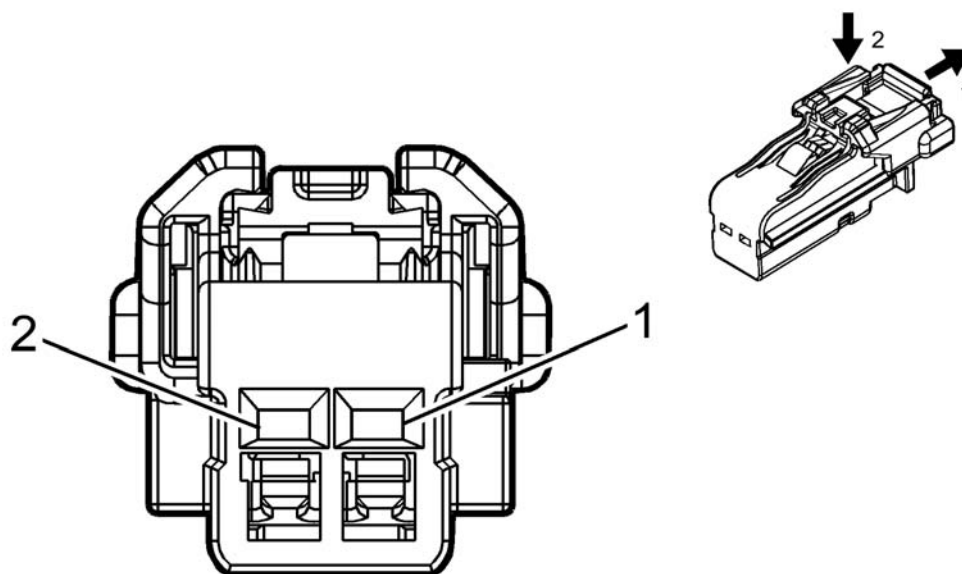
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BK	5409	Battery Module Temperature Signal 5	I	-
2	0.35	BK/VT	3777	Battery Module Temperature Sensor Low Reference 5	I	-

B32F HYBRID/EV BATTERY TEMPERATURE SENSOR 6



Connector Part Information

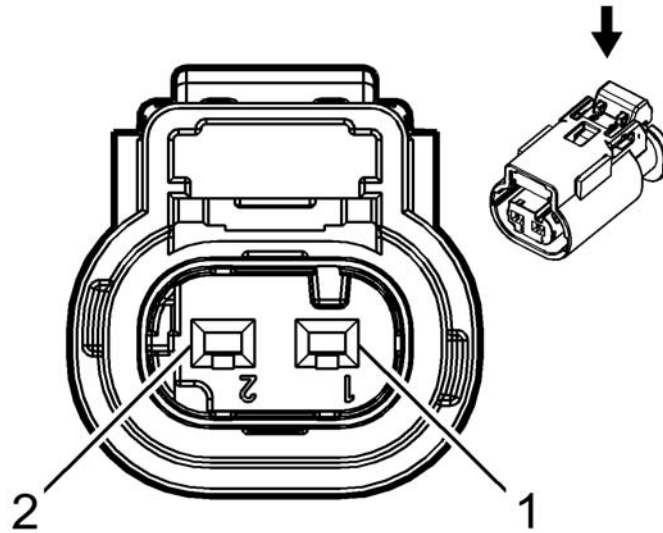
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33148040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/BN	5410	Battery Module Temperature Signal 6	I	-
2	0.35	BK/YE	3778	Battery Module Temperature Sensor Low Reference 6	I	-

B34 ENGINE COOLANT TEMPERATURE SENSOR



Connector Part Information

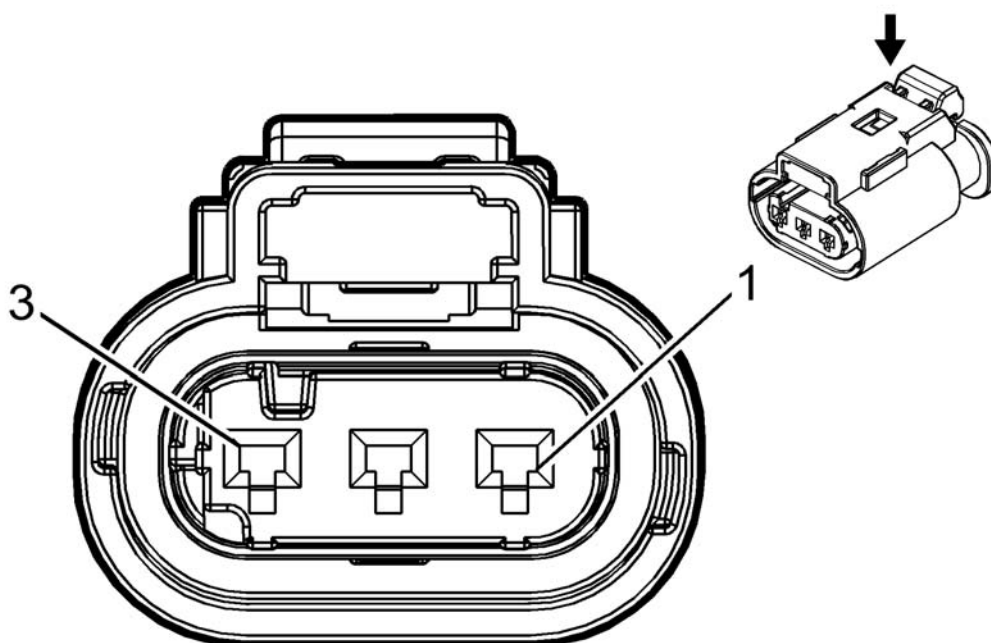
- Harness Type: Engine
- OEM Connector: 13503566
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU	410	Engine Coolant Temperature Sensor Signal	I	-
2	0.5	BK/WH	2051	Signal Ground	I	-

B37B ENGINE OIL PRESSURE SENSOR



Connector Part Information

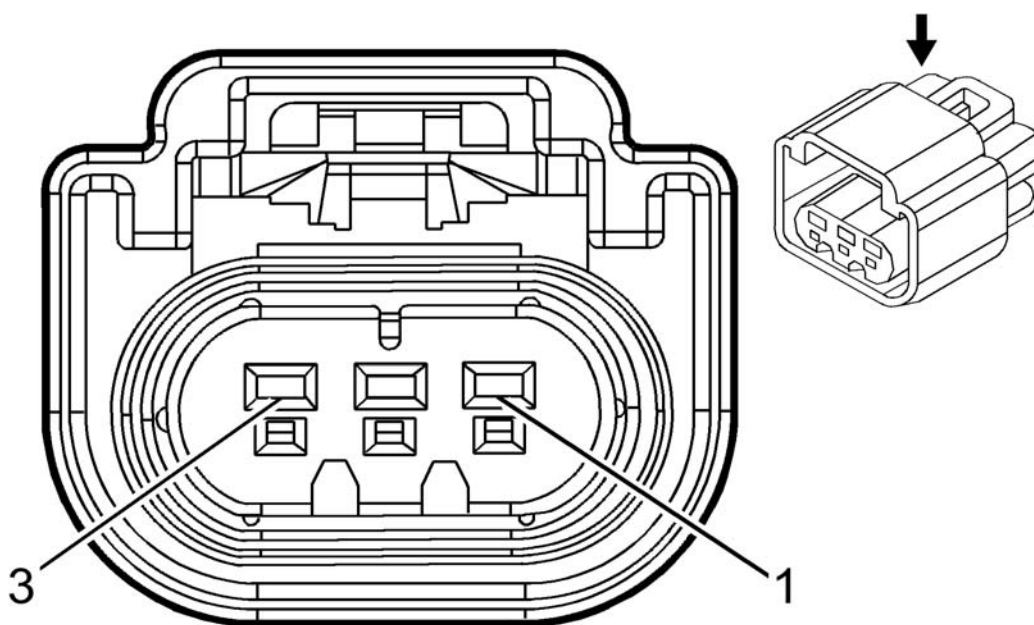
- Harness Type: Engine
- OEM Connector: 13503573
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BN	331	Oil Pressure Sensor Signal	I	-
2	0.5	BK/VT	2755	Oil Pressure Sensor Low Reference	I	-
3	0.5	WH/RD	2705	Oil Pressure Sensor 5V Reference	I	-

B47 FUEL PRESSURE SENSOR



Connector Part Information

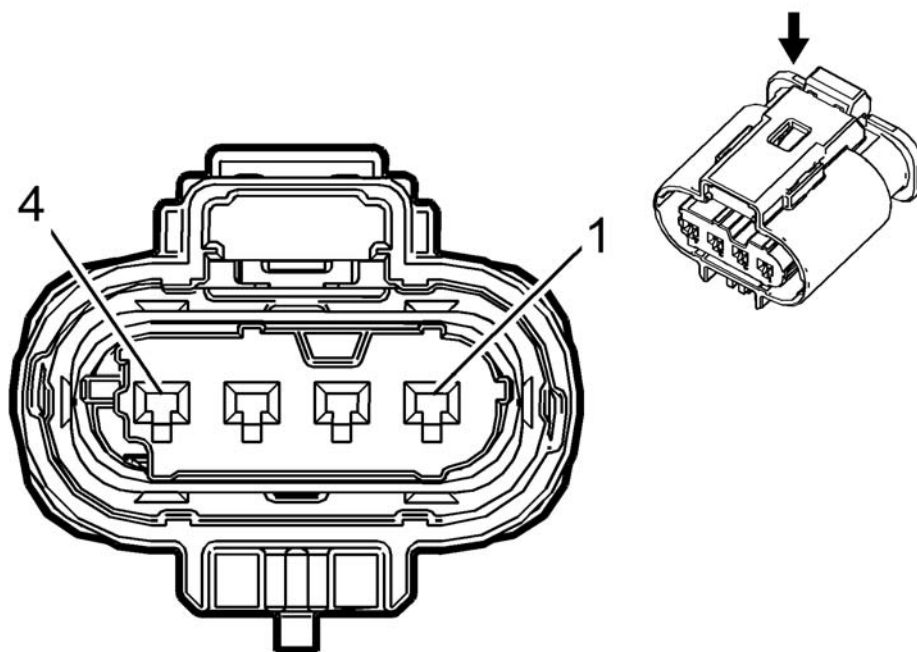
- Harness Type: Body
- OEM Connector: 13511131
- Service Connector: 19168035
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/WH	7446	Fuel Line Pressure Sensor Signal	I	-
2	0.35	BK/YE	7447	Fuel Line Pressure Sensor Low Reference	I	-
3	0.35	BN/RD	7445	Fuel Line Pressure Sensor 5V Reference	I	-

B52A HEATED OXYGEN SENSOR 1



Connector Part Information

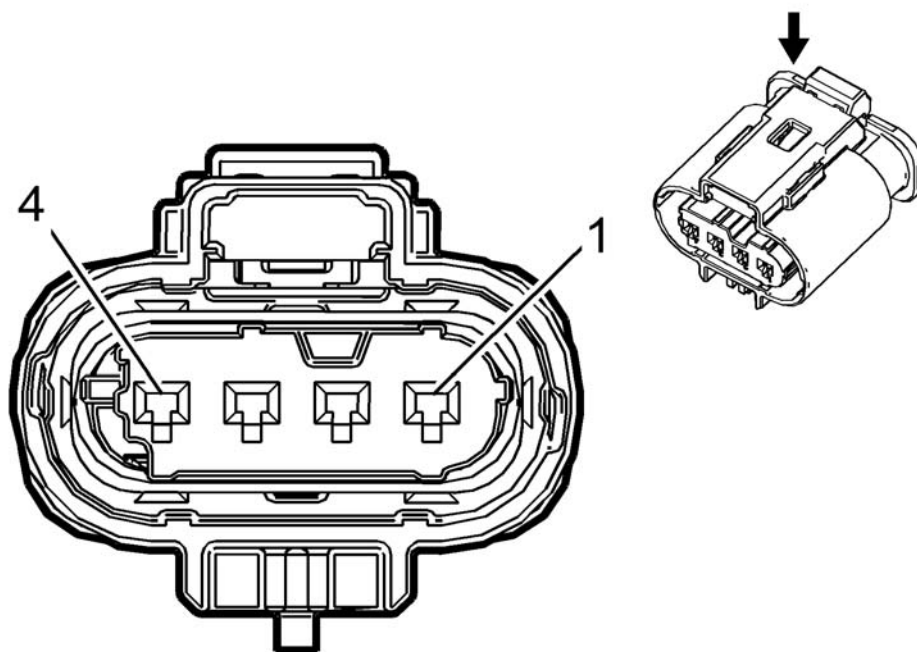
- Harness Type: Engine
- OEM Connector: 10010348
- Service Connector: 19301716
- Description: 4-Way F 1.2 Multilock Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/WH	3113	Heated Oxygen Sensor Heater Low Control Bank 1 Sensor 1	I	-
2	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
3	0.5	WH/BK	3111	Heated Oxygen Sensor Low Signal Bank 1 Sensor 1	I	-
4	0.5	VT/GY	3110	Heated Oxygen Sensor High Signal Bank 1 Sensor 1	I	-

B52B HEATED OXYGEN SENSOR 2



Connector Part Information

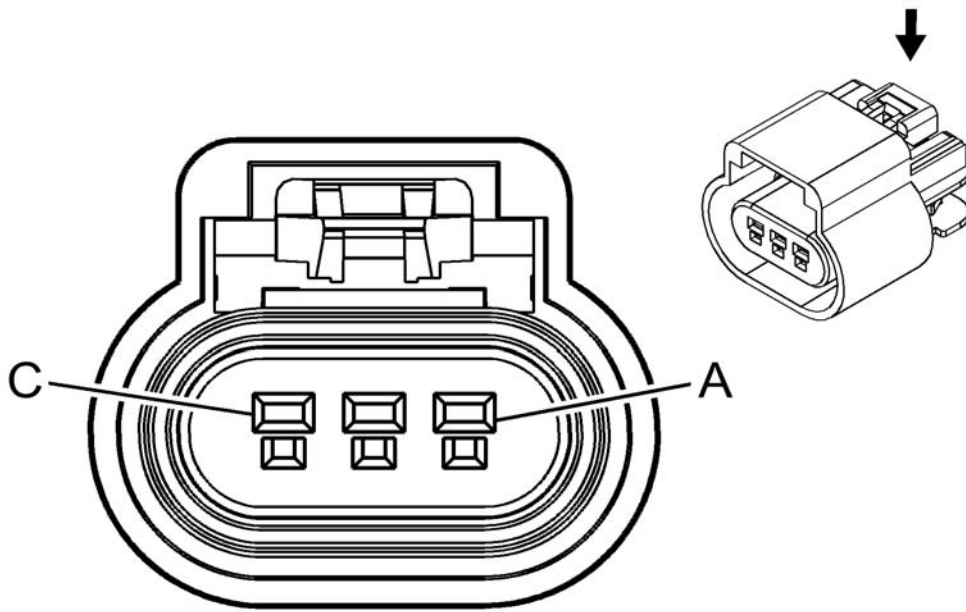
- Harness Type: Engine
- OEM Connector: 10010348
- Service Connector: 19301716
- Description: 4-Way F 1.2 Multilock Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/WH	3122	Heated Oxygen Sensor Heater Low Control Bank 1 Sensor 2	I	-
2	0.5	VT/BU	5294	Powertrain Main Relay Fused Supply 5	I	-
3	0.5	WH/YE	3121	Heated Oxygen Sensor Low Signal Bank 1 Sensor 2	I	-
4	0.5	VT/BU	3120	Heated Oxygen Sensor High Signal Bank 1 Sensor 2	I	-

B55 ENGINE HOOD SWITCH



Connector Part Information

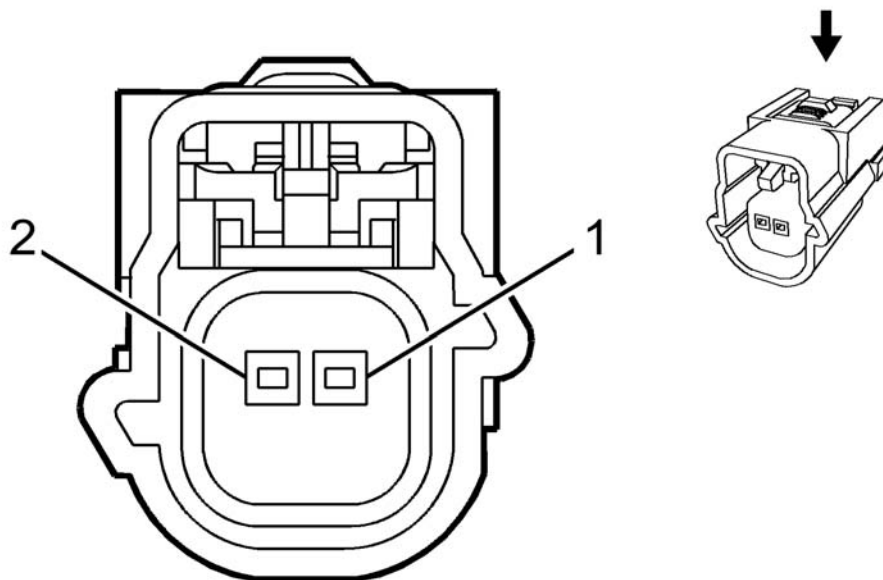
- Harness Type: Forward Lamp
- OEM Connector: 13519047
- Service Connector: 13580871
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	YE	4063	Hood Status A Signal	I	-
B	0.5	BN/GN	4064	Hood Status B Signal	I	-
C	0.5	BK	1150	Ground	I	-

B59L FRONT IMPACT SENSOR - LEFT



Connector Part Information

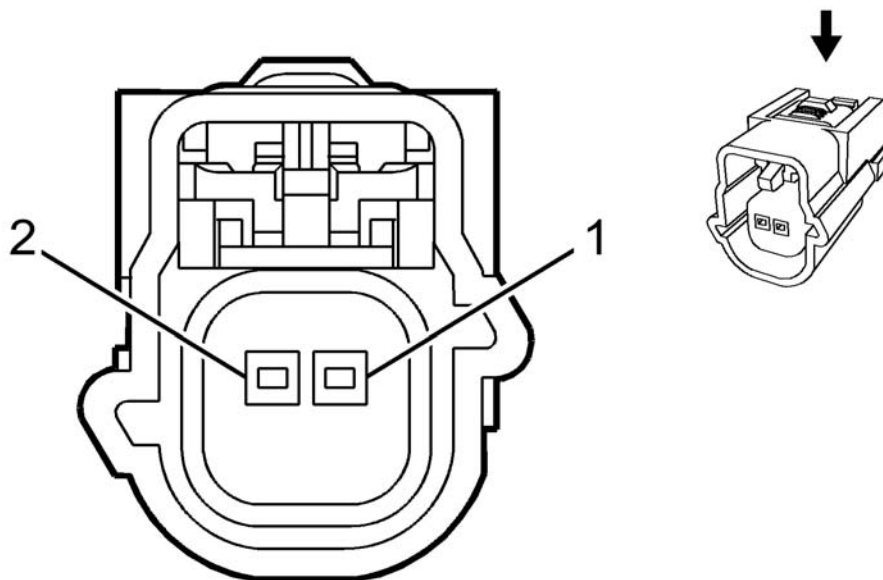
- Harness Type: Body
- OEM Connector: 54390242
- Service Connector: 13585852
- Description: 2-Way F 0.64 Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/YE	354	Left Front Discriminating Sensor Signal	I	-
2	0.5	BK/OG	5045	Left Front Discriminating Sensor Low Reference	I	-

B59R FRONT IMPACT SENSOR - RIGHT



Connector Part Information

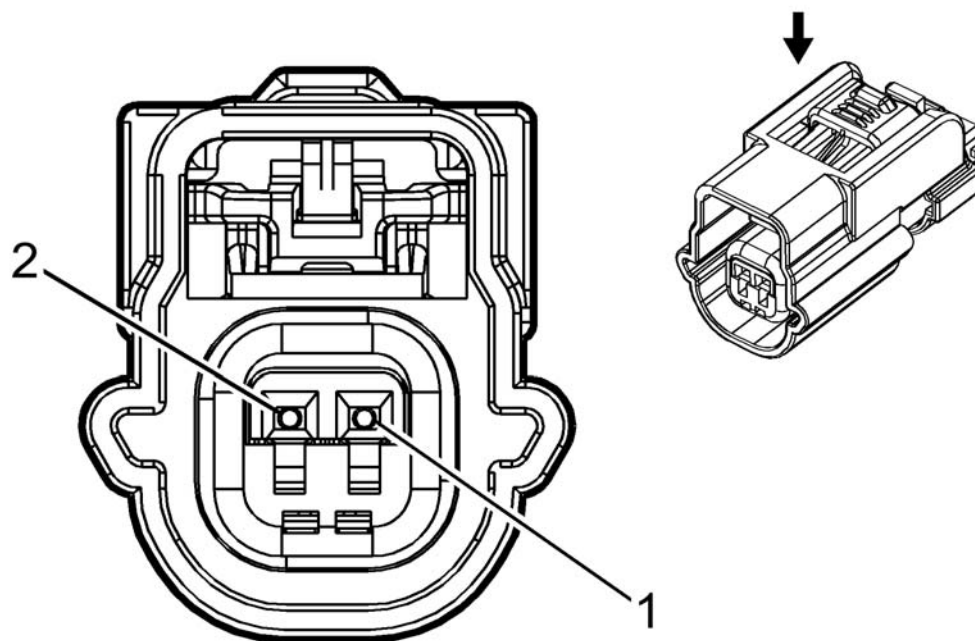
- Harness Type: Body
- OEM Connector: 54390242
- Service Connector: 13585852
- Description: 2-Way F 0.64 Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GN	1409	Right Front Discriminating Sensor Signal	I	-
2	0.5	GN	5600	Right Front Discriminating Sensor Low Reference	I	-

B63LF SIDE IMPACT SENSOR - LEFT FRONT



Connector Part Information

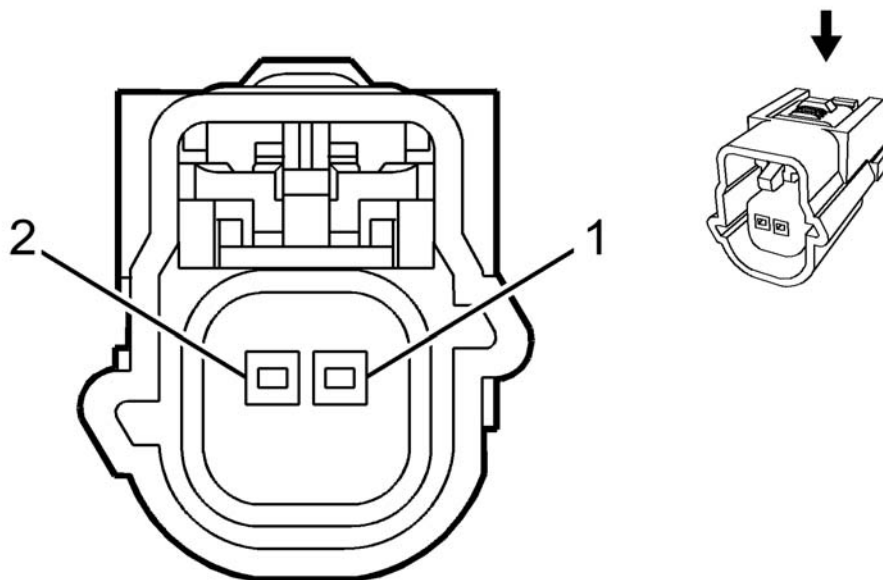
- Harness Type: Driver Door
- OEM Connector: 54390240
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/WH	2132	Left Front Side Impact Sensing Module Signal	I	-
2	0.5	GN	6628	Left Front Side Impact Sensing Module Low Reference	I	-

B63LR SIDE IMPACT SENSOR - LEFT REAR



Connector Part Information

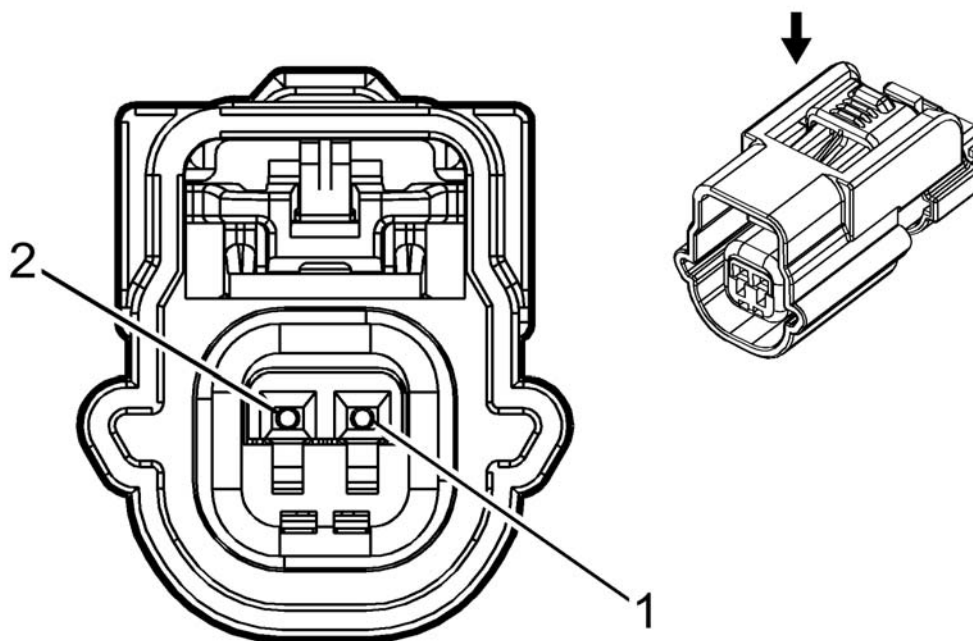
- Harness Type: Body
- OEM Connector: 54390242
- Service Connector: 13585852
- Description: 2-Way F 0.64 Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BU	6620	Left Middle Side Impact Sensing Module Signal	I	-
2	0.5	BU	6621	Left Middle Side Impact Sensing Module Low Reference	I	-

B63RF SIDE IMPACT SENSOR - RIGHT FRONT



Connector Part Information

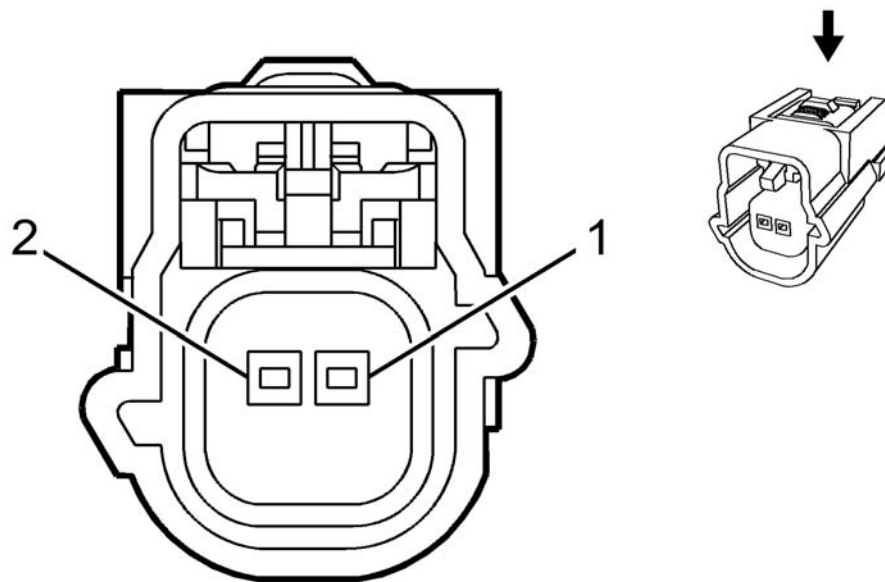
- Harness Type: Passenger Door
- OEM Connector: 54390240
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/OG	2134	Right Front Side Impact Sensing Module Signal	I	-
2	0.5	BN/WH	6629	Right Front Side Impact Sensing Module Low Reference	I	-

B63RR SIDE IMPACT SENSOR - RIGHT REAR



Connector Part Information

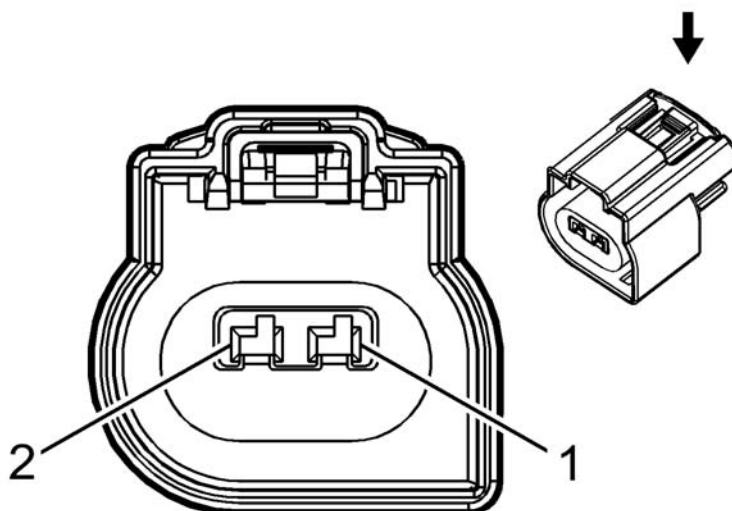
- Harness Type: Body
- OEM Connector: 54390242
- Service Connector: 13585852
- Description: 2-Way F 0.64 Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	6624	Right Middle Side Impact Sensing Module Signal	I	-
2	0.5	BK/OG	6625	Right Middle Side Impact Sensing Module Low Reference	I	-

B68 KNOCK SENSOR



Connector Part Information

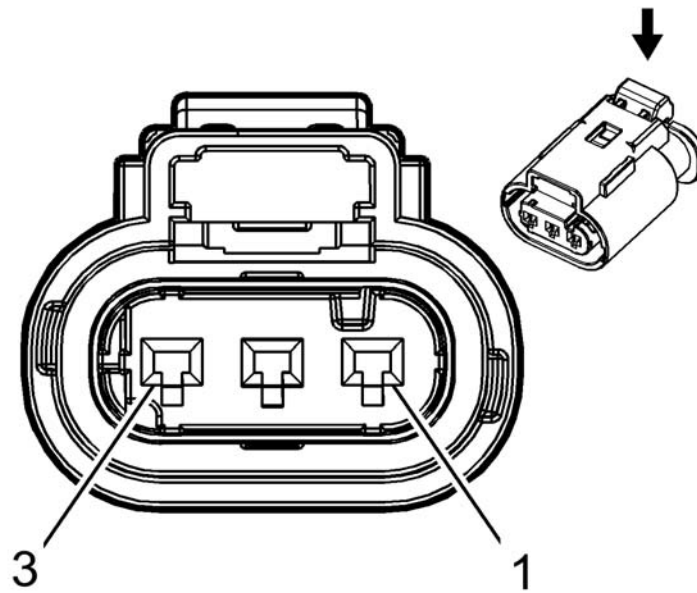
- Harness Type: Engine
- OEM Connector: 13583154
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/GY	496	Knock Sensor Signal 1	I	-
2	0.5	BK/YE	1716	Knock Sensor Low Reference 1	I	-

B74 MANIFOLD ABSOLUTE PRESSURE SENSOR



Connector Part Information

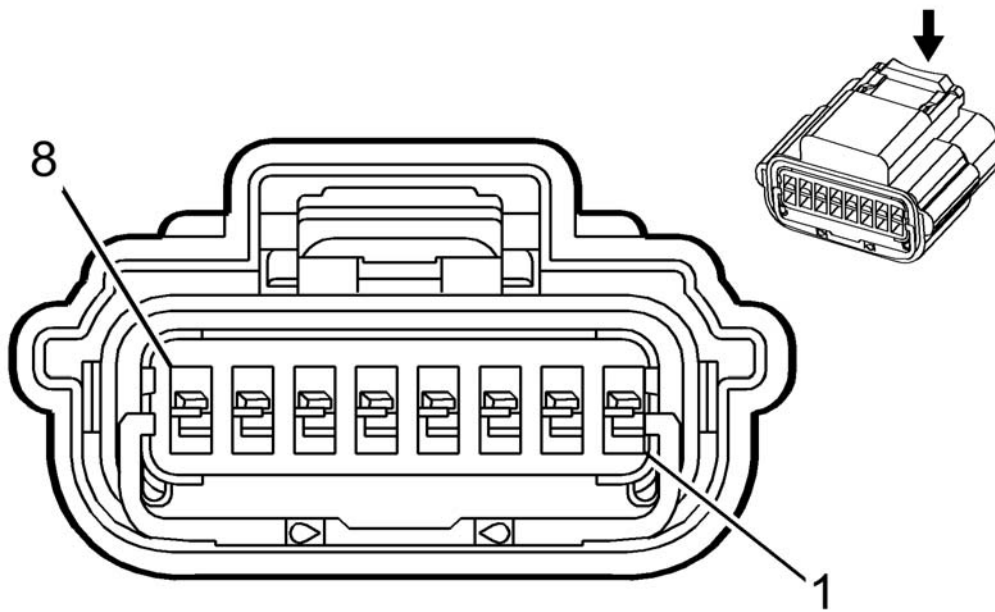
- Harness Type: Engine
- OEM Connector: 13503570
- Service Connector: 19299690
- Description: 3-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/RD	2704	Manifold Absolute Pressure Sensor 5V Reference	I	-
2	0.5	BK/GN	469	Manifold Absolute Pressure Sensor Low Reference	I	-
3	0.5	GN/WH	432	Manifold Absolute Pressure Sensor Signal	I	-

B75C MULTIFUNCTION INTAKE AIR SENSOR



Connector Part Information

- Harness Type: Engine
- OEM Connector: ATSSPB-C08C-1AK
- Service Connector: 13583440
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/BU	6289	Induction Air Temperature Sensor Signal	I	-
2	0.5	WH/RD	3201	Throttle Inlet Absolute Pressure Sensor 5V Reference	I	-
3	0.5	BK/WH	2051	Signal Ground	I	-
4	0.5	YE/WH	3200	Throttle Inlet Absolute Pressure Sensor Signal	I	-
5	0.5	VT/BU	5294	Powertrain Main Relay Fused Supply 5	I	-
6	0.5	GN/WH	492	Mass Air Flow Sensor Signal	I	-
7	0.5	BK/WH	151	Signal Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	BN/GY	4008	Humidity Sensor Signal	I	-

B81B PARK POSITION SWITCH

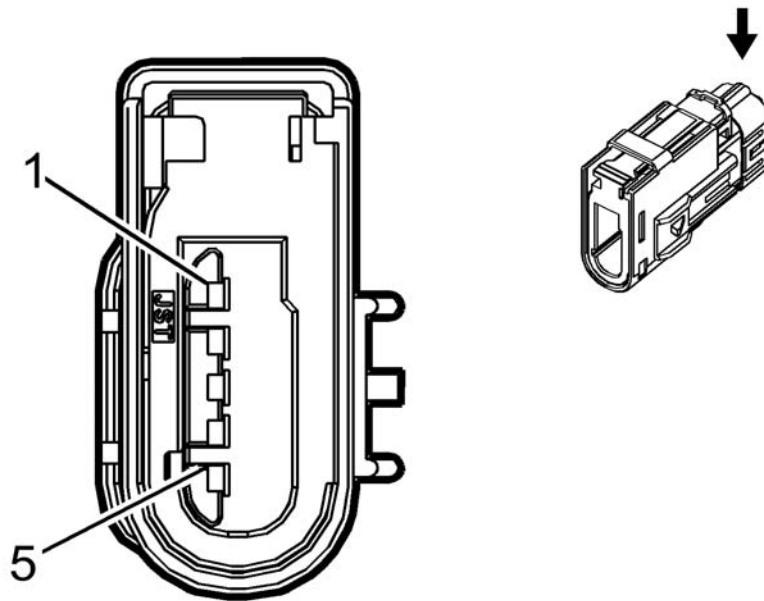
-
Connector Part Information • Harness Type: Shift Lock • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.3	BU	5905	Key Capture/Column Lock Shift Position Signal	I	-
2	0.3	BK	650	Ground	I	-

B87 REARVIEW CAMERA



Connector Part Information

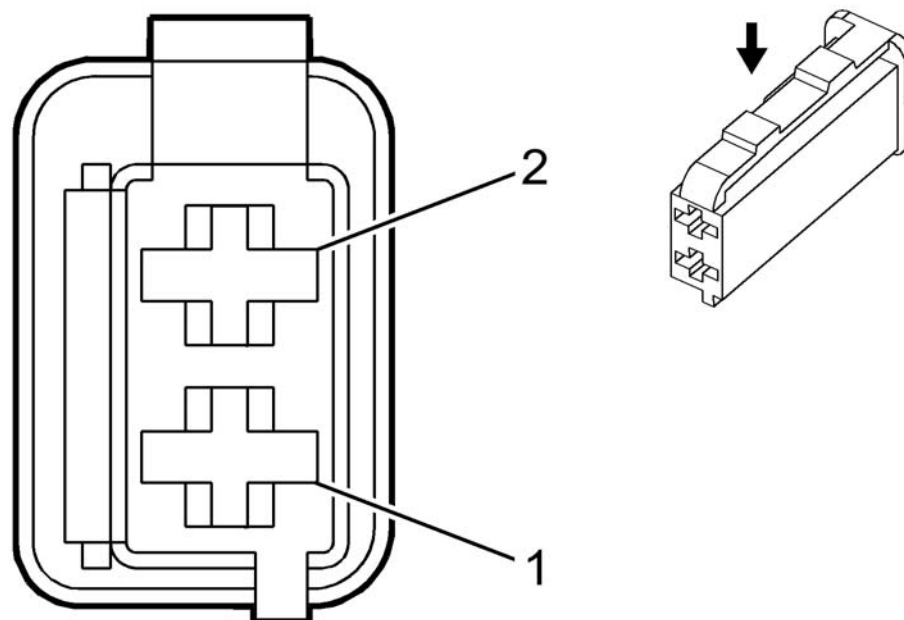
- Harness Type: Rear Lamp
- OEM Connector: SRVWSB-05-AH
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/YE	6972	Camera Signal 2 +	I	-
2	0.5	WH/BU	6973	Camera Signal 2	I	-
3	0.5	BK	6974	Camera Low Reference	I	-
4	0.5	BK	650	Ground	I	-
5	0.5	VT/GN	439	Run/Crank Ignition 1 Voltage	I	-

B88D SEAT BELT SWITCH - DRIVER



Connector Part Information

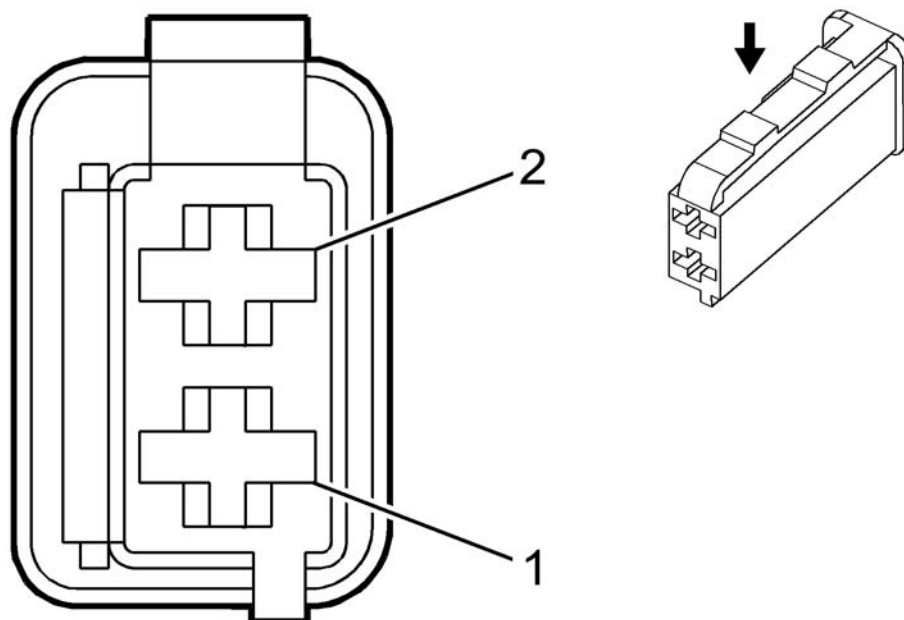
- Harness Type: Seats
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/OG	1363	Driver Seat Belt Switch Low Reference	I	-
2	0.5	TN/WH	238	Driver Seat Belt Switch Signal	I	-

B88P SEAT BELT SWITCH - PASSENGER



Connector Part Information

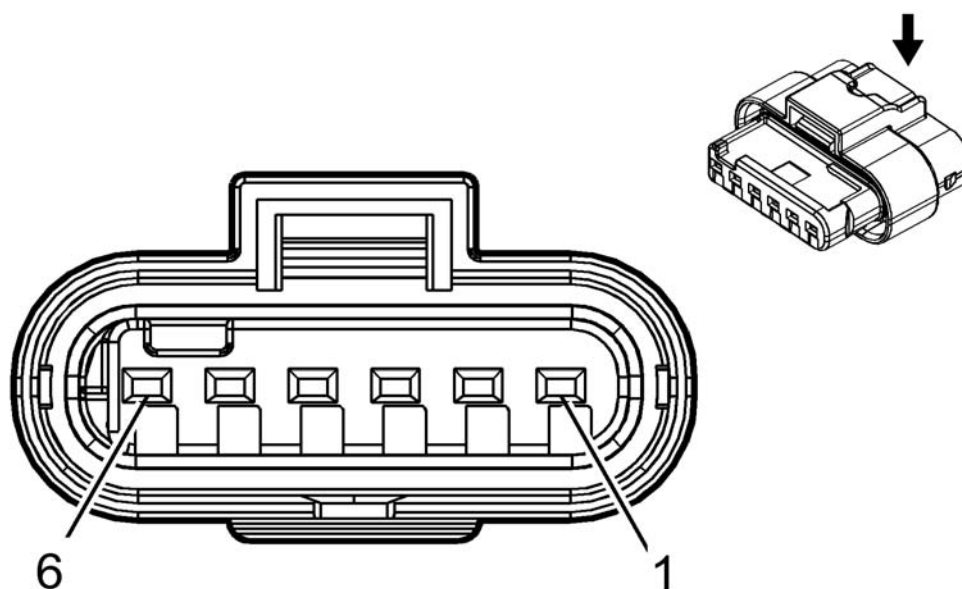
- Harness Type: Seats
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-
2	0.5	OG	1362	Passenger Seat Belt Switch Signal	I	-

B107 ACCELERATOR PEDAL POSITION SENSOR



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1924292-1
- Service Connector: 19330667
- Description: 6-Way F 1.2 MCP Series, Sealed (BK)

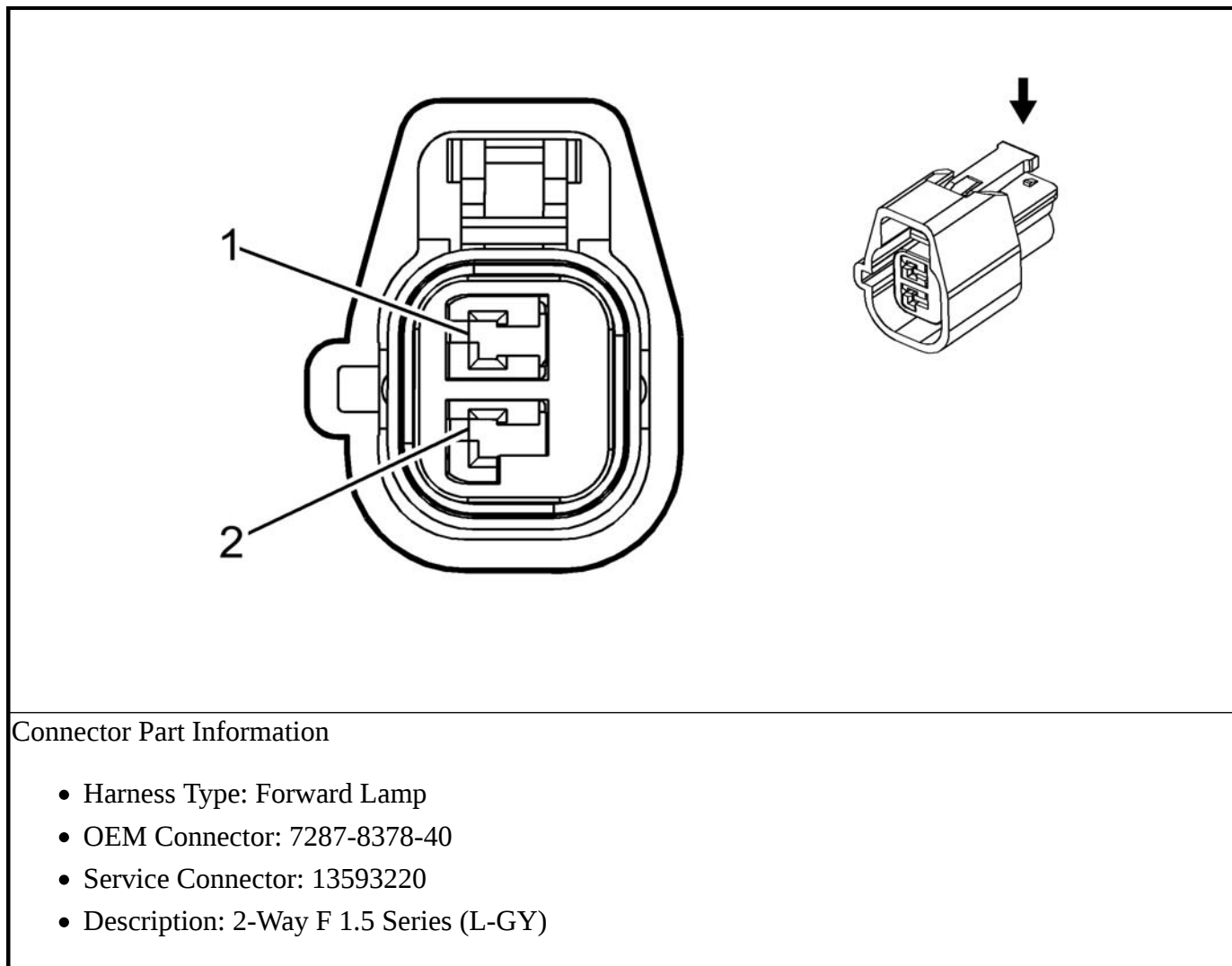
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/RD	1274	Accelerator Pedal Position 5V Reference 2	I	-
2	0.35	WH/RD	1164	Accelerator Pedal Position 5V Reference 1	I	-
3	0.35	YE/WH	1161	Accelerator Pedal Position Signal 1	I	-
4	0.35	BK/BU	1271	Accelerator Pedal Position Low Reference 1	I	-
5	0.35	BK/VT	1272	Accelerator Pedal Position Low Reference 2	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
6	0.35	GN/WH	1162	Accelerator Pedal Position Signal 2	I	-

B118B WINDSHIELD WASHER FLUID LEVEL SWITCH

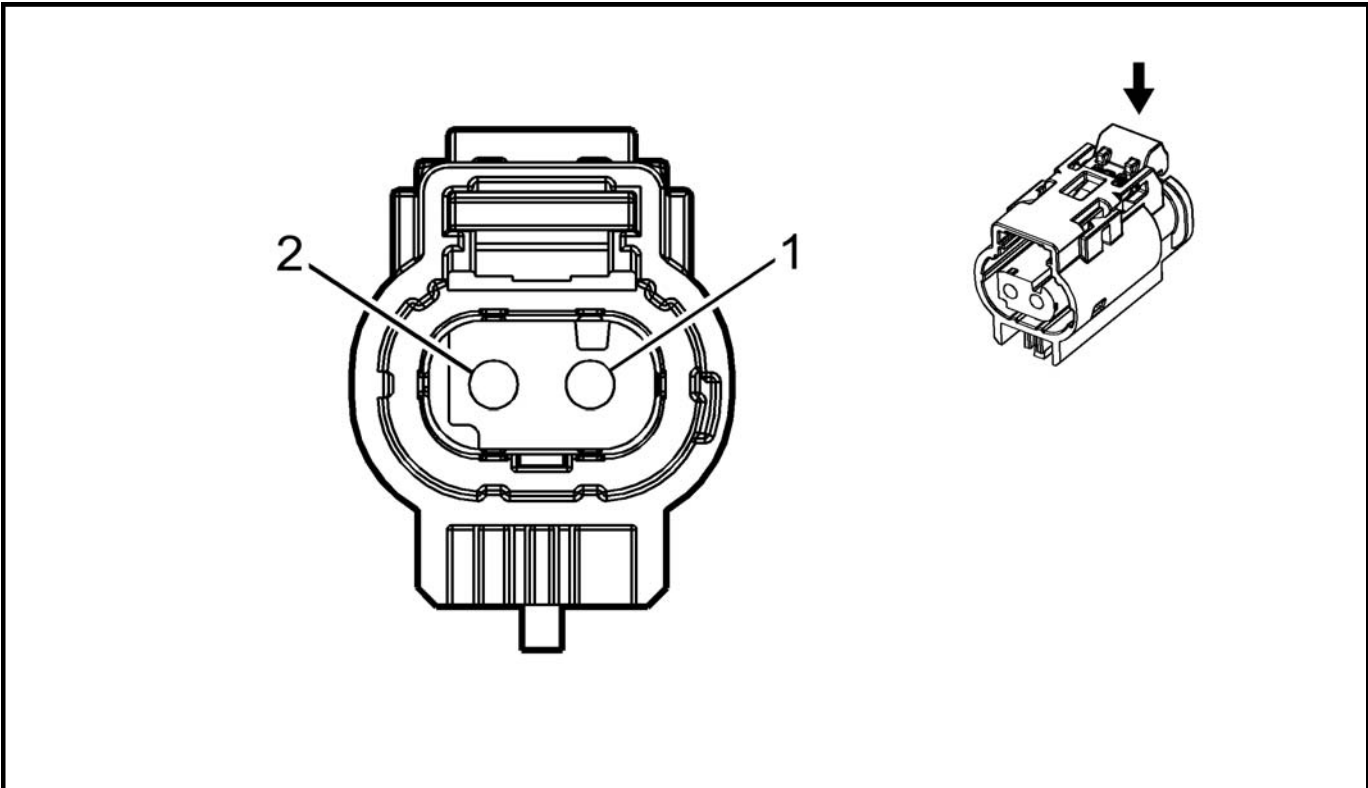


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT	185	Low Washer Fluid Indicator Control	I	-
2	0.5	BK	1050	Ground	I	-

B130A EXHAUST GAS RECIRCULATION TEMPERATURE SENSOR 1



Connector Part Information

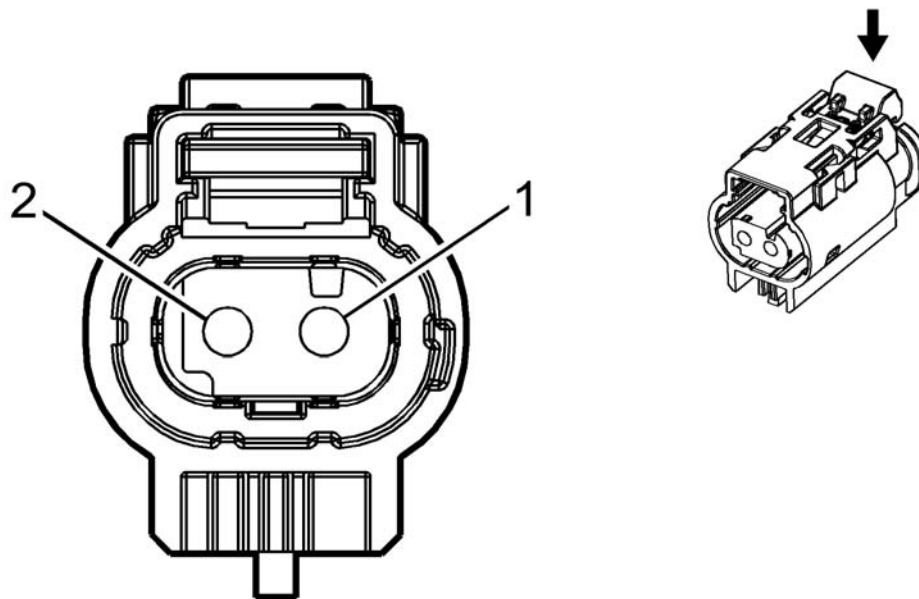
- Harness Type: Engine
- OEM Connector: 10094234
- Service Connector: 19332719
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/BN	3237	Exhaust Gas Recirculation Temperature Sensor Signal	I	-
2	0.5	BK/WH	2051	Signal Ground	I	-

B130B EXHAUST GAS RECIRCULATION TEMPERATURE SENSOR 2



Connector Part Information

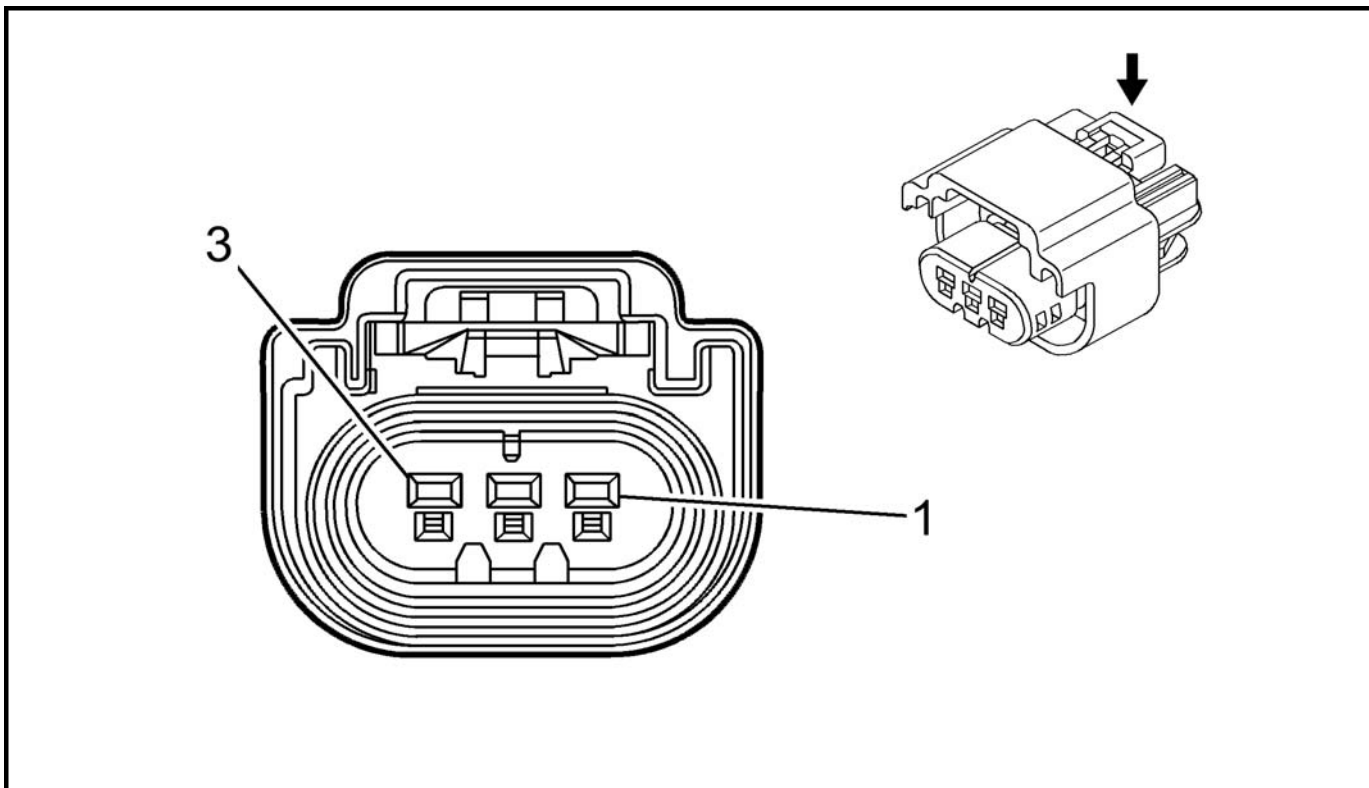
- Harness Type: Engine
- OEM Connector: 10094234
- Service Connector: 19332719
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/GN	3236	Exhaust Gas Recirculation Temperature Sensor 2 Signal	I	-
2	0.5	BK/WH	2051	Signal Ground	I	-

B150 FUEL TANK PRESSURE SENSOR



Connector Part Information

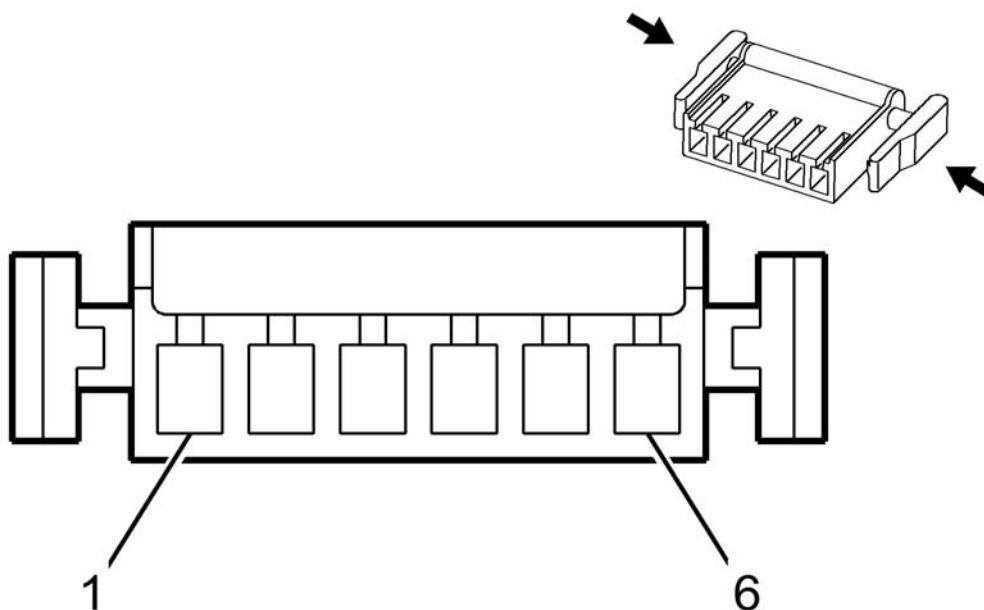
- Harness Type: Seats
- OEM Connector: 88988721
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/WH	890	Fuel Tank Pressure Sensor Signal	I	-
2	0.5	BK/GN	6281	Fuel Level Sensor Low Reference	I	-
3	0.5	YE/RD	2709	Fuel Tank Pressure Sensor 5V Reference	I	-

B160 WINDSHIELD TEMPERATURE AND INSIDE MOISTURE SENSOR



Connector Part Information

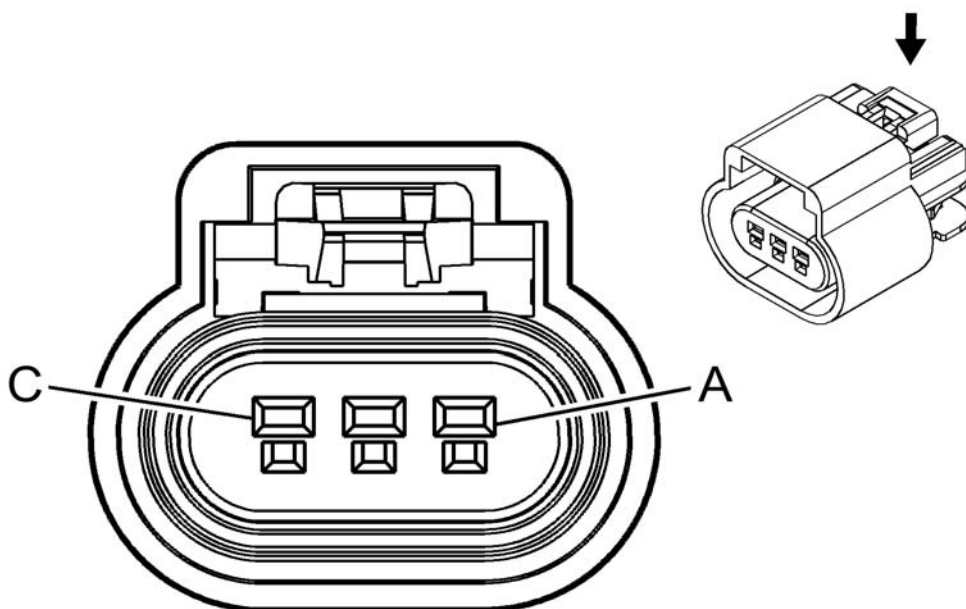
- Harness Type: Body
- OEM Connector: 13726957
- Service Connector: 13576539
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE/RD	597	5V Reference	I	-
2	0.35	GY/BU	7564	Humidity Sensor Signal	I	-
3	0.35	BK/BN	6102	Inside Air Temperature Sensor Low Reference	I	-
4	0.35	GY/GN	7565	Windscreen Temp Sensor Signal	I	-
5	0.35	YE/BU	3197	Humidity Temperature Sensor Signal	I	-
6	-	-	-	Not Occupied	-	-

B197 CHARGE PORT DOOR POSITION SWITCH



Connector Part Information

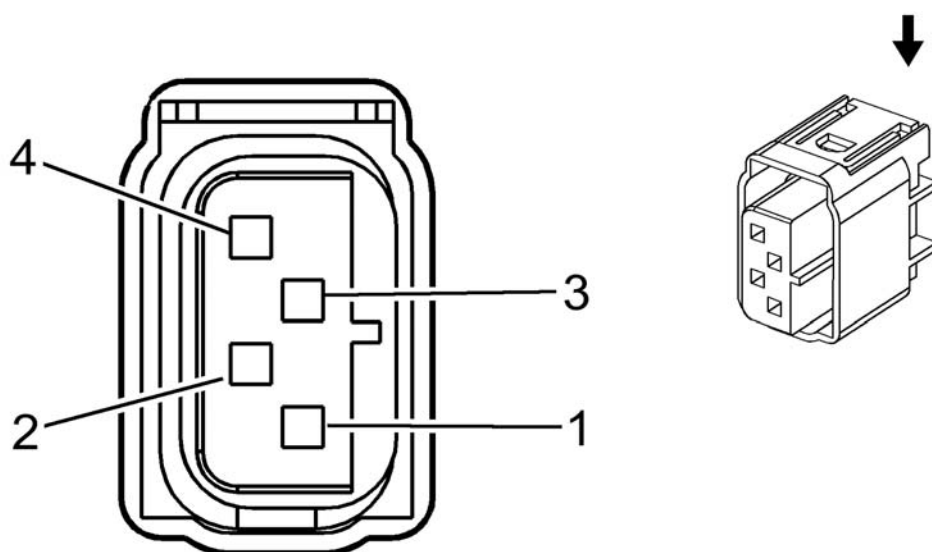
- Harness Type: Body
- OEM Connector: 13519047
- Service Connector: 13580871
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/BU	3697	Charge Port Door Sensor Signal	I	-
B	-	-	-	Not Occupied	-	-
C	0.5	BK	1550	Ground	I	-

B201 BRAKE CONTROL BRAKE PEDAL POSITION SENSOR



Connector Part Information

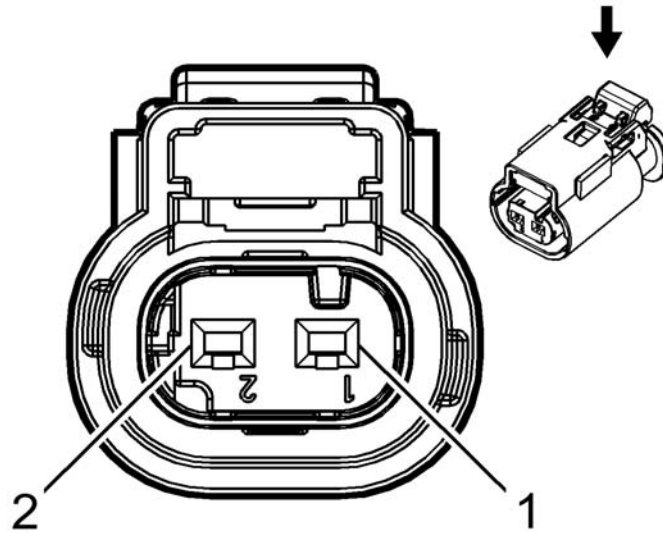
- Harness Type: Body
- OEM Connector: 1-967640-1
- Service Connector: 13585332
- Description: 4-Way F 0.64 Micro-Quadlock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/RD	3335	Brake Pedal Travel Sensor 1 High Reference	I	-
2	0.35	BU/YE	3334	Brake Pedal Travel Sensor 1 Signal	I	-
3	0.35	BK/GY	3417	Brake Pedal Travel Sensor 1 Low Reference	I	-
4	0.35	VT/BN	3333	Brake Pedal Travel Sensor 2 Signal	I	-

B202 HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR



Connector Part Information

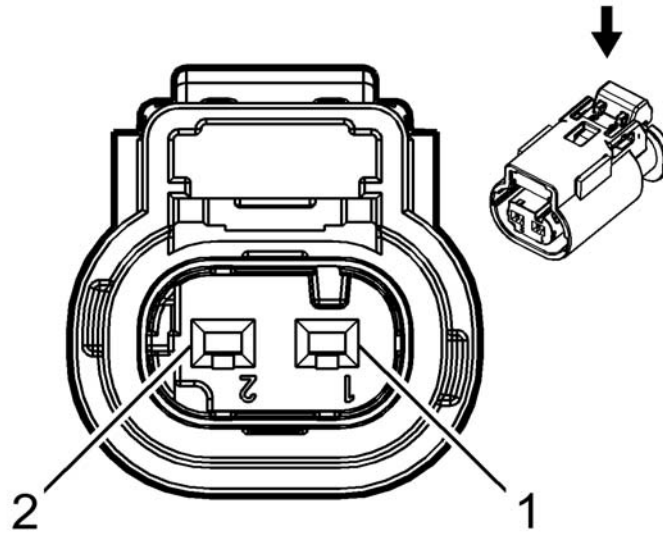
- Harness Type: Cooling Fan
- OEM Connector: 10010337
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/VT	2032	Coolant Temperature Sensor Signal	I	-
2	0.5	BK/YE	407	Sensor Low Reference	I	-

B203 ENGINE COOLANT RADIATOR TEMPERATURE SENSOR



Connector Part Information

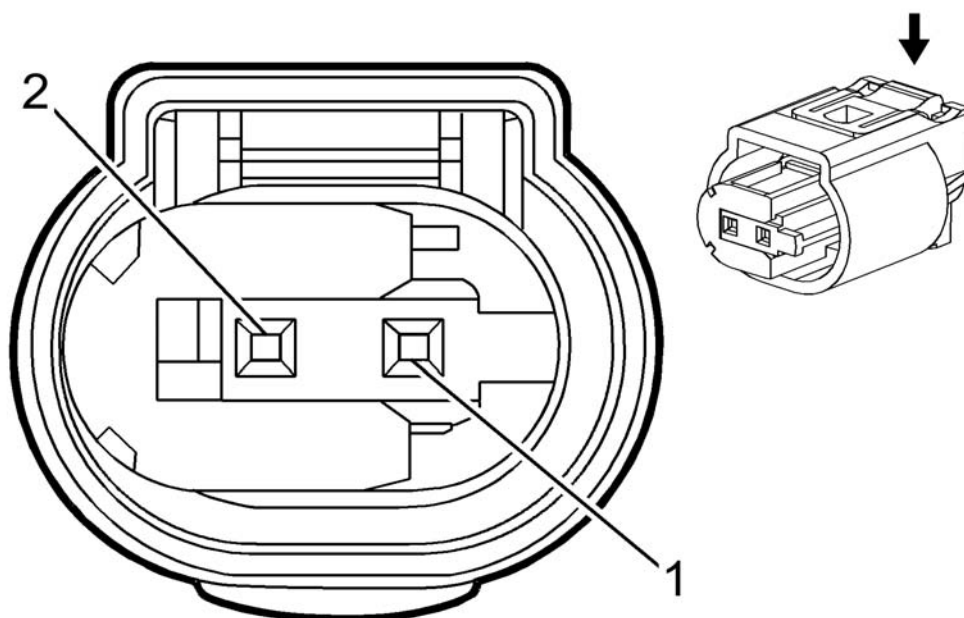
- Harness Type: Cooling Fan
- OEM Connector: 10010337
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	I	-
2	0.5	BK/BU	6813	Coolant Temperature Sensor 2 Low Reference	I	-

B204A HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1



Connector Part Information

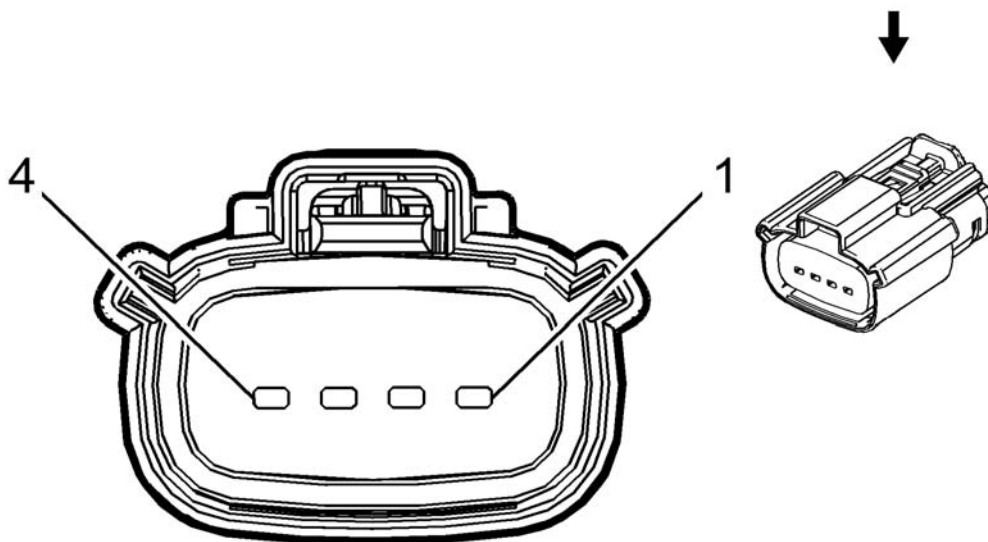
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 1-967644-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Micro-Quadlock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	5411	Battery Module Temperature Signal 7	I	-
2	0.5	BK/BU	3779	Battery Module Temperature Sensor Low Reference 7	I	-

B208 FUEL FILL DOOR STATUS SWITCH ASSEMBLY



Connector Part Information

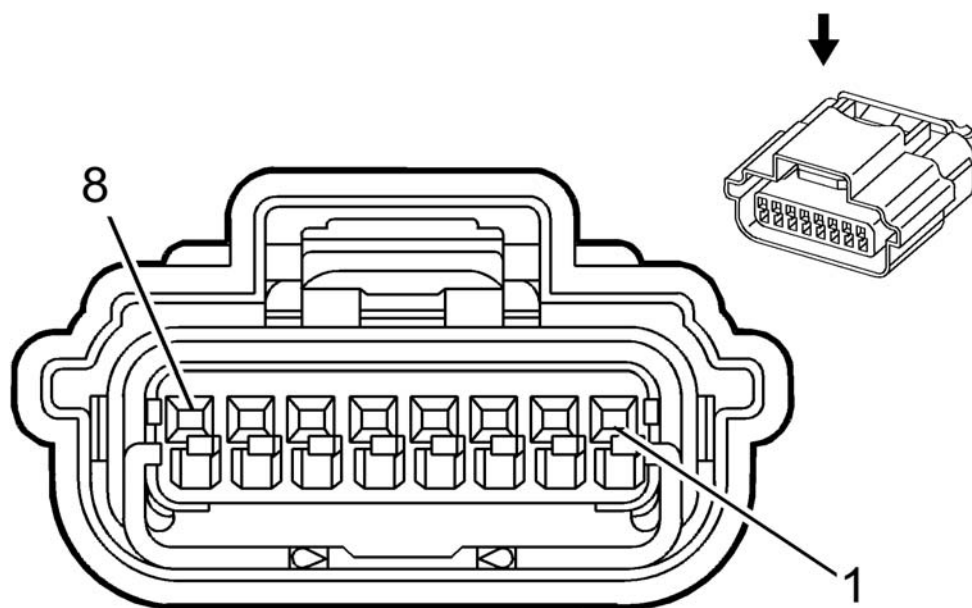
- Harness Type: Body
- OEM Connector: 33471-0406
- Service Connector: 13577535
- Description: 4-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/BK	6502	Fuel Door Open Signal	I	-
2	0.5	BK	850	Ground	I	-
3	0.5	YE/BK	3829	Fuel Door Status Signal	I	-
4	0.5	BK	850	Ground	I	-

B218L SIDE OBJECT SENSOR MODULE - LEFT



Connector Part Information

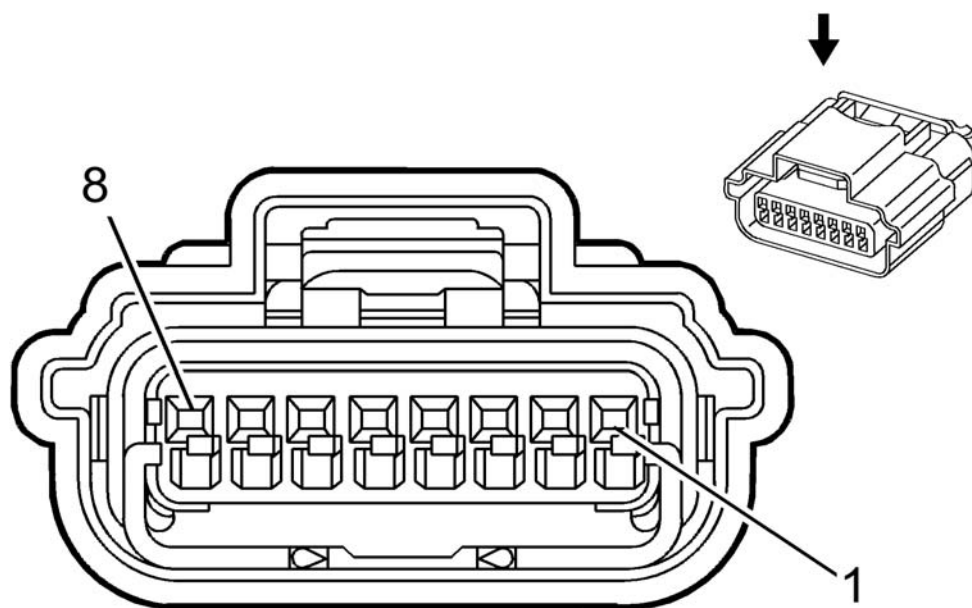
- Harness Type: Rear Lamp
- OEM Connector: ATSSPB-A0805G-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	GY/YE	5853	Driver Side Object Detection LED Signal 1	I	-
5	0.5	RD/GY	2840	Battery Positive Voltage	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
8	0.5	BK	650	Ground	I	-

B218R SIDE OBJECT SENSOR MODULE - RIGHT



Connector Part Information

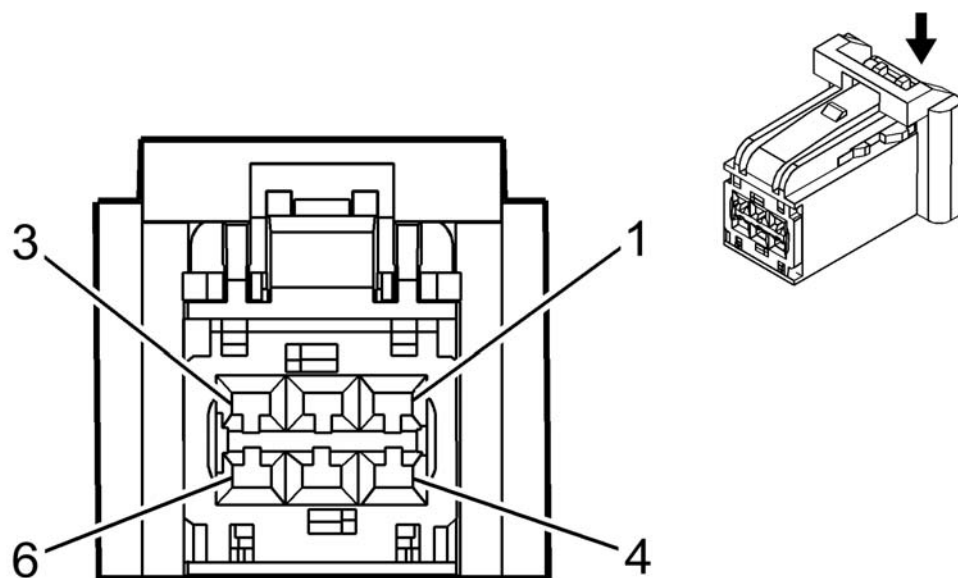
- Harness Type: Rear Lamp
- OEM Connector: ATSSPB-A0805H-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	BK	650	Ground	I	-
4	0.5	GY	5861	Passenger Side Object Detection LED Signal 1	I	-
5	0.5	RD/GY	2840	Battery Positive Voltage	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
8	0.5	BK	650	Ground	I	-

B228A DRIVE MOTOR 1 POSITION SENSOR



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 33134940
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.2 OCS Series (NA)

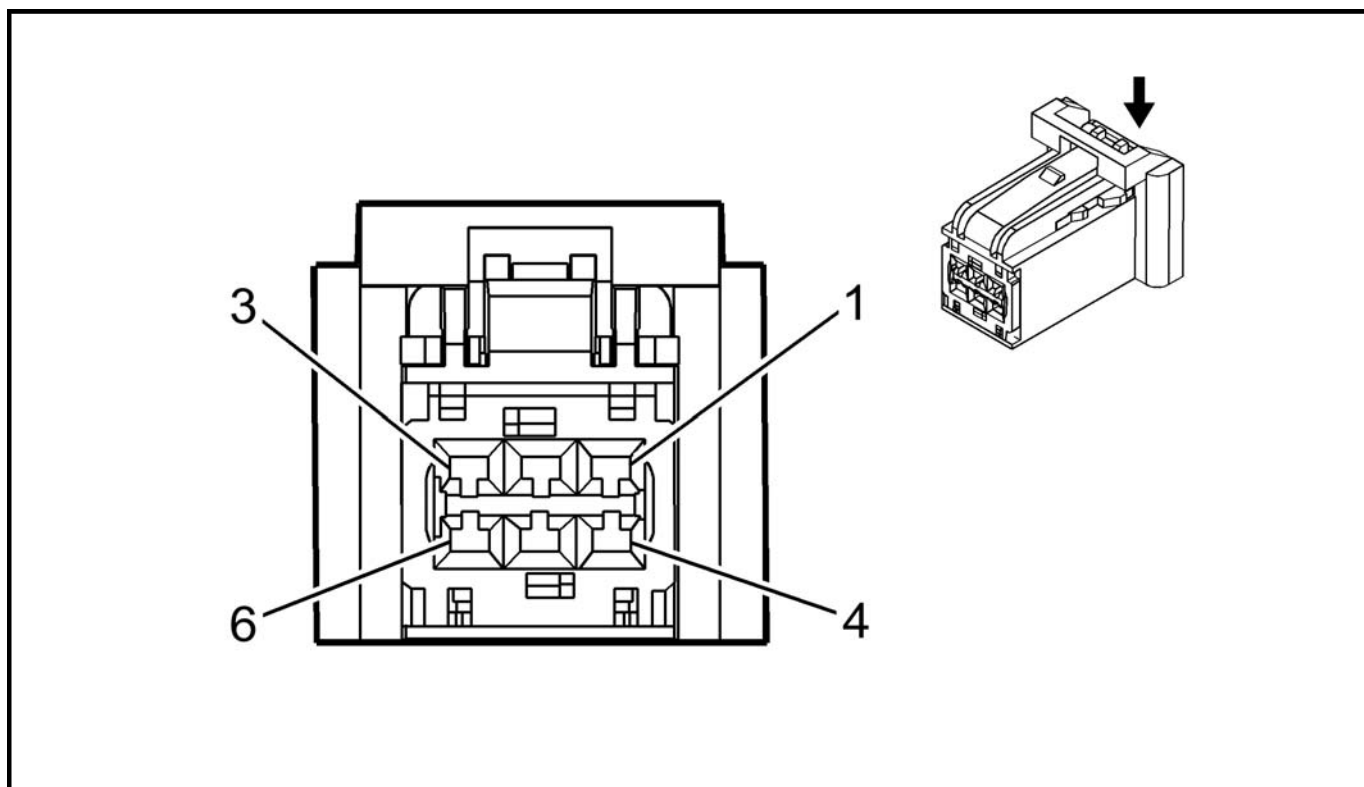
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/WH	7652	Traction Power Inverter Module Resolver 1 S3 Signal	I	-
2	0.5	YE/BK	7649	Traction Power Inverter Module Resolver 1 S1 Signal	I	-
3	0.5	GN	7645	Traction Power Inverter Module Resolver 1 Excitation Signal Positive	I	-
4	0.5	PK	7648	Traction Power Inverter Module Resolver 1 Excitation Signal Negative	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.5	RD	7647	Transmission Traction Power Inverter Module Resolver 1 S2 Signal	I	-
6	0.5	BU	7646	Transmission Traction Power Inverter Module Resolver 1 S4 Signal	I	-

B228B DRIVE MOTOR 2 POSITION SENSOR



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 33134940
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.2 OCS Series (NA)

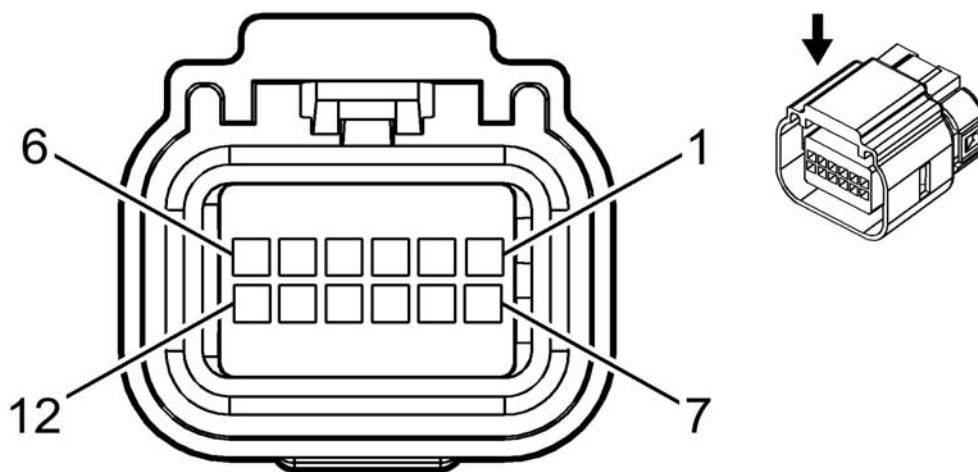
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-----	------	-------	---------	----------	------------------	--------

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU	3487	Traction Power Inverter Module Resolver 2 S3 Signal	I	-
2	0.5	YE	3488	Traction Power Inverter Module Resolver 2 S1 Signal	I	-
3	0.5	WH	3486	Traction Power Inverter Module Resolver 2 Excitation Signal Positive	I	-
4	0.5	TN	3485	Transmission Traction Power Inverter Module Resolver 2 Excitation Signal Negative	I	-
5	0.5	GN	3491	Traction Power Inverter Module Resolver 2 S2 Signal	I	-
6	0.5	BK	3492	Traction Power Inverter Module Resolver 2 S4 Signal	I	-

B233B RADAR SENSOR MODULE - LONG RANGE



Connector Part Information

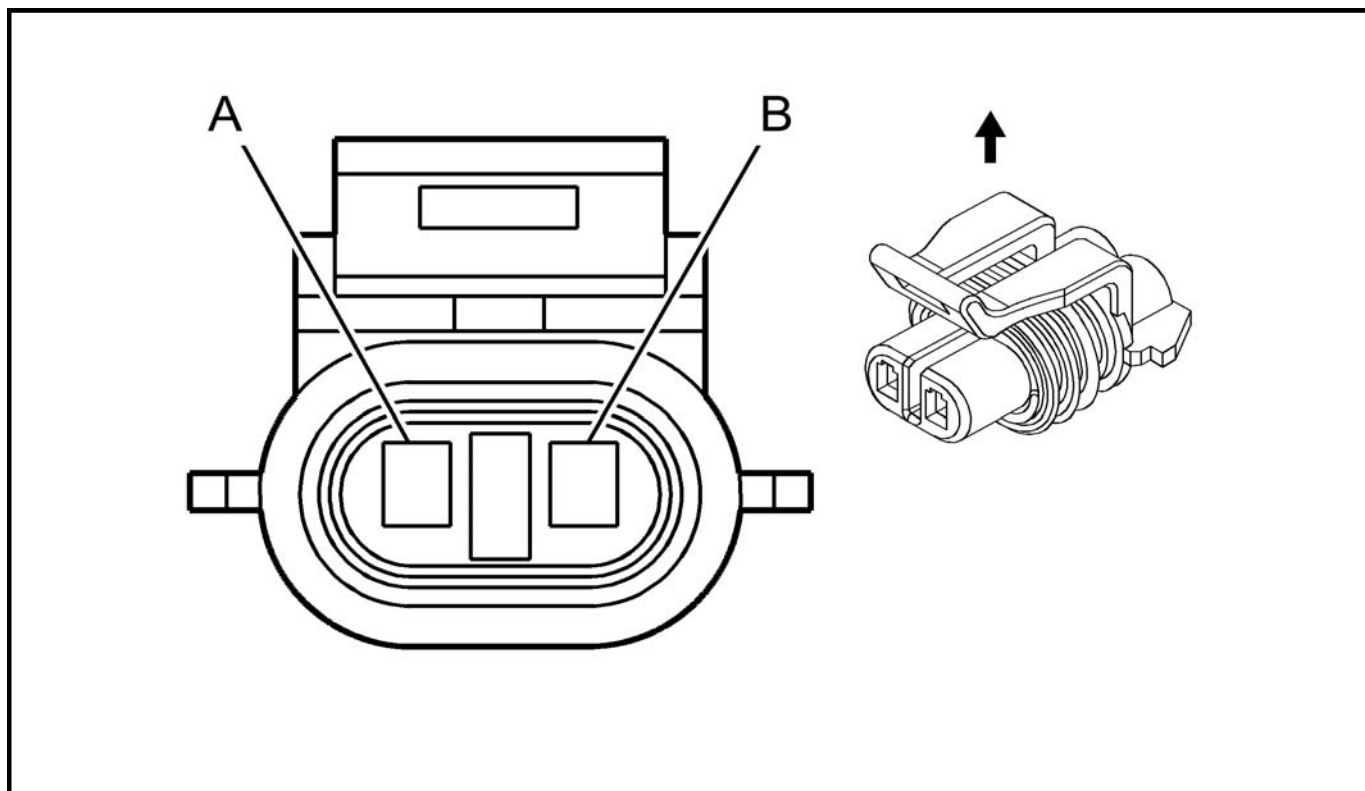
- Harness Type: Forward Lamp
- OEM Connector: 13833301
- Service Connector: 19299773
- Description: 12-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300649	J-35616-64B (LT BU)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
3	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
4	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
5	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
6	0.35	GY/VT	3808	Front Object Sensor Control 2	I	-
7	0.5	BK	1050	Ground	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
11	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
12	-	-	-	Not Occupied	-	-

B258 HYBRID/EV BATTERY COOLANT LEVEL SWITCH



Connector Part Information

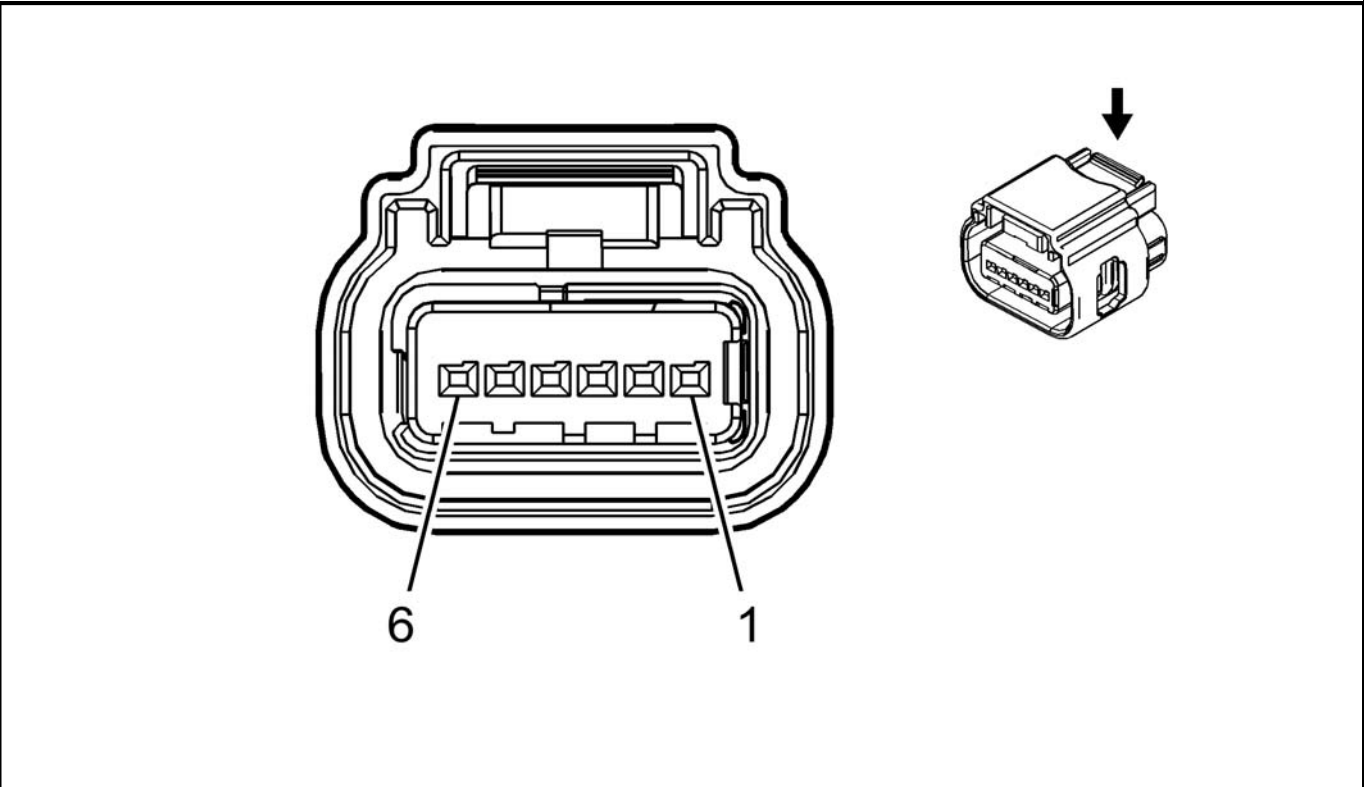
- Harness Type: Cooling Fan
- OEM Connector: 12186685
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	BU/YE	68	Low Coolant Level Indicator Control	I	-
B	0.5	BK/GN	476	Sensor Low Reference	I	-

B284 VEHICLE DYNAMIC SENSOR



Connector Part Information

- Harness Type: Body
- OEM Connector: 47715-6100
- Service Connector: 19299684

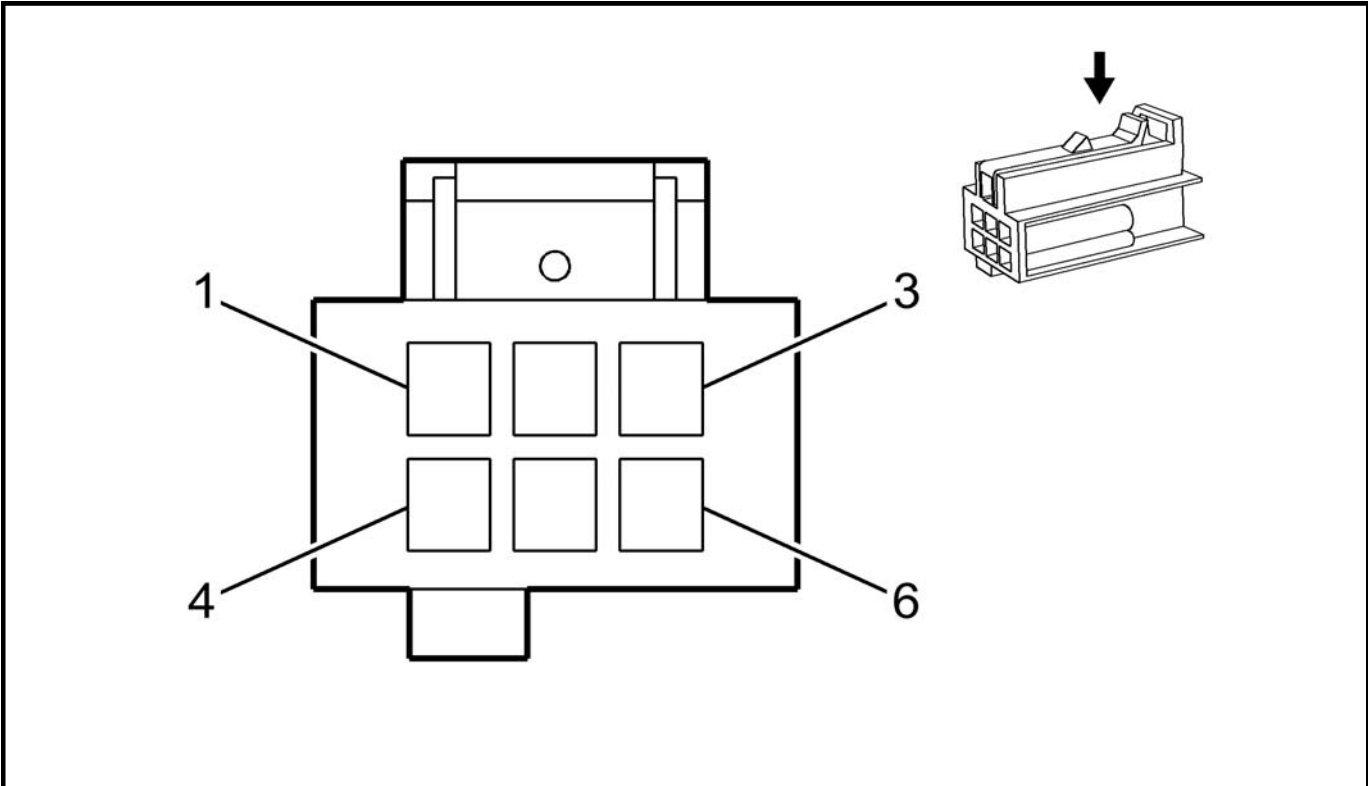
- Description: 6-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
2	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
3	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
4	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
5	0.5	GN/BN	2087	Combined Vehicle Inertial Sensor Supply Voltage	I	-
6	0.5	BK	850	Ground	I	-

B305 AMBIENT LIGHT/SUNLOAD SENSOR AND BATTERY STATE OF CHARGE INDICATOR



Connector Part Information

- Harness Type: Instrument Panel

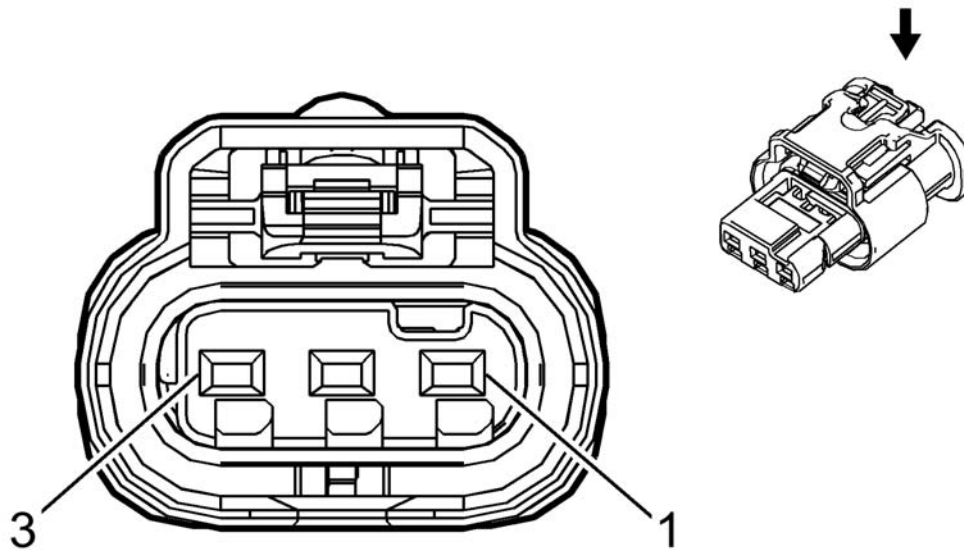
- OEM Connector: 965413-1
- Service Connector: 19333315
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	2150	Ground	I	-
2	0.35	GN/WH	4115	Local Interconnect Network Serial Data Bus 15	I	-
3	0.35	YE/VT	3956	Charging Status Indicator Control	I	-
4	0.35	GY/GN	3957	Charging Pilot Signal Indicator Control	I	-
5	0.35	RD/WH	3440	Battery Positive Voltage	I	-
6	0.5	BK	2150	Ground	I	-

B306A PARKING ASSIST SENSOR - FRONT LEFT OUTER



Connector Part Information

- Harness Type: Front Fascia

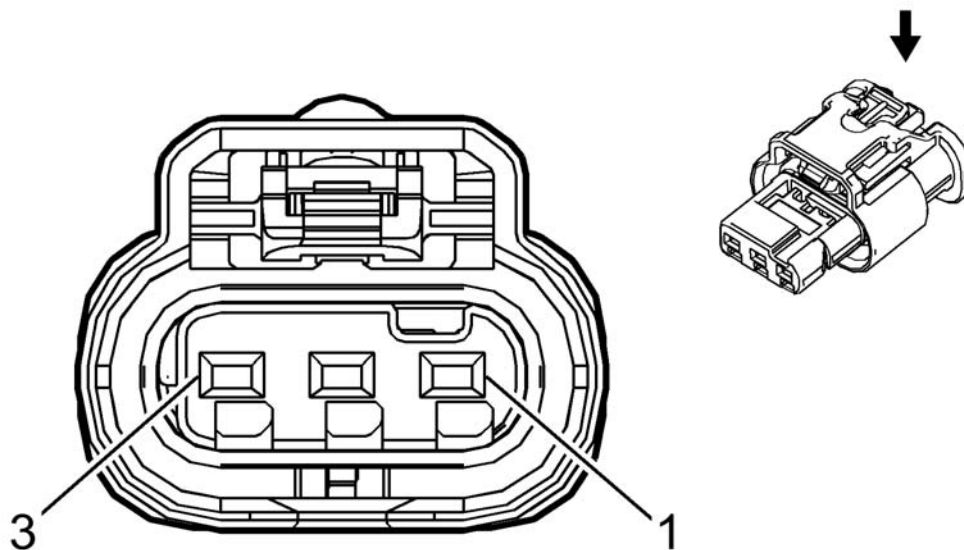
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	VT/WH	5215	Front Parking Left Corner Sensor	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306B PARKING ASSIST SENSOR - FRONT LEFT MIDDLE



Connector Part Information

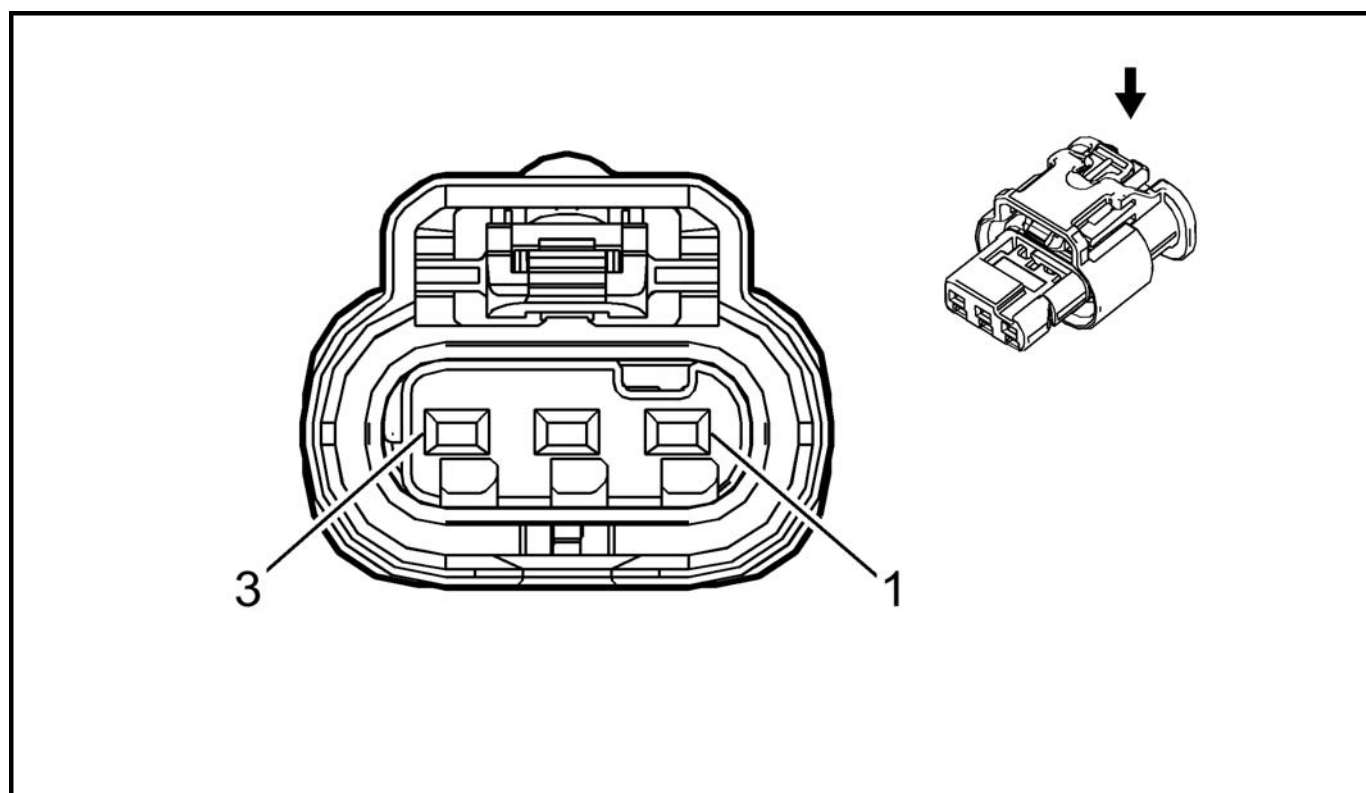
- Harness Type: Front Fascia
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	YE/GY	5216	Front Parking Left Mid Sensor	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306C PARKING ASSIST SENSOR - FRONT RIGHT MIDDLE



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

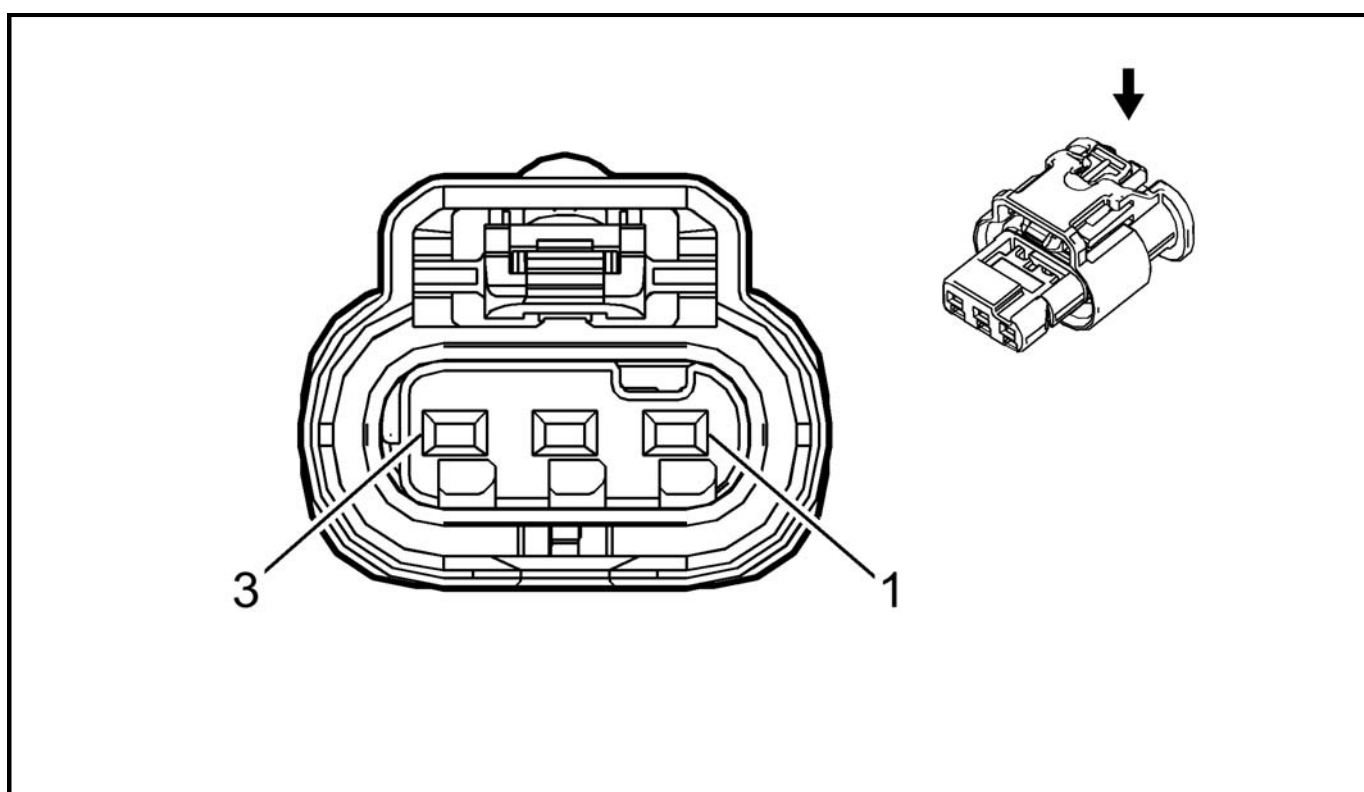
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	VT/GY	5218	Front Parking Right Mid Sensor	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306D PARKING ASSIST SENSOR - FRONT RIGHT OUTER



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

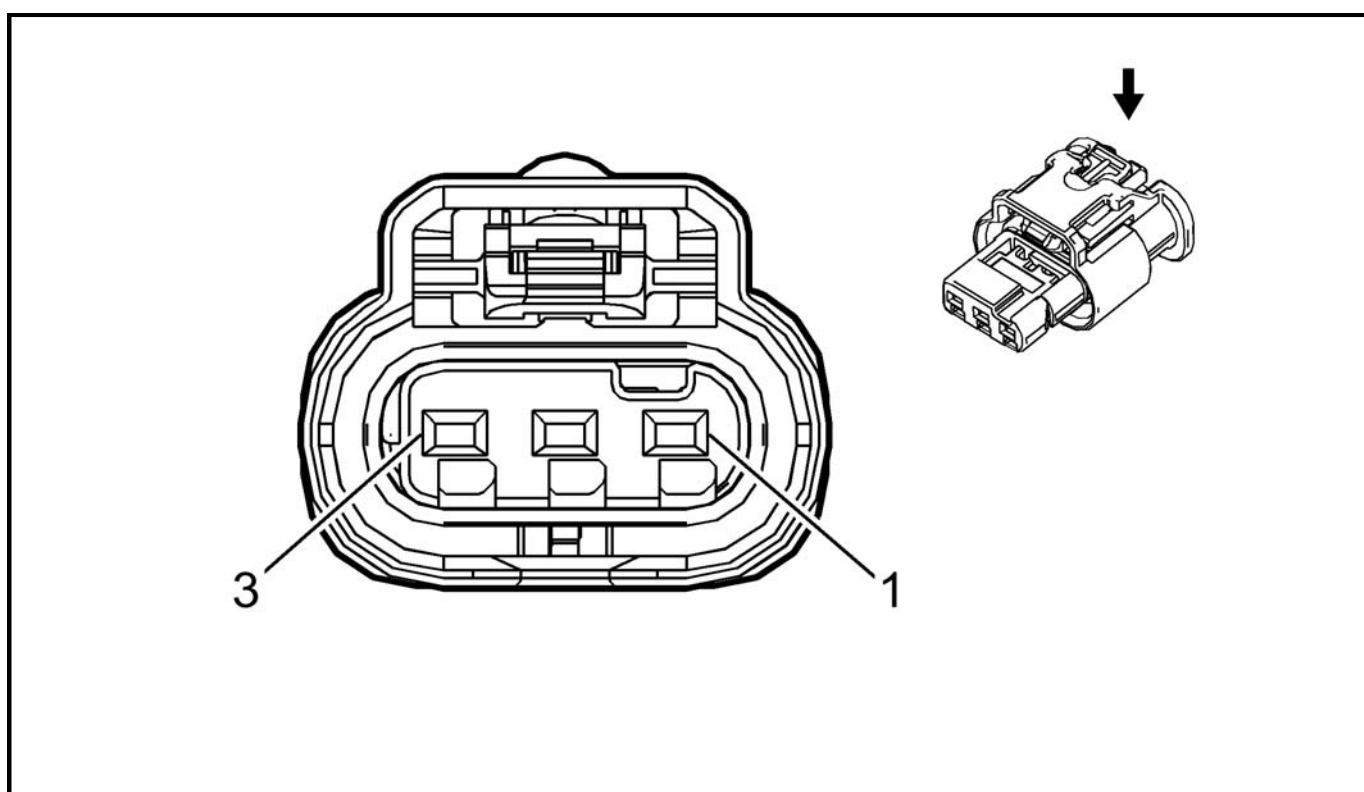
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(LT GN)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	WH/GY	5217	Front Parking Right Corner Sensor	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306E PARKING ASSIST SENSOR - REAR LEFT OUTER



Connector Part Information

- Harness Type: Rear Lamp
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

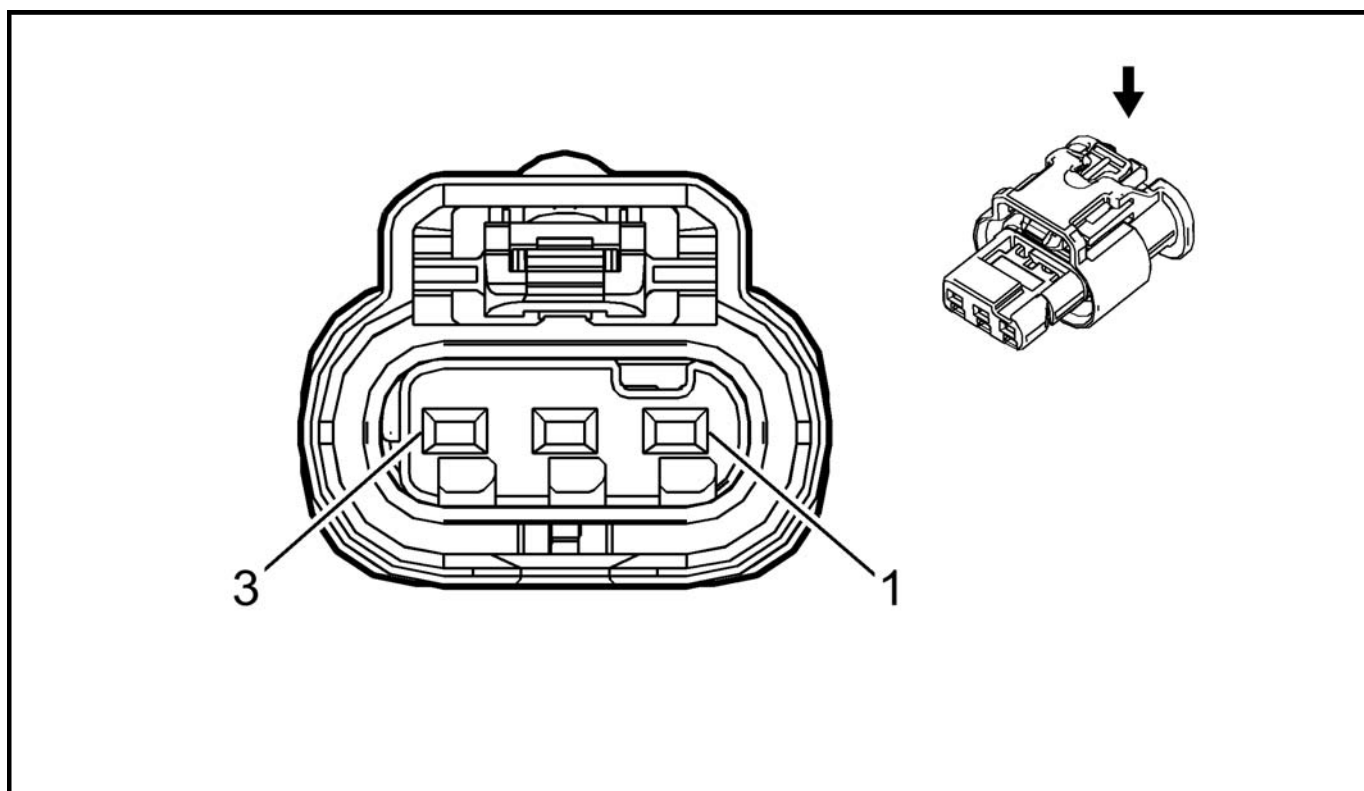
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(LT GN)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/VT	5974	Park Assist Sensor Control Park	I	-
2	0.5	YE	2375	Left Rear Corner Object Sensor Signal	I	-
3	0.5	BK/GY	2379	Object Sensor Low Reference	I	-

B306F PARKING ASSIST SENSOR - REAR LEFT MIDDLE



Connector Part Information

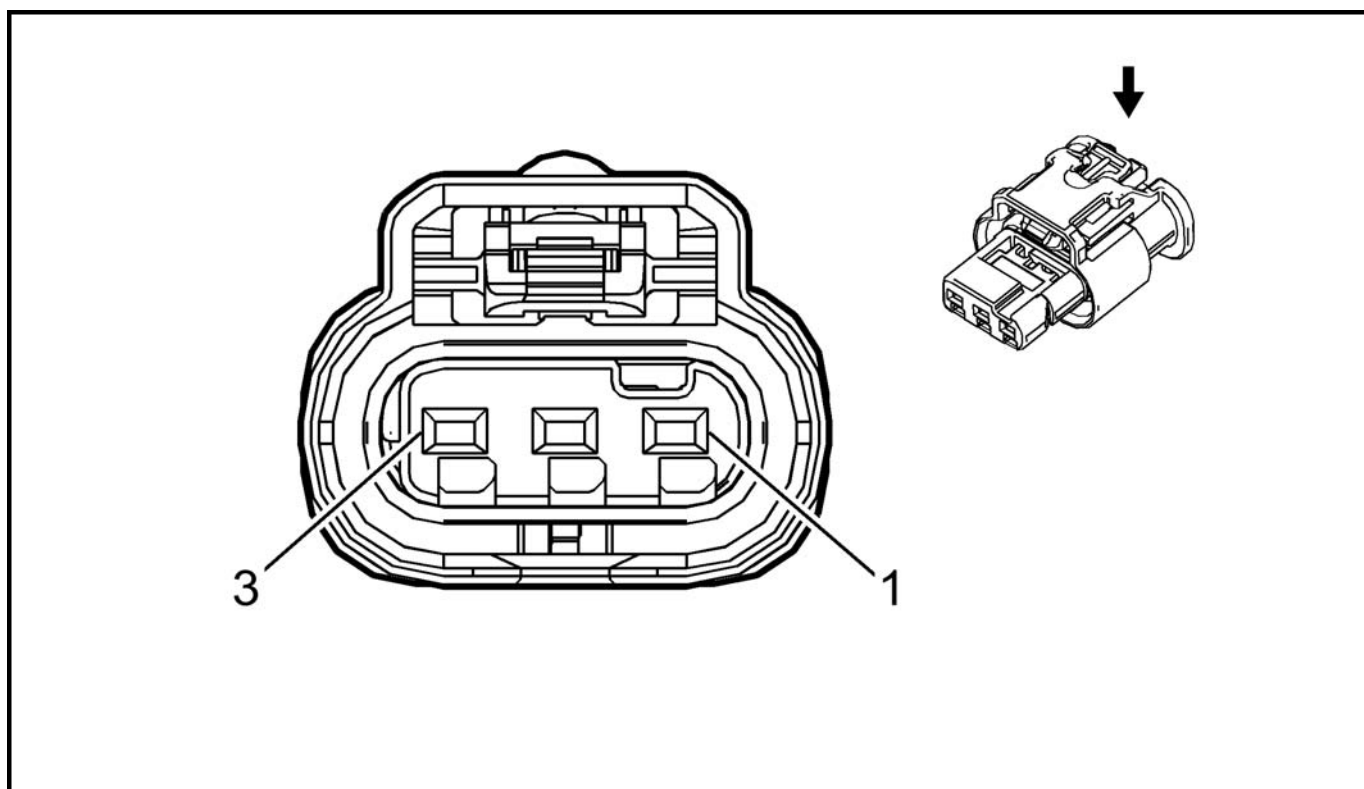
- Harness Type: Rear Lamp
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/VT	5974	Park Assist Sensor Control Park	I	-
2	0.5	YE/BU	2376	Left Rear Middle Object Sensor Signal	I	-
3	0.5	BK/GY	2379	Object Sensor Low Reference	I	-

B306G PARKING ASSIST SENSOR - REAR RIGHT MIDDLE



Connector Part Information

- Harness Type: Rear Lamp
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

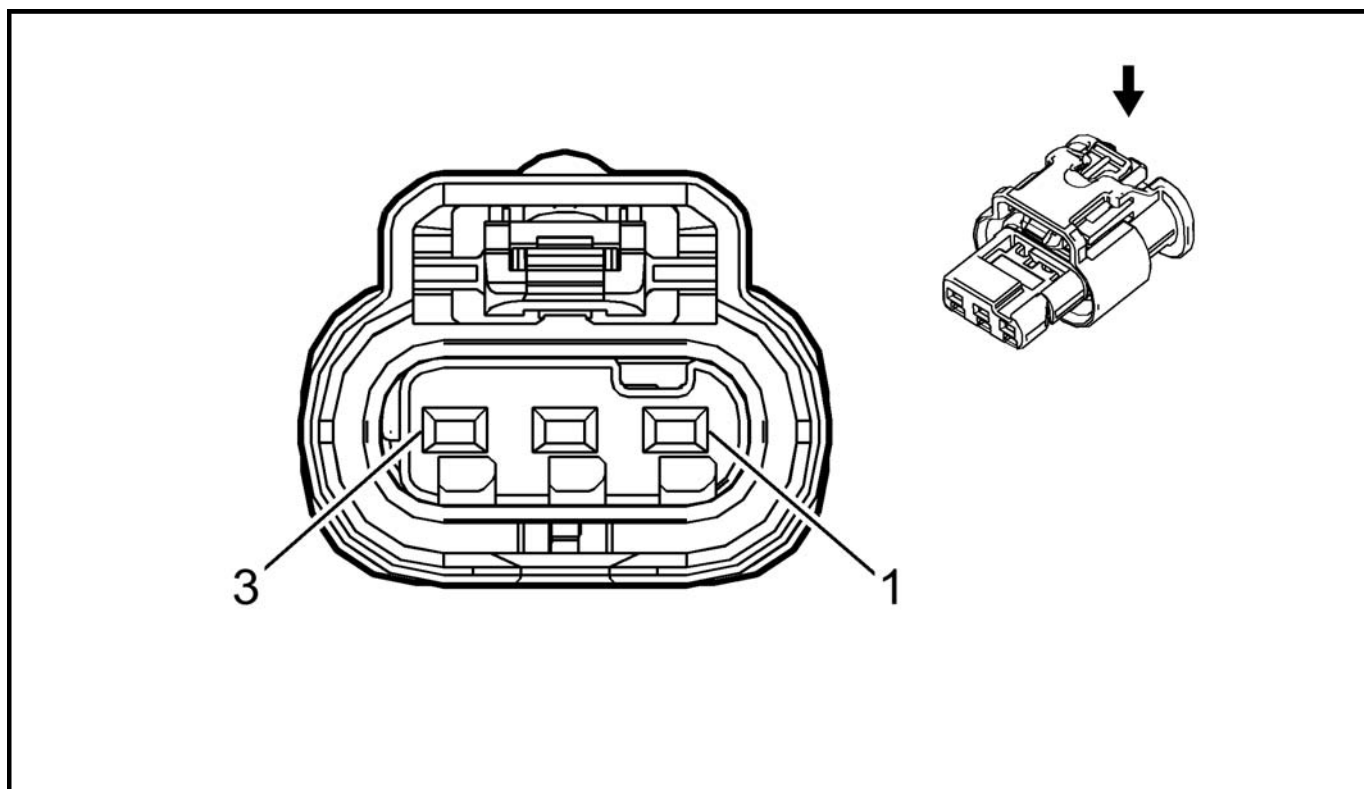
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/VT	5974	Park Assist Sensor Control Park	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	YE/WH	2377	Right Rear Middle Object Sensor Signal	I	-
3	0.5	BK/GY	2379	Object Sensor Low Reference	I	-

B306H PARKING ASSIST SENSOR - REAR RIGHT OUTER



Connector Part Information

- Harness Type: Rear Lamp
- OEM Connector: 1488991-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (BK)

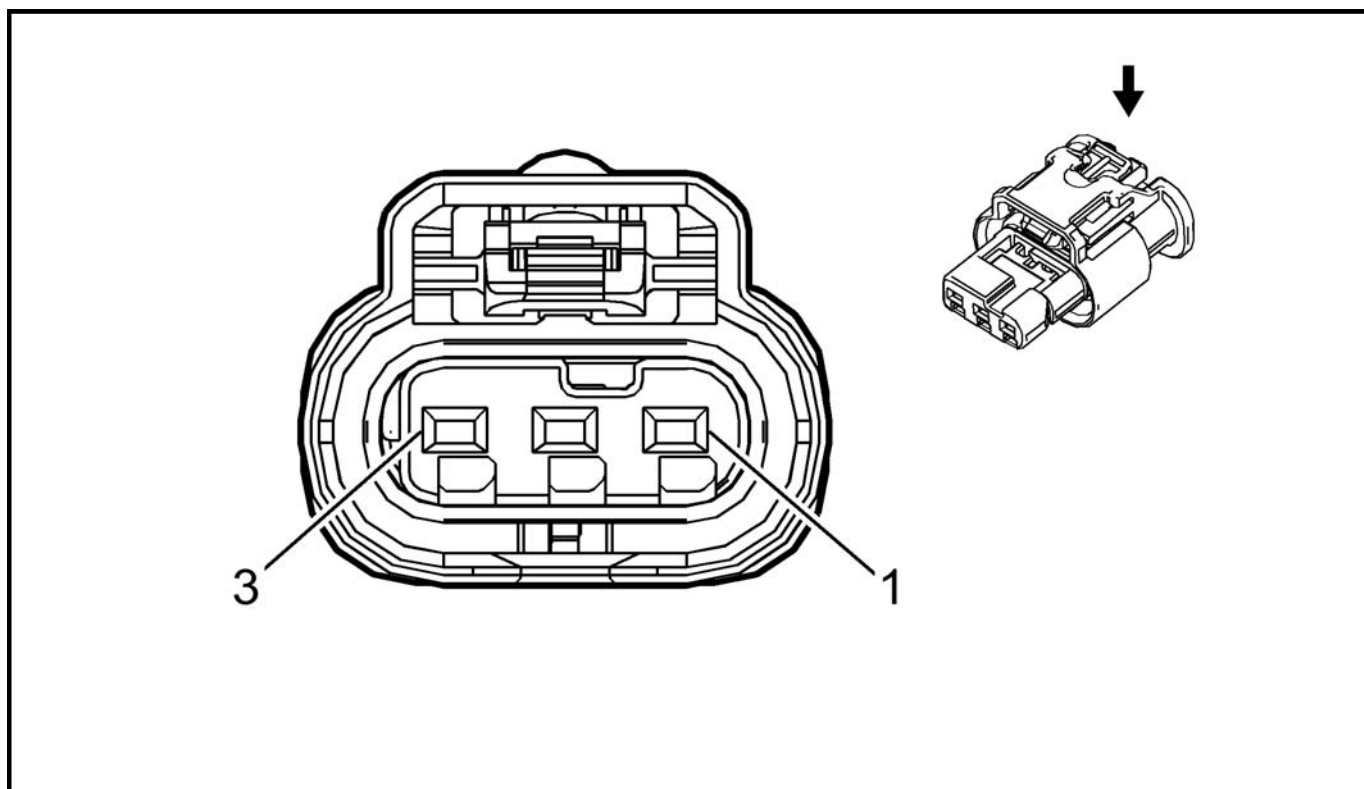
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/VT	5974	Park Assist Sensor Control Park	I	-
2	0.5	YE/VT	2378	Right Rear Corner Object Sensor Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.5	BK/GY	2379	Object Sensor Low Reference	I	-

B306K PARKING ASSIST SENSOR - SIDE LEFT FRONT



Connector Part Information

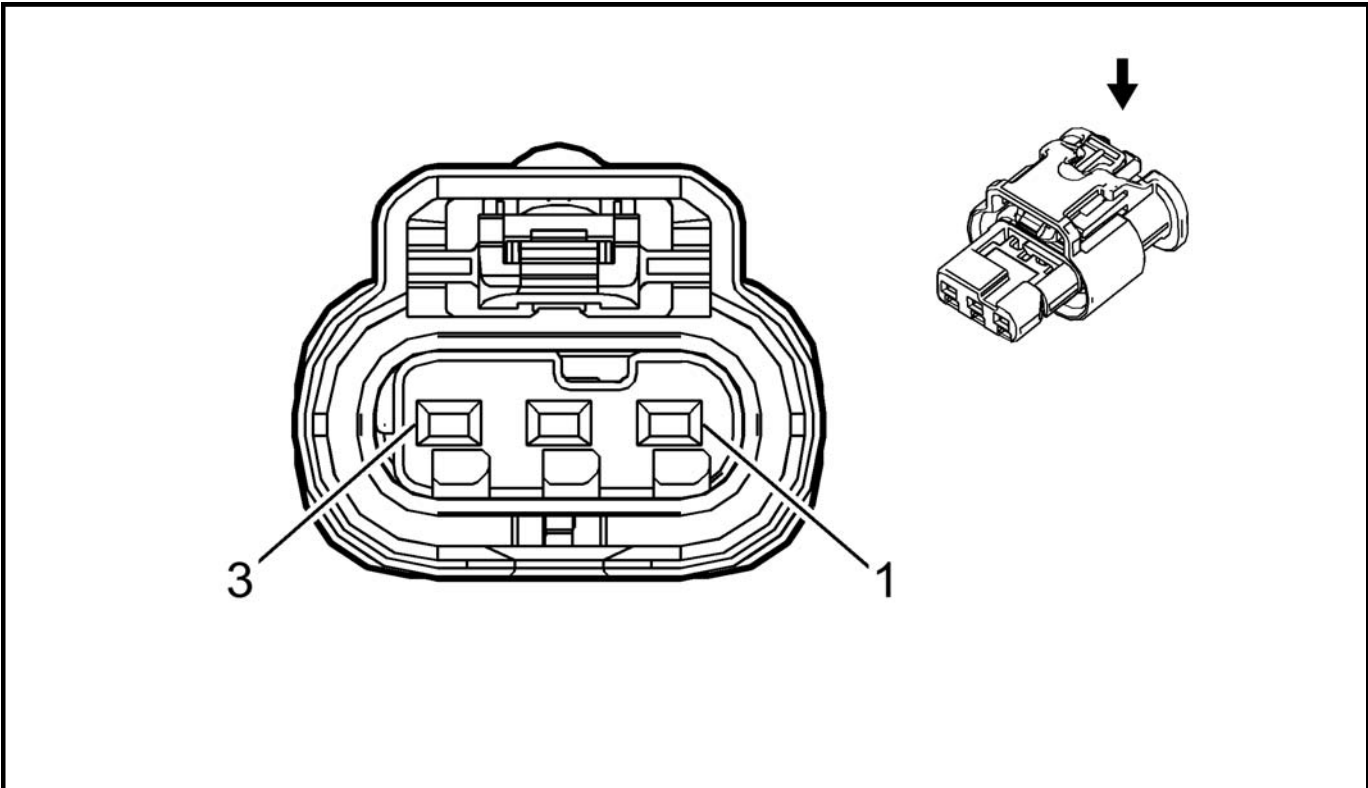
- Harness Type: Front Fascia
- OEM Connector: 1488991-6
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	GY	3154	Left Front Supplemental Object Sensor Signal	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306L PARKING ASSIST SENSOR - SIDE RIGHT FRONT



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 1488991-6
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 MCP Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

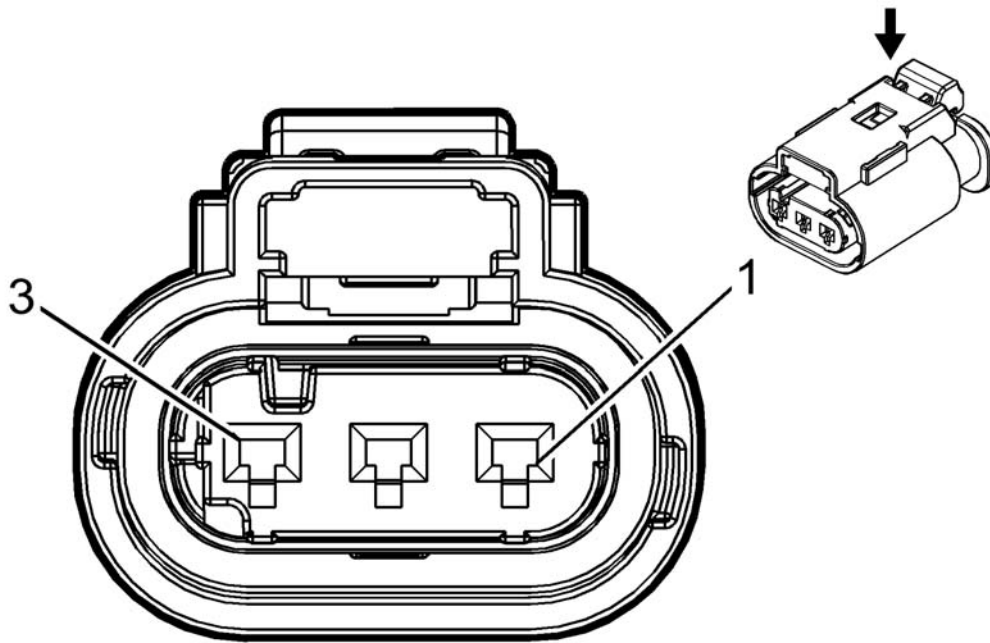
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	0.5	GN	3155	Right Front Supplemental Object Sensor Signal	I	-
3	0.5	BK/BU	5214	Front Parking Sensor Low Reference	I	-

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Volt

COMPONENT CONNECTOR END VIEWS

B310 FUEL PRESSURE/TEMPERATURE SENSOR



Connector Part Information

- Harness Type: Engine
- OEM Connector: 13503573
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/GN	2919	Fuel Rail Pressure Sensor Low Reference	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	BU/WH	2918	Fuel Rail Pressure Sensor Signal	I	-
3	0.5	BN/RD	2917	Fuel Rail Pressure Sensor 5V Reference	I	-

C1 BATTERY

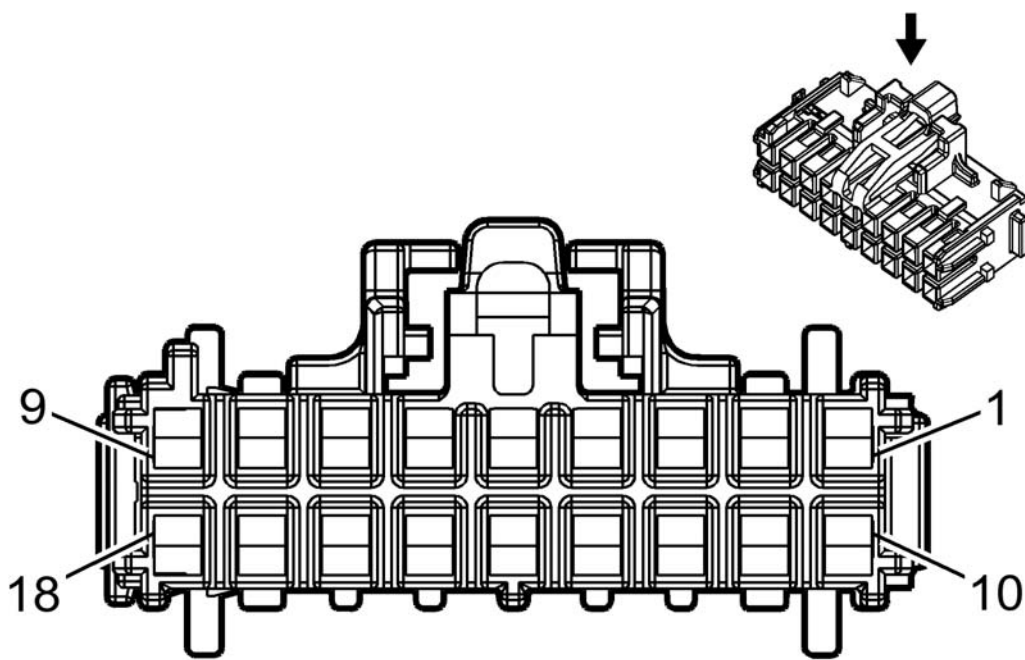
-
Connector Part Information • Harness Type: Negative Battery Cable • OEM Connector: 13574943 • Service Connector: Service by Cable Assembly - See Part Catalog • Description: Ring Terminal 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	1 25	BK/BN BK	1798 50	Low Reference Ground	I	- -

C5A HYBRID/EV BATTERY MODULE 1



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

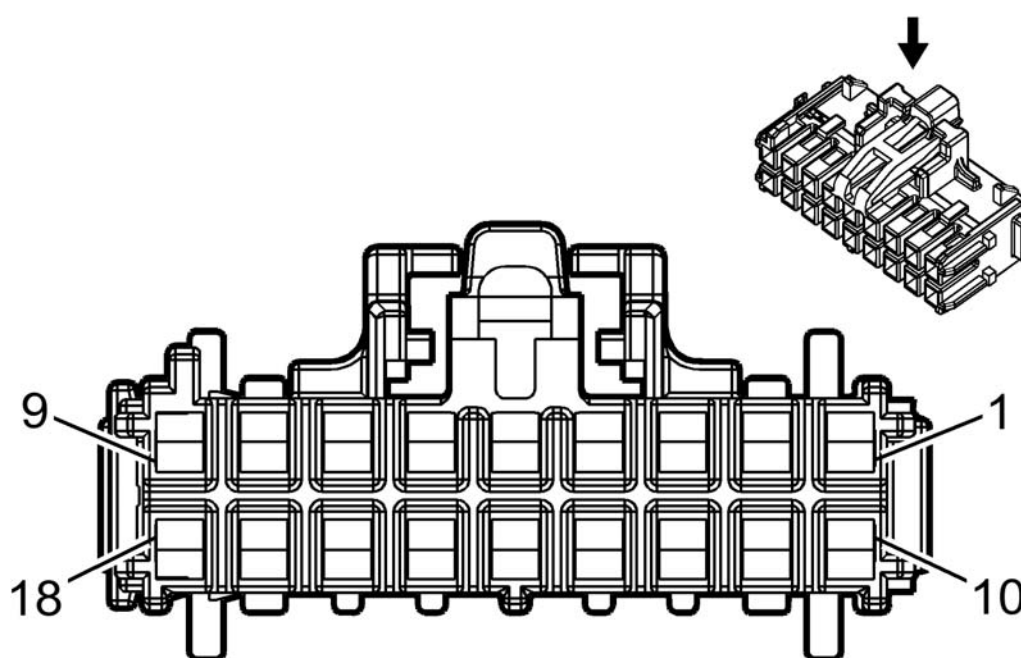
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/VT	5403	Battery Pack Monitor Low Reference	I	-
2	0.35	YE/VT	5394	Battery Voltage Signal 2	I	-
3	0.35	GY/YE	5396	Battery Voltage Signal 4	I	-
4	0.35	GN	5398	Battery Voltage Signal 6	I	-
5	0.35	BU	5400	Battery Voltage Signal 8	I	-
6	0.35	BU/GY	5392	Battery Voltage Signal 10	I	-
7	0.35	BN	5571	Battery Voltage Signal 12	I	-
8	0.35	YE	5573	Battery Voltage Signal 14	I	-
9	0.35	BN/WH	5575	Battery Voltage Signal 16	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
10	0.35	VT	5391	Battery Voltage Signal 1	I	-
11	0.35	WH	5395	Battery Voltage Signal 3	I	-
12	0.35	YE/GN	5397	Battery Voltage Signal 5	I	-
13	0.35	YE/BN	5399	Battery Voltage Signal 7	I	-
14	0.35	GN/BK	5401	Battery Voltage Signal 9	I	-
15	0.35	GN/GY	5393	Battery Voltage Signal 11	I	-
16	0.35	YE/GY	5572	Battery Voltage Signal 13	I	-
17	0.35	WH/BK	5574	Battery Voltage Signal 15	I	-
18	-	-	-	Not Occupied	-	-

C5B HYBRID/EV BATTERY MODULE 2



Connector Part Information

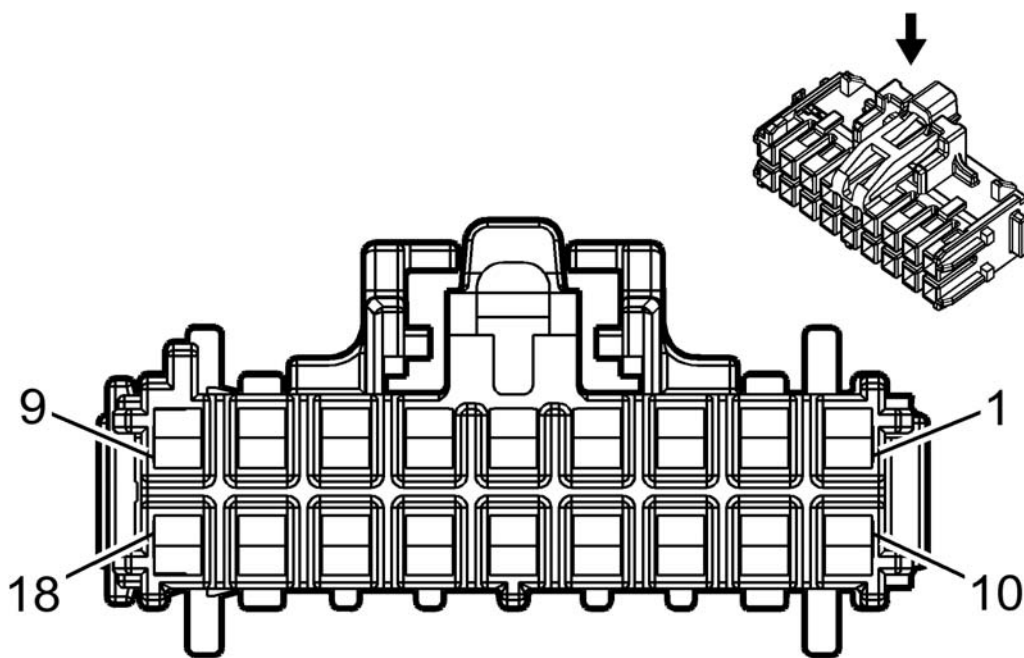
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	5575	Battery Voltage Signal 16	I	-
2	0.35	GN/VT	5577	Battery Voltage Signal 18	I	-
3	0.35	YE/BK	5579	Battery Voltage Signal 20	I	-
4	0.35	BU/WH	5581	Battery Voltage Signal 22	I	-
5	0.35	WH/BK	5583	Battery Voltage Signal 24	I	-
6	0.35	GY/GN	5585	Battery Voltage Signal 26	I	-
7	0.35	GY/BK	5587	Battery Voltage Signal 28	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	WH/BU	5576	Battery Voltage Signal 17	I	-
11	0.35	GN/WH	5578	Battery Voltage Signal 19	I	-
12	0.35	GY/BN	5580	Battery Voltage Signal 21	I	-
13	0.35	GY/BK	5582	Battery Voltage Signal 23	I	-
14	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
15	0.35	BU/BK	5586	Battery Voltage Signal 27	I	-
16 - 18	-	-	-	Not Occupied	-	-

C5C HYBRID/EV BATTERY MODULE 3



Connector Part Information

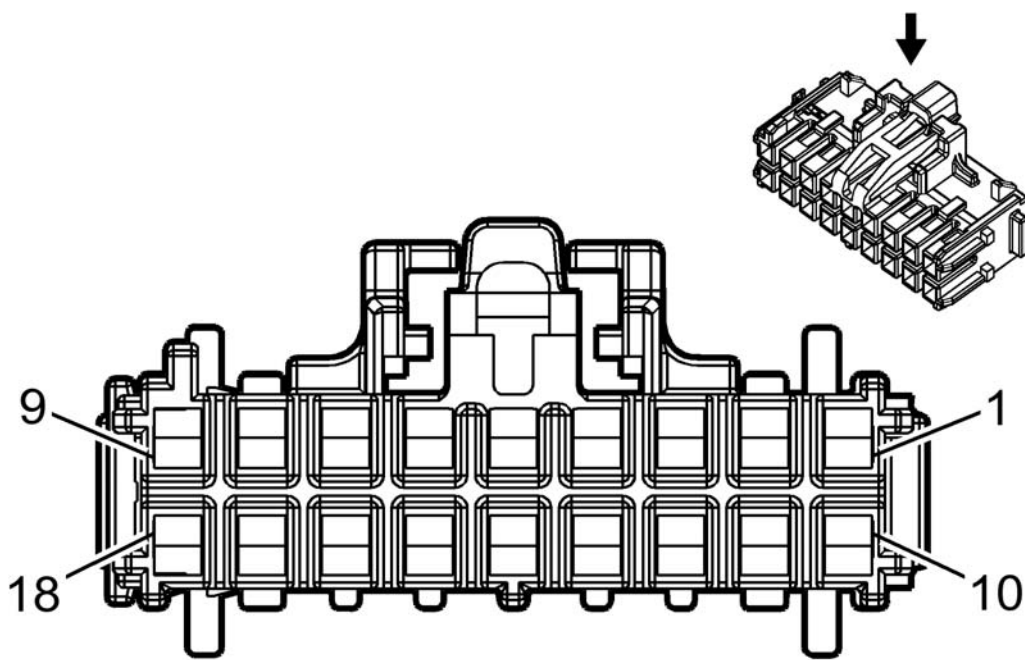
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/BK	5587	Battery Voltage Signal 28	I	-
2	0.35	VT/GN	5589	Battery Voltage Signal 30	I	-
3	0.35	GY	5591	Battery Voltage Signal 32	I	-
4	0.35	VT/BK	4514	Battery Cell Voltage Signal 34	I	-
5	0.35	VT	4517	Battery Cell Voltage Signal 36	I	-
6	0.35	WH	4519	Battery Cell Voltage Signal 38	I	-
7	0.35	YE/GN	4521	Battery Cell Voltage Signal 40	I	-
8	0.35	YE/BN	4523	Battery Cell Voltage Signal 42	I	-
9	0.35	GN/BK	4525	Battery Cell Voltage Signal 44	I	-
10	0.35	YE/WH	5588	Battery Voltage Signal 29	I	-
11	0.35	GN/BK	5590	Battery Voltage Signal 31	I	-
12	0.35	GY/WH	5592	Battery Voltage Signal 33	I	-
13	0.35	BK/VT	4516	Battery Cell Voltage Signal 35	I	-
14	0.35	YE/VT	4518	Battery Cell Voltage Signal 37	I	-
15	0.35	GY/YE	4520	Battery Cell Voltage Signal 39	I	-
16	0.35	GN	4522	Battery Cell Voltage Signal 41	I	-
17	0.35	BU	4524	Battery Cell Voltage Signal 43	I	-
18	-	-	-	Not Occupied	-	-

C5D HYBRID/EV BATTERY MODULE 4



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

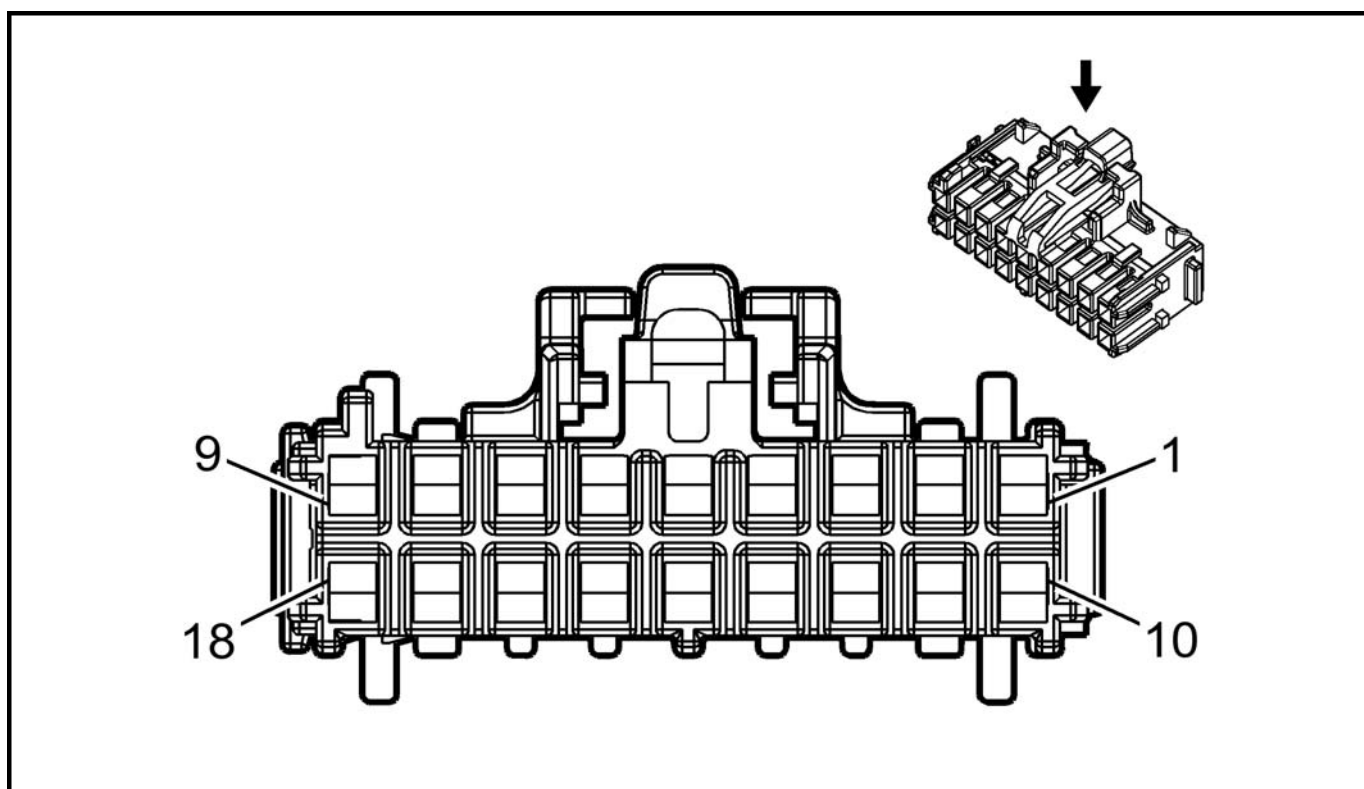
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BK	4525	Battery Cell Voltage Signal 44	I	-
2	0.35	GN/GY	4527	Battery Cell Voltage Signal 46	I	-
3	0.35	YE/GY	4529	Battery Cell Voltage Signal 48	I	-
4	0.35	WH/BK	4531	Battery Cell Voltage Signal 50	I	-
5	0.35	BU/YE	4533	Battery Cell Voltage Signal 52	I	-
6	0.35	GN/VT	4536	Battery Cell Voltage Signal 54	I	-
7	0.35	YE/BK	4538	Battery Cell Voltage Signal 56	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	BU/GY	4526	Battery Cell Voltage Signal 45	I	-
11	0.35	BN	4528	Battery Cell Voltage Signal 47	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.35	YE	4530	Battery Cell Voltage Signal 49	I	-
13	0.35	BN/WH	4532	Battery Cell Voltage Signal 51	I	-
14	0.35	WH/BU	4535	Battery Cell Voltage Signal 53	I	-
15	0.35	GN/WH	4537	Battery Cell Voltage Signal 55	I	-
16 - 18	-	-	-	Not Occupied	-	-

C5E HYBRID/EV BATTERY MODULE 5



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

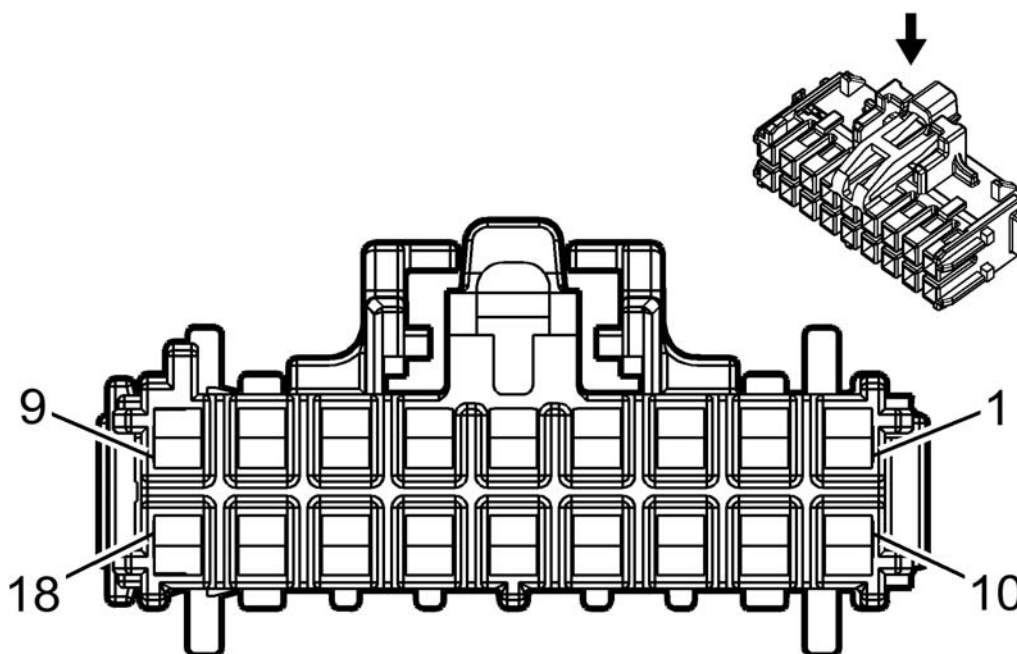
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE/BK	4538	Battery Cell Voltage Signal 56	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	BU/WH	4543	Battery Cell Voltage Signal 58	I	-
3	0.35	WH/BK	4545	Battery Cell Voltage Signal 60	I	-
4	0.35	GY/GN	4547	Battery Cell Voltage Signal 62	I	-
5	0.35	GY/BK	4549	Battery Cell Voltage Signal 64	I	-
6	0.35	VT/GN	4554	Battery Cell Voltage Signal 66	I	-
7	0.35	GY	4556	Battery Cell Voltage Signal 68	I	-
8	0.35	VT/BK	4558	Battery Cell Voltage Signal 70	I	-
9	0.35	VT	4561	Battery Cell Voltage Signal 72	I	-
10	0.35	GY/BN	4541	Battery Cell Voltage Signal 57	I	-
11	0.35	GY/BK	4544	Battery Cell Voltage Signal 59	I	-
12	0.35	VT/WH	4546	Battery Cell Voltage Signal 61	I	-
13	0.35	BU/BK	4548	Battery Cell Voltage Signal 63	I	-
14	0.35	YE/WH	4553	Battery Cell Voltage Signal 65	I	-
15	0.35	GN/BK	4555	Battery Cell Voltage Signal 67	I	-
16	0.35	GY/WH	4557	Battery Cell Voltage Signal 69	I	-
17	0.35	BK/VT	4560	Battery Cell Voltage Signal 71	I	-
18	-	-	-	Not Occupied	-	-

C5F HYBRID/EV BATTERY MODULE 6



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog

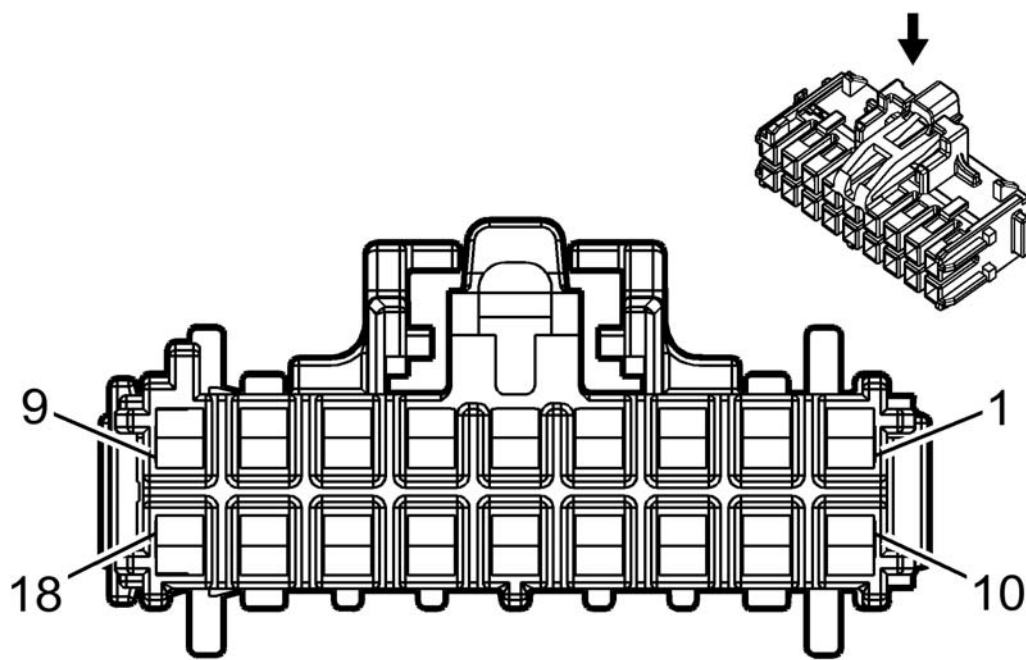
- Description: 18-Way F 1.2 Multilock Series (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT	4561	Battery Cell Voltage Signal 72	I	-
2	0.35	WH	4563	Battery Cell Voltage Signal 74	I	-
3	0.35	YE/GN	4565	Battery Cell Voltage Signal 76	I	-
4	0.35	YE/BN	4567	Battery Cell Voltage Signal 78	I	-
5	0.35	GN/BK	4569	Battery Cell Voltage Signal 80	I	-
6	0.35	GN/GY	4571	Battery Cell Voltage Signal 82	I	-
7	0.35	YE/GY	4573	Battery Cell Voltage Signal 84	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	YE/VT	4562	Battery Cell Voltage Signal 73	I	-
11	0.35	GY/YE	4564	Battery Cell Voltage Signal 75	I	-
12	0.35	GN	4566	Battery Cell Voltage Signal 77	I	-
13	0.35	BU	4568	Battery Cell Voltage Signal 79	I	-
14	0.35	BU/GY	4570	Battery Cell Voltage Signal 81	I	-
15	0.35	BN	4572	Battery Cell Voltage Signal 83	I	-
16 - 18	-	-	-	Not Occupied	-	-

C5G HYBRID/EV BATTERY MODULE 7



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33201128
- Service Connector: Service by Harness - See Part Catalog
- Description: 18-Way F 1.2 Multilock Series (OG)

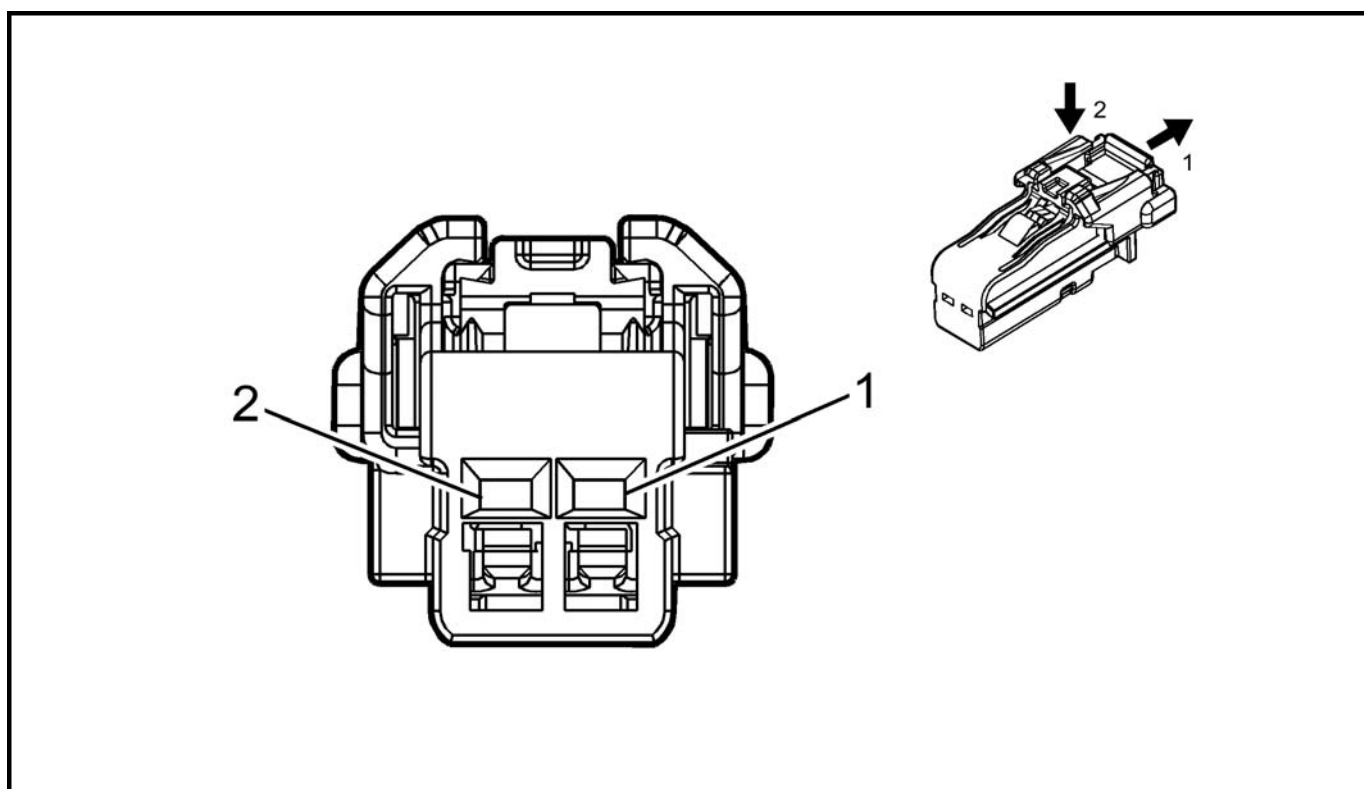
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE/GY	4573	Battery Cell Voltage Signal 84	I	-
2	0.35	WH/BK	4575	Battery Cell Voltage Signal 86	I	-
3	0.35	BU/YE	4577	Battery Cell Voltage Signal 88	I	-
4	0.35	WH/BU	2390	Battery Cell Voltage Signal 90	I	-
5	0.35	BU/BK	2392	Battery Cell Voltage Signal 92	I	-
6	0.35	GN/BK	2394	Battery Cell Voltage Signal 94	I	-
7	0.35	GY/YE	2396	Battery Cell Voltage Signal 96	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	YE	4574	Battery Cell Voltage Signal 85	I	-
11	0.35	BN/WH	4576	Battery Cell Voltage Signal 87	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.35	BN/WH	2389	Battery Cell Voltage Signal 89	I	-
13	0.35	GN/VT	2391	Battery Cell Voltage Signal 91	I	-
14	0.35	YE/VT	2393	Battery Cell Voltage Signal 93	I	-
15	0.35	BU/GY	2395	Battery Cell Voltage Signal 95	I	-
16 - 18	-	-	-	Not Occupied	-	-

E1D ACCENT LAMP - DRIVER DOOR



Connector Part Information

- Harness Type: Driver Door Trim
- OEM Connector: 6098-7685
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

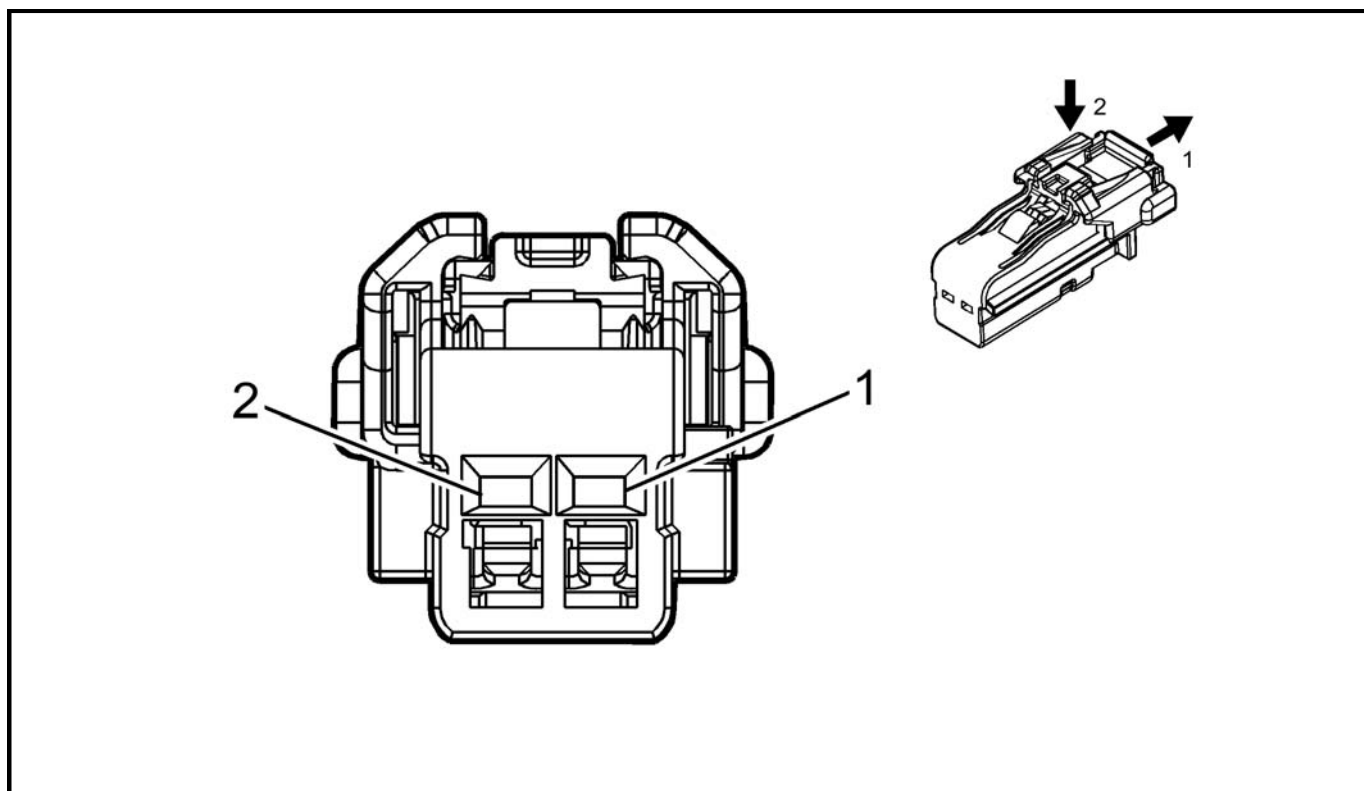
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1550	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-

E1P ACCENT LAMP - PASSENGER DOOR



Connector Part Information

- Harness Type: Passenger Door Trim
- OEM Connector: 6098-7685
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	2050	Ground	I	-
2	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-

E2LF SIDE MARKER LAMP - LEFT FRONT

-							
Connector Part Information							
• Harness Type: Headlamp • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way							

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	WH/YE	1204	Left Park Lamp Control	I	-
B	0.75	BK	1150	Ground	I	-

E2RF SIDE MARKER LAMP - RIGHT FRONT

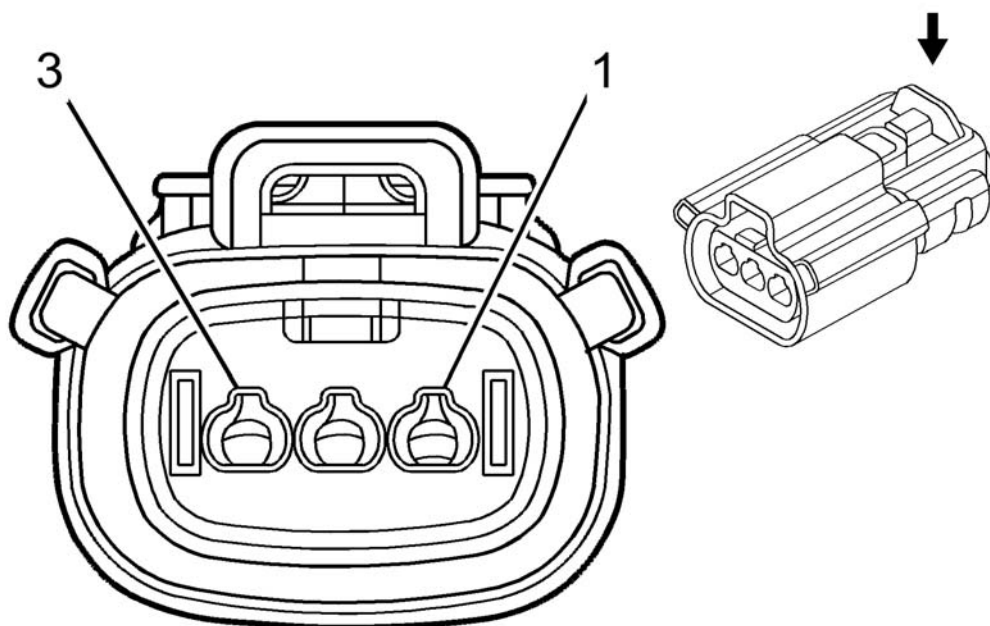
-							
Connector Part Information							
• Harness Type: Headlamp • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way							

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	VT	1203	Right Park Lamp Control	I	-
B	0.75	BK	1050	Ground	I	-

E4AC PARK/DAYTIME RUNNING LAMP - LEFT



Connector Part Information

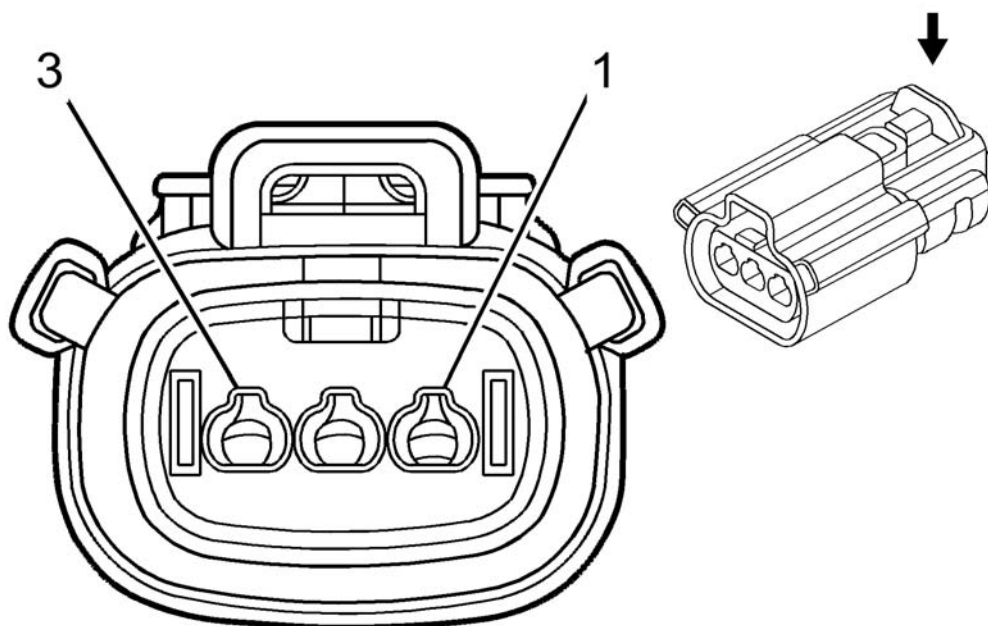
- Harness Type: Front Fascia
- OEM Connector: 33471-0306
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BU	7538	Left Front DRL Control	I	-
2	0.5	WH/YE	1204	Left Park Lamp Control	I	-
3	0.5	BK	1150	Ground	I	-

E4AD PARK/DAYTIME RUNNING LAMP - RIGHT



Connector Part Information

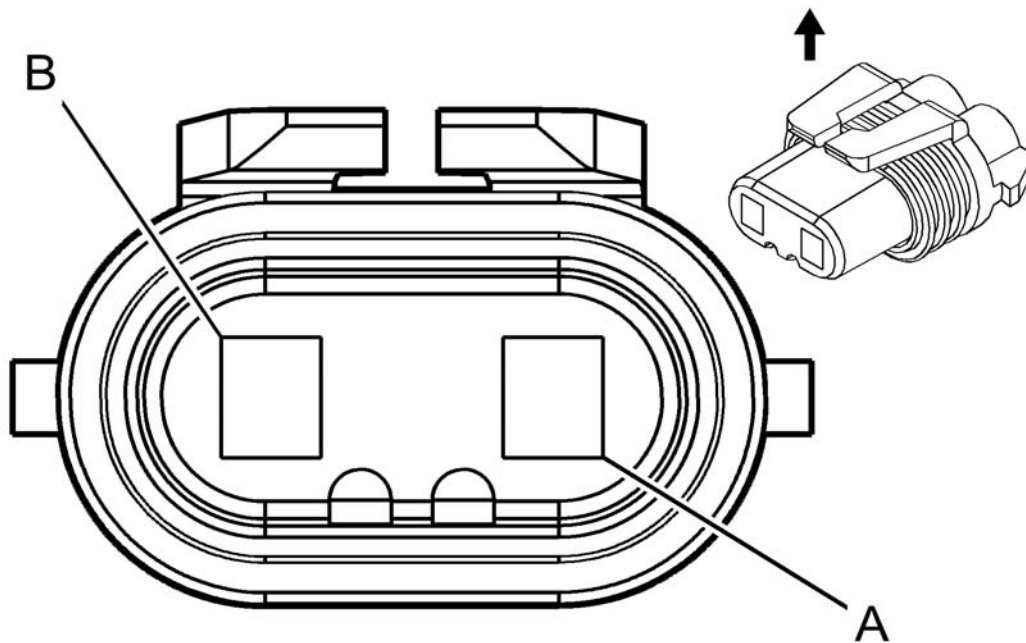
- Harness Type: Front Fascia
- OEM Connector: 33471-0306
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/BN	7539	Right Front DRL Control	I	-
2	0.5	VT	1203	Right Park Lamp Control	I	-
3	0.5	BK	1150	Ground	I	-

E4E HEADLAMP - LEFT HIGH BEAM



Connector Part Information

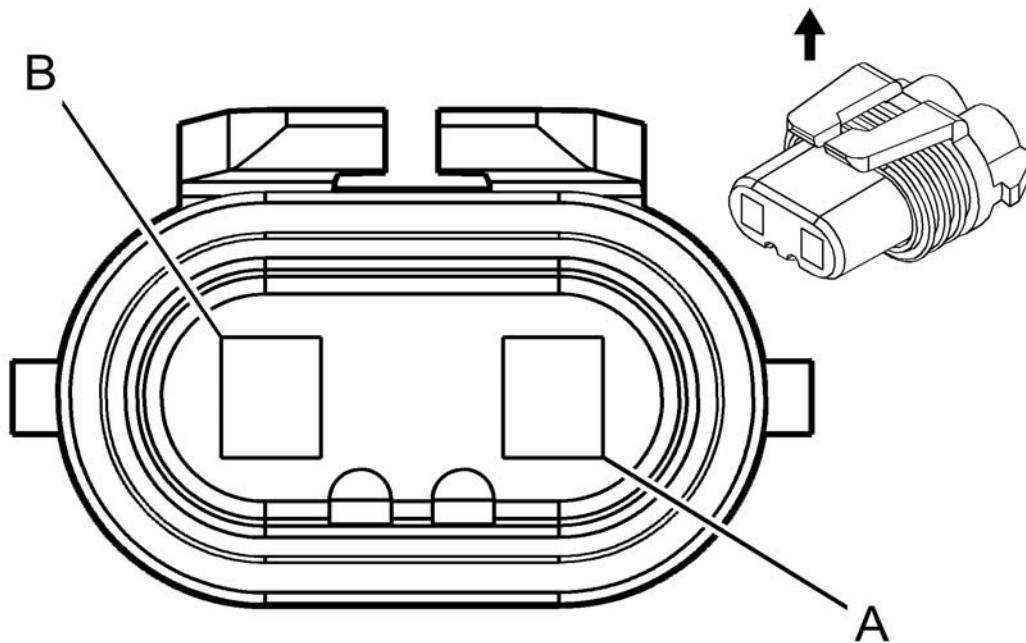
- Harness Type: Headlamp
- OEM Connector: 12059183
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	WH	711	Left Headlamp High Beam Control	I	-
B	0.75	BK	1150	Ground	I	-

E4F HEADLAMP - RIGHT HIGH BEAM



Connector Part Information

- Harness Type: Headlamp
- OEM Connector: 12059183
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	WH	311	Right Headlamp High Beam Control	I	-
B	0.75	BK	1050	Ground	I	-

E4G HEADLAMP - LEFT LOW BEAM

Connector Part Information

- Harness Type: Headlamp
- OEM Connector: Not Available

- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.75	BK	1150	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.75	YE	712	Left Headlamp Low Beam Control	I	-

E4H HEADLAMP - RIGHT LOW BEAM

-
Connector Part Information • Harness Type: Headlamp • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.75	BK	1050	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.75	YE	312	Right Headlamp Low Beam Control	I	-

E4LF TURN SIGNAL LAMP - LEFT FRONT

-

Connector Part Information

- Harness Type: Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	BU/WH	1314	Left Front Turn Signal Lamp Control	I	-
B	0.75	BK	1150	Ground	I	-

E4LR TURN SIGNAL LAMP - LEFT REAR**Connector Part Information**

- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	YE/BN	618	Left Rear Turn Signal Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E4RF TURN SIGNAL LAMP - RIGHT FRONT

Connector Part Information

- Harness Type: Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	GN/VT	1315	Right Front Turn Signal Lamp Control	I	-
B	0.75	BK	1050	Ground	I	-

E4RR TURN SIGNAL LAMP - RIGHT REAR**Connector Part Information**

- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	GN/VT	619	Right Rear Turn Signal Lamp Control	I	-
B	0.8	BK	850	Ground	I	-

E5A BACKUP LAMP - LEFT

Connector Part Information

- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.8	GN/WH	1324	Backup Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E5B BACKUP LAMP - RIGHT**Connector Part Information**

- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.8	GN/WH	1324	Backup Lamp Control	I	-
B	0.8	BK	850	Ground	I	-

E5L STOP LAMP - LEFT

Connector Part Information

- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	GY/YE	7542	Left Rear Stop Lamp Control	I	-
B	0.8	BK	650	Ground	I	-

E5R STOP LAMP - RIGHT**Connector Part Information**

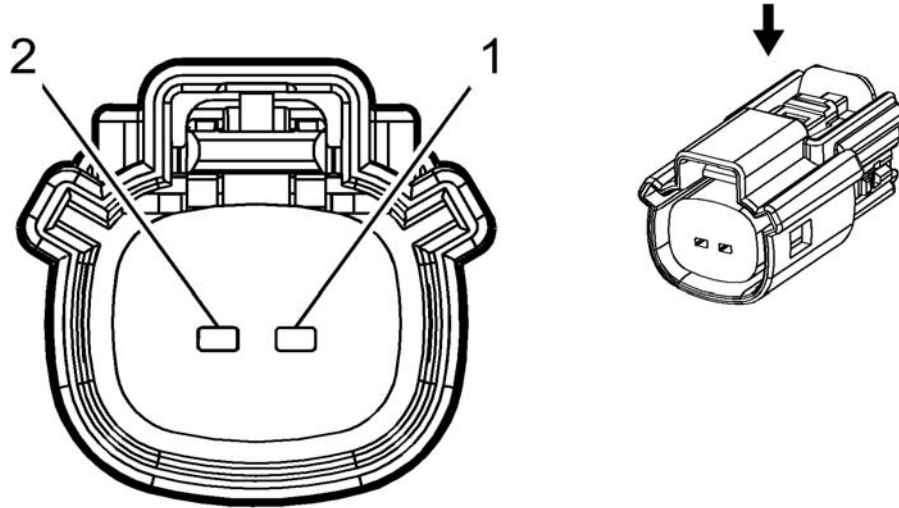
- Harness Type: Tail Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/YE	7541	Right Rear Stop Lamp Control	I	-
B	0.8	BK	850	Ground	I	-

E6 CENTER HIGH MOUNTED STOP LAMP



Connector Part Information

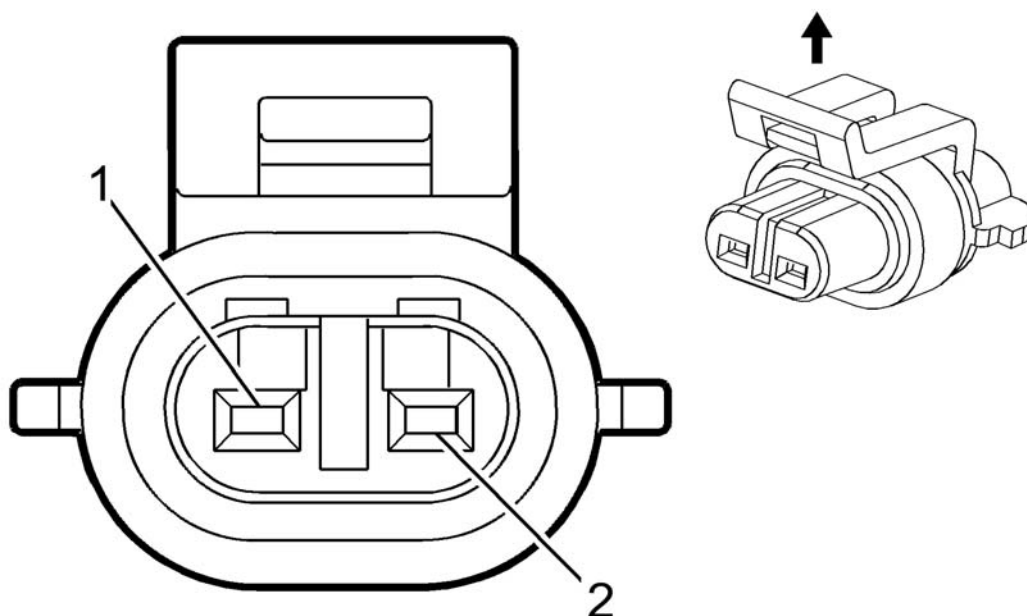
- Harness Type: Liftgate
- OEM Connector: 33471-0206
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/YE	820	CHMSL Control	I	-
2	0.5	BK	850	Ground	I	-

E7L LICENSE PLATE LAMP - LEFT



Connector Part Information

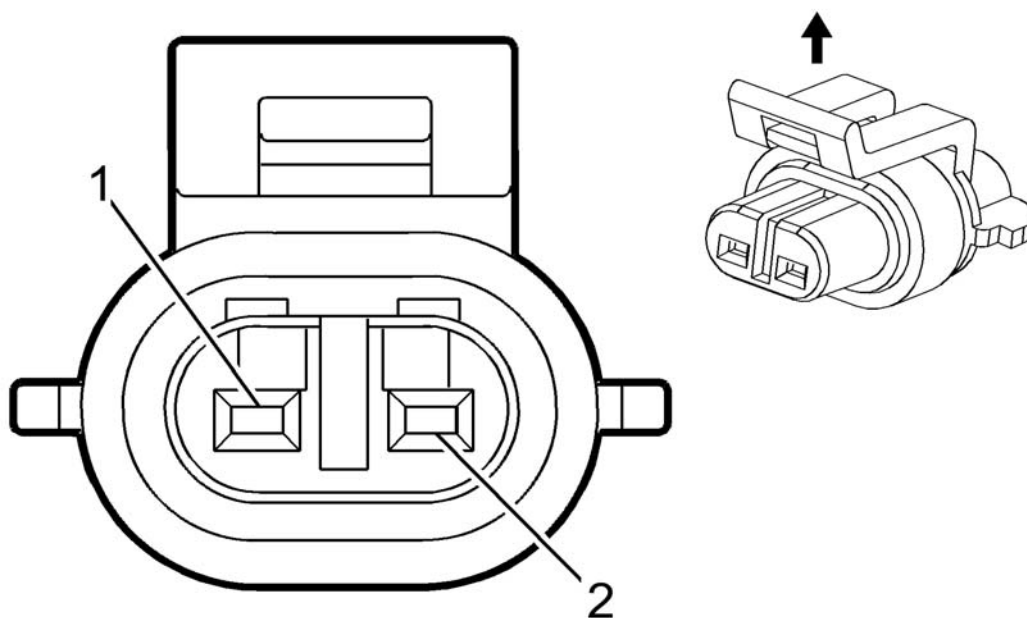
- Harness Type: Rear Lamp
- OEM Connector: 15344089
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 GT Series, Sealed (WH)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/YE	6846	Rear License Lamp Control	I	-
2	0.5	BK	650	Ground	I	-

E7R LICENSE PLATE LAMP - RIGHT



Connector Part Information

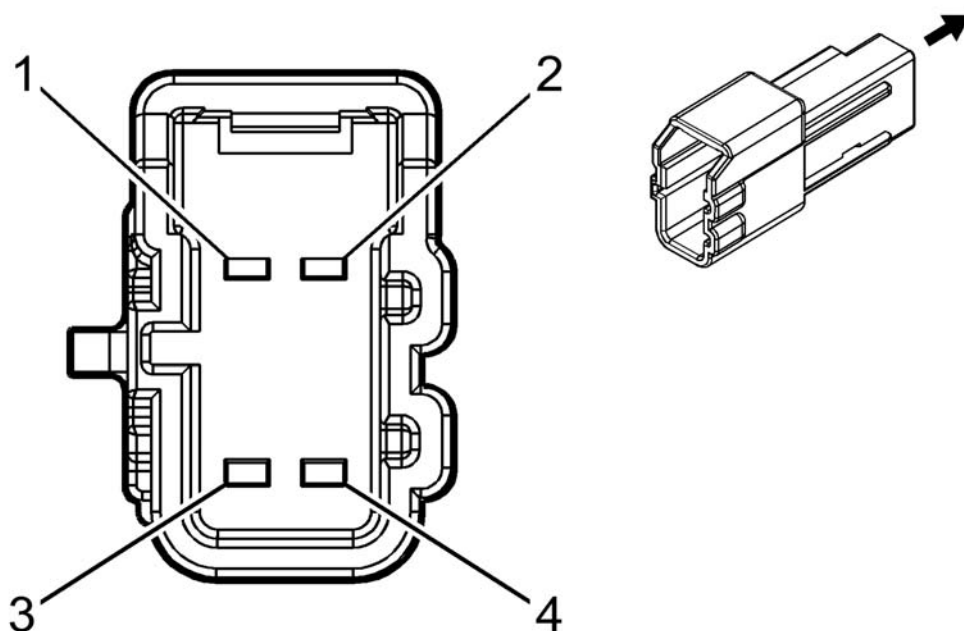
- Harness Type: Rear Lamp
- OEM Connector: 15344089
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 GT Series, Sealed (WH)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/YE	6846	Rear License Lamp Control	I	-
2	0.5	BK	650	Ground	I	-

E14A SEAT HEATING ELEMENT - DRIVER BACK



Connector Part Information

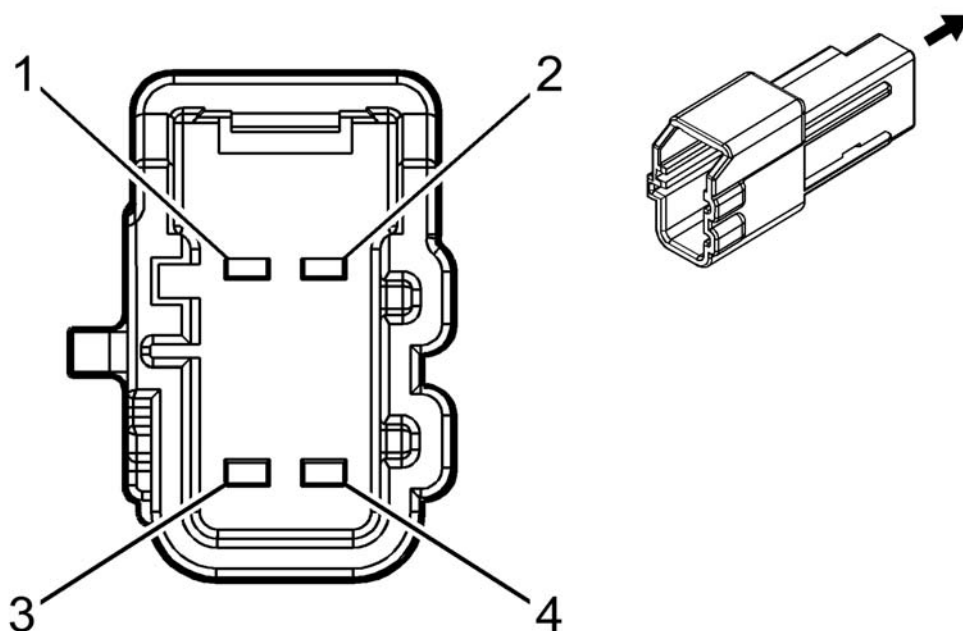
- Harness Type: Seat
- OEM Connector: 6098-7781
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/VT	2077	Driver Heated Seat Element Control	I	-
2	0.35	BU	2425	Driver Heated Back NTC Signal	I	-
3	0.35	BK/YE	2080	Driver Heated Seat NTC Low Reference	I	-
4	0.5	VT/BK	2424	Driver Heated Back Element Low Reference	I	-

E14B SEAT HEATING ELEMENT - DRIVER CUSHION



Connector Part Information

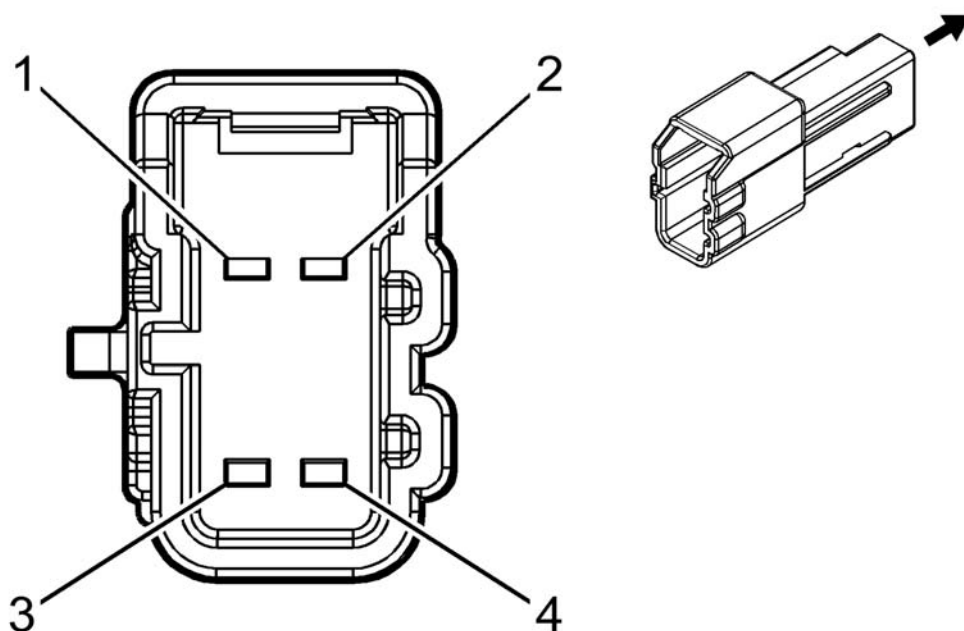
- Harness Type: Seats
- OEM Connector: 6098-7779
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/VT	2077	Driver Heated Seat Element Control	I	-
2	0.35	YE/GY	2079	Driver Heated Seat NTC Signal	I	-
3	0.35	BK/YE	2080	Driver Heated Seat NTC Low Reference	I	-
4	0.5	VT/BK	2424	Driver Heated Back Element Low Reference	I	-

E14C SEAT HEATING ELEMENT - PASSENGER BACK



Connector Part Information

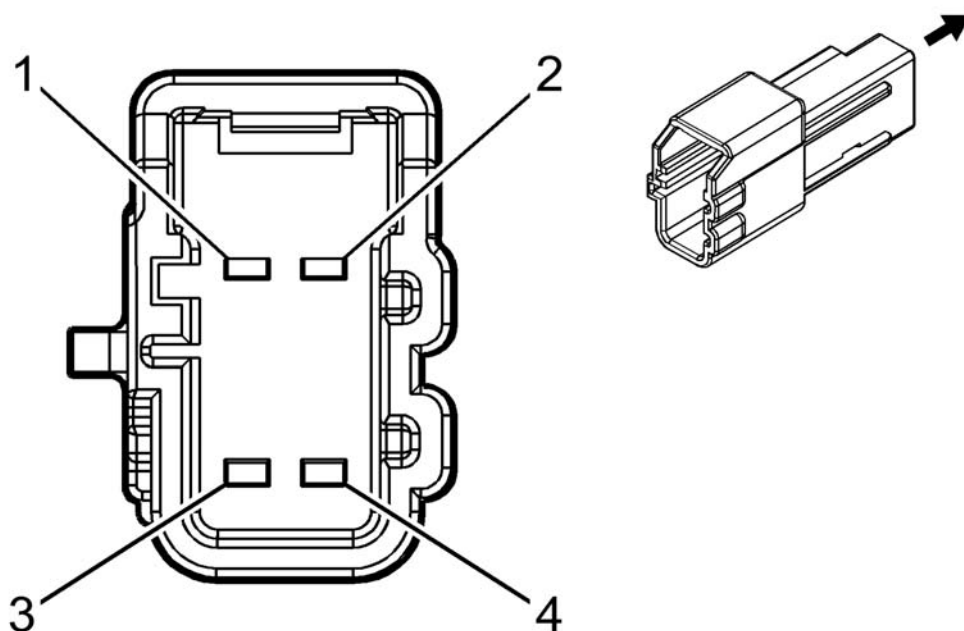
- Harness Type: Seats
- OEM Connector: 6098-7781
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BU	2479	Passenger Heated Seat Element Control	I	-
2	0.35	WH/BU	2436	Passenger Heated Back NTC Signal	I	-
3	0.35	BK/GN	2482	Passenger Heated Back NTC Low Reference	I	-
4	0.5	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-

E14D SEAT HEATING ELEMENT - PASSENGER CUSHION



Connector Part Information

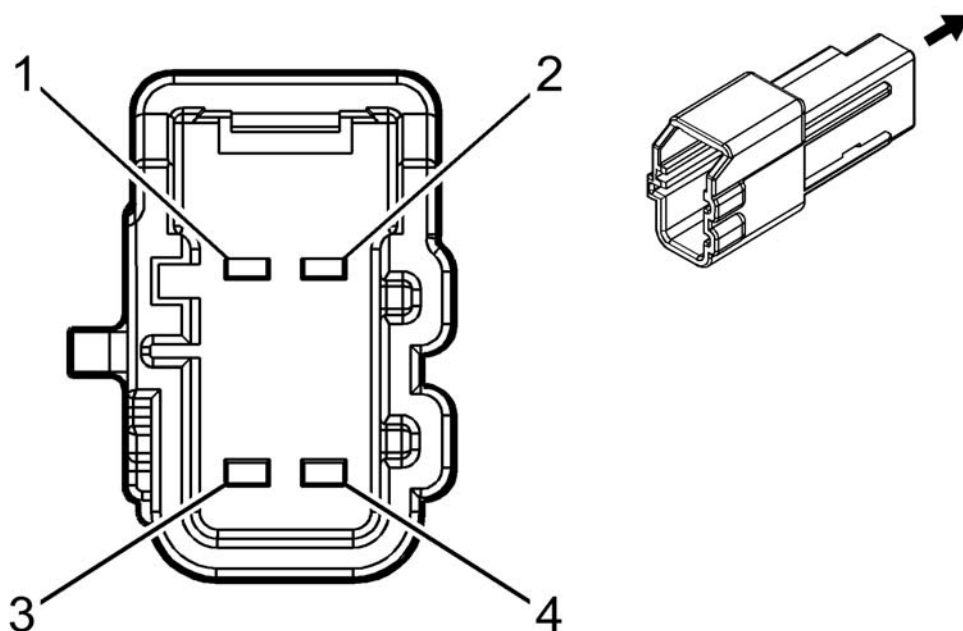
- Harness Type: Seats
- OEM Connector: 6098-7779
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BU	2479	Passenger Heated Seat Element Control	I	-
2	0.35	WH/GY	2434	Passenger Heated Seat NTC Signal	I	-
3	0.35	BK/GY	2435	Passenger Heated Seat NTC Low Reference	I	-
4	0.5	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-

E14F SEAT HEATING ELEMENT - LEFT REAR CUSHION



Connector Part Information

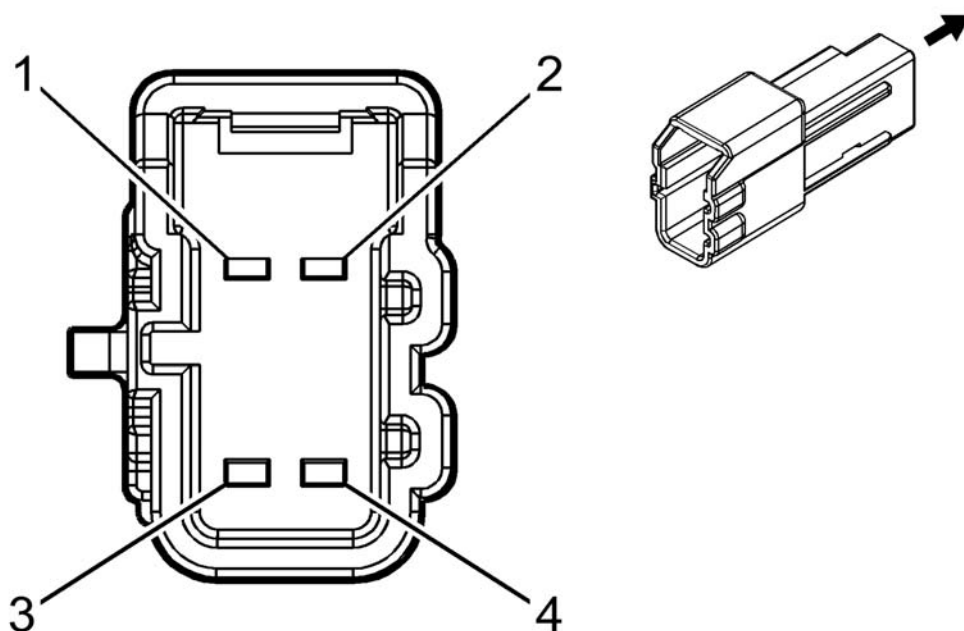
- Harness Type: Seats
- OEM Connector: 6098-7779
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	2294	Left Rear Heated Seat Cushion Element Control	I	-
2	0.35	WH/BU	7047	Left Rear Cushion NTC Signal	I	-
3	0.35	BU/WH	7048	Left Rear Cushion NTC Low Reference	I	-
4	0.5	BN/BK	2295	Left Rear Heated Seat Cushion Element Low Reference	I	-

E14H SEAT HEATING ELEMENT - RIGHT REAR CUSHION



Connector Part Information

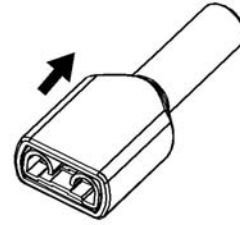
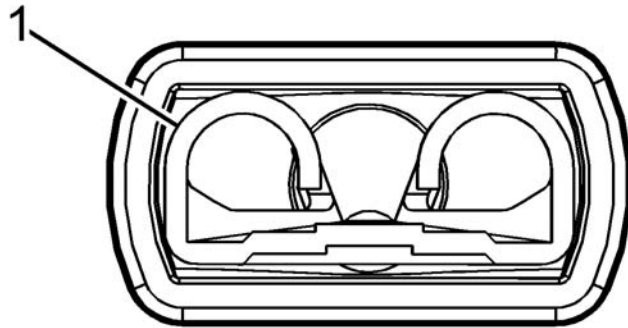
- Harness Type: Seats
- OEM Connector: 6098-7781
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/BN	2296	Right Rear Heated Seat Cushion Element Control	I	-
2	0.35	YE/WH	7053	Right Rear Cushion NTC Signal	I	-
3	0.35	WH/BK	7054	Right Rear Cushion NTC Low Reference	I	-
4	0.5	GN/BK	2297	Right Rear Heated Seat Cushion Element Low Reference	I	-

E17D OUTSIDE REARVIEW MIRROR GLASS - DRIVER X1



Connector Part Information

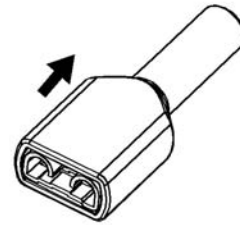
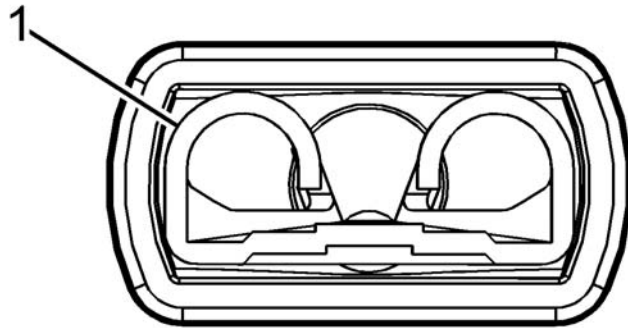
- Harness Type: Outside Rearview Mirror - Driver
- OEM Connector: 9-520272-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/GY	2267	Mirror Heating Element Control	I	-

E17D OUTSIDE REARVIEW MIRROR GLASS - DRIVER X2



Connector Part Information

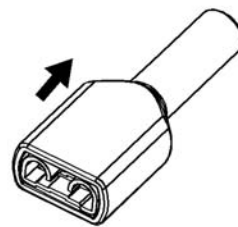
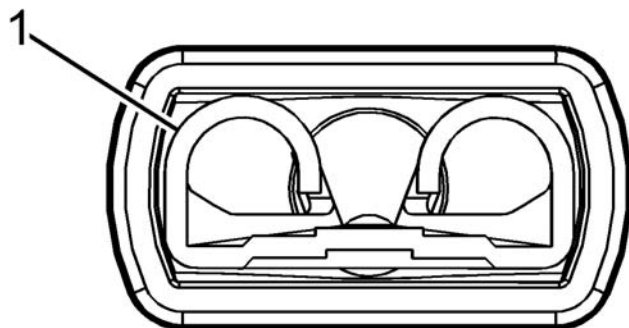
- Harness Type: Outside Rearview Mirror - Driver
- OEM Connector: 9-520272-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1550	Ground	I	-

E17P OUTSIDE REARVIEW MIRROR GLASS - PASSENGER X1



Connector Part Information

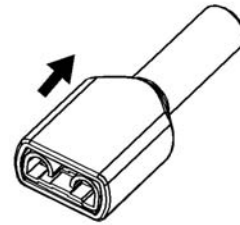
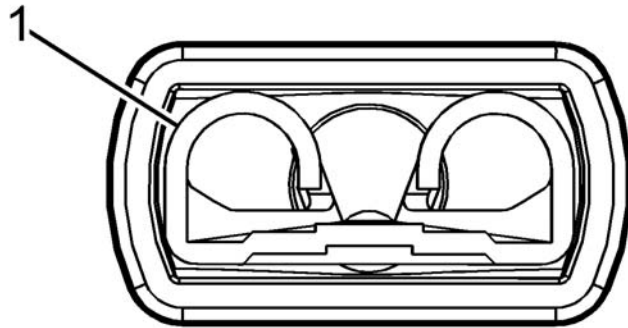
- Harness Type: Outside Rearview Mirror - Passenger
- OEM Connector: 9-520272-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/GY	2267	Mirror Heating Element Control	I	-

E17P OUTSIDE REARVIEW MIRROR GLASS - PASSENGER X2



Connector Part Information

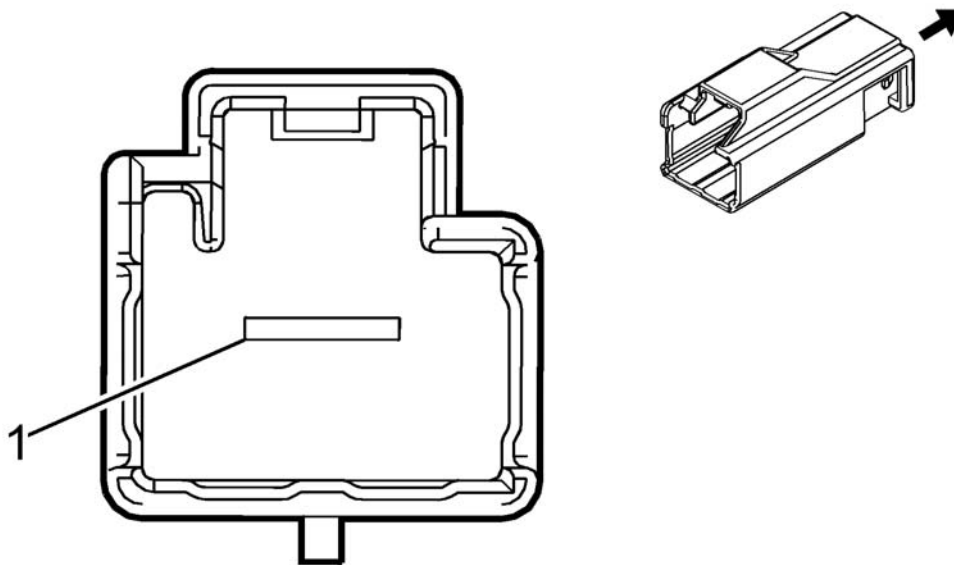
- Harness Type: Outside Rearview Mirror - Passenger
- OEM Connector: 9-520272-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	2050	Ground	I	-

E18 REAR DEFOGGER GRID X1



Connector Part Information

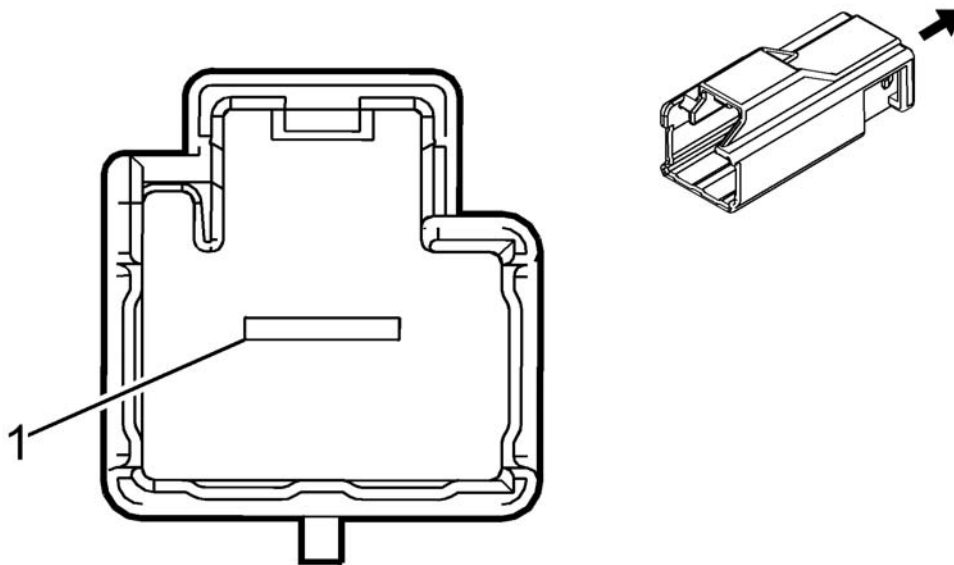
- Harness Type: Liftgate
- OEM Connector: 7286-9357-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way M 6.3 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-43 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	BK	293	Rear Defog Element Control	I	-

E18 REAR DEFOGGER GRID X2



Connector Part Information

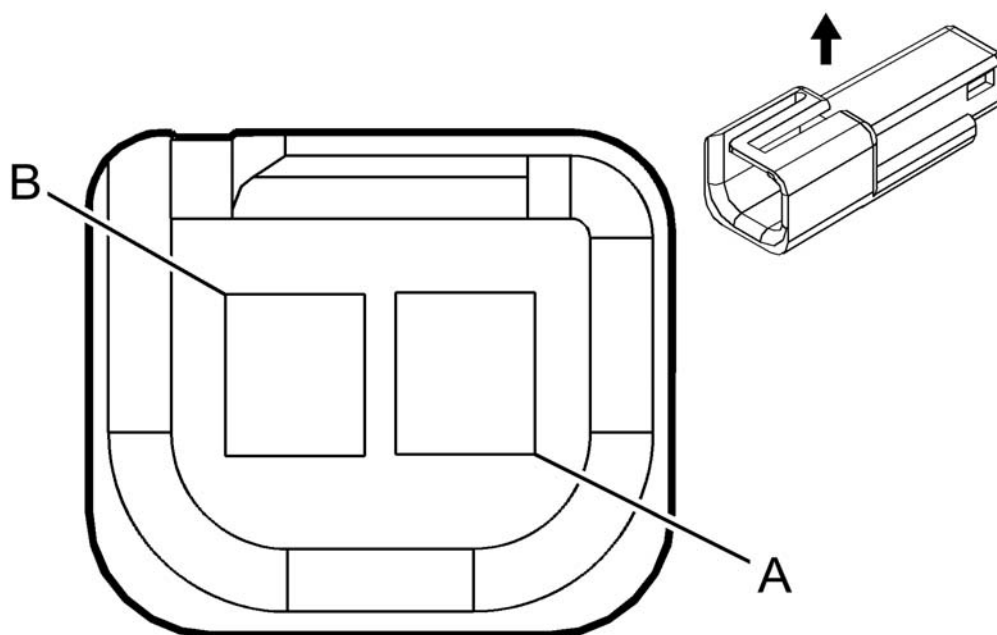
- Harness Type: Liftgate
- OEM Connector: 7286-9357-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way M 6.3 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-43 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	BK	850	Ground	I	-

E31L SUNSHADE MIRROR LAMP - LEFT



Connector Part Information

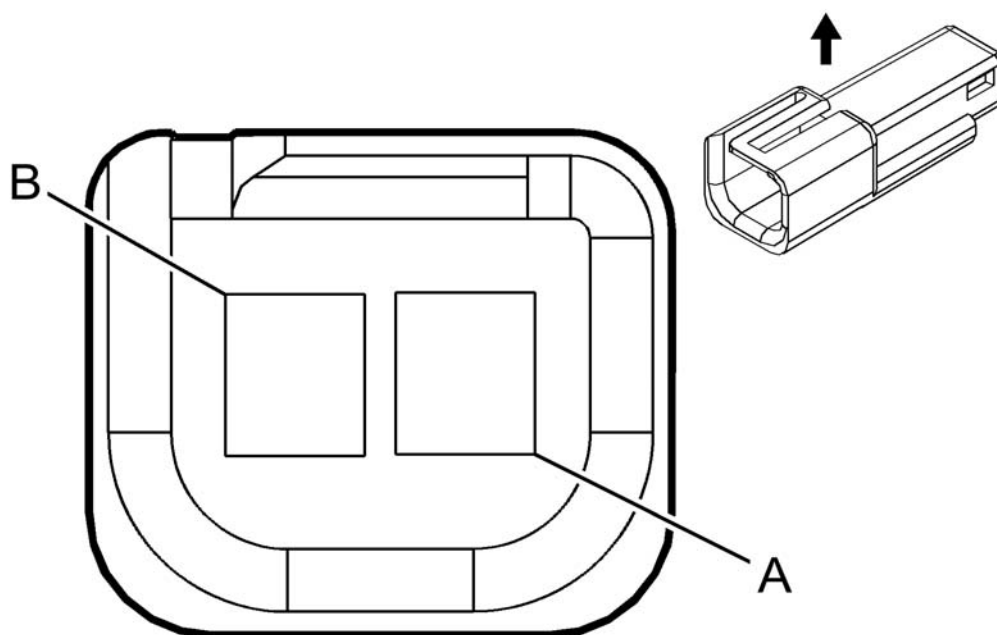
- Harness Type: Headliner
- OEM Connector: 12047663
- Service Connector: 13584278
- Description: 2-Way M 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/BN	6815	Inadvertent Power Control	I	-
B	0.5	BK	2150	Ground	I	-

E31R SUNSHADE MIRROR LAMP - RIGHT



Connector Part Information

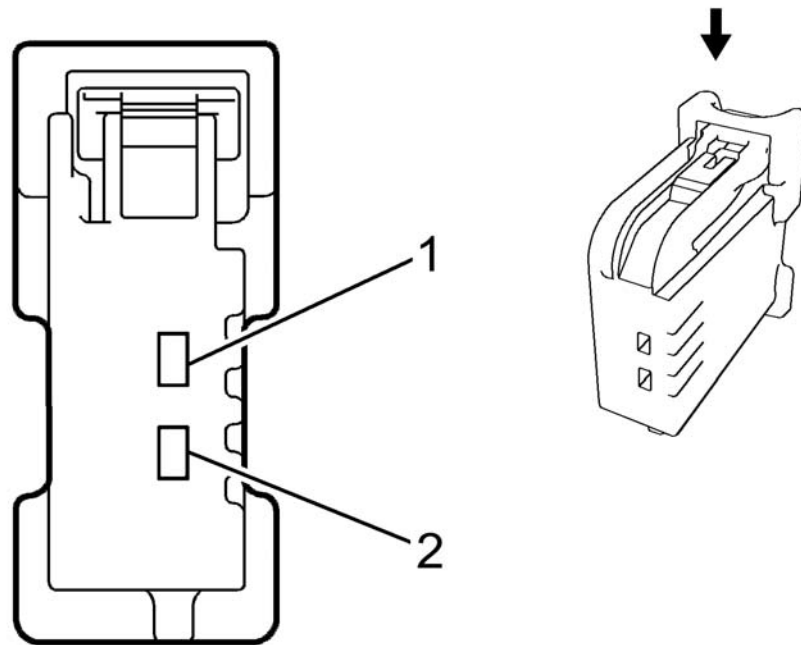
- Harness Type: Headliner
- OEM Connector: 12047663
- Service Connector: 13584278
- Description: 2-Way M 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/BN	6815	Inadvertent Power Control	I	-
B	0.5	BK	2150	Ground	I	-

E33 CARGO LAMP



Connector Part Information

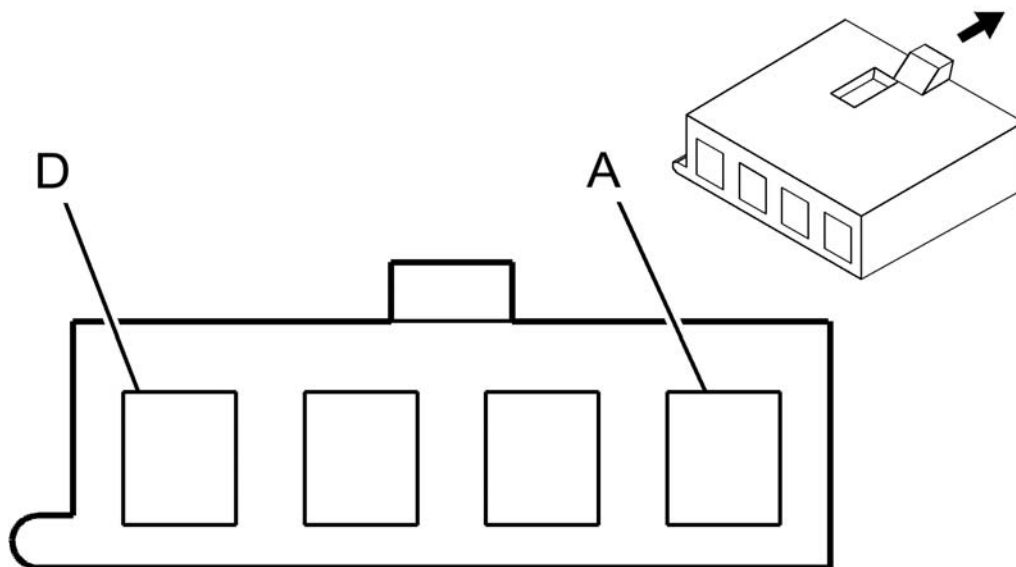
- Harness Type: Liftgate
- OEM Connector: 6098-5510
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	737	Rear Compartment Lid Lamp Control	I	-
2	0.5	BK	850	Ground	I	-

E37R DOME/READING LAMPS - REAR



Connector Part Information

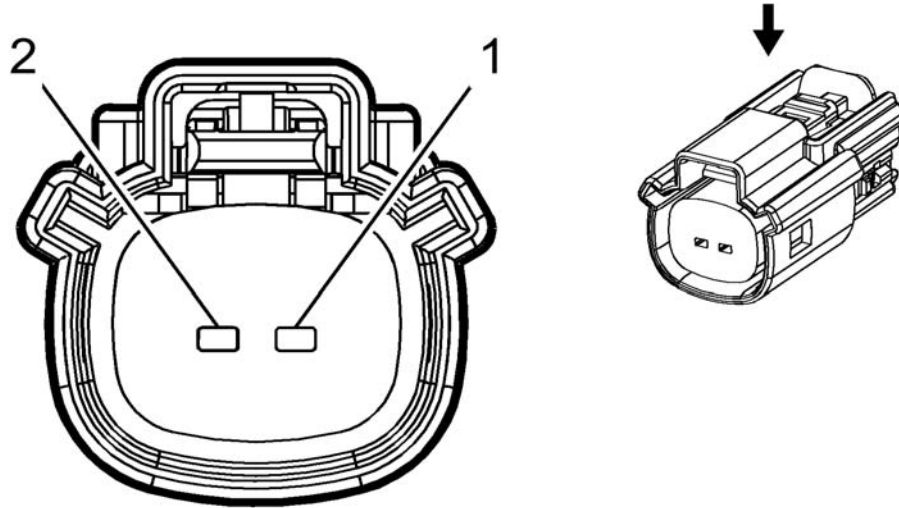
- Harness Type: Headliner
- OEM Connector: 12092162
- Service Connector: 15306021
- Description: 4-Way F 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	WH/BN	6815	Inadvertent Power Control	I	-
B	0.5	BK	2150	Ground	I	-
C	0.5	GY	157	Interior Lamp Control	I	-
D	0.35	YE	6817	LED Backlight Dimming Control	I	-

E41 ENGINE COOLANT THERMOSTAT HEATER



Connector Part Information

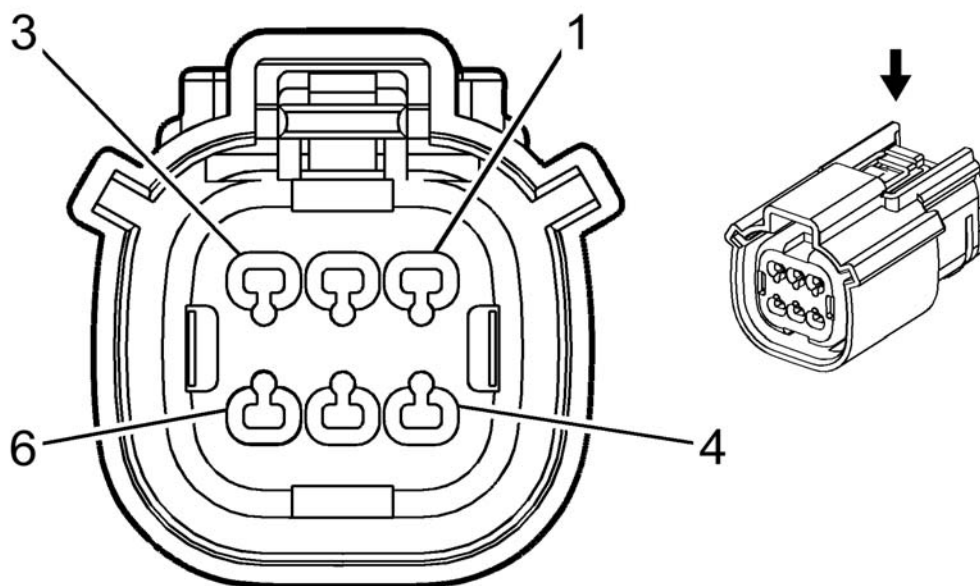
- Harness Type: Engine
- OEM Connector: 33471-0206
- Service Connector: 13577534
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
2	0.5	BU	6814	Thermostat Engine Cool Control	I	-

E42L TAIL LAMP ASSEMBLY - LEFT



Connector Part Information

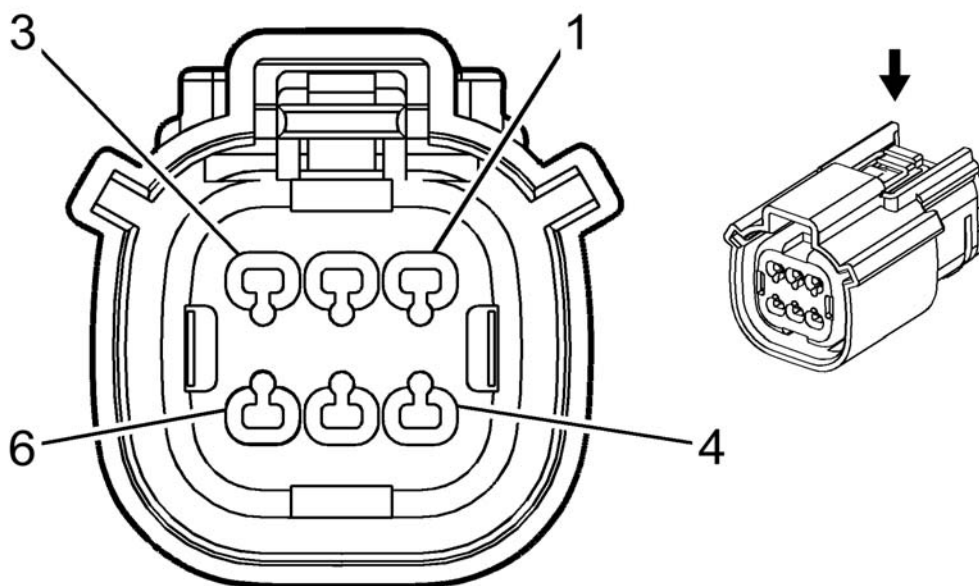
- Harness Type: Body
- OEM Connector: 33472-0606
- Service Connector: 13585853
- Description: 6-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	650	Ground	I	-
2	0.5	WH/YE	1204	Left Park Lamp Control	I	-
3	0.5	GY/YE	7542	Left Rear Stop Lamp Control	I	-
4	0.5	YE/BN	618	Left Rear Turn Signal Lamp Control	I	-
5	0.5	GN/WH	1324	Backup Lamp Control	I	-
6	0.5	BK	650	Ground	I	-

E42R TAIL LAMP ASSEMBLY - RIGHT



Connector Part Information

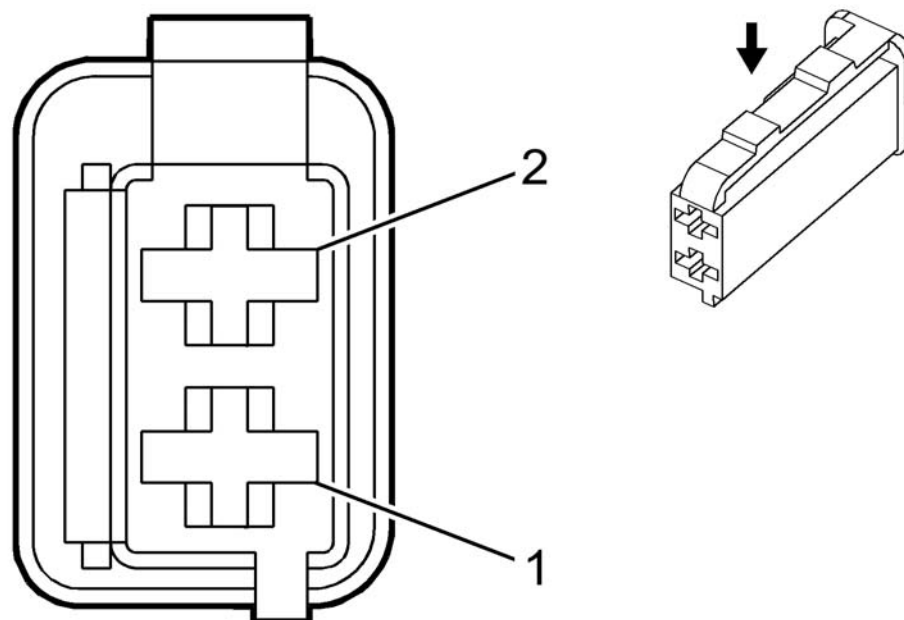
- Harness Type: Body
- OEM Connector: 33472-0606
- Service Connector: 13585853
- Description: 6-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	850	Ground	I	-
2	0.5	VT	1203	Right Park Lamp Control	I	-
3	0.5	WH/YE	7541	Right Rear Stop Lamp Control	I	-
4	0.5	GN/VT	619	Right Rear Turn Signal Lamp Control	I	-
5	0.5	GN/WH	1324	Backup Lamp Control	I	-
6	0.5	BK	850	Ground	I	-

E63D FLOOD LAMP - DRIVER DOOR HANDLE



Connector Part Information

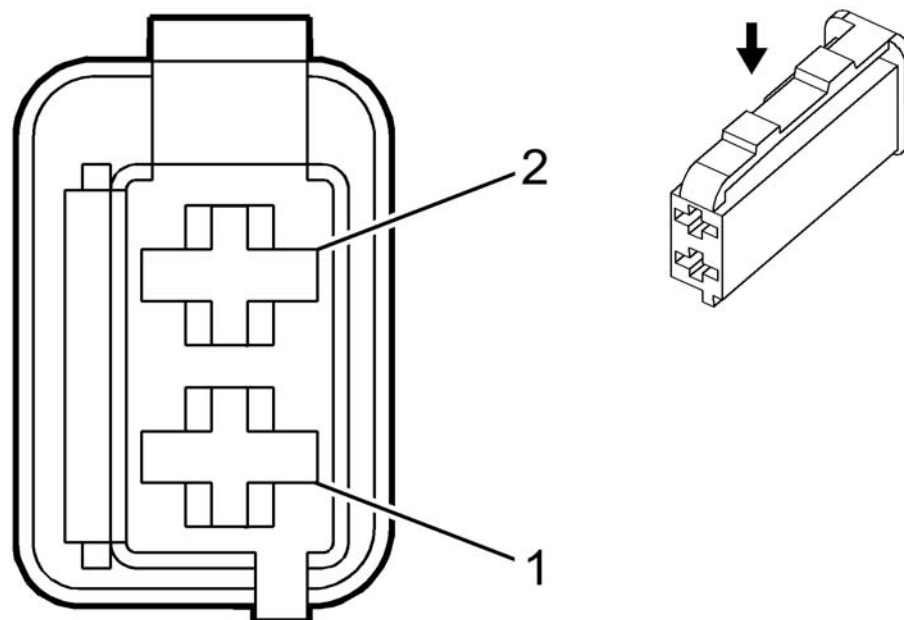
- Harness Type: Driver Door Trim
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-
2	0.5	BK	1550	Ground	I	-

E63LR FLOOD LAMP - LEFT REAR DOOR HANDLE



Connector Part Information

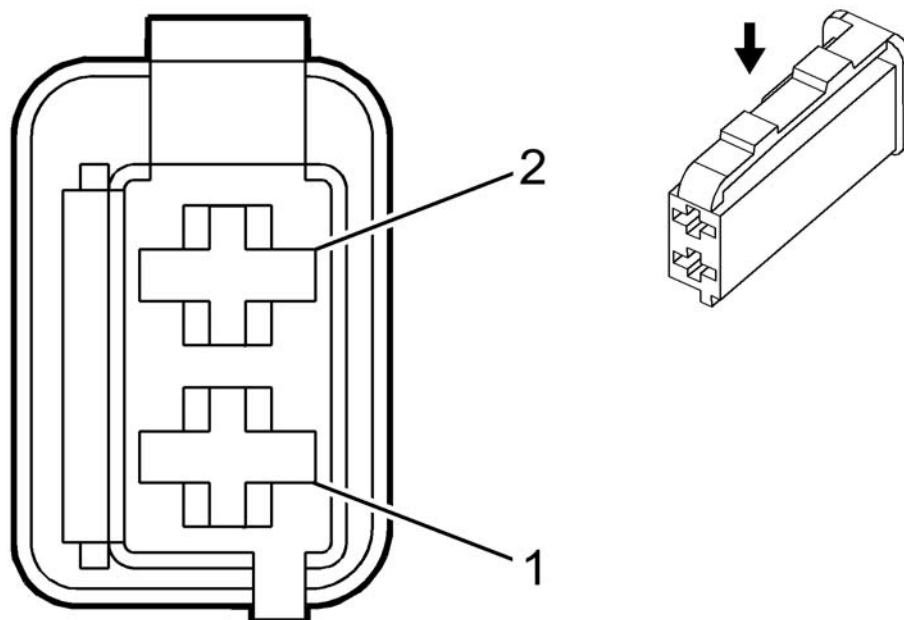
- Harness Type: Left Rear Door
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-
2	0.5	BK	650	Ground	I	-

E63P FLOOD LAMP - PASSENGER DOOR HANDLE



Connector Part Information

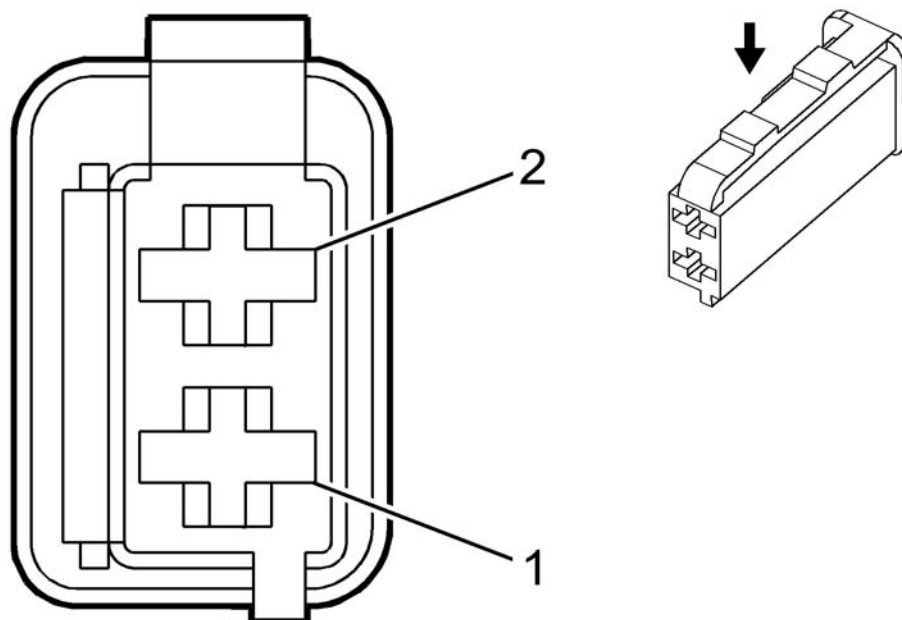
- Harness Type: Passenger Door Trim
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-
2	0.5	BK	2050	Ground	I	-

E63RR FLOOD LAMP - RIGHT REAR DOOR HANDLE



Connector Part Information

- Harness Type: Right Rear Door
- OEM Connector: 1563189-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-
2	0.5	BK	850	Ground	I	-

E85 HYBRID/EV BATTERY CHARGER RECEPTACLE ACCENT LAMP

Connector Part Information

- Harness Type: Charge Port
- OEM Connector: Not Available

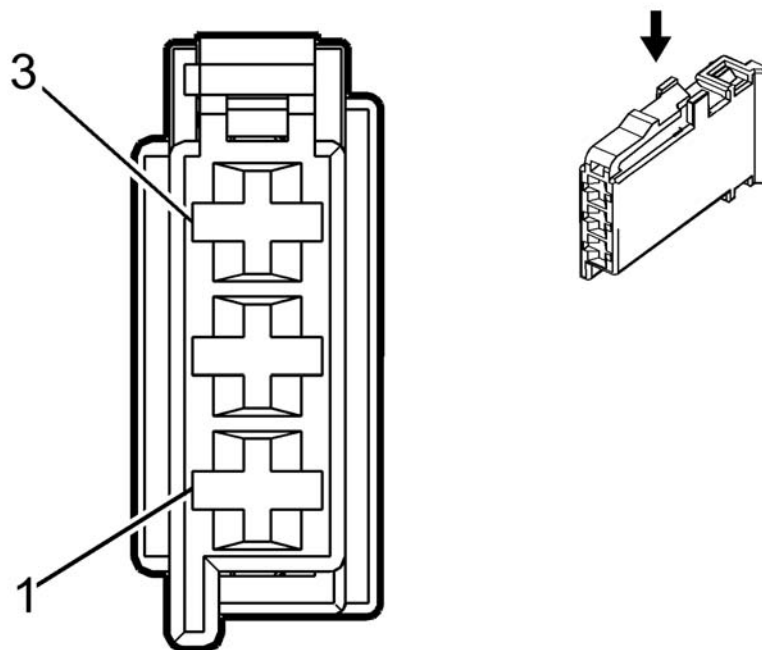
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/BU	9000	Power	I	-
2	0.5	BK	1550	Ground	I	-

E1W ACCENT LAMP - INSTRUMENT PANEL



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1452142-1
- Service Connector: 93186706
- Description: 3-Way F 1.6 Micro-Timer Series (BK)

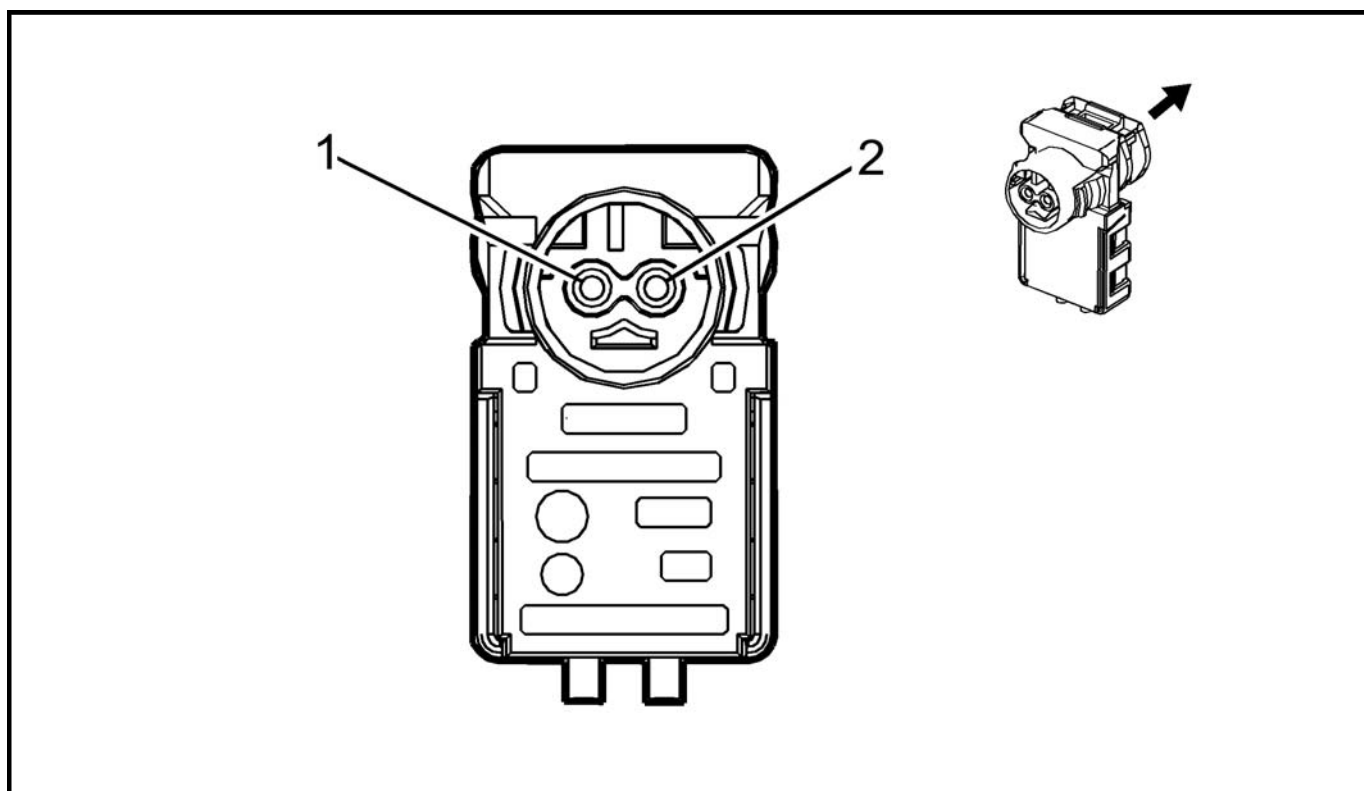
Terminal Part Information

Terminal	Terminated	Diagnostic	Terminal	Service	Tray	Core	Insulation
----------	------------	------------	----------	---------	------	------	------------

Type ID	Lead	Test Probe	Removal Tool	Terminal	Name	Crimp	Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	157	Interior Lamp Control	I	-
2	0.5	BK	1650	Ground	I	-
3	0.35	WH/YE	7557	LED Ambient Lighting Control 1	I	-

F101 PASSENGER INSTRUMENT PANEL AIR BAG X1



Connector Part Information

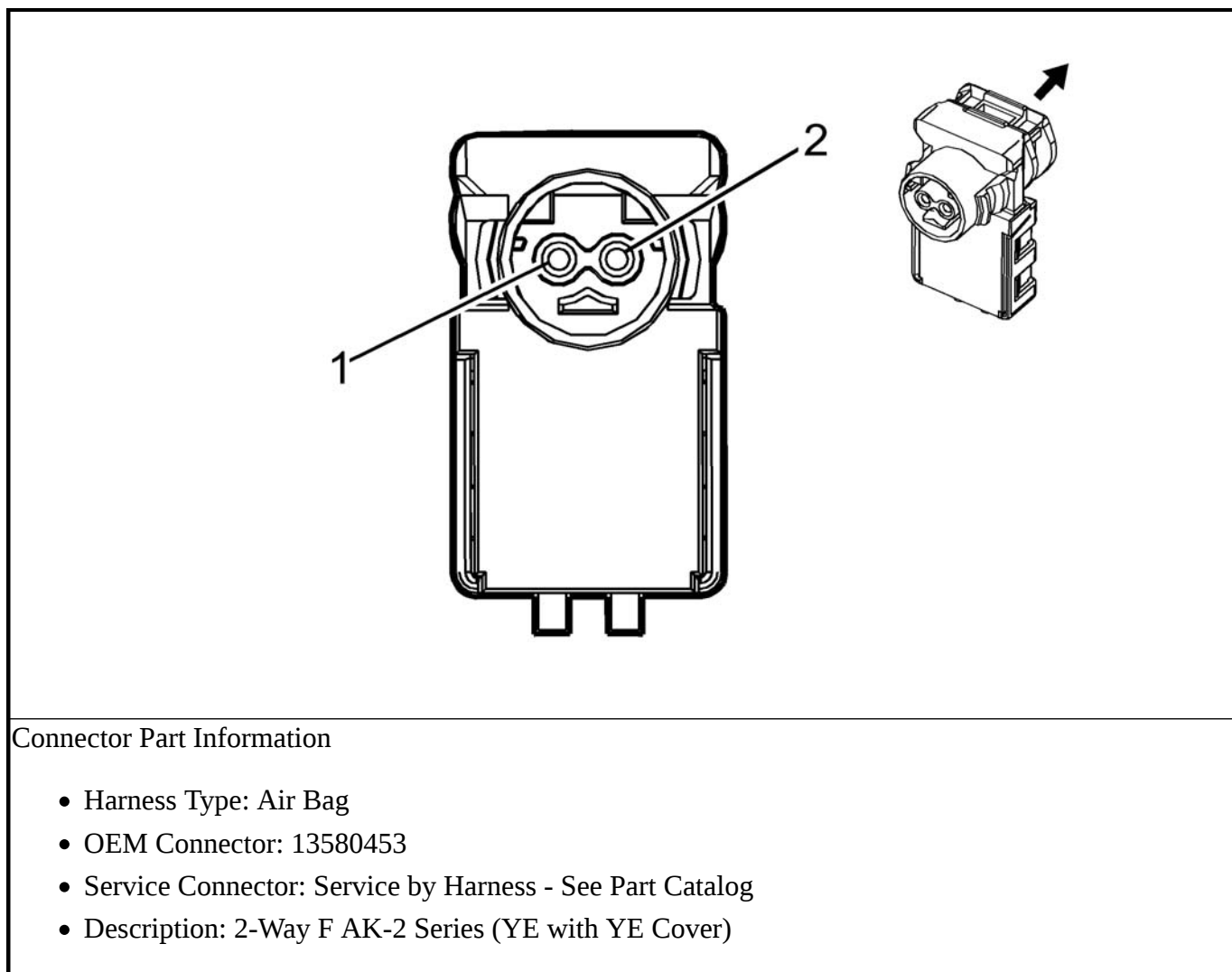
- Harness Type: Air Bag
- OEM Connector: 13580454
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F AK-2 Series (L-GN with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/OG	3025	Passenger IP Module Stage 1 High Control	I	-
2	0.5	OG/WH	3024	Passenger IP Module Stage 1 Low Control	I	-

F101 PASSENGER INSTRUMENT PANEL AIR BAG X2



Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/OG	3027	Passenger IP Module Stage 2 High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	OG/VT	3026	Passenger IP Module Stage 2 Low Control	I	-

F101 PASSENGER INSTRUMENT PANEL AIR BAG X3

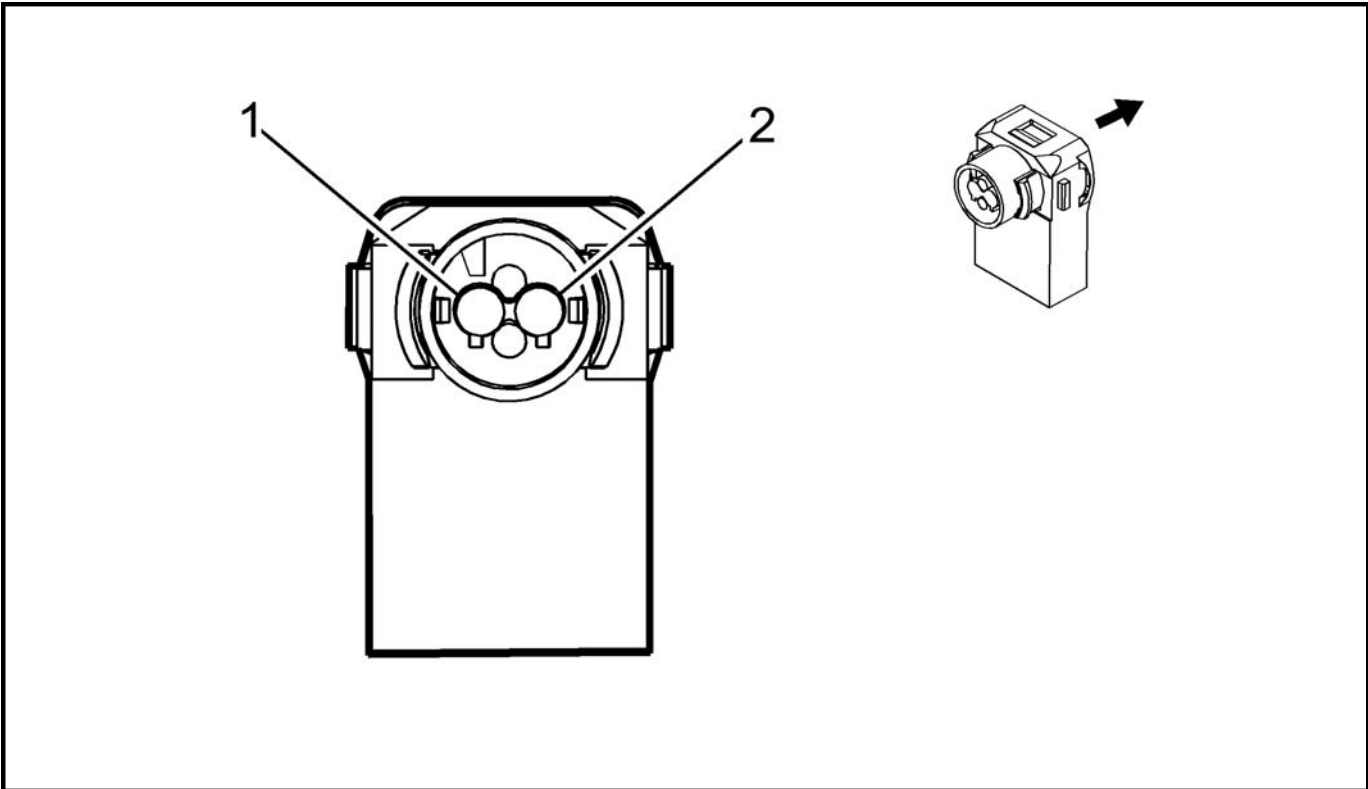
-
Connector Part Information • Harness Type: Air Bag • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool
I	Not Required	Not Available	No Tool Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1650	Ground	I	-

F105L ROOF RAIL AIR BAG - LEFT



Connector Part Information

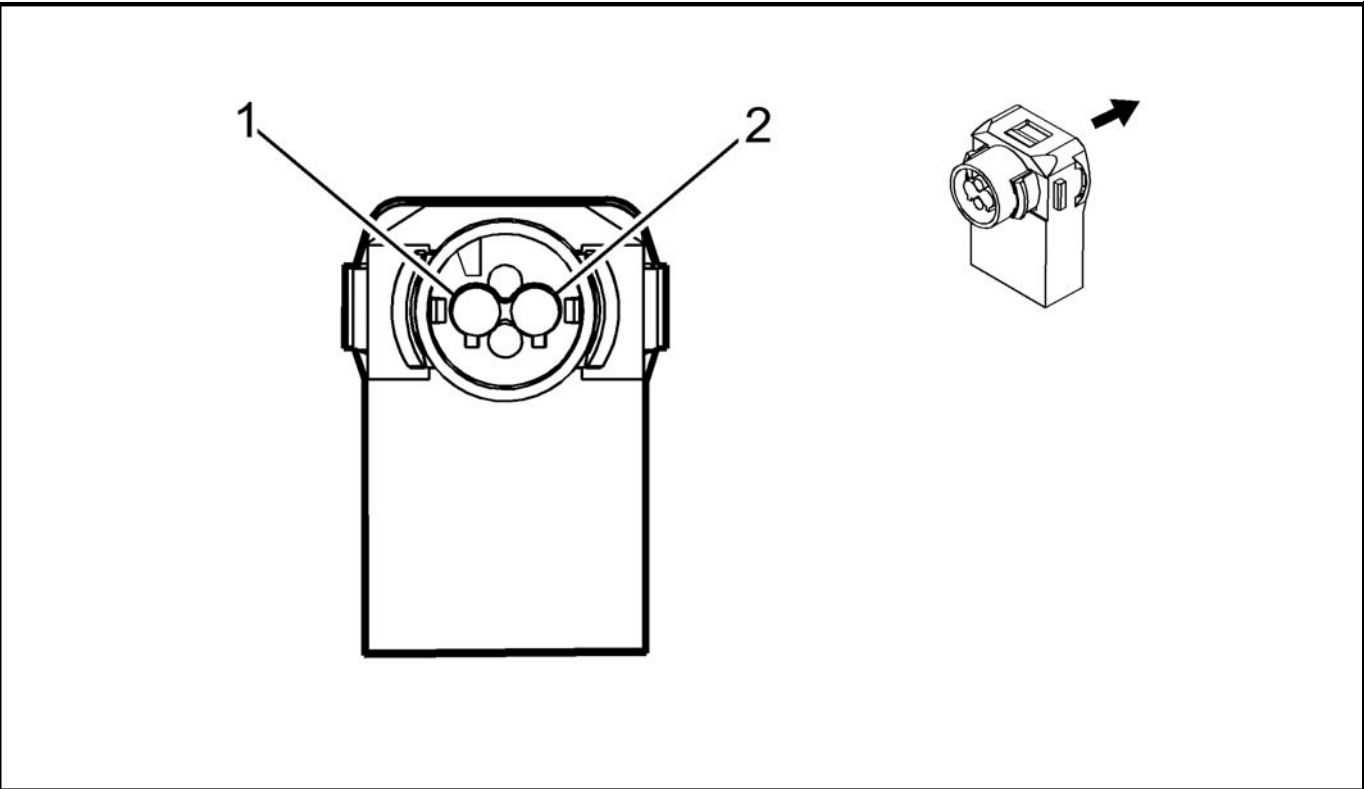
- Harness Type: Body
- OEM Connector: 13596556
- Service Connector: 13596556
- Description: 2-Way F 1.0 MAC Series (GY with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/GN	5019	Left Front Head Curtain Module High Control	I	-
2	0.35	VT/OG	5020	Left Front Head Curtain Module Low Control	I	-

F105R ROOF RAIL AIR BAG - RIGHT



Connector Part Information

- Harness Type: Body
- OEM Connector: 13596556

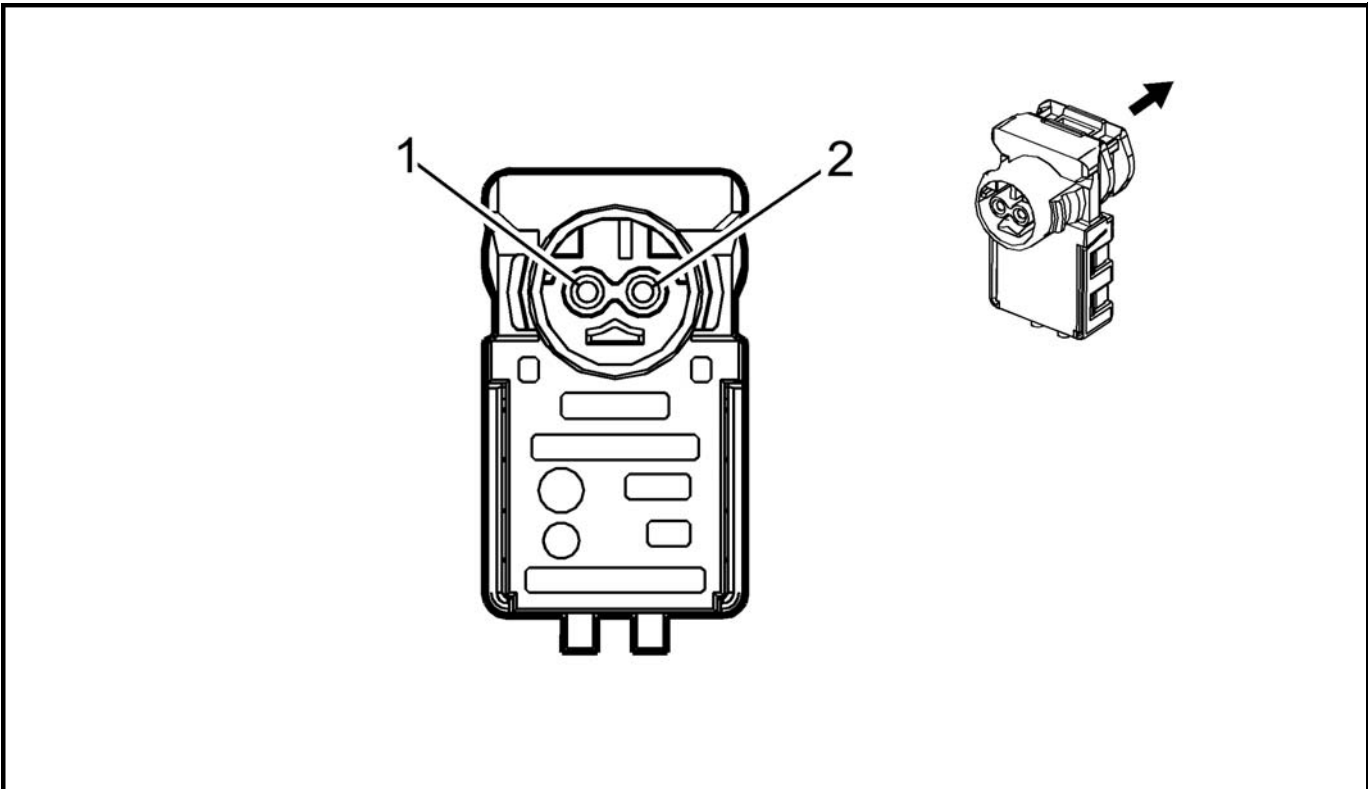
- Service Connector: 13596556
- Description: 2-Way F 1.0 MAC Series (GY with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/GY	5021	Right Front Head Curtain Module High Control	I	-
2	0.35	GY	5022	Right Front Head Curtain Module Low Control	I	-

F106LF SEAT SIDE AIR BAG - LEFT FRONT



Connector Part Information

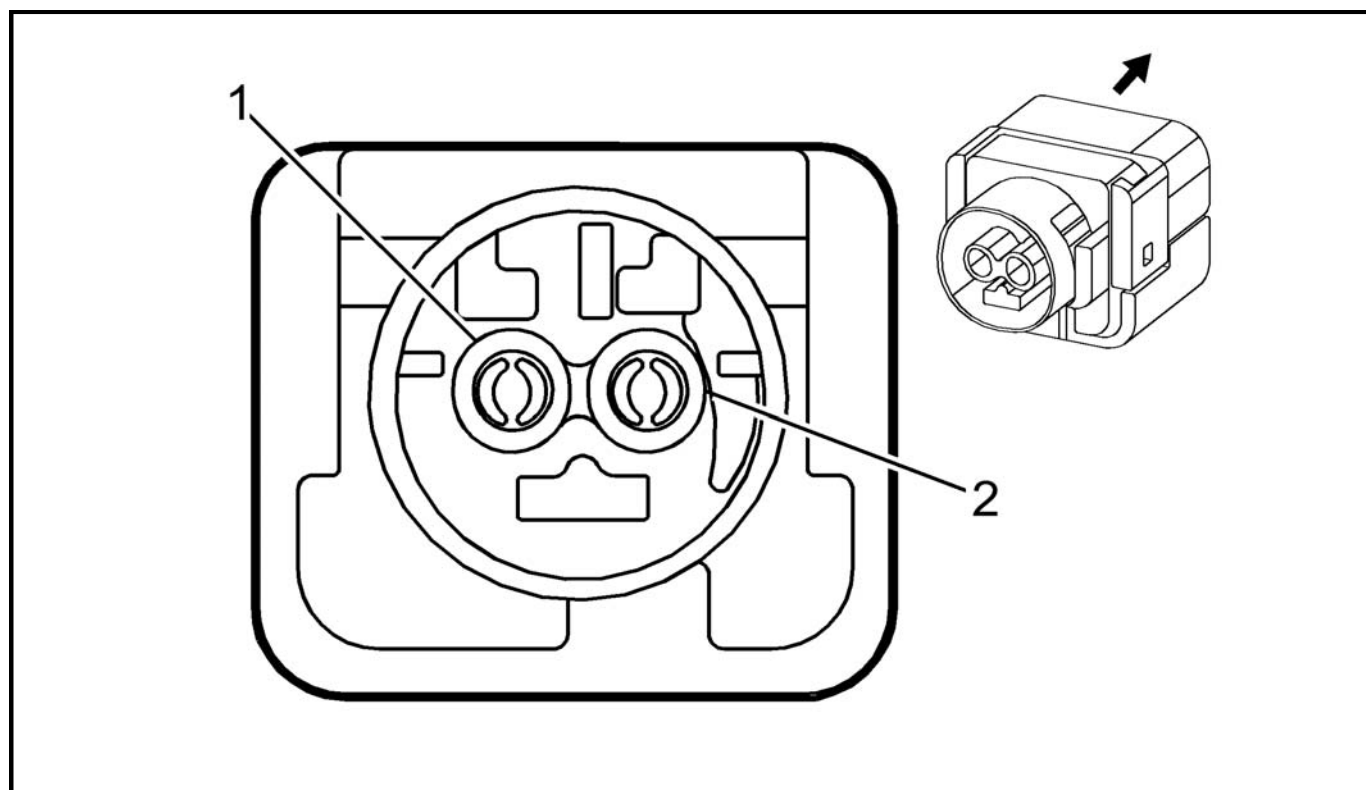
- Harness Type: Seat
- OEM Connector: 13580455
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F AK-2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/BU	3068	Driver Side Impact Module High Control	I	-
2	0.35	GN/OG	3069	Driver Side Impact Module Low Control	I	-

F106LR SEAT SIDE AIR BAG - LEFT REAR



Connector Part Information

- Harness Type: Body
- OEM Connector: 19178108
- Service Connector: 19300405
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

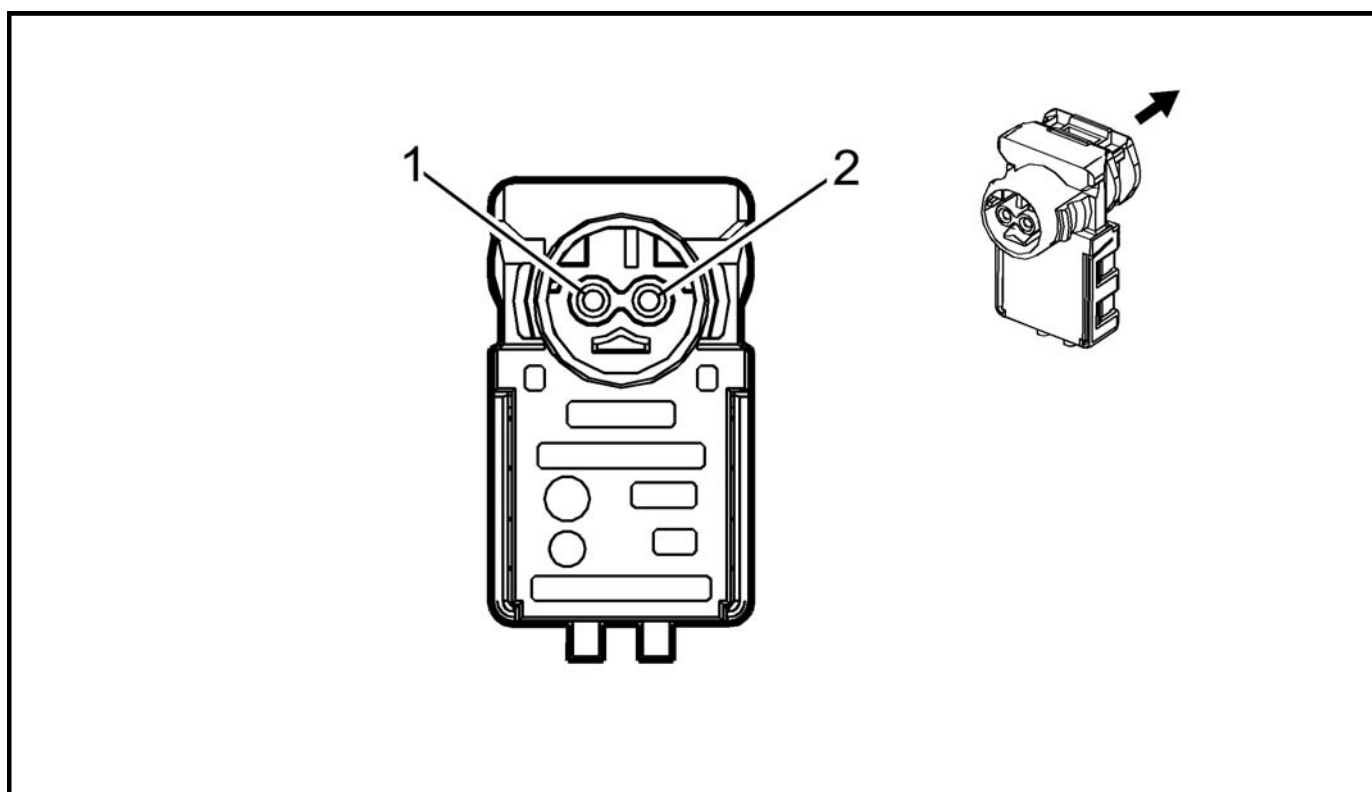
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GY	5223	Left Rear Side Impact SIR Inflator Control	I	-
2	0.5	VT/OG	5224	Left Rear Side Impact SIR Inflator Control	I	-

F106RF SEAT SIDE AIR BAG - RIGHT FRONT



Connector Part Information

- Harness Type: Seat
- OEM Connector: 13580455
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F AK-2 Series (BK)

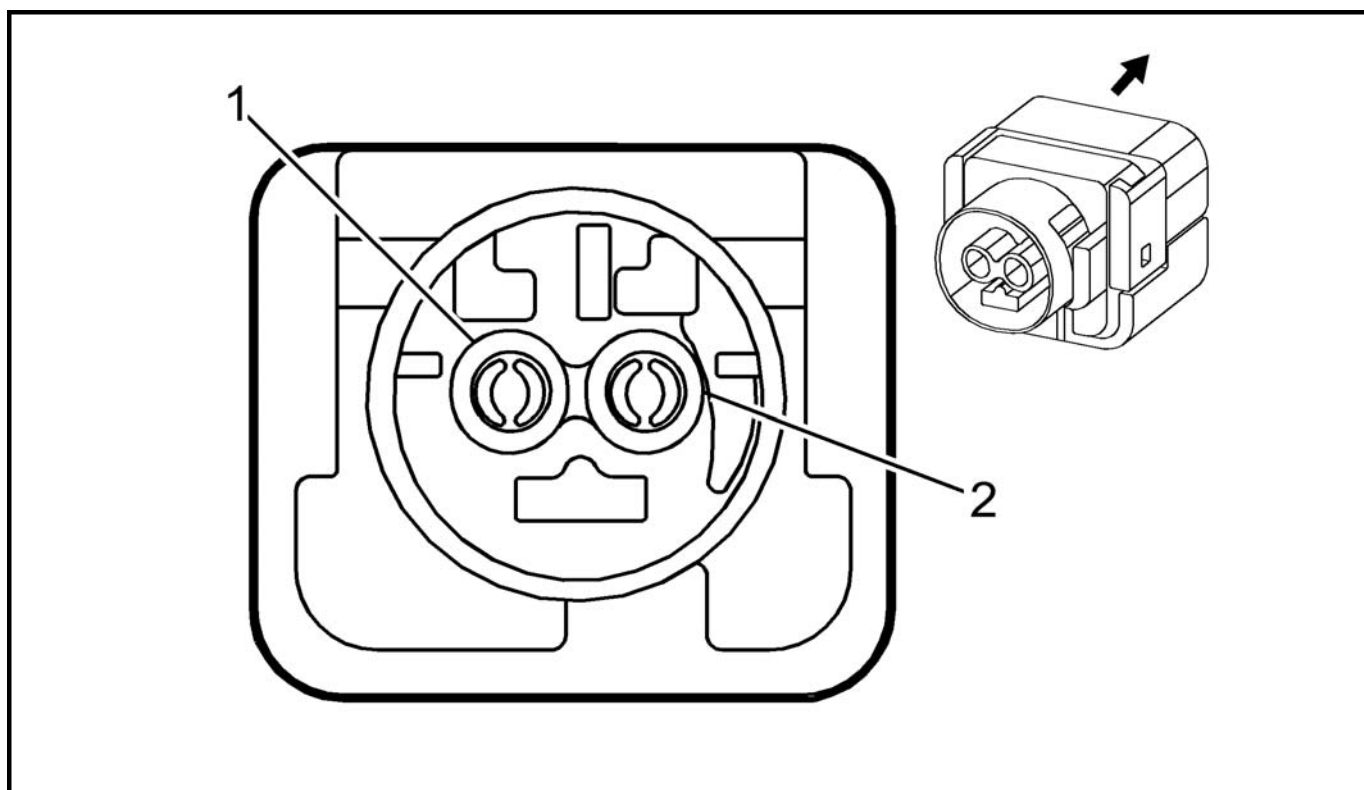
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
			Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/GY	3066	Passenger Side Impact Module High Control	I	-
2	0.35	BN/OG	3067	Passenger Side Impact Module Low Control	I	-

F106RR SEAT SIDE AIR BAG - RIGHT REAR



Connector Part Information

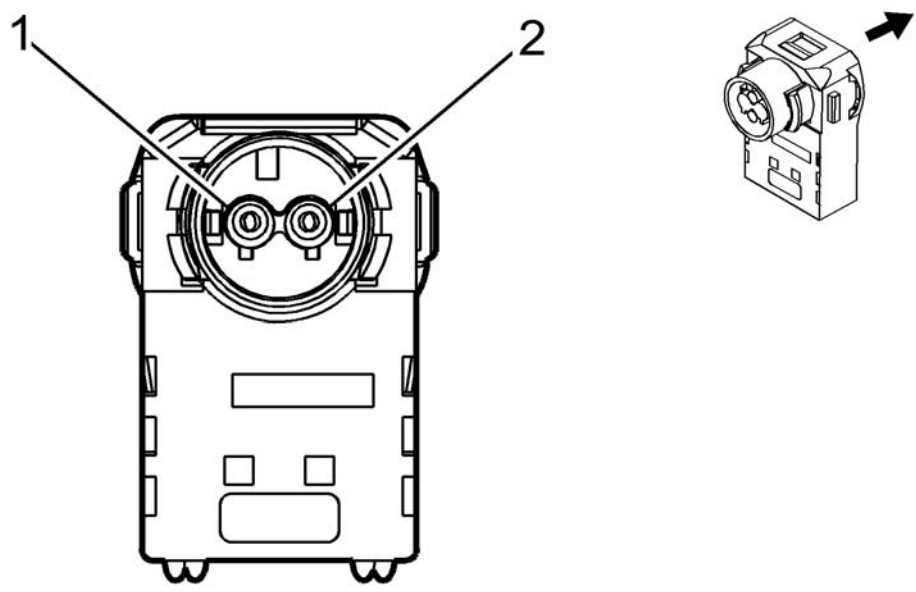
- Harness Type: Body
- OEM Connector: 19178108
- Service Connector: 19300405
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/OG	5225	Right Rear Side Impact SIR Inflator Control	I	-
2	0.5	OG/GY	5226	Right Rear Side Impact SIR Inflator Control	I	-

F107 STEERING WHEEL AIR BAG X1



Connector Part Information

- Harness Type: Steering Wheel
- OEM Connector: 33154418
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

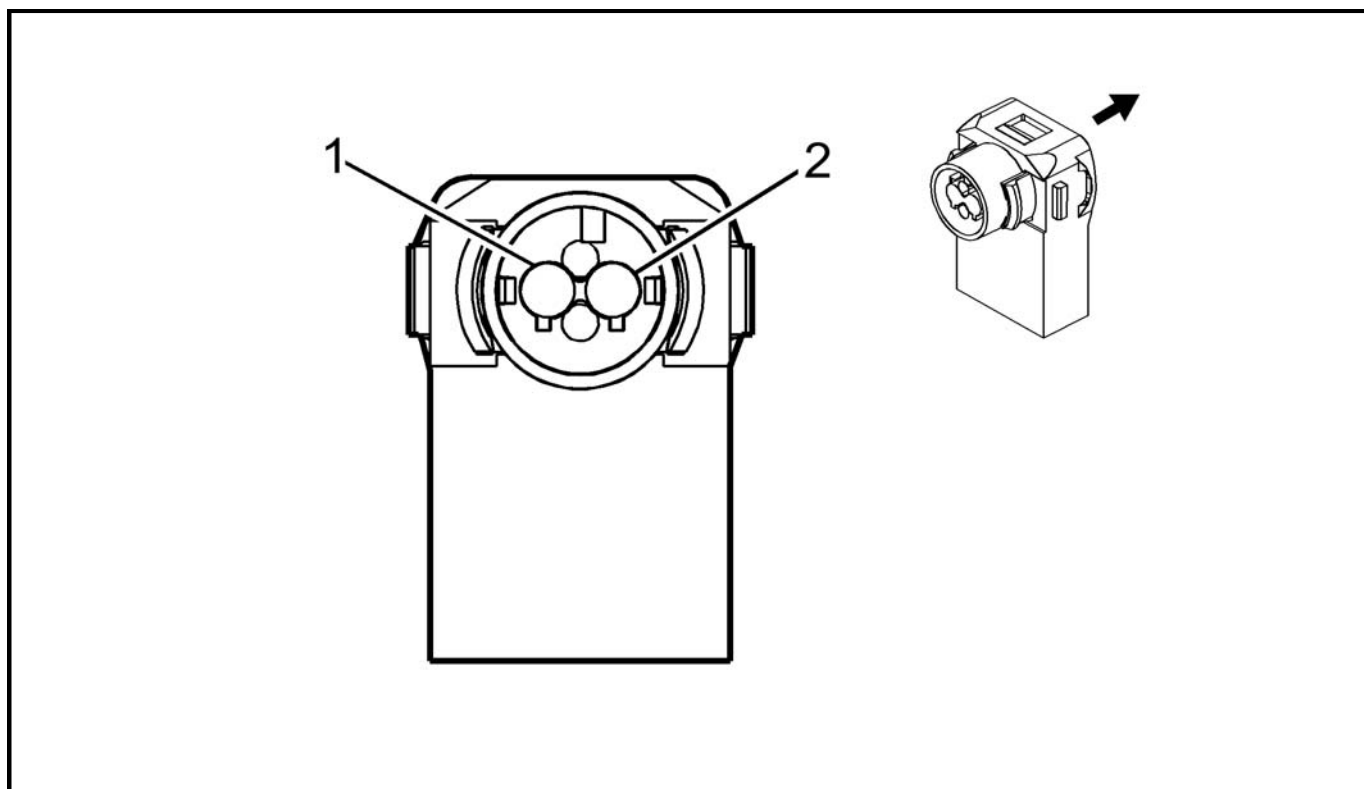
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU	3021	Steering Wheel Module Stage 1 High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	GN	3020	Steering Wheel Module Stage 1 Low Control	I	-

F107 STEERING WHEEL AIR BAG X2



Connector Part Information

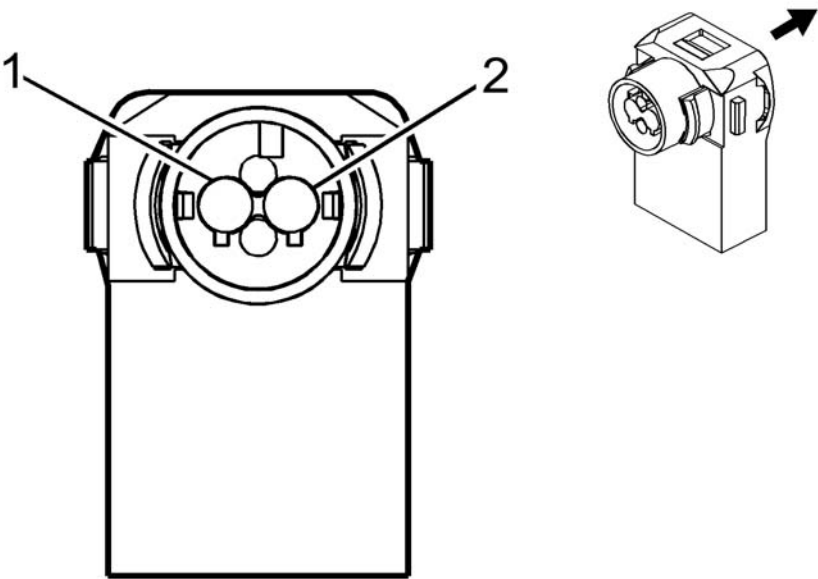
- Harness Type: Steering Wheel
- OEM Connector: 33154433
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	TN	3023	Steering Wheel Module Stage 2 High Control	I	-
2	0.5	BN	3022	Steering Wheel Module Stage 2 Low Control	I	-

F112D SEAT BELT RETRACTOR PRETENSIONER - DRIVER



Connector Part Information

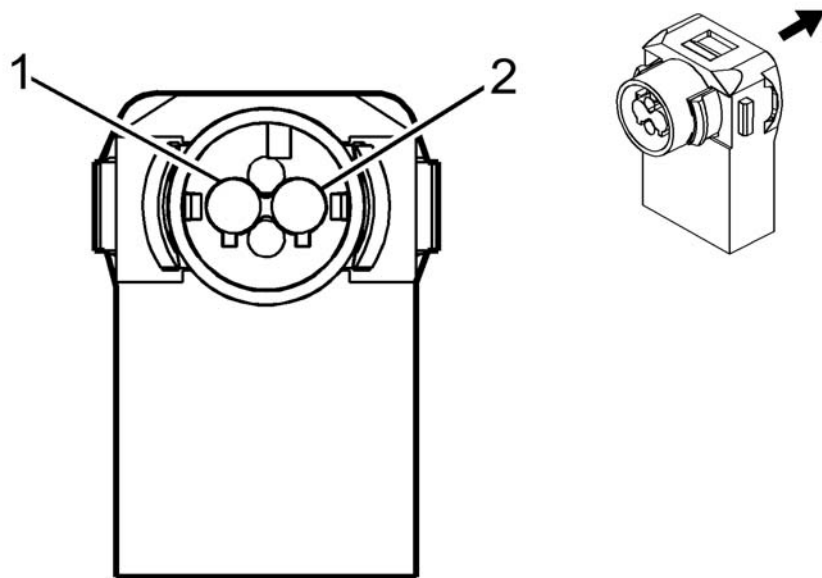
- Harness Type: Body
- OEM Connector: 13596555
- Service Connector: 13596555
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/WH	3477	Driver Seat Belt Retractor Pretensioner High Control	I	-
2	0.35	WH	3478	Driver Seat Belt Retractor Pretensioner Low Control	I	-

F112P SEAT BELT RETRACTOR PRETENSIONER - PASSENGER



Connector Part Information

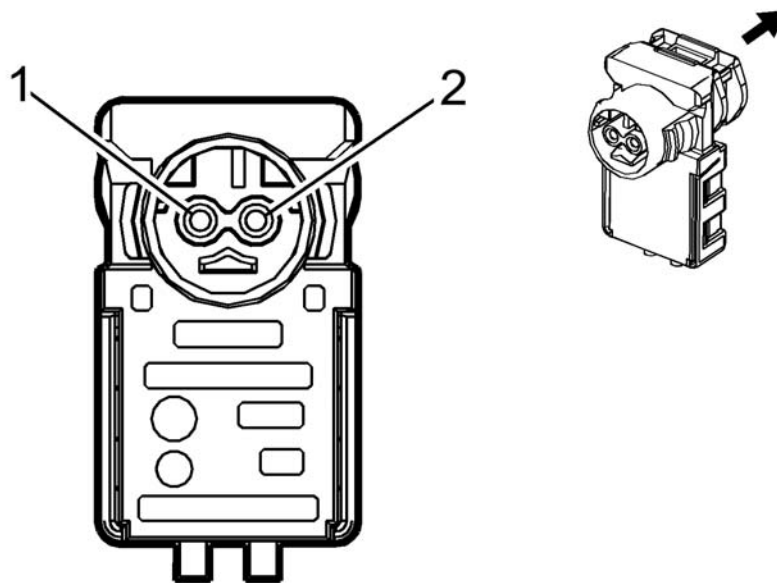
- Harness Type: Body
- OEM Connector: 13596555
- Service Connector: 13596555
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/GN	3475	Passenger Seat Belt Retractor Pretensioner High Control	I	-
2	0.35	WH/OG	3476	Passenger Seat Belt Retractor Pretensioner Low Control	I	-

F113D SEAT BELT ANCHOR PRETENSIONER - DRIVER



Connector Part Information

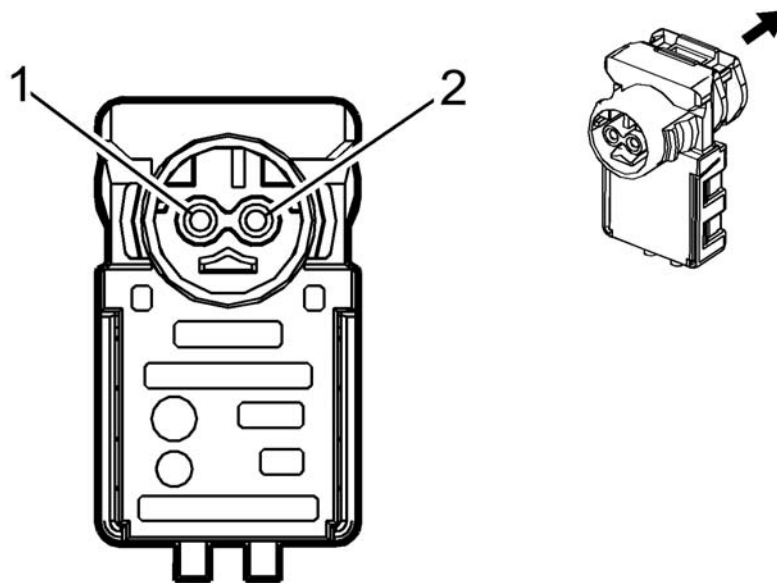
- Harness Type: Seat
- OEM Connector: 13580455
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F AK-2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/YE	3481	Driver Seat Belt Anchor Pretensioner High Control	I	-
2	0.5	VT/OG	3482	Driver Seat Belt Anchor Pretensioner Low Control	I	-

F113P SEAT BELT ANCHOR PRETENSIONER - PASSENGER



Connector Part Information

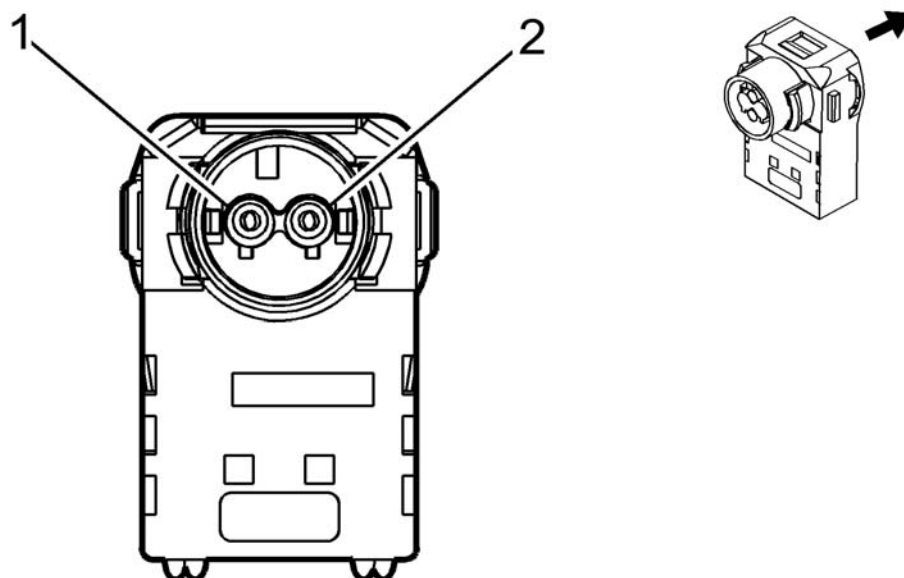
- Harness Type: Seat
- OEM Connector: 13580455
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F AK-2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BN	3479	Passenger Seat Belt Anchor Pretensioner High Control	I	-
2	0.5	GY/OG	3480	Passenger Seat Belt Anchor Pretensioner Low Control	I	-

F114D KNEE AIR BAG - DRIVER



Connector Part Information

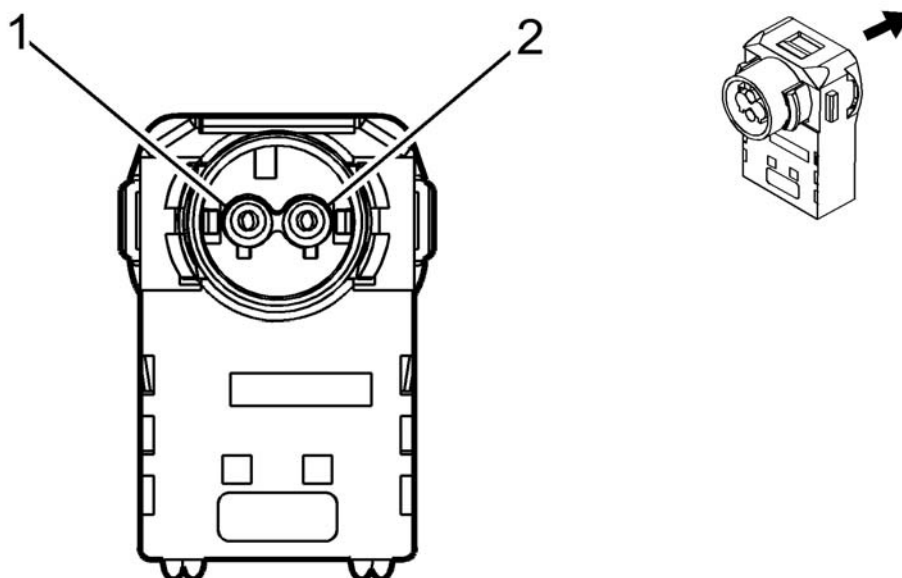
- Harness Type: Instrument Panel
- OEM Connector: 13596554
- Service Connector: 13596554
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/BK	3078	Driver Knee Module High Control	I	-
2	0.35	GY/OG	3079	Driver Knee Module Low Control	I	-

F114P KNEE AIR BAG - PASSENGER



Connector Part Information

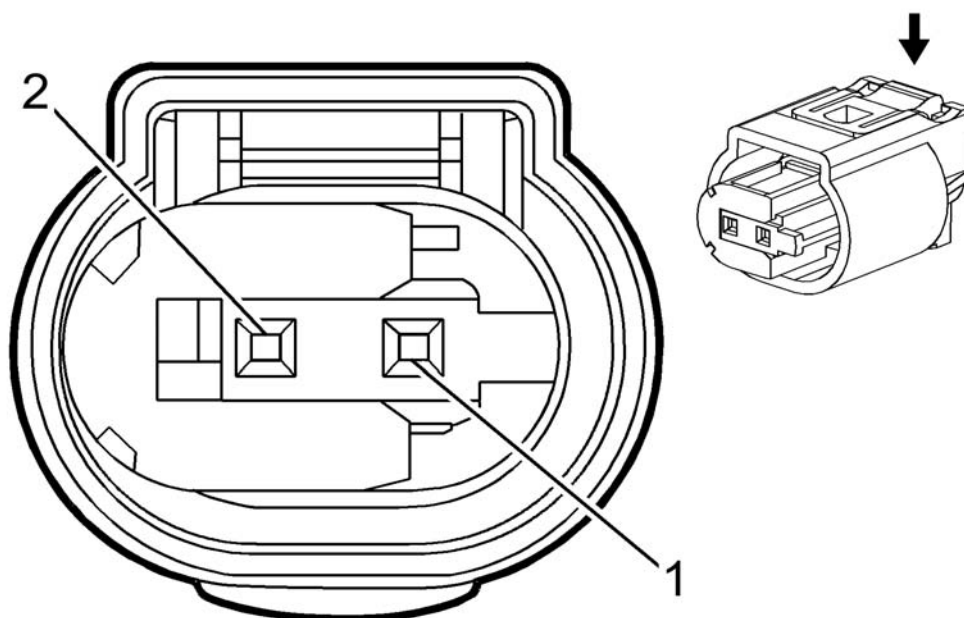
- Harness Type: Instrument Panel
- OEM Connector: 13596554
- Service Connector: 13596554
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/BK	3076	Passenger Knee Module High Control	I	-
2	0.35	WH/OG	3077	Passenger Knee Module Low Control	I	-

F115 HYBRID/EV BATTERY PACK FUSE COVER



Connector Part Information

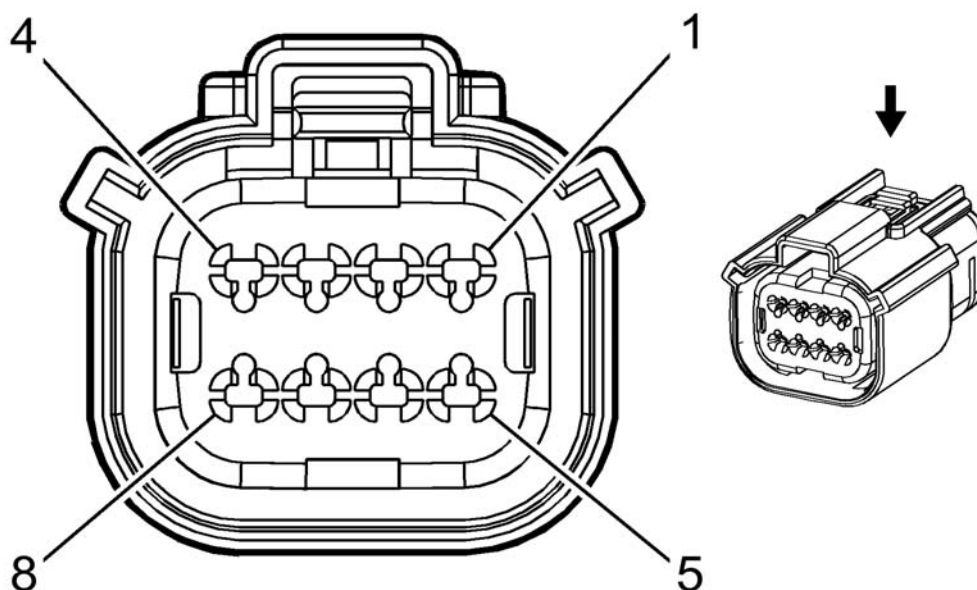
- Harness Type: Battery Pack
- OEM Connector: 24461693
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Micro-Quadlock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	5087	High Voltage Interlock Loop Signal 1	I	-
2	0.5	VT/WH	5087	High Voltage Interlock Loop Signal 1	I	-

G1 A/C COMPRESSOR X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 33472-0806
- Service Connector: 13577527
- Description: 8-Way F 150 MX Series, Sealed (BK)

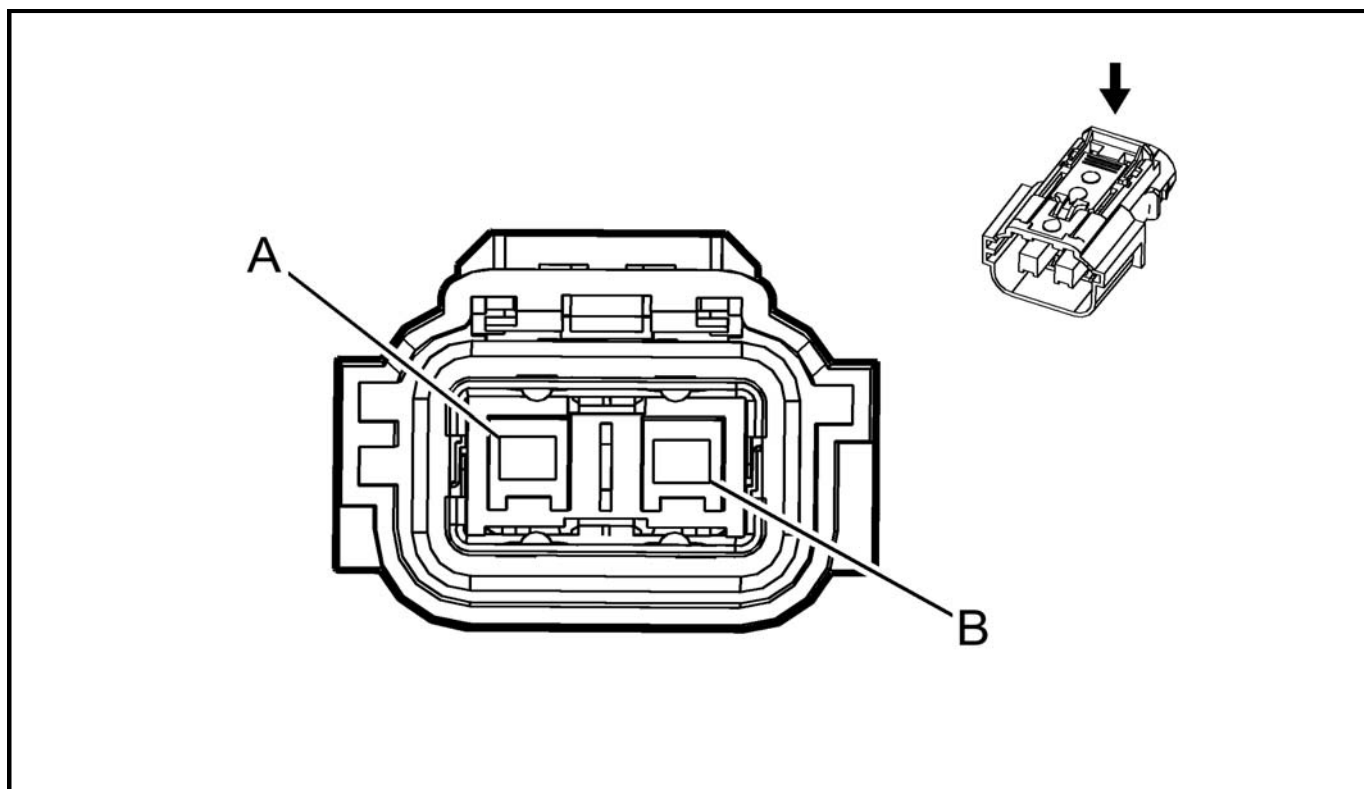
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	250	Ground	I	-
2	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
3	0.5	VT/WH	639	Run/Crank Ignition 1 Voltage	I	-
4	0.5	RD/WH	2740	Battery Positive Voltage	I	-
5	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
6	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

G1 A/C COMPRESSOR X2



Connector Part Information

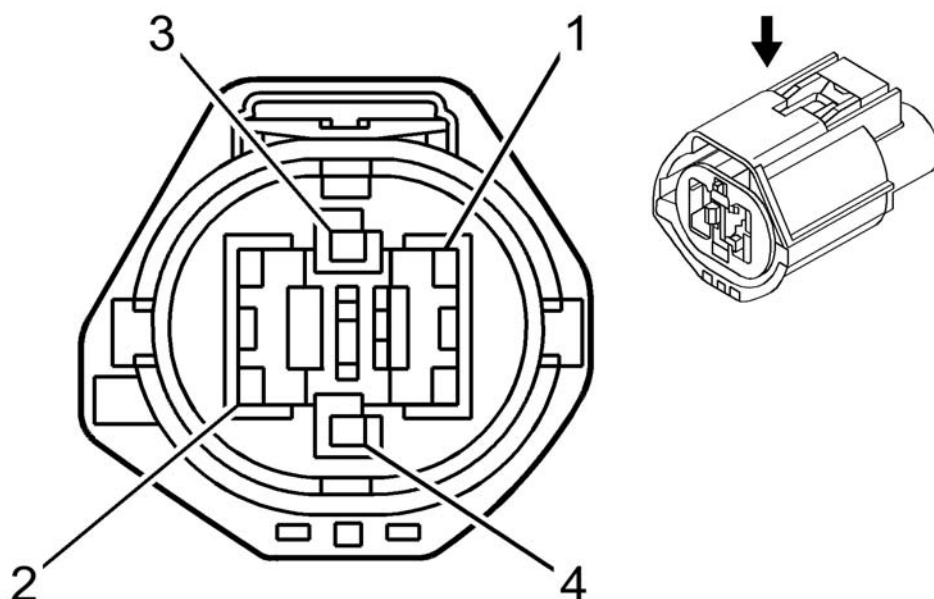
- Harness Type: Battery Cable
- OEM Connector: 13830159
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	5	OG	3974	High Voltage Battery 5 (+)	I	-
B	5	OG/BK	3973	High Voltage Battery 5 (-)	I	-

G10L COOLING FAN MOTOR - LEFT



Connector Part Information

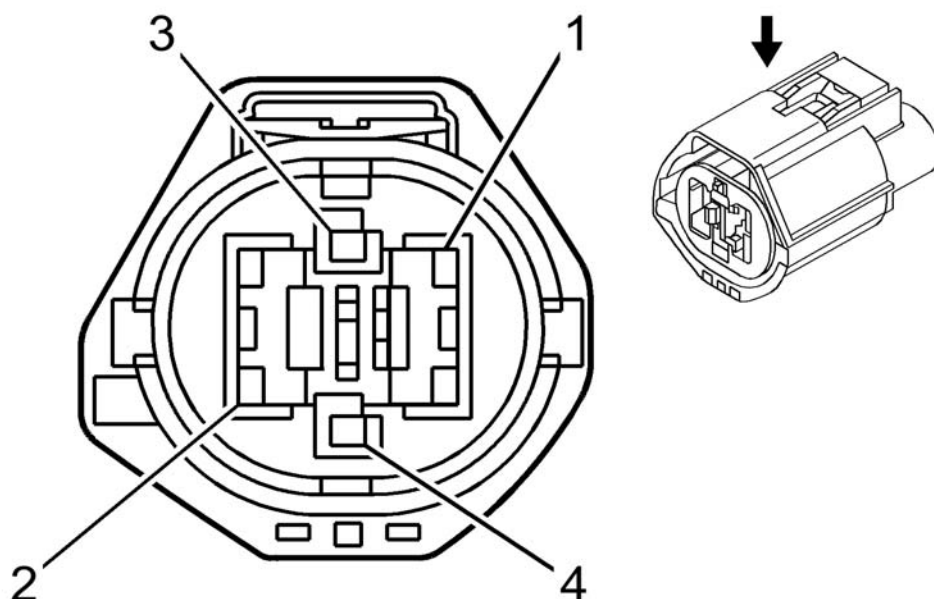
- Harness Type: Cooling Fan
- OEM Connector: 7283-8496-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.5, 9.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/WH	140	Battery Positive Voltage	I	-
2	3	BK	1250	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	WH	2368	Cooling Fan Control Signal	II	-

G10R COOLING FAN MOTOR - RIGHT



Connector Part Information

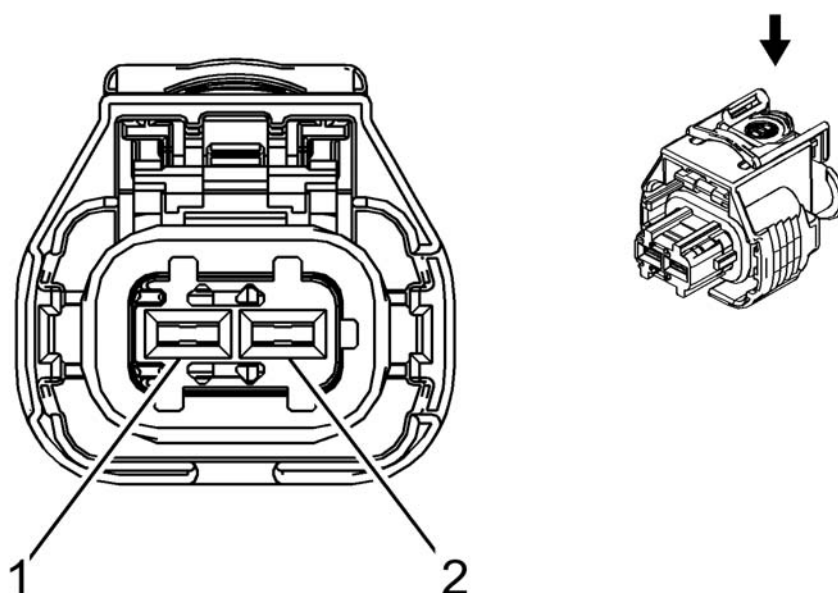
- Harness Type: Cooling Fan
- OEM Connector: 7283-8496-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.5, 9.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/BU	540	Battery Positive Voltage	I	-
2	3	BK	1250	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	WH	2368	Cooling Fan Control Signal	II	-

G18 HIGH PRESSURE FUEL PUMP



Connector Part Information

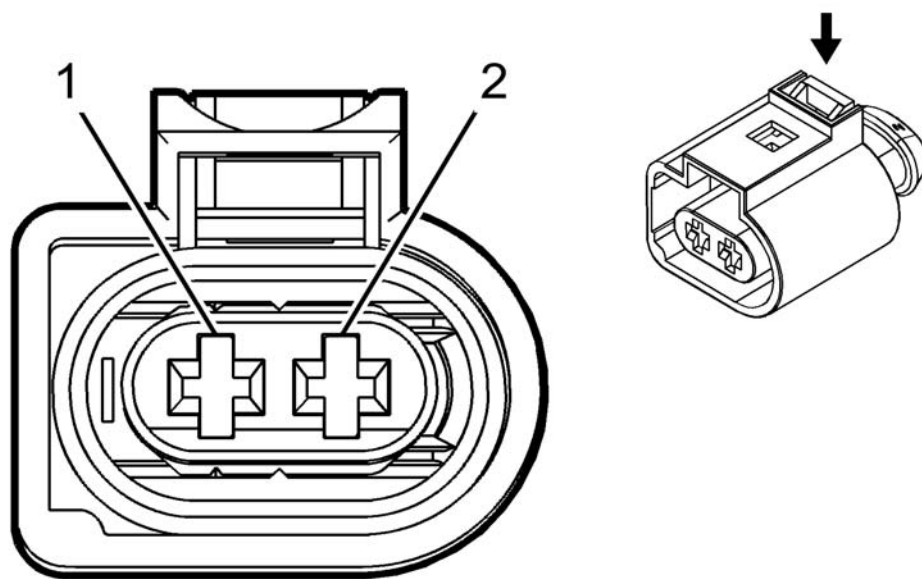
- Harness Type: Engine
- OEM Connector: 13343443
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BK	7300	High Pressure Fuel Pump Actuator Low - Control	I	-
2	0.5	YE	7301	High Pressure Fuel Pump Actuator High - Control	I	-

G24 WINDSHIELD WASHER PUMP



Connector Part Information

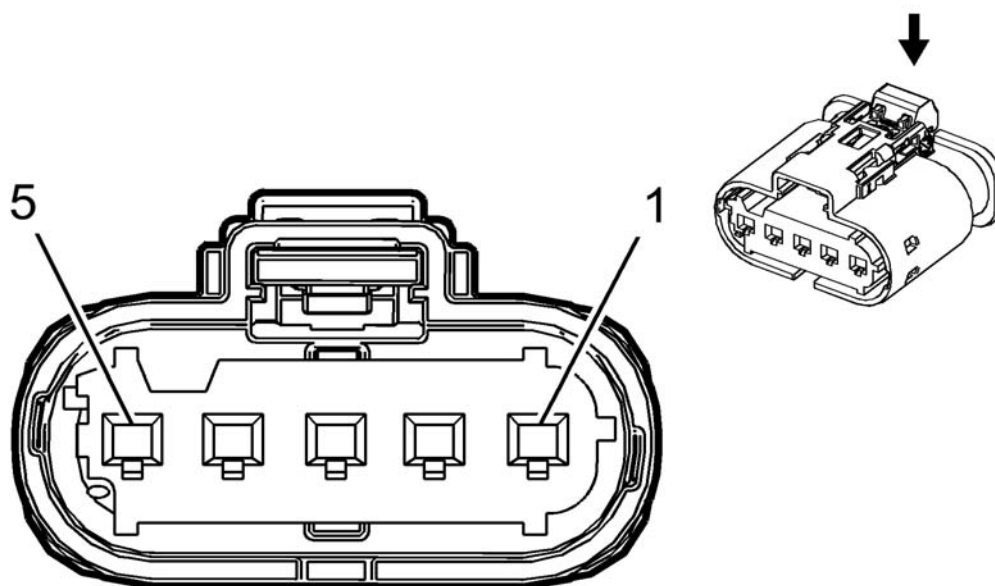
- Harness Type: Forward Lamp
- OEM Connector: 1-1355200-1
- Service Connector: 13576532
- Description: 2-Way F 2.8 MDK5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/VT	228	Windshield Washer Pump Control	I	-
2	0.5	BK	1050	Ground	I	-

G35 HYBRID/EV ELECTRONICS COOLANT PUMP



Connector Part Information

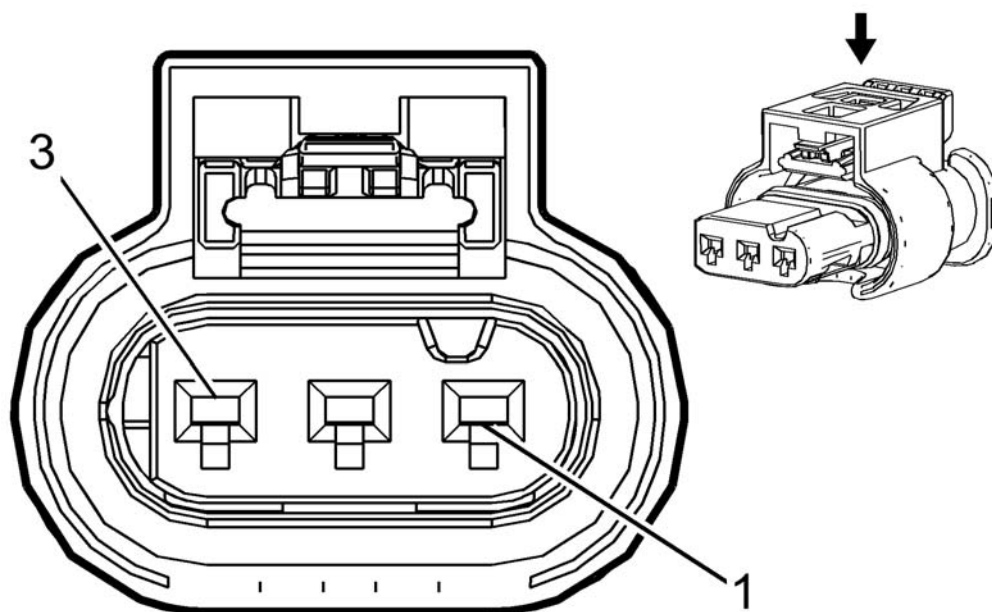
- Harness Type: Forward Lamp
- OEM Connector: 9408621
- Service Connector: 19300589
- Description: 5-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BU	3788	Electric Coolant Motor Control	I	-
2	0.5	VT/BU	3790	Electric Coolant Motor Feedback Signal	I	-
3	0.5	YE/GN	3789	Electric Coolant Motor Control	I	-
4	0.75	BK	1150	Ground	I	-
5	0.75	RD/BU	3940	Battery Positive Voltage	I	-

G36 AUXILIARY HEATER COOLANT PUMP



Connector Part Information

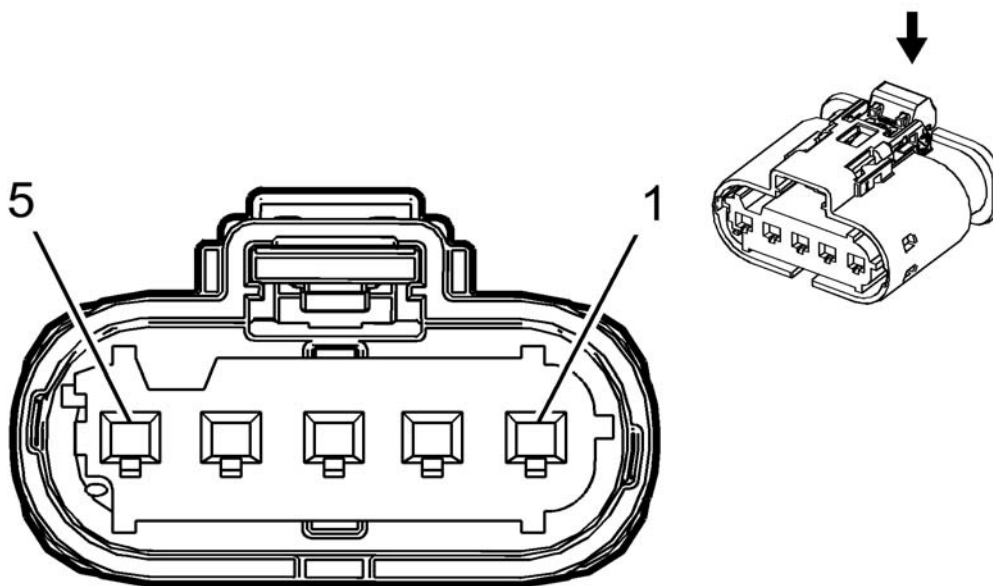
- Harness Type: Engine
- OEM Connector: 805-121-521
- Service Connector: 13574937
- Description: 3-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	250	Ground	I	-
2	0.5	VT/GN	1097	Coolant Pump Motor Control	I	-
3	-	-	-	Not Occupied	-	-

G37 HYBRID/EV BATTERY PACK COOLANT PUMP



Connector Part Information

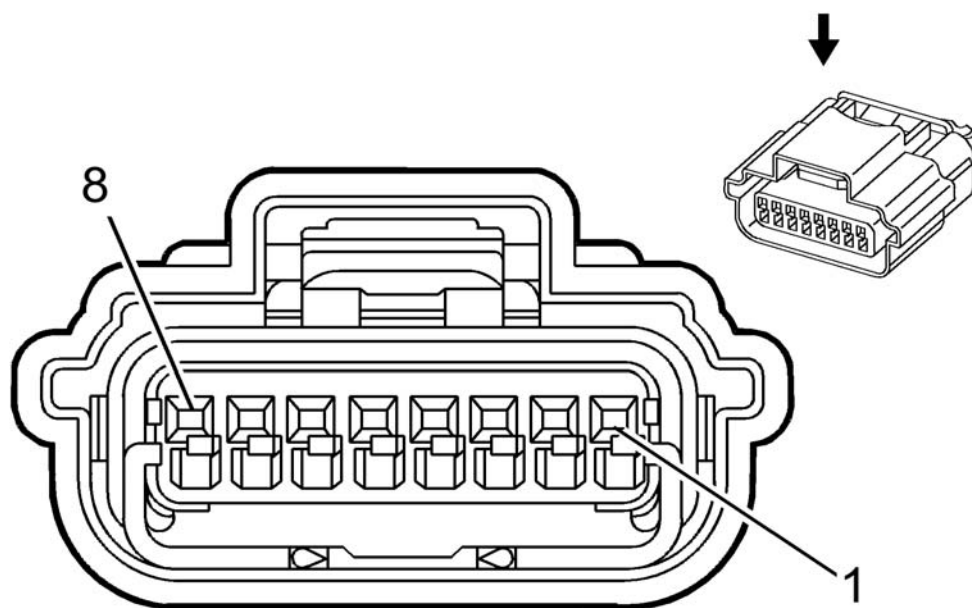
- Harness Type: Cooling Fan
- OEM Connector: 9408621
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/GN	3794	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
2	0.5	YE/GY	3796	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	I	-
3	0.5	BU/VT	3795	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
4	0.75	BK	1250	Ground	I	-
5	0.75	RD/VT	3340	Battery Positive Voltage	I	-

K1 14V POWER MODULE X1



Connector Part Information

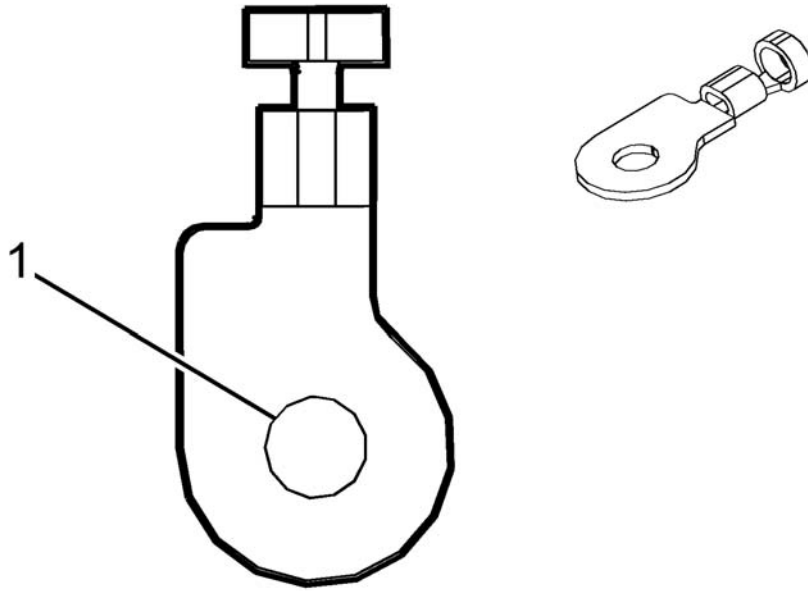
- Harness Type: Body
- OEM Connector: ATSSPB-C0802Y-1AK
- Service Connector: 19352910
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN	25	Charge Indicator Control	I	-
2	-	-	-	Not Occupied	-	-
3	0.75	GY	23	Generator Field Duty Cycle Signal	I	-
4 - 8	-	-	-	Not Occupied	-	-

K1 14V POWER MODULE X2



Connector Part Information

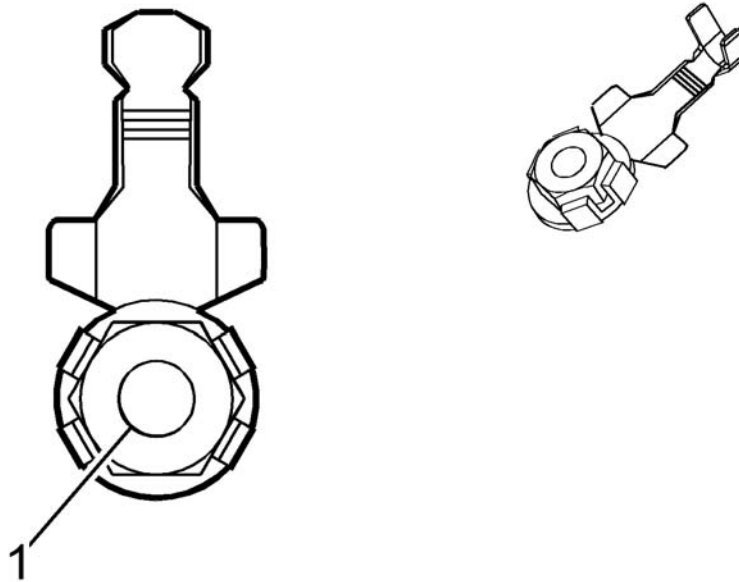
- Harness Type: Battery Cable
- OEM Connector: 33194395
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	25	RD	2	Battery Positive Voltage	I	-

K1 14V POWER MODULE X3



Connector Part Information

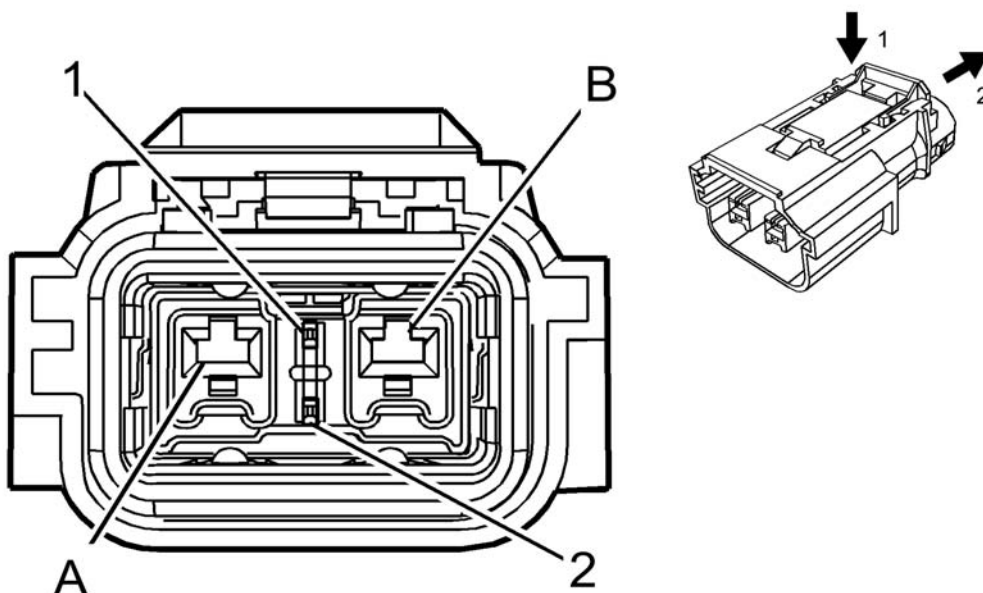
- Harness Type: Battery Cable
- OEM Connector: 33194394
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	25	BK	50	Ground	I	-

K1 14V POWER MODULE X4



Connector Part Information

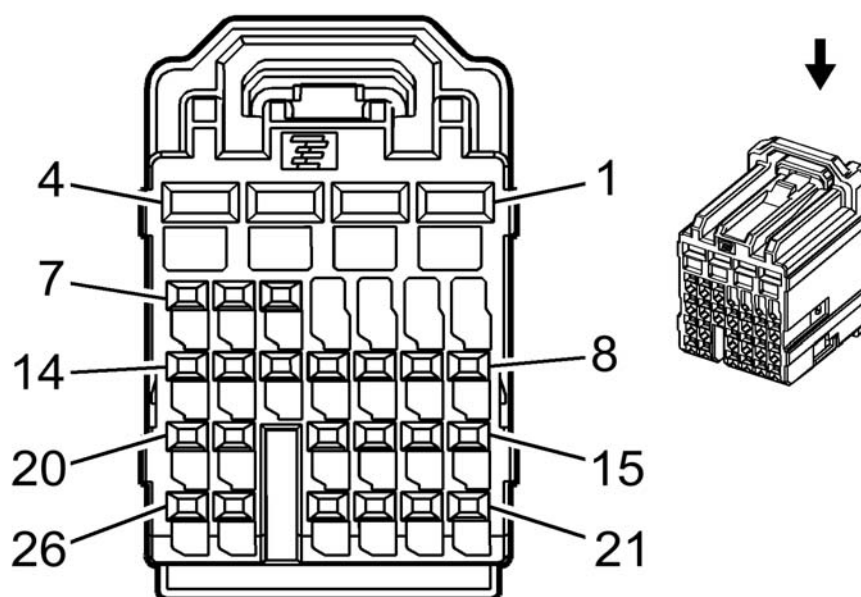
- Harness Type: Battery Cable
- OEM Connector: 33107347
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F/M 0.8, 2.8 Metri-Pack Series, Sealed (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
A	3	OG/BK	3833	High Voltage Battery 2 (-)	I	-
B	3	OG	3834	High Voltage Battery 2 (+)	I	-

K9 BODY CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098067-1
- Service Connector: 13576031
- Description: 26-Way F 0.64, 2.8 Series (NA)

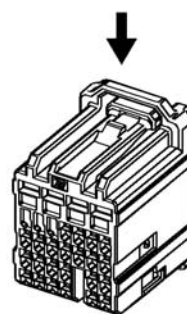
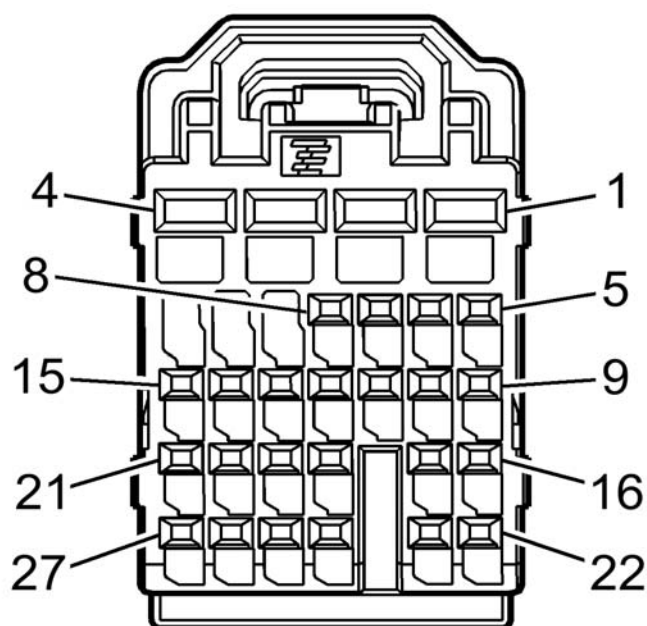
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575578	J-35616-35 (VT)	J-38125-553	Not Available	Not Available	Not Available	Not Available
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	BK	2150	Ground	I	-
2	1.5	RD/YE	4340	Battery Positive Voltage	I	-
3	1.5	RD/GN	4440	Battery Positive Voltage	I	-
4	1	RD/BU	4540	Battery Positive Voltage	III	-
5	0.35	WH	6816	Indicator Dimming Control	II	-
6	0.35	GY/VT	755	RAP Relay Coil Control	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	II	-
8 - 10	-	-	-	Not Occupied	-	-
11	0.35	GN/BN	306	Headlamp Switch Headlamps Off Signal Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.35	GN/RD	812	12V Reference	II	-
14	0.35	GY/GN	328	Interior Lamp Defeat Switch Signal	II	-
15	0.35	GN	4512	Wireless Charging System Charge Indicator Control	II	-
16	0.35	WH/VT	103	Headlamp Switch On Signal	II	-
17	0.35	GY/YE	7543	Hazard LED Dimming Signal	II	-
18	-	-	-	Not Occupied	-	-
19	0.35	BK/BN	5360	Brake Apply Sensor Low Reference	II	-
20	0.35	BU/BK	5719	Ignition Mode Switch Start LED Signal	II	-
21	-	-	-	Not Occupied	-	-
22	0.35	GN/GY	13	Headlamp Switch Park Lamp Signal	II	-
23	0.5	WH/YE	7557	LED Ambient Lighting Control 1	II	-
24	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
25	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
26	0.35	BU/WH	3275	Remote Function Actuator Receive Signal	II	-

K9 BODY CONTROL MODULE X2



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098067-2
- Service Connector: 13576032
- Description: 27-Way F 0.64, 2.8 Series (BU)

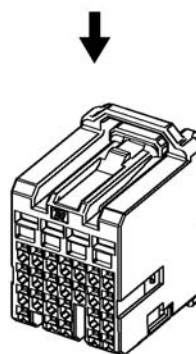
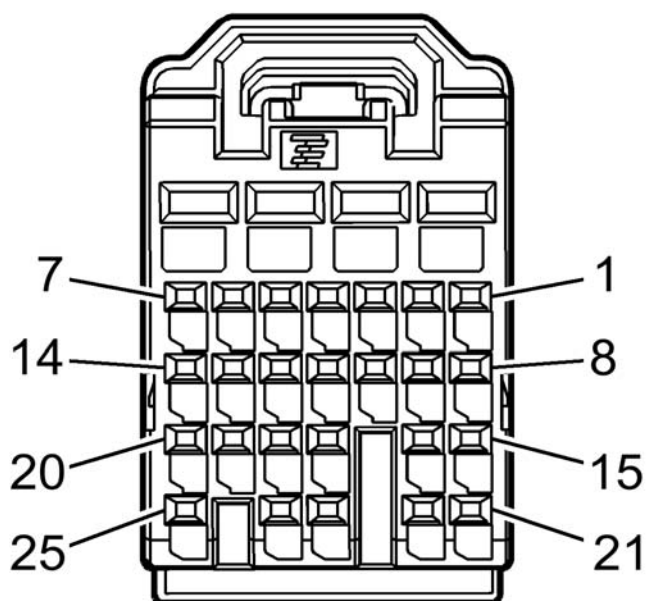
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575578	J-35616-35 (VT)	J-38125-553	Not Available	Not Available	Not Available	Not Available
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	RD/BN	4240	Battery Positive Voltage	III	-
2	1.5	BK	2150	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	1	RD/BN	4940	Battery Positive Voltage	III	-
5	0.35	GY	157	Interior Lamp Control	II	-
6	-	-	-	Not Occupied	-	-
7	0.35	BU/YE	5361	Brake Apply Sensor Signal	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.35	YE	6817	LED Backlight Dimming Control	II	-
9	0.35	YE/GY	44	Instrument Panel Lamp Dimmer Switch Signal	II	-
10 - 12	-	-	-	Not Occupied	-	-
13	0.35	WH	5359	Brake Apply Sensor Control	II	-
14	0.35	BU/VT	1788	Traction Control Switch Signal 1	II	-
15	0.35	BN/WH	781	Driver Door Lock Switch Unlock Signal	II	-
16	-	-	-	Not Occupied	-	-
17	0.35	BU/GN	5723	Ignition Mode Switch Mode Voltage	II	-
18	0.5	BU	6856	Headlamp Automatic High Beam Dim Control	II	-
19	0.35	BN/YE	780	Driver Door Lock Switch Lock Signal	II	-
20	-	-	-	Not Occupied	-	-
21	0.35	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	II	-
22	0.5	GN	5060	Low Speed GMLAN Serial Data	II	-
23 - 24	-	-	-	Not Occupied	-	-
25	0.35	GY/WH	3272	Remote Function Actuator Control	II	-
26	0.35	GN/WH	111	Hazard Switch Signal	II	-
27	0.35	YE/GN	3274	Remote Function Actuator Transmit Signal	II	-

K9 BODY CONTROL MODULE X3



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098067-7
- Service Connector: 13576037
- Description: 25-Way F 0.64, 2.8 Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/GY	3277	Vehicle Anti-Theft System Immobilizer Low Reference	I	-
2	0.35	GN/VT	7533	Local Interconnect Network Serial Data Bus 11	I	-
3	0.35	GY/BK	3276	Vehicle Anti-Theft System Immobilizer Control	I	-
4	0.5	WH/RD	1444	12V Reference	I	-
5	0.35	VT/YE	4	Accessory Ignition Voltage	I	-
6	0.35	VT/BK	3	Run/Crank Ignition 1 Voltage	I	-
7	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	GY/GN	5737	Adaptive Cruise Control Gap Up/Down Switch Signal	I	-
9	0.5	BN/GN	1884	Cruise Control Set/Coast/Resume /Accelerate Switch Signal	I	-
10	0.5	BK/GY	6009	Windshield Wiper Switch Low Reference	I	-
11	0.5	WH	524	Headlamp Dimmer Switch High Beam Signal	I	-
12	0.5	BU/WH	1414	Left Front Turn Signal Switch Signal	I	-
13	0.5	YE/BU	1714	Windshield Wiper Switch Low Signal	I	-
14 - 16	-	-	-	Not Occupied	-	-
17	0.5	YE/BN	307	Headlamp Switch Flash To Pass Signal	I	-
18	0.5	GN/WH	3287	Horn Switch Signal	I	-
19	0.35	GN/WH	4115	Local Interconnect Network Serial Data Bus 15	I	-
20	0.5	GY	1715	Windshield Wiper Switch High Signal	I	-
21	0.5	VT/YE	5526	Tap Up/Tap Down Switch Signal	I	-
22 - 23	-	-	-	Not Occupied	-	-
24	0.5	GN/VT	1415	Right Front Turn Signal Switch Signal	I	-
25	0.5	WH/BK	94	Windshield Washer Switch Signal	I	-

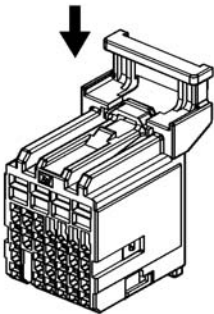
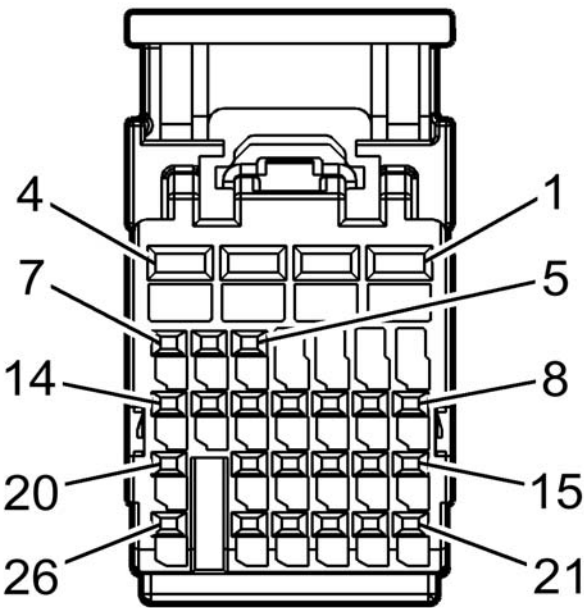
Article GUID: A00884637

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Volt

COMPONENT CONNECTOR END VIEWS

K9 BODY CONTROL MODULE X4



Connector Part Information

- Harness Type: Body
- OEM Connector: 1-2141127-3
- Service Connector: 13581575
- Description: 26-Way F 0.64, 2.8 Series (BK)

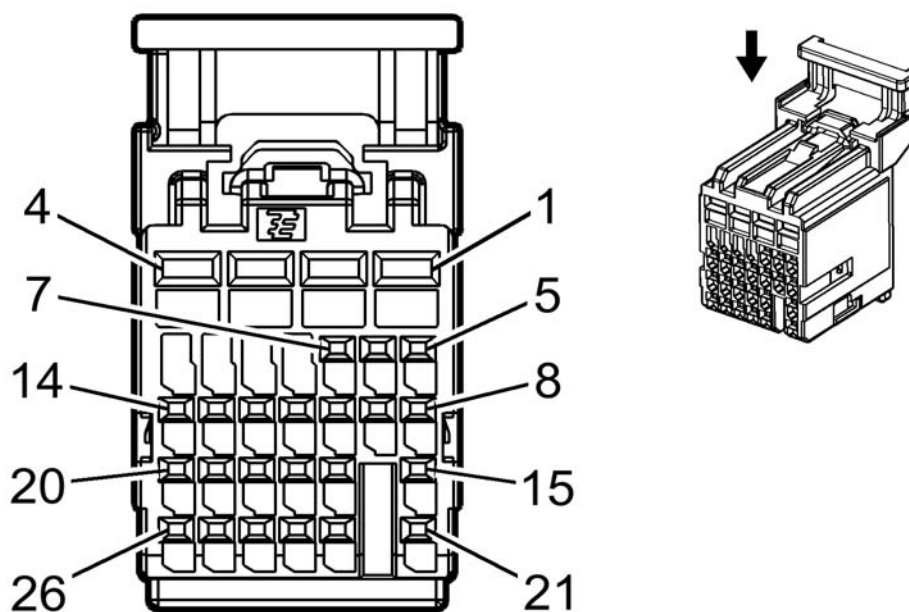
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582298	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.5	BU	312	Right Headlamp Low Beam Control	I	-
2	0.5	YE	712	Left Headlamp Low Beam Control	I	-
3	0.5	GN/VT	1315	Right Front Turn Signal Lamp Control	I	-
4	0.5	GN/VT	619	Right Rear Turn Signal Lamp Control	I	-
5	0.5	VT	1203	Right Park Lamp Control	II	-
6	0.5	WH/YE	1204	Left Park Lamp Control	II	-
7	0.5	GY/YE	7542	Left Rear Stop Lamp Control	II	-
8 - 10	-	-	-	Not Occupied	-	-
11	0.35	BN/YE	820	CHMSL Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.5	GN/YE	6846	Rear License Lamp Control	II	-
14	0.35	BN/GY	2268	Windshield Washer Relay Control	II	-
15	0.5	GN/VT	5199	Run/Crank Relay Coil Control	II	-
16	0.5	GY	91	Windshield Wiper Motor Relay Coil Control	II	-
17	-	-	-	Not Occupied	-	-
18	0.35	WH/YE	5075	Current Sensor Signal	II	-
19	0.35	BN/WH	1637	Left Rear Heated Seat Switch Signal	II	-
20	0.75	RD/WH	4740	Battery Positive Voltage	III	-
21	0.35	BU/VT	5076	Current Sensor Control	II	-
22	0.5	VT/YE	5985	Accessory Wakeup Serial Data	II	-
23	0.35	WH/BU	5986	Serial Data Communication Enable	II	-
24	0.35	BN/GN	4064	Hood Status B Signal	II	-
25	0.35	BN/GN	1634	Right Rear Heated Seat Switch Signal	II	-
26	0.75	BK/BN	1798	Low Reference	III	-

K9 BODY CONTROL MODULE X5



Connector Part Information

- Harness Type: Body
- OEM Connector: 1-2141127-4
- Service Connector: 13581576
- Description: 26-Way F 0.64, 2.8 Series (BN)

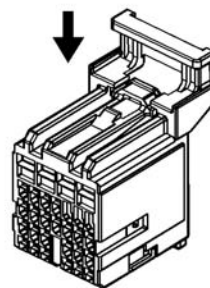
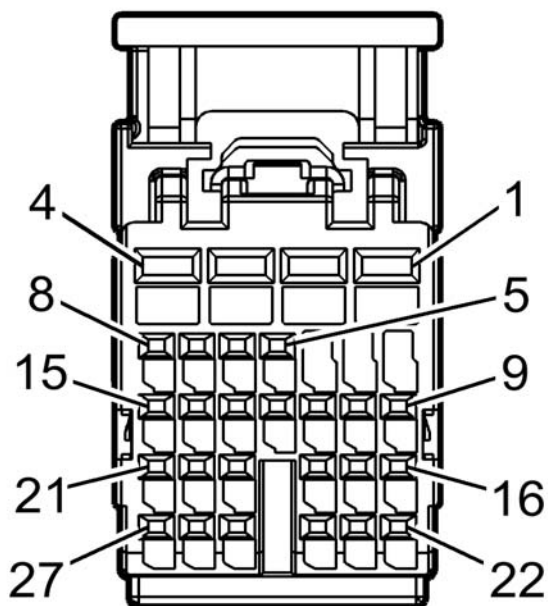
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BN	618	Left Rear Turn Signal Lamp Control	I	-
2	0.5	BU/WH	1314	Left Front Turn Signal Lamp Control	I	-
3	0.75	RD/GY	4840	Battery Positive Voltage	III	-
4	0.75	RD/GN	4140	Battery Positive Voltage	III	-
5	0.5	GY/BU	7538	Left Front DRL Control	II	-
6	0.35	BK/VT	5077	Current Sensor Low Reference	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7	0.5	WH/YE	7541	Right Rear Stop Lamp Control	II	-
8	0.35	WH	1638	Left Rear Heated Seat High Indicator Control	II	-
9	-	-	-	Not Occupied	-	-
10	0.35	BN/WH	1635	Right Rear Heated Seat High Indicator Control	II	-
11	0.35	YE	5704	Endgate Latch Relay Coil Control	II	-
12	0.35	WH/BU	6311	Cruise/ETC/TCC Brake Signal	II	-
13	-	-	-	Not Occupied	-	-
14	0.35	VT/BN	41	Run Ignition 3 Voltage	II	-
15 - 17	-	-	-	Not Occupied	-	-
18	0.35	BN/VT	1969	Headlamp High Beam Relay Control	II	-
19	0.35	BN/WH	28	Horn Relay Control	II	-
20	-	-	-	Not Occupied	-	-
21	0.35	BU/GY	4672	Dome Lamp Off Indicator Control	II	-
22 - 26	-	-	-	Not Occupied	-	-

K9 BODY CONTROL MODULE X6



Connector Part Information

- Harness Type: Body
- OEM Connector: 1-2141127-5
- Service Connector: 13581577

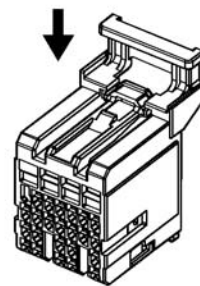
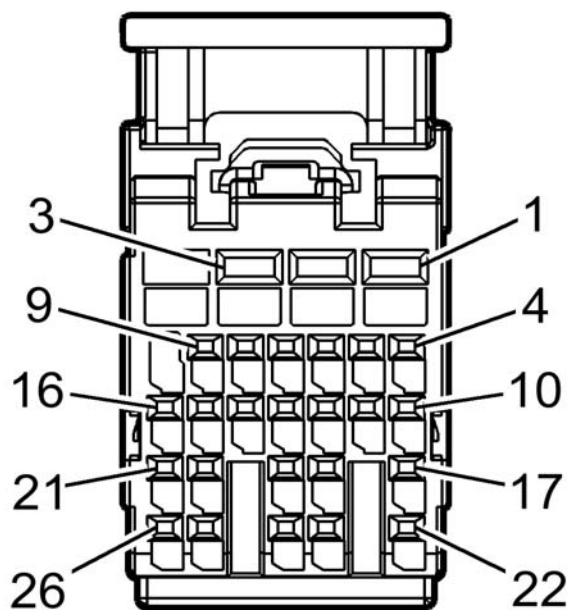
- Description: 27-Way F 0.64, 2.8 Series (PK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575578	J-35616-35 (VT)	J-38125-553	Not Available	Not Available	Not Available	Not Available
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GY	5911	Door Lock Actuator Lock Control 2	III	-
2	1	GY	295	Door Lock Actuator Lock Control	III	-
3	1.5	BK	850	Ground	I	-
4	1	BN/YE	294	Door Lock Actuator Unlock Control	III	-
5	0.35	VT/GY	1303	Lift Gate Ajar Switch Signal 1	II	-
6	0.35	BN/VT	245	Passenger Door Lock Switch Unlock Control	II	-
7 - 8	-	-	-	Not Occupied	-	-
9	0.35	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	II	-
10	0.5	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	II	-
11 - 12	-	-	-	Not Occupied	-	-
13	0.35	YE/VT	244	Passenger Door Lock Switch Lock Control	II	-
14	-	-	-	Not Occupied	-	-
15	0.35	YE/BU	5797	Rear Closure Handle Switch Open Signal	II	-
16	0.5	GN/BN	6132	Local Interconnect Network Serial Data Bus 1	II	-
17 - 21	-	-	-	Not Occupied	-	-
22	0.35	GY	5054	Sport Mode Switch Signal	II	-
23	-	-	-	Not Occupied	-	-
24	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
25	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
26 - 27	-	-	-	Not Occupied	-	-

K9 BODY CONTROL MODULE X7



Connector Part Information

- Harness Type: Body
- OEM Connector: 1-2141127-6
- Service Connector: 13581578
- Description: 26-Way F 0.64, 2.8 Series (GY)

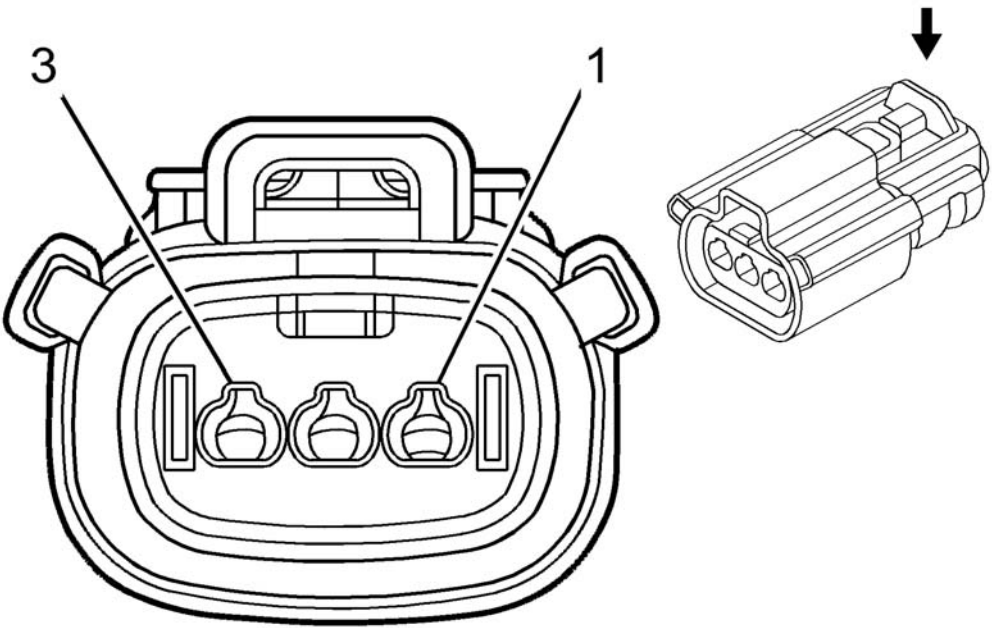
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GY	157	Interior Lamp Control	III	-
2	0.5	GN/WH	1324	Backup Lamp Control	I	-
3	0.75	WH/BN	6815	Inadvertent Power Control	III	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.35	VT/BK	7553	Park Lock Solenoid Control	II	-
7	0.5	GN/GY	737	Rear Compartment Lid Lamp Control	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	BU/BN	7539	Right Front DRL Control	II	-
9	0.5	YE	6817	LED Backlight Dimming Control	II	-
10 - 12	-	-	-	Not Occupied	-	-
13	0.35	WH/VT	5905	Key Capture/Column Lock Shift Position Signal	II	-
14	0.35	YE/BU	4086	Pushbutton Start Challenge Active Signal	II	-
15 - 18	-	-	-	Not Occupied	-	-
19	0.35	GY	156	Courtesy Lamp Switch Signal	II	-
20 - 21	-	-	-	Not Occupied	-	-
22	0.35	YE/GY	230	Instrument Panel Lamp Dimming Control	II	-
23	0.5	GN	5060	Low Speed GMLAN Serial Data	II	-
24 - 26	-	-	-	Not Occupied	-	-

K10 COOLANT HEATER CONTROL MODULE X1



Connector Part Information

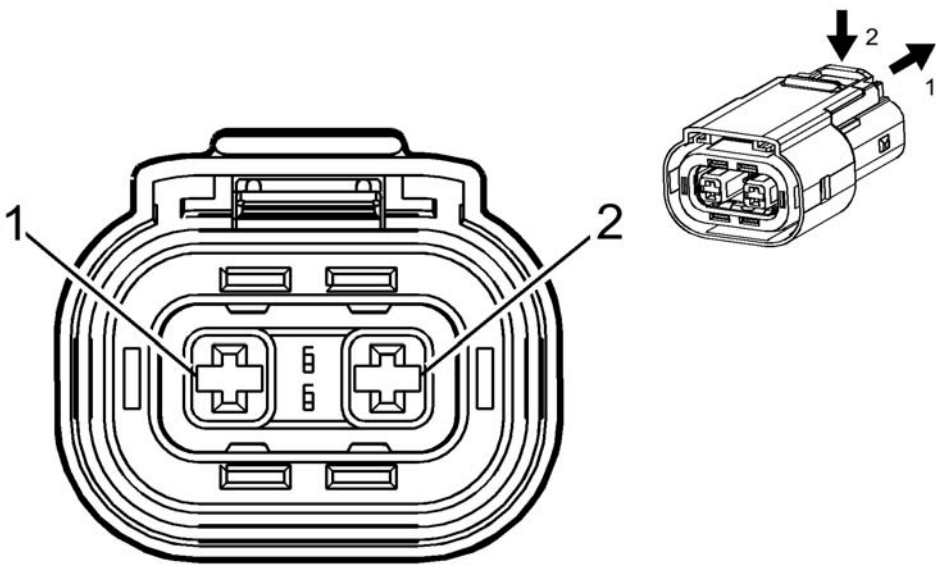
- Harness Type: Body
- OEM Connector: 33471-0306
- Service Connector: 19301648
- Description: 3-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BU	4119	Local Interconnect Network Serial Data Bus 19	I	-
2	0.5	RD/GY	2140	Battery Positive Voltage	I	-
3	0.5	BK	2050	Ground	I	-

K10 COOLANT HEATER CONTROL MODULE X2



Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: 33184733
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

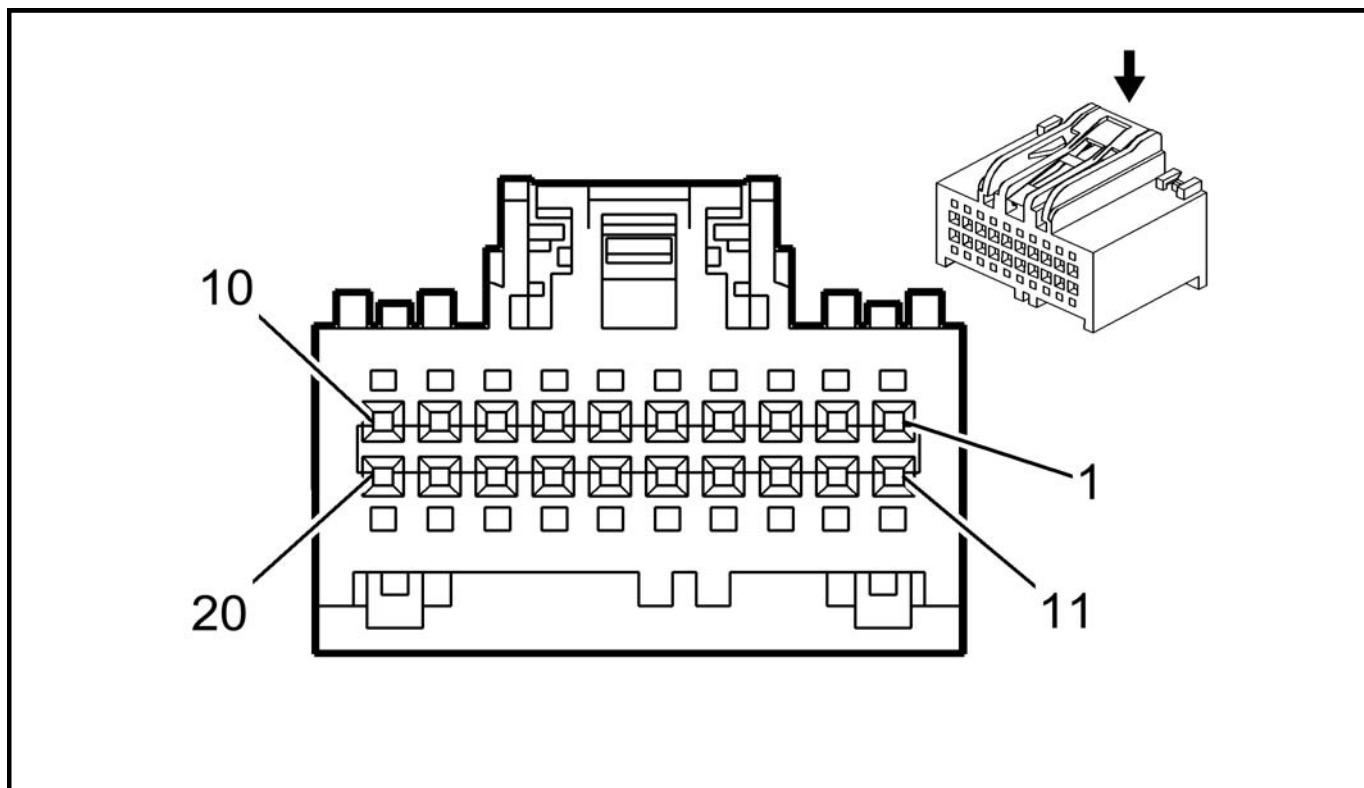
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(VT)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	5	OG	3970	High Voltage Battery 4 (+)	I	-
2	5	OG/BK	3969	High Voltage Battery 4 (-)	I	-

K16 BATTERY ENERGY CONTROL MODULE X1



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33125545
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 64 Series, Sealed (BK)

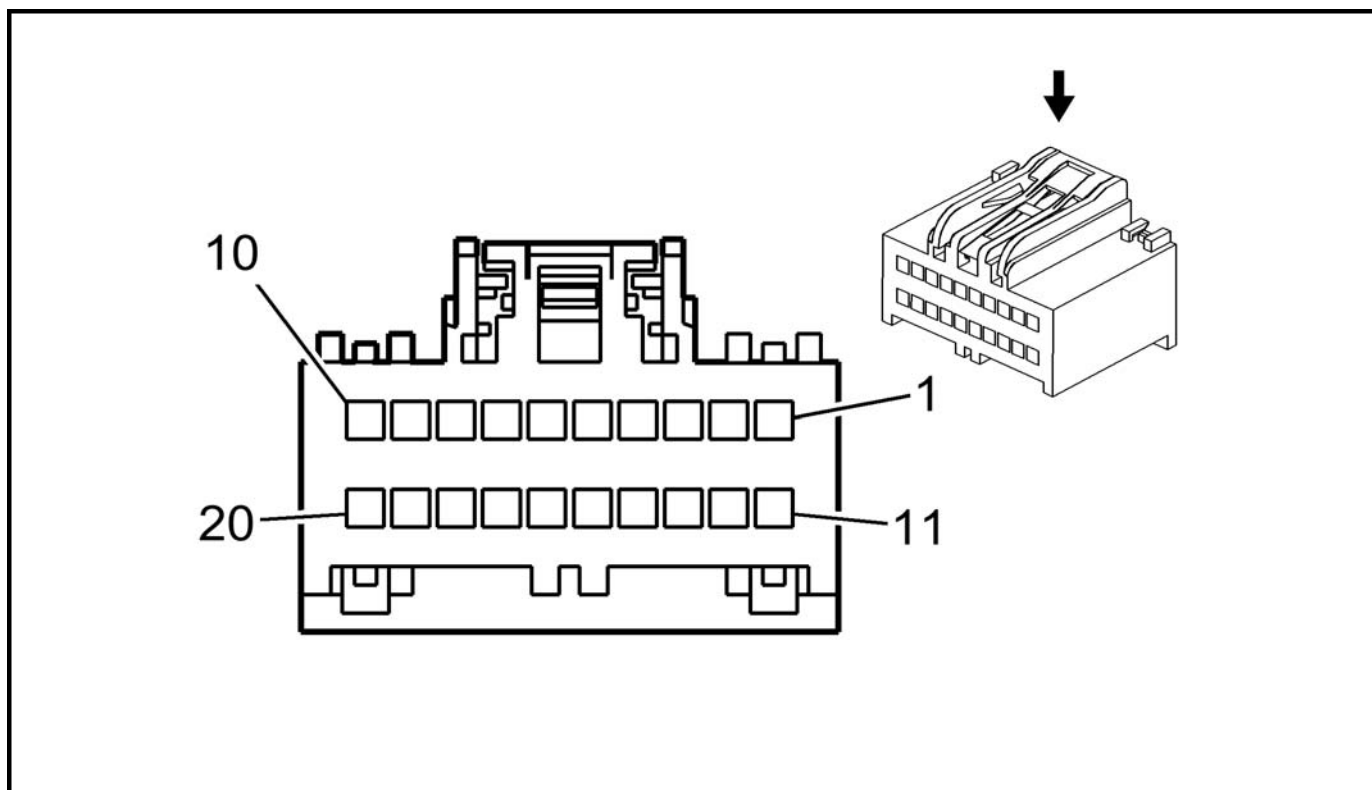
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	-	-	-	Not Occupied	-	-
2	0.35	VT	5391	Battery Voltage Signal 1	I	-
3	0.35	WH	5395	Battery Voltage Signal 3	I	-
4	0.35	GY/YE	5396	Battery Voltage Signal 4	I	-
5	0.35	GN	5398	Battery Voltage Signal 6	I	-
6	0.35	BU	5400	Battery Voltage Signal 8	I	-
7	0.35	BU/GY	5392	Battery Voltage Signal 10	I	-
8	0.35	BN	5571	Battery Voltage Signal 12	I	-
9	0.35	YE/GY	5572	Battery Voltage Signal 13	I	-
10	0.35	WH/BK	5574	Battery Voltage Signal 15	I	-
11	0.35	BK/VT	5403	Battery Pack Monitor Low Reference	I	-
12	0.35	YE/VT	5394	Battery Voltage Signal 2	I	-
13	0.35	GY/YE	5396	Battery Voltage Signal 4	I	-
14	0.35	YE/GN	5397	Battery Voltage Signal 5	I	-
15	0.35	YE/BN	5399	Battery Voltage Signal 7	I	-
16	0.35	GN/BK	5401	Battery Voltage Signal 9	I	-
17	0.35	GN/GY	5393	Battery Voltage Signal 11	I	-
18	0.35	BN	5571	Battery Voltage Signal 12	I	-
19	0.35	YE	5573	Battery Voltage Signal 14	I	-
20	0.35	BN/WH	5575	Battery Voltage Signal 16	I	-

K16 BATTERY ENERGY CONTROL MODULE X2



Connector Part Information

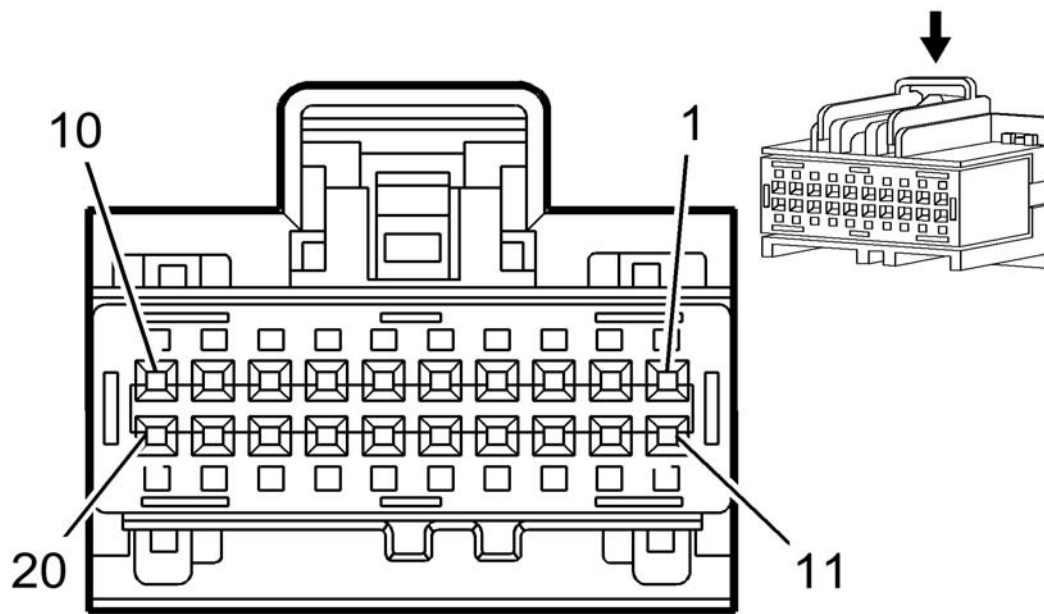
- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13859758
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F USCAR 64 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	5575	Battery Voltage Signal 16	I	-
2	0.35	GN/VT	5577	Battery Voltage Signal 18	I	-
3	0.35	GN/WH	5578	Battery Voltage Signal 19	I	-
4	0.35	GN/WH	5578	Battery Voltage Signal 19	I	-
5	0.35	GY/BN	5580	Battery Voltage Signal 21	I	-
6	0.35	GY/BK	5582	Battery Voltage Signal 23	I	-
7	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
8	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
9	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
10	0.35	BU/BK	5586	Battery Voltage Signal 27	I	-
11	0.35	WH/BU	5576	Battery Voltage Signal 17	I	-
12	0.35	GN/WH	5578	Battery Voltage Signal 19	I	-
13	0.35	GN/WH	5578	Battery Voltage Signal 19	I	-
14	0.35	YE/BK	5579	Battery Voltage Signal 20	I	-
15	0.35	BU/WH	5581	Battery Voltage Signal 22	I	-
16	0.35	WH/BK	5583	Battery Voltage Signal 24	I	-
17	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
18	0.35	VT/WH	5584	Battery Voltage Signal 25	I	-
19	0.35	GY/GN	5585	Battery Voltage Signal 26	I	-
20	0.35	GY/BK	5587	Battery Voltage Signal 28	I	-

K16 BATTERY ENERGY CONTROL MODULE X3



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13950640
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F USCAR 64 Series (BN)

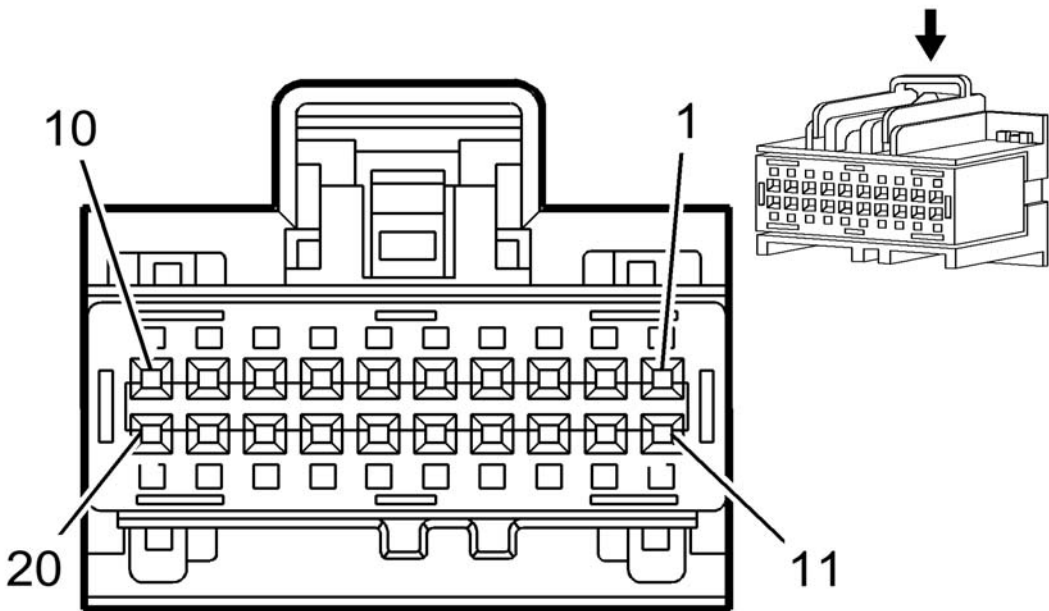
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/BK	5587	Battery Voltage Signal 28	I	-
2	0.35	VT/GN	5589	Battery Voltage Signal 30	I	-
3	0.35	GY	5591	Battery Voltage Signal 32	I	-
4	0.35	GY/WH	5592	Battery Voltage Signal 33	I	-
5	0.35	BK/VT	4516	Battery Cell Voltage Signal 35	I	-
6	0.35	YE/VT	4518	Battery Cell Voltage Signal 37	I	-
7	0.35	GY/YE	4520	Battery Cell Voltage Signal 39	I	-
8	0.35	YE/GN	4521	Battery Cell Voltage Signal 40	I	-
9	0.35	GN	4522	Battery Cell Voltage Signal 41	I	-
10	0.35	BU	4524	Battery Cell Voltage Signal 43	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	YE/WH	5588	Battery Voltage Signal 29	I	-
12	0.35	GN/BK	5590	Battery Voltage Signal 31	I	-
13	0.35	GY	5591	Battery Voltage Signal 32	I	-
14	0.35	VT/BK	4514	Battery Cell Voltage Signal 34	I	-
15	0.35	VT	4517	Battery Cell Voltage Signal 36	I	-
16	0.35	WH	4519	Battery Cell Voltage Signal 38	I	-
17	0.35	YE/GN	4521	Battery Cell Voltage Signal 40	I	-
18	0.35	YE/GN	4521	Battery Cell Voltage Signal 40	I	-
19	0.35	YE/BN	4523	Battery Cell Voltage Signal 42	I	-
20	0.35	GN/BK	4525	Battery Cell Voltage Signal 44	I	-

K16 BATTERY ENERGY CONTROL MODULE X4



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13950640
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F USCAR 64 Series (BN)

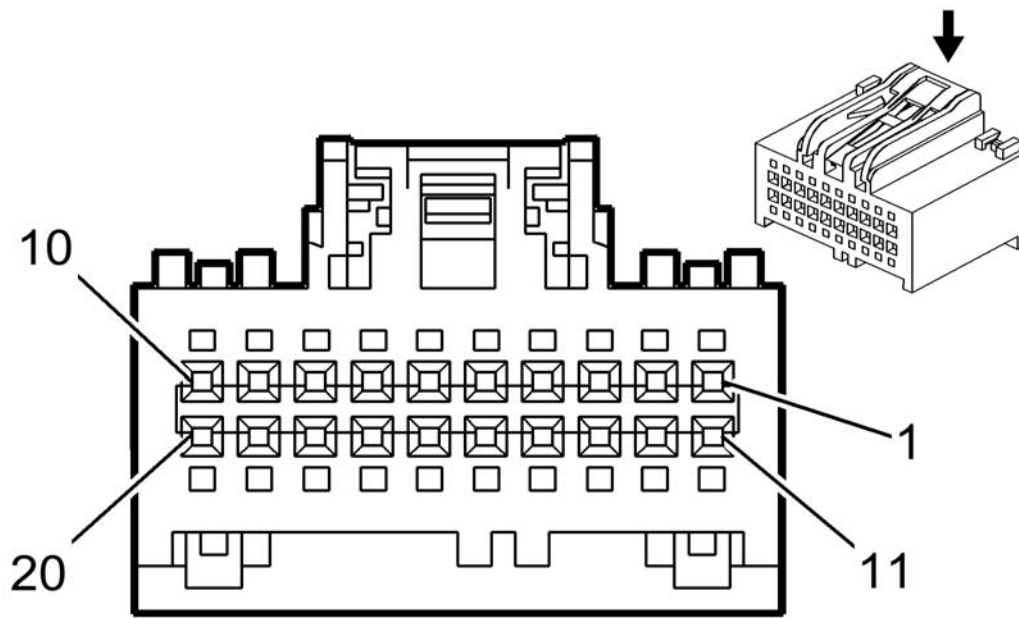
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BK	4525	Battery Cell Voltage Signal 44	I	-
2	0.35	GN/GY	4527	Battery Cell Voltage Signal 46	I	-
3	0.35	YE/GY	4529	Battery Cell Voltage Signal 48	I	-
4	0.35	WH/BK	4531	Battery Cell Voltage Signal 50	I	-
5	0.35	BU/YE	4533	Battery Cell Voltage Signal 52	I	-
6	0.35	GN/VT	4536	Battery Cell Voltage Signal 54	I	-
7	0.35	YE/BK	4538	Battery Cell Voltage Signal 56	I	-
8	0.35	GY/BN	4541	Battery Cell Voltage Signal 57	I	-
9	0.35	GY/BK	4544	Battery Cell Voltage Signal 59	I	-
10	0.35	VT/WH	4546	Battery Cell Voltage Signal 61	I	-
11	0.35	BU/GY	4526	Battery Cell Voltage Signal 45	I	-
12	0.35	BN	4528	Battery Cell Voltage Signal 47	I	-
13	0.35	YE	4530	Battery Cell Voltage Signal 49	I	-
14	0.35	BN/WH	4532	Battery Cell Voltage Signal 51	I	-
15	0.35	WH/BU	4535	Battery Cell Voltage Signal 53	I	-
16	0.35	GN/WH	4537	Battery Cell Voltage Signal 55	I	-
17	0.35	YE/BK	4538	Battery Cell Voltage Signal 56	I	-
18	0.35	BU/WH	4543	Battery Cell Voltage Signal 58	I	-
19	0.35	WH/BK	4545	Battery Cell Voltage Signal 60	I	-
20	0.35	GY/GN	4547	Battery Cell Voltage Signal 62	I	-

K16 BATTERY ENERGY CONTROL MODULE X5



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 33125545
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 64 Series, Sealed (BK)

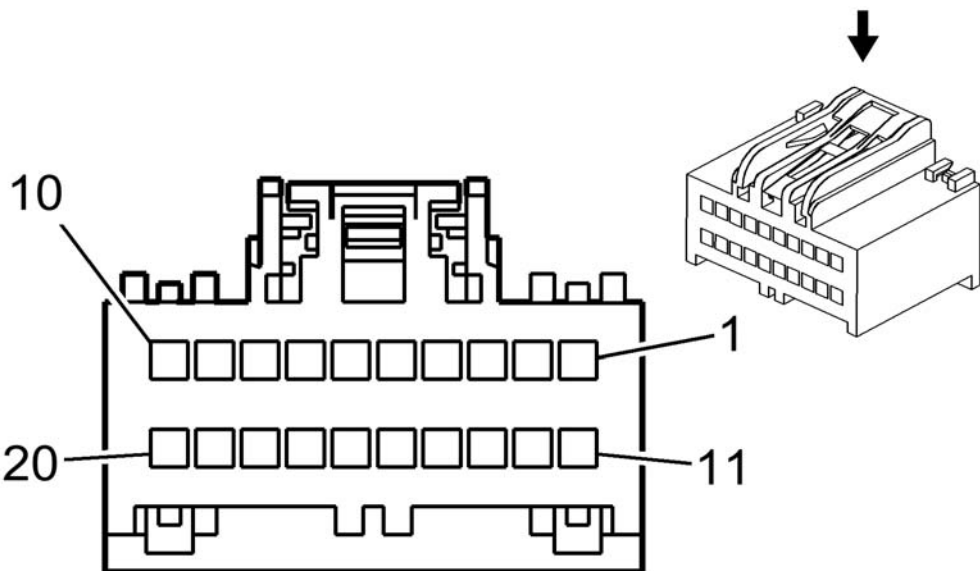
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/GN	4547	Battery Cell Voltage Signal 62	I	-
2	0.35	GY/BK	4549	Battery Cell Voltage Signal 64	I	-
3	0.35	VT/GN	4554	Battery Cell Voltage Signal 66	I	-
4	0.35	GY	4556	Battery Cell Voltage Signal 68	I	-
5	0.35	VT/BK	4558	Battery Cell Voltage Signal 70	I	-
6	0.35	VT	4561	Battery Cell Voltage Signal 72	I	-
7	0.35	YE/VT	4562	Battery Cell Voltage Signal 73	I	-
8	0.35	GY/YE	4564	Battery Cell Voltage Signal 75	I	-
9	0.35	YE/GN	4565	Battery Cell Voltage Signal 76	I	-
10	0.35	YE/BN	4567	Battery Cell Voltage Signal 78	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	BU/BK	4548	Battery Cell Voltage Signal 63	I	-
12	0.35	YE/WH	4553	Battery Cell Voltage Signal 65	I	-
13	0.35	GN/BK	4555	Battery Cell Voltage Signal 67	I	-
14	0.35	GY/WH	4557	Battery Cell Voltage Signal 69	I	-
15	0.35	BK/VT	4560	Battery Cell Voltage Signal 71	I	-
16	0.35	VT	4561	Battery Cell Voltage Signal 72	I	-
17	0.35	WH	4563	Battery Cell Voltage Signal 74	I	-
18	0.35	GY/YE	4564	Battery Cell Voltage Signal 75	I	-
19	0.35	GN	4566	Battery Cell Voltage Signal 77	I	-
20	0.35	BU	4568	Battery Cell Voltage Signal 79	I	-

K16 BATTERY ENERGY CONTROL MODULE X6



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13859758
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F USCAR 64 Series (GY)

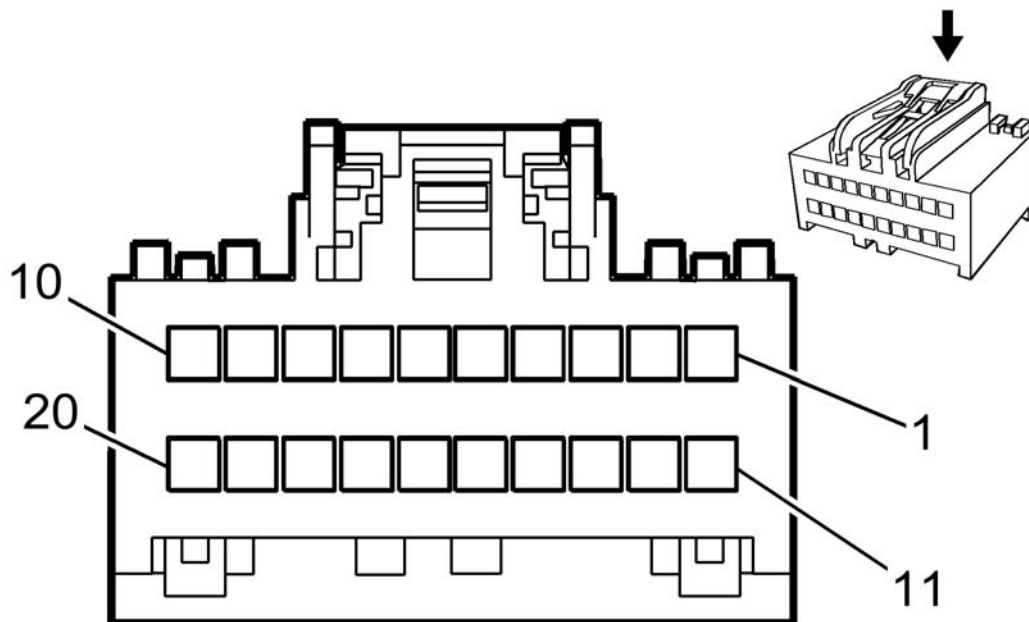
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU	4568	Battery Cell Voltage Signal 79	I	-
2	0.35	BU/GY	4570	Battery Cell Voltage Signal 81	I	-
3	0.35	BN	4572	Battery Cell Voltage Signal 83	I	-
4	0.35	YE/GY	4573	Battery Cell Voltage Signal 84	I	-
5	0.35	WH/BK	4575	Battery Cell Voltage Signal 86	I	-
6	0.35	BU/YE	4577	Battery Cell Voltage Signal 88	I	-
7	0.35	WH/BU	2390	Battery Cell Voltage Signal 90	I	-
8	0.35	BU/BK	2392	Battery Cell Voltage Signal 92	I	-
9	0.35	GN/BK	2394	Battery Cell Voltage Signal 94	I	-
10	0.35	GY/YE	2396	Battery Cell Voltage Signal 96	I	-
11	0.35	GN/BK	4569	Battery Cell Voltage Signal 80	I	-
12	0.35	GN/GY	4571	Battery Cell Voltage Signal 82	I	-
13	0.35	YE/GY	4573	Battery Cell Voltage Signal 84	I	-
14	0.35	YE	4574	Battery Cell Voltage Signal 85	I	-
15	0.35	BN/WH	4576	Battery Cell Voltage Signal 87	I	-
16	0.35	BN/WH	2389	Battery Cell Voltage Signal 89	I	-
17	0.35	GN/VT	2391	Battery Cell Voltage Signal 91	I	-
18	0.35	YE/VT	2393	Battery Cell Voltage Signal 93	I	-
19	0.35	BU/GY	2395	Battery Cell Voltage Signal 95	I	-
20	-	-	-	Not Occupied	-	-

K16 BATTERY ENERGY CONTROL MODULE X7



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13950637
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 0.64 Series (GN)

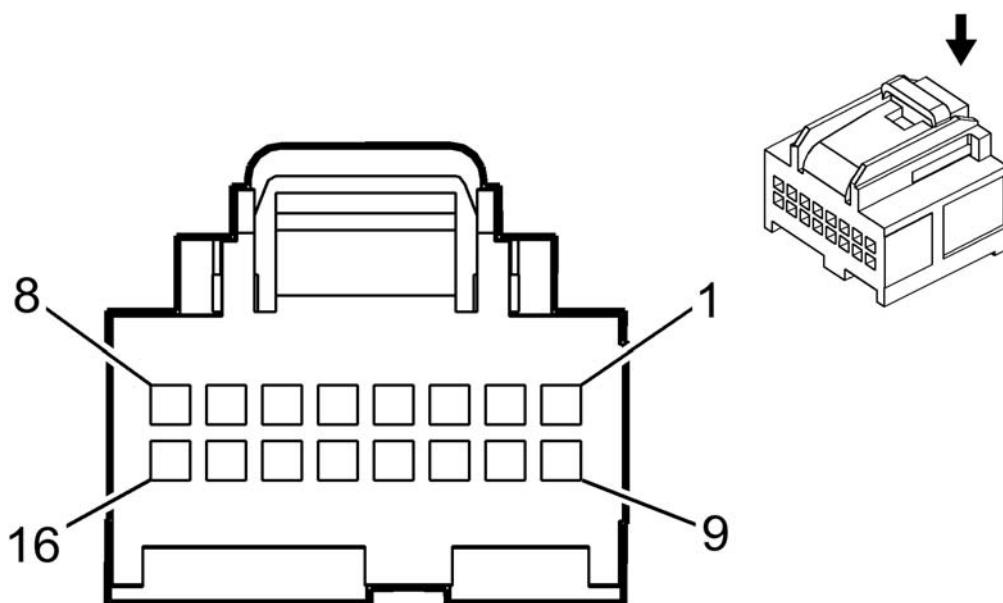
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	5405	Battery Module Temperature Signal 1	I	-
2	0.35	BN/WH	5406	Battery Module Temperature Signal 2	I	-
3	0.35	GN/GY	5407	Battery Module Temperature Signal 3	I	-
4	0.35	WH/BK	5408	Battery Module Temperature Signal 4	I	-
5	0.35	GN/BK	5409	Battery Module Temperature Signal 5	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
6	0.35	GY/BN	5410	Battery Module Temperature Signal 6	I	-
7	0.5	YE	5411	Battery Module Temperature Signal 7	I	-
8	-	-	-	Not Occupied	-	-
9	0.5	VT/RD	2965	High Voltage Battery Current Sensor Voltage Reference	I	-
10	0.5	BU/YE	2962	High Voltage Battery Current Sensor Course Signal	I	-
11	0.35	BK/BN	3773	Battery Module Temperature Sensor Low Reference 1	I	-
12	0.35	BK/BU	3774	Battery Module Temperature Sensor Low Reference 2	I	-
13	0.35	BK/GN	3775	Battery Module Temperature Sensor Low Reference 3	I	-
14	0.35	BK/GY	3776	Battery Module Temperature Sensor Low Reference 4	I	-
15	0.35	BK/VT	3777	Battery Module Temperature Sensor Low Reference 5	I	-
16	0.35	BK/YE	3778	Battery Module Temperature Sensor Low Reference 6	I	-
17	0.5	BK/BU	3779	Battery Module Temperature Sensor Low Reference 7	I	-
18	-	-	-	Not Occupied	-	-
19	0.5	BK/GY	2963	High Voltage Battery Current Sensor Low Reference	I	-
20	0.5	GN/BN	2961	High Voltage Battery Current Sensor Fine Signal	I	-

K16 BATTERY ENERGY CONTROL MODULE X8



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13819409
- Service Connector: Service by Harness - See Part Catalog
- Description: 16-Way F 0.64 OCS Series (BK)

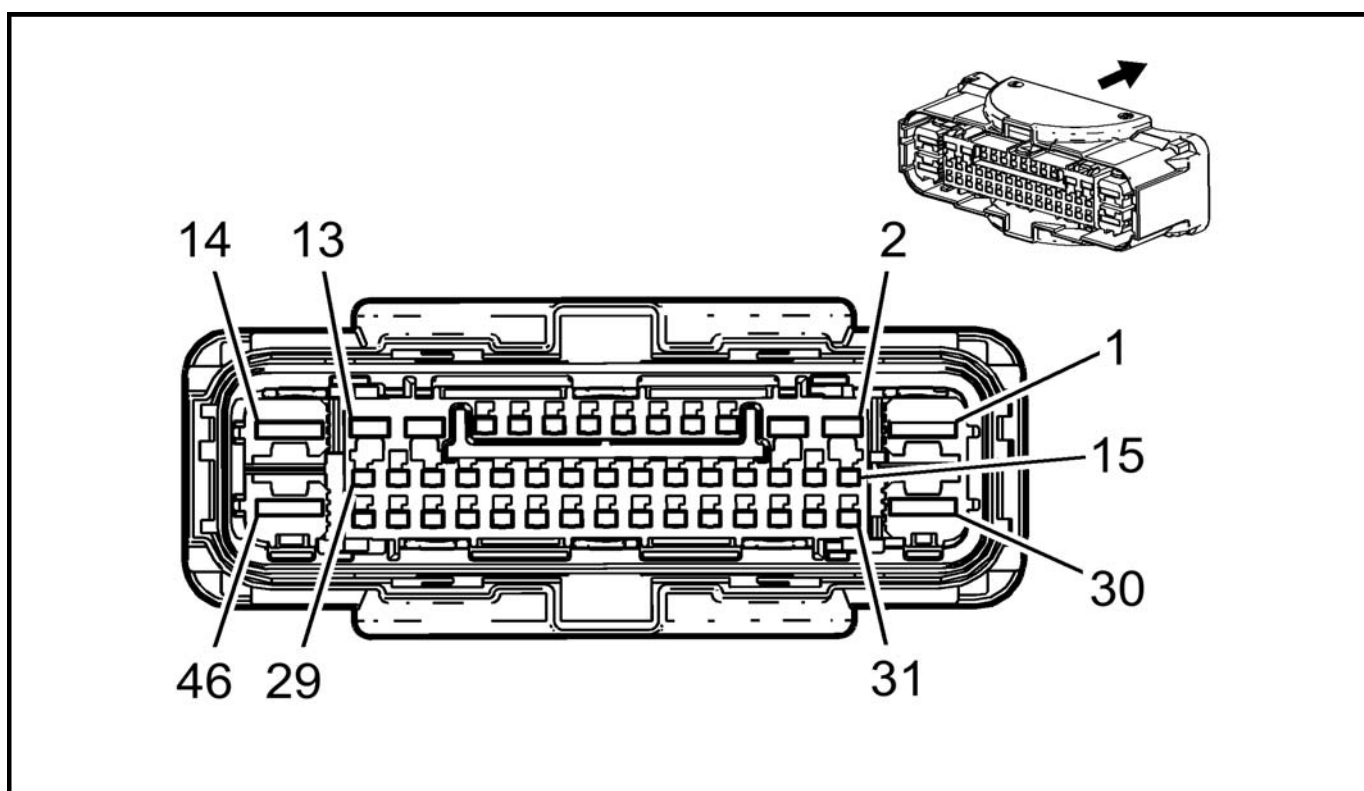
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/VT	1640	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
4	0.5	WH/BK	6435	CAN Bus Low 2 Serial Data	I	-
5	0.5	BU/GY	6434	CAN Bus High 2 Serial Data	I	-
6	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
8	0.5	BU/GN	5139	High Voltage Fault Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
9	0.5	VT/WH	1139	Run/Crank Ignition 1 Voltage	I	-
10	0.5	BU/BN	3787	High Voltage Energy Management Communication Control	I	-
11	0.5	BK	2050	Ground	I	-
12 - 13	-	-	-	Not Occupied	-	-
14	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
15	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
16	-	-	-	Not Occupied	-	-

K17 ELECTRONIC BRAKE CONTROL MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 1928405782
- Service Connector: 19333357
- Description: 46-Way F 1.5, 2.8, 5.8 Series, Sealed (BK)

Terminal Part Information

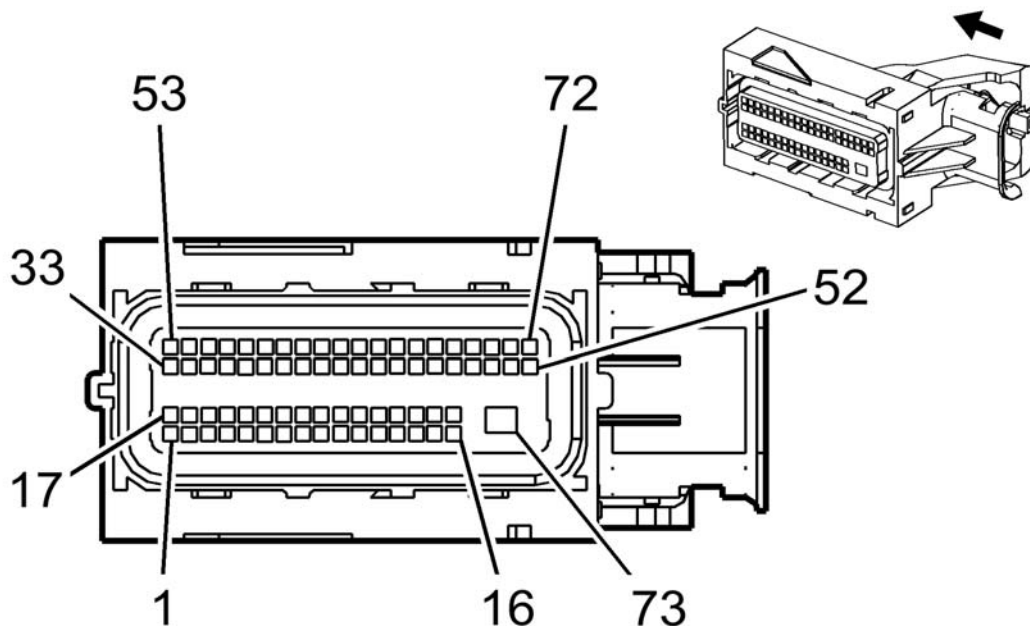
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19330700	J-35616-35 (VT)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
II	19333305	J-35616-40 (BU)	J-38125-556	Not Available	Not Available	Not Available	Not Available
III	19333312	J-35616-16 (LT GN)	J-38125-22	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/BN	1742	Battery Positive Voltage	II	-
2	2.5	GN/VT	1988	Park Brake Motor Apply Right Rear Control	I	-
3	2.5	GY	4368	Park Brake Motor Low Reference Right Rear	I	-
4	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
5	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
6	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	III	-
7	0.5	GY	830	Wheel Speed Sensor Signal Left Front	III	-
8	0.5	YE/RD	7683	Park Brake Release Switch Voltage Reference	III	-
9	0.5	BU/VT	1134	Park Brake Switch Signal	III	-
10	-	-	-	Not Occupied	-	-
11	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	III	-
12	2.5	GY/BK	4369	Park Brake Motor Low Reference Left Rear	I	-
13	2.5	WH	2001	Park Brake Motor Apply Left Rear Control	I	-
14	4	BK	2650	Ground	II	-
15	0.5	BU/BK	6108	Park Brake Release Switch Signal	III	-
16	0.5	YE	1492	Park Brake Switch Supply Voltage	III	-
17	0.5	VT/GY	139	Run/Crank Ignition 1 Voltage	III	-
18	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
19	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
20	-	-	-	Not Occupied	-	-
21	0.5	GY/BN	7065	Wheel Speed Sensor Control Right Front	III	-
22	0.5	GY/YE	7128	Wheel Speed Sensor Control Right Rear	III	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
23	0.5	BU	884	Wheel Speed Sensor Signal Left Rear	III	-
24	0.5	GY/WH	7064	Wheel Speed Sensor Control Left Front	III	-
25	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	III	-
26	0.5	YE	872	Wheel Speed Sensor Signal Right Front	III	-
27 - 29	-	-	-	Not Occupied	-	-
30	4	RD/WH	342	Battery Positive Voltage	II	-
31	0.5	BN	6107	Park Brake Apply Switch Signal	III	-
32	0.5	GY/RD	7684	Park Brake Apply Switch Voltage Reference	III	-
33 - 35	-	-	-	Not Occupied	-	-
36	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	III	-
37	0.5	VT	882	Wheel Speed Sensor Signal Right Rear	III	-
38	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	III	-
39	0.5	GY/BK	7127	Wheel Speed Sensor Control Left Rear	III	-
40	0.5	GN/BN	2087	Combined Vehicle Inertial Sensor Supply Voltage	III	-
41	-	-	-	Not Occupied	-	-
42	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	III	-
43 - 45	-	-	-	Not Occupied	-	-
46	4	BK	2650	Ground	II	-

K20 ENGINE CONTROL MODULE X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34566-6743
- Service Connector: 13574946
- Description: 73-Way F 0.64, 2.8 Series, Sealed (BK with BU Terminal Position Assurance)

Terminal Part Information

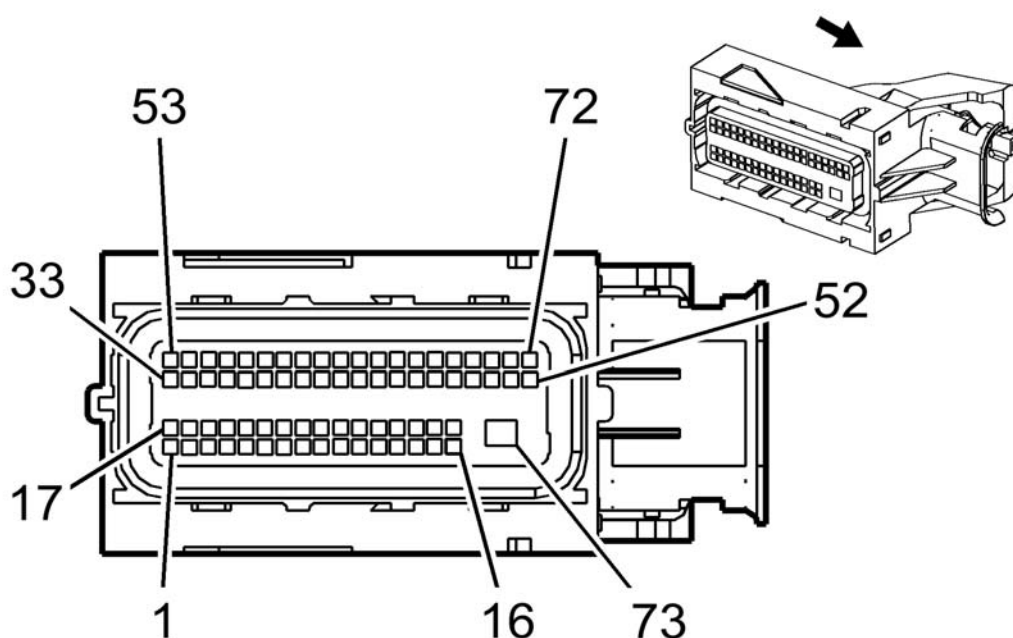
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576392	J-35616-4A (PU)	J-38125-11A	7116-4152-02	Yazaki 9	2	5
II	19301532	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 6	-	-	-	Not Occupied	-	-
7	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	II	-
8	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	II	-
9	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
10	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.5	BN/RD	1274	Accelerator Pedal Position 5V Reference 2	II	-
12	0.5	WH/RD	1164	Accelerator Pedal Position 5V Reference 1	II	-
13	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	II	-
14	0.5	VT/BK	339	Run/Crank Ignition 1 Voltage	II	-
15	0.5	RD/BN	440	Battery Positive Voltage	II	-
16	0.75	VT/BU	5292	Powertrain Main Relay Fused Supply 3	II	-
17 - 24	-	-	-	Not Occupied	-	-
25	0.5	BK/YE	5382	Brake Position Sensor Low Reference	II	-
26	-	-	-	Not Occupied	-	-
27	0.5	BK/VT	1272	Accelerator Pedal Position Low Reference 2	II	-
28	0.5	BK/BU	1271	Accelerator Pedal Position Low Reference 1	II	-
29 - 32	-	-	-	Not Occupied	-	-
33	0.5	GN/WH	1162	Accelerator Pedal Position Signal 2	II	-
34	0.5	GN/WH	492	Mass Air Flow Sensor Signal	II	-
35 - 36	-	-	-	Not Occupied	-	-
37	0.5	BN/RD	2700	A/C Pressure Sensor 5V Reference	II	-
38 - 40	-	-	-	Not Occupied	-	-
41	0.5	WH/RD	5381	Brake Position Sensor 5V Reference	II	-
42	-	-	-	Not Occupied	-	-
43	0.5	BN/RD	3724	Evap Leak Check Module (ELCM) Pressure Sensor 5V Reference	II	-
44	-	-	-	Not Occupied	-	-
45	0.5	YE/WH	1161	Accelerator Pedal Position Signal 1	II	-
46	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	II	-
47	-	-	-	Not Occupied	-	-
48	0.5	WH/BU	6289	Induction Air Temperature Sensor Signal	II	-
49	-	-	-	Not Occupied	-	-
50	0.5	WH/BU	6311	Cruise/ETC/TCC Brake Signal	II	-
51	0.5	VT/BU	5291	Powertrain Main Relay Fused Supply 2	II	-
52	0.5	BU/VT	2364	Cooling Fan Speed Signal	II	-
53 - 56	-	-	-	Not Occupied	-	-
57	0.5	GN	380	A/C Refrigerant Pressure Sensor Signal	II	-
58 - 59	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
60	0.5	BN/GY	4008	Humidity Sensor Signal	II	-
61	0.5	WH/GN	5380	Brake Position Sensor Signal	II	-
62	-	-	-	Not Occupied	-	-
63	0.5	BU/GN	3725	Evap Leak Check Module (ELCM) Pressure Sensor Signal	II	-
64	0.5	GY	5660	Fuel Pump Controller Data Out Signal	II	-
65	0.5	GY	3723	Evap Leak Check Module (ELCM) Changeover Valve Ground	II	-
66	-	-	-	Not Occupied	-	-
67	0.5	YE	5991	Powertrain Relay Coil Control	II	-
68	0.5	GN	3726	Diurnal Control Valve (DCV) Ground	II	-
69	0.5	BU	6814	Thermostat Engine Cool Control	II	-
70	-	-	-	Not Occupied	-	-
71	0.5	BN/WH	419	Check Engine Indicator Control	II	-
72	-	-	-	Not Occupied	-	-
73	2	VT/BU	5290	Powertrain Main Relay Fused Supply 1	I	-

K20 ENGINE CONTROL MODULE X2



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34566-6753

- Service Connector: 13574947
- Description: 73-Way F 0.64, 2.8 Series, Sealed (BK with BK Terminal Position Assurance)

Terminal Part Information

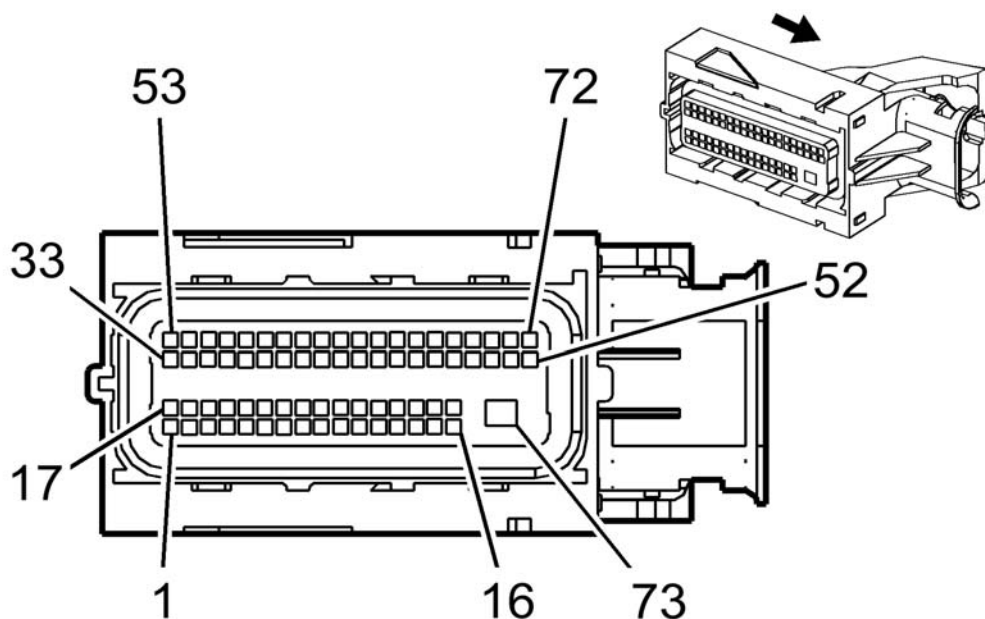
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576392	J-35616-4A (PU)	J-38125-11A	7116-4152-02	Yazaki 9	2	5
II	19301532	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BU	410	Engine Coolant Temperature Sensor Signal	II	-
3	-	-	-	Not Occupied	-	-
4	0.5	BN/RD	7445	Fuel Line Pressure Sensor 5V Reference	II	-
5	0.5	GY/RD	2704	Manifold Absolute Pressure Sensor 5V Reference	II	-
6	0.5	GY/YE	5297	Camshaft Position Exhaust Sensor Control 1	II	-
7	0.5	GY/BU	5300	Camshaft Position Intake Sensor Control 1	II	-
8 - 11	-	-	-	Not Occupied	-	-
12	0.5	BN/RD	2701	Throttle Position Sensor 5V Reference	II	-
13	0.5	BU/WH	3630	Throttle Position Sensor (SENT1) Signal	II	-
14	0.5	WH/RD	2705	Oil Pressure Sensor 5V Reference	II	-
15	0.5	VT/BU	6270	Crankshaft 60X Sensor 5V Reference	II	-
16 - 19	-	-	-	Not Occupied	-	-
20	0.5	BU/WH	7446	Fuel Line Pressure Sensor Signal	II	-
21	0.5	BK/GN	469	Manifold Absolute Pressure Sensor Low Reference	II	-
22	0.5	BK/GY	5296	Camshaft Position Exhaust Sensor Low Reference 1	II	-
23	0.5	BK/GN	5301	Camshaft Position Intake Sensor Low Reference 1	II	-
24 - 27	-	-	-	Not Occupied	-	-
28	0.5	BK/BN	2752	Throttle Position Sensor Low Reference	II	-
29	0.5	YE/BN	331	Oil Pressure Sensor Signal	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
30	0.5	BK/VT	2755	Oil Pressure Sensor Low Reference	II	-
31	0.5	BK/VT	6272	Crankshaft 60X Sensor Low Reference	II	-
32	-	-	-	Not Occupied	-	-
33	0.5	WH/BK	3111	Heated Oxygen Sensor Low Signal Bank 1 Sensor 1	II	-
34	0.5	WH/YE	3121	Heated Oxygen Sensor Low Signal Bank 1 Sensor 2	II	-
35	-	-	-	Not Occupied	-	-
36	0.5	BK/VT	6754	Cam Phaser X Low Reference	II	-
37	0.5	BK/BN	6753	Cam Phaser W Low Reference	II	-
38	0.5	VT/BK	5273	Camshaft Position Exhaust Sensor 1	II	-
39	0.5	YE/VT	5275	Camshaft Position Intake Sensor 1	II	-
40	0.5	GN	6271	Crankshaft 60X Sensor Signal	II	-
41	-	-	-	Not Occupied	-	-
42	0.5	VT/BU	6091	Crankshaft Position Sensor Replicated Signal	II	-
43	0.5	BK/WH	2051	Signal Ground	II	-
44	0.5	BK/BU	2129	Ignition Control Low Reference Bank 1	II	-
45	0.5	GN/BU	2123	Ignition Control 3	II	-
46	0.5	BU/VT	2121	Ignition Control 1	II	-
47	-	-	-	Not Occupied	-	-
48	0.75	BU	4802	Direct Fuel Injector (DFI) High Voltage Control Cylinder 2	II	-
49	0.75	GY/BU	4804	Direct Fuel Injector (DFI) High Voltage Control Cylinder 4	II	-
50	0.75	GN	4803	Direct Fuel Injector (DFI) High Voltage Control Cylinder 3	II	-
51	0.75	BN	4801	Direct Fuel Injector (DFI) High Voltage Control Cylinder 1	II	-
52	0.5	YE	581	Throttle Actuator Control Open	II	-
53	0.5	VT/GY	3110	Heated Oxygen Sensor High Signal Bank 1 Sensor 1	II	-
54	0.5	VT/BU	3120	Heated Oxygen Sensor High Signal Bank 1 Sensor 2	II	-
55	-	-	-	Not Occupied	-	-
56	0.5	GY/BU	5282	Camshaft Phaser Exhaust Solenoid 1	II	-
57	0.5	VT/BN	5284	Camshaft Phaser Intake Solenoid 1	II	-
58 - 59	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
60	0.5	GY/WH	3122	Heated Oxygen Sensor Heater Low Control Bank 1 Sensor 2	II	-
61	0.5	GY/WH	3113	Heated Oxygen Sensor Heater Low Control Bank 1 Sensor 1	II	-
62 - 63	-	-	-	Not Occupied	-	-
64	0.5	BU	179	Oil Pump Command Signal	II	-
65	0.5	BU/WH	2122	Ignition Control 2	II	-
66	0.5	YE/BU	2124	Ignition Control 4	II	-
67	-	-	-	Not Occupied	-	-
68	0.75	BU/GY	4902	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 2	II	-
69	0.75	BU/WH	4904	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 4	II	-
70	0.75	GN/GY	4903	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 3	II	-
71	0.75	BN/WH	4901	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 1	II	-
72	0.5	BN/WH	582	Throttle Actuator Control Close	II	-
73	2	BK/WH	151	Signal Ground	I	-

K20 ENGINE CONTROL MODULE X3



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34566-6763

- Service Connector: 13574948
- Description: 73-Way F 0.64, 2.8 Series, Sealed (BK with GY Terminal Position Assurance)

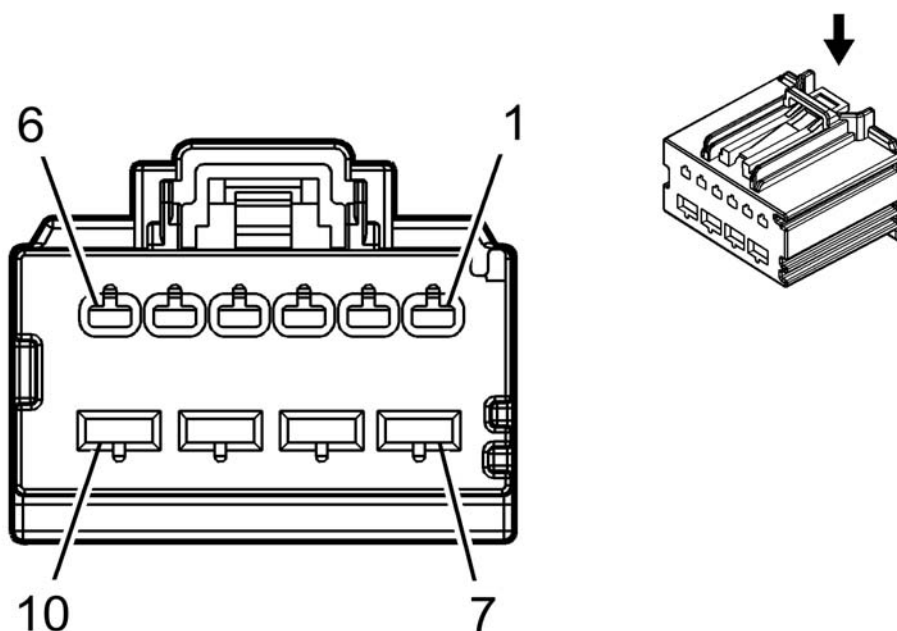
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576392	J-35616-4A (PU)	J-38125-11A	7116-4152-02	Yazaki 9	2	5
II	19301532	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 3	-	-	-	Not Occupied	-	-
4	0.5	GN/BU	428	EVAP Canister Purge Solenoid Control	II	-
5	0.5	BU	3722	Evap Leak Check Module (ELCM) Vacuum Pump Ground	II	-
6	0.5	BN/RD	2917	Fuel Rail Pressure Sensor 5V Reference	II	-
7	-	-	-	Not Occupied	-	-
8	0.5	YE/RD	2709	Fuel Tank Pressure Sensor 5V Reference	II	-
9 - 13	-	-	-	Not Occupied	-	-
14	0.5	WH/RD	3201	Throttle Inlet Absolute Pressure Sensor 5V Reference	II	-
15	-	-	-	Not Occupied	-	-
16	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	II	-
17	-	-	-	Not Occupied	-	-
18	0.5	BN	25	Charge Indicator Control	II	-
19	0.5	GY	23	Generator Field Duty Cycle Signal	II	-
20	0.5	BK/WH	2151	Signal Ground	II	-
21	0.5	BU/WH	2918	Fuel Rail Pressure Sensor Signal	II	-
22	0.5	BK/GN	2919	Fuel Rail Pressure Sensor Low Reference	II	-
23 - 28	-	-	-	Not Occupied	-	-
29	0.5	BK/BN	2753	Exhaust Gas Recirculation Sensor Low Reference	II	-
30 - 33	-	-	-	Not Occupied	-	-
34	0.5	BN/VT	4322	Exhaust Gas Recirculation Pulse Width Modulated Input Signal	II	-
35 - 39	-	-	-	Not Occupied	-	-
40	0.5	GN/WH	432	Manifold Absolute Pressure Sensor Signal	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
41 - 42	-	-	-	Not Occupied	-	-
43	0.5	BU/VT	1589	Primary Fuel Level Sensor Signal	II	-
44	-	-	-	Not Occupied	-	-
45	0.5	BN/WH	4323	Exhaust Gas Recirculation Pulse Width Modulated Output Signal	II	-
46	0.5	YE/WH	3200	Throttle Inlet Absolute Pressure Sensor Signal	II	-
47 - 48	-	-	-	Not Occupied	-	-
49	0.5	YE/GN	3236	Exhaust Gas Recirculation Temperature Sensor 2 Signal	II	-
50	0.5	WH/BN	3237	Exhaust Gas Recirculation Temperature Sensor Signal	II	-
51	-	-	-	Not Occupied	-	-
52	0.5	VT/BK	7300	High Pressure Fuel Pump Actuator Low - Control	II	-
53 - 54	-	-	-	Not Occupied	-	-
55	0.5	GN/VT	4621	Local Interconnect Network Serial Data Bus 21	II	-
56 - 60	-	-	-	Not Occupied	-	-
61	0.5	BK/YE	1716	Knock Sensor Low Reference 1	II	-
62	0.5	VT/GY	496	Knock Sensor Signal 1	II	-
63 - 67	-	-	-	Not Occupied	-	-
68	0.5	BU/WH	890	Fuel Tank Pressure Sensor Signal	II	-
69 - 71	-	-	-	Not Occupied	-	-
72	0.5	YE	7301	High Pressure Fuel Pump Actuator High - Control	II	-
73	2	BK/WH	151	Signal Ground	I	-

K29F SEAT HEATING CONTROL MODULE - FRONT X1 (KA1)



Connector Part Information

- Harness Type: Rear Seat Cushion
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

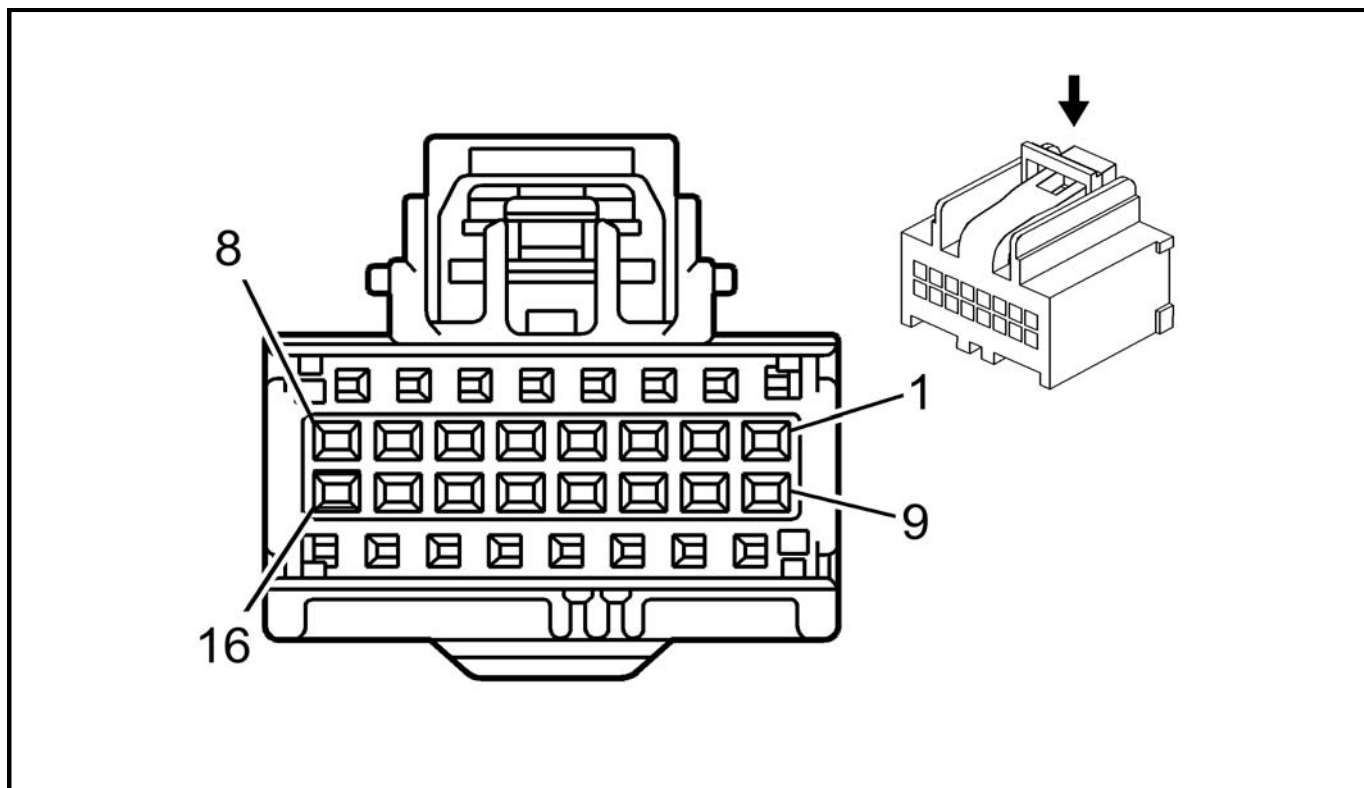
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.75	BN/BU	2479	Passenger Heated Seat Element Control	I	-
3	0.75	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-
4	0.75	VT/BK	2424	Driver Heated Back Element Low Reference	I	-
5	-	-	-	Not Occupied	-	-
6	0.75	BN/VT	2077	Driver Heated Seat Element Control	I	-
7	0.75	RD/BN	1742	Battery Positive Voltage	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	1.0	BK	2050	Ground	I	-
9	-	-	-	Not Occupied	-	-
10	0.75	RD/GY	1740	Battery Positive Voltage	I	-

K29F SEAT HEATING CONTROL MODULE - FRONT X2 (KA1)



Connector Part Information

- Harness Type: Rear Seat Cushion
- OEM Connector: 7283-9076-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 16-Way F 0.64 Kaizen Series (BK)

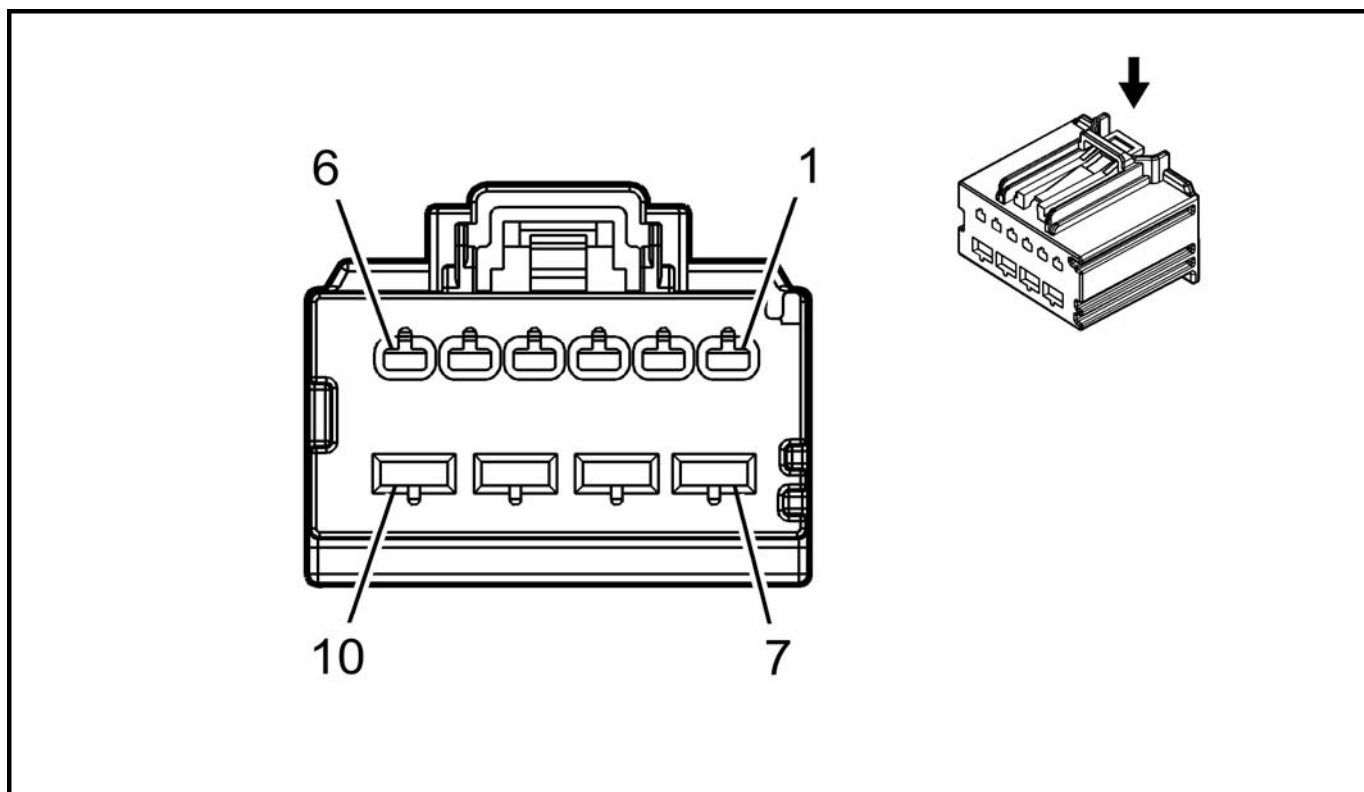
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/YE	2080	Driver Heated Seat NTC Low Reference	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	BK/GY	2435	Passenger Heated Seat NTC Low Reference	I	-
3	0.35	BU	2425	Driver Heated Back NTC Signal	I	-
4	0.35	WH/BU	2436	Passenger Heated Back NTC Signal	I	-
5	0.35	WH/GY	2434	Passenger Heated Seat NTC Signal	I	-
6	0.35	YE/GY	2079	Driver Heated Seat NTC Signal	I	-
7	-	-	-	Not Occupied	-	-
8	0.35	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	I	-
9 - 11	-	-	-	Not Occupied	-	-
12	0.35	BK/GN	2482	Passenger Heated Back NTC Low Reference	I	-
13 - 16	-	-	-	Not Occupied	-	-

K29R SEAT HEATING CONTROL MODULE - REAR X1 (KA6)



Connector Part Information

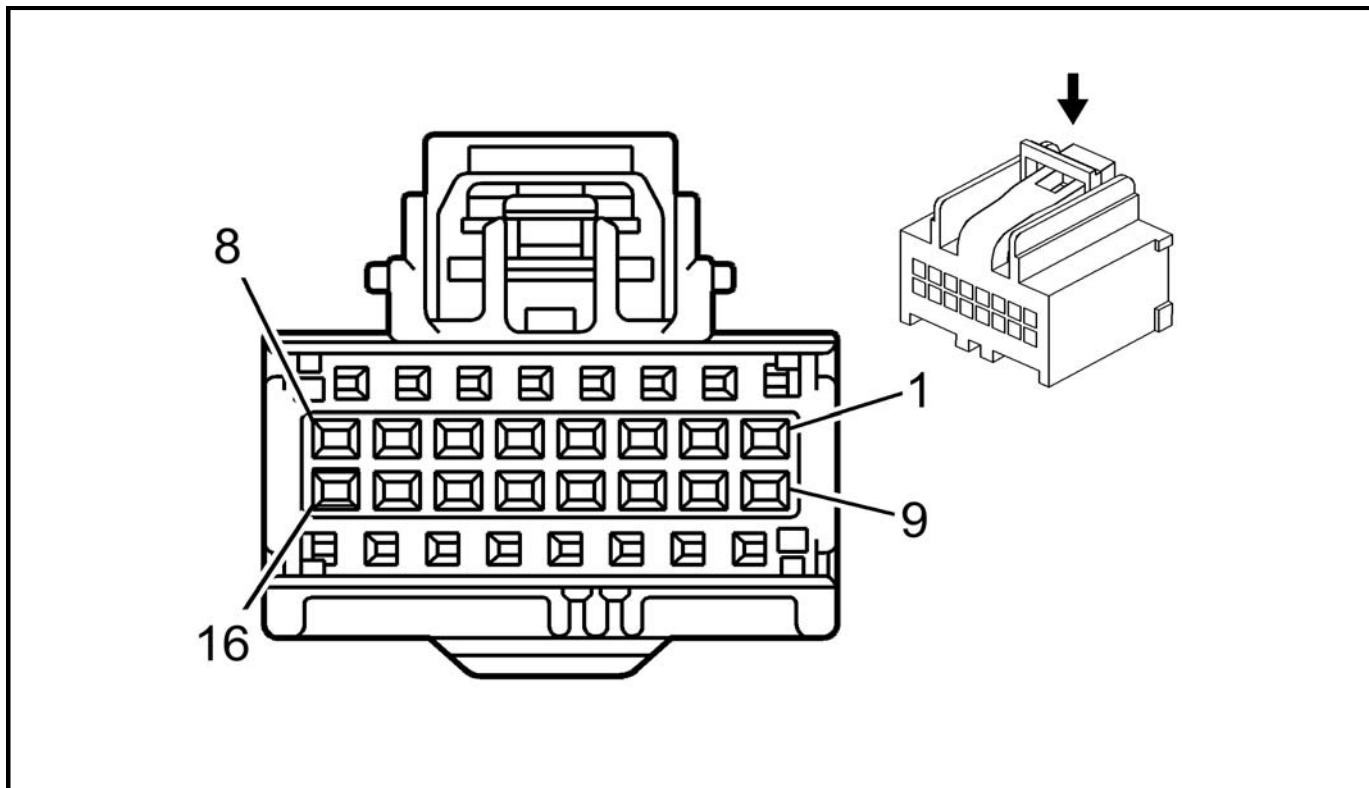
- Harness Type: Rear Seat Cushion
- OEM Connector: 13582823
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	GN/BN	2296	Right Rear Heated Seat Cushion Element Control	I	-
3	0.5	GN/BK	2297	Right Rear Heated Seat Cushion Element Low Reference	I	-
4	0.5	BN/BK	2295	Left Rear Heated Seat Cushion Element Low Reference	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	GY	2294	Left Rear Heated Seat Cushion Element Control	I	-
7	0.75	RD/GN	1840	Battery Positive Voltage	I	-
8	1.0	BK	850	Ground	I	-
9	-	-	-	Not Occupied	-	-
10	0.75	RD/GN	1840	Battery Positive Voltage	I	-

K29R SEAT HEATING CONTROL MODULE - REAR X2 (KA6)



Connector Part Information

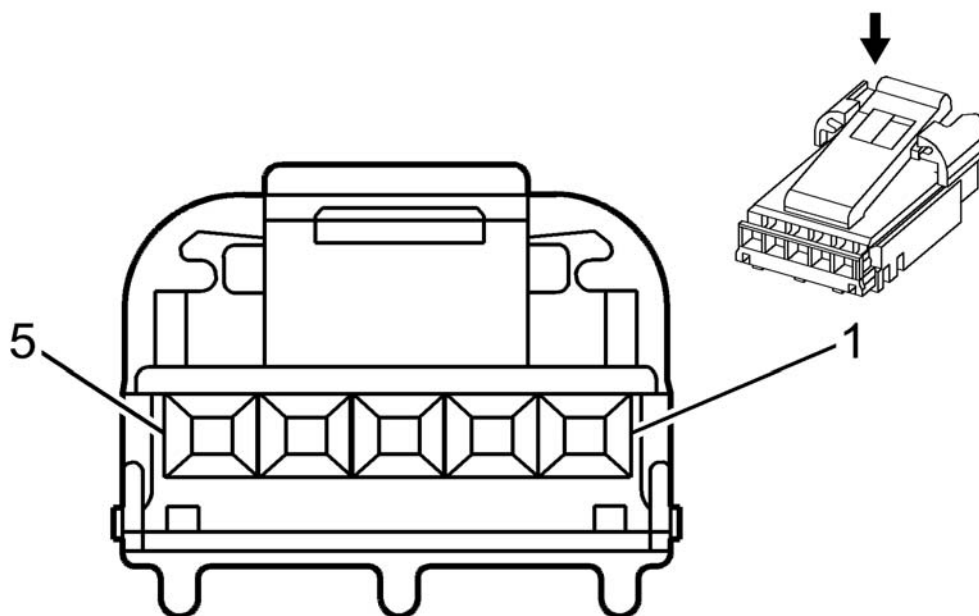
- Harness Type: Rear Seat Cushion
- OEM Connector: 15136073
- Service Connector: Service by Harness - See Part Catalog
- Description: 16-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/WH	7048	Left Rear Cushion NTC Low Reference	I	-
2	0.35	WH/BK	7054	Right Rear Cushion NTC Low Reference	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.35	YE/WH	7053	Right Rear Cushion NTC Signal	I	-
6	0.35	WH/BU	7047	Left Rear Cushion NTC Signal	I	-
7	0.5	BK	850	Ground	I	-
8	0.5	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	I	-
9 - 16	-	-	-	Not Occupied	-	-

K32 STEERING WHEEL HEATING CONTROL MODULE X1



Connector Part Information

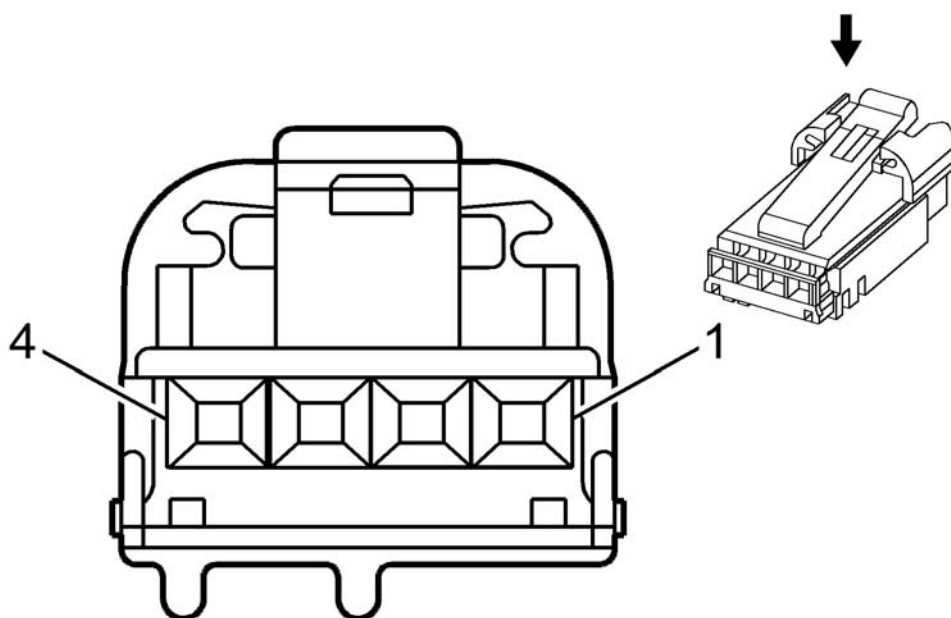
- Harness Type: Steering Wheel
- OEM Connector: 31072-1010
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way F 31072 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/RD	5883	Heated Steering Wheel Switch Signal	I	-
2	0.35	GN/RD	5884	Heated Steering Wheel Switch LED Control	I	-
3	0.5	OG	239	Run/Crank Ignition 1 Voltage	I	-
4	0.35	BK	1650	Ground	I	-
5	0.35	BK	1650	Ground	I	-

K32 STEERING WHEEL HEATING CONTROL MODULE X2



Connector Part Information

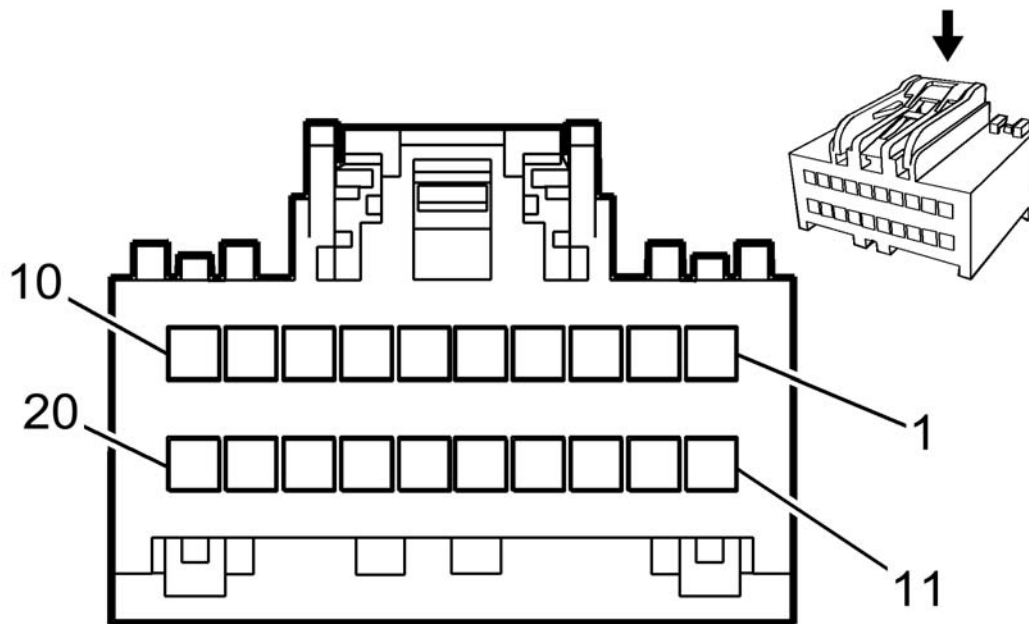
- Harness Type: Steering Wheel
- OEM Connector: 31068-1010
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 H-DAC Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	1650	Ground	I	-
2	0.35	GY	5885	Heated Steering Wheel Voltage Reference	I	-
3	0.8	WH	5888	Heated Steering Wheel High Control	I	-
4	0.8	BK	1650	Ground	I	-

K33 HVAC CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1203
- Service Connector: 13576644
- Description: 20-Way F 0.64 Series (GN)

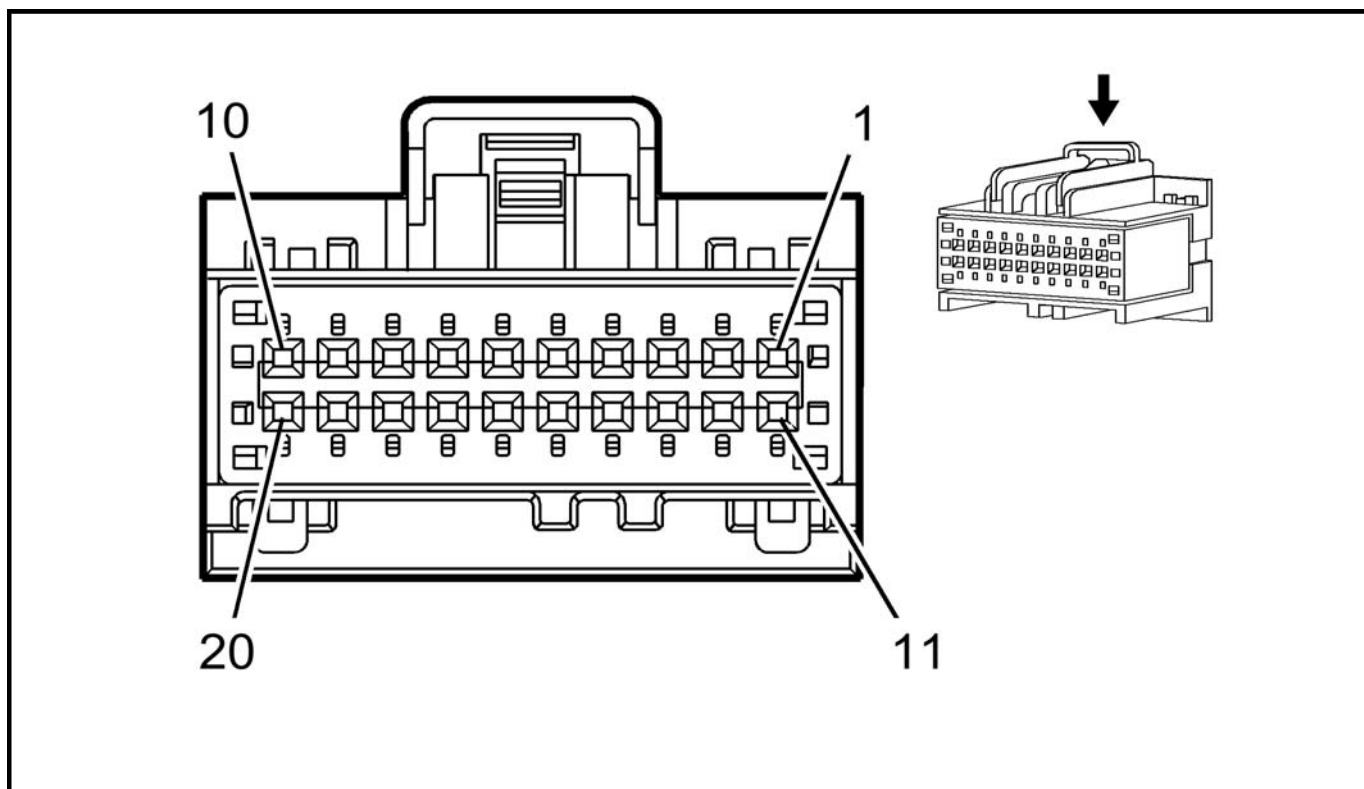
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575845	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.35	GY/GN	7565	Windscreen Temp Sensor Signal	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.35	YE/BU	3197	Humidity Temperature Sensor Signal	I	-
6	0.35	YE/RD	597	5V Reference	I	-
7	0.35	BK/BN	6102	Inside Air Temperature Sensor Low Reference	I	-
8 - 11	-	-	-	Not Occupied	-	-
12	0.35	GY/BU	7564	Humidity Sensor Signal	I	-
13 - 17	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
18	0.75	BN	518	Lower Left Air Temperature Sensor Signal	I	-
19 - 20	-	-	-	Not Occupied	-	-

K33 HVAC CONTROL MODULE X2



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1202
- Service Connector: 15126709
- Description: 20-Way F 64 Series, Sealed (BN)

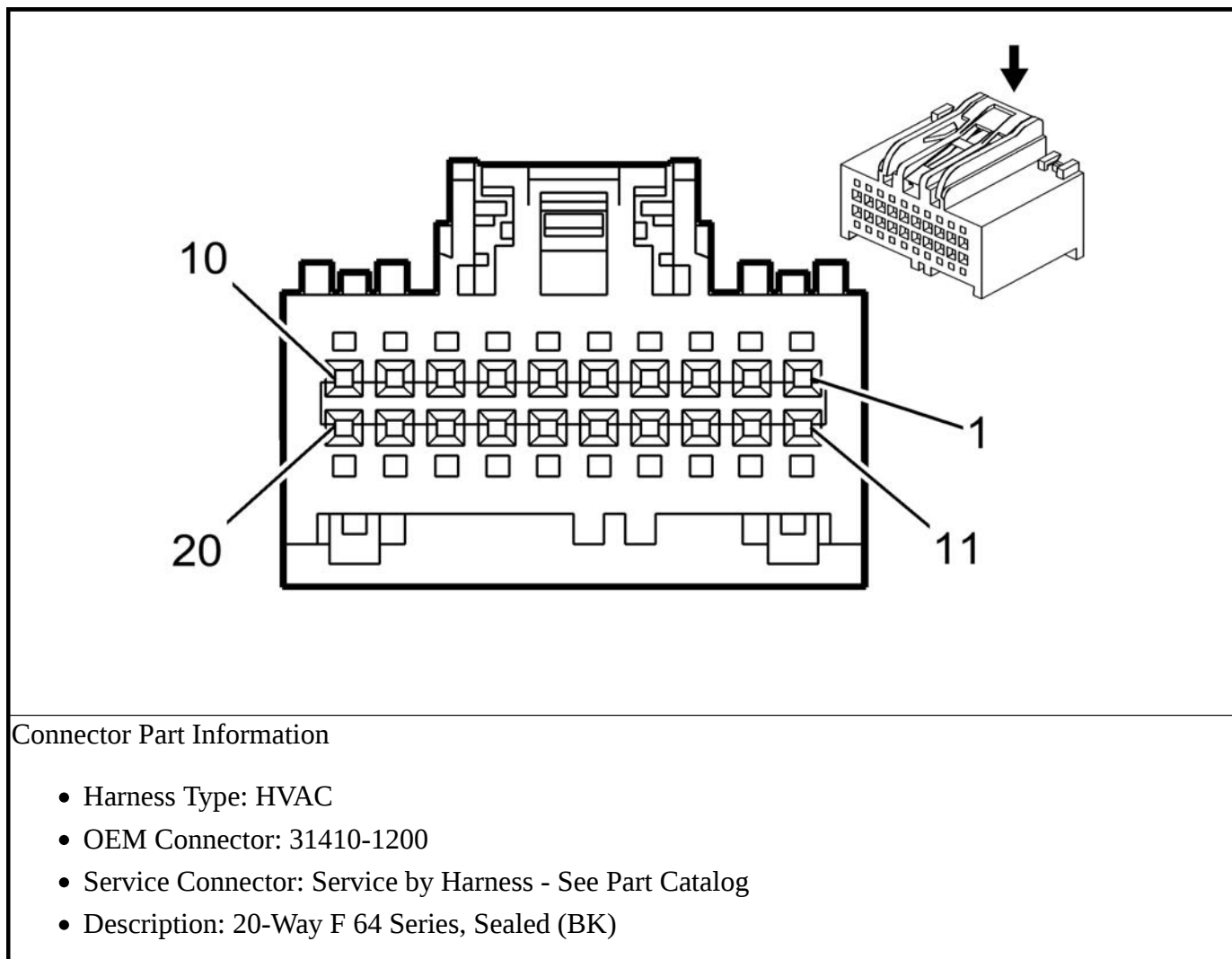
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575845	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/WH	3440	Battery Positive Voltage	I	-
2	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
3	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	0.35	GN/YE	7531	Local Interconnect Network Serial Data Bus 9	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	GN/BU	4119	Local Interconnect Network Serial Data Bus 19	I	-
7	-	-	-	Not Occupied	-	-
8	0.5	BK	1650	Ground	I	-
9	0.35	VT/BN	41	Run Ignition 3 Voltage	I	-
10 - 12	-	-	-	Not Occupied	-	-
13	0.35	WH/BN	1089	Coolant Pump Motor Relay Control	I	-
14	-	-	-	Not Occupied	-	-
15	0.35	BU/GY	754	Blower Motor Speed Control	I	-
16 - 18	-	-	-	Not Occupied	-	-
19	0.35	BN/VT	193	Rear Defog Relay Control	I	-
20	-	-	-	Not Occupied	-	-

K33 HVAC CONTROL MODULE X3

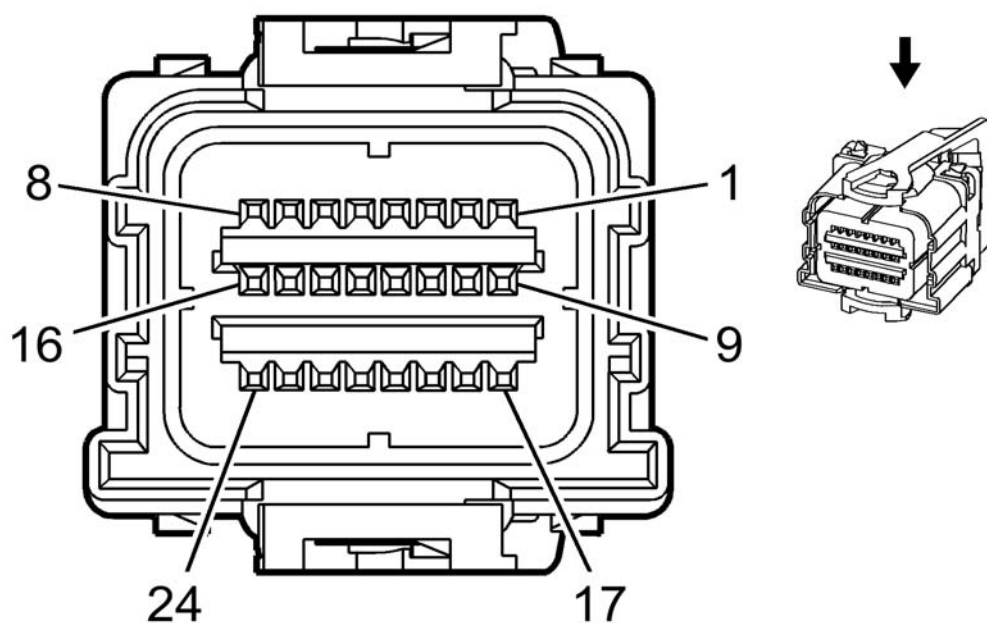


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT	516	Upper Left Air Temperature Sensor Signal	I	-
2	0.5	BU/BN	3167	Mode Door Stepper Motor Control 3	I	-
3	0.5	GN/RD	3165	Mode Door Stepper Motor Control 1	I	-
4	0.5	BN/RD	3168	Mode Door Stepper Motor Control 4	I	-
5	0.5	BU	3166	Mode Door Stepper Motor Control 2	I	-
6 - 8	-	-	-	Not Occupied	-	-
9	0.75	BK	6101	Air Temperature Sensor Common Low Reference	I	-
10	-	-	-	Not Occupied	-	-
11	0.5	BU/VT	3169	Temp Door Stepper Motor Control 1	I	-
12	0.5	GN/RD	3170	Temp Door Stepper Motor Control 2	I	-
13	0.5	BN/RD	3171	Temp Door Stepper Motor Control 3	I	-
14	0.5	BU	3172	Temp Door Stepper Motor Control 4	I	-
15	0.5	RD	7572	HVAC Motor Control	I	-
16	0.5	BU/VT	3173	Air Inlet Door Stepper Motor Control 1	I	-
17	0.5	GN/RD	3174	Air Inlet Door Stepper Motor Control 2	I	-
18	0.5	BN/RD	3175	Air Inlet Door Stepper Motor Control 3	I	-
19	0.5	BU	3176	Air Inlet Door Stepper Motor Control 4	I	-
20	-	-	-	Not Occupied	-	-

K36 INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2203516-7
- Service Connector: 19332831
- Description: 24-Way F 0.64 Series, Sealed (YE)

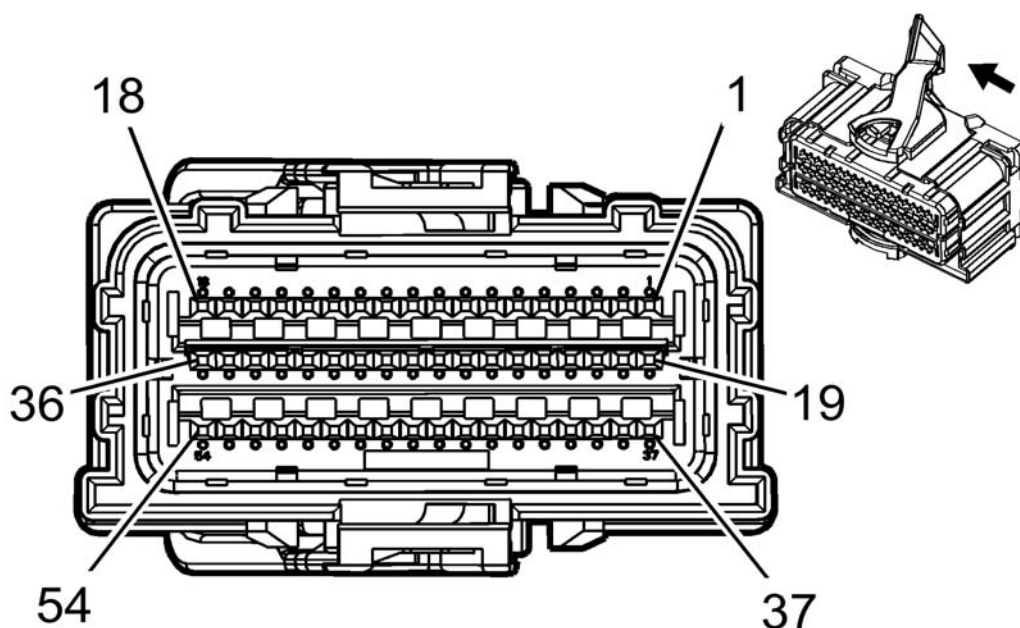
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19328872	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
II	Not Required	No Tool Required	No Tool Required	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BK	3023	Steering Wheel Module Stage 2 High Control	I	-
2	0.5	WH/OG	3022	Steering Wheel Module Stage 2 Low Control	I	-
3	0.5	BN/OG	3020	Steering Wheel Module Stage 1 Low Control	I	-
4	0.5	OG/VT	3021	Steering Wheel Module Stage 1 High Control	I	-
5	0.35	YE/OG	3025	Passenger IP Module Stage 1 High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
6	0.35	OG/WH	3024	Passenger IP Module Stage 1 Low Control	I	-
7	0.35	OG/VT	3026	Passenger IP Module Stage 2 Low Control	I	-
8	0.35	VT	3027	Passenger IP Module Stage 2 High Control	I	-
9	0.5	RD/BK	2240	Battery Positive Voltage	I	-
10	0.35	VT/WH	5234	Passenger Seat Belt Indicator Control	I	-
11	0.35	BU	2307	Passenger Air Bag On Indicator Control	I	-
12	0.35	GN	2308	Passenger Air Bag Off Indicator Control	I	-
13 - 14	-	-	-	Not Occupied	-	-
15	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
16	-	-	-	Not Occupied	-	-
17	0.35	WH/BU	5986	Serial Data Communication Enable	I	-
18	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
19	0.75	BK	2450	Ground	I	-
20	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
21	0.35	OG/BK	3078	Driver Knee Module High Control	II	-
22	0.35	GY/OG	3079	Driver Knee Module Low Control	II	-
23	0.35	WH/OG	3077	Passenger Knee Module Low Control	II	-
24	0.35	OG/BK	3076	Passenger Knee Module High Control	II	-

K36 INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 7-2098922-3
- Service Connector: 19333100
- Description: 54-Way F 0.64 Series, Sealed (YE)

Terminal Part Information

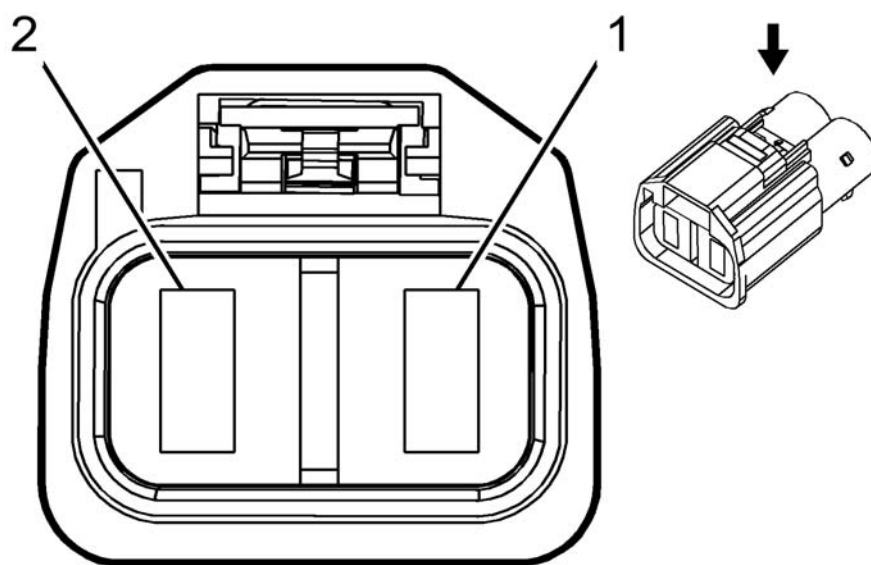
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19328872	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GY	5223	Left Rear Side Impact SIR Inflator Control	I	-
2	0.5	VT/OG	5224	Left Rear Side Impact SIR Inflator Control	I	-
3	0.5	OG/GY	5226	Right Rear Side Impact SIR Inflator Control	I	-
4	0.5	VT/OG	5225	Right Rear Side Impact SIR Inflator Control	I	-
5 - 8	-	-	-	Not Occupied	-	-
9	0.5	OG/YE	3481	Driver Seat Belt Anchor Pretensioner High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
10	0.5	YE/OG	3482	Driver Seat Belt Anchor Pretensioner Low Control	I	-
11	0.35	GY/OG	3480	Passenger Seat Belt Anchor Pretensioner Low Control	I	-
12	0.35	OG/BN	3479	Passenger Seat Belt Anchor Pretensioner High Control	I	-
13	0.5	OG/BU	3068	Driver Side Impact Module High Control	I	-
14	0.5	GN/OG	3069	Driver Side Impact Module Low Control	I	-
15	0.35	BN/OG	3067	Passenger Side Impact Module Low Control	I	-
16	0.35	OG/GY	3066	Passenger Side Impact Module High Control	I	-
17	0.35	OG/GN	5019	Left Front Head Curtain Module High Control	I	-
18	0.35	VT/OG	5020	Left Front Head Curtain Module Low Control	I	-
19	0.35	GN/WH	2132	Left Front Side Impact Sensing Module Signal	I	-
20	0.35	GN	6628	Left Front Side Impact Sensing Module Low Reference	I	-
21	0.35	BN/WH	6629	Right Front Side Impact Sensing Module Low Reference	I	-
22	0.35	BN/OG	2134	Right Front Side Impact Sensing Module Signal	I	-
23	0.5	OG/YE	354	Left Front Discriminating Sensor Signal	I	-
24	0.5	BK/OG	5045	Left Front Discriminating Sensor Low Reference	I	-
25	0.5	GN	5600	Right Front Discriminating Sensor Low Reference	I	-
26	0.5	OG/GN	1409	Right Front Discriminating Sensor Signal	I	-
27	0.5	OG/BU	6620	Left Middle Side Impact Sensing Module Signal	I	-
28	0.5	BU	6621	Left Middle Side Impact Sensing Module Low Reference	I	-
29	0.5	BK/OG	6625	Right Middle Side Impact Sensing Module Low Reference	I	-
30	0.5	OG/VT	6624	Right Middle Side Impact Sensing Module Signal	I	-
31 - 36	-	-	-	Not Occupied	-	-
37	0.35	OG/WH	3477	Driver Seat Belt Retractor Pretensioner High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
38	0.35	WH	3478	Driver Seat Belt Retractor Pretensioner Low Control	I	-
39	0.35	WH/OG	3476	Passenger Seat Belt Retractor Pretensioner Low Control	I	-
40	0.35	OG/GN	3475	Passenger Seat Belt Retractor Pretensioner High Control	I	-
41	0.5	OG/BN	238	Driver Seat Belt Switch Signal	I	-
42	-	-	-	Not Occupied	-	-
43	0.5	BK/WH	1363	Driver Seat Belt Switch Low Reference	I	-
44	0.5	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-
45	0.35	OG/VT	1362	Passenger Seat Belt Switch Signal	I	-
46 - 52	-	-	-	Not Occupied	-	-
53	0.35	OG/GY	5021	Right Front Head Curtain Module High Control	I	-
54	0.35	GY	5022	Right Front Head Curtain Module Low Control	I	-

K43 POWER STEERING CONTROL MODULE X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 7287-1990-30
- Service Connector: Service by Harness - See Part Catalog

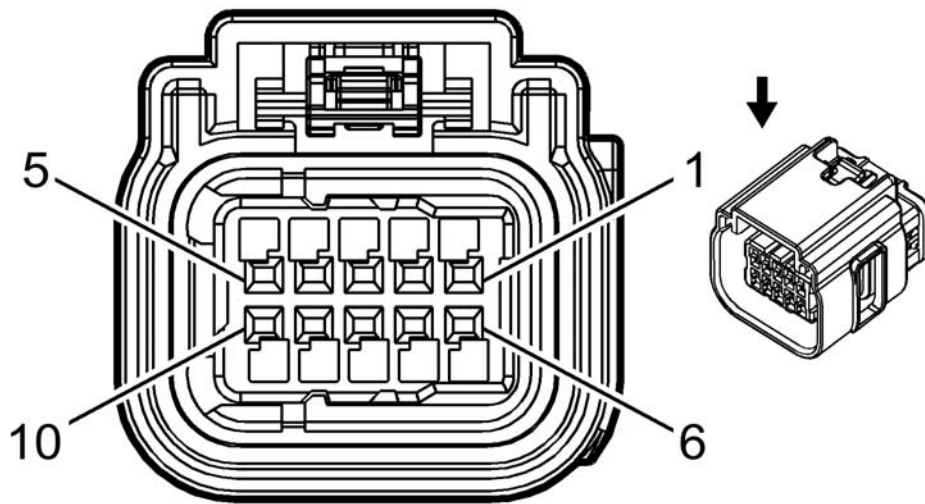
- Description: 2-Way F 9.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	10	BK	350	Ground	I	-
2	10	RD/GN	242	Battery Positive Voltage	I	-

K43 POWER STEERING CONTROL MODULE X2



Connector Part Information

- Harness Type: Engine
- OEM Connector: 3-2098269-8
- Service Connector: 19299774
- Description: 10-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300631	J-35616-64B (LT BU)	J-38125-215A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
2	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
3	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
4	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
5	0.5	WH/BU	5986	Serial Data Communication Enable	I	-
6	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
7	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
8	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
9	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
10	-	-	-	Not Occupied	-	-

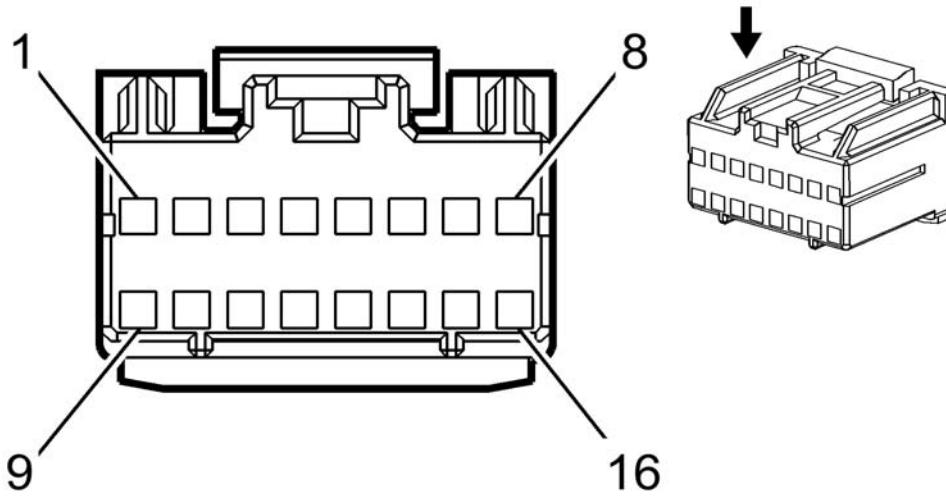
Article GUID: A00884638

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Volt

COMPONENT CONNECTOR END VIEWS

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1456601-1
- Service Connector: 19153138
- Description: 16-Way F 040 Multilock II Series (WH)

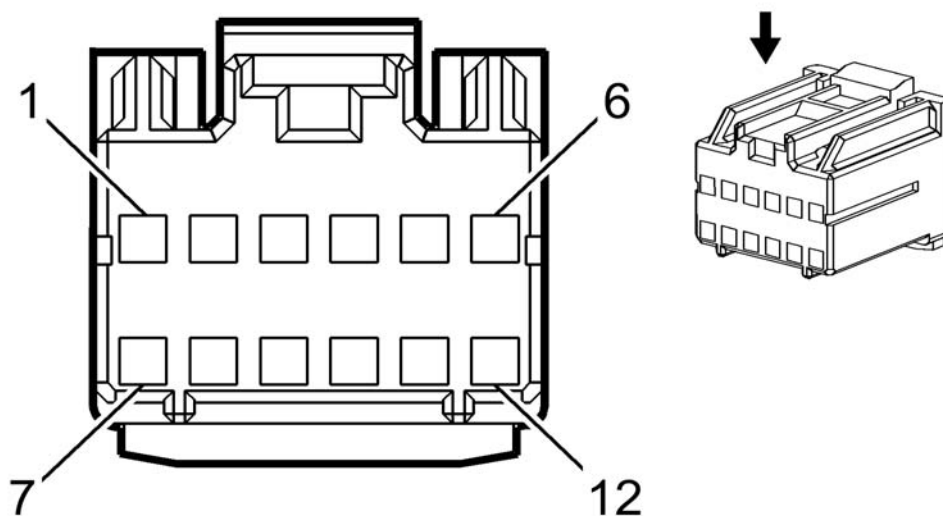
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575740	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J
II	13575803	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	BN/WH	2517	Keypad Red LED Control	II	-
3	0.35	YE/VT	2516	Keypad Green LED Control	II	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.35	GN/BK	2515	Keypad Control	II	-
7	0.5	BK	1450	Ground	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
11	0.35	GN/WH	2514	Keypad Signal	II	-
12	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
13 - 14	-	-	-	Not Occupied	-	-
15	0.5	RD/VT	2640	Battery Positive Voltage	I	-
16	-	-	-	Not Occupied	-	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X2



Connector Part Information

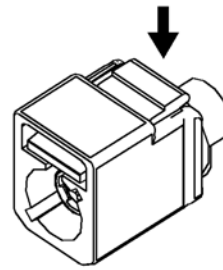
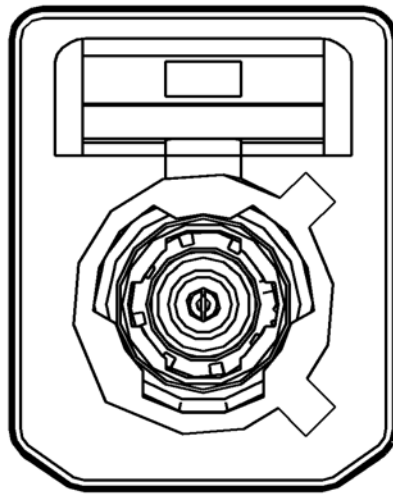
- Harness Type: Instrument Panel
- OEM Connector: 1456599-1
- Service Connector: 88952886
- Description: 12-Way F 040 Multilock II Series (WH)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575740	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J
II	13575803	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE	658	Cellular Telephone Voice Signal	II	-
2	0.35	BK/YE	659	Cellular Telephone Voice Low Reference	II	-
3	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
4	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
5	0.5	BK	1792	Low Reference	I	-
6	0.35	GY/YE	5149	Voice Recognition Audio Signal	II	-
7	0.35	WH/BU	5986	Serial Data Communication Enable	II	-
8	0.5	BK	1782	Low Reference	I	-
9	0.35	BU	655	Cellular Telephone Microphone Signal	II	-
10	0.35	BK/BN	654	Cellular Telephone Microphone Low Reference	II	-
11	-	-	-	Not Occupied	-	-
12	0.35	BK/GY	5152	Voice Recognition Audio Low Reference	II	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X5



Connector Part Information

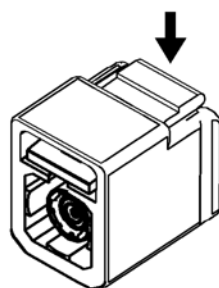
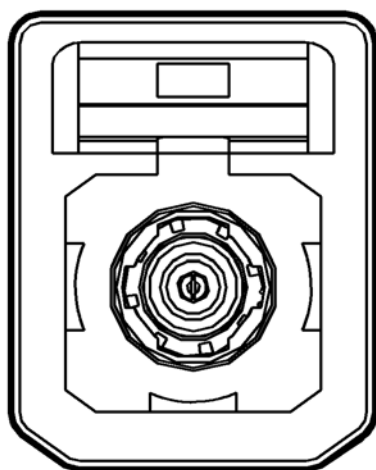
- Harness Type: Instrument Panel
- OEM Connector: 13591273
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (VT)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(Cell only) Coaxial Antenna Cell Phone Signal	I	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X7



Connector Part Information

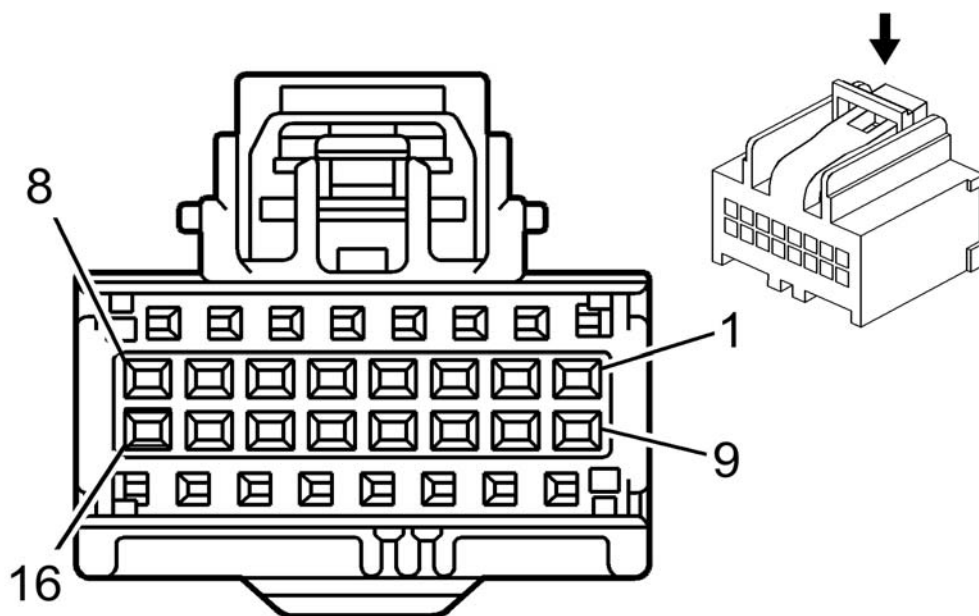
- Harness Type: Instrument Panel
- OEM Connector: 13595582
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS only) Coaxial Antenna GPS Signal	I	-

K74 HUMAN MACHINE INTERFACE CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 15136073
- Service Connector: 15136073
- Description: 16-Way F 0.64 Kaizen Series (BK)

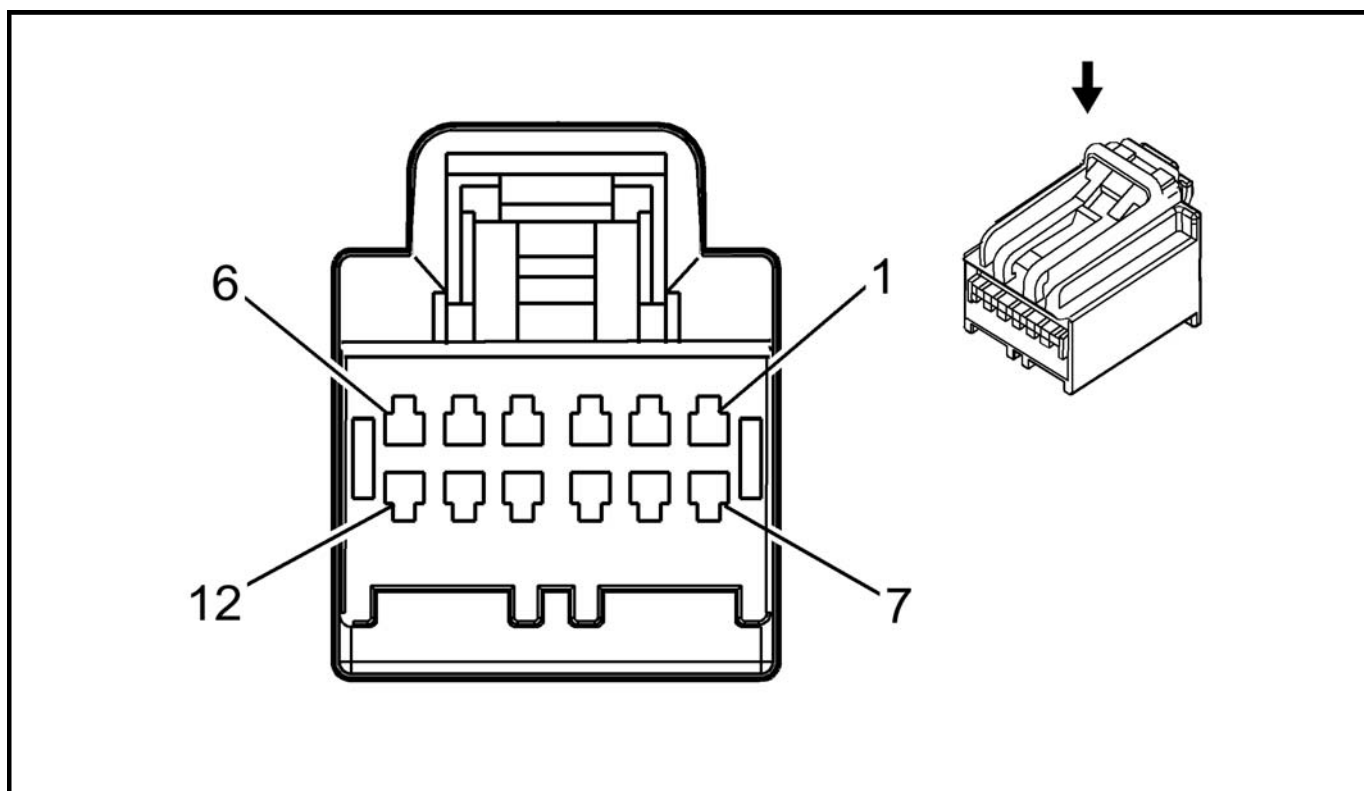
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575845	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/YE	5149	Voice Recognition Audio Signal	I	-
2	0.35	BK/GY	5152	Voice Recognition Audio Low Reference	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.35	WH/BU	5986	Serial Data Communication Enable	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	RD/YE	5040	Battery Positive Voltage	I	-
8	0.5	BK	1650	Ground	I	-
9	0.35	GN/WH	7527	Local Interconnect Network Serial Data Bus 5	I	-
10	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
12	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
13	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
14	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
15 - 16	-	-	-	Not Occupied	-	-

K74 HUMAN MACHINE INTERFACE CONTROL MODULE X2



Connector Part Information

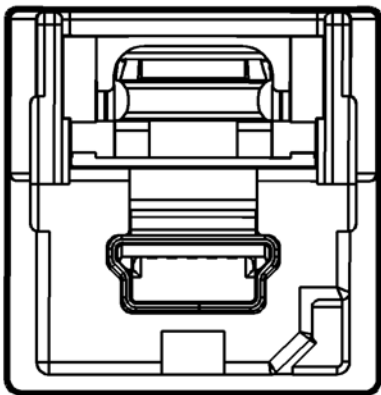
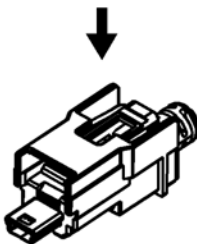
- Harness Type: Instrument Panel
- OEM Connector: 31410-1121
- Service Connector: 19151154
- Description: 12-Way F 64 Series, Sealed (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575845	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/VT	3999	MOST Control	I	-
2	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
3	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GY/YE	6972	Camera Signal 2 +	I	-
6	0.35	WH/BU	6973	Camera Signal 2	I	-
7	-	-	-	Not Occupied	-	-
8	0.5	GY/VT	3998	MOST Serial Data (+)	I	-
9	0.5	WH/GN	3997	MOST Serial Data (-)	I	-
10 - 12	-	-	-	Not Occupied	-	-

K74 HUMAN MACHINE INTERFACE CONTROL MODULE X3

Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13576672
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 5-Way M 2.0 Mini-B USB Type (GY)

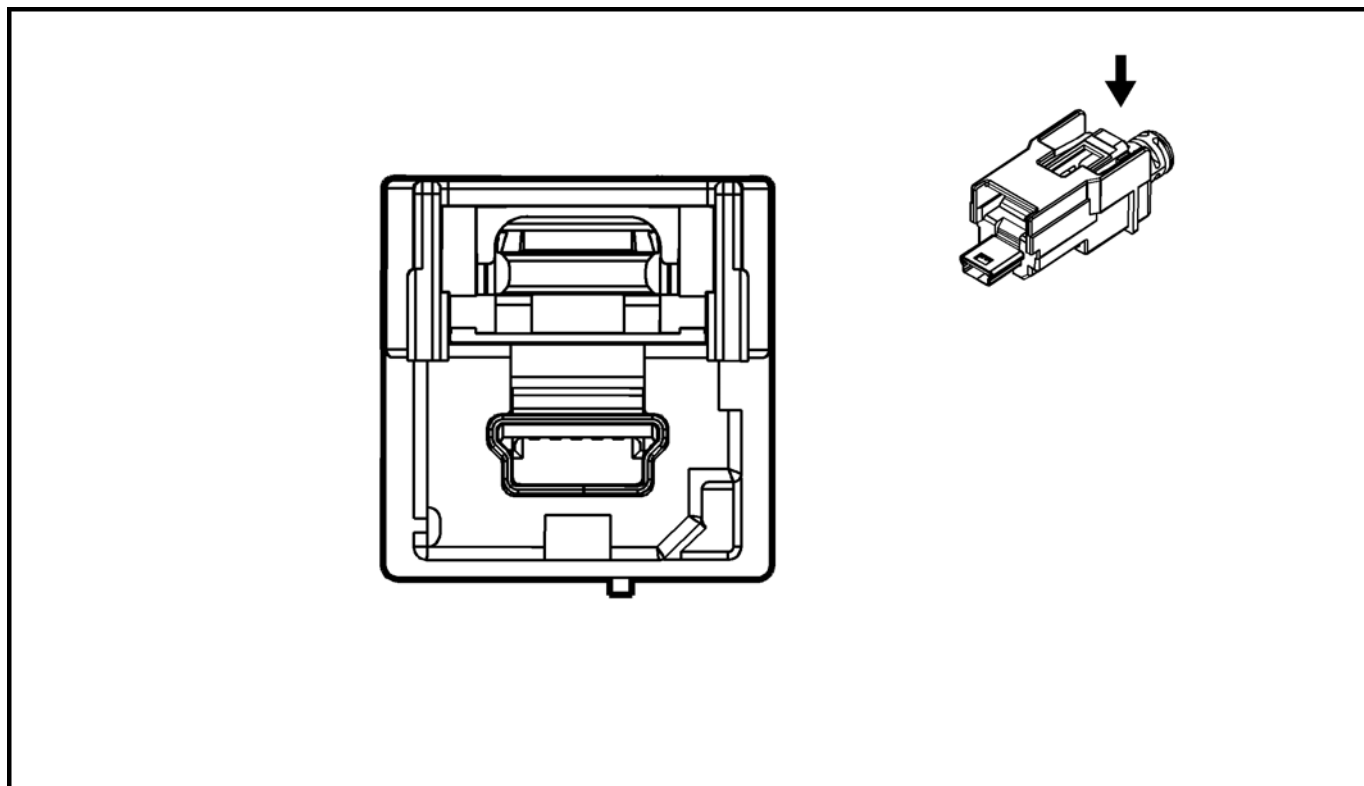
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	USB	-	USB Serial Data	I	-

K74 HUMAN MACHINE INTERFACE CONTROL MODULE X5



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13578154
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 5-Way M 2.0 Mini-B USB Type (BU)

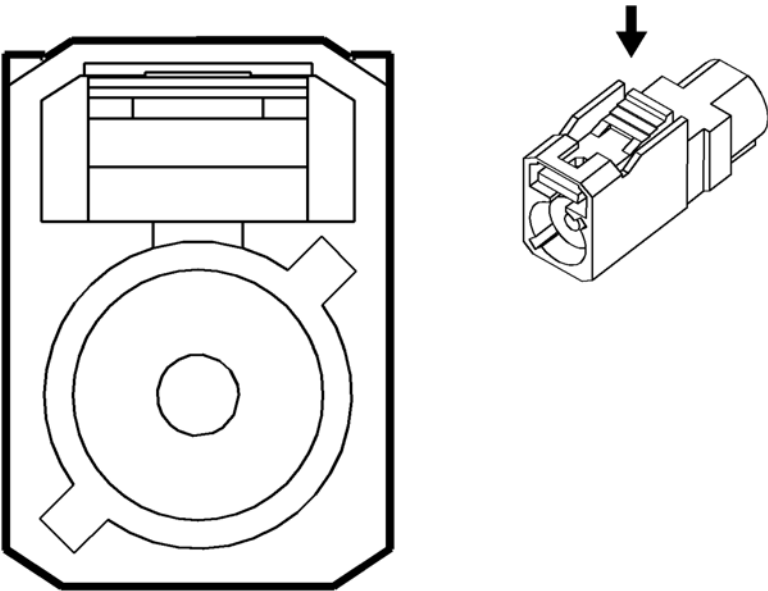
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
-	-	USB	-	USB Serial Data	I	-

K74 HUMAN MACHINE INTERFACE CONTROL MODULE X7



Connector Part Information

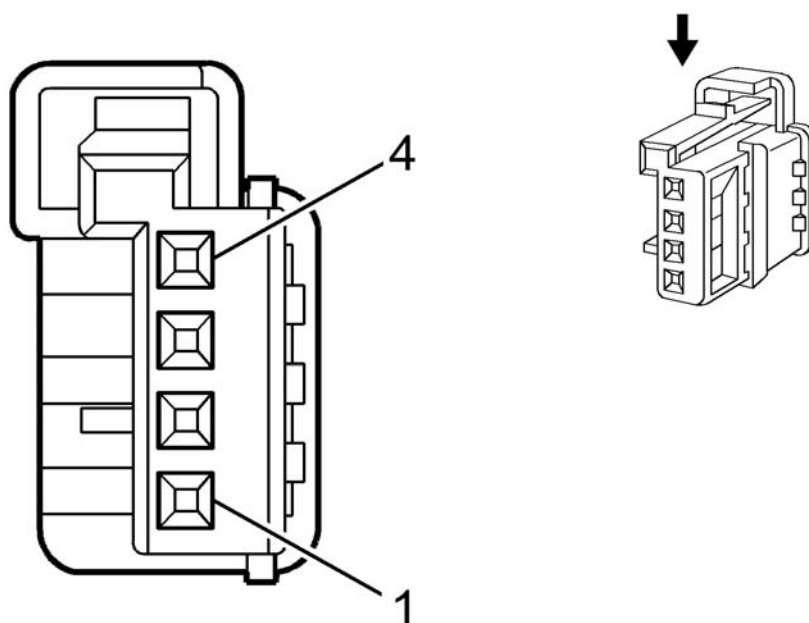
- Harness Type: Instrument Panel
- OEM Connector: 13585520
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS only) Coaxial Antenna GPS Signal	I	-

K77 REMOTE CONTROL DOOR LOCK RECEIVER



Connector Part Information

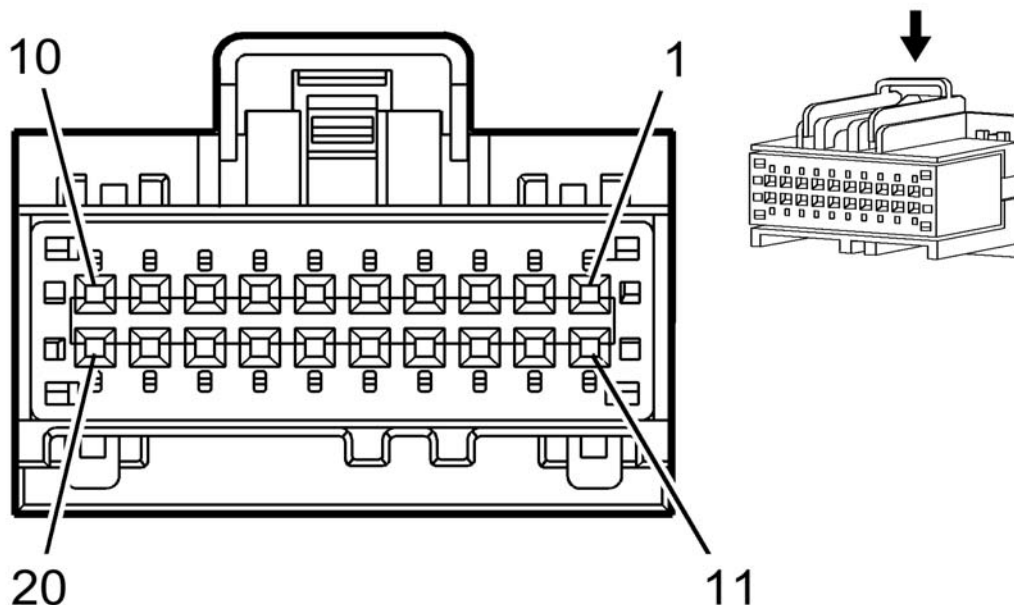
- Harness Type: Body
- OEM Connector: 1379029-3
- Service Connector: 13316147
- Description: 4-Way F 0.64 Micro-Quadlock Series (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	650	Ground	I	-
2	0.35	YE/GN	3274	Remote Function Actuator Transmit Signal	I	-
3	0.35	BU/WH	3275	Remote Function Actuator Receive Signal	I	-
4	0.35	GY/WH	3272	Remote Function Actuator Control	I	-

K84 KEYLESS ENTRY CONTROL MODULE X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1202
- Service Connector: 15126709
- Description: 20-Way F 64 Series, Sealed (BN)

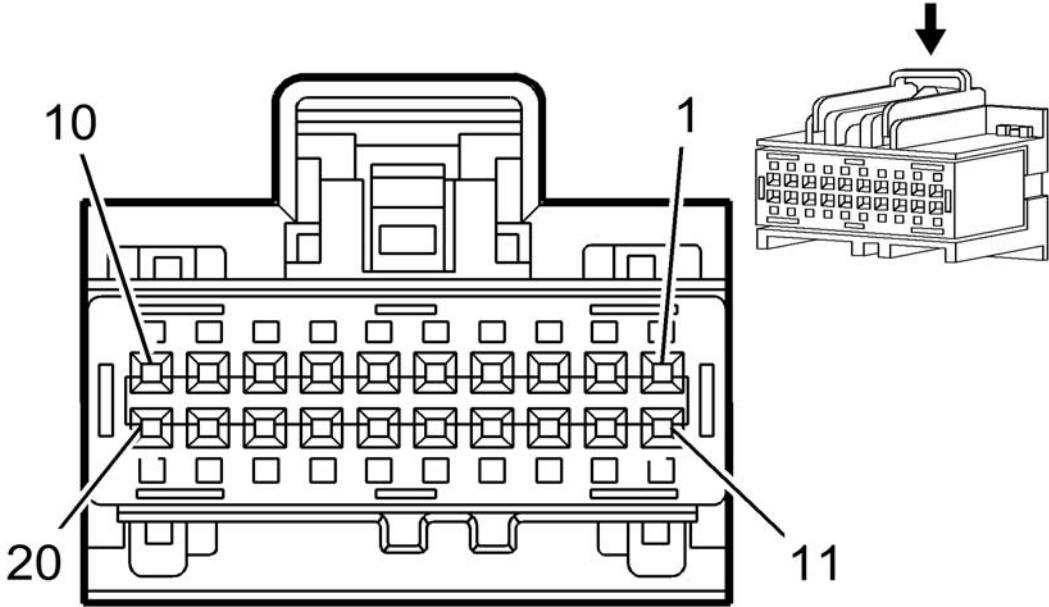
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	RD/WH	640	Battery Positive Voltage	I	-
3	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	VT/YE	4	Accessory Ignition Voltage	I	-
6	-	-	-	Not Occupied	-	-
7	0.35	GY/GN	4083	RAP Relay 2 Coil Control	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	YE/BU	4086	Pushbutton Start Challenge Active Signal	I	-
11	0.35	GN/BK	3558	Passive Start Switch Signal 2	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.35	BK/GY	3559	Passive Start Switch 2 Low Reference	I	-
13	0.35	VT/BK	3	Run/Crank Ignition 1 Voltage	I	-
14	0.5	BK	650	Ground	I	-
15	0.35	OG/BU	3555	Passive Start Interior Antenna 2 Signal Lo	I	-
16	0.35	BN/WH	3552	Passive Start Interior Antenna 1 Signal Hi	I	-
17	0.35	WH	3553	Passive Start Interior Antenna 1 Signal Lo	I	-
18	0.5	OG	3556	Passive Start Interior Antenna 3 Signal Hi	I	-
19	0.5	OG/BU	3557	Passive Start Interior Antenna 3 Signal Lo	I	-
20	0.35	OG	3554	Passive Start Interior Antenna 2 Signal Hi	I	-

K84 KEYLESS ENTRY CONTROL MODULE X2



Connector Part Information

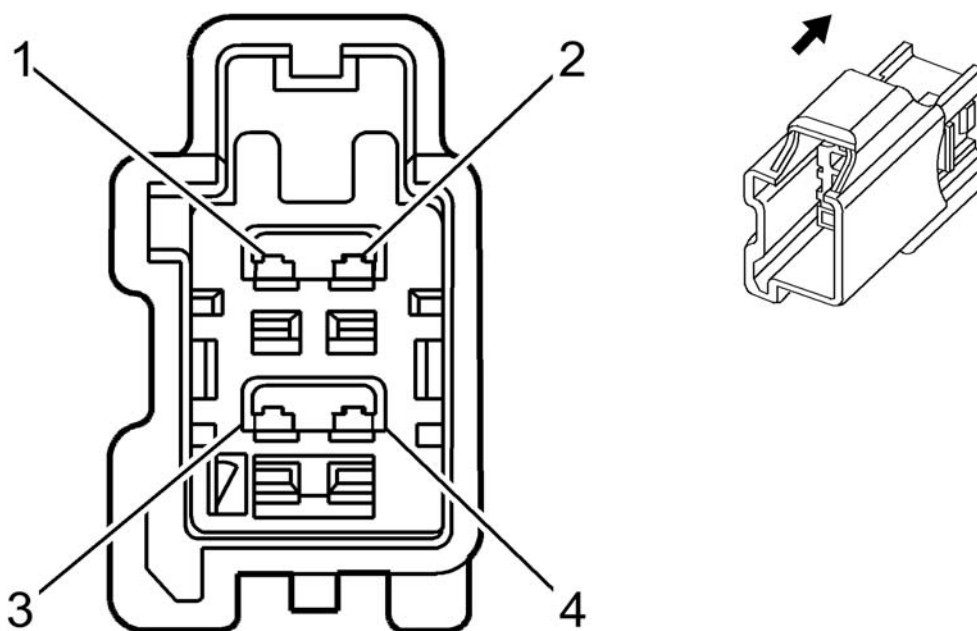
- Harness Type: Body
- OEM Connector: 31410-1201
- Service Connector: 15126710
- Description: 20-Way F 64 Series, Sealed (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE/GY	6158	Right Rear Door Handle Switch Signal	I	-
2	0.35	BN/YE	6157	Left Rear Door Handle Switch Signal	I	-
3 - 5	-	-	-	Not Occupied	-	-
6	0.35	VT	3560	Passive Entry Driver Door Antenna Signal Hi	I	-
7	0.35	VT/GY	3561	Passive Entry Driver Door Antenna Signal Lo	I	-
8	-	-	-	Not Occupied	-	-
9	0.35	GN/BK	3563	Passive Entry Passenger Door Antenna Signal Lo	I	-
10	-	-	-	Not Occupied	-	-
11	0.35	VT/WH	3571	Passenger Door Handle Switch Signal	I	-
12	0.35	GN/WH	3570	Driver Door Handle Switch Signal	I	-
13 - 15	-	-	-	Not Occupied	-	-
16	0.5	BN/GN	3568	Passive Entry Rear Closure Antenna Signal Hi	I	-
17	-	-	-	Not Occupied	-	-
18	0.5	GN/GY	3569	Passive Entry Rear Closure Antenna Signal Lo	I	-
19	-	-	-	Not Occupied	-	-
20	0.35	GN/YE	3562	Passive Entry Passenger Door Antenna Signal Hi	I	-

K85 PASSENGER PRESENCE MODULE



Connector Part Information

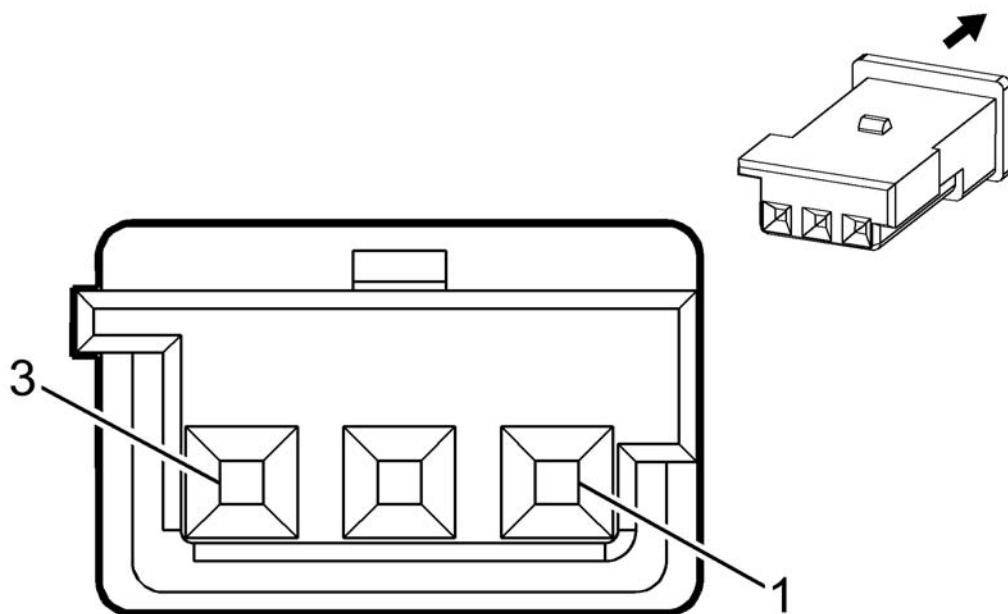
- Harness Type: Driver Seat
- OEM Connector: 7282-6449-40
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.5 Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	BK	2050	Ground	I	-
4	0.5	RD	2440	Battery Positive Voltage	I	-

K89 IMMOBILIZER CONTROL MODULE



Connector Part Information

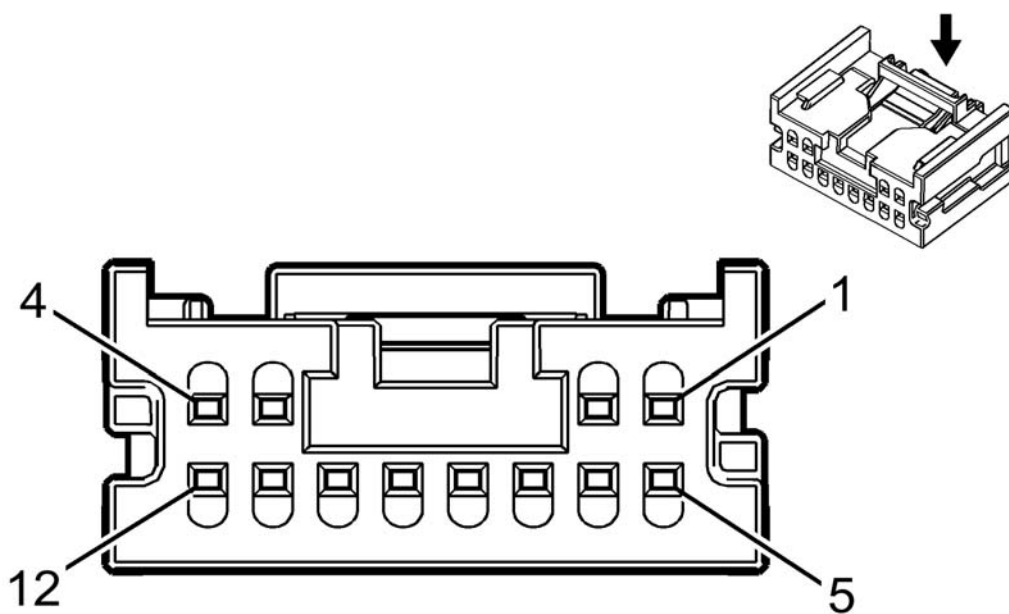
- Harness Type: Floor Console
- OEM Connector: 4-1718346-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Micro-Quadlock Series (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/GY	3277	Vehicle Anti-Theft System Immobilizer Low Reference	I	-
2	0.35	GN/VT	7533	Local Interconnect Network Serial Data Bus 11	I	-
3	0.35	GY/BK	3276	Vehicle Anti-Theft System Immobilizer Control	I	-

K109 FRONTVIEW CAMERA MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 34824-1124
- Service Connector: 13588265
- Description: 12-Way F Mini 50 Series (BK)

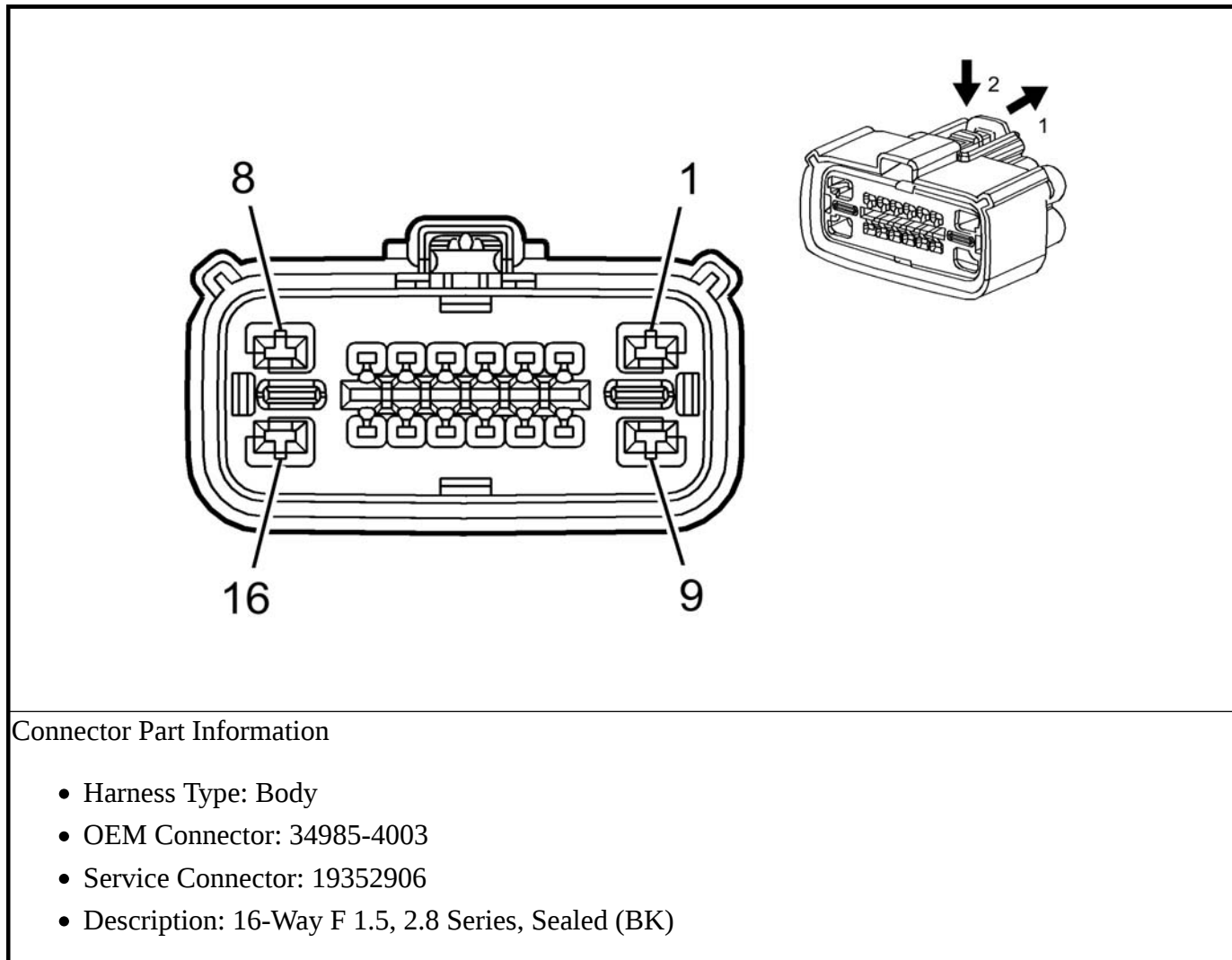
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19333221	EL-35616-58 (BK)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1550	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	RD/GY	2840	Battery Positive Voltage	I	-
4	0.35	WH	3152	Lane Departure Warning Indicator Control	I	-
5	0.35	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	UGN
	0.35	BU	2500	High Speed GMLAN Serial Data (+) 1	I	UHY
6	0.35	WH	3811	High Speed GMLAN Serial Data (-) 4	I	UGN
	0.35	WH	2501	High Speed GMLAN Serial	I	UHY

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
				Data (-) 1		
7	0.35 0.35	BU/VT BU	3813 2500	High Speed GMLAN Serial Data (+) 4 High Speed GMLAN Serial Data (+) 1	I I	UGN UHY
8	0.35 0.35	WH WH	3811 2501	High Speed GMLAN Serial Data (-) 4 High Speed GMLAN Serial Data (-) 1	I I	UGN UHY
9	0.35 0.35	GY/VT WH/BU	3808 5986	Front Object Sensor Control 2 Serial Data Communication Enable	I I	UHX/UEU+UGN UHX/UEU-UGN
10	-	-	-	Not Occupied	-	-
11	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
12	-	-	-	Not Occupied	-	-

K111 FUEL PUMP DRIVER CONTROL MODULE

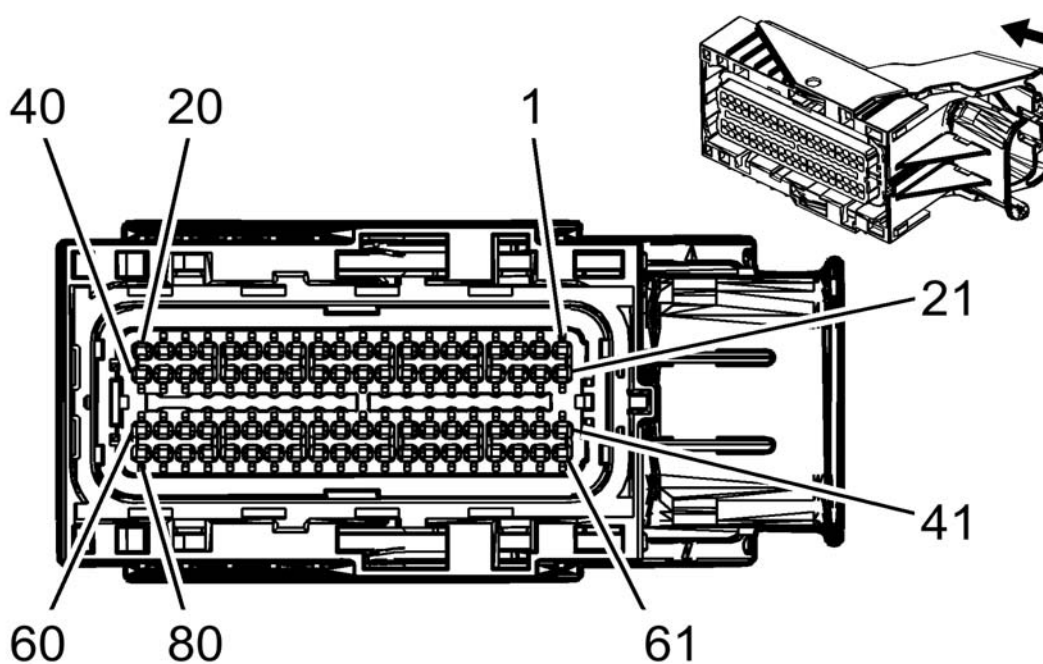


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	4	D
II	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
III	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	RD/GN	1540	Battery Positive Voltage	I	-
2	0.5	GY	5660	Fuel Pump Controller Data Out Signal	III	-
3	-	-	-	Not Occupied	-	-
4	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	III	-
5	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	III	-
6	0.5	VT/WH	639	Run/Crank Ignition 1 Voltage	III	-
7	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	III	-
8	2	GY	120	Fuel Pump Control	II	-
9	1	BK	850	Ground	II	-
10 - 14	-	-	-	Not Occupied	-	-
15	0.5	BARE	7444	Fuel System Control Module Shield Ground	III	-
16	2	BK/GN	1580	Fuel Pump Low Reference	II	-

K114B HYBRID/EV POWERTRAIN CONTROL MODULE 2 X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 34566-6733
- Service Connector: 13577545
- Description: 80-Way F MX123 Series, Sealed (BK with BU Terminal Position Assurance)

Terminal Part Information

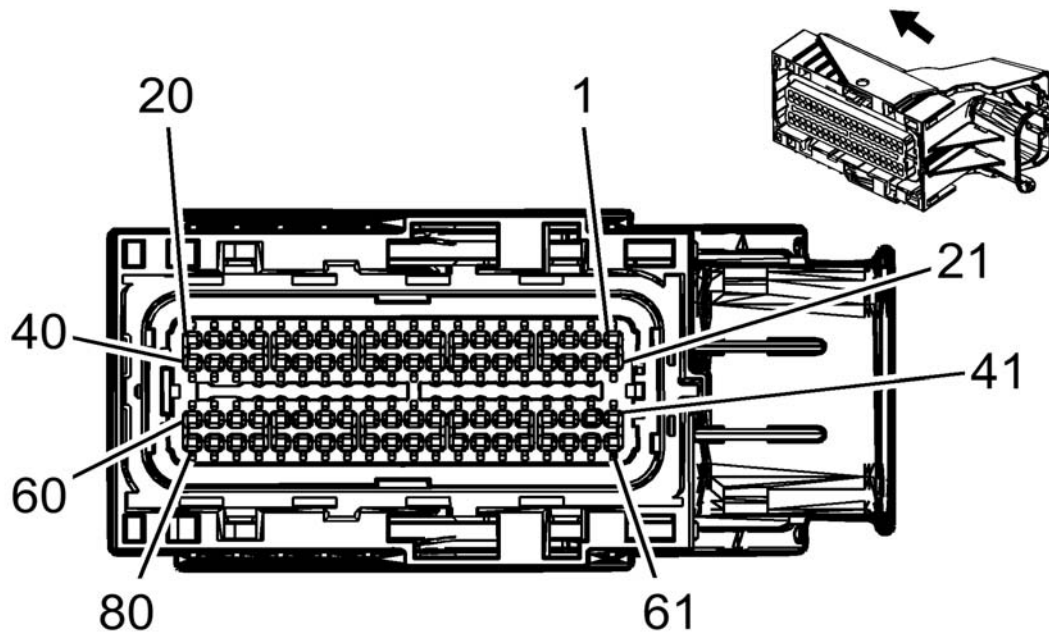
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	J	J
II	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	K	K

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	2050	Ground	II	-
2	0.75	RD/BU	5240	Battery Positive Voltage	II	-
3	0.5	YE/VT	3962	High Voltage Battery 3 (+) Relay Control	I	-
4	0.5	WH/BU	9000	-	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	VT/GY	3961	High Voltage Battery (-) Relay Control	I	-
7	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	WH/VT	5137	Precharge Relay PWM Signal	I	-
9	0.5	BN/GN	3959	High Voltage Battery 1 (+) Relay Control	I	-
10	0.5	VT	3195	Auxiliary Heater Control	I	-
11 - 16	-	-	-	Not Occupied	-	-
17	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
18	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
19	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
20	0.5	BK/YE	407	Sensor Low Reference	I	-
21 - 25	-	-	-	Not Occupied	-	-
26	0.5	BU/GY	636	Outside Ambient Air Temperature Sensor Signal	I	-
27	0.5	GN/VT	2032	Coolant Temperature Sensor Signal	I	-
28 - 30	-	-	-	Not Occupied	-	-
31	0.5	BU	204	A/C Low Pressure Sensor Signal	I	-
32	0.5	BU/YE	68	Low Coolant Level Indicator Control	I	-
33	0.5	BK/VT	476	Sensor Low Reference	I	-
34 - 36	-	-	-	Not Occupied	-	-
37	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
38	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
39	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
40	0.5	BK/BU	61	Outside Ambient Temperature Sensor Low Reference	I	-
41 - 44	-	-	-	Not Occupied	-	-
45	0.5	BK/YE	5088	High Voltage Interlock Loop Low Reference 1	I	-
46	-	-	-	Not Occupied	-	-
47	0.5	VT/WH	5087	High Voltage Interlock Loop Signal 1	I	-
48	-	-	-	Not Occupied	-	-
49	0.5	BK/BU	720	Sensor Low Reference	I	-
50	0.5	VT/BN	2028	Coolant Valve Position Sensor Signal	I	-
51	0.5	YE/BK	3829	Fuel Door Status Signal	I	-
52	0.5	YE	4063	Hood Status A Signal	I	-
53	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
54	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
55	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
56	-	-	-	Not Occupied	-	-
57	0.5	BU/GY	6434	CAN Bus High 2 Serial Data	I	-
58	0.5	WH/BU	6435	CAN Bus Low 2 Serial Data	I	-
59	-	-	-	Not Occupied	-	-
60	0.5	BK/GN	476	Sensor Low Reference	I	-
61 - 62	-	-	-	Not Occupied	-	-
63	0.5	BU/RD	474	5V Reference	I	-
64	0.5	WH/RD	596	5V Reference	I	-
65 - 69	-	-	-	Not Occupied	-	-
70	0.5	GY/WH	1447	Fuel Door Release Switch Signal	I	-
71	-	-	-	Not Occupied	-	-
72	0.5	BU/BK	6502	Fuel Door Open Signal	I	-
73	-	-	-	Not Occupied	-	-
74	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
75	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
76	-	-	-	Not Occupied	-	-
77	0.5	BU/GY	6434	CAN Bus High 2 Serial Data	I	-
78	0.5	WH/BU	6435	CAN Bus Low 2 Serial Data	I	-
79 - 80	-	-	-	Not Occupied	-	-

K114B HYBRID/EV POWERTRAIN CONTROL MODULE 2 X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 34566-6723
- Service Connector: 19115670
- Description: 80-Way F 0.64 Series, Sealed (BK with GY Terminal Position Assurance)

Terminal Part Information

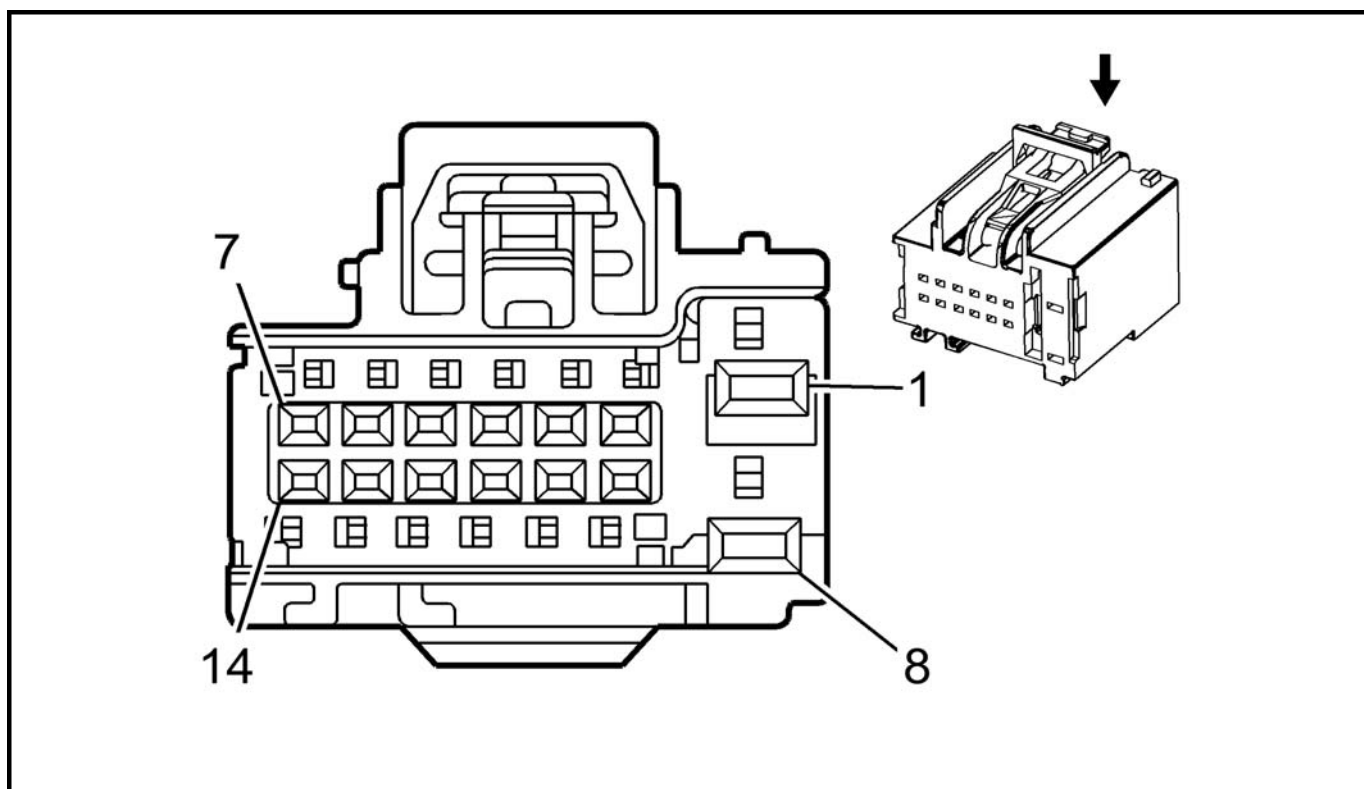
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 6	-	-	-	Not Occupied	-	-
7	0.5	BN/WH	3827	Refuel Request Switch Signal	I	-
8	0.5	GY/GN	3954	Control Pilot Signal 1	I	-
9	0.5	BU/VT	2364	Cooling Fan Speed Signal	I	-
10	0.5	BU/GN	5139	High Voltage Fault Signal	I	-
11	-	-	-	Not Occupied	-	-
12	0.5	GN/GY	3644	High Voltage Onboard Charging AC Voltage Sense Signal	I	-
13	0.5	VT/WH	3643	High Voltage Onboard Charging DC Voltage Sense Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
14	0.5	VT/BU	3790	Electric Coolant Motor Feedback Signal	I	-
15	0.5	BU/YE	3953	Proximity Status Signal 1	I	-
16 - 17	-	-	-	Not Occupied	-	-
18	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
19 - 24	-	-	-	Not Occupied	-	-
25	0.5	WH/BU	3697	Charge Port Door Sensor Signal	I	-
26	-	-	-	Not Occupied	-	-
27	0.5	VT/GY	2339	Run/Crank Ignition 1 Voltage	I	-
28 - 32	-	-	-	Not Occupied	-	-
33	0.5	YE/GY	3796	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	I	-
34 - 37	-	-	-	Not Occupied	-	-
38	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
39 - 40	-	-	-	Not Occupied	-	-
41	0.5	BU/BK	6801	Fuel Door Lock/Unlock 1 Reference	I	-
42	0.5	WH/GN	3794	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
43	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
44	0.5	BU/YE	3646	High Voltage Onboard Charging Enable	I	-
45 - 51	-	-	-	Not Occupied	-	-
52	0.5	WH	2368	Cooling Fan Control Signal	I	-
53	0.5	YE/GY	3645	High Voltage Onboard Charging Control	I	-
54 - 58	-	-	-	Not Occupied	-	-
59	0.5	BU/VT	3818	Rechargeable Energy Storage System Coolant HVAC Mode Motor High Control	I	-
60	-	-	-	Not Occupied	-	-
61	0.5	BU	6800	Fuel Door Lock/Unlock 1 Signal	I	-
62	0.5	GY/GN	3957	Charging Pilot Signal Indicator Control	I	-
63	0.5	BN/BU	3788	Electric Coolant Motor Control	I	-
64	0.5	YE/VT	3956	Charging Status Indicator Control	I	-
65	0.5	BU/BN	3787	High Voltage Energy Management Communication Control	I	-
66	-	-	-	Not Occupied	-	-
67	0.5	VT/YE	5985	Accessory Wakeup Serial Data	I	-
68 - 72	-	-	-	Not Occupied	-	-
73	0.5	BU/VT	3795	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
74	0.5	YE/GN	3789	Electric Coolant Motor Control	I	-
75 - 78	-	-	-	Not Occupied	-	-
79	0.5	WH/YE	3819	Rechargeable Energy Storage System Coolant HVAC Mode Motor Low Control	I	-
80	-	-	-	Not Occupied	-	-

K124 ACTIVE SAFETY CONTROL MODULE X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 89047362
- Service Connector: 89047362
- Description: 14-Way F 0.64, 1.5 Series (BK)

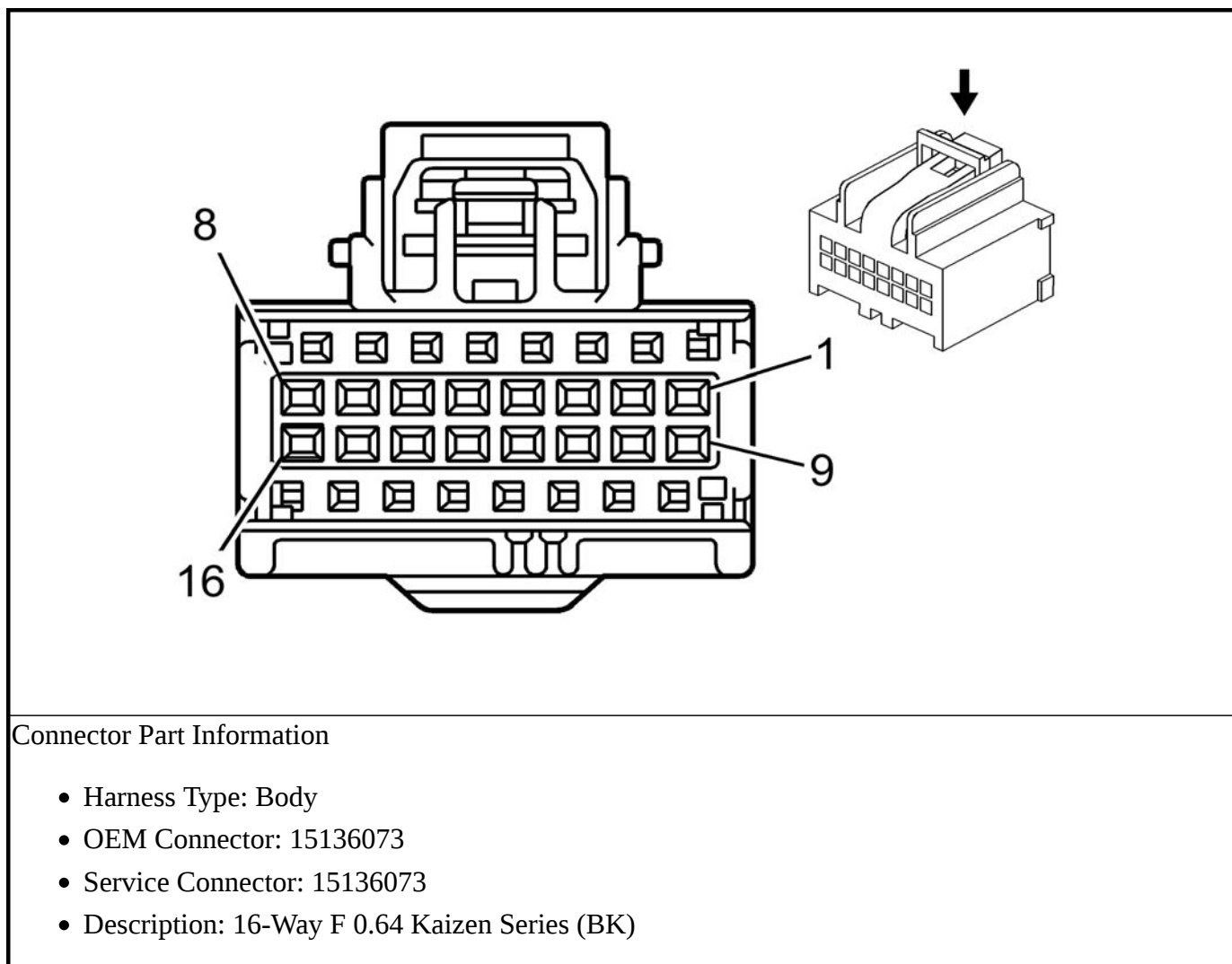
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575735	J-35616-14 (GN)	J-38125-553	12191812	Delphi 19	E	C
II	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.5	RD/GY	2840	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	WH	3152	Lane Departure Warning Indicator Control	II	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
8	0.5	BK	650	Ground	I	-
9	0.35	GY/VT	3808	Front Object Sensor Control 2	II	-
10 - 11	-	-	-	Not Occupied	-	-
12	0.35	WH/BU	5986	Serial Data Communication Enable	II	-
13	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
14	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-

K124 ACTIVE SAFETY CONTROL MODULE X2

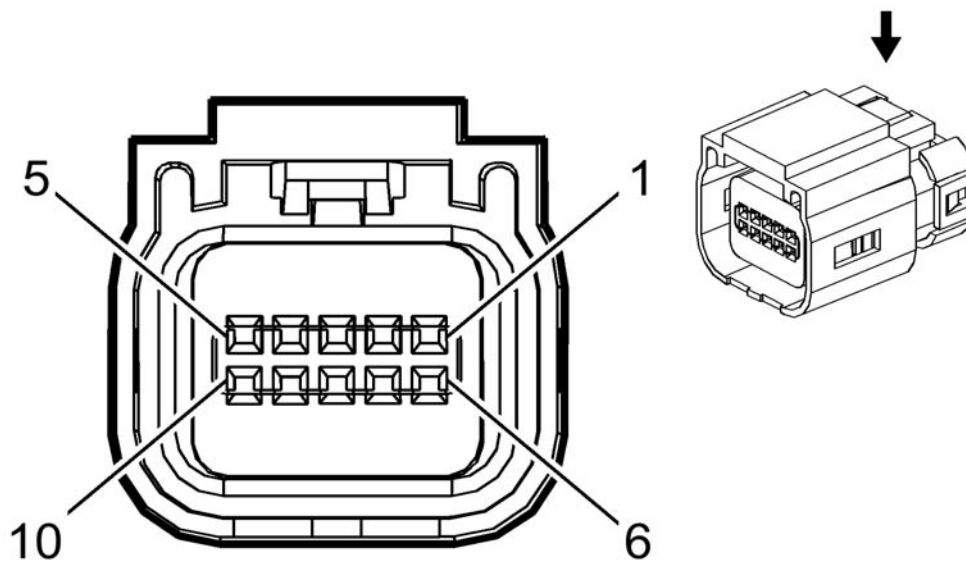


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
2	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
3	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
4	0.35	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
7	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
8	-	-	-	Not Occupied	-	-
9	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
10	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
11	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
12	0.35	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
13	-	-	-	Not Occupied	-	-
14	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
15 - 16	-	-	-	Not Occupied	-	-

K132 PEDESTRIAN ALERT SOUND CONTROL MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 13569289
- Service Connector: 19178082
- Description: 10-Way F 0.64 Series, Sealed (BK)

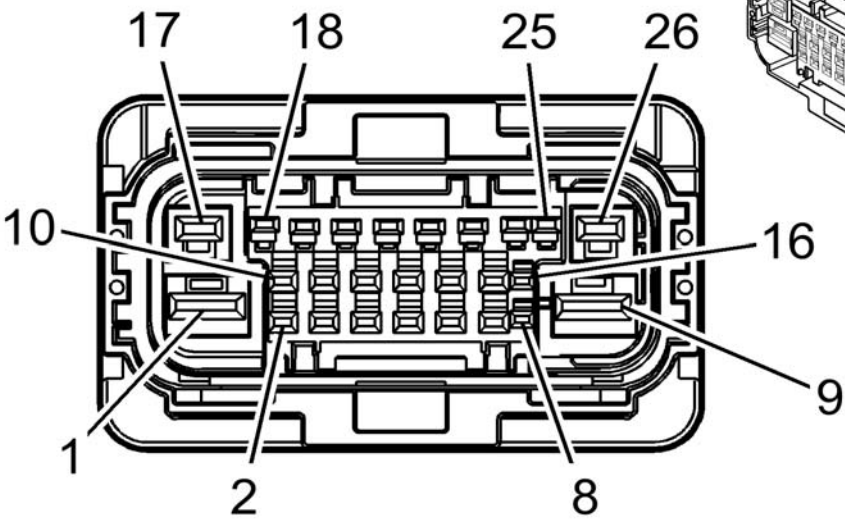
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
2	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
3	0.5	BK	1450	Ground	I	-
4	0.5	WH/BU	5986	Serial Data Communication Enable	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	I	-
9	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	I	-
10	0.5	RD/VT	4640	Battery Positive Voltage	I	-

K177 BRAKE BOOSTER CONTROL MODULE



Connector Part Information

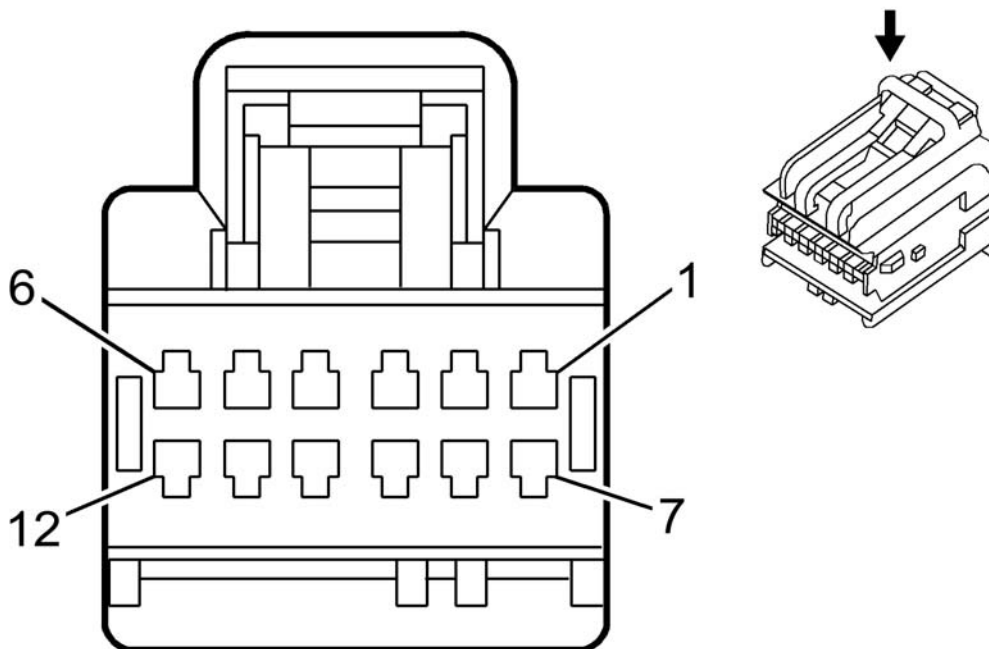
- Harness Type: Body
- OEM Connector: 13590059
- Service Connector: 19332378
- Description: 26-Way F 1.5, 2.8, 4.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13584537	J-35616-35 (VT)	J-38125-561	Not Available	Not Available	Not Available	Not Available
II	19330700	J-35616-35 (VT)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
III	19333305	J-35616-40 (BU)	J-38125-556	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/BU	1542	Battery Positive Voltage	III	-
2	0.35	BU/RD	3335	Brake Pedal Travel Sensor 1 High Reference	I	-
3 - 7	-	-	-	Not Occupied	-	-
8	0.35	BK/GY	3417	Brake Pedal Travel Sensor 1 Low Reference	I	-
9	4	BK	1550	Ground	III	-
10	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
11	0.35	WH	2501	High Speed GMLAN Serial Data (-) 1	I	UHY -UHY
	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	
12 - 14	-	-	-	Not Occupied	-	-
15	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
16	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
17	1.5	RD/BU	3240	Battery Positive Voltage	II	-
18	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
19	0.35	BU	2500	High Speed GMLAN Serial Data (+) 1	I	UHY -UHY
	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	
20	0.35	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
21	0.35	VT/GY	139	Run/Crank Ignition 1 Voltage	I	-
22	0.35	BU/YE	3334	Brake Pedal Travel Sensor 1 Signal	I	-
23	0.35	VT/BN	3333	Brake Pedal Travel Sensor 2 Signal	I	-
24	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
25	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
26	-	-	-	Not Occupied	-	-

K182 PARKING ASSIST CONTROL MODULE X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1120
- Service Connector: 89047364
- Description: 12-Way F 0.64 Series, Sealed (BK)

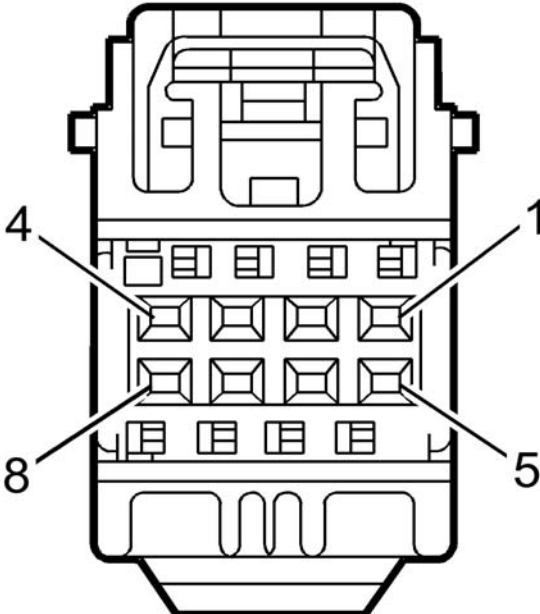
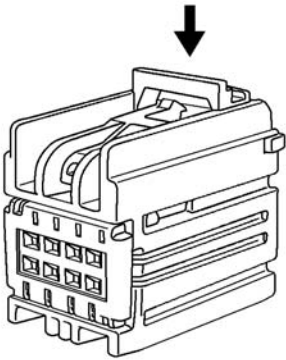
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/GY	2840	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	GN/BN	5852	Rear Park Assist LED Disable Signal	I	-
4	-	-	-	Not Occupied	-	-
5	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
6	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
7	0.5	BK	650	Ground	I	-
8	0.35	GY/GN	2555	Rear Park Assist Disable Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
9	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
10	0.35	BU/BN	3161	Parallel Park Assist Disable Switch Signal	I	-
11	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-
12	0.5	WH/BU	6106	High Speed GMLAN Serial Data (-) 2	I	-

K182 PARKING ASSIST CONTROL MODULE X2

Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9029-40
- Service Connector: 19115653
- Description: 8-Way F YESC Kaizen Series (L-GY)

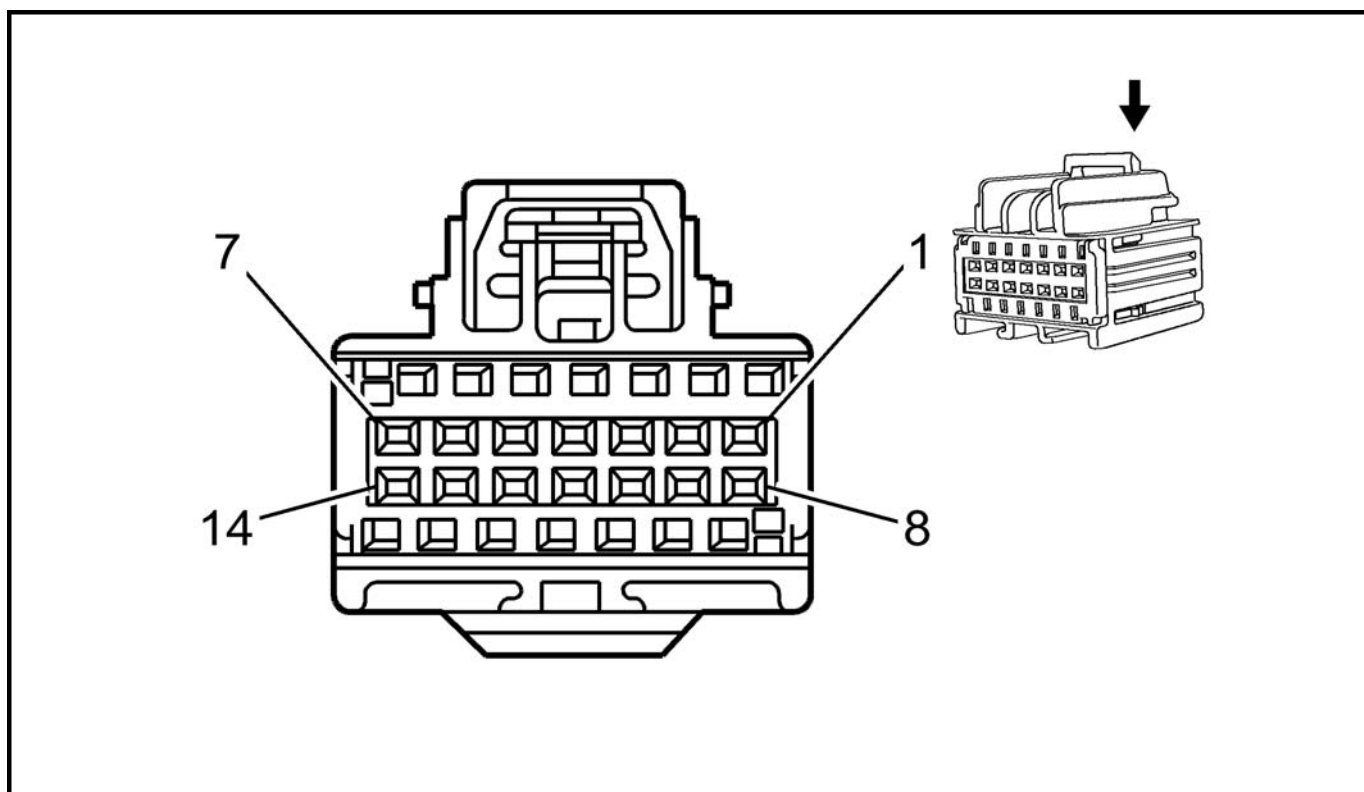
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.5	YE	2375	Left Rear Corner Object Sensor Signal	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	YE/BU	2376	Left Rear Middle Object Sensor Signal	I	-
4	0.5	RD/VT	5974	Park Assist Sensor Control Park	I	-
5	0.5	YE/VT	2378	Right Rear Corner Object Sensor Signal	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	YE/WH	2377	Right Rear Middle Object Sensor Signal	I	-
8	0.5	BK/GY	2379	Object Sensor Low Reference	I	-

K182 PARKING ASSIST CONTROL MODULE X3



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9068-90
- Service Connector: 15127038
- Description: 14-Way F 0.64 Kaizen Series (BU)

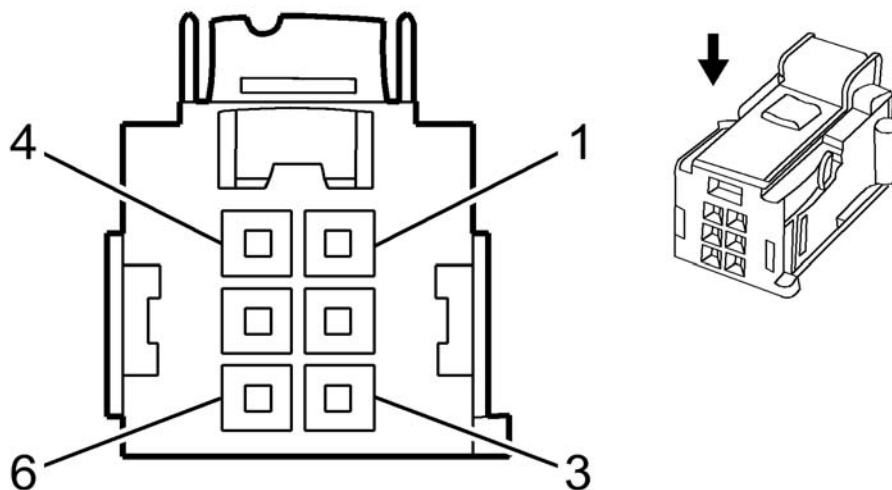
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B	J-38125-215A	SAIT-A03T-	Yazaki	P	P

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(LT BU)		M064	14		

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/BU	5974	Park Assist Sensor Control Park	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	GY	3154	Left Front Supplemental Object Sensor Signal	I	-
4	0.35	VT/WH	5215	Front Parking Left Corner Sensor	I	-
5	0.35	YE/GY	5216	Front Parking Left Mid Sensor	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	-
9	-	-	-	Not Occupied	-	-
10	0.35	GN	3155	Right Front Supplemental Object Sensor Signal	I	-
11	0.35	WH/GY	5217	Front Parking Right Corner Sensor	I	-
12	0.35	VT/GY	5218	Front Parking Right Mid Sensor	I	-
13 - 14	-	-	-	Not Occupied	-	-

M6 AIR TEMPERATURE DOOR ACTUATOR



Connector Part Information

- Harness Type: HVAC

- OEM Connector: 13691690
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/VT	3169	Temp Door Stepper Motor Control 1	I	-
2	0.5	RD	7572	HVAC Motor Control	I	-
3	0.5	GN/RD	3170	Temp Door Stepper Motor Control 2	I	-
4	0.5	BN/RD	3171	Temp Door Stepper Motor Control 3	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	BU	3172	Temp Door Stepper Motor Control 4	I	-

M7 TRANSMISSION SHIFT LOCK CONTROL SOLENOID ACTUATOR

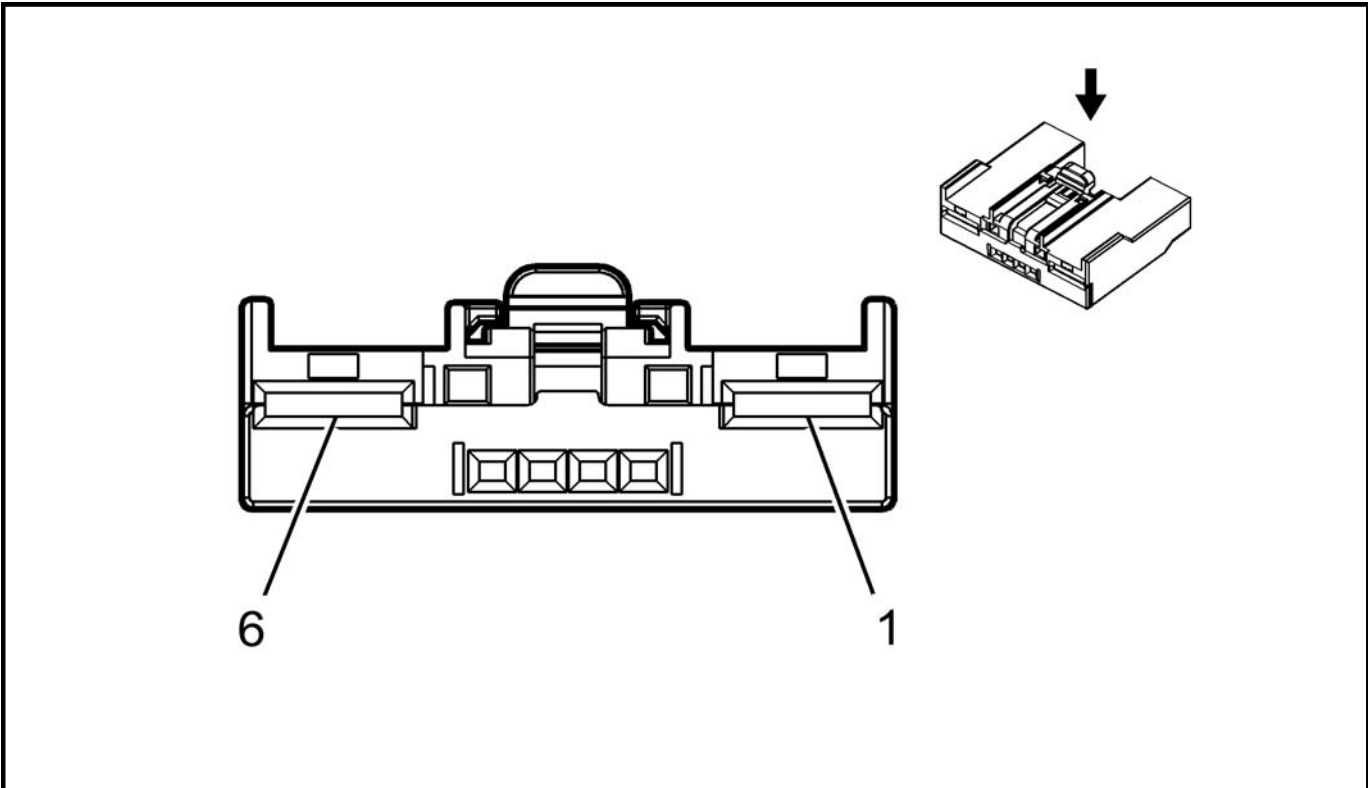
-
Connector Part Information • Harness Type: Shift Lock • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.3	RD	5905	Key Capture/Column Lock Shift Position Signal	I	-
2	0.3	BK	650	Ground	I	-

M8 BLOWER MOTOR



Connector Part Information

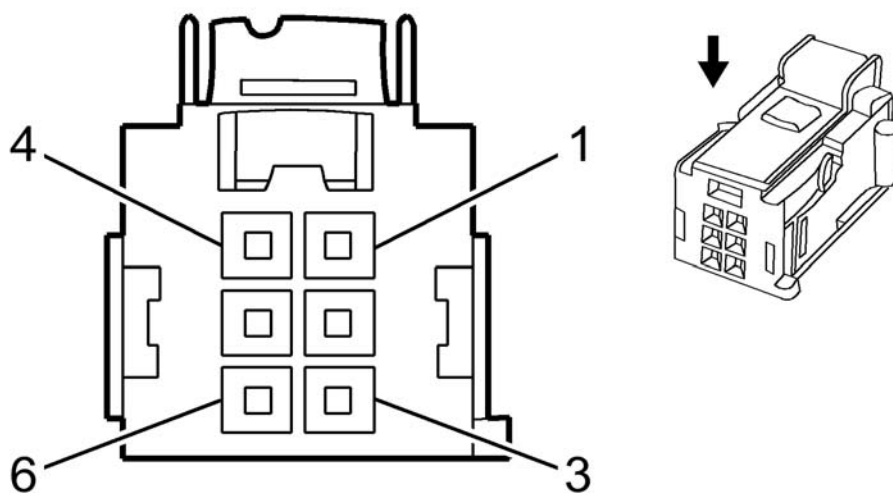
- Harness Type: Instrument Panel
- OEM Connector: 7287-9355-30
- Service Connector: 19330673
- Description: 6-Way F 0.64 GET, 6.3 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/VT	542	Battery Positive Voltage	I	-
2	0.35	BU/GY	754	Blower Motor Speed Control	II	-
3 - 5	-	-	-	Not Occupied	-	-
6	4	BK	2150	Ground	I	-

M37 MODE DOOR ACTUATOR



Connector Part Information

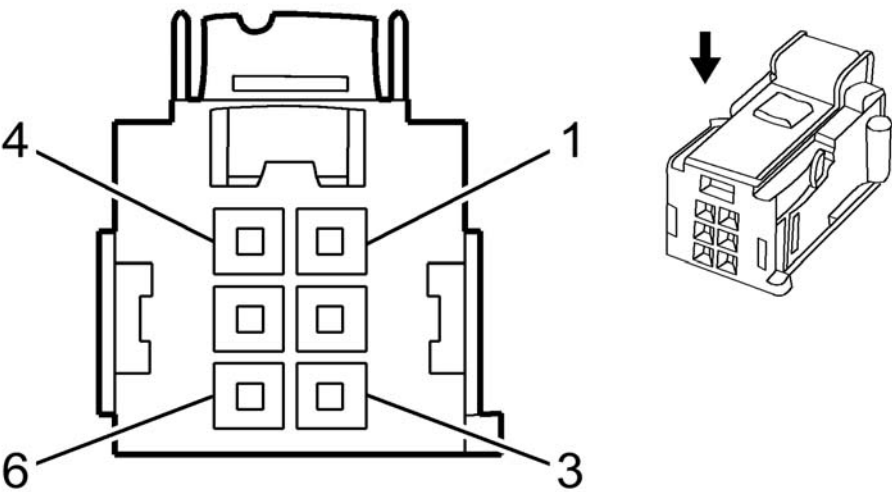
- Harness Type: HVAC
- OEM Connector: 13691690
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/BN	3167	Mode Door Stepper Motor Control 3	I	-
2	0.5	RD	7572	HVAC Motor Control	I	-
3	0.5	GN/RD	3165	Mode Door Stepper Motor Control 1	I	-
4	0.5	BN/RD	3168	Mode Door Stepper Motor Control 4	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	BU	3166	Mode Door Stepper Motor Control 2	I	-

M46 AIR RECIRCULATION DOOR ACTUATOR



Connector Part Information

- Harness Type: HVAC
- OEM Connector: 13691690
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series (BK)

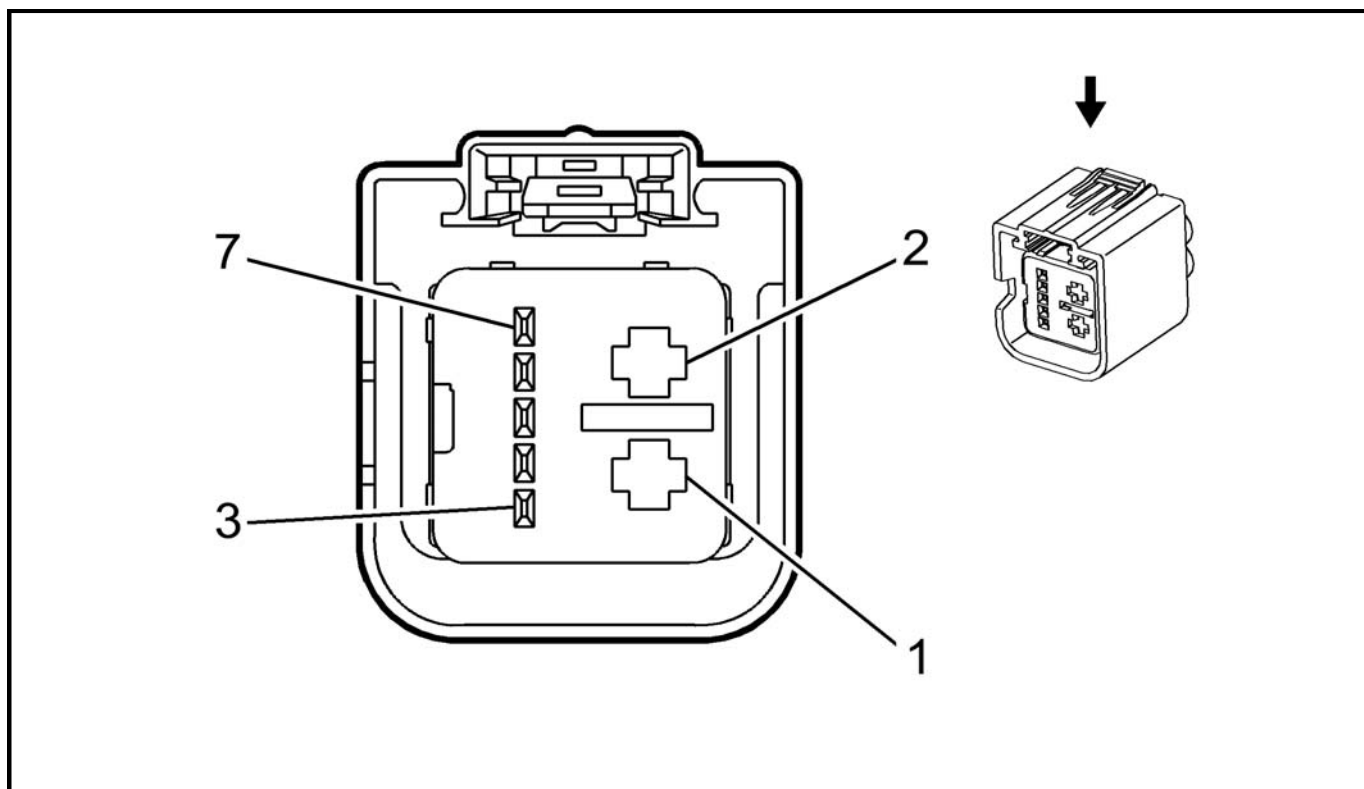
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/VT	3173	Air Inlet Door Stepper Motor Control 1	I	-
2	0.5	RD	7572	HVAC Motor Control	I	-
3	0.5	GN/RD	3174	Air Inlet Door Stepper Motor Control 2	I	-
4	0.5	BN/RD	3175	Air Inlet Door Stepper Motor Control 3	I	-
5	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
6	0.5	BU	3176	Air Inlet Door Stepper Motor Control 4	I	-

M74D WINDOW MOTOR - DRIVER



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 1-1732115-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 7-Way F 0.64, 2.8 Kaizen Timer Series, Sealed (BK)

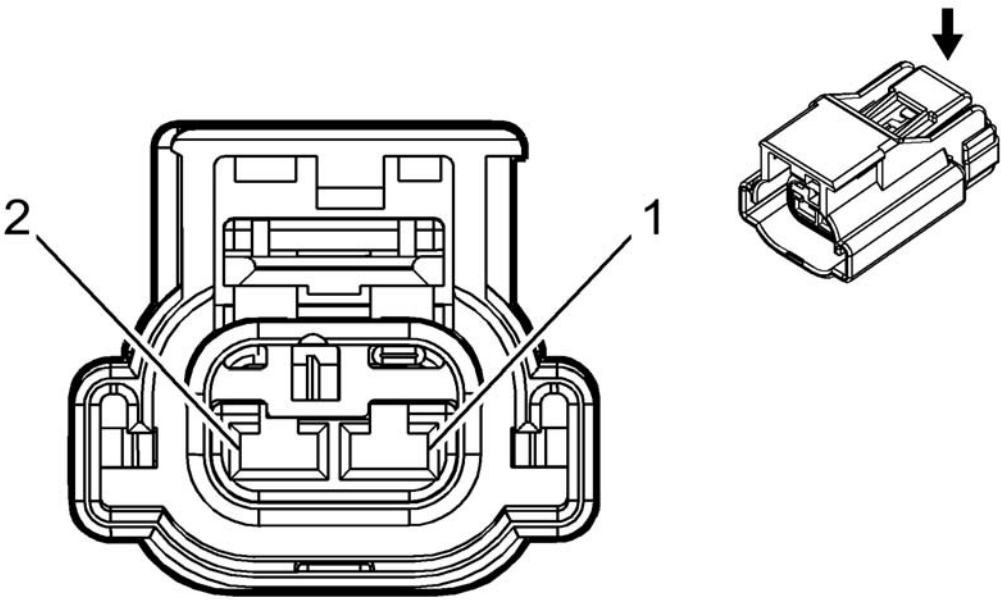
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	BK	1550	Ground	I	-
2	2.5	RD/BN	3640	Battery Positive Voltage	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	GN/WH	3379	Power Window Switch Driver Up Signal	II	-
4	0.35	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	II	-
5	0.35	GN	3381	Power Window Switch Driver Express Signal	II	-
6	0.35	GY/BK	745	Left Front Door Ajar Switch Signal	II	-
7	0.35	GY	3380	Power Window Switch Driver Down Signal	II	-

M74LR WINDOW MOTOR - LEFT REAR



Connector Part Information

- Harness Type: Left Rear Door
- OEM Connector: 54200220N
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

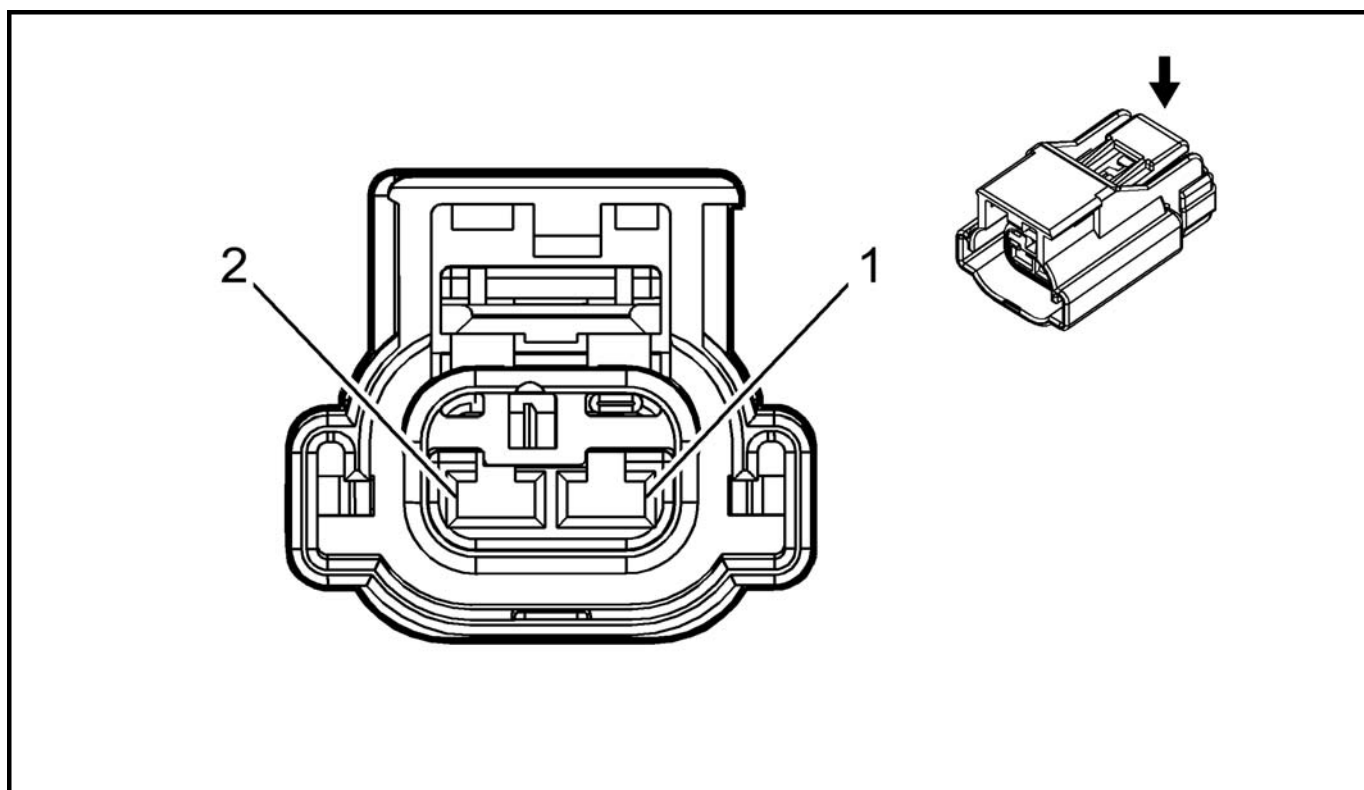
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(VT)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	YE/BU	669	Power Window Motor Left Rear Down Control	I	-
2	2.5	BU/VT	668	Power Window Motor Left Rear Up Control	I	-

M74P WINDOW MOTOR - PASSENGER



Connector Part Information

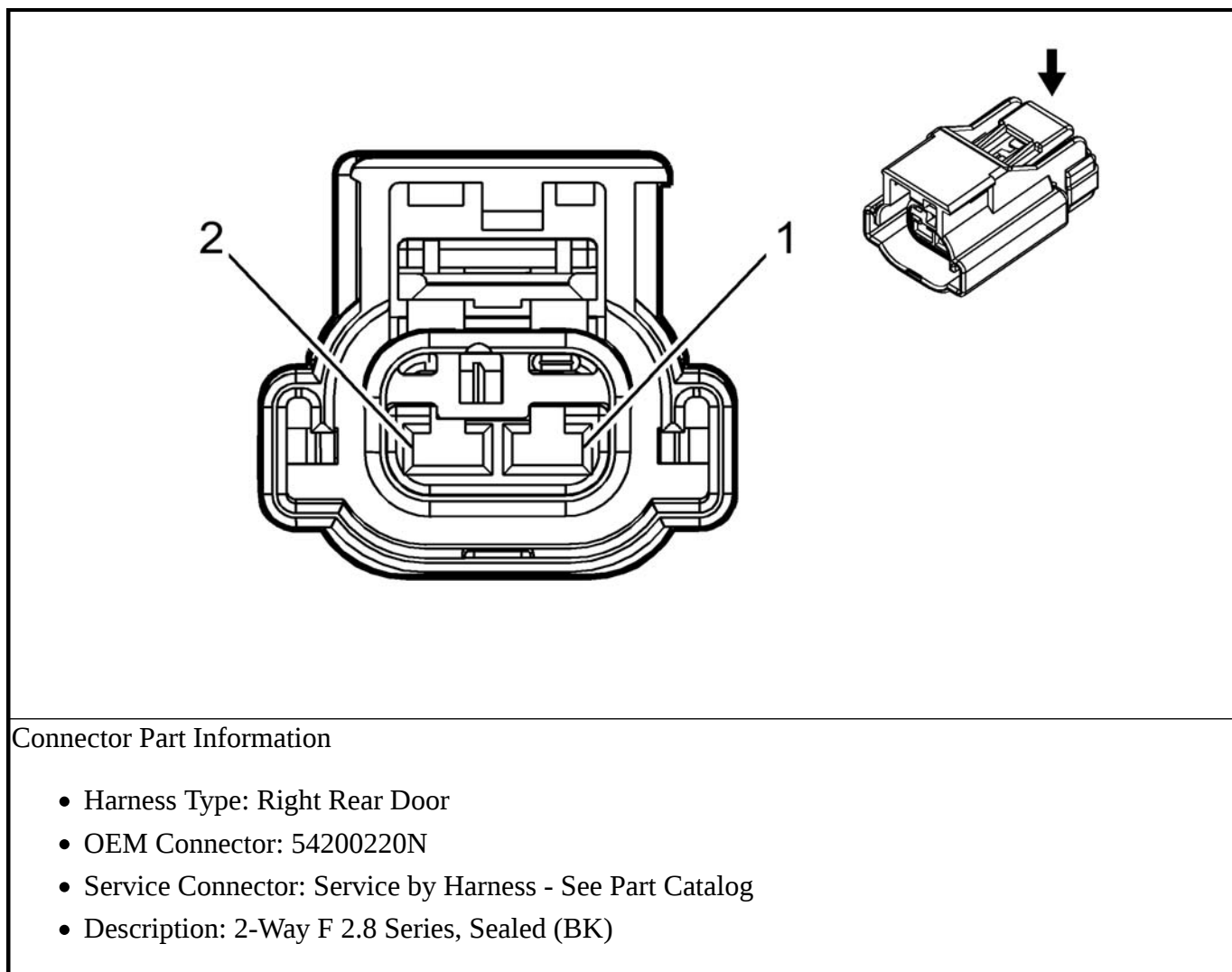
- Harness Type: Passenger Door
- OEM Connector: 54200220N
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	YE/BU	3388	Power Window Motor Passenger Down Control	I	-
2	2.5	GN/GY	3387	Power Window Motor Passenger Up Control	I	-

M74RR WINDOW MOTOR - RIGHT REAR



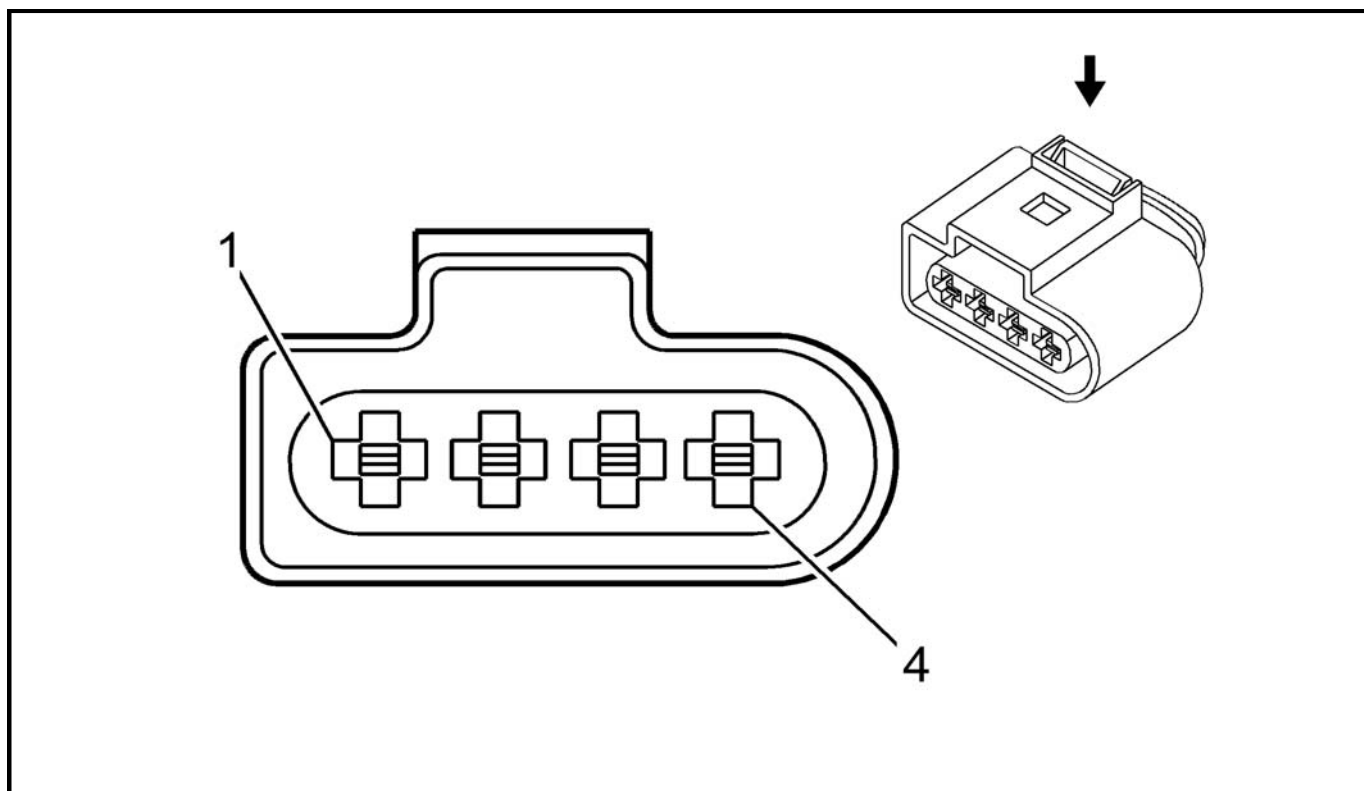
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	GN/BK	671	Power Window Motor Right Rear Down Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	2.5	BU/GY	670	Power Window Motor Right Rear Up Control	I	-

M75 WINDSHIELD WIPER MOTOR



Connector Part Information

- Harness Type: Body
- OEM Connector: 42122100
- Service Connector: 13578531
- Description: 4-Way F 2.8 Junior Power Timer Series, Sealed (BK)

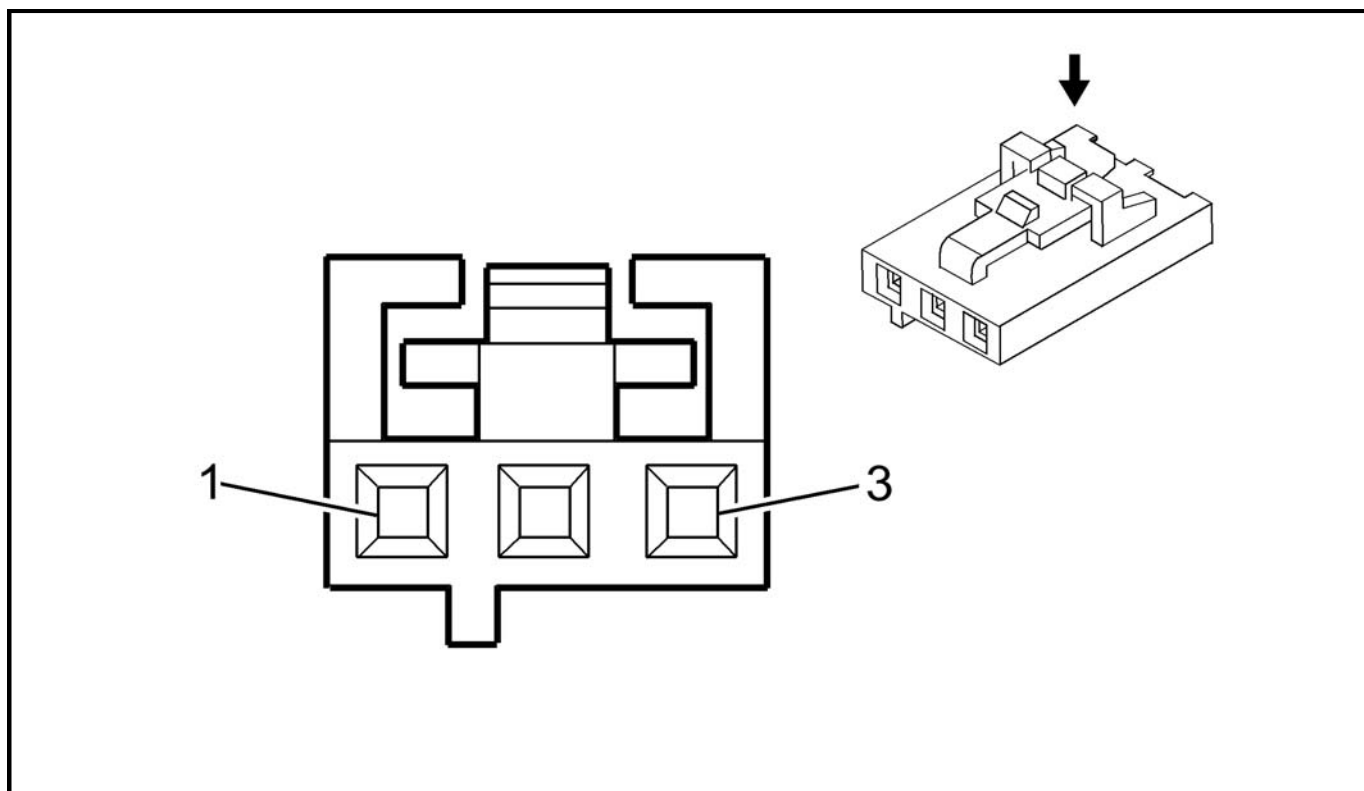
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	RD/YE	3740	Battery Positive Voltage	I	-
2	2.5	BK	2050	Ground	I	-
3	0.5	GY	91	Windshield Wiper Motor Relay Coil Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	0.5	GN/BN	6132	Local Interconnect Network Serial Data Bus 1	I	-

M77D OUTSIDE REARVIEW MIRROR MOTOR - DRIVER



Connector Part Information

- Harness Type: Outside Rear View Mirror
- OEM Connector: 50-57-9403
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 SL Series (BK)

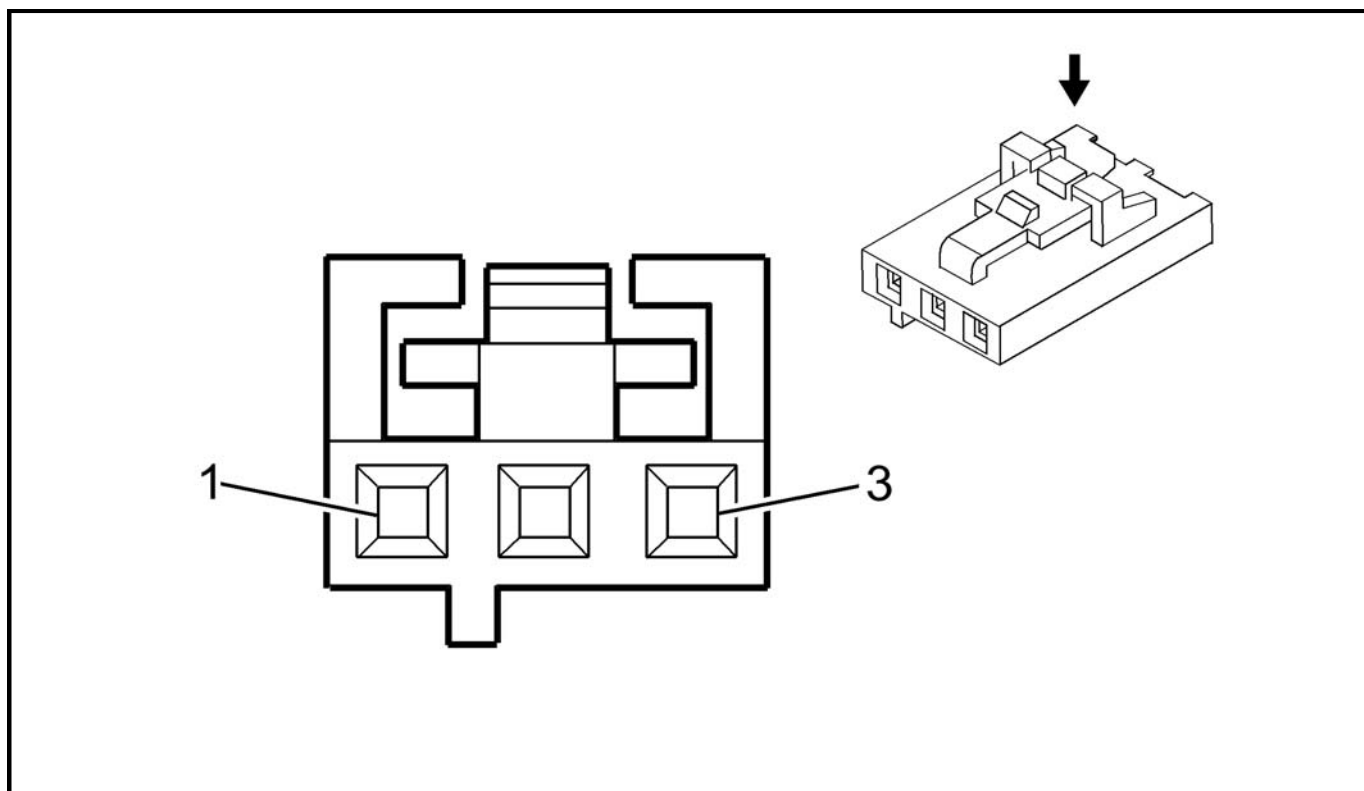
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	3389	Driver Mirror Motor Right (+) Left (-) Control	I	-
2	0.35	BU	3391	Driver Mirror Motor Common Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	VT/BU	3390	Driver Mirror Motor Up (+) Down (-) Control	I	-

M77P OUTSIDE REARVIEW MIRROR MOTOR - PASSENGER



Connector Part Information

- Harness Type: Outside Rear View Mirror
- OEM Connector: 50-57-9403
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 SL Series (BK)

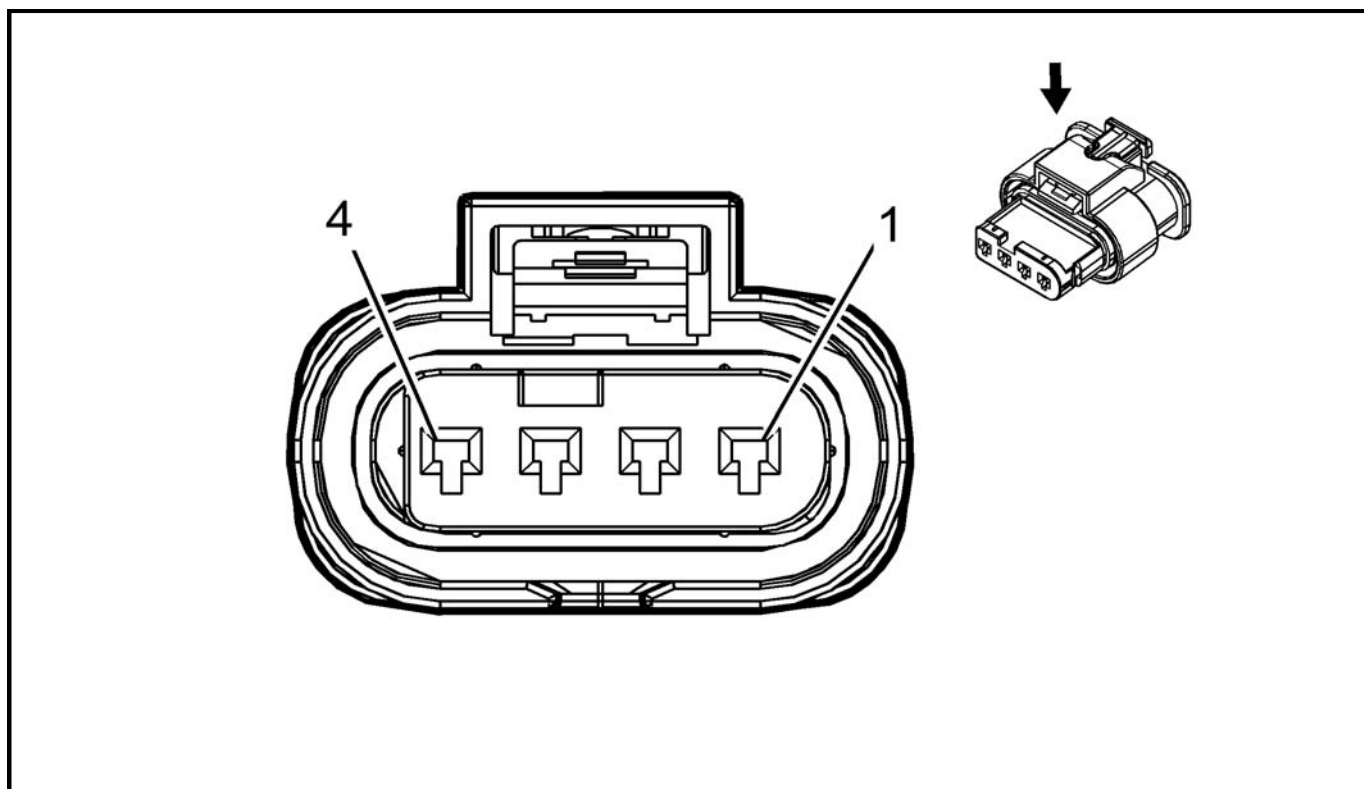
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	3396	Passenger Mirror Motor Right (+) Left (-) Control	I	-
2	0.35	BU	3398	Passenger Mirror Motor Common Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	VT/BU	3397	Passenger Mirror Motor Up (+) Down (-) Control	I	-

M96 ACTIVE GRILLE AIR SHUTTER ACTUATOR



Connector Part Information

- Harness Type: Forward Lamp Extension
- OEM Connector: 1-1456426-6
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 MCON Series (NA)

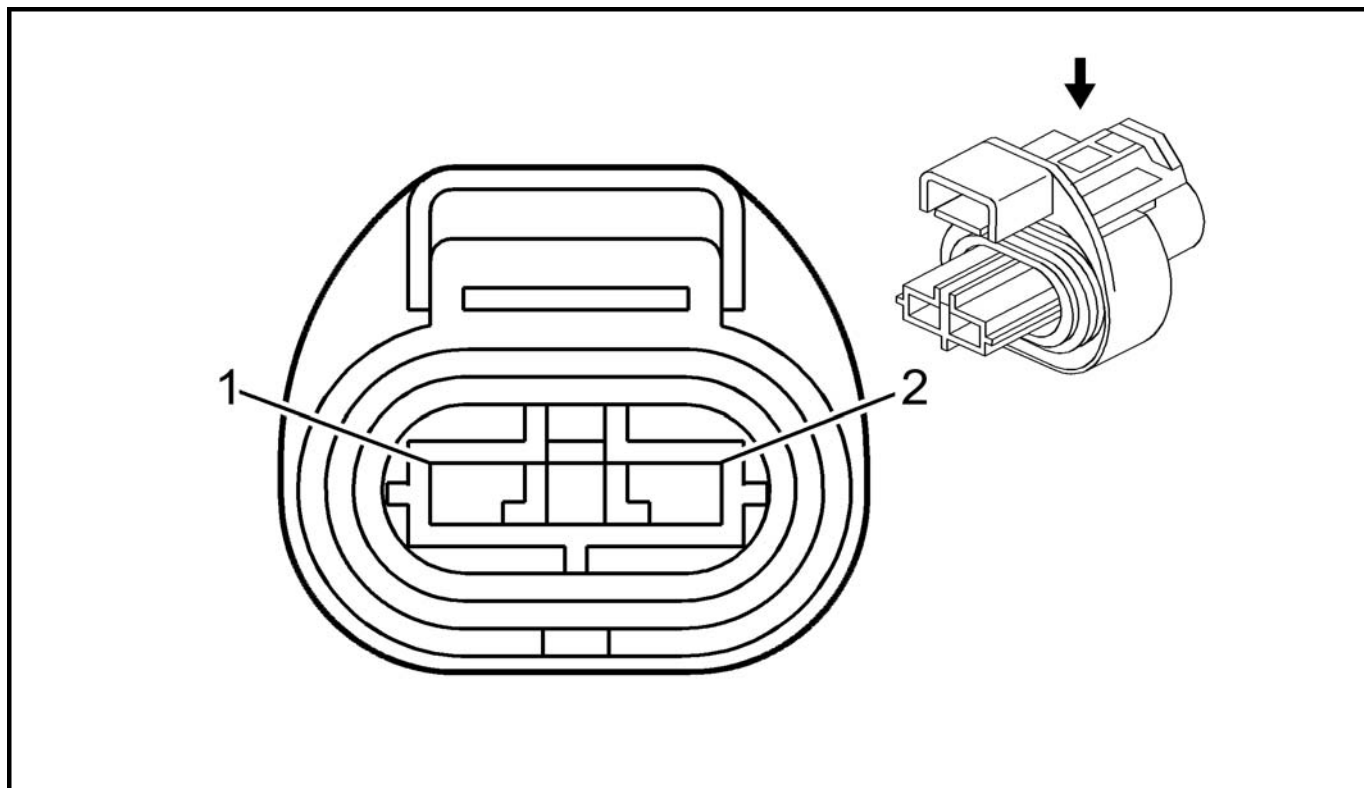
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5705	Powertrain Main Relay Fused Control 6	I	-
2	0.35	GN/VT	4621	Local Interconnect Network Serial Data Bus 21	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	-	-	-	Not Occupied	-	-
4	0.5	BK/	1150	Ground	I	-

M97 FUEL FILL DOOR LOCK ACTUATOR



Connector Part Information

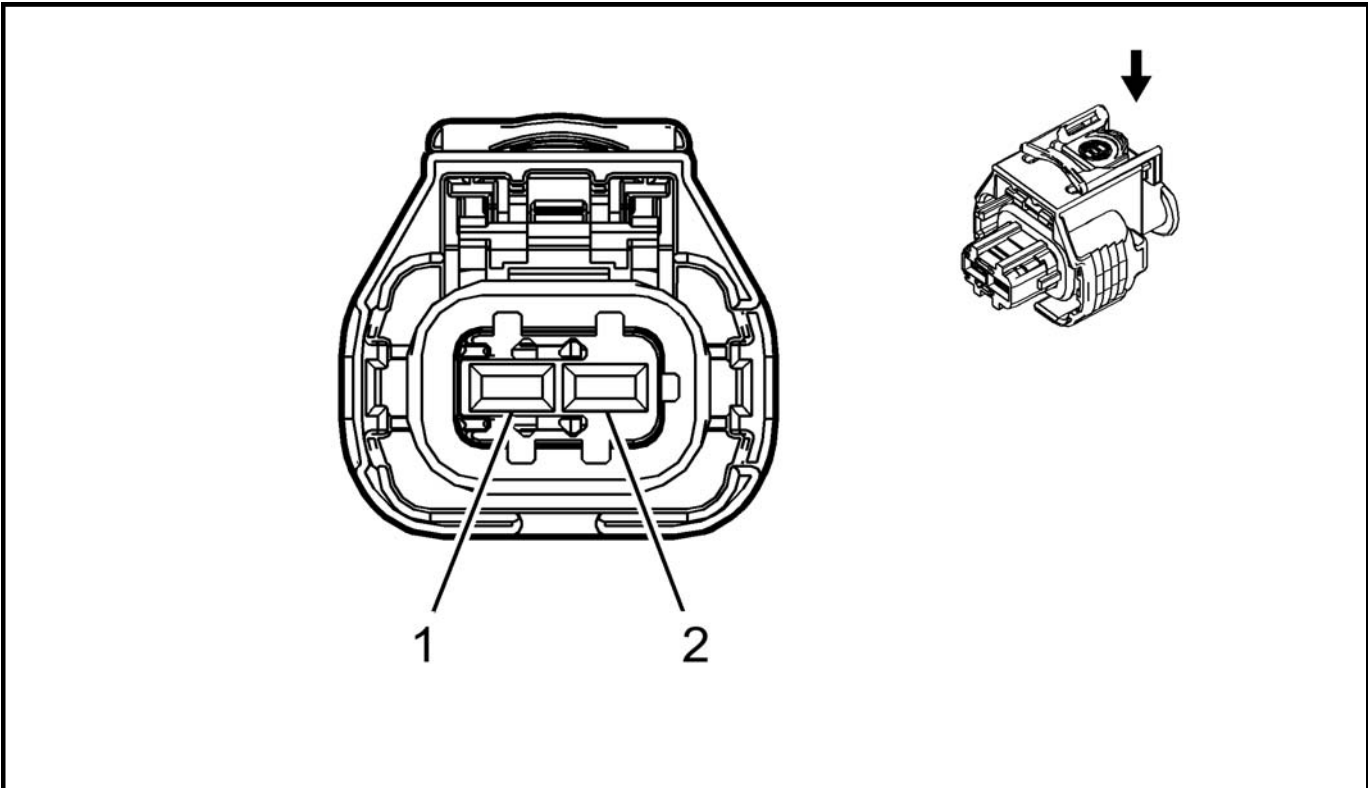
- Harness Type: Body
- OEM Connector: 1452680-1
- Service Connector: 13314083
- Description: 2-Way F 1.2 Timer Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU	6800	Fuel Door Lock/Unlock 1 Signal	I	-
2	0.5	BU/BK	6801	Fuel Door Lock/Unlock 1 Reference	I	-

M104L PARK BRAKE ACTUATOR - LEFT



Connector Part Information

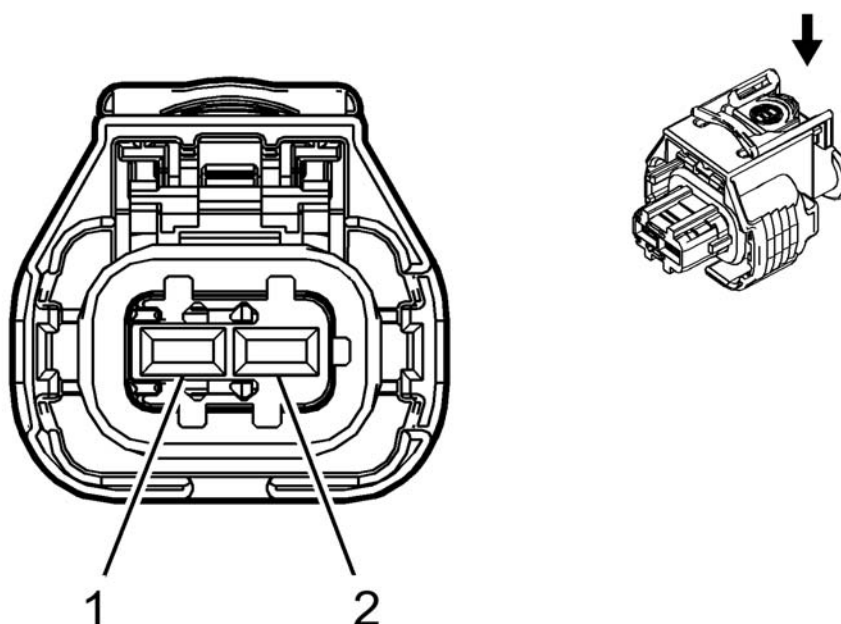
- Harness Type: Body
- OEM Connector: 1928405715
- Service Connector: 19299882
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	WH	2001	Park Brake Motor Apply Left Rear Control	I	-
2	2.5	GY/BK	4369	Park Brake Motor Low Reference Left Rear	I	-

M104R PARK BRAKE ACTUATOR - RIGHT



Connector Part Information

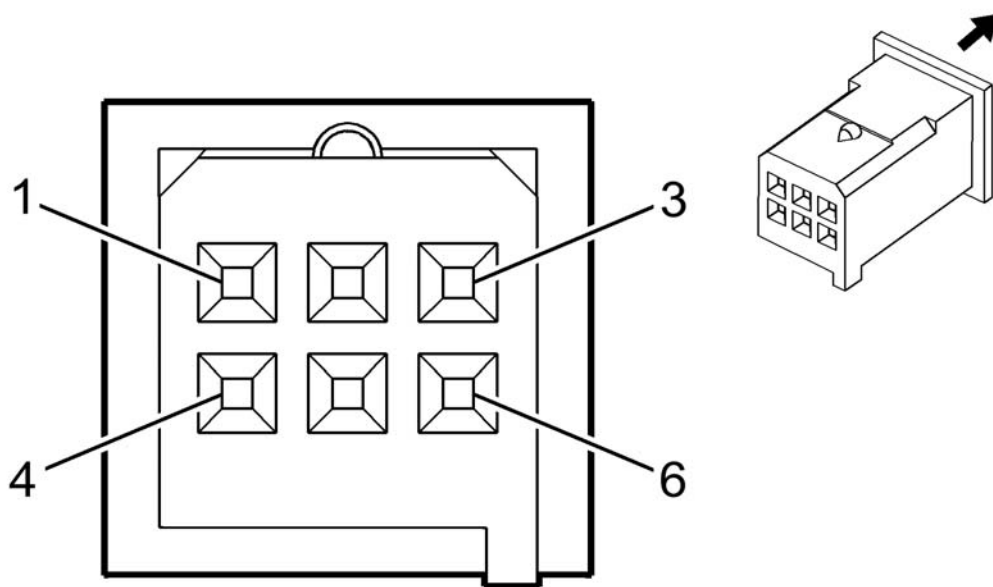
- Harness Type: Body
- OEM Connector: 1928405715
- Service Connector: 19299882
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	GN/VT	1988	Park Brake Motor Apply Right Rear Control	I	-
2	2.5	GY	4368	Park Brake Motor Low Reference Right Rear	I	-

P2 TRANSMISSION SHIFT LEVER POSITION INDICATOR



Connector Part Information

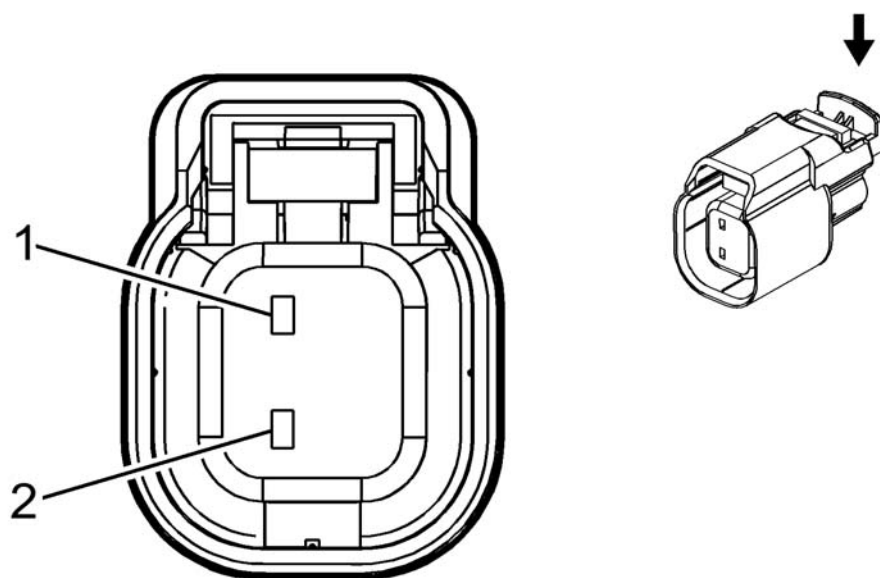
- Harness Type: Floor Console
- OEM Connector: 24414934
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 3	-	-	-	Not Occupied	-	-
4	0.35	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	I	-
5	0.35	BK	1650	Ground	I	-
6	0.35	GY/VT	755	RAP Relay Coil Control	I	-

P12 HORN



Connector Part Information

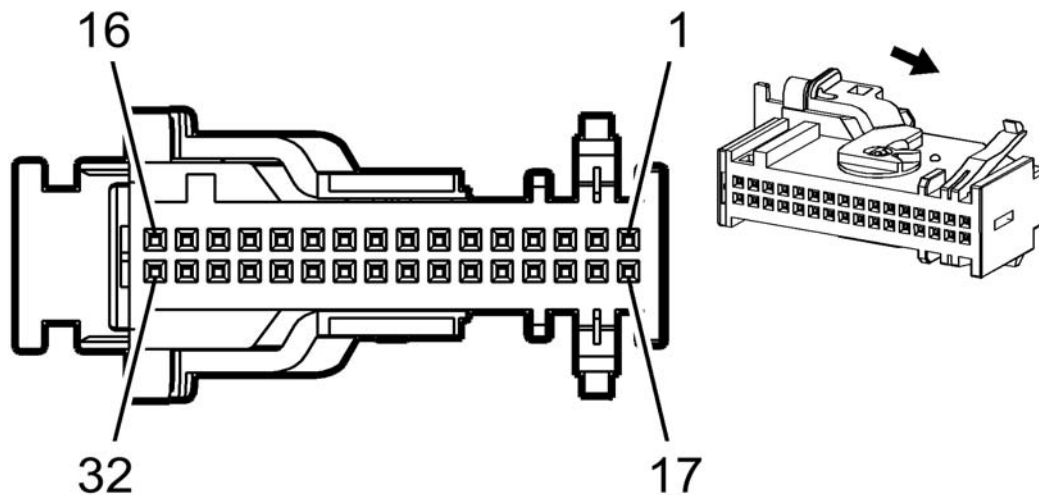
- Harness Type: Forward Lamp
- OEM Connector: 34062-0027
- Service Connector: 19300543
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	BK	1050	Ground	I	-
2	1	BN/GY	29	Horn Control	I	-

P16 INSTRUMENT CLUSTER



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 90587345
- Service Connector: 88988405
- Description: 32-Way F 0.64 Micro-Quadlock Series (BK)

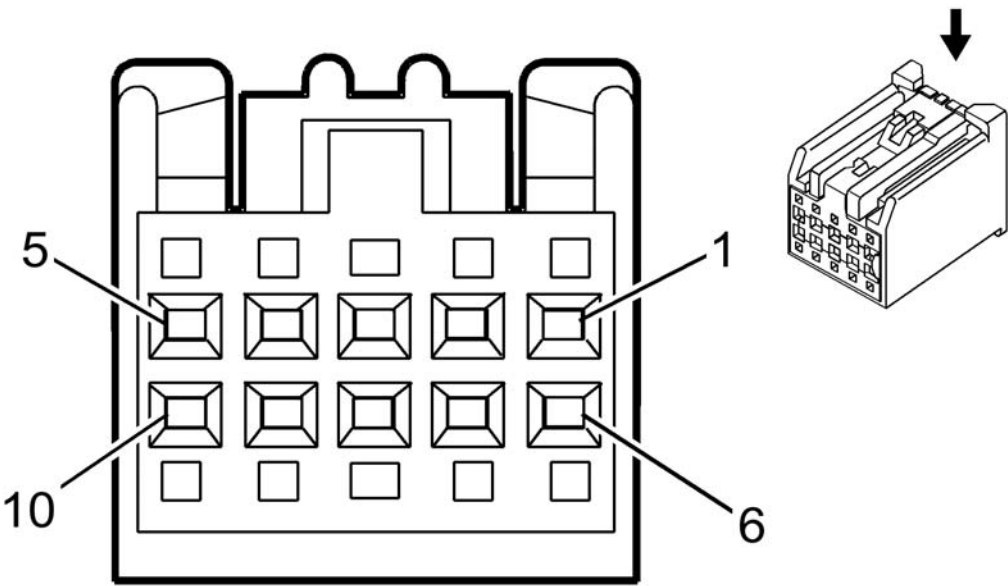
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575584	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
II	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
2	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
3	0.5	GN	5060	Low Speed GMLAN Serial Data	II	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.35	WH/VT	3999	MOST Control	I	-
7	0.5	RD/GN	502	Battery Positive Voltage	II	-
8	0.5	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
9 - 11	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.35	GY/YE	3885	Forward Collision Alert LED Control	I	-
13 - 15	-	-	-	Not Occupied	-	-
16	0.35	BN/WH	419	Check Engine Indicator Control	I	-
17	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
18	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
19	0.5	BK	1650	Ground	II	-
20	0.5	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	II	-
21 - 23	-	-	-	Not Occupied	-	-
24	0.35	VT	185	Low Washer Fluid Indicator Control	I	-
25 - 29	-	-	-	Not Occupied	-	-
30	0.35	WH/GN	3535	Reflected LED Display Dimming Control	I	-
31 - 32	-	-	-	Not Occupied	-	-

P17 INFO DISPLAY MODULE X1



Connector Part Information

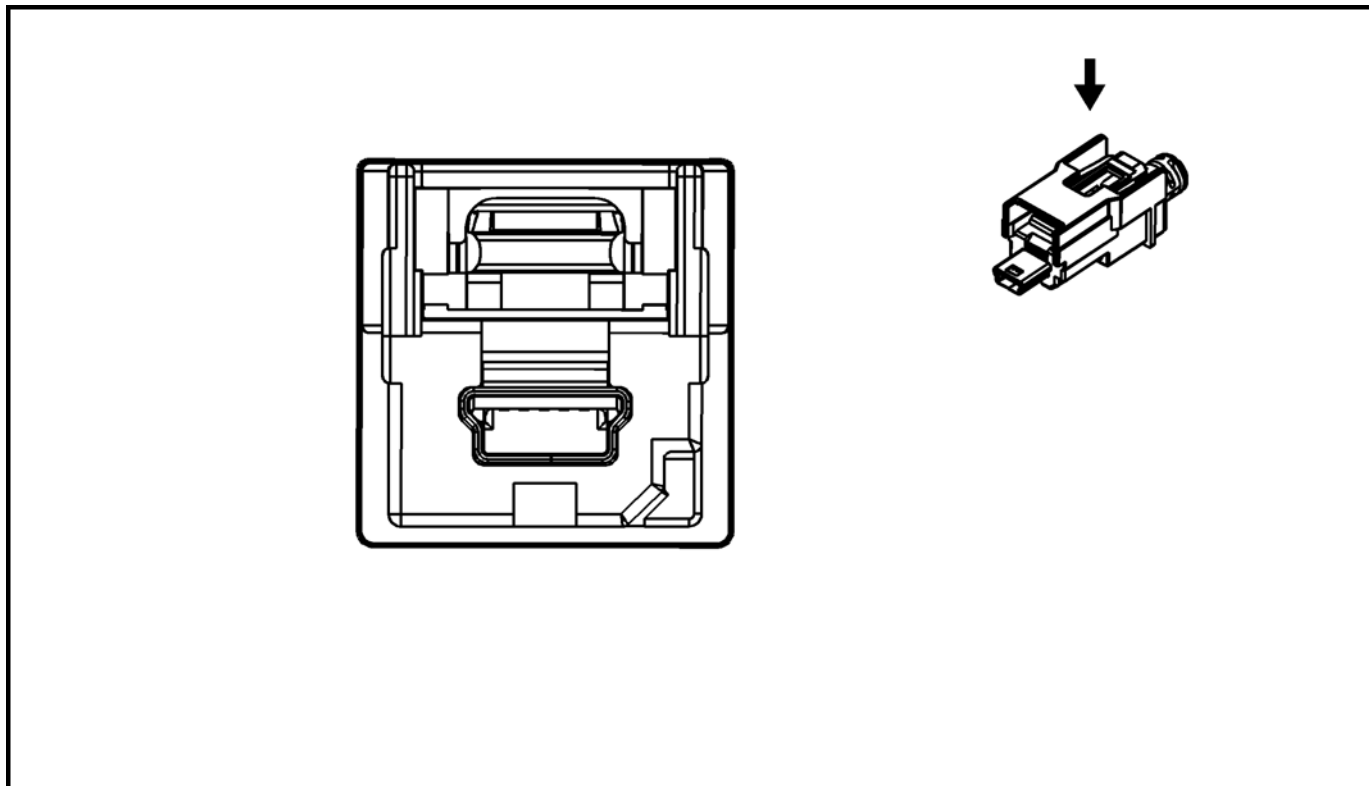
- Harness Type: Instrument Panel
- OEM Connector: 13577390
- Service Connector: 13577390
- Description: 10-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/BU	3240	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GN/BU	7532	Local Interconnect Network Serial Data Bus 10	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.35	GN/WH	7527	Local Interconnect Network Serial Data Bus 5	I	-
9	-	-	-	Not Occupied	-	-
10	0.5	BK	1650	Ground	I	-

P17 INFO DISPLAY MODULE X2



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13580212
- Service Connector: Service by Cable Assembly - See Part Catalog

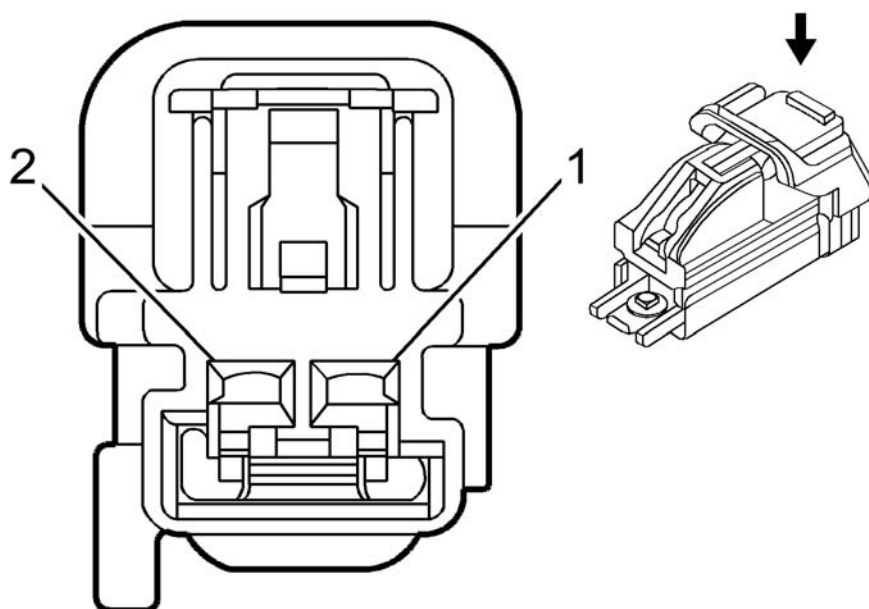
- Description: 5-Way M 2.0 Mini-B USB Type (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	USB	-	USB Serial Data	I	-

P19AC SPEAKER - SUBWOOFER (UQA)



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-6443-40
- Service Connector: 88988504
- Description: 2-Way F 1.5 YESC Series (L-GY)

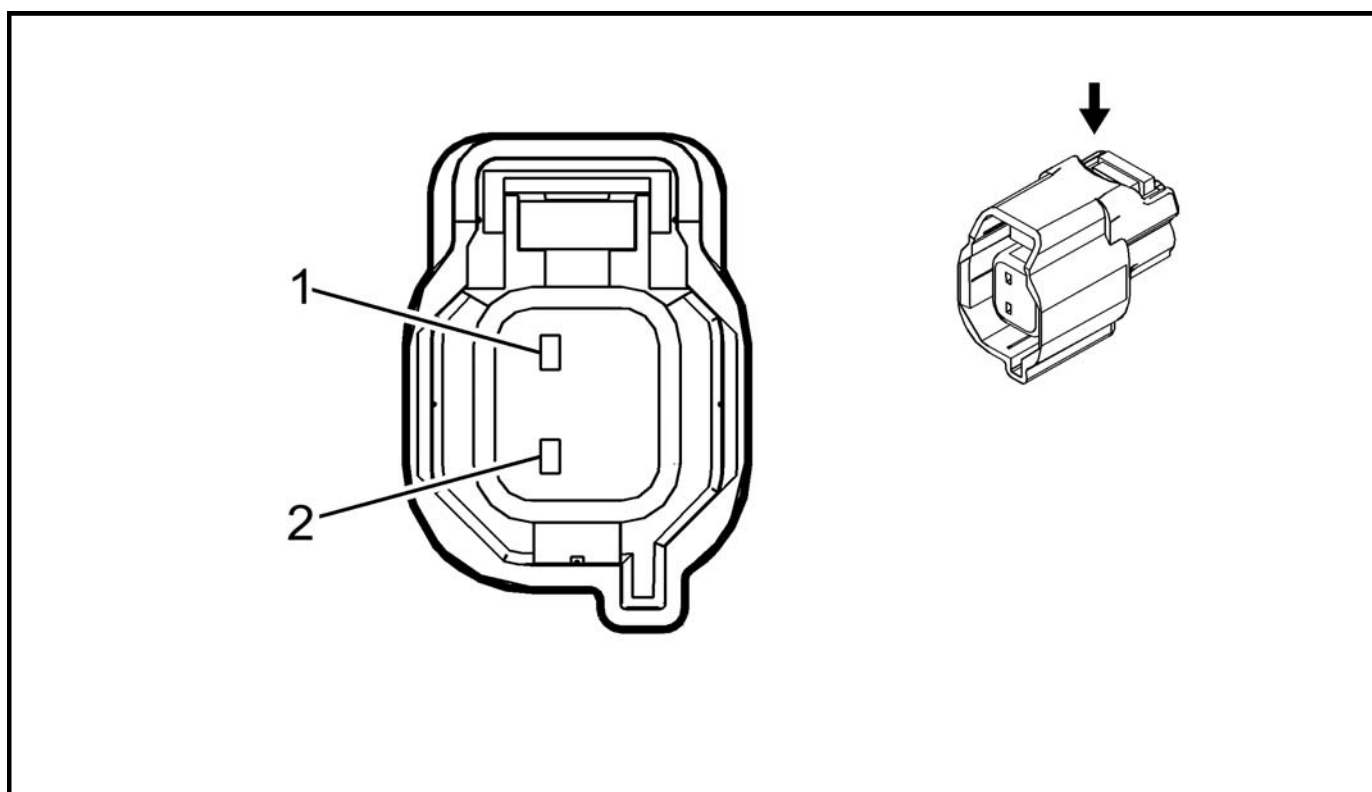
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	GN/BK	1794	Left/Rear Subwoofer Speaker (-) Low Reference	I	-
2	1.5	BU/GY	346	Left/Rear Subwoofer Speaker Control (+)	I	-

P19AG SPEAKER - LEFT FRONT DOOR (UQA)



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 34062-0026
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

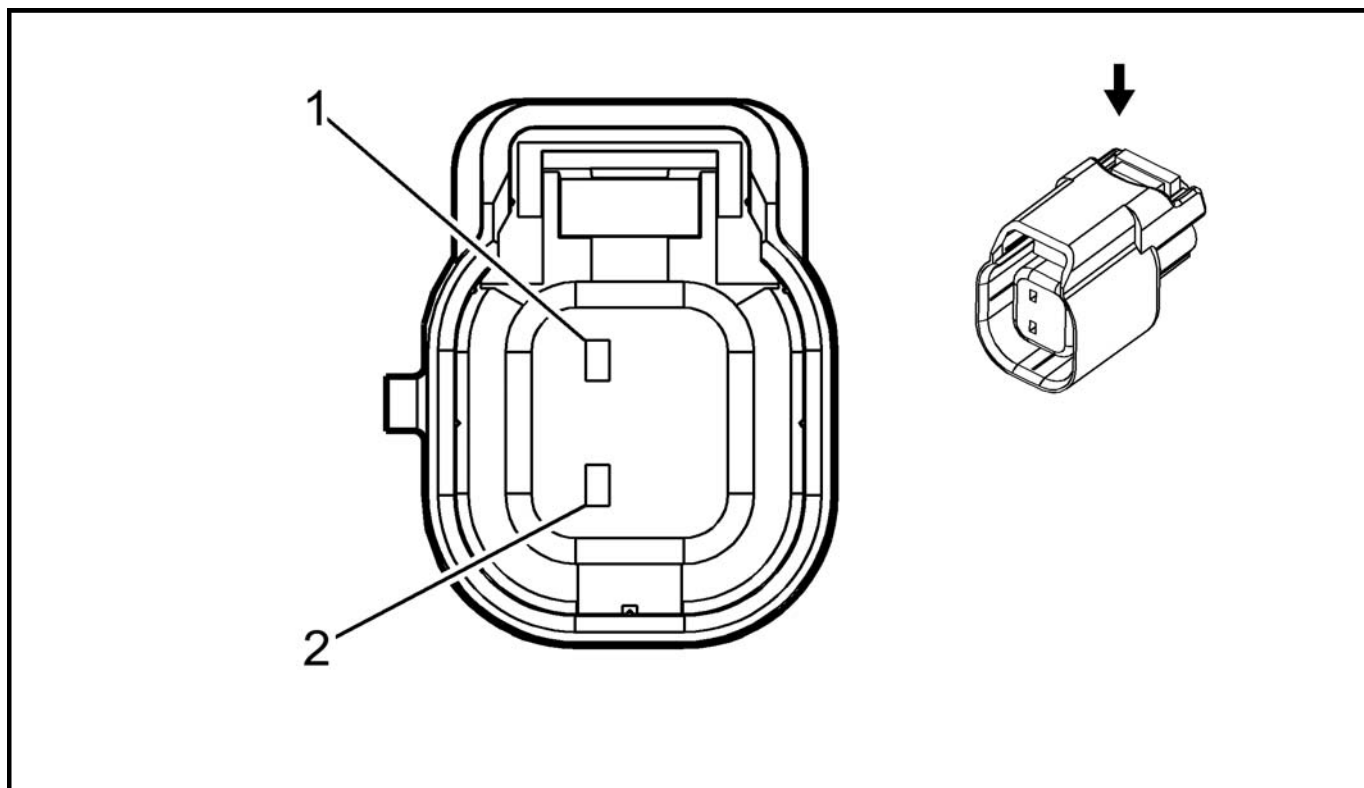
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(GY)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
2	1	BU	201	Left Front Speaker Control (+) 1	I	-

P19AG SPEAKER - LEFT FRONT DOOR (UZ6)



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

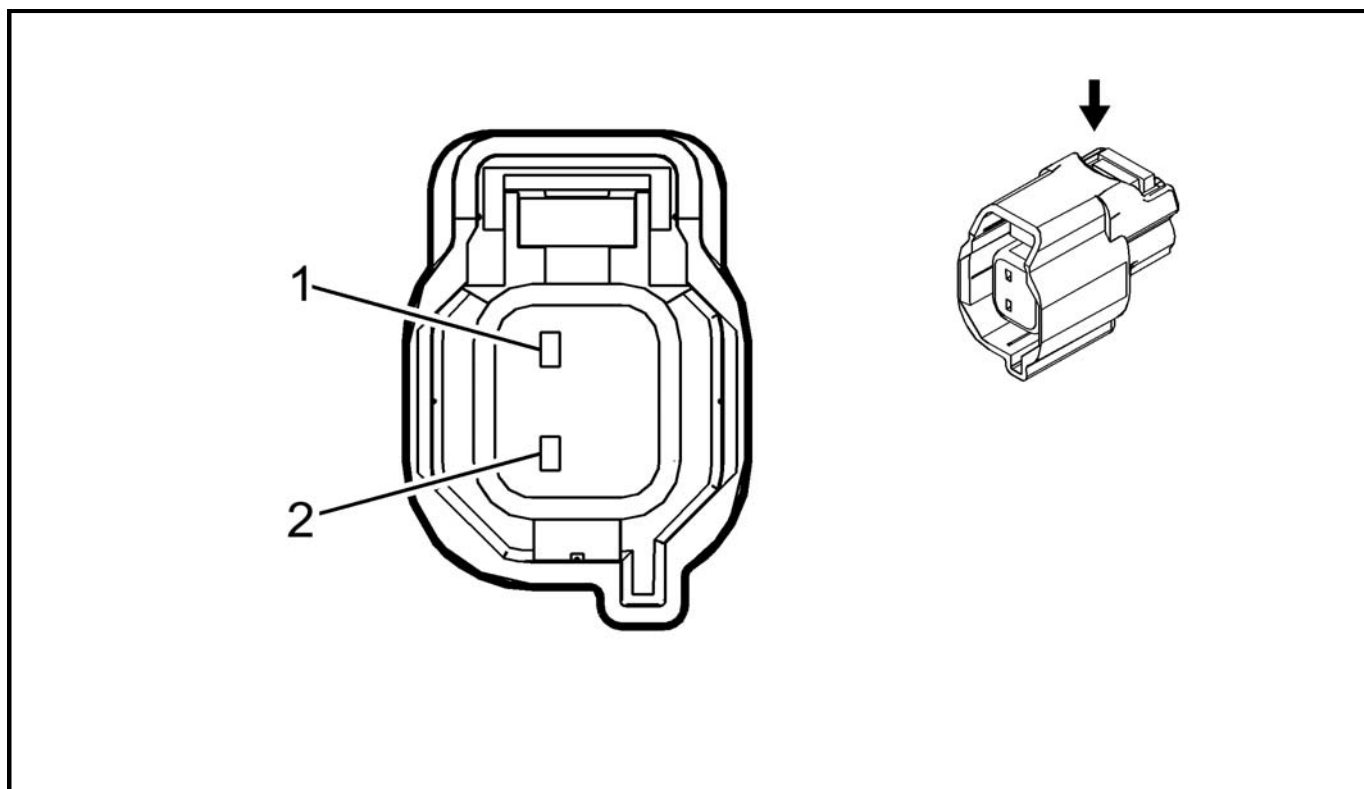
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.75	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
2	0.75	BU	201	Left Front Speaker Control (+) 1	I	-

P19AH SPEAKER - RIGHT FRONT DOOR (UQA)



Connector Part Information

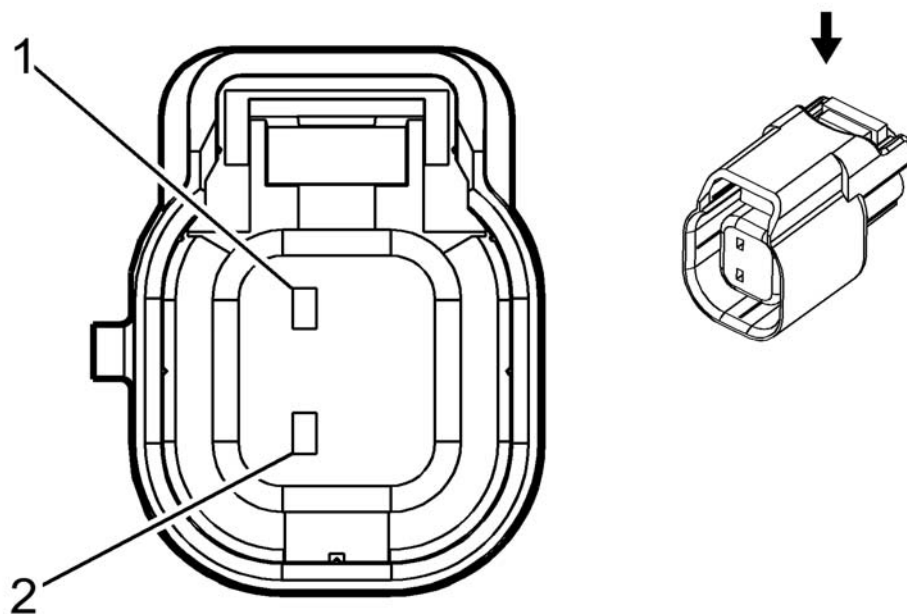
- Harness Type: Passenger Door
- OEM Connector: 34062-0026
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	YE/BK	117	Right Front Speaker Signal (-) 1	I	-
2	1	YE	200	Right Front Speaker Control (+) 1	I	-

P19AH SPEAKER - RIGHT FRONT DOOR (UZ6)



Connector Part Information

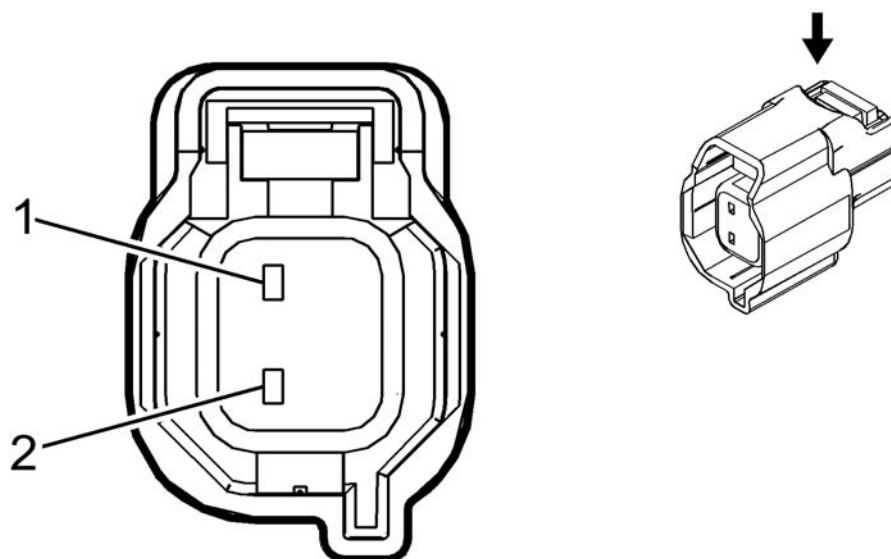
- Harness Type: Passenger Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/YE	117	Right Front Speaker Signal (-) 1	I	-
2	0.75	YE	200	Right Front Speaker Control (+) 1	I	-

P19AL SPEAKER - LEFT REAR DOOR (UQA)



Connector Part Information

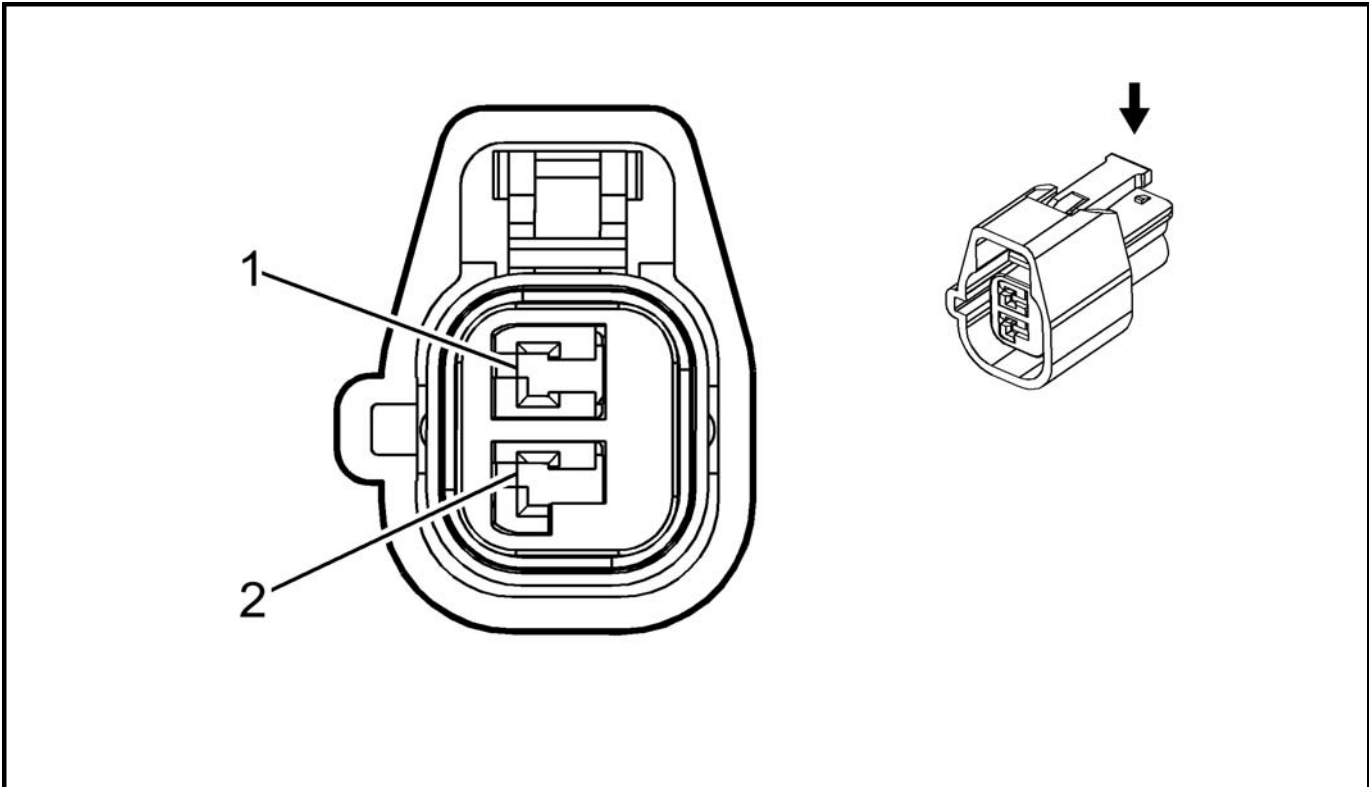
- Harness Type: Left Rear Door
- OEM Connector: 34062-0026
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/GN	116	Left Rear Speaker Signal (-)	I	-
2	0.75	GN	199	Left Rear Speaker Control (+)	I	-

P19AL SPEAKER - LEFT REAR DOOR (UZ6)



Connector Part Information

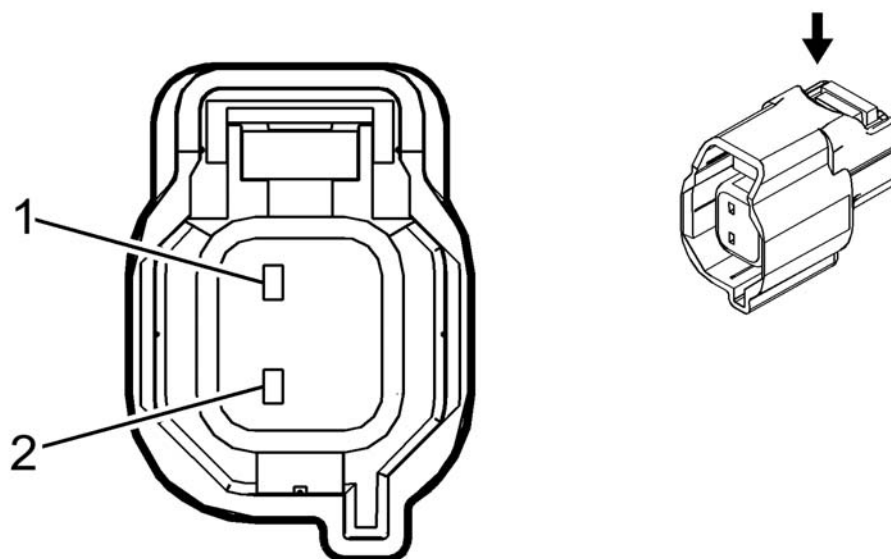
- Harness Type: Left Rear Door
- OEM Connector: 7287-8378-40
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/GN	116	Left Rear Speaker Signal (-)	I	-
2	0.75	GN	199	Left Rear Speaker Control (+)	I	-

P19AM SPEAKER - RIGHT REAR DOOR (UQA)



Connector Part Information

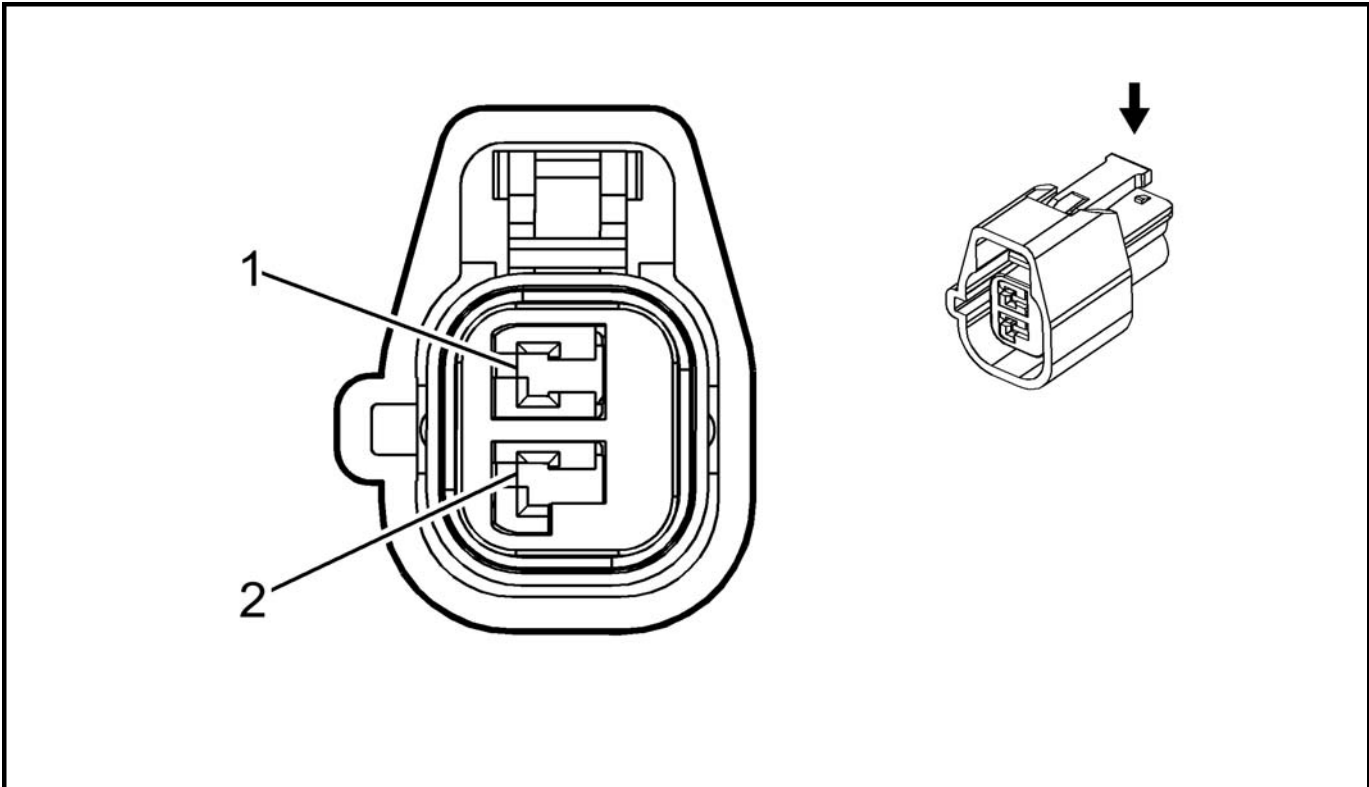
- Harness Type: Right Rear Door
- OEM Connector: 34062-0026
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	WH/BN	115	Right Rear Speaker Signal (-)	I	-
2	0.75	WH	46	Right Rear Speaker Control (+)	I	-

P19AM SPEAKER - RIGHT REAR DOOR (UZ6)



Connector Part Information

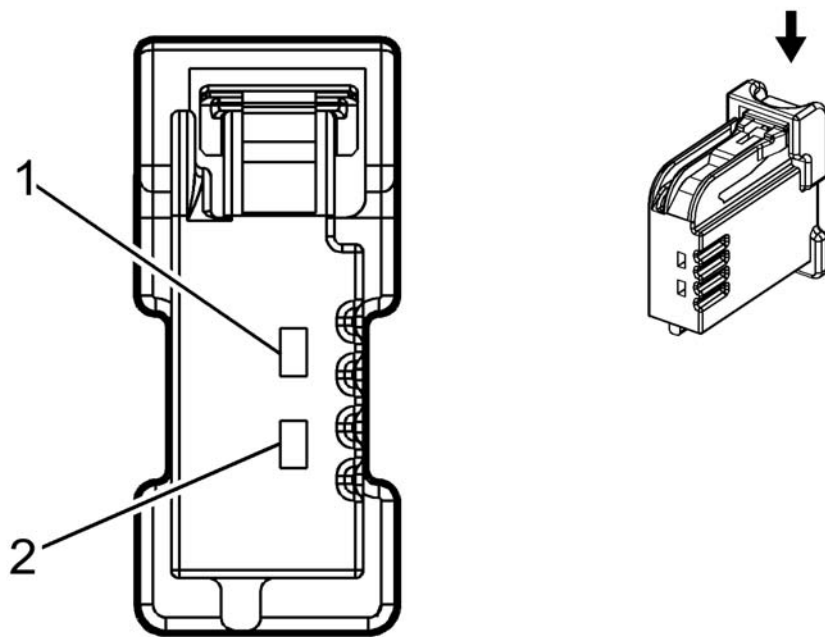
- Harness Type: Right Rear Door
- OEM Connector: 7287-8378-40
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	WH/BN	115	Right Rear Speaker Signal (-)	I	-
2	0.75	WH	46	Right Rear Speaker Control (+)	I	-

P19B SPEAKER - CENTER INSTRUMENT PANEL (UQA)



Connector Part Information

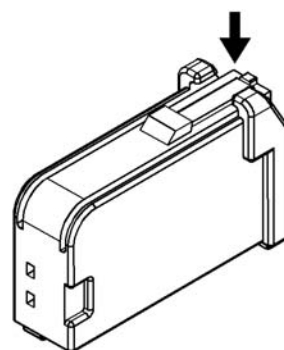
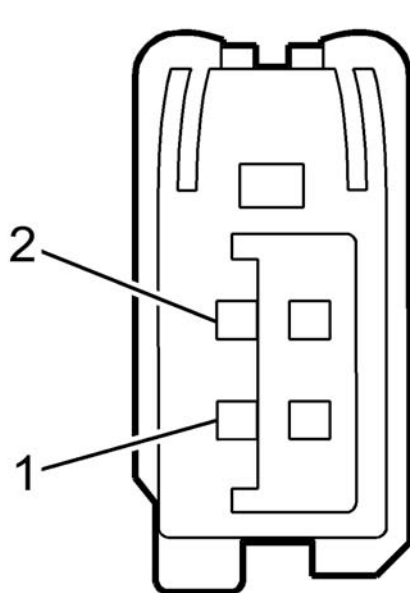
- Harness Type: Instrument Panel
- OEM Connector: 6098-5527
- Service Connector: 19352037
- Description: 2-Way F 1.5 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU/YE	1960	Front Center Speaker (-) Low Reference	I	-
2	0.75	YE/WH	1860	Front Center Speaker Control (+)	I	-

P19H SPEAKER - LEFT FRONT TWEETER



Connector Part Information

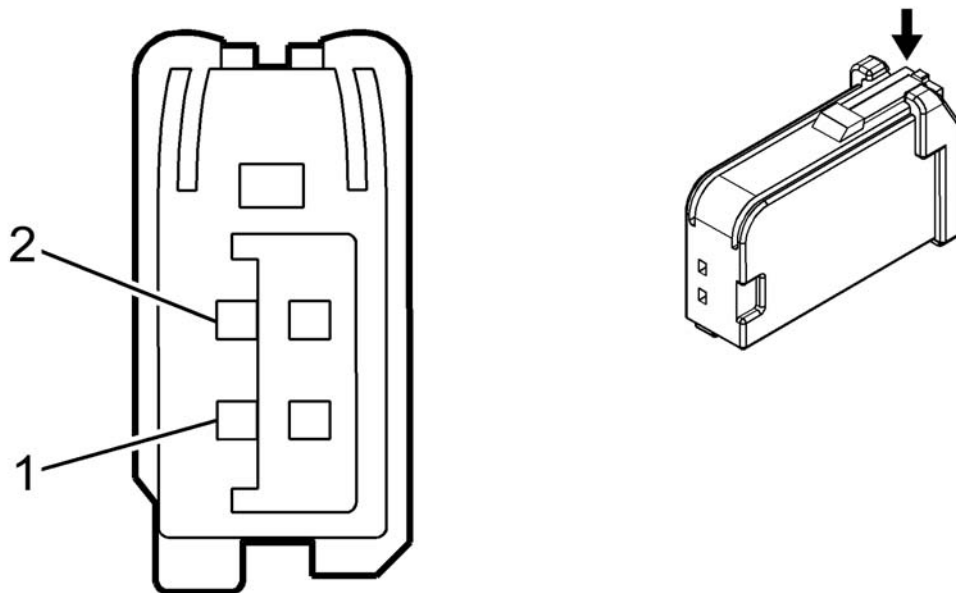
- Harness Type: Instrument Panel
- OEM Connector: AIT2PB-2G-1AK
- Service Connector: 19332379
- Description: 2-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
2	0.5	BU	201	Left Front Speaker Control (+) 1	I	-

P19V SPEAKER - RIGHT FRONT TWEETER



Connector Part Information

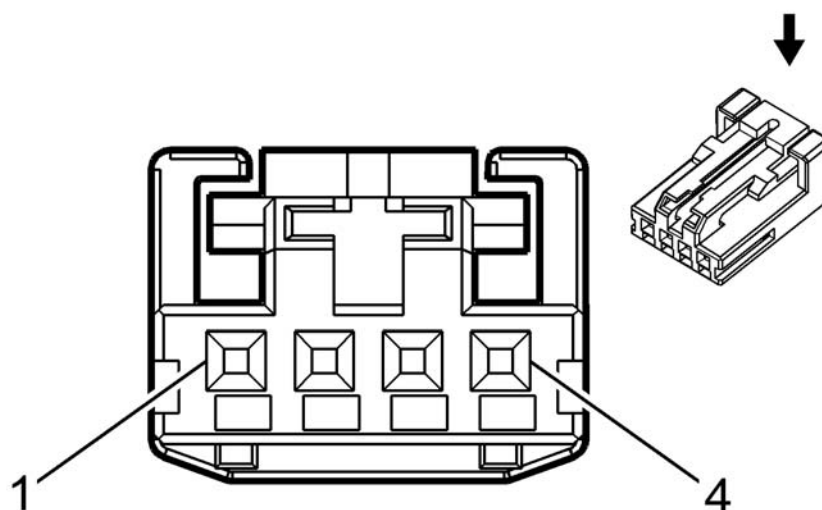
- Harness Type: Instrument Panel
- OEM Connector: AIT2PB-2G-1AK
- Service Connector: 19332379
- Description: 2-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BK	117	Right Front Speaker Signal (-) 1	I	UQA
	0.5	BN/YE	117	Right Front Speaker Signal (-) 1	I	UZ6
2	0.5	YE	200	Right Front Speaker Control (+) 1	I	-

P43 COLLISION ALERT INDICATORS



Connector Part Information

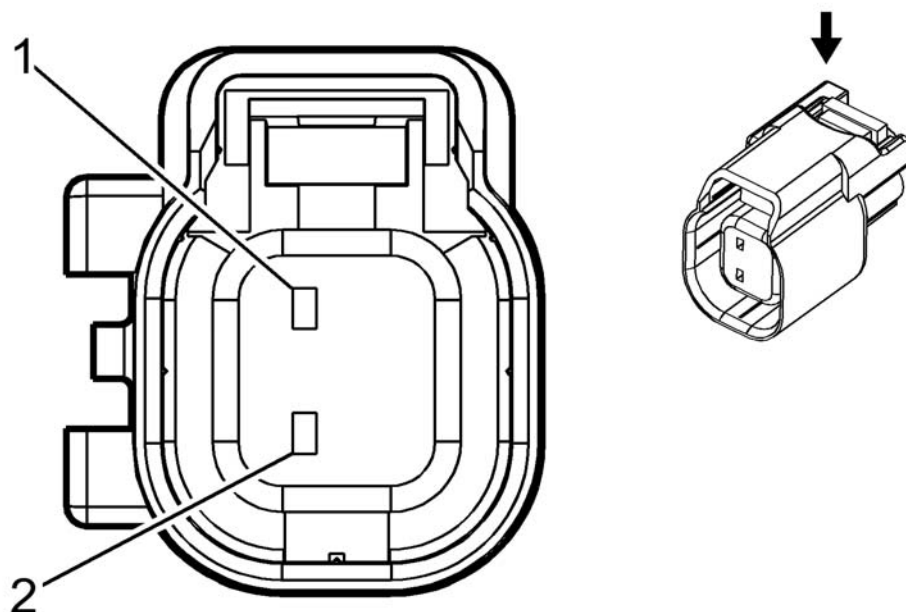
- Harness Type: Instrument Panel
- OEM Connector: 936119-1
- Service Connector: 13587297
- Description: 4-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT/GN	39	Run/Crank Ignition 1 Voltage	I	-
2	0.35	GY/YE	3885	Forward Collision Alert LED Control	I	-
3	0.35	WH/GN	3535	Reflected LED Display Dimming Control	I	-
4	0.5	BK	1650	Ground	I	-

P48 PEDESTRIAN ALERT SOUND SPEAKER



Connector Part Information

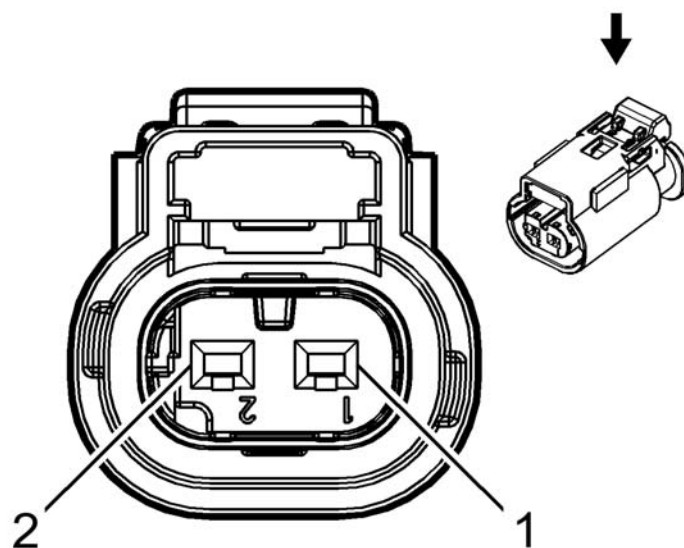
- Harness Type: Forward Lamp
- OEM Connector: 34062-0033
- Service Connector: 19332516
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	I	-
2	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	I	-

Q6E CAMSHAFT POSITION ACTUATOR SOLENOID VALVE - EXHAUST



Connector Part Information

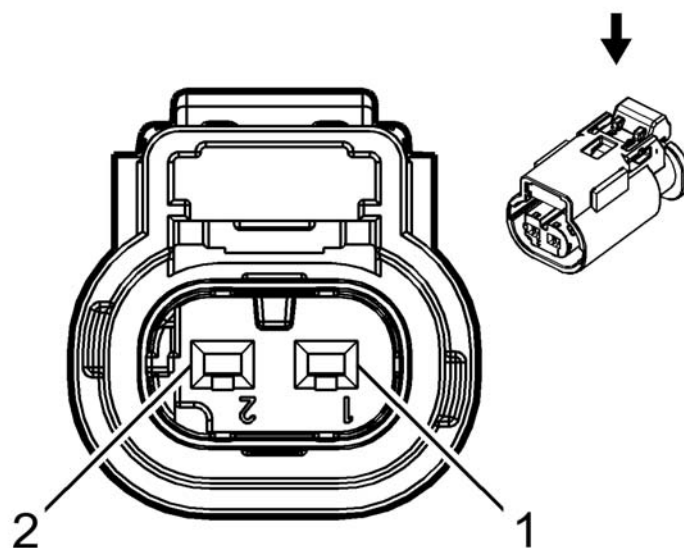
- Harness Type: Engine
- OEM Connector: 10010338
- Service Connector: 13587325
- Description: 2-Way F 1.2 Multilock Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BU	5282	Camshaft Phaser Exhaust Solenoid 1	I	-
2	0.5	BK/VT	6754	Cam Phaser X Low Reference	I	-

Q6F CAMSHAFT POSITION ACTUATOR SOLENOID VALVE - INTAKE



Connector Part Information

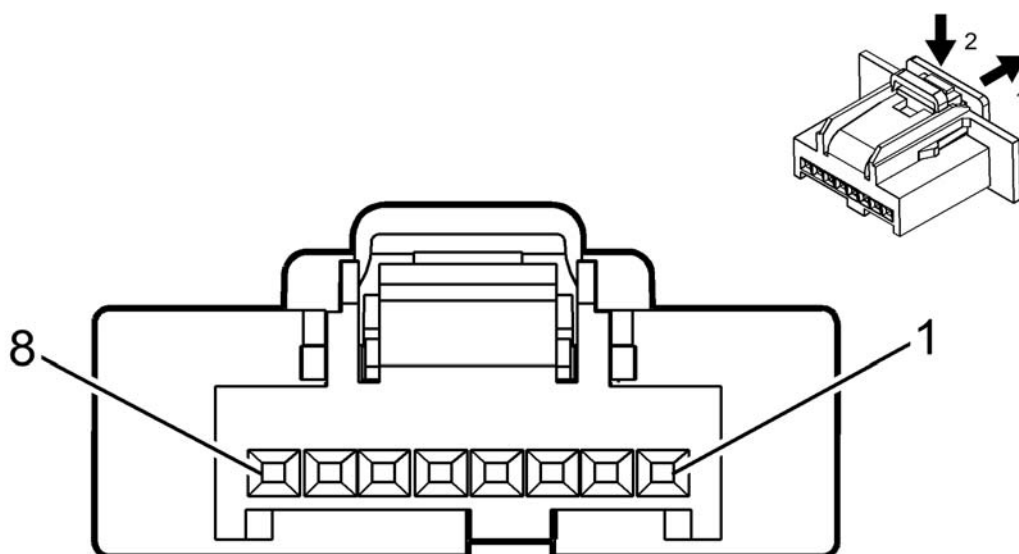
- Harness Type: Engine
- OEM Connector: 10010338
- Service Connector: 13587325
- Description: 2-Way F 1.2 Multilock Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BN	5284	Camshaft Phaser Intake Solenoid 1	I	-
2	0.5	BK/BN	6753	Cam Phaser W Low Reference	I	-

Q8 CONTROL SOLENOID VALVE ASSEMBLY



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 13960977
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 II Series (GY)

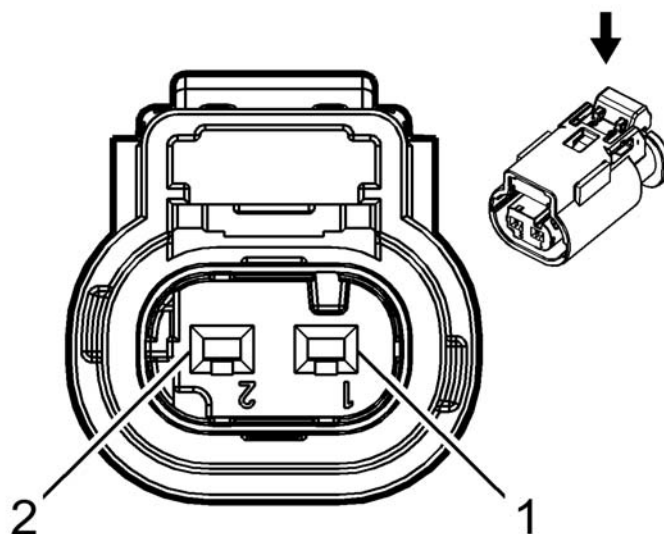
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	6387	Transmission High Side Driver 1 Signal Driver	I	-
2	0.5	TN	6401	Clutch B Control	I	-
3	0.5	VT	585	Transmission Oil Temperature Sensor Signal	I	-
4	0.5	GN	586	Transmission Oil Temperature Sensor Low Reference	I	-
5	0.5	WH	6404	Clutch E Control	I	-
6	0.5	OG	6403	Clutch D Control	I	-
7	0.75	BN	6388	Transmission High Side Driver 2 Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	GY	6402	Clutch C Control	I	-

Q12 EVAPORATIVE EMISSION PURGE SOLENOID VALVE



Connector Part Information

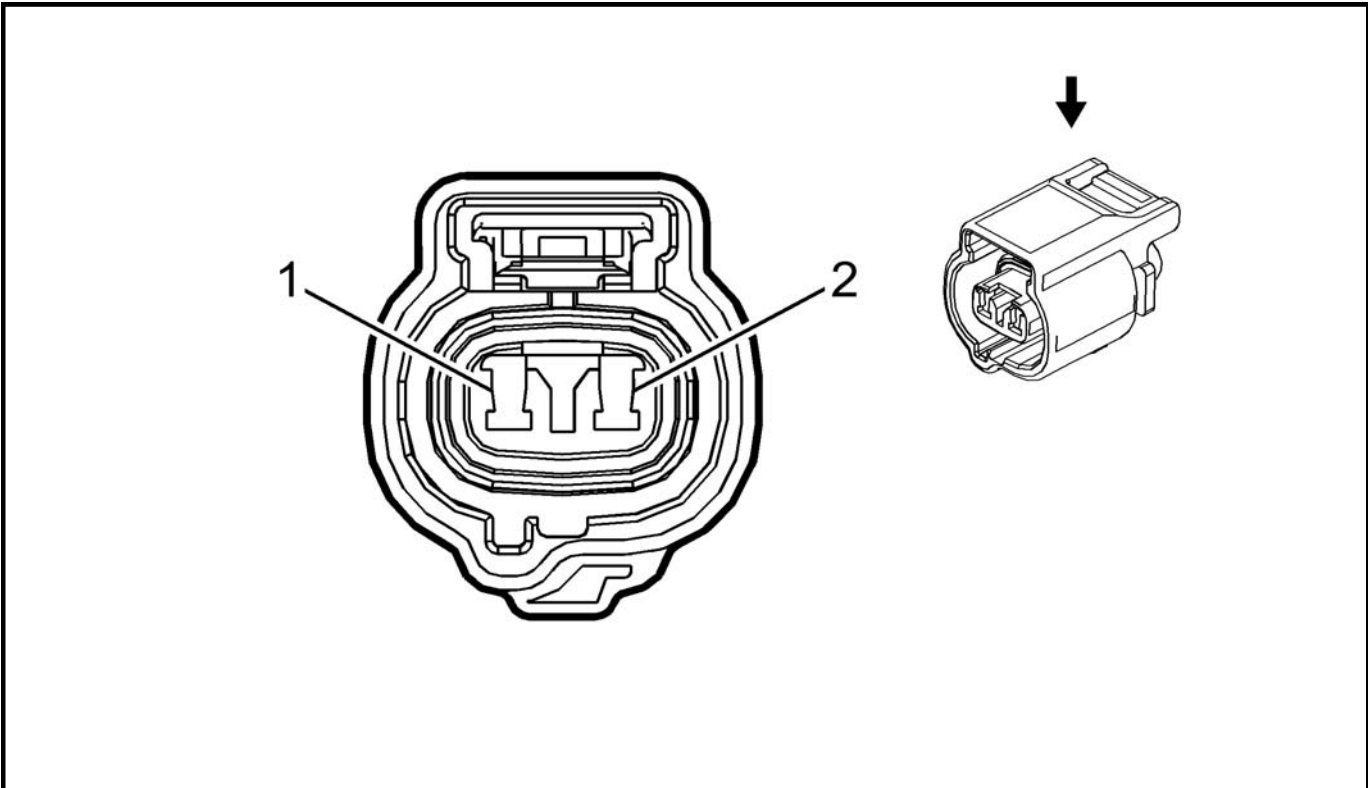
- Harness Type: Engine
- OEM Connector: 10010337
- Service Connector: 13587326
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
2	0.5	GN/BU	428	EVAP Canister Purge Solenoid Control	I	-

Q13 EVAPORATIVE EMISSION VENT SOLENOID VALVE



Connector Part Information

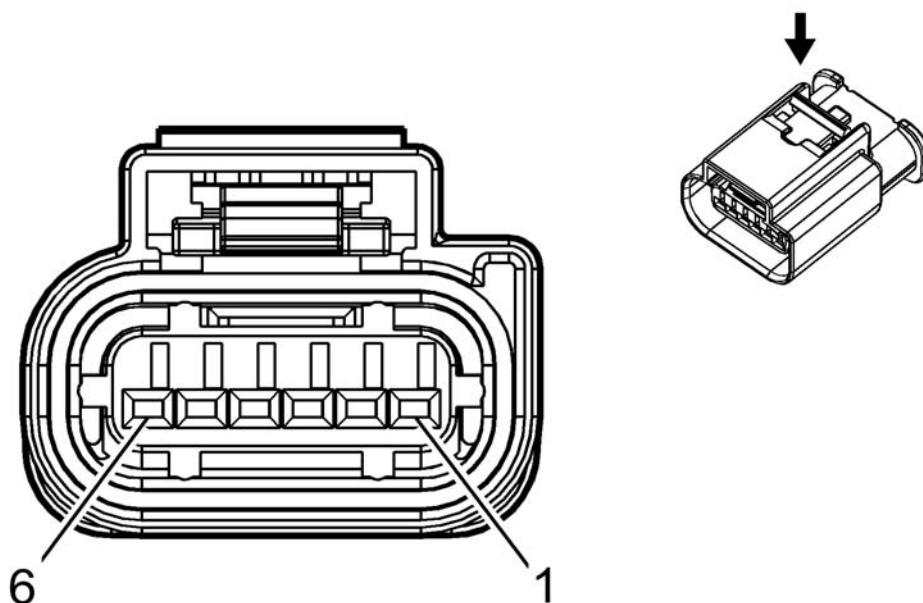
- Harness Type: EVAP
- OEM Connector: 7283-5062-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 090 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN	3726	Diurnal Control Valve (DCV) Ground	I	-
2	0.5	RD/WH	1340	Battery Positive Voltage	I	-

Q14 EXHAUST GAS RECIRCULATION VALVE



Connector Part Information

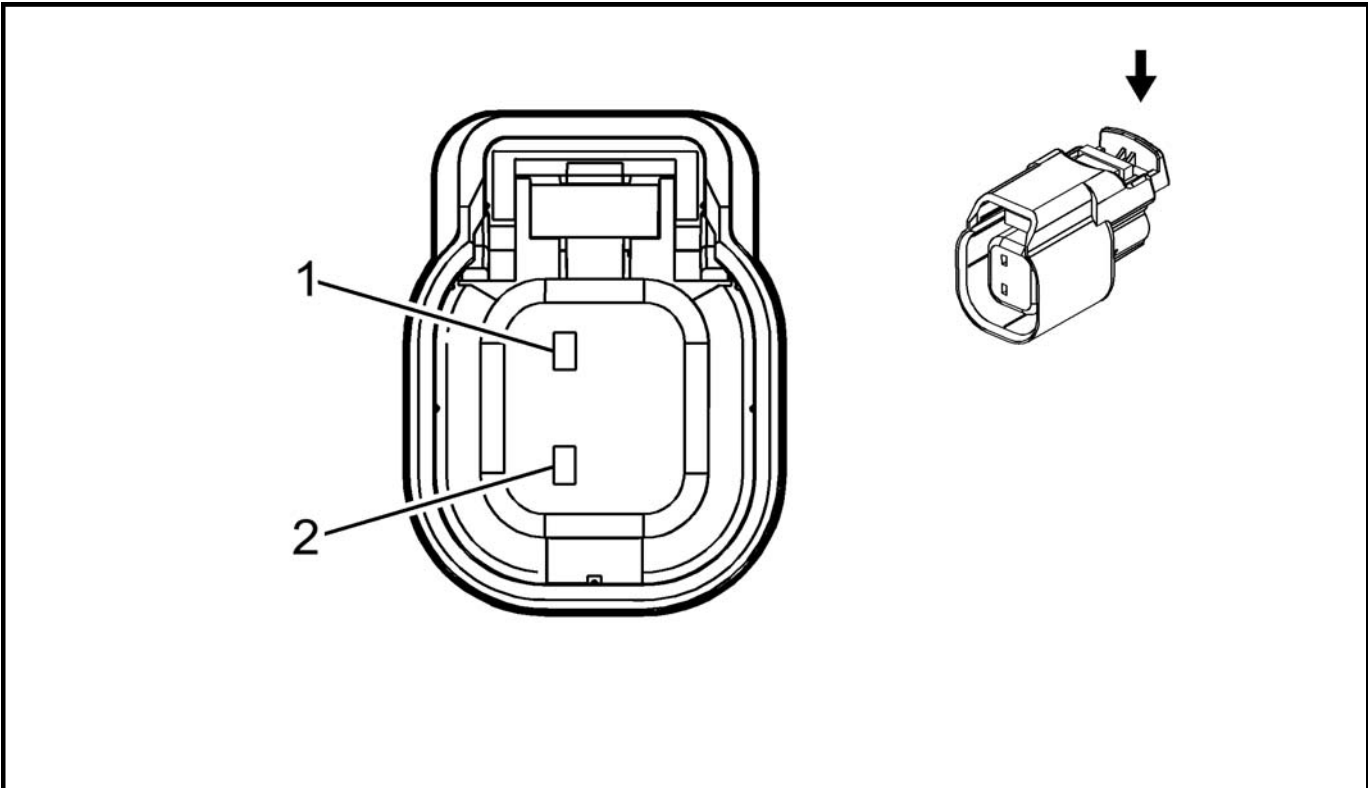
- Harness Type: Engine
- OEM Connector: 2272975-5
- Service Connector: 19352911
- Description: 6-Way F 1.2 MCON Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
2	0.5	BK	250	Ground	I	-
3	0.5	BN/VT	4322	Exhaust Gas Recirculation Pulse Width Modulated Input Signal	I	-
4	0.5	BN/WH	4323	Exhaust Gas Recirculation Pulse Width Modulated Output Signal	I	-
5	0.5	BK/BN	2753	Exhaust Gas Recirculation Sensor Low Reference	I	-
6	-	-	-	Not Occupied	-	-

Q17A FUEL INJECTOR 1



Connector Part Information

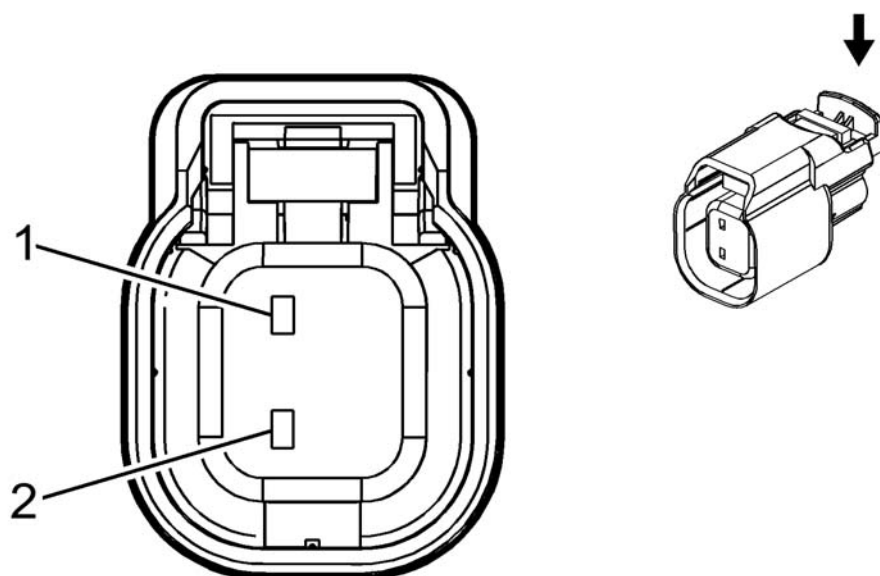
- Harness Type: Fuel
- OEM Connector: 13581410
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/WH	4901	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 1	I	-
2	0.75	BN	4801	Direct Fuel Injector (DFI) High Voltage Control Cylinder 1	I	-

Q17B FUEL INJECTOR 2



Connector Part Information

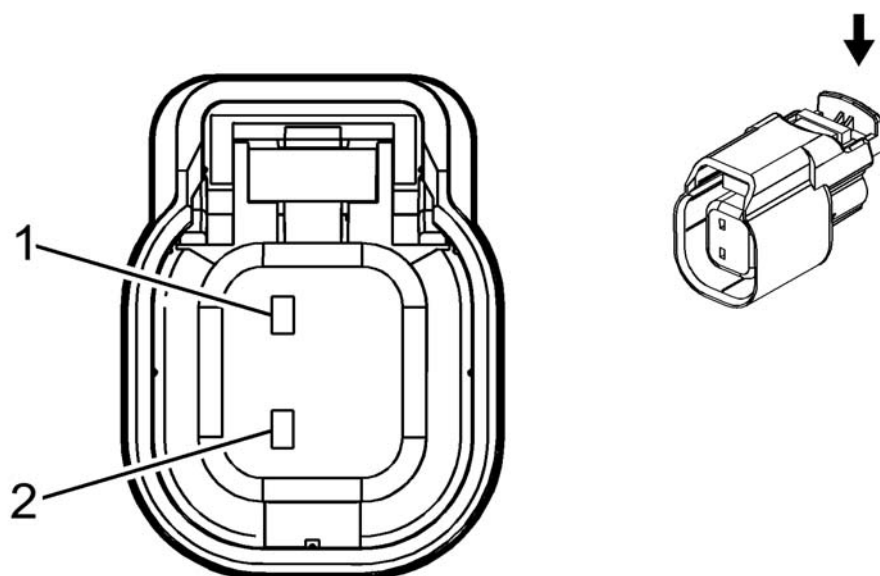
- Harness Type: Fuel
- OEM Connector: 13581410
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU/GY	4902	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 2	I	-
2	0.75	BU	4802	Direct Fuel Injector (DFI) High Voltage Control Cylinder 2	I	-

Q17C FUEL INJECTOR 3



Connector Part Information

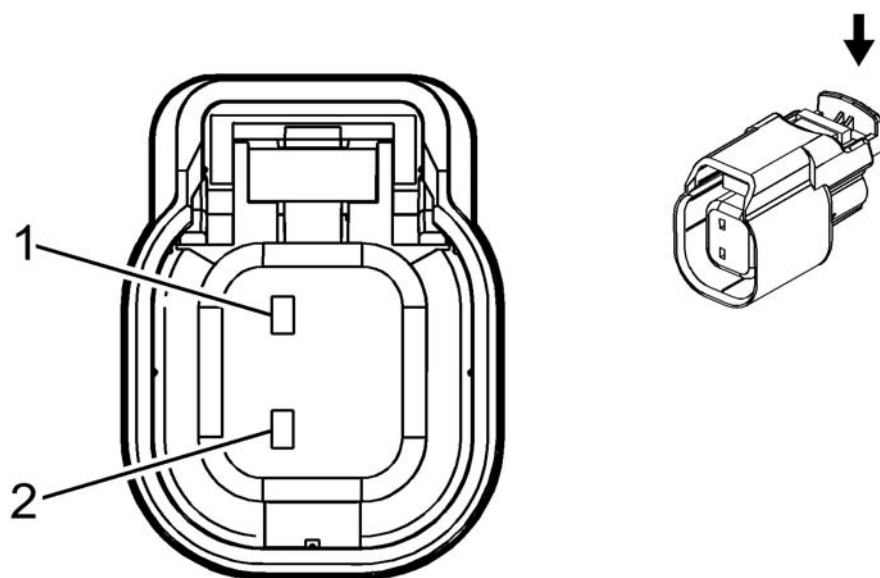
- Harness Type: Fuel
- OEM Connector: 13581410
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GN/GY	4903	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 3	I	-
2	0.75	GN	4803	Direct Fuel Injector (DFI) High Voltage Control Cylinder 3	I	-

Q17D FUEL INJECTOR 4



Connector Part Information

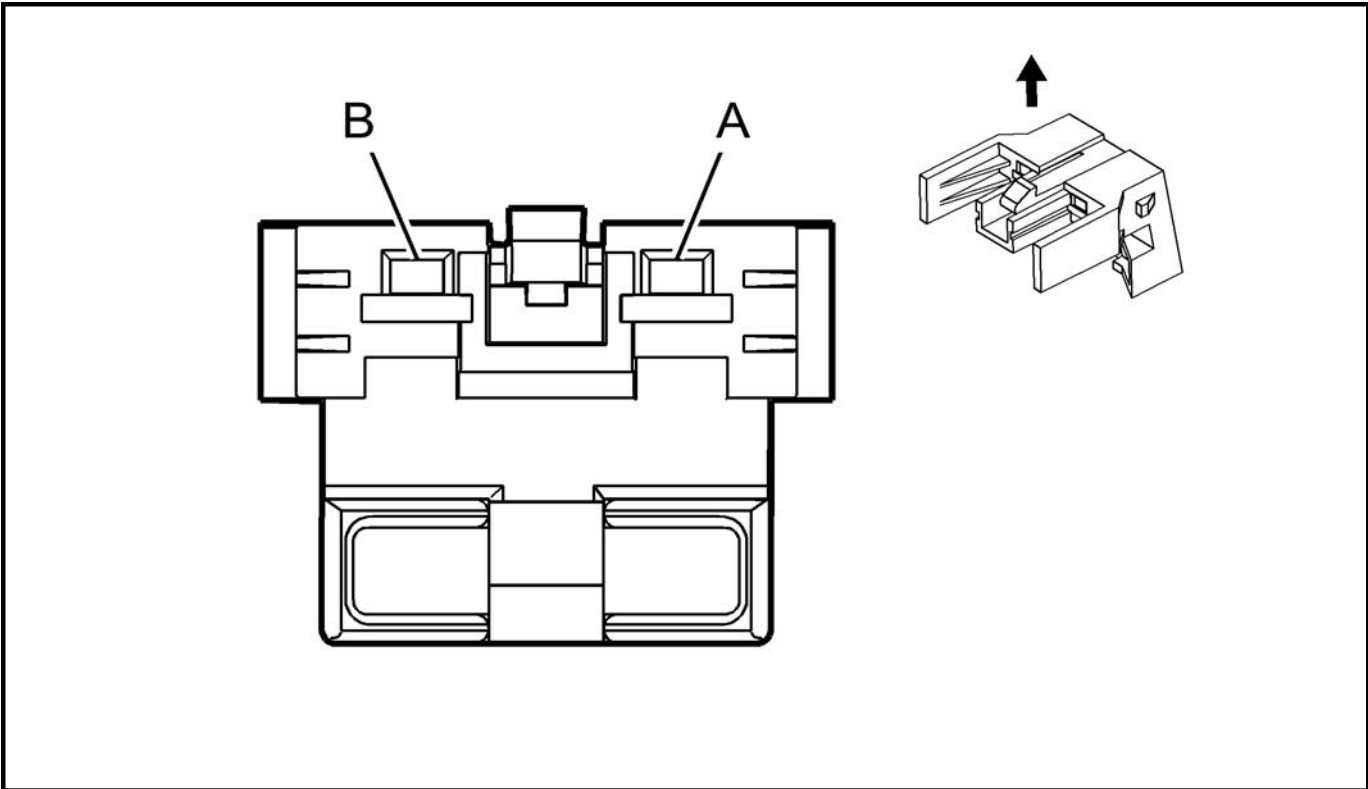
- Harness Type: Fuel
- OEM Connector: 13581410
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU/WH	4904	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 4	I	-
2	0.75	GY/BU	4804	Direct Fuel Injector (DFI) High Voltage Control Cylinder 4	I	-

Q23 LINE PRESSURE CONTROL SOLENOID VALVE



Connector Part Information

Terminal Part Information

• Harness Type: Body • OEM Connector: 15544185 • Service Connector: Service by Harness - See Part Catalog	Terminal Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
• IDescription: Not Required	Not Required	Not Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

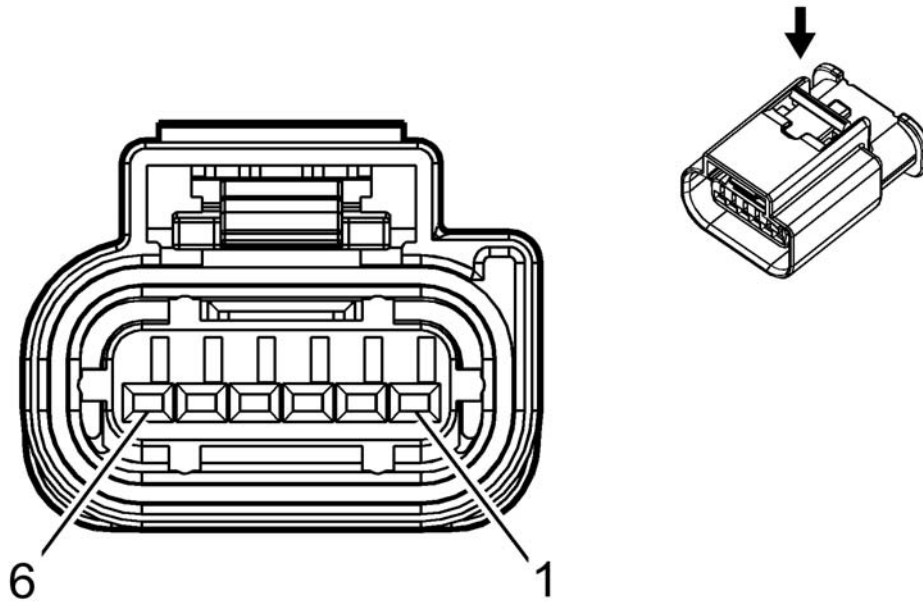
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.75	BK	6387	Transmission High Side Driver 1 Signal Driver	I	-
B	0.5	YE	6400	Clutch A Control	I	-

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Volt

COMPONENT CONNECTOR END VIEWS

Q38 THROTTLE BODY



Connector Part Information

- Harness Type: Engine
- OEM Connector: 2272975-5
- Service Connector: 19352911
- Description: 6-Way F 1.2 MCON Series, Sealed (BK)

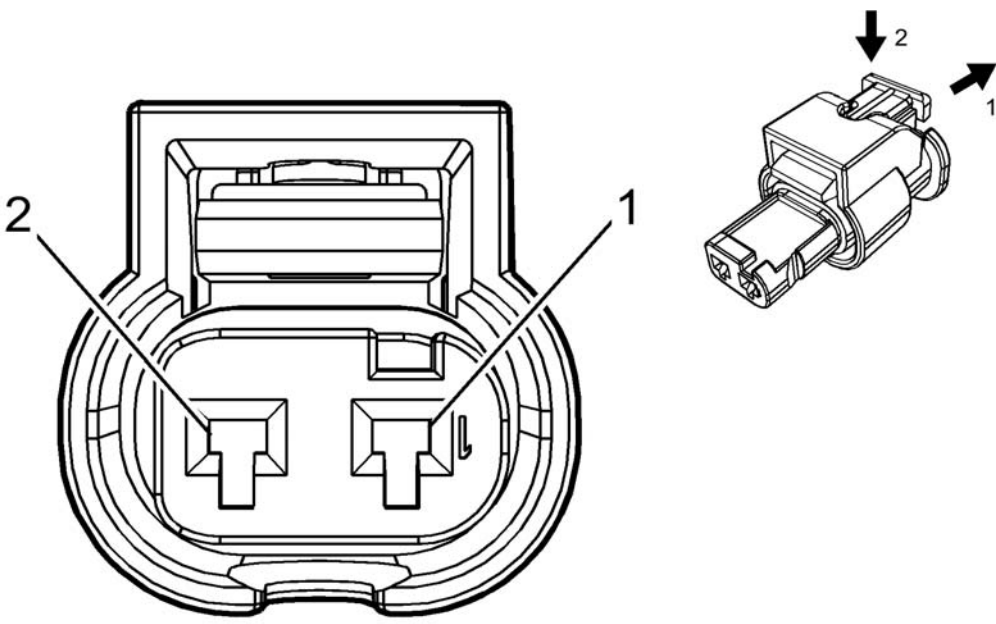
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	581	Throttle Actuator Control Open	I	-
2	0.5	BN/WH	582	Throttle Actuator Control Close	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.5	BU/WH	3630	Throttle Position Sensor (SENT1) Signal	I	-
4	0.5	BK/BN	2752	Throttle Position Sensor Low Reference	I	-
5	0.5	BN/RD	2701	Throttle Position Sensor 5V Reference	I	-
6	-	-	-	Not Occupied	-	-

Q44 ENGINE OIL PRESSURE CONTROL SOLENOID VALVE



Connector Part Information

- Harness Type: Engine Oil Level Sensor
- OEM Connector: 13587570
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCON Series (BN)

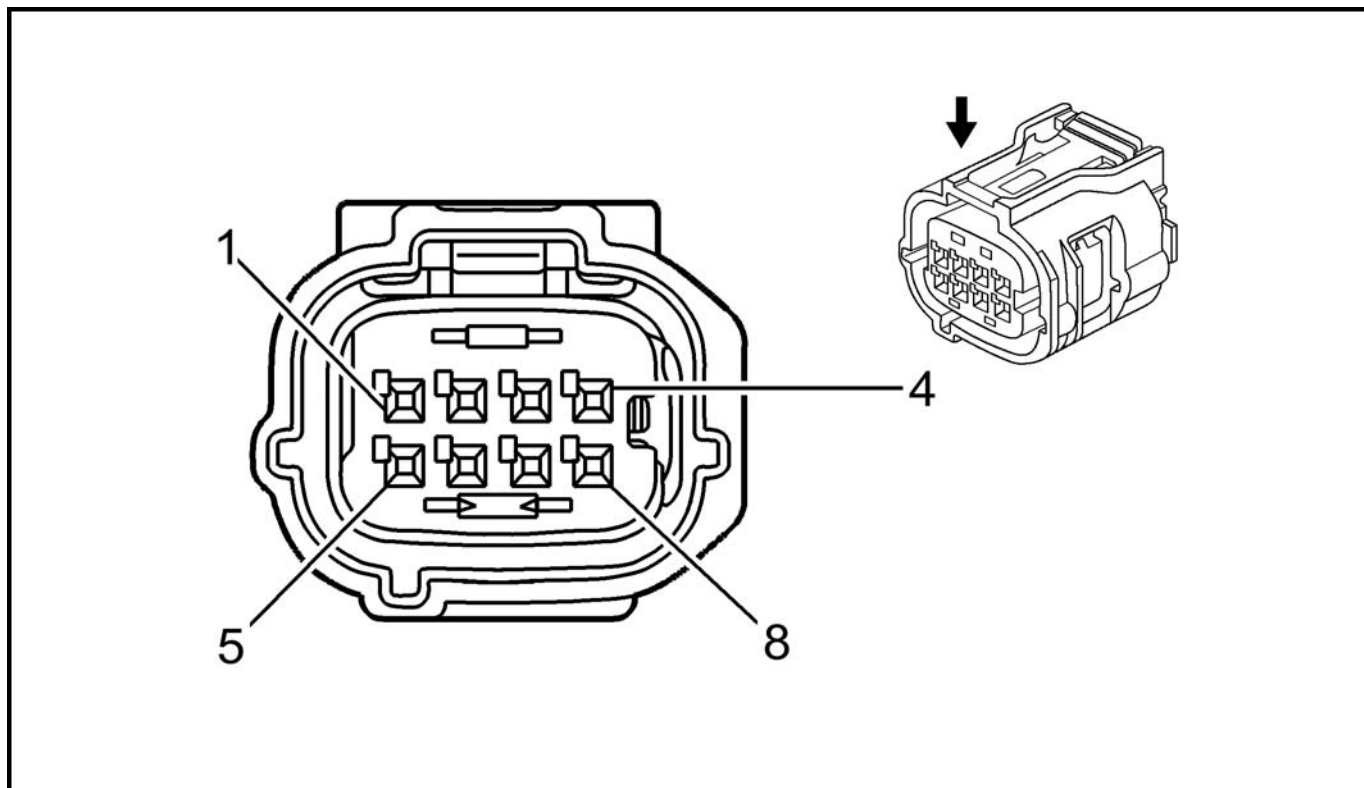
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
2	0.5	BU	179	Oil Pump Command Signal	I	-

Q63 EVAPORATIVE EMISSION SYSTEM LEAK DETECTION PUMP ASSEMBLY



Connector Part Information

- Harness Type: EVAP
- OEM Connector: 6189-1240
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F TS Series, Sealed (D-GY)

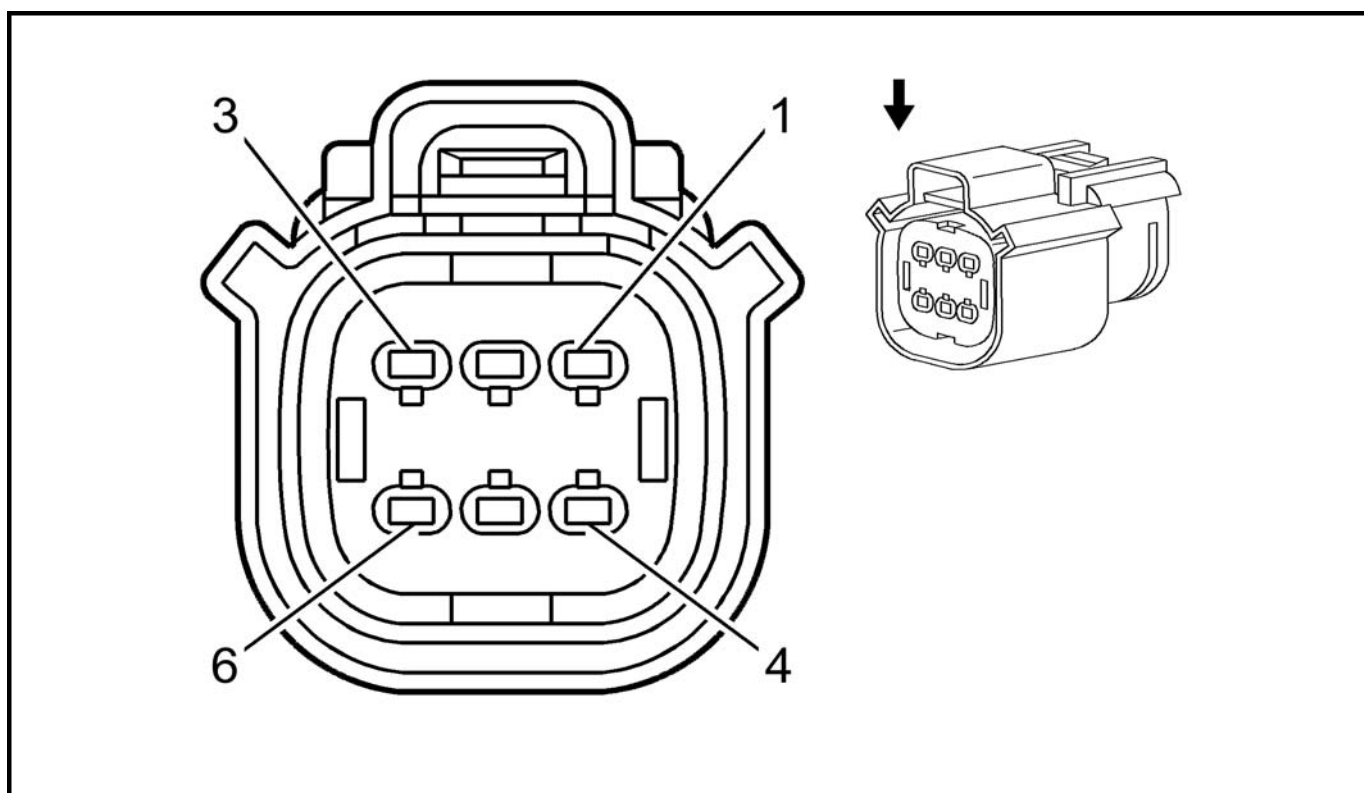
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	3723	Evap Leak Check Module (ELCM) Changeover Valve Ground	I	-
2	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.5	RD/WH	1340	Battery Positive Voltage	I	-
4	0.5	BU	3722	Evap Leak Check Module (ELCM) Vacuum Pump Ground	I	-
5	0.5	RD/WH	1340	Battery Positive Voltage	I	-
6	0.5	BN/RD	3724	Evap Leak Check Module (ELCM) Pressure Sensor 5V Reference	I	-
7	0.5	BU/GN	3725	Evap Leak Check Module (ELCM) Pressure Sensor Signal	I	-
8	0.5	BK/GN	6281	Fuel Level Sensor Low Reference	I	-

Q66 PASSENGER COMPARTMENT HEATER COOLANT CONTROL VALVE



Connector Part Information

- Harness Type: Engine
- OEM Connector: 33472-0611
- Service Connector: 13585853
- Description: 6-Way F 150 MX Series, Sealed (BK)

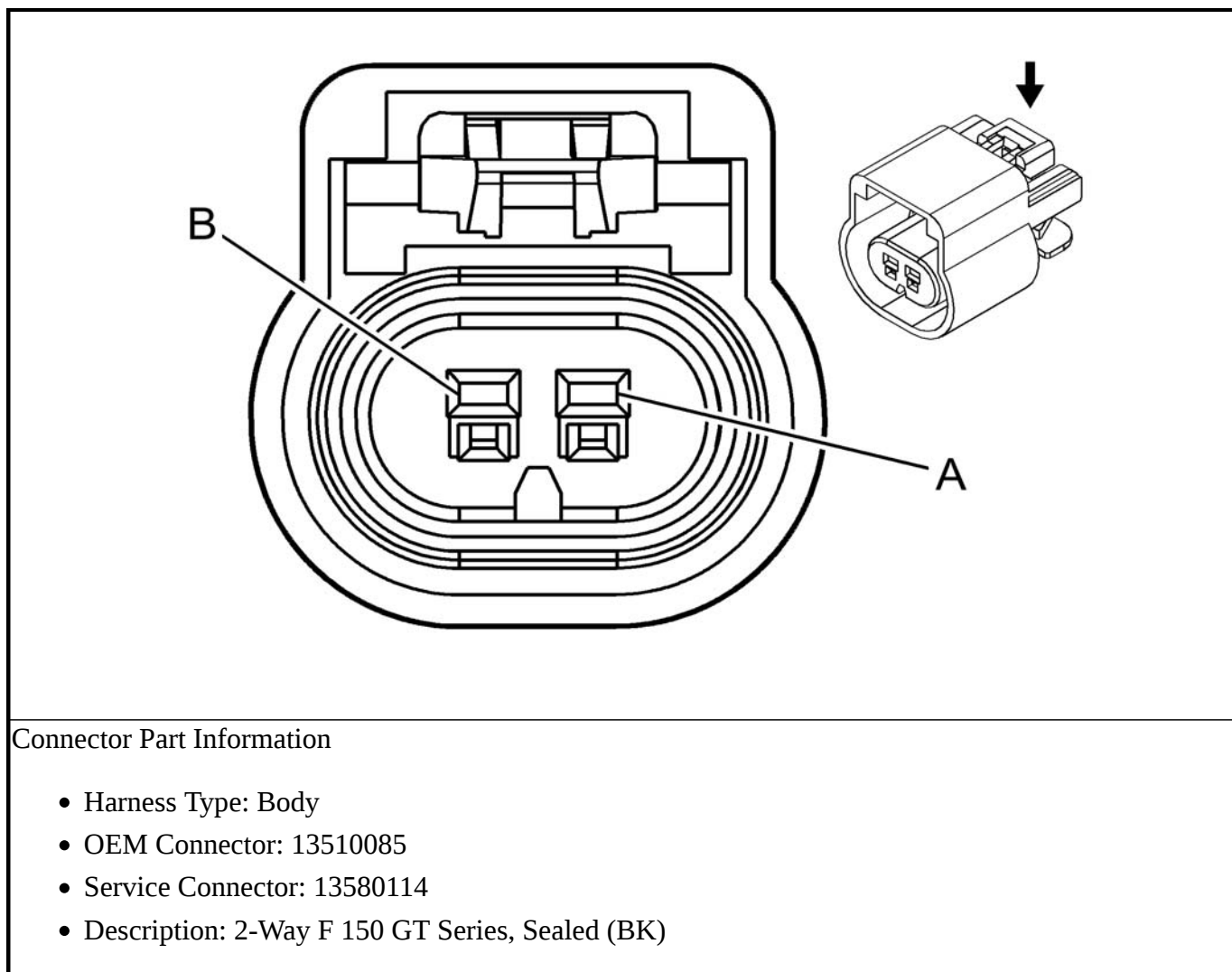
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A	Not	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(GY)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/VT	3818	Rechargeable Energy Storage System Coolant HVAC Mode Motor High Control	I	-
2	0.5	WH/YE	3819	Rechargeable Energy Storage System Coolant HVAC Mode Motor Low Control	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	VT/BN	2028	Coolant Valve Position Sensor Signal	I	-
5	0.5	BK/BU	720	Sensor Low Reference	I	-
6	0.5	WH/RD	596	5V Reference	I	-

R6A TERMINATING RESISTOR - HIGH SPEED BUS

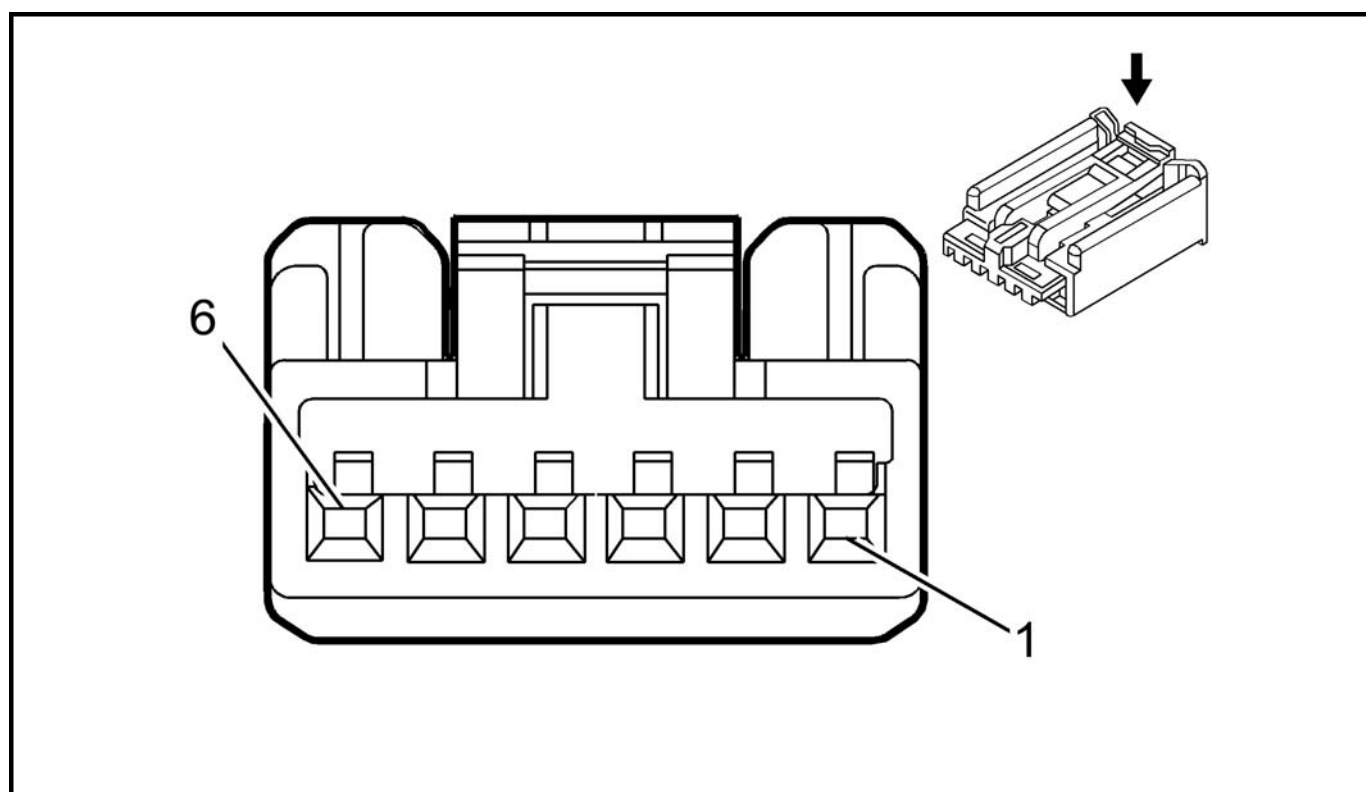


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	BU/GY	6434	CAN Bus High 2 Serial Data	I	-
B	0.5	WH/BU	6435	CAN Bus Low 2 Serial Data	I	-

S3 TRANSMISSION SHIFT LEVER



Connector Part Information

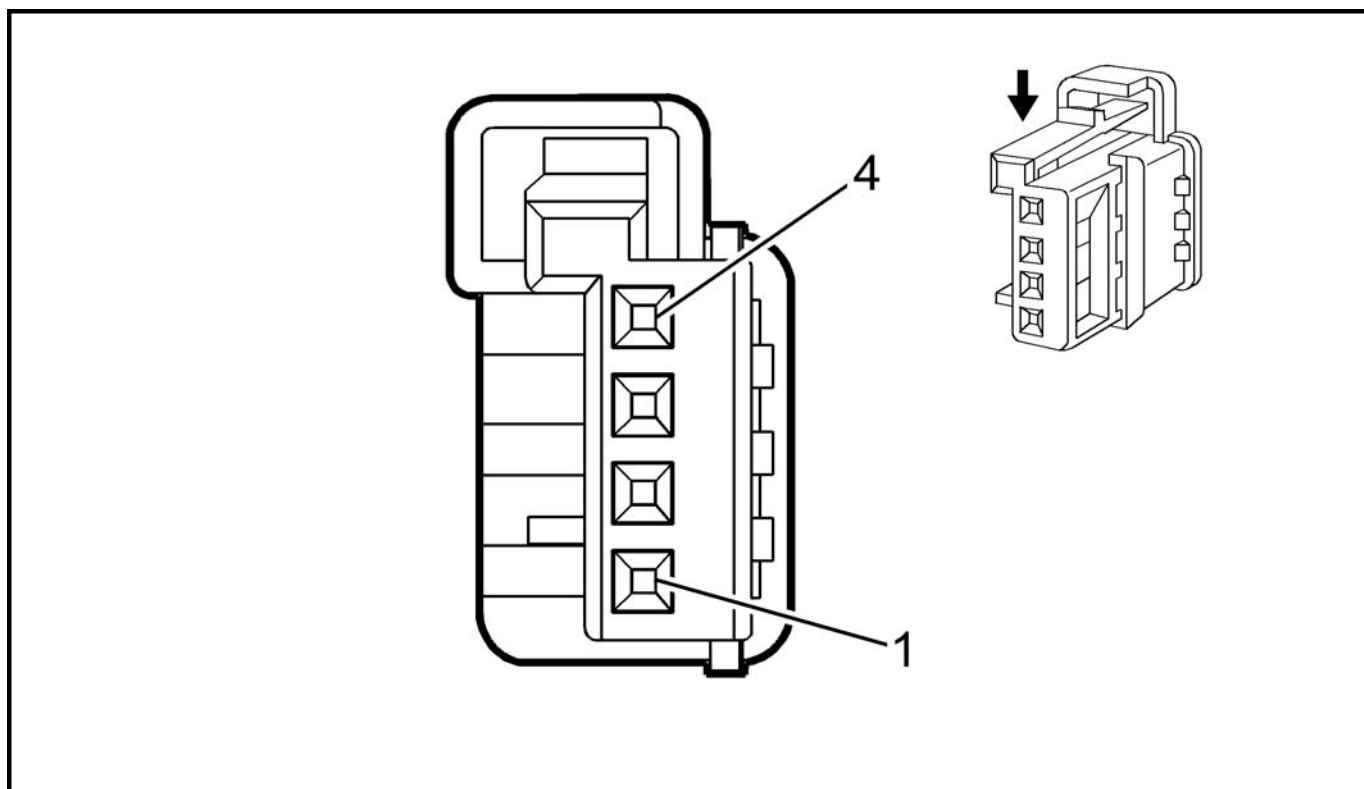
- Harness Type: Body
- OEM Connector: AIT2PB-06-1AK
- Service Connector: 19167753
- Description: 6-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	650	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.35	VT/BK	7553	Park Lock Solenoid Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	WH/VT	5905	Key Capture/Column Lock Shift Position Signal	I	-

S13D DOOR LOCK SWITCH - DRIVER



Connector Part Information

- Harness Type: Driver Door Trim
- OEM Connector: 1379029-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 Micro-Quadlock Series (WH)

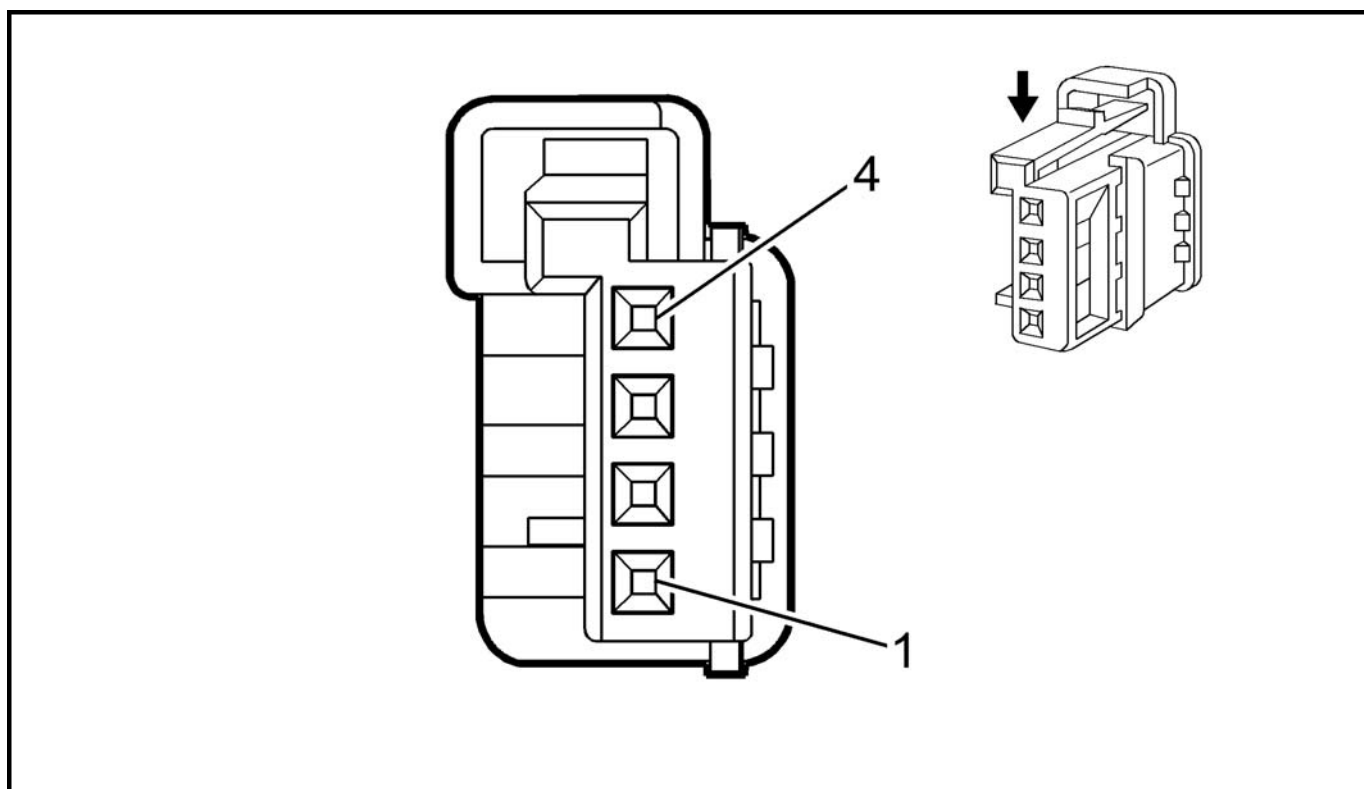
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal	Option
-----	------	-------	---------	----------	----------	--------

					Type ID	
1	0.35	YE	6817	LED Backlight Dimming Control	I	-
2	0.35	BN/YE	780	Driver Door Lock Switch Lock Signal	I	-
3	0.35	BN/WH	781	Driver Door Lock Switch Unlock Signal	I	-
4	0.35	BK	1550	Ground	I	-

S13P DOOR LOCK SWITCH - PASSENGER



Connector Part Information

- Harness Type: Passenger Door Trim
- OEM Connector: 1379029-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 Micro-Quadlock Series (WH)

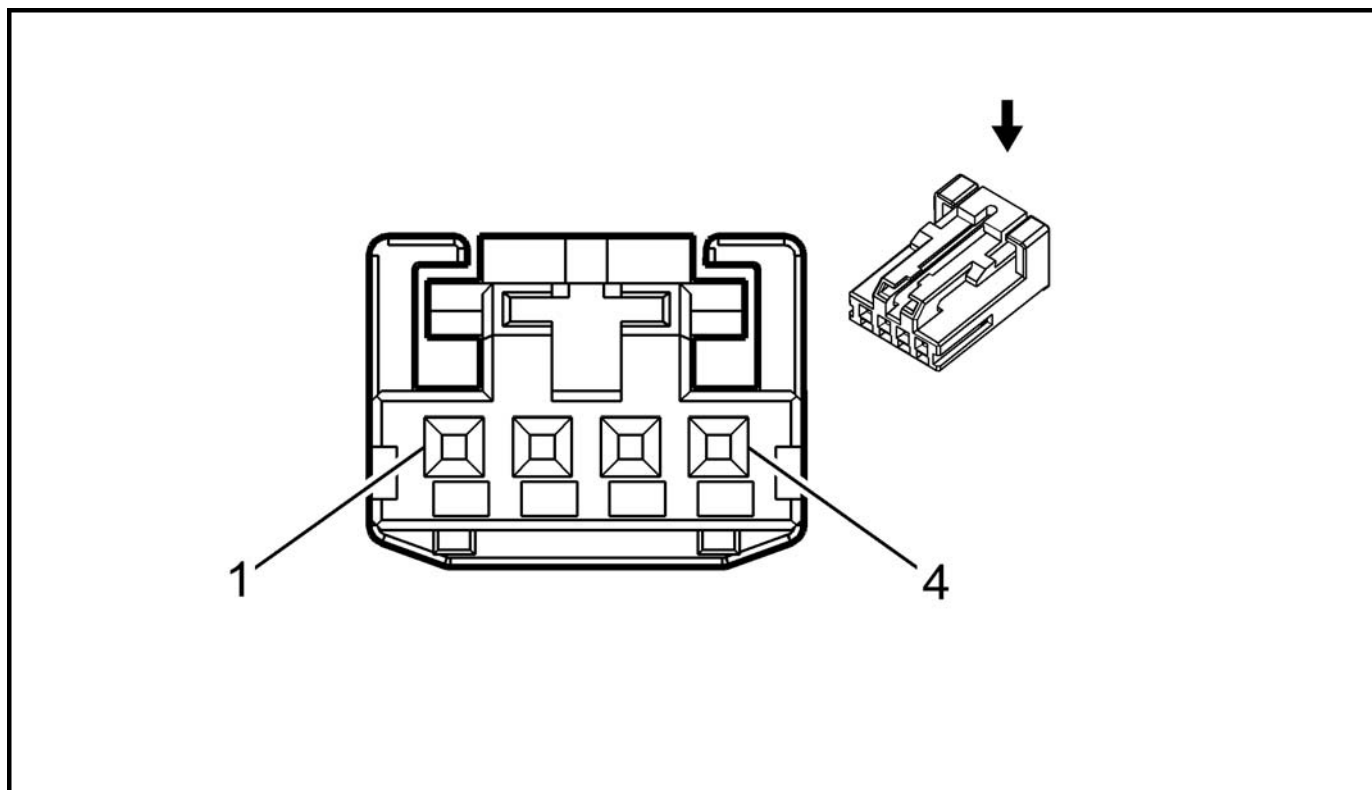
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-----	------	-------	---------	----------	------------------	--------

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE	6817	LED Backlight Dimming Control	I	-
2	0.35	YE/VT	244	Passenger Door Lock Switch Lock Control	I	-
3	0.35	BN/VT	245	Passenger Door Lock Switch Unlock Control	I	-
4	0.35	BK	2050	Ground	I	-

S26 HAZARD WARNING SWITCH



Connector Part Information

- Harness Type: Floor Console
- OEM Connector: 1-936119-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 Micro-Quadlock Series (BK)

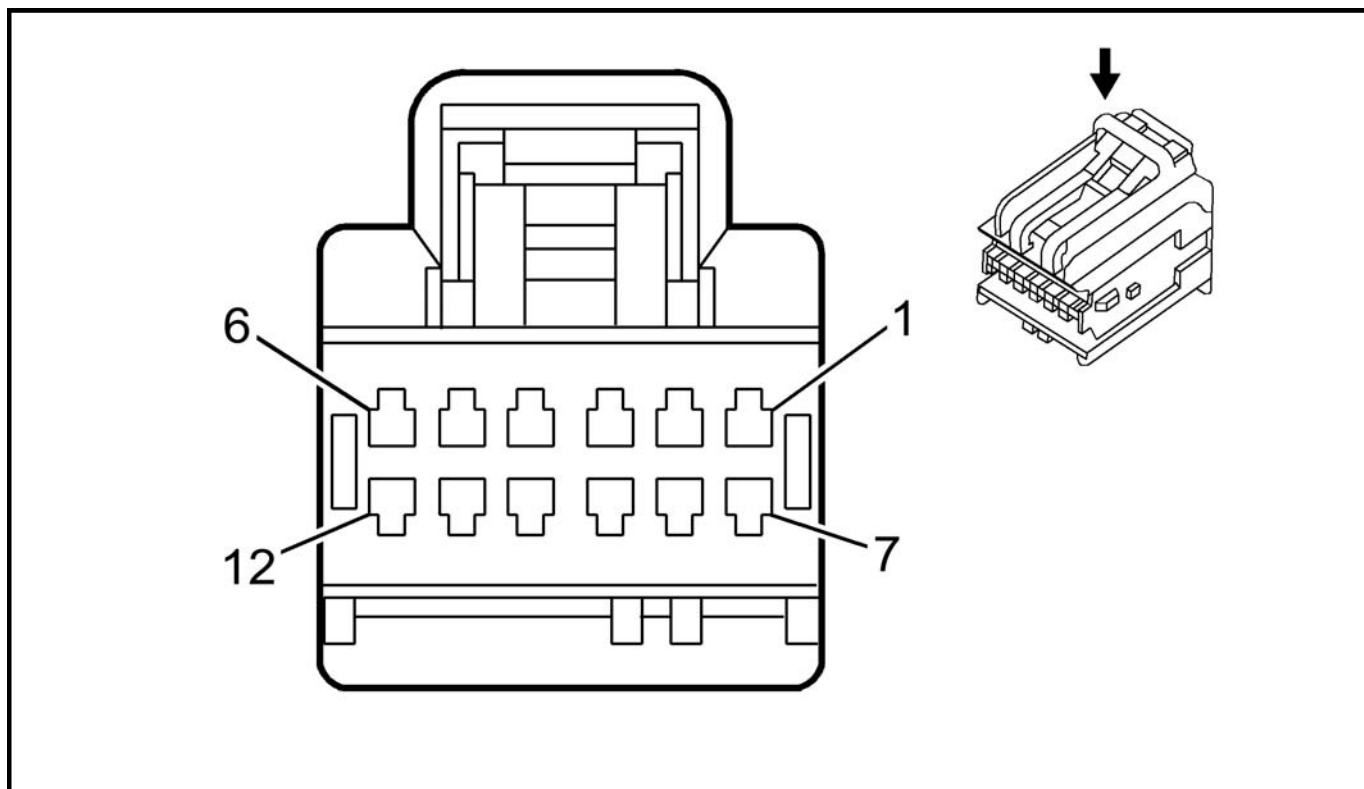
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-----	------	-------	---------	----------	------------------	--------

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	0.35	GY/YE	7543	Hazard LED Dimming Signal	I	-
3	0.35	GN/WH	111	Hazard Switch Signal	I	-
4	-	-	-	Not Occupied	-	-

S30 HEADLAMP SWITCH



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1120
- Service Connector: 89047364
- Description: 12-Way F 0.64 Series, Sealed (BK)

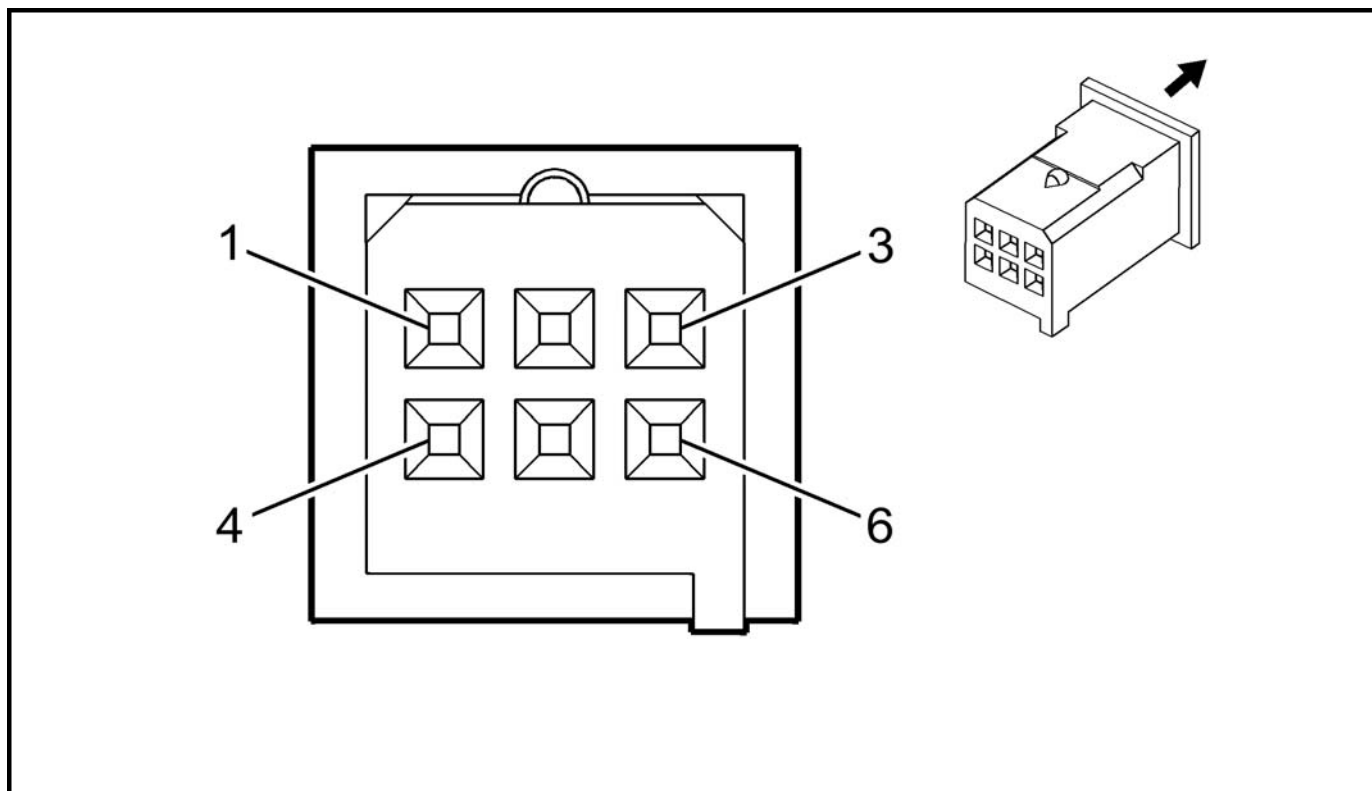
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575845	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/VT	103	Headlamp Switch On Signal	I	-
2	0.35	YE	6817	LED Backlight Dimming Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	GN/BN	306	Headlamp Switch Headlamps Off Signal Control	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GN/GY	13	Headlamp Switch Park Lamp Signal	I	-
6	-	-	-	Not Occupied	-	-
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	I	-
8	0.5	BK	1650	Ground	I	-
9 - 10	-	-	-	Not Occupied	-	-
11	0.35	YE/GY	44	Instrument Panel Lamp Dimmer Switch Signal	I	-
12	0.35	GN/RD	812	12V Reference	I	-

S32LR SEAT HEATING SWITCH - LEFT REAR



Connector Part Information

- Harness Type: Body
- OEM Connector: 24414934
- Service Connector: 88988105
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

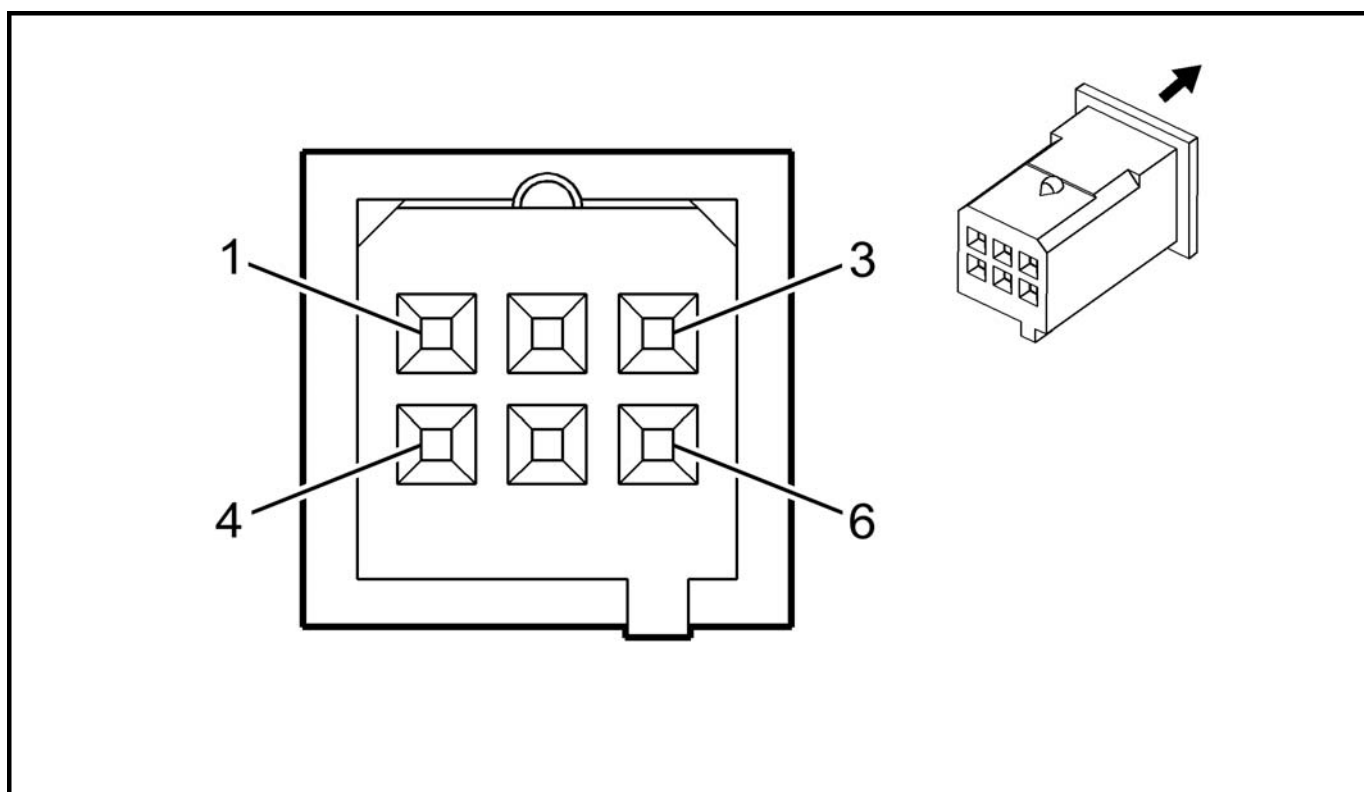
Terminal Part Information

Terminal	Terminated	Diagnostic	Terminal	Service	Tray	Core	Insulation
----------	------------	------------	----------	---------	------	------	------------

Type ID	Lead	Test Probe	Removal Tool	Terminal	Name	Crimp	Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	650	Ground	I	-
2	0.35	YE	6817	LED Backlight Dimming Control	I	-
3	0.35	BN/WH	1637	Left Rear Heated Seat Switch Signal	I	-
4	0.35	WH	1638	Left Rear Heated Seat High Indicator Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	WH	6816	Indicator Dimming Control	I	-

S32RR SEAT HEATING SWITCH - RIGHT REAR



Connector Part Information

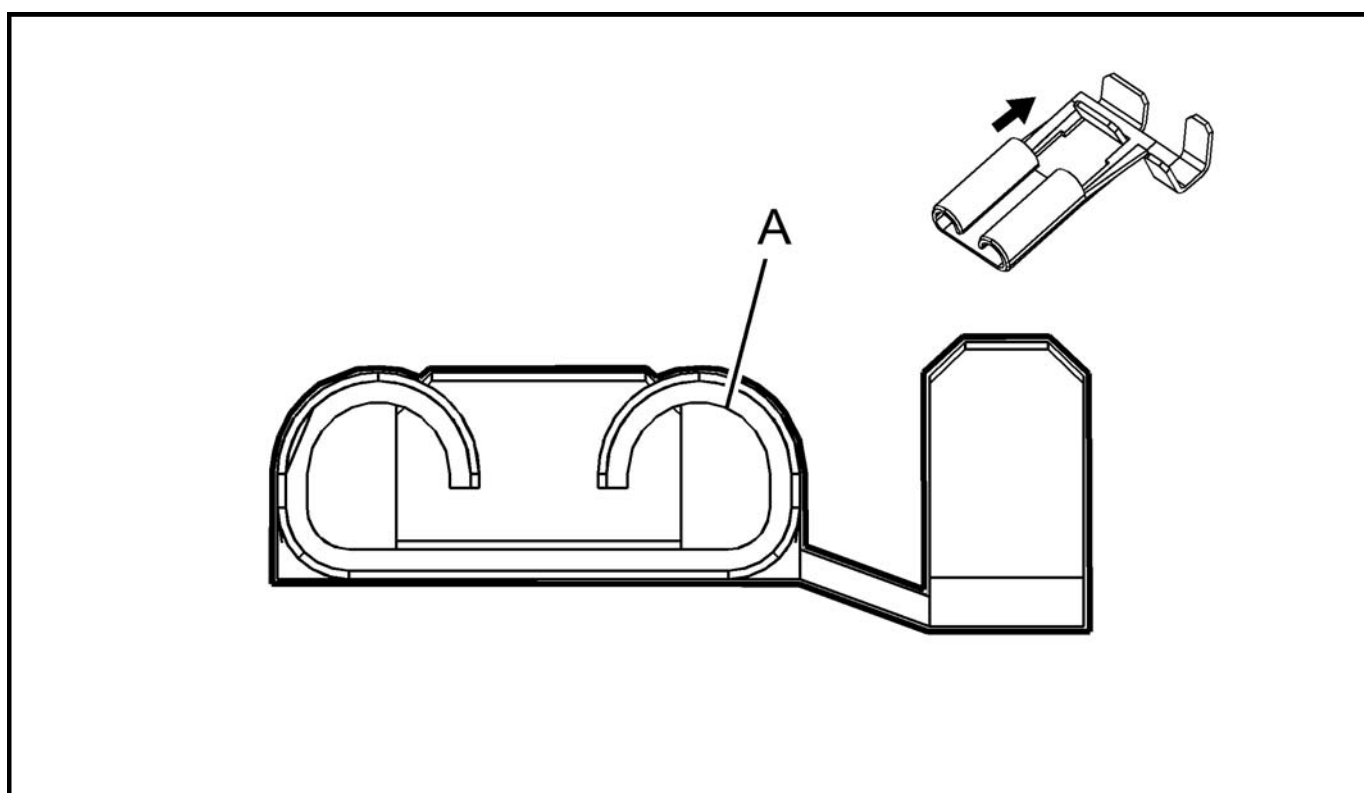
- Harness Type: Body
- OEM Connector: 2-968291-2
- Service Connector: 13225892
- Description: 6-Way F 0.64 Micro-Quadlock Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	650	Ground	I	-
2	0.35	YE	6817	LED Backlight Dimming Control	I	-
3	0.35	BN/GN	1634	Right Rear Heated Seat Switch Signal	I	-
4	0.35	BN/WH	1635	Right Rear Heated Seat High Indicator Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	WH	6816	Indicator Dimming Control	I	-

S33 HORN SWITCH X1



Connector Part Information

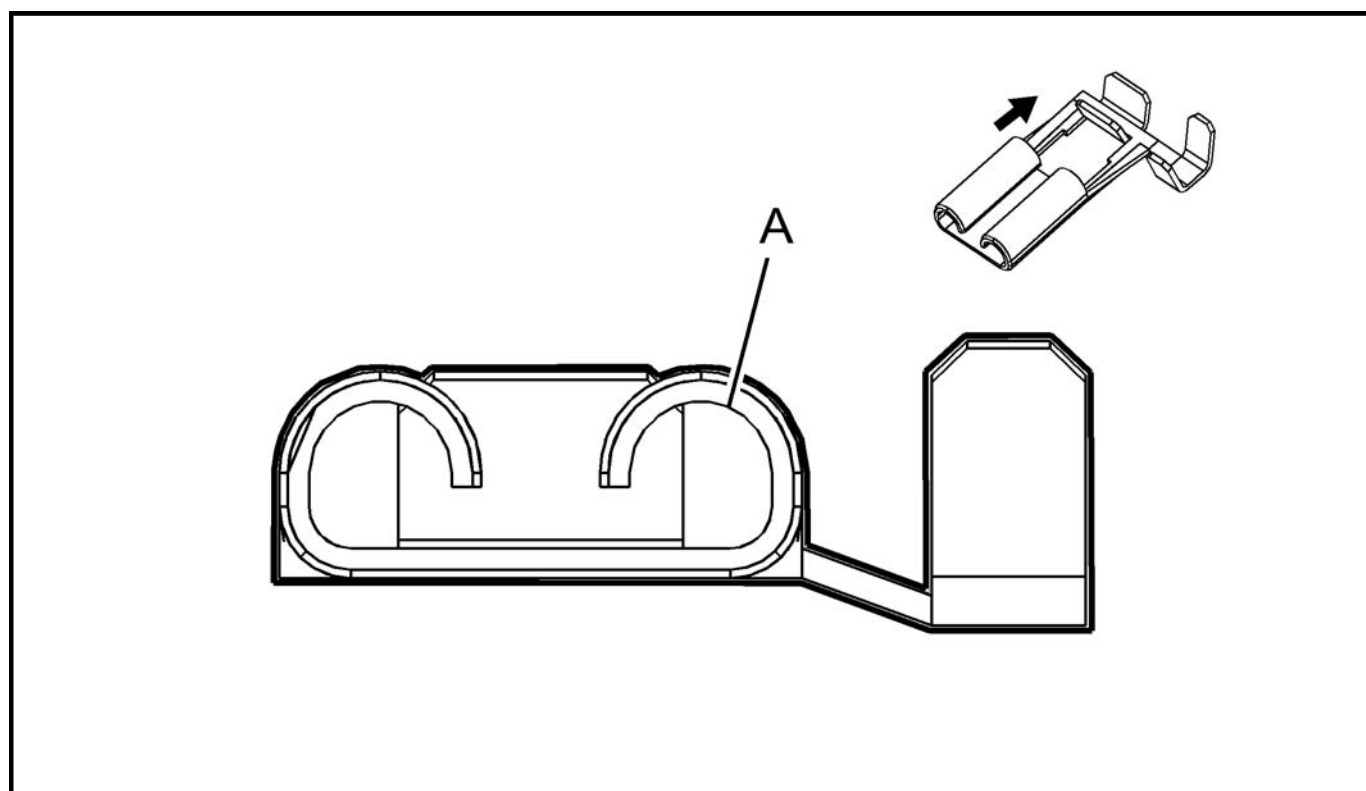
- Harness Type: Steering Wheel
- OEM Connector: 1742086-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F Fast-In-On Series

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.35	RD	3287	Horn Switch Signal	I	-

S33 HORN SWITCH X2



Connector Part Information

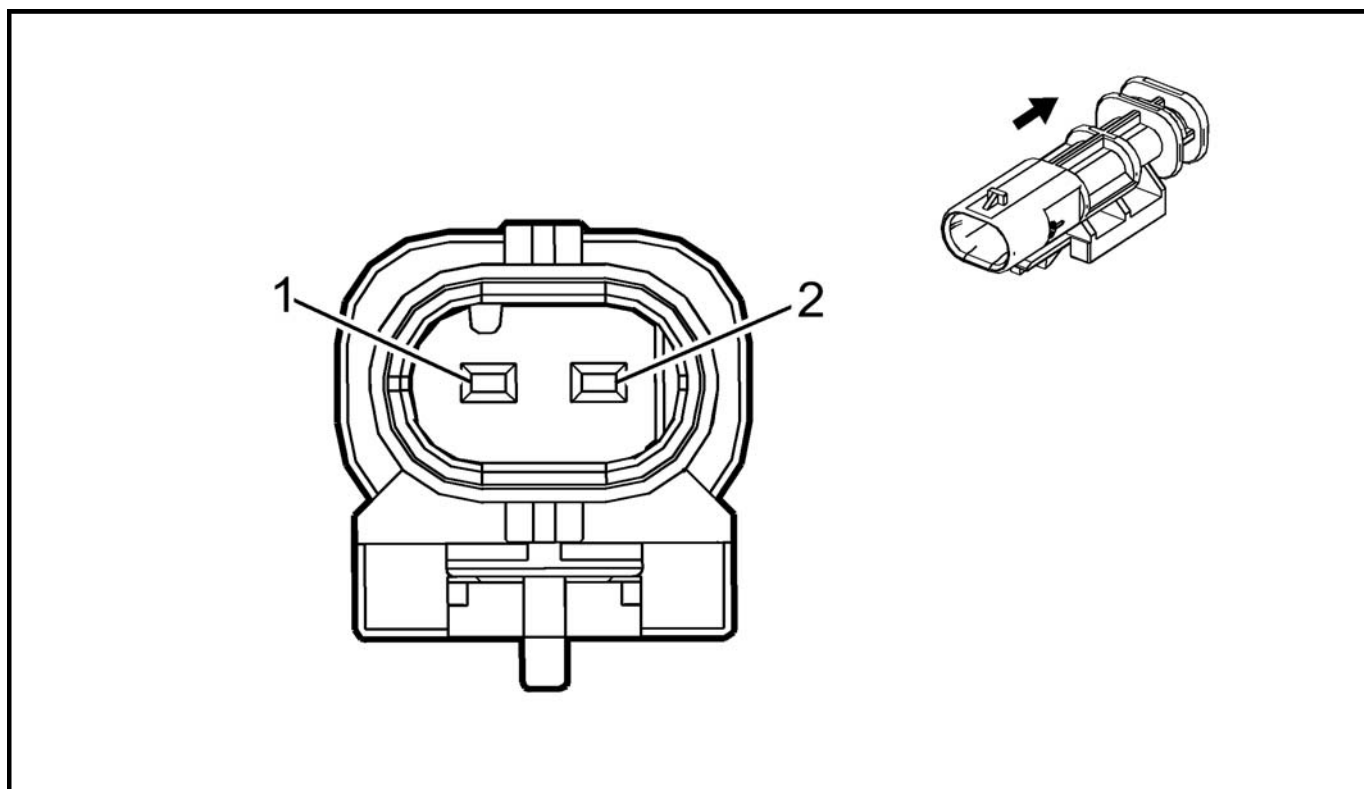
- Harness Type: Steering Wheel
- OEM Connector: 1742086-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F Fast-In-On Series

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.35	BK	1650	Ground	I	-

S46 LIFTGATE HANDLE SWITCH



Connector Part Information

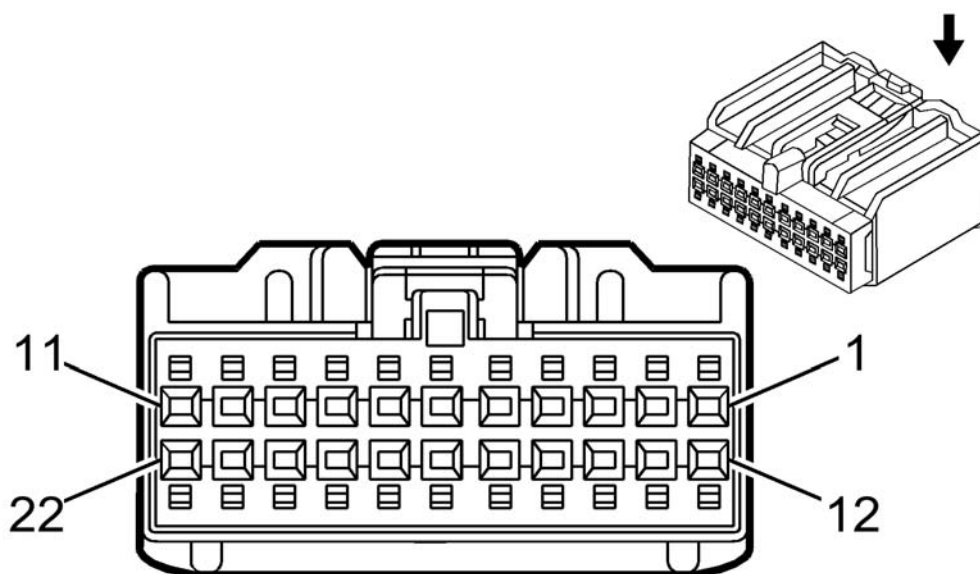
- Harness Type: Liftgate
- OEM Connector: 1-1703498-3
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BU	5797	Rear Closure Handle Switch Open Signal	I	-
2	0.5	BK	850	Ground	I	-

S48B MULTIFUNCTION SWITCH - OVERHEAD CONSOLE



Connector Part Information

- Harness Type: Headliner
- OEM Connector: AIT2PB-22-2AK
- Service Connector: 13504097
- Description: 22-Way F 0.64 Kaizen Series (BK)

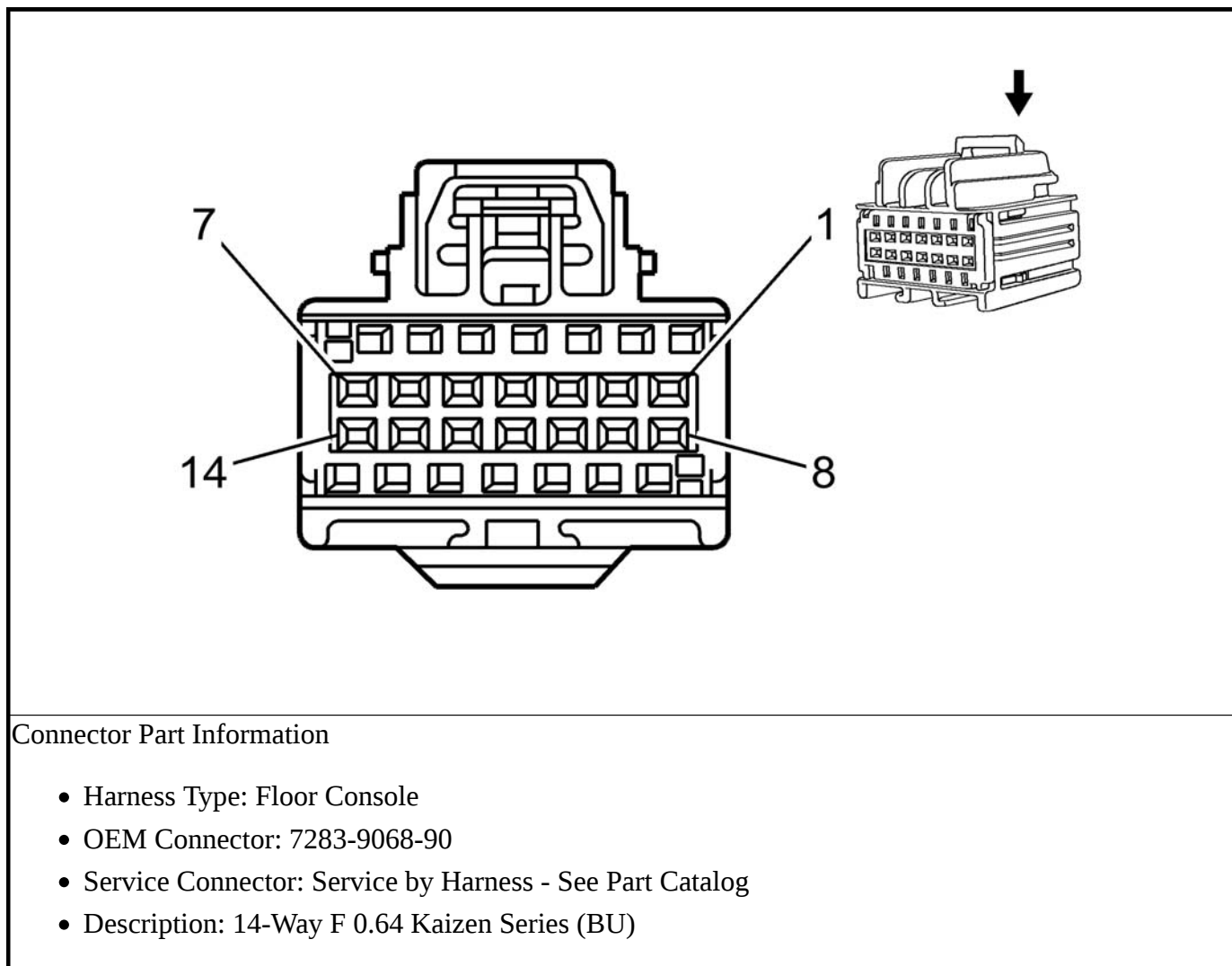
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	RD/GN	2440	Battery Positive Voltage	I	-
2	0.5	WH/YE	7557	LED Ambient Lighting Control 1	I	-
3	0.35	GY	156	Courtesy Lamp Switch Signal	I	-
4	-	-	-	Not Occupied	-	-
5	0.5	BK	2150	Ground	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	WH/BN	6815	Inadvertent Power Control	I	-
8	0.5	GY	157	Interior Lamp Control	I	-
9 - 10	-	-	-	Not Occupied	-	-
11	0.35	GN	2308	Passenger Air Bag Off Indicator Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.35	BU	2307	Passenger Air Bag On Indicator Control	I	-
13	0.35	VT/WH	5234	Passenger Seat Belt Indicator Control	I	-
14	0.35	BN/WH	2517	Keypad Red LED Control	I	-
15	0.35	YE/VT	2516	Keypad Green LED Control	I	-
16	0.35	GN/BK	2515	Keypad Control	I	-
17	0.35	GN/WH	2514	Keypad Signal	I	-
18	0.35	WH	6816	Indicator Dimming Control	I	-
19	0.35	BU/GY	4672	Dome Lamp Off Indicator Control	I	-
20	-	-	-	Not Occupied	-	-
21	0.35	GY/GN	328	Interior Lamp Defeat Switch Signal	I	-
22	0.35	YE	6817	LED Backlight Dimming Control	I	-

S48E MULTIFUNCTION SWITCH - CENTER CONSOLE

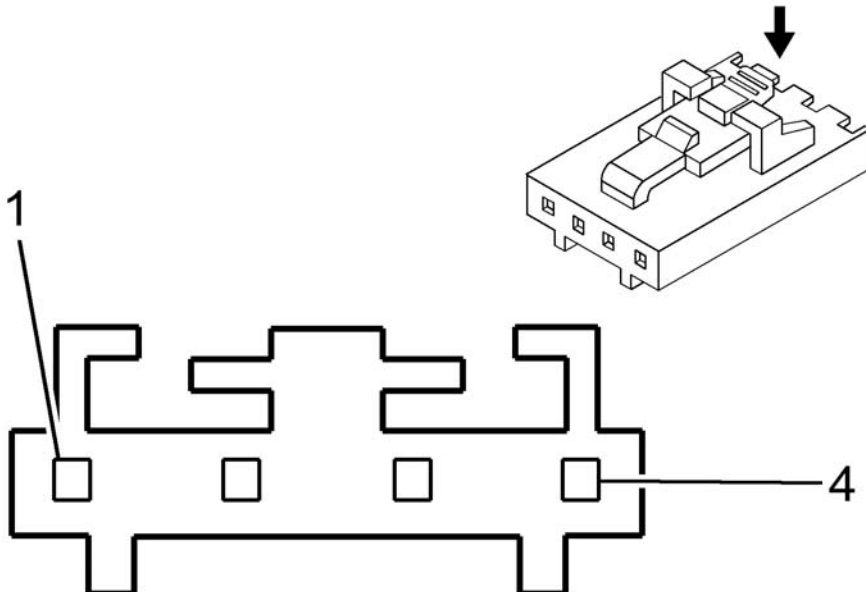


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	0.35	YE	6817	LED Backlight Dimming Control	I	-
3	0.5	WH	6816	Indicator Dimming Control	I	-
4	0.35	BU/VT	1788	Traction Control Switch Signal 1	I	-
5	0.35	GY/GN	2555	Rear Park Assist Disable Signal	I	-
6	0.35	GN/BN	5852	Rear Park Assist LED Disable Signal	I	-
7	0.35	BU/BN	3161	Parallel Park Assist Disable Switch Signal	I	-
8 - 9	-	-	-	Not Occupied	-	-
10	0.35	GY	5054	Sport Mode Switch Signal	I	-
11 - 14	-	-	-	Not Occupied	-	-

S70E STEERING WHEEL CONTROLS SWITCH - RADIO PRESETS



Connector Part Information

- Harness Type: Steering Wheel

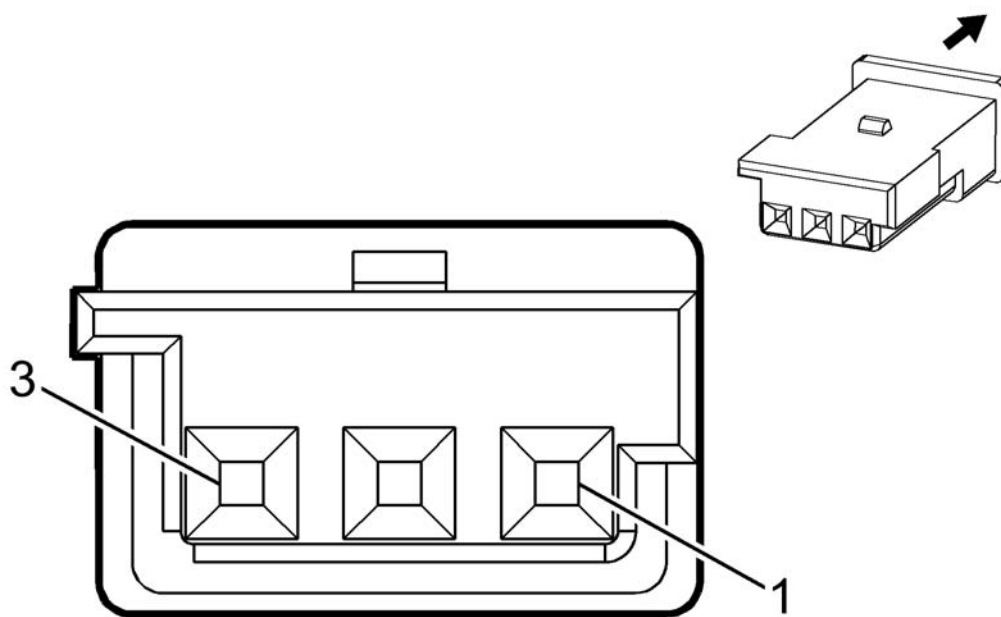
- OEM Connector: 50-57-9404
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 SL Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	0.35	GN/OG	4313	Radio Favorite Forward Signal	I	-
3	0.35	GY/OG	4312	Radio Favorite Back Signal	I	-
4	0.35	BN/RD	6817	LED Backlight Dimming Control	I	-

S70F STEERING WHEEL CONTROLS SWITCH - RADIO VOLUME



Connector Part Information

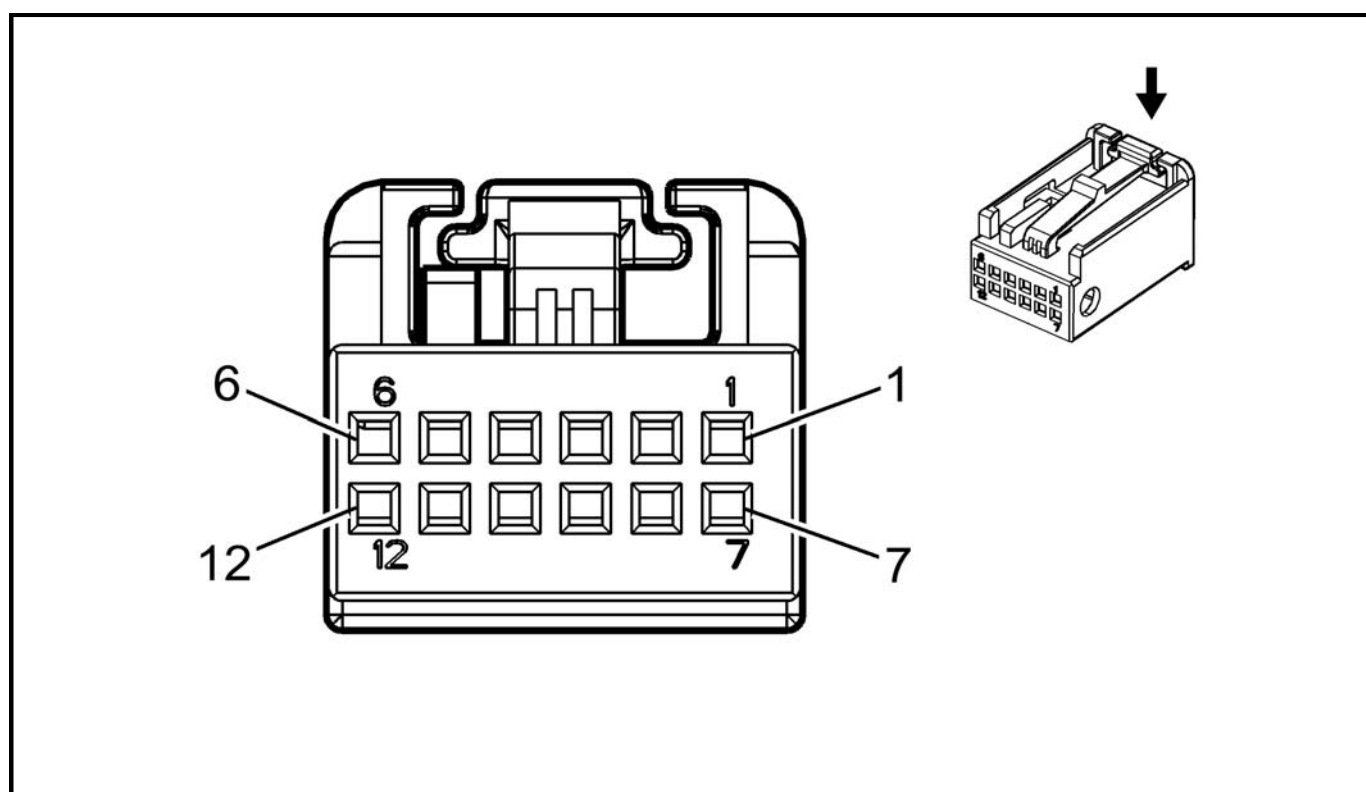
- Harness Type: Steering Wheel
- OEM Connector: 4-1718346-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Micro-Quadlock Series (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/BU	4315	Radio Volume Up Signal	I	-
2	0.35	BU/RD	4314	Radio Volume Down Signal	I	-
3	0.35	BK	1650	Ground	I	-

S70L STEERING WHEEL CONTROLS SWITCH - LEFT



Connector Part Information

- Harness Type: Steering Wheel
- OEM Connector: 1-1355524-3
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 0.64 GET Series (BK with BK Case)

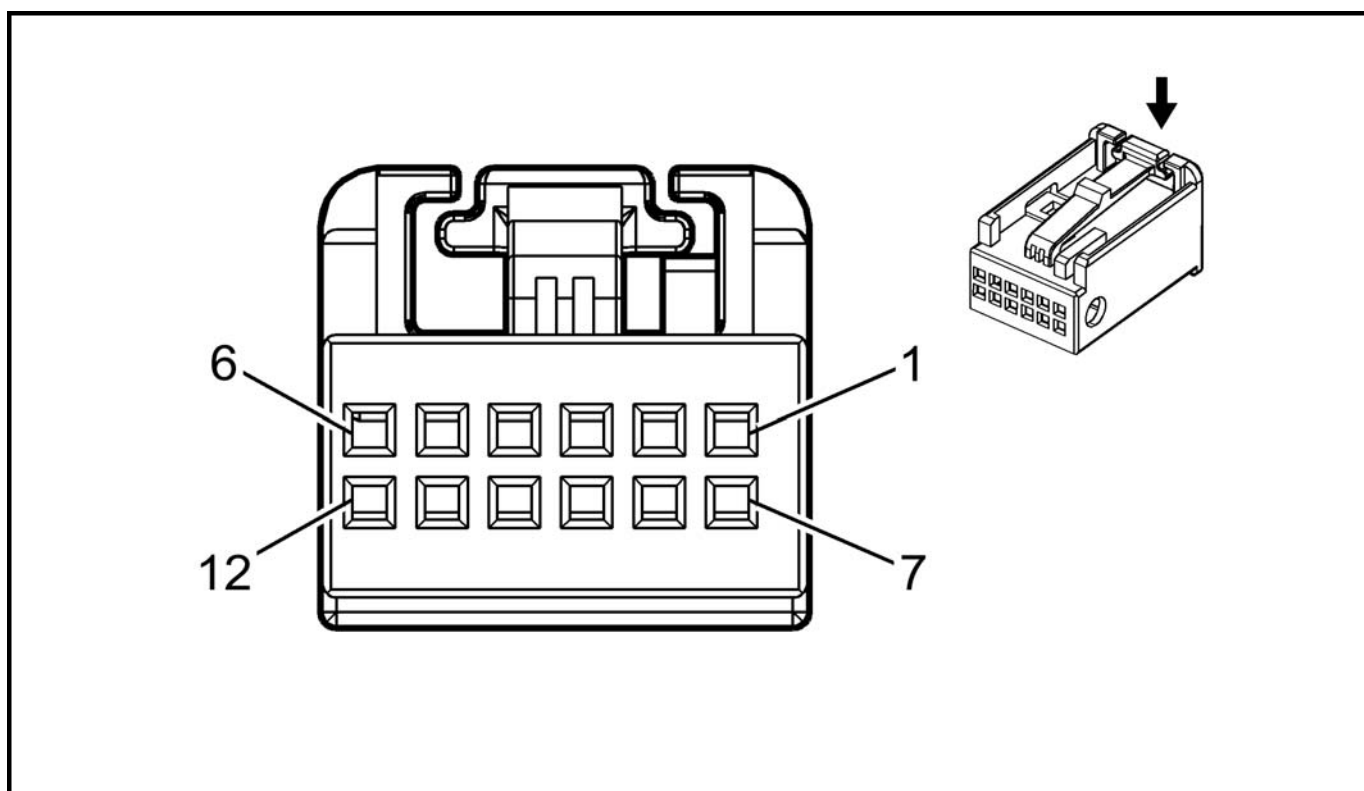
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
			Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	GN	3893	LED Backlight Dimming Control 2	I	-
4	0.5	GY	6816	Indicator Dimming Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	BU	5440	Battery Positive Voltage	I	-
7	0.35	GN/RD	5884	Heated Steering Wheel Switch LED Control	I	UVD
8	0.35	BU/RD	5883	Heated Steering Wheel Switch Signal	I	UVD
9	0.35	BK/RD	1884	Cruise Control Set/Coast/Resume /Accelerate Switch Signal	I	-
10	0.35	GY	5737	Adaptive Cruise Control Gap Up/Down Switch Signal	I	-
11	0.35	PK	3152	Lane Departure Warning Indicator Control	I	-
12	0.35	BU	1444	12V Reference	I	-

S70R STEERING WHEEL CONTROLS SWITCH - RIGHT



Connector Part Information

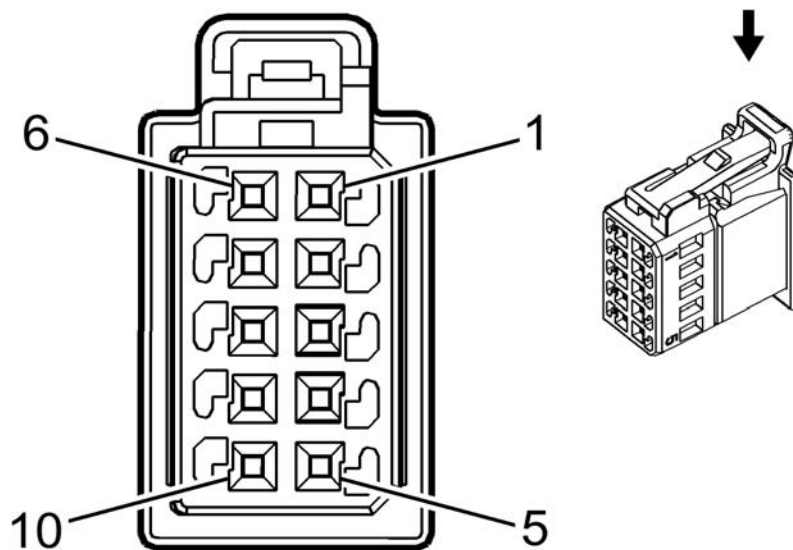
- Harness Type: Steering Wheel
- OEM Connector: 2-1355524-3
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 0.64 GET Series (BK with NA Case)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	0.35	WH	3894	Local Interconnect Network Serial Data Bus 12	I	-
3	0.35	GN	3893	LED Backlight Dimming Control 2	I	-
4	0.5	GY	6816	Indicator Dimming Control	I	-
5 - 6	-	-	-	Not Occupied	-	-
7	0.35	GN/OG	4313	Radio Favorite Forward Signal	I	-
8	0.35	GY/OG	4312	Radio Favorite Back Signal	I	-
9	0.35	BU/RD	4314	Radio Volume Down Signal	I	-
10	0.35	BK/BU	4315	Radio Volume Up Signal	I	-
11	-	-	-	Not Occupied	-	-
12	0.35	BU	5440	Battery Positive Voltage	I	-

S78 TURN SIGNAL/MULTIFUNCTION SWITCH



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1488973-1
- Service Connector: 19299776
- Description: 10-Way F 0.64 Micro-Quadlock Series (BK)

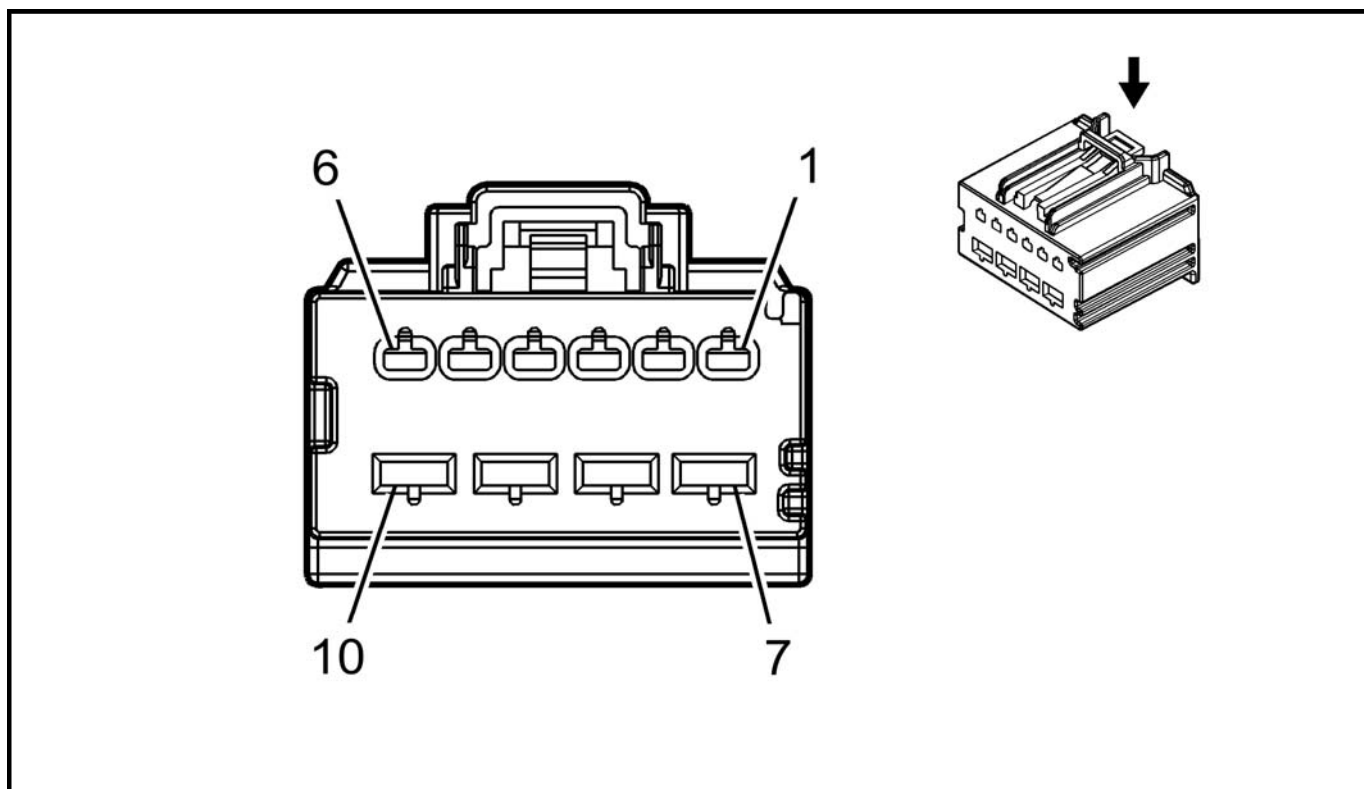
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/WH	1414	Left Front Turn Signal Switch Signal	I	-
2	0.5	GN/VT	1415	Right Front Turn Signal Switch Signal	I	-
3	0.5	BK	1650	Ground	I	-
4	0.5	BU	6856	Headlamp Automatic High Beam Dim Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	YE/BN	307	Headlamp Switch Flash To Pass Signal	I	-
7	0.5	WH	524	Headlamp Dimmer Switch High Beam Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8 - 10	-	-	-	Not Occupied	-	-

S79LR WINDOW SWITCH - LEFT REAR



Connector Part Information

- Harness Type: Left Rear Door
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

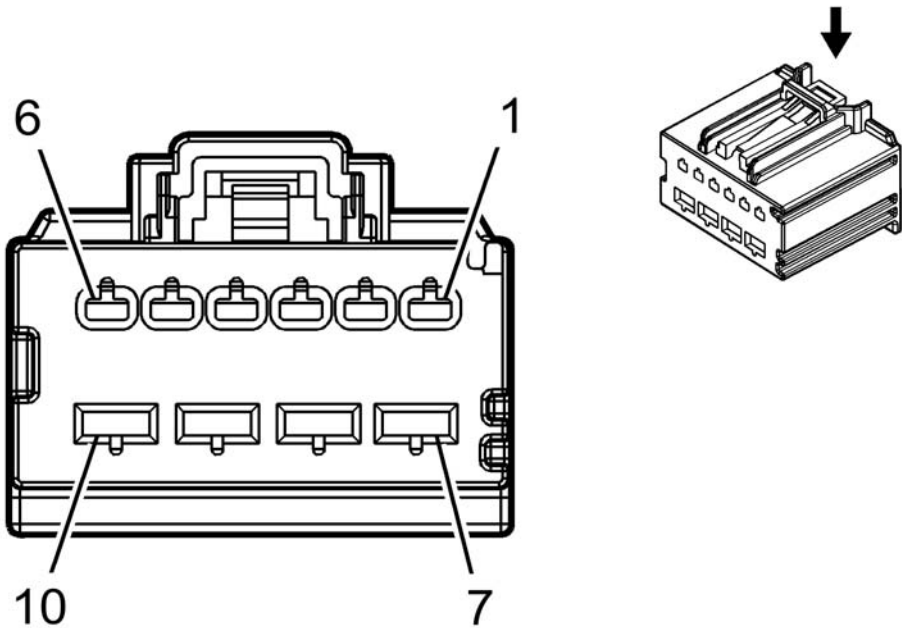
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	GY	747	Left Rear Door Ajar Switch Signal	I	-
3	0.35	BK	650	Ground	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	2.5	BK	650	Ground	II	-
8	2.5	RD/BN	3640	Battery Positive Voltage	II	-
9	2.5	BU/VT	668	Power Window Motor Left Rear Up Control	II	-
10	2.5	YE/BU	669	Power Window Motor Left Rear Down Control	II	-

S79P WINDOW SWITCH - PASSENGER



Connector Part Information

- Harness Type: Passenger Door Trim
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

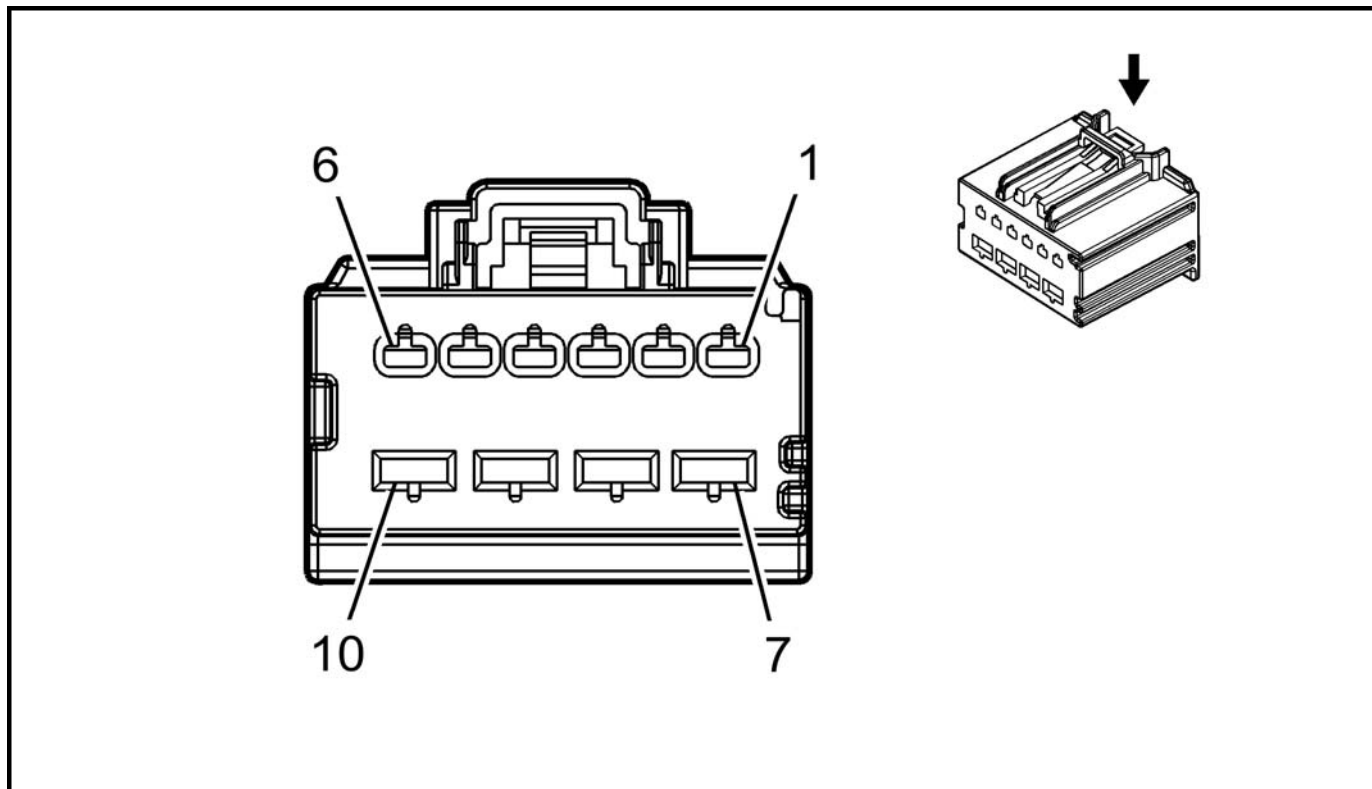
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A	No Tool	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(GY)	Required		Required	Required	Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	I	-
2	0.35	GY	746	Right Front Door Ajar Switch Signal	I	-
3 - 6	-	-	-	Not Occupied	-	-
7	2.5	BK	2050	Ground	II	-
8	2.5	RD/YE	3740	Battery Positive Voltage	II	-
9	2.5	GN/GY	3387	Power Window Motor Passenger Up Control	II	-
10	2.5	YE/BU	3388	Power Window Motor Passenger Down Control	II	-

S79RR WINDOW SWITCH - RIGHT REAR



Connector Part Information

- Harness Type: Right Rear Door
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog

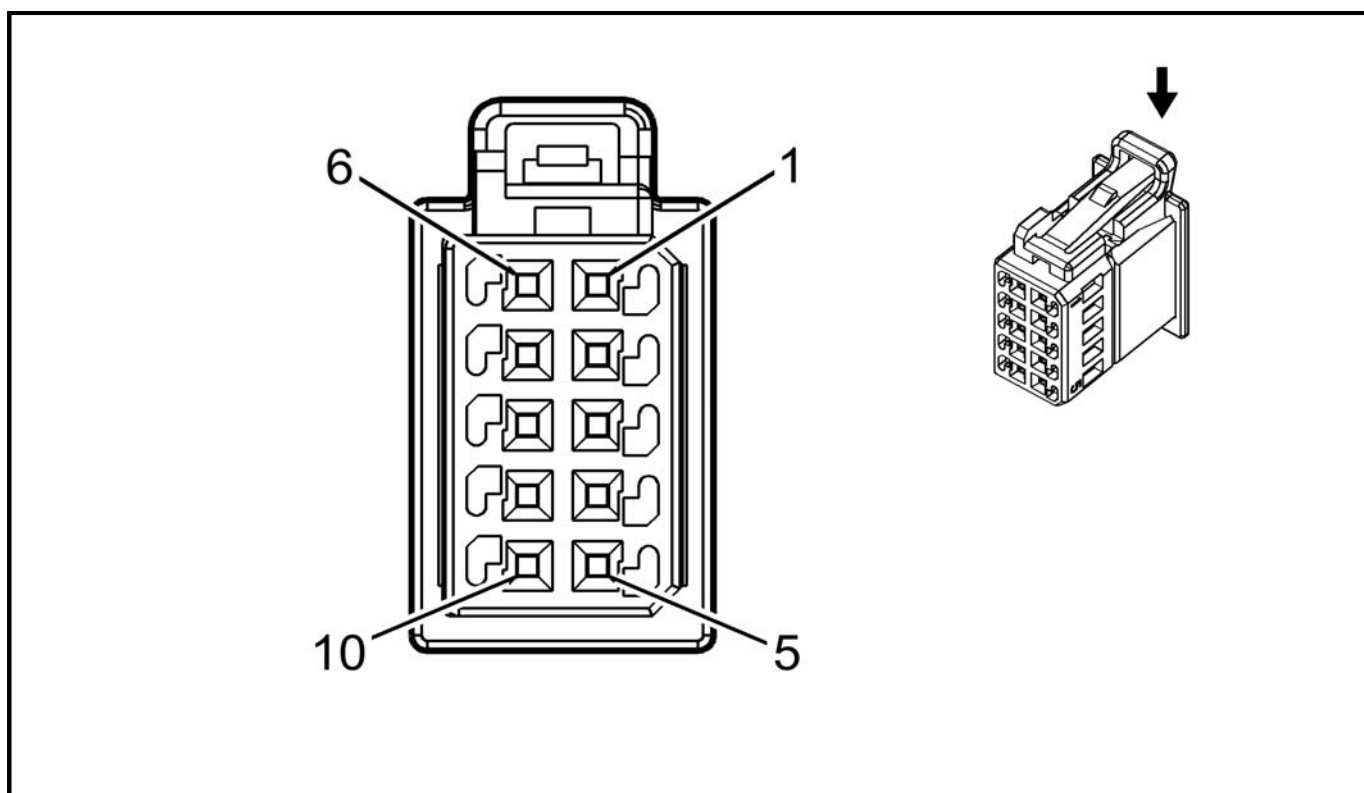
- Description: 10-Way F 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	I	-
2	0.35	GY	748	Right Rear Door Ajar Switch Signal	I	-
3 - 6	-	-	-	Not Occupied	-	-
7	2.5	BK	850	Ground	II	-
8	2.5	RD/YE	3740	Battery Positive Voltage	II	-
9	2.5	BU/GY	670	Power Window Motor Right Rear Up Control	II	-
10	2.5	GN/BK	671	Power Window Motor Right Rear Down Control	II	-

S82 WINDSHIELD WIPER/WASHER SWITCH



Connector Part Information

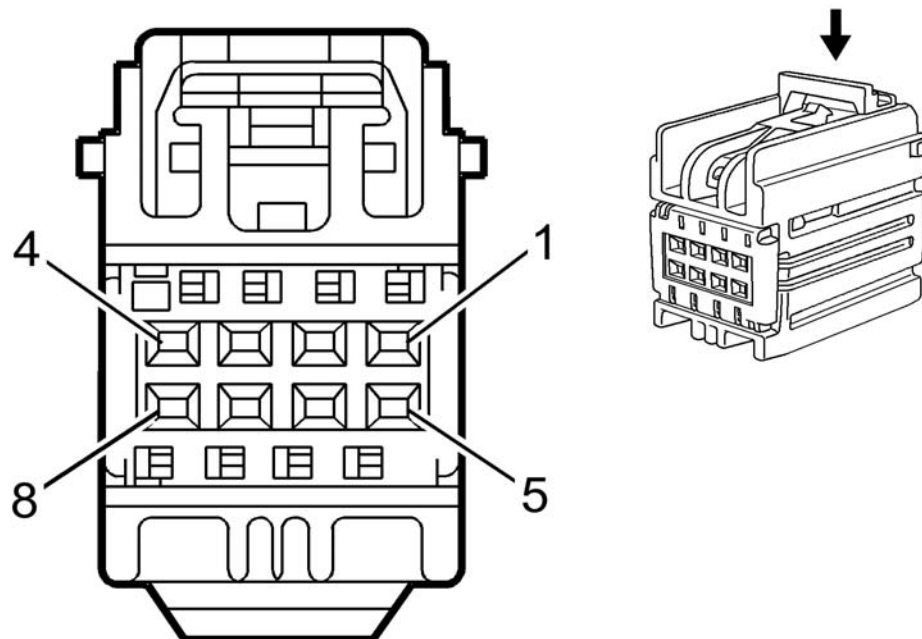
- Harness Type: Instrument Panel
- OEM Connector: 1488973-2
- Service Connector: 19330677
- Description: 10-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/GY	6009	Windshield Wiper Switch Low Reference	I	-
2	0.5	GY	1715	Windshield Wiper Switch High Signal	I	-
3	0.5	YE/BU	1714	Windshield Wiper Switch Low Signal	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	0.5	WH/BK	94	Windshield Washer Switch Signal	I	-
8 - 10	-	-	-	Not Occupied	-	-

S83 VEHICLE ON/OFF SWITCH



Connector Part Information

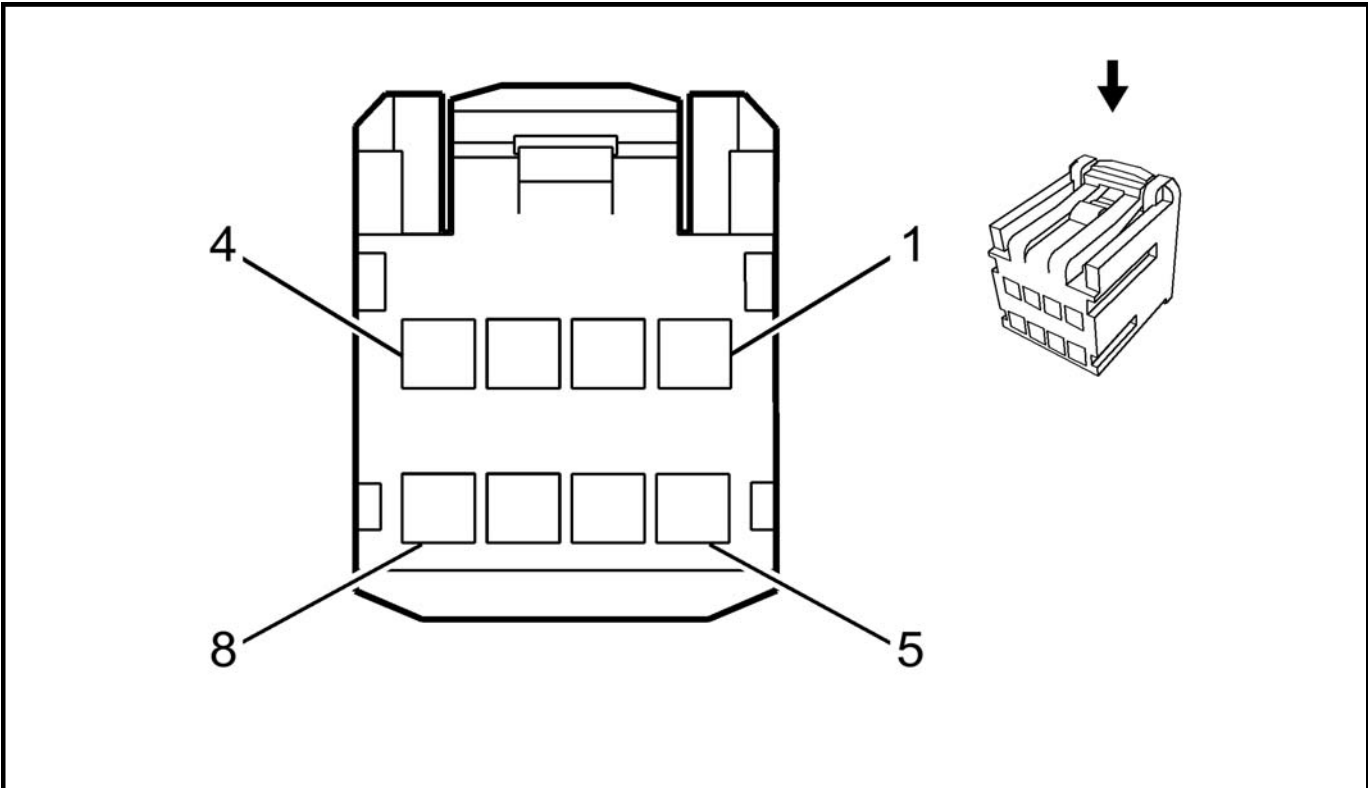
- Harness Type: Instrument Panel
- OEM Connector: 7283-9029-40
- Service Connector: 19115653
- Description: 8-Way F YESC Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.35	GN/BK	3558	Passive Start Switch Signal 2	I	-
4	0.5	BK	1650	Ground	I	-
5	0.35	BU/BK	5719	Ignition Mode Switch Start LED Signal	I	-
6	0.35	BU/GN	5723	Ignition Mode Switch Mode Voltage	I	-
7	0.35	BK/GY	3559	Passive Start Switch 2 Low Reference	I	-
8	0.35	YE/GY	230	Instrument Panel Lamp Dimming Control	I	-

S91 PARK BRAKE CONTROL SWITCH



Connector Part Information

- Harness Type: Floor Console
- OEM Connector: HCMDPB-08-K
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 1.2 HCM Series (BK)

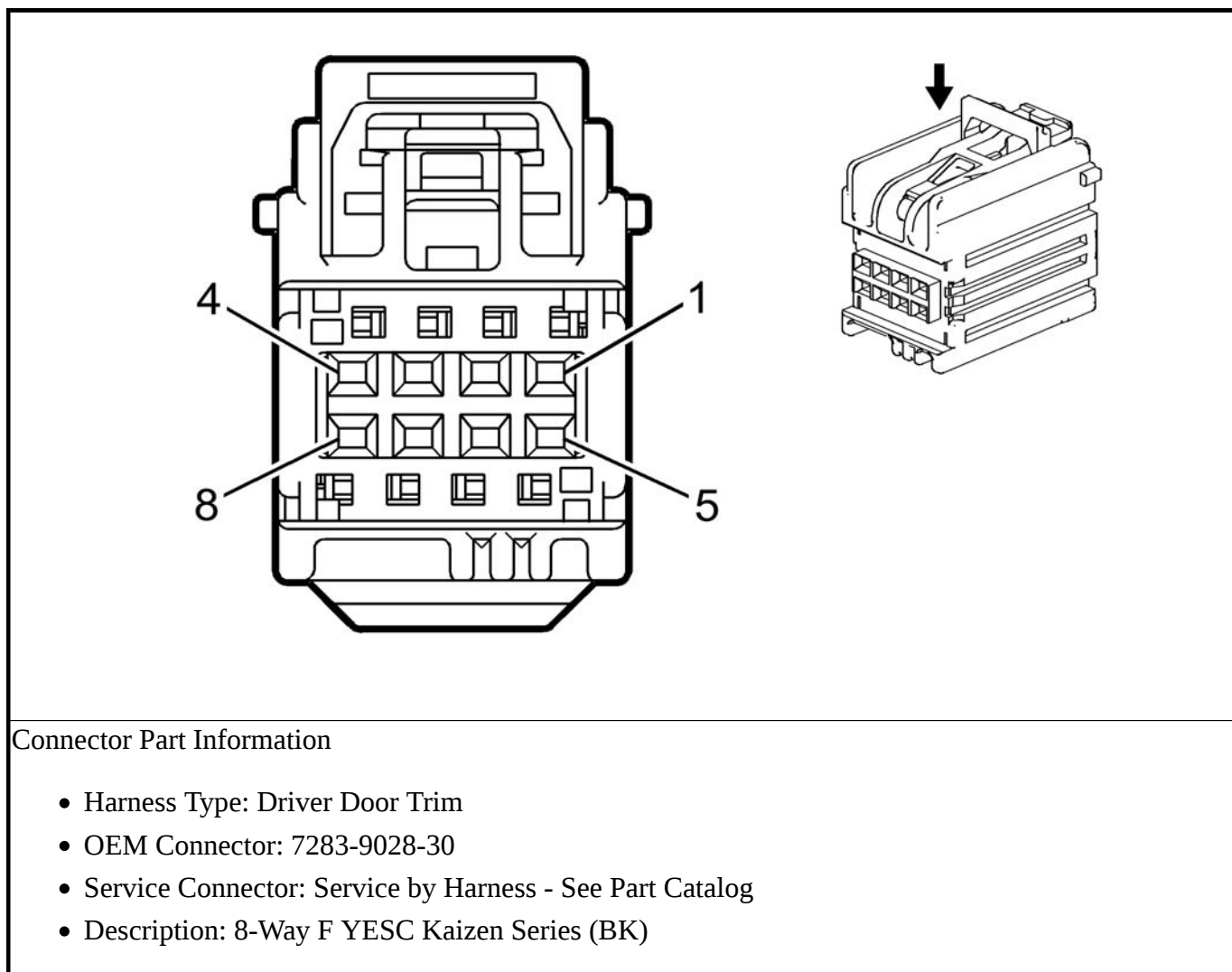
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE	1492	Park Brake Switch Supply Voltage	I	-
2	0.35	BU/VT	1134	Park Brake Switch Signal	I	-
3	0.35	YE/RD	7683	Park Brake Release Switch Voltage Reference	I	-
4	0.35	BN	6107	Park Brake Apply Switch Signal	I	-
5	0.35	BU/BK	6108	Park Brake Release Switch Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
6	0.35	YE	6817	LED Backlight Dimming Control	I	-
7	0.35	GY/RD	7684	Park Brake Apply Switch Voltage Reference	I	-
8	0.35	BK	1650	Ground	I	-

S117 REFUEL REQUEST SWITCH



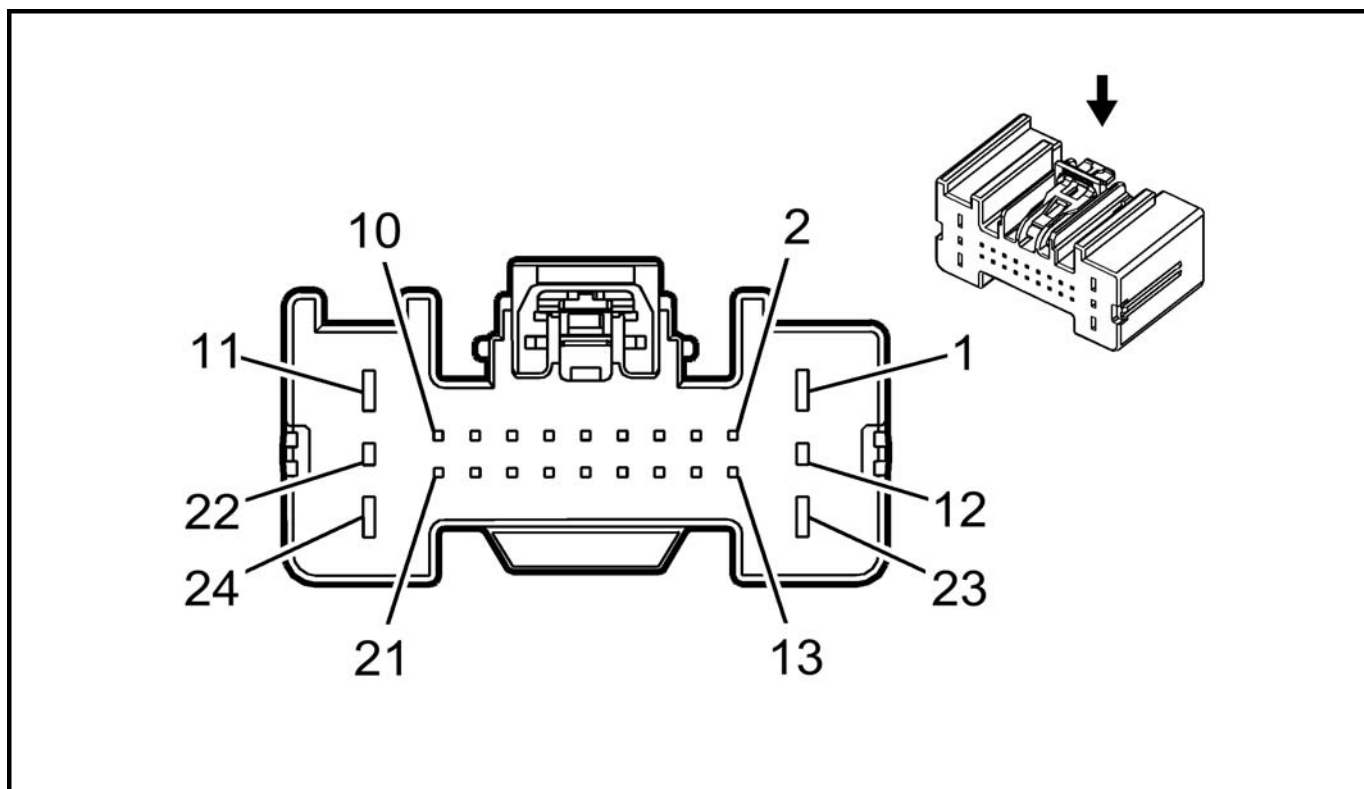
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/WH	4740	Battery Positive Voltage	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	BN/WH	3827	Refuel Request Switch Signal	I	-
3	0.35	GY/WH	1447	Fuel Door Release Switch Signal	I	-
4	0.35	BK	1550	Ground	I	-
5	0.35	YE	6817	LED Backlight Dimming Control	I	-
6	0.35	BK	1550	Ground	I	-
7 - 8	-	-	-	Not Occupied	-	-

S146 WINDOW/OUTSIDE REARVIEW MIRROR SWITCH - DRIVER



Connector Part Information

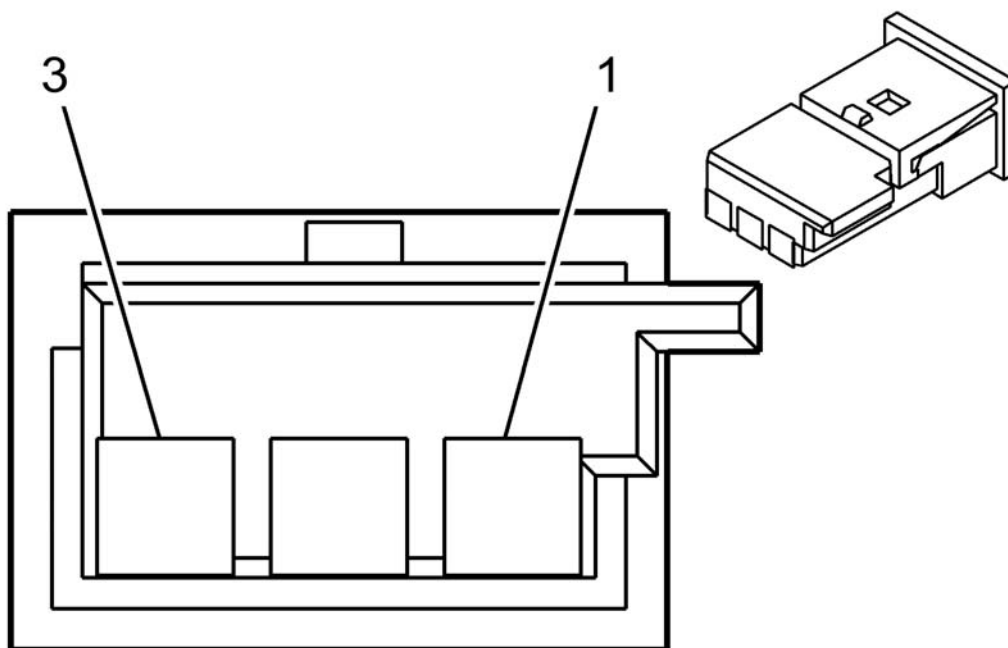
- Harness Type: Driver Door Trim
- OEM Connector: 7287-3260-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 24-Way F 0.64, 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	3380	Power Window Switch Driver Down Signal	I	-
2	0.35	YE/VT	3397	Passenger Mirror Motor Up (+) Down (-) Control	II	-
3	0.35	WH	3398	Passenger Mirror Motor Common Control	II	-
4	0.35	GN/BK	3396	Passenger Mirror Motor Right (+) Left (-) Control	II	-
5	0.35	GN	3381	Power Window Switch Driver Express Signal	II	-
6	0.35	BN/BK	3389	Driver Mirror Motor Right (+) Left (-) Control	II	-
7	0.35	VT/BU	3390	Driver Mirror Motor Up (+) Down (-) Control	II	-
8	0.35	YE/BN	3391	Driver Mirror Motor Common Control	II	-
9	0.35	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	II	-
10	-	-	-	Not Occupied	-	-
11	0.35	GN/WH	3379	Power Window Switch Driver Up Signal	I	-
12 - 13	-	-	-	Not Occupied	-	-
14	0.35	BN/GN	3270	Driver Door Lock Motor Status Signal	II	-
15	0.35	BN/WH	1124	Door Lock Key Switch Unlock Signal	II	-
16 - 22	-	-	-	Not Occupied	-	-
23	0.35	RD/WH	4740	Battery Positive Voltage	I	-
24	0.35	BK	1550	Ground	I	-

S151 REGENERATIVE BRAKING ON-DEMAND SWITCH



Connector Part Information

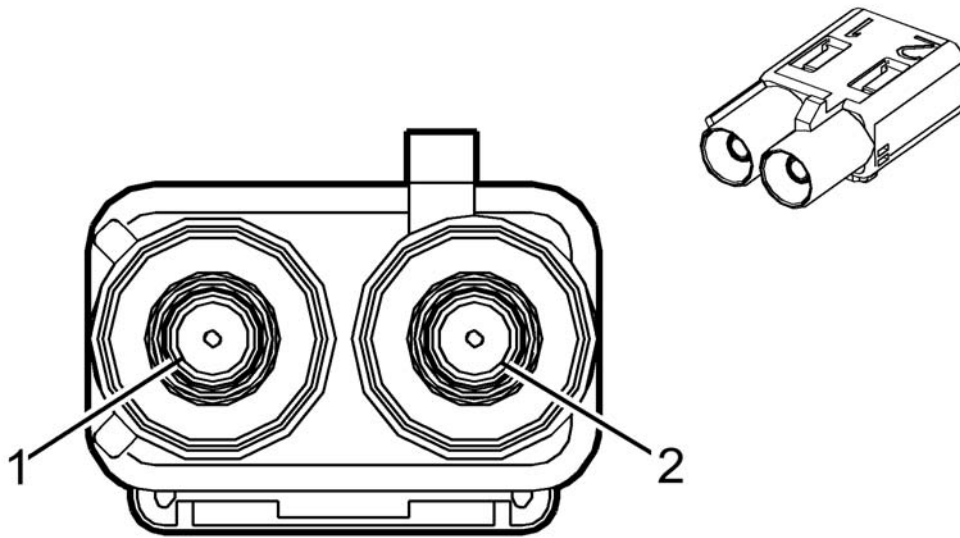
- Harness Type: Steering Wheel
- OEM Connector: 1-1718346-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.35	VT	5526	Tap Up/Tap Down Switch Signal	I	-
3	0.35	BK	1650	Ground	I	-

T2RR ANTENNA - ROOF REAR X1



Connector Part Information

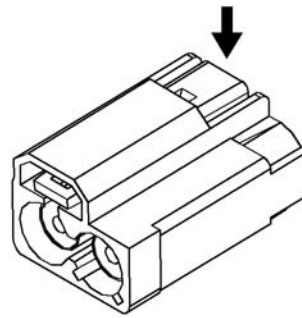
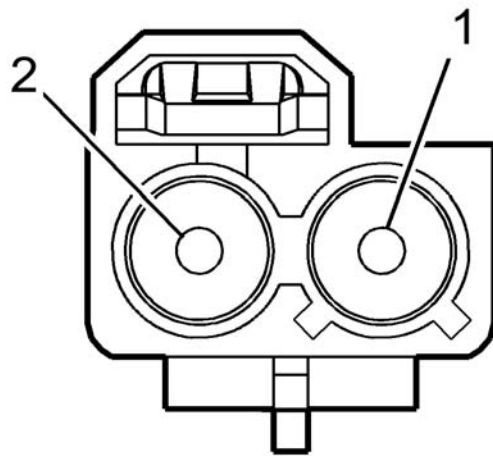
- Harness Type: Instrument Panel
- OEM Connector: 13583909
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way M Coax Type (VT)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	Coax	6758	Coaxial Antenna GPS 2 Signal	I	-
2	-	Coax	6449	Coaxial Antenna Cell Phone Signal	I	-

T2RR ANTENNA - ROOF REAR X2



Connector Part Information

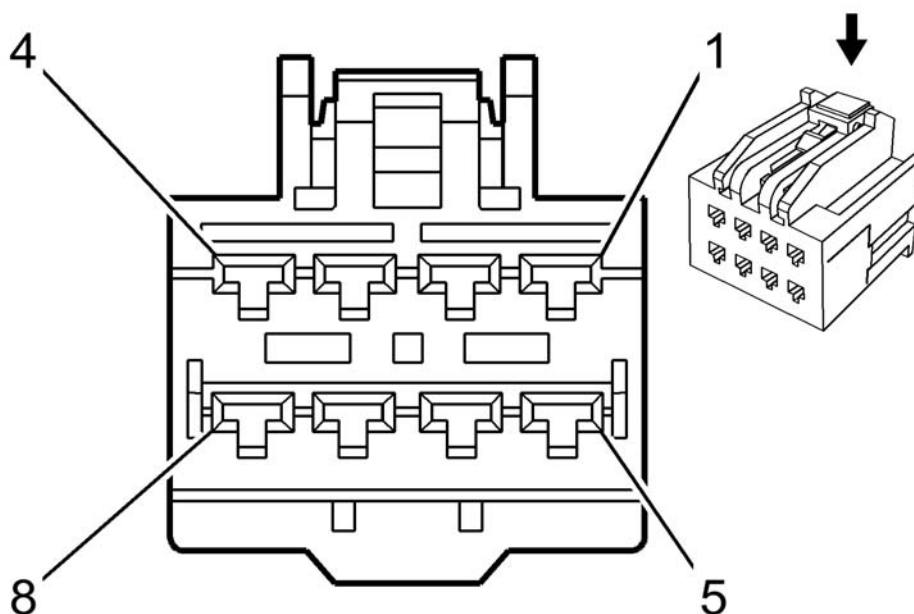
- Harness Type: Body
- OEM Connector: 13585485
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way F Coax Type (YE)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	Coax	6130	Coaxial Antenna XM Signal	I	-
2	-	Coax	6001	Antenna RF Signal	I	-

T3 AUDIO AMPLIFIER X1



Connector Part Information

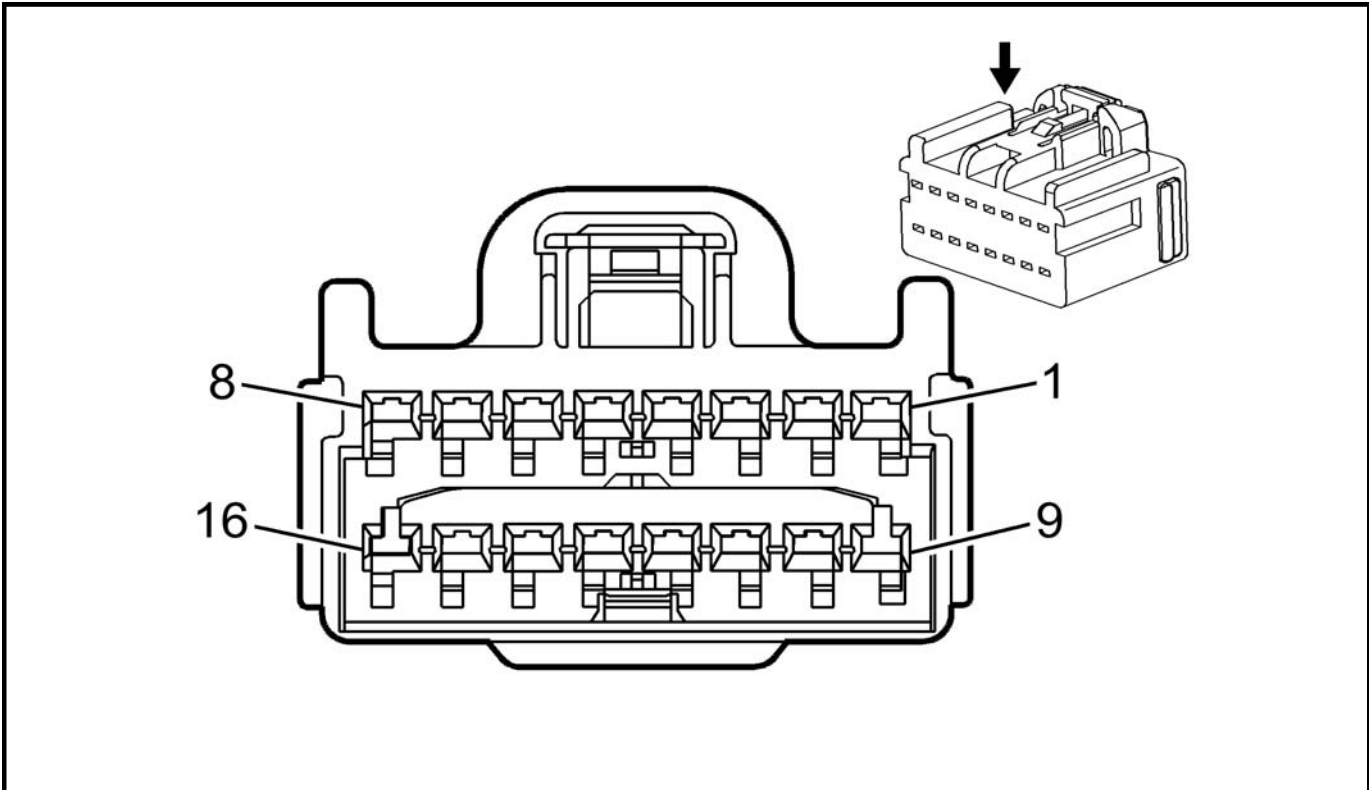
- Harness Type: Body
- OEM Connector: 6098-4798
- Service Connector: 19115652
- Description: 8-Way F 2.8 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	BU/GY	346	Left/Rear Subwoofer Speaker Control (+)	I	-
2	2	YE	200	Right Front Speaker Control (+) 1	I	-
3	2	BU	201	Left Front Speaker Control (+) 1	I	-
4	3	RD/BN	1140	Battery Positive Voltage	I	-
5	1.5	GN/BK	1794	Left/Rear Subwoofer Speaker (-) Low Reference	I	-
6	2	YE/BK	117	Right Front Speaker Signal (-) 1	I	-
7	2	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
8	3	BK	1450	Ground	I	-

T3 AUDIO AMPLIFIER X2



Connector Part Information

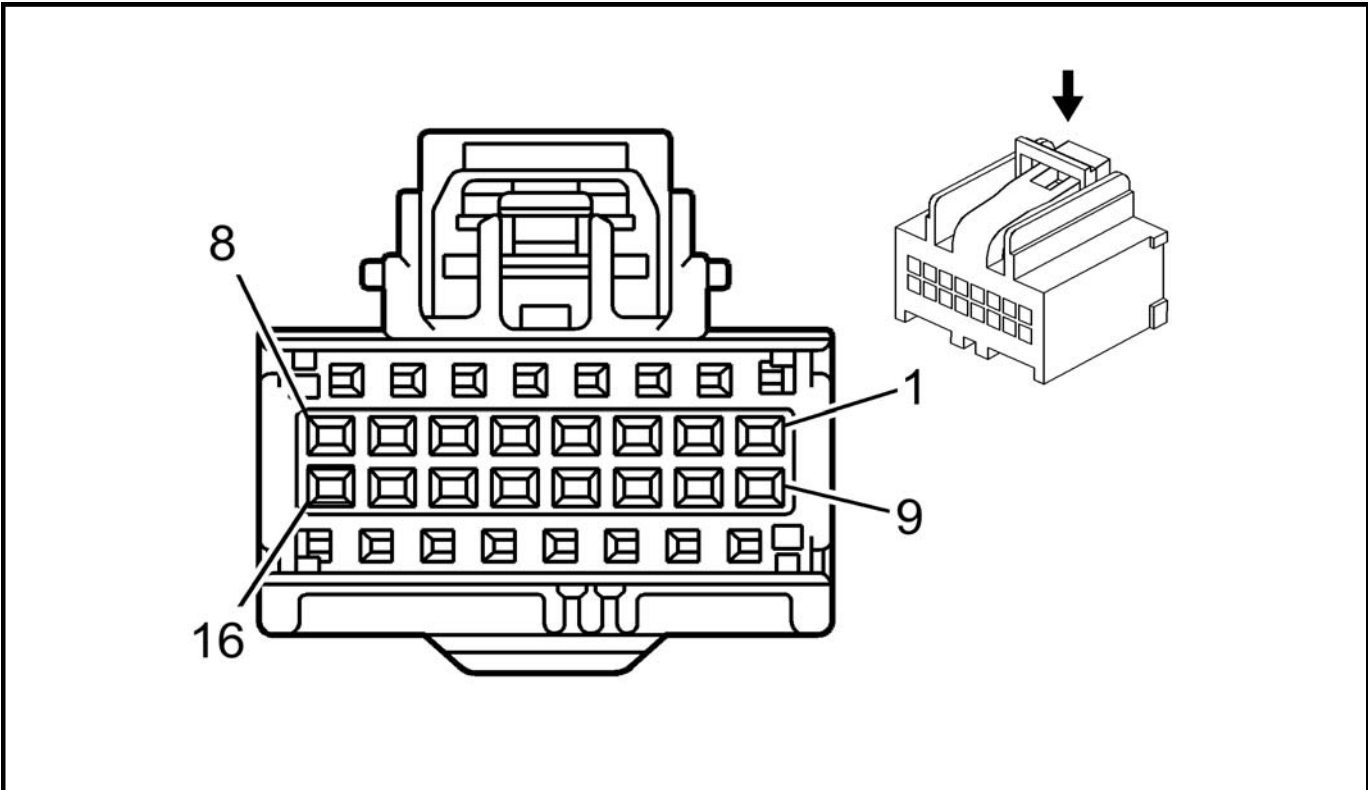
- Harness Type: Body
- OEM Connector: 7283-6453-60
- Service Connector: 89047090
- Description: 16-Way F 1.5 Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575829	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 4	-	-	-	Not Occupied	-	-
5	1	YE/WH	1860	Front Center Speaker Control (+)	I	-
6	0.75	WH	46	Right Rear Speaker Control (+)	I	-
7	0.75	GN	199	Left Rear Speaker Control (+)	I	-
8 - 12	-	-	-	Not Occupied	-	-
13	1	BU/YE	1960	Front Center Speaker (-) Low Reference	I	-
14	0.75	BU/BK	115	Right Rear Speaker Signal (-)	I	-
15	0.75	GN/BK	116	Left Rear Speaker Signal (-)	I	-
16	-	-	-	Not Occupied	-	-

T3 AUDIO AMPLIFIER X3



Connector Part Information

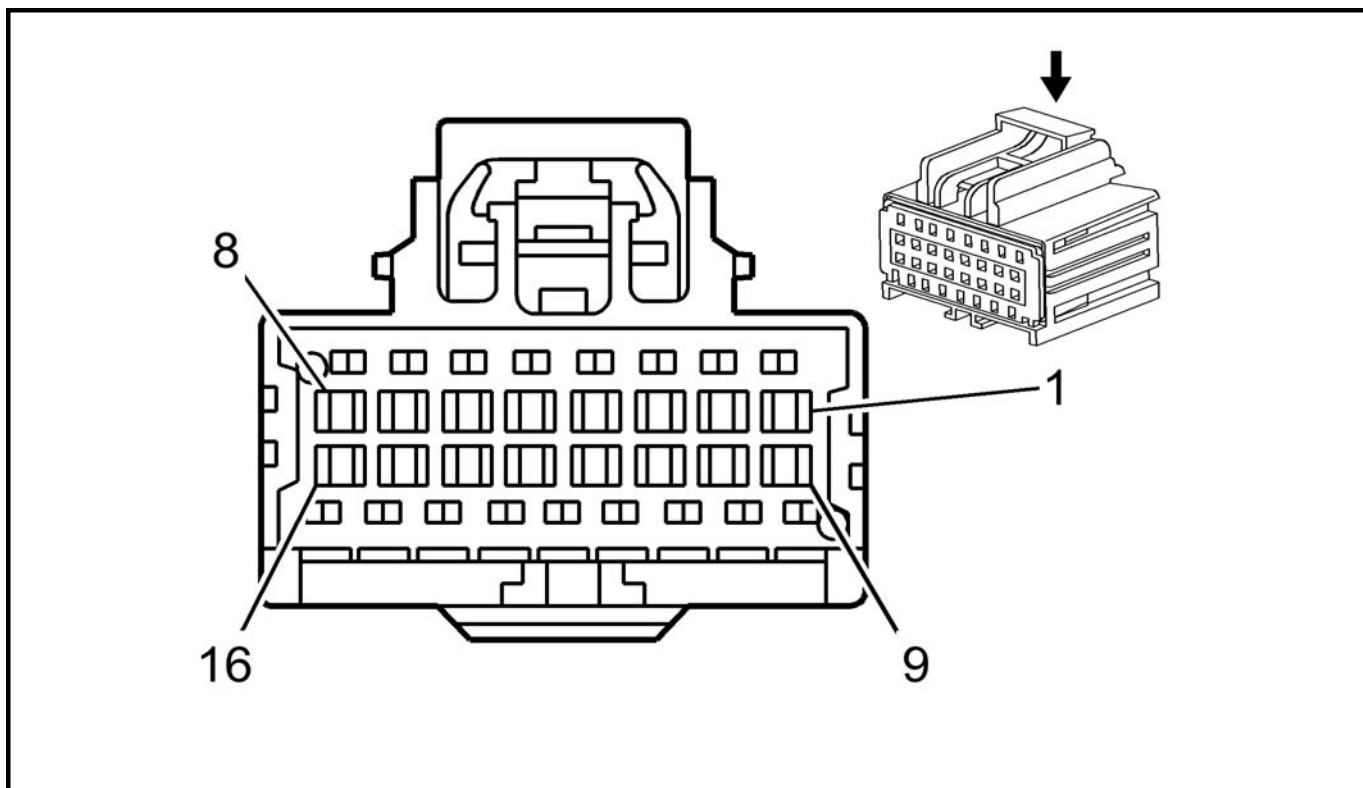
- Harness Type: Body
- OEM Connector: 15136073
- Service Connector: 15136073
- Description: 16-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GN	5060	Low Speed GMLAN Serial Data	I	-
2 - 16	-	-	-	Not Occupied	-	-

T3 AUDIO AMPLIFIER X4



Connector Part Information

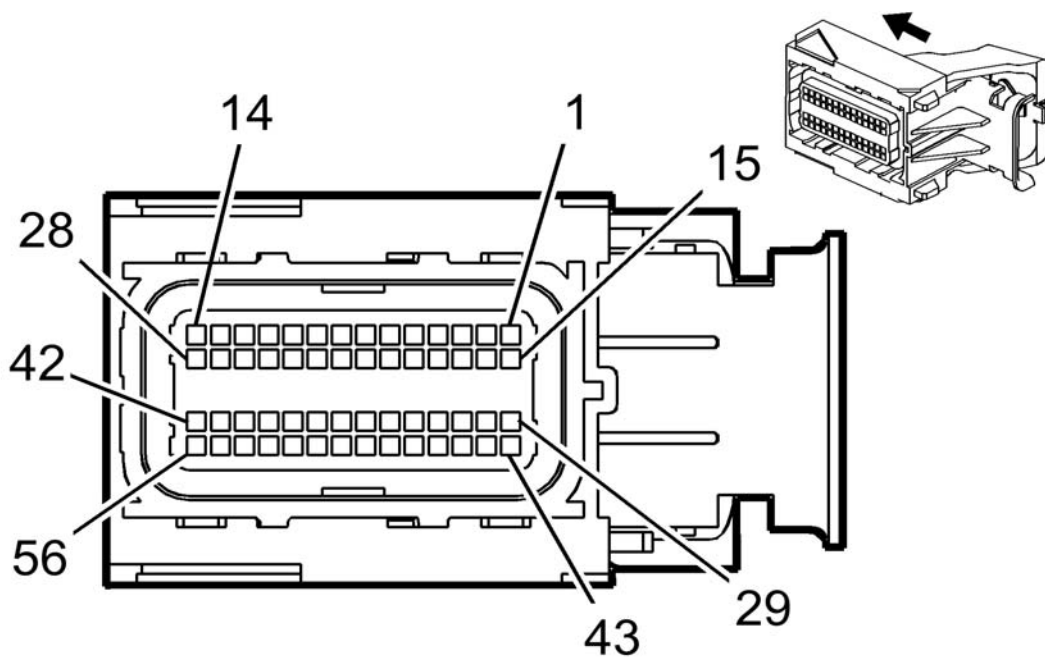
- Harness Type: Body
- OEM Connector: 7283-9078-80
- Service Connector: 15136074
- Description: 16-Way F 0.64 Kaizen Series (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
4	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
5	0.35	WH/GN	3997	MOST Serial Data (-)	I	-
6	0.35	GY/VT	3998	MOST Serial Data (+)	I	-
7 - 13	-	-	-	Not Occupied	-	-
14	0.35	WH/VT	3999	MOST Control	I	-
15 - 16	-	-	-	Not Occupied	-	-

T6 POWER INVERTER MODULE X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34576-0803
- Service Connector: 19352787
- Description: 56-Way F MX123 34576 Series (BK with GY Terminal Position Assurance)

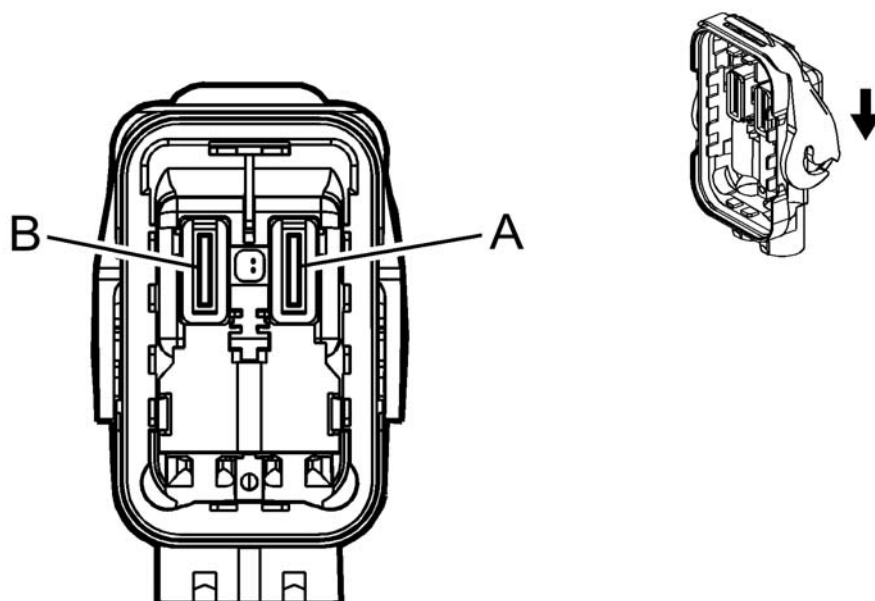
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575812	J-35616-64B (LT BU)	J-38125-12A	33467-0005	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK/WH	151	Signal Ground	I	-
2	0.75	RD/YE	240	Battery Positive Voltage	I	-
3	0.5	VT/BK	339	Run/Crank Ignition 1 Voltage	I	-
4	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
7	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
8	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
9	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
10 - 19	-	-	-	Not Occupied	-	-
20	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
21	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
22 - 28	-	-	-	Not Occupied	-	-
29	0.5	VT/BU	6091	Crankshaft Position Sensor Replicated Signal	I	-
30	-	-	-	Not Occupied	-	-
31	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
32	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
33	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+)3	I	-
34	0.5	WH	7494	High Speed GMLAN Serial Data (-)3	I	-
35 - 44	-	-	-	Not Occupied	-	-
45	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
46	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
47	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+)3	I	-
48	0.5	WH	7494	High Speed GMLAN Serial Data (-)3	I	-
49	-	-	-	Not Occupied	-	-
50	0.75	RD/VT	1940	Battery Positive Voltage	I	-
51	0.75	BK/WH	151	Signal Ground	I	-
52 - 56	-	-	-	Not Occupied	-	-

T6 POWER INVERTER MODULE X2



Connector Part Information

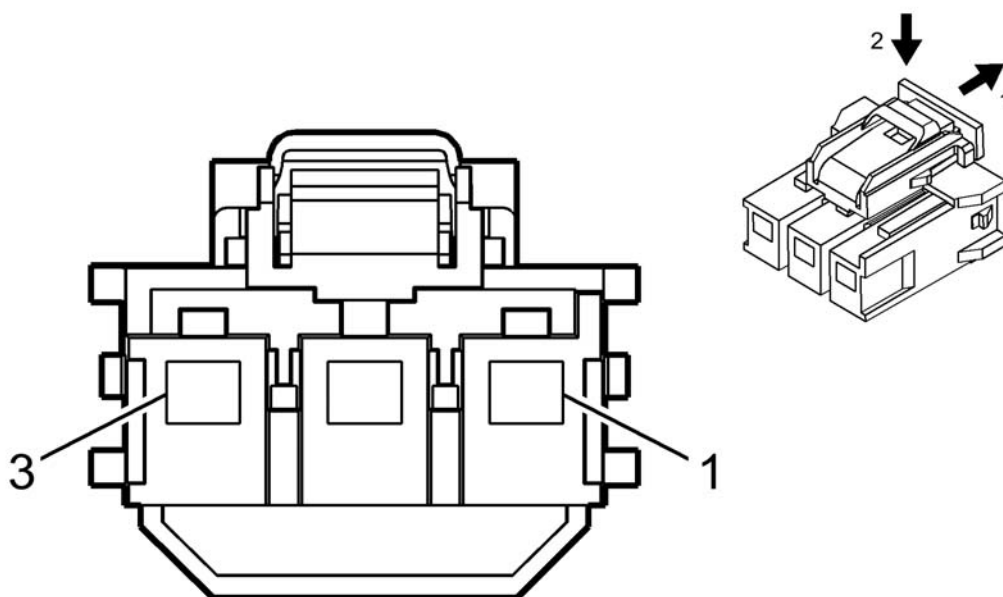
- Harness Type: Battery Cable
- OEM Connector: 15515644
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000 Series, Sealed

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	35	OG/BK	7644	High Voltage Battery Pack Traction Power Inverter Module Negative Control	I	-
B	35	OG	7639	High Voltage Battery Pack Traction Power Inverter Module Positive Control	I	-

G5 TRANSMISSION FLUID PUMP - ELECTRIC/AUXILIARY



Connector Part Information

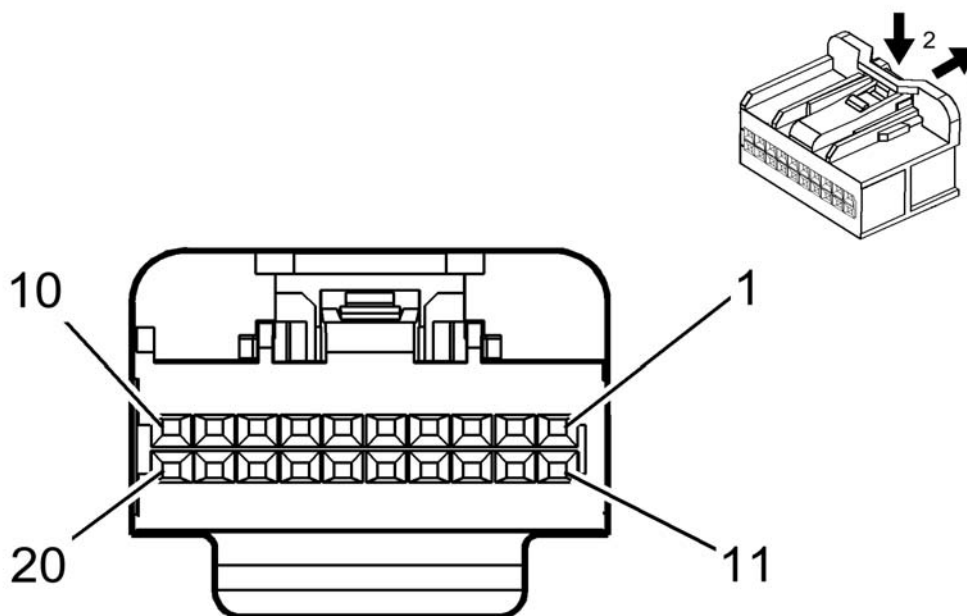
- Harness Type: Transmission
- OEM Connector: 13805752
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 2.8 Hybrid Series (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	WH	3770	MGU Phase W Control	I	-
2	2.5	BK	3771	MGU Phase V Control	I	-
3	2.5	RD	3772	MGU Phase U Control	I	-

T6 POWER INVERTER MODULE X4



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 13578969
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 0.64 Kaizen Series (GY)

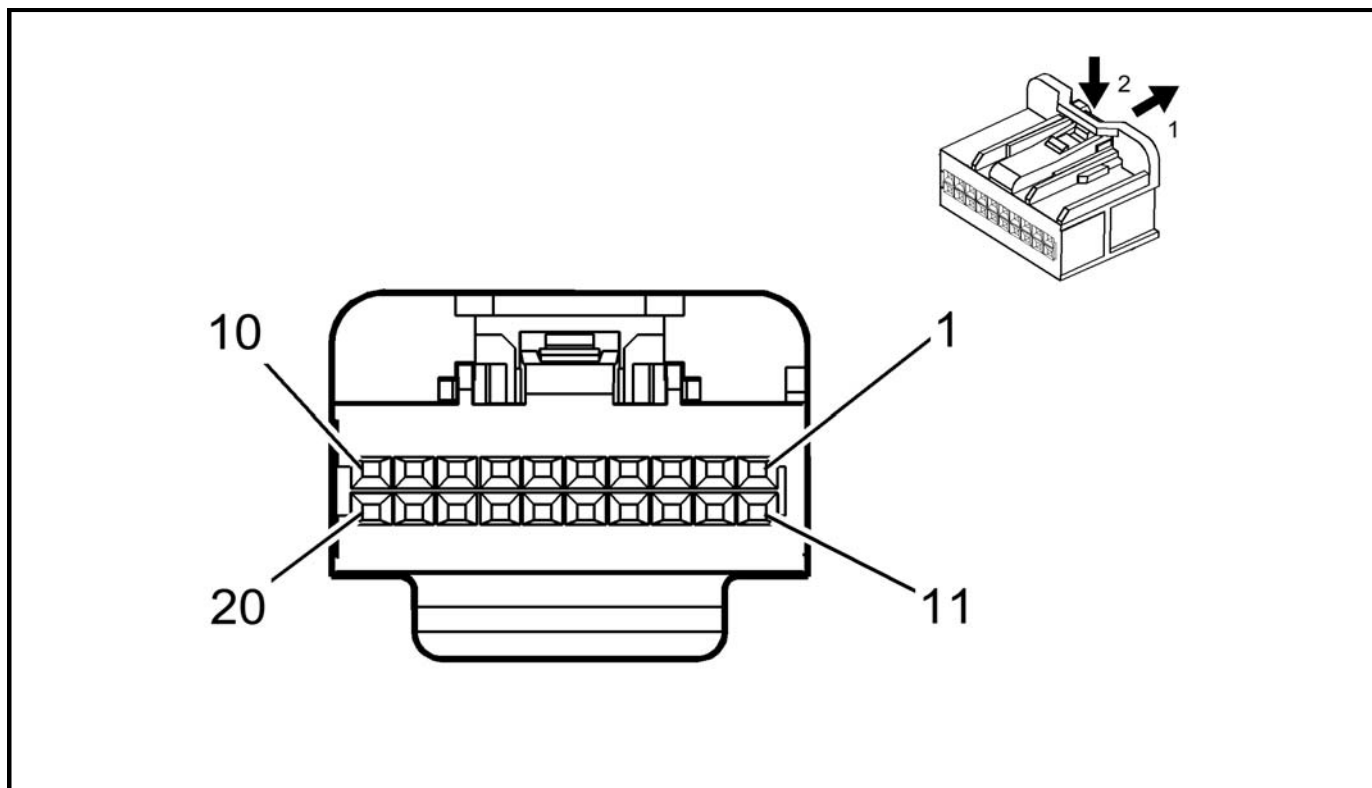
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 4	-	-	-	Not Occupied	-	-
5	0.5	RD	7647	Transmission Traction Power Inverter Module Resolver 1 S2 Signal	I	-
6	0.5	BU	7646	Transmission Traction Power Inverter Module Resolver 1 S4 Signal	I	-
7	0.5	YE/BK	7649	Traction Power Inverter Module Resolver 1 S1 Signal	I	-
8	0.5	GY/WH	7652	Traction Power Inverter Module Resolver 1 S3 Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
9	0.5	GN	7645	Traction Power Inverter Module Resolver 1 Excitation Signal Positive	I	-
10	0.5	PK	7648	Traction Power Inverter Module Resolver 1 Excitation Signal Negative	I	-
11	0.8	BK	6387	Transmission High Side Driver 1 Signal Driver	I	-
12	0.5	YE	6400	Clutch A Control	I	-
13	0.5	TN	6401	Clutch B Control	I	-
14	0.8	BN	6388	Transmission High Side Driver 2 Signal	I	-
15	0.5	GY	6402	Clutch C Control	I	-
16	0.5	OG	6403	Clutch D Control	I	-
17	0.5	WH	6404	Clutch E Control	I	-
18	0.5	GN	586	Transmission Oil Temperature Sensor Low Reference	I	-
19	0.5	VT	585	Transmission Oil Temperature Sensor Signal	I	-
20	-	-	-	Not Occupied	-	-

T6 POWER INVERTER MODULE X5



Connector Part Information

- Harness Type: Transmission
- OEM Connector: 13578970
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 0.64 Kaizen Series (GN)

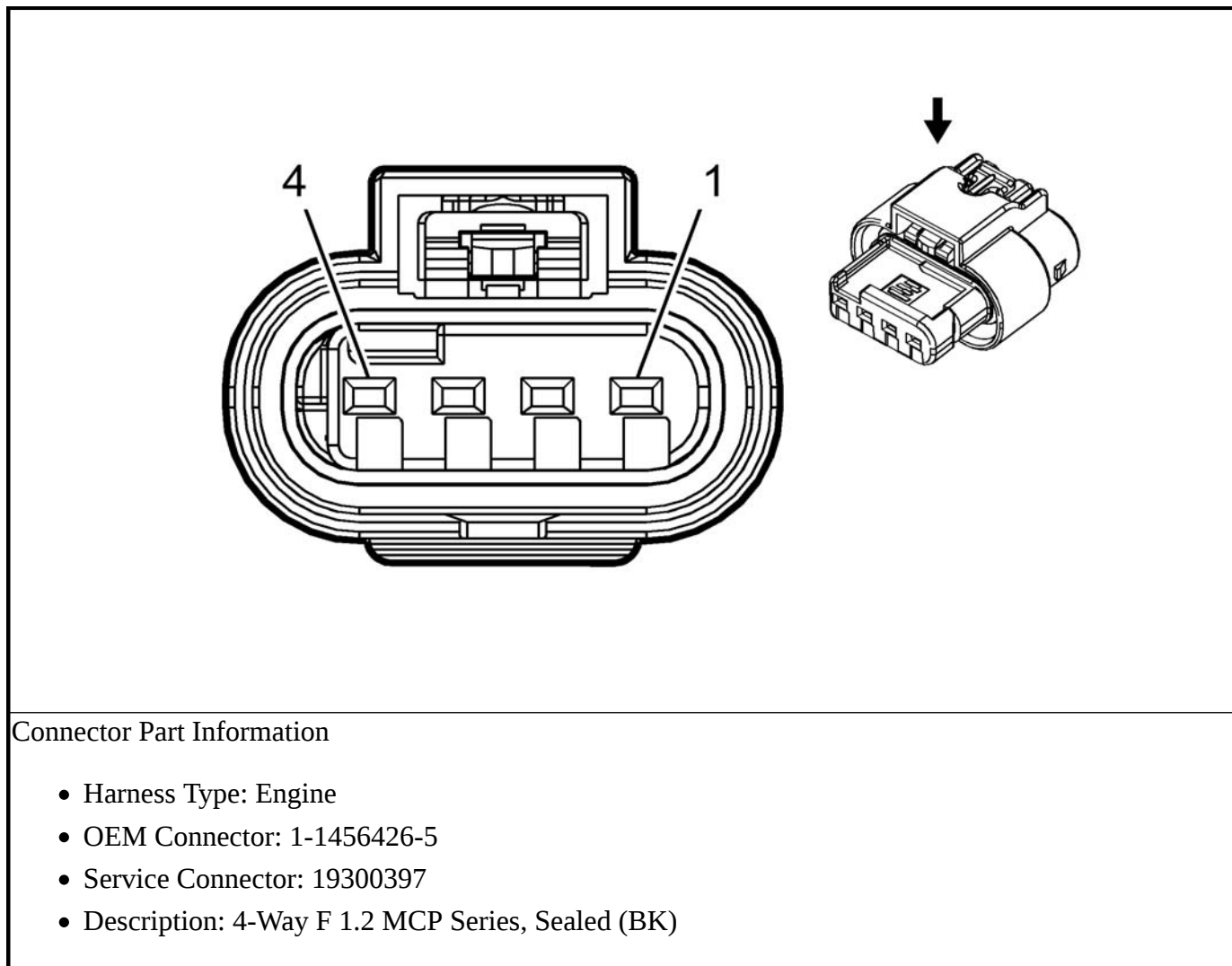
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 4	-	-	-	Not Occupied	-	-
5	0.5	GN	3491	Traction Power Inverter Module Resolver 2 S2 Signal	I	-
6	0.5	BK	3492	Traction Power Inverter Module Resolver 2 S4 Signal	I	-
7	0.5	YE	3488	Traction Power Inverter Module Resolver 2 S1 Signal	I	-
8	0.5	BU	3487	Traction Power Inverter Module Resolver 2 S3 Signal	I	-
9	0.5	WH	3486	Traction Power Inverter Module Resolver 2 Excitation Signal Positive	I	-
10	0.5	TN	3485	Transmission Traction Power Inverter Module Resolver 2 Excitation Signal Negative	I	-
11	-	-	-	Not Occupied	-	-
12	0.5	RD	3098	Output Speed (Digital) Signal	I	-
13	0.5	VT	3604	Transmission Output Speed Sensor Supply	I	-
14	0.5	PK	3992	Internal Mode Switch Voltage Supply A	I	-
15	0.5	OG	3991	Internal Mode Switch Voltage Supply B	I	-
16	0.5	BK	3494	Transmission IMS Mode Switch R1 bit Signal	I	-
17	0.5	BU	3495	Transmission IMS Mode Switch R2 bit Signal	I	-
18	0.5	BN	3496	Transmission IMS Mode Switch D1 bit Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
19	0.5	GY	3497	Transmission IMS Mode Switch D2 bit Signal	I	-
20	0.5	GN	3493	Transmission IMS Mode Switch S bit Signal	I	-

T8A IGNITION COIL 1



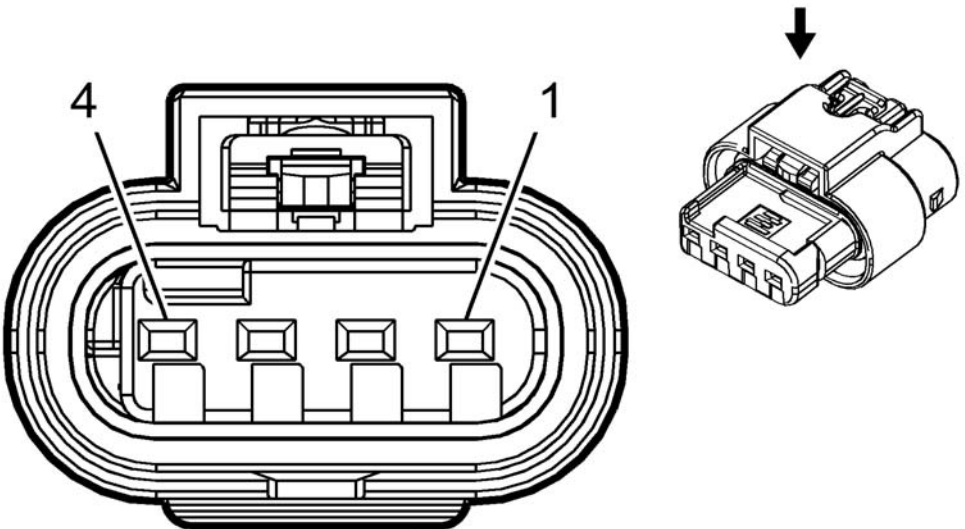
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	450	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	BK/BU	2129	Ignition Control Low Reference Bank 1	I	-
3	0.5	BU/VT	2121	Ignition Control 1	I	-
4	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply 2	I	-

T8B IGNITION COIL 2



Connector Part Information

- Harness Type: Engine
- OEM Connector: 1-1456426-5
- Service Connector: 19300397
- Description: 4-Way F 1.2 MCP Series, Sealed (BK)

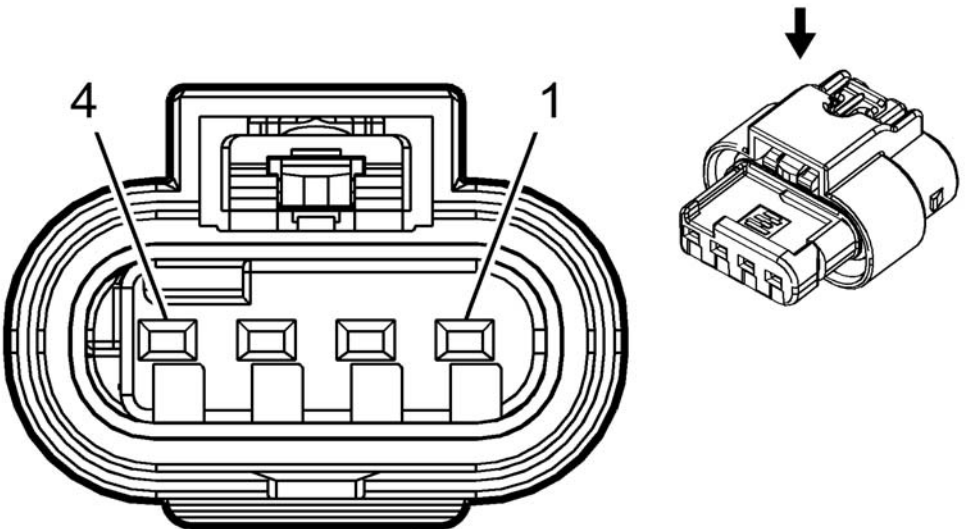
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	450	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	BK/BU	2129	Ignition Control Low Reference Bank 1	I	-
3	0.5	BU/WH	2122	Ignition Control 2	I	-
4	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply 2	I	-

T8C IGNITION COIL 3



Connector Part Information

- Harness Type: Engine
- OEM Connector: 1-1456426-5
- Service Connector: 19300397
- Description: 4-Way F 1.2 MCP Series, Sealed (BK)

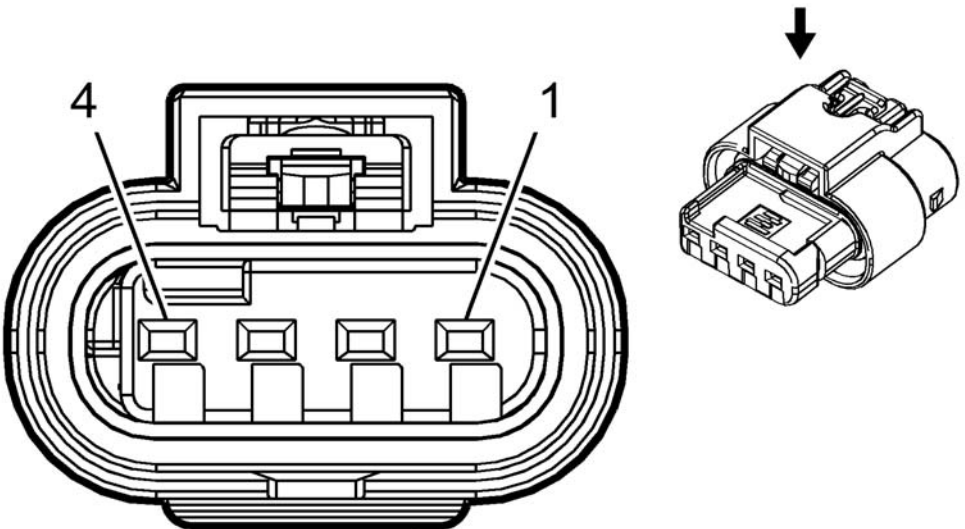
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	450	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	BK/BU	2129	Ignition Control Low Reference Bank 1	I	-
3	0.5	GN/BU	2123	Ignition Control 3	I	-
4	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply 2	I	-

T8D IGNITION COIL 4



Connector Part Information

- Harness Type: Engine
- OEM Connector: 1-1456426-5
- Service Connector: 19300397
- Description: 4-Way F 1.2 MCP Series, Sealed (BK)

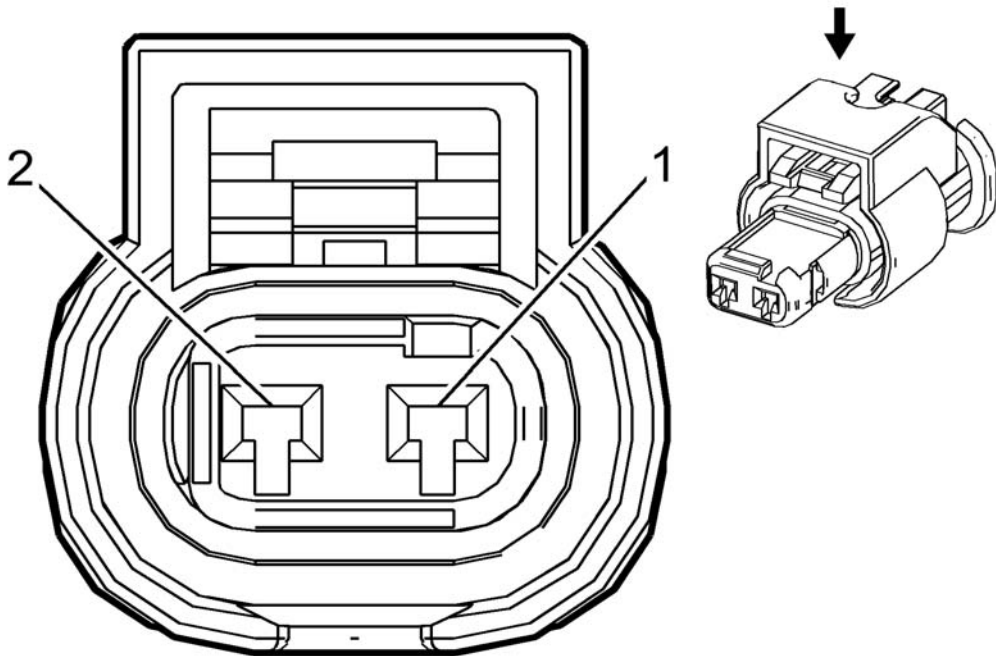
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	450	Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	BK/BU	2129	Ignition Control Low Reference Bank 1	I	-
3	0.5	YE/BU	2124	Ignition Control 4	I	-
4	0.75	VT/BU	5291	Powertrain Main Relay Fused Supply 2	I	-

T10 KEYLESS ENTRY ANTENNA



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1-1823608-5
- Service Connector: 19300402
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

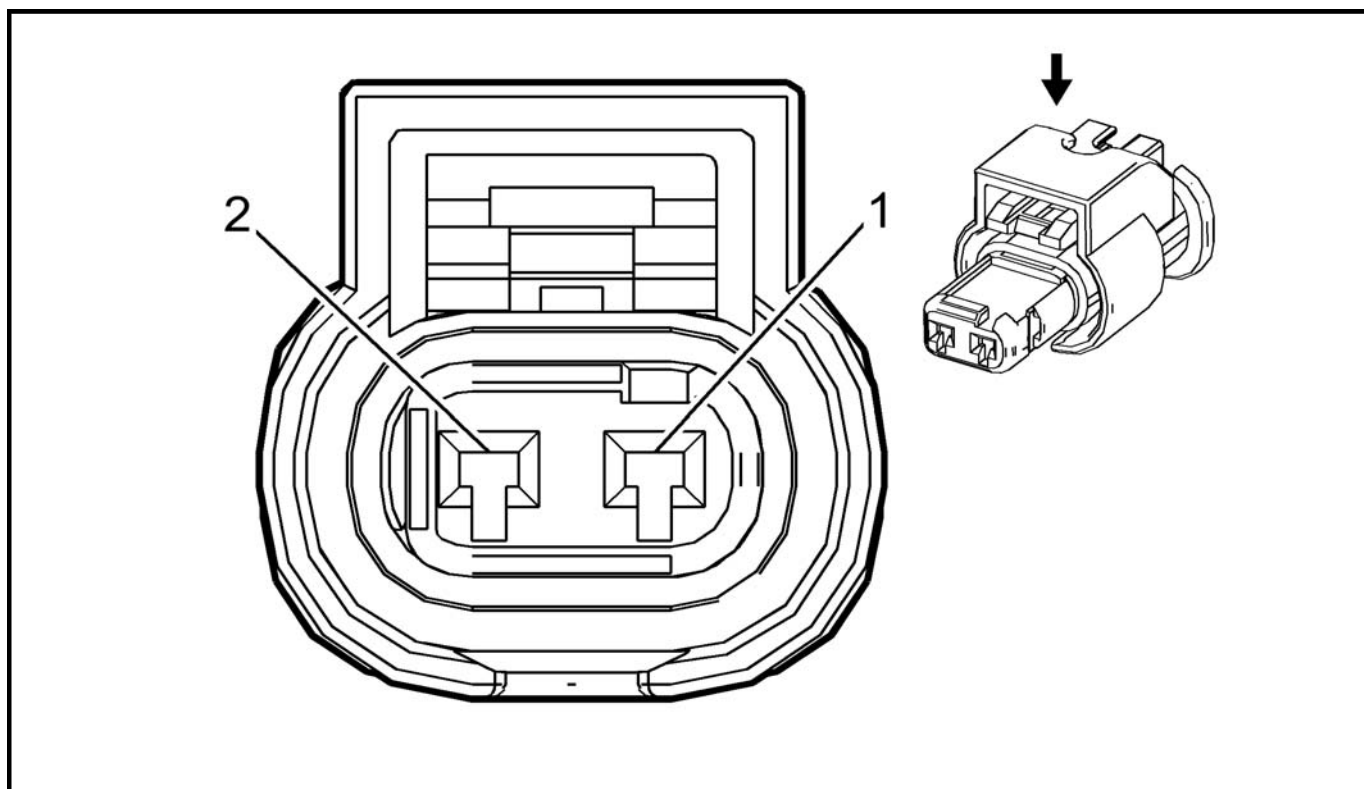
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/WH	3552	Passive Start Interior Antenna 1	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
				Signal Hi		
2	0.5	WH	3553	Passive Start Interior Antenna 1 Signal Lo	I	-

T10B KEYLESS ENTRY ANTENNA - INSTRUMENT PANEL COMPARTMENT



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1-1823608-5
- Service Connector: 19300402
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

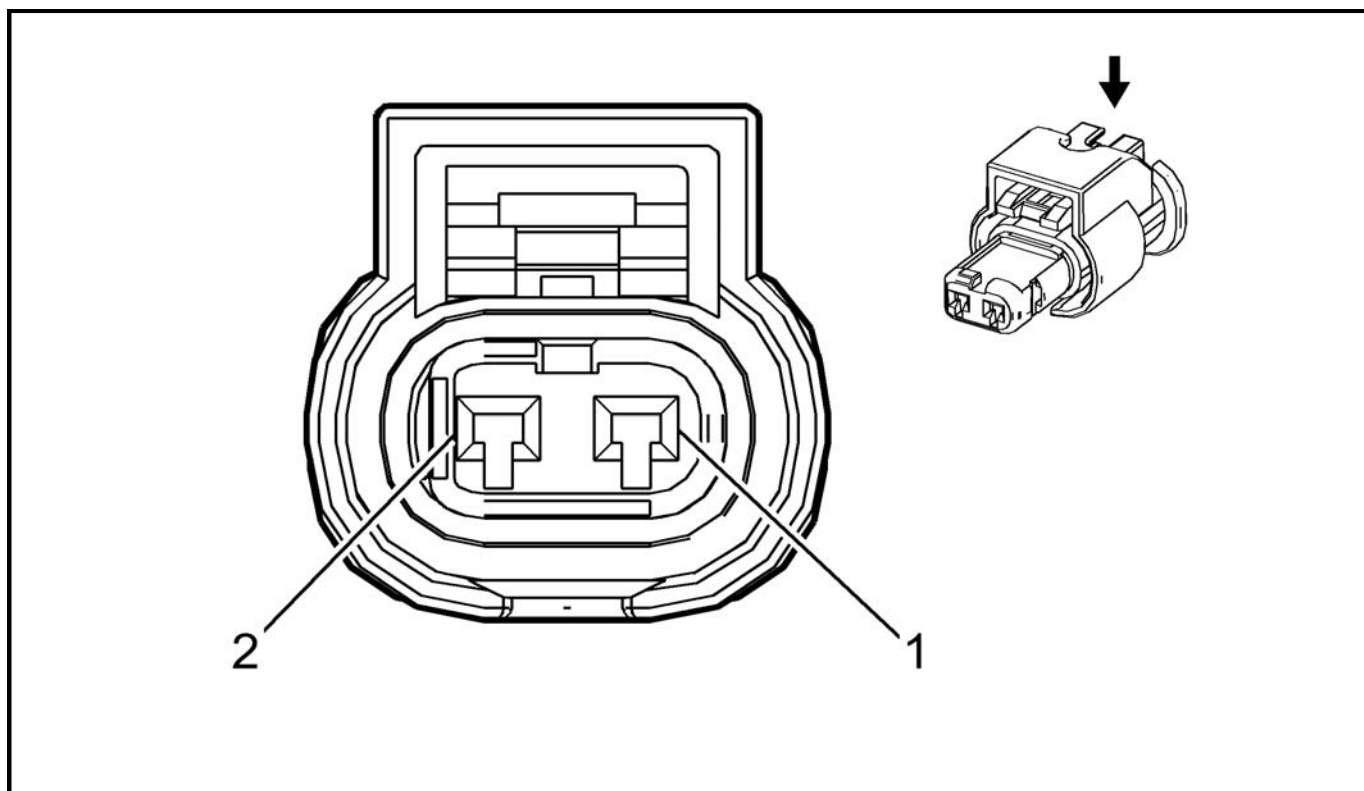
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/WH	3552	Passive Start Interior Antenna 1 Signal Hi	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	WH	3553	Passive Start Interior Antenna 1 Signal Lo	I	-

T10E KEYLESS ENTRY ANTENNA - REAR COMPARTMENT



Connector Part Information

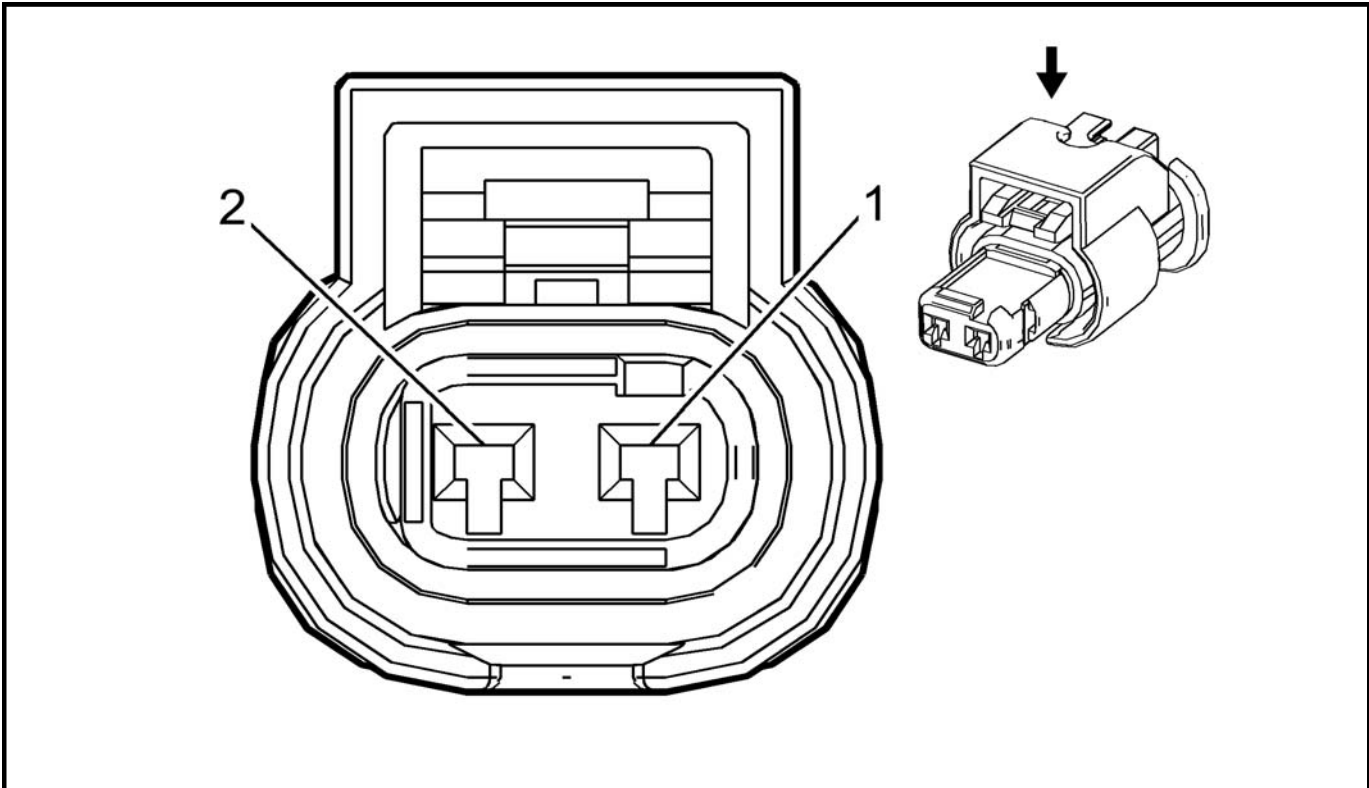
- Harness Type: Body
- OEM Connector: 2-1823608-1
- Service Connector: 19332213
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG	3556	Passive Start Interior Antenna 3 Signal Hi	I	-
2	0.5	OG/BU	3557	Passive Start Interior Antenna 3 Signal Lo	I	-

T10G KEYLESS ENTRY ANTENNA - REAR FASCIA



Connector Part Information

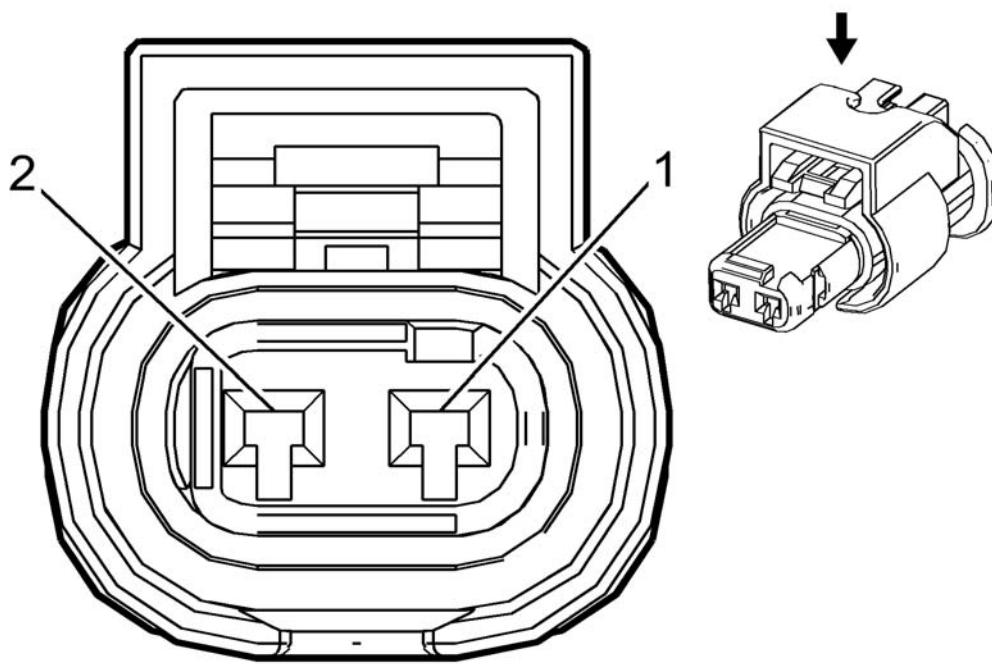
- Harness Type: Body
- OEM Connector: 1-1823608-5
- Service Connector: 19300402
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/GN	3568	Passive Entry Rear Closure Antenna Signal Hi	I	-
2	0.5	GN/GY	3569	Passive Entry Rear Closure Antenna Signal Lo	I	-

T10K KEYLESS ENTRY ANTENNA - CENTER CONSOLE REAR



Connector Part Information

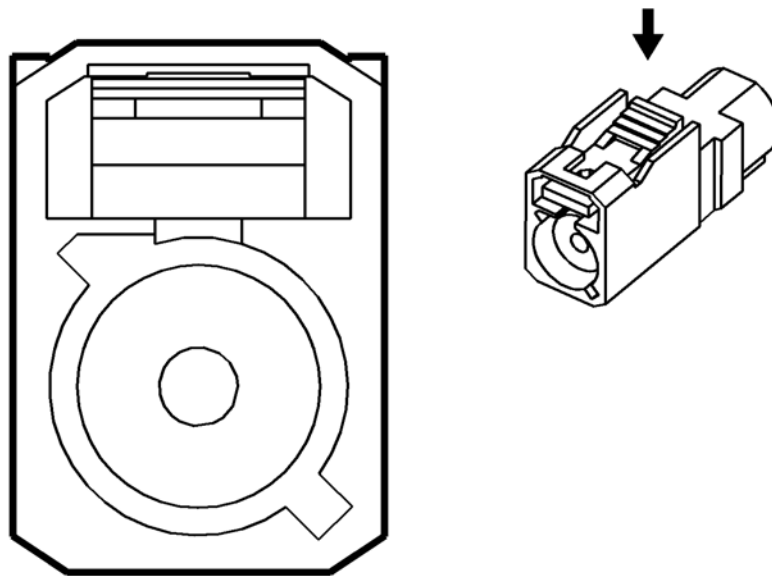
- Harness Type: Floor Console
- OEM Connector: 1-1823608-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG	3554	Passive Start Interior Antenna 2 Signal Hi	I	-
2	0.5	OG/BU	3555	Passive Start Interior Antenna 2 Signal Lo	I	-

T15 NAVIGATION ANTENNA SIGNAL SPLITTER X1



Connector Part Information

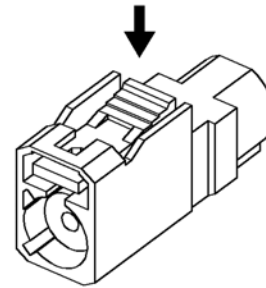
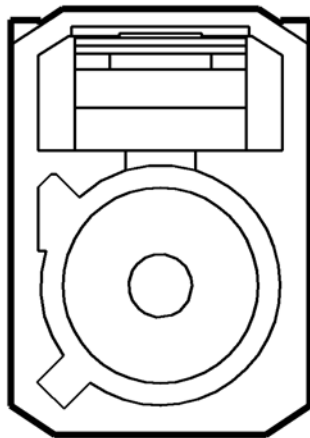
- Harness Type: Instrument Panel
- OEM Connector: 13585502
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS only) Coaxial Antenna GPS Signal	I	-

T15 NAVIGATION ANTENNA SIGNAL SPLITTER X2



Connector Part Information

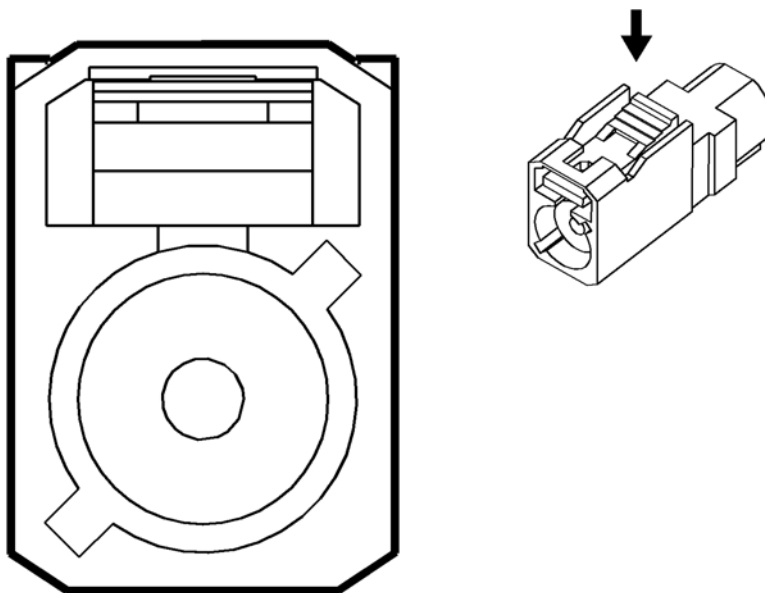
- Harness Type: Instrument Panel
- OEM Connector: 13585501
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (PK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS only) Coaxial Antenna GPS Signal	I	-

T15 NAVIGATION ANTENNA SIGNAL SPLITTER X3



Connector Part Information

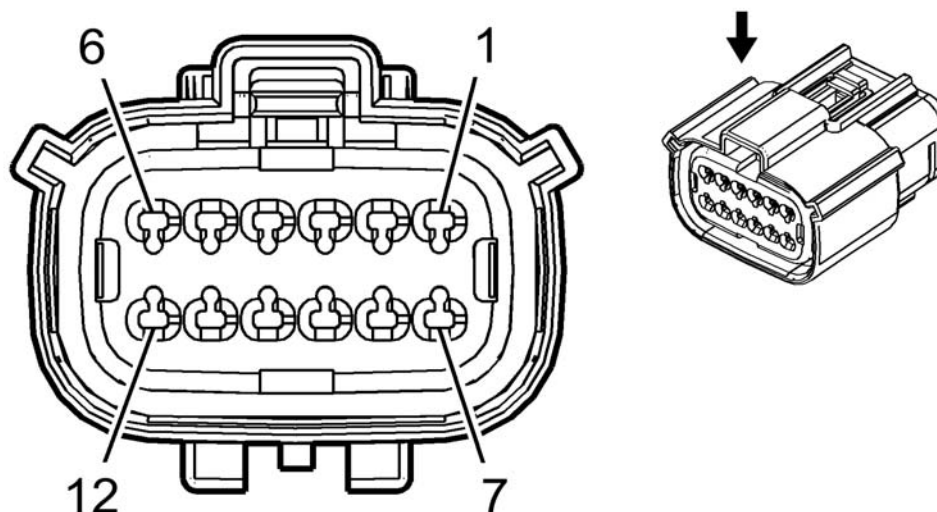
- Harness Type: Instrument Panel
- OEM Connector: 13585520
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS only) Coaxial Antenna GPS Signal	I	-

T18 BATTERY CHARGER X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 33472-1291
- Service Connector: 19352907
- Description: 12-Way F 150 MX Series, Sealed (BK)

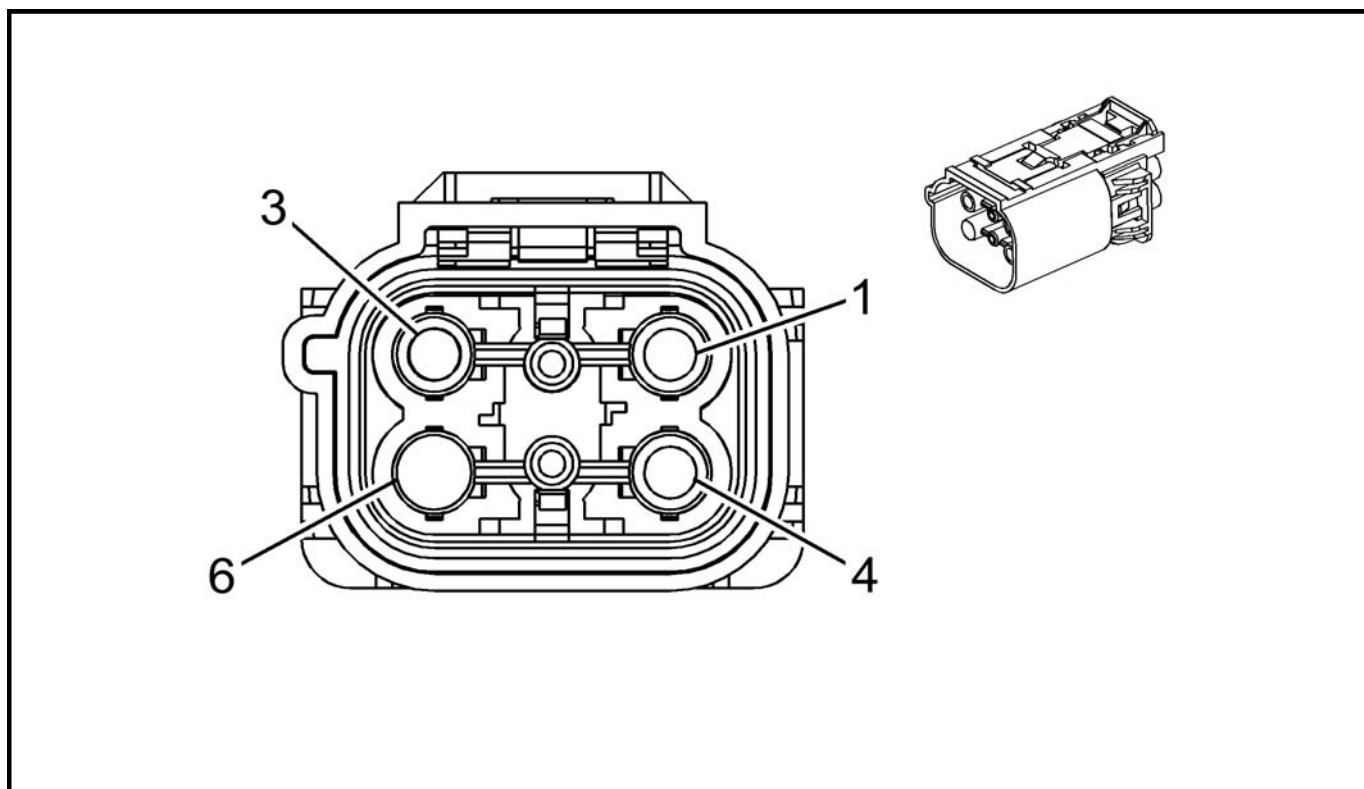
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	850	Ground	I	-
3	0.5	VT/WH	3643	High Voltage Onboard Charging DC Voltage Sense Signal	I	-
4	0.5	YE/GY	3645	High Voltage Onboard Charging Control	I	-
5 - 8	-	-	-	Not Occupied	-	-
9	0.5	RD/BU	1240	Battery Positive Voltage	I	-
10	0.5	GN/GY	3644	High Voltage Onboard Charging AC Voltage Sense Signal	I	-
11	0.5	BU/YE	3646	High Voltage Onboard Charging Enable	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	-	-	-	Not Occupied	-	-

T18 BATTERY CHARGER X2



Connector Part Information

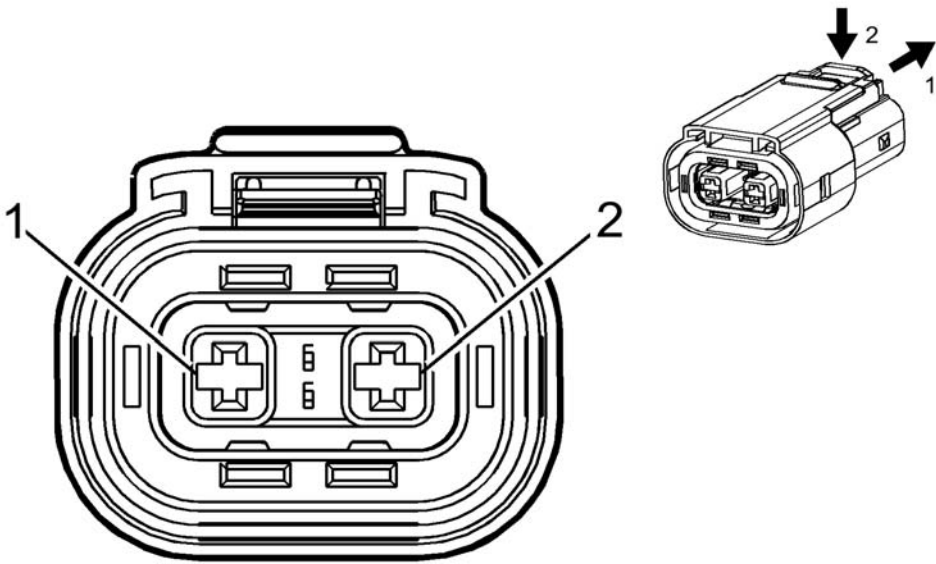
- Harness Type: Battery Cable
- OEM Connector: 15525754
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.0, 2.4 HES Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-44 (YE)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	BU	3837	Voltage AC Line 1	I	-
2	-	-	-	Not Occupied	-	-
3	3	GN	3952	Voltage AC Ground	I	-
4	3	WH	3838	Voltage AC Neutral Line 2	I	-
5 - 6	-	-	-	Not Occupied	-	-

T18 BATTERY CHARGER X3



Connector Part Information

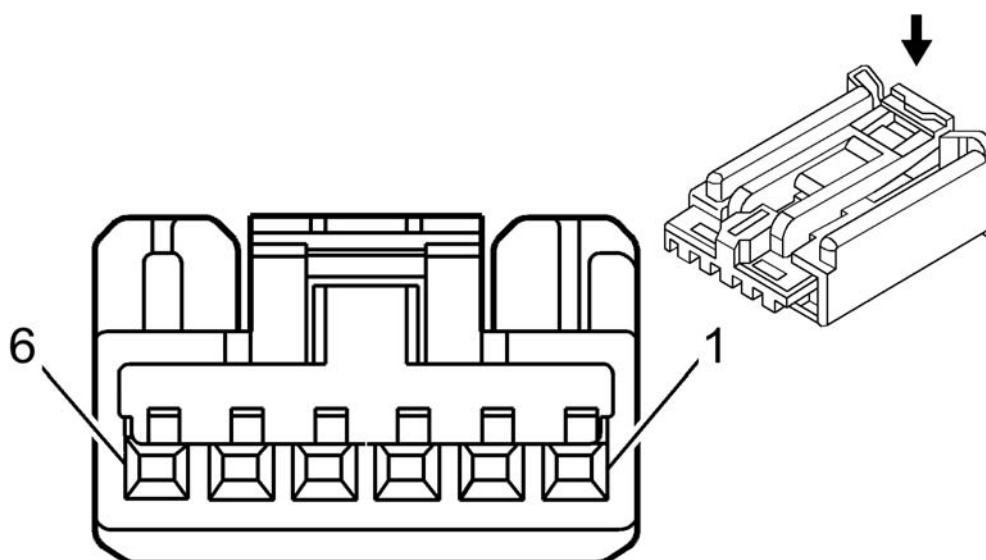
- Harness Type: Battery Cable
- OEM Connector: 33184905
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	OG	3834	High Voltage Battery 2 (+)	I	-
2	3	OG/BK	3833	High Voltage Battery 2 (-)	I	-

T22 MOBILE DEVICE WIRELESS CHARGER MODULE



Connector Part Information

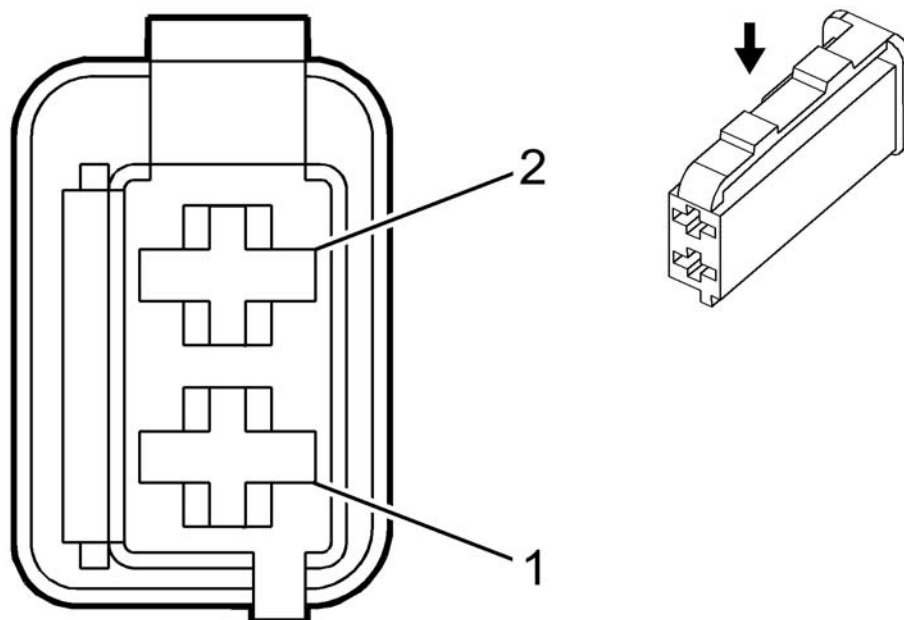
- Harness Type: Floor Console
- OEM Connector: AIT2PB-06-1FS
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT	4601	Retained Accessory Power Fused Control	I	-
2	0.5	BK	2150	Ground	I	-
3	0.35	GN	4512	Wireless Charging System Charge Indicator Control	I	-
4 - 6	-	-	-	Not Occupied	-	-

X21 MANUAL SERVICE DISCONNECT RECEPTACLE



Connector Part Information

- Harness Type: Auxiliary Battery Cable
- OEM Connector: 13670097
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	5087	High Voltage Interlock Loop Signal 1	I	-
2	0.5	BK/YE	5088	High Voltage Interlock Loop Low Reference 1	I	-

X21 MANUAL SERVICE DISCONNECT RECEPTACLE X2

Connector Part Information

- Harness Type: High Voltage Manual Service Disconnect

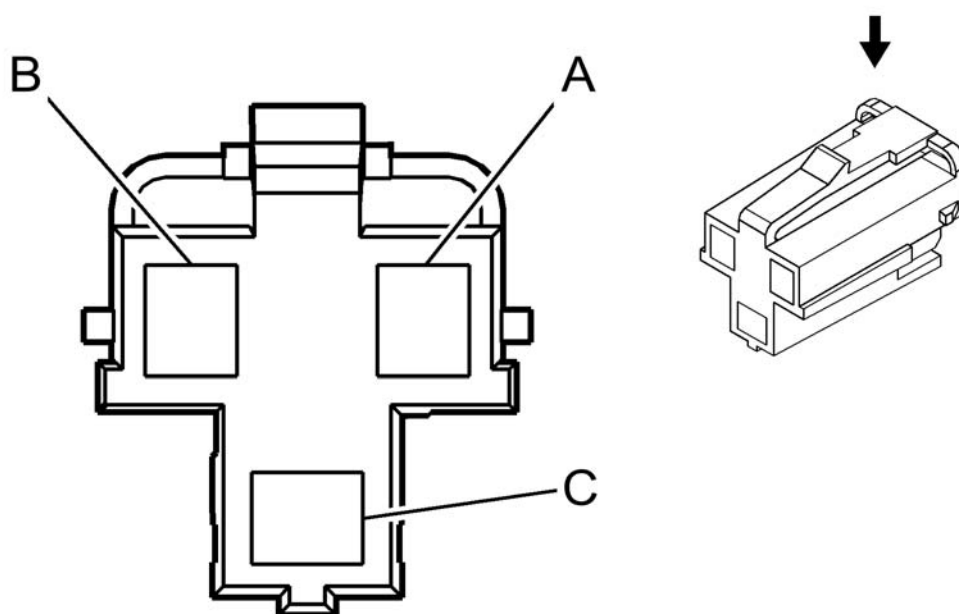
- OEM Connector: E02393900
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	20	OG	5083	High Voltage Battery (-)	I	-
2	20	OG	5084	High Voltage Battery (+)	I	-

X80H ACCESSORY POWER RECEPTACLE - CENTER CONSOLE



Connector Part Information

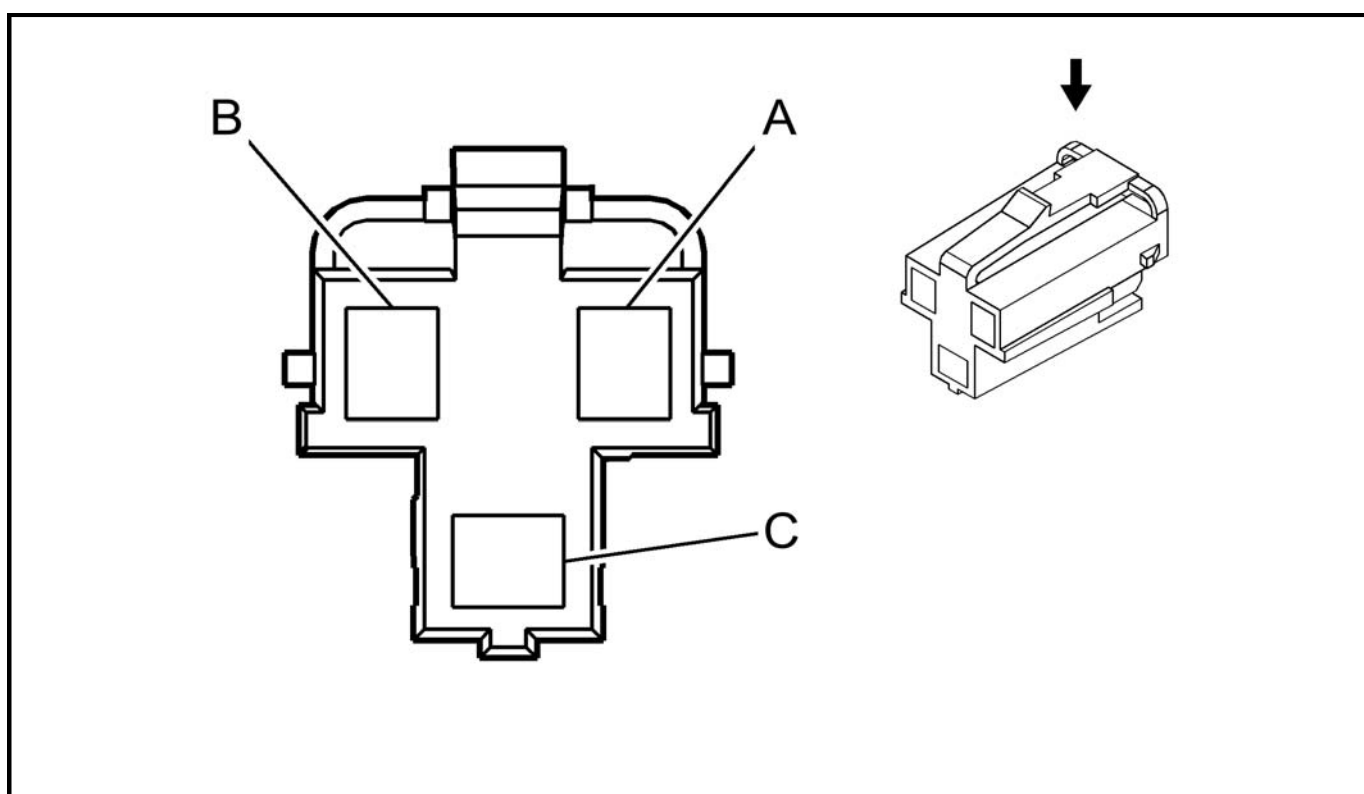
- Harness Type: Floor Console
- OEM Connector: 12176836
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 280 Metri-Pack Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	1	VT	1301	Retained Accessory Power Fuse Control	I	-
B	-	-	-	Not Occupied	-	-
C	1	BK	2150	Ground	I	-

X80L ACCESSORY POWER RECEPTACLE - CENTER CONSOLE REAR



Connector Part Information

- Harness Type: Body
- OEM Connector: 12176836
- Service Connector: 19257374
- Description: 3-Way F 280 Metri-Pack Series (GY)

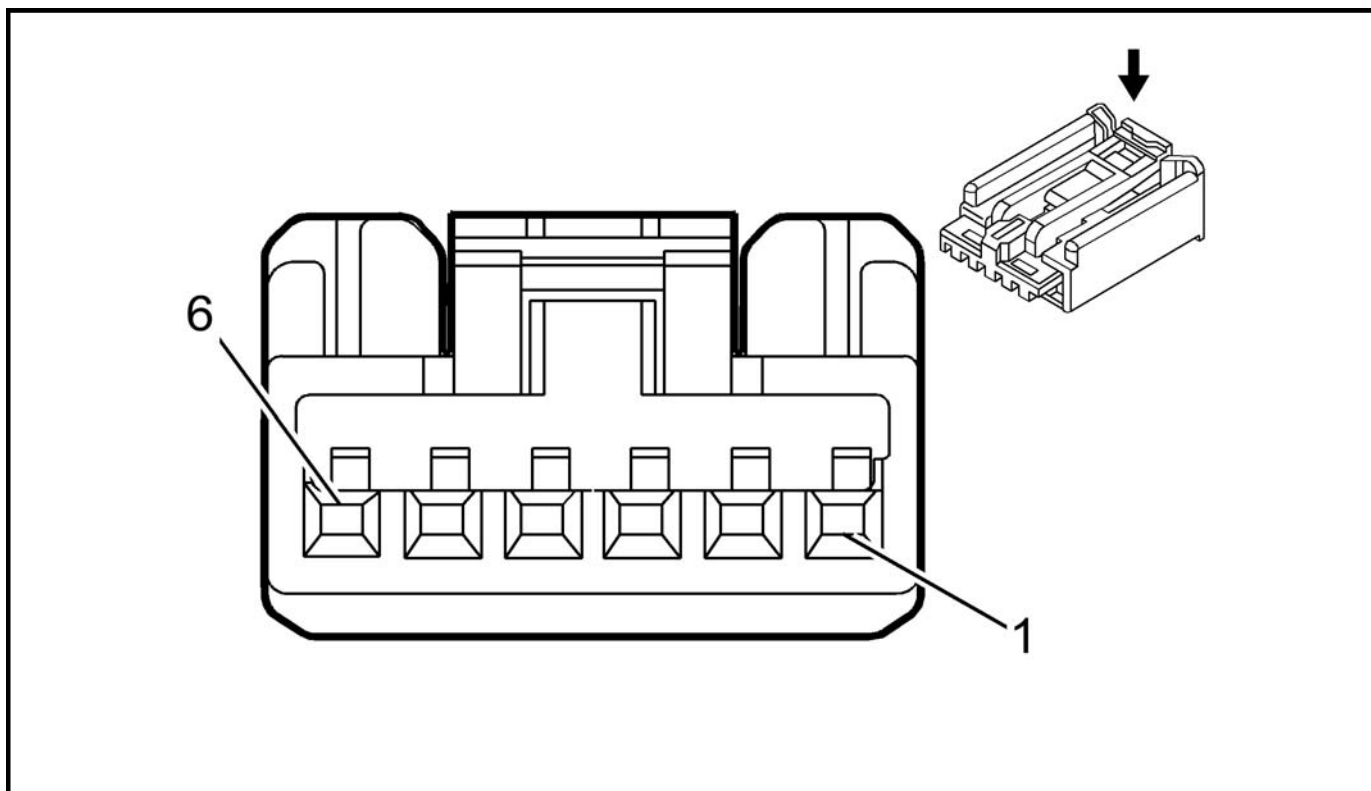
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A	Not	Not Required	Not	Not	Not

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
		(PU)	Required		Required	Required	Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	1	VT/WH	1701	Retained Accessory Power Ignition	I	-
B	-	-	-	Not Occupied	-	-
C	1	BK	850	Ground	I	-

X83 AUXILIARY AUDIO INPUT X1



Connector Part Information

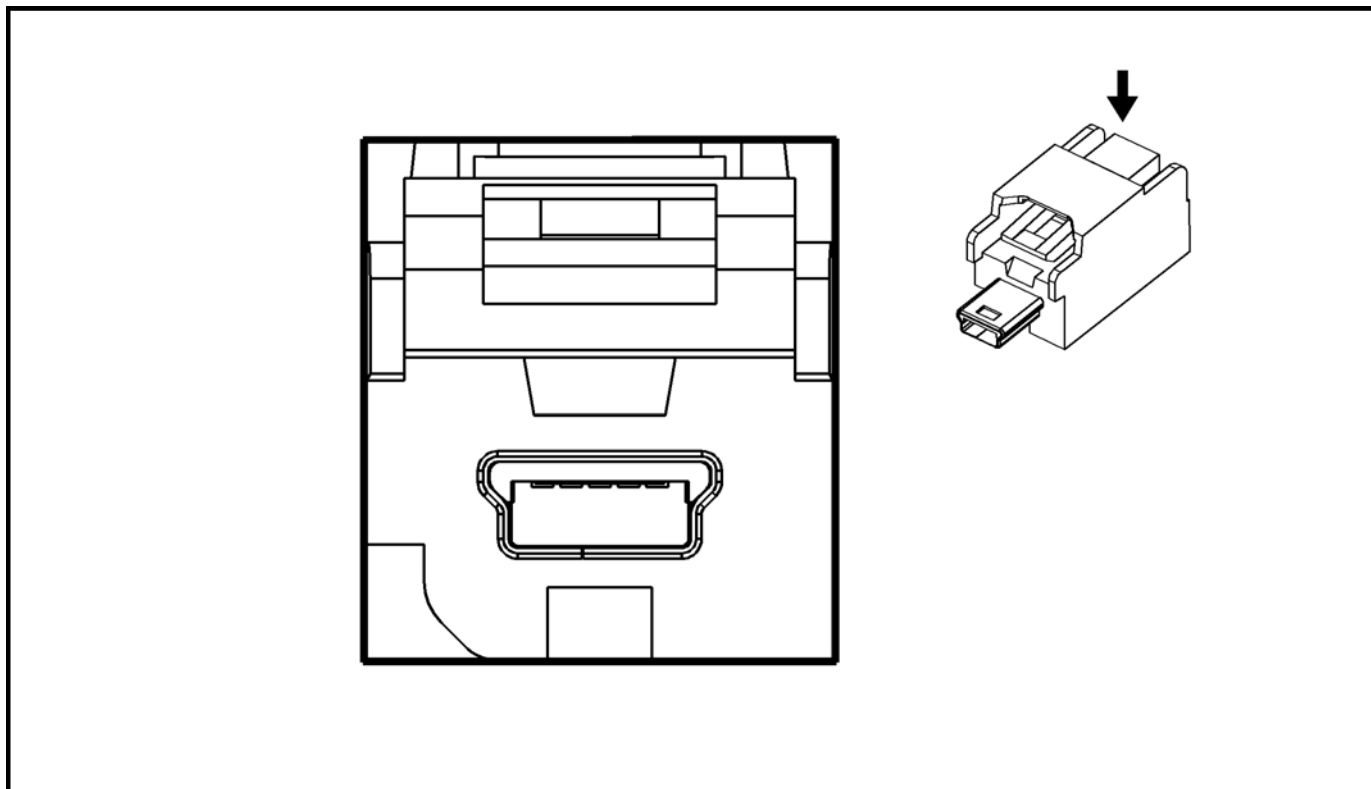
- Harness Type: Floor Console
- OEM Connector: AIT2PB-06-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 3	-	-	-	Not Occupied	-	-
4	0.5	BK	1650	Ground	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	RD/YE	5040	Battery Positive Voltage	I	-

X83 AUXILIARY AUDIO INPUT X2



Connector Part Information

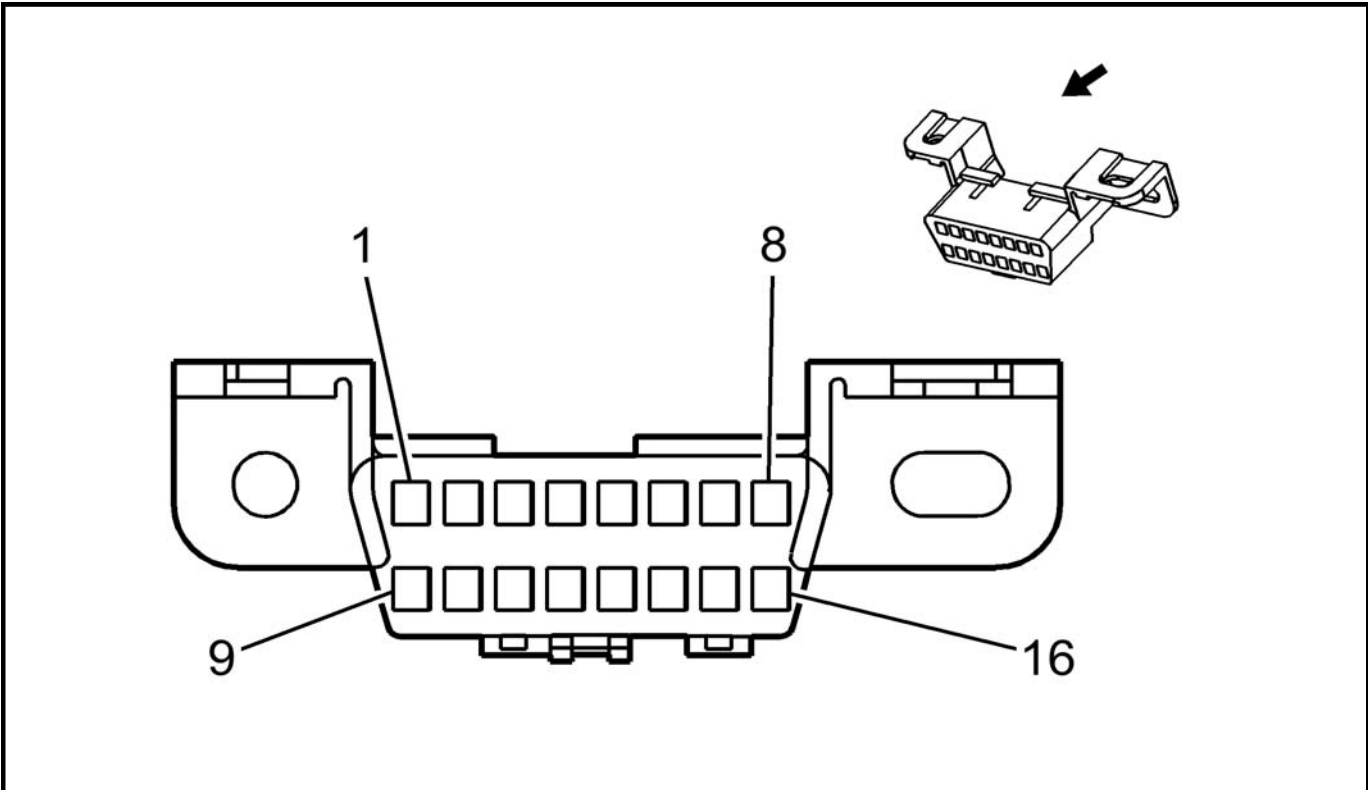
- Harness Type: Floor Console
- OEM Connector: 13584747
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 5-Way M 2.0 Mini-B USB Type (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	USB	-	USB Serial Data	I	-

X84 DATA LINK CONNECTOR



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 12110250
- Service Connector: 12110250
- Description: 16-Way F 150 Metri-Pack Series (BK)

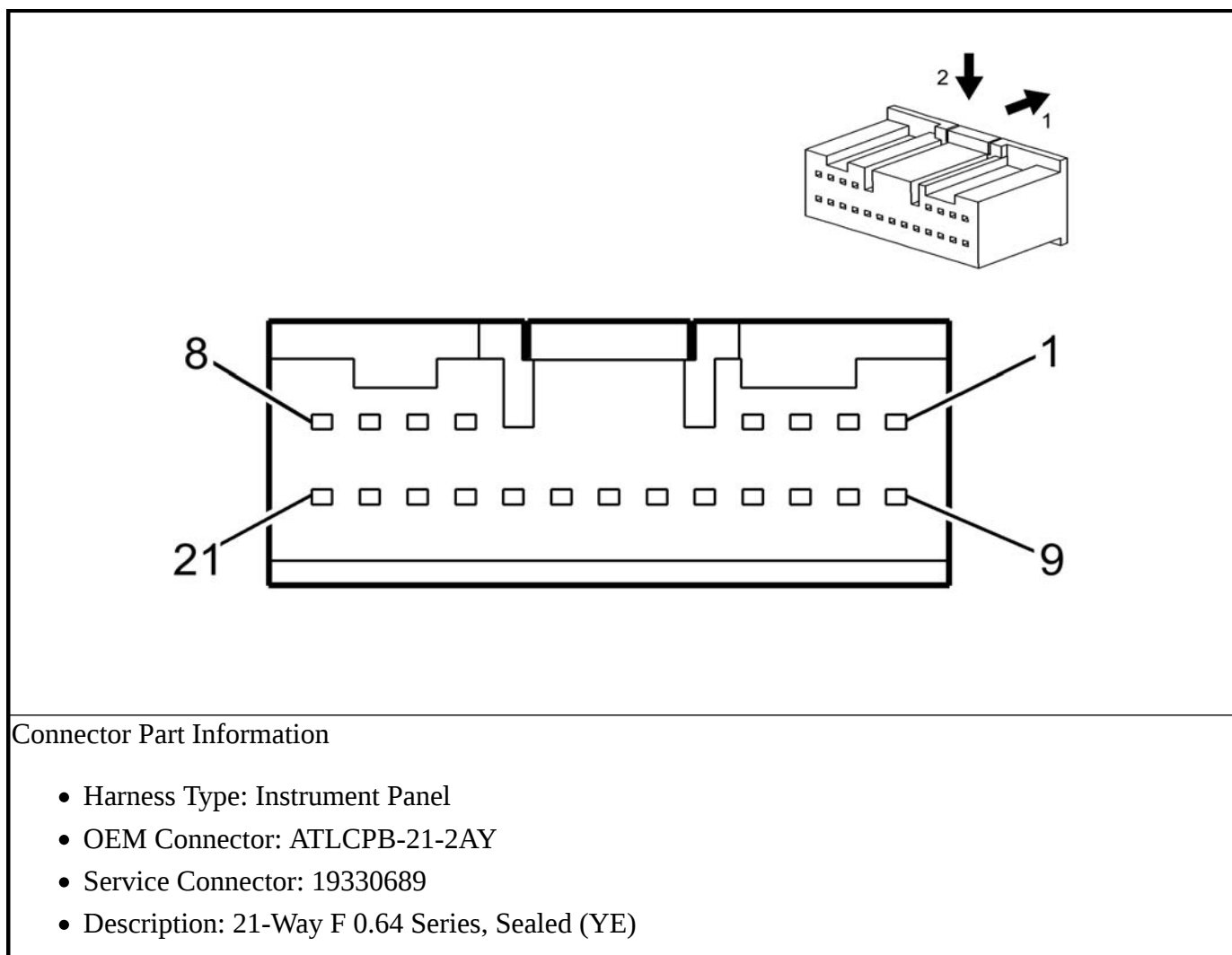
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575725	J-35616-14 (GN)	J-38125-12A	12129484	Delphi 19	E	C

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BU/VT	3813	High Speed GMLAN Serial Data (+) 4	I	-
4	0.5	BK	1650	Ground	I	-
5	0.5	BK	1650	Ground	I	-
6	0.35 0.5	BU BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
			2500	High Speed GMLAN Serial Data (+) 1		-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7 - 10	-	-	-	Not Occupied	-	-
11	0.5	WH	3811	High Speed GMLAN Serial Data (-) 4	I	-
12	0.35 0.5	BU/YE BU/YE	6105 6105	High Speed GMLAN Serial Data (+) 2 High Speed GMLAN Serial Data (+) 2	I	- -
13	0.35 0.5	WH WH	6106 6106	High Speed GMLAN Serial Data (-) 2 High Speed GMLAN Serial Data (-) 2	I	- -
14	0.35 0.5	WH WH	2501 2501	High Speed GMLAN Serial Data (-) 1 High Speed GMLAN Serial Data (-) 1	I	- -
15	-	-	-	Not Occupied	-	-
16	0.5	RD/GY	1740	Battery Positive Voltage	I	-

X85 STEERING WHEEL AIR BAG COIL X1

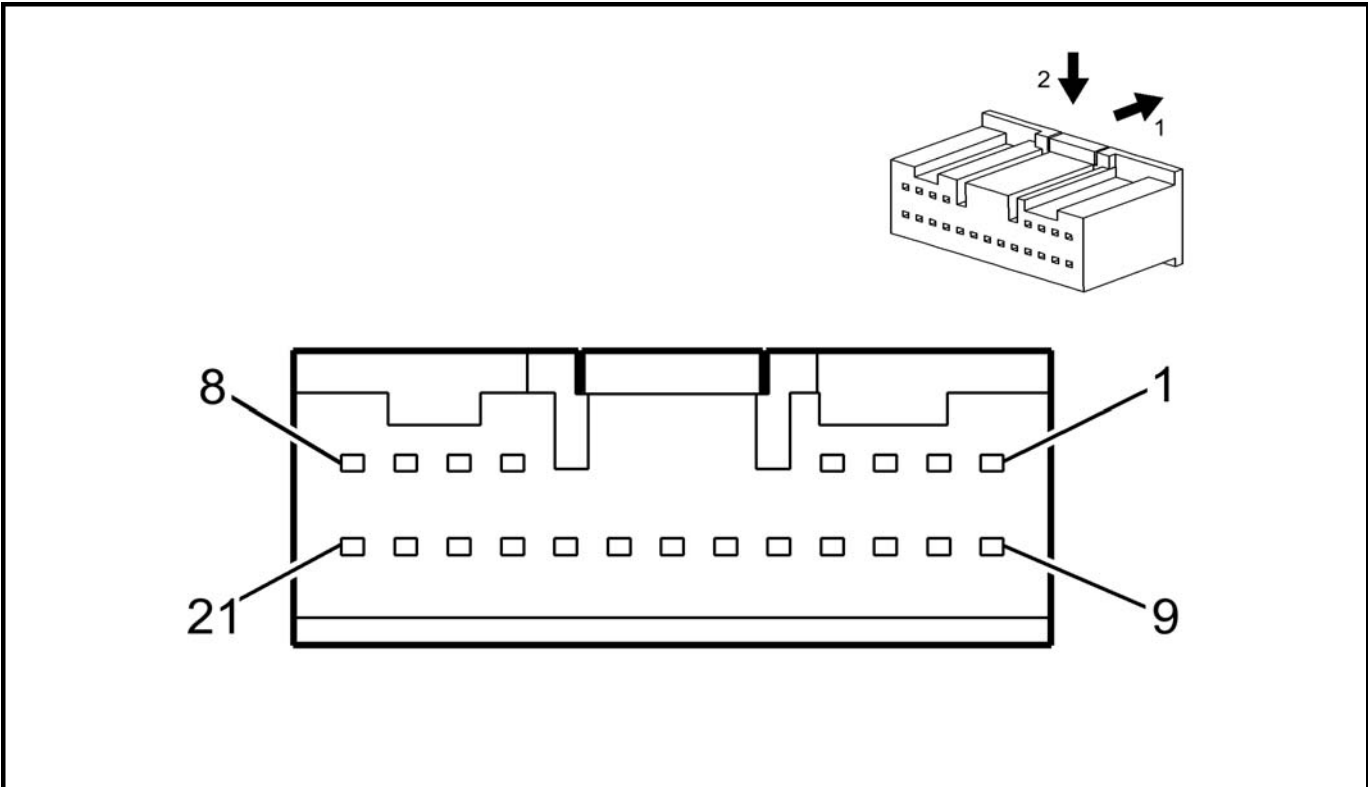


Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575865	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03GF-M064	Yazaki 27	P	P
II	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	3021	Steering Wheel Module Stage 1 High Control	I	-
2	0.5	BN/OG	3020	Steering Wheel Module Stage 1 Low Control	I	-
3	0.5	WH/OG	3022	Steering Wheel Module Stage 2 Low Control	I	-
4	0.5	OG/BK	3023	Steering Wheel Module Stage 2 High Control	I	-
5	0.5	GN/WH	3287	Horn Switch Signal	II	-
6	0.5	BK	1650	Ground	II	-
7	-	-	-	Not Occupied	-	-
8	0.5	BK	2150	Ground	II	-
9	0.5	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	II	-
10	0.5	YE	6817	LED Backlight Dimming Control	II	-
11	0.5	BN/GN	1884	Cruise Control Set/Coast/Resume /Accelerate Switch Signal	II	-
12	0.5	WH	3152	Lane Departure Warning Indicator Control	II	-
13	0.5	WH/RD	1444	12V Reference	II	-
14	-	-	-	Not Occupied	-	-
15	0.5	GY/GN	5737	Adaptive Cruise Control Gap Up/Down Switch Signal	II	-
16	0.5	VT/YE	5526	Tap Up/Tap Down Switch Signal	II	-
17	-	-	-	Not Occupied	-	-
18	0.5	RD/WH	5440	Battery Positive Voltage	II	-
19 - 20	-	-	-	Not Occupied	-	-
21	0.5	VT/WH	239	Run/Crank Ignition 1 Voltage	II	-

X85 STEERING WHEEL AIR BAG COIL X2



Connector Part Information

- Harness Type: Steering Wheel
- OEM Connector: ATLCPB-21-2AY
- Service Connector: Service by Harness - See Part Catalog
- Description: 21-Way F 0.64 Series, Sealed (YE)

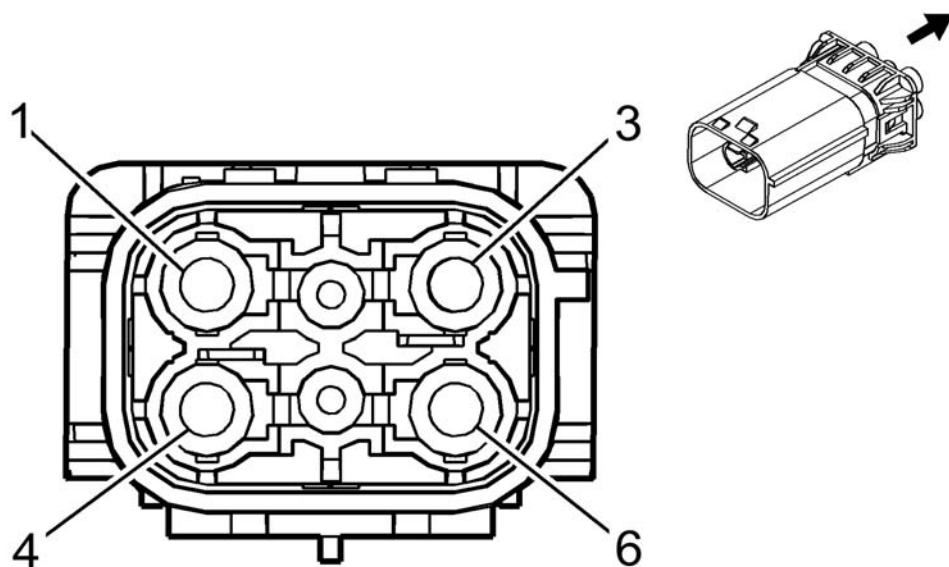
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1650	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BK	1650	Ground	I	-
4	0.35	RD	3287	Horn Switch Signal	I	-
5	0.5	TN	3023	Steering Wheel Module Stage 2 High Control	I	-
6	0.5	BN	3022	Steering Wheel Module Stage 2 Low Control	I	-
7	0.5	GN	3020	Steering Wheel Module Stage 1 Low Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	BU	3021	Steering Wheel Module Stage 1 High Control	I	-
9	0.5	OG	239	Run/Crank Ignition 1 Voltage	I	-
10 - 11	-	-	-	Not Occupied	-	-
12	0.35	BU	5440	Battery Positive Voltage	I	-
13	-	-	-	Not Occupied	-	-
14	0.35	VT	5526	Tap Up/Tap Down Switch Signal	I	-
15	0.35	GN	5737	Adaptive Cruise Control Gap Up/Down Switch Signal	I	-
16	-	-	-	Not Occupied	-	-
17	0.35	BU	1444	12V Reference	I	-
18	0.35	PK	3152	Lane Departure Warning Indicator Control	I	-
19	0.35	BK/RD	1884	Cruise Control Set/Coast/Resume /Accelerate Switch Signal	I	-
20	0.35	BN/RD	6817	LED Backlight Dimming Control	I	-
21	0.35	WH	3894	Local Interconnect Network Serial Data Bus 12	I	-

X98 HYBRID/EV BATTERY CHARGER RECEPTACLE



Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: 13990592

- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M 1.0, 2.4 HES Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-7 (BN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	3	GN	3952	Voltage AC Ground	I	-
2	0.5	GY/GN	3954	Control Pilot Signal 1	II	-
3	3	BU	3837	Voltage AC Line 1	I	-
4	3	WH	3838	Voltage AC Neutral Line 2	I	-
5	0.5	BU/YE	3953	Proximity Status Signal 1	II	-
6	-	-	-	Not Occupied	-	-

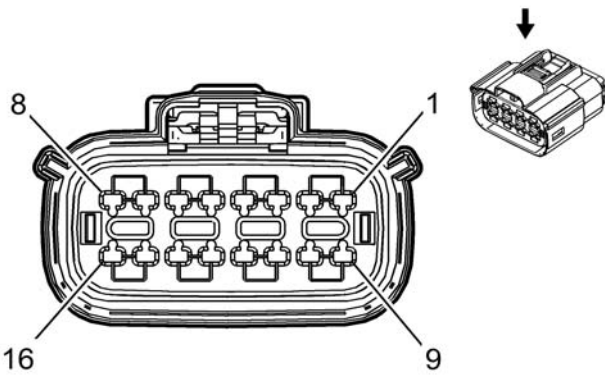
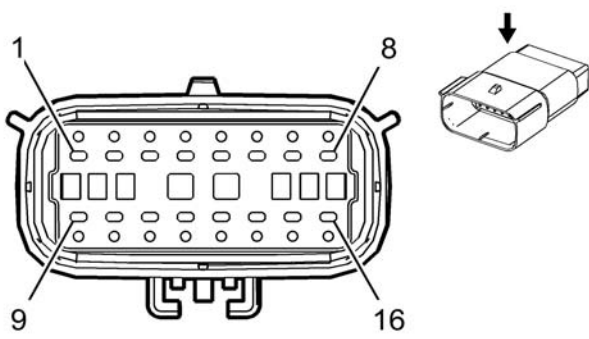
Article GUID: A00884640

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Inline Harness Connector End Views - Volt

INLINE HARNESS CONNECTOR END VIEWS

X100 FORWARD LAMP HARNESS TO FRONT FASCIA HARNESS (UFQ)

	
Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 54241630 • Service Connector: 13577550 • Description: 16-Way F 1.5 Series, Sealed (BK)	Connector Part Information • Harness Type: Front Fascia • OEM Connector: 54241604 • Service Connector: Service by Harness - See Part Catalog • Description: 16-Way M 1.5 APEX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13579989	J-35616-2A (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	BK/BU	5214	I	-	Front Parking Sensor Low Reference	2	0.5	BK/BU	5214	II	-
3	0.5	VT/WH	5215	I	-	Front Parking Left Corner Sensor	3	0.5	VT/WH	5215	II	-
4	0.5	YE/GY	5216	I	-	Front Parking Left Mid Sensor	4	0.5	YE/GY	5216	II	-
5	0.5	WH/GY	5217	I	-	Front Parking Right Corner Sensor	5	0.5	WH/GY	5217	II	-
6	0.5	VT/GY	5218	I	-	Front Parking Right Mid Sensor	6	0.5	VT/GY	5218	II	-
7	0.5	BK	1150	I	-	Ground	7	0.5	BK	1150	II	-
8	0.5	GN	3155	I	-	Right Front Supplemental Object Sensor Signal	8	0.5	GN	3155	II	-
9	0.5	BK/BU	61	I	-	Outside Ambient Temperature Sensor Low Reference	9	0.5	BK/BU	61	II	-
10	0.5	BU/GY	636	I	-	Outside Ambient Air Temperature Sensor Signal	10	0.5	BU/GY	636	II	-
11	0.5	GY/BU	7538	I	-	Left Front DRL Control	11	0.5	GY/BU	7538	II	-
12	0.5	BU/BN	7539	I	-	Right Front DRL Control	12	0.5	BU/BN	7539	II	-
13	0.5	WH/YE	1204	I	-	Left Park Lamp Control	13	0.5	WH/YE	1204	II	-
14	0.5	VT	1203	I	-	Right Park Lamp Control	14	0.5	VT	1203	II	-
15	0.5	GY	3154	I	-	Left Front Supplemental Object Sensor Signal	15	0.5	GY	3154	II	-
16	0.5	RD/BU	5974	I	-	Park Assist Sensor Control Park	16	0.5	RD/BU	5974	II	-

X100 FORWARD LAMP HARNESS TO FRONT FASCIA HARNESS (-UFQ)

Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 13580235 • Service Connector: 19301723 • Description: 8-Way F 1.5 Series, Sealed (BK)	Connector Part Information • Harness Type: Front Fascia • OEM Connector: 33482-0827 • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way M 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH/YE	1204	I	-	Left Park Lamp Control	1	0.5	WH/YE	1204	II	-
2	0.5	GY/BU	7538	I	-	Left Front DRL Control	2	0.5	GY/BU	7538	II	-
3	0.5	VT	1203	I	-	Right Park Lamp Control	3	0.5	VT	1203	II	-
4	0.5	BU/BN	7539	I	-	Right Front DRL Control	4	0.5	BU/BN	7539	II	-
5	0.5	BK/BU	61	I	-	Outside Ambient Temperature Sensor Low Reference	5	0.5	BK/BU	61	II	-
6	0.5	BU/GY	636	I	-	Outside Ambient Air Temperature Sensor Signal	6	0.5	BU/GY	636	II	-
7	0.5	BK	1150	I	-	Ground	7	0.5	BK	1150	II	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-

X102 FORWARD LAMP HARNESS TO COOLING FAN HARNESS

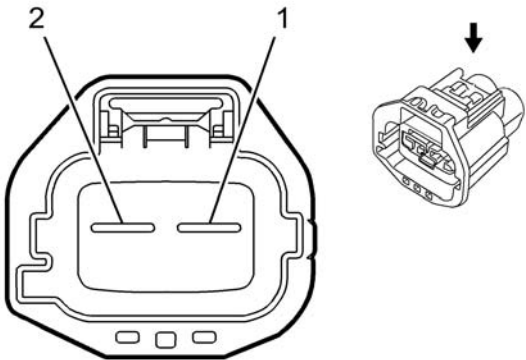
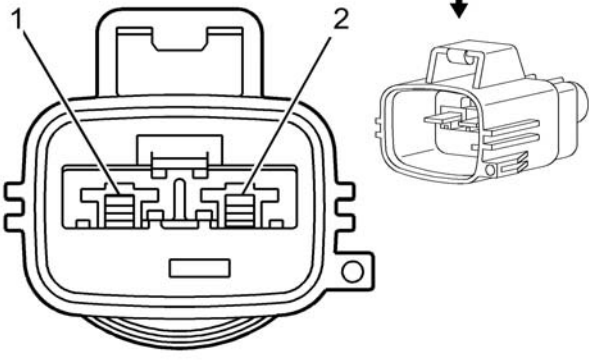
Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 33472-1206 • Service Connector: 13503528 • Description: 12-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Cooling Fan • OEM Connector: 33482-1201 • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13579989	J-35616-2A (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
II	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
III	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH	2368	I	-	Cooling Fan Control Signal	1	0.5	WH	2368	III	-
2	0.5	GN/VT	2032	I	-	Coolant Temperature Sensor Signal	2	0.5	GN/VT	2032	III	-
3	0.5	BK/YE	407	I	-	Sensor Low Reference	3	0.5	BK/YE	407	III	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.5	YE/BK	3000	I	-	Coolant Temperature Sensor 2 Signal	5	0.5	YE/BK	3000	III	-
6	0.5	BK/BU	6813	I	-	Coolant Temperature Sensor 2 Low Reference	6	0.5	BK/BU	6813	III	-
7	0.5	BU/YE	68	I	-	Low Coolant Level Indicator Control	7	0.5	BU/YE	68	III	-
8	0.5	BK/GN	476	I	-	Sensor Low Reference	8	0.5	BK/GN	476	III	-
9	0.75	RD/VT	3340	II	-	Battery Positive Voltage	9	0.75	RD/VT	3340	III	-
10	0.5	WH/GN	3794	I	-	Rechargeable Energy Storage System 1 Coolant Motor Control	10	0.5	WH/GN	3794	III	-
11	0.5	BU/VT	3795	I	-	Rechargeable Energy Storage System 1 Coolant Motor Control	11	0.5	BU/VT	3795	III	-
12	0.5	YE/GY	3796	I	-	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	12	0.5	YE/GY	3796	III	-

X104 COOLING FAN HARNESS TO FORWARD LAMP HARNESS

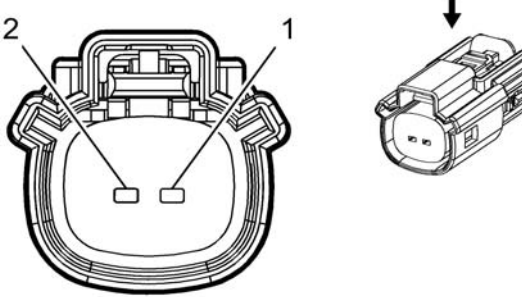
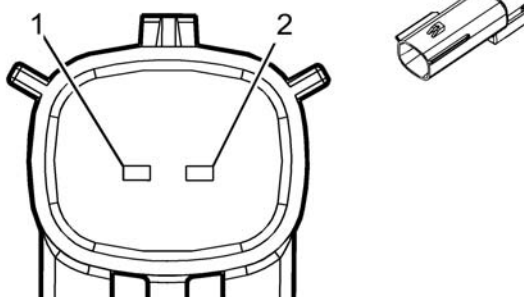
	
Connector Part Information • Harness Type: Cooling Fan • OEM Connector: 7283-5596-10 • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way F YESC USCAR Class III Series (D-GY)	Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 7282-5596-10 • Service Connector: 88953304 • Description: 2-Way M 6.3 Weather Pack Series (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-43 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	4	RD/WH	140	I	-	Battery Positive Voltage	1	3	RD/WH	140	II	-
2	4	RD/BU	540	I	-	Battery Positive Voltage	2	3	RD/BU	540	II	-

X105 BODY HARNESS TO BATTERY CABLE HARNESS

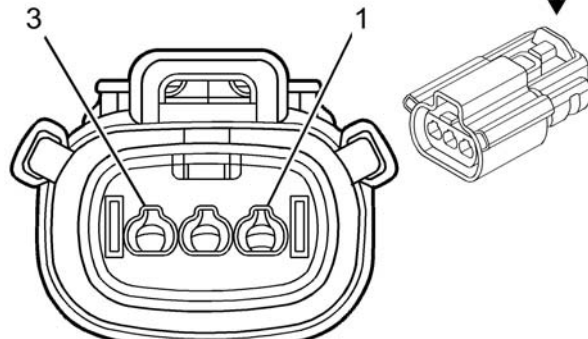
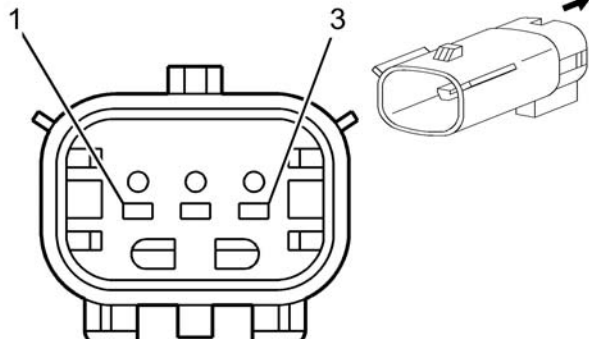
	
Connector Part Information • Harness Type: Body • OEM Connector: 13782480 • Service Connector: 13577534 • Description: 2-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Battery Cable • OEM Connector: 13883040 • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way M 1.5 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	GY/GN	3954	I	-	Control Pilot Signal 1	1	0.5	GY/GN	3954	II	-
2	0.5	BU/YE	3953	I	-	Proximity Status Signal 1	2	0.5	BU/YE	3953	II	-

X106 FORWARD LAMP EXTENSION HARNESS TO FORWARD LAMP HARNESS

	
Connector Part Information • Harness Type: Forward Lamp Extension • OEM Connector: 33471-0306 • Service Connector: Service by Harness - See Part Catalog • Description: 3-Way F 1.5 Series, Sealed (BK)	Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 33481-0301 • Service Connector: 13580232 • Description: 3-Way M 150 MX Series (BK)

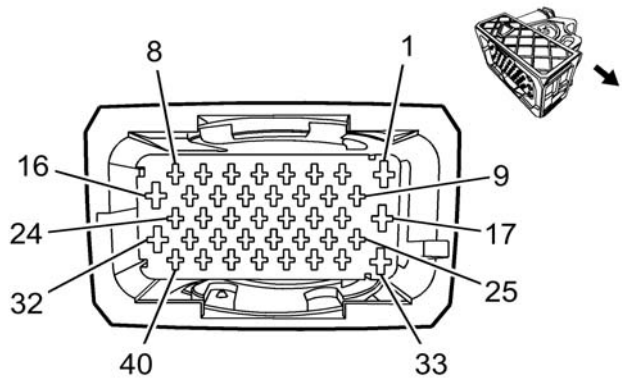
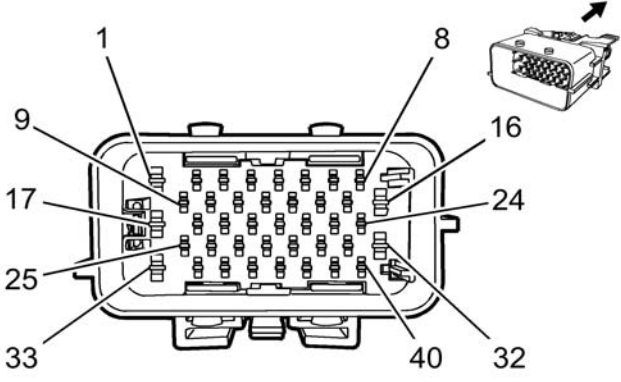
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	VT/BU	5705	I	-	Powertrain Main Relay Fused Control 6	1	0.5	VT/BU	5705	II	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.35	GN/VT	4621	I	-	Local Interconnect Network Serial Data Bus 21	2	0.35	GN/VT	4621	II	-
3	0.5	BK	1150	I	-	Ground	3	0.5	BK	1150	II	-

X107 FORWARD LAMP HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 13603185 • Service Connector: 13576549 • Description: 40-Way F 1.5, 2.8 Series, Sealed (BK)	Connector Part Information • Harness Type: Body • OEM Connector: 13603205 • Service Connector: 13576552 • Description: 40-Way M 1.5, 2.8 Series, Sealed (BK)

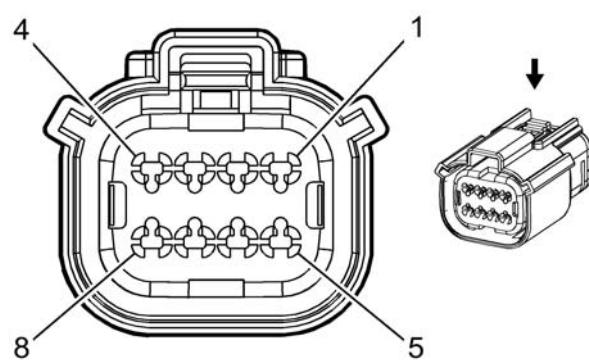
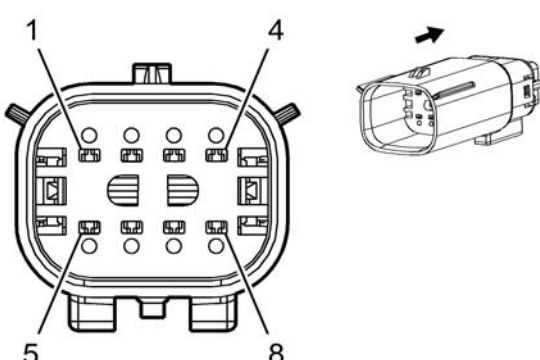
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576369	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available
II	13580830	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
III	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13578882	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13581368	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BK	1150	II	-	Ground	1	0.75	BK	1150	V	-
2	0.5	BN/GN	4064	I	-	Hood Status B Signal	2	0.35	BN/GN	4064	IV	-
3	0.5	YE	4063	I	-	Hood Status A Signal	3	0.5	YE	4063	III	-
4 - 5	-	-	-	-	-	Not Occupied	4 - 5	-	-	-	-	-
6	0.5	WH	3811	I	-	High Speed GMLAN Serial Data (-) 4	6	0.35	WH	3811	IV	-
7	0.5	BU/VT	3813	I	-	High Speed GMLAN Serial Data (+) 4	7	0.35	BU/VT	3813	IV	-
8	0.35	GN/VT	4621	I	-	Local Interconnect Network Serial Data Bus 21	8	0.35	GN/VT	4621	IV	-
9	0.35	GY/VT	3808	I	-	Front Object Sensor Control 2	9	0.35	GY/VT	3808	IV	-
10 - 11	-	-	-	-	-	Not Occupied	10 - 11	-	-	-	-	-
12	0.5	WH	2368	I	-	Cooling Fan Control Signal	12	0.5	WH	2368	III	-
13 - 15	-	-	-	-	-	Not Occupied	13 - 15	-	-	-	-	-
16	0.5	WH	711	II	-	Left Headlamp High Beam Control	16	0.5	WH	711	V	-
17	0.5	BK	1150	II	-	Ground	17	0.5	BK	1150	V	-
18	0.5	VT/BU	5705	I	-	Powertrain Main Relay Fused Control 6	18	0.5	VT/BU	5705	III	-
19 - 23	-	-	-	-	-	Not Occupied	19 - 23	-	-	-	-	-
24	0.5	BU/YE	68	I	-	Low Coolant Level Indicator Control	24	0.5	BU/YE	68	III	-
25	0.5	BK/GN	476	I	-	Sensor Low Reference	25	0.5	BK/VT	476	III	-
26	0.5	WH/YE	1204	I	-	Left Park Lamp Control	26	0.5	WH/YE	1204	III	-
27	-	-	-	-	-	Not Occupied	27	-	-	-	-	-
28	0.5	GY	3154	I	-	Left Front Supplemental Object Sensor Signal	28	0.35	GY	3154	IV	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
29	0.5	GN	3155	I	-	Right Front Supplemental Object Sensor Signal	29	0.35	GN	3155	IV	-
30 - 31	-	-	-	-	-	Not Occupied	30 - 31	-	-	-	-	-
32	0.5	GY/BU	7538	II	-	Left Front DRL Control	32	0.5	GY/BU	7538	V	-
33	0.5	BU/BN	7539	II	-	Right Front DRL Control	33	0.5	BU/BN	7539	V	-
34	0.5	RD/BU	5974	I	-	Park Assist Sensor Control Park	34	0.35	RD/BU	5974	IV	-
35	0.5	BK/BU	5214	I	-	Front Parking Sensor Low Reference	35	0.35	BK/BU	5214	IV	-
36	0.5	VT/WH	5215	I	-	Front Parking Left Corner Sensor	36	0.35	VT/WH	5215	IV	-
37	0.5	YE/GY	5216	I	-	Front Parking Left Mid Sensor	37	0.35	YE/GY	5216	IV	-
38	0.5	VT/GY	5218	I	-	Front Parking Right Mid Sensor	38	0.35	VT/GY	5218	IV	-
39	0.5	WH/GY	5217	I	-	Front Parking Right Corner Sensor	39	0.35	WH/GY	5217	IV	-
40	0.5	VT	185	I	-	Low Washer Fluid Indicator Control	40	0.35	VT	185	IV	-

X110 BODY HARNESS TO LEFT HEADLAMP HARNESS

	
Connector Part Information • Harness Type: Body • OEM Connector: 33472-0806 • Service Connector: 13577527 • Description: 8-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Left Headlamp • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH	711	I	-	Left Headlamp High Beam Control	1	0.5	WH	711	II	-
2	0.5	BU/WH	1314	I	-	Left Front Turn Signal Lamp Control	2	0.5	BU/WH	1314	II	-
3	0.75	BK	1150	I	-	Ground	3	-	-	-	-	-
4	0.5	YE	712	I	-	Left Headlamp Low Beam Control	4	0.5	YE	712	II	-
5	0.5	WH/YE	1204	I	-	Left Park Lamp Control	5	0.5	WH/YE	1204	II	-
6	0.5	BK	1150	I	-	Ground	6	0.5	BK	1150	II	-
7 - 8	-	-	-	-	-	Not Occupied	7 - 8	-	-	-	-	-

X120 BODY HARNESS TO RIGHT HEADLAMP HARNESS

Connector Part Information • Harness Type: Body • OEM Connector: 33472-0806 • Service Connector: 13577527 • Description: 8-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Right Headlamp • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH	311	I	-	Right Headlamp High Beam Control	1	0.5	WH	311	II	-
2	0.5	GN/VT	1315	I	-	Right Front Turn Signal Lamp Control	2	0.5	GN/VT	1315	II	-
3	0.75	BK	1050	I	-	Ground	3	0.75	BK	1050	II	-
4	0.5	BU	312	I	-	Right Headlamp Low Beam Control	4	0.5	BU	312	II	-
5	0.5	VT	1203	I	-	Right Park Lamp Control	5	0.5	VT	1203	II	-
6	0.5	BK	1050	I	-	Ground	6	0.5	BK	1050	II	-
7 - 8	-	-	-	-	-	Not Occupied	7 - 8	-	-	-	-	-

X121 FORWARD LAMP HARNESS TO BODY HARNESS

Connector Part Information • Harness Type: Forward Lamp • OEM Connector: 33476-1606 • Service Connector: 13587961 • Description: 16-Way F 1.5, 2.8 Series, Sealed (BN)	Connector Part Information • Harness Type: Body • OEM Connector: 34986-1601 • Service Connector: 19331031 • Description: 16-Way M 1.5, 2.8 Series, Sealed (BK)

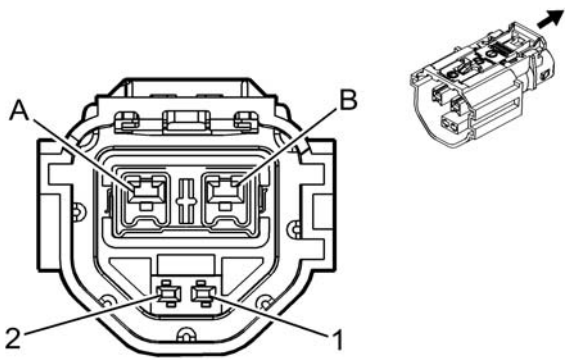
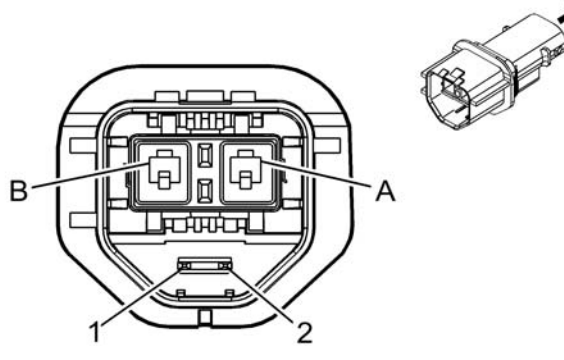
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
------------------	-----------------	-----------------------	-----------------------	------------------	-----------	------------	------------------

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
II	19300625	J-35616-2A (GY)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	19119440	J-35616-3 (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
IV	19329833	J-35616-5 (PU)	J-38125-12A	1326030-6	Lear 17	E	2
V	19329833	J-35616-5 (PU)	J-38125-12A	1326030-6	Lear 17	E	C

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BK	1050	I	-	Ground	1	0.75	BK	1050	V	-
2	0.5	BK/BU	61	II	-	Outside Ambient Temperature Sensor Low Reference	2	0.5	BK/BU	61	III	-
3	0.5	BU/GY	636	II	-	Outside Ambient Air Temperature Sensor Signal	3	0.5	BU/GY	636	III	-
4	0.5	WH/GN	3794	II	-	Rechargeable Energy Storage System 1 Coolant Motor Control	4	0.5	WH/GN	3794	III	-
5	0.5	BU/VT	3795	II	-	Rechargeable Energy Storage System 1 Coolant Motor Control	5	0.5	BU/VT	3795	III	-
6	0.5	YE/GY	3796	II	-	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	6	0.5	YE/GY	3796	III	-
7	0.5	BN/BU	3788	II	-	Electric Coolant Motor Control	7	0.5	BN/BU	3788	III	-
8	1.5	WH	311	I	-	Right Headlamp High Beam Control	8	0.5	WH	311	IV	-
9	0.5	VT	1203	I	-	Right Park Lamp Control	9	0.5	VT	1203	IV	-
10	0.5	YE/GN	3789	II	-	Electric Coolant Motor Control	10	0.5	YE/GN	3789	III	-
11	0.5	VT/BU	3790	II	-	Electric Coolant Motor Feedback Signal	11	0.5	VT/BU	3790	III	-
12	0.5	GN/VT	2032	II	-	Coolant Temperature Sensor Signal	12	0.5	GN/VT	2032	III	-
13	0.5	BK/YE	407	II	-	Sensor Low Reference	13	0.5	BK/YE	407	III	-
14	0.5	VT/BN	4337	II	-	Pedestrian Friendly Alert Speaker Control (-)	14	0.5	VT/BN	4337	III	-
15	0.5	GY/GN	4338	II	-	Pedestrian Friendly Alert Speaker Control (+)	15	0.5	GY/GN	4338	III	-
16	0.5	BK	1050	I	-	Ground	16	0.5	BK	1050	IV	-

X130 BATTERY CABLE HARNESS TO BATTERY CABLE HARNESS

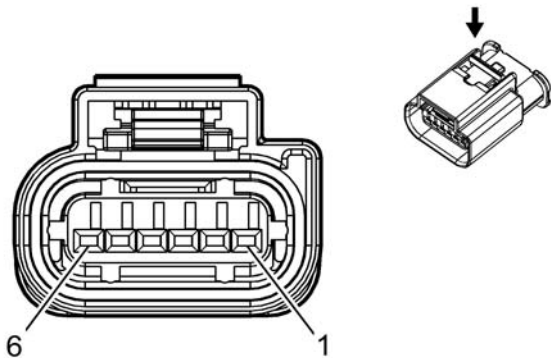
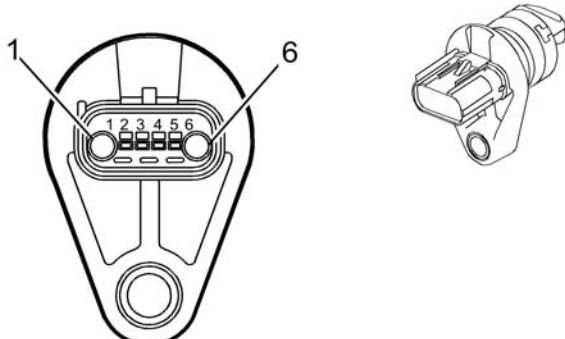
	
Connector Part Information • Harness Type: Battery Cable • OEM Connector: 13859922 • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way F 150, 280 CTS Series, Sealed (OG)	Connector Part Information • Harness Type: Battery Cable • OEM Connector: 13966949 • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way M 2.8 High Voltage Shield Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1 - 2	-	-	-	-	-	Not Occupied	1 - 2	-	-	-	-	-
A	5	OG	3974	I	-	High Voltage Battery 5 (+)	A	5	OG	3974	II	-
B	5	OG	3973	I	-	High Voltage Battery 5 (-)	B	5	OG	3973	II	-

X149 ENGINE HARNESS TO ENGINE OIL LEVEL SENSOR HARNESS

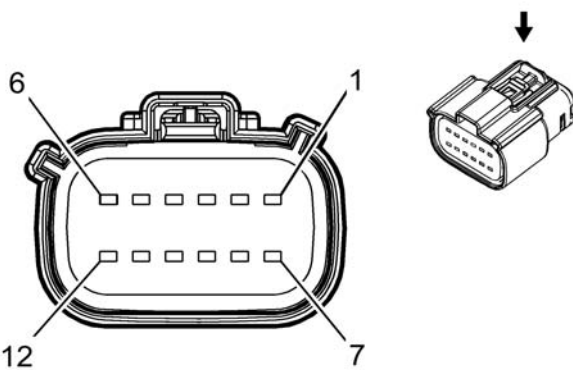
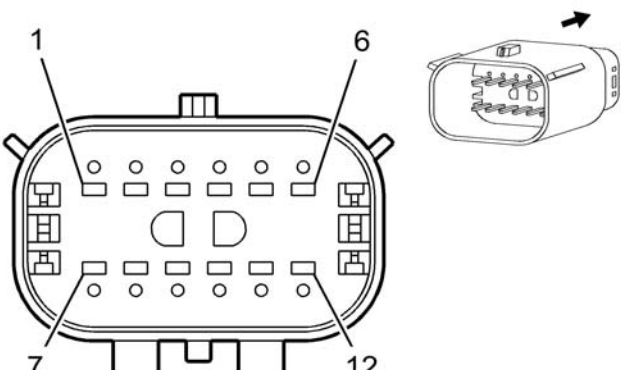
	
Connector Part Information • Harness Type: Engine • OEM Connector: 2138387-9 • Service Connector: 19333443 • Description: 6-Way F 1.2 Series, Sealed (BK)	Connector Part Information • Harness Type: Engine Oil Level Sensor • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 6-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1 - 3	-	-	-	-	-	Not Occupied	1 - 3	-	-	-	-	-
4	0.5	BU	179	I	-	Oil Pump Command Signal	4	0.5	BU	179	II	-
5	0.5	VT/BU	5293	I	-	Powertrain Main Relay Fused Supply 4	5	0.5	VT/BU	5293	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-

X150 ENGINE HARNESS TO ENGINE JUMPER HARNESS

	
---	--

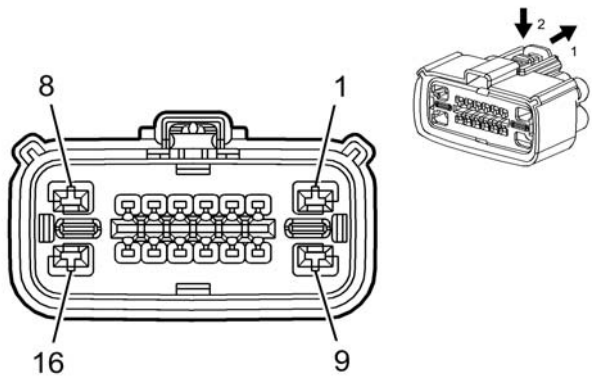
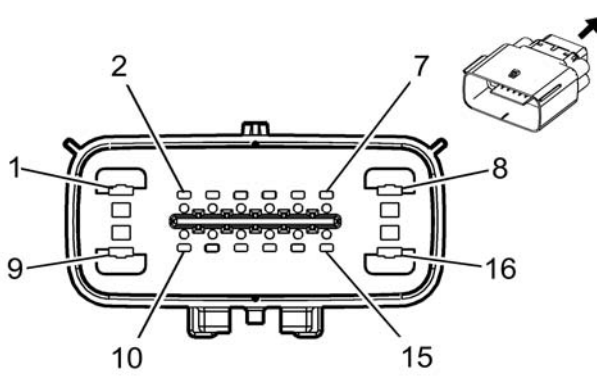
Connector Part Information • Harness Type: Engine • OEM Connector: 33472-1278 • Service Connector: 19300601 • Description: 12-Way F 150 MX Series, Sealed (L-GY)	Connector Part Information • Harness Type: Engine Jumper • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M
---	---

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13578813	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	YE	7301	I	-	High Pressure Fuel Pump Actuator High - Control	1	0.5	YE	7301	II	-
2	0.5	VT/BK	7300	I	-	High Pressure Fuel Pump Actuator Low - Control	2	0.5	VT/BK	7300	II	-
3	0.5	BK/YE	1716	I	-	Knock Sensor Low Reference 1	3	0.5	BK/YE	1716	II	-
4	0.5	VT/GY	496	I	-	Knock Sensor Signal 1	4	0.5	VT/GY	496	II	-
5	0.5	BU	410	I	-	Engine Coolant Temperature Sensor Signal	5	0.5	BU	410	II	-
6	0.5	BK/WH	2051	I	-	Signal Ground	6	0.5	BK/WH	2051	II	-
7	0.5	WH/RD	2705	I	-	Oil Pressure Sensor 5V Reference	7	0.5	WH/RD	2705	II	-
8	0.5	BK/VT	2755	I	-	Oil Pressure Sensor Low Reference	8	0.5	BK/VT	2755	II	-
9	0.5	YE/BN	331	I	-	Oil Pressure Sensor Signal	9	0.5	YE/BN	331	II	-
10 - 11	-	-	-	-	-	Not Occupied	10 - 11	-	-	-	-	-
12	1	BK	450	I	-	Ground	12	1	BK	450	II	-

X155 ENGINE HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Engine • OEM Connector: 34985-4015 • Service Connector: 19352906 • Description: 16-Way F 1.5, 2.8 Series, Sealed (BK)	Connector Part Information • Harness Type: Body • OEM Connector: 34986-1958 • Service Connector: 19331031 • Description: 16-Way M 1.5, 2.8 Series, Sealed (BK)

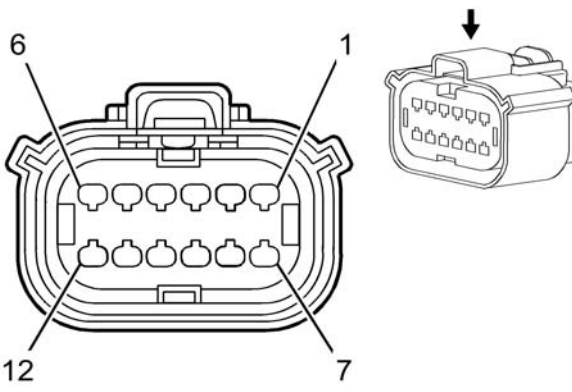
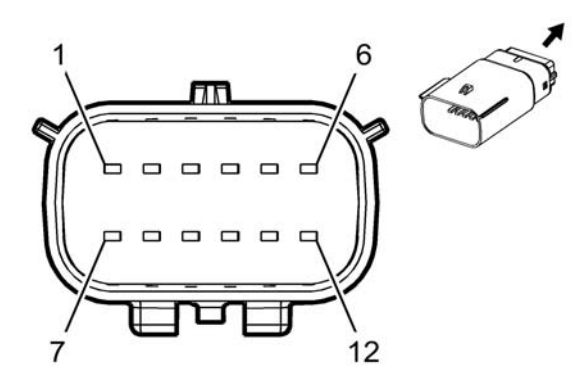
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
II	19300625	J-35616-2A (GY)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	19119440	J-35616-3 (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
IV	19329833	J-35616-5 (PU)	J-38125-12A	1326030-6	Lear 17	E	2

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.5	BK/YE	7447	II	-	Fuel Line Pressure Sensor Low Reference	2	0.35	BK/YE	7447	III	-
3	0.5	BU/WH	7446	II	-	Fuel Line Pressure Sensor Signal	3	0.35	BU/WH	7446	III	-
4	0.5	BN/RD	7445	II	-	Fuel Line Pressure Sensor 5V Reference	4	0.35	BN/RD	7445	III	-
5	0.5	GY	5660	II	-	Fuel Pump Controller Data Out Signal	5	0.5	GY	5660	III	-
6	0.5	GN/VT	4621	II	-	Local Interconnect Network Serial Data Bus 21	6	0.35	GN/VT	4621	III	-
7	0.5	BK	1550	II	62G	Ground	7	0.5	BK	1550	III	62G
8	0.5	WH/BU	9000	I	62G	Charge Port Illumination High Side	8	0.5	WH/BU	9000	IV	62G
9	0.5	RD/WH	2740	I	-	Battery Positive Voltage	9	0.5	RD/WH	2740	IV	-
10 - 13	-	-	-	-	-	Not Occupied	10 - 13	-	-	-	-	-
14	0.5	GY	23	II	-	Generator Field Duty Cycle Signal	14	0.75	GY	23	III	-
15	0.5	BN	25	II	-	Charge Indicator Control	15	0.75	BN	25	III	-
16	-	-	-	-	-	Not Occupied	16	-	-	-	-	-

X160 ENGINE HARNESS TO FUEL SYSTEM HARNESS

	
Connector Part Information • Harness Type: Engine • OEM Connector: 33472-1216 • Service Connector: 19150019 • Description: 12-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Fuel System • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M

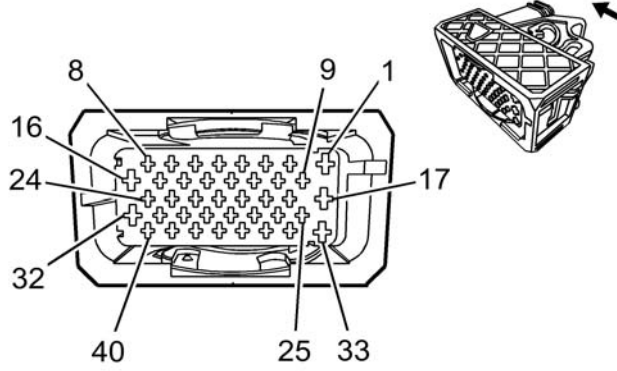
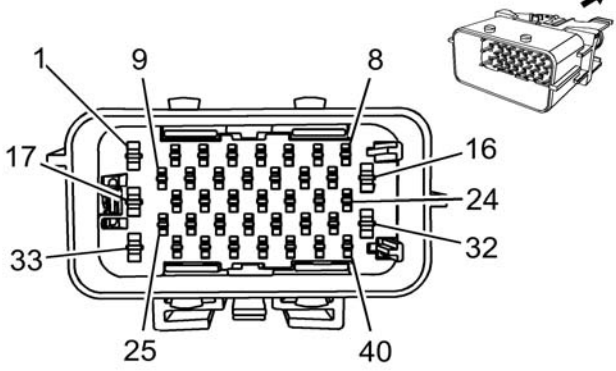
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13578813	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	GY/BU	4804	I	-	Direct Fuel Injector (DFI) High Voltage Control Cylinder 4	1	0.75	GY/BU	4804	II	-
2	0.75	BN	4801	I	-	Direct Fuel Injector (DFI) High Voltage Control Cylinder 1	2	0.75	BN	4801	II	-
3	0.75	BN/WH	4901	I	-	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 1	3	0.75	BN/WH	4901	II	-
4	0.75	BU	4802	I	-	Direct Fuel Injector (DFI) High Voltage Control Cylinder 2	4	0.75	BU	4802	II	-
5	0.75	BU/GY	4902	I	-	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 2	5	0.75	BU/GY	4902	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
7	0.75	BU/WH	4904	I	-	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 4	7	0.75	BU/WH	4904	II	-
8	0.5	BN/RD	2917	I	-	Fuel Rail Pressure Sensor 5V Reference	8	0.5	BN/RD	2917	II	-
9	0.75	GN	4803	I	-	Direct Fuel Injector (DFI) High Voltage Control Cylinder 3	9	0.75	GN	4803	II	-
10	0.75	GN/GY	4903	I	-	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 3	10	0.75	GN/GY	4903	II	-
11	0.5	BK/GN	2919	I	-	Fuel Rail Pressure Sensor Low Reference	11	0.5	BK/GN	2919	II	-
12	0.5	BU/WH	2918	I	-	Fuel Rail Pressure Sensor Signal	12	0.5	BU/WH	2918	II	-

X190 ENGINE HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Engine • OEM Connector: 13603186 • Service Connector: 13576550 • Description: 40-Way F 1.5, 2.8 Series, Sealed (GY)	Connector Part Information • Harness Type: Body • OEM Connector: 13603206 • Service Connector: 13576553 • Description: 40-Way M 1.5, 2.8 Series, Sealed (GY)

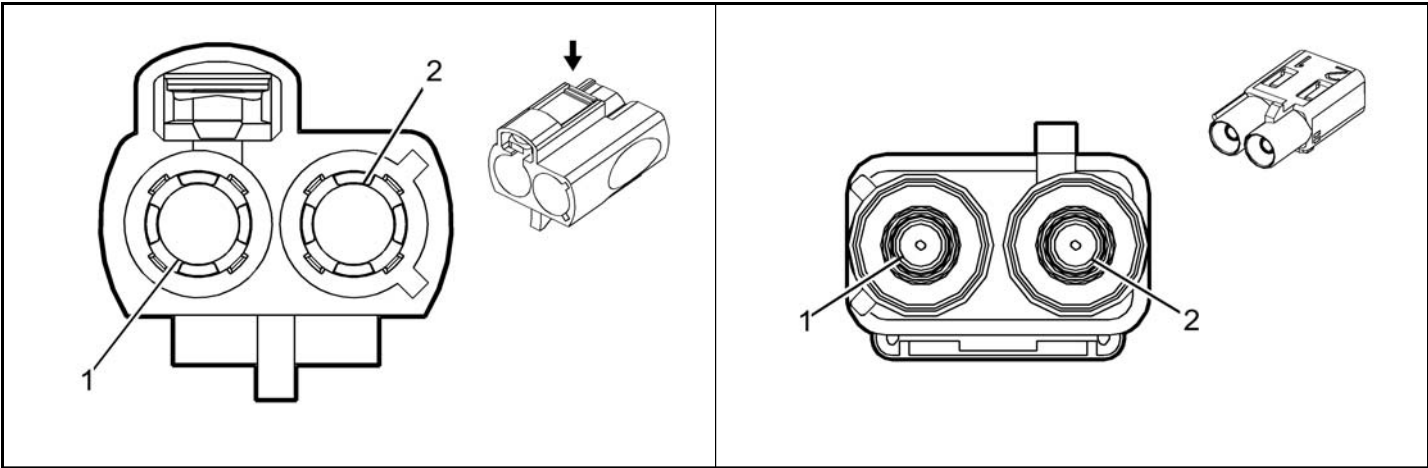
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576369	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available
II	13580830	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
III	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13578882	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13580819	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VI	13581368	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	YE/WH	1161	I	-	Accelerator Pedal Position Signal 1	2	0.35	YE/WH	1161	IV	-
3	0.5	WH/RD	1164	I	-	Accelerator Pedal Position 5V Reference 1	3	0.35	WH/RD	1164	IV	-
4	0.5	BK/BU	1271	I	-	Accelerator Pedal Position Low Reference 1	4	0.35	BK/BU	1271	IV	-
5	0.5	BK/VT	1272	I	-	Accelerator Pedal Position Low Reference 2	5	0.35	BK/VT	1272	IV	-
6	0.5	BN/RD	1274	I	-	Accelerator Pedal Position 5V Reference 2	6	0.35	BN/RD	1274	IV	-
7	0.5	GN/WH	1162	I	-	Accelerator Pedal Position Signal 2	7	0.35	GN/WH	1162	IV	-
8	0.5	GN	3726	I	-	Diurnal Control Valve (DCV) Ground	8	0.35	GN	3726	IV	-
9	0.5	GY	3723	I	-	Evap Leak Check Module (ELCM) Changeover Valve Ground	9	0.35	GY	3723	IV	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
10	0.5	BU	3722	I	-	Evap Leak Check Module (ELCM) Vacuum Pump Ground	10	0.35	BU	3722	IV	-
11	0.5	WH/BU	6311	I	-	Cruise/ETC/TCC Brake Signal	11	0.35	WH/BU	6311	IV	-
12	0.5	BU/GN	3725	I	-	Evap Leak Check Module (ELCM) Pressure Sensor Signal	12	0.35	BU/GN	3725	IV	-
13	0.5	BN/RD	3724	I	-	Evap Leak Check Module (ELCM) Pressure Sensor 5V Reference	13	0.35	BN/RD	3724	IV	-
14	0.5	BU/WH	890	I	-	Fuel Tank Pressure Sensor Signal	14	0.5	BU/WH	890	III	-
15	0.5	YE/RD	2709	I	-	Fuel Tank Pressure Sensor 5V Reference	15	0.5	YE/RD	2709	III	-
16	-	-	-	-	-	Not Occupied	16	-	-	-	-	-
17	0.5	WH/BN	1089	II	-	Coolant Pump Motor Relay Control	17	0.35	WH/BN	1089	V	-
18	0.5	BU/VT	1589	I	-	Primary Fuel Level Sensor Signal	18	0.5	BU/VT	1589	III	-
19	0.5	WH/GN	5380	I	-	Brake Position Sensor Signal	19	0.35	WH/GN	5380	IV	-
20	0.5	BK/YE	5382	I	-	Brake Position Sensor Low Reference	20	0.35	BK/YE	5382	IV	-
21	0.5	BK/GN	6281	I	-	Fuel Level Sensor Low Reference	21	0.5	BK/GN	6281	III	-
22	0.5	BN/WH	419	I	-	Check Engine Indicator Control	22	0.35	BN/WH	419	IV	-
23	0.5	BU/YE	6105	I	-	High Speed GMLAN Serial Data (+) 2	23	0.5	BU/YE	6105	III	-
24	0.5	WH	6106	I	-	High Speed GMLAN Serial Data (-) 2	24	0.5	WH/BU	6106	III	-
25	0.5	BU/BK	7493	I	-	High Speed GMLAN Serial Data (+)3	25	0.5	BU/BK	7493	III	-
26	0.5	WH	7494	I	-	High Speed GMLAN Serial Data (-)3	26	0.5	WH	7494	III	-
27	0.5	WH/RD	5381	I	-	Brake Position Sensor 5V Reference	27	0.35	WH/RD	5381	IV	-
28	0.5	WH/RD	596	I	-	5V Reference	28	0.5	WH/RD	596	III	-
29	0.5	VT/BN	2028	I	-	Coolant Valve Position Sensor Signal	29	0.5	VT/BN	2028	III	-
30	0.5	BK/BU	720	I	-	Sensor Low Reference	30	0.5	BK/BU	720	III	-
31	0.5	BU/VT	2364	I	-	Cooling Fan Speed Signal	31	0.5	BU/VT	2364	III	-
32	0.5	BU/VT	3818	II	-	Rechargeable Energy Storage System Coolant HVAC Mode Motor High Control	32	0.5	BU/VT	3818	VI	-
33	0.5	WH/YE	3819	II	-	Rechargeable Energy Storage System Coolant HVAC Mode Motor Low Control	33	0.5	WH/YE	3819	VI	-
34	0.5	BU/RD	474	I	-	5V Reference	34	0.5	BU/RD	474	III	-
35	0.5	BU	204	I	-	A/C Low Pressure Sensor Signal	35	0.5	BU	204	III	-
36	0.5	BK/GN	476	I	-	Sensor Low Reference	36	0.5	BK/GN	476	III	-
37	0.5	WH/BU	5986	I	-	Serial Data Communication Enable	37	0.35	WH/BU	5986	IV	-
38	0.5	BU/WH	3977	I	-	Accessory Wakeup Serial Data 2	38	0.35	BU/WH	3977	IV	-
39	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	39	0.5	BU	2500	III	-
40	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	40	0.5	WH	2501	III	-

X211 BODY HARNESS TO INSTRUMENT PANEL HARNESS



Connector Part Information							Connector Part Information										
Terminal Part Information																	
Harness Type: Body		Terminated Lead		Diagnostic Test Probe		Terminal Removal Tool		• Harness Type: Instrument Panel		Service Terminal		Tray Name		Core Crimp		Insulation Crimp	
• OEM Connector: 13583911								• OEM Connector: Not Available									
• Service Connector: Service by Cable Assembly - See Part Catalog		Not Required		No Tool Required		No Tool Required		• Not Required		Not Required		Not Required		Not Required		Not Required	
• Description: 2-Way F Coax Type (PU)							• Description: 2-Way M										
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option					
1	-	Coax	6758	I	-	Coaxial Antenna GPS 2 Signal	1	-	Coax	6758	I	-					
2	-	Coax	6449	I	-	Coaxial Antenna Cell Phone Signal	2	-	Coax	6449	I	-					

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Inline Harness Connector End Views - Volt

INLINE HARNESS CONNECTOR END VIEWS

X225 INSTRUMENT PANEL HARNESS TO BODY HARNESS

Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 1355713-1 • Service Connector: 13574784 • Description: 102-Way F 1.5, 2.5, 9.5 Series (BK)	Connector Part Information • Harness Type: Body • OEM Connector: 1670174-4 • Service Connector: 13588077 • Description: 102-Way M 1.6, 2.8, 8.0 Timer Series (BK)

Terminal Part Information

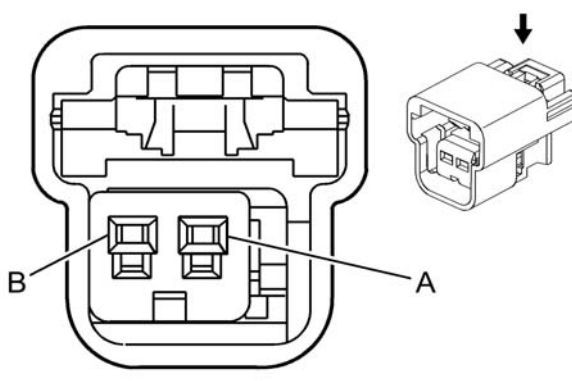
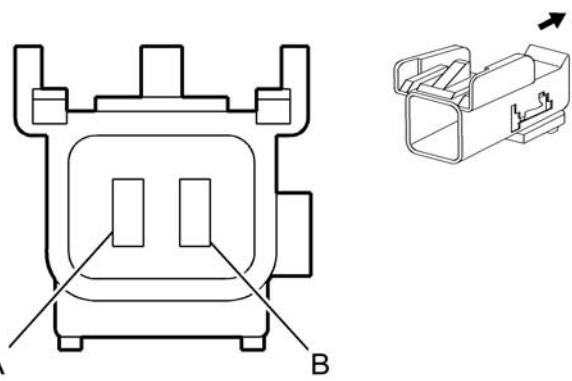
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575760	J-35616-14 (GN)	J-38125-560	964274-2	Lear 16	E	1
II	13578858	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	2
III	13578858	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	C
IV	13578858	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
V	Not Required	J-35616-22 (RD)	No Tool Required	Not Available	Not Available	Not Available	Not Available
VI	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VIII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
IX	Not Required	J-35616-22 (RD)	No Tool Required	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	YE/WH	1161	I	-	Accelerator Pedal Position Signal 1	1	0.35	YE/WH	1161	VII	-
2	0.35	WH/RD	1164	I	-	Accelerator Pedal Position 5V Reference 1	2	0.35	WH/RD	1164	VII	-
3	0.35	BK/BU	1271	I	-	Accelerator Pedal Position Low Reference 1	3	0.35	BK/BU	1271	VII	-
4	0.35	BK/VT	1272	I	-	Accelerator Pedal Position Low Reference 2	4	0.35	BK/VT	1272	VII	-
5	0.35	BN/RD	1274	I	-	Accelerator Pedal Position 5V Reference 2	5	0.35	BN/RD	1274	VII	-
6	0.35	GN/WH	1162	I	-	Accelerator Pedal Position Signal 2	6	0.35	GN/WH	1162	VII	-
7	0.35	BN/WH	419	I	-	Check Engine Indicator Control	7	0.35	BN/WH	419	VII	-
8	0.5	RD/WH	640	I	-	Battery Positive Voltage	8	0.5	RD/WH	640	VII	-
9	0.35	GY/GN	4083	I	-	RAP Relay 2 Coil Control	9	0.35	GY/GN	4083	VII	-
10	0.35	WH/GN	5380	I	-	Brake Position Sensor Signal	10	0.35	WH/GN	5380	VII	-
11	0.35	BK/YE	5382	I	-	Brake Position Sensor Low Reference	11	0.35	BK/YE	5382	VII	-
12	0.35	WH/RD	5381	I	-	Brake Position Sensor 5V Reference	12	0.35	WH/RD	5381	VII	-
13	0.35	YE/BU	3197	I	-	Humidity Temperature Sensor Signal	13	0.35	YE/BU	3197	VII	-
14 - 15	-	-	-	-	-	Not Occupied	14 - 15	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
16	0.35	BU/YE	6105	I	-	High Speed GMLAN Serial Data (+) 2	16	0.5	BU/YE	6105	VII	-
17	0.35	WH	6106	I	-	High Speed GMLAN Serial Data (-) 2	17	0.5	WH/BU	6106	VII	-
18	0.35	YE/GY	230	I	-	Instrument Panel Lamp Dimming Control	18	0.35	YE/GY	230	VII	-
19	0.5	YE	6817	I	-	LED Backlight Dimming Control	19	0.5	YE	6817	VII	-
20	0.35	VT/BN	41	I	-	Run Ignition 3 Voltage	20	0.35	VT/BN	41	VII	-
21	0.35	YE/RD	597	I	-	5V Reference	21	0.35	YE/RD	597	VII	-
22 - 24	-	-	-	-	-	Not Occupied	22 - 24	-	-	-	-	-
25	0.35	BN/VT	193	I	-	Rear Defog Relay Control	25	0.5	BN/VT	193	VII	-
26	0.35	BN/YE	780	I	-	Driver Door Lock Switch Lock Signal	26	0.35	BN/YE	780	VII	-
27	0.35	BN/WH	781	I	-	Driver Door Lock Switch Unlock Signal	27	0.35	BN/WH	781	VII	-
28	0.5	WH	3152	I	-	Lane Departure Warning Indicator Control	28	0.35	WH	3152	VII	-
29 - 33	-	-	-	-	-	Not Occupied	29 - 33	-	-	-	-	-
34	0.35	GY/GN	2555	I	-	Rear Park Assist Disable Signal	34	0.35	GY/GN	2555	VII	-
35	0.35	BU/BN	3161	I	-	Parallel Park Assist Disable Switch Signal	35	0.35	BU/BN	3161	VII	-
36	0.35	GN/BN	5852	I	-	Rear Park Assist LED Disable Signal	36	0.35	GN/BN	5852	VII	-
37	0.35	GY/RD	7684	I	-	Park Brake Apply Switch Voltage Reference	37	0.5	GY/RD	7684	VII	-
38	0.35	YE/RD	7683	I	-	Park Brake Release Switch Voltage Reference	38	0.5	YE/RD	7683	VII	-
39	0.35	BN	6107	I	-	Park Brake Apply Switch Signal	39	0.5	BN	6107	VII	-
40	0.35	BU/BK	6108	I	-	Park Brake Release Switch Signal	40	0.5	BU/BK	6108	VII	-
41	0.35	YE	1492	I	-	Park Brake Switch Supply Voltage	41	0.5	YE	1492	VII	-
42	0.35	BU/VT	1134	I	-	Park Brake Switch Signal	42	0.5	BU/VT	1134	VII	-
43	-	-	-	-	-	Not Occupied	43	-	-	-	-	-
44	0.35	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	44	0.35	GN/BU	6133	VII	-
45	0.35	WH/BU	5986	I	-	Serial Data Communication Enable	45	0.5	WH/BU	5986	VII	-
46	-	-	-	-	-	Not Occupied	46	-	-	-	-	-
47	0.35	YE	5704	I	-	Endgate Latch Relay Coil Control	47	0.35	YE	5704	VII	-
48	0.5	BU/YE	6795	I	-	Lift Glass/Rear Compartment Lid Motor Release Control 2	48	0.75	BU/YE	6795	VIII	-
49	0.35	YE	6817	I	-	LED Backlight Dimming Control	49	0.5	YE	6817	VII	-
50	0.35	VT	185	I	-	Low Washer Fluid Indicator Control	50	0.35	VT	185	VII	-
51 - 58	-	-	-	-	-	Not Occupied	51 - 58	-	-	-	-	-
59	0.35	GN/BU	7532	I	-	Local Interconnect Network Serial Data Bus 10	59	0.35	GN/BU	7532	VII	-
60 - 63	-	-	-	-	-	Not Occupied	60 - 63	-	-	-	-	-
64	0.35	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1 High Speed GMLAN Serial Data (-) 1	64	0.5 0.35	WH WH	2501 2501	VII VII	-UHY UHY
65	0.35	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1 High Speed GMLAN Serial Data (+) 1	65	0.5 0.35	BU BU	2500 2500	VII VII	-UHY UHY
66	-	-	-	-	-	Not Occupied	66	-	-	-	-	-
67	0.35	BK/BN	6102	I	-	Inside Air Temperature Sensor Low Reference	67	0.35	BK/BN	6102	VII	-
68	0.35	GY/GN	7565	I	-	Windscreen Temp Sensor Signal	68	0.35	GY/GN	7565	VII	-
69	0.35	GY/BU	7564	I	-	Humidity Sensor Signal	69	0.35	GY/BU	7564	VII	-
70	-	-	-	-	-	Not Occupied	70	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
71	0.35	GY/WH	3272	I	-	Remote Function Actuator Control	71	0.35	GY/WH	3272	VII	-
72	0.35	YE/GN	3274	I	-	Remote Function Actuator Transmit Signal	72	0.35	YE/GN	3274	VII	-
73	0.35	BU/WH	3275	I	-	Remote Function Actuator Receive Signal	73	0.35	BU/WH	3275	VII	-
74	-	-	-	-	-	Not Occupied	74	-	-	-	-	-
75	0.5	BK	1450	I	-	Ground	75	0.5	BK	1450	VII	-
76 - 78	-	-	-	-	-	Not Occupied	76 - 78	-	-	-	-	-
79	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	79	0.35	WH/YE	7557	VII	-
80 - 88	-	-	-	-	-	Not Occupied	80 - 88	-	-	-	-	-
89	8	RD/BU	42	V	-	Battery Positive Voltage	89	8	RD/BU	42	IX	-
90	8	RD/GY	142	V	-	Battery Positive Voltage	90	8	RD/GY	142	IX	-
91	2	RD/GN	1540	IV	-	Battery Positive Voltage	91	2.5	RD/GN	1540	VI	-
92	1	RD/GN	4140	IV	-	Battery Positive Voltage	92	0.75	RD/GN	4140	VI	-
93	1	RD/GY	4840	IV	-	Battery Positive Voltage	93	0.75	RD/GY	4840	VI	-
94 - 95	-	-	-	-	-	Not Occupied	94 - 95	-	-	-	-	-
96	1	RD/VT	340	IV	-	Battery Positive Voltage	96	0.75	RD/VT	340	VI	-
97	0.5	VT/WH	239	III	-	Run/Crank Ignition 1 Voltage	97	0.75	VT/GY	539	VI	-
98	0.5	WH	3811	III	-	High Speed GMLAN Serial Data (-) 4	98	0.35	WH	3811	VI	-
99	0.5	BU/VT	3813	III	-	High Speed GMLAN Serial Data (+) 4	99	0.35	BU/VT	3813	VI	-
100	0.5	BU	201	III	UQA	Left Front Speaker Control (+) 1	100	1.5	BU	201	VI	UQA
	2	BU	201	IV	UQA	Left Front Speaker Control (+) 1		0.75	BN/BU	118	VI	UZ6
	0.75	BN/BU	118		UZ6	Left Front Speaker Signal (-) 1						
101	0.5	BN/BU	118	III	UQA	Left Front Speaker Signal (-) 1	101	1.5	BN/BU	118	VI	UQA
	2	BN/BU	118	IV	UQA	Left Front Speaker Signal (-) 1		0.75	BU	201	VI	UZ6
	0.75	BU	201		UZ6	Left Front Speaker Control (+) 1						
102	0.35	VT/GN	39	II	DD8	Run/Crank Ignition 1 Voltage	102	0.5	VT/GN	39	VI	UEC
	0.5	VT/GN	39	III	UEC	Run/Crank Ignition 1 Voltage		0.35	VT/GN	39	VI	DD8
	0.35	VT/GN	39	II	UEU/UHX	Run/Crank Ignition 1 Voltage						

X252 INSTRUMENT PANEL HARNESS TO HVAC SYSTEM HARNESS

							
Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 15332129 • Service Connector: 15306425 • Description: 2-Way F 150 GT Series (BK)				Connector Part Information • Harness Type: HVAC System • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way M			

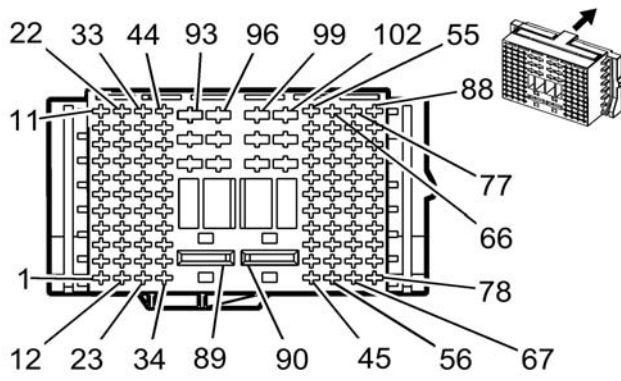
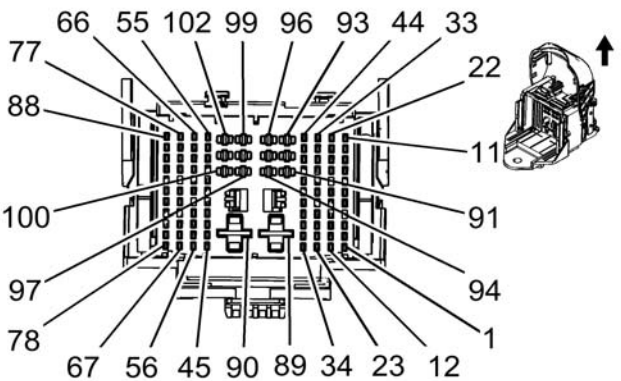
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
A	-	-	-	-	-	Not Occupied	A	-	-	-	-	-
B	0.75	BN	518	I	-	Lower Left Air Temperature Sensor Signal	B	0.75	BN	518	II	-

X275 INSTRUMENT PANEL HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 1355713-1 • Service Connector: 13574784 • Description: 102-Way F 1.5, 2.5, 9.5 Series (BK)	Connector Part Information • Harness Type: Body • OEM Connector: 1670174-4 • Service Connector: 13588077 • Description: 102-Way M 1.6, 2.8, 8.0 Timer Series (BK)

Terminal Part Information

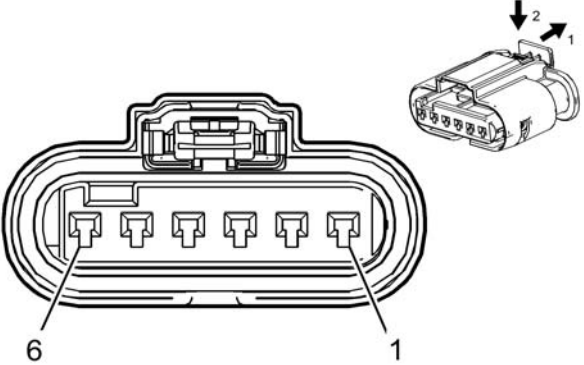
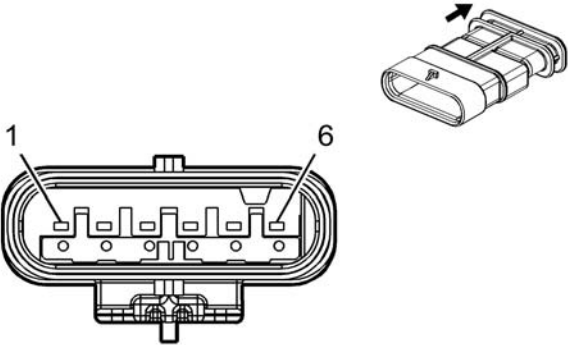
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575760	J-35616-14 (GN)	J-38125-560	964274-2	Lear 16	E	1
II	13575856	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	2
III	13578858	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	C
IV	13578858	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
V	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VI	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1 - 3	-	-	-	-	-	Not Occupied	1 - 3	-	-	-	-	-
4	0.35	GY	156	I	-	Courtesy Lamp Switch Signal	4	0.35	GY	156	VI	-
5	0.75	GY	157	I	-	Interior Lamp Control	5	0.75	GY	157	VII	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.35	BU/GY	4672	I	-	Dome Lamp Off Indicator Control	7	0.35	BU/GY	4672	VI	-
8 - 11	-	-	-	-	-	Not Occupied	8 - 11	-	-	-	-	-
12	0.35	WH/VT	3999	I	-	MOST Control	12	0.35	WH/VT	3999	VI	-
13	0.5	BARE	1782	I	-	Low Reference	13	0.5	BARE	1782	VI	-
14	0.35	YE	658	I	-	Cellular Telephone Voice Signal	14	0.35	YE	658	VI	-
15	0.35	BK/YE	659	I	-	Cellular Telephone Voice Low Reference	15	0.35	BK/YE	659	VI	-
16	0.35	GY/VT	3998	I	-	MOST Serial Data (+)	16	0.35	GY/VT	3998	VI	-
17	0.35	WH/GN	3997	I	-	MOST Serial Data (-)	17	0.35	WH/GN	3997	VI	-
18 - 20	-	-	-	-	-	Not Occupied	18 - 20	-	-	-	-	-
21	0.5	GY/VT	3998	I	-	MOST Serial Data (+)	21	0.35	GY/VT	3998	VI	-
22	0.5	WH/GN	3997	I	-	MOST Serial Data (-)	22	0.35	WH/GN	3997	VI	-
23	0.35	VT/BK	3	I	-	Run/Crank Ignition 1 Voltage	23	0.35	VT/BK	3	VI	-
24 - 29	-	-	-	-	-	Not Occupied	24 - 29	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
30	0.5	BN/WH	3552	I	-	Passive Start Interior Antenna 1 Signal Hi	30	0.35	BN/WH	3552	VI	-
31	0.5	WH	3553	I	-	Passive Start Interior Antenna 1 Signal Lo	31	0.35	WH	3553	VI	-
32 - 33	-	-	-	-	-	Not Occupied	32 - 33	-	-	-	-	-
34	0.35	GN/BK	3558	I	-	Passive Start Switch Signal 2	34	0.35	GN/BK	3558	VI	-
35	0.35	BK/GY	3559	I	-	Passive Start Switch 2 Low Reference	35	0.35	BK/GY	3559	VI	-
36	-	-	-	-	-	Not Occupied	36	-	-	-	-	-
37	0.35	GY	5054	I	-	Sport Mode Switch Signal	37	0.35	GY	5054	VI	-
38 - 39	-	-	-	-	-	Not Occupied	38 - 39	-	-	-	-	-
40	0.35	YE/VT	3956	I	-	Charging Status Indicator Control	40	0.5	YE/VT	3956	VI	-
41	-	-	-	-	-	Not Occupied	41	-	-	-	-	-
42	0.35	GY/GN	3957	I	-	Charging Pilot Signal Indicator Control	42	0.5	GY/GN	3957	VI	-
43	-	-	-	-	-	Not Occupied	43	-	-	-	-	-
44	0.35	VT/YE	4	I	-	Accessory Ignition Voltage	44	0.35	VT/YE	4	VI	-
45 - 48	-	-	-	-	-	Not Occupied	45 - 48	-	-	-	-	-
49	0.35	RD/BK	2240	I	-	Battery Positive Voltage	49	0.5	RD/GY	2240	VI	-
50	-	-	-	-	-	Not Occupied	50	-	-	-	-	-
51	0.35	WH/BN	1089	I	-	Coolant Pump Motor Relay Control	51	0.35	WH/BN	1089	VI	-
52 - 55	-	-	-	-	-	Not Occupied	52 - 55	-	-	-	-	-
56	0.5	BK	6974	I	-	Camera Low Reference	56	0.5	BK	6974	VI	-
57	0.35	GY/YE	6972	I	-	Camera Signal 2 +	57	0.5	GY/YE	6972	VI	-
58	0.35	WH/BU	6973	I	-	Camera Signal 2	58	0.5	WH/BU	6973	VI	-
59 - 62	-	-	-	-	-	Not Occupied	59 - 62	-	-	-	-	-
63	0.35	WH	6816	I	-	Indicator Dimming Control	63	0.35	WH	6816	VI	-
64	0.5	WH/BN	6815	I	-	Inadvertent Power Control	64	0.75	WH/BN	6815	VII	-
65 - 68	-	-	-	-	-	Not Occupied	65 - 68	-	-	-	-	-
69	0.35	OG	3554	I	-	Passive Start Interior Antenna 2 Signal Hi	69	0.35	OG	3554	VI	-
70	0.35	OG/BU	3555	I	-	Passive Start Interior Antenna 2 Signal Lo	70	0.35	OG/BU	3555	VI	-
71 - 90	-	-	-	-	-	Not Occupied	71 - 90	-	-	-	-	-
91	1	VT/WH	1701	IV	-	Retained Accessory Power Ignition	91	1	VT/WH	1701	V	-
92	0.5	YE/BK	117	III	-	Right Front Speaker Signal (-) 1 Right Front Speaker Signal (-) 1	92	0.5 2	YE/BK YE/BK	117 117	V V	UQA UQA
93	0.5	YE	200	III	-	Right Front Speaker Control (+) 1 Right Front Speaker Control (+) 1	93	0.5 2	YE YE	200 200	V V	UQA UQA
94	-	-	-	-	-	Not Occupied	94	-	-	-	-	-
95	0.75 0.5	BU/YE YE	1960 200	IV III	UQA UZ6	Right Front Speaker Control (+) 1 Front Center Speaker (-) Low Reference Right Front Speaker Control (+) 1	95	0.5 1 1	YE BU/YE YE	200 1960 200	V V V	UZ6 UQA UZ6
96	0.75 0.5	YE/WH BN/YE	1860 117	IV III	UQA UZ6	Right Front Speaker Signal (-) 1 Front Center Speaker Control (+) Right Front Speaker Signal (-) 1	96	0.5 1 1	BN/YE YE/WH BN/YE	117 1860 117	V V V	UZ6 UQA UZ6
97 - 98	-	-	-	-	-	Not Occupied	97 - 98	-	-	-	-	-
99	0.35	GN/GY	6135	II	-	Local Interconnect Network Serial Data Bus 4 Local Interconnect Network Serial Data Bus 4	99	0.35 0.5	GN/GY GN/GY	6135 6135	V V	- -
100	2 0.5 0.75	BU BN/BU BN/BU	201 118 118	IV III IV	UQA UZ6 UZ6	Left Front Speaker Control (+) 1 Left Front Speaker Signal (-) 1 Left Front Speaker Signal (-) 1	100	2 0.75	BU BN/BU	201 118	V V	UQA UZ6

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
101	2 0.5 0.75	BN/BU BU BU	118 201 201	IV III IV	UQA UZ6 UZ6	Left Front Speaker Signal (-) 1 Left Front Speaker Control (+) 1 Left Front Speaker Control (+) 1	101	2 0.75	BN/BU BU	118 201	V V	UQA UZ6
102	-	-	-	-	-	Not Occupied	102	-	-	-	-	-

X302 INSTRUMENT PANEL HARNESS TO PASSENGER INSTRUMENT PANEL AIR BAG HARNESS

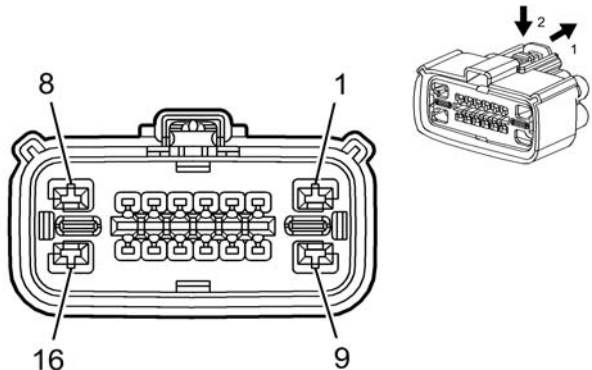
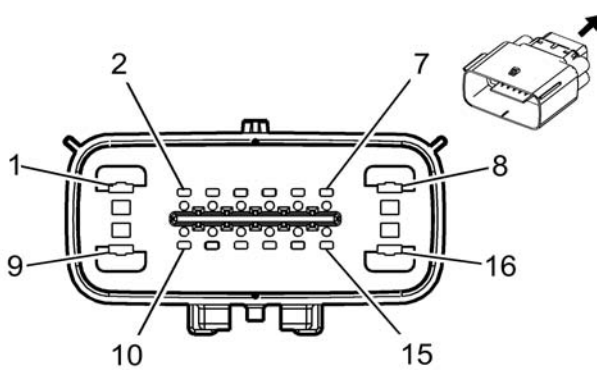
	
Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 13599892 • Service Connector: 19353876 • Description: 6-Way F 1.2 MCON-LL Series, Sealed (YE)	Connector Part Information • Harness Type: Passenger Instrument Panel Air Bag • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 6-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	YE/OG	3025	I	-	Passenger IP Module Stage 1 High Control	1	0.35	YE/OG	3025	II	-
2	0.35	OG/WH	3024	I	-	Passenger IP Module Stage 1 Low Control	2	0.35	OG/WH	3024	II	-
3	0.35	VT	3027	I	-	Passenger IP Module Stage 2 High Control	3	0.35	GY/OG	3027	II	-
4	0.35	OG/VT	3026	I	-	Passenger IP Module Stage 2 Low Control	4	0.35	OG/VT	3026	II	-
5	0.5	BK	1650	I	-	Ground	5	0.5	BK	1650	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-

X310 BODY HARNESS TO DRIVER SEAT HARNESS

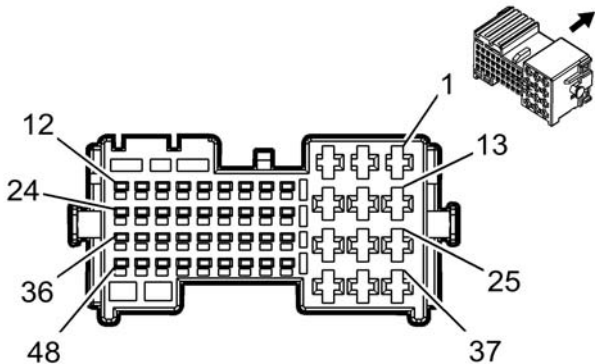
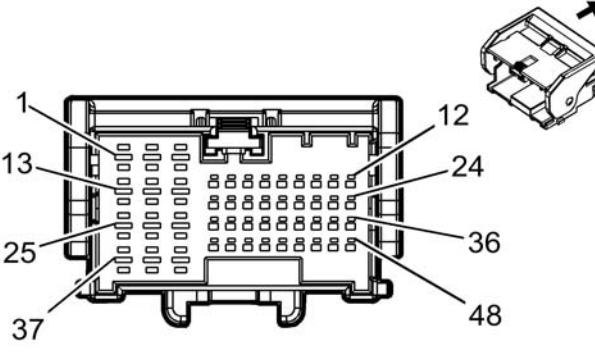
	
Connector Part Information • Harness Type: Body • OEM Connector: 34985-2294 • Service Connector: 19352908 • Description: 16-Way F 1.5, 2.8 Series, Sealed (YE)	Connector Part Information • Harness Type: Driver Seat • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 16-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
II	13575868	J-35616-2A (GY)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	13578813	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
IV	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BN/VT	2077	I	-	Driver Heated Seat Element Control	1	0.75	BN/VT	2077	IV	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	OG/BN	238	II	-	Driver Seat Belt Switch Signal	3	0.5	TN/WH	238	IV	-
4	0.5	BK/WH	1363	II	-	Driver Seat Belt Switch Low Reference	4	0.5	BK/OG	1363	IV	-
5	0.5	BK/YE	2080	II	-	Driver Heated Seat NTC Low Reference	5	0.5	BK/YE	2080	IV	-
6	0.5	YE/GY	2079	II	-	Driver Heated Seat NTC Signal	6	0.5	YE/GY	2079	IV	-
7	0.5	BU	2425	II	-	Driver Heated Back NTC Signal	7	0.5	BU	2425	IV	-
8 - 9	-	-	-	-	-	Not Occupied	8 - 9	-	-	-	-	-
10	0.5	OG/BU	3068	III	-	Driver Side Impact Module High Control	10	0.5	OG/BU	3068	IV	-
11	0.5	GN/OG	3069	III	-	Driver Side Impact Module Low Control	11	0.5	GN/OG	3069	IV	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-
13	0.5	OG/YE	3481	III	-	Driver Seat Belt Anchor Pretensioner High Control	13	0.5	OG/YE	3481	IV	-
14	0.5	YE/OG	3482	III	-	Driver Seat Belt Anchor Pretensioner Low Control	14	0.5	YE/OG	3482	IV	-
15	-	-	-	-	-	Not Occupied	15	-	-	-	-	-
16	0.75	VT/BK	2424	I	-	Driver Heated Back Element Low Reference	16	0.75	VT/BK	2424	IV	-

X315 FLOOR CONSOLE HARNESS TO INSTRUMENT PANEL HARNESS

	
Connector Part Information • Harness Type: Floor Console • OEM Connector: 1-2109452-3 • Service Connector: Service by Harness - See Part Catalog • Description: 48-Way F 1.2 MCON, 2.8 MCP Series (GY)	Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 1-2109455-3 • Service Connector: 19329738 • Description: 48-Way M 1.2 MCON, 2.8 MCP Series

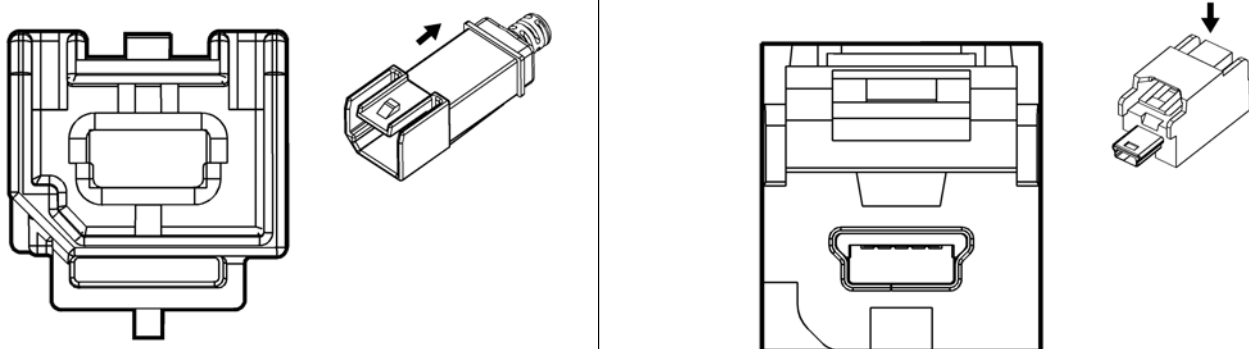
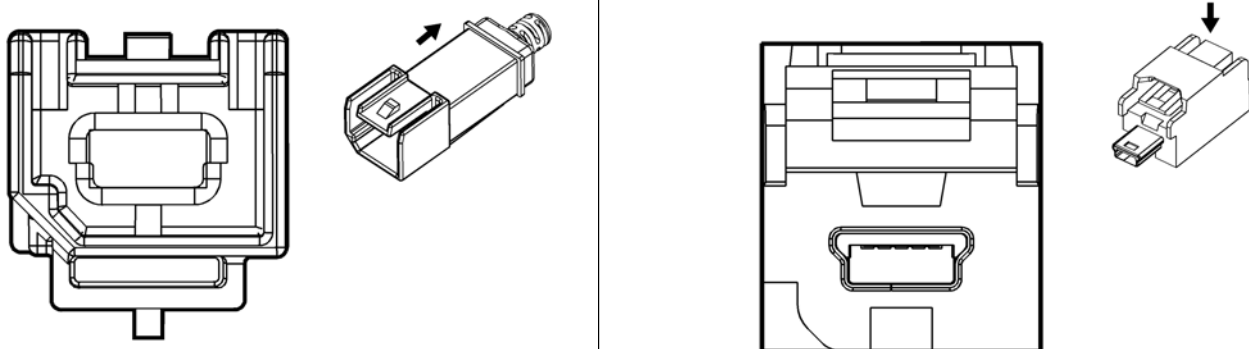
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575529	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
IV	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
V	19329749	J-35616-13 (BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	RD/YE	5040	II	-	Battery Positive Voltage	1	0.35	RD/YE	5040	III	-
2	0.35	GY/VT	755	II	-	RAP Relay Coil Control	2	0.35	GY/VT	755	III	-
3	1	VT	1301	II	-	Retained Accessory Power Fuse Control	3	1	VT	1301	IV	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.35	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	5	0.35	GN/BU	6133	V	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.5	YE	6817	I	-	LED Backlight Dimming Control	7	0.35	YE	6817	V	-
8	0.35	GN	4512	I	-	Wireless Charging System Charge Indicator Control	8	0.35	GN	4512	V	-
9 - 10	-	-	-	-	-	Not Occupied	9 - 10	-	-	-	-	-
11	0.5	OG	3554	I	-	Passive Start Interior Antenna 2 Signal Hi	11	0.35	OG	3554	V	-
12	0.5	OG/BU	3555	I	-	Passive Start Interior Antenna 2 Signal Lo	12	0.35	OG/BU	3555	V	-
13	-	-	-	-	-	Not Occupied	13	-	-	-	-	-
14	0.35	VT	4601	II	-	Retained Accessory Power Fused Control	14	0.35	VT	4601	III	-
15	-	-	-	-	-	Not Occupied	15	-	-	-	-	-
16	0.35	GY/RD	7684	I	-	Park Brake Apply Switch Voltage Reference	16	0.35	GY/RD	7684	V	-
17	0.35	YE/RD	7683	I	-	Park Brake Release Switch Voltage Reference	17	0.35	YE/RD	7683	V	-
18	0.35	BN	6107	I	-	Park Brake Apply Switch Signal	18	0.35	BN	6107	V	-
19	0.35	BU/BK	6108	I	-	Park Brake Release Switch Signal	19	0.35	BU/BK	6108	V	-
20	0.35	YE	1492	I	-	Park Brake Switch Supply Voltage	20	0.35	YE	1492	V	-
21	0.35	BU/VT	1134	I	-	Park Brake Switch Signal	21	0.35	BU/VT	1134	V	-
22	0.35	BU/VT	1788	I	-	Traction Control Switch Signal 1	22	0.35	BU/VT	1788	V	-
23 - 27	-	-	-	-	-	Not Occupied	23 - 27	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
28	0.35	GY	5054	I	-	Sport Mode Switch Signal	28	0.35	GY	5054	V	-
29	0.5	WH	6816	I	-	Indicator Dimming Control	29	0.35	WH	6816	V	-
30 - 36	-	-	-	-	-	Not Occupied	30 - 36	-	-	-	-	-
37	0.5	BK	1650	II	-	Ground	37	0.5	BK	1650	IV	-
38	1 0.5	BK BK	2150 2150	II	- K68	Ground Ground	38	1.5	BK	2150	IV	-
39	0.5	BK	1650	II	-	Ground	39	0.5	BK	1650	IV	-
40	0.35	GY/GN	2555	I	-	Rear Park Assist Disable Signal	40	0.35	GY/GN	2555	V	-
41	0.35	BU/BN	3161	I	-	Parallel Park Assist Disable Switch Signal	41	0.35	BU/BN	3161	V	-
42	0.35	GN/BN	5852	I	-	Rear Park Assist LED Disable Signal	42	0.35	GN/BN	5852	V	-
43	0.35	GN/GY	3277	I	-	Vehicle Anti-Theft System Immobilizer Low Reference	43	0.35	GN/GY	3277	V	-
44	0.35	GN/VT	7533	I	-	Local Interconnect Network Serial Data Bus 11	44	0.35	GN/VT	7533	V	-
45	0.35	GY/BK	3276	I	-	Vehicle Anti-Theft System Immobilizer Control	45	0.35	GY/BK	3276	V	-
46	-	-	-	-	-	Not Occupied	46	-	-	-	-	-
47	0.35	GY/YE	7543	I	-	Hazard LED Dimming Signal	47	0.35	GY/YE	7543	V	-
48	0.35	GN/WH	111	I	-	Hazard Switch Signal	48	0.35	GN/WH	111	V	-

X316 INSTRUMENT PANEL HARNESS TO FLOOR CONSOLE HARNESS

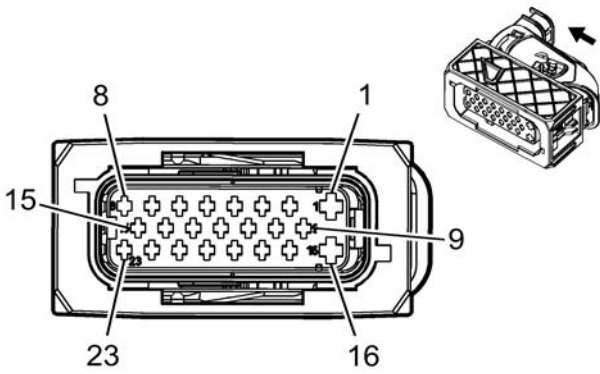
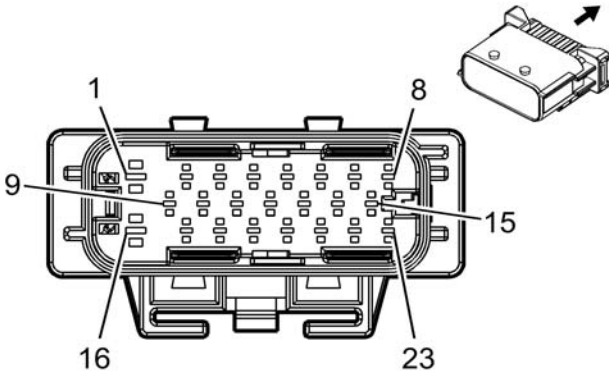
	
Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 13578976 • Service Connector: Service by Cable Assembly - See Part Catalog • Description: 5-Way F 2.0 Mini-B USB Type (BK)	Connector Part Information • Harness Type: Floor Console • OEM Connector: 13584747 • Service Connector: Service by Cable Assembly - See Part Catalog • Description: 5-Way M 2.0 Mini-B USB Type (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
-	-	USB	-	I	-	USB Serial Data	-	-	USB	-	I	-

X320 DRIVER SEAT HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Driver Seat • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 23-Way F	Connector Part Information • Harness Type: Body • OEM Connector: 13750010 • Service Connector: 19332380 • Description: 23-Way M 1.5 DSQ, 2.8 AST Series, Sealed (BK)

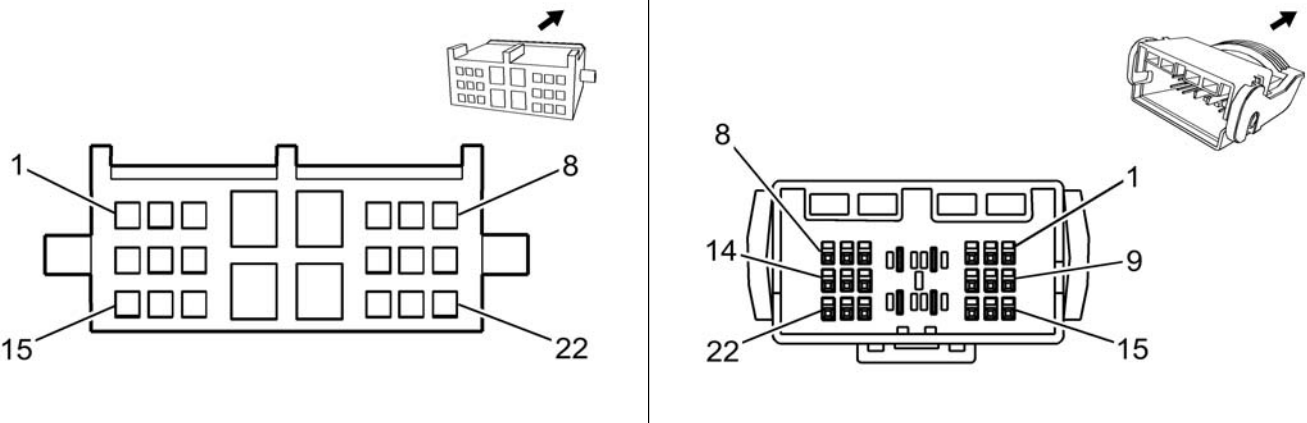
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
III	13578882	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13581368	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
V	19353142	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
VI	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	RD/GY	1740	I	-	Battery Positive Voltage	1	0.75	RD/GY	1740	IV	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.35	OG	1362	I	-	Passenger Seat Belt Switch Signal	3	0.35	OG/VT	1362	III	-
4	0.5	BK/OG	1361	I	-	Passenger Seat Belt Switch Low Reference	4	0.5	BK/OG	1361	II	-
5	0.5	BK/YE	2080	I	-	Driver Heated Seat NTC Low Reference	5	0.5	BK/YE	2080	II	-
6	0.5	YE/GY	2079	I	-	Driver Heated Seat NTC Signal	6	0.5	YE/GY	2079	II	-
7	0.75	BN/VT	2077	I	-	Driver Heated Seat Element Control	7	0.75	BN/VT	2077	II	-
8	0.5	BU	2425	I	-	Driver Heated Back NTC Signal	8	0.5	BU	2425	II	-
9	0.35	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	9	0.35	GN/BU	6133	III	-
10	0.35	OG/GY	3066	I	-	Passenger Side Impact Module High Control	10	0.35	OG/GY	3066	V	-
11	0.35	BN/OG	3067	I	-	Passenger Side Impact Module Low Control	11	0.35	BN/OG	3067	V	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-
13	0.5	GN	5060	I	-	Low Speed GMLAN Serial Data	13	0.5	GN	5060	II	-
14	0.5	RD	2240	I	-	Battery Positive Voltage	14	0.5	RD/GY	2240	II	-
15	0.35	BK	2050	I	-	Ground	15	0.5	BK	2050	VI	-
16	1	BK	2050	I	KA1	Ground	16	1	BK	2050	IV	KA1
17	-	-	-	-	-	Not Occupied	17	-	-	-	-	-
18	0.35	OG/BN	3479	I	-	Passenger Seat Belt Anchor Pretensioner High Control	18	0.35	OG/BN	3479	V	-
19	0.35	GY/OG	3480	I	-	Passenger Seat Belt Anchor Pretensioner Low Control	19	0.35	GY/OG	3480	V	-
20	-	-	-	-	-	Not Occupied	20	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
21	0.75	RD/BN	1742	I	-	Battery Positive Voltage	21	0.75	RD/BN	1742	II	-
22	-	-	-	-	-	Not Occupied	22	-	-	-	-	-
23	0.75	VT/BK	2424	I	-	Driver Heated Back Element Low Reference	23	0.75	VT/BK	2424	II	-

X325 HEADLINER HARNESS TO INSTRUMENT PANEL HARNESS

	
Connector Part Information • Harness Type: Headliner • OEM Connector: 1897543-2 • Service Connector: 13395404 • Description: 22-Way F 0.64 Micro-Quadlock, 2.8 Micro-Power Series (BK)	Connector Part Information • Harness Type: Instrument Panel • OEM Connector: 1897540-2 • Service Connector: 13580994 • Description: 22-Way M 0.64 MQS, 2.8 MCP Series (BK)

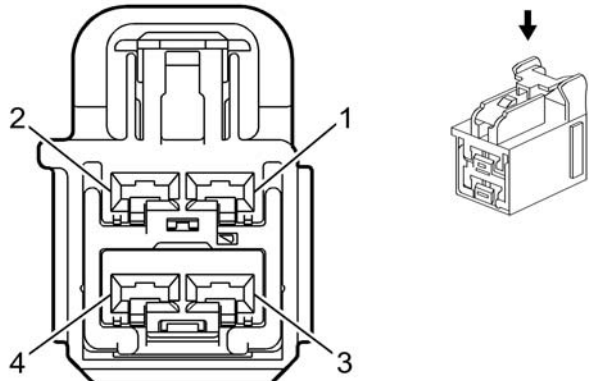
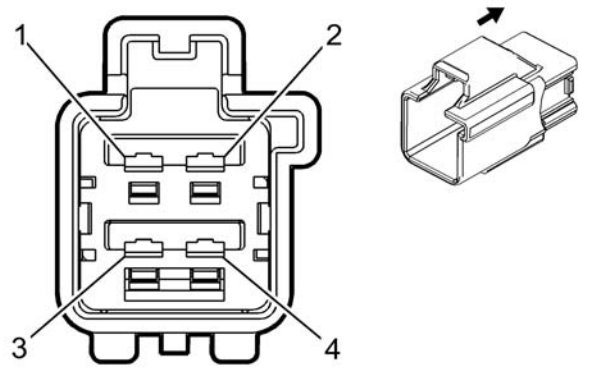
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575584	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
II	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	13582285	J-35616-35 (VT)	J-38125-557	1241388-1	Lear 17	E	C
IV	13575569	J-35616-65B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
V	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	GY/GN	328	I	-	Interior Lamp Defeat Switch Signal	1	0.35	GY/GN	328	IV	-
2	0.35	GY	156	I	-	Courtesy Lamp Switch Signal	2	0.35	GY	156	IV	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	0.5	BK	2150	III	-	Ground	4	0.5	BK	2150	V	-
5	-	-	-	-	-	Not Occupied	5	-	-	-	-	-
6	0.5	WH/YE	7557	II	-	LED Ambient Lighting Control 1	6	0.35	WH/YE	7557	IV	-
7	0.5	YE	6817	II	-	LED Backlight Dimming Control	7	0.35	YE	6817	IV	-
8	0.5	WH/BN	6815	II	-	Inadvertent Power Control	8	0.5	WH/BN	6815	IV	-
9	0.35	WH	6816	I	-	Indicator Dimming Control	9	0.35	WH	6816	IV	-
10	0.35	BU/GY	4672	I	-	Dome Lamp Off Indicator Control	10	0.35	BU/GY	4672	IV	-
11	0.5	GY	157	II	-	Interior Lamp Control	11	0.75	GY	157	IV	-
12	0.35	GN/BK	2515	I	-	Keypad Control	12	0.35	GN/BK	2515	IV	-
13	0.35	GN/WH	2514	I	-	Keypad Signal	13	0.35	GN/WH	2514	IV	-
14	0.35	YE/VT	2516	I	-	Keypad Green LED Control	14	0.35	YE/VT	2516	IV	-
15	0.35	GN	2308	I	-	Passenger Air Bag Off Indicator Control	15	0.35	GN	2308	IV	-
16	0.35	BU	2307	I	-	Passenger Air Bag On Indicator Control	16	0.35	BU	2307	IV	-
17	0.35	VT/WH	5234	I	-	Passenger Seat Belt Indicator Control	17	0.35	VT/WH	5234	IV	-
18	-	-	-	-	-	Not Occupied	18	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
19	0.5	RD/GN	2440	III	-	Battery Positive Voltage	19	0.5	RD/GN	2440	V	-
20	0.35	BN/WH	2517	I	-	Keypad Red LED Control	20	0.35	BN/WH	2517	IV	-
21	0.5	BU	655	II	-	Cellular Telephone Microphone Signal	21	0.35	BU	655	IV	-
22	0.5	BK/BN	654	II	-	Cellular Telephone Microphone Low Reference	22	0.35	BK/BN	654	IV	-

X340 BODY HARNESS TO REAR SEAT HARNESS

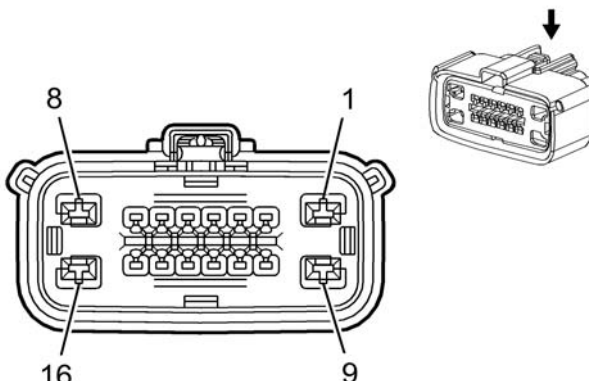
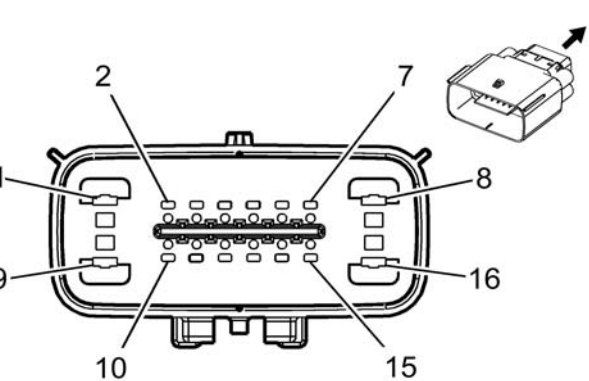
	
Connector Part Information • Harness Type: Body • OEM Connector: 7283-6446-40 • Service Connector: 19119857 • Description: 4-Way F YESC Kaizen Series (L-GY)	Connector Part Information • Harness Type: Rear Seat • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	1	RD/GN	1840	I	-	Battery Positive Voltage	1	1	RD/GN	1840	II	-
2	0.35	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	2	0.35	GN/BU	6133	II	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	1	BK	850	I	-	Ground	4	1	BK	850	II	-

X350 BODY HARNESS TO FUEL SYSTEM HARNESS

	
---	--

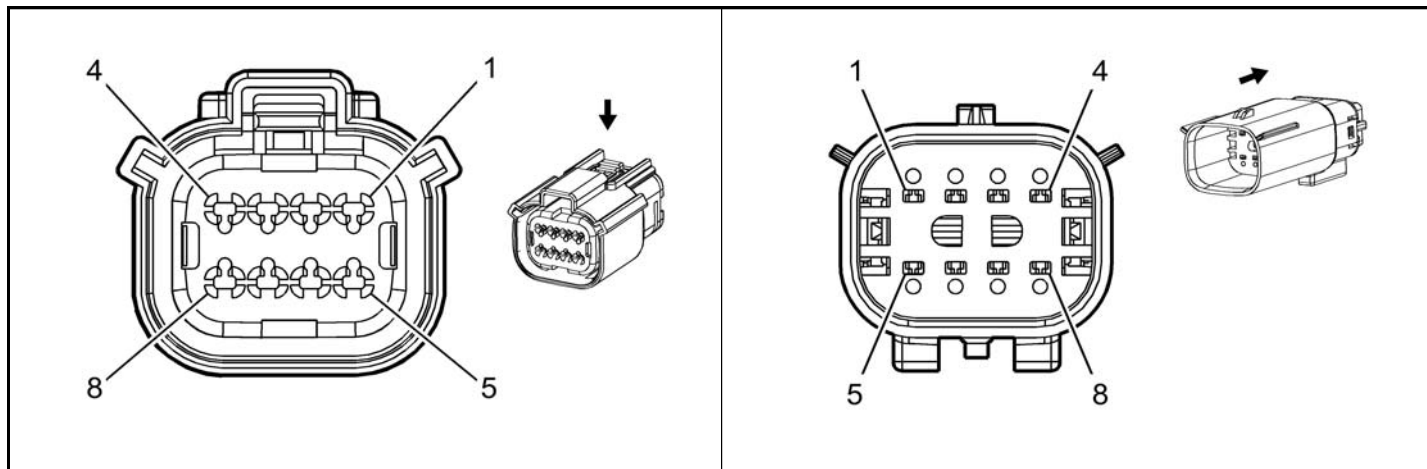
Connector Part Information • Harness Type: Body • OEM Connector: 34985-1606 • Service Connector: 19352906 • Description: 16-Way F 1.5, 2.8 Series, Sealed (BK)	Connector Part Information • Harness Type: Fuel System • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 16-Way M
---	---

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13505803	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
II	13575868	J-35616-2A (GY)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required
IV	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	GY	120	I	-	Fuel Pump Control	1	2	GY	120	IV	-
2	0.5	YE/RD	2709	II	-	Fuel Tank Pressure Sensor 5V Reference	2	0.5	YE/RD	2709	IV	-
3	0.5	BU/WH	890	II	-	Fuel Tank Pressure Sensor Signal	3	0.5	BU/WH	890	IV	-
4	0.5	BU/VT	1589	II	-	Primary Fuel Level Sensor Signal	4	0.5	BU/VT	1589	IV	-
5 - 11	-	-	-	-	-	Not Occupied	5 - 11	-	-	-	-	-
12	0.5	BK/GN	6281	II	-	Fuel Level Sensor Low Reference	12	0.5	BK/GN	6281	IV	-
13	0.5	BK/GN	6281	III	-	Fuel Level Sensor Low Reference	13	0.5	BK/GN	6281	IV	-
14	0.5	BK/GN	6281	III	-	Fuel Level Sensor Low Reference	14	0.5	BK/GN	6281	IV	-
15	0.5	BARE	7444	II	-	Fuel System Control Module Shield Ground	15	0.5	BARE	7444	IV	-
16	2	BK/GN	1580	I	-	Fuel Pump Low Reference	16	2	BK/GN	1580	IV	-

X351 BODY HARNESS TO FUEL SYSTEM HARNESS



Connector Part Information • Harness Type: Body • OEM Connector: 33472-0806 • Service Connector: 13577527 • Description: 8-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Fuel System • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way M
--	--

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	GY	3723	I	-	Evap Leak Check Module (ELCM) Changeover Valve Ground	1	0.35	GY	3723	II	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.35	BU	3722	I	-	Evap Leak Check Module (ELCM) Vacuum Pump Ground	2	0.35	BU	3722	II	-
3	0.35	BU/GN	3725	I	-	Evap Leak Check Module (ELCM) Pressure Sensor Signal	3	0.35	BU/GN	3725	II	-
4	0.35	BN/RD	3724	I	-	Evap Leak Check Module (ELCM) Pressure Sensor 5V Reference	4	0.35	BN/RD	3724	II	-
5	0.35	GN	3726	I	-	Diurnal Control Valve (DCV) Ground	5	0.35	GN	3726	II	-
6	0.5	RD/WH	1340	I	-	Battery Positive Voltage	6	0.5	RD/WH	1340	II	-
7	0.5	RD/WH	1340	I	-	Battery Positive Voltage	7	0.5	RD/WH	1340	II	-
8	0.5	RD/WH	1340	I	-	Battery Positive Voltage	8	0.5	RD/WH	1340	II	-

X354 FUEL TANK JUMPER TO FUEL JUMPER

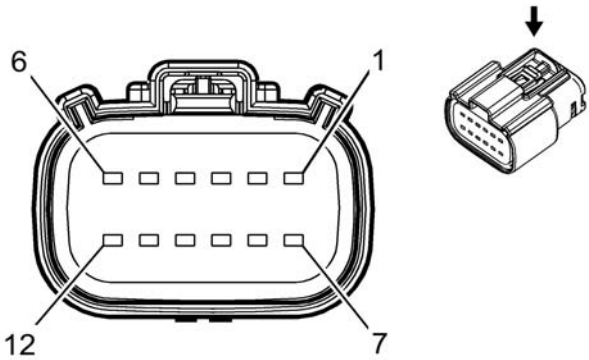
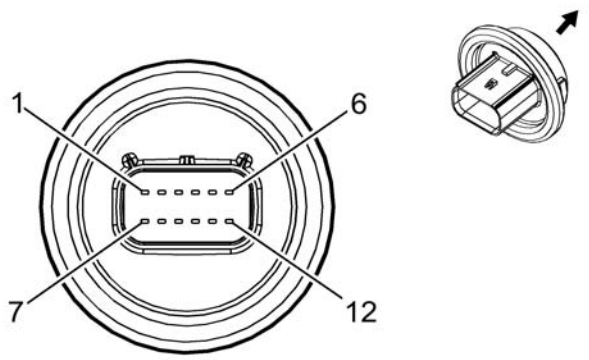
Connector Part Information • Harness Type: Body • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 6-Way F	Connector Part Information • Harness Type: Fuel Tank • OEM Connector: 7282-5577-10 • Service Connector: Service by Harness - See Part Catalog • Description: 6-Way M 2.8 Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	GY	120	I	-	Fuel Pump Control	1	2	GY	120	II	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	2	BK/GN	1580	I	-	Fuel Pump Low Reference	3	2	BK/GN	1580	II	-
4	0.5	BU/VT	1589	I	-	Primary Fuel Level Sensor Signal	4	0.5	BU/VT	1589	II	-
5	-	-	-	-	-	Not Occupied	5	-	-	-	-	-
6	0.5	BK/GN	6281	I	-	Fuel Level Sensor Low Reference	6	0.5	BK/GN	6281	II	-

X357 BODY HARNESS TO BATTERY PACK JUMPER HARNESS

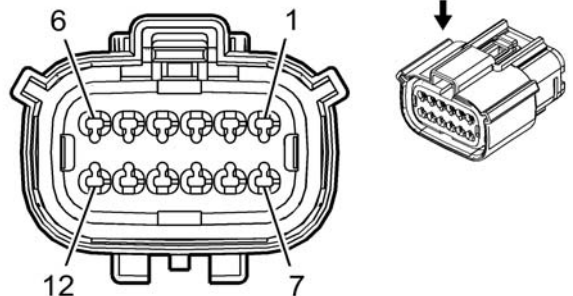
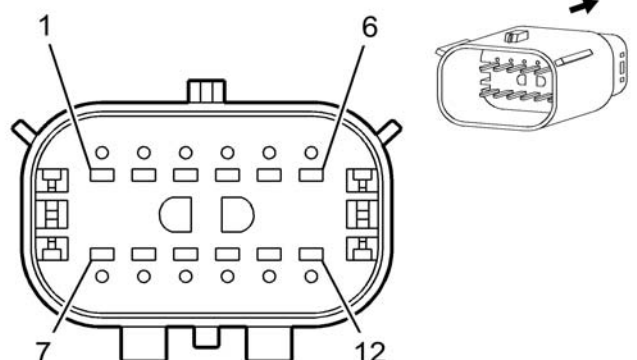
	
Connector Part Information • Harness Type: Body • OEM Connector: 33472-1260 • Service Connector: 19352788 • Description: 12-Way F 150 MX Series, Sealed (D-GY)	Connector Part Information • Harness Type: Battery Pack Jumper • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/GY	6434	I	-	CAN Bus High 2 Serial Data	1	0.5	BU/GY	6434	II	-
2	0.5	BN/GN	3959	I	-	High Voltage Battery 1 (+) Relay Control	2	0.5	BN/GN	3959	II	-
3	0.5	WH/BU	6435	I	-	CAN Bus Low 2 Serial Data	3	0.5	WH/BU	6435	II	-
4	0.5	VT/GY	3961	I	-	High Voltage Battery (-) Relay Control	4	0.5	VT/GY	3961	II	-
5	0.5	BU/BN	3787	I	-	High Voltage Energy Management Communication Control	5	0.5	BU/BN BU/GY	3787 3787	II II	EARLY/LATE MID
6	0.5	WH/VT	5137	I	-	Precharge Relay PWM Signal	6	0.5	WH/VT	5137	II	-
7	0.5	YE/VT	3962	I	-	High Voltage Battery 3 (+) Relay Control	7	0.5	YE/VT	3962	II	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.5	VT/WH	5087	I	-	High Voltage Interlock Loop Signal 1	9	0.5	VT/WH	5087	II	-
10	-	-	-	-	-	Not Occupied	10	-	-	-	-	-
11	0.5	BK/YE	5088	I	-	High Voltage Interlock Loop Low Reference 1	11	0.5	BK/YE	5088	II	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

X358 BODY HARNESS TO BATTERY PACK JUMPER HARNESS

	
---	--

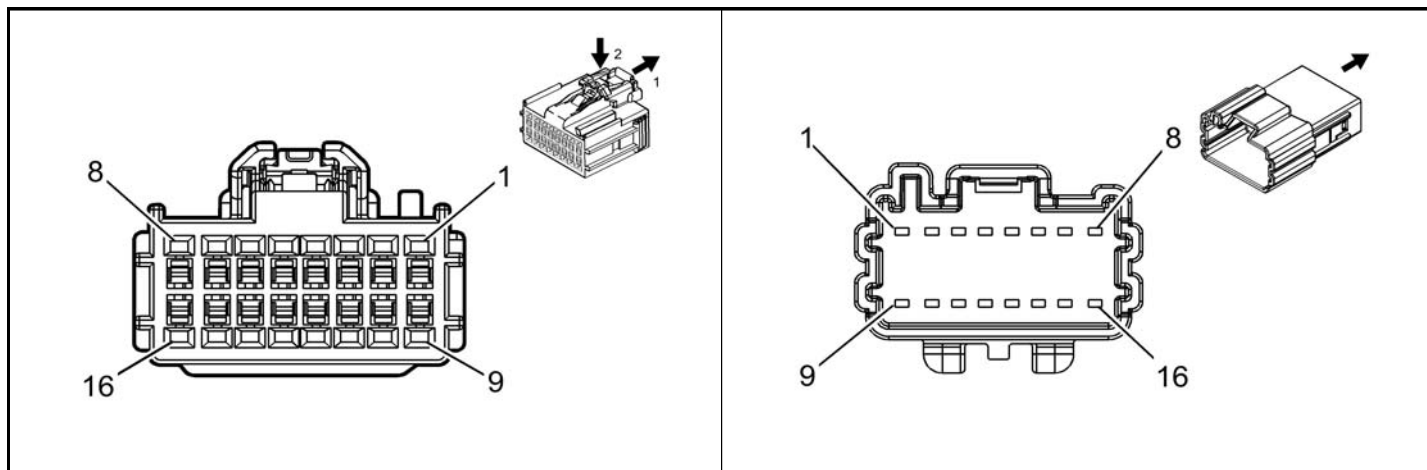
Connector Part Information • Harness Type: Body • OEM Connector: 33472-1290 • Service Connector: 19352907 • Description: 12-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Battery Pack Jumper • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M
---	---

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	RD/VT	1640	I	-	Battery Positive Voltage	1	0.75	RD/VT	1640	II	-
2	0.5	VT	3195	I	-	Auxiliary Heater Control	2	0.5	VT	3195	II	-
3	0.5	BU/WH	3977	I	-	Accessory Wakeup Serial Data 2	3	0.5	BU/WH	3977	II	-
4	0.5	VT/GY	139	I	-	Run/Crank Ignition 1 Voltage	4	0.5	VT/GY	139	II	-
5	0.5	BK	2050	I	-	Ground	5	0.5	BK	2050	II	-
6	0.5	BU/GN	5139	I	-	High Voltage Fault Signal	6	0.5	BU/GN	5139	II	-
7	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	7	0.5	BU	2500	II	-
8	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	8	0.5	WH	2501	II	-
9	-	-	-	-	-	Not Occupied	9	-	-	-	-	-
10	0.5	BK	2050	I	-	Ground	10	0.5	BK	2050	II	-
11	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	11	0.5	BU	2500	II	-
12	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	12	0.5	WH	2501	II	-

X359 AUXILIARY BATTERY CABLE HARNESS TO BATTERY PACK JUMPER HARNESS



Connector Part Information • Harness Type: Auxiliary Battery Cable • OEM Connector: 33155082 • Service Connector: Service by Harness - See Part Catalog • Description: 16-Way F 1.2 Series (BK)	Connector Part Information • Harness Type: Battery Pack Jumper • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 16-Way M
--	---

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/GY	6434	I	-	CAN Bus High 2 Serial	1	0.5	BU/GY	6434	II	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
						Data						
2	0.5	WH/BK	6435	I	-	CAN Bus Low 2 Serial Data	2	0.5	WH/BU	6435	II	-
3	0.5	BU/BN	3787	I	-	High Voltage Energy Management Communication Control	3	0.5 0.5	BU/BN BU/GY	3787 3787	II II	EARLY/LATE MID
4	0.5	BK	2050	I	-	Ground	4	0.5	BK	2050	II	-
5	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	5	0.5	WH	2501	II	-
6	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	6	0.5	BU	2500	II	-
7	0.5	BK/YE	5088	I	-	High Voltage Interlock Loop Low Reference 1	7	0.5	BK/YE	5088	II	-
8	0.5	VT/WH	5087	I	-	High Voltage Interlock Loop Signal 1	8	0.5	VT/WH	5087	II	-
9	0.5	RD/VT	1640	I	-	Battery Positive Voltage	9	0.5	RD/VT	1640	II	-
10	0.5	BU/WH	3977	I	-	Accessory Wakeup Serial Data 2	10	0.5	BU/WH	3977	II	-
11	0.5	VT/WH	1139	I	-	Run/Crank Ignition 1 Voltage	11	0.5	VT/WH	1139	II	-
12	0.5	BU/GN	5139	I	-	High Voltage Fault Signal	12	0.5	BU/GN	5139	II	-
13	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	13	0.5	BU	2500	II	-
14	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	14	0.5	WH	2501	II	-
15	0.5	YE	5411	I	-	Battery Module Temperature Signal 7	15	0.5	YE	5411	II	-
16	0.5	BK/BU	3779	I	-	Battery Module Temperature Sensor Low Reference 7	16	0.5	BK/BU	3779	II	-

Article GUID: A00884681

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Inline Harness Connector End Views - Volt

INLINE HARNESS CONNECTOR END VIEWS

X359 BATTERY CABLE - HIGH VOLTAGE HARNESS TO HYBRID/EV POWERTRAIN CONTROL MODULE HARNESS (LATE)

Connector Part Information • Harness Type: Battery Cable - High Voltage • OEM Connector: 13650143 • Service Connector: Service by Harness - See Part Catalog • Description: 20-Way F 1.5 Series, Sealed (BK)	Connector Part Information • Harness Type: Hybrid/EV Powertrain Control Module • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 20-Way M

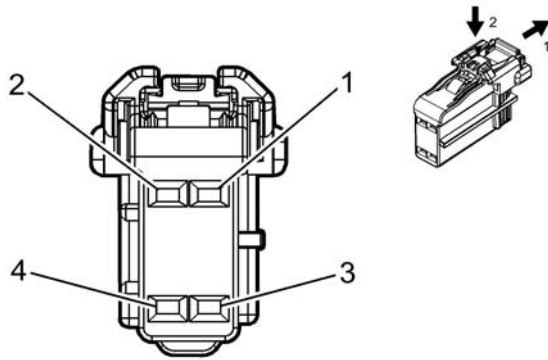
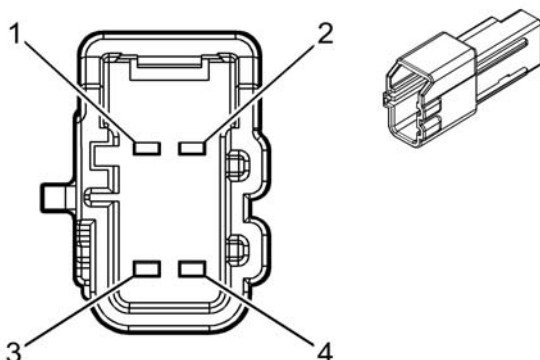
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool
I	Not Required	J-35616-2A (GY)	No Tool Required
II	Not Required	J-35616-3 (GY)	No Tool Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/GY	6434	I	-	CAN Bus High 2 Serial Data	1	0.5	BU/GY	6434	II	-
2	0.5	WH/BK	6435	I	-	CAN Bus Low 2 Serial Data	2	0.5	WH/BU	6435	II	-
3	0.5	BU/BN	3787	I	-	High Voltage Energy Management Communication Control	3	-	-	-	-	-
4	0.5	BK	2050	I	-	Ground	4	0.5	BK	2050	II	-
5	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	5	0.5	WH	2501	II	-
6	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	6	0.5	BU	2500	II	-
7	0.5	BK/YE	5088	I	-	High Voltage Interlock Loop Low Reference 1	7	0.5	BK/YE	5088	II	-
8	0.5	VT/WH	5087	I	-	High Voltage Interlock Loop Signal 1	8	0.5	VT/WH	5087	II	-
9	0.5	RD/VT	1640	I	-	Battery Positive Voltage	9	0.5	RD/VT	1640	II	-
10	0.5	BU/WH	3977	I	-	Accessory Wakeup Serial Data 2	10	0.5	BU/WH	3977	II	-
11	0.5	VT/WH	1139	I	-	Run/Crank Ignition 1 Voltage	11	0.5	VT/WH	1139	II	-
12	0.5	BU/GN	5139	I	-	High Voltage Fault Signal	12	0.5	BU/GN	5139	II	-
13	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	13	0.5	BU	2500	II	-
14	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	14	0.5	WH	2501	II	-
15	0.5	YE	5411	I	-	Battery Module Temperature Signal 7	15	0.5	YE	5411	II	-
16	0.5	BK/BU	3779	I	-	Battery Module Temperature Sensor Low Reference 7	16	0.5	BK/BU	3779	II	-
17	0.5	BU/YE	2962	I	-	High Voltage Battery Current Sensor Course Signal	17	0.5	BU/YE	2962	II	-
18	0.5	VT/RD	2965	I	-	High Voltage Battery Current Sensor Voltage Reference	18	0.5	VT/RD	2965	II	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
19	0.5	BK/GY	2963	I	-	High Voltage Battery Current Sensor Low Reference	19	0.5	BK/GY	2963	II	-
20	0.5	GN/BN	2961	I	-	High Voltage Battery Current Sensor Fine Signal	20	0.5	GN/BN	2961	II	-

X360 AUXILIARY BATTERY CABLE HARNESS TO BATTERY FUSE BLOCK HARNESS

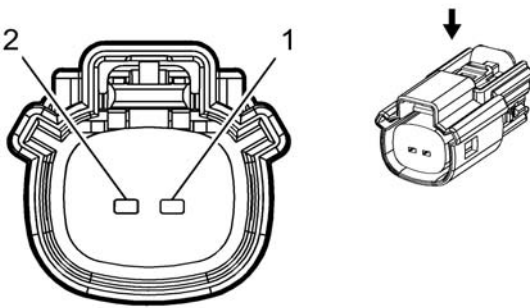
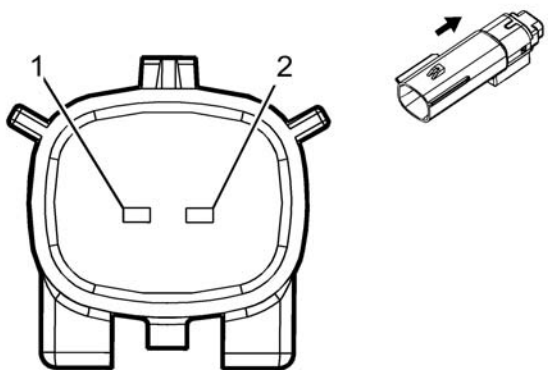
	
Connector Part Information • Harness Type: Auxiliary Battery Cable • OEM Connector: 33124854 • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way F 1.2 Series (BK)	Connector Part Information • Harness Type: Battery Fuse Block • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 4-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/YE	2962	I	-	High Voltage Battery Current Sensor Course Signal	1	0.5	BU/YE	2962	II	-
2	0.5	VT/RD	2965	I	-	High Voltage Battery Current Sensor Voltage Reference	2	0.5	VT/RD	2965	II	-
3	0.5	BK/GY	2963	I	-	High Voltage Battery Current Sensor Low Reference	3	0.5	BK/GY	2963	II	-
4	0.5	GN/BN	2961	I	-	High Voltage Battery Current Sensor Fine Signal	4	0.5	GN/BN	2961	II	-

X400 BODY HARNESS TO BATTERY FUSE BLOCK HARNESS

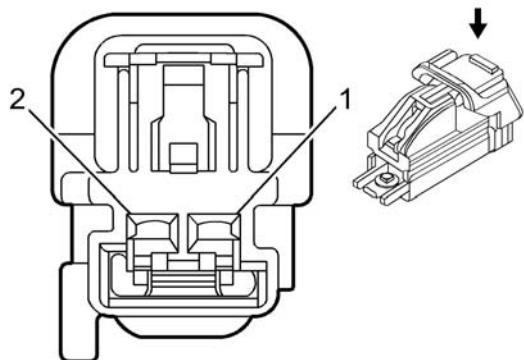
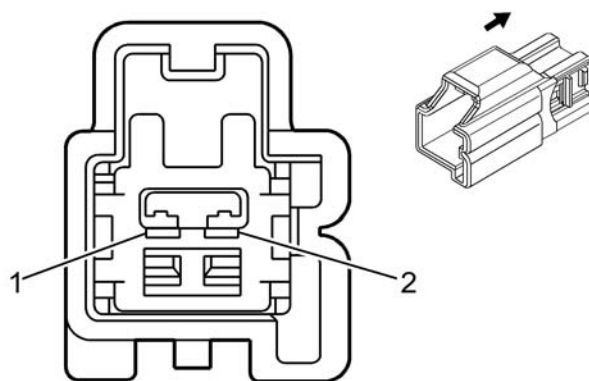
	
Connector Part Information • Harness Type: Body • OEM Connector: 33471-0224 • Service Connector: 19352909 • Description: 2-Way F 1.5 Series, Sealed (BK)	Connector Part Information • Harness Type: Battery Fuse Block • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	RD/WH	4740	I	-	Battery Positive Voltage	1	0.75	RD/WH	4740	II	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-

X406 BODY HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Body • OEM Connector: 7283-6443-40 • Service Connector: 88988504 • Description: 2-Way F 1.5 YESC Series (L-GY)	Connector Part Information • Harness Type: Body • OEM Connector: 7282-6443-40 • Service Connector: 88988503 • Description: 2-Way M 1.5 Series (L-GY)

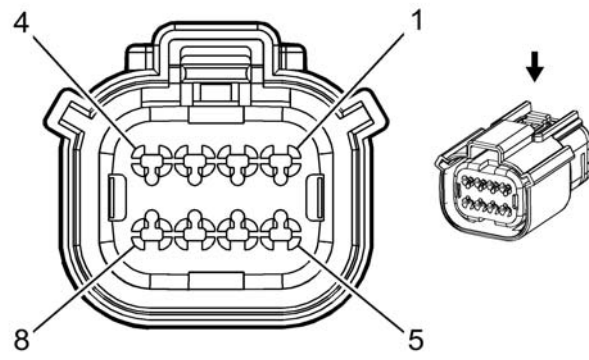
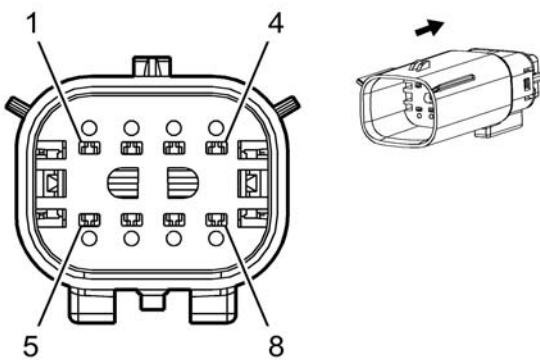
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	GY/VT	3998	I	-	MOST Serial Data (+)	1	0.5	GY/VT	3998	II	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.35	WH/GN	3997	I	-	MOST Serial Data (-)	2	0.5	WH/GN	3997	II	-

X450 REAR LAMP HARNESS TO BODY HARNESS (-UFQ)

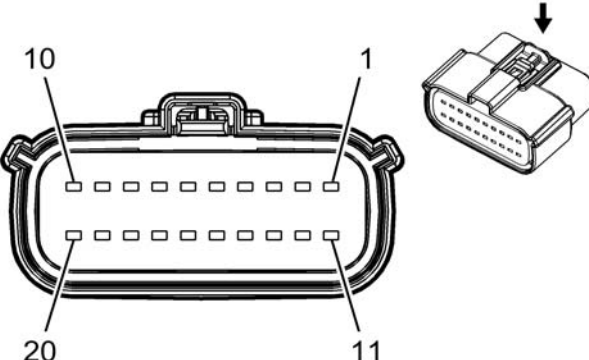
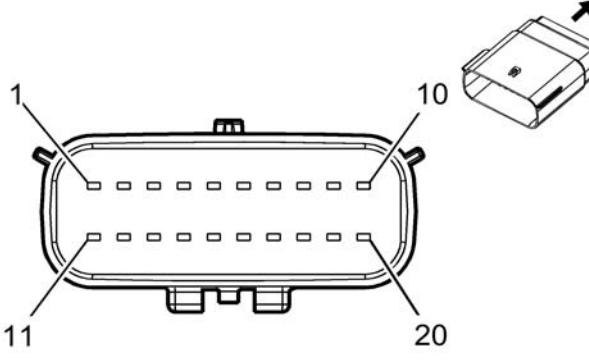
	
Connector Part Information • Harness Type: Rear Lamp • OEM Connector: 33472-1008 • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way F 150 MX Series, Sealed (BK)	Connector Part Information • Harness Type: Body • OEM Connector: 33482-0842 • Service Connector: 13577534 • Description: 8-Way M 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	VT/GN	439	I	-	Run/Crank Ignition 1 Voltage	1	0.5	VT/GN	439	II	-
2	0.5	BK	650	I	-	Ground	2	0.5	BK	650	II	-
3	0.5	BK	6974	I	-	Camera Low Reference	3	0.5	BK	6974	II	-
4	0.5	GY/YE	6972	I	-	Camera Signal 2 +	4	0.5	GY/YE	6972	II	-
5	0.5	WH/BU	6973	I	-	Camera Signal 2	5	0.5	WH/BU	6973	II	-
6	0.5	GN/YE	6846	I	-	Rear License Lamp Control	6	0.5	GN/YE	6846	II	-
7	-	-	-	-	-	Not Occupied	7	-	-	-	-	-
8	0.5	BK	650	I	-	Ground	8	0.5	BK	650	II	-

X450 REAR LAMP HARNESS TO BODY HARNESS (UFQ)

	
Connector Part Information • Harness Type: Rear Lamp • OEM Connector: 33472-2001 • Service Connector: Service by Harness - See Part Catalog	Connector Part Information • Harness Type: Body • OEM Connector: 33482-2101 • Service Connector: 19351705

• Description: 20-Way F 150 MX Series, Sealed (BK)

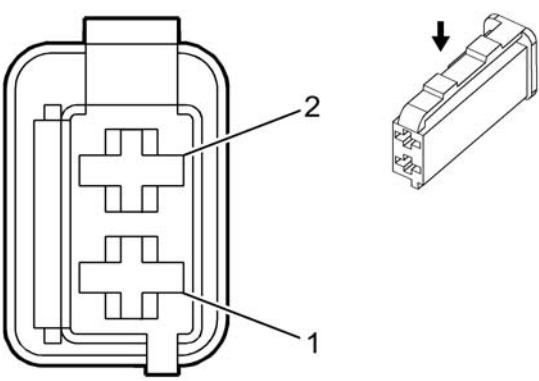
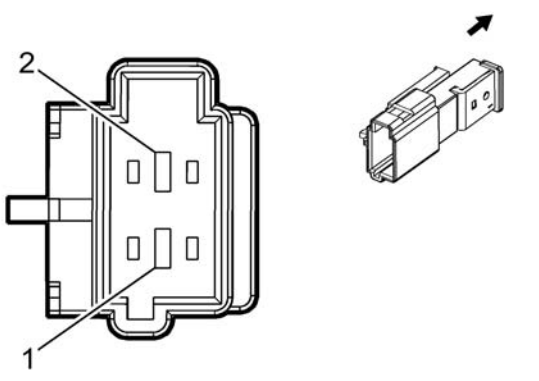
• Description: 20-Way M 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	19119440	J-35616-3 (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	BK	650	I	-	Ground	2	0.5	BK	650	II	-
3	0.5	RD/GY	2840	I	-	Battery Positive Voltage	3	0.5	RD/GY	2840	II	-
4	0.5	GN	5060	I	-	Low Speed GMLAN Serial Data	4	0.5	GN	5060	II	-
5	0.5	YE/VT	2378	I	-	Right Rear Corner Object Sensor Signal	5	0.5	YE/VT	2378	II	-
6	0.5	YE	2375	I	-	Left Rear Corner Object Sensor Signal	6	0.5	YE	2375	II	-
7	0.5	YE/BU	2376	I	-	Left Rear Middle Object Sensor Signal	7	0.5	YE/BU	2376	II	-
8	0.5	VT/GN	439	I	-	Run/Crank Ignition 1 Voltage	8	0.5	VT/GN	439	II	-
9	-	-	-	-	-	Not Occupied	9	-	-	-	-	-
10	0.5	GY/YE	6972	I	-	Camera Signal 2 +	10	0.5	GY/YE	6972	II	-
11	0.5	GN/YE	6846	I	-	Rear License Lamp Control	11	0.5	GN/YE	6846	II	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-
13	0.5	GY/YE	5853	I	-	Driver Side Object Detection LED Signal 1	13	0.5	GY/YE	5853	II	-
14	0.5	GY	5861	I	-	Passenger Side Object Detection LED Signal 1	14	0.5	GY	5861	II	-
15	0.5	RD/VT	5974	I	-	Park Assist Sensor Control Park	15	0.5	RD/VT	5974	II	-
16	0.5	YE/WH	2377	I	-	Right Rear Middle Object Sensor Signal	16	0.5	YE/WH	2377	II	-
17	0.5	BK/GY	2379	I	-	Object Sensor Low Reference	17	0.5	BK/GY	2379	II	-
18	0.5	BK	650	I	-	Ground	18	0.5	BK	650	II	-
19	0.5	BK	6974	I	-	Camera Low Reference	19	0.5	BK	6974	II	-
20	0.5	WH/BU	6973	I	-	Camera Signal 2	20	0.5	WH/BU	6973	II	-

X452 BODY HARNESS TO BATTERY CABLE HARNESS

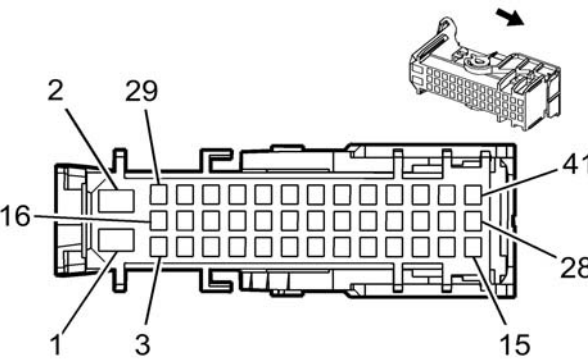
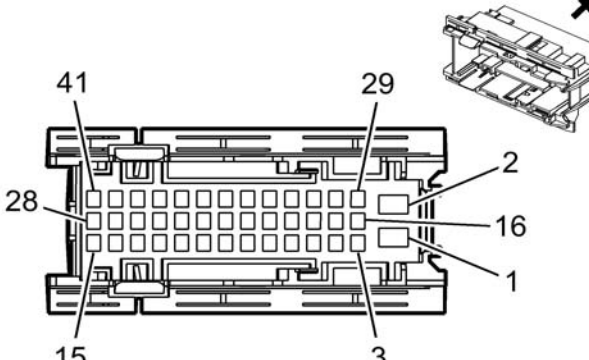
	
Connector Part Information • Harness Type: Body • OEM Connector: 1563189-1 • Service Connector: 13580951 • Description: 2-Way F 1.6 Timer Series (BK)	Connector Part Information • Harness Type: Battery Cable • OEM Connector: 13662506 • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way M 1.6 Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	Not Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-34 (YE)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BK/BN	1798	I	-	Low Reference	1	1	BK/BN	1798	II	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-

X500 DRIVER DOOR HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Driver Door • OEM Connector: 13678795 • Service Connector: Service by Harness - See Part Catalog • Description: 41-Way F 4.8 Timer, 1.5 DSQ Series (GY)	Connector Part Information • Harness Type: Body • OEM Connector: 13946876 • Service Connector: 13587760 • Description: 41-Way M 1.5, 2.8 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575556	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VI	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VII	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2.5	RD/BN	3640	II	-	Battery Positive Voltage	1	2	RD/BN	3640	VII	-
2	2.5	BK	1550	II	-	Ground	2	2.5	BK	1550	VII	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	0.5	GN/WH	3570	I	-	Driver Door Handle Switch Signal	4	0.35	GN/WH	3570	IV	-
5	-	-	-	-	-	Not Occupied	5	-	-	-	-	-
6	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	6	0.75	BN/YE	294	VI	-
7	0.75	GY	5911	I	-	Door Lock Actuator Lock Control 2	7	0.75	GY	5911	VI	-
8	0.75	BN/YE	2267	I	-	Mirror Heating Element Control	8	0.5	BN/YE	2267	V	-
9	0.5	YE/VT	3397	I	-	Passenger Mirror Motor Up (+) Down (-) Control	9	0.35	YE/VT	3397	IV	-
10	0.5	GN/BK	3396	I	-	Passenger Mirror Motor Right (+) Left (-) Control	10	0.35	GN/BK	3396	IV	-
11	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	11	0.35	WH	3398	IV	-
12	0.5	YE	6817	I	-	LED Backlight Dimming Control	12	0.35	YE	6817	IV	-
13 - 14	-	-	-	-	-	Not Occupied	13 - 14	-	-	-	-	-
15	0.5	RD/WH	4740	I	-	Battery Positive Voltage	15	0.5	RD/WH	4740	V	-
16 - 17	-	-	-	-	-	Not Occupied	16 - 17	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
18	0.5	VT	3560	I	-	Passive Entry Driver Door Antenna Signal Hi	18	0.35	VT	3560	IV	-
19	0.5	VT/GY	3561	I	-	Passive Entry Driver Door Antenna Signal Lo	19	0.35	VT/GY	3561	IV	-
20	0.5	BN/YE	780	I	-	Driver Door Lock Switch Lock Signal	20	0.35	BN/YE	780	IV	-
21	0.5	BN/WH	781	I	-	Driver Door Lock Switch Unlock Signal	21	0.35	BN/WH	781	IV	-
22 - 26	-	-	-	-	-	Not Occupied	22 - 26	-	-	-	-	-
27	0.5	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	27	0.35	GN/YE	6134	IV	-
28	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	28	0.35	WH/YE	7557	IV	-
29	0.5	GY/YE	5853	I	-	Driver Side Object Detection LED Signal 1	29	0.5	GY/YE	5853	V	-
30	0.5	BK	1550	I	-	Ground	30	0.5	BK	1550	V	-
31	0.5	BN/WH	3827	I	-	Refuel Request Switch Signal	31	0.5	BN/WH	3827	V	-
32	0.5	GY/WH	1447	I	-	Fuel Door Release Switch Signal	32	0.5	GY/WH	1447	V	-
33 - 37	-	-	-	-	-	Not Occupied	33 - 37	-	-	-	-	-
38	0.5	GN/WH	2132	I	-	Left Front Side Impact Sensing Module Signal	38	0.35	GN/WH	2132	IV	-
39	0.5	GN	6628	I	-	Left Front Side Impact Sensing Module Low Reference	39	0.35	GN	6628	IV	-
40	1 0.75	BU BU	201 201	I I	UQA UZ6	Left Front Speaker Control (+) 1 Left Front Speaker Control (+) 1	40	1.5 0.75	BU BU	201 201	III VI	UQA UZ6
41	1 0.75	BN/BU BN/BU	118 118	I I	UQA UZ6	Left Front Speaker Signal (-) 1 Left Front Speaker Signal (-) 1	41	1.5 0.75	BN/BU BN/BU	118 118	III VI	UQA UZ6

X505 DRIVER DOOR HARNESS TO DRIVER DOOR TRIM HARNESS

Connector Part Information • Harness Type: Driver Door • OEM Connector: 1897543-2 • Service Connector: Service by Harness - See Part Catalog • Description: 22-Way F 0.64 Micro-Quadlock, 2.8 Micro-Power Series (BK)	Connector Part Information • Harness Type: Driver Door Trim • OEM Connector: 1897540-2 • Service Connector: Service by Harness - See Part Catalog • Description: 22-Way M 0.64 MQS, 2.8 MCP Series (BK)

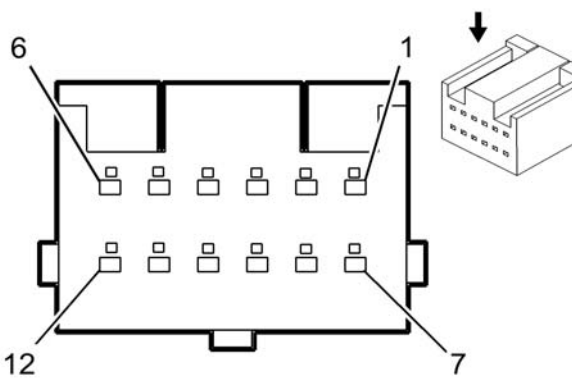
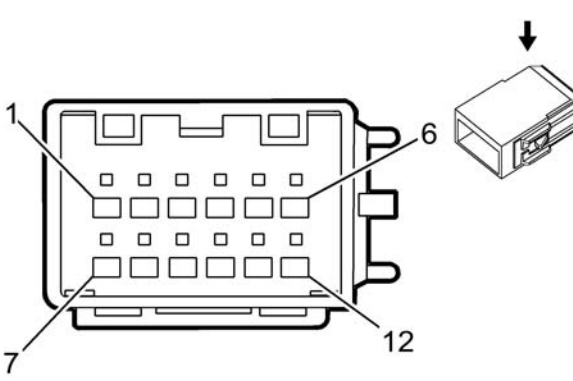
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
IV	Not Required	J-35616-65B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type	Option	Function	Pin	Size	Color	Circuit	Terminal Type	Option
-----	------	-------	---------	---------------	--------	----------	-----	------	-------	---------	---------------	--------

				ID							ID	
1	0.5	RD/WH	4740	II	-	Battery Positive Voltage	1	0.35	RD/WH	4740	IV	-
2	0.35	YE/BN	3391	II	-	Driver Mirror Motor Common Control	2	0.35	YE/BN	3391	IV	-
3	0.35	VT/BU	3390	II	-	Driver Mirror Motor Up (+) Down (-) Control	3	0.35	VT/BU	3390	IV	-
4	0.35	BN/BK	3389	I	-	Driver Mirror Motor Right (+) Left (-) Control	4	0.35	BN/BK	3389	III	-
5	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	5	0.35	WH	3398	III	-
6	0.5	YE/VT	3397	II	-	Passenger Mirror Motor Up (+) Down (-) Control	6	0.35	YE/VT	3397	IV	-
7	0.5	GN/BK	3396	II	-	Passenger Mirror Motor Right (+) Left (-) Control	7	0.35	GN/BK	3396	IV	-
8	0.5	BN/YE	780	II	-	Driver Door Lock Switch Lock Signal	8	0.35	BN/YE	780	IV	-
9	0.5	BN/WH	781	II	-	Driver Door Lock Switch Unlock Signal	9	0.35	BN/WH	781	IV	-
10	0.5	WH/YE	7557	II	-	LED Ambient Lighting Control 1	10	0.5	WH/YE	7557	IV	-
11	0.5	YE	6817	II	-	LED Backlight Dimming Control	11	0.35	YE	6817	IV	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-
13	0.5	GY/WH	1447	II	-	Fuel Door Release Switch Signal	13	0.35	GY/WH	1447	IV	-
14	0.5	BN/WH	3827	II	-	Refuel Request Switch Signal	14	0.35	BN/WH	3827	IV	-
15	0.35	GN	3381	II	-	Power Window Switch Driver Express Signal	15	0.35	GN	3381	IV	-
16	0.35	GY	3380	II	-	Power Window Switch Driver Down Signal	16	0.35	GY	3380	IV	-
17	0.35	GN/WH	3379	II	-	Power Window Switch Driver Up Signal	17	0.35	GN/WH	3379	IV	-
18	0.35	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	18	0.35	GN/YE	6134	III	-
19	-	-	-	-	-	Not Occupied	19	-	-	-	-	-
20	0.5	BK	1550	II	-	Ground	20	0.5	BK	1550	IV	-
21	0.35	BN/GN	3270	II	-	Driver Door Lock Motor Status Signal	21	0.35	BN/GN	3270	IV	-
22	0.35	BN/WH	1124	II	-	Door Lock Key Switch Unlock Signal	22	0.35	BN/WH	1124	IV	-

X510 DRIVER DOOR HARNESS TO OUTSIDE REAR VIEW MIRROR HARNESS

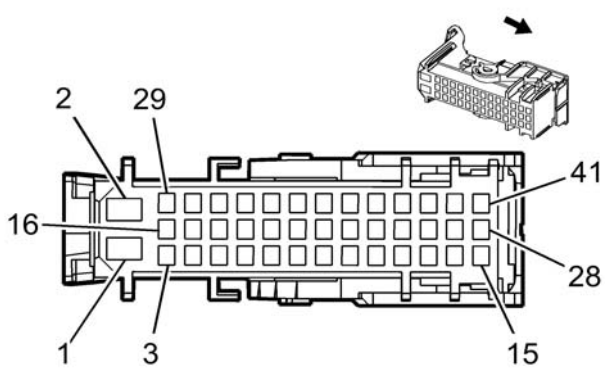
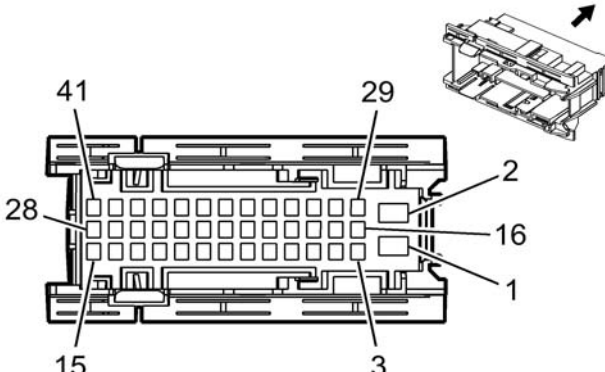
	
Connector Part Information • Harness Type: Driver Door • OEM Connector: ARVPB-12C12-2AK • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way F 0.64 Series (BK)	Connector Part Information • Harness Type: Outside Rear View Mirror • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BN/YE	2267	I	-	Mirror Heating Element Control	1	0.75	BK/GY	2267	II	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.35	VT/BU	3390	I	-	Driver Mirror Motor Up (+) Down (-) Control	3	0.35	VT/BU	3390	II	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.35	BN/BK	3389	I	-	Driver Mirror Motor Right (+) Left (-) Control	5	0.35	BN/BK	3389	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.5	BK	1550	I	-	Ground	7	0.5	BK	1550	II	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.35	YE/BN	3391	I	-	Driver Mirror Motor Common Control	9	0.35	YE/BN	3391	II	-
10	-	-	-	-	-	Not Occupied	10	-	-	-	-	-
11	0.5	GY/YE	5853	I	-	Driver Side Object Detection LED Signal 1	11	0.5	VT/	5853	II	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

X600 PASSENGER DOOR HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Passenger Door • OEM Connector: 13678795 • Service Connector: Service by Harness - See Part Catalog • Description: 41-Way F 4.8 Timer, 1.5 DSQ Series (GY)	Connector Part Information • Harness Type: Body • OEM Connector: 13946876 • Service Connector: 13587760 • Description: 41-Way M 1.5, 2.8 Series (GY)

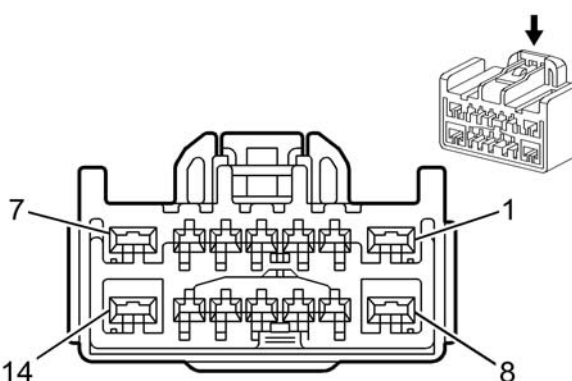
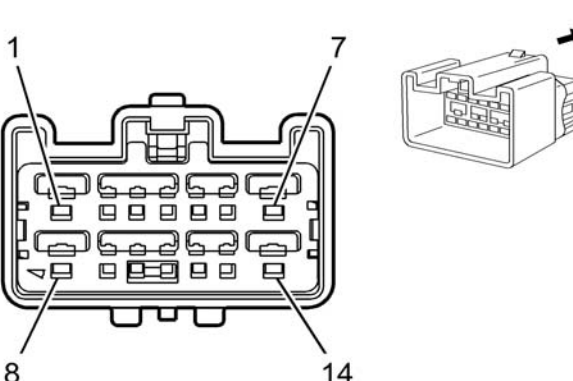
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VI	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2.5	RD/YE	3740	II	-	Battery Positive Voltage	1	2	RD/YE	3740	VI	-
2	2.5	BK	2050	II	-	Ground	2	2.5	BK	2050	VI	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	0.5	VT/WH	3571	I	-	Passenger Door Handle Switch Signal	4	0.35	VT/WH	3571	III	-
5	-	-	-	-	-	Not Occupied	5	-	-	-	-	-
6	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	6	0.75	BN/YE	294	V	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
7	0.75	GY	295	I	-	Door Lock Actuator Lock Control	7	0.75	GY	295	V	-
8	0.75	BN/YE	2267	I	-	Mirror Heating Element Control	8	0.5	BN/YE	2267	IV	-
9	0.5	YE/VT	3397	I	-	Passenger Mirror Motor Up (+) Down (-) Control	9	0.35	YE/VT	3397	III	-
10	0.5	GN/BK	3396	I	-	Passenger Mirror Motor Right (+) Left (-) Control	10	0.35	GN/BK	3396	III	-
11	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	11	0.35	WH	3398	III	-
12	0.5	YE	6817	I	-	LED Backlight Dimming Control	12	0.35	YE	6817	III	-
13 - 17	-	-	-	-	-	Not Occupied	13 - 17	-	-	-	-	-
18	0.5	GN/YE	3562	I	-	Passive Entry Passenger Door Antenna Signal Hi	18	0.35	GN/YE	3562	III	-
19	0.5	GN/BK	3563	I	-	Passive Entry Passenger Door Antenna Signal Lo	19	0.35	GN/BK	3563	III	-
20	0.5	YE/VT	244	I	-	Passenger Door Lock Switch Lock Control	20	0.35	YE/VT	244	III	-
21	0.5	BN/VT	245	I	-	Passenger Door Lock Switch Unlock Control	21	0.35	BN/VT	245	III	-
22 - 26	-	-	-	-	-	Not Occupied	22 - 26	-	-	-	-	-
27	0.5	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	27	0.35	GN/YE	6134	III	-
28	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	28	0.35	WH/YE	7557	III	-
29	0.5	GY	5861	I	-	Passenger Side Object Detection LED Signal 1	29	0.5	GY	5861	IV	-
30	0.5	BK	2050	I	-	Ground	30	0.5	BK	2050	IV	-
31 - 37	-	-	-	-	-	Not Occupied	31 - 37	-	-	-	-	-
38	0.5	BN/OG	2134	I	-	Right Front Side Impact Sensing Module Signal	38	0.35	BN/OG	2134	III	-
39	0.5	BN/WH	6629	I	-	Right Front Side Impact Sensing Module Low Reference	39	0.35	BN/WH	6629	III	-
40	1 0.75	YE YE	200 200	I I	UQA UZ6	Right Front Speaker Control (+) 1 Right Front Speaker Control (+) 1	40	0.5	YE	200	IV	-
41	1 0.75	YE/BK BN/YE	117 117	I I	UQA UZ6	Right Front Speaker Signal (-) 1 Right Front Speaker Signal (-) 1	41	0.5 0.5	YE/BK BN/YE	117 117	IV IV	UQA UZ6

X605 PASSENGER DOOR HARNESS TO PASSENGER DOOR TRIM HARNESS

	
Connector Part Information • Harness Type: Passenger Door • OEM Connector: 7283-6447-40	Connector Part Information • Harness Type: Passenger Door Trim • OEM Connector: 89047433

- Service Connector: Service by Harness - See Part Catalog
- Description: 14-Way F 1.5, 2.8 Series (L-GY)

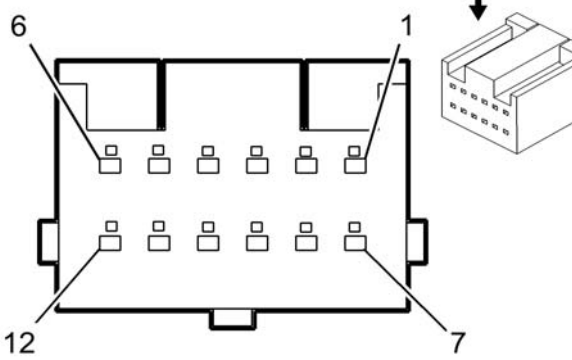
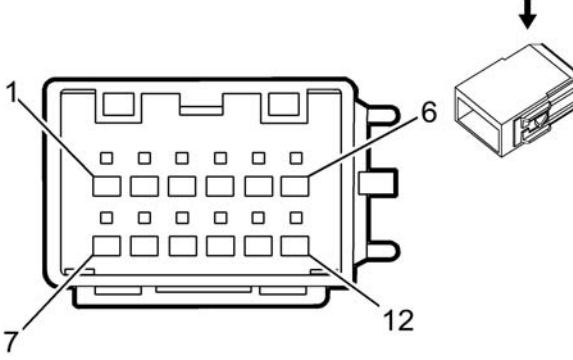
- Service Connector: Service by Harness - See Part Catalog
- Description: 14-Way M 1.5, 2.8 Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
IV	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2.5	RD/YE	3740	II	-	Battery Positive Voltage	1	2.5	RD/YE	3740	IV	-
2	0.5	YE	6817	I	-	LED Backlight Dimming Control	2	0.35	YE	6817	III	-
3	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	3	0.5	WH/YE	7557	III	-
4	0.35	GY	746	I	-	Right Front Door Ajar Switch Signal	4	0.35	GY	746	III	-
5	0.5	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	5	0.5	GN/YE	6134	III	-
6	0.5	BK	2050	I	-	Ground	6	0.5	BK	2050	III	-
7	2.5	BK	2050	II	-	Ground	7	2.5	BK	2050	IV	-
8	2.5	GN/GY	3387	II	-	Power Window Motor Passenger Up Control	8	2.5	GN/GY	3387	IV	-
9	0.5	BN/VT	245	I	-	Passenger Door Lock Switch Unlock Control	9	0.35	BN/VT	245	III	-
10	0.5	YE/VT	244	I	-	Passenger Door Lock Switch Lock Control	10	0.35	YE/VT	244	III	-
11 - 13	-	-	-	-	-	Not Occupied	11 - 13	-	-	-	-	-
14	2.5	YE/BU	3388	II	-	Power Window Motor Passenger Down Control	14	2.5	YE/BU	3388	IV	-

X610 PASSENGER DOOR HARNESS TO OUTSIDE REAR VIEW MIRROR HARNESS

	
Connector Part Information • Harness Type: Passenger Door • OEM Connector: ARVPB-12C12-2AK • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way F 0.64 Series (BK)	Connector Part Information • Harness Type: Outside Rear View Mirror • OEM Connector: Not Available • Service Connector: Service by Harness - See Part Catalog • Description: 12-Way M

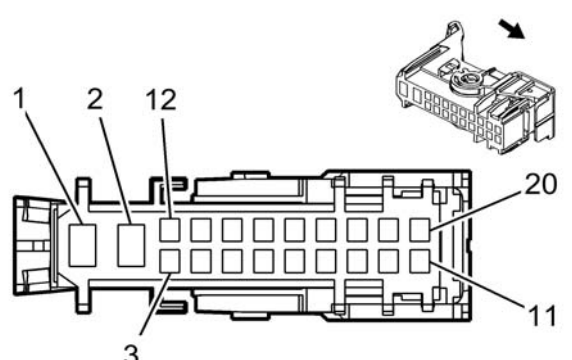
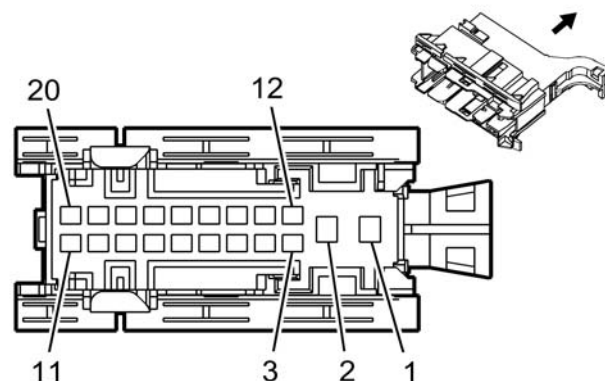
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BN/YE	2267	I	-	Mirror Heating Element Control	1	0.75	BK/GY	2267	II	-
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
3	0.5	YE/VT	3397	I	-	Passenger Mirror Motor Up (+) Down (-) Control	3	0.5	YE/VT	3397	II	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.5	GN/BK	3396	I	-	Passenger Mirror Motor Right (+) Left (-) Control	5	0.5	GN/BK	3396	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.75	BK	2050	I	-	Ground	7	0.75	BK	2050	II	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	9	0.5	WH	3398	II	-
10	-	-	-	-	-	Not Occupied	10	-	-	-	-	-
11	0.5	GY	5861	I	-	Passenger Side Object Detection LED Signal 1	11	0.5	VT/	5861	II	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

X700 LEFT REAR DOOR HARNESS TO BODY HARNESS

	
Connector Part Information • Harness Type: Left Rear Door • OEM Connector: 13678789 • Service Connector: Service by Harness - See Part Catalog • Description: 20-Way F 4.8 Timer, 1.5 DSQ Series (GY)	Connector Part Information • Harness Type: Body • OEM Connector: 13680032 • Service Connector: 13577518 • Description: 20-Way M 1.5, 5.8 TTS Series (GY)

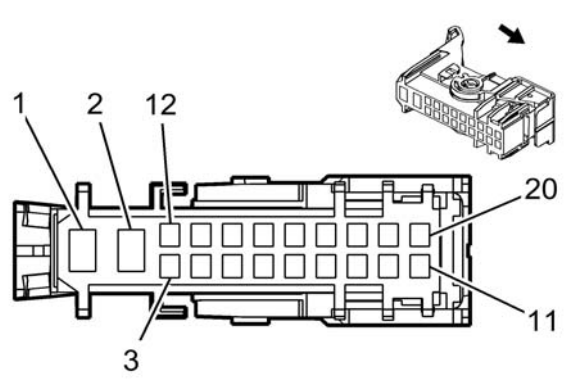
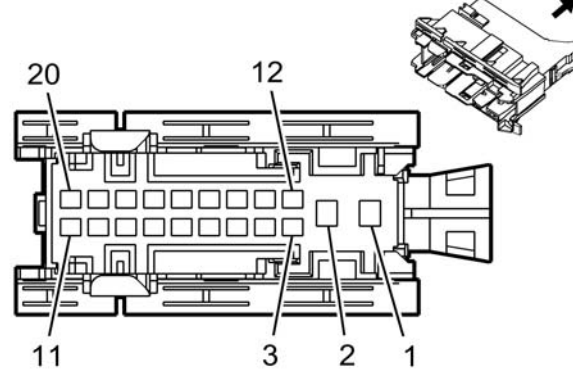
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VI	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2.5	RD/BN	3640	II	-	Battery Positive Voltage	1	2.5	RD/BN	3640	VI	-
2	2.5	BK	650	II	-	Ground	2	2.5	BK	650	VI	-
3	0.5	BK	650	I	-	Ground	3	0.5	BK	650	IV	-
4	0.75	GY	295	I	-	Door Lock Actuator Lock Control	4	0.75	GY	295	V	-
5	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	5	0.75	BN/YE	294	V	-
6 - 8	-	-	-	-	-	Not Occupied	6 - 8	-	-	-	-	-
9	0.5	BN/YE	6157	I	-	Left Rear Door Handle Switch Signal	9	0.35	BN/YE	6157	III	-
10	0.5	GN/GY	6135	I	-	Local Interconnect Network Serial Data Bus 4	10	0.5	GN/GY	6135	IV	-
11 - 14	-	-	-	-	-	Not Occupied	11 - 14	-	-	-	-	-
15	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	15	0.35	WH/YE	7557	III	-
16 - 18	-	-	-	-	-	Not Occupied	16 - 18	-	-	-	-	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
19	0.75	GN	199	I	-	Left Rear Speaker Control (+)	19	0.75	GN	199	V	-
20	0.75	BN/GN	116	I	-	Left Rear Speaker Signal (-) Left Rear Speaker Signal (-)	20	0.75 0.75	GN/BK BN/GN	116 116	V V	UQA UZ6

X800 RIGHT REAR DOOR HARNESS TO BODY HARNESS

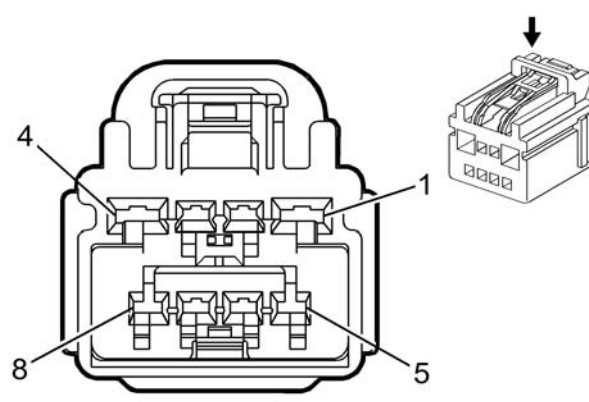
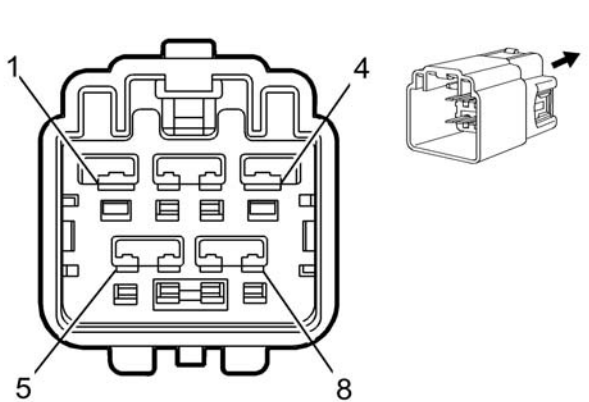
	
Connector Part Information • Harness Type: Right Rear Door • OEM Connector: 13678789 • Service Connector: Service by Harness - See Part Catalog • Description: 20-Way F 4.8 Timer, 1.5 DSQ Series (GY)	Connector Part Information • Harness Type: Body • OEM Connector: 13680032 • Service Connector: 13577518 • Description: 20-Way M 1.5, 5.8 TTS Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VI	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2.5	RD/YE	3740	II	-	Battery Positive Voltage	1	2	RD/YE	3740	VI	-
2	2.5	BK	850	II	-	Ground	2	2.5	BK	850	VI	-
3	0.5	BK	850	I	-	Ground	3	0.5	BK	850	IV	-
4	0.75	GY	295	I	-	Door Lock Actuator Lock Control	4	0.75	GY	295	V	-
5	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	5	0.75	BN/YE	294	V	-
6 - 8	-	-	-	-	-	Not Occupied	6 - 8	-	-	-	-	-
9	0.5	YE/GY	6158	I	-	Right Rear Door Handle Switch Signal	9	0.35	YE/GY	6158	III	-
10	0.5	GN/GY	6135	I	-	Local Interconnect Network Serial Data Bus 4	10	0.35	GN/GY	6135	III	-
11 - 14	-	-	-	-	-	Not Occupied	11 - 14	-	-	-	-	-
15	0.5	WH/YE	7557	I	-	LED Ambient Lighting Control 1	15	0.35	WH/YE	7557	III	-
16 - 18	-	-	-	-	-	Not Occupied	16 - 18	-	-	-	-	-
19	0.75	WH	46	I	-	Right Rear Speaker Control (+)	19	0.75	WH	46	V	-
20	0.75	WH/BN	115	I	-	Right Rear Speaker Signal (-) Right Rear Speaker Signal (-)	20	0.75 0.75	WH/BN BU/BK	115 115	V V	UZ6 UQA

X900 LIFTGATE JUMPER HARNESS TO BODY HARNESS

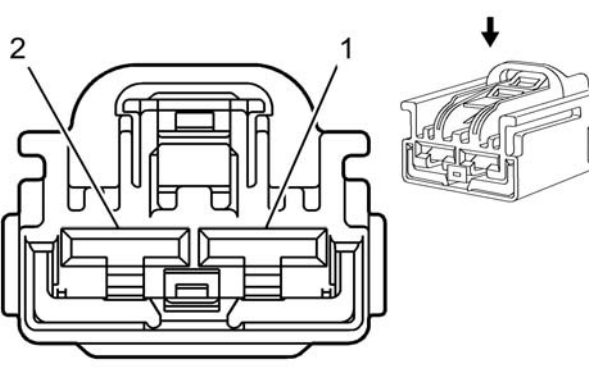
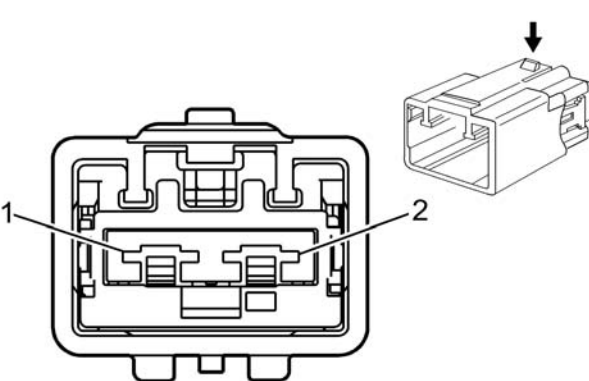
	
Connector Part Information • Harness Type: Liftgate Jumper • OEM Connector: 7283-6448-40 • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way F YESC Kaizen Series (L-GY)	Connector Part Information • Harness Type: Body • OEM Connector: 7282-6448-40 • Service Connector: 19301405 • Description: 8-Way M 1.5, 2.8 Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	BN/YE	820	I	-	CHMSL Control	2	0.35	BN/YE	820	II	-
3	0.5	GN/GY	737	I	-	Rear Compartment Lid Lamp Control	3	0.5	GN/GY	737	II	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.5	VT/GY	1303	I	-	Lift Gate Ajar Switch Signal 1	5	0.35	VT/GY	1303	II	-
6	0.5	BU/YE	6795	I	-	Lift Glass/Rear Compartment Lid Motor Release Control 2	6	0.75	BU/YE	6795	II	-
7	0.5	YE/BU	5797	I	-	Rear Closure Handle Switch Open Signal	7	0.35	YE/BU	5797	II	-
8	0.75	BK	850	I	-	Ground	8	0.75	BK	850	II	-

X901 LIFTGATE JUMPER HARNESS TO BODY HARNESS

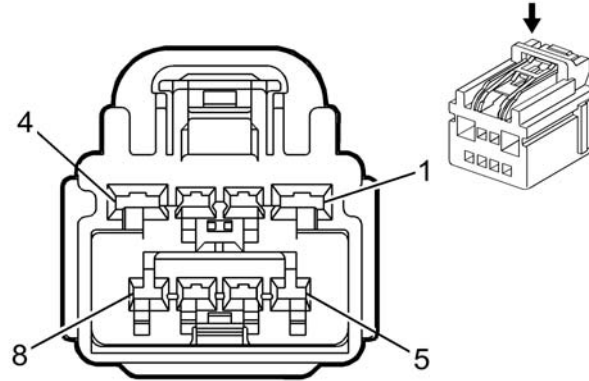
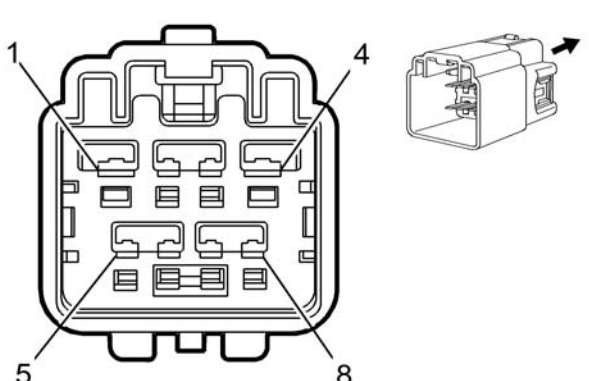
	
Connector Part Information • Harness Type: Liftgate Jumper • OEM Connector: 7283-6458-40 • Service Connector: Service by Harness - See Part Catalog • Description: 2-Way F 6.3 Series (L-GY)	Connector Part Information • Harness Type: Body • OEM Connector: 7282-6458-40 • Service Connector: 13577788 • Description: 2-Way M YESC Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-43 (RD)	Not Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	3	BN/VT	293	I	-	Rear Defog Element Control	1	4	BN/VT	293	II	-
2	3	BK	850	I	-	Ground	2	4	BK	850	II	-

X905 LIFTGATE JUMPER HARNESS TO LIFTGATE HARNESS

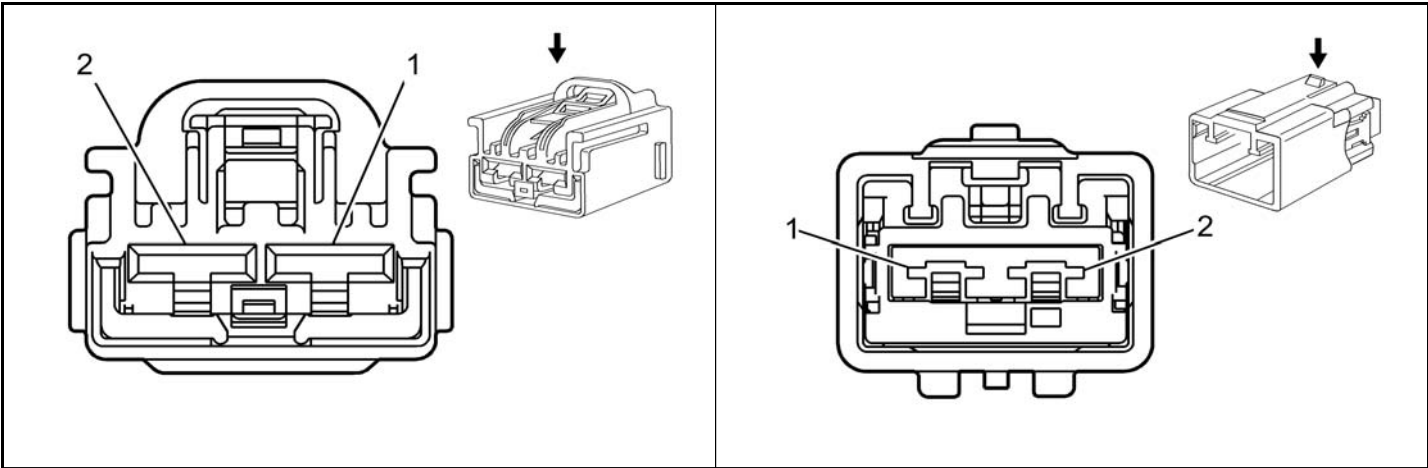
	
Connector Part Information • Harness Type: Liftgate Jumper • OEM Connector: 7283-6448-40 • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way F YESC Kaizen Series (L-GY)	Connector Part Information • Harness Type: Liftgate • OEM Connector: 7282-6448-40 • Service Connector: Service by Harness - See Part Catalog • Description: 8-Way M 1.5, 2.8 Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	BN/YE	820	I	-	CHMSL Control	2	0.5	BN/YE	820	II	-
3	0.5	GN/GY	737	I	-	Rear Compartment Lid Lamp Control	3	0.5	GN/GY	737	II	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.5	VT/GY	1303	I	-	Lift Gate Ajar Switch Signal 1	5	0.5	VT/GY	1303	II	-
6	0.5	BU/YE	6795	I	-	Lift Glass/Rear Compartment Lid Motor Release Control 2	6	0.5	BU/YE	6795	II	-
7	0.5	YE/BU	5797	I	-	Rear Closure Handle Switch Open Signal	7	0.5	YE/BU	5797	II	-
8	0.75	BK	850	I	-	Ground	8	0.75	BK	850	II	-

X906 LIFTGATE JUMPER HARNESS TO LIFTGATE HARNESS



Connector Part Information

Terminal Part Information

Terminal Type	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool
• OEM Connector: 7283-6458-40	Not Required	J-35616-42 (RD)	No Tool Required
• Service Connector: Service by Harness - See Part Catalog	Not Required	J-35616-43 (RD)	No Tool Required
• Description: 2-Way M VPS-Serialized Series (I-CV)	Not Required		

Connector Part Information

Service Terminal	Tray Name	Core Crimp	Insulation Crimp
• Harness Type: Liftgate			
• OEM Connector: 7282-6458-40	Not Required	Not Required	Not Required
• Service Connector: Service by Harness - See Part Catalog	Not Required	Not Required	Not Required
• Description: 2-Way M VPS-Serialized Series (I-CV)	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	3	BN/VT	293	I	-	Rear Defog Element Control	1	3	BK	293	II	-
2	3	BK	850	I	-	Ground	2	3	BK	850	II	-

ELECTRICAL

Wiring Systems and Power Management - Description and Operation - Volt

DESCRIPTION AND OPERATION

ELECTRONIC PARK LOCK DESCRIPTION AND OPERATION

If the vehicle is equipped with automatic transmission and a floor mounted console gear shift, it has an electronic park lock system. The electronic park lock system purpose is to prevent the ignition from being switched to the Vehicle OFF position when the transmission is in any position other than PARK and the vehicle may still be moving. The electronic park lock system incorporates the park position switch that located in the A/T shift lock control switch. When the transmission shift selector is in PARK, the park position switch closes and the BCM allows the ignition to be turned Vehicle OFF.

If the vehicle is not in PARK, the ignition will return to ACC/ACCESSORY and display the message SHIFT TO PARK in the Driver Information Center. When the vehicle is shifted into PARK, the ignition system will switch to Vehicle OFF.

POWER MODE DESCRIPTION AND OPERATION

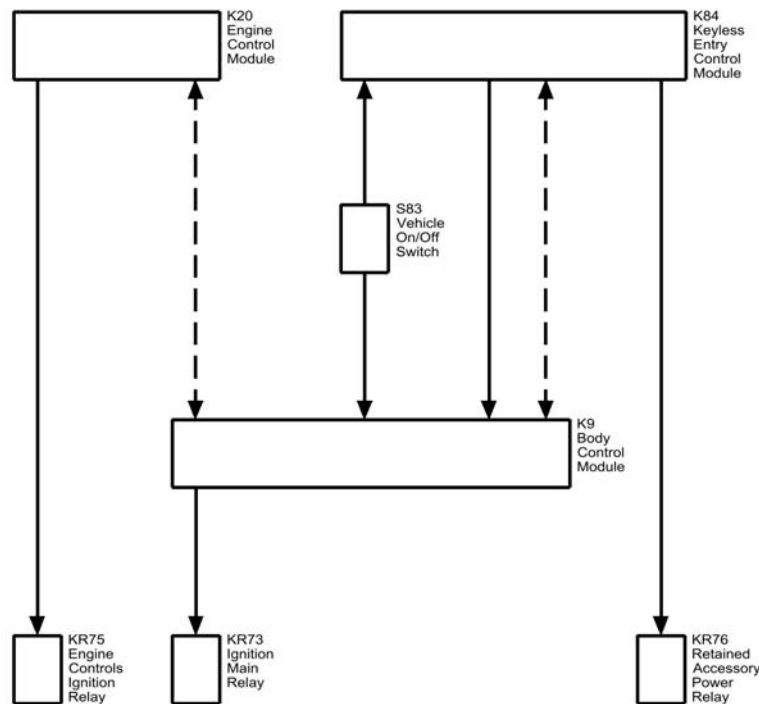


Fig. 1: Power Mode System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K20	K20 Engine Control Module
KR73	KR73 Ignition Main Relay

Callout	Component Name
KR75	KR75 Engine Controls Ignition Relay
K9	K9 Body Control Module
K84	K84 Keyless Entry Control Module
S83	S83 Vehicle On/Off Switch
KR76	KR76 Retained Accessory Power Relay

Serial Data Power Mode Master

Power to many of this vehicles circuits is controlled by the module that is designated the power mode master. This vehicles power mode master is the body control module (BCM). The BCM has multiple B+ circuits that feed into it. Each of those circuits are partitioned within the controller to drive certain outputs of the vehicle's body functions. An open or short in any one of the B+ circuits may induce multiple codes/or a section of non-functionality within the BCM with the rest of the BCM functioning normally. In this case it is useful to refer to the power distribution schematics to determine if the non-functional partition of the controller shares a common B+ circuit. The power button switch is a low current push button switch with discrete power button switch signals to the power mode master for determination of the power mode that will be sent over the serial data circuits to the other modules that need this information. The power mode master will also activate relays and other direct outputs of the power mode master as needed. The power mode master determines which power mode (Vehicle Off, Vehicle On, Vehicle in Service Mode) is required, and reports this information to other modules via serial data. Modules which have switched voltage inputs may operate in a default mode if the power mode serial data message does not match what the individual module can see from its own connections.

The power mode master receives power button switch signals and transmitter in range signals to identify the operators desired power mode. The Power Mode Parameters table below illustrates the correct state of these input parameters (circuits) in correspondence to the power button switch position and the transmitter to vehicle range:

Power Mode Parameters

Power Mode	Power Mode Transmitted	Push Button Ignition Switch (Power Button Switch Circuit Input to the BCM)	Push Button Ignition Switch Voltage Push Button Ignition Switch Voltage Input to the BCM	Key in Cylinder Switch/Key Fob in Vehicle (Transmitter in Range to the BCM Signal)
Transmitter in Range	Vehicle Off	Inactive	9 V	Yes
Transmitter out of Range	Vehicle Off	Inactive	9 V	No
Vehicle On Power Mode, then Press the Power Button Switch (Foot on or off the Brake Pedal); Transmitter in Vehicle	Vehicle Off	Active (pushed)/Inactive (not pushed)	6 V (pressed)	Yes
Vehicle Off Power Mode, then Press the Power Button	Vehicle On	Active (pushed)/Inactive (not pushed)	6 V (pressed)	Yes

Power Mode	Power Mode Transmitted	Push Button Ignition Switch (Power Button Switch Circuit Input to the BCM)	Push Button Ignition Switch Voltage Push Button Ignition Switch Voltage Input to the BCM	Key in Cylinder Switch/Key Fob in Vehicle (Transmitter in Range to the BCM Signal)
Switch with foot on the Brake Pedal; Transmitter in Vehicle				
Vehicle Off Power Mode, then Press and Hold the Power Button Switch for 5 s with foot off the Brake Pedal; Transmitter in Vehicle	Vehicle in Service Mode	Active (pushed)/Inactive (not pushed)	6 V (pressed)	Yes
Vehicle Off Power Mode, then Press and Hold the Power Button Switch for over 10 s with foot off the Brake Pedal; Transmitter in Vehicle	Vehicle in Service Mode	Active (pushed)/Inactive (not pushed)	6 V (pressed)	Yes

Relay Controlled Power Mode

The BCM uses the discrete power button switch inputs, transmitter in range status, current power mode state, and the brake pedal position state to distinguish the correct power mode (Vehicle Off, Vehicle On, and Vehicle in Service Mode). The BCM, after determining the desired power mode, will activate the appropriate relays for that power mode and send the power mode message out to other modules in a serial data message.

The retained accessory power relay remains on for a timed period after the power mode transitions to Vehicle Off. Refer to [Retained Accessory Power Description and Operation](#) for more information on the retained accessory power function.

Push Button Start

The vehicle has an electronic push button start switch. The power button switch is equipped with two LED's, one for backlighting and one for Vehicle On indication or Vehicle In Service Mode indication. The power button switch light flashes when the driver door is open and the vehicle is not on. The flashing light will eventually time out. The power button switch light is on steady when in Vehicle On or Vehicle In Service Mode. When the vehicle is turned off, the power button switch light will turn off.

Vehicle On

This position is for driving and starting. The Vehicle On mode will be used for service (including maintenance and lubrication) and diagnostics on the electronic propulsion system or the gas engine. With the vehicle off,

transmitter in the vehicle and the brake pedal applied, pressing the power button switch once will place the vehicle in Vehicle On mode. The instrument cluster displays an active fuel or battery gauge, along with an audio startup cue, when the vehicle is ready to be driven. This could take up to 15 s at extremely cold temperatures. The gas engine will only start if needed. If the vehicle did not start, the instrument cluster will display a screen with inactive fuel and battery gauges. The electric propulsion system is active in this power mode. The gas engine will start if the hood is opened while in this power mode. The vehicle can be charged while in this power mode. If the vehicle is left in PARK while in Vehicle On mode and the transmitter is removed from the vehicle, the vehicle will automatically turn off after 1.5 hours. If the vehicle is left in PARK while in Vehicle On mode and the transmitter is in the vehicle, the vehicle will automatically turn OFF after 3 hours. The timer will stop when the vehicle is shifted out of PARK and the timer will reset after the vehicle is placed back in PARK while in Vehicle On mode.

Vehicle In Service Mode

NOTE: **The vehicle will not charge if the charging cable is attached to the vehicle after being placed into the Vehicle In Service Mode. Attach the charging cable to the vehicle before entering the Vehicle In Service Mode to charge the vehicle.**

This power mode is available for service and diagnostics, and to verify the proper operation of the MIL as may be required for emission inspection purposes. The Vehicle In Service Mode will be used for service and diagnostics for items not requiring the electronic propulsion to be active or the operation of the gas engine. With the vehicle off, and the brake pedal not applied, pressing and holding the power button switch for 5 s will place the vehicle in Vehicle In Service Mode for approximately 3 hours. After being in Vehicle In Service Mode for 1.5 hours, the vehicle will look to see if the transmitter is still present. If the transmitter is not present in the vehicle, it will power down instead of staying powered up for the full 3 hours. Pressing and holding the power button switch for at least 10 s will place the vehicle in Vehicle In Service Mode until the vehicle is manually turned OFF. The instruments and audio systems will operate as they do in Vehicle On mode, but the vehicle will not be able to be driven. The electric propulsion system is inactive in this power mode. The gas engine will not start if the hood is opened while in this power mode. The vehicle can only be charged in this power mode if the charging cable is attached before this power mode is enabled.

Vehicle Off

To turn the vehicle off, push the power button switch with the vehicle in P (Park). Retained Accessory Power (RAP) will remain active until the driver door is opened. Refer to [Retained Accessory Power Description and Operation](#) for more information on the retained accessory power function. When turning off the vehicle, if the vehicle is not in P (Park), the SHIFT TO PARK message is displayed in the Driver Information Center (DIC). The electric propulsion system is inactive in this power mode. The gas engine will not start if the hood is opened in this power mode. The vehicle can be charged while in this power mode.

Battery Saver Mode (Transport Mode) (If Equipped)

The battery saver mode (transport mode) reduces the parasitic load of some modules during overseas shipment or during vehicle storage conditions. This improves the drain time on the battery (up to 70 days without the battery going dead). When the vehicle is in transport/storage, some features may have reduced functionality while in the battery saver mode (transport mode), such as disabling the Remote Function Actuator or content theft features.

The battery saver mode (transport mode) incorporates a latching relay that when enabled disconnects some modules from their ignition power or memory power sources. Battery saver mode (transport mode) is initiated by turning on the hazard flashers, applying the brake pedal, and then pushing the power button switch for greater than 15 s. The mode is disengaged by repeating the previous process causing the relay to latch in the

other direction. Once the vehicle is in Vehicle On mode and the hazard flashers are on, pushing the power button switch for greater than 15 s will latch the relay in the other direction. This feature can be used as many times as necessary if the vehicle is to be stored for an extended period of time.

BCM Awake/Sleep States

The BCM is able to control or perform all of the BCM functions in the awake state. The BCM enters the sleep state when active control or normal monitoring of system functions has stopped and a time limit has passed. The BCM must detect certain wake-up inputs before entering the awake state. The BCM monitors for these inputs during the sleep state.

The BCM will enter the awake state if any of the following wake-up inputs are detected:

- Activity on the serial data line (including wake-up circuits)
- Detection of a battery reconnect
- Any door open signal
- Headlamps ON
- Vehicle On
- Vehicle In Service Mode
- Park lamps ON
- Keyless entry or remote start message

The BCM will enter a sleep state when all of the following conditions exist:

- Vehicle Off, transmitter is out of range
- No activity exists on the serial data line (including wake-up circuits)
- No outputs are commanded.
- No delay timers are actively counting.
- No wake-up inputs are present.

If all these conditions are met, the BCM will enter a low power or sleep condition.

Serial Data Wake-Up

Control modules on the serial data wake-up circuit enable or disable communication based on the voltage level of this circuit.

RETAINED ACCESSORY POWER DESCRIPTION AND OPERATION

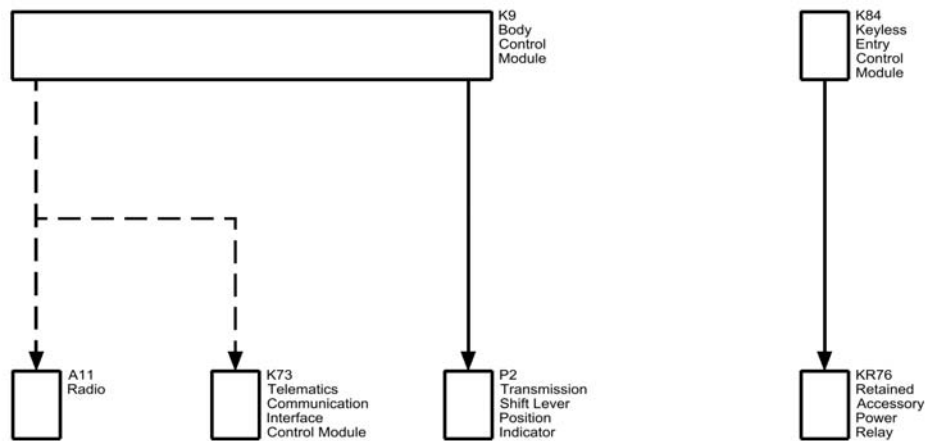


Fig. 2: 16 Volt Retained Accessory Power System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K9	K9 Body Control Module
A11	A11 Radio
K73	K73 Telematics Communication Interface Control Module
P2	P2 Transmission Shift Lever Position Indicator
K84	K84 Keyless Entry Control Module
KR76	KR76 Retained Accessory Power Relay

Retained Accessory Power

The body control module (BCM) monitors the vehicle power modes, battery condition, and each door ajar/open switch status to determine whether the retained accessory power should be initiated or terminated. Retained accessory power is controlled by two different methods; relay control and serial data. Some modules receive a retained accessory power message from the BCM over the serial data circuits. Serial data controlled retained accessory power is deactivated as required by their modules retained accessory power mode operation. Other subsystems are activated directly. Components and systems that are active in retained accessory power are also activated anytime the vehicle power mode is any state other than Vehicle OFF regardless of the door switch signals.

Interruptible Retained Accessory Power Relay Controlled Retained Accessory Power

The Keyless entry control module keeps the relay energized during all power modes, except Vehicle Off. The relay is also energized for approximately 10 minutes after moving to the Vehicle OFF state and moving the transmitter out of range, providing no door is opened. The keyless entry control module controls components in

the same manner as BCM direct controlled retained accessory power with one exception; interruptible retained accessory power is deactivated during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle On/Off switch is pressed which may result in "NO REMOTE DETECTED" displayed on the driver information center.

Relay controlled retained accessory power will end when one of the following conditions is met:

- The keyless entry control module receives a message that any door ajar or open switch indicating the opening of any door after entering the Vehicle Off state and the transmitter is out of range.

NOTE: If the keyless entry control module is receiving any door ajar or open signal from those switches when the Vehicle Off state is entered and the transmitter is out of range, retained accessory power will not initiate.

-

- The keyless entry control module detects a decrease in battery capacity below a prescribed limit.

Systems powered by the retained accessory power relay during the retained accessory power mode are as follows:

- Accessory Power Receptacle
- Cigarette Lighter Receptacle

Serial Data Controlled Retained Accessory Power

Retained accessory power systems controlled by serial data are as follows:

Radio

Radio retained accessory power activation/termination is the same as relay operation with one exception; the only door switch that will turn off the radio during retained accessory power is the driver door open switch.

Vehicle Communication Interface Module (VCIM) (Onstar®) (If Equipped)

VCIM RAP activation/termination is the same as radio operation with 1 exception; if there is an active call when the ignition key is turned off the VCIM will remain in RAP mode, and keep the radio in RAP mode until the call is terminated.

Article GUID: A00884707

ACCESSORIES & EQUIPMENT

Wiring Systems and Power Management - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B097B: POWER MODE START SWITCH CIRCUIT (1 OF 2)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B097B

Power Mode Start Switch Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 04*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF switch indicator always OFF 2. Power mode mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors

the s switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

Control module voltage is 9 - 16 V.

Conditions for Setting the DTC

B097B 00

- The voltage seen at the BCM monitored switch does not match the voltage seen at the keyless entry control module monitored switch.
- The above condition exists for more than 1 s

B097B 02

- The control module detects a short to ground in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 04

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 05

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 08

- The control module detects a change in the ignition mode without observing a switch press
- The above condition occurs 4 consecutive times

B097B 61

- The control module detects a continuously closed vehicle ON/OFF switch
- The above condition exists for more than 1 min

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears after 40 consecutive module ignition cycles without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify DTC B097B 61 is not set.
 - **If DTC B097B 61 is set**

Test or replace the S83 Vehicle On/Off Switch.
 - **If DTC B097B 61 is not set**
2. Refer to Circuit/System Testing.

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If less than 10 Ω**

4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.

5. Disconnect the S83 Vehicle On/Off Switch.

6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.

- **If 11 V or less**

1. Connect the S83 Vehicle On/Off Switch.

2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.

3. Test for infinite resistance between the signal circuit terminal 6 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If greater than 11 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.

8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

9. Connect the harness connector at the S83 Vehicle On/Off Switch.

10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.

- **If not between 8 - 10 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 8 - 10 V**

11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V, with the S83 Vehicle On/Off Switch pressed.

- **If not between 4 - 7 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 4 - 7 V**

12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.

13. Test for infinite resistance between the signal circuit terminal 11 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

14. Vehicle in Service Mode.

15. Test for less than 1 V between the signal circuit terminal 11 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch released.

- **If not between 4.5 - 5.5 k Ω**

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.

2. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , test or replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.

- **If not between 1 - 1.5 k Ω**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

18. Replace the K84 Keyless Entry Control Module.

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

2. Test for 4.5 - 5.5 k Ω between the terminal listed below with the S83 Vehicle ON/OFF Switch released:

- Signal terminal 6 and ground terminal 4

- Signal terminal 3 and low reference terminal 7

- **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. Test for 1 - 1.5k Ω between the terminals listed below with the S83 Vehicle On/Off Switch pressed, :

- Signal terminal 6 and ground terminal 4

- Signal terminal 3 and low reference terminal 7

- **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the appropriate control module replacement, programming and setup.

DTC B097B: POWER MODE START SWITCH CIRCUIT (2 OF 2)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B097B

Power Mode Start Switch Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 04*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF switch indicator always OFF 2. Power mode mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two

resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the s switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

Control module voltage is 9 - 16 V.

Conditions for Setting the DTC

B097B 00

- The voltage seen at the BCM monitored switch does not match the voltage seen at the keyless entry control module monitored switch.
- The above condition exists for more than 1 s

B097B 02

- The control module detects a short to ground in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 04

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 05

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 08

- The control module detects a change in the ignition mode without observing a switch press
- The above condition occurs 4 consecutive times

B097B 61

- The control module detects a continuously closed vehicle ON/OFF switch
- The above condition exists for more than 1 min

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears after 40 consecutive module ignition cycles without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTC B097B 61 is not set.

- **If DTC B097B 61 is set**

Test or replace the S83 Vehicle On/Off Switch.

- **If DTC B097B 61 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**

3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If less than 10 Ω**
4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.
5. Disconnect the S83 Vehicle On/Off Switch.
6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
 - **If 11 V or less**
 1. Connect the S83 Vehicle On/Off Switch.
 2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.
 3. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If greater than 11 V**
7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.
 - **If 1 V or greater**
 1. Disconnect the harness connector at the K9 Body Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If less than 1 V**
9. Verify the scan tool K84 Keyless Entry Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
 - **If 11 V or less**
 1. Connect the S83 Vehicle On/Off Switch.
 2. Vehicle OFF, disconnect the X1 harness connector at the K84 Keyless Entry Control Module and S83 Vehicle On/Off Switch.
 3. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K84 Keyless Entry Control Module.
 - **If greater than 11 V**
10. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.

11. Verify the scan tool K84 Keyless Entry Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

12. Test or replace the S83 Vehicle On/Off Switch

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

2. Test for 4.5 - 5.5 k Ω between the terminal listed below with the S83 Vehicle ON/OFF Switch released:

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7
- **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. Test for 1 - 1.5k Ω between the terminals listed below with the S83 Vehicle On/Off Switch pressed, :

- Signal terminal 6 and ground terminal 4
- Signal terminal 3 and low reference terminal 7
- **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition and Start Switch Replacement**
- **Control Module References** for control module replacement, programming and setup.

DTC B097C: POWER MODE RUN/CRANK INDICATOR CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B097C 02

Power Mode Run/Crank Indicator Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B097C 02	2	1	-
Ground	-	2	-	-
1. Vehicle ON/OFF switch indicator always ON 2. Vehicle ON/OFF switch indicator inoperative				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicates the vehicle power mode. When the vehicle is in the OFF mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

Conditions for Running the DTC

Control module voltage is 9 - 16 V

Conditions for Setting the DTC

- The BCM detects a short to ground in the control circuit.
- The above condition exists for more than 1 min.

Action Taken When the DTC Sets

The BCM disables the control output.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the module power mode cycle counter reaches 40, without a repeat of the malfunction.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the blue LED illuminates when the S83 Vehicle On/Off Switch is pressed and held up to 10 s, with the brake pedal released.

- **If the blue LED does not illuminate**

Refer to Circuit/System Testing.

- **If the blue LED illuminates**

2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Test for less than 1 V between the control circuit terminal 5 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - **If less than 1 V**
4. Vehicle OFF, connect the harness connector at the S83 Vehicle On/Off Switch.
5. Vehicle in Service Mode, disconnect the harness connector at the S83 Vehicle On/Off Switch.

6. Verify a test lamp illuminates between the control circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
7. Test or replace the S83 Vehicle On/Off Switch.

Component Testing

1. Vehicle OFF, disconnect the harness at the S83 Vehicle On/Off Switch.
2. Connect a jumper wire between the S83 Vehicle On/Off Switch terminal 4 and ground.
3. Connect a 3 A fused jumper wire between the S83 Vehicle On/Off Switch terminal 5 and B+.
4. Verify the blue LED illuminates.
 - **If the LED does not illuminate**

Replace the S83 Vehicle On/Off Switch.
 - **If the LED illuminates**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition and Start Switch Replacement**
- **Control Module References** for the body control module replacement, programming and setup.

DTC B1370: CONTROL MODULE IGNITION ON AND START CIRCUIT (INSTRUMENT CLUSTER)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370

Control Module Ignition On and Start Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Instrument Cluster Ignition (Instrument Panel Cluster terminal 8)	B1370 06	B1370 06	B1370 01	-

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed. The power mode master will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch.

Conditions for Running the DTC

B1370 01

Vehicle ON.

B1370 06

Vehicle ON, or Vehicle in Service Mode.

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 06

- Ignition circuit is open.
- Ignition circuit is shorted to ground.

Action Taken When the DTC Sets

The Instrument Cluster still functions except the malfunction indicator light is always off.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free Vehicle On/Off cycles have occurred.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Instrument Cluster Description and Operation
- Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B144B is not set.

- **If DTC B144B is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If DTC B144B is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the P16 Instrument Cluster.

2. Verify that a test lamp does not illuminate between the ignition circuit terminal 8 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode.

4. Verify that a test lamp illuminates between the ignition terminal 8 and ground.

- **If the test lamp does not illuminate and the Ignition fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , refer to Power Mode Mismatch.

- **If the test lamp does not illuminate and the Ignition fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.

- **If the test lamp illuminates**

5. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

DTC B144A: RUN POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B144A

Run Power Relay Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay coil control	B144A 02	-	-	-

Circuit/System Description

The body control module (BCM) feeds the ignition circuit by applying voltage when the vehicle is in Vehicle in Service Mode or Vehicle ON mode.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the ignition circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the ignition circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC control module.
2. Connect a test lamp between the ignition circuit terminal 9 and ground.
3. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**
4. Test or replace the K33 HVAC control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for body control module and HVAC control module replacement, programming and setup.

DTC B144B: RUN/CRANK POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B144B

Run/Crank Power Relay Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B144B 02*	B144B 04*	B144B 01*	-
Control	B144B 02**	1	2	-
1. No start 2. Engine will continue to run after the ignition is turned OFF * DTC set in keyless entry control module ** DTC set in BCM				

Circuit/System Description

The body control module (BCM) controls the ignition main relay through the control circuit by applying voltage to the ignition main relay coil control circuit. The ignition main relay is energized when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested. This is part of the BCM's primary function in controlling the vehicle power mode.

The keyless entry control module controls the backup power for the ignition main relay through the control circuit by applying voltage to the ignition circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

System voltage is greater than 9 V

Conditions for Setting the DTC

B144B 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit

B144B 02 - BCM

A short to ground is detected on the ignition main relay coil control circuit

B144B 02 - Keyless Entry Control Module

The ignition output is active and a short to ground is detected 3 consecutive times on the ignition voltage circuit

B144B 04

The ignition output is not active and an open is detected 20 consecutive times on the ignition voltage circuit

Action Taken When the DTC Sets

B144B 01, B144B 04

No action is taken

B144B 02

The ignition relay is deactivated when the fault is set. After 100 ms, the ignition main relay will be activated. If the fault is still set, the relay will be deactivated. The ignition main relay will again be activated after 100 ms. If this also results in a fault, the ignition main relay will be deactivated until a new ignition request is received.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and an ignition request is received.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Diagnostic Aids

A short to voltage on the ignition main relay coil control will cause the engine to remain running after the vehicle mode is changed to OFF.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the KR73 Ignition Main Relay clicks ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
 - **If the KR73 Ignition Main Relay does not click ON and OFF**

Refer to Circuit/System Testing.
 - **If the KR73 Ignition Main Relay clicks ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
2. Test for less than 1 V between the ignition circuit terminal 6 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp illuminates**

5. Vehicle OFF, connect the X3 harness connector at the K9 Body Control Module.
6. Vehicle OFF and all vehicle systems OFF, disconnect the KR73 Ignition Main Relay. It may take up to 2 min for all vehicle systems to power down.
7. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
8. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
9. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
10. Test or replace the KR73 Ignition Main Relay.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

DTC B1451: ACCESSORY POWER CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1451

Accessory Power Circuit

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B1451 02	B1451 04	B1451 01	-

Circuit/System Description

The keyless entry control module provides backup controls for the ignition power circuit, through the control circuit, by applying voltage to the circuit. The ignition power circuit is energized when the vehicle power mode is in Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

B1451 01, B1451 04

- Vehicle power mode is Vehicle OFF
- Module is awake
- DTC B1451 not already set
- System voltage between 6 and 16 V

B1451 02

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode
- Module is awake
- The DTC is only run when the output is active
- DTC B1451 is not already set
- System voltage between 6 and 16 V

Conditions for Setting the DTC

B1451 01

Ignition output is not active and a short to battery is detected 3 consecutive times.

B1451 02

Ignition output is active and a short to ground is detected 3 consecutive times.

B1451 04

Ignition output is not active and an open circuit is detected 20 consecutive times.

Action Taken When the DTC Sets

B1451 02

The ignition output is deactivated when a short to ground is detected. After 100 ms the output is activated again. This happens 3 times and then the output is deactivated until a new Vehicle ON or Vehicle in Service Mode request is received.

B1451 01, B1451 04

No action is taken.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present during a DTC check.
- A history DTC clears when the module power mode cycle counter reaches the reset threshold of 40, without a repeat of the malfunction.

Diagnostic Aids

- A short to voltage in the ignition control circuit will keep the vehicle modules awake, which can drain the vehicle's battery.
- A short to ground in the extension of this circuit through the body control module can back feed to the keyless entry control module. Check for a short to ground on the ignition circuit on the other side of the ignition pass thru, in the body control module, before replacing the body control module.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814 is not set.
 - **If DTC U1814 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If DTC U1814 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle in Service Mode, disconnect the X2 harness connector at the K84 Keyless Entry Control Module.
2. Verify that a test lamp illuminates between B+ circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K84 Keyless Entry Control Module.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K84 Keyless Entry Control Module and disconnect the X3 harness connector at the K9 Body Control Module.
4. Test for less than 1 V between the ignition circuit terminal 5 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

5. Vehicle in Service Mode.
6. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF. remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If the test lamp illuminates**

7. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Control Module References for the body control module and keyless entry control module replacement, programming and setup.

DTC B305E: INTERRUPTIBLE RAP RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B305E

Interruptible RAP Relay Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-

Circuit/System Description

The keyless entry control module controls the retained accessory power relay through the control circuit by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized when the ignition is in the Vehicle In Service Mode or the Vehicle On mode. The relay is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened

Conditions for Running the DTC

- System voltage is greater than 6 V.
- The DTC can only set when the output is actively being requested by the module.

Conditions for Setting the DTC

B305E 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit.

B305E 02

The ignition output is active and a short to ground is detected on the ignition voltage circuit.

B305E 05

The ignition output is active and an open or short to battery is detected on the ignition voltage circuit.

Action Taken When the DTC Sets

B305E 01, B305E 05

No action is taken.

B305E 02

The module output driver will be shut down and not supply voltage to the circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and the ignition output is active.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- [Power Moding Schematics](#)
- [Power Distribution Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the KR76 Retained Accessory Power Relay clicks ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
 - **If the KR76 Retained Accessory Power Relay does not click ON and OFF**

Refer to Circuit/System Testing.
 - **If the KR76 Retained Accessory Power Relay clicks ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 86 and ground circuit terminal 85.
4. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the KR76 Retained Accessory Power Relay.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical Center\)](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC P15B9 OR P15BA: ELECTRIC A/C COMPRESSOR CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P15B9

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P15BA

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Electric A/C compressor control module ignition	P15B9	P15B9	P15BA	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode. The hybrid powertrain control module 2 receives the power mode status from the A/C compressor over serial data and compares this status to its own internal power mode status.

Conditions for Running the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

Conditions for Setting the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 ignition input is active.
- A/C compressor ignition input is not active for more than 2 s.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- Hybrid powertrain control module 2 ignition input is not active.
- A/C compressor ignition input is active for more than 2 s

Action Taken When the DTC Sets

P15B9, P15BA

DTCs P15B9 and P15BA are type B DTCs.

Conditions for Clearing the DTC

P15B9 or P15BA

DTCs P15B9 and P15BA, are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.

- **If the DTC is set**

Refer to [DTC B144B](#).

- **If the DTC is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X1 harness connector at the G1 A/C Compressor.

2. Verify that a test lamp does not illuminate between the ignition circuit terminal 3 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode

4. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Power Mode Mismatch](#).
- **If the test lamp does not illuminate and the circuit fuse is open**
1. Vehicle OFF, disconnect the harness connector at the G1 A/C Compressor and all devices that share the same ignition circuit.
2. Test for infinite resistance between the ignition circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Connect each of the devices one at a time and test for greater than 10 Ω between the ignition circuit terminal 3 and ground.
 - If 10 Ω or less, disconnect the appropriate device and retest to verify if the short is in the circuit or the component.
 - If greater than 10 Ω replace the appropriate device.
- **If the test lamp illuminates**
5. Replace the G1 A/C Compressor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

DTC P1A5E OR P1A5F: BATTERY ENERGY CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A5E

Battery Energy Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P1A5F

Battery Energy Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Energy Control Module Ignition	P1A5E	P1A5E	P1A5F	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay through the control circuit by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Battery energy control module is awake.
- System voltage greater than 9 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle OFF.
- Battery energy control module is awake.
- System voltage greater than 9 V.

Conditions for Setting the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Ignition input is active and not above 5 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Ignition input is not active and not below 5 V.

Action Taken When the DTC Sets

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Conditions for Clearing the DTC

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

[Power Distribution Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Power Mode Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify DTC B144B is not set.

- **If the DTC is set**

Refer to [DTC B144B](#).

- **If the DTC is not set**

2. Refer to Circuit/System Testing.

[Circuit/System Testing](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)
2. Connect the 12 V battery, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 4 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.
 - **If the test lamp does not illuminate**
4. Vehicle in Service Mode
5. Verify a test lamp illuminates between the ignition circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Power Mode Mismatch](#).
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, disconnect the harness connector at all devices that share the same ignition circuit.
 2. Test for infinite resistance between the ignition circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 - 3. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)
 - 4. Connect the **EL-50211** low voltage jumper harness extension.
 - 5. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
 - 6. Test for infinite resistance between the ignition circuit terminal 9 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 - 7. Connect each of the devices that share the same ignition circuit one at a time and test for greater than 100 Ω between the ignition circuit terminal 9 and ground.
 - If 100 Ω or less, disconnect the appropriate device and retest to verify if the short is in the

circuit or the component.

- If greater than 100 Ω replace the appropriate device.

- **If the test lamp illuminates**

6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)

7. Connect the **EL-50211** low voltage jumper harness extension.

8. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.

9. Verify that a test lamp does not illuminate between the ignition circuit terminal 9 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

10. Vehicle in Service Mode

11. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.

- **If the test lamp does not illuminate.**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- **If the test lamp illuminates**

12. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

DTC P1A60: BATTERY ENERGY CONTROL MODULE IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A60

Battery Energy Control Module Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data Wake-Up	P1A60, P06E4,	P1A60	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	U1814, U2099			

Circuit/System Description

The hybrid powertrain control module 2 sends the serial data wake-up power mode status in a serial data message to the battery energy control module. The hybrid powertrain control module 2 also powers up the serial data wake-up circuit to the battery energy control module when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode
- Battery energy control module is awake
- System voltage greater than 9 V

Conditions for Setting the DTC

Ignition input is active, and 500 ms after the ignition input transitions high, a voltage below 5 V is detected 3 consecutive times

Action Taken When the DTC Sets

DTC P1A60 is a type B DTC.

Conditions for Clearing the DTC

DTC P1A60 is a type B DTC.

Diagnostic Aids

A short to voltage in the serial data wake-up circuit will keep the vehicle bus awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify DTC U1814, U2099, or P06E4 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

2. Refer to Circuit/System Testing.

[Circuit/System Testing](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#)

2. Connect the 12 V battery, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
3. Connect a test lamp between the serial data wake-up circuit terminal 5 and ground.
4. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 2 Ω in the serial data wake-up circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the test lamp turns ON and OFF**
5. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to [High Voltage Battery Cover Replacement](#)
6. Connect the **EL-50211** low voltage jumper harness extension.
7. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
8. Connect a test lamp between the serial data wake-up circuit terminal 3 and ground.
9. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the **EL-50211** low voltage jumper harness extension.
 2. Test for less than 2 Ω in the serial data wake-up circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the **EL-50211** low voltage jumper harness extension.
 2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - **If the test lamp turns ON and OFF**
10. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup,

DTC P2534 OR P2535: IGNITION ON/START SWITCH CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2534

Ignition On/Start Switch Circuit Low Voltage

DTC P2535

Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2534	P2534	P2535	-

Circuit/System Description

The body control module (BCM) controls the ignition relay through the control circuit by applying voltage to the circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P2534, P2535

The control module is awake.

Conditions for Setting the DTC

P2534

The control module detects 2 V or less on the ignition voltage circuit.

P2535

The control module detects greater than 5 V or greater on the ignition voltage circuit, with the ignition turned OFF.

Action Taken When the DTC Sets

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Conditions for Clearing the DTC

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.
 - **If the DTC is set**

Refer to **DTC B144B**.
 - **If the DTC is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

For European Regions

WARNING: High voltage enabling and disabling shall be only performed by High Voltage Qualified Technicians. The procedures for high voltage enabling/disabling can be found in the service instructions and must be strictly followed at all times. The usage of the Protocol High Voltage Disabling / Enabling is mandatory. The High Voltage Qualified Technician is responsible for the adherence to the

manufacturer's service instructions as well as current national legal regulations.

Failure to follow the procedures exactly as written may result in serious injury or death.

Questions regarding training can be answered by your national training center.

WARNING: Any hybrid/EV battery pack replacement shall be performed by High Voltage Qualified Technicians only. The replacement procedure can be found in the service instruction and must be strictly followed at all times. The High Voltage Qualified Technician is responsible for adherence to the manufacturer's service instructions as well as current national legal regulations. If the hybrid/EV battery pack needs to be replaced contact the Technical Assistance Centre for further instructions prior removal of the battery pack.

For Non-European Regions

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF and all vehicle systems off, disconnect the harness connector at the control module setting the DTC.
2. Verify that a test lamp does not illuminate between the ignition circuit and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

3. Vehicle in Service Mode.

4. Verify a test lamp illuminates between the ignition circuit and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , refer to [Power Mode Mismatch](#)

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the control module setting the DTC.

- **If the test lamp illuminates**

5. Replace the control module setting the DTC.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for the appropriate control module replacement, programming and setup.

DTC P2537: IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2537

Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2537, P06E4, U1814, U2099	P2537	-	-

Circuit/System Description

The control module continuously monitors the voltage on the ignition accessory circuit every 0.1s. Higher or lower than normal voltage may cause erratic vehicle operation.

Conditions for Running the DTC

P2537

Propulsion system is active for 5 s.

Conditions for Setting the DTC

P2537

The device detects the accessory voltage circuit is open for 0.1 s.

Action Taken When the DTC Sets

P2537

P2537 is a Type B DTC.

Conditions for Clearing the DTC

P2537

P2537 is a Type B DTC.

Diagnostic Aids

Short to ground may set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814, U2099, or P06E4 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

Hybrid/EV Powertrain Control Module 2 Circuit Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module
2.

2. Vehicle in Service Mode.

3. Verify a test lamp illuminates between the accessory wake up serial data circuit terminal 67 and ground.

- **If the test lamp does not illuminate.**

1. Ignition OFF remove the test lamp, disconnect the X4 connector at the K9 Body Control Module.

2. Test for less than 2 Ω on the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Engine Control Module Circuit Malfunction

1. Vehicle OFF and all vehicle systems off, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the Accessory Wake up Serial Data 2 circuit terminal 13 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the KR114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 2 Ω on the Accessory Wake up Serial Data 2 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the KR114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp illuminates**

4. Replace the control module setting the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup,

SYMPTOMS - WIRING SYSTEMS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to:
 - **Power Mode Description and Operation**
 - **Retained Accessory Power Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Power Mode Mismatch](#)
- [Retained Accessory Power Malfunction](#)
- [Vehicle ON/OFF Switch Indicator Malfunction](#)
- [Vehicle Will Not Change Power Mode](#)

IGNITION CAN/CANNOT BE TURNED OFF WITH TRANSMISSION IN ANY GEAR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	2	1	-	-
Ground	-	1	-	-
1. Ignition will not turn to OFF with vehicle in park 2. Ignition will turn to OFF with vehicle out of park				

Circuit/System Description

The electronic park lock system purpose is to prevent the ignition from being switched to the OFF position when the transmission shift lever is in any position other than Park and the vehicle may still be moving. The electronic park lock system incorporates the park position switch that located in the shift lock control switch. When the transmission shift lever is in Park, the park position switch closes and the BCM allows the ignition to be turned OFF.

If the vehicle is not in Park, the ignition will turn to ACC/ACCESSORY and display the message SHIFT TO PARK in the Driver Information Center. When the vehicle is shifted into Park, the ignition system will switch to OFF.

Diagnostic Aids

Verify that the transmission shift selector indicator matches the position of the gear shift lever while selecting between the Park, Reverse, Drive and Low positions.

Reference Information

Schematic Reference

[Shift Lock Control Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Electronic Park Lock Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Body Control Module In Park Switch Status parameter changes between On and Off when shifting the S3 Transmission Shift Lever in and out of Park.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Body Control Module In Park Switch Status parameter is Off.
 - **If not Off**
 1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Off**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 2.
6. Verify the scan tool Body Control Module In Park Switch Status parameter is On.
 - **If not On**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control

Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
- **If On**
7. Test or replace the S3 Transmission Shift Lever.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Transmission Control Replacement \(With Base\)](#) [Transmission Control Replacement \(Without Base\)](#)
- [Control Module References](#) for the appropriate control module replacement, programming, and setup.

POWER MODE MISMATCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to the run/crank relay coil control circuit. The ignition main relay is energized when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing, no door is opened and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center.

The engine control module (ECM) controls the engine controls ignition relay by applying voltage to the engine controls relay control circuit.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Use schematics to determine which ignition relay supplies the ignition feed for the appropriate devices. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Vehicle in Service Mode.
2. Verify that the appropriate devices controlled by the KR73 Ignition Main Relay turn ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
 - **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic A.
 - **If the devices turn ON and OFF**
3. Verify that the appropriate devices controlled by the KR75 Engine Controls Ignition Relay turn ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
 - **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic B.
 - **If the devices turn ON and OFF**
4. Verify that the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
 - **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic C.
 - **If the devices turn ON and OFF**
5. All OK.

Circuit/System Testing

WARNING: High voltage enabling and disabling shall be only performed by High Voltage Qualified Technicians. The procedures for high voltage enabling/disabling can be found in the service instructions and must be strictly followed at all times. The usage of the Protocol High Voltage Disabling / Enabling is mandatory. The High Voltage Qualified Technician is responsible for the adherence to the manufacturer's service instructions as well as current national legal regulations.

Failure to follow the procedures exactly as written may result in serious injury or death.

Questions regarding training can be answered by your national training centre.

WARNING: Any hybrid/EV battery pack replacement shall be performed by High Voltage Qualified Technicians only. The replacement procedure can be found in the service instruction and must be strictly followed at all times. The High Voltage Qualified Technician is responsible for adherence to the manufacturer's service instructions as well as current national legal regulations. If the hybrid/EV battery pack needs to be replaced contact the Technical Assistance Centre for further instructions prior removal of the battery pack.

Diagnostic A

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR73 Ignition Main Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood
 - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 2 and the ground circuit terminal 1.
6. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance.
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 7. Verify that a test lamp does not illuminate between the ignition circuit terminal 5 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.
 - **If the test lamp does not illuminate**
 8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 3 and the ignition circuits listed below.
 - Ignition circuit terminal 4
 - Ignition circuit terminal 5
 9. Verify the device is activated.
 - **If the device does not activate**
 1. Vehicle OFF, disconnect the harness connector at the device.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the device.
 - **If the device activates**
 10. Test or replace the KR73 Ignition Main Relay.

Diagnostic B

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR75 Engine Controls Ignition Relay, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

- **If the test lamp does not illuminate**

Replace the X50A Fuse Block - Underhood

- **If the test lamp illuminates**

4. Connect a test lamp between the B+ circuit terminal 1 and the control circuit terminal 2.
5. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 engine control module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 engine control module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 engine control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 engine control module.

- **If the test lamp turns ON and OFF**

6. Verify that a test lamp does not illuminate between the ignition circuit terminal 5 and ground.

- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

7. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 3 and the ignition circuit terminal 5.
8. Verify device is activated.

- **If the device does not activate**

1. Vehicle OFF, disconnect the harness connector at the device.
2. Test for infinite resistance between the ignition circuit terminal 87 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the device.

- **If the device activates**

9. Test or replace the KR75 Engine Controls Ignition Relay.

Diagnostic C

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - **If the test lamp does not illuminate**

Replace the X51A Fuse Block - Instrument Panel

- **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
 6. Verify the test lamp turns ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.
 - **If the test lamp turns ON and OFF**
 7. Verify that a test lamp does not illuminate between the ignition circuit terminal 87 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the ignition circuit terminal 87.

9. Verify device is activated.

- **If the device does not activate**

1. Vehicle OFF, disconnect the harness connector at the device.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the device.

- **If the device activates**

10. Test or replace the KR76 Retained Accessory Power Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the appropriate relay.

2. Test for 70 - 150 Ω between terminals (85 or 1) and (86 or 2).

- **If less than 70 or greater than 150 Ω**

Replace the relay.

- **If between 70 - 150 Ω**

3. Test for infinite resistance between the terminals listed below:

- (30 or 3) and (86 or 2)

- (30 or 3) and (87 or 5)

- (30 or 3) and (85 or 1)

- (85 or 1) and (87 or 5)

- (86 or 2) and (87 or 5)

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.

5. Test for less than 5.0 Ω between terminals (30 or 3) and (87 or 5).

- **If 5.0 Ω or greater**

Replace the relay.

- **If less than 5.0 Ω**

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Module References](#) for control module replacement, programming and setup.

RETAINED ACCESSORY POWER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Switch B+	1	1	1	-
Relay Switch Ignition	1	1	1, 2	-
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-
Relay Coil Ground	-	B305E 05	-	-
Ground	-	1	-	-
1. Retained accessory power malfunction 2. Retained accessory power relay always ON				

Circuit/System Description

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing, no door is opened and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Retained Accessory Power Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Relay Replacement \(Attached to Wire Harness\) Relay Replacement \(Within an Electrical Center\)](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Use schematics to determine which devices are controlled by the KR76 Retained Accessory Power Relay. Use the connector end view to identify the ignition circuit terminal for each of those devices.

1. Ignition ON.
2. Verify the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.

- **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing

- **If the devices turn ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

- **If the test lamp does not illuminate**

Replace the X51A Fuse Block - Instrument Panel

- **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.

6. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in

Service Mode and Vehicle OFF with the door open.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the ignition circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If the test lamp turns ON and OFF**

7. Connect the KR76 Retained Accessory Power Relay.
 8. Disconnect the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.
 9. Vehicle OFF.
 10. Verify that a test lamp does not illuminate between each of the ignition circuits listed below and ground.
 - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
 - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A
 - T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1
- **If the test lamp illuminates**

Repair the short to voltage on the ignition circuit.

- **If the test lamp does not illuminate**

11. Vehicle in Service Mode.
 12. Verify that a test lamp illuminates between each of the ignition circuits listed below and ground.
 - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
 - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A
 - T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1
- **If the test lamp does not illuminate and the circuit breaker or fuse is good**
1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the K84 Keyless Entry Control Module.
- **If the test lamp does not illuminate and the circuit breaker or fuse is open**
1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.

• **If the test lamp illuminates**

13. Test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR76 Retained Accessory Power Relay.

2. Test for 70 - 150 Ω between terminals 85 and 86.

- **If less than 70 or greater than 150 Ω**

Replace the relay.

- **If between 70 - 150 Ω**

3. Test for infinite resistance between the following terminals:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Test for less than 5.0 Ω between terminals 30 and 87.

- **If 5.0 Ω or greater**

Replace the relay.

- **If less than 5.0 Ω**

5. Install a 3 A fused jumper wire between relay terminal 41 and 12 V. Install a jumper wire between relay terminal 40 and ground.

6. Test for less than 5.0 Ω between terminals 30 and 87.

- **If 5.0 Ω or greater**

Replace the relay.

- **If less than 5.0 Ω**

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Accessory Power Receptacle Replacement](#)
- [Control Module References](#) for control module replacement, programming and setup.

VEHICLE ON/OFF SWITCH INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B097C 02	2	1	-
Ground	-	2	-	-
1. Vehicle ON/OFF switch indicator always ON 2. Vehicle ON/OFF switch indicator inoperative				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicates the vehicle power mode. When the vehicle is in the OFF mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for at least 5 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch.

Reference Information

Schematic Reference

[Power Moding Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Power Mode Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify the blue LED illuminates when the S83 Vehicle ON/OFF Switch is pressed and held for at least 5 s, with the brake pedal released.

- **If the blue LED does not illuminate**

Refer to Circuit/System Testing.

- **If the blue LED illuminates**

2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Test for less than 1 V between the control circuit terminal 5 and ground.

- **If 1 V or greater**

1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V

3. Test for less than 2 Ω in control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

4. Vehicle OFF, connect the harness connector at the S83 Vehicle ON/OFF Switch.
5. Vehicle in Service Mode, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

6. Verify a test lamp illuminates between the control circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
7. Test or replace the S83 Vehicle ON/OFF Switch.

Component Testing

1. Vehicle OFF, disconnect the harness at the S83 Vehicle ON/OFF Switch.
2. Connect a jumper wire between the S83 Vehicle ON/OFF Switch terminal 4 and ground.
3. Connect a 3 A fused jumper wire between the S83 Vehicle ON/OFF Switch terminal 5 and B+.
4. Verify the blue LED illuminates.
 - **If the LED does not illuminate**

Replace the S83 vehicle ON/OFF switch.
 - **If the LED illuminates**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition and Start Switch Replacement](#)
- [Control Module References](#) for the body control module replacement, programming and setup.

VEHICLE WILL NOT CHANGE POWER MODE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 05*	2	-
Low Reference	-	B097B 05*	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground	-	1	-	-
1. Vehicle ON/OFF Switch Indicator Always Off 2. Power Mode Mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains 2 individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through 2 resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Reference Information

Schematic Reference

- [Power Distribution Schematics](#)
- [Power Moding Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Power Mode Description and Operation](#)
- [Keyless Entry System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B097B 08 or B097B 61 is not set.
 - **If either DTC is set**

Test or replace the S83 Vehicle On/Off Switch.
 - **If the DTCs are not set**
2. Verify the blue LED illuminates when the S83 Vehicle On/Off Switch is pressed and held for up to 10 s, with the brake pedal released.
 - **If the blue LED does not illuminate**

Refer to Circuit/System Testing.
 - **If the blue LED illuminates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
 - **If 10 Ω or greater**
 1. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K84 Keyless Entry Control Module.
 - **If less than 10 Ω**
4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.
5. Disconnect the S83 Vehicle On/Off Switch.
6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
 - **If 11 V or less**
 1. Connect the S83 Vehicle On/Off Switch.
 2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.
 3. Test for infinite resistance between the signal circuit terminal 6 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If greater than 11 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.

8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.

- **If 1 V or greater**

1. Disconnect the harness connector at the K9 Body Control Module.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If less than 1 V**

9. Connect the harness connector at the S83 Vehicle On/Off Switch.

10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.

- **If not between 8 - 10 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 8 - 10 V**

11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V, with the S83 Vehicle On/Off Switch pressed.

- **If not between 4 - 7 V**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 4 - 7 V**

12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.

13. Test for infinite resistance between the signal circuit terminal 11 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

14. Vehicle in Service Mode.

15. Test for less than 1 V between the signal circuit terminal 11 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with

the S83 Vehicle On/Off Switch released.

- **If not between 4.5 - 5.5 k Ω**

1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.
2. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , test or replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.

- **If not between 1 - 1.5 k Ω**

Test or replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

18. Replace the K84 Keyless Entry Control Module.

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 vehicle ON/OFF switch.
2. With the S83 vehicle ON/OFF switch released, test for 4.5 - 5.5 k Ω between the terminal listed below:
 - Signal terminal 6 and ground terminal 4
 - Signal terminal 3 and low reference terminal 7
 - **If not between 4.5 - 5.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 4.5 - 5.5 k Ω**

3. With the S83 Vehicle On/Off Switch pressed, test for 1 - 1.5k Ω between the terminals listed below:
 - Signal terminal 6 and ground terminal 4
 - Signal terminal 3 and low reference terminal 7
 - **If not between 1 - 1.5 k Ω**

Replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition and Start Switch Replacement**
- **Control Module References** for the appropriate control module replacement, programming and setup.

GENERAL ELECTRICAL DIAGNOSIS

Basic Knowledge Required

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in the service manual. You should understand the basic theory of electricity, and know the meaning of voltage (V), current (A), and resistance (Ω). You should also be able to read and understand a wiring diagram, as well as understand what happens in a circuit with an open or a shorted wire.

CHECKING AFTERMARKET ACCESSORIES

WARNING: Refer to [SIR Warning](#) .

Do not connect aftermarket accessories into the SIR circuits, all such circuits are indicated on circuit diagrams with the SIR symbol.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery
- Antenna location
- Transceiver wiring located too close to vehicle electronic modules or wiring
- Poor shielding or poor connectors on antenna feed line
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

CIRCUIT TESTING

The Circuit Testing section contains the following diagnostic testing information. Using this information along with the diagnostic procedures will identify the cause of the electrical malfunction.

- [Using Connector Test Adapters](#)
- [Probing Electrical Connectors](#)
- [Troubleshooting with a Digital Multimeter](#)
- [Troubleshooting with a Test Lamp](#)
- [Using Fused Jumper Wires](#)
- [Measuring Voltage](#)
- [Measuring Voltage Drop](#)
- [Measuring Frequency](#)
- [Testing Ground and Low Reference Circuits](#)
- [Testing for Continuity](#)
- [Testing for Short to Ground](#)
- [Testing for a Short to Voltage](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Inducing Intermittent Fault Conditions](#)
- [Testing for Electrical Intermittents](#)
- [Scan Tool Snapshot Procedure](#)

- [Circuit Protection - Fuses](#)
- [Circuit Protection - Circuit Breakers](#)
- [Circuit Protection - Fusible Links](#)

USING CONNECTOR TEST ADAPTERS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the J-35616-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the J-35616-F GM Approved Terminal Release Tool Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

PROBING ELECTRICAL CONNECTORS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: Always be sure to reinstall the connector position assurance (CPA) and terminal position assurance (TPA) when reconnecting connectors or replacing terminals.

Front probe

Disconnect the connector and probe the terminals from the mating side (front) of the connector.

CAUTION: Refer to [Test Probe Caution](#) .

NOTE: When probing female 0.64 terminals, it is important to use the correct adapter. There have been some revisions to the test adapter for 0.64 terminals. The proper adapter for 0.64 terminals is the J-35616-64B which has a gold terminal and a black wire between the base and tip. Failure to use the proper test adapter may result in damage to the terminal being tested and improper diagnosis.

NOTE: The proper adapter for probing the terminals for fuses, relays, or diodes in an electrical center is J-35616-35. Using any other tool or adapter may damage the terminal being tested.

Refer to the following table as a guide in selecting the correct test adapter for front probing connectors:

Test Adapter	Description
J-35616-2A	150 Male Probe Adapter (gray)
J-35616-3	150 Female Probe Adapter (gray)
J-35616-4A	280 Male Probe Adapter (purple)
J-35616-5	280 Female Probe Adapter (purple)
J-35616-6	100W Male (round) Probe Adapter (brown)
J-35616-7	100W Female (round) Probe Adapter (brown)
J-35616-8	Weather Pack Male Probe Adapter (orange)
J-35616-9	Weather Pack Female Probe Adapter (orange)
J-35616-10	100W Male (round) Probe Adapter (green)
J-35616-11	100W Female (round) Probe Adapter (green)
J-35616-12	130 Male Probe Adapter (blue)
J-35616-13	130 Female Probe Adapter (blue)
J-35616-14	150 Male Probe Adapter (green)
J-35616-16	100 Male Probe Adapter (lt green)
J-35616-17	100 Female Probe Adapter (lt green)
J-35616-18	220 Male Probe Adapter (black)
J-35616-19	220 Female Probe Adapter (black)
J-35616-21	950 Female Probe Adapter (red)
J-35616-22	950 Male Probe Adapter (red)
J-35616-31	500 Male Probe Adapter (orange)
J-35616-32	500 Female Probe Adapter (orange)
J-35616-33	160/180 Male Probe Adapter (yellow)
J-35616-34	160/180 Female Probe Adapter (yellow)
J-35616-35	280 Male Probe Adapter (violet)
J-35616-40	480 Male Probe Adapter (dk blue)
J-35616-41	480 Female Probe Adapter (dk blue)
J-35616-42	630 Male Probe Adapter (red)
J-35616-43	630 Female Probe Adapter (red)
J-35616-44	800 Male Probe Adapter (yellow)
J-35616-45	800 Female Probe Adapter (yellow)
J-35616-54	280 Male (round) Probe Adapter (tan)
J-35616-55	280 Female (round) Probe Adapter (tan)

Test Adapter	Description
J-35616-64B	0.64 Male Probe Adapter (lt blue)
J-35616-65B	0.64 Female Probe Adapter (lt blue)
J-35616-66	150 Male (round) Probe Adapter (yellow)
J-35616-67	150 Female (round) Probe Adapter (yellow)

Backprobe

NOTE:

- Backprobe connector terminals only when specifically required in diagnostic procedures.
- Do not backprobe a sealed (Weather Pack®) connector, less than a 280 series Metri-Pack connector, a Micro-Pack connector, or a flat wire connector.
- Backprobing can be a source of damage to connector terminals. Use care in order to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large of a test probe.
- After backprobing any connector, inspect for terminal damage. If terminal damage is suspected, test for proper terminal contact.

Do not disconnect the connector and probe the terminals from the harness side (back) of the connector.

TROUBLESHOOTING WITH A DIGITAL MULTIMETER

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

Digital Multimeter (DMM) Basic Requirements

Service information is validated using digital multimeters that meet or exceed the following requirements. Using a multimeter that does not meet these basic requirements may give inaccurate readings which could lead to an incorrect diagnosis.

Display and Settings

1. Four digits displayed
2. Voltage, current, resistance, frequency, diode test settings, and min-max function
3. Display positive and negative values

Voltage

1. Have at least 10 M Ω input impedance
2. Test a DC voltage range of 0.1 - 1000 V.
3. Test an AC voltage range of 0.1 - 1000 V.

Current

1. Test a DC current range of 0.1 μ A - 10 A.
2. Test an AC current range of 0.1 μ A - 10 A.

Resistance

Test a resistance range of 0.1 Ω - 40 M Ω and displays infinite for a value greater than 40 M Ω (O.L. (Over-load))

Frequency

Test for a frequency range of 0.5 HZ - 199 K HZ

Diode Test

1. Apply at least 2 mA when performing the diode bias test
2. Display the break over voltage drop (0 - 3 V) of a forward biased diode
3. Display infinite (O.L. (Over-load)) when a diode is reverse biased

Min-Max Readings

1. Can update at a 25 ms sample rate
2. Saves and displays minimum and maximum values

NOTE: **Circuits which include any solid state control modules, such as the engine control module (ECM), should only be tested with a 10 megohm or higher impedance digital multimeter such as the EL-39200.**

The DMM instruction manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for future reference.

A DMM should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The ohmmeter function on a DMM shows how much resistance exists between 2 points along a circuit. Low resistance in a circuit means good continuity.

NOTE: **Disconnect the power feed from the suspect circuit when measuring resistance with a DMM. This prevents incorrect readings. DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.**

Diodes and solid state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement take a reading once, then reverse the leads and take a second reading. If

the readings differ the solid state component is affecting the measurement.

Following are examples of the various methods of connecting the DMM to the circuit to be tested:

- Probe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test driving. Refer to [Probing Electrical Connectors](#).
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.
- If the system that is being diagnosed has a specified pinout or breakout box, it may be used in order to simplify connecting the DMM to the circuit or for testing multiple circuits quickly.

TROUBLESHOOTING WITH A TEST LAMP

Special Tools

EL-35616-200 Test Light - Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

A test lamp can simply and quickly test a low impedance circuit for voltage. A digital multimeter (DMM) should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The **EL-35616-200** kit is Micro-Pack compatible and comprised of a 12 V light bulb with an attached pair of leads.

To properly operate this tool use the following procedures.

When testing for voltage:

1. Attach one lead to ground.
2. Touch the other lead to various points along the circuit where voltage should be present.
3. When the bulb illuminates, there is voltage at the point being tested.

When testing for ground:

1. Attach one lead to battery positive voltage.
2. Touch the other lead to various points along the circuit where ground should be present.
3. When the bulb illuminates, there is ground at the point being tested.

USING FUSED JUMPER WIRES

Special Tools

EL 35616-20F Fused Jumper Wire

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: A fused jumper may not protect solid state components from being damaged.

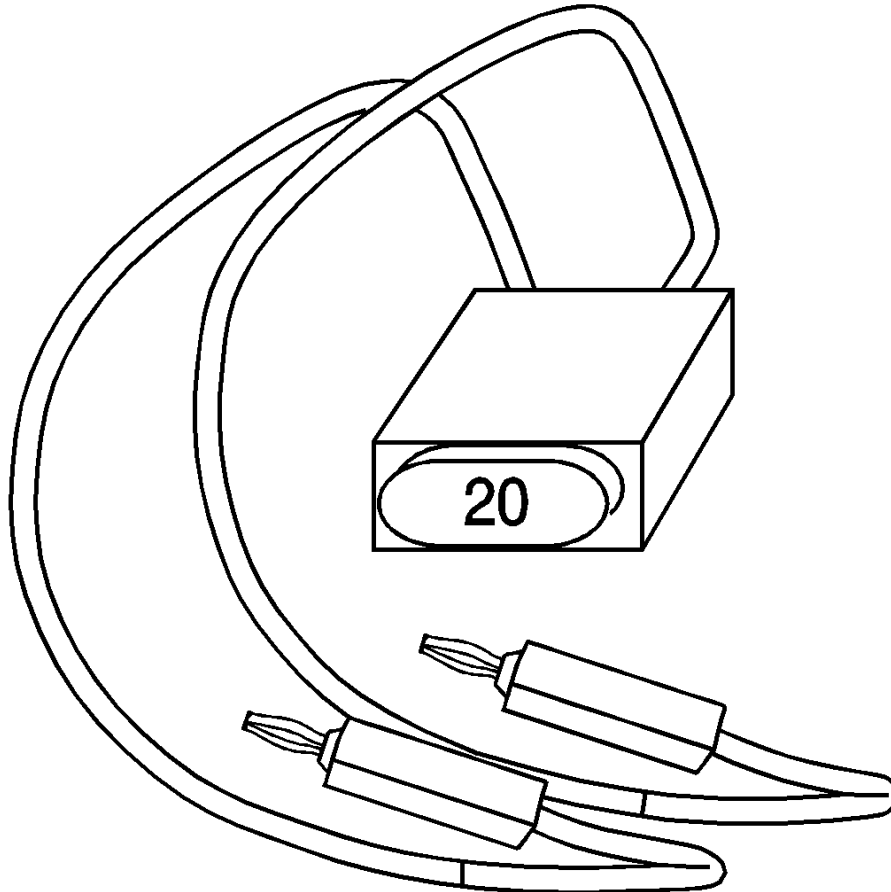


Fig. 1: Fused Jumper Wire

Courtesy of GENERAL MOTORS COMPANY

The EL 35616-20F Fused Jumper Wire includes banana jack connectors that provide adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

MEASURING VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure measures the voltage at a selected point in a circuit.

1. Disconnect the electrical harness connector for the circuit being tested, if necessary.
2. Enable the circuit and/or system being tested. Use the following methods:
 - Vehicle power mode to Vehicle in Service Mode or Vehicle On.
 - Turn ON the circuit and/or system with a scan tool in Output Controls.
 - Turn ON the switch for the circuit and/or system being tested.
3. Select the V (AC) or V (DC) position on the digital multimeter (DMM).
4. Connect the positive lead of the DMM to the point of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. The DMM displays the voltage measured at that point.

MEASURING VOLTAGE DROP

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure determines the difference in voltage potential between 2 points.

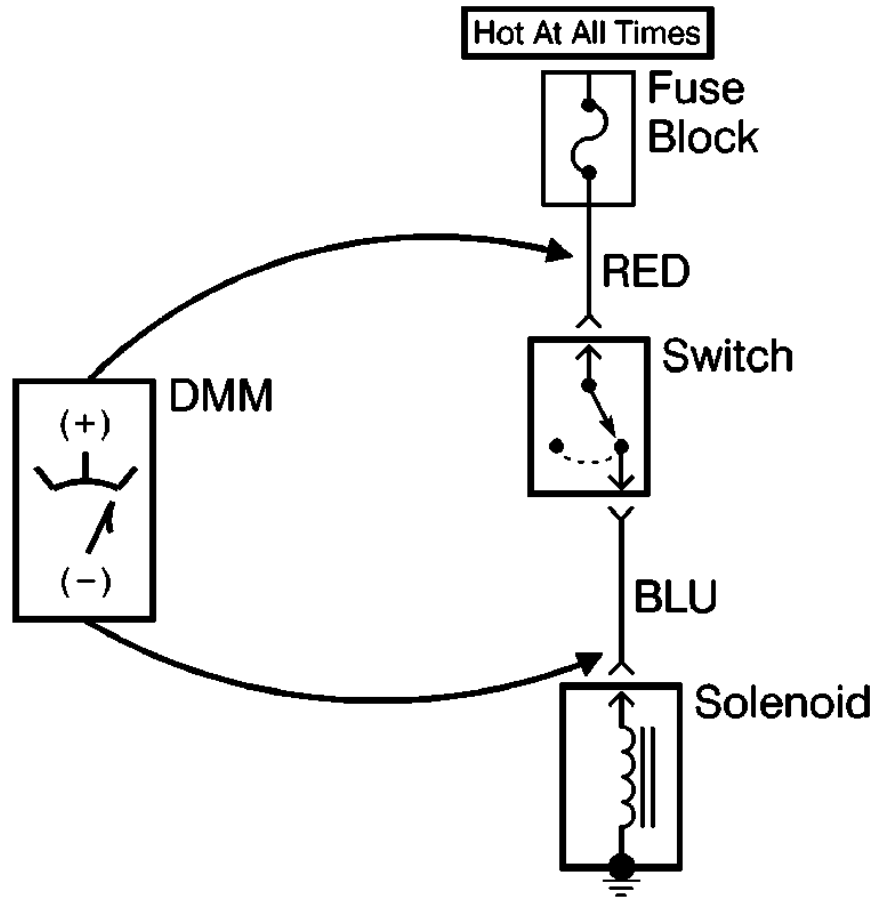


Fig. 2: Measuring Voltage Drop

Courtesy of GENERAL MOTORS COMPANY

1. Set the Digital Multimeter (DMM) to the V (DC) position.
2. Connect the positive lead of the DMM to one point of the circuit to be tested.
3. Connect the negative lead of the DMM to the other point of the circuit.
4. Operate the circuit.
5. The DMM displays the difference in voltage between the 2 points.

MEASURING FREQUENCY

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure determines the frequency of a signal.

NOTE: **Connecting the Digital Multimeter (DMM) to the circuit before pressing the Hz button will allow the DMM to autorange to an appropriate range.**

1. Apply power to the circuit.
2. Set the DMM to the V (AC) position.
3. Connect the positive lead of the DMM to the circuit to be tested.
4. Connect the negative lead of the DMM to a good ground.
5. Set to Hz on the DMM.
6. The DMM will display the frequency measured.

TESTING GROUND AND LOW REFERENCE CIRCUITS

Because a test lamp can light with up to 200 Ω in a ground or low reference circuit they are not recommended to be used for this type of test. A low impedance test lamp can light and indicate the circuit is good when there is as much as 20 - 30 Ω present, while a high impedance test lamp can light with up to 200 Ω present in the circuit. This is why the Digital Multi-Meter (DMM) is used when validating a ground or low reference circuit continuity.

When using the DMM there are many vehicle conditions that can affect the ground and low reference continuity testing. If these conditions are not met, a ground or low reference circuit test can fail on a good circuit. This may cause longer diagnosis time and incorrect component replacement.

Any current flow through a ground or low reference circuit, while being tested, will skew the DMM continuity reading, or display a reading higher than when there is no current flowing. Performing a ground or low reference circuit continuity test, in reference to the vehicles battery negative terminal, will have the highest risk of failing a good ground or low reference circuit test than any other ground reference point. The best ground test points would be a control module housing (if the control modules housing is metal and grounded), door jamb striker (if attached to metal), under dash metal frame work, engine block, or body ground studs (other than where the negative battery cable is attached).

A typical DMM ground or low reference circuit continuity reading can be as high as 100 Ω with the vehicle power mode in Vehicle ON or Vehicle in Service Mode, and drop to 15 - 25 Ω after switching the vehicle off. The reading will drop below 10 Ω after 30 - 40 s, then below 5 Ω after 60 s. Once the vehicle completely goes to sleep (generally 3-10 min) the reading will drop below 0.3 Ω .

The following list of conditions may need to be met to ensure a valid continuity reading on a ground or low reference circuit:

- Vehicle off
- Transmitter out of range of the vehicle
- Retained Accessory Power off (open and close the driver door after vehicle off)
- Battery charger set at a 2 A or less charge rate
- Scan tool not communicating with any vehicle control module (in some cases it may need to be disconnected from the DLC)
- All entry doors closed
- Headlamps off(auto headlamps disabled)
- Any delay lighting off

- HVAC after blow off
- Any accessory that can work when the vehicle power mode is Vehicle OFF
- Wait up to 60 s (after all other listed conditions are met)

Locking the doors with a remote transmitter can greatly reduce the time to achieve a valid ground or low reference continuity test result.

There are some low reference circuits that use a driver to isolate the circuit while the ignition is off. This is done in most cases for accidental reverse battery connections or reverse polarity jump starting. When this driver is present, the ignition will need to be on to validate the circuit.

TESTING FOR CONTINUITY

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#).

The following procedures verify good continuity in a circuit.

With a Digital Multimeter (DMM)

1. Set the DMM to the Ω position.
2. Disconnect the power feed (i.e. fuse, control module) from the suspect circuit.
3. Disconnect the load.
4. Select the MIN MAX function on the DMM.
5. Connect one lead of the DMM to one end of the circuit to be tested.
6. Connect the other lead of the DMM to the other end of the circuit.
7. If the DMM displays low or no resistance, the circuit has good continuity.

With a Test Lamp

NOTE: Only use the test lamp procedure on low impedance power and ground circuits.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.
6. If the test lamp illuminates (full intensity), then the circuit has good continuity.

TESTING FOR SHORT TO GROUND

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedures test for a short to ground in a circuit.

With a Digital Multimeter (DMM)

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the DMM to the Ω position.
4. Connect one lead of the DMM to one end of the circuit to be tested.
5. Connect the other lead of the DMM to a good ground.
6. If the DMM does NOT display infinite resistance (OL), there is a short to ground in the circuit.

With a Test Lamp

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to battery positive voltage.
4. Connect the other lead of the test lamp to one end of the circuit to be tested.
5. If the test lamp illuminates, there is a short to ground in the circuit.

Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
 - When the DMM displays voltage the short is in the wiring leading to the first connector or switch.
 - If the DMM does not display voltage refer to the next step.
4. Close each connector or switch until the DMM displays voltage in order to find which circuit is shorted.

TESTING FOR A SHORT TO VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

CAUTION: Refer to [Test Probe Caution](#) .

The following procedure tests for a short to voltage in a circuit.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.

2. Disconnect the load.
3. Set the digital multimeter (DMM) to the V (DC) position.
4. Connect the positive lead of the DMM to one end of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. Switch the vehicle power mode to Vehicle in Service Mode and operate all accessories.
7. If the voltage measured is greater than 1 V, there is a short to voltage in the circuit.

TESTING FOR INTERMITTENT CONDITIONS AND POOR CONNECTIONS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the

connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers (BEC)

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center (BEC). Use **EL-35616** kit to test for proper terminal contact. Failure to use **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the

connector as oil from your skin may be a source of contamination as well.

3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter from the on the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#), and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#), and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference (EMI) or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator, etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#).
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

INDUCING INTERMITTENT FAULT CONDITIONS

Special Tools

EL-25070 Heat Gun

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves at all times when working with the high**

voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, torque, bumps/rough pavement, etc. In order to duplicate the customer's concern, it may be necessary to manipulate the wiring harness if the malfunction appears to be vibration related. Manipulation of a circuit can consist of a wide variety of actions, including:

- Wiggling the harness
- Disconnecting a connector and reconnecting
- Stressing the mechanical connection of a connector
- Pulling on the harness or wire in order to identify a separation/break inside the insulation
- Relocating a harness or wires

All these actions should be performed with some goal in mind. For instance, with a scan tool connected, wiggling the wires may uncover a faulty input to the control module. The snapshot option would be appropriate here. Refer to [Scan Tool Snapshot Procedure](#). Another option is, with the component commanded ON and OFF by the scan tool, to move related connectors and wiring and observe the component operation. With the vehicle ON, move related connectors and wiring while monitoring vehicle operation. If harness or connector movement affects the data displayed, component/system operation, or vehicle operation, inspect and repair the harness/connections as necessary.

You may need to load the vehicle in order to duplicate the concern. This may require the use of weights, floor jacks, jackstands, frame machines, etc. In these cases you are attempting to duplicate the concern by manipulating the suspension or frame. This method is useful in finding harnesses that are too short and their connectors pull apart enough to cause a poor connection. A DMM set to the Min/Max mode and connected to the suspect circuit while testing can yield desirable results. Refer to [Testing for Electrical Intermittents](#).

Certainly, using the senses of sight, smell, and hearing while manipulating the circuit can provide good results as well.

There may be instances where circuit manipulation alone will not meet the required criteria for the fault condition to appear. In such cases it may be necessary to expose the suspect circuit to other conditions while manipulating the harness. Such conditions would include high moisture conditions, along with exceptionally high or low temperatures. The following discusses how to expose the circuit to these kinds of conditions.

High Temperature Conditions

If the complaint tends to be heat related, you can simulate the condition using the **EL-25070** heat gun.

Using the heat gun, you can heat up the suspected area or component. Manipulate the harnesses under high temperature conditions while monitoring the scan tool or DMM to locate the fault condition.

The high temperature condition may be achieved simply by test driving the vehicle at normal operating temperature. If a heat gun is unavailable, consider this option to enhance your diagnosis. This option does not allow for the same control, however.

Low Temperature Conditions

Depending on the nature of the fault condition, placing a fan in front of the vehicle while the vehicle is in the

shade can have the desired effect.

If this is unsuccessful, use local cooling treatments such as ice or a venturi type nozzle (one that provides hot or cold air). This type of tool is capable of producing air stream temperatures down to -18°C (0°F) from one end and $+71^{\circ}\text{C}$ (160°F) from the other. This is ideally suited for localized cooling needs. In addition, circuit cooling spray can be used to cool down a component or circuit.

Once the vehicle, component, or harness has been sufficiently cooled, manipulate the harness or components in an effort to duplicate the concern.

Duplicating Failure Conditions

- If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions.
- Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set.
 1. Review and record Freeze Frame/Failure Records data.
 2. Clear the DTCs using the scan tool.
 3. Switch the vehicle power mode to Vehicle Off and wait 15 seconds.
 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text if a DTC is being diagnosed.
 5. Monitor DTC Status for the DTC being tested. The scan tool will indicate Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed.
- An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the concern occurs, may help you locate the concern.

TESTING FOR ELECTRICAL INTERMITTENTS

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.

Perform the following procedures while wiggling the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test equipment.

- [Testing for Short to Ground](#)
- [Testing for Continuity](#)
- [Testing for a Short to Voltage](#)

If the fault is not identified, perform the procedure below using the MIN MAX feature on the **EL-39200** DMM. This feature allows you to manipulate the circuit without having to watch the DMM. The DMM will generate an audible tone when a change is detected.

NOTE: The DMM must be used in order to perform the following procedure since the DMM can monitor current, resistance or voltage while recording the minimum (MIN), and maximum (MAX) values measured.

1. Connect the DMM to both sides of a suspected connector (still connected), or from one end of a suspected circuit to the other. Refer to [Troubleshooting with a Digital Multimeter](#) for information on connecting the DMM to the circuit.
2. Set the rotary dial of the DMM to the V (AC) or V (DC) position.
3. Press the range button of the DMM in order to select the desired voltage range.

NOTE: The 100 ms RECORD mode is the length of time an input must stay at a new value in order to record the full change.

4. Select the MIN MAX function of the DMM. The DMM displays the 100 ms RECORD and emits an audible tone (beep).
5. Simulate the condition that is potentially causing the intermittent connection, either by wiggling the connections or the wiring, test driving, or performing other operations. Refer to [Inducing Intermittent Fault Conditions](#).
6. Listen for the audible Min Max Alert which indicates that a new minimum or maximum value has been recorded.
7. Press the MIN MAX button until the MAX value is displayed and note the value.
8. Press the MIN MAX button until the MIN value is displayed and note the value.
9. Determine the difference between the MIN and MAX values.
 - If the variation between the recorded MIN and MAX voltage values is 1 V or greater an intermittent open or high resistance condition exists. Repair the condition as necessary.
 - If the variation between the recorded MIN and MAX voltage values is less than 1 V an intermittent open or high resistance condition does not exist.

SCAN TOOL SNAPSHOT PROCEDURE

Reviewing Stored Data in Global Diagnostic System (GDS)

Overview

A snapshot is a recording of what a control module on the vehicle was receiving for information while the snapshot is being made. A snapshot is used to analyze the data during the time a vehicle condition is current. In GDS 2 there is not a traditional snapshot as there has been in the past. GDS 2 saves all past VIN and diagnostic data for future viewing. GDS 2 automatically records data whenever the user views Module Diagnostics, Vehicle Diagnostics and/or Systems Diagnostics. Module Diagnostics includes DTC Data, Identification Information, Data Display, Control Functions and Configuration/Reset Functions. Vehicle Diagnostics includes Vehicle Wide DTCs. Systems Diagnostics includes Inspection/Maintenance Status and Inspection/Maintenance Information.

Reviewing Stored Data

The Review Stored Data function allows viewing and playing of previously recorded vehicle data. This information can be used in analysis of vehicle problems and detection of trigger error conditions. The graph function can be used to compare multiple parameters to see if a component is functioning properly. Recorded sessions can be selected for viewing by the following two methods:

- From the Home Page, click on Review Stored Data. In the Review Stored Data page, highlight a vehicle in the Sessions screen located in the upper pane and highlight the desired Stored Data in the lower pane, then click the Review button.
- The user can view stored data without ending a current on-vehicle diagnostic session by clicking the Vehicle Menu button (when active) or Back button until the Session Manager is displayed in the menu. This is used when a user is viewing live data and wants the quickest way to review the data. Click on the Session Manager button. Highlight the desired Stored Data in the lower pane and click the Review button.

Stored Data Review Selections

The following information can be selected in the tabs at the top of the screen:

- Graphical Data Display - Allows a detailed review of parameter data. The buttons on the right side modify the graph data
- Diagnostic Data Display - Displays incoming information from the file. The current value of the parameters is displayed on the screen.
- Line Graph - Allows selected locked parameters to be graphed with parameters overlaid for data comparison. The current value of the parameters is displayed on the screen. Use the buttons on the right side to modify the graph data.
- Bookmarks - If bookmarks are present, this displays the Type, Description and Time of automatic and manually generated bookmarks.
- System Information - Displays the GDS 2 Software Version and MDI Serial Number used when the session was recorded.
- Selected Vehicle Configuration - Displays vehicle identifiers, such as transmission type, for the vehicle selected on the Stored Data Review screen in the Sessions field.
- RPO - Displays vehicle build information.

Graphical Data Display

On the Graphical Data Display tab there are multiple selections at the top of the page. The selections available are:

- Create Report - Opens an internet browser page where a data display report can be printed or saved for future reference.
- Unit Switch - Toggles graph units between English and metric.
- Lock - When a parameter is selected, clicking the lock button locks a selected parameter for viewing in the Line Graph tab. In the Line Graph tab, locked parameters are isolated and overlaid for data comparison.
- Up Arrow - Click the up arrow to move a highlighted parameter up a position on the list.
- Down Arrow - Click the down arrow to move a highlighted parameter down a position on the list.
- Save As - This selection is available in the Graphical Data Display and Diagnostic Data Display tabs. This allows the user to export the graph data to a worksheet for in depth analysis and to timestamp data.

Review Stored Data Functions

To review the session there are buttons at the bottom of the window to control the cursor. From left to right the buttons are:

- Insert Bookmark - This button allows the user to insert bookmarks anywhere along the timeline. This

provision allows the user to record notes regarding the inserted bookmark.

- Return Bookmark - This button moves the cursor to the previous bookmark.
- Back - This button moves the cursor back 1 frame.
- Timeline Slider Control - This allows the user to slide and select any position on the Timeline required.
- Forward - This button moves the cursor forward 1 frame.
- Forward Bookmark - This button moves the cursor forward 1 bookmark.
- Bookmarks - Allows the user to toggle bookmark visibility ON and OFF.

Graphical Preference Selections

The vertical side bar on the right side of the screen in the Graphical Data Display and Line Graph tabs toggles the Graphical Selection Panel from hidden to visible. The graphical preference selections available are:

- Reset - Resets the graph display back to the initial standard GDS 2 setting.
- Grid Line Toggle - This toggle reverses the current state of showing or removing grid lines.
- Hash Mark Toggle - This toggle reverses the current state of showing or removing data acquisition points or hash marks.
- Horizontal Graph Compression - Compresses the scale of the graph horizontally.
- Horizontal Graph Expansion - Expands the scale of the graph horizontally.
- Vertical Graph Compression - Compresses the scale of the graph vertically.
- Vertical Graph Expansion - Expands the scale of the graph vertically.
- Move Centerline of Graph Up - Moves the centerline of the graph up incrementally.
- Move Centerline of Graph Down - Moves the centerline of the graph down incrementally.

CIRCUIT PROTECTION - FUSES

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to [Special Tools](#) .

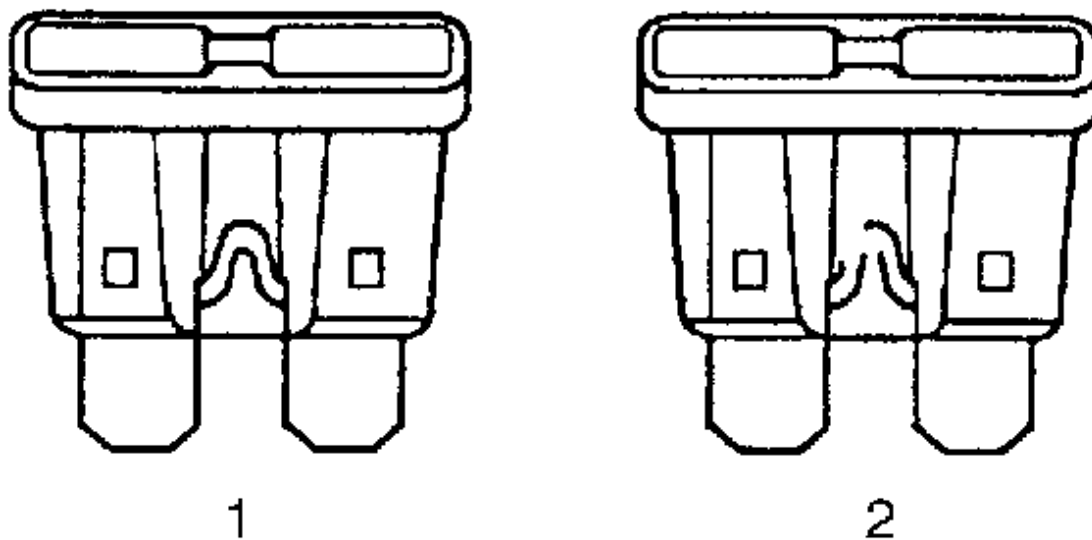


Fig. 3: Identifying Open Fuse Element
 Courtesy of GENERAL MOTORS COMPANY

The fuse is the most common method of an automotive wiring circuit protection. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a one time protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is open, remove the suspected fuse and examine if the element in the fuse is broken (2). If not broken (1), also check for continuity using a Digital Multimeter (DMM) or a continuity tester. If the element is broken or continuity is suspect, replace the fuse with one of equal current rating.

Fuse Types

Current Rating Amperes	Color
Auto Fuses, Mini Fuses	
2	Gray
3	Violet
5	Tan
7.5	Brown

Current Rating Amperes	Color
10	Red
15	Blue
20	Yellow
25	White or Natural
30	Green
Maxi Fuses	
20	Yellow
30	Light Green
40	Orange or Amber
60	Blue
50	Red
J-Case Fuses	
20	Blue
30	Pink
40	Green
50	Red
60	Yellow
Midi Fuses	
80	Black
Mega Fuses	
100	Black
150	Black
200	Black

CIRCUIT PROTECTION - CIRCUIT BREAKERS

A circuit breaker is a protective device that is designed to open the circuit when a current load is in excess of the rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. Two types of circuit breakers are used.

Circuit Breaker

This type opens when excessive current passes through it for a period of time. It closes again after a few seconds, and if the cause of the high current is still present, it will open again. The circuit breaker will continue to cycle open and closed until the condition causing the high current is removed.

Positive Temperature Coefficient (PTC) Circuit Breaker

This type greatly increases its resistance when excessive current passes through it. The excessive current heats the PTC device, as the device heats its resistance increases. Eventually the resistance gets so high that the circuit is effectively open. Unlike the ordinary circuit breaker the PTC unit will not reset until the circuit is opened, by removing the voltage from its terminals. Once the voltage is removed the circuit breaker will re-close within a second or 2.

CIRCUIT PROTECTION - FUSIBLE LINKS

Special Tools

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: When repairing a fusible link, fusible links cut longer than 225 mm (approximately 9 in) will not provide sufficient overload protection.

Fusible link is wire designed to melt and break continuity when excessive current is applied. It is often located between or near the battery and starter or electrical center. Use a continuity tester or a Digital Multimeter (DMM) at each end of the wire containing the fusible link in order to determine if it is broken. If broken, it must be replaced with fusible link of the same gauge size.

WIRING REPAIRS

The Wiring Repairs section contains the following types of wiring repair information. Using these elements together will make wiring repair faster and easier:

- [Flat Wire Repairs](#)
- [Serial Data Circuit Wiring Repairs](#)
- [High Temperature Wiring Repairs](#)
- [Heated Oxygen Sensor Wiring Repairs](#)
- [Wire to Wire Repair](#)
- [Splicing Inline Harness Diodes](#)
- [Splicing Twisted or Shielded Cable](#)
- [SIR/SRS Wiring Repairs](#)

CONNECTOR REPAIRS

Connector Repairs contains a list of all connector repairs. The connector repairs are listed by the connector manufacturer and then by connector type. If the technician cannot identify the manufacturer of the connector, refer to Identifying Connectors below. Knowing the connector manufacturer will assist in finding the correct connector repair from the following list:

- [Connector Position Assurance Locks](#)
- [Terminal Position Assurance Locks](#)
- [AFL/EPC Connectors](#)
- [Bosch Connectors \(BSK\)](#) [Bosch Connectors \(0.64\)](#) [Bosch Connectors \(2.8 JPT\)](#) [Bosch Connectors \(ECM\)](#)
- [Delphi Connectors \(Weather Pack\)](#) [Delphi Connectors \(Push To Seat\)](#) [Delphi Connectors \(Pull To Seat\)](#) [Delphi Connectors \(Micro-Pack 100W\)](#) [Delphi Connectors \(Micro.64\)](#) [Delphi Connectors \(12-Way\)](#) [Delphi Connectors \(Steering Gear\)](#)
- [FCI Connectors \(Lever Lock\)](#) [FCI Connectors \(SIR\)](#)
- [FEP Connectors \(Steering Gear\)](#)
- [JST Connectors](#)
- [Kostal Connectors \(Glow Plug Control Module\)](#) [Kostal Connectors \(Transmission\)](#)
- [Molex Connectors \(Lever Lock\)](#) [Molex Connectors \(SIR\)](#)
- [Sumitomo Connectors](#)

- [Tyco/AMP Connectors \(CM 42-Way\)](#) [Tyco/AMP Connectors \(Sensor\)](#) [Tyco/AMP Connectors \(0.25 Cap\)](#) [Tyco/AMP Connectors \(43-Way\)](#) [Tyco/AMP Connectors \(Door Module\)](#) [Tyco/AMP Connectors \(Seat\)](#) [Tyco/AMP Connectors \(102-Way Inline\)](#) [Tyco/AMP Connectors \(SIR\)](#)
- [Yazaki Connectors \(2-Way\)](#) [Yazaki Connectors \(16-Way\)](#)
- [Repairing Connector Terminals \(Terminated Lead Repair\)](#) [Repairing Connector Terminals \(Terminal Repair\)](#)

Connector Anatomy

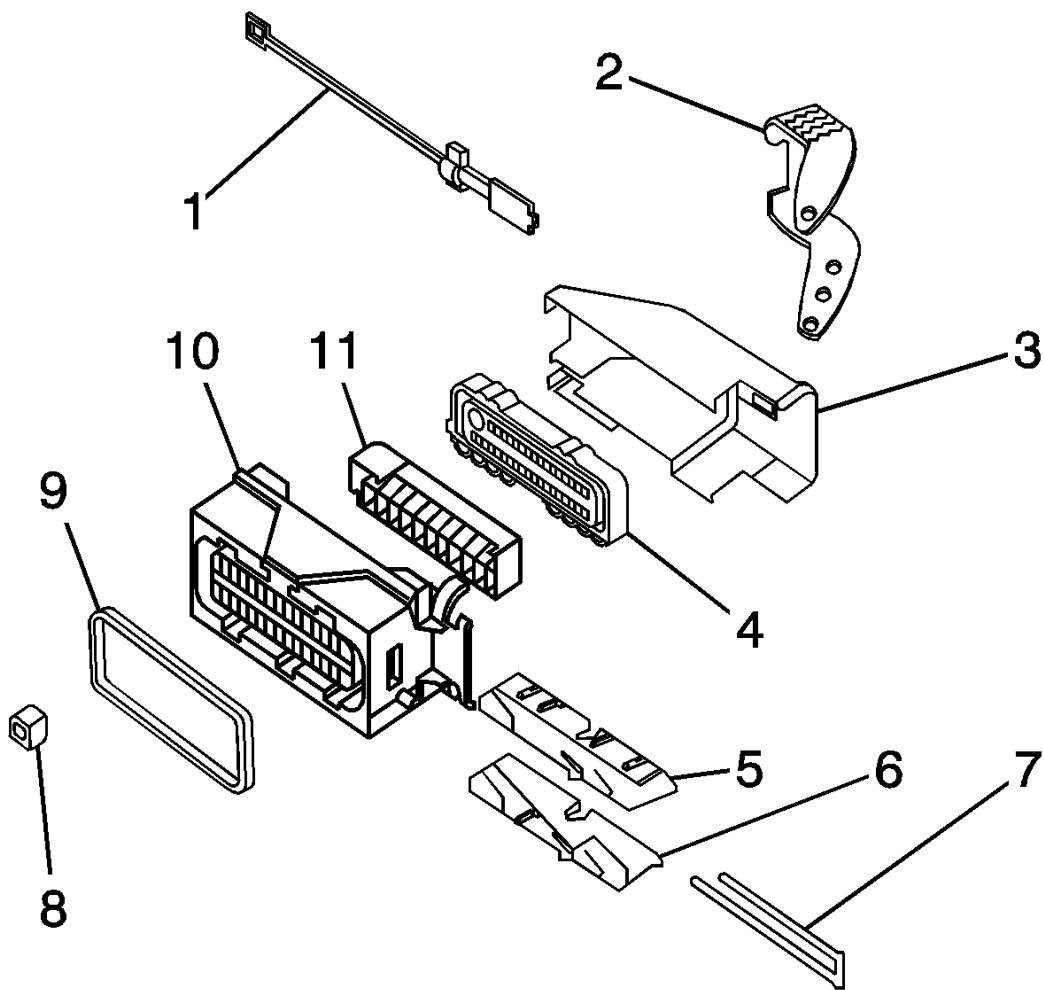


Fig. 4: Identifying Typical Connector Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Connector Positive Assurance (CPA)
2	Assist Lever
3	Wiredress Cover
4	Seal Strain/Relief
5	Slide Left Hand
6	Slide Right Hand
7	Terminal Positive Assurance (TPA)

Callout	Component Name
8	Terminal Positive Assurance (TPA)
9	Connector Seal
10	Connector Housing
11	Inner Connector

Identifying Connectors

Knowing the connector manufacturer is helpful when trying to locating the correct connector repair procedure. There are many different connector designs used on GM vehicles and it is sometimes difficult to identify the connector manufacturer. The information in this document should help with the identification of connector manufactures.

The following connector manufacturers make most of the connectors found in GM vehicles:

- AFL/EPC (Alcoa Fujikura Ltd./Engineered Plastics Components)
- Bosch
- Delphi
- FCI (Framatome Connectors International)
- JAE (Japan Aviation Electronics)
- JST (Japan Solderless Terminals)
- Kostal
- Molex
- Sumitomo
- Tyco/AMP
- Yazaki

Identifying the manufacturer of a connector is often difficult. When trying to determine the manufacturer of a connector, look for specific identifying marks that are unique to that connector supplier. Most of these identify marks are hard to find or see. Check the connector carefully and refer to the information below for pictures and descriptions of connector identification markings.

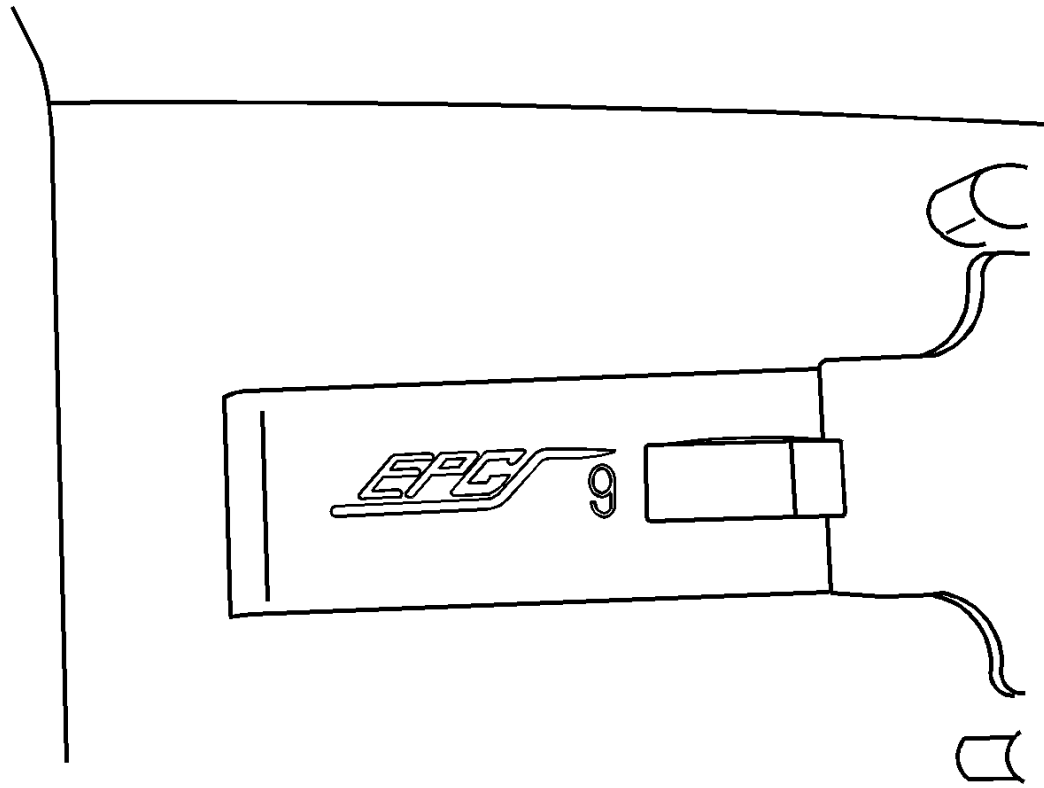


Fig. 5: View Of EPC Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- Most of AFL's connectors have EPC on their connector body. Some of the smaller connectors will not have any markings on them.

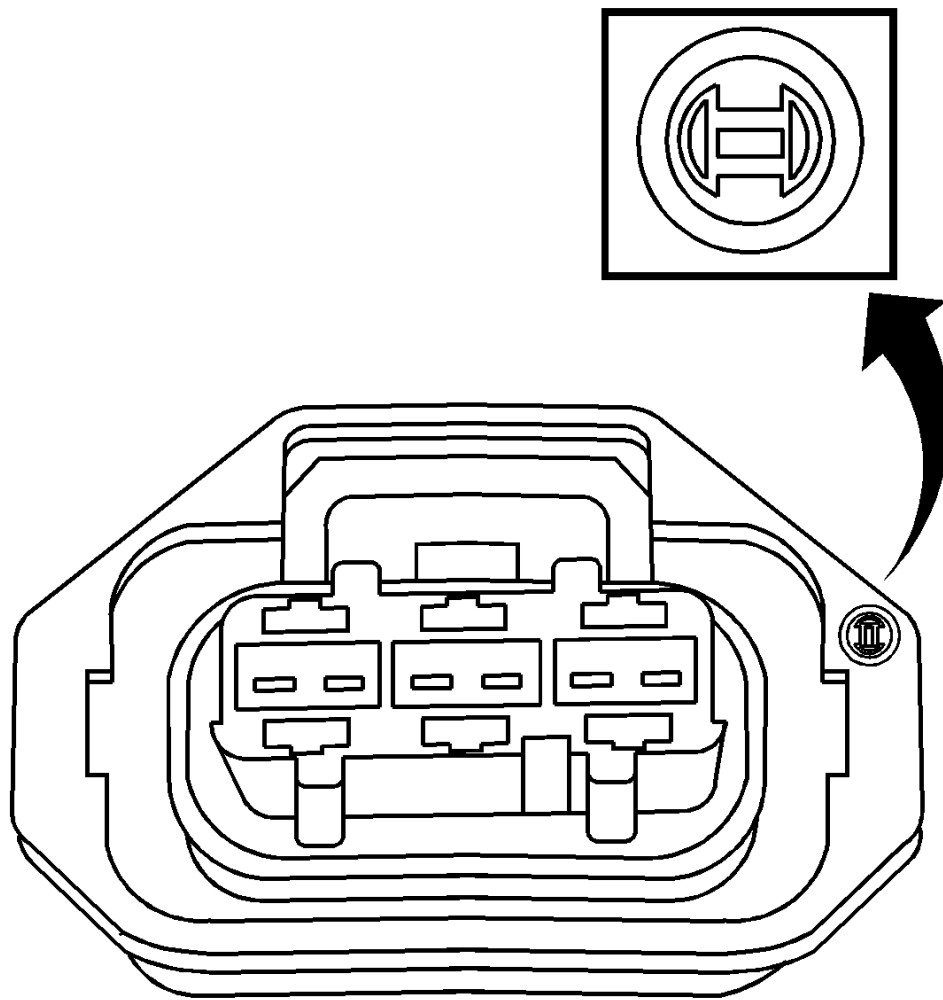


Fig. 6: View Of Bosch Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- In some cases Bosch will actually be printed on the connector. If Bosch does not appear on the connector, look for the Bosch logo. The Bosch logo is a circle with a blunted arrow inside. This logo can appear anywhere on the connector and is often very small.

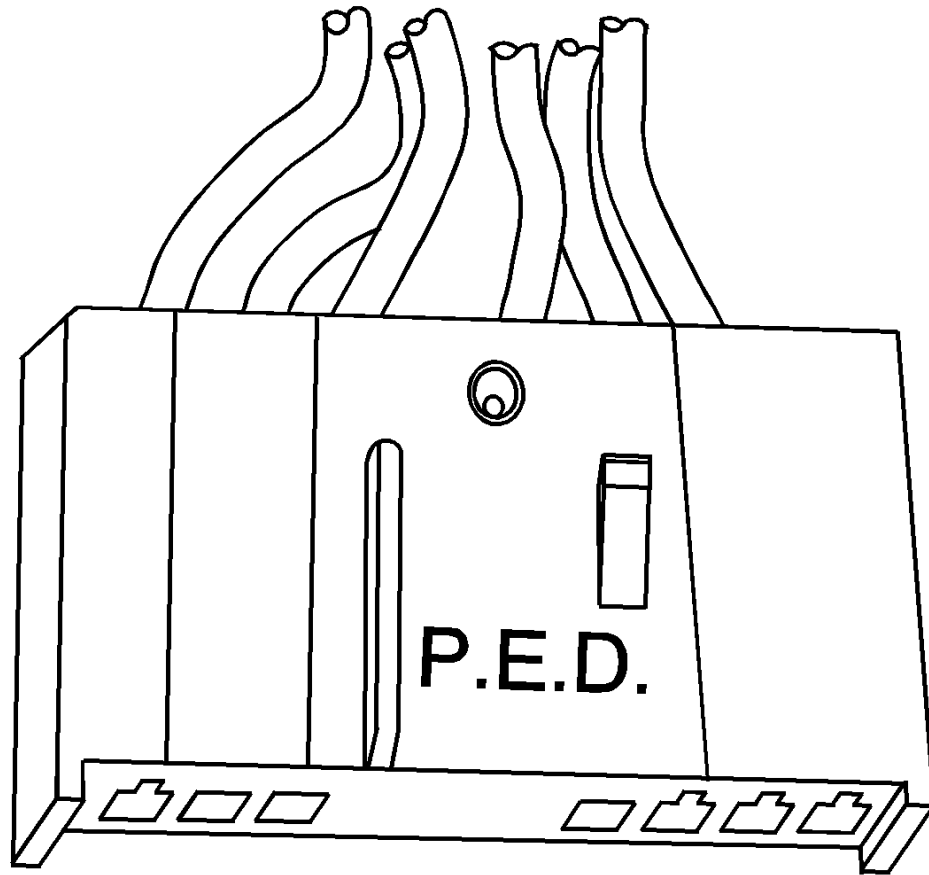


Fig. 7: View Of PED Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- In some cases Delphi will actually be printed on the connector. If Delphi is not printed on the connector, look for PED. In both cases there is no specific orientation for Delphi or PED and they can appear anywhere on the connector.

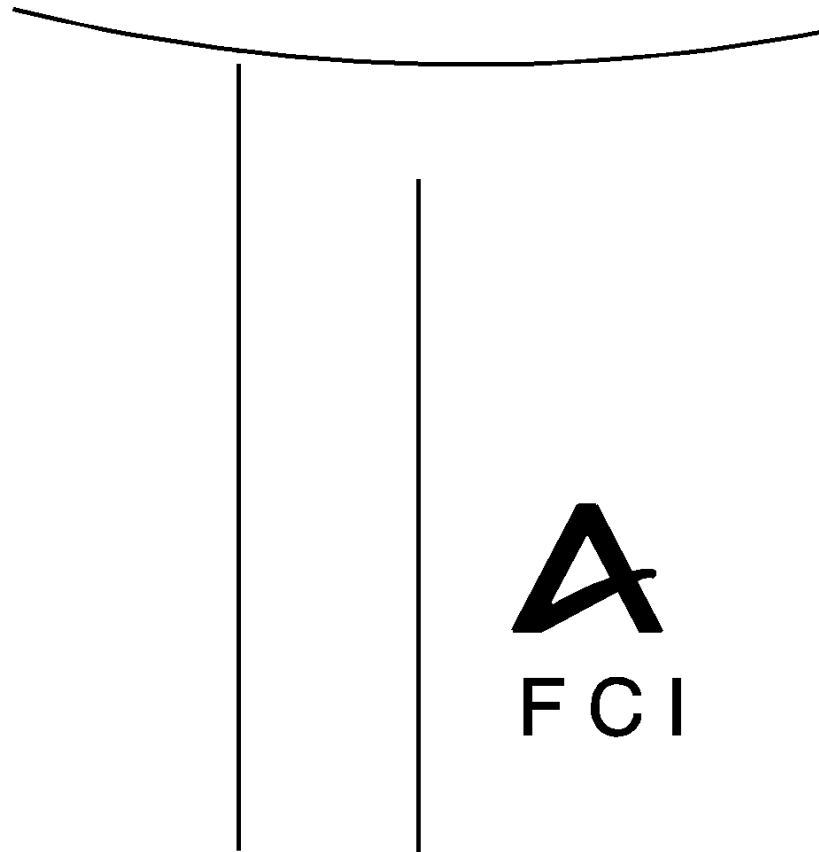


Fig. 8: View Of FCI Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- FCI connectors may have the FCI logo on their connectors. The logo is the letters FCI with an "A" above it.

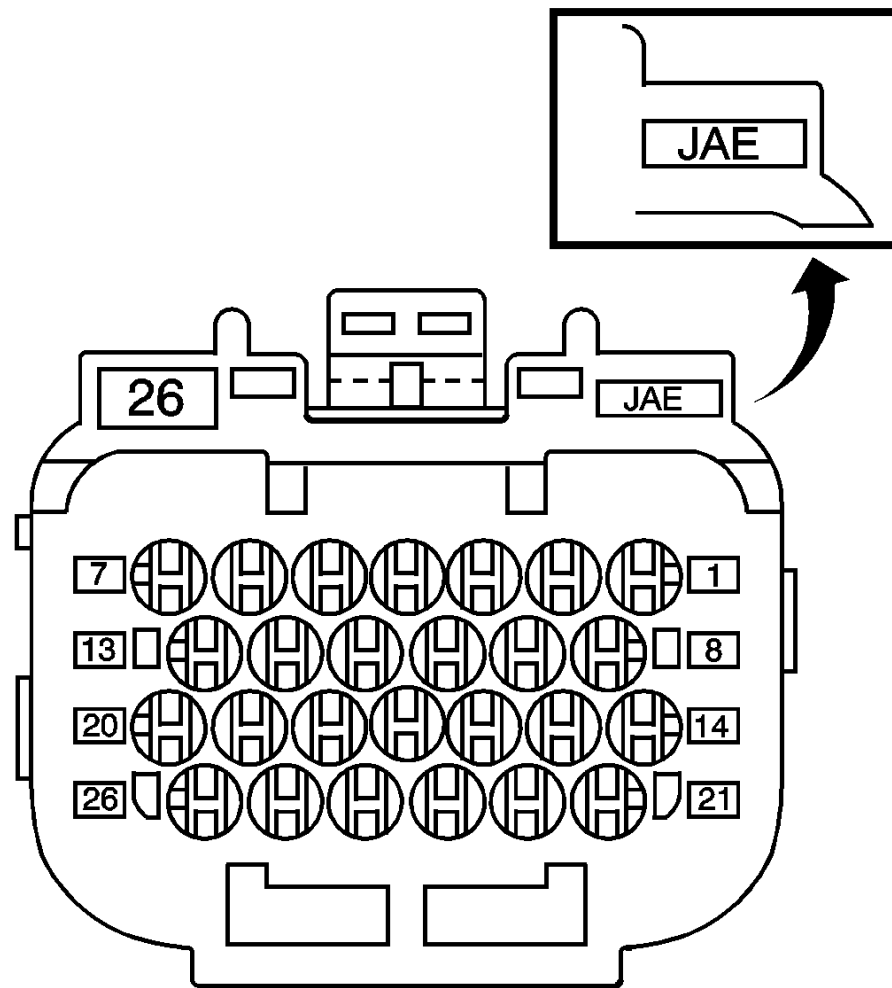


Fig. 9: View Of JAF Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- JAE connector have JAE in small letters on their connectors.

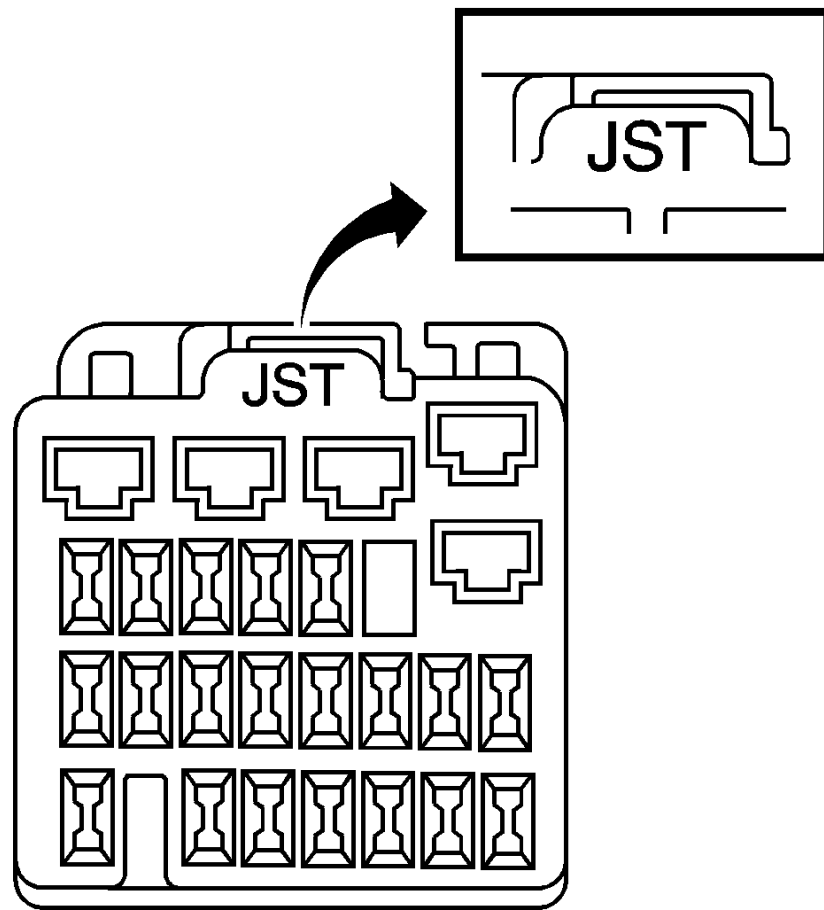


Fig. 10: View Of JST Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- JST connectors have JST in small letters on their connectors, similar to that above. The location of the logo will vary with the connector size and style.

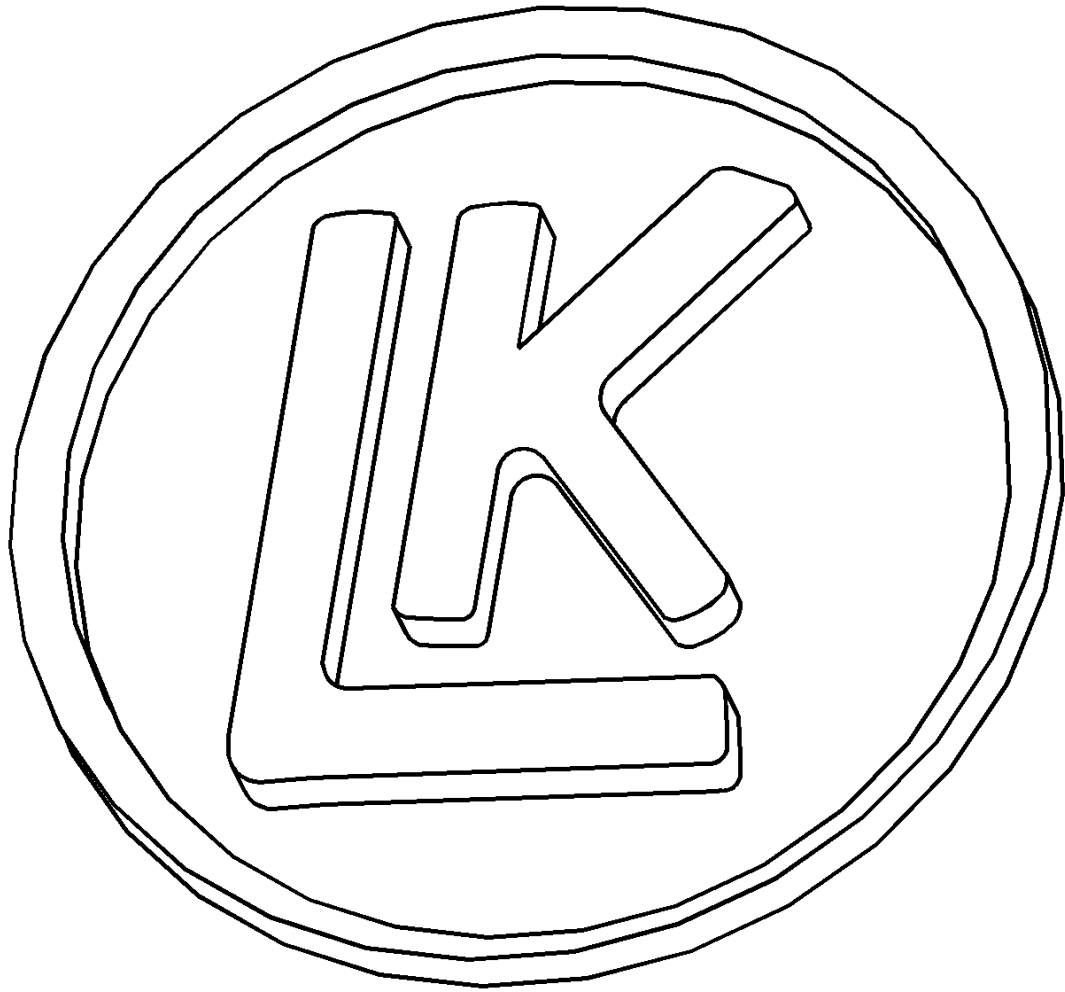


Fig. 11: View Of Kostel Connector Identifier

Courtesy of GENERAL MOTORS COMPANY

- Kostel has an "LK" with a circle around it. These connector are usually used as a transmissions connection.

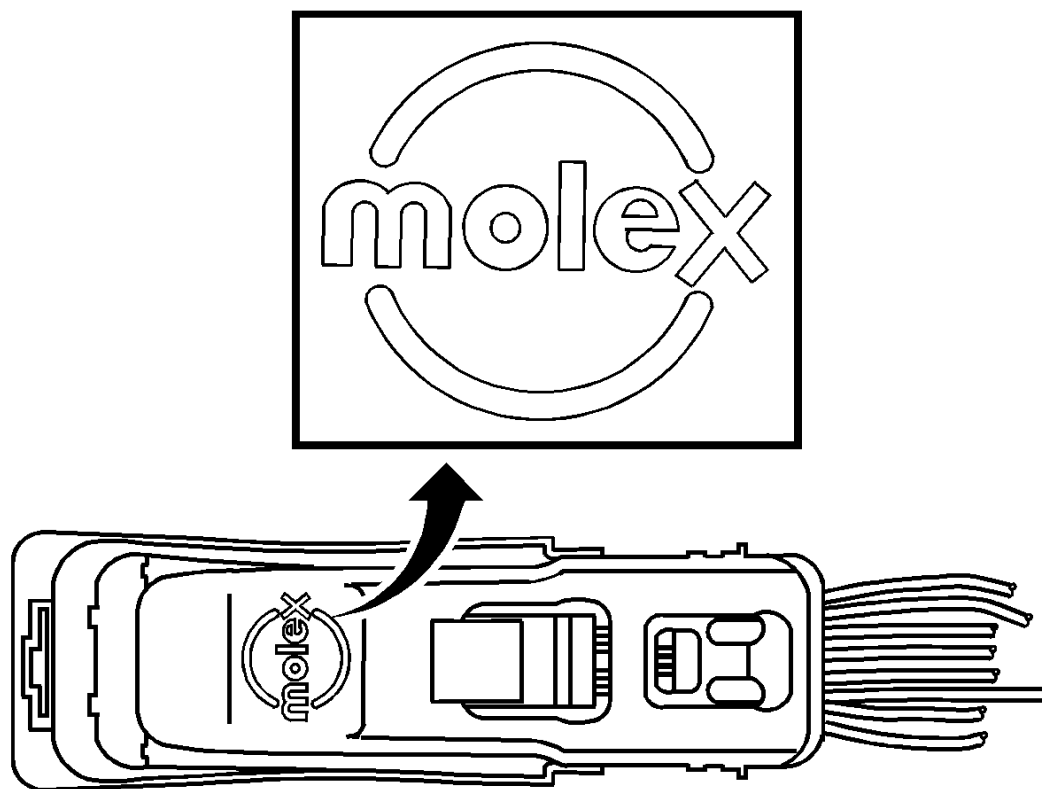


Fig. 12: View Of Molex Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

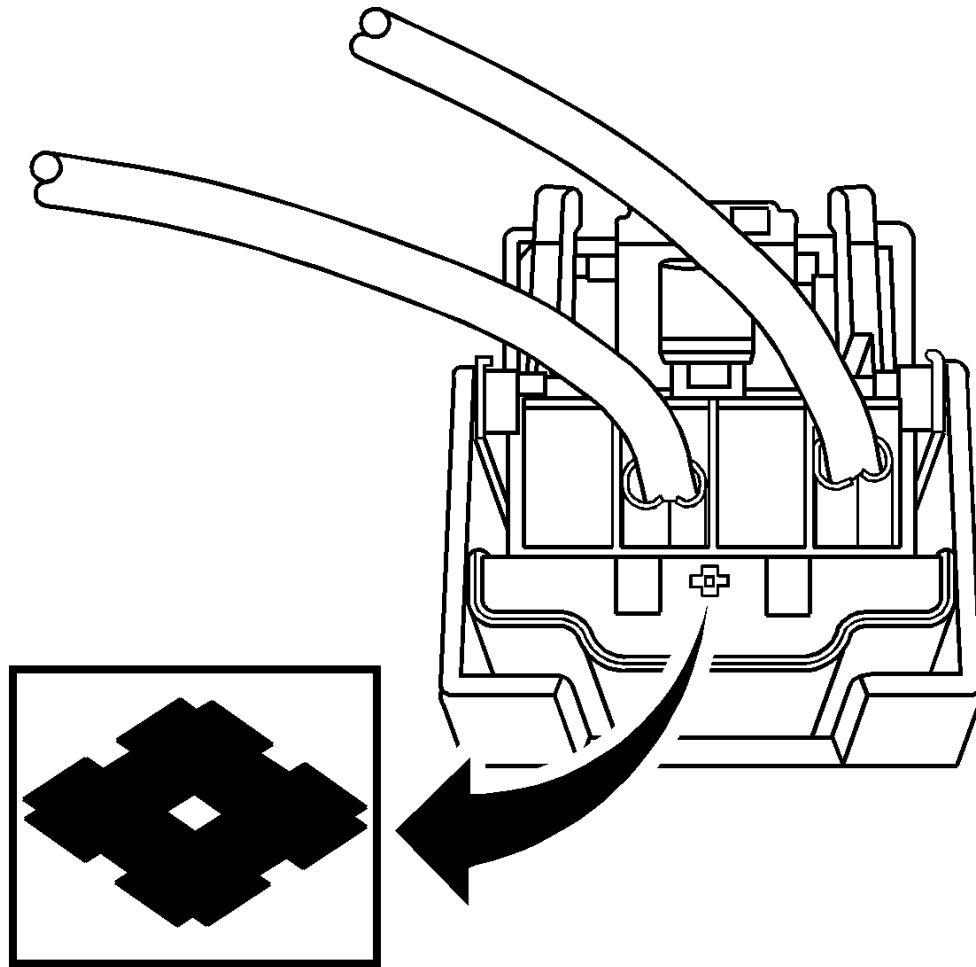


Fig. 13: View Of Sumitomo Identification On Connector Body

Courtesy of GENERAL MOTORS COMPANY

- Most Molex connectors will have the Molex logo on the dresscover of the connector. In some cases the connectors may have MX followed by another letter. The third letter indicates where the connector was made. A connector with MXD is a Molex connector made in Detroit.

Sumitomo has a unique symbol on their connector and possibly a part number. The symbol is similar to that of a diamond lying on its side, similar to that shown. The logo could appear anywhere but the most common place is at the wire side of the housing.

- Tyco/AMP has many different and unique connector designs. Some may or may not have identifiable marks on them.

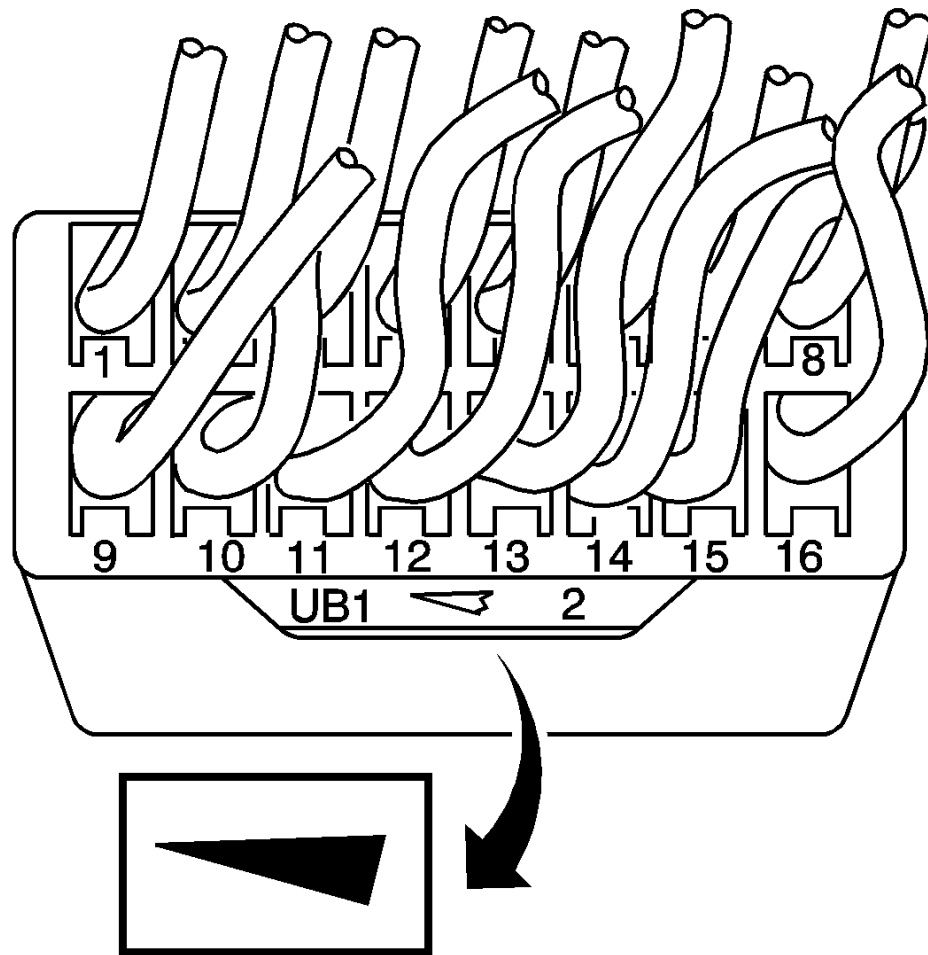


Fig. 14: View Of Yazaki Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- Yazaki has a wedge or arrow shape, similar to that shown.

Article GUID: A00884641

ELECTRICAL

Wiring Systems And Power Management - Inline Harness Connector End Views - Index - Volt

INLINE HARNESS CONNECTOR END VIEWS - INDEX

Inline Harness Connector End Views - Index

Description
<u>X100 Forward Lamp Harness to Front Fascia Harness (UFQ)</u>
<u>X100 Forward Lamp Harness to Front Fascia Harness (-UFQ)</u>
<u>X102 Forward Lamp Harness to Cooling Fan Harness</u>
<u>X104 Cooling Fan Harness to Forward Lamp Harness</u>
<u>X105 Body Harness to Battery Cable Harness</u>
<u>X106 Forward Lamp Extension Harness to Forward Lamp Harness ()</u>
<u>X107 Forward Lamp Harness to Body Harness</u>
<u>X110 Body Harness to Left Headlamp Harness ()</u>
<u>X120 Body Harness to Right Headlamp Harness ()</u>
<u>X121 Forward Lamp Harness to Body Harness</u>
<u>X130 Battery Cable Harness to Battery Cable Harness</u>
<u>X149 Engine Harness to Engine Oil Level Sensor Harness ()</u>
<u>X150 Engine Harness to Engine Jumper Harness</u>
<u>X155 Engine Harness to Body Harness ()</u>
<u>X160 Engine Harness to Fuel System Harness ()</u>
<u>X190 Engine Harness to Body Harness</u>
<u>X211 Body Harness to Instrument Panel Harness</u>
<u>X225 Instrument Panel Harness to Body Harness ()</u>
<u>X252 Instrument Panel Harness to HVAC System Harness ()</u>
<u>X275 Instrument Panel Harness to Body Harness ()</u>
<u>X302 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness ()</u>
<u>X310 Body Harness to Driver Seat Harness ()</u>
<u>X315 Floor Console Harness to Instrument Panel Harness ()</u>
<u>X316 Instrument Panel Harness to Floor Console Harness</u>
<u>X320 Driver Seat Harness to Body Harness ()</u>
<u>X325 Headliner Harness to Instrument Panel Harness</u>
<u>X340 Body Harness to Rear Seat Harness</u>
<u>X350 Body Harness to Fuel System Harness ()</u>
<u>X351 Body Harness to Fuel System Harness</u>
<u>X354 Body Harness to Fuel Tank Harness</u>
<u>X357 Body Harness to Battery Pack Jumper Harness</u>
<u>X358 Body Harness to Battery Pack Jumper Harness ()</u>
<u>X359 Auxiliary Battery Cable Harness to Battery Pack Jumper Harness</u>
<u>X359 Battery Cable - High Voltage Harness to Hybrid/EV Powertrain Control Module Harness (LATE)</u>
<u>X360 Auxiliary Battery Cable Harness to Battery Fuse Block Harness</u>
<u>X400 Body Harness to Battery Fuse Block Harness</u>

Description
<u>X406 Body Harness to Body Harness</u>
<u>X450 Rear Lamp Harness to Body Harness (-UFQ)</u>
<u>X450 Rear Lamp Harness to Body Harness (UFQ)</u>
<u>X452 Body Harness to Battery Cable Harness</u>
<u>X500 Driver Door Harness to Body Harness</u>
<u>X505 Driver Door Harness to Driver Door Trim Harness</u>
<u>X510 Driver Door Harness to Outside Rear View Mirror Harness</u>
<u>X600 Passenger Door Harness to Body Harness</u>
<u>X605 Passenger Door Harness to Passenger Door Trim Harness</u>
<u>X610 Passenger Door Harness to Outside Rear View Mirror Harness</u>
<u>X700 Left Rear Door Harness to Body Harness</u>
<u>X800 Right Rear Door Harness to Body Harness</u>
<u>X900 Liftgate Jumper Harness to Body Harness</u>
<u>X901 Liftgate Jumper Harness to Body Harness</u>
<u>X905 Liftgate Jumper Harness to Liftgate Harness</u>
<u>X906 Liftgate Jumper Harness to Liftgate Harness</u>

Article GUID: A00888957

ACCESSORIES & EQUIPMENT

Wiring Systems and Power Management - Repair Instructions - Volt

REPAIR INSTRUCTIONS

REPAIRING DAMAGED WIRE INSULATION

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

If the wire insulation has been chafed, or broken, enough to show the conductive portion of the wire, and the wire is not damaged, determine the length of insulation that needs to be repaired. If the repair is less than 280 mm (11 in), cut the wire within the damaged area. Then slide the appropriate heat shrink tubing (listed below) over the wire, and repair the wire by splicing the wires together. Refer to [Wire to Wire Repair](#). Once the wire is spliced together slide heat shrink tubing over the damaged area and apply heat to seal the repaired wire.

If the wire is damaged, or the damaged area is larger than 280 mm (11 in), then replace the damaged wire by splicing in a new section of wire. Refer to [Wire to Wire Repair](#).

GM Part Number	Diameter		Description	Color	Length	
	Metric	English			Metric	English
12355003	9.5 mm ²	0.375 in	Tubing, Shrink 3/8	Black	305 mm ²	12 in
12355005	12.7 mm ²	0.5 in	Tubing, Shrink 1/2	Black	305 mm ²	12 in
12355011	19.1 mm ²	0.75 in	Tubing, Shrink 3/4	Black	305 mm ²	12 in
12355008	25.4 mm ²	1.0 in	Tubing, Shrink 1.00	Black	305 mm ²	12 in

Wire Size Conversion

Metric Wire Sizes (mm ²)	AWG Sizes
0.13	26
0.20	24
0.32	22
0.52	20
0.82	18
1.31	16
2.09	14
3.30	12
5.27	10

Metric Wire Sizes (mm ²)	AWG Sizes
8.35	8
13.3	6

COAXIAL CABLE REPAIRS

The GM global coaxial cable repair strategy uses coaxial cables, connectors and jumpers to repair coaxial cables. The intent is to install the new service cable in vehicle, but removal of the old cable is not necessary. There are several repair scenarios:

- New cables, jumpers, and connector housing are required.
- Only new cables are required while it is possible to reuse the existing connector housing in vehicle. A jumper may or may not be needed.
- Only new connector housing are required, while it is possible to reuse the existing cable in the vehicle.
- A new cable would need to be installed from source to destination and by-pass the inline connector in some cases when an inline connector is unrepairable (Example: a cracked male end of a 1-way connector).

Coaxial Cable Kits

Four different kits will be available to repair coaxial cables. Components of each kit cannot be ordered separately from the kit.

- **Communication Interface Module Antenna Cable Kit** (Kit # 13581174) is used to repair Cellular coaxial cables. This kit uses RG58 low loss coaxial cables that are available in four lengths. The coaxial cables can be attached together in various lengths to closely match the length of the faulty/damaged coaxial cable.
- **Digital Radio and Vehicle Locator Antenna Coaxial Cable Kit** (Kit # 13581173) is used to repair XM and GPS coaxial cables. For vehicles that have a combined GPS and Cellular/OnStar signal on one cable, use Kit # 13581174. This kit uses RG316 low loss coaxial cables that are available in three lengths. The coaxial cables can be attached together in various lengths to closely match the length of the faulty/damaged coaxial cable.
- **Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit** (Kit # 19119056) is used with OnStar, XM, and GPS cables. This kit consists of jumpers and connectors. The jumpers are used to adapt different types of connectors together (to attach 2-way and 3-way connector onto the long 7, 5, and 3 foot cables). The connectors are used to replace existing connectors. The 1-way and 2-way connectors in the kit are in water-blue color (different than what the vehicle is built with) and are non-keyed (universal fit). The 3-way connectors in the kit are in the same color as in the vehicle.
- **Communication Interface Module Antenna Cable Kit** (Kit # 22803854) is used for the OnStar module on some vehicles built before the 2011 model year.

Coaxial Cable Repair Kits

Repair Kit Name	Description
Communication Interface Module Antenna Cable Kit (Kit # 13581174)	RG58 coaxial cable with female/female connectors - 7ft/2.1m
	RG58 coaxial cable with female/male connectors - 5ft/1.5m
	RG58 coaxial cable with female/male connectors - 3.5ft/1.1m

Repair Kit Name		Description
		RG58 coaxial cable with female/male connectors - 3.5ft/1.1m
Digital Radio and Vehicle Locator Antenna Coaxial Cable Kit (Kit # 13581173)		RG316 coaxial cable with female/female connectors - 7ft/2.1m
		RG316 coaxial cable with female/male connectors - 5ft/1.5m
		RG316 coaxial cable with female/male connectors - 3.5ft/1.1m
Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit (Kit # 19119056)	3-way Gen 1 sub-kit	1-way to 3-way Gen 1 jumper for female connector - Part # 13581154 - 4in/10cm
		1-way to 3-way Gen 1 jumper for male connector - Part # 19119052 - 4in/10cm
		White female connector
		White male connector
		Blue female connector
		Blue male connector
	3-way Gen 2 sub-kit	1-way to 3-way Gen 2 jumper for female connector - Part # 13581155 - 4in/10cm
		1-way to 3-way Gen 2 jumper for male connector - Part # 19119058 - 4in/10cm
		Tan female connector
		Tan male connector
		Gray female connector
		Gray male connector
	2-way Gen 1 sub-kit	1-way to 2-way Gen 1 jumper for female connector - Part # 13581156 - 4in/10cm
		Water-blue female connector
	2-way Gen 2 sub-kit (wide)	1-way to 2-way Gen 2 jumper for female connector - Part # 13581157 - 4in/10cm
		1-way to 2-way Gen 2 jumper for male connector - Part # 13581158 - 4in/10cm
		Water-blue female connector
		Water-blue male connector
	2-way Gen 2 and 3 sub-kit (narrow)	1-way to 2-way Gen 2 and 3 jumper for female connector - Part # 13582468 - 4in/10cm
		Use the 1-way to 2-way Gen 2 jumper for female connector 19119058 - 4in/10cm from the 2-way Gen 2 sub-kit.

Repair Kit Name	Description
	Water-blue female connector
	Water-blue male connector
	Right-angle jumper with water-blue universal 1-way connector - 4in/10cm
Communication Interface Module Antenna Cable Kit (Kit # 22803854)	1-way to mini UHF jumper - 4in/10cm

Connector Housing Repair Procedure

The connector housings (available in Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit) are available for 1-way housings, 2-way housings and 3-way housings. Determine the connector housing required:

1-way housing

No change to the service coaxial cable is necessary in order to install the new coaxial cable into the vehicle.

2-way housing

A 4-inch jumper is required.

1. Determine the appropriate generation (1, 2, or 3) and/or size (12.7mm or 8mm) of the 2-way housing that is in the vehicle.
2. Remove the faulty/damaged coaxial cable from the 2-way connector housing by removing the terminal position assurance (TPA) from the connector housing and then slide the cable out of the connector.

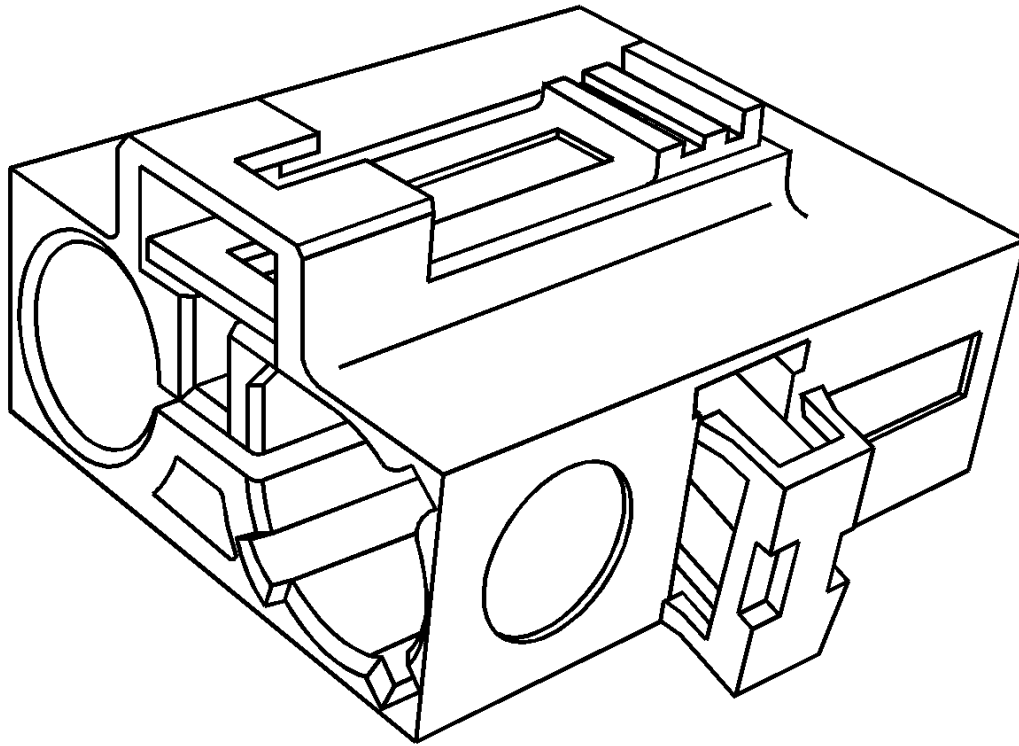


Fig. 1: Connector Housing

Courtesy of GENERAL MOTORS COMPANY

3. Install the new service coaxial cable into the vehicle. Use the 4-inch jumper for the appropriate 2-way connector housing to connect the new service coaxial cable to the connector housing.
4. If the issue is found to be the connector housing and not cable, a new connector housing may be installed while reusing all other components.

3-way housing

A 4-inch jumper is required.

1. Determine the appropriate generation (1 or 2) and keyed 3-way connector housing based on the connector housing color.
2. Note the locations of each of the cables in 3-way housing, as it is important for new cables be placed in the appropriate terminal location in the new connector. The connector housing colors are not interchangeable.
3. Remove the faulty/damaged coaxial cable from the 3-way connector housing by using a pair of side/diagonal cutters to nip and break away the housing.

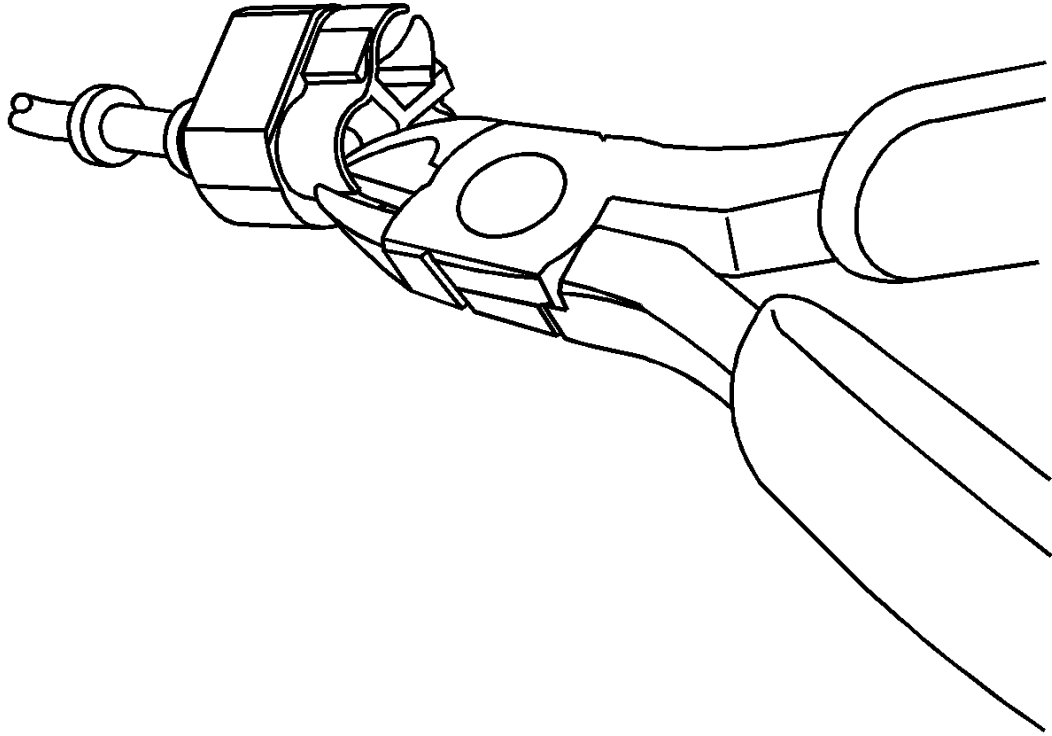


Fig. 2: Using Side/Diagonal Cutters To Nip And Break Away Connector Housing
Courtesy of GENERAL MOTORS COMPANY

4. Use caution not to damage the conductive ends of the coaxial cables inside the connector housing. Do not bend or force the terminal out or it could be damaged.

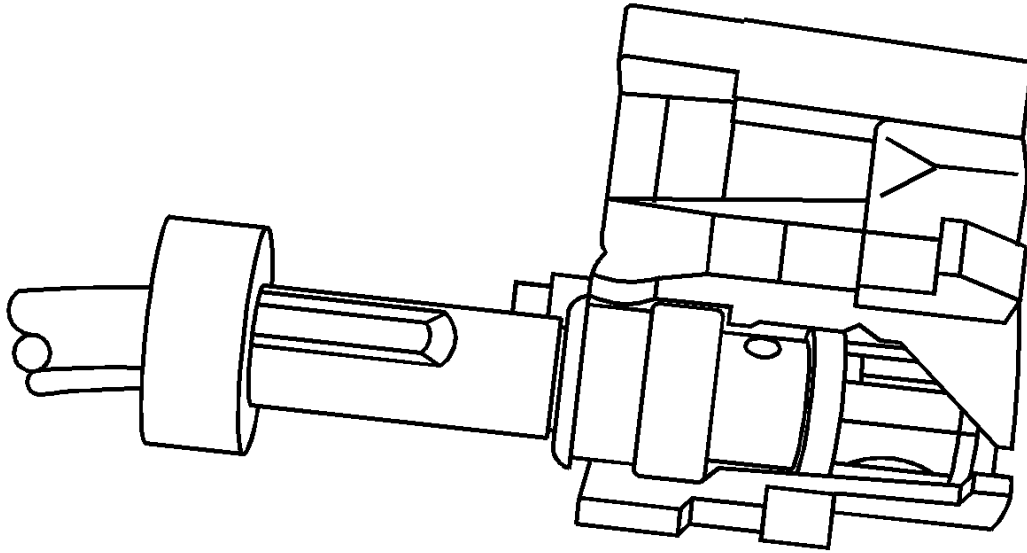


Fig. 3: Connecting New Service Coaxial Cable To New 3-Way Connector Housing
Courtesy of GENERAL MOTORS COMPANY

5. Install the new service coaxial cable into the vehicle. Use the 4-inch jumper for the appropriate color 3-way connector housing to connect the new service coaxial cable to the new 3-way connector housing.
6. If the issue is found to be the connector housing and not cable, a new connector housing may be installed while reusing all other components.

Coaxial Cable Repair Procedure

1. Identify the faulty/damaged coaxial cable.
2. Disconnect the faulty/damaged coaxial cable and leave it in the vehicle.
3. Identify the type of coaxial cable to be replaced and match up with the appropriate pieces to repair the damaged coaxial cable. Match up the type of coaxial cable, cable length and connector types. In some cases there may be extra length of cable left over.

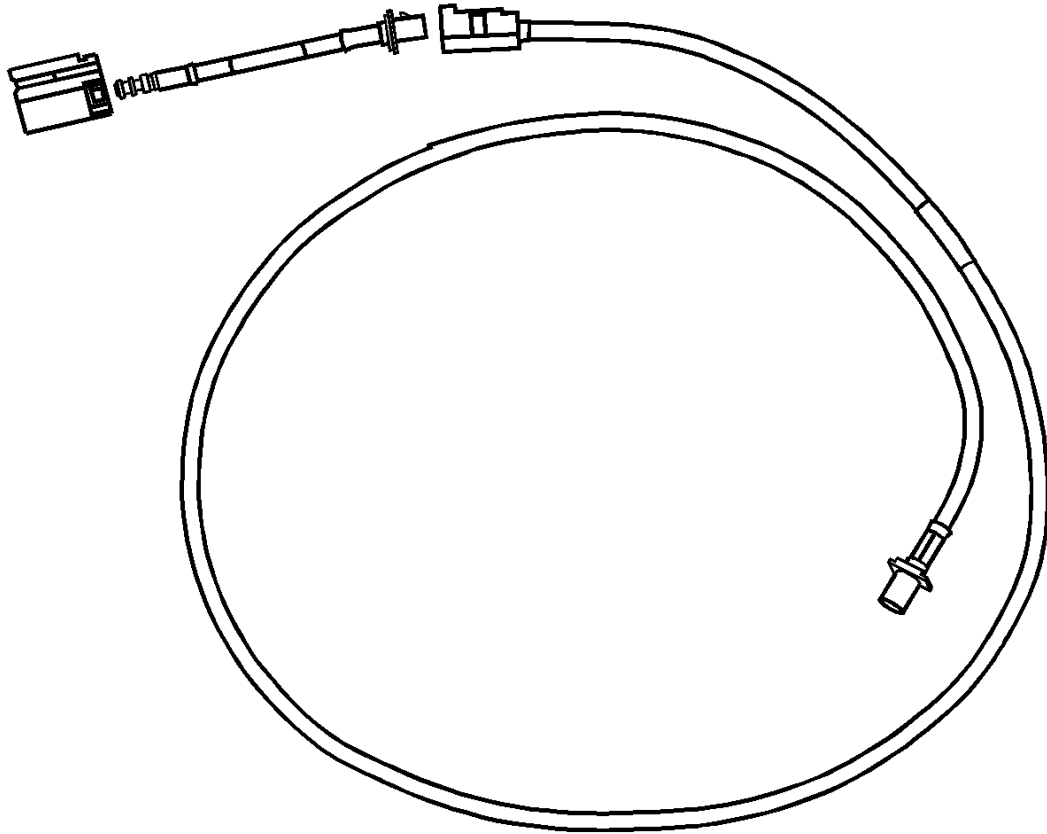


Fig. 4: Coaxial Cable

Courtesy of GENERAL MOTORS COMPANY

NOTE: Avoid routing the new coaxial cable near sharp edges that can damage the new coaxial cable.

4. Install the new coaxial cable in the vehicle.

Use tie-straps to attach the new service coaxial cable to existing harnesses or brackets. Use felt tape/foam to reduce rattles, as necessary.

NOTE: To avoid permanent damage, do not pinch the cable or bend it tighter than a 2 inch (5 centimeter) radius.

5. Remove the faulty/damaged connectors, if applicable.
6. Install new connectors or jumpers, as needed. Refer to Connector Housing Repair Procedure.
7. Verify the repair by operating the system with the vehicle in Service Mode.

FLAT WIRE REPAIRS

The flat wire within the flex wiring harness is not serviceable. If an open or short exists within the flex wiring

harness the complete harness must be replaced.

FOLDED-OVER WIRE REPAIR

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

The GM global wire repair strategy uses connector assemblies (pigtails) and terminated leads to repair wiring harnesses.

To reduce and manage GM Service Parts proliferation, the service pigtails and terminated leads are designed with the largest wire gauge size that can be held by either the terminal or the connector housing.

The folded over wire repair technique, in which the copper wire strands are folded over before being installed into a splice sleeve, allows the service part to be used when repairing a smaller gauge size wire in a vehicle. This technique has passed all GM testing standards.

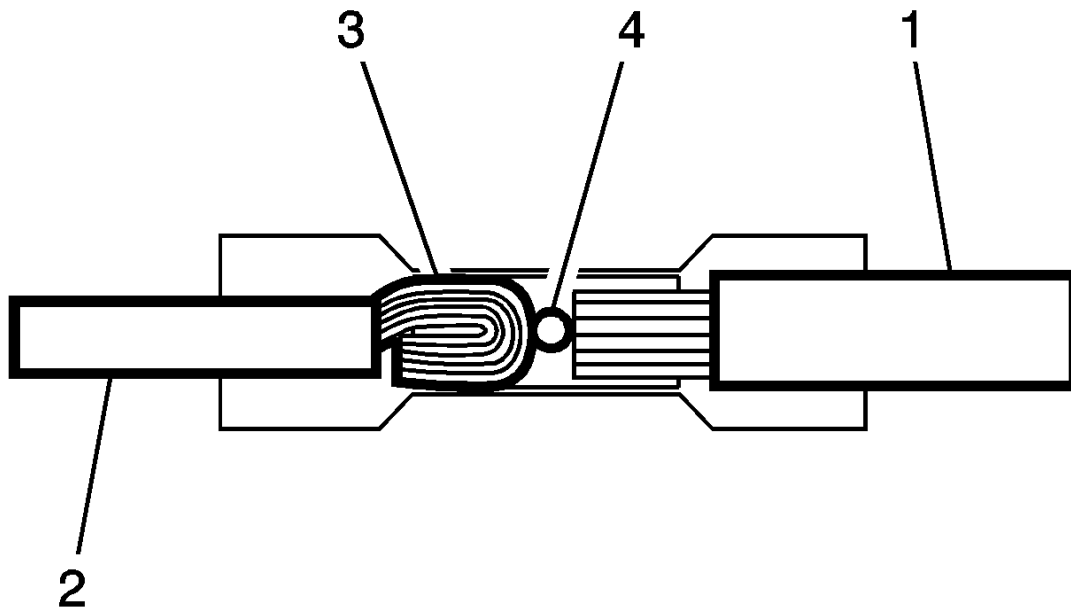


Fig. 5: View Of Stripped Wires In Splice Sleeve Connector

Courtesy of GENERAL MOTORS COMPANY

The larger harness size wires (1) will be placed in one side of the splice sleeve and match the splice sleeve closely in size. The wires are moved into the splice sleeve until they hit the stop (4) in the splice sleeve. The smaller harness size wires (2) will be placed in the other side of the splice sleeve. The smaller harness size wires will be folded over (3) to match up with the splice sleeve size.

Use the folded over wire repair for:

NOTE: Increasing the amount of copper strands in the smaller gauge size will allow for a better crimp

- Splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes)

NOTE: Vehicle side needs to be of same or less gauge size (not greater than the service part's gauge size)

- Splicing wires of different gauges

Use the Service Information (SI) connector end-views to determine:

- Gauge size of wiring harness
- Recommended Repair: Terminated Lead or Pigtail

The following table lists the acceptable variance within the gauge size

Folded-Over Wire Selection Table

Harness Wire Gauge		Connector Assembly (Pigtail) or Terminated Lead Wire Gauge Size			
-		Salmon Color Splice Sleeve		Blue Color Splice Sleeve	Yellow Color Splice Sleeve
Metric	-	0.35 mm	0.5 - 0.8 mm	1.0 - 2.0 mm	3.0 - 6.0 mm
-	Wire Gauge (AWG)	22	20 - 18	16 - 14	12 - 10
0.13 mm	26	Fold Over Wire	Double Fold Over Wire	Not Acceptable	Not Acceptable
0.22 mm	24	Fold Over Wire	Fold Over Wire	Not Acceptable	Not Acceptable
0.35 mm	22	Wire to Wire	Fold Over Wire	Double Fold Over Wire	Not Acceptable
0.5 mm	20	Not Acceptable	Wire to Wire	Fold Over Wire	Not Acceptable
0.75 mm	-	Not Acceptable	Wire to Wire	Fold Over Wire	Double Fold Over Wire
0.8 mm	18	Not Acceptable	Wire to Wire	Fold Over Wire	Double Fold Over Wire
1.0 mm	16	Not Acceptable	Not Acceptable	Wire to Wire	Double Fold Over Wire
1.5 mm	-	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire
2.0 mm	14	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire
2.5 mm	-	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire

Harness Wire Gauge		Connector Assembly (Pigtail) or Terminated Lead Wire Gauge Size			
3.0-6.0 mm	12 - 10	Not Acceptable	Not Acceptable	Not Acceptable	Wire to Wire

Example

For an IP Harness of 0.22 mm (24 gauge on left side of table) wire size, the SI connector end-view recommends a pigtail with leads of 0.8 mm (18 gauge on the top of the table) with a salmon colored DuraSeal splice sleeve of 0.5 - 1.0 mm (20 - 16 gauge).

Follow these steps to use the folded over wire (1) technique on an IP Harness.

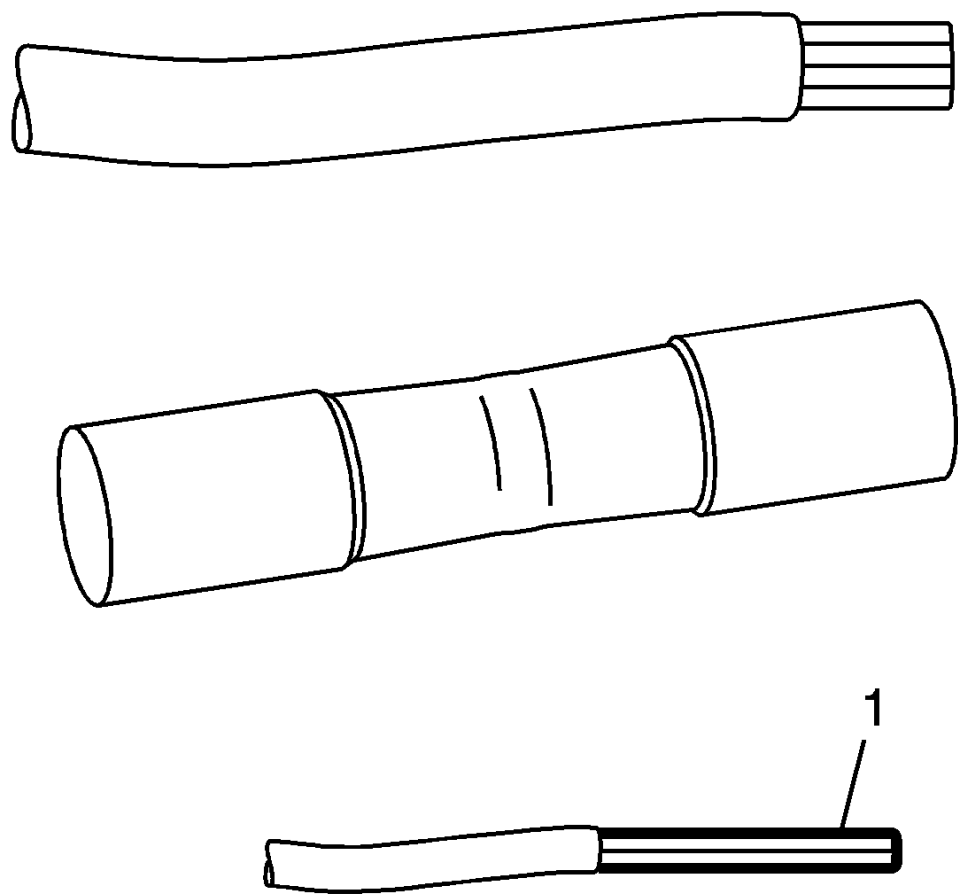


Fig. 6: View Of Stripped Wires
Courtesy of GENERAL MOTORS COMPANY

Strip twice the amount of insulation on the smaller (1) wire (IP Harness is the lower wire) than normally required. Normally, the terminated leads have 5 mm of insulation stripped off the wire.

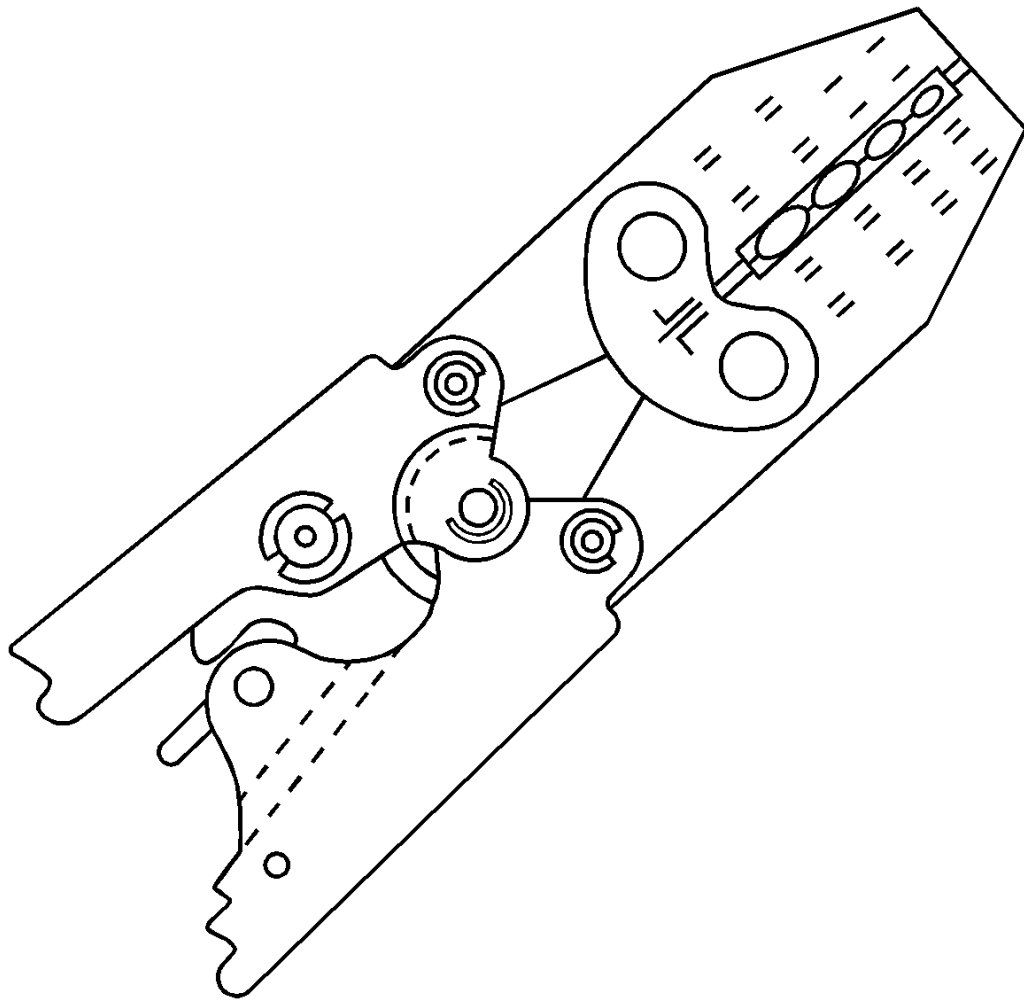


Fig. 7: Splice Sleeve Crimping Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use EL-38125-10 splice sleeve crimping tool (non GMNA) or J-38125-8 splice sleeve crimping tool (GMNA).

1. For wiring repair, refer to [Wire to Wire Repair](#).

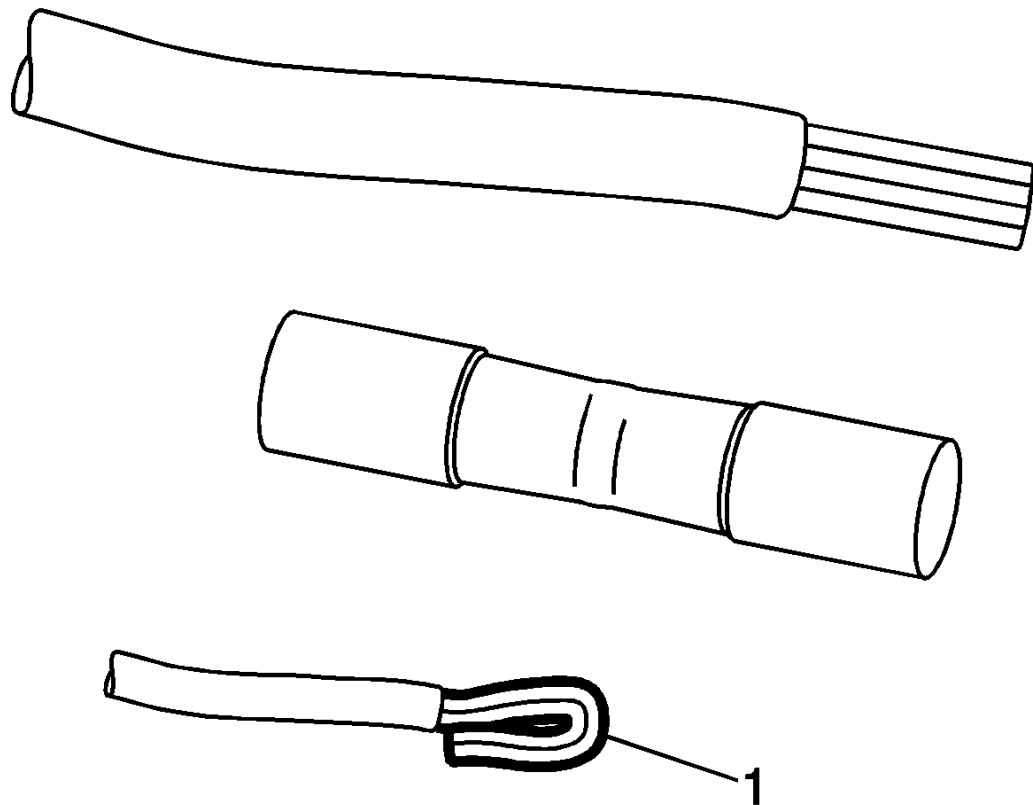


Fig. 8: View Of Twisted And Folded Wire To Length

Courtesy of GENERAL MOTORS COMPANY

2. Twist the wires before you fold them over to prevent the wire strands from opening up. Fold over the copper wire strands of the smaller (1) gauge wire so that it is the same length as the non-folded wire.

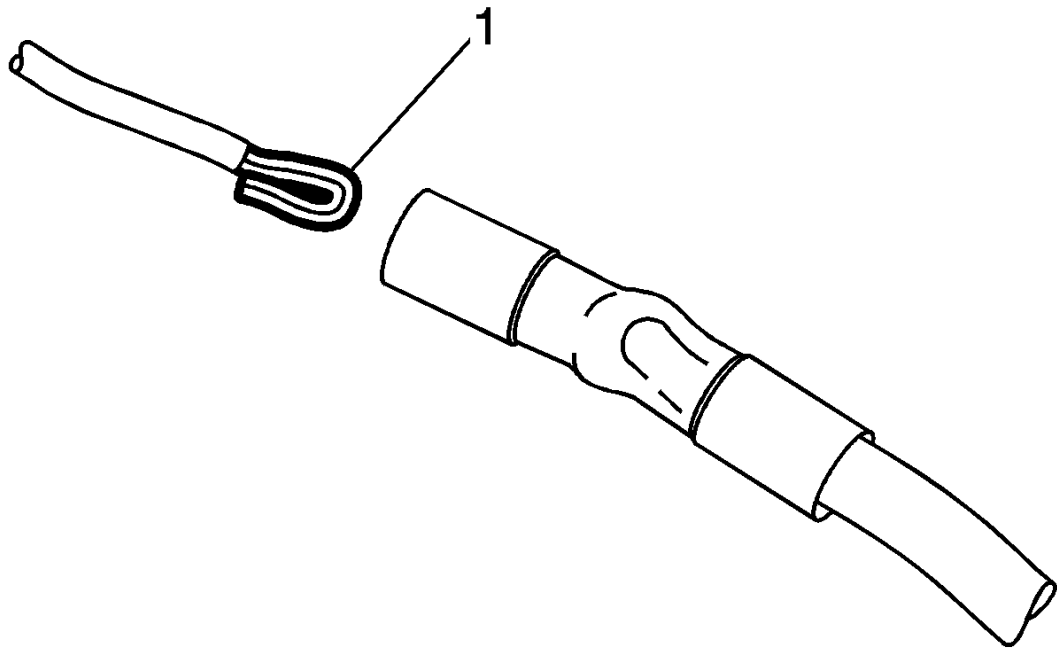


Fig. 9: View Of Folded Wire & Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

3. Insert the folded over wire (1) into the splice sleeve.

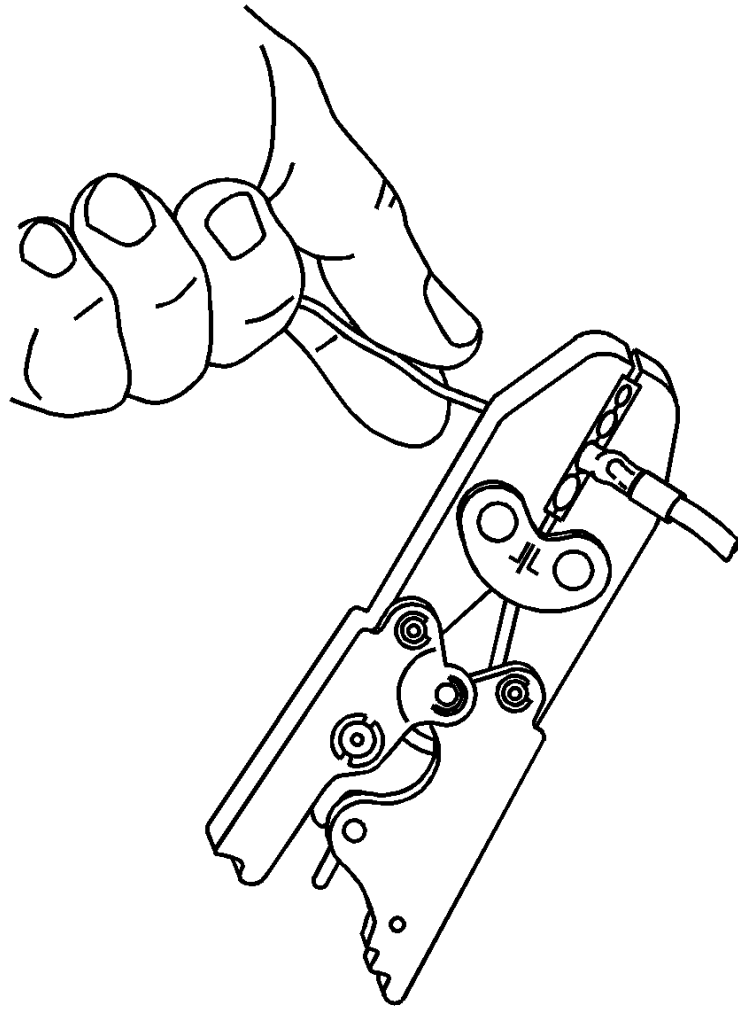


Fig. 10: Crimping The Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

4. Use the proper crimp tool to crimp the splice sleeve to the smaller wire (harness side of repair). Complete the crimp as usual (using the heat tool to shrink the tube).

SERIAL DATA CIRCUIT WIRING REPAIRS

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool
- DuraSeal splice sleeves
- A wire stripping tool

For equivalent regional tools, refer to [Special Tools](#).

The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides necessary contact integrity for the sensitive, low energy

circuits.

The GM Local Area Network (GMLAN) System requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working on GMLAN connectors and terminals.

GMLAN Repairs

NOTE: When making a repair to any GMLAN network, the original wire length after the repair must be the same length as before the repair. If the network is a twisted pair, the twist must be maintained after the repair is completed.

GMLAN has 2 types of networks, low speed and high speed. Low speed GMLAN has a single wire and works at slow speeds. High speed GMLAN has 2 wires in a twisted pair and works at higher speeds. For more information on GMLAN, refer to [Data Link Communications Description and Operation](#).

GMLAN Connector Terminal Repair

NOTE: A terminated lead can be used to replace damaged connector terminals for both high speed and low speed GMLAN systems. When making a connector terminal repair on a GMLAN high speed system with twisted pair wires, do not untwist the wires more than necessary to make the repair.

If the individual terminals are damaged on any GMLAN connection, use the appropriate connector repair procedure in order to repair the terminal. Refer to [Connector Repairs](#) for the appropriate connector repair procedure.

GMLAN Wire Repair

NOTE: Refer to Wiring Repairs in the service information connector end views or the vehicle schematics in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm², 0.8 mm², 1.0 mm² etc.). Use the DuraSeal splice sleeves and **EL-38125-10** tool. For wiring repair, refer to [Wire to Wire Repair](#).

Media Oriented Systems Transport (MOST) Wiring Repair

NOTE: If harness repair/analysis is performed, MOST bus Twist Pair unshielded wire should be 0.35 mm² (22 AWG) wire with at least one twist per each 1 45/64 inch (45 mm) and must not be untwisted for more than 3 15/16 of an inch (10 cm).

The following conditions need to be met to ensure a valid continuity:

- Untwisted length for all MOST 50 circuits at each wire harness connector should be no longer 50 mm max (25 mm preferred).
- When wire repairs are made, a minimum 25 twists/meter for all MOST 50 circuits.
- MOST 50 has specific receive and transmit I/O.

The transmit of one module is connected to receive of the next module in ring topology.

HEATED OXYGEN SENSOR WIRING REPAIRS

CAUTION: Do not solder repairs under any circumstances as this could result in the air reference being obstructed.

If the heated oxygen sensor pigtail wiring, connector, or terminal is damaged the entire oxygen sensor assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly it must have a clean air reference. This clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference and degrade oxygen sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor, causing poor performance. Also, the sensor pigtail and harness wires must not be damaged in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Neither the sensor nor vehicle lead wires should be bent sharply or kinked. Sharp bends, kinks, etc., could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire (where applicable). Vehicles that utilize the ground wire sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will also cause poor engine performance.
- To prevent damage due to water intrusion, be sure that the peripheral seal remains intact on the vehicle harness connector.

HIGH TEMPERATURE WIRING REPAIRS

NOTE: All wiring repairs need to be 200 mm from the heat zone. Areas of consideration would be any area located near the exhaust manifolds, catalytic converter, exhaust pipes, and turbocharged engines.

Items Required

- DuraSeal splice sleeves to crimp and seal connections
- High temperature SCT1 shrink tubing to protect the splice sleeves
- Terminated leads or pigtails
- The correct tools to remove the terminals from the connectors

Use high temperature bulk wire rated at 150°C (302°F) continuous temperature of the same or larger gauge size as the original wire when repair damage wire. Also replace any reflective tape that you remove during the repair.

High Temperature Wiring

Wiring that is exposed to high temperatures, 135°C (275°F) or higher, for prolonged periods of time may use materials i.e. wires, connectors, and shielding that has a higher heat rating than typical wiring. When making a repair in a high temperature area observe the following:

- Use high temperature bulk wire rated at 150°C (302°F) continuous temperature to replace any

damaged wire.

- Replace any heat shielding that is removed.
- Cover any DuraSeal splice sleeves with SCT1 shrink tubing.
- After making a wiring repair, ensure that the location of the wiring is not moved closer to the heat source.

Identifying High Temperature Wiring

NOTE: High temperature areas would be areas located near exhaust manifolds, catalytic converters, exhaust pipes, and turbocharged engines.

Wiring that is exposed to high temperature, 135Â°C (275Â°F) or higher, for prolonged periods of time need special considerations when making wiring repairs. Areas that may be exposed to higher temperatures can be identified by heat resistant materials that are being used in those areas. These materials may include heat reflective tape and high temperature shrink tubing. Also conduit and other protective coverings may be used. Because conduit or similar coverings are used throughout the vehicle regardless of the temperature, it may be necessary for the technician to determine if an area is exposed to excessive heat before making a wiring repair.

SIR/SRS WIRING REPAIRS

NOTE: Refer to [SIR Service Precautions](#) .

For European Regions

CAUTION: If the SIR/SRS wiring, connector, or terminal is damaged, the affected wiring harness must be replaced. Do not attempt to repair the wiring, connector, or terminals. Any attempt to repair the wires, connectors, or terminals could result in performance problems of the SIR/SRS System. Operations on restraint systems must only be performed by trained and qualified personnel.

For Non-European Regions

Special Tools

Splice Sleeve Crimping Tool, refer to [Special Tools](#) .

The Supplemental Inflatable Restraint (SIR) System/Supplemental Restraint System (SRS) requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working with the SIR/SRS, and the wiring components, such as connectors and terminals.

SIR/SRS Connector Repair (Plastic Body and Terminal Metal Pin)

NOTE: Do not use the terminals in the kit in order to replace damaged SIR/SRS system terminals. Use either an SIR/SRS pigtail or a terminated lead from the SIR Repair Kit Tray.

The terminals in the SIR/SRS system are made with a special plating. This plating provides the necessary contact integrity for the sensitive, low energy circuits.

Pigtail repair packs are available for SIR/SRS connectors with eight or less terminals. Only the connector body is available for connectors with more than eight terminals. Terminated leads can be used to replace damaged terminals when replacing the connector body.

SIR/SRS Component Wire Pigtail Repair

NOTE: Do not make wire, connector, or terminal repairs on components with wire pigtails.

A wire pigtail is a wire or wires attached directly to the device, not by a connector. If a wiring pigtail is damaged, you must replace the entire component, with pigtail. The inflatable restraint steering wheel module coil is an example of a pigtail component.

SIR/SRS Wire Repair

CAUTION: Do not install more than 2 DuraSeal splice sleeves per SIR deployment loop. A deployment loop consists of both wires from the K36 Inflatable Restraint Sensing and Diagnostic Module to the deployable component. If more than 2 DuraSeal splice sleeves are required for any SIR deployment loop, the complete circuit of the loop must be replaced. More than 2 DuraSeal splice sleeves per deployment loop may increase the resistance in the circuit causing a DTC to be set.

NOTE: Refer to Wiring Repairs in the service information connector end views or the vehicle schematics in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm, 0.8 mm, 1.0 mm etc.). Use the DuraSeal splice sleeves and the appropriate splice sleeve crimping tool. For wiring repair, refer to [Wire to Wire Repair](#).

For connector position assurance (CPA), refer to [Connector Position Assurance Locks](#).

For terminal position assurance (TPA), refer to [Terminal Position Assurance Locks](#).

SPLICING INLINE HARNESS DIODES

Many vehicle electrical systems use a diode to isolate circuits and protect the components from voltage spikes. When installing a new diode use the following procedure.

1. Open the harness.
 - If the harness is taped, remove the tape.
 - To avoid wiring insulation damage, use a sewing seam ripper (available from sewing supply stores) in order to cut open the harness.
 - If the harness has a black plastic conduit, pull out the diode.
2. If the diode is taped to the harness, remove all of the tape.
3. Check and record the current flow direction and orientation of diode.
4. Remove the inoperative diode from the harness with a suitable soldering tool.

NOTE: If the diode is located next to a connector terminal remove the terminal(s) from the connector to prevent damage from the soldering tool.

5. Carefully strip away a section of insulation next to the old soldered portion of the wire(s). Do not remove

any more than is needed to attach the new diode.

6. Check current flow direction of the new diode, being sure to install the diode with correct bias. Reference the appropriate service manual wiring schematic to obtain the correct diode installation position.
7. Attach the new diode to the wire(s) using 60/40 rosin core solder. Before soldering attach some heat sinks (aluminum alligator clips) across the diode wire ends to protect the diode from excessive heat. Follow the manufacturer's instruction for the soldering equipment.
8. Reinstall terminal(s) into the connector body if previously removed.

NOTE: To prevent shorts to ground and water intrusion, completely cover all exposed wire and diode attachment points with tape.

9. Tape the diode to the harness or connector using electrical tape.

SPLICING TWISTED OR SHIELDED CABLE

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

Twisted/shielded cable is used in order to protect wiring from electrical noise. Two-conductor cable of this construction is used between the radio and the Delco-Bose® speaker/amplifier units and other applications where low level, sensitive signals must be carried. Follow the instructions below in order to repair the twisted/shielded cable.

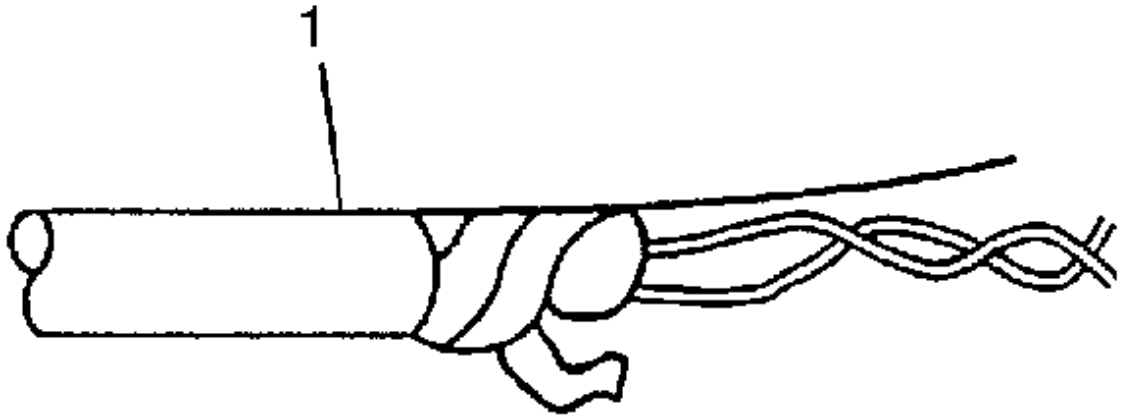


Fig. 11: View Of Outer Wiring Jacket

Courtesy of GENERAL MOTORS COMPANY

1. Remove the outer jacket (1). Use care not to cut into the drain wire of the mylar tape.
2. Unwrap the tape. Do not remove the tape. Use the tape in order to rewrap the twisted conductors after the splice is made.



Fig. 12: Preparing The Splice

Courtesy of GENERAL MOTORS COMPANY

3. Prepare the splice. Untwist the conductors and follow the instructions for [Wire to Wire Repair](#). Staggering the splices by 65 mm (2.5 in) is recommended.

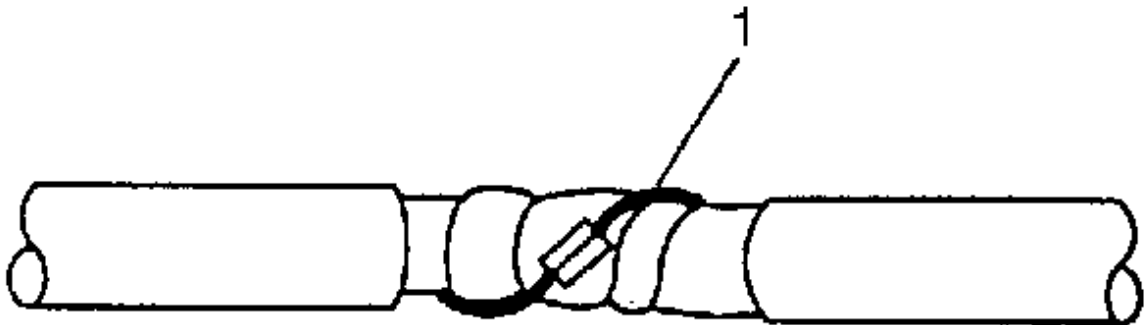


Fig. 13: Identifying Diode On Wire

Courtesy of GENERAL MOTORS COMPANY

NOTE: **Apply the mylar tape with the aluminum side inward. This ensures good electrical contact with the drain wire.**

4. Re-assemble the cable.

- Rewrap the conductors with the mylar tape. If the mylar tape is damaged, use 3M product AL-36FR to replace the damaged mylar tape.
- Use caution not to wrap the drain wire in the tape (1).
- Follow the splicing instructions for copper wire and splice the drain wire.
- Wrap the drain wire around the conductors and tape with electrical tape to replace the outer insulation.



Fig. 14: View Of Repaired Wire Covered With Electrical Tape
Courtesy of GENERAL MOTORS COMPANY

5. Tape over the entire cable. Use a winding motion when you apply the tape.

WIRE TO WIRE REPAIR

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool
- **EL-38125-5** Ultra Torch Special Tool
- DuraSeal splice sleeves, in order to repair the SIR/SRS wiring

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not

repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE:

- Use only DuraSeal splice sleeves. Other splice sleeves may not protect the splice from moisture or provide a good electrical connection.
- For wire Gauge smaller than .5 mm (18 gauge) refer to [Folded-Over Wire Repair](#)

Use DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19168446	Red (1) or Red/Green (1)	Red (2)	0.5 - 0.8/(18 - 20)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.6/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

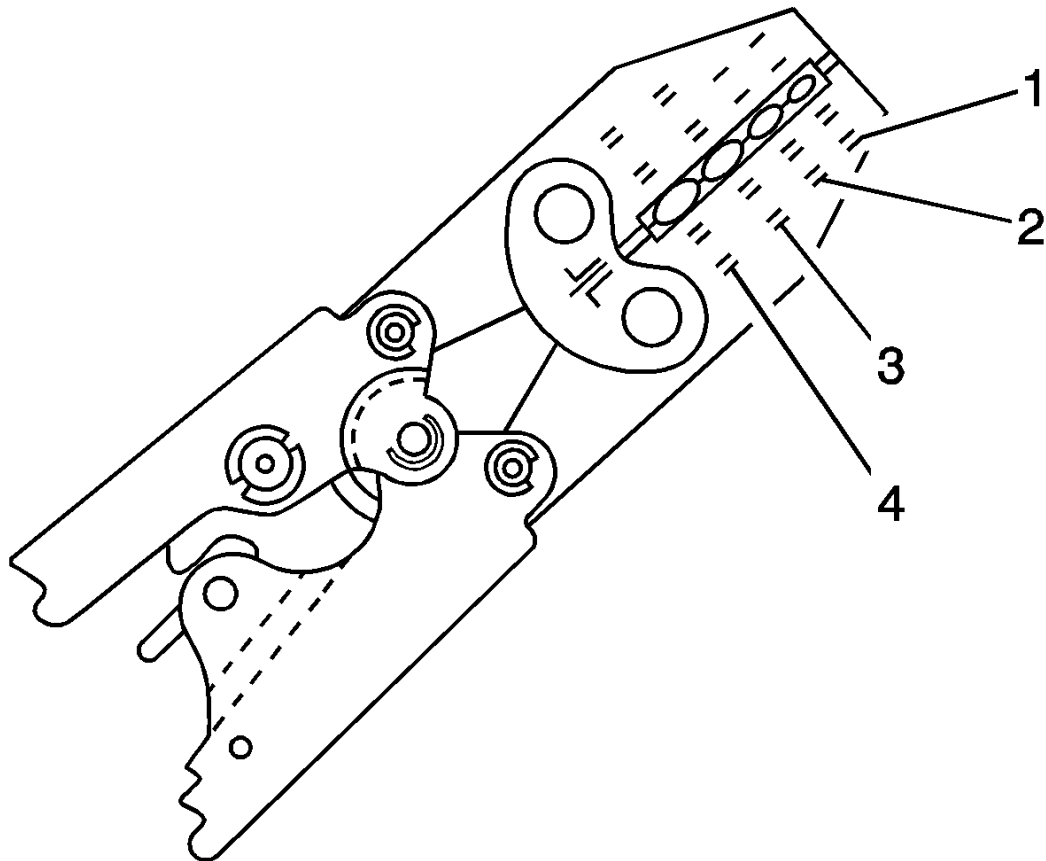


Fig. 15: Splice Sleeve Crimping Tool With 4 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for

crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

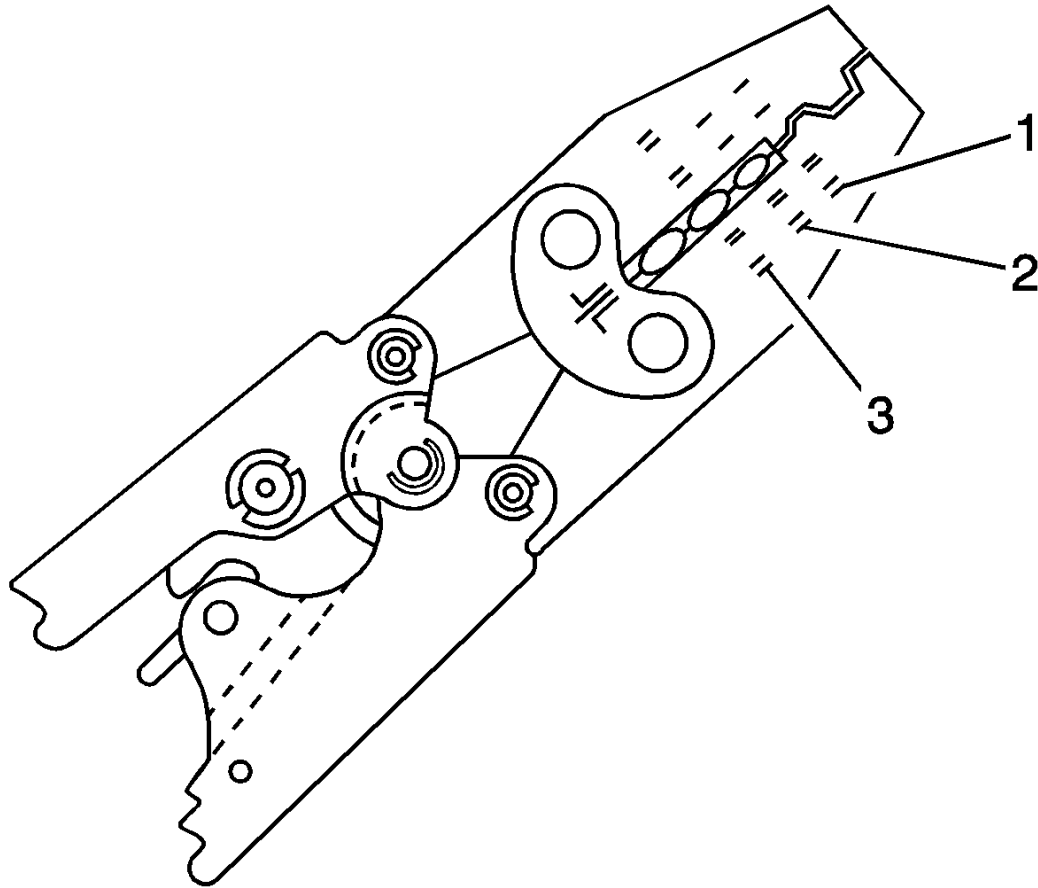


Fig. 16: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

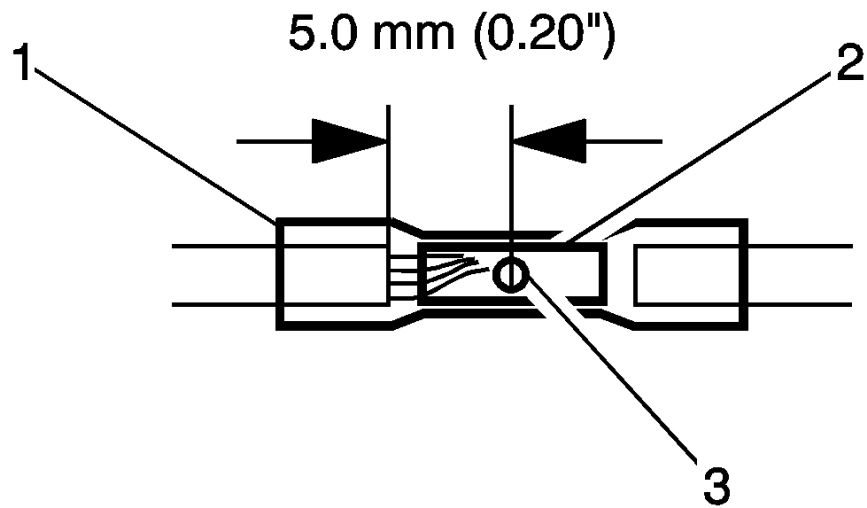


Fig. 17: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 18: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 19: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the EL-38125 - 5 ultra torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

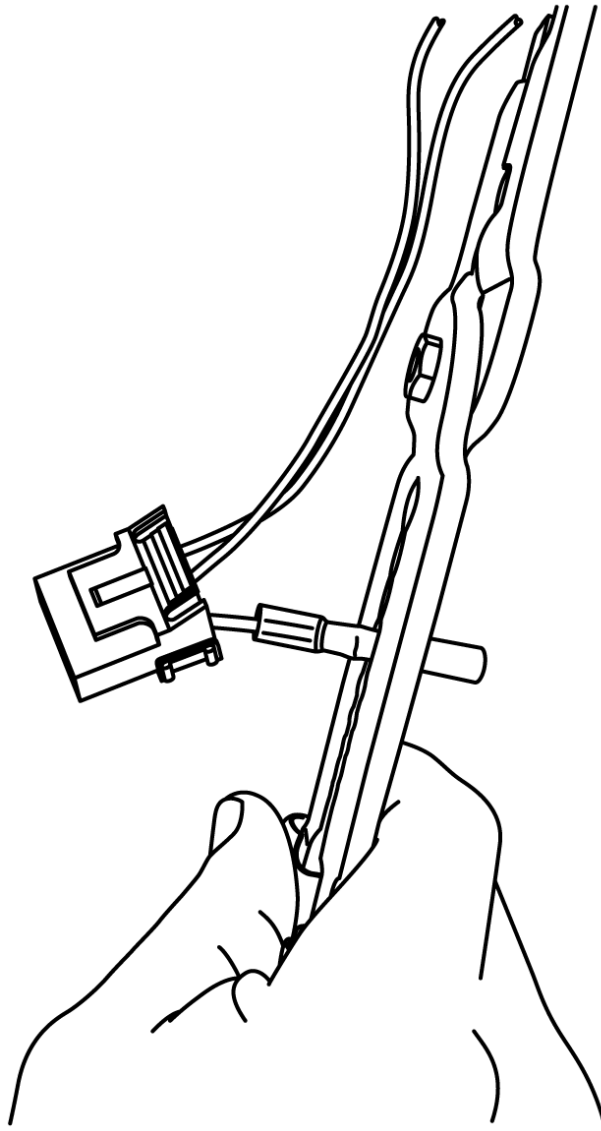


Fig. 20: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

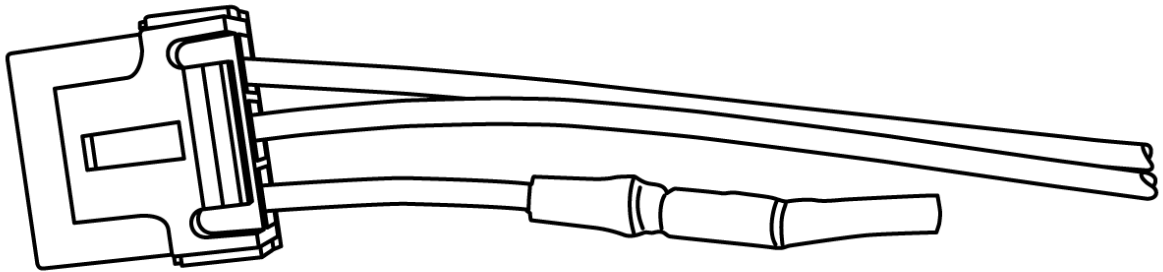


Fig. 21: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

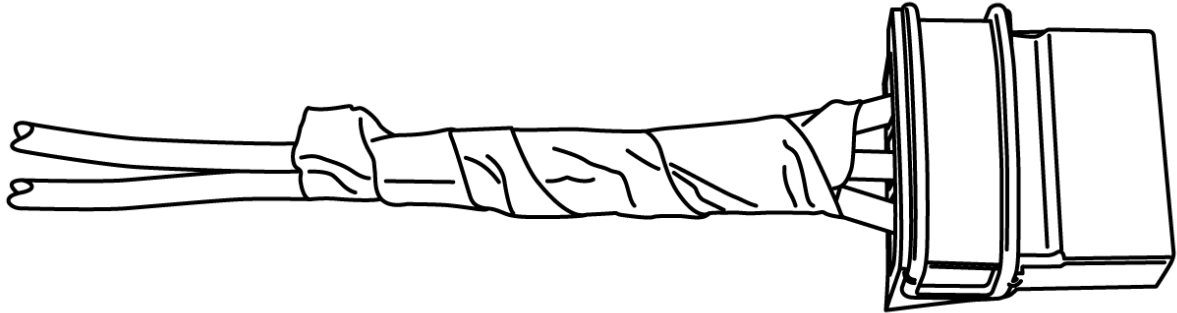


Fig. 22: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the EL-38125 - 5 ultra torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR POSITION ASSURANCE LOCKS

The connector position assurance (CPA) is a small plastic insert that fits through the locking tabs of the connector. CPAs are used in various connectors throughout the vehicle. CPAs are also used in all SIR system electrical connectors. The CPA ensures that the connector halves cannot vibrate apart. You must have the CPA in place in order to ensure good contact between the mating terminals of the connector.

TERMINAL POSITION ASSURANCE LOCKS

The terminal position assurance (TPA) insert resembles the plastic combs used in the control module connectors. The TPA keeps the terminal securely seated in the connector body. Do not remove the TPA from the connector body unless you remove a terminal for replacement. If the TPA is removed, be sure to reinstall it before reconnecting the connector.

AFL/EPC CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-216** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

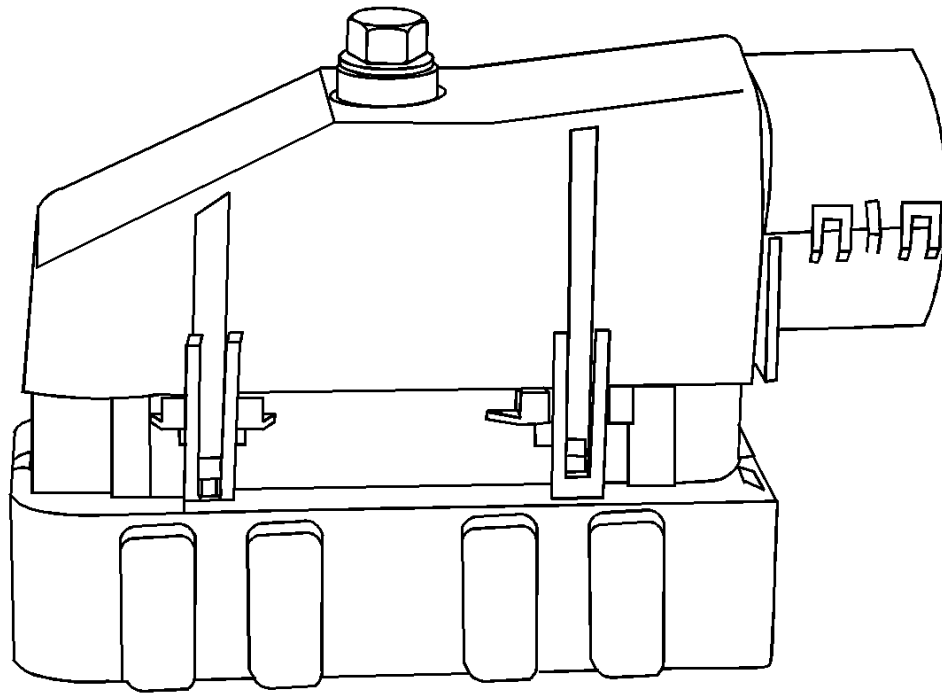


Fig. 23: View Of Bolt On Connector Cover
Courtesy of GENERAL MOTORS COMPANY

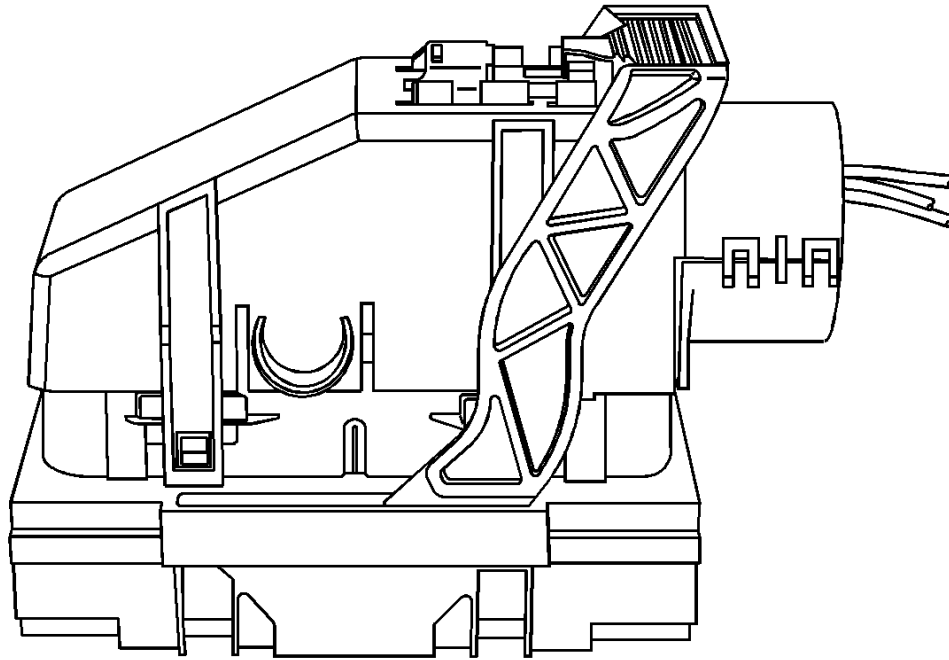


Fig. 24: Identifying Connector Position Assurance (CPA)

Courtesy of GENERAL MOTORS COMPANY

1. For connectors with a bolt in the dress cover, turn the bolt counterclockwise to remove the connector from the component.
2. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

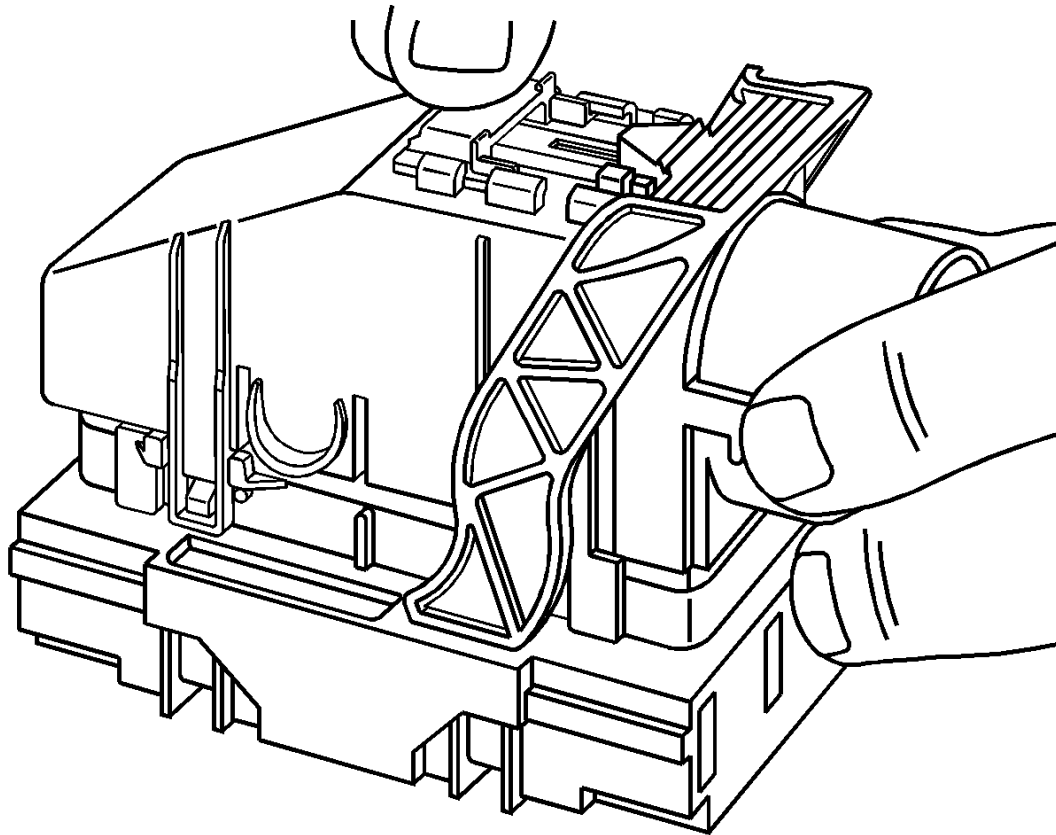


Fig. 25: Identifying Lever Lock & Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

3. Slide the lever lock forward while pressing down on the lever lock release tab.

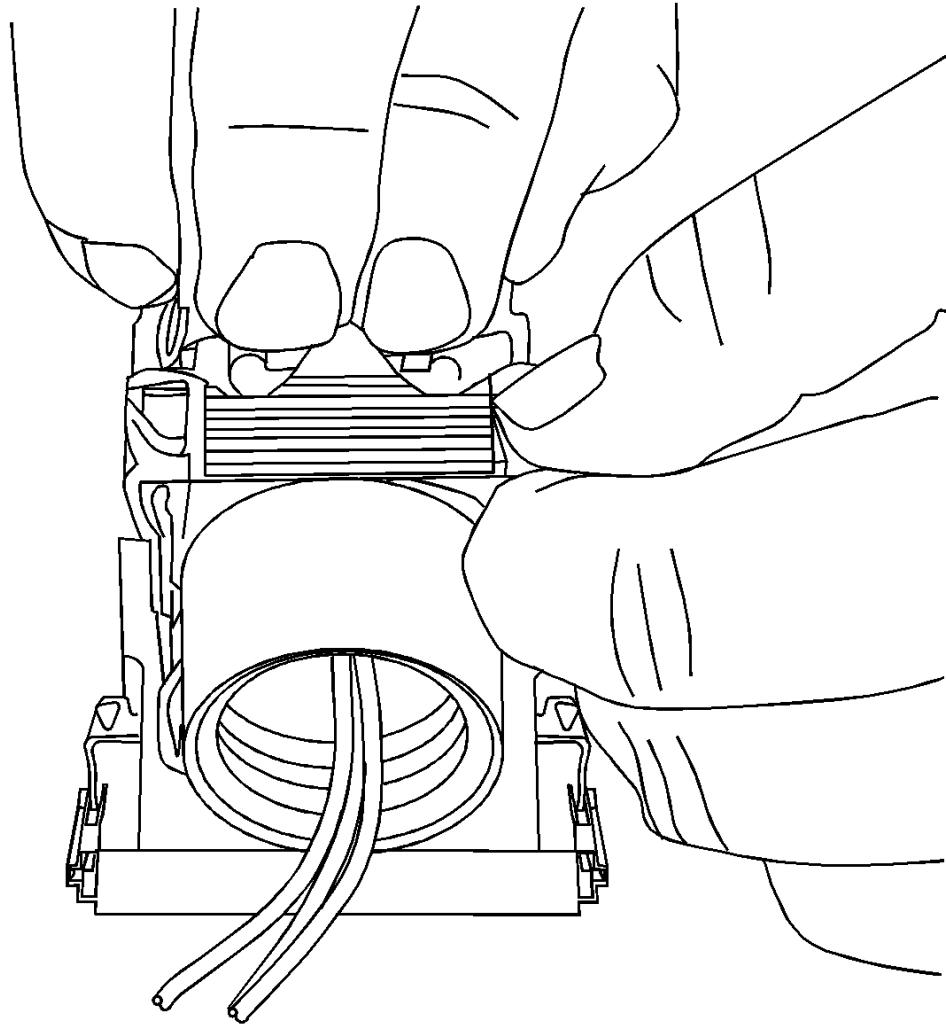


Fig. 26: View Showing Depressing Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

4. View showing depressing of the lever lock release tab.

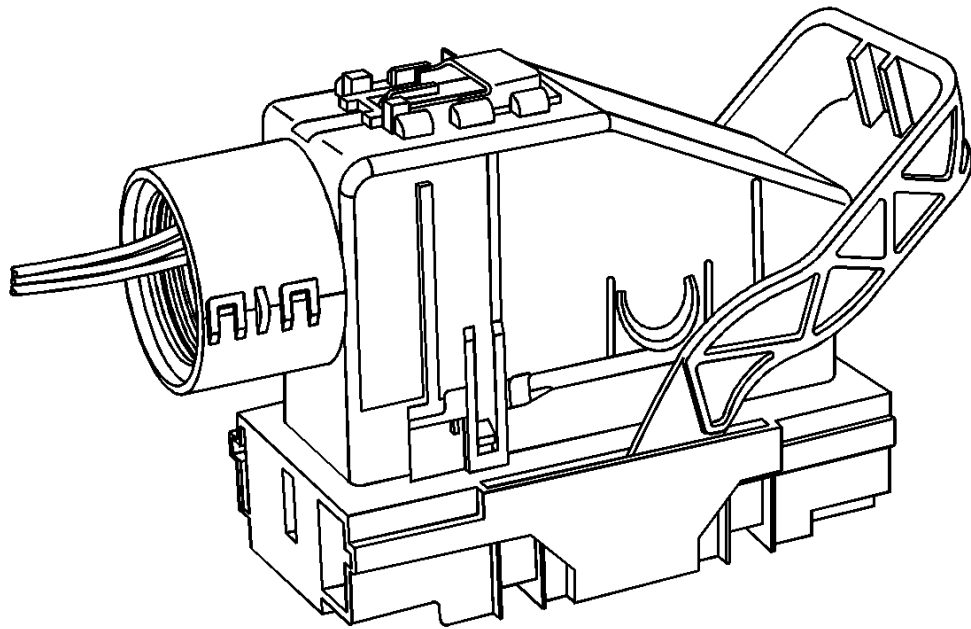


Fig. 27: View of connector in released position
Courtesy of GENERAL MOTORS COMPANY

5. View of connector in released position.
6. Disconnect the connector from the component.
7. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

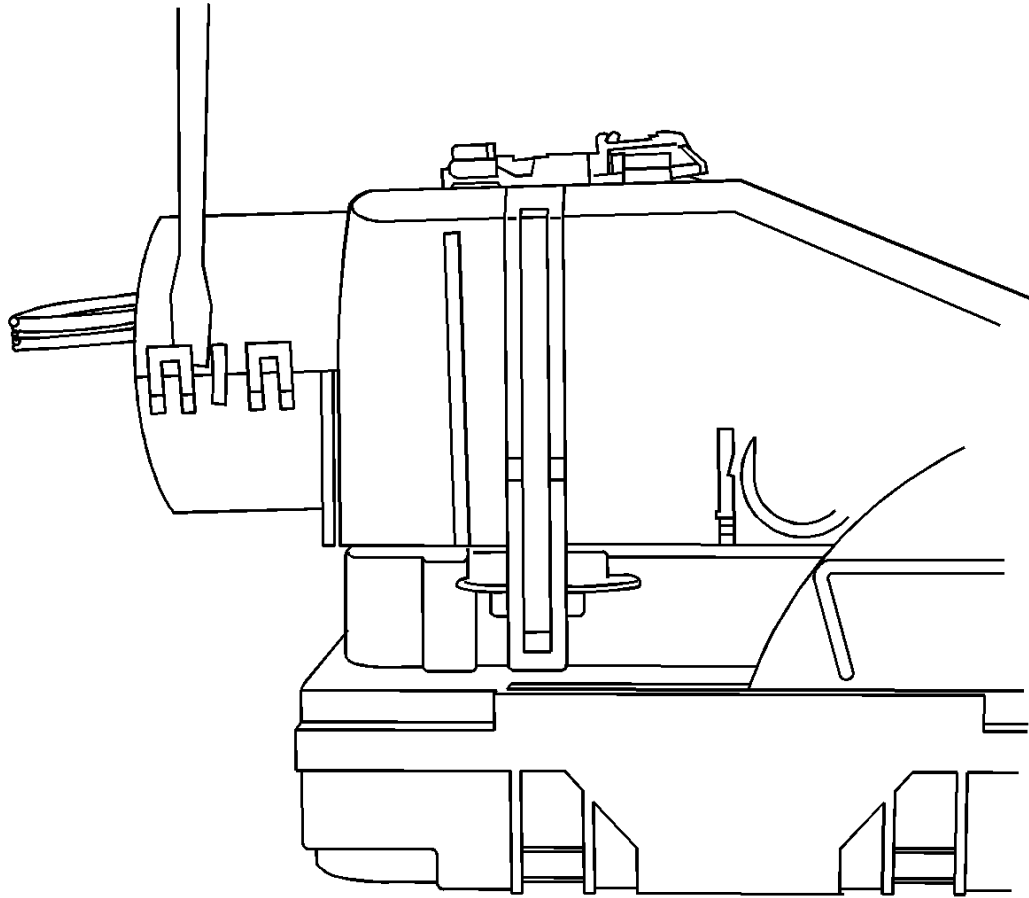


Fig. 28: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

8. Release the rear lower half of the wiredress cover.

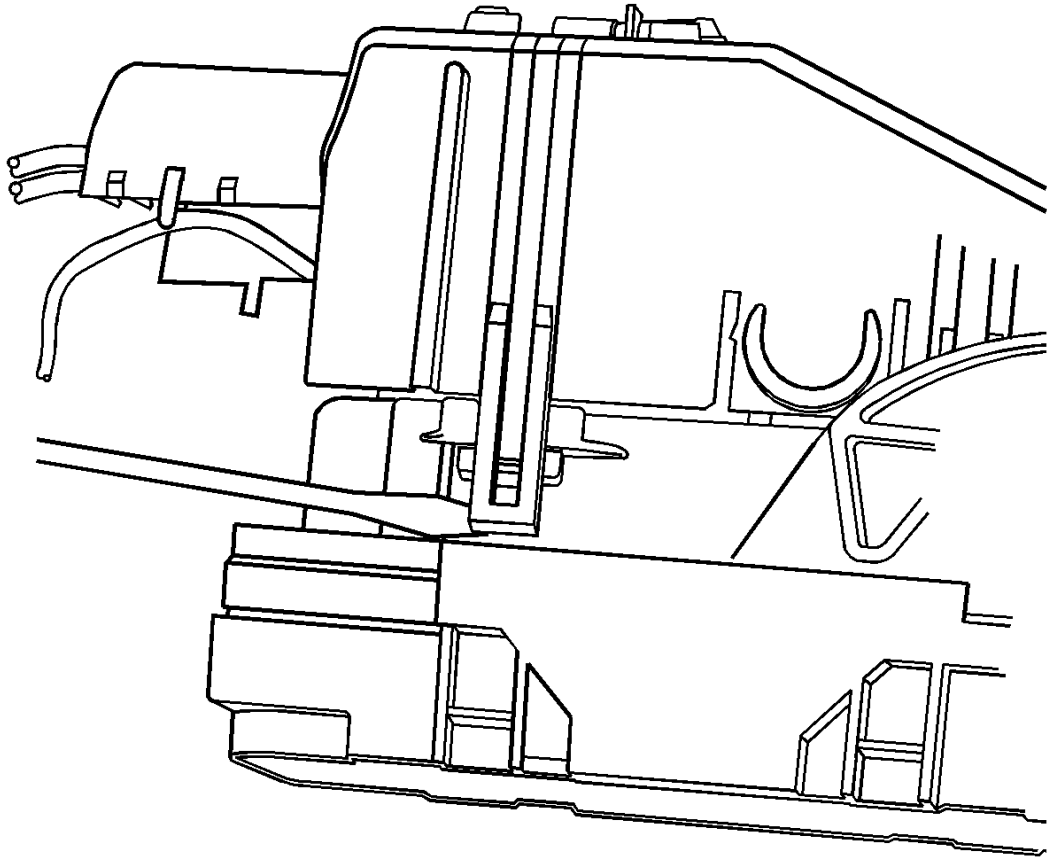


Fig. 29: Identifying Tabs Holding Wiredress Cover

Courtesy of GENERAL MOTORS COMPANY

9. Release the tabs that are holding the wiredress cover to the connector body.
10. Remove the nose piece by inserting a small flat-blade tool into the slots on both ends of the connector body. Gently pry the nose piece out of the connector. J-38125-216 can also be used to remove the nose piece.

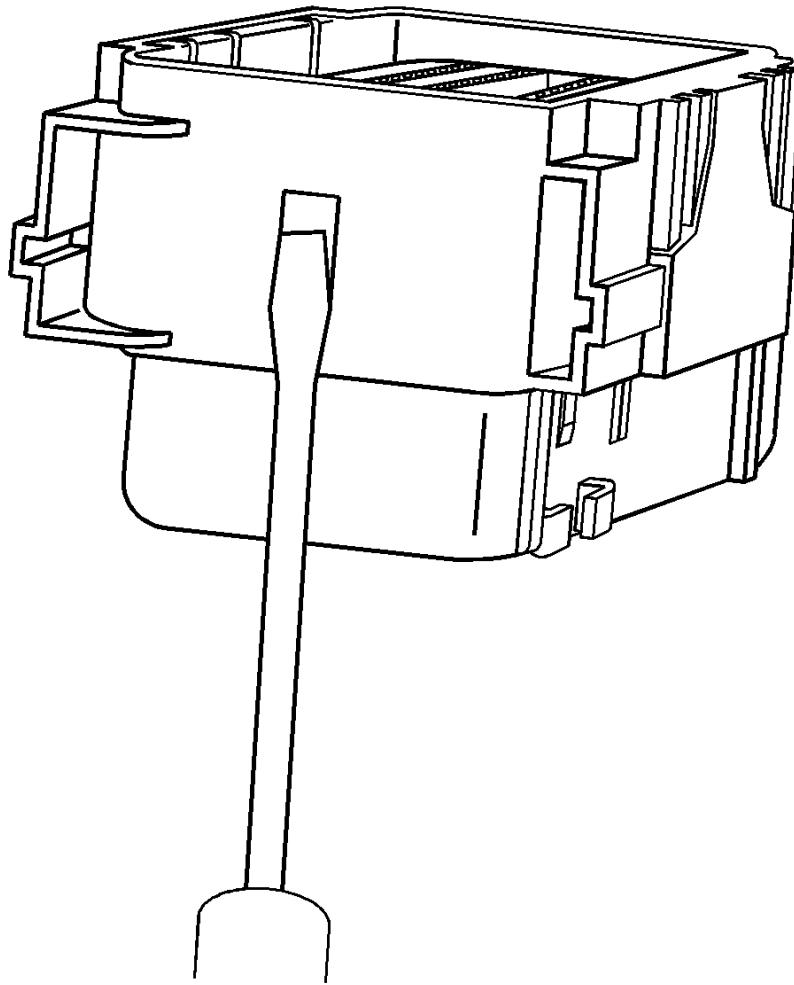


Fig. 30: Lifting Terminal Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

11. Use the J-38125-12A tool to release the terminals by lifting the terminal retaining tabs on the inside of the connector.

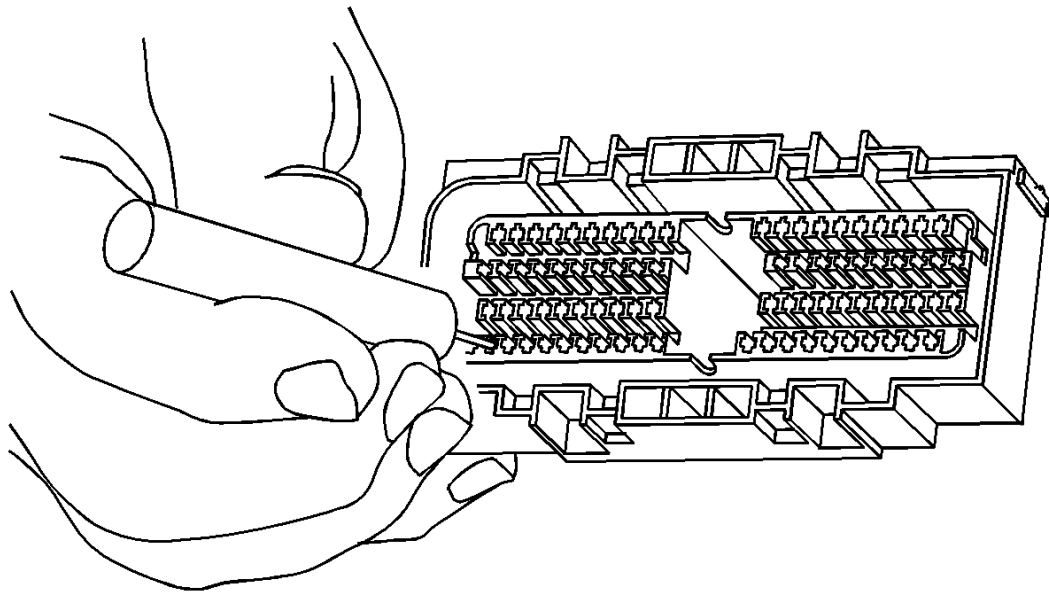


Fig. 31: Pulling Wire Out Of Back Of Connector

Courtesy of GENERAL MOTORS COMPANY

12. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
13. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
14. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (BSK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-561** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

1. Disconnect the connector from the component.
2. Remove the wire dress cover, if necessary.
3. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

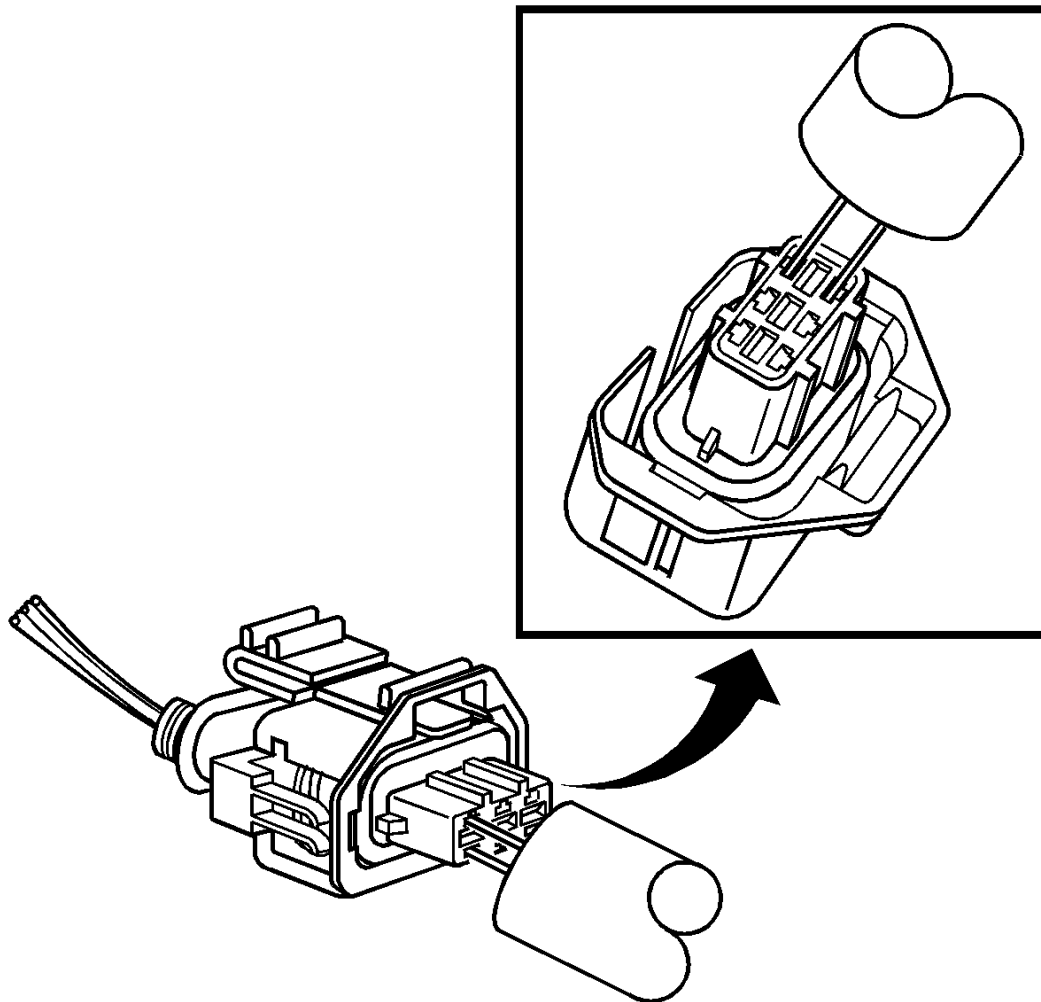


Fig. 32: View Of Bosch Connector Terminals (BSK)

Courtesy of GENERAL MOTORS COMPANY

4. Insert the J-38125-561 tool into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers.
5. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
6. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (0.64)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit

- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

1. Locate the lever lock on the wire dress cover. While pressing the lock, pull the lever over and past the lock until the lever is at the end of its travel.
2. Disconnect the connector from the component.
3. Pull the rubber boot that covers the wires back to expose the end of the connector dress cover.
4. Place the connector locking lever in the center of the connector.

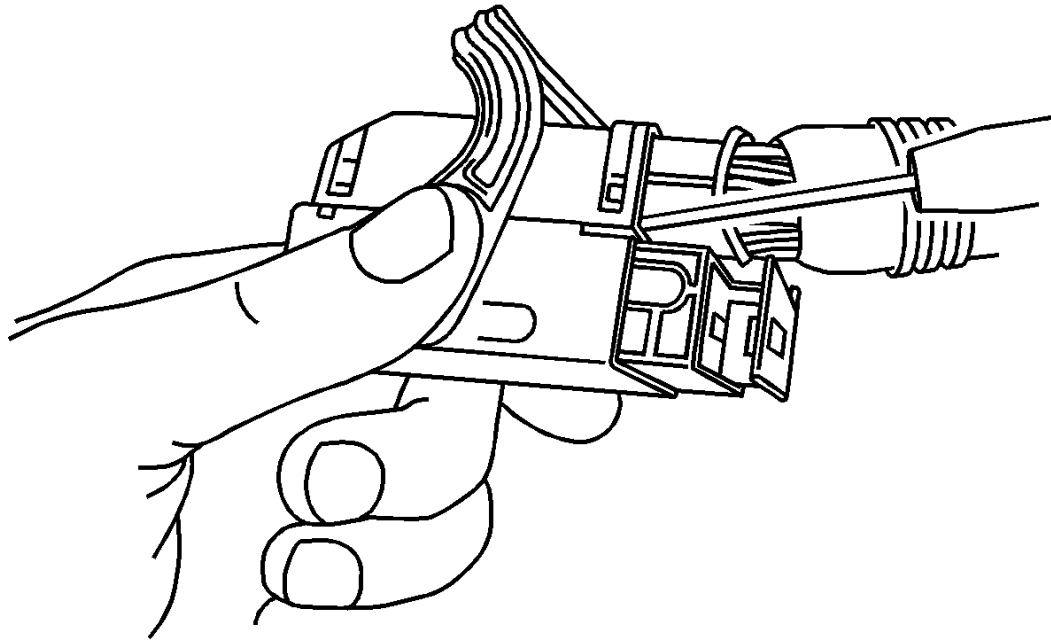


Fig. 33: View Of Flat-Bladed Tool Being Inserted Between Cover & Connector Body
Courtesy of GENERAL MOTORS COMPANY

5. Locate the 2 dress cover locking tabs that are on the wire end of the connector. Insert a small flat-bladed tool between the cover and connector body and pry up.

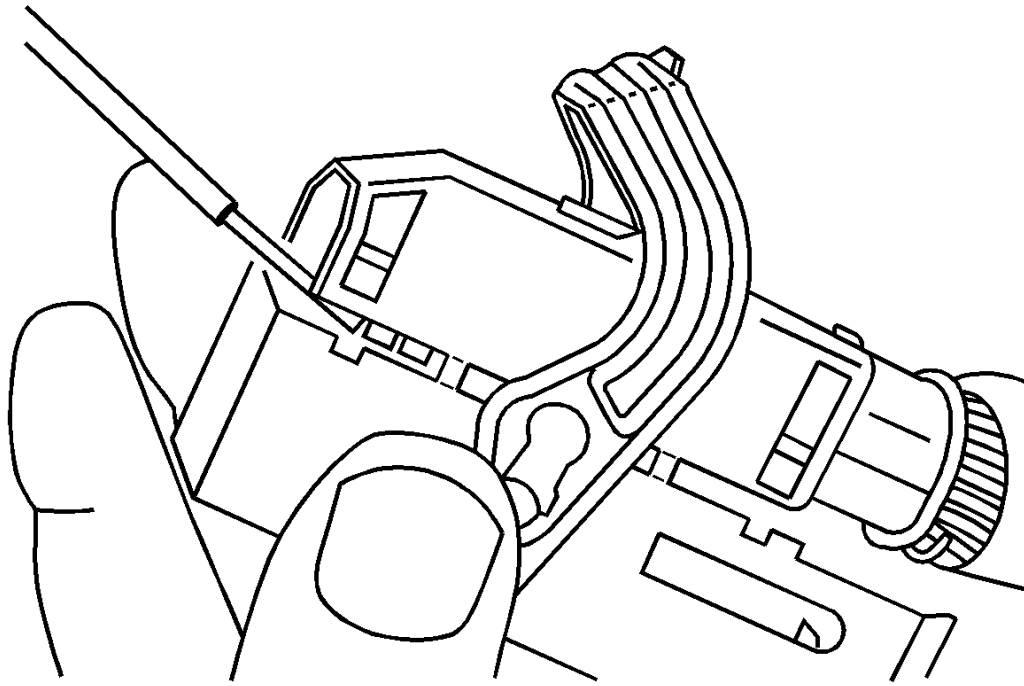


Fig. 34: View Of Flat-Bladed Tool Between Cover & Connector End
Courtesy of GENERAL MOTORS COMPANY

6. Locate the 2 dress cover locking tabs located on the opposite side of the connector. Insert a small flat-bladed tool between the cover at the connector end and pry up.
7. Remove the dress cover.
8. Cut the tie wrap on the wire bundle.

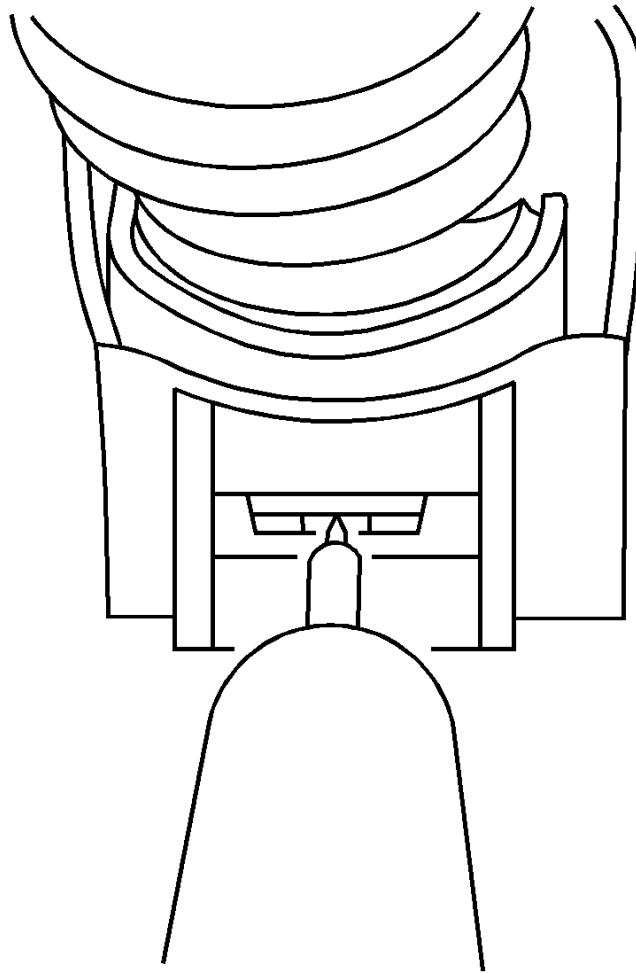


Fig. 35: View Of Terminal Position Assurance (TPA)

Courtesy of GENERAL MOTORS COMPANY

9. Remove the terminal position assurance (TPA) by inserting a small flat-bladed tool into the small slot in the end of the slider and pushing on the TPA until it comes out of the connector. When the TPA exits the opposite side of the connector, grasp the TPA and pull it completely out of the connector.
10. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

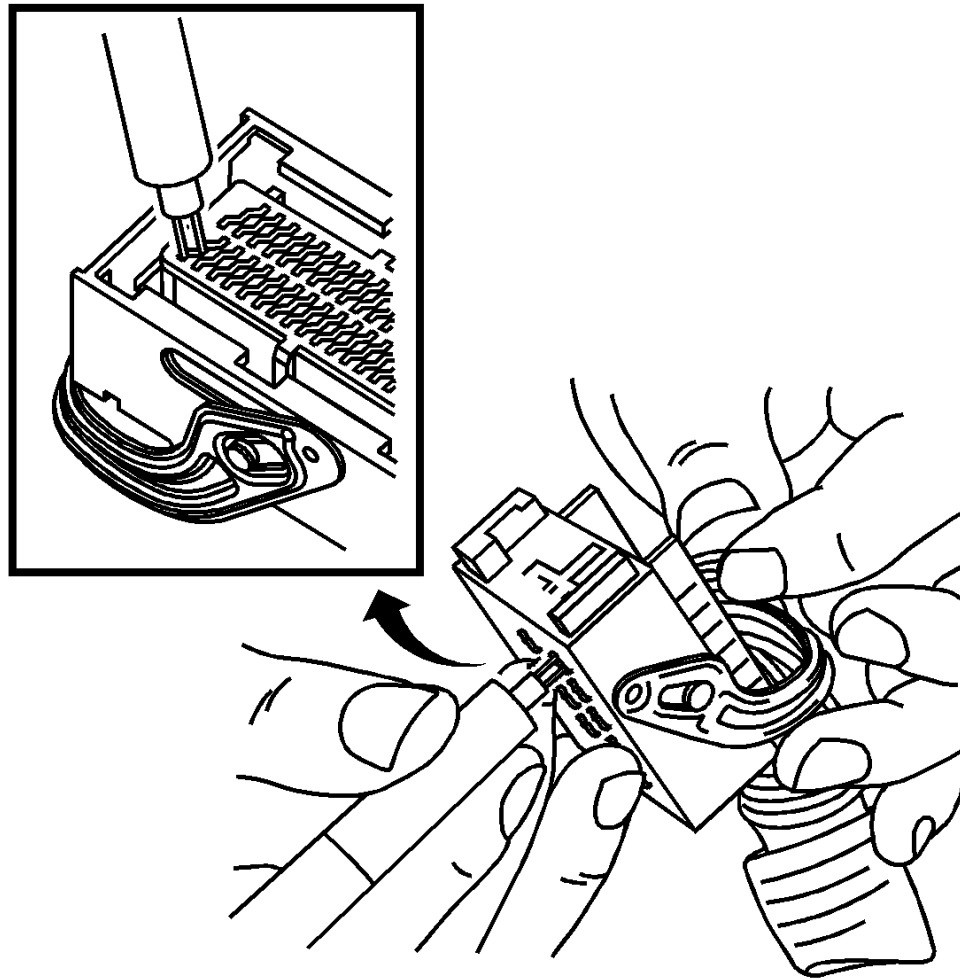


Fig. 36: View Of J 38125-560 Being Inserted Into Triangular Cavities
 Courtesy of GENERAL MOTORS COMPANY

11. Insert the J-38125-560 into the 2 triangular cavities on each side of the terminal at the front of the connector.
12. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
13. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)Repairing Connector Terminals (Terminal Repair) procedure.
14. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

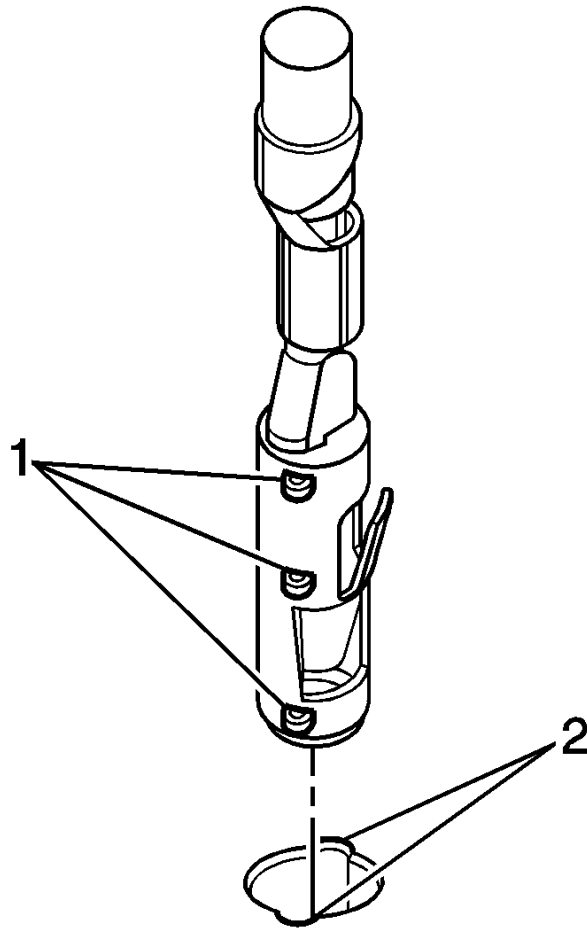


Fig. 37: Aligning Coding Lugs With Connector Coding Grooves

Courtesy of GENERAL MOTORS COMPANY

1. Prior to installation the terminal must be aligned so the (1) coding lugs align with the (2) coding grooves on the connector.
2. Once the terminal is aligned, slide the terminal into the cavity until the retainer has engaged in the cavity of the connector.
3. Slide the TPA in the connector body and seat it using a small flat bladed tool. The TPA is seated when it is flush with the contact housing.
4. Secure the wires to the connector body using a tie wrap and replace the dress cover and grommet.

BOSCH CONNECTORS (2.8 JPT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-557** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

1. Pull out the slider on the connector position assurance (CPA) until it is at the end of its travel.
2. Disconnect the connector from the component.
3. Remove the wire dress cover, if necessary.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

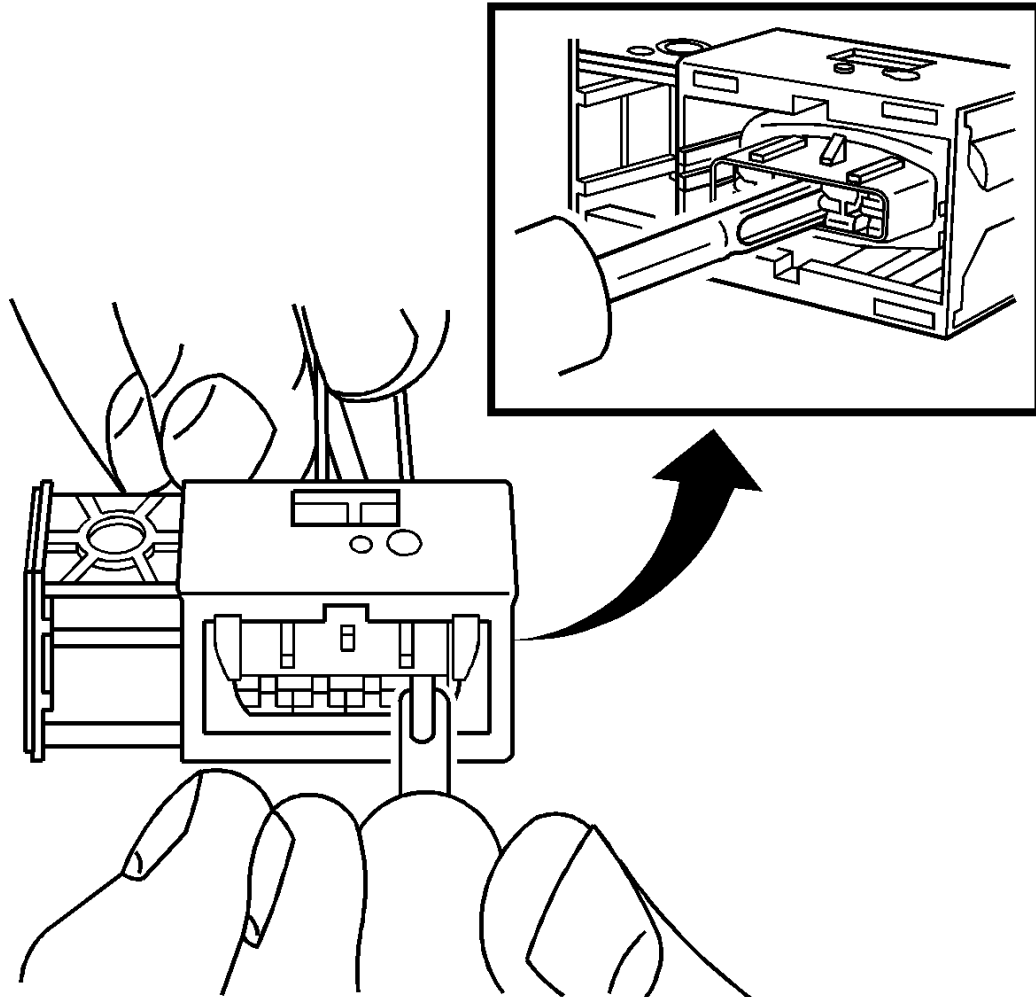


Fig. 38: Bosch Connector Terminals

Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-557 into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers.
6. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
7. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (ECM)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-213** Terminal Release Tool
- **J-38125-556** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

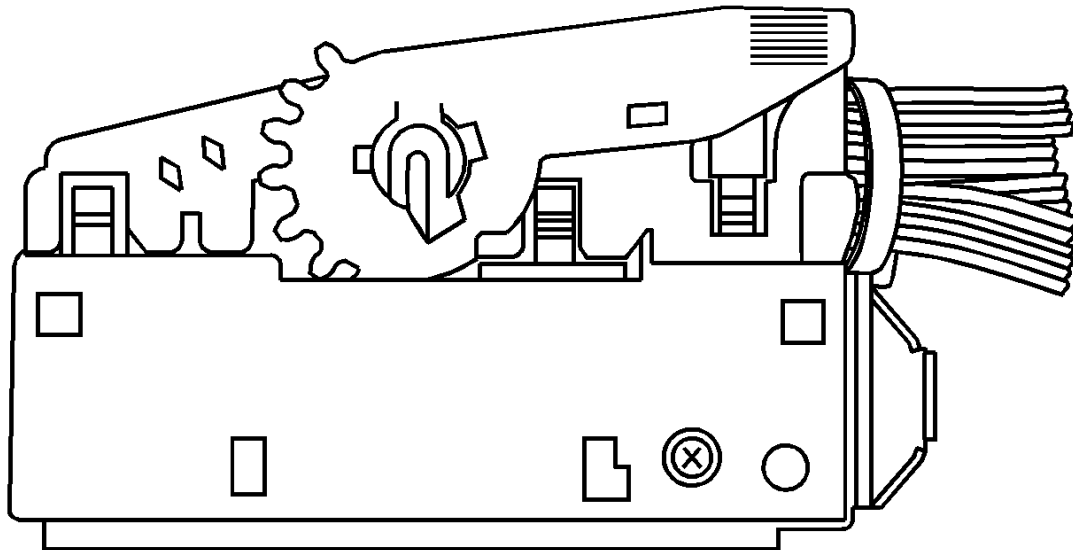


Fig. 39: View Of Bosch Connectors

Courtesy of GENERAL MOTORS COMPANY

1. Locate the assist lever on the top of the connector. Move the assist lever to the forward position.

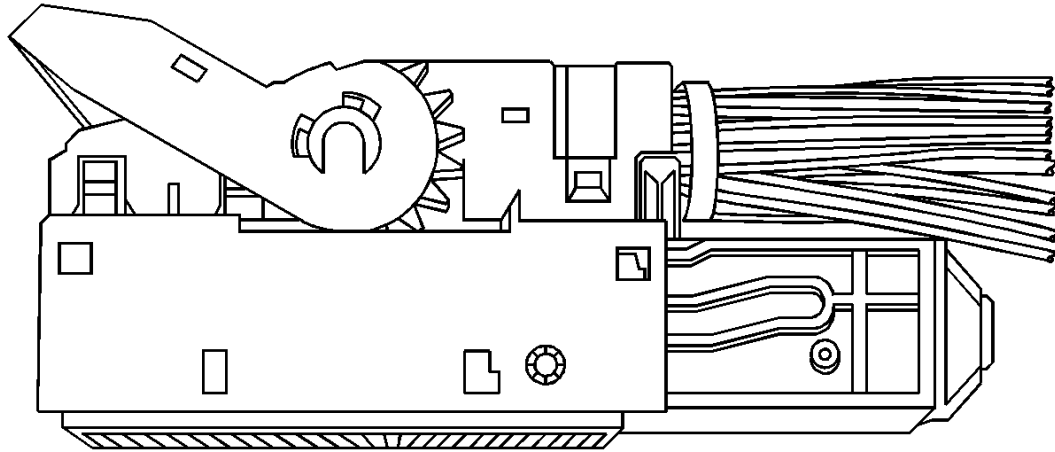


Fig. 40: Identifying Assist Lever In Forward Position
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the connector from the component.

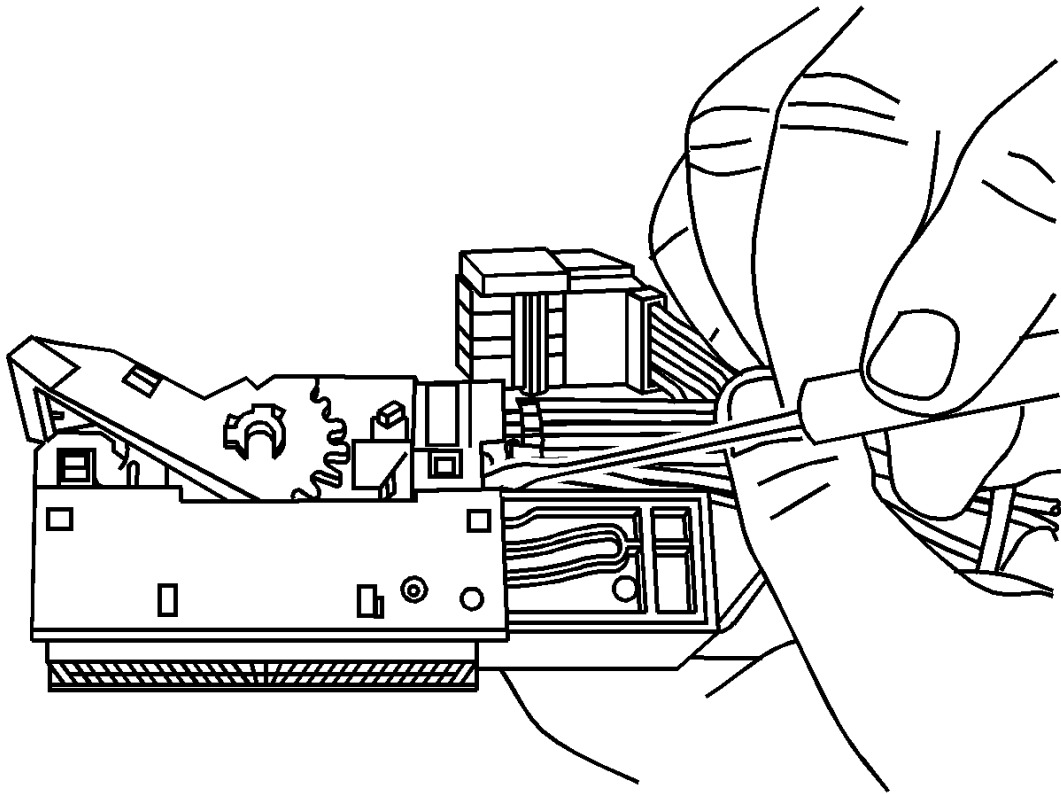


Fig. 41: View Of Releasing Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs at the corners of the connector. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

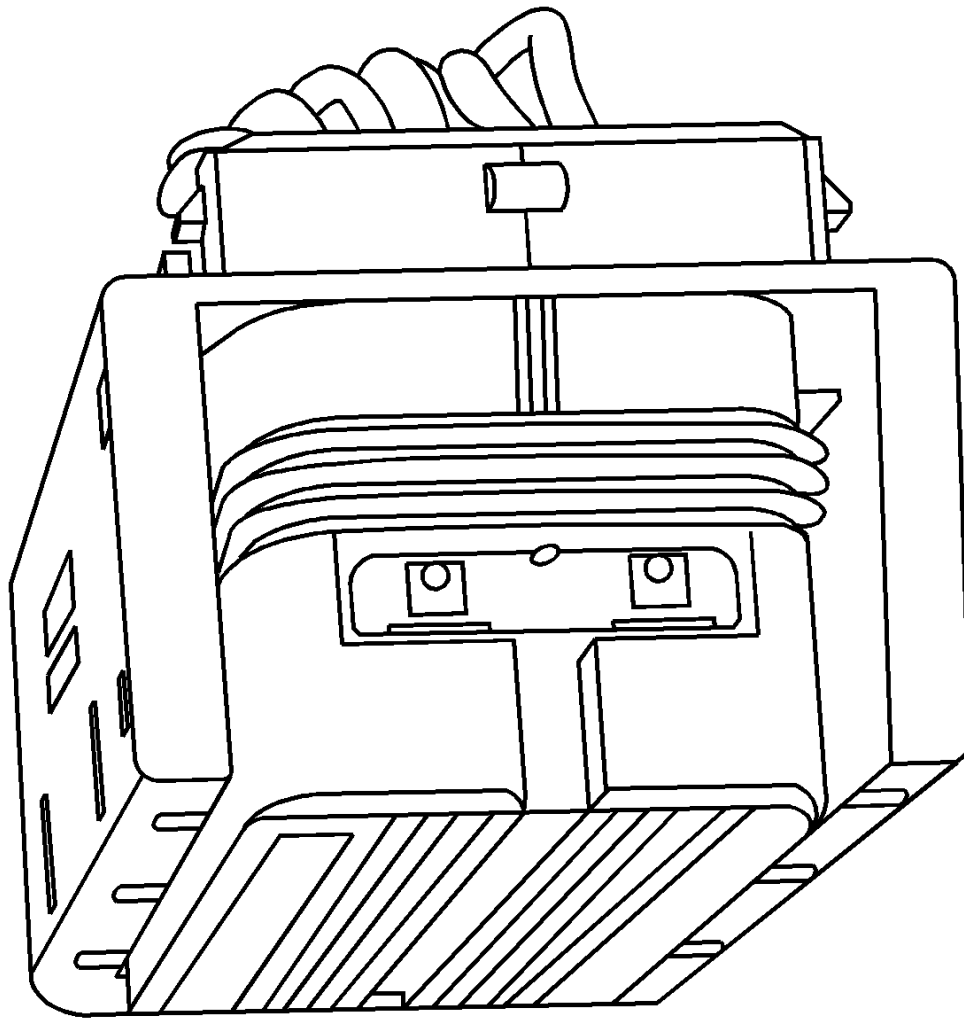


Fig. 42: View Of Terminal Positive Assurance (TPA) Connector

Courtesy of GENERAL MOTORS COMPANY

4. The terminal positive assurance (TPA) is located in the front of the connector.

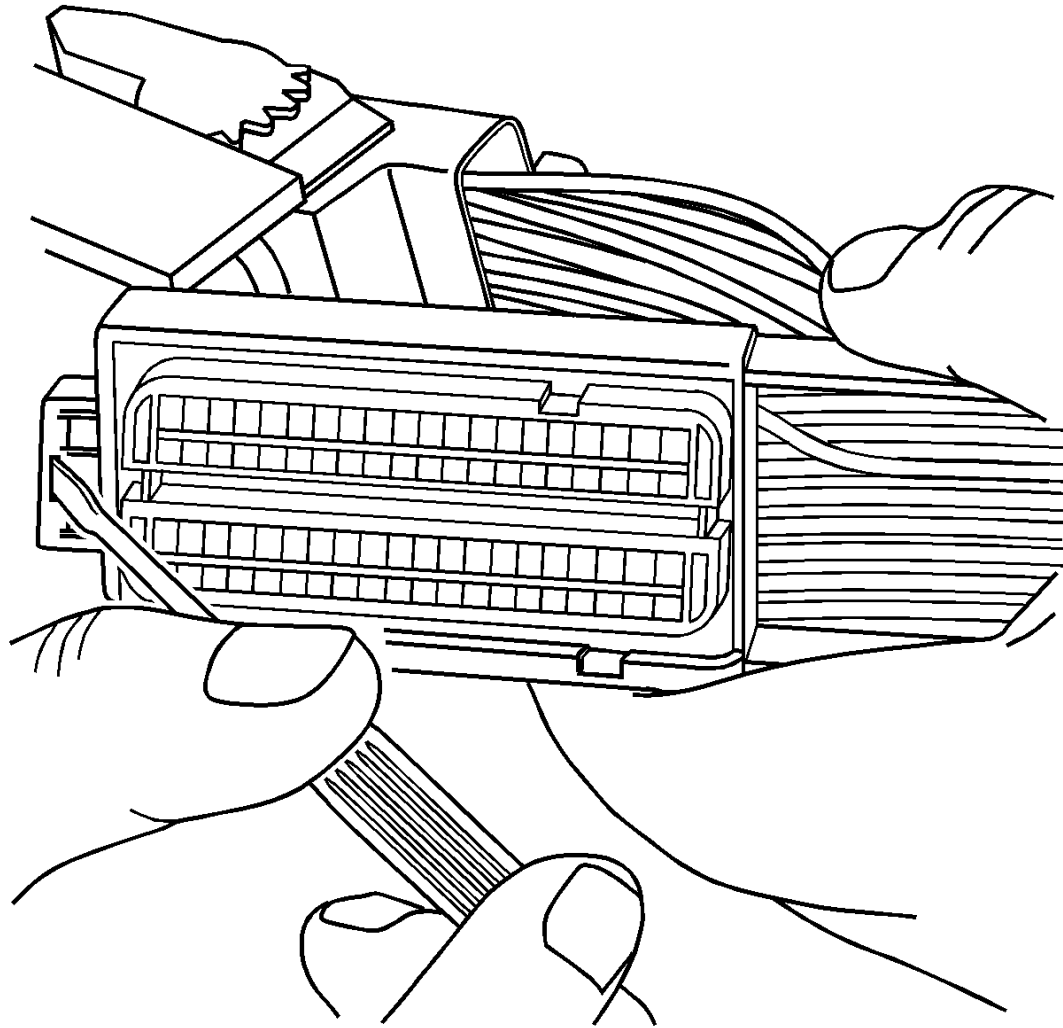


Fig. 43: View Of Removing TPA From Connector
Courtesy of GENERAL MOTORS COMPANY

5. Use a small flat-blade tool to remove TPA from the connector.

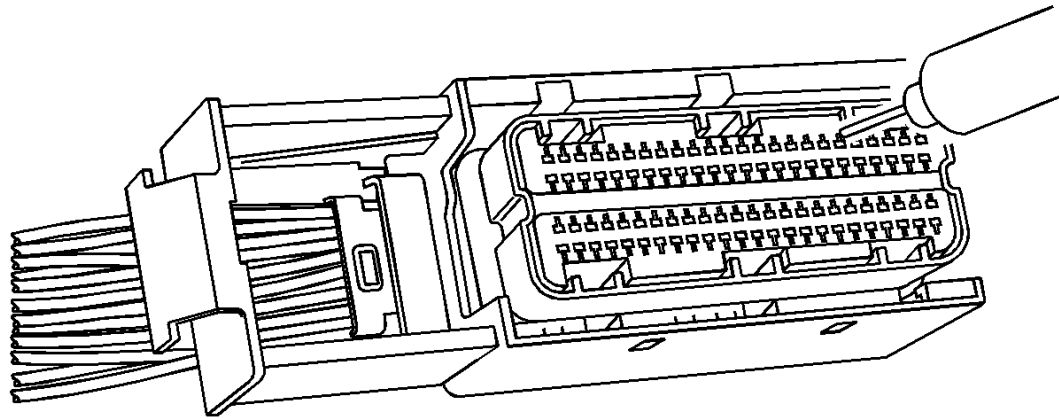


Fig. 44: View Of Special Tools And Terminals
Courtesy of GENERAL MOTORS COMPANY

6. Use the J-38125-213 or the J-38125-556 tool to release the terminals by inserting the tool into the terminal release cavity.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

NOTE: Ensure that the dress cover and connector body are both in the released position before reassembling. Failure to do so may cause damage to the connector and component.

10. Reconnect the connector bodies.

DELPHI CONNECTORS (WEATHER PACK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-10A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

The following is the proper procedure for the repair of Weather Pack® Connectors.

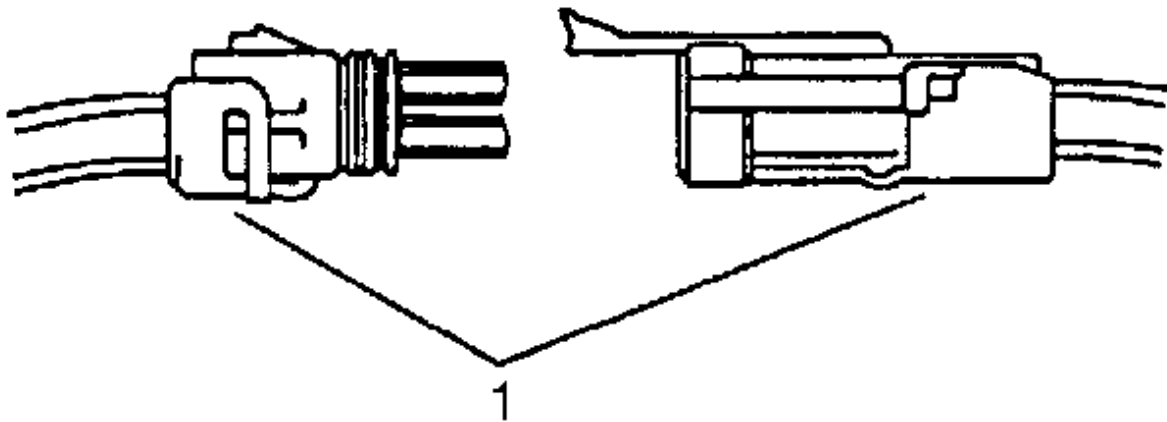


Fig. 45: View Of Connector Halves

Courtesy of GENERAL MOTORS COMPANY

1. Separate the connector halves (1).
2. Open the secondary lock. A secondary lock aids in terminal retention and is usually molded to the connector (1).
3. Grasp the wire and push the terminal to the forward most position. Hold the wire in this position.

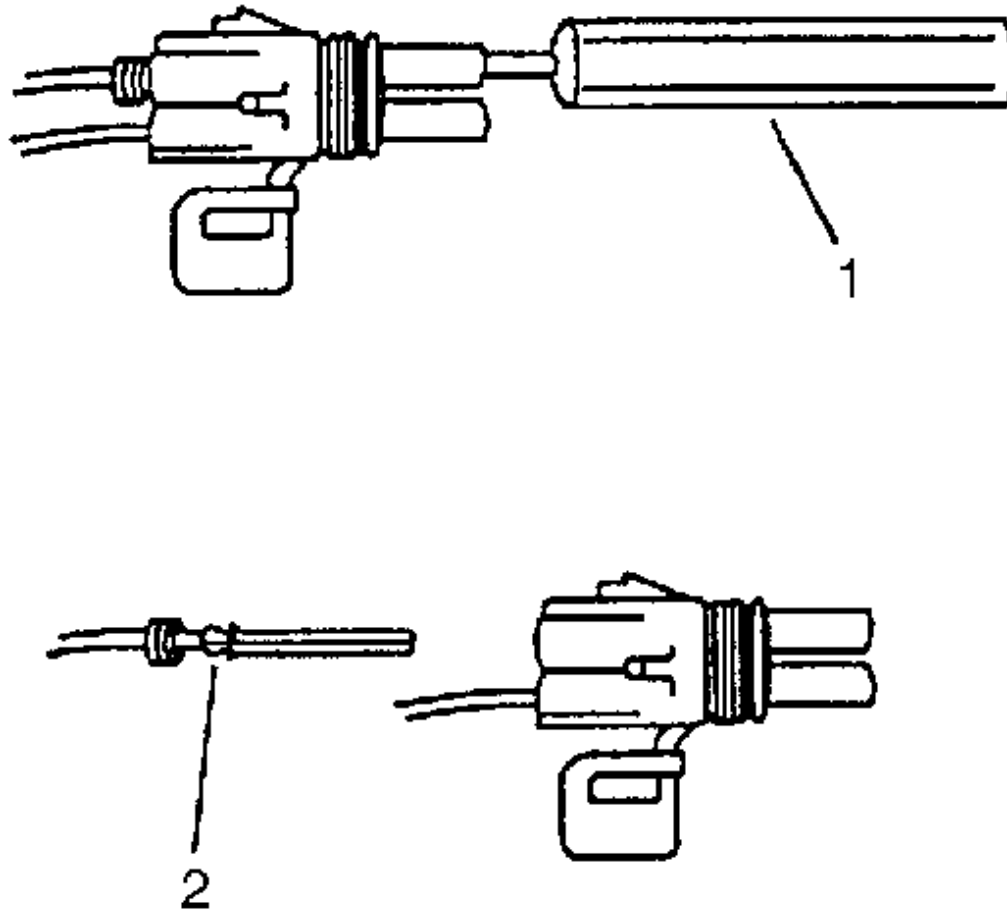


Fig. 46: Identifying Removal Tool & Terminal
 Courtesy of GENERAL MOTORS COMPANY

4. Insert the Weather Pack® terminal removal tool J-38125-10A into the front (mating end) of the connector cavity until it rests on the cavity shoulder (1).
5. Gently pull on the wire to remove the terminal through the back of the connector (2).

NOTE: **Never use force to remove a terminal from a connector.**

6. Inspect the terminal and connector for damage. Repair as necessary. Refer to [Repairing Connector Terminals \(Terminated Lead Repair\)](#) [Repairing Connector Terminals \(Terminal Repair\)](#).
7. Reform the lock tang (2) and reset terminal in connector body.
8. Close secondary locks and join connector halves.
9. Verify that circuit is complete and working satisfactorily.
10. Perform system check.
11. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead](#)

Repair)Repairing Connector Terminals (Terminal Repair) procedure.

12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (PUSH TO SEAT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to repair push to seat connectors.

1. Remove the terminal position assurance (TPA) device, the connector position assurance (CPA) device, and/or the secondary lock.

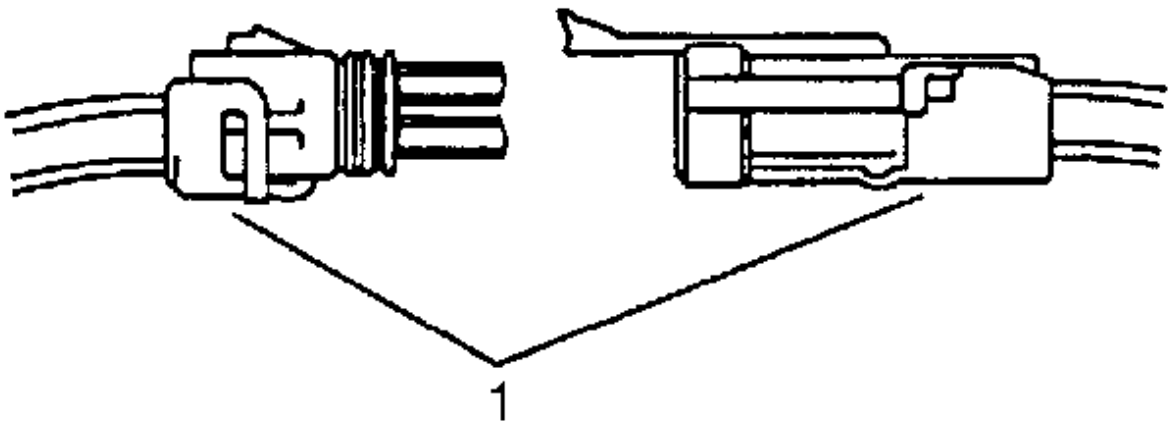


Fig. 47: View Of Connector Halves
Courtesy of GENERAL MOTORS COMPANY

2. Separate the connector halves (1).

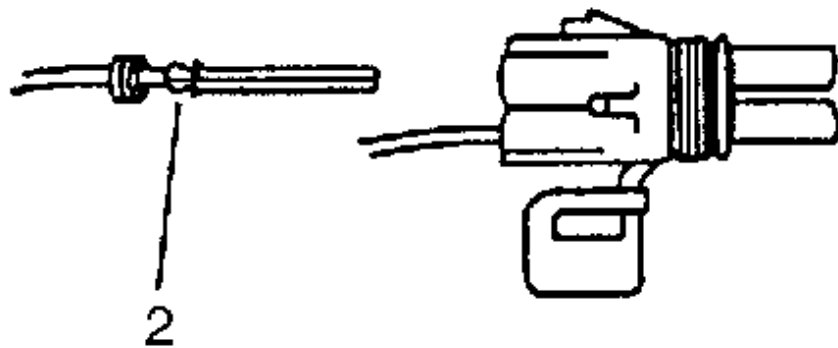
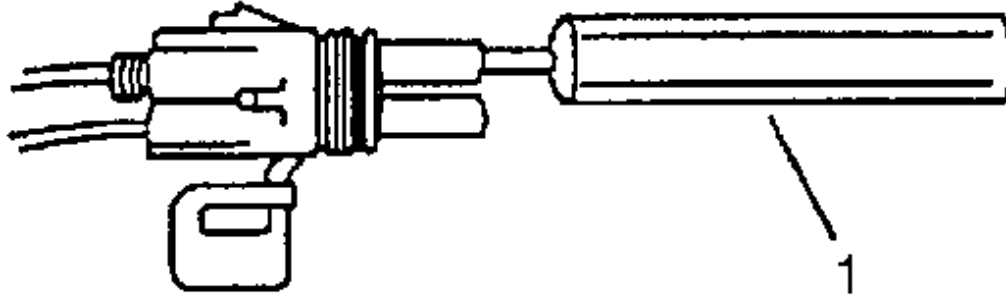


Fig. 48: Identifying Removal Tool & Terminal
Courtesy of GENERAL MOTORS COMPANY

3. Use the proper pick or removal tool (1) in order to release the terminal.
4. Gently pull the cable and the terminal (2) out of the back of the connector.

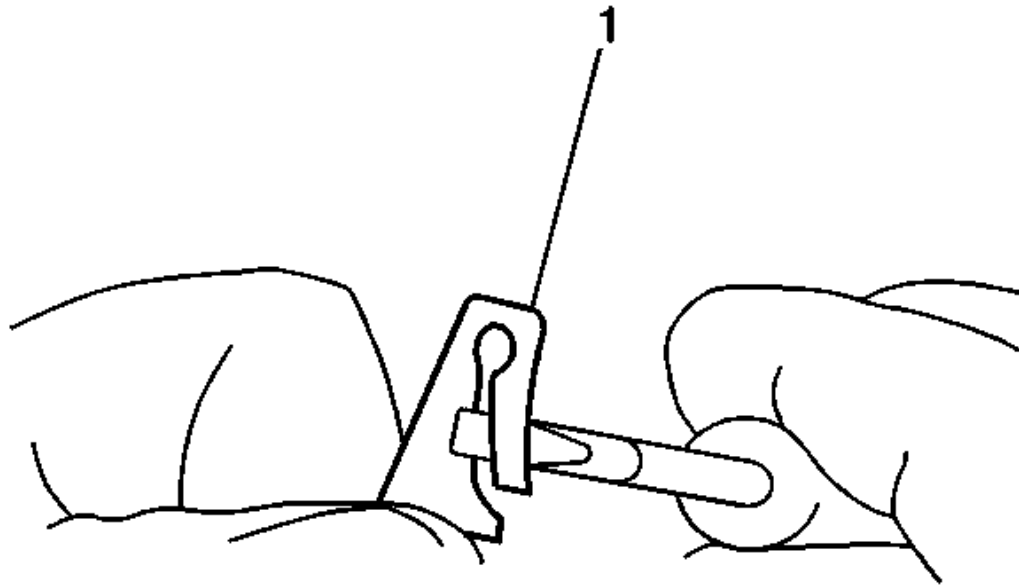


Fig. 49: Identifying Locking Device

Courtesy of GENERAL MOTORS COMPANY

5. Re-form the locking device if you are going to reuse the terminal (1).
6. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

1. In order to reuse a terminal or lead assembly, refer to [Wiring Repairs](#) .
2. Ensure that the cable seal is kept on the terminal side of the splice.
3. Insert the lead from the back until it catches.
4. Install the TPA, CPA, and/or the secondary locks.

DELPHI CONNECTORS (PULL TO SEAT)

Special Tools

- EL-38125-550 Terminal Release Tool Kit

- **EL-38125-580** Terminal Release Tool Kit

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

If the terminal is visibly damaged or is suspected of having a faulty connection, the terminal should be replaced.

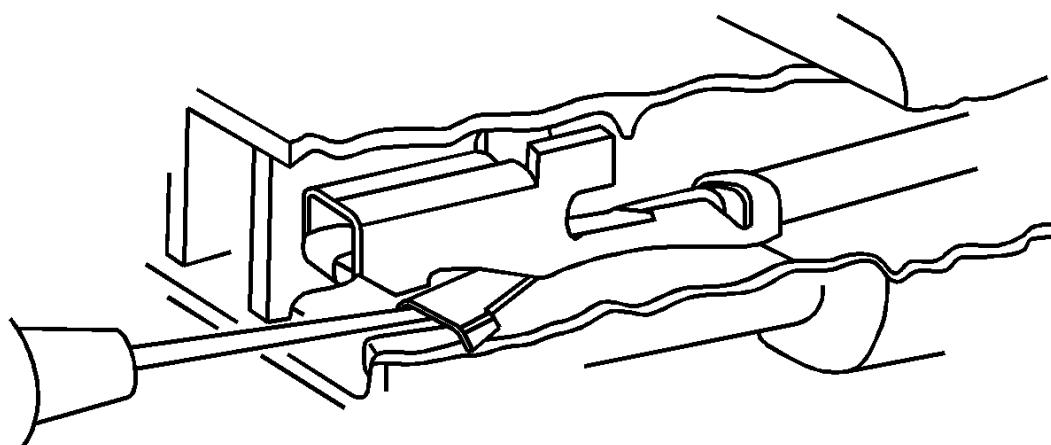


Fig. 50: Aligning Removal Tool - Delphi (Pull To Seat)

Courtesy of GENERAL MOTORS COMPANY

Follow the steps below in order to repair pull-to-seat connectors:

1. Remove the connector position assurance (CPA) device and/or the secondary lock.
2. Disconnect the connector from the component or separate the connectors for in-line connectors.
3. Remove the terminal position assurance (TPA) device.
4. Review the connector end view to determine the proper test probe and release tool.
5. Insert the release tool into the front of the connector body.
6. Grasp the wire at the back of the connector body and gently push the terminal out the front of the connector body.

7. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

1. Align the terminal and pull the wire from the back of the connector in order to seat the terminal.
2. If the connector is outside of the passenger compartment, apply dielectric grease to the connector.
3. Install the TPA, CPA, and/or the secondary locks.

DELPHI CONNECTORS (MICRO-PACK 100W)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

There are 2 styles of Micro-Pack 100W connectors. These connectors are very similar but use different terminals and have some minor physical differences also.

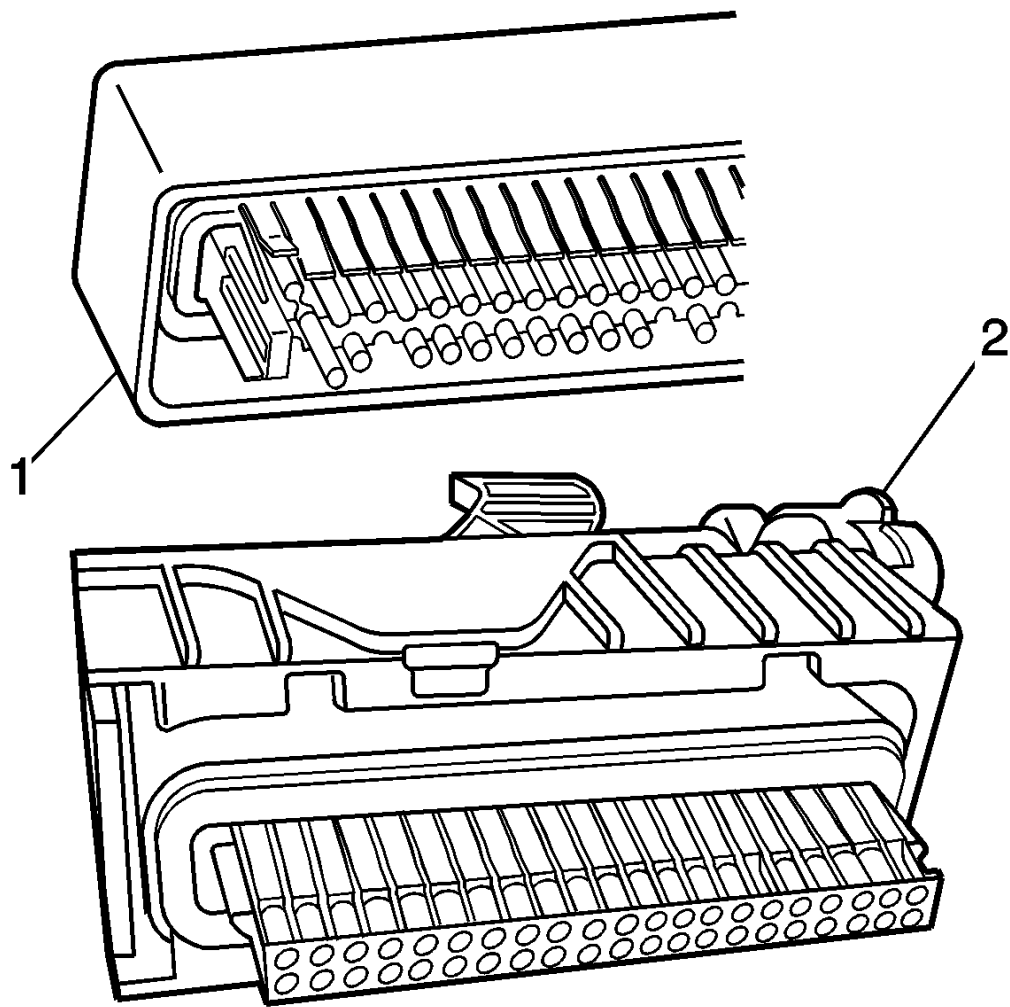


Fig. 51: Identifying Micro-Pack 100W First & Second Connector Designs

Courtesy of GENERAL MOTORS COMPANY

The first connector design of the Micro-Pack 100W (1) has a white connector interface that holds the terminals. The second design of the Micro-Pack 100W (2) has a gray interface to hold the terminals. Also, the first design has terminal cavities that are further apart (3 mm centerline) and offset from the other row of terminal cavities in the connector. The second design has terminals cavities that are closer together (2.54 mm centerline) and aligned vertically. One other way to identify the second design is the thin strip of material that runs along the outside of the cavities.

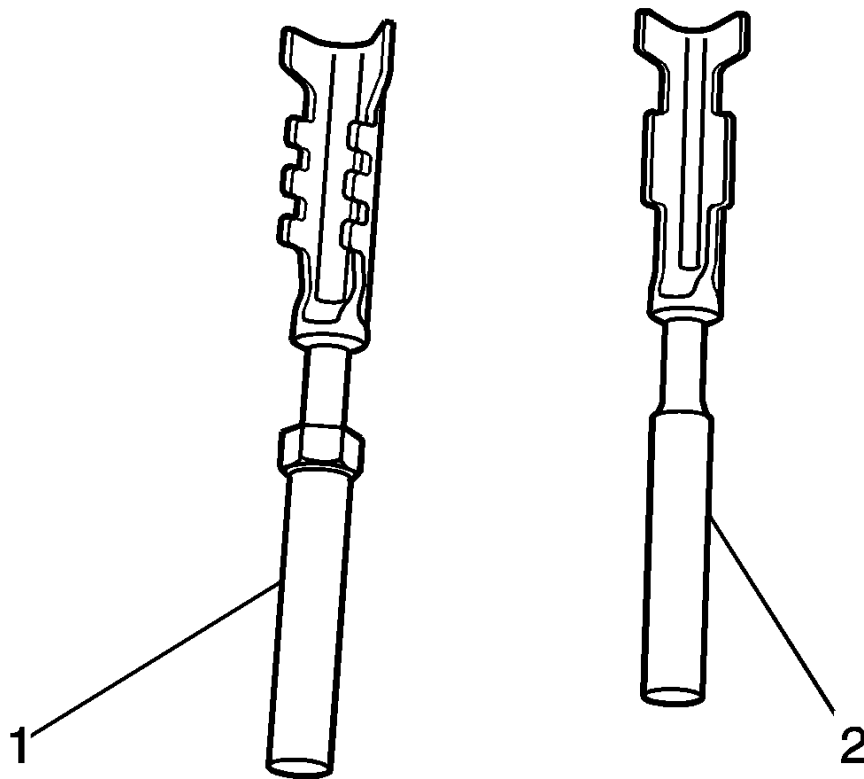


Fig. 52: Identifying Micro-Pack 100W Short & Long Terminals

Courtesy of GENERAL MOTORS COMPANY

NOTE: There are 2 styles of Micro-Pack 100W terminals which are very similar. Ensure that you have the correct terminal before crimping the new terminal to the wire. The first design connector uses the longer terminal (1) that has a raised area in front of the recess in the terminal. The second design connector uses the shorter terminal without the raised area.

Follow the steps below in order to remove terminals from Micro-Pack 100W connectors. Some Micro-Pack 100W connector disassembly procedures will vary. Use this procedure as a guide.

1. Disconnect the connector from the component.

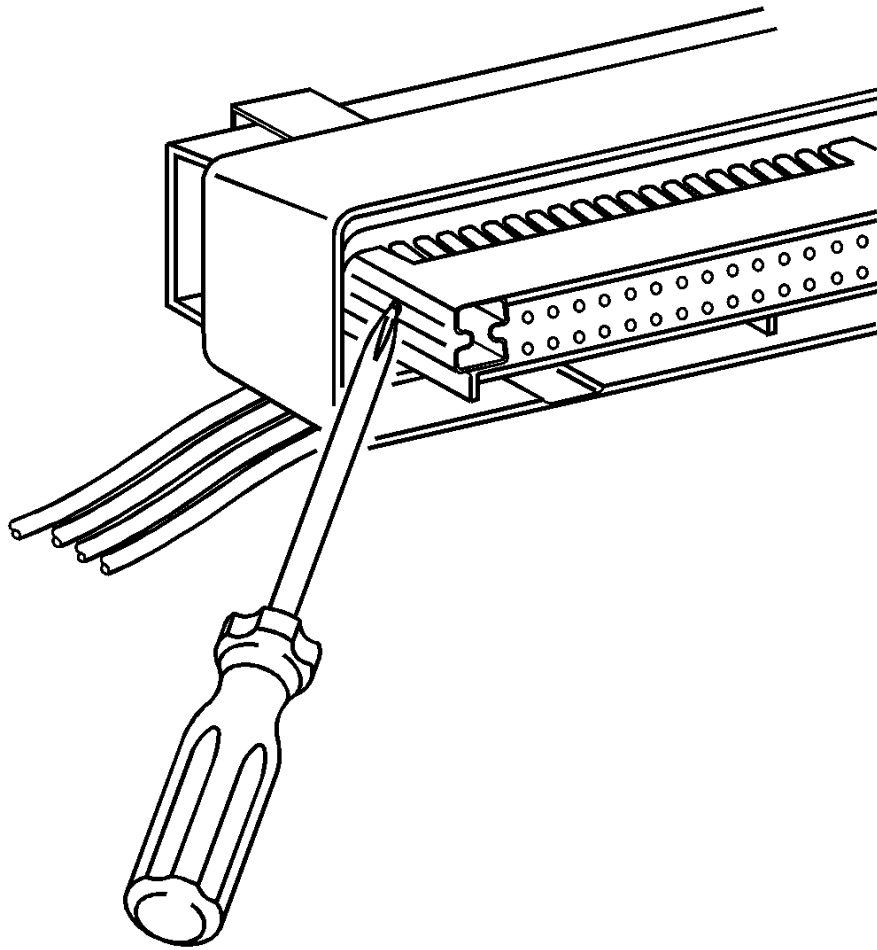


Fig. 53: Locating Nose Piece Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

2. Locate the nose piece locking tabs that are positioned on the side of the connector nose piece. The connector nose piece acts as a terminal positive assurance (TPA) and may be referred to as such.

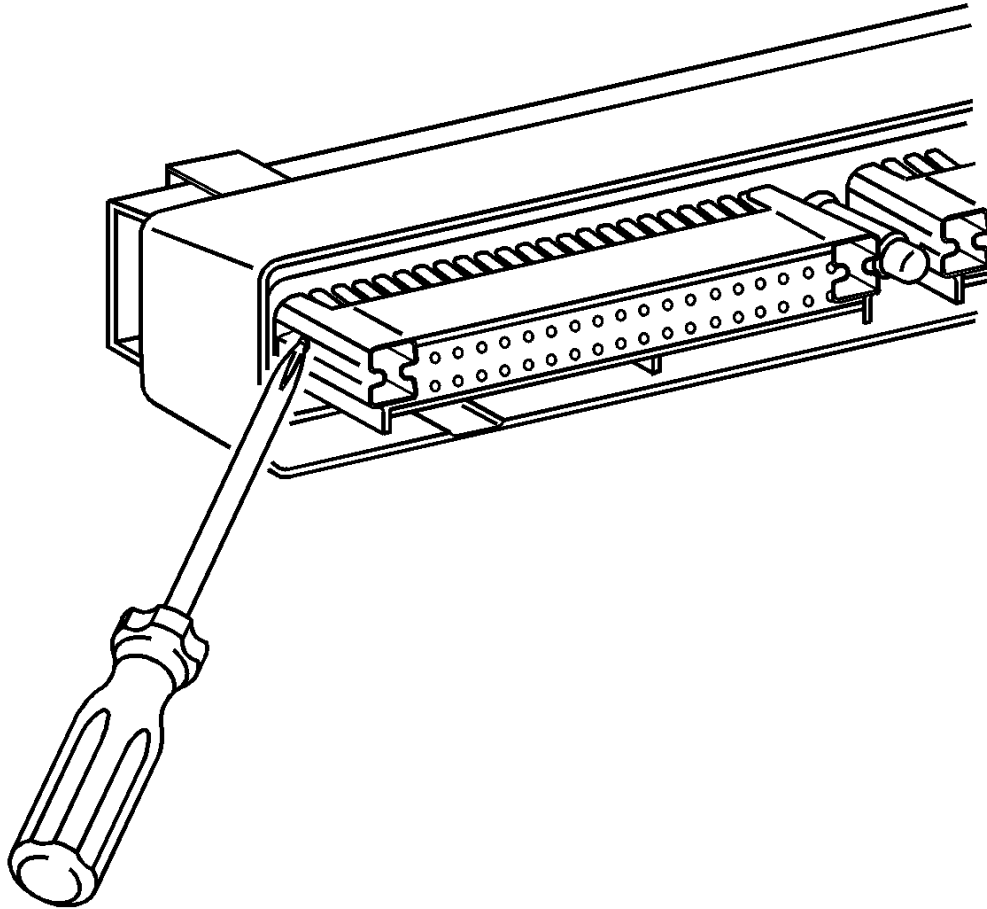


Fig. 54: Loosening Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-blade tool to push in one of the locking tabs while gently pulling on the same side of the nose piece.
4. Repeat the procedure for the other locking tab and remove the nose piece.
5. Remove the wire dress cover. The following is a general procedure for wire dress cover removal. Use this procedure as a guide, some dress cover removal procedures may vary.

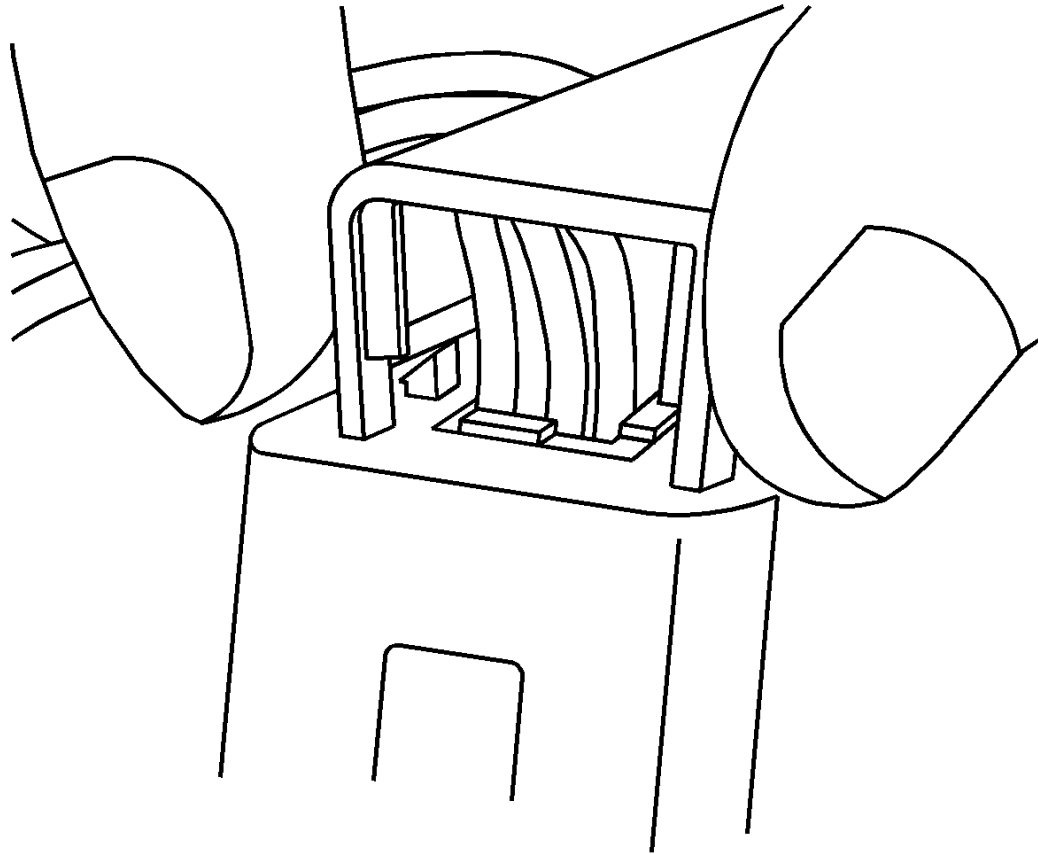


Fig. 55: Squeezing Cover Locking Legs
Courtesy of GENERAL MOTORS COMPANY

6. Use fingers to squeeze the 2 locking legs of the cover.

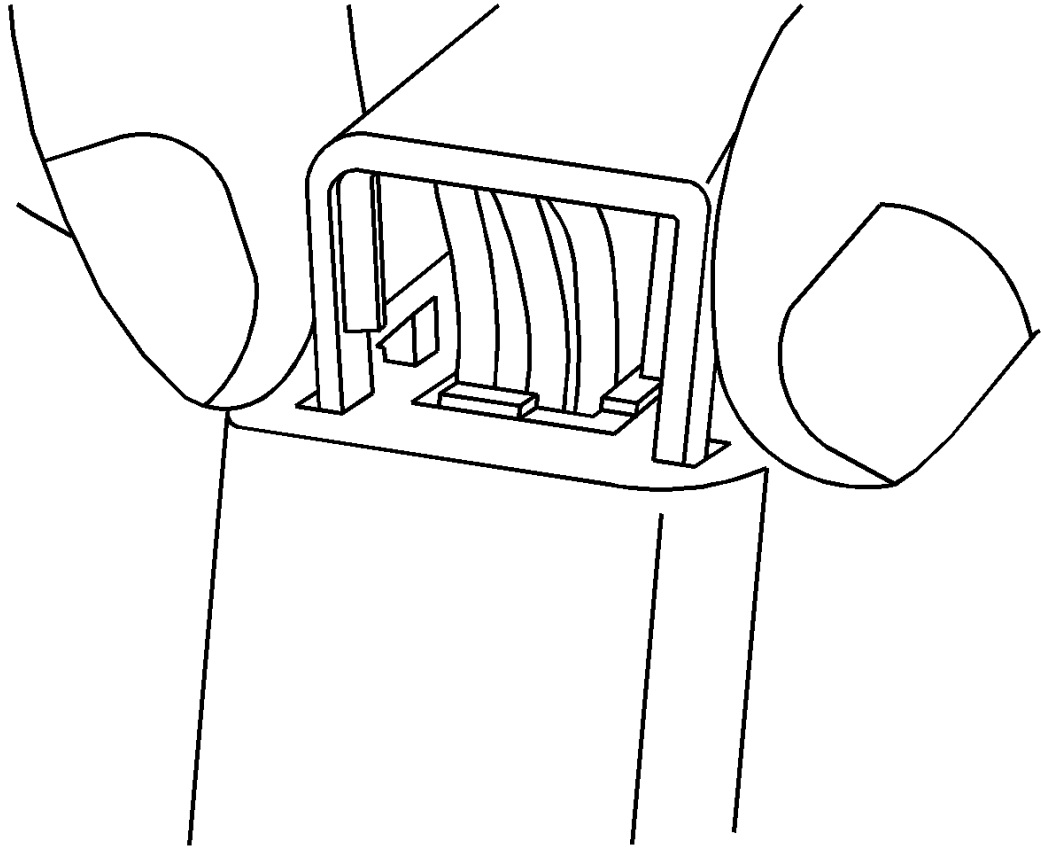


Fig. 56: Unseating Locking Leg

Courtesy of GENERAL MOTORS COMPANY

7. Apply pressure and gently rock the cover until one locking leg is unseated.

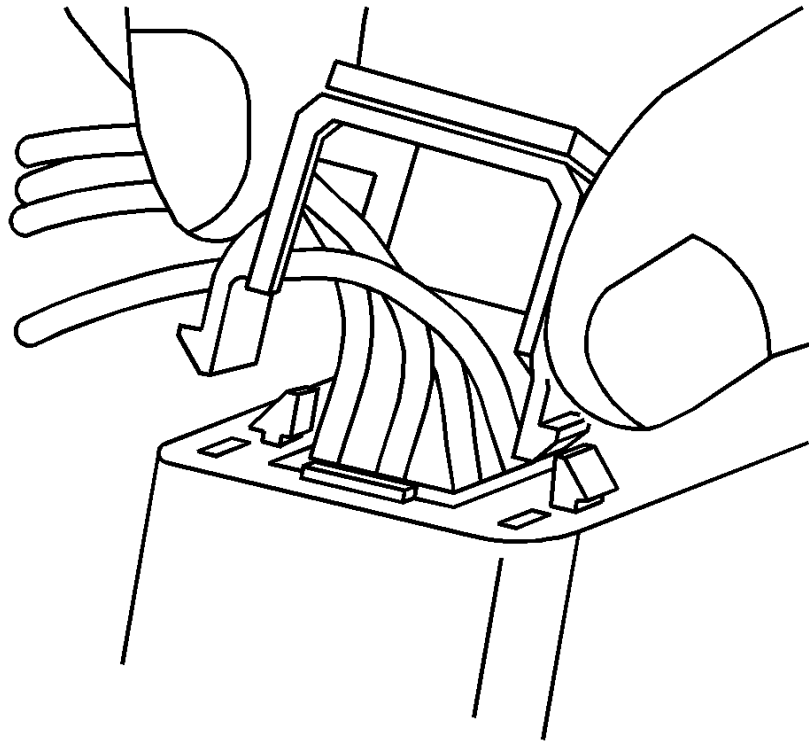


Fig. 57: Removing Cover

Courtesy of GENERAL MOTORS COMPANY

8. Continue to apply pressure and rock the cover until the second locking leg is unseated. Repeat procedure for the other side of the dress cover and remove the cover.

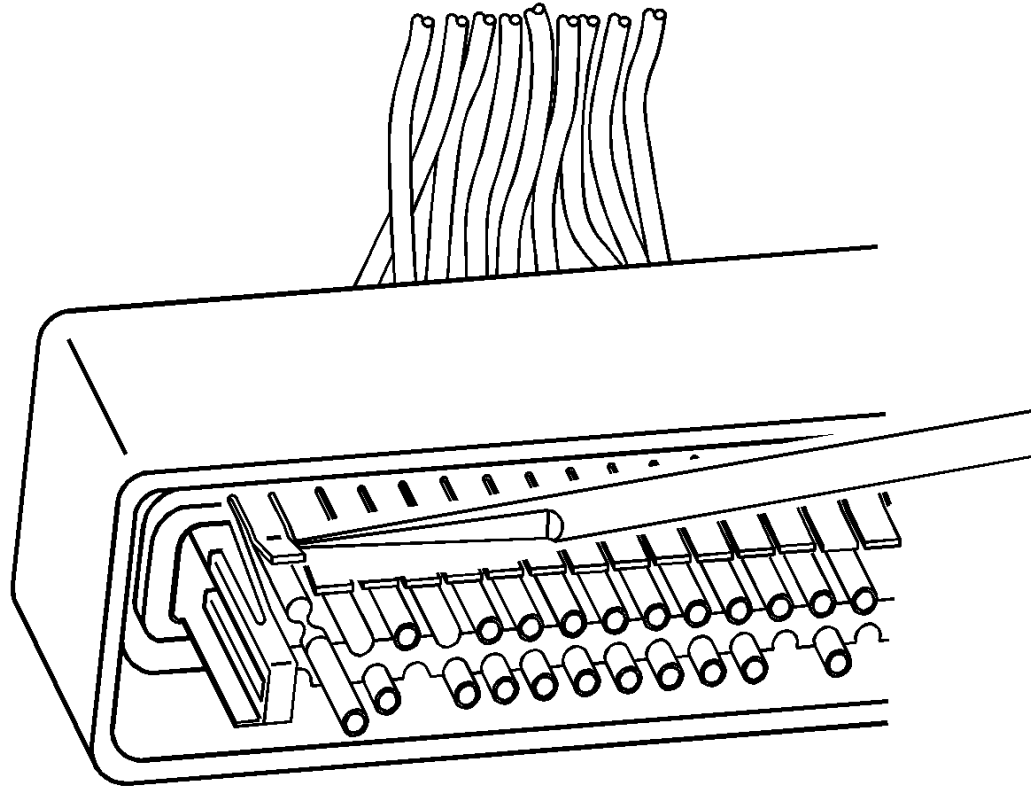


Fig. 58: Identifying Terminal Retaining Tab
 Courtesy of GENERAL MOTORS COMPANY

9. Use J-38125-12A to gently lift the terminal retaining tab while gently pulling the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
10. If the terminal is severely bent or damaged, it may be possible on some connectors to push the wire out of the front of the connector instead of pulling it through. This will prevent damage to the internal seals of the connector. Once the terminal is pushed out of the connector, cut the wire as close to the terminal as possible and pull the wire through the connector.
11. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

After the terminal is crimped to the wire perform the following procedure in order to replace Micro-Pack 100 terminals.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the

other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.

3. To assemble the connector, reverse the Terminal Removal Procedure.

DELPHI CONNECTORS (MICRO.64)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-21** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from Micro.64 connectors.

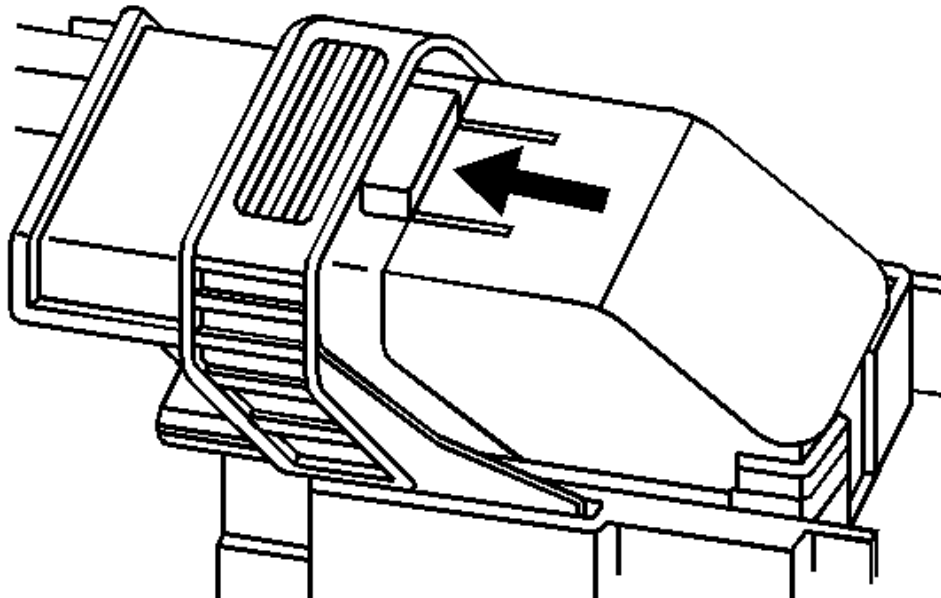


Fig. 59: Identifying Wire Dress Cover Lever Lock
Courtesy of GENERAL MOTORS COMPANY

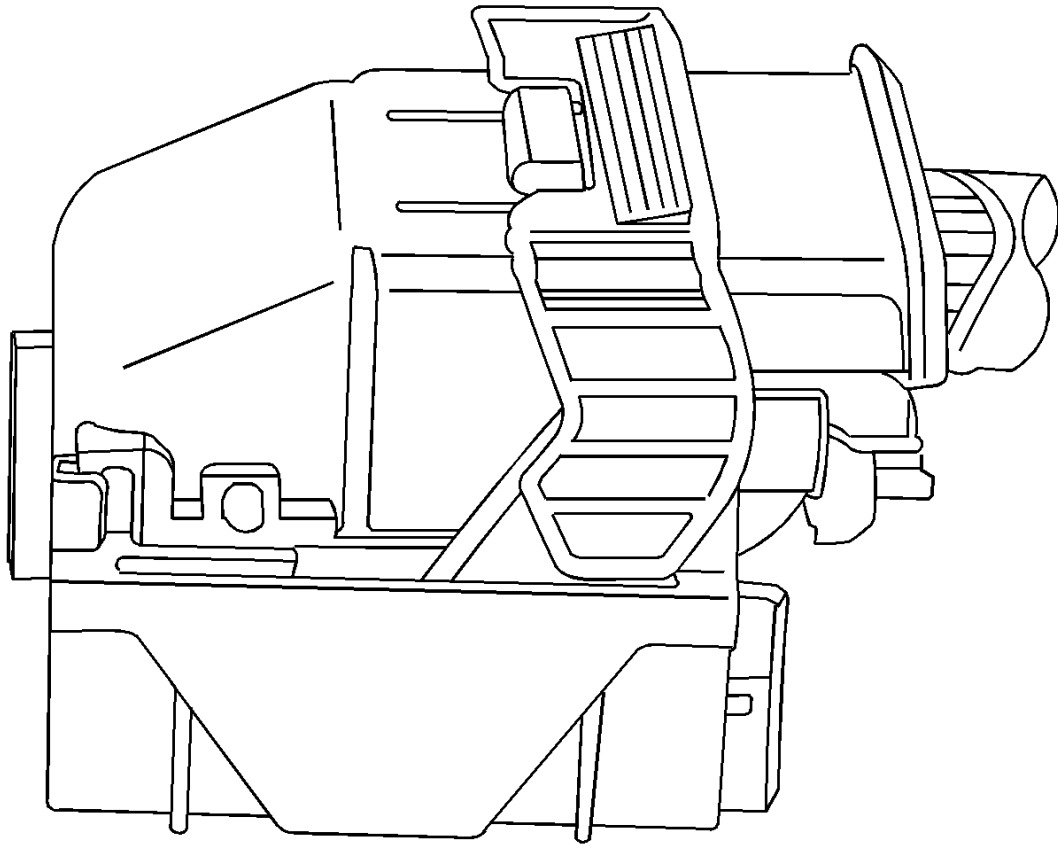


Fig. 60: View Of Typical Micro 64 Connector
Courtesy of GENERAL MOTORS COMPANY

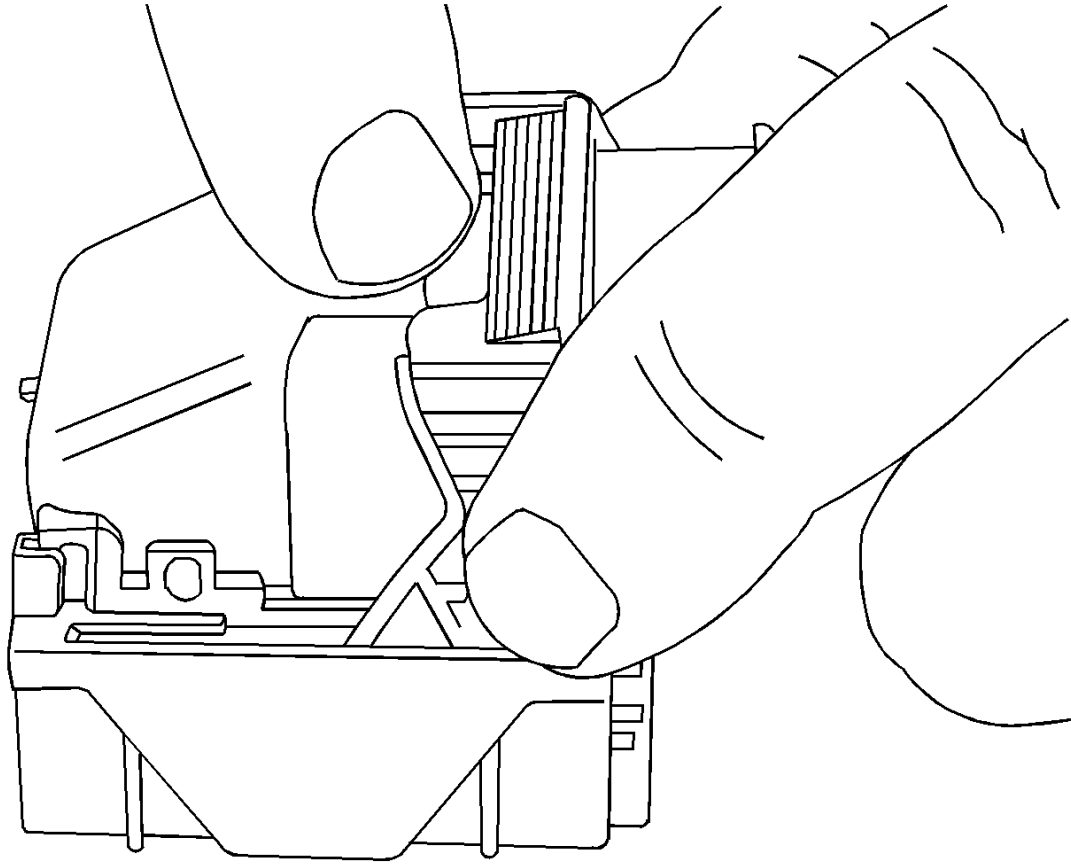


Fig. 61: Depressing Lock And Pulling Lever
Courtesy of GENERAL MOTORS COMPANY

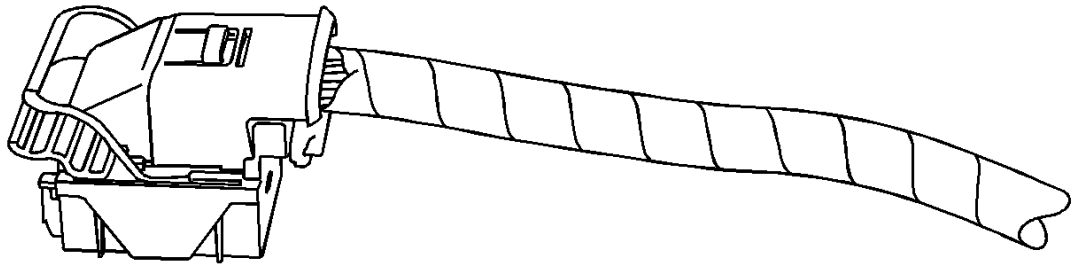


Fig. 62: View Of Connector When Released From Component
Courtesy of GENERAL MOTORS COMPANY

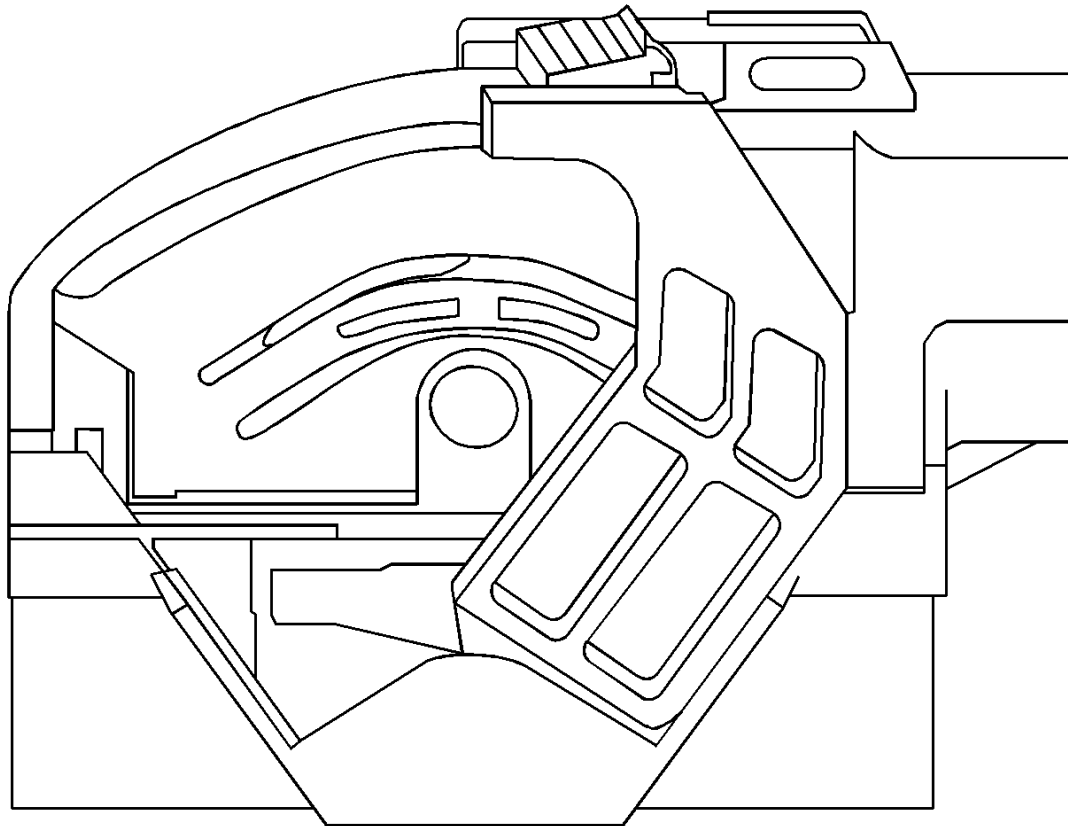


Fig. 63: View Of Another Type Of Micro 64 Connector
Courtesy of GENERAL MOTORS COMPANY

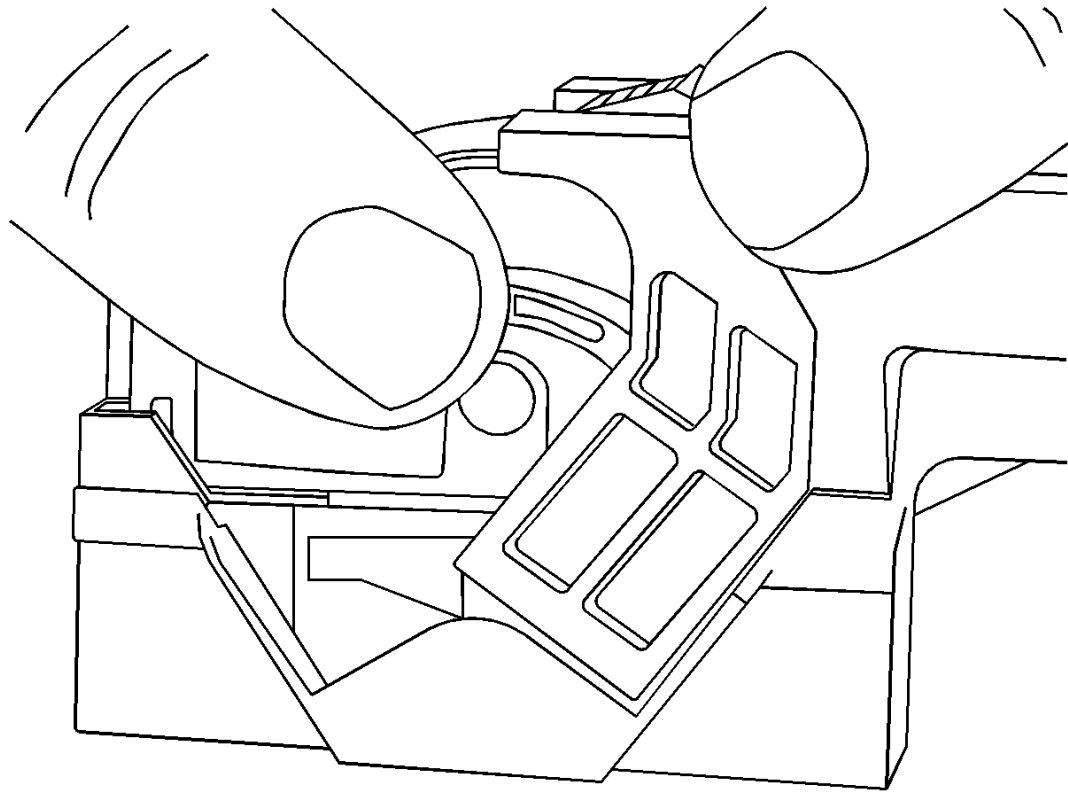


Fig. 64: Locating Locks On Both Sides Of Wiredress Cover
Courtesy of GENERAL MOTORS COMPANY

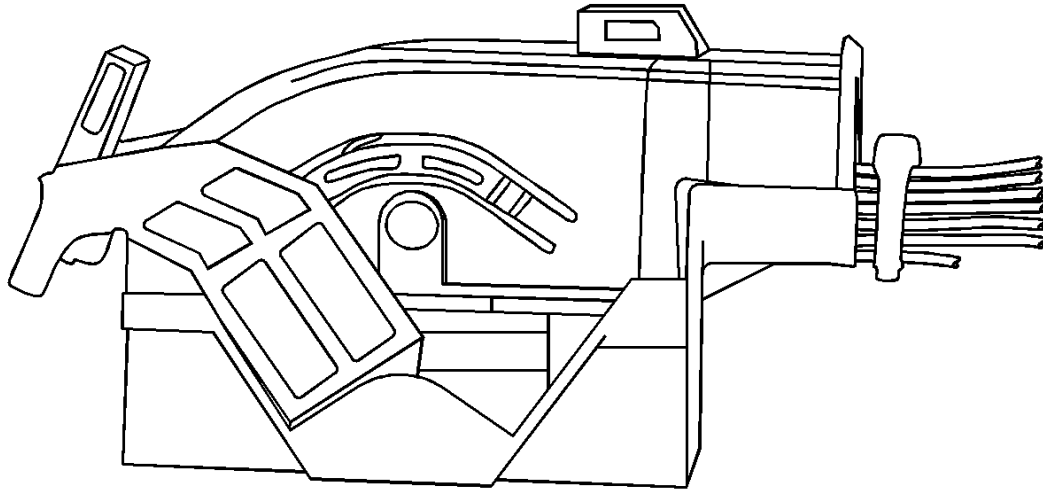


Fig. 65: View Of Connector When Released From Component
Courtesy of GENERAL MOTORS COMPANY

1. Locate the lever lock on the wire dress cover. While depressing the lock, pull the lever over and past the lock. The lever lock may be located on the top or sides of the wire dress cover.

View of a typical Micro 64 connector.

Depress the lock and pull the lever over and past the lock.

View of the connector when released from the component.

View of another type of Micro 64 connector.

Depress the locks that are located on both sides of the wire dress cover and pull the lever over and past the locks.

View of the connector when released from the component.

2. Disconnect the connector from the component.

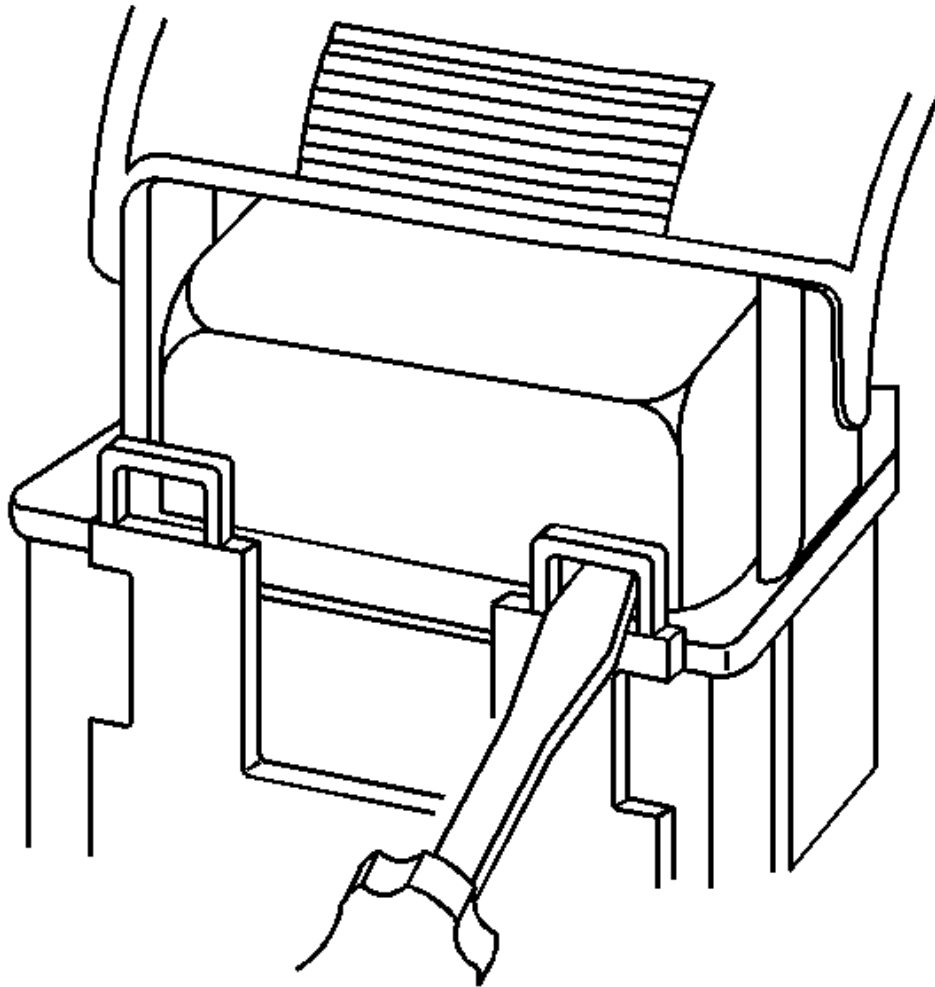


Fig. 66: View Of Releasing Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs at the front of the connector. Using a small flat-blade tool push down on one of the locking tabs and pull the cover up until the dress cover releases. Repeat this procedure for the other locking tab.
4. Once the front 2 locks are unlocked, lift the front of the dress cover and pull it forward.

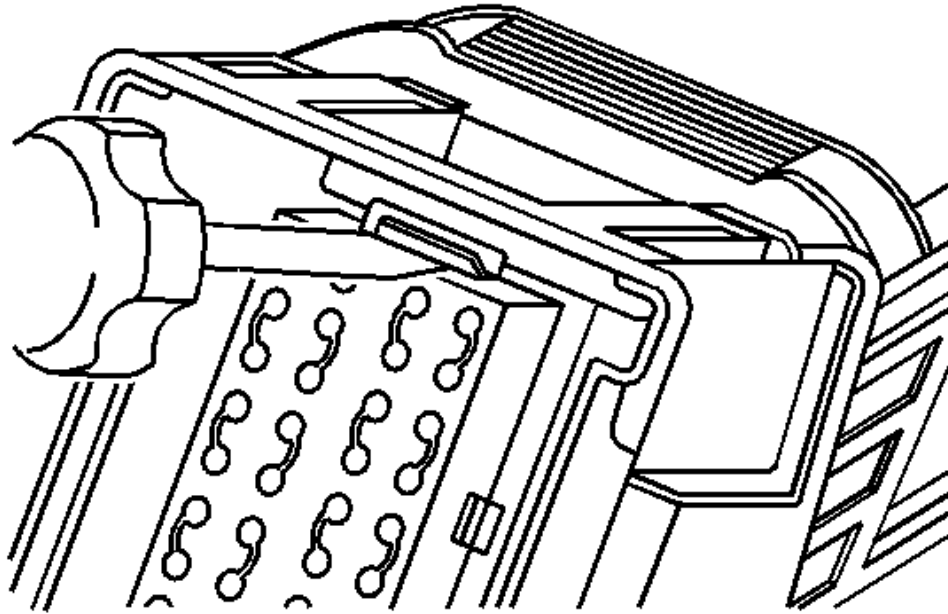


Fig. 67: View Of Removing Terminal Position Assurance

Courtesy of GENERAL MOTORS COMPANY

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

5. Remove the TPA by inserting a small flat-blade tool into the small slot on the TPA and pushing down until the TPA releases. Gently pry the TPA out of the connector.

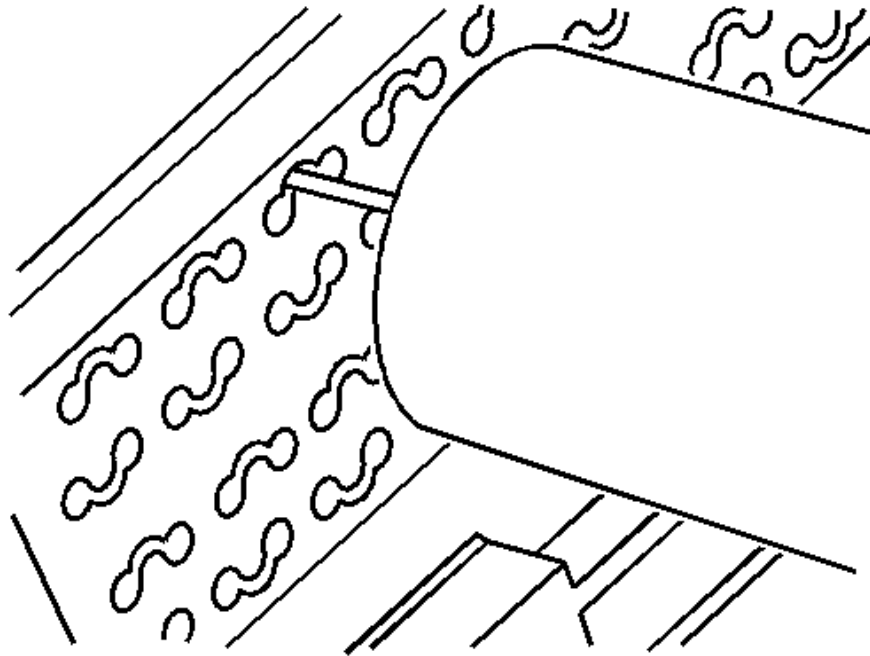


Fig. 68: Identifying Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: Be careful not to angle or rock the J-38125-21 tool when inserting it into the connector or the tool may break.

6. Insert the J-38125-21 tool into the round canal between the terminals cavities at the front of the connector.

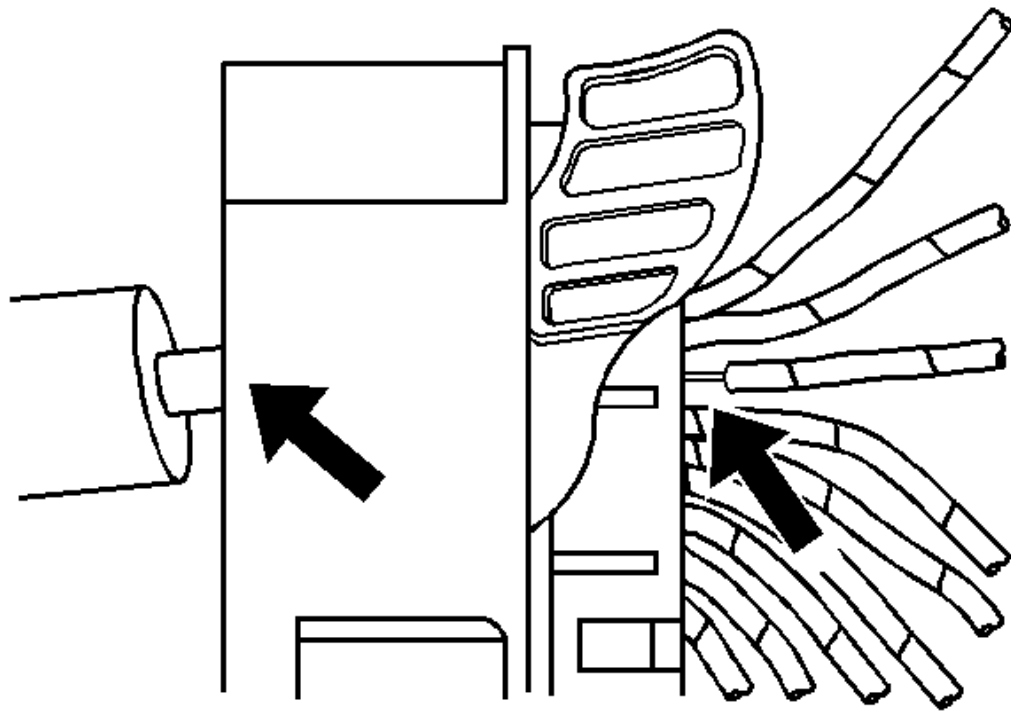


Fig. 69: Removing Wire From Back Of Connector

Courtesy of GENERAL MOTORS COMPANY

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (12-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

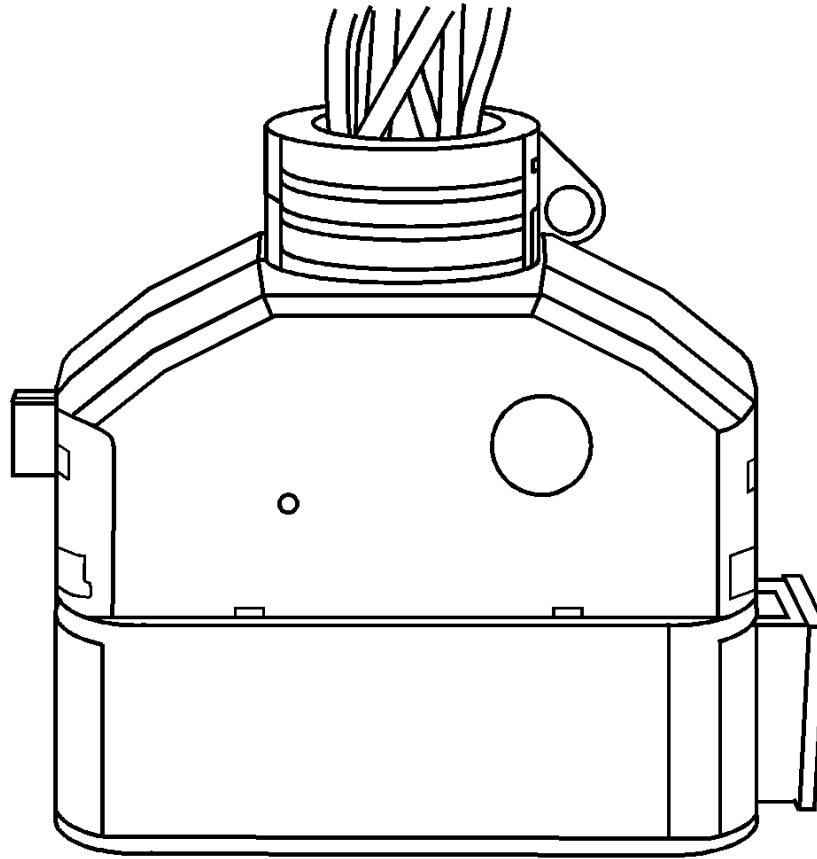


Fig. 70: Identifying Lever Lock

Courtesy of GENERAL MOTORS COMPANY

1. Locate the lever lock on the wire dress cover. Remove the connector position assurance (CPA) and slide the lever lock away from the connector body.
2. Disconnect the connector from the component.

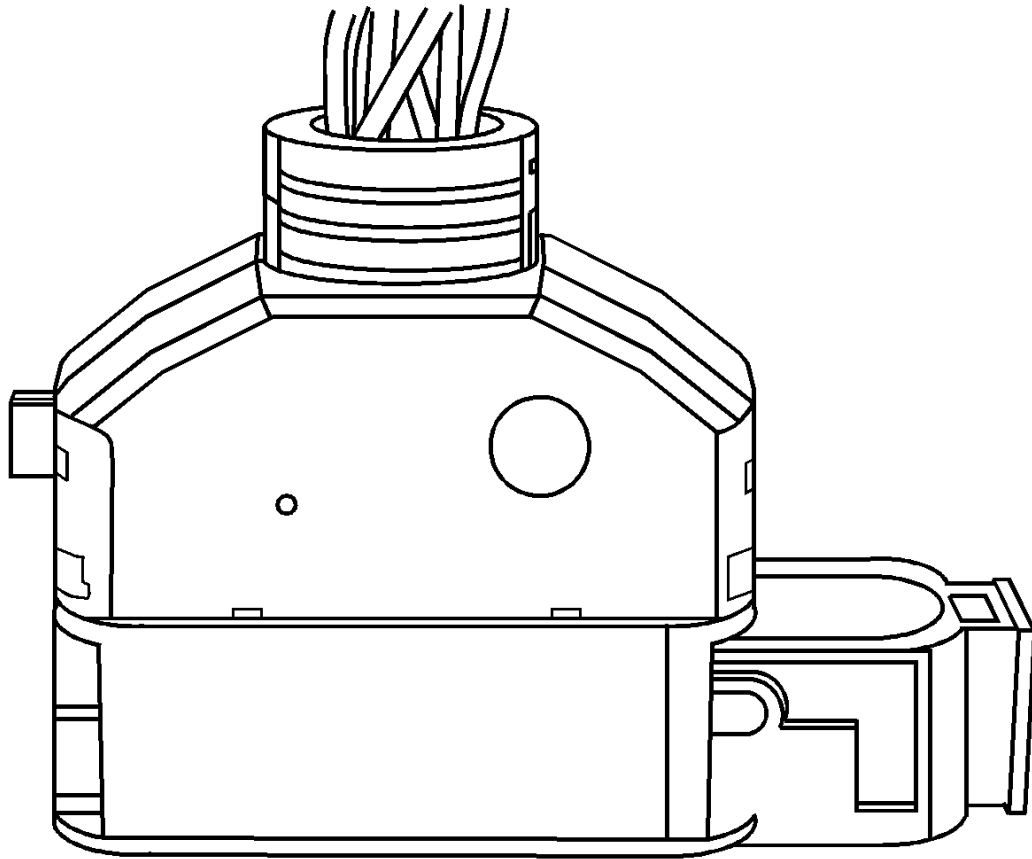


Fig. 71: Identifying Dress Cover Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-blade tool release all of the locking tabs.

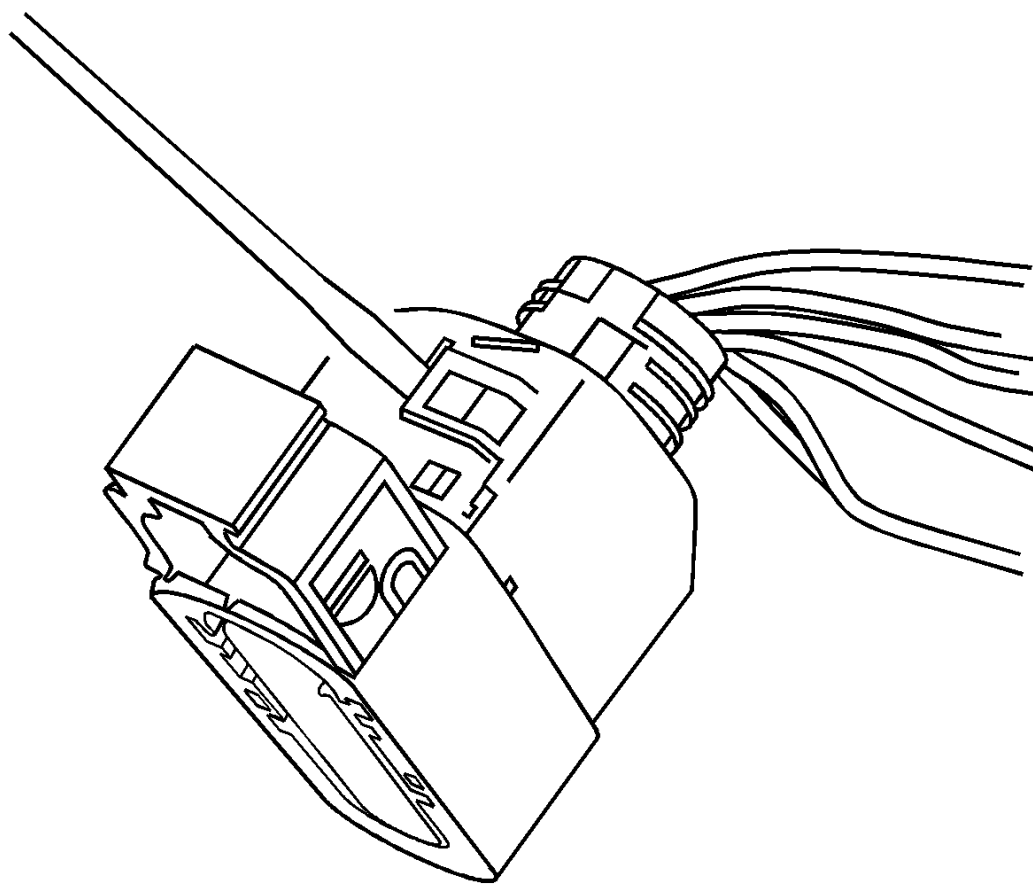


Fig. 72: Identifying Lower Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS COMPANY

4. Release the lower wire dress cover locking tab.

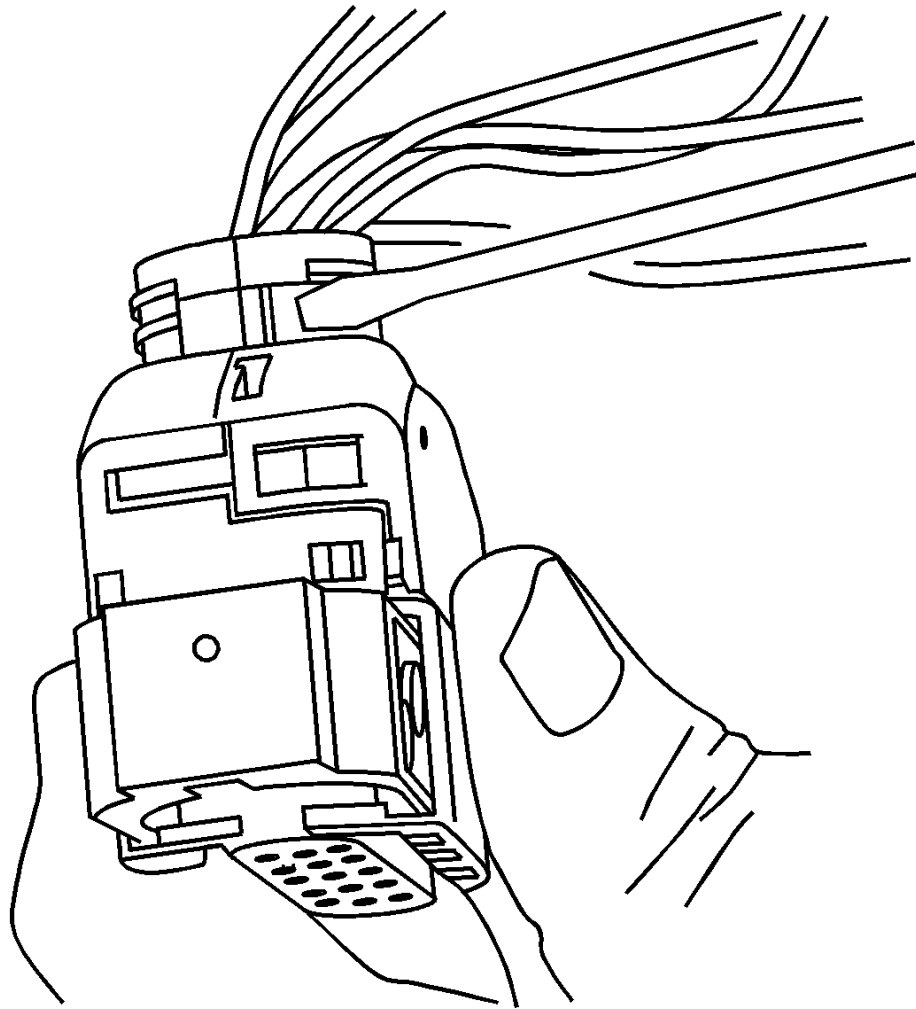


Fig. 73: Identifying Upper Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS COMPANY

5. Release the upper wire dress cover locking tab.
6. Once the locks are unlocked, lift the dress cover off.

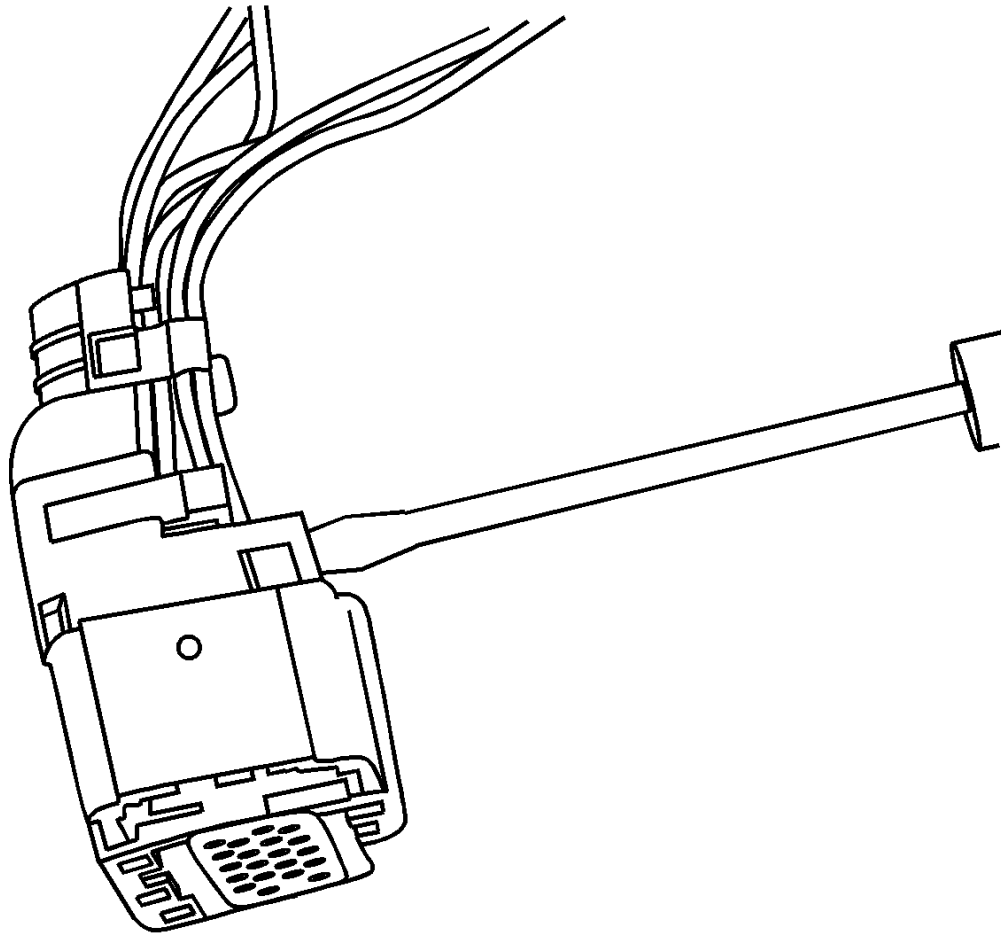


Fig. 74: View Of TPA Being Pried Out Of Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

7. Remove the TPA by inserting a small flat-blade tool into the locking tabs on both sides of the TPA. Gently pry the TPA out of the connector.

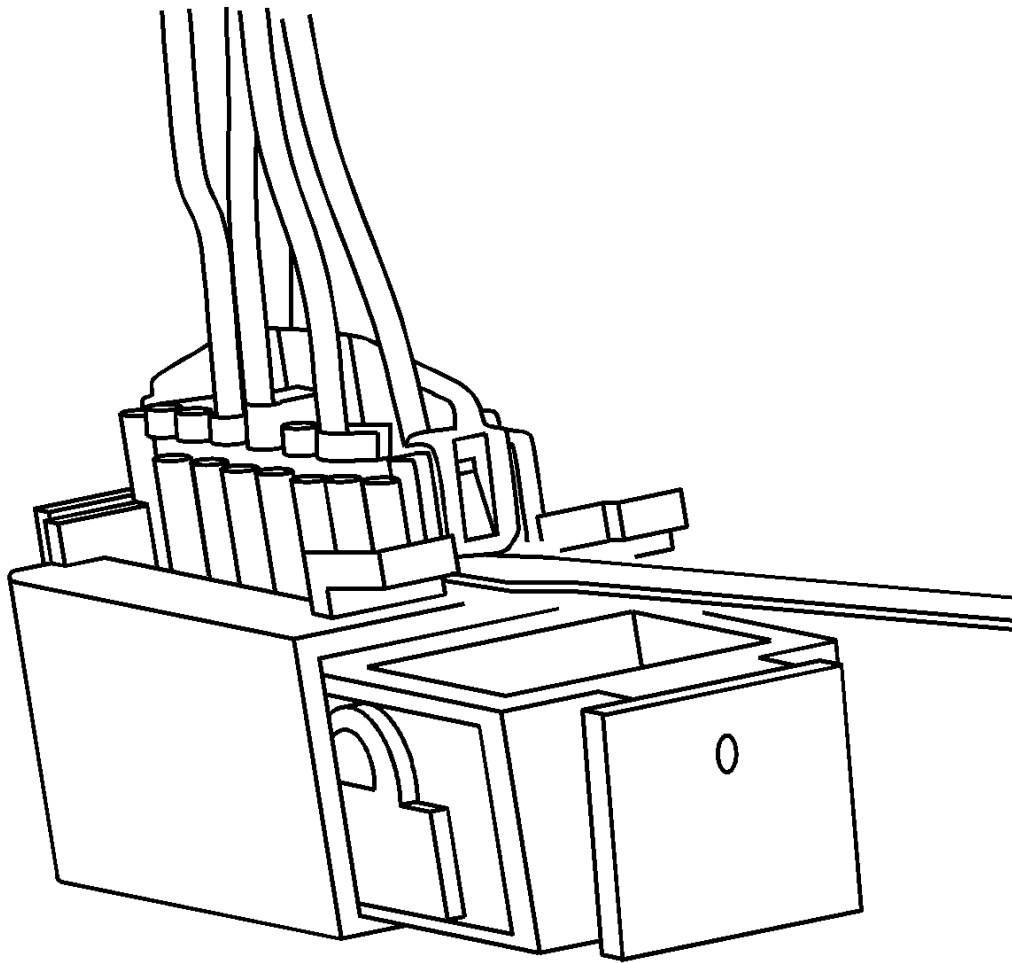


Fig. 75: View Of Nose Piece

Courtesy of GENERAL MOTORS COMPANY

8. Remove the nose piece by inserting a small flat-blade tool into the locking tabs on both sides of the nose piece. Gently pry the nose piece out of the connector.

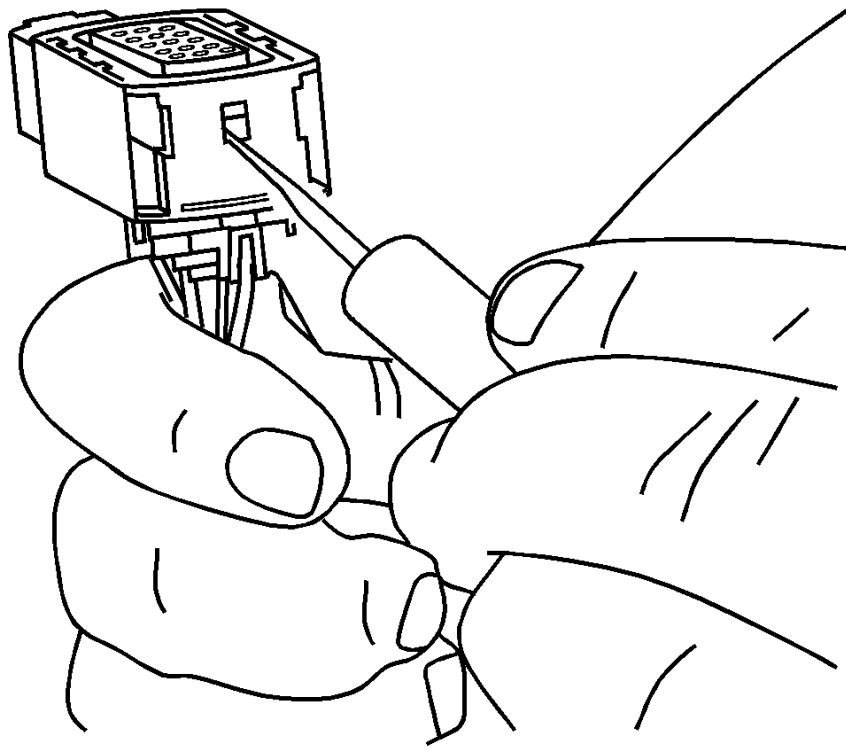


Fig. 76: Inserting Special Tool Into Terminal Release Cavity

Courtesy of GENERAL MOTORS COMPANY

9. Insert the J-38125-12A tool to release the terminals by inserting the tool into the terminal release cavity.

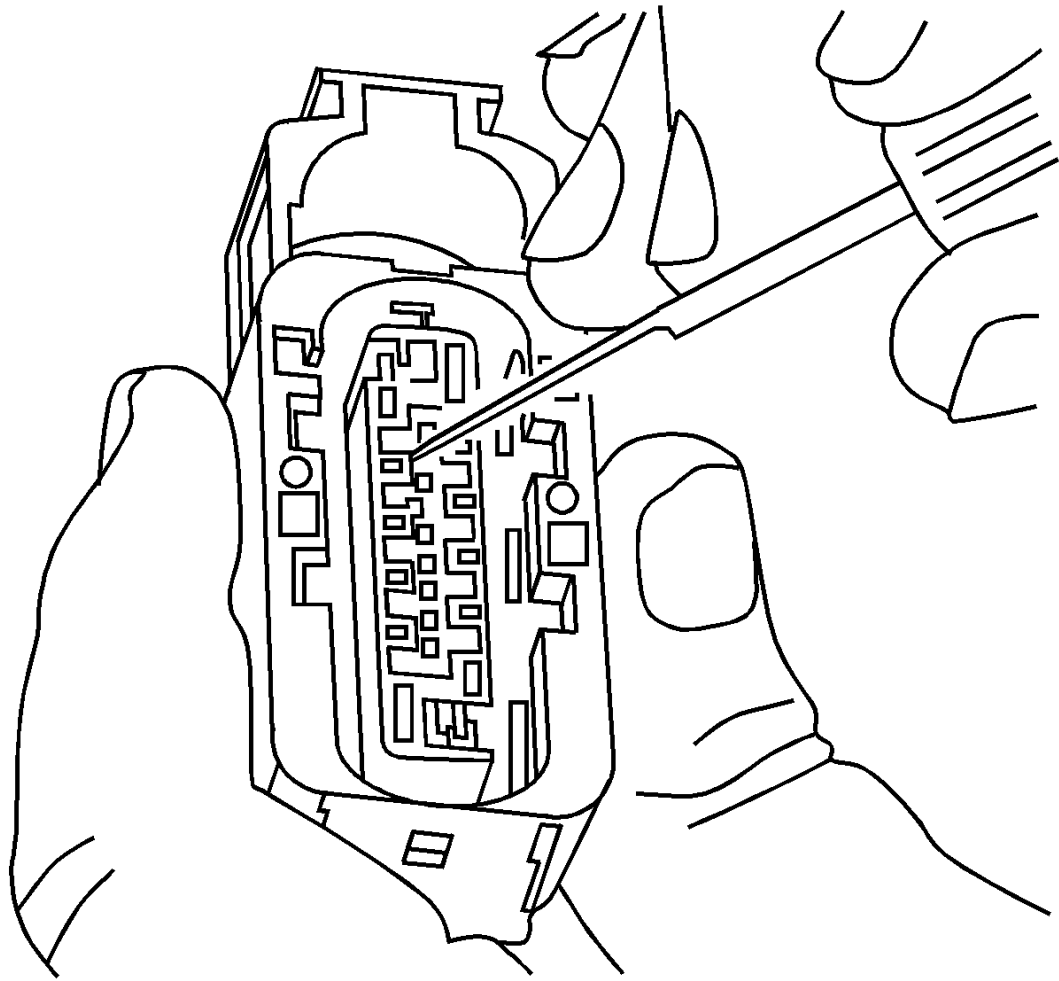


Fig. 77: Pulling Wire Out Of Back Of Connector

Courtesy of GENERAL MOTORS COMPANY

10. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
11. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (STEERING GEAR)

Removal Procedure

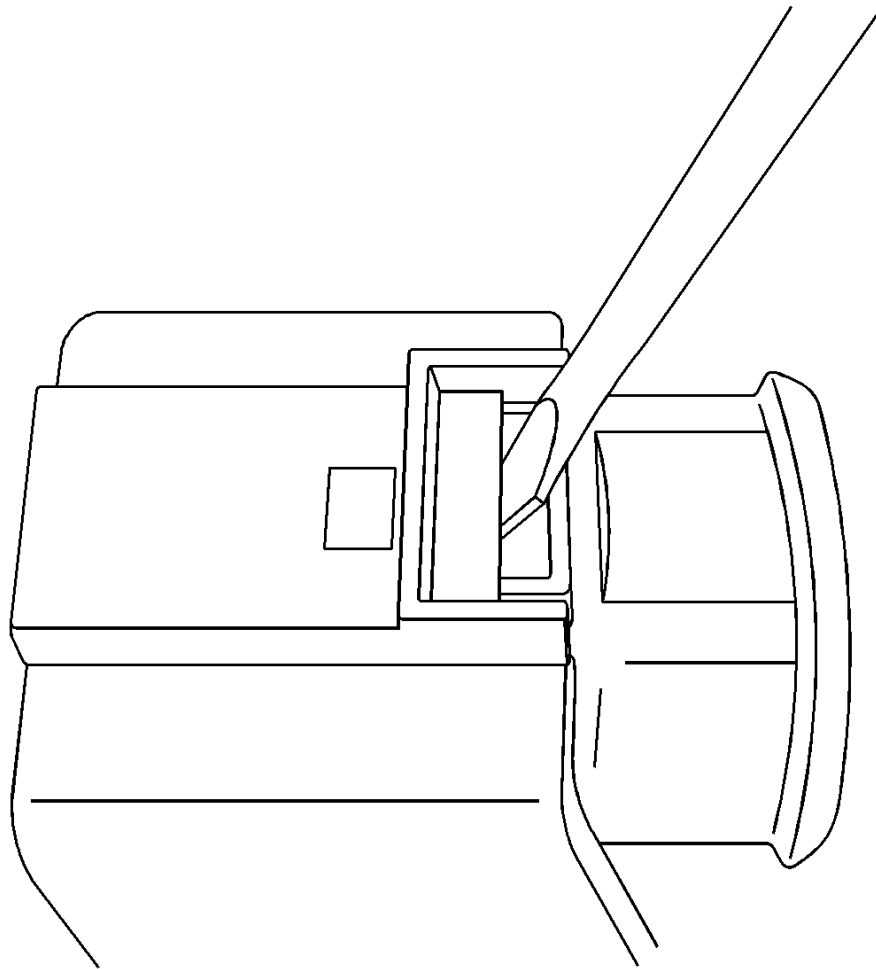


Fig. 78: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS COMPANY

1. Use a small flat-bladed tool to release the locking tab on the connector.

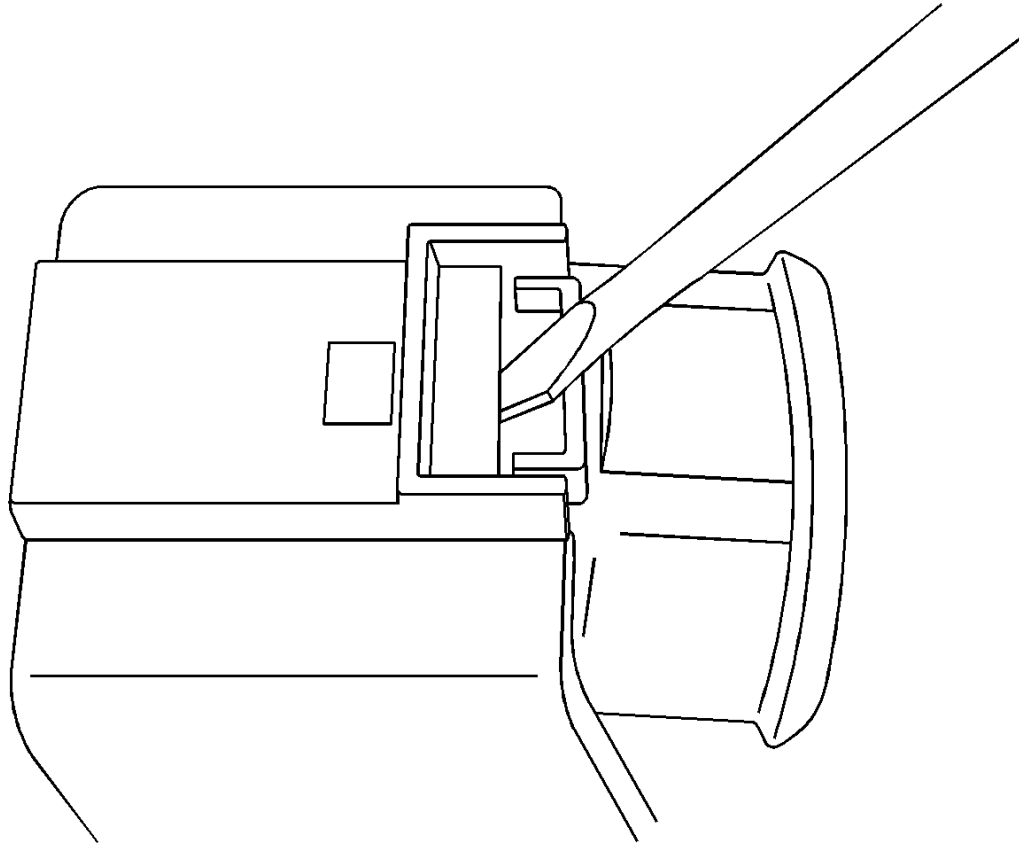


Fig. 79: Releasing Connector

Courtesy of GENERAL MOTORS COMPANY

2. Push down the locking tab to release the connector. The small flat-bladed tool may need to be pushed down and angled back slightly to depress the locking tab. Pull on the connector body while releasing the locking tab to disconnect the connector.

FCI CONNECTORS (LEVER LOCK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-556** Terminal Release Tool
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

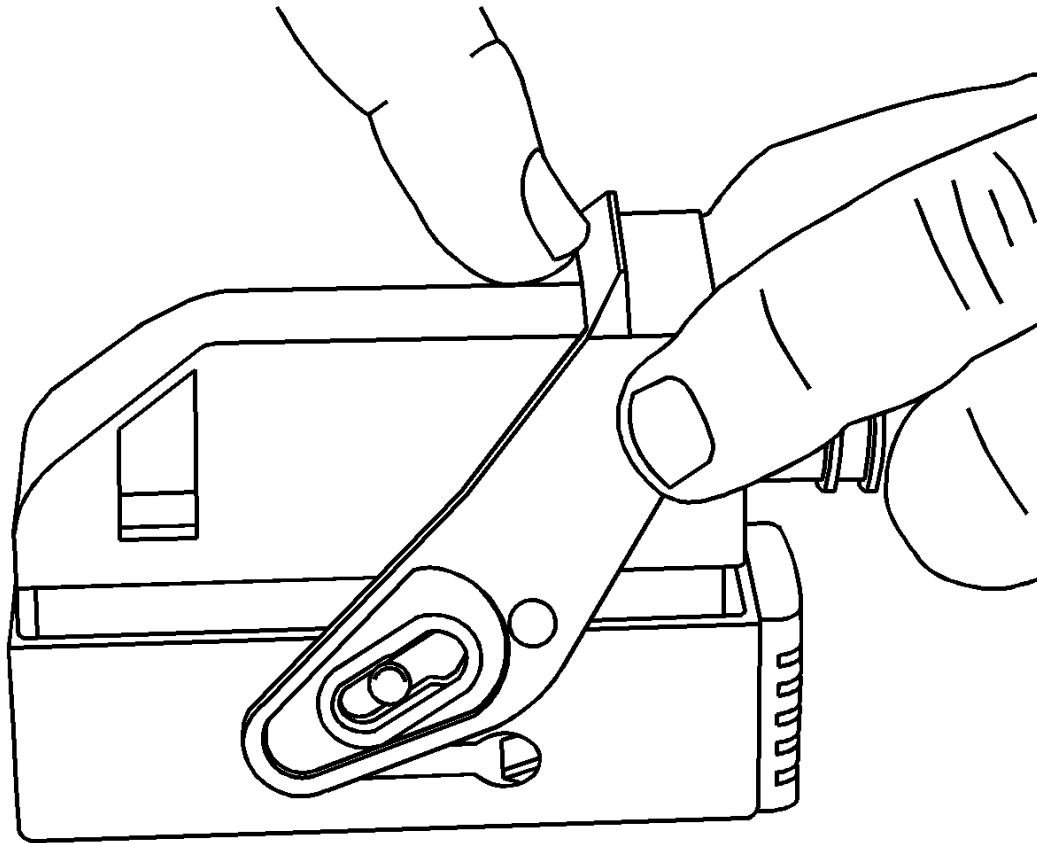


Fig. 80: Identifying Release Tab

Courtesy of GENERAL MOTORS COMPANY

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. The release tab is located on the top of the wiredress cover.

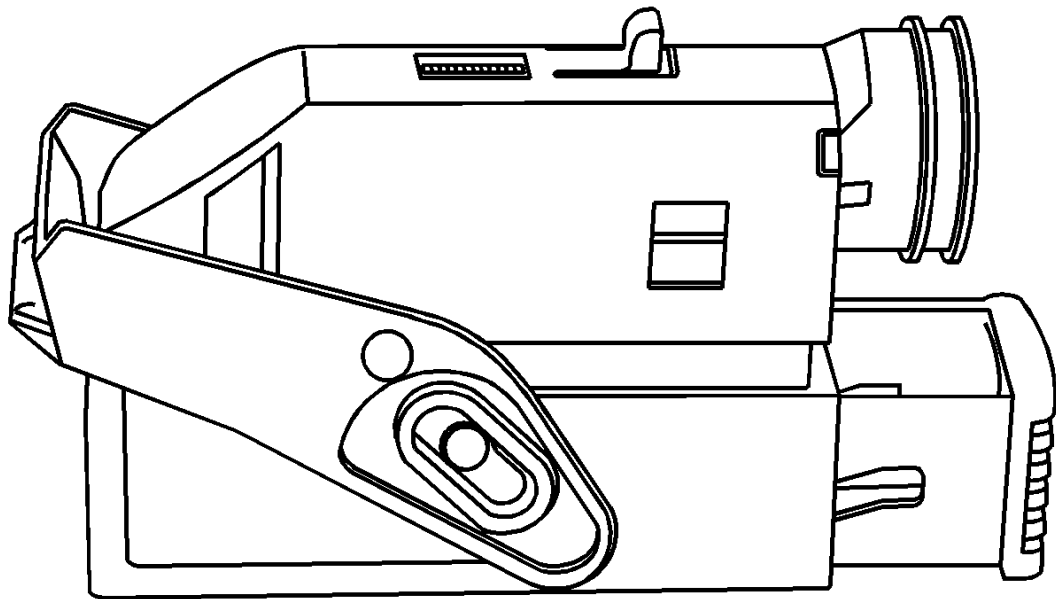


Fig. 81: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

3. View of connector in released position.
4. Disconnect the connector from the component.
5. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

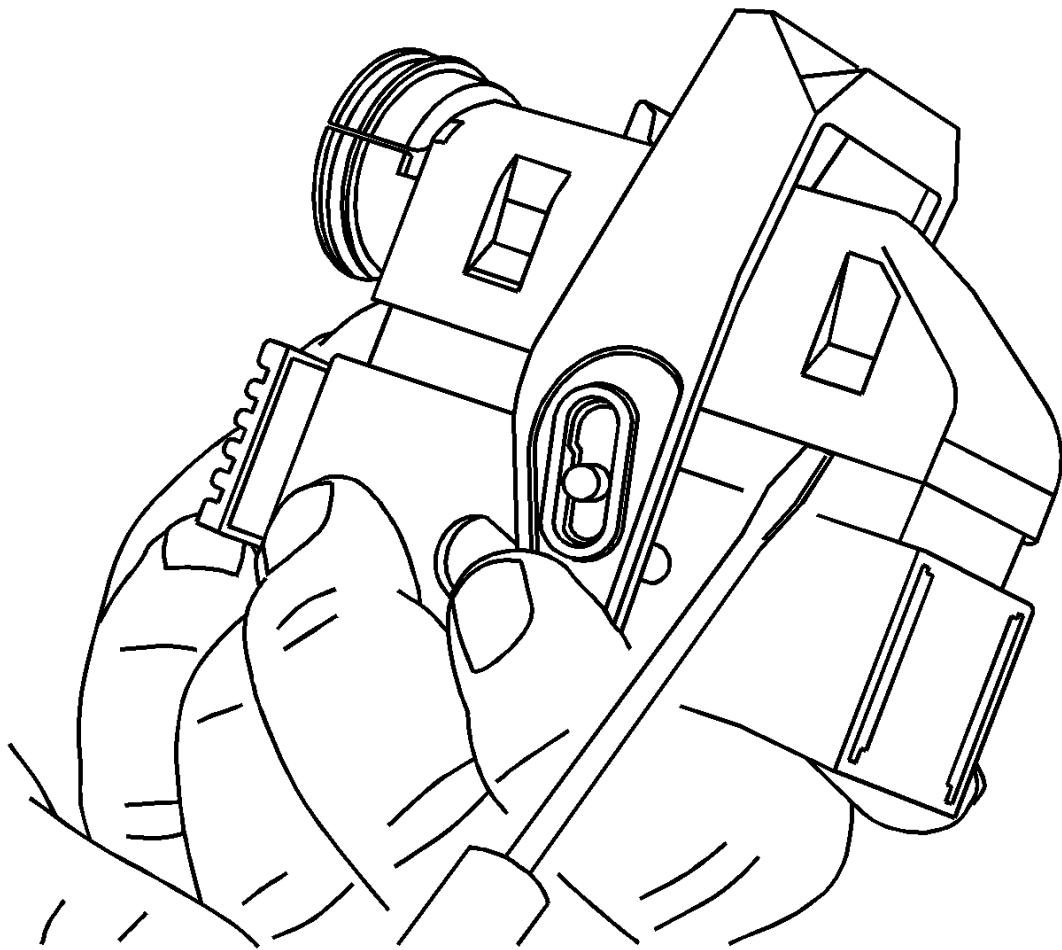


Fig. 82: View Of Sliding Terminal Position Assurance (TPA) Up One Notch
Courtesy of GENERAL MOTORS COMPANY

6. Use a small flat-blade tool to slide the terminal position assurance (TPA) up one notch on both ends of the connector. The TPA is located underneath the wire dress cover.

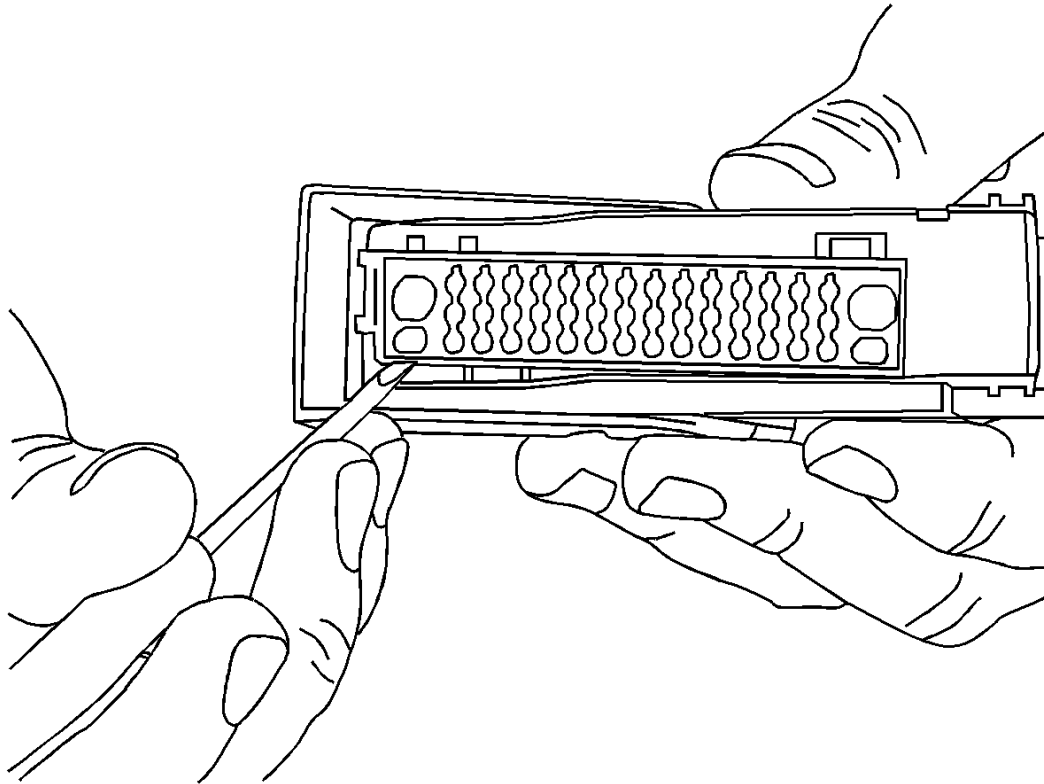


Fig. 83: View Of Releasing Terminals

Courtesy of GENERAL MOTORS COMPANY

7. For the larger terminals insert the J-38125-556 tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the J-38125-560 tool to release the terminals by inserting the tool into the terminal release cavity.

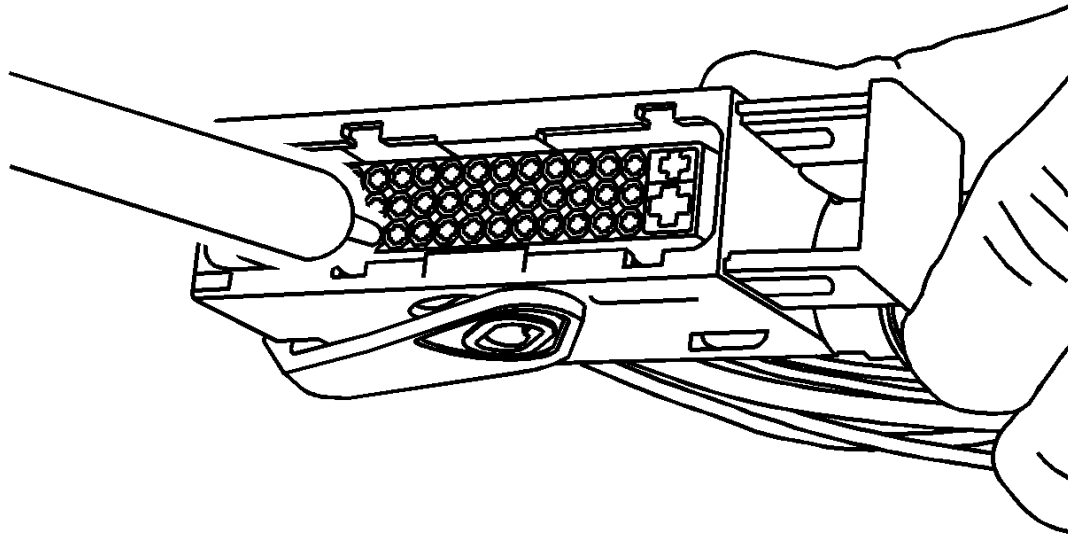


Fig. 84: View Of Wire Being Pulled Out Of Back Of Connector While Holding Removal Tool In Place

Courtesy of GENERAL MOTORS COMPANY

8. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
9. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
10. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

FCI CONNECTORS (SIR)

Removal Procedure

NOTE: The orange or yellow connector position assurance (CPA) must be released first to disconnect or to connect the connector.

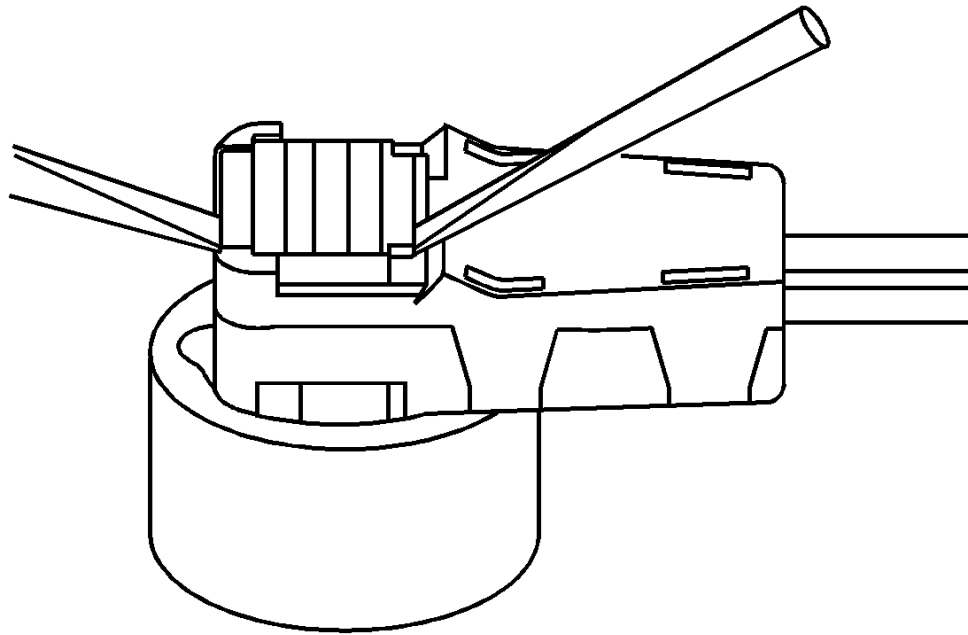


Fig. 85: Lifting Orange CPA

Courtesy of GENERAL MOTORS COMPANY

1. Lift the orange or yellow CPA vertically (avoid lifting on an angle to the connector) approximately 4 mm to release the connector. Use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

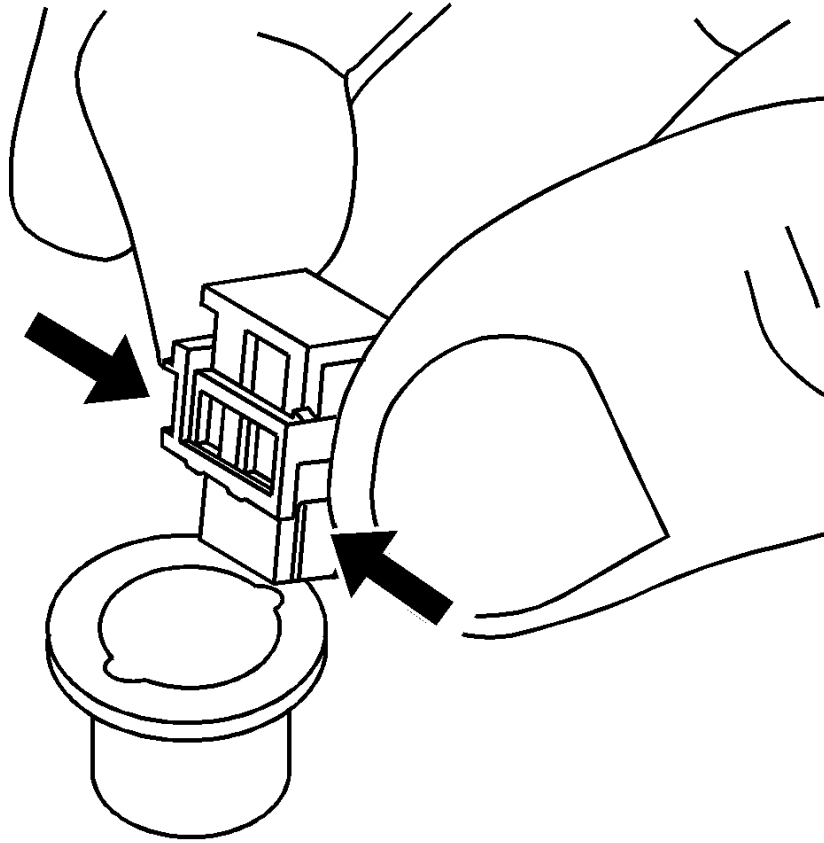


Fig. 86: Grabbing Connector On Both Sides
Courtesy of GENERAL MOTORS COMPANY

2. Grab the connector on both sides and lift vertically to disconnect the connector.

Installation Procedure

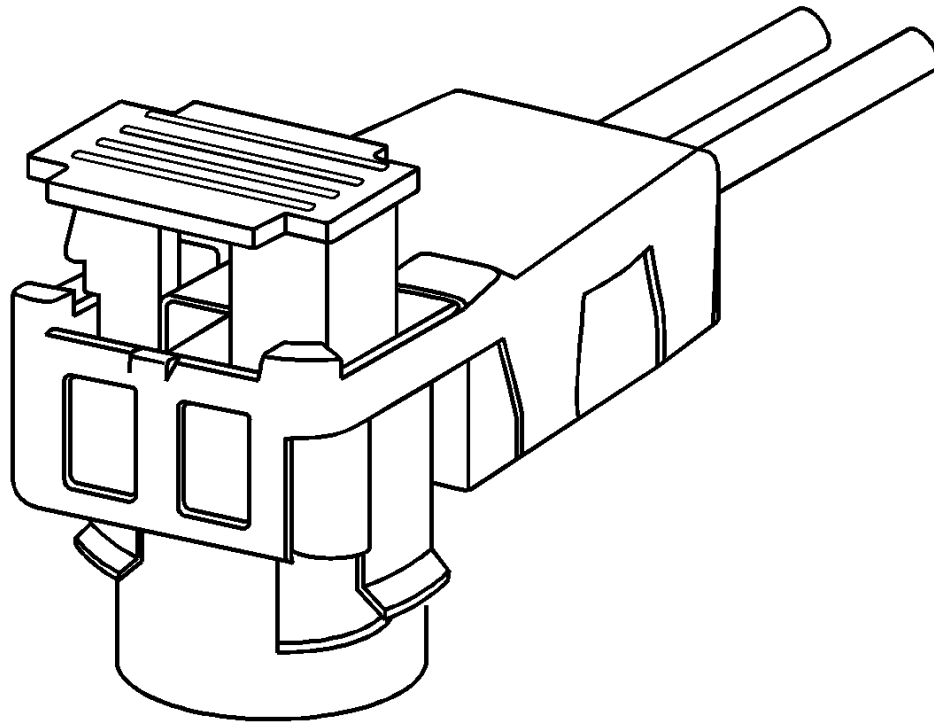


Fig. 87: Lifting Orange CPA

Courtesy of GENERAL MOTORS COMPANY

1. The CPA should be approximately 4 mm above the yellow cover before installing the connector. If not, use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

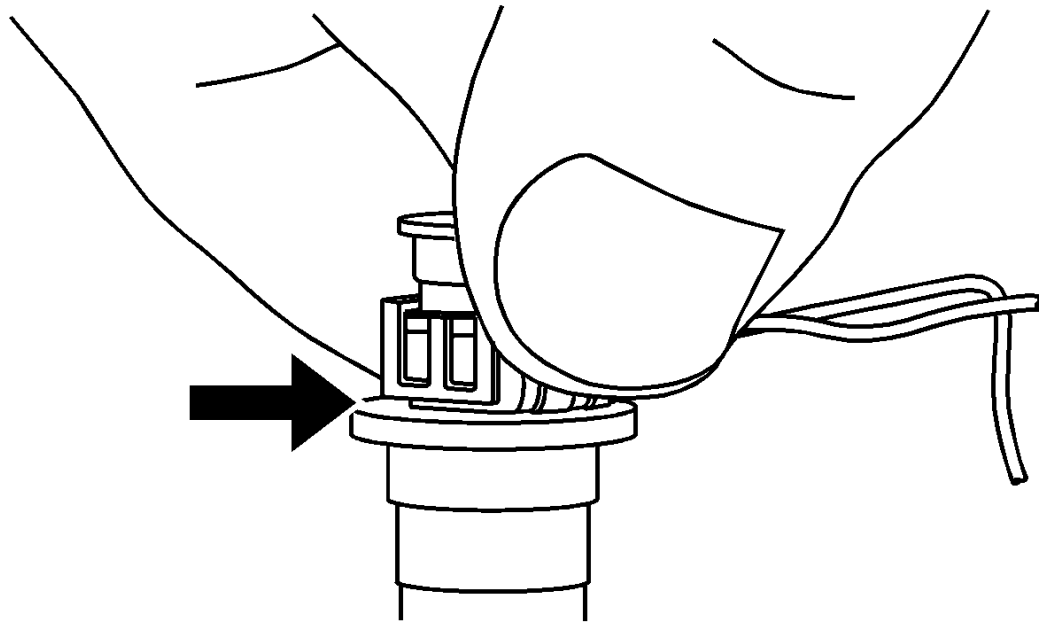


Fig. 88: Seating Connector Sub-Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Line up the connector key tabs with the initiator key slots. Grab the connector on both sides and push down into the initiator connector sub assembly until fully seated.

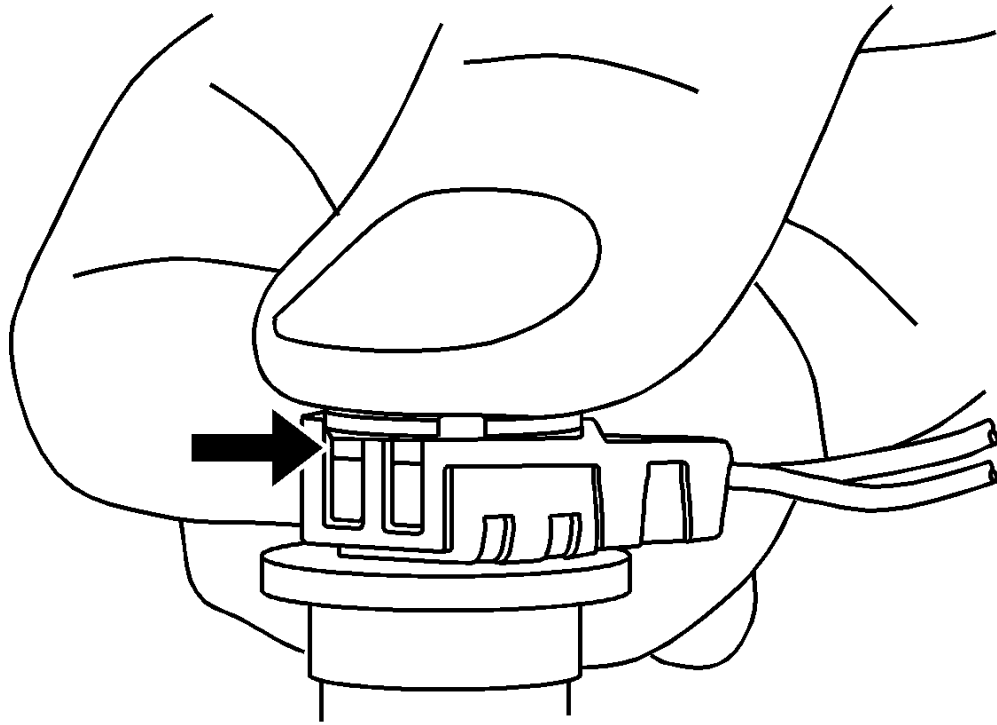


Fig. 89: Pushing CPA Down

Courtesy of GENERAL MOTORS COMPANY

3. After the connector is fully seated, push the CPA down with your thumb until the CPA is touching the yellow cover on the connector.
4. After the CPA is seated, lightly pull on the connector, it should not pull off if the connector and CPA are properly engaged.

FEP CONNECTORS (STEERING GEAR)

Removal Procedure

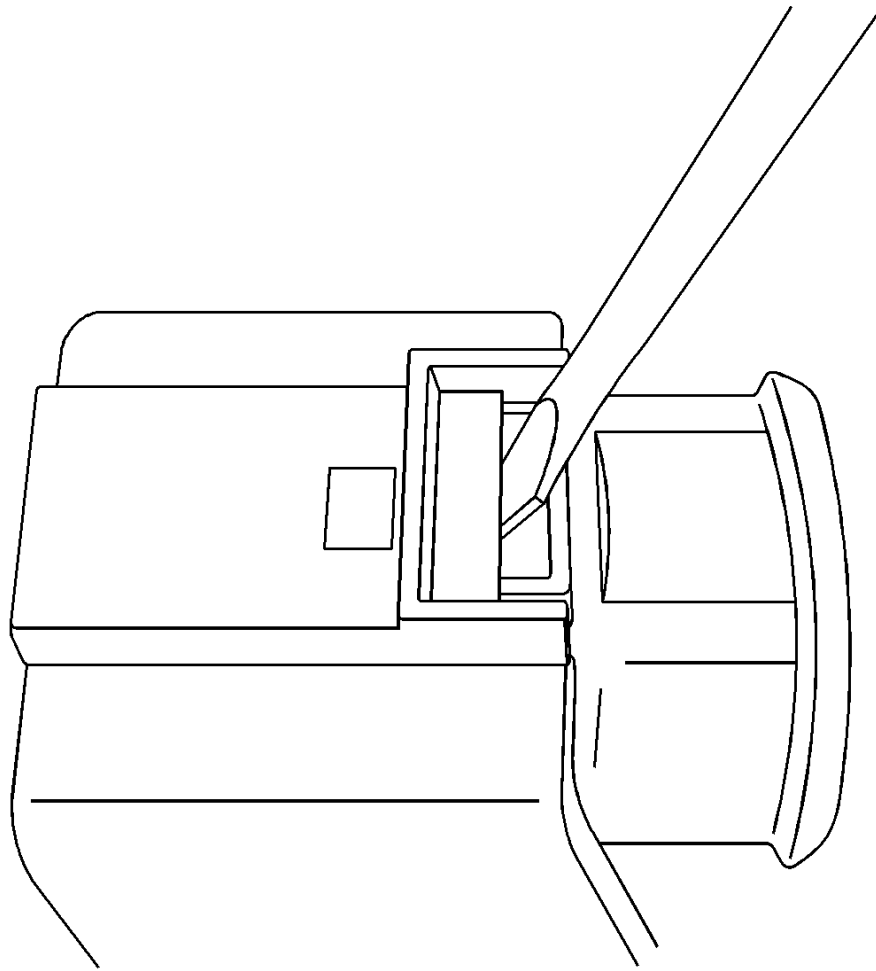


Fig. 90: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS COMPANY

1. Use a flat-bladed tool to release the locking tab on the connector.

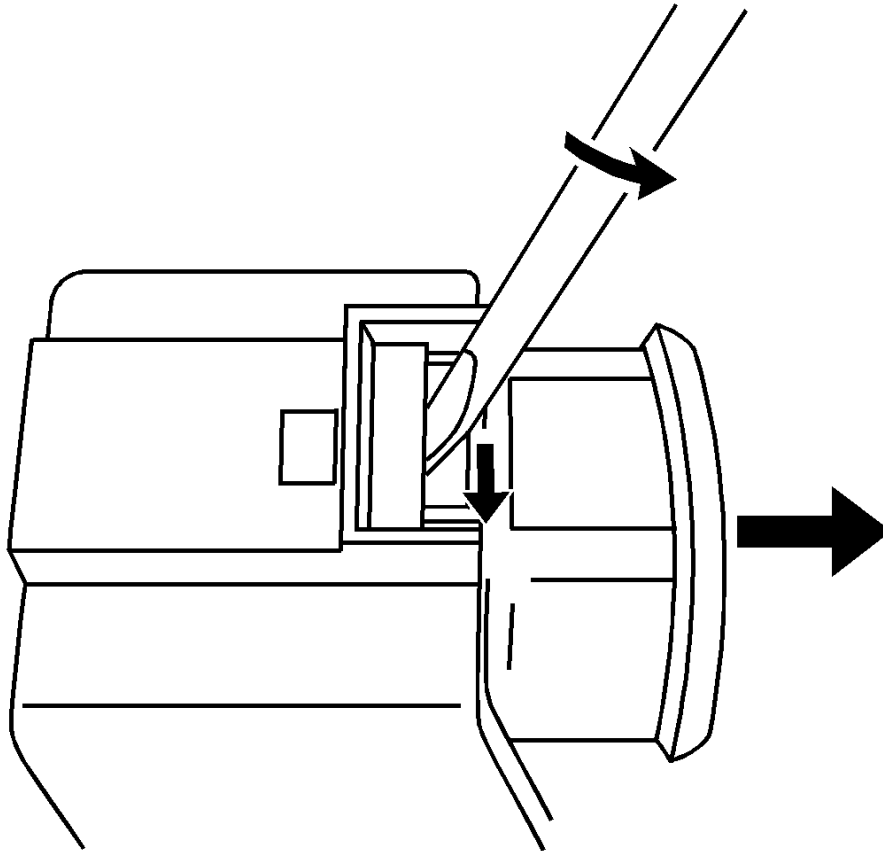


Fig. 91: Twisting Flat-Bladed Tool To Push Top Of Locking Tab Inward
Courtesy of GENERAL MOTORS COMPANY

2. Option 1: Twist the flat-bladed tool to push the top of the locking tab inward while pulling the connector body out.

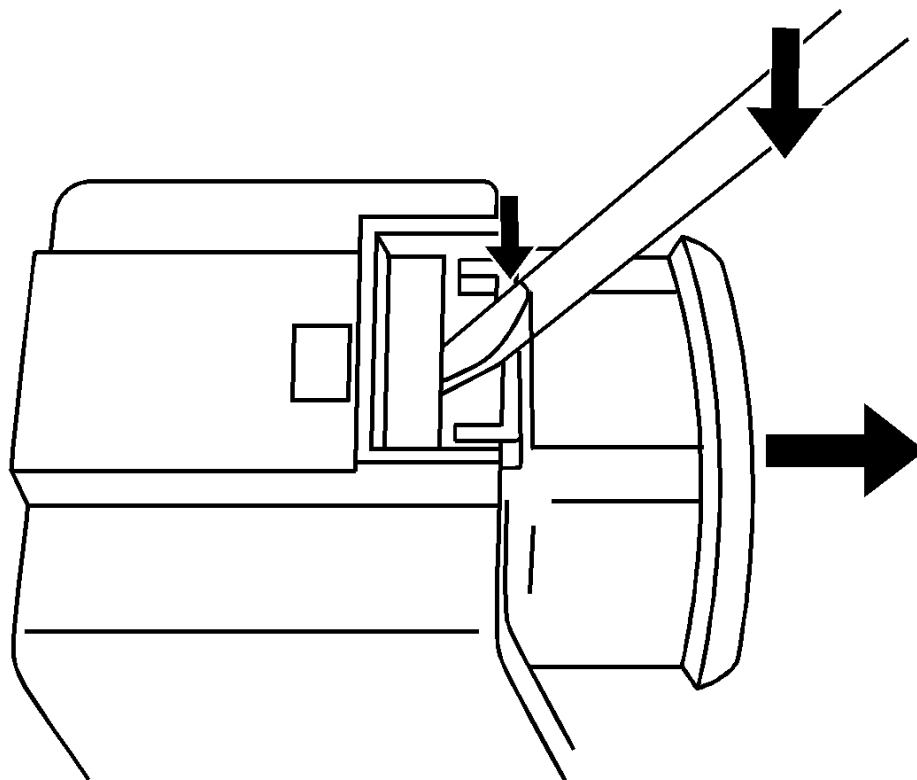


Fig. 92: Using Flat-Bladed Tool To Depress Locking Tab

Courtesy of GENERAL MOTORS COMPANY

3. Option 2: Pry using the flat-bladed tool to depress the locking tab while pulling the connector body out.

JST CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-553** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

The JST connector family consists of seven unique connector housings differentiated by color and keying. This connector family is designed to use both 0.64 and 2.8 sized terminals.

JST BCM Connector

GM Service Part #	Color
-------------------	-------

GM Service Part #	Color
88988806	Gray
88988837	Brown
88988838	Lt Green
88988839	Natural
88988840	Lt Blue
88988841	Black
88988842	Pink

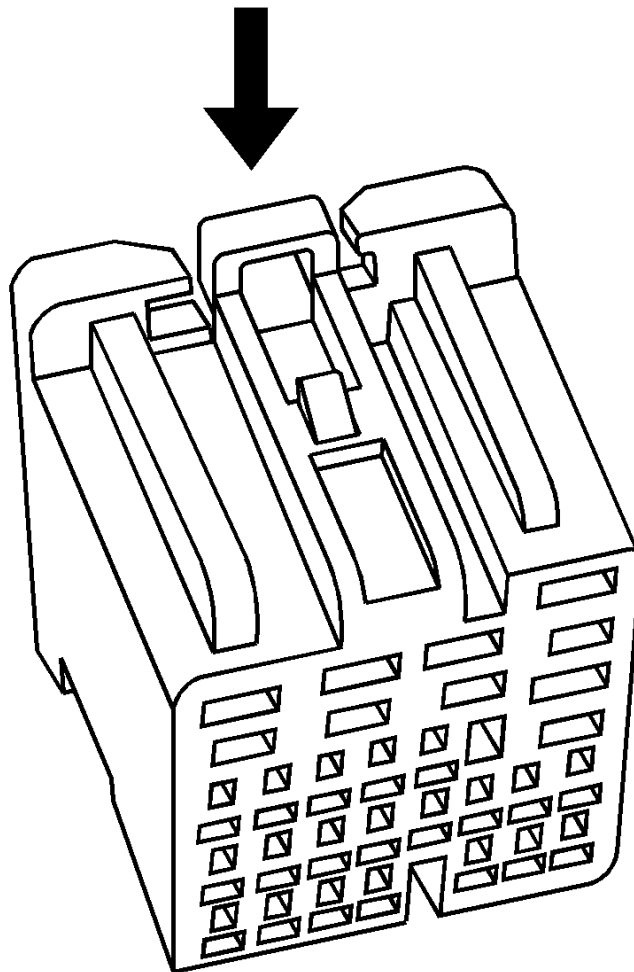


Fig. 93: Identifying Terminal Position Assurance (TPA)

Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, remove the connector from the component.

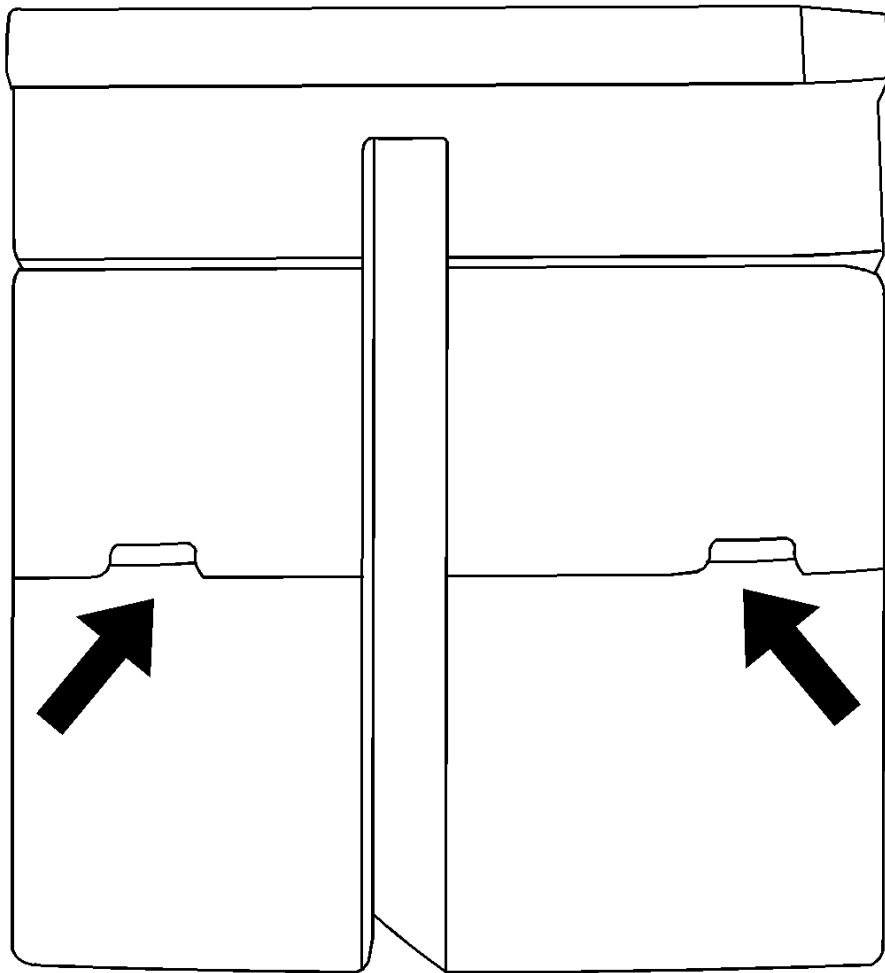


Fig. 94: Identifying TPA On Both Sides Of Connector
Courtesy of GENERAL MOTORS COMPANY

2. Unlock the terminal position assurance (TPA):
 - Position connector as shown (above) and locate TPA staging cavities.

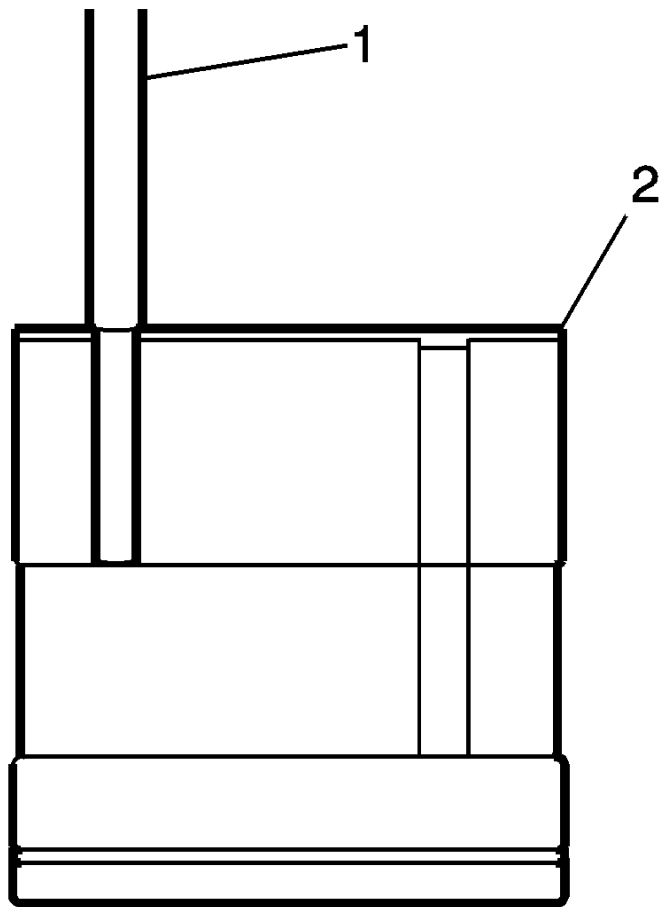


Fig. 95: Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

- Using connector terminal release tool J-38125-553 (1) lift the TPA into the staged position. Perform this step on both sides of the TPA.

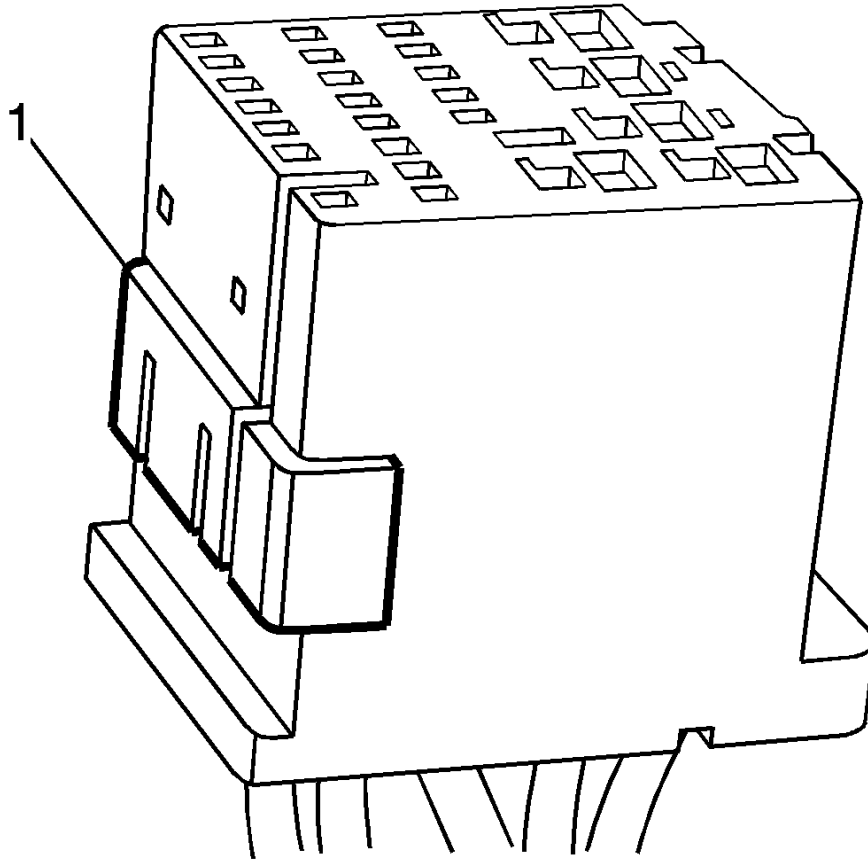


Fig. 96: TPA In Staged Position

Courtesy of GENERAL MOTORS COMPANY

- You will feel the TPA click into place when fully extended into the staged position. The figure above shows the TPA (1) in the staged position.

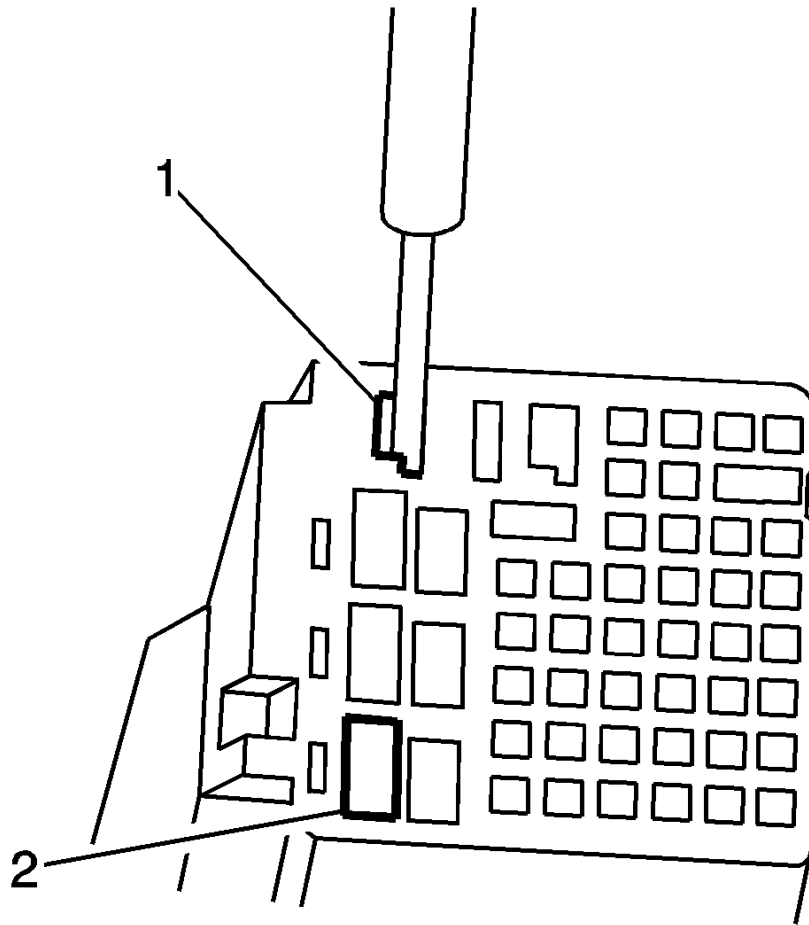


Fig. 97: Connector Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

3. Release the terminal from the connector:

- Position the connector as shown (above) and locate the terminal release entry canal (1) of the suspect terminal.
- Insert the connector terminal release tool J-38125-553 into the entry canal with the angled side of the tool facing the connector wall containing cavity 4 (2).

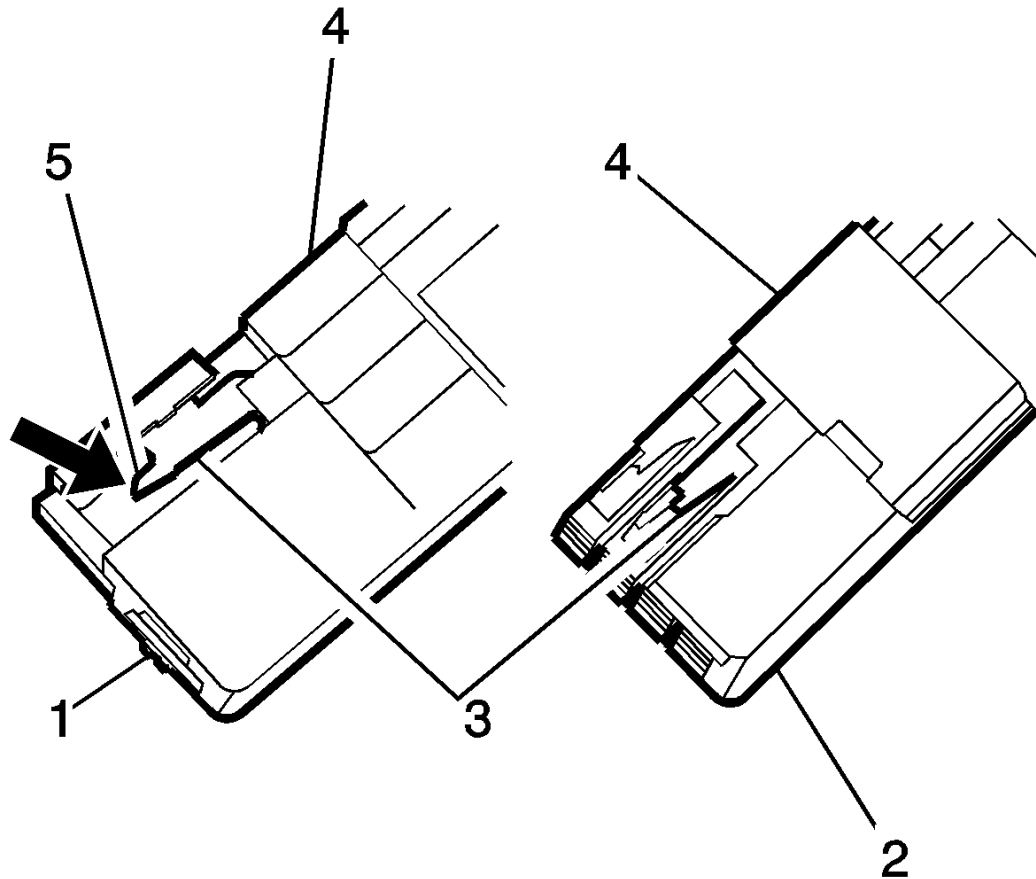


Fig. 98: Connector Lance And TPA

Courtesy of GENERAL MOTORS COMPANY

- The cavity on the left (1) is a 2.8 mm² cavity and the cavity on the right (2) is a 0.64 mm² cavity.
 - Place the tip of the connector terminal release tool onto the connector lance (3) and deflect the lance to the right (5) to release the lock. Hold this released position.
 - Holding the lance in the released position, slightly pull on the suspect terminal to remove it from the connector housing. The side TPA (4) is a secondary lock.
4. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
 5. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

KOSTAL CONNECTORS (GLOW PLUG CONTROL MODULE)

Special Tools

- EL-38125-550 Terminal Release Tool Kit
- EL-38125-580 Terminal Release Tool Kit
- J-38125-24 Terminal Release Tool

- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

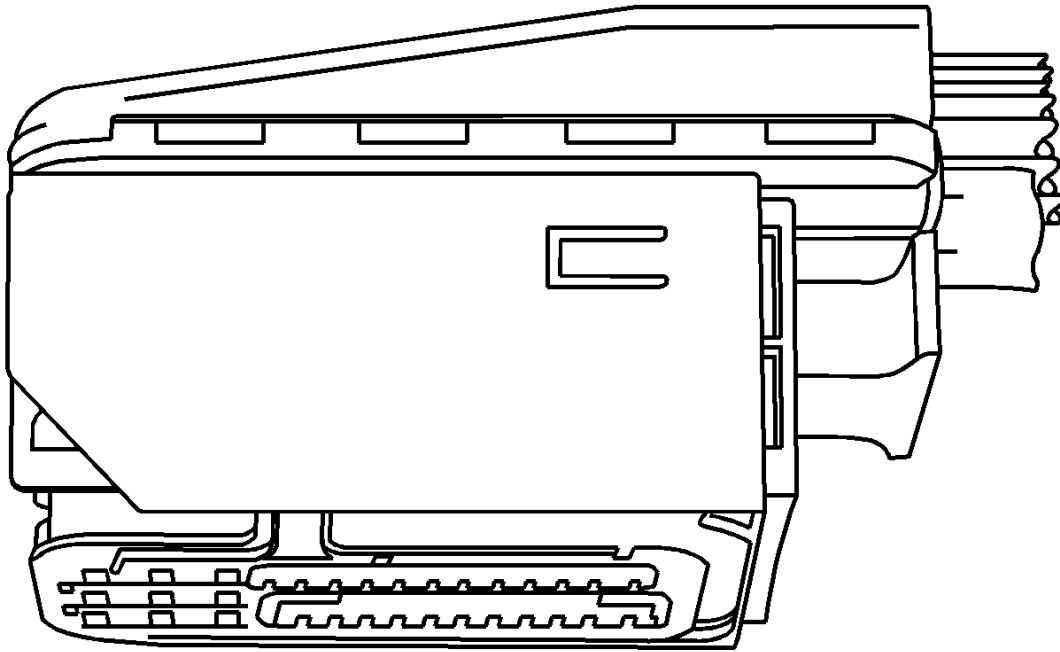


Fig. 99: View Of Typical Kostal Connector
Courtesy of GENERAL MOTORS COMPANY

View of typical connector.

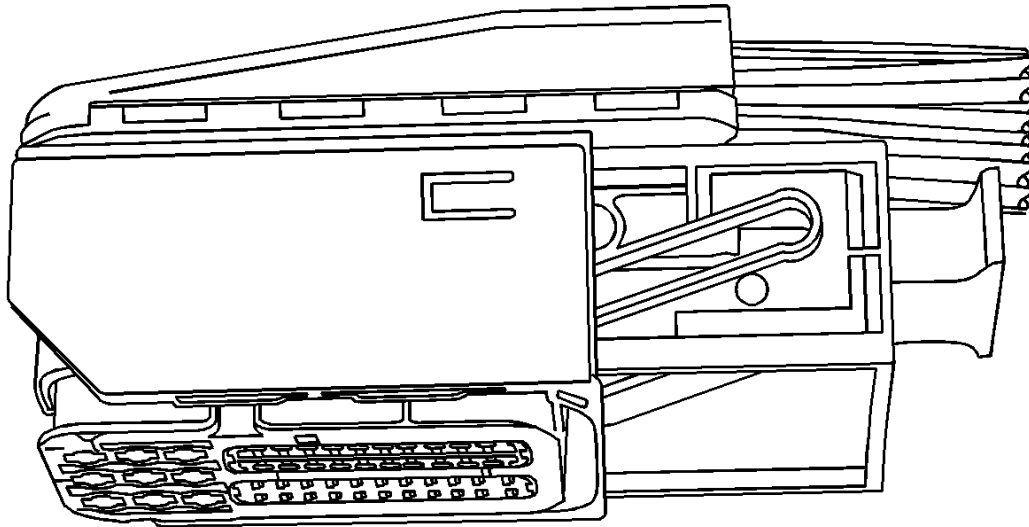


Fig. 100: View Of Connector In Released Position

Courtesy of GENERAL MOTORS COMPANY

View of connector in released position.

1. Locate the assist lever at the back of the connector. Move the assist lever to the rear position.
2. Disconnect the connector from the component.

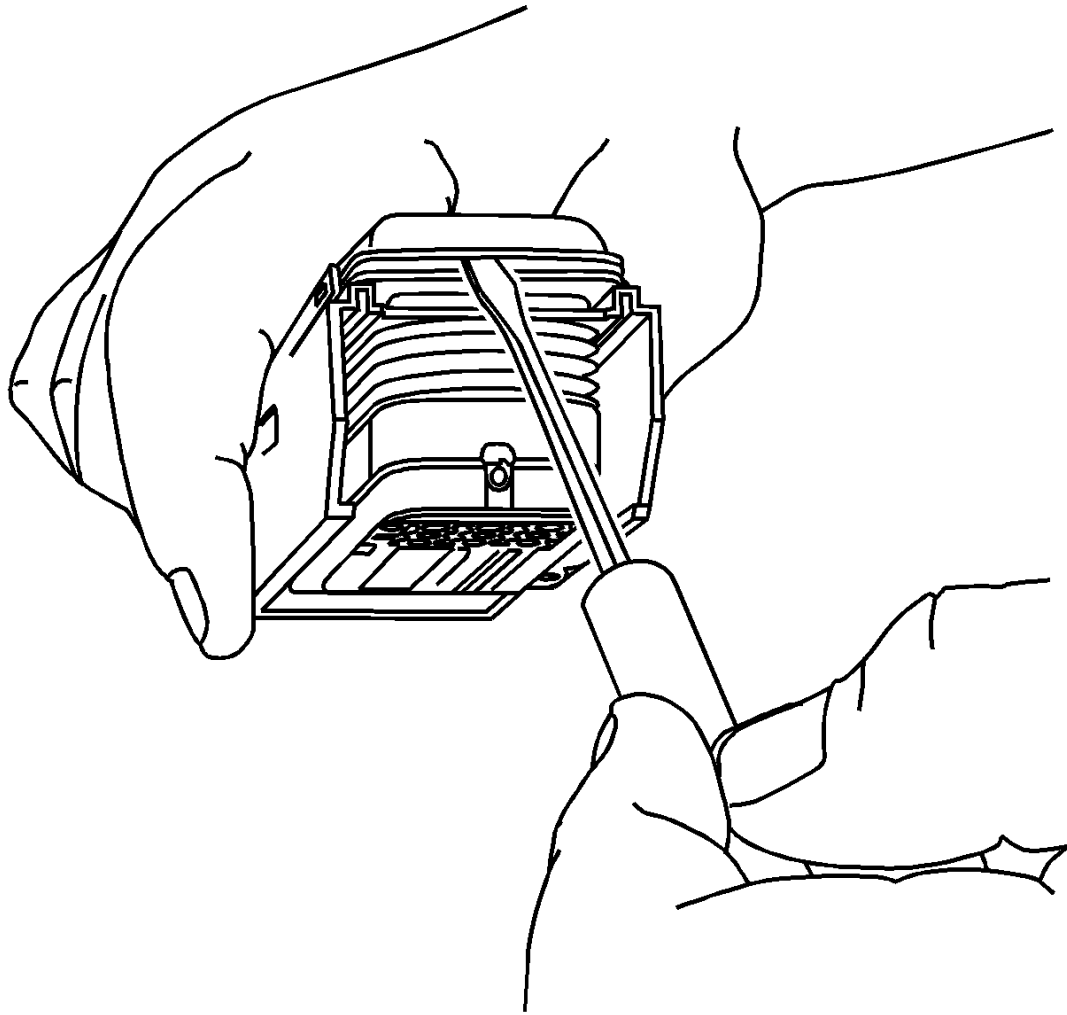


Fig. 101: Using Small Flat-Blade Tool To Remove Dress Cover
Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-blade tool to remove the dress cover.

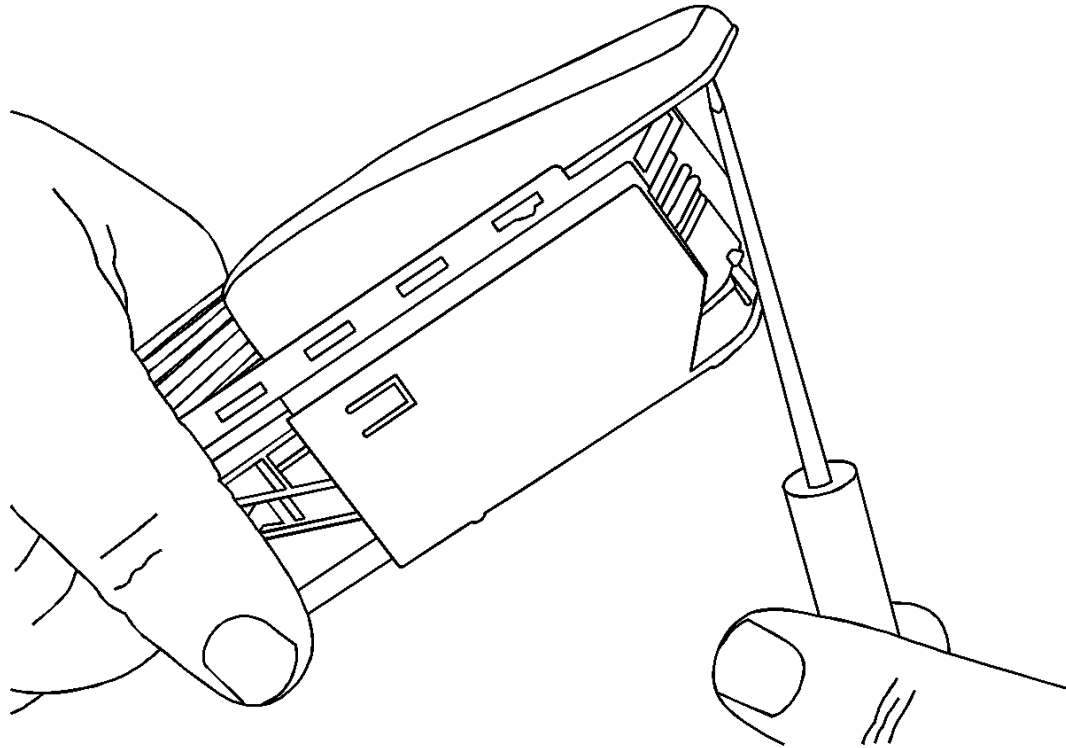


Fig. 102: Sliding Dress Cover Forward & Off Of Kostal Connector (Glow Plug Control Module)
Courtesy of GENERAL MOTORS COMPANY

4. Slide the dress cover forward and off of the connector.

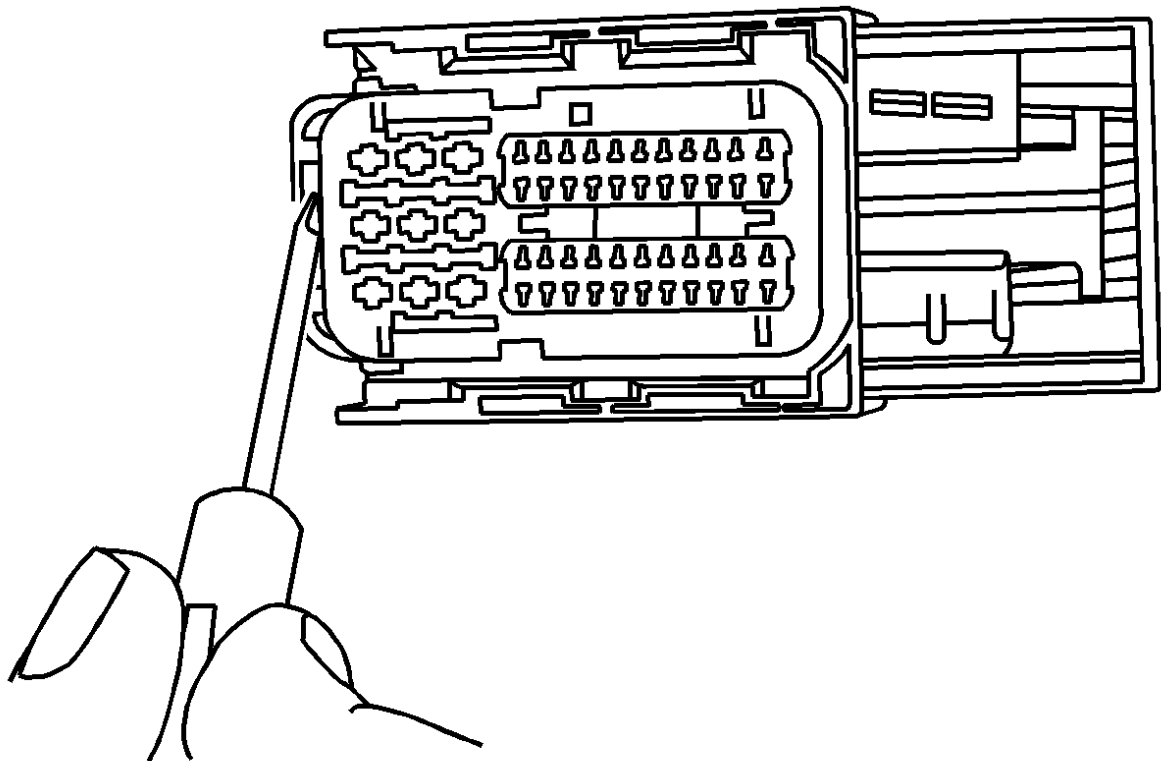


Fig. 103: Locating TPA In Front & Rear Of Connector

Courtesy of GENERAL MOTORS COMPANY

5. The terminal positive assurance (TPA) is located in the front and rear of the connector.

NOTE: **The front TPA cannot be removed from the connector. Only move it to the preset position.**

6. Use a small flat-blade tool to move the front TPA to the preset position, outboard approximately 0.125 in. (3 mm).

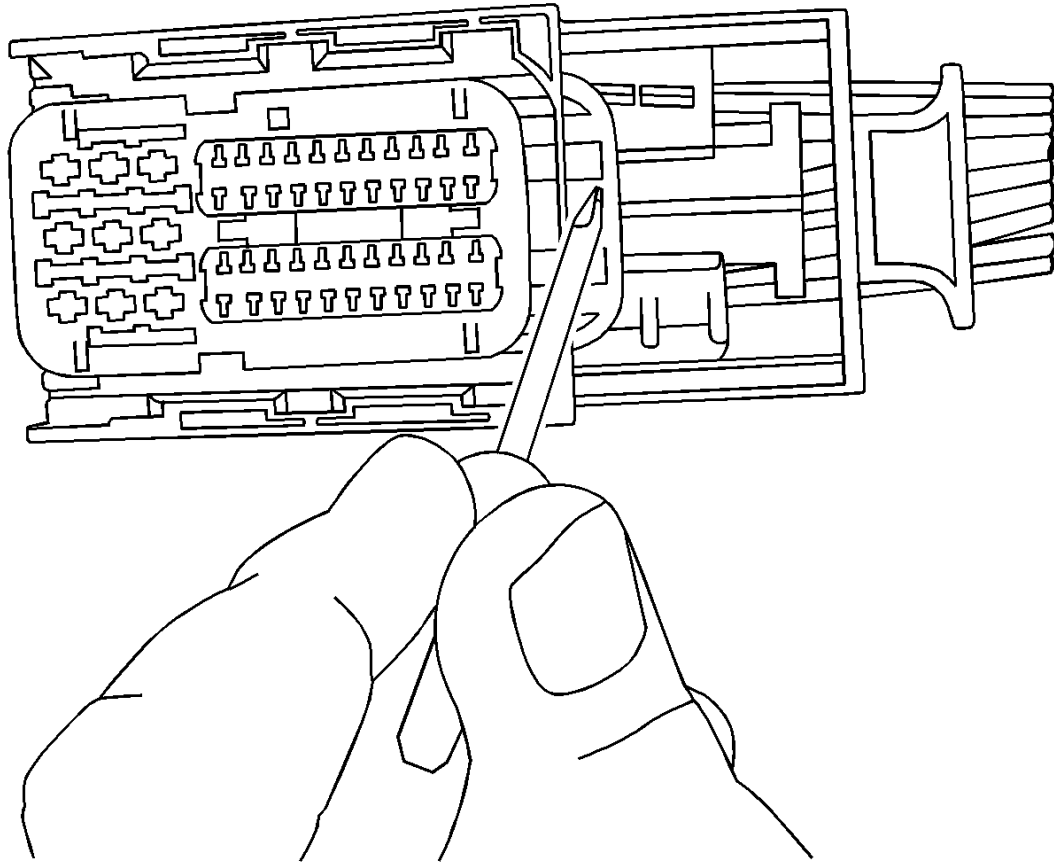


Fig. 104: Using Small Flat-Blade Tool To Remove Rear TPA
Courtesy of GENERAL MOTORS COMPANY

7. Use a small flat-blade tool to completely remove the rear TPA from the connector.

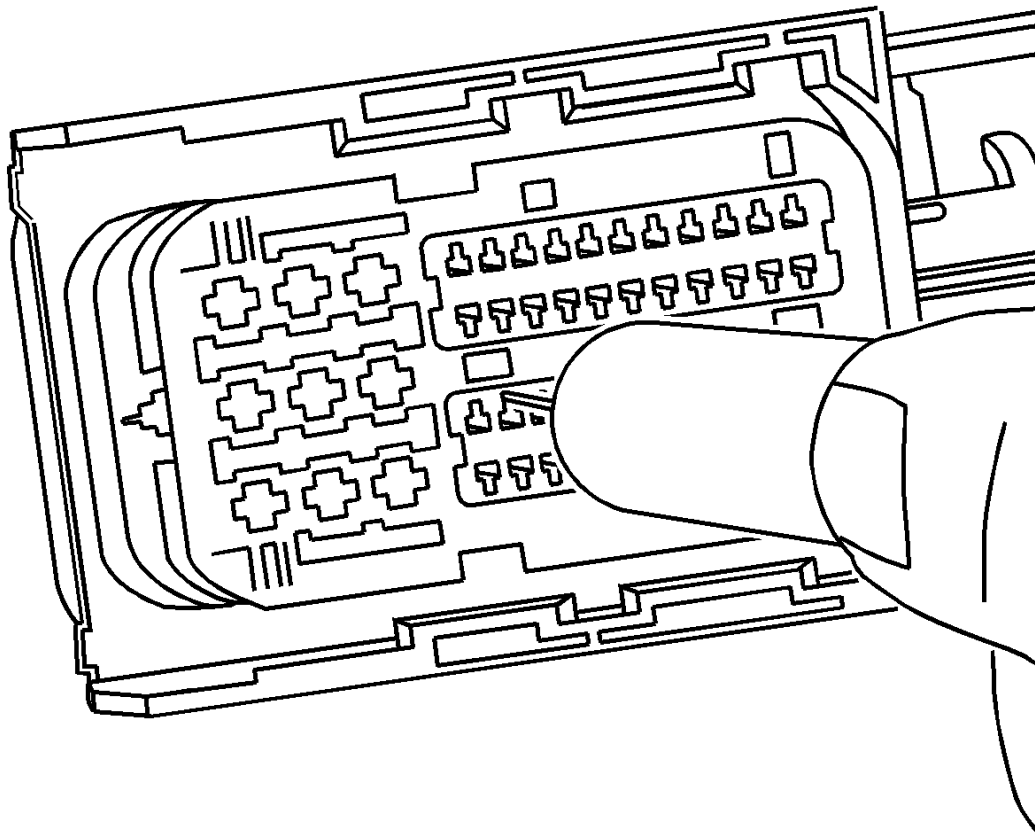


Fig. 105: Using Special Tool To Release Terminals

Courtesy of GENERAL MOTORS COMPANY

8. Use the J-38125-24 or the J-38125-560 tool to release the terminals by inserting the tool into the terminal release cavity.
9. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
10. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.

KOSTAL CONNECTORS (TRANSMISSION)

Special Tools

- EL-38125-550 Terminal Release Tool Kit
- EL-38125-580 Terminal Release Tool Kit
- J-38125-28 Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

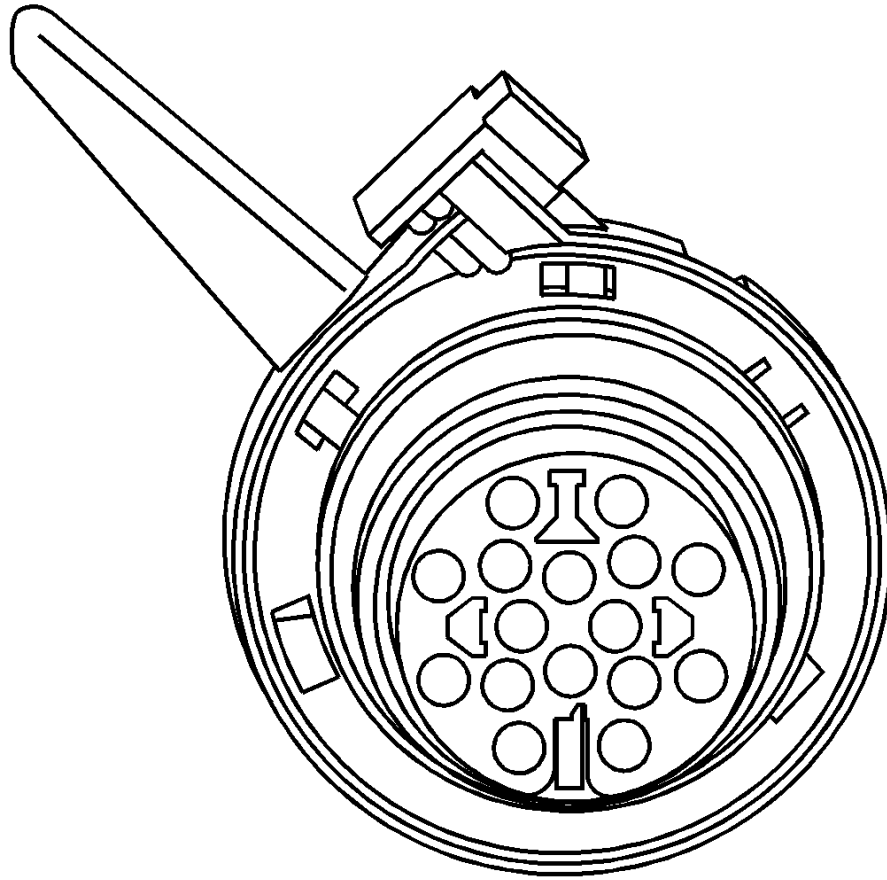


Fig. 106: View Of Connector & Lock

Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, twist and remove the connector from the component.

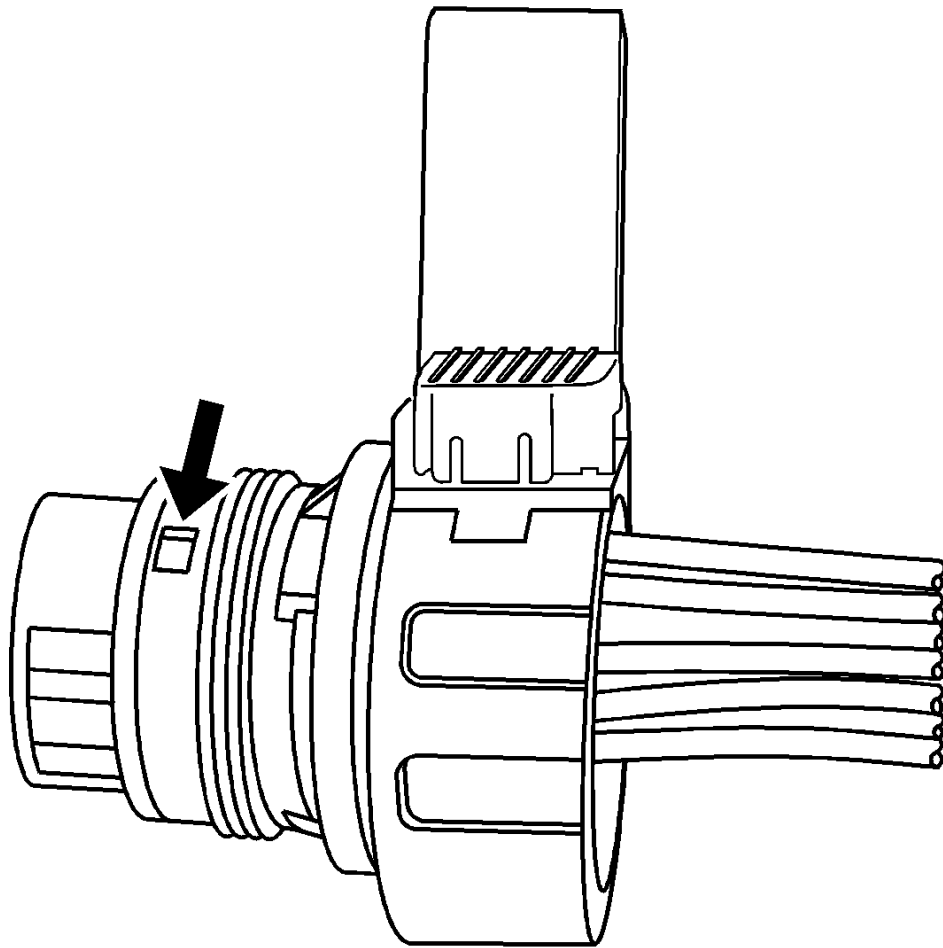


Fig. 107: View Of Terminal Position Assurance (TPA)

Courtesy of GENERAL MOTORS COMPANY

2. Locate the terminal position assurance (TPA).

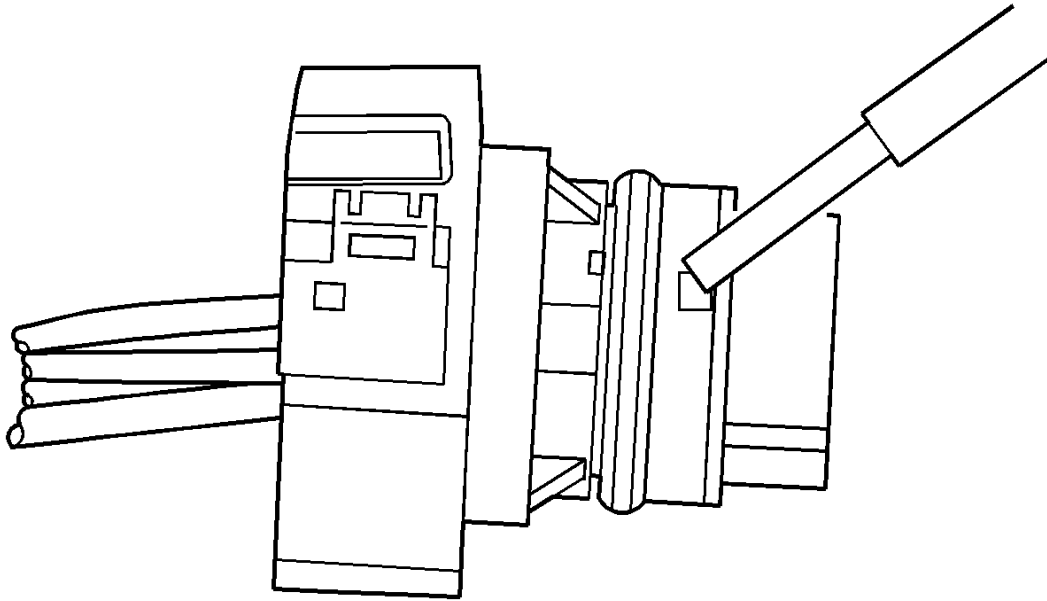


Fig. 108: View Of TPA & Flat-Bladed Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: The TPA cannot be removed from the connector while there are terminals present in the connector body.

3. Use a small flat-blade tool to push the TPA until it bottoms out.

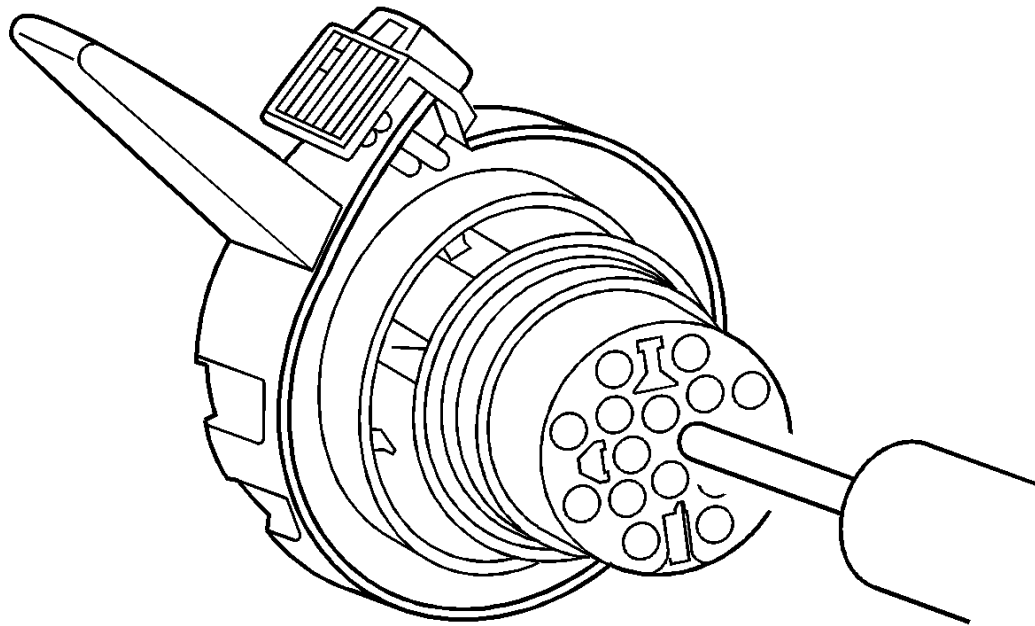


Fig. 109: Using J 38125-28 Tool To Release Terminals

Courtesy of GENERAL MOTORS COMPANY

4. Use the J-38125-28 tool to release the terminals by inserting the tool into the terminal cavity as shown in the graphic.
5. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
6. Repair the terminal by following the [**Repairing Connector Terminals \(Terminated Lead Repair\)**](#) procedure.

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.

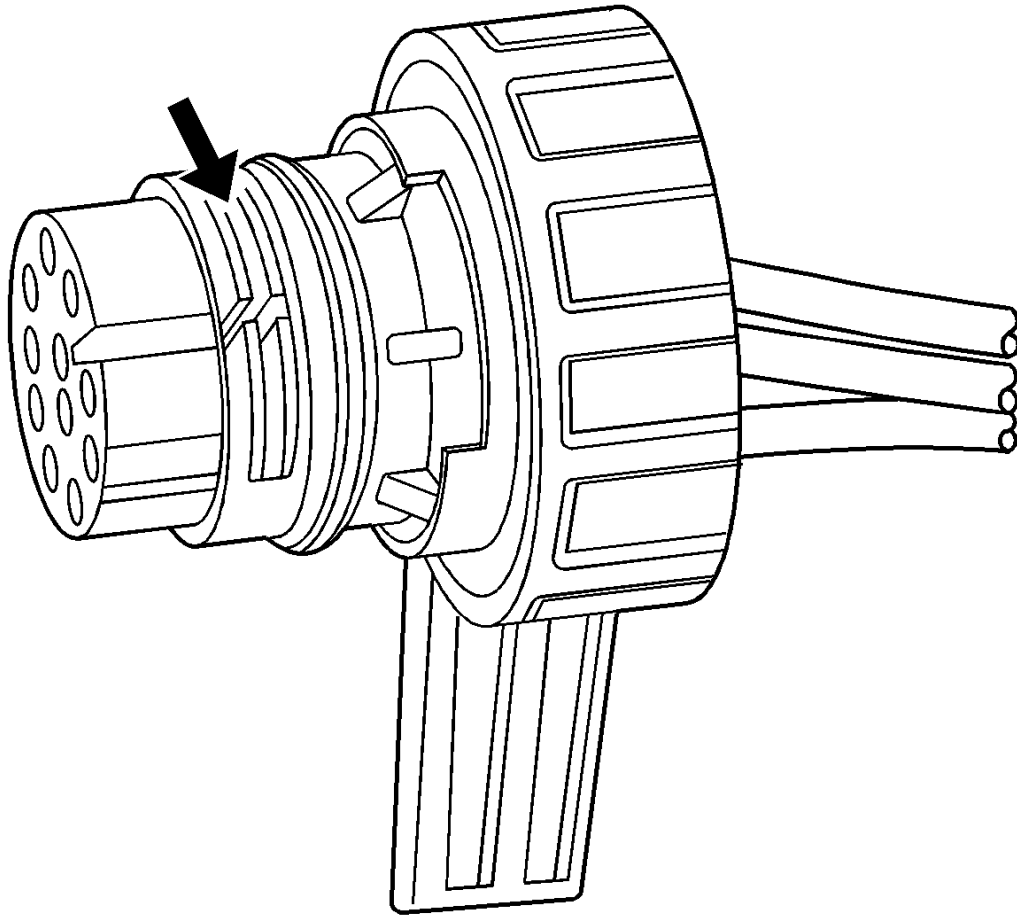


Fig. 110: Locating Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

3. Locate the TPA.

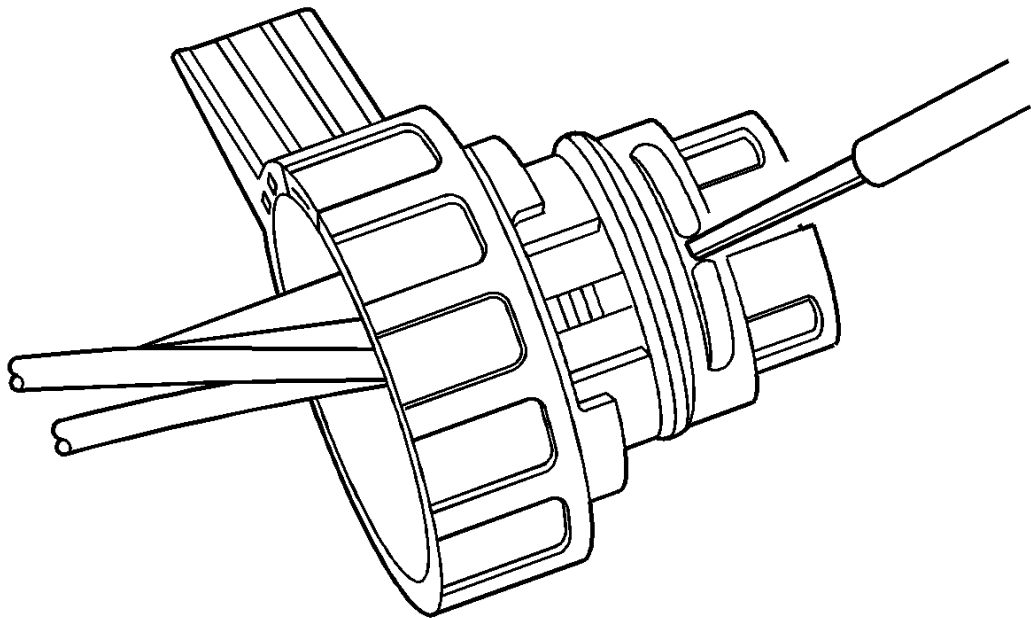


Fig. 111: View Of TPA & Flat-Bladed Tool

Courtesy of GENERAL MOTORS COMPANY

4. Use a small flat-blade tool to push the TPA until it bottoms out.

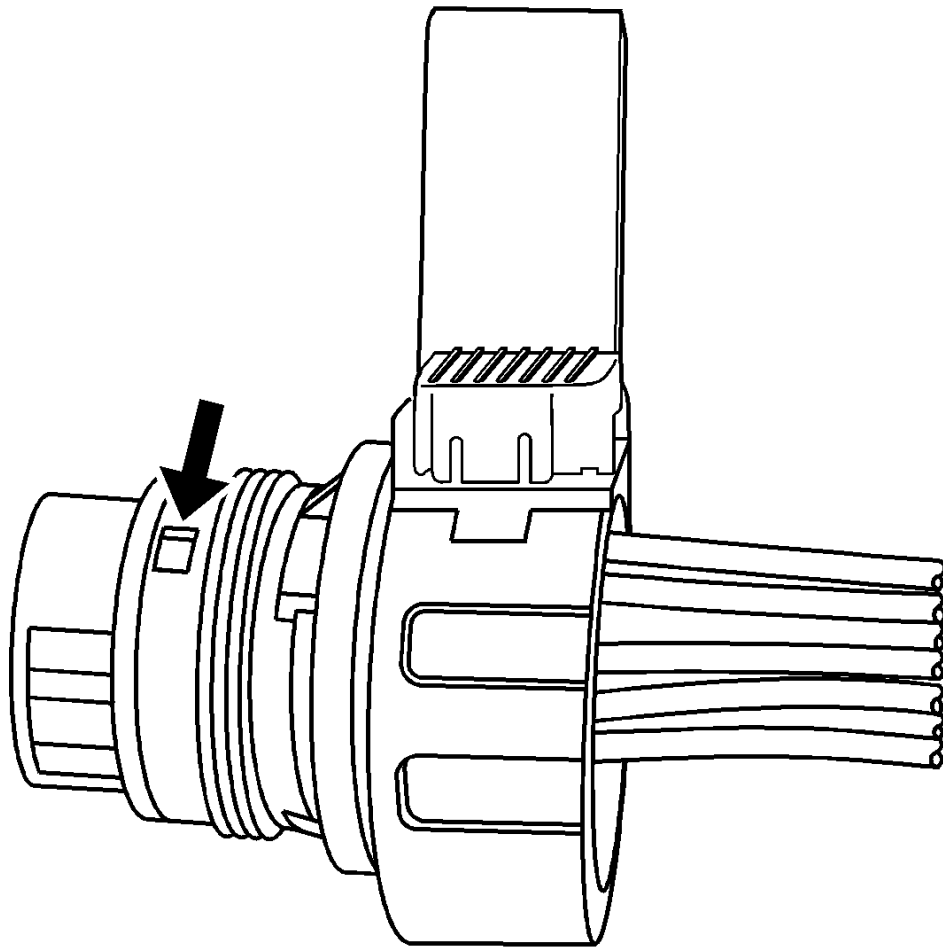


Fig. 112: View Of Terminal Position Assurance (TPA)

Courtesy of GENERAL MOTORS COMPANY

5. Ensure the TPA is fully seated. The TPA should be centered and flush with the connector body when viewed.

MOLEX CONNECTORS (LEVER LOCK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-213** Terminal Release Tool

For equivalent regional tools, refer to [**Special Tools**](#) .

Terminal Removal Procedure

1. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

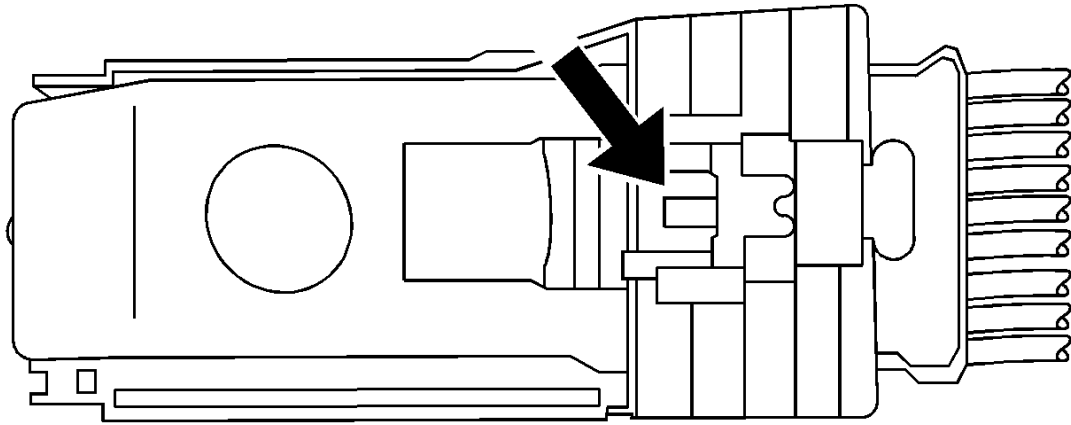


Fig. 113: Identifying Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

2. Slide the lever lock forward while pressing down on the lever lock release tab.

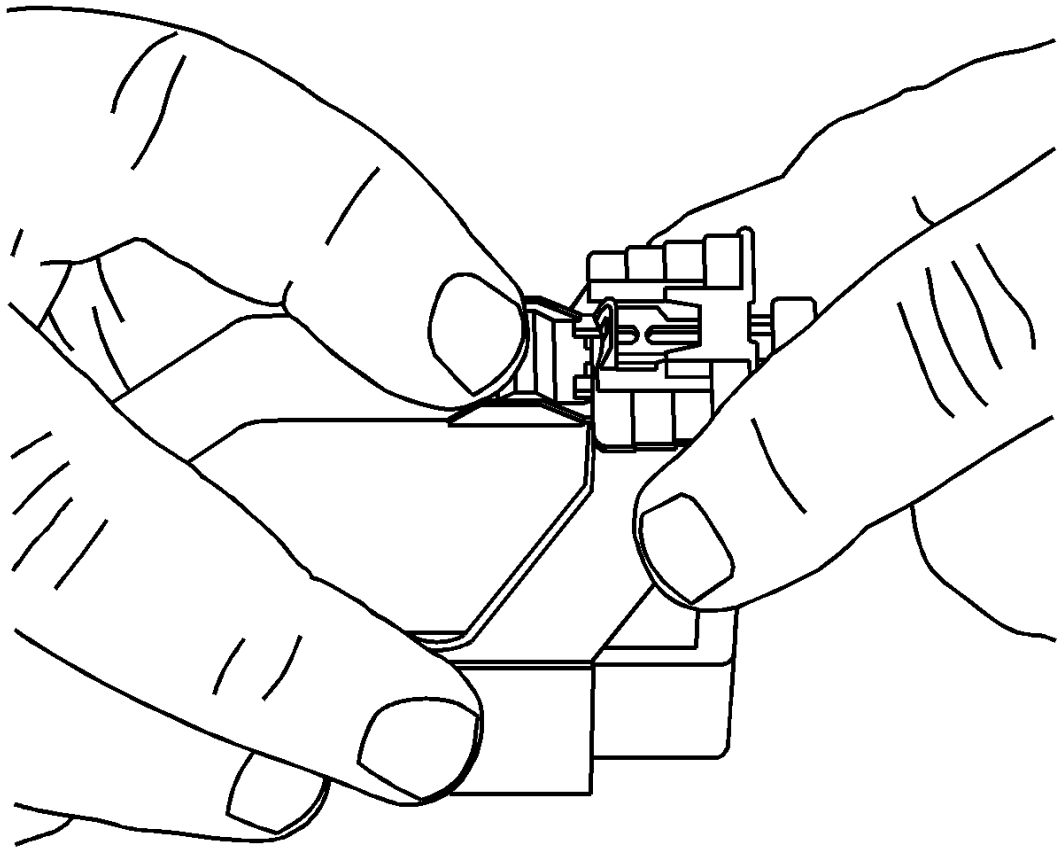


Fig. 114: View Of Lever In Full Forward Position
Courtesy of GENERAL MOTORS COMPANY

3. The lever should be in the full forward position.

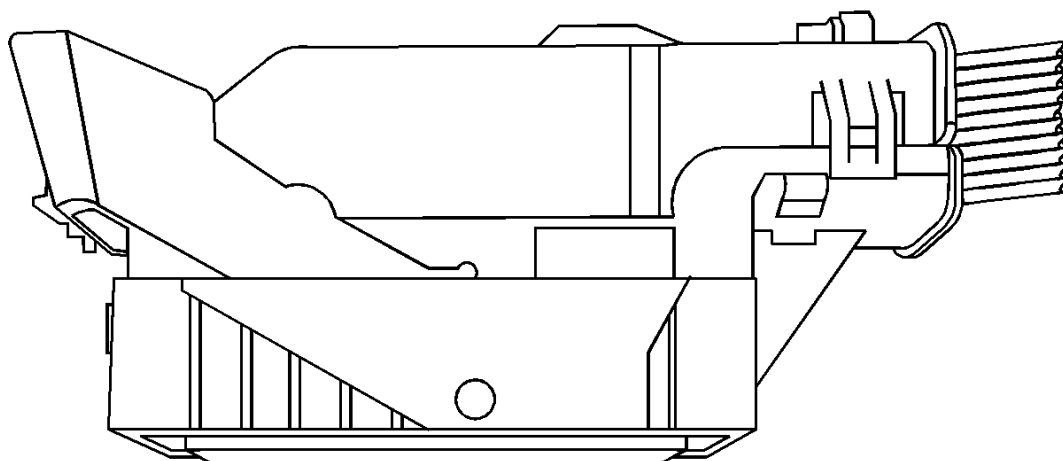


Fig. 115: View Of CPA Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the connector from the component.

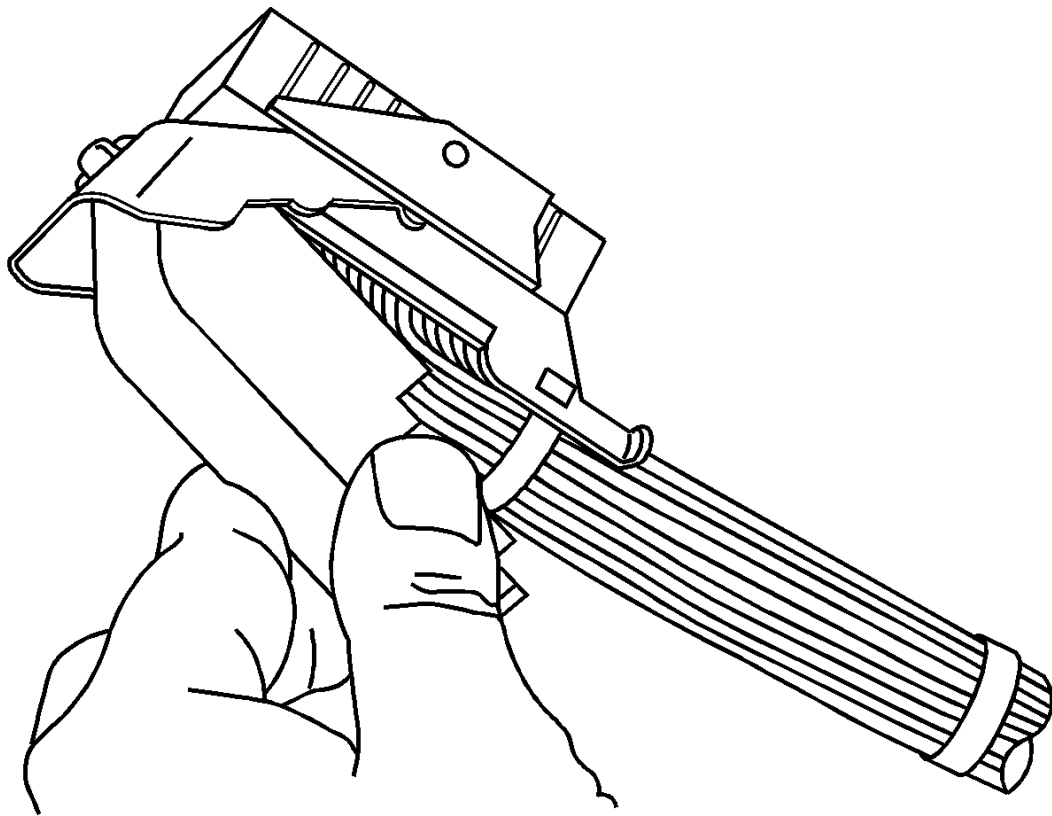


Fig. 116: View Of Dress Cover

Courtesy of GENERAL MOTORS COMPANY

5. Remove the dress cover by using a flat bladed tool to release the dress cover locking tabs and lift up on the dress cover.
6. Cut the tie wrap that holds the wires to the connector body.

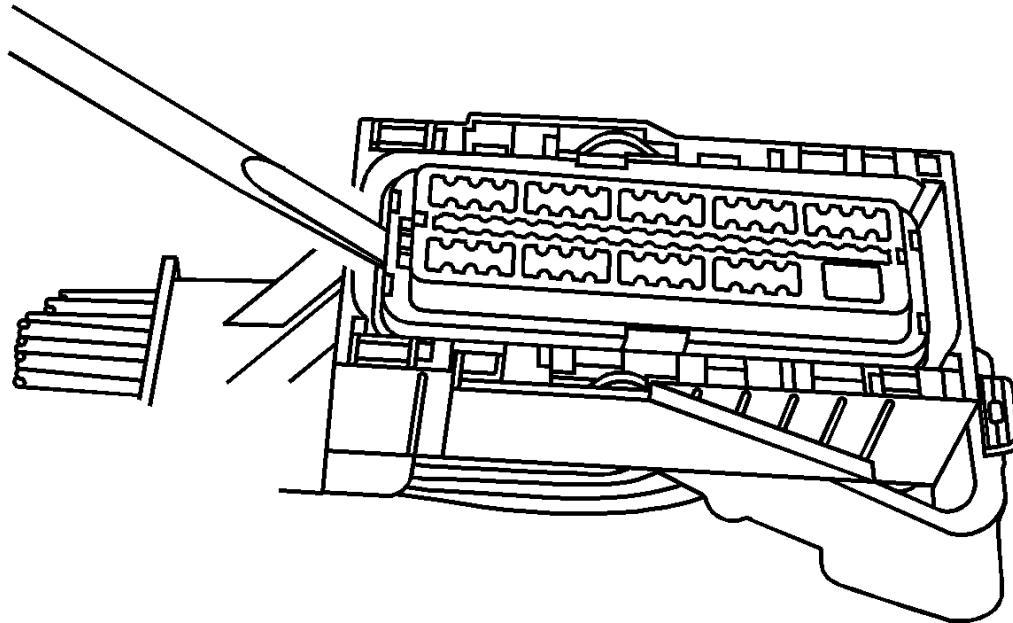


Fig. 117: Prying One Side Of Nose Piece

Courtesy of GENERAL MOTORS COMPANY

7. Use a small flat-blade tool to pry one side of the nose piece up to the pre-stage position. When the nose piece is in the pre-staged position, the nose piece will be raised above the connector body the length of the step in the nose piece.

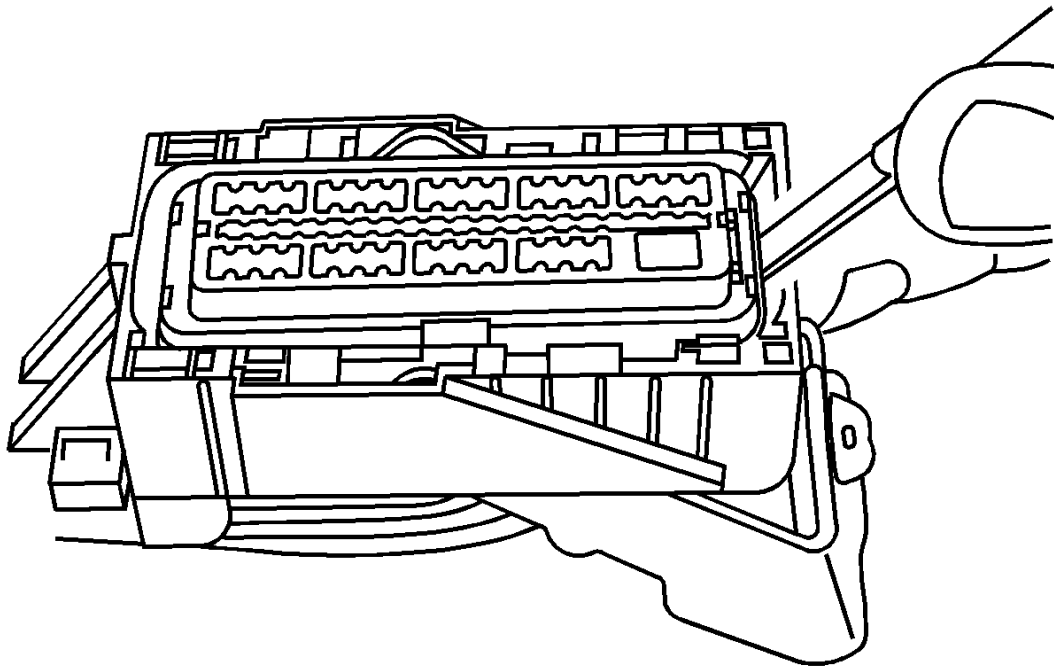


Fig. 118: Prying Side Of Nose Piece

Courtesy of GENERAL MOTORS COMPANY

8. Use a small flat-blade tool to pry the other side of the piece to the pre-stage position. If the nose piece is higher than the first step in the nose piece, gently push down on the nose piece until it meets with resistance from the connector body, you should feel the nose piece click into position.

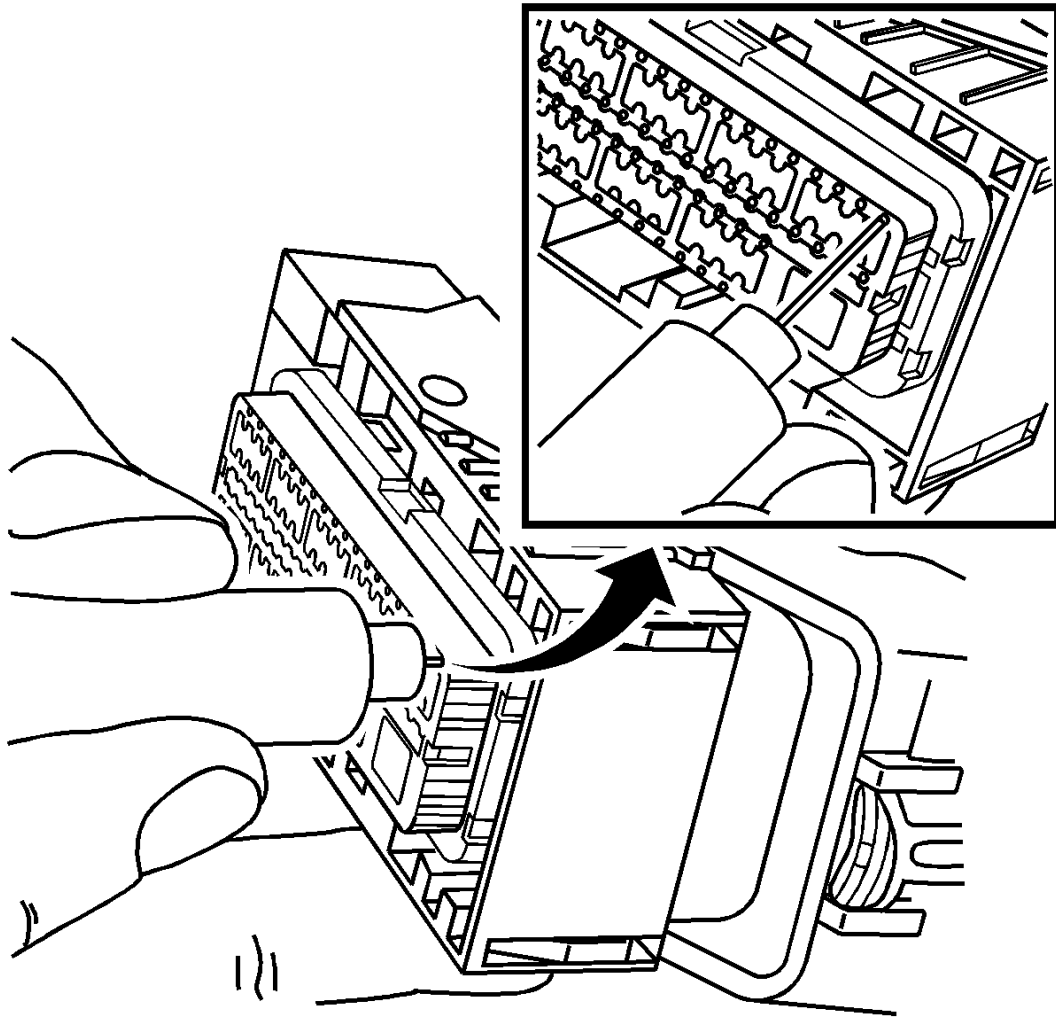


Fig. 119: Releasing Terminal

Courtesy of GENERAL MOTORS COMPANY

9. Insert the J-38125-213 into the small terminal release hole on the nose piece and gently pull on the back of the wire.
10. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminated Lead Repair

1. Remove the terminal.
2. Find the appropriate terminated lead.
3. Use the appropriate splice sleeves depending on the gauge size.
4. Refer to [Wire to Wire Repair](#).

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Insure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the connector disassembly procedure.

MOLEX CONNECTORS (SIR)

Removal Procedure

NOTE: The orange or yellow connector position assurance (CPA) must be released first to disconnect or to connect the connector.

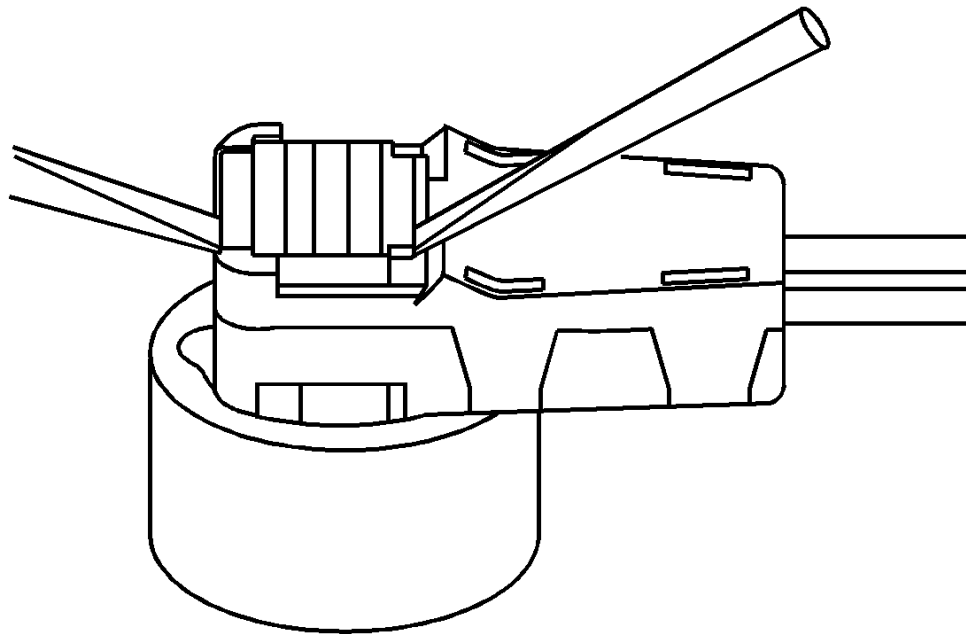


Fig. 120: Lifting Orange CPA

Courtesy of GENERAL MOTORS COMPANY

1. Lift the orange or yellow CPA vertically (avoid lifting on an angle to the connector) approximately 4 mm to release the connector. Use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

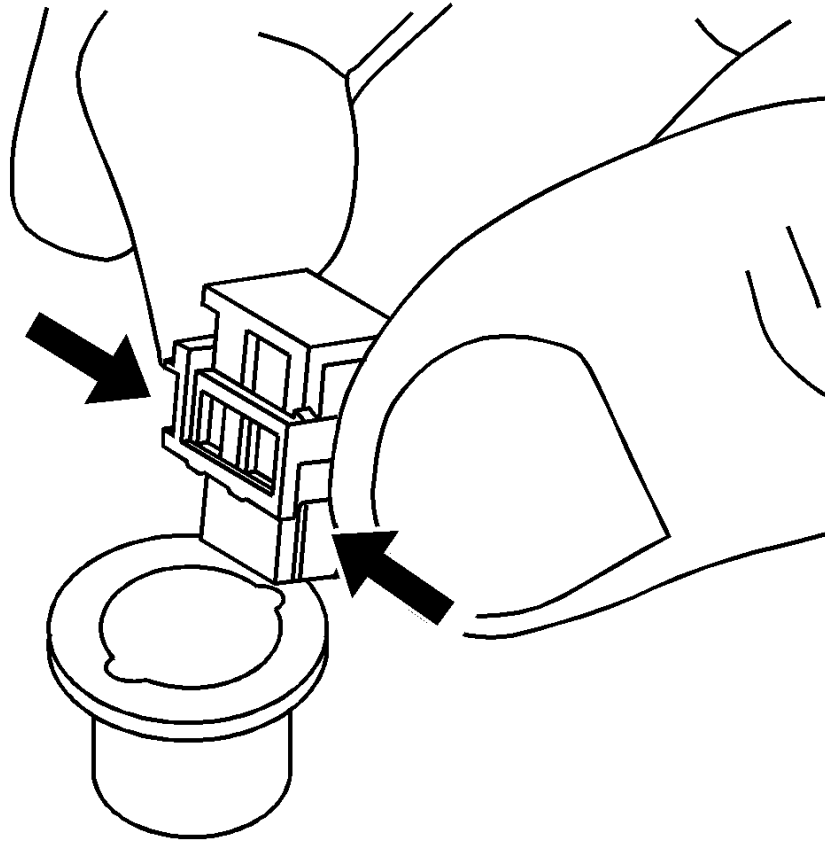


Fig. 121: Grabbing Connector On Both Sides
Courtesy of GENERAL MOTORS COMPANY

2. Grab the connector on both sides and lift vertically to disconnect the connector.

Installation Procedure

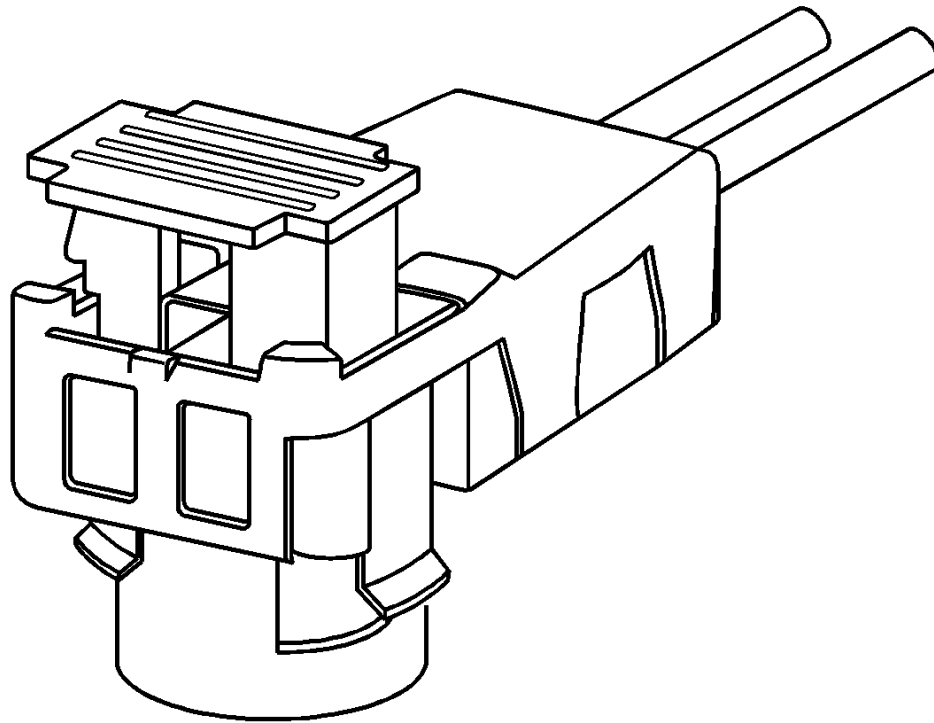


Fig. 122: Lifting Orange CPA

Courtesy of GENERAL MOTORS COMPANY

1. The CPA should be approximately 4 mm above the yellow cover before installing the connector. If not, use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

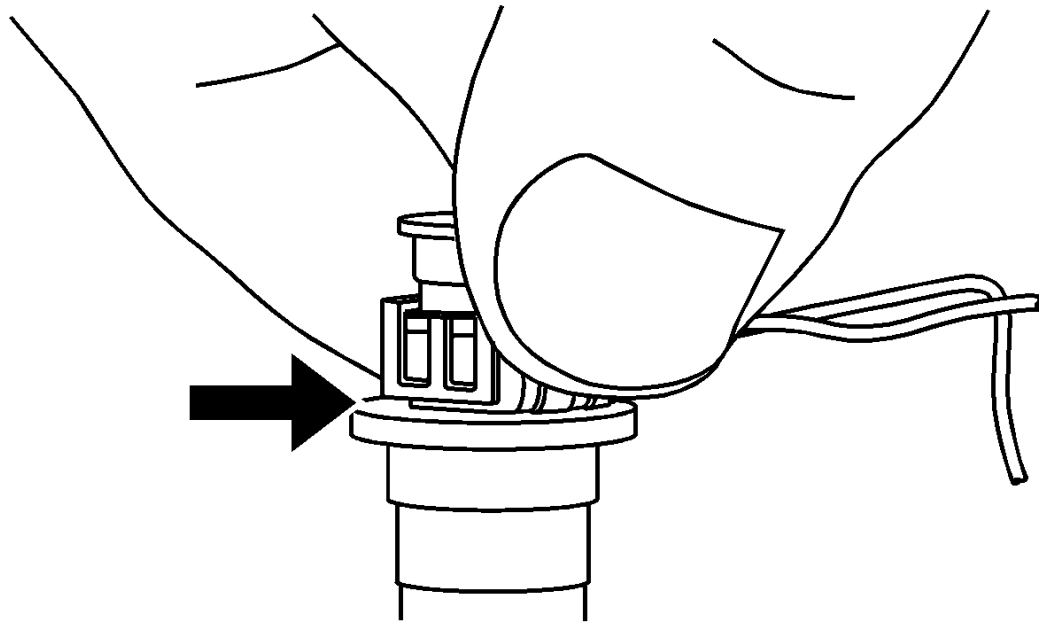


Fig. 123: Seating Connector Sub-Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Line up the connector key tabs with the initiator key slots. Grab the connector on both sides and push down into the initiator connector sub assembly until fully seated.

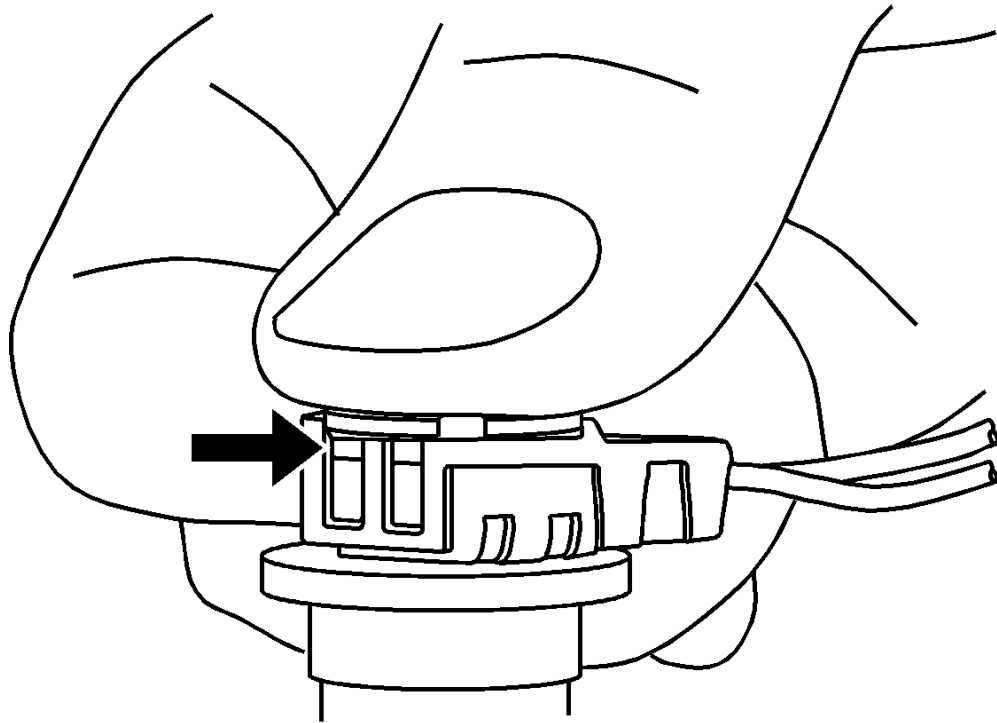


Fig. 124: Pushing CPA Down

Courtesy of GENERAL MOTORS COMPANY

3. After the connector is fully seated, push the CPA down with your thumb until the CPA is touching the yellow cover on the connector.

SUMITOMO CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-552** Terminal Release Tool
- **J-38125-553** Terminal Release Tool

For equivalent regional tools, refer to [**Special Tools**](#) .

Terminal Removal Procedure

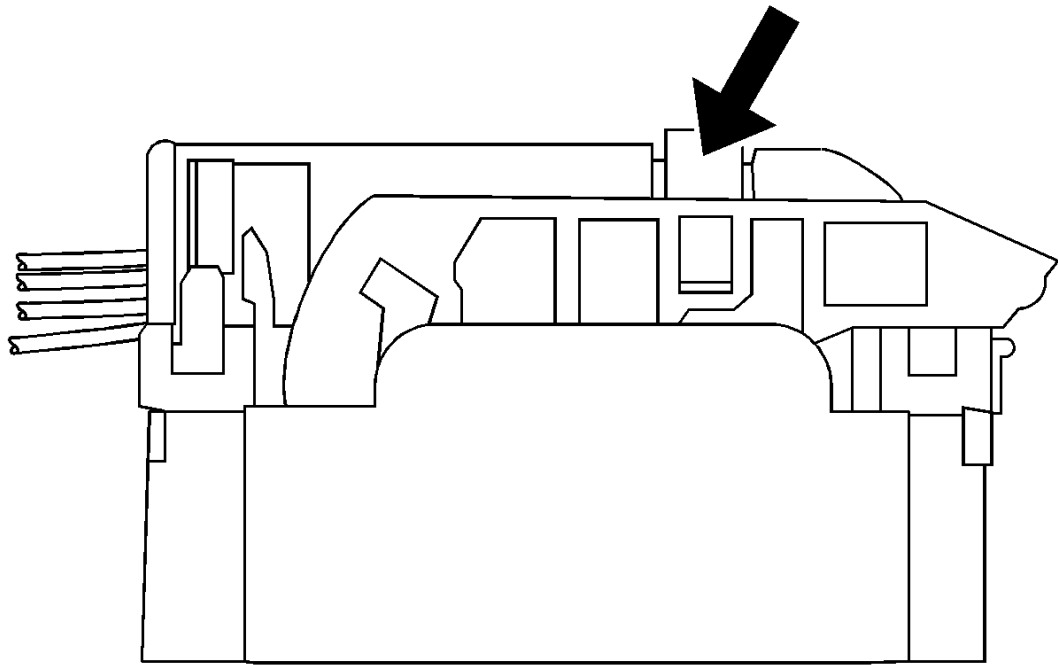


Fig. 125: Identifying Lever Lock

Courtesy of GENERAL MOTORS COMPANY

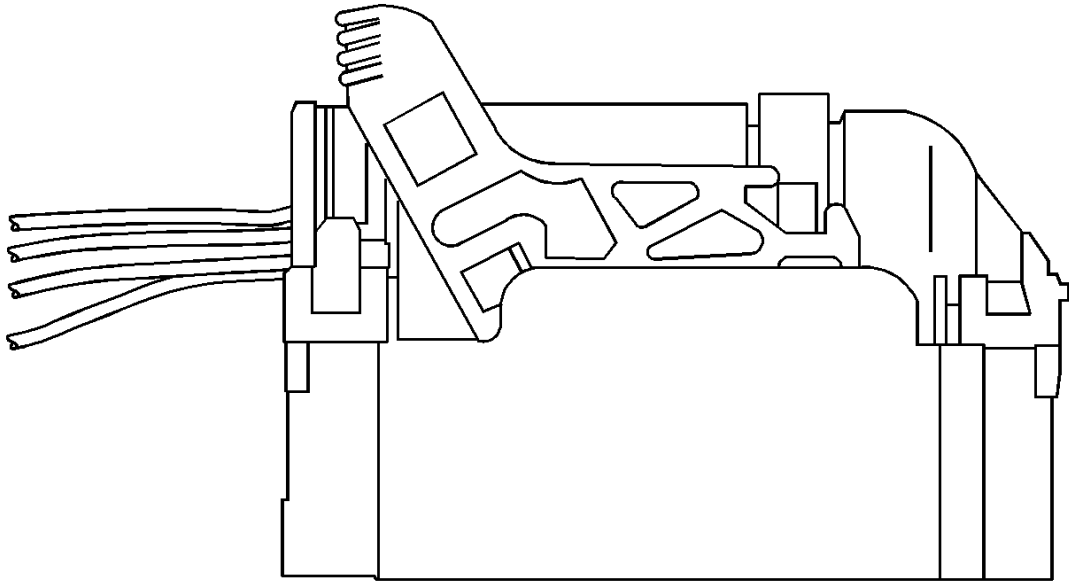


Fig. 126: View Of Lever Lock In Forward Position

Courtesy of GENERAL MOTORS COMPANY

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. Disconnect the connector from the component.

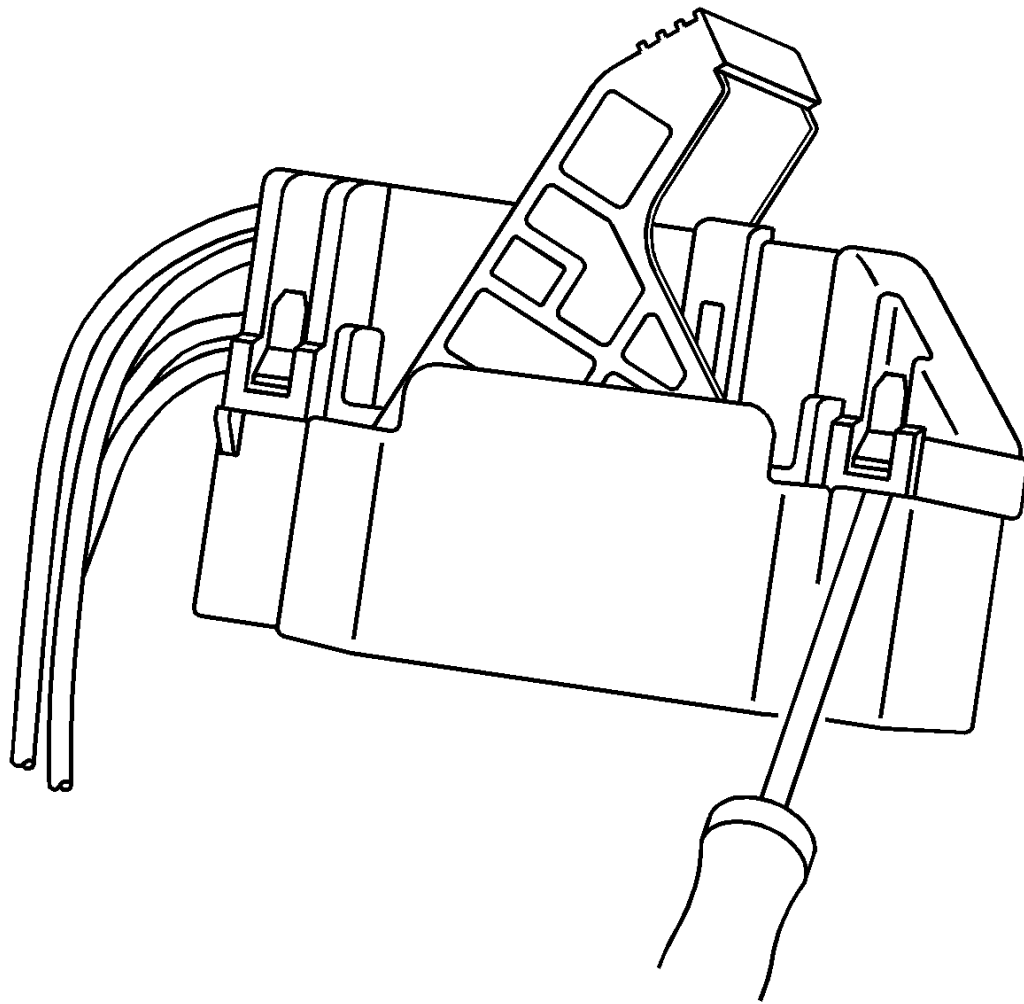


Fig. 127: View Of Connector Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

3. Remove the dress cover by using a flat-blade tool to release the connector locking tabs and pulling off the dress cover.

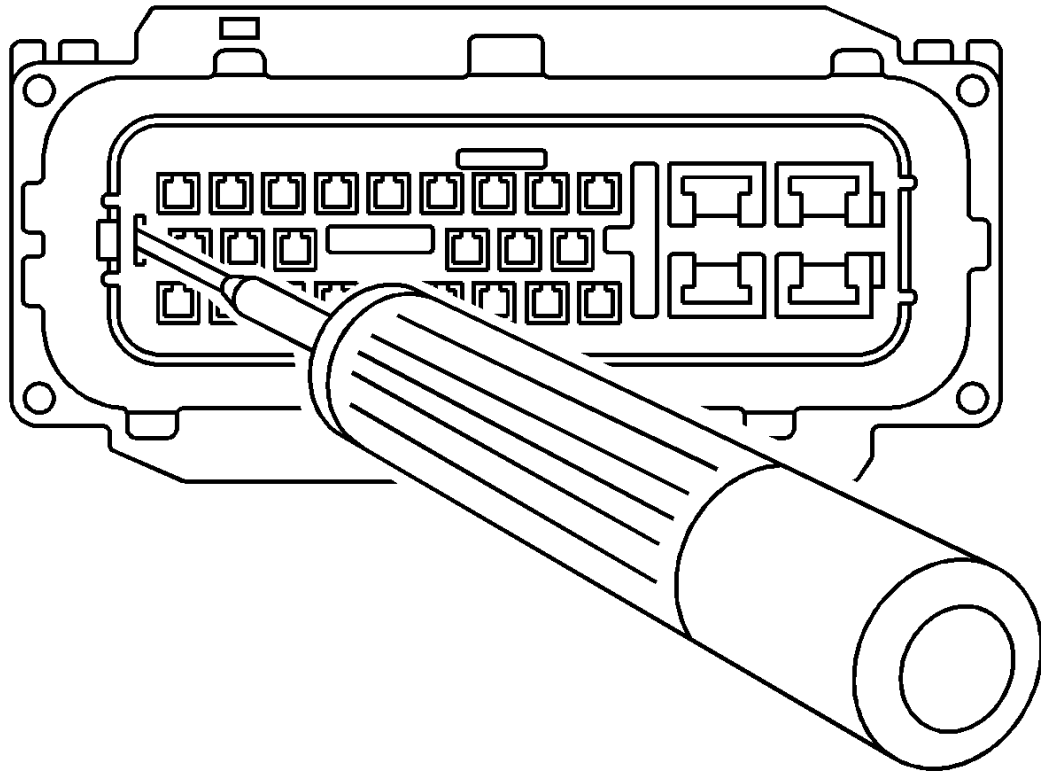


Fig. 128: Identifying Nose Piece Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

4. Relieve the tension on the nose piece retainers by inserting J-38125-12A into the single retainer slot on the end of the nose piece and gently prying out the locking tab. Repeat the process for both of the nose piece locking tabs on the opposite side of the nose piece.

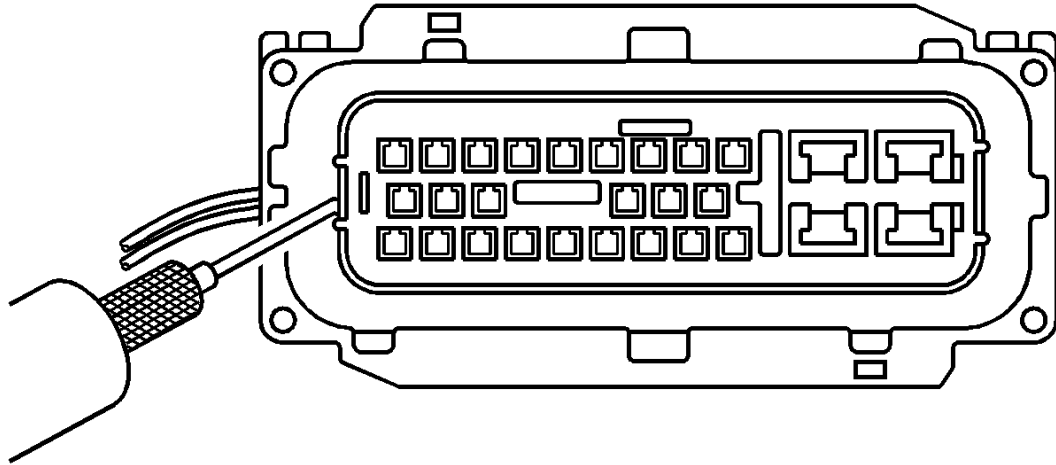


Fig. 129: Pulling Up One End Of Nose Piece (1st Side)

Courtesy of GENERAL MOTORS COMPANY

5. Once the nose piece retainers are relaxed, use the J-38125-552 to pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should raise slightly.

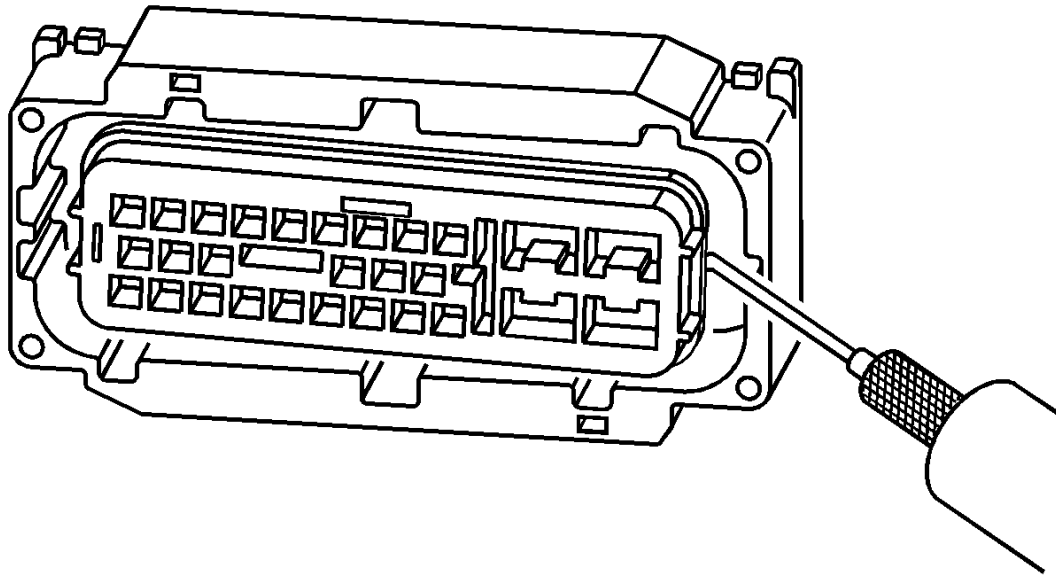


Fig. 130: Pulling Up One End Of Nose Piece (2nd Side)

Courtesy of GENERAL MOTORS COMPANY

6. On the opposite side of the nose piece, use the J-38125-552 pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should release completely. If the nose piece does not come off, repeat the procedure on the opposite side.

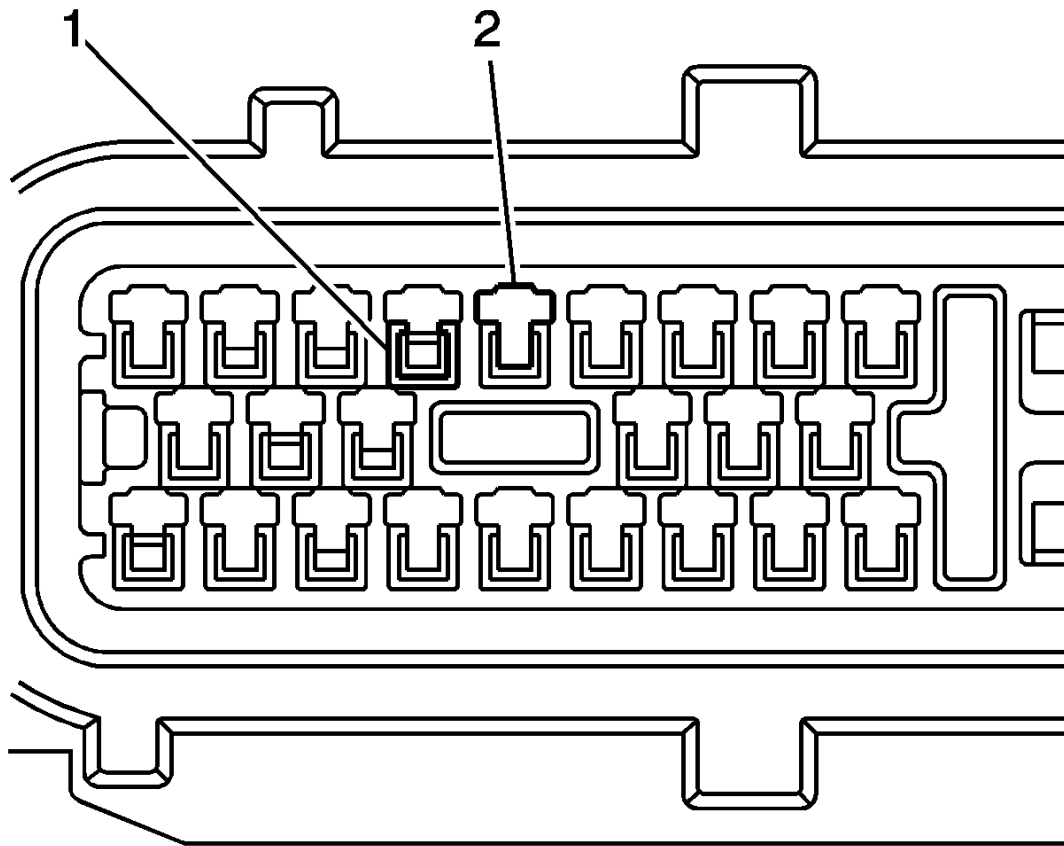


Fig. 131: View Of Terminal & Entry Canal

Courtesy of GENERAL MOTORS COMPANY

7. The illustration above identifies the entry canal where the terminal release tool will be inserted, and the terminal cavity.

- Terminal (1)
- Entry Canal (2)

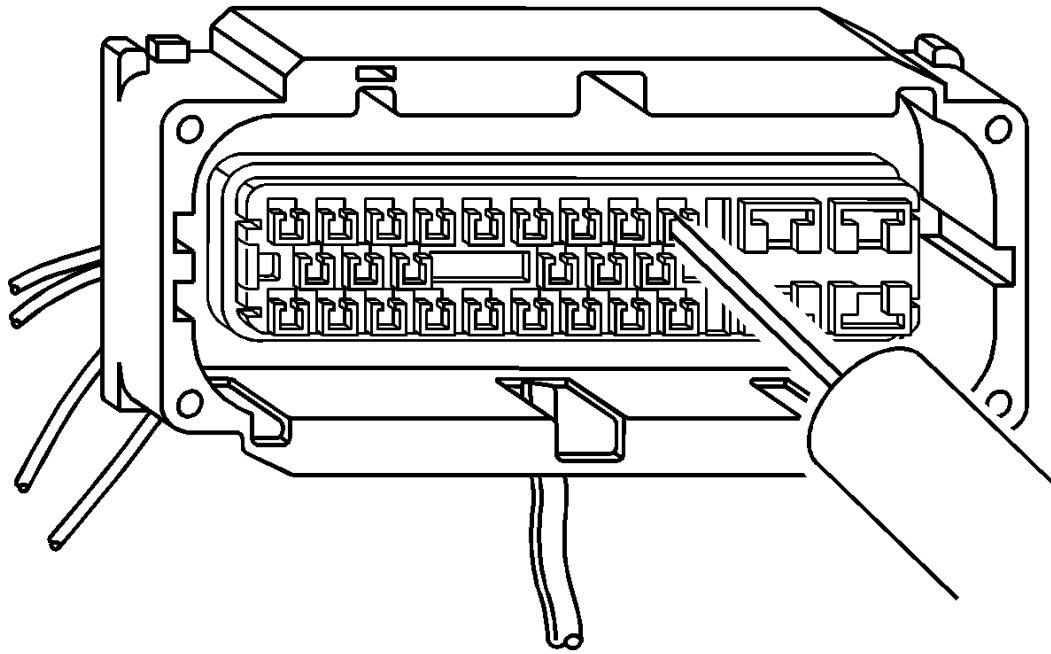


Fig. 132: Inserting J-38125-553 (15315247) Tool Into Entry Canal

Courtesy of GENERAL MOTORS COMPANY

8. Insert the J-38125-553 tool into the entry canal and pry up on the terminal retainer. The terminal retainer is a small plastic piece on the top of the terminal. The terminal retainer must be held up while the terminal is pulled out of the connector.

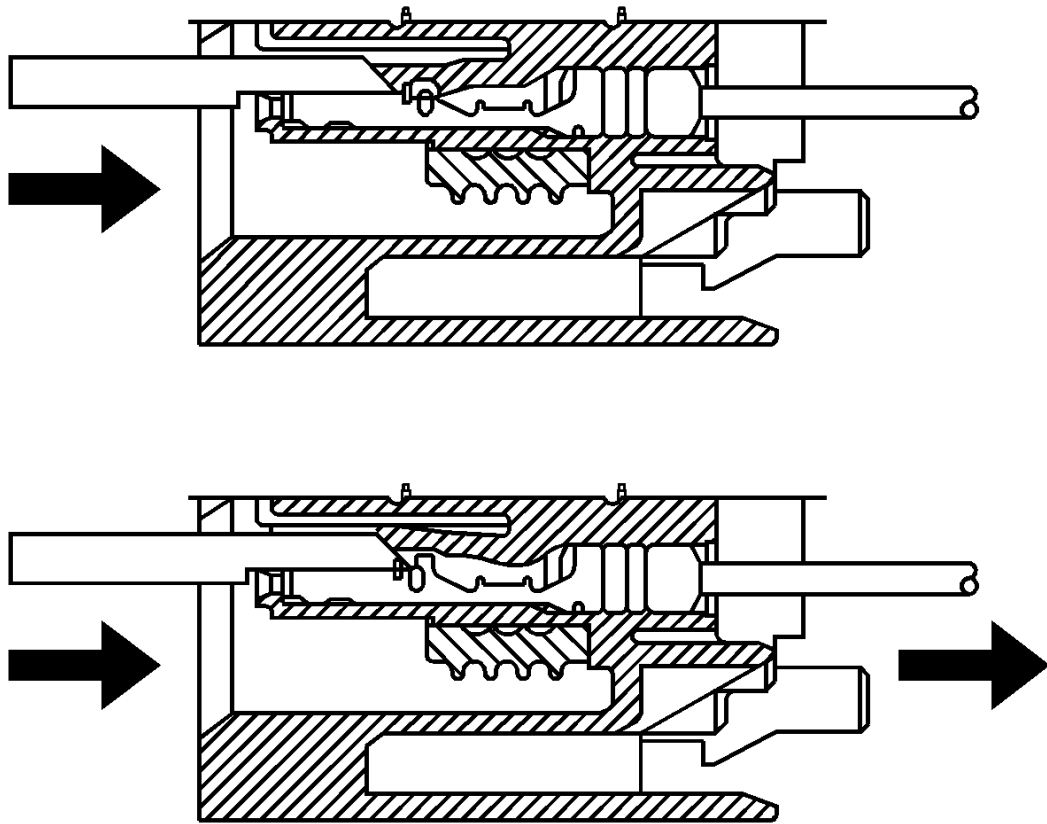


Fig. 133: Cutaway View Of Connector

Courtesy of GENERAL MOTORS COMPANY

9. The illustration shows a cutaway view of the connector to aid the technician in releasing the terminal retainer.
10. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the connector disassembly procedure.

TYCO/AMP CONNECTORS (CM 42-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

1. Locate the connector position assurance (CPA) on the connector body and pull the CPA out. The CPA is on the wire harness side of connector.
2. Disconnect the connector from the component.

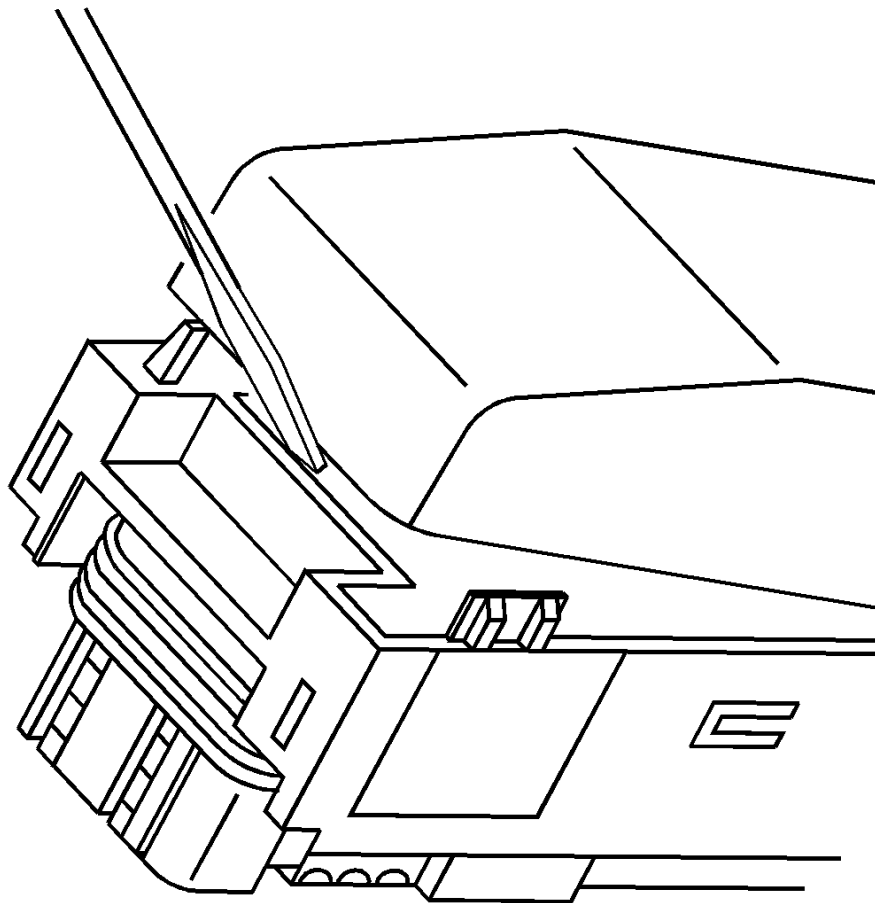


Fig. 134: View Of Dress Cover

Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-bladed tool to gently pry off the dress cover by inserting the tool under the cover opposite the harness side and prying up.
4. Remove the cover.

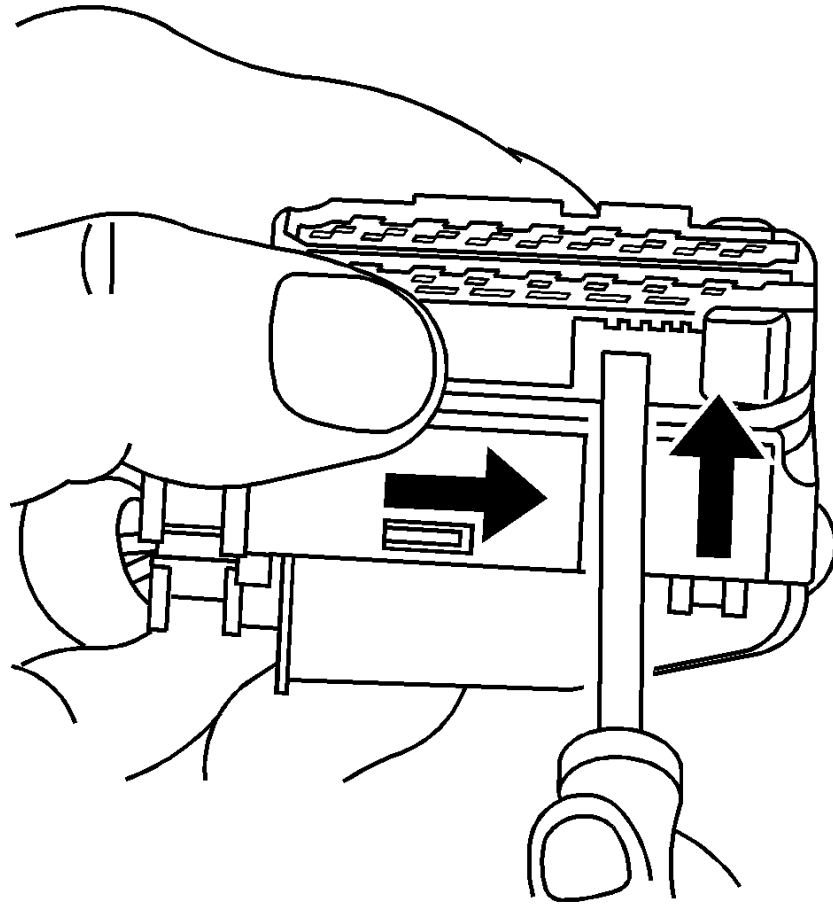


Fig. 135: View Of Terminal Position Assurance (TPA)

Courtesy of GENERAL MOTORS COMPANY

5. Using a small flat-bladed tool, push on the side of the nose piece retainer while pushing the nose piece forward with your thumb. This will release the terminal position assurance (TPA).

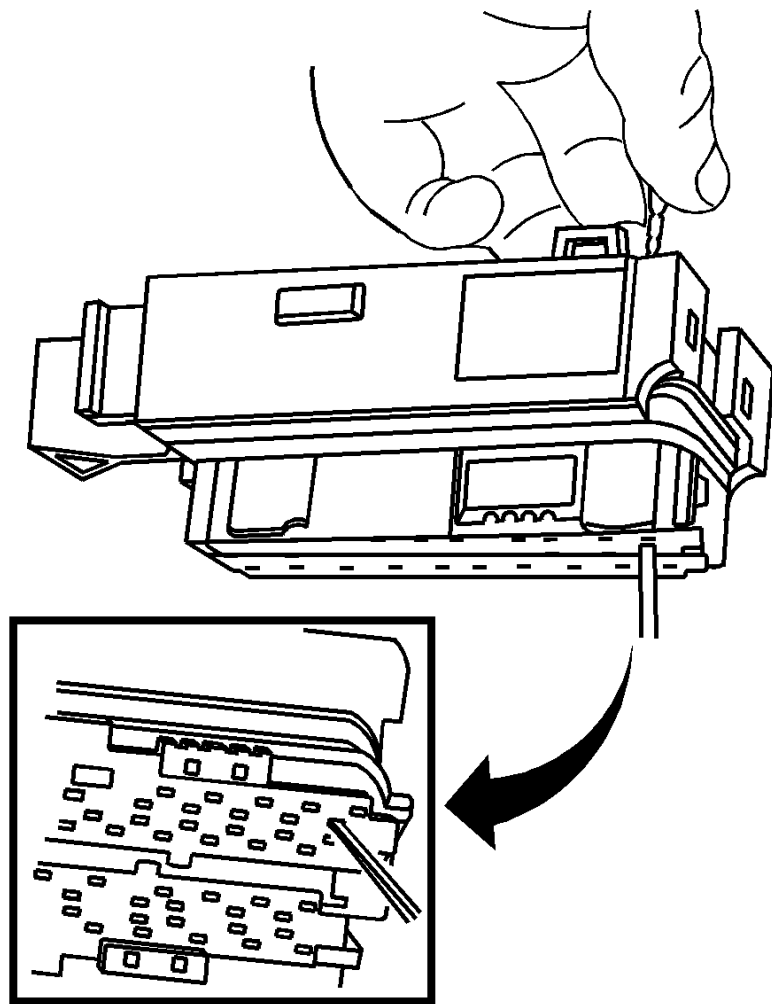


Fig. 136: Inserting Special Tool Into Terminal Release Cavity

Courtesy of GENERAL MOTORS COMPANY

6. Insert the **J-38125-12A** tool into the corresponding terminal release cavity. The release cavities are the 2 center rows of cavities on one half of the connector.

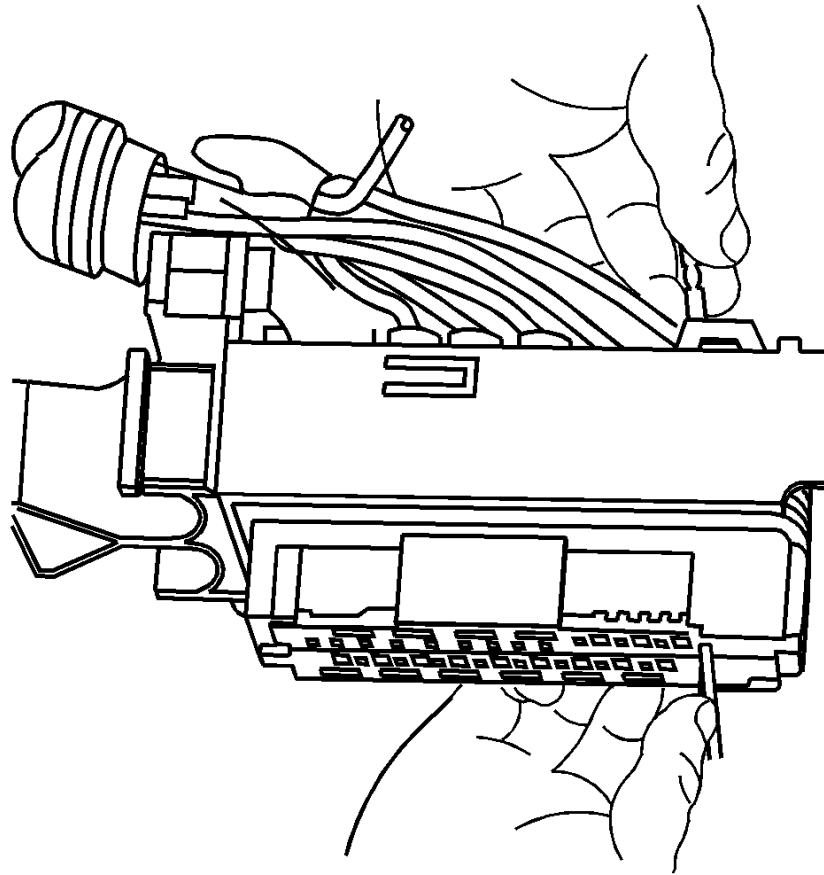


Fig. 137: Identifying Special Tool & Release Cavity

Courtesy of GENERAL MOTORS COMPANY

7. Pressing the **J-38125-12A** tool in the release cavity of the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)** procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SENSOR)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

1. Disconnect the connector from the component.

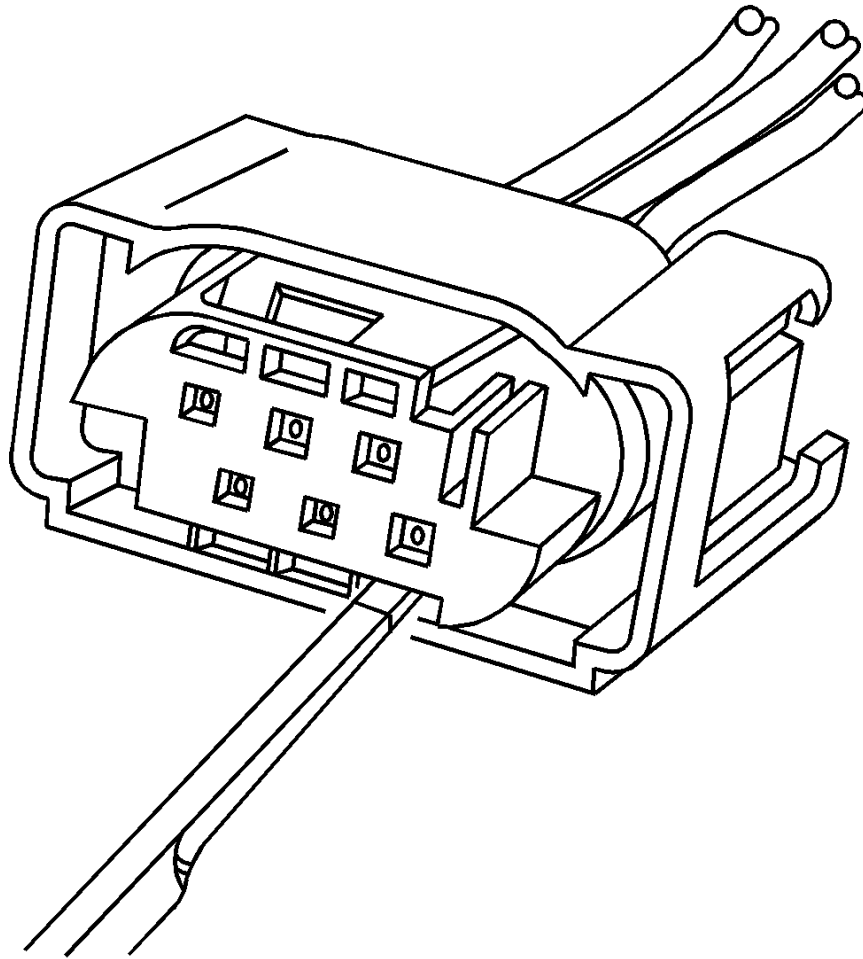


Fig. 138: View Of Inserting Special Tool Into Lower Right Face Cavity

Courtesy of GENERAL MOTORS COMPANY

2. Insert the J-38125-11A tool into the cavity on the lower right hand face of the connector until the terminal release tang access panel slides over.

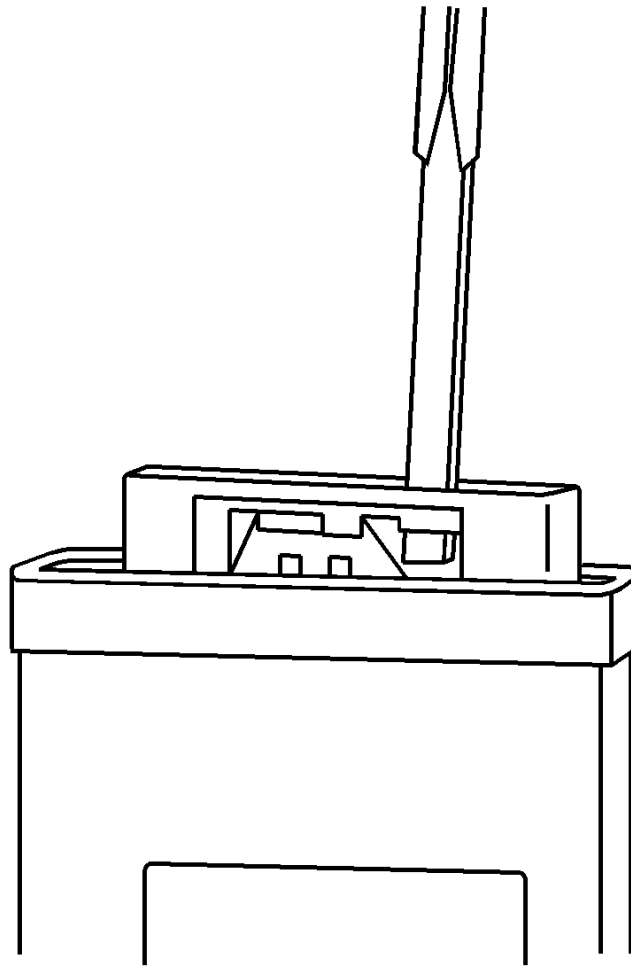


Fig. 139: Pushing Wire Side Of Terminal Toward Connector
Courtesy of GENERAL MOTORS COMPANY

3. Ensure that the terminal release tang access panel is in the correct location to access the terminals.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

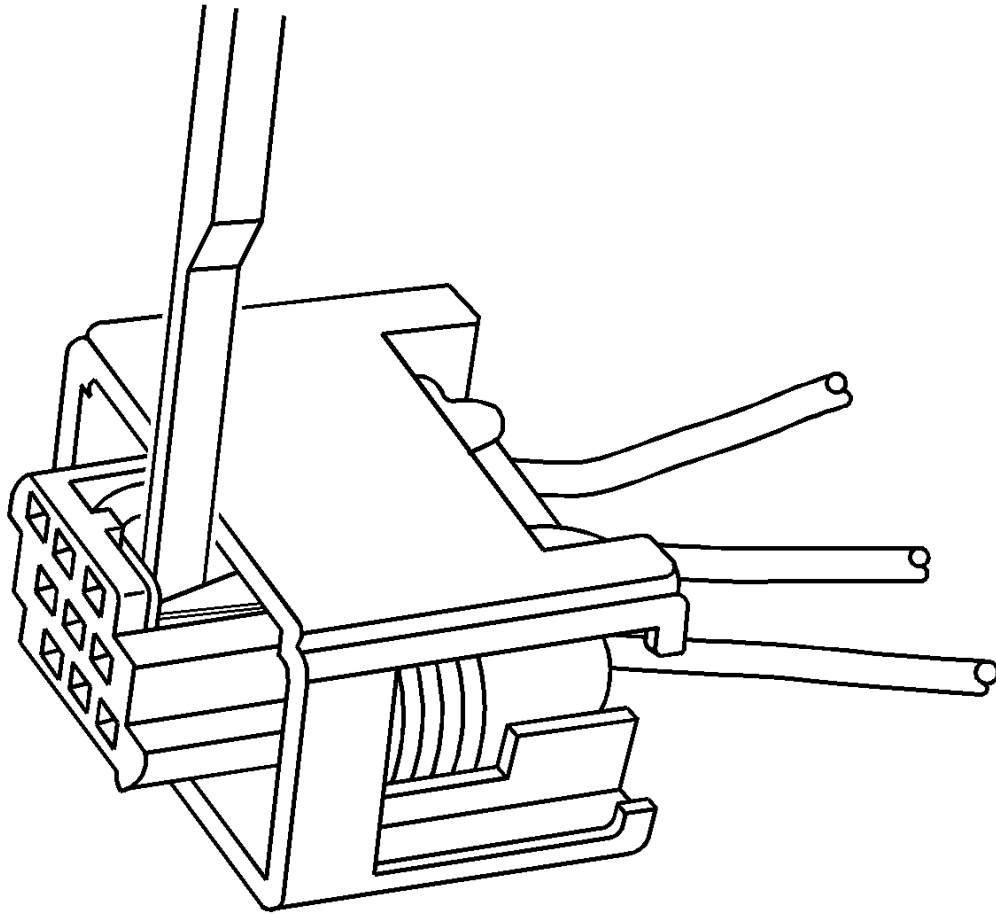


Fig. 140: View Of Inserting Tool Into Terminal Release Tang Access Slot (Sensor)

Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-11A into the terminal release tang access slot located behind the access panel of the connector and press down on the terminal while carefully pulling the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
6. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (0.25 CAP)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-24** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

1. Disconnect the connector from the component by pressing down on the connector position assurance (CPA).

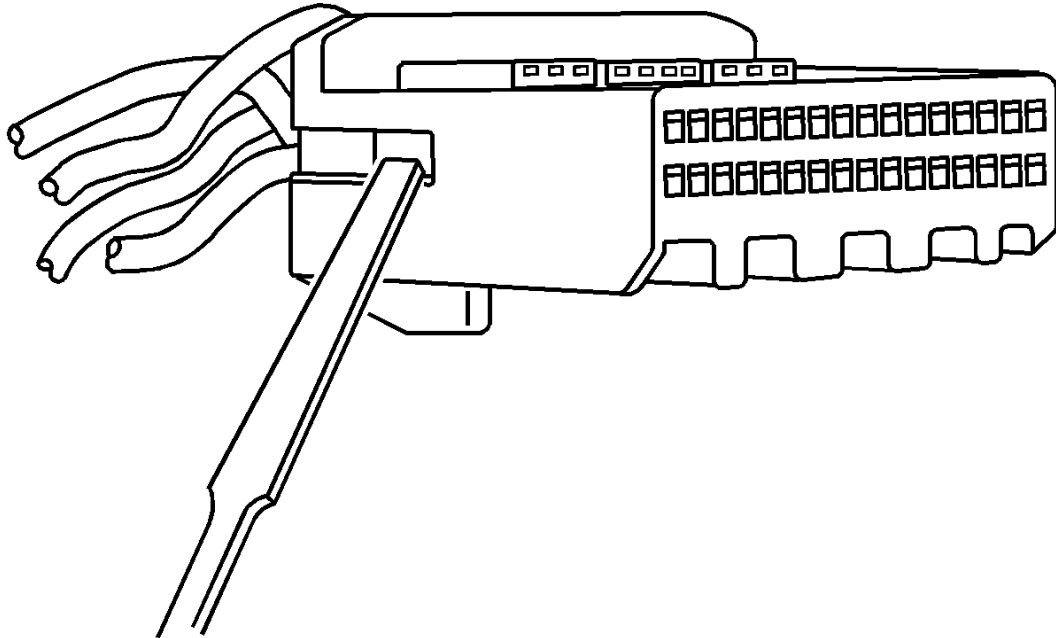


Fig. 141: Releasing TPA Using Small Flat-Bladed Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: The TPA on this connector cannot be removed unless the terminals are removed first. The TPA will come out of the connector body, but only slightly. When the TPA is slightly raised the terminals can be removed. Using excessive force to remove the TPA with the terminals still in the connector will damage the connector.

2. Use a small flat-bladed tool to release the terminal position assurance (TPA) by inserting the tool in the small recess on the side of the connector and pushing up until the TPA releases from the connector body. The TPA should raise just slightly. Do not try to remove the TPA.
3. Repeat the process for the other side of the connector.

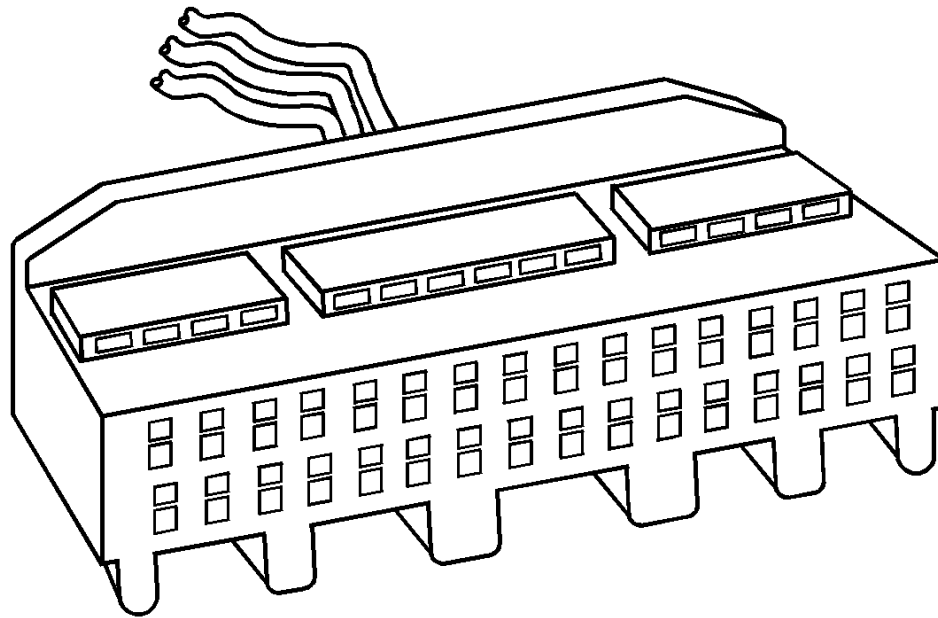


Fig. 142: View Of Terminal Position Assurance
Courtesy of GENERAL MOTORS COMPANY

4. Ensure that the TPA is in the proper position to remove the terminals.

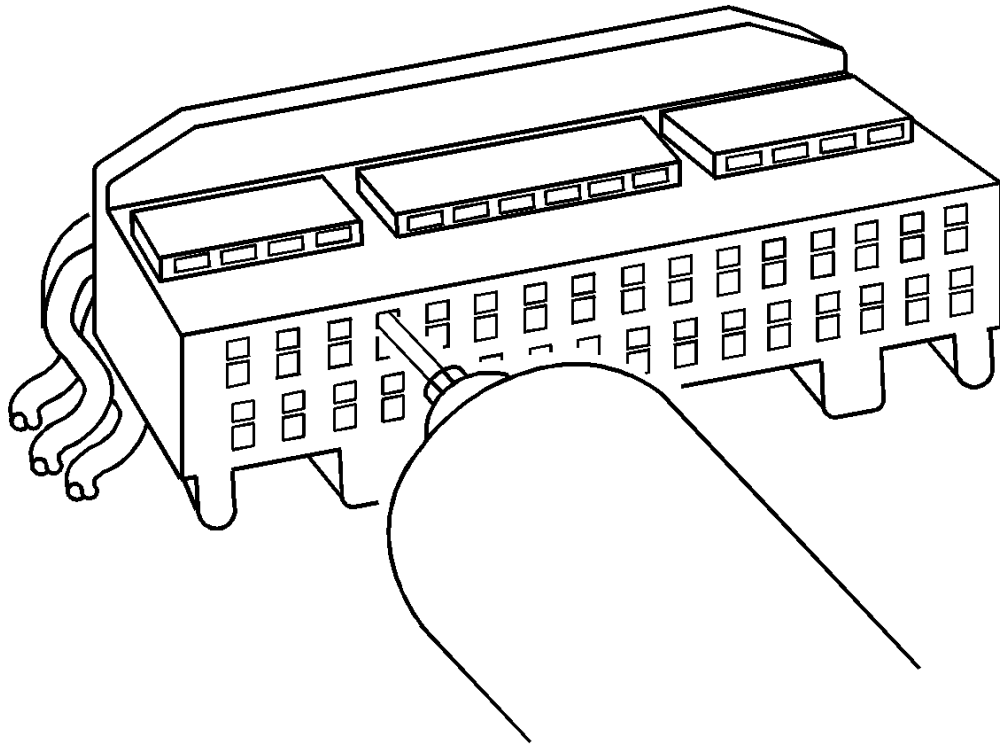


Fig. 143: Identifying Special Tool & Release Cavity
Courtesy of GENERAL MOTORS COMPANY

5. While pushing the terminal forward, insert the J-38125-24 in the release cavity above the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
6. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (43-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-13A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

1. Locate the lever lock on the wire dress cover. Slide the lever lock away from the connector body.
2. Disconnect the connector from the component.
3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-bladed tool release all of the locking tabs.
4. Once the locks are unlocked, lift the dress cover off.

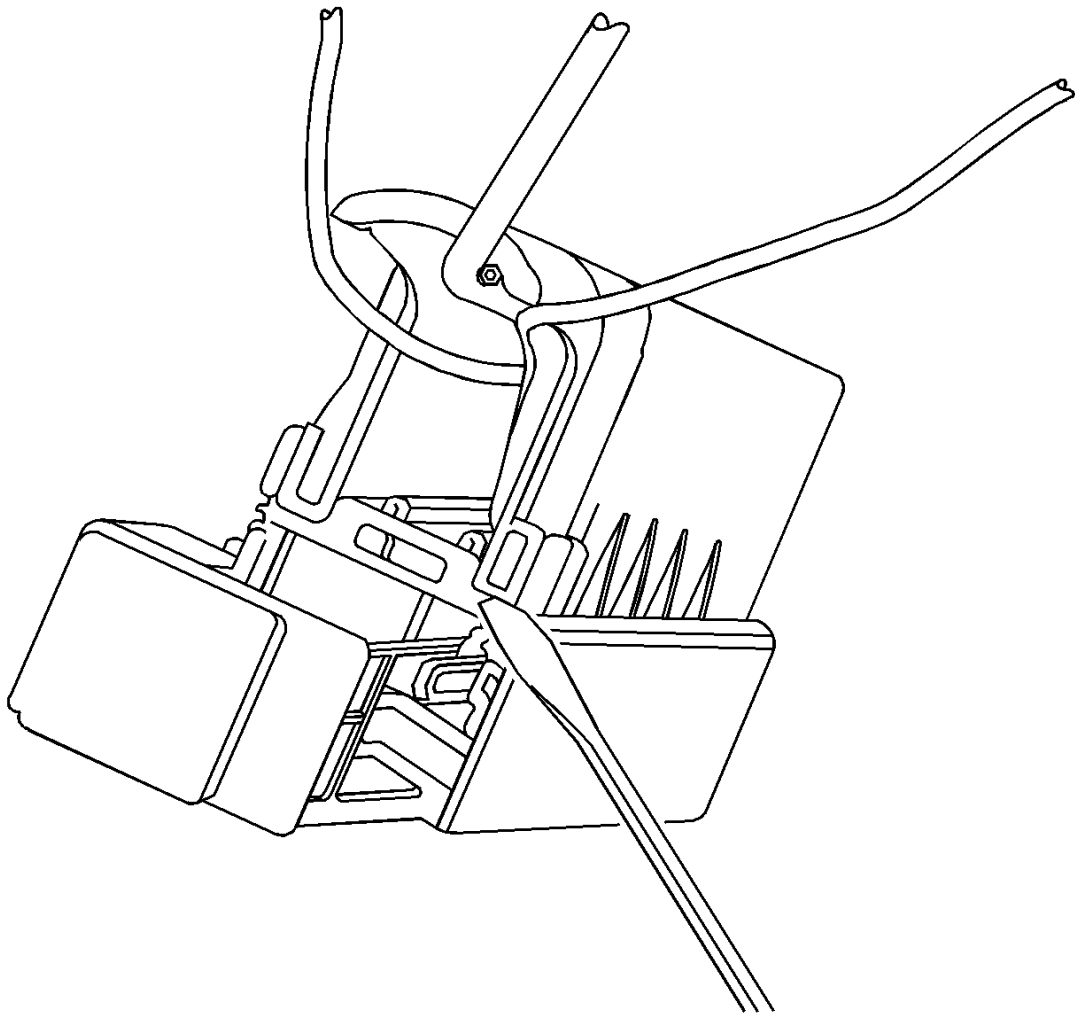


Fig. 144: Releasing TPA

Courtesy of GENERAL MOTORS COMPANY

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

5. Release the TPA by inserting a small flat-bladed tool into the blue locking tabs on both ends of the connector. Gently slide the TPA up to the released position on both ends.

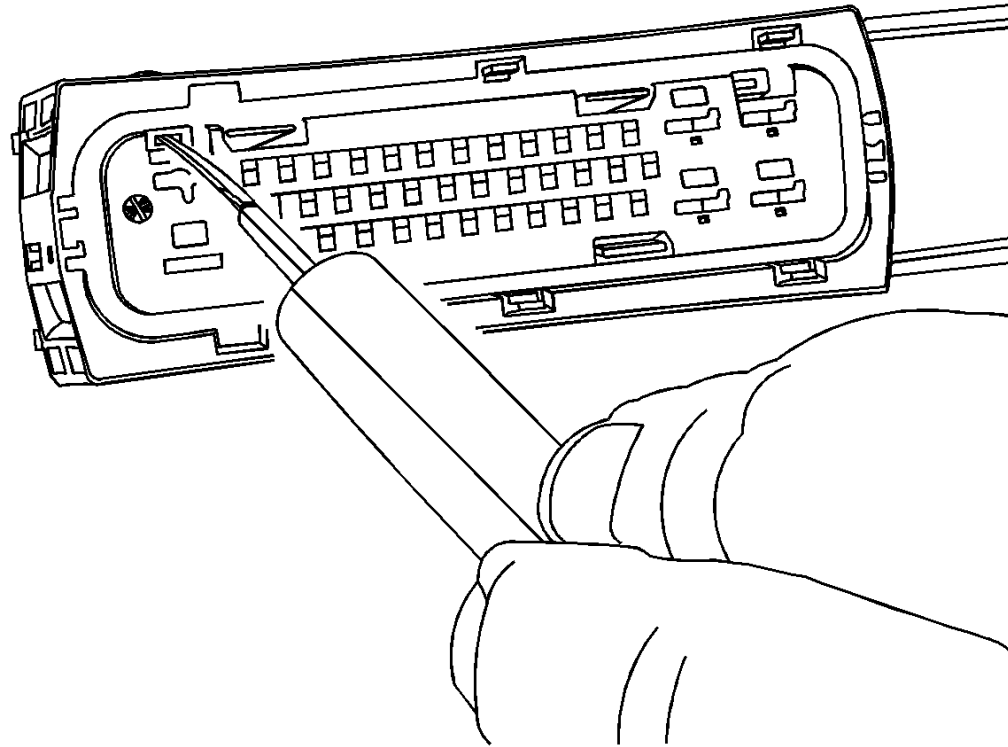


Fig. 145: View Of Inserting Tool Into Terminal Release Cavity
Courtesy of GENERAL MOTORS COMPANY

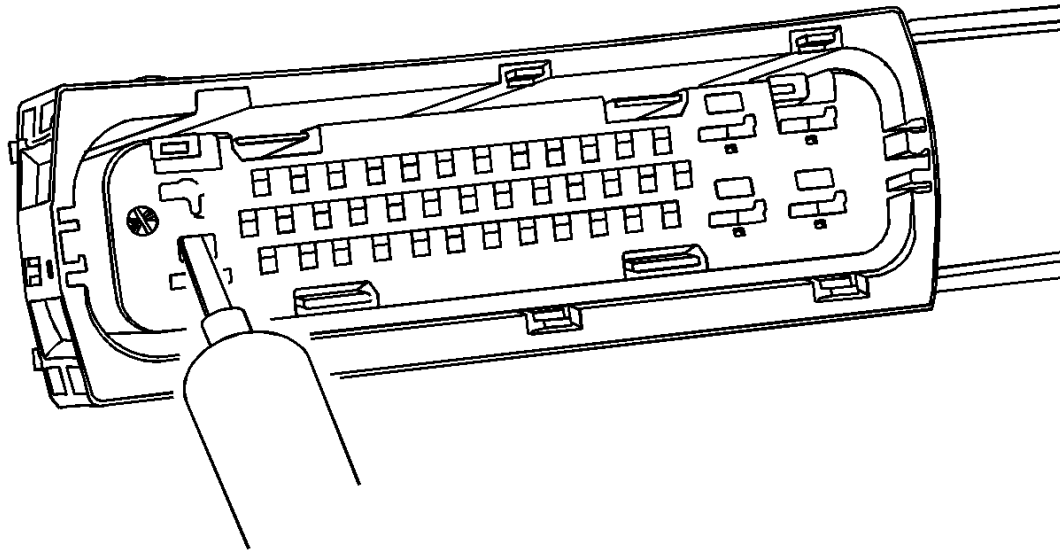


Fig. 146: View Of Release Tool Being Used For Larger Terminals
Courtesy of GENERAL MOTORS COMPANY

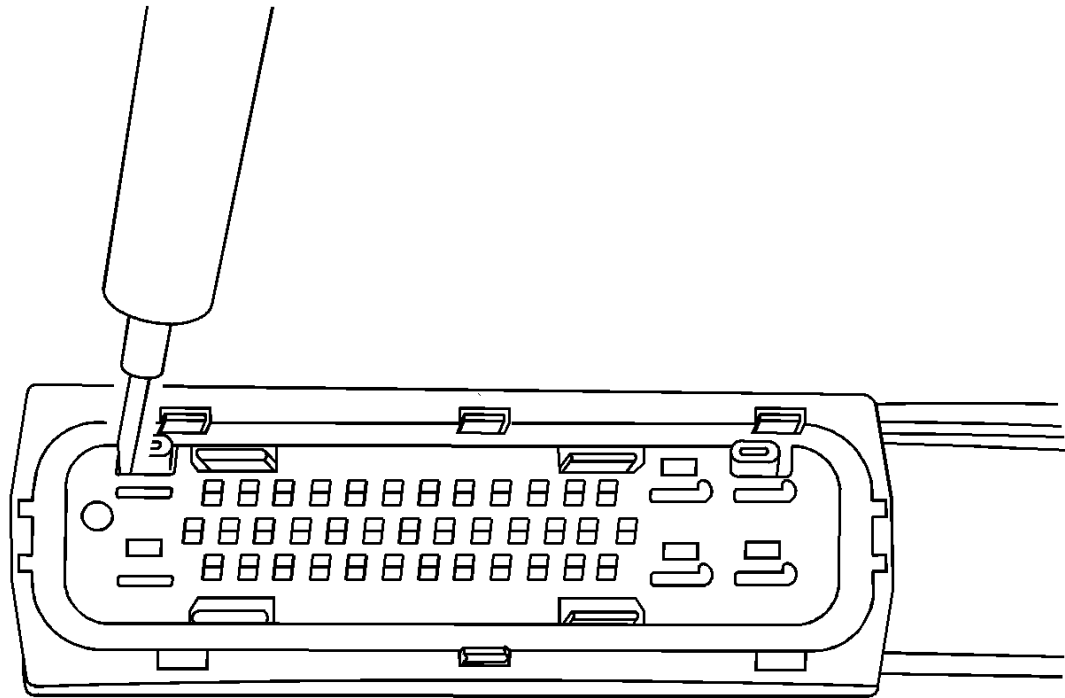


Fig. 147: View Of Release Tool Being Used For Larger Terminals
Courtesy of GENERAL MOTORS COMPANY

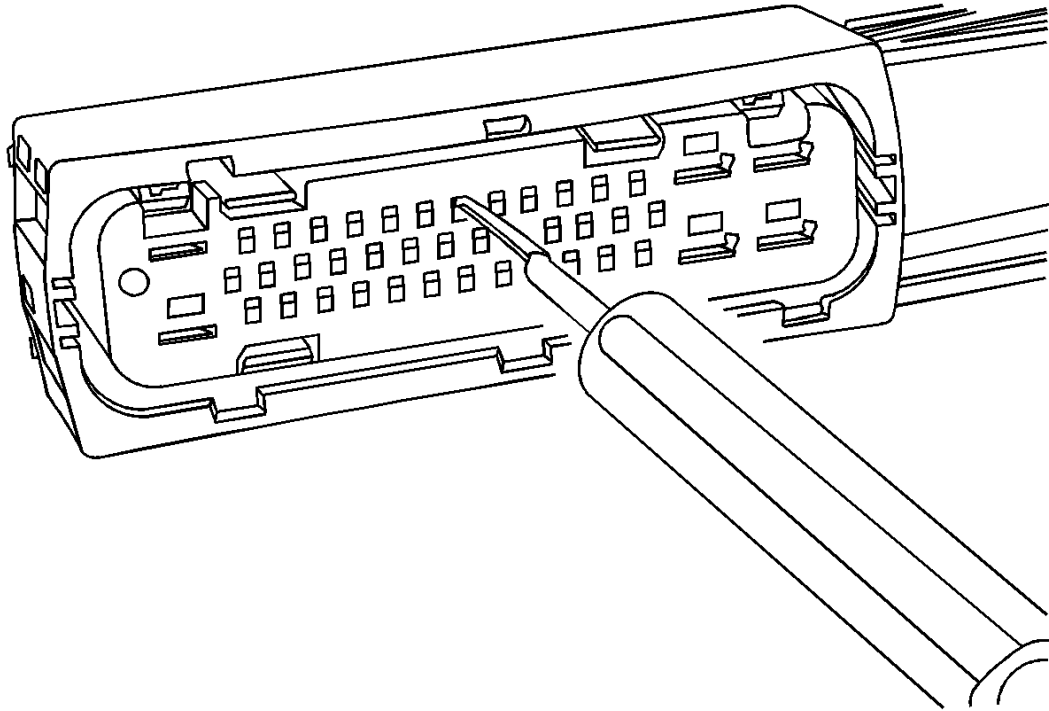


Fig. 148: View Of Release Tool Being Used For Smaller Terminals

Courtesy of GENERAL MOTORS COMPANY

6. For the larger terminals insert the **J-38125-13A** tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the **J-38125-12A** tool to release the terminals by inserting the tool into the terminal release cavity.

View of the release tool being used for the larger terminals.

View of the release tool being used for the larger terminals.

View of the release tool being used for the smaller terminals.

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)****Repairing Connector Terminals (Terminal Repair)** procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (DOOR MODULE)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

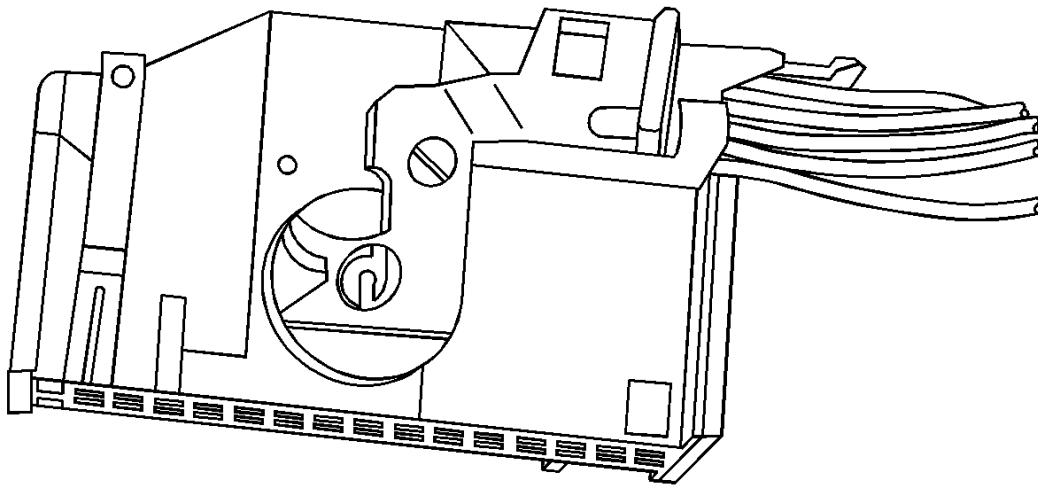


Fig. 149: Side View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS COMPANY

Side view of connector.

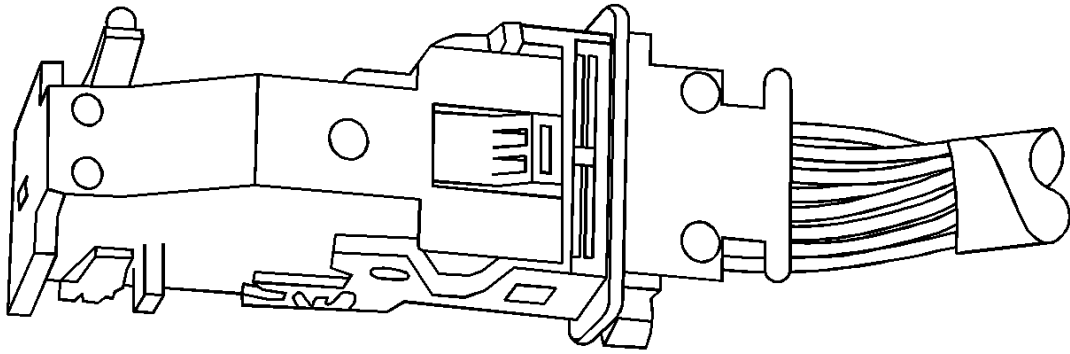


Fig. 150: Top View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS COMPANY

View of top of connector.

1. Locate the assist lever and lock on the top of the connector.

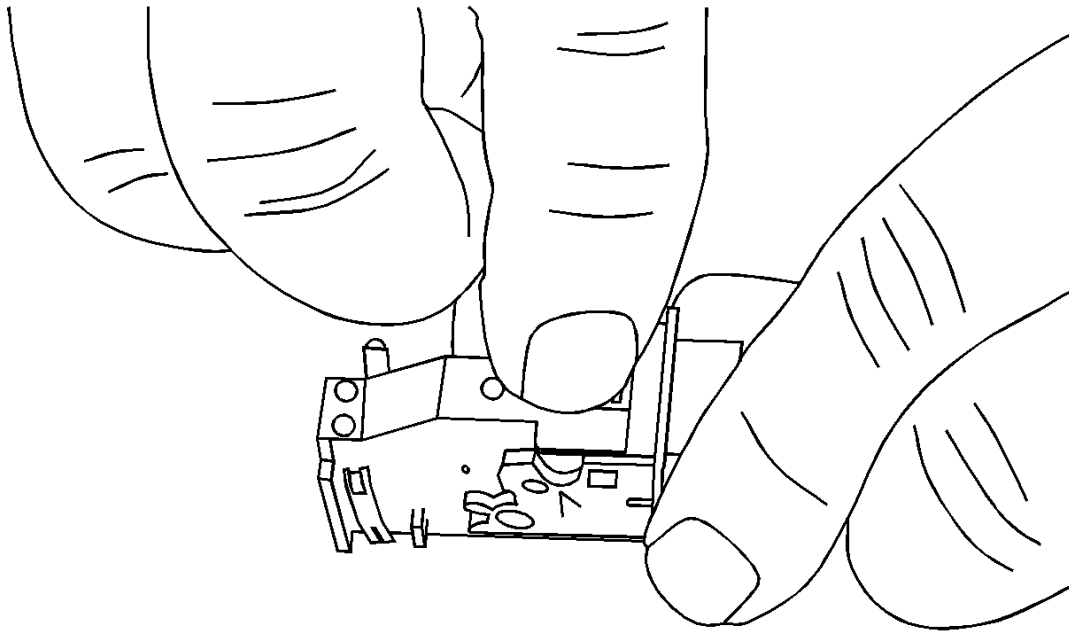


Fig. 151: View Of Depressing Lock & Pulling Assist Lever
Courtesy of GENERAL MOTORS COMPANY

2. While depressing the lock, pull the lever over and past the lock.

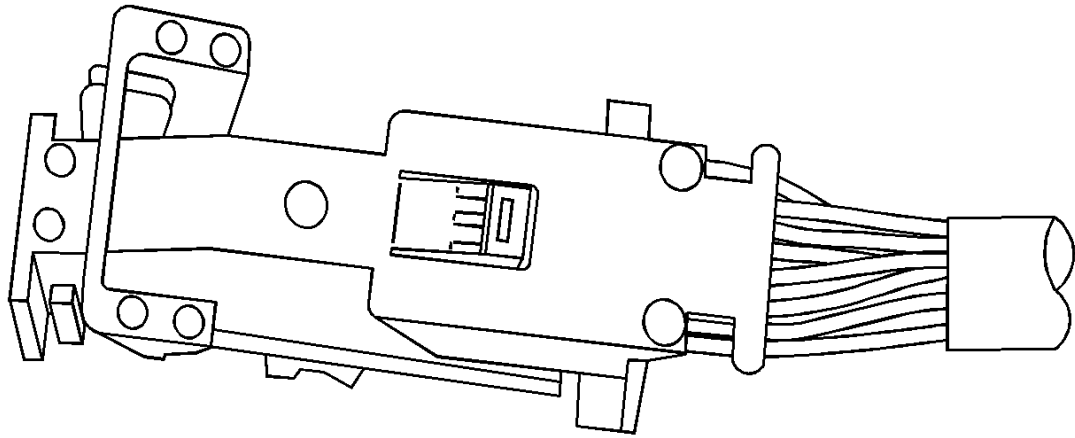


Fig. 152: View Of Component Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the connector from the component.

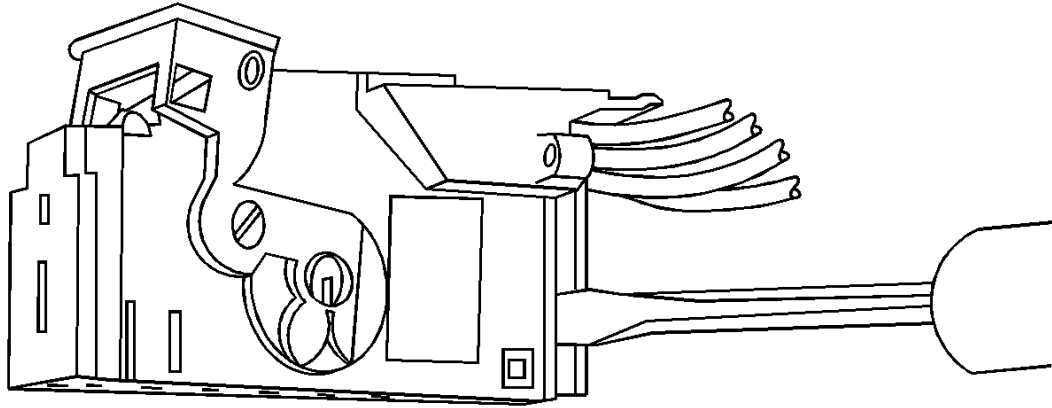


Fig. 153: Identifying Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

4. Locate the dress cover locking tabs at the rear of the connector. Use a small flat-blade tool to release the locking tabs. Repeat this procedure for the other locking tab.

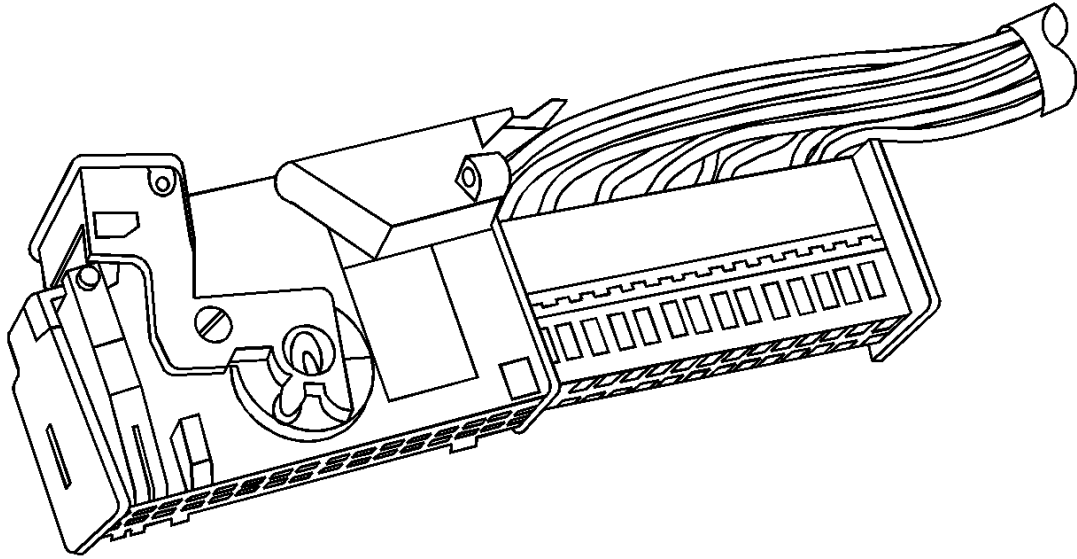


Fig. 154: Sliding Inner Connector Out Of Connector Housing

Courtesy of GENERAL MOTORS COMPANY

5. Once the locking tabs are unlocked, slide the inner connector out of the rear of the connector housing.

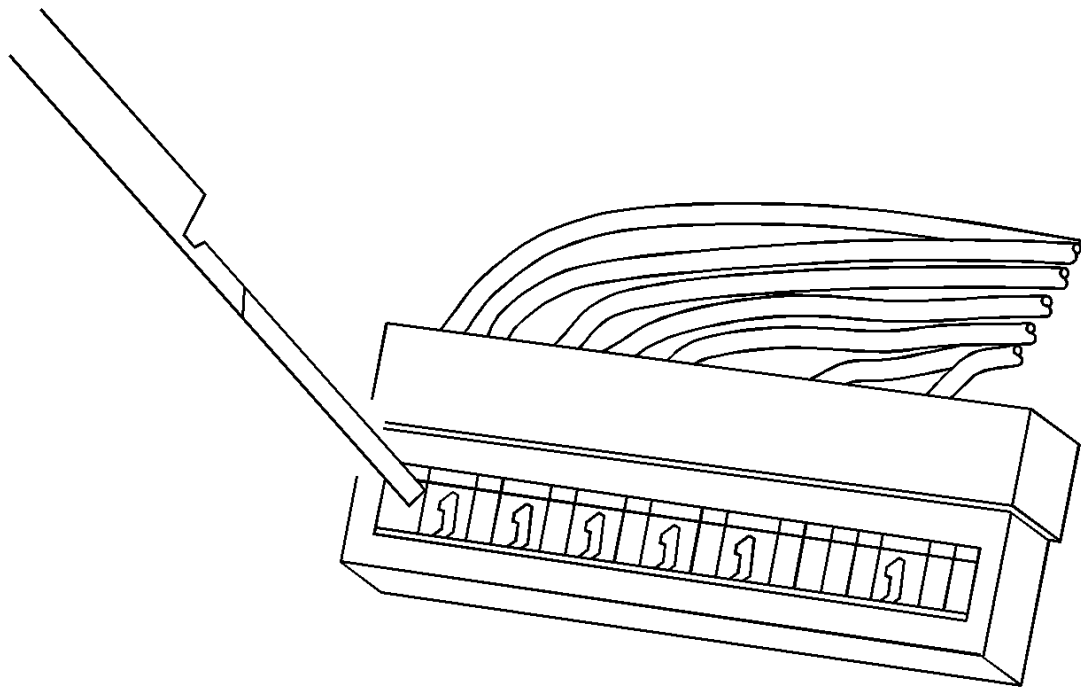


Fig. 155: Using Special Tool To Release Terminals

Courtesy of GENERAL MOTORS COMPANY

6. Use the J-38125-12A tool to release the terminals by pressing on the tang.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SEAT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool
- **J-38125-212** Terminal Release Tool
- **J-38125-556** Terminal Release Tool

- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

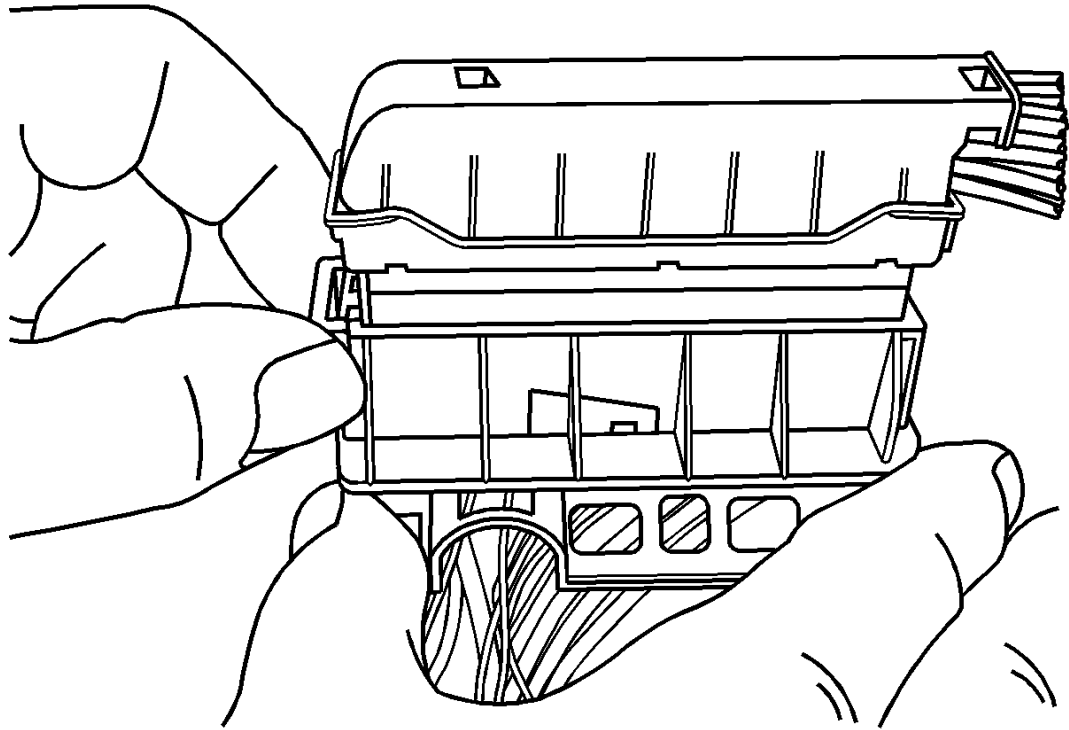


Fig. 156: Locating Locking Slide Lever

Courtesy of GENERAL MOTORS COMPANY

1. Grasp the locking slide lever and pull outward from the end of the connector.

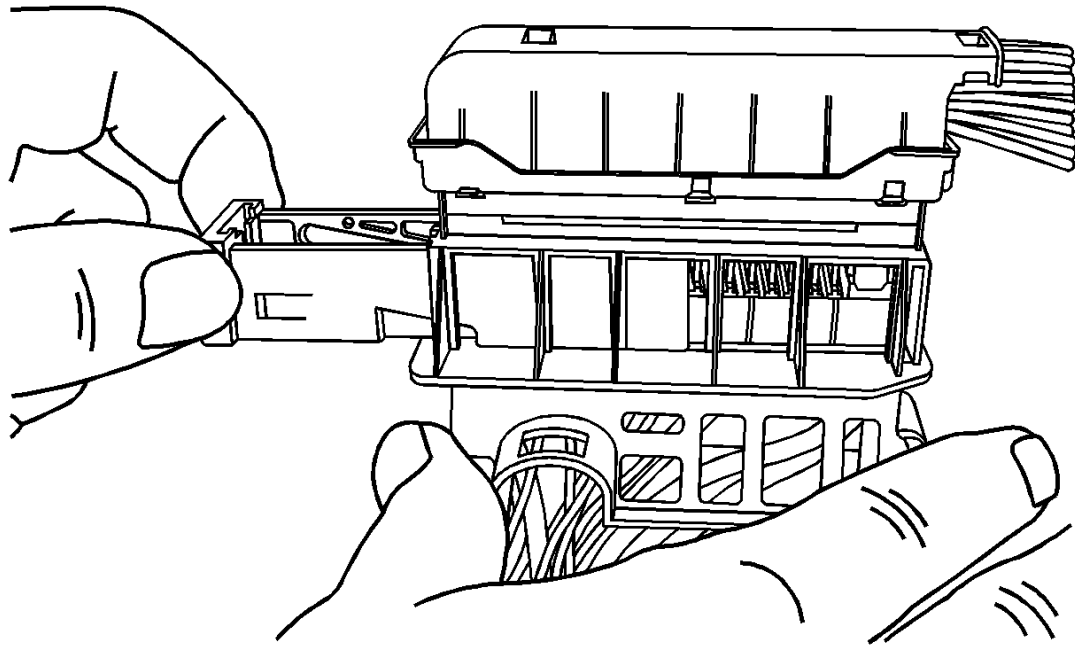


Fig. 157: Pulling Slide Lever Out Of Mating Connector
Courtesy of GENERAL MOTORS COMPANY

2. As the slide lever is pulled out the mating connector is lifted from the seated position.

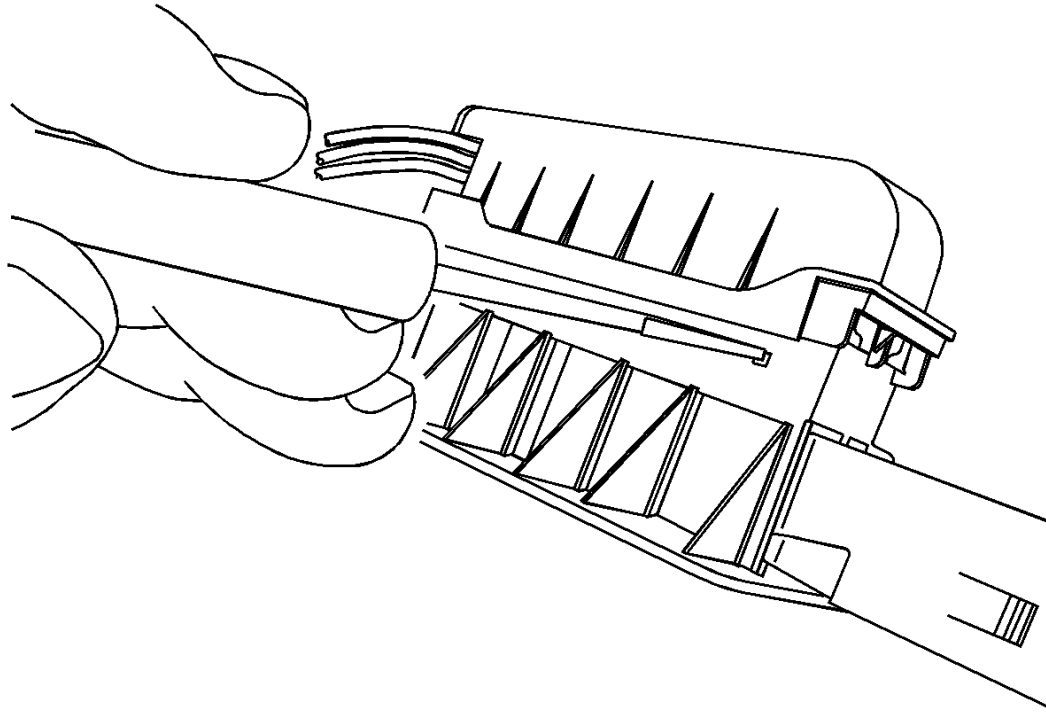


Fig. 158: Pushing TPA Tabs Into Connector Body

Courtesy of GENERAL MOTORS COMPANY

NOTE: Terminal position assurance (TPA) is keyed and can only be inserted in one direction.

3. Using terminal release tool J-38125-11A or equivalent, push the TPA tabs into the connector body.

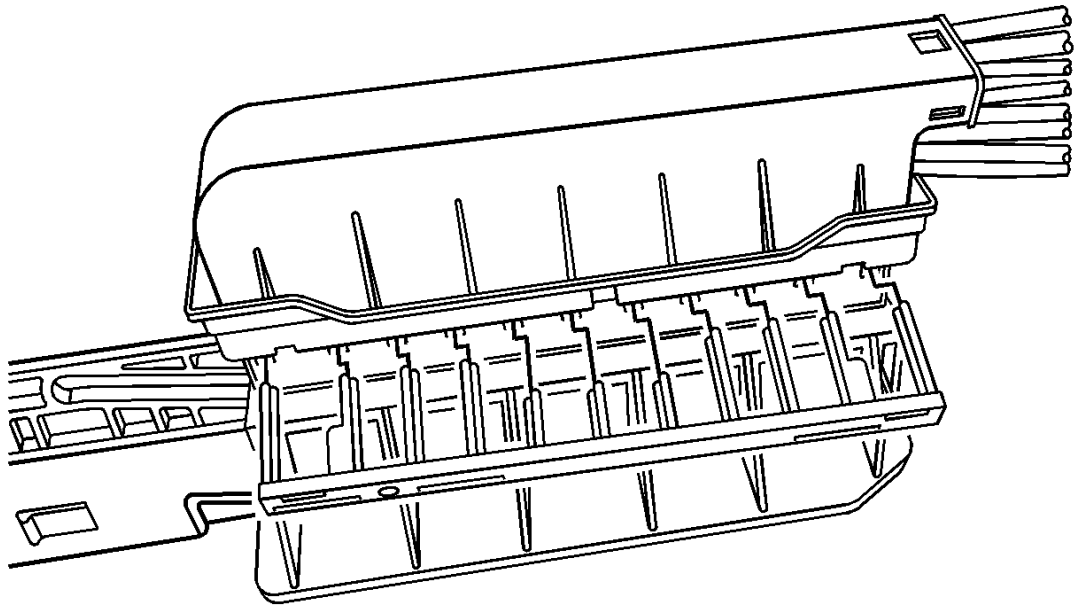


Fig. 159: Pulling TPA From Connector Body
Courtesy of GENERAL MOTORS COMPANY

4. Pull the TPA from the connector body.

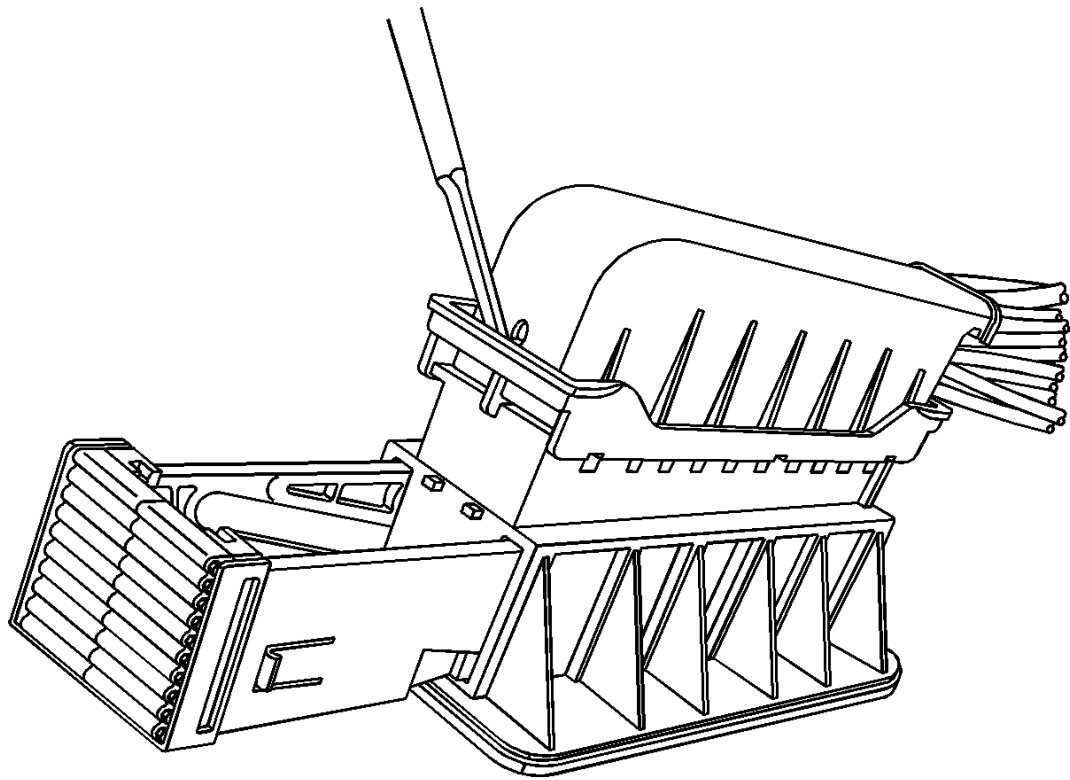


Fig. 160: Releasing Connector Wire Dress Cover Locking Tab

Courtesy of GENERAL MOTORS COMPANY

5. Using terminal release tool J-38125-11A or equivalent, release the connector wire dress cover locking tab.

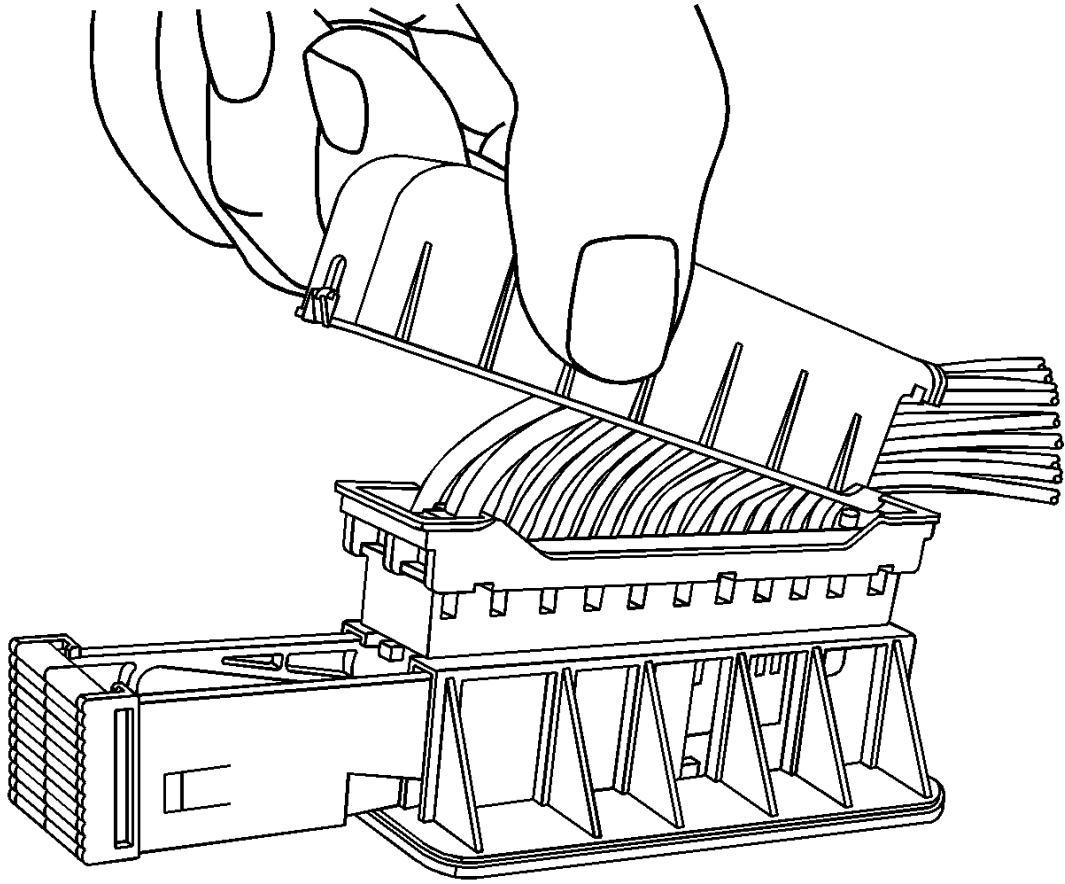


Fig. 161: Lifting Connector Wire Dress Cover From Connector Body

Courtesy of GENERAL MOTORS COMPANY

6. With the lock tab released, lift the connector wire dress cover from the connector body.

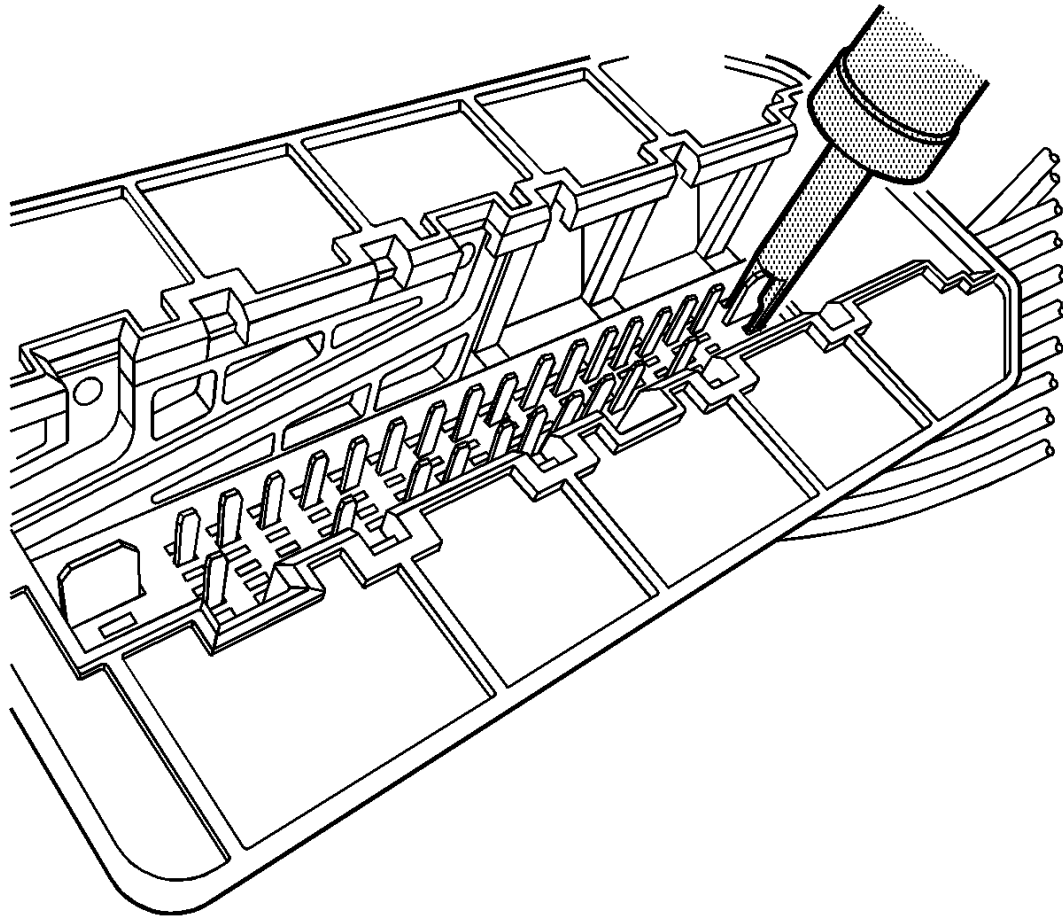


Fig. 162: Using Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

7. Using terminal release tool J-38125-212, press the prongs into the holes each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

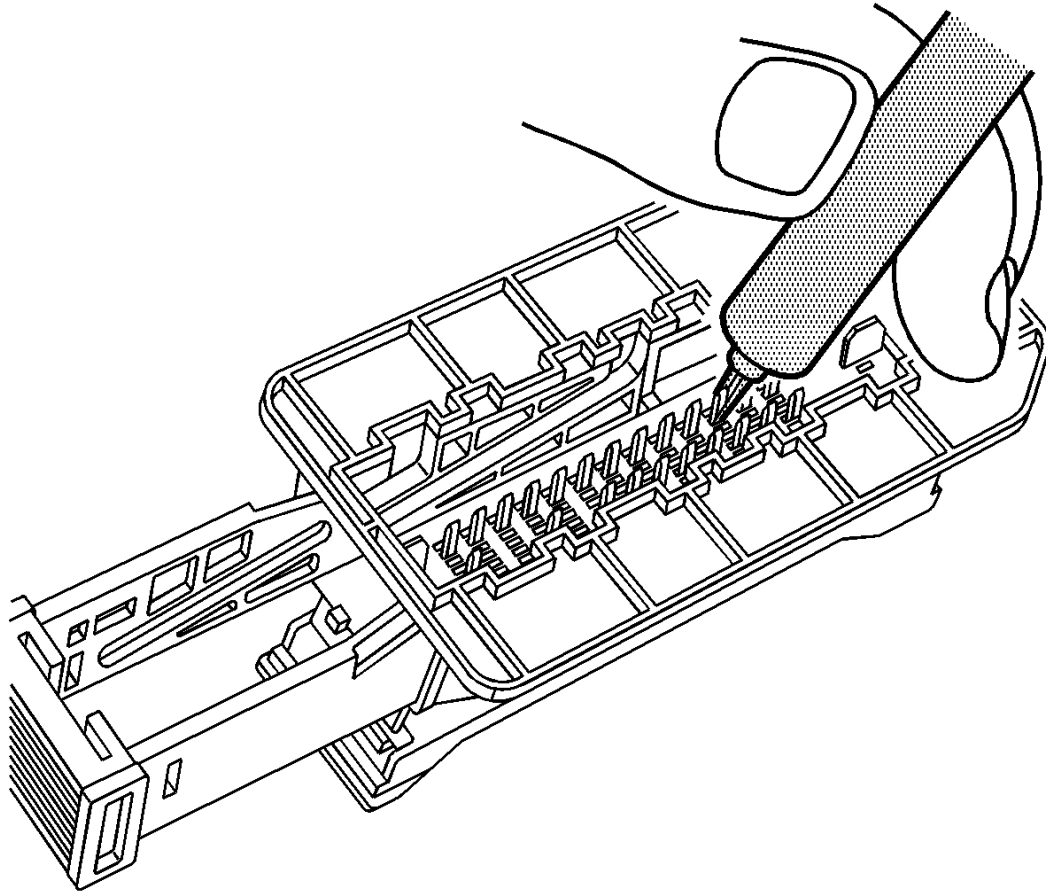


Fig. 163: Using Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

8. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

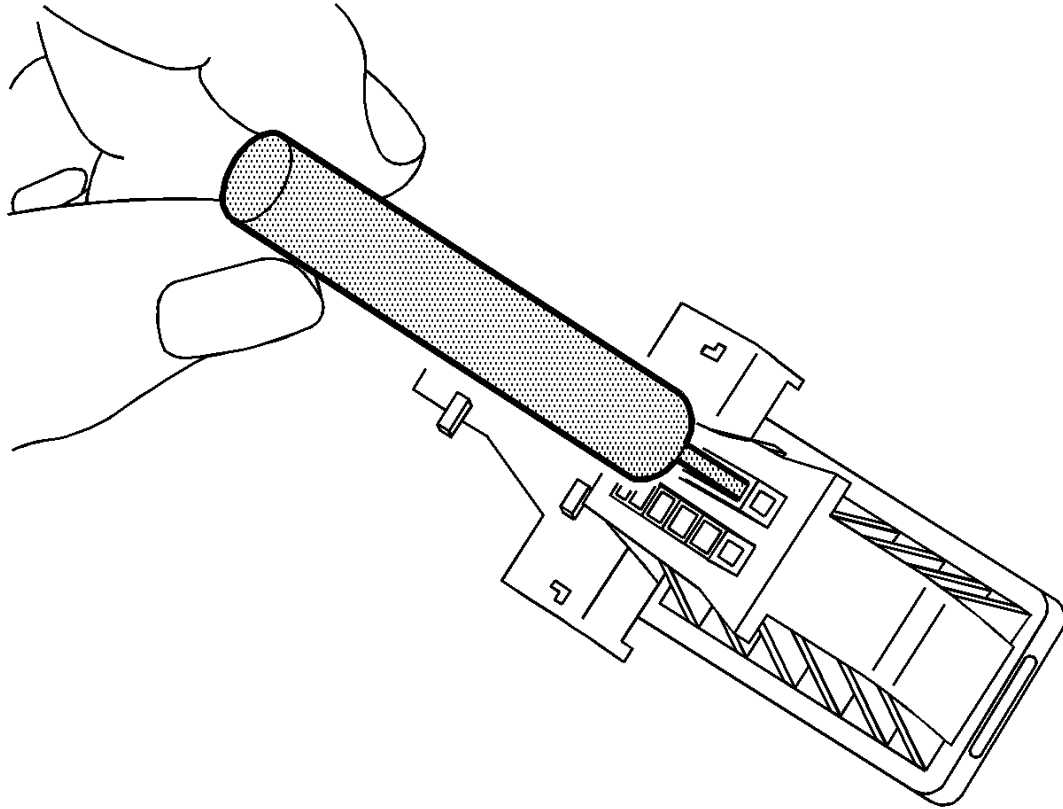


Fig. 164: Using Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

9. Using terminal release tool J-38125-556, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.
10. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (102-WAY INLINE)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool
- **J-38125-212** Terminal Release Tool
- **J-38125-216** Terminal Release Tool
- **J-38125-221** Terminal Release Tool

- **J-38125-560** Terminal Release Tool
- **J-38125-566** Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Terminal Removal Procedure

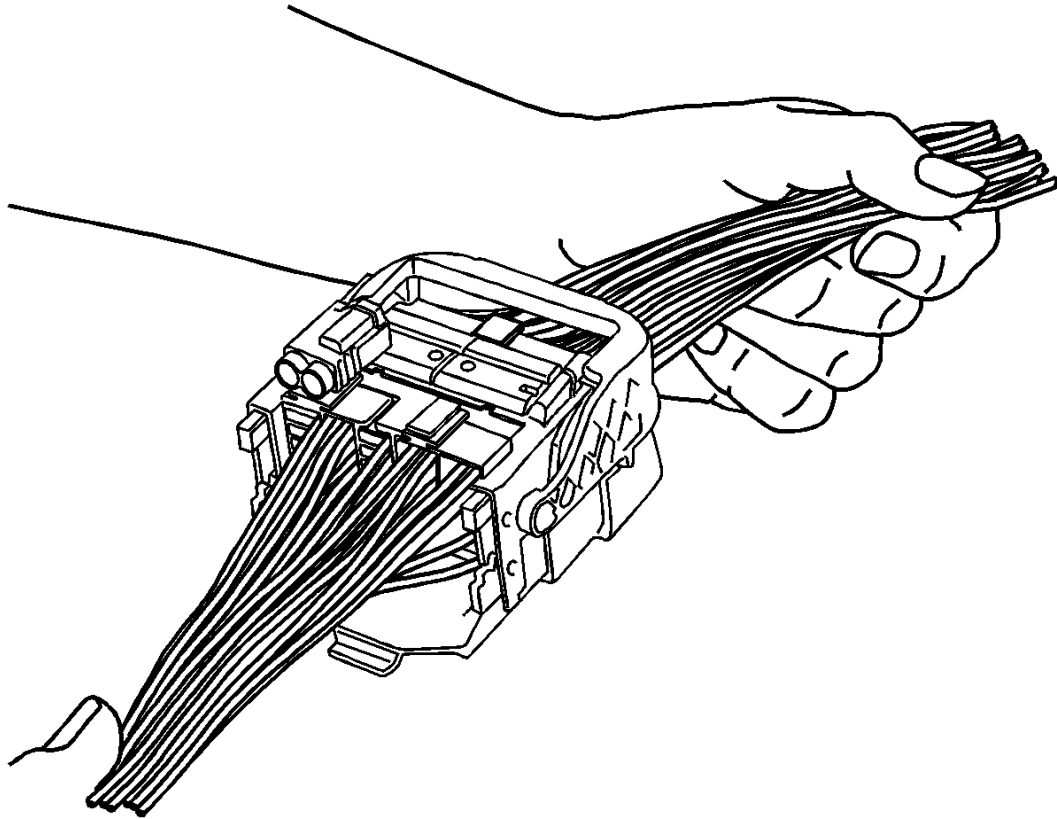


Fig. 165: View Of Typical Connector In Assembled Position
Courtesy of GENERAL MOTORS COMPANY

View of a typical connector in the assembled position.

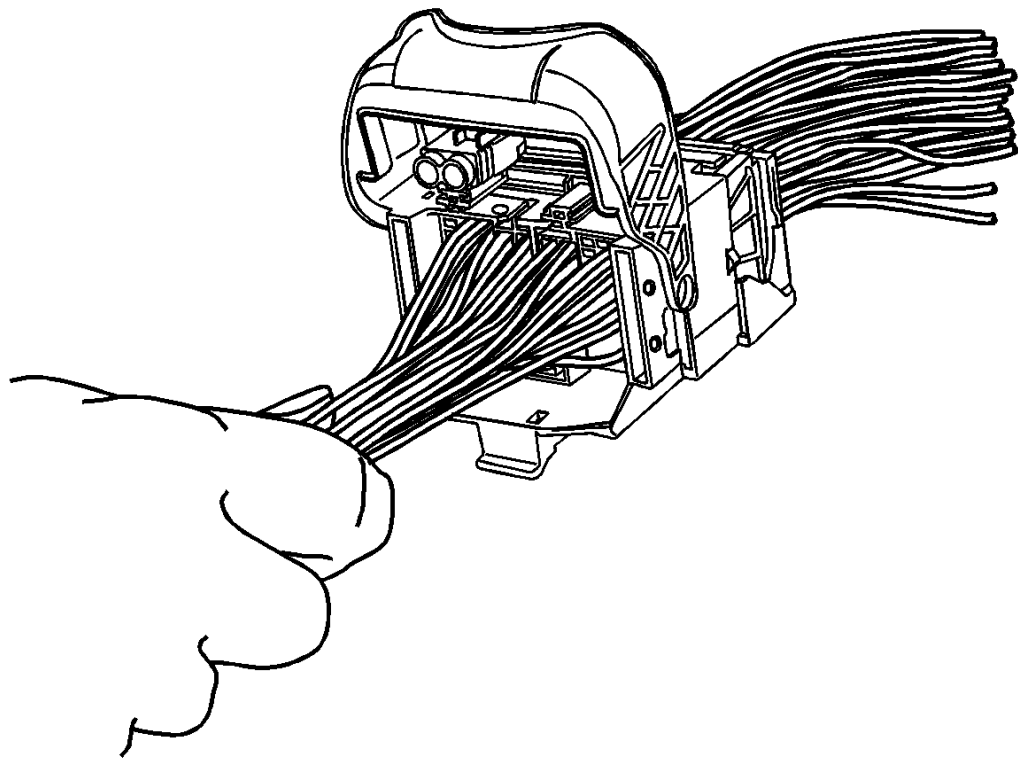


Fig. 166: View Of Locking Lever At 90 Degrees From Connector Body
Courtesy of GENERAL MOTORS COMPANY

1. Pull the locking lever to the 90 degree position from the connector body.

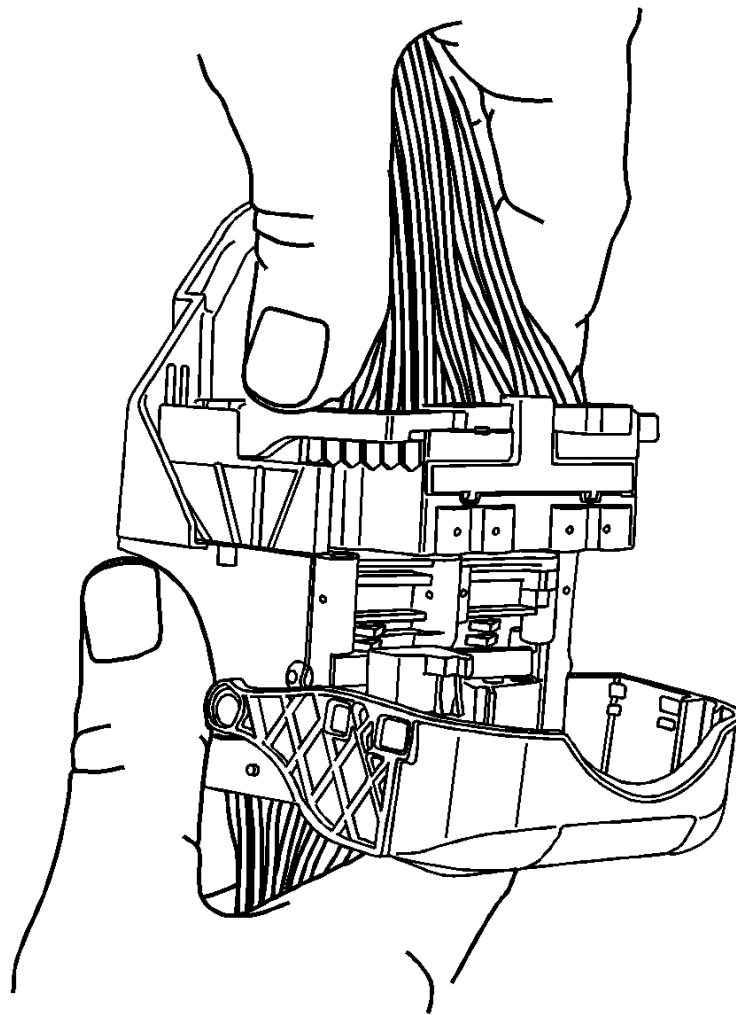


Fig. 167: Assembled View Of Connector - Tyco/AMP (102-Way Inline)

Courtesy of GENERAL MOTORS COMPANY

2. With the locking lever in the 90 degree position and the male connector body separated, it can be slid outward for removal.

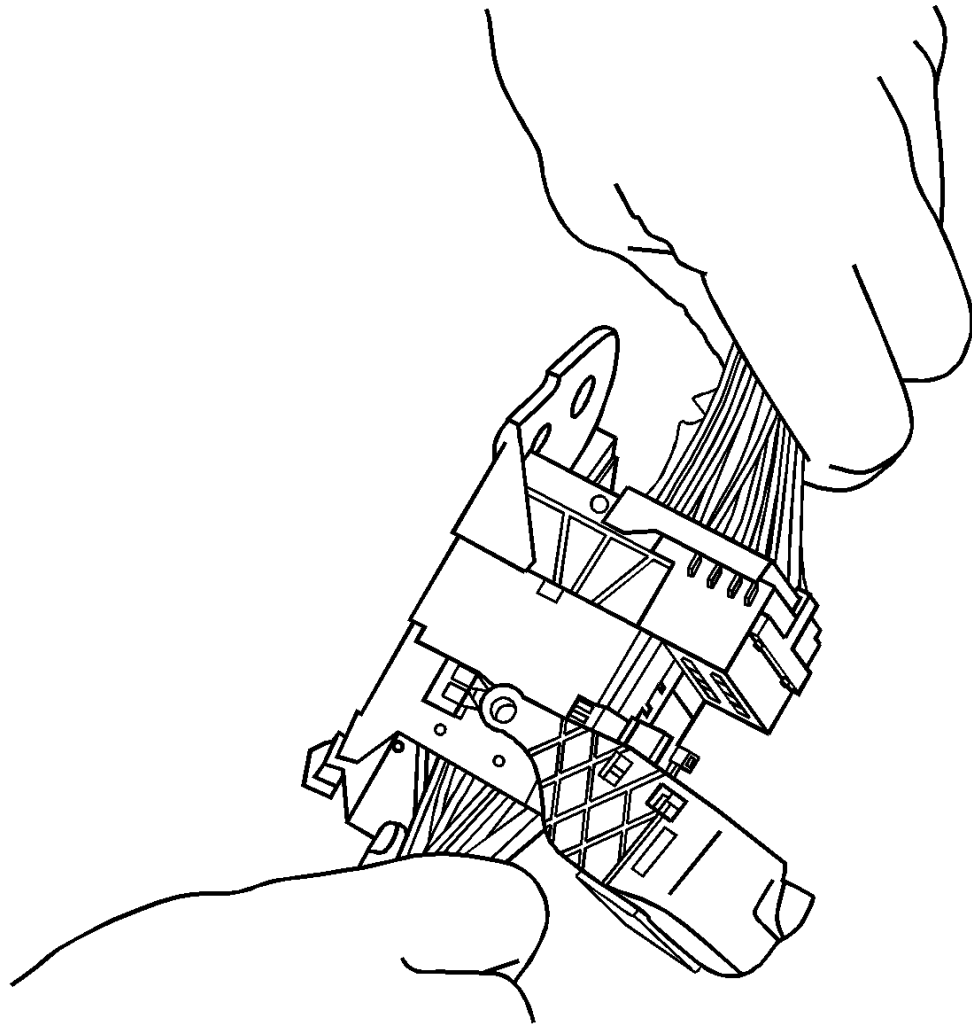


Fig. 168: Sliding Male Connector Body Away From Guide Plates
Courtesy of GENERAL MOTORS COMPANY

3. Slide the male connector body out away from the guide plates.

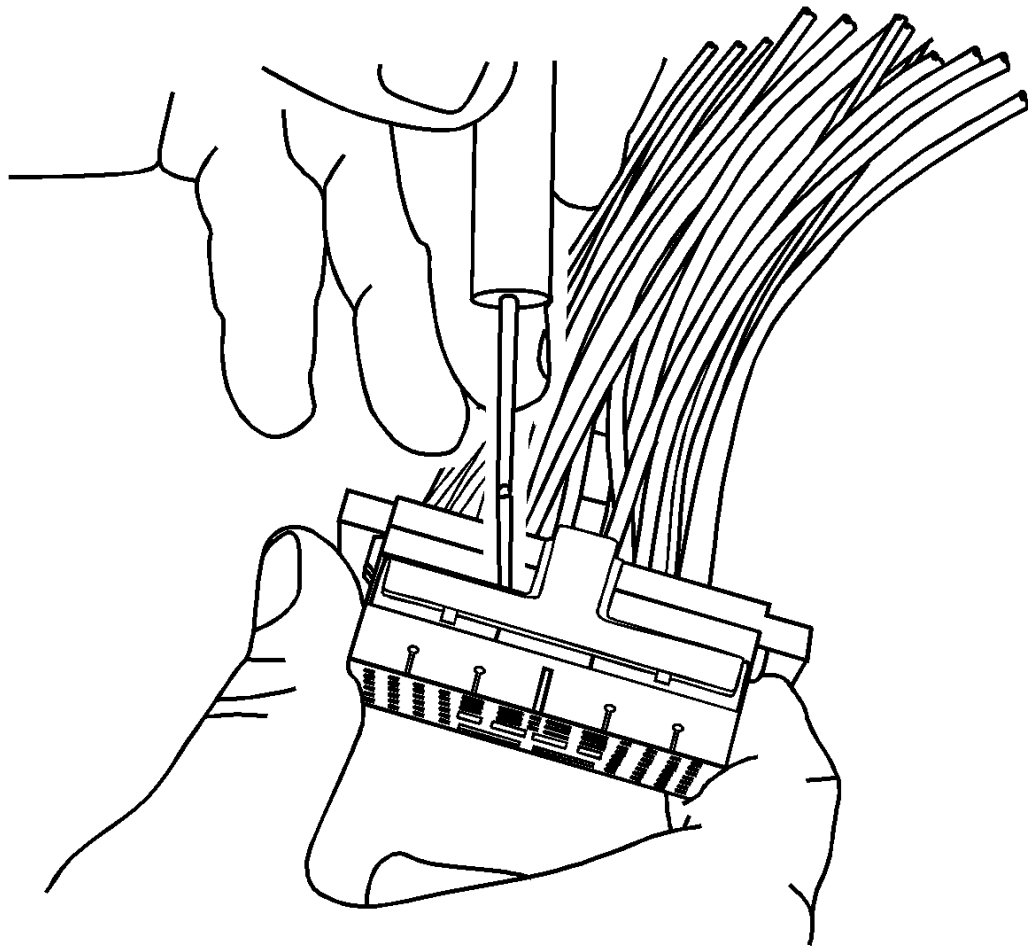


Fig. 169: View of Terminal Release Tool And TPA

Courtesy of GENERAL MOTORS COMPANY

NOTE: During assembly the terminal position assurance (TPA) will not fully seat if any terminal is not fully seated.

4. Using terminal release tool J-38125-11A or equivalent, remove the TPA from the connector body.

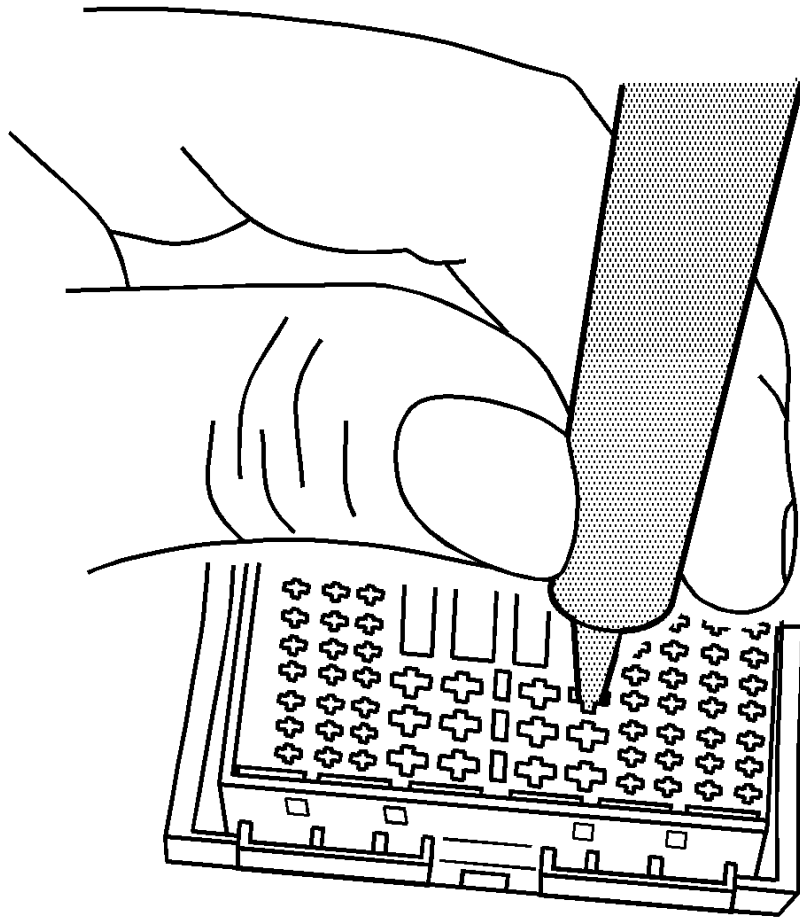


Fig. 170: Releasing Lock Tabs

Courtesy of GENERAL MOTORS COMPANY

5. Using terminal release tool J-38125-566, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

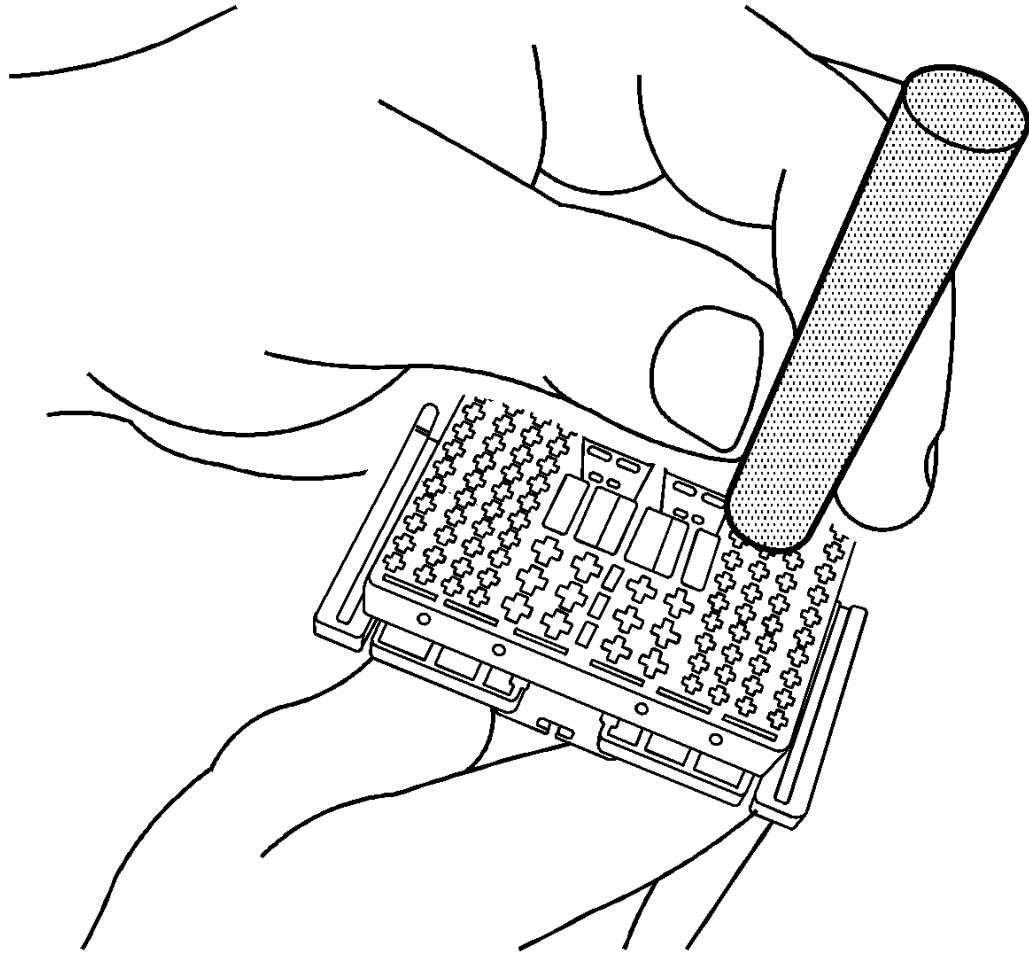


Fig. 171: Using Terminal Release Tool

Courtesy of GENERAL MOTORS COMPANY

6. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

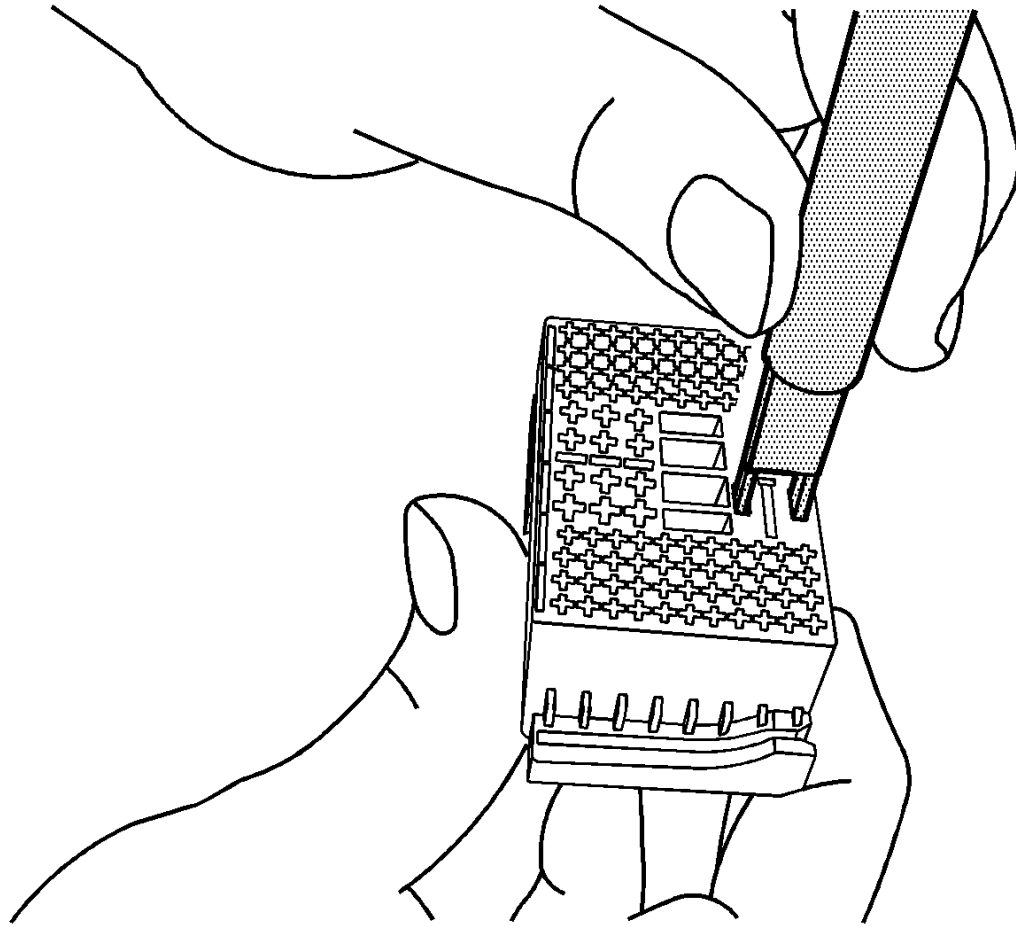


Fig. 172: Releasing Lock Tabs - Tyco/AMP (102-Way Inline)

Courtesy of GENERAL MOTORS COMPANY

7. Using terminal release tool J-38125-221, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

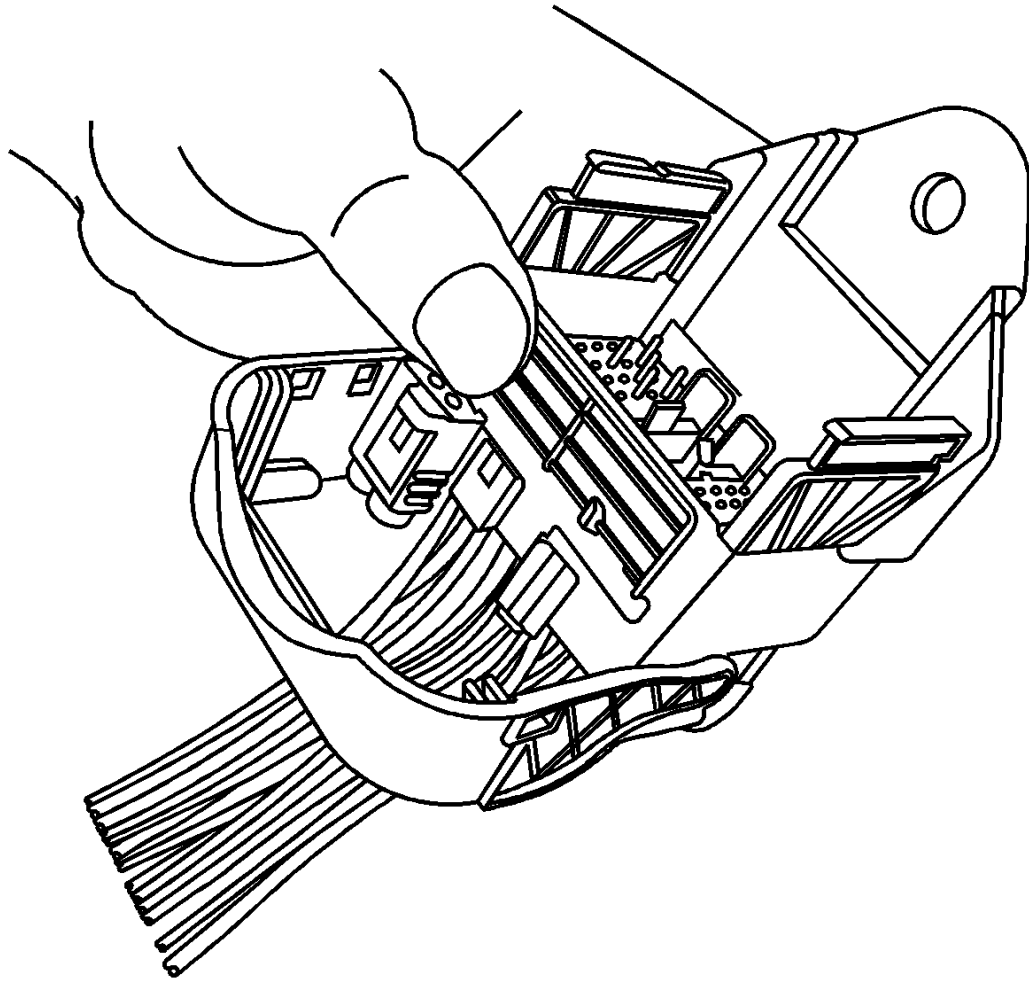


Fig. 173: View Of Female Connector Body - Tyco/AMP (102-Way Inline)

Courtesy of GENERAL MOTORS COMPANY

8. The female connector body may have an additional connector hooked to the edge of the body. Use terminal release tool J-38125-11A or equivalent to release the locking tab and slide the connector off the female body.

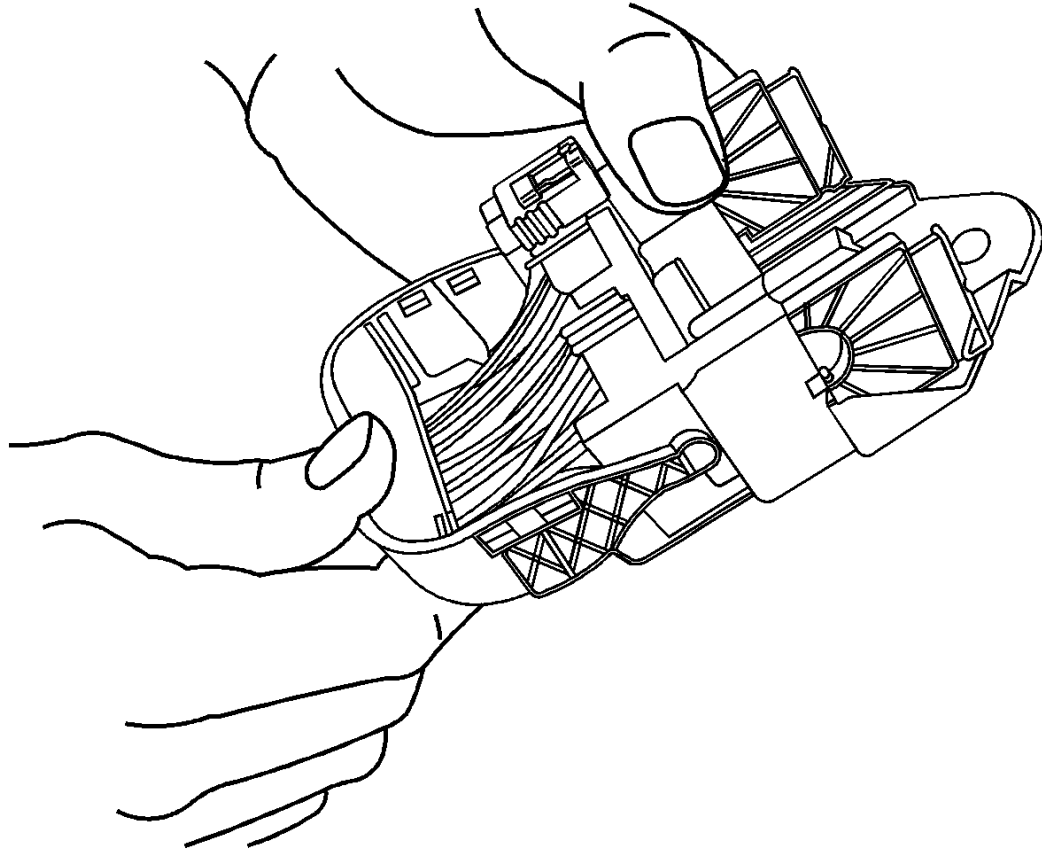


Fig. 174: Moving Locking Lever

Courtesy of GENERAL MOTORS COMPANY

9. Move the locking lever 180 degrees from the connected position.

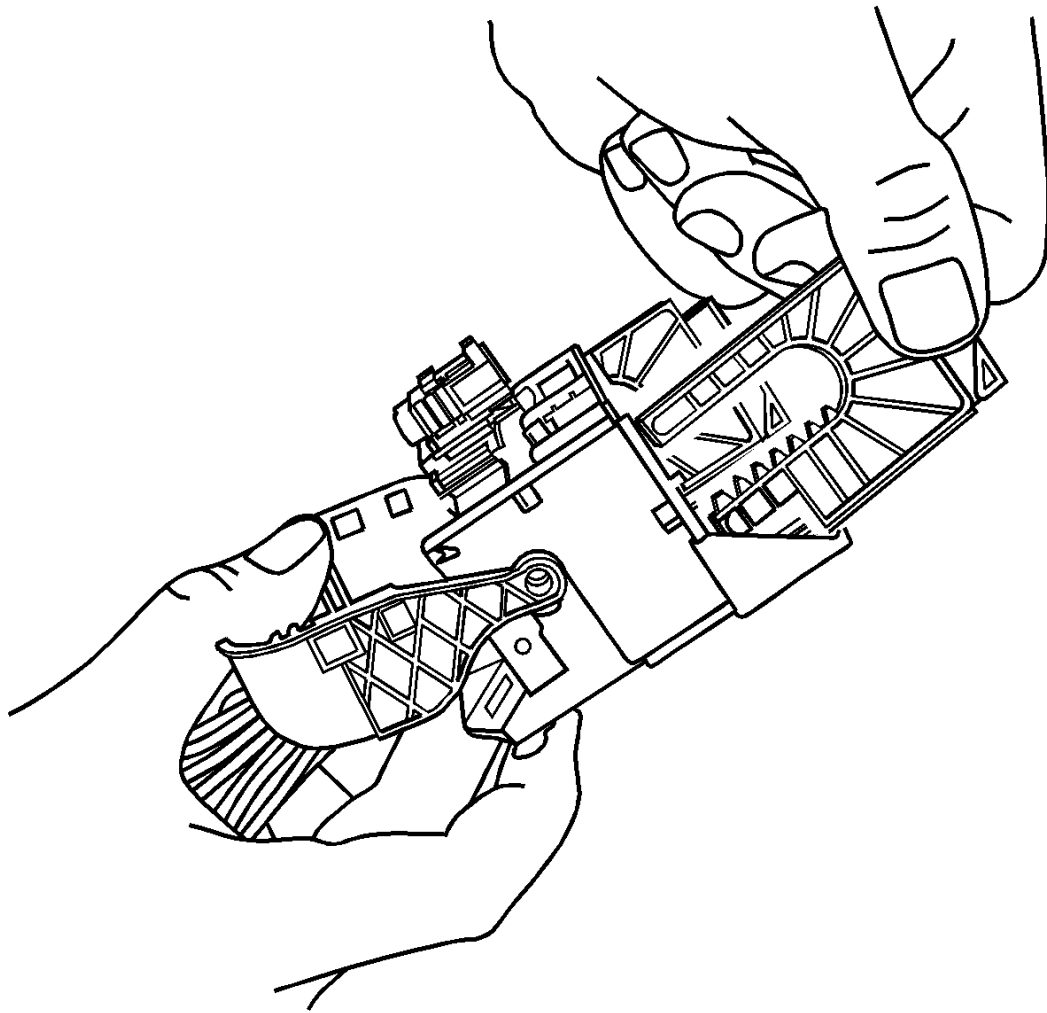


Fig. 175: Removing Guide Plates From Connector Body
Courtesy of GENERAL MOTORS COMPANY

10. With the locking lever in the 180 degree position the guide plates can be removed from the connector body.

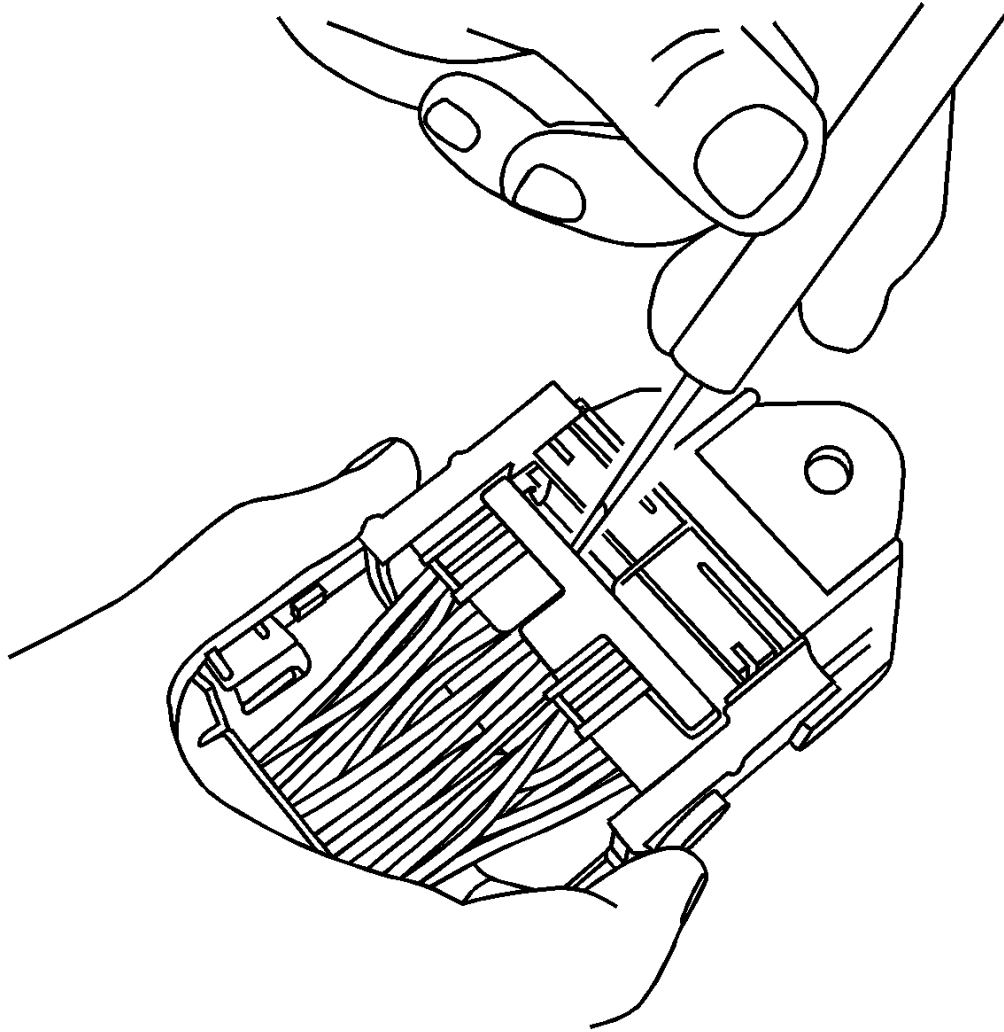


Fig. 176: Removing TPA

Courtesy of GENERAL MOTORS COMPANY

NOTE: During assembly the TPA will not fully seat if any terminal is not fully seated.

11. Using terminal release tool J-38125-11A or equivalent, remove the TPA from the connector body.

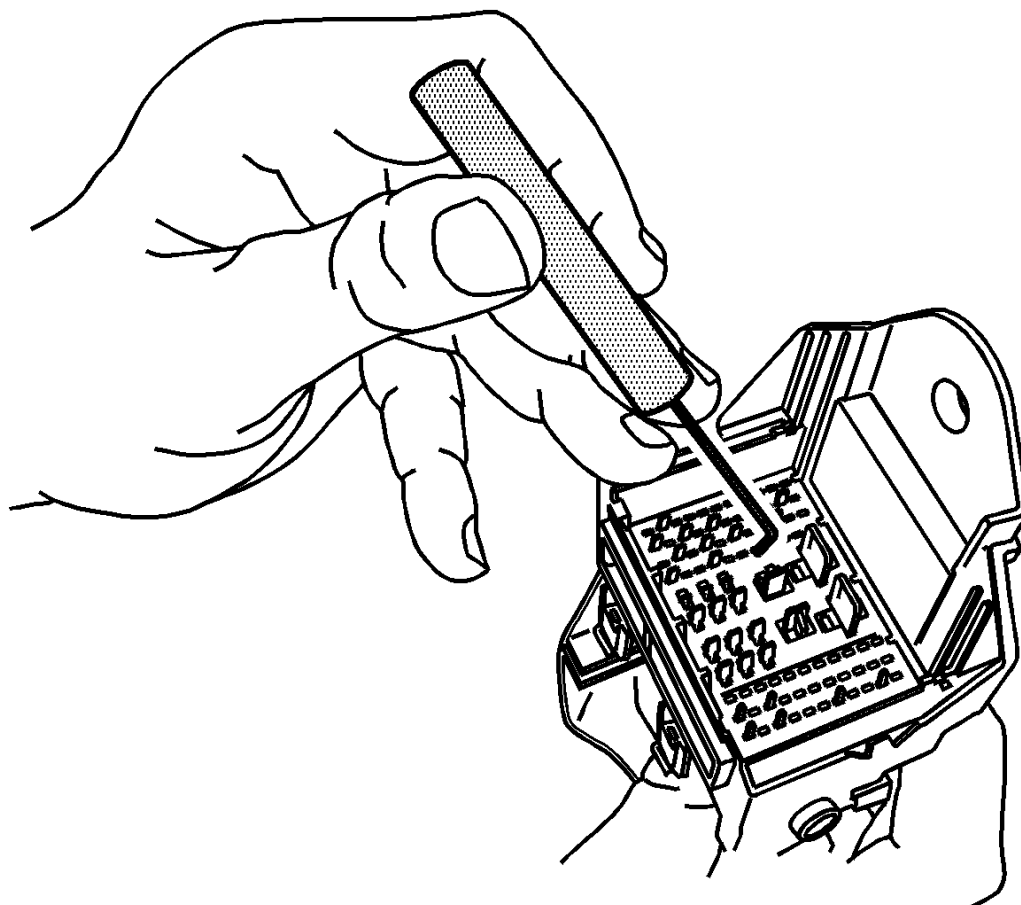


Fig. 177: Lifting Terminal Plate Past The Terminals

Courtesy of GENERAL MOTORS COMPANY

12. Using terminal release tool J-38125-216, lift the terminal plate past the terminals and out of the connector body cavity.

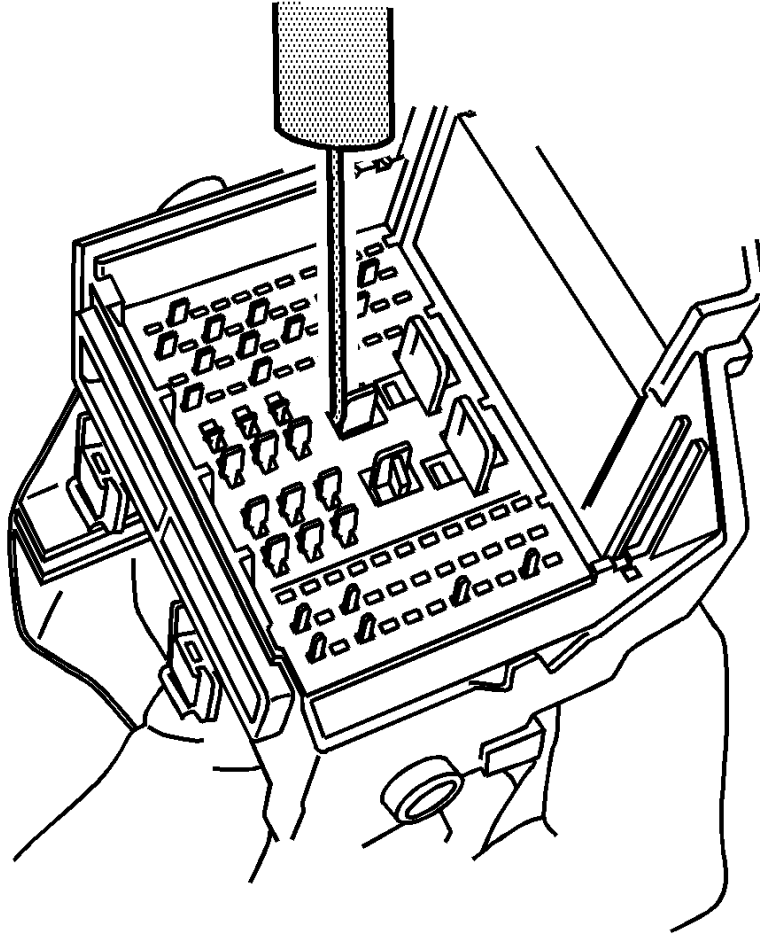


Fig. 178: View Of Terminal Plate

Courtesy of GENERAL MOTORS COMPANY

13. Terminal plate will bind slightly on each corner.

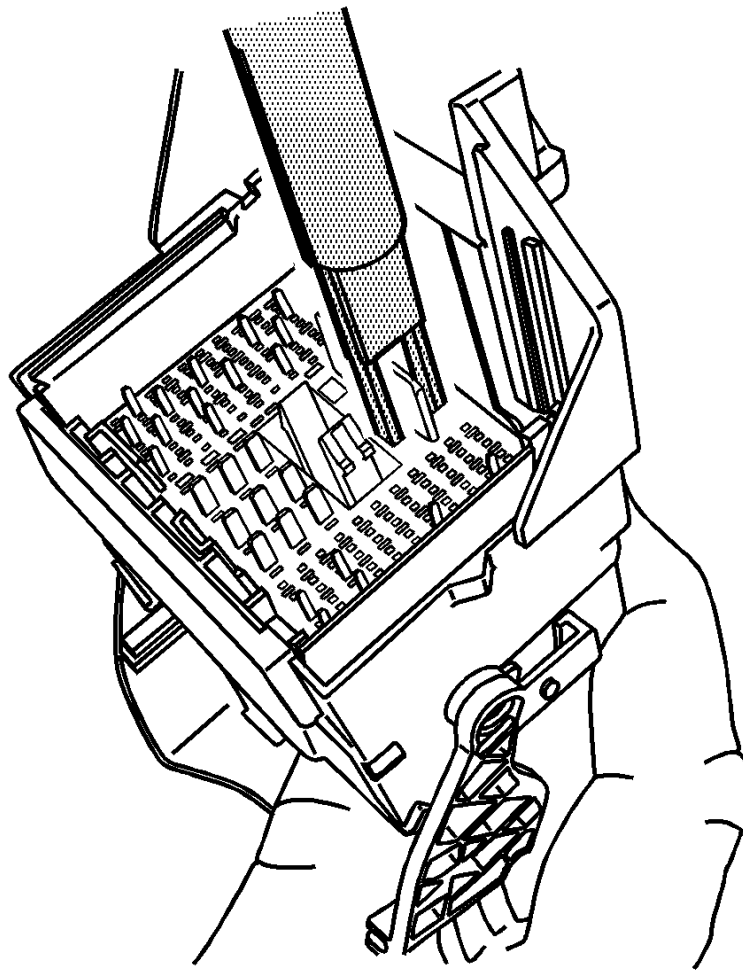


Fig. 179: Releasing Lock Tabs

Courtesy of GENERAL MOTORS COMPANY

14. Using terminal release tool J-38125-221, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

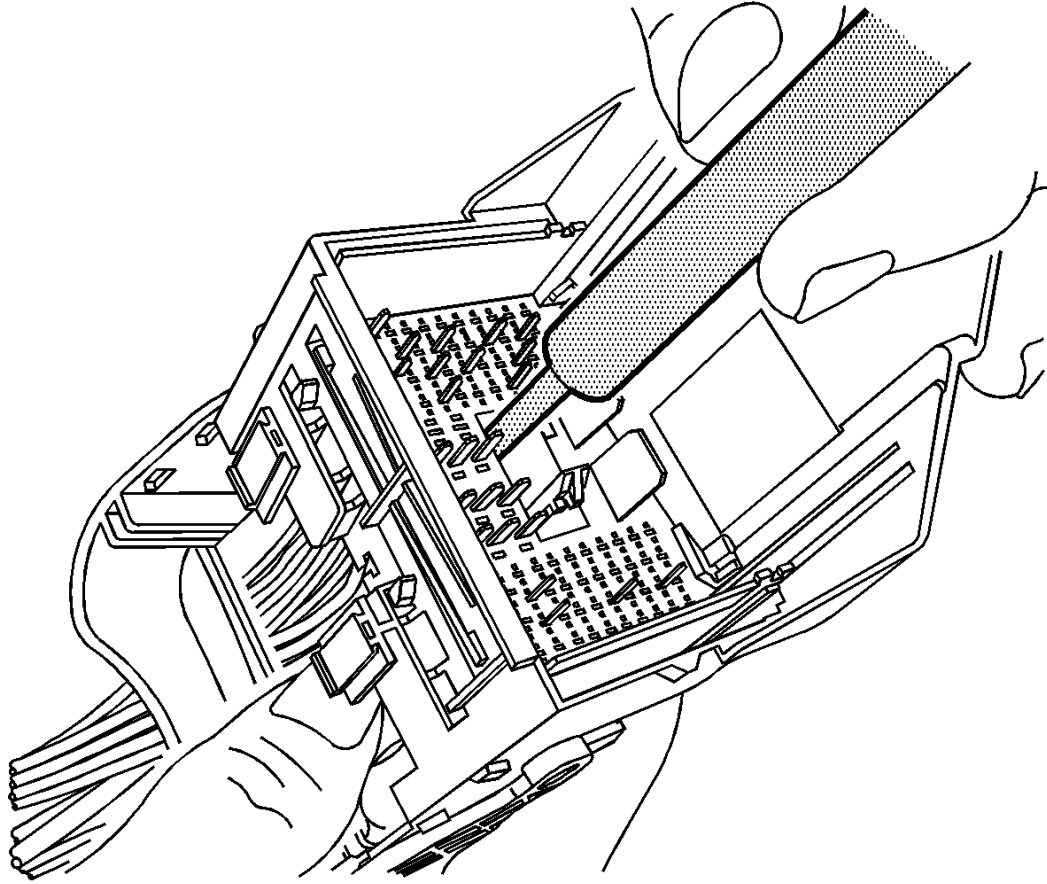


Fig. 180: View of Pressing Prongs On Each Side Of Terminal

Courtesy of GENERAL MOTORS COMPANY

15. Using terminal release tool J-38125-212, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

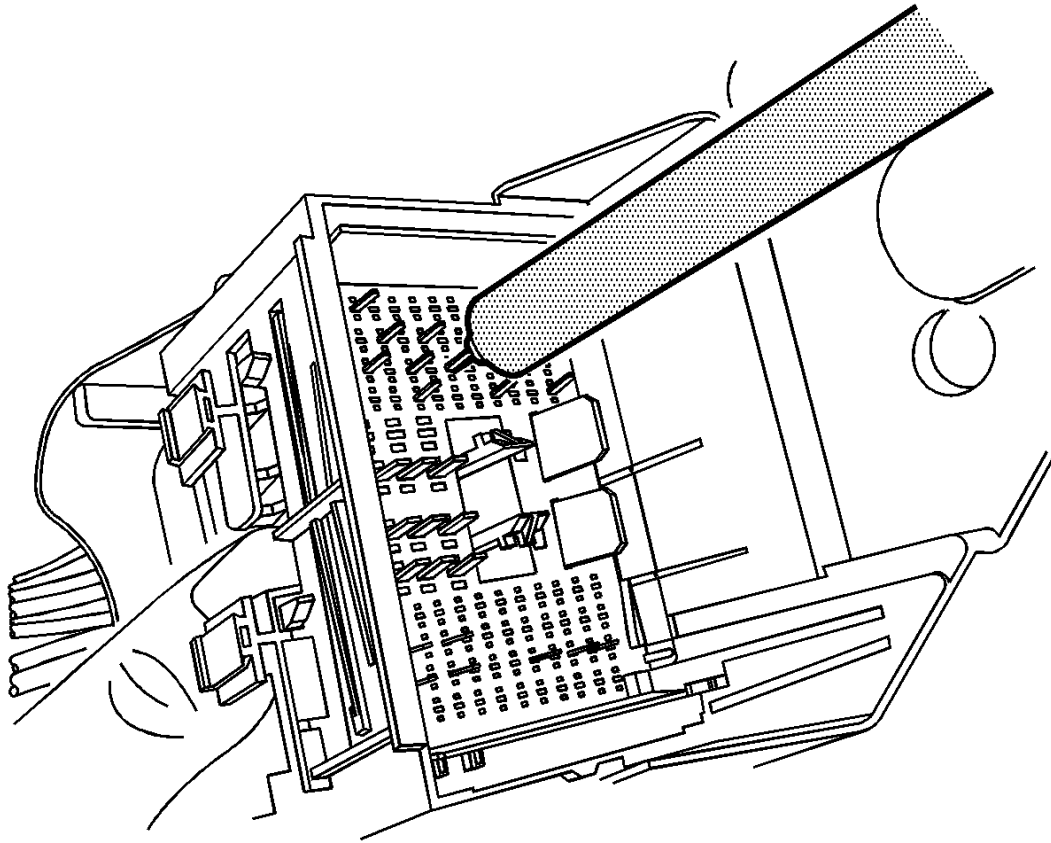


Fig. 181: Pressing Prongs On Each Side Of Terminal - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

16. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

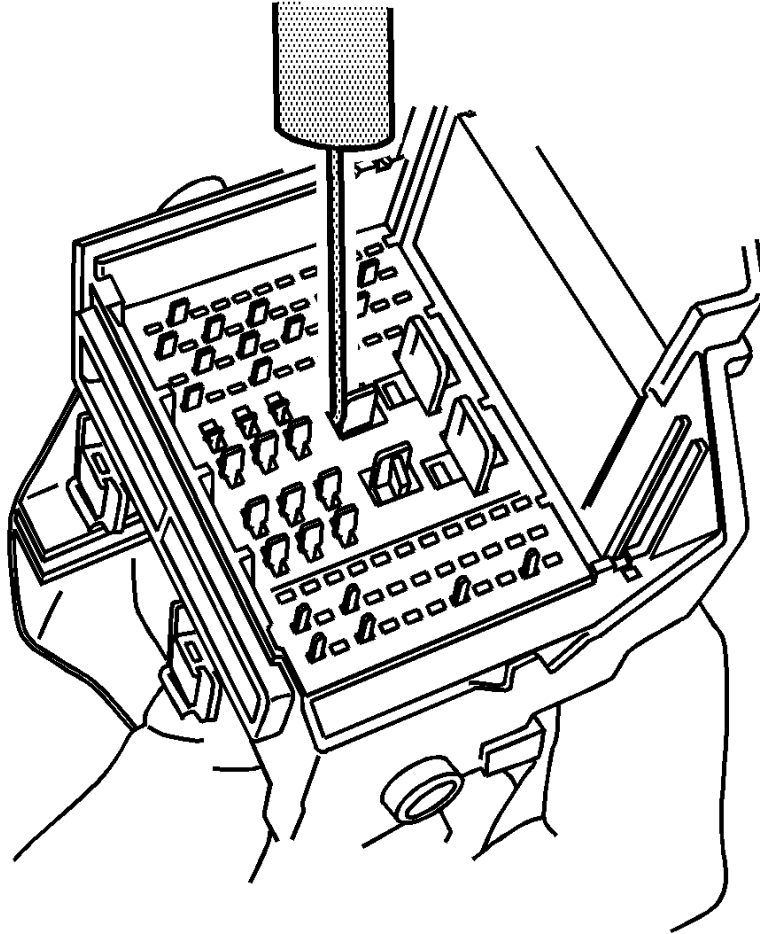


Fig. 182: View Of Terminal Plate

Courtesy of GENERAL MOTORS COMPANY

17. Press the terminal plate back into the female connector to the preset position. The plate will bind slightly on each corner.

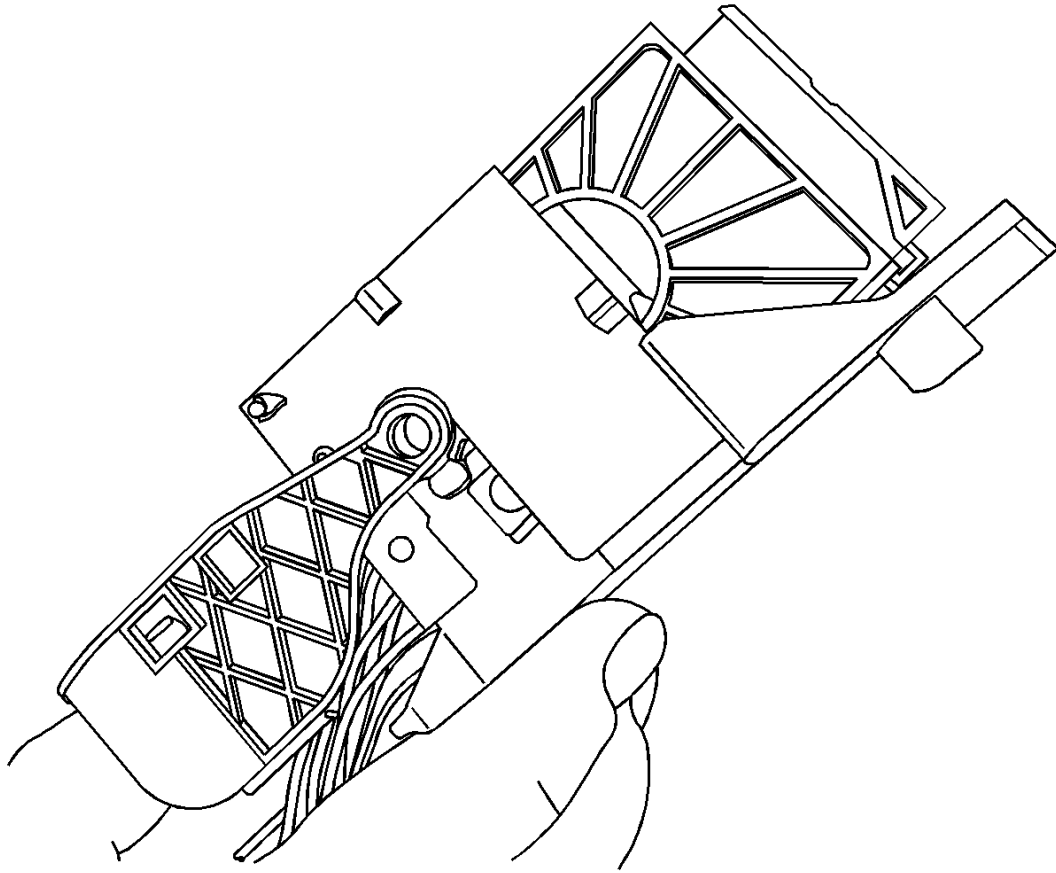


Fig. 183: Aligning Guide Plates To Mesh With Locking Lever Gears
Courtesy of GENERAL MOTORS COMPANY

18. With the locking lever in the 180 degree position, align the guide plates to mesh with the gears on the locking lever.

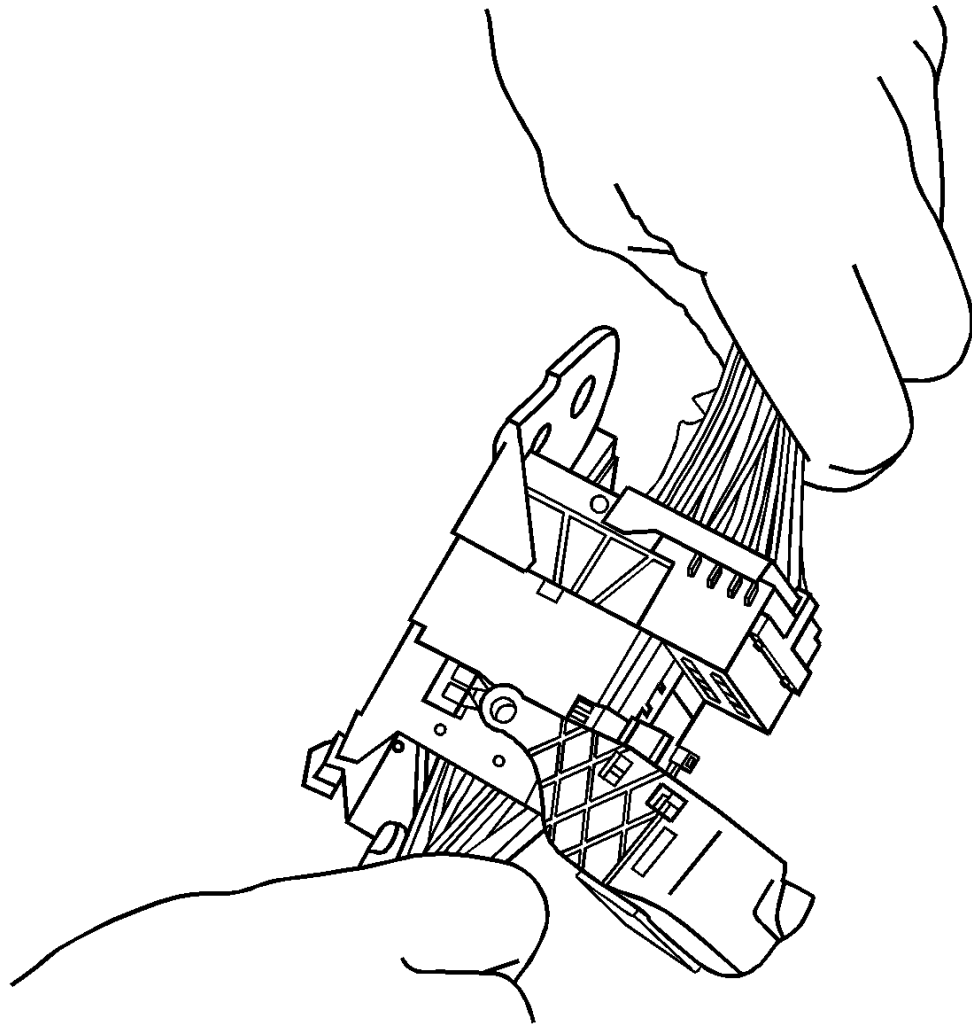


Fig. 184: Sliding Male Connector Body Away From Guide Plates
Courtesy of GENERAL MOTORS COMPANY

19. Slide the male connector body back inward toward the guide plates.

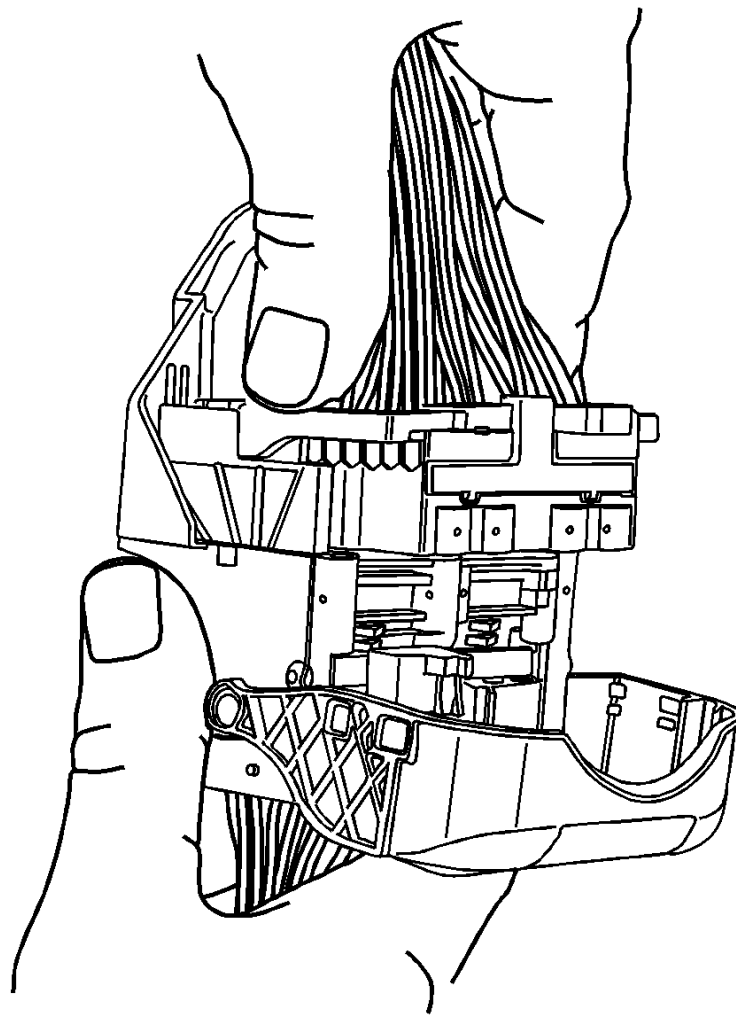


Fig. 185: Assembled View Of Connector - Tyco/AMP (102-Way Inline)

Courtesy of GENERAL MOTORS COMPANY

20. With the locking lever in the 90 degree position and the male connector body connected, it can be slid inward for assembly.

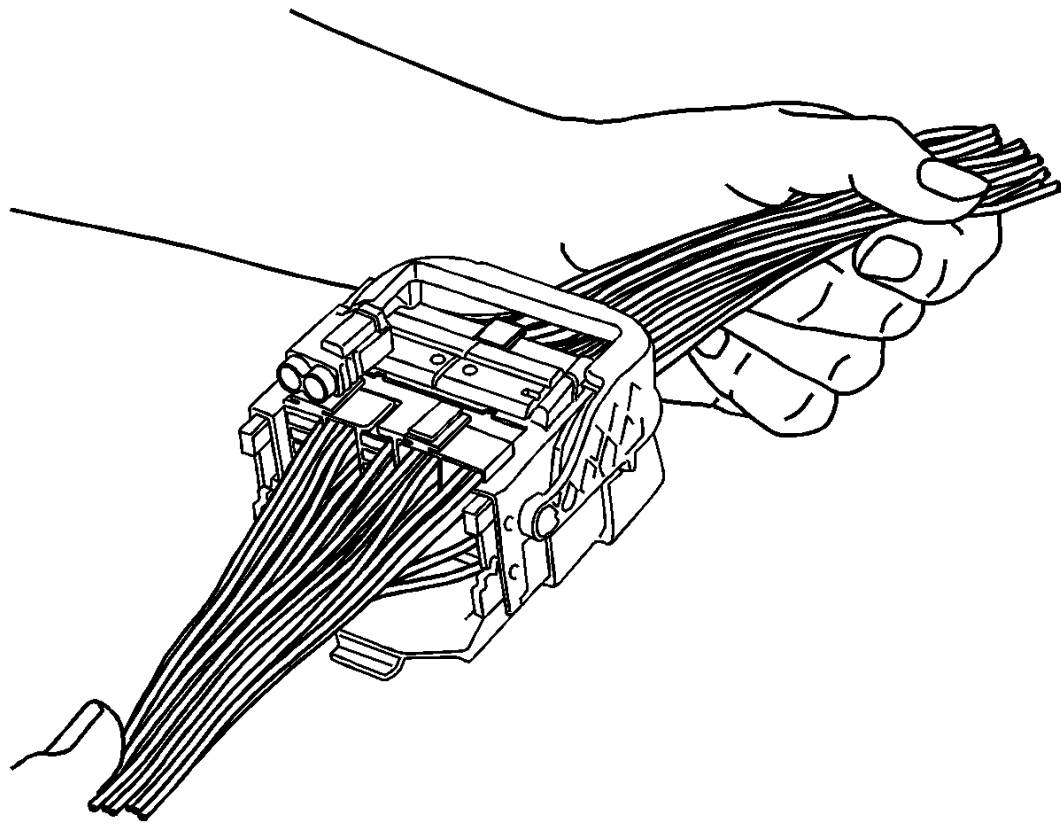


Fig. 186: View Of Typical Connector In Assembled Position

Courtesy of GENERAL MOTORS COMPANY

21. Move the lever into the locked position or in the assembled position. This will pull the male connector down into the female connector.
22. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
23. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SIR)

Special Tools

- EL-38125 - 550 Terminal Release Tool Kit
- EL-38125 - 580 Terminal Release Tool Kit
- J-38125 - 11A Terminal Release Tool
- J-38125-215A Terminal Release Tool

For equivalent regional tools, refer to [Special Tools](#) .

Removal Procedure

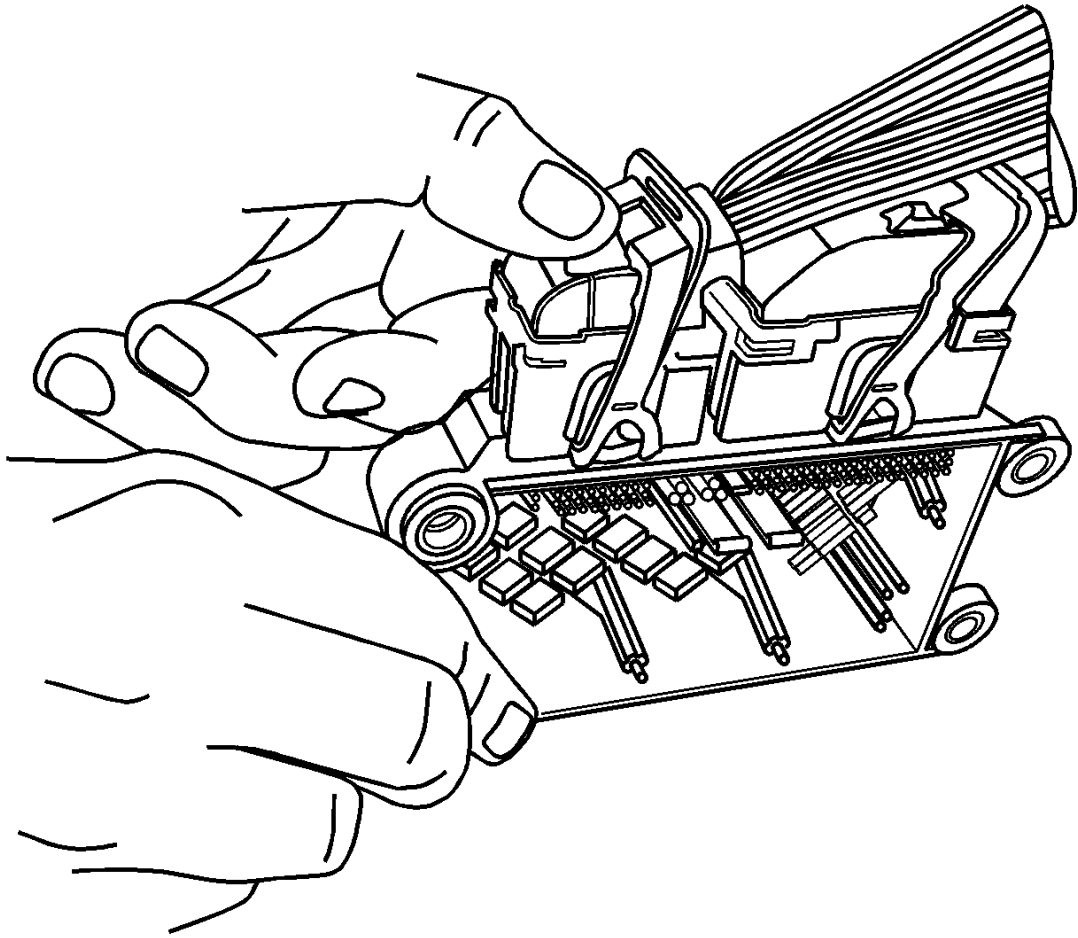


Fig. 187: Sliding Red CPA Away From Connector Lever

Courtesy of GENERAL MOTORS COMPANY

1. Using your thumbs press down and slide the red CPA away from the connector lever.

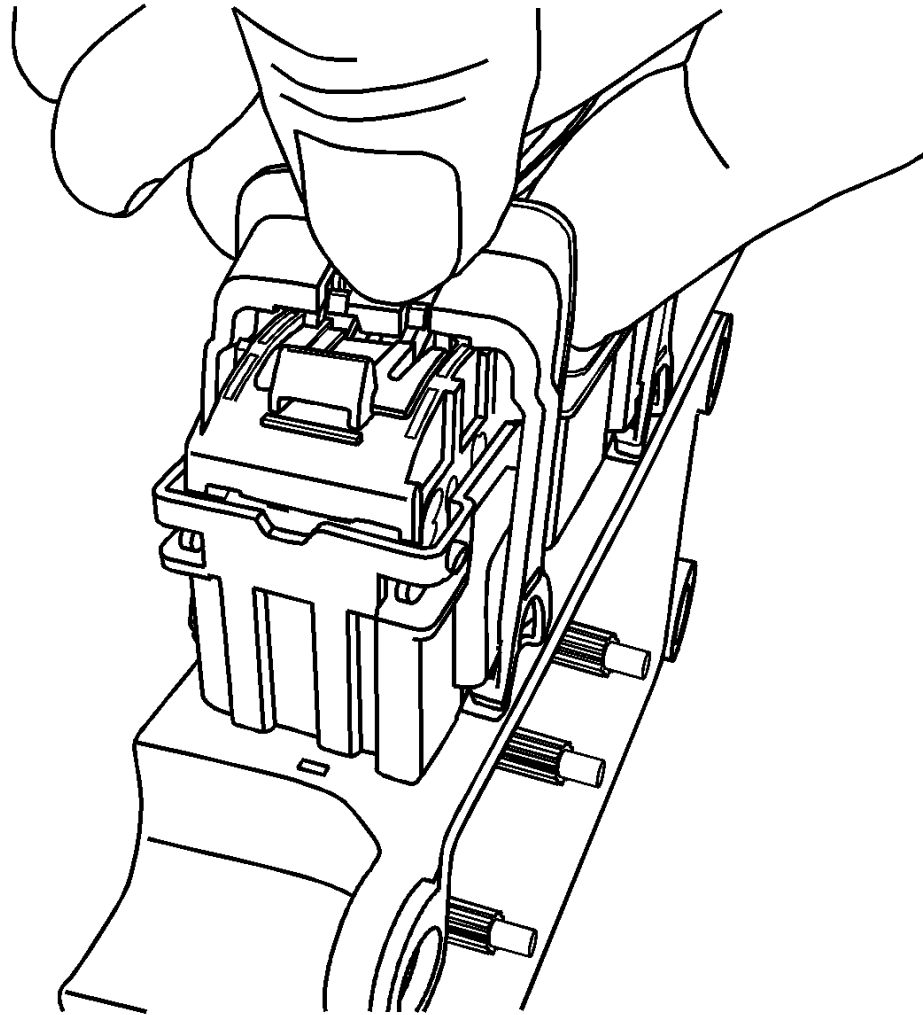


Fig. 188: Pressing Down On Locking Tab - Tyco/AMP Connectors (SIR)

Courtesy of GENERAL MOTORS COMPANY

2. Using your thumb press down on the locking tab and move the lever to the released position.

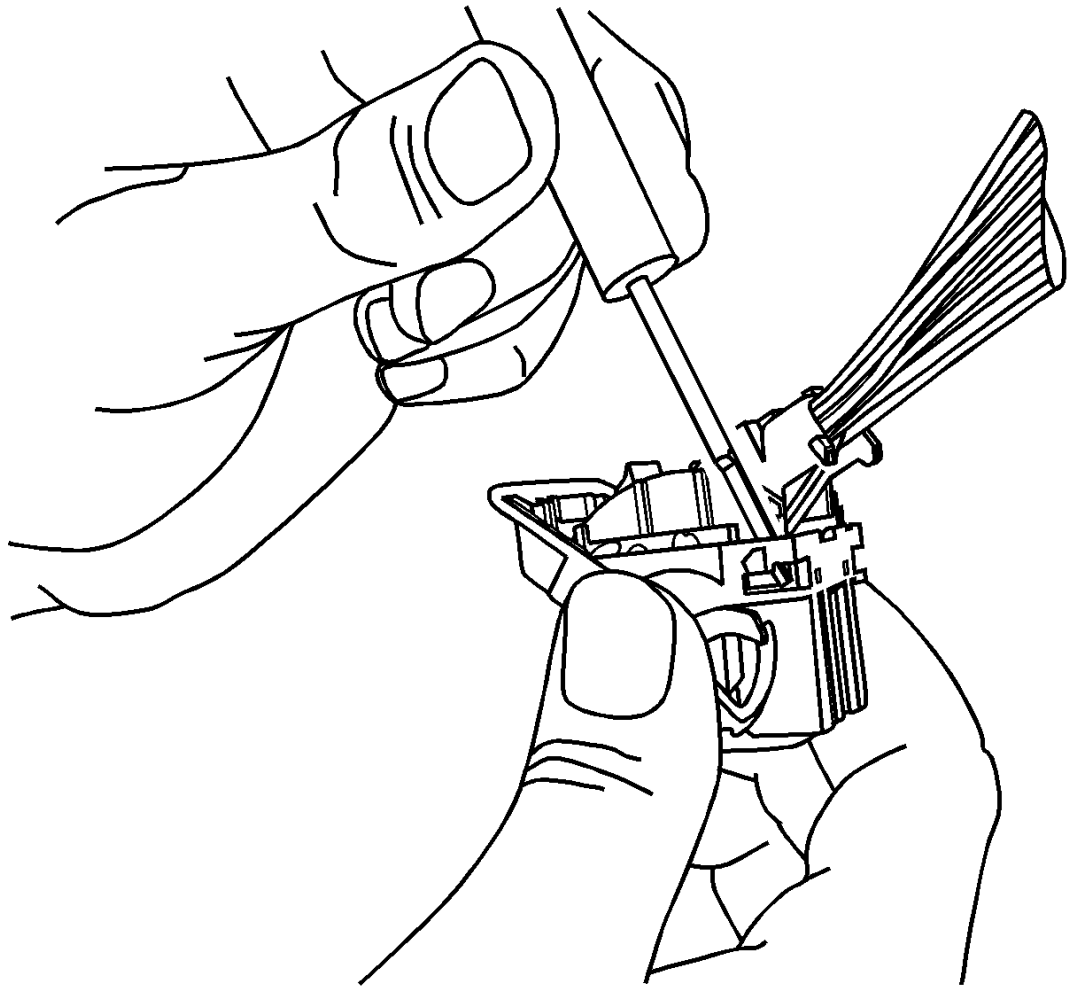


Fig. 189: Releasing Wire Dress Cover Locking Tabs

Courtesy of GENERAL MOTORS COMPANY

3. Using terminal tool J-38125-11A or equivalent, release the wire dress cover locking tabs.

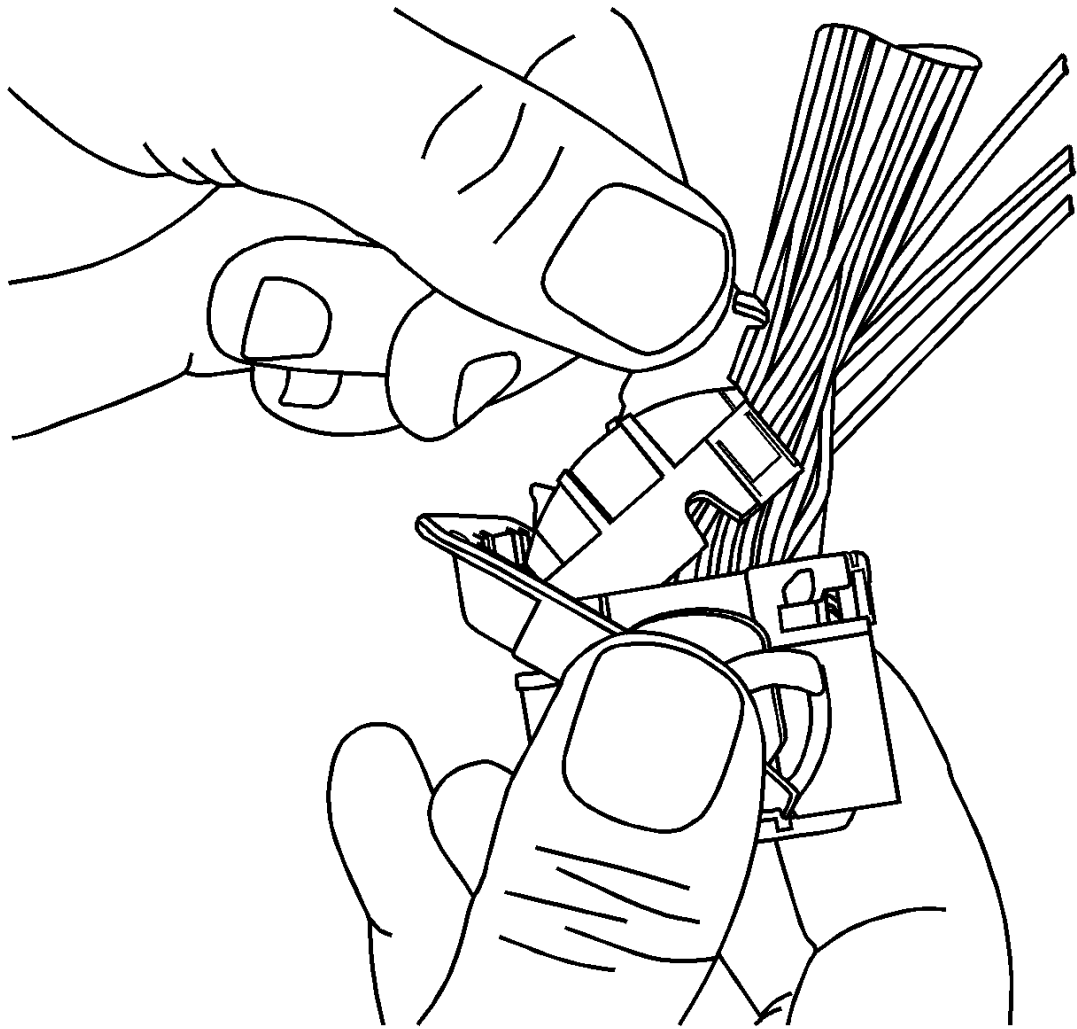


Fig. 190: Pivoting Connector Wire Dress Cover
Courtesy of GENERAL MOTORS COMPANY

4. Pivot connector wire dress cover while removing from the connector body.

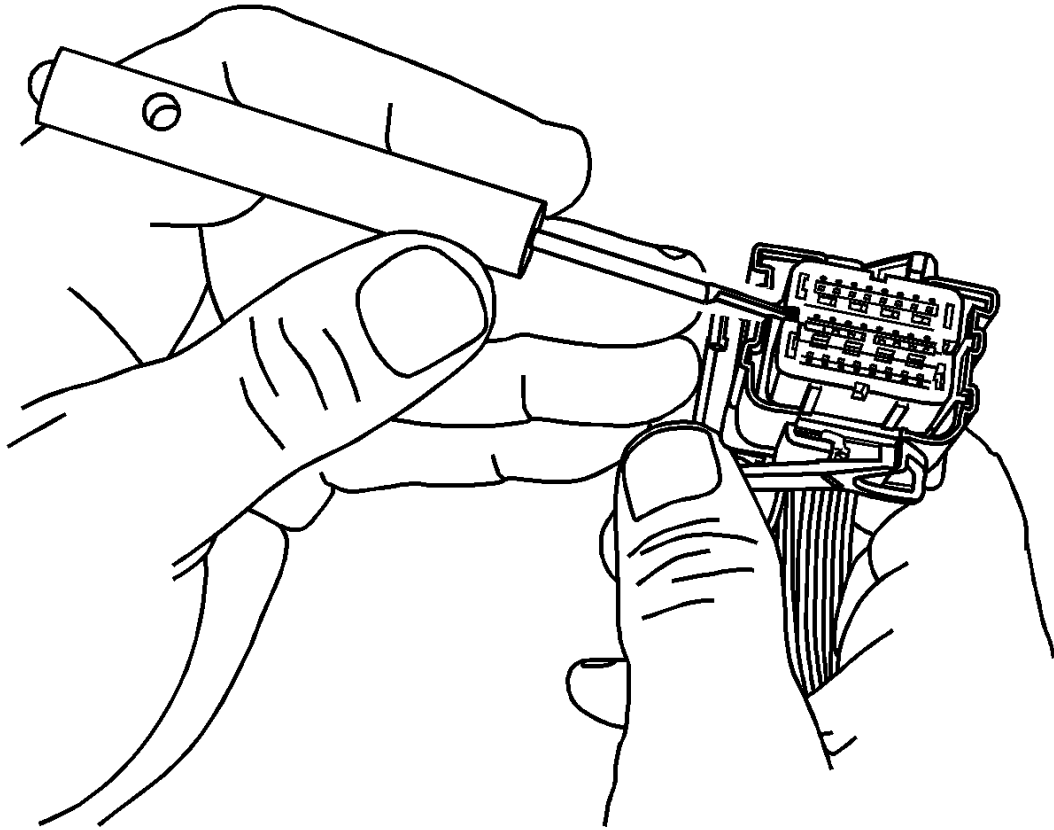


Fig. 191: Removing TPA

Courtesy of GENERAL MOTORS COMPANY

5. Using terminal tool J-38125-11A or equivalent, remove the TPA by lifting straight off the connector body.

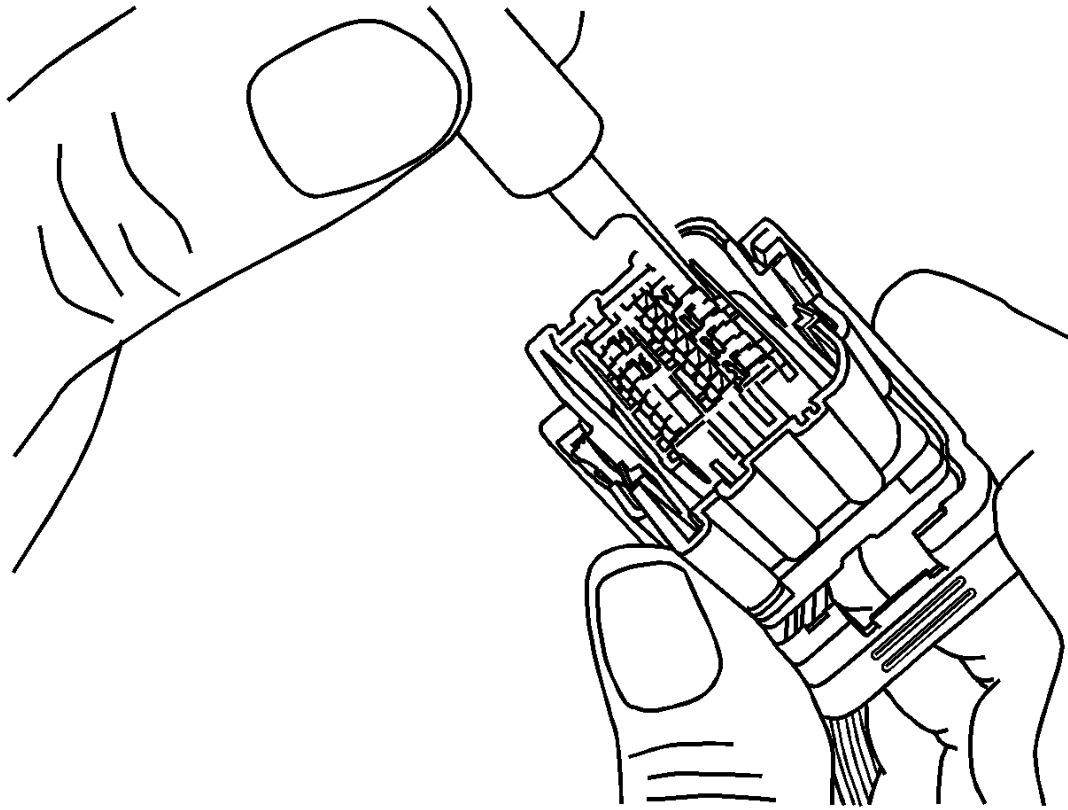


Fig. 192: View of Terminal Release Tool & Rear of Connector Body
Courtesy of GENERAL MOTORS COMPANY

6. Using terminal release tool J-38125-215A, place the tip of the tool on the outside edge next to the terminal and depress the lock tab and remove the rear of the connector body.

Terminal Repair Procedure

Use the appropriate terminal and crimper in order to replace the terminal.

YAZAKI CONNECTORS (2-WAY)

For equivalent regional tools, refer to [Special Tools](#) .

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-553** Terminal Release Tool

Terminal Removal Procedure

1. Disconnect the connector from the component.

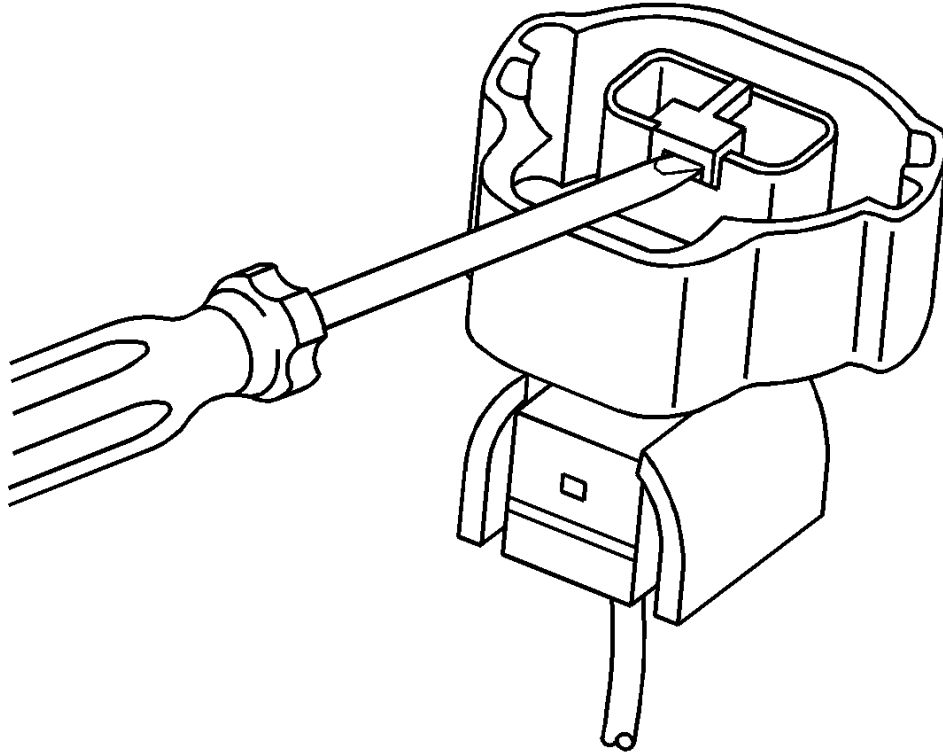


Fig. 193: Identifying Terminal Position Assurance
Courtesy of GENERAL MOTORS COMPANY

2. Insert a small flat-blade tool in the slot below the front loaded terminal position assurance (TPA) and pry up.
3. Remove the TPA by pulling it out of the connector.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

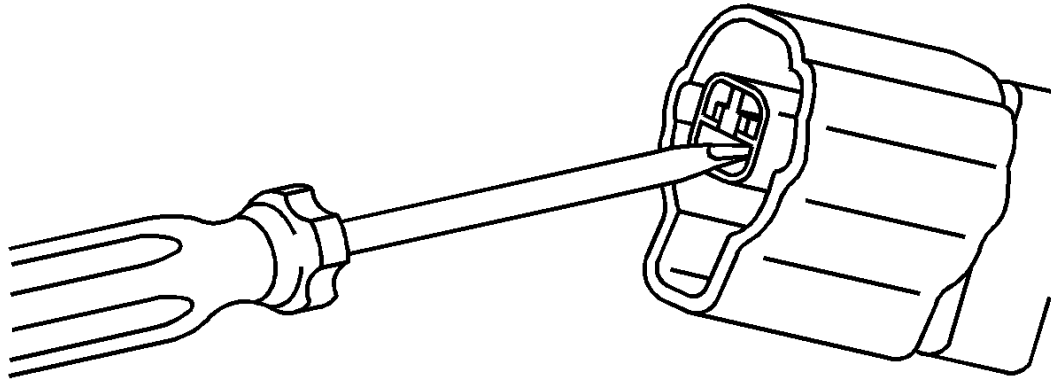


Fig. 194: Inserting Tool Into Terminal Cavity
Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-553 on a slight upward angle into the cavity below the terminal to be removed. Ensure that the pointed on the end of the tool is facing the bottom of the terminal and it stays in contact with the terminal until it stops on the plastic terminal retainer.

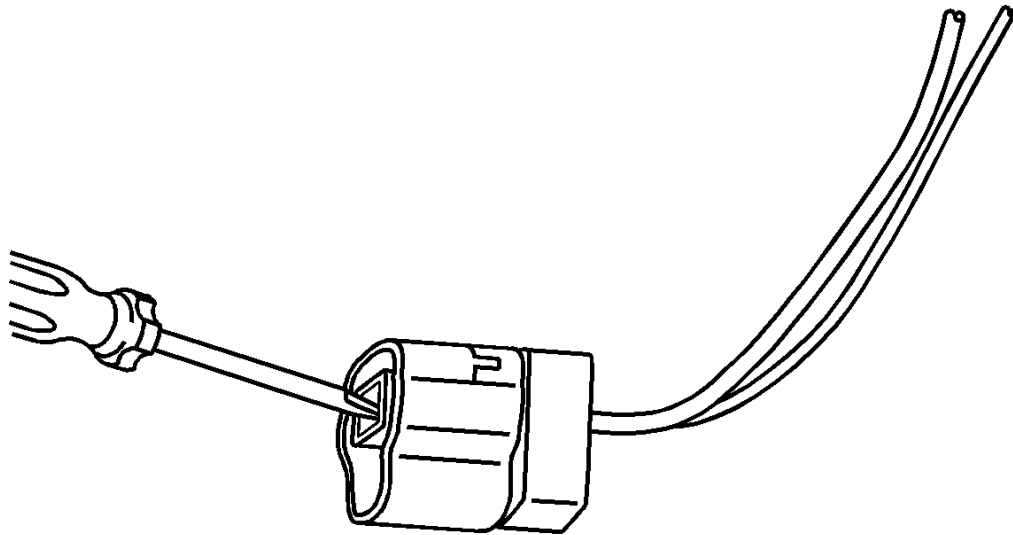


Fig. 195: Pulling Terminal Out Of Connector
Courtesy of GENERAL MOTORS COMPANY

6. Gently pry the plastic terminal retainer down and carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
7. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)** procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

YAZAKI CONNECTORS (16-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-215** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

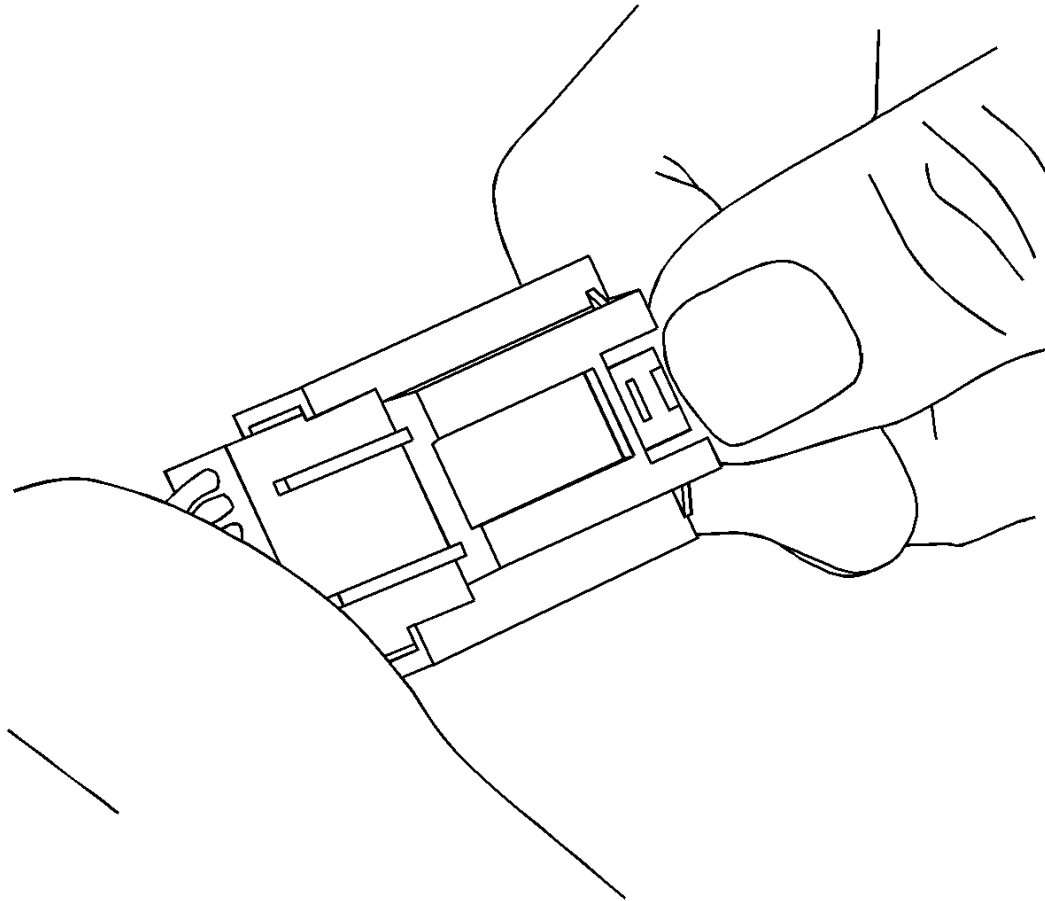


Fig. 196: Pulling Two Connector Halves Apart
Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, pull the two connector halves apart.

NOTE: The terminal position assurance (TPA) is fragile and may break if not done carefully.

2. Use a small flat-blade tool to very carefully push the TPA towards the face of the connector on both sides of the connector.

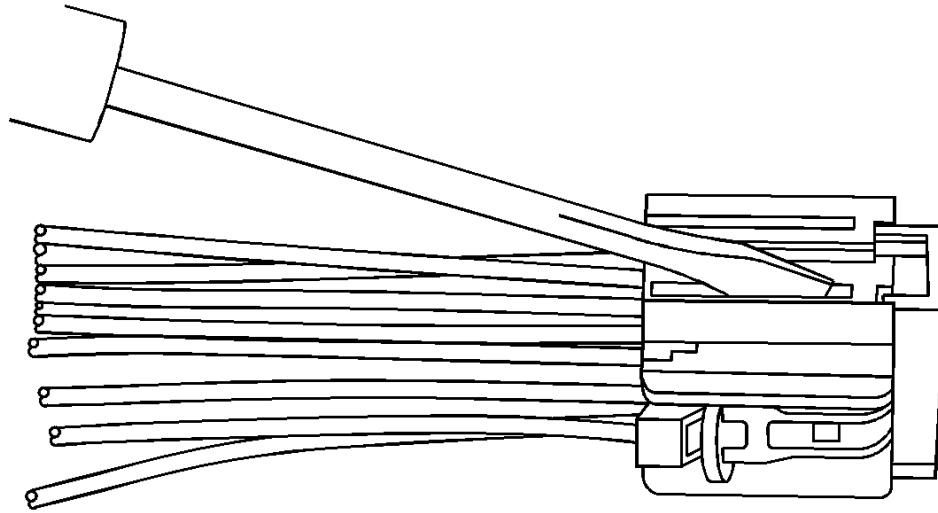


Fig. 197: View Of Male Connector Half & Female Terminals
Courtesy of GENERAL MOTORS COMPANY

3. View of the male half of the connector with female terminals.

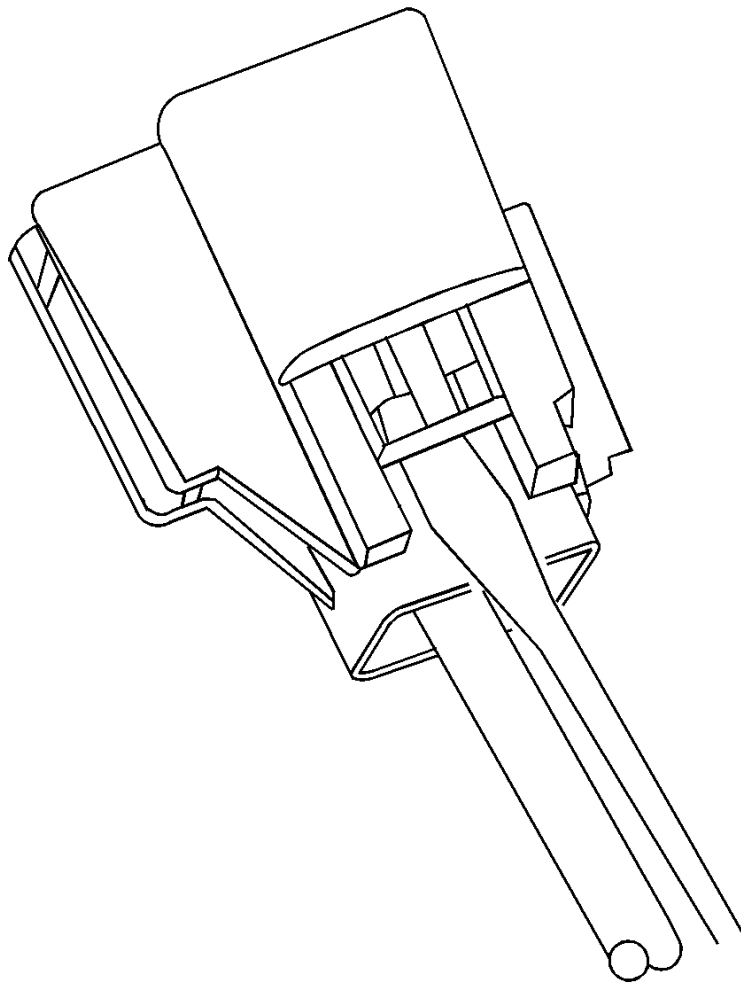


Fig. 198: View Of Female Half Of Connector With Male Terminals
Courtesy of GENERAL MOTORS COMPANY

4. View of the female half of the connector with male terminals.
5. Use the J-38125-215 tool to release the terminals by inserting the tool into the terminal release cavity.

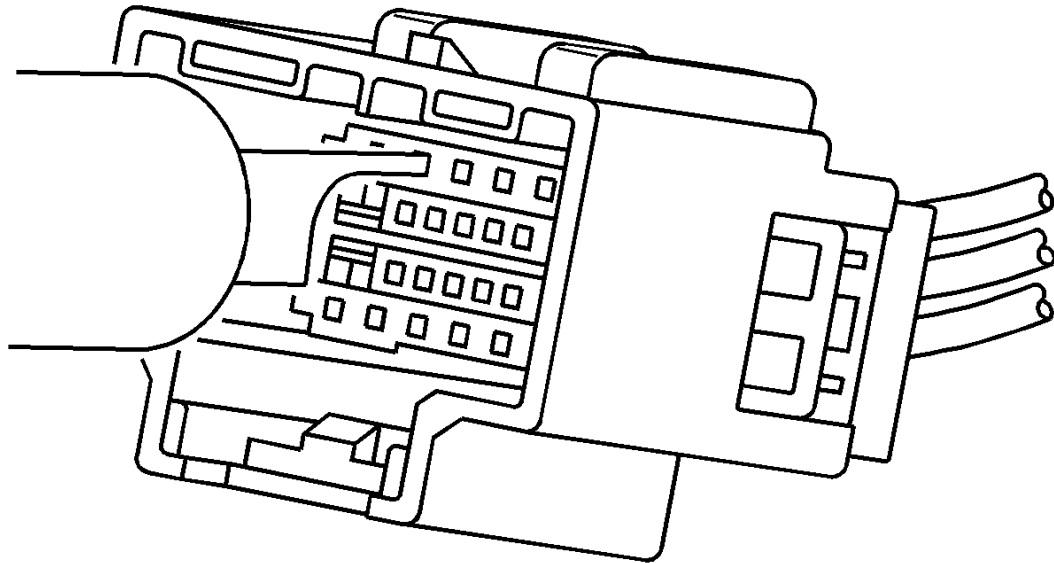


Fig. 199: Using Removal Tool On Female Half Of Connector
Courtesy of GENERAL MOTORS COMPANY

6. View of the female half of the connector with male terminals.

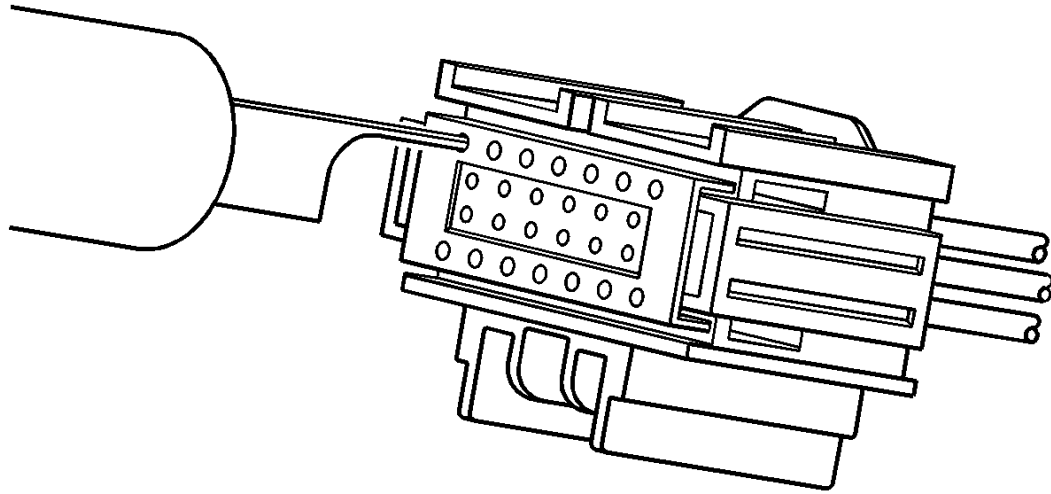


Fig. 200: Using Removal Tool On Male Half Of Connector
Courtesy of GENERAL MOTORS COMPANY

7. View of the male half of the connector with female terminals.
8. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
9. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#) procedure.
10. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

REPAIRING CONNECTOR TERMINALS (TERMINATED LEAD REPAIR)

Special Tools

EL-38125-10 Splice Sleeve Crimp Tool

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repairs procedures.

For high temperature wiring repairs, refer to [High Temperature Wiring Repairs](#).

Terminated leads are terminals that are crimped onto wires. The terminated lead can be used throughout the vehicle since it is designed for temperatures up to 150°C. The length of the wire is 450 mm.

1. Use the connector end view to identify the correct terminated lead.
2. The terminated lead package should include a DuraSeal splice sleeve. If not, use the chart to in Splicing Copper Wire Using Splice Sleeves to identify the correct DuraSeal splice sleeve, refer to [Wire to Wire Repair](#).

REPAIRING CONNECTOR TERMINALS (TERMINAL REPAIR)

Special Tools

- J-38125 - 580 Terminal Repair Kit
- J-38125-6 Crimp Tool
- J-38125-7 Crimp Tool
- J-38125-8 Crimp Tool
- J-38125-64 Crimp Tool
- J-38125-101 Crimp Tool
- J-38125-641 Crimp Tool
- J-38125-642 Crimp Tool
- J-38125-643 Crimp Tool

For equivalent regional tools, refer to [Special Tools](#).

Use the following repair procedures to repair each type of terminal:

- For push to seat terminals, refer to [Delphi Connectors \(Weather Pack\)Delphi Connectors \(Push To Seat\)Delphi Connectors \(Pull To Seat\)Delphi Connectors \(Micro-Pack 100W\)Delphi Connectors \(Micro.64\)Delphi Connectors \(12-Way\)Delphi Connectors \(Steering Gear\)](#).
- For pull to seat terminals, refer to [Delphi Connectors \(Weather Pack\)Delphi Connectors \(Push To Seat\)Delphi Connectors \(Pull To Seat\)Delphi Connectors \(Micro-Pack 100W\)Delphi Connectors \(Micro.64\)Delphi Connectors \(12-Way\)Delphi Connectors \(Steering Gear\)](#).

NOTE: The first step for all terminal repairs is to find the connector end view in SI.

Cable Seal Terminals

1. Cut off the terminal between the core and the insulation crimp to minimize any wire loss.
2. Remove the old seal.
3. Apply the correct cable seal, per the wire gauge size, from the kit. Slide the seal back along the wire to enable removal of the insulation.
4. To minimize wire loss, remove only the insulation required.
5. Using the connector end view, determine the correct crimp tool and crimp jaw.
6. Align the seal with the end of the cable insulation.
7. Position the stripped wire and seal in the terminal.
8. Hand Crimp the core wings first.

9. Hand Crimp the insulation wings around the seal and the cable.

Unsealed Terminals

1. Cut off the terminal between the core and the insulation crimp to minimize any wire loss.
2. To minimize wire loss, remove only the insulation required.
3. Position the stripped wire in the terminal.
4. Hand Crimp the core wings first.
5. Hand Crimp the insulation wings around the cable.

Micro-Pack 100W Size Terminal

The Micro-Pack 100W connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-101 (W jaw) crimping tool was developed to crimp Micro-Pack 100W terminals. The J 38125-101 (W jaw) crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. After the terminal is removed from the connector perform the following procedure in order to repair Micro-Pack 100 terminals.

1. Cut the wire as close to the terminal as possible.

NOTE: After cutting the damaged terminal from the wire, determine if the remaining wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.

2. Strip 5 mm (3/16 in) of insulation from the wire.

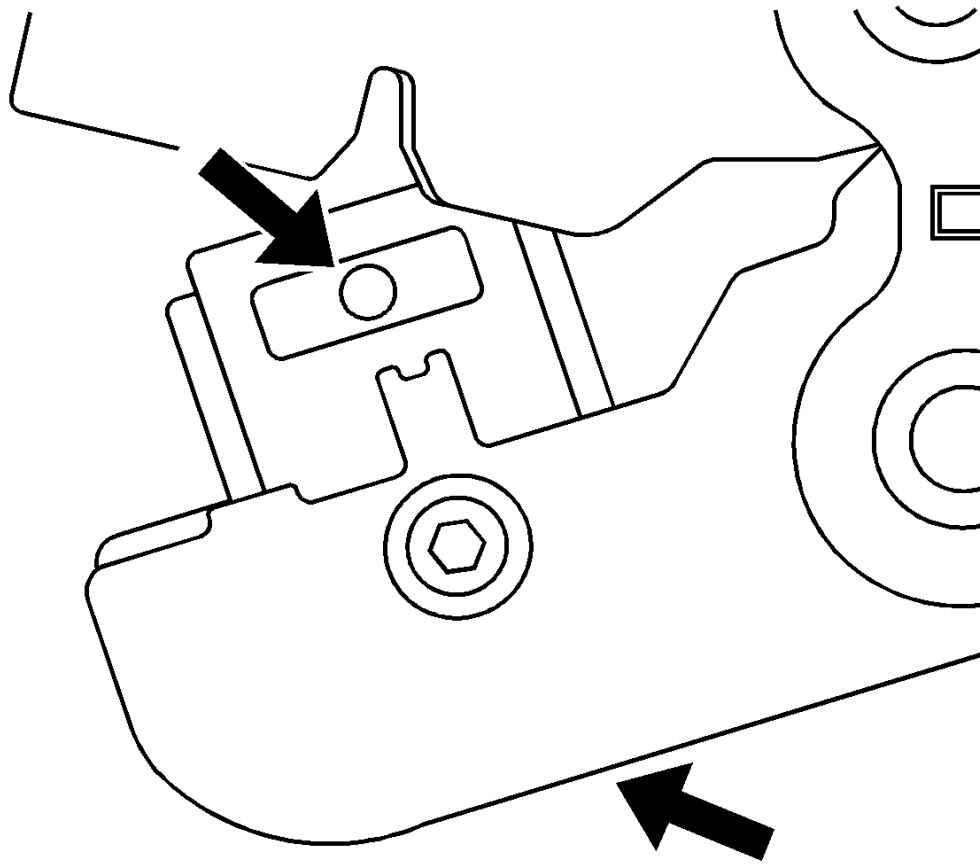


Fig. 201: Identifying Crimping Tool Spring Loaded Locator

Courtesy of GENERAL MOTORS COMPANY

3. Depress the spring loaded locator of the J 38125-101 (W jaw) crimping tool until the terminal holder is completely visible.

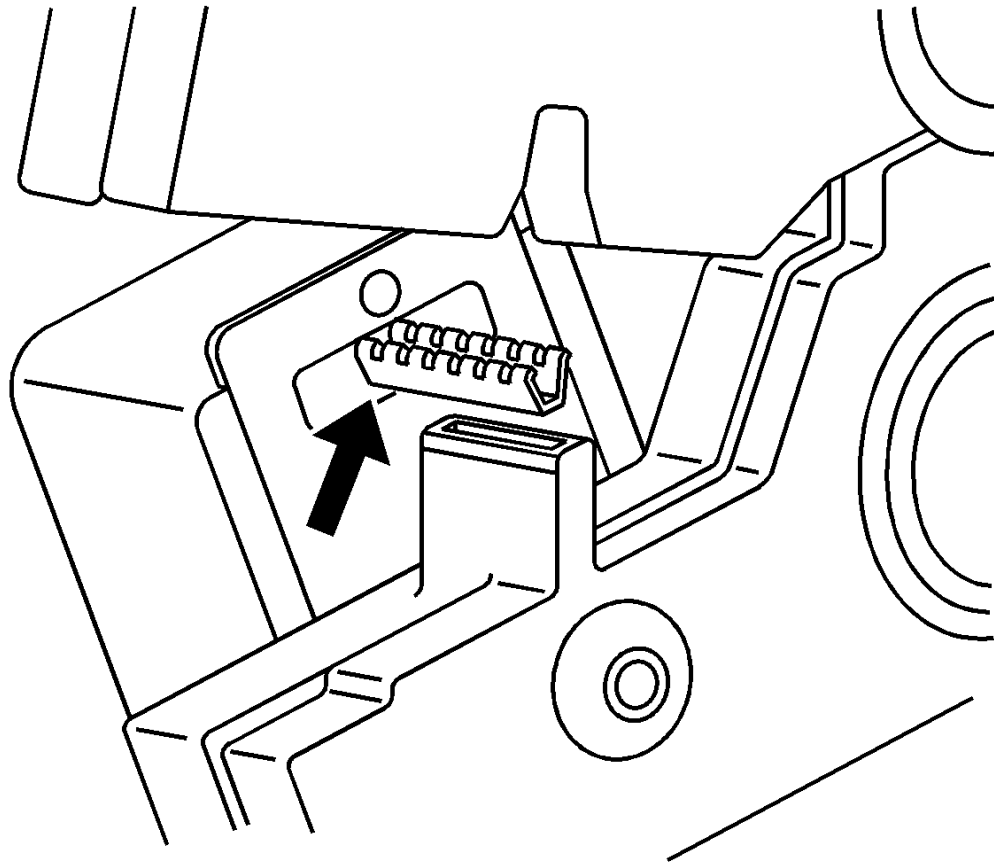


Fig. 202: Locating Terminal In Crimping Tool
Courtesy of GENERAL MOTORS COMPANY

4. Insert the terminal into the crimp tool until the core wings are flush with the anvil on the crimp tool. Be sure that the wings are pointed toward the crimp tool former and release the spring locator. The locator will hold the terminal in place. Inspect the alignment of the terminal wings with the crimp tool former. If the terminal wings are wider than the crimp tool former, remove the terminal and bend the terminal wings in slightly.
5. Place stripped wire into terminal.
6. Crimp the new terminal to the wire. If a jam occurs, press the emergency release to open applicator.

Micro 0.64 Size Terminal

The Micro 64 connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-64 (M jaw) was developed to crimp Micro 64 terminals. The J-38125-64 crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. The J-38125-64 crimping tool is also designed to crimp both the wire and the insulation at the same time.

After the terminal is removed from the connector perform the following procedure in order to repair Micro 64 terminals.

NOTE: After cutting the damaged terminal from the wire, determine if the remaining wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.

1. Cut the wire as close to the damaged terminal as possible.
2. Strip 5 mm (3/16 in) of insulation from the wire.

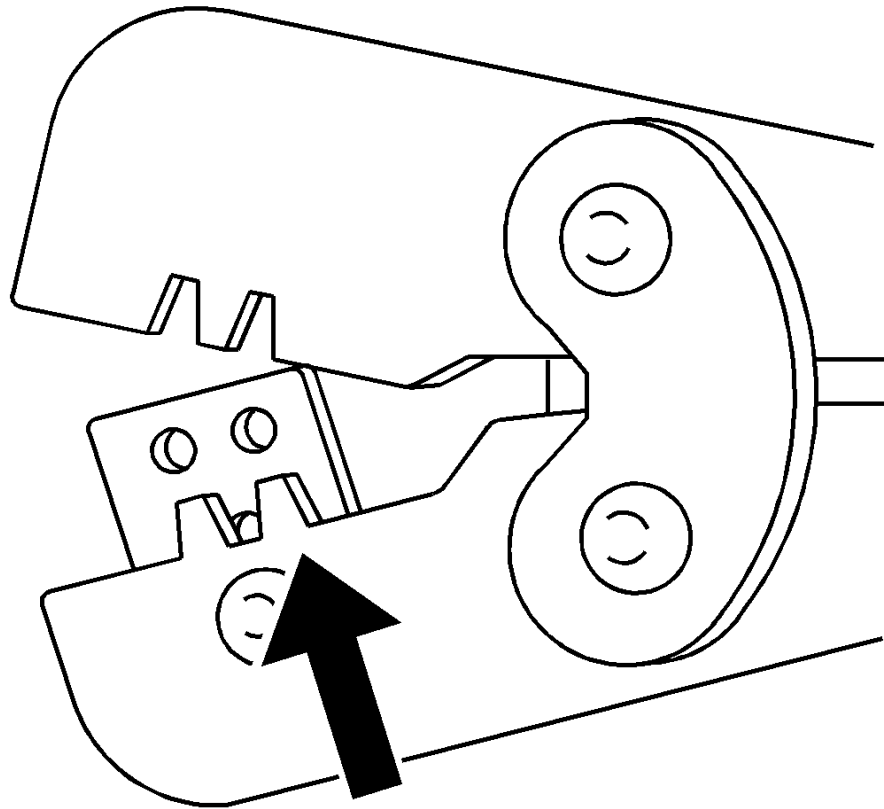


Fig. 203: Identifying Crimping Tool Spring Loaded Locator
Courtesy of GENERAL MOTORS COMPANY

3. Depress the spring loaded locator of the crimping tool until the terminal holder is completely visible.

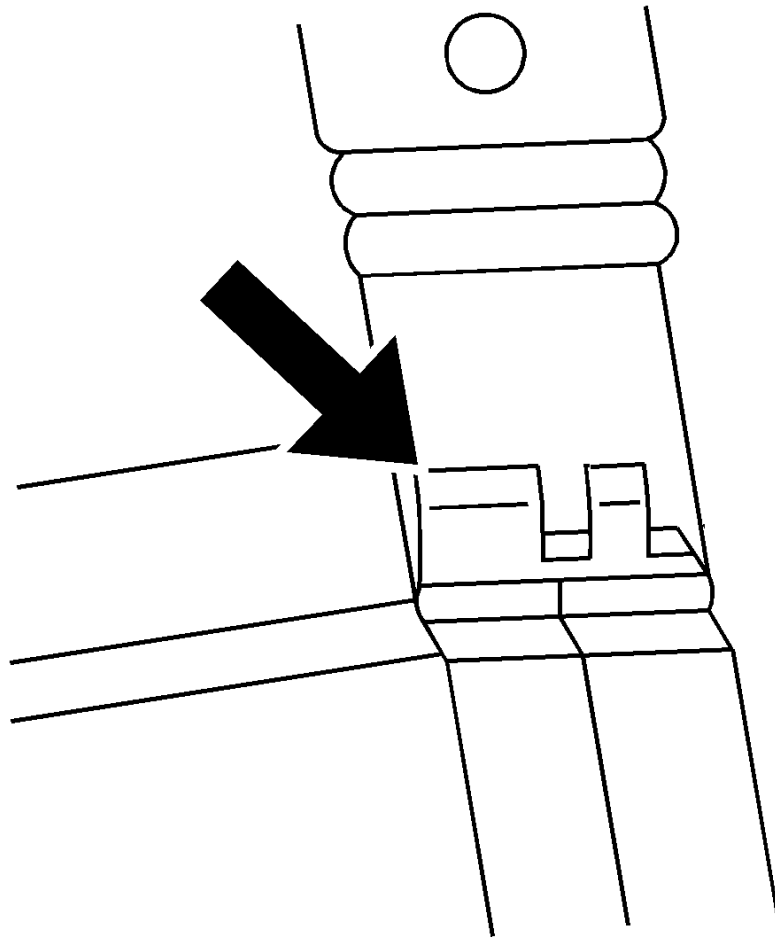


Fig. 204: Identifying Terminal Holder

Courtesy of GENERAL MOTORS COMPANY

4. Insert terminal into the appropriate terminal holder until it hits bottom and stops. The correct terminal holder is determined by the wire size. Also ensure that the terminal's wings are pointing towards the former on the tool and the release locator.
5. Insert the stripped cable into the terminal. Insulation should be visible on both sides of the terminal insulation wings.
6. Compress the handles until the ratchet automatically releases.
7. Place the terminal into the appropriate cavity and assemble the connector.

TERMINAL REMOVAL

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **EL-35616** Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

NOTE: All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repair procedures.

1. Find the appropriate connector end view within the connector end view section. The connector end view has the following information:
 - Diagnostic probe tool
 - Terminal release tool
 - Terminal/terminated lead part numbers

NOTE: Not using the proper test kit probe may cause damage to the terminal(s) that are probed.

2. Determine if a terminal is damaged.
 1. Locate the diagnostic probe tool from the connector end view. The connector end view describes the color and part number to help the technician find and use the correct tool.
 2. Connect the probe tool to the Digital Multimeter.
 3. Insert the probe tool into the cavity and follow the procedures from the [Troubleshooting with a Digital Multimeter](#) .
3. Disconnect the connector body to perform the repair.
4. Use the following procedure to remove the terminal from the connector body.

NOTE: Several procedures for specific connector bodies are called out in the Wiring Repairs section.

1. The terminal position assurance (TPA) and connector position assurance (CPA) should be removed before releasing the terminal for the connector body.
2. Look at the connector end view to locate the cavity of the damaged terminal and find the proper terminal release tool from the terminal release tool kit.

NOTE: Using the incorrect terminal release tool can damage the connector body.

NOTE: Some terminals have a lever that must be disengaged before the terminal can be released.

3. Insert the terminal release tool into the cavity.

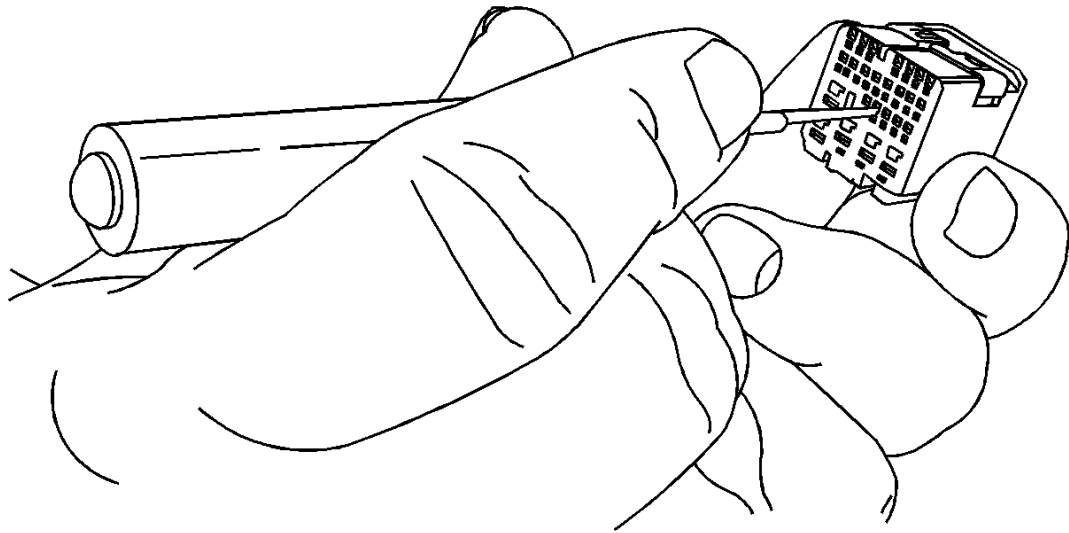


Fig. 205: Gently Pulling Wire Out Of Back Of Connector

Courtesy of GENERAL MOTORS COMPANY

5. Gently pull the wire out of the back of the connector.
6. Repair the terminal by following the [Repairing Connector Terminals \(Terminated Lead Repair\)](#)[Repairing Connector Terminals \(Terminal Repair\)](#) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

RELAY REPLACEMENT (ATTACHED TO WIRE HARNESS)

Removal Procedure

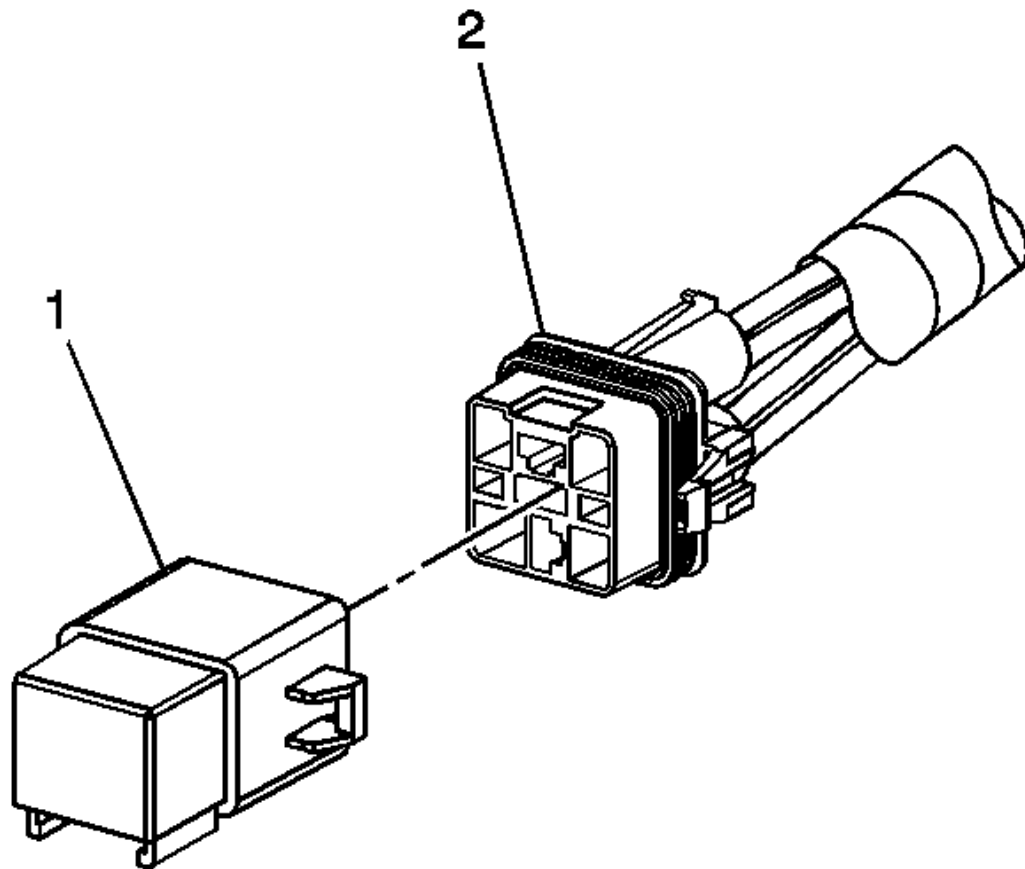


Fig. 206: Identifying Relay & Wire Harness Connector

Courtesy of GENERAL MOTORS COMPANY

1. Locate the relay. Refer to the [Master Electrical Component List](#) to locate the relay in the vehicle.
2. Remove any fasteners which hold the relay in place.
3. Remove any connector position assurance (CPA) devices or secondary locks.

NOTE: Use care when removing a relay in a wiring harness when the relay is secured by fasteners or tape.

4. Separate the relay (1) from the wire harness connector (2).

Installation Procedure

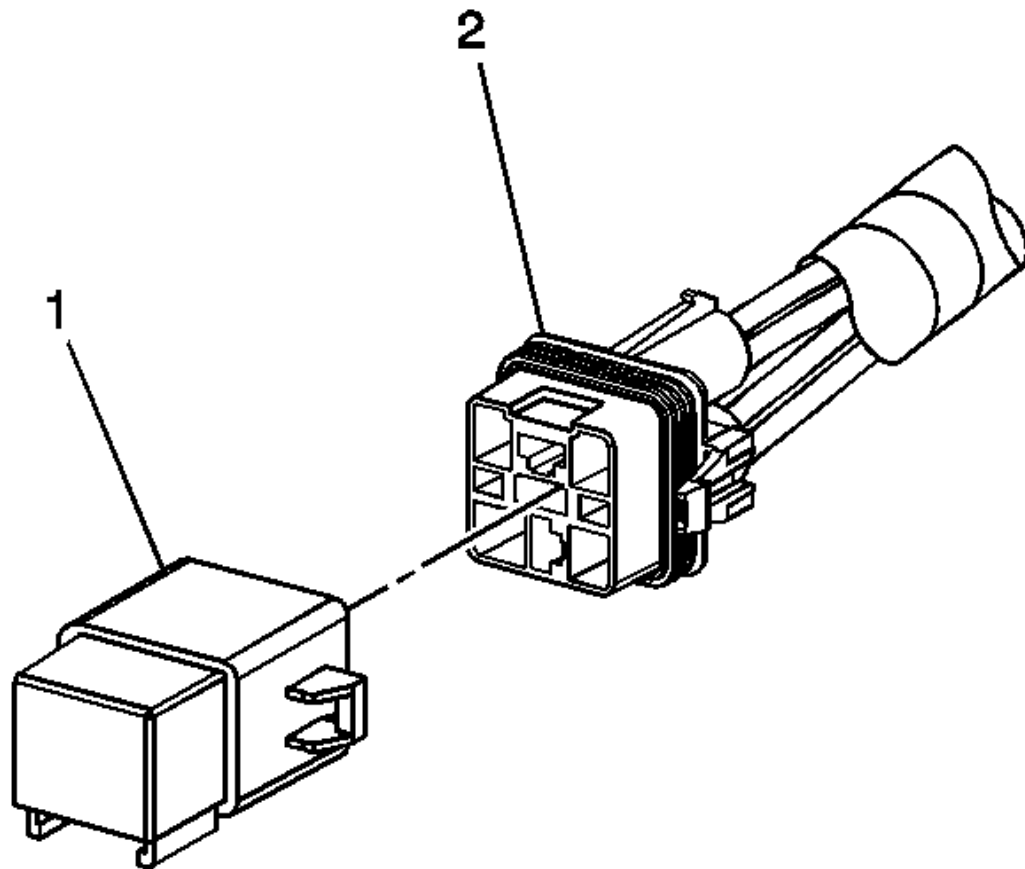


Fig. 207: Identifying Relay & Wire Harness Connector

Courtesy of GENERAL MOTORS COMPANY

1. Connect the relay (1) to the wire harness connector (2).
2. Install any connector position assurance (CPA) devices or secondary locks.
3. Install the relay using any fasteners or tape that originally held the relay in place.

RELAY REPLACEMENT (WITHIN AN ELECTRICAL CENTER)

Special Tools

EL-43244 Relay Puller Pliers

Removal Procedure

1. Remove the electrical center cover.

NOTE:

- Always note the orientation of the relay.
- If equipped with a notch style relay; observe the location of the notch on the old relay to verify the new relay is installed with the notch in the same location.

- Ensure that the electrical center is secure, as not to put added stress on the wires or terminals.

2. Locate the relay. Refer to [Electrical Center Identification Views](#) to locate the electrical center where the relay exists.

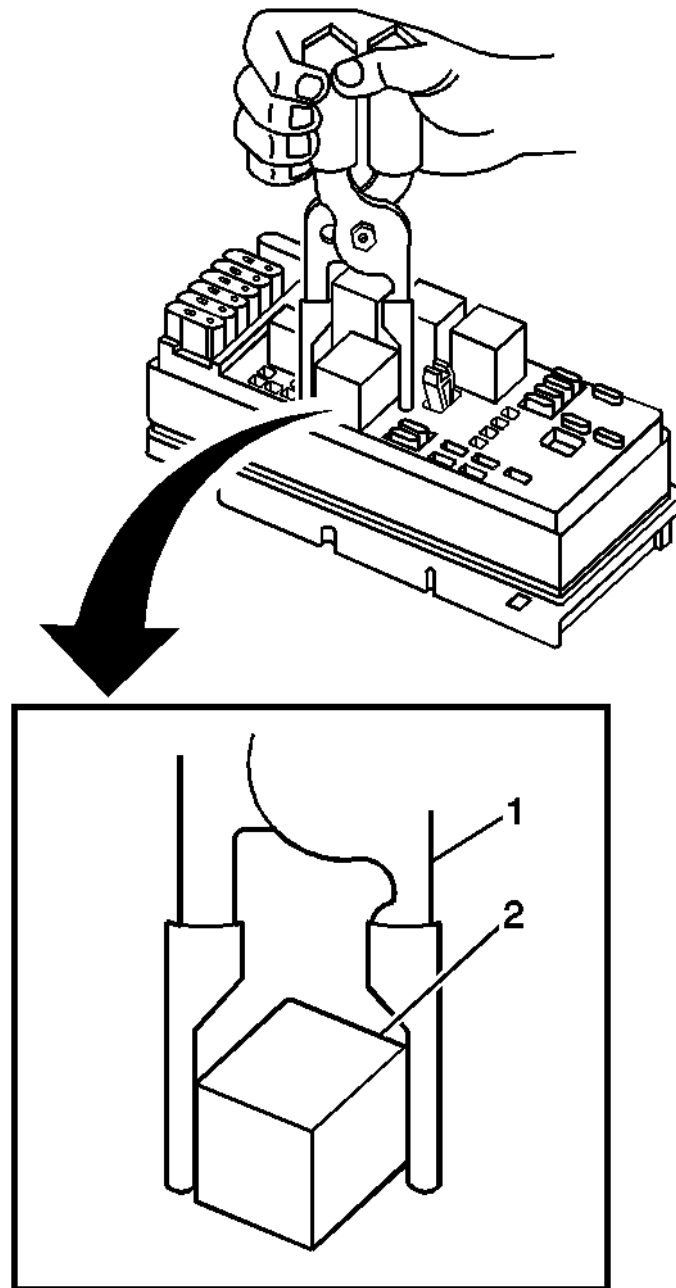


Fig. 208: Identifying Relay & Special Tool

Courtesy of GENERAL MOTORS COMPANY

3. Using the EL-43244 (1) position the tool on opposing corners of the relay (2).

CAUTION: Use EL-43244 to pull the relay straight out from the electrical center terminals. The use of pliers or a flat bladed tool could damage the electrical center.

4. Remove the relay (2) from the electrical center.

Installation Procedure

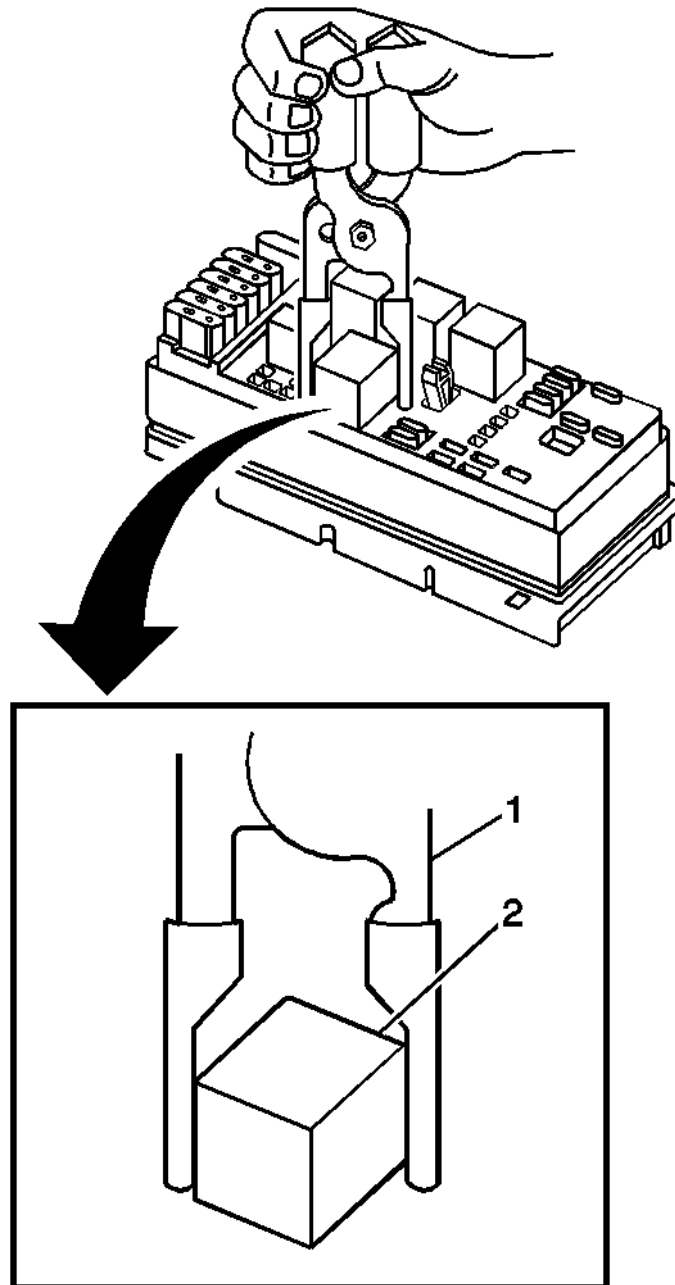


Fig. 209: Identifying Relay & Special Tool
Courtesy of GENERAL MOTORS COMPANY

1. Install the relay (2) in the same position as removed.
2. Install the electrical center cover.

GROUND REPAIR

Electrical Grounds

Proper electrical system function relies on secure, positive, corrosion-free ground connections. Loose, stripped, or corroded connections increase the possibility of improper system function and loss of module communication. These conditions may also lead to unnecessary repairs and component replacements.

In general, electrical ground connections are accomplished using one, or a combination of, three attachment methods:

- Welded M6 stud and nut
- Welded M6 nut and bolt
- Welded M8 nut and bolt

CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

Determine which attachment method is used, and carry out the appropriate repair.

M6 Weld Stud Replacement

1. Select a location adjacent the damaged or missing M6 ground stud having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the M6 rivet stud flange.
2. Using GM approved residue-free solvent or equivalent, remove any grease from the repair site and allow to dry.

NOTE: Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.

3. Drill a 10 mm (0.40 in) diameter hole through the panel.
4. Carefully remove paint and primer from the area surrounding the rivet stud flange until bare metal is visible.

CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

5. Select a replacement conductive M6 rivet stud. Reference the GM parts catalog for the correct part number and application.
6. Using a rivet stud installer, install the replacement conductive M6 rivet stud.
7. Ensure the new rivet stud is securely fastened, with no detectable movement.

NOTE: The rivet stud and surrounding panel area must be properly refinished prior to the installation of the ground terminal and nut to maintain positive electrical grounding.

8. Completely wrap the threads of the rivet stud with painters tape or equivalent.
9. Refinish the repair area using an anti-corrosion primer.
10. Allow the refinished repair area to cure sufficiently before removing the protective material applied to the rivet stud threads.
11. Remove the painters tape or equivalent from the rivet stud threads.

12. Using GM approved residue-free solvent or equivalent, thoroughly clean the rivet stud threads to remove any adhesive and allow to dry.
13. Carefully remove any corrosion from the electrical ground wire terminal. [Testing for Intermittent Conditions and Poor Connections](#)
14. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new conductive M6 rivet stud threads.
15. Install the ground terminal to the new rivet stud.
16. Select a new, conductive M6 nut. Reference the GM parts catalog for the correct part number and application.

CAUTION: [Fastener Caution](#)

17. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).
18. Check for proper system operation.

M6 Weld Nut

CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

1. If the M6 weld nut at the electrical ground location is damaged or stripped, a new, conductive self-threading M7 bolt may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding the weld nut and allow to dry.
3. Remove any loose metal particles from the damaged or stripped weld nut with a stiff brush.
4. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive, self-threading M7 bolt threads.
5. Carefully remove any corrosion from the electrical ground terminal. [Testing for Intermittent Conditions and Poor Connections](#)
6. Install the electrical ground terminal to the new, conductive M7 bolt.

CAUTION: [Fastener Caution](#)

7. Install the conductive M7 bolt and tighten to 9 N.m (80 lb in).
8. Check for proper system operation.

M6 Weld Nut (Alternative Repair)

CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

1. If the electrical ground location is accessible from both sides of the panel, a conductive M6 bolt and a conductive M6 nut may be used to secure the electrical ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent the damaged M6 weld nut having 20 mm (0.79) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new electrical ground site.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding

the ground location and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the new ground site until bare metal is visible.
6. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive M6 bolt threads.
7. Carefully remove any corrosion from the electrical ground terminal. Testing for Intermittent Conditions and Poor Connections
8. Install the electrical ground terminal and new, conductive M6 bolt to the ground location.

CAUTION: **Fastener Caution**

9. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).

NOTE: **The repair area must be properly refinished to maintain positive electrical grounding.**

10. Refinish the repair area using an anti-corrosion primer.
11. Check for proper system operation.

M8 Weld Nut

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. If the M8 weld nut electrical ground location is accessible from both sides of the panel, a conductive M8 bolt and a conductive M8 nut may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent to M8 weld nut having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new electrical ground site.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding the ground location and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the new ground site until bare metal is visible.
6. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive M8 bolt threads.
7. Carefully remove any corrosion from the electrical ground terminal. Testing for Intermittent Conditions and Poor Connections
8. Install the electrical ground terminal and new, conductive M8 bolt to the ground location.

CAUTION: Fastener Caution

9. Install the conductive M8 nut and tighten to 22 N.m (16 lb ft).

NOTE: **The repair area must be properly refinished to maintain positive electrical grounding.**

10. Refinish the repair area using an anti-corrosion primer.

11. Check for proper system operation.

M8 Weld Nut (Alternative Repair)

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. If the M8 weld nut electrical ground location is not accessible from both sides of the panel, a conductive M6 rivet stud and a conductive M6 nut may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent the damaged M8 weld nut having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new, conductive M6 rivet stud flange.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the repair site and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the rivet stud flange until bare metal is visible.
6. Using a rivet stud installer, install the replacement conductive M6 rivet stud.
7. Ensure the new rivet stud is securely fastened, with no detectable movement.

NOTE: **The rivet stud and surrounding panel area must be properly refinished prior to the installation of the ground terminal and nut to maintain positive electrical grounding.**

8. Completely wrap the threads of the rivet stud with painters tape or equivalent.
9. Refinish the repair area using an anti-corrosion primer.
10. Allow the refinished repair area to cure sufficiently before removing the protective material applied to the rivet stud threads.
11. Remove the painters tape or equivalent from the rivet stud threads.
12. Using GM approved residue-free solvent or equivalent, thoroughly clean the rivet stud threads to remove any adhesive and allow to dry.
13. Carefully remove any corrosion from the electrical ground wire terminal. Testing for Intermittent Conditions and Poor Connections
14. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new conductive M6 rivet stud threads.

15. Install the ground terminal to the new, conductive M6 rivet stud.

CAUTION: Fastener Caution

16. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).

17. Check for proper system operation.

Securing Loose Electrical Ground Connections

If the electrical ground connection is loose and the ground attachments are not damaged, properly securing the loose electrical ground may be all that is necessary. Carry out the following procedure to secure loose electrical ground connections.

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. Using GM approved residue-free solvent or equivalent, thoroughly clean the ground stud threads and allow to dry.
2. Carefully remove any corrosion from the electrical ground wire terminal. Testing for Intermittent Conditions and Poor Connections
3. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the ground stud threads.
4. Install the ground wire terminal to the ground stud.

CAUTION: Fastener Caution

5. Install the appropriate conductive nut.
 - Conductive M6 nut: Tighten to 8 N.m (71 lb in)
 - Conductive M8 nut: Tighten to 22 N.m (16 lb ft)
 - Conductive M10 nut: Tighten to 45 N.m (33 lb ft)
6. Check for proper system operation.

FUSE BLOCK REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury

or death.

Preliminary Procedures

1. High Voltage Disabling .
2. Battery Negative Cable Disconnection and Connection
3. Rear Compartment Floor Stowage Trim Compartment Replacement

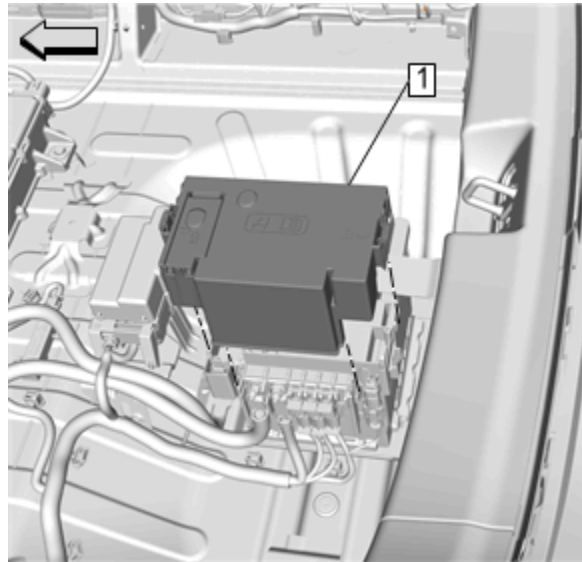


Fig. 210: Fuse Block Cover

Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuse Block Cover(1)

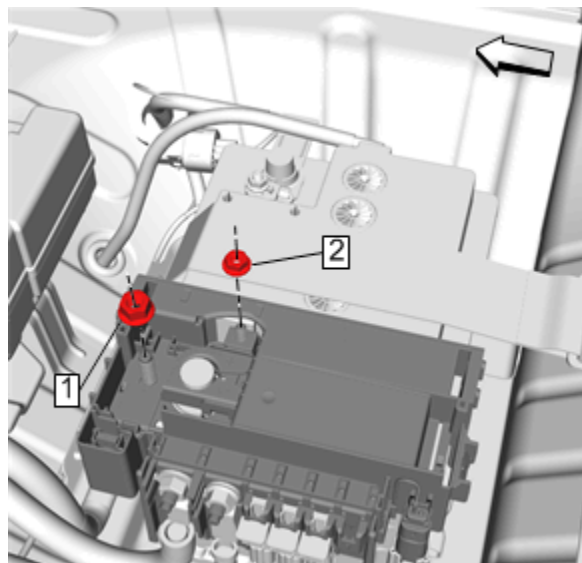


Fig. 211: Fuse Block Terminal Hold Down Nut

Courtesy of GENERAL MOTORS COMPANY

5. Remove Fuse Block Terminal Hold Down Nut (1) and (2)

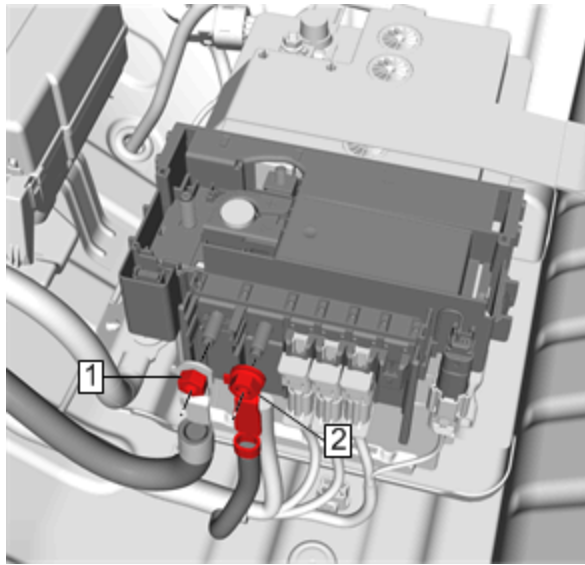


Fig. 212: Battery Positive Cable Junction Block Nut And Body Wiring Harness Nut
Courtesy of GENERAL MOTORS COMPANY

6. Remove Battery Positive Cable Junction Block Nut (1) and Body Wiring Harness Nut (2)

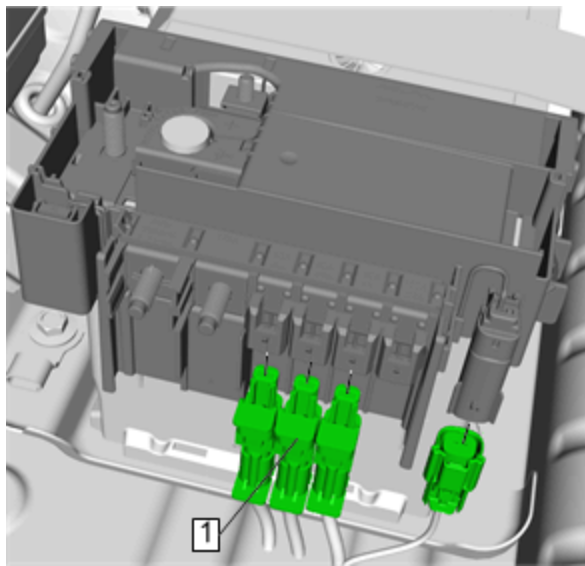


Fig. 213: Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect all electrical connectors.(1)

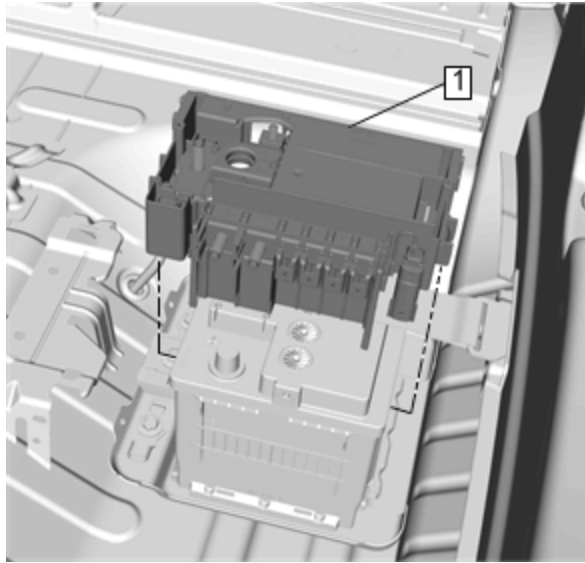


Fig. 214: Fuse Block

Courtesy of GENERAL MOTORS COMPANY

8. Remove Fuse Block(1)

Installation Procedure

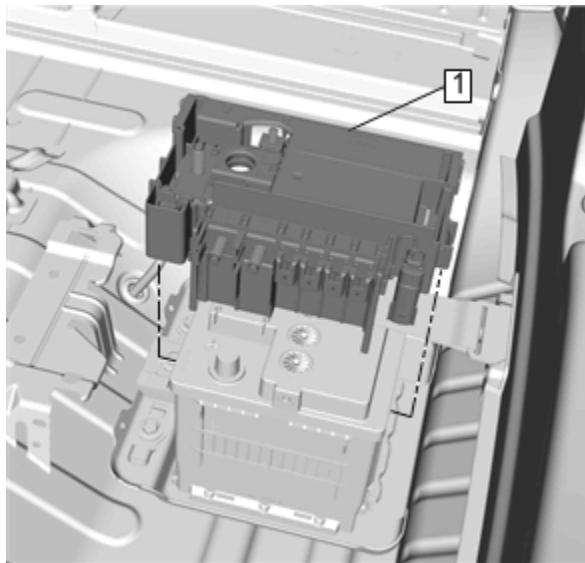


Fig. 215: Fuse Block

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuse Block(1)

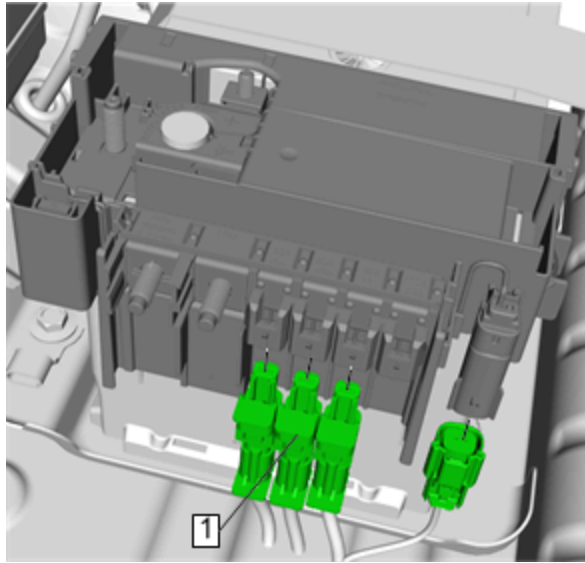


Fig. 216: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Connect all electrical connectors.

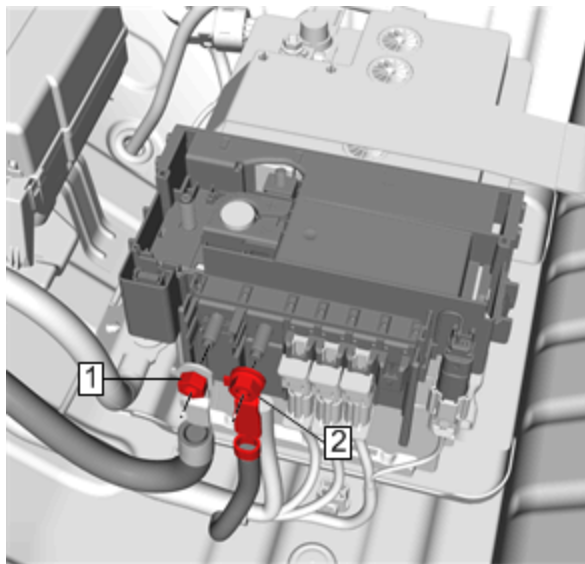


Fig. 217: Battery Positive Cable Junction Block Nut And Body Wiring Harness Nut

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Battery Positive Cable Junction Block Nut (1) and tighten 15 N.m (11 lb ft)
4. Install Body Wiring Harness Nut (2) and tighten 15 N.m (11 lb ft)

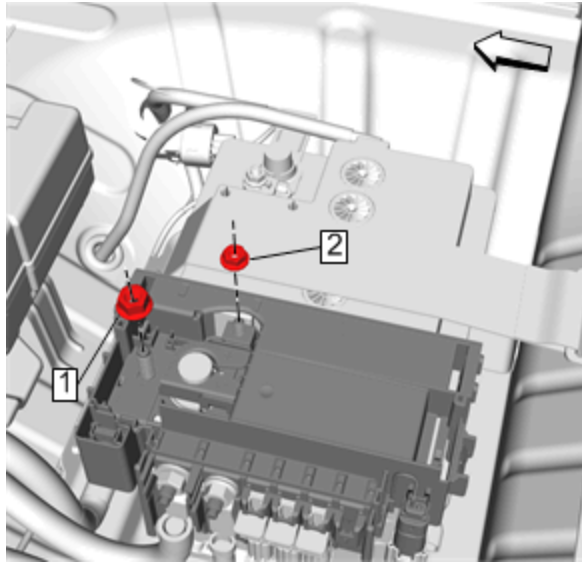


Fig. 218: Fuse Block Terminal Hold Down Nut
Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Post Clamp Nut (2) and tighten 9 N.m (80 lb in)
6. Install Battery Positive Cable Junction Block Nut (1) and tighten 15 N.m (11 lb ft)

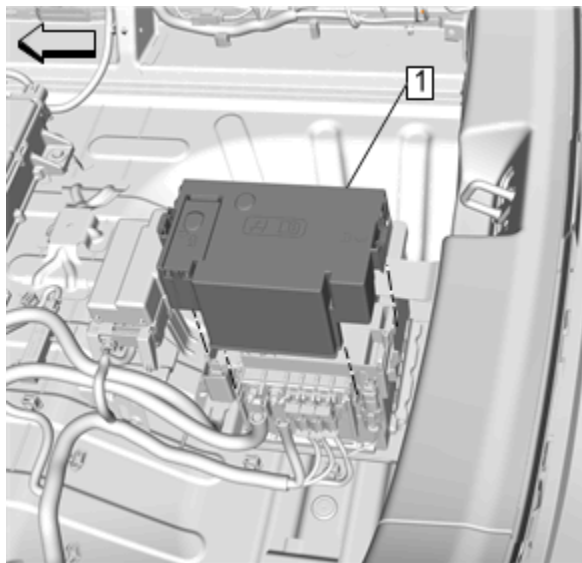


Fig. 219: Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

7. Install Fuse Block Cover(1)
8. **Battery Negative Cable Disconnection and Connection**
9. **Rear Compartment Floor Stowage Trim Compartment Replacement**
10. **High Voltage Enabling**

IGNITION AND START SWITCH REPLACEMENT

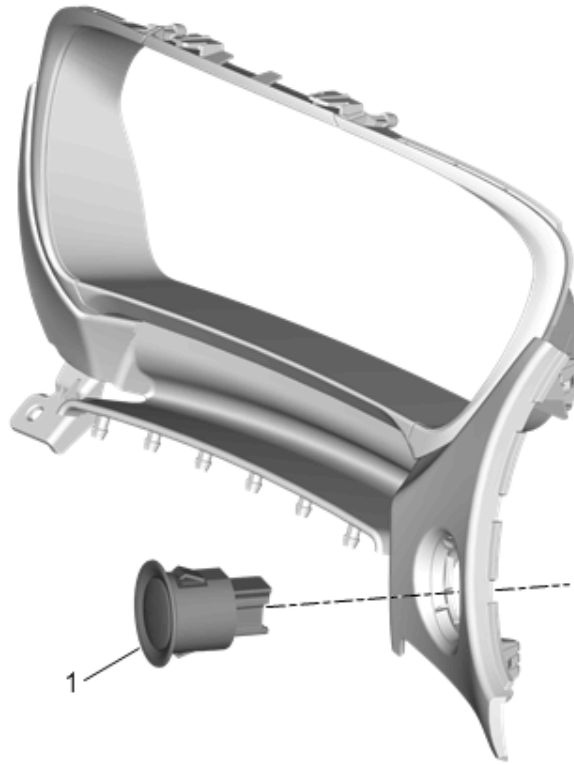


Fig. 220: Ignition and Start Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Instrument Panel Cluster Trim Plate Replacement</u>	
1	Ignition and Start Switch Procedure 1. Disconnect the electrical connector. 2. Release the retaining tabs and remove the ignition and start switch from the trim piece.

Article GUID: A00884670

ELECTRICAL

Wiring Systems and Power Management - Schematic and Routing Diagrams - Volt

SCHEMATIC WIRING DIAGRAMS

HARNESS ROUTING VIEWS

Front Fascia Harness Routing

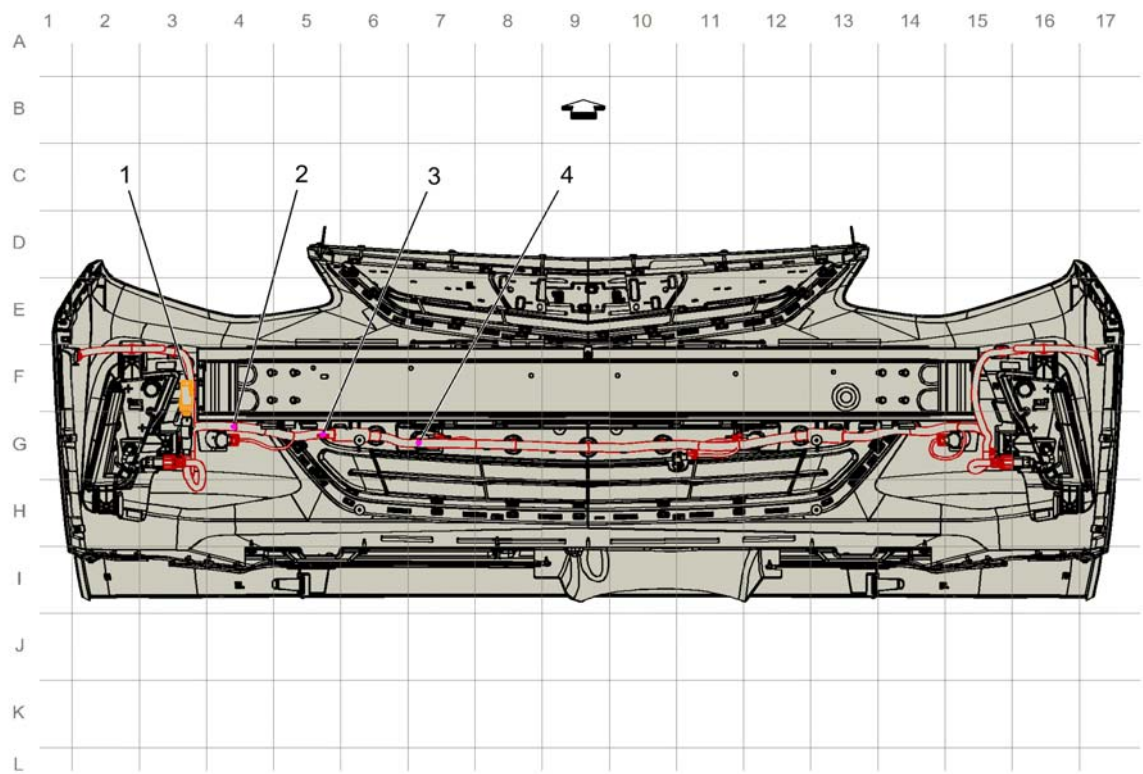


Fig. 1: Front Fascia Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. X100 <u>X100 Forward Lamp Harness to Front Fascia Harness (-UFQ)</u> <u>X100 Forward Lamp Harness to Front Fascia Harness (UFQ)</u>
2. J115
3. J101
4. J100
Â

Front of Engine Compartment Harness Routing

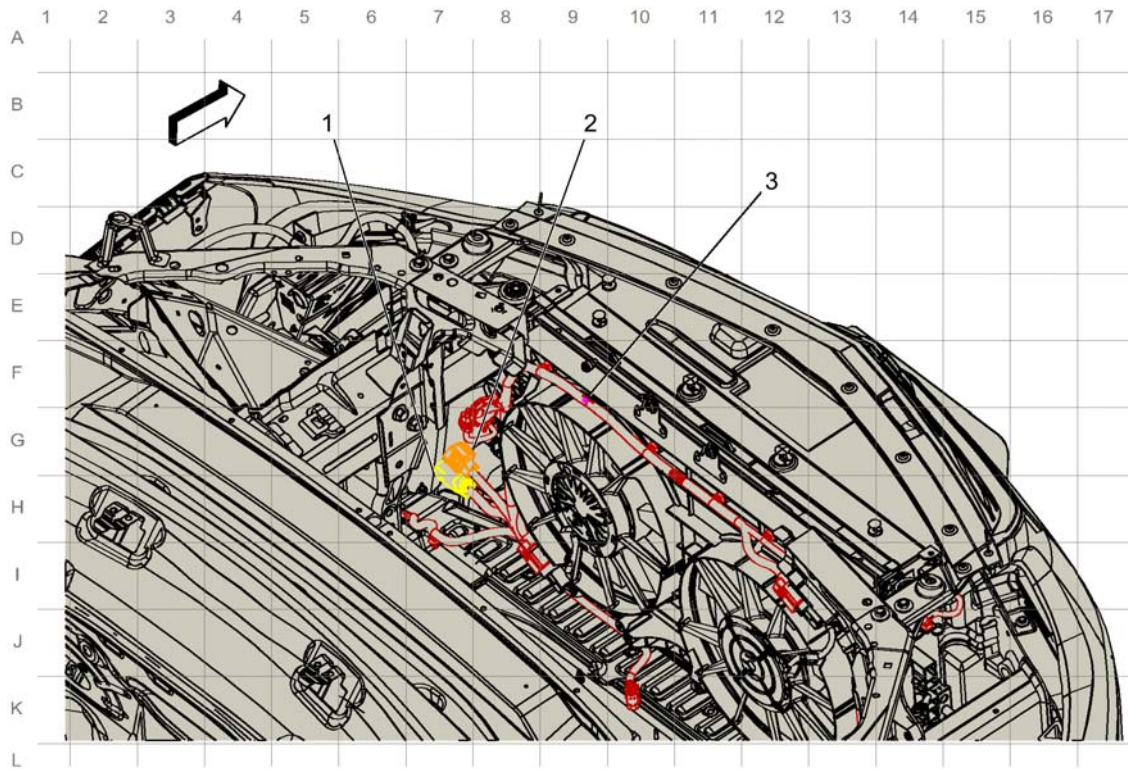


Fig. 2: Front of Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X102	<u>X102 Forward Lamp Harness to Cooling Fan Harness</u>
2. X104	<u>X104 Cooling Fan Harness to Forward Lamp Harness</u>
3. J110	

Forward Lamp Harness Routing

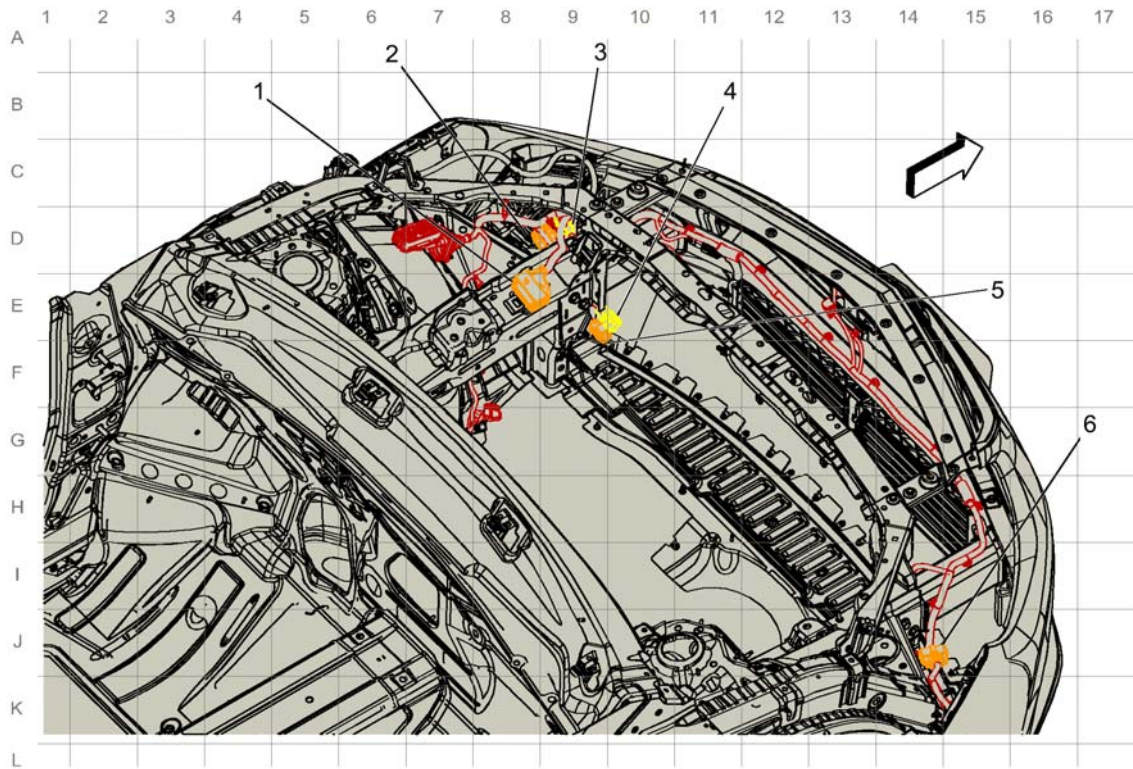


Fig. 3: Forward Lamp Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. X107 <u>X107 Forward Lamp Harness to Body Harness</u>
2. X110 <u>X110 Body Harness to Left Headlamp Harness</u>
3. X100 <u>X100 Forward Lamp Harness to Front Fascia Harness (-UFQ)</u> <u>X100 Forward Lamp Harness to Front Fascia Harness (UFQ)</u>
4. X104 <u>X104 Cooling Fan Harness to Forward Lamp Harness</u>
5. X102 <u>X102 Forward Lamp Harness to Cooling Fan Harness</u>
6. X120 <u>X120 Body Harness to Right Headlamp Harness</u>

Left Side of Engine Compartment Harness Routing

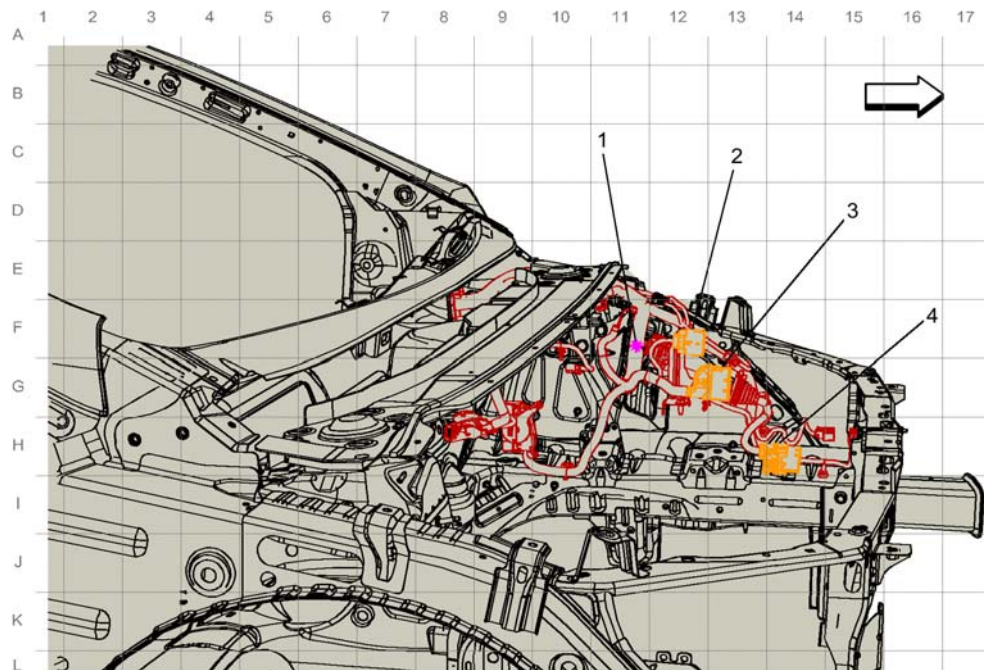


Fig. 4: Left Side of Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. J139 X155 <u>X155 Engine Harness to Body Harness</u>
2. X190 <u>X190 Engine Harness to Body Harness</u>
3. X107 <u>X107 Forward Lamp Harness to Body Harness</u>

Left of Engine Compartment Harness Routing

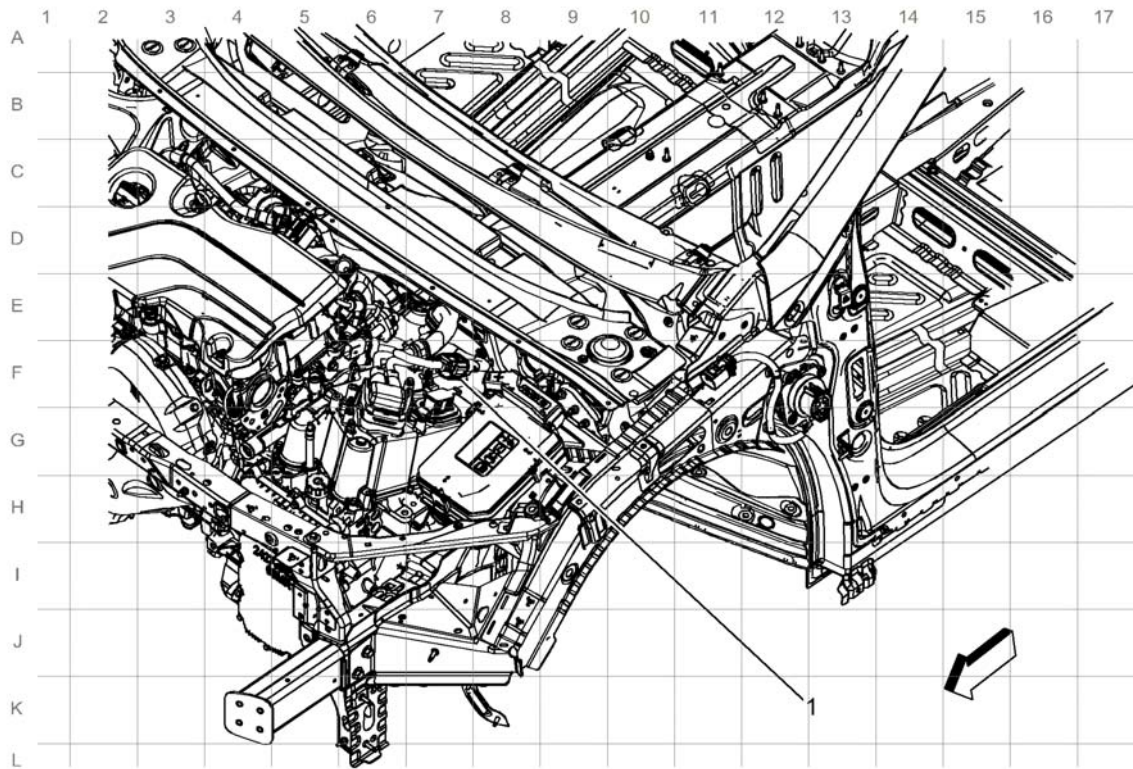


Fig. 5: Left of Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X130	<u>X130 Battery Cable Harness to Battery Cable Harness</u>

Right Side of Engine Compartment Harness Routing

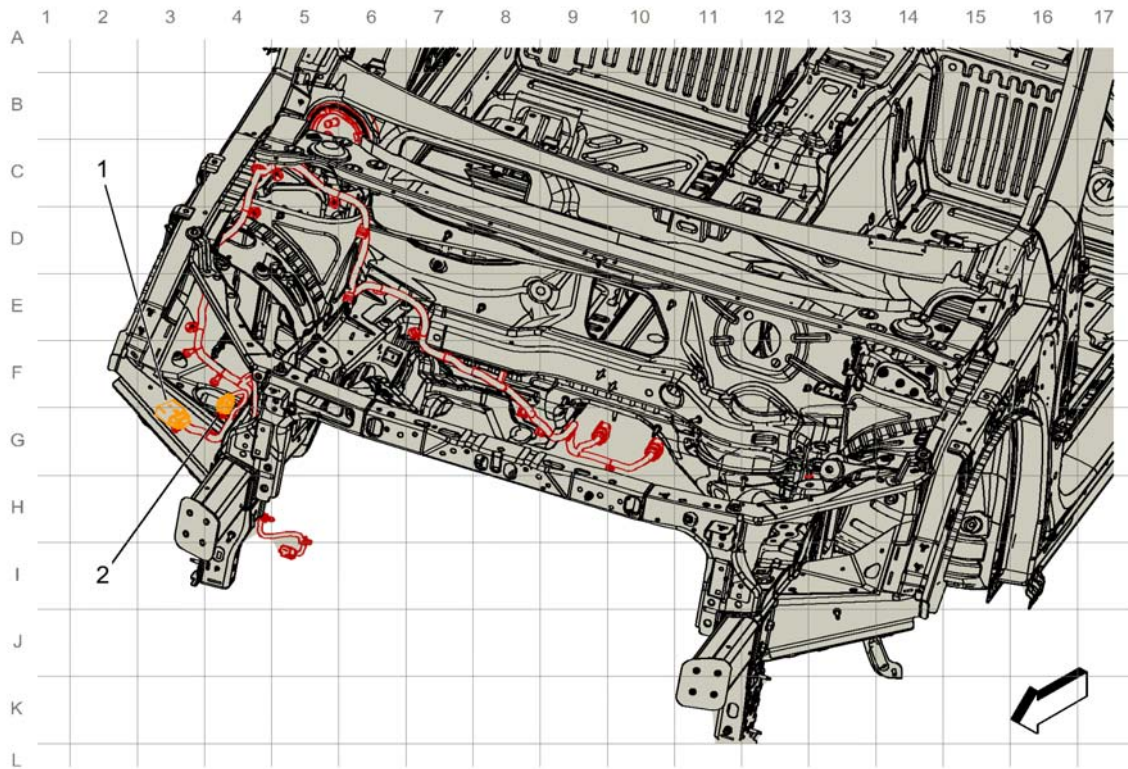


Fig. 6: Right Side of Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X121	<u>X121 Forward Lamp Harness to Body Harness</u>
2. X120	<u>X120 Body Harness to Right Headlamp Harness</u>

Engine Harness Routing

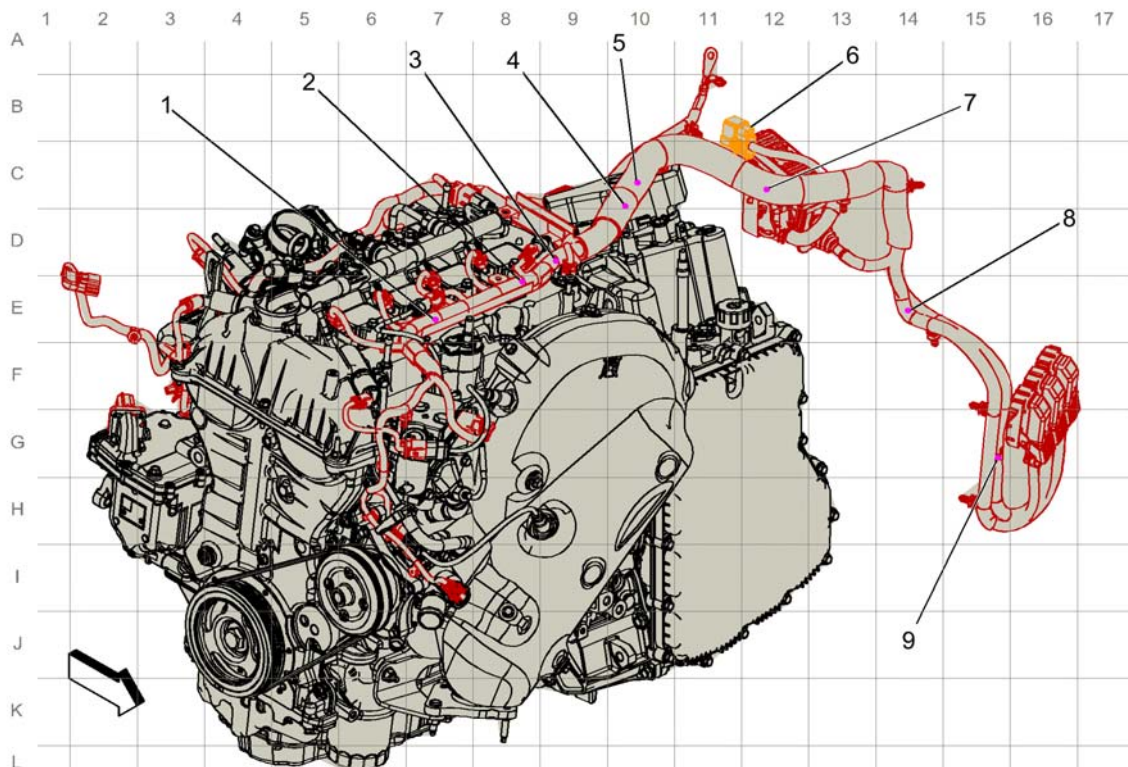


Fig. 7: Engine Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items
1. J131 (NU6)
2. J127
3. J125
4. J128
5. J129
6. X155 <u>X155 Engine Harness to Body Harness</u>
7. J135
8. J136
9. J137

Right Side of Engine Harness Routing

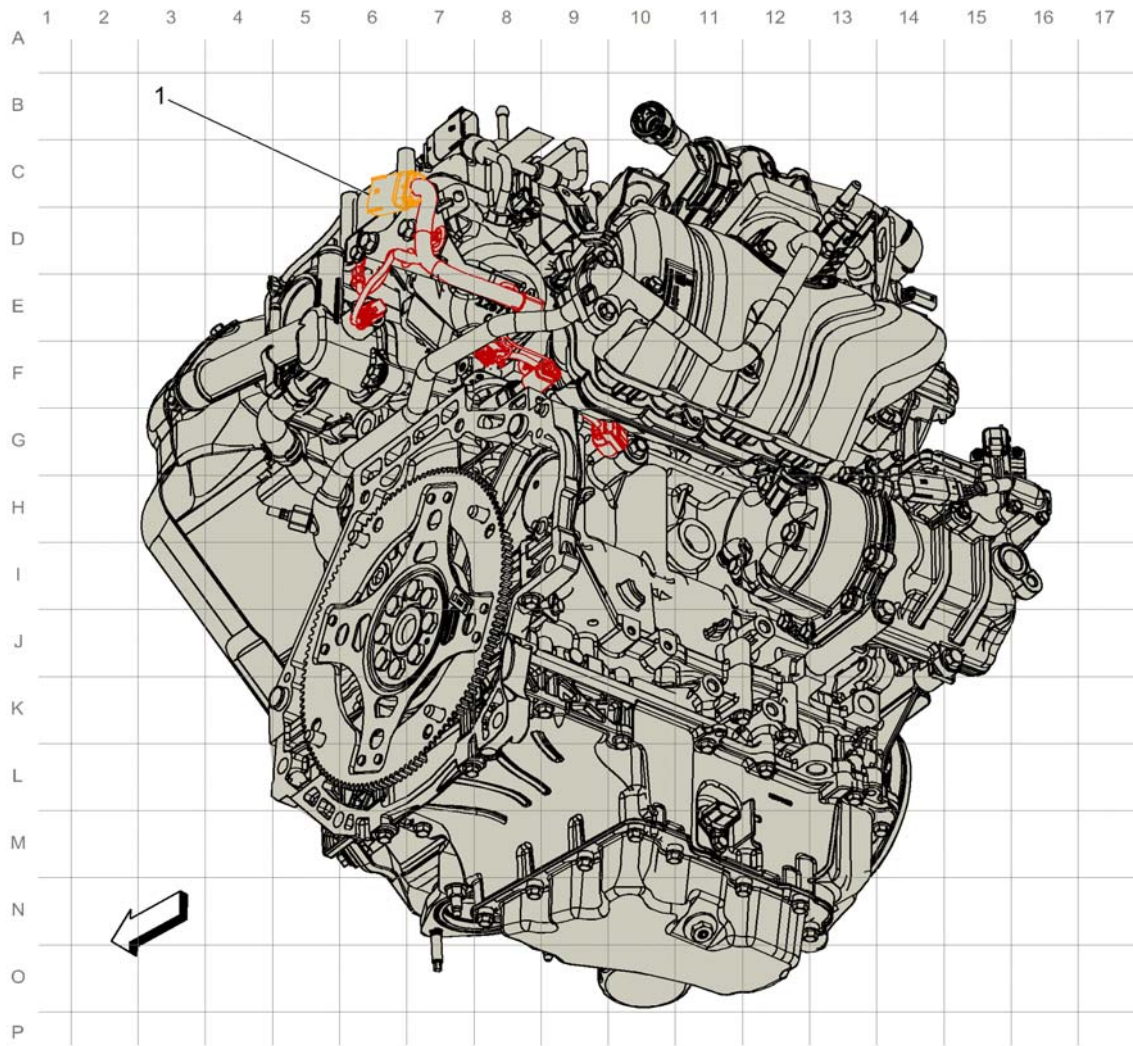


Fig. 8: Right Side of Engine Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. X150 <u>X150 Engine Harness to Engine Jumper Harness</u>

Instrument Panel Harness Routing

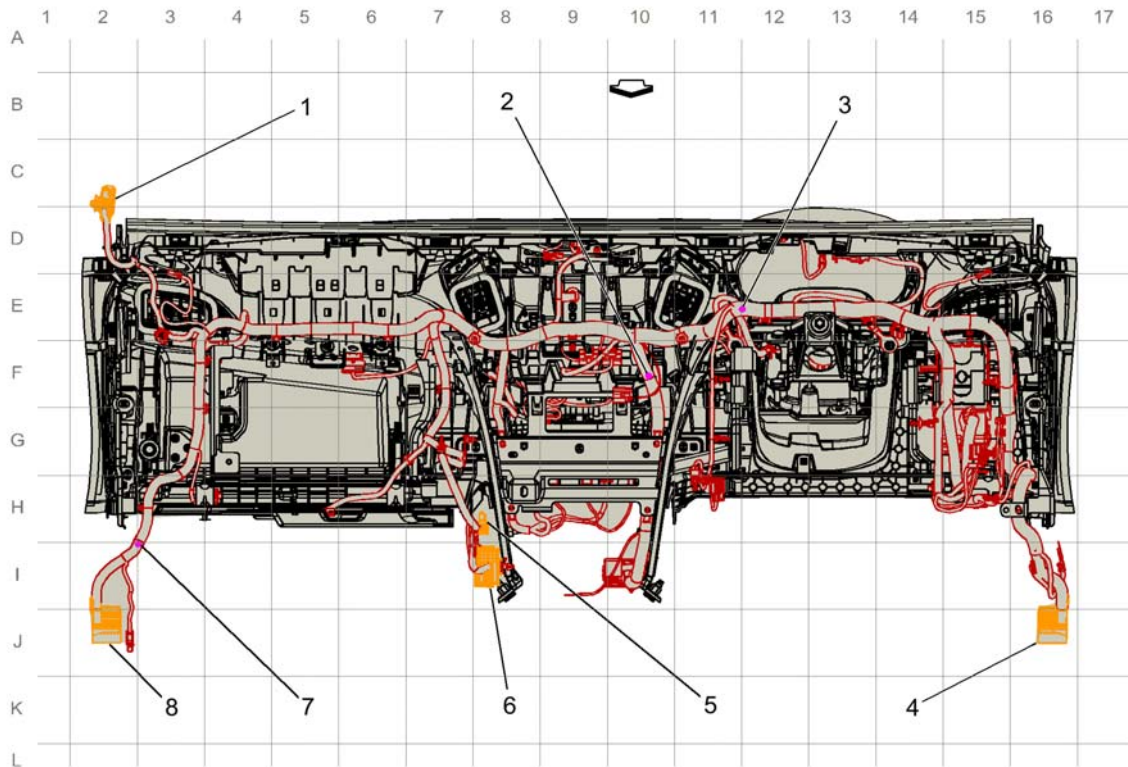


Fig. 9: Instrument Panel Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. X325 <u>X325 Headliner Harness to Instrument Panel Harness</u>
2. J303
3. J221
4. X225 <u>X225 Instrument Panel Harness to Body Harness</u>
5. X316 <u>X316 Instrument Panel Harness to Floor Console Harness</u>
6. X315 <u>X315 Floor Console Harness to Instrument Panel Harness</u>
7. J232
8. X275 <u>X275 Instrument Panel Harness to Body Harness</u>

Headliner Harness Routing

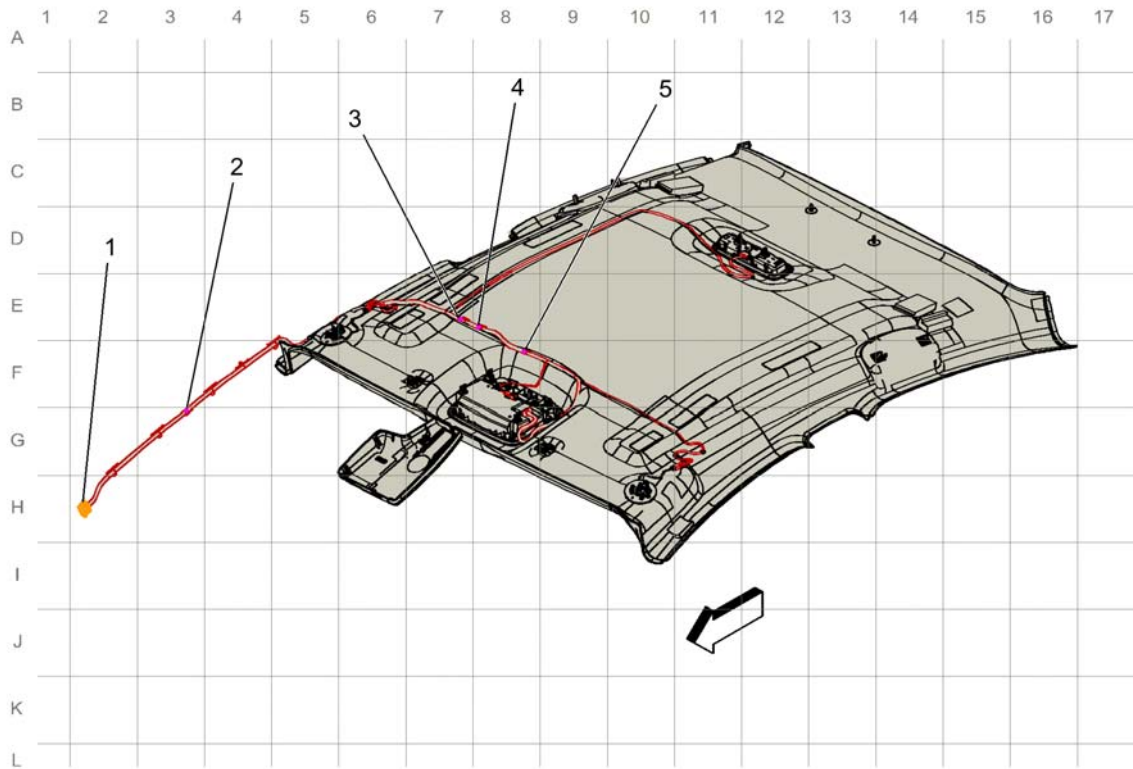


Fig. 10: Headliner Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items
1. X325 <u>X325 Headliner Harness to Instrument Panel Harness</u>
2. J352
3. J354
4. J351
5. J353

Roof Airbag Harness Routing

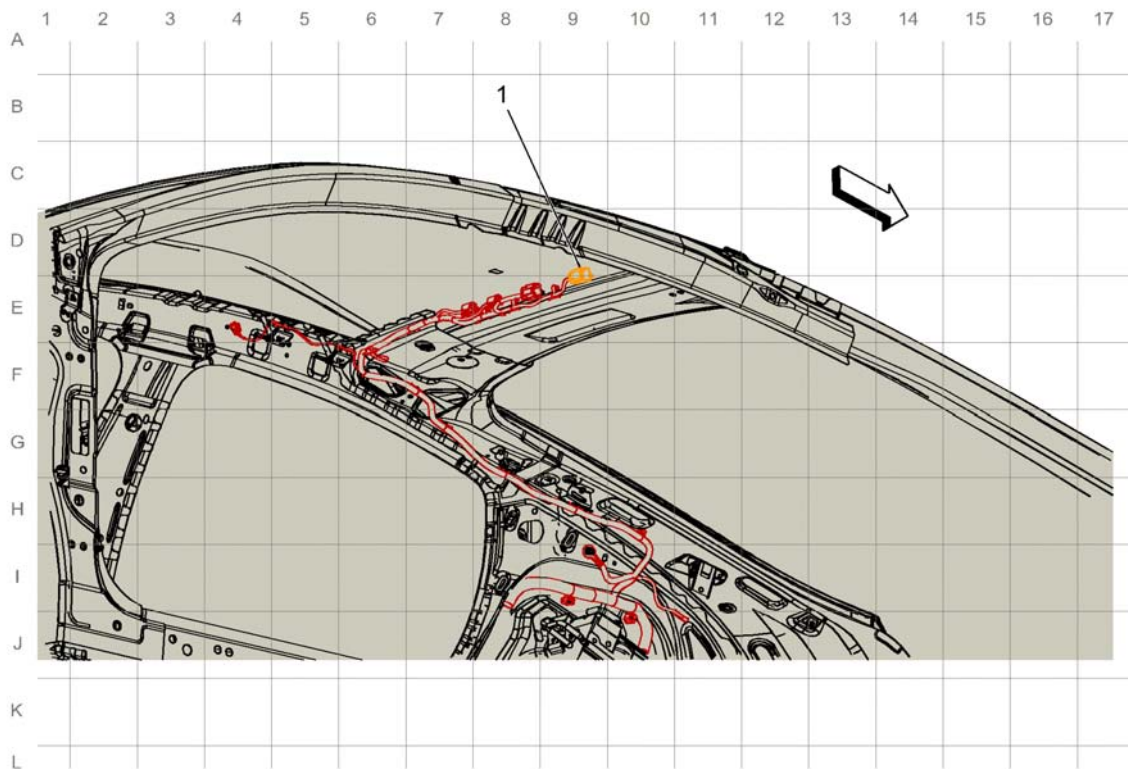


Fig. 11: Roof Airbag Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items	
1. X900	<u>X900 Liftgate Jumper Harness to Body Harness</u>

Left Front Door Harness Routing

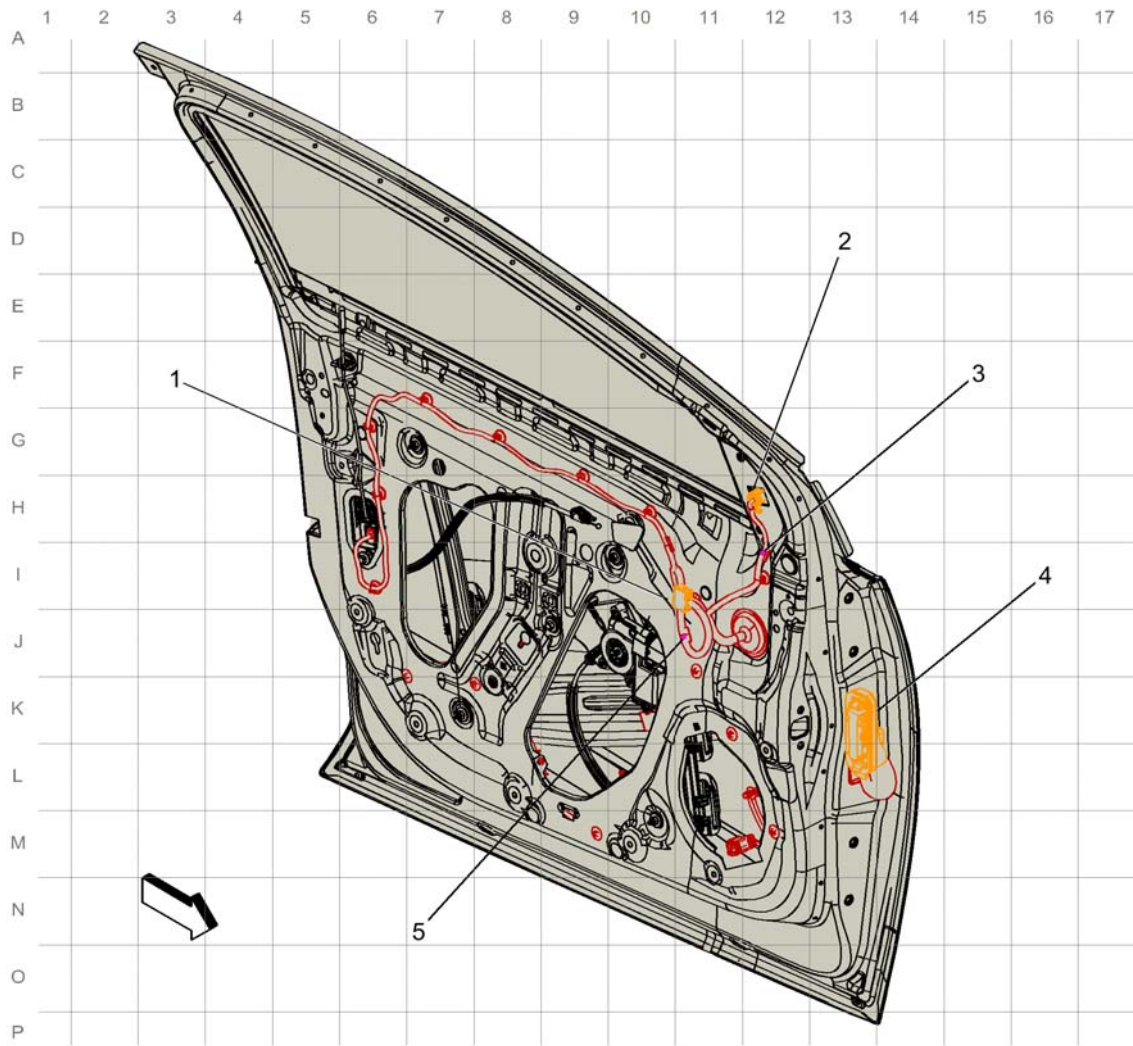


Fig. 12: Left Front Door Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. X505 <u>X505 Driver Door Harness to Driver Door Trim Harness</u>
2. X510 <u>X510 Driver Door Harness to Outside Rear View Mirror Harness</u>
3. J515
4. X500 <u>X500 Driver Door Harness to Body Harness</u>
5. J514

Left Front Door Trim Harness Routing

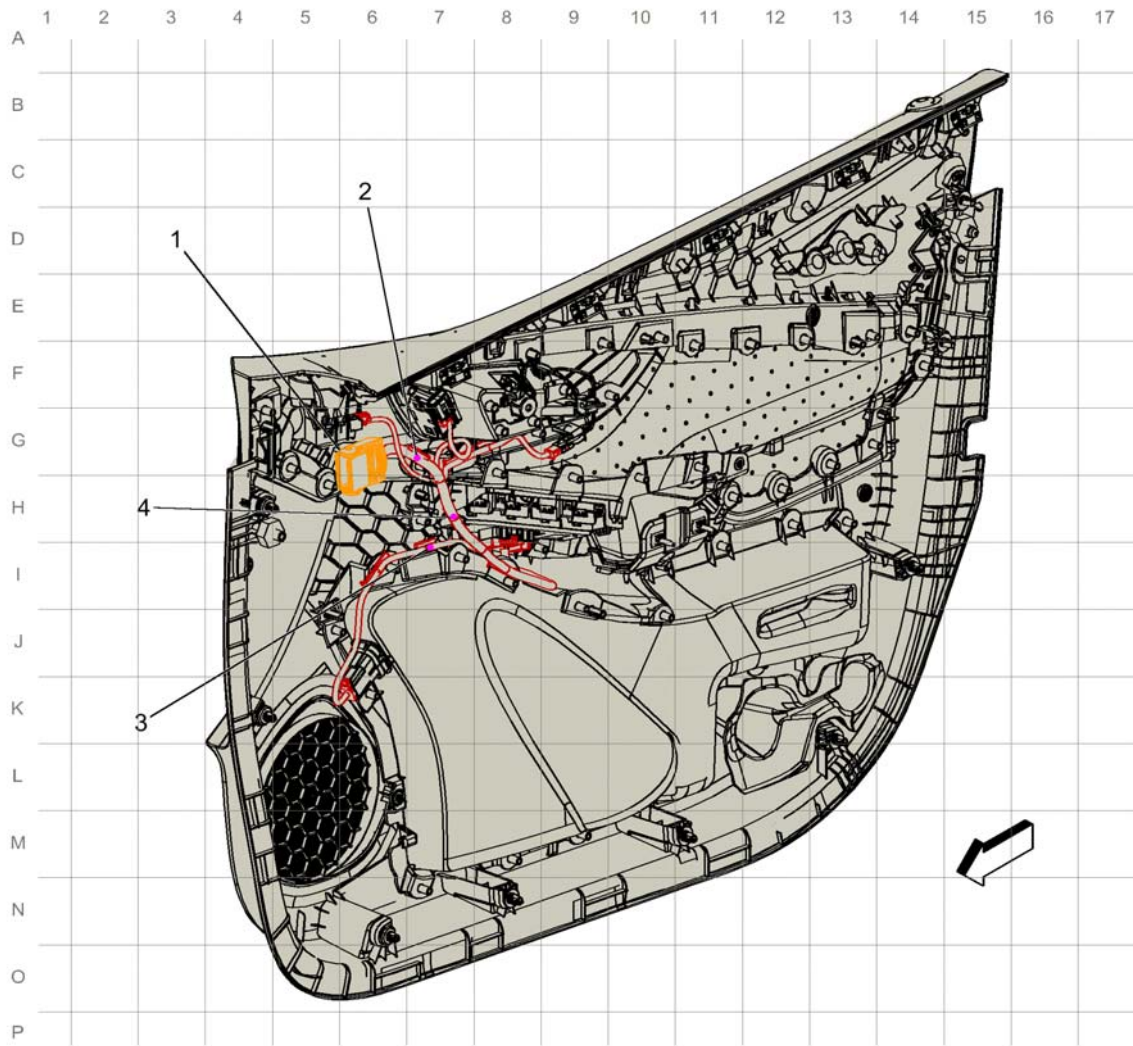


Fig. 13: Left Front Door Trim Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. X505 <u>X505 Driver Door Harness to Driver Door Trim Harness</u>
2. J517
3. J519
4. J518

Right Front Door Harness Routing

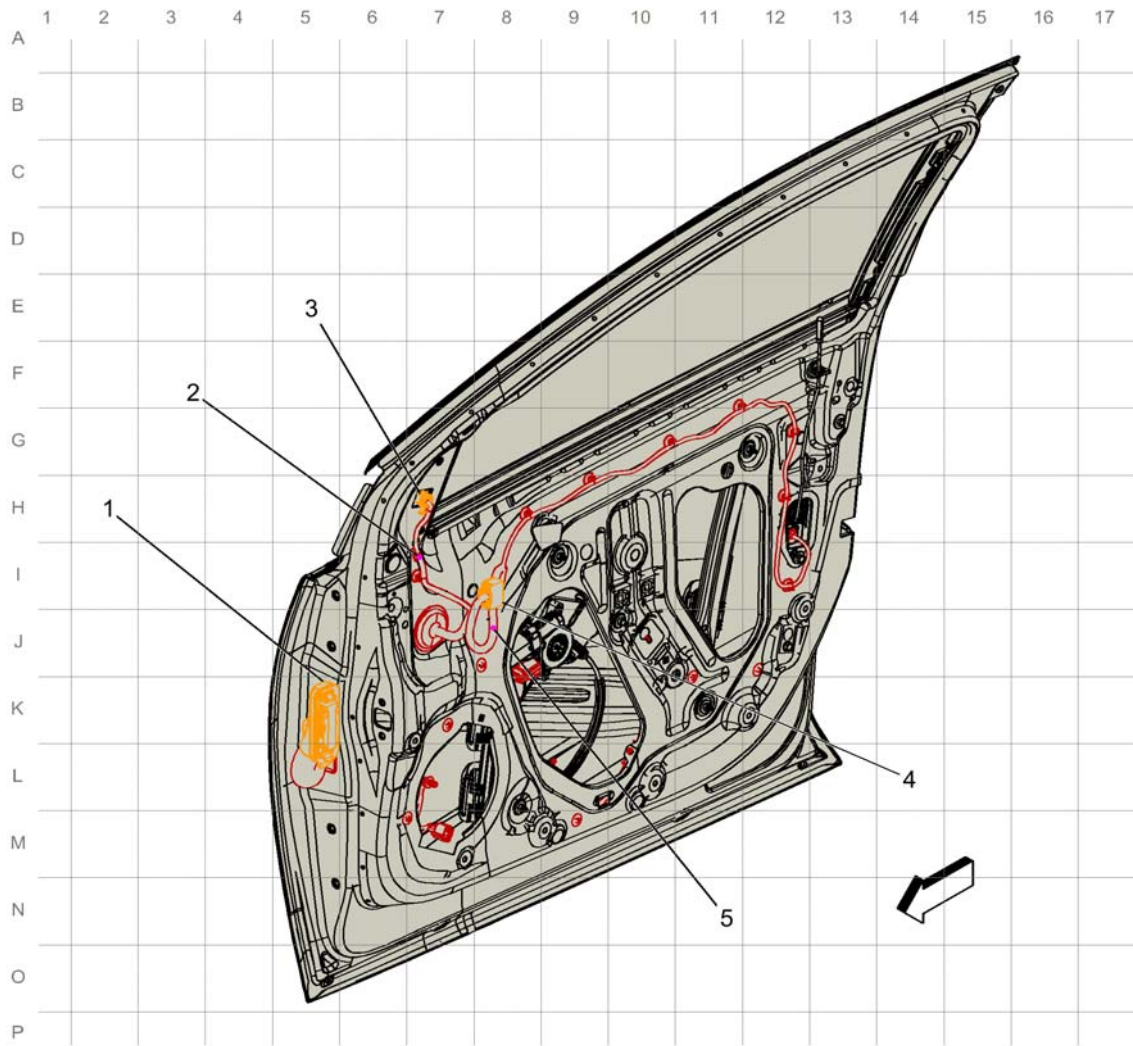


Fig. 14: Right Front Door Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. X600 <u>X600 Passenger Door Harness to Body Harness</u>
2. J615
3. X610 <u>X610 Passenger Door Harness to Outside Rear View Mirror Harness</u>
4. X605 <u>X605 Passenger Door Harness to Passenger Door Trim Harness</u>
5. J611

Right Front Door Trim Harness Routing

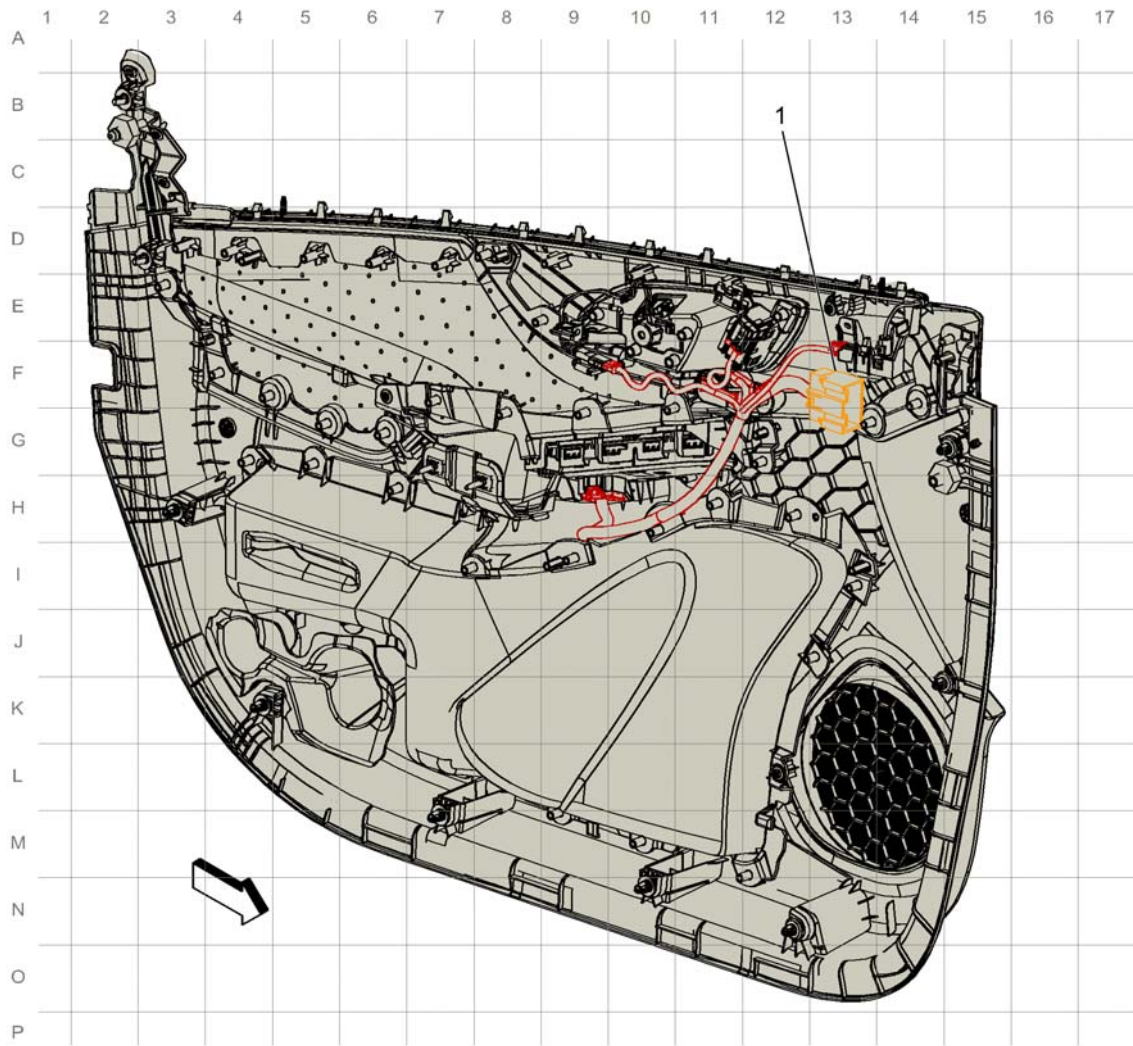


Fig. 15: Right Front Door Trim Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items	
1. X605	<u>X605 Passenger Door Harness to Passenger Door Trim Harness</u>

Left Rear Door Harness Routing

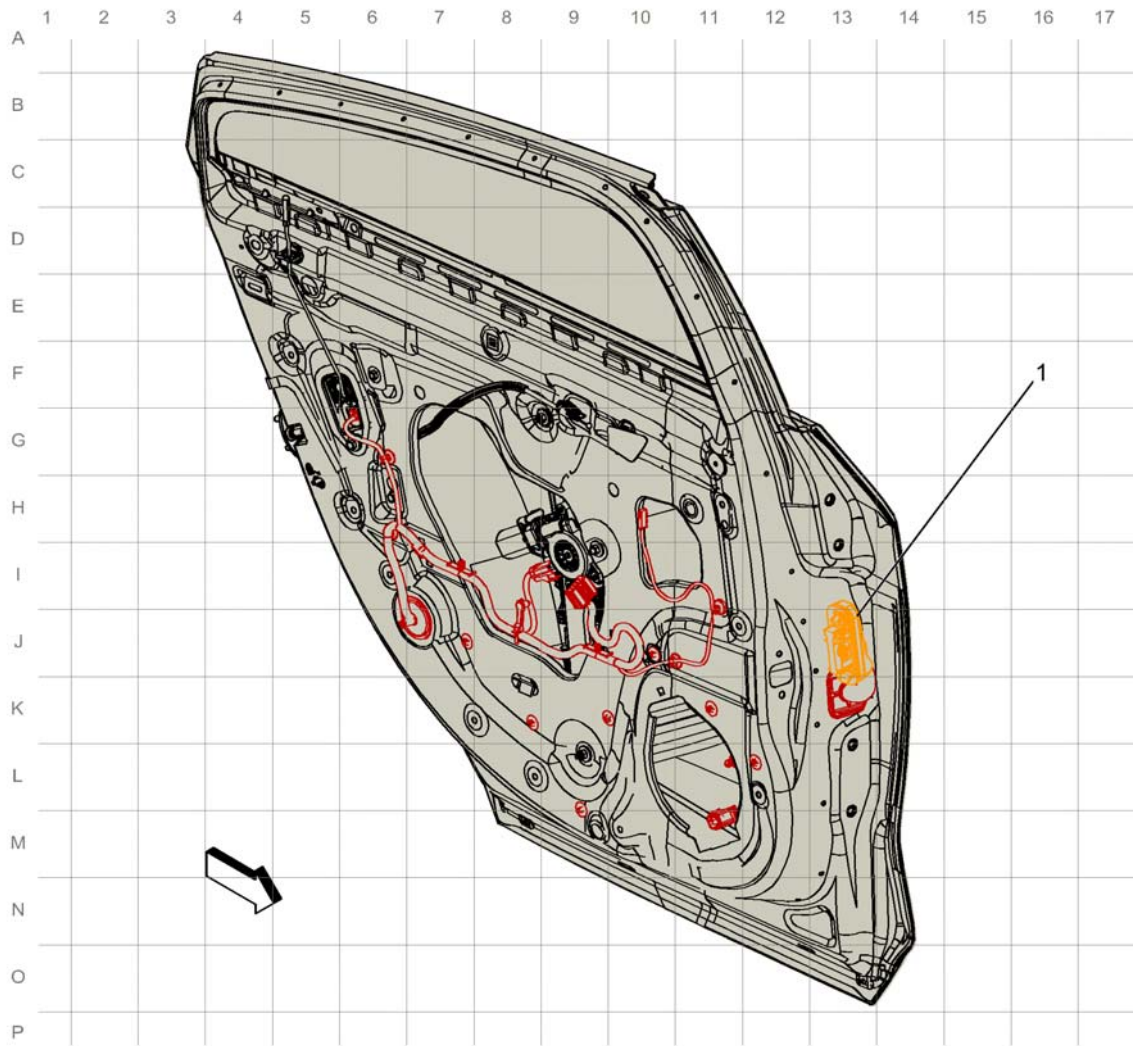


Fig. 16: Left Rear Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X700	<u>X700 Left Rear Door Harness to Body Harness</u>

Right Rear Door Harness Routing

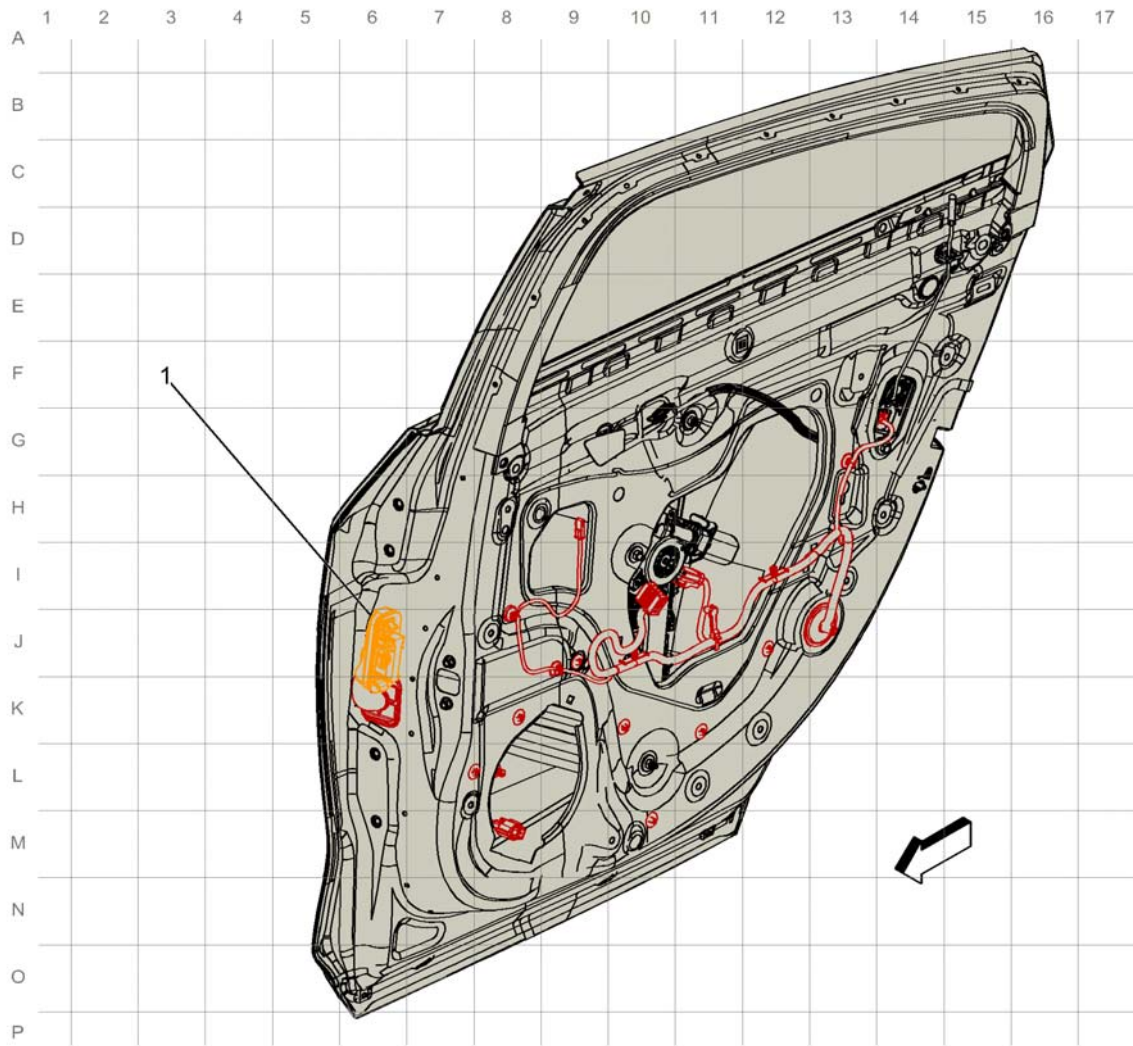


Fig. 17: Right Rear Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X800	<u>X800 Right Rear Door Harness to Body Harness</u>

Center Console Harness Routing

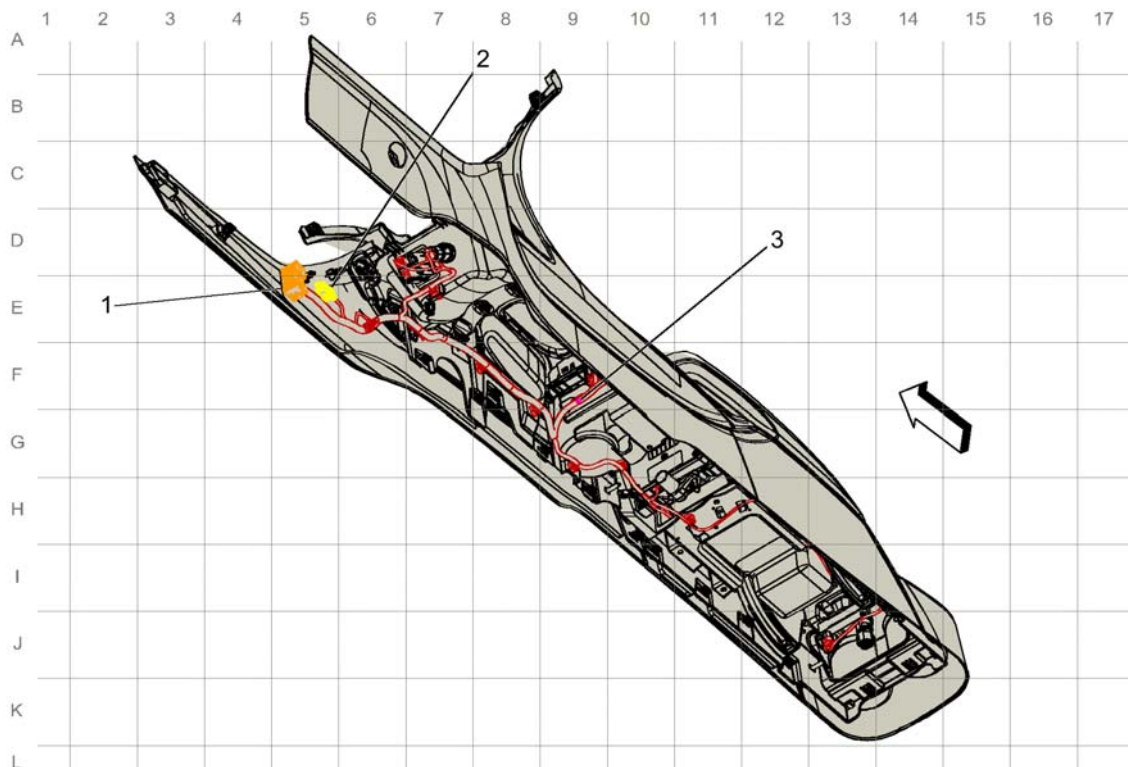


Fig. 18: Center Console Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items	
1. X315	<u>X315 Floor Console Harness to Instrument Panel Harness</u>
2. X316	<u>X316 Instrument Panel Harness to Floor Console Harness</u>
3. J350	

Left Side of Passenger Compartment Harness Routing

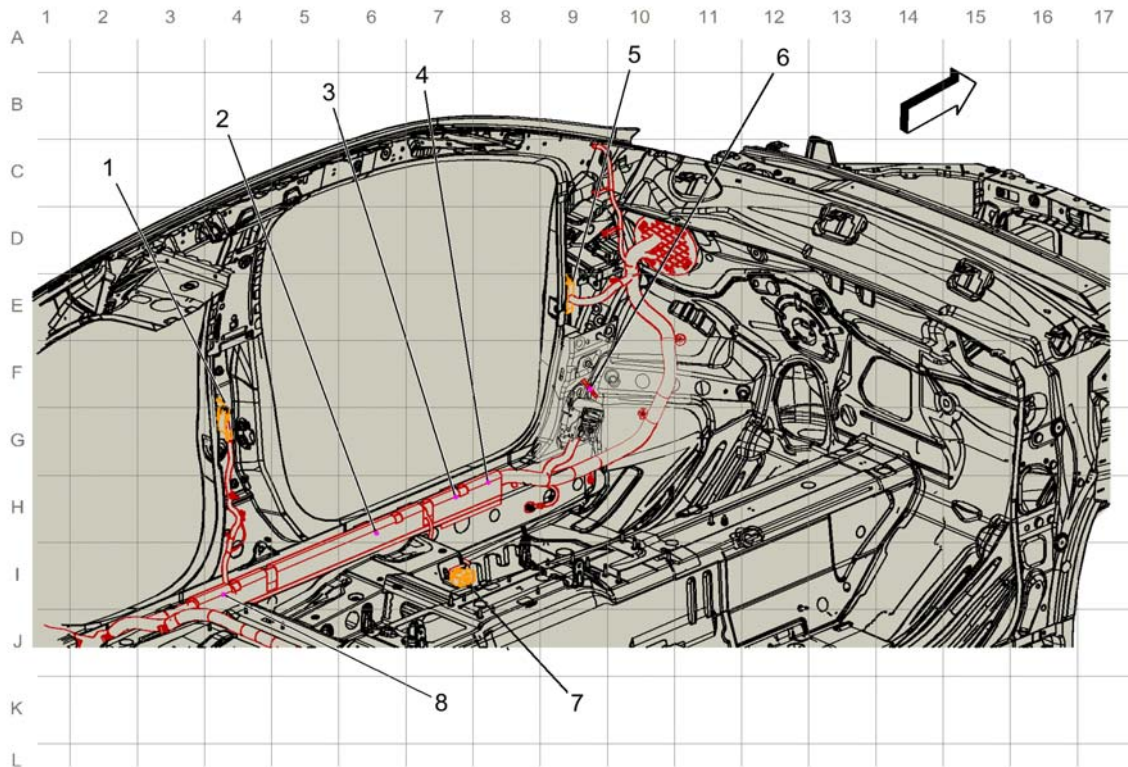


Fig. 19: Left Side of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. X700 <u>X700 Left Rear Door Harness to Body Harness</u>
2. J116
3. J234
4. J301
5. X500 <u>X500 Driver Door Harness to Body Harness</u>
6. J200
7. X310 <u>X310 Body Harness to Driver Seat Harness</u>
8. J328

Right Side of Passenger Compartment Harness Routing

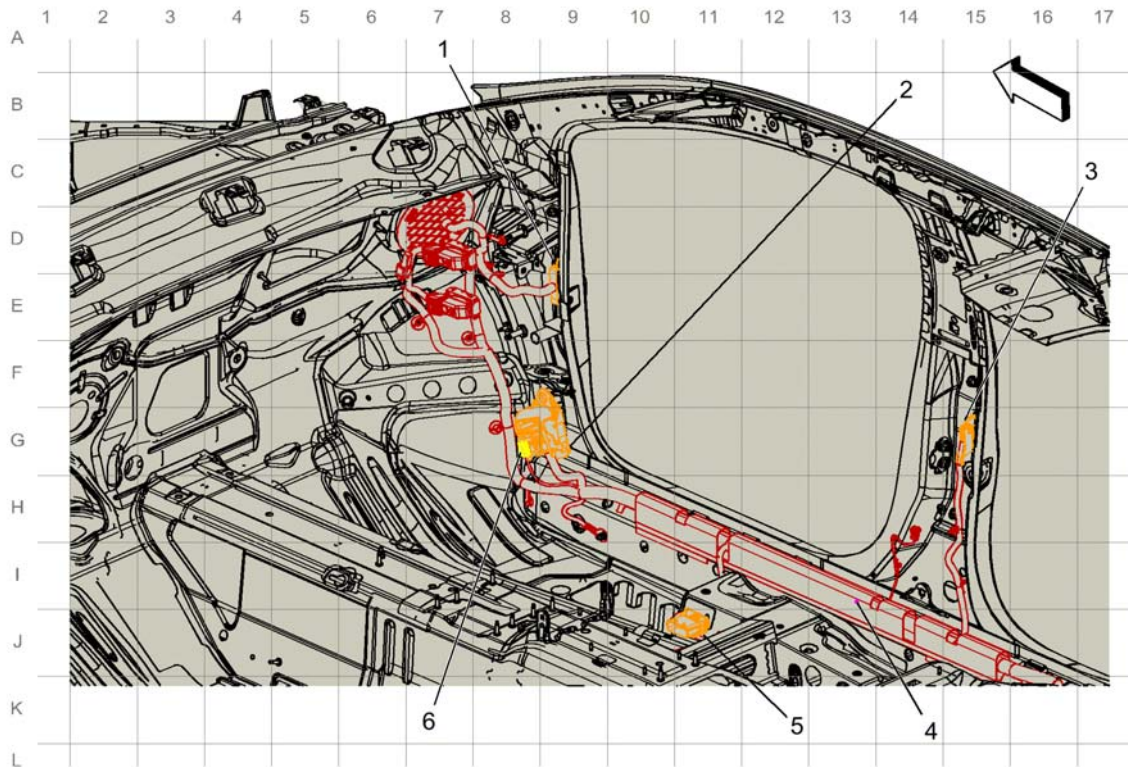


Fig. 20: Right Side of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. X600 <u>X600 Passenger Door Harness to Body Harness</u>
2. X275 <u>X275 Instrument Panel Harness to Body Harness</u>
3. X800 <u>X800 Right Rear Door Harness to Body Harness</u>
4. J117
5. X320 <u>X320 Driver Seat Harness to Body Harness</u>
6. X211 <u>X211 Body Harness to Instrument Panel Harness</u>

Left Rear of Passenger Compartment Harness Routing

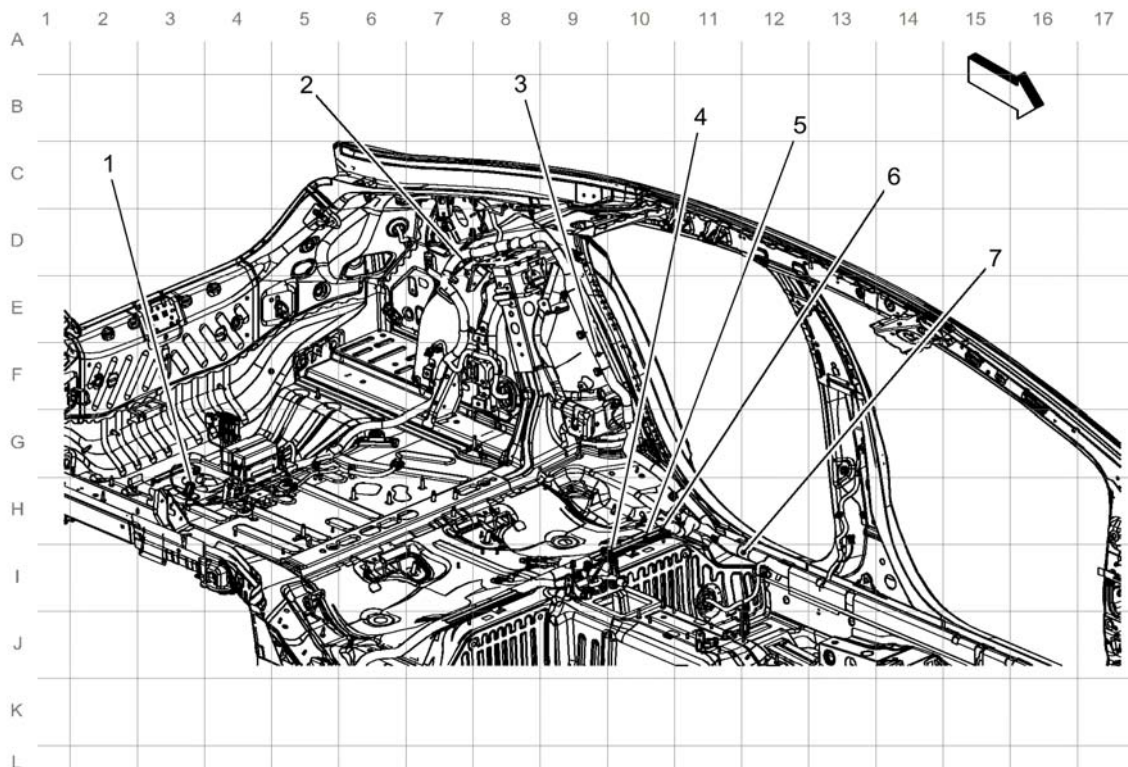


Fig. 21: Left Rear of Passenger Compartment Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items	
1. X452	<u>X452 Body Harness to Battery Cable Harness</u>
2. J314	
3. J407	
4. J320	
5. J402	
6. J308	
7. J333	

Right Rear of Passenger Compartment Harness Routing

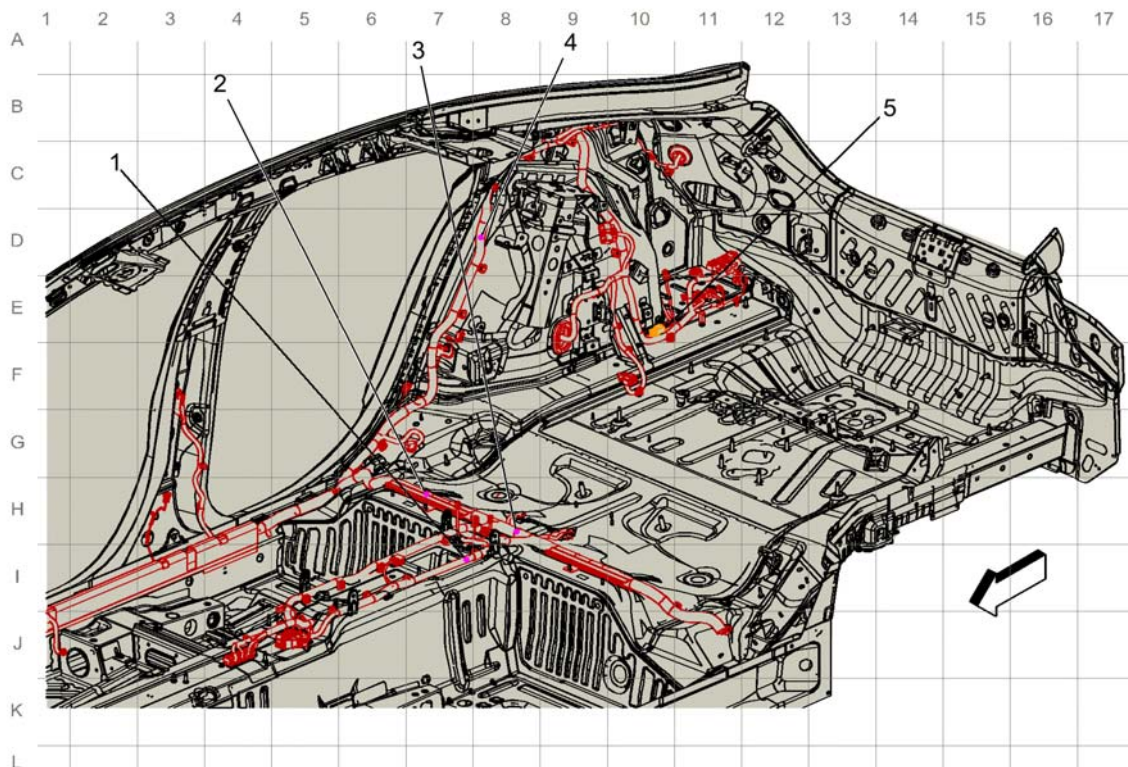


Fig. 22: Right Rear of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. J310
2. J222 (KA1/KA6)
3. J376
4. J377
5. X406 <u>X406 Body Harness to Body Harness</u>

Hybrid/EV Battery Pack Harness Routing

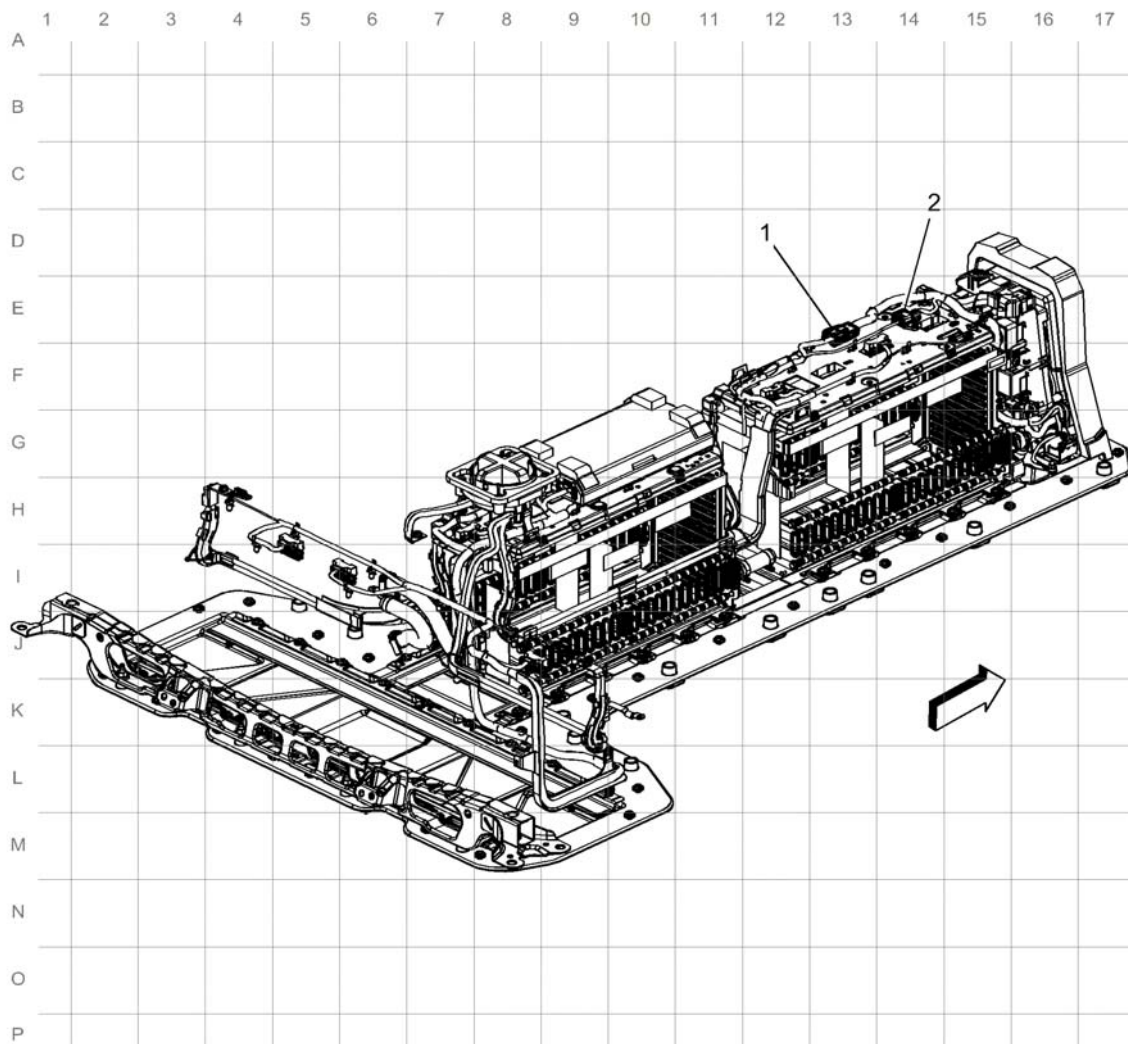


Fig. 23: Hybrid/EV Battery Pack Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items	
1. X359	<u>X359 Auxiliary Battery Cable Harness to Battery Pack Jumper Harness</u>
2. X360	<u>X360 Auxiliary Battery Cable Harness to Battery Fuse Block Harness</u>

Left Side of Luggage Compartment Harness Routing

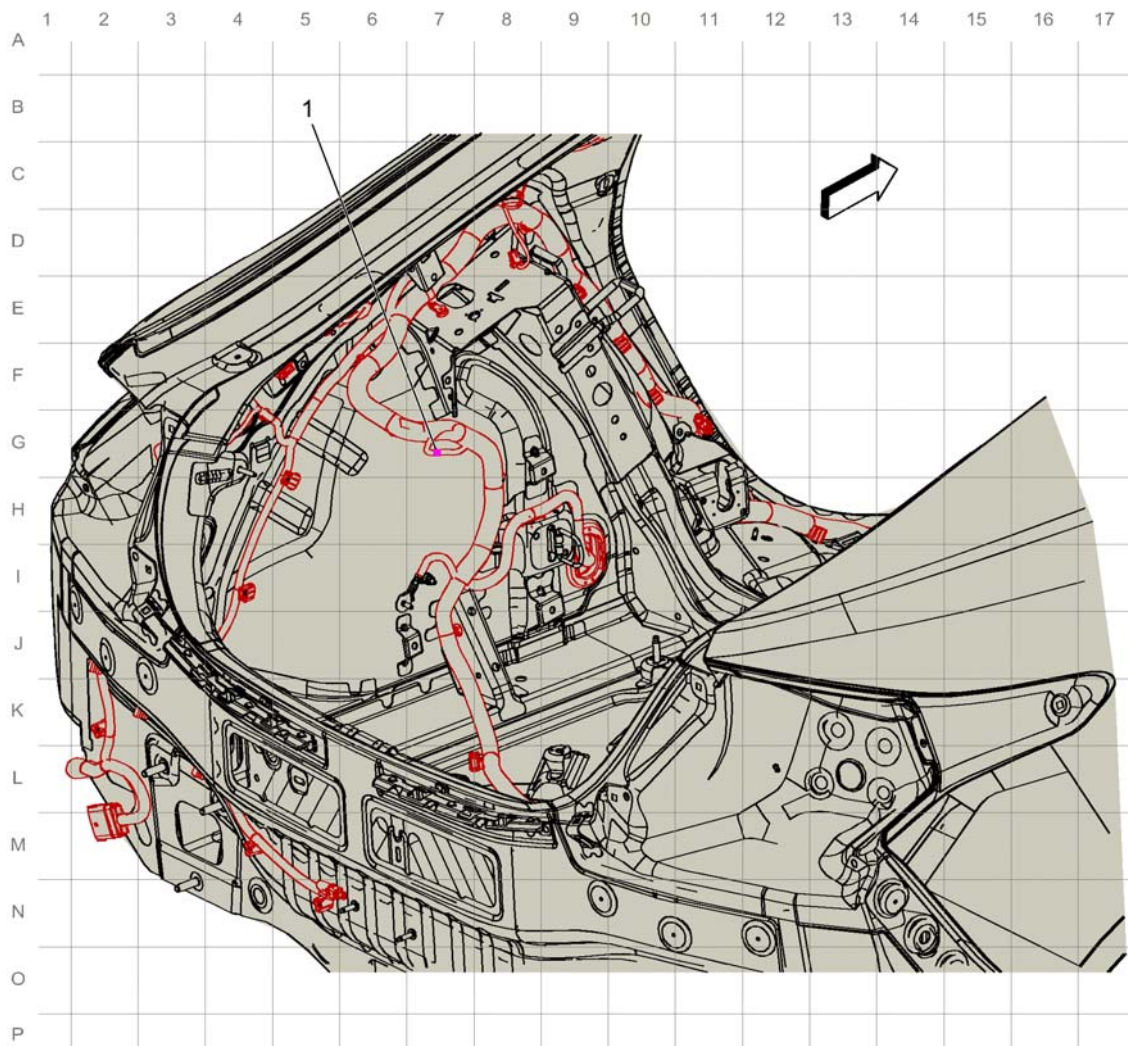


Fig. 24: Left Side of Luggage Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. J400	

Left Rear of Vehicle Harness Routing

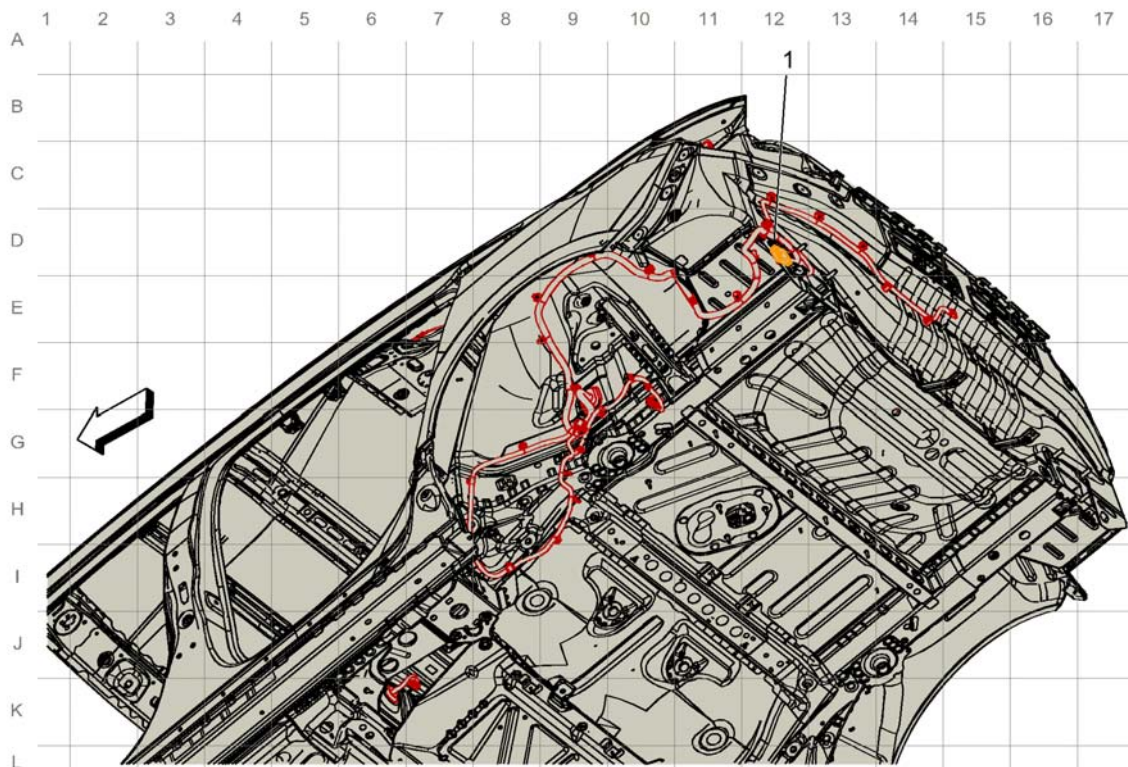


Fig. 25: Left Rear of Vehicle Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X451	<u>X450 Rear Lamp Harness to Body Harness (UFQ)</u>
Â	

Right Rear of Vehicle Harness Routing

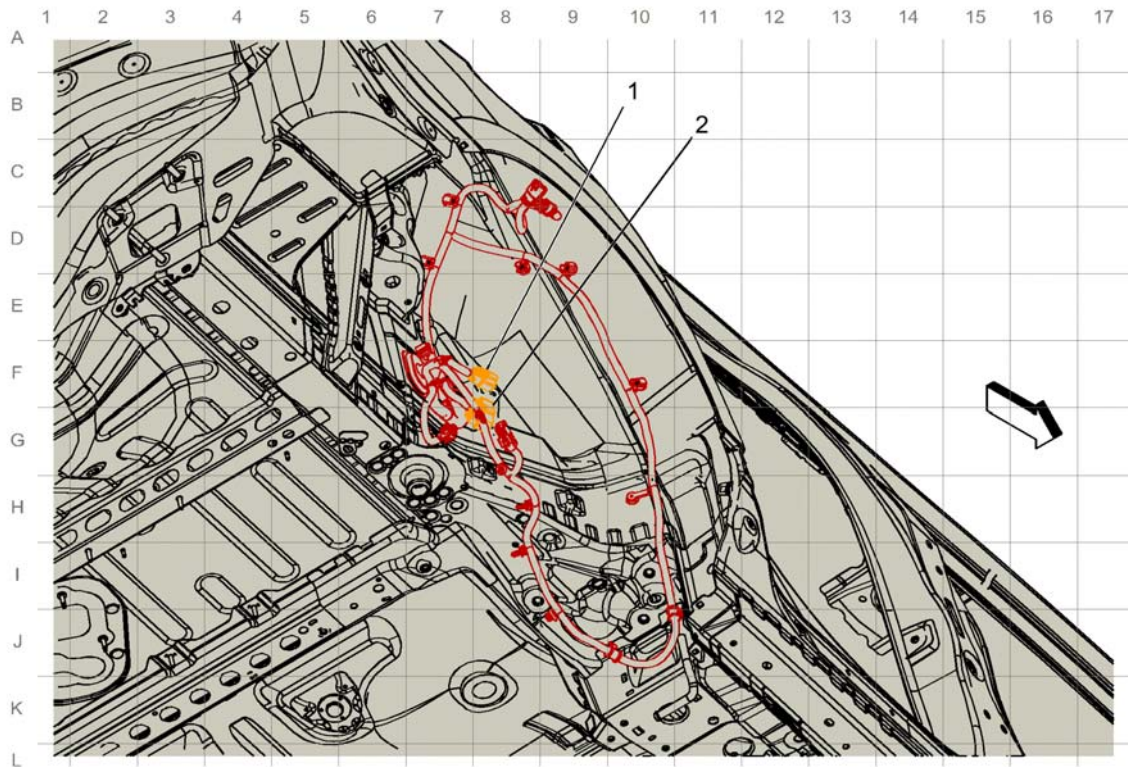


Fig. 26: Right Rear of Vehicle Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1. J403
2. X351 <u>X351 Body Harness to Fuel System Harness</u>
3. X350 <u>X350 Body Harness to Fuel System Harness</u>

12V Battery Negative Harness Routing

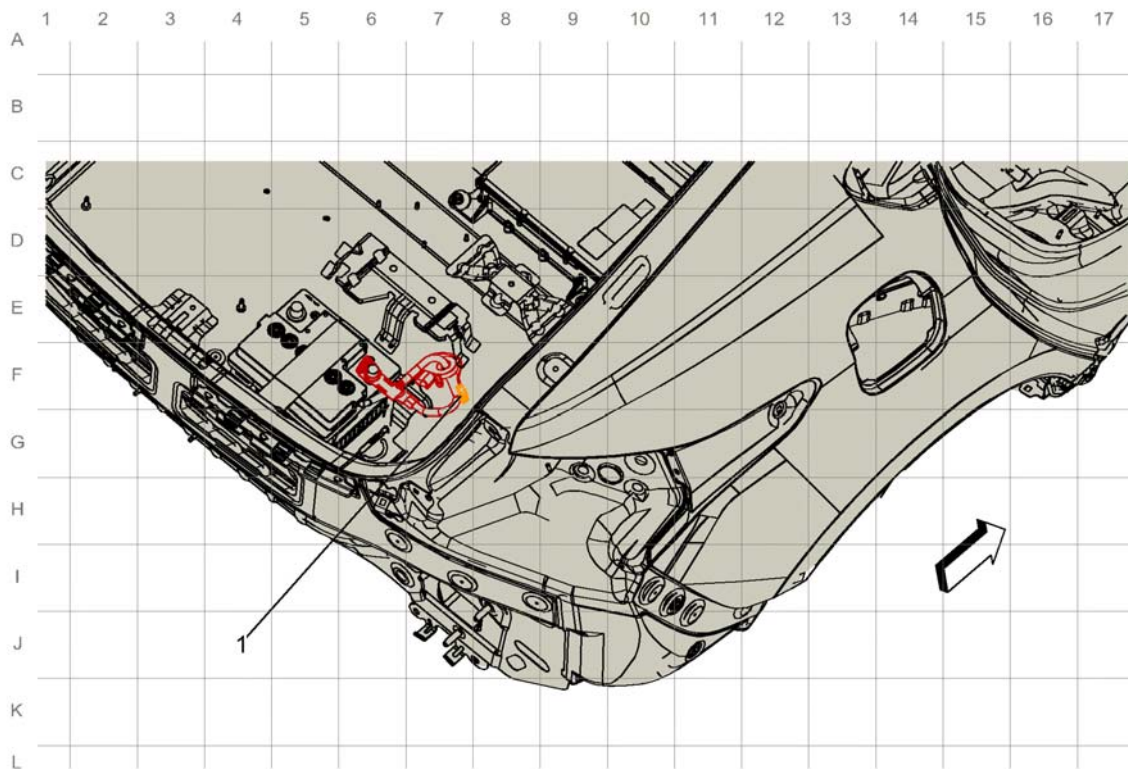


Fig. 27: 12V Battery Negative Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items	
1. X452	<u>X452 Body Harness to Battery Cable Harness</u>

Liftgate Harness Routing

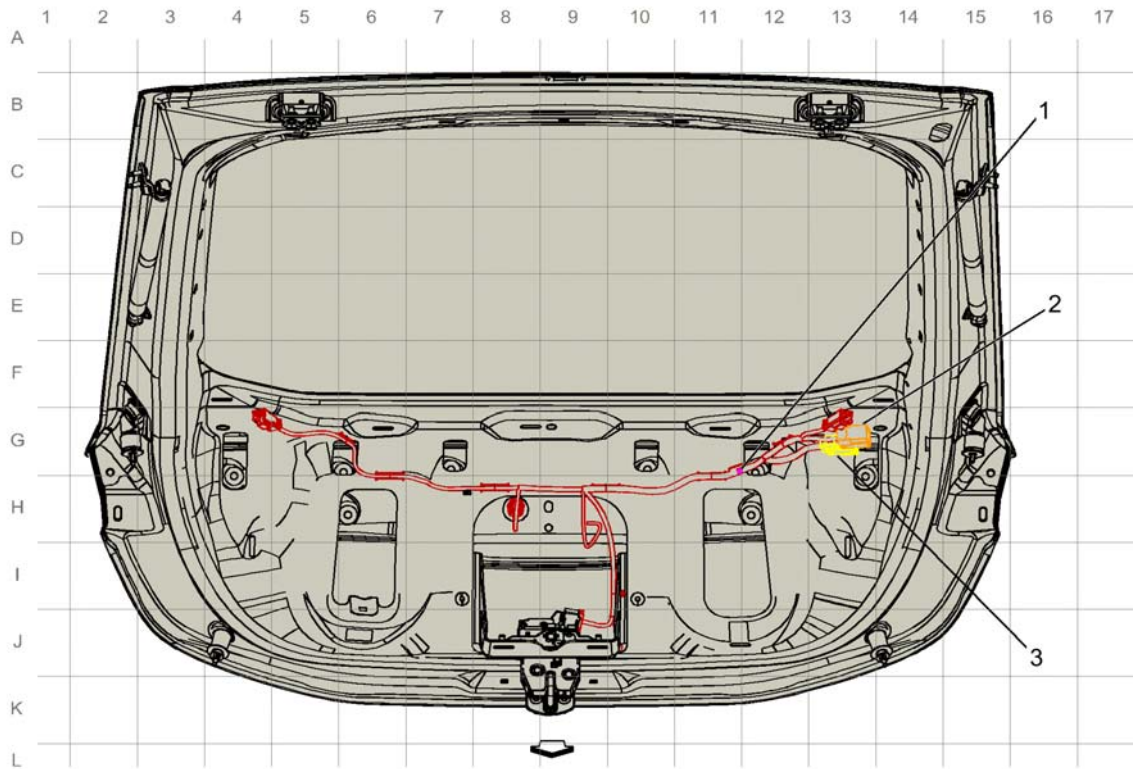


Fig. 28: Liftgate Harness Routing

Courtesy of GENERAL MOTORS COMPANY

Items
1. J902
2. X905 <u>X905 Liftgate Jumper Harness to Liftgate Harness</u>
3. X906 <u>X906 Liftgate Jumper Harness to Liftgate Harness</u>

Rear Fascia Harness Routing

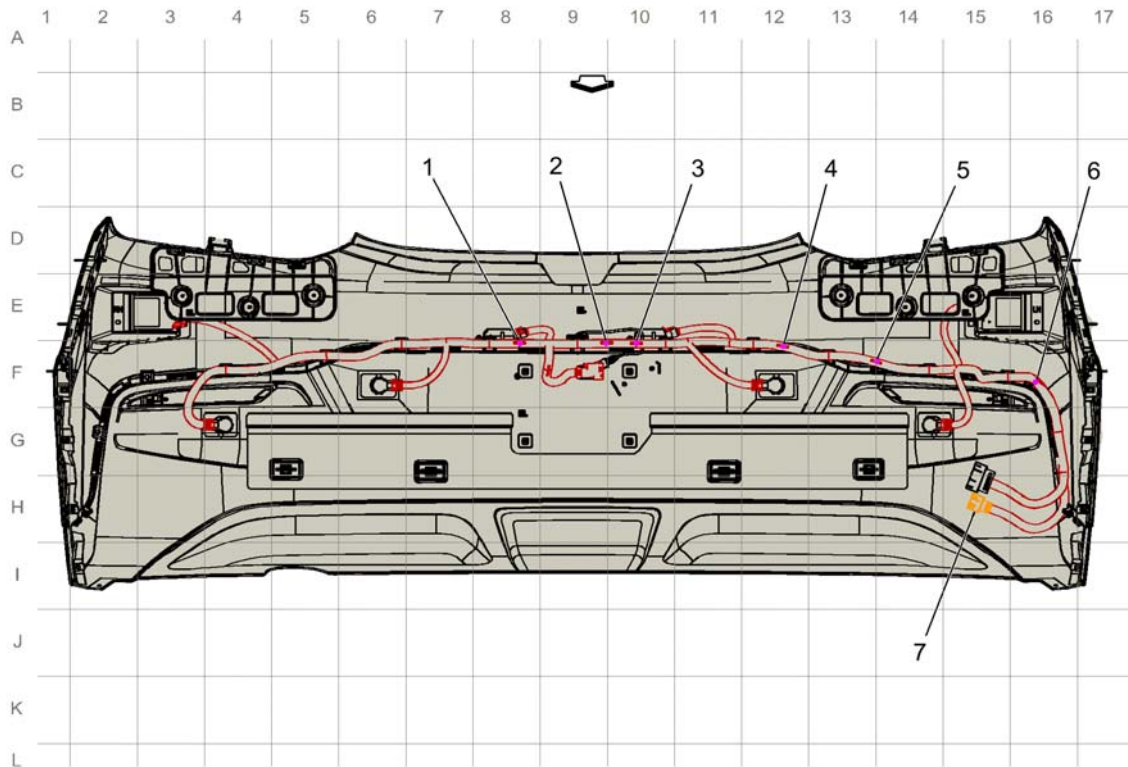


Fig. 29: Rear Fascia Harness Routing
 Courtesy of GENERAL MOTORS COMPANY

Items
1. J456
2. J453
3. J451
4. J455
5. J409 (UKC)
6. J908
7. X450 <u>X450 Rear Lamp Harness to Body Harness (-UFQ)</u>
Â

HOW TO USE ELECTRICAL SCHEMATICS

Information Overview

The following explains some of the key parts of the GM wiring diagrams. Included are:

- Color Abbreviations
- Electronic Delivery Navigation Features

Color Abbreviations

The following sequence is used when depicting wire colors:

1. Color modifier of the wire, such as light or dark (if applicable)
2. Primary color of the wire

3. Secondary color of the wire (tracer/stripe)

Wire insulation and connector body colors in schematic information are abbreviated with a two character code as listed below.

Abbreviation	Color	Abbreviation	Color
AM	Amber	OG	Orange
BARE	Bare	PK	Pink
BG	Beige	PU	Purple
BK	Black	RD	Red
BN	Brown	RU	Rust
BU	Blue	SR	Silver
CL	Clear	TL	Teal
CR	Cream	TN	Tan
CU	Curry	TQ	Turquoise
GD	Gold	VT	Violet
GN	Green	WH	White
GY	Gray	YE	Yellow
NA	Natural	-	-
Color Modifiers			
L	Light	D	Dark

Additionally, industry standard cable types are not identified by color, but are listed by cable type as follows:

Abbreviation	Cable Type
COAX	Coax Cable
ENET	Ethernet
FW	Flat Wire
HDMI	High Definition Multimedia Interface
LDVS	Low-voltage Differential Signaling
TWINAX	Twinax Cable
USB	Universal Serial Bus

Electronic Delivery Navigation Features

The schematics information has been enhanced for electronic delivery and the following explains the features that are now available.

The enhanced features are categorized into three types:

- Mouse-overs, which are active when the mouse pointer is placed over the activated area
- Hotspots (links to other information), which are active by placing the mouse pointer over the activated area and clicking the left mouse button
- Hotspot Target Highlighting, which is when linking from one graphic to another graphic, the point of interest will be highlighted in red. This feature is available only when linking from a schematic graphic to a component locator/harness routing view, or when linking from a schematic to an electrical center identification view

Depending on the amount of information that is linked to from a hotspot, the mouse pointer changes shape.

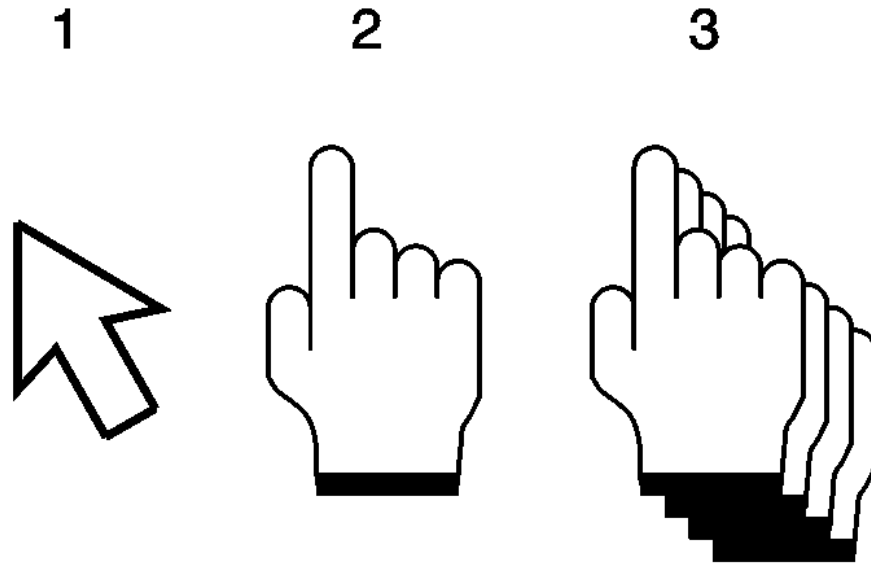


Fig. 30: Mouse Pointer Changes Shape

Courtesy of GENERAL MOTORS COMPANY

1. Basic mouse pointer - this means there are no hotspots available, but there may be a mouse-over available.
2. Single hand pointer - this means there is a mouse-over and hotspot link to a single document. Clicking on these areas will automatically take you to the target link.
3. Multiple hand pointer - this means there is a mouse-over and hotspot link to a multiple document. Clicking on these areas will bring up a pop-up menu that will display all available links. You may then select one of the available links clicking on one of the displayed links.

To see which areas of the schematic information have an available hotspot and/or a mouse-over, select and hold down the highlight hotspots button of the cgm viewer. This will highlight all areas of the graphic that have an available hotspot and/or a mouse-over in red. Once the button is released, the areas of the graphic will no longer be highlighted.



Fig. 31: Available Hotspot And/Or A Mouse-Over In Red
Courtesy of GENERAL MOTORS COMPANY

Each type of schematic related information has some level of these features. The schematic related information consists of the following information types:

- Schematics
- Connector End Views
- Component Locator Views
- Harness Routing Views
- Electrical Center Identification Views
- Master Electrical Component List
- Master Electrical Schematic Icons
- Schematics RPO Code List
- Circuit Number/Wire Colors
- Wire Lines
- Connector Cavities

Schematics

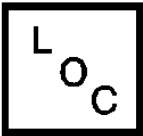
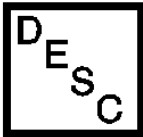
An electrical schematic hotspot is an activated icon or area in the schematic that can be cursor selected to link to additional information. Additionally, each of the hotspots in schematics has a mouse-over.

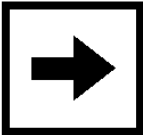
Hotspots in schematics are categorized into three types:

- Schematic Navigational Icon Hotspots
- Schematic Informational Icon Hotspots
- Schematic Navigational Hotspots

Schematic Navigational Icon Hotspots

The following lists icons that may appear on the upper right corner of a schematic that have an available mouse-over and hotspot.

Icon	Mouse-Over	Hotspot Link to Information
	Master Electrical Component List	Links to the vehicle Master Electrical Component List that shows all electrical components and harness items on the vehicle and has links to any available views
	Title of the subsystem description and operation	Links to the System Description and Operation

Icon	Mouse-Over	Hotspot Link to Information
	Control Module References	Links to the Control Module References table
	Title of the next schematic page	Links to the next schematic of the subsystem schematics

Icon	Mouse-Over	Hotspot Link to Information
	Title of the previous schematic page	Links to the previous schematic of the subsystem schematics

Schematic Informational Icon Hotspots

The following lists the icons that may appear anywhere on a schematic that have an available mouse-over and hotspot.

Icon	Mouse-Over	Hotspot Link to Information
 Danger	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.

Icon	Mouse-Over	Hotspot Link to Information
High Voltage 	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
 Caution	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
Supplemental Restraint	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.

Icon	Mouse-Over	Hotspot Link to Information
		
Pedestrian Impact 	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
Additional Information	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.

Icon	Mouse-Over	Hotspot Link to Information
		

Schematic Navigational Hotspots

In addition to the navigational icons, schematics have other active hotspots that link to supporting information such as related schematics, component locator views, harness routing views, and connector end views.

These hotspots can be either text based or symbol based. The following are the items that will have a mouse-over and hotspot.

Schematic Title Circuit References

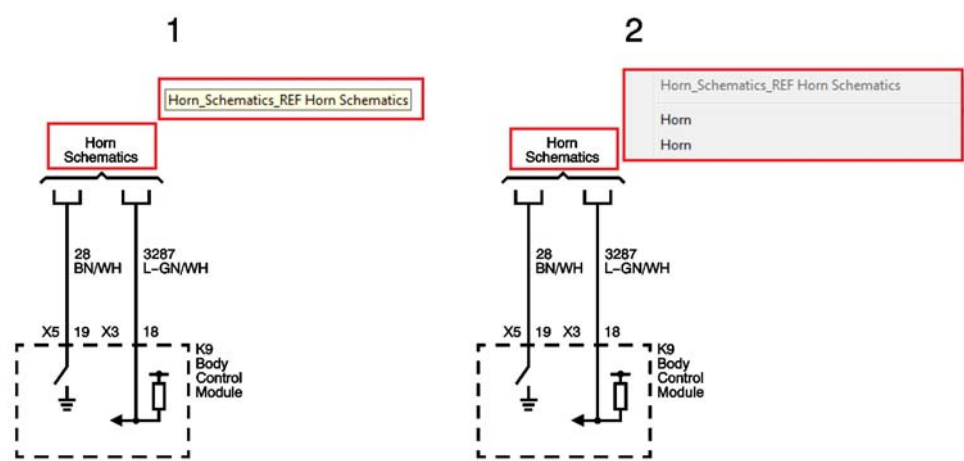


Fig. 32: Schematic Title Circuit References
 Courtesy of GENERAL MOTORS COMPANY

- 1. Mouse-over:** Displays the title of the schematic page linked to.
- 2. Hotspot Link to Information:** Links to the individual subsystem schematic page(s) that shows the circuit

in detail. If multiple circuits are included, or if the circuit is shown in multiple schematics, a menu will appear when the link is selected. This menu includes links to all schematics that contain the same circuit number as the circuit being referenced. Additionally, when the target schematic is opened, the referenced circuit will be highlighted to draw visual attention. Note that when there are multiple target links, the links may appear to be duplicate in the menu, however, they are not. The exact same title is repeated for each circuit number that is pointing to the same target schematic. A future update will include the circuit number before the link description to further assist in link selection.

Serial Data Functional Circuit Icon

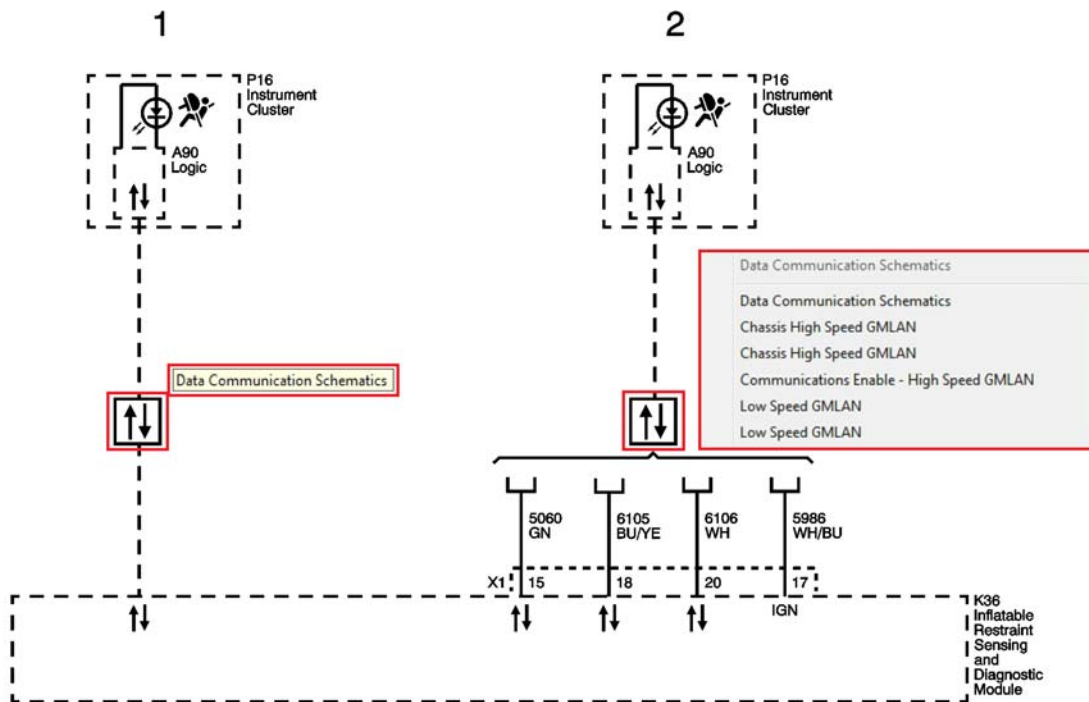


Fig. 33: Serial Data Functional Circuit Icon
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the schematic title Data Communication Schematics.
2. **Hotspot Link to Information:**
 - When a dashed serial data wire and icon are shown without any circuit numbers, the serial data circuit icon will link to the complete list of Data Communication schematic pages, and not a specific schematic. This is due to no circuit numbers are shown.
 - When a circuit wire(s) are shown with circuit numbers, a menu will appear when the link is selected. This menu includes links to the list of Data Communication schematic pages as well as links to the individual schematics that contain the same circuit number as the circuit being referenced. Additionally, when the target schematic is opened, the referenced circuit will be highlighted to draw visual attention. Note that when there are multiple target links, the links may appear to be duplicate in the menu, however, they are not. The exact same title is repeated for each circuit number that is pointing to the same target schematic. A future update will include the circuit number before the link description to further assist in link selection.

Fuse/Circuit Breaker Symbol and Name within Subsystem Schematics

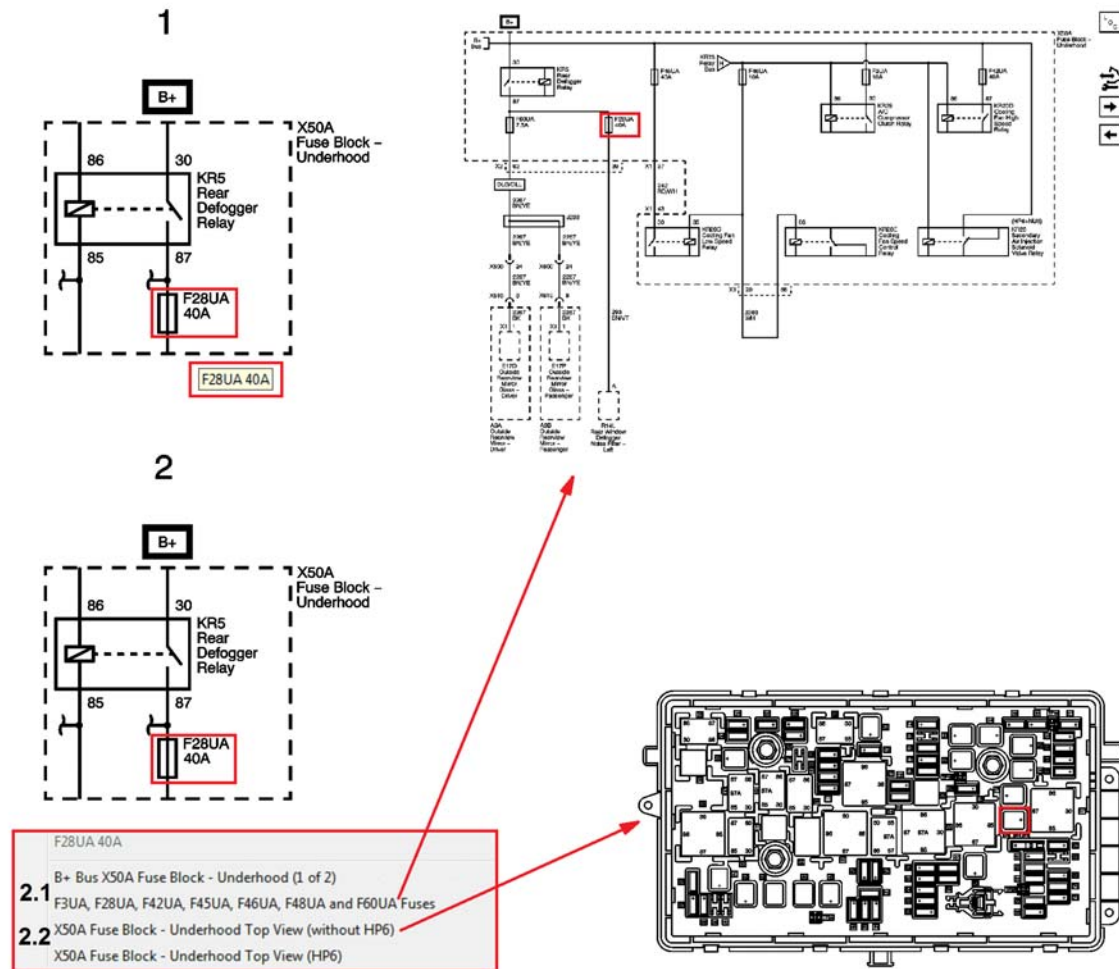


Fig. 34: Fuse/Circuit Breaker Symbol And Name Within Subsystem Wiring Schematics
 Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and the amperage of the protection device.
2. **Hotspot Link to Information:**
 - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
 1. Links to the individual schematic page(s) within the Power Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the circuit protection device will be highlighted to draw visual attention.
 2. Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Ground Symbol/Name in Subsystem Schematics

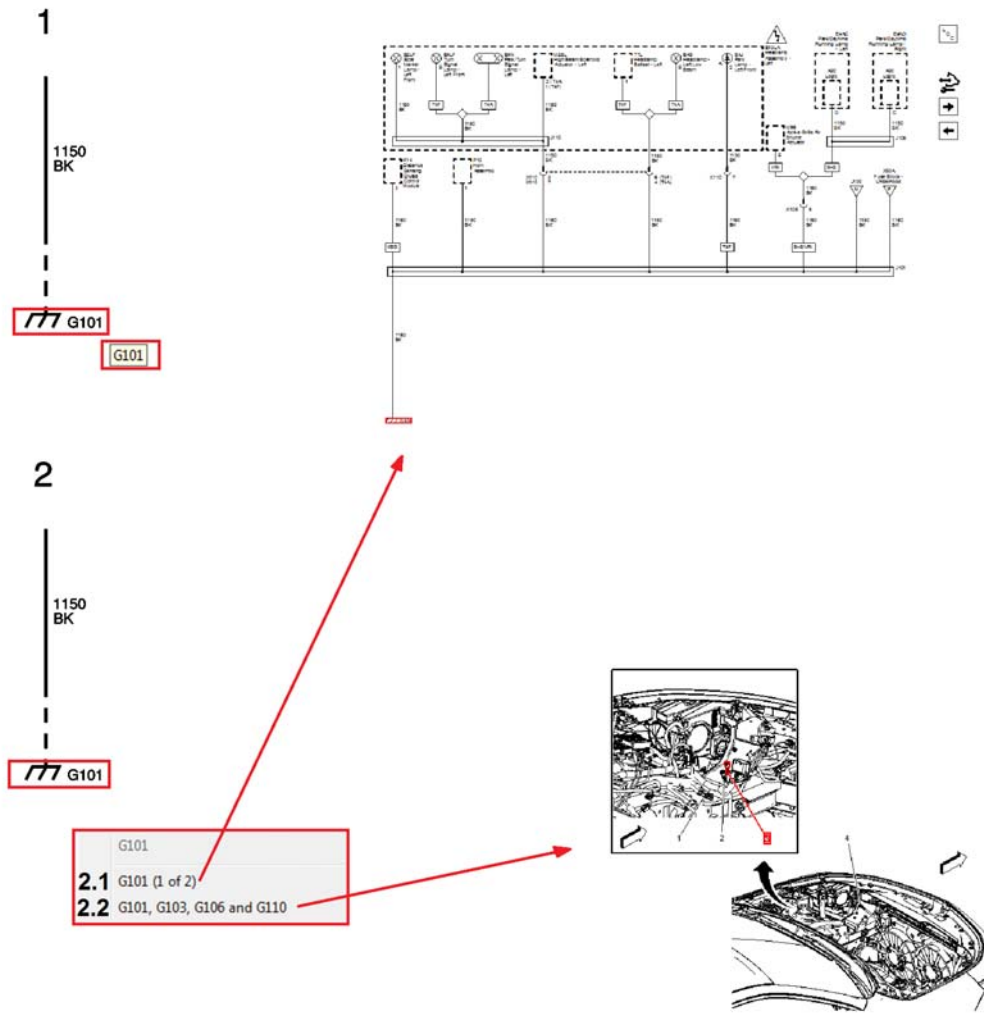


Fig. 35: Ground Symbol/Name In Subsystem Wiring Schematics

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the ground number.

2. **Hotspot Link to Information:**

- When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
 1. Links to the individual schematic page(s) within the Ground Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the ground will be highlighted to draw visual attention.
 2. Links to the individual locator view(s) within the Ground Views and will show where the ground is located on the vehicle. Additionally, when the target view is opened, the ground and callout leader line/number will be highlighted to draw visual attention.

Body Control Module High-Side Driver Output Symbol/Driver Source Fuse Name in Subsystem Schematics

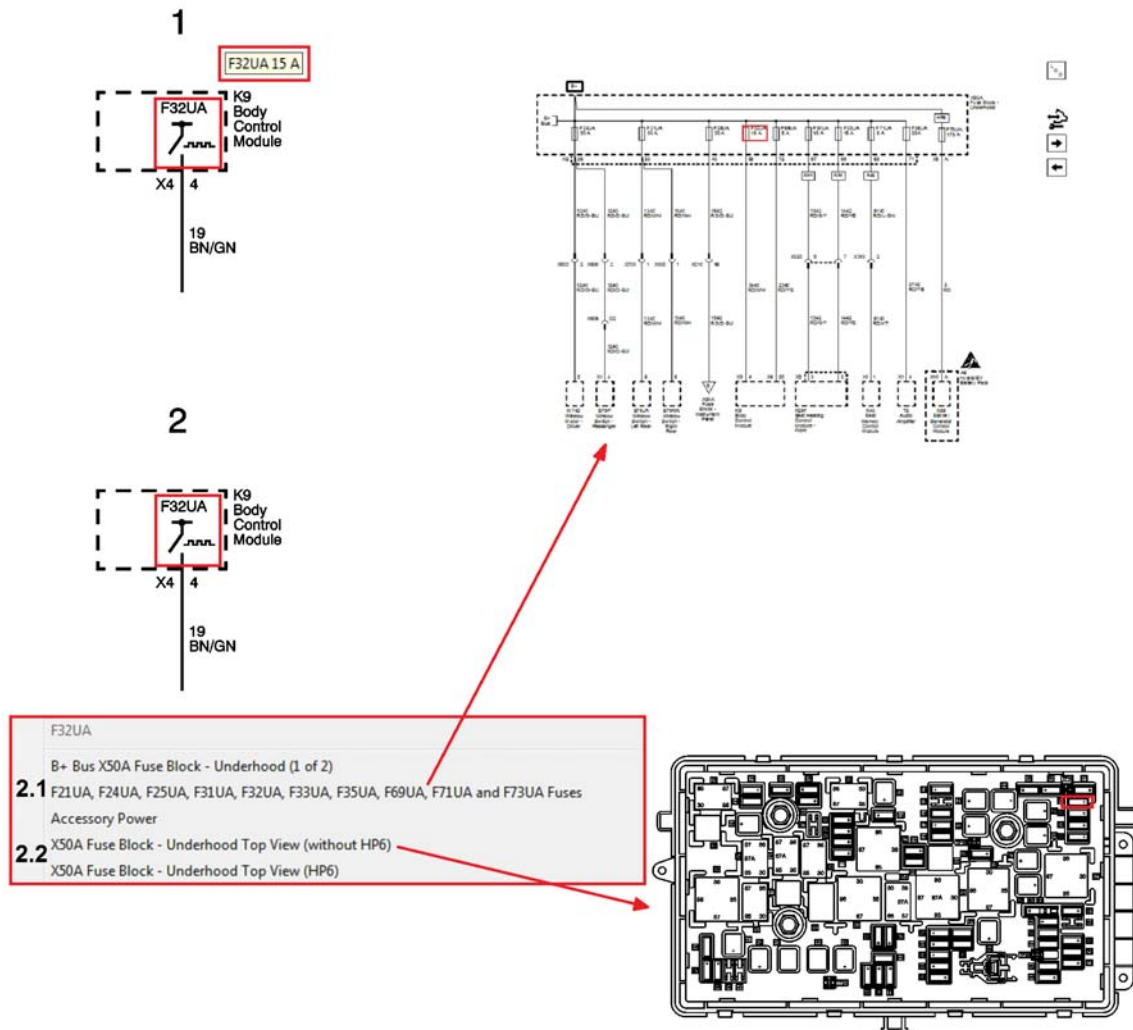


Fig. 36: Body Control Module High-Side Driver Output Symbol/Driver Source Fuse Name in Subsystem Wiring Schematics

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the protection device that supplies the high-side driver output circuit.
2. **Hotspot Link to Information:**
 - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
 1. Links to the individual schematic page(s) within the Power Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the circuit protection device will be highlighted to draw visual attention.
 2. Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Component Name in Power and Ground Distribution Schematics

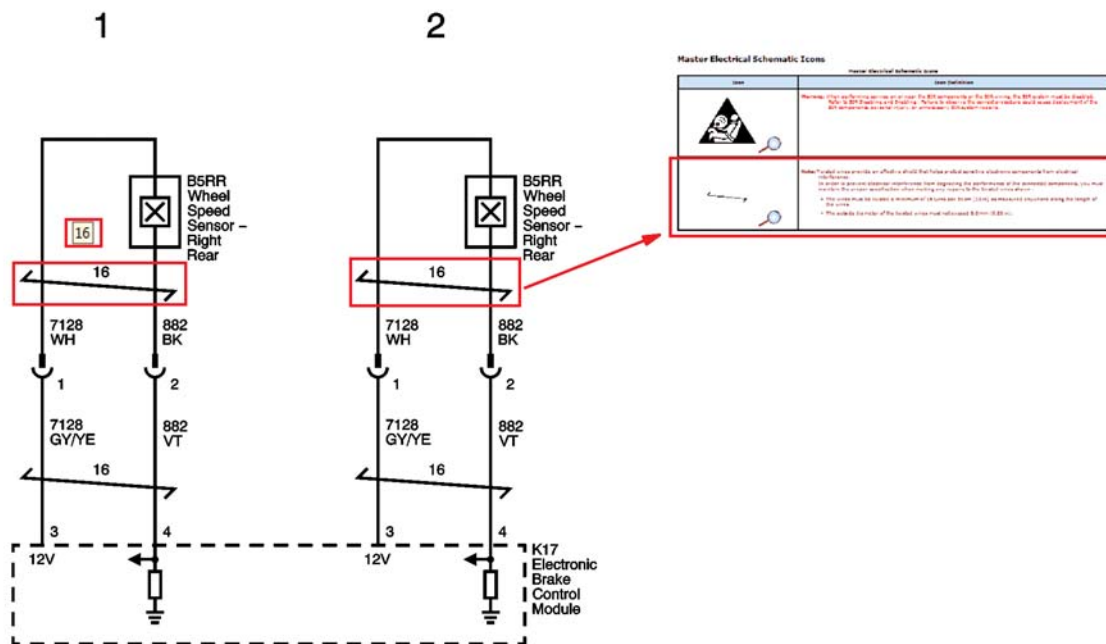


Fig. 38: Twisted Pair Symbols

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the repair specification for the number of twists of the wire within the specified distance.
2. **Hotspot Link to Information:** Links to the Master Electrical Schematic Icons list that shows the icon along with the repair specification details for the wire.

Relay Name (located within a block)

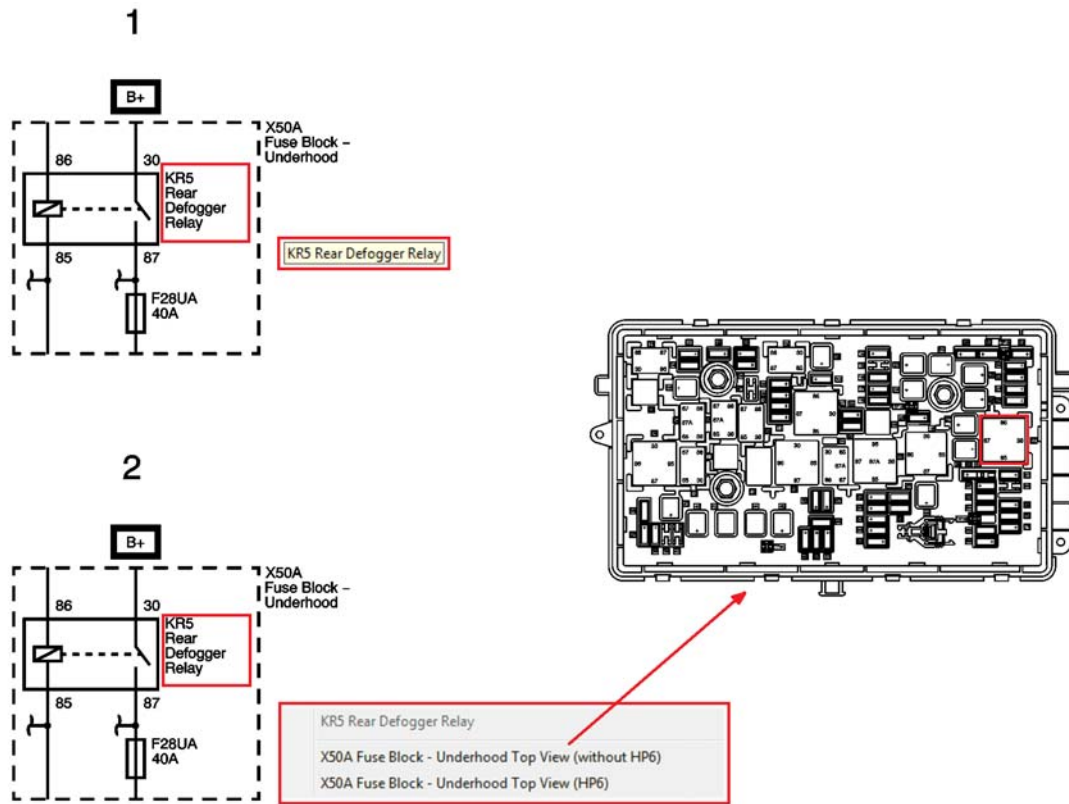


Fig. 39: Relay Name (located within a block)
 Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the relay code and name.
2. **Hotspot Link to Information:** Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Component Name in Subsystem Schematics

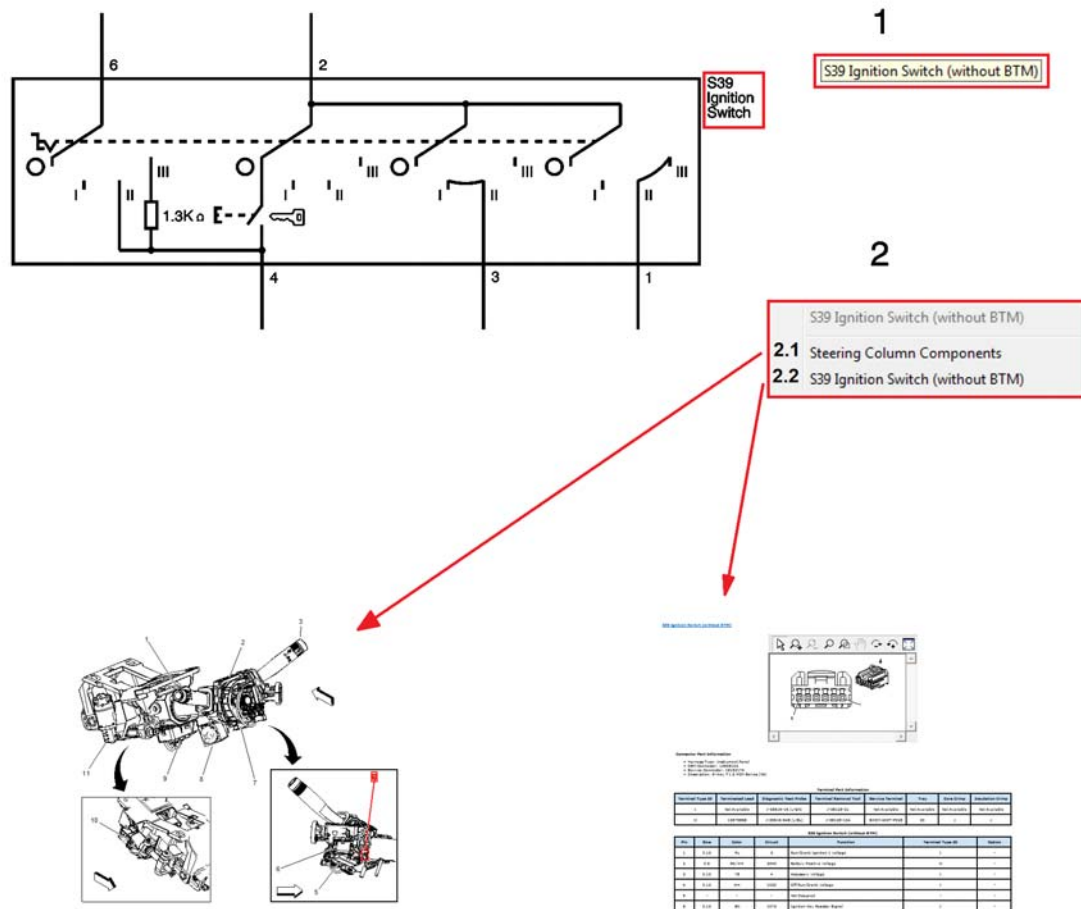


Fig. 40: Component Name In Subsystem Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and name of the component.

2. **Hotspot Link to Information:**

- When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
1. Links to the individual locator view(s) within the applicable component view category and will show where the component is located on the vehicle. Additionally, when the target view is opened, the component and callout leader line/number will be highlighted to draw visual attention.
 2. Links to individual connector end view(s) within the Component Connector End Views.

Splice Names

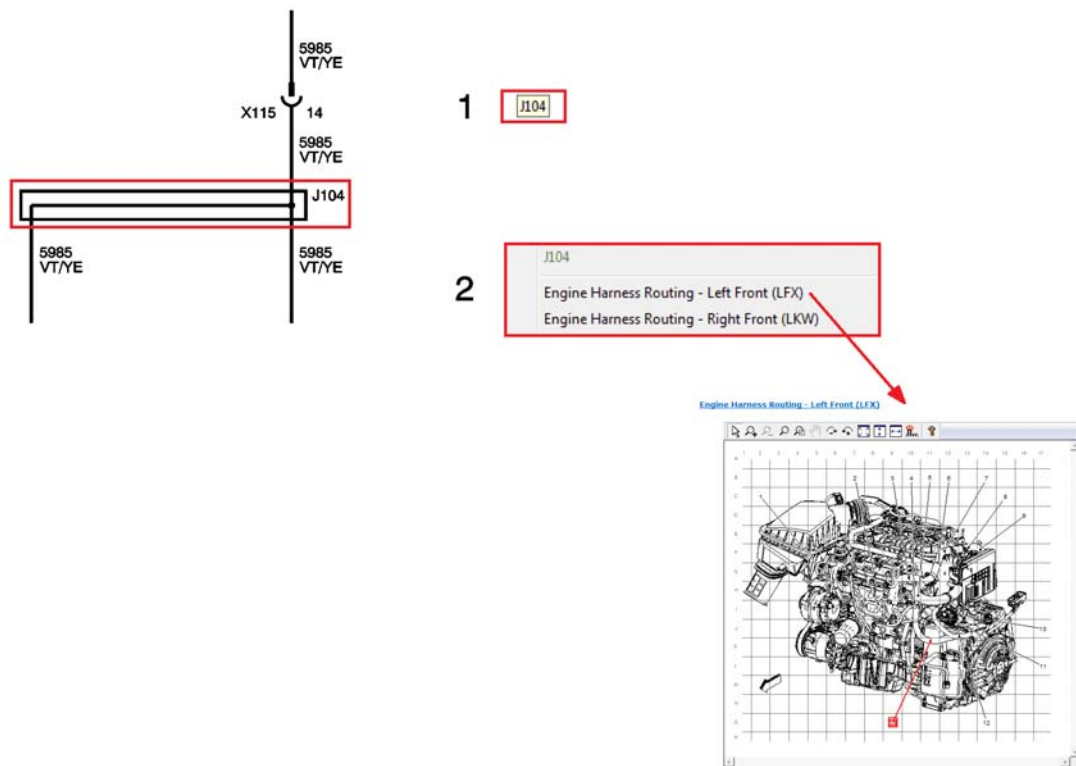


Fig. 41: Splice Names

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness splice.
2. **Hotspot Link to Information:** Links to the individual harness routing view(s) within the Harness Routing Views and will show where the harness item is located on the vehicle harness. Additionally, when the target view is opened, the harness item and callout leader line/number will be highlighted to draw visual attention.

Splice Pack Names

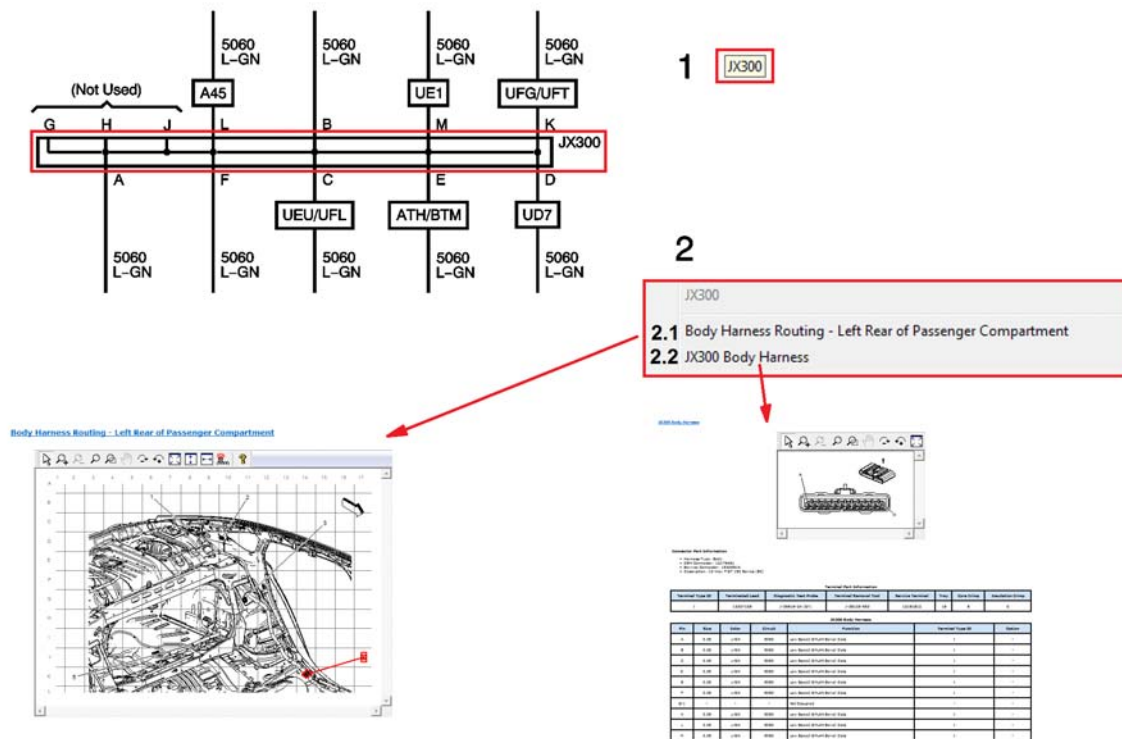


Fig. 42: Splice Pack Names

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness splice pack.

2. **Hotspot Link to Information:**

- When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.

- Links to the individual harness routing view(s) within the Harness Routing Views and will show where the harness item is located on the vehicle harness. Additionally, when the target view is opened, the harness item and callout leader line/number will be highlighted to draw visual attention.
- Links to individual connector end view(s) within the Splice Pack Connector End Views.

Inline Harness Connector Names

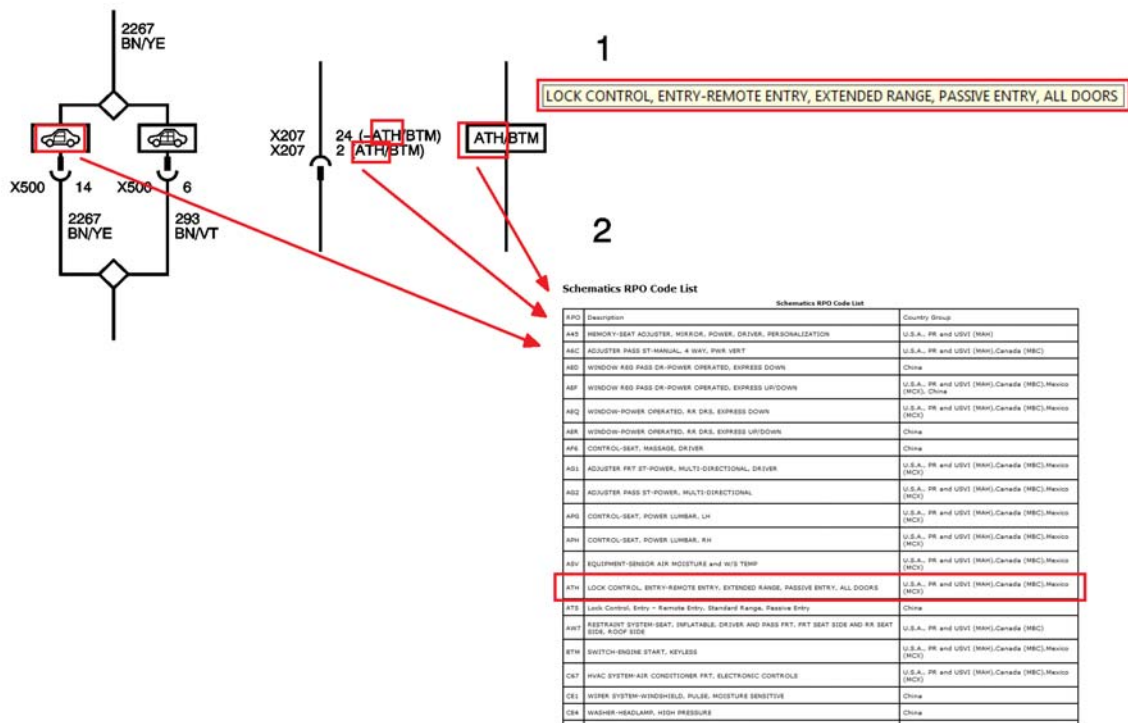


Fig. 44: Regular Production Option (RPO) Codes/Icons
 Courtesy of GENERAL MOTORS COMPANY

- 1. Mouse-over:** Displays the description of the RPO code as well as the country group names where the option is possible to order. Note that each RPO shown will have its own mouse-over and description. Also note that the mouse-over does not include any symbols indicating with (shown as a + sign if combined option) or without (shown as a - sign to mean without/except).
- 2. Hotspot Link to Information:** Links to the Schematics RPO Code List that shows the RPO, the description of the option, and the country group names where the option is possible to order.

Circuit Number/Wire Colors

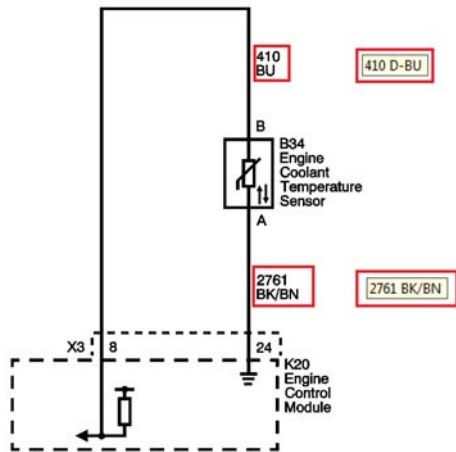


Fig. 45: Circuit Number/Wire Colors

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the circuit number (if shown) and the color abbreviation of the wire insulation. Refer to Color Abbreviations for an explanation of each wire color abbreviation. A future update may spell out the wire colors in all languages.
2. **Hotspot Link to Information:** None at this time.

Wire Lines

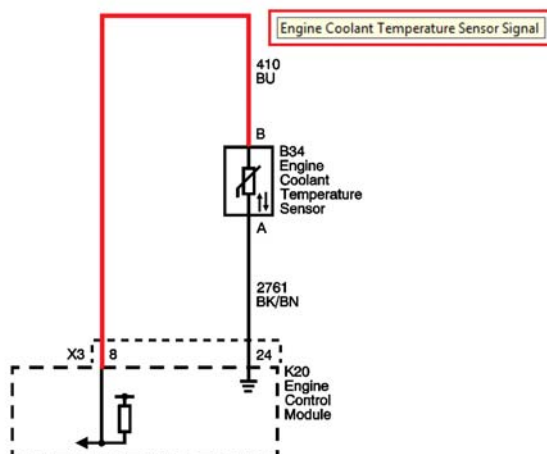


Fig. 46: Wire Lines

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the circuit function of the wire as used on the vehicle. This same function is shown in the connector end view pinout table for the component the wire connects. Note if there is no circuit number shown, the circuit will not have an associated mouse-over.
2. **Hotspot Link to Information:** None at this time. A future update may include links to harness routing views to show the routing of the circuit within the vehicle harness.

Connector Identifiers and Cavities

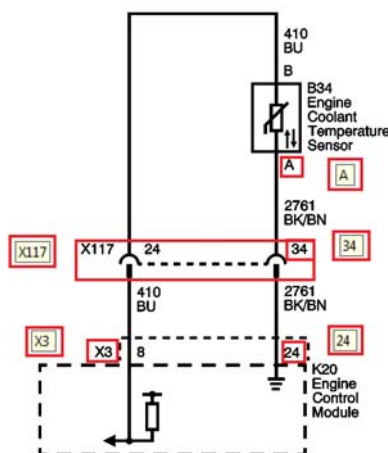


Fig. 47: Connector Identifiers And Cavities
Courtesy of GENERAL MOTORS COMPANY

- 1. **Mouse-over:** Displays the cavity (pin) identifier (letter/number) for the connection at the component or inline harness connection.
- 2. **Hotspot Link to Information:** None at this time.

Connector End Views

Connector end view graphics now have mouse-overs to show the wire details of each of the populated cavities. Additionally, the terminal part information has been restructured into an easier to read table.

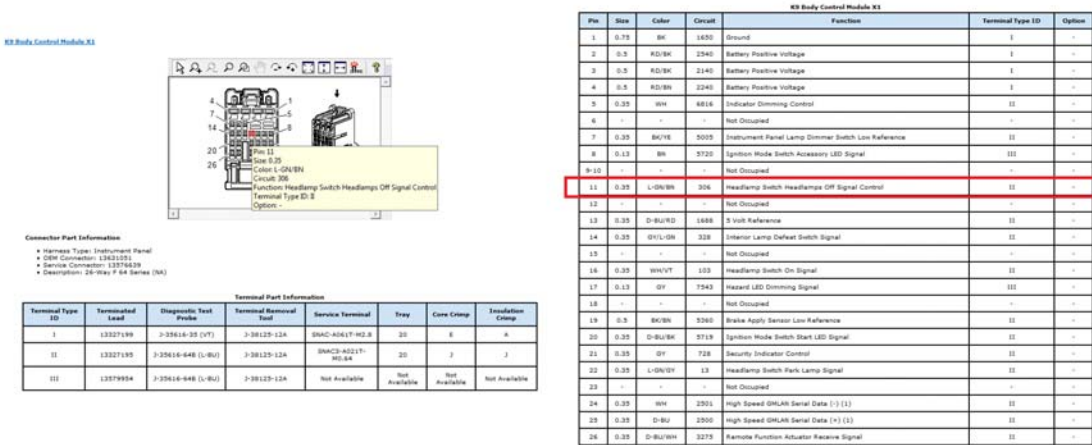


Fig. 48: Connector End View Graphics Table Information
Courtesy of GENERAL MOTORS COMPANY

- 1. **Mouse-over:** Displays all of the pinout table information for each column including Pin, Size, Color, Circuit, Function, Terminal Type ID, and Option. Note, that not used/not occupied cavities will not have a mouse-over at all. For not used/not occupied cavities, the connector graphic will appear to have a mouse-over, but no information will be displayed in a pop-up menu.
- 2. **Hotspot Link to Information:** None at this time. A future update may include links to individual subsystem schematic(s) for each circuit.

Component Locator Views

Component locator views now have links to component connector end views.

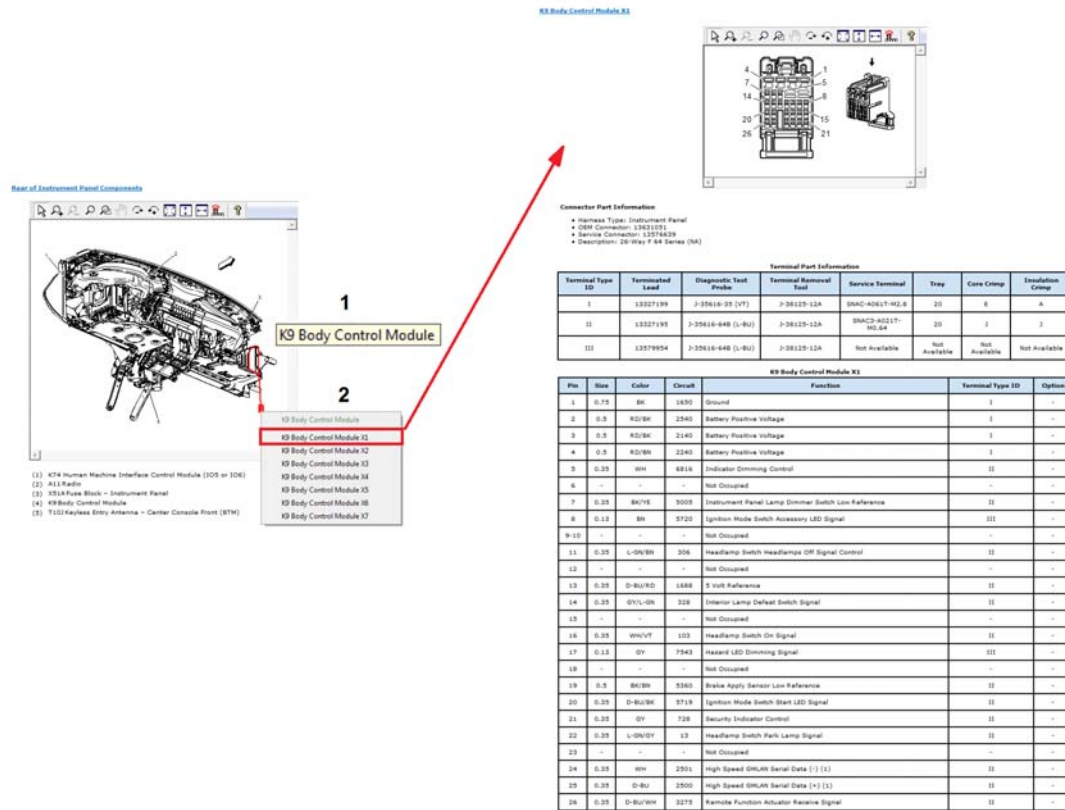


Fig. 49: Component Locator Views Have Links To Component Connector End Views
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and name of the component.
2. **Hotspot Link to Information:** Links to individual connector end view(s) within Component Connector End Views.

Harness Routing Views

Harness routing views now have links to splice pack and inline harness connector end views.

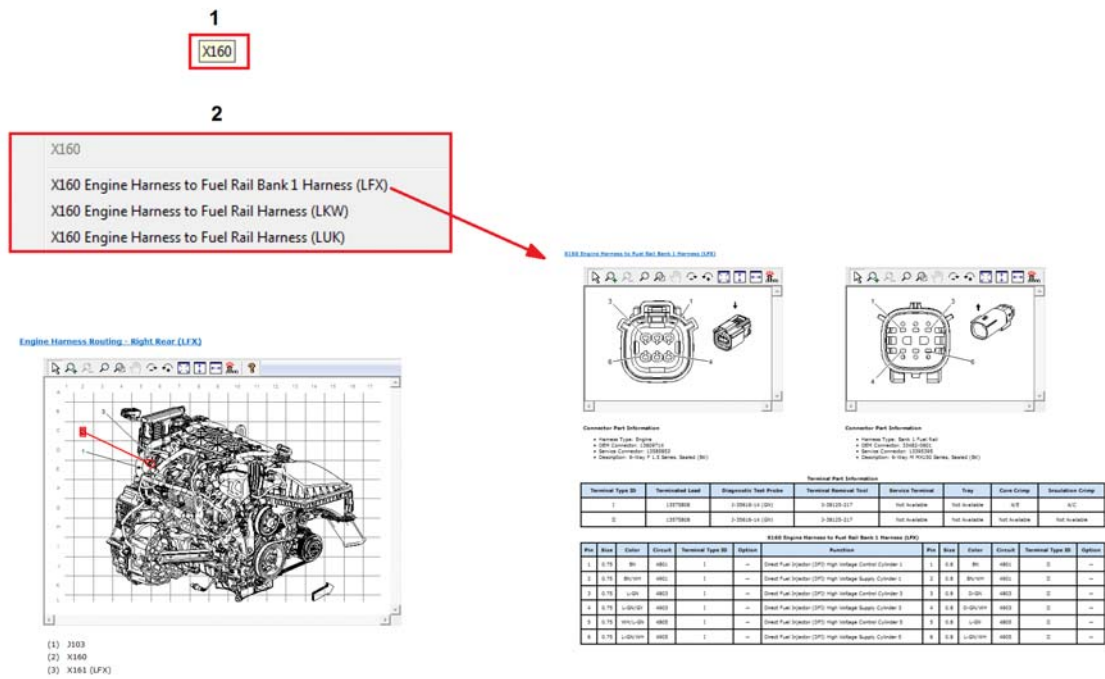


Fig. 50: Harness Routing Views Have Links To Splice Pack And Inline Harness Connector End Views
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness item.
2. **Hotspot Link to Information:** Links to individual splice pack connector end view(s) within Splice Pack Connector End Views for splice packs and to the individual inline harness connector end view(s) within Inline Harness Connector End Views for inline harness connectors.

Electrical Center Identification Views

Electrical center identification views (top and bottom/front and back) graphics now have mouse-overs to show the function details of each of utilized devices. Note that the label view will not have any mouse-overs or links at all.

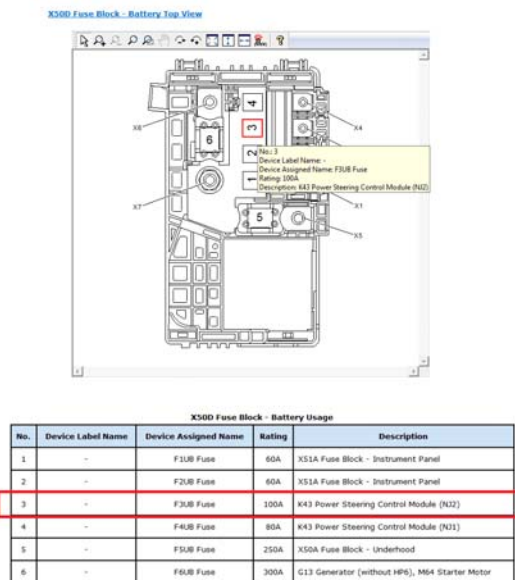


Fig. 51: Electrical Center Identification Views Graphics Have Mouse-Overs To Show Function Details
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays all of the usage table information for each column including No., Device Label Name, Device Assigned Name, Rating, and Description. Note, that not used/not occupied devices will not have a mouse-over at all. For not used/not occupied devices, the device graphic may appear to have a mouse-over, but no information will be displayed in a pop-up screen.
2. **Hotspot Link to Information:** None at this time.

Master Electrical Component List

While the master electrical component list format has not changed, it will continue to have links to component locator, harness routing, and connector end views for each of the available electrical devices within the vehicle.

Master Electrical Component List					
Master Electrical Component List					
Code	Name	Option	Location	Locator View	Connector End View
ASL	Sunshade - Left	—	In the passenger compartment, left front, mounted to the headliner at left front	—	—
ASR	Sunshade - Right	—	In the passenger compartment, right front, mounted to the headliner at right front	—	—
HA	Hybrid/IV Battery pack	H96	In the luggage compartment, right behind rear of the seats	Right Side of Luggage Compartment Components	—
A7	Fuel Pump and Level Sensor Assembly	—	In the vehicle underbody, below rear seats, mounted to fuel tank	Fuel Tank Components	A7 Fuel Pump and Level Sensor Assembly
ABA	Outside Rearview Mirror - Driver	—	On outside of driver door, front middle, forward of window opening	Driver Door Components	—
ABR	Outside Rearview Mirror - Passenger	—	On outside of passenger door, front middle, forward of window opening	Passenger Door Components	—
A10	Inside Rearview Mirror	DOB	In the passenger compartment, front center, mounted to top of windshield	Headboard Components	A10 Inside Rearview Mirror (DOB)
A11	Radio	—	In the passenger compartment, front right in instrument panel, rear instrument panel modules being right	Rear of Instrument Panel Components	- A11 Radio X1 - A11 Radio X2 - A11 Radio X3 - A11 Radio X4 (DPR or DPR) - A11 Radio X2 (DPR) - A11 Radio X4 (DPR)
A14D	Seat Lumbar Support Pump - Driver	—	In the passenger compartment, left forward of center, in driver seat back outboard side	Driver Seat Components	A14D Seat Lumbar Support Pump - Driver
A14P	Seat Lumbar Support Pump - Passenger	ABH	In the passenger compartment, right forward of center, in the passenger seat back outboard side	Passenger Seat Components	A14P Seat Lumbar Support Pump - Passenger (ABH)
A15	Starter/Generator	H96	In the engine compartment, right front of engine	—	- A15 Starter/Generator X1 (DPR) - A15 Starter/Generator X2 (DPR)
A22	Radio Controls	—	In the passenger compartment, center front, part of the info display module, in instrument panel, above HVAC controls	Front of Instrument Panel Components	—
A23D	Door Latch Assembly - Driver	—	Inside the driver door, at rear below middle	Driver Door Components	A23D Door Latch Assembly - Driver
A23R	Door Latch Assembly - Left Rear	—	Inside the left rear door, at rear below middle	Left Rear Door Components	A23R Door Latch Assembly - Left Rear
A23P	Door Latch Assembly - Passenger	—	Inside the passenger door, at rear below middle	Passenger Door Components	A23P Door Latch Assembly - Passenger
A23RR	Door Latch Assembly - Right Rear	—	Inside the right rear door, at rear below middle	Right Rear Door Components	A23RR Door Latch Assembly - Right Rear
A24D	Door Handle Assembly - Driver Exterior	ATH	On the outside of driver door, rear middle	Driver Door Components	A24D Door Handle Assembly - Driver Exterior (ATH)
A24LR	Door Handle Assembly - Left Rear Exterior	ATH	On the outside of left rear door, rear middle	Left Rear Door Components	A24LR Door Handle Assembly - Left Rear Exterior (ATH)
A24P	Door Handle Assembly - Passenger Exterior	ATH	On the outside of passenger door, rear middle	Passenger Door Components	A24P Door Handle Assembly - Passenger Exterior (ATH)
A24RR	Door Handle Assembly - Right Rear Exterior	ATH	On the outside of right rear door, rear middle	Right Rear Door Components	A24RR Door Handle Assembly - Right Rear Exterior (ATH)
A26	HVAC Controls	—	In the passenger compartment, front center, on instrument panel, below radio controls	Front of Instrument Panel Components	A26 HVAC Controls
A28	Radio Dtn Waver	—	In the passenger compartment, front center, on instrument panel, below and forward of radio controls	—	A28 Radio Dtn Waver
B1	A/C Refrigerant Pressure Sensor	—	At the front of vehicle, right of center, front of A/C condenser, mounted to right side rear bottom	Radiator Assembly Components	- B1 A/C Refrigerant Pressure Sensor (DPR or DPR) - B1 A/C Refrigerant Pressure Sensor (DOB)
B5LF	Wheel Speed Sensor - Left Front	—	At the left front suspension, mounted to knuckle, rearward of axle	Fuel Conversion Sensor, Wheel Speed Sensors and Parkings Brake	B5LF Wheel Speed Sensor - Left Front
B5LR	Wheel Speed Sensor - Left Rear	—	At the left rear suspension, mounted to knuckle, forward side	Fuel Conversion Sensor, Wheel Speed Sensors and Parkings Brake	B5LR Wheel Speed Sensor - Left Rear
B5RF	Wheel Speed Sensor - Right Front	—	At the right front suspension, mounted to knuckle, rearward of axle	Fuel Conversion Sensor, Wheel Speed Sensors and Parkings Brake	B5RF Wheel Speed Sensor - Right Front
B5RR	Wheel Speed Sensor - Right Rear	—	At the right rear suspension, mounted to knuckle, forward side	Fuel Conversion Sensor, Wheel Speed Sensors and Parkings Brake	B5RR Wheel Speed Sensor - Right Rear
B7D	Air Temperature Sensor - Duct Left Lower	C12	In the passenger compartment, within the instrument panel, center front, left side middle of HVAC assembly	HVAC Assembly Components (C12)	B7D Air Temperature Sensor - Duct Left Lower (C12)
B7L	Air Temperature Sensor - Duct Right Lower	C12	In the passenger compartment, within the instrument panel, center front, right side middle of HVAC assembly	HVAC Assembly Components (C12)	B7L Air Temperature Sensor - Duct Right Lower (C12)
B7U	Air Temperature Sensor - Duct Left Upper	C12	In the passenger compartment, within the instrument panel, center front, left side top of HVAC assembly	HVAC Assembly Components (C12)	B7U Air Temperature Sensor - Duct Left Upper (C12)
B7I	Air Temperature Sensor - Duct Right Upper	C12	In the passenger compartment, within the instrument panel, center front, right side top of HVAC assembly	HVAC Assembly Components (C12)	B7I Air Temperature Sensor - Duct Right Upper (C12)
B8	Ambient Air Temperature Sensor	—	At the front of vehicle, left of center, mounted to rear of lower grille	Front of Vehicle Components	B8 Ambient Air Temperature Sensor
B10B	Ambient Light/Sunload Sensor	—	In the passenger compartment, center front, in instrument panel, rear of windshield defroster outlet	Front of Instrument Panel Components	B10B Ambient Light/Sunload Sensor
B12A	Transmission Fluid Pressure Switch	—	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	—	—
B13	Transmission Fluid Temperature Sensor	—	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	—	—

Fig. 52: Master Electrical Component List Format
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** None at this time.

2. **Hotspot Link to Information:**

- A future update may include links to individual subsystem schematic(s) for each component/harness item.
- **Components**
- Links to individual locator view within one of the eight component view categories and will show where the component is located in the vehicle.
- Links to individual connector end view(s) within Component Connector End Views.
- **Electrical Centers (Fuse Blocks)**
- Links to individual locator view within one of the eight component view categories and will show where the component is located in the vehicle.
- Links to individual connector end view(s) within Electrical Center Identification Views.
- **Inline Harness Connectors**
- Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.

- Links to individual connector end view(s) within Inline Harness Connector End Views.
- **Grounds**
- Links to individual locator view within Ground Views component view and will show where the ground is located in the vehicle.
- **Splices**
- Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.
- **Splice Packs**
- Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.
- Links to individual connector end view(s) within Splice Pack Connector End Views.

Master Electrical Schematic Icons

While the master electrical schematic icons list format has not changed, it will continue to include icons used in the vehicle schematics along with the message for the icon.

Master Electrical Schematic Icons	
Icon	Icon Definition
	Warning: When performing service on or near the ESR components on the ESR wiring, the ESR system must be disabled. Refer to ESR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the ESR components, personal injury, or unnecessary ESR system repairs.
	Warning: When performing service on or near the pedestrian impact detection system (PIDS) components on the PIDS wiring, the PIDS must be disabled. Failure to observe the correct procedure could cause deployment of the PIDS components, serious injury can occur. Failure to observe the correct procedure could also result in unnecessary PIDS repairs.
	Warning: The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns: • Never open the high intensity discharge system ballast or the air tube assembly starter. • Never probe between the high intensity discharge system ballast output connector and the air tube assembly. Warning: To help avoid personal injury, always test the accessory power receptacle, accessory DC/AC power inverter module, AC circuit wires, and connectors as if AC high-voltage is present. DANGER: Always perform the high voltage Disabling procedure prior to servicing any high voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The high voltage Disabling procedure will perform the following tasks: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify conditions under which high voltage is where present and personal protection equipment (PPE) and proper procedures must be followed. Failure to follow the procedures exactly as written may result in serious injury or death.
	Caution: The connector at the component cannot be disconnected or removed without damage to the component. If the connector is removed, the entire component with jumper harness must be replaced.
	Refer: Tinned wires provide an effective shield that helps protect sensitive electronic components from electrical interference. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the tested wires shown: • The wires must be tinned a minimum of 80µm per 23 cm (12 in) as measured anywhere along the length of the wires. • The outside diameter of the tested wires must not exceed 6.0 mm (0.25 in).

Fig. 53: Master Electrical Wiring Schematic Icons List Format
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** None at this time.
2. **Hotspot Link to Information:** None at this time.

Schematic RPO Code List

The schematic RPO code list only includes RPOs shown in schematics and also includes the country groupings for the options. This list is in addition to the vehicle RPO Code List that is included in General Information.

Schematics RPO Code List

Schematics RPO Code List		
RPO	Description	Country Group
445	HEXKEY-SEAT ADJUSTER, HEXLOCK, POWER, DRIVER, PERSONALIZATION	U.S.A., PR and UEVI (NAH)
45C	ADJUSTER PASS ST-MANUAL, 4 WAY, PWR VERT	U.S.A., PR and UEVI (NAH);Canada (NBC)
46D	WINDOW PASS PASS DA-POWER OPERATED, EXPRESS DOWN	China
46F	WINDOW PASS PASS DA-POWER OPERATED, EXPRESS UP/DOWN	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE), China
46G	WINDOW-POWER OPERATED, KR DAS, EXPRESS DOWN	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
46R	WINDOW-POWER OPERATED, KR DAS, EXPRESS UP/DOWN	China
4P6	CONTROL-SEAT, MASSAGE, DRIVER	China
4D1	ADJUSTER PRT ST-POWER, MULTI-DIRECTIONAL, DRIVER	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4D2	ADJUSTER PASS ST-POWER, MULTI-DIRECTIONAL	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4P0	CONTROL-SEAT, POWER LUMBAR, LH	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4P4	CONTROL-SEAT, POWER LUMBAR, RH	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4B1	EQUIPMENT-SENSOR AIR NOISURE and H/D TEMP	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4TH	LOCK CONTROL, ENTRY-REMOTE ENTRY, EXTENDED RANGE, PASSIVE ENTRY, ALL DOORS	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4F8	Lock Control, Entry - Remote Entry, Standard Range, Passive Entry	China
467	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER AND PASS PRT, PRT SEAT SIDE AND KR SEAT SIDE, ROOF SIDE	U.S.A., PR and UEVI (NAH);Canada (NBC)
8TH	SWITCH-ENGINE START, KEYLESS	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
C87	HVAC SYSTEM-AIR CONDITIONER PRT, ELECTRONIC CONTROLS	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
C81	WIPER SYSTEM-WINDSHIELD, PULSE, NOISURE SENSITIVE	China
C84	WASHER-HEADLAMP, HIGH PRESSURE	China
CPS	ROOF-RUN GLASS, SLIDING, ELEC	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
C33	HVAC SYSTEM-AIR CONDITIONER PRT, AUTO TEMP CONT, AIR TEMP CONT	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
C32	COUNTRY-CHINA	China
C38	MIRROR SR R/L-Y-Z SENSITIVE	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
8P7	COUNTRY-UNITED STATES OF AMERICA (USA)	U.S.A., PR and UEVI (NAH)
P45	CHASSIS-CONTINUOUSLY VARIABLE REAL TIME SAMPLING	U.S.A., PR and UEVI (NAH);Canada (NBC)
P16	VEHICLE FUEL-GASOLINE 885	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4P6	HYBRID PROPULSION-ELECTRIC, RAKALUL, 14KW CONTINUOUS POWER	U.S.A., PR and UEVI (NAH);Canada (NBC)
J71	BRAKE PARKING-POWER OPERATED	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
K41	HEATER SEAT PRT-DRIVER and PASS	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
R04	RECEPTACLE-ELECTRICAL, PRT CONSOLE	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
R16	RECEPTACLE-ELECTRICAL, PRT CONSOLE KR 130 VOLT	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
R1J	CONTROL-CONSOLE, INFOTAINMENT, REDUNDANT CONTROLS, JOYSTICK	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
4TA	AUDIO INTERFACE	China
H21	VENTILATED SEAT-DRIVER-FRONT	U.S.A., PR and UEVI (NAH)
H23	VENTILATED SEAT-PASS-FRONT	U.S.A., PR and UEVI (NAH)
L4P	ENGINE-GAS, 4 CYL, 2.4L, 161, DOHC, VVT, ALUM, 99 - DO NOT USE AFTER 2013, USE L84	China
L2K	ENGINE-GAS, 4 CYL, 2.0L, 151, DOHC, TURBO-HD, VARIABLE CAMSHAFT PHASING - DO NOT USE AFTER 2013, USE L4P	China
L4U	ENGINE-GAS, 2.0L, 152, 161, DOHC TURBO, 885 MM, ALUM	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
L3U	ENGINE-GAS, 4 CYL, 1.8L, 161, DOHC, TURBO, PRT-ON, 132KW	China
L7D	ENGINE-GAS, 4 CYL, 2.0L, 161, ALUM, DOHC, 88W	China
L1K	ENGINE-GAS, 4 CYL, 2.4L, 161, ALUM, DOHC, 885, ECOTEC	U.S.A., PR and UEVI (NAH);Canada (NBC)
H04	TRANSMISSION-AUTO 6 SPD, AISEN-WARNER, AB-APAC, ELECTRONIC, 88W	U.S.A., PR and UEVI (NAH);Canada (NBC)
H08	TRANSMISSION-AUTO 6 SPD, HMD, 923P	U.S.A., PR and UEVI (NAH);Canada (NBC)
H09	TRANSMISSION-AUTO 6 SPD, HMD, 9M, 840+, 8740, HYBRID, PMS	U.S.A., PR and UEVI (NAH);Canada (NBC)
H06	TRANSMISSION-AUTO 6 SPD, 87SD	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
H06	TRANSMISSION-HAX 6 SPD, 87SD, 83MM, 3.92 LIT, 0.62 KTH (740 WH), REDUCE HELEX	U.S.A., PR and UEVI (NAH);Canada (NBC)
H01	STEERING-POWER, NON-VARIABLE RATIO, ELECTRIC	U.S.A., PR and UEVI (NAH);Canada (NBC)
H06	STEERING SYSTEM-CALIFORNIA, P2EV	U.S.A., PR and UEVI (NAH)
H07	STEERING-POWER, VARIABLE EFFORT	U.S.A., PR and UEVI (NAH);Canada (NBC);Mexico (MCE)
H0C	STEERING-POWER, VARIABLE EFFORT, REDUCED RACK TRAVEL	U.S.A., PR and UEVI (NAH);Canada (NBC)
T44	HEADLAMPS-HALOGEN	U.S.A., PR and UEVI (NAH);Canada (NBC)

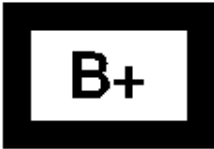
Fig. 54: Schematic RPO Code List
Courtesy of GENERAL MOTORS COMPANY

1. Mouse-over: None at this time.
2. Hotspot Link to Information: None at this time.

ELECTRICAL SCHEMATIC SYMBOLS

Voltage Indicators

Symbol	Description
--------	-------------

Symbol	Description
	Battery Voltage

Symbol	Description
	Ignition Switch - Off Position

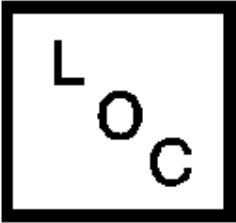
Symbol	Description
	Ignition Switch - Accessory Position

Symbol	Description
	Ignition Switch - Run Position

Symbol	Description
	Ignition Switch - Start Position

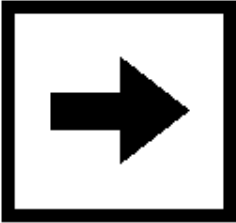
General Icons

Symbol	Description
--------	-------------

Symbol	Description
	Master Component List Icon This icon is used on the schematic to link to the Master Electrical Component List.

Symbol	Description
 A square icon with a thick black border. Inside the square, the letters 'D', 'E', 'S', and 'C' are arranged diagonally from the top-left to the bottom-right. The 'D' is at the top-left, 'E' is below and to the right of 'D', 'S' is below and to the right of 'E', and 'C' is at the bottom-right.	Description and Operation Icon This icon is used on the schematic to link to the Description and Operation of that particular system.

Symbol	Description
	Computer Programming Icon This icon is used on the schematic to link to Control Module References, which identifies which components need programming upon replacement.

Symbol	Description
	Next Schematic Page Icon This icon is used on the schematic to navigate to the next schematic in the subsystem.

Symbol	Description
	Previous Schematic Page Icon This icon is used on the schematic to navigate to the previous schematic in the subsystem.

Symbol	Description
 A black triangular warning icon containing a white silhouette of a person seated in a car seat, with a circular airbag inflating in front of them.	Supplemental Inflatable Restraint (SIR) or Supplemental Restraint System (SRS) Icon This icon is used to alert the technician that the system contains SIR/SRS components that require certain precautions before servicing.

Symbol	Description
	Information Icon This icon is used to alert the technician that there is additional information that will aid in servicing a system.

Symbol	Description
	Danger Icon This icon is intended to alert the technician that a component within the system contains labeling with the same icon. This icon is used when a source component has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.

Symbol	Description
	High Voltage Icon This icon is intended to alert the technician that a component within the system contains labeling with the same icon. This icon is used when a component/circuit has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.

Symbol	Description
	Caution Icon This icon is used to advise the technician to use caution when servicing this component. This icon may be used when a component/circuit has a voltage range potential between 30-60 volts DC or 15-42 volts AC.

Symbol	Description
	Functional Serial Data Communication This icon is used to show the technician that the serial data circuit detail is shown incomplete. It also provides an active link to the Data Communication Schematics where the circuit is shown complete.

Switch Position Icons

Symbol	Description
--------	-------------

Symbol	Description
	Generic Up Arrows

Symbol	Description
	Generic Down Arrows

Symbol	Description
	Generic Left Arrows

Symbol	Description
	Generic Right Arrows

Symbol	Description
	Generic Express Down Arrows

Symbol	Description
	On/Off Icon

Symbol	Description
	Generic Lock Icon

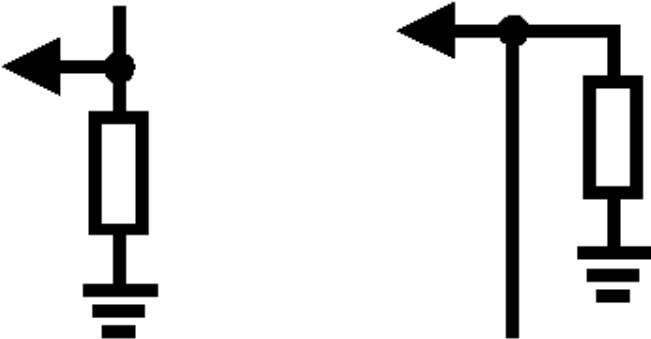
Symbol	Description
	Generic Unlock Icon

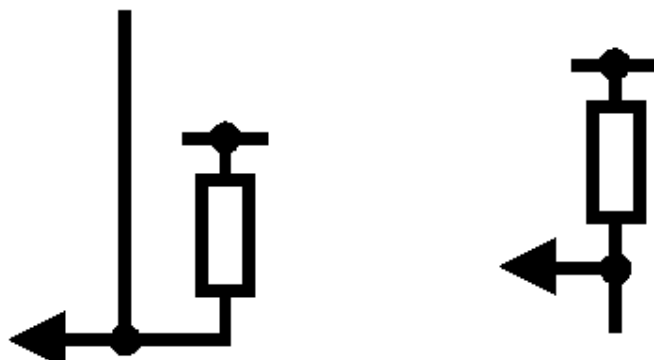
Symbol	Description
	Generic Window Switch Positions - 4 Door

Symbol	Description
	Generic Window Switch Positions - 2 Door

Module Circuit Function Icons

Symbol	Description
--------	-------------

Symbol	Description
	I/O Pull-Down Resistors (-)

Symbol	Description
	I/O Pull-Up Resistors (+)

Symbol	Description
	I/O High-Side Drive Switch (+)

Symbol	Description
	I/O Low-Side Drive Switch (+)

Symbol	Description
	I/O Bidirectional Switch (+/-)

Symbol	Description
	Pulse-Width Modulation Symbol

Symbol	Description
B+	Battery Voltage

Symbol	Description
IGN	Ignition Voltage

Symbol	Description
5V	Voltage Reference

Symbol	Description
5V AC	A/C Voltage

Symbol	Description
	Low Reference
	

Symbol	Description
	Ground

Symbol	Description
	Serial Data

Symbol	Description
 The image contains two antenna symbols. The symbol on the left consists of a vertical line with a downward-pointing arrowhead and a horizontal line with a downward-pointing arrowhead. The symbol on the right consists of a vertical line with an upward-pointing arrowhead and a horizontal line with an upward-pointing arrowhead.	Antenna Signal - In

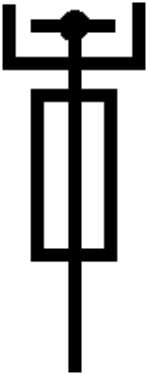
Symbol	Description
	Antenna Signal - Out

Symbol	Description
	Brake Apply

Harness Components

Symbol	Description
--------	-------------

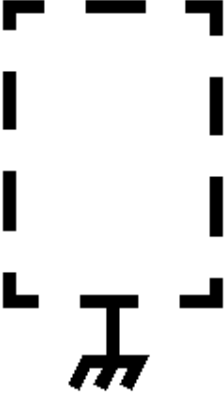
Symbol	Description
	Fuse

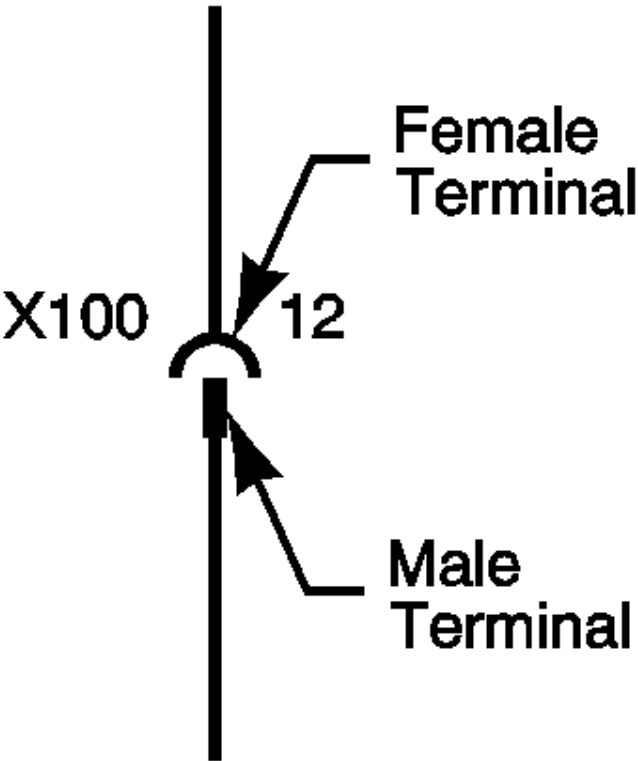
Symbol	Description
PWR/TRN Relay 	Fuse Supplied by a Relay

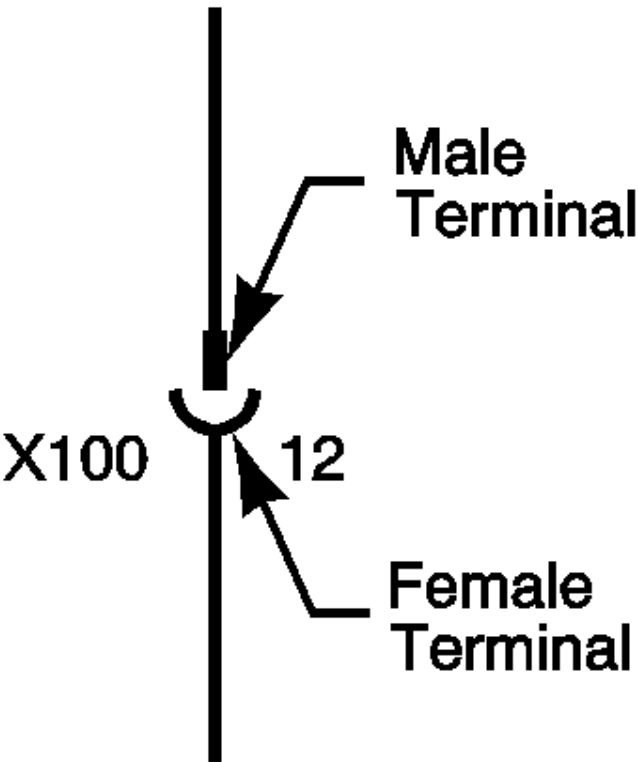
Symbol	Description
	Circuit Breaker

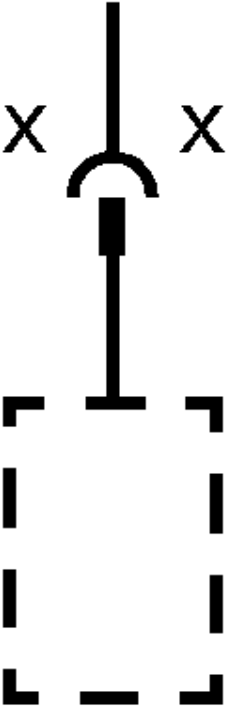
Symbol	Description
	Fusible Link

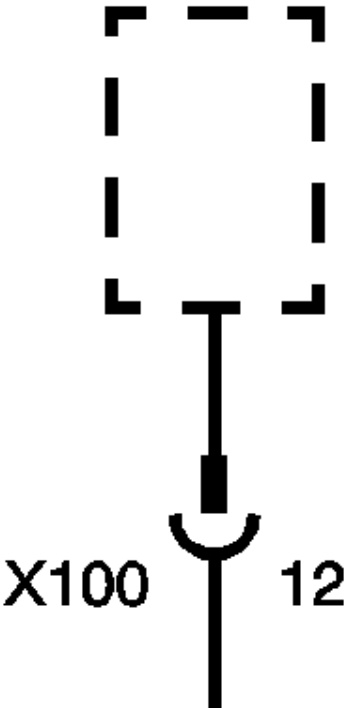
Symbol	Description
	Ground

Symbol	Description
	Case Ground

Symbol	Description
 The symbol depicts a vertical line representing a wire. A semi-circular bump is located on the left side of this line. An arrow points from the text 'Female Terminal' to the top of the bump, which is also labeled with the number '12'. Another arrow points from the text 'Male Terminal' to the bottom of the bump. The label 'X100' is positioned to the left of the bump.	Inline Harness Connector

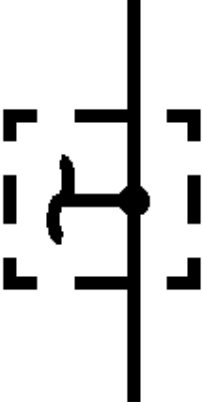
Symbol	Description
 X100 12 Male Terminal Female Terminal	Inline Harness Connector

Symbol	Description
 The diagram shows a vertical line with a semi-circular arc at its base. Two 'X' marks are positioned on either side of the arc. Below the vertical line is a dashed rectangular box. The vertical line terminates at the top center of this dashed box.	Pigtail Connection

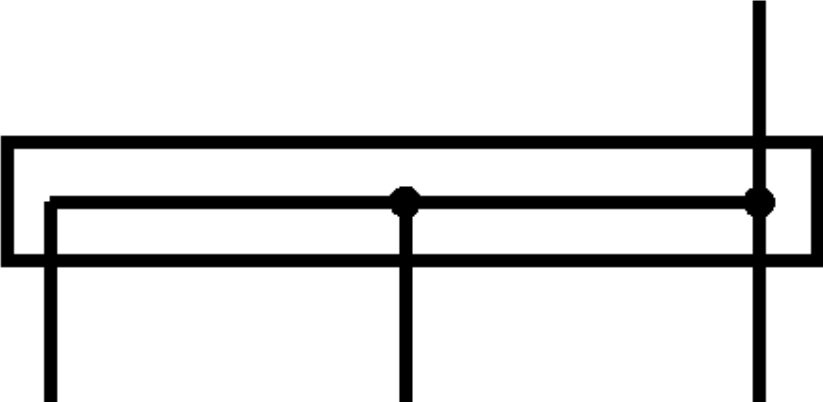
Symbol	Description
 The symbol depicts a pigtail connection. It features a dashed rectangular box at the top. A vertical line descends from the center of the bottom edge of this box, passing through a small solid black rectangle. Below this rectangle is a semi-circular arc, and a final vertical line extends downwards from the center of the arc. To the left of the semi-circular arc is the text 'X100', and to the right is the number '12'.	Pigtail Connection

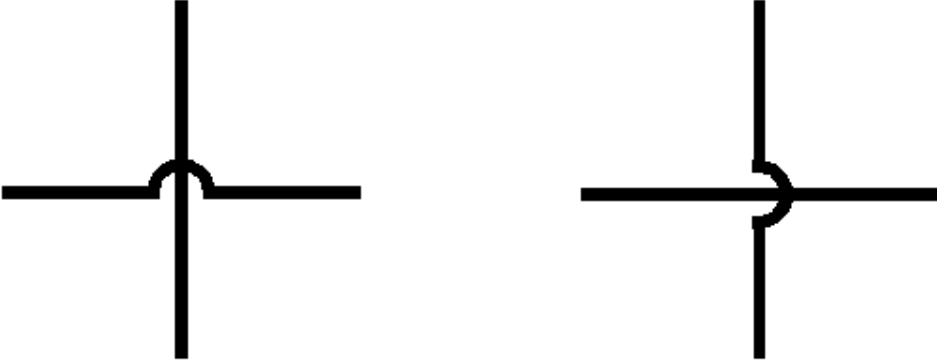
Symbol	Description
	Provisional or Diagnostic Connector

Symbol	Description
	Blunt Cut Wire

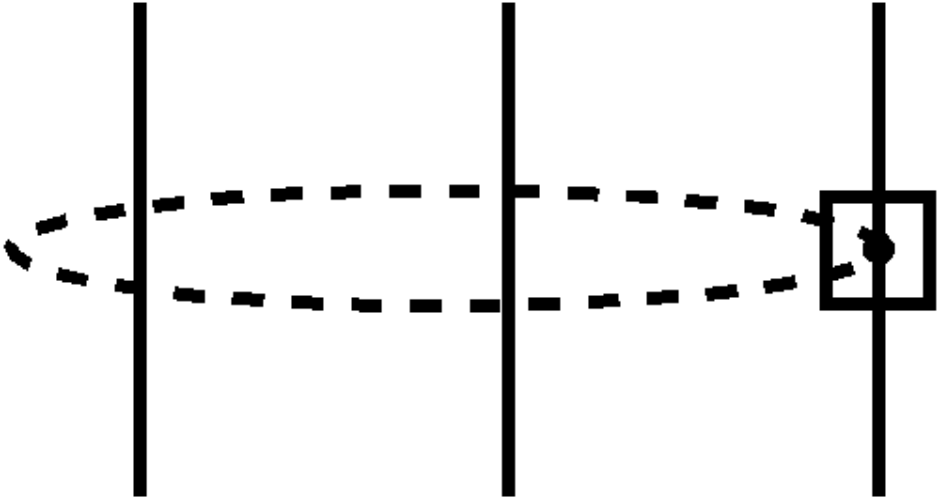
Symbol	Description
	Incomplete Physical Splice

Symbol	Description
	Complete Physical Splice - 2 Wires

Symbol	Description
 The symbol consists of three horizontal lines representing wires. The top and bottom lines are connected at both ends by vertical lines, forming a rectangular frame. A third horizontal line is positioned between them. Two solid black dots are placed on the middle horizontal line, one at the center and one at the right end, indicating connection points for additional wires.	Complete Physical Splice - 3 or more wires

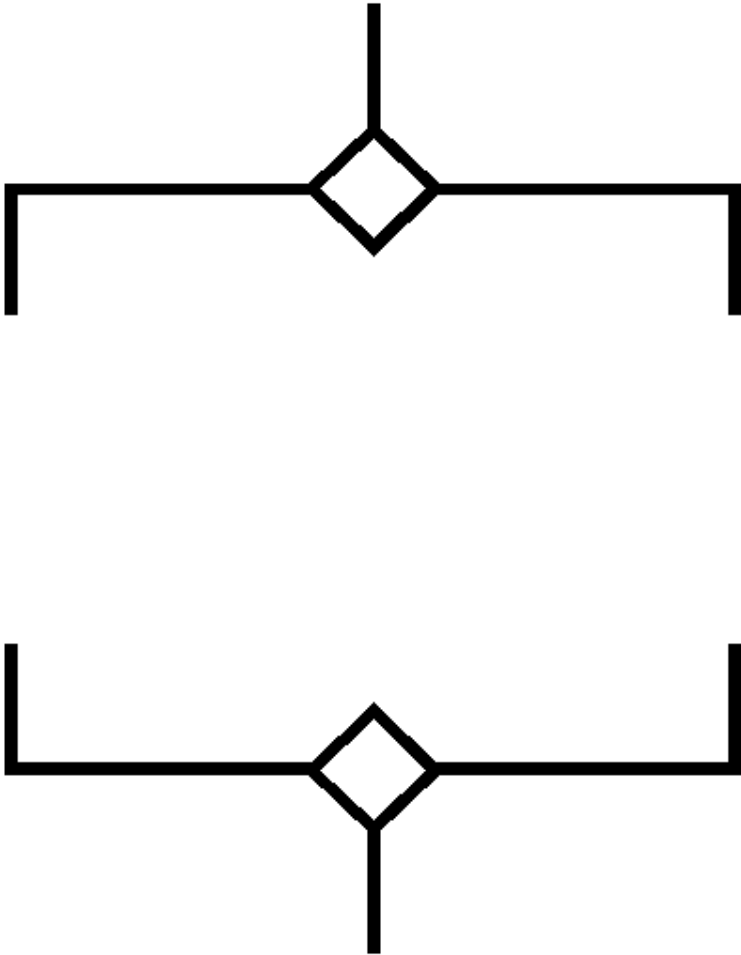
Symbol	Description
	Wire Crosses

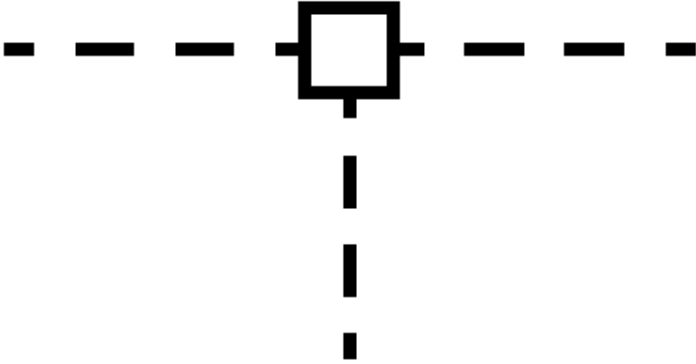
Symbol	Description
	Twisted Wires

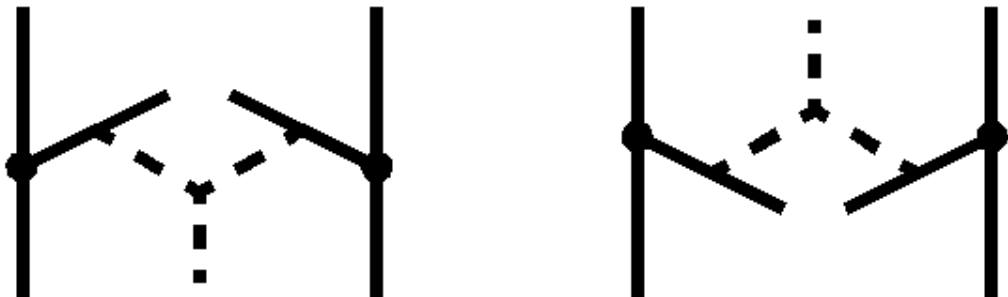
Symbol	Description
	Shield

Symbol	Description
	Circuit References
	
	
	

Symbol	Description
	Circuit Continuation Arrowheads

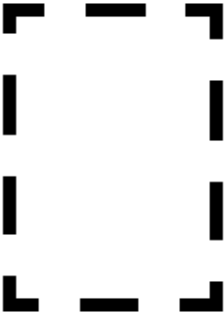
Symbol	Description
	Option Breakpoint

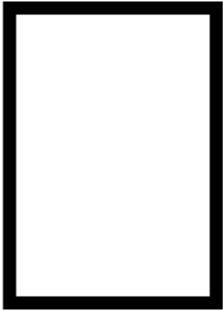
Symbol	Description
 The symbol consists of a central square with a thick border. A horizontal dashed line passes through the center of the square. A vertical dashed line extends downwards from the bottom center of the square.	Ground Circuit Connection

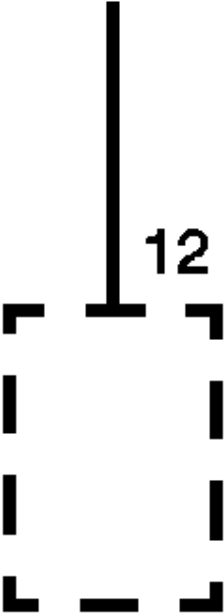
Symbol	Description
	Connector Shorting Clip

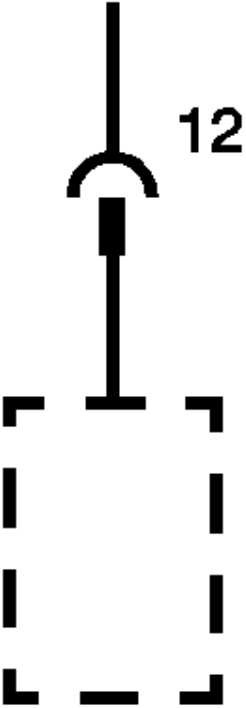
Component Parts

Symbol	Description
--------	-------------

Symbol	Description
	Partial Component When a component is represented in a dashed box, the component or its wiring is not shown in its entirety.

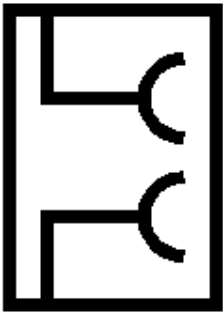
Symbol	Description
	Entire Component When a component is represented in a solid box the component or its wiring is shown in its entirety.

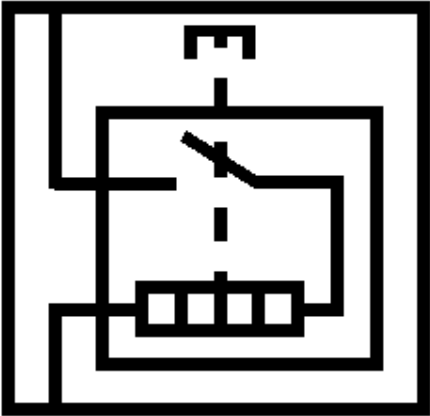
Symbol	Description
	Connector Directly Attached to Component

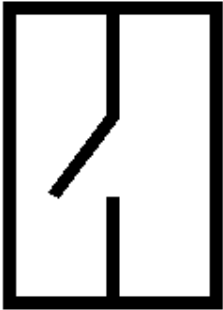
Symbol	Description
 The symbol for a Pigtail Connector consists of a vertical line at the top, followed by a semi-circular arc, then a small rectangular block, and another vertical line. To the right of the top vertical line is the number '12'. Below this assembly is a dashed rectangular box with L-shaped corner markers at each of the four corners.	Pigtail Connector

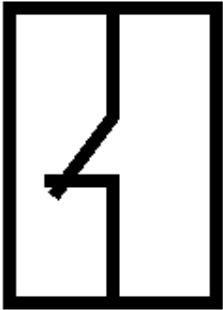
Switches and Relays

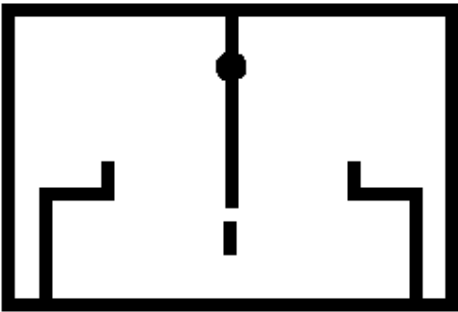
Symbol	Description
--------	-------------

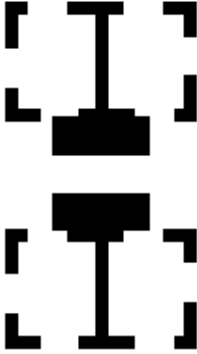
Symbol	Description
	Accessory Power Outlet

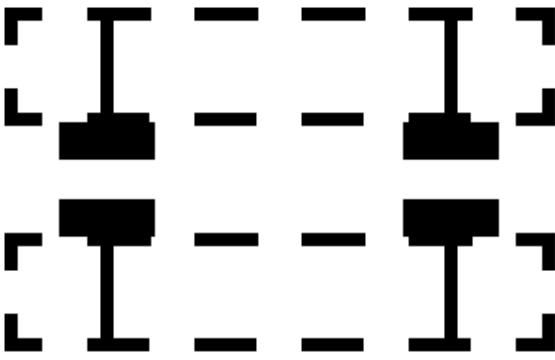
Symbol	Description
	Cigar Lighter

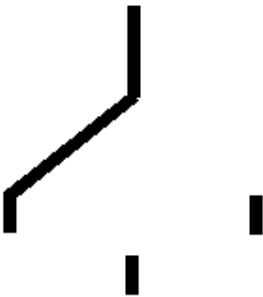
Symbol	Description
	Switch - 2 Position Normally Open

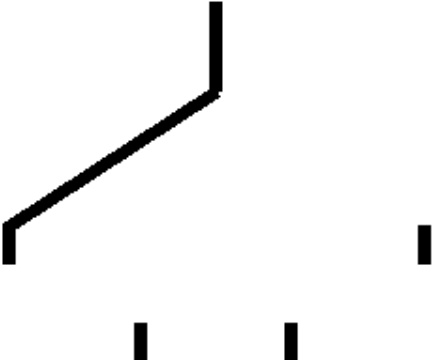
Symbol	Description
	Switch - 2 Position Normally Closed

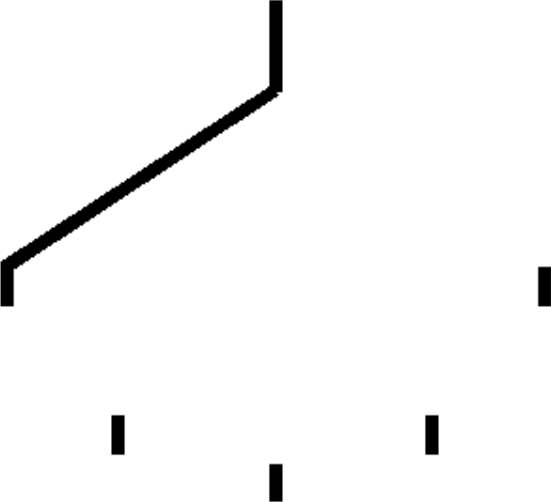
Symbol	Description
	Switch - Rocker

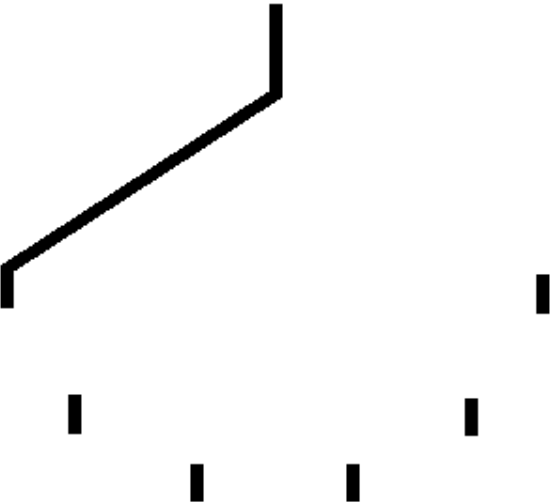
Symbol	Description
 The symbol consists of two identical vertical components arranged one above the other. Each component features a central vertical line with a horizontal bar at its top and bottom. These horizontal bars are connected to a central rectangular contact plate. The entire assembly is enclosed within a dashed rectangular border.	Switch - Contact Plate (1 Wire)

Symbol	Description
	Switch - Contact Plate (2 Wire)

Symbol	Description
	Switch - 3 Position

Symbol	Description
	Switch - 4 Position

Symbol	Description
	Switch - 5 Position

Symbol	Description
	Switch - 6 Position

Symbol	Description
	Switch Actuator - Push (Momentary)

Symbol	Description
	Switch Actuator - Push (Latching)

Symbol	Description
	Switch Actuator - Pull (Momentary)

Symbol	Description
	Switch Actuator - Pull (Latching)

Symbol	Description
	Switch Actuator - Rotate (Momentary)

Symbol	Description
	Switch Actuator - Rotate (Latching)

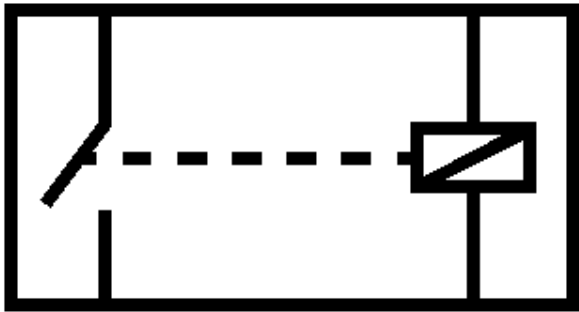
Symbol	Description
	Switch Actuator - Slide (Momentary)

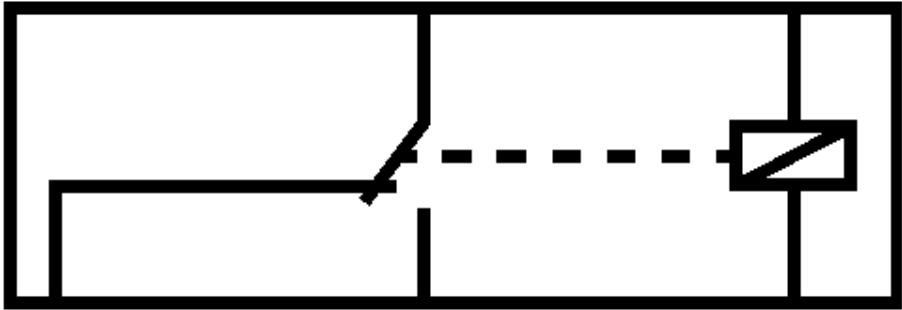
Symbol	Description
	Switch Actuator - Slide (Latching)

Symbol	Description
	Switch Actuator - Pressure (Momentary)

Symbol	Description
	Switch Actuator - Temperature (Momentary)

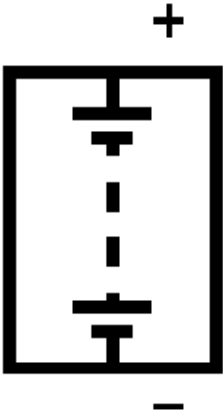
Symbol	Description
	Switch Actuator - Volume (Latching)

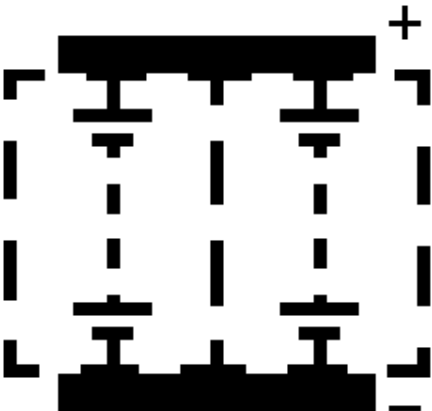
Symbol	Description
 The symbol is a schematic representation of a 4-pin single pole/throw relay in its normally open state. It is enclosed in a rectangular frame. On the left side, there are two vertical lines representing the input terminals. A diagonal line, representing the relay's contact, starts from the upper input terminal and extends towards the right. This line is dashed for most of its length and becomes solid as it enters a small rectangular box on the right side. This box represents the relay's coil, which is connected to two more vertical lines on the right side, representing the output terminals. The diagonal line is positioned such that the circuit is open.	4-Pin Single Pole/Throw Relay - Normally Open

Symbol	Description
 The diagram shows a 5-pin relay symbol. It consists of a large rectangle divided into three vertical sections. The leftmost section contains a horizontal line with a vertical step down on its left side. The middle section contains a diagonal line with an arrow pointing towards the right. The rightmost section contains a rectangle with a diagonal line from the bottom-left to the top-right. A dashed line connects the arrow in the middle section to the rectangle in the rightmost section.	5-Pin Relay - Normally Closed

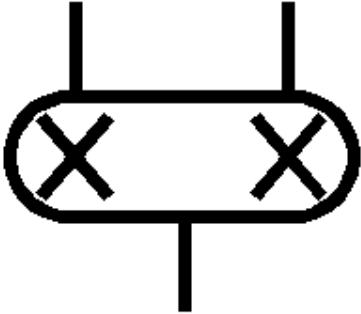
Devices and Sensors

Symbol	Description
--------	-------------

Symbol	Description
	Battery

Symbol	Description
 The symbol for a Battery Assembly - Hybrid is a schematic representation of a battery pack. It consists of a central 3x2 grid of six individual cell symbols. Each cell is represented by a long vertical line (positive terminal) and a shorter horizontal line (negative terminal). The cells are connected in a series-parallel configuration. The entire grid is enclosed within a dashed rectangular border. Above the top-right corner of the dashed border is a '+' sign, and below the bottom-right corner is a '-' sign, indicating the overall polarity of the assembly.	Battery Assembly - Hybrid

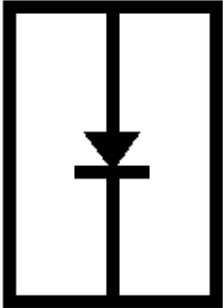
Symbol	Description
	Single Filament Light Bulb

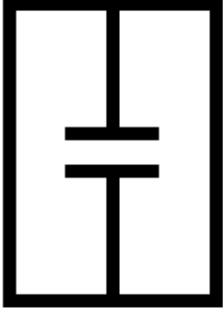
Symbol	Description
	Double Filament Light Bulb

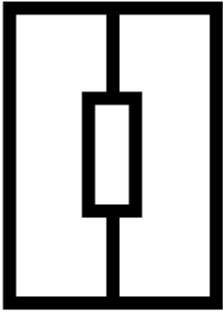
Symbol	Description
	Light Emitting Diode (LED)

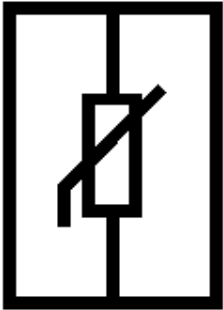
Symbol	Description
	Photo Sensor

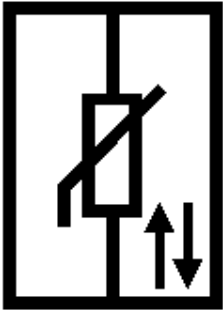
Symbol	Description
	Gauge

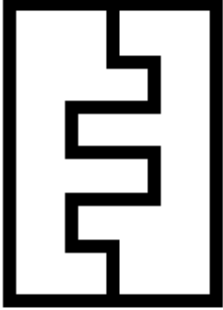
Symbol	Description
	Diode

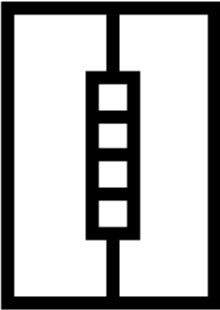
Symbol	Description
	Capacitor

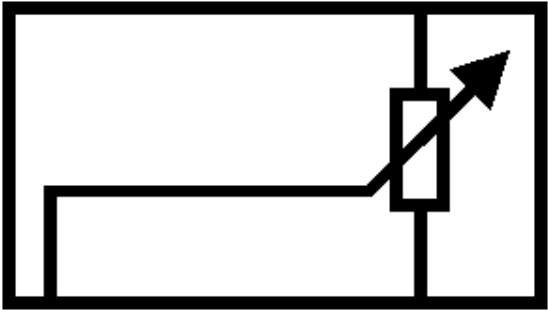
Symbol	Description
 The image shows a standard electronic symbol for a resistor. It consists of a large rectangle with a smaller rectangle centered inside it. The smaller rectangle is oriented vertically, while the larger one is oriented horizontally. This symbol is used to represent a resistor in circuit diagrams.	Resistor

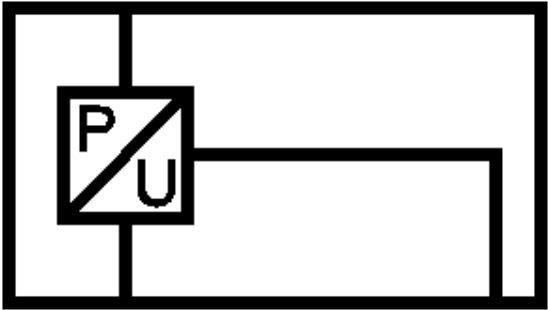
Symbol	Description
	Variable Resistor

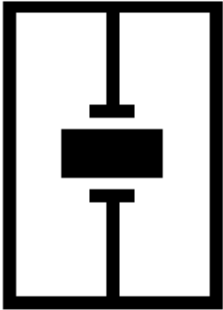
Symbol	Description
 The symbol consists of a rectangular box. Inside the box, there is a resistor symbol (a rectangle with a diagonal line through it). To the right of the resistor symbol, there are two vertical arrows, one pointing up and one pointing down, indicating a variable resistance. The entire symbol is enclosed in a square frame.	Variable Resistor - NTC

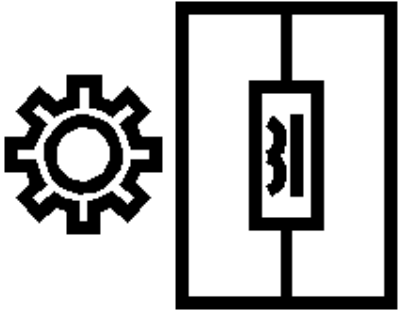
Symbol	Description
	Breakable Wire

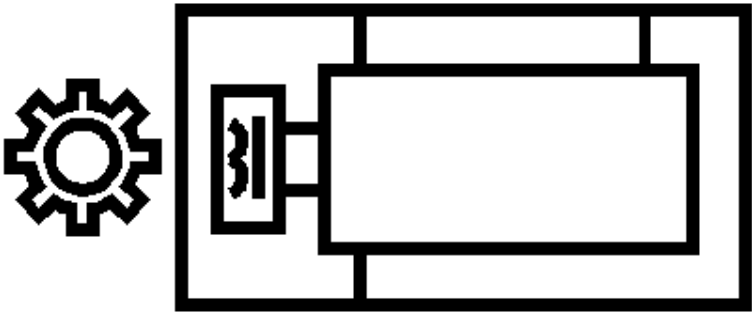
Symbol	Description
	Heating Element

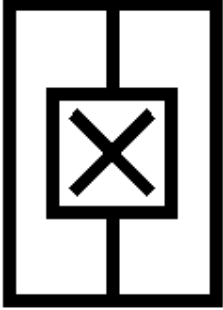
Symbol	Description
 A schematic symbol for a position sensor. It consists of a large rectangle containing a smaller rectangle on the right side. A horizontal line extends from the left side of the smaller rectangle to the left edge of the large rectangle. An arrow points diagonally upwards and to the right, passing through the smaller rectangle.	Position Sensor

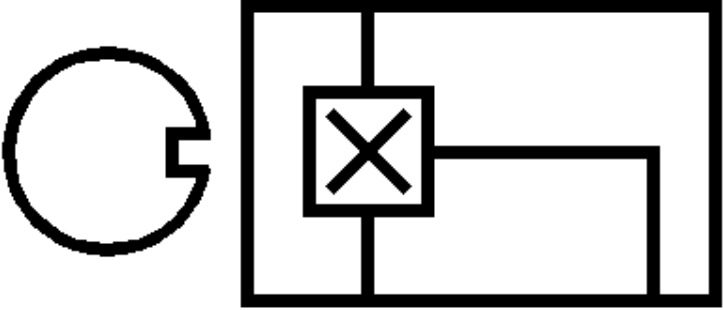
Symbol	Description
 The symbol for a pressure sensor is a rectangular box. Inside the box, on the left side, is a smaller square. This square is divided diagonally from the top-left corner to the bottom-right corner. The upper-left triangle of this square contains the letter 'P', and the lower-right triangle contains the letter 'U'. To the right of this square, a horizontal line extends from the middle of the square to the right edge of the main rectangular box. The top and bottom lines of the main rectangular box are continuous across the entire width of the symbol.	Pressure Sensor

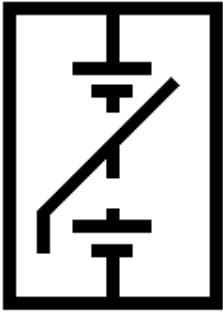
Symbol	Description
 A schematic symbol for a knock sensor. It consists of a central rectangular block with a vertical line passing through its center. The line has a small horizontal bar at the top and bottom, resembling a T-junction. This entire assembly is enclosed within a square frame.	Knock Sensor

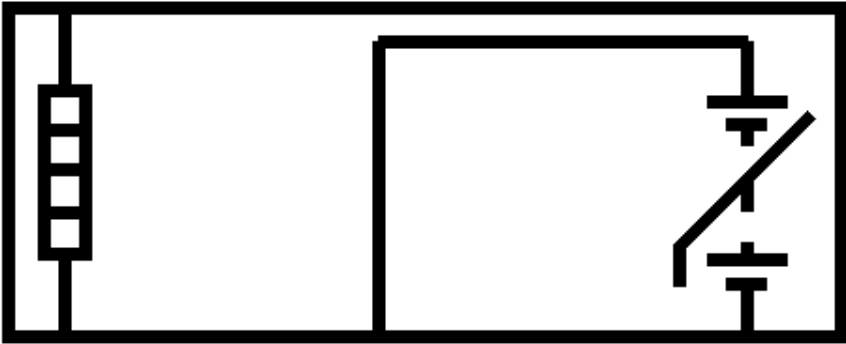
Symbol	Description
 The symbol consists of a gear icon on the left, representing an inductive sensor, and a rectangular box on the right. Inside the box is a vertical line with a small rectangle in the center, which contains a stylized '3' or 'I' shape, representing a 2-wire connection.	Inductive Type Sensor - 2-Wire

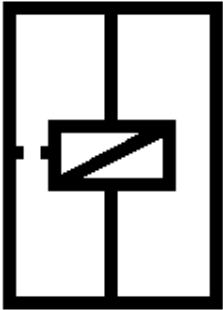
Symbol	Description
 The symbol consists of a gear icon on the left, representing a mechanical part. To its right is a rectangular box containing a smaller rectangle. Inside this smaller rectangle is a stylized '3' followed by a vertical line, indicating a 3-wire configuration. The entire assembly is enclosed within a larger rectangular frame with horizontal and vertical lines extending from the inner box, suggesting electrical connections.	Inductive Type Sensor - 3-Wire

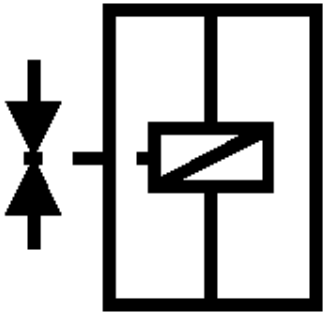
Symbol	Description
	Hall Effect Sensor - 2-Wire

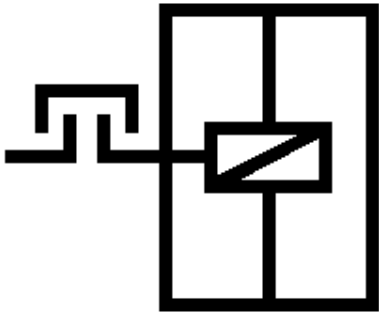
Symbol	Description
	Hall Effect Sensor - 3-Wire

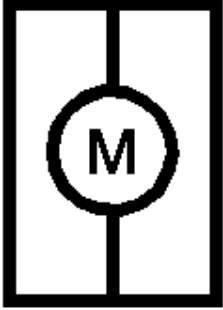
Symbol	Description
 The symbol for a 2-wire oxygen sensor is enclosed in a square box. It features a diagonal line from the bottom-left to the top-right. On the left side of the diagonal line, there are two horizontal bars, one above the other, representing electrical terminals. On the right side of the diagonal line, there are also two horizontal bars, one above the other, representing electrical terminals.	Oxygen Sensor - 2-Wire

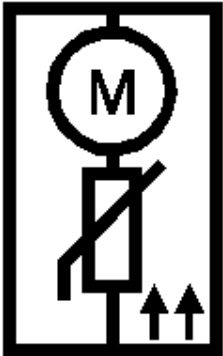
Symbol	Description
	Heated Oxygen Sensor - 4-Wire

Symbol	Description
 A schematic symbol for a solenoid actuator. It consists of a square frame divided into four quadrants by a vertical line. In the center, there is a smaller square containing a diagonal line from the bottom-left to the top-right. To the left of this central square, there is a small horizontal rectangle with a dot in its center, representing a solenoid coil.	Solenoid - Actuator

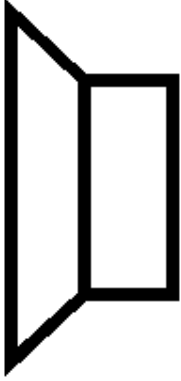
Symbol	Description
	Solenoid - Valve

Symbol	Description
 A hydraulic symbol for a clutch valve. It consists of a rectangular body divided into four quadrants by a vertical line. A diagonal line runs from the bottom-left to the top-right of the right half. To the left of the body is a horizontal line with a stepped, zig-zag profile.	Clutch

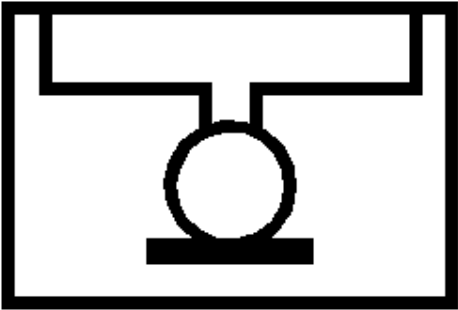
Symbol	Description
	Motor

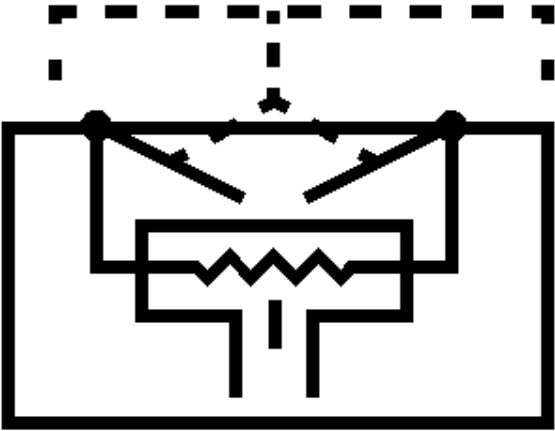
Symbol	Description
 The symbol is enclosed in a rectangular frame. At the top is a circle containing the letter 'M'. Below the circle is a rectangular component with a diagonal line through it, representing a PTC. At the bottom of the frame are two upward-pointing arrows.	Motor with PTC

Symbol	Description
	Antenna

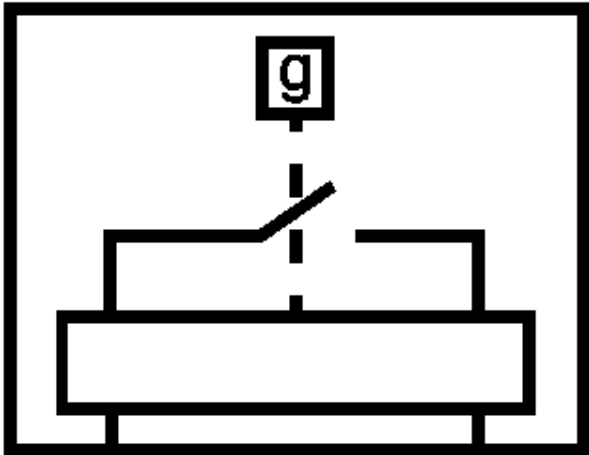
Symbol	Description
 A black outline symbol of a speaker, consisting of a trapezoidal shape with a smaller rectangle inside, representing a sound source.	Speaker

Symbol	Description
	Horn

Symbol	Description
 A black and white line drawing of a microphone. It features a circular head with a small circle in the center, mounted on a rectangular base. The entire microphone is enclosed within a square frame that has a horizontal bar across the top, resembling a stand or a mounting bracket.	Microphone

Symbol	Description
	Airbag

Symbol	Description
	SIR Coil

Symbol	Description
	SIR Impact Sensor

VEHICLE ZONING STRATEGY

All grounds, in-line connectors, and splices have identifying numbers that correspond to where they are located in the vehicle. The following table explains the numbering system.

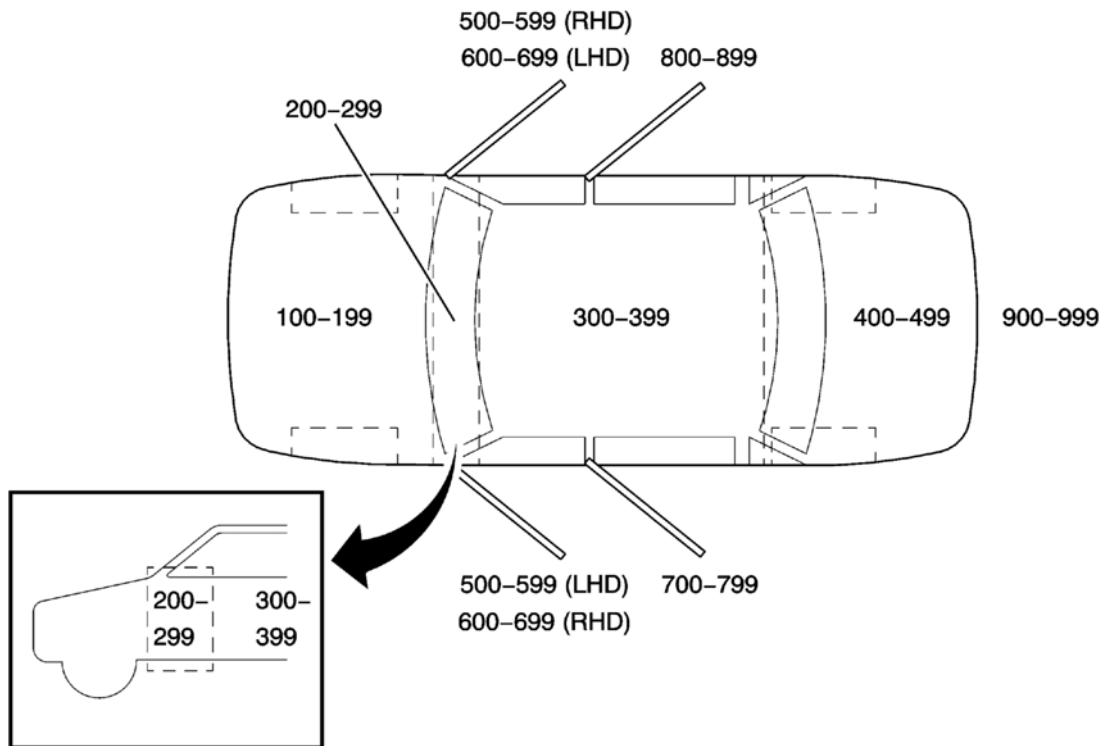


Fig. 55: Passenger Car Zoning View

Courtesy of GENERAL MOTORS COMPANY

Callout Numbers	Zone Description
100-199	Engine compartment (all forward of the instrument panel)
200-299	Within the instrument panel area (between the bulkhead and the front plane of the instrument panel)
300-399	Passenger compartment (from instrument panel to the back of the rear seats)
400-499	Luggage compartment (from the back of the rear seats to the rear of the vehicle)
500-599	Inline harness connectors to or within the driver door
600-699	Inline harness connectors to or within the front passenger door
700-799	Inline harness connectors to or within the left rear door
800-899	Inline harness connectors to or within the right rear door
900-999	Inline harness connectors to or within the luggage compartment lid or hatch

SCHEMATICS RPO CODE LIST

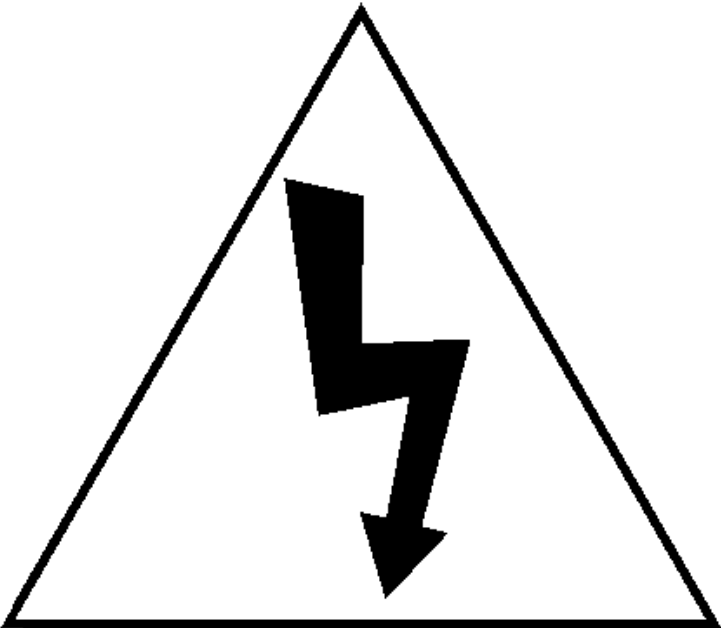
RPO	Option Name
62G	ACCESSORY-ACCENT LIGHTING - FRONT EXTERIOR
D71	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING

RPO	Option Name
DLW	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED
IO5	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY
IO6	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY, EMBEDDED NAVIGATION
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
KA1	HEATER SEAT FRT-DRVR and PASS
KA6	HEATER SEAT-REAR
TQ5	HEADLAMP HIGH BEAM-AUTO CONTROL
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UGN	COLL IMMINENT BRK-ALL SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER
UVC	VISION-REAR VIEW, MONO, ANALOG
UVD	STEERING WHEEL HEAT-MANUAL
UZ6	SPEAKER SYSTEM-6, PREMIUM
V7Y	SALES PACKAGE-#2

MASTER ELECTRICAL SCHEMATIC ICONS

Icon	Icon Definition
-------------	------------------------

Icon	Icon Definition
	WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

Icon	Icon Definition
	WARNING: The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns: • Never open the high intensity discharge system ballast or the arc tube assembly starter. • Never probe between the high intensity discharge system ballast output connector and the arc tube assembly. WARNING: To help avoid personal injury, always treat the accessory power

Icon	Icon Definition
	receptacle, accessory DC/AC power inverter module, AC circuit wires, and connectors as if AC high-voltage is present. WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure will perform the following tasks: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage.

Icon	Icon Definition
	Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Failure to follow the procedures exactly as written may result in serious injury or death.
	WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: - Identify how to disable high voltage. - Identify how to test for the presence of high voltage. - Identify

Icon	Icon Definition
	condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the

Icon	Icon Definition
	high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death.
	NOTE: Twisted wires provide an effective shield that helps protect sensitive electronic components from electrical interference. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted wires shown : • The wires must be twisted a minimum of 16

Icon	Icon Definition
	turns per 31 cm (12 in) as measured anywhere along the length of the wires. • The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).

POWER DISTRIBUTION WIRING SCHEMATICS

X50A Fuse Block - Underhood Bussing

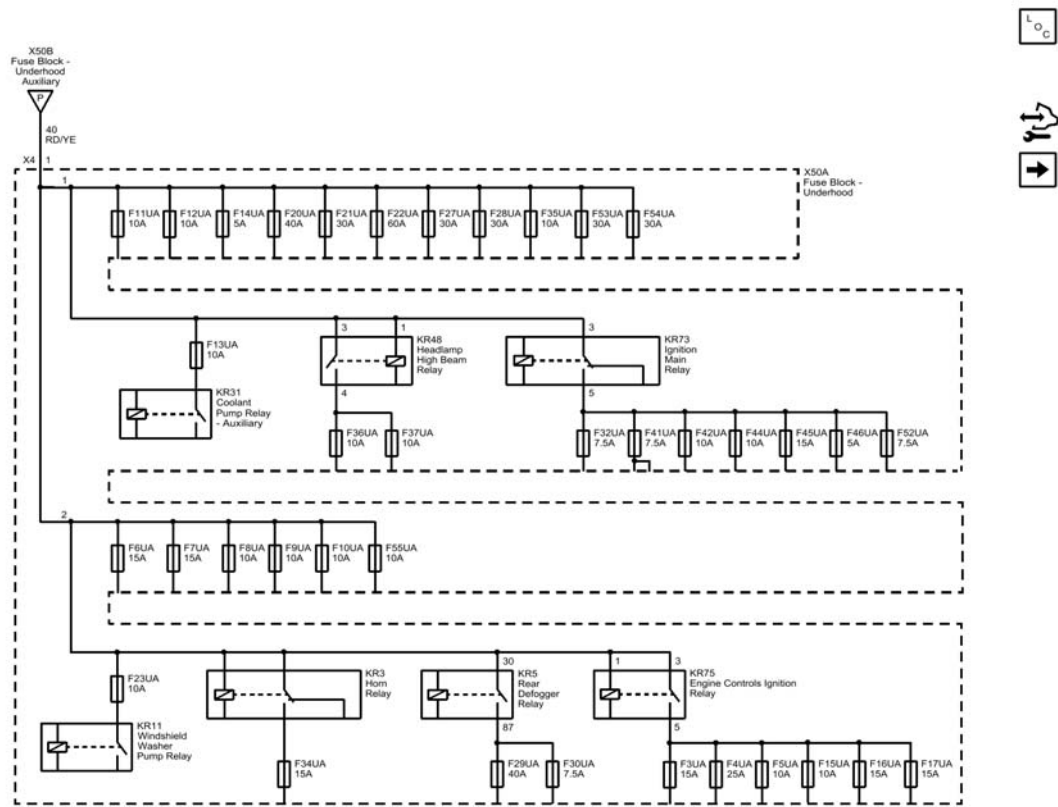


Fig. 56: X50A Fuse Block - Underhood Bussing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Battery Positive Voltage
2_RD/YE	2 RD/YE
P_REF	P
F21UA	F21UA 30A
F22UA	F22UA 60A
F27UA	F27UA 30A
F28UA	F28UA 30A
F35UA	F35UA 10A
F44UA	F44UA 10A
F46UA	F46UA 5A
F53UA	F53UA 30A
F54UA	F54UA 30A
F55UA	F55UA 10A
F36UA	F36UA 10A
F37UA	F37UA 10A
F34UA	F34UA 15A
F7UA	F7UA 15A
F8UA	F8UA 10A
F6UA	F6UA 15A
F32UA	F32UA 7.5A
F41UA	F41UA 7.5A
F42UA	F42UA 10A
F45UA	F45UA 15A
F52UA	F52UA 7.5A
F30UA	F30UA 7.5A
F29UA	F29UA 40A
F3UA	F3UA 15A
F4UA	F4UA 25A
F5UA	F5UA 10A
F9UA	F9UA 10A
F10UA	F10UA 10A
F11UA	F11UA 10A
F12UA	F12UA 10A
F14UA	F14UA 5A
F15UA	F15UA 10A
F16UA	F16UA 15A
F17UA	F17UA 15A
F20UA	F20UA 40A
F13UA	F13UA 10A
F23UA	F23UA 10A
KR48	KR48 Headlamp High Beam Relay
X50B	X50B Fuse Block - Underhood Auxiliary

Callout	Component Name
KR75	KR75 Engine Controls Ignition Relay
KR73	KR73 Ignition Main Relay
KR5	KR5 Rear Defogger Relay
KR3	KR3 Horn Relay
X50A	X50A Fuse Block - Underhood
KR31	KR31 Auxiliary Coolant Pump Relay
KR11	KR11 Windshield Washer Pump Relay

X50D Fuse Block - Battery and X50B Fuse Block - Underhood Auxiliary Bussing

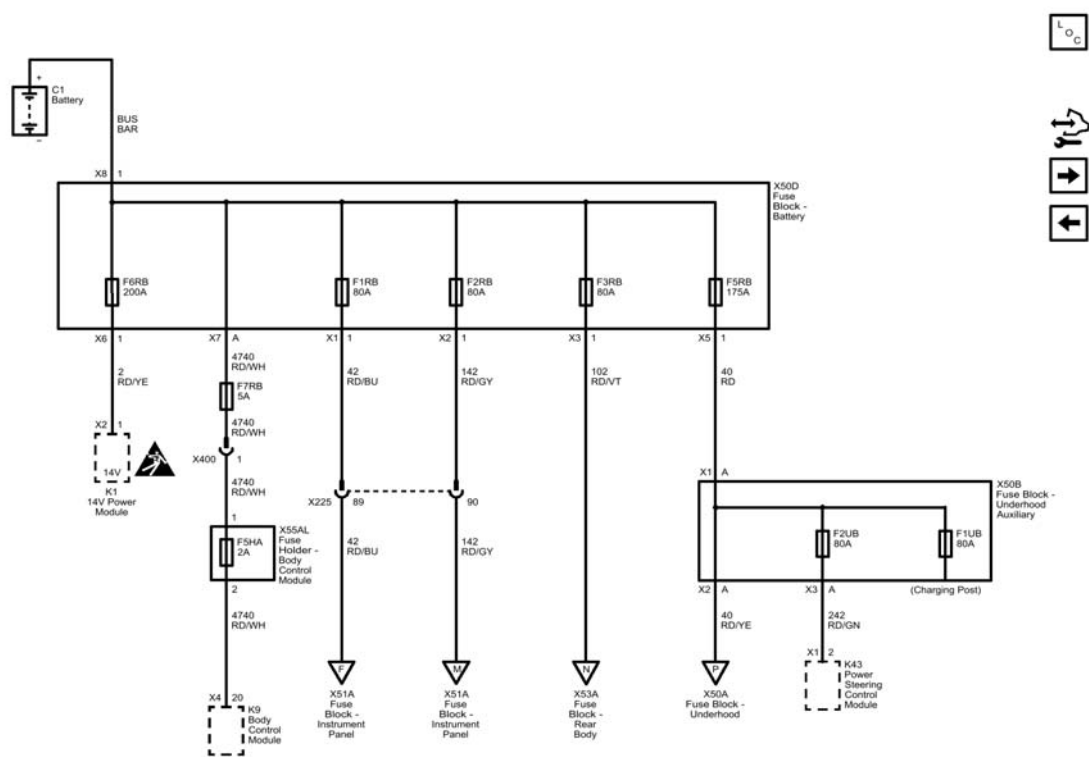


Fig. 57: X50D Fuse Block - Battery and X50B Fuse Block - Underhood Auxiliary Bussing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Battery Positive Voltage
2_RD/YE	2 RD/YE
CONN_X2	X2
CAV_A	A
CONN_X6	X6
4740	Battery Positive Voltage
42	Battery Positive Voltage
42_RD/BU	42 RD/BU
CAV_A	A

Callout	Component Name
CONN_X1	X1
142	Battery Positive Voltage
142_RD/GY	142 RD/GY
CAV_A	A
CONN_X2	X2
102	Battery Positive Voltage
102_RD/VT	102 RD/VT
CAV_A	A
CONN_X3	X3
40	Battery Positive Voltage
40_RD	40 RD
CAV_A	A
CONN_X1	X1
CAV_A	A
CONN_X5	X5
2_RD/YE	2 RD/YE
CAV_A	A
CONN_X2	X2
242	Battery Positive Voltage
242_RD/GN	242 RD/GN
CAV_2	2
CONN_X1	X1
CAV_A	A
CONN_X3	X3
42_RD/BU	42 RD/BU
142_RD/GY	142 RD/GY
CAV_20	20
CAV_1	1
CONN_X4	X4
BUS	BUS
BUS_BAR	BUS BAR
CAV_A	A
CONN_X8	X8
4740_RD/WH	4740 RD/WH
4740_RD/WH	4740 RD/WH
CAV_A	A
Â	Â
X225	X225
CAV_89	89
CAV_90	90
F_REF	F
M_REF	M
N_REF	N
P_REF	P

Callout	Component Name
F1RB	F1RB 80A
F2RB	F2RB 80A
F5RB	F5RB 175A
F3RB	F3RB 80A
F2UB	F2UB 80A
F1UB	F1UB 80A
X400	X400
F6RB	F6RB 200A
F7RB	F7RB 5A
X7	X7
F5HA	F5HA 2A
X225	X225
X50D	X50D Fuse Block - Battery
X50B	X50B Fuse Block - Underhood Auxiliary
K43	K43 Power Steering Control Module
X53A	X53A Fuse Block - Rear Body
X50A	X50A Fuse Block - Underhood
X51A	X51A Fuse Block - Instrument Panel
X51A	X51A Fuse Block - Instrument Panel
K9	K9 Body Control Module
K1	K1 14V Power Module
C1	C1 Battery
X55AL	X55AL

F3UA, F4UA, F5UA, F10UA, F15UA, F16UA, F17UA, F22UA and F27UA Fuses

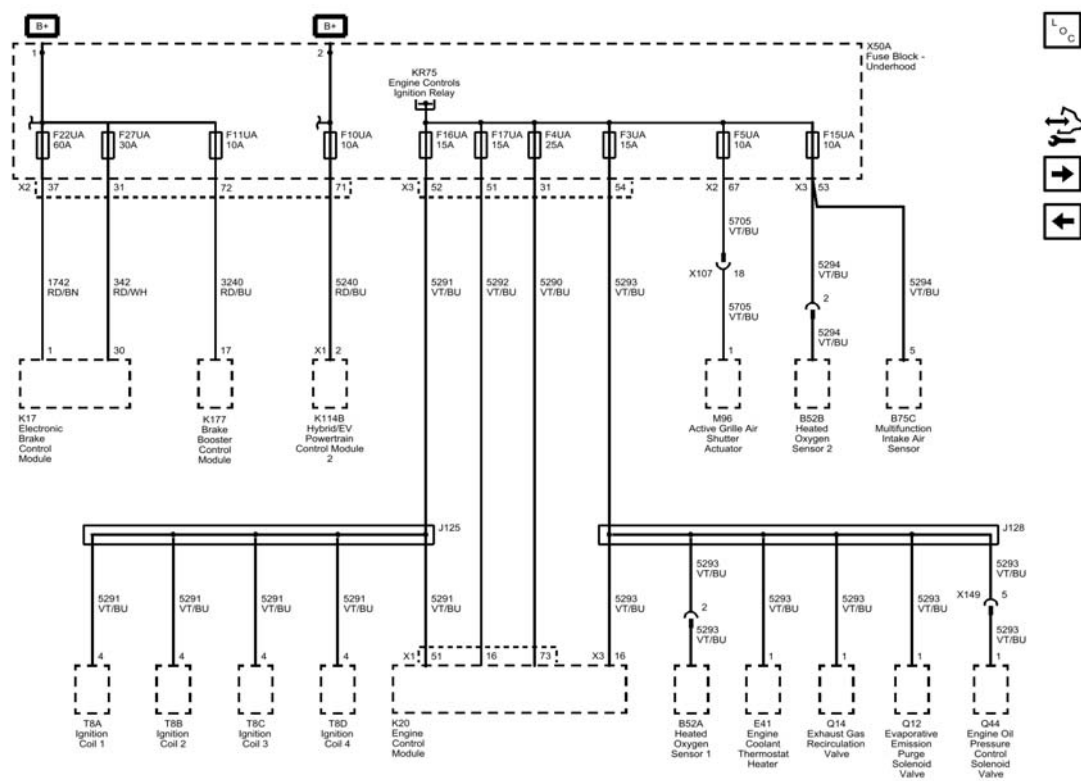


Fig. 58: F3UA, F4UA, F5UA, F10UA, F15UA, F16UA, F17UA, F22UA and F27UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
342	Battery Positive Voltage
342_RD/WH	342 RD/WH
CAV_30	30
CAV_31	31
5240	Battery Positive Voltage
5240_RD/BU	5240 RD/BU
CAV_2	2
CONN_X1	X1
CAV_71	71
5291	Powertrain Main Relay Fused Supply (2)
CAV_1	1
5291_BU	5291 BU
CAV_1	1
5291_BU	5291 BU
CAV_1	1
5290	Powertrain Main Relay Fused Supply (1)
CAV_73	73
5293	Powertrain Main Relay Fused Supply (4)
CAV_53	53
5293_VT/BU	5293 VT/BU

Callout	Component Name
CAV_1	1
5290_VT/BU	5290 VT/BU
5293_VT/BU	5293 VT/BU
5293_VT/BU	5293 VT/BU
5291_VT/YE	5291 VT/YE
5291_BU	5291 BU
5291_BU	5291 BU
5293_VT/BU	5293 VT/BU
CAV_1	1
5293_VT/BU	5293 VT/BU
5293_VT/BU	5293 VT/BU
CAV_1	1
CAV_16	16
CONN_X3	X3
CAV_5	5
5293_VT/BU	5293 VT/BU
5294	Powertrain Main Relay Fused Supply (5)
CAV_5	5
CAV_2	2
5294_VT/BU	5294 VT/BU
5294_VT/BU	5294 VT/BU
CAV_2	2
5705_VT/BU	5705 VT/BU
5705_VT/BU	5705 VT/BU
CAV_52	52
CONN_X3	X3
1742	Battery Positive Voltage
1742_RD/BN	1742 RD/BN
CAV_1	1
CAV_37	37
CONN_X2	X2
5293_VT/BU	5293 VT/BU
CAV_1	1
CAV_54	54
5705	Powertrain Main Relay Fused Control (6)
CAV_1	1
CAV_67	67
CONN_X2	X2
CAV_18	18
CONN_X3	X3
CAV_31	31
5291_BU	5291 BU
CAV_1	1
CAV_51	51

Callout	Component Name
CONN_X1	X1
5292	Powertrain Main Relay Fused Supply (3)
CAV_16	16
5292_VT/BU	5292 VT/BU
CAV_51	51
5293_VT/BU	5293 VT/BU
5294_VT/BU	5294 VT/BU
X149	X149
J125	J125
J128	J128
X107	X107
F15UA	F15UA 10A
F5UA	F5UA 10A
F3UA	F3UA 15A
F4UA	F4UA 25A
F16UA	F16UA 15A
F17UA	F17UA 15A
F22UA	F22UA 60A
F27UA	F27UA 30A
F10UA	F10UA 10A
K17	K17 Electronic Brake Control Module
Q12	Q12 Evaporative Emission Purge Solenoid Valve
B52A	B52A Heated Oxygen Sensor 1
B52B	B52B Heated Oxygen Sensor 2
E41	E41 Engine Coolant Thermostat Heater
Q14	Q14 Exhaust Gas Recirculation Valve
Q44	Q44 Engine Oil Pressure Control Solenoid Valve
K20	K20 Engine Control Module
B75C	B75C Multifunction Intake Air Sensor
K114B	K114B Hybrid/EV Powertrain Control Module 2
X50A	X50A Fuse Block - Underhood
M96	M96 Active Grille Air Shutter Actuator
KR75	KR75 Engine Controls Ignition Relay
T8A	T8A Ignition Coil 1
T8B	T8B Ignition Coil 2
T8C	T8C Ignition Coil 3
T8D	T8D Ignition Coil 4
K20	K20 Engine Control Module

F6UA, F7UA, F8UA, F9UA, F12UA, F13UA and F28UA Fuses

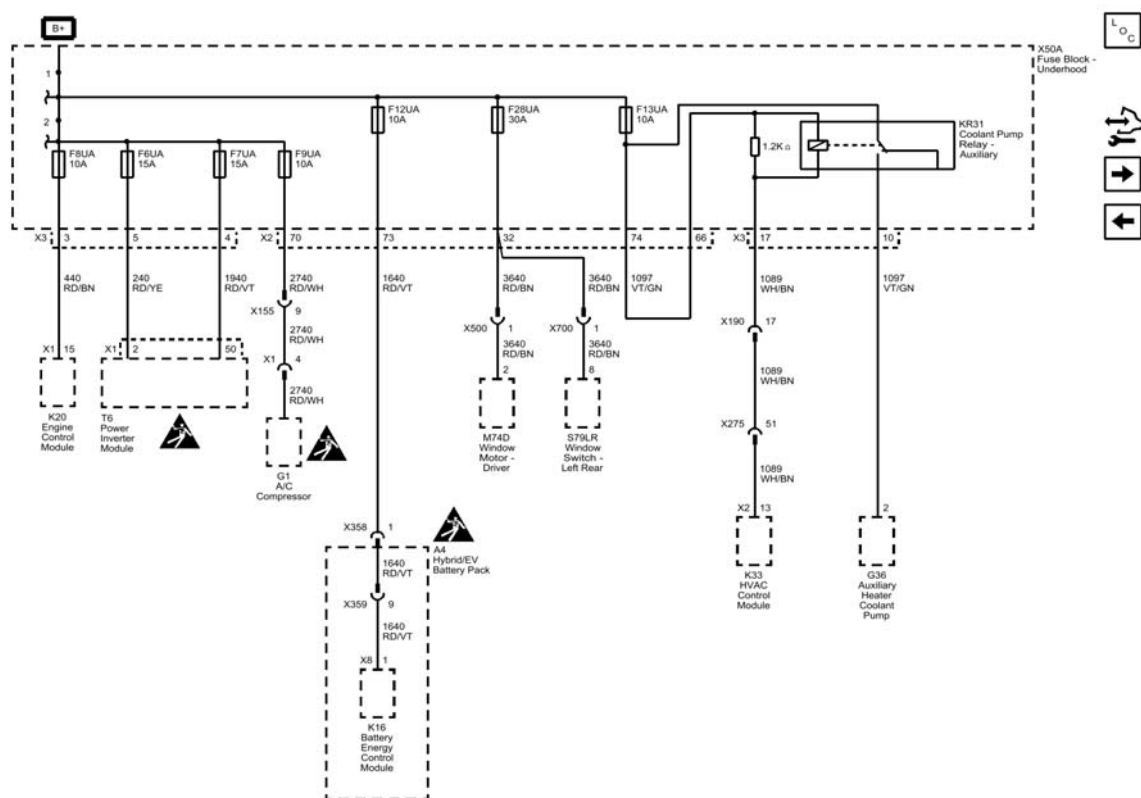


Fig. 59: F6UA, F7UA, F8UA, F9UA, F12UA, F13UA and F28UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
440	Battery Positive Voltage
440_RD/BN	440 RD/BN
CAV_15	15
CONN_X1	X1
CAV_3	3
240	Battery Positive Voltage
CAV_5	5
240_RD/YE	240 RD/YE
1940	Battery Positive Voltage
CAV_4	4
3640	Battery Positive Voltage
3640_RD/BN	3640 RD/BN
CAV_2	2
3640_RD/BN	3640 RD/BN
CAV_8	8
1089	Coolant Pump Motor Relay Control
CAV_17	17
CAV_2	2
2740	Battery Positive Voltage
2740_RD/WH	2740 RD/WH

Callout	Component Name
CAV_70	70
1640_RD/VT	1640 RD/VT
1940_RD/VT	1940 RD/VT
3640_RD/BN	3640 RD/BN
3640_RD/BN	3640 RD/BN
2740_RD/WH	2740 RD/WH
CONN_X8	X8
CAV_13	13
CONN_X2	X2
1089_WH/BN	1089 WH/BN
1089_WH/BN	1089 WH/BN
CAV_51	51
1089_WH/BN	1089 WH/BN
1097	Coolant Pump Motor Supply Voltage
1097_VT/GN	1097 VT/GN
CAV_10	10
CAV_4	4
CAV_1	1
CAV_1	1
CAV_9	9
CAV_17	17
1097_VT/GN	1097 VT/GN
CAV_74	74
CAV_66	66
CAV_2	2
CONN_X1	X1
CAV_50	50
1640_RD/VT	1640 RD/VT
1640_RD/VT	1640 RD/VT
1640	Battery Positive Voltage
CAV_1	1
CAV_73	73
CAV_9	9
CONN_X3	X3
CONN_X3	X3
CONN_X2	X2
CAV_9	9
2740_RD/WH	2740 RD/WH
1640_RD/VT	1640 RD/VT
CAV_32	32
F8UA	F8UA 10A
F6UA	F6UA 15A
F7UA	F7UA 15A
F9UA	F9UA 10A

Callout	Component Name
X275	X275
X1	X1
X500	X500
X700	X700
X155	X155
X190	X190
X358	X358
X359	X359
F28UA	F28UA 30A
F13UA	F13UA 10A
F12UA	F12UA 10A
X50A	X50A Fuse Block - Underhood
K20	K20 Engine Control Module
M74D	M74D Window Motor - Driver
G1	G1 A/C Compressor
G36	G36 Auxiliary Heater Coolant Pump
K16	K16 Battery Energy Control Module
A4	A4 Hybrid/EV Battery Pack
S79LR	S79LR Window Switch - Left Rear
K33	K33 HVAC Control Module
T6	T6 Power Inverter Module
KR31	KR31 Coolant Pump Relay - Auxiliary

F7UA, F21UA, F23UA, F29UA, F30UA, F34UA, F36UA and F37UA Fuses

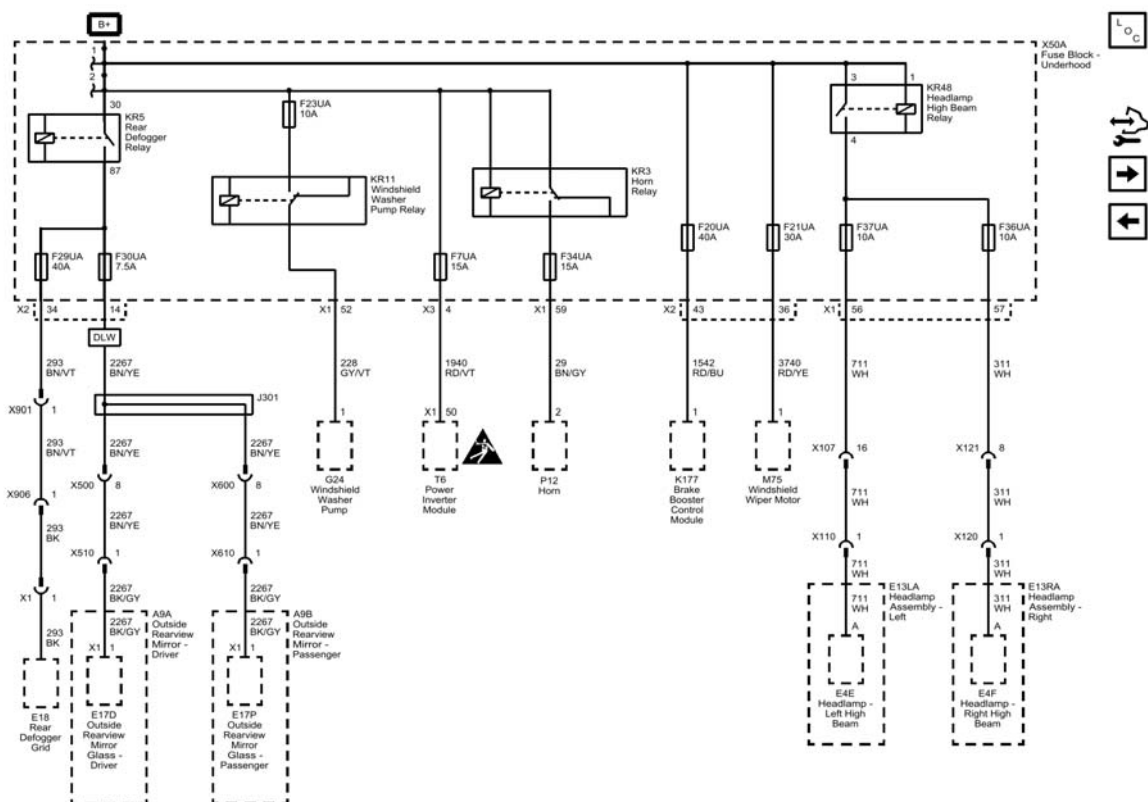


Fig. 60: F7UA, F21UA, F23UA, F29UA, F30UA, F34UA, F36UA and F37UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2267	Mirror Heating Element Supply Voltage
CAV_14	14
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
CAV_8	8
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
CAV_8	8
29	Horn Control
29_BN/GY	29 BN/GY
CAV_2	2
CONN_X1	X1
2267_BK/GY	2267 BK/GY
2267_BK/GY	2267 BK/GY
CAV_1	1
CAV_1	1
CAV_1	1
CONN_X1	X1
CAV_1	1

Callout	Component Name
CONN_X1	X1
DLW	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED
293_BN/VT	293 BN/VT
1940_RD/VT	1940 RD/VT
228_GY/VT	228 GY/VT
293	Rear Defog Element Supply Voltage
CAV_1	1
CONN_X1	X1
CAV_34	34
CONN_X2	X2
228	Windshield Washer Pump Control
CAV_1	1
CAV_52	52
CONN_X1	X1
1940	Battery Positive Voltage
CAV_50	50
CONN_X1	X1
CAV_4	4
CONN_X3	X3
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
711_WH	711 WH
311	Right Headlamp High Beam Supply Voltage
311_WH	311 WH
CAV_57	57
3740_RD/YE	3740 RD/YE
711_WH	711 WH
311_WH	311 WH
CAV_8	8
CAV_A	A
711_WH	711 WH
311_WH	311 WH
3740	Battery Positive Voltage
CAV_1	1
CAV_36	36
CONN_X2	X2
711	Left Headlamp High Beam Supply Voltage
CAV_A	A
CAV_56	56
CONN_X1	X1
CAV_16	16
CAV_1	1
CAV_1	1

Callout	Component Name
711_WH	711 WH
311_WH	311 WH
CAV_59	59
CONN_X1	X1
X500	X500
X600	X600
F29UA	F29UA 40A
F30UA	F30UA 7.5A
F23UA	F23UA 10A
F34UA	F34UA 15A
F7UA	F7UA 15A
X510	X510
X610	X610
J301	J301
F37UA	F37UA 10A
F36UA	F36UA 10A
F21UA	F21UA 30A
X121	X121
X107	X107
X120	X120
X110	X110
X50A	X50A Fuse Block - Underhood
E17D	E17D Outside Rearview Mirror Glass - Driver
KR11	KR11 Windshield Washer Pump Relay
E17P	E17P Outside Rearview Mirror Glass - Passenger
A9B	A9B Outside Rearview Mirror - Passenger
A9A	A9A Outside Rearview Mirror - Driver
P12	P12 Horn
G24	G24 Windshield Washer Pump
E18	E18 Rear Defogger Grid
KR3	KR3 Horn Relay
T6	T6 Power Inverter Module
KR5	KR5 Rear Defogger Relay
KR48	KR48 Headlamp High Beam Relay
M75	M75 Windshield Wiper Motor
E13LA	E13LA Headlamp Assembly - Left
E4E	E4E Headlamp - Left High Beam
E4F	E4F Headlamp - Right High Beam
E13RA	E13RA Headlamp Assembly - Right

F14UA, F35UA, F53UA, F54UA and F55UA Fuses

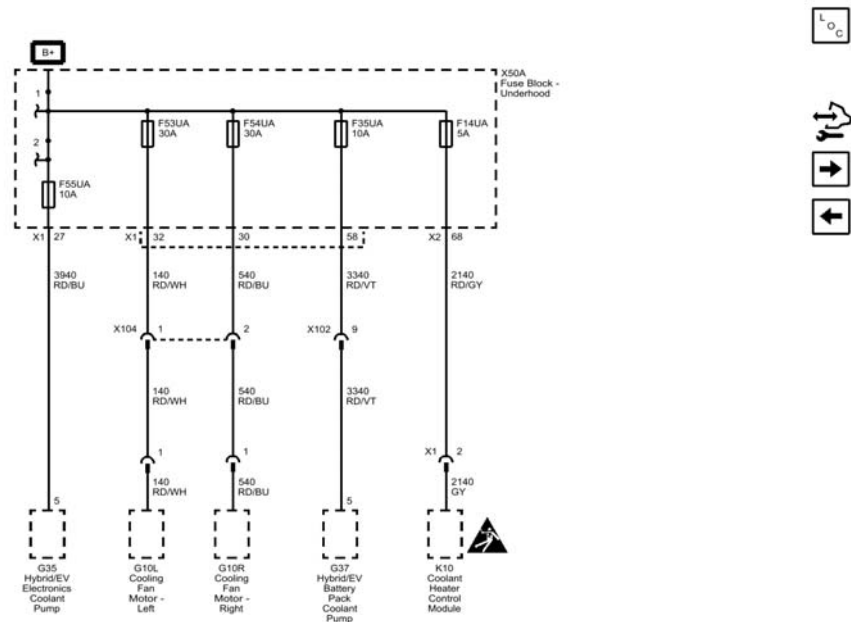


Fig. 61: F14UA, F35UA, F53UA, F54UA and F55UA Fuses
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
540	Battery Positive Voltage
CAV_30	30
3340	Battery Positive Voltage
CAV_5	5
CAV_58	58
2140	Battery Positive Voltage
CAV_68	68
3940	Battery Positive Voltage
CAV_5	5
CAV_27	27
CAV_9	9
3340_RD/VT	3340 RD/VT
540_RD/BU	540 RD/BU
540_RD/BU	540 RD/BU
140_RD/WH	140 RD/WH
140_RD/WH	140 RD/WH
3940_RD/BU	3940 RD/BU
2140_GY	2140 GY
3340_RD/VT	3340 RD/VT
CAV_2	2

Callout	Component Name
CAV_1	1
140	Battery Positive Voltage
CAV_32	32
CONN_X1	X1
CONN_X2	X2
CONN_X1	X1
CAV_1	1
X104	X104
CAV_2	2
CAV_1	1
F53UA	F53UA 30A
F54UA	F54UA 30A
F35UA	F35UA 10A
F14UA	F14UA 5A
F55UA	F55UA 10A
X102	X102
X1	X1
X104	X104
G10L	G10L Cooling Fan Motor - Left
G10R	G10R Cooling Fan Motor - Right
X50A	X50A Fuse Block - Underhood
K10	K10 Coolant Heater Control Module
G37	G37 Hybrid/EV Battery Pack Coolant Pump
G35	G35 Hybrid/EV Electronics Coolant Pump

F32UA, F41UA, F42UA, F44UA, F45UA, F46UA and F52UA Fuses

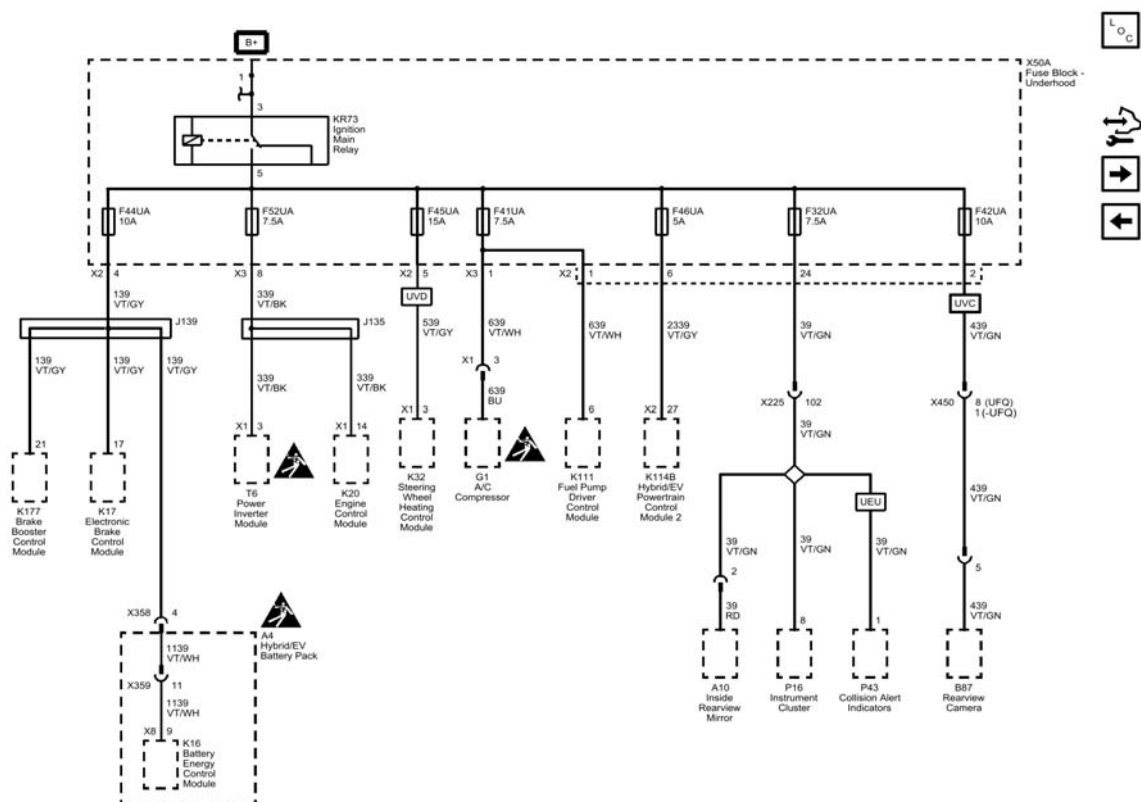


Fig. 62: F32UA, F41UA, F42UA, F44UA, F45UA, F46UA and F52UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
139_VT/GY	139 VT/GY
139	Run/Crank Ignition 1 Voltage
139_VT/GY	139 VT/GY
439	Run/Crank Ignition 1 Voltage
CAV_2	2
39	Run/Crank Ignition 1 Voltage
CAV_8	8
CAV_24	24
2339	Run/Crank Ignition 1 Voltage
2339_VT/GY	2339 VT/GY
CAV_27	27
CONN_X2	X2
CAV_6	6
639	Run/Crank Ignition 1 Voltage
639_VT/WH	639 VT/WH
CAV_6	6
CAV_1	1
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN

Callout	Component Name
39_RD	39 RD
CAV_102	102
439_VT/GN	439 VT/GN
439_VT/GN	439 VT/GN
UVC	VISION-REAR VIEW, MONO, ANALOG
39_VT/GN	39 VT/GN
CAV_1	1
CAV_4	4
39_VT/GN	39 VT/GN
DD8	MIRROR I/S R/V-LT SENSITIVE
CAV_2	2
139_VT/GY	139 VT/GY
CAV_21	21
CAV_8	8
CAV_1	1
CAV_5	5
CONN_X2	X2
V7Y	SALES PACKAGE-#2
CAV_11	11
CAV_9	9
CONN_X8	X8
Â	Â
139_VT/GY	139 VT/GY
139_VT/GY	139 VT/GY
CAV_17	17
CAV_4	4
CONN_X2	X2
539	Run/Crank Ignition 1 Voltage
539_VT/GY	539 VT/GY
CAV_21	21
CONN_X1	X1
CAV_5	5
CONN_X2	X2
639_VT/BU	639 VT/BU
CAV_1	1
CONN_X3	X3
UVD	STEERING WHEEL HEAT-MANUAL
CAV_3	3
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
339_VT/BK	339 VT/BK
CAV_14	14

Callout	Component Name
CONN_X1	X1
339	Run/Crank Ignition 1 Voltage
339_VT/BK	339 VT/BK
CAV_8	8
CONN_X3	X3
339_VT/BK	339 VT/BK
CAV_3	3
CONN_X1	X1
139_VT/GY	139 VT/GY
639_VT/BU	639 VT/BU
439_VT/GN	439 VT/GN
139_VT/GY	139 VT/GY
X225	X225
F44UA	F44UA 10A
F45UA	F45UA 15A
F42UA	F42UA 10A
F32UA	F32UA 7.5A
F46UA	F46UA 5A
F41UA	F41UA 7.5A
X358	X358
X450	X450
X359	X359
X1	X1
F52UA	F52UA 7.5A
J139	J139
J135	J135
K17	K17 Electronic Brake Control Module
B87	B87 Rearview Camera (UVC)
A10	A10 Inside Rearview Mirror
P16	P16 Instrument Cluster
K16	K16 Battery Energy Control Module
G1	G1 A/C Compressor
K111	K111 Fuel Pump Driver Control Module
K114B	K114B Hybrid/EV Powertrain Control Module 2
P43	P43 Collision Alert Indicators
K32	K32 Steering Wheel Heating Control Module
K177	K177 Brake Booster Control Module
A4	A4 Hybrid/EV Battery Pack
X50A	X50A Fuse Block - Underhood
K20	K20 Engine Control Module
T6	T6 Power Inverter Module

F4DA, F5DA, F8DA, F9DA, F17DA, F18DA, and F19DA Fuses

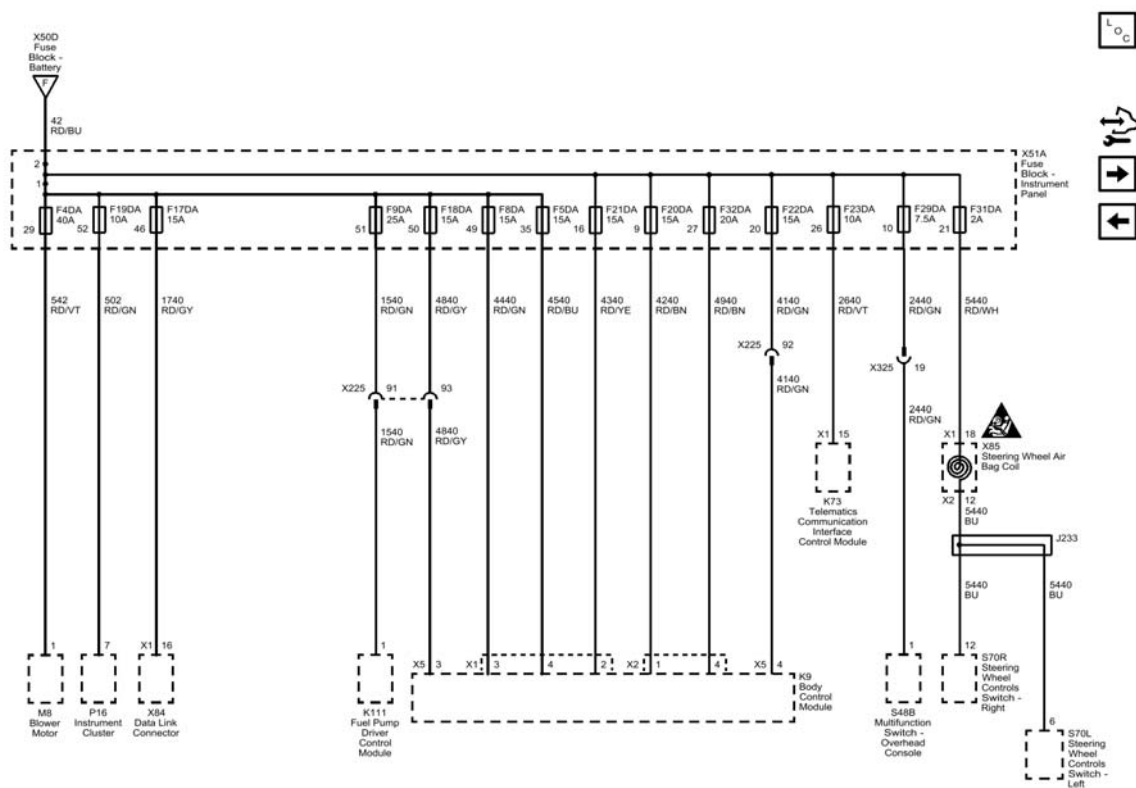


Fig. 63: F4DA, F5DA, F8DA, F9DA, F17DA, F18DA, and F19DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_29	29
CAV_49	49
CAV_35	35
CAV_50	50
42	Battery Positive Voltage
42_RD/BU	42 RD/BU
542	Battery Positive Voltage
542_RD/VT	542 RD/VT
CAV_1	1
4440	Battery Positive Voltage
4440_RD/BU	4440 RD/BU
CONN_X1	X1
CAV_3	3
4540	Battery Positive Voltage
4540_RD/BU	4540 RD/BU
CAV_4	4
4840	Battery Positive Voltage
4840_RD/GY	4840 RD/GY
CAV_3	3
4840_RD/GY	4840 RD/GY

Callout	Component Name
CONN_X5	X5
1540	Battery Positive Voltage
1540_RD/GN	1540 RD/GN
CAV_1	1
CONN_X1	X1
1740	Battery Positive Voltage
1740_RD/GY	1740 RD/GY
502	Battery Positive Voltage
502_RD/GN	502 RD/GN
CAV_7	7
CAV_51	51
CAV_46	46
CAV_52	52
1540_RD/GN	1540 RD/GN
CAV_16	16
X225	X225
CAV_93	93
CAV_91	91
F4DA	F4DA 40A
F8DA	F8DA 15A
F5DA	F5DA 15A
F18DA	F18DA 15A
F_REF	F
F17DA	F17DA 15A
F9DA	F9DA 25A
F19DA	F19DA 10A
X225	X225
X51A	X51A Fuse Block - Instrument Panel
P16	P16 Instrument Cluster
K111	K111 Fuel Pump Driver Control Module
K9	K9 Body Control Module
M8	M8 Blower Motor
X50D	X50D Fuse Block - Battery
X84	X84 Data Link Connector

F20DA, F21DA, F22DA, F23DA, F26DA, F29DA, F31DA, F32DA, F33DA, F34DA, and F36DA Fuses

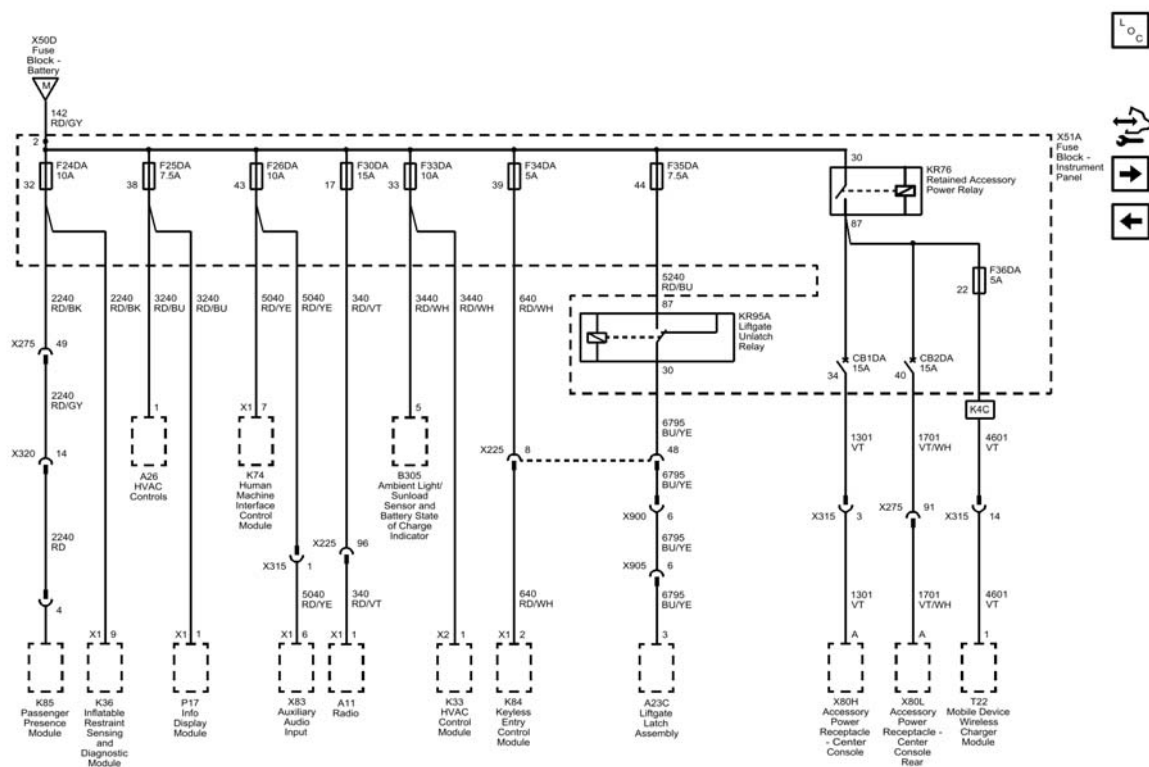


Fig. 64: F20DA, F21DA, F22DA, F23DA, F26DA, F29DA, F31DA, F32DA, F33DA, F34DA, and F36DA Fuses

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1301	Retained Accessory Power Fuse Supply Voltage
1301_VT	1301 VT
CAV_A	A
CAV_A	A
1701_VT	1701 VT
1701_VT	1701 VT
1701	Retained Accessory Power Fuse Supply Voltage
842	Battery Positive Voltage
842_RD/BU	842 RD/BU
842_RD/BU	842 RD/BU
4340	Battery Positive Voltage
4340_RD/YE	4340 RD/YE
CAV_2	2
CONN_X1	X1
4240	Battery Positive Voltage
4240_RD/BN	4240 RD/BN
CAV_1	1
CONN_X2	X2
2640	Battery Positive Voltage

Callout	Component Name
2640_RD/VT	2640 RD/VT
CAV_15	15
CONN_X1	X1
5040_RD/YE	5040 RD/YE
CAV_6	6
CONN_X1	X1
2440	Battery Positive Voltage
2440_RD/GN	2440 RD/GN
2440_RD/GN	2440 RD/GN
CAV_19	19
142	Battery Positive Voltage
142_RD/GY	142 RD/GY
CAV_40	40
CAV_34	34
CAV_91	91
1301_VT	1301 VT
CAV_1	1
5040	Battery Positive Voltage
5040_RD/YE	5040 RD/YE
CAV_7	7
CONN_X1	X1
5040_RD/YE	5040 RD/YE
4601	Retained Accessory Power Fused Supply Voltage
CAV_1	1
CAV_14	14
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
CAV_27	27
4140	Battery Positive Voltage
4140_RD/GN	4140 RD/GN
CAV_4	4
4940	Battery Positive Voltage
4940_RD/BN	4940 RD/BN
CAV_4	4
CONN_X2	X2
4140_RD/GN	4140 RD/GN
CAV_92	92
3440	Battery Positive Voltage
3440_RD/WH	3440 RD/WH
CAV_5	5
CONN_X1	X1
640	Battery Positive Voltage
640_RD/WH	640 RD/WH
CAV_2	2
CONN_X1	X1

Callout	Component Name
640_RD/WH	640 RD/WH
CONN_X5	X5
CAV_8	8
3440_RD/WH	3440 RD/WH
CAV_1	1
CONN_X2	X2
4601_VT	4601 VT
4601_VT	4601 VT
5440	Battery Positive Voltage
5440_RD/WH	5440 RD/WH
CAV_12	12
CONN_X1	X1
5440_RD/WH	5440 RD/WH
CAV_6	6
CAV_18	18
CONN_X1	X1
CAV_12	12
CONN_X2	X2
5440_RD/WH	5440 RD/WH
5440_RD/WH	5440 RD/WH
CAV_20	20
CAV_10	10
CAV_43	43
CAV_22	22
CAV_16	16
CAV_9	9
CAV_21	21
CAV_26	26
CAV_33	33
CAV_39	39
X315	X315
CAV_3	3
CAV_1	1
X325	X325
M_REF	M
F29DA	F29DA 7.5A
F23DA	F23DA 10A
F20DA	F20DA 15A
F21DA	F21DA 15A
CB2DA	CB2DA 15A
CB1DA	CB1DA 15A
X275	X275
X315	X315
X225	X225

Callout	Component Name
X225	X225
F31DA	F31DA 2A
J233	J233
F36DA	F36DA 5A
F34DA	F34DA 5A
F33DA	F33DA 10A
F32DA	F32DA 20A
F22DA	F22DA 15A
F26DA	F26DA 10A
X315	X315
X80H	X80H Accessory Power Receptacle - Center Console
KR76	KR76 Retained Accessory Power Relay
K73	K73 Telematics Communication Interface Control Module (UE1)
X80L	X80L Accessory Power Receptacle - Center Console Rear
S48B	S48B Multifunction Switch - Overhead Console
K74	K74 Human Machine Interface Control Module
X83	X83 Auxiliary Audio Input
X51A	X51A Fuse Block - Instrument Panel
T22	T22 Mobile Device Wireless Charger Module
K84	K84 Keyless Entry Control Module
K9	K9 Body Control Module
K33	K33 HVAC Control Module
S70R	S70R Steering Wheel Controls Switch - Right
S70L	S70L Steering Wheel Controls Switch - Left
X85	X85 Steering Wheel Air Bag Coil
X50D	X50D Fuse Block - Battery
B305	B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator

F5RA, F6RA, F7RA, F8RA, F9RA, F11RA, F21RA and F22RA Fuses

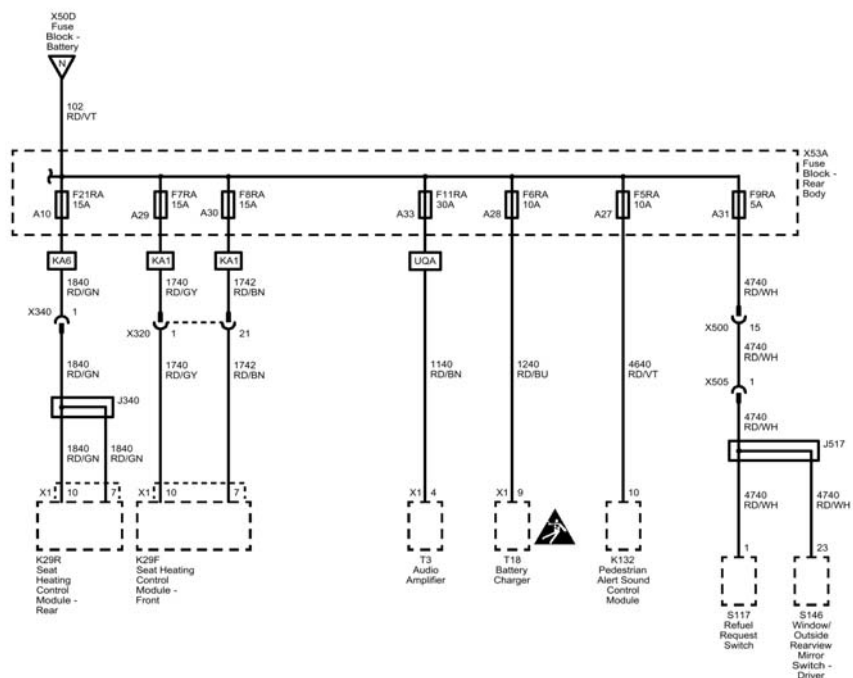


Fig. 65: F5RA, F6RA, F7RA, F8RA, F9RA, F11RA, F21RA and F22RA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
102	Battery Positive Voltage
102_RD/VT	102 RD/VT
CAV_A29	A29
CAV_A33	A33
CAV_A28	A28
1840	Battery Positive Voltage
1840_RD/GN	1840 RD/GN
CAV_10	10
CONN_X1	X1
1740_RD/GY	1740 RD/GY
CAV_10	10
CONN_X1	X1
3740	Battery Positive Voltage
3740_RD/YE	3740 RD/YE
3740_RD/YE	3740 RD/YE
1140	Battery Positive Voltage
1140_RD/BN	1140 RD/BN
CAV_4	4
CONN_X1	X1
1240	Battery Positive Voltage

Callout	Component Name
1240_RD/BU	1240 RD/BU
CAV_9	9
CONN_X1	X1
4740	Battery Positive Voltage
4740_RD/WH	4740 RD/WH
CAV_1	1
4740_RD/WH	4740 RD/WH
CAV_23	23
4740_RD/WH	4740 RD/WH
4740_RD/WH	4740 RD/WH
4740_RD/WH	4740 RD/WH
3740_RD/YE	3740 RD/YE
3740_RD/YE	3740 RD/YE
1740_RD/GY	1740 RD/GY
1740	Battery Positive Voltage
CAV_1	1
CAV_1	1
CAV_15	15
CAV_1	1
KA1	(U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX), Korea (MAW))
UQA	(U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX), Korea (MAW))
CAV_A11	A11
CAV_A10	A10
1840_RD/GN	1840 RD/GN
CAV_7	7
1840_RD/GN	1840 RD/GN
1840_RD/GN	1840 RD/GN
CAV_1	1
CAV_8	8
CONN_X1	X1
CAV_8	8
CONN_X1	X1
4640_RD/VT	4640 RD/VT
CAV_10	10
KA6	(U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX), Korea (MAW))
CAV_7	7
1742_RD/BN	1742 RD/BN
KA1	(U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX), Korea (MAW))
1742_RD/BN	1742 RD/BN
CAV_A27	A27
CAV_A31	A31
CAV_A30	A30
X320	X320
CAV_1	1

Callout	Component Name
CAV_21	21
Q_REF	Q
F21RA	F21RA 15A
F7RA	F7RA 15A
F22RA	F22RA 30A
F11RA	F11RA 30A
F6RA	F6RA 10A
F9RA	F9RA 5A
F20RA	F20RA
N_REF	N
X600	X600
X800	X800
X500	X500
X505	X505
X340	X340
J517	J517
J340	J340
F5RA	F5RA 10A
F8RA	F8RA 15A
X320	X320
T3	T3 Audio Amplifier (UQA)
S79RR	S79RR Window Switch - Right Rear
X50D	X50D Fuse Block - Battery
S117	S117 Refuel Request Switch
S146	S146 Window/Outside Rearview Mirror Switch - Driver
K29R	K29R Seat Heating Control Module - Rear (KA6)
S79P	S79P Window Switch - Passenger
X53A	X53A Fuse Block - Rear Body
K132	K132 Pedestrian Alert Sound Control Module
K29F	K29F Seat Heating Control Module - Front (KA1)
T18	T18 Battery Charger

F19RA, F20RA and F22RA Fuses

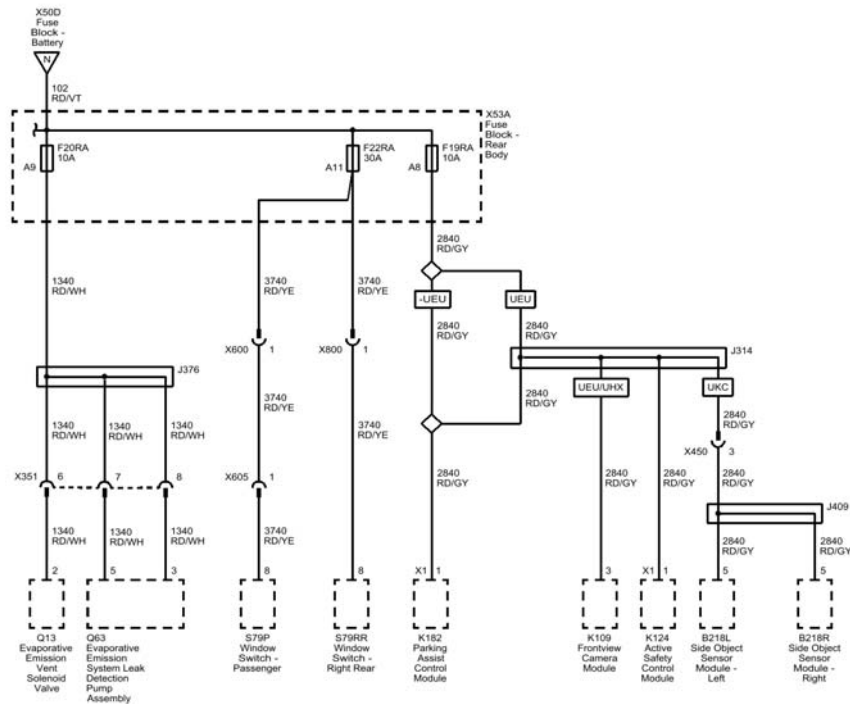


Fig. 66: F19RA, F20RA and F22RA Fuses
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_2	2
1340	Battery Positive Voltage
CAV_5	5
CAV_3	3
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
1340_RD/WH	1340 RD/WH
CAV_A9	A9
2840	Battery Positive Voltage
2840_RD/GY	2840 RD/GY
CAV_1	1
CONN_X1	X1
2840_RD/GY	2840 RD/GY
2840_RD/GY	2840 RD/GY
2840_RD/GY	2840 RD/GY
CAV_3	3

Callout	Component Name
CONN_X1	X1
2840_RD/GY	2840 RD/GY
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
2840_RD/GY	2840 RD/GY
CAV_5	5
CONN_X1	X1
CAV_3	3
2840_RD/GY	2840 RD/GY
CAV_5	5
CONN_X1	X1
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
V7Y	SALES PACKAGE-#2
V7Y	SALES PACKAGE-#2
2840_RD/GY	2840 RD/GY
2840_RD/GY	2840 RD/GY
2840_RD/GY	2840 RD/GY
CAV_A8	A8
CAV_A11	A11
3740	Battery Positive Voltage
3740_RD/YE	3740 RD/YE
CAV_8	8
CAV_8	8
CAV_1	1
3740_RD/YE	3740 RD/YE
3740_RD/YE	3740 RD/YE
2840_RD/GY	2840 RD/GY
CAV_1	1
CONN_X1	X1
3740_RD/YE	3740 RD/YE
102	Battery Positive Voltage
102_RD/VT	102 RD/VT
3740_RD/YE	3740 RD/YE
CAV_1	1
CAV_1	1
X351	X351
CAV_8	8
CAV_7	7
CAV_6	6
X450	X450
J314	J314
J409	J409
J376	J376
X800	X800

Callout	Component Name
F19RA	F19RA 10A
F20RA	F20RA 10A
F22RA	F22RA 30A
N_REF	N
X600	X600
X605	X605
X351	X351
Q13	Q13 Evaporative Emission Vent Solenoid Valve
Q63	Q63 Evaporative Emission System Leak Detection Pump Assembly
X53A	X53A Fuse Block - Rear Body
B218L	B218L Side Object Sensor Module - Left (UFG)
B218R	B218R Side Object Sensor Module - Right (UFG)
K182	K182 Parking Assist Control Module (UFQ)
S79P	S79P Window Switch - Passenger
S79RR	S79RR Window Switch - Right Rear
K124	K124 Active Safety Control Module (UGN)
B174	B174 Frontview Camera (UHY)
X50D	X50D Fuse Block - Battery

Vehicle On/Off Switch

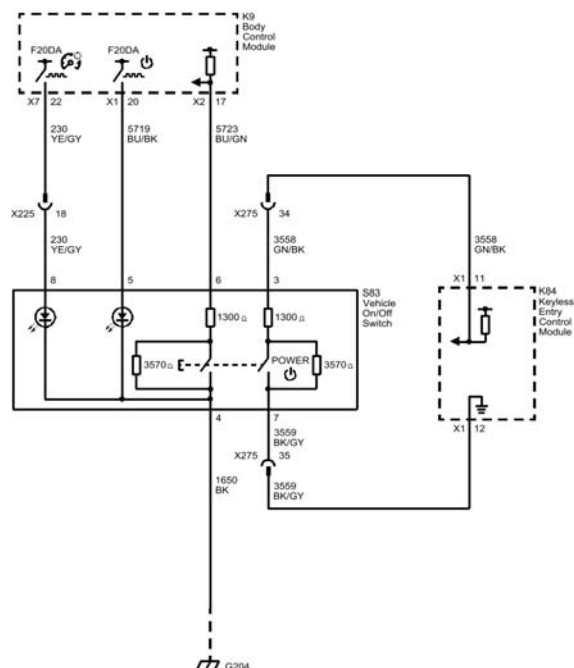


Fig. 67: Vehicle On/Off Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
230	Instrument Panel Lamp Dimming Control
230_YE/GY	230 YE/GY
CAV_8	8
CAV_22	22
CONN_X7	X7
5719	Ignition Mode Switch Start LED Signal
5719_BU/BK	5719 BU/BK
CAV_5	5
CAV_20	20
CONN_X1	X1
5723	Ignition Mode Switch Mode Voltage
5723_BU/GN	5723 BU/GN
CAV_6	6
CAV_17	17
CONN_X2	X2
3558	Passive Start Switch Signal 2
3558_GN/BK	3558 GN/BK
CAV_11	11
CONN_X1	X1
CAV_3	3
3559	Passive Start Switch 2 Low Reference
3559_BK/GY	3559 BK/GY
CAV_7	7
CAV_12	12
CONN_X1	X1
1650	Ground
1650_BK	1650 BK
CAV_4	4
3558_GN/BK	3558 GN/BK
3559_BK/GY	3559 BK/GY
CAV_35	35
CAV_34	34
CAV_18	18
230_YE/GY	230 YE/GY
G204	G204
X275	X275
X275	X275
F20DA	F20DA
F20DA	F20DA
X225	X225
K9	K9 Body Control Module
K84	K84 Keyless Entry Control Module
S83	S83 Vehicle On/Off Switch

POWER MODING WIRING SCHEMATICS

Power Moding

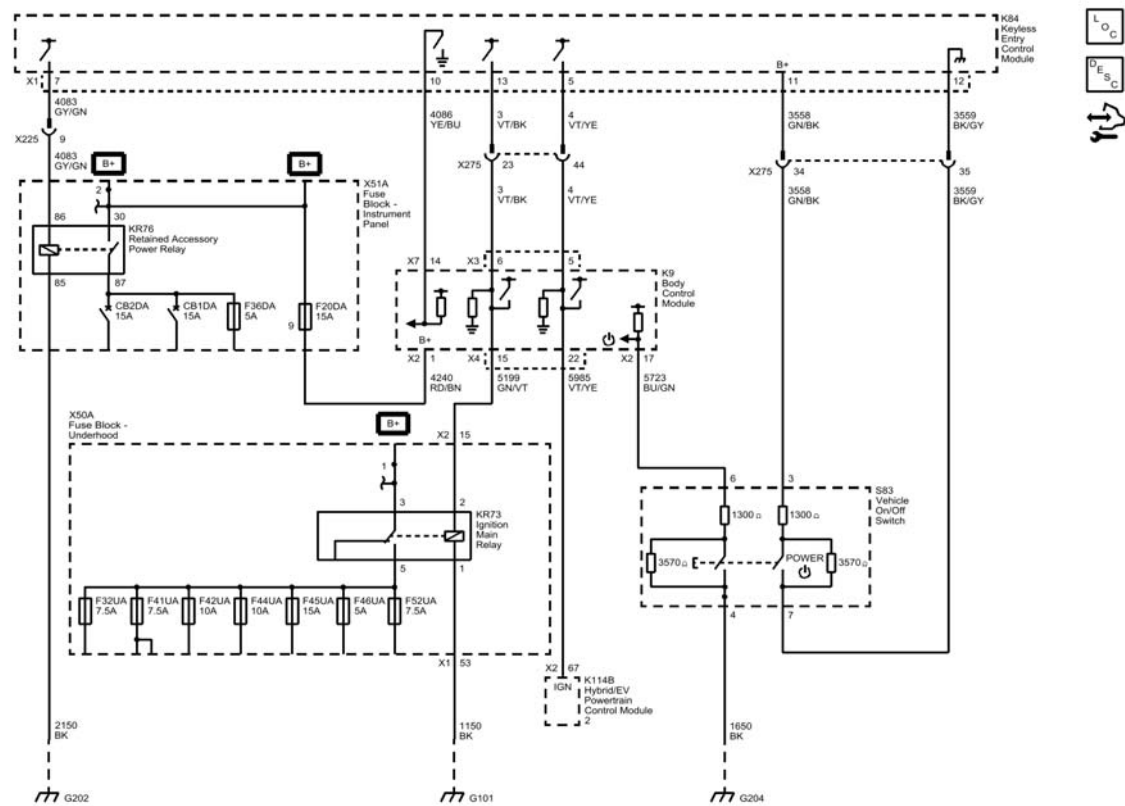


Fig. 68: Power Moding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4240	Battery Positive Voltage
3	Run/Crank Ignition 1 Voltage
3_VT/BK	3 VT/BK
CAV_6	6
CONN_X3	X3
CAV_13	13
3_VT/BK	3 VT/BK
4	Accessory Voltage
CAV_5	5
CAV_5	5
4_VT/YE	4 VT/YE
4_VT/YE	4 VT/YE
1150	Ground
1150_BK	1150 BK
CAV_53	53
CONN_X1	X1
5985	Accessory Wakeup Serial Data

Callout	Component Name
CAV_22	22
5985_VT/YE	5985 VT/YE
4083	RAP Relay 2 Coil Control
4083_GY/GN	4083 GY/GN
2150	Ground
2150_BK	2150 BK
CAV_9	9
4083_GY/GN	4083 GY/GN
CAV_67	67
CONN_X2	X2
CAV_9	9
CAV_7	7
CONN_X1	X1
4086	Pushbutton Start Challenge Active Signal
4086_YE/BU	4086 YE/BU
CAV_14	14
CONN_X7	X7
CAV_10	10
1650	Ground
1650_BK	1650 BK
4240_RD/BN	4240 RD/BN
CAV_1	1
CONN_X2	X2
CAV_4	4
CAV_6	6
5199	Run/Crank Relay Coil Control
5199_GN/VT	5199 GN/VT
CAV_15	15
CONN_X2	X2
CAV_15	15
CONN_X4	X4
3558	Passive Start Switch Signal 2
3558_GN/BK	3558 GN/BK
CAV_3	3
CAV_11	11
3559	Passive Start Switch 2 Low Reference
3559_BK/GY	3559 BK/GY
CAV_12	12
CAV_7	7
3558_GN/BK	3558 GN/BK
3559_BK/GY	3559 BK/GY
5723	Ignition Mode Switch Mode Voltage
5723_BU/GN	5723 BU/GN
CAV_17	17

Callout	Component Name
CONN_X2	X2
X275	X275
CAV_23	23
CAV_44	44
X275	X275
CAV_34	34
CAV_35	35
G101	G101
F36DA	F36DA 5A
F41UA	F41UA 7.5A
F45UA	F45UA 15A
F32UA	F32UA 7.5A
F52UA	F52UA 7.5A
F42UA	F42UA 10A
G202	G202
X225	X225
CB2DA	CB2DA 15A
CB1DA	CB1DA 15A
F20DA	F20DA 15A
G204	G204
X275	X275
X275	X275
X50A	X50A Fuse Block - Underhood
K9	K9 Body Control Module
K84	K84 Keyless Entry Control Module
K114B	K114B Hybrid/EV Powertrain Control Module 2
KR73	KR73 Ignition Main Relay
KR76	KR76 Retained Accessory Power Relay
X51A	X51A Fuse Block - Instrument Panel
S83	S83 Vehicle On/Off Switch

GROUND DISTRIBUTION WIRING SCHEMATICS

G101 and G102

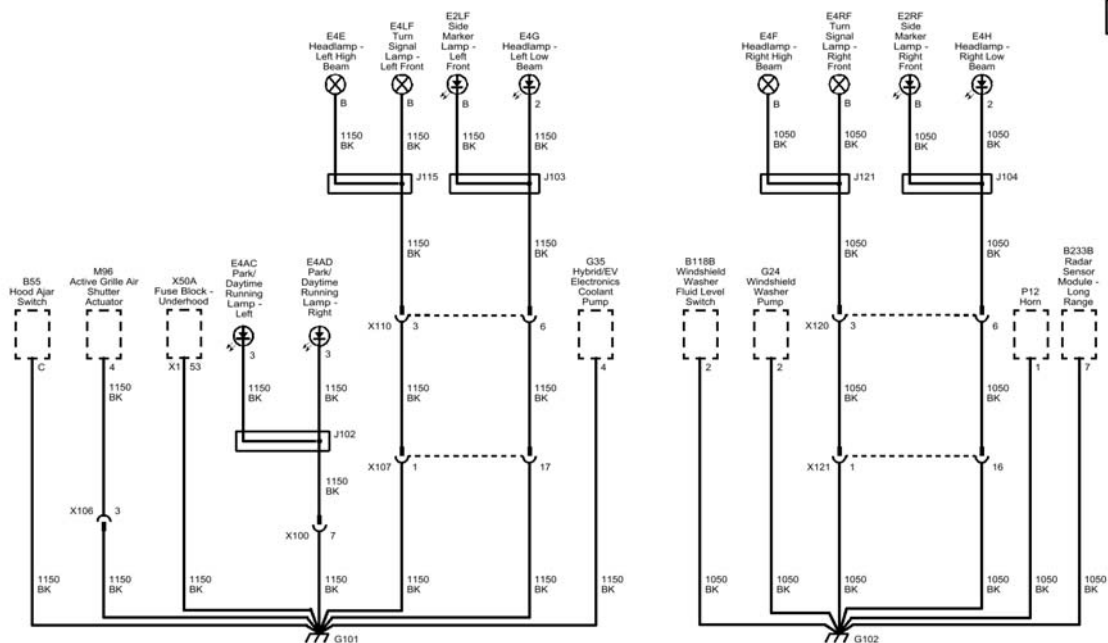


Fig. 69: G101 and G102
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_3	3
CAV_4	4
1050	Ground
1050_BK	1050 BK
CAV_1	1
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
CAV_2	2
CAV_2	2
1050_BK	1050 BK
1150	Ground
1150_BK	1150 BK
CAV_B	B
CAV_B	B
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_B	B
CAV_2	2

Callout	Component Name
1150_BK	1150 BK
1150_BK	1150 BK
1050_BK	1050 BK
CAV_B	B
CAV_B	B
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
CAV_B	B
CAV_2	2
1050_BK	1050 BK
1050_BK	1050 BK
CAV_3	3
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1050_BK	1050 BK
1050_BK	1050 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_7	7
CAV_4	4
CAV_3	3
1150_BK	1150 BK
CAV_C	C
CAV_53	53
CONN_X1	X1
1050_BK	1050 BK
CAV_7	7
X120	X120
CAV_6	6
CAV_3	3
X121	X121
CAV_1	1
CAV_16	16
X107	X107
CAV_17	17

Callout	Component Name
CAV_1	1
X110	X110
CAV_6	6
CAV_3	3
G102	G102
J115	J115
J103	J103
J121	J121
J104	J104
X100	X100
J102	J102
X106	X106
G101	G101
X120	X120
X121	X121
X107	X107
X110	X110
P12	P12 Horn
G24	G24 Windshield Washer Pump
B118B	B118B Windshield Washer Fluid Level Switch
G35	G35 Hybrid/EV Electronics Coolant Pump
X50A	X50A Fuse Block - Underhood
M96	M96 Active Grille Air Shutter Actuator
B55	B55 Hood Ajar Switch
E4AC	E4AC Park/Daytime Running Lamp - Left
E4AD	E4AD Park/Daytime Running Lamp - Right
E4LF	E4LF Turn Signal Lamp - Left Front
E4G	E4G Headlamp - Left Low Beam
E4E	E4E Headlamp - Left High Beam
E2LF	E2LF Side Marker Lamp - Left Front
E4F	E4F Headlamp - Right High Beam
E4RF	E4RF Turn Signal Lamp - Right Front
E2RF	E2RF Side Marker Lamp - Right Front
E4H	E4H Headlamp - Right Low Beam
B233B	B233B Radar Sensor Module - Long Range (UGN)

G104 and G105

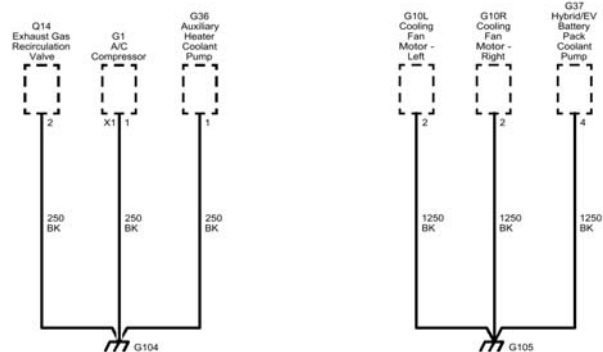


Fig. 70: G104 and G105

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
250	Ground
250_BK	250 BK
CAV_1	1
1250	Ground
1250_BK	1250 BK
1250_BK	1250 BK
1250_BK	1250 BK
CAV_4	4
CAV_E	E
CAV_E	E
G104	G104
G105	G105
G10L	G10L Cooling Fan Motor - Left
G10R	G10R Cooling Fan Motor - Right
G37	G37 Hybrid/EV Battery Pack Coolant Pump
B197	B197 Charge Port Door Position Switch

G110, G112, G113 and G117

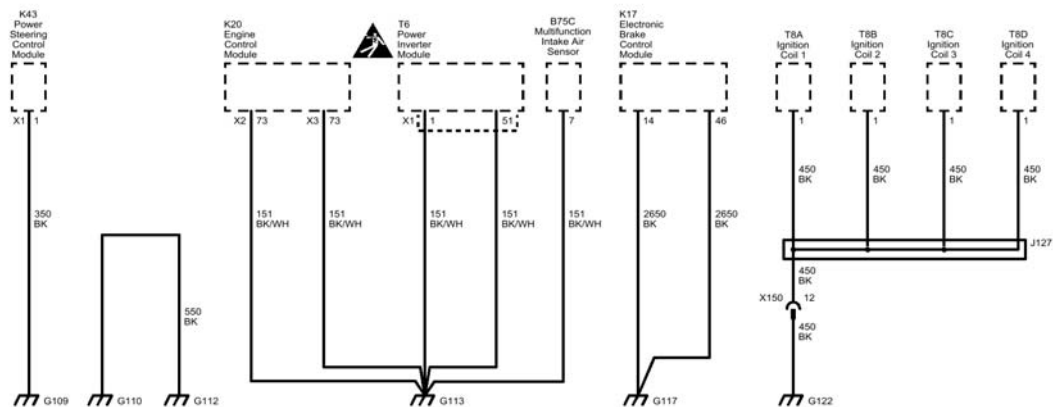


Fig. 71: G110, G112, G113 and G117
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
350	Ground
350_BK	350 BK
CAV_1	1
CONN_X1	X1
550	Ground
550_BK	550 BK
151	Signal Ground
151_BK/WH	151 BK/WH
CAV_73	73
CONN_X2	X2
2650	Ground
2650_BK	2650 BK
2650_BK	2650 BK
CAV_73	73
CONN_X3	X3
CAV_7	7
CONN_X1	X1
CAV_14	14
CAV_46	46
151_BK/WH	151 BK/WH

Callout	Component Name
151_BK/WH	151 BK/WH
151_BK/WH	151 BK/WH
151_BK/WH	151 BK/WH
250	Ground
CAV_1	1
CONN_X1	X1
CAV_51	51
G112	G112
G110	G110
G112	G112
G113	G113
G117	G117
K43	K43 Power Steering Control Module
K17	K17 Electronic Brake Control Module
K20	K20 Engine Control Module
B75C	B75C Multifunction Intake Air Sensor
T6	T6 Power Inverter Module

G201, G205, G304, G401 and G404

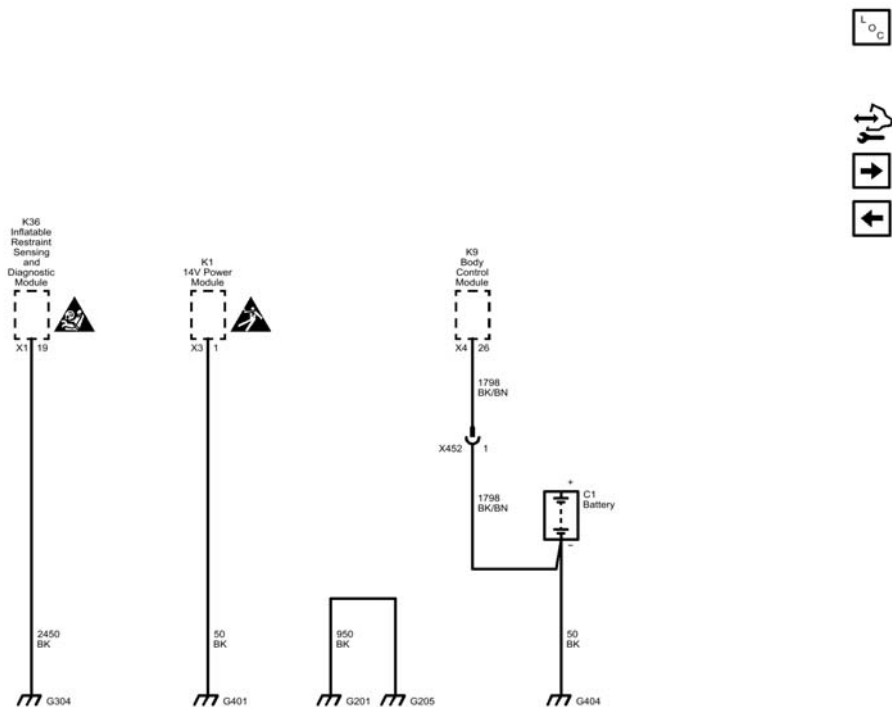


Fig. 72: G201, G205, G304, G401 and G404
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2450	Ground
2450_BK	2450 BK
CAV_19	19
CONN_X1	X1
50	Ground
50_BK	50 BK
CONN_X3	X3
1798	Low Reference
1798_BK/BN	1798 BK/BN
CAV_26	26
CONN_X4	X4
50_BK	50 BK
950_BK	950 BK
1798_BK/BN	1798 BK/BN
CAV_1	1
950	Ground
G304	G304
G401	G401
G201	G201
G205	G205
G404	G404
X452	X452
K9	K9 Body Control Module
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
K1	K1 14V Power Module
C1	C1 Battery

G202

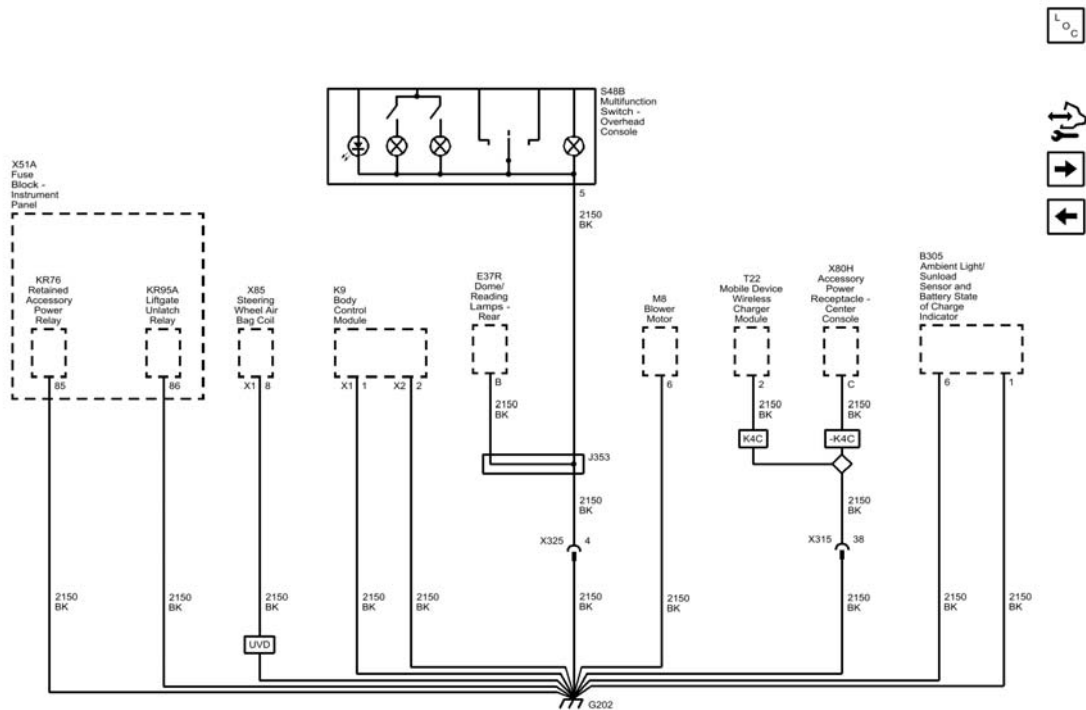


Fig. 73: G202
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2150	Ground
2150_BK	2150 BK
2150_BK	2150 BK
CAV_1	1
CONN_X1	X1
2150_BK	2150 BK
2150_BK	2150 BK
CAV_2	2
CONN_X2	X2
CAV_5	5
2150_BK	2150 BK
2150_BK	2150 BK
2150_BK	2150 BK
CAV_4	4
2150_BK	2150 BK
CAV_B	B
2150_BK	2150 BK
2150_BK	2150 BK
2150_BK	2150 BK
CAV_C	C

Callout	Component Name
2150_BK	2150 BK
CAV_C	C
2150_BK	2150 BK
CAV_6	6
CAV_6	6
CAV_38	38
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
2150_BK	2150 BK
2150_BK	2150 BK
CAV_1	1
2150_BK	2150 BK
CAV_85	85
CAV_86	86
UVD	STEERING WHEEL HEAT-MANUAL
CAV_8	8
CONN_X1	X1
X325	X325
X315	X315
J353	J353
G202	G202
X80H	X80H Accessory Power Receptacle - Center Console
E37R	E37R Dome/Reading Lamps - Rear
T22	T22 Mobile Device Wireless Charger Module
S48B	S48B Multifunction Switch - Overhead Console
KR76	KR76 Retained Accessory Power Relay
X85	X85 Steering Wheel Air Bag Coil
K9	K9 Body Control Module
KR95A	KR95A Liftgate Unlatch Relay
B305	B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator
M8	M8 Blower Motor

G204

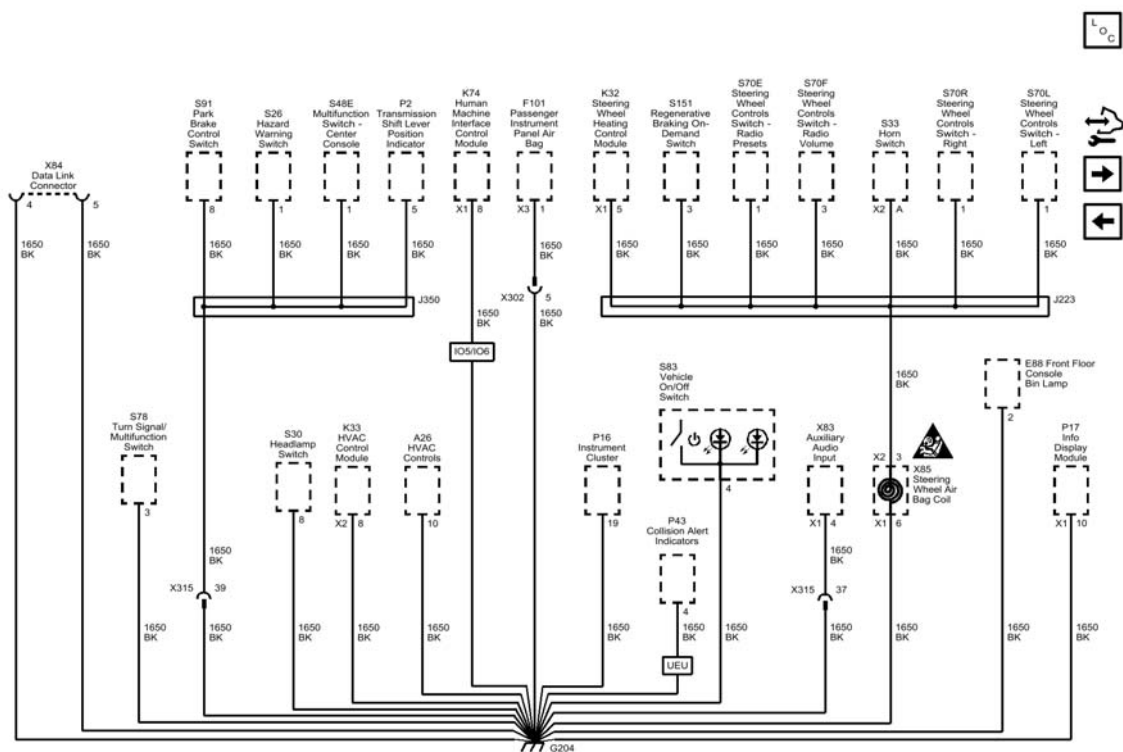


Fig. 74: G204

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1650_BK	1650 BK
CAV_19	19
1650	Ground
1650_BK	1650 BK
CAV_10	10
1650_BK	1650 BK
CAV_6	6
CONN_X1	X1
1650_BK	1650 BK
CAV_4	4
1650_BK	1650 BK
CAV_4	4
1650_BK	1650 BK
CAV_37	37
1650_BK	1650 BK
1650_BK	1650 BK
CAV_3	3
CONN_X2	X2
1650_BK	1650 BK

Callout	Component Name
CAV_4	4
1650_BK	1650 BK
CAV_1	1
CONN_X1	X1
CAV_1	1
CAV_A	A
CONN_X1	X1
CAV_3	3
CONN_X1	X1
CAV_1	1
CONN_X1	X1
1650_BK	1650 BK
V7Y	SALES PACKAGE-#2
1650_BK	1650 BK
CAV_2	2
1650_BK	1650 BK
CAV_3	3
CONN_X1	X1
1650_BK	1650 BK
CAV_5	5
CONN_X1	X1
1650_BK	1650 BK
CAV_8	8
CONN_X2	X2
1650_BK	1650 BK
1650_BK	1650 BK
CAV_8	8
1650_BK	1650 BK
CAV_1	1
CONN_X3	X3
CAV_10	10
1650_BK	1650 BK
1650_BK	1650 BK
CAV_3	3
1650_BK	1650 BK
CAV_8	8
1650_BK	1650 BK
CAV_8	8
1650_BK	1650 BK
CAV_1	1
1650_BK	1650 BK
CAV_1	1
1650_BK	1650 BK
CAV_5	5

Callout	Component Name
1650_BK	1650 BK
1650_BK	1650 BK
1650_BK	1650 BK
IO5	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY
IO6	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY, EMBEDDED NAVIGATION
CAV_39	39
CAV_5	5
1650_BK	1650 BK
1650_BK	1650 BK
CAV_5	5
CAV_4	4
X315	X315
J223	J223
J350	J350
X315	X315
X302	X302
G204	G204
P16	P16 Instrument Cluster
S33	S33 Horn Switch
X85	X85 Steering Wheel Air Bag Coil
S70R	S70R Steering Wheel Controls Switch - Right
S70L	S70L Steering Wheel Controls Switch - Left
P17	P17 Info Display Module
X83	X83 Auxiliary Audio Input
P43	P43 Collision Alert Indicators
S83	S83 Vehicle On/Off Switch
S70F	S70F Steering Wheel Controls Switch - Radio Volume
S70E	S70E Steering Wheel Controls Switch - Radio Presets
E1W	E1W Accent Lamp - Instrument Panel
S2L	S2L Transmission Manual Shift Switch - Left
K32	K32 Steering Wheel Heating Control Module
K33	K33 HVAC Control Module
F101	F101 Passenger Instrument Panel Air Bag
K74	K74 Human Machine Interface Control Module
S78	S78 Turn Signal/Multifunction Switch
S91	S91 Park Brake Control Switch
S26	S26 Hazard Warning Switch
S48E	S48E Multifunction Switch - Center Console
P2	P2 Transmission Shift Lever Position Indicator
A26	A26 HVAC Controls
S30	S30 Headlamp Switch
X84	X84 Data Link Connector

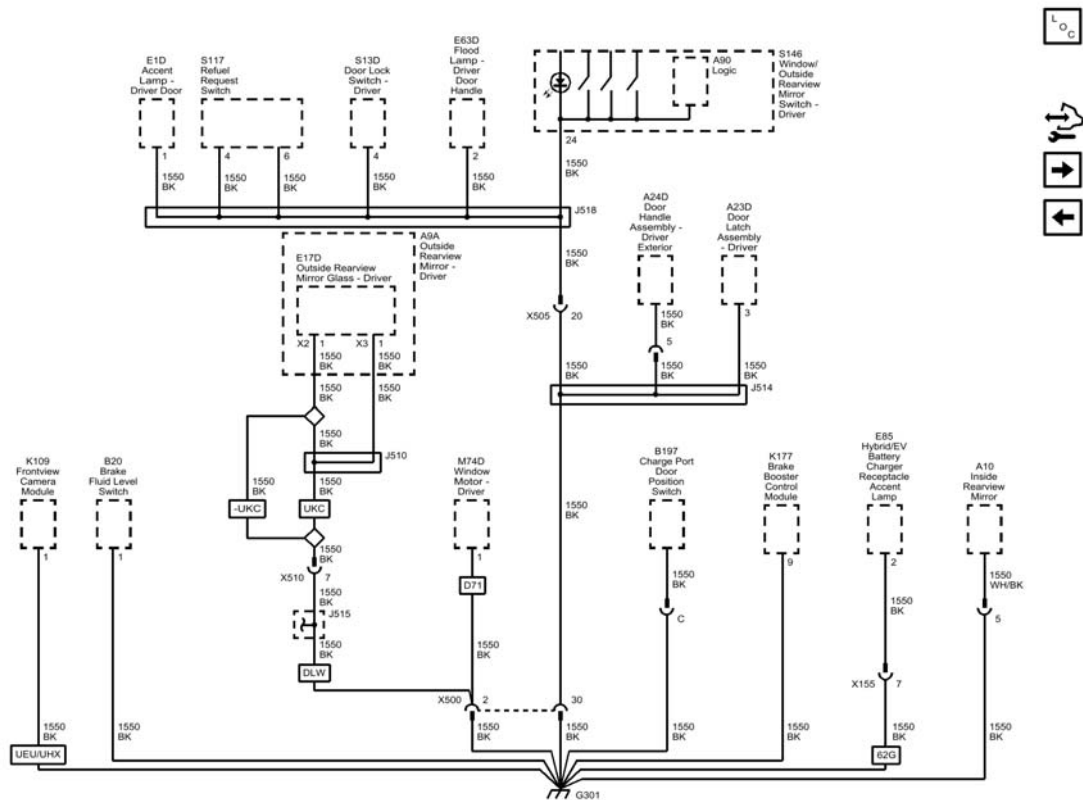


Fig. 75: G301
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1550	Ground
1550_BK	1550 BK
CAV_1	1
1550_BK	1550 BK
CAV_1	1
CAV_1	1
1550_BK	1550 BK
CAV_1	1
CONN_X2	X2
1550_BK	1550 BK
CAV_1	1
1550_BK	1550 BK
1550_BK	1550 BK
CAV_3	3
1550_BK	1550 BK
CAV_24	24
1550_BK	1550 BK
CAV_4	4

Callout	Component Name
1550_BK	1550 BK
CAV_6	6
1550_BK	1550 BK
CAV_2	2
1550_BK	1550 BK
1550_BK	1550 BK
1550_BK	1550 BK
CAV_20	20
1550_BK	1550 BK
CAV_7	7
CAV_9	9
CONN_X1	X1
1550_BK	1550 BK
1550_BK	1550 BK
62G	ACCESSORY-ACCENT LIGHTING - FRONT EXTERIOR
CAV_2	2
CONN_X1	X1
CAV_C	C
CAV_5	5
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
1550_BK	1550 BK
CAV_4	4
CAV_1	1
1550_BK	1550 BK
1550_BK	1550 BK
CAV_4	4
CONN_X1	X1
1550_BK	1550 BK
1550_BK	1550 BK
1550_BK	1550 BK
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
1550_BK	1550 BK
1550_BK	1550 BK
DLW	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
CAV_7	7
1550_BK	1550 BK
D71	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING
1550_BK	1550 BK
1550_BK	1550 BK
CAV_2	2

Callout	Component Name
1550_BK	1550 BK
1550_BK	1550 BK
1550_BK	1550 BK
1550_BK	1550 BK
DD8	MIRROR I/S R/V-LT SENSITIVE
1550_BK	1550 BK
1550_BK	1550 BK
X500	X500
CAV_30	30
CAV_2	2
G301	G301
X505	X505
X155	X155
J514	J514
J518	J518
J515	J515
X510	X510
J510	J510
X500	X500
M74D	M74D Window Motor - Driver
A9A	A9A Outside Rearview Mirror - Driver
A90	A90 Logic
B20	B20 Brake Fluid Level Switch
S117	S117 Refuel Request Switch
A23D	A23D Door Latch Assembly - Driver
A24D	A24D Door Handle Assembly - Driver Exterior
K177	K177 Brake Booster Control Module
B197	B197 Charge Port Door Position Switch
A10	A10 Inside Rearview Mirror
S79P	S79P Window Switch - Passenger
S146	S146 Window/Outside Rearview Mirror Switch - Driver
S13D	S13D Door Lock Switch - Driver
E17D	E17D Outside Rearview Mirror Glass - Driver
E63D	E63D Flood Lamp - Driver Door Handle
E1D	E1D Accent Lamp - Driver Door
B174	B174 Frontview Camera (UHY)
E85	E85 Hybrid/EV Battery Charger Receptacle Accent Lamp

G302

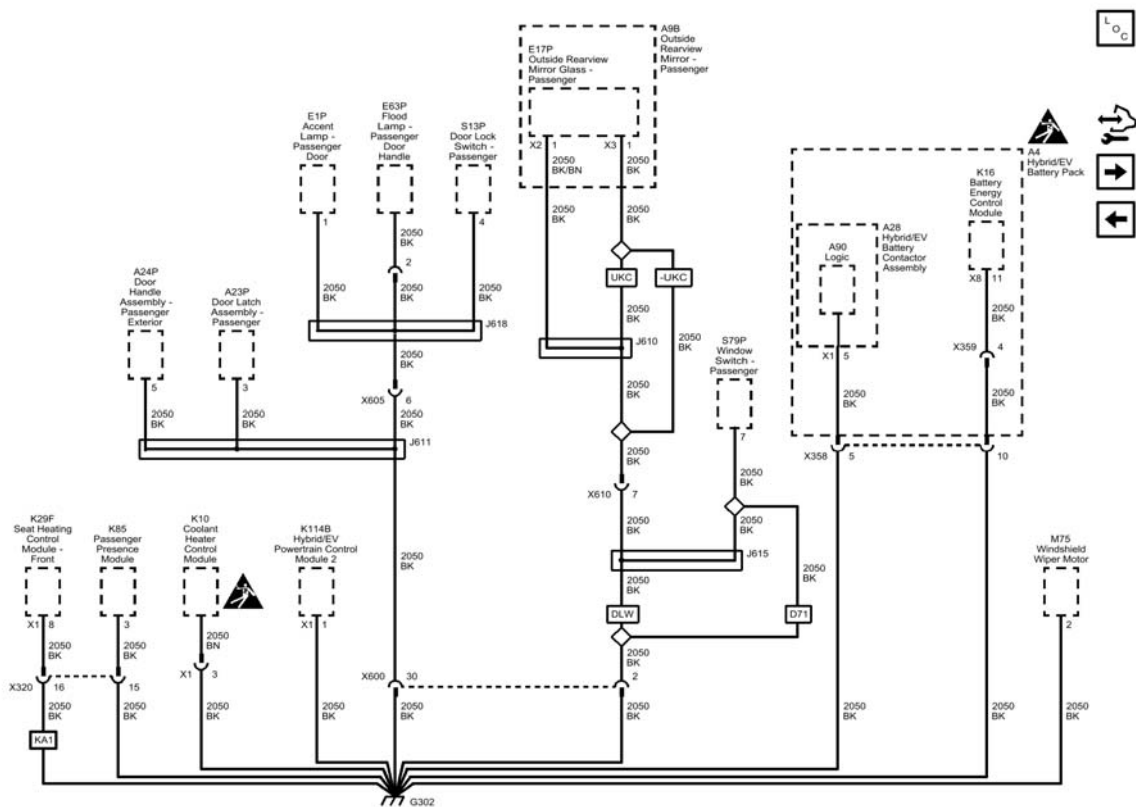


Fig. 76: G302
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2050	Ground
2050_BK	2050 BK
CAV_4	4
2050_BK	2050 BK
2050_BK	2050 BK
CAV_7	7
2050_BK	2050 BK
2050_BK	2050 BK
CAV_4	4
CONN_X1	X1
2050_BK	2050 BK
2050_BK/BN	2050 BK/BN
2050_BK	2050 BK
2050_BK	2050 BK
CAV_1	1
CONN_X1	X1
2050_BK	2050 BK
2050_BK	2050 BK
CAV_3	3
2050_BK	2050 BK

Callout	Component Name
2050_BK	2050 BK
2050_BK	2050 BK
CAV_8	8
CONN_X1	X1
2050_BK	2050 BK
2050_BK	2050 BK
CAV_3	3
2050_BK	2050 BK
CAV_1	1
CONN_X1	X1
2050_BK	2050 BK
CAV_16	16
2050_BK	2050 BK
KA1	HEATER SEAT FRT-DRVR and PASS
CAV_11	11
CONN_X8	X8
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
CAV_2	2
CAV_2	2
CAV_6	6
DLW	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED
2050_BK	2050 BK
2050_BK	2050 BK
CAV_7	7
2050_BK	2050 BK
CAV_1	1
CONN_X2	X2
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
2050_BK	2050 BK
2050_BK	2050 BK
CAV_3	3
2050_BK	2050 BK
CAV_4	4
2050_BK	2050 BK
CAV_1	1
CAV_5	5
CONN_X1	X1
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK

Callout	Component Name
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
D71	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
X600	X600
CAV_30	30
CAV_2	2
X358	X358
CAV_10	10
CAV_5	5
G302	G302
X320	X320
X605	X605
X610	X610
J610	J610
J618	J618
J611	J611
X1	X1
J615	J615
X359	X359
X600	X600
X358	X358
S79P	S79P Window Switch - Passenger
K10	K10 Coolant Heater Control Module
K114B	K114B Hybrid/EV Powertrain Control Module 2
K16	K16 Battery Energy Control Module
A4	A4 Hybrid/EV Battery Pack
A90	A90 Logic
S13P	S13P Door Lock Switch - Passenger
B27P	B27P Door Handle Switch - Passenger Exterior
A23P	A23P Door Latch Assembly - Passenger
K85	K85 Passenger Presence Module
M75	M75 Windshield Wiper Motor
E17P	E17P Outside Rearview Mirror Glass - Passenger
A9B	A9B Outside Rearview Mirror - Passenger
A28	A28 Hybrid/EV Battery Contactor Assembly
K29F	K29F Seat Heating Control Module - Front (KA1)
E63P	E63P Flood Lamp - Passenger Door Handle
E1P	E1P Accent Lamp - Passenger Door

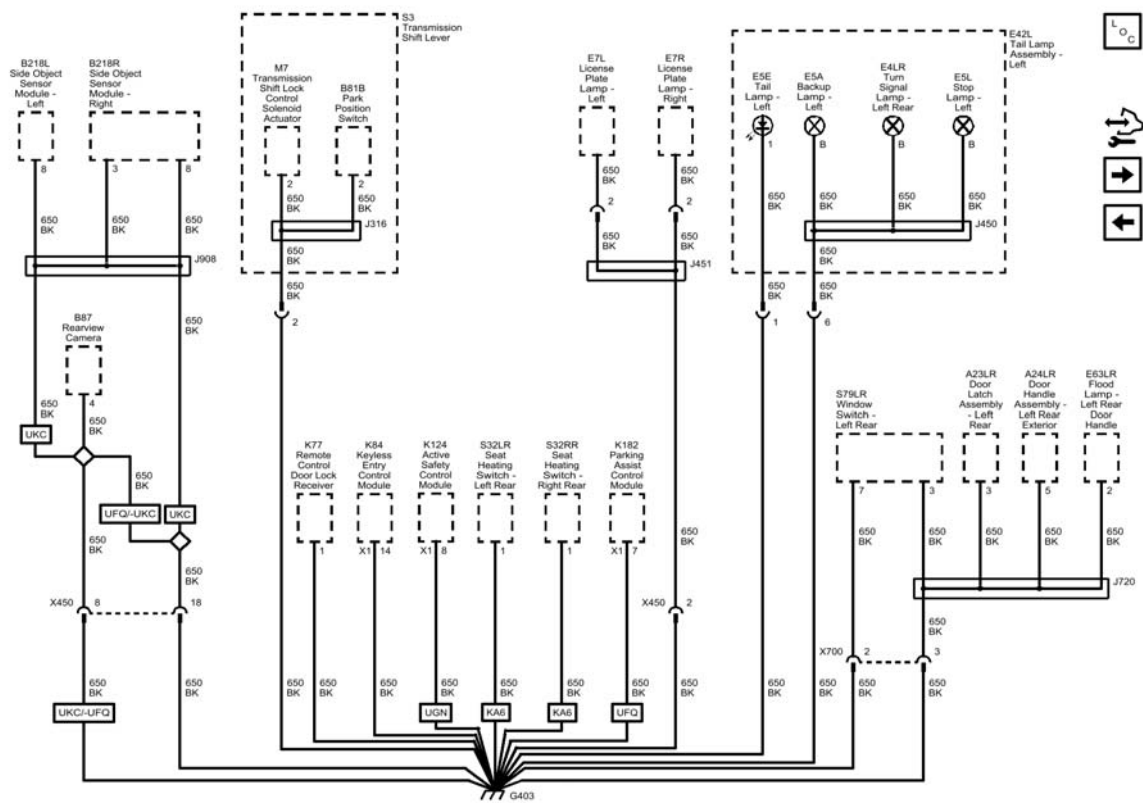


Fig. 77: G403
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
650_BK	650 BK
650	Ground
650_BK	650 BK
650_BK	650 BK
CAV_1	1
650_BK	650 BK
CAV_7	7
CONN_X1	X1
650_BK	650 BK
CAV_7	7
650_BK	650 BK
CAV_3	3
650_BK	650 BK
CAV_3	3
650_BK	650 BK
CAV_1	1
650_BK	650 BK
650_BK	650 BK

Callout	Component Name
650_BK	650 BK
CAV_1	1
CONN_X1	X1
CAV_14	14
CONN_X1	X1
650_BK	650 BK
CAV_4	4
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
CAV_3	3
CAV_8	8
CAV_8	8
650_BK	650 BK
650_BK	650 BK
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
CAV_2	2
650_BK	650 BK
CAV_2	2
650_BK	650 BK
CAV_2	2
650_BK	650 BK
KA6	HEATER SEAT-REAR
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
650_BK	650 BK
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
650_BK	650 BK
650_BK	650 BK
CAV_1	1
KA6	HEATER SEAT-REAR
650_BK	650 BK
CAV_8	8
UGN	COLL IMMINENT BRK-ALL SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED

Callout	Component Name
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
CAV_B	B
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
CAV_B	B
CAV_B	B
CAV_1	1
CAV_6	6
CAV_1	1
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
CAV_2	2
CAV_2	2
CAV_2	2
CAV_2	2
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
X700	X700
CAV_2	2
CAV_3	3
X450	X450
CAV_8	8
CAV_18	18
J720	J720
G403	G403
J908	J908
J316	J316
J450	J450
J451	J451
X450	X450
X700	X700
X450	X450

Callout	Component Name
A23LR	A23LR Door Latch Assembly - Left Rear
S79LR	S79LR Window Switch - Left Rear
K77	K77 Remote Control Door Lock Receiver
K84	K84 Keyless Entry Control Module
B87	B87 Rearview Camera (UVC)
B218L	B218L Side Object Sensor Module - Left (UFG)
B218R	B218R Side Object Sensor Module - Right (UFG)
B27LR	B27LR Door Handle Switch - Left Rear Exterior
S3	S3 Transmission Shift Lever
M7	M7 Transmission Shift Lock Control Solenoid Actuator
B81B	B81B Park Position Switch
K182	K182 Parking Assist Control Module (UFQ)
S32LR	S32LR Seat Heating Switch - Left Rear (KA6)
S32RR	S32RR Seat Heating Switch - Right Rear (KA6)
E63LR	E63LR Flood Lamp - Left Rear Door Handle
K124	K124 Active Safety Control Module (UGN)
E5A	E5A Backup Lamp - Left
E5L	E5L Stop Lamp - Left
E4LR	E4LR Turn Signal Lamp - Left Rear
E42L	E42L Tail Lamp Assembly - Left
E5E	E5E Tail Lamp - Left
E7L	E7L License Plate Lamp - Left
E7R	E7R License Plate Lamp - Right

G405

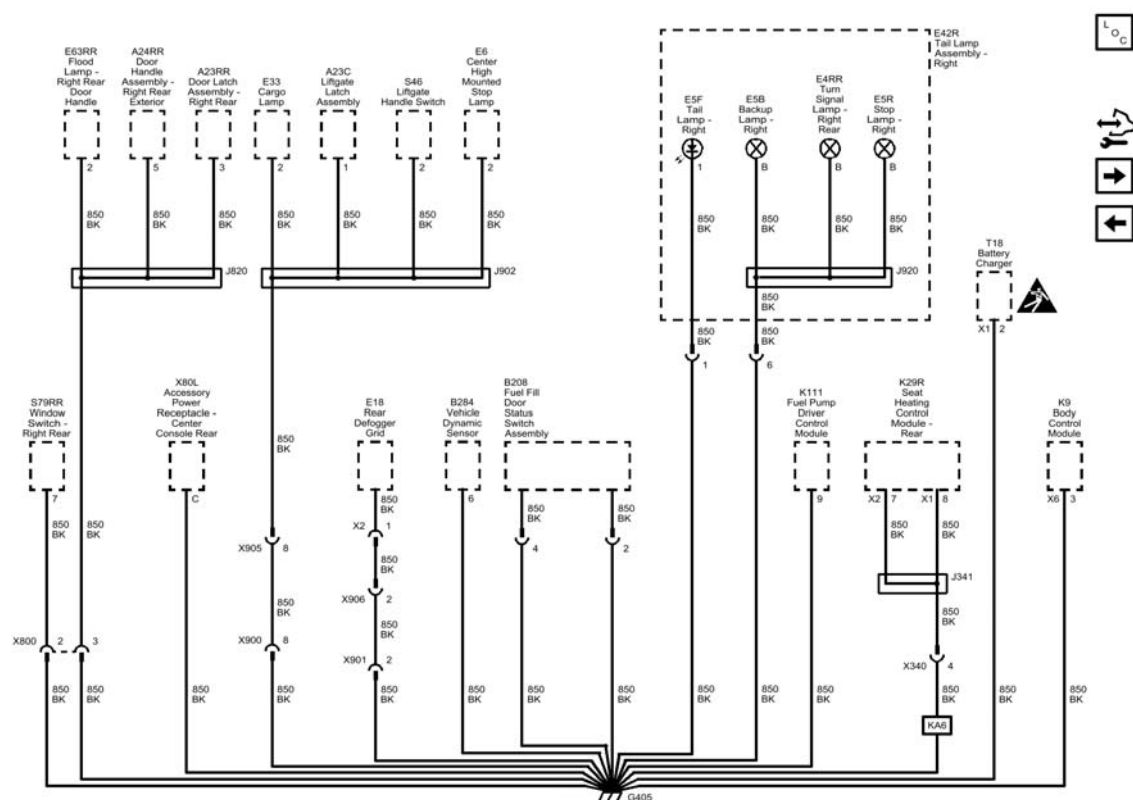


Fig. 78: G405

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
850	Ground
850_BK	850 BK
850_BK	850 BK
CAV_C	C
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
CAV_7	7
850_BK	850 BK
CAV_9	9
850_BK	850 BK
CAV_8	8
CONN_X1	X1
850_BK	850 BK
850_BK	850 BK
CAV_3	3
CONN_X6	X6
KA6	HEATER SEAT-REAR
CAV_3	3
850_BK	850 BK

Callout	Component Name
CAV_1	1
850_BK	850 BK
CAV_2	2
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
CAV_8	8
CAV_8	8
850_BK	850 BK
850_BK	850 BK
CAV_B	B
850_BK	850 BK
CAV_1	1
850_BK	850 BK
CAV_2	2
850_BK	850 BK
CAV_2	2
850_BK	850 BK
CAV_4	4
CAV_2	2
850_BK	850 BK
850_BK	850 BK
CAV_7	7
CONN_X2	X2
850_BK	850 BK
CAV_4	4
850_BK	850 BK
CAV_2	2
CONN_X1	X1
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
CAV_6	6
CAV_1	1
850_BK	850 BK
CAV_1	1
CAV_B	B
CAV_B	B
CAV_B	B
850_BK	850 BK
CAV_6	6
850_BK	850 BK

Callout	Component Name
CAV_1	1
CONN_X2	X2
CAV_2	2
CAV_2	2
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
X800	X800
CAV_3	3
CAV_2	2
G405	G405
X900	X900
X905	X905
J902	J902
J820	J820
X340	X340
J341	J341
J920	J920
X906	X906
X901	X901
X800	X800
B208	B208 Fuel Fill Door Status Switch Assembly
X80L	X80L Accessory Power Receptacle - Center Console Rear
K9	K9 Body Control Module
K111	K111 Fuel Pump Driver Control Module
S79RR	S79RR Window Switch - Right Rear
A23RR	A23RR Door Latch Assembly - Right Rear
B27RR	B27RR Door Handle Switch - Right Rear Exterior
E6	E6 Center High Mounted Stop Lamp
S46	S46 Liftgate Handle Switch
A23C	A23C Liftgate Latch Assembly
E33	E33 Cargo Lamp
T18	T18 Battery Charger
K29R	K29R Seat Heating Control Module - Rear (KA6)
E63RR	E63RR Flood Lamp - Right Rear Door Handle
E42R	E42R Tail Lamp Assembly - Right
E5B	E5B Backup Lamp - Right
E4RR	E4RR Turn Signal Lamp - Right Rear
E5R	E5R Stop Lamp - Right
E5F	E5F Tail Lamp - Right

Callout	Component Name
B284	B284 Vehicle Dynamic Sensor
E18	E18 Rear Defogger Grid

G406

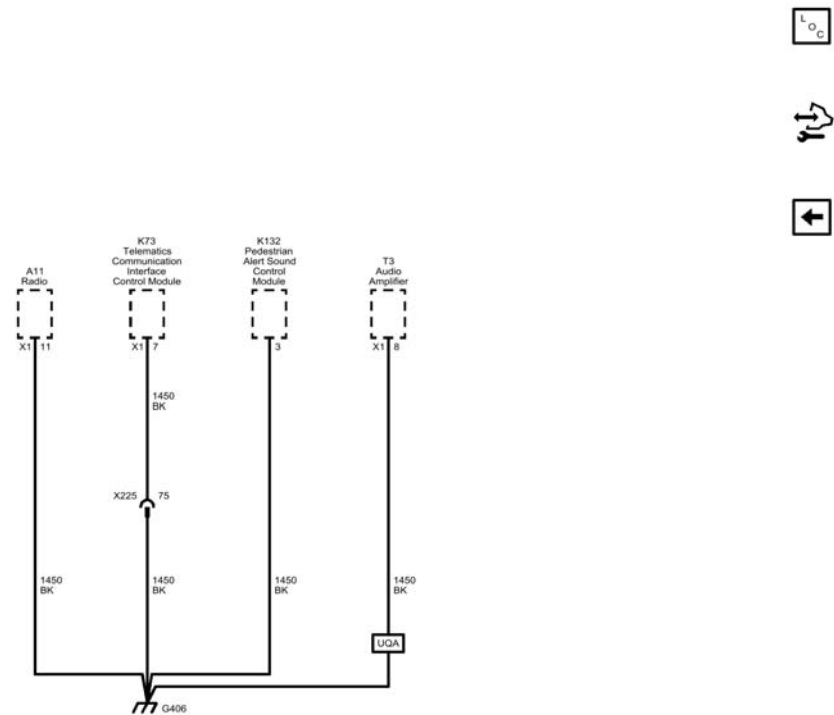


Fig. 79: G406
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_11	11
CONN_X1	X1
1450_BK	1450 BK
CAV_7	7
CONN_X1	X1
1450	Ground
CAV_3	3
CAV_8	8
1450_BK	1450 BK
1450_BK	1450 BK
1450_BK	1450 BK
1450_BK	1450 BK
UQA	(U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX), Korea (MAW))
CAV_75	75

Callout	Component Name
G406	G406
X225	X225
A11	A11 Radio
T3	T3 Audio Amplifier (UQA)
K132	K132 Pedestrian Alert Sound Control Module
K73	K73 Telematics Communication Interface Control Module (UE1)

Article GUID: A00884671

ELECTRICAL

Wiring Systems and Power Management - Special Tools and Equipment - Special Tools - Volt

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

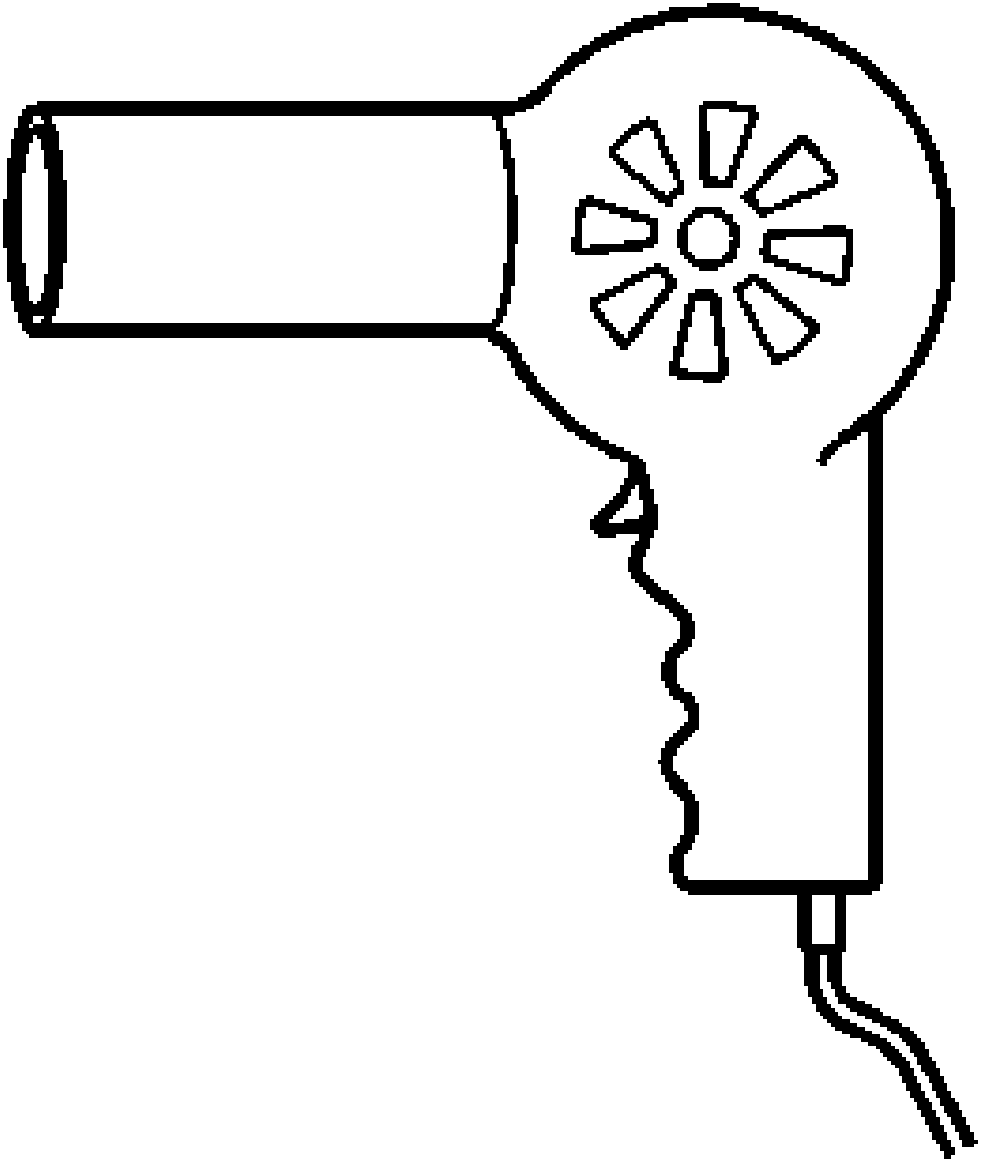
Illustration	Tool Number / Description
	EL-25070 EL-38125-5A EL-38125-5 J-38125-5A Heat Gun 500 - 700 F

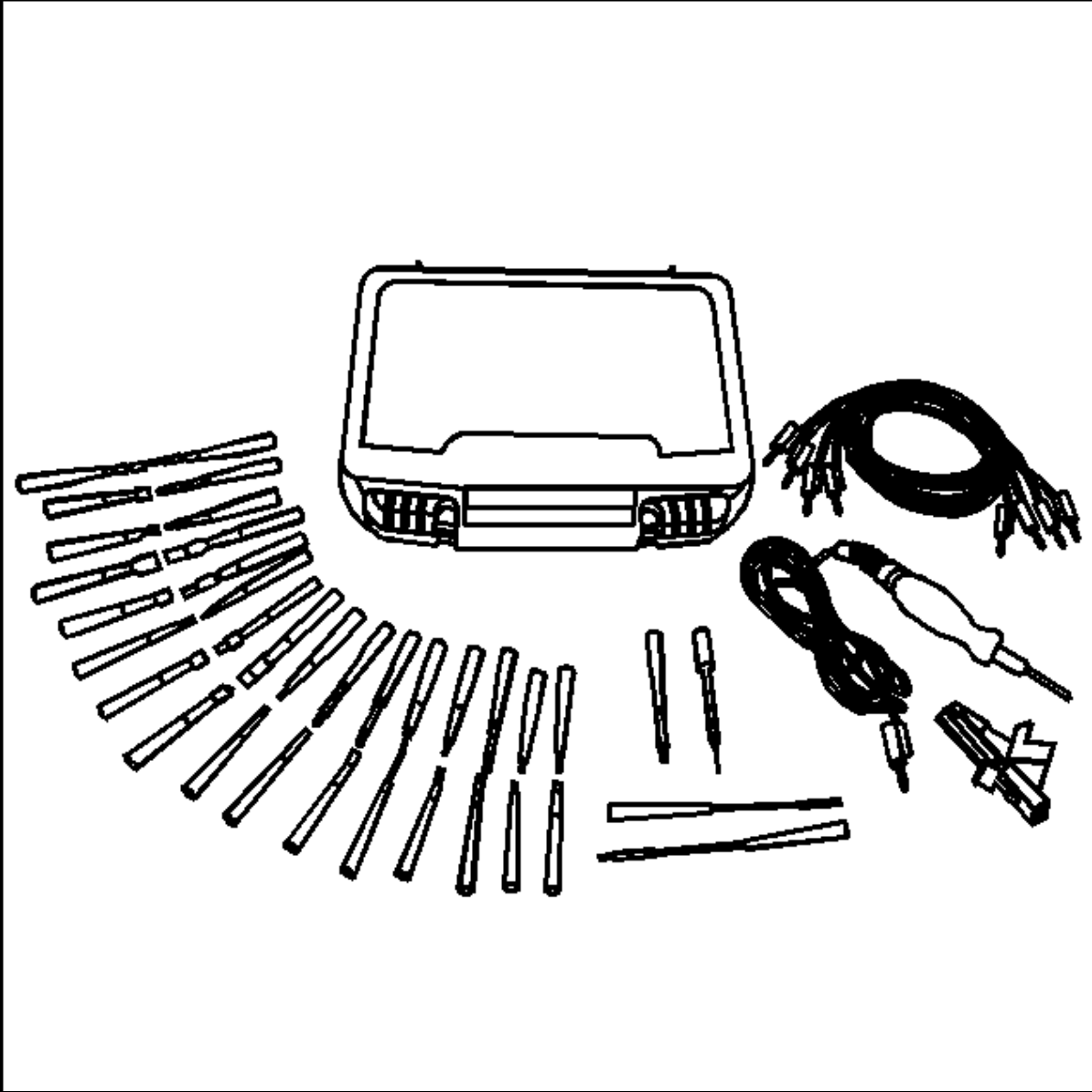
Illustration	Tool Number / Description
	EL-35616 KM-609 Tyco Electronic Tool (5 - 1579007 - 3) Terminal Test Probe Kit

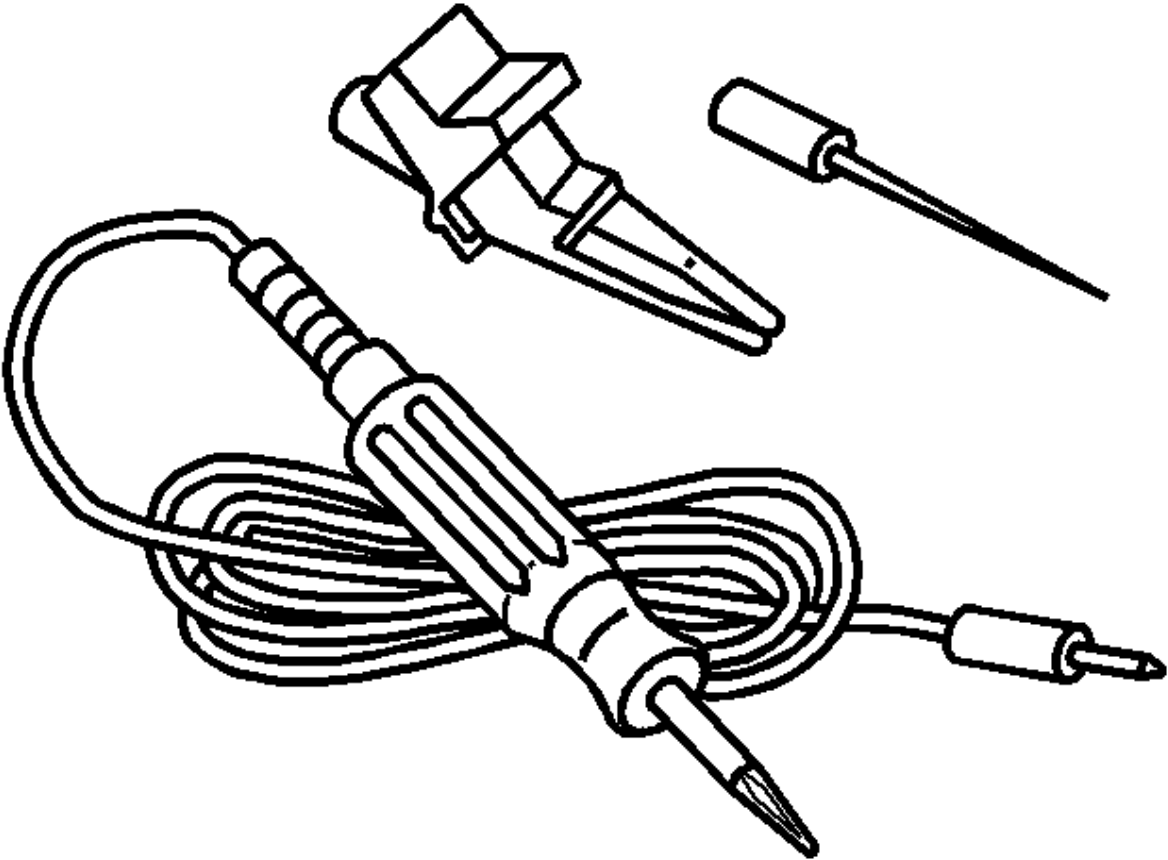
Illustration	Tool Number / Description
	EL-35616-200 KM-J-34142 - B Test Light - Probe Kit

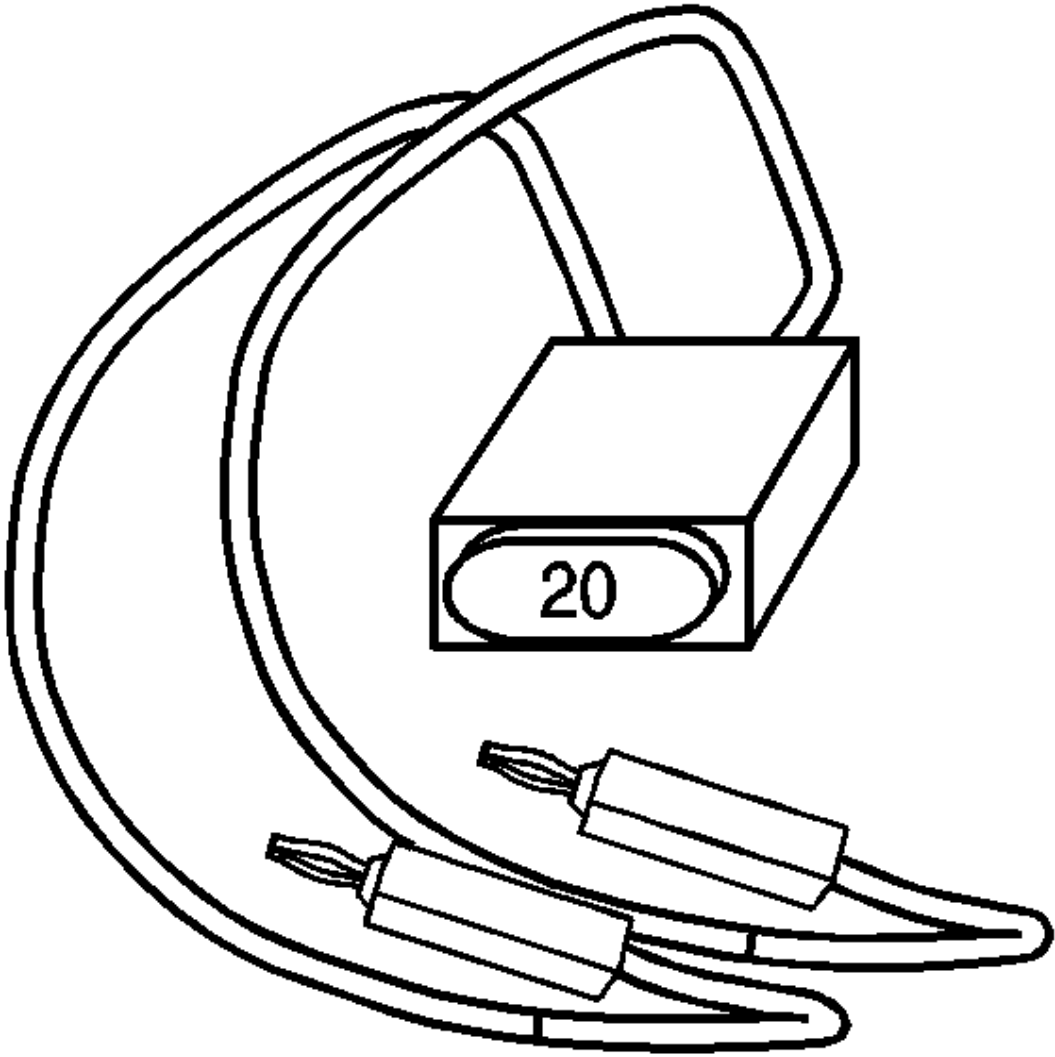
Illustration	Tool Number / Description
	EL-35616-20F KM-963 Fused Jumper Wire

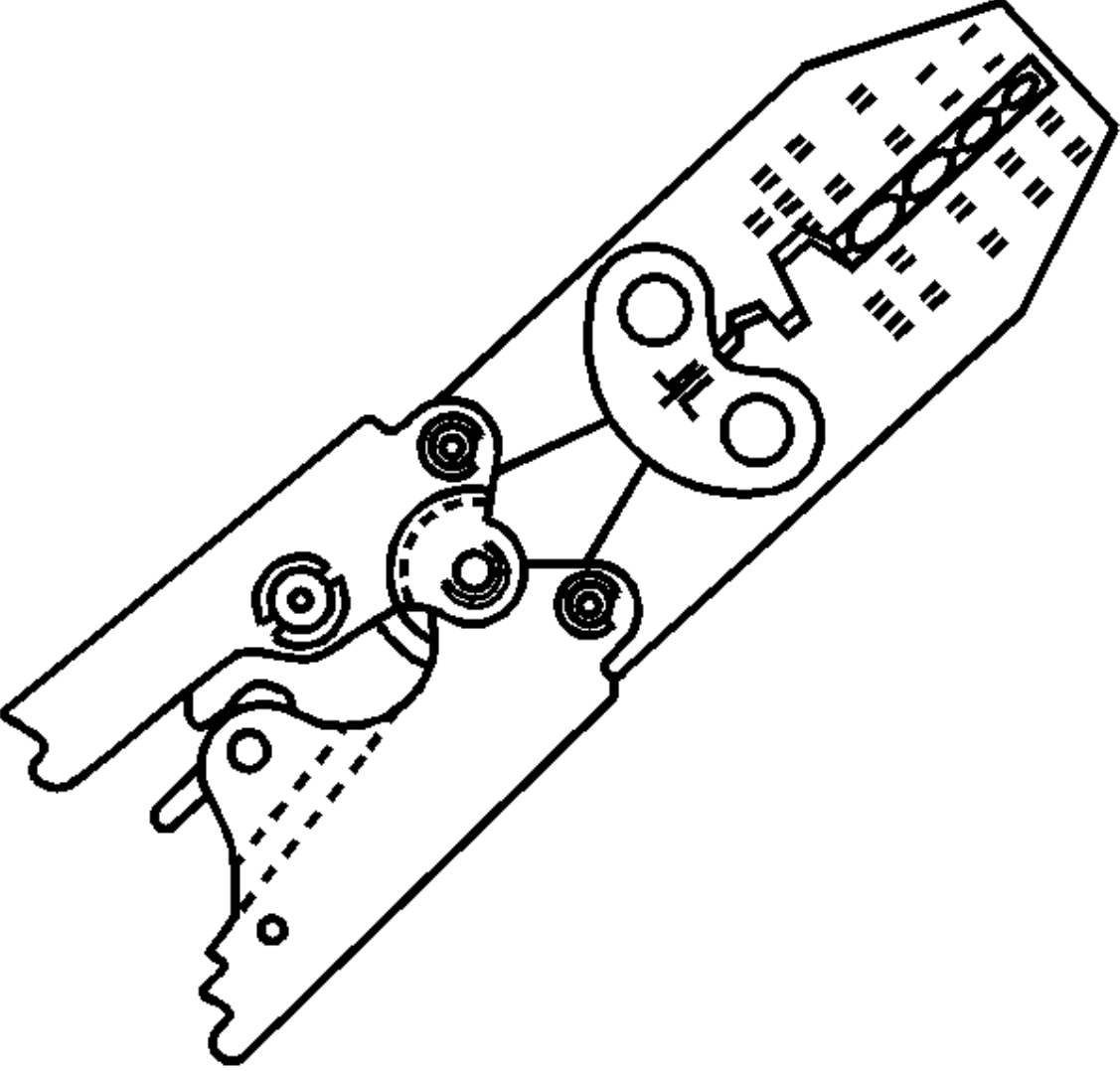
Illustration	Tool Number / Description
	EL-38125 - EU (Europe) J-38125-8 (North America Only) EL-38125 - 10 (Non-North America/Non Europe) Splice Sleeve Crimp Tool

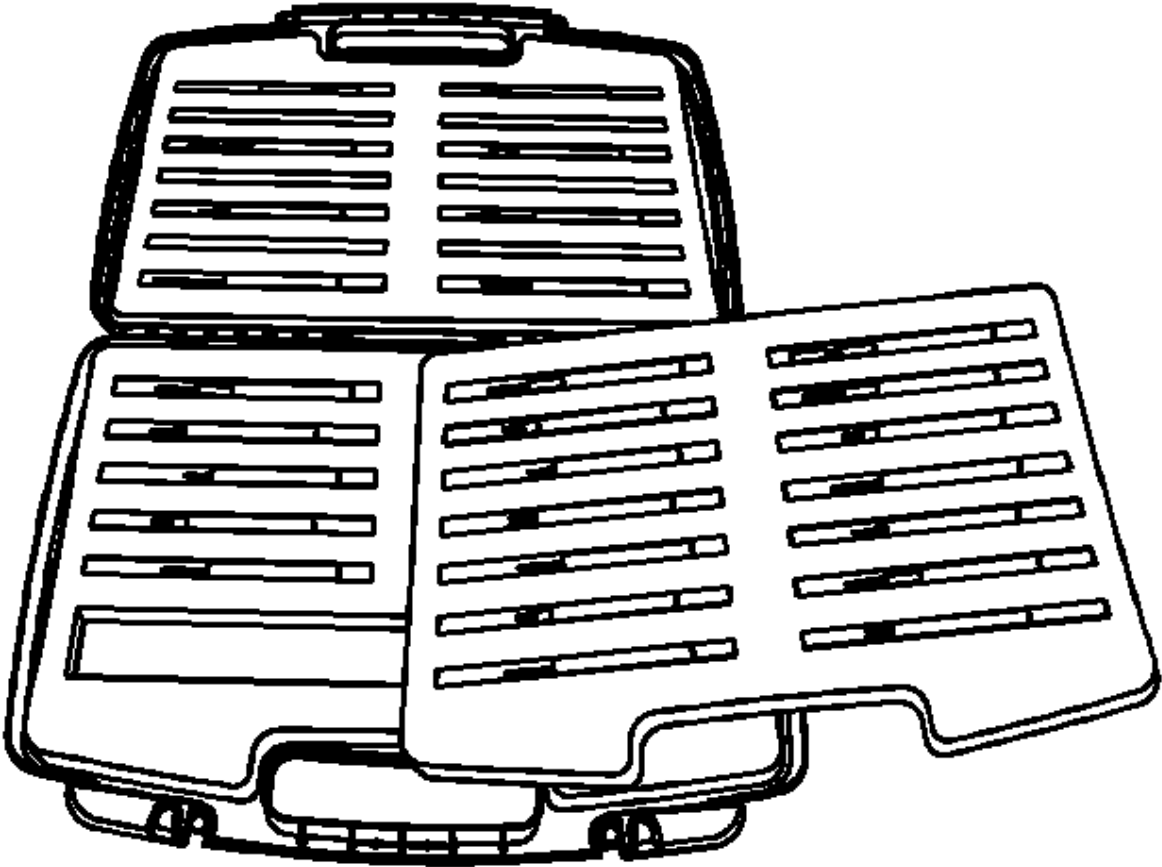
Illustration	Tool Number / Description
	EL-38125-550 (North America Only) Terminal Release Tool Kit

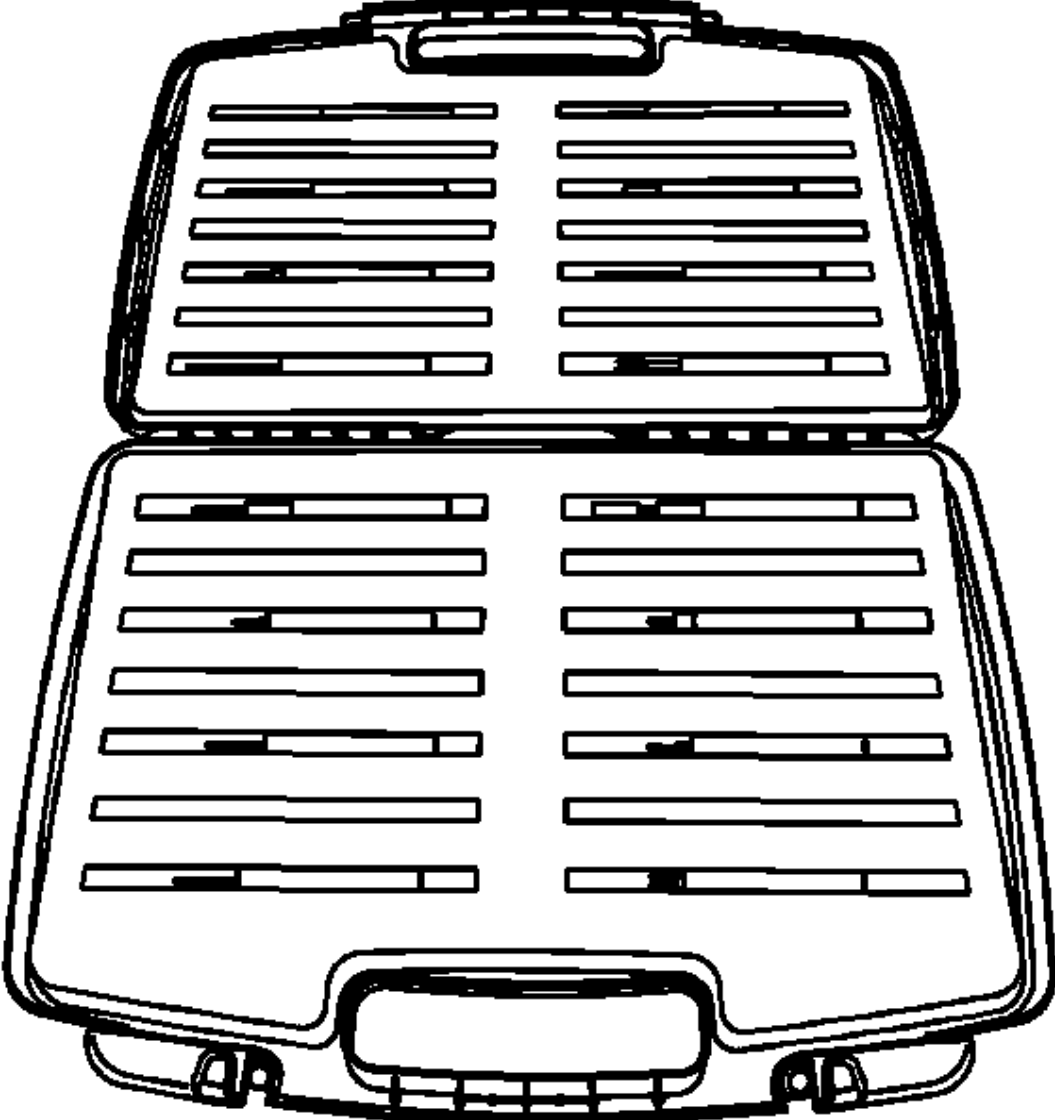
Illustration	Tool Number / Description
	EL-38125-580 (Non-North America) Terminal Release Tool Kit

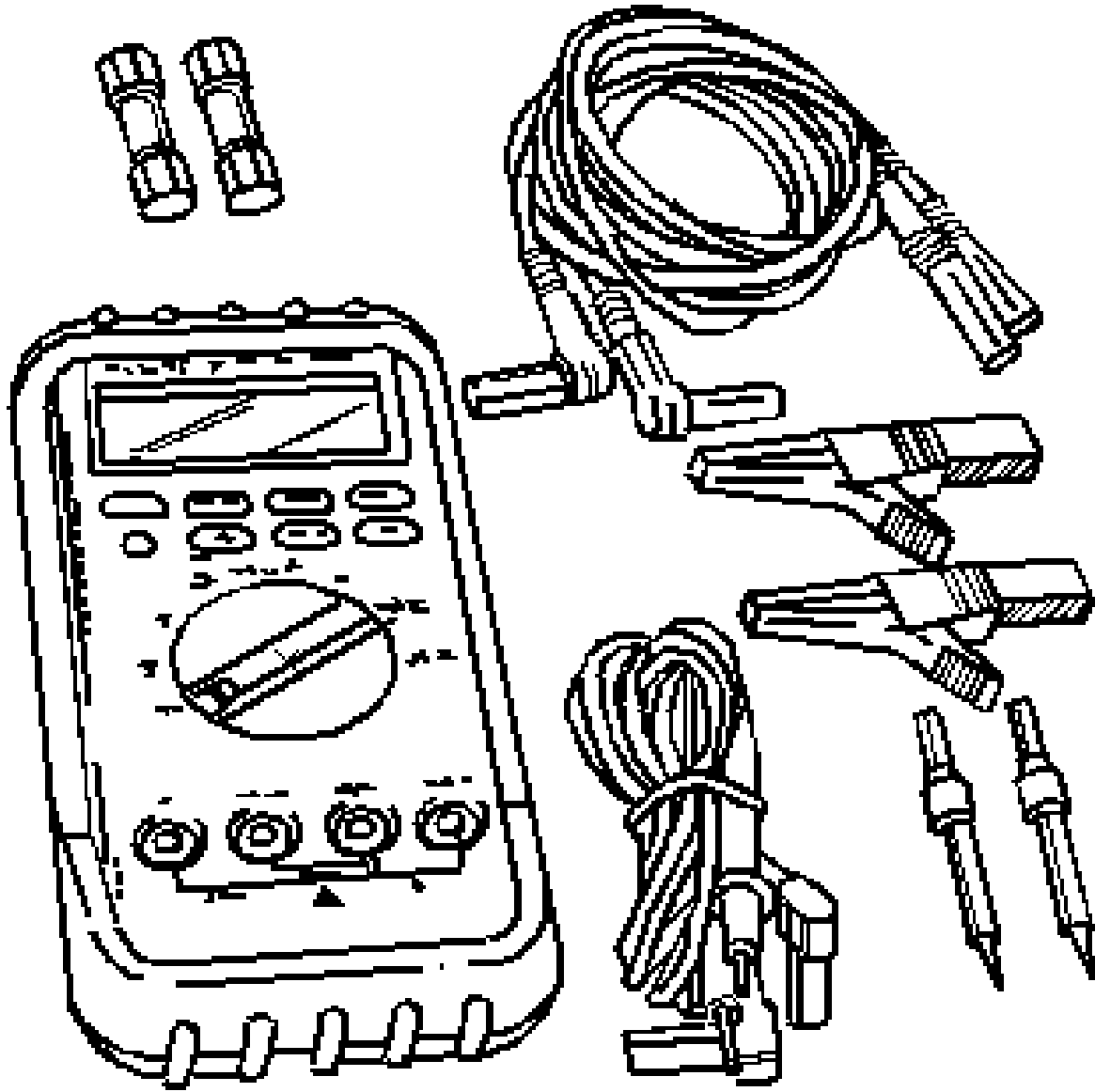
Illustration	Tool Number / Description
	EL-39200 Digital Multimeter

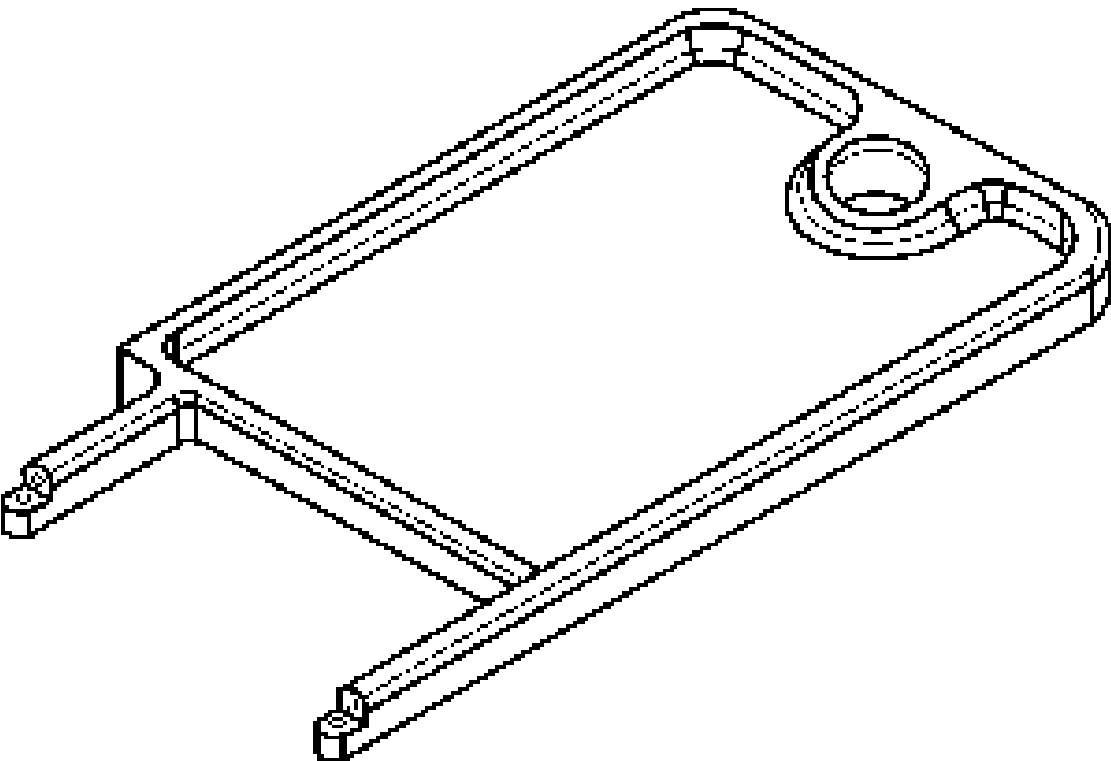
Illustration	Tool Number / Description
	EL-42759 Ignition Switch Connector Release Tool

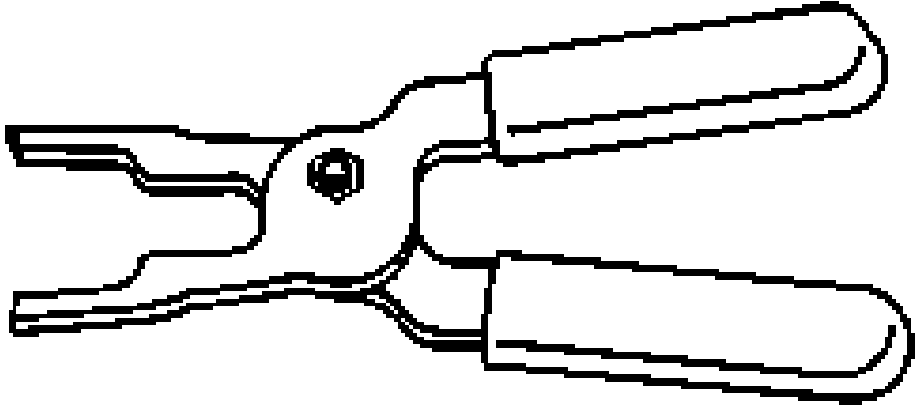
Illustration	Tool Number / Description
	EL-43244 Relay Puller Pliers

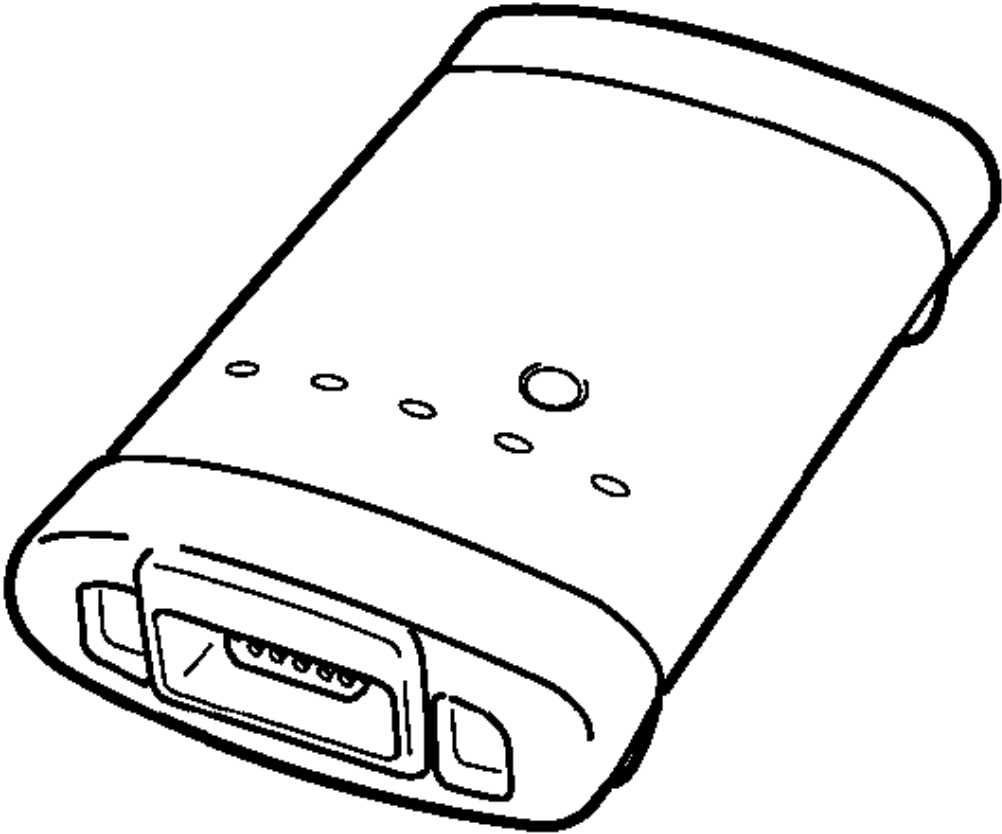
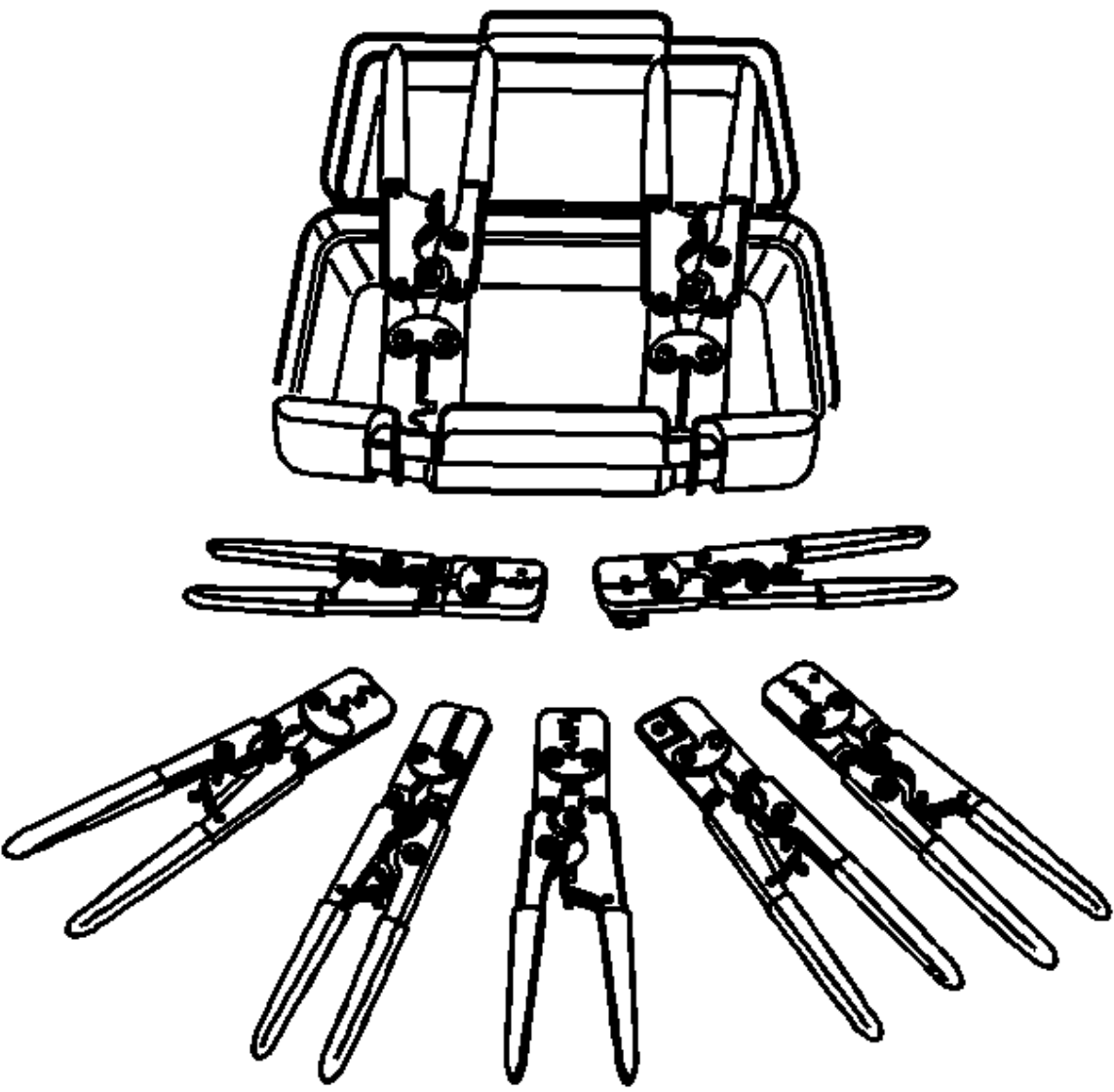
Illustration	Tool Number / Description
	EL-47955 J-2534 Multi Diagnostic Interface MDI

Illustration	Tool Number / Description
	EL-50040 (Holden Only) Crimping Tool Kit

Article GUID: A00884669

ELECTRICAL

Wiring Systems and Power Management - Specifications - Fastener Specifications - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Battery Positive Cable Junction Block Nut	15 N.m (11 lb ft)
Battery Positive Post Clamp Nut	9 N.m (80 lb in)
Body Wiring Harness Nut	15 N.m (11 lb ft)

Article GUID: A00884749

ELECTRICAL

12 V Starting and Charging - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Battery Hold Down Retainer Bolt	18 N.m (13 lb ft)
Battery Negative Ground Cable Bolt	22 N.m (16 lb ft)
Battery Negative Pole Clamp Nut	9 N.m (80 lb in)
Battery Positive and Negative Cable (Accessory Power Module Ground Cable) Bolt	22 N.m (16 lb ft)
Battery Positive and Negative Cable (APM Ground Cable) Nut	22 N.m (16 lb ft)
Battery Positive and Negative Cable (B+ APM Module to Battery Fuse Block) Nut (APM Module Side)	22 N.m (16 lb ft)
Battery Positive and Negative Cable (B+ APM Module to Battery Fuse Block) Nut (Fuse Block Side)	15 N.m (11 lb ft)
Battery Positive Cable Fuse Block Nut	9 N.m (80 lb in)
Battery Positive Pole Clamp Nut	9 N.m (80 lb in)
Engine Ground Strap Bolt	25 N.m (18 lb ft)
Engine Wiring Harness Junction Block Bolt	7 N.m (62 lb in)
Engine Wiring Harness Junction Block Supply Nut (M5)	4.7 N.m (42 lb in)
Engine Wiring Harness Junction Block Supply Nut (M8)	9 N.m (80 lb in)
Panel Trim Nut	6 N.m (13 lb in)

SCHEMATIC WIRING DIAGRAMS

STARTING AND CHARGING WIRING SCHEMATICS

12V Battery Management



DTC B1330 04

Device Power 2 Circuit Voltage Open Circuit

DTC B1517 03

Battery Voltage Below Threshold

DTC B1517 07

Battery Voltage Above Threshold

DTC B1517 5A

Battery Voltage Plausibility Failure

DTC C0800 03

Device Power 1 Circuit Voltage Below Threshold

DTC C0800 07

Device Power 1 Circuit Voltage Above Threshold

DTC C0800 11

Device Power 1 Circuit High Input

DTC C0800 0D

Device Power 1 Circuit High Resistance

DTC C0899 00

Device Voltage Low

DTC C0899 03

Device Voltage Low

DTC C0900 00

Device Voltage High

DTC C0900 07

Device Voltage Above Threshold

DTC C12E1

Electronic Brake Control Module Supply Circuit Low Voltage

DTC C12E2

Electronic Brake Control Module Supply Circuit High Voltage

DTC P0561

System Voltage Performance

DTC P0562

System Voltage Low Voltage

DTC P0563

System Voltage High Voltage

DTC P1A0C

Battery Energy Control Module System Voltage Low Voltage

DTC P1A0D

Battery Energy Control Module System Voltage High Voltage

DTC P1EFC

Battery Charger Control Module System Voltage Low Voltage

Circuit/System Description

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 9 V or greater than 18 V for approximately 5 seconds.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the 12 V charging system.
- A possible cause of this DTC could be overcharging with a 12 V battery charger or jump starting.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF, disconnect the drive motor battery charger cable from the X98 Hybrid/EV Battery Charger Receptacle. Measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.
 - **If battery voltage is less than 12.4 V or more than 12.8 V**

Refer to Battery Inspection/Test.

- **If battery voltage is between 12.4 and 12.8 V**
3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
 4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
 - **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

Refer to DC Power Conversion Test .

- **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**
5. Verify the appropriate control module battery voltage and ignition voltage parameters are available in the scan tool.
 - **If parameters are not available in the scan tool**

Refer to Circuit/System Testing

- **If parameters are available in the scan tool**

6. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing

- **If within 1 V of the battery voltage**

7. All OK.

Circuit/System Testing

NOTE: Use the schematic to identify the following:

- **Control modules the vehicle is equipped with**
- **The control module's ground, B+, and Ignition circuit terminal IDs and connectors**

NOTE: Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 10 Ω . In most cases the readings will drop below 20 Ω within 1 min indicating the control module is going to sleep.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the appropriate control module.

- **If the test lamp illuminates**

4. Ignition ON.

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the appropriate control module.

- **If the test lamp illuminates**

6. Replace the control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup

DTC B1516: BATTERY CURRENT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1516 08

Battery Current Sensor Signal Invalid

DTC B1516 66

Battery Current Sensor Wrong Mounting Position

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1516 08	B1516 08	B1516 08	-
Signal	B1516 08	B1516 08	B1516 08	B1516 08, B1516 66
Low Reference	-	B1516 08	-	-

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The body control module (BCM) supplies 5 V and ground to the battery current sensor. The battery current sensor measures the amount of current flowing to or from the battery, and supplies a pulse width modulation (PWM) signal to the BCM.

Conditions for Running the DTC

B1516 08

The BCM is awake.

B1516 66

- The BCM is awake.
- The engine is OFF.

Conditions for Setting the DTC

B1516 08

The battery current signal is less than 4 percent or greater than 96 percent duty cycle for 2 minutes.

B1516 66

The battery current polarity is positive for 2 minutes.

Action Taken When the DTC Sets

The regulated voltage control (RVC) is disabled.

Conditions for Clearing the DTC

The DTC passes when the battery current returns to the normal range for 15 seconds.

Diagnostic Aids

DTC B1516 08 could be set by overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

B1516 08

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the B18 Battery Current Sensor.
It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal 2 and ground.
 - **If 30 Ω or greater**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If less than 30 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

• **If between 4.8 - 5.2 V**

6. Test or replace the B18 Battery Current Sensor.

B1516 66

1. Verify that the B18 Battery Current Sensor is installed securely around the negative battery cable, with the tape tab pointing away from the negative terminal on the C1 Battery.

• **If the B18 Battery Current sensor is not installed correctly**

Remove and reinstall the B18 Battery Current Sensor properly.

• **If the B18 Battery Current Sensor is installed correctly**

2. Replace the B18 Battery Current Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for BCM replacement, setup, and programming

DTC B151A: LOW BATTERY CAPACITY DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B151A 58

Low Battery Capacity Detected

Circuit/System Description

The body control module (BCM) monitors the battery voltage level during an engine crank event to detect a low battery voltage condition.

Conditions for Running the DTC

The vehicle is ON

Conditions for Setting the DTC

A minimum crank battery voltage is less than the minimum crank battery voltage threshold for 16 consecutive crank events.

Action Taken When the DTC Sets

A driver information center message is displayed.

Conditions for Clearing the DTC

The DTC will clear if the minimum crank voltage is greater than the minimum crank voltage threshold during a crank event.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Refer to the Battery Inspection/Test.
- Refer to the Charging System Test.

DTC B1527: PARASITIC LOAD

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1527 00

Parasitic Load

Circuit/System Description

The body control module (BCM) monitors the state of charge of the electrical system.

Conditions for Running the DTC

The ignition is in Accessory or Run mode.

Conditions for Setting the DTC

The state of charge at ignition ON is 30% lower than when the engine was running and battery drain is more than 2 A.

Action Taken When the DTC Sets

There is no battery telltale illuminated or DIC message displayed.

Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run state of charge is greater than or equal to 80%.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Refer to **Battery Electrical Drain/Parasitic Load Test**.

DTC P0A8D: 14V POWER MODULE SYSTEM VOLTAGE LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A8D

14V Power Module System Voltage Low Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, converts the high voltage (360V) direct current (DC) to low voltage (14V) DC to charge the 12V battery and to operate the power accessories. The ECM controls the 14V power module by supplying a 5V pulse width modulated (PWM) signal through a control circuit. The ECM monitors 12V battery voltage to ensure the 14V power module is maintaining the desired voltage.

Conditions for Running the DTC

14V power module is commanded ON.

Conditions for Setting the DTC

The ECM monitored battery voltage is less than or equal to 11V for 8 s within a 10 s window.

Action Taken When the DTC Sets

- The charge indicator is illuminated.
- The 14V power module stops supplying power to the 12V system.
- DTC P0A8D is a Type C DTC.

Conditions for Clearing the DTC

DTC P0A8D is a Type C DTC.

Diagnostic Aids

An improperly fastened 200-amp in-line mega-fuse may cause this DTC to set.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If the DTC is not set

2. Perform the DC Power Conversion Test .

DTC P1F5D OR P1F5E: 14 VOLT POWER MODULE L-TERMINAL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC P1F5D

14 Volt Power Module L-Terminal Circuit Low Voltage

DTC P1F5E

14 Volt Power Module L-Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module. The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14V power module. The duty cycle controls the 14V power module output. The ECM monitors the state of the 14V power module control circuit. The ECM will detect faults on the 14V power module control circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5D: The ECM detects a low voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.
- P1F5E: The ECM detects a high voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.

Action Taken When the DTC Sets

DTCs P1F5D and P1F5E are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F5D and P1F5E are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [Hybrid/EV Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#) for Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Do not have a 12V battery charger connected during the testing.

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K1 14V Power Module, Vehicle On
2. Test for 3.0 - 5.5 V between the signal circuit terminal 1 X1 and ground.

- **If less than 3.0 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If greater the 2 Ω , repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.5 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit 1 X1 and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 3.0 - 5.5 V**

3. Test or replace the K1 14V Power Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming, and setup

DTC P1F59, P1F5A, OR P1F5B: 14 VOLT POWER MODULE STATUS TERMINAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1F59

14 Volt Power Module Status Terminal Circuit Performance

DTC P1F5A

14 Volt Power Module Status Terminal Circuit Low Voltage

DTC P1F5B

14 Volt Power Module Status Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14V power module applies a duty cycled voltage to the ECM. The duty cycle indicates 14V power module internal temperature and operational condition. The ECM will detect faults on the 14V power module status circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5A: The ECM detects a 5% or lower PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F5B: The ECM detects a 96% or higher PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F59: The status circuit PWM signal is not in a valid range.

Action Taken When the DTC Sets

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [Hybrid/EV Controls Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle OFF. Connect the vehicle to an AC supply to begin charging
2. Vehicle in Service Mode
3. Verify that DTC P0D26 is not set and that the vehicle will charge
 - **If the DTC is set or the vehicle will not charge**

Refer to DTC P0D26

- **If the DTC is not set**

NOTE: Do not have a 12V battery charger connected during the testing.

- 4.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing, specific to the DTC(s) set
 - **If the DTC does not set**
7. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

- 1.

DTC P1F5A or P1F5B, without P1F59 Diagnosis

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle On
2. Test for 4.6 V - 7.0 V between the signal circuit terminal 19 X3 and ground.
 - **If less than 4.6 V**
 1. Vehicle OFF, disconnect the harness connector at the K1 14V Power Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If greater the 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K1 14V Power Module.
 - **If greater than 7.0 V**
 1. Vehicle OFF, disconnect the harness connector at the K1 14V Power Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit 19 X3 and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K1 14V Power Module..
 - **If between 4.6 V - 7.0 V**
 3. Test or replace the K20 Engine Control Module.

DTC P1F59 Diagnosis

NOTE: You must perform Circuit/System Verification first

1. Disable the high voltage system for servicing the T18 Battery Charger, K1 14V Power Module and the A4 Hybrid/EV Battery Pack. Refer to High Voltage Disabling
2. Disconnect the X3 connector at the T18 Battery Charger, the X4 connector at the K1 14V Power Module and the X6 connector at the A28 Hybrid/EV Battery Contactor Assembly
3. Verify that all HV harness connector and the mating module connector terminals are free from moisture, corrosion, and arc flash damage.

- **If any terminals show signs of damage**

Replace the HV wiring harness and affected modules as necessary

- **If no arc flash damage, moisture, or corrosion is found**

4. Test the following HV harness terminals for less than 2 Ω end to end:

- X6-1 to X4-B
- X6-1 to X3-1
- X6-2 to X4-A
- X6-2 to X3-2

- **If greater than 2 Ω**

Replace the HV wiring harness

- **If less than 2 Ω**

Replace the K1 14V Power Module

5. Enable high voltage. Refer to High Voltage Enabling
6. Verify the DTC does not set

- **If the DTC sets**

Replace the K20 Engine Control Module

- If the DTC does not set

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Charger Receptacle, Accessory DC Power Control Module, and Drive Motor Battery Charger

[Control Module References](#) for control module replacement, programming, and setup

DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, OR U3500-U350B: BATTERY VOLTAGE/CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U3001

Control Module Improper Shutdown

DTC U3003

Battery Voltage

DTC U3006

Control Module Input Power 1

DTC U3007

Control Module Supply Circuit 2

DTC U3008

Control Module Ground 1

DTC U3009

Control Module Ground 2

DTC U3013

Control Module Input Power 3

DTC U3014

Control Module Input Power 4

DTC U3018

Control Module Supply Circuit 1-2 Not Plausible

DTC U3019

Control Module Supply Circuit 3-4 Not Plausible

DTC U3500

Control Module Input Power "A" Circuit Range/Performance

DTC U3501

Control Module Supply Circuit 1 Low Voltage

DTC U3502

Control Module Supply Circuit 1 High Voltage

DTC U3503

Control Module Input Power "A" Circuit Intermittent/Erratic

DTC U3504

Control Module Input Power "B" Circuit Range/Performance

DTC U3505

Control Module Supply Circuit 2 Low Voltage

DTC U3506

Control Module Supply Circuit 2 High Voltage

DTC U3507

Control Module Input Power "B" Circuit Intermittent/Erratic

DTC U3508

Control Module Input Power "C" Circuit Range/Performance

DTC U3509

Control Module Supply Circuit 3 Low Voltage

DTC U350A

Control Module Supply Circuit High Voltage

DTC U350B

Control Module Input Power "C" Circuit Intermittent/Erratic

Circuit/System Description

The vehicle control module monitors the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 7.5 V or greater than 16 V for approximately 5 seconds.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the 12 V charging system.
- A possible cause of this DTC could be overcharging with a 12 V battery charger or jump starting.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF, disconnect the drive motor battery charger cable from the X98 Hybrid/EV Battery Charger Receptacle. Measure and record the 12 V battery voltage at the battery terminals. The battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the Vehicle OFF.
 - **If battery voltage is not between 12.4 and 12.8 V**
Refer to [Battery Inspection/Test](#).
 - **If battery voltage is between 12.4 and 12.8 V**
2. Vehicle ON, accessories OFF, measure and record the battery voltage at the battery terminals.
3. Verify the voltage is at least 1 V greater than the minimum voltage measured in step 1, but less than 15 V.
 - **If the voltage is not at least 1 V greater than the minimum voltage measured in step 1 or is greater than 15 V.**
Refer to [DC Power Conversion Test](#).
 - **If the voltage is at least 1 V greater than the minimum voltage measured in step 1, but less than 15 V.**
4. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.
 - **If not within 1 V of the battery voltage**
Refer to Circuit/System Testing.
 - **If within 1 V of the battery voltage**
5. All OK.

Circuit/System Testing

NOTE: Use the schematic to identify the following:

- **Which control modules the vehicle is equipped with**
 - **The control modules ground, B+, and Ignition circuit terminal IDs and connectors**
1. Vehicle OFF, and all vehicle systems off, disconnect the scantool and harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.
 2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 3. Verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.
- **If the test lamp illuminates**

4. Vehicle ON.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Power Mode Mismatch](#).

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.

- **If the test lamp illuminates**

6. Replace the appropriate control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

SYMPTOMS - ENGINE ELECTRICAL

The following steps must be completed before using the symptom tables.

- Perform [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - The power modes are correct.
 - The control modules can communicate via the serial data link.
 - There are no DTCs set.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
 - [Battery Description and Operation](#)
 - [Charging System Description and Operation](#)

- **Starting System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the 12 V charging system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Battery Inspection/Test**
- **Battery Charging**
- **Battery Electrical Drain/Parasitic Load Test**
- **Charging System Test**

BATTERY INSPECTION/TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

NOTE: For Warranty repairs -

You must use regionally required battery test equipment for warranty repairs.

For accurate test results the battery must be disconnected from the vehicle and the equipment connected directly to the battery posts. When setting up the equipment, select "Out of Vehicle" and then the correct battery type (Flooded, AGM or Stop/Start AGM) and rated CCA (both from the battery label) must be entered.

- **Failure to obtain the correct connections during the test may result in a failed test on a good battery.**
- **Use the Out of Vehicle test (battery disconnected with test equipment connected directly to the posts) for each battery when testing a vehicle with dual batteries.**

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Starting System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL 50313 Battery Tester For equivalent regional tools, refer to [Special Tools](#)

Circuit/System Testing

WARNING: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

1. Verify the C1 Battery or C1B Battery - Auxiliary (if equipped) case is not cracked, broken, or damaged, which may be indicated by battery acid leakage.
 - If there is any apparent damage

Replace the C1 Battery or C1B Battery - Auxiliary.

- **If there is no damage**

2. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in [Fastener Specifications](#).

- **If the battery cables need to be cleaned or tightened**

Clean as required and tighten as specified.

- **If the battery cables are clean and tight**

3. Disconnect battery from the vehicle. There is no need to remove the battery from the vehicle.
4. Connect the EL-50313 directly to the battery terminal posts.
5. Select "Charging," "Diagnostic" and "Out of Vehicle" when setting up the test.
6. Select the proper battery type, Flooded, AGM or Stop/Start AGM.
7. Enter the CCA as shown on the battery label.
8. Verify the test result is not REPLACE BATTERY or BAD CELL-REPLACE

NOTE: Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the Out of Vehicle test.

- **If the test result is REPLACE BATTERY or BAD CELL-REPLACE**

Replace the C1 Battery or C1B Battery - Auxiliary.

- **If the test result is not REPLACE BATTERY or BAD CELL-REPLACE**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Battery Replacement

BATTERY CHARGING

12 V Battery

The following procedure is for the 12 V battery only.

Special Tools

EL 50313 Midtronics GR8 Battery Tester Charger

For equivalent regional tools, refer to [Special Tools](#).

Diagnostic Aids

NOTE: This vehicle is equipped with an Absorbent Glass Matt Battery. This type of battery

requires different charging and testing parameters than the more common regular flooded lead acid type battery. ANY time you perform charging and or testing you MUST set up the charging/testing equipment or permanent damage to the battery may result.

- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the EL 50313 before charging.
- An AGM battery may be damaged if charged to more than 14.5 V.
- A Flooded Cell battery may be damaged if charged to more than 16.5 V.
- Vehicles with dual batteries must be charged individually which will result in two printouts.

Battery State of Charge

NOTE: Using voltage to determine the battery's state of charge is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery state of charge will only be an estimate.

The maintenance-free batteries state of charge is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the battery's state of charge:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
 - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
 - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

NOTE: The table is accurate to 10 percent only after the battery has been at rest for 12 hours.

4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the state of charge according to the estimated battery temperature:

Battery Voltage	% Charge at 0Â°C (32Â°F)	% Charge at 25Â°C (75Â°F)
12.75 V	100%	100%
12.7 V	100%	90%
12.6 V	90%	75%
12.45 V	75%	65%
12.2 V	65%	45%
12.0 V	40%	20%

Use the state of charge information as follows:

- A battery with a state of charge that is below 65 percent must always be recharged before returning it to service or continuing storage.
- A battery with a state of charge that is 65 percent or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90 percent, before returning it to service or continuing storage.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity - The higher the charger amperage, the less time it will take to charge the battery.
- The state of charge of the battery - A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 V, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery - The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

CAUTION: Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the ECM/PCM or other electronic components.

CAUTION: Refer to [Fastener Caution](#) .

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

Use the following procedure to charge the battery:

1. Ensure that all of the battery terminal connections are clean and tight.
2. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

CAUTION: Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

3. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
4. Select "Charging," "PDI" and "In Vehicle" when setting up the charger.

5. Select the proper battery type, Flooded, AGM, Spiral AGM or Stop/Start AGM.
6. Enter the CCA as shown on the battery label.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

12 V Battery

The following procedure is for the 12 V battery only.

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

Components most likely to cause a parasitic draw on the vehicle's battery are switches, relays, and control modules. After the vehicle is turned OFF the control modules will begin to go to sleep (shut OFF). All control modules do not go to sleep at the same time, some may take up to 30 minutes or longer after turning the Vehicle OFF before going to sleep, like the HVAC and body control modules. Others such as the telematics communication interface control module and remote control door lock receiver may periodically wake up then go back to sleep. These are all normal conditions.

Diagnostic Aids

- Rule out any possible aftermarket equipment causing an unacceptable parasitic current drain. Aftermarket accessories installed into the courtesy lamp circuit can cause the inadvertent power timer in the body control module (BCM) to keep resetting. This would cause the BCM to remain awake and cause a current drain on the battery.
- Rule out customer driving habits such as regular short trips that do not allow enough time to properly charge the battery. Refer to [Battery Description and Operation](#).
- Verify that the battery and charging system are in proper working order. Refer to [Battery Charging](#), and [Charging System Test](#).
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar[®], and regulated voltage control, if equipped, are designed to wake-up, perform a task, and go back asleep at regular intervals. Refer to [Body Control System Description and Operation](#) for the system or modules description and operation.
- An engine off natural vacuum evaporative test can occur if the engine control module (ECM) determines the drive cycle has met the appropriate criteria immediately after key off. The ECM will stay awake and the vent solenoid will stay energized for as long as 45 minutes. The typical current draw for this is about 1 A.
- The telematics communication interface control module current draw is very low, less than 40 mA, so the OnStar system is left in that "awake" state for up to the first 48 hours. Parasitic draw of up to 40 mA with an occasional spike as high as 80 mA through the telematics communication interface control module for the first 48 hours is normal.
- Some automatic climate control systems can remain in a semi-awake state for up to three hours, actual draw amounts vary by vehicle platform but are typically not greater than 50 mA.
- An extremely low mA current level is consumed by the RKE receiver for monitoring purposes, actual system wake up only occurs when the fobs for the vehicle are used. When other devices on the same RKE operating

frequency are activated, such as the 4 tire pressure monitoring sensors and other vehicle transmitters in the vicinity, the RKE receiver will have a 100 mA spike. These spikes are normal and occur too briefly to have a significant effect on battery drain. Competing signals may cause RKE performance issues such as jamming but should not cause excessive battery draw.

- If an excessive current draw is not present during initial testing, continue periodic testing over a 1-2 hour period to see if the current draw increases and stays above an unacceptable level.

NOTE: The battery specification listed below is a generic specification. Refer to the label on the original battery when testing the battery.

- The battery run down time will vary depending on the batteries reserve capacity. If the reserve capacity is higher, then the battery run down time would be longer. If the reserve capacity is lower, then the battery run down time would be shorter. The graph below indicates roughly how many days a 690 cold cranking amp battery with a 110 minute reserve capacity starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery reserve capacity and temperature will affect the results.

Current Drain	Days
25 mA	33
50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 38758 Parasitic Draw Test Switch

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

NOTE:

- Most vehicle systems will go to sleep within 30 minutes but it can take up to 2 hours before all systems power down allowing the parasitic draw test to pass. An occasional increase in the parasitic draw is normal as long as it returns within 1 second.
- Closing the door latches/ajar switch while leaving the doors open is recommended, this allows the vehicle systems to perform in a "doors closed" mode while allowing vehicle interior access that may be needed to complete the diagnostic steps.
- Locking doors will arm the vehicle content theft deterrent system if equipped. Failure to arm the system may cause a theft system fault to not be present during testing.
- There are many things that can prevent the vehicle from completely going to sleep and passing the parasitic draw test. Make sure all the conditions listed below are met before performing the parasitic current draw test.
 - Vehicle OFF
 - Retained Accessory Power RAP OFF - open and close the driver door after Vehicle OFF
 - Scan tool not communicating with a vehicle control module - in some cases it may need to be disconnected from the data link connector.
 - All access doors closed
 - Headlamps OFF - auto headlamps disabled
 - Any delay lighting OFF
 - If equipped with an under hood lamp disable it
 - HVAC after blow OFF
 - Any accessory that can work with Vehicle OFF inactive or OFF
 - Wait up to 2 minutes or longer, after all other listed conditions are met

Using an Inductive Pickup Probe

1. Connect an inductive pickup probe to the negative battery cable that can read down to 1 mA.
2. Vehicle OFF, as the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Using the EL 38758 Parasitic Draw Test Switch

WARNING: Refer to [Battery Disconnect Warning](#) .

CAUTION: When a fused jumper wire or digital multimeter is connected to the test switch terminals, always turn the test switch ON before opening any access door, turning the ignition on, or turning any accessory on. This is to prevent damaging the jumper wire or digital multimeter fuse.

NOTE: The switch knob on the EL 38758 switch is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Vehicle OFF, disconnect the battery negative cable from the battery. Refer to [Battery Negative Cable Disconnection and Connection](#).
2. Turn the EL 38758 switch knob to the OFF position.
3. Install the male end of the EL 38758 switch to the battery ground terminal.
4. Install the battery negative cable to the female end of the EL 38758 switch.
5. Turn the EL 38758 switch knob to the ON position.
6. Road test the vehicle and activate all of the accessories such as the radio and air conditioning.
7. Vehicle OFF, connect a 10 A fused jumper wire to the test switch tool terminals.
8. Turn the EL 38758 switch knob to the OFF position. The current now flows through the jumper wire.
9. Check the fuse in the jumper wire. The fuse should be OK.
 - Failed: If the jumper wire fuse is blown, refer to Circuit/System Testing.
 - Passed
10. Turn the EL 38758 switch knob to the ON position. Remove the fused jumper wire.
11. Connect a digital multimeter set to the 10 A DC scale between the test switch tool terminals.
12. Turn the EL 38758 switch knob to the OFF position. The current now flows through the DMM.
13. As the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Circuit/System Testing

- NOTE:**
- Removing or installing a fuse, relay, or connector, to determine the area causing high parasitic draw may wake up control modules. You must wait for the control modules to go back to sleep before retesting. It is best to install any removed or disconnected components after the diagnosis is completed.
 - Fuses for power mode master components such as the BCM should be removed last to avoid misdiagnosis.
 - If a scan tool is connected to the DLC, either disconnect it or subtract the scan tool current draw from the DMM reading to get the actual vehicle parasitic current draw.

If the vehicle has an unacceptable amount of parasitic current draw, remove each fuse one at a time until the current draw falls to an acceptable level. A drop of more than 10-20 mA, when disabling a single system or circuit, is an indication of an overly high current draw that could be causing the battery drain. Refer to [Power Distribution Schematics](#) to diagnose exactly which circuit of the suspect system is causing the high parasitic drain. The follow is a list of common components that could cause a high current draw:

- Stuck switch
- Stuck relay
- Control module

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for control module replacement, programming and setup

CHARGING SYSTEM TEST

The accessory power module (APM) supplies the energy that flows between the high voltage (300 volt) direct current (DC) and low voltage (14 volt) DC to charge the 12 volt battery and power accessories. To test the charging system, refer to [DC Power Conversion Test](#).

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

Removal Procedure

1. Ensure that all lamps and accessories are turned off.
2. Turn the ignition OFF and remove the ignition key.
3. Disconnect and remove all 12V battery chargers and the AC charger cable from the hybrid battery charger receptacle.

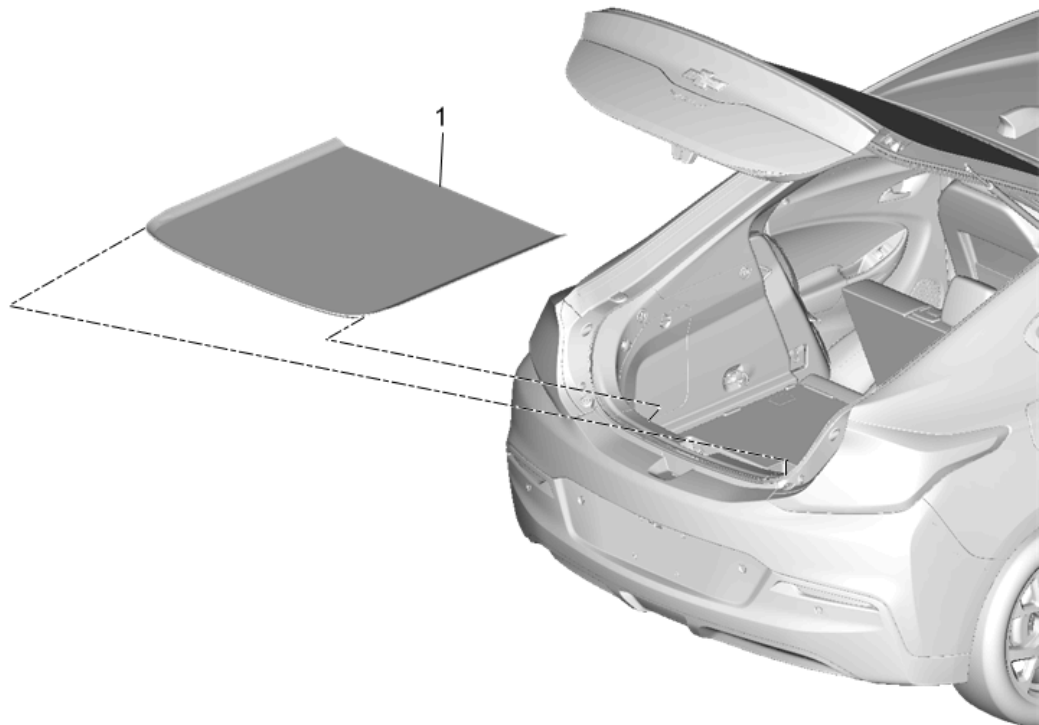


Fig. 2: Rear Compartment Floor Panel Trim

Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Compartment Floor Panel Trim (1) [Rear Compartment Floor Panel Trim Replacement](#)

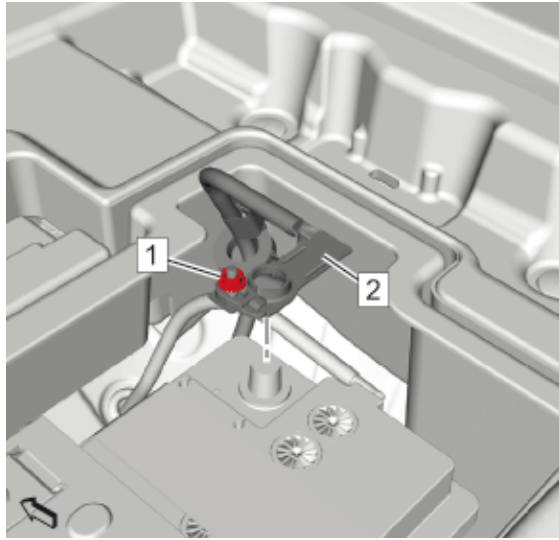


Fig. 3: Battery Negative Post Clamp And Nut
Courtesy of GENERAL MOTORS COMPANY

WARNING: Battery Disconnect Warning

5. Loosen the battery negative post clamp nut (1).
6. Disconnect the battery negative post clamp (2).

Installation Procedure

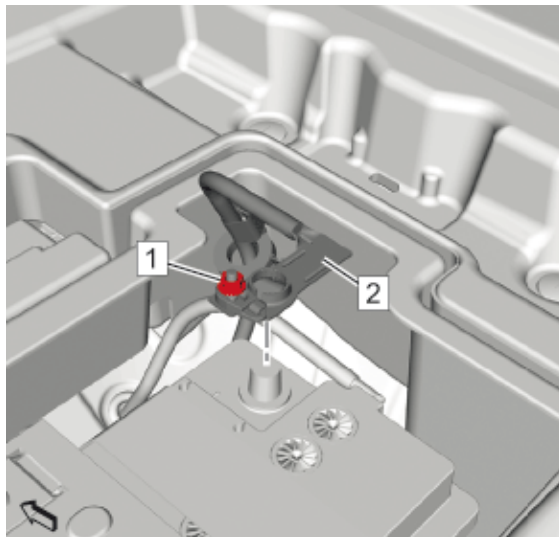


Fig. 4: Battery Negative Post Clamp And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Connect the battery negative post clamp (2).

CAUTION: Fastener Caution

2. Tighten the battery negative post clamp nut (1) to 9 N.m (80 lb in)

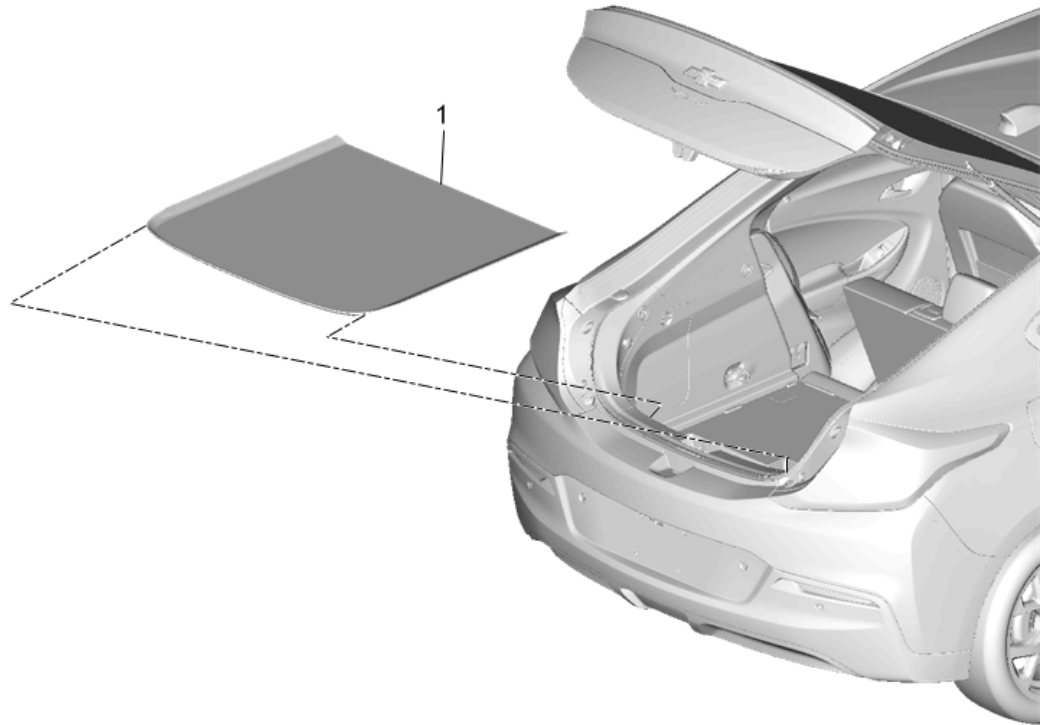


Fig. 5: Rear Compartment Floor Panel Trim
Courtesy of GENERAL MOTORS COMPANY

3. Install Rear Compartment Floor Panel Trim (1) [Rear Compartment Floor Panel Trim Replacement](#)

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (12 V BATTERY TO ACCESSORY DC POWER CONTROL MODULE)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. [High Voltage Disabling](#)
2. Remove Rear Compartment Floor Stowage Trim Compartment [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
3. Disconnect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)

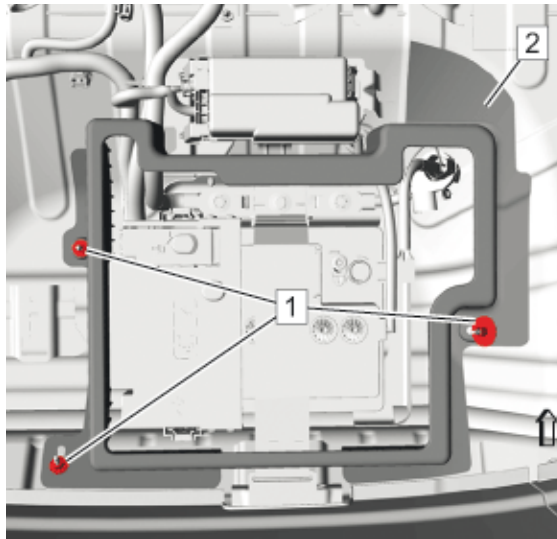


Fig. 6: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 3 panel trim nuts (1).
5. Remove the panel trim (2).

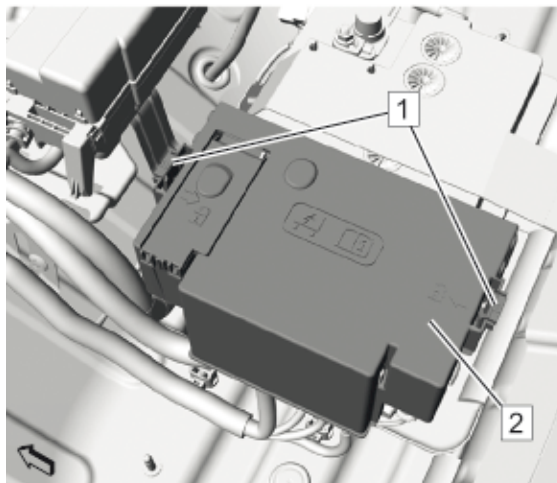


Fig. 7: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

6. Release the retaining tabs.(1)
7. Remove Battery Fuse Block Cover(2)

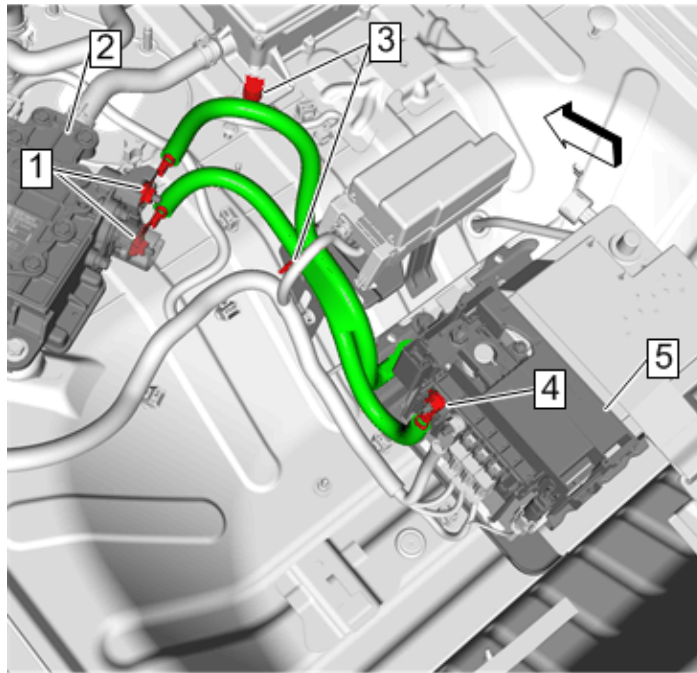


Fig. 8: Battery Positive Cable And Nut

Courtesy of GENERAL MOTORS COMPANY

8. Remove Battery Positive Cable Nut (4) @Battery Distribution Fuse Block (5)
9. Remove Battery Positive Cable Nut (1) @Accessory DC Power Control Module (2)
10. Disengage Retainer (3)

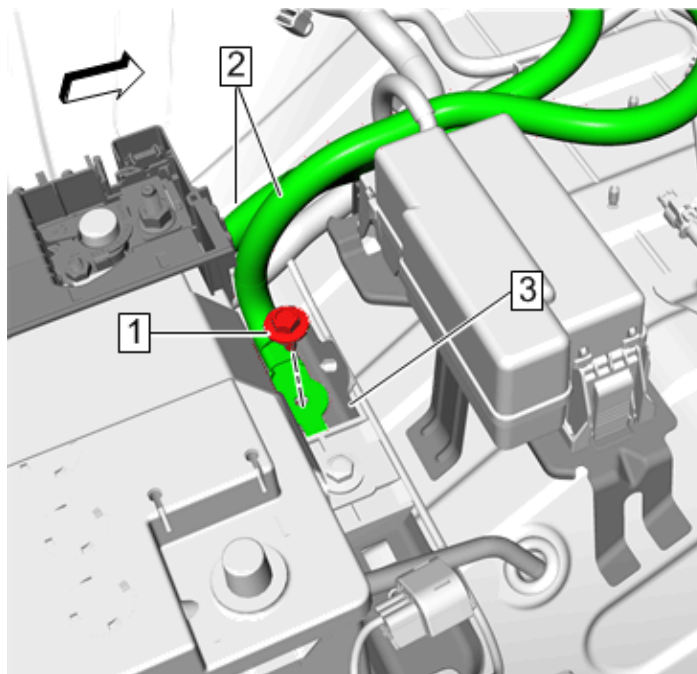


Fig. 9: Battery Negative Cable Ground Fastener

Courtesy of GENERAL MOTORS COMPANY

11. Remove Battery Negative Cable Ground Fastener (1) @Battery Tray (3)
12. Remove Battery Positive and Negative Cable (2)

Installation Procedure

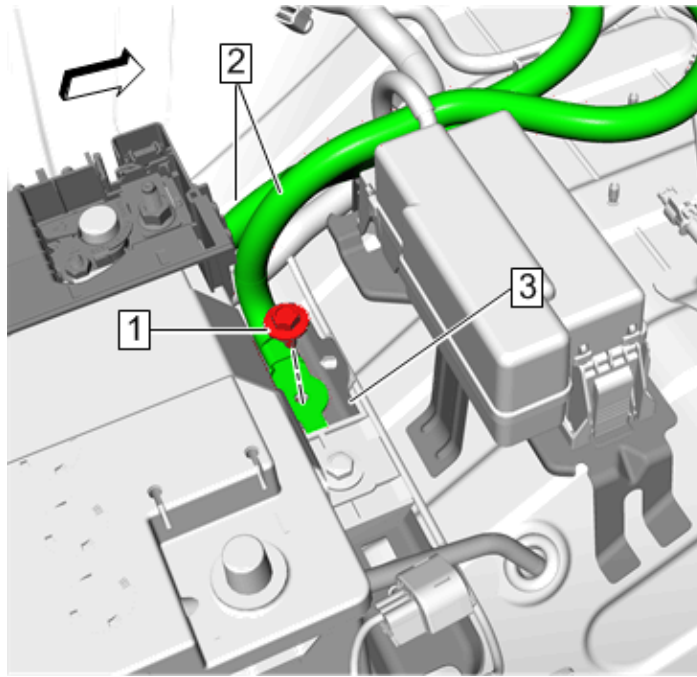


Fig. 10: Battery Negative Cable Ground Fastener

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Positive and Negative Cable (2)

CAUTION: Fastener Caution

2. Install Battery Negative Cable Ground Fastener (1) @Battery Tray (3) and tighten 22 N.m (16 lb ft)

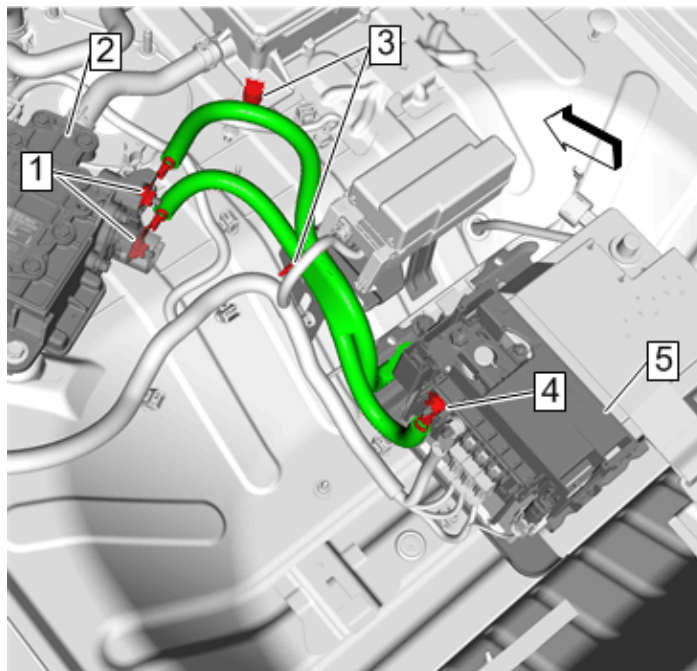


Fig. 11: Battery Positive Cable And Nut

Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Positive Cable Nut (4) @Battery Distribution Fuse Block (5) and tighten 15 N.m (133 lb in)
4. Install Battery Positive Cable Nut (1) @Accessory DC Power Control Module and tighten 22 N.m (16 lb ft)
5. Engage Retainer (3)

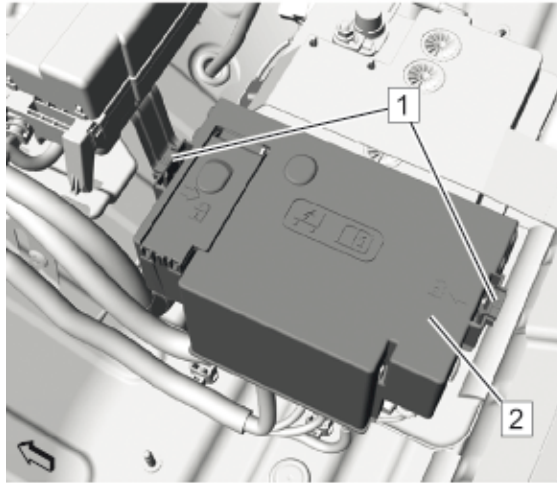


Fig. 12: Battery Fuse Block Cover And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

6. Install Battery Fuse Block Cover (2)
7. Check the 2 locked retaining tabs (1).

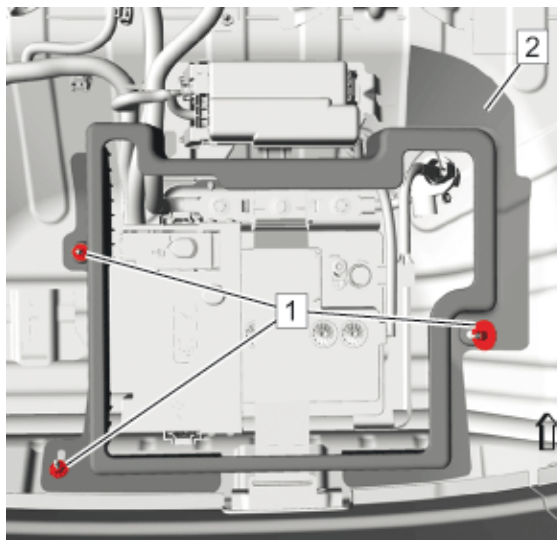


Fig. 13: Panel Trim And Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Install the panel trim (2).
9. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
10. Connect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)
11. Install Rear Compartment Floor Stowage Trim Compartment [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
12. Enable the high voltage system. [High Voltage Enabling](#)

BATTERY NEGATIVE CABLE REPLACEMENT

Removal Procedure

1. Record all of the radio station presets.
2. Ensure that all lamps and accessories are turned off.
3. Turn the ignition OFF and remove the ignition key.
4. Remove Rear Compartment Floor Panel Trim Replacement

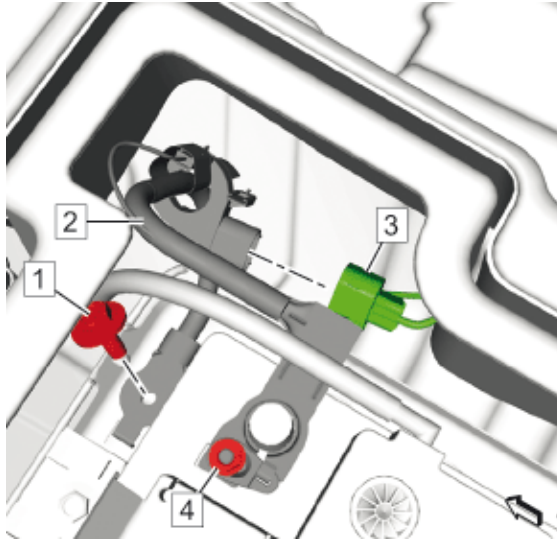


Fig. 14: Battery Negative Pole Clamp Nut And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

WARNING: Battery Disconnect Warning

5. Loosen the battery negative pole clamp nut (4).
6. Disconnect the battery negative pole clamp.
7. Disconnect Electrical Connector (3)
8. Remove the battery negative ground cable bolt (1).
9. Remove Battery Negative Cable (2)

Installation Procedure

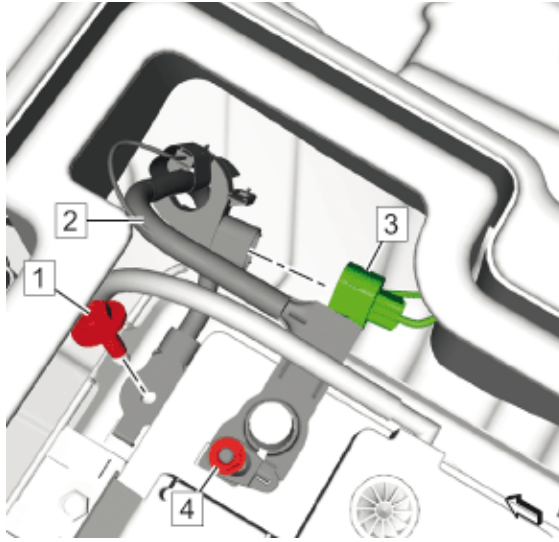


Fig. 15: Battery Negative Pole Clamp Nut And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Install Battery Negative Cable (2)

CAUTION: Fastener Caution

2. Install the battery negative ground cable bolt (1) and tighten to 22 N.m (16 lb ft).
3. Connect Electrical Connector (3)
4. Connect the battery negative pole clamp.
5. Tighten the battery negative pole clamp nut (4) to 9 N.m (80 lb in).
6. Install Rear Compartment Floor Panel Trim Replacement
7. Insert the ignition key and turn the ignition to the ON position.
8. Program all of the customer's radio station presets and set the radio clock to the current time.

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

1. Remove Rear Compartment Floor Stowage Trim Compartment Replacement
2. Disconnect Battery Negative Cable Disconnection and Connection

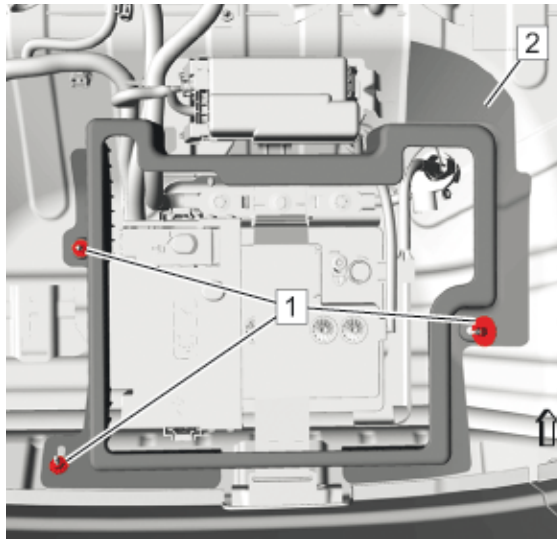


Fig. 16: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the 3 panel trim nuts (1).
4. Remove the panel trim (2).

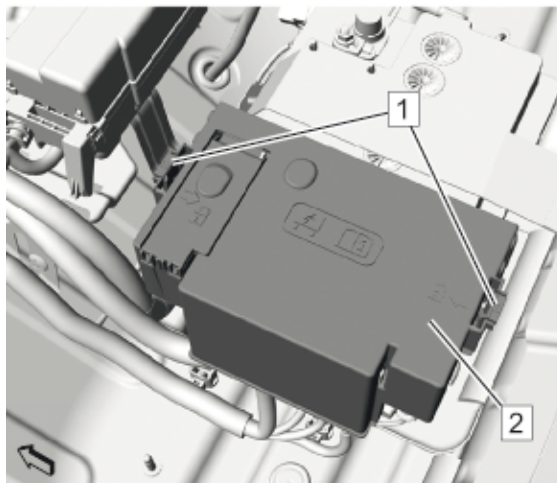


Fig. 17: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

5. Release the retaining tabs.(1)
6. Remove Battery Fuse Block Cover (2)

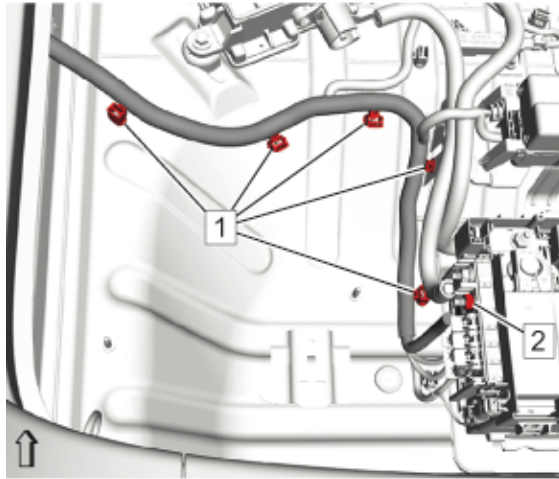


Fig. 18: Battery Positive Cable Fuse Block Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery positive cable fuse block nut (2).
8. Unclip Retainer(1)
9. Remove **Quarter Lower Rear Trim Panel Replacement (Left Side)** **Quarter Lower Rear Trim Panel Replacement (Right Side)**

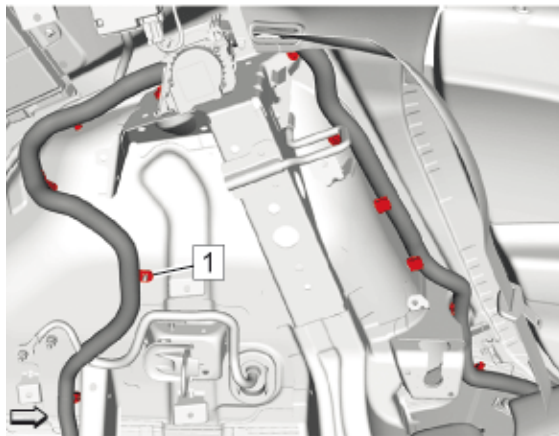


Fig. 19: Retainer
Courtesy of GENERAL MOTORS COMPANY

10. Unclip Retainer (1)
11. Unclip **Center Pillar Lower Trim Panel Replacement**

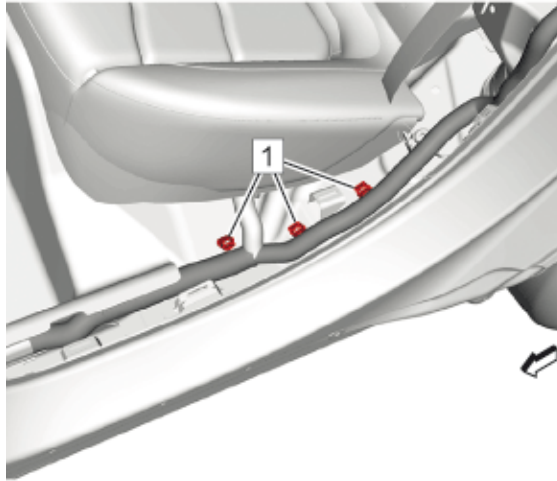


Fig. 20: Retainer

Courtesy of GENERAL MOTORS COMPANY

12. Unclip Retainer (1)

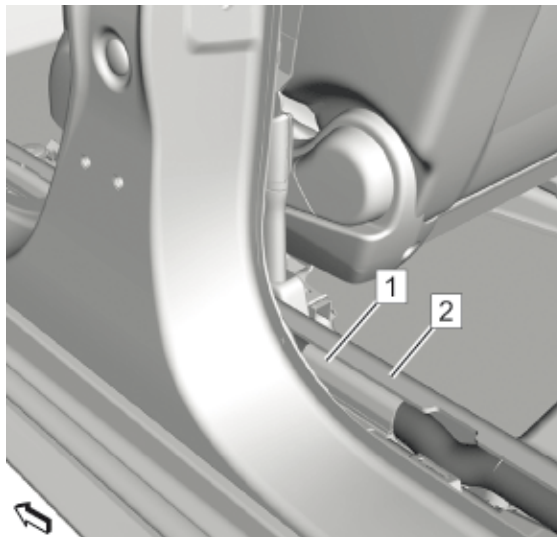


Fig. 21: Battery Positive Cable And Floor Carpet

Courtesy of GENERAL MOTORS COMPANY

13. For a better access, fold the floor carpet (2) aside.
14. Remove the battery positive cable (1) from the left channel.

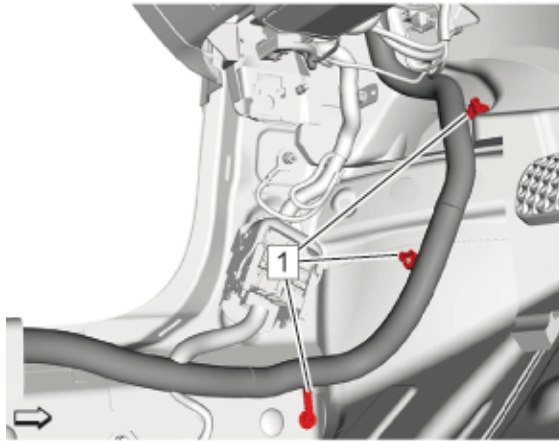


Fig. 22: Retainer

Courtesy of GENERAL MOTORS COMPANY

15. For a better access, fold the floor carpet aside.
16. Unclip Retainer (1)
17. Remove [Dash Upper Extension Panel Opening Cover Replacement](#)
18. Remove [Windshield Wiper System Module Replacement](#)
19. Remove [Engine Wiring Harness Junction Block Replacement](#)

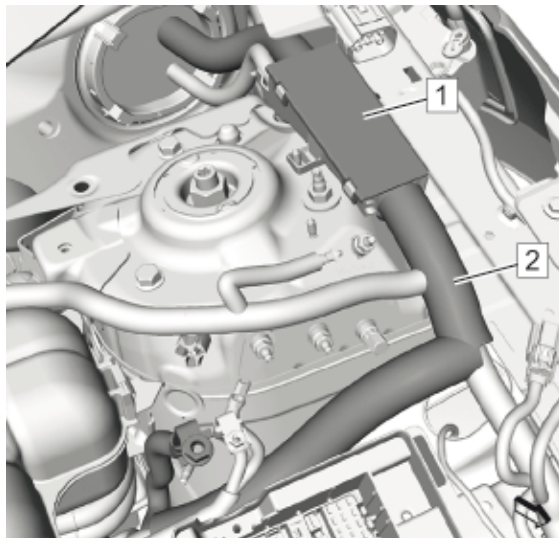


Fig. 23: Battery Positive Cable And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

20. Release the 2 retaining tabs to open the cover (1).
21. Pull the battery positive cable (2) through the harness grommet into the passenger compartment.
22. Separate the battery positive cable from the body harness.
23. Remove the battery positive cable from the vehicle.

Installation Procedure

1. Position the battery positive cable to the vehicle.
2. Insert the battery positive cable to the body harness.
3. Push the battery positive cable terminal through the grommet into the front engine compartment.

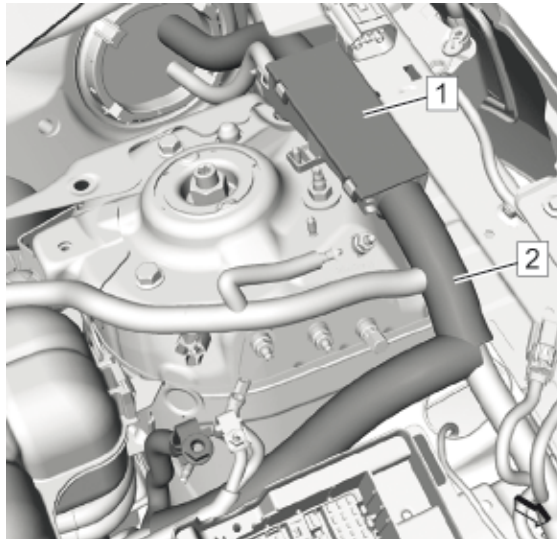


Fig. 24: Battery Positive Cable And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

4. Close the cover (1).
5. Install [Engine Wiring Harness Junction Block Replacement](#)
6. Install [Windshield Wiper System Module Replacement](#)
7. Install [Dash Upper Extension Panel Opening Cover Replacement](#)

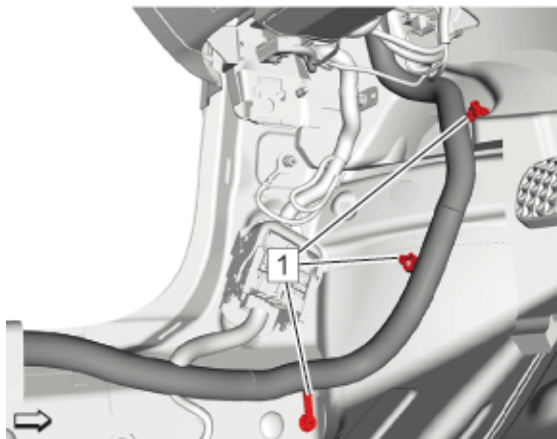


Fig. 25: Retainer

Courtesy of GENERAL MOTORS COMPANY

8. For a better access, fold the floor carpet aside.
9. Install Retainer (1)

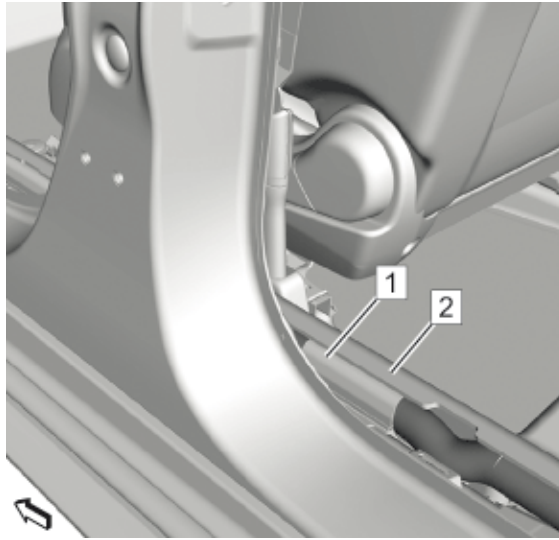


Fig. 26: Battery Positive Cable And Floor Carpet
Courtesy of GENERAL MOTORS COMPANY

10. For a better access, fold the floor carpet (2) aside.
11. Install the battery positive cable (1) to the left channel.

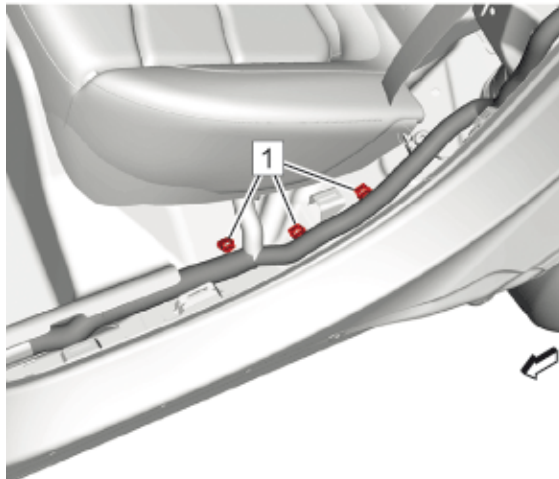


Fig. 27: Retainer
Courtesy of GENERAL MOTORS COMPANY

12. Install Retainer (1)
13. Install [Center Pillar Lower Trim Panel Replacement](#)

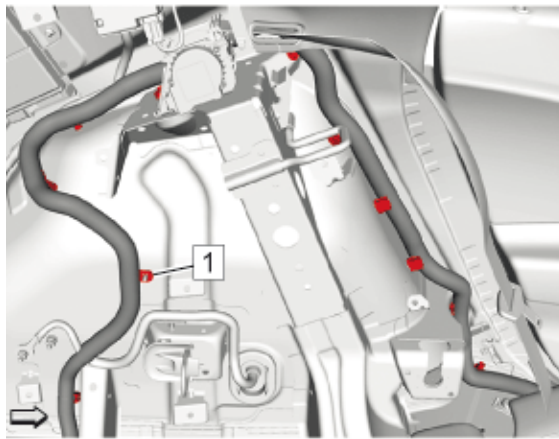


Fig. 28: Retainer

Courtesy of GENERAL MOTORS COMPANY

14. Install Retainer (1)
15. Install Quarter Lower Rear Trim Panel Replacement (Left Side) Quarter Lower Rear Trim Panel Replacement (Right Side)

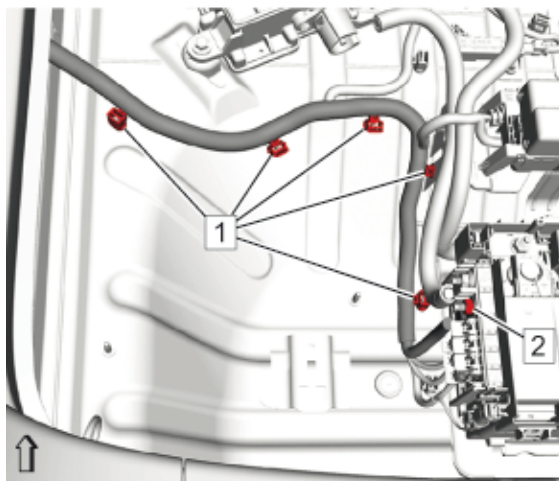


Fig. 29: Battery Positive Cable Fuse Block Nut

Courtesy of GENERAL MOTORS COMPANY

16. Install Retainer (1)

CAUTION: Fastener Caution

17. Install the battery positive cable fuse block nut (2) and tighten to 9 N.m (80 lb in).

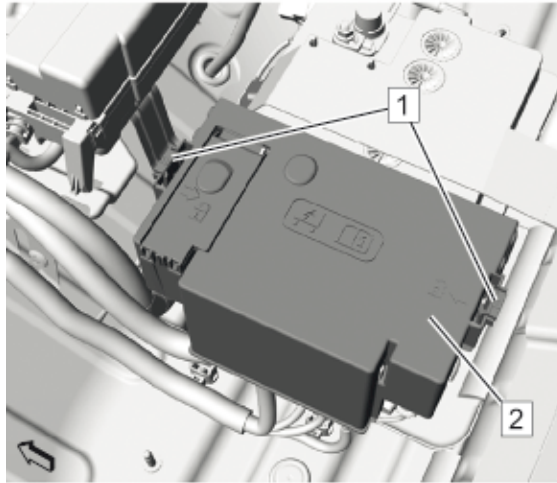


Fig. 30: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

18. Install Battery Fuse Block Cover (2)
19. Lock the 2 retaining tabs (1).

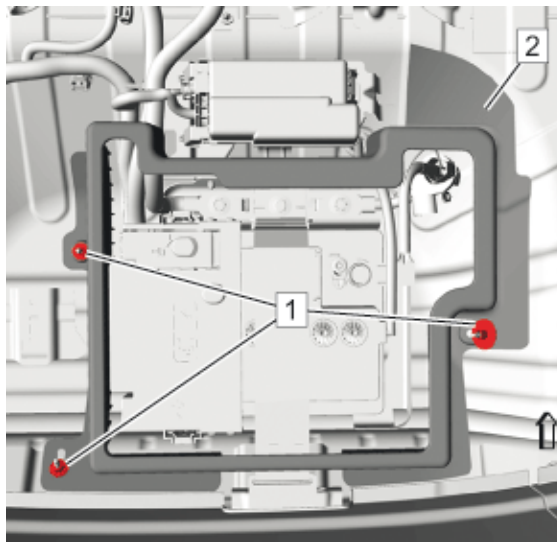


Fig. 31: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

20. Install the panel trim (2).
21. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
22. Connect **Battery Negative Cable Disconnection and Connection**
23. **Rear Compartment Floor Stowage Trim Compartment Replacement**

ENGINE WIRING HARNESS JUNCTION BLOCK REPLACEMENT

Removal Procedure

1. Disconnect **Battery Negative Cable Disconnection and Connection**

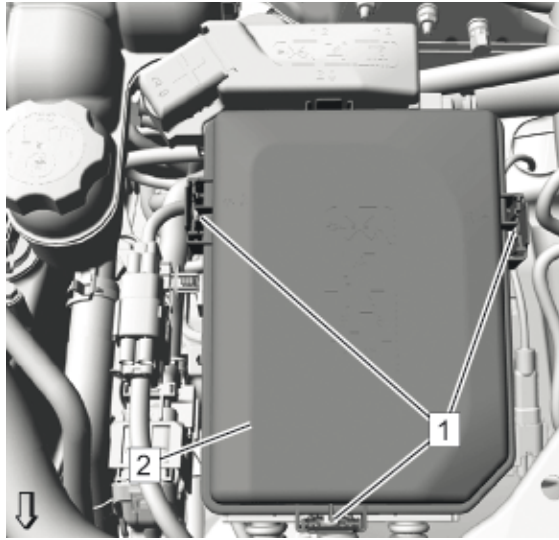


Fig. 32: Plastic Quick Connect Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

2. Squeeze the 3 plastic quick connect fitting release tabs (1) to remove the cover (2).

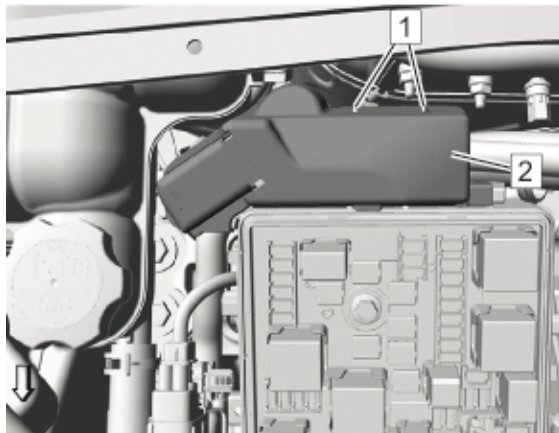


Fig. 33: Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

3. Release the 2 tabs (1).
4. Remove the cover (2).

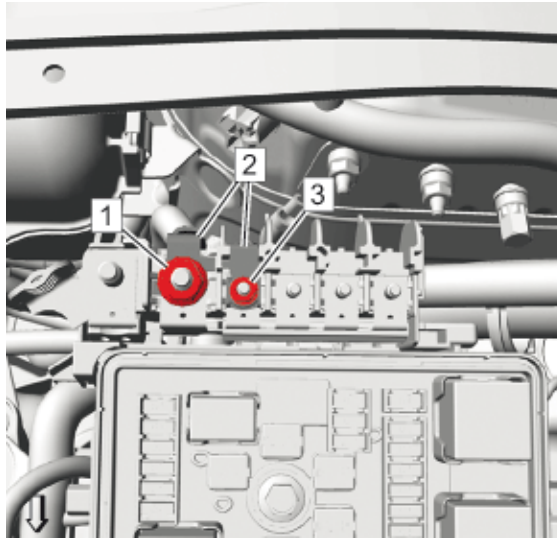


Fig. 34: Engine Wiring Harness Junction Block Supply Nuts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 engine wiring harness junction block supply nuts (1, 3).
6. Remove the 2 engine wiring harness junction block supply (2).

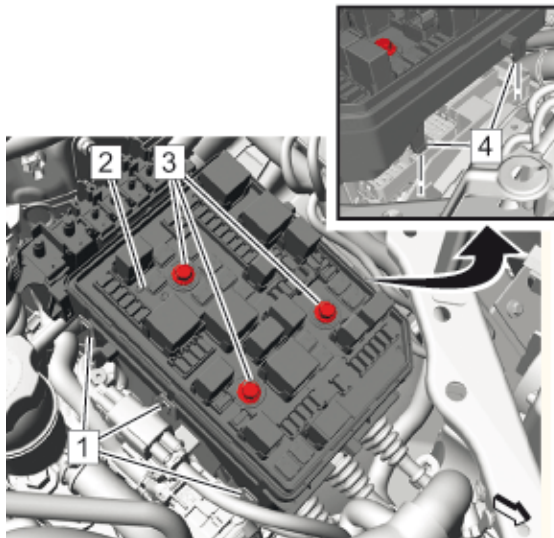


Fig. 35: Engine Wiring Harness Junction Block Bolts And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

NOTE: Bolts (3) are encapsulated on the end of threads so that they can not be removed from the fuse block.

7. Loosen the 3 engine wiring harness junction block bolts (3).
8. Unlock the 3 retaining tabs (1) and the retaining tabs (4) and remove the engine wiring harness junction block (2).

Installation Procedure

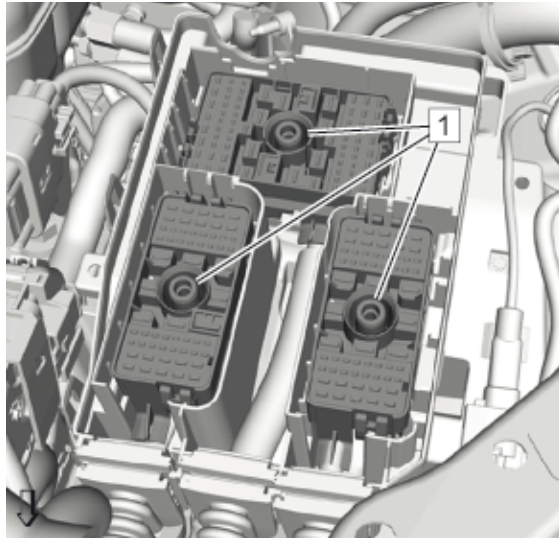


Fig. 36: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

1. Push down the 3 electrical connectors (1) before installation of the engine wiring harness junction block.

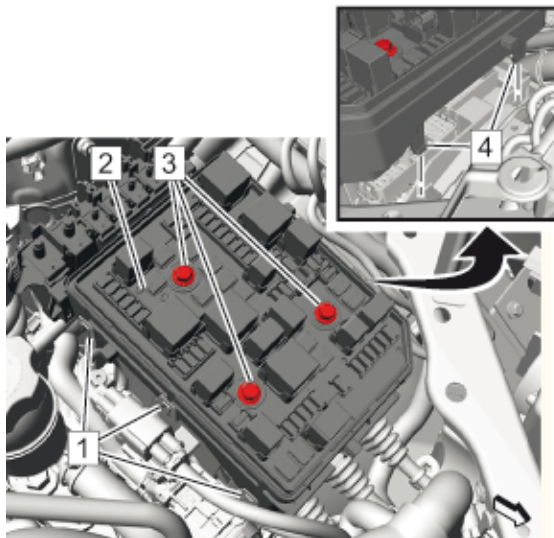


Fig. 37: Engine Wiring Harness Junction Block Bolts And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

2. Install the engine wiring harness junction block (2):
 1. Lock the 3 retaining tabs (1) and the retaining tabs (4).

CAUTION: Fastener Caution

2. Tighten the 3 engine wiring harness junction block bolts (3) to 7 N.m (62 lb in).

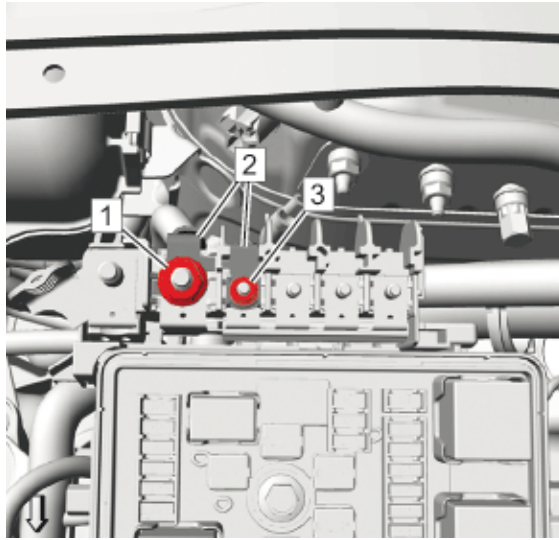


Fig. 38: Engine Wiring Harness Junction Block Supply Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Install the 2 engine wiring harness junction block supply (2).
4. Install the engine wiring harness junction block supply nut (1) and tighten to 15 N.m (11 lb ft).
5. Install the engine wiring harness junction block supply nut (3) and tighten to 5 N.m (44 lb in).

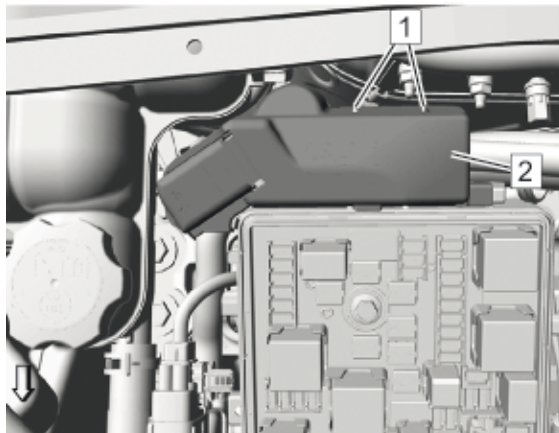


Fig. 39: Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

6. Install the cover (2).
7. Check the locked tabs (1).

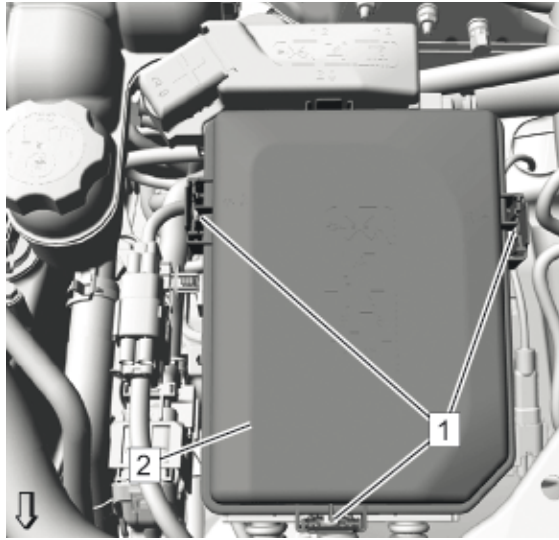


Fig. 40: Plastic Quick Connect Fitting Release Tabs And Cover
Courtesy of GENERAL MOTORS COMPANY

8. Install the cover (2). Check the locked 3 plastic quick connect fitting tabs (1).
9. Connect [Battery Negative Cable Disconnection and Connection](#)

BATTERY REPLACEMENT

Removal Procedure

1. Remove [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)

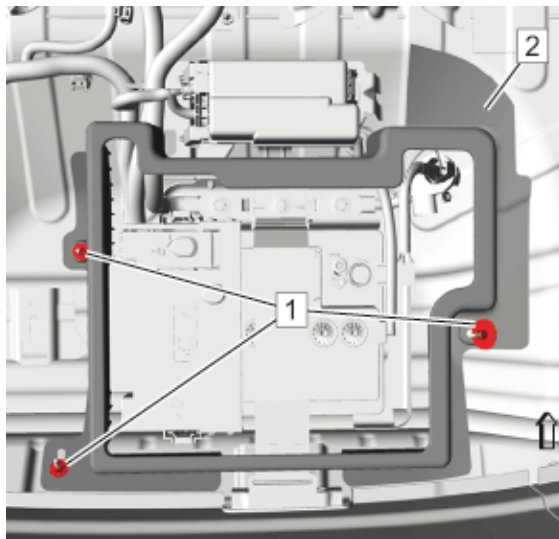


Fig. 41: Panel Trim And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 3 panel trim nuts (1).
4. Remove the panel trim (2).

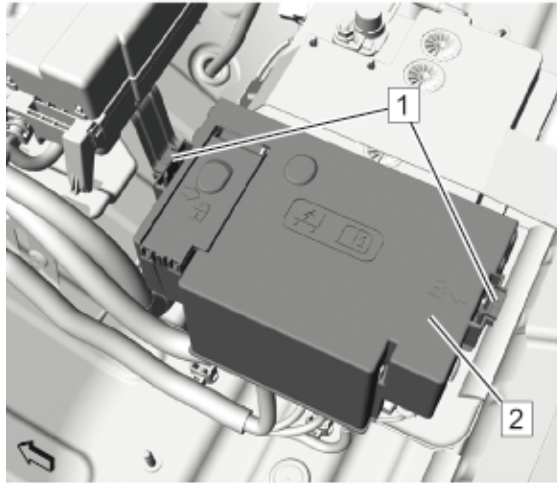


Fig. 42: Battery Fuse Block Cover And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

5. Remove Release the retaining tabs.(1)
6. Remove Battery Fuse Block Cover (2)

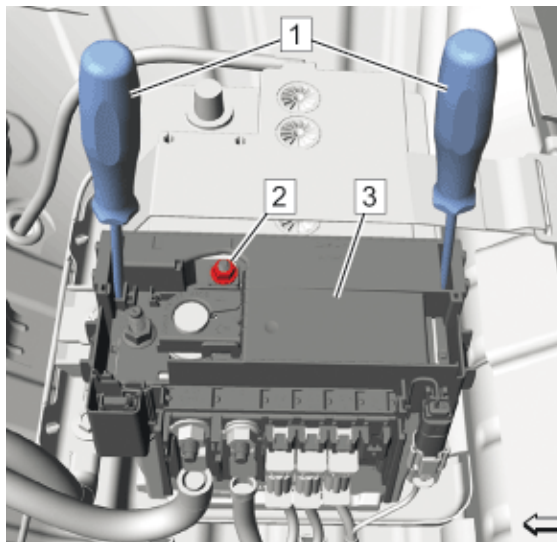


Fig. 43: Battery Positive Pole Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

7. Loosen the battery positive pole clamp nut (2).
8. Use a screwdriver (1) to unclip the 2 battery fuse block retainer tabs from the battery and remove the battery fuse block (3) along with the battery positive cables.

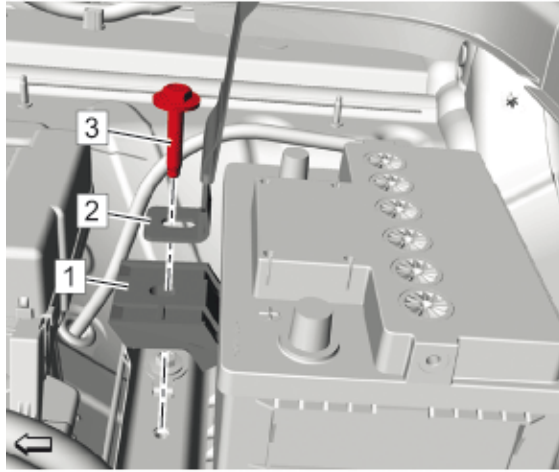


Fig. 44: Battery Hold Down Retainer Bolt

Courtesy of GENERAL MOTORS COMPANY

9. Remove the battery hold down retainer bolt (3).
10. Remove the battery retainer strap (2).
11. Remove Battery Hold Down Retainer(1)

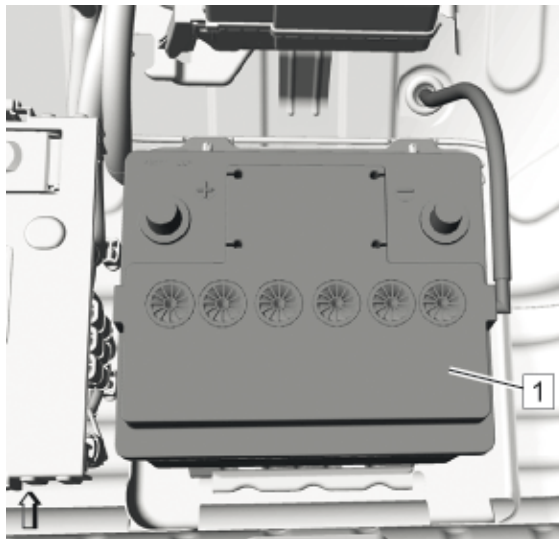


Fig. 45: View Of Battery

Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery (1) from the rear compartment area along with their vent hose.

Installation Procedure

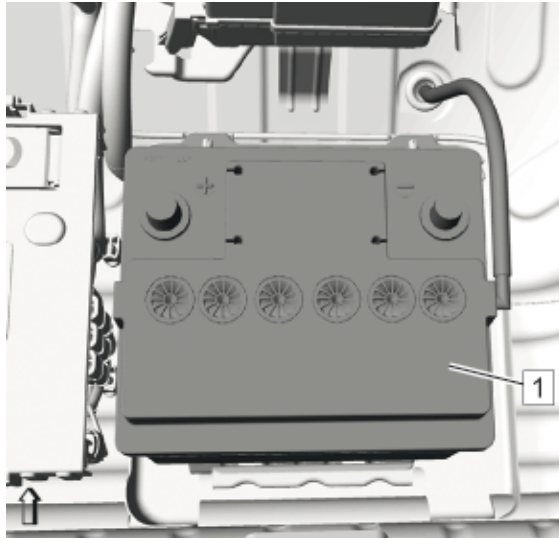


Fig. 46: View Of Battery

Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Position the battery (1) onto the tray to the rear of the vehicle as shown in the graphic.
2. Install the vent hose through the body.

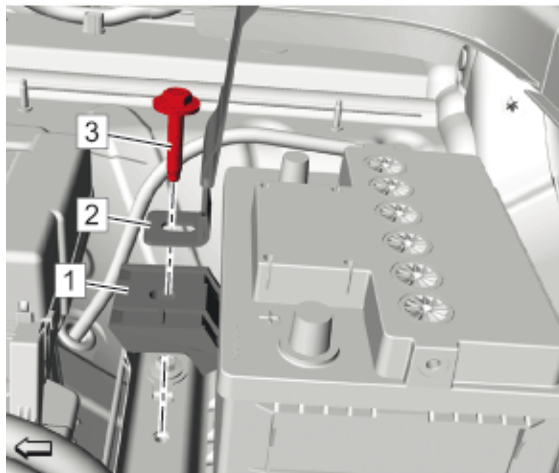


Fig. 47: Battery Hold Down Retainer Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Hold Down Retainer (1)
4. Install the battery retainer strap (2).

CAUTION: Fastener Caution

5. Install the battery hold down retainer bolt (3) and tighten to 18 N.m (13 lb ft).

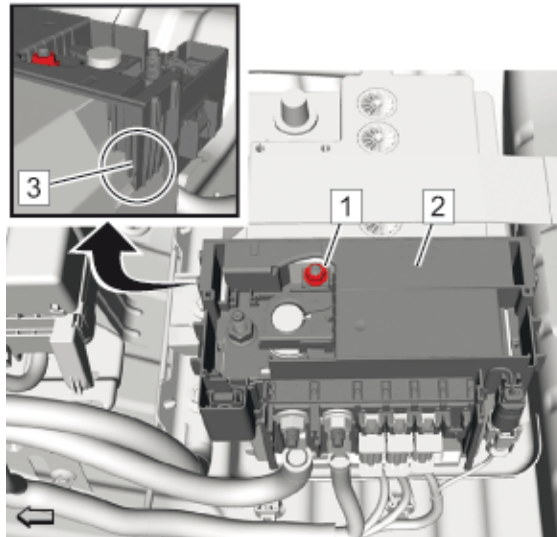


Fig. 48: Battery Fuse Block

Courtesy of GENERAL MOTORS COMPANY

6. Install the battery fuse block (2) along with the battery positive cables to the battery:
 1. Align the rear side of the battery fuse block exactly to the battery housing.
 2. Clip in the 2 battery fuse block retainer tabs (3).
 3. Tighten the battery positive pole clamp nut (1) to 9 N.m (80 lb in).

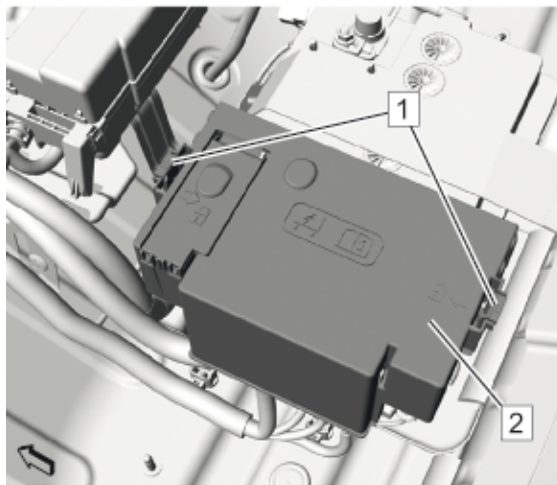


Fig. 49: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

7. Install Battery Fuse Block Cover (2)
8. Check the locked 2 retaining tabs (1).

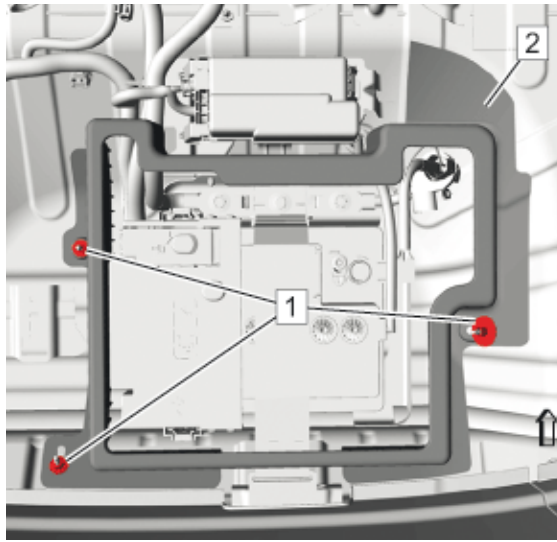


Fig. 50: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Install the panel trim (2).
10. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
11. Connect [Battery Negative Cable Disconnection and Connection](#)
12. Install [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

ENGINE GROUND STRAP REPLACEMENT

Removal Procedure

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

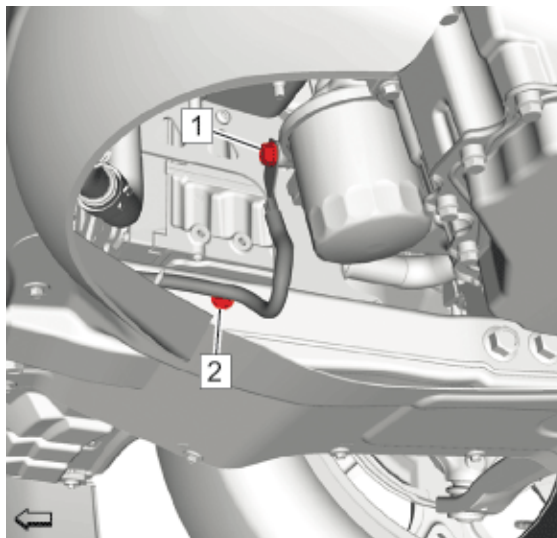


Fig. 51: Engine Ground Strap Bolt And Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Remove the engine ground strap bolt (1).
4. Unclip Retainer(2)

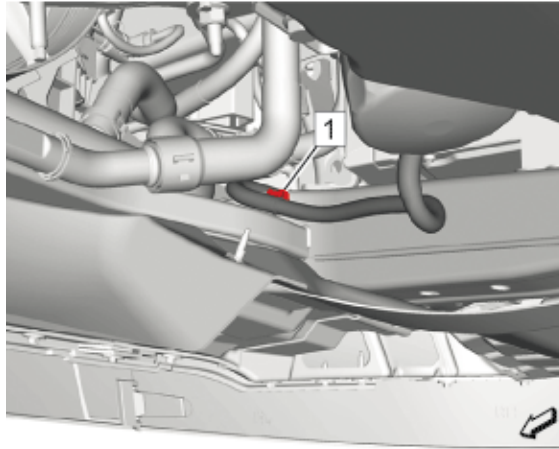


Fig. 52: Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Unclip Retainer(1)
6. Remove **Front Wheelhouse Liner Replacement (Left Side)** **Front Wheelhouse Liner Replacement (Right Side)**

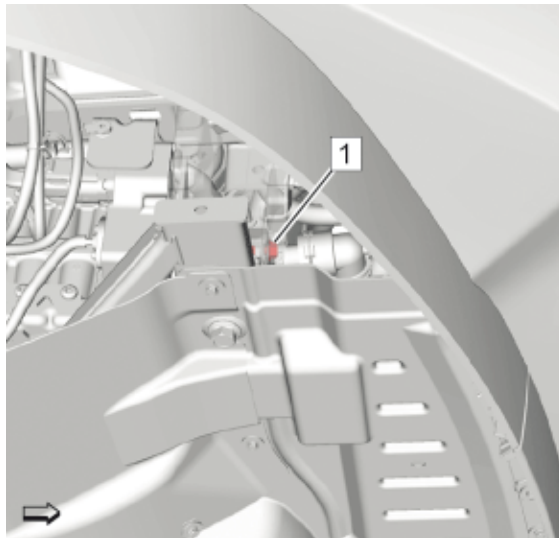


Fig. 53: Engine Ground Strap Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: The bolt is behind the body plate.

7. Remove the engine ground strap bolt (1).

Installation Procedure

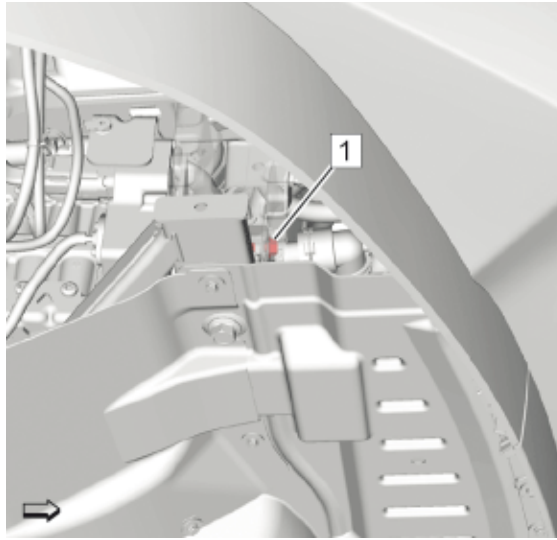


Fig. 54: Engine Ground Strap Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

NOTE: The bolt is behind the body plate.

1. Install the engine ground strap bolt (1) and tighten to 25 N.m (18 lb ft).
2. Install Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)

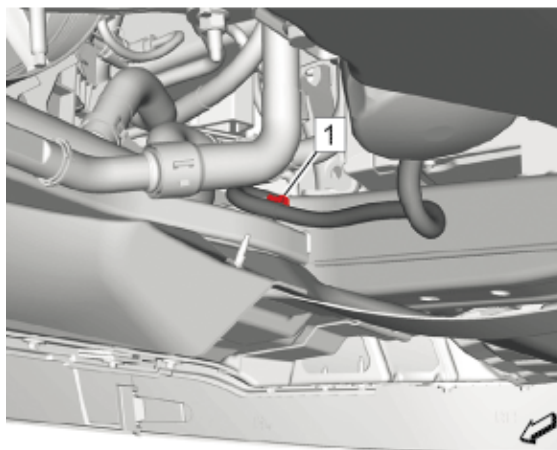


Fig. 55: Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Install Retainer(1)

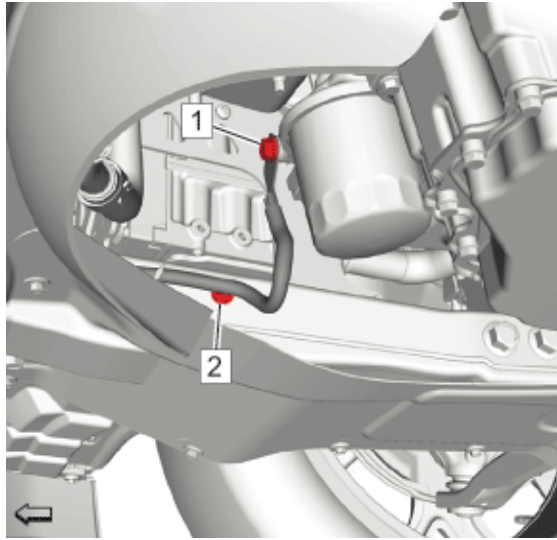


Fig. 56: Engine Ground Strap Bolt And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install the engine ground strap bolt (1) and tighten to 25 N.m (18 lb ft).
5. Install Retainer(2)
6. Lower the vehicle.
7. Connect [Battery Negative Cable Disconnection and Connection](#)

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

300 V Battery

For information about the 355 V hybrid drive motor battery, refer to [Drive Motor Battery System Description](#) .

Absorbent Glass Mat Battery

This vehicle is equipped with an absorbent glass mat battery. This is similar to current vehicle lead acid flood batteries, except they use glass mats that absorb electrolytes that are pressed between the plates instead of immersing the plates in electrolytes. This allows a smaller, lighter battery with the same amount of power and is less susceptible to heat.

The maximum permissible voltage allowed for the absorbent glass mat battery is 14.8 V (at room temperature).

12 V Battery

WARNING: Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.

- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

NOTE: Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

Battery Ratings

A battery has 2 ratings:

- Cold cranking amperage
- Amp hours

When a battery is replaced use a battery with similar ratings. Refer to the battery specification label on the original battery.

Amp Hours

The amp hour rating tells you how much amperage is available when discharged evenly over a 20 hour period. The amp hour rating is cumulative, so in order to know how many constant amps the battery will output for 20 hours, you have to divide the amp hour rating by 20. Example: If a battery has an amp hour rating of 74, dividing by 20 = 3.75. Such a battery can carry a 3.75 A load for 20 hours before dropping to 10.5 V. (10.5 V is the fully discharged level, at which point the battery needs to be recharged.) A battery with an amp hour rating of 55 will carry a 2.75 A load for 20 hours before dropping to 10.5 V.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 V. Refer to the battery specification label on the original battery for the cold cranking amperage rating for this vehicle.

CHARGING SYSTEM DESCRIPTION AND OPERATION

12 V Battery

The following information is for the 12 V battery only.

For information about charging the high voltage drive motor batteries, refer to [**Drive Motor Battery System Description**](#) .

Electrical Power Management Overview

The electrical power management system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems. This electrical power management system primarily utilizes existing on-board computer capability to maximize the effectiveness of the charging system, manage the load, improve battery state of charge and life, and minimize the system's impact on fuel economy. The electrical power management system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during Vehicle OFF and during Vehicle in Service Mode. During Vehicle OFF the state of charge of the battery is determined by measuring the open-circuit voltage. The state of charge is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The state of charge can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. During Vehicle ON mode, the algorithm continuously estimates state of charge based on adjusted net amp hours, battery capacity, initial state of charge, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the electrical power management function is designed to perform regulated voltage control to improve battery state of charge, battery life, and fuel economy. This is accomplished by using knowledge of the battery state of charge and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

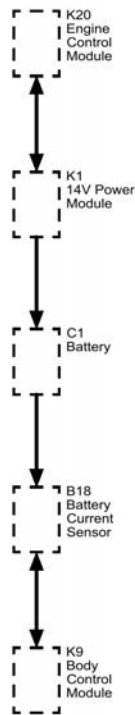


Fig. 57: Charging Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K1	K1 14V Power Module
C1	C1 Battery
B18	B18 Battery Current Sensor
K20	K20 Engine Control Module
K9	K9 Body Control Module

Charging System Components

Drive Motor/Generators

The drive motor/generators are serviceable components located within the transmission housing. When the rotors are spun, an alternating current (AC) is induced into the stator windings. This AC voltage is then sent to the drive motor generator power inverter module (PIM) where it is converted to high voltage direct current (DC) power. The output of the PIM is converted into low voltage electrical power by the accessory DC power converter module (APM) for use by the vehicle's electrical system to maintain electrical loads and battery charge.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster for electrical power management operation. The BCM determines the desired voltage set point and sends the information to the APM. The BCM monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5 V pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0 - 100 percent. Normal duty cycle is between 5 - 95 percent. Between 0 - 5 percent and 95 - 100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM receives control decisions based on messages from the BCM.

Instrument Panel Cluster

The instrument panel cluster provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of notification, a charge indicator and a driver information center message of SERVICE BATTERY CHARGING SYSTEM.

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Battery Sulfation Mode
- Normal Mode
- Fuel Economy Mode
- Headlamp Mode
- Voltage Reduction Mode
- Plant Assembly Mode

Battery Sulfation Mode

Battery sulfation mode is used to help maintain the battery life. The charging system will enter a battery sulfation mode which tries to increase the vehicle charging when the charging system voltage is less than 13.2 V for about 30 minutes. Once in this mode, the BCM will set a targeted output voltage between 13.9 - 15.5 V for about 5 minutes. Following this 5 minutes, the BCM will then determine which mode to enter depending on the system voltage requirements.

Normal Mode

The BCM will enter Normal Mode whenever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN Climate Control Voltage Boost Mode Request is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0Â°C (32Â°F).
- Vehicle Speed is greater than 145 km/h (90 mph)
- Current Sensor Fault Exists
- System Voltage was determined to be below 12.56 V
- Tow/Haul Mode is enabled

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9 - 15.5 V, depending on the battery state of charge and estimated battery temperature.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the ambient air temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is greater than -8 A but less than 5 A, and the battery state of charge is greater than or equal to 85 percent. Its targeted APM set-point voltage is the open circuit voltage of the battery and can be between 12.6 - 13.2 V. The BCM will exit this mode and enter Normal Mode when any of the conditions described above are present.

Headlamp Mode

The BCM will enter Headlamp Mode whenever the high or low beam headlamps are ON. Voltage will be regulated between 13.9 - 14.5 V.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated battery temperature is above 0°C (32°F) and the calculated battery current is greater than -7 A but less than 1 A. Its targeted APM set-point voltage is 12.9 - 13.2 V. The BCM will exit this mode once the criteria are met for Normal Mode.

Plant Assembly Mode

The BCM will increase charging voltage for the first 500 miles of operation in an effort to ensure that the 12 V battery is fully charged when the vehicle is delivered to the customer.

Instrument Panel Cluster Operation

Charge Indicator Operation

The instrument panel cluster illuminates the charge indicator and displays a charging system warning message in the driver information center when the one or more of the following occurs:

- The engine control module (ECM) detects system voltage less than 11 V or greater than 16 V. The instrument panel cluster receives a GMLAN message from the ECM requesting illumination.
- The BCM determines that the system voltage is less than 11 V or greater than 16 V.
- The instrument panel cluster receives a GMLAN message from the BCM indicating there is a system voltage range concern.
- The instrument panel cluster performs the displays test at the start of each Vehicle ON cycle. The indicator illuminates for approximately 3 seconds.
- Vehicle ON, with the engine OFF.

Battery Voltage Gauge Operation

The instrument panel cluster displays the system voltage as received from the BCM over the GMLAN serial data circuit. If there is no communication with the BCM then the gauge will indicate minimum.

This vehicle is equipped with a regulated voltage control system. This will cause the voltmeter to fluctuate between 12 - 14 V, as opposed to non-regulated systems which usually maintain a more consistent reading of 14 V. This fluctuation with the regulated voltage control system is normal system operation and NO repairs should be attempted.

SERVICE BATTERY CHARGING SYSTEM

The BCM and the ECM will send a GMLAN message to the driver information center for the SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is displayed whenever the charge indicator is commanded ON due to a failure.

STARTING SYSTEM DESCRIPTION AND OPERATION

The HQ1 hybrid system does not use a conventional starter. Refer to [Hybrid Modes of Operation Description](#) for information about the starting system.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

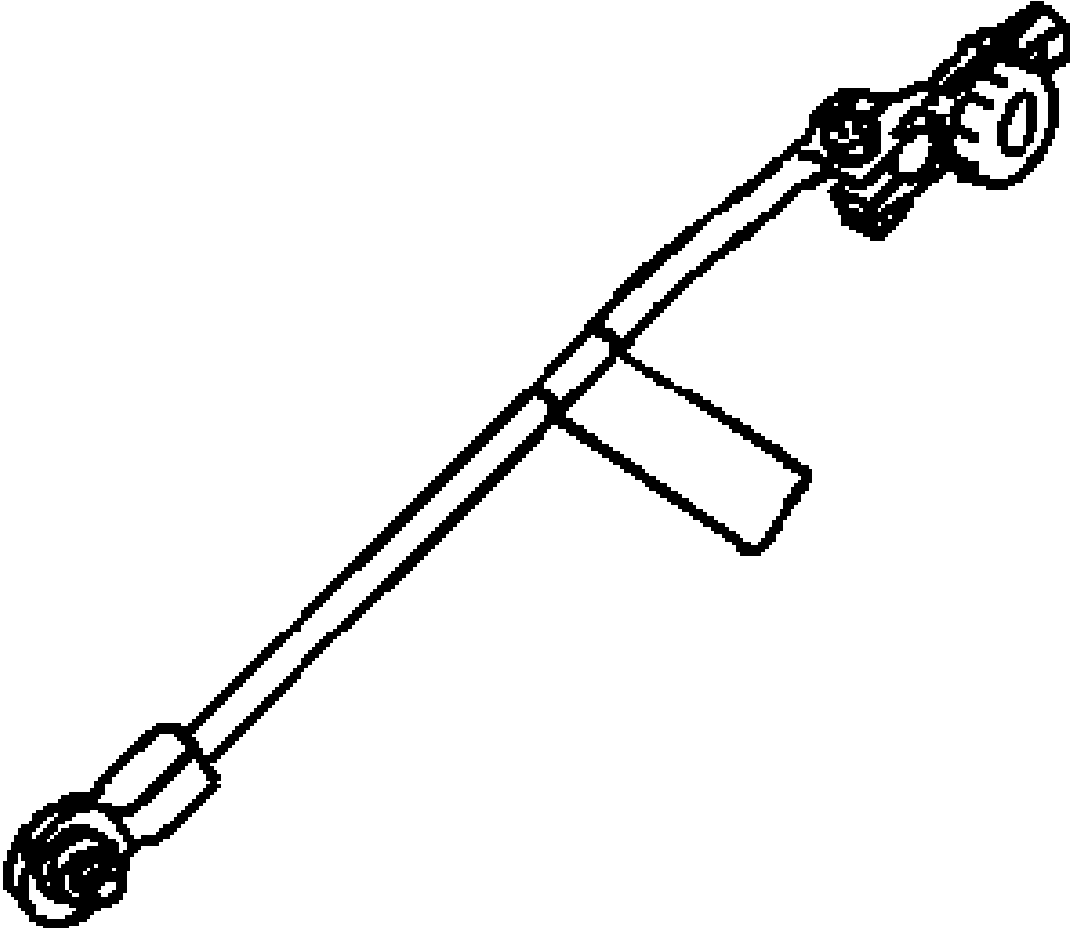
Illustration	Tool Number/Description
	EL 38758 EL 50074 J 38758 Parasitic Draw Test Switch

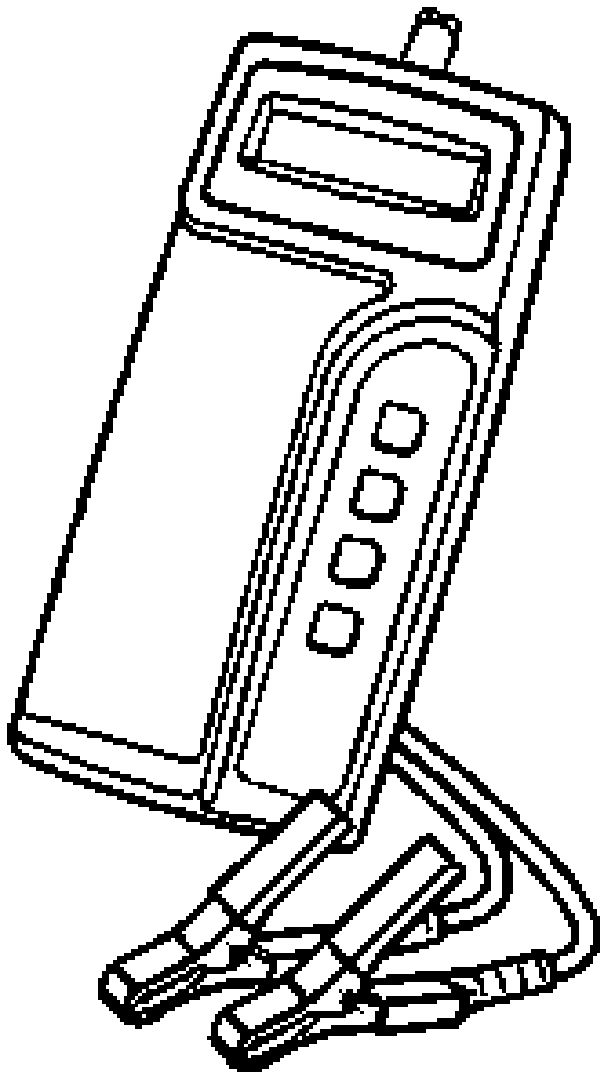
Illustration	Tool Number/Description
	J 42000 Battery Tester

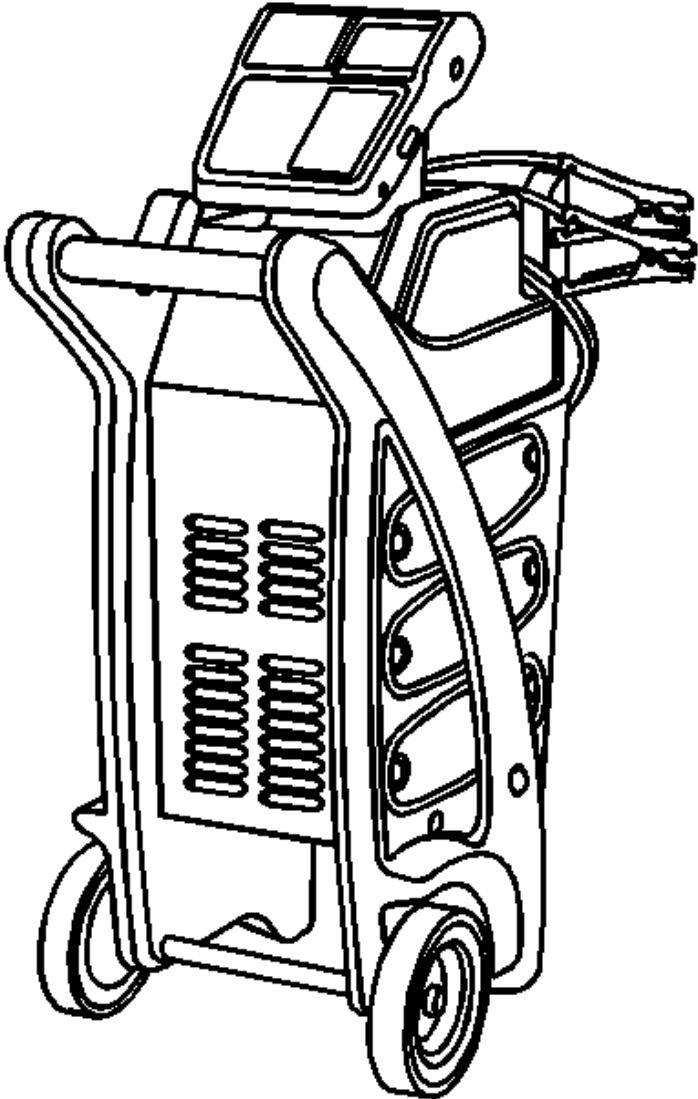
Illustration	Tool Number/Description
	EL 50313 EL 42000 EL 50076 Battery Tester

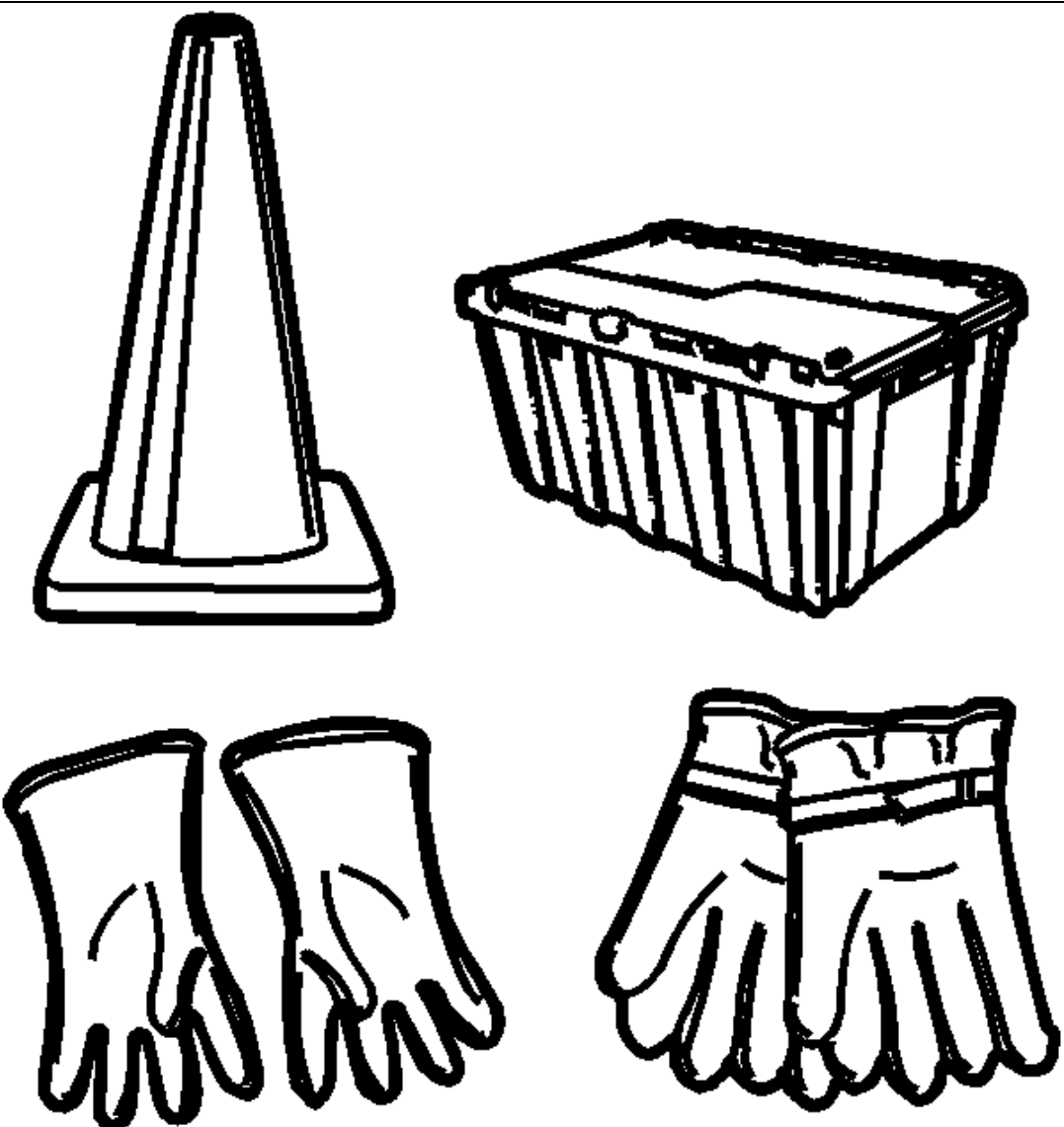
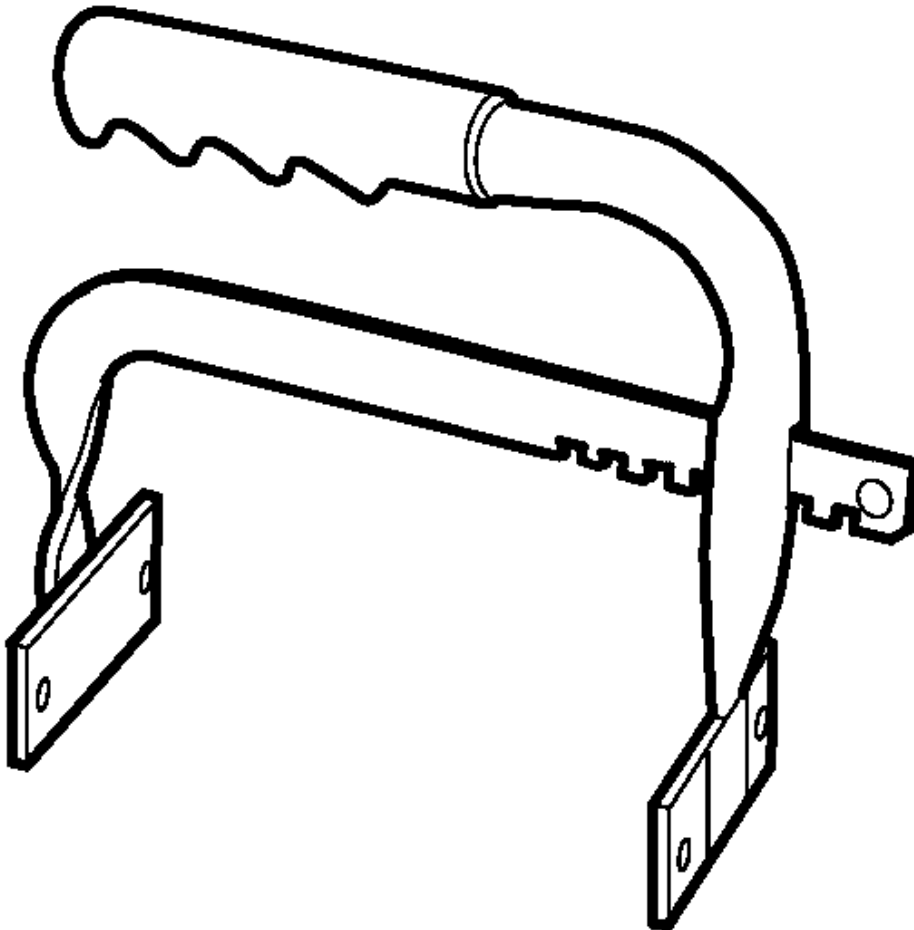
Illustration	Tool Number/Description
 The illustration shows four items: a traffic cone in the top left, a rectangular storage bin with vertical ridges in the top right, a pair of work gloves with a textured palm side in the bottom left, and another pair of work gloves with a smoother palm side in the bottom right.	EL-48900 HEV Safety Kit

Illustration	Tool Number/Description
	GE-49379 Battery Remover / Installer

Article GUID: A00884656

ELECTRICAL

Wiring Systems And Power Management - Component Connector End Views - Index - Volt

COMPONENT CONNECTOR END VIEWS - INDEX

Component Connector End Views - Index

Description
<u>A7 Fuel Pump and Level Sensor Assembly</u>
<u>A10 Inside Rearview Mirror</u>
<u>A11 Radio X1</u>
<u>A11 Radio X2</u>
<u>A11 Radio X3</u>
<u>A11 Radio X4</u>
<u>A11 Radio X6</u>
<u>A23C Liftgate Latch Assembly</u>
<u>A23D Door Latch Assembly - Driver</u>
<u>A23LR Door Latch Assembly - Left Rear</u>
<u>A23P Door Latch Assembly - Passenger</u>
<u>A23RR Door Latch Assembly - Right Rear</u>
<u>A24D Door Handle Assembly - Driver Exterior</u>
<u>A24LR Door Handle Assembly - Left Rear Exterior</u>
<u>A24P Door Handle Assembly - Passenger Exterior</u>
<u>A24RR Door Handle Assembly - Right Rear Exterior</u>
<u>A26 HVAC Controls</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X1</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X2</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X3</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X4</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X5</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X6</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X7</u>
<u>A28 Hybrid/EV Battery Contactor Assembly X8</u>
<u>B1 A/C Refrigerant Pressure Sensor</u>
<u>B1C A/C Low Side Pressure Sensor</u>
<u>B5LF Wheel Speed Sensor - Left Front</u>
<u>B5LR Wheel Speed Sensor - Left Rear</u>
<u>B5RF Wheel Speed Sensor - Right Front</u>
<u>B5RR Wheel Speed Sensor - Right Rear</u>
<u>B7D Air Temperature Sensor - Duct Left Lower</u>
<u>B7H Air Temperature Sensor - Duct Left Upper</u>
<u>B9 Ambient Air Temperature Sensor</u>

Description
<u>B14A Transmission Output Shaft Speed Sensor</u>
<u>B15 Transmission Internal Mode Switch</u>
<u>B18 Battery Current Sensor</u>
<u>B20 Brake Fluid Level Switch</u>
<u>B22 Brake Pedal Position Sensor</u>
<u>B23E Camshaft Position Sensor - Exhaust</u>
<u>B23F Camshaft Position Sensor - Intake</u>
<u>B24 Mobile Telephone Microphone</u>
<u>B26 Crankshaft Position Sensor</u>
<u>B30 Hybrid/EV Battery Pack Current Sensor</u>
<u>B32A Hybrid/EV Battery Temperature Sensor 1</u>
<u>B32B Hybrid/EV Battery Temperature Sensor 2</u>
<u>B32C Hybrid/EV Battery Temperature Sensor 3</u>
<u>B32D Hybrid/EV Battery Temperature Sensor 4</u>
<u>B32E Hybrid/EV Battery Temperature Sensor 5</u>
<u>B32F Hybrid/EV Battery Temperature Sensor 6</u>
<u>B34 Engine Coolant Temperature Sensor</u>
<u>B37B Engine Oil Pressure Sensor</u>
<u>B47 Fuel Pressure Sensor</u>
<u>B52A Heated Oxygen Sensor 1</u>
<u>B52B Heated Oxygen Sensor 2</u>
<u>B55 Engine Hood Switch</u>
<u>B59L Front Impact Sensor - Left</u>
<u>B59R Front Impact Sensor - Right</u>
<u>B63LF Side Impact Sensor - Left Front</u>
<u>B63LR Side Impact Sensor - Left Rear</u>
<u>B63RF Side Impact Sensor - Right Front</u>
<u>B63RR Side Impact Sensor - Right Rear</u>
<u>B68 Knock Sensor</u>
<u>B74 Manifold Absolute Pressure Sensor</u>
<u>B75C Multifunction Intake Air Sensor</u>
<u>B81B Park Position Switch</u>
<u>B87 Rearview Camera</u>
<u>B88D Seat Belt Switch - Driver</u>
<u>B88P Seat Belt Switch - Passenger</u>
<u>B107 Accelerator Pedal Position Sensor</u>
<u>B118B Windshield Washer Fluid Level Switch</u>
<u>B130A Exhaust Gas Recirculation Temperature Sensor 1</u>
<u>B130B Exhaust Gas Recirculation Temperature Sensor 2</u>
<u>B150 Fuel Tank Pressure Sensor</u>
<u>B160 Windshield Temperature and Inside Moisture Sensor</u>

Description
<u>B197 Charge Port Door Position Switch</u>
<u>B201 Brake Control Brake Pedal Position Sensor</u>
<u>B202 Hybrid/EV Electronics Coolant Temperature Sensor</u>
<u>B203 Engine Coolant Radiator Temperature Sensor</u>
<u>B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1</u>
<u>B208 Fuel Fill Door Status Switch Assembly</u>
<u>B218L Side Object Sensor Module - Left</u>
<u>B218R Side Object Sensor Module - Right</u>
<u>B228A Drive Motor 1 Position Sensor</u>
<u>B228B Drive Motor 2 Position Sensor</u>
<u>B233B Radar Sensor Module - Long Range</u>
<u>B258 Hybrid/EV Battery Coolant Level Switch</u>
<u>B284 Vehicle Dynamic Sensor</u>
<u>B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator</u>
<u>B306A Parking Assist Sensor - Front Left Outer</u>
<u>B306B Parking Assist Sensor - Front Left Middle</u>
<u>B306C Parking Assist Sensor - Front Right Middle</u>
<u>B306D Parking Assist Sensor - Front Right Outer</u>
<u>B306E Parking Assist Sensor - Rear Left Outer</u>
<u>B306F Parking Assist Sensor - Rear Left Middle</u>
<u>B306G Parking Assist Sensor - Rear Right Middle</u>
<u>B306H Parking Assist Sensor - Rear Right Outer</u>
<u>B306K Parking Assist Sensor - Side Left Front</u>
<u>B306L Parking Assist Sensor - Side Right Front</u>
<u>B310 Fuel Pressure/Temperature Sensor</u>
<u>C1 Battery</u>
<u>C5A Hybrid/EV Battery Module 1</u>
<u>C5B Hybrid/EV Battery Module 2</u>
<u>C5C Hybrid/EV Battery Module 3</u>
<u>C5D Hybrid/EV Battery Module 4</u>
<u>C5E Hybrid/EV Battery Module 5</u>
<u>C5F Hybrid/EV Battery Module 6</u>
<u>C5G Hybrid/EV Battery Module 7</u>
<u>E1D Accent Lamp - Driver Door</u>
<u>E1P Accent Lamp - Passenger Door</u>
<u>E2LF Side Marker Lamp - Left Front</u>
<u>E2RF Side Marker Lamp - Right Front</u>
<u>E4AC Park/Daytime Running Lamp - Left</u>
<u>E4AD Park/Daytime Running Lamp - Right</u>
<u>E4E Headlamp - Left High Beam</u>
<u>E4F Headlamp - Right High Beam</u>

Description
<u>E4G Headlamp - Left Low Beam</u>
<u>E4H Headlamp - Right Low Beam</u>
<u>E4LF Turn Signal Lamp - Left Front</u>
<u>E4LR Turn Signal Lamp - Left Rear</u>
<u>E4RF Turn Signal Lamp - Right Front</u>
<u>E4RR Turn Signal Lamp - Right Rear</u>
<u>E5A Backup Lamp - Left</u>
<u>E5B Backup Lamp - Right</u>
<u>E5L Stop Lamp - Left</u>
<u>E5R Stop Lamp - Right</u>
<u>E6 Center High Mounted Stop Lamp</u>
<u>E7L License Plate Lamp - Left</u>
<u>E7R License Plate Lamp - Right</u>
<u>E14A Seat Heating Element - Driver Back</u>
<u>E14B Seat Heating Element - Driver Cushion</u>
<u>E14C Seat Heating Element - Passenger Back</u>
<u>E14D Seat Heating Element - Passenger Cushion</u>
<u>E14F Seat Heating Element - Left Rear Cushion</u>
<u>E14H Seat Heating Element - Right Rear Cushion</u>
<u>E17D Outside Rearview Mirror Glass - Driver X1</u>
<u>E17D Outside Rearview Mirror Glass - Driver X2</u>
<u>E17P Outside Rearview Mirror Glass - Passenger X1</u>
<u>E17P Outside Rearview Mirror Glass - Passenger X2</u>
<u>E18 Rear Defogger Grid X1</u>
<u>E18 Rear Defogger Grid X2</u>
<u>E31L Sunshade Mirror Lamp - Left</u>
<u>E31R Sunshade Mirror Lamp - Right</u>
<u>E33 Cargo Lamp</u>
<u>E37R Dome/Reading Lamps - Rear</u>
<u>E41 Engine Coolant Thermostat Heater</u>
<u>E42L Tail Lamp Assembly - Left</u>
<u>E42R Tail Lamp Assembly - Right</u>
<u>E63D Flood Lamp - Driver Door Handle</u>
<u>E63LR Flood Lamp - Left Rear Door Handle</u>
<u>E63P Flood Lamp - Passenger Door Handle</u>
<u>E63RR Flood Lamp - Right Rear Door Handle</u>
<u>E85 Hybrid/EV Battery Charger Receptacle Accent Lamp</u>
<u>E1W Accent Lamp - Instrument Panel</u>
<u>F101 Passenger Instrument Panel Air Bag X1</u>
<u>F101 Passenger Instrument Panel Air Bag X2</u>
<u>F101 Passenger Instrument Panel Air Bag X3</u>

Description
<u>F105L Roof Rail Air Bag - Left</u>
<u>F105R Roof Rail Air Bag - Right</u>
<u>F106LF Seat Side Air Bag - Left Front</u>
<u>F106LR Seat Side Air Bag - Left Rear</u>
<u>F106RF Seat Side Air Bag - Right Front</u>
<u>F106RR Seat Side Air Bag - Right Rear</u>
<u>F107 Steering Wheel Air Bag X1</u>
<u>F107 Steering Wheel Air Bag X2</u>
<u>F112D Seat Belt Retractor Pretensioner - Driver</u>
<u>F112P Seat Belt Retractor Pretensioner - Passenger</u>
<u>F113D Seat Belt Anchor Pretensioner - Driver</u>
<u>F113P Seat Belt Anchor Pretensioner - Passenger</u>
<u>F114D Knee Air Bag - Driver</u>
<u>F114P Knee Air Bag - Passenger</u>
<u>F115 Hybrid/EV Battery Pack Fuse Cover</u>
<u>G1 A/C Compressor X1</u>
<u>G1 A/C Compressor X2</u>
<u>G10L Cooling Fan Motor - Left</u>
<u>G10R Cooling Fan Motor - Right</u>
<u>G18 High Pressure Fuel Pump</u>
<u>G24 Windshield Washer Pump</u>
<u>G35 Hybrid/EV Electronics Coolant Pump</u>
<u>G36 Auxiliary Heater Coolant Pump</u>
<u>G37 Hybrid/EV Battery Pack Coolant Pump</u>
<u>K1 14V Power Module X1</u>
<u>K1 14V Power Module X2</u>
<u>K1 14V Power Module X3</u>
<u>K1 14V Power Module X4</u>
<u>K9 Body Control Module X1</u>
<u>K9 Body Control Module X2</u>
<u>K9 Body Control Module X3</u>
<u>K9 Body Control Module X4</u>
<u>K9 Body Control Module X5</u>
<u>K9 Body Control Module X6</u>
<u>K9 Body Control Module X7</u>
<u>K10 Coolant Heater Control Module X1</u>
<u>K10 Coolant Heater Control Module X2</u>
<u>K16 Battery Energy Control Module X1</u>
<u>K16 Battery Energy Control Module X2</u>
<u>K16 Battery Energy Control Module X3</u>
<u>K16 Battery Energy Control Module X4</u>

Description
<u>K16 Battery Energy Control Module X5</u>
<u>K16 Battery Energy Control Module X6</u>
<u>K16 Battery Energy Control Module X7</u>
<u>K16 Battery Energy Control Module X8</u>
<u>K17 Electronic Brake Control Module</u>
<u>K20 Engine Control Module X1</u>
<u>K20 Engine Control Module X2</u>
<u>K20 Engine Control Module X3</u>
<u>K29F Seat Heating Control Module - Front X1 (KA1)</u>
<u>K29F Seat Heating Control Module - Front X2 (KA1)</u>
<u>K29R Seat Heating Control Module - Rear X1 (KA6)</u>
<u>K29R Seat Heating Control Module - Rear X2 (KA6)</u>
<u>K32 Steering Wheel Heating Control Module X1</u>
<u>K32 Steering Wheel Heating Control Module X2 (UVD)</u>
<u>K33 HVAC Control Module X1</u>
<u>K33 HVAC Control Module X2</u>
<u>K33 HVAC Control Module X3</u>
<u>K36 Inflatable Restraint Sensing and Diagnostic Module X1</u>
<u>K36 Inflatable Restraint Sensing and Diagnostic Module X2</u>
<u>K43 Power Steering Control Module X1</u>
<u>K43 Power Steering Control Module X2</u>
<u>K73 Telematics Communication Interface Control Module X1</u>
<u>K73 Telematics Communication Interface Control Module X2</u>
<u>K73 Telematics Communication Interface Control Module X5</u>
<u>K73 Telematics Communication Interface Control Module X7</u>
<u>K74 Human Machine Interface Control Module X1</u>
<u>K74 Human Machine Interface Control Module X2</u>
<u>K74 Human Machine Interface Control Module X3</u>
<u>K74 Human Machine Interface Control Module X5</u>
<u>K74 Human Machine Interface Control Module X7</u>
<u>K77 Remote Control Door Lock Receiver</u>
<u>K84 Keyless Entry Control Module X1</u>
<u>K84 Keyless Entry Control Module X2</u>
<u>K85 Passenger Presence Module</u>
<u>K89 Immobilizer Control Module</u>
<u>K109 Frontview Camera Module</u>
<u>K111 Fuel Pump Driver Control Module</u>
<u>K114B Hybrid/EV Powertrain Control Module 2 X1</u>
<u>K114B Hybrid/EV Powertrain Control Module 2 X2</u>
<u>K124 Active Safety Control Module X1</u>
<u>K124 Active Safety Control Module X2</u>

Description
<u>K132 Pedestrian Alert Sound Control Module</u>
<u>K177 Brake Booster Control Module</u>
<u>K182 Parking Assist Control Module X1</u>
<u>K182 Parking Assist Control Module X2</u>
<u>K182 Parking Assist Control Module X3</u>
<u>M6 Air Temperature Door Actuator</u>
<u>M7 Transmission Shift Lock Control Solenoid Actuator</u>
<u>M8 Blower Motor</u>
<u>M37 Mode Door Actuator</u>
<u>M46 Air Recirculation Door Actuator</u>
<u>M74D Window Motor - Driver</u>
<u>M74LR Window Motor - Left Rear</u>
<u>M74P Window Motor - Passenger</u>
<u>M74RR Window Motor - Right Rear</u>
<u>M75 Windshield Wiper Motor</u>
<u>M77D Outside Rearview Mirror Motor - Driver</u>
<u>M77P Outside Rearview Mirror Motor - Passenger</u>
<u>M96 Active Grille Air Shutter Actuator</u>
<u>M97 Fuel Fill Door Lock Actuator</u>
<u>M104L Park Brake Actuator - Left</u>
<u>M104R Park Brake Actuator - Right</u>
<u>P2 Transmission Shift Lever Position Indicator</u>
<u>P12 Horn</u>
<u>P16 Instrument Cluster</u>
<u>P17 Info Display Module X1</u>
<u>P17 Info Display Module X2</u>
<u>P19AC Speaker - Subwoofer (UQA)</u>
<u>P19AG Speaker - Left Front Door (UQA)</u>
<u>P19AG Speaker - Left Front Door (UZ6)</u>
<u>P19AH Speaker - Right Front Door (UQA)</u>
<u>P19AH Speaker - Right Front Door (UZ6)</u>
<u>P19AL Speaker - Left Rear Door (UQA)</u>
<u>P19AL Speaker - Left Rear Door (UZ6)</u>
<u>P19AM Speaker - Right Rear Door (UQA)</u>
<u>P19AM Speaker - Right Rear Door (UZ6)</u>
<u>P19B Speaker - Center Instrument Panel (UQA)</u>
<u>P19H Speaker - Left Front Tweeter</u>
<u>P19V Speaker - Right Front Tweeter</u>
<u>P43 Collision Alert Indicators</u>
<u>P48 Pedestrian Alert Sound Speaker</u>
<u>Q6E Camshaft Position Actuator Solenoid Valve - Exhaust</u>

Description
<u>Q6F Camshaft Position Actuator Solenoid Valve - Intake</u>
<u>Q8 Control Solenoid Valve Assembly</u>
<u>Q12 Evaporative Emission Purge Solenoid Valve</u>
<u>Q13 Evaporative Emission Vent Solenoid Valve</u>
<u>Q14 Exhaust Gas Recirculation Valve</u>
<u>Q17A Fuel Injector 1</u>
<u>Q17B Fuel Injector 2</u>
<u>Q17C Fuel Injector 3</u>
<u>Q17D Fuel Injector 4</u>
<u>Q23 Line Pressure Control Solenoid Valve</u>
<u>Q38 Throttle Body</u>
<u>Q44 Engine Oil Pressure Control Solenoid Valve</u>
<u>Q63 Evaporative Emission System Leak Detection Pump Assembly</u>
<u>Q66 Passenger Compartment Heater Coolant Control Valve</u>
<u>R6A Terminating Resistor - High Speed Bus</u>
<u>S3 Transmission Shift Lever</u>
<u>S13D Door Lock Switch - Driver</u>
<u>S13P Door Lock Switch - Passenger</u>
<u>S26 Hazard Warning Switch</u>
<u>S30 Headlamp Switch</u>
<u>S32LR Seat Heating Switch - Left Rear</u>
<u>S32RR Seat Heating Switch - Right Rear</u>
<u>S33 Horn Switch X1</u>
<u>S33 Horn Switch X2</u>
<u>S46 Liftgate Handle Switch</u>
<u>S48B Multifunction Switch - Overhead Console</u>
<u>S48E Multifunction Switch - Center Console</u>
<u>S70E Steering Wheel Controls Switch - Radio Presets</u>
<u>S70F Steering Wheel Controls Switch - Radio Volume</u>
<u>S70L Steering Wheel Controls Switch - Left</u>
<u>S70R Steering Wheel Controls Switch - Right</u>
<u>S78 Turn Signal/Multifunction Switch</u>
<u>S79LR Window Switch - Left Rear</u>
<u>S79P Window Switch - Passenger</u>
<u>S79RR Window Switch - Right Rear</u>
<u>S82 Windshield Wiper/Washer Switch</u>
<u>S83 Vehicle On/Off Switch</u>
<u>S91 Park Brake Control Switch</u>
<u>S117 Refuel Request Switch</u>
<u>S146 Window/Outside Rearview Mirror Switch - Driver</u>
<u>S151 Regenerative Braking On-Demand Switch</u>

Description
<u>T2RR Antenna - Roof Rear X1</u>
<u>T2RR Antenna - Roof Rear X2</u>
<u>T3 Audio Amplifier X1</u>
<u>T3 Audio Amplifier X2</u>
<u>T3 Audio Amplifier X3</u>
<u>T3 Audio Amplifier X4</u>
<u>T6 Power Inverter Module X1</u>
<u>T6 Power Inverter Module X2</u>
<u>G5 Transmission Fluid Pump - Electric/Auxiliary</u>
<u>T6 Power Inverter Module X4</u>
<u>T6 Power Inverter Module X5</u>
<u>T8A Ignition Coil 1</u>
<u>T8B Ignition Coil 2</u>
<u>T8C Ignition Coil 3</u>
<u>T8D Ignition Coil 4</u>
<u>T10 Keyless Entry Antenna</u>
<u>T10B Keyless Entry Antenna - Instrument Panel Compartment</u>
<u>T10E Keyless Entry Antenna - Rear Compartment</u>
<u>T10G Keyless Entry Antenna - Rear Fascia</u>
<u>T10K Keyless Entry Antenna - Center Console Rear</u>
<u>T15 Navigation Antenna Signal Splitter X1</u>
<u>T15 Navigation Antenna Signal Splitter X2</u>
<u>T15 Navigation Antenna Signal Splitter X3</u>
<u>T18 Battery Charger X1</u>
<u>T18 Battery Charger X2</u>
<u>T18 Battery Charger X3</u>
<u>T22 Mobile Device Wireless Charger Module</u>
<u>X21 Manual Service Disconnect Receptacle</u>
<u>X21 Manual Service Disconnect Receptacle X2</u>
<u>X80H Accessory Power Receptacle - Center Console</u>
<u>X80L Accessory Power Receptacle - Center Console Rear</u>
<u>X83 Auxiliary Audio Input X1</u>
<u>X83 Auxiliary Audio Input X2</u>
<u>X84 Data Link Connector</u>
<u>X85 Steering Wheel Air Bag Coil X1</u>
<u>X85 Steering Wheel Air Bag Coil X2</u>
<u>X98 Hybrid/EV Battery Charger Receptacle</u>

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Door Component Views - Volt

DOOR COMPONENT VIEWS

DRIVER DOOR COMPONENTS

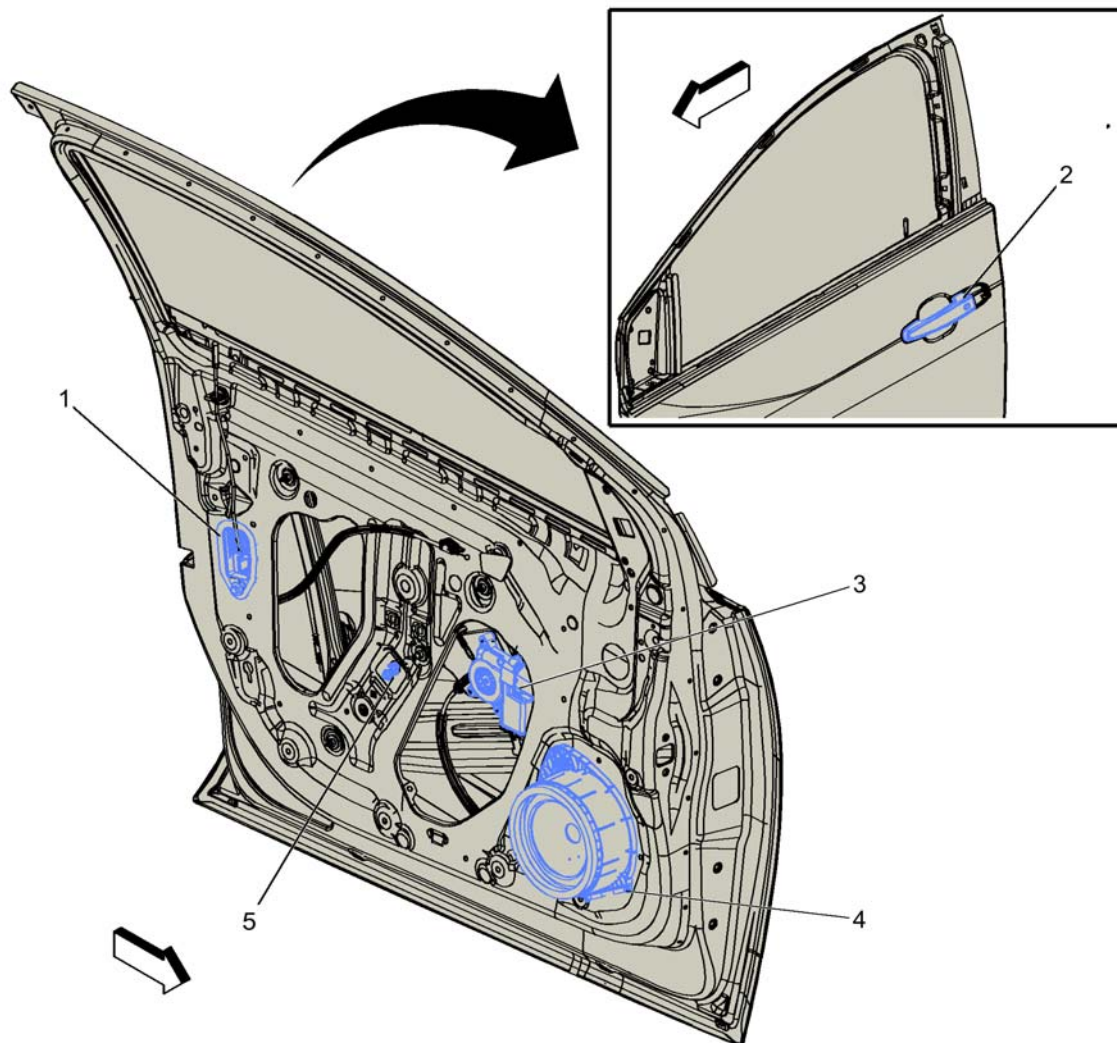


Fig. 1: Driver Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A23D Door Latch Assembly - Driver A23D Door Latch Assembly - Driver
2. A24D Door Handle Assembly - Driver Exterior A24D Door Handle Assembly - Driver Exterior
3. M74D Window Motor - Driver M74D Window Motor - Driver
4. P19AG Speaker - Left Front Door P19AG Speaker - Left Front Door (UQA) P19AG Speaker - Left Front Door (UZ6)
5. B63LF Side Impact Sensor - Left Front B63LF Side Impact Sensor - Left Front

DRIVER DOOR TRIM COMPONENTS

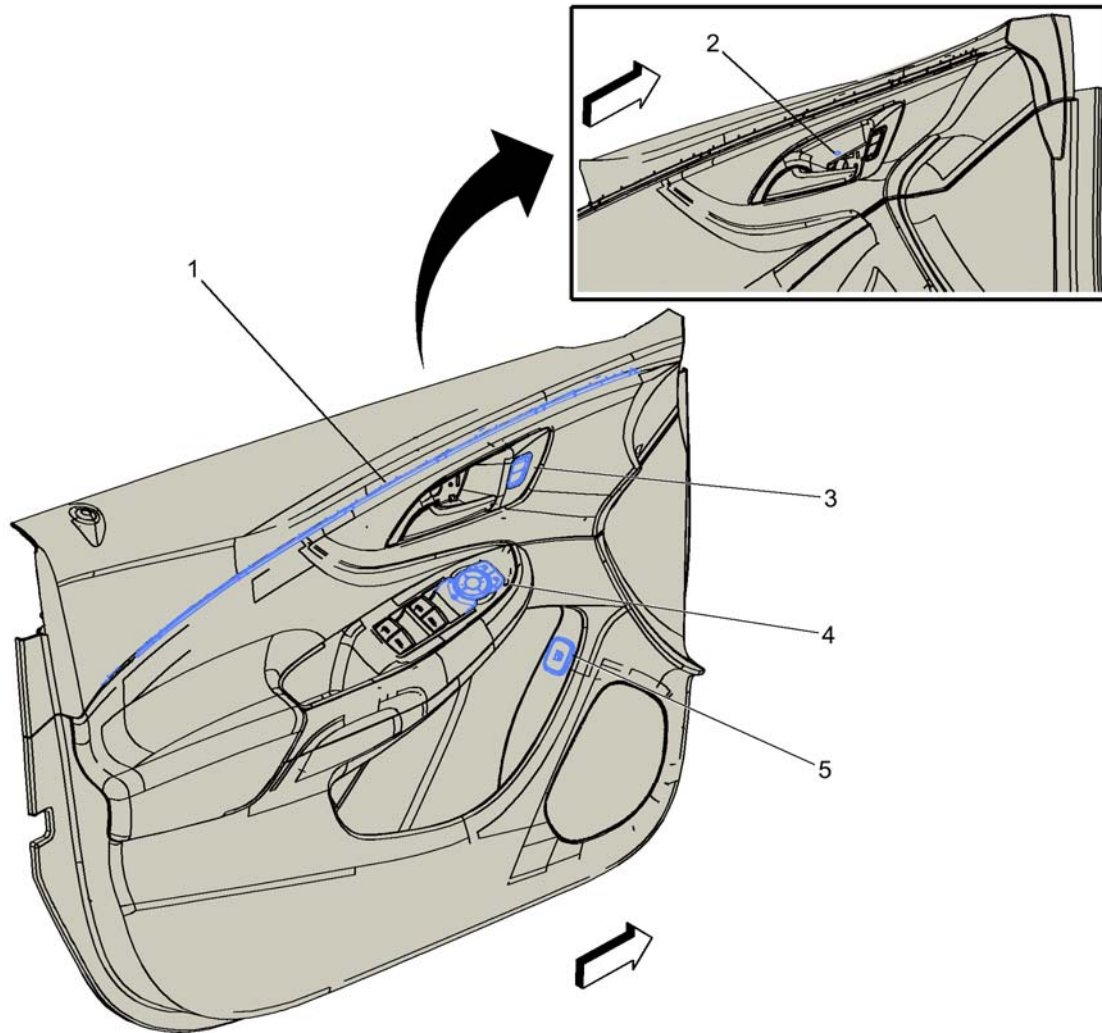


Fig. 2: Driver Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. E1D Accent Lamp - Driver Door E1D Accent Lamp - Driver Door
2. E63D Flood Lamp - Driver Door Handle E63D Flood Lamp - Driver Door Handle
3. S13D Door Lock Switch - Driver S13D Door Lock Switch - Driver
4. S146 Window/Outside Rearview Mirror Switch - Driver S146 Window/Outside Rearview Mirror Switch - Driver
5. S117 Refuel Request Switch S117 Refuel Request Switch

PASSENGER DOOR COMPONENTS

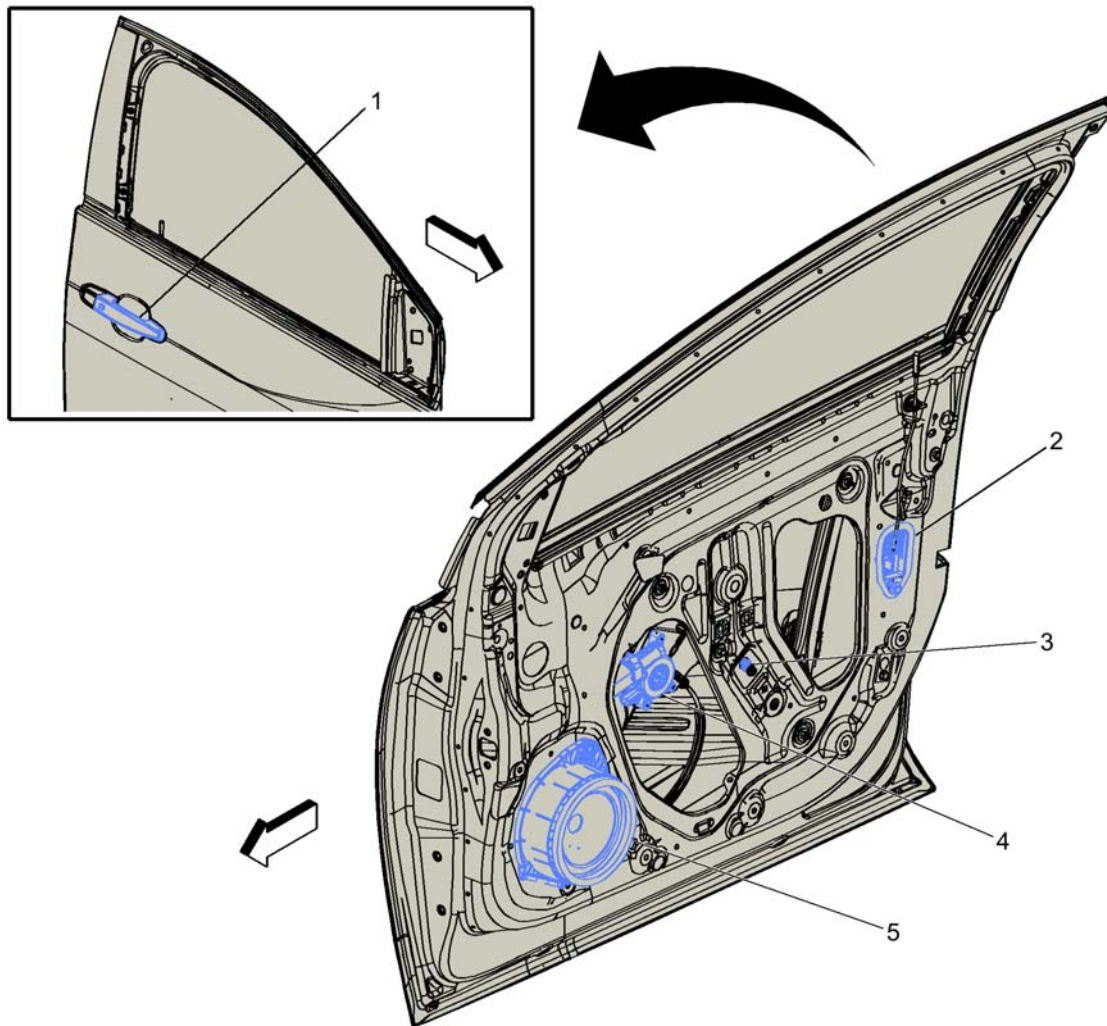


Fig. 3: Passenger Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A24P Door Handle Assembly - Passenger Exterior <u>A24P Door Handle Assembly - Passenger Exterior</u>
2. A23P Door Latch Assembly - Passenger <u>A23P Door Latch Assembly - Passenger</u>
3. B63RF Side Impact Sensor - Right Front <u>B63RF Side Impact Sensor - Right Front</u>
4. M74P Window Motor - Passenger <u>M74P Window Motor - Passenger</u>
5. P19AH Speaker - Right Front Door <u>P19AH Speaker - Right Front Door (UQA)</u>

PASSENGER DOOR TRIM COMPONENTS

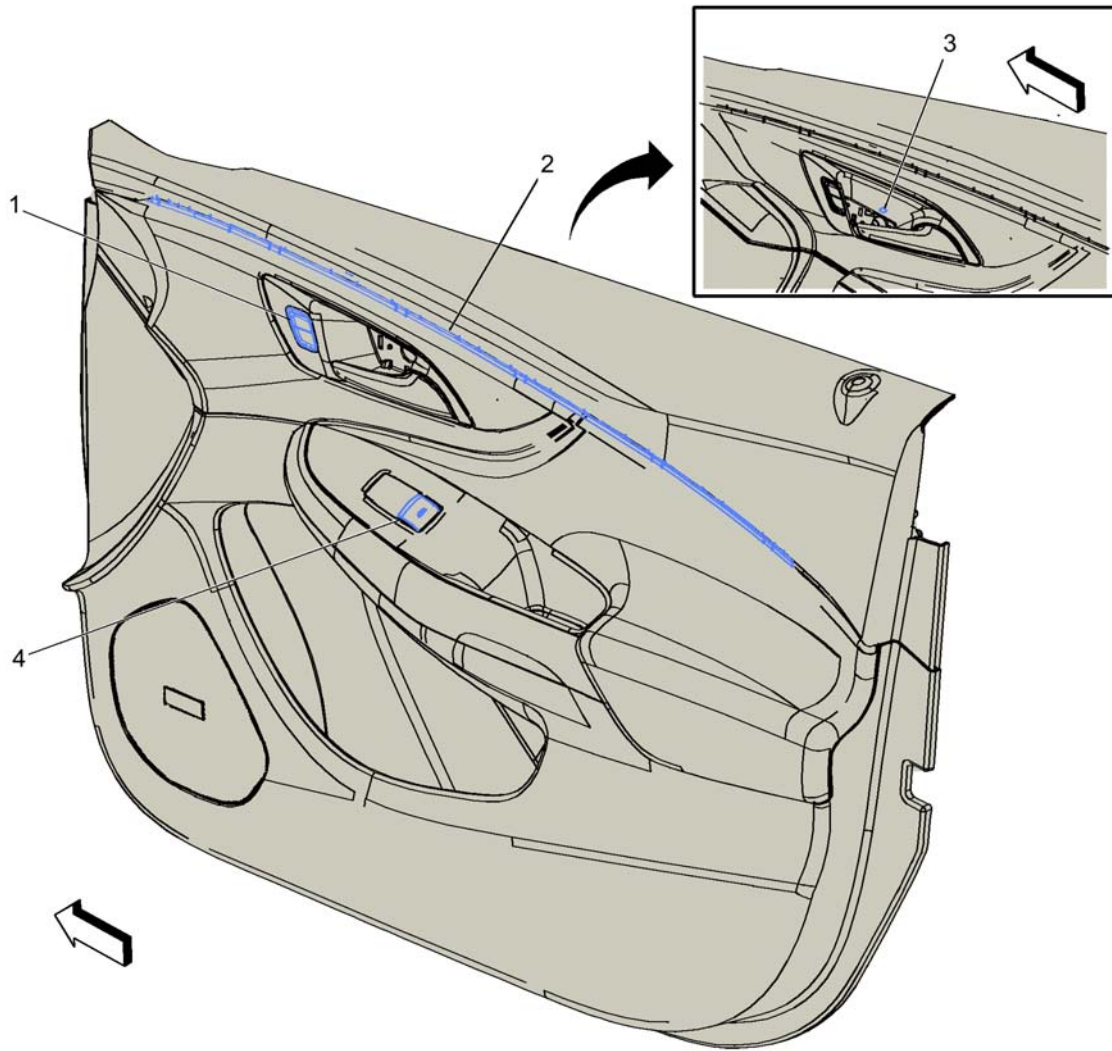


Fig. 4: Passenger Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S13P Door Lock Switch - Passenger <u>S13P Door Lock Switch - Passenger</u>
2. E1P Accent Lamp - Passenger Door <u>E1P Accent Lamp - Passenger Door</u>
3. E63P Flood Lamp - Passenger Door Handle <u>E63P Flood Lamp - Passenger Door Handle</u>
4. S79P Window Switch - Passenger <u>S79P Window Switch - Passenger</u>

LEFT REAR DOOR COMPONENTS

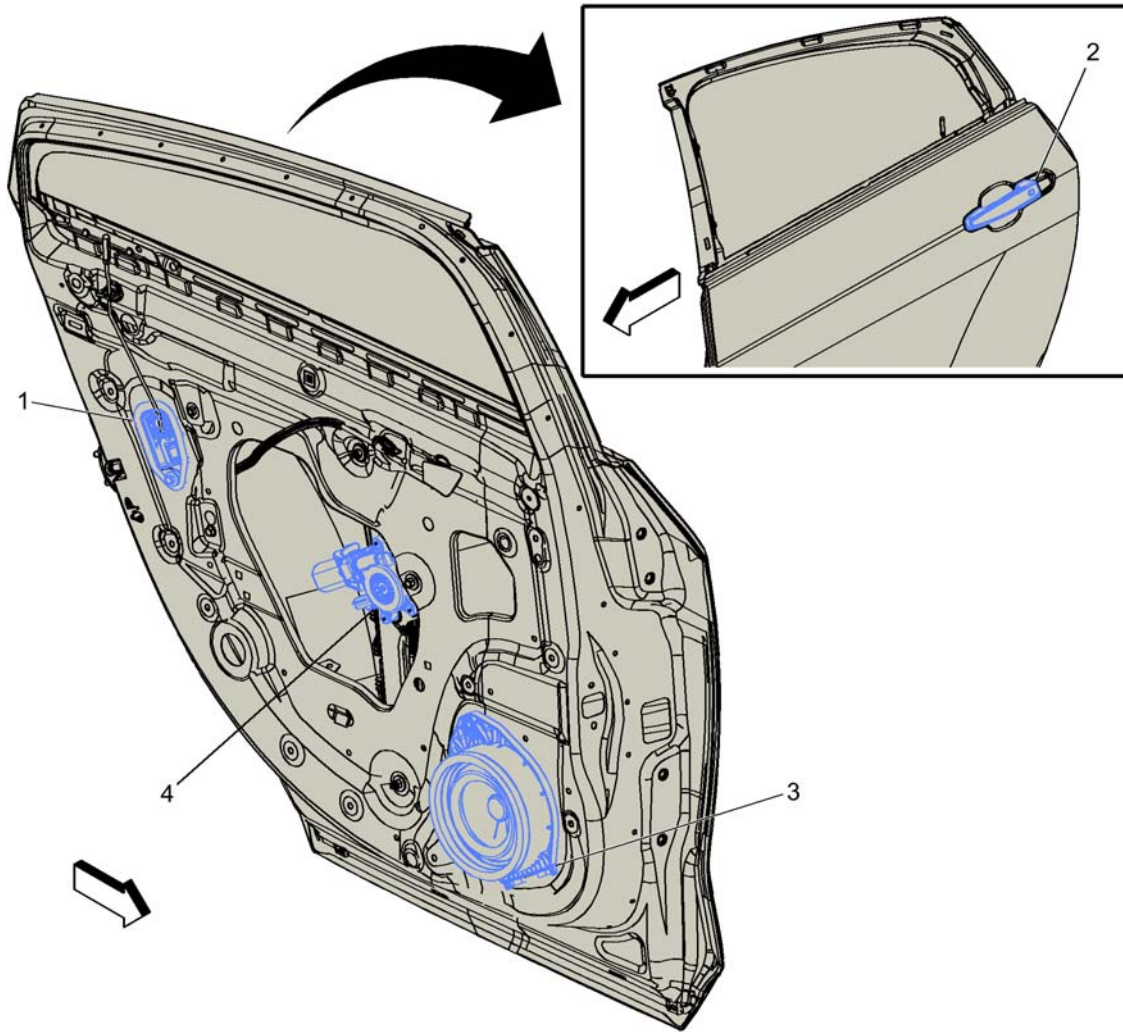


Fig. 5: Left Rear Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A23LR Door Latch Assembly - Left Rear <u>A23LR Door Latch Assembly - Left Rear</u>
2. A24LR Door Handle Assembly - Left Rear Exterior <u>A24LR Door Handle Assembly - Left Rear Exterior</u>
3. P19AL Speaker - Left Rear Door <u>P19AL Speaker - Left Rear Door (UQA)</u> <u>P19AL Speaker - Left Rear Door (UZ6)</u>
4. M74LR Window Motor - Left Rear <u>M74LR Window Motor - Left Rear</u>

LEFT REAR DOOR TRIM COMPONENTS

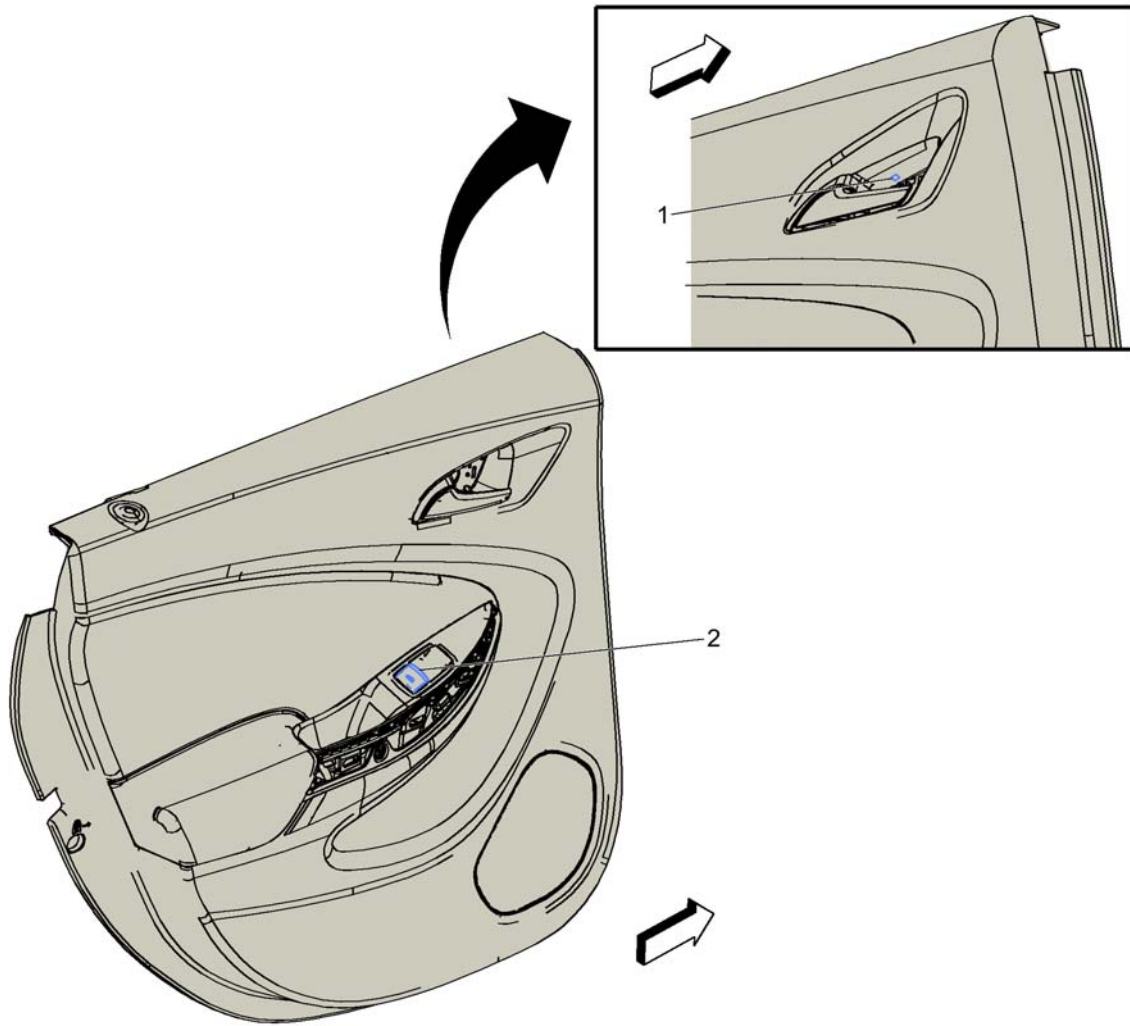


Fig. 6: Left Rear Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. E63LR Flood Lamp - Left Rear Door Handle E63LR Flood Lamp - Left Rear Door Handle
2. S79LR Window Switch - Left Rear S79LR Window Switch - Left Rear

RIGHT REAR DOOR COMPONENTS

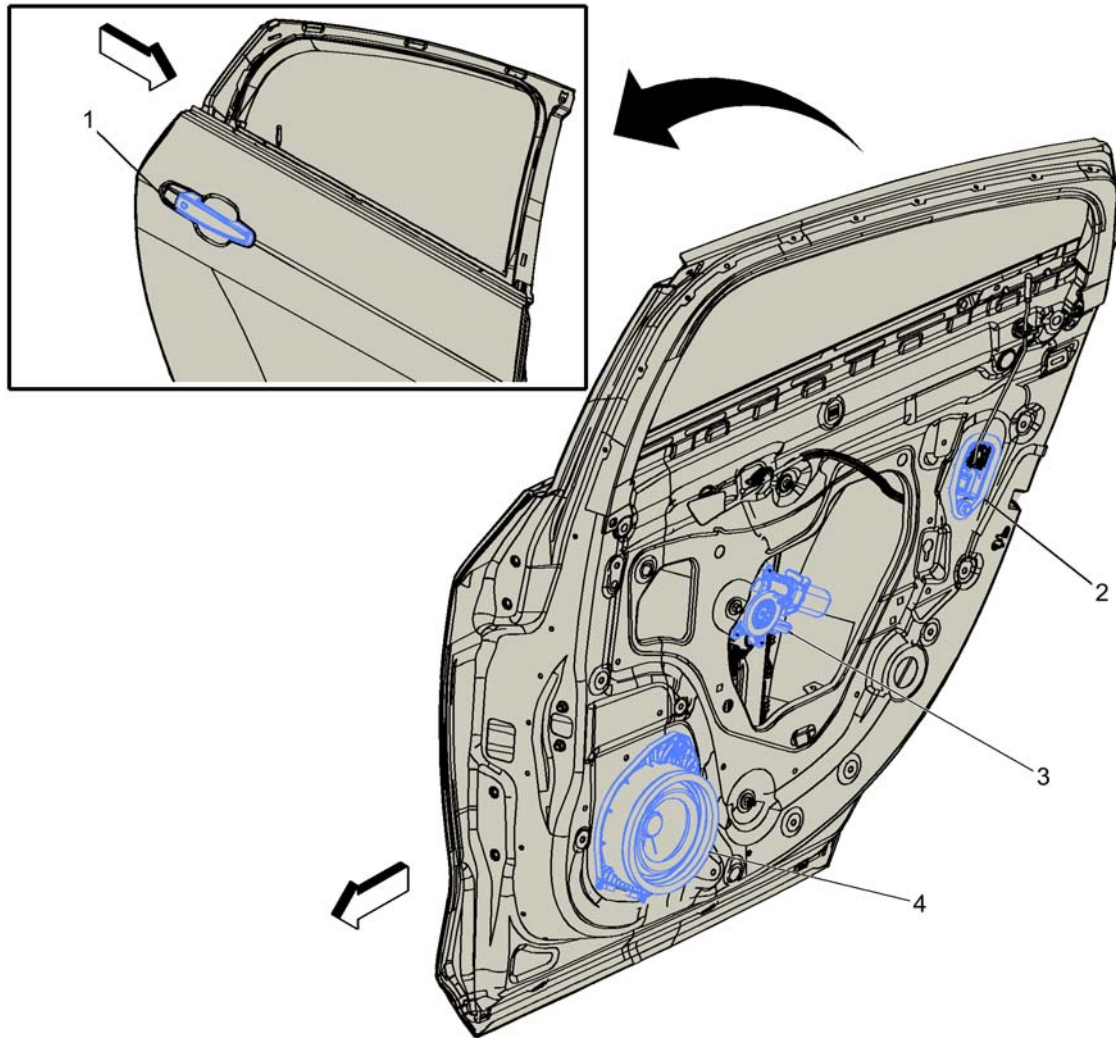


Fig. 7: Right Rear Door Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. A24RR Door Handle Assembly - Right Rear Exterior <u>A24RR Door Handle Assembly - Right Rear Exterior</u>
2. A23RR Door Latch Assembly - Right Rear <u>A23RR Door Latch Assembly - Right Rear</u>
3. M74RR Window Motor - Right Rear <u>M74RR Window Motor - Right Rear</u>
4. P19AM Speaker - Right Rear Door <u>P19AM Speaker - Right Rear Door (UQA)</u> <u>P19AM Speaker - Right Rear Door (UZ6)</u>

RIGHT REAR DOOR TRIM COMPONENTS

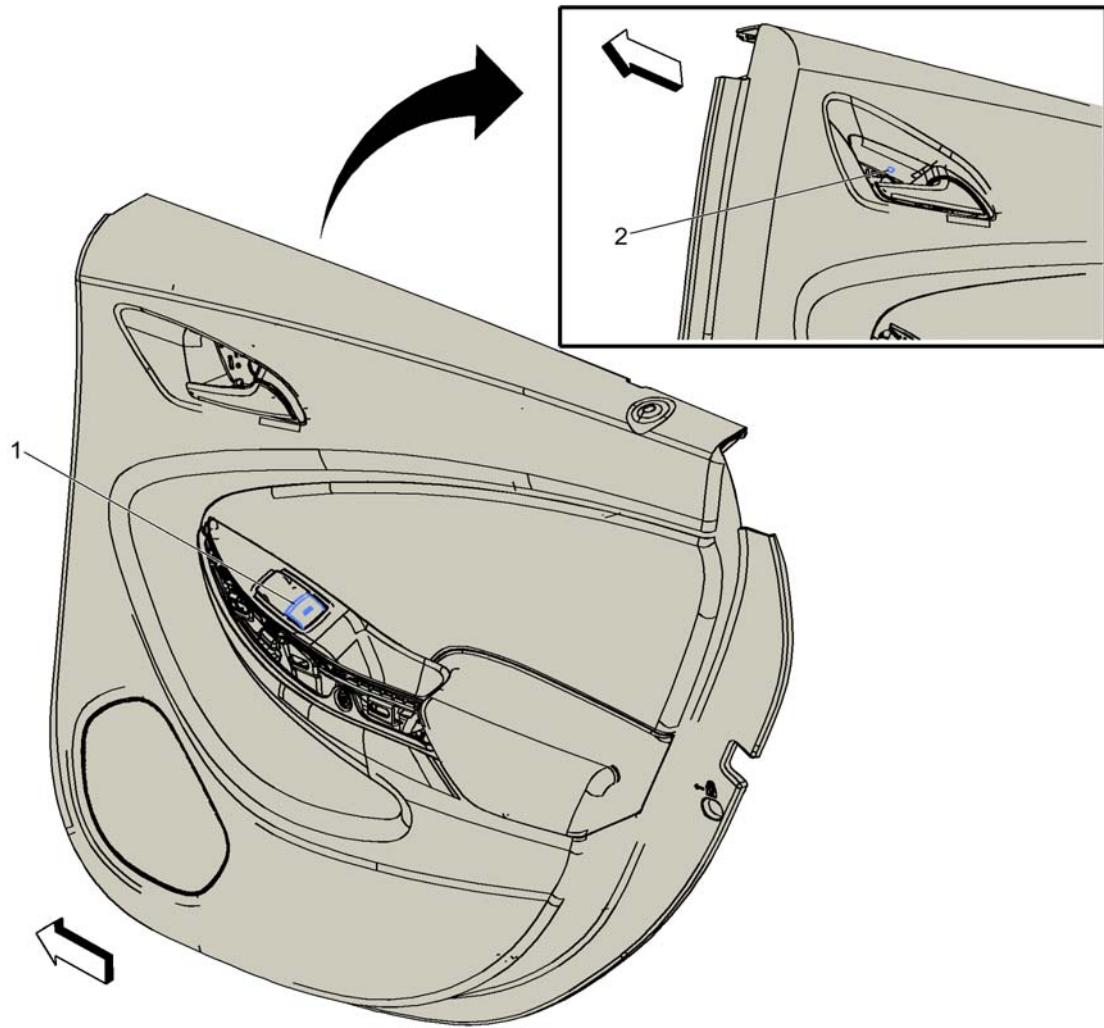


Fig. 8: Right Rear Door Trim Components

Courtesy of GENERAL MOTORS COMPANY

Items	
1. S79RR Window Switch - Right Rear	S79RR Window Switch - Right Rear
2. E63RR Flood Lamp - Right Rear Door Handle	E63RR Flood Lamp - Right Rear Door Handle

Article GUID: A00884673

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Front of Vehicle/Engine Compartment Component Views - Volt

FRONT OF VEHICLE/ENGINE COMPARTMENT COMPONENT VIEWS

ENGINE COMPARTMENT COMPONENTS

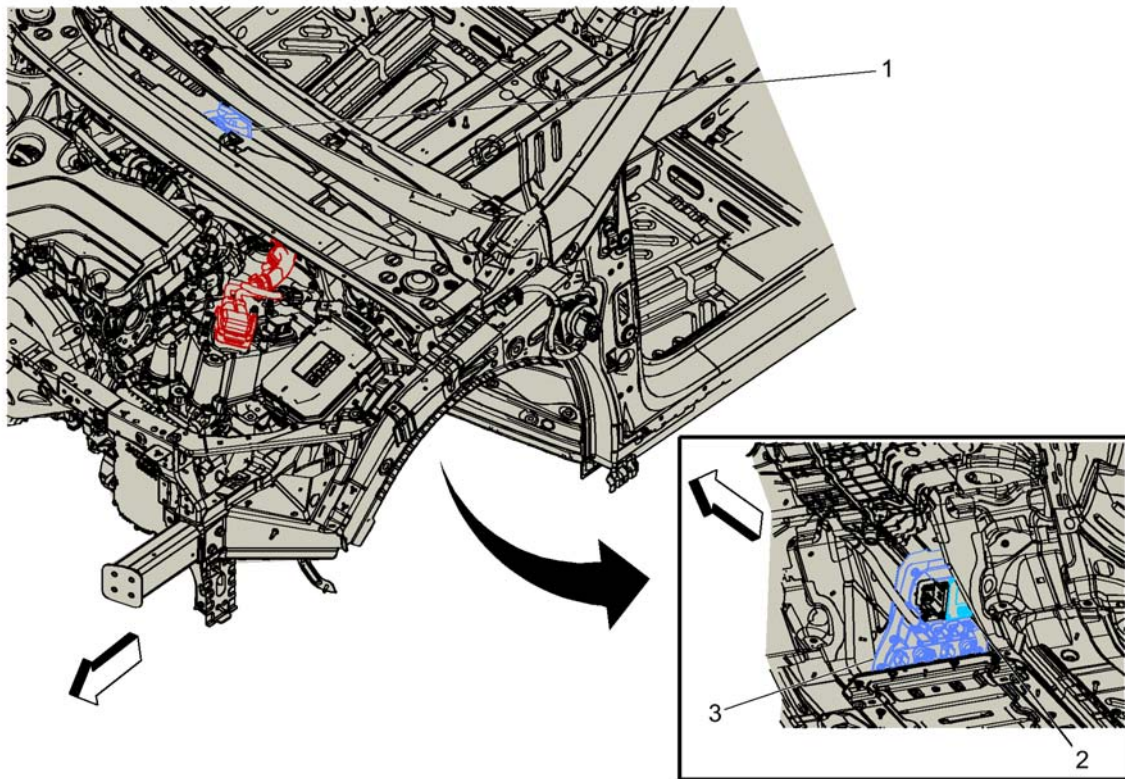


Fig. 1: Engine Compartment Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. M75 Windshield Wiper Motor M75 Windshield Wiper Motor
2. X55QA Fuse Holder 1 - Hybrid/EV Battery Pack
3. A28 Hybrid/EV Battery Contactor Assembly A28 Hybrid/EV Battery Contactor Assembly X3 A28 Hybrid/EV Battery Contactor Assembly X4 A28 Hybrid/EV Battery Contactor Assembly X5 A28 Hybrid/EV Battery Contactor Assembly X6

ENGINE COMPARTMENT COMPONENTS - FRONT (1 OF 4)

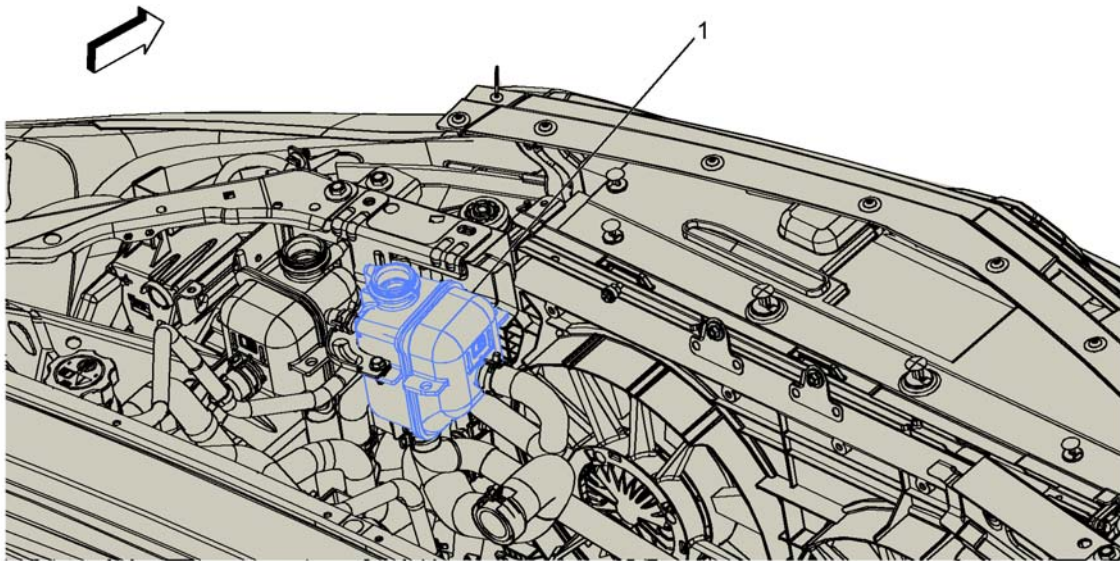


Fig. 2: Engine Compartment Components - Front (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B258 Hybrid/EV Battery Coolant Level Switch B258 Hybrid/EV Battery Coolant Level Switch

ENGINE COMPARTMENT COMPONENTS - FRONT (2 OF 4)

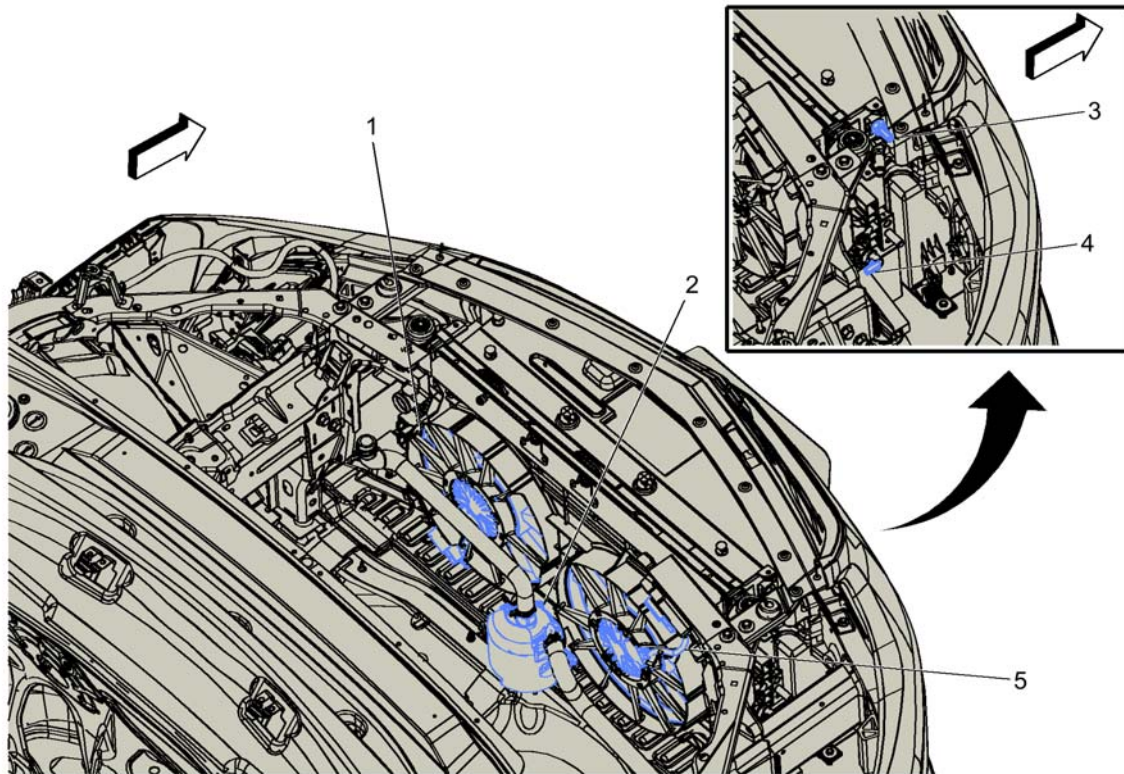


Fig. 3: Engine Compartment Components - Front (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. G10L Cooling Fan Motor - Left <u>G10L Cooling Fan Motor - Left</u>
2. G37 Hybrid/EV Battery Pack Coolant Pump <u>G37 Hybrid/EV Battery Pack Coolant Pump</u>
3. B202 Hybrid/EV Electronics Coolant Temperature Sensor <u>B202 Hybrid/EV Electronics Coolant Temperature Sensor</u>
4. B203 Radiator Coolant Temperature Sensor <u>B203 Engine Coolant Radiator Temperature Sensor</u>
5. G10R Cooling Fan Motor - Right <u>G10R Cooling Fan Motor - Right</u>

ENGINE COMPARTMENT COMPONENTS - FRONT (3 OF 4)

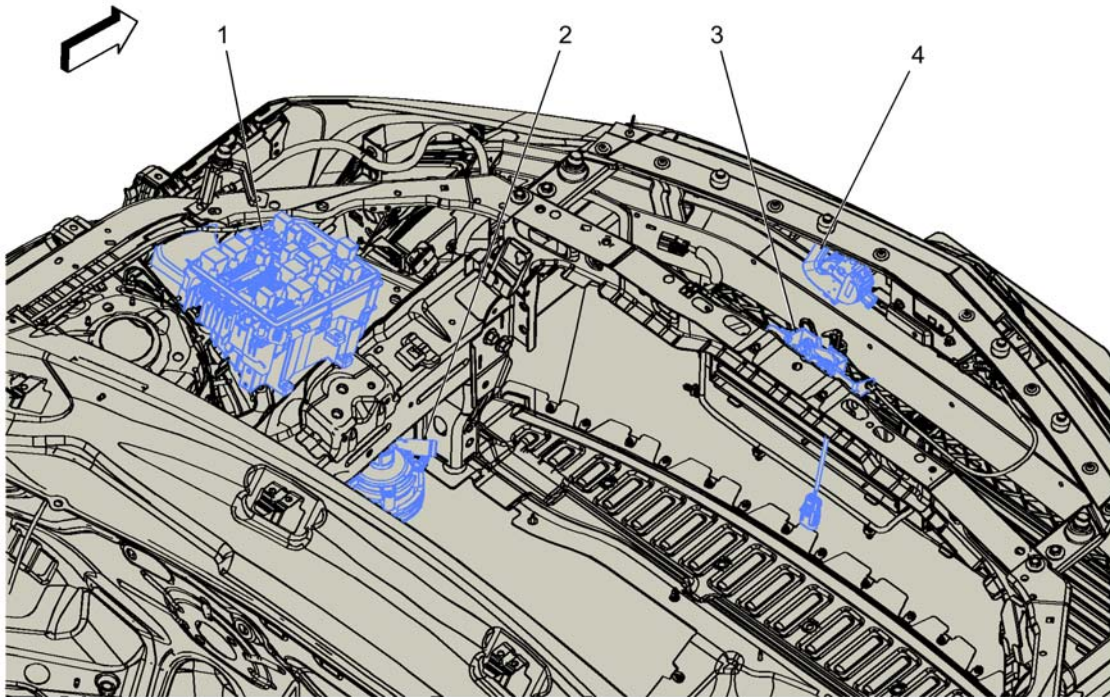


Fig. 4: Engine Compartment Components - Front (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X50A Fuse Block - Underhood <u>X50A Fuse Block - Underhood X1 X50A Fuse Block - Underhood X2 X50A Fuse Block - Underhood X3</u>
2. G35 Hybrid/EV Electronics Coolant Pump <u>G35 Hybrid/EV Electronics Coolant Pump</u>
3. B55 Hood Ajar Switch <u>B55 Engine Hood Switch</u>
4. P48 Pedestrian Alert Sound Speaker <u>P48 Pedestrian Alert Sound Speaker</u>

ENGINE COMPARTMENT COMPONENTS - FRONT (4 OF 4)

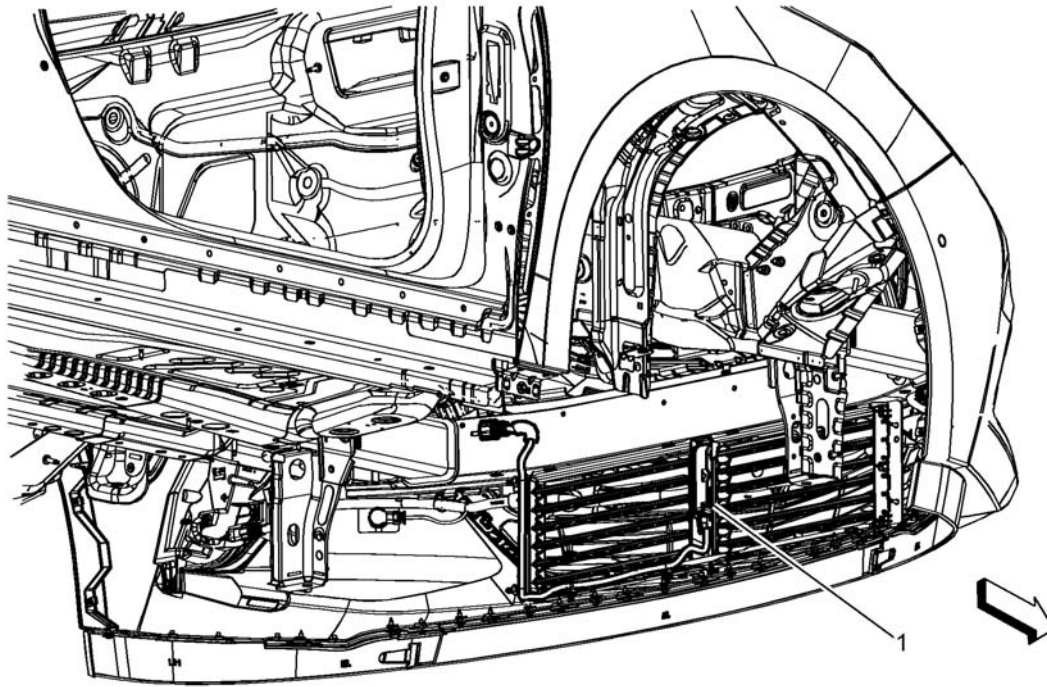


Fig. 5: Engine Compartment Components - Front (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. M96 Active Grille Air Shutter Actuator M96 Active Grille Air Shutter Actuator

ENGINE COMPARTMENT COMPONENTS - LEFT

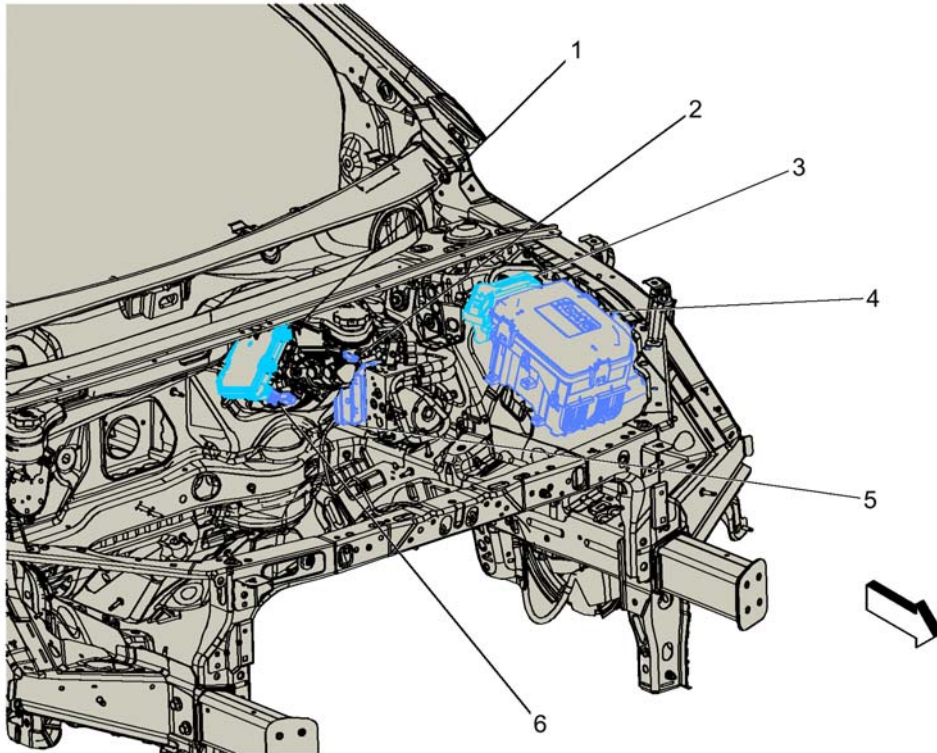


Fig. 6: Engine Compartment Components - Left

Courtesy of GENERAL MOTORS COMPANY

Items
1. K177 Brake Booster Control Module <u>K177 Brake Booster Control Module</u>
2. B20 Brake Fluid Level Switch <u>B20 Brake Fluid Level Switch</u>
3. X50B Fuse Block - Underhood Auxiliary <u>X50B Fuse Block - Underhood Auxiliary X1</u>
4. X50A Fuse Block - Underhood <u>X50A Fuse Block - Underhood X1</u> <u>X50A Fuse Block - Underhood X2</u> <u>X50A Fuse Block - Underhood X3</u>
5. K17 Electronic Brake Control Module <u>K17 Electronic Brake Control Module</u>
6. B201 Brake Control Brake Pedal Position Sensor <u>B201 Brake Control Brake Pedal Position Sensor</u>

ENGINE COMPARTMENT COMPONENTS - RIGHT

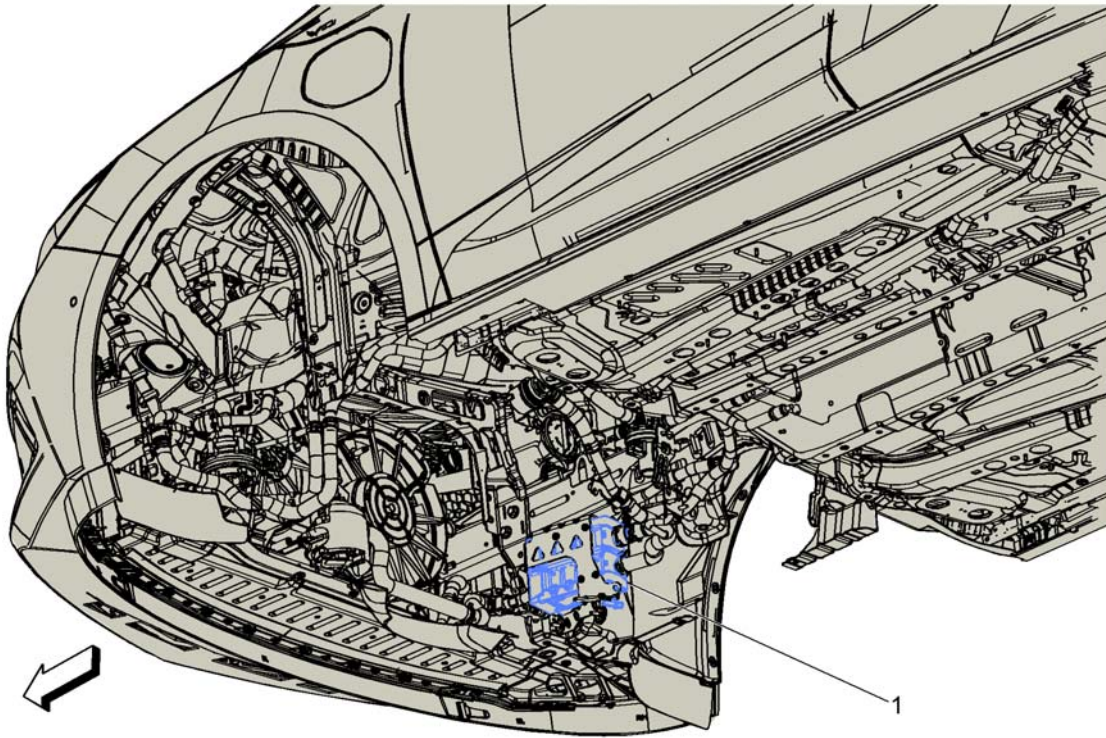


Fig. 7: Engine Compartment Components - Right

Courtesy of GENERAL MOTORS COMPANY

Items
1. K10 Coolant Heater Control Module <u>K10 Coolant Heater Control Module X1</u>

FRONT OF VEHICLE COMPONENTS (1 OF 2)

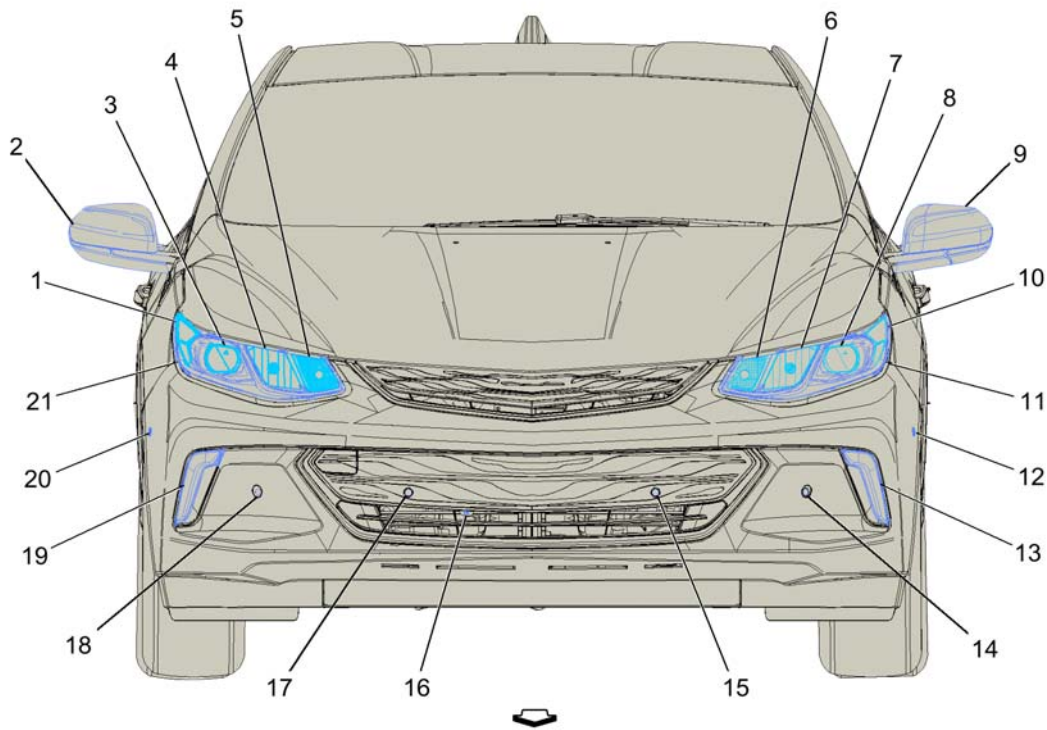


Fig. 8: Front of Vehicle Components (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Items
1. E2RF Side Marker Lamp - Right Front
2. A9B Outside Rearview Mirror - Passenger
3. E4H Headlamp - Right Low Beam
4. E4F Headlamp - Right High Beam <u>E4F Headlamp - Right High Beam</u>
5. E4RF Turn Signal Lamp - Right Front
6. E4LF Turn Signal Lamp - Left Front
7. E4E Headlamp - Left High Beam <u>E4E Headlamp - Left High Beam</u>
8. E4G Headlamp - Left Low Beam
9. A9A Outside Rearview Mirror - Driver
10. E2LF Side Marker Lamp - Left Front
11. E13LA Headlamp Assembly - Left
12. B306K Parking Assist Sensor - Side Left Front (UKC) <u>B306K Parking Assist Sensor - Side Left Front</u>
13. E4AC Park/Daytime Running Lamp - Left <u>E4AC Park/Daytime Running Lamp - Left</u>
14. B306A Parking Assist Sensor - Front Left Outer (UFQ) <u>B306A Parking Assist Sensor - Front Left Outer</u>
15. B306B Parking Assist Sensor - Front Left Middle (UFQ) <u>B306B Parking Assist Sensor - Front Left Middle</u>
16. B9 Ambient Air Temperature Sensor <u>B9 Ambient Air Temperature Sensor</u>

Items
17. B306C Parking Assist Sensor - Front Right Middle (UFQ) B306C Parking Assist Sensor - Front Right Middle
18. B306D Parking Assist Sensor - Front Right Outer (UFQ) B306D Parking Assist Sensor - Front Right Outer
19. E4AD Park/Daytime Running Lamp - Right E4AD Park/Daytime Running Lamp - Right
20. B306L Parking Assist Sensor - Side Right Front (UKC) B306L Parking Assist Sensor - Side Right Front
21. E13RA Headlamp Assembly - Right

FRONT OF VEHICLE COMPONENTS (2 OF 2)

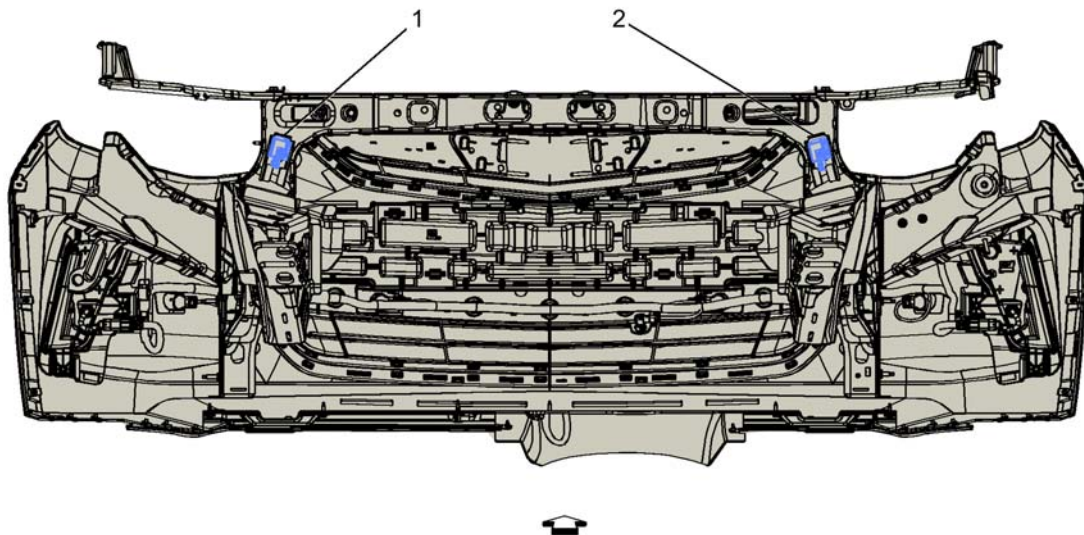


Fig. 9: Front of Vehicle Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B59L Front Impact Sensor - Left B59L Front Impact Sensor - Left
2. B59R Front Impact Sensor - Right B59R Front Impact Sensor - Right

LEFT FRONT OF VEHICLE COMPONENTS (1 OF 2)

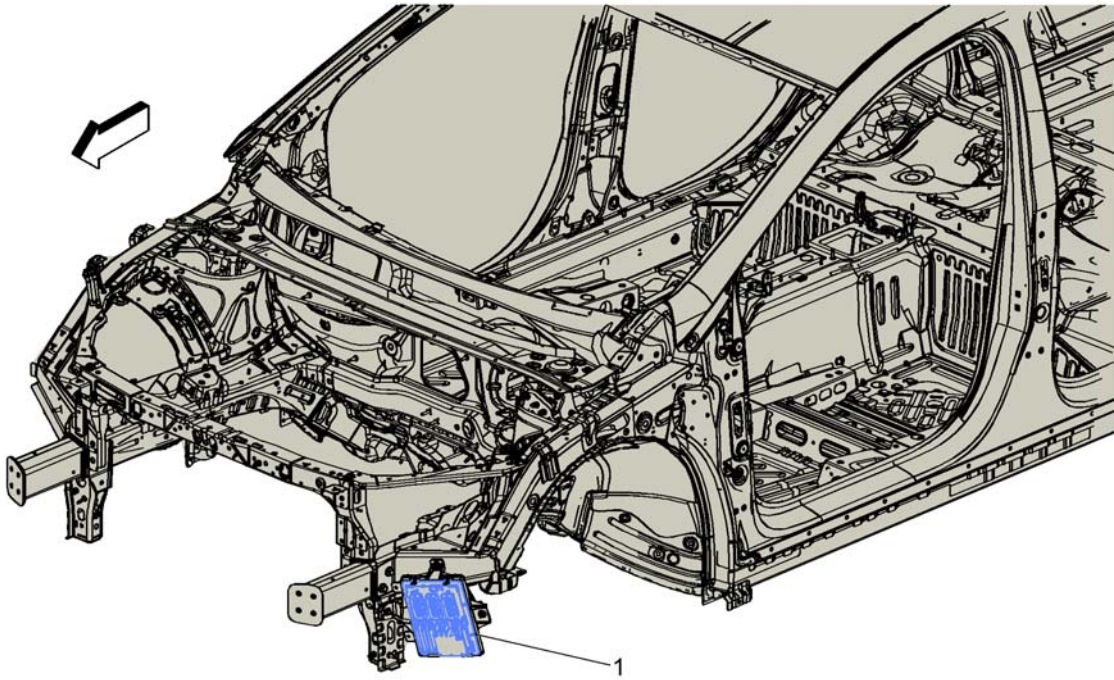


Fig. 10: Left Front of Vehicle Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K20 Engine Control Module <u>K20 Engine Control Module X1</u> <u>K20 Engine Control Module X2</u> <u>K20 Engine Control Module X3</u>

LEFT FRONT OF VEHICLE COMPONENTS (2 OF 2)

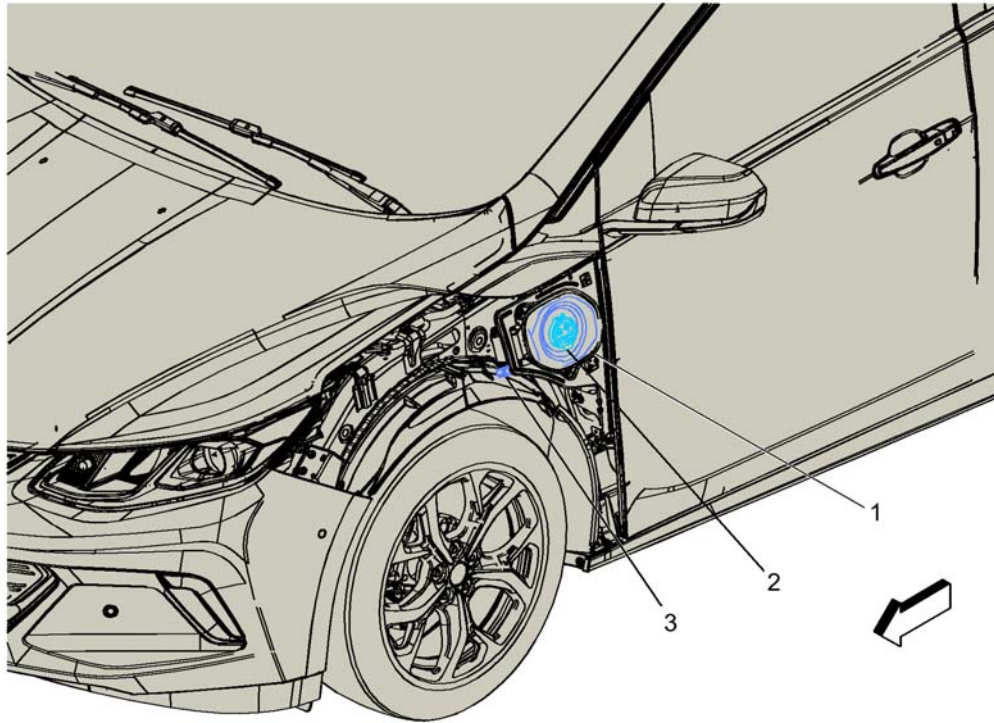


Fig. 11: Left Front of Vehicle Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X98 Hybrid/EV Battery Charger Receptacle X98 Hybrid/EV Battery Charger Receptacle
2. E85 Hybrid/EV Battery Charger Receptacle Accent Lamp
3. B197 Charge Port Door Position Switch B197 Charge Port Door Position Switch

RIGHT FRONT OF VEHICLE COMPONENTS

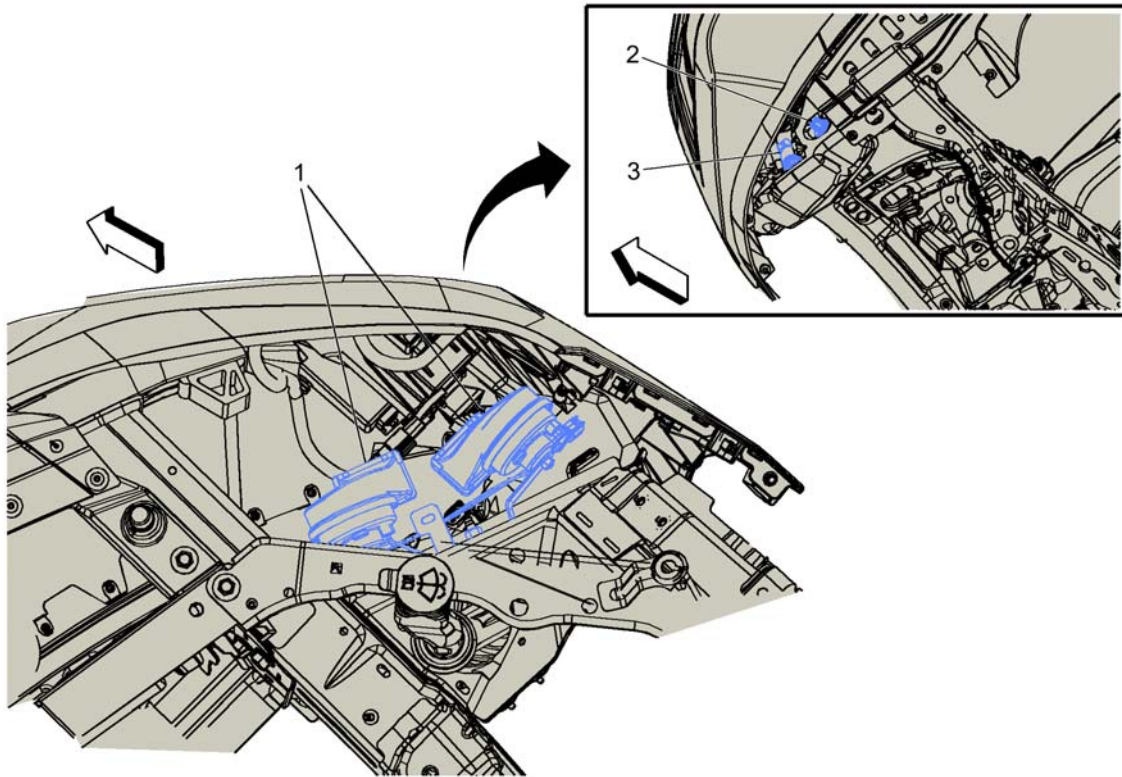


Fig. 12: Right Front of Vehicle Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. P12 Horn P12 Horn
2. B118B Windshield Washer Fluid Level Switch B118B Windshield Washer Fluid Level Switch
3. G24 Windshield Washer Pump G24 Windshield Washer Pump

Article GUID: A00884703

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Ground Views - Volt

GROUND VIEWS

G101

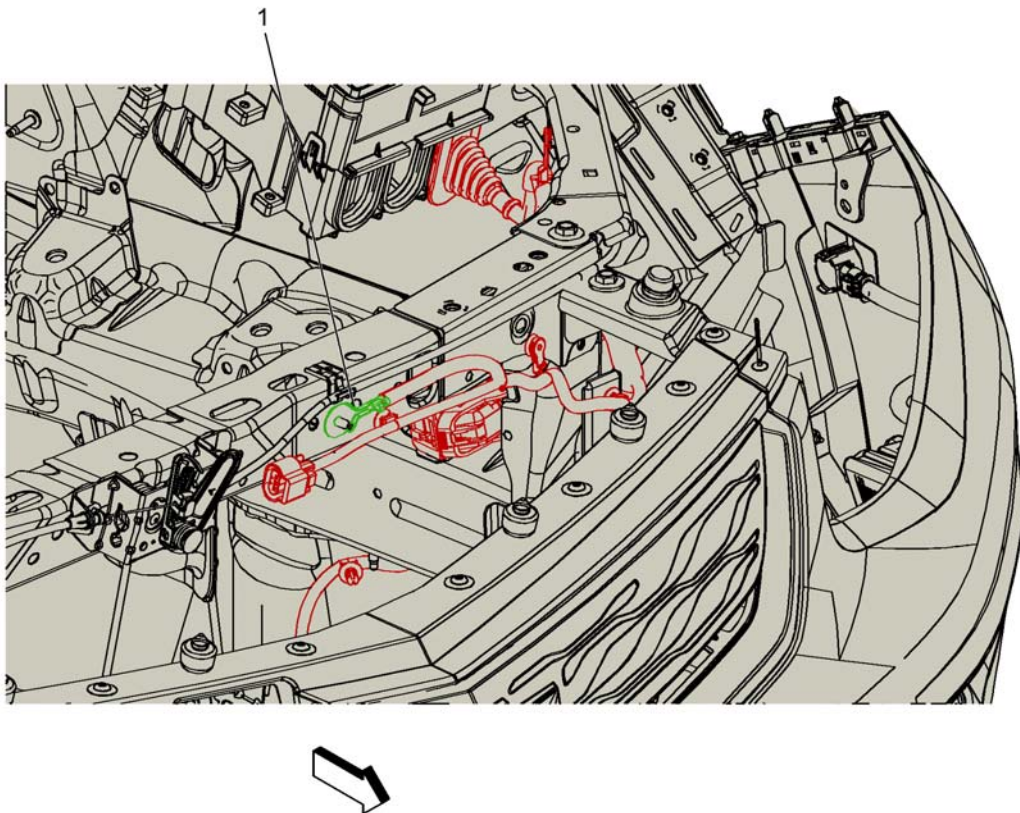


Fig. 1: G101

Courtesy of GENERAL MOTORS COMPANY

Items
1. G101

G102

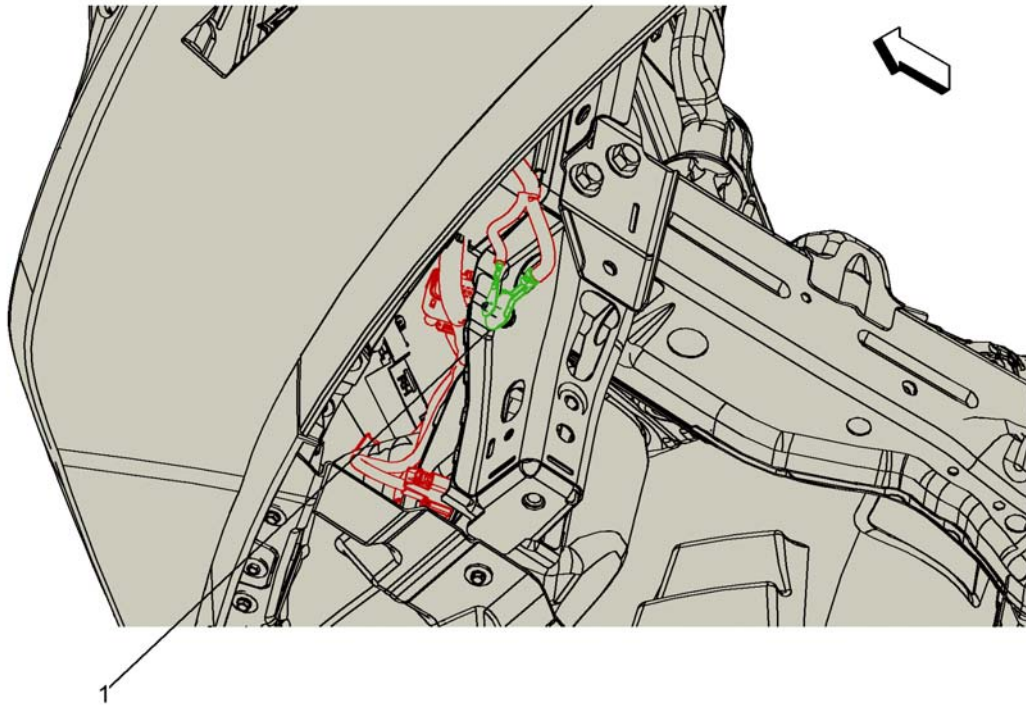


Fig. 2: G102

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G102	

G104 AND G113

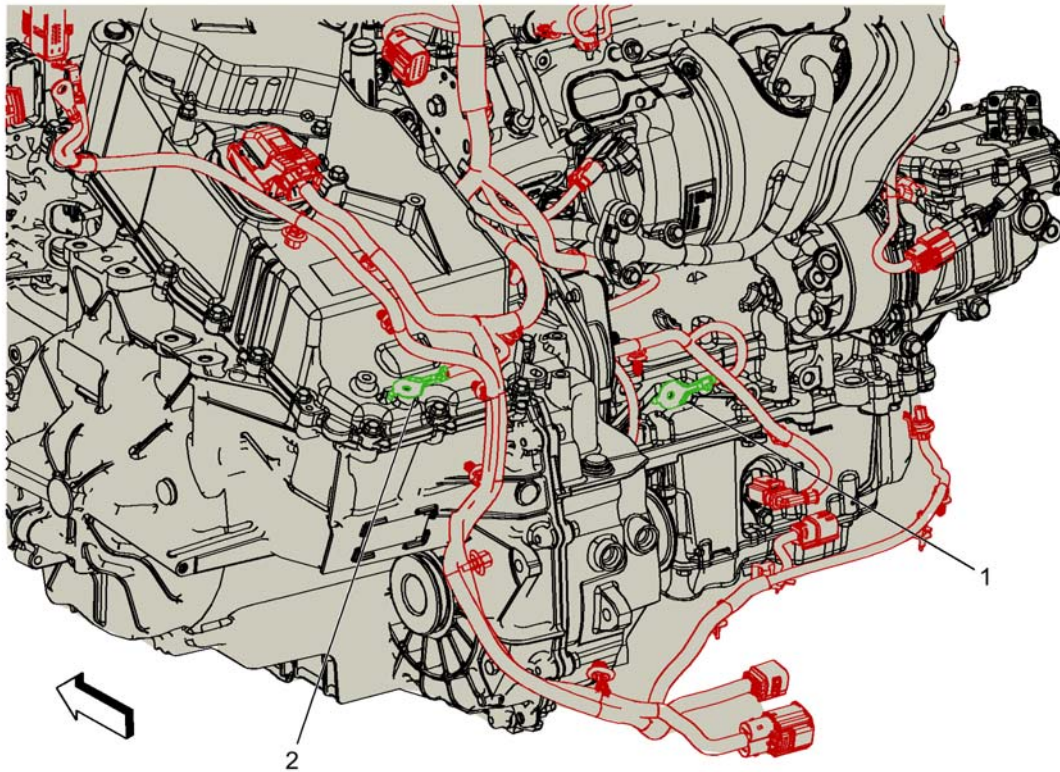


Fig. 3: G104 and G113

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G104	
2. G113	

G105

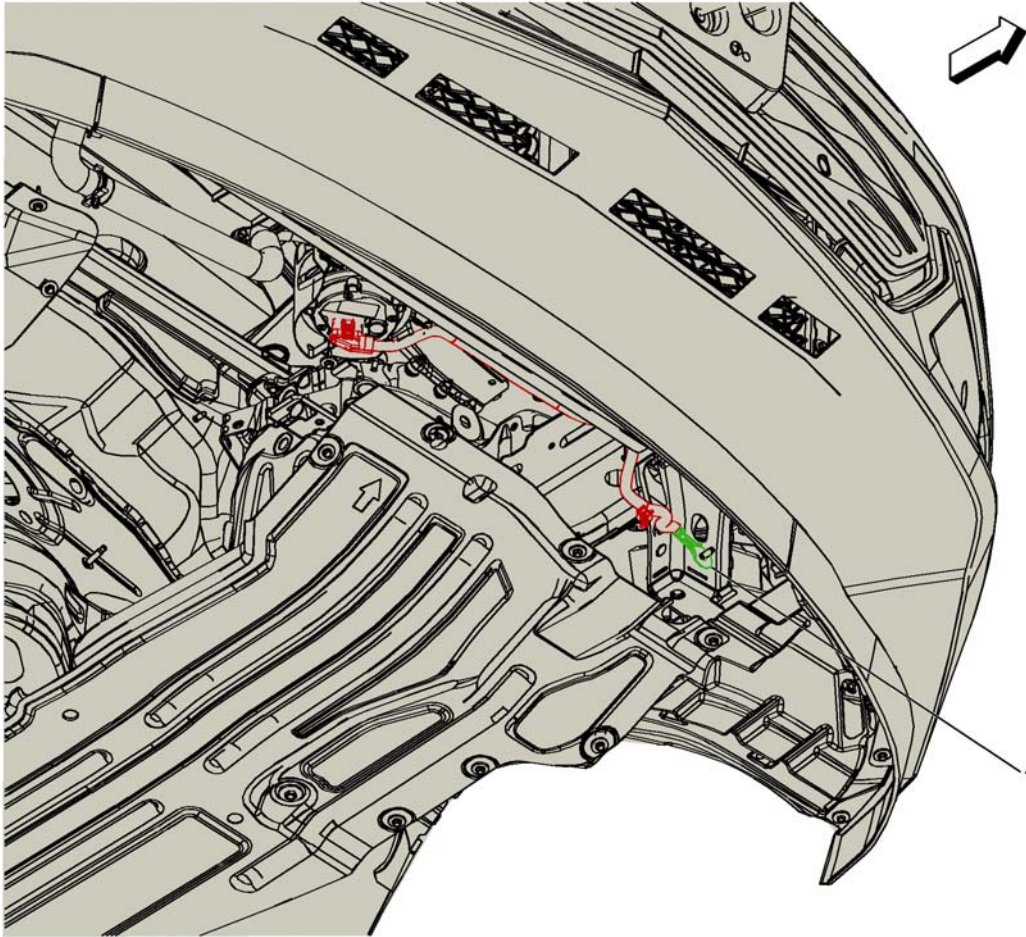


Fig. 4: G105

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G105	

G109

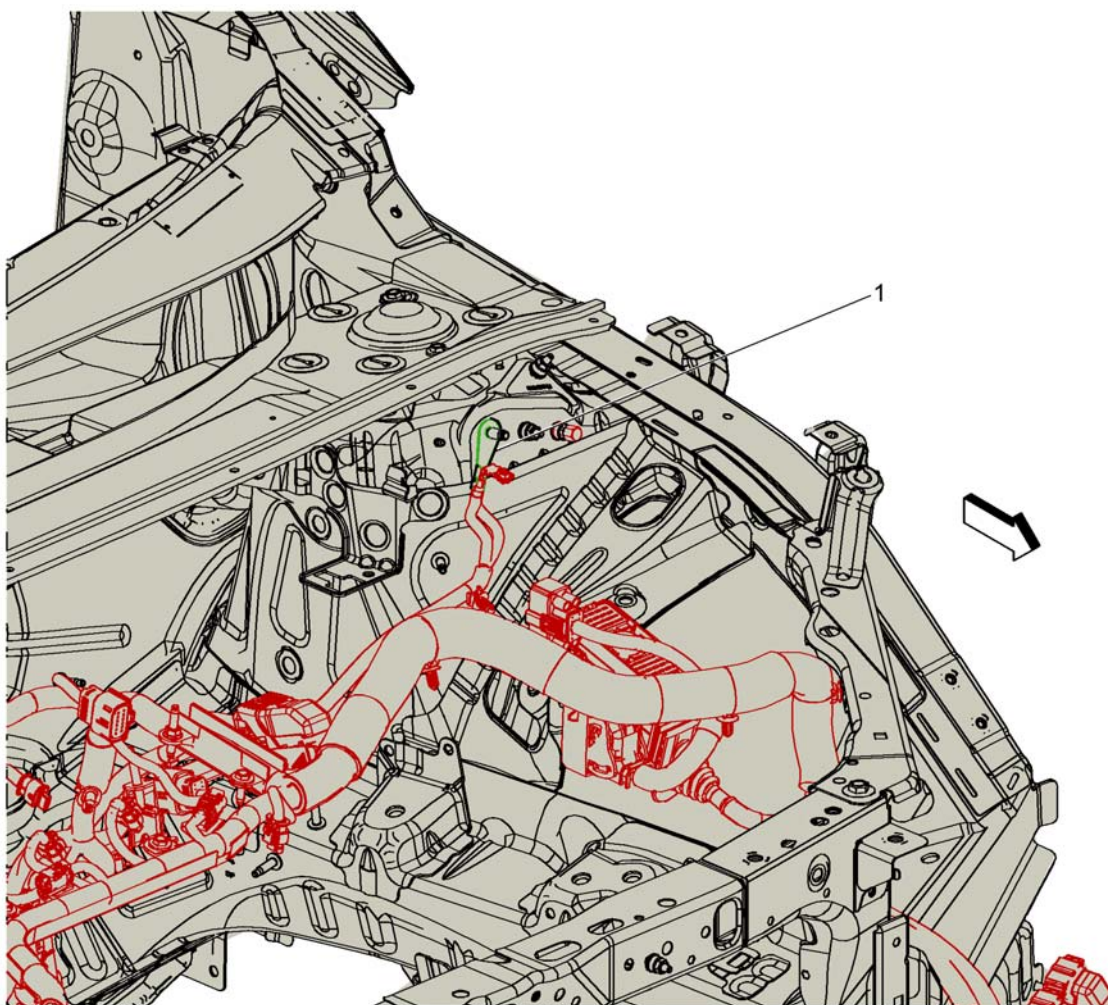


Fig. 5: G109

Courtesy of GENERAL MOTORS COMPANY

Items
1. G109

G110 AND G112

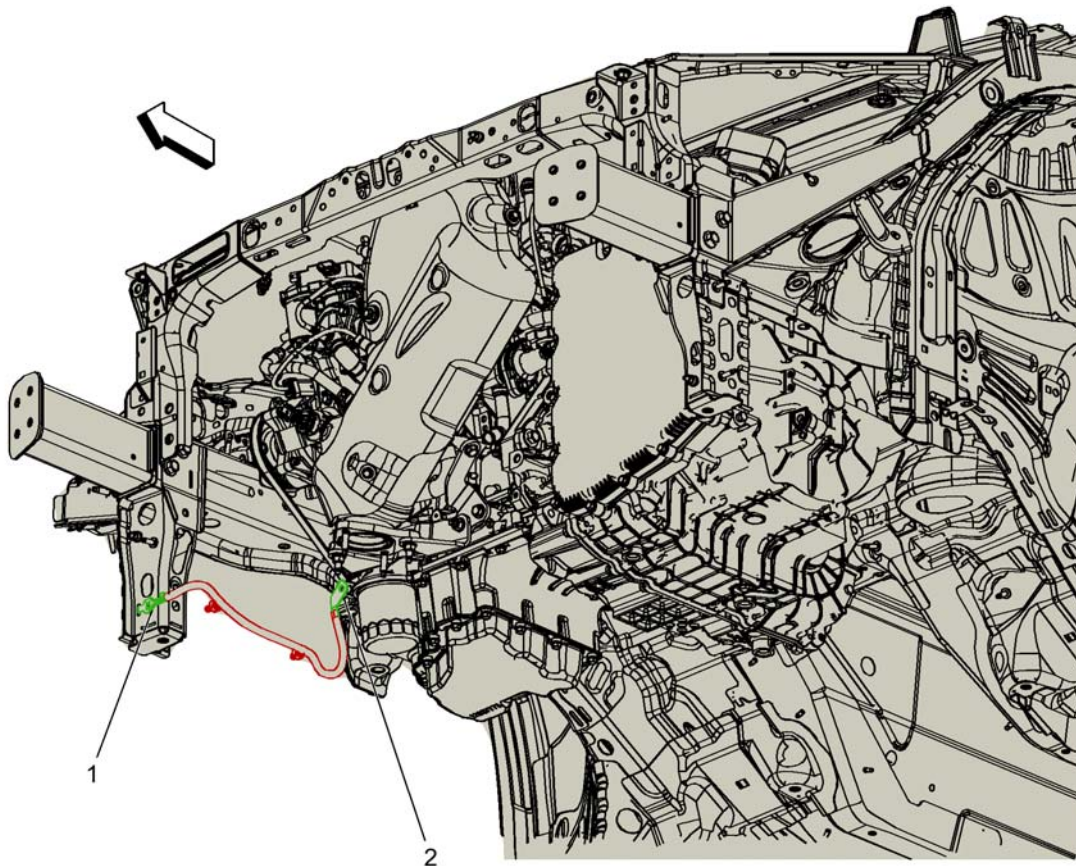


Fig. 6: G110 and G112

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G110	
2. G112	

G117

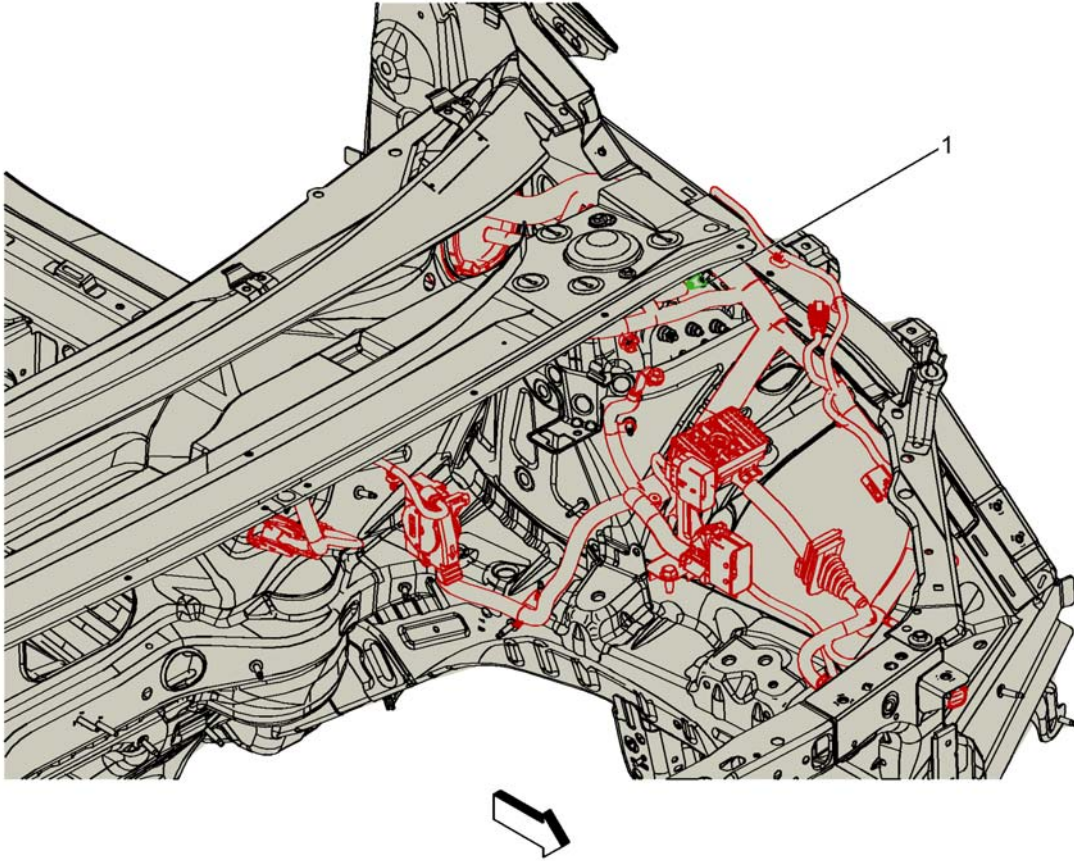


Fig. 7: G117

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G117	

G122

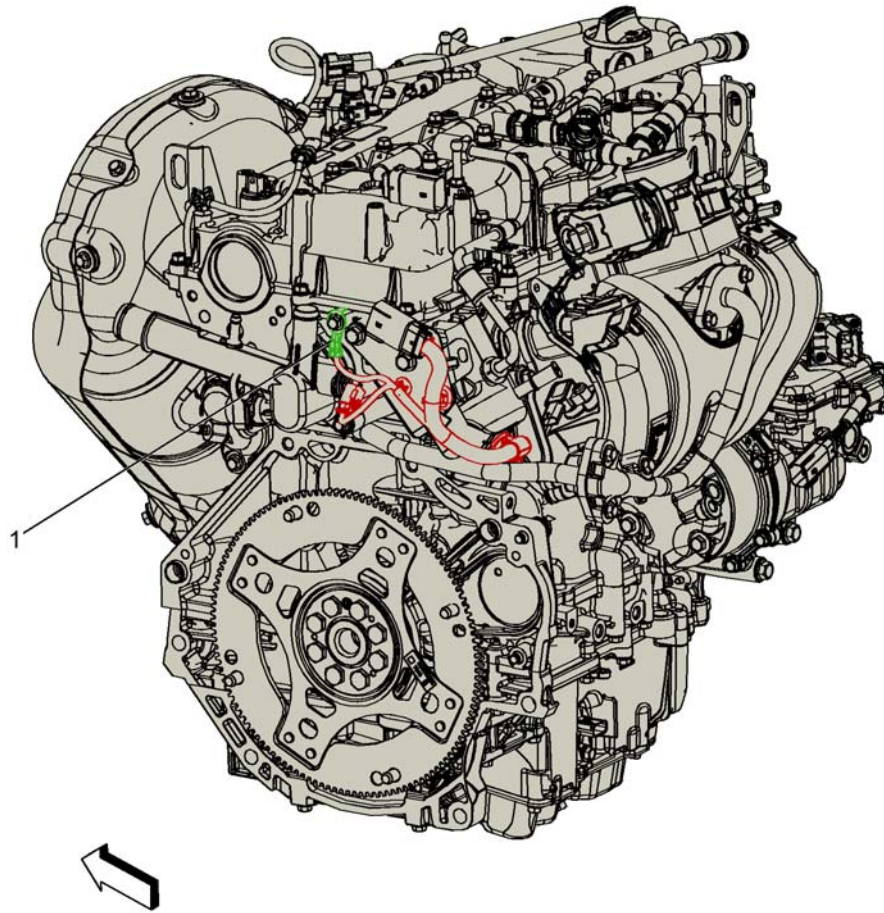


Fig. 8: G122

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G122	

G201 AND G204

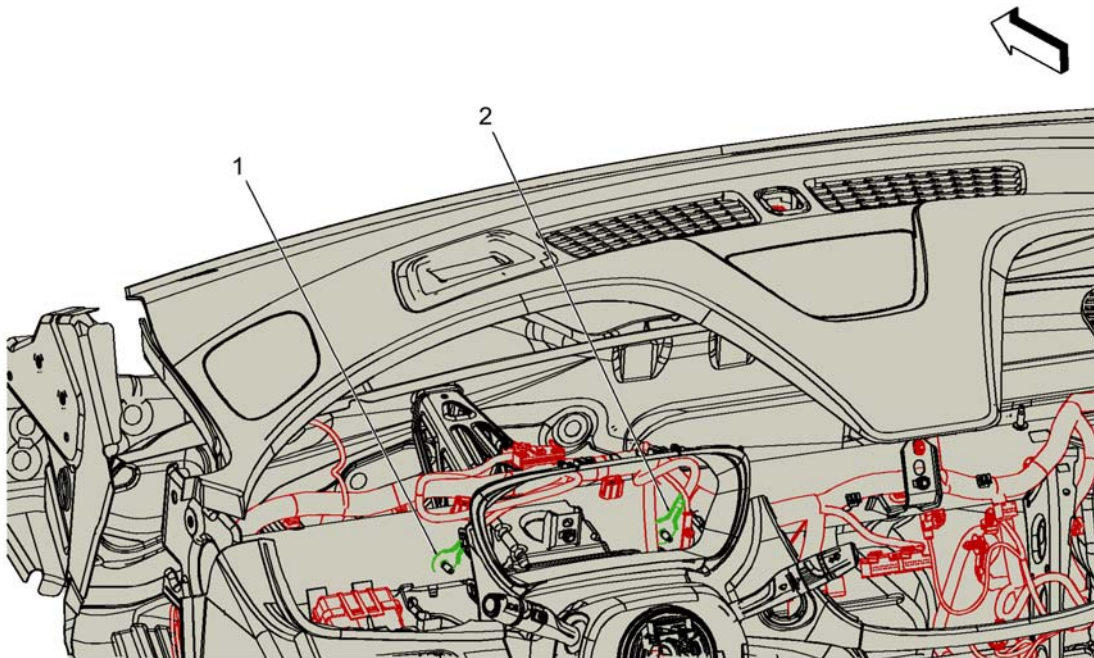


Fig. 9: G201 and G204

Courtesy of GENERAL MOTORS COMPANY

Items
1. G201
2. G204

G202

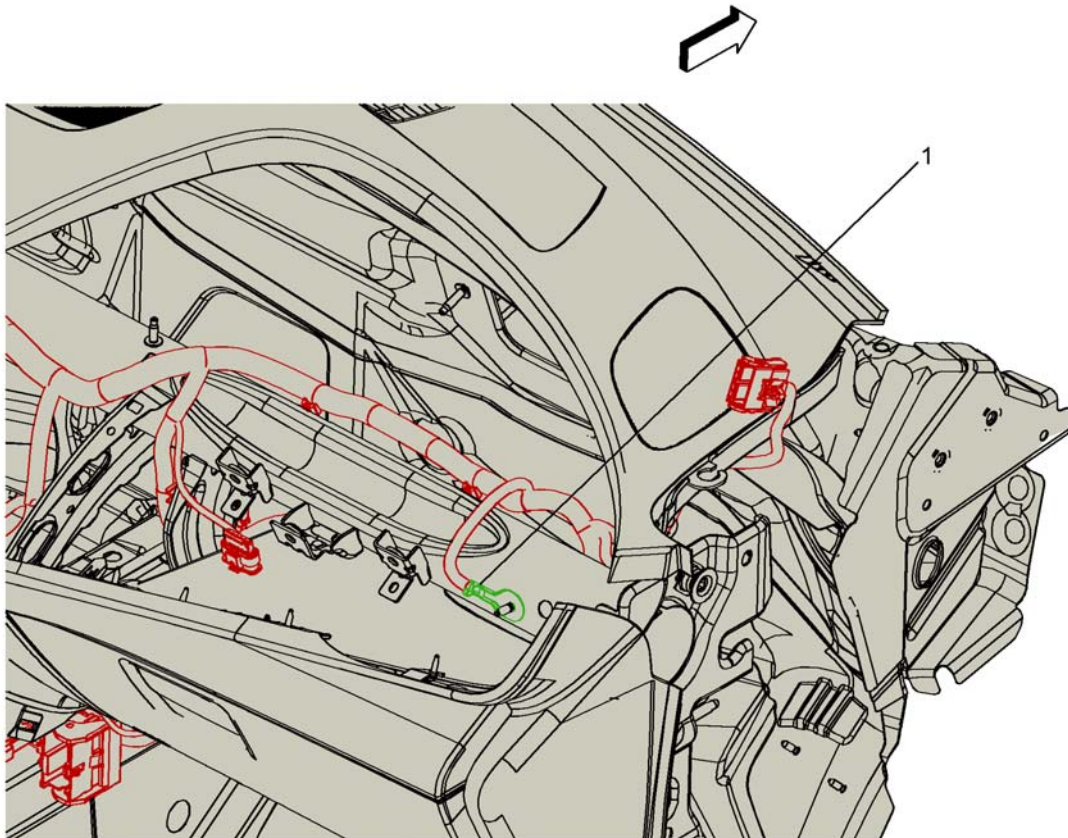


Fig. 10: G202

Courtesy of GENERAL MOTORS COMPANY

Items
1. G202

G205

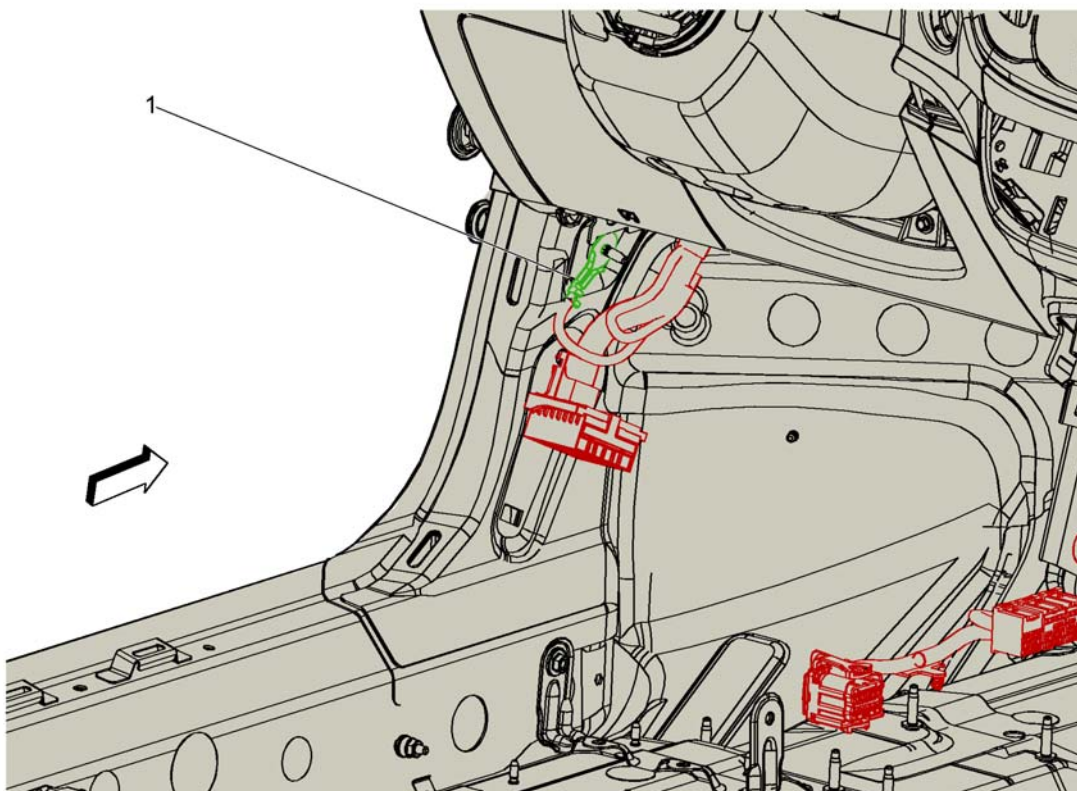


Fig. 11: G205

Courtesy of GENERAL MOTORS COMPANY

Items
1. G205

G301

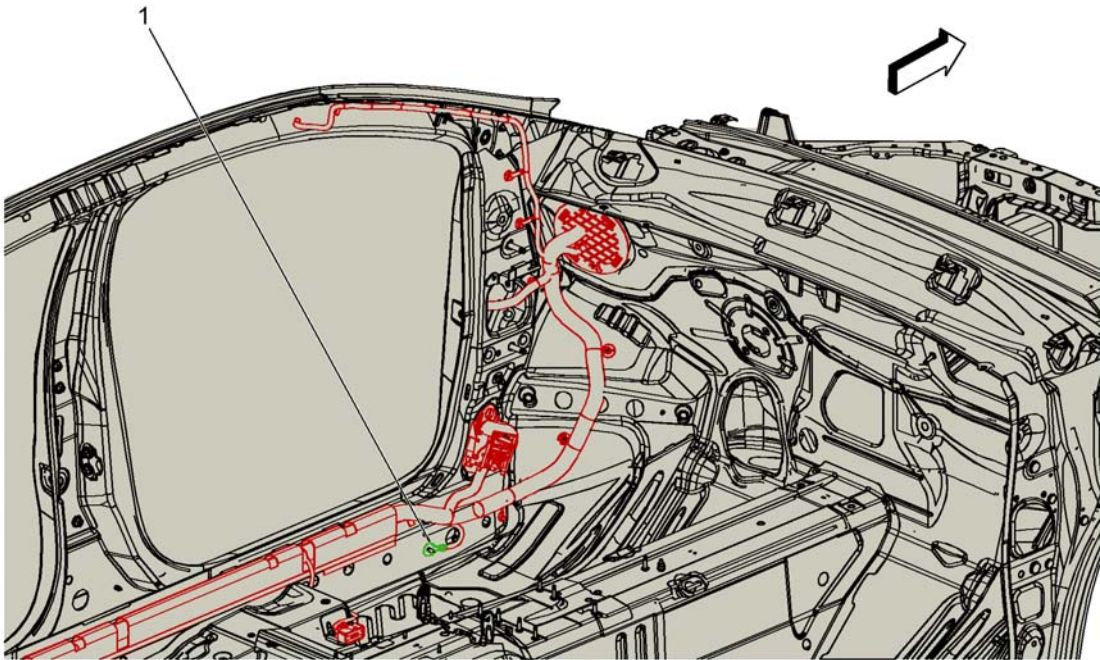


Fig. 12: G301

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G301	

G302

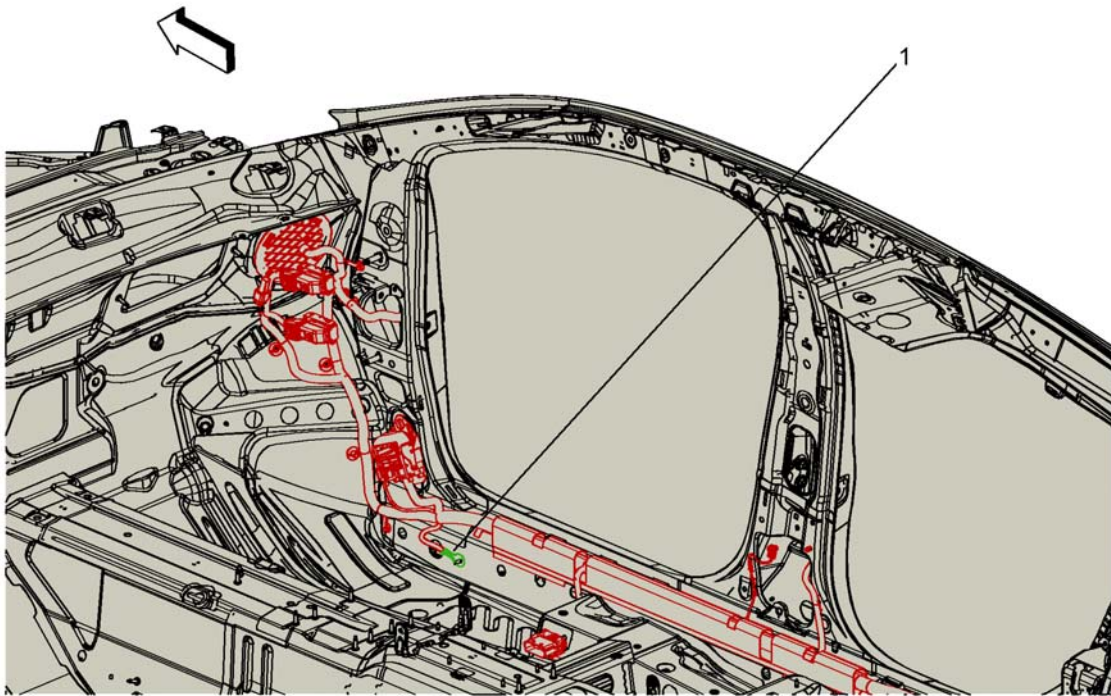


Fig. 13: G302

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G302	

G304

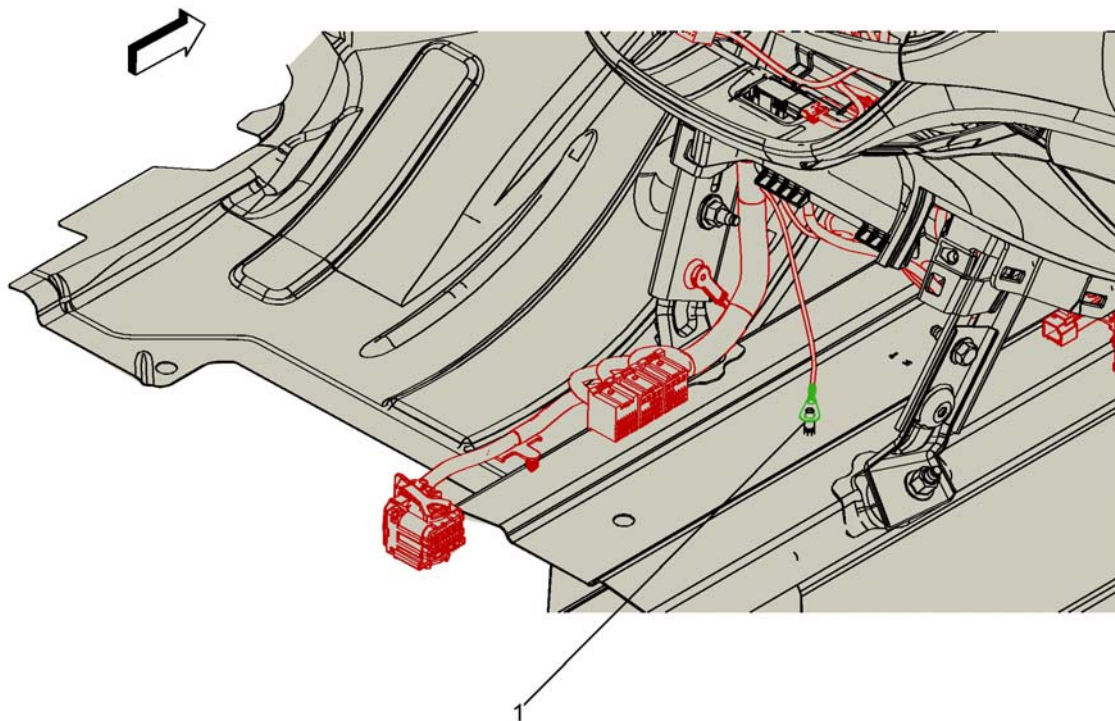


Fig. 14: G304

Courtesy of GENERAL MOTORS COMPANY

Items
1. G304

G340 AND G341

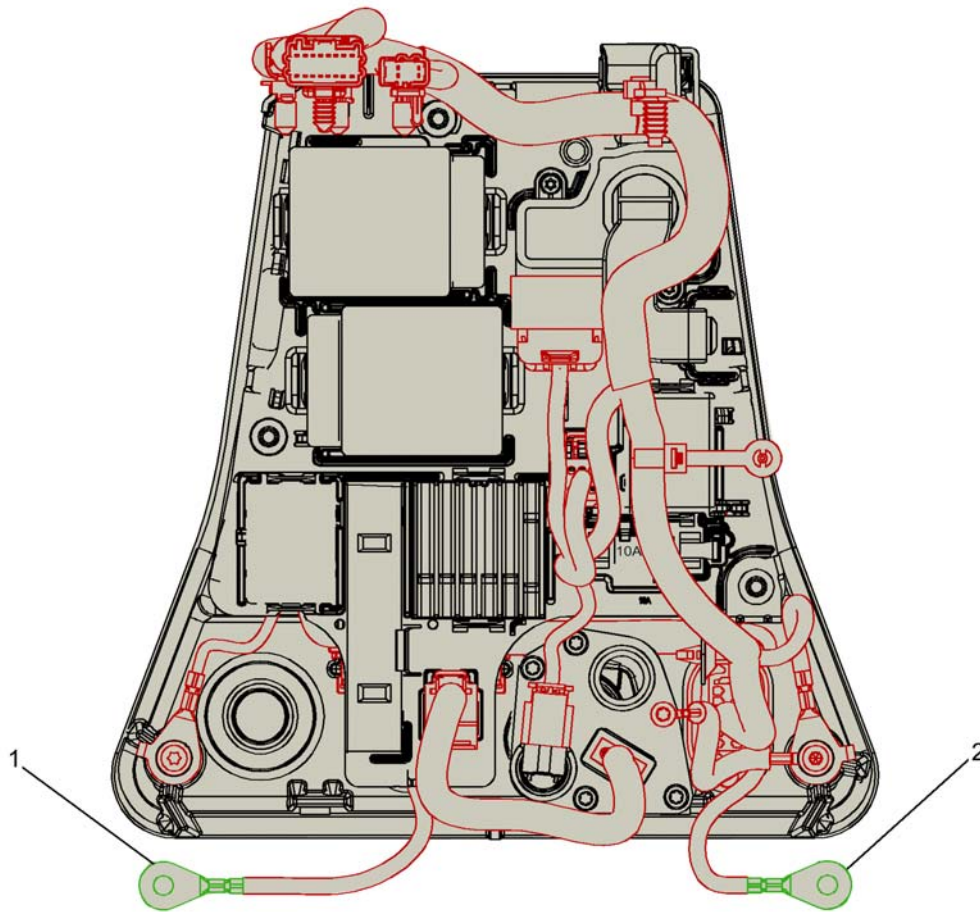


Fig. 15: G340 and G341

Courtesy of GENERAL MOTORS COMPANY

Items	
1.	G340
2.	G341

G403

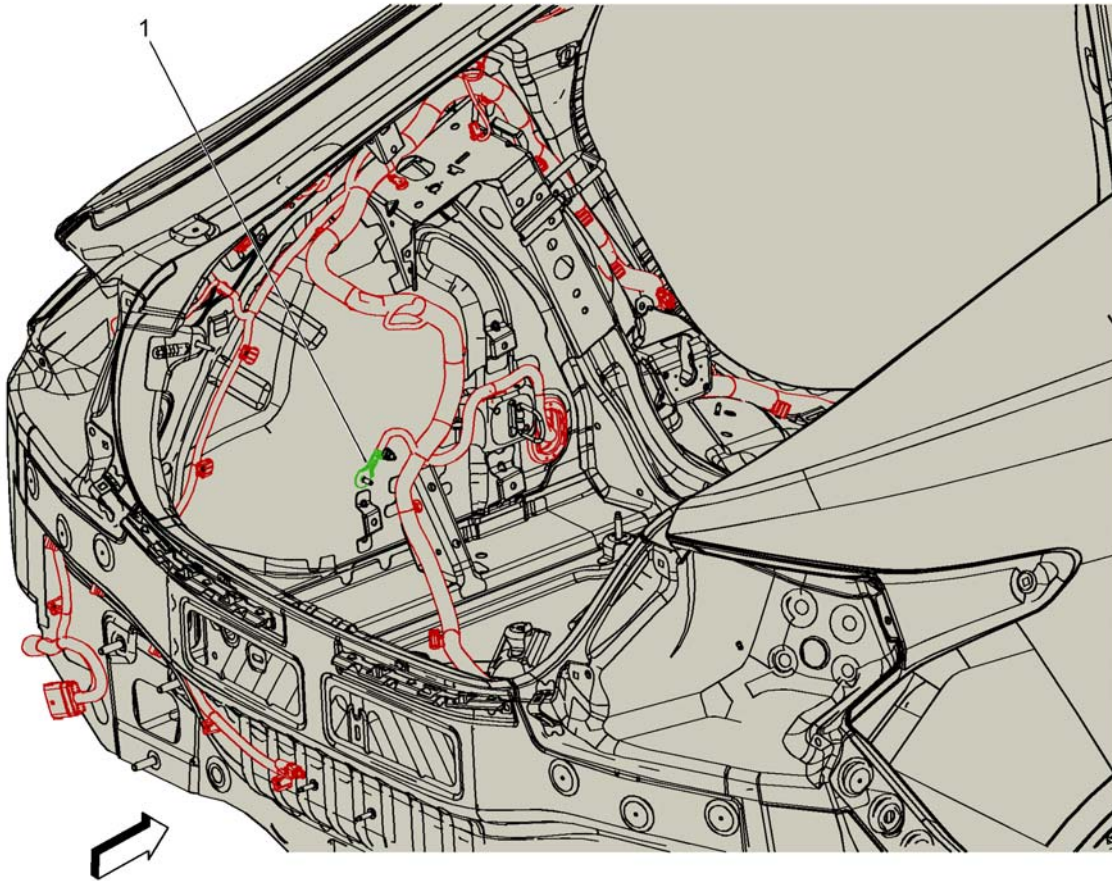


Fig. 16: G403

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G403	

G405

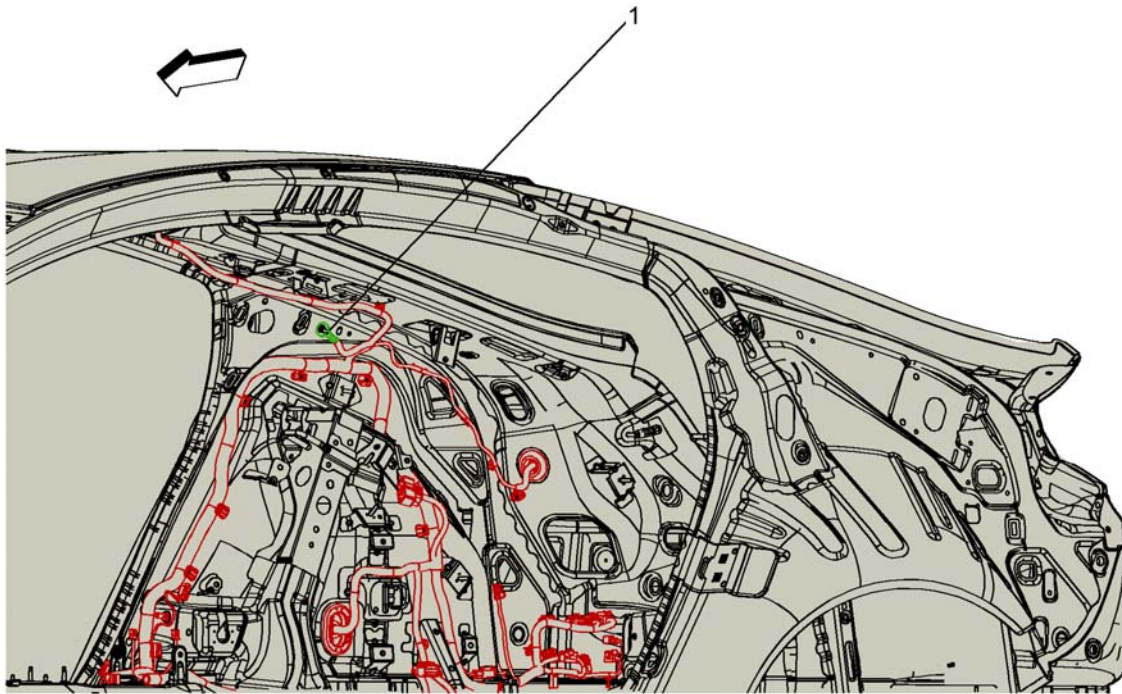


Fig. 17: G405

Courtesy of GENERAL MOTORS COMPANY

Items	
1. G405	

G406

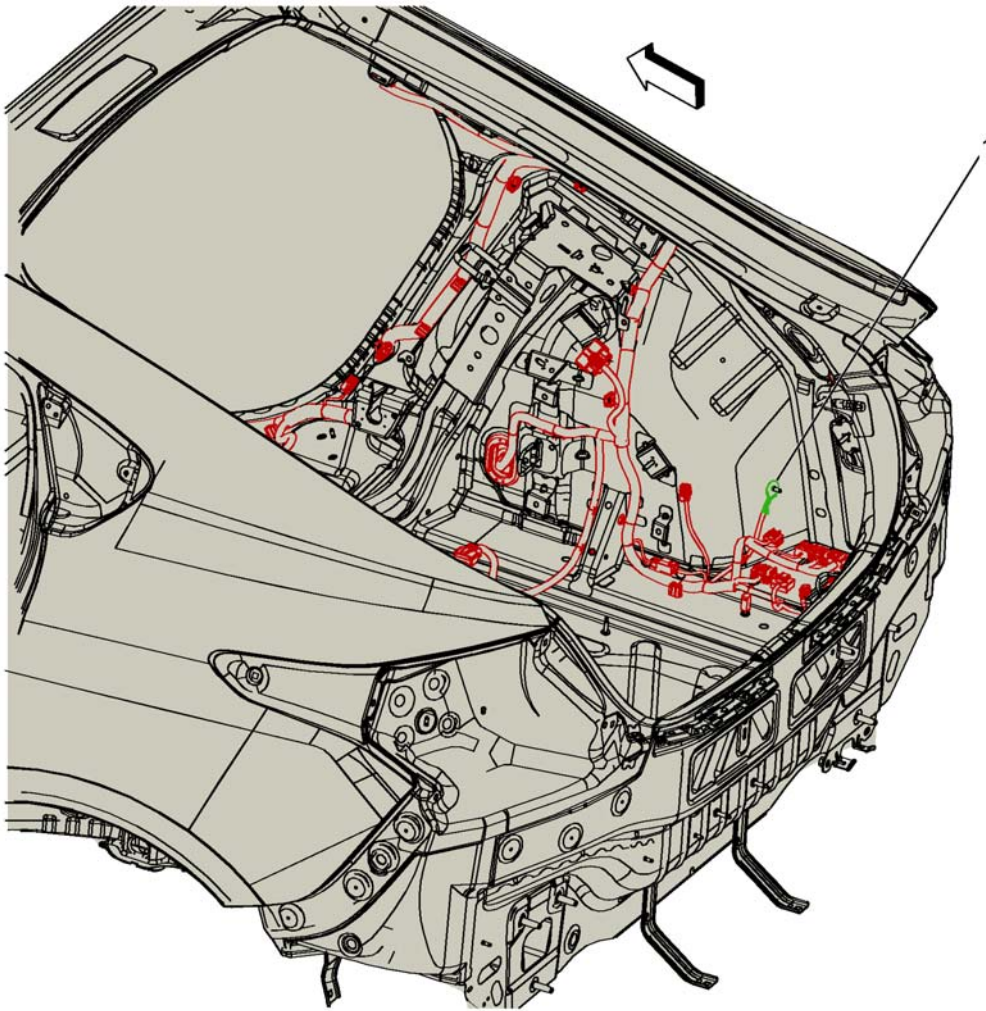


Fig. 18: G406

Courtesy of GENERAL MOTORS COMPANY

Items	
1.	G406

G408 AND G409

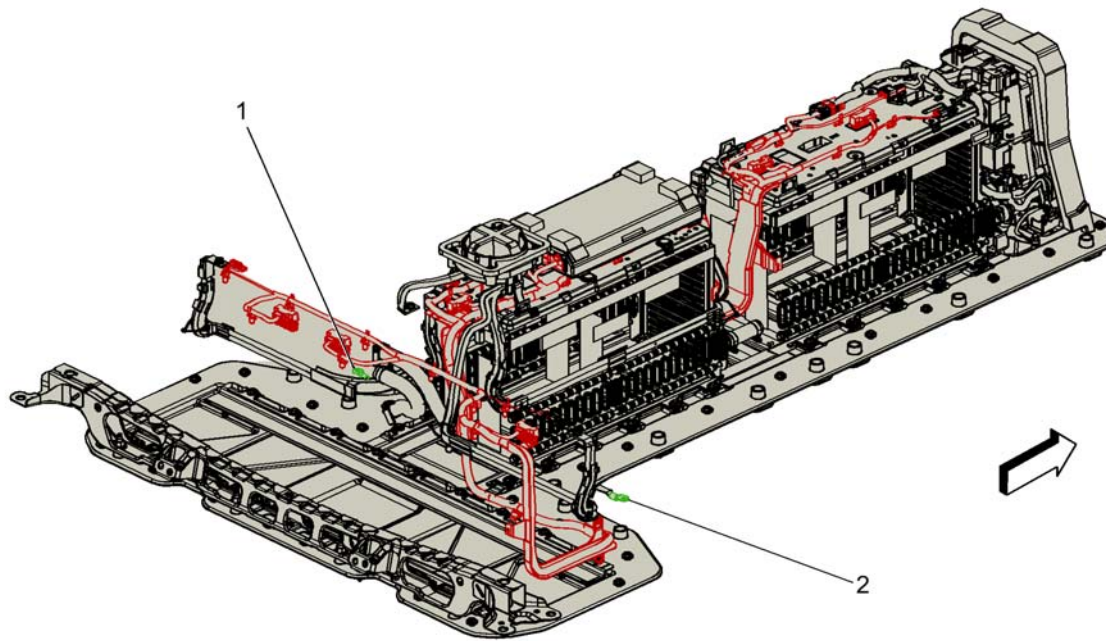


Fig. 19: G408 and G409

Courtesy of GENERAL MOTORS COMPANY

Items
1. G408
2. G409

Article GUID: A00884716

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Instrument Panel/Center Console Component Views - Volt

INSTRUMENT PANEL/CENTER CONSOLE COMPONENT VIEWS

INSTRUMENT PANEL COMPONENTS (1 OF 4)

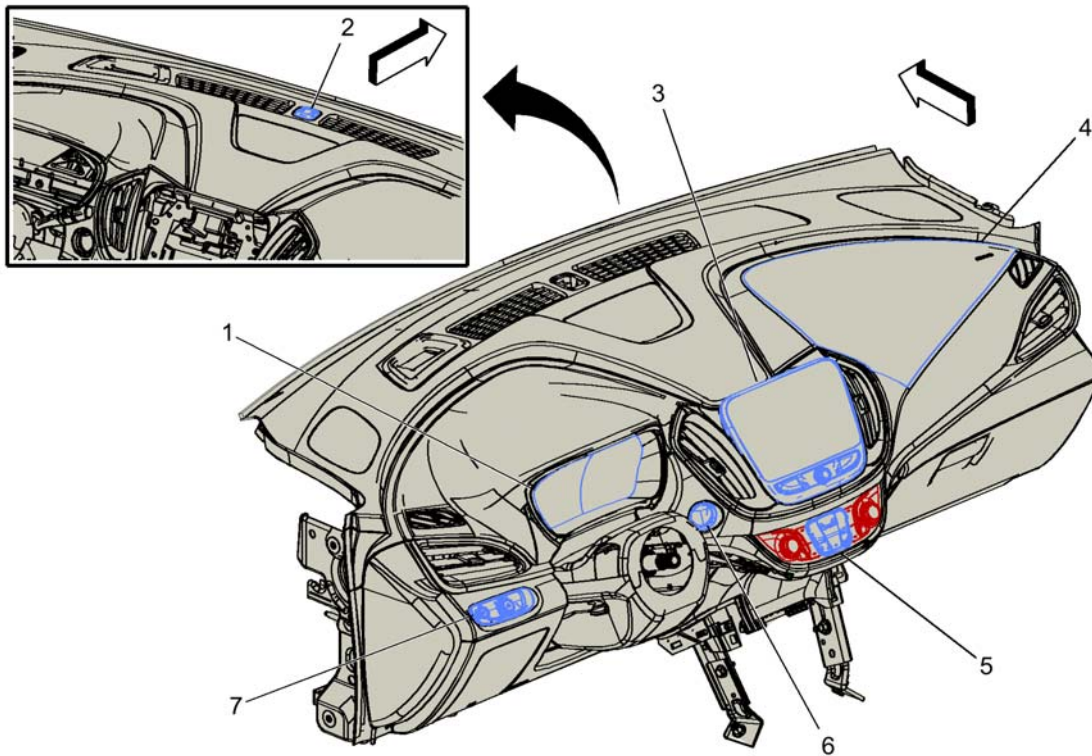


Fig. 1: Instrument Panel Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. P16 Instrument Cluster P16 Instrument Cluster
2. B305 B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator
3. P17 Info Display Module P17 Info Display Module X1
4. F101 Passenger Instrument Panel Air Bag F101 Passenger Instrument Panel Air Bag X1 F101 Passenger Instrument Panel Air Bag X2
5. A26 HVAC Controls A26 HVAC Controls
6. S83 Vehicle On/Off Switch S83 Vehicle On/Off Switch
7. S30 Headlamp Switch S30 Headlamp Switch

INSTRUMENT PANEL COMPONENTS (2 OF 4)

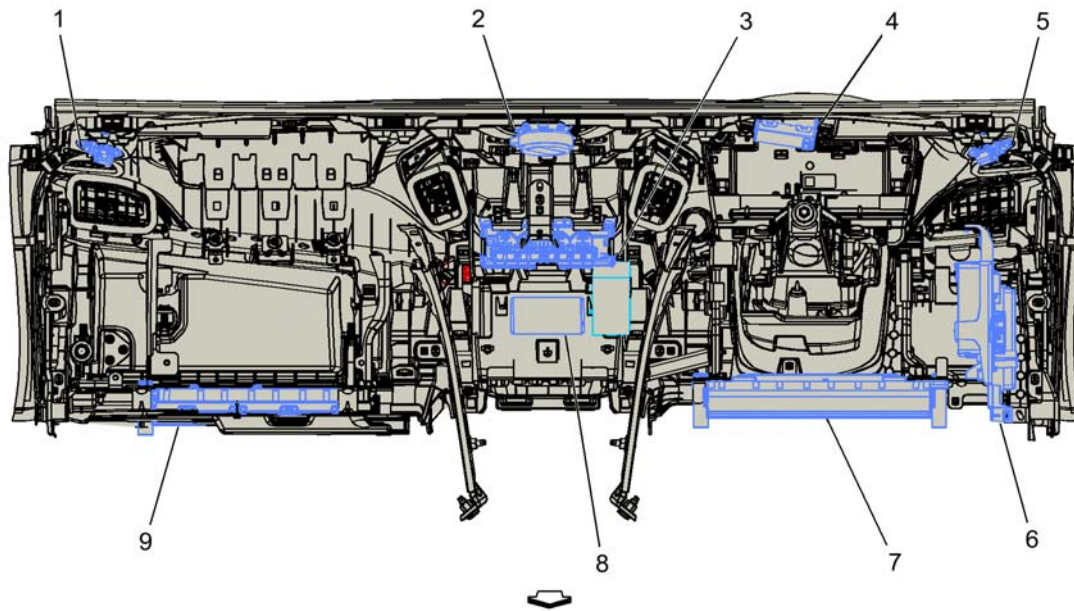


Fig. 2: Instrument Panel Components (2 of 4)
 Courtesy of GENERAL MOTORS COMPANY

Items
1. P19V Speaker - Right Front Tweeter <u>P19V Speaker - Right Front Tweeter</u>
2. P19B Speaker - Center Instrument Panel <u>P19B Speaker - Center Instrument Panel (UQA)</u>
3. K33 HVAC Control Module <u>K33 HVAC Control Module X1</u> <u>K33 HVAC Control Module X2</u> <u>K33 HVAC Control Module X3</u>
4. P43 Collision Alert Indicators <u>P43 Collision Alert Indicators</u>
5. P19H Speaker - Left Front Tweeter <u>P19H Speaker - Left Front Tweeter</u>
6. K73 Telematics Communication Interface Control Module (UE1) <u>K73 Telematics Communication Interface Control Module X1</u> <u>K73 Telematics Communication Interface Control Module X2</u>
7. F114D Knee Air Bag - Driver <u>F114D Knee Air Bag - Driver</u>
8. K74 Human Machine Interface Control Module <u>K74 Human Machine Interface Control Module X1</u> <u>K74 Human Machine Interface Control Module X2</u> <u>K74 Human Machine Interface Control Module X3</u> <u>K74 Human Machine Interface Control Module X5</u> <u>K74 Human Machine Interface Control Module X7</u>
9. F114P Knee Air Bag - Passenger <u>F114P Knee Air Bag - Passenger</u>

INSTRUMENT PANEL COMPONENTS (3 OF 4)

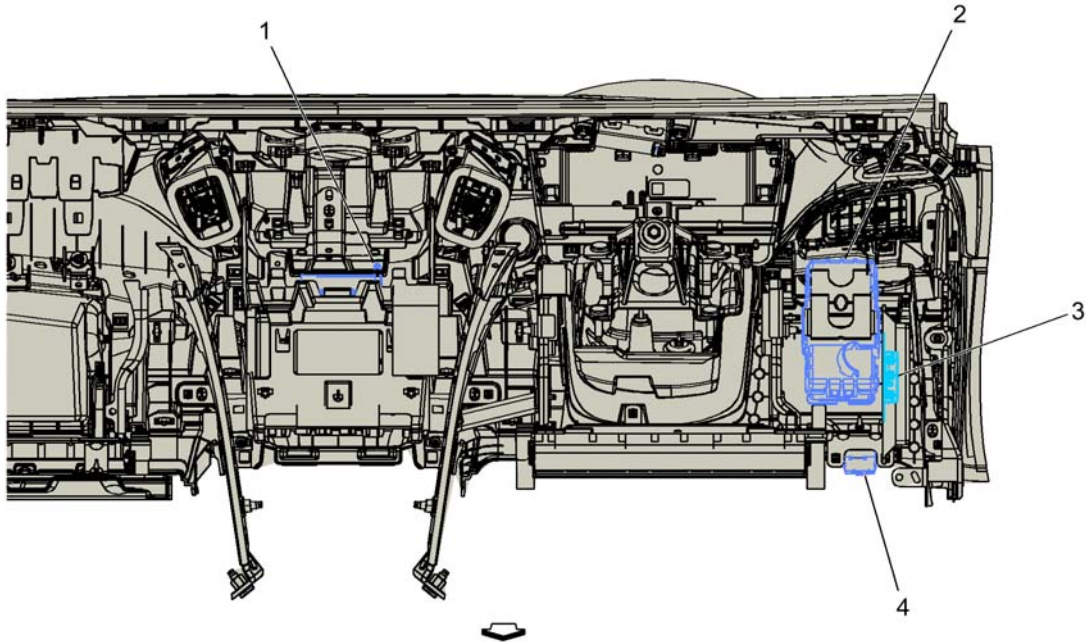


Fig. 3: Instrument Panel Components (3 of 4)
Courtesy of GENERAL MOTORS COMPANY

Items
1. T10B Keyless Entry Antenna - Instrument Panel Compartment <u>T10B Keyless Entry Antenna - Instrument Panel Compartment</u>
2. X51A Fuse Block - Instrument Panel
3. X84 Data Link Connector <u>X84 Data Link Connector</u>
4. T15 Navigation Antenna Signal Splitter <u>T15 Navigation Antenna Signal Splitter X1</u> <u>T15 Navigation Antenna Signal Splitter X2</u> <u>T15 Navigation Antenna Signal Splitter X3</u>

INSTRUMENT PANEL COMPONENTS (4 OF 4)

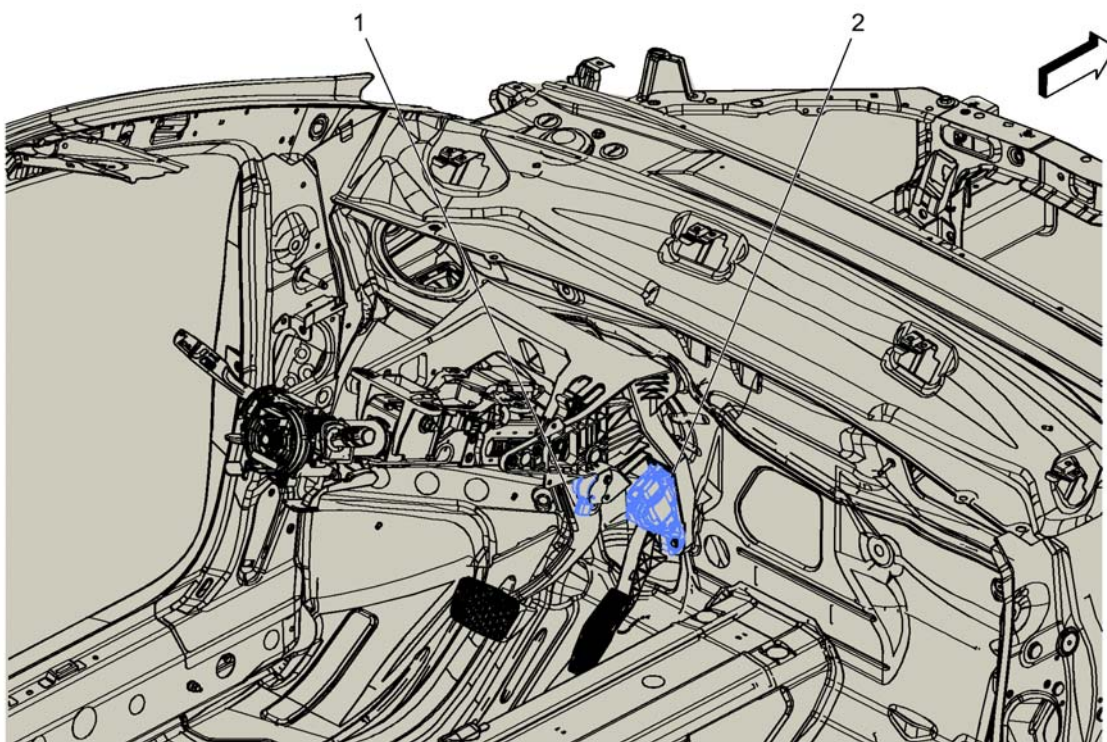


Fig. 4: Instrument Panel Components (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B22 Brake Pedal Position Sensor <u>B22 Brake Pedal Position Sensor</u>
2. B107 Accelerator Pedal Position Sensor <u>B107 Accelerator Pedal Position Sensor</u>

INSTRUMENT PANEL - BOTTOM

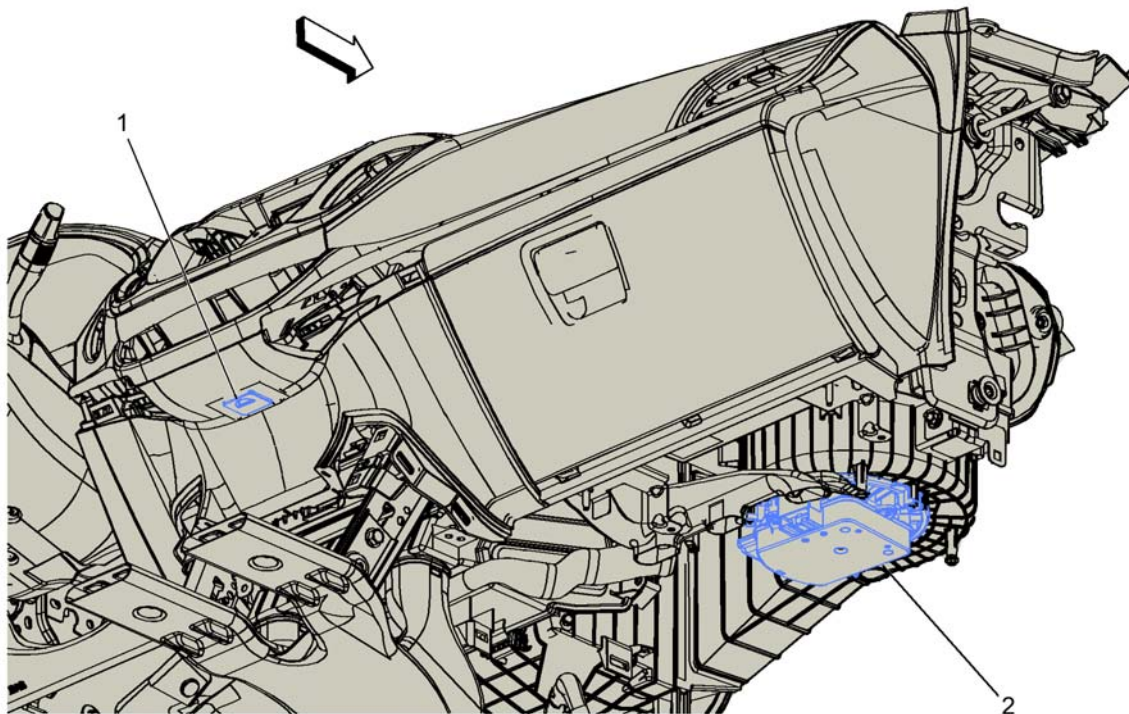


Fig. 5: Instrument Panel - Bottom

Courtesy of GENERAL MOTORS COMPANY

Items
1. E88 <u>E1W Accent Lamp - Instrument Panel</u>
2. M8 Blower Motor <u>M8 Blower Motor</u>

CENTER CONSOLE COMPONENTS (1 OF 3)

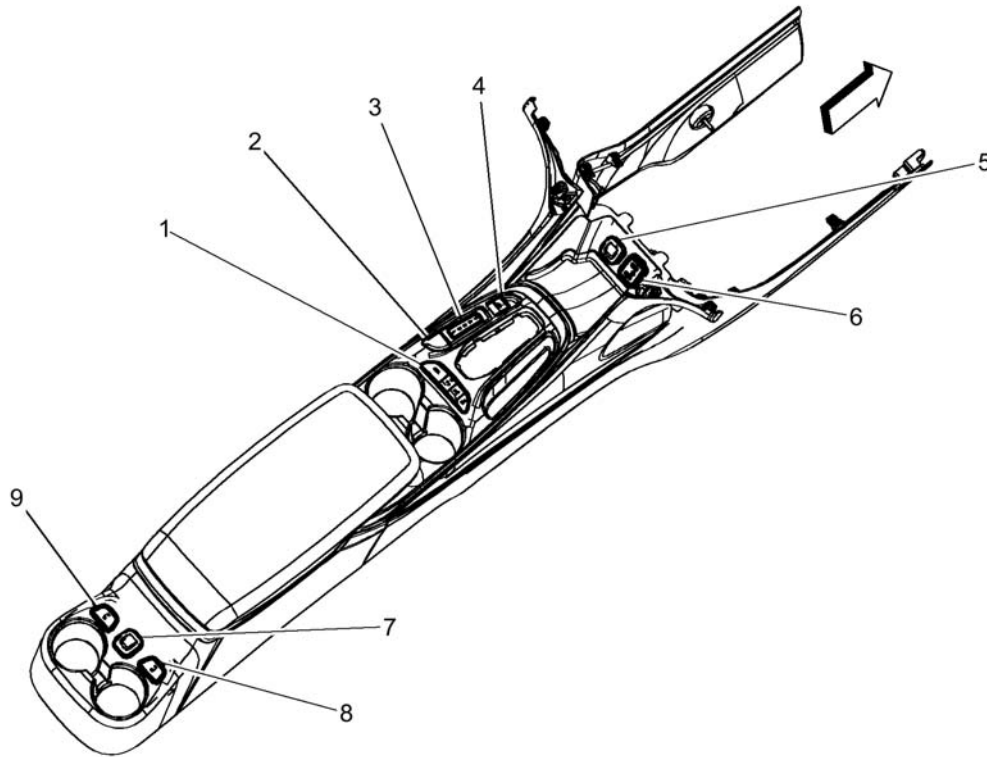


Fig. 6: Center Console Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S48E Multifunction Switch - Center Console <u>S48E Multifunction Switch - Center Console</u>
2. S26 Hazard Warning Switch <u>S26 Hazard Warning Switch</u>
3. P2 Transmission Shift Lever Position Indicator <u>P2 Transmission Shift Lever Position Indicator</u>
4. S91 Park Brake Control Switch <u>S91 Park Brake Control Switch</u>
5. X80H Accessory Power Receptacle - Center Console <u>X80H Accessory Power Receptacle - Center Console</u>
6. X83 Auxiliary Audio Input <u>X83 Auxiliary Audio Input X1</u> <u>X83 Auxiliary Audio Input X2</u>
7. X80L Accessory Power Receptacle - Center Console Rear <u>X80L Accessory Power Receptacle - Center Console Rear</u>
8. S32RR Seat Heating Switch - Right Rear (KA6) <u>S32RR Seat Heating Switch - Right Rear</u>
9. S32LR Seat Heating Switch - Left Rear (KA6) <u>S32LR Seat Heating Switch - Left Rear</u>

CENTER CONSOLE COMPONENTS (2 OF 3)

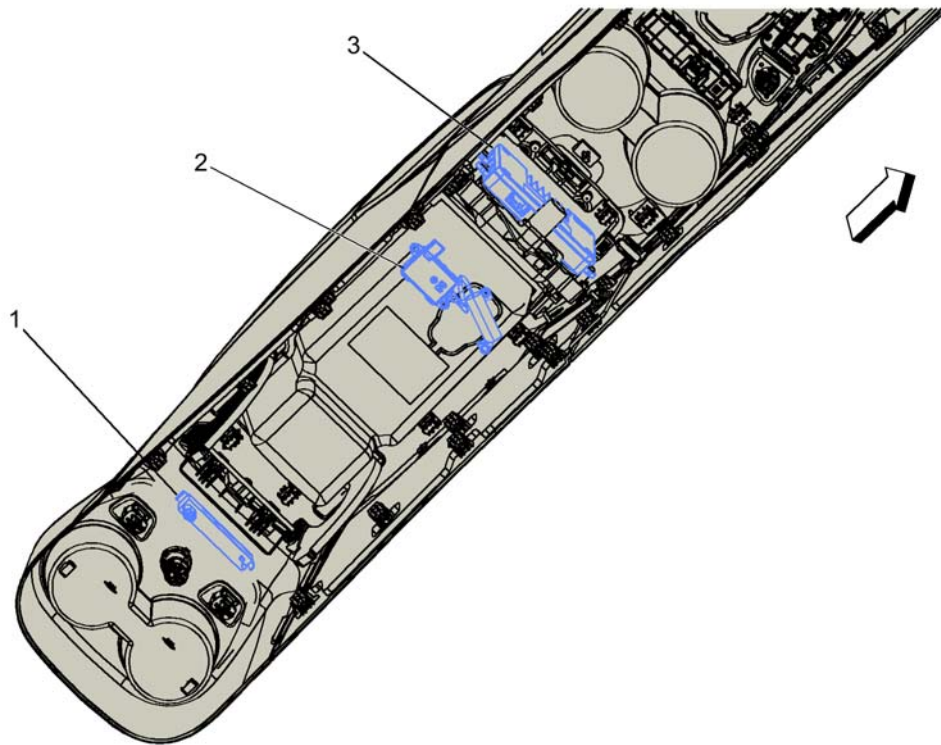


Fig. 7: Center Console Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. T10K Keyless Entry Antenna - Center Console Rear T10K Keyless Entry Antenna - Center Console Rear
2. K89 Immobilizer Control Module K89 Immobilizer Control Module
3. T22 Mobile Device Wireless Charger Module T22 Mobile Device Wireless Charger Module

CENTER CONSOLE COMPONENTS (3 OF 3)

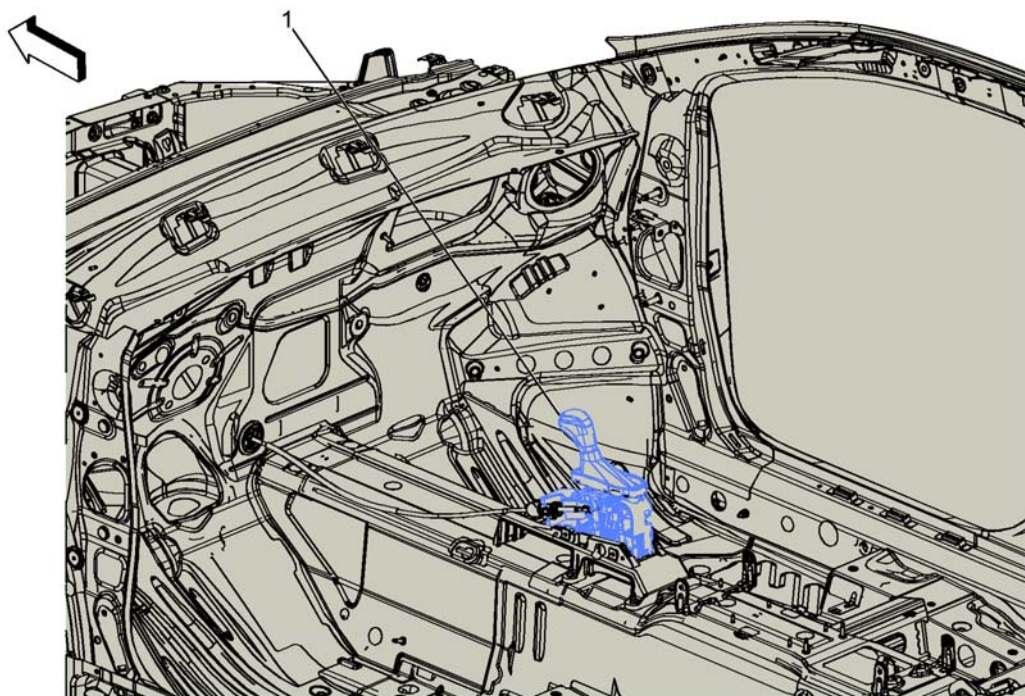


Fig. 8: Center Console Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S3 Transmission Shift Lever <u>S3 Transmission Shift Lever</u>

STEERING WHEEL COMPONENTS

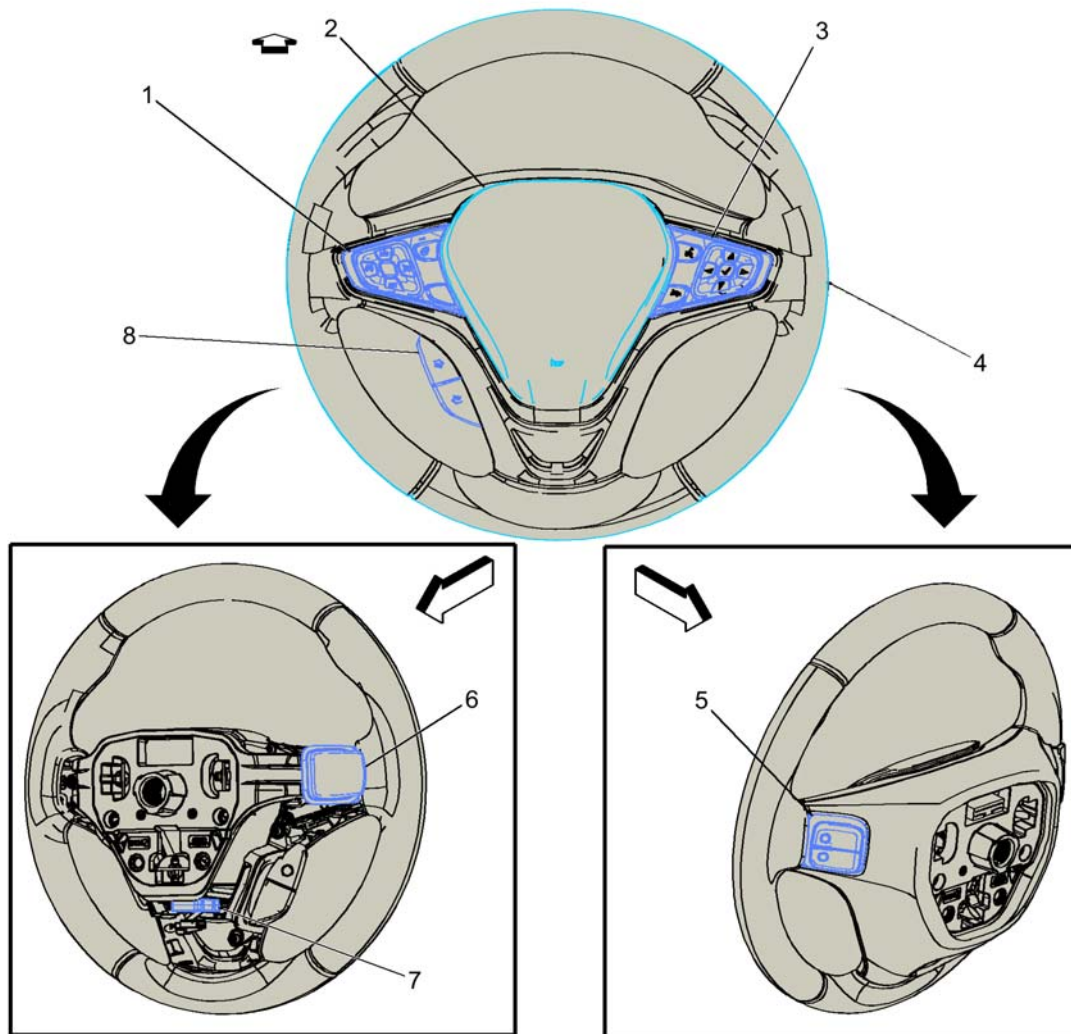


Fig. 9: Steering Wheel Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S70L Steering Wheel Controls Switch - Left S70L Steering Wheel Controls Switch - Left
2. F107 Steering Wheel Air Bag F107 Steering Wheel Air Bag X1 F107 Steering Wheel Air Bag X2
3. S70R Steering Wheel Controls Switch - Right S70R Steering Wheel Controls Switch - Right
4. E15 Steering Wheel Heater (UVD)
5. S70F Steering Wheel Controls Switch - Radio Volume S70F Steering Wheel Controls Switch - Radio Volume
6. S2L Transmission Manual Shift Switch - Left S151 Regenerative Braking On-Demand Switch
7. K32 Steering Wheel Heating Control Module K32 Steering Wheel Heating Control Module X1 K32 Steering Wheel Heating Control Module X2 (UVD)
8. S70E Steering Wheel Controls Switch - Radio Presets S70E Steering Wheel Controls Switch - Radio Presets

STEERING COLUMN COMPONENTS

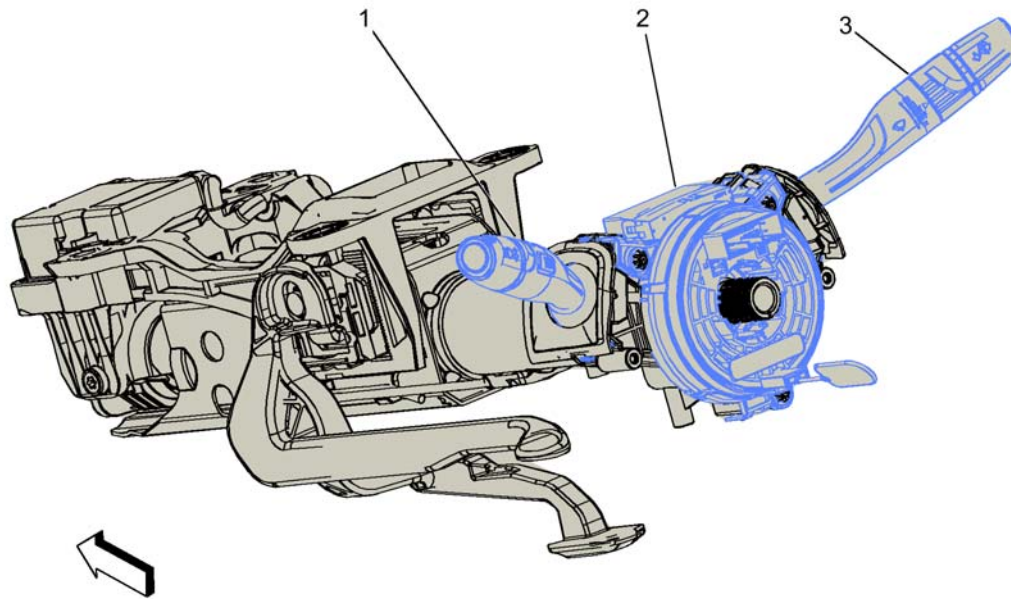


Fig. 10: Steering Column Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. S78 Turn Signal/Multifunction Switch <u>S78 Turn Signal/Multifunction Switch</u>
2. X85 Steering Wheel Air Bag Coil <u>X85 Steering Wheel Air Bag Coil X1</u>
3. S82 Windshield Wiper/Washer Switch <u>S82 Windshield Wiper/Washer Switch</u>

Article GUID: A00884683

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Luggage Compartment/Rear of Vehicle Component Views - Volt

LUGGAGE COMPARTMENT/REAR OF VEHICLE COMPONENT VIEWS

LUGGAGE COMPARTMENT COMPONENTS (1 OF 2)

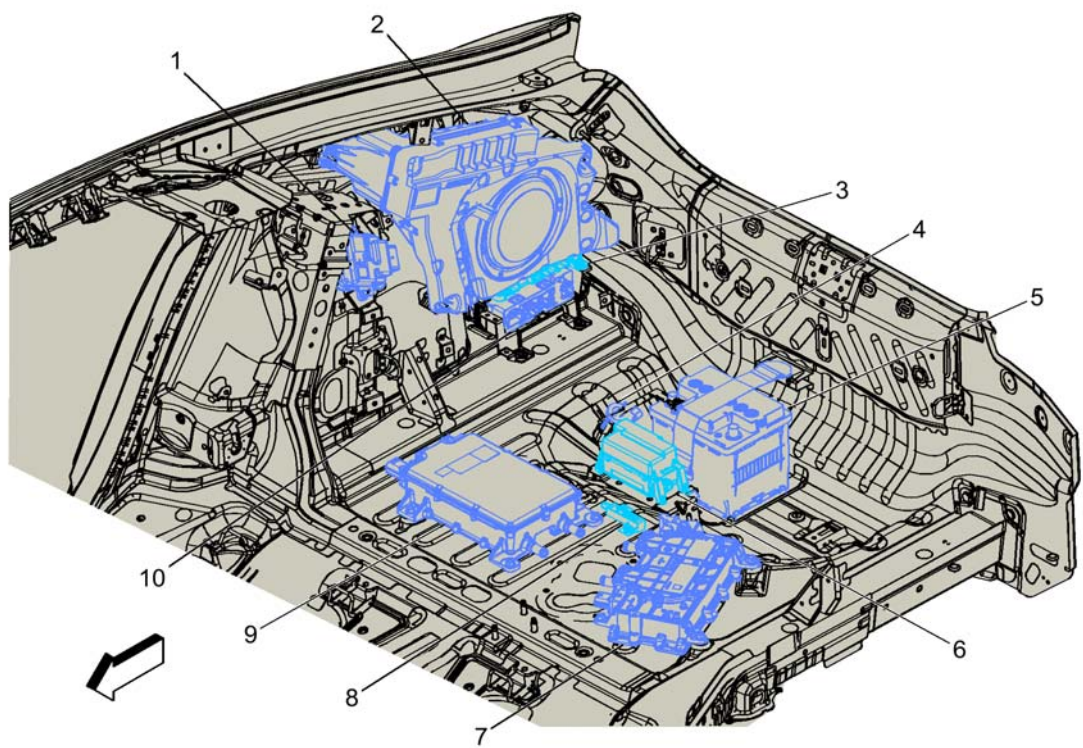


Fig. 1: Luggage Compartment Components (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Items
1. K111 Fuel Pump Driver Control Module K111 Fuel Pump Driver Control Module
2. P19AC Speaker - Subwoofer P19AC Speaker - Subwoofer (UQA)
3. T3 Audio Amplifier (UQA) T3 Audio Amplifier X1 T3 Audio Amplifier X2 T3 Audio Amplifier X3 T3 Audio Amplifier X4
4. B18 Battery Current Sensor B18 Battery Current Sensor
5. C1 Battery C1 Battery
6. X53A Fuse Block - Rear Body X53A Fuse Block - Rear Body Wire Entry
7. K1 14V Power Module K1 14V Power Module X1 K1 14V Power Module X2 K1 14V Power Module X3 K1 14V Power Module X4
8. T10E Keyless Entry Antenna - Rear Compartment T10E Keyless Entry Antenna - Rear Compartment
9. T18 Battery Charger T18 Battery Charger X1

Items
10. A11 Radio A11 Radio X1 A11 Radio X2 A11 Radio X3 A11 Radio X4 A11 Radio X6

LUGGAGE COMPARTMENT COMPONENTS (2 OF 2)

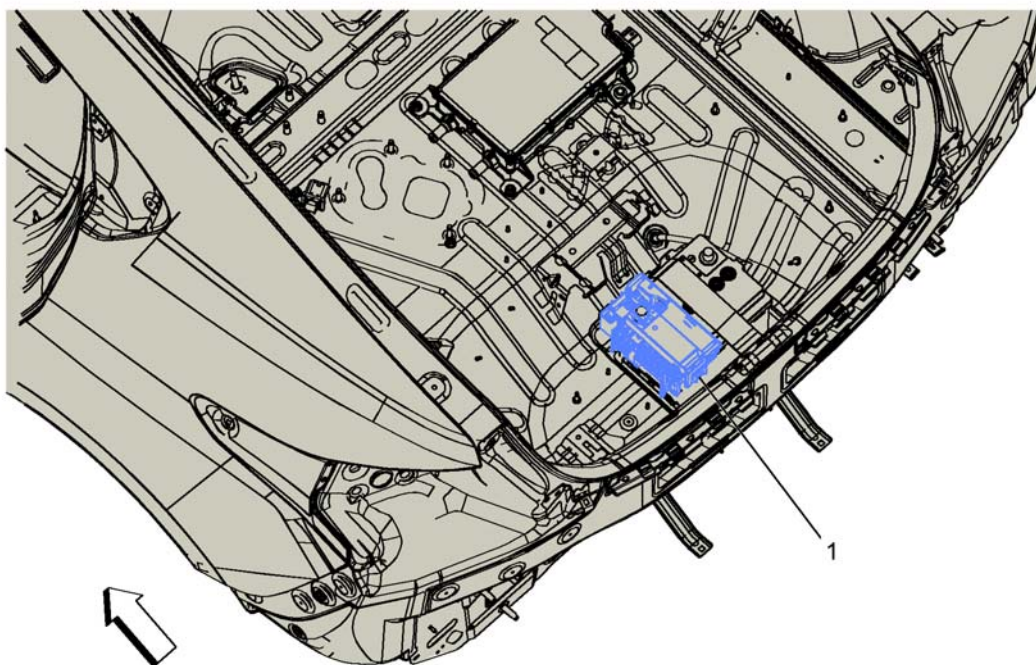


Fig. 2: Luggage Compartment Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. X50D Fuse Block - Battery X50D Fuse Block - Battery X1 X50D Fuse Block - Battery X2 X50D Fuse Block - Battery X3 X50D Fuse Block - Battery X5 X50D Fuse Block - Battery X6 X50D Fuse Block - Battery X8

LIFTGATE COMPONENTS (1 OF 2)

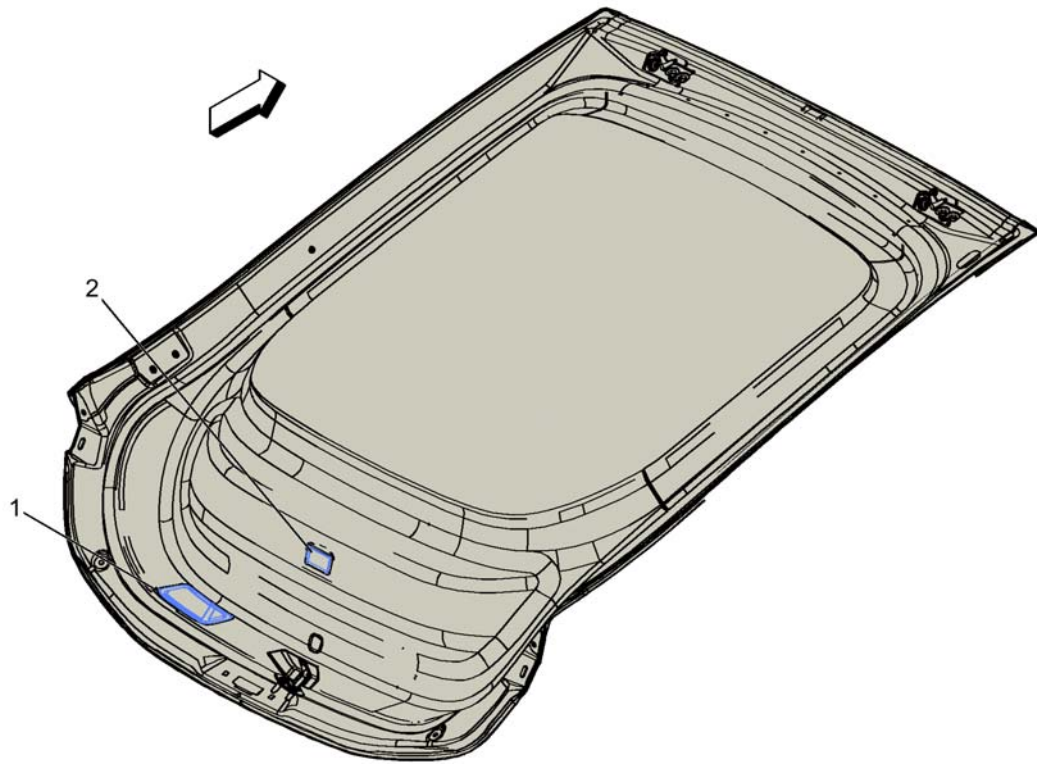


Fig. 3: Liftgate Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. S46 Liftgate Handle Switch S46 Liftgate Handle Switch
2. E33 Cargo Lamp E33 Cargo Lamp

LIFTGATE COMPONENTS (2 OF 2)

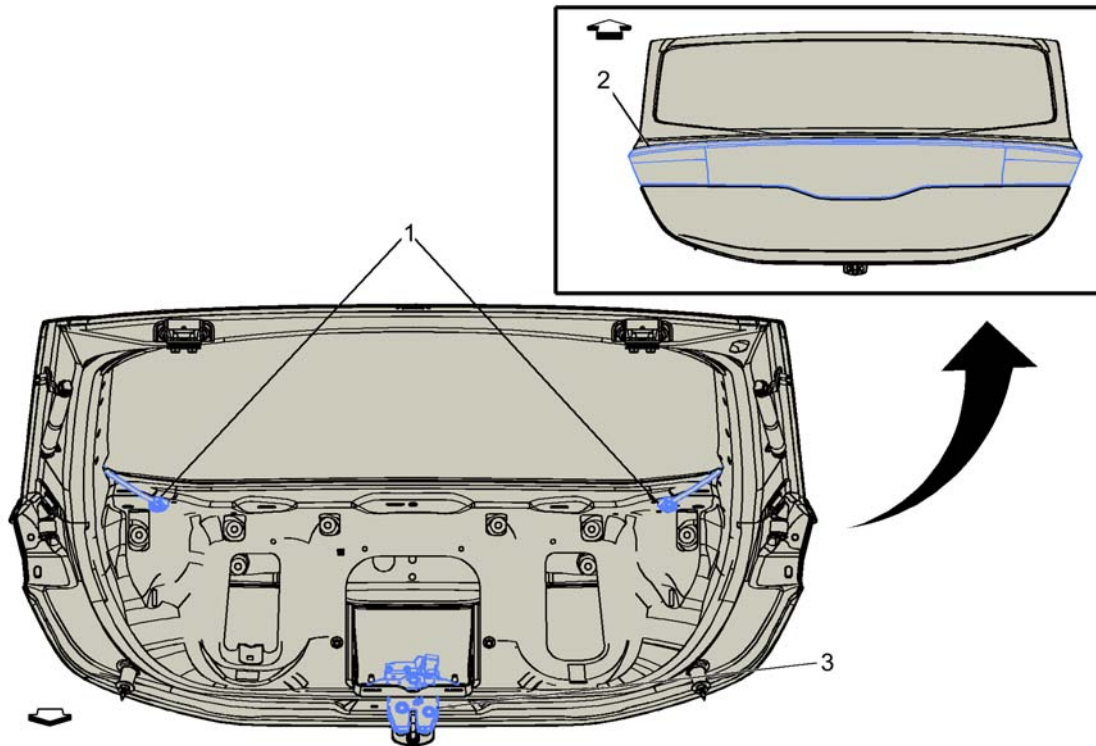


Fig. 4: Liftgate Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E18 Rear Defogger Grid E18 Rear Defogger Grid X1 E18 Rear Defogger Grid X2
2. E6 Center High Mounted Stop Lamp E6 Center High Mounted Stop Lamp
3. A23C Liftgate Latch Assembly A23C Liftgate Latch Assembly

REAR OF VEHICLE COMPONENTS (1 OF 3)

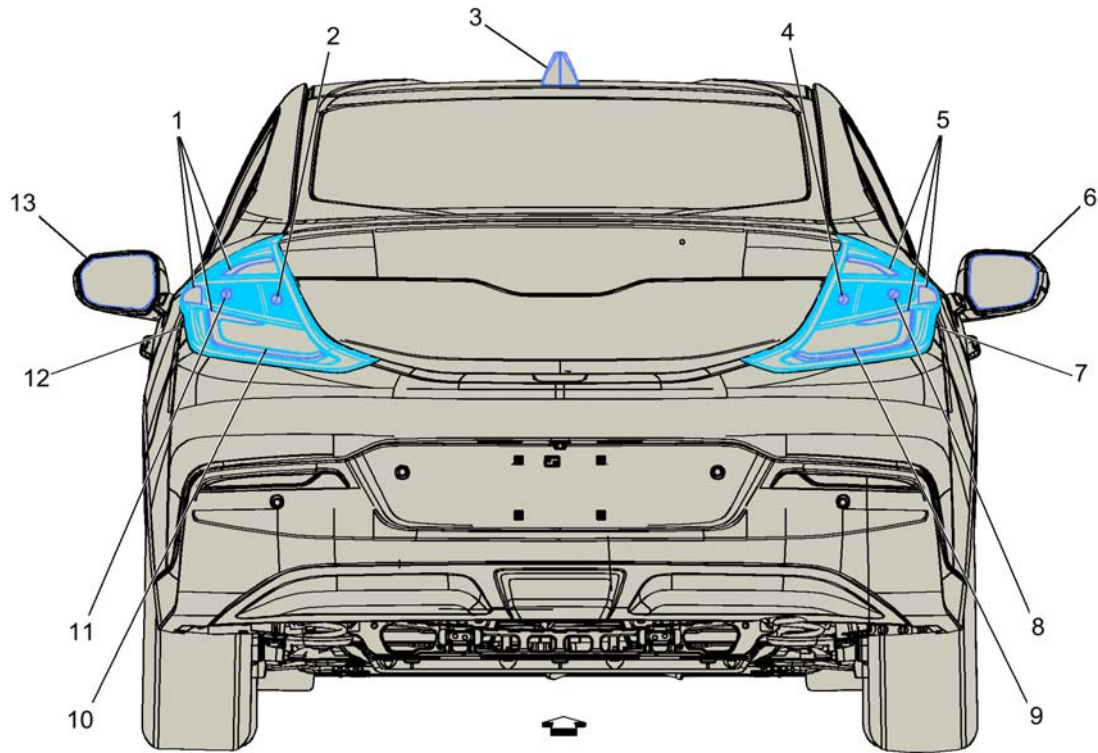


Fig. 5: Rear of Vehicle Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E5E Tail Lamp - Left
2. E5A Backup Lamp - Left <u>E5A Backup Lamp - Left</u>
3. T2RR Antenna - Roof Rear <u>T2RR Antenna - Roof Rear X1</u> <u>T2RR Antenna - Roof Rear X2</u>
4. E5B Backup Lamp - Right <u>E5B Backup Lamp - Right</u>
5. E5F Tail Lamp - Right
6. E17P Outside Rearview Mirror Glass - Passenger <u>E17P Outside Rearview Mirror Glass - Passenger X1</u> <u>E17P Outside Rearview Mirror Glass - Passenger X2</u>
7. E42R Tail Lamp Assembly - Right <u>E42R Tail Lamp Assembly - Right</u>
8. E4RR Turn Signal Lamp - Right Rear <u>E4RR Turn Signal Lamp - Right Rear</u>
9. E5R Stop Lamp - Right <u>E5R Stop Lamp - Right</u>
10. E5L Stop Lamp - Left <u>E5L Stop Lamp - Left</u>
11. E4LR Turn Signal Lamp - Left Rear <u>E4LR Turn Signal Lamp - Left Rear</u>
12. E42L Tail Lamp Assembly - Left <u>E42L Tail Lamp Assembly - Left</u>
13. E17D Outside Rearview Mirror Glass - Driver <u>E17D Outside Rearview Mirror Glass - Driver X1</u> <u>E17D Outside Rearview Mirror Glass - Driver X2</u>

REAR OF VEHICLE COMPONENTS (2 OF 3)

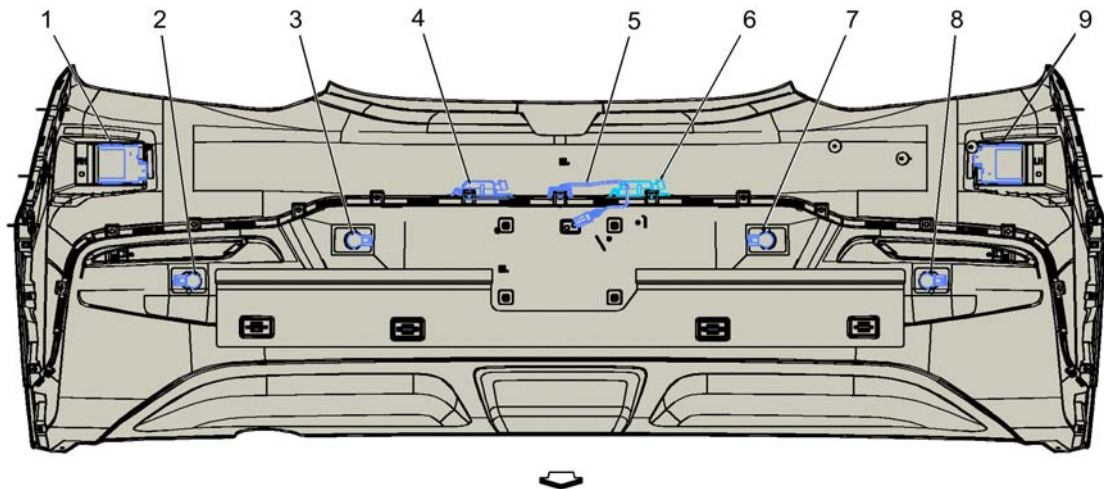


Fig. 6: Rear of Vehicle Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B218R Side Object Sensor Module - Right (UFG) <u>B218R Side Object Sensor Module - Right</u>
2. B306H Parking Assist Sensor - Rear Right Outer (UD7) <u>B306H Parking Assist Sensor - Rear Right Outer</u>
3. B306G Parking Assist Sensor - Rear Right Middle (UD7) <u>B306G Parking Assist Sensor - Rear Right Middle</u>
4. E7R License Plate Lamp - Right <u>E7R License Plate Lamp - Right</u>
5. B87 Rearview Camera (UVC) <u>B87 Rearview Camera</u>
6. E7L License Plate Lamp - Left <u>E7L License Plate Lamp - Left</u>
7. B306F Parking Assist Sensor - Rear Left Middle (UD7) <u>B306F Parking Assist Sensor - Rear Left Middle</u>
8. B306E Parking Assist Sensor - Rear Left Outer (UD7) <u>B306E Parking Assist Sensor - Rear Left Outer</u>
9. B218L Side Object Sensor Module - Left (UFG) <u>B218L Side Object Sensor Module - Left</u>

REAR OF VEHICLE COMPONENTS (3 OF 3)

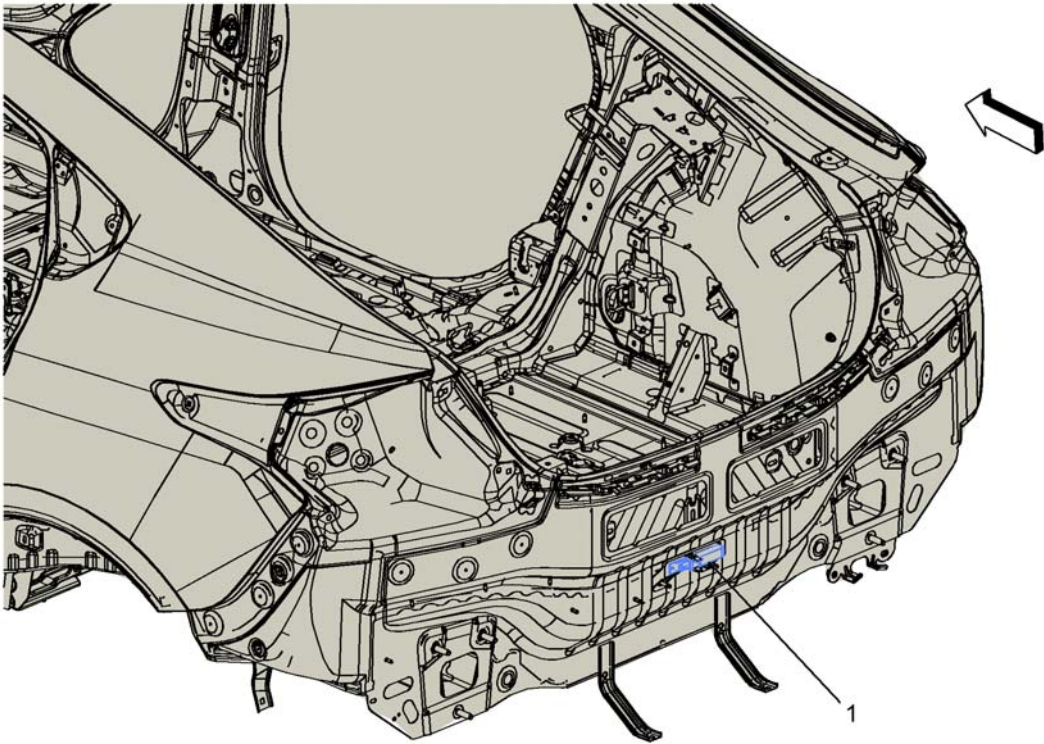


Fig. 7: Rear of Vehicle Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. T10G Keyless Entry Antenna - Rear Fascia <u>T10G Keyless Entry Antenna - Rear Fascia</u>

Article GUID: A00884714

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Master Electrical Component List - Volt

MASTER ELECTRICAL COMPONENT LIST

Code	Name	Option	Location	Locator View	Connector End View
A4	Hybrid/EV Battery Pack	-	Under the center of the vehicle	-	-
A7	Fuel Pump and Level Sensor Assembly	-	Under the vehicle, in the fuel tank	-	<u>A7 Fuel Pump and Level Sensor Assembly</u>
A9A	Outside Rearview Mirror - Driver	-	Outside the vehicle, at the front of the driver door	<u>Front of Vehicle Components (1 of 2)</u>	-
A9B	Outside Rearview Mirror - Passenger	-	Outside the vehicle, at the front of the passenger door	<u>Front of Vehicle Components (1 of 2)</u>	-
A10	Inside Rearview Mirror	-	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>A10 Inside Rearview Mirror</u>
A11	Radio	-	In the right side of luggage compartment, behind the trim panel, below the subwoofer	<u>Luggage Compartment Components (1 of 2)</u>	• <u>A11 Radio X1</u> • <u>A11 Radio X2</u> • <u>A11 Radio X3</u> • <u>A11 Radio X4</u> • <u>A11 Radio X6</u>
A22	Radio Controls	-	Internal to the info display module	-	-
A23C	Liftgate Latch Assembly	-	At the rear center of the vehicle, in the liftgate	<u>Liftgate Components (2 of 2)</u>	<u>A23C Liftgate Latch Assembly</u>
A23D	Door Latch Assembly - Driver	-	In the passenger compartment, in the rear middle of the driver door	<u>Driver Door Components</u>	<u>A23D Door Latch Assembly - Driver</u>
A23LR	Door Latch Assembly - Left Rear	-	In the passenger compartment, in	<u>Left Rear Door Components</u>	<u>A23LR Door Latch Assembly - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			the rear middle of the left rear door		
A23P	Door Latch Assembly - Passenger	-	In the passenger compartment, in the rear middle of the passenger door	<u>Passenger Door Components</u>	<u>A23P Door Latch Assembly - Passenger</u>
A23RR	Door Latch Assembly - Right Rear	-	In the passenger compartment, in the rear middle of the right rear door	<u>Right Rear Door Components</u>	<u>A23RR Door Latch Assembly - Right Rear</u>
A24D	Door Handle Assembly - Driver Exterior	-	In the passenger compartment, in the driver door handle	<u>Driver Door Components</u>	<u>A24D Door Handle Assembly - Driver Exterior</u>
A24LR	Door Handle Assembly - Left Rear Exterior	-	In the passenger compartment, in the left rear door handle	<u>Left Rear Door Components</u>	<u>A24LR Door Handle Assembly - Left Rear Exterior</u>
A24P	Door Handle Assembly - Passenger Exterior	-	In the passenger compartment, in the passenger door handle	<u>Passenger Door Components</u>	<u>A24P Door Handle Assembly - Passenger Exterior</u>
A24RR	Door Handle Assembly - Right Rear Exterior	-	In the passenger compartment, in the right rear door handle	<u>Right Rear Door Components</u>	<u>A24RR Door Handle Assembly - Right Rear Exterior</u>
A26	HVAC Controls	-	In the passenger compartment, at the center of the instrument panel, below the info display module	<u>Instrument Panel Components (1 of 4)</u>	<u>A26 HVAC Controls</u>
A28	Hybrid/EV Battery Contactor Assembly	-	Under the vehicle, part of the hybrid/EV battery assembly	<u>Engine Compartment Components</u>	• <u>A28 Hybrid/EV Battery Contactor Assembly X1</u> • <u>A28 Hybrid/EV Battery Contactor Assembly X2</u> • <u>A28 Hybrid/EV</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>Battery</u> <u>Contactor</u> <u>Assembly X3</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X4</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X5</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X6</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X7</u> • <u>A28 Hybrid/EV</u> <u>Battery</u> <u>Contactor</u> <u>Assembly X8</u>
B1	A/C Refrigerant Pressure Sensor	-	In the engine compartment, at the right rear top of engine, in the high pressure A/C line	<u>Right Rear of Engine Components</u>	<u>B1 A/C Refrigerant Pressure Sensor</u>
B1C	A/C Low Side Pressure Sensor	-	In the engine compartment, at the rear center of the engine, in the low pressure A/C line	<u>Right Rear of Engine Components</u>	<u>B1C A/C Low Side Pressure Sensor</u>
B5LF	Wheel Speed Sensor - Left Front	-	Under the vehicle, mounted to the left front steering knuckle, near the wheel bearing	<u>Underbody - Wheel Components (3 of 4)</u>	<u>B5LF Wheel Speed Sensor - Left Front</u>

Code	Name	Option	Location	Locator View	Connector End View
B5LR	Wheel Speed Sensor - Left Rear	-	Under the vehicle, mounted to the left rear suspension, near the wheel bearing	<u>Underbody - Wheel Components (2 of 4)</u>	<u>B5LR Wheel Speed Sensor - Left Rear</u>
B5RF	Wheel Speed Sensor - Right Front	-	Under the vehicle, mounted to the right front steering knuckle, near the wheel bearing	<u>Underbody - Wheel Components (1 of 4)</u>	<u>B5RF Wheel Speed Sensor - Right Front</u>
B5RR	Wheel Speed Sensor - Right Rear	-	Under the vehicle, mounted to the right rear suspension, near the wheel bearing	<u>Underbody - Wheel Components (4 of 4)</u>	<u>B5RR Wheel Speed Sensor - Right Rear</u>
B7D	Air Temperature Sensor - Duct Left Lower	-	In the passenger compartment, front, left of center within the instrument panel, on lower duct	-	<u>B7D Air Temperature Sensor - Duct Left Lower</u>
B7H	Air Temperature Sensor - Duct Left Upper	-	In the passenger compartment, front, left of center within the instrument panel, on upper duct	-	<u>B7H Air Temperature Sensor - Duct Left Upper</u>
B9	Ambient Air Temperature Sensor	-	At the right front corner of the vehicle, behind the right side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B9 Ambient Air Temperature Sensor</u>
B13	Transmission Fluid Temperature Sensor	-	In the engine compartment, internal to the transmission	-	-

Code	Name	Option	Location	Locator View	Connector End View
			control solenoid valve assembly		
B14A	Transmission Output Shaft Speed Sensor	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>B14A Transmission Output Shaft Speed Sensor</u>
B15	Transmission Internal Mode Switch	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>B15 Transmission Internal Mode Switch</u>
B18	Battery Current Sensor	-	In the luggage compartment, under the storage compartment floor, on the negative battery cable	<u>Luggage Compartment Components (1 of 2)</u>	<u>B18 Battery Current Sensor</u>
B20	Brake Fluid Level Switch	-	In the left rear of the engine compartment, at the bottom of the brake fluid reservoir	<u>Engine Compartment Components - Left</u>	<u>B20 Brake Fluid Level Switch</u>
B22	Brake Pedal Position Sensor	-	In the passenger compartment, under the driver side of the instrument panel, connected to the brake pedal	<u>Instrument Panel Components (4 of 4)</u>	<u>B22 Brake Pedal Position Sensor</u>
B23E	Camshaft Position Sensor - Exhaust	-	In the left front of the engine, on the left front of the cylinder head	<u>Left Rear of Engine Components</u>	<u>B23E Camshaft Position Sensor - Exhaust</u>
B23F	Camshaft Position Sensor - Intake	-	In the left rear of the engine, on the left rear of the cylinder head	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>B23F Camshaft Position Sensor - Intake</u>
B24	Cellular Phone Microphone	-	In the passenger compartment, at the front center	<u>Headliner Components (2 of 4)</u>	<u>B24 Mobile Telephone Microphone</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the headliner, in the overhead console		
B26	Crankshaft Position Sensor	-	In the left rear of the engine compartment, in the left rear of the engine block, above the oil pan	<u>Right Rear of Engine Components</u>	<u>B26 Crankshaft Position Sensor</u>
B27D	Door Handle Switch - Driver Exterior	-	In the driver door, part of the driver exterior door handle assembly	-	-
B27LR	Door Handle Switch - Left Rear Exterior	-	In the left rear door, part of the left rear exterior door handle assembly	-	-
B27P	Door Handle Switch - Passenger Exterior	-	In the passenger door, part of the passenger exterior door handle assembly	-	-
B27RR	Door Handle Switch - Right Rear Exterior	-	In the right rear door, part of the right rear exterior door handle assembly	-	-
B30	Hybrid/EV Battery Pack Current Sensor	-	Under the vehicle, in the Hybrid/EV battery pack, on the rear of the A28 Hybrid/EV Battery Contactor Assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	<u>B30 Hybrid/EV Battery Pack Current Sensor</u>
B32A	Hybrid/EV Battery Temperature Sensor 1	-	Under the vehicle, in the Hybrid/EV battery section 3, part of Hybrid/EV battery module	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32A Hybrid/EV Battery Temperature Sensor 1</u>

Code	Name	Option	Location	Locator View	Connector End View
			1		
B32B	Hybrid/EV Battery Temperature Sensor 2	-	Under the vehicle, in the Hybrid/EV battery section 3, part of Hybrid/EV battery module 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32B Hybrid/EV Battery Temperature Sensor 2</u>
B32C	Hybrid/EV Battery Temperature Sensor 3	-	Under the vehicle, in the Hybrid/EV battery section 2, part of Hybrid/EV battery module 4	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32C Hybrid/EV Battery Temperature Sensor 3</u>
B32D	Hybrid/EV Battery Temperature Sensor 4	-	Under the vehicle, in the Hybrid/EV battery section 2, part of Hybrid/EV battery module 5	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32D Hybrid/EV Battery Temperature Sensor 4</u>
B32E	Hybrid/EV Battery Temperature Sensor 5	-	Under the vehicle, in the Hybrid/EV battery section 1, part of Hybrid/EV battery module 6	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32E Hybrid/EV Battery Temperature Sensor 5</u>
B32F	Hybrid/EV Battery Temperature Sensor 6	-	Under the vehicle, in the Hybrid/EV battery section 1, part of Hybrid/EV battery module 7	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>B32F Hybrid/EV Battery Temperature Sensor 6</u>
B34	Engine Coolant Temperature Sensor	-	In the engine compartment, at the left end of the cylinder head, mounted	<u>Left Rear of Engine Components</u>	<u>B34 Engine Coolant Temperature Sensor</u>

Code	Name	Option	Location	Locator View	Connector End View
			in the coolant outlet housing		
B37B	Engine Oil Pressure Sensor	-	In the rear of the engine, below the high pressure fuel pump	<u>Left Rear of Engine Components</u>	<u>B37B Engine Oil Pressure Sensor</u>
B46	Fuel Level Sensor	-	Under the vehicle, in the fuel tank, part of the fuel pump and level sensor assembly	-	-
B47	Fuel Pressure Sensor	-	Under the vehicle, at the right of the fuel tank, in the fuel feed line	<u>Underbody - Fuel System Components (2 of 2)</u>	<u>B47 Fuel Pressure Sensor</u>
B52A	Heated Oxygen Sensor 1	-	In the front of the engine compartment, at the top of the catalytic converter	<u>Right Front of Engine Components (2 of 2)</u>	<u>B52A Heated Oxygen Sensor 1</u>
B52B	Heated Oxygen Sensor 2	-	In the front of the engine compartment, in the exhaust pipe, downstream of the catalytic converter	<u>Right Front of Engine Components (2 of 2)</u>	<u>B52B Heated Oxygen Sensor 2</u>
B55	Hood Ajar Switch	-	At the front center of the vehicle, part of the hood latch	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>B55 Engine Hood Switch</u>
B59L	Front Impact Sensor - Left	-	At the front of the vehicle, mounted to the top left of the radiator core support	<u>Front of Vehicle Components (2 of 2)</u>	<u>B59L Front Impact Sensor - Left</u>
B59R	Front Impact Sensor - Right	-	At the front of the vehicle, mounted to the top right of the	<u>Front of Vehicle Components (2 of 2)</u>	<u>B59R Front Impact Sensor - Right</u>

Code	Name	Option	Location	Locator View	Connector End View
			radiator core support		
B63LF	Side Impact Sensor - Left Front	-	In the passenger compartment, in the center of the left front door	<u>Driver Door Components</u>	<u>B63LF Side Impact Sensor - Left Front</u>
B63LR	Side Impact Sensor - Left Rear	-	In the passenger compartment, in the center of the left rear door	<u>Rear Seat Components (2 of 3)</u>	<u>B63LR Side Impact Sensor - Left Rear</u>
B63RF	Side Impact Sensor - Right Front	-	In the passenger compartment, in the center of the right front door	<u>Passenger Door Components</u>	<u>B63RF Side Impact Sensor - Right Front</u>
B63RR	Side Impact Sensor - Right Rear	-	In the passenger compartment, in the center of the right rear door	<u>Rear Seat Components (3 of 3)</u>	<u>B63RR Side Impact Sensor - Right Rear</u>
B68	Knock Sensor	-	In the engine compartment, at the rear of the engine block, in the center, under the intake manifold	<u>Left Front of Engine Components</u>	<u>B68 Knock Sensor</u>
B74	Manifold Absolute Pressure Sensor	-	In the engine compartment, mounted in the left side of the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>B74 Manifold Absolute Pressure Sensor</u>
B75C	Multifunction Intake Air Sensor	-	At the right rear of the engine, in the intake air snorkel	<u>Right Front of Engine Components (1 of 2)</u>	<u>B75C Multifunction Intake Air Sensor</u>
B81B	Park Position Switch	-	In the passenger compartment, part of the automatic transmission shift lever assembly	-	<u>B81B Park Position Switch</u>
B87	Rearview Camera	UVC	At the rear of the vehicle, between the license plate	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B87 Rearview Camera</u>

Code	Name	Option	Location	Locator View	Connector End View
			lamps, in the center of the fascia		
B88D	Seat Belt Switch - Driver	-	In the passenger compartment, part of the driver seat belt buckle	-	<u>B88D Seat Belt Switch - Driver</u>
B88P	Seat Belt Switch - Passenger	-	In the passenger compartment, part of the passenger seat belt buckle	-	<u>B88P Seat Belt Switch - Passenger</u>
B101	Immobilizer Antenna	-	In the passenger compartment, behind the center of the instrument panel, above the HVAC control module, part of the immobilizer control module	-	-
B107	Accelerator Pedal Position Sensor	-	In the passenger compartment, under the driver side of the instrument panel, part of the accelerator pedal	<u>Instrument Panel Components (4 of 4)</u>	<u>B107 Accelerator Pedal Position Sensor</u>
B118B	Windshield Washer Fluid Level Switch	-	At the left front of the vehicle, behind the left side of the fascia, in the bottom washer solvent bottle	<u>Right Front of Vehicle Components</u>	<u>B118B Windshield Washer Fluid Level Switch</u>
B130A	Exhaust Gas Recirculation Temperature Sensor 1	-	On the right front top of the engine, on the EGR valve	<u>Right Front of Engine Components (2 of 2)</u>	<u>B130A Exhaust Gas Recirculation Temperature Sensor 1</u>
B130B	Exhaust Gas Recirculation Temperature Sensor 2	-	On the engine, behind the left front side of the exhaust	<u>Right Front of Engine Components (2 of 2)</u>	<u>B130B Exhaust Gas Recirculation Temperature Sensor 2</u>

Code	Name	Option	Location	Locator View	Connector End View
			manifold, near cylinder 4		
B150	Fuel Tank Pressure Sensor	-	Under the vehicle, rear of the fuel tank, mounted on the evaporative emission canister	-	<u>B150 Fuel Tank Pressure Sensor</u>
B153D	Seat Belt Buckle - Driver	-	In the passenger compartment, on the inboard side of the driver seat	-	-
B153P	Seat Belt Buckle - Passenger	-	In the passenger compartment, on the inboard side of the passenger seat	-	-
B160	Windshield Temperature and Inside Moisture Sensor	-	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>B160 Windshield Temperature and Inside Moisture Sensor</u>
B197	Charge Port Door Position Switch	-	At the left front of the vehicle, behind the rear of the left front fender	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>B197 Charge Port Door Position Switch</u>
B201	Brake Control Brake Pedal Position Sensor	-	In the engine compartment, below the master cylinder	<u>Engine Compartment Components - Left</u>	<u>B201 Brake Control Brake Pedal Position Sensor</u>
B202	Hybrid/EV Electronics Coolant Temperature Sensor	-	At the right front of the engine compartment, mounted in the top right of the Hybrid/EV electronics radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>B202 Hybrid/EV Electronics Coolant Temperature Sensor</u>
B203	Radiator Coolant Temperature Sensor	-	At the right front of the engine compartment, mounted in the	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>B203 Engine Coolant Radiator Temperature Sensor</u>

Code	Name	Option	Location	Locator View	Connector End View
			right center of the engine radiator side tank		
B204A	Hybrid/EV Battery Pack Coolant Temperature Sensor 1	-	Under the vehicle, inside the hybrid/EV battery pack, in the coolant inlet tube	-	<u>B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1</u>
B208	Fuel Fill Door Status Switch Assembly	-	At the right rear of the vehicle, behind the right rear quarter panel	<u>Underbody - Fuel System Components (1 of 2)</u>	<u>B208 Fuel Fill Door Status Switch Assembly</u>
B218L	Side Object Sensor Module - Left	UFG	At the right rear of the vehicle, behind the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B218L Side Object Sensor Module - Left</u>
B218R	Side Object Sensor Module - Right	UFG	At the left rear of the vehicle, behind the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B218R Side Object Sensor Module - Right</u>
B228A	Drive Motor 1 Position Sensor	-	In the engine compartment, internal to the automatic transmission, part of drive motor 1	<u>Transmission Components</u>	<u>B228A Drive Motor 1 Position Sensor</u>
B228B	Drive Motor 2 Position Sensor	-	In the engine compartment, internal to the automatic transmission, part of drive motor 2	<u>Transmission Components</u>	<u>B228B Drive Motor 2 Position Sensor</u>
B233B	Radar Sensor Module - Long Range	UGN	In the engine compartment, behind the grill, next to the left headlamp assembly	-	<u>B233B Radar Sensor Module - Long Range</u>
B258	Hybrid/EV Battery Coolant Level Switch	-	In the front middle of the engine	<u>Engine Compartment Components - Front (1 of 4)</u>	<u>B258 Hybrid/EV Battery Coolant Level Switch</u>

Code	Name	Option	Location	Locator View	Connector End View
			compartment, in the Hybrid/EV Battery Coolant Surge Tank		
B284	Vehicle Dynamic Sensor	-	In the passenger compartment, under the center console, at the rear	<u>Passenger Compartment Components (3 of 3)</u>	<u>B284 Vehicle Dynamic Sensor</u>
B305	Ambient Light/Sunload Sensor and Battery State of Charge Indicator	-	In the passenger compartment, at the top center of the instrument panel, in the windshield defog vent	<u>Instrument Panel Components (1 of 4)</u>	<u>B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator</u>
B306A	Parking Assist Sensor - Front Left Outer	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306A Parking Assist Sensor - Front Left Outer</u>
B306B	Parking Assist Sensor - Front Left Middle	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306B Parking Assist Sensor - Front Left Middle</u>
B306C	Parking Assist Sensor - Front Right Middle	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306C Parking Assist Sensor - Front Right Middle</u>
B306D	Parking Assist Sensor - Front Right Outer	UFQ	At the front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306D Parking Assist Sensor - Front Right Outer</u>
B306E	Parking Assist Sensor - Rear Left Outer	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306E Parking Assist Sensor - Rear Left Outer</u>
B306F	Parking Assist Sensor - Rear Left Middle	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306F Parking Assist Sensor - Rear Left Middle</u>
B306G	Parking Assist Sensor - Rear Right Middle	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306G Parking Assist Sensor - Rear Right Middle</u>

Code	Name	Option	Location	Locator View	Connector End View
B306H	Parking Assist Sensor - Rear Right Outer	UD7	At the rear of the vehicle, mounted in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>B306H Parking Assist Sensor - Rear Right Outer</u>
B306K	Parking Assist Sensor - Side Left Front	UKC	At the front of the vehicle, mounted in the left side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306K Parking Assist Sensor - Side Left Front</u>
B306L	Parking Assist Sensor - Side Right Front	UKC	At the front of the vehicle, mounted in the right side of the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>B306L Parking Assist Sensor - Side Right Front</u>
B310	Fuel Pressure/Temperature Sensor	-	On the top of the engine, mounted to the center of the fuel rail	<u>Right Front of Engine Components (2 of 2)</u>	<u>B310 Fuel Pressure/Temperature Sensor</u>
C1	Battery	-	In the luggage compartment, under the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	<u>C1 Battery</u>
C4A	Hybrid/EV Battery Section 1	-	Under the vehicle, in the Hybrid/EV battery pack, forward section	-	-
C4B	Hybrid/EV Battery Section 2	-	Under the vehicle, in the Hybrid/EV battery pack, middle section	-	-
C4C	Hybrid/EV Battery Section 3	-	Under the vehicle, in the Hybrid/EV battery pack, rear section	-	-
C5A	Hybrid/EV Battery Module 1	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5A Hybrid/EV Battery Module 1</u>

Code	Name	Option	Location	Locator View	Connector End View
			battery section 3		
C5B	Hybrid/EV Battery Module 2	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5B Hybrid/EV Battery Module 2</u>
C5C	Hybrid/EV Battery Module 3	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 3	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5C Hybrid/EV Battery Module 3</u>
C5D	Hybrid/EV Battery Module 4	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 2	-	<u>C5D Hybrid/EV Battery Module 4</u>
C5E	Hybrid/EV Battery Module 5	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 2	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5E Hybrid/EV Battery Module 5</u>
C5F	Hybrid/EV Battery Module 6	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 1	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	<u>C5F Hybrid/EV Battery Module 6</u>
C5G	Hybrid/EV Battery Module 7	-	Under the vehicle, in the Hybrid/EV battery pack, part of Hybrid/EV battery section 1	-	<u>C5G Hybrid/EV Battery Module 7</u>
E1D	Accent Lamp - Driver Door	-	In the passenger compartment, in the driver door	<u>Driver Door Trim Components</u>	<u>E1D Accent Lamp - Driver Door</u>

Code	Name	Option	Location	Locator View	Connector End View
			trim		
E1P	Accent Lamp - Passenger Door	-	In the passenger compartment, in the passenger door trim	<u>Passenger Door Trim Components</u>	<u>E1P Accent Lamp - Passenger Door</u>
E2LF	Side Marker Lamp - Left Front	-	At left side, front of vehicle, part of the left headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E2LF Side Marker Lamp - Left Front</u>
E2RF	Side Marker Lamp - Right Front	-	At right side, front of vehicle, part of the right headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E2RF Side Marker Lamp - Right Front</u>
E4AC	Park/Daytime Running Lamp - Left	-	At the left front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4AC Park/Daytime Running Lamp - Left</u>
E4AD	Park/Daytime Running Lamp - Right	-	At the right front of the vehicle, mounted in the front fascia	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4AD Park/Daytime Running Lamp - Right</u>
E4E	Headlamp - Left High Beam	-	At the left front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4E Headlamp - Left High Beam</u>
E4F	Headlamp - Right High Beam	-	At the right front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4F Headlamp - Right High Beam</u>
E4G	Headlamp - Left Low Beam	-	At the left front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4G Headlamp - Left Low Beam</u>
E4H	Headlamp - Right Low Beam	-	At the right front of the vehicle, part of the headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4H Headlamp - Right Low Beam</u>

Code	Name	Option	Location	Locator View	Connector End View
E4LF	Turn Signal Lamp - Left Front	-	At the left front of the vehicle, part of the left headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4LF Turn Signal Lamp - Left Front</u>
E4LR	Turn Signal Lamp - Left Rear	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E4LR Turn Signal Lamp - Left Rear</u>
E4RF	Turn Signal Lamp - Right Front	-	At the right front of the vehicle, part of the right headlamp assembly	<u>Front of Vehicle Components (1 of 2)</u>	<u>E4RF Turn Signal Lamp - Right Front</u>
E4RR	Turn Signal Lamp - Right Rear	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E4RR Turn Signal Lamp - Right Rear</u>
E5A	Backup Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5A Backup Lamp - Left</u>
E5B	Backup Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5B Backup Lamp - Right</u>
E5E	Tail Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	-
E5F	Tail Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	-
E5L	Stop Lamp - Left	-	At the left rear corner of the vehicle, in the left tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5L Stop Lamp - Left</u>

Code	Name	Option	Location	Locator View	Connector End View
E5R	Stop Lamp - Right	-	At the right rear corner of the vehicle, in the right tail lamp assembly	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E5R Stop Lamp - Right</u>
E6	Center High Mounted Stop Lamp	-	At the rear of the vehicle, in the center of the liftgate assembly, above the lower glass	<u>Liftgate Components (2 of 2)</u>	<u>E6 Center High Mounted Stop Lamp</u>
E7L	License Plate Lamp - Left	-	At the rear of the vehicle, above the license plate pocket, in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>E7L License Plate Lamp - Left</u>
E7R	License Plate Lamp - Right	-	At the rear of the vehicle, above the license plate pocket, in the rear fascia	<u>Rear of Vehicle Components (2 of 3)</u>	<u>E7R License Plate Lamp - Right</u>
E13LA	Headlamp Assembly - Left	-	At the left front corner of the vehicle	<u>Front of Vehicle Components (1 of 2)</u>	-
E13RA	Headlamp Assembly - Right	-	At the right front corner of the vehicle	<u>Front of Vehicle Components (1 of 2)</u>	-
E14A	Seat Heating Element - Driver Back	KA1	In the passenger compartment, part of the driver seat back	-	<u>E14A Seat Heating Element - Driver Back</u>
E14B	Seat Heating Element - Driver Cushion	KA1	In the passenger compartment, part of the driver seat cushion assembly	-	<u>E14B Seat Heating Element - Driver Cushion</u>
E14C	Seat Heating Element - Passenger Back	KA1	In the passenger compartment, part of the passenger seat back	-	<u>E14C Seat Heating Element - Passenger Back</u>

Code	Name	Option	Location	Locator View	Connector End View
E14D	Seat Heating Element - Passenger Cushion	KA1	In the passenger compartment, part of the passenger seat cushion assembly	-	<u>E14D Seat Heating Element - Passenger Cushion</u>
E14F	Seat Heating Element - Left Rear Cushion	KA6	In the passenger compartment, part of the left rear seat cushion	-	<u>E14F Seat Heating Element - Left Rear Cushion</u>
E14H	Seat Heating Element - Right Rear Cushion	KA6	In the passenger compartment, part of the right rear seat cushion	-	<u>E14H Seat Heating Element - Right Rear Cushion</u>
E15	Steering Wheel Heater	UVD	In the passenger compartment, left front, within the steering wheel rim	<u>Steering Wheel Components</u>	-
E17D	Outside Rearview Mirror Glass - Driver	-	Outside the vehicle, at the front of the driver door, part of the outside rearview mirror assembly	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>E17D Outside Rearview Mirror Glass - Driver X1</u> • <u>E17D Outside Rearview Mirror Glass - Driver X2</u>
E17P	Outside Rearview Mirror Glass - Passenger	-	Outside the vehicle, at the front of the passenger door, part of the outside rearview mirror assembly	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>E17P Outside Rearview Mirror Glass - Passenger X1</u> • <u>E17P Outside Rearview Mirror Glass - Passenger X2</u>
E18	Rear Defogger Grid	-	In the passenger compartment, part of the rear glass	• <u>Passenger Compartment/Roof Component Views</u> • <u>Liftgate Components (2 of 2)</u>	• <u>E18 Rear Defogger Grid X1</u> • <u>E18 Rear Defogger Grid X2</u>
E31L	Sunshade Mirror Lamp - Left	-	In the passenger compartment, at the front left of the headliner,	<u>Headliner Components (1 of 4)</u>	<u>E31L Sunshade Mirror Lamp - Left</u>

Code	Name	Option	Location	Locator View	Connector End View
			part of the sunshade assembly		
E31R	Sunshade Mirror Lamp - Right	-	In the passenger compartment, at the right front of the headliner, part of the sunshade assembly	<u>Headliner Components (1 of 4)</u>	<u>E31R Sunshade Mirror Lamp - Right</u>
E33	Cargo Lamp	-	In the luggage compartment, at the left	<u>Liftgate Components (1 of 2)</u>	<u>E33 Cargo Lamp</u>
E37F	Dome/Reading Lamps - Front	-	In the passenger compartment, at the front center of the headliner	<u>Headliner Components (1 of 4)</u>	-
E37R	Dome/Reading Lamps - Rear	-	In the passenger compartment, at the rear center of the headliner	<u>Headliner Components (1 of 4)</u>	<u>E37R Dome/Reading Lamps - Rear</u>
E41	Engine Coolant Thermostat Heater	-	In the engine compartment, at the right front of the cylinder head, part of the thermostat housing	<u>Right Front of Engine Components (2 of 2)</u>	<u>E41 Engine Coolant Thermostat Heater</u>
E42L	Tail Lamp Assembly - Left	-	At the left rear corner of the vehicle	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E42L Tail Lamp Assembly - Left</u>
E42R	Tail Lamp Assembly - Right	-	At the right rear corner of the vehicle	<u>Rear of Vehicle Components (1 of 3)</u>	<u>E42R Tail Lamp Assembly - Right</u>
E54	Hybrid/EV Battery Pack Coolant Heater	-	Under the vehicle, inside the hybrid/EV battery pack in the coolant inlet tube	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
E63D	Flood Lamp - Driver Door Handle	-	In the passenger compartment, in the driver door trim	<u>Driver Door Trim Components</u>	<u>E63D Flood Lamp - Driver Door Handle</u>

Code	Name	Option	Location	Locator View	Connector End View
E63LR	Flood Lamp - Left Rear Door Handle	-	In the passenger compartment, in the left rear door trim	<u>Left Rear Door Trim Components</u>	<u>E63LR Flood Lamp - Left Rear Door Handle</u>
E63P	Flood Lamp - Passenger Door Handle	-	In the passenger compartment, in the passenger door trim	<u>Passenger Door Trim Components</u>	<u>E63P Flood Lamp - Passenger Door Handle</u>
E63RR	Flood Lamp - Right Rear Door Handle	-	In the passenger compartment, in the right rear door trim	<u>Right Rear Door Trim Components</u>	<u>E63RR Flood Lamp - Right Rear Door Handle</u>
E85	Hybrid/EV Battery Charger Receptacle Accent Lamp	-	In the left fender, behind the charge port door	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>E85 Hybrid/EV Battery Charger Receptacle Accent Lamp</u>
E88	Front Floor Console Bin Lamp	-	In center of instrument panel, under the HVAC control panel	<u>Instrument Panel - Bottom</u>	<u>E1W Accent Lamp - Instrument Panel</u>
F101	Passenger Instrument Panel Air Bag	-	In the passenger compartment, mounted in the passenger side of the instrument panel	<u>Instrument Panel Components (1 of 4)</u>	• <u>F101 Passenger Instrument Panel Air Bag X1</u> • <u>F101 Passenger Instrument Panel Air Bag X2</u> • <u>F101 Passenger Instrument Panel Air Bag X3</u>
F105L	Roof Rail Air Bag - Left	-	In the passenger compartment, along the left roof rail	<u>Passenger Compartment Components (2 of 3)</u>	<u>F105L Roof Rail Air Bag - Left</u>
F105R	Roof Rail Air Bag - Right	-	In the passenger compartment, along the right roof rail	<u>Passenger Compartment Components (3 of 3)</u>	<u>F105R Roof Rail Air Bag - Right</u>
F106LF	Seat Side Air Bag - Left Front	-	In the passenger compartment, mounted in the outboard side of the left front seat back	-	<u>F106LF Seat Side Air Bag - Left Front</u>

Code	Name	Option	Location	Locator View	Connector End View
F106LR	Seat Side Air Bag - Left Rear	-	In the passenger compartment, mounted in the left, outboard side of the rear seat back	<u>Rear Seat Components (1 of 3)</u>	<u>F106LR Seat Side Air Bag - Left Rear</u>
F106RF	Seat Side Air Bag - Right Front	-	In the passenger compartment, mounted in the outboard side of the right front seat back	-	<u>F106RF Seat Side Air Bag - Right Front</u>
F106RR	Seat Side Air Bag - Right Rear	-	In the passenger compartment, mounted in the right, outboard side of the rear seat back	<u>Rear Seat Components (1 of 3)</u>	<u>F106RR Seat Side Air Bag - Right Rear</u>
F107	Steering Wheel Air Bag	-	In the passenger compartment, mounted in the center of the steering wheel	<u>Steering Wheel Components</u>	• <u>F107 Steering Wheel Air Bag X1</u> • <u>F107 Steering Wheel Air Bag X2</u>
F112D	Seat Belt Retractor Pretensioner - Driver	-	In the passenger compartment, at the base of the driver B-pillar	<u>Passenger Compartment Components (2 of 3)</u>	<u>F112D Seat Belt Retractor Pretensioner - Driver</u>
F112P	Seat Belt Retractor Pretensioner - Passenger	-	In the passenger compartment, at the base of the passenger B-pillar	<u>Passenger Compartment Components (3 of 3)</u>	<u>F112P Seat Belt Retractor Pretensioner - Passenger</u>
F113D	Seat Belt Anchor Pretensioner - Driver	-	In the passenger compartment, under the outboard side of the driver seat cushion	-	<u>F113D Seat Belt Anchor Pretensioner - Driver</u>
F113P	Seat Belt Anchor Pretensioner - Passenger	-	In the passenger compartment, under the outboard side of the passenger seat cushion	-	<u>F113P Seat Belt Anchor Pretensioner - Passenger</u>

Code	Name	Option	Location	Locator View	Connector End View
F114D	Knee Air Bag - Driver	-	In the passenger compartment, at the bottom of the driver side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>F114D Knee Air Bag - Driver</u>
F114P	Knee Air Bag - Passenger	-	In the passenger compartment, at the bottom of the passenger side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>F114P Knee Air Bag - Passenger</u>
F115	Hybrid/EV Battery Pack Fuse Cover	-	Under the vehicle, at the front of the Hybrid/EV battery pack	-	<u>F115 Hybrid/EV Battery Pack Fuse Cover</u>
G1	A/C Compressor	-	In the engine compartment, mounted to the right rear of the engine	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	• <u>G1 A/C Compressor X1</u> • <u>G1 A/C Compressor X2</u>
G5	Transmission Fluid Pump - Electric/Auxiliary	-	In the engine compartment, internal to the transmission assembly	-	-
G10L	Cooling Fan Motor - Left	-	At the front of the engine compartment, rear of the left side of the radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G10L Cooling Fan Motor - Left</u>
G10R	Cooling Fan Motor - Right	-	At the front of the engine compartment, rear of the right side of the radiator	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G10R Cooling Fan Motor - Right</u>
G12	Fuel Pump	-	Under the rear of the vehicle, in the fuel tank, part of the fuel pump and level sensor assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
G18	High Pressure Fuel Pump	-	In the fuel system, mounted in-line to the high pressure fuel line, at the top left rear of the engine	<u>Left Front of Engine Components</u>	<u>G18 High Pressure Fuel Pump</u>
G24	Windshield Washer Pump	-	At the left front of the vehicle, behind the left side of the fascia, in the washer solvent bottle	<u>Right Front of Vehicle Components</u>	<u>G24 Windshield Washer Pump</u>
G35	Hybrid/EV Electronics Coolant Pump	-	At the left front of the engine compartment, mounted to the left side of the lower radiator support	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>G35 Hybrid/EV Electronics Coolant Pump</u>
G36	Auxiliary Heater Coolant Pump	-	At the rear of the engine compartment, mounted to the suspension cradle	<u>Right Rear of Engine Components</u>	<u>G36 Auxiliary Heater Coolant Pump</u>
G37	Hybrid/EV Battery Pack Coolant Pump	-	At the front of the engine compartment, mounted to the center of the lower radiator support	<u>Engine Compartment Components - Front (2 of 4)</u>	<u>G37 Hybrid/EV Battery Pack Coolant Pump</u>
K1	14V Power Module	-	In the luggage compartment, under the left side of the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	• <u>K1 14V Power Module X1</u> • <u>K1 14V Power Module X2</u> • <u>K1 14V Power Module X3</u> • <u>K1 14V Power Module X4</u>

Code	Name	Option	Location	Locator View	Connector End View
K9	Body Control Module	-	In the passenger compartment, under the center console	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K9 Body Control Module X1</u> • <u>K9 Body Control Module X2</u> • <u>K9 Body Control Module X3</u> • <u>K9 Body Control Module X4</u> • <u>K9 Body Control Module X5</u> • <u>K9 Body Control Module X6</u> • <u>K9 Body Control Module X7</u>
K10	Coolant Heater Control Module	-	At the right side of the engine compartment, near the engine crankshaft pulley	<u>Engine Compartment Components - Right</u>	• <u>K10 Coolant Heater Control Module X1</u> • <u>K10 Coolant Heater Control Module X2</u>
K16	Battery Energy Control Module	-	Under the vehicle, part of the hybrid/EV battery pack	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	• <u>K16 Battery Energy Control Module X1</u> • <u>K16 Battery Energy Control Module X2</u> • <u>K16 Battery Energy Control Module X3</u> • <u>K16 Battery Energy Control Module X4</u> • <u>K16 Battery Energy Control Module X5</u> • <u>K16 Battery Energy Control Module X6</u> • <u>K16 Battery Energy Control Module X7</u>

Code	Name	Option	Location	Locator View	Connector End View
					• <u>K16 Battery Energy Control Module X8</u>
K17	Electronic Brake Control Module	-	At the left rear of the engine compartment, part of the master cylinder assembly	<u>Engine Compartment Components - Left</u>	<u>K17 Electronic Brake Control Module</u>
K20	Engine Control Module	-	At the left front corner of the vehicle, behind the left side of the front fascia, below the left headlamp	<u>Left Front of Vehicle Components (1 of 2)</u>	• <u>K20 Engine Control Module X1</u> • <u>K20 Engine Control Module X2</u> • <u>K20 Engine Control Module X3</u>
K29F	Seat Heating Control Module - Front	KA1	In the passenger compartment, under the passenger seat cushion	-	• <u>K29F Seat Heating Control Module - Front X1 (KA1)</u> • <u>K29F Seat Heating Control Module - Front X2 (KA1)</u>
K29R	Seat Heating Control Module - Rear	KA6	In the passenger compartment, under the center of the rear seat cushion	-	• <u>K29R Seat Heating Control Module - Rear X1 (KA6)</u> • <u>K29R Seat Heating Control Module - Rear X2 (KA6)</u>
K32	Steering Wheel Heating Control Module	-	In the passenger compartment, attached to the lower portion of the steering wheel	<u>Steering Wheel Components</u>	• <u>K32 Steering Wheel Heating Control Module X1</u> • <u>K32 Steering Wheel Heating Control Module</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>X2</u>
K33	HVAC Control Module	-	In the passenger compartment, behind the center of the instrument panel, above the human interface module	<u>Instrument Panel Components (2 of 4)</u>	• <u>K33 HVAC Control Module X1</u> • <u>K33 HVAC Control Module X2</u> • <u>K33 HVAC Control Module X3</u>
K36	Inflatable Restraint Sensing and Diagnostic Module	-	In the passenger compartment, between the front seats, under the center console	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K36 Inflatable Restraint Sensing and Diagnostic Module X1</u> • <u>K36 Inflatable Restraint Sensing and Diagnostic Module X2</u>
K43	Power Steering Control Module	-	Under the vehicle, at the rear of the engine cradle, part of the steering gear assembly	<u>Underbody - Steering Components</u>	• <u>K43 Power Steering Control Module X1</u> • <u>K43 Power Steering Control Module X2</u>
K57	Battery Charger Control Module	-	In the luggage compartment, under trim panel, on the right side floor, part of the battery charger	-	-
K73	Telematics Communication Interface Control Module	UE1	In the passenger compartment, behind the left side of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	• <u>K73 Telematics Communication Interface Control Module X1</u> • <u>K73 Telematics Communication Interface Control Module X2</u> • <u>K73 Telematics Communication</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>Interface Control Module X5</u> • <u>K73 Telematics Communication Interface Control Module X7</u>
K74	Human Machine Interface Control Module	-	In the passenger compartment, within the center of the instrument panel, below the HVAC control module	<u>Instrument Panel Components (2 of 4)</u>	• <u>K74 Human Machine Interface Control Module X1</u> • <u>K74 Human Machine Interface Control Module X2</u> • <u>K74 Human Machine Interface Control Module X3</u> • <u>K74 Human Machine Interface Control Module X5</u> • <u>K74 Human Machine Interface Control Module X7</u>
K77	Remote Control Door Lock Receiver	-	In the luggage compartment, behind the left side trim panel	<u>Passenger Compartment Components (1 of 3)</u>	<u>K77 Remote Control Door Lock Receiver</u>
K84	Keyless Entry Control Module	-	In the luggage compartment, behind the left side trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K84 Keyless Entry Control Module X1</u> • <u>K84 Keyless Entry Control Module X2</u>
K85	Passenger Presence Module	-	In the passenger compartment, under the passenger seat	-	<u>K85 Passenger Presence Module</u>
K89	Immobilizer Control Module	-	In the passenger compartment,	<u>Center Console Components (2 of 3)</u>	<u>K89 Immobilizer Control Module</u>

Code	Name	Option	Location	Locator View	Connector End View
			under the center console		
K107A	Drive Motor 1 Control Module	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K107B	Drive Motor 2 Control Module	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K109	Frontview Camera Module	UHY	In the passenger compartment, at the top center of the windshield	<u>Headliner Components (3 of 4)</u>	<u>K109 Frontview Camera Module</u>
K111	Fuel Pump Driver Control Module	-	In the luggage compartment, behind the right side trim panel	<u>Luggage Compartment Components (1 of 2)</u>	<u>K111 Fuel Pump Driver Control Module</u>
K114A	Hybrid/EV Powertrain Control Module 1	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K114B	Hybrid/EV Powertrain Control Module 2	-	In the passenger compartment, behind the right side of the instrument panel	<u>Passenger Compartment Components (3 of 3)</u>	• <u>K114B Hybrid/EV Powertrain Control Module 2 X1</u> • <u>K114B Hybrid/EV Powertrain Control Module 2 X2</u>
K118	Electric A/C Compressor Control Module	-	In the engine compartment, part of the A/C Compressor	-	-

Code	Name	Option	Location	Locator View	Connector End View
K124	Active Safety Control Module	UGN	In the left rear corner of the luggage compartment, behind the trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K124 Active Safety Control Module X1</u> • <u>K124 Active Safety Control Module X2</u>
K132	Pedestrian Alert Sound Control Module	-	In the passenger compartment, under the passenger seat, on the floor	<u>Passenger Compartment Components (2 of 3)</u>	<u>K132 Pedestrian Alert Sound Control Module</u>
K177	Brake Booster Control Module	-	In the engine compartment, under the left side of the front cowl	<u>Engine Compartment Components - Left</u>	<u>K177 Brake Booster Control Module</u>
K182	Parking Assist Control Module	UFQ	In the left rear corner of the luggage compartment, behind the trim panel	<u>Passenger Compartment Components (1 of 3)</u>	• <u>K182 Parking Assist Control Module X1</u> • <u>K182 Parking Assist Control Module X2</u> • <u>K182 Parking Assist Control Module X3</u>
M6	Air Temperature Door Actuator	-	In the passenger compartment, under the driver side of the instrument panel, mounted to the HVAC module assembly	-	<u>M6 Air Temperature Door Actuator</u>
M7	Transmission Shift Lock Control Solenoid Actuator	-	In the passenger compartment, part of the automatic transmission shift lever assembly	-	<u>M7 Transmission Shift Lock Control Solenoid Actuator</u>
M8	Blower Motor	-	In the passenger compartment, under the	<u>Instrument Panel - Bottom</u>	<u>M8 Blower Motor</u>

Code	Name	Option	Location	Locator View	Connector End View
			passenger side of the instrument panel, mounted to the HVAC module assembly		
M15A	Drive Motor 1	-	In the engine compartment, internal to the automatic transmission	<u>Transmission Components</u>	-
M15B	Drive Motor 2	-	In the engine compartment, internal to the automatic transmission	<u>Transmission Components</u>	-
M37	Mode Door Actuator	-	In the passenger compartment, under the driver side of the instrument panel, mounted to the HVAC module assembly	-	<u>M37 Mode Door Actuator</u>
M46	Air Recirculation Door Actuator	-	In the passenger compartment, under the passenger side of the instrument panel, mounted to the HVAC module assembly, above the blower motor	-	<u>M46 Air Recirculation Door Actuator</u>
M74D	Window Motor - Driver	-	In the passenger compartment, behind the driver door panel	<u>Driver Door Components</u>	<u>M74D Window Motor - Driver</u>
M74LR	Window Motor - Left Rear	-	In the passenger compartment, behind the left	<u>Left Rear Door Components</u>	<u>M74LR Window Motor - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			rear door panel		
M74P	Window Motor - Passenger	-	In the passenger compartment, behind the passenger door panel	<u>Passenger Door Components</u>	<u>M74P Window Motor - Passenger</u>
M74RR	Window Motor - Right Rear	-	In the passenger compartment, behind the right rear door panel	<u>Right Rear Door Components</u>	<u>M74RR Window Motor - Right Rear</u>
M75	Windshield Wiper Motor	-	At the rear of the engine compartment, below the center on the windshield	<u>Engine Compartment Components</u>	<u>M75 Windshield Wiper Motor</u>
M77D	Outside Rearview Mirror Motor - Driver	-	At the front of the driver door, part of the outside rearview mirror assembly	-	<u>M77D Outside Rearview Mirror Motor - Driver</u>
M77P	Outside Rearview Mirror Motor - Passenger	-	At the front of the passenger door, part of the outside rearview mirror assembly	-	<u>M77P Outside Rearview Mirror Motor - Passenger</u>
M96	Active Grille Air Shutter Actuator	-	At front of vehicle, center, behind upper grille	<u>Engine Compartment Components - Front (4 of 4)</u>	<u>M96 Active Grille Air Shutter Actuator</u>
M97	Fuel Fill Door Lock Actuator	-	At the right rear of the vehicle, behind the right rear quarter panel	<u>Underbody - Fuel System Components (1 of 2)</u>	<u>M97 Fuel Fill Door Lock Actuator</u>
M104L	Park Brake Actuator - Left	-	Behind the left rear wheel, mounted to the brake caliper assembly	<u>Underbody - Wheel Components (2 of 4)</u>	<u>M104L Park Brake Actuator - Left</u>
M104R	Park Brake Actuator - Right	-	Behind the right rear wheel, mounted to the brake caliper assembly	<u>Underbody - Wheel Components (4 of 4)</u>	<u>M104R Park Brake Actuator - Right</u>

Code	Name	Option	Location	Locator View	Connector End View
P2	Transmission Shift Lever Position Indicator	-	In the passenger compartment, under the center console	<u>Center Console Components (1 of 3)</u>	<u>P2 Transmission Shift Lever Position Indicator</u>
P12	Horn	-	At right front corner of vehicle, behind right headlamp	<u>Right Front of Vehicle Components</u>	<u>P12 Horn</u>
P16	Instrument Cluster	-	In the passenger compartment, at the top of the driver side of the instrument panel, above the steering column	<u>Instrument Panel Components (1 of 4)</u>	<u>P16 Instrument Cluster</u>
P17	Info Display Module	-	In the passenger compartment, at the top center of the instrument panel, above the radio/HVAC control	<u>Instrument Panel Components (1 of 4)</u>	• <u>P17 Info Display Module X1</u> • <u>P17 Info Display Module X2</u>
P19AC	Speaker - Subwoofer	-	In the luggage compartment, behind the right side trim panel	<u>Luggage Compartment Components (1 of 2)</u>	<u>P19AC Speaker - Subwoofer (UQA)</u>
P19AG	Speaker - Left Front Door	-	In the passenger compartment, behind the left front door panel	<u>Driver Door Components</u>	• <u>P19AG Speaker - Left Front Door (UQA)</u> • <u>P19AG Speaker - Left Front Door (UZ6)</u>
P19AH	Speaker - Right Front Door	-	In the passenger compartment, behind the right front door panel	<u>Passenger Door Components</u>	• <u>P19AH Speaker - Right Front Door (UQA)</u> • <u>P19AH Speaker - Right Front Door (UZ6)</u>
P19AL	Speaker - Left Rear Door	-	In the passenger compartment, behind the left rear door panel	<u>Left Rear Door Components</u>	• <u>P19AL Speaker - Left Rear Door (UQA)</u> • <u>P19AL Speaker - Left Rear Door</u>

Code	Name	Option	Location	Locator View	Connector End View
					<u>(UZ6)</u>
P19AM	Speaker - Right Rear Door	-	In the passenger compartment, behind the right rear door panel	<u>Right Rear Door Components</u>	• <u>P19AM Speaker - Right Rear Door (UQA)</u> • <u>P19AM Speaker - Right Rear Door (UZ6)</u>
P19B	Speaker - Center Instrument Panel	-	In the passenger compartment, at the top center of the instrument panel	<u>Instrument Panel Components (2 of 4)</u>	<u>P19B Speaker - Center Instrument Panel (UQA)</u>
P19H	Speaker - Left Front Tweeter	-	In the passenger compartment, at the base of the left A-pillar molding	<u>Instrument Panel Components (2 of 4)</u>	<u>P19H Speaker - Left Front Tweeter</u>
P19V	Speaker - Right Front Tweeter	-	In the passenger compartment, at the base of the right A-pillar molding	<u>Instrument Panel Components (2 of 4)</u>	<u>P19V Speaker - Right Front Tweeter</u>
P34D	Side Object Detection Indicator - Driver	-	Outside the vehicle, at the front of the driver door, part of the outside rear view mirror glass	-	-
P34P	Side Object Detection Indicator - Passenger	-	Outside the vehicle, at the front of the passenger door, part of the outside rear view mirror glass	-	-
P43	Collision Alert Indicators	-	In the passenger compartment, left front, mounted to instrument panel, forward of instrument	<u>Instrument Panel Components (2 of 4)</u>	<u>P43 Collision Alert Indicators</u>

Code	Name	Option	Location	Locator View	Connector End View
			cluster		
P48	Pedestrian Alert Sound Speaker	-	At the front of the vehicle, behind the upper grille	<u>Engine Compartment Components - Front (3 of 4)</u>	<u>P48 Pedestrian Alert Sound Speaker</u>
Q5	Brake Pressure Modulator	-	At the left rear of the engine compartment, part of the electronic brake control module	-	-
Q6E	Camshaft Position Actuator Solenoid Valve - Exhaust	-	At the right front of the engine, in the top right front of the cylinder head	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q6E Camshaft Position Actuator Solenoid Valve - Exhaust</u>
Q6F	Camshaft Position Actuator Solenoid Valve - Intake	-	At the right rear of the engine, in the top right rear of the cylinder head	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q6F Camshaft Position Actuator Solenoid Valve - Intake</u>
Q8	Control Solenoid Valve Assembly	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>Q8 Control Solenoid Valve Assembly</u>
Q12	Evaporative Emission Purge Solenoid Valve	-	In the engine compartment, at the top rear center of the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>Q12 Evaporative Emission Purge Solenoid Valve</u>
Q13	Evaporative Emission Vent Solenoid Valve	-	Under the vehicle, rear of the fuel tank, near the evaporative emission canister	-	<u>Q13 Evaporative Emission Vent Solenoid Valve</u>
Q14	Exhaust Gas Recirculation Valve	-	On the front of the engine, mounted at the right of the exhaust manifold	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q14 Exhaust Gas Recirculation Valve</u>

Code	Name	Option	Location	Locator View	Connector End View
Q17A	Fuel Injector 1	-	In the engine compartment, at the top of the engine, next to spark plug 1	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17A Fuel Injector 1</u>
Q17B	Fuel Injector 2	-	In the engine compartment, at the top of the engine, next to spark plug 2	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17B Fuel Injector 2</u>
Q17C	Fuel Injector 3	-	In the engine compartment, at the top of the engine, next to spark plug 3	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17C Fuel Injector 3</u>
Q17D	Fuel Injector 4	-	In the engine compartment, at the top of the engine, next to spark plug 4	<u>Right Front of Engine Components (2 of 2)</u>	<u>Q17D Fuel Injector 4</u>
Q23	Line Pressure Control Solenoid Valve	-	In the engine compartment, internal to the transmission	<u>Transmission Components</u>	<u>Q23 Line Pressure Control Solenoid Valve</u>
Q27B	Pressure Control Solenoid Valve 2	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27C	Pressure Control Solenoid Valve 3	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27D	Pressure Control Solenoid Valve 4	-	In the engine compartment, internal to the transmission control solenoid valve assembly	-	-
Q27E	Pressure Control Solenoid Valve 5	-	In the engine compartment, internal to the transmission	-	-

Code	Name	Option	Location	Locator View	Connector End View
			control solenoid valve assembly		
Q38	Throttle Body	-	In the engine compartment, at the right rear of the engine at the inlet for the intake manifold	• <u>Left Rear of Engine Components</u> • <u>Left Rear of Engine/Transmission Components</u>	<u>Q38 Throttle Body</u>
Q44	Engine Oil Pressure Control Solenoid Valve	-	In the engine compartment, mounted to the rear lower portion of the engine	<u>Left Rear of Engine/Transmission Components</u>	<u>Q44 Engine Oil Pressure Control Solenoid Valve</u>
Q63	Evaporative Emission System Leak Detection Pump Assembly	-	Under the vehicle, to the rear of the fuel tank	-	<u>Q63 Evaporative Emission System Leak Detection Pump Assembly</u>
Q66	Passenger Compartment Heater Coolant Control Valve	-	In the rear middle of the engine compartment, mounted to the bulkhead	<u>Right Rear of Engine Components</u>	<u>Q66 Passenger Compartment Heater Coolant Control Valve</u>
R6A	Terminating Resistor - High Speed Bus	-	In the passenger compartment, behind the right side of the instrument panel, taped to the hybrid/ev powertrain control module 2 harness	<u>Passenger Compartment Components (3 of 3)</u>	<u>R6A Terminating Resistor - High Speed Bus</u>
R25	Hybrid/EV Battery Pre-Charge Resistor	-	Under the vehicle, part of the hybrid/EV battery assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
S3	Transmission Shift Lever	-	In the passenger compartment, at the front of the center console	<u>Center Console Components (3 of 3)</u>	<u>S3 Transmission Shift Lever</u>
S13D	Door Lock Switch - Driver	-	In the passenger compartment, at the upper front	<u>Driver Door Trim Components</u>	<u>S13D Door Lock Switch - Driver</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the driver door panel		
S13P	Door Lock Switch - Passenger	-	In the passenger compartment, at the upper front of the passenger door panel	<u>Passenger Door Trim Components</u>	<u>S13P Door Lock Switch - Passenger</u>
S15	Manual Service Disconnect	-	Under the vehicle at the top of the Hybrid/EV battery, accessed by removing the storage compartment in the rear of the center console	<u>Underbody - Hybrid/EV Battery Pack Internals</u>	-
S26	Hazard Warning Switch	-	In the passenger compartment, on top of the center console, rear of the transmission shift lever position indicator	<u>Center Console Components (1 of 3)</u>	<u>S26 Hazard Warning Switch</u>
S30	Headlamp Switch	-	In the instrument panel, to the left of the steering wheel, under the vent	<u>Instrument Panel Components (1 of 4)</u>	<u>S30 Headlamp Switch</u>
S32LR	Seat Heating Switch - Left Rear	KA6	In the center console, in front of the rear cup holders	<u>Center Console Components (1 of 3)</u>	<u>S32LR Seat Heating Switch - Left Rear</u>
S32RR	Seat Heating Switch - Right Rear	KA6	In the center console, in front of the rear cup holders	<u>Center Console Components (1 of 3)</u>	<u>S32RR Seat Heating Switch - Right Rear</u>
S33	Horn Switch	-	In the passenger compartment, in the center of the steering wheel, behind the driver side air	-	• <u>S33 Horn Switch X1</u> • <u>S33 Horn Switch X2</u>

Code	Name	Option	Location	Locator View	Connector End View
			bag		
S46	Liftgate Handle Switch	-	At the rear of the vehicle, in the lower center of the liftgate	<u>Liftgate Components (1 of 2)</u>	<u>S46 Liftgate Handle Switch</u>
S48B	Multifunction Switch - Overhead Console	-	In the passenger compartment, at the front center of the headliner	<u>Headliner Components (2 of 4)</u>	<u>S48B Multifunction Switch - Overhead Console</u>
S48E	Multifunction Switch - Center Console	-	In the passenger compartment, at the front of the center console, rear of transmission shift lever	<u>Center Console Components (1 of 3)</u>	<u>S48E Multifunction Switch - Center Console</u>
S70E	Steering Wheel Controls Switch - Radio Presets	-	In the passenger compartment, on the left side bottom of the steering wheel	<u>Steering Wheel Components</u>	<u>S70E Steering Wheel Controls Switch - Radio Presets</u>
S70F	Steering Wheel Controls Switch - Radio Volume	-	In the passenger compartment, on the steering wheel	<u>Steering Wheel Components</u>	<u>S70F Steering Wheel Controls Switch - Radio Volume</u>
S70L	Steering Wheel Controls Switch - Left	-	In the passenger compartment, on the left side of the steering wheel	<u>Steering Wheel Components</u>	<u>S70L Steering Wheel Controls Switch - Left</u>
S70R	Steering Wheel Controls Switch - Right	-	In the passenger compartment, on the right side of the steering wheel	<u>Steering Wheel Components</u>	<u>S70R Steering Wheel Controls Switch - Right</u>
S78	Turn Signal/Multifunction Switch	-	In the passenger compartment, on the left side of the steering column	<u>Steering Column Components</u>	<u>S78 Turn Signal/Multifunction Switch</u>
S79LR	Window Switch - Left Rear	-	In the passenger compartment, at the center of the left rear door panel	<u>Left Rear Door Trim Components</u>	<u>S79LR Window Switch - Left Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
S79P	Window Switch - Passenger	-	In the passenger compartment, at the center of the passenger door panel	<u>Passenger Door Trim Components</u>	<u>S79P Window Switch - Passenger</u>
S79RR	Window Switch - Right Rear	-	In the passenger compartment at the center of the right rear door panel	<u>Right Rear Door Trim Components</u>	<u>S79RR Window Switch - Right Rear</u>
S82	Windshield Wiper/Washer Switch	-	In the passenger compartment, on the right side of the steering column	<u>Steering Column Components</u>	<u>S82 Windshield Wiper/Washer Switch</u>
S83	Vehicle On/Off Switch	-	In the passenger compartment, in the center of the instrument panel, to the right side of the steering wheel	<u>Instrument Panel Components (1 of 4)</u>	<u>S83 Vehicle On/Off Switch</u>
S91	Park Brake Control Switch	-	In the passenger compartment, in the center console, forward of the transmission shift lever position indicator	<u>Center Console Components (1 of 3)</u>	<u>S91 Park Brake Control Switch</u>
S117	Refuel Request Switch	-	In the passenger compartment, on the driver door panel, above the storage compartment	<u>Driver Door Trim Components</u>	<u>S117 Refuel Request Switch</u>
S146	Window/Outside Rearview Mirror Switch - Driver	-	In the passenger compartment, at the front of the driver door panel	<u>Driver Door Trim Components</u>	<u>S146 Window/Outside Rearview Mirror Switch - Driver</u>
S151	Regenerative Braking On-Demand Switch	-	In the passenger compartment, left front, in the	<u>Steering Wheel Components</u>	<u>S151 Regenerative Braking On-Demand Switch</u>

Code	Name	Option	Location	Locator View	Connector End View
			steering wheel on rear of left spoke		
T2RR	Antenna - Roof Rear	-	Outside the vehicle, at the rear center of the roof	<u>Rear of Vehicle Components (1 of 3)</u>	• <u>T2RR Antenna - Roof Rear X1</u> • <u>T2RR Antenna - Roof Rear X2</u>
T3	Audio Amplifier	UQA	In the luggage compartment, behind the right side trim panel, under the subwoofer	<u>Luggage Compartment Components (1 of 2)</u>	• <u>T3 Audio Amplifier X1</u> • <u>T3 Audio Amplifier X2</u> • <u>T3 Audio Amplifier X3</u> • <u>T3 Audio Amplifier X4</u>
T6	Power Inverter Module	-	In the engine compartment, to the left of the engine, on top of the transmission	• <u>Left Rear of Engine/Transmission Components</u> • <u>Transmission Components</u>	• <u>T6 Power Inverter Module X1</u> • <u>T6 Power Inverter Module X2</u> • <u>G5 Transmission Fluid Pump - Electric/Auxiliary</u> • <u>T6 Power Inverter Module X4</u> • <u>T6 Power Inverter Module X5</u>
T8A	Ignition Coil 1	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 1	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8A Ignition Coil 1</u>
T8B	Ignition Coil 2	-	In the engine compartment, on the top of the cylinder head,	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8B Ignition Coil 2</u>

Code	Name	Option	Location	Locator View	Connector End View
			between the camshafts, at cylinder 2		
T8C	Ignition Coil 3	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 3	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8C Ignition Coil 3</u>
T8D	Ignition Coil 4	-	In the engine compartment, on the top of the cylinder head, between the camshafts, at cylinder 4	<u>Right Front of Engine Components (2 of 2)</u>	<u>T8D Ignition Coil 4</u>
T10B	Keyless Entry Antenna - Instrument Panel Compartment	-	In the passenger compartment, behind the center of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>T10B Keyless Entry Antenna - Instrument Panel Compartment</u>
T10C	Keyless Entry Antenna - Left Front Door Handle	-	In the driver door, part of the driver exterior door handle assembly	-	-
T10D	Keyless Entry Antenna - Right Front Door Handle	-	In the passenger door, part of the passenger exterior door handle assembly	-	-
T10E	Keyless Entry Antenna - Rear Compartment	-	In the passenger compartment, behind the rear seat, in luggage compartment center of seat back	<u>Luggage Compartment Components (1 of 2)</u>	<u>T10E Keyless Entry Antenna - Rear Compartment</u>
T10G	Keyless Entry Antenna - Rear Fascia	-	On the vehicle exterior, behind the center of the rear fascia	<u>Rear of Vehicle Components (3 of 3)</u>	<u>T10G Keyless Entry Antenna - Rear Fascia</u>
T10K	Keyless Entry Antenna - Center Console Rear	-	In the passenger compartment, under the center	<u>Center Console Components (2 of 3)</u>	<u>T10K Keyless Entry Antenna - Center Console Rear</u>

Code	Name	Option	Location	Locator View	Connector End View
			console - rear		
T12	Automatic Transmission Assembly	-	In the engine compartment, to the left of the engine	<u>Left Rear of Engine/Transmission Components</u>	-
T15	Navigation Antenna Signal Splitter	-	In the passenger compartment, behind the glove box, mounted to the telematics communication interface control module bracket	<u>Instrument Panel Components (3 of 4)</u>	• <u>T15 Navigation Antenna Signal Splitter X1</u> • <u>T15 Navigation Antenna Signal Splitter X2</u> • <u>T15 Navigation Antenna Signal Splitter X3</u>
T18	Battery Charger	-	In the luggage compartment, under the storage compartment floor	<u>Luggage Compartment Components (1 of 2)</u>	• <u>T18 Battery Charger X1</u> • <u>T18 Battery Charger X2</u> • <u>T18 Battery Charger X3</u>
T21	Hybrid/EV Battery Coolant Heater Transistor	-	Under the vehicle, part of the hybrid/EV battery contactor assembly	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	-
T22	Mobile Device Wireless Charger Module	-	In the passenger compartment, inside the center console	<u>Center Console Components (2 of 3)</u>	<u>T22 Mobile Device Wireless Charger Module</u>
X21	Manual Service Disconnect Receptacle	-	At the top of the Hybrid/EV battery, under the battery cover at the top rear of section 2, under the manual service disconnect	-	• <u>X21 Manual Service Disconnect Receptacle</u> • <u>X21 Manual Service Disconnect Receptacle X2</u>
X50A	Fuse Block - Underhood	-	In the left side of the engine compartment, next to the	• <u>Engine Compartment Components - Front (3 of 4)</u>	<u>Electrical Center Identification Views</u>

Code	Name	Option	Location	Locator View	Connector End View
			power inverter module assembly	<u>Engine Compartment Components - Left</u>	
X50B	Fuse Block - Underhood Auxiliary	-	In the left rear of the engine compartment, to the rear of the fuse block - underhood	<u>Engine Compartment Components - Left</u>	<u>Electrical Center Identification Views</u>
X50D	Fuse Block - Battery	-	In the luggage compartment, under the storage compartment floor, attached to the positive battery post	<u>Luggage Compartment Components (2 of 2)</u>	<u>Electrical Center Identification Views</u>
X51A	Fuse Block - Instrument Panel	-	At the left side of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>Electrical Center Identification Views</u>
X53A	Fuse Block - Rear Body	-	In the luggage compartment, under the storage compartment floor, at the front of the battery	<u>Luggage Compartment Components (1 of 2)</u>	<u>Electrical Center Identification Views</u>
X55AL	Fuse Holder - Body Control Module	-	In the luggage compartment, on the positive battery cable, near the positive battery post	-	<u>Electrical Center Identification Views</u>
X55QA	Fuse Holder 1 - Hybrid/EV Battery Pack	-	In the hybrid/EV battery pack, on the front of the contactor assembly	<u>Engine Compartment Components</u>	<u>Electrical Center Identification Views</u>
X55QB	Fuse Holder 2 - Hybrid/EV Battery Pack	-	In the hybrid/EV battery pack, on the back of the contactor	<u>Underbody - Hybrid/EV Battery Pack Contactor Assembly Components</u>	<u>Electrical Center Identification Views</u>

Code	Name	Option	Location	Locator View	Connector End View
			assembly		
X80H	Accessory Power Receptacle - Center Console	-	In the passenger compartment, in the center console storage compartment	<u>Center Console Components (1 of 3)</u>	<u>X80H Accessory Power Receptacle - Center Console</u>
X80L	Accessory Power Receptacle - Center Console Rear	-	In the passenger compartment, at the rear of the center console	<u>Center Console Components (1 of 3)</u>	<u>X80L Accessory Power Receptacle - Center Console Rear</u>
X83	Auxiliary Audio Input	-	In the passenger compartment, in the center console storage compartment	<u>Center Console Components (1 of 3)</u>	• <u>X83 Auxiliary Audio Input X1</u> • <u>X83 Auxiliary Audio Input X2</u>
X84	Data Link Connector	-	In the passenger compartment, at the bottom of the driver side of the instrument panel	<u>Instrument Panel Components (3 of 4)</u>	<u>X84 Data Link Connector</u>
X85	Steering Wheel Air Bag Coil	-	In the passenger compartment, behind the steering wheel	<u>Steering Column Components</u>	• <u>X85 Steering Wheel Air Bag Coil X1</u> • <u>X85 Steering Wheel Air Bag Coil X2</u>
X98	Hybrid/EV Battery Charger Receptacle	-	At the left front of the vehicle, behind the charging port door	<u>Left Front of Vehicle Components (2 of 2)</u>	<u>X98 Hybrid/EV Battery Charger Receptacle</u>
X100	Forward Lamp Harness to Front Fascia Harness (16 cavities)	-	• (UFQ) At the left front corner of the vehicle, behind the left side of the front fascia • (-UFQ)	• <u>Forward Lamp Harness Routing</u> • <u>Front Fascia Harness Routing</u>	• <u>X100 Forward Lamp Harness to Front Fascia Harness (UFQ)</u> • <u>X100 Forward Lamp Harness to Front Fascia Harness (-UFQ)</u>

Code	Name	Option	Location	Locator View	Connector End View
			At the left front corner of the vehicle, behind the left side of the front fascia		
X102	Forward Lamp Harness to Engine Cooling Fan Harness	-	In the engine compartment, at the lower left of the cooling fan housing	• <u>Forward Lamp Harness Routing</u> • <u>Front of Engine Compartment Harness Routing</u>	<u>X102 Forward Lamp Harness to Cooling Fan Harness</u>
X104	Engine Cooling Fan Harness to Forward Lamp Harness (2 cavities)	-	In the engine compartment, at the lower left of the cooling fan housing	• <u>Forward Lamp Harness Routing</u> • <u>Front of Engine Compartment Harness Routing</u>	<u>X104 Cooling Fan Harness to Forward Lamp Harness</u>
X105	Body Harness to Battery Pack Charge Harness (2 cavities)	-	In the right rear of the engine compartment, at the top of the strut tower, left of the underhood fuse block	-	<u>X105 Body Harness to Battery Cable Harness</u>
X106	Forward Lamp Extension Harness to Forward Lamp Harness (3 cavities)	-	In the engine compartment, behind the left side of the front bumper bar	-	<u>X106 Forward Lamp Extension Harness to Forward Lamp Harness</u>
X107	Forward Lamp Harness to Body Harness (40 cavities)	-	In the left front of the engine compartment, at the top of the left frame rail	• <u>Forward Lamp Harness Routing</u> • <u>Left Side of Engine Compartment Harness Routing</u>	<u>X107 Forward Lamp Harness to Body Harness</u>
X110	Body Harness to Left Headlamp Harness (8 cavities)	-	In the engine compartment, at the rear of the left headlamp	<u>Forward Lamp Harness Routing</u>	<u>X110 Body Harness to Left Headlamp Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			assembly		
X120	Body Harness to Right Headlamp Harness (8 cavities)	-	In the engine compartment, at the rear of the right headlamp assembly	• <u>Forward Lamp Harness Routing</u> • <u>Right Side of Engine Compartment Harness Routing</u>	<u>X120 Body Harness to Right Headlamp Harness</u>
X121	Forward Lamp Harness to Body Harness (16 cavities)	-	In the engine compartment, under the right headlamp	<u>Right Side of Engine Compartment Harness Routing</u>	<u>X121 Forward Lamp Harness to Body Harness</u>
X130	Battery Cable Harness to Battery Cable Harness (4 cavities)	-	In the left rear of the engine compartment, at the top rear of the Power Inverter Module	<u>Left of Engine Compartment Harness Routing</u>	<u>X130 Battery Cable Harness to Battery Cable Harness</u>
X149	Engine Harness to Engine Jumper Harness (6 cavities)	-	At the rear lower center portion of the engine	-	<u>X149 Engine Harness to Engine Oil Level Sensor Harness</u>
X150	Engine Harness to Engine Jumper Harness (12 cavities)	-	In the engine compartment, at the left side of the cylinder head	<u>Right Side of Engine Harness Routing</u>	<u>X150 Engine Harness to Engine Jumper Harness</u>
X155	Body Harness to Engine Harness (16 cavities)	-	In the left side of the engine compartment, above the Transmission	• <u>Engine Harness Routing</u> • <u>Left Side of Engine Compartment Harness Routing</u>	<u>X155 Engine Harness to Body Harness</u>
X160	Engine Harness to Fuel System Harness (12 cavities)	-	At the left top side of the engine, near fuel rail injector 4	-	<u>X160 Engine Harness to Fuel System Harness</u>
X190	Engine Harness to Body Harness (40 cavities)	-	In the left side of the engine compartment, on the side of underhood fuse block	<u>Left Side of Engine Compartment Harness Routing</u>	<u>X190 Engine Harness to Body Harness</u>
X211	Body Harness to Instrument Panel Harness (2 cavities)	-	In the passenger compartment right front	<u>Right Side of Passenger Compartment Harness Routing</u>	<u>X211 Body Harness to Instrument Panel Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			footwell, behind the kick panel		
X225	Instrument Panel Harness to Body Harness (102 cavities)	-	In the passenger compartment left front footwell, behind the kick panel	<u>Instrument Panel Harness Routing</u>	<u>X225 Instrument Panel Harness to Body Harness</u>
X252	Instrument Panel Harness to HVAC System Harness (2 cavities)	-	In the passenger compartment, behind the center of the instrument panel, behind the human interface control panel, on HVAC case	-	<u>X252 Instrument Panel Harness to HVAC System Harness</u>
X275	Instrument Panel Harness to Body Harness (102 cavities)	-	In the passenger compartment, in the right front footwell, behind the kick panel	• <u>Instrument Panel Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X275 Instrument Panel Harness to Body Harness</u>
X302	Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness (6 cavities)	-	Behind the right side of the instrument panel, on instrument panel cross beam	-	<u>X302 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness</u>
X310	Body Harness to Driver Seat Harness (16 cavities)	-	In the passenger compartment, under the driver seat	<u>Left Side of Passenger Compartment Harness Routing</u>	<u>X310 Body Harness to Driver Seat Harness</u>
X315	Floor Console Harness to Instrument Panel Harness (48 cavities)	-	In the passenger compartment, under the front of the center console	• <u>Center Console Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X315 Floor Console Harness to Instrument Panel Harness</u>
X316	Instrument Panel Harness to Floor Console Harness (USB)	-	In the passenger compartment, under the front of the center console	• <u>Center Console Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X316 Instrument Panel Harness to Floor Console Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
X320	Driver Seat Harness to Body Harness (23 cavities)	-	In the passenger compartment, under the passenger seat	<u>Right Side of Passenger Compartment Harness Routing</u>	<u>X320 Driver Seat Harness to Body Harness</u>
X325	Headliner Harness to Instrument Panel Harness (22 cavities)	-	In the passenger compartment, at the base of the right side A-pillar trim	• <u>Headliner Harness Routing</u> • <u>Instrument Panel Harness Routing</u>	<u>X325 Headliner Harness to Instrument Panel Harness</u>
X340	Body Harness to Rear Seat Harness (4 cavities)	KA6	Under the right side of the rear seat cushion	-	<u>X340 Body Harness to Rear Seat Harness</u>
X350	Body Harness to Fuel System Harness (16 cavities)	-	Under the vehicle, to the right rear of the fuel tank	<u>Right Rear of Vehicle Harness Routing</u>	<u>X350 Body Harness to Fuel System Harness</u>
X351	Body Harness to Fuel System Harness (8 cavities)	-	Under the vehicle, near the right rear wheel well	<u>Right Rear of Vehicle Harness Routing</u>	<u>X351 Body Harness to Fuel System Harness</u>
X354	Fuel Tank Jumper to Fuel Jumper (6 cavities)	-	Under the vehicle, to the rear of the fuel tank, between the EVAP system and the fuel tank	-	<u>X354 Body Harness to Fuel Tank Harness</u>
X357	Body Harness to Battery Pack Jumper Harness (12 cavities)	-	Under the vehicle, at the front of the hybrid/EV battery pack	-	<u>X357 Body Harness to Battery Pack Jumper Harness</u>
X358	Body Harness to Battery Pack Jumper Harness (12 cavities)	-	Under the vehicle, at the front of the hybrid/EV battery pack	-	<u>X358 Body Harness to Battery Pack Jumper Harness</u>
X359	Auxiliary Battery Cable Harness to Battery Pack Jumper Harness (16 cavities)	-	• (EARLY) Beneath the hybrid/EV battery pack cover, at the top of the	<u>Hybrid/EV Battery Pack Harness Routing</u>	• <u>X359 Auxiliary Battery Cable Harness to Battery Pack Jumper Harness</u> • <u>X359 Battery Cable - High Voltage Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			forward most energy storage module. • (LATE) Beneath the hybrid/EV battery pack cover, at the top of the forward most energy storage module.		<u>to Hybrid/EV Powertrain Control Module Harness (LATE)</u>
X360	Body Harness to Battery Fuse Block Harness (4 cavities)	EARLY	Beneath the hybrid/EV battery pack cover, at the top of the forward most energy storage module.	<u>Hybrid/EV Battery Pack Harness Routing</u>	<u>X360 Auxiliary Battery Cable Harness to Battery Fuse Block Harness</u>
X400	Body Harness to Battery Fuse Block Harness (2 cavities)	-	In the luggage compartment, at the positive battery cable of the battery fuse block	-	<u>X400 Body Harness to Battery Fuse Block Harness</u>
X406	Body Harness to Body Harness (2 cavities)	-	In the luggage compartment, under the storage compartment floor, on the right side	<u>Right Rear of Passenger Compartment Harness Routing</u>	<u>X406 Body Harness to Body Harness</u>
X450	Rear Fascia Harness to Body Harness (20 cavities)	-	• (UFQ) At the rear of the vehicle, behind the left side	• <u>Left Rear of Vehicle Harness Routing</u> • <u>Rear Fascia Harness Routing</u>	• <u>X450 Rear Lamp Harness to Body Harness (UFQ)</u> • <u>X450 Rear Lamp Harness to Body Harness (-UFQ)</u>

Code	Name	Option	Location	Locator View	Connector End View
			of the rear fascia • (-UFQ) At the rear of the vehicle, behind the left side of the rear fascia		
X452	Body Harness to Negative Battery Cable Harness (2 cavities)	-	In the luggage compartment, under the storage compartment floor, near the battery current sensor	• <u>12V Battery Negative Harness Routing</u> • <u>Left Rear of Passenger Compartment Harness Routing</u>	<u>X452 Body Harness to Battery Cable Harness</u>
X500	Driver Door Harness to Body Harness (41 cavities)	-	In the passenger compartment, on the left side of the body, between the door hinges	• <u>Left Front Door Harness Routing</u> • <u>Left Side of Passenger Compartment Harness Routing</u>	<u>X500 Driver Door Harness to Body Harness</u>
X505	Driver Door Harness to Driver Door Trim Harness (22 cavities)	-	In the passenger compartment, behind the driver door panel	• <u>Left Front Door Harness Routing</u> • <u>Left Front Door Trim Harness Routing</u>	<u>X505 Driver Door Harness to Driver Door Trim Harness</u>
X510	Driver Door Harness to Outside Rear View Mirror Harness (12 cavities)	-	In the passenger compartment, behind the driver door panel	<u>Left Front Door Harness Routing</u>	<u>X510 Driver Door Harness to Outside Rear View Mirror Harness</u>
X600	Passenger Door Harness to Body Harness (41 cavities)	-	In the passenger compartment, on the right side of the body, between the door hinges	• <u>Right Front Door Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X600 Passenger Door Harness to Body Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
X605	Passenger Door Harness to Passenger Door Trim Harness (14 cavities)	-	In the passenger compartment, behind the passenger door panel	• <u>Right Front Door Harness Routing</u> • <u>Right Front Door Trim Harness Routing</u>	<u>X605 Passenger Door Harness to Passenger Door Trim Harness</u>
X610	Passenger Door Harness to Outside Rear View Mirror Harness (12 cavities)	-	In the passenger compartment, behind the passenger door panel	<u>Right Front Door Harness Routing</u>	<u>X610 Passenger Door Harness to Outside Rear View Mirror Harness</u>
X700	Left Rear Door Harness to Body Harness (20 cavities)	-	In the passenger compartment, behind the left B-pillar, between the door hinges	• <u>Left Rear Door Harness Routing</u> • <u>Left Side of Passenger Compartment Harness Routing</u>	<u>X700 Left Rear Door Harness to Body Harness</u>
X800	Right Rear Door Harness to Body Harness (20 cavities)	-	In the passenger compartment, behind the right B-pillar, between the door hinges	• <u>Right Rear Door Harness Routing</u> • <u>Right Side of Passenger Compartment Harness Routing</u>	<u>X800 Right Rear Door Harness to Body Harness</u>
X900	Liftgate Jumper Harness to Body Harness (8 cavities)	-	In the passenger compartment, above the rear of the headliner, between the hinges	<u>Roof Airbag Harness Routing</u>	<u>X900 Liftgate Jumper Harness to Body Harness</u>
X901	Liftgate Jumper Harness to Body Harness (2 cavities)	-	In the passenger compartment, above the rear of the headliner, between the hinges	-	<u>X901 Liftgate Jumper Harness to Body Harness</u>
X905	Liftgate Jumper Harness to Liftgate Harness (8 cavities)	-	In the liftgate, on the right side, behind the trim, near the glass	<u>Liftgate Harness Routing</u>	<u>X905 Liftgate Jumper Harness to Liftgate Harness</u>
X906	Liftgate Jumper Harness to Liftgate Harness (2 cavities)	-	In the liftgate, on the right side, behind the	<u>Liftgate Harness Routing</u>	<u>X906 Liftgate Jumper Harness to Liftgate Harness</u>

Code	Name	Option	Location	Locator View	Connector End View
			trim, near the glass		
G101	Forward Lamp Harness	-	In the engine compartment, on the front of the left frame rail, forward of G103	<u>G101</u>	-
G102	Forward Lamp Harness	-	In the engine compartment, on the front of the right frame rail, forward of G104	<u>G102</u>	-
G104	Forward Lamp Harness	-	In the engine compartment, on the front of the right frame rail, rear of G102	<u>G104 and G113</u>	-
G105	Cooling Fan Jumper Harness	-	In the engine compartment, on the front of the right frame rail, below the right front headlamp assembly	<u>G105</u>	-
G109	Engine Harness	-	In the engine compartment, above the left frame rail, on the left strut tower	<u>G109</u>	-
G110	Engine Harness	-	In the engine compartment, on the front of the right core support	<u>G110 and G112</u>	-
G112	Engine Harness	-	In the engine compartment, on the front right of the engine	<u>G110 and G112</u>	-
G113	Engine Harness	-	In the engine compartment,	<u>G104 and G113</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			on the rear of the transmission assembly		
G117	Body Harness	-	In the engine compartment, at the front of the left strut tower	<u>G117</u>	-
G122	Engine Extension Harness	-	In the engine compartment, on the engine, at the left side of the cylinder head	<u>G122</u>	-
G201	Instrument Panel Harness	-	In the passenger compartment, behind the instrument panel, above the brake pedal, on the instrument panel support	<u>G201 and G204</u>	-
G202	Instrument Panel Harness	-	In the passenger compartment, behind the right side of the instrument panel, above the glove box, on the instrument panel support	<u>G202</u>	-
G204	Instrument Panel Harness	-	In the passenger compartment, behind the center of the instrument panel, on the instrument panel support	<u>G201 and G204</u>	-
G205	Instrument Panel Harness	-	In the passenger compartment, behind the left side of the instrument panel, ground strap from body to instrument	<u>G205</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			panel support		
G301	Body Harness	-	In the passenger compartment, under the left front door sill trim	<u>G301</u>	-
G302	Body Harness	-	In the passenger compartment, under the right front door sill trim	<u>G302</u>	-
G304	Instrument Panel Harness	-	In the passenger compartment, under the center console, to the rear of the shifter	<u>G304</u>	-
G340	Hybrid/EV Battery Pack Contactor Harness	-	Under the vehicle, at the bottom of the hybrid/EV battery pack contactor assembly	<u>G340 and G341</u>	-
G341	Hybrid/EV Battery Pack Contactor Harness	-	Under the vehicle, at the bottom of the hybrid/EV battery pack contactor assembly	<u>G340 and G341</u>	-
G401	14V Power Module Harness	-	In the luggage compartment	-	-
G403	Body Harness	-	In the luggage compartment, behind the left trim panel below the fuse block - rear	<u>G403</u>	-
G404	Body Harness	-	In the luggage compartment, near the battery	-	-
G405	Body Harness	-	In the luggage compartment, behind the right trim panel	<u>G405</u>	-

Code	Name	Option	Location	Locator View	Connector End View
G406	Body Harness	-	In the luggage compartment, behind the right trim panel	<u>G406</u>	-
G408	Hybrid/EV Battery Pack	-	Under the vehicle, at the bottom rear of the hybrid/EV battery pack assembly	<u>G408 and G409</u>	-
G409	Hybrid/EV Battery Pack	-	Under the vehicle, at the bottom rear of the hybrid/EV battery pack assembly	<u>G408 and G409</u>	-
J100	Front Fascia Harness	-	In the front fascia harness approximately 13.6 cm (5.35 in) from the X100 and X101 breakout	<u>Front Fascia Harness Routing</u>	-
J101	Front Fascia Harness	-	In the front fascia harness approximately 21 cm (8.26 in) from the X100 and X101 breakout	<u>Front Fascia Harness Routing</u>	-
J102	Front Fascia Harness	TR6	In the front fascia harness approximately 11 cm (4.33 in) from the front object sensor - left middle connector breakout	-	-
J103	Left Headlamp Harness	TR6	In the left headlamp assembly	-	-
J104	Right Headlamp Harness	-	In the right headlamp assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
J110	Cooling Fan Jumper Harness	-	In the cooling fan jumper harness approximately 4.5 cm (1.77 in) from the X103 breakout	<u>Front of Engine Compartment Harness Routing</u>	-
J115	Left Headlamp Assembly Harness	-	In the left headlamp assembly jumper harness, ground splice for the lamps	<u>Front Fascia Harness Routing</u>	-
J116	Body Harness	-	In the passenger compartment, under the left front door sill trim	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J117	Body Harness	-	In the passenger compartment, under the right front door sill trim	<u>Right Side of Passenger Compartment Harness Routing</u>	-
J121	Right Headlamp Assembly Harness	-	In the right headlamp assembly jumper harness, ground splice for the lamps	-	-
J125	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) from the engine coolant temperature sensor breakout	<u>Engine Harness Routing</u>	-
J127	Engine Harness	-	In the engine harness, between J125 and J131	<u>Engine Harness Routing</u>	-
J128	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) from the power	<u>Engine Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			inverter module assembly cover connector breakout		
J129	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) in to the power inverter module assembly connector breakout	Engine Harness Routing	-
J131	Engine Harness	-	In the engine harness on the secondary air injection solenoid valve breakout approximately 10 cm (3.94 in) from secondary air injection solenoid valve connector	Engine Harness Routing	-
J133	Transmission Harness	-	Internal to the transmission, between the power inverter X4 connector and the drive motor 1 position sensor, approximately 4 cm (1.5 in) from the drive motor 1 position sensor breakout	-	-
J135	Engine Harness	-	In back of engine control module harness connector X1	Engine Harness Routing	-
J136	Engine Harness	-	In back of engine control module harness connector X2	Engine Harness Routing	-

Code	Name	Option	Location	Locator View	Connector End View
J137	Engine Harness	-	In back of engine control module harness connector X3	<u>Engine Harness Routing</u>	-
J139	Body Harness	-	In the engine compartment, near the left strut tower, approximately 11.8 cm (4.6 in) from the electronic brake control module X1 breakout	<u>Left Side of Engine Compartment Harness Routing</u>	-
J150	HVAC Harness	-	In the HVAC harness approximately 5 cm (1.96 in) from the HVAC control module X3 connector breakout	-	-
J200	Instrument Panel Harness	-	In the instrument panel harness, near the hood release handle, approximately 15 cm (5.9 in) from headlamp switch breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J201	Instrument Panel Harness	-	In the instrument panel harness, near the instrument panel fuse block	-	-
J218	Instrument Panel Harness	UQA	In the instrument panel harness, approximately 14.8 cm (5.83 in) from the blower motor connector breakout	-	-

Code	Name	Option	Location	Locator View	Connector End View
J220	Body Harness	-	In the body harness, approximately 8.9 cm (3.5 in) from the pedestrian alert sound control module connector breakout	-	-
J221	Instrument Panel Harness	KA1/KA6	In the instrument panel harness approximately 5 cm (1.96 in) from passenger instrument panel air bag breakout	<u>Instrument Panel Harness Routing</u>	-
J222	Body Harness	-	At the rear of the hybrid/EV battery pack compartment, on the left	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J223	Steering Wheel Harness	UVD	In the steering wheel harness, behind the driver airbag	-	-
J225	Steering Wheel Heater Harness	-	In the steering wheel harness, behind the driver airbag	-	-
J227	Instrument Panel Harness	-	In the instrument panel harness approximately 4.6 cm (1.81 in) in to the telematics communication interface control module connector breakout	-	-
J228	Instrument Panel Harness	UGN	In the instrument panel harness	-	-

Code	Name	Option	Location	Locator View	Connector End View
			approximately 4.6 cm (1.81 in) in to the telematics communication interface control module connector breakout		
J230	Body Harness	-	In the body harness, near the windshield wiper motor	-	-
J232	Instrument Panel Harness	-	In the instrument panel harness approximately 9.6 cm (3.77 in) from the G202 breakout	<u>Instrument Panel Harness Routing</u>	-
J233	Steering Wheel Harness	-	In the steering wheel harness	-	-
J234	Instrument Panel Harness	-	In the instrument panel harness approximately 50 cm (19.67 in) from the G204 breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J255	HVAC Harness	-	In the HVAC harness approximately 29 cm (11.4 in) from the HVAC control module X3 connector	-	-
J301	Body Harness	-	In the body harness approximately 23 cm (119.05 in) from the X500 breakout	<u>Left Side of Passenger Compartment Harness Routing</u>	-
J303	Body Harness	-	In the body harness approximately 15.7 cm (6.18	<u>Instrument Panel Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			in) from the X600 breakout		
J308	Body Harness	-	In the body harness approximately 28 cm (11.02 in) from the X700 breakout	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J310	Body Harness	-	In the body harness approximately 8.5 cm (3.34 in) from the X700 breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J314	Headliner Harness	-	In the headliner harness approximately 5 cm (1.96 in) from the breakout for the passenger air bag disable indicator breakout	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J316	Transmission Shift Lever Harness	-	Inside the transmission shift lever	-	-
J325	Instrument Panel Harness	-	In the instrument panel harness approximately 5 cm (1.96 in) from the X252 breakout	-	-
J326	Body Harness	-	In the body harness approximately 112 cm (44 in) from the transmission shift lever breakout	-	-
J328	Body Harness	-	In the passenger compartment, at the bottom of the left B-pillar	<u>Left Side of Passenger Compartment Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
J330	Passenger Seat Harness	-	In the passenger seat harness	-	-
J331	Passenger Seat Harness	-	In the passenger seat harness	-	-
J333	Body Harness	-	In the passenger compartment, under the left rear door sill trim	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J335	Driver Seat Harness	-	In the driver seat harness	-	-
J336	Driver Seat Harness	-	In the driver seat harness	-	-
J337	Driver Seat Harness	-	In the driver seat harness	-	-
J340	Rear Seat Harness	-	In the rear seat harness	-	-
J341	Rear Seat Harness	-	In the rear seat harness	-	-
J350	Headliner Harness	-	In the headliner harness approximately 5 cm (1.96 in) from the breakout for overhead console connectors	<u>Center Console Harness Routing</u>	-
J351	Headliner Harness	-	In the headliner harness approximately 6.3 cm (2.48 in) in to the breakout for the overhead console connectors	<u>Headliner Harness Routing</u>	-
J352	Headliner Harness	-	In the headliner harness approximately 16.2 cm (6.37 in) from the sunshade mirror lamp - right breakout	<u>Headliner Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
J353	Headliner Harness	-	In the headliner harness approximately 35.4 cm (13.93 in) from the sunshade mirror lamp - right breakout	<u>Headliner Harness Routing</u>	-
J354	Headliner Harness	-	In the headliner harness approximately 45.4 cm (17.87 in) from the sunshade mirror lamp - Right breakout	<u>Headliner Harness Routing</u>	-
J355	Body Harness	-	In the body harness approximately 45 cm (18.89 in) from the G302 breakout	-	-
J376	Body Harness	-	In the body harness, approximately 31 cm (12.20 in) from the terminating resistor - high speed bus breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J377	Body Harness	-	In the body harness, approximately 35.6 cm (14.02 in) from the terminating resistor - high speed bus breakout	<u>Right Rear of Passenger Compartment Harness Routing</u>	-
J400	Body Harness	-	In the luggage compartment, on the body harness approximately 38.9 cm (15.31 in) from the	<u>Left Side of Luggage Compartment Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			G403 breakout		
J402	Body Harness	-	In the body harness approximately 32 cm (12.59 in) from the seat belt switch - left rear	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J407	Body Harness	UKC	In the passenger compartment, at the left C-pillar	<u>Left Rear of Passenger Compartment Harness Routing</u>	-
J409	Rear Fascia Harness	-	Behind the left side of the rear bumper cover	<u>Rear Fascia Harness Routing</u>	-
J420	High Voltage Battery Charger Harness	-	In the high voltage battery charger harness, in the luggage compartment, approximately 18.3 cm (7.2 in) from the battery charger X2 and X3 connector breakout	-	-
J421	High Voltage Battery Charger Harness	-	In the high voltage battery charger harness, in the luggage compartment, approximately 28.3 cm (11.14 in) from the battery charger X2 and X3 connector breakout	-	-
J450	Left Tail Lamp Harness	-	In the left tail lamp harness	-	-
J451	Rear Fascia Harness	-	In the rear fascia harness approximately 22.8 cm (8.97 in) in to the backup lamp connector	<u>Rear Fascia Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			breakout		
J452	Rear Fascia Harness	-	In the rear fascia harness in the X450 and X451 breakout approximately 5 cm (1.96 in) from X451	-	-
J453	Rear Fascia Harness	-	In the rear fascia harness approximately 9 cm (3.54 in) from rear object sensor - left middle connector breakout	<u>Rear Fascia Harness Routing</u>	-
J455	Rear Fascia Harness	-	In the rear fascia harness approximately 5 cm (1.96 in) from the license plate lamp - left connector breakout	<u>Rear Fascia Harness Routing</u>	-
J456	Rear Fascia Harness	-	In the rear fascia harness approximately 7.5 cm (2.95 in) from the rearview camera connector breakout	<u>Rear Fascia Harness Routing</u>	-
J505	Driver Door Trim Harness	UKC	In the driver door trim harness approximately 7.1 cm (2.79 in) from driver door handle flood lamp connector	-	-
J510	Driver Outside Rearview Mirror Harness	-	In the driver outside rearview mirror harness	-	-
J514	Driver Door Harness	-	In the left front door harness	<u>Left Front Door Harness Routing</u>	-

Code	Name	Option	Location	Locator View	Connector End View
			approximately 8.3 cm (3.26 in) from the X510 connector breakout		
J515	Driver Door Harness	-	In the left front door harness approximately 8.3 cm (3.26 in) from the X510 connector breakout	<u>Left Front Door Harness Routing</u>	-
J516	Driver Door Harness	-	In the left front door harness approximately 3.5 cm (1.38 in) from the X510 connector breakout	-	-
J517	Driver Door Trim Harness	-	In the left door trim harness approximately 12.3 cm (4.84 in) from X505 connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J518	Driver Door Trim Harness	-	In the left door trim harness approximately 16.3 cm (6.41 in) from X505 connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J519	Driver Door Trim Harness	-	In the left door trim harness approximately 6.5 cm (2.55 in) from the outside rearview mirror switch connector breakout	<u>Left Front Door Trim Harness Routing</u>	-
J520	Body Harness	-	In the body harness, approximately 45 cm (17.72 in)	-	-

Code	Name	Option	Location	Locator View	Connector End View
			from the transmission shift lever connector breakout		
J605	Passenger Door Trim Harness	UKC	In the passenger door trim harness approximately 5.1 cm (2 in) from the X605 connector	-	-
J610	Passenger Outside Rearview Mirror Harness	-	In the passenger outside rearview mirror harness	-	-
J611	Passenger Door Harness	-	In the right front door harness approximately 24.4 cm (9.60 in) from the X610 connector breakout	<u>Right Front Door Harness Routing</u>	-
J615	Passenger Door Harness	-	In the right front door harness approximately 12.2 cm (4.80 in) from the X610 connector breakout	<u>Right Front Door Harness Routing</u>	-
J618	Passenger Door Trim Harness	-	In the passenger door trim harness approximately 8.8 cm (3.46 in) from the passenger door lock switch connector	-	-
J720	Left Rear Door Harness	-	In the left rear door trim harness approximately 34.3 cm (13.5 in) from the left rear window switch breakout	-	-

Code	Name	Option	Location	Locator View	Connector End View
J820	Right Rear Door Harness	-	In the right rear door trim harness approximately 34.3 cm (13.5 in) from the right rear window switch breakout	-	-
J902	Liftgate Harness	-	In the liftgate harness approximately 11.4 cm (4.48 in) from the rear defogger grid connector breakout	<u>Liftgate Harness Routing</u>	-
J908	Rear Fascia Harness	-	Behind the left side of the rear bumper cover	<u>Rear Fascia Harness Routing</u>	-
J920	Right Tail Lamp Harness	-	In the right tail lamp harness	-	-

Article GUID: A00884676

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Passenger Compartment/Roof Component Views - Volt

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

PASSENGER COMPARTMENT COMPONENTS (1 OF 3)

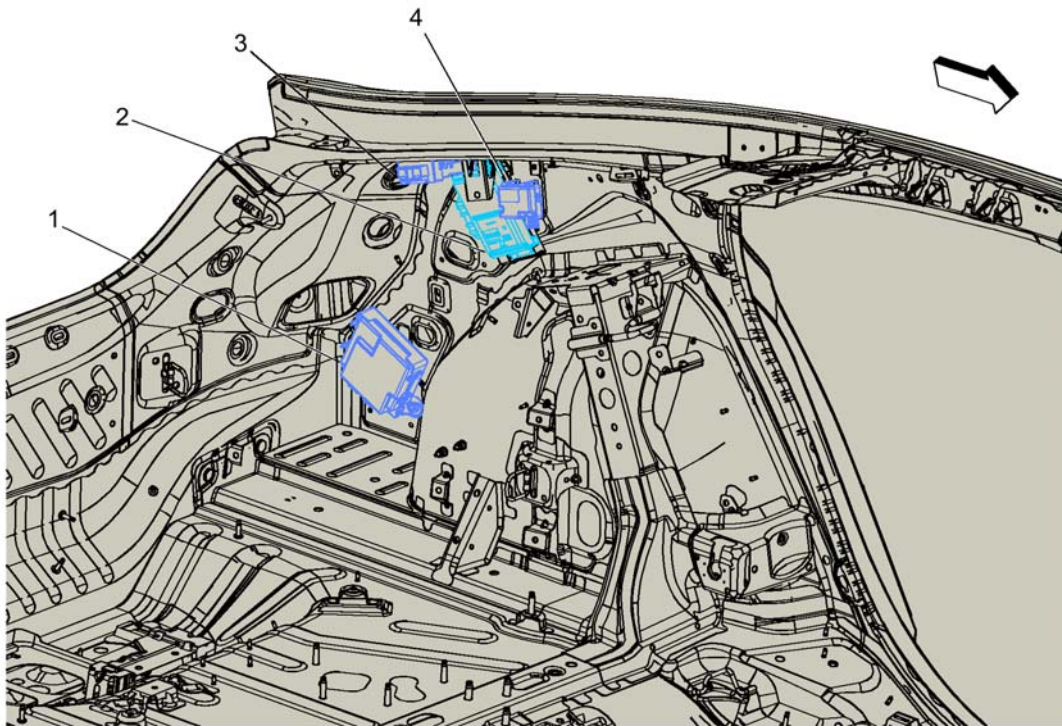


Fig. 1: Passenger Compartment Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K84 Keyless Entry Control Module K84 Keyless Entry Control Module X1 K84 Keyless Entry Control Module X2
2. K124 Active Safety Control Module (UGN) K124 Active Safety Control Module X1 K124 Active Safety Control Module X2
3. K182 Parking Assist Control Module (UFQ) K182 Parking Assist Control Module X1 K182 Parking Assist Control Module X2 K182 Parking Assist Control Module X3
4. K77 Remote Control Door Lock Receiver K77 Remote Control Door Lock Receiver

PASSENGER COMPARTMENT COMPONENTS (2 OF 3)

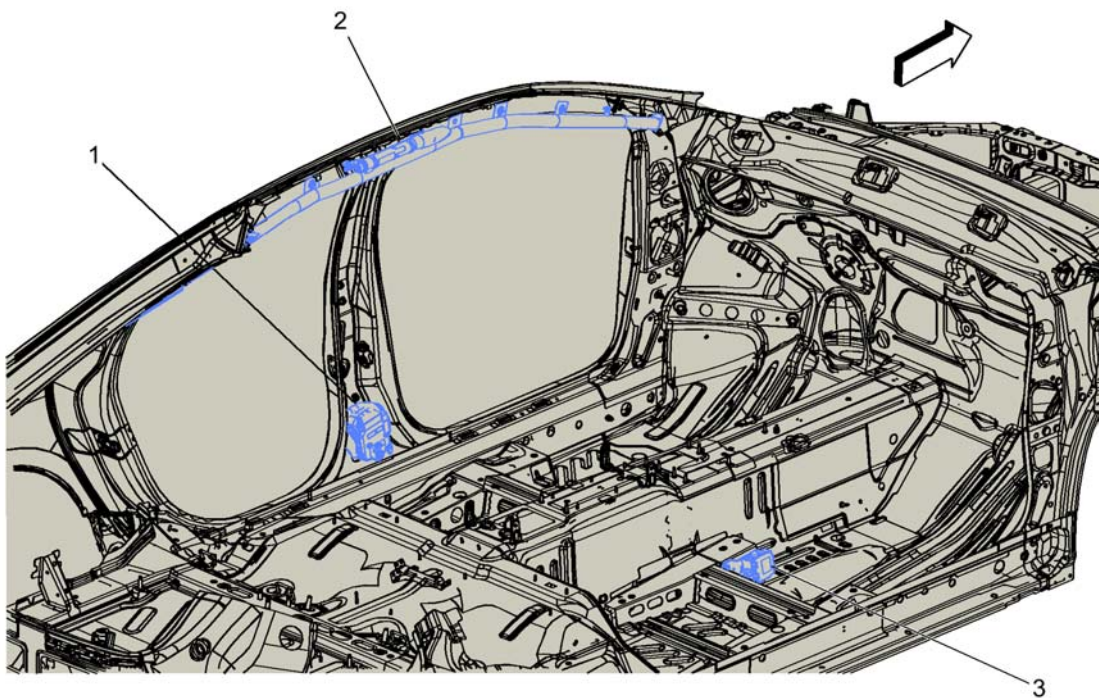


Fig. 2: Passenger Compartment Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. F112D Seat Belt Retractor Pretensioner - Driver <u>F112D Seat Belt Retractor Pretensioner - Driver</u>
2. F105L Roof Rail Air Bag - Left <u>F105L Roof Rail Air Bag - Left</u>
3. K132 Pedestrian Alert Sound Control Module <u>K132 Pedestrian Alert Sound Control Module</u>

PASSENGER COMPARTMENT COMPONENTS (3 OF 3)

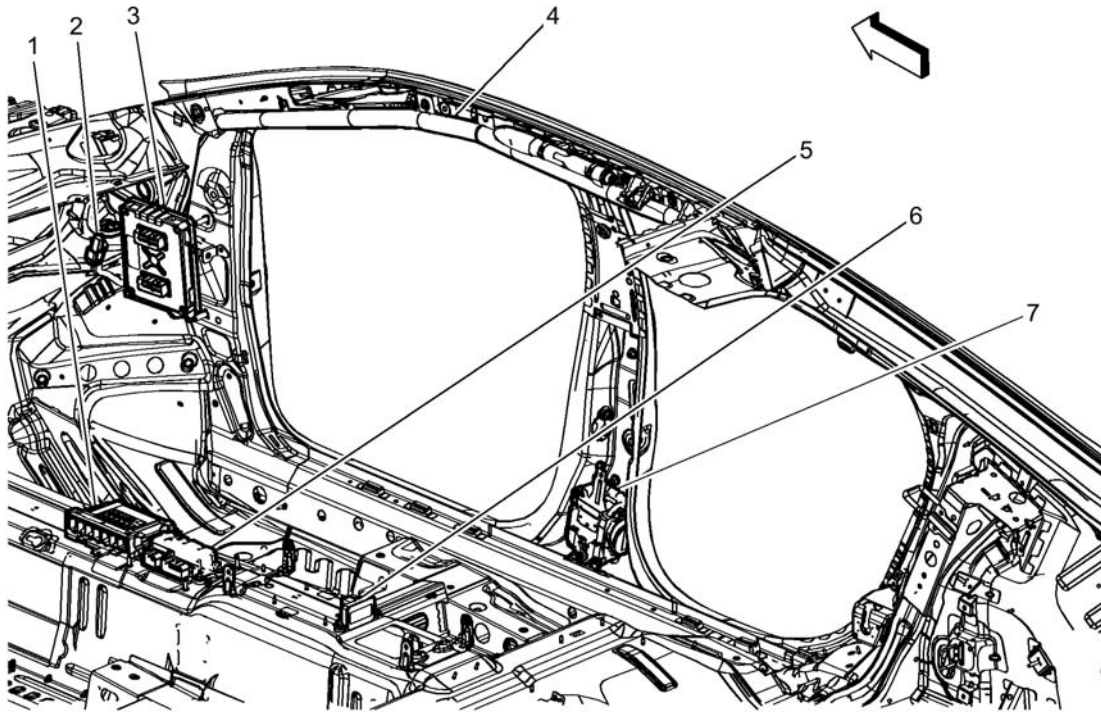


Fig. 3: Passenger Compartment Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. K9 Body Control Module <u>K9 Body Control Module X1</u> <u>K9 Body Control Module X2</u> <u>K9 Body Control Module X3</u> <u>K9 Body Control Module X4</u> <u>K9 Body Control Module X5</u> <u>K9 Body Control Module X6</u> <u>K9 Body Control Module X7</u>
2. R6A Terminating Resistor - High Speed Bus <u>R6A Terminating Resistor - High Speed Bus</u>
3. K114B Hybrid/EV Powertrain Control Module 2 <u>K114B Hybrid/EV Powertrain Control Module 2 X1</u> <u>K114B Hybrid/EV Powertrain Control Module 2 X2</u>
4. F105R Roof Rail Air Bag - Right <u>F105R Roof Rail Air Bag - Right</u>
5. K36 Inflatable Restraint Sensing and Diagnostic Module <u>K36 Inflatable Restraint Sensing and Diagnostic Module X1</u> <u>K36 Inflatable Restraint Sensing and Diagnostic Module X2</u>
6. B284 Vehicle Dynamic Sensor <u>B284 Vehicle Dynamic Sensor</u>
7. F112P Seat Belt Retractor Pretensioner - Passenger <u>F112P Seat Belt Retractor Pretensioner - Passenger</u>

HEADLINER COMPONENTS (1 OF 4)

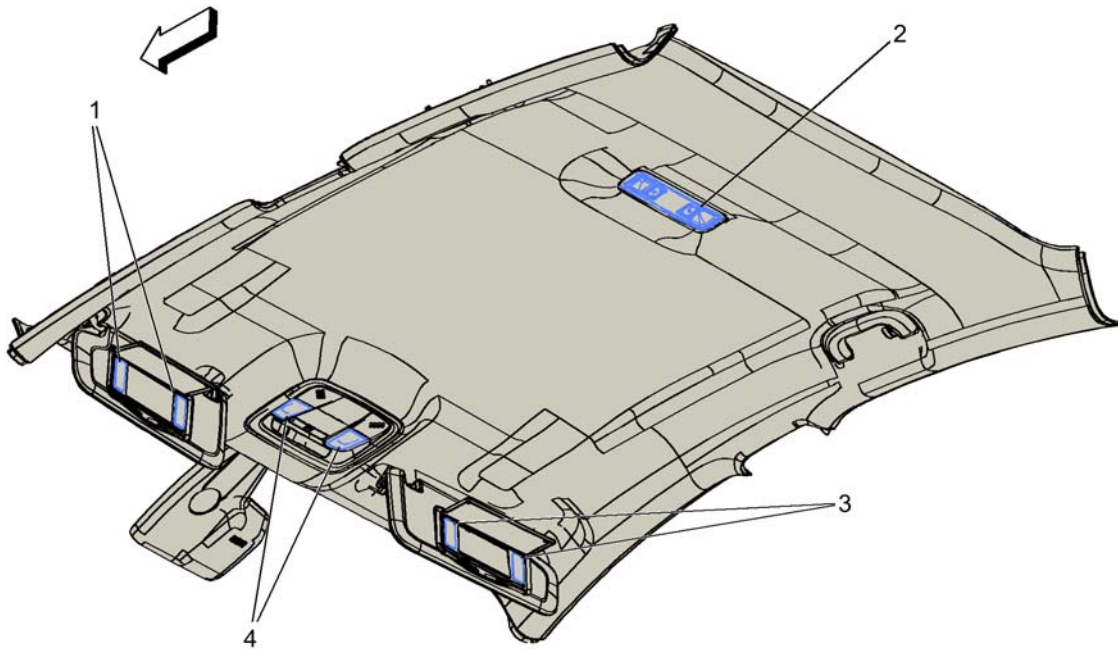


Fig. 4: Headliner Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E31L Sunshade Mirror Lamp - Left <u>E31L Sunshade Mirror Lamp - Left</u>
2. E37R Dome/Reading Lamps - Rear <u>E37R Dome/Reading Lamps - Rear</u>
3. E31R Sunshade Mirror Lamp - Right <u>E31R Sunshade Mirror Lamp - Right</u>
4. E37F Dome/Reading Lamps - Front

HEADLINER COMPONENTS (2 OF 4)

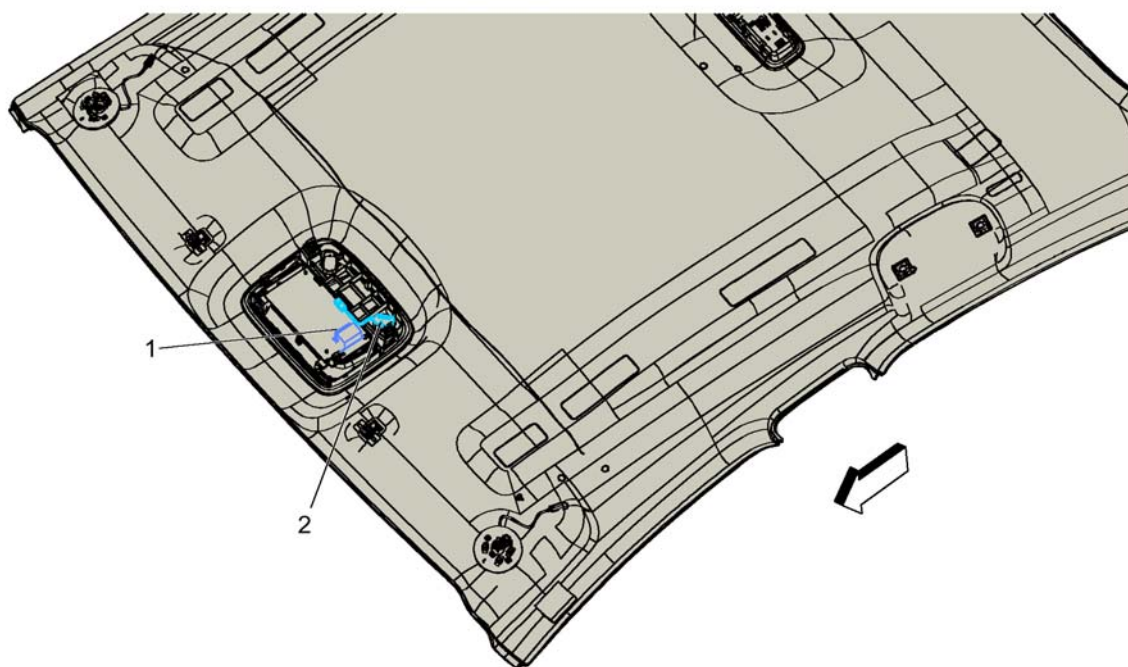


Fig. 5: Headliner Components (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items	
1. S48B Multifunction Switch - Overhead Console	<u>S48B Multifunction Switch - Overhead Console</u>
2. B24 Cellular Phone Microphone	<u>B24 Mobile Telephone Microphone</u>

HEADLINER COMPONENTS (3 OF 4)

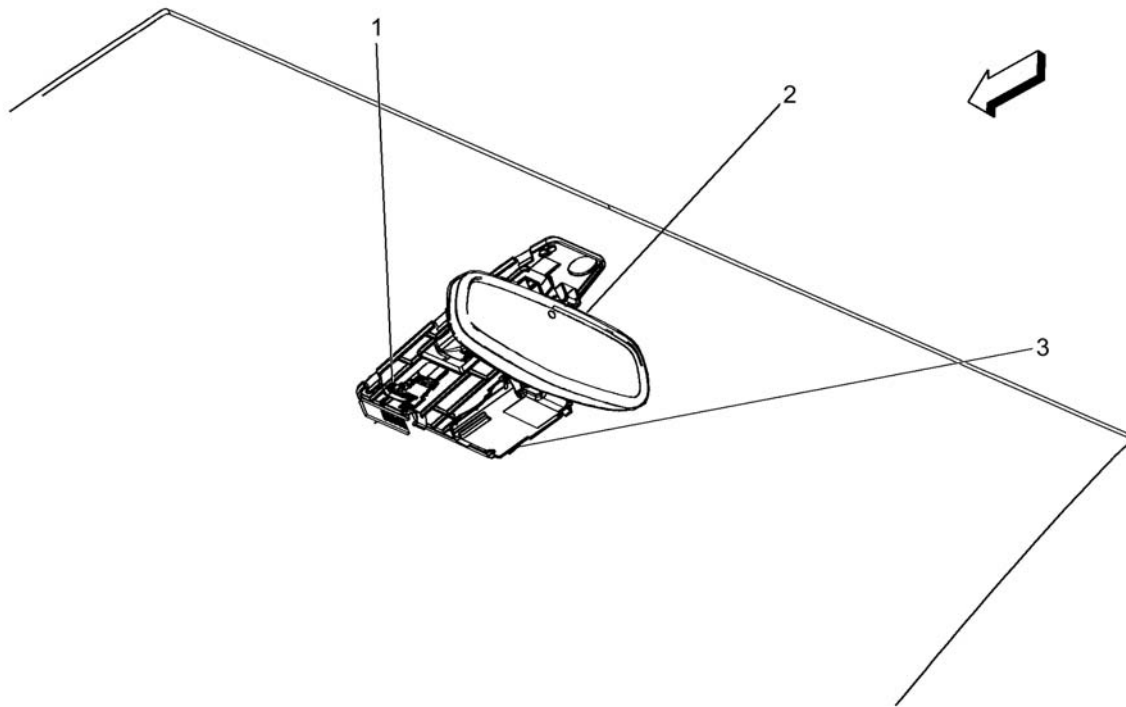


Fig. 6: Headliner Components (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B160 Windshield Temperature and Inside Moisture Sensor <u>B160 Windshield Temperature and Inside Moisture Sensor</u>
2. A10 Inside Rearview Mirror <u>A10 Inside Rearview Mirror</u>
3. K109 Frontview Camera Module (UHY) <u>K109 Frontview Camera Module</u>

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

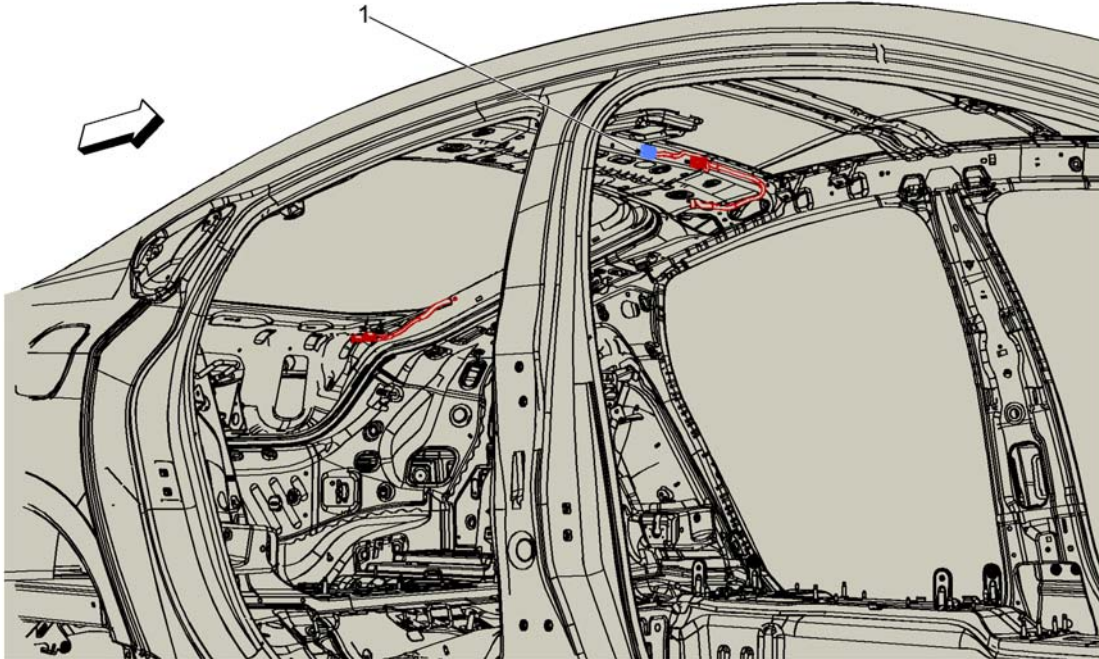


Fig. 7: Headliner Components (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. E18 Rear Defogger Grid <u>E18 Rear Defogger Grid X1</u> <u>E18 Rear Defogger Grid X2</u>

REAR SEAT COMPONENTS (1 OF 3)

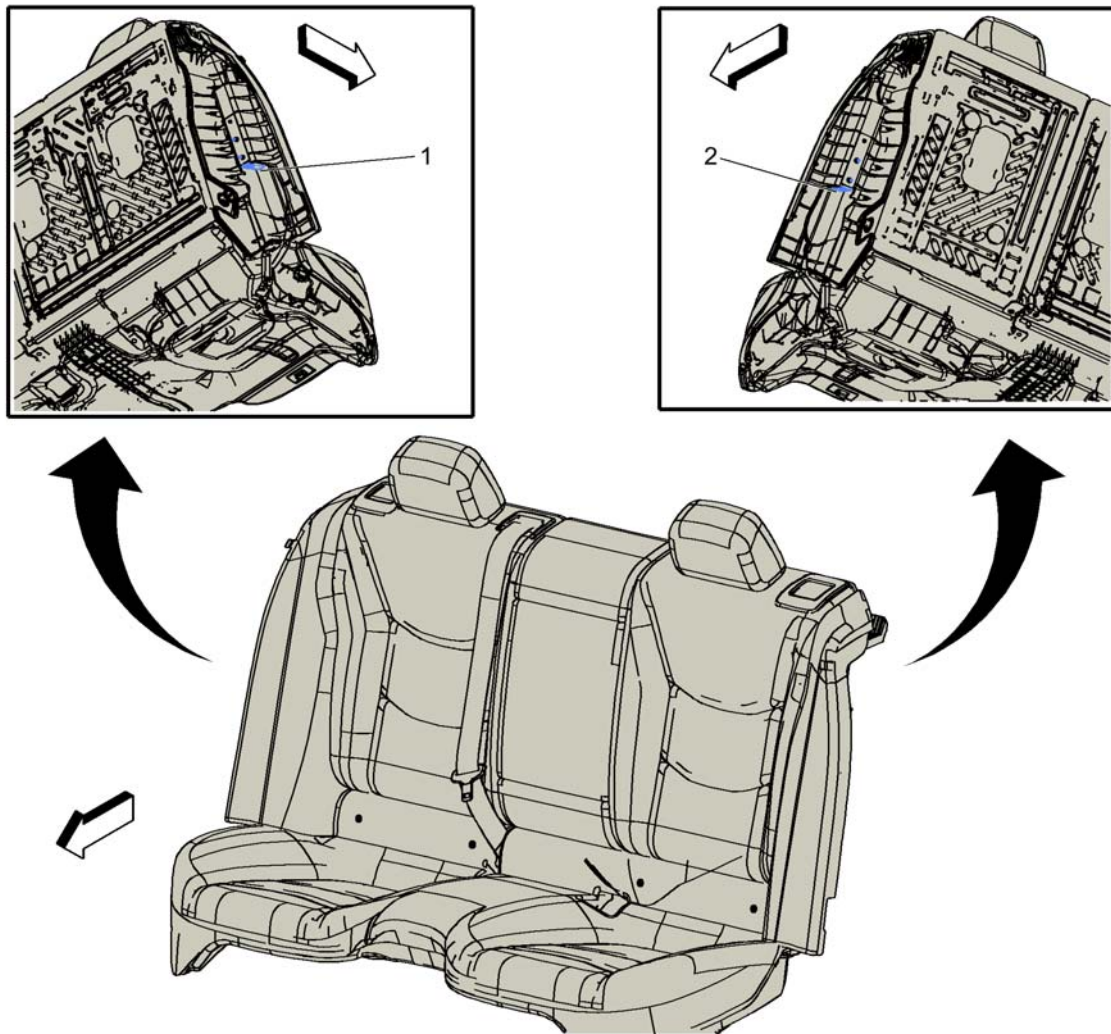


Fig. 8: Rear Seat Components (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items	
1. F106RR Seat Side Air Bag - Right Rear	<u>F106RR Seat Side Air Bag - Right Rear</u>
2. F106LR Seat Side Air Bag - Left Rear	<u>F106LR Seat Side Air Bag - Left Rear</u>

REAR SEAT COMPONENTS (2 OF 3)

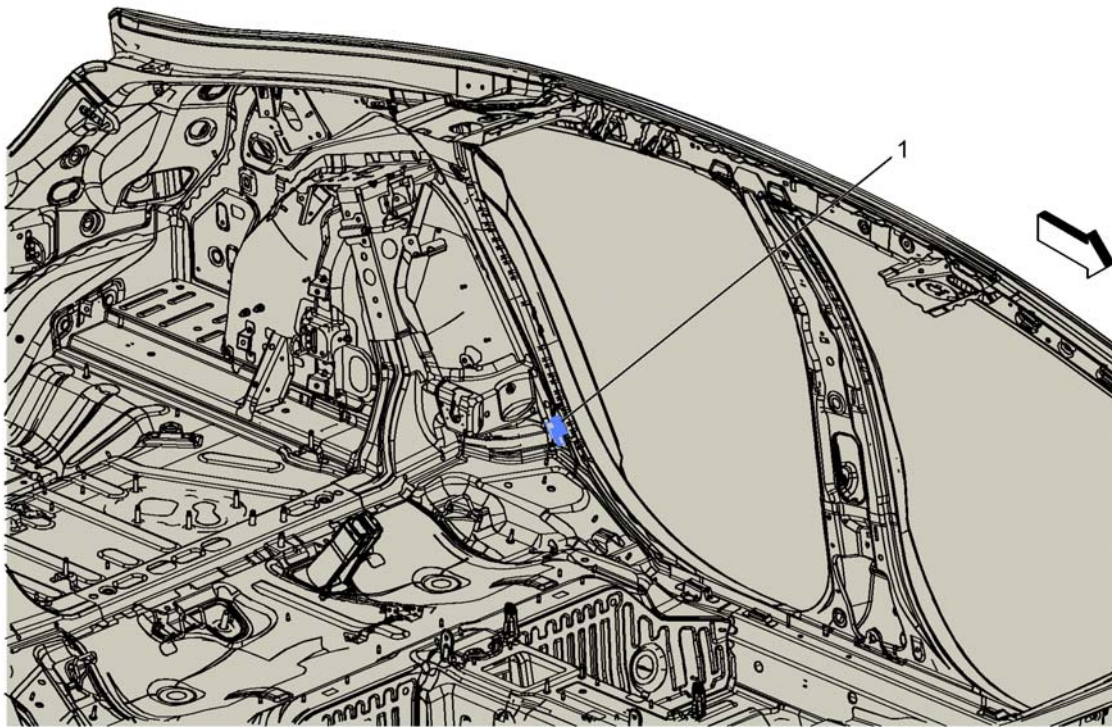


Fig. 9: Rear Seat Components (2 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B63LR Side Impact Sensor - Left Rear <u>B63LR Side Impact Sensor - Left Rear</u>

REAR SEAT COMPONENTS (3 OF 3)

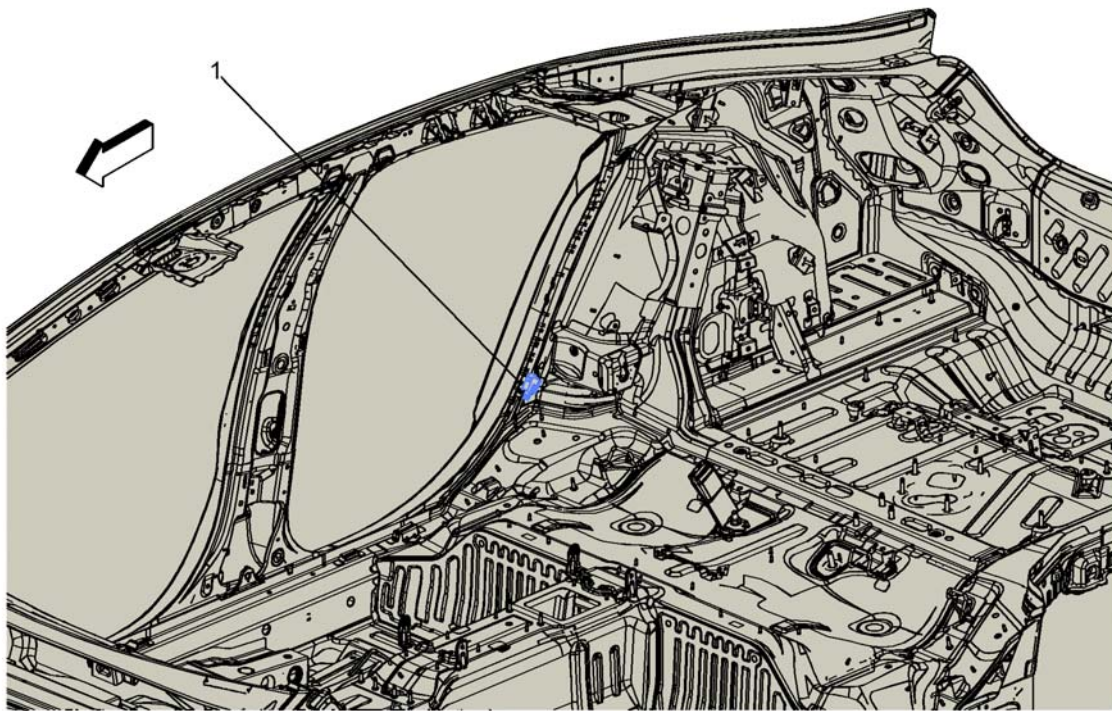


Fig. 10: Rear Seat Components (3 of 3)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B63RR Side Impact Sensor - Right Rear <u>B63RR Side Impact Sensor - Right Rear</u>

Article GUID: A00884713

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Powertrain Component Views - Volt

POWERTRAIN COMPONENT VIEWS

RIGHT FRONT OF ENGINE COMPONENTS (1 OF 2)

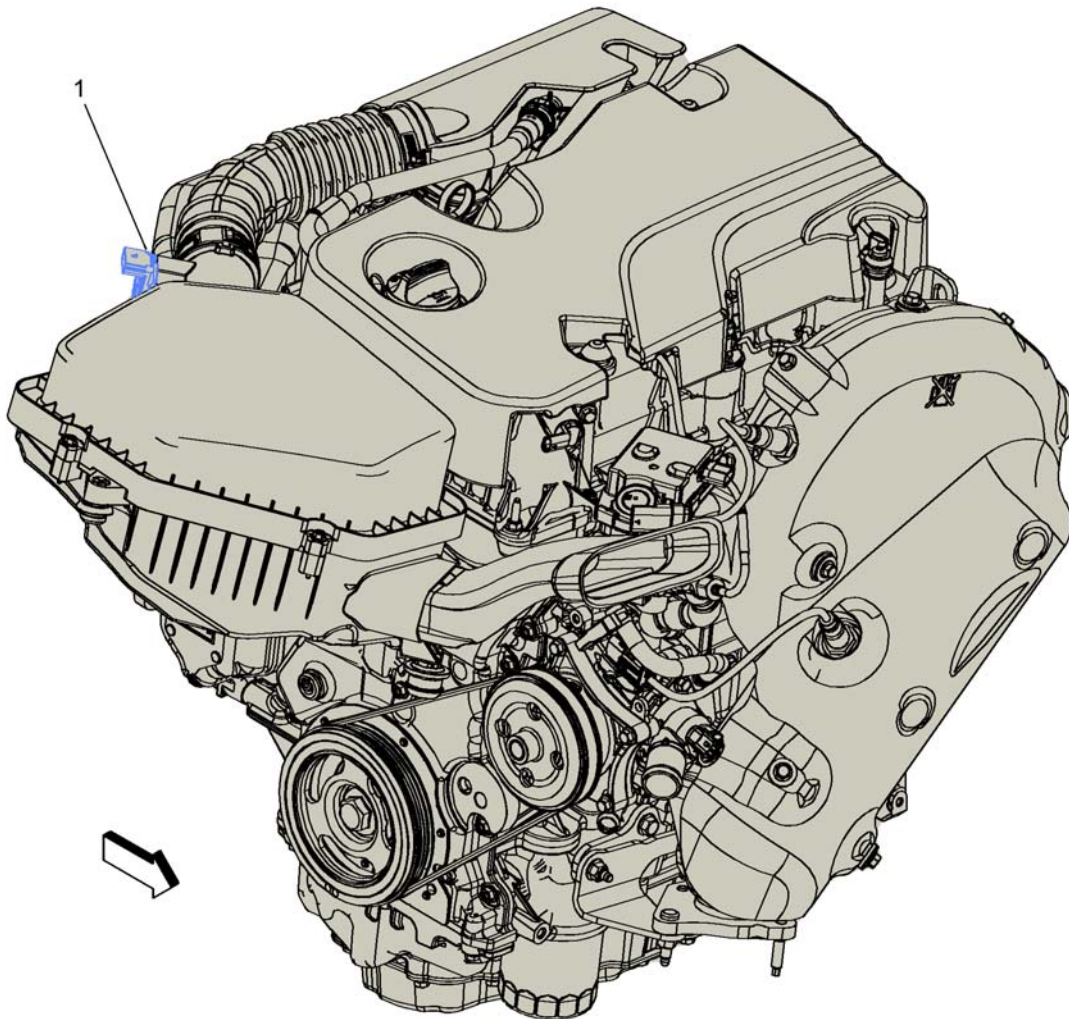


Fig. 1: Right Front of Engine Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B75C Multifunction Intake Air Sensor B75C Multifunction Intake Air Sensor

RIGHT FRONT OF ENGINE COMPONENTS (2 OF 2)

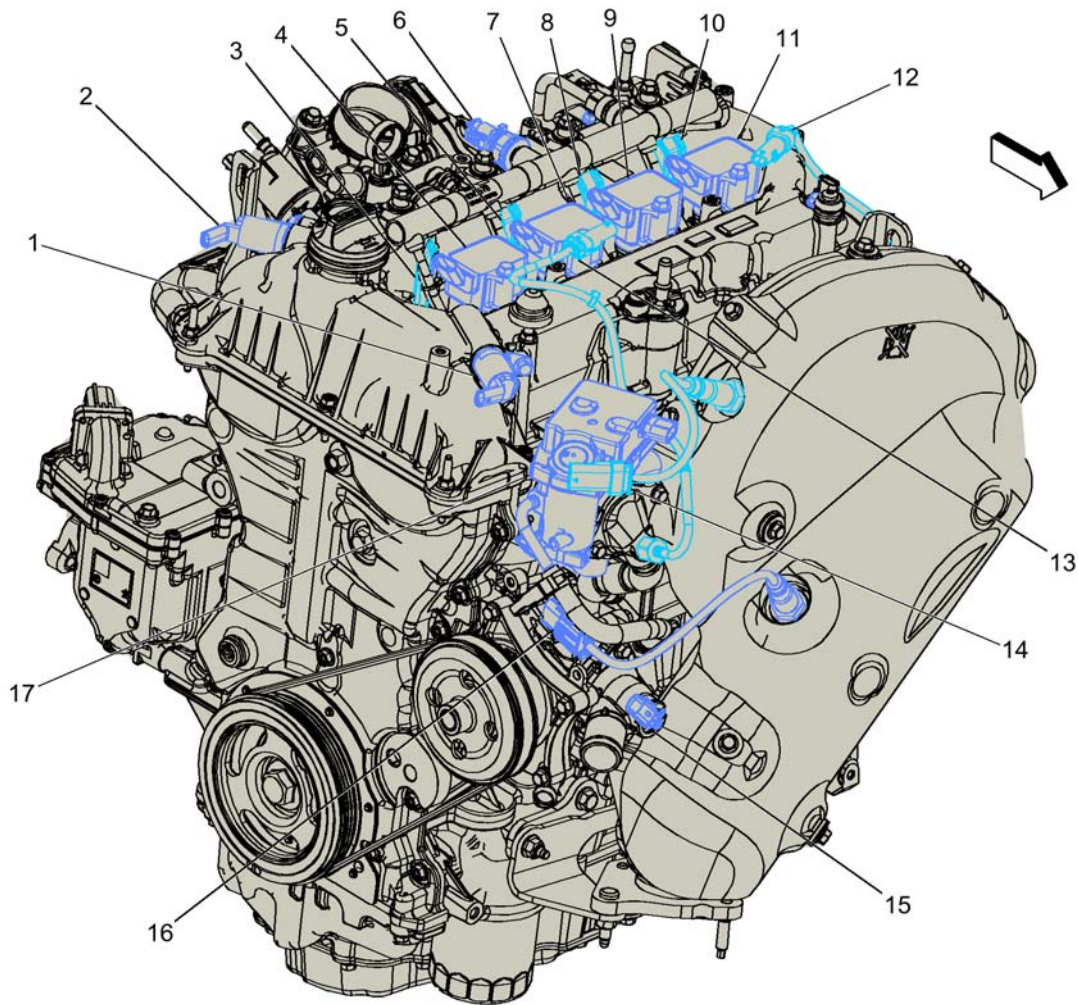


Fig. 2: Right Front of Engine Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. Q6E Camshaft Position Actuator Solenoid Valve - Exhaust <u>Q6E Camshaft Position Actuator Solenoid Valve - Exhaust</u>
2. Q6F Camshaft Position Actuator Solenoid Valve - Intake <u>Q6F Camshaft Position Actuator Solenoid Valve - Intake</u>
3. Q17A Fuel Injector 1 <u>Q17A Fuel Injector 1</u>
4. T8A Ignition Coil 1 <u>T8A Ignition Coil 1</u>
5. Q17B Fuel Injector 2 <u>Q17B Fuel Injector 2</u>
6. B310 Fuel Pressure/Temperature Sensor <u>B310 Fuel Pressure/Temperature Sensor</u>
7. T8B Ignition Coil 2 <u>T8B Ignition Coil 2</u>
8. Q17C Fuel Injector 3 <u>Q17C Fuel Injector 3</u>
9. T8C Ignition Coil 3 <u>T8C Ignition Coil 3</u>
10. Q17D Fuel Injector 4 <u>Q17D Fuel Injector 4</u>
11. T8D Ignition Coil 4 <u>T8D Ignition Coil 4</u>

Items
12. B130B Exhaust Gas Recirculation Temperature Sensor 2 <u>B130B Exhaust Gas Recirculation Temperature Sensor 2</u>
13. B130A Exhaust Gas Recirculation Temperature Sensor 1 <u>B130A Exhaust Gas Recirculation Temperature Sensor 1</u>
14. B52A Heated Oxygen Sensor 1 <u>B52A Heated Oxygen Sensor 1</u>
15. E41 Engine Coolant Thermostat Heater <u>E41 Engine Coolant Thermostat Heater</u>
16. B52B Heated Oxygen Sensor 2 <u>B52B Heated Oxygen Sensor 2</u>
17. Q14 Exhaust Gas Recirculation Valve <u>Q14 Exhaust Gas Recirculation Valve</u>

LEFT FRONT OF ENGINE COMPONENTS

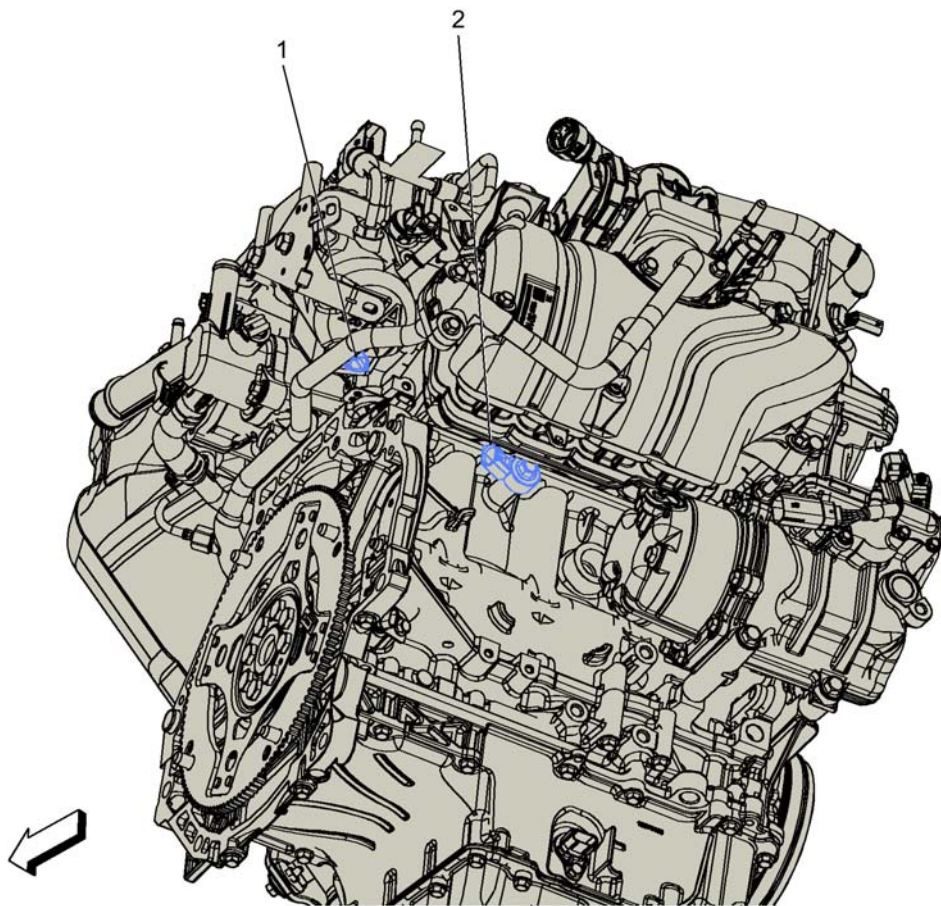


Fig. 3: Left Front of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. G18 High Pressure Fuel Pump <u>G18 High Pressure Fuel Pump</u>
2. B68 Knock Sensor <u>B68 Knock Sensor</u>

RIGHT REAR OF ENGINE COMPONENTS

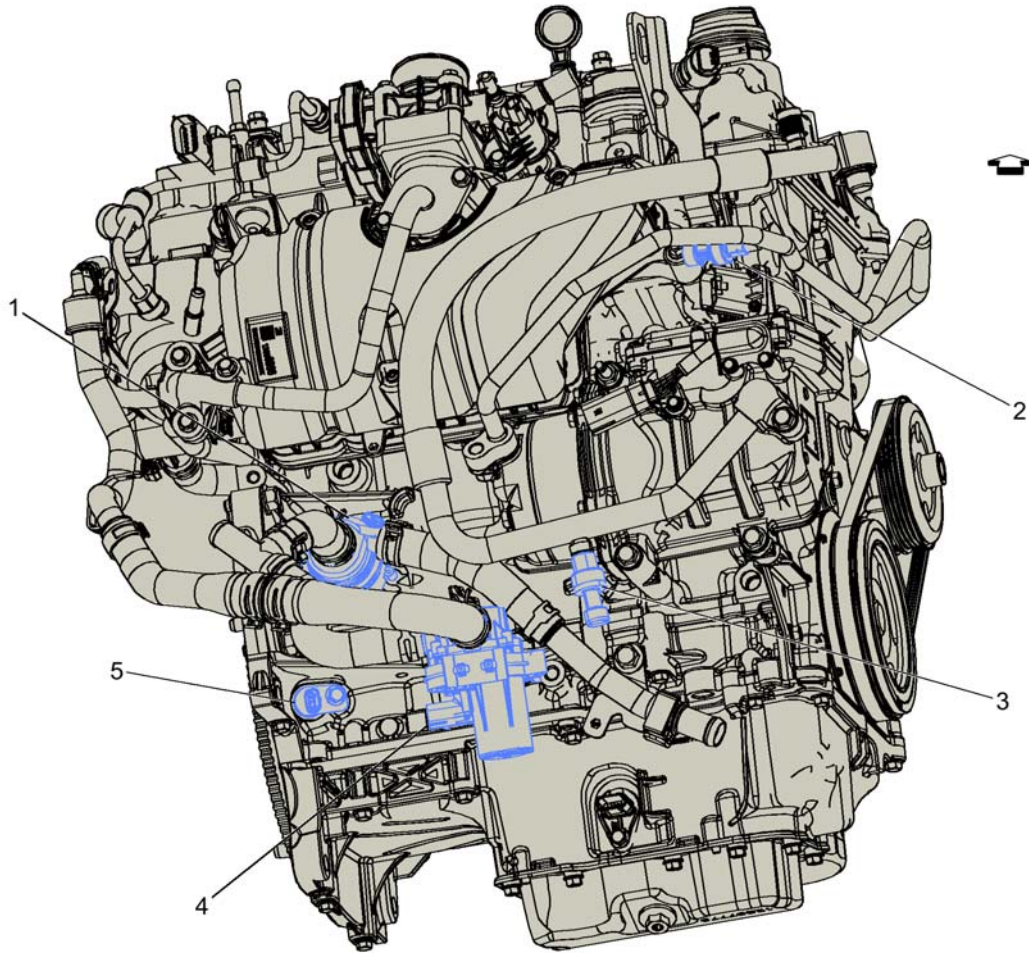


Fig. 4: Right Rear of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. G36 Auxiliary Heater Coolant Pump <u>G36 Auxiliary Heater Coolant Pump</u>
2. B1 A/C Refrigerant Pressure Sensor <u>B1 A/C Refrigerant Pressure Sensor</u>
3. B1C A/C Low Side Pressure Sensor <u>B1C A/C Low Side Pressure Sensor</u>
4. Q66 Passenger Compartment Heater Coolant Control Valve <u>Q66 Passenger Compartment Heater Coolant Control Valve</u>
5. B26 Crankshaft Position Sensor <u>B26 Crankshaft Position Sensor</u>

LEFT REAR OF ENGINE COMPONENTS

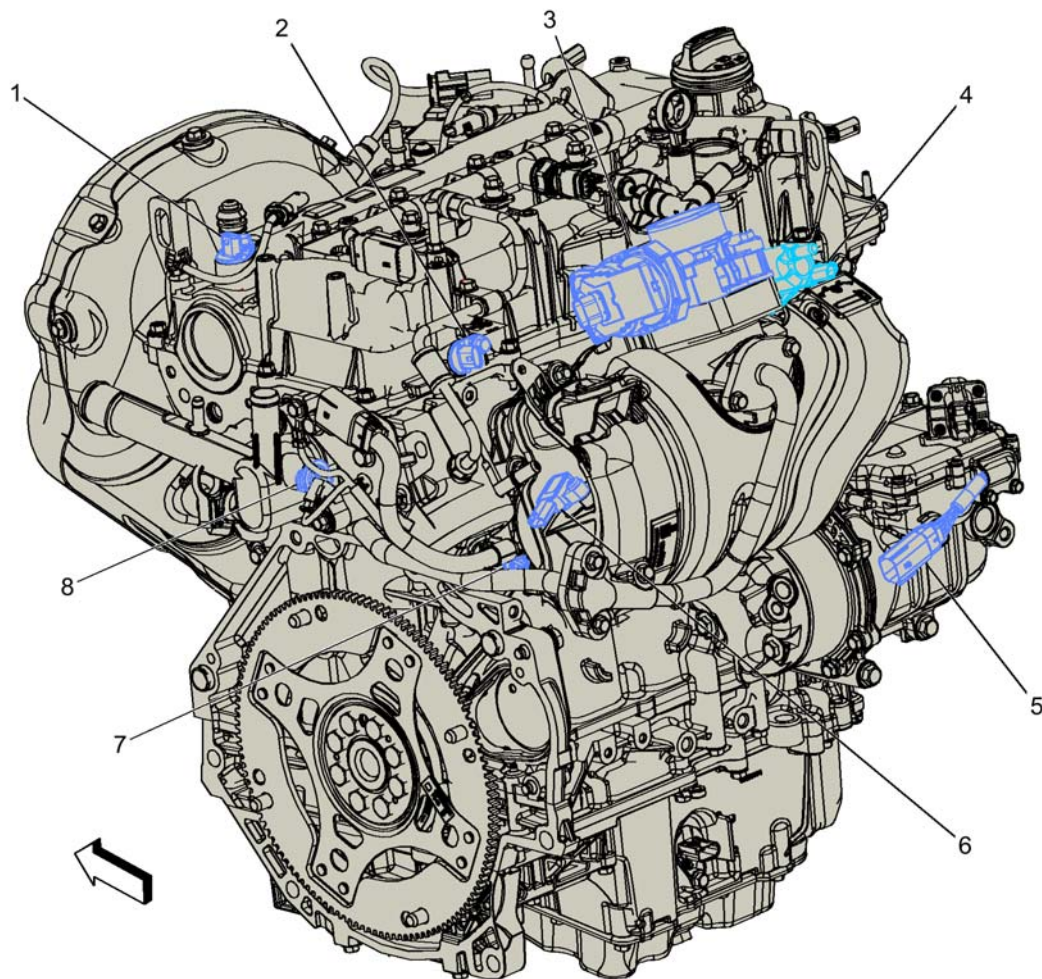


Fig. 5: Left Rear of Engine Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. B23E Camshaft Position Sensor - Exhaust <u>B23E Camshaft Position Sensor - Exhaust</u>
2. B23F Camshaft Position Sensor - Intake <u>B23F Camshaft Position Sensor - Intake</u>
3. Q38 Throttle Body <u>Q38 Throttle Body</u>
4. Q12 Evaporative Emission Purge Solenoid Valve <u>Q12 Evaporative Emission Purge Solenoid Valve</u>
5. G1 A/C Compressor <u>G1 A/C Compressor X1</u> <u>G1 A/C Compressor X2</u>
6. B74 Manifold Absolute Pressure Sensor <u>B74 Manifold Absolute Pressure Sensor</u>
7. B37B Engine Oil Pressure Sensor <u>B37B Engine Oil Pressure Sensor</u>
8. B34 Engine Coolant Temperature Sensor <u>B34 Engine Coolant Temperature Sensor</u>

LEFT REAR OF ENGINE/TRANSMISSION COMPONENTS

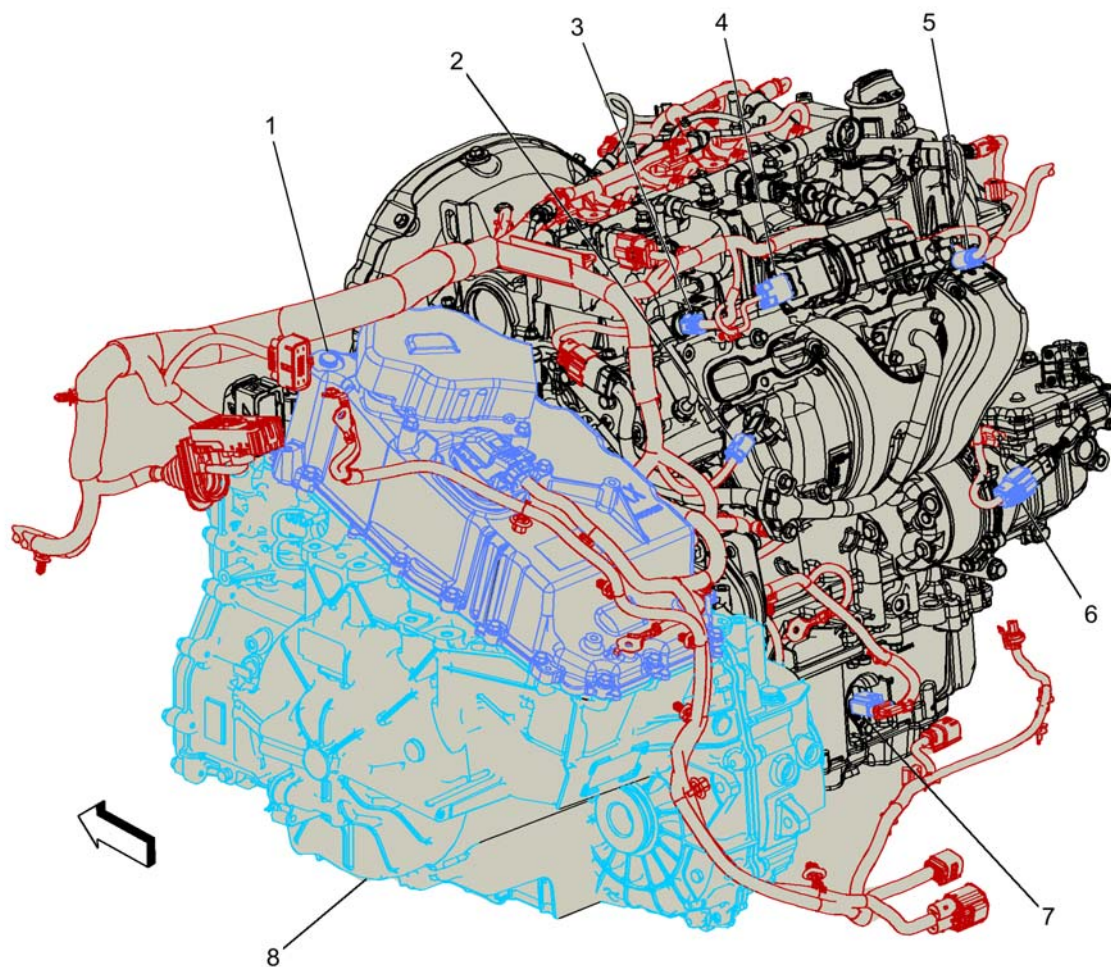


Fig. 6: Left Rear of Engine/Transmission Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. T6 Power Inverter Module <u>T6 Power Inverter Module X1</u> <u>T6 Power Inverter Module X2</u> <u>G5 Transmission Fluid Pump - Electric/Auxiliary</u> <u>T6 Power Inverter Module X4</u>
2. B74 Manifold Absolute Pressure Sensor <u>B74 Manifold Absolute Pressure Sensor</u>
3. B23F Camshaft Position Sensor - Intake <u>B23F Camshaft Position Sensor - Intake</u>
4. Q38 Throttle Body <u>Q38 Throttle Body</u>
5. Q12 Evaporative Emission Purge Solenoid Valve <u>Q12 Evaporative Emission Purge Solenoid Valve</u>
6. G1 A/C Compressor <u>G1 A/C Compressor X1</u> <u>G1 A/C Compressor X2</u>
7. Q44 Engine Oil Pressure Control Solenoid Valve <u>Q44 Engine Oil Pressure Control Solenoid Valve</u>
8. T12 Automatic Transmission Assembly

TRANSMISSION COMPONENTS

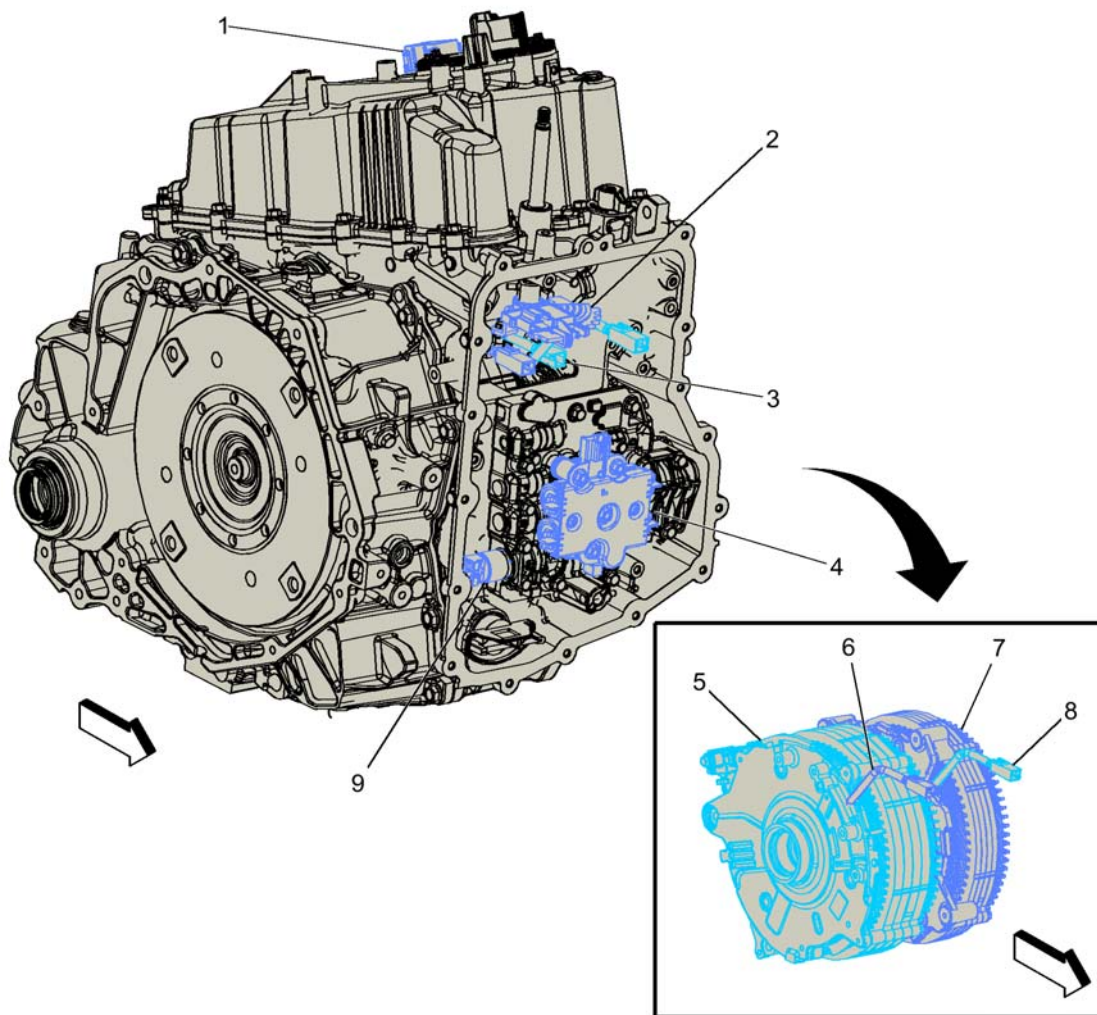


Fig. 7: Transmission Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. T6 Power Inverter Module T6 Power Inverter Module X1 T6 Power Inverter Module X2 G5 Transmission Fluid Pump - Electric/Auxiliary T6 Power Inverter Module X4
2. B15 Transmission Internal Mode Switch B15 Transmission Internal Mode Switch
3. B14A Transmission Output Shaft Speed Sensor B14A Transmission Output Shaft Speed Sensor
4. Q8 Control Solenoid Valve Assembly Q8 Control Solenoid Valve Assembly
5. M15B Drive Motor 2
6. B228B Drive Motor 2 Position Sensor B228B Drive Motor 2 Position Sensor
7. M15A Drive Motor 1
8. B228A Drive Motor 1 Position Sensor B228A Drive Motor 1 Position Sensor
9. Q23 Line Pressure Control Solenoid Valve Q23 Line Pressure Control Solenoid Valve

SYSTEM WIRING DIAGRAMS

Chevrolet - Volt

ACTIVE BODYWORKS



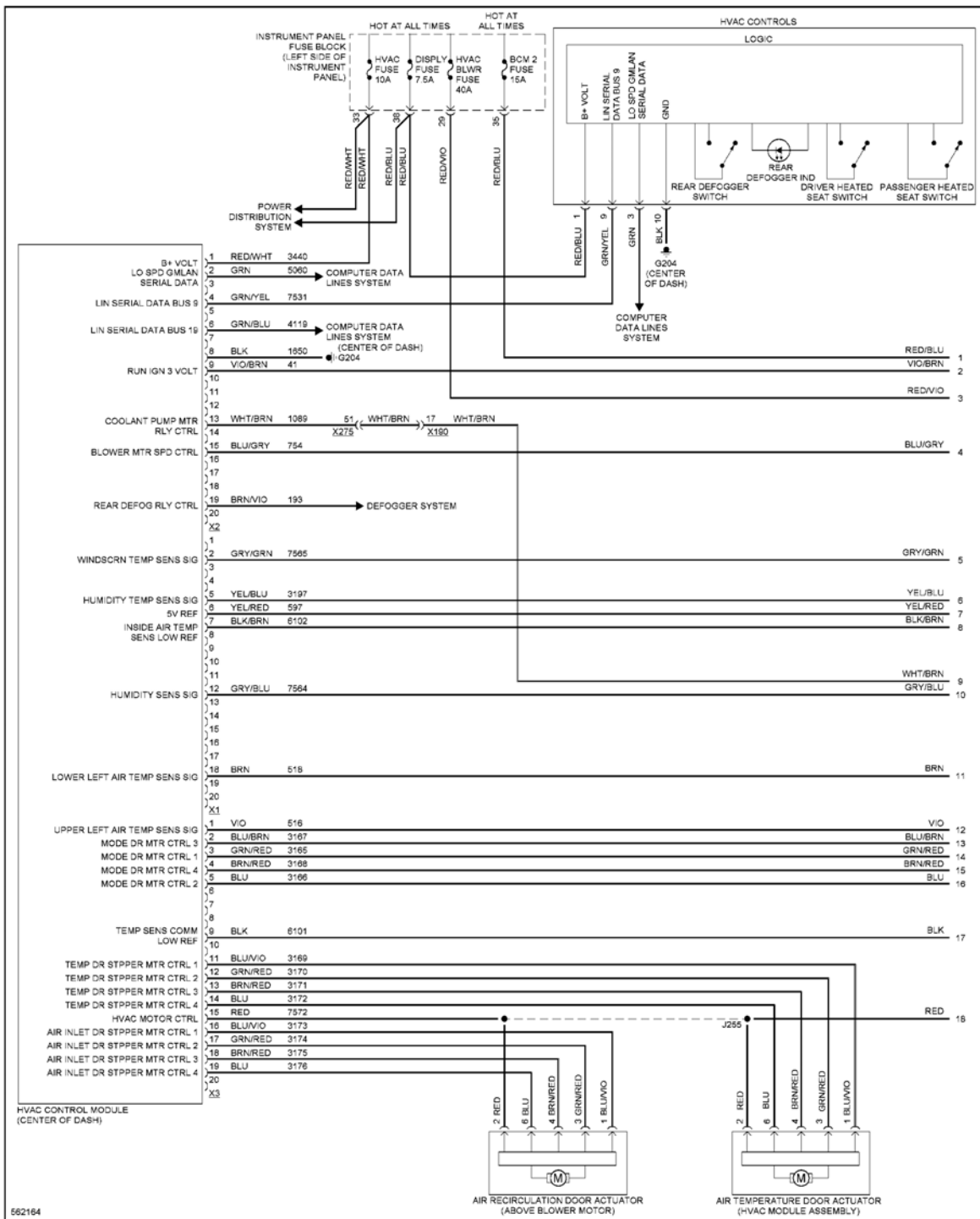


Fig. 2: Automatic A/C Circuit (1 of 6)

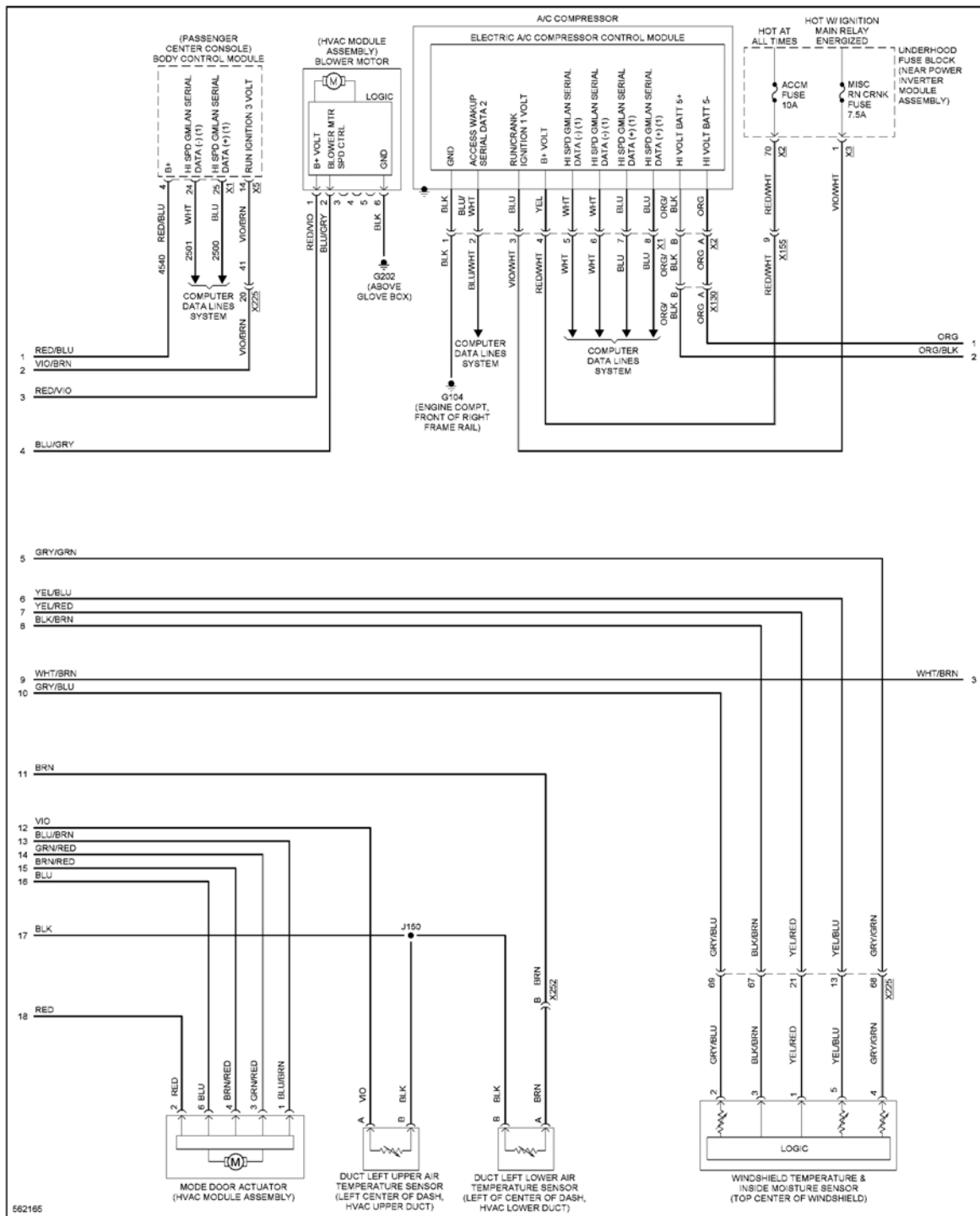


Fig. 3: Automatic A/C Circuit (2 of 6)

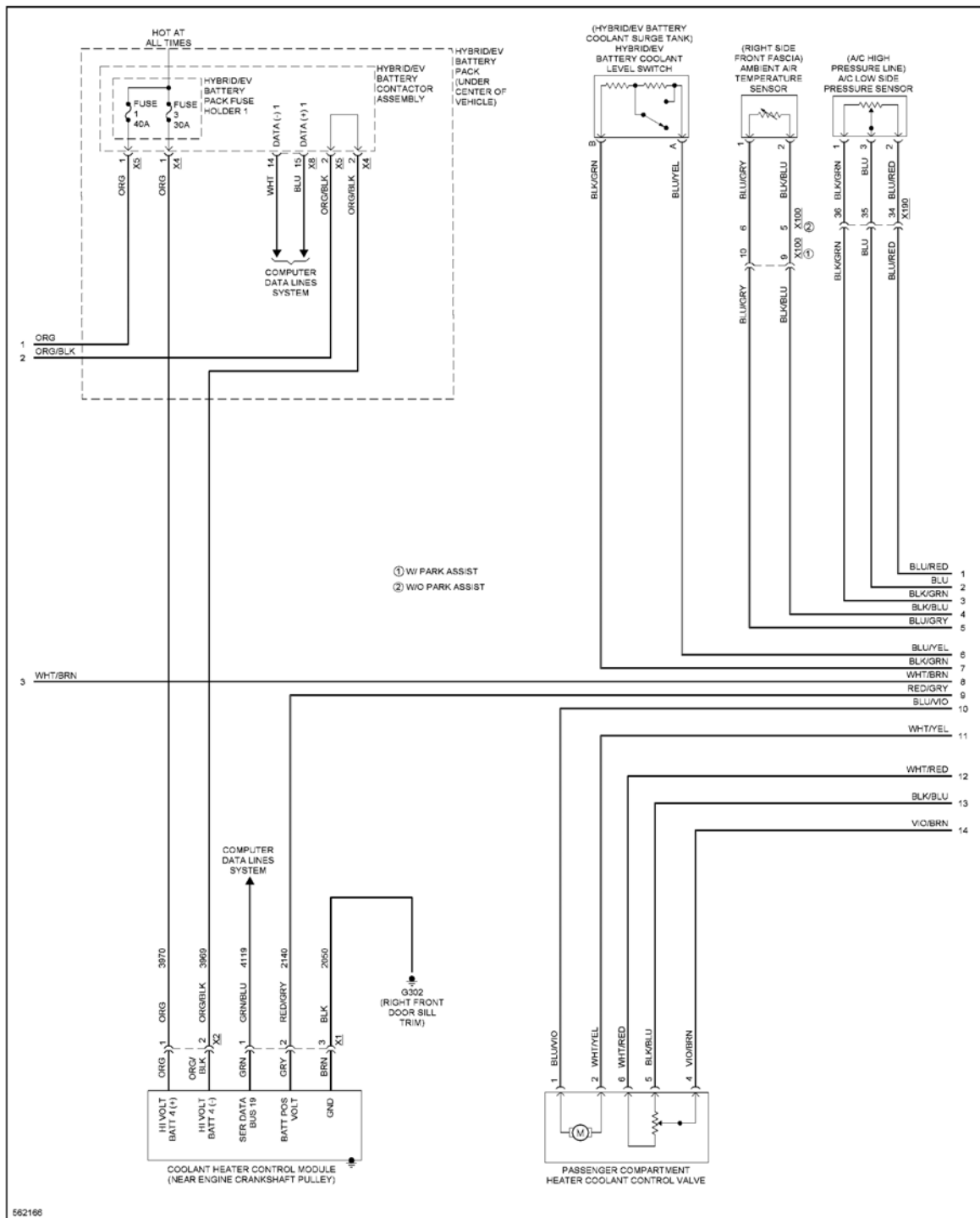


Fig. 4: Automatic A/C Circuit (3 of 6)

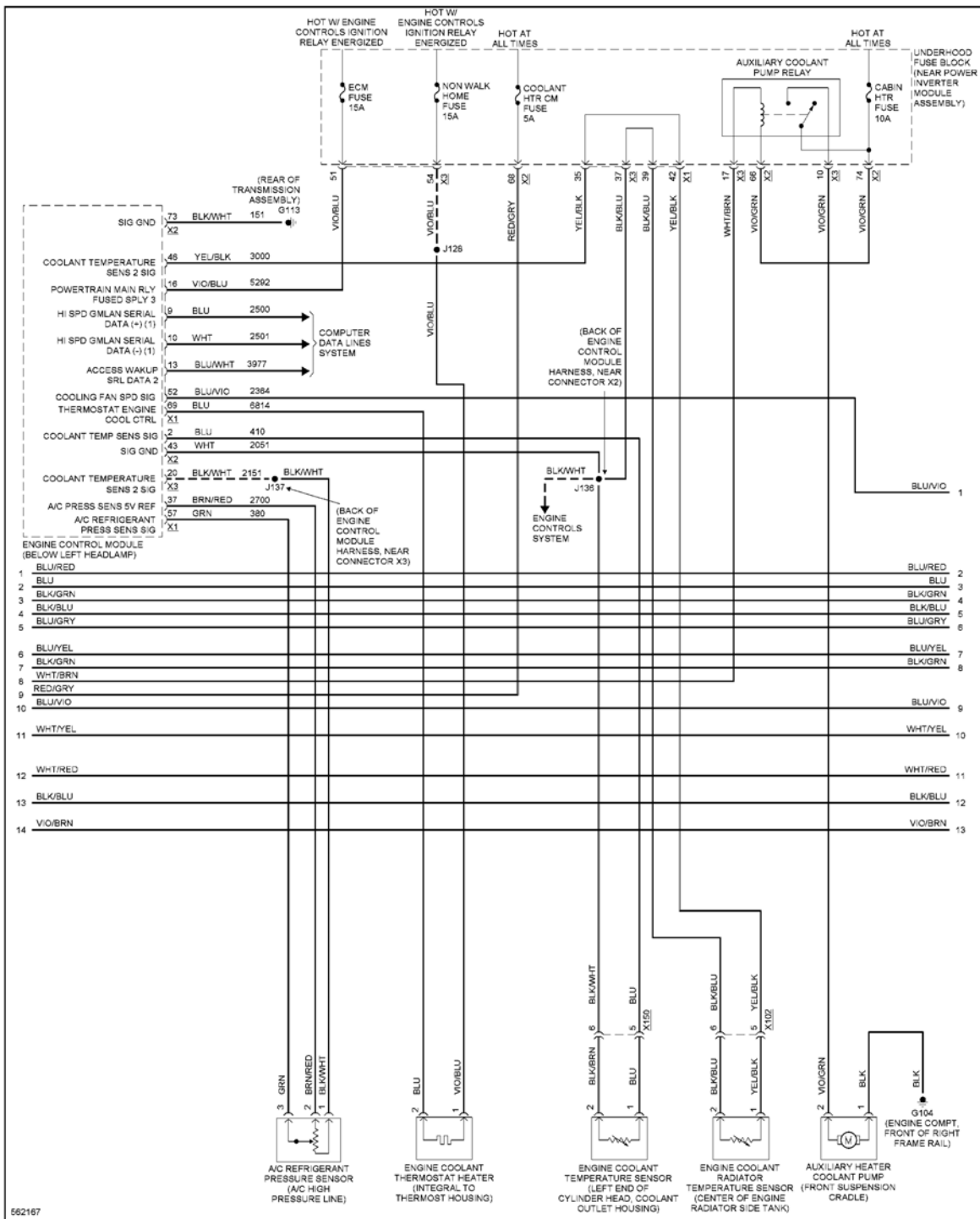


Fig. 5: Automatic A/C Circuit (4 of 6)

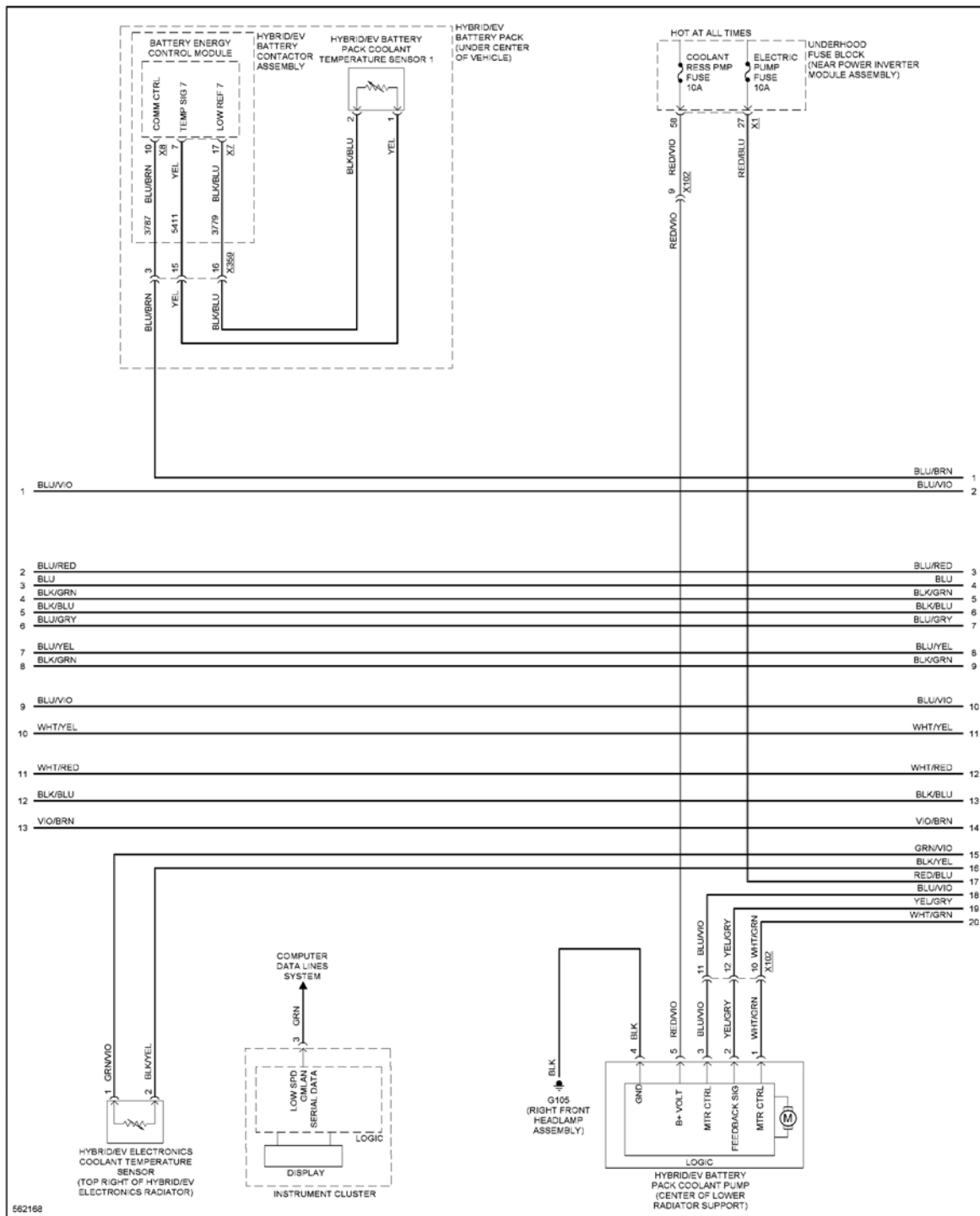


Fig. 6: Automatic A/C Circuit (5 of 6)

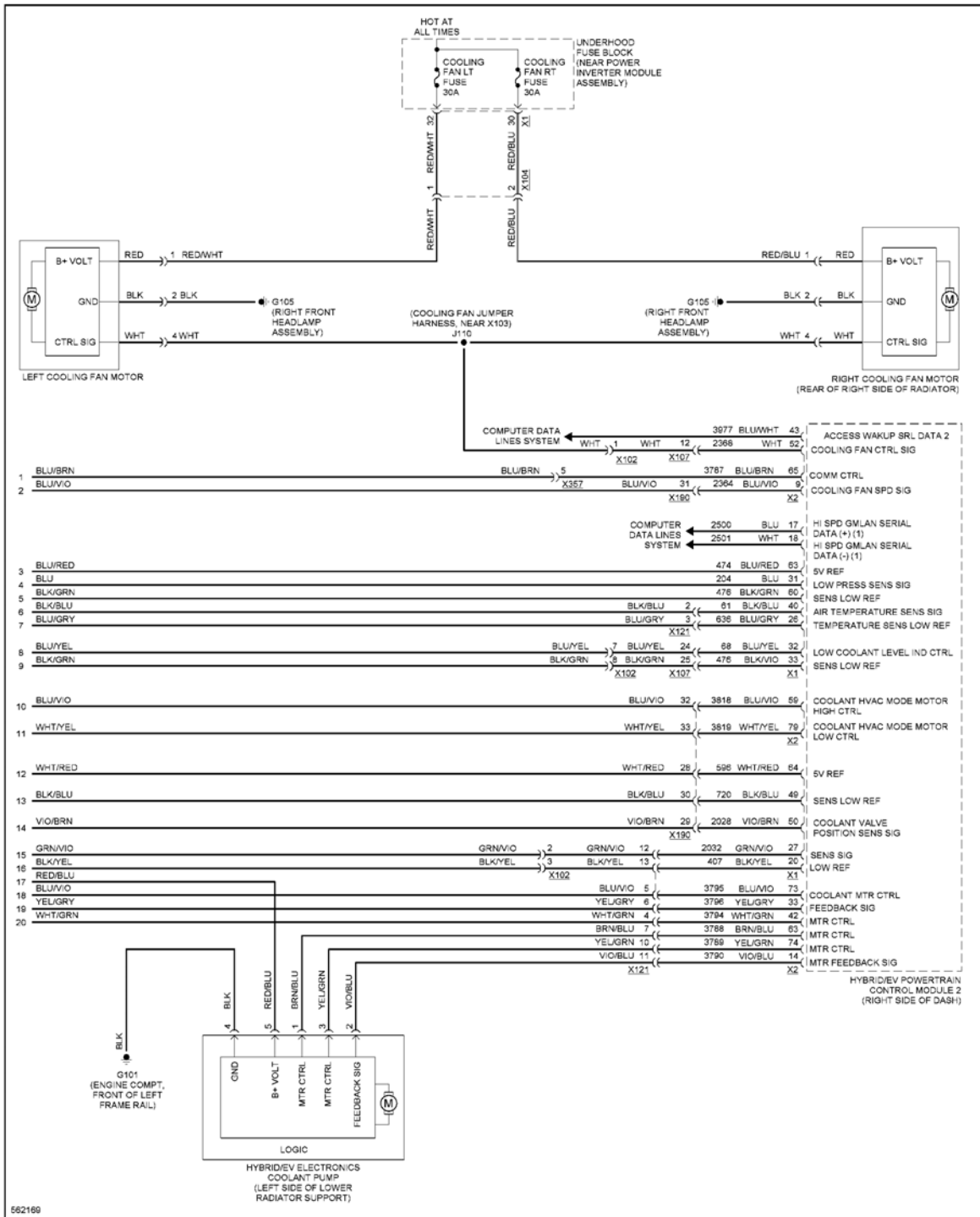


Fig. 7: Automatic A/C Circuit (6 of 6)

ANTI-LOCK BRAKES

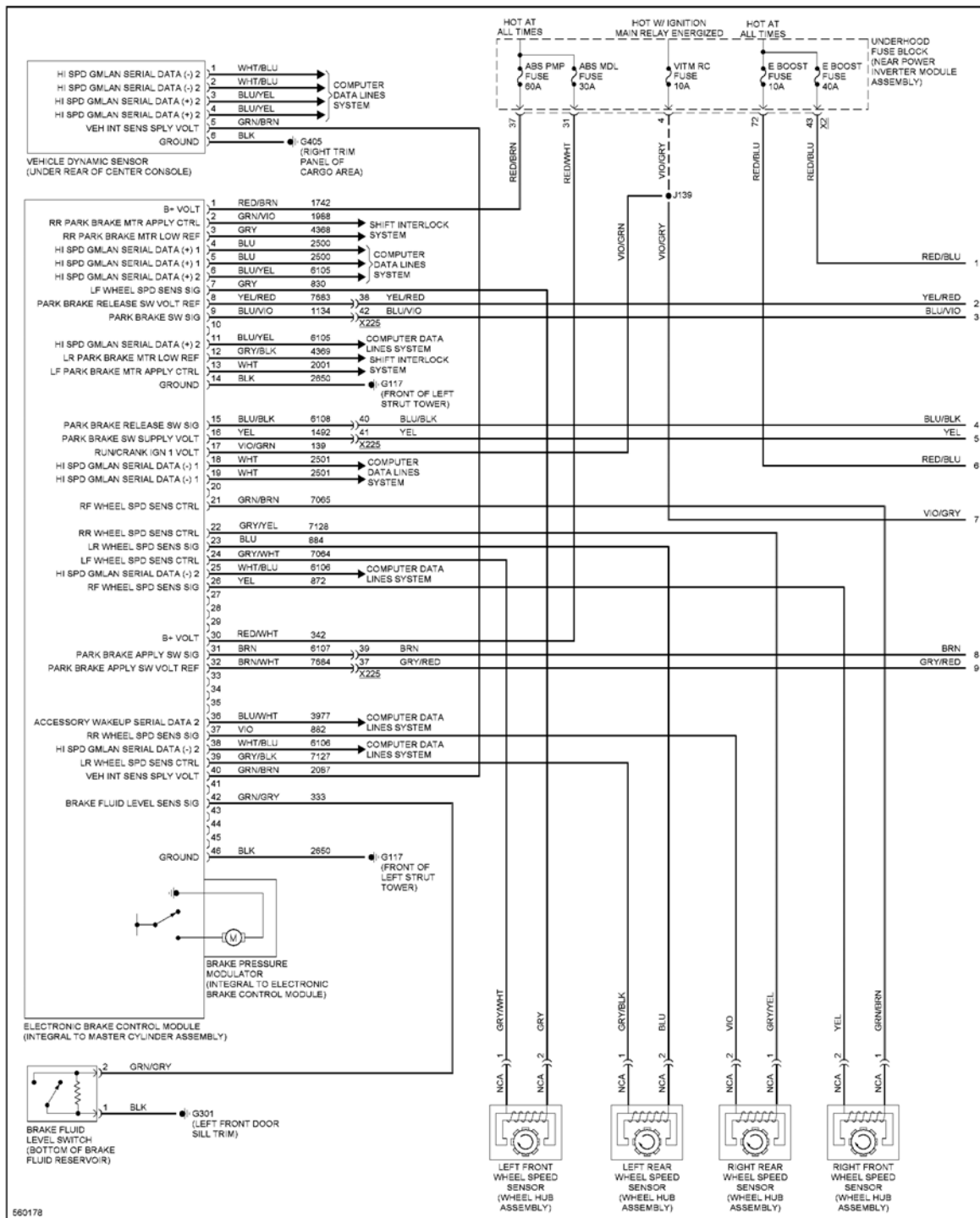


Fig. 8: Anti-lock Brakes Circuit (1 of 2)

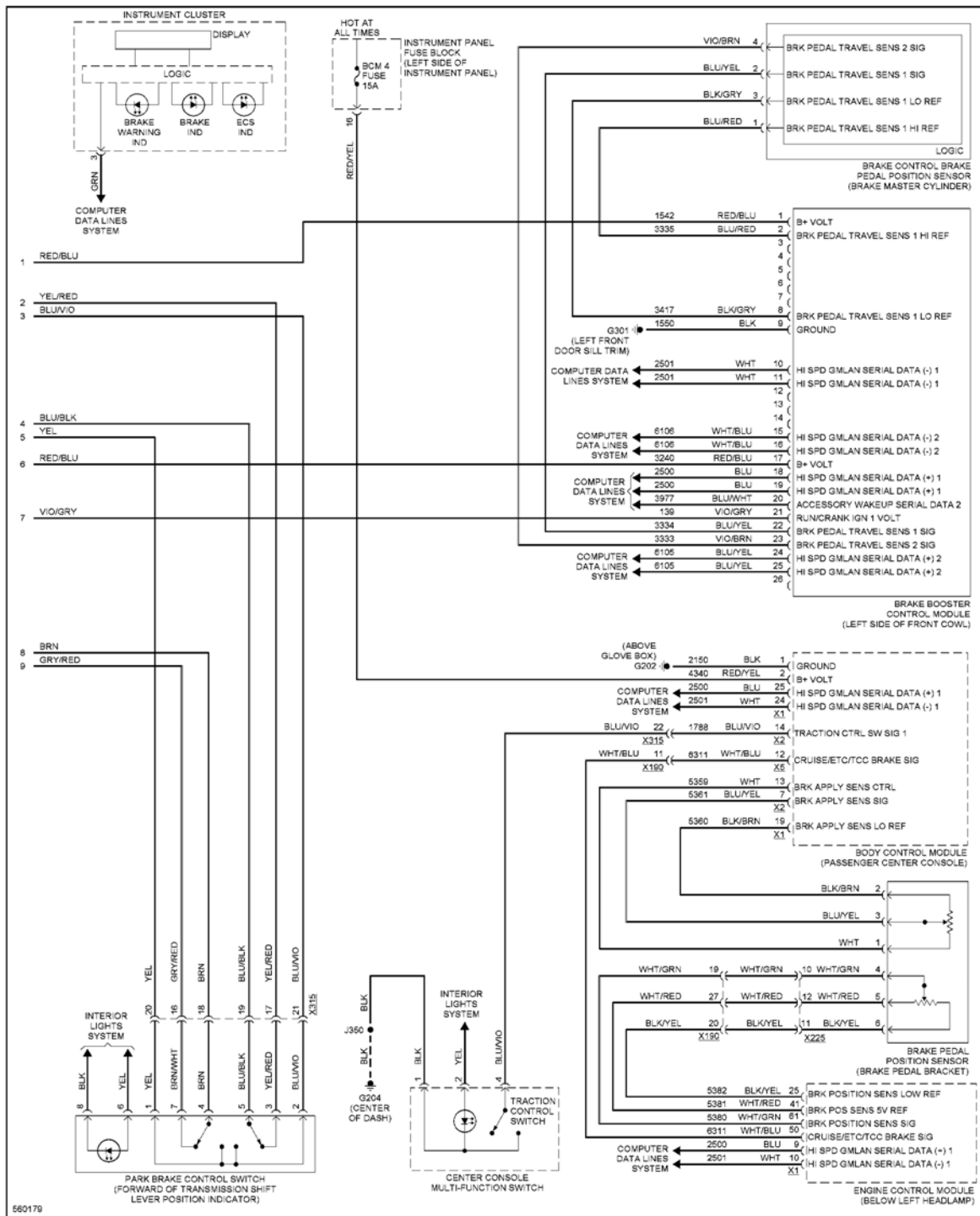


Fig. 9: Anti-lock Brakes Circuit (2 of 2)

ANTI-THEFT

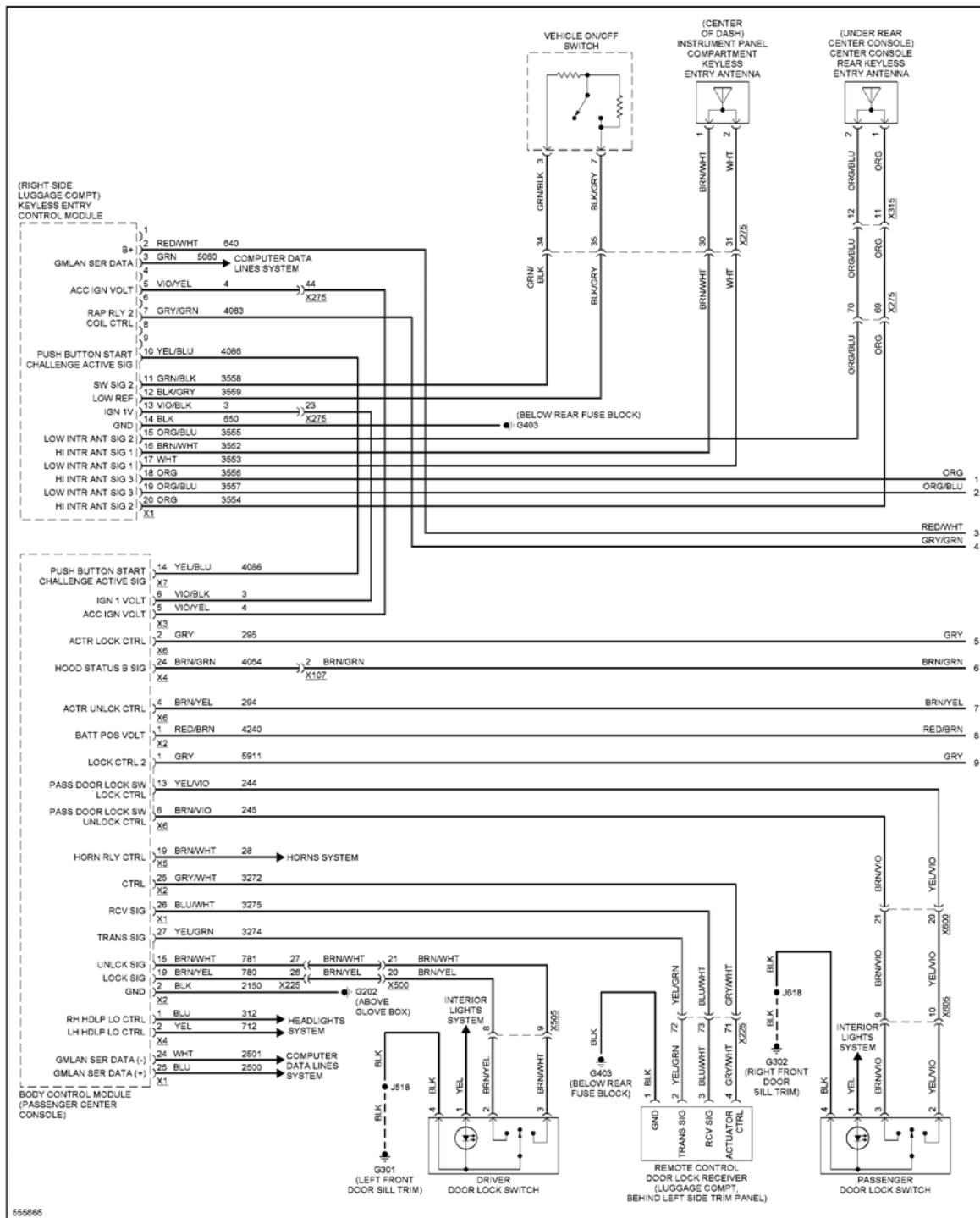


Fig. 10: Forced Entry Circuit, W/ Passive Keyless Entry (1 of 4)

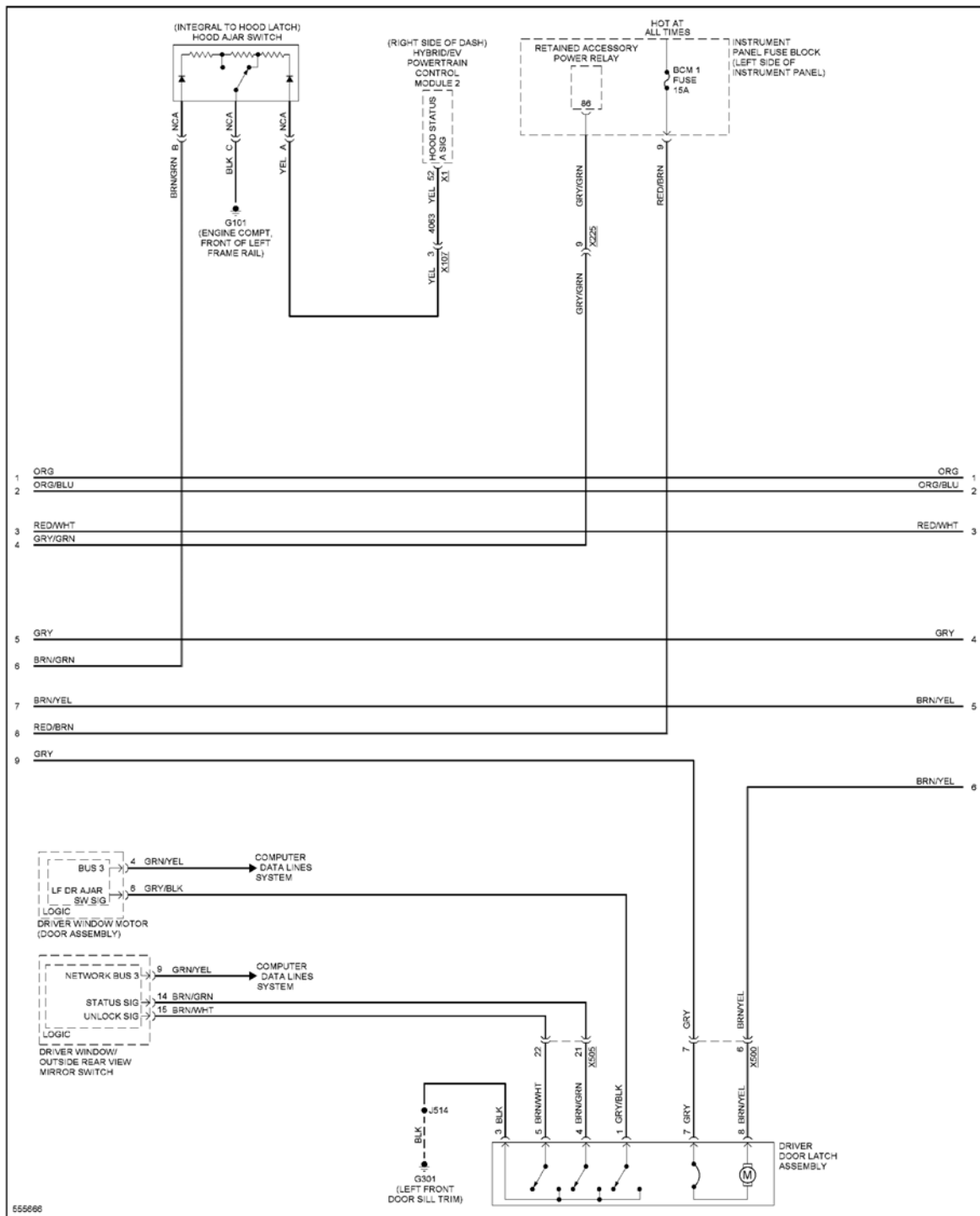


Fig. 11: Forced Entry Circuit, W/ Passive Keyless Entry (2 of 4)

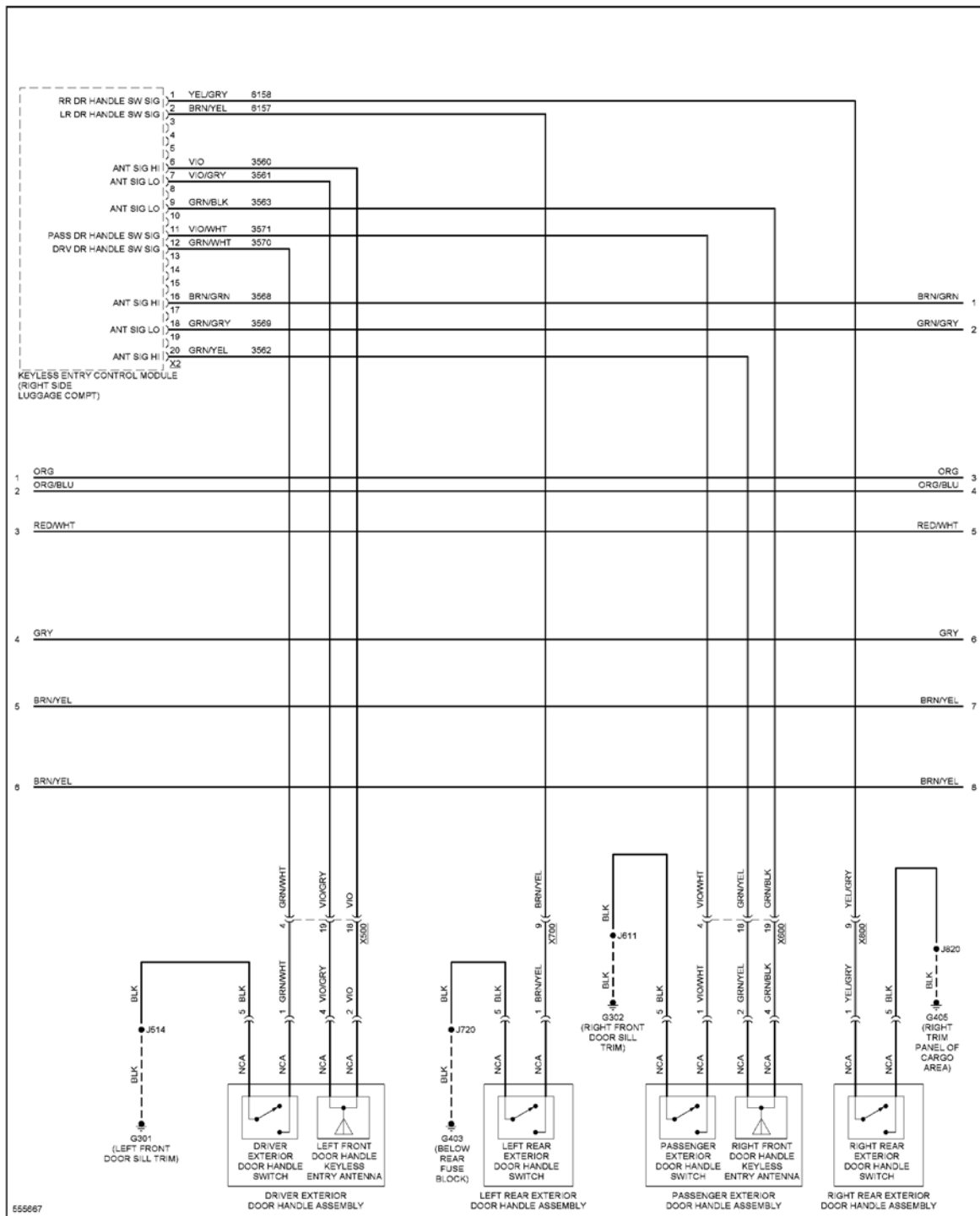


Fig. 12: Forced Entry Circuit, W/ Passive Keyless Entry (3 of 4)

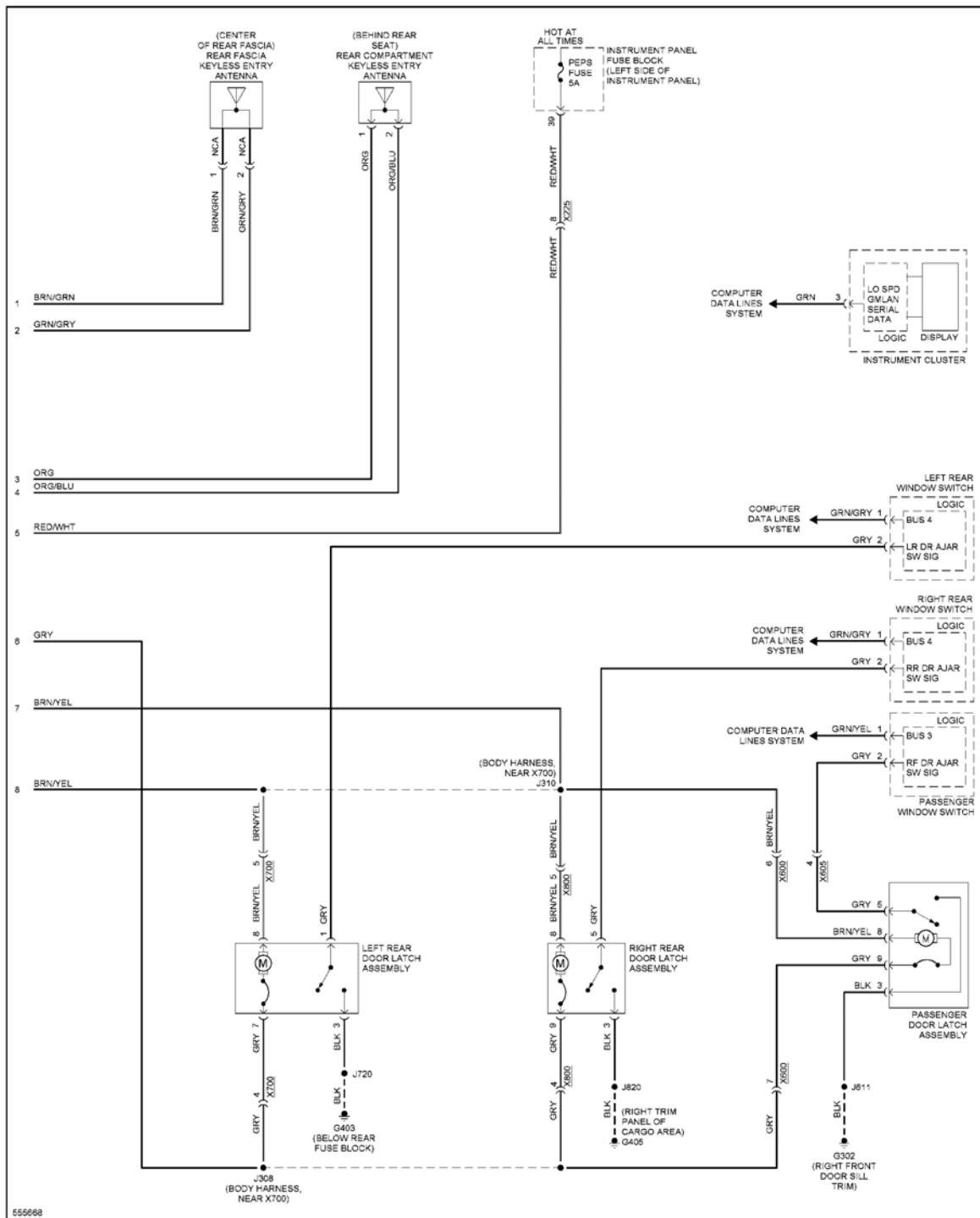


Fig. 13: Forced Entry Circuit, W/ Passive Keyless Entry (4 of 4)

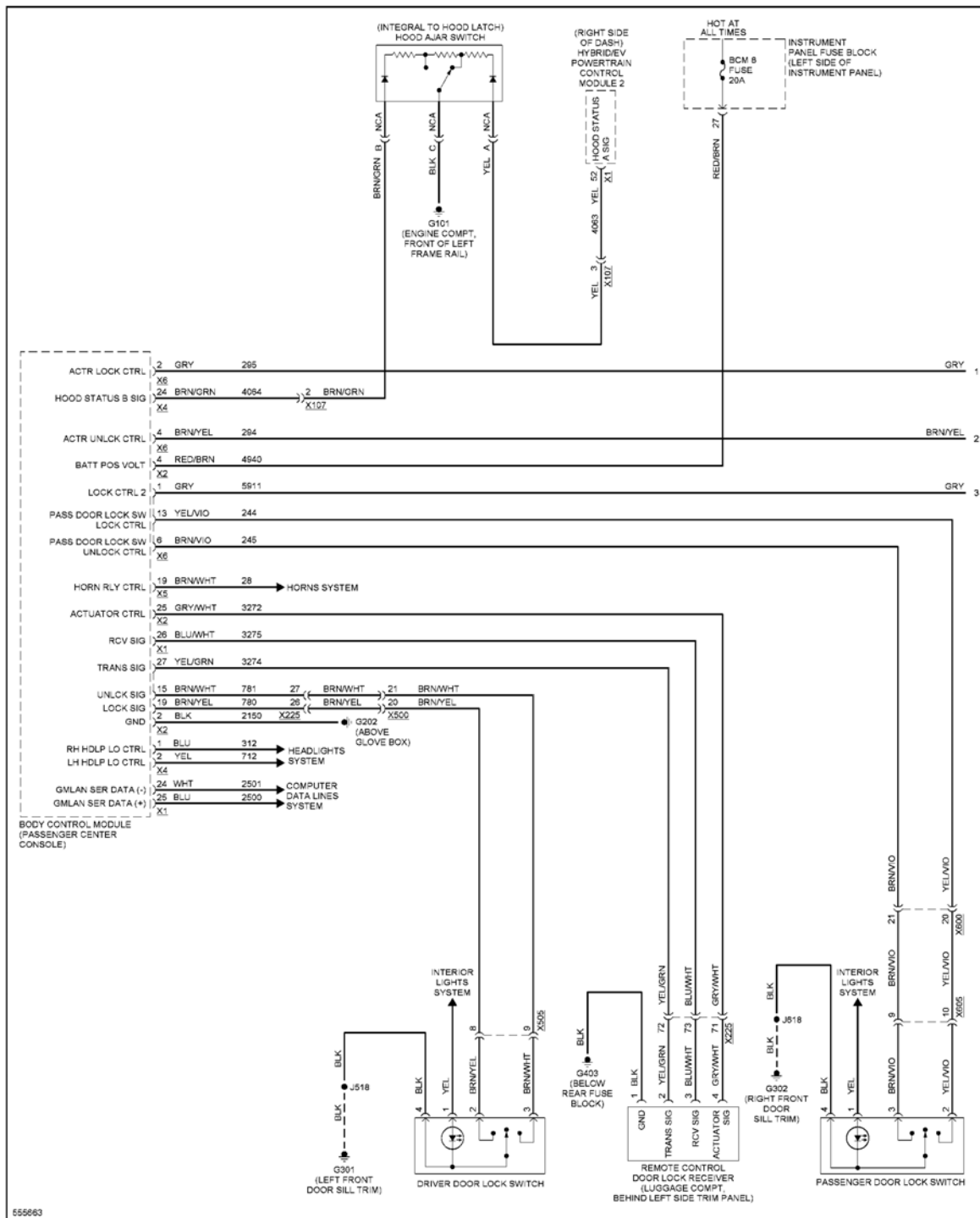


Fig. 14: Forced Entry Circuit, W/O Passive Keyless Entry (1 of 2)

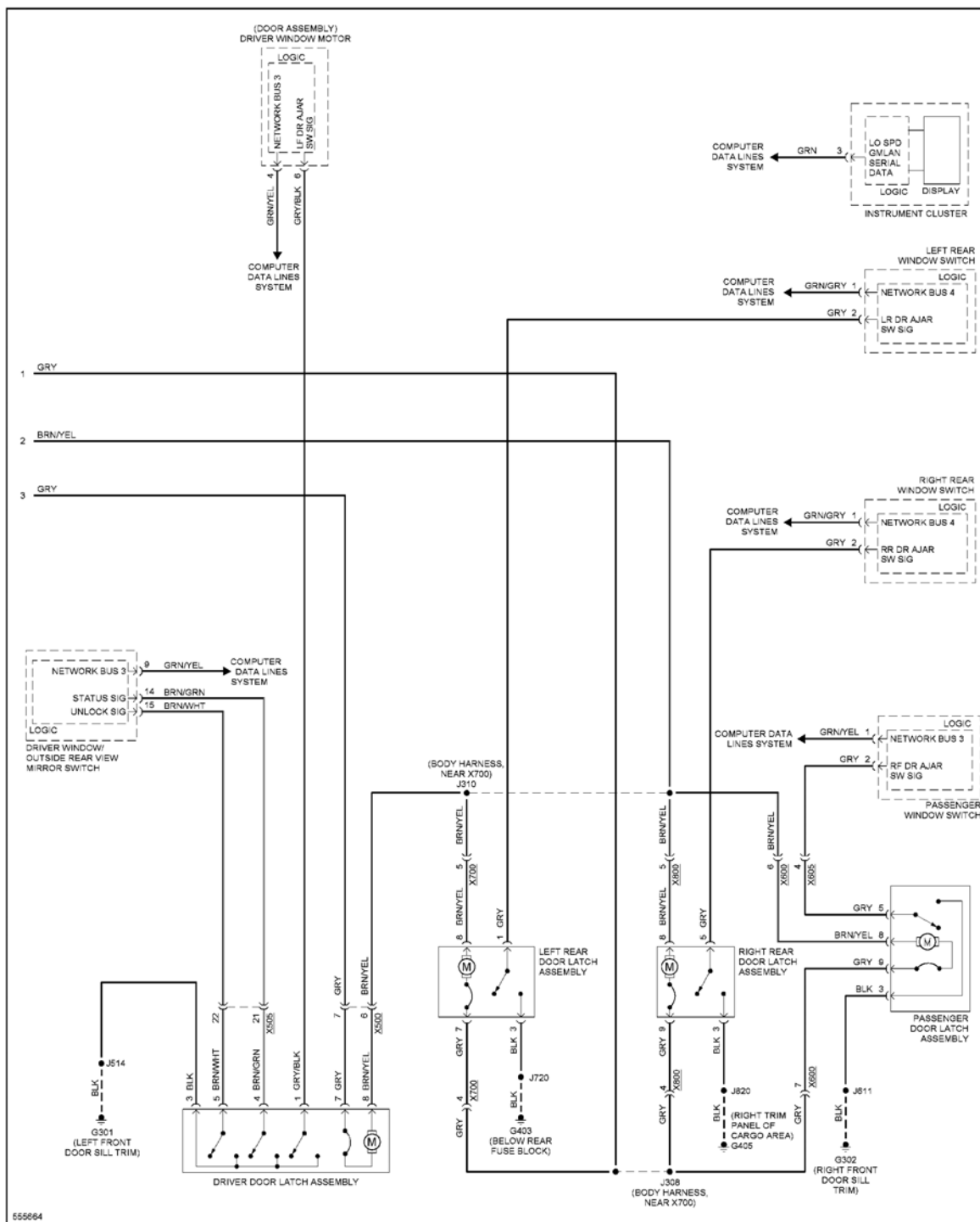


Fig. 15: Forced Entry Circuit, W/O Passive Keyless Entry (2 of 2)

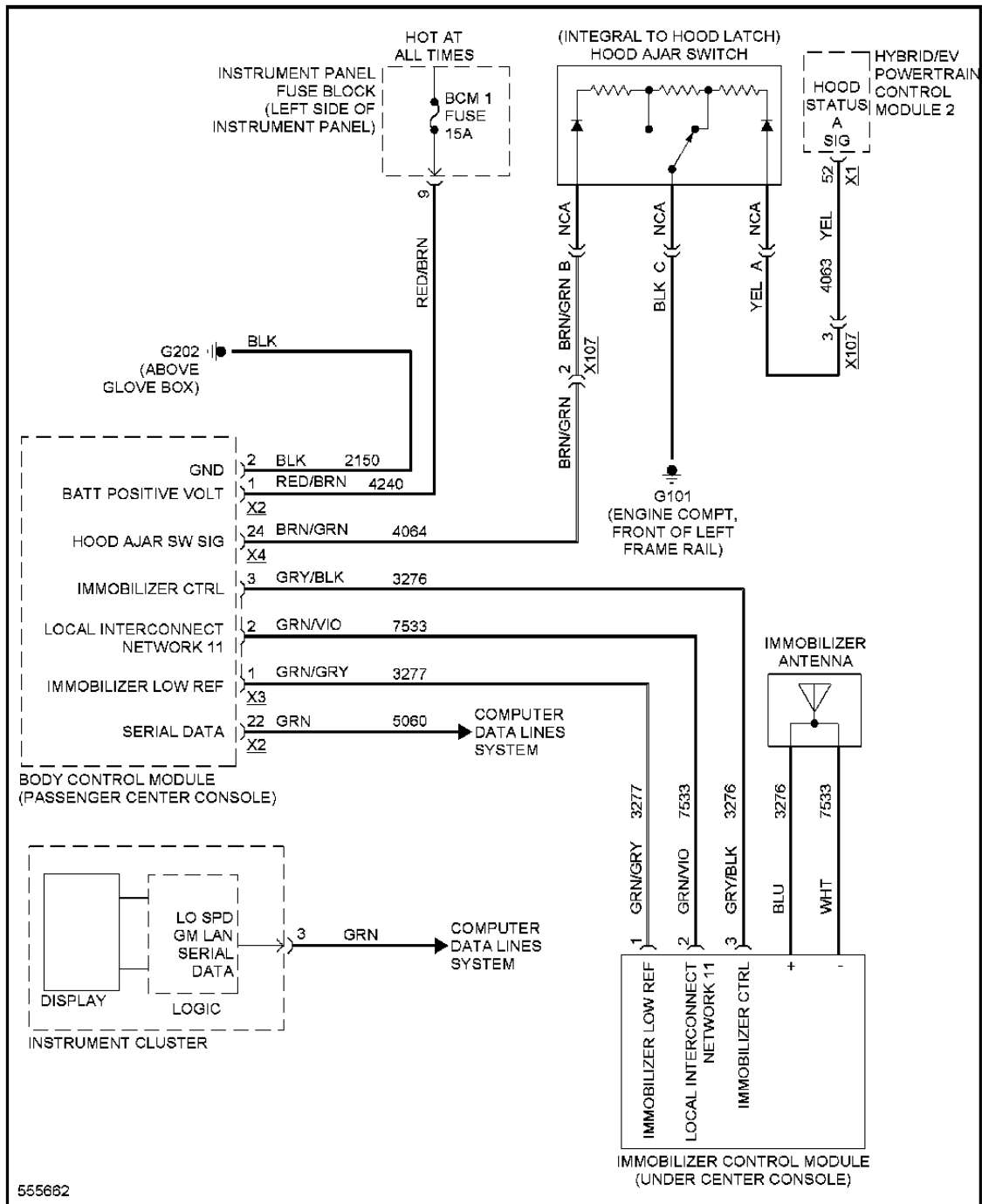


Fig. 16: Pass-Key Circuit

BODY CONTROL MODULES

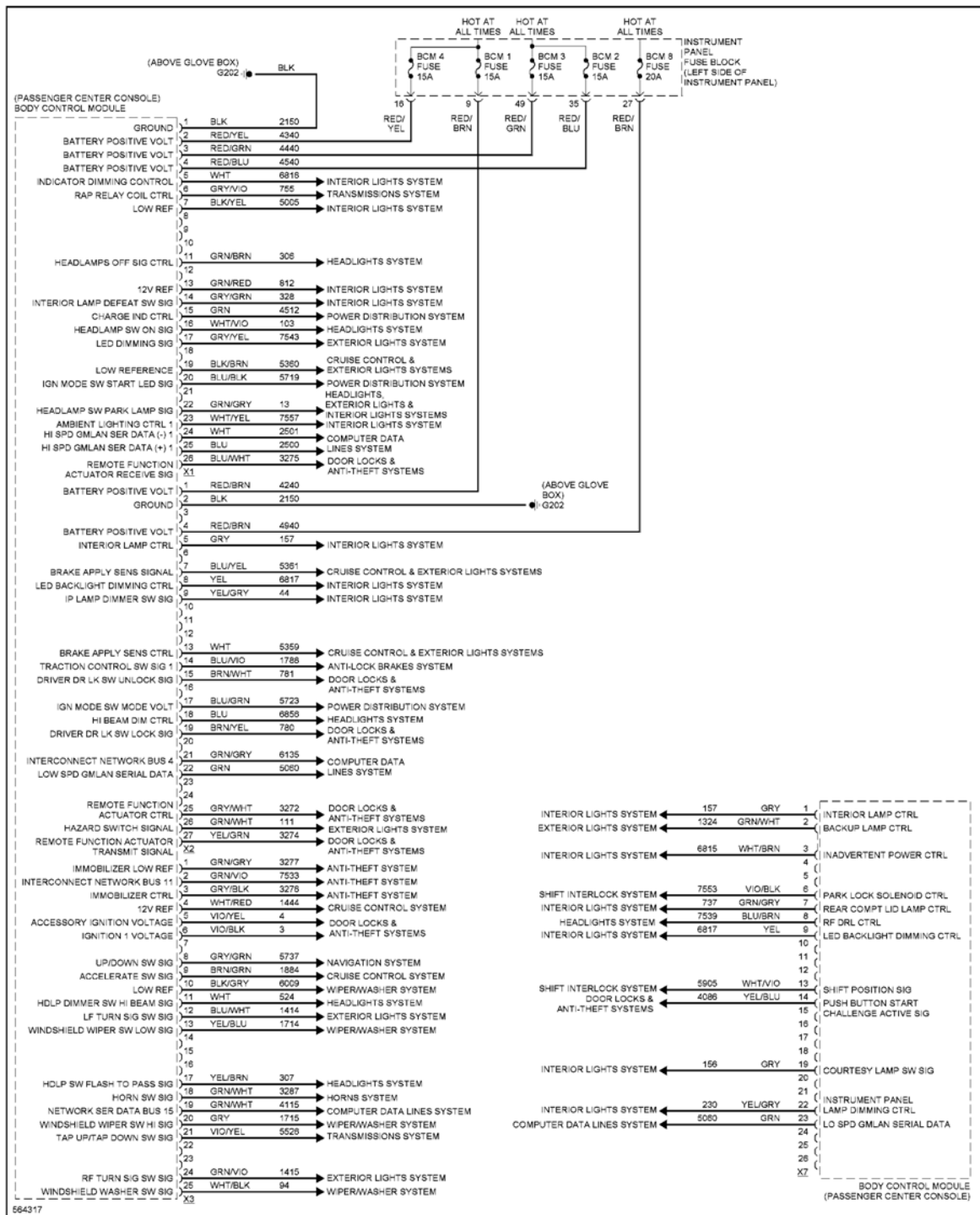


Fig. 17: Body Control Modules Circuit (1 of 2)

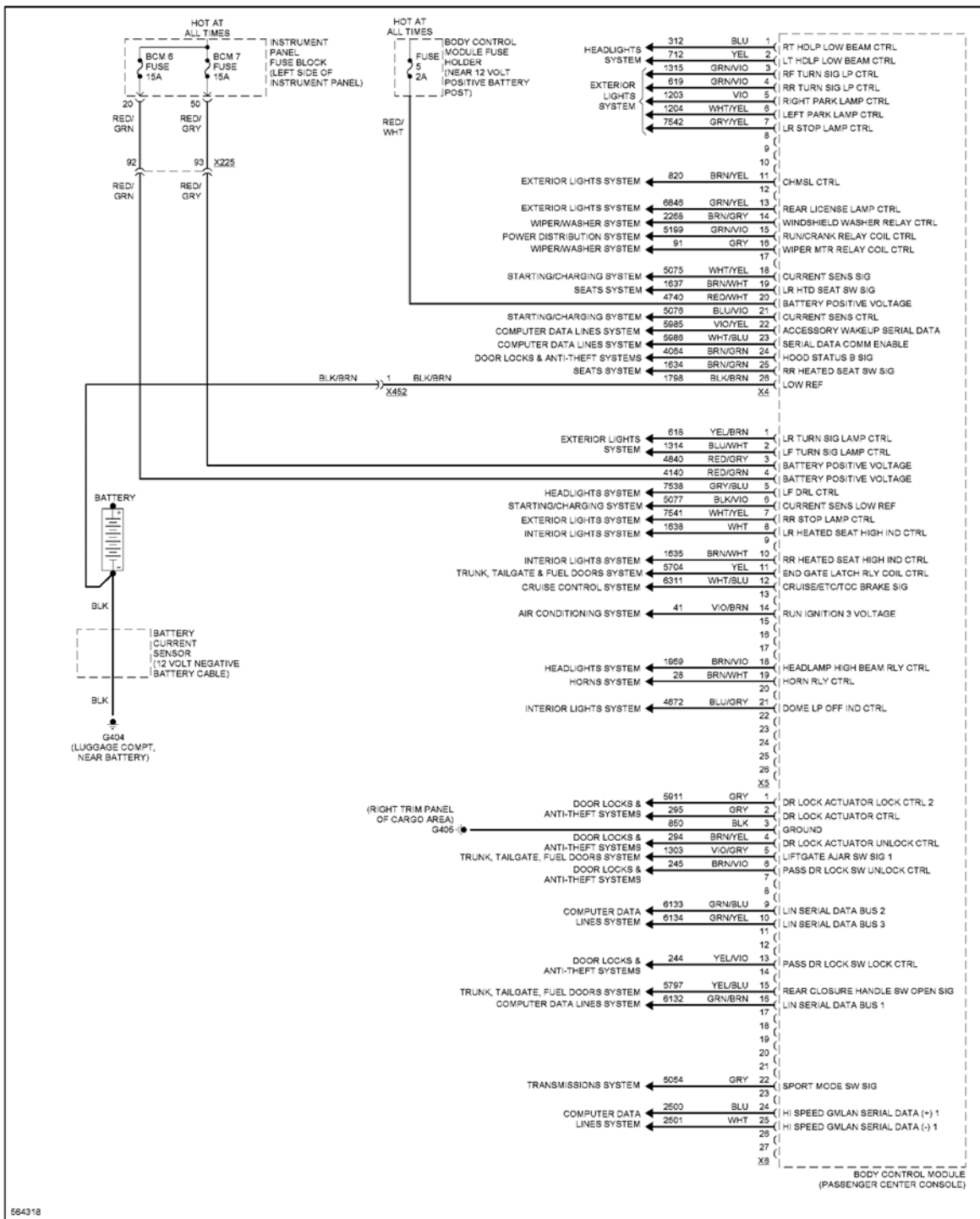


Fig. 18: Body Control Modules Circuit (2 of 2)

COMPUTER DATA LINES

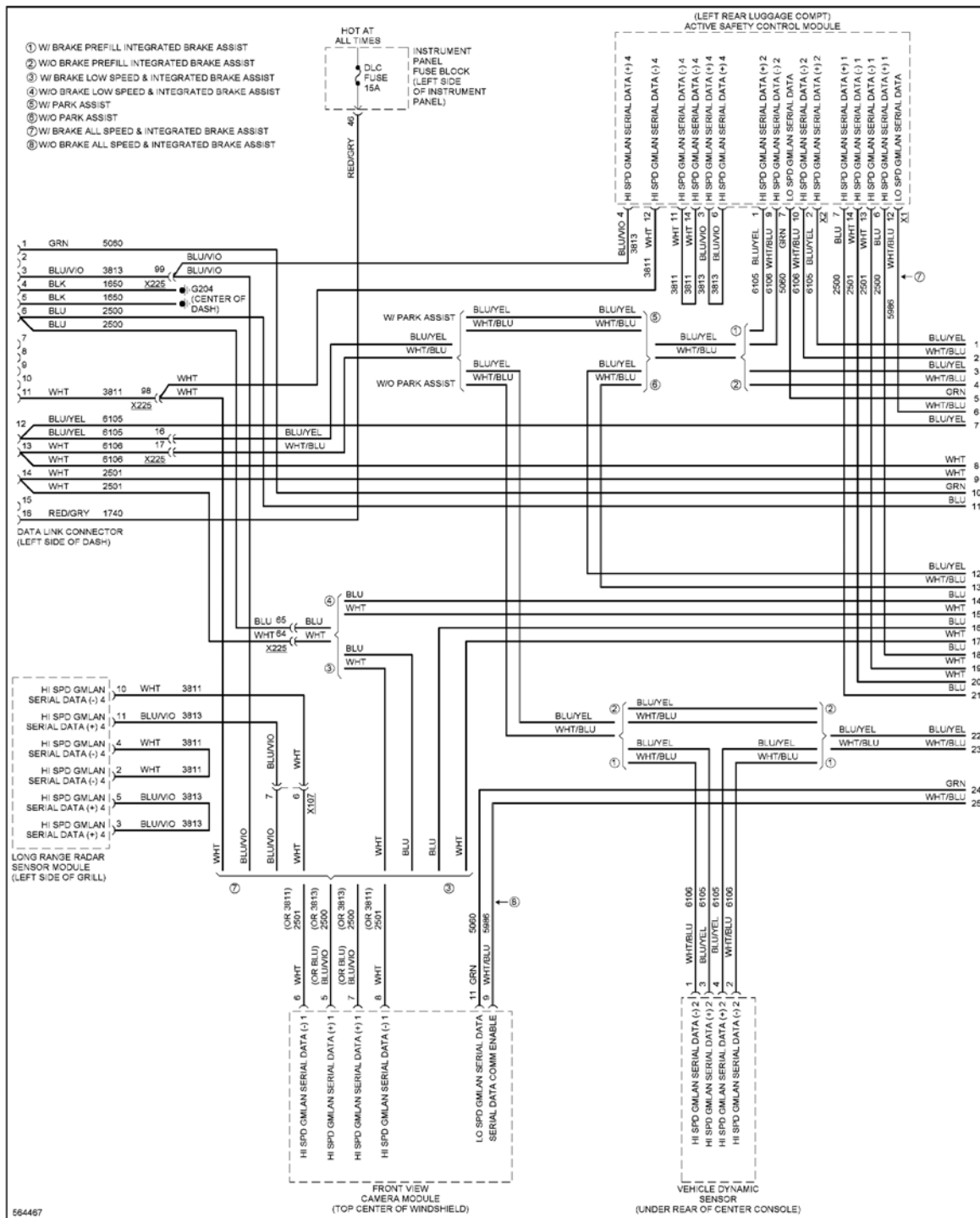


Fig. 19: Computer Data Lines Circuit (1 of 5)

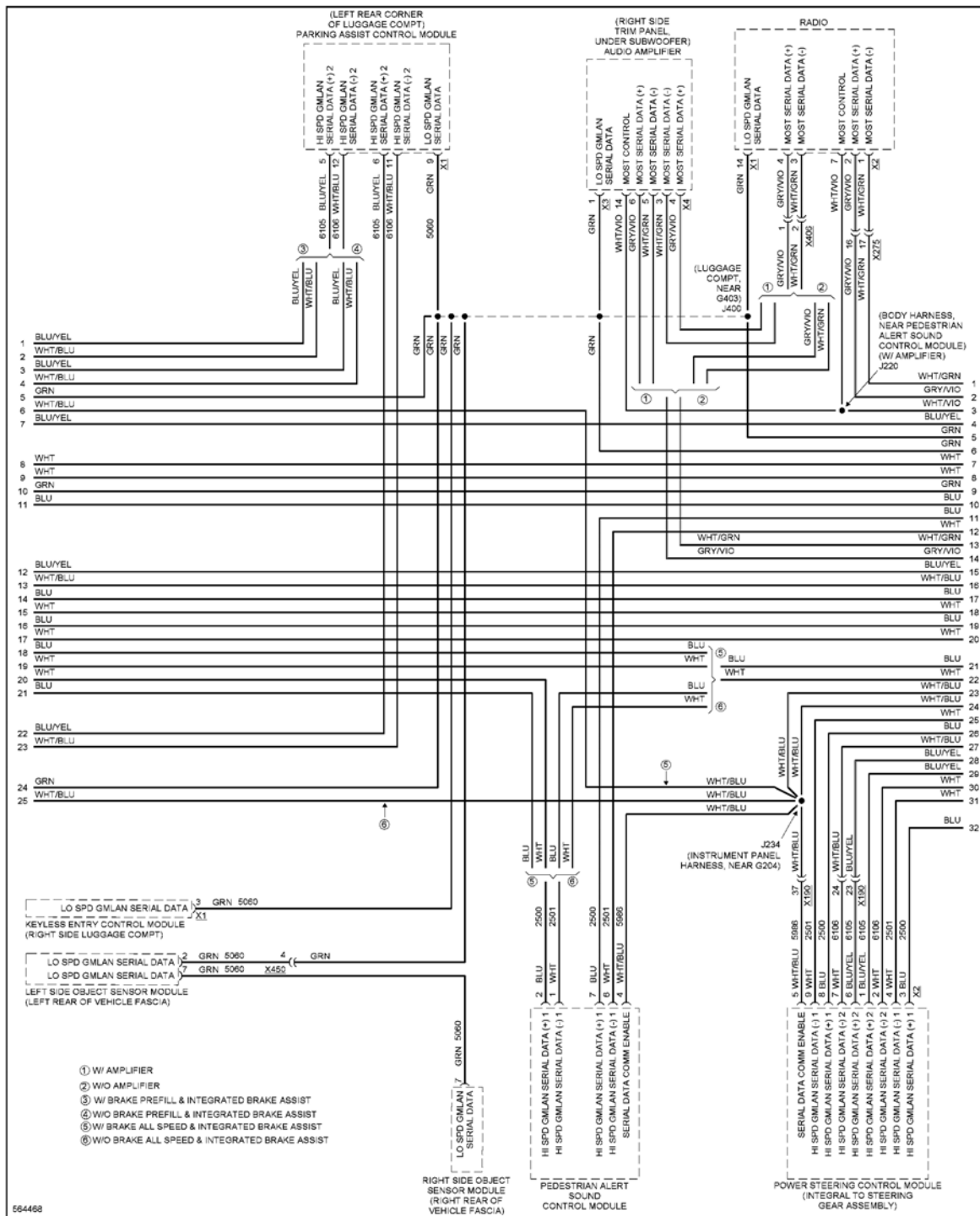


Fig. 20: Computer Data Lines Circuit (2 of 5)

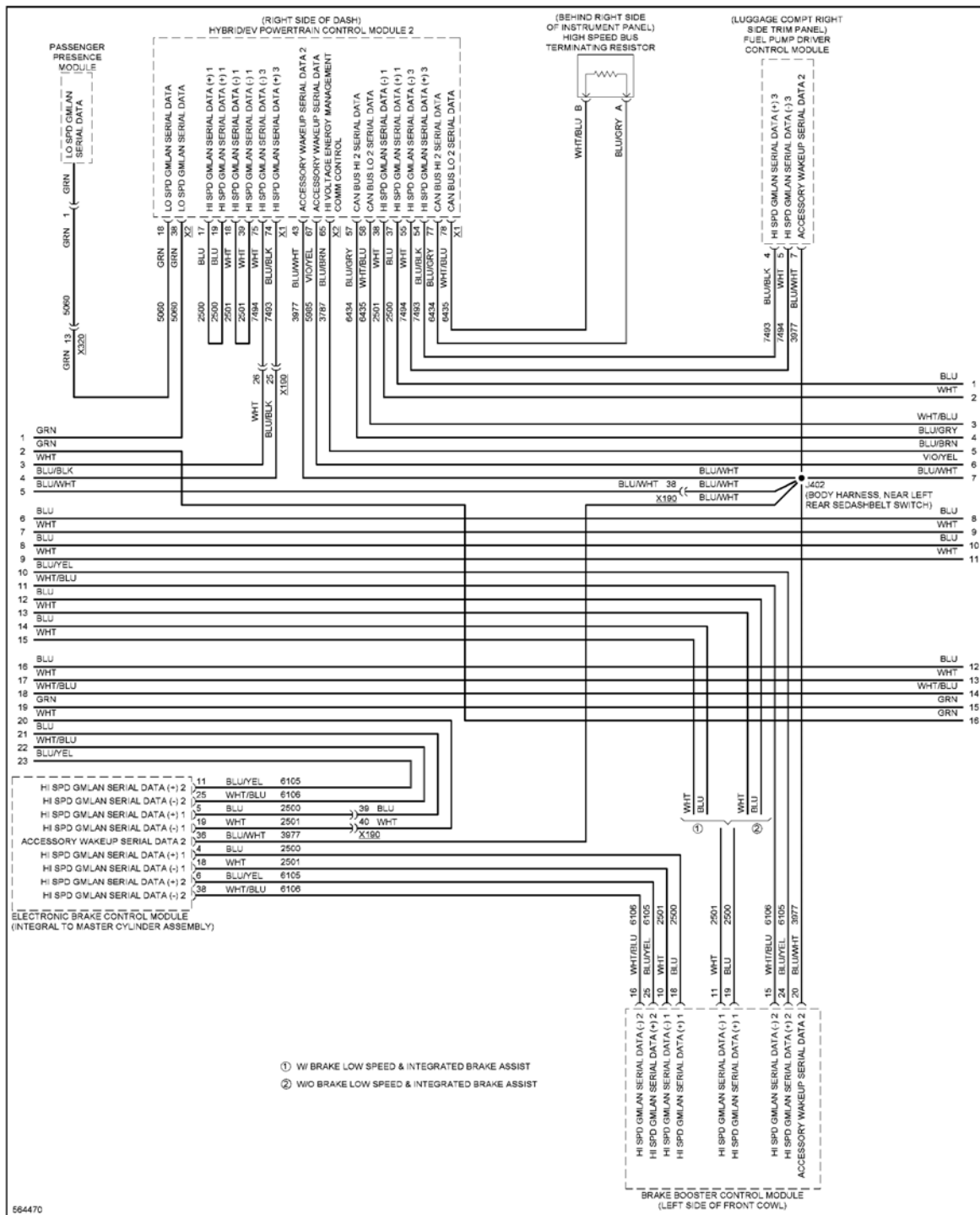


Fig. 22: Computer Data Lines Circuit (4 of 5)

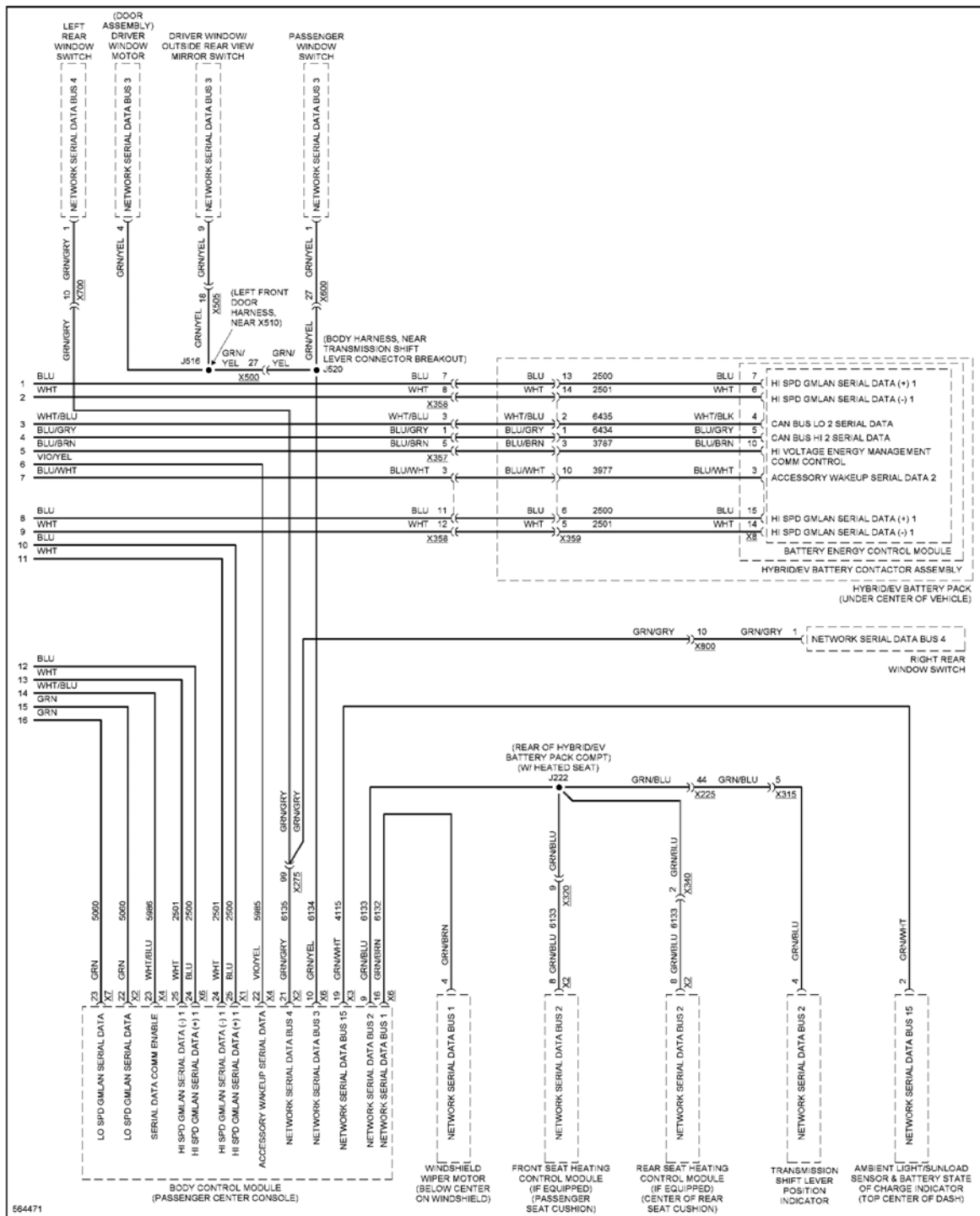
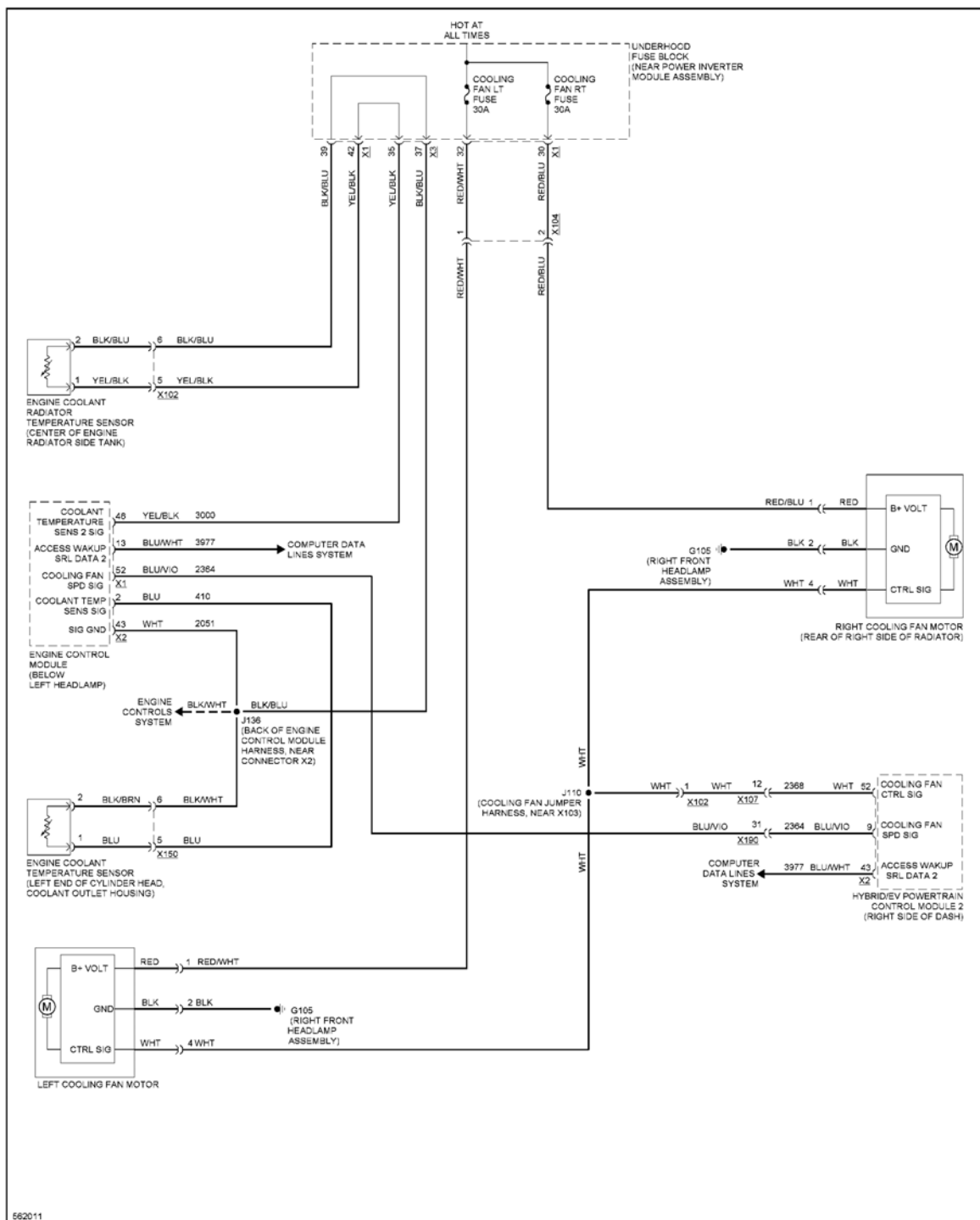


Fig. 23: Computer Data Lines Circuit (5 of 5)

COOLING FAN



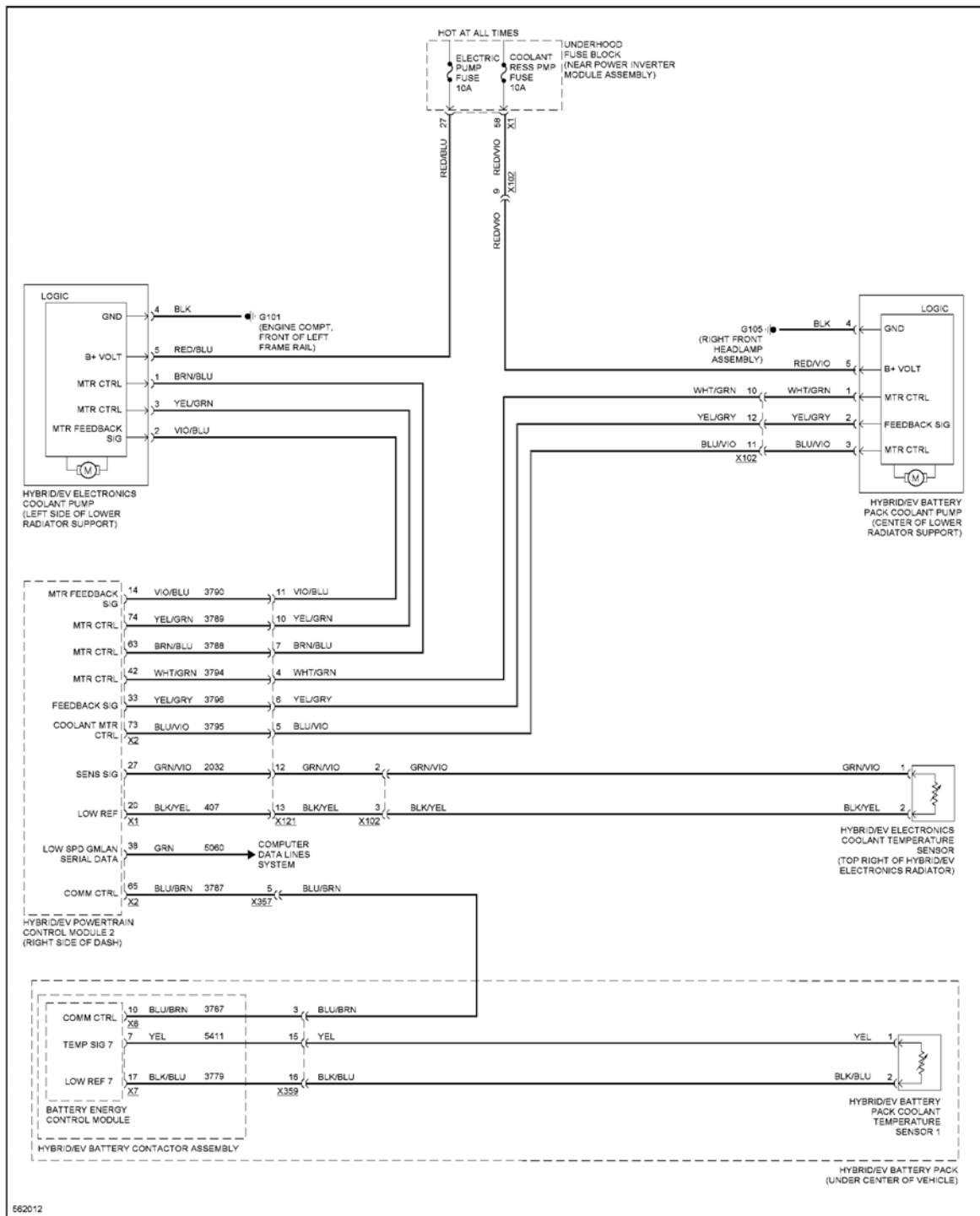


Fig. 25: Hybrid Cooling Fan Circuit

CRUISE CONTROL

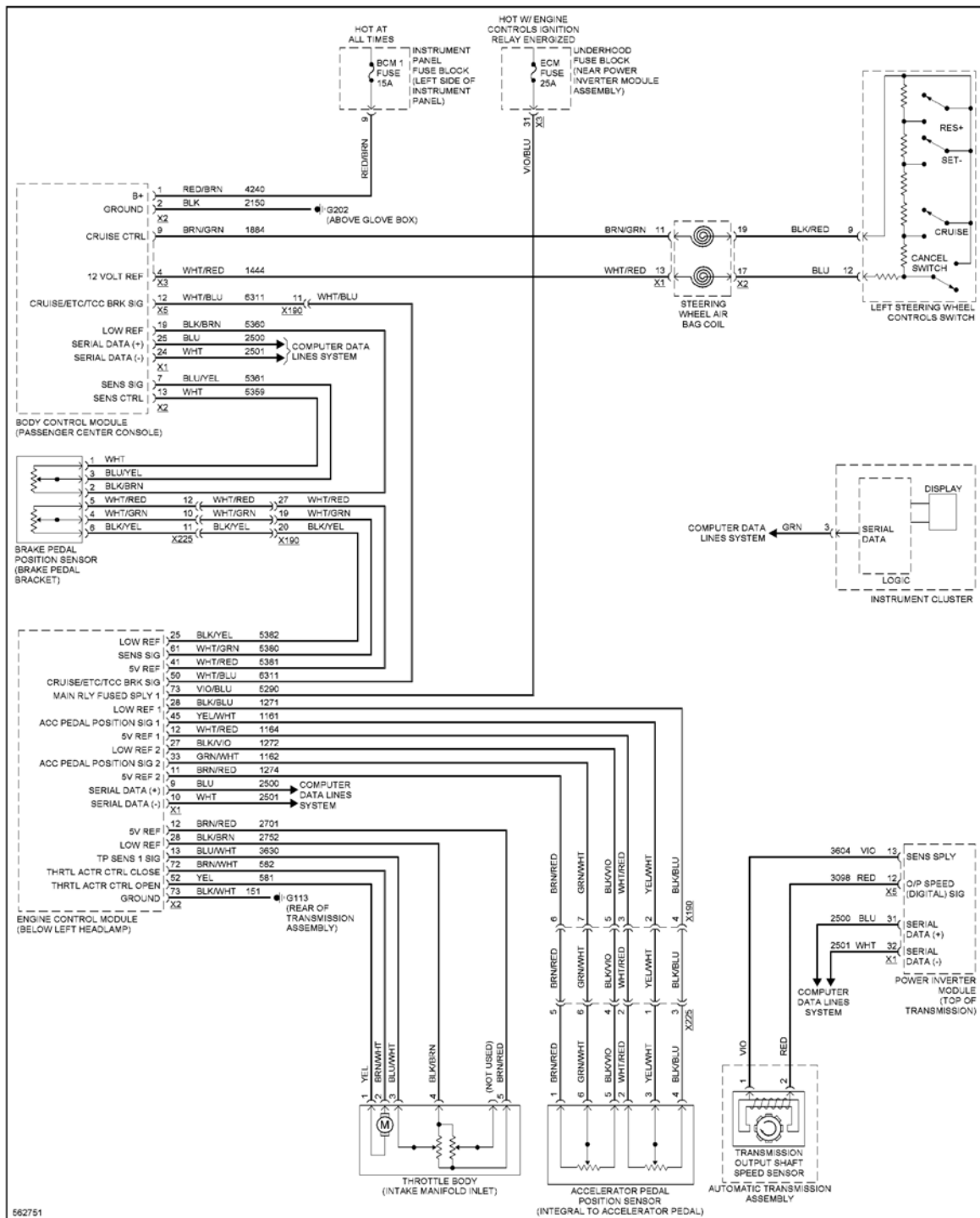


Fig. 26: Cruise Control Circuit

DEFOGGERS

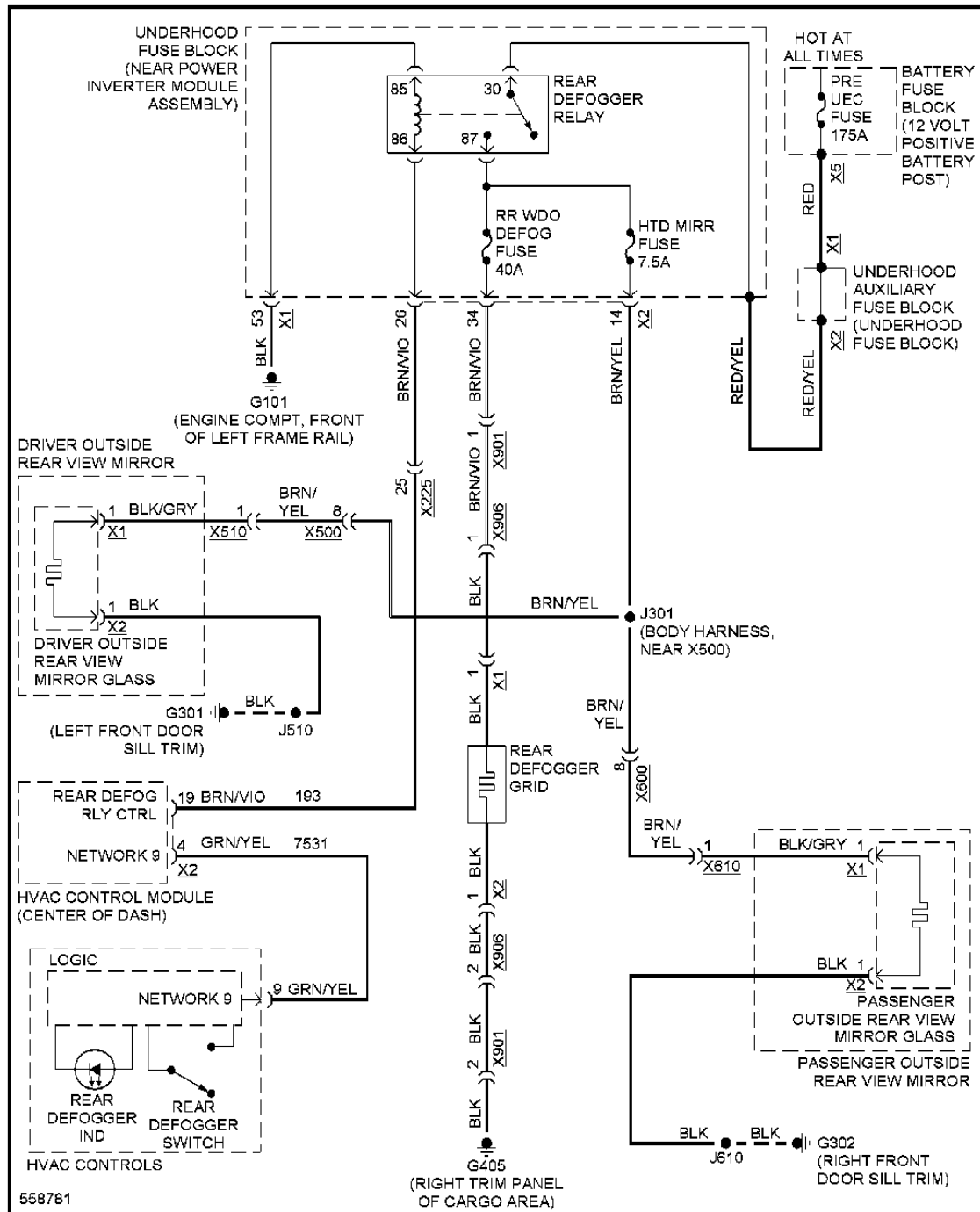


Fig. 27: Defoggers Circuit

ELECTRONIC POWER STEERING

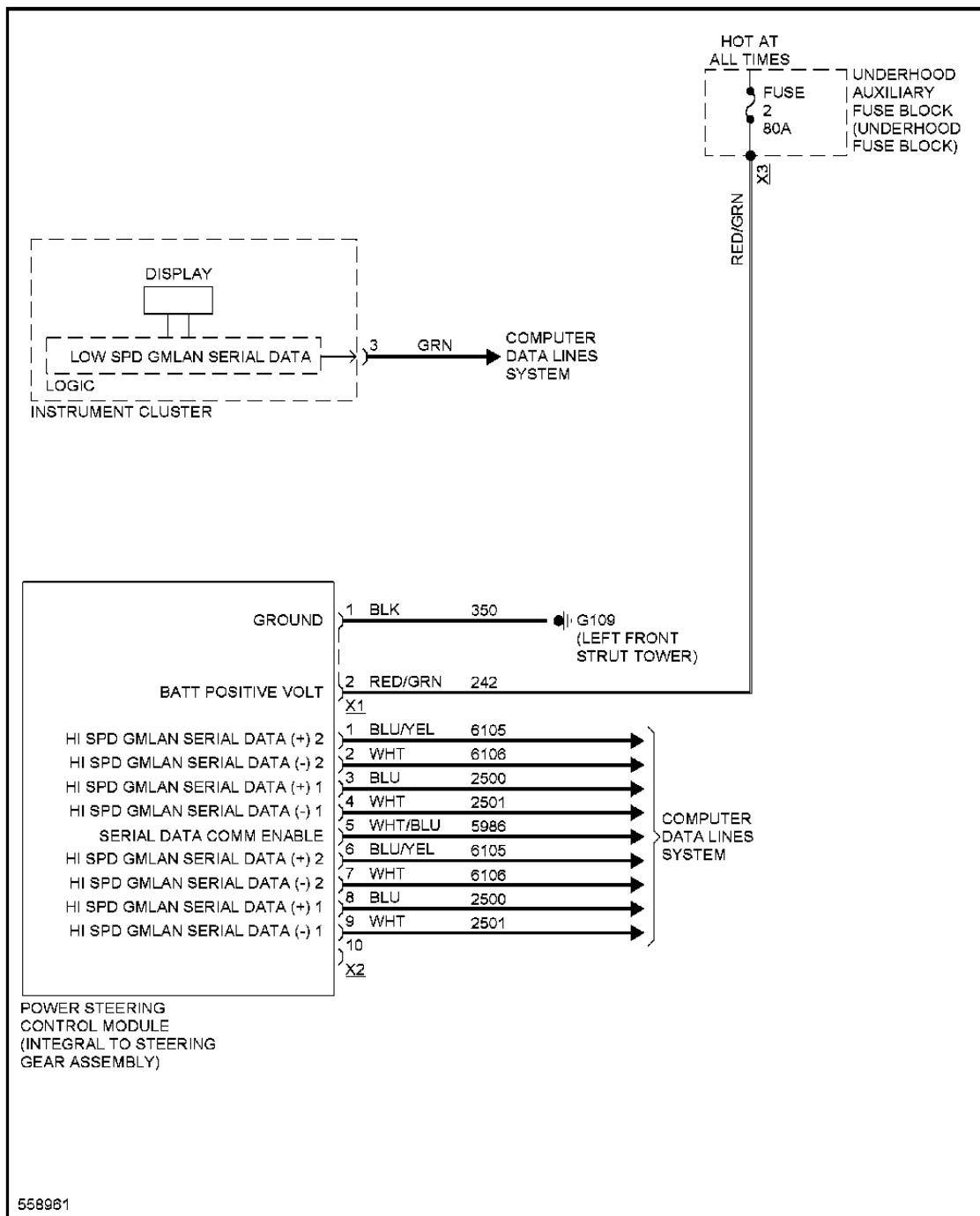


Fig. 28: Electronic Power Steering Circuit

ENGINE PERFORMANCE

1.5L VIN 5

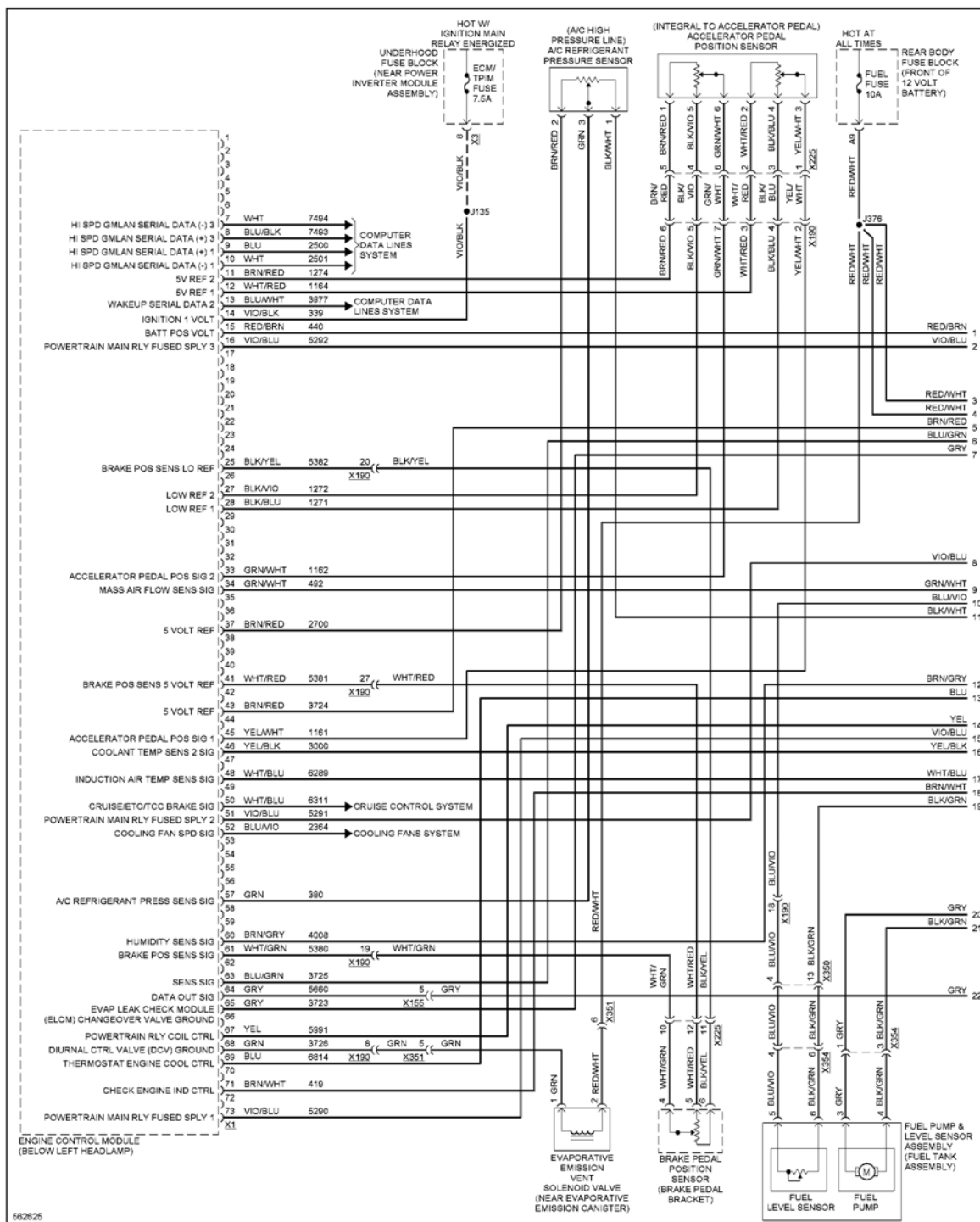


Fig. 29: 1.5L VIN 5, Engine Controls Circuit (1 of 7)

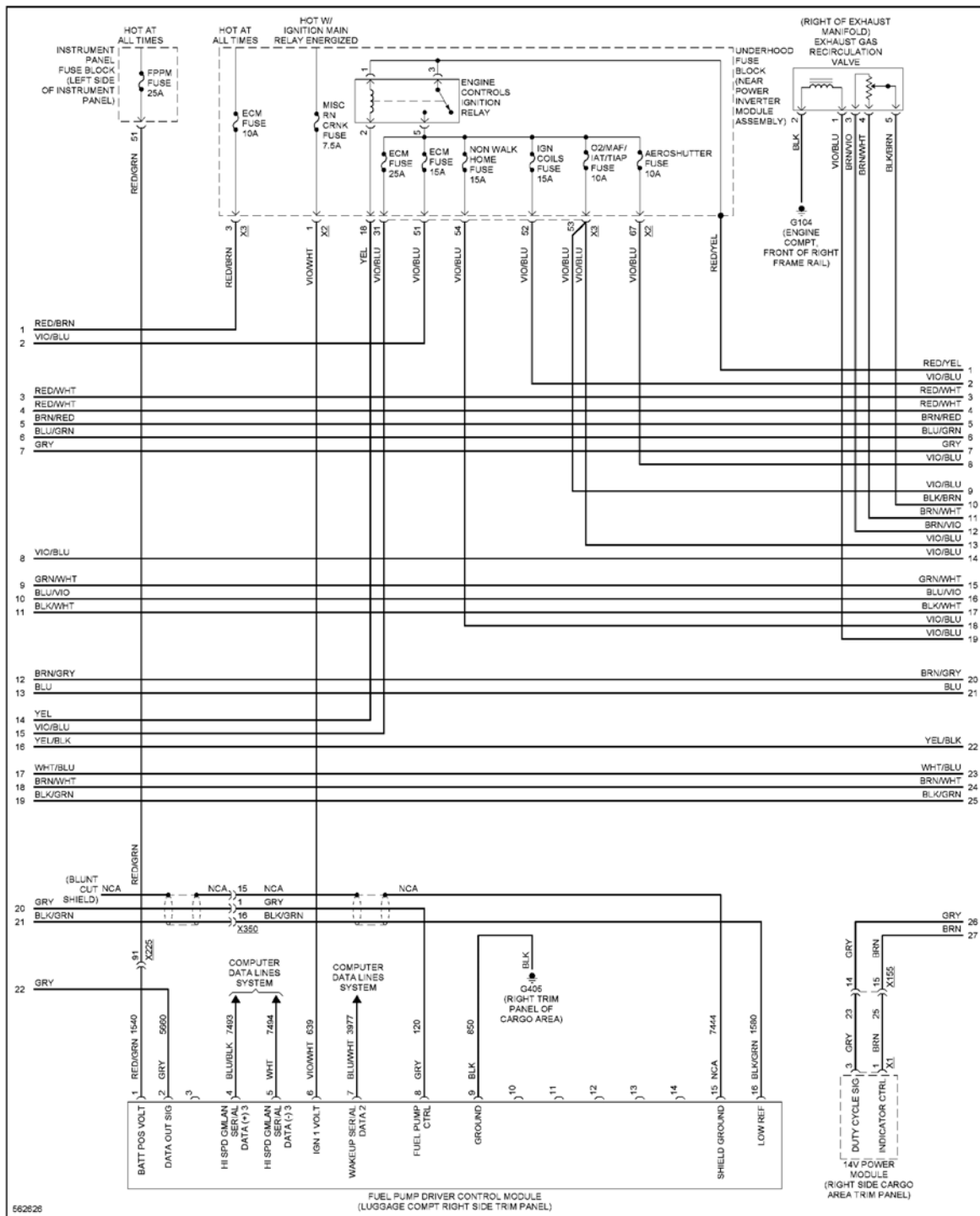


Fig. 30: 1.5L VIN 5, Engine Controls Circuit (2 of 7)

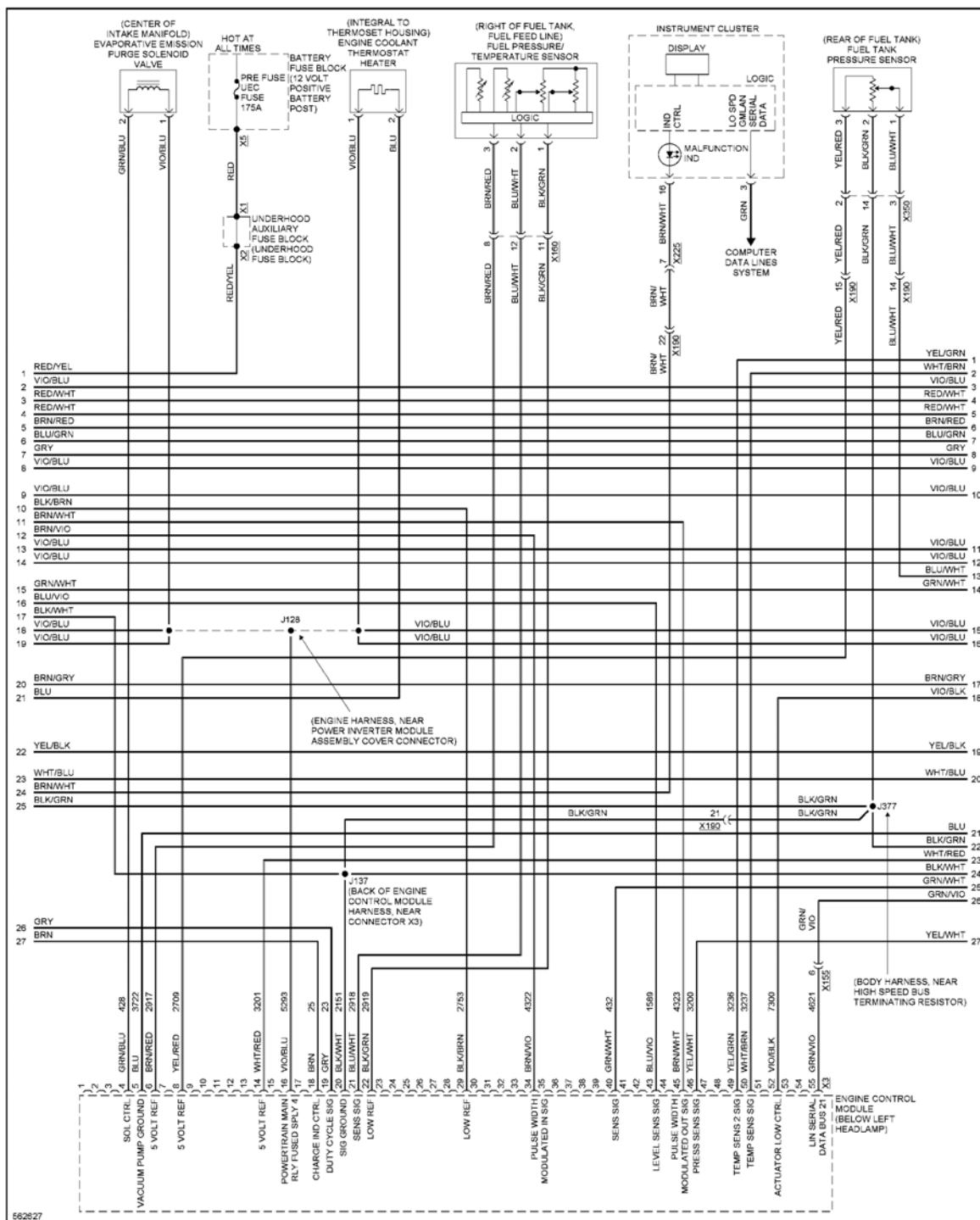


Fig. 31: 1.5L VIN 5, Engine Controls Circuit (3 of 7)

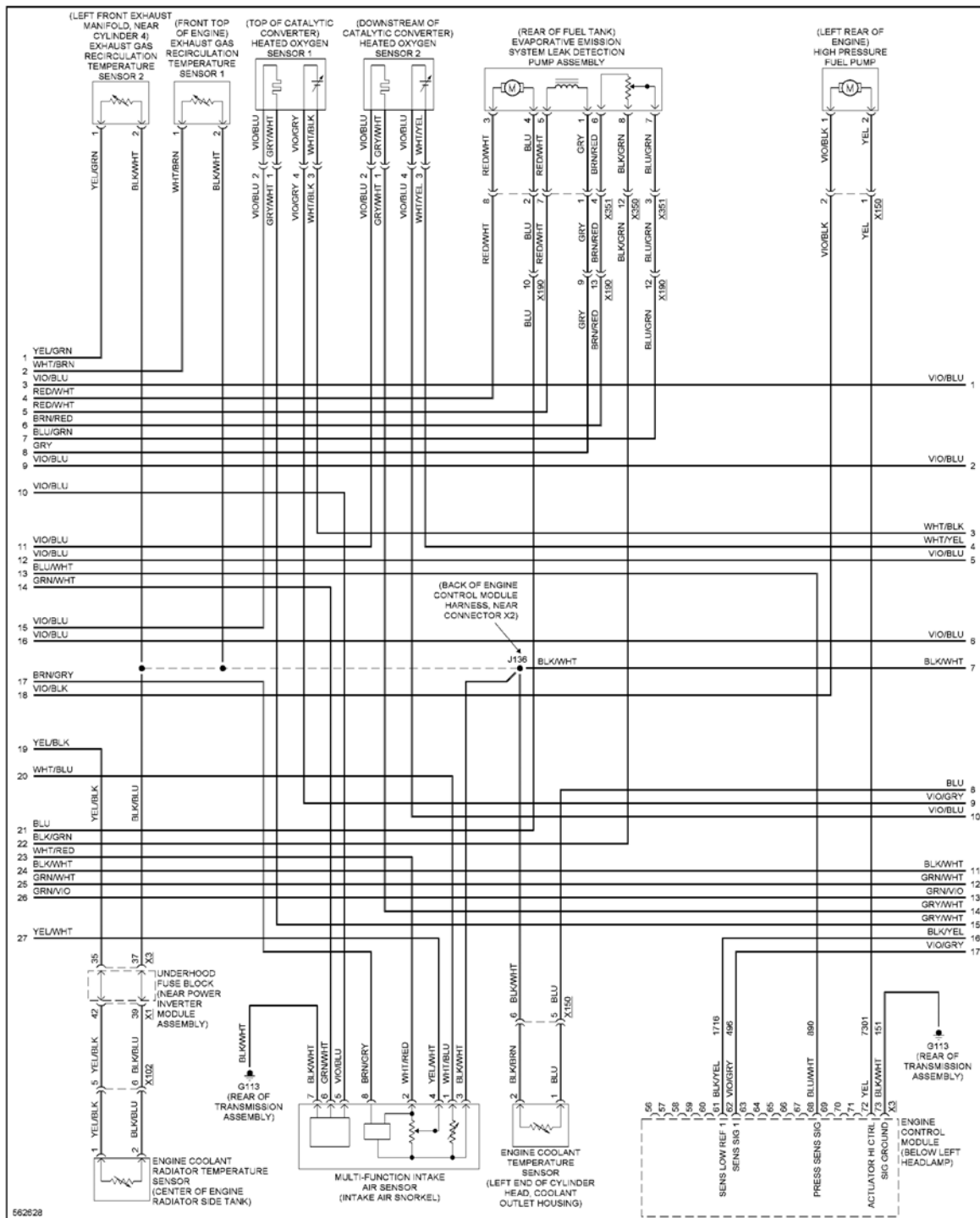


Fig. 32: 1.5L VIN 5, Engine Controls Circuit (4 of 7)

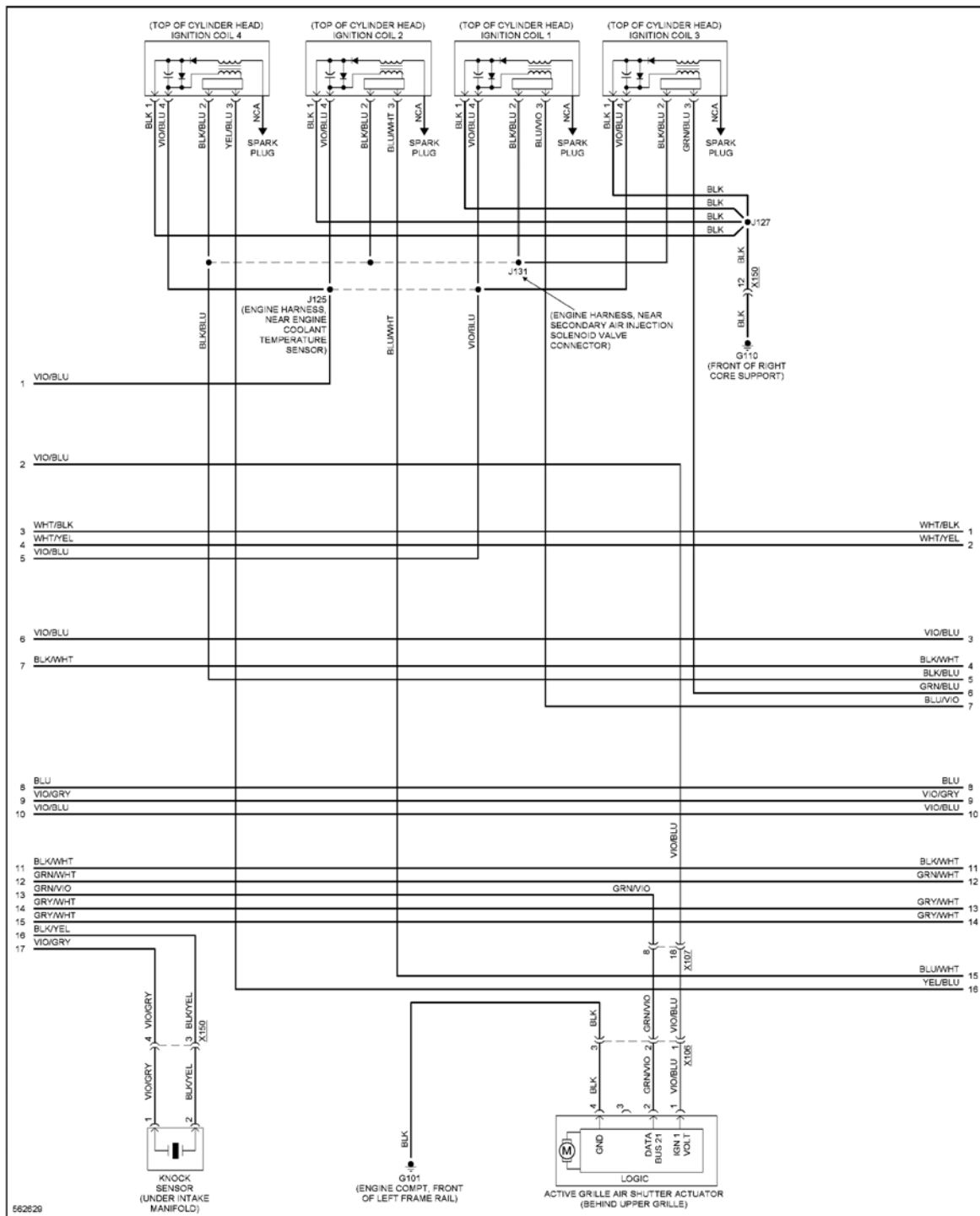


Fig. 33: 1.5L VIN 5, Engine Controls Circuit (5 of 7)

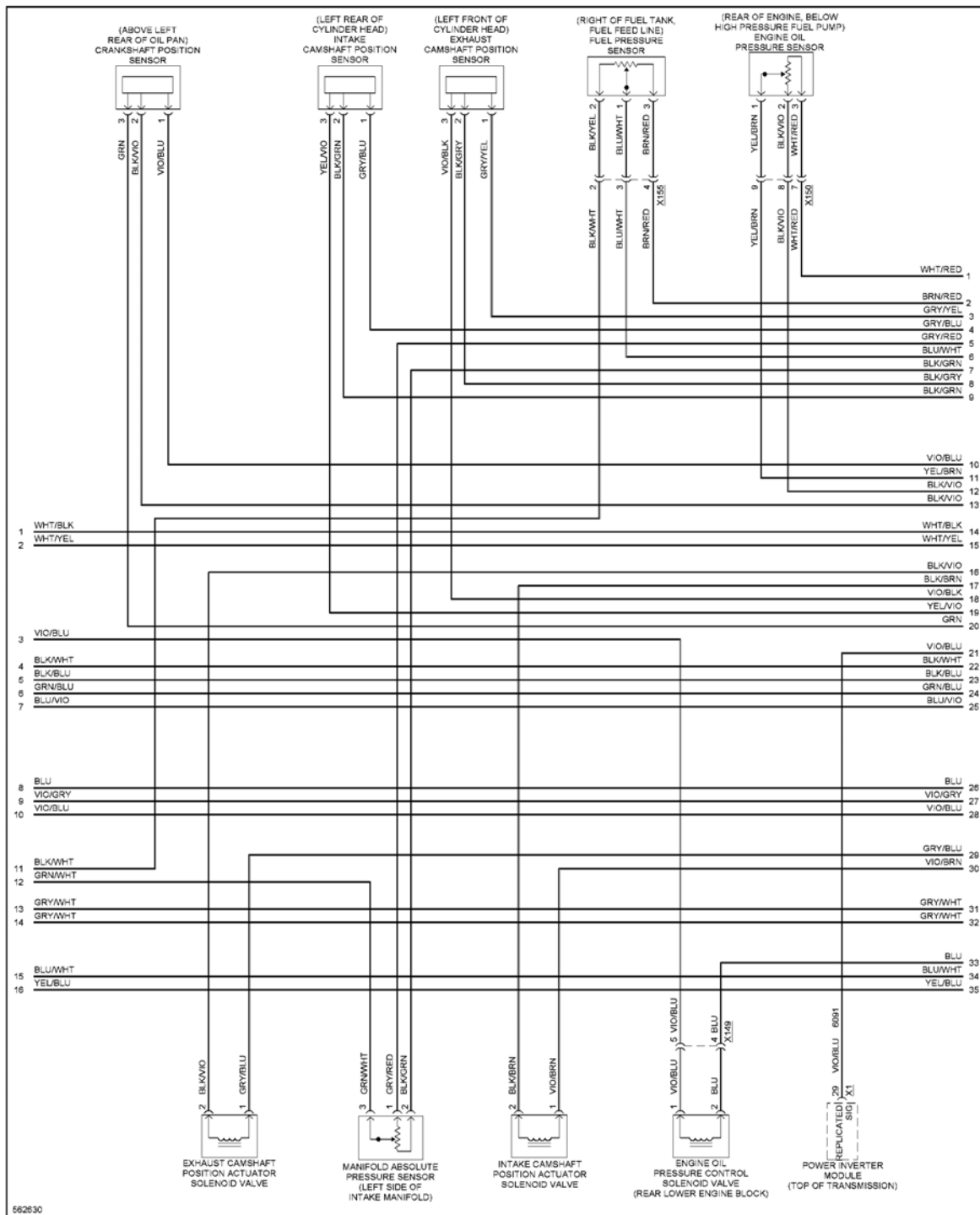


Fig. 34: 1.5L VIN 5, Engine Controls Circuit (6 of 7)

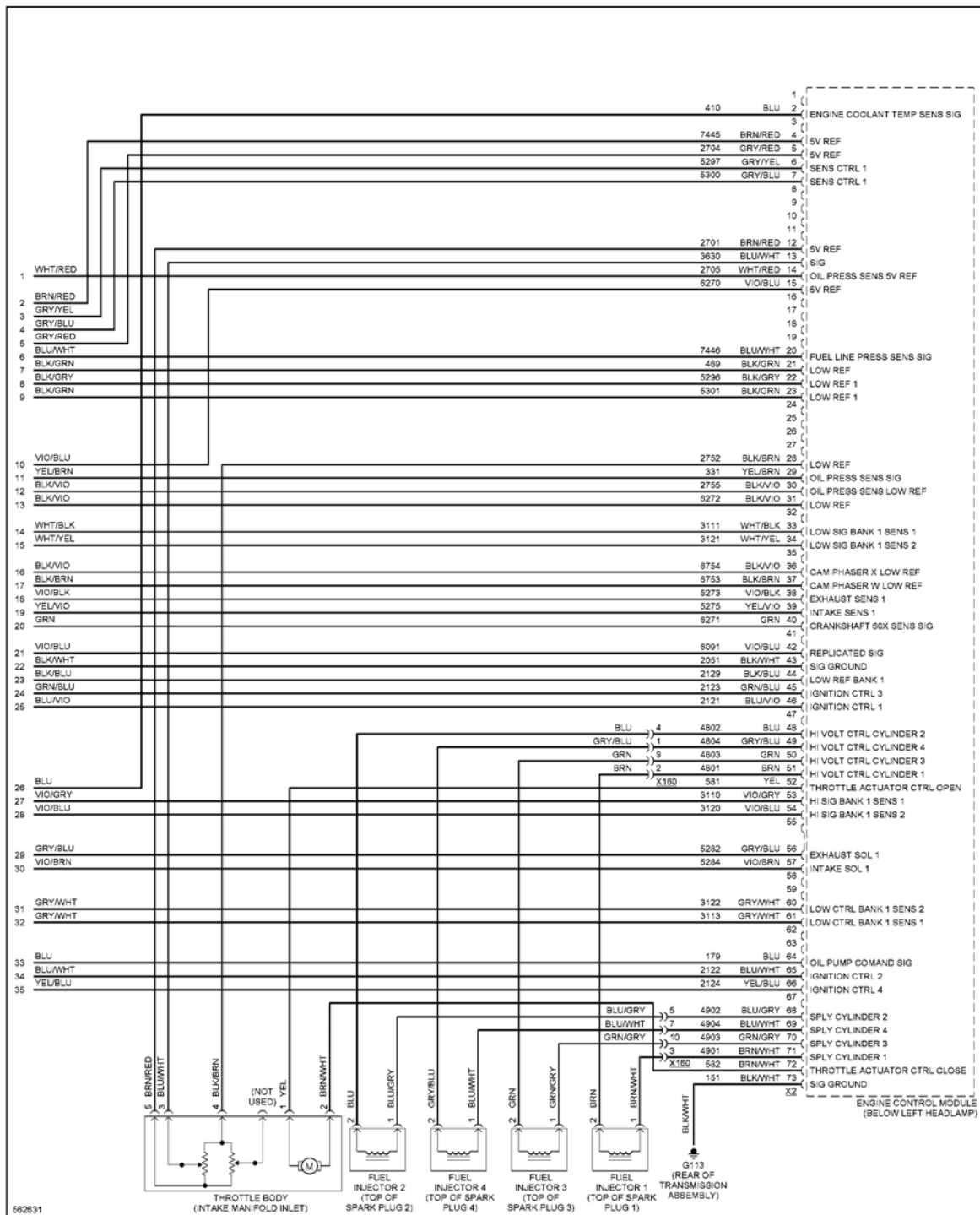


Fig. 35: 1.5L VIN 5, Engine Controls Circuit (7 of 7)

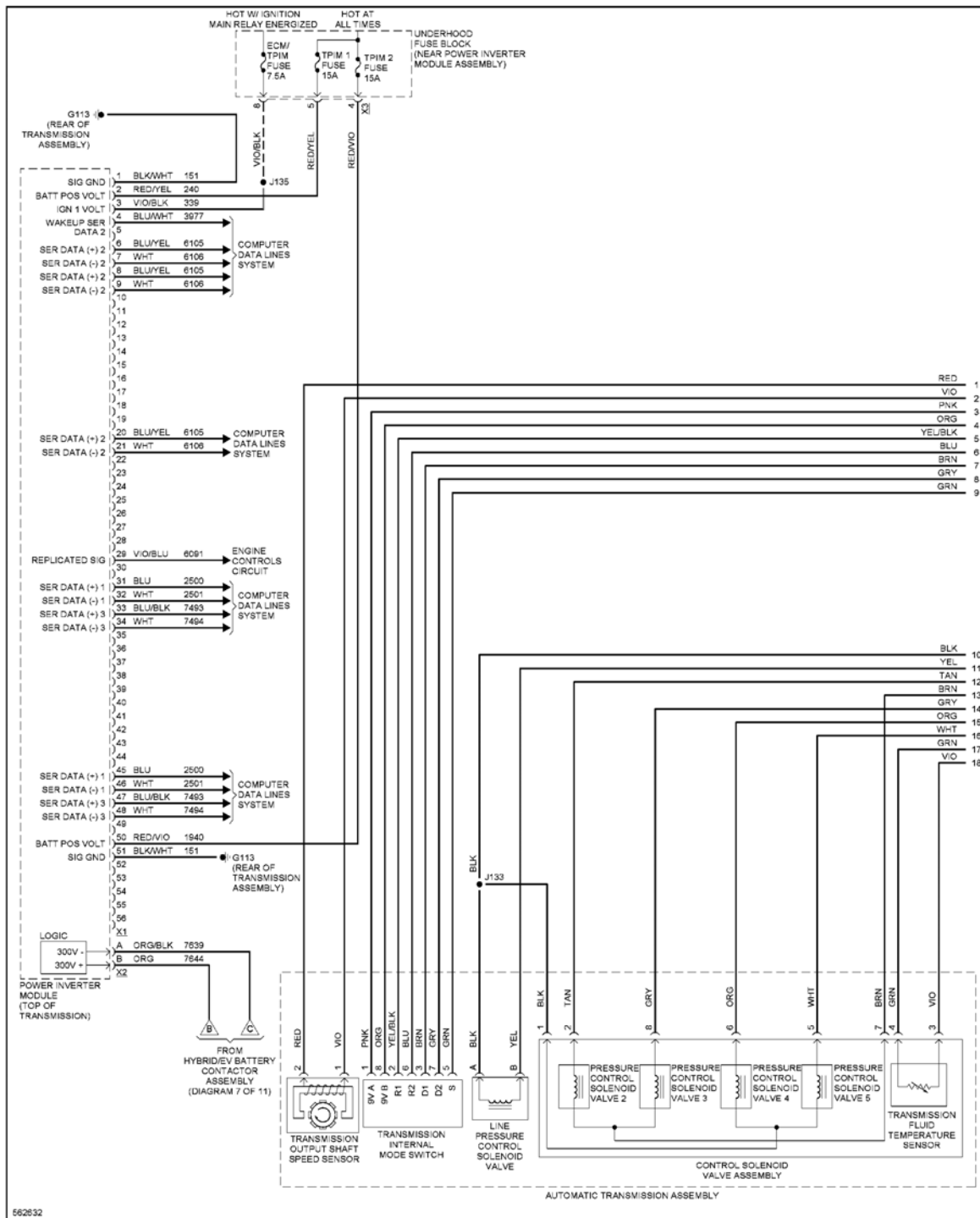


Fig. 36: 1.5L VIN 5, Hybrid System Circuit (1 of 11)

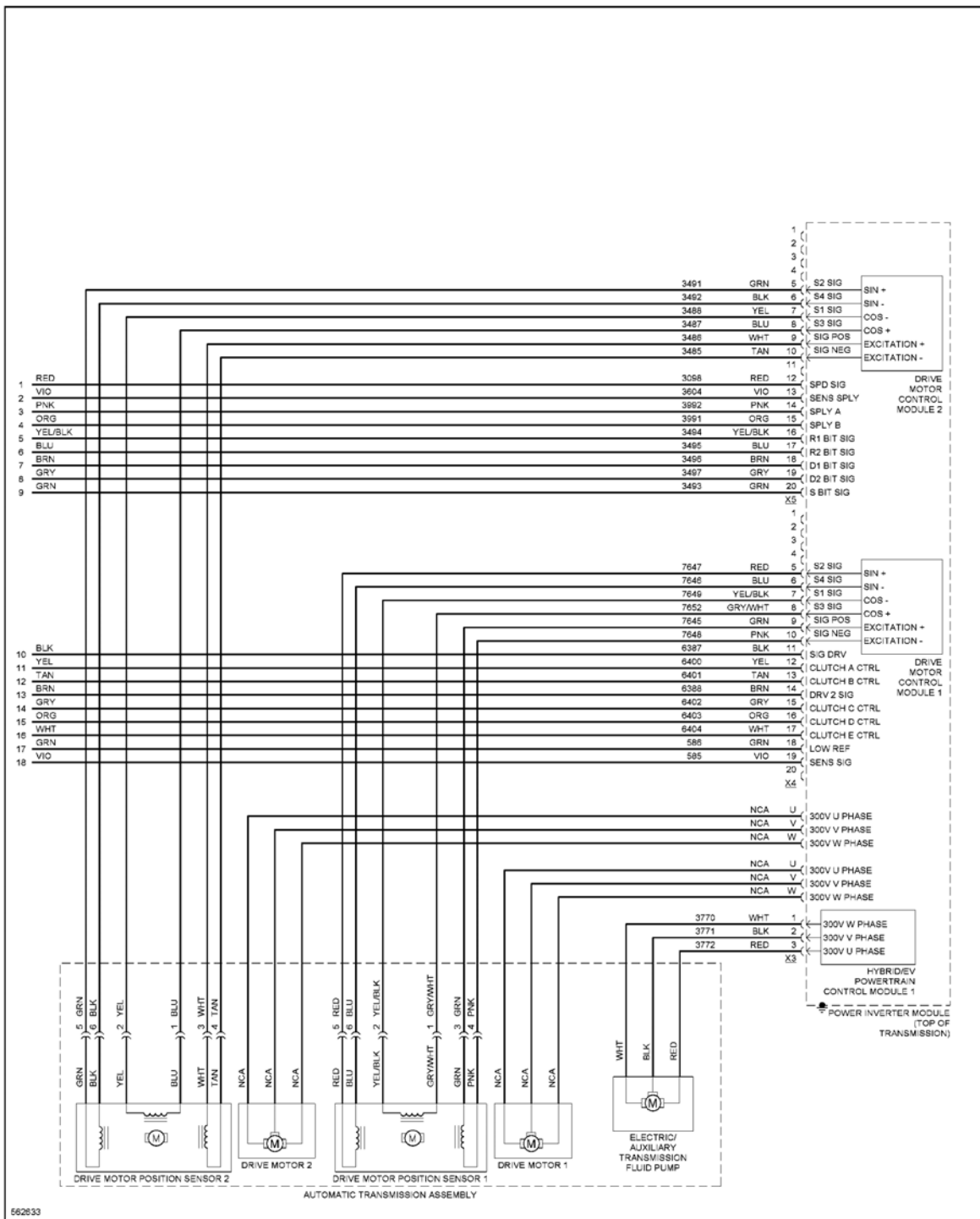


Fig. 37: 1.5L VIN 5, Hybrid System Circuit (2 of 11)



39 of 113

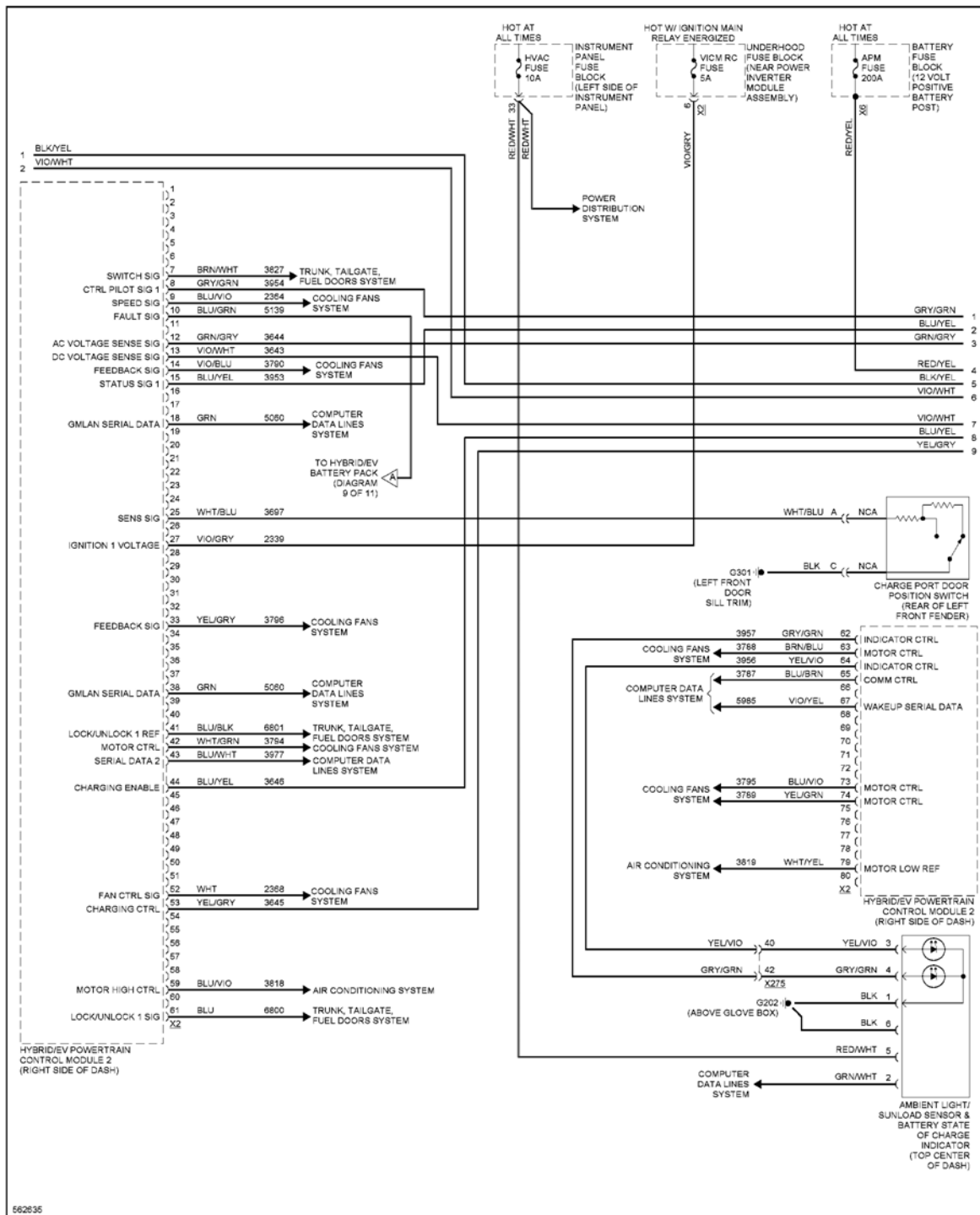


Fig. 39: 1.5L VIN 5, Hybrid System Circuit (4 of 11)

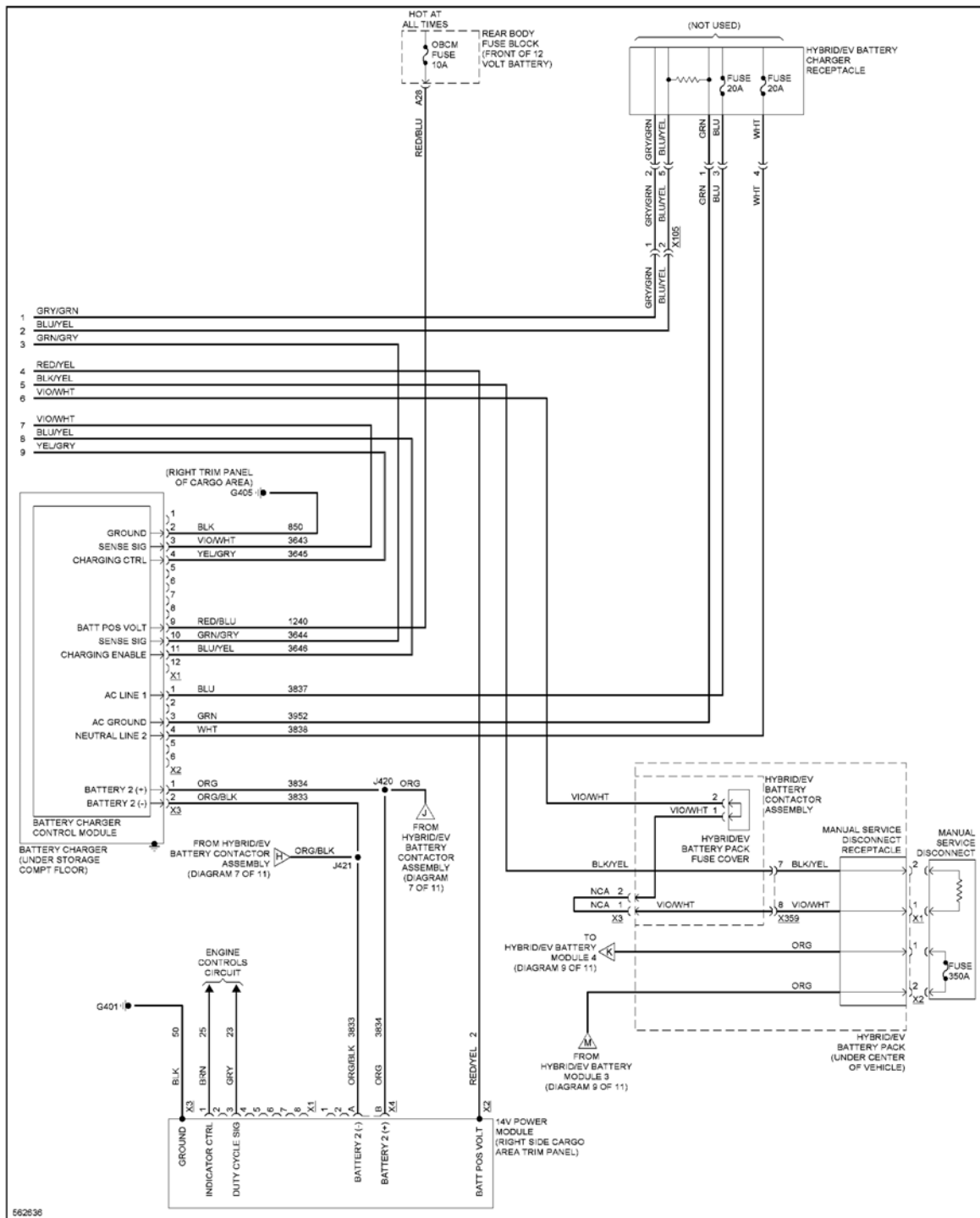


Fig. 40: 1.5L VIN 5, Hybrid System Circuit (5 of 11)

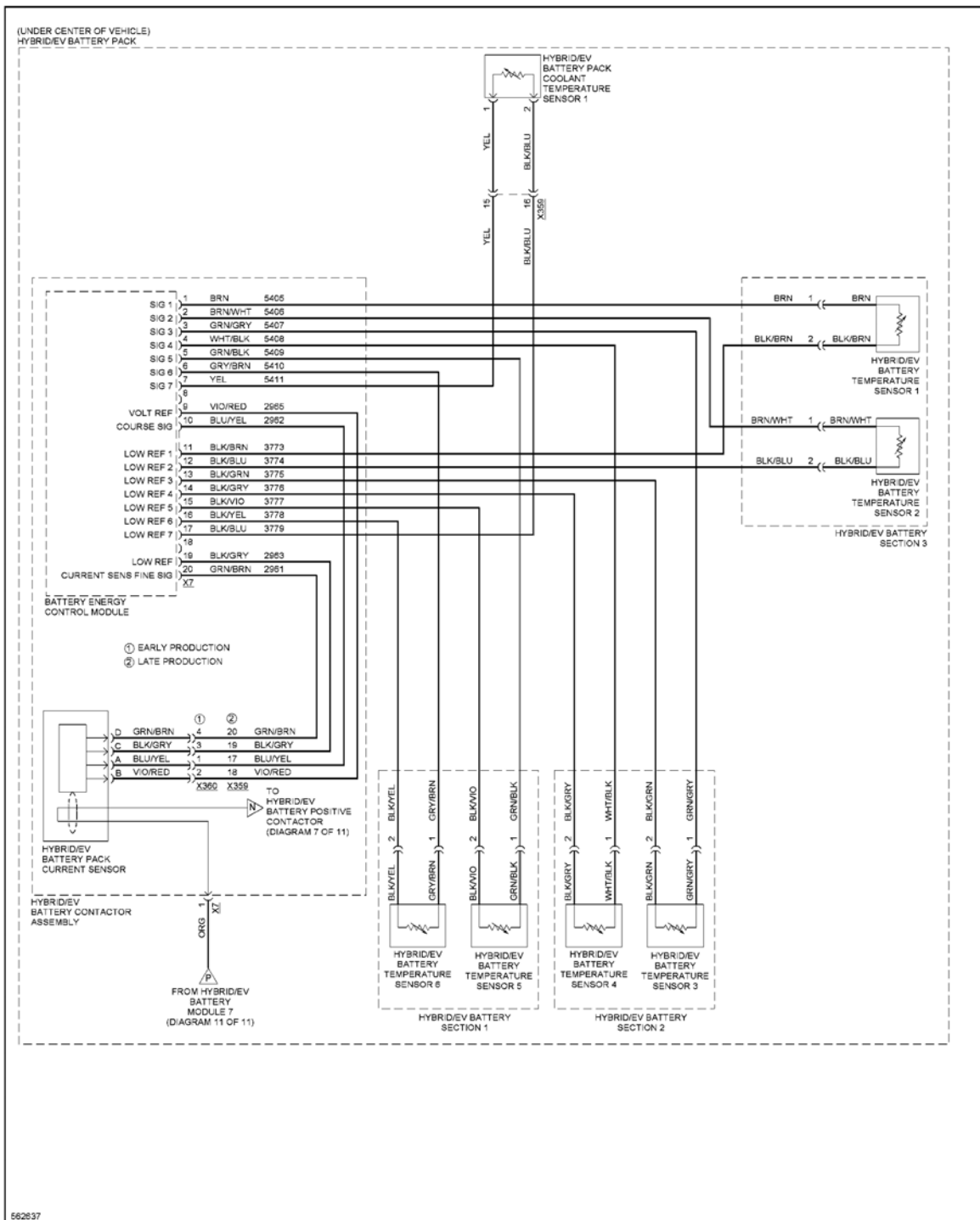


Fig. 41: 1.5L VIN 5, Hybrid System Circuit (6 of 11)

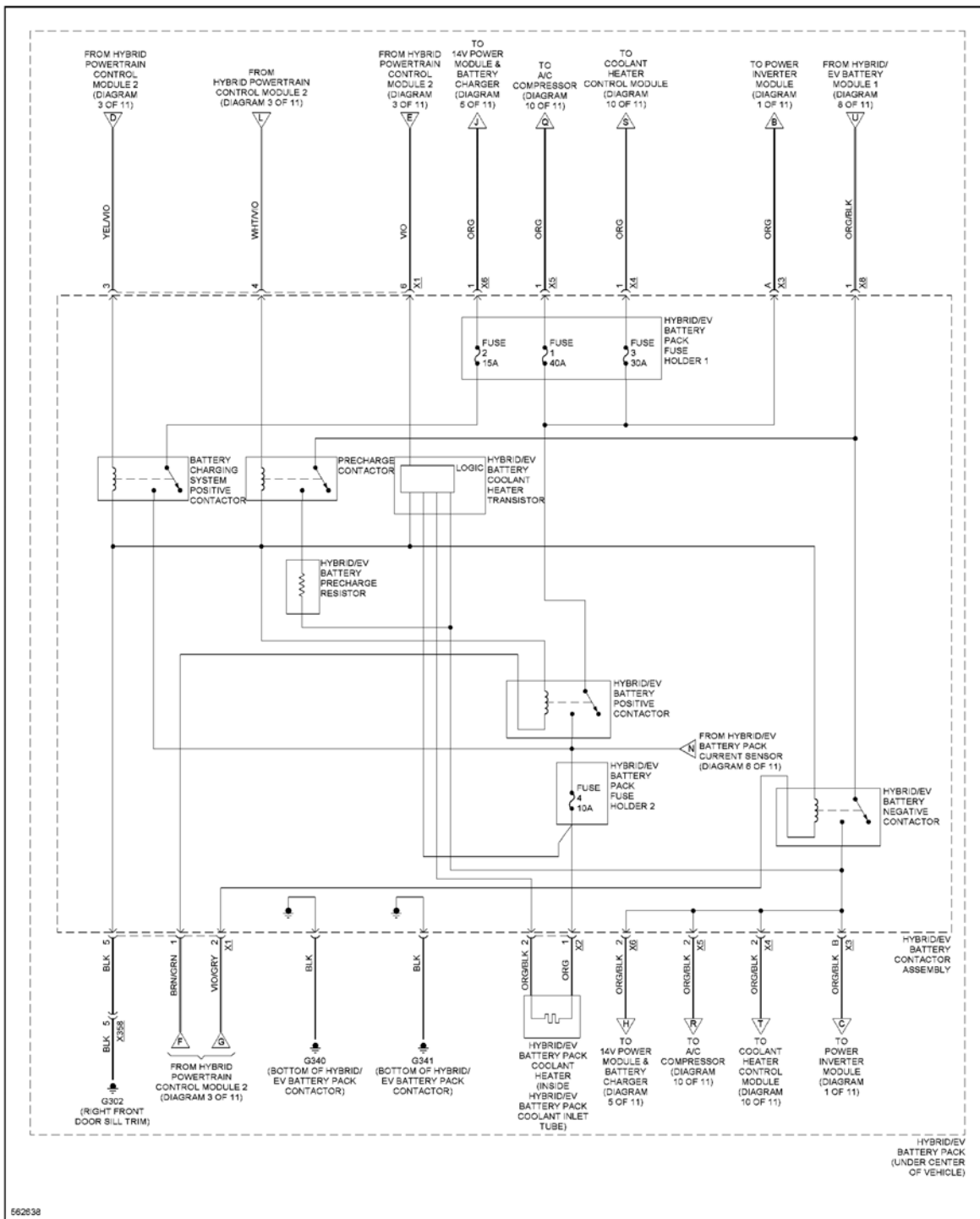


Fig. 42: 1.5L VIN 5, Hybrid System Circuit (7 of 11)

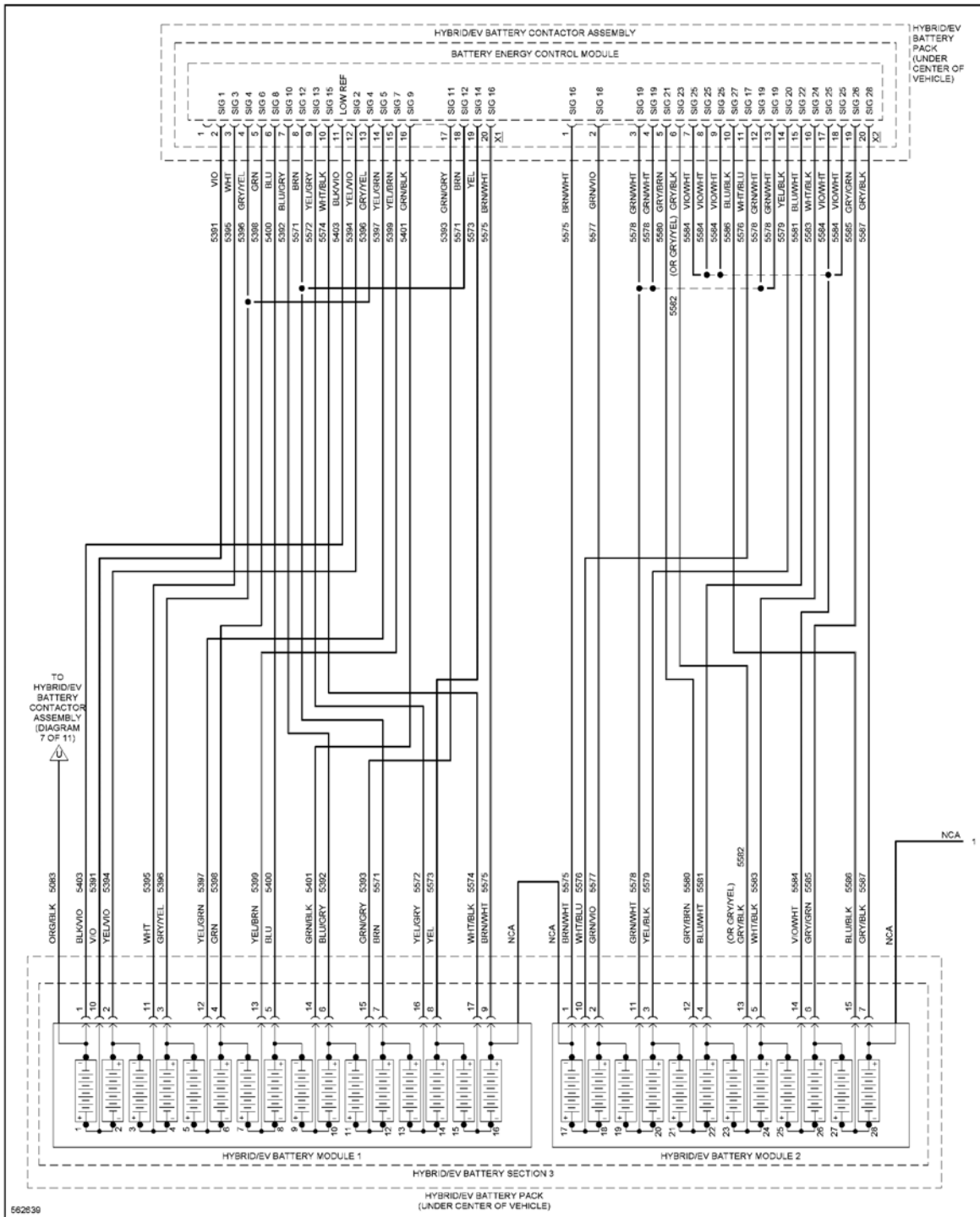


Fig. 43: 1.5L VIN 5, Hybrid System Circuit (8 of 11)

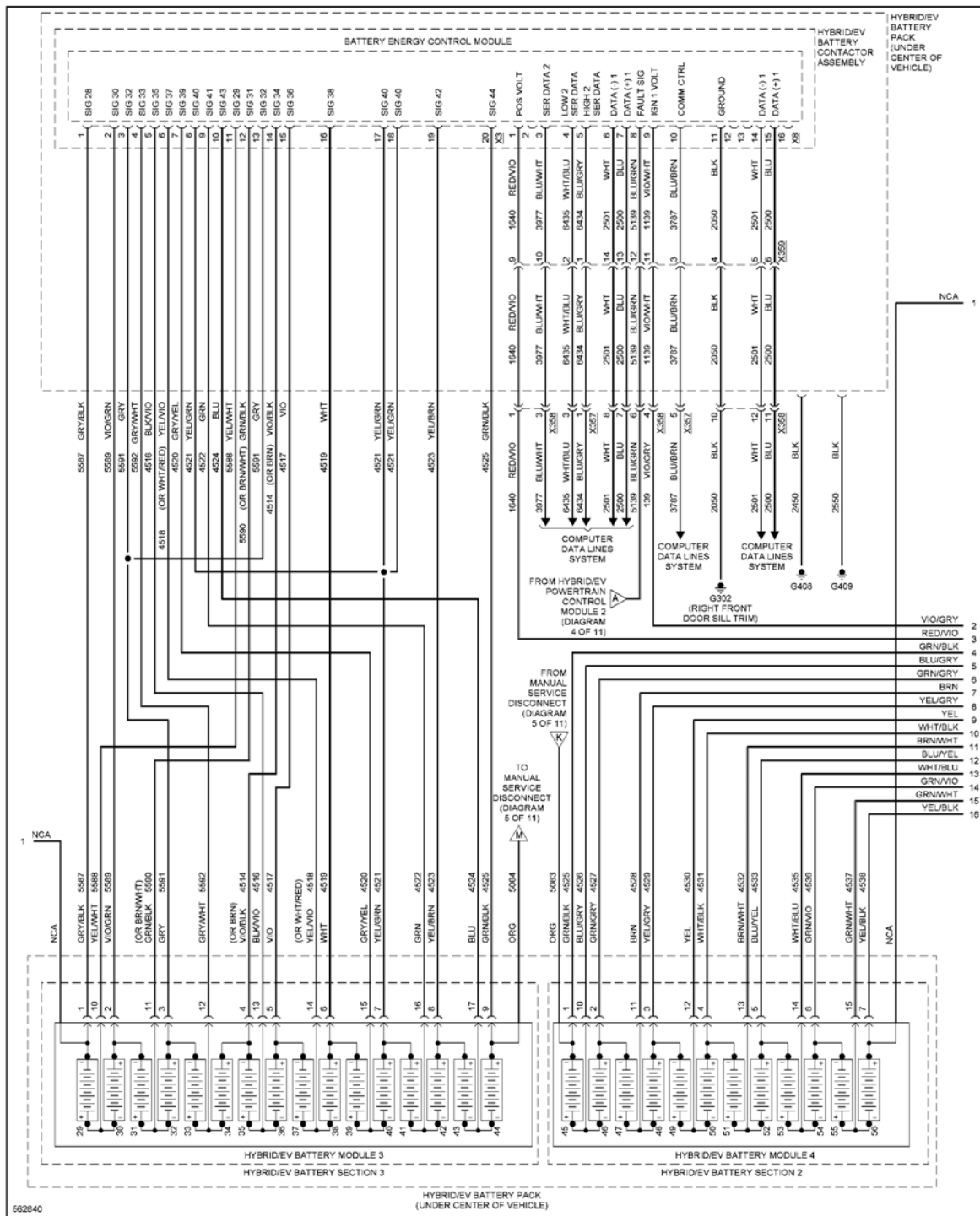


Fig. 44: 1.5L VIN 5, Hybrid System Circuit (9 of 11)

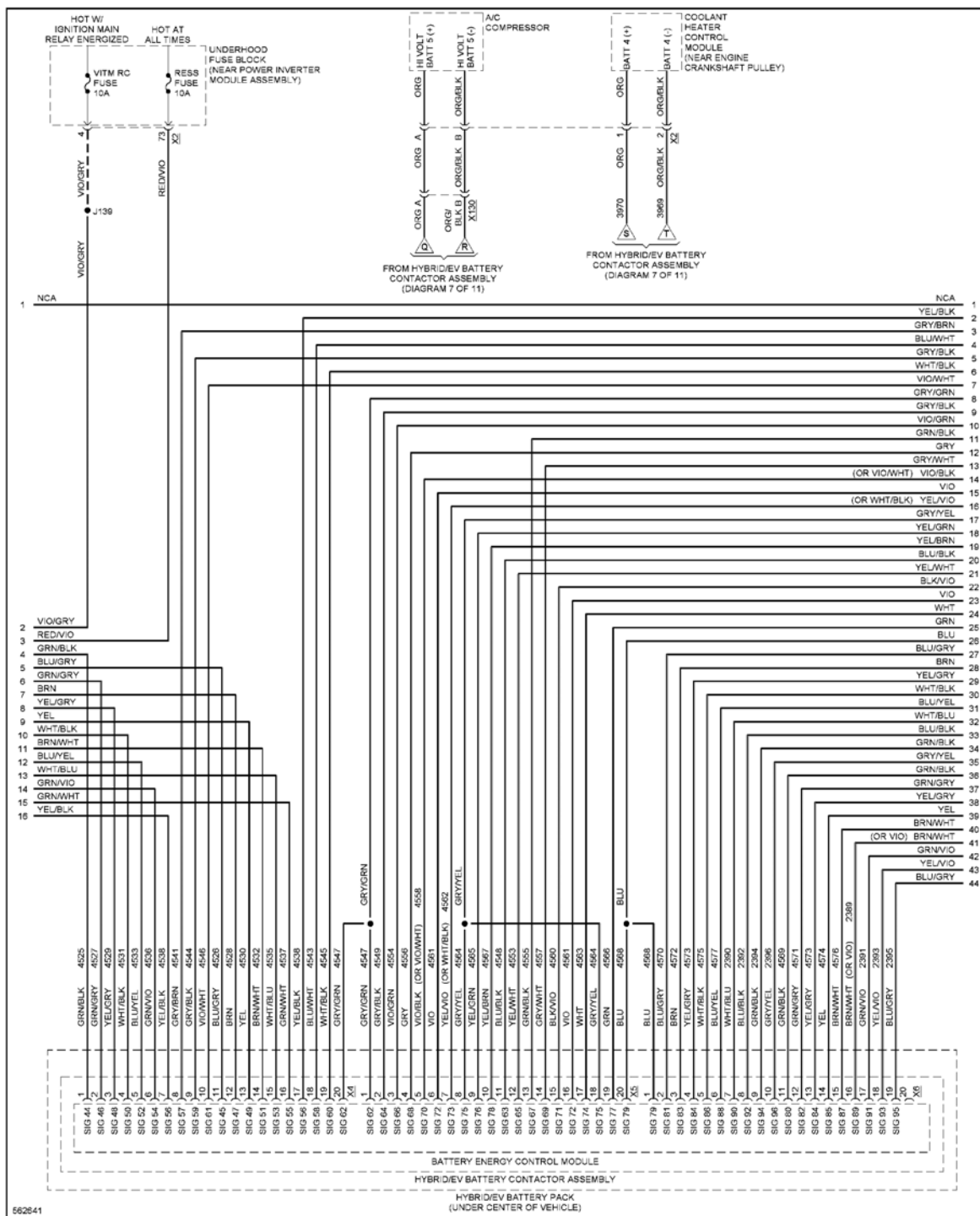


Fig. 45: 1.5L VIN 5, Hybrid System Circuit (10 of 11)

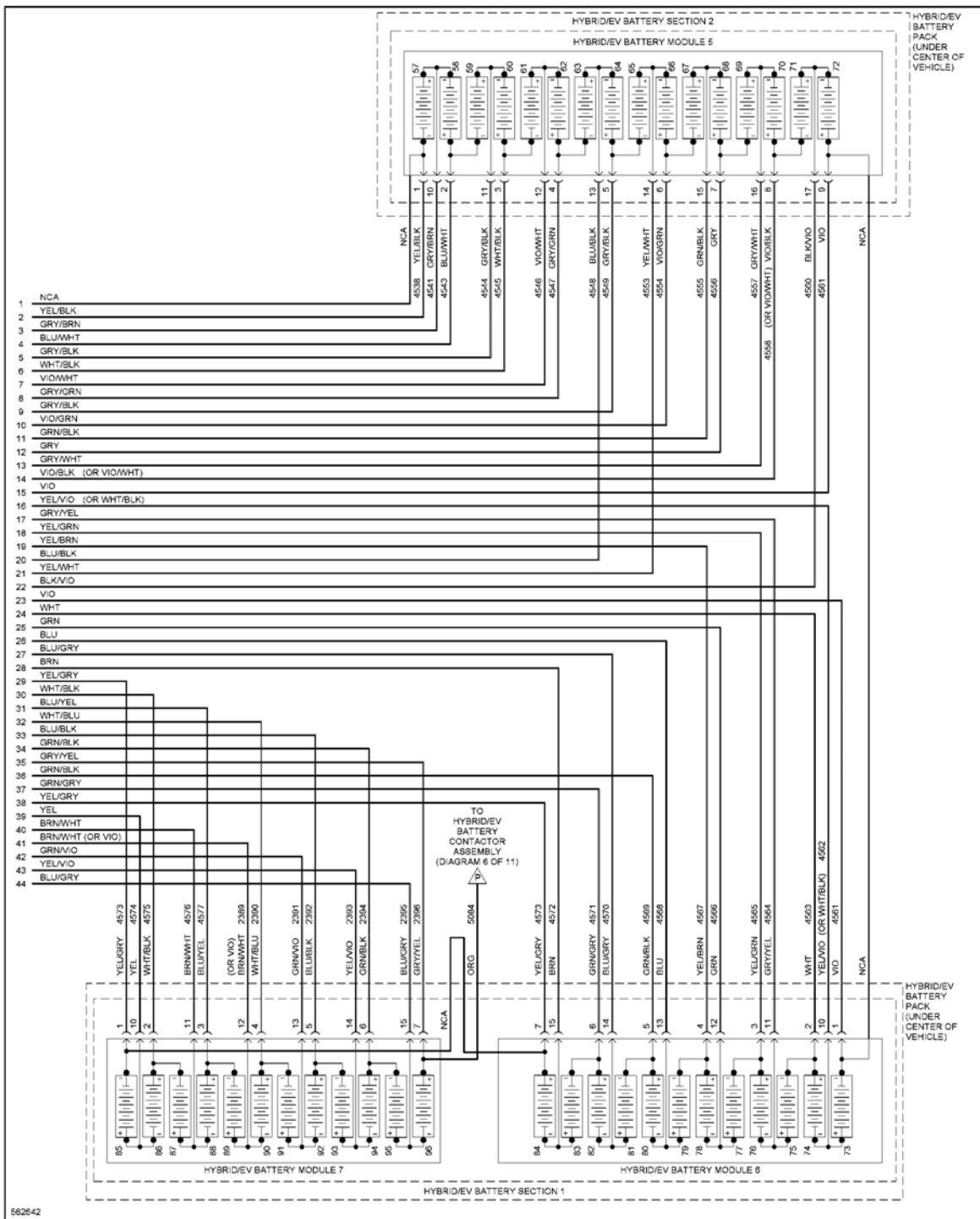


Fig. 46: 1.5L VIN 5, Hybrid System Circuit (11 of 11)

EXTERIOR LIGHTS

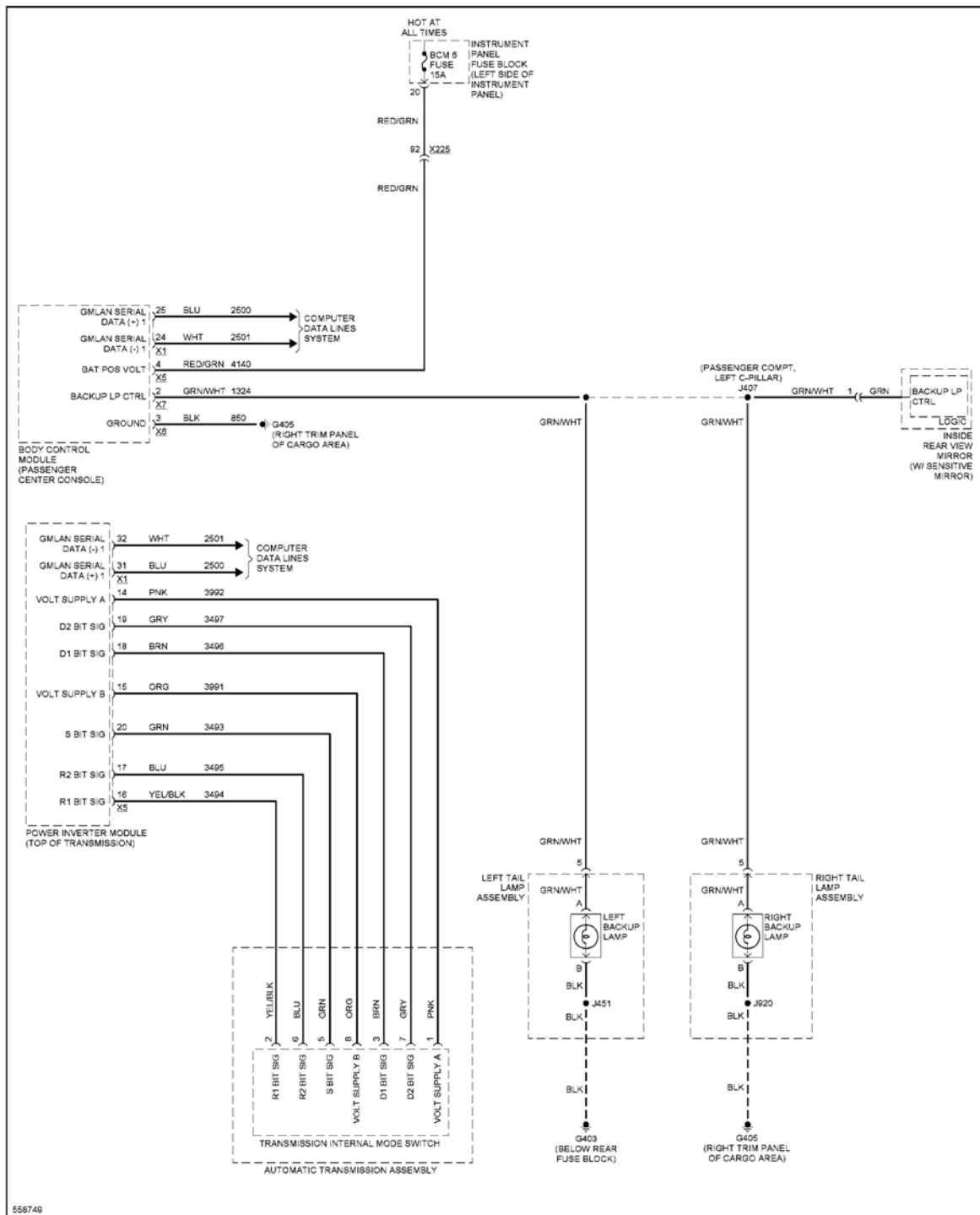


Fig. 47: Backup Lamps Circuit

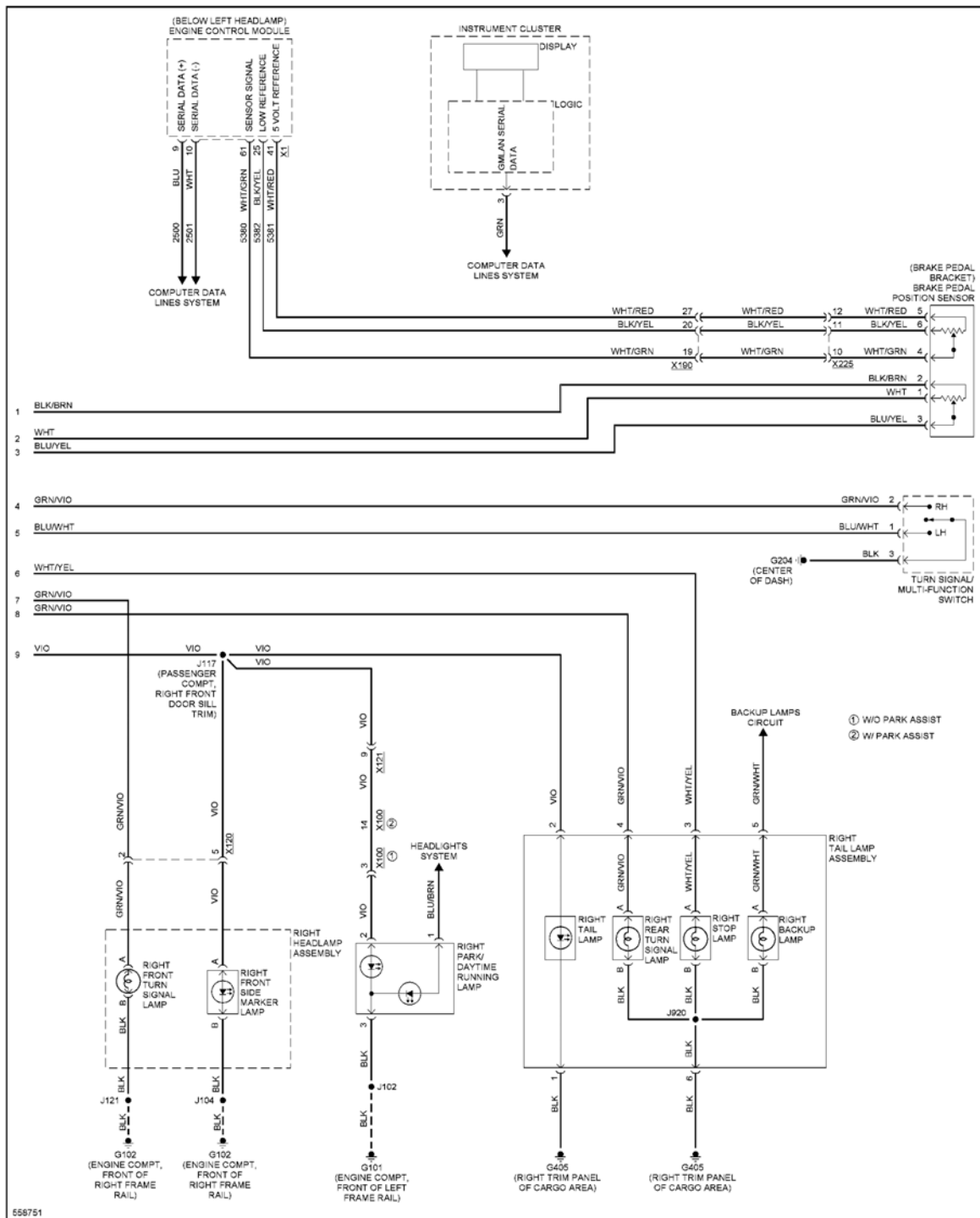


Fig. 49: Exterior Lamps Circuit (2 of 2)

GROUND DISTRIBUTION

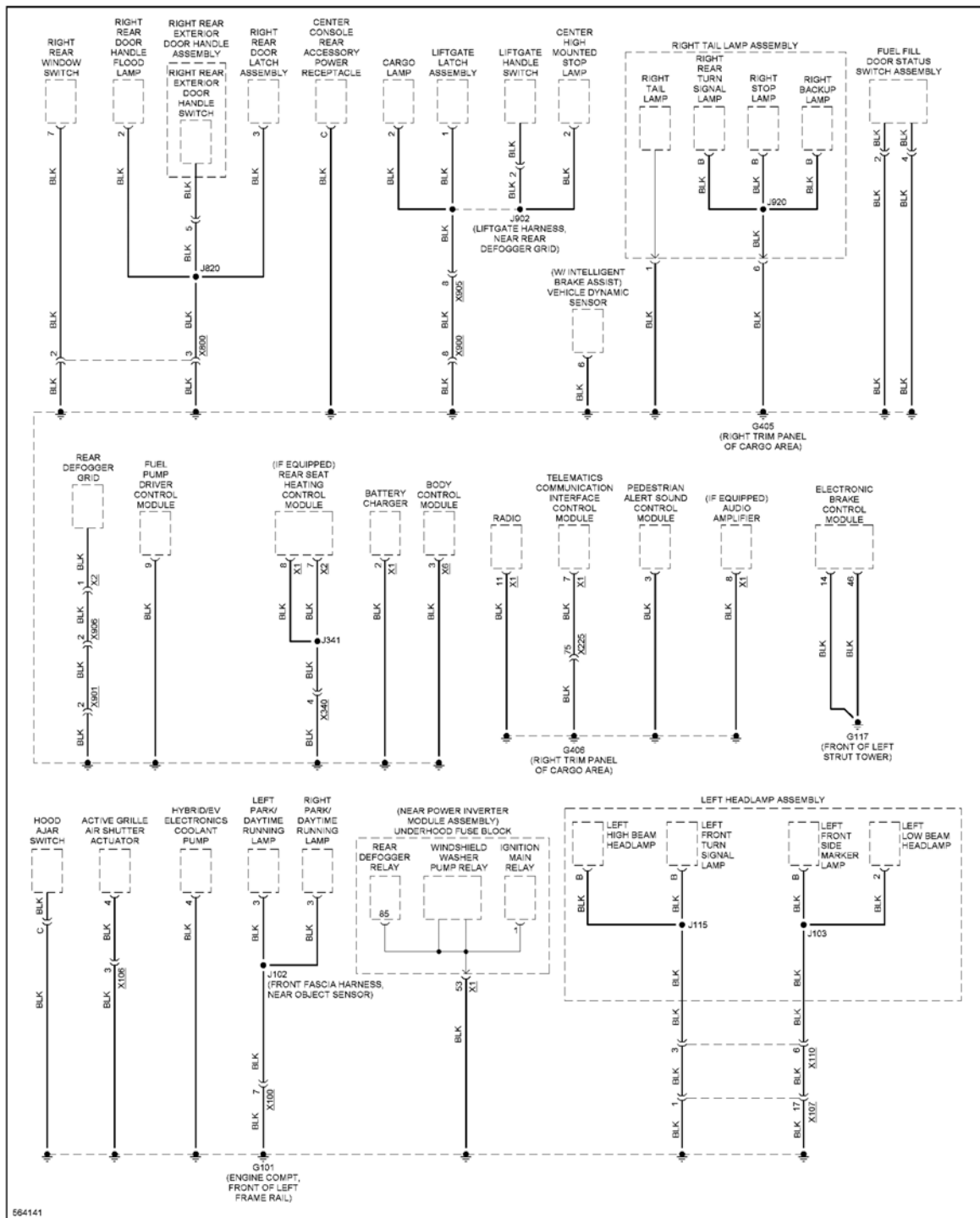


Fig. 50: Ground Distribution Circuit (1 of 5)

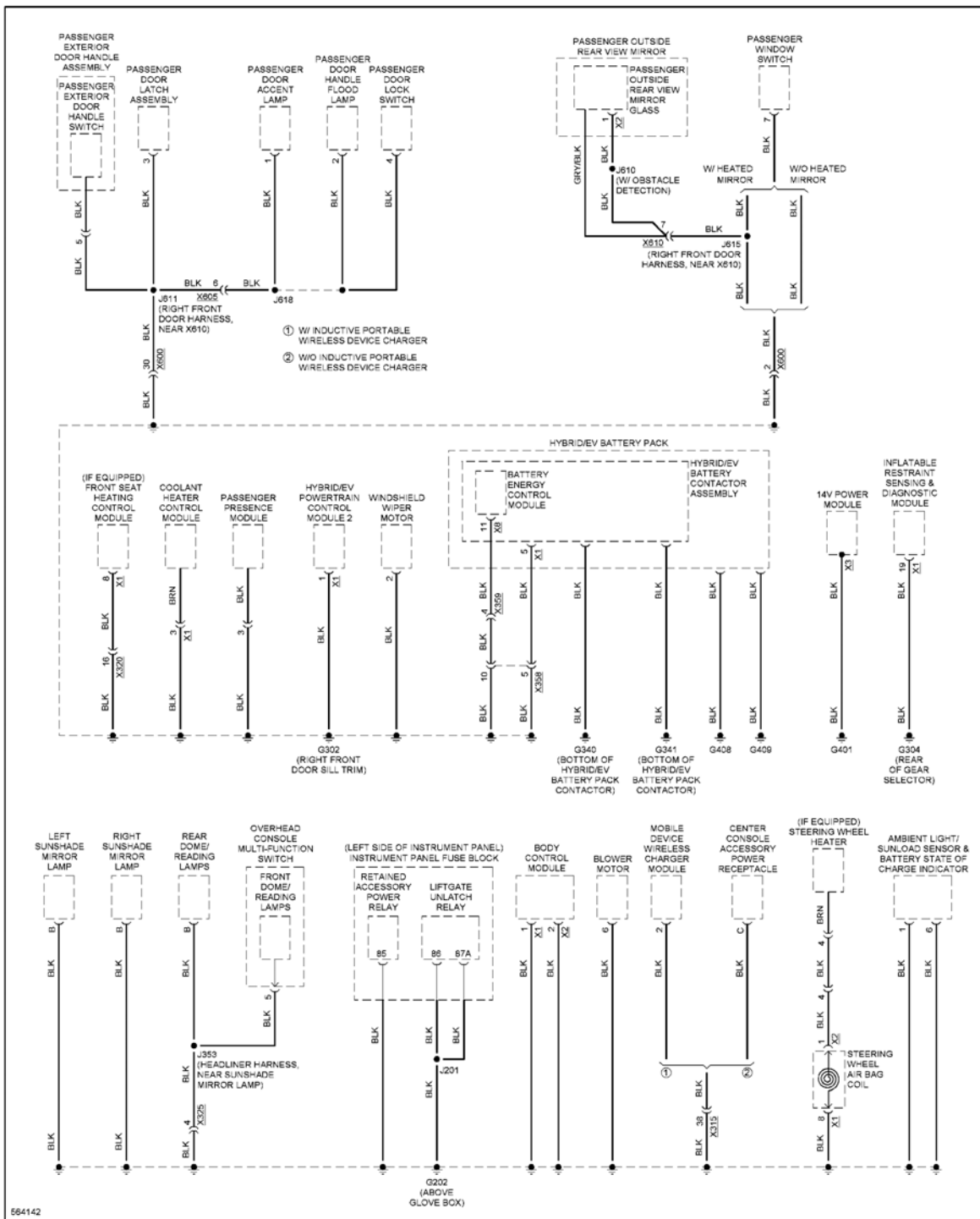


Fig. 51: Ground Distribution Circuit (2 of 5)

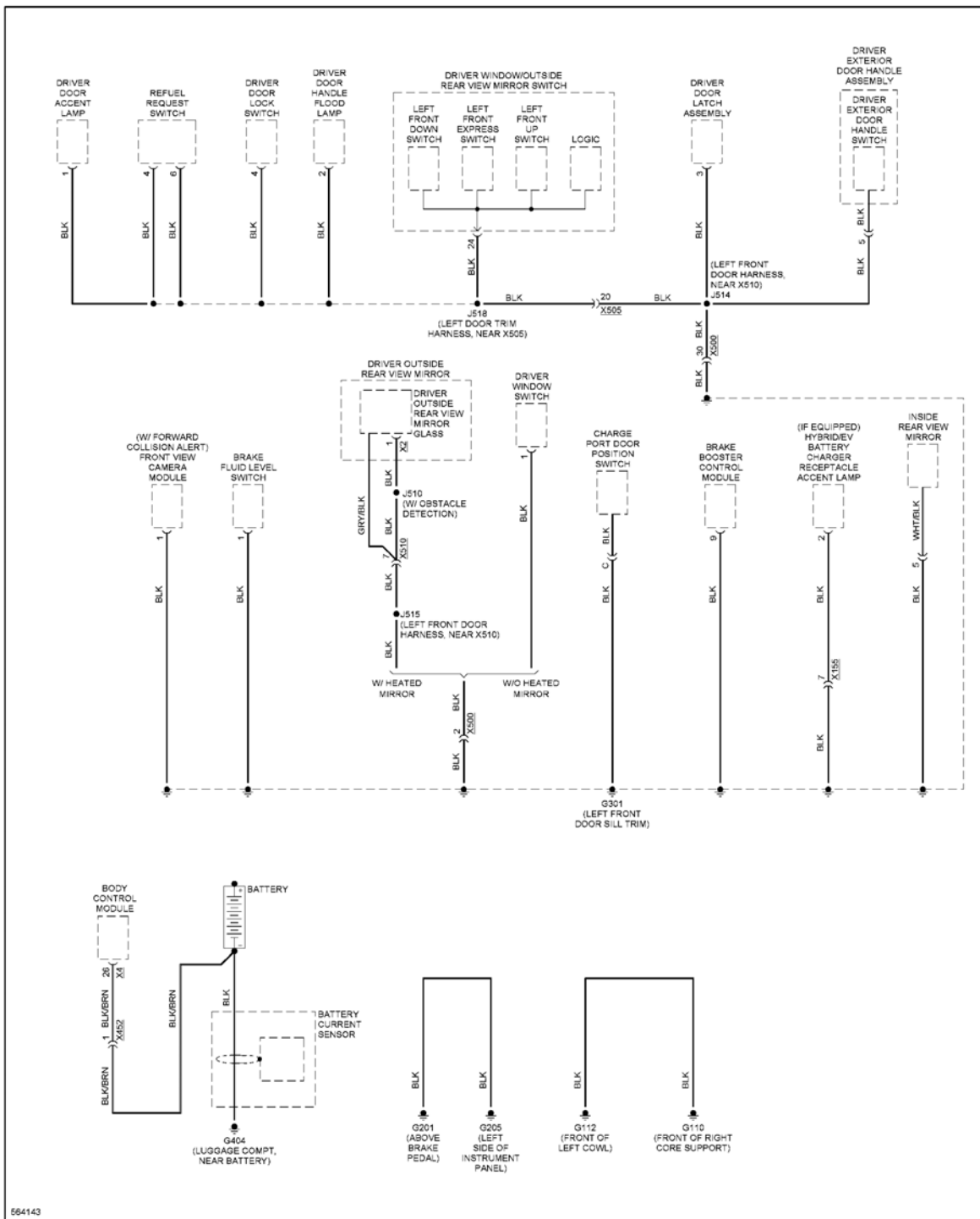


Fig. 52: Ground Distribution Circuit (3 of 5)

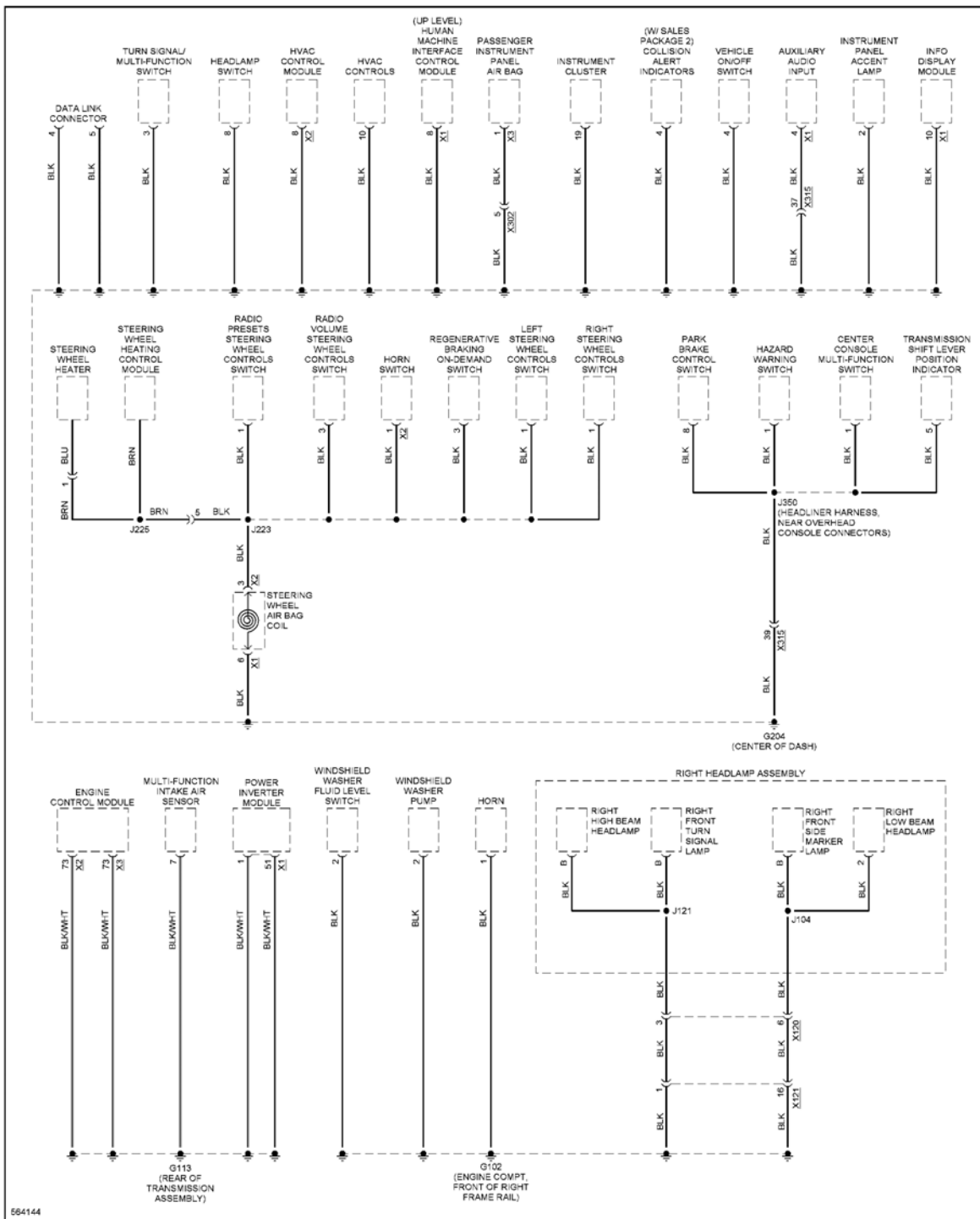


Fig. 53: Ground Distribution Circuit (4 of 5)

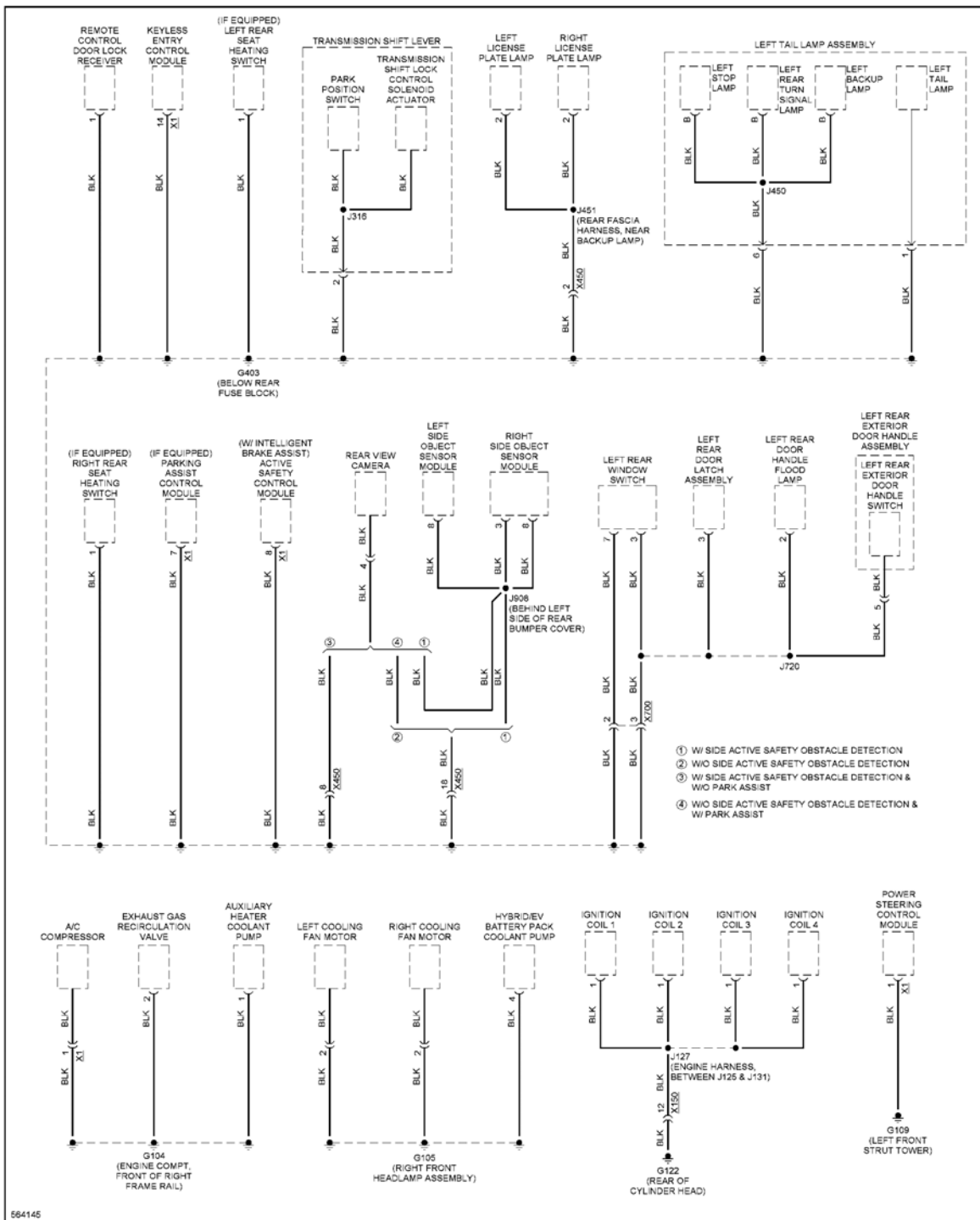


Fig. 54: Ground Distribution Circuit (5 of 5)

HEADLIGHTS

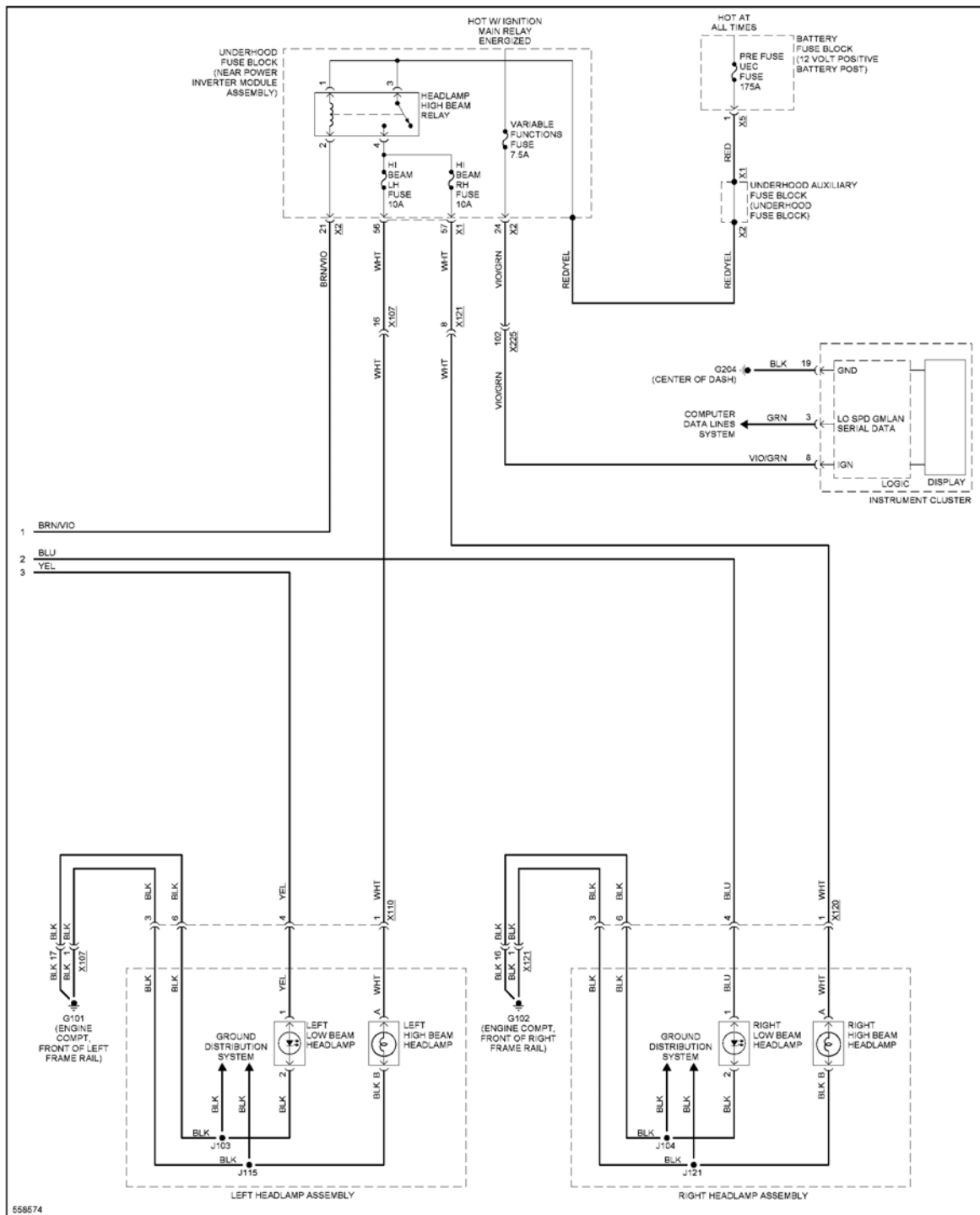


Fig. 56: Headlights Circuit (2 of 2)

HORN

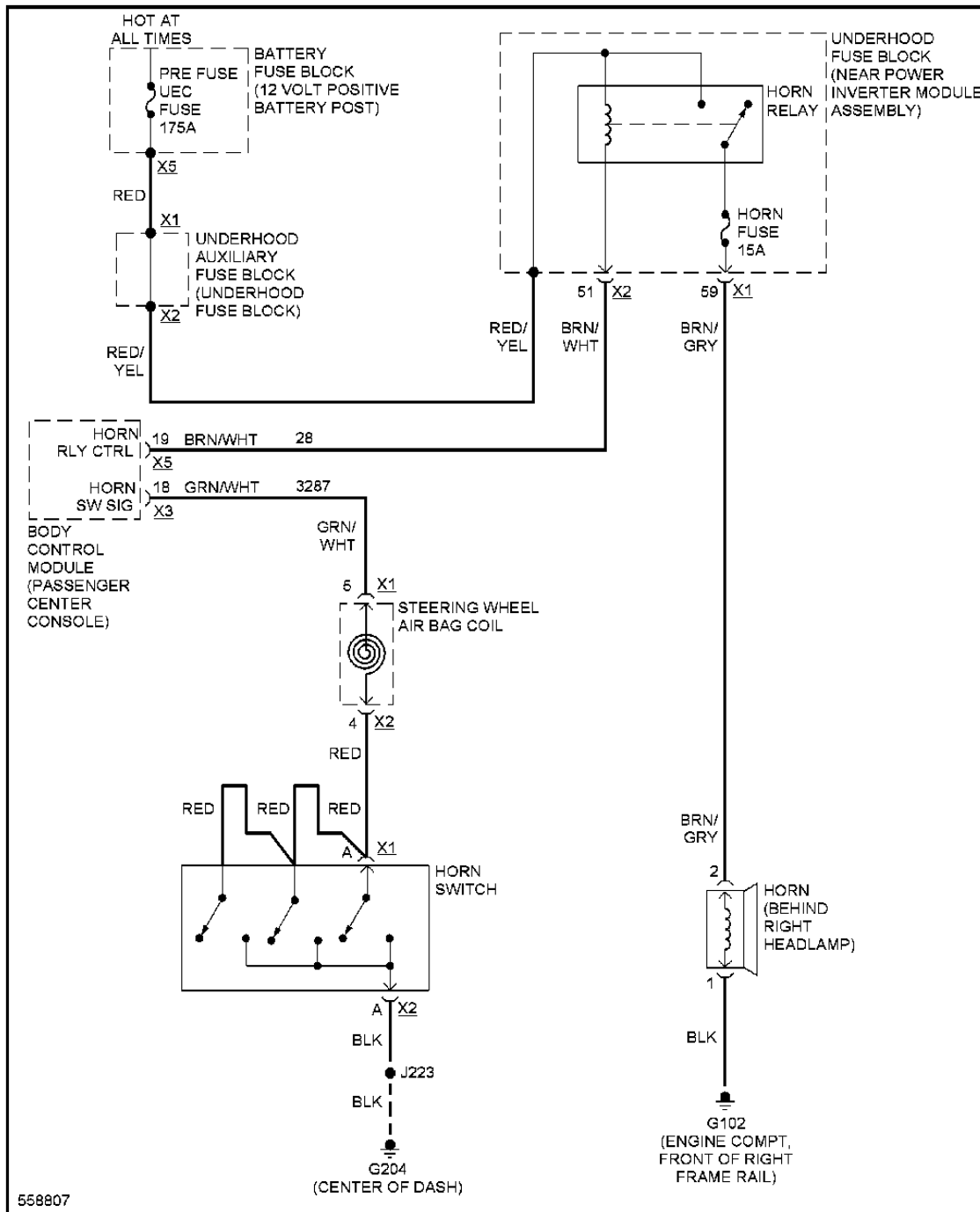


Fig. 57: Horn Circuit

INSTRUMENT CLUSTER

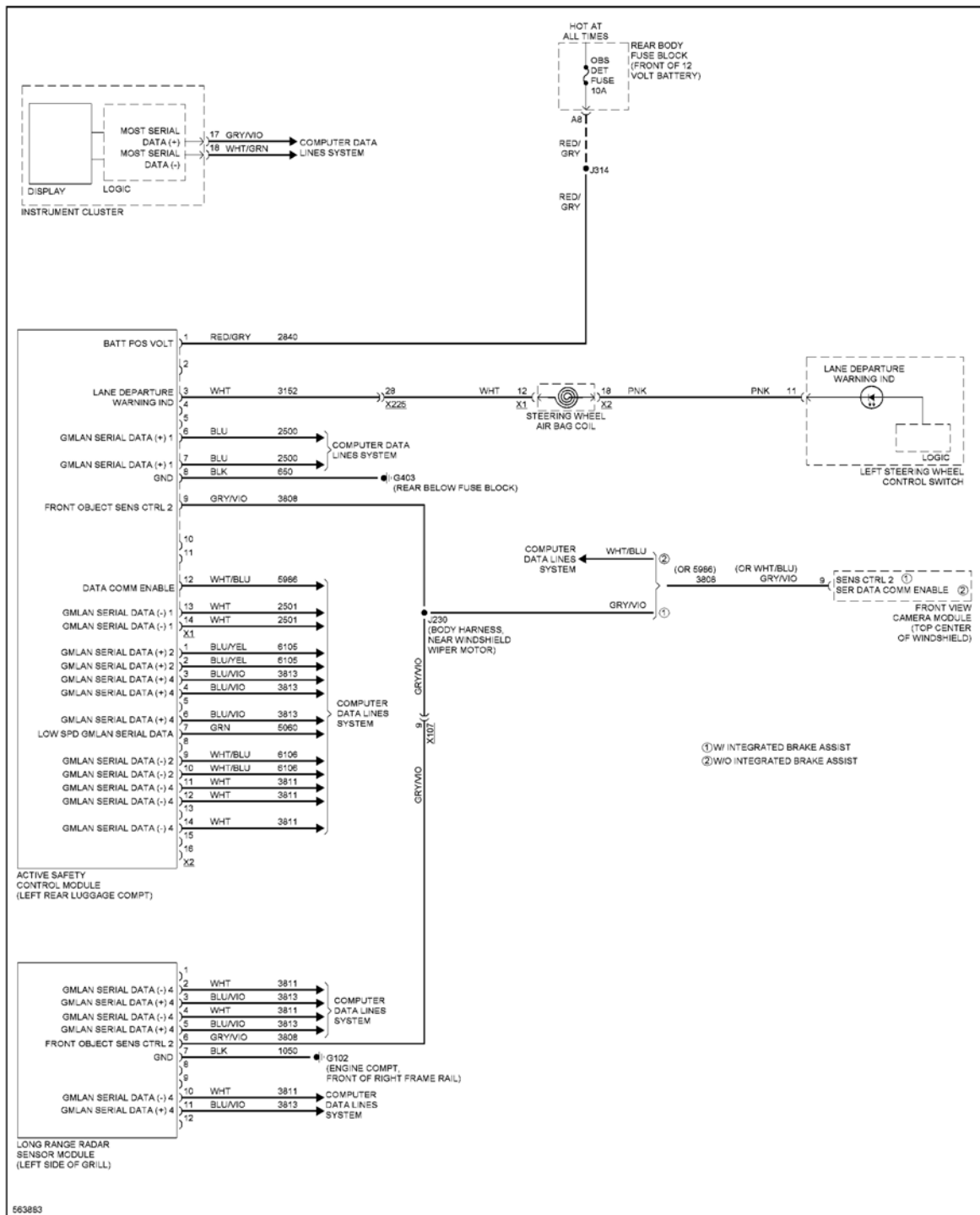


Fig. 58: Collision Avoidance Circuit

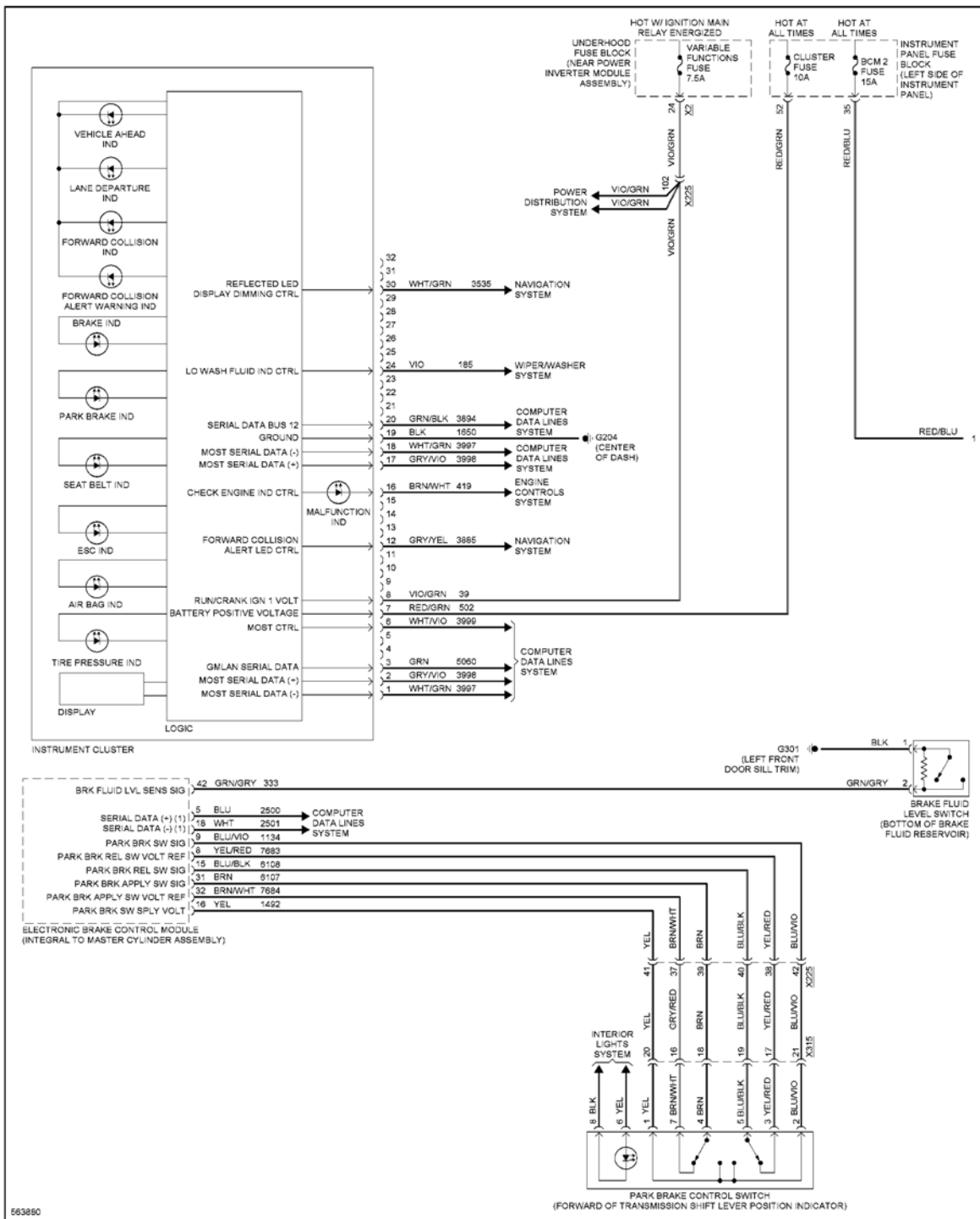


Fig. 59: Instrument Cluster Circuit (1 of 3)

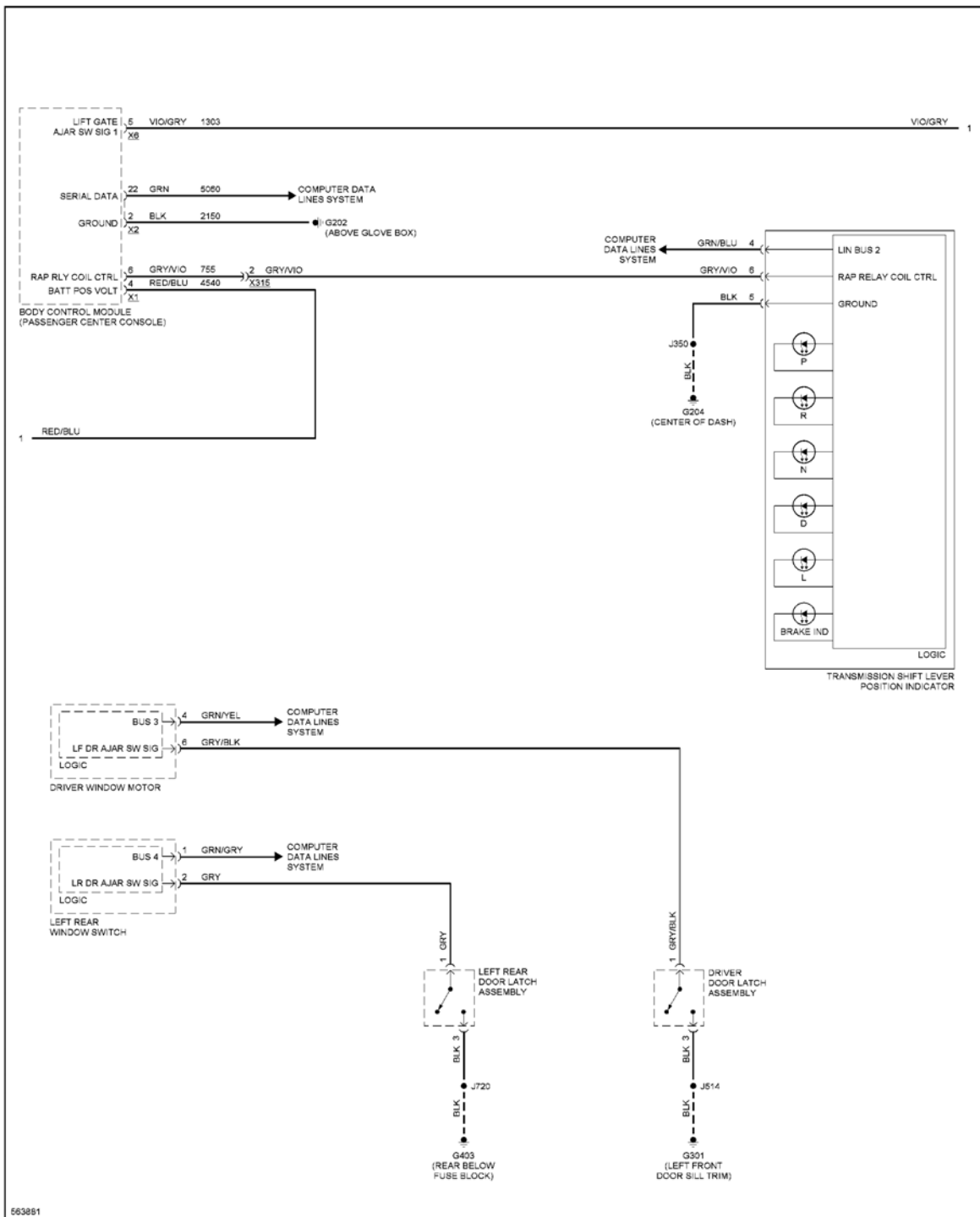


Fig. 60: Instrument Cluster Circuit (2 of 3)

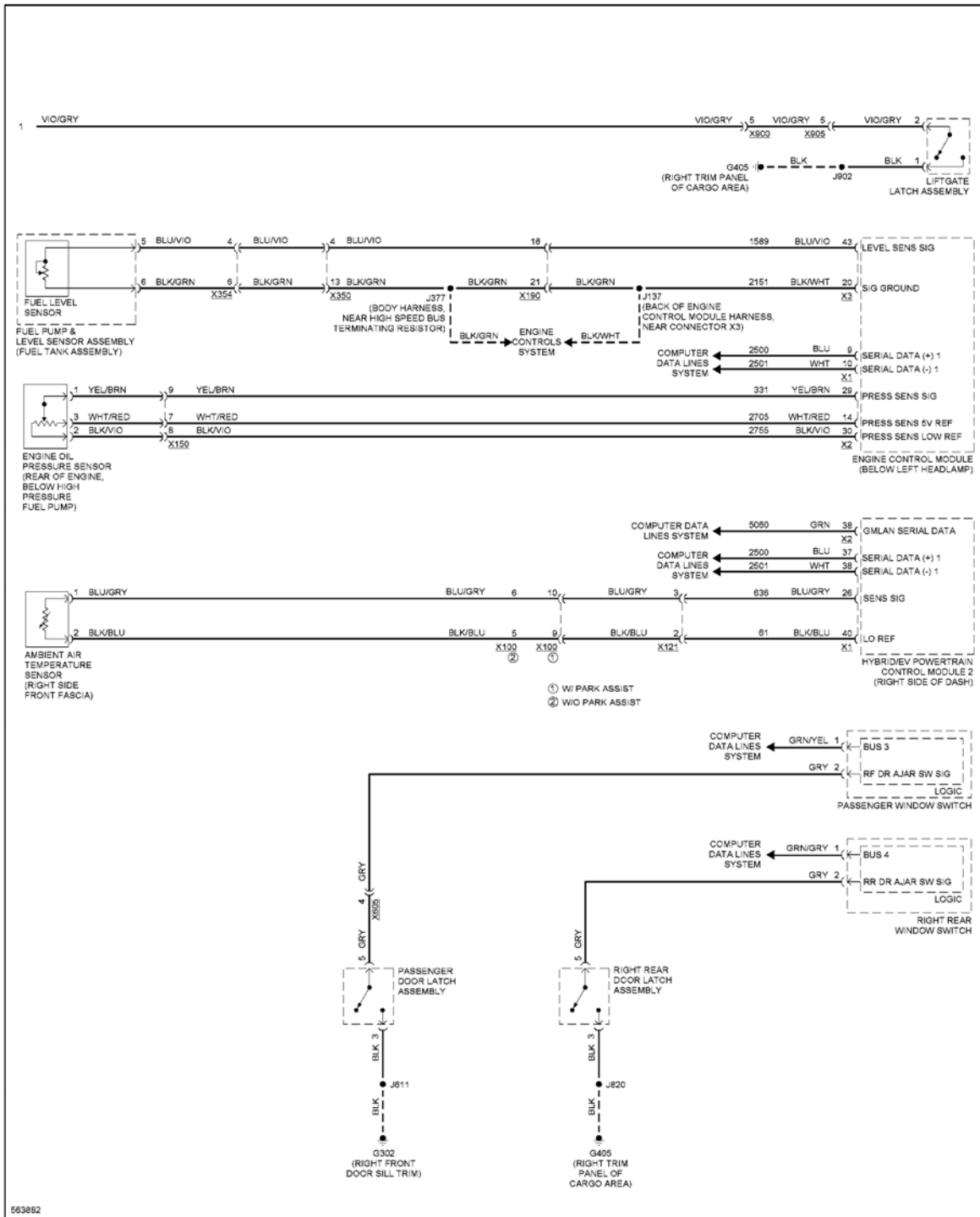


Fig. 61: Instrument Cluster Circuit (3 of 3)

INTERIOR LIGHTS

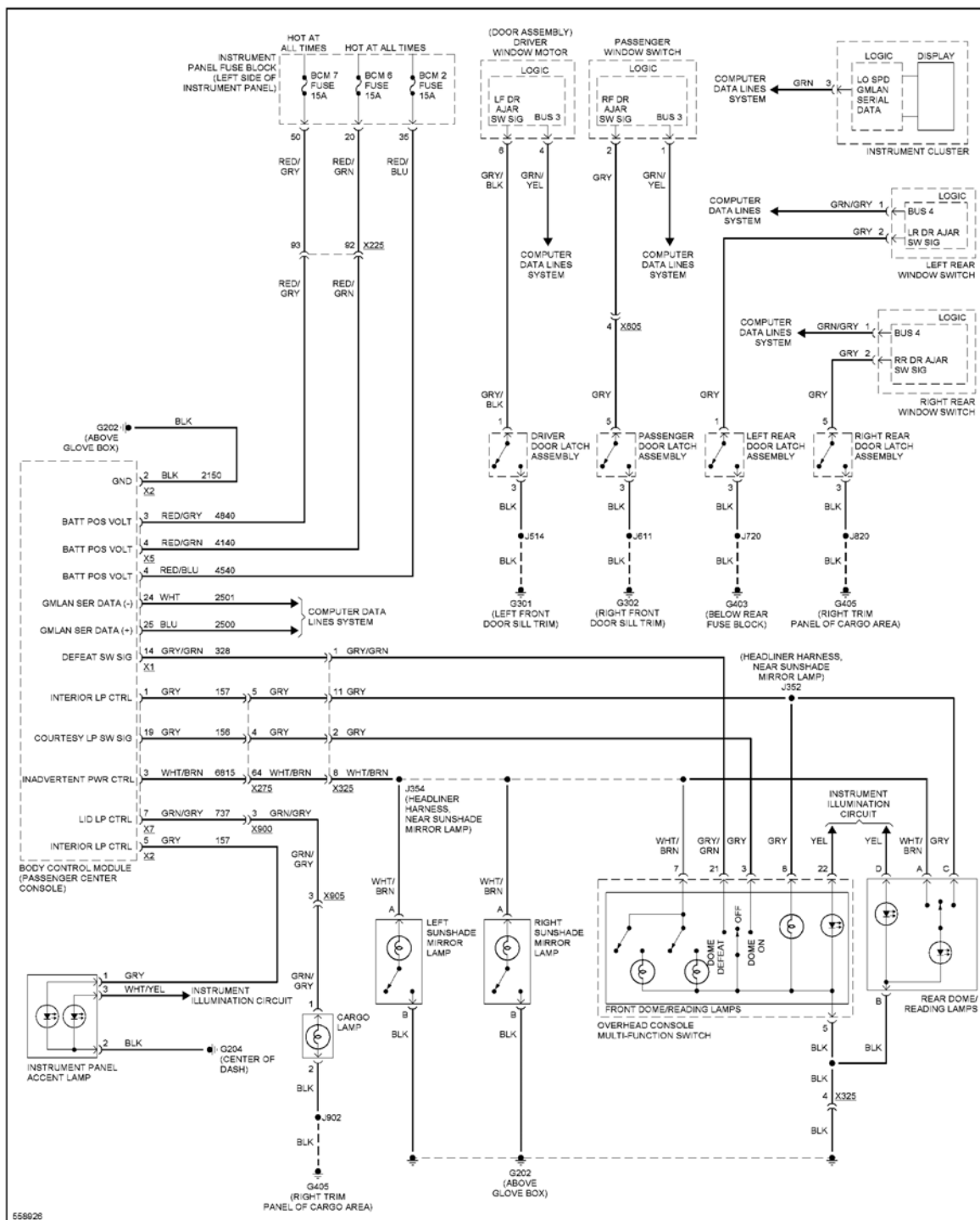


Fig. 62: Courtesy Lamps Circuit

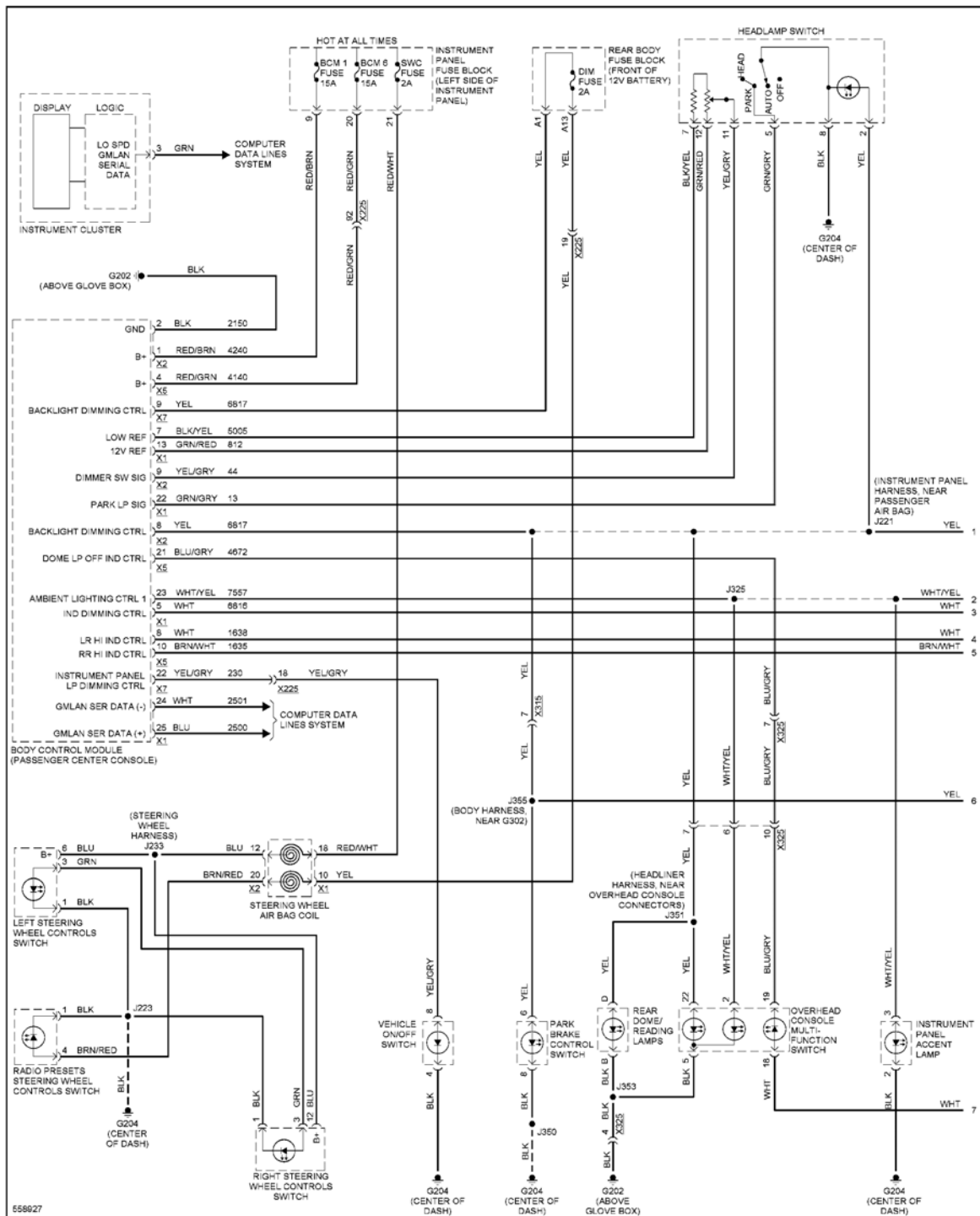


Fig. 63: Instrument Illumination Circuit (1 of 2)

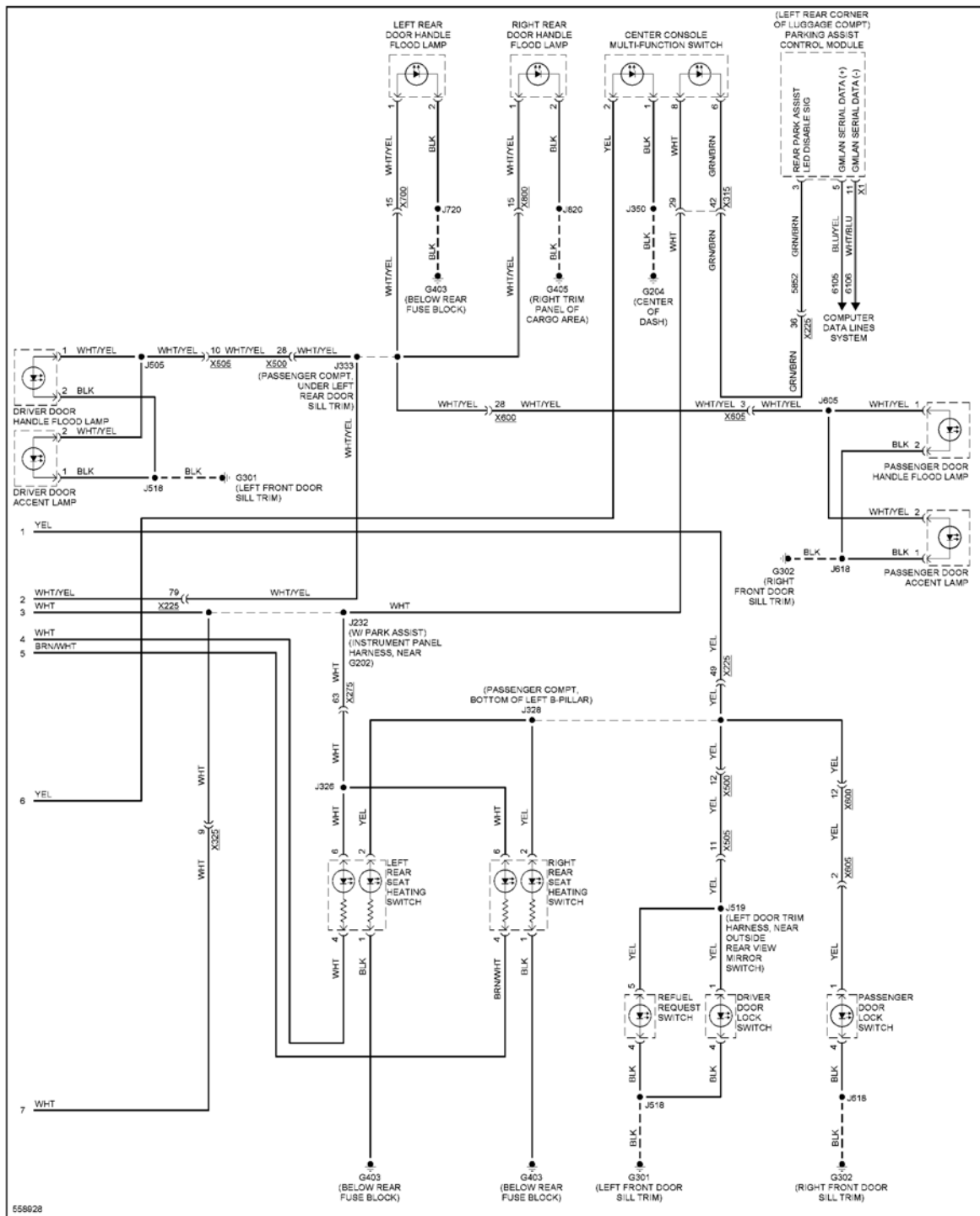
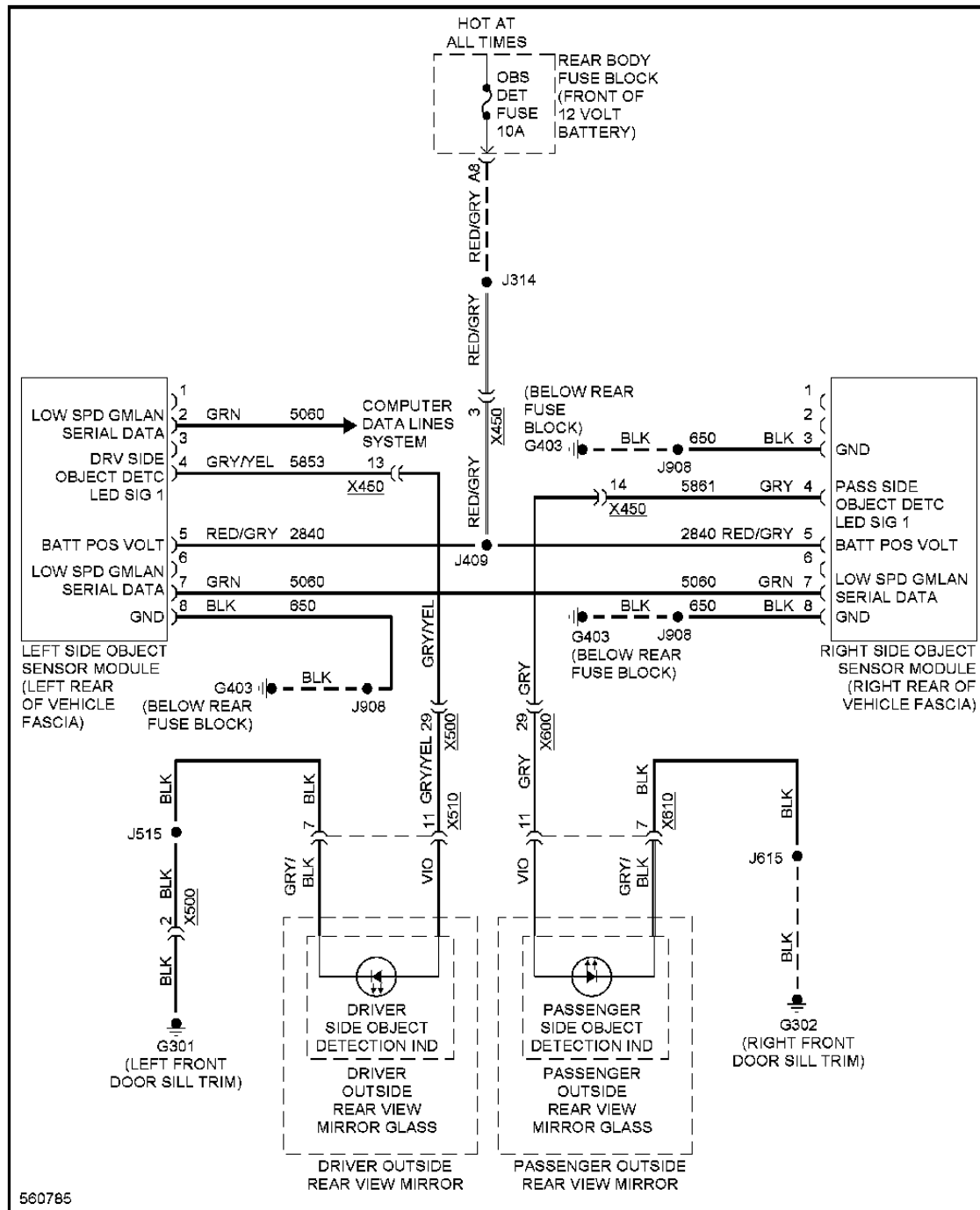


Fig. 64: Instrument Illumination Circuit (2 of 2)

NAVIGATION



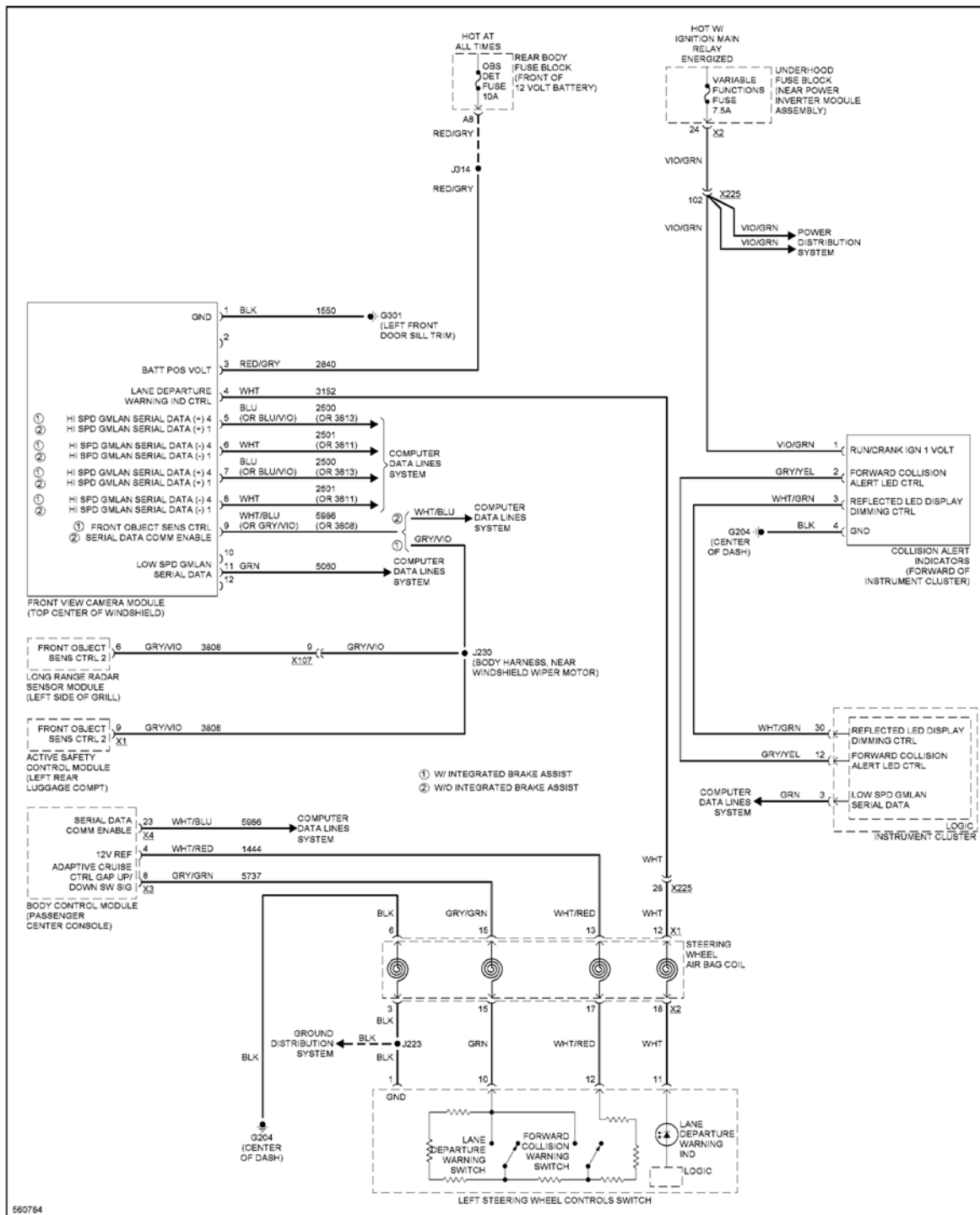


Fig. 66: Lane Departure Warning Circuit

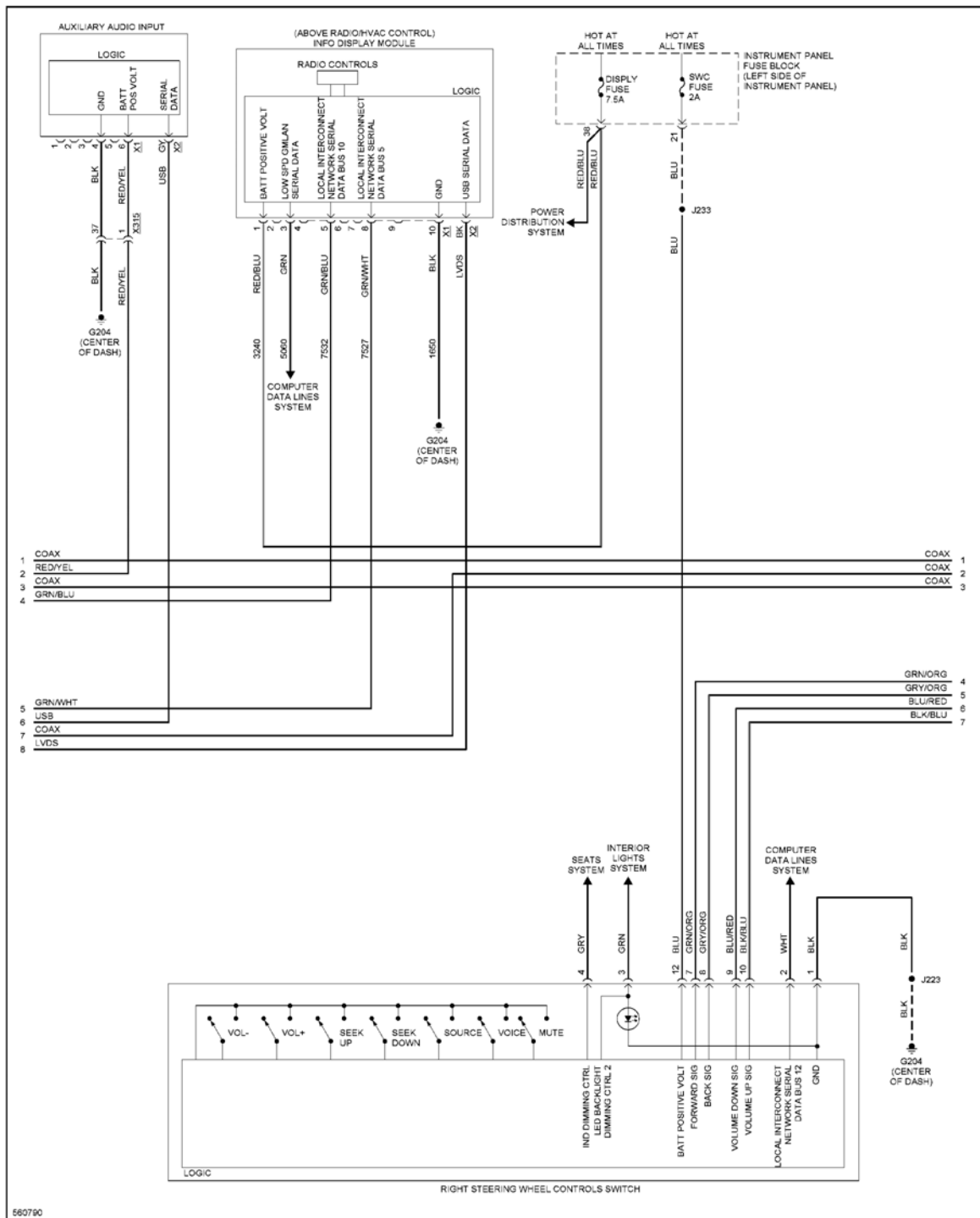


Fig. 68: Navigation Circuit, W/ Amplifier (2 of 4)

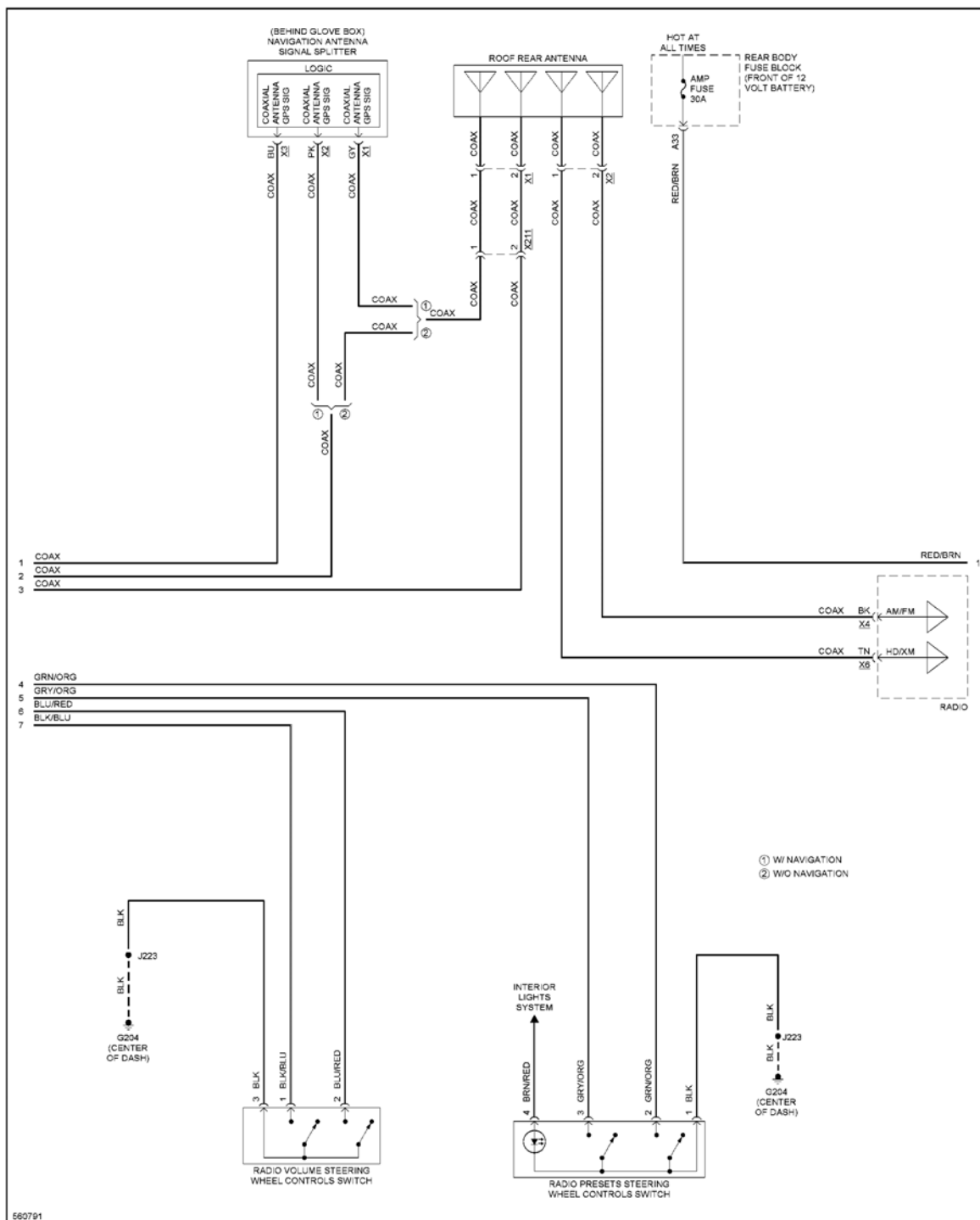


Fig. 69: Navigation Circuit, W/ Amplifier (3 of 4)

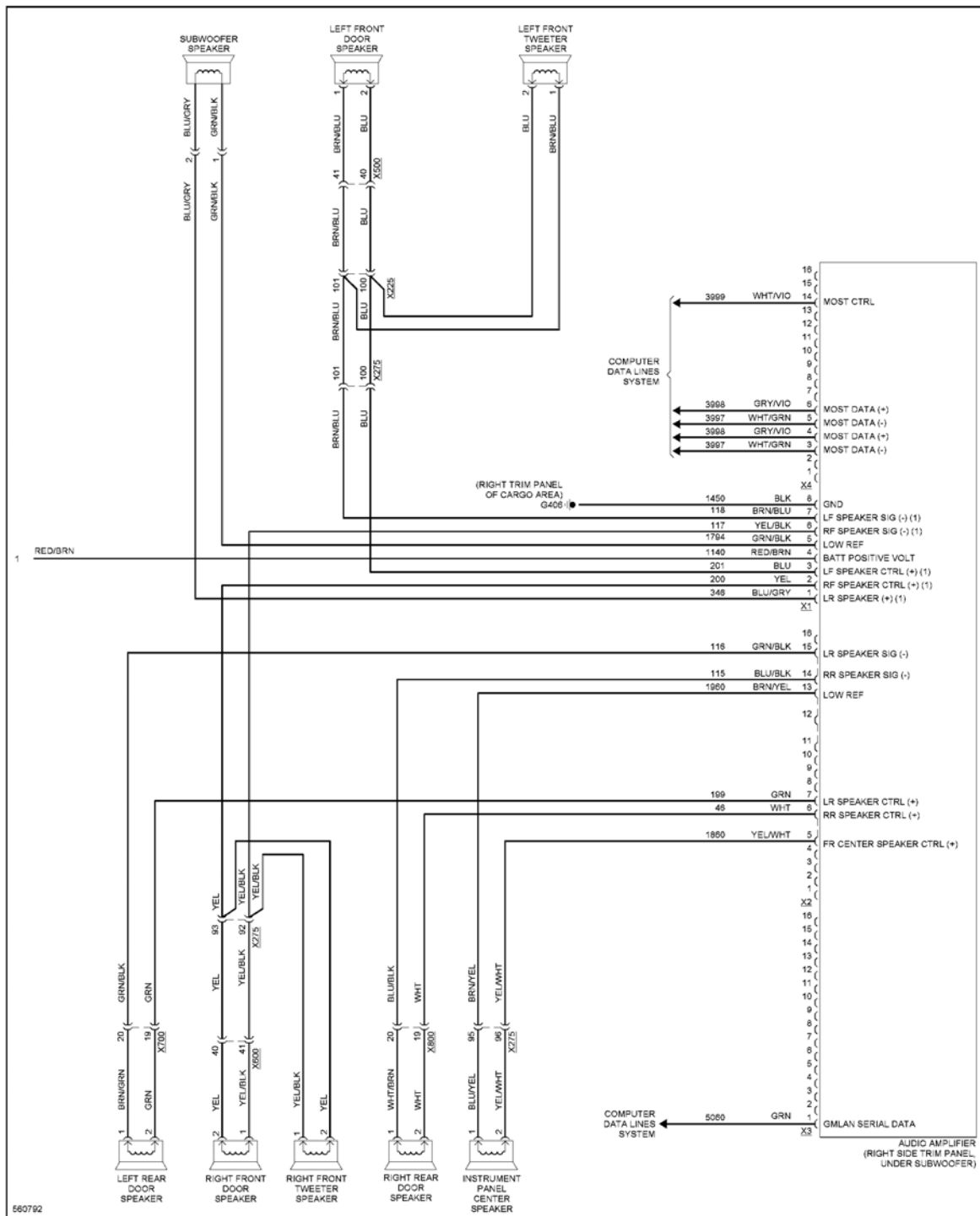


Fig. 70: Navigation Circuit, W/ Amplifier (4 of 4)

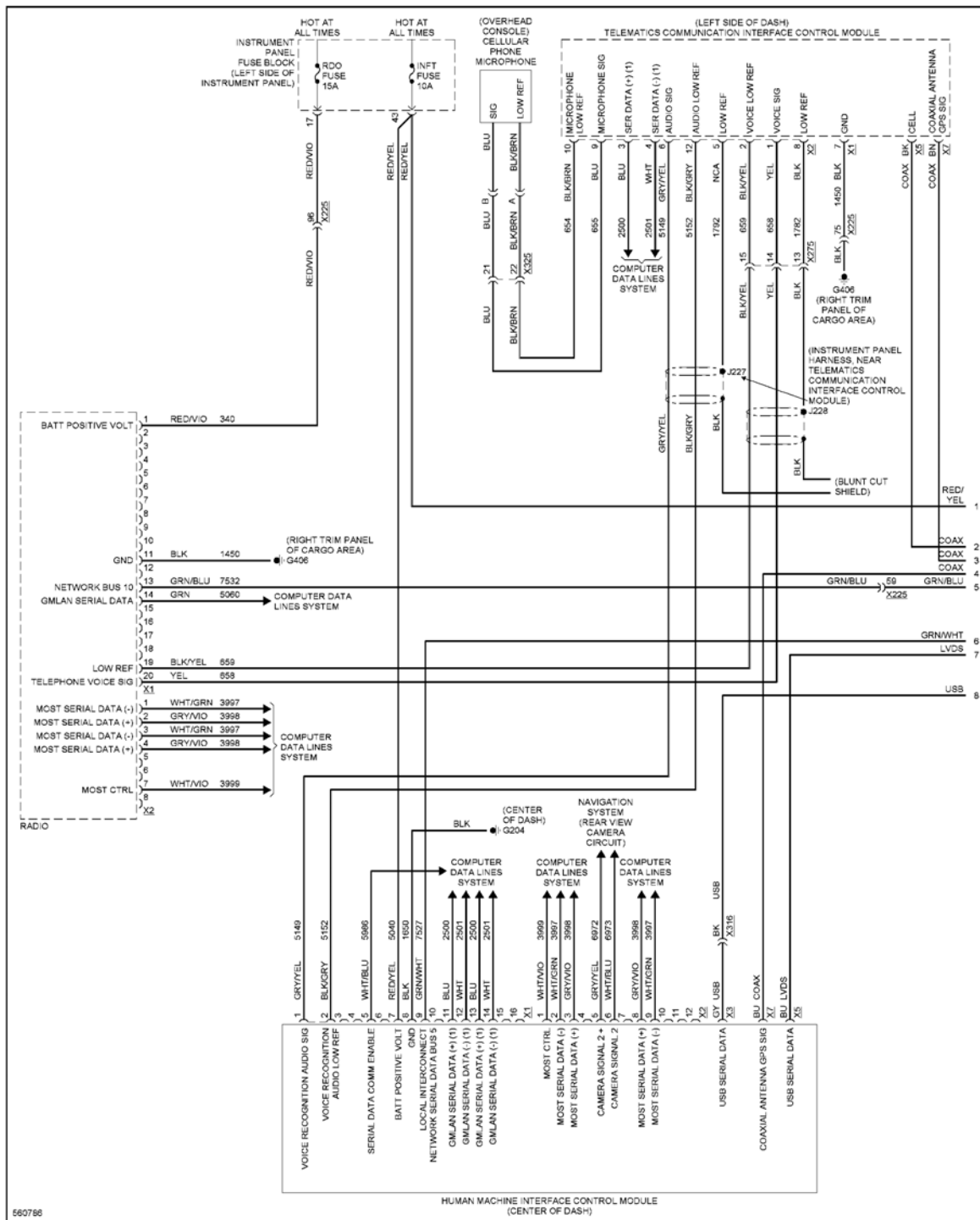


Fig. 71: Navigation Circuit, W/O Amplifier (1 of 3)

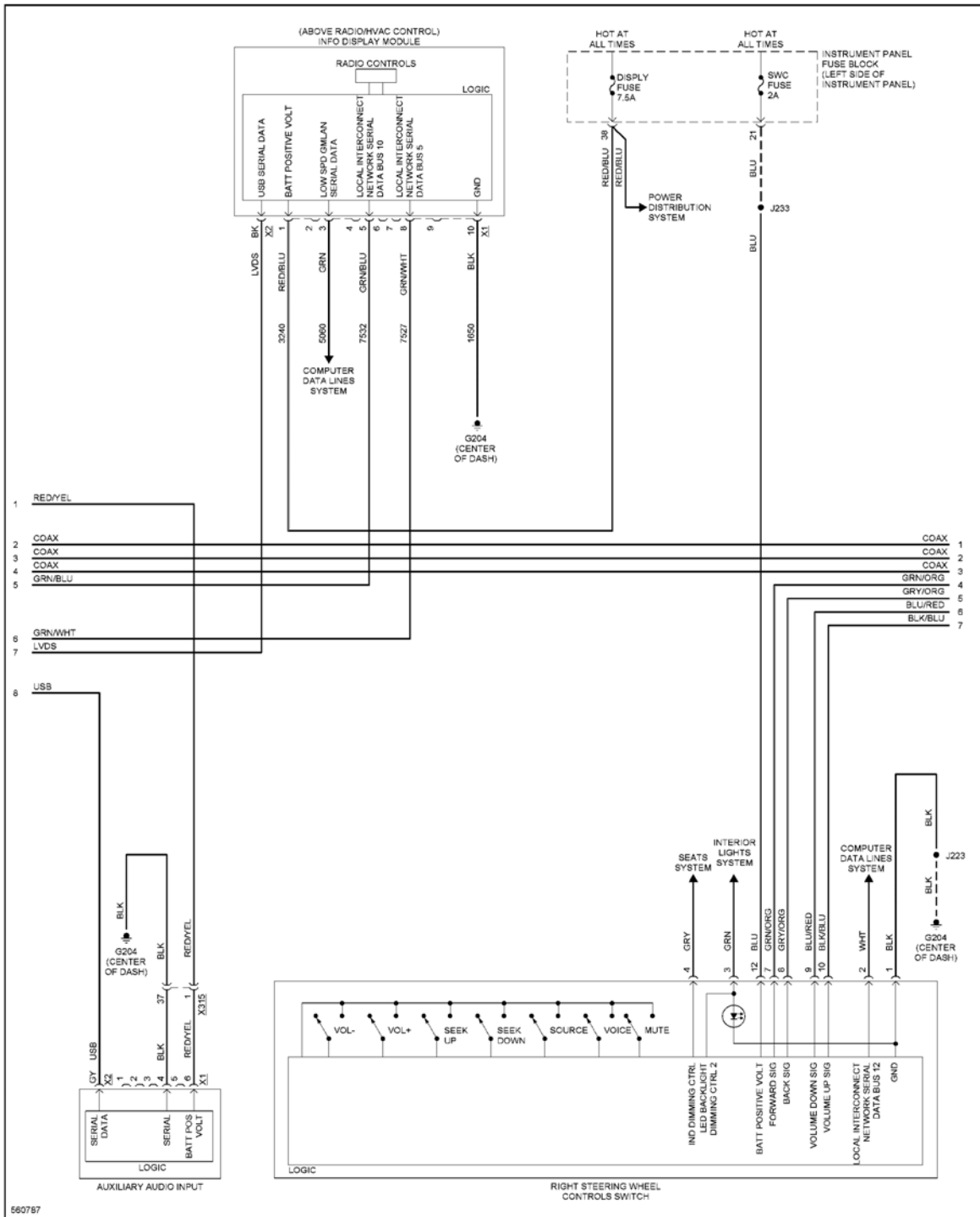


Fig. 72: Navigation Circuit, W/O Amplifier (2 of 3)

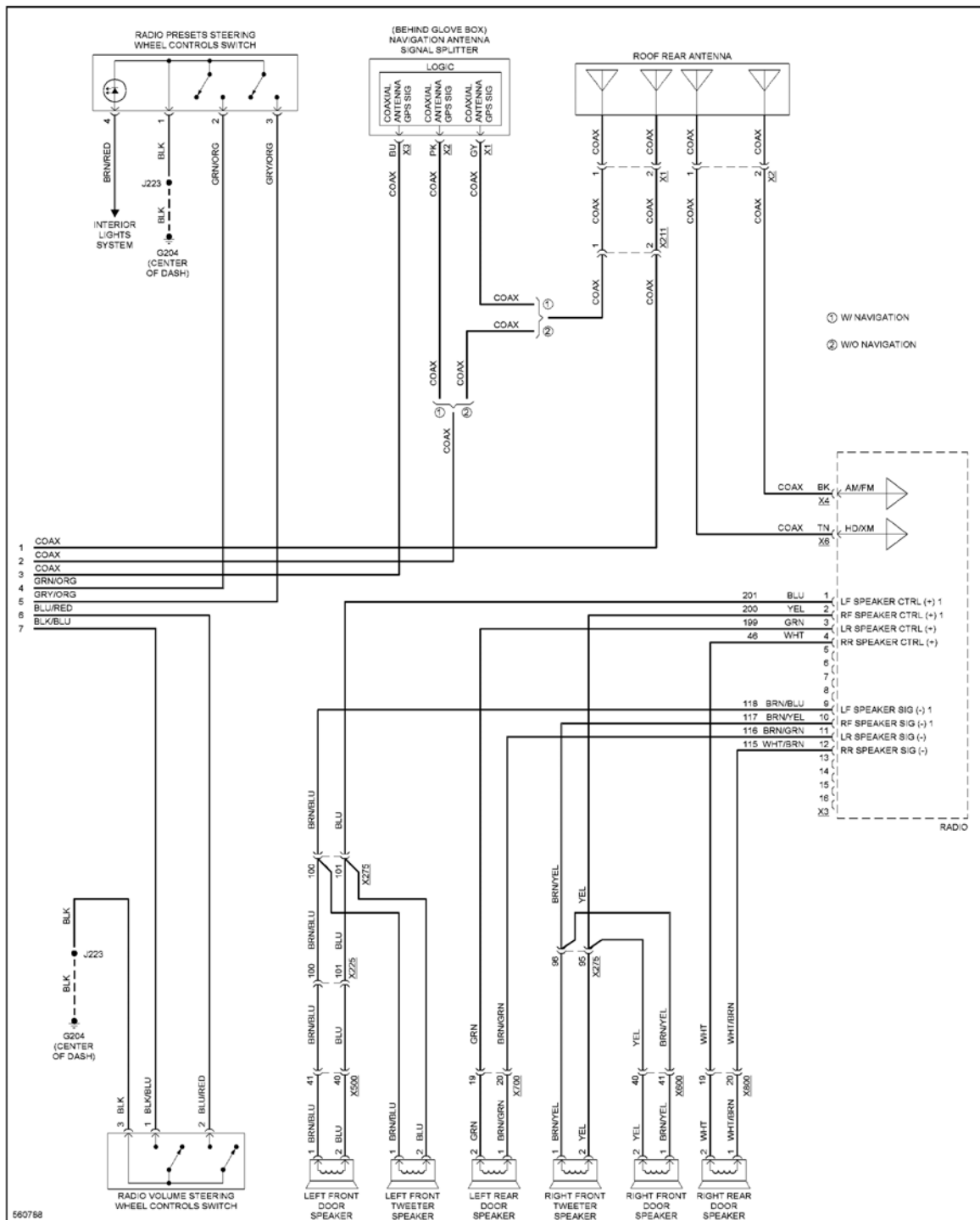


Fig. 73: Navigation Circuit, W/O Amplifier (3 of 3)

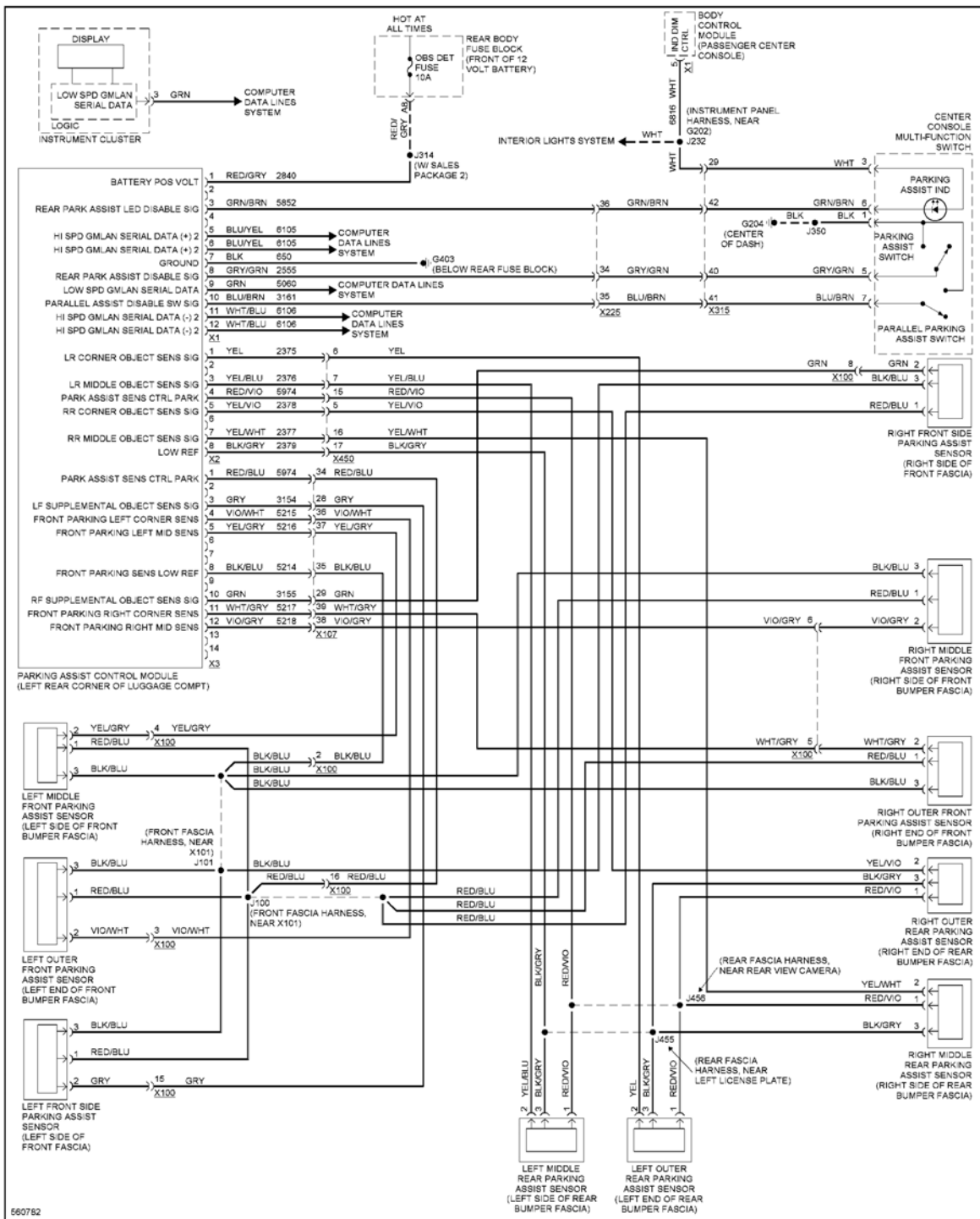


Fig. 74: Parking Assistant Circuit

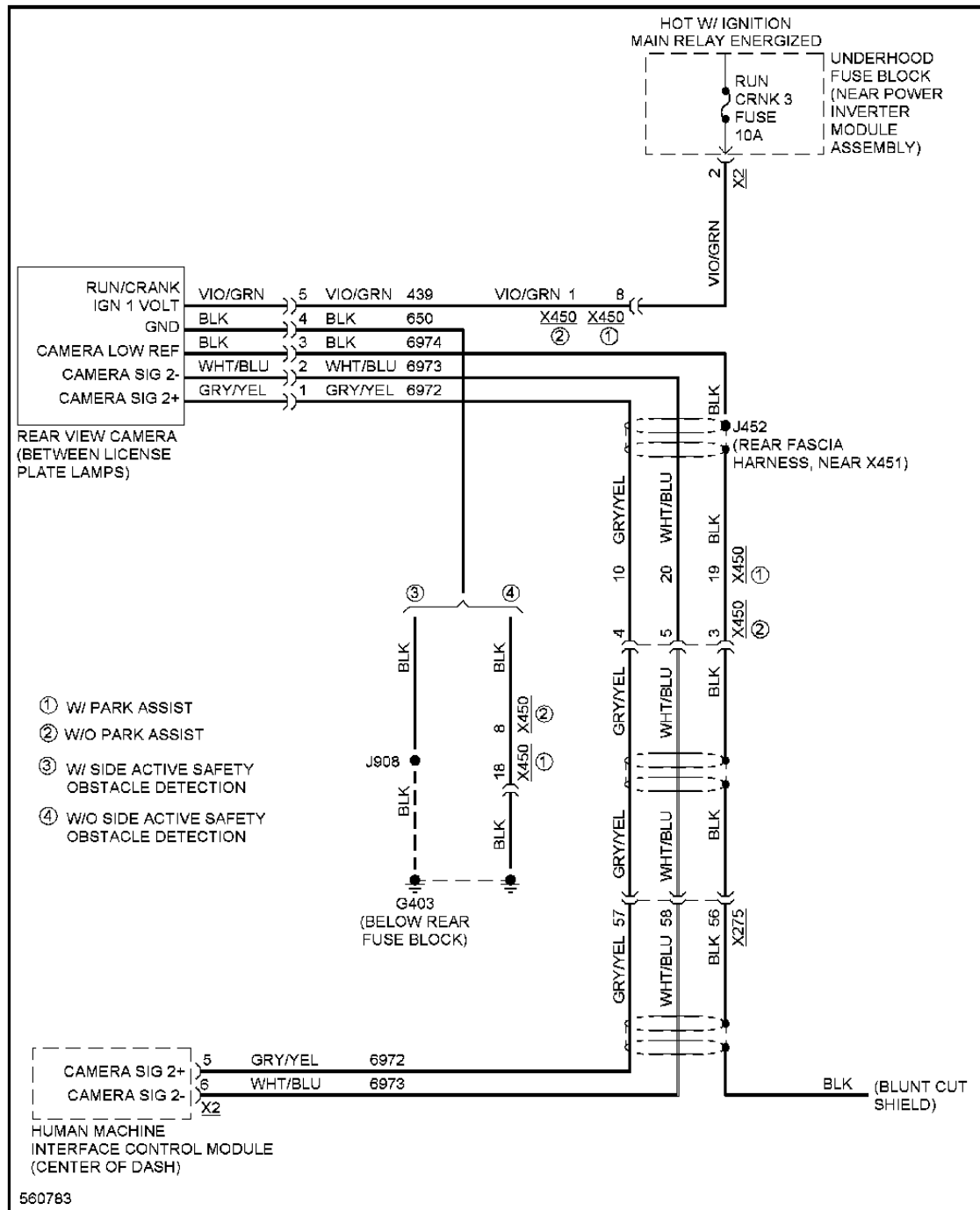


Fig. 75: Rear View Camera Circuit

POWER DISTRIBUTION

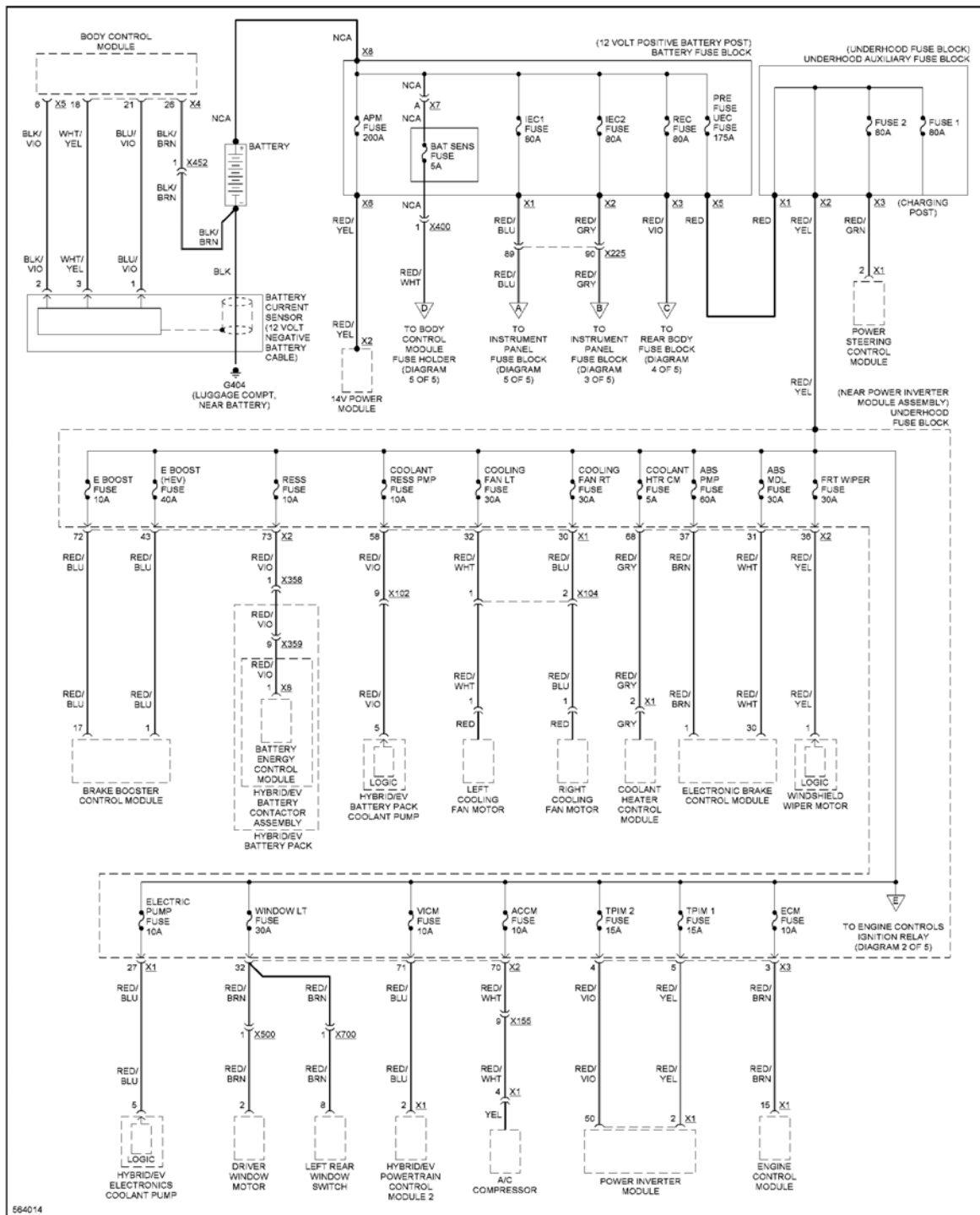


Fig. 76: Power Distribution Circuit (1 of 5)

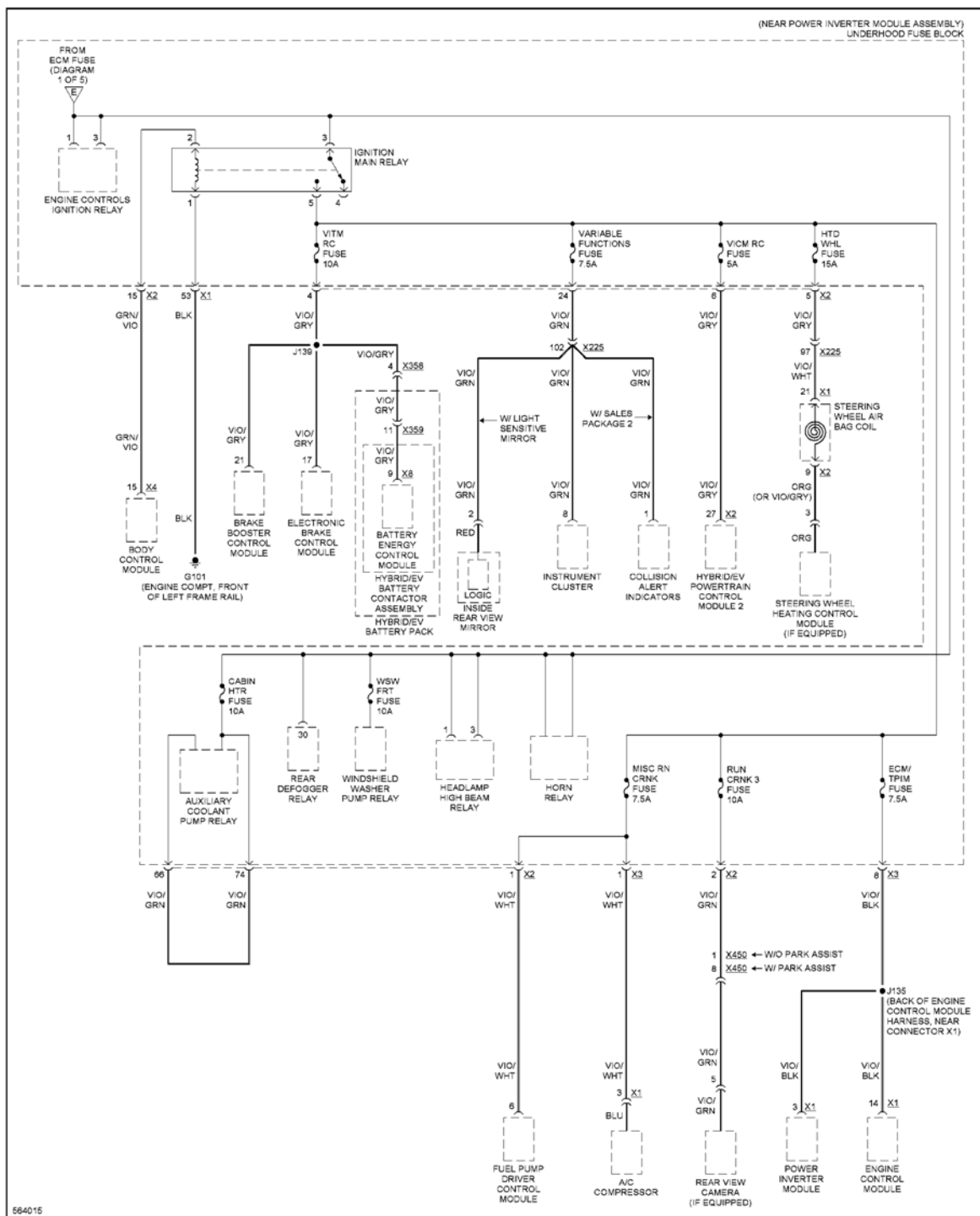


Fig. 77: Power Distribution Circuit (2 of 5)

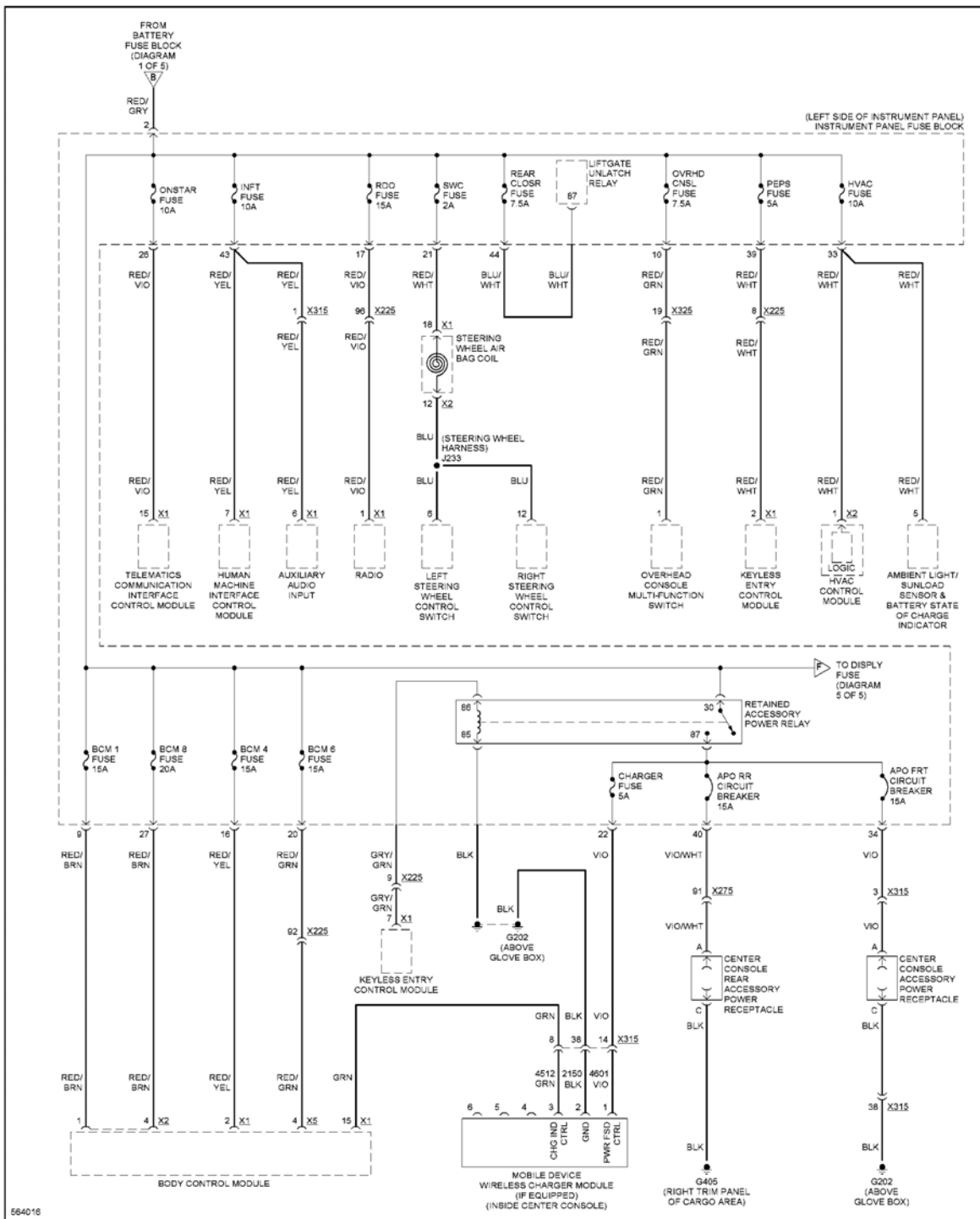


Fig. 78: Power Distribution Circuit (3 of 5)

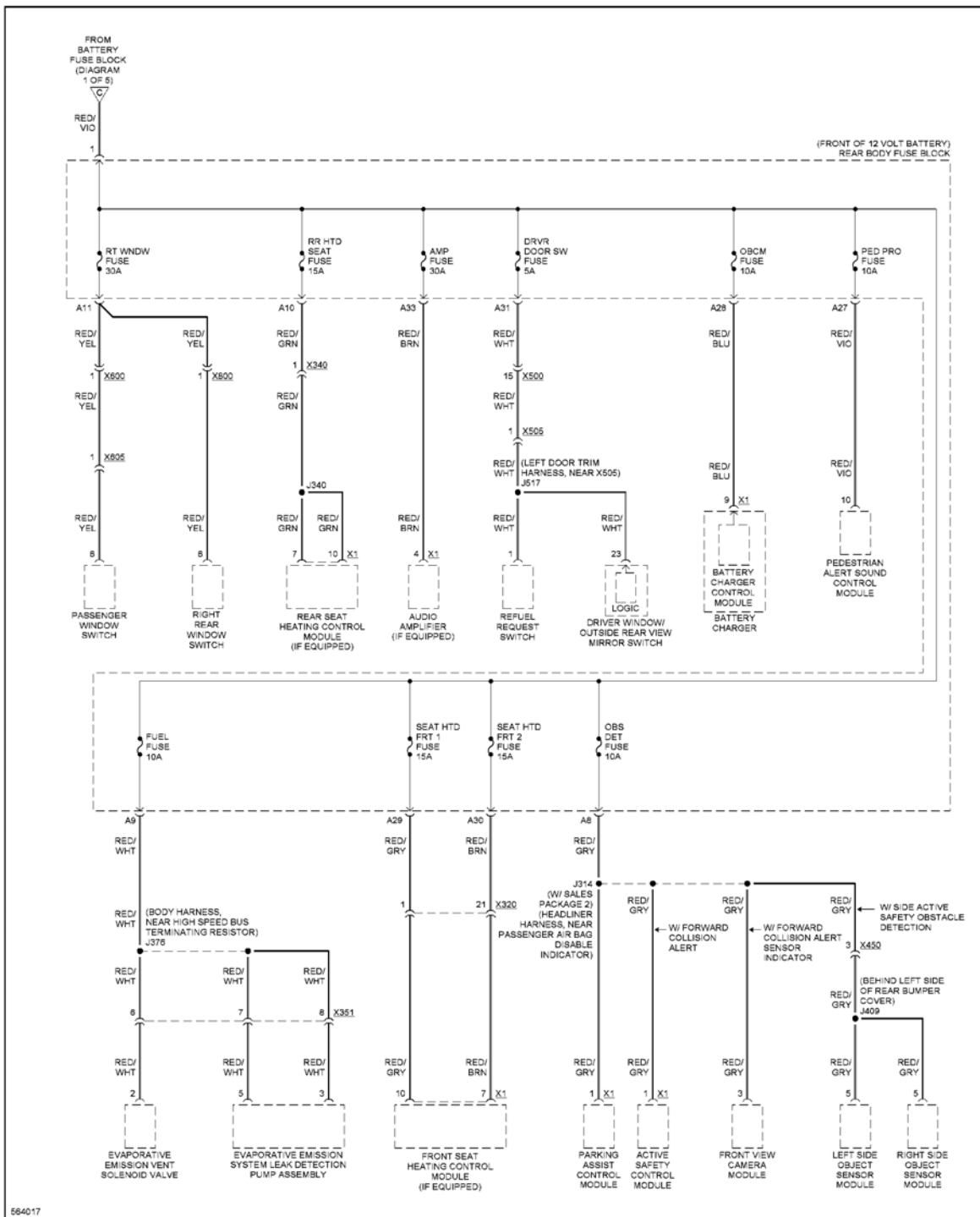


Fig. 79: Power Distribution Circuit (4 of 5)



POWER DOOR LOCKS

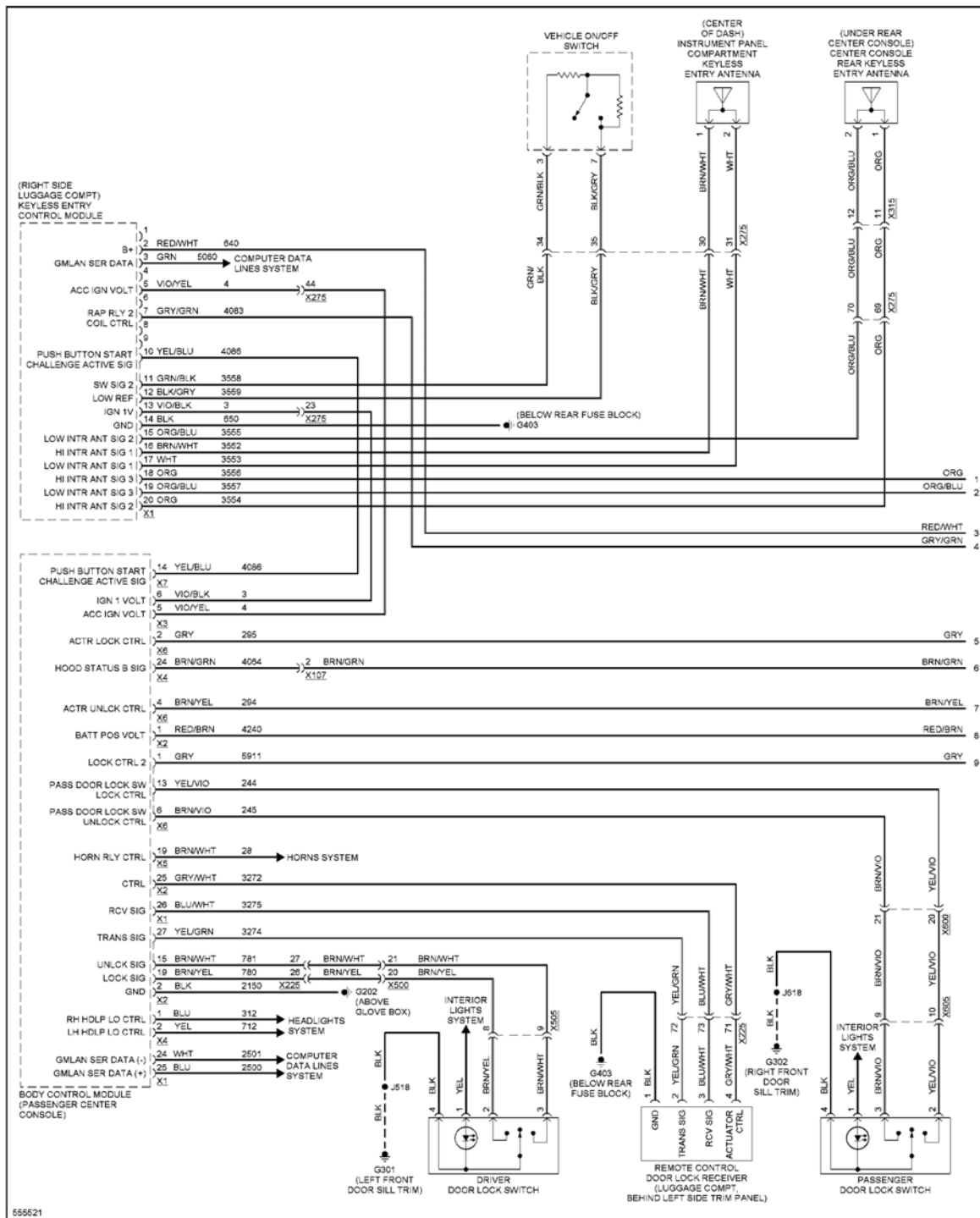


Fig. 81: Power Door Locks Circuit, W/ Passive Keyless Entry (1 of 4)

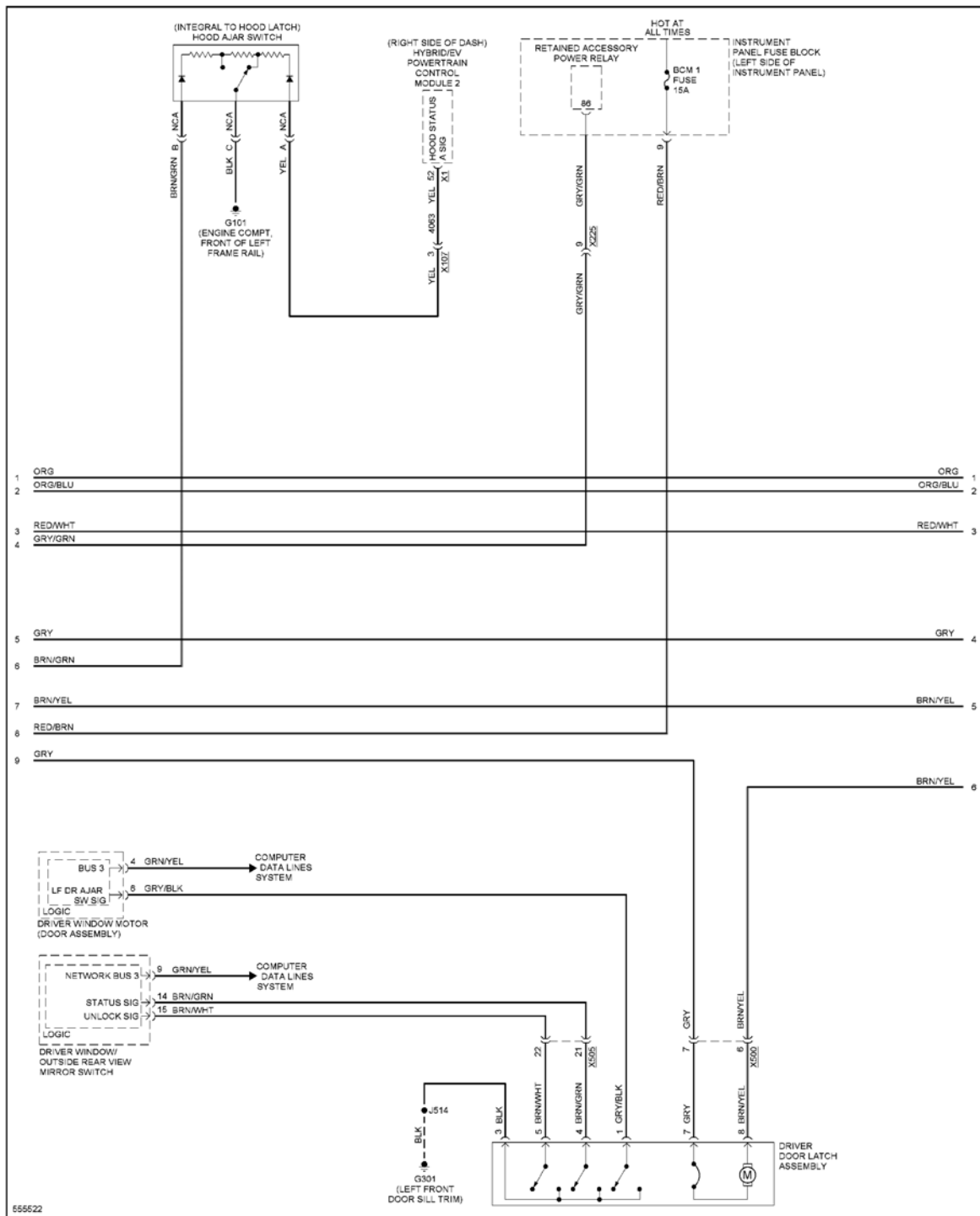


Fig. 82: Power Door Locks Circuit, W/ Passive Keyless Entry (2 of 4)

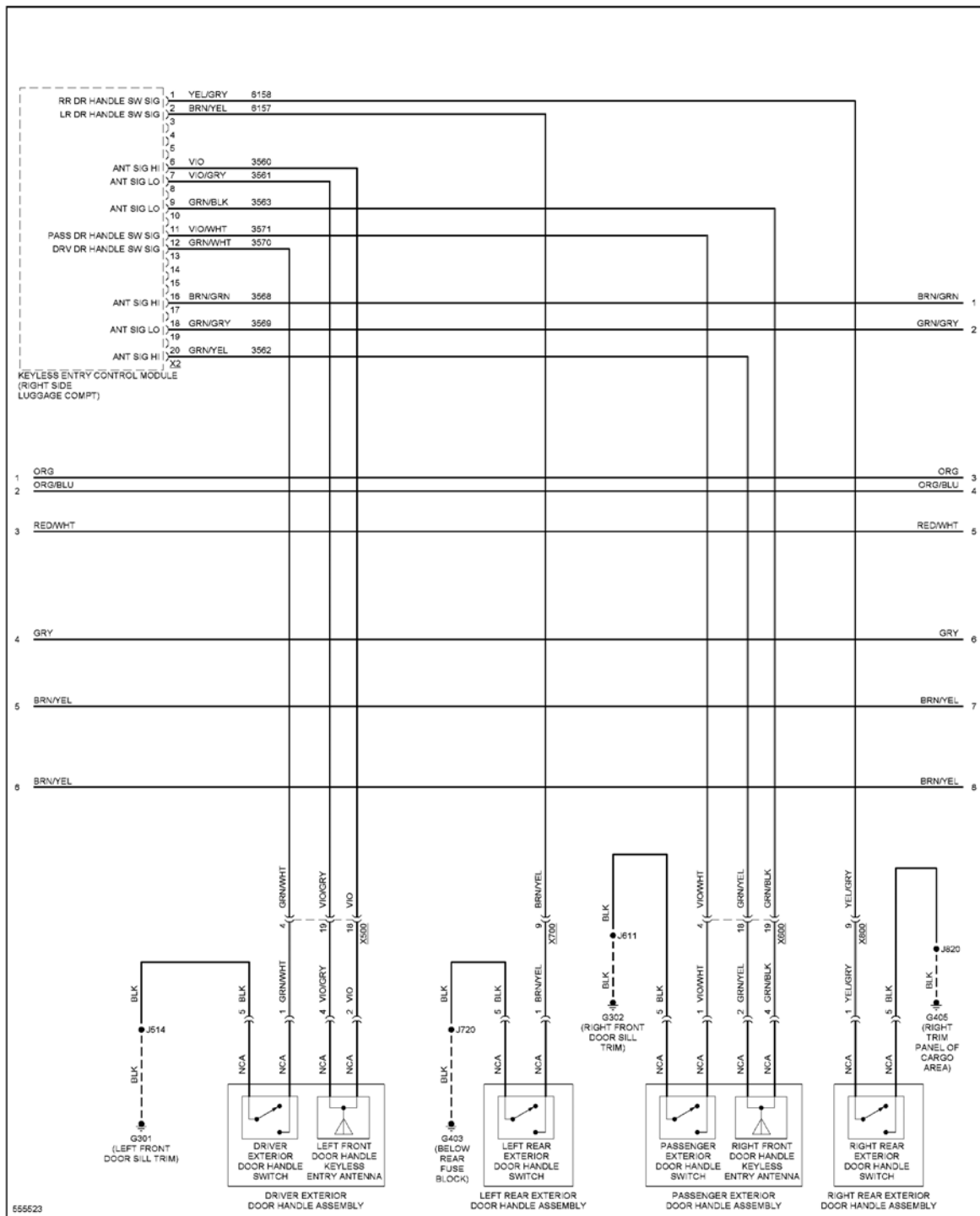


Fig. 83: Power Door Locks Circuit, W/ Passive Keyless Entry (3 of 4)

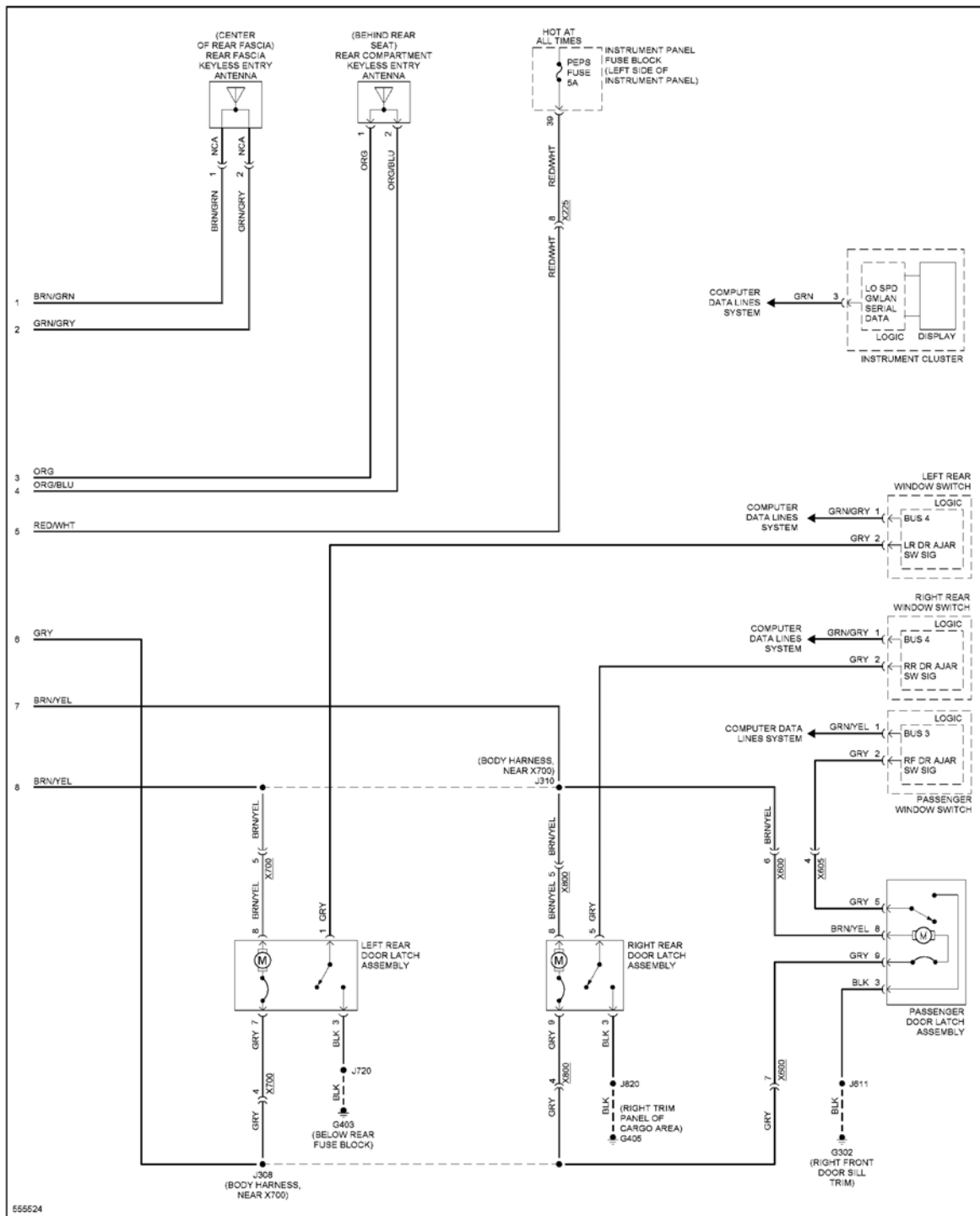


Fig. 84: Power Door Locks Circuit, W/ Passive Keyless Entry (4 of 4)

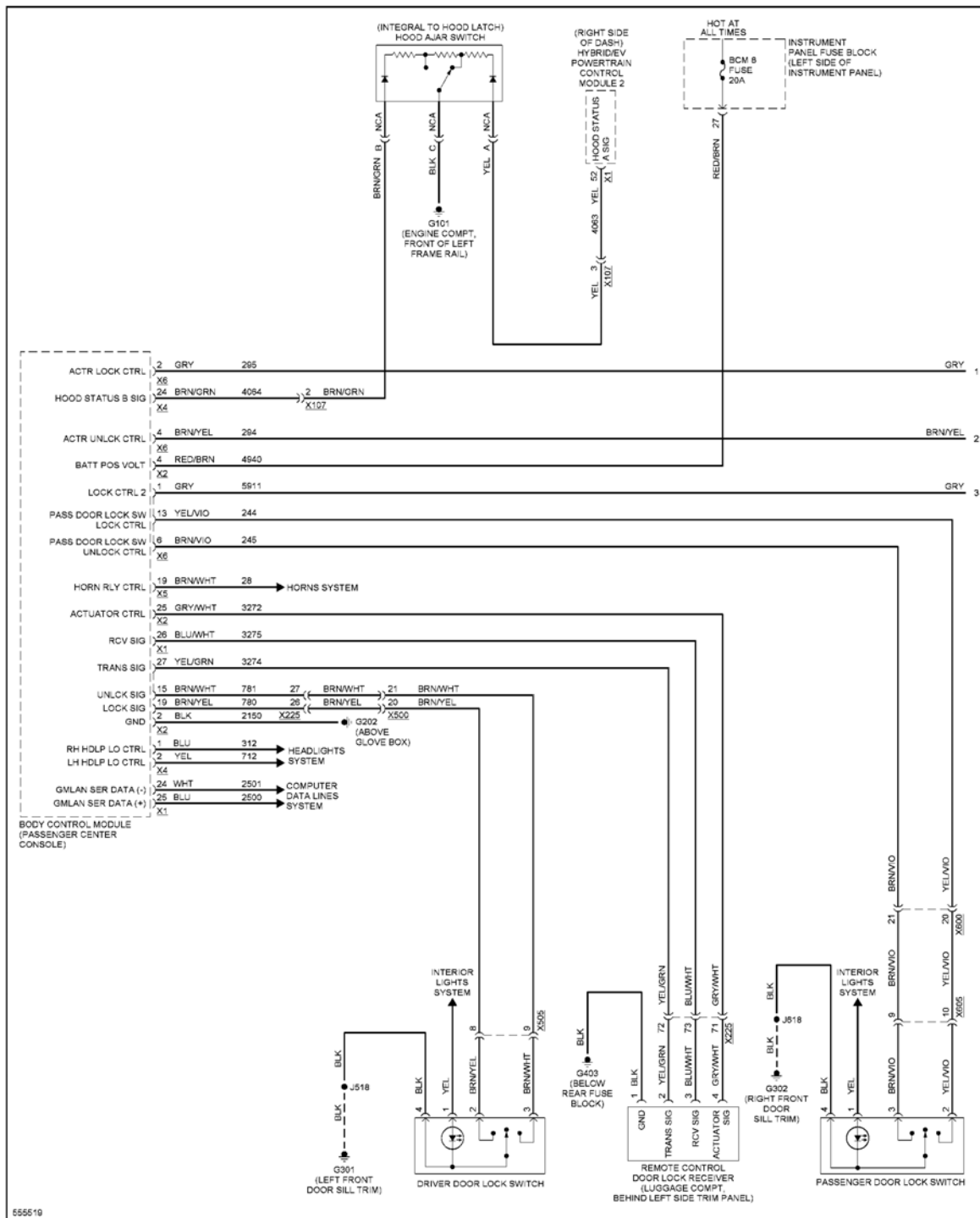
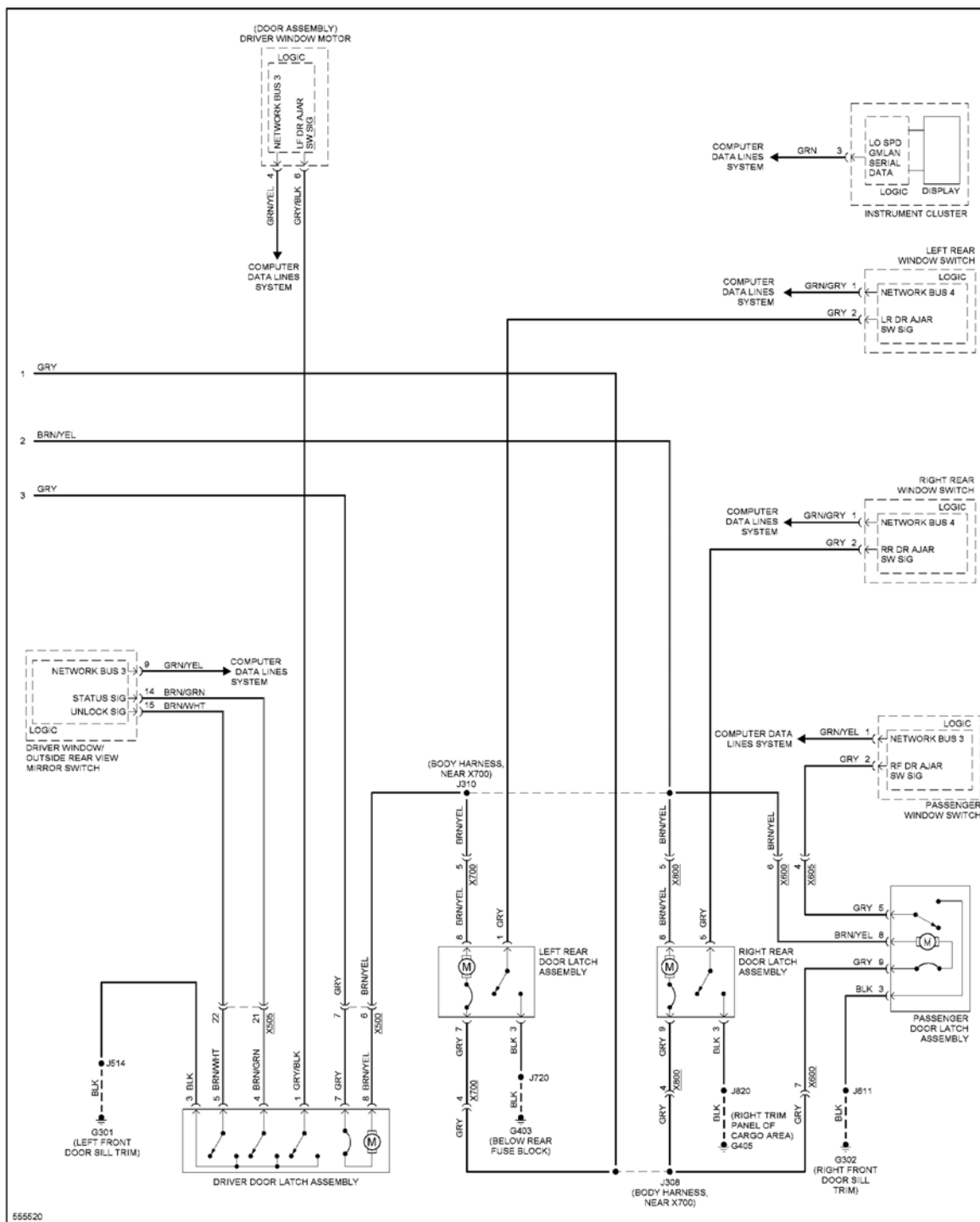


Fig. 85: Power Door Locks Circuit, W/O Passive Keyless Entry (1 of 2)



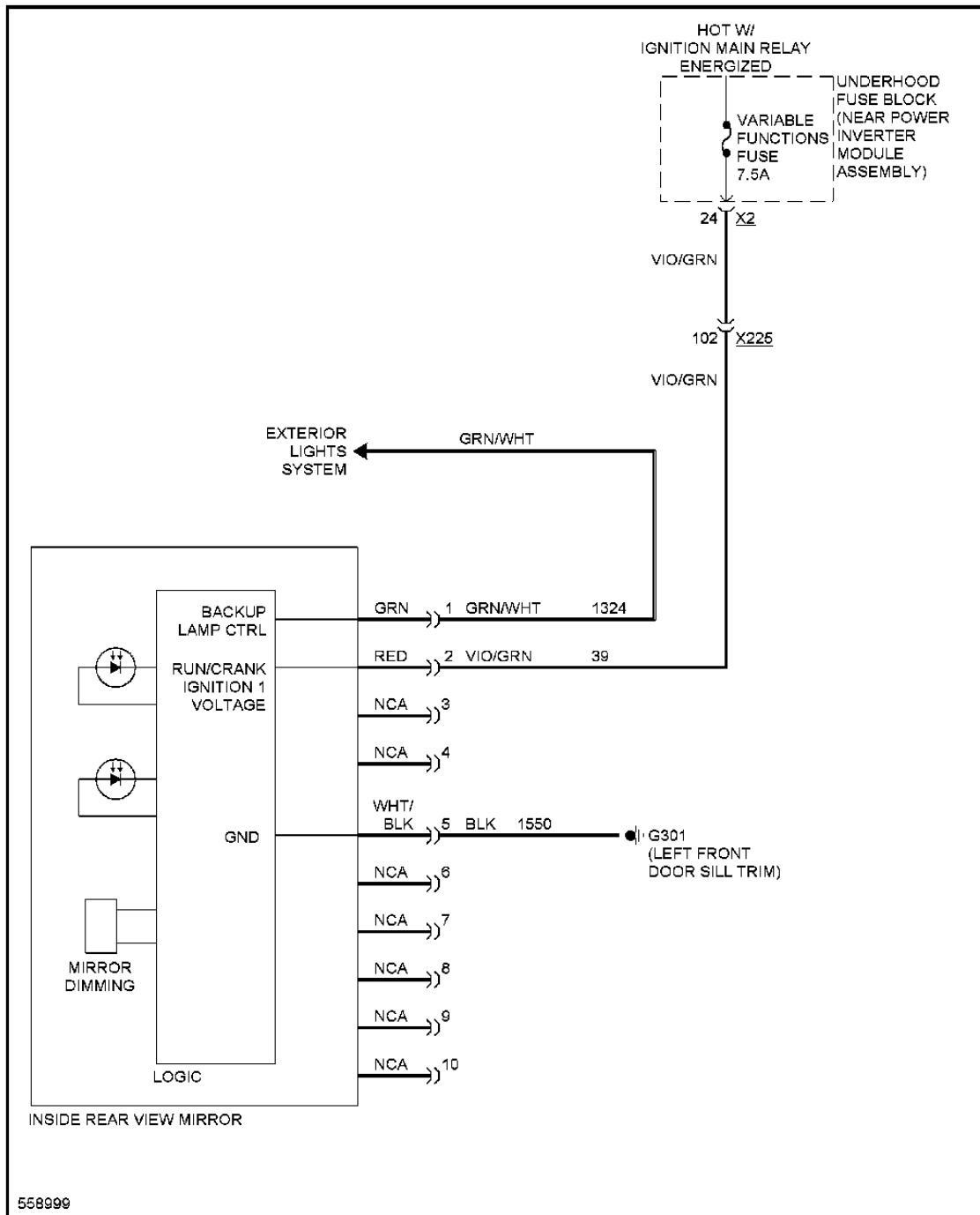


Fig. 87: Electrochromic Mirror Circuit

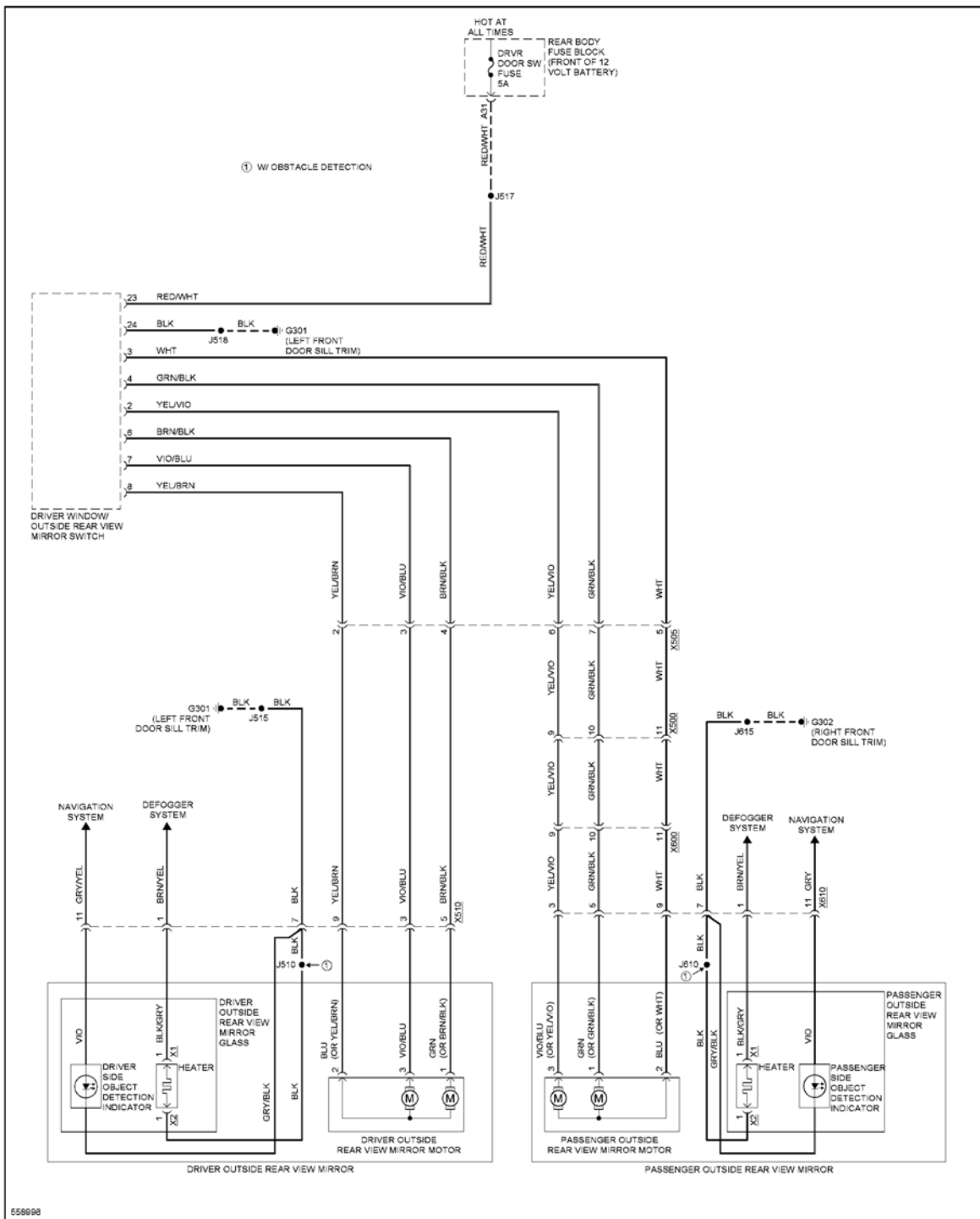


Fig. 88: Power Mirrors Circuit

POWER SEATS

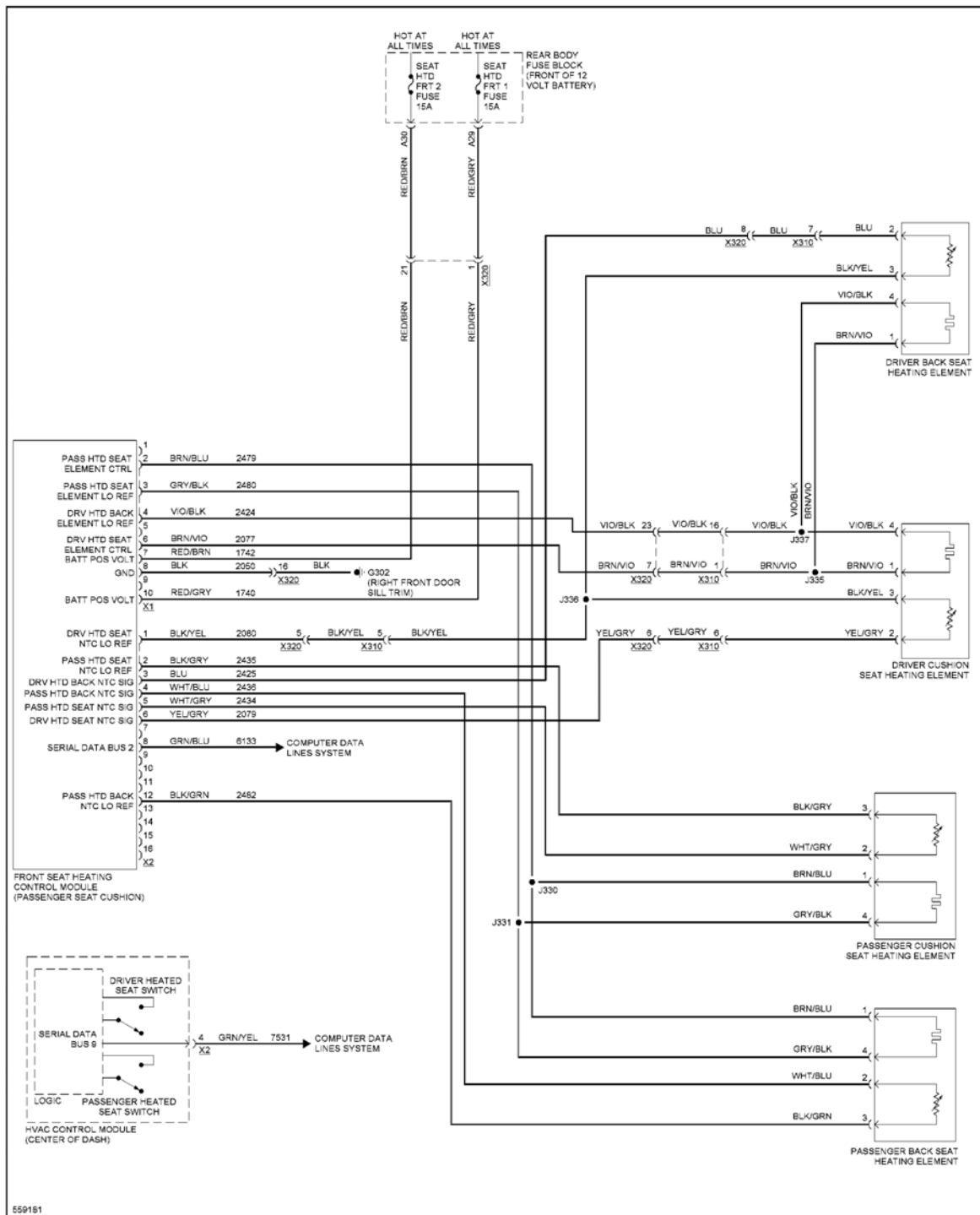


Fig. 89: Front Heated Seats Circuit

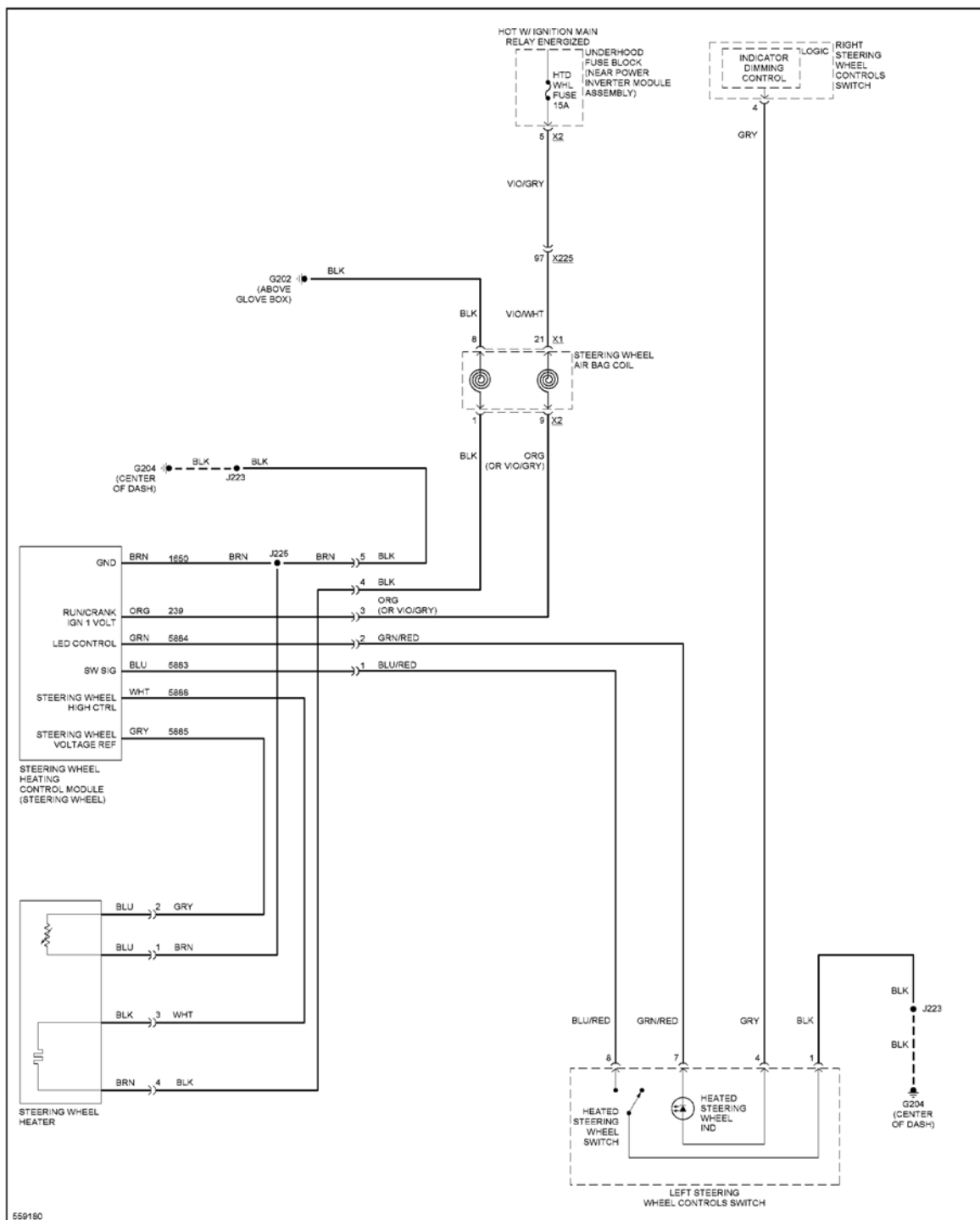


Fig. 90: Heated Steering Wheel Circuit



POWER WINDOWS

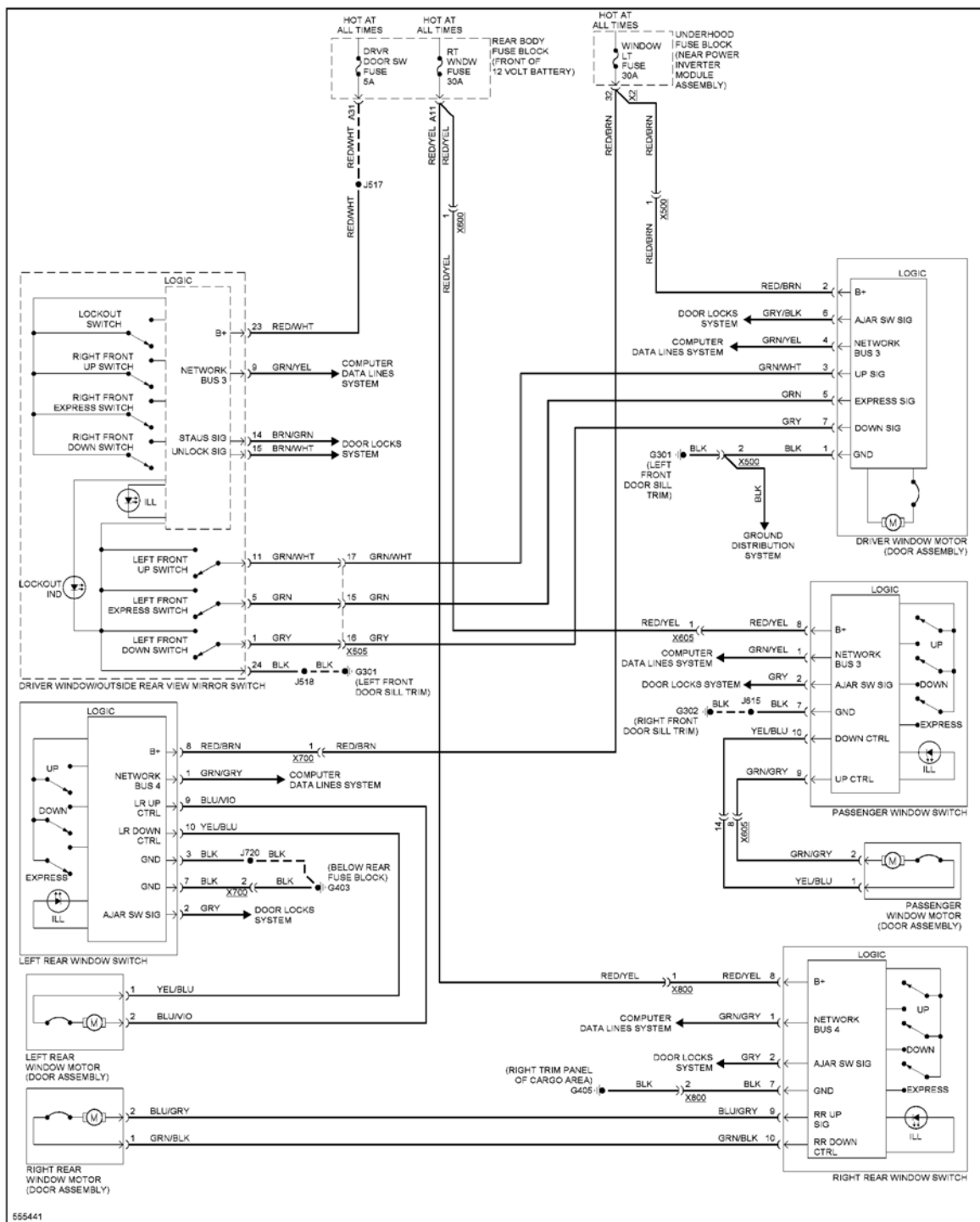


Fig. 92: Power Windows Circuit

RADIO



94 of 113

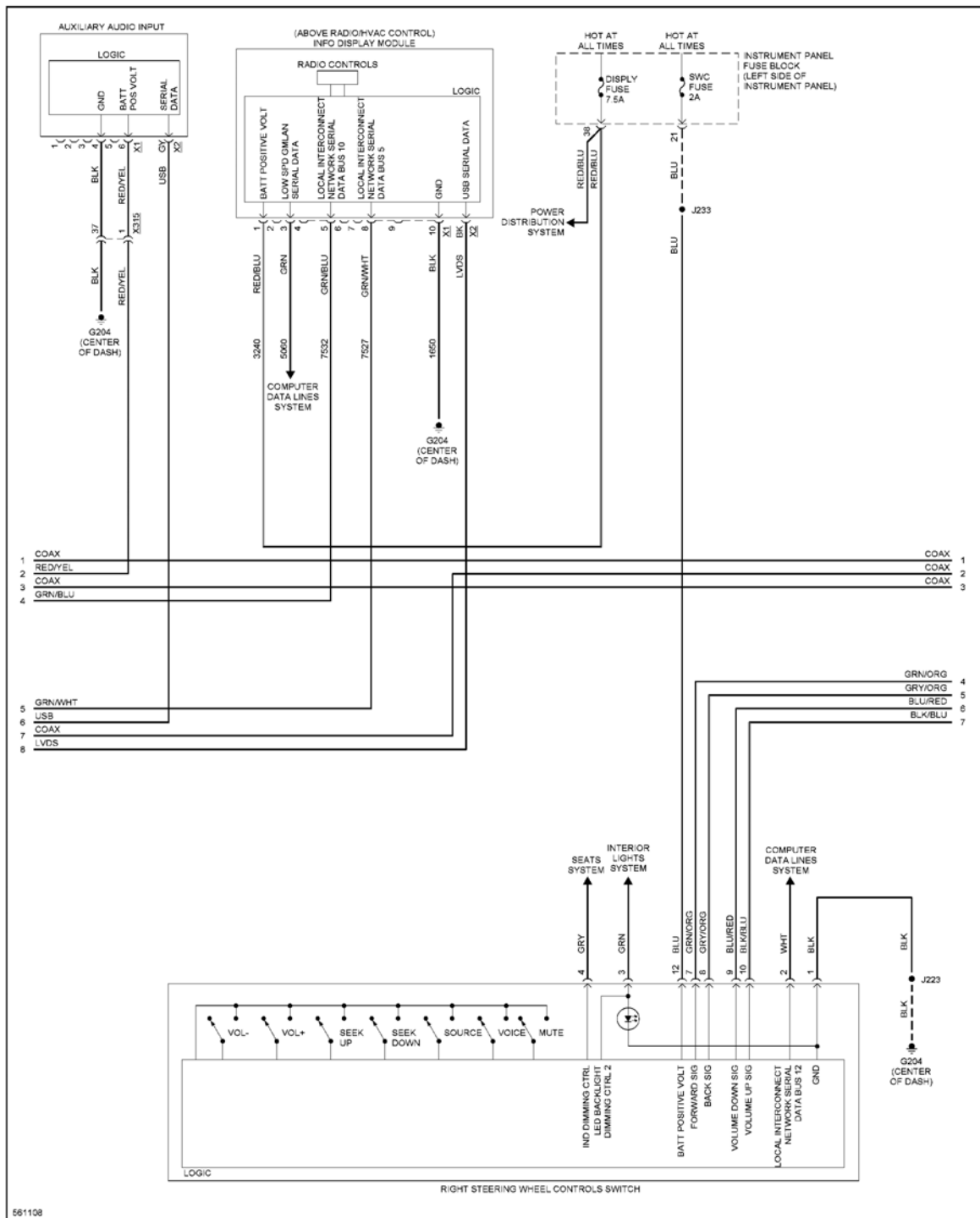


Fig. 94: Radio Circuit, W/ Amplifier (2 of 4)

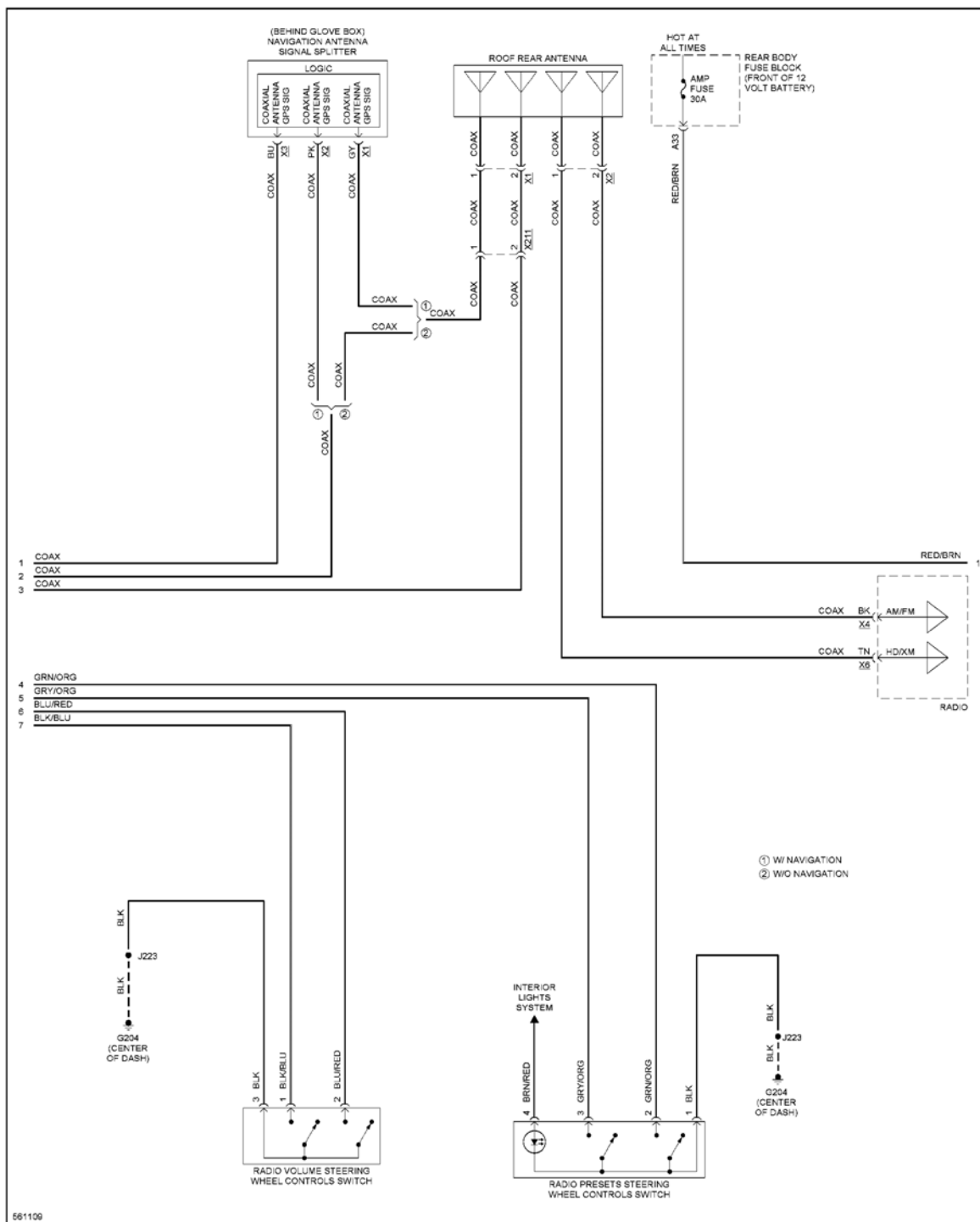


Fig. 95: Radio Circuit, W/ Amplifier (3 of 4)

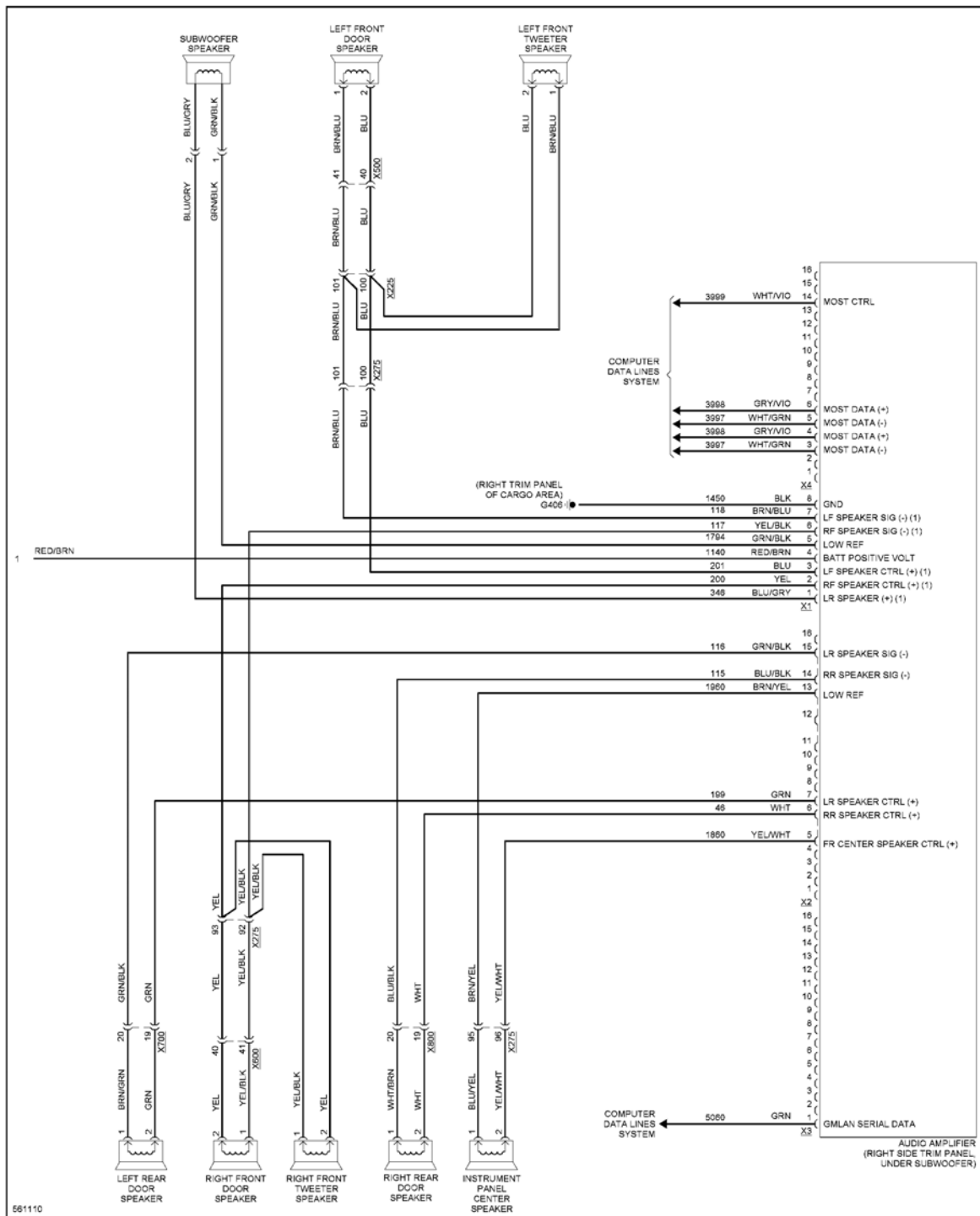


Fig. 96: Radio Circuit, W/ Amplifier (4 of 4)



98 of 113

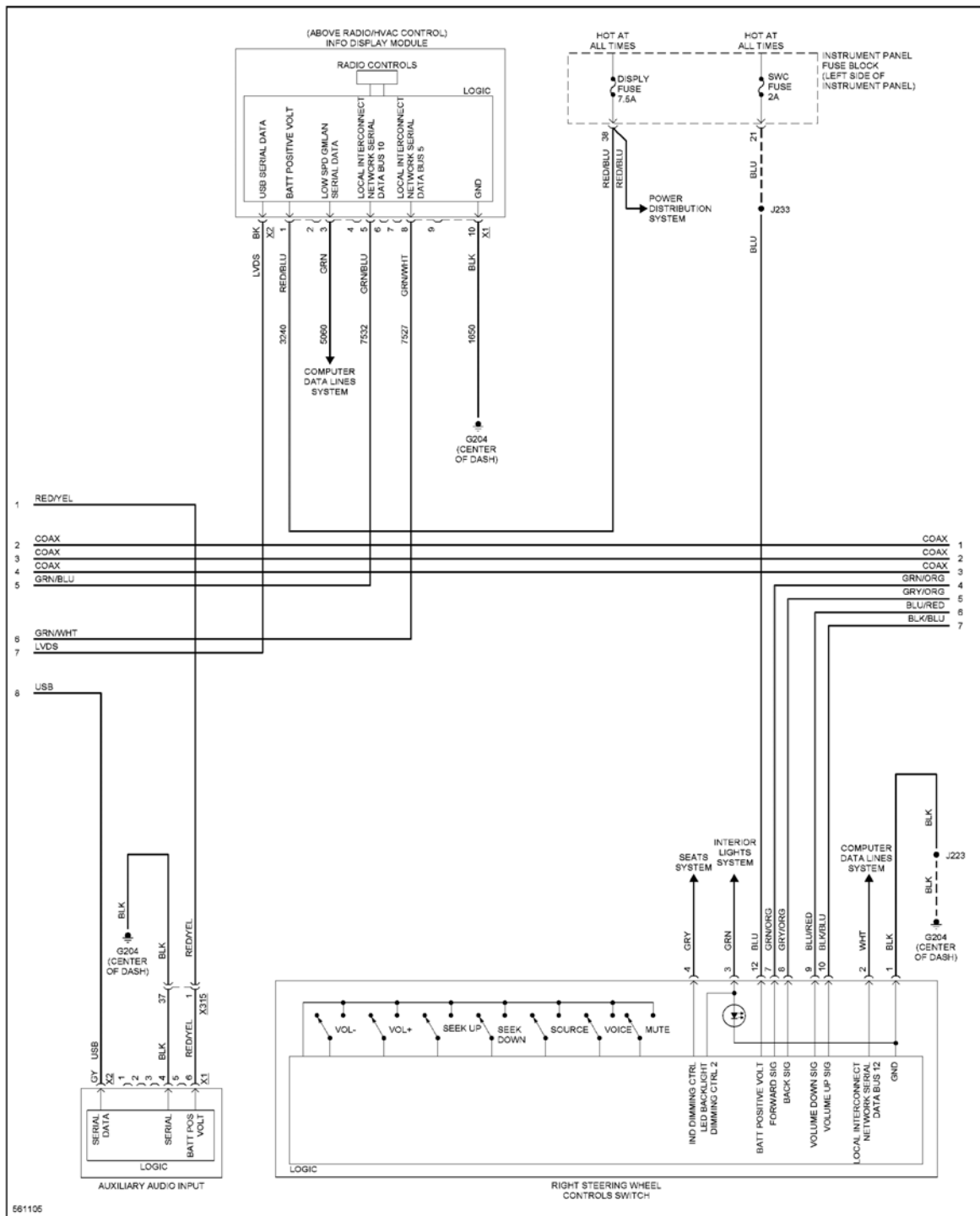


Fig. 98: Radio Circuit, W/O Amplifier (2 of 3)

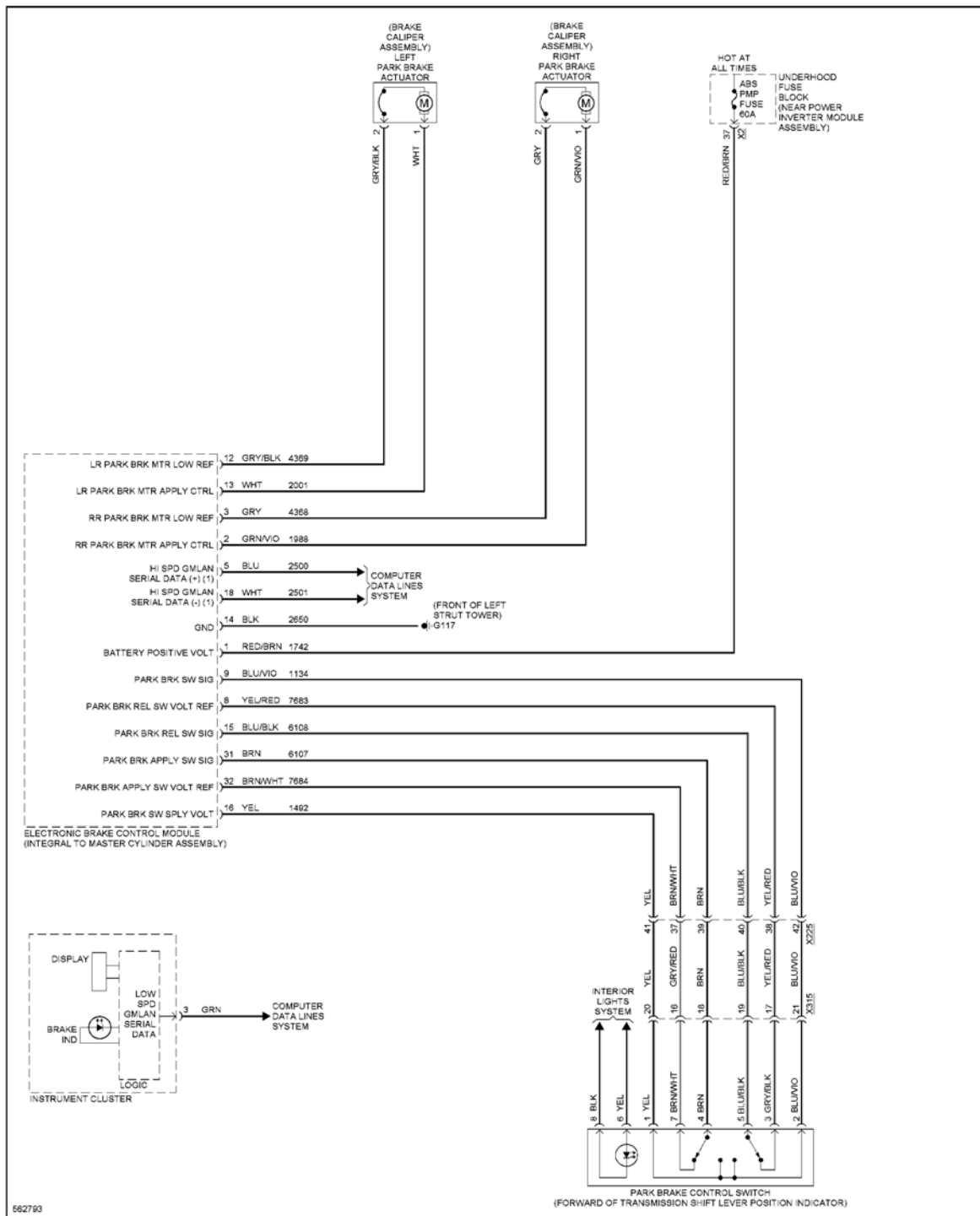


Fig. 100: Park Brake System Circuit

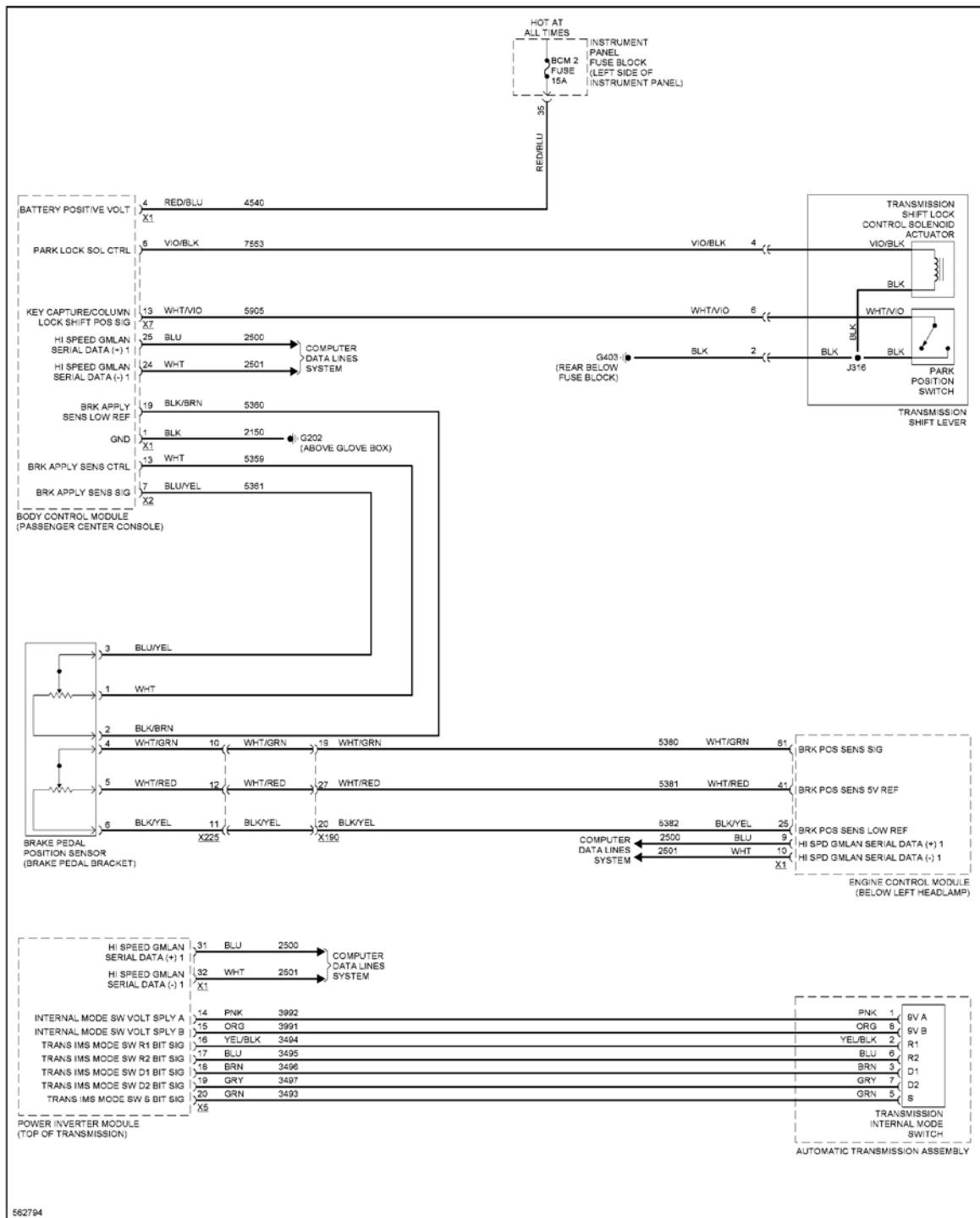


Fig. 101: Shift Interlock Circuit

SUPPLEMENTAL RESTRAINTS

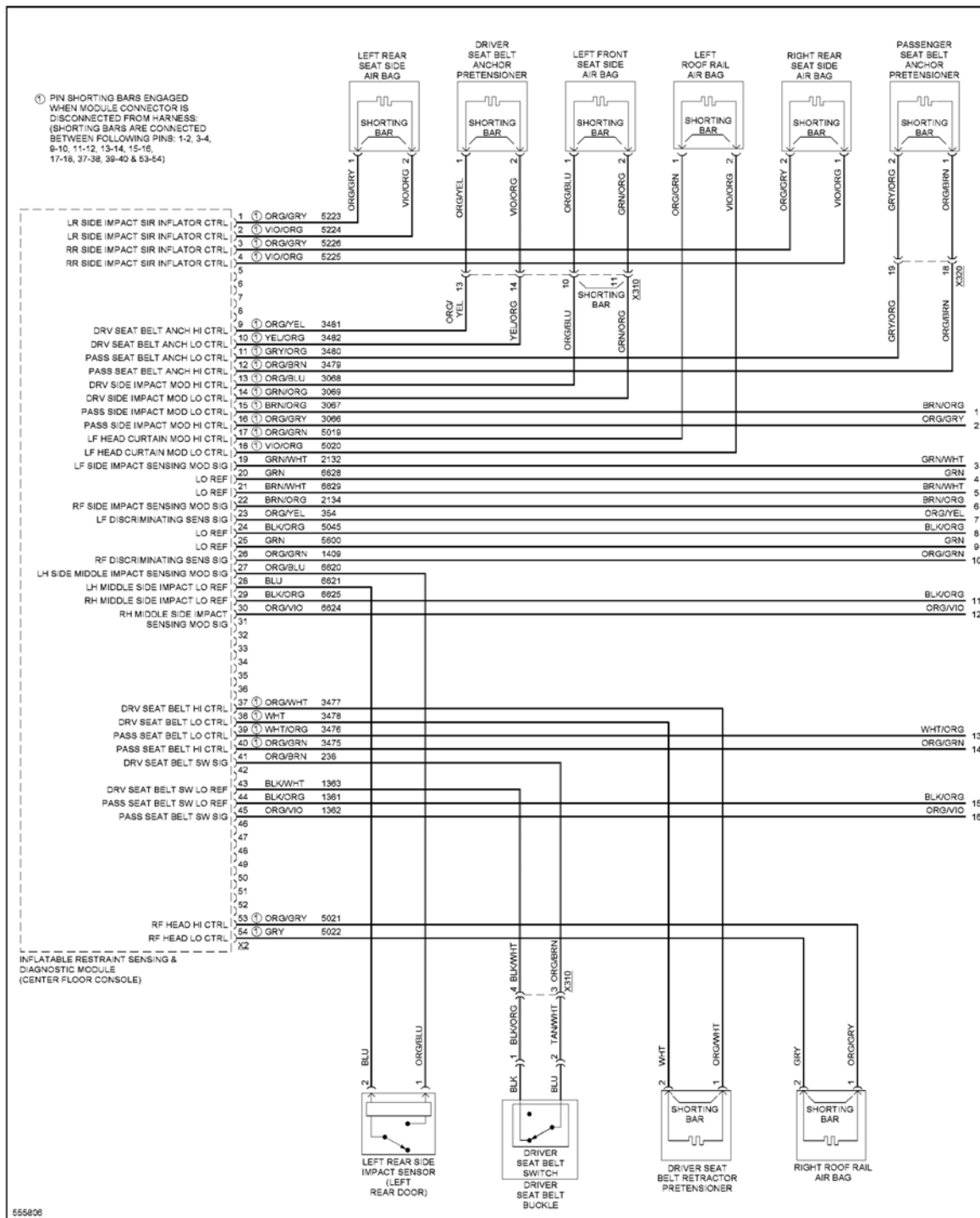


Fig. 102: Supplemental Restraints Circuit (1 of 3)

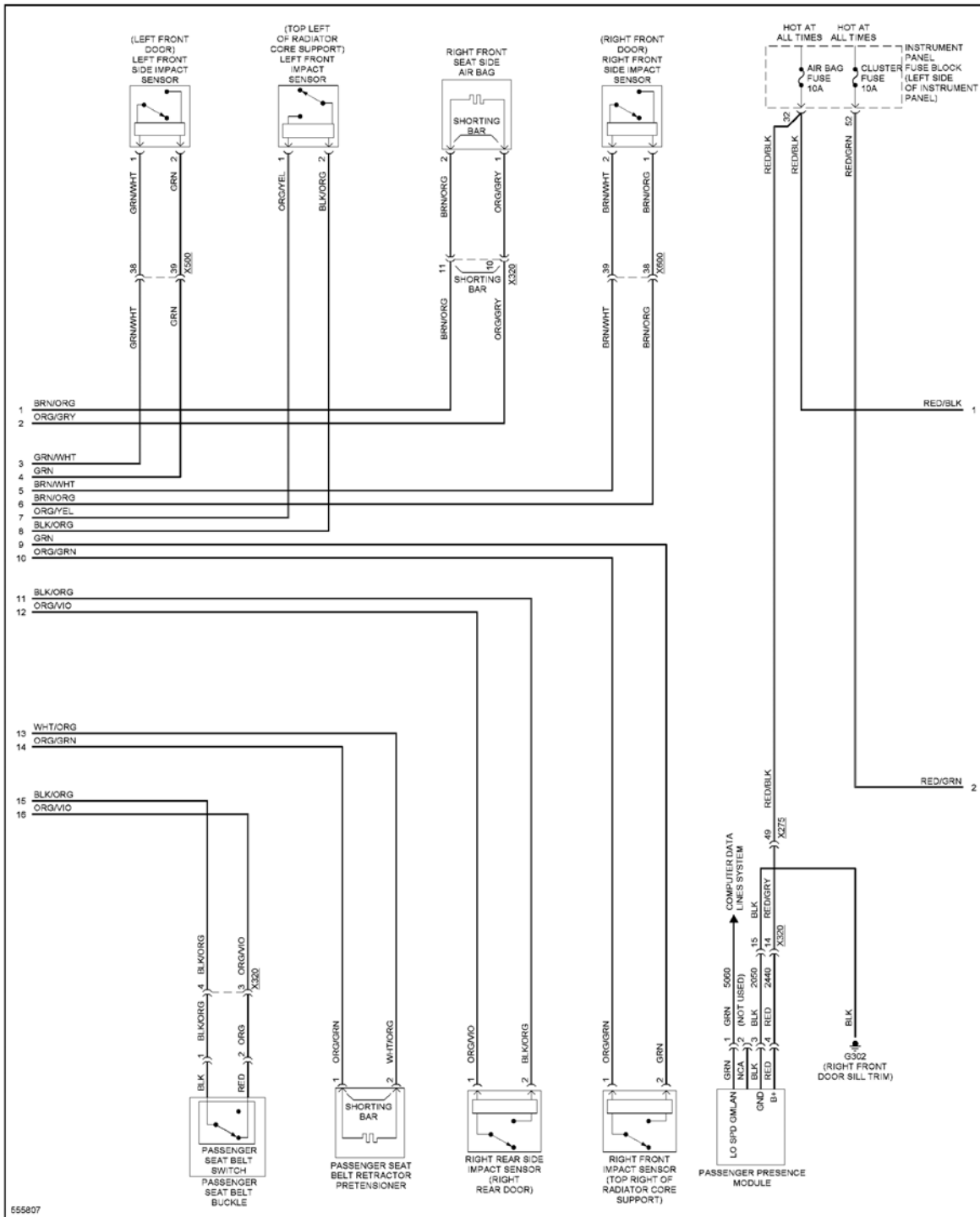


Fig. 103: Supplemental Restraints Circuit (2 of 3)

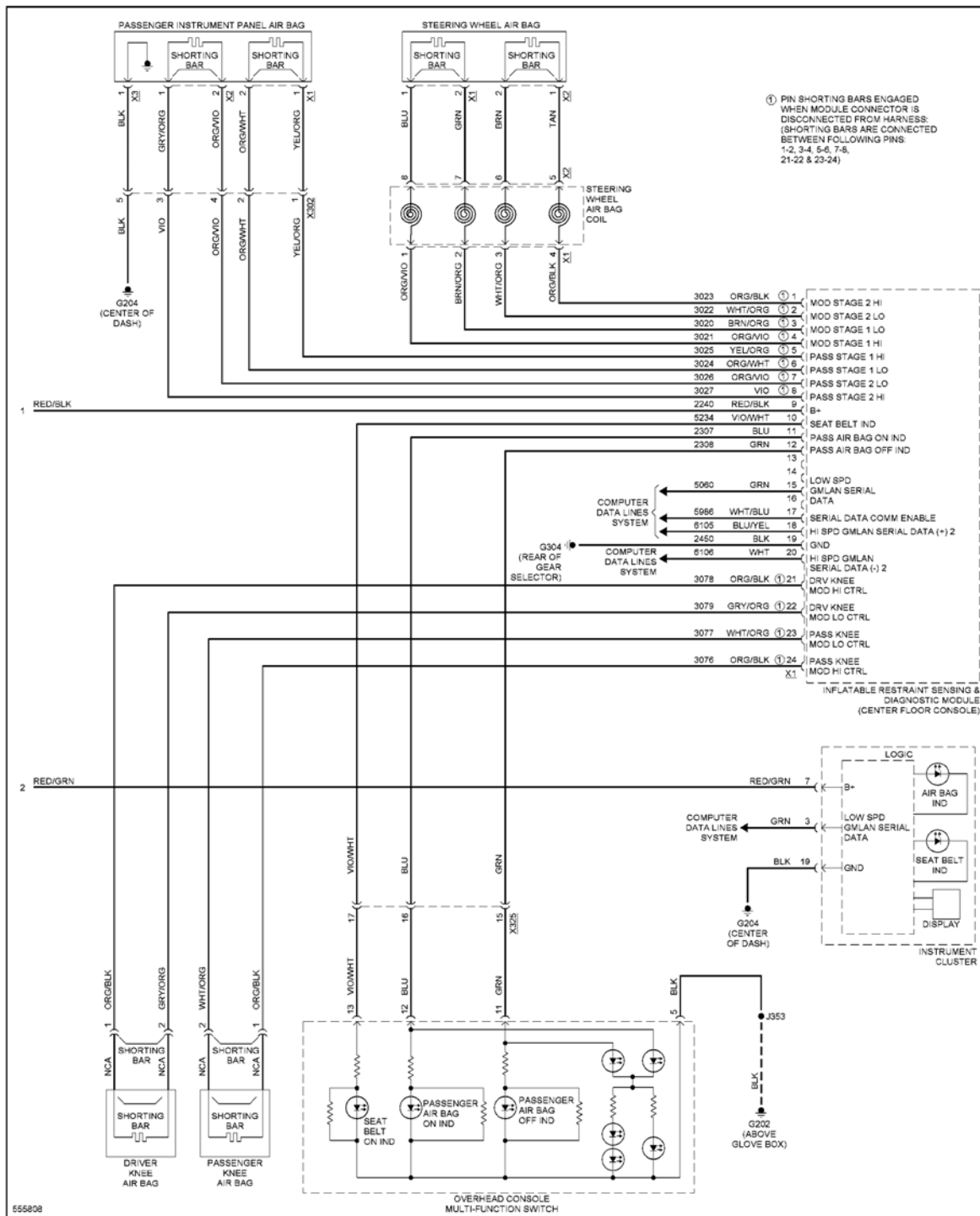


Fig. 104: Supplemental Restraints Circuit (3 of 3)

TRANSMISSION

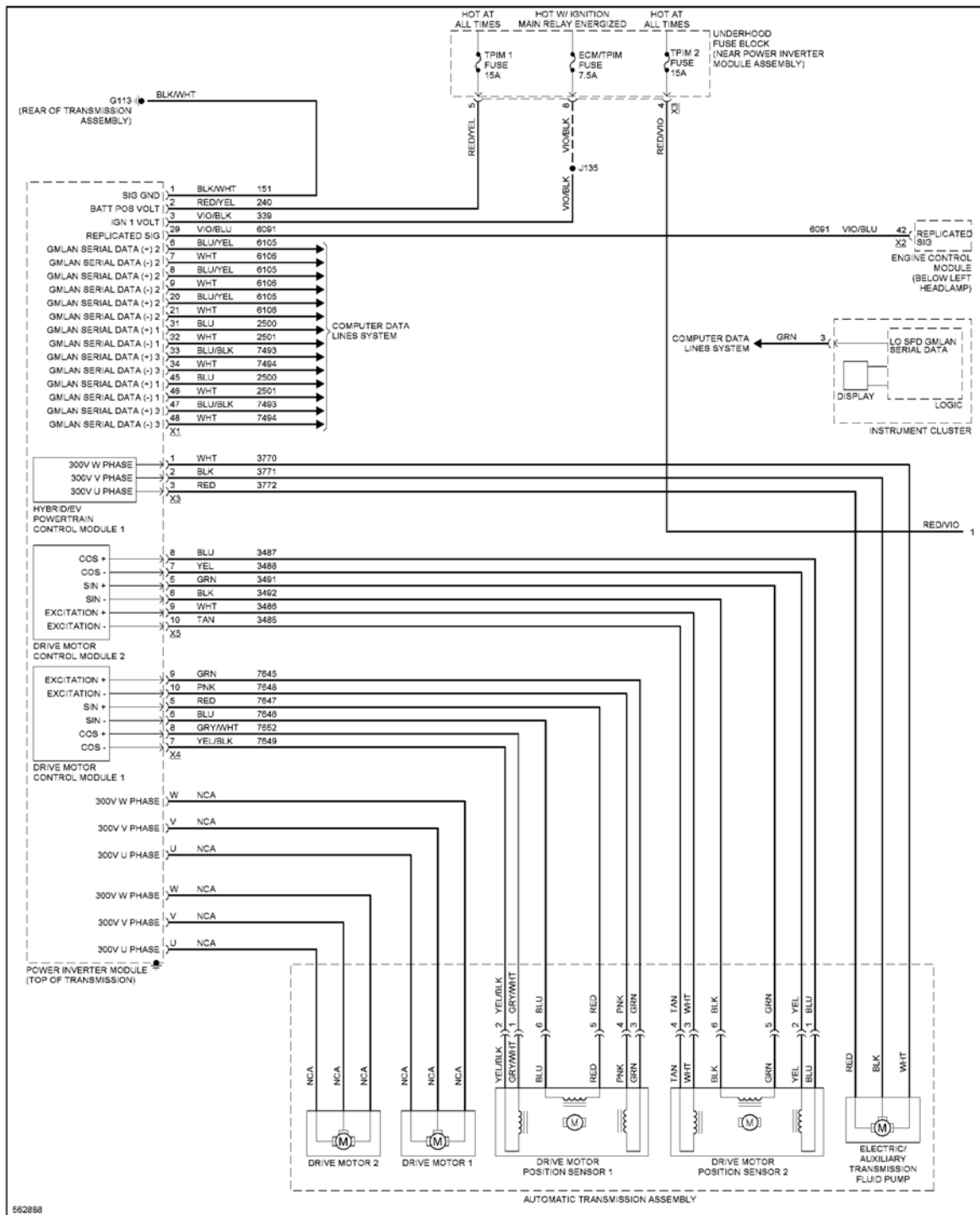


Fig. 105: Transmission Circuit (1 of 3)

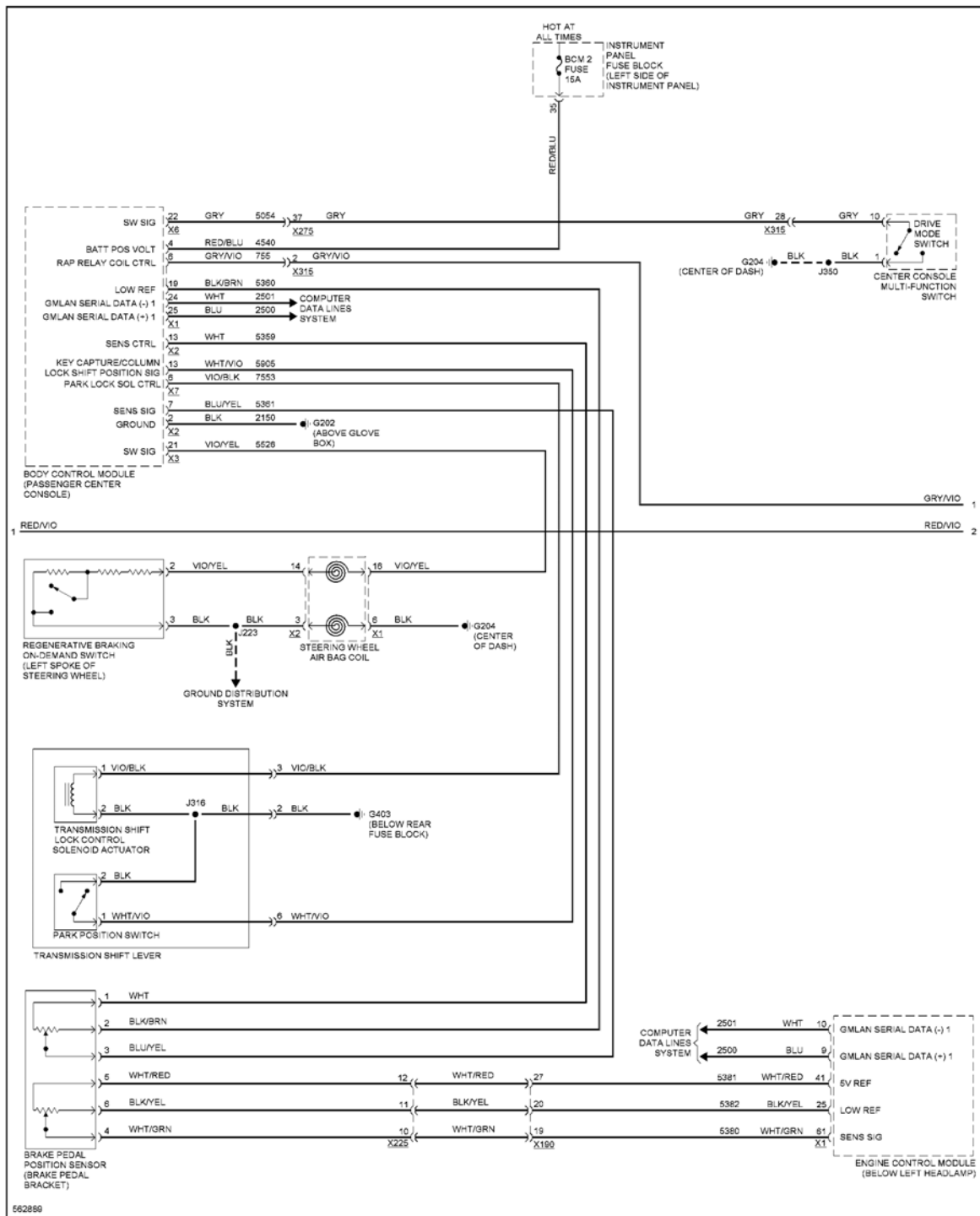


Fig. 106: Transmission Circuit (2 of 3)

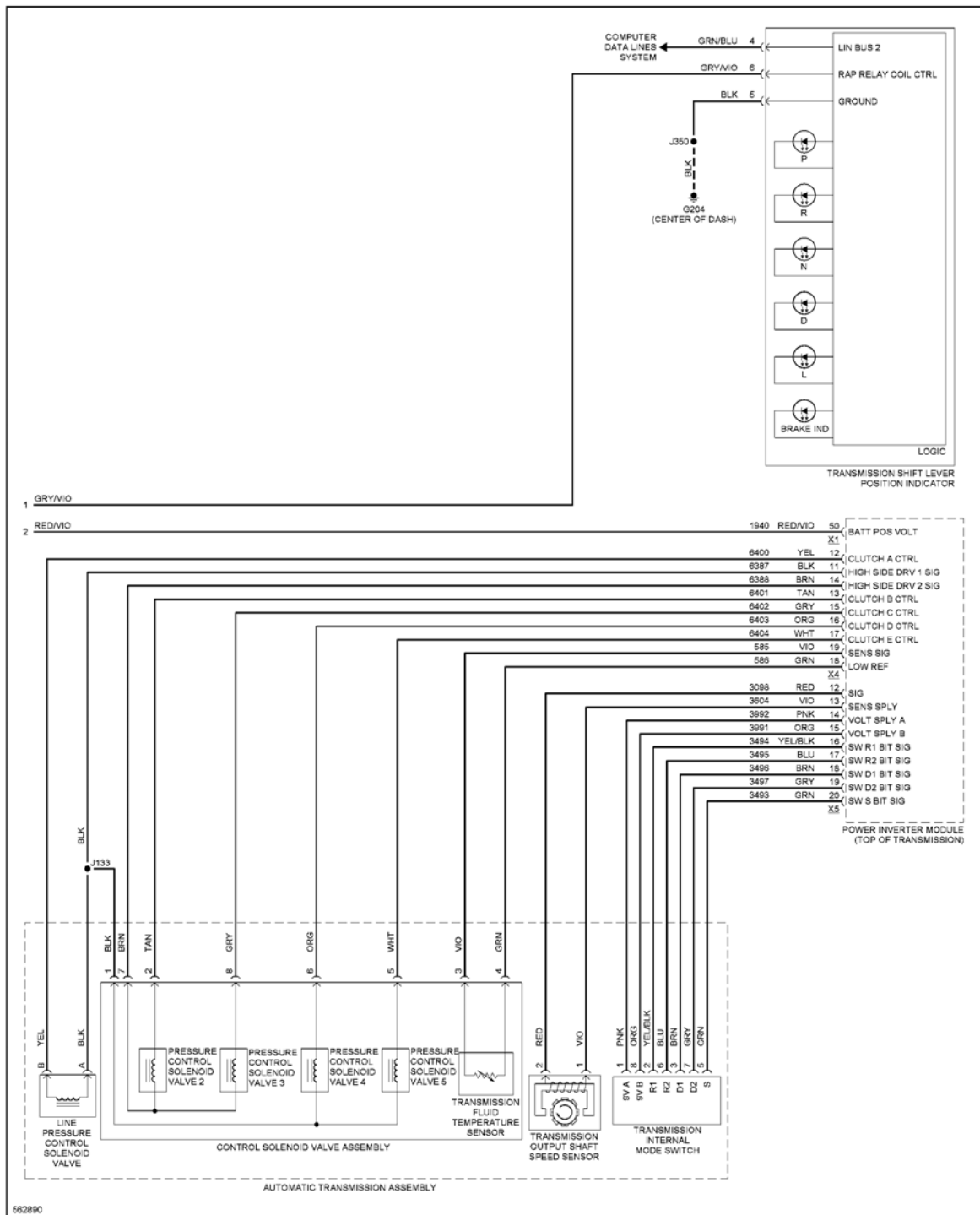


Fig. 107: Transmission Circuit (3 of 3)

TRUNK, TAILGATE, FUEL DOOR

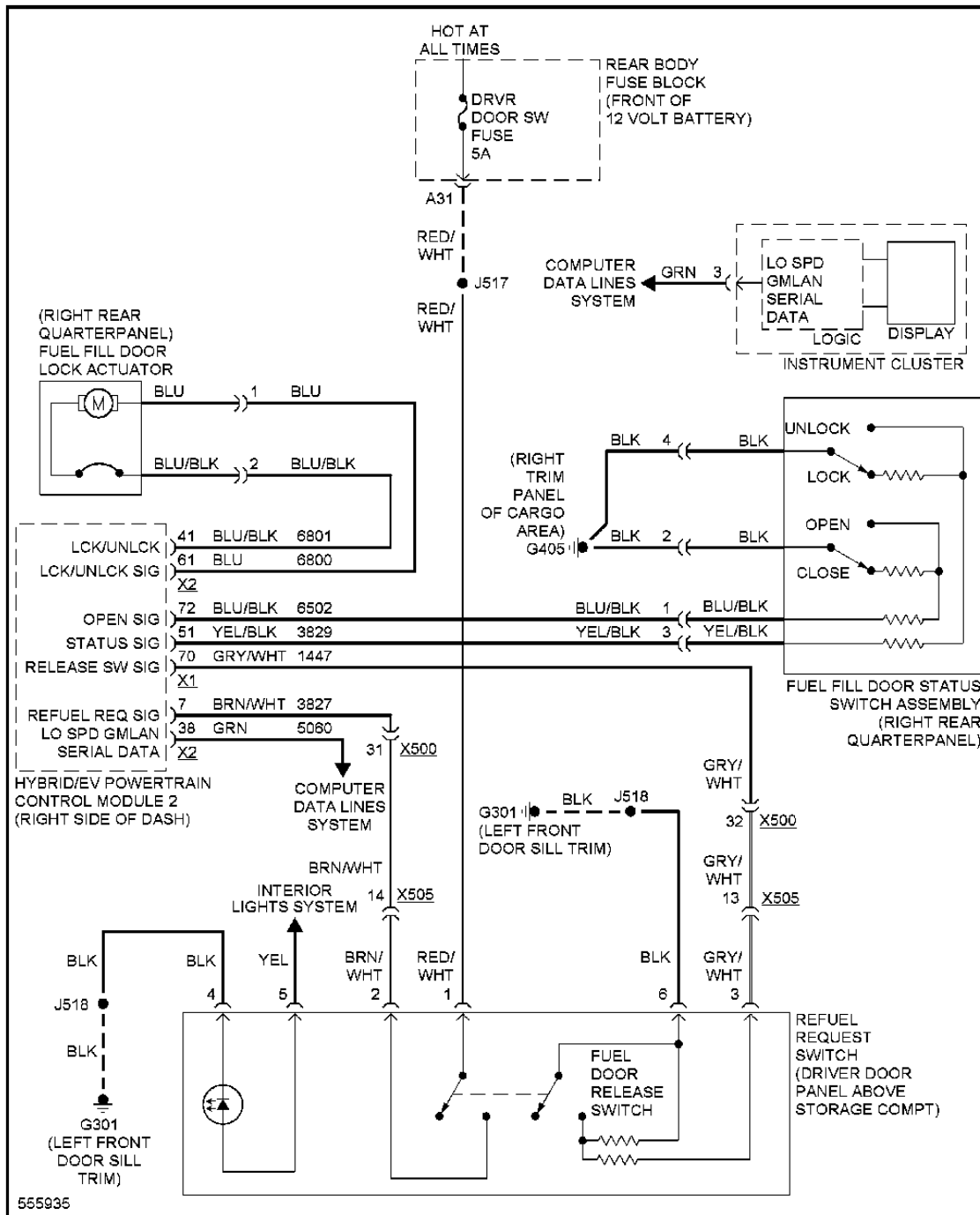


Fig. 108: Fuel Door Release Circuit

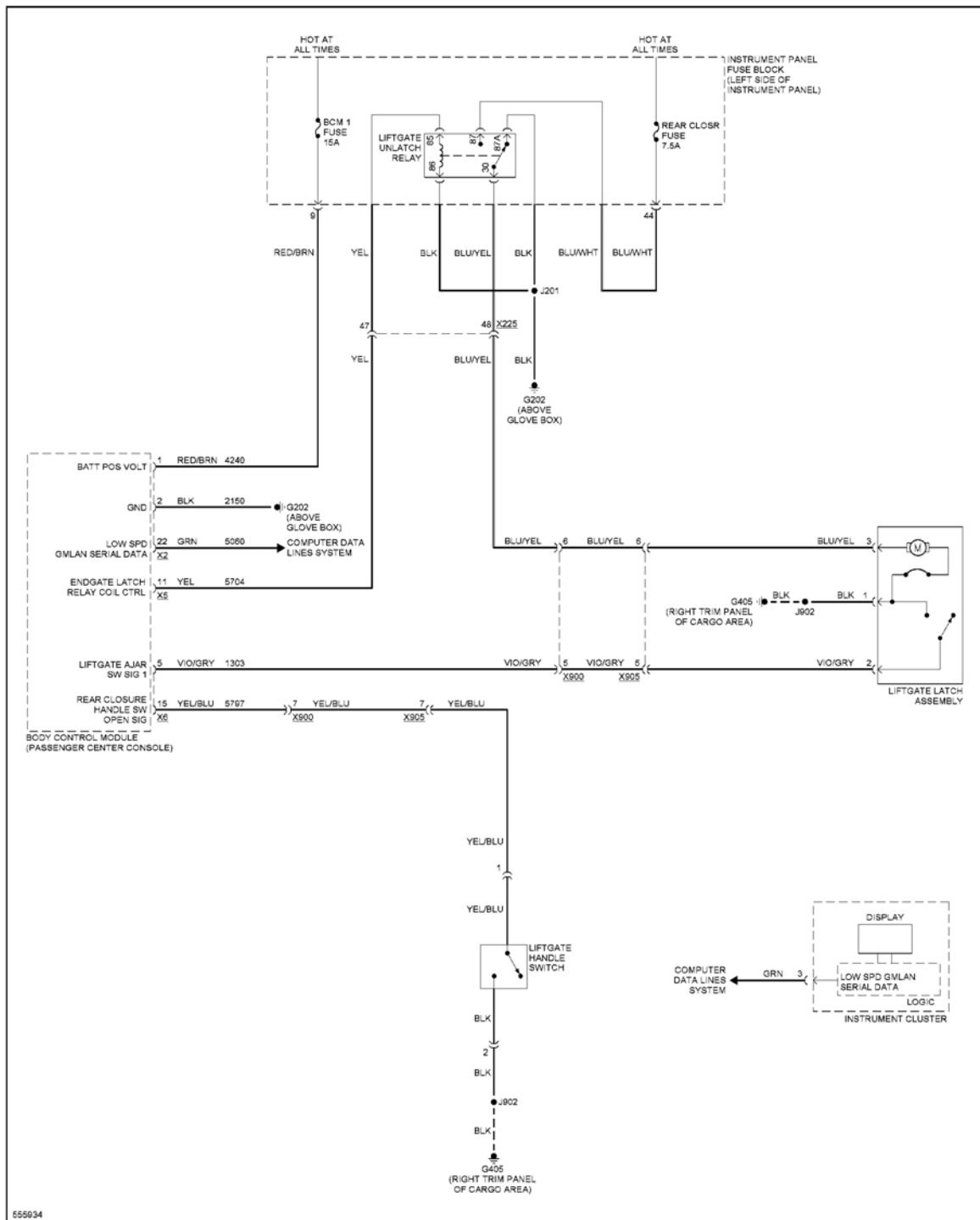


Fig. 109: Liftgate Release Circuit

WARNING SYSTEMS

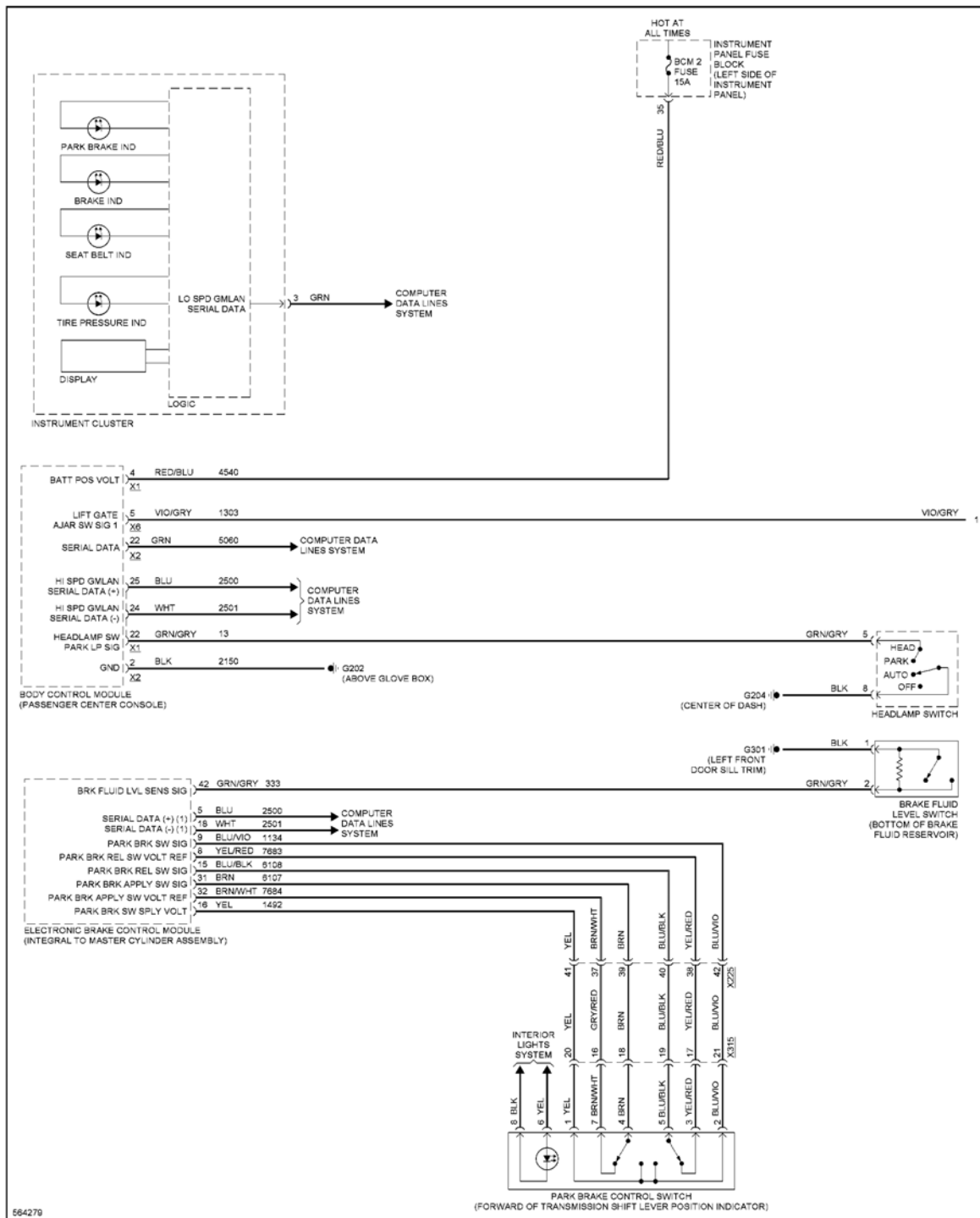


Fig. 110: Warning Systems Circuit (1 of 2)

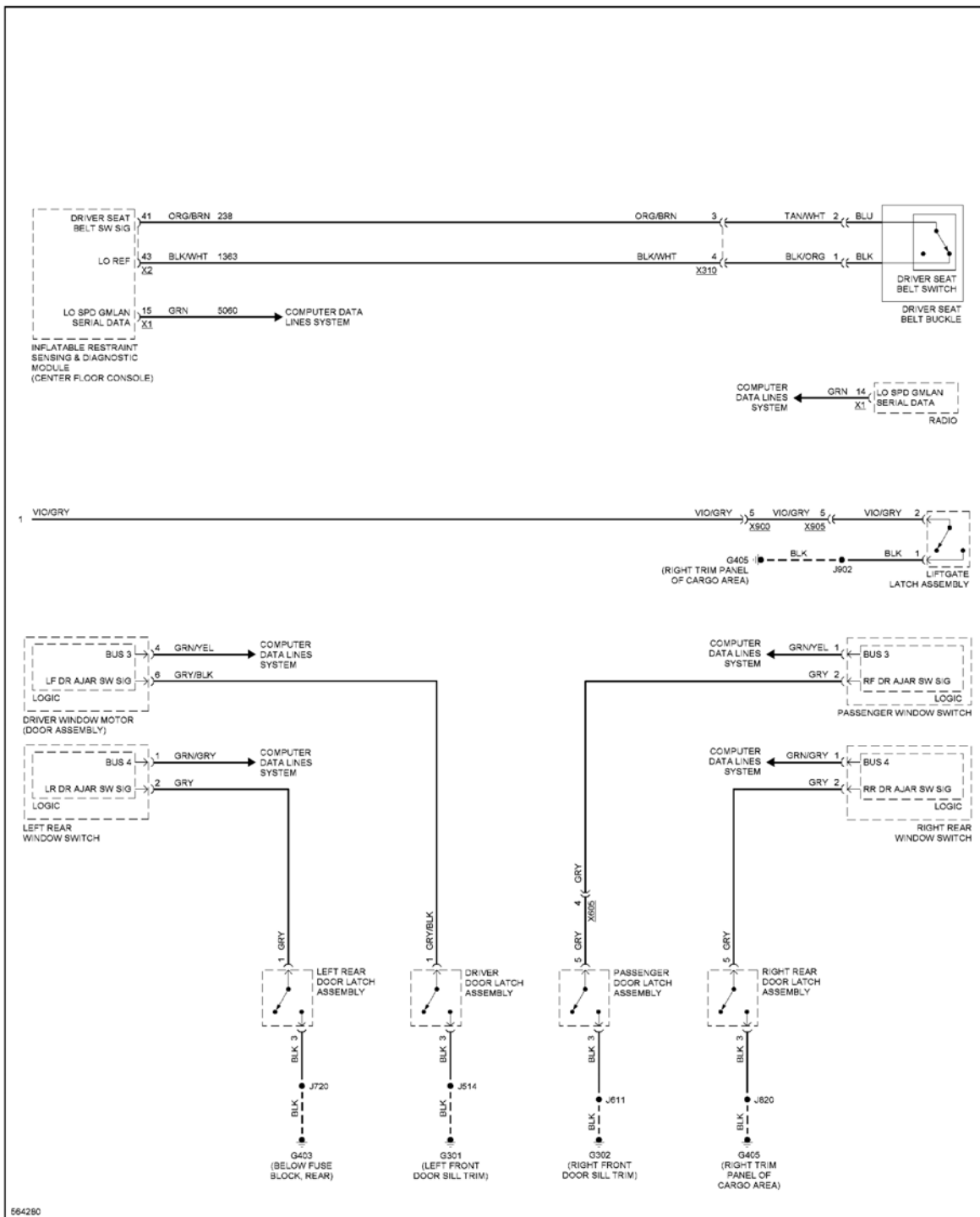


Fig. 111: Warning Systems Circuit (2 of 2)

WIPER/WASHER

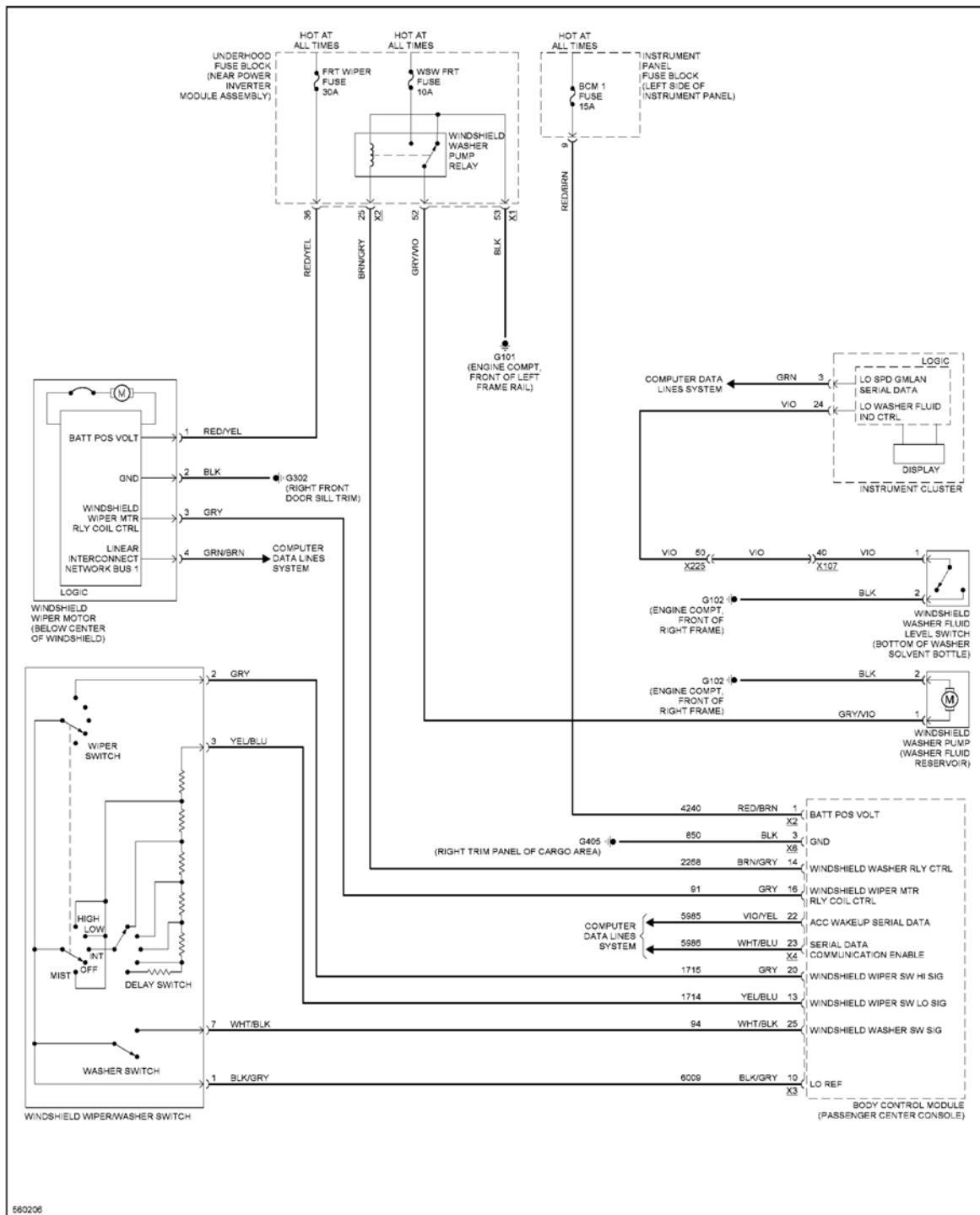


Fig. 112: Wiper/Washer Circuit

ELECTRICAL

Wiring Systems and Power Management - Component Locator - Wheels/Vehicle Underbody Component Views - Volt

WHEELS/VEHICLE UNDERBODY COMPONENT VIEWS

UNDERBODY - HYBRID/EV BATTERY PACK INTERNALS

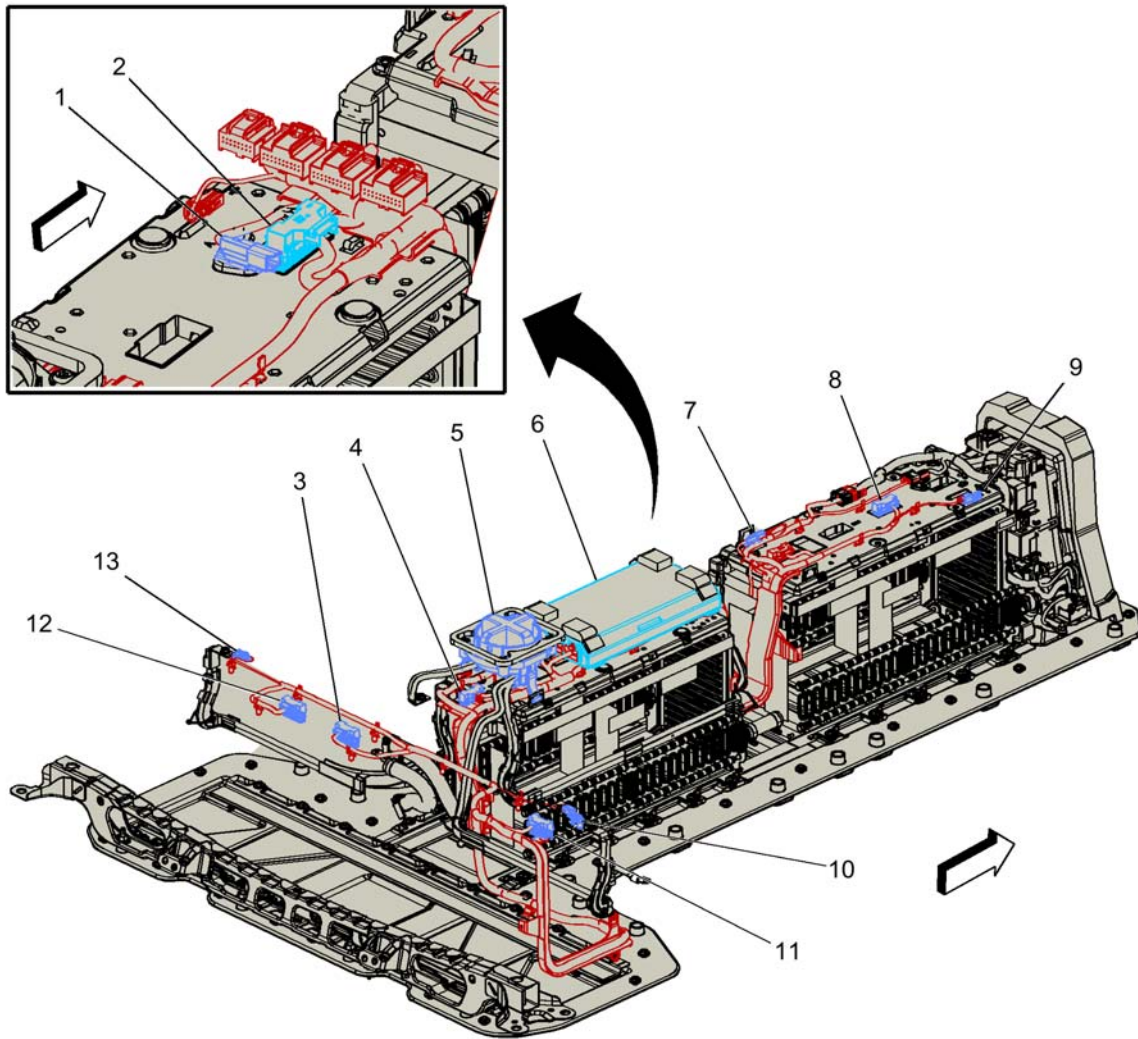


Fig. 1: Underbody - Hybrid/EV Battery Pack Internals

Courtesy of GENERAL MOTORS COMPANY

Items
1. B32D Hybrid/EV Battery Temperature Sensor 4 B32D Hybrid/EV Battery Temperature Sensor 4
2. C5E Hybrid/EV Battery Module 5 C5E Hybrid/EV Battery Module 5
3. C5B Hybrid/EV Battery Module 2 C5B Hybrid/EV Battery Module 2
4. B32C Hybrid/EV Battery Temperature Sensor 3 B32C Hybrid/EV Battery Temperature Sensor 3
5. S15 Manual Service Disconnect

Items
6. K16 Battery Energy Control Module <u>K16 Battery Energy Control Module X1</u> <u>K16 Battery Energy Control Module X2</u> <u>K16 Battery Energy Control Module X3</u> <u>K16 Battery Energy Control Module X4</u> <u>K16 Battery Energy Control Module X5</u> <u>K16 Battery Energy Control Module X6</u> <u>K16 Battery Energy Control Module X7</u> <u>K16 Battery Energy Control Module X8</u>
7. B32E Hybrid/EV Battery Temperature Sensor 5 <u>B32E Hybrid/EV Battery Temperature Sensor 5</u>
8. C5F Hybrid/EV Battery Module 6 <u>C5F Hybrid/EV Battery Module 6</u>
9. B32F Hybrid/EV Battery Temperature Sensor 6 <u>B32F Hybrid/EV Battery Temperature Sensor 6</u>
10. C5C Hybrid/EV Battery Module 3 <u>C5C Hybrid/EV Battery Module 3</u>
11. B32B Hybrid/EV Battery Temperature Sensor 2 <u>B32B Hybrid/EV Battery Temperature Sensor 2</u>
12. C5A Hybrid/EV Battery Module 1 <u>C5A Hybrid/EV Battery Module 1</u>
13. B32A Hybrid/EV Battery Temperature Sensor 1 <u>B32A Hybrid/EV Battery Temperature Sensor 1</u>

UNDERBODY - HYBRID/EV BATTERY PACK CONTACTOR ASSEMBLY COMPONENTS

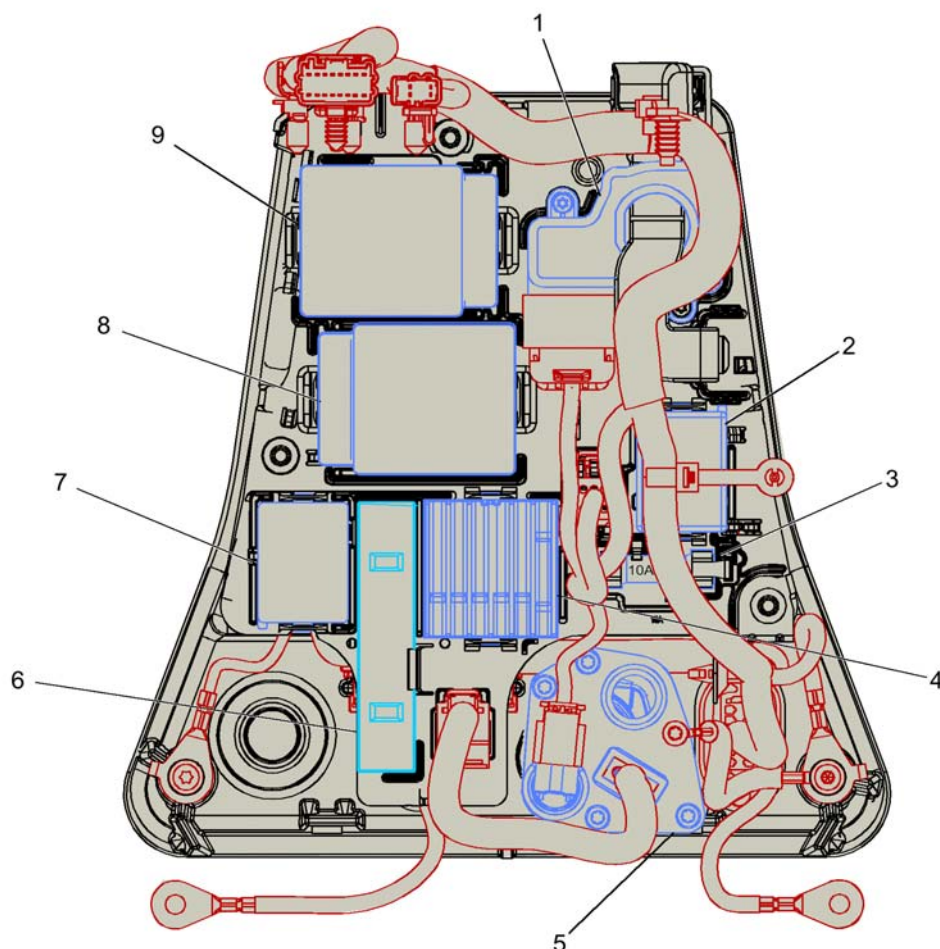


Fig. 2: Underbody - Hybrid/EV Battery Pack Contactor Assembly Components
 Courtesy of GENERAL MOTORS COMPANY

Items
1. B30 Hybrid/EV Battery Pack Current Sensor B30 Hybrid/EV Battery Pack Current Sensor ()
2. KR116B Battery Charging System Positive Contactor
3. X55QB Fuse Holder 2 - Hybrid/EV Battery Pack
4. T21 Hybrid/EV Battery Coolant Heater Transistor
5. E54 Hybrid/EV Battery Pack Coolant Heater
6. R25 Hybrid/EV Battery Pre-Charge Resistor
7. KR134 Pre-Charge Contactor
8. KR34A Drive Motor Battery Negative High Voltage Contactor Relay
9. KR34B Drive Motor Battery Positive High Voltage Contactor Relay

UNDERBODY - FUEL SYSTEM COMPONENTS (1 OF 2)

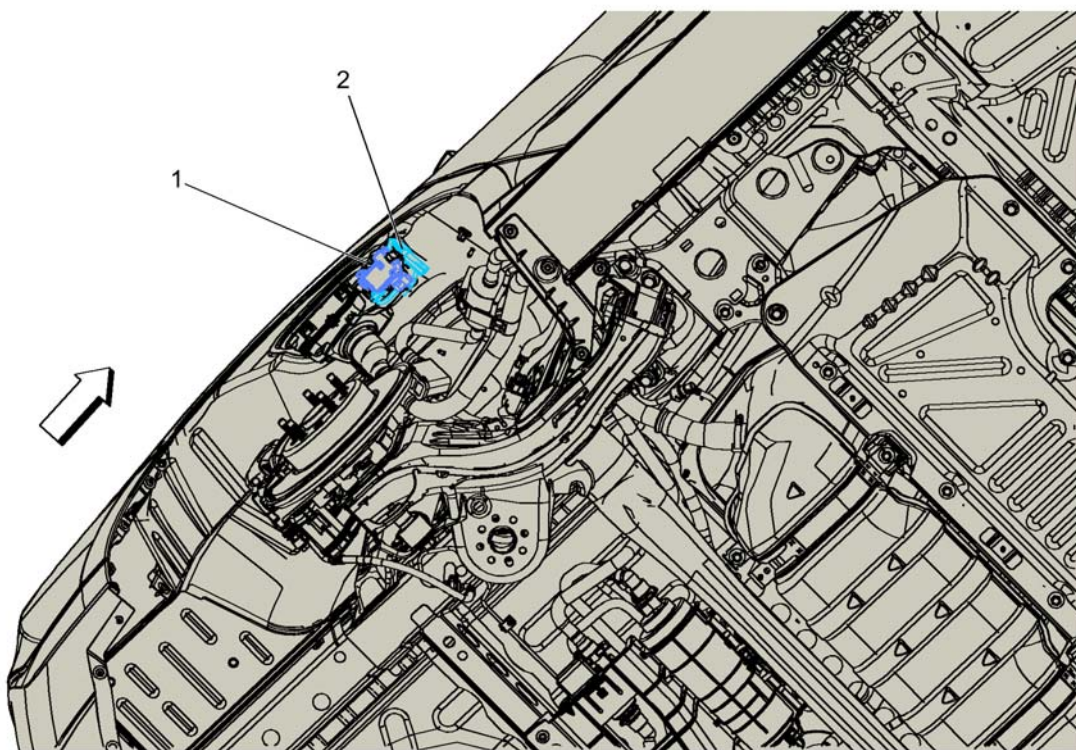


Fig. 3: Underbody - Fuel System Components (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. M97 Fuel Fill Door Lock Actuator M97 Fuel Fill Door Lock Actuator
2. B208 Fuel Fill Door Status Switch Assembly B208 Fuel Fill Door Status Switch Assembly

UNDERBODY - FUEL SYSTEM COMPONENTS (2 OF 2)

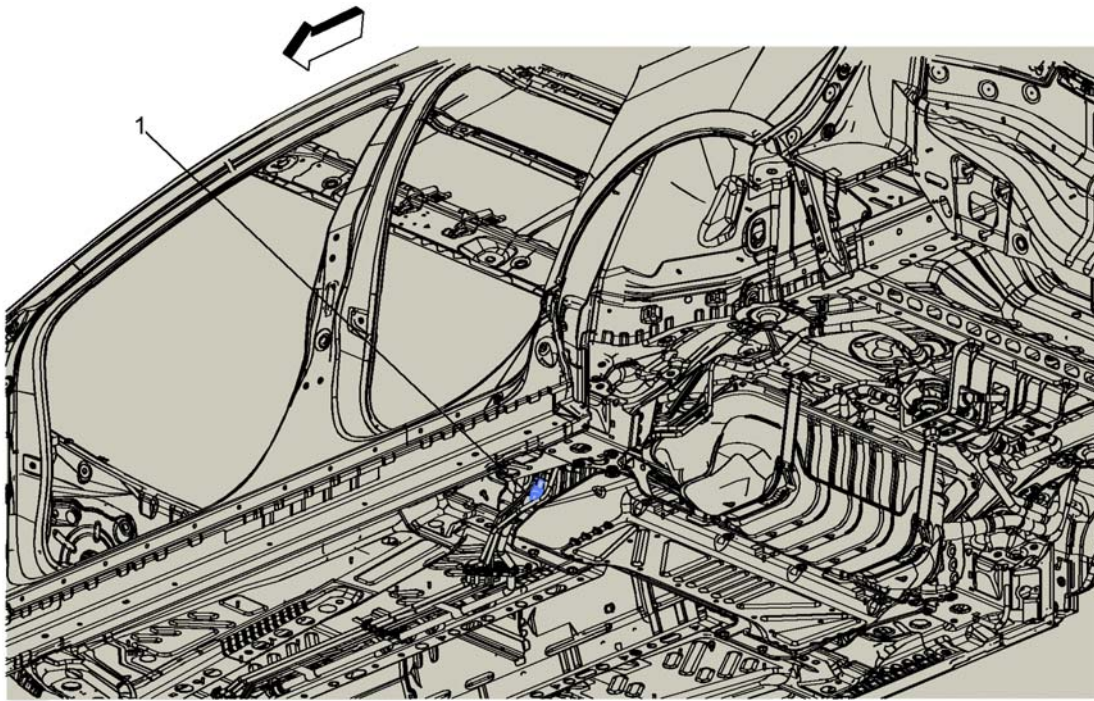


Fig. 4: Underbody - Fuel System Components (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B47 Fuel Pressure Sensor <u>B47 Fuel Pressure Sensor</u>

UNDERBODY - STEERING COMPONENTS

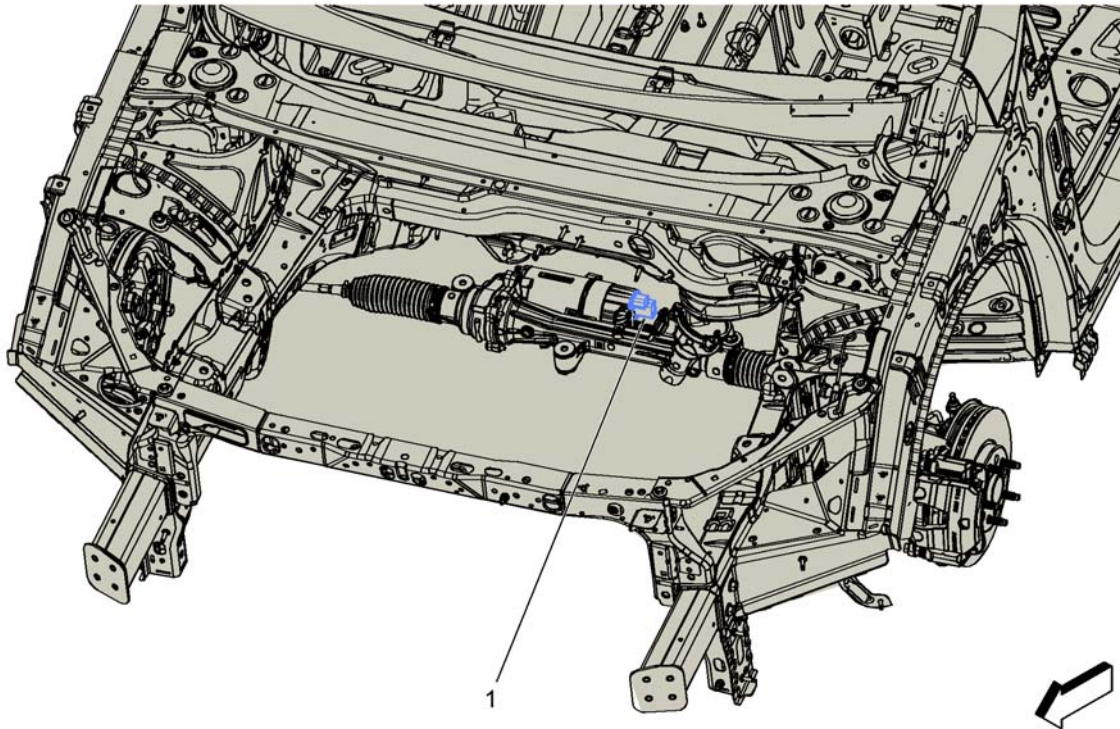


Fig. 5: Underbody - Steering Components

Courtesy of GENERAL MOTORS COMPANY

Items
1. K43 Power Steering Control Module K43 Power Steering Control Module X1 K43 Power Steering Control Module X2

UNDERBODY - WHEEL COMPONENTS (1 OF 4)

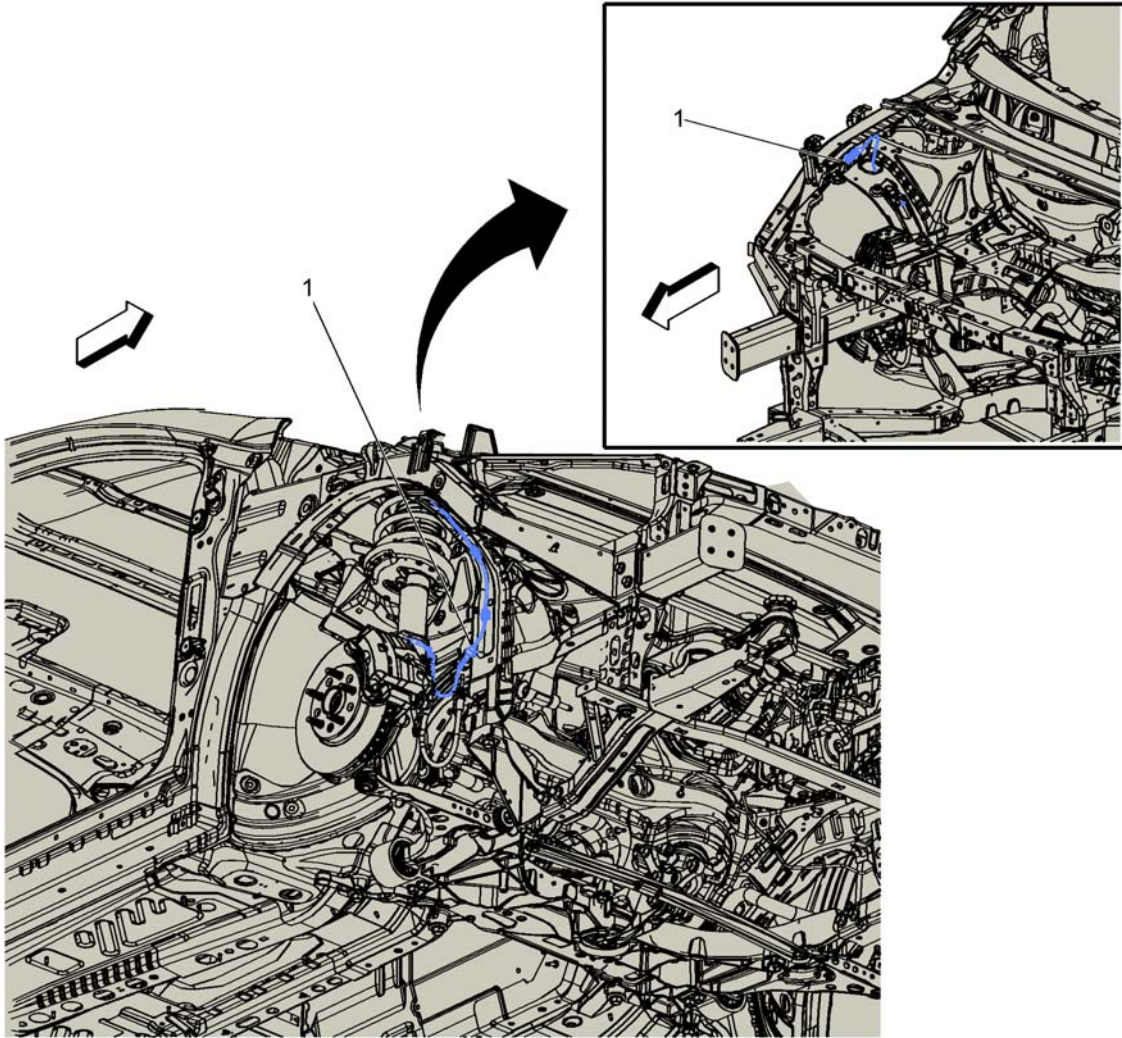


Fig. 6: Underbody - Wheel Components (1 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5RF Wheel Speed Sensor - Right Front <u>B5RF Wheel Speed Sensor - Right Front</u>

UNDERBODY - WHEEL COMPONENTS (2 OF 4)

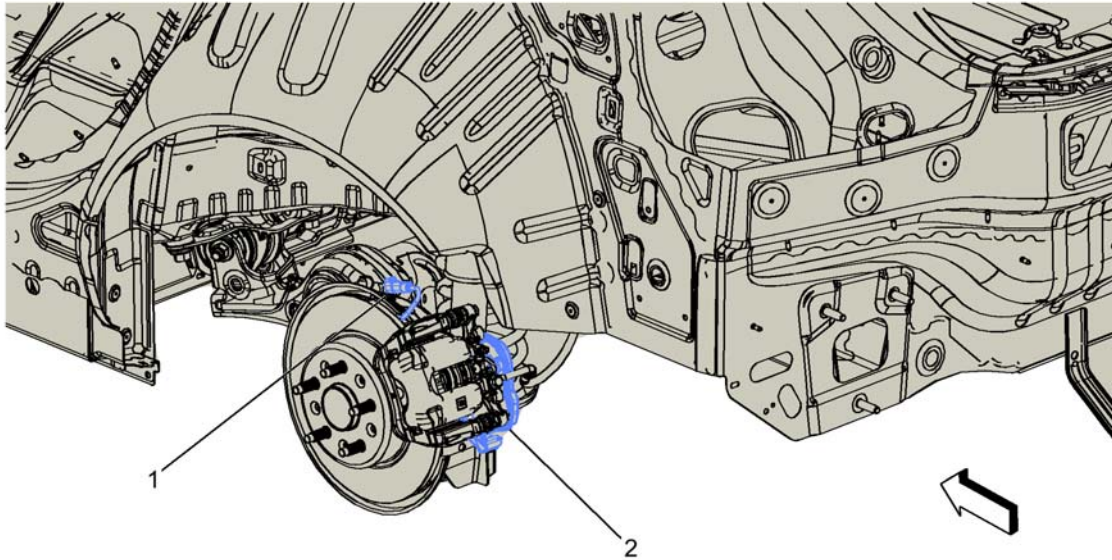


Fig. 7: Underbody - Wheel Components (2 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5LR Wheel Speed Sensor - Left Rear B5LR Wheel Speed Sensor - Left Rear
2. M104L Park Brake Actuator - Left M104L Park Brake Actuator - Left

UNDERBODY - WHEEL COMPONENTS (3 OF 4)

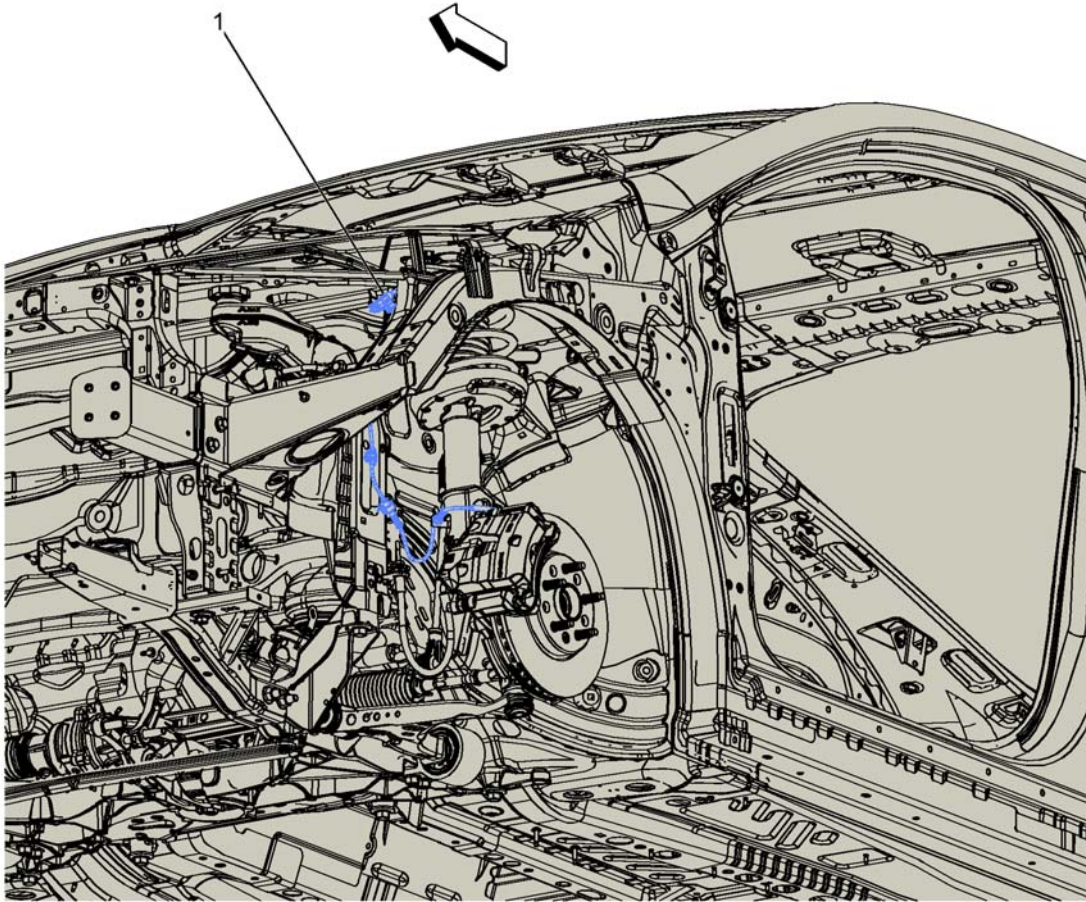


Fig. 8: Underbody - Wheel Components (3 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5LF Wheel Speed Sensor - Left Front <u>B5LF Wheel Speed Sensor - Left Front</u>

UNDERBODY - WHEEL COMPONENTS (4 OF 4)

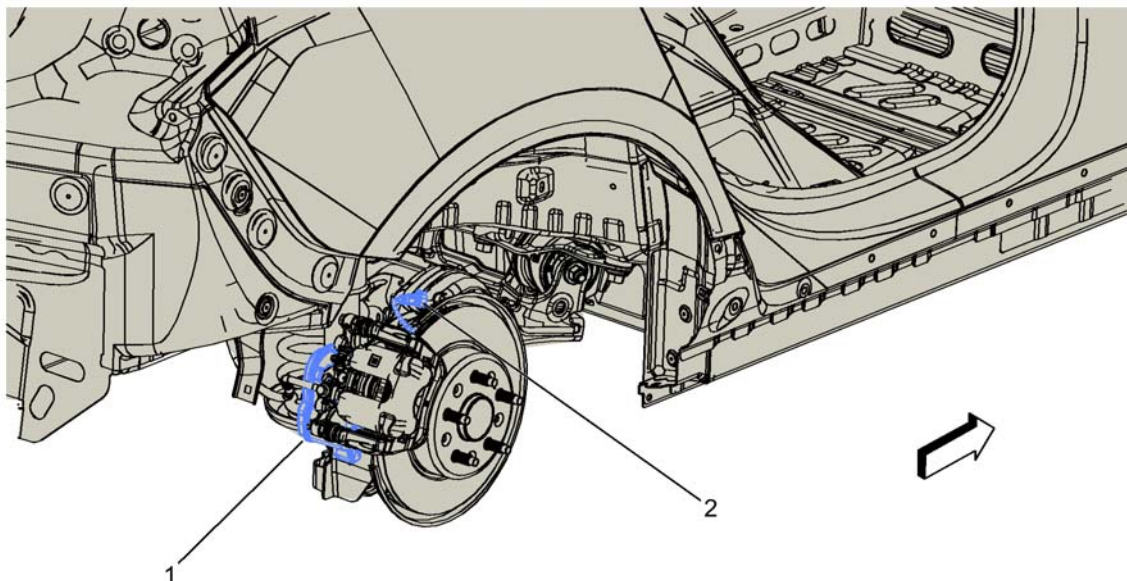


Fig. 9: Underbody - Wheel Components (4 of 4)

Courtesy of GENERAL MOTORS COMPANY

Items
1. M104R Park Brake Actuator - Right M104R Park Brake Actuator - Right
2. B5RR Wheel Speed Sensor - Right Rear B5RR Wheel Speed Sensor - Right Rear

Article GUID: A00884715

EMISSION APPLICATIONS

GM - Chevrolet Volt

EMISSION APPLICATIONS

Volt

Engine & Fuel System	<u>(1)</u> Emission Control Systems & Devices	EGR Test No.
1.5L (91") 4-Cyl. DI	PCV, <u>(2)</u> EVAP, TWC, FR, <u>(2)</u> SPK, <u>(3)</u> HO2S, CEC, <u>(2)</u> MIL, EVAP-CPCSV, EVAP-CVCSV, EVAP-FTPS, EVAP-VC	...
(1) Major emission control systems and devices are listed in bold type; components and other related devices are listed in light type. (2) PCM-controlled. (3) Equipped with 2.		

Article GUID: A00768985

EMISSION CONTROL ABBREVIATIONS

Gasoline & Diesel

"A"

A/C

Air Conditioning

A/C-ISUS

A/C Idle Speed-Up Solenoid

A/F

Air/Fuel

AAI

Air Assist Injector

ACL

Air Cleaner (Thermostatic Air Cleaner)

ACL-BMS

ACL Bimetallic Sensor

ACL-CKV

ACL Check Valve

ACL-DV

ACL Delay Valve

ACL-ESC

Electronic Spark Control

ACL-PVS

ACL Ported Vacuum Switch

ACL-RDV

ACL Reverse Delay Valve

ACL-RDVS

ACL Reverse Delay Valve (Single)

ACL-TCV

ACL Thermal Control Valve

ACL-TS

ACL Temperature Sensor

ACL-TSOV

ACL Temperature Sensor Override Valve

ACL-TVS

ACL Thermal Vacuum Switch

ACL-TVV

ACL Thermal Vacuum Valve

ACL-VCDV

ACL Vacuum Control Delay Valve

ACL-VCV

ACL Vacuum Control Valve

ACL-VM

ACL Vacuum Motor

ACL-WP

ACL Wax Pellet Type Motor

ADS

Anti-Dieseling Solenoid

AFR

Air/Fuel Ratio Sensor

AFS

Air/Fuel Ratio Sensor

AIH

Air Intake Heaters

AIH-TS

AIH Temperature Sensor

AIR

Air Injection System

AIS

Air Injection System

AIS-ACV

AIS Air Control Valve

AIS-AF

Air Injection System Air Filter

AIS-AMV

AIS Air Management Valve

AIS-ASV

AIS Air Switching Valve

AIS-BPV

AIS By-Pass Valve

AIS-CC

AIS Computer Controlled

AIS-CKV

AIS Check Valve

AIS-CSV

AIS Control Solenoid Valve

AIS-CV

AIS Combination Valve

AIS-DV

AIS Diverter Valve

AIS-IMCV

AIS Intake Manifold Change-Over Valve

AIS-MCV

AIS Manifold Change-Over Valve

AIS-OWV

AIS One Way Valve

AIS-PAF

AIS Pulse Air Feeder

AIS-PM

AIS Pump Motor

AIS-PV

AIS Pneumatic Valve

AIS-RV

AIS Relief Valve

AIS-SAV

AIS Secondary Air Valve

AIS-SOL

AIS Solenoid

AIS-SV

AIS Solenoid Valve

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIS-VT

AIS Vacuum Tank

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIV

Air Injection Valve

AIV-SOL

Air Injection Valve Solenoid

ALVW

Adjusted Loaded Vehicle Weight

AMV

Air Management Valve

AP

Air Pump Injection System

AP-ABV

Air Pump Air Bypass Valve

AP-ACV

AP Air Control Valve

AP-AMV

AP Air Management Valve

AP-ASRV

AP Air Switching Relief Valve

AP-ASS

AP Air Switching Solenoid

AP-ASV

AP Air Switching Valve

AP-BP

AP By-Pass Valve

AP-BPV

AP By-Pass Valve

AP-CKV

AP Check Valve

AP-CS

AP Control Solenoid

AP-CV

AIR Cut-Off Valve

AP-DCTO

AP Dual Coolant Temperature Override

AP-DLY

AP Delay Valve

AP-DV

AP Diverter Valve

AP-EADV

AP Electric Air Control Diverter Valve

AP-EAMR

AP Electric Air Management Relay

AP-EAMS

AP Electric Air Management Solenoid

AP-EAP

AP Electric Air Pump

AP-EC

AP Electromagnetic Clutch

AP-ERLY

AP Electric Air Pump Relay

AP/PAIR

Pulsed Secondary Air Injection

AP-RDV

AP Reed Valve

AP-RV

AP Relief Valve

AP-SOL

AP Solenoid

AP-SOV

AP Shut-Off Valve

AP-SV

AP Solenoid Valve

AP-SWV

AP Switchover Valve

AP-TV

AP Transmitting Valve

AP-VCS

AP Vacuum Control Solenoid

AP-VCSV

AP Vacuum Controlled Air Shut-Off Valve

AP-VCV

AP Vacuum Control Valve

AP-VSV

AP Vacuum Switching Valve

A/T

Automatic Transmission

ATCV

Air Temperature Control Valve

"B"

BP/EGR

Backpressure EGR System

BP/EGR-BPS

BP/EGR Backpressure Sensor

BP/EGR-BPT

BP/EGR Backpressure Transducer

BP/EGR-BPV

BP/EGR Backpressure Valve

BP/EGR-BS

BP/EGR Bleed Solenoid

BP/EGR-BVSV

BP/EGR Bimetallic Vacuum Switching Valve

BP/EGR-C

BP/EGR Controller

BP/EGR-CLR

BP/EGR Cooler

BP/EGR-CS

BP/EGR Control Solenoid

BP/EGR-CTO

BP/EGR Coolant Temperature Override

BP/EGR-CV

BP/EGR Control Valve

BP/EGR-DCTO

BP/EGR Dual Coolant Temperature Override

BP/EGR-DS

BP/EGR Diagnostic Solenoid

BP/EGR-DSOL

BP/EGR Duty Solenoid

BP/EGR-DTVSW

BP/EGR Distributor Thermal Vacuum Switch

BP/EGR-DV

BP/EGR Delay Valve

BP/EGR-EET

BP/EGR Electric Transducer

BP/EGR-EPV

BP/EGR External Pressure Valve

BP/EGR-FDV

BP/EGR Forward Delay Valve

BP/EGR-LCV

BP/EGR Vacuum Control Valve

BP/EGR-LC

BP/EGR Load Control Valve

BP/EGR-OVS

BP/EGR Orifice Valve Sensing

BP/EGR-PS

BP/EGR Position Sensor

BP/EGR-PT

BP/EGR Pressure Transducer

BP/EGR-PVS

BP/EGR Ported Vacuum Switch

BP/EGR-RES

BP/EGR Reservoir

BP/EGR-RST

BP/EGR Restrictor

BP/EGR-SOL

BP/EGR Solenoid

BP/EGR-TCTVS

BP/EGR Torque Converter Thermal Vacuum Switch

BP/EGR-TCV

BP/EGR Thermal Control Valve

BP/EGR-TCVLV

BP/EGR Temperature Control Valve

BP/EGR-T

BP/EGR Temperature Sensor

BP/EGR-TS

BP/EGR Temperature Sensor

BP/EGR-TVC

BP/EGR Thermal Control Valve

BP/EGR-TVS

BP/EGR Thermal Vacuum Switch

BP/EGR-TVV

BP/EGR Thermal Vacuum Valve

BP/EGR-VC

BP/EGR Diagnostic Valve

BP/EGR-VCV

BP/EGR Vacuum Control Valve

BP/EGR-VM

BP/EGR Vacuum Modulator

BP/EGR-VRV

BP/EGR Vacuum Regulator Valve

BP/EGR-VS

BP/EGR Vacuum Switch

BP/EGR-VSOL

BP/EGR Vent Solenoid

BP/EGR-VSV

BP/EGR Vacuum Switching Valve

"C"

C-4

Computer Controlled Catalytic Converter

CAC

Charge Air Cooler

CAS

Clean Air System

CB

Crankcase Breather

CB-VC

Crankcase Breather-Vapor Canister

CBPS

Coasting By-Pass System

CBVC

Crankcase Breather Vapor Canister

CCIEV

Coolant Controlled Idle Enrichment Valve

CCO

Computerized Engine Controls

CCS

Controlled Combustion System

CCV

Closed Crankcase Ventilation

CD-REGVLV

Crankcase Depression Regulator Valve

CDRV

Crankcase Depression Relief Valve

CEAB

Cold Engine Air Bleed

CEAB-TVS

CEAB Thermal Vacuum Switch

CEAB-TVV

CEAB Thermal Vacuum Valve

CEC

Computerized Engine Controls

CESS

Cold Engine Sensor Switch

CETS

Cold Engine Temperature Switch

CFI

Continuous Fuel Injection

CMH

Cold Mixture Heater

CNG

Compressed Natural Gas

CO

Carbon Monoxide

CO2

Carbon Dioxide

CPI

Central Port Injection

CRV

Coasting Richer Valve

CSI

Central Sequential Injection

CTAVS

Cold Temperature Activated Vacuum System

CTOX

Continuous Trap Oxidizer

CVOT

Crankcase Ventilation Orifice Tube

CVOT-CKV

Crankcase Ventilation Orifice Tube Check Valve

"D"

DCLV

Deceleration Valve

DCS

Deceleration Control System

DDI

Direct Diesel Injection

DFI

Direct Diesel Injection

DI

Direct Injection

DKV

Deceleration Kick Valve

DLCV

Deceleration Mixture Control Valve

DM-TL

Diagnostic Module Tank Leakage

DMS

Dual Manifold System

DOC

Diesel Oxidation Catalyst

DOHC

Dual Overhead Cam

DPD

Dual Point Distributor

DPF

Diesel Particulate Filter

DPF/TWC

Combination Diesel Particulate Filter and Three Way Catalyst

DPFE

Differential Pressure Feedback EGR Valve

DPFEGR

Differential Pressure Feedback EGR Valve

DTM

Deceleration Throttle Modulator

"E"

EAIR

Electric Air Injection System

EAIR-DV

EAIR Diverter Valve

EC

Computerized Engine Controls

ECM

Electronic Control Module

ECU

Electronic Control Unit

EDC

Electronic Diesel Control

EDS

Electronic Diesel System

EEC

Electronic Engine Control

EFE

Early Fuel Evaporation

EFE-CKV

EFE Check Valve

EFE-CV

EFE Control Valve

EFE-DTVS

EFE Delay Thermal Vacuum Switch

EFE-HTR

EFE Heater

EFE-HCV

EFE Heat Control Valve

EFE-OTS

EFE Oil Temperature Switch

EFE-PTC

EFE Positive Temperature Coefficient (Intake Heater Grid)

EFE-PVS

EFE Ported Vacuum Switch

EFE-SOL

EFE Solenoid

EFE-TVS

EFE Thermal Vacuum Switch

EFE-TVV

EFE Thermal Vacuum Valve

EFE-VSV

EFE Vacuum Switching Valve

EFI

Electronic Fuel Injection

EFI-MA

EFI Mass Airflow Sensor

EFI-MAF

EFI Mass Airflow Sensor

EGR

Exhaust Gas Recirculation System

EGR-BCS

EGR Boost Check Solenoid

EGR-BPBV

EGR By-Pass Backpressure Valve

EGR-BPT

EGR Backpressure Transducer

EGR-BPV

EGR By-Pass Valve

EGR-BS

EGR Bleed Solenoid

EGR-BSSV

EGR Boost Sensor Solenoid Valve

EGR-BV

EGR Bypass Valve

EGR-BVSV

EGR Bimetallic Vacuum Switching Valve

EGR-C

EGR Controller

EGR-CC

EGR Coolant Controlled

EGR-CLR

EGR Cooler

EGR-VSOL

EGR Vacuum Solenoid

EGR-CKV

EGR Check Valve

EGR-CS

EGR Control Solenoid

EGR-CSOL

EGR Cut-Off Solenoid

EGR-CSV

EGR Control Solenoid

EGR-CTO

EGR Coolant Temperature Override

EGR-CTS

EGR Charge Temperature Sensor

EGR-CTSW

EGR Charge Temperature Switch

EGR-CTTS

EGR Coolant Temperature Thermostat

EGR-CV

EGR Control Valve

EGR-CVCV

EGR Constant Vacuum Control Valve

EGR-CVS

EGR Control Vent Solenoid

EGR-DC

EGR Digital Control

EGR-DCTO

EGR Dual Coolant Temperature Override

EGR-DPFE

Differential Pressure Feedback EGR Sensor

EGR-DPFS

EGR Differential Pressure Feedback Sensor

EGR-DS

EGR Diagnostic Solenoid

EGR-DSOL

EGR Duty Solenoid

EGR-DTVS

EGR Delay Thermal Vacuum Switch

EGR-DTVSW

EGR Distributor Thermal Vacuum Switch

EGR-DV

EGR Delay Valve

EGR-EPRS

EGR Exhaust Pressure Regulator Solenoid

EGR-EPRV

EGR Exhaust Pressure Regulator Valve

EGR-EPV

EGR External Pressure Valve

EGR/EVAP-CSV

EGR/EVAP Control Solenoid Valve

EGR-EVR

EGR Vacuum Regulator

EGR-EVRV

EGR Electronic Vacuum Regulator Valve

EGR-FDV

EGR Forward Delay Valve

EGR-FJS

EGR Floor Jet System

EGR-FPS

EGR Feedback Pressure Sensor

EGR-LCV

EGR Load Control Valve

EGR-MAP

EGR Manifold Absolute Pressure Sensor

EGR-PFE

EGR-PFE Sensor

EGR-PS

EGR Position Sensor

EGR-PSW

EGR Pulse Switch

EGR-PVS

EGR Ported Vacuum Switch

EGR-REG

EGR Regulator

EGR-RES

EGR Reservoir

EGR-RST

EGR Restrictor

EGR-SC

EGR Signal Converter

EGR-SEC

EGR, Secondary

EGR-SEN

EGR Sensor

EGR-SM

EGR Stepper Motor

EGR-SOL

EGR Solenoid

EGR-SU

EGR Switchover Valve

EGR-SUB

Sub-EGR Valve

EGR-SV

EGR Switchover Valve

EGR-SVV

EGR Solenoid Vacuum Valve

EGR-T

EGR Temperature Sensor

EGR-TC

EGR Transmission Controlled

EGR-TCTVS

EGR Torque Converter Thermal Vacuum Switch

EGR-TCV

EGR Thermal Control Valve

EGR-TCVLV

EGR Temperature Control Valve

EGR-TRANS

EGR Transducer

EGR-TS

EGR Temperature Sensor

EGR-TSW

EGR Temperature Switch

EGR-TV

EGR Thermal Valve

EGR-TVD

EGR Throttle Valve Diaphragm

EGR-TVS

EGR Thermal Vacuum Switch

EGR-TVSOL

EGR Throttle Valve Solenoid

EGR-TVV

EGR Thermal Vacuum Valve

EGR-V

EGR Valve

EGR-VA

EGR Vacuum Amplifier

EGR-VCV

EGR Vacuum Control Valve

EGR-VM

EGR Vacuum Modulator

EGR-VR

EGR Vacuum Regulator

EGR-VRS

EGR Vacuum Regulator Solenoid

EGR-VRSV

EGR Vacuum Regulator Solenoid Valve

EGR-VRV

EGR Vacuum Regulator Valve

EGR-VS

EGR Vacuum Switch

EGR-VSDV

EGR Vacuum Switch Dump Valve

EGR-VSEN

EGR Vacuum Sensor

EGR-VSOL

EGR Vent Solenoid

EGR-VSS

EGR Vacuum Switching Solenoid

EGR-VST

EGR Vacuum Surge Tank

EGR-VSV

EGR Vacuum Switching Valve

EGR-VVCS

EGR Venturi Vacuum Control System

EGRB

EGR Boost Sensor

EGRC

EGR Control Solenoid

EGRC-BPT

EGR Control Backpressure Transducer

EGRC-SV

EGR Control Solenoid Valve

EHOC

Electronically Heated Oxidation Catalyst

EHTWC

Electronically Heated Three-Way Catalyst

EI

Electronic Ignition System

EIS

Electronic Ignition System

ELB

Electronic Lean Burn

EPR

Exhaust Pressure Regulator

EPR-SOL

EPR Solenoid

ESA

Electronic Spark Advance

ESIM

Evaporative System Integrity Monitor

EVAP

Fuel Evaporative System

EVAP-AAC

EVAP Auxiliary Air Control

EVAP-BPSV

EVAP By-Pass Solenoid Valve

EVAP-BVSV

EVAP Bimetallic Vacuum Switching Valve

EVAP-CAV

EVAP Canister Air Valve

EVAP-CCV

EVAP Control Canister Close Valve

EVAP-CCVSV

EVAP Control Canister Vent Shut Valve

EVAP-CCVVSV

EVAP Closed Canister Valve Vacuum Switching Valve

EVAP-CDCV

EVAP Canister Drain Cut Valve

EVAP-CKV

EVAP Check Valve

EVAP-CPCS

EVAP Canister Purge Control Solenoid

EVAP-CPCSV

EVAP Canister Purge Control Solenoid Valve

EVAP-CPCV

EVAP Canister Purge Control Valve

EVAP-CPRV

EVAP Canister Purge Regulator Valve

EVAP-CPSV

EVAP Canister Vent Shut Valve

EVAP-CPT

EVAP Canister Purge Timer

EVAP-CPTVS

EVAP Canister Purge Thermal Vacuum Switch

EVAP-CPV

EVAP Canister Vent Valve

EVAP-CPVCSV

EVAP Canister Purge Volume Control

EVAP-CPVCV

EVAP Canister Purge Volume Control Valve

EVAP-CPVDV

EVAP Canister Purge Vacuum Delay Valve

EVAP-CPVR

EVAP Canister Purge Valve Resonator

EVAP-CS

EVAP Control Solenoid

EVAP-CSPS

EVAP Control System Pressure Sensor

EVAP-CSPV

EVAP Canister Purge Valve

EVAP-CST

EVAP Canister Surge Tank

EVAP-CSV

EVAP Control Solenoid Valve

EVAP-CT

EVAP Catch Tank

EVAP-CV

EVAP Control Solenoid Valve

EVAP-CVCS

EVAP Canister Vent Control Solenoid

EVAP-CVCSV

EVAP Canister Vent Control Solenoid Valve

EVAP-CVCV

EVAP Canister Vent Control Valve

EVAP-CVS

EVAP Canister Vent Solenoid

EVAP-CVSV

EVAP Carburetor Vent Switching Valve

EVAP-CVV

EVAP Canister Vent Valve

EVAP-DCTO

EVAP Dual Coolant Temperature Override

EVAP-DF

EVAP Drain Filter

EVAP-DPS

EVAP Differential Pressure Sensor

EVAP-DV

EVAP-Drain Valve

EVAP-ESIM

Evaporative System Integrity Monitor

EVAP-EV

EVAP Emission Valve

EVAP-FBVV

EVAP Fuel Bowl Vent Valve

EVAP-FBVS

EVAP Fuel Bowl Vent Solenoid

EVAP-FCV

EVAP Fuel Cut Valve

EVAP-FLS

EVAP Fuel Level Sensor

EVAP-FOLV

EVAP Fuel Overflow Limiter Valve

EVAP-FR/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-FS

EVAP Flow Switch

EVAP-FSV

EVAP Flow Switchover Valve

EVAP-FTCV

EVAP Tank Pressure Control Valve

EVAP-FTEV

EVAP Fuel Tank EVAP Valve

EVAP-FTPCSV

EVAP Fuel Tank Pressure Control Solenoid Valve

EVAP-FTPS

EVAP Fuel Tank Pressure Sensor

EVAP-FTS

EVAP Fuel Temperature Sensor

EVAP-FVCV

EVAP Fuel Vapor Control Valve

EVAP-FVS

EVAP Fuel Vapor Separator

EVAP-FVTS

EVAP Fuel Vapor Temperature Sensor

EVAP-FVV

EVAP Fuel Vent Valve

EVAP-FVVV

EVAP Fuel Vapor Vent Valve

EVAP-FWV

EVAP Fuel Vent Valve

EVAP-IVS

EVAP Inner Vent Solenoid

EVAP-LDAF

EVAP Leak Detection Pump Air Filter

EVAP-LDP

EVAP Leak Detection Pump

EVAP-LDPAF

EVAP Leak Detection Pump Air Filter

EVAP-LDPF

EVAP Leak Detection Pump Filter

EVAP-LDPVV

EVAP Leak Detection Pump Vent Valve

EVAP-LSEP

EVAP Liquid Separator

EVAP-NVLD

EVAP Natural Vacuum Leak Detection

EVAP-ORVR

Evaporative On-Board Refueling Vapor Recovery System

EVAP-ORVRCV

Evaporative On-Board Refueling Vapor Recovery Check Valve

EVAP-ORVRFTVRV

EVAP-ORVR Fuel Tank Vapor Recirculation

EVAP-OVCV

EVAP Outer Vent Control Valve

EVAP-OWV

EVAP One-Way Valve

EVAP-PCDV

EVAP Purge Control Diaphragm Valve

EVAP-PCS

EVAP Purge Control Solenoid Valve

EVAP-PCSV

EVAP Purge Cut-Off Solenoid Valve

EVAP-PFS

EVAP Purge Flow Sensor

EVAP-PFSVVS

EVAP Purge Flow Switching Valve Vacuum Switching Valve

EVAP-PPS

EVAP Proportional Purge Solenoid

EVAP-PR

EVAP Purge Resonator

EVAP-PRRV

EVAP Pressure Relief Rollover Valve

EVAP-PRV

EVAP Pressure Relief Valve

EVAP-PS

EVAP Purge Solenoid

EVAP-PSOL

EVAP Purge Solenoid

EVAP-PSSV

EVAP Pressure Switching Solenoid

EVAP-PSVVS

EVAP Pressure Switching Valve Vacuum Switching Valve

EVAP-PV

EVAP Purge (Frequency) Valve

EVAP-PVS

EVAP Ported Vacuum Switch

EVAP-RV

EVAP Rollover Valve

EVAP-RV/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-RVSV

EVAP Rollover Vapor Separator Valve

EVAP-SNR

EVAP Canister Sensor

EVAP-SOL

EVAP Solenoid

EVAP-SOV

EVAP Shutoff Valve

EVAP-SSV

EVAP Shut-Off Solenoid Valve

EVAP-SV

EVAP Solenoid Valve

EVAP-TC

EVAP Trap Canister

EVAP-TS

EVAP Temperature Switch

EVAP-TPBPV

EVAP Tank Pressure By-Pass Valve

EVAP-TPCS

EVAP Tank Pressure Control Solenoid

EVAP-TPCV

EVAP Tank Pressure Control Valve

EVAP-TRWV

EVAP Tree-Way Valve

EVAP-TV

EVAP Thermal Valve

EVAP-TVS

EVAP Thermal Vacuum Switch

EVAP-TVV

EVAP Thermal Vacuum Valve

EVAP-TWV

EVAP Two-Way Valve

EVAP-VC

EVAP Vapor Canister

EVAP-VCAT

EVAP Vapor Canister Air Tank

EVAP-VCF

EVAP Vapor Canister Filter

EVAP-VCSV

EVAP Vapor Canister Shut-off Valve

EVAP-VCTV

EVAP Vacuum Control Valve

EVAP-VCV

EVAP Vacuum Canister Valve

EVAP-VCVS

EVAP Vapor Canister Vent Solenoid

EVAP-VLFR

EVAP Vent Line Flow Restrictor

EVAP-VM

EVAP Vacuum Motor

EVAP-VMV

EVAP Vapor Management Valve

EVAP-VPS

EVAP Vapor Pressure Sensor

EVAP-VPSVSV

EVAP Vapor Pressure Sensor Vacuum Switching Valve

EVAP-VS

EVAP Vacuum Sensor

EVAP-VSOL

EVAP Ventilation Solenoid

EVAP-VSOL/LDP

EVAP Ventilation Solenoid/Leak Detection Pump

EVAP-VST

EVAP Vacuum Surge Tank

EVAP-VSV

EVAP Vacuum Switching Valve

EVAP-VV

EVAP Ventilation Valve

EVRS

EGR Vacuum Regulator Solenoid

"F"

FBC

Feedback Carburetor

FCOV

Fuel Change Over Valve

FF

Flex Fuel

FF-CKV

Fuel Fill Check Valve

FF-FCV

Fuel Tank Fuel Cut-Off Valve

FF-FLVV

Fuel Tank Fill Limit Vent Valve

FFC-PVRV

Fuel Fill Cap Pressure Vacuum Relief Valve

FGOV

Fuel Gravity/Overflow Valve

FGVV

Fuel Gravity Vent Valve

FI

Fuel Injected

FICD

Fast Idle Control Device

FISR

Fast Idle Solenoid Relay

FLV

Fill Limit Valve

FLVV

Fill Limiting Vent Valve

FP-CKV

Fill Pipe Check Valve

FP-RV

Fill Pipe Rollover Valve

FR

Fill Pipe Restrictor

FT-FLVV

Fuel Tank Fill Limit Vent Valve

FT-GVV

Fuel Tank Grade Vent Valve

FT-OPRV

Fuel Tank Over Pressure Vent Valve

FT-PCV

Fuel Tank Pressure Control Valve

FT-VCV

Fuel Tank Vapor Control Valve

FT-VRV

Fuel Tank Vapor Recirculation Valve

FTCV

Fuel Tank Check Valve

FTDPS

Fuel Tank Differential Pressure Sensor

FTEV

Fuel Tank EVAP Valve

FTPS

Fuel Tank Pressure Sensor

FTT

Fuel Tank Temperature Sensor

FTTS

Fuel Tank Temperature Sensor

FTV/LSV

Fuel Tank Vapor/Liquid Separation Valve

FTVCV

Fuel Tank Vapor Control Valve

FTVPRV

Fuel Tank Ventilation Pressure Retention Valve

FVPS

Fuel Vapor Pressure Sensor

FTVV

Fuel Tank Vent Valve

FVV

Fuel Vapor Valve

"G"

GVWR

Gross Vehicle Weight Rating

"H"

HAC

High Altitude Compensator

HAFS

Heated Air Fuel Ratio Sensor

HAI

Hot Air Intake

HAS

High Altitude System

HC

Hydrocarbons

HCAC-VSV

Hydrocarbon Absorber Catalyst Vacuum Switching Valve

HDC

Heavy Duty Cooling

HDC-CTO

HDC Coolant Temperature Override

HFM-SFI

Hot Film Engine Management SFI

HIC

Hot Idle Compensator

HIM

Heated Intake Manifold

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HP

Horsepower

HPCA

Housing Pressure Cold Advance

HSC

High Swirl Combustion

"I"

IAC

Idle Air Control Valve

IACV-SW

IACV Switch

ICOM

Idle Compensator

IDI

Indirect Diesel Injection

IES

Idle Enrichment System

IMCO

Improved Combustion System

"K"

KS

Knock Sensor

"L"

LH-SFI

Hot Wire Sequential Multiport Fuel Injection

LVFD

Liquid/Vapor Fuel Discriminator

LVW

Loaded Vehicle Weight

"M"

MD-TICS

Timing & Injection rate Control System

MDP

Manifold Differential Pressure sensor

ME-SFI

Motor Electronics Sequential Fuel Injection

MFI

Multiport Fuel Injection

MFI-MAF

MFI Mass Airflow Sensor

MFLS

Main Fuel Level Sensor

MI

Mechanical Fuel Injection

MIL

Malfunction Indicator Light

M/T

Manual Transmission

"N"

NAC

Nitrogen Oxides (NOx) Adsorbing Catalyst

NLV

Non-Linear Valve

NOS

NOx Sensor

NOx

NOx Emission Control

NOxATWC

NOx Adsorptive TWC

NOxC

Nitrogen Oxide Catalyst

NOxS

Nitrogen Oxide Sensor

NO_xTWC

NO_x Adsorptive TWC

NSC

Nitrogen Oxides (NO_x) Storage Catalyst

"O"

OBD

On-Board Diagnostic System

PBD (F)/(P)

Full/Partial On-Board Diagnostic

OC

Oxidation Catalytic Converter

OHC

Overhead Cam

ORVR

On-Board Refueling Vapor Recovery

ORVR-COV

ORVR Cut-Off Valve

ORVR-CV

ORVR Control Valve

ORVR-FAV

ORVR Fresh Air Valve

ORVR-FMV

ORVR Flow Management Valve

ORVR-FTVCV

ORVR Fuel Tank Vapor Control Valve

ORVR-FTVRV

ORVR Fuel Tank Vapor Recirculation Valve

ORVR-FVRS

ORVR Fuel Vapor Recovery System

ORVR-FVV

ORVR Fuel Vent Valve

ORVR-LV

ORVR Leveling Valve

ORVR-OCKV

ORVR Overfill Check Valve

ORVR-RCV

ORVR Refueling Control Valve

ORVR-VCV

ORVR Vapor Cut Valve

ORVR-VRV

ORVR Vapor Recirculating Valve

ORVR-VSV

ORVR Vent Shut Valve

ORVR-VV

ORVR Vent Valve

OVCV

Outer Vent Control Valve

O2S

Oxygen Sensor

"P"

PAIR

Pulsed Secondary Air Injection

PAIR-ABV

PAIR Anti-Backfire Valve

PAIR-ACOV

PAIR Air Cut-Off Valve

PAIR-ACS

PAIR Air Control Solenoid

PAIR-ACV

PAIR Air Control Valve

PAIR-AIV

PAIR Air Injection Valve

PAIR-ASCS

PAIR Air Suction Control Solenoid

PAIR-ASOV

PAIR Air Shutoff Valve

PAIR-ASS

PAIR Air Switching Solenoid

PAIR-ASV

PAIR Air Switching Valve

PAIR-ASVL

PAIR Air Suction Valve

PAIR-AVCS

PAIR Air Valve Control Solenoid

PAIR-CSV

PAIR Control Solenoid Valve

PAIR-CKV

PAIR Check Valve

PAIR-DV

PAIR Diverter Valve

PAIR-PAF

PAIR Pulse Air Feeder

PAIR-PAV

PAIR Pulse Air Valve

PAIR-RES

PAIR Resonator

PAIR-RV

PAIR Reed Valve

PAIR-SCSV

PAIR Swirl Control Solenoid Valve

PAIR-SCV

PAIR Swirl Control Valve

PAIR-SOL

PAIR Solenoid

PAIR-VSV

PAIR Vacuum Switching Valve

PCM

Powertrain Control Module

PCV

Positive Crankcase Ventilation

PCV-DOV

PCV Dual Orifice Valve

PCV-HCB

PCV Heated Crankcase Breather

PCV-HE

PCV Heating Element

PCV-PRV

PCV Pressure Regulator Valve

PCV-SOL

PCV Solenoid

PEVR

Power Enrichment Vacuum Regulator

PPM

Parts Per Million

PTOX

Periodic Trap Oxidizer

PURCV

Purge Crankcase Ventilation

PVCS

Ported Valve Control System

PVCS-A

PVCS Actuator

PVCS-CS

PVCS Control Solenoid

PVLCS

Power Valve Control System

"R"

RC

NOx Reduction Catalyst

ROV

Rollover Valve

"S"

SAI-SV

Secondary Air Injection Shutoff Valve

SAIR-CV

Secondary Air Injection Control Valve

SC

Supercharged or Super Charger

SC MFI

Supercharged Multiport Fuel Injection

SCR

Selective Catalytic Reduction

SCSV

Swirl Control Solenoid Valve

SCV

Swirl Control Valve

SCV-A

SCV Actuator

SFI

Sequential Multiport Fuel Injection

SFI-MAF

SFI Mass Airflow Sensor

SFLS

Sub-Fuel Level Sensor

SOHC

Single Overhead Cam

SPK

Spark Controls

SPK-AVM

SPK Advance Vacuum Modulator

SPK-BVSV

SPK Bimetal Vacuum Switching Valve

SPK-CC

SPK Computer Controlled

SPK-CKV

SPK Check Valve

SPK-CSSA

SPK Cold Start Spark Advance System

SPK-CSSH

SPK Cold Start Spark Hold System

SPK-CTO

SPK Coolant Temperature Override

SPK-DAVS

SPK Distributor Vacuum Advance Solenoid

SPK-DCKV

SPK Distributor Check Valve

SPK-DCTO

SPK Dual Coolant Temperature Override

SPK-DDD

SPK Dual Diaphragm Distributor

SPK-DMV

SPK Distributor Modulator Valve

SPK-DPD

SPK Dual Point Distributor

SPK-DPVS

SPK Distributor Ported Vacuum Switch

SPK-DRCV

SPK Distributor Retard Control Valve

SPK-DRS

SPK Distributor Retard Solenoid

SPK-DSVMV

SPK Distributor Spark Vacuum Modulator Valve

SPK-DTVS

SPK Distributor Thermal Vacuum Switch

SPK-DTVV

SPK Distributor Thermal Vacuum Valve

SPK-DV

SPK Delay Valve

SPK-DVA

SPK Distributor Vacuum Advance

SPK-DVAS

SPK Distributor Vacuum Advance Solenoid

SPK-DVCS

SPK Distributor Vacuum Control Solenoid

SPK-DVCSW

SPK Distributor Vacuum Controlled Switch

SPK-DVCV

SPK Distributor Vacuum Control Valve

SPK-DVDV

SPK Distributor Vacuum Delay Valve

SPK-DVRS

SPK Distributor Vacuum Retard Switch

SPK-DVRV

SPK Distributor Vacuum Regulating Valve

SPK-DVVV

SPK Distributor Vacuum Vent Valve

SPK-EAVS

SPK Electronically Actuated Vacuum Switch

SPK-EDM

SPK Electronic Distributor Modulator

SPK-EI

SPK Electronic Ignition

SPK-ESA

SPK Electronic Spark Advance

SPK-ESC

SPK Electronic Spark Control (Retard)

SPK-ESS

SPK Electronic Spark Selection

SPK-EST

SPK Electronic Spark Timing

SPK-FDV

SPK Forward Delay Valve

SPK-HPCA

SPK Housing Pressure Cold Advance

SPK-ITCS

SPK Ignition Timing Control System

SPK-ITVS

SPK Ignition Timing Vacuum Switch

SPK-NLVR

SPK Non-Linear Vacuum Regulator

SPK-OSAC

SPK Orifice Spark Advance Control

SPK-PVA

SPK Ported Vacuum Advance

SPK-PVS

SPK Ported Vacuum Switch

SPK-RDO

SPK Retard Delay Orifice

SPK-RDV

SPK Reverse Delay Valve

SPK-RDVD

SPK Reverse Delay Valve (Dual)

SPK-RDVLV

SPK Retard Delay Valve

SPK-RDVS

SPK Reverse Delay Valve (Single)

SPK-RETS

SPK Retard Switch

SPK-SC

SPK Speed Controlled

SPK-SDV

SPK Spark Delay Valve

SPK-SOL

SPK Solenoid

SPK-SRRV

SPK Spark Relay Regulator Valve

SPK-TAVIA

SPK Temperature Activated Vacuum Ignition Advance

SPK-TCS

SPK Transmission Controlled Spark

SPK-TCSYS

SPK Timing Control System

SPK-TIDC

SPK Thermostatic Ignition Distributor Control

SPK-TV

SPK Thermal Valve

SPK-TVS

SPK Thermal Vacuum Switch

SPK-VACTO

SPK Vacuum Advance Coolant Temperature Override

SPK-VAS

SPK Vacuum Advance Solenoid

SPK-VAV

SPK Vacuum Advance Valve

SPK-VR

SPK Vacuum Retard

SPK-VRSW

SPK Vacuum Retard Switch

SPK-VSV

SPK Vacuum Switching Valve

SPK-VTCS

SPK Vacuum Timing Control System

SPL

Smoke Puff Limiter

SRI

Service Reminder Indicator

SSCA

Stepped Speed Control Actuator

SSCS

Stepped Speed Control Solenoid

STS

Service Throttle Soon Light

STVS

Secondary Throttle Valve System

SUB-HO2S

Sub-Heated Oxygen Sensor (after CAT)

SUB-O2S

Sub-Oxygen Sensor

SUB-TWC

Sub Three-Way Catalytic Converter

"T"

TAA

Turbo Air-To-Air

TAA

Throttle Actuator Assembly

TAB

Thermactor Air By-Pass

TAD

Thermactor Air Diverter

TAC

Thermostatic Air Cleaner

TBI

Throttle Body Injection

TBPCS

Throttle By-Pass Control System

TC

Turbo Charger

TCC

Torque Converter Clutch

TCCL

Torque Converter Control

TCD

Throttle Closing Dashpot

TC-DV

TC Delay Valve

TC-TVC

TC Thermal Vacuum Switch

TC-VS

TC Vacuum Switch

TD

Thermactor Diverter

TFT

Tank Fuel Temperature Sensor

THOS2

Third Heated Oxygen Sensor

TICV

Thermal Ignition Control Valve

TIV

Thermal Idle Valve

TK

Throttle Kicker

TLUC

Transmission Lock-Up Converter

TLUC-TVS

TLUC Thermal Vacuum Switch

TLUC-VS

TLUC Vacuum Switch

TM

Throttle Modulator

TOS

Throttle Opener System

TP

Throttle Positioner

TPI

Tuned Port Fuel Injection

TPV

Throttle Poppet Valve

TR

Thermal Reactor

TRC

Throttle Return Control

TRCS

Throttle Return Control Solenoid

TRCTL

Throttle Return Control Throttle Lever Actuator

TRSCV

Throttle Return Solenoid Control Valve

TRTVV

Temperature Regulator Thermal Vacuum Valve

TRVV

Transmission Vacuum Valve

TSOL

Throttle Solenoid

TVISD

Throttle Vacuum Idle Speed Diaphragm

TVM

Transmission Vacuum Modulator

TVS

Thermal Vacuum Switch

TWC

Three-Way Catalytic Converter

TWC+OC

Three-Way + Oxidation Catalytic Converter

"V"

VA

Vacuum Advance Unit

VAC-AMP

Vacuum Amplifier

VA-CTO

VA Coolant Temperature Override

VC

Vapor Canister

VCV

Vacuum Cut Valve

VCV-BV

VCV By-Pass Valve

VLFR

Vent Line Flow Restrictor/Anti-Trickle Fill Valve

"W"

WU

Warm-Up Catalyst

WU-OC

Warm-Up Oxidation Converter

WU-TWC

Warm-Up Three-Way Catalytic Converter

Article GUID: A00158541

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Description and Operation - Volt

DESCRIPTION AND OPERATION

ENGINE CONTROL MODULE DESCRIPTION

The Engine Control Module (ECM) interacts with many emission related components and systems, and monitors emission related components and systems for deterioration. OBD II diagnostics monitor the system performance and a diagnostic trouble code (DTC) sets if the system performance degrades. The ECM is part of a network and communicates with various other vehicle control modules.

Malfunction indicator lamp (MIL) operation and DTC storage are dictated by the DTC type. A DTC is ranked as a Type A or Type B if the DTC is emissions related. Type C is a non-emissions related DTC.

The ECM is the control center of the engine controls system. Review the components and wiring diagrams in order to determine which systems are controlled by the ECM.

The ECM constantly monitors the information from various sensors and other inputs, and controls the systems that affect engine performance and emissions. The ECM also performs diagnostic tests on various parts of the system and can turn on the MIL when it recognizes an operational problem that affects emissions. When the ECM detects a malfunction, the ECM stores a DTC. The condition area is identified by the particular DTC that is set. This aids the technician in making repairs.

ECM Function

The ECM can supply 5 V or 12 V to various sensors or switches. This is done through pull-up resistors to regulated power supplies within the ECM. In some cases, even an ordinary shop voltmeter will not give an accurate reading due to low input resistance. Therefore, a digital multimeter (DMM) with at least 10 megaohms input impedance is required in order to ensure accurate voltage readings.

The ECM controls the output circuits by controlling the ground or the power feed circuit through transistors or a device called an output driver module.

EEPROM

The electronically erasable programmable read only memory (EEPROM) is an integral part of the ECM. The EEPROM contains program and calibration information that the ECM needs in order to control engine operation.

Special equipment, as well as the correct program and calibration for the vehicle, are required in order to reprogram the ECM.

Data Link Connector (DLC)

The data link connector (DLC) provides serial data communication for ECM diagnosis. This connector allows the technician to use a scan tool in order to monitor various serial data parameters, and display DTC information. The DLC is located inside the driver's compartment, underneath the instrument panel.

Malfunction Indicator Lamp (MIL)

The malfunction indicator lamp (MIL) is inside the instrument panel cluster (IPC). The MIL is controlled by the ECM and illuminates when the ECM detects a condition that affects vehicle emissions.

ECM Service Precautions

The ECM, by design, can withstand normal current draws that are associated with vehicle operations. However, care must be used in order to avoid overloading any of these circuits. When testing for opens or shorts, do not ground or apply voltage to any of the ECM circuits unless the diagnostic procedure instructs you to do so. These circuits should only be tested with a DMM unless the diagnostic procedure instructs otherwise.

Emissions Diagnosis For State I/M Programs

This OBD II equipped vehicle is designed to diagnose any conditions that could lead to excessive levels of the following emissions:

- Hydrocarbons (HC)
- Carbon monoxide (CO)
- Oxides of nitrogen (NOx)
- Evaporative emission (EVAP) system losses

Should this vehicle's on-board diagnostic system (ECM) detect a condition that could result in excessive emissions, the ECM turns ON the MIL and stores a DTC that is associated with the condition.

Aftermarket (Add-On) Electrical And Vacuum Equipment

CAUTION: Do not attach add-on vacuum operated equipment to this vehicle. The use of add-on vacuum equipment may result in damage to vehicle components or systems.

CAUTION: Connect any add-on electrically operated equipment to the vehicle's electrical system at the 12 V battery (power and ground) in order to prevent damage to the vehicle.

Aftermarket, add-on, electrical and vacuum equipment is defined as any equipment installed on a vehicle after leaving the factory that connects to the vehicle's electrical or vacuum systems. No allowances have been made in the vehicle design for this type of equipment.

Add-on electrical equipment, even when installed to these strict guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system, such as portable telephones and radios. Therefore, the first step in diagnosing any powertrain condition is to eliminate all of the aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, the problem may be diagnosed in the normal manner.

Electrostatic Discharge (ESD) Damage

NOTE: In order to prevent possible electrostatic discharge damage to the ECM, DO NOT touch the connector pins on the ECM.

The electronic components that are used in the control systems are often designed to carry very low voltage. These electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 V of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4,000 V for a person to even feel a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore, it is important to use care when handling and testing electronic components.

Emissions Control Information Label

The underhood Vehicle Emissions Control Information Label contains important emission specifications. This identifies the year, the displacement of the engine in liters, and the class of the vehicle.

This label is located in the engine compartment of every General Motors vehicle. If the label has been removed, it can be ordered from GM service parts operations (GMSPO).

FUEL SYSTEM DESCRIPTION

Fuel System Overview

The fuel system is an electronic returnless on-demand design. The returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

An electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank. The fuel pump supplies fuel through the fuel filter and the fuel feed pipe to the high pressure fuel pump. The high pressure fuel pump supplies fuel to a variable-pressure fuel rail. Fuel enters the combustion chamber through precision multi-hole fuel injectors. The high pressure fuel pump, fuel rail pressure, fuel injection timing, and injection duration are controlled by the engine control module (ECM).

Electronic Returnless Fuel System

The electronic returnless fuel system is a microprocessor controlled fuel delivery system which transports fuel from the tank to the fuel rail. It functions as an electronic replacement for a traditional, mechanical fuel pressure regulator. The pressure relief regulator valve within the fuel tank provides an added measure of over-pressure protection. Desired fuel pressure is commanded by the engine control module (ECM), and transmitted to the fuel pump driver control module via a GMLAN serial data message. A fuel pressure sensor located on the fuel feed pipe provides the feedback the ECM requires for Closed Loop fuel pressure control.

Fuel Pump Driver Control Module

The fuel pump driver control module is a serviceable GMLAN module. The fuel pump driver control module receives the desired fuel pressure message from the engine control module (ECM) and controls the fuel pump located within the fuel tank to achieve the desired fuel pressure. The fuel pump driver control module sends a 25 kHz PWM signal to the fuel pump, and pump speed is changed by varying the duty cycle of this signal. Maximum current supplied to the fuel pump is 15 amps. A fuel pressure sensor located on the fuel feed pipe

provides fuel pressure feedback to the ECM.

Fuel Pressure Sensor

The fuel pressure sensor is a serviceable 5 V, 3-pin device. It is located on the fuel feed pipe forward of the fuel tank, and receives power and ground from the ECM through a vehicle wiring harness. The sensor provides a fuel pressure signal to the ECM, which is used to provide Closed Loop fuel pressure control.

Fuel Tank

The fuel tank stores the fuel supply. The fuel tank is located in the rear of the vehicle. The fuel tank is held in place by 2 metal straps that attach to the underbody of the vehicle. The fuel tank is molded from high-density polyethylene.

Fuel Fill Pipe

The fuel fill pipe has a built-in restrictor in order to prevent refueling with leaded fuel.

Fuel Tank Fuel Pump Module

The electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank and supplies fuel through the fuel feed pipe to the high pressure fuel pump. The fuel tank fuel pump module contains a reverse flow check valve. The check valve maintains fuel pressure in the fuel feed pipe in order to prevent long cranking times.

The fuel tank fuel pump module consists of the following major components:

- The fuel level sensor
- The fuel pump and reservoir assembly
- The fuel filter
- The fuel strainer
- The pressure relief regulator valve
- The jet pump

Fuel Level Sensor

The fuel level sensor consists of a float, a wire float arm, and a ceramic resistor card. The position of the float arm indicates the fuel level. The fuel level sensor contains a variable resistor which changes resistance in correspondence with the position of the float arm.

Fuel Pump

The fuel pump is mounted in the fuel tank fuel pump module reservoir. The fuel pump is an electric turbine style pump which pumps fuel to the high pressure fuel pump at a pressure that is based on feedback from the fuel feed pipe fuel pressure sensor. The fuel pump delivers a constant flow of fuel even during low fuel conditions and aggressive vehicle maneuvers. The fuel pump flex pipe acts to dampen the fuel pulses and noise generated by the fuel pump.

Fuel Filter

The fuel filter is located in the fuel tank fuel pump module. The paper filter element traps particles in the fuel

that may damage the fuel injection system. The filter housing is made to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature.

Fuel Strainer

The fuel strainer attaches to the lower end of the fuel tank fuel pump module. The fuel strainer is made of woven plastic. The functions of the fuel strainer are to filter contaminants and to wick fuel. The fuel strainer normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or contamination.

Jet Pump

The jet pump is located in the fuel tank fuel pump module. Fuel pump flow loss, caused by vapor expulsion in the pump inlet chamber, is diverted to the jet pump through a restrictive orifice located on the pump cover. The jet pump fills the reservoir of the fuel tank fuel pump module.

Pressure Relief Regulator Valve

The pressure relief regulator valve replaces the typical fuel pressure regulator used on a mechanical returnless fuel system. The pressure relief regulator valve is closed during normal vehicle operation. The pressure relief regulator valve is used to vent pressure during hot soaks and also functions as a fuel pressure regulator in the event of the fuel pump driver control module defaulting to 100 percent pulse width modulation (PWM) of the fuel pump. Due to variation in the fuel system pressures, the opening pressure for the pressure relief regulator valve is set higher than the pressure that is used on a mechanical returnless fuel system pressure regulator.

Nylon Fuel Pipes

WARNING: In order to reduce the risk of fire and personal injury observe the following items:

- Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes
- Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.
- Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.
- Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature.

Heat resistant rubber hose or corrugated plastic conduit protect the sections of the pipes that are exposed to chafing, high temperature, or vibration.

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if nylon fuel pipes are forced into sharp bends, the pipes may kink and restrict the fuel flow. Also, once exposed to fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Take special care when working on a vehicle with nylon fuel pipes.

Quick-Connect Fittings

Quick-connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consist of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs inside the female connector hold the fittings together.

Fuel Feed Front Pipe Check Valve

The one way in-line check valve is a part of the fuel feed front pipe. The check valve is located just before the high pressure fuel pump. Fuel flows into the large end of the check valve and unseats a round check ball. Fuel then flows around the check ball and out the small end and the holes around the small end. The check ball is seated closed by a spring when the fuel pressure is very low. The spring seats the check ball and keeps the fuel from draining back when the engine is not operating in order to help prevent long cranking times. The check valve also acts as a pulse damper to help limit the high pressure fuel pump pressure pulsations from affecting the low side fuel pressure sensor located by the fuel tank.

High Pressure Fuel Pump

The high fuel pressure necessary for direct injection is supplied by the high pressure fuel pump. The pump is mounted on the rear of the engine and is driven by a four-lobe cam on the camshaft. This pump also regulates the fuel pressure using an actuator in the form of an internal solenoid-controlled valve. In order to keep the engine running efficiently under all operating conditions, the engine control module (ECM) requests pressure ranging from 2 to 15 MPa (290 to 2176 psi), depending on engine speed and load. Output drivers in the ECM provide the pump control circuit with a 12 V pulse-width modulated (PWM) signal, which regulates fuel pressure by closing and opening the control valve at specific times during pump strokes. This effectively regulates the portion of each pump stroke that is delivered to the fuel rail. When the control solenoid is NOT powered, the pump operates at maximum flow rate. In the event of pump control failure, the high pressure system is protected by a relief valve in the pump.

Fuel Rail Assembly

The fuel rail assembly attaches to the cylinder head and distributes the high pressure fuel to the fuel injectors. The fuel rail assembly consists of the following components:

- The direct fuel injectors
- The fuel rail pressure sensor

Fuel Injectors

The fuel injection system is a high pressure, direct injection, returnless on-demand design. The fuel injectors are mounted in the cylinder head beneath the intake ports and spray fuel directly into the combustion chamber. Direct injection requires high fuel pressure due to the fuel injector's location in the combustion chamber. Fuel pressure must be higher than compression pressure requiring a high pressure fuel pump. The fuel injectors also require more electrical power due to the high fuel pressure. The ECM supplies a high voltage supply circuit and a high voltage control circuit for each fuel injector. The injector high voltage supply circuit and the high voltage

control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit. The ECM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through an injector, allowing for initial injector opening. The injector is then held open with 12 V.

The fuel injector assembly is an inside opening electrical magnetic injector. The injector has six precision machined holes that generate a cone shaped oval spray pattern. The fuel injector has a slim extended tip in order to allow a sufficient cooling jacket in the cylinder head.

Fuel Injection Fuel Rail Fuel Pressure Sensor

The fuel rail pressure sensor detects fuel pressure within the fuel rail. The engine control module (ECM) provides a 5 V reference voltage on the 5 V reference circuit and ground on the reference ground circuit. The ECM receives a varying signal voltage on the signal circuit. The ECM monitors the voltage on the fuel rail pressure sensor circuits. When the fuel pressure is high, the signal voltage is high. When the fuel pressure is low, the signal voltage is low.

CAMSHAFT ACTUATOR SYSTEM DESCRIPTION

Circuit/System Description

The camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust system enables the engine control module (ECM) to change camshaft timing while the engine is running. The camshaft position actuator assembly varies camshaft position in response to directional changes in oil pressure. The camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust controls the oil pressure that is applied to advance or retard the camshaft. Modifying camshaft timing under changing engine demand provides better balance between the following performance concerns:

- Engine power output
- Fuel economy
- Lower exhaust emissions

The ECM uses information from the following sensors in order to calculate the desired camshaft position:

- The engine coolant temperature (ECT) sensor
- The mass air flow (MAF) sensor
- The throttle position sensor
- The vehicle speed sensor (VSS)

Camshaft Position Actuator System Operation

The ECM operates the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust by pulse width modulation (PWM) of the solenoid coil. The higher the PWM duty cycle, the larger the change in camshaft timing. Oil pressure that is applied to the advance side of the fixed vanes will rotate the camshaft in a clockwise direction. The clockwise movement of the camshaft will advance the timing up to a maximum of 21° . When oil pressure is applied to the return side of the vanes, the camshaft will rotate counterclockwise until returning to 0° .

Oil flowing to the camshaft position actuator solenoid valve - intake and camshaft position actuator solenoid

valve - exhaust housing from the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust advance passage applies pressure to the advance side of the vane wheel in the camshaft position actuator assembly. At the same time the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust retard passage is open, allowing oil pressure to decrease on the retard side of the vane wheel. These two simultaneous actions cause the vane wheel to rotate clockwise, advancing camshaft advance timing.

When the oil flowing to the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust housing is from the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust retard passage, oil pressure is applied to the retard side of the vane wheel. Because the solenoid advance passage is open, allowing oil pressure to decrease on the advance side of the vane wheel, the camshaft position retards.

The ECM can also command the camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust to stop oil flow from both passages in order to hold the current camshaft position. The ECM is continuously comparing camshaft position sensor - intake and camshaft position sensor - exhaust input with camshaft position actuator solenoid valve - Intake and camshaft position actuator solenoid valve - exhaust input in order to monitor camshaft position and detect any system malfunctions. The following table provides camshaft phase commands for common driving conditions:

Driving Conditions	Change in Camshaft Position	Objective	Result
Idle	No change	Minimize valve overlap	Stabilize idle speed
Light engine load	Retard valve timing	Decrease valve overlap	Stable engine output
Medium engine load	Advance valve timing	Increase valve overlap	Better fuel economy with lower emissions
High RPM with heavy load	Retard valve timing	Retard intake valve closing	Improve engine output

Intake Camshaft Mid Park Lock (if Equipped)

The intake camshaft position actuator park lock solenoid valve is supplied a dedicated ground control circuit from the ECM and an ignition voltage supply circuit. The ECM operates the intake camshaft position actuator park lock solenoid valve by applying ground to the solenoid valve control circuit to control the oil flow that applies the pressure to disengage the intake camshaft actuator park pin. This allows the ECM to advance or retard the camshaft. When the ECM determines that cam phasing is not desired, it will command the camshaft to the lock position at 0° . At that stage, the ECM control circuit ground is then removed from the solenoid, oil pressure is unapplied, and the camshaft actuator park pin will re-engage preventing cam phasing. The ECM can also determine if the park pin is engaged by applying a slight amount of camshaft advance or retard to verify if movement is present.

EVAPORATIVE EMISSION CONTROL SYSTEM DESCRIPTION

Typical Evaporative Emission (EVAP) System Hose Routing Diagram

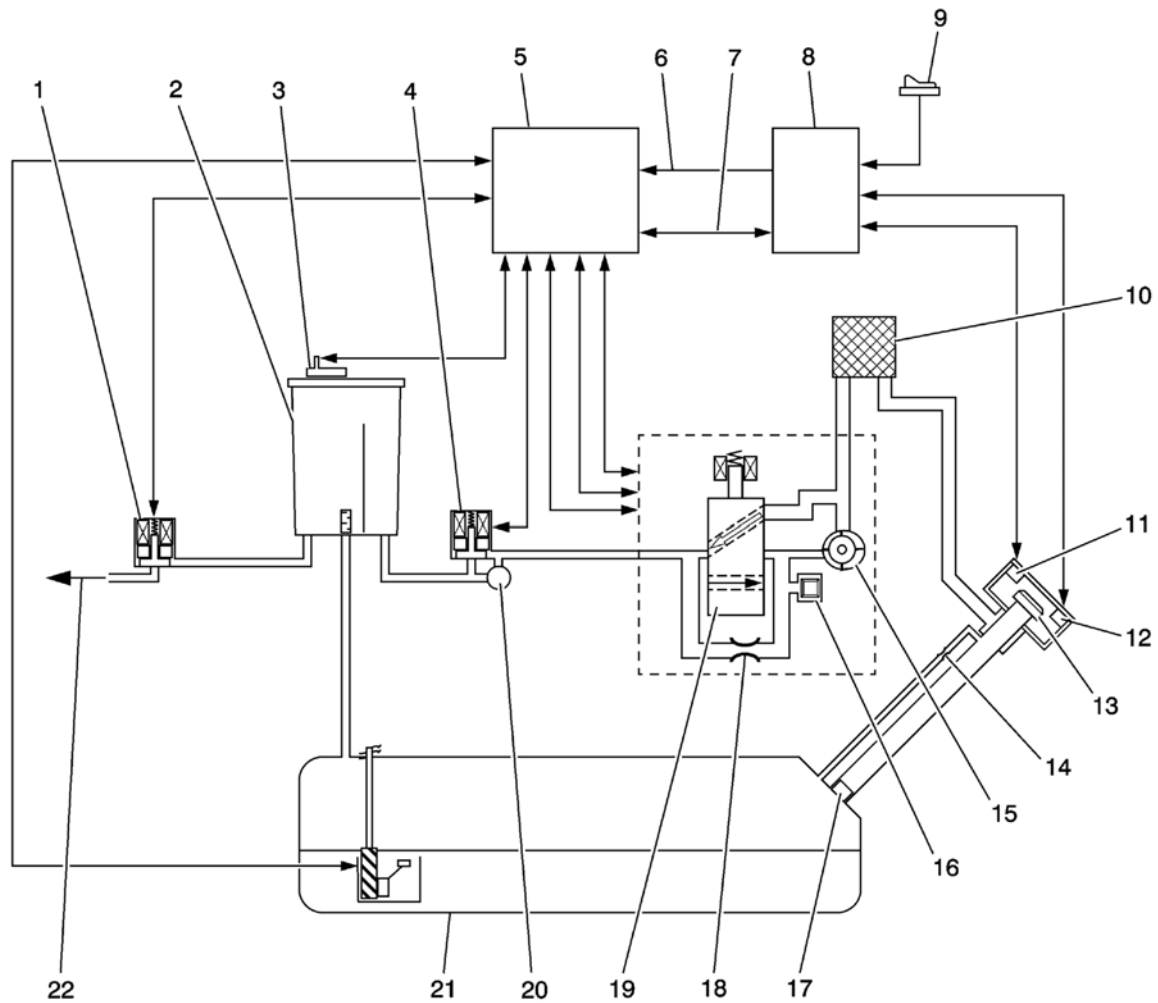


Fig. 1: Typical Evaporative Emission (EVAP) System Hose Routing Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Evaporative Emissions (EVAP) Purge Solenoid Valve
2	EVAP Canister
3	Fuel Tank Pressure Sensor
4	EVAP Vent Solenoid Valve
5	Engine Control Module (ECM)
6	Accessory Wake-up Line
7	Serial Data Communication
8	Hybrid Powertrain Control Module 2 with Alarm Clock
9	Refuel Request Switch
10	Fresh Air Filter
11	Fuel Fill Door Lock Solenoid
12	Fuel Fill Door Position Sensor
13	Fuel Filler Cap
14	2.54 mm (0.100 in) Orifice in Fuel Fill Vapor Recirculation Pipe

Callout	Component Name
15	EVAP Leak Detection Pump
16	EVAP Leak Detection Pump Sensor
17	Fuel Fill Pipe Inlet Check Valve
18	EVAP Leak Detection Pump Reference Orifice 0.51 mm (0.020 in)
19	EVAP Leak Detection Pump Switching Valve
20	Relief Valve
21	Fuel Tank
22	To Engine Intake Manifold Vacuum

EVAP System Operation

The evaporative emission (EVAP) control system limits fuel vapors from escaping into the atmosphere. Fuel tank vapors are allowed to move from the fuel tank, due to pressure in the tank, through the EVAP vapor tube, into the EVAP canister. Carbon in the canister adsorbs and stores the fuel vapors. The EVAP canister stores the fuel vapors until the engine is able to use them.

This vehicles sealed fuel system features a normally sealed fuel tank and canister to reduce canister loading during daily cycles. Different than the EVAP diagnostic hardware from conventional EVAP systems this vent solenoid valve is normally closed. This keeps the fuel vapor sealed in the fuel tank and canister. The vent solenoid valve is only open for canister purge, refueling, fuel tank pressure (FTP) sensor correlation or leak check with the EVAP leak detection pump. Additional, excessive pressure is vented through the vent hose and EVAP canister vent solenoid valve to the atmosphere at a predetermined limit. Diagnostics are performed with the propulsion system ON and OFF.

Propulsion System OFF

The engine control module (ECM) wake-up timer, which is located in the Hybrid Powertrain Control Module 2, activates the ECM at three predetermined times so that leak detection can occur. This is where the EVAP leak detection pump hardware is used. The ECM uses several tests to determine if the EVAP system is leaking or restricted. These tests execute with the engine OFF at 5, 7, or 9.5 hours after the vehicle has been shut OFF. These soak times allow the fuel temperature and pressure to be stabilized.

Propulsion System ON

EVAP purge flow, FTP sensor and EVAP leak detection pump sensor performance diagnostics are conducted.

Purge Solenoid Valve Leak Test

This vehicle does not have a purge solenoid leak test. A leaking purge solenoid will set DTCs P0442 or P0455.

Large Leak Test

This vehicle does not have an engine running version of the large leak diagnostic. The large leak diagnostic only runs when the propulsion system is not active. This is accomplished by using the EVAP leak detection pump hardware and a prior refueling event was detected.

Small Leak Test

This vehicle does not use the engine OFF natural vacuum diagnostic for small leak detection. Instead it uses the

EVAP leak detection pump hardware. This test executes when the propulsion is not active at 5, 7, or 9.5 hours after the vehicle has been shut OFF.

EVAP System Components

The EVAP system consists of the following components:

EVAP Purge Solenoid Valve

The EVAP purge solenoid valve controls the flow of vapors from the EVAP system to the intake manifold. The purge solenoid valve opens when commanded ON by the ECM. This normally closed valve is pulse width modulated (PWM) by the ECM to precisely control the flow of fuel vapor to the engine. This valve will also be opened during some portions of the EVAP testing when the engine is running, allowing engine vacuum to enter the EVAP system.

EVAP Canister

The canister is filled with carbon pellets used to adsorb and store fuel vapors. Fuel vapor is stored in the canister until the ECM determines that the vapor can be consumed in the normal combustion process.

Fuel Tank Pressure Sensor

The FTP sensor measures the difference between the pressure or vacuum in the fuel tank and outside air pressure. The ECM provides 5 V reference, ground and signal circuit to the FTP sensor. Depending on the vehicle, the sensor can be located in the vapor space on top of the fuel tank, in the vapor tube between the canister and the tank, or on the EVAP canister. The FTP sensor provides a signal voltage back to the ECM that can vary between 0.15 - 4.85 V. A high FTP sensor voltage indicates a fuel tank pressure. A low FTP sensor voltage indicates a fuel tank vacuum.

EVAP Vent Solenoid Valve

The EVAP vent solenoid valve controls fresh airflow into the EVAP canister. The EVAP vent solenoid valve is normally closed. This keeps vent fuel vapor sealed in the fuel tank and canister. The EVAP vent solenoid valve is similar to a conventional vent valve, but a conventional vent valve is normally open. This vent solenoid valve is only open for canister purge, refueling, fuel tank pressure sensor correlation or leak check with the EVAP leak detection pump.

Relief Valve

This is a mechanical pressure relieve valve that is part of the vent solenoid valve assembly. It protects the fuel tank by relieving excessive pressure or excessive vacuum that could build up in the sealed fuel tank from environmental changes.

EVAP Leak Detection Pump Assembly

The leak detection pump assembly consists of three main components. These components are integral parts of the EVAP leak detection pump assembly and are not serviceable.

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve

- EVAP leak detection pump pressure sensor

This leak detection pump assembly is used for FTP sensor correlation and leak checking the EVAP system for small and large system leaks.

- EVAP leak detection pump pressure sensor's primary purpose is to perform leak detection diagnostics. The sensor itself is diagnosed by a correlation to barometric pressure based off the MAP sensor.
- EVAP leak detection pump 0.51 mm (0.020 in) reference orifice, working in conjunction with the EVAP leak detection pump and pressure sensor. This orifice is used to establish a vacuum reference baseline for diagnosing EVAP leaks
- EVAP leak detection pump switching valve switches from a vent position to a pump position depending on the EVAP diagnostics taking place.

Fresh Air Filter

An in-line 5 micron air filter exists between the EVAP leak detection pump fresh air intake and behind the fuel tank fill door pocket to keep the pump hardware from becoming contaminated.

Vapor Recirculation Tube

A vapor path between the fuel fill pipe and the fuel tank is necessary to fully diagnose the EVAP system. It also accommodates service diagnostic procedures by allowing the entire EVAP system to be diagnosed from the either end of the system.

2.54 mm (0.100 in) Orifice in Fuel Fill Vapor Recirculation Pipe

The orifice aids refueling, onboard refueling vapor recovery (ORVR), to avoid canister overload while still allowing closed system leak detection and compliance with ORVR emissions standards.

Fuel Fill Door Lock Solenoid

Prevents fuel fill door opening prior to pressing the Refuel Request Switch.

Fuel Fill Door Position Switch

Provides input to the Hybrid Powertrain Control Module 2 to determine if the door position is open or closed.

Fuel Fill Cap, Capless if equipped

The fuel fill cap/capless fuel fill is equipped with a seal and has no relief valve.

Fuel Fill Pipe Check Valve

The check valve on the fuel fill pipe prevents spit-back during refueling.

Refuel Request Switch

NOTE: There is a 30 minute time frame for refueling to occur. If testing the EVAP system the vent solenoid valve will go back to it's normal closed state after 30 min. and refueling will become difficult.

NOTE: If more time is needed to open the fuel door a second 1 second press of the switch will be required. Or use the scan tool to command the vent solenoid open, if necessary, for additional testing.

Located in the driver's door panel, this switch when pressed for 1 second, puts the EVAP diagnostics into an abort state, opens the vent solenoid valve for refueling and releases the fuel fill door. A message will be displayed on the driver information center.

ELECTRONIC IGNITION SYSTEM DESCRIPTION

The electronic ignition system produces and controls a high-energy secondary spark. This spark is used to ignite the compressed air/fuel mixture at precisely the correct time. This provides optimal performance, fuel economy, and control of exhaust emissions. This ignition system uses an individual coil for each cylinder. The ignition coils are mounted near each cylinder with short integrated boots or high tension wires connecting the coils to the spark plugs. The driver modules within each ignition coil are commanded ON/OFF by the Engine Control Module (ECM). The ECM uses engine speed, the mass air flow (MAF) sensor signal, and position information from the crankshaft position and the camshaft position sensors to control the sequence, dwell, and timing of the spark.

The electronic ignition system consists of the following components:

Crankshaft Position Sensor

The crankshaft position sensor works in conjunction with a reluctor wheel on the crankshaft (front mounted crankshaft position sensor) or a reluctor wheel that is part of the flywheel (rear mounted crankshaft position sensor). The ECM monitors the voltage frequency on the crankshaft position sensor signal circuit. As each reluctor wheel tooth rotates past the sensor, the sensor creates a digital ON/OFF pulse. This digital signal is processed by the ECM. This creates a signature pattern that enables the ECM to determine the crankshaft position. The ECM uses the signal to determine which pair of cylinders is approaching top dead center based on the crankshaft position signal alone. The camshaft position sensor signals are used in order to determine which of these 2 cylinders is on a firing stroke, and which is on the exhaust stroke. The ECM uses this to properly synchronize the ignition system, the fuel injectors, and the knock control. This sensor is also used in order to detect misfire.

The ECM also has a dedicated replicated crankshaft position sensor signal output circuit that may be used as an input signal to other modules for monitoring engine RPM.

Camshaft Position Sensor

This engine uses a camshaft position sensor for each camshaft. The camshaft position sensor signals are a digital ON/OFF pulse and output 4 times per revolution of the camshaft. The camshaft position sensor does not directly affect the operation of the ignition system. The camshaft position sensor information is used by the ECM to determine the position of the camshaft relative to the crankshaft position. By monitoring the camshaft position and crankshaft position signals the ECM can accurately time the operation of the fuel injectors. The ECM supplies the camshaft position sensor with a 5 V reference circuit and a low reference circuit. The camshaft position sensor signals are an input to the ECM. These signals are also used to detect camshaft alignment with the crankshaft.

The ECM also has a dedicated replicated camshaft position sensor signal output circuit that may be used as an input signal to other modules for monitoring engine RPM.

Knock Sensor

The knock sensor system enables the ECM to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation, also known as spark knock. The knock sensor system uses 1 or 2 flat response 2-wire sensors. The sensor uses piezo-electric crystal technology that produces an AC voltage signal of varying amplitude and frequency based on the engine vibration or noise level. The amplitude and frequency depend upon the level of knock that the knock sensor detects. The ECM receives the knock sensor signal through the high and low signal circuits.

The ECM learns a minimum noise level, or background noise, at idle from the knock sensor and uses calibrated values for the rest of the RPM range. The ECM uses the minimum noise level to calculate a noise channel. A normal knock sensor signal will ride within the noise channel. As engine speed and load change, the noise channel upper and lower parameters will change to accommodate the normal knock sensor signal, keeping the signal within the channel. In order to determine which cylinders are knocking, the ECM only uses knock sensor signal information when each cylinder is near top dead center (TDC) of the firing stroke. If knock is present, the signal will range outside of the noise channel.

If the ECM has determined that knock is present, it will retard the ignition timing to attempt to eliminate the knock. The ECM will always try to work back to a zero compensation level, or no spark retard. An abnormal knock sensor signal will stay outside of the noise channel or will not be present. Knock sensor diagnostics are calibrated to detect faults with the knock sensor circuitry inside the ECM, the knock sensor wiring, or the knock sensor voltage output. Some diagnostics are also calibrated to detect constant noise from an outside influence such as a loose/damaged component or excessive engine mechanical noise.

Ignition Coils

Each ignition coil has an ignition voltage feed and a ground circuit. The engine control module (ECM) supplies a low reference and an ignition control (IC) circuit. Each ignition coil contains a solid state driver module. The ECM will command the IC circuit ON, which allows the current to flow through the primary coil windings. When the ECM commands the IC circuit OFF, this will interrupt current flow through the primary coil windings. The magnetic field created by the primary coil windings will collapse across the secondary coil windings, which induces a high voltage across the spark plug electrodes.

Engine Control Module (ECM)

The ECM controls all ignition system functions and constantly corrects the spark timing. The ECM monitors information from various sensor inputs that may include the following components, if applicable:

- Throttle position sensor
- Engine coolant temperature (ECT) sensor
- Mass air flow (MAF) sensors
- Intake air temperature (IAT) sensors
- Vehicle speed sensor (VSS)
- Transmission gear position or range information sensors
- Engine knock sensors
- Ambient pressure sensors (BARO)

THROTTLE ACTUATOR CONTROL (TAC) SYSTEM DESCRIPTION

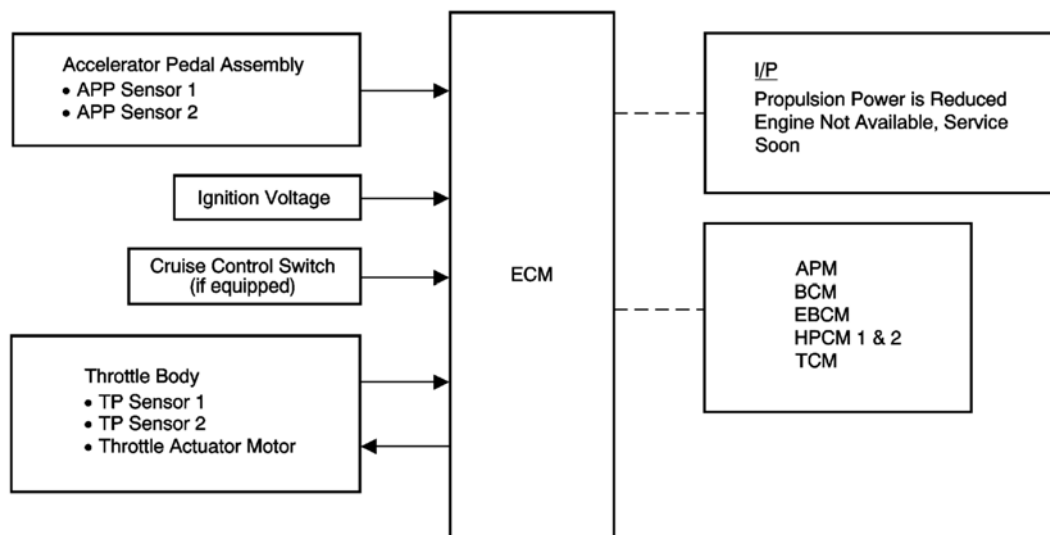


Fig. 2: Throttle Actuator Control (TAC) System Description

Courtesy of GENERAL MOTORS COMPANY

Circuit/System Description

The system torque coordination is provided by the hybrid powertrain control module. The engine control module (ECM) provides the accelerator pedal interface in which the driver requests a vehicle torque. These driver requests are coordinated and arbitrated within the ECM and the final driver requested torque is sent to the hybrid powertrain control module. The hybrid powertrain control module then determines how the torque output will be distributed between the two electric motors and the engine. After the torque distribution has been determined, torque reductions are imposed based upon system interrupts that are listed below:

- Vehicle stability
- Torque security
- Component overheating protection

The final arbitrated values are distributed to the system. Torque coordination of the system depends directly upon the high voltage battery pack state of charge.

This system is a distributed control system where the system torque is controlled over a system network. The system network consists of serial data communications between the controllers listed below:

- Engine control module (ECM)
- Hybrid powertrain control module 1 and 2 (HPCM 1 and 2)
- Transmission control module (TCM)
- Electronic brake control module (EBCM)
- Accessory Power Module (APM)

The hybrid powertrain control module determines the engine speed which is based on the high voltage battery pack state of charge. The ECM achieves throttle positioning by providing a pulse width modulated voltage to the throttle actuator motor. The throttle blade is spring loaded in both directions, and the default position is slightly open.

Modes Of Operation

Normal Mode

During the operation of the TAC system, several modes, or functions, are considered normal. The following modes may be entered during normal operations:

- Minimum pedal value - At Vehicle ON, the ECM updates the learned minimum pedal value.
- Minimum throttle position values - At Vehicle ON, the ECM updates the learned minimum throttle position value. In order to learn the minimum throttle position value, the throttle blade is moved to the closed position.
- Ice break mode - If the throttle blade is not able to reach a predetermined minimum throttle position, the ice break mode is entered. During the ice break mode, the ECM commands the maximum pulse width several times to the throttle actuator motor in the closing direction.
- Battery saver mode - After a predetermined time without engine speed, the ECM commands the battery saver mode. During the battery saver mode, the ECM disables the TAC motor control circuits, which removes the current draw used to maintain the engine speed and allows the throttle to return to the spring loaded default position.

Reduced Power Mode

When the ECM detects a condition with the TAC system, the ECM may enter a propulsion power reduced mode. Propulsion power reduced mode may cause one or more of the following conditions:

- Acceleration limiting - The ECM will continue to use the accelerator pedal for propulsion control, however, the vehicle acceleration is limited.
- Limited throttle mode - The ECM will continue to use the accelerator pedal for propulsion control, however, the propulsion power is reduced.
- Throttle default mode - The ECM will turn OFF the throttle actuator motor, and the throttle will return to the spring loaded default position.
- Forced idle mode - The ECM will ignore the accelerator pedal input.
- Engine shutdown mode - The ECM will disable fuel and de-energize the throttle actuator.

If the throttle blade becomes stuck, a DTC will set. Depending on the position of the throttle blade, the ECM may enter Engine Shutdown Mode. The ECM will disable fuel and de-energize the throttle actuator. If the condition remains present during the next ignition cycle, the ECM may disable engine cranking. Inspect the throttle body assembly for a stuck throttle blade if a throttle actuator DTC is current and the engine won't crank.

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0010, P0013, OR P2088-P2091: CAMSHAFT POSITION ACTUATOR SOLENOID VALVE CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0010

Intake Camshaft Position Actuator Solenoid Valve Control Circuit

DTC P0013

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit

DTC P2088

Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage

DTC P2089

Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

DTC P2090

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage

DTC P2091

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Control	P0010, P0013, P2088, P2090	P0010, P0013, P2089, P2091	P0010, P0013, P2089, P2091	P0010, P0013, P2089, P2091	P0011, P0014

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Low Reference	-	P0010, P0013, P2089, P2091	P0010, P0013, P2089, P2091	-	-

Circuit/System Description

The camshaft position actuator system enables the engine control module (ECM) to change the timing of the camshafts while the engine is operating. The camshaft position actuator solenoid valves are each supplied a dedicated pulse width modulated (PWM) control circuit and low reference circuit from the ECM. The ECM operates each camshaft position actuator solenoid valve by controlling the amount of solenoid valve duty cycle to control the oil flow that applies the pressure to advance or retard the camshafts.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V
- The ignition switch is in the crank or run position.
- The ECM has commanded the camshaft position actuator solenoid valve On.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 5 s.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type A DTC - Exceptions listed below

If equipped with a turbocharger=Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC - Exceptions listed below

If equipped with a turbocharger=Type A DTC

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Description and Operation

Camshaft Actuator System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: If a crankshaft or camshaft position sensor DTC is set, the Camshaft Position Actuator output control will not function.

1. Ignition On/Vehicle in Service Mode.
2. Verify DTC P0335, P0336, P0340, or P0341 is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If the DTC is not set**

3. Engine Running.
4. Verify the scan tool parameters listed below do not display Malfunction while commanding the appropriate Camshaft Position Actuator Solenoid Valve On and Off:
 - Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status
 - Intake Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status
 - Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status
 - Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status
 - Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status
 - Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

5. Verify that none of the scan tool Camshaft Position Actuator Solenoid Valve Control Circuit Test Status parameters change from OK or Not Run to Malfunction while moving the related harness/connectors of the Q6 Camshaft Position Actuator Solenoid Valves.

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 or B and ground.

- **If 5 Ω or greater**

1. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Engine Running.

4. Verify the appropriate scan tool Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status does not display Malfunction.

- **If Malfunction is displayed**

1. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module, ignition On/Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If greater than 1 V, repair the short to voltage on the control circuit.

- If less than 1 V, replace the K20 Engine Control Module.

- **If Malfunction is not displayed**

5. Ignition/Vehicle Off, install a 5 A fused jumper wire between the control circuit terminal 1 or A and B+, engine Running.

6. Verify the appropriate scan tool Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

Test Status displays Malfunction.

- **If Malfunction is not displayed**

1. Ignition/Vehicle Off, remove the fused jumper, and disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the control circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

7. Test or replace the Q6 Camshaft Position Actuator Solenoid Valve.

Component Testing

1. Ignition/Vehicle Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve.
2. Test for 7-12 Ω between the control terminal 1 or A and the low reference circuit terminal 2 or B.
 - **If not between 7-12 Ω**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.
 - **If between 7-12 Ω**
3. Test for infinite resistance between each terminal and the Q6 Camshaft Position Actuator Solenoid Valve housing.
 - **If not infinite resistance**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.
 - **If infinite resistance**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Camshaft Position Actuator Solenoid Valve Replacement - Intake**
- **Camshaft Position Actuator Solenoid Valve Replacement - Exhaust**
- **Control Module References** for engine control module replacement, programming, and setup.

DTC P0011 OR P0014: INTAKE/EXHAUST CAMSHAFT POSITION SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0011

Intake Camshaft Position System Performance

DTC P0014

Exhaust Camshaft Position System Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Intake Actuator Solenoid Control	P0010	P0010	P0010	P0011
Exhaust Actuator Solenoid Control	P0013	P0013	P0013	P0014
Intake Actuator Solenoid Low Reference	-	P0010, P0011	-	P0011
Exhaust Actuator Solenoid Low Reference	-	P0013, P0014	-	P0014

Circuit/System Description

The camshaft position actuator system enables the engine control module (ECM) to change the timing of the camshafts while the engine is operating. The camshaft position actuator solenoid valves are each supplied a dedicated pulse width modulated (PWM) control circuit and low reference circuit from the ECM. The ECM operates each camshaft position actuator solenoid valve by controlling the amount of solenoid valve signal duty cycle to control the oil flow that applies the pressure to advance or retard the camshafts.

Conditions for Running the DTC

- DTC P0010, P0013, P2088, P2089, P2090 or P2091 is not set.
- The engine is running.
- The ignition voltage is greater than 11 V.
- The camshaft position actuator is enabled.
- The desired camshaft position variation is less than 3° for 4 s.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

The ECM detects a difference of greater than 8° between the camshaft position angle position and the desired camshaft position for greater than 30 s.

Action Taken When the DTC Sets

- DTCs listed in the DTC Descriptor Category=Type B DTC - Exceptions listed below

If equipped with a turbocharger=Type A DTC

- The camshaft position actuator solenoid valve - intake and camshaft position actuator solenoid valve - exhaust are commanded to the park position.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC - Exceptions listed below

If equipped with a turbocharger=Type A DTC

Diagnostic Aids

- A low oil level or condition may set this DTC.
- Inspect the engine for any recent engine mechanical repairs. An incorrectly installed camshaft, camshaft actuator, or timing chain can cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Description and Operation

Camshaft Actuator System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE:

- The engine oil level and the oil pressure are critical to the correct operation of the camshaft position actuator system. Verify that the engine has the correct oil level and the correct oil pressure before continuing with this diagnostic.
- The engine oil condition has a major impact on the camshaft actuator system. Debris in the oil can interfere with the camshaft position actuator solenoid and the mechanical camshaft actuator operation. Inspect for dirty or degraded crankcase oil. The engine may require an oil change. Inquire

with the customer when the last oil change was performed. You may also monitor the scan tool Engine Oil Life Remaining parameter. Advise the customer an oil change may be required.

1. Verify the engine has the proper oil condition, level, and pressure. Refer to [Oil Pressure Diagnosis and Testing](#).

- **If the oil condition, level, and oil pressure are not correct**

Repair as necessary

- **If the oil condition, level, and oil pressure are correct**

2. Verify DTC P0010, P0011, P0013, P0014, P0016, P0017, P0335, P0336, P0340, P0341, P0365, P0366, P2088, P2089, P2090 or P2091 is not set.

- **If any DTCs other than P0011 or P0014 are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If only DTC P0011 or P0014 is set**

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

2. Verify the DTC does not set.

- If the DTC sets, refer to Circuit/System Testing.
- If the DTC does not set, all OK.

- **If none of the DTCs are set**

3. All OK.

Circuit/System Testing

NOTE: You must complete the Circuit/System Verification before proceeding with Circuit/System Testing

1. Ignition/Vehicle Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve, ignition On/vehicle in Service Mode.
2. Verify a test lamp illuminates between the control circuit terminal 1 or A and ground when commanding the appropriate Camshaft Position Actuator Solenoid Valve On with a scan tool.

- **If the test lamp does not illuminate**

1. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance or short to ground in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If the test lamp illuminates**

3. Ignition/Vehicle Off.

4. Remove the appropriate Q6 Camshaft Position Actuator Solenoid Valve. Inspect the Camshaft Position Actuator Solenoid Valve and mounting area for the following conditions:

- For a torn, restricted, incorrect positioned, or missing screens at the Q6 Camshaft Position Actuator Solenoid Valve
- For engine oil leaks between the oil sealing lands of the Q6 Camshaft Position Actuator Solenoid Valve
- For oil seepage at the Q6 Camshaft Position Actuator Solenoid Valve connector

- **If a condition is found**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If a condition is not found**

NOTE: This step is testing the mechanical operation of the camshaft position actuator solenoid valve that set the DTC.

5. Exchange the suspected Q6 Camshaft Position Actuator Solenoid Valve with a Q6 Camshaft Position Actuator Solenoid Valve that is operating correctly.
6. Engine Running.
7. Command the appropriate camshaft position actuator from 0 degrees to 20 degrees and back to zero while observing the appropriate scan tool Intake/Exhaust Camshaft Position Variance parameters. The Intake/Exhaust Camshaft Position Variance should be less than 2 degrees in each of the commanded states.

- **If the Camshaft Position Variance parameter is greater than 2 degrees**

Replace or repair the mechanical camshaft position actuator

- **If the Camshaft Position Variance parameter is less than 2 degrees**

8. Test or replace the Q6 Camshaft Position Actuator Solenoid Valve.

Component Testing

1. Ignition/Vehicle Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve.

2. Test for 7 - 12 Ω between the control terminal 1 or A and the low reference terminal 2 or B.

- **If not between 7 - 12 Ω**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If between 7 - 12 Ω**

3. Test for infinite resistance between each terminal and the Q6 Camshaft Position Actuator Solenoid Valve housing.

- **If not infinite resistance**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Camshaft Position Actuator Solenoid Valve Replacement - Intake](#)
- [Camshaft Position Actuator Solenoid Valve Replacement - Exhaust](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0016 OR P0017: CRANKSHAFT POSITION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0016

Crankshaft Position - Intake Camshaft Position Not Plausible

DTC P0017

Crankshaft Position - Exhaust Camshaft Position Not Plausible

Circuit/System Description

The engine control module (ECM) uses the crankshaft position sensor, intake camshaft position sensor, and exhaust camshaft position sensor information to monitor the correlation between the crankshaft, intake camshaft, and exhaust camshaft position.

Conditions for Running the DTC

- DTC P0335, P0336, P0340, P0341, P0365, P0366, P0641, and P0651 are not set.
- The engine is cranking or running.
- The crankshaft and camshaft position signals are synchronized.
- The camshaft position actuator solenoid valves are in the parked position.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

The ECM detects a camshaft that is greater than 8 degrees advanced or 9 degrees retarded in relationship to the crankshaft.

Action Taken When the DTC Sets

DTCs P0016 and P0017 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0016 and P0017 are Type B DTCs.

Diagnostic Aids

- Inspect the engine for any recent engine mechanical repairs. An incorrectly installed timing chain can cause this DTC to set.
- A camshaft position actuator solenoid valve that is in the full advance or retard position can cause this DTC to set.
- The Camshaft Position Variance data parameter can be used to detect a binding camshaft position mechanical actuator which can cause this DTC to set.

Reference Information

Description and Operation

Camshaft Actuator System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0010, P0013, P0335, P0336, P0340, P0341, P0365, or P0366 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If none of the DTCs are set**

3. Engine Running at normal operating temperature.
4. Verify DTC P0016 or P0017 is not set.

- **If the DTC is set**

Inspect for the following and repair as necessary:

- A Q6 Camshaft Position Actuator Solenoid Valve that is stuck in the full advance or retard position.
- The correct installation of the Q6 Camshaft Position Actuator Solenoid Valves.
- The correct installation of the B23 Camshaft Position Sensors.
- The correct installation of the B26 Crankshaft Position Sensor.
- A timing chain tensioner condition.
- An incorrectly installed timing chain.
- Excessive play in the timing chain.
- A timing chain that jumped teeth.

- A crankshaft reluctor wheel that has moved in relationship to top dead center (TDC) on the crankshaft.
 - **If the DTC is not set**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
- **If the DTC sets**
- A mechanical condition listed above still exists.
- **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Camshaft Position Actuator Solenoid Valve Replacement - Exhaust**
- **Camshaft Position Actuator Solenoid Valve Replacement - Intake**
- **Camshaft Position Sensor Replacement - Exhaust**
- **Camshaft Position Sensor Replacement - Intake**
- **Crankshaft Position Sensor Replacement**
- **Camshaft Timing Chain and Sprocket Cleaning and Inspection**

DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, OR P0141: HO2S HEATER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC P0030

HO2S Heater Control Circuit Sensor 1

DTC P0031

HO2S Heater Control Circuit Low Voltage Sensor 1

DTC P0032

HO2S Heater Control Circuit High Voltage Sensor 1

DTC P0036

HO2S Heater Control Circuit Sensor 2

DTC P0037

HO2S Heater Control Circuit Low Voltage Sensor 2

DTC P0038

HO2S Heater Control Circuit High Voltage Sensor 2

DTC P0053

HO2S Heater Resistance Sensor 1

DTC P0054

HO2S Heater Resistance Sensor 2

DTC P0135

HO2S Heater Performance Sensor 1

DTC P0141

HO2S Heater Performance Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
HO2S Heater Voltage Supply	P0030, P0036, P0037, P0132, P0135, P0138, P0141, *	P0030, P0036, P0132, P0135, P0138, P0141	P0690	P0135, P0141
HO2S Heater Control	P0030, P0031, P0036, P0037, P0053, P0054, P0135, P0141	P0030, P0036, P0132, P0135, P0138, P0141	P0030, P0032, P0036, P0038, P0132, P0135, P0138, P0141, P0690	P0135, P0141
* Opens Fuse				

Circuit/System Description

Heated oxygen sensors (HO2S) are used for fuel control and post-catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. Each HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside each of the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by an ignition voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the ECM. The ECM uses pulse-width modulation (PWM) to control the HO2S heater operation to maintain a specific HO2S operating temperature range.

Conditions for Running the DTC

P0030, P0031, P0032, P0036, P0037 and P0038

- The Ignition voltage is between 11 - 32 V.
- The engine speed is greater than 400 RPM.
- The DTCs run continuously when the above conditions are met for greater than 5 s.

P0053 and P0054

- DTCs P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119 or P2610 are not set.
- The Ignition voltage is less than 32 V.
- The Ignition is OFF for greater than 8 h.
- The engine is running.
- The engine coolant temperature and the intake air temperature (IAT) are within 8°C (14°F).
- The engine coolant temperature is between -30 to +255°C (-22 to +491°F).
- The DTCs run once per valid cold start-up when the above conditions are met.

P0135 and P0141

- DTCs P0116, P0117, P0118, P0119 or P0128 are not set.
- The Ignition voltage is between 10 - 32 V.
- The heated oxygen sensor heaters are at operating temperature.
- The scan tool HO2S Heater device control is not active.
- The commanded HO2S heater duty cycle is greater than 0%.
- The DTCs run twice per drive cycle when the above conditions are met for greater than 120 s.

Conditions for Setting the DTC

P0030, P0031, P0032, P0036, P0037 and P0038

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 5 s.

P0053 and P0054

The ECM detects the HO2S heater is not within a specified resistance range at engine start-up.

P0135 and P0141

The ECM detects the HO2S heater current is less than 0.30 A or greater than 2.5 A for greater than 10 s.

Action Taken When the DTC Sets

DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0135, and P0141 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0135, and P0141 are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool circuit status parameters for the component. The circuit status parameters will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.
- An open fuse in the HO2S heater circuit may be caused by the heater element in one of the sensors. The condition may not be present until the sensor operates for a period of time. If no fault is present in the heater circuit, monitor the amperage of each heater with a scan tool to determine if one of the heater elements is the cause of the open fuse. Inspect the sensor pigtail or the harness for contacting the exhaust system.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running.
2. Verify the parameters listed below do not display Malfunction.
 - HO2S 1 or 2 Heater Control Circuit High Voltage Test Status
 - HO2S 1 or 2 Heater Control Circuit Open Voltage Test Status
 - HO2S 1 or 2 Heater Control Circuit Low Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**
3. Verify the scan tool HO2S 1 Heater or HO2S 2 Heater is between 0.3 - 2.4 A.

- **If not between 0.3 - 2.4 A**

Refer to Circuit/System Testing.

- **If between 0.3 - 2.4 A**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate B52 Heated Oxygen Sensor, Vehicle in Service Mode.

2. Verify that a test lamp illuminates between the ignition voltage circuit terminal 2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test all components connected to the fuse and replace as necessary.

- **If the test lamp illuminates**

3. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 2 and the control circuit terminal 1.

- **If the test lamp illuminates**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

4. Remove the test lamp.

5. Engine running, verify the scan tool HO2S 1 or 2 Heater Control Circuit Open Test Status parameter displays Malfunction.

- **If Malfunction is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If Malfunction is displayed**

NOTE:

- **Less than 10 Ω of additional resistance on the ignition voltage circuit or control circuit may set a DTC. If there is resistance on a circuit, the driver will remain ON and the scan tool HO2S High Voltage Test Status parameter will display OK.**
- **Performing this test may set additional DTCs.**

6. Vehicle OFF, install a 3 A fused jumper wire between the control circuit terminal 1 and ground, engine running.
7. Verify the scan tool HO2S 1 or 2 Heater Control Circuit Low Voltage Test Status parameter displays Malfunction.

- **If Malfunction is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

8. Test or replace the B52 Heated Oxygen Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Heated Oxygen Sensor Replacement - Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing a HO2S.
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0089, P00C6, P228C, OR P228D: FUEL PRESSURE REGULATOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0089

Fuel Pressure Regulator Performance

DTC P00C6

Fuel Rail Pressure Low During Engine Cranking

DTC P228C

Fuel Pressure Regulator Control Performance - Low Pressure

DTC P228D

Fuel Pressure Regulator Control Performance - High Pressure

Circuit/System Description

The high fuel pressure necessary for direct injection is supplied by the high pressure fuel pump. The high pressure fuel pump is mounted on the rear of the engine and is driven by a four-lobe cam on the camshaft. This high pressure fuel pump also regulates the fuel pressure using an actuator in the form of an internal solenoid-controlled valve. In order to keep the engine running efficiently under all operating conditions, the engine control module (ECM) requests pressure ranging from 2 to 15 MPa (290 to 2,176 PSI), depending on engine speed and load. Output drivers in the ECM provide the high pressure fuel pump control circuit with a 12 V pulse-width modulated (PWM) signal, which regulates fuel pressure by opening and closing the control valve at specific times during pump strokes. This effectively regulates the portion of each pump stroke that is delivered to the fuel rail. The high pressure fuel pump is normally closed and will not deliver an increase in fuel pressure when the control solenoid is NOT powered. In the event of pump control failure, the high pressure system is protected by a relief valve in the pump that prevents the pressure from exceeding 24 MPa (3,481 PSI).

The fuel rail pressure sensor provides the feedback necessary to the ECM to control the high pressure fuel pump and the fuel injectors. The sensor is diagnosed separately from the fuel pressure control system.

The ECM monitors the fuel rail pressure sensor and the high pressure fuel pump solenoid to determine if the commanded and actual pressures are within a predetermined range during engine cranking and at all times while the engine is running. The ECM also monitors the high pressure fuel pump solenoid to make sure it is operating within expected limits.

Conditions for Running the DTC

P0089, P228C, or P228D

- DTC P0016, P0017, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0335, P0336, P0340, P0341, P0365, P0366, P0627, P0628, P0629, P111E, P128A, P128B, P128F, P1682, P16E4, or P16E5 are not present.
- Battery voltage is greater than 11 V.
- The engine has been running for greater than or equal to 10 s.
- Low side fuel pressure is greater than 300 kPa (44 PSI).
- Barometric (BARO) pressure is greater than or equal to 70 kPa.

- Intake air temperature (IAT) is warmer than or equal to -10°C (14°F).
- Fuel temperature is between -10°C and $+132^{\circ}\text{C}$ (14°F and 270°F).
- Vehicle is not in a low fuel condition
- The DTCs run continuously when the above conditions are met.

P00C6

- DTC P0016, P0017, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0335, P0336, P0340, P0341, P0365, P0366, P0627, P0628, P0629, P111E, P128A, P128B, P128F, P1682, P16E4, or P16E5 are not present.
- Ignition voltage is greater than 8 V.
- Engine coolant temperature is between -42°C and $+130^{\circ}\text{C}$ (43°F and 266°F).
- Low side fuel pressure is greater than 0 kPa (0 PSI).
- Barometric (BARO) pressure is greater than or equal to 70 kPa.
- Intake air temperature (IAT) is warmer than or equal to -10°C (14°F).
- Vehicle is not in a low fuel condition
- The diagnostic runs once for each engine start.

Conditions for Setting the DTC

P0089

- The high pressure fuel pump has exceeded the control limits. This condition exists when the scan tool Fuel Rail Pressure Regulator Command parameter is 0° or greater than 92° .
- The above condition exists for 750 out of 938 counts, approximately 30 s at idle.

P00C6 Condition 1

- If the fuel rail pressure is less than the target set point before the engine is cranked, the pressure rise diagnostic is used.
- The pressure rise diagnostic will fail if the fuel rail pressure has not increased to the target set point within 9 s at -16°C (3.2°F) ECT or within 4 s if ECT is greater than 0°C (32°F).

P00C6 Condition 2

- If the fuel rail pressure is greater than the target set point before the engine is cranked, the pressure fall diagnostic is used.
- The pressure fall diagnostic will fail if the fuel rail pressure has dropped below 2 MPa (290 PSI) for 10 engine cycles if the ECT is less than -16°C (3.2°F) or 0.6 MPa (87 PSI) for 10 engine cycles if the ECT is greater than -16°C (3.2°F).

P228C

- The fuel rail pressure is 3 MPa (435 PSI) less than the desired fuel rail pressure.
- The above condition exists for 750 out of 938 counts, approximately 30 s at idle.

P228D

- The fuel rail pressure is 3 MPa (435 PSI) greater than the desired fuel rail pressure.
- The above condition exists for 750 out of 938 counts, approximately 30 s at idle.

Action Taken When the DTC Sets

- DTCs P0089 and P00C6 are Type B DTCs.
- DTCs P228C and P228D are Type A DTCs.
- A message center or an indicator displays Propulsion Power is Reduced and Service Stabilitrak.
- Scan tool control of the high pressure fuel pump is inhibited.

Conditions for Clearing the DTC

- DTCs P0089 and P00C6 are Type B DTCs.
- DTCs P228C and P228D are Type A DTCs.

Diagnostic Aids

- Any problem with the camshaft may set fuel pressure DTCs due to the location and design of the high pressure fuel pump. If camshaft position control DTCs are current or in history, a cam control issue may be the root cause.
- A faulty valve, plunger, or solenoid in the high pressure fuel pump may set a DTC. High pressure fuel pump damage will most likely be undetectable upon visual inspection.
- A restricted fuel feed pipe between the fuel feed pipe fuel pressure sensor and the high pressure fuel pump may set a DTC.
- A leaking or restricted fuel injector may set a DTC.
- A leak in the high pressure fuel system may set a DTC.
- Vapor lock may set DTC P0089.
- For DTC P00C6, park the vehicle outdoors overnight and perform a start in the morning.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running.
2. Verify DTCs P0089, P00C6, P228C, and P228D are not set.
 - **If any of the DTCs are set**
Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
3. Verify the scan tool Fuel Rail Pressure Sensor parameter is approximately 1.9 - 5.0 MPa (276 - 725 PSI).
 - **If not between 1.9 - 5.0 MPa (276 - 725 PSI)**
Refer to Circuit/System Testing.
 - **If between 1.9 - 5.0 MPa (276 - 725 PSI)**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed first or misdiagnosis may result.**

1. Remove the G18 High Pressure Fuel Pump.
2. Verify the lobes on the camshaft do not have unusual wear or are worn.
 - **If the lobes have unusual wear or are worn**
Replace the Camshaft.
 - **If the lobes are OK**
3. Test or replace the G18 High Pressure Fuel Pump.

Component Testing

1. Ignition OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump.

NOTE: The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.

2. Test for 1.09 - 1.21 Ω at 20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$) between the high control circuit terminal 2 and the low control circuit terminal 1.

- If not between 1.09 - 1.21 Ω

Replace the G18 High Pressure Fuel Pump.

- If between 1.09 - 1.21 Ω

3. Test for infinite resistance between each terminal and the G18 High Pressure Fuel Pump housing.

- If less than infinite resistance

Replace the G18 High Pressure Fuel Pump.

- If infinite resistance

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Fuel Injection Pump Replacement
- Intake Camshaft Replacement

DTC P0090-P0092, P00C8, P00C9, OR P00CA: FUEL PRESSURE REGULATOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0090

Fuel Pressure Regulator Control Circuit

DTC P0091

Fuel Pressure Regulator Control Circuit Low Voltage

DTC P0092

Fuel Pressure Regulator Control Circuit High Voltage

DTC P00C8

Fuel Pressure Regulator High Control Circuit

DTC P00C9

Fuel Pressure Regulator High Control Circuit Low Voltage

DTC P00CA

Fuel Pressure Regulator High Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Control	P0091, P00C9	P0090, P00C8	P0092, P00CA, P0690	-
Low Control	P0091, P00C9	P0090, P00C8	P0092, P00CA, P0690	-

Circuit/System Description

The high fuel pressure necessary for direct injection is supplied by the high pressure fuel pump. The high pressure fuel pump is mounted on the rear of the engine and is driven by a three-lobe cam on the camshaft. This high pressure fuel pump also regulates the fuel pressure using an actuator in the form of an internal solenoid-controlled valve. In order to keep the engine running efficiently under all operating conditions, the engine control module (ECM) requests pressure ranging from 2 - 15 MPa (290 - 2,176 psi), depending on engine speed and load. Output drivers in the ECM provide the pump control circuit with a 12 V pulse-width modulated (PWM) signal, which regulates fuel pressure by closing and opening the control valve at specific times during pump strokes. This effectively regulates the portion of each pump stroke that is delivered to the fuel rail.

It is important to note that the high pressure fuel pump is a trailing-edge control system, meaning that if the control solenoid is NOT powered, the pump operates at maximum flow rate. In the event of pump control failure, the high pressure system is protected by a relief valve in the pump that prevents the pressure from exceeding 17.5 MPa (2,538 psi).

NOTE: The fuel rail pressure sensor is diagnosed separately from the fuel pressure control system and should not be replaced for any codes referenced in this document.

The fuel rail fuel pressure sensor operates on a 5 V reference circuit and it provides the feedback necessary to the ECM to control the high pressure fuel pump and the fuel injectors.

Conditions for Running the DTC

- Battery voltage is greater than or equal to 11 V.
- Engine speed is greater than or equal to 50 RPM.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0090

The ECM detects an open circuit in the high pressure fuel pump actuator low control circuit for 4 s.

P0091

The ECM detects a short to ground in the high pressure fuel pump actuator low control circuit for 4 s.

P0092

The ECM detects a short to voltage in the high pressure fuel pump actuator low control circuit for 4 s.

P00C8

The ECM detects an open circuit in the high pressure fuel pump actuator high control circuit for 4 s.

P00C9

The ECM detects a short to ground in the high pressure fuel pump actuator high control circuit for 4 s.

P00CA

The ECM detects a short to voltage in the high pressure fuel pump actuator high control circuit for 4 s.

Action Taken When the DTC Sets

DTCs P0090, P0091, P0092, P00C8, P00C9, and P00CA are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0090, P0091, P0092, P00C8, P00C9, and P00CA are Type A DTCs.

Diagnostic Aids

- Before performing any circuit testing, ensure that the harness connector for the G18 High Pressure Fuel Pump is properly seated.
- Before performing any circuit testing, visually inspect the harness connector and the G18 High Pressure Fuel Pump connector for damage or bent pins.
- Circuit faults in the high pressure fuel control system may result in performance diagnostic failures, such as P0089, P00C6, P163A, P228C, or P228D. If any of the circuit DTCs referenced in this document are active, they take priority over any fuel system performance diagnostic. Always attempt to diagnose and repair circuit faults first, before reviewing other system DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0685 or P1682 is not set.

- **If any of the DTCs are set**

Refer to [DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3](#) for further diagnosis.

- **If none of the DTCs are set**

3. Verify the scan tool parameters listed below do not display Malfunction.
 - Fuel Pressure Regulator Control Circuit High Voltage Test Status
 - Fuel Pressure Regulator Control Circuit Open Test Status
 - Fuel Pressure Regulator Control Circuit Low Voltage Test Status
 - Fuel Pressure Regulator High Control Circuit High Voltage Test Status
 - Fuel Pressure Regulator High Control Circuit Open Test Status
 - Fuel Pressure Regulator High Control Circuit Low Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump, Vehicle in Service Mode.
2. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the high control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
3. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and ground.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the low control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and B+.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the high control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
5. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and B+.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the low control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**

6. Remove the test lamp, connect a 3 A fused jumper wire between the high control circuit terminal 2 and ground.
7. Engine Running.
8. Verify the Fuel Pressure Regulator High Control Circuit Low Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the fused jumper, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the high control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
9. Connect a 3 A fused jumper wire between the low control circuit terminal 1 and B+.
10. Verify the Fuel Pressure Regulator Control Circuit High Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the fused jumper, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
11. Test or replace the G18 High Pressure Fuel Pump.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump.

NOTE: The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.

2. Test for 1.09 - 1.21 Ω at 20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$) between the high control circuit terminal 2 and the low control circuit terminal 1.
 - **If not between 1.09 - 1.21 Ω**

Replace the G18 High Pressure Fuel Pump.
 - **If between 1.09 - 1.21 Ω**
3. Test for infinite resistance between each terminal and the G18 High Pressure Fuel Pump housing.
 - **If less than infinite resistance**

Replace the G18 High Pressure Fuel Pump.
 - **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Injection Pump Replacement](#)
- [Control Module References](#) for K20 Engine Control Module replacement, setup, and programming

DTC P0096 OR P0111: INTAKE AIR TEMPERATURE (IAT) SENSOR 2 PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0096

Intake Air Temperature (IAT) Sensor 2 Performance

DTC P0111

Intake Air Temperature (IAT) Sensor 1 Performance

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P0114, P2199	P0111, P0113, P0114, P2199	P0113*, P0114, P2199	P0111, P2199
Low Reference	-	P0113, P2199, P2227, P2229	P0113*, P0114	-

*Internal ECM or sensor damage may occur if the circuit is shorted to B+.

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F4, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102,	-	P0096

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
		P2199		
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

IAT Sensor 2 and Intake Air Humidity Sensor

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient humidity, temperature, and engine bay conditions			
Ignition Voltage	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz 0%	-
Signal	-40Â°C (-40Â°F) 10 Hz 100%	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz* 0%
Ground	-	-40Â°C (-40Â°F) 10 Hz 0%	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F).

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- BARO pressure sensor

IAT Sensor 1 - Temperature, Resistance, Voltage Table

IAT Sensor 1	IAT Sensor 1 Resistance	IAT Sensor 1 Signal Voltage
Cold	High	High
Warm	Low	Low

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	10 Hz	-40Â°C (-40Â°F)
Warm	302 Hz	104Â°C (219Â°F)

Conditions for Running the DTCs

P0096 and P0111

- DTCs P0097, P0098, P0112, P0113, P0114, P0117, P00F4, P00F5, P00F6, P0118, P0119, or P1682 are not set.
- The vehicle has been OFF at least 8 hours.
- Ignition voltage is at least 11 V.
- The DTCs run once per ignition cycle when the conditions above are met.

Conditions for Setting the DTCs

P0096

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The absolute difference between ECT start-up temperature and the IAT sensor 2 start-up temperature is greater or equal to the absolute difference between ECT start-up temperature and the IAT sensor 1 start-up temperature.
- The DTCs run once per ignition cycle when the conditions above are met.

P0111

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The absolute difference between ECT start-up temperature and the IAT sensor 1 start-up temperature is greater or equal to the absolute difference between ECT start-up temperature and the IAT 2 start-up temperature.
- The DTCs run once per ignition cycle when the conditions above are met.

Action Taken When the DTC Sets

- DTC P0096 is a Type B DTC.
- DTC P0111 is a Type B DTC.
- The ECM commands the cooling fans ON.

Conditions for Clearing the DTCs

- DTC P0096 is a Type B DTC.
- DTC P0111 is a Type B DTC.

Diagnostic Aids

The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40Â°C (-40Â°F), and there are also Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to Special Tools (Diagnostic Tools) Special Tools (Repair Tools) .

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify that DTC P0097, P0098, P0099, P00F4, P00F5, P00F6, P0102, P0103, P0112, P0113, P0114, P0641, P0651, P0697, P06A3 or P06D2 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

- **If none of the DTCs are set**

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 3 and 4 of this verification procedure only if the ignition has been OFF for 8 hours or more.

3. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.

- Start-Up IAT Sensor 1
- IAT Sensor 2
- **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

4. Vehicle ON, verify the following scan tool parameters are between: -38 and +149Â°C (-36 and +300Â°F).

- IAT Sensor 1
- IAT Sensor 2
- **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit/System Testing.

- **If between: -38 and +149Â°C (-36 and +300Â°F)**

5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Check the integrity of the entire air induction system and verify that none of the following conditions exist:

- A restricted or collapsed air intake duct
- An intake manifold leak
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- **If a condition exists**

Repair or replace component as necessary.

- **If no condition exists**

2. Vehicle OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module.

- **If less than 5 Ω**

4. Vehicle OFF, all vehicle systems OFF, test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

5. Vehicle in Service Mode.

6. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
1. Vehicle OFF, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
- **If a test lamp illuminates**
7. Vehicle in Service Mode.
8. Verify the scan tool Intake Air Temperature Sensor 1 parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F).**
 - 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F).**
9. Vehicle OFF, install a 3 A fused jumper wire between the IAT 1 signal circuit terminal 1 and the low reference circuit terminal 3, vehicle in Service Mode.
10. Verify the scan tool Intake Air Temperature Sensor 1 parameter is warmer than 148°C (298°F).
 - **If colder than 148°C (298°F).**
 - 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 - 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If warmer than 148°C (298°F).**
11. Vehicle in Service Mode.

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage near B+ can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

12. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.

- **If 1% or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If less than 1%**

13. Vehicle OFF, install a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3, vehicle in Service Mode.

14. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.

- **If 99% or less**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Vehicle OFF, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V.

3. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 99%**

15. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air Sensor.

2. Connect a DMM between the IAT sensor 1 signal terminal 1 and the low reference terminal 3

NOTE: A thermometer can be used to test the sensor off the vehicle.

3. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance - Intake Air Temperature Sensor (Hitachi sensor) table for Hitachi Sensors. The resistance values should be in range of the table values.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

4. All OK.

Multifunction Intake Air Sensor

1. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

2. All OK.

Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Vehicle OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50 % (Normal)
 - Frequency switch to 250 Hz
4. Vehicle in Service Mode.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
 - IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76Â°C (160 - 166Â°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

Replace the K20 Engine Control Module.

- **If all the parameters are within the specified range**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0097, P0098, OR P0099: INTAKE AIR TEMPERATURE (IAT) SENSOR 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0097

Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage

DTC P0098

Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

DTC P0099

Intake Air Temperature (IAT) Sensor 2 Circuit Intermittent

Diagnostic Fault Information

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F5, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102, P2199	-	P0096

*Internal ECM or sensor damage may occur if the circuit is shorted to B+.

Typical Scan Tool Data

IAT Sensor 2

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Ignition Voltage	-40°C (-40°F) 10 Hz	-40°C (-40°F) 10 Hz	-
Signal	-40°C (-40°F) 10 Hz	-40°C (-40°F) 10 Hz	-40°C (-40°F)* 10 Hz
Ground	-	-40°C (-40°F) 10 Hz	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Intake Air Humidity Sensor

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient humidity, temperature, and engine bay conditions			
Ignition 1	0 %	0 %	-
Signal	100 %	0 %	0 %*
Ground	-	0 %	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as °C (°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- BARO pressure sensor

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	45 Hz	-40Â°C (-40Â°F)
Warm	302 Hz	104Â°C (219Â°F)

Conditions for Running the DTCs

P0097, P0098, and P0099

- DTCs P0685, P0686, P0687, P0689, P0690 or P1682 are not set.
- The ignition is ON, or the engine is running.
- The Ignition 1 voltage is at least 11 V.
- The DTCs run continuously within the enabling conditions.

Conditions for Setting the DTCs

P0097

NOTE: The scan tool display range is between -40 and +150Â°C (-40 and +302Â°F).

The ECM detects that the IAT sensor 2 signal is less than 13 Hz, colder than -60Â°C (-76Â°F), for greater than 5 s.

P0098

The ECM detects that the IAT sensor 2 signal is greater than 390 Hz, warmer than 150Â°C (302Â°F), for greater than 5 s.

P0099

The ECM detects that the IAT sensor 2 signal is intermittent or has abruptly changed for longer than 5 s.

Action Taken When the DTC Sets

- DTCs P0097, P0098, and P0099 are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the MIL/DTC

- DTCs P0097, P0098, and P0099 are Type B DTCs.

Diagnostic Aids

- With the Vehicle in Service Mode, if the engine is cold, a properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameter. This is due to the heat that is generated by the MAF sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40Â°C (-40Â°F), and there are also Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P00F4, P00F5, P00F6, P0102, P0103, P0641, P0651, P0697, P06A3, or P06D2 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

- **If none of the DTCs are set**

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 3 and 4 of this verification procedure only if the ignition has been OFF for 8 hours or more.

3. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

4. Engine running.

5. Verify the following scan tool parameters are between -38 and +149Â°C (-36 and +300Â°F).

- IAT Sensor 1
- IAT Sensor 2
- **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit System Testing.

- **If between: -38 and +149Â°C (-36 and +300Â°F)**

6. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

2. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

4. Vehicle in Service Mode, verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.

1. Vehicle OFF, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
- **If a test lamp illuminates**

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage near B+ can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

5. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.

- **If 1% or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If less than 1%**

6. Vehicle OFF, install a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3, vehicle in Service Mode.
7. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.
 - **If 99% or less**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Vehicle OFF, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V.
3. Vehicle OFF.
 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 99%**

8. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air sensor.
2. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.
 - **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.
 - **If within the specified range**
3. All OK.

Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Vehicle OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50 % (Normal)
 - Frequency switch to 250 Hz
4. Vehicle in Service Mode, verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
 - IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76Â°C (160 - 166Â°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

Replace the K20 Engine Control Module.

- **If all the parameters are within the specified range**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P00C7: INTAKE AIR PRESSURE MEASUREMENT SYSTEM - MULTIPLE SENSORS NOT PLAUSIBLE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P00C7

Intake Air Pressure Measurement System - Multiple Sensors Not Plausible

Circuit/System Description

This system consists of the following components:

- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor

This DTC sets when the control module detects an inconsistency between the pressure sensors and cannot identify which sensor failed.

Conditions for Running the DTC

- DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230 = Not set
- Engine=Not Running

- Time between current ignition cycle and the last time the engine was running=Greater than 10 s
- Manifold Absolute Pressure= 50 to 115 kPa (7.2 to 16.6 PSI)
- Barometric Pressure= 50 to 115 kPa (7.2 to 16.6 PSI)

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

Manifold Absolute Pressure & Barometric Pressure= Not within 10 kPa (1.5 PSI) of each other.

Actions Taken When the DTC Sets

DTC P00C7 is a Type B DTC.

Conditions for Clearing the DTC

DTC P00C7 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230 is not set.
 - **If any of the DTCs are set**

Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

- **If none of the DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation=Less than 90 %

- **If 90 % or greater**

Refer to: [Throttle Body Inspection and Cleaning](#)

- **If less than 90 %**

4. Verify the following conditions do not exist:

- Loose clamps, cracks, or other damages to the intake system.
- Clogged air cleaner.
- Vacuum hoses with kinks, leaks, or improper connections.
- Leaks at the intake manifold or throttle body.
- Leaking, missing, or damaged O-ring on the components listed below:
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
- **If a condition exists**

Repair or replace as necessary.

- **If no condition exists**

5. Verify the scan tool parameter:

- BARO Sensor= [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- MAP Sensor= [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- **If not in the specified range**
- {BARO Sensor} Refer to: [DTC P2227-P2230](#) .
- {MAP Sensor} Refer to: [DTC P0106](#).
- **If in the specified range**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

DTC P00F4-P00F6: INTAKE AIR HUMIDITY SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P00F4

Intake Air Humidity Sensor Circuit Low Voltage

DTC P00F5

Intake Air Humidity Sensor Circuit High Voltage

DTC P00F6

Intake Air Humidity Sensor Circuit Erratic

Diagnostic Fault Information

Intake Air Humidity and IAT Sensor 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F4, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102, P2199	-	P0096
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Intake Air Humidity Sensor

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient humidity and temperature; and engine bay conditions			
Ignition 1	0 %	0 %	-
Signal	100 %	0 %	0 %*
Ground	-	0 %	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

IAT Sensor 2

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Ignition 1	-40Â°C (-40Â°F) 10 Hz	-40Â°C (-40Â°F) 10 Hz	-

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Signal	-40Â°C (-40Â°F) 10 Hz	-40Â°C (-40Â°F) 10 Hz	-40Â°C (-40Â°F) 10 Hz*
Ground	-	-40Â°C (-40Â°F) 10 Hz	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The sensors listed below are integrated within the Multifunction Intake Air sensor:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- BARO pressure sensor

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the intake air humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

Conditions for Running the DTCs

P00F4, P00F5, and P00F6

- DTC P1682 is not active.
- The ignition is ON.
- The Ignition 1 voltage is at least 11 V for longer than 0.9 s.
- The DTCs run continuously within the enabling conditions.

Conditions for Setting the DTCs

P00F4

The ECM detects that the humidity sensor signal is less than or equal to 5 % for greater than 5 s.

P00F5

The ECM detects that the humidity sensor signal is greater than or equal to 95 % for greater than 5 s.

P00F6

The ECM monitors the humidity sensor signal every 0.1 s, to determine if the signal has changed more than 80%. The DTC sets when the condition exists for greater than 4 s.

Action Taken When the DTC Sets

- DTCs P00F4, P00F5, and P00F6 are Type B DTCs.

Conditions for Clearing the MIL/DTC

- DTCs P00F4, P00F5, and P00F6 are Type B DTCs.

Diagnostic Aids

- The Intake Air Humidity Signal parameter displays the measured humidity within the air intake system and may differ from atmospheric humidity measured outside the air intake system.
- With the Vehicle in Service Mode, if the engine is cold, a properly functioning humidity sensor will gradually increase the scan tool Intake Air Humidity Signal parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the Intake Air Humidity parameter displays the value: 0 % or 100 %, and there are also IAT Sensor 2 DTCs, check for a circuit problem.
- With the Vehicle in Service Mode, if the engine is cold, a properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to Special Tools (Diagnostic Tools) Special Tools (Repair Tools) .

Circuit/System Verification

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 1 and 2 of this verification procedure only if the ignition has been OFF for 8 hours or more.

1. Vehicle in Service Mode.
2. Verify that DTC P0102, P0103, P0641, P0651, P0697, P06A3, or P06D2 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

- **If none of the DTCs are set**

3. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.

- Start-Up IAT Sensor 1
- IAT Sensor 2
- **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

4. Engine Running.
5. Verify the scan tool Intake Air Humidity Sensor parameter is between 5 and 90 %.

- **If not between 5 and 90 %**

Refer to Circuit/System Testing.

- **If between 5 and 90 %**

6. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
 7. Verify the DTC does not set.
- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

2. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

4. Vehicle in Service Mode.

5. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.

2. Test for less than 2 Ω in the ignition voltage circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.

1. Vehicle OFF, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.

2. Test for infinite resistance between the ignition voltage circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
- **If a test lamp illuminates**

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage near B+ can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

6. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.

- **If 1% or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If less than 1%**

7. Vehicle OFF, connect a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3, vehicle in Service Mode.

8. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.

- **If 99% or less**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Vehicle OFF, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Vehicle OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 99%**

9. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air sensor.
2. Test the Intake Air Humidity Sensor by varying the air humidity in the intake duct near the sensor, while

observing the scan tool Intake Air Humidity Sensor parameter. The parameter should change and be within 5 - 95%.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

3. All OK.

Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Vehicle OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50 % (Normal)
 - Frequency switch to 250 Hz
4. Vehicle in Service Mode.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
 - IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76Â°C (160 - 166Â°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

Replace the K20 Engine Control Module.

- **If all the parameters are within the specified range**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, OR P26C9: CONTROL MODULE REQUESTED MIL ILLUMINATION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each of the diagnostic category.

DTC Descriptor

DTC P00FF

Body Control Module Requested MIL Illumination

DTC P069E

Fuel Pump Control Module Requested MIL Illumination

DTC P06EC

Fuel Injector Control Module Requested MIL Illumination

DTC P0700

Transmission Control Module Requested MIL Illumination

DTC P0800

Active Transfer Case Control Module Requested MIL Illumination

DTC P0AC4

Hybrid/EV Powertrain Control Module Requested MIL Illumination

DTC P1E00

Hybrid/EV Powertrain Control Module 2 Requested MIL Illumination

DTC P2561

Air Conditioning (A/C) Control Module Requested MIL Illumination

DTC P25A2

Brake System Control Module Requested MIL Illumination

DTC P25AF

Coolant Temperature Control Module Requested MIL Illumination

DTC P25C9

Brake System Control Module 2 Requested MIL Illumination

DTC P26C8

Chassis Control Module Requested MIL Illumination

DTC P26C9

Auxiliary Chassis Control Module Requested MIL Illumination

Circuit/System Description

Control modules constantly monitor the vehicle for any condition which may adversely affect vehicle performance. If a condition is detected, the module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets a DTC to inform the technician that the module has set a DTC. The serial data message sent by the module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

The technician can observe the DTC that was set by the module by reviewing the ECM Freeze Frame records on the scan tool. The ECM Freeze Frame records also contain the engine operating conditions present when the DTC set.

Conditions for Running the DTC

- The ignition is ON or the engine is running.
- These DTCs run continuously.

Conditions for Setting the DTC

The ECM receives a serial data message from a specific module indicating that DTC has set in the module.

Action Taken When the DTC Sets

DTCs P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, and P26C9 are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, and P26C9 are Type A DTCs.

Diagnostic Aids

Communication codes, U-codes, and P-codes that set in a module can request a DTC to be set in the ECM.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Do not replace the engine control module for these informational DTCs.
- Correct any engine control and communication DTCs before diagnosing these DTCs.

1. Vehicle in Service Mode.
2. Verify there are no engine control or communication DTCs set.
 - If a DTC is set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If a DTC is not set
3. Verify there are no DTCs set in any other control module.
 - If a DTC is set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If a DTC is not set
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 5. Verify the DTC does not set.
 - If the DTC sets

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If the DTC does not set
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P0101: MASS AIR FLOW (MAF) SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC P0101

Mass Air Flow (MAF) Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	P0102	P0096	P0101, P0103
Signal	P0102	P0102	P0102	P0102	P0101, P0103, P1101
Ground	-	P0096, P0097, P00F4, P0102, P2199	P0102	-	P0102

Circuit Description

The intake flow rationality diagnostic provides the within-range rationality check for the mass air flow (MAF), manifold absolute pressure (MAP), and the throttle position sensors. This is an explicit model-based diagnostic containing 4 separate models for the intake system.

The estimates of MAF and MAP obtained from this system of models and calculations are then compared to the actual measured values from the MAF, MAP, and the throttle position sensors and to each other to determine the appropriate DTC to fail.

Conditions for Running the DTCs

- DTC P0102, P0103, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0128, P0335, or P0336 is not set
- The engine speed is between 0 - 5, 400 RPM.
- The engine coolant temperature (ECT) is between -7 to +125Â°C (+19 to +257Â°F).
- The intake air temperature (IAT) is between -20 and +125Â°C (-4 and +257Â°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The engine control module (ECM) detects that the actual measured airflow from the MAF, MAP, and throttle position sensors is not within range of the calculated airflow that is derived from the system of models for greater than 2 s.

Action Taken When the DTC Sets

DTC P0101 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0101 is a Type B DTC.

Diagnostic Aids

- Any type of contamination on the MAF sensor heating elements will degrade the proper operation of the sensor. Certain types of contaminants act as a heat insulator, which will impair the response of the sensor to airflow changes. Water or snow can create the opposite effect, and cause the signal to increase rapidly.
- Certain aftermarket air filters may cause this DTC to set.
- Certain aftermarket air induction systems may cause this DTC to set.
- Modifications to the air induction system may cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify that DTC DTC P0641, P0651, P0697, P06A3, or P06D2 is not set.

- **If any of the DTCs are set**

Refer to [DTC P0641, P0651, P0697, P06A3, or P06D2](#) for further diagnosis.

- **If none of the DTCs are set**

3. If you were sent here from DTC P0068, P0106, P0121, or P1101; refer to Circuit/System Testing.

4. Verify the scan tool Throttle Body Idle Airflow Compensation parameter is less than 90 %.

- **90 % or greater**

Refer to [Throttle Body Inspection and Cleaning](#) .

- **If less than 90 %**

NOTE: **The Sweep Test may need to be commanded manually.**

5. Verify the scan tool Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.

- **If Disagree**

Refer to [DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135](#) for further diagnosis.

- **If Agree**

6. Determine the current vehicle testing altitude.

7. Verify the scan tool MAP Sensor pressure parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.

- **If the MAP Sensor parameter is not in range**

Refer to [DTC P0106](#) for further diagnosis.

- **If the MAP Sensor parameter is within range**

8. Engine running, verify the scan tool MAP Sensor pressure parameter is between 26 - 52 kPa (3.8 - 7.5 PSI) and changes.

- **If not between 26 - 52 kPa (3.8 - 7.5 PSI) or does not change**

Refer to [DTC P0106](#) for further diagnosis.

- **If between 26 - 52 kPa (3.8 - 7.5 PSI) and changes**

9. Engine speed between 1, 375 and 1, 425 RPM, and at normal operating temperature.

10. Verify the scan tool MAF Sensor parameter is between 1, 800 and 2, 400 Hz.

- **If the MAF Sensor parameter is not between 1, 800 and 2, 400 Hz.**

Refer to Circuit/System Testing.

- **If the MAF Sensor parameter between 1, 800 and 2, 400 Hz.**

11. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

12. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

13. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Verify the integrity of the entire air induction system by verifying that none of the following conditions exist:

- Any damaged components
- Improperly installed components
- Collapsed, restricted, or damaged components
- Loose clamps, cracks, or other damage
- An air flow restriction
- Restricted air filter
- Splits, kinks, leaks, or improper connections at the vacuum hoses
- Vacuum leaks at the intake manifold, MAP sensor, and throttle body
- Water intrusion
- Any snow or ice buildup, in cold climates
- Contamination of the Mass Air Flow sensor element
- **If a condition is found**

Repair or replace component as necessary.

- **If no condition is found**

2. Vehicle Off, disconnect the harness connector at the B75C Multifunction Intake Air sensor.

3. Test for less than 2 Ω between the ground circuit terminal 7 and ground.

- **If 2 Ω or greater**

1. Vehicle Off.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 2 Ω**

4. Vehicle in Service Mode.

5. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle Off, remove the test lamp and remove the fuse for the ignition voltage circuit.
2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle Off, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
- **If a test lamp illuminates**
6. Test for 4.8 - 5.2 volts between the signal circuit terminal 6 and ground.
 - **If less than 4.8 V**
 1. Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle Off, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
7. Determine if **EL-38522-A** Variable Signal Generator or equivalent is available.
 - **EL-38522-A Variable Signal Generator; or equivalent is not available**
 1. Test or replace the B75C Multifunction Intake Air sensor.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
 3. Verify the DTC does not set.
 - If the DTC sets

Replace the K20 Engine Control Module.
 - If no DTCs set
4. All OK.

- **EL-38522-A Variable Signal Generator; or equivalent is available**

8. Vehicle Off, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

- Red lead to the signal circuit terminal 6 at the harness connector
- Black leads to ground
- Battery voltage supply lead to B+

9. Set the **EL-38522-A** Variable Signal Generator to the following specifications.

- Signal switch to 5 V
- Frequency switch to 5 kHz
- Duty Cycle switch to 50 % (Normal)

10. Engine running.

11. Verify the scan tool MAF Sensor parameter is between 4, 950 - 5, 050 Hz.

- **If not between 4, 950 - 5, 050 Hz.**

Replace the K20 Engine Control Module.

- **If between 4, 950 - 5, 050 Hz.**

12. Test or replace the B75C Multifunction Intake Air sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Mass Airflow Sensor Replacement** for multifunction intake air sensor replacement
- **Control Module References** for engine control module replacement, programming, and setup

DTC P0102 OR P0103: MASS AIR FLOW (MAF) SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0102

Mass Air Flow (MAF) Sensor Circuit Low Frequency

DTC P0103

Mass Air Flow (MAF) Sensor Circuit High Frequency

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
---------	-----------------	-----------------	------	------------------	--------------------

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199**	P0096, P0097, P00F4, P0102, P2199**	P0097, P00F4, P0102, P2199	P0096	P0101, P0103
Signal	P0102	P0102	P0102	P0102	P0101, P0103, P1101
Ground	-	P0096, P0097, P00F4, P0102, P2199**	P0097, P00F4, P0102, P2199	-	P0102
**If applicable.					

Typical Scan Tool Data

MAF Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions			
Parameter Normal Range: 2, 000 - 10, 000 Hz			
Ignition Voltage	0 Hz	0 Hz	-
Signal	0 Hz	0 Hz	0 Hz
Ground	-	0 Hz	-

Circuit/System Description

The mass air flow (MAF) sensor is integrated with the multifunction intake air sensor. The MAF sensor is an air flow meter that measures the amount of air in the sensor bore. The engine control module (ECM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition.

The ECM applies 5 V to the MAF sensor on the MAF sensor signal circuit. The sensor uses the voltage to produce a variable frequency signal based on the inlet air flow through the sensor bore. The signal varies with engine load and is displayed by the scan tool as Hertz (Hz) and grams per second (g/s). Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- Intake Air Temperature (IAT) sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor

- MAF sensor
- BARO pressure sensor

Conditions for Running the DTC

- The engine speed is at least 300 RPM.
- The ignition signal is at least 10 V.
- The above conditions are met for at least 1 s.
- DTC's run continuously when the above conditions are met.

Conditions for Setting the DTC

P0102

The ECM detects that the MAF Sensor signal parameter is less than 1.825 Hz (about 1.46 g/s) for at least 250 cylinder firing events.

P0103

The ECM detects that the MAF Sensor signal parameter is at least 12, 800 Hz (about 257 g/s) for at least 250 cylinder firing events.

Action Taken When the DTCs Set

DTCs P0102 and P0103 are Type B DTCs.

Conditions for Clearing the MIL/DTCs

DTCs P0102 and P0103 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to Special Tools (Diagnostic Tools) Special Tools (Repair Tools) .

Circuit/System Verification

1. Engine idling.
2. Verify the scan tool MAF Sensor parameter is between 2.5 - 5.5 g/s.
 - **If not between 2.5 - 5.5 g/s**

Refer to Circuit/System Testing.
 - **If between 2.5 - 5.5 g/s**
3. Engine speed between 1, 375 and 1, 425 RPM, and at normal operating temperature.
4. Verify the scan tool MAF Sensor parameter is between 1, 800 and 2, 400 Hz.
 - **If the MAF Sensor parameter is not between 1, 800 and 2, 400 Hz.**

Refer to Circuit/System Testing.
 - **If the MAF Sensor parameter between 1, 800 and 2, 400 Hz.**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
7. All OK

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air sensor.
2. Test for less than 2 Ω between the ground circuit terminal 7 and ground.
 - **If 2 Ω or greater**

1. Disconnect the sensor chassis ground.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the chassis ground connection.
- **If less than 2 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
 2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle Off, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
 - **If a test lamp illuminates**
5. Vehicle in Service Mode, test for 4.8 - 5.2 volts between the signal circuit terminal 6 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Vehicle in Service Mode, test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
6. Determine if EL-38522-A Variable Signal Generator or equivalent is available.
 - **EL-38522-A Variable Signal Generator; or equivalent is not available**
 1. Test or replace the B75C Multifunction Intake Air sensor.
 2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle

within the conditions that you observed from the freeze frame/failure records data.

3. Verify the DTC does not set.

- If the DTC sets

Replace the K20 Engine Control Module.

- If no DTCs set

4. All OK.

- **EL-38522-A Variable Signal Generator; or equivalent is available**

7. Vehicle OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

- Red lead to the signal circuit terminal 6 at the harness connector
- Black leads to ground
- Battery voltage supply lead to B+

8. Set the **EL-38522-A** Variable Signal Generator to the following specifications.

- Signal switch to 5 V
- Frequency switch to 5 kHz
- Duty Cycle switch to 50 % (Normal)

9. Engine idling.

10. Verify the scan tool MAF Sensor parameter is between 4, 950 - 5, 050 Hz.

- **If not between 4, 950 - 5, 050 Hz.**

Replace the K20 Engine Control Module.

- **If between 4, 950 - 5, 050 Hz.**

11. Test or replace the B75C Multifunction Intake Air sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0106: MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0106

Manifold Absolute Pressure (MAP) Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0106, P0107, P0697	P0106, P0107	P0106, P0108, P0697	P0106
Signal	P0106, P0107	P0108	P0108	P0106
Low Reference	-	P0108	-	P0106

Typical Scan Tool Data

MAP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: - Engine - Idling - At normal operating temperature - Accessories=Off			
Parameter Normal Range: 26 to 52 kPa (3.8 to 7.6 PSI)			
5 V Reference	0 kPa (0.0 PSI)	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)
Signal	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)	127 kPa (18.4 PSI)
Low Reference	-	127 kPa (18.4 PSI)	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B74 Manifold Absolute Pressure Sensor	The sensor is a 3-wire capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The sensor measures the pressure in the intake manifold. The signal is used to determine the engine load. When the engine is idling or decelerating, the sensor pressure should be low. When the engine is off or under wide-open throttle conditions the pressure should be the same or close to the barometric pressure.

Conditions for Running the DTC

- DTC P0102, P0103, P0107, P0108, P010C, P010D, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0335, P0336, P0401, P0405, P0406, P042E = Not set
- Intake Air Temperature = -20 to 125Â°C (-4 to 257Â°F)
- Engine Coolant Temperature...= -20 to 125Â°C (-4 to 257Â°F)
- Engine Speed.= 500 to 8000 RPM

or

- DTC P0107, P0108, P2227, P2228, P2229, P2230, P2610 = Not set
- Ignition On - Engine Off

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

The difference between the manifold absolute pressure measured by the manifold absolute pressure sensor and a calculated value based on the throttle position exceeds the allowed range.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Disassembled Views

Description and Operation

Engine Control Module Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

Special Tools

EN-23738-A Vacuum Pump

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

[Circuit/System Verification](#)

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0641, P0651, P0697, P06A3, P06D2 is not set.
 - **If any of the DTCs are set**

Refer to: [DTC P0641, P0651, P0697, P06A3, or P06D2](#)

- **If none of the DTCs are set**
3. If you were sent here from DTC P0101, P0121, P1101 - Refer to Circuit/System Testing.
 4. Verify the scan tool parameter:Throttle Body Idle Air Flow Compensation=Less than 90 %
 - **If 90 % or greater**

Refer to: [Throttle Body Inspection and Cleaning](#)

- **If less than 90 %**
5. Perform the scan tool control function:Throttle Sweep - Start

Verify the scan tool parameter:Throttle Position Sensors 1 and 2=Agree

- **If not the specified state**

Refer to: [DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135](#)

- **If the specified state**
6. Determine the current vehicle testing altitude.
 7. Verify the scan tool parameter:MAP Sensor=The value should be within the range listed in the table:
 [Altitude Versus Barometric Pressure](#)

- **If not in the specified range**

Refer to: Circuit/System Testing

- **If in the specified range**

8. Engine - Idling - At normal operating temperature
9. Verify the scan tool parameter:MAP Sensor= 26 to 52 kPa (3.8 to 7.6 PSI) and changes
 - **If not between 26 to 52 kPa (3.8 to 7.6 PSI) or does not change**

Refer to: Circuit/System Testing

- **If between 26 to 52 kPa (3.8 to 7.6 PSI) and changes**
10. Observe the following scan tool parameter:MAF Sensor & Engine Speed.
 11. Increase the engine speed slowly to 2000 RPM and then back to idle.
 12. Verify the scan tool parameter:MAF Sensor=The value should change smoothly and gradually as the engine speed is increased and decreased.
 - **If the value does not change smoothly and gradually**

Refer to:[**DTC P0101**](#)

- **If the value changes smoothly and gradually**
13. Verify the scan tool parameter:MAP Sensor=The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector:B74 Manifold Absolute Pressure Sensor
- Wiggle the harness and connector:K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **If the value does not spike or drop out**
14. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 15. Verify the DTC does not set.
 - **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC is not set**
16. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle - Off
2. Verify the following conditions do not exist:
 - Collapsed or restricted intake air duct.
 - Leaking or restricted component:Exhaust System

- Leaking, missing, or damaged O-ring on the components listed below:
 - B74 Manifold Absolute Pressure Sensor
- Engine vacuum leaks.
- An engine mechanical condition. - Wear of timing chain, tensioner, or sprockets. or If one or more cylinders indicate low compression

Refer to: [Symptoms - Engine Mechanical](#)

- **If a condition exists - Repair or replace as necessary**
- **If no condition exists**

3. Disconnect the electrical connector:

4. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground

- **If 10 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @Component harness & Terminal 21 X2 @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If less than 10 ohms**

5. Ignition - On / Vehicle - In Service Mode

6. Test for 4.8 to 5.2 V between the test points: 5V Reference circuit terminal 1 & Low Reference circuit terminal 2

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @Component harness & Terminal 5 X2 @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.

- If less than 1 V - Replace the component:K20 Engine Control Module
 - **If between 4.8 and 5.2 V**
7. Verify the scan tool parameter:MAP Sensor=Greater than 4.7 V
- **If 4.7 V or less**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector:K20 Engine Control Module
 3. Test for infinite resistance between the test points:Signal circuit terminal 3 @Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component:K20 Engine Control Module
 - **If greater than 4.7 V**
8. Connect a 3 A fused jumper wire between the test points:Signal circuit terminal 3 & Low Reference circuit terminal 2
9. Verify the scan tool parameter:MAP Sensor =Less than 0.2 V
- **If 0.2 V or greater**
 1. Ignition/Vehicle - OffRemove - Jumper Wire
 2. Disconnect the electrical connector:K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:Signal circuit terminal 3 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points:Signal circuit terminal 3 @Component harness & Terminal 40 X3 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K20 Engine Control Module
 - **If less than 0.2 V**
10. Test or replace the component:B74 Manifold Absolute Pressure Sensor

Component Testing

Dynamic Test - Using Vehicle Harness

1. Ignition/Vehicle - Off
2. Remove the component:B74 Manifold Absolute Pressure Sensor - Leave the electrical connector connected.
3. Install the special tool: **EN-23738-A** Vacuum Pump @B74 Manifold Absolute Pressure Sensor
4. Use the special tool to achieve a gauge reading between -13 and -21 kPa (-0.13 and -0.21 bar, -3.8 and -6.2 in Hg).

Verify the scan tool parameter:MAP Sensor=Decreases between 13 and 21 kPa (1.8 and 3.0 PSI)

- **If the parameter does not decrease between 13 and 21 kPa (1.8 and 3.0 PSI)**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **If the parameter decreases between 13 and 21 kPa (1.8 and 3.0 PSI)**

5. Use the special tool to achieve a gauge reading between -30 and -38 kPa (-0.3 and -0.38 bar, -8.8 and -11.2 in Hg).

Verify the scan tool parameter: MAP Sensor=Decreases between 30 and 38 kPa (4.4 and 5.5 PSI)

- **If the parameter does not decrease between 30 and 38 kPa (4.4 and 5.5 PSI)**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **If the parameter decreases between 30 and 38 kPa (4.4 and 5.5 PSI)**

6. All OK.

Dynamic Test - Using Jumper Wires

1. Ignition/Vehicle - Off
2. Remove the component: B74 Manifold Absolute Pressure Sensor
3. Connect a 3 A fused jumper wire between the test points: 5 V Reference terminal 1 & 5 V
4. Connect a jumper wire between the test points: Low Reference terminal 2 & Ground
5. Connect a DMM between the test points: Signal terminal 3 @B74 Manifold Absolute Pressure Sensor & Ground
6. Install the special tool: EN-23738-A Vacuum Pump @B74 Manifold Absolute Pressure Sensor
7. Use the special tool to achieve a gauge reading between -55 and -47 kPa (-0.55 and -0.47 bar, -13.8 and -16.2 in Hg).

Verify the DMM displays between 0.2 and 4.9 V. - The value should not spike or drop out.

- **If not between 0.2 and 4.9 V or has spikes or drops out**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **If between 0.2 and 4.9 V and there are no spikes or drops out**

8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Manifold Absolute Pressure Sensor Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0107 OR P0108: MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P0107

Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

DTC P0108

Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0106, P0107, P0697	P0106, P0107	P0106, P0108, P0697	P0106
Signal	P0106, P0107	P0108	P0108	P0106
Low Reference	-	P0108	-	P0106

Typical Scan Tool Data

MAP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: • Engine - Idling - At normal operating temperature • All accessories Off.			
Parameter Normal Range: 26 to 52 kPa (3.8 to 7.6 PSI)			
5 V Reference	0 kPa (0.0 PSI)	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)
Signal	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)	127 kPa (18.4 PSI)
Low Reference	-	127 kPa (18.4 PSI)	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B74 Manifold Absolute Pressure Sensor	The sensor is a 3-wire capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The sensor measures the pressure in the intake manifold. The signal is used to determine the engine load.

When the engine is idling or decelerating, the sensor pressure should be low. When the engine is off or under wide-open throttle conditions the pressure should be the same or close to the barometric pressure.

Conditions for Running the DTC

Ignition=On

DTCs run continuously when the above condition is met.

Conditions for Setting the DTC

P0107

MAP Sensor=Less than 0.2 V - For greater than 4 s

P0108

MAP Sensor=Greater than 0.5 V - For greater than 4 s

Actions Taken When the DTC Sets

DTCs P0107, P0108 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0107, P0108 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Disassembled Views

Description and Operation

Engine Control Module Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0651, P0697, P06A3, P06D2 is not set.
 - **If any of the DTCs are set**

Refer to: **DTC P0641, P0651, P0697, P06A3, or P06D2**
 - **If none of the DTCs are set**
3. Verify the scan tool parameter:MAP Sensor=The value should be within the range listed in the table:
Altitude Versus Barometric Pressure
 - **If not in the specified range**

Refer to: Circuit/System Testing
 - **If in the specified range**
4. Engine - Idling - At normal operating temperatureAll accessories Off.
5. Verify the scan tool parameter:MAP Sensor= 26 and 52 kPa (3.8 and 7.6 PSI)
 - **If not between 26 and 52 kPa (3.8 and 7.6 PSI)**

Refer to: Circuit/System Testing
 - **If between 26 and 52 kPa (3.8 and 7.6 PSI)**
6. Verify the scan tool parameter:MAP Sensor=The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector:B74 Manifold Absolute Pressure Sensor
- Wiggle the harness and connector:K20 Engine Control Module

- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **If the value does not spike or drop out**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC is not set**

9. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector:B74 Manifold Absolute Pressure Sensor

3. Test for less than 10 ohms between the test points:Low Reference circuit terminal 2 & Ground

- **If 10 ohms or greater**

1. Disconnect the electrical connector:K20 Engine Control Module

2. Test for less than 2 ohms between the test points:Low Reference circuit terminal 2 @Component harness & Terminal 21 X2 @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component:K20 Engine Control Module

- **If less than 10 ohms**

4. Vehicle in Service Mode.

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Low Reference circuit terminal 2

- **If less than 4.8 V**

1. Vehicle Off.

2. Disconnect the electrical connector:K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2 ohms between the test points:5 V Reference circuit terminal 1 @Component harness & Terminal 5 X2 @Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component:K20 Engine Control Module
- **If greater than 5.2 V**
 1. Vehicle Off.
 2. Disconnect the electrical connector:K20 Engine Control Module
 3. Vehicle in Service Mode.
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component:K20 Engine Control Module
 - **If between 4.8 and 5.2 V**
- 6. Verify the scan tool parameter:MAP Sensor=Greater than 4.7 V
 - **If 4.7 V or less**
 1. Vehicle Off.
 2. Disconnect the electrical connector:K20 Engine Control Module
 3. Test for infinite resistance between the test points:Signal circuit terminal 3 @Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component:K20 Engine Control Module
 - **If greater than 4.7 V**
- 7. Connect a 3 A fused jumper wire between the test points:Signal circuit terminal 3 & Low Reference circuit terminal 2
- 8. Verify the scan tool parameter:MAP Sensor =Less than 0.2 V
 - **If 0.2 V or greater**
 1. Vehicle Off, remove jumper wire.
 2. Disconnect the electrical connector:K20 Engine Control Module
 3. Vehicle in Service Mode.
 4. Test for less than 1 V between the test points:Signal circuit terminal 3 @Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Vehicle Off.
 6. Test for less than 2 ohms between the test points:Signal circuit terminal 3 @Component harness & Terminal 40 X3 @Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component:K20 Engine Control Module
 - **If less than 0.2 V**
- 9. Replace the component:B74 Manifold Absolute Pressure Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Manifold Absolute Pressure Sensor Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0112, P0113, OR P0114: INTAKE AIR TEMPERATURE (IAT) SENSOR 1

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0112

Intake Air Temperature (IAT) Sensor 1 Circuit Low Voltage

DTC P0113

Intake Air Temperature (IAT) Sensor 1 Circuit High Voltage

DTC P0114

Intake Air Temperature (IAT) Sensor 1 Circuit Intermittent

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P2199**	P0113, P2199**	P0097*, P0113, P0114, P11C2, P2199**	P0111, P2199**
Low Reference	-	P0111, P0113, P0114, P2199**	P0113*, P0114	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				
**If applicable.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F).

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- Mass Air Flow (MAF) sensor
- BARO pressure sensor

IAT Sensor 1 - Temperature, Resistance, Voltage Table

IAT Sensor 1	IAT Sensor 1 Resistance	IAT Sensor 1 Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTCs

P0112, P0113, and P0114

- The ignition is ON, or the engine is running.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and +150Â°C (-40 and +302Â°F).

P0112

The ECM detects that the IAT sensor signal is warmer than 150Â°C (302Â°F) for at least 5 s.

P0113

The ECM detects that the IAT sensor signal is colder than -60Â°C (-76Â°F) for at least 5 s.

P0114

Where this DTC is used, the ECM detects that the IAT sensor signal is intermittent or has abruptly changed for at least 5 s.

Action Taken When the DTCs Set

- DTCs P0112, P0113, and P0114 are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the DTCs

DTCs P0112, P0113, and P0114 are Type B DTCs.

Diagnostic Aids

With the Vehicle in Service Mode, the engine OFF, if the engine is cold, a properly functioning IAT sensor 1 will gradually increase the scan tool IAT Sensor 1 parameter. This is due to the heat that is generated by the MAF sensor heating elements.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 1 and 2 of this verification procedure only if the ignition has been OFF for 8 hours or more.

1. Vehicle in Service Mode.

2. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.

- Start-Up IAT Sensor 1
- IAT Sensor 2
- **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

3. Engine idling.

4. Verify the following scan tool parameters are between: -38 and +149Â°C (-36 and +300Â°F).

- IAT Sensor 1
- IAT Sensor 2
- **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit/System Testing.

- **If between: -38 and +149Â°C (-36 and +300Â°F)**

5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

2. Test for less than 2 Ω between the low reference circuit terminal 3 and ground.

- **If 2 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 engine control module.

- **If less than 2 Ω**

3. Vehicle in Service Mode, test for 4.8 - 5.2 V between the intake air temperature sensor 1 signal circuit terminal 1 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 engine control module.
- **If greater than 5.2 V**

NOTE: **If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.
2. Vehicle in Service Mode, test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 engine control module.
- **If between 4.8 - 5.2 V**
4. Vehicle in Service Mode, verify the scan tool IAT Sensor 1 parameter is colder than -39 $^{\circ}\text{C}$ (-38 $^{\circ}\text{F}$).
 - **If warmer than -39 $^{\circ}\text{C}$ (-38 $^{\circ}\text{F}$).**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If colder than -39 $^{\circ}\text{C}$ (-38 $^{\circ}\text{F}$).**
5. Vehicle OFF, install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 3.
6. Verify the scan tool IAT Sensor 1 parameter is warmer than 148 $^{\circ}\text{C}$ (298 $^{\circ}\text{F}$).
 - **If colder than 148 $^{\circ}\text{C}$ (298 $^{\circ}\text{F}$).**
1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- If warmer than 148Â°C (298Â°F).

7. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air Sensor.

NOTE: A thermometer can be used to test the sensor off the vehicle.

2. Test resistance of the IAT sensor 1, between signal terminal 1 and the low reference terminal 3, by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance - Intake Air Temperature Sensor (Hitachi sensor) table for Hitachi Sensors. The resistance values should be in range of the table values.

- If not within the specified range

Replace the B75C Multifunction Intake Air Sensor.

- If within the specified range

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Mass Airflow Sensor Replacement for multifunction intake air sensor replacement
- Control Module References for engine control module replacement, programming, and setup.

DTC P0117, P0118, OR P0119: ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0117

Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

DTC P0118

Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

DTC P0119

Engine Coolant Temperature (ECT) Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal Circuit	P0117	P0118	P0118*	P0116, P0119, P0128
Low Reference	-	P0118	-	P0119, P0128
*ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: -39 to 149Â°C (-38 to 300Â°F)			
ECT Sensor	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-

Circuit/System Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 V to the ECT sensor signal circuit and a ground for the low reference circuit. This diagnostic checks for an open, short to ground or an intermittent circuit condition between the ECM and ECT sensor.

Conditions for Running the DTC

P0117

- Vehicle ON, or the engine is running.
- This DTC runs continuously when the above conditions are met.

P0118

- The engine run time is greater than 10 s.
- The intake air temperature (IAT) sensor is greater than 0Â°C (32Â°F).
- This DTC runs continuously when the above conditions are met.

P0119

- DTC P0117 or P0118 are not set.
- Vehicle ON, or the engine is running.
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0117

The ECM detects that the ECT sensor signal is warmer than 149Â°C (300Â°F) for greater than 5 s.

P0118

The ECM detects that the ECT is colder than -39°C (-38°F) for greater than 5 s.

P0119

The ECM detects that the ECT is intermittent or has abruptly changed for greater than 4 seconds.

Action Taken When the DTC Sets

- DTCs P0117, P0118 and P0119 are Type B DTCs
- The cooling fans will be commanded ON.
- The engine is forced ON and Autostop is disabled.

Conditions for Clearing the DTC

DTCs P0117, P0118 and P0119 are Type B DTCs

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify the scan tool ECT Sensor parameter is warmer than -40°C (-40°F) and colder than 150°C (302°F) and changes with engine run time.

- **If colder than -39°C (-38°F) or warmer than 149°C (300°F) or does not change**

Refer to Circuit/System Testing.

- **If warmer than -40°C (-40°F) and colder than 150°C (302°F) and changes**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems OFF, disconnect the B34 Engine Coolant Temperature sensor harness connector at the sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than $5\ \Omega$ between the low reference circuit terminal 2 and ground.

- **If $5\ \Omega$ or greater**

1. Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than $2\ \Omega$ in the low reference circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.

- **If less than $5\ \Omega$**

3. Vehicle in Service Mode.

4. Verify the scan tool ECT Sensor parameter is colder than -39°C (-38°F).

- **If warmer than -39°C (-38°F)**

1. Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If colder than -39°C (-38°F)**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.

6. Verify the scan tool ECT sensor parameter is warmer than 149°C (300°F).

- **If 149°C (300°F) or colder**

1. Vehicle Off, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Vehicle Off.

4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If warmer than 149 $^{\circ}$ C (300 $^{\circ}$ F)**

7. Test or replace the B34 Engine Coolant Temperature Sensor.

Component Testing

1. Vehicle Off, disconnect the harness connector at the B34 Engine Coolant Temperature Sensor.

2. Test the ECT sensor by varying the sensor temperature while measuring the sensor resistance. Compare the readings with the Temperature Versus Resistance (Engine Coolant Temperature Sensor) table. The resistance values should be in range of the table values.

- **If not within the specified range**
- Replace the B34 Engine Coolant Temperature Sensor.
- **If within the specified range**

3. Test for infinite resistance between each terminal and the sensor housing.

- **If less than infinite resistance**

Replace the B34 Engine Coolant Temperature Sensor.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Engine Coolant Temperature Sensor Replacement - Water Outlet
- Control Module References for control module replacement, programming, and setup.

DTC P0121-P0123, P0222, P0223, P16A0-P16A2, OR P2135: THROTTLE POSITION SENSOR/SENSOR COMMUNICATION CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0121

Throttle Position Sensor 1 Performance

DTC P0122

Throttle Position Sensor 1 Circuit Low Voltage

DTC P0123

Throttle Position Sensor 1 Circuit High Voltage

DTC P0222

Throttle Position Sensor 2 Circuit Low Voltage

DTC P0223

Throttle Position Sensor 2 Circuit High Voltage

DTC P16A0

Sensor Communication Circuit Low Voltage

DTC P16A1

Sensor Communication Circuit High Voltage

DTC P16A2

Sensor Communication Circuit Performance

DTC P2135

Throttle Position Sensors 1-2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P06A3	P0122*, P0222*, P16A0	P06A3	P0121, P16A2, P2135*
Signal	P0122*, P0222*, P16A0	P0122*, P0222*, P16A1	P0123*, P0223*, P16A0**, P16A1**, P16A2**	P0121, P16A2, P2135*
Low Reference	-	P0123*, P0223*, P16A1	-	P0121, P16A2, P2135*
* This DTC set indicates an internal throttle body condition. ** A short to voltage causes P16A1 to set. If DTC P16A0, P16A1, and P16A2 set at the same time, an intermittent circuit condition exists.				

Typical Scan Tool Data

Throttle Position Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating with the throttle closed. All accessories OFF.			
Parameter Normal Range: Throttle Position Sensor 1 3.75 - 4.75 V			
5 V Reference	5.0 V	5.0 V	5.0 V
Signal	5.0 V	0.0 V	0.0 V
Low Reference	-	0.0 V	-

Throttle Position Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating with the throttle closed. All accessories OFF.			
Parameter Normal Range: Throttle Position Sensor 2 0.45 - 0.90 V			
5 V Reference	0.0 V	0.0 V	0.0 V
Signal	0.0 V	5.0 V	5.0 V
Low Reference	-	5.0 V	-

Circuit/System Description

The throttle body assembly contains a contact-less inductive throttle position sensing element that is managed by a customized integrated circuit. The throttle position sensor is mounted within the throttle body assembly and is not serviceable. The engine control module (ECM) supplies the throttle body with a 5 V reference circuit, a low reference circuit, an H-bridge motor directional control circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the throttle body to the ECM. The throttle body cannot receive data from the ECM over the signal/serial data circuit. The throttle position sensor provides a signal voltage that changes relative to throttle blade angle. The customized integrated circuit translates the voltage based position information into serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The throttle position sensor information is transmitted between the throttle body and the ECM on the signal/serial data circuit. The ECM decodes the serial data signal into separate voltages which are displayed on a scan tool as the voltage inputs from throttle position sensors 1 and 2.

Conditions for Running the DTC

P0121

- DTCs P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0335, or P0336 is not set.
- The engine speed is between 0 - 5, 400 RPM.
- The engine coolant temperature (ECT) is -7 to +125Â°C (19 - 257Â°F).
- The intake air temperature (IAT) is -20 to +125Â°C (-4 to +257Â°F).
- The DTC runs continuously when the above conditions are met.

P0122, P0123, P0222, P0223

- DTC P06A3 is not set.
- The ignition is ON or the engine is running.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The DTCs run continuously when the above condition are met.

P16A0, P16A1, or P16A2

- DTC P06A3 is not set.
- The ignition is ON or the engine is operating.
- The run/crank voltage is greater than 6.41 V.
- The DTCs run continuously once the above conditions are met for greater than 1 s.

P2135

- DTCs P0122, P0123, P0222, P0223, or P06A3 are not set.
- The ignition is ON or the engine is running.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0121

The ECM detects that the throttle position sensor 1 voltage is stuck within normal operating range for greater than 1 s.

P0122

The ECM detects the throttle position sensor 1 signal voltage is less than 0.32 V for greater than 1 s.

P0123

The ECM detects the throttle position sensor 1 signal voltage is greater than 4.75 V for greater than 1 s.

P0222

The ECM detects the throttle position sensor 2 signal voltage is less than 0.25 V for greater than 1 s.

P0223

The ECM detects the throttle position sensor 2 signal voltage is greater than 4.59 V for greater than 1 s.

P16A0

The ECM detects a low voltage circuit condition on the throttle position sensor signal circuit for greater than 1 s.

P16A1

The ECM detects a high voltage circuit condition on the throttle position sensor signal circuit for greater than 1 s.

P16A2

The ECM detects an incorrect message was received over the throttle position sensor signal circuit for greater

than 1 s.

P2135

The ECM detects that throttle position sensors 1 and 2 disagree greater than 7 - 10 percent for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P0121 is a Type B DTC.
- DTCs P0122, P0123, P0222, P0223, P16A0, P16A1, P16A2, and P2135 are Type A DTCs.
- The ECM commands the throttle actuator control (TAC) system to operate in a Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions, the ECM commands the engine OFF.

Conditions for Clearing the DTC

- DTCs P0121 is a Type B DTC.
- DTCs P0122, P0123, P0222, P0223, P16A0, P16A1, P16A2, and P2135 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- If the accelerator pedal is pressed to the wide open throttle position, the throttle blade angle or Throttle Position angle is limited to less than 40 percent.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Throttle Actuator Control (TAC) System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: If you were sent here from DTC P0068, P0101, P0106, or P1101 refer to **Circuit/System Testing**.

1. Vehicle in Service Mode.
2. Verify that DTC P0601 - P0606, P06A3, and P16F3 is not set.
 - **If a DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.
 - **If a DTC is not set**
3. Verify the scan tool Throttle Body Idle Air flow Compensation parameter is less than 90 %.
 - **If 90 % or greater**

Refer to Throttle Body Inspection and Cleaning .
 - **If less than 90 %**
4. Verify that DTC P0122, P0123, P0222, P0223, P16A0, P16A1, P16A2, or P2135 are not set.
 - **If DTC P0122, P0123, P0222, P0223, or P2135 are the only DTCs set**

Replace the Q38 Throttle Body.
 - **If DTC P16A0, P16A1, or P16A2 is set with any of the DTCs**

Refer to Circuit/System Testing
 - **If none of the DTCs are set**
5. Verify the Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.
 - **If Agree is not displayed**

Replace the Q38 Throttle Body.
 - **If Agree is displayed**
6. Verify DTC P0122, P0123, P0222, P0223, P16A0, P16A1, P16A2, and P2135 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.
 - **If a DTC is not set**
7. Determine the current vehicle testing altitude.

8. Verify the scan tool MAP Sensor pressure parameter is within range specified in the [Altitude Versus Barometric Pressure](#) table.

- **If the MAP Sensor pressure is not in range**

Refer to [DTC P0106](#).

- **If the MAP Sensor pressure is within range**

9. Engine idling.

10. Verify the scan tool MAP Sensor pressure parameter is between 26 - 52 kPa (3.8 - 7.5 psi) and changes with accelerator pedal input.

- **If not between 26 - 52 kPa (3.8 - 7.5 psi) or does not change**

Refer to [DTC P0106](#).

- **If between 26 - 52 kPa (3.8 - 7.5 psi) and changes**

11. Engine speed between 1, 375 and 1, 425 RPM, and at normal operating temperature.

12. Verify the scan tool MAF Sensor parameter is between 1, 800 and 2, 400 Hz.

- **If the MAF Sensor parameter is not between 1, 800 and 2, 400 Hz.**

Refer to [DTC P0101](#).

- **If the MAF Sensor parameter between 1, 800 and 2, 400 Hz.**

13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

14. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

15. All OK.

Circuit/System Testing

NOTE: **Disconnecting the throttle body harness connector causes additional DTCs to set.**

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at Q38 Throttle Body. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 4 and ground.

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 5 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

6. Replace the Q38 Throttle Body.

Repair Instructions

- [Throttle Body Assembly Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Vehicle in Service Mode.
6. Verify the Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.

- **If Agree is not displayed**

Test or replace the Q38 Throttle Body.

- **If Agree is displayed**

7. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not set.

- **If DTC sets**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If DTC does not set**

8. All OK.

DTC P0128: ENGINE COOLANT TEMPERATURE (ECT) BELOW THERMOSTAT REGULATING TEMPERATURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0128

Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ECT Sensor Signal	P0117, P0119	P0118	P0118*	P0116, P0119, P0128
Low Reference	-	P0118, P0119	-	P0119, P0128

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
*ECM or sensor damage may occur if the circuit is shorted to B+				

Typical Scan Tool Data

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running			
Parameter Normal Range: Varies with coolant temperature			
ECT Sensor Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)

Circuit/System Description

The engine control module (ECM) monitors the temperature of the engine coolant for engine control and as enabling criteria for some diagnostics. The ECM monitors the amount of time to reach a predetermined temperature based on the Start up ECT sensor. The ECM uses this temperature to determine if the engine has warmed up to the thermostat regulating temperature. If the engine coolant temperature does not increase normally or does not reach the thermostat regulating temperature, diagnostics that use the ECT as enabling criteria, may not run when expected. If the engine coolant temperature fails to reach the thermostat regulating temperature, before a predetermined amount of time, the DTC sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P00B3, P00B4, P00B6 or P010C are not set.
- The start-up ECT sensor is between -40 to 69Â°C (19 to 156Â°F).
- The engine OFF time is greater than 30 min.
- The engine run time is between 10 s and 30 min.
- The thermostat heater duty cycle is less than 50%.
- The fuel ethanol percentage is 87 % or less.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

- The ECM determines that the modeled ECT has met the calibrated target of 74Â° C (165 Â°F) and the measured ECT is less than 63Â° C (145Â° F) for greater than 1 s.

OR

- The ECM determines that the modeled ECT has met the calibrated target of 55Â° C (131 Â°F) and the measured ECT is less than 25Â° C (77Â° F) for greater than 1 s.

Action Taken When the DTC Sets

- DTC P0128 is a Type B DTC.
- The engine is forced ON and Autostop is disabled.

Conditions for Clearing the DTC

DTC P0128 is a Type B DTC.

Diagnostic Aids

- DTC P0128 can fail when there is a Q66 Passenger Compartment Heater Coolant Control Valve fault.
- Failing DTC P0128 will in turn set an A/C disabled message.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Engine Running
2. Verify DTC P00B3, P00B4, P00B6, P0116, P0117 or P0118 is not set.
 - **If DTC P00B3, P00B4, P00B6, P0116, P0117 or P0118 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If DTC P00B3, P00B4, P00B6, P0116, P0117 or P0118 is not set**
3. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.
 - **If a condition is found**

Refer to [Cooling System Draining and Filling](#) , and [Loss of Coolant](#) .

- **If a condition is not found**

4. Engine Running for 15 min with the A/C OFF.
5. Command the Engine Coolant Thermostat Heater to 0 % with a scan tool, engine at 2, 000 RPM.
6. Verify the scan tool ECT Sensor parameter is between 80Â° C and 102Â° C (176Â° F and 215Â° F).
 - **If ECT sensor is not between 80Â° C and 102Â° C (176Â° F and 215Â° F)**

Replace the engine coolant thermostat.

- **If ECT sensor is between 80Â° C and 102Â° C (176Â° F and 215Â° F)**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
8. Verify the DTC does not set.

- **If the DTC sets**

Refer to step 1.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Thermostat Housing Replacement](#) for engine coolant thermostat replacement.
- [Control Module References](#) for control module replacement, programming, and setup.

DTC P0131, P0132, P0137, OR P0138: HO2S CIRCUIT LOW/HIGH VOLTAGE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC P0131

HO2S Circuit Low Voltage Sensor 1

DTC P0132

HO2S Circuit High Voltage Sensor 1

DTC P0137

HO2S Circuit Low Voltage Sensor 2

DTC P0138

HO2S Circuit High Voltage Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
HO2S High Signal	P0131, P0137	P0132, P0138	P0132, P0138	P0133, P1133*, P015A*, P015B*
HO2S Low Signal	P0131, P0137	P0132, P0138	P0132, P0138	P0133, P1133*, P015A*, P015B*
*If equipped				

Typical Scan Tool Data

HO2S 1 or 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine operating in Closed Loop			
Parameter Normal Range: 23 - 1 930 mV			
HO2S 1 or 2 High Signal	0 mV	1700 - 2 100 mV	1700 - 2 100 mV
HO2S 1 or 2 Low Signal	-	1700 - 2 100 mV	1700 - 2 100 mV

Circuit/System Description

The heated oxygen sensors (HO2S) are used for fuel control and catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content of the exhaust stream. When the engine is started, the control module operates in an open loop mode, ignoring the HO2S signal voltage while calculating the air to fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 0 - 1 275 mV. Once sufficient HO2S voltage fluctuation is observed by the control module, closed loop is entered. The control module uses the HO2S voltage to determine the air to fuel ratio. An HO2S voltage that increases toward 1 000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.

The heating elements inside each HO2S heat the sensor to bring the sensor up to operating conditions faster. This allows the system to enter closed loop earlier and the control module to calculate the air to fuel ratio sooner.

Conditions for Running the DTC

DTC P0131 or P0137

- DTCs P0068, P0106, P0108, P0122, P0123, P0201, P0202, P0203, P0204, P0222, P0223, P0442, P0443, P0449, P0452, P0455, P0496, P0606, P16F3 and P2101 are not set.
- The Ignition voltage is between 10 - 32 V.
- The fuel level is greater than 10%.
- The fuel composition is less than 87% ethanol.
- The fuel system is in Closed Loop.

- The engine is not decelerating.
- DTC P0131 runs continuously when the above conditions are met for greater than 3 s.
- DTC P0137 runs continuously when the above conditions are met for greater than 5 s.

DTC P0132 or P0138

- DTCs P0106, P0108, P0201, P0202, P0203, P0204, P0442, P0443, P0449, P0452, P0453, P0455 and P0496 are not set.
- The Ignition voltage is between 10 - 32 V.
- The Ignition is OFF for greater than 8 h.
- The fuel level is greater than 10%.
- The fuel composition is less than 87% ethanol.
- The fuel system is in Closed Loop.
- The engine runtime is greater than 5 s.
- The engine is not decelerating.
- DTC P0132 and P0138 run continuously when the above conditions are met for greater than 3 s.

Conditions for Setting the DTC

P0131 or P0137

The engine control module detects that the heated oxygen sensor voltage is less than 40 mV for greater than 40 s.

P0132 or P0138

The engine control module detects that the heated oxygen sensor voltage is greater than 1 050 mV for greater than 10 s.

Action Taken When the DTC Sets

DTCs P0131, P0132, P0137 and P0138 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0131, P0132, P0137 and P0138 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Ignition ON.
2. Verify no HO2S heater DTCs are set.
 - **If a HO2S heater DTC is set.**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no HO2S heater DTC is set.**
3. Allow the engine to reach operating temperature, engine running.
4. Verify the scan tool HO2S Sensor 1 or 2 voltage parameters are between 50 - 1 050 mV.
 - **If not between 50 - 1 050 mV.**

Refer to Circuit/System Testing.
 - **If between 50 - 1 050 mV.**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets.**

Refer to Circuit/System Testing.
 - **If the DTC does not set.**
7. All OK.

[Circuit/System Testing](#)

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the appropriate B52 Heated Oxygen Sensor. It may take up to 2 min for all vehicle systems to power down. Ignition ON.
2. Test for 1.7 - 3.0 V between the high signal circuit terminal 4 and ground.
 - **If less than 1.7 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the high signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the high signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 3.0 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the high signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 1.7 - 3.0 V**
 3. Verify the scan tool heated oxygen sensor Bank 1 or 2 Sensor 1 or 2 parameter is between 1.7 - 2.1 V.
 - **If less than 1.7 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the low signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If between 1.7 - 2.1 V**
 4. Connect a 3 A fused jumper wire between the high signal circuit terminal 4 and the low signal circuit terminal 3.

NOTE: **The low signal circuit is tied to a pull-up circuit within the engine control module. A voltage of 0.0 - 1.10 V on the low signal circuit is normal.**

5. Verify the scan tool heated oxygen sensor Bank 1 or 2 Sensor 1 or 2 parameter displays 0.0 V.
 - **If greater than 0.0 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 2 Ω in the low signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω .
 3. Test for less than 1 V between the low signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If 0.0 V**
6. Verify none of the following conditions exist:
 - Lean or rich fuel injectors. Refer to [Fuel Injector Diagnosis](#) .
 - Water intrusion in the HO2S harness connector
 - Low or high fuel system pressure. Refer to [Fuel System Diagnosis](#) .
 - Fuel that is contaminated. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .

- Fuel saturation of the evaporative emission (EVAP) canister
- Exhaust leaks
- Engine vacuum leaks
- **If any of the conditions exist**

Repair as necessary.

- **If none of the conditions exist**

7. Test or replace the B52 Heated Oxygen Sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Heated Oxygen Sensor Replacement - Sensor 1
- Heated Oxygen Sensor Replacement - Sensor 2
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing a HO2S.
- Control Module References for ECM replacement, programming, and setup

DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, OR P2271: HO2S SLOW/DELAYED RESPONSE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0133

HO2S Slow Response Sensor 1

DTC P013A

HO2S Slow Response Rich to Lean Sensor 2

DTC P013B

HO2S Slow Response Lean to Rich Sensor 2

DTC P013E

HO2S Delayed Response Rich to Lean Sensor 2

DTC P013F

HO2S Delayed Response Lean to Rich Sensor 2

DTC P015A

HO2S Delayed Response Rich to Lean Sensor 1

DTC P015B

HO2S Delayed Response Lean to Rich Sensor 1

DTC P2270

HO2S Signal Stuck Lean Sensor 2

DTC P2271

HO2S Signal Stuck Rich Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
HO2S High Signal	P0131, P0137	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P013A, P013B, P013E, P013F, P015A, P015B
HO2S Low Signal	P0131, P0137	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P013A, P013B, P013E, P013F, P015A, P015B

Typical Scan Tool Data

HO2S 1 or 2

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: 200 - 800 mV			
High Signal	0.00 V	1.7 - 2.1 V	1.7 - 2.1 V
Low Signal	0.00 V	1.7 - 2.1 V	1.7 - 2.1 V

Circuit/System Description

The heated oxygen sensors (HO2S) are used for fuel control and catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content of the exhaust stream. When the engine is started, the control module operates in an Open Loop mode, ignoring the HO2S signal voltage while calculating the air-to-fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 0 - 1, 000 mV. Once sufficient HO2S voltage fluctuation is observed by the control module, Closed Loop is entered. The control module uses the HO2S voltage to determine the air-to-fuel ratio. An HO2S voltage that increases toward 1, 000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.

The heating elements inside each HO2S heat the sensor to bring the sensor up to operating conditions faster. This allows the system to enter Closed Loop earlier and the control module to calculate the air-to-fuel ratio

sooner.

Conditions for Running the DTC

P0133

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0128, P0131, P0132, P0134, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0220, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300 - P0308, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P1104, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P1516, P16F3, P2100 - P2103, P2119, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P2176, P2227 - P2230 are not set.
- The Ignition voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The engine coolant temperature (ECT) is warmer than 60°C (140°F).
- The intake air temperature (IAT) is warmer than -40°C (-40°F)
- The fuel level is greater than 10%.
- The engine run time is greater than 30 s.
- The engine speed is between 1,000 - 3,500 RPM.
- The barometric (BARO) pressure is greater than 70 kPa.
- The mass airflow (MAF) is between 12 - 60 g/s.
- The fuel system is in Closed Loop.
- Device controls are not active.
- Ethanol content is less than 87%.
- Fuel control is not in power enrichment.
- Decel fuel cut-off is not active.
- The DTCs run once per drive cycle when the above conditions are met for 4 s.

P013A or P013E

- Before the ECM can report DTC P013A, or P013C failed, DTCs P013E, P014A, P2270, and P2272 must run and pass.
- Before the ECM can report DTC P013E, or P014A failed, DTCs P2270 and P2272 must run and pass.
- DTCs P0030, P0036, P0053, P0054, P0101, P0102, P0103, P0106, P0107, P0108, P0120, P0121, P0122, P0123, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0171, P0172, P0201 - P0208, P0220, P0222, P0223, P0300 - P0308, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1174, P1516, P2101, P2119, P2135, P2176, P2270, P2271, P2A00 are not set.
- The Ignition voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The learned heater resistance is valid.

- The fuel level is greater than 10%.
- After the above conditions are met decel fuel cut-off continues without driver initiated pedal input.
- The DTCs run once per ignition cycle, during decel fuel cut-off (DFCO), when the above conditions are met.

P013B or P013F

- Before the ECM can report DTC P013B, or P013D failed, DTCs P013A, P013C, P013E, P013F, P014A, P014B, P2270, P2271, P2272, and P2273 must run and pass.
- Before the ECM can report DTC P013F, or P014B failed, DTCs P013A, P013C, P013E, P014A, P2270, P2271, P2272, and P2273 must run and pass.
- DTCs P0030, P0036, P0053, P0054, P0101, P0102, P0103, P0106, P0107, P0108, P0120, P0121, P0122, P0123, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0171, P0172, P0201 - P0208, P0220, P0222, P0223, P0300 - P0308, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1174, P1516, P2101, P2119, P2135, P2176, P2270, P2271, P2A00 are not set.
- The Ignition voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The learned heater resistance is valid.
- The fuel level is greater than 10%.
- After the above conditions are met, fuel enrich mode is continued.
- The DTCs run once per ignition cycle when the above conditions are met.

P015A or P015B

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0128, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0220, P0222, P0223, P0442, P0443, P0446, P0449, P0455, P0496, P1516, P2101, P2119, P2135, P2176 are not set.
- The Ignition voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The engine coolant temperature (ECT) is warmer than 60°C (140°F).
- The intake air temperature (IAT) is warmer than -40°C (-40°F)
- The fuel level is greater than 10%.
- The engine run time is greater than 30 s.
- The engine speed is between 1, 100 - 3, 500 RPM.
- The vehicle speed is between 52 - 124 km/h (32 - 77 mph).
- The mass airflow (MAF) is between 2 - 50 g/s.
- The fuel system is in Closed Loop.
- Device controls are not active.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- The heated oxygen sensor 1 heater is on for greater than 40 s.

- The heated oxygen sensor 2 heater is on for greater than 175 s
- After the above conditions are met for 1 s the fuel mixture is forced rich.
- At the end of the forced rich fuel state, the heated oxygen sensor 1 is greater than 0.690 V and decel fuel cut-off is active.
- The DTCs run once per drive cycle when the above conditions are met.

P2270

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0128, P013A, P013B, P013E, P013F, P0171, P0172, P0201, P0202, P0203, P0204, P0220, P0222, P0223, P0300, P0411, P0412, P0418, P1174, P1516, P2101, P2119, P2135, P2176, P2270, P2271 are not set.
- The system voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The fuel level is greater than 10%.
- The engine speed is between 1, 100 - 3, 500 RPM.
- The engine airflow is between 2 - 50 g/s.
- The vehicle speed is between 52 - 124 km/h (32 - 77 mph).
- The fuel state is in Closed Loop.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- The HO2S heaters are ON for more than 180 s.
- The predicted catalytic converter temperature is between 550 - 910Â°C (1, 022 - 1, 670Â°F).
- This DTC runs once per trip when all of the above conditions have been met for 2 s.

P2271

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0128, P013A, P013B, P013E, P013F, P0171, P0172, P0201, P0202, P0203, P0204, P0220, P0222, P0223, P0300, P0411, P0412, P0418, P1174, P1516, P2101, P2119, P2135, P2176, P2270 are not set.
- The system voltage is between 10 - 32 V.
- The engine is OFF for greater 8 hours.
- The fuel level is greater than 10%.
- The engine speed is between 1, 100 - 3, 500 RPM.
- The engine airflow is between 2 - 50 g/s.
- The vehicle speed is between 52 - 124 km/h (32 - 77 mph).
- The fueling state is in Closed Loop.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- Power take-off is not active.
- The heated oxygen sensor heaters have been on more than 180 s.
- The predicted catalyst temperature is between 550 - 910Â°C (1, 022 - 1, 670Â°F).
- DTCs P013A, P013E, and P2270 have run and passed.

THEN

- Decel fuel cut-off is active.
- The accelerator pedal position is stable.
- This DTC runs once per trip when the above conditions are met for 3 s.

Conditions for Setting the DTC

P0133, P015A or P015B

- The engine control module detects that the heated oxygen sensor rich-to-lean or lean-to-rich average response time is greater than a calibrated value.
- The DTCs set within 60 s when the above condition is met.

P013A

The engine control module detects that the accumulated mass air flow monitored during rich-to-lean transitions between 450 - 150 mV is greater than 75 grams.

P013B

The engine control module detects that the accumulated mass air flow monitored during lean-to-rich transitions between 300 - 600 mV is greater than 75 grams.

P013E

The engine control module detects that the heated oxygen sensor voltage has not decreased below 450 mV within a calibrated value of accumulated air flow.

P013F

The engine control module detects that the heated oxygen sensor voltage has not increased above 300 mV within a calibrated value of accumulated air flow.

P2270

The engine control module does not detect a heated oxygen sensor voltage greater than 825 mV before accumulated mass air flow exceeds a calibrated value.

P2271

The engine control module does not detect an heated oxygen sensor voltage less than 100 mV before accumulated mass air flow exceeds a calibrated value.

Action Taken When the DTC Sets

- DTCs P0133, P013E, P013F, P2270, and P2271 are Type B DTCs.
- DTCs P013A, P013B, P015A, and P015B are Type A DTCs.

Conditions for Clearing the DTC

- DTCs P0133, P013E, P013F, P2270, and P2271 are Type B DTCs.
- DTCs P013A, P013B, P015A, and P015B are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no HO2S heater DTCs are set.

- **If a DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If a DTC is not set**

3. Verify none of the conditions listed below exist:

- Lean or rich fuel injectors - Refer to Fuel Injector Diagnosis .
- Water intrusion in the HO2S harness connector
- Low or high fuel system pressure - Refer to Fuel System Diagnosis .
- Fuel that is contaminated - Refer to Alcohol/Contaminants-in-Fuel Diagnosis .
- Fuel saturation of the evaporative emission (EVAP) canister
- Exhaust leaks
- Engine vacuum leaks
- Engine oil consumption - Refer to Oil Consumption Diagnosis .
- Engine coolant consumption - Refer to Loss of Coolant .

- **If any of the above conditions exist**

Repair as necessary.

- **If none of the conditions exist**

4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Test or replace the appropriate B52 HO2S.

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Heated Oxygen Sensor Replacement - Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing an HO2S.
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0171 OR P0172: FUEL TRIM SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0171

Fuel Trim System Lean

DTC P0172

Fuel Trim System Rich

Circuit/System Description

The engine control module (ECM) controls a Closed Loop air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. The ECM monitors the heated oxygen sensor (HO2S) signal voltage, and adjusts the fuel delivery based on the signal voltage while in Closed Loop. A change made to the fuel delivery changes the long and short term fuel trim values. The short term fuel trim

values change rapidly in response to the HO2S signal voltages. These changes fine tune the engine fueling. The long term fuel trim values change in response to trends in the short term fuel trim. The long term fuel trim makes coarse adjustments to fueling in order to re-center and restore control to short term fuel trim. The ideal fuel trim values are around 0 %. A positive fuel trim value indicates that the ECM is adding fuel in order to compensate for a lean condition. A negative fuel trim value indicates that the ECM is reducing the amount of fuel in order to compensate for a rich condition.

Conditions for Running the DTC

- DTCs P0030, P0053, P0101, P0102, P0103, P0106, P0107, P0108, P0131 - P0135, P0201 - P0204, P0236, P0237, P0238, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300 - P0304, P0458, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2227, P2228, P2229, or P2230 are not set.
- The engine is in Closed Loop status.
- The catalyst monitor diagnostic intrusive test, post 02 diagnostic intrusive test, device control, and evaporative emission leak test are not active.
- The engine coolant temperature (ECT) is between -20 and +150°C (-4 and +302°F).
- The intake air temperature (IAT) is between -20 and +150°C (-4 and +302°F).
- The manifold absolute pressure (MAP) is between 5 - 255 kPa (0.7 - 37 psi).
- The engine speed is between 400 - 6, 100 RPM.
- The mass air flow (MAF) is between 0.5 - 510 g/s.
- The barometric pressure (BARO) is greater than 70 kPa (10.2 psi).
- The fuel level is greater than 10 % and no fuel level sensor fault is present.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

- The average long term fuel trim weighted average value is greater or less than a calibrated value.
- The above condition is present for approximately 3 min after the Conditions for Running the DTC have been met.

Action Taken When the DTC Sets

DTCs P0171 and P0172 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0171 and P0172 are Type B DTCs.

Diagnostic Aids

- Allow the engine to reach operating temperature. With the engine running, observe the HO2S parameter with a scan tool. The HO2S value should vary from approximately 40 mV to approximately 900 mV, and respond to fueling changes.
- The normal Short Term Fuel Trim and Long Term Fuel Trim parameters should be between +10 and -10 % with 0 % the optimum, with the engine running at operating temperature.
- Any un-metered air into the engine causes this DTC to set. Thoroughly inspect all areas of the engine for

vacuum leaks.

- A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.
- Verify that the air filter is the correct one for this application. Verify that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Component View Reference

Powertrain Component Views

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If no other DTCs are set**
3. Verify DTC P0171 or P0172 does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.

5. Verify DTC P0171 or P0172 does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle in Service Mode.

2. Verify the manifold absolute pressure sensor is within the range specified for your altitude. Refer to [**Altitude Versus Barometric Pressure**](#)

- **If not within the specified range**

Refer to [**DTC P0106**](#)

- **If within the specified range**

3. Engine running at the operating temperature.

4. Verify the Long Term Fuel Trim parameter is between -10 % and +10 %.

- **If greater than +10 %**

1. Vehicle OFF.

2. Inspect for the conditions listed below:

- Mass air flow (MAF) sensor signal skewed - If the Short Term Fuel Trim parameter changes greater than 20 % when the MAF sensor is disconnected, refer to [**DTC P0101**](#).
- Fuel contamination - Refer to [**Alcohol/Contaminants-in-Fuel Diagnosis**](#) .
- Missing, restricted, or leaking exhaust components - Refer to [**Symptoms - Engine Exhaust**](#) .
- Malfunctioning fuel injectors - Refer to [**Fuel Injector Diagnosis**](#) .
- Vacuum hoses for splits, kinks, and improper connections
- Insufficient fuel in the tank
- Low fuel pressure - Refer to [**Fuel System Diagnosis**](#) .
- Vacuum leaks at the intake manifold, the throttle body, and the injector O-rings.
- Leaks in the air induction system and the air intake ducts
- Leaks in the components of the vacuum operated engine mount system
- Missing air filter element
- Cracked EVAP canister
- Evaporative pipes obstructed or leaking
- The crankcase ventilation system for leaks - Refer to [**Crankcase Ventilation System Inspection/Diagnosis**](#) .
 - If a condition is found, repair as necessary.
 - If no condition is found, inspect the engine for a mechanical condition. Refer to [**Symptoms - Engine Mechanical**](#) .

- **If less than -10 %**

1. Vehicle OFF.

2. Inspect for the conditions listed below:

- Mass air flow (MAF) sensor signal skewed - If the Short Term Fuel Trim parameters for both banks changes greater than 20 % when the MAF sensor is disconnected, refer to [**DTC P0101**](#).
- Fuel contamination - Refer to [**Alcohol/Contaminants-in-Fuel Diagnosis**](#) .
- Missing, restricted, or leaking exhaust components - Refer to [**Symptoms - Engine Exhaust**](#) .
- Malfunctioning fuel injectors - Refer to [**Fuel Injector Diagnosis**](#)
- Collapsed or restricted air intake duct
- Excessive fuel pressure - Refer to [**Fuel System Diagnosis**](#)
- Dirty or restricted air filter
- Objects blocking the throttle body
- Improper operation of the evaporative emissions control system
- Excessive fuel in the crankcase - Change the engine oil as necessary.

- If a condition is found, repair as necessary.

- If no condition is found, inspect the engine for a mechanical condition. Refer to [**Symptoms - Engine Mechanical**](#) .

- **If between -10 % and +10 %**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.

6. Verify DTC P0171 or P0172 is not set.

- **If any of the DTCs set**

Refer to conditions listed above.

- **If none of the DTCs set**

7. All OK.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P0191 OR P0192: FUEL RAIL PRESSURE SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the [**Diagnostic System Check - Vehicle**](#) prior to using this diagnostic procedure.
- Review [**Strategy Based Diagnosis**](#) for an overview of the diagnostic approach.
- [**Diagnostic Procedure Instructions**](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0191

Fuel Rail Pressure Sensor Performance

DTC P0192

Fuel Rail Pressure Sensor Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0340, P0365, P0452, P0506, P0522, P0532, P055C, P0641, P2227, P2228	P0192	P018D, P0453, P0523, P0533, P055D, P0641, P2227	P0191
Signal	P0192, P0506	P0192	-	P0191
Low Reference	-	P0506	-	P0191

Circuit/System Description

The fuel pressure/temperature sensor transmits fuel pressure and temperature information by serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The fuel pressure/temperature sensor internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor. The engine control module (ECM) supplies the fuel pressure/temperature sensor with a 5 V reference circuit, a low reference circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the fuel pressure/temperature sensor to the ECM. The ECM decodes the serial data signal into separate voltages.

Conditions for Running the DTC

P0191

- The engine is running for greater than 1 min.
- The commanded fuel pressure rate of change, increase or decrease, is less than 3 MPa (435 PSI) for greater than or equal to 1.25 s.
- The DTC runs continuously within the enabling conditions.

P0192

- The engine is cranking or running.
- The DTC runs continuously within the enabling condition.

Conditions for Setting the DTC

P0191

The difference between the commanded high pressure and the measured high pressure is greater than or less

than a predefined threshold for greater than or equal to 1.5 s.

P0192

The ECM detects that the fuel pressure/temperature sensor signal voltage is low for greater than 30 s with the engine running or greater than 10 s with the engine cranking.

Action Taken When the DTC Sets

- DTCs P0191, P0192, are Type A DTCs.
- A message center or an indicator may display Reduced Engine Power.

Conditions for Clearing the DTC

DTCs P0191, P0192 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the fuel pressure/temperature sensor circuits could cause a DTC to set.
- Inspect for a contaminated fuel system.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify there are no DTCs set related to the following system/component: 5V Reference
 - **If any of the DTCs are set**

Refer to: **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **If none of the DTCs are set**
3. Verify there are no DTCs set related to the following system/component: B310 Fuel Pressure/Temperature Sensor
 - **If other DTCs are set - With DTC P0191 set.**

Refer to Circuit/System Testing.
 - **If only DTC P0191 set. is set & No other DTCs related to the concerned component are set.**

Replace the component: B310 Fuel Pressure/Temperature Sensor
 - **If none of the DTCs are set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify that no DTCs are set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
6. All OK.

Circuit/System Testing

NOTE: **Disconnecting the fuel pressure/temperature sensor harness connector causes additional DTCs to set.**

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at B310 Fuel Pressure/Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**

3. Ignition ON.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

6. Replace the B310 Fuel Pressure/Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement** for B310 Fuel Pressure/Temperature Sensor.
- **Control Module References** for control module replacement, programming and setup.

DTC P0182, P0183, P0187, P0188, P111F, P126E, OR P126F: FUEL TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0182

Fuel Temperature Sensor Circuit Low Voltage

DTC P0183

Fuel Temperature Sensor Circuit High Voltage

DTC P0187

Fuel Rail Temperature Sensor Circuit Low Voltage

DTC P0188

Fuel Rail Temperature Sensor Circuit High Voltage

DTC P111F

Fuel Temperature Sensor 1 Fuel Temperature Sensor 2 Not Plausible

DTC P126E

Fuel Rail Temperature Sensor 1 Internal Performance

DTC P126F

Fuel Rail Temperature Sensor 2 Internal Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P06D2, P16E5	P16E4	P06D2, P128A, P128B	P0191
Signal	P16E4	P128C, P128D, P16E5	P16E5	P0191
Low Reference	-	P128C, P128D, P16E5	-	P0191

Circuit/System Description

The fuel rail pressure sensor transmits fuel pressure and temperature information by serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The fuel rail pressure sensor internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor. The engine control module (ECM) supplies the fuel rail pressure sensor with a 5 V reference circuit, a low reference circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the fuel rail pressure sensor to the ECM.

Conditions for Running the DTC

P0182 or P0183

- DTC P126E, P128C, P16E4, or P16E5 is not set.
- DTC P126E or P128C is not pending.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

P0187 or P0188

- DTC P126F, P128D, P16E4, or P16E5 is not set.
- DTC P126F or P128D is not pending.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

P111F

- DTC P0182, P0183, P0187, P0188, P126E, P126F, P128C, P128D, P16E4, or P16E5 is not set.
- DTC P128C, P128D, P16E4, or P16E5 is not pending.
- Ignition is ON.
- The DTC runs continuously when the above conditions are met.

P126E

- DTC P128C, P16E4, or P16E5 is not set.
- DTC P128C is not pending.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

P126F

- DTC P128D, P16E4, or P16E5 is not set.
- DTC P128D is not pending.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0182

The ECM detects the scan tool Fuel Rail Temperature Sensor 1 parameter counts are less than 145 for greater than 6 s.

P0183

The ECM detects the scan tool Fuel Rail Temperature Sensor 1 parameter counts are greater than 1,865 for greater than 6 s.

P0187

The ECM detects the scan tool Fuel Rail Temperature Sensor 2 parameter counts are less than 145 for greater than 6 s.

P0188

The ECM detects the scan tool Fuel Rail Temperature Sensor 2 parameter counts are greater than 1,865 for greater than 6 s.

P111F

The ECM detects the difference between fuel rail temperature sensor 1 and fuel rail temperature sensor 2 is greater than 20°C (68°F) for greater than 12 s.

P126E

The ECM detects the scan tool Fuel Rail Temperature Sensor 1 parameter counts are greater than 4,089 for greater than 6 s.

P126F

The ECM detects the scan tool Fuel Rail Temperature Sensor 2 parameter counts are greater than 4,089 for greater than 6 s.

Action Taken When the DTC Sets

- DTC P0182, P0183, P0187, P0188, P111F, P126E, and P126F are Type B DTCs.
- A message center or an indicator displays Propulsion Power is Reduced and Service Stabilitrak.

Conditions for Clearing the DTC

DTC P0182, P0183, P0187, P0188, P111F, P126E, and P126F are Type B DTCs.

Diagnostic Aids

A high resistance condition on the fuel rail pressure sensor circuits could cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697, P06A3, or P06D2** for further diagnosis.
 - **If none of the DTCs are set**
3. Verify that DTC P0182, P0183, P0187, P0188, P111F, P126E, P126F, P128A, P128B, P128C, P128D, P128F, P16E4, or P16E5 is not set.
 - **If DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F are the only DTCs set**

Test or replace the B47B Fuel Rail Pressure Sensor.
 - **If DTC P128A, P128B, P128C, P128D, P128F, P16E4, or P16E5 is set with any of the DTCs**

Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

NOTE: **Disconnecting the fuel rail pressure sensor harness connector causes additional DTCs to set.**

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at B47B Fuel Rail Pressure Sensor. It may take up to 2 mins for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8 - 5.2 V**
6. Replace the B47B Fuel Rail Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement](#)
- [Control Module References](#) for K20 Engine Control Module replacement, programming, and setup

DTC P018B-P018D: FUEL PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P018B

Fuel Pressure Sensor Performance

DTC P018C

Fuel Pressure Sensor Circuit Low Voltage

DTC P018D

Fuel Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0106, P0107, P018C, P0532, P0641	P018C	P00C7, P0106, P018D, P0523, P0641	P018B
Signal	P018C	P018C	P018D	P018B
Low Reference	-	P018D, P0453, P0463, P0533, P24BB	P018D	P018B

Circuit/System Description

The fuel pressure sensor is located on the chassis fuel pipe. The fuel pressure sensor monitors the fuel pressure in the fuel line. The engine control module (ECM) monitors the voltage signal from the fuel pressure sensor. The sensor provides a fuel pressure signal to the ECM, which is used to provide Closed Loop fuel pressure control.

Conditions for Running the DTC

P018B

- DTC P018C, P018D, P0231, P0232, P023F, P0641, P1255, P129D, or P12A6 is not set.
- Engine is running for greater than or equal to 5 s.
- Fuel pump enable circuit is commanded ON.
- Fuel pressure is greater than 0 kPa (0 PSI)
- Low fuel level warning not present.
- The DTC runs continuously when the above conditions are met.

P018C or P018D

- Engine is cranking or running.
- The DTCs run continuously when the above condition is met.

Conditions for Setting the DTC

P018B

The ECM does not detect a normal fuel pressure change of at least 30 kPa (4.4 PSI) when the fuel pump is operating. The fuel pressure sensor performance diagnostic provides a means to detect fuel pressure sensor output that is stuck within the normal operating range of the sensor.

P018C

The ECM detects that the fuel pressure sensor voltage is less than 0.2 V for 1 s.

P018D

The ECM detects that the fuel pressure sensor voltage is greater than 4.8 V for 1 s.

Action Taken When the DTC Sets

DTC P018B, P018C and P018D are Type B DTCs.

Conditions for Clearing the DTC

DTC P018B, P018C and P018D are Type B DTCs.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0074 or U18A2 is not set or stored in history.

- **If DTC U0074 or U18A2 is set or stored in history**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC U0074 or U18A2 is not set or stored in history**

3. Engine Running.

4. Verify the scan tool Fuel Pressure Sensor parameter is between 0.2 - 4.8 V.

- **If not between 0.2 - 4.8 V**

Refer to Circuit/System Testing.

- **If between 0.2 - 4.8 V**

5. Verify the scan tool Fuel Pressure Sensor increases or decreases when commanding an increase and decrease in Fuel Pressure with a scan tool.

- **If the pressure does not change**

Refer to Circuit/System Testing.

- **If the pressure changes**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B47 Fuel Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool Fuel Pressure Sensor parameter is less than 1 V.
 - **If 1 V or greater**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3, wait 15 s.
7. Verify the scan tool Fuel Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
8. Replace the B47 Fuel Pressure Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Fuel Pressure Sensor Replacement
- **Control Module References** for control module replacement, programming and setup

DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, OR P2157: CYLINDER INJECTOR CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0201

Cylinder 1 Injector Control Circuit

DTC P0202

Cylinder 2 Injector Control Circuit

DTC P0203

Cylinder 3 Injector Control Circuit

DTC P0204

Cylinder 4 Injector Control Circuit

DTC P0261

Cylinder 1 Injector Control Circuit Low Voltage

DTC P0262

Cylinder 1 Injector Control Circuit High Voltage

DTC P0264

Cylinder 2 Injector Control Circuit Low Voltage

DTC P0265

Cylinder 2 Injector Control Circuit High Voltage

DTC P0267

Cylinder 3 Injector Control Circuit Low Voltage

DTC P0268

Cylinder 3 Injector Control Circuit High Voltage

DTC P0270

Cylinder 4 Injector Control Circuit Low Voltage

DTC P0271

Cylinder 4 Injector Control Circuit High Voltage

DTC P1248

Cylinder 1 Injector High Control Circuit Shorted to Control Circuit

DTC P1249

Cylinder 2 Injector High Control Circuit Shorted to Control Circuit

DTC P124A

Cylinder 3 Injector High Control Circuit Shorted to Control Circuit

DTC P124B

Cylinder 4 Injector High Control Circuit Shorted to Control Circuit

DTC P2147

Cylinder 1 Injector High Control Circuit Low Voltage

DTC P2148

Cylinder 1 Injector High Control Circuit High Voltage

DTC P2150

Cylinder 2 Injector High Control Circuit Low Voltage

DTC P2151

Cylinder 2 Injector High Control Circuit High Voltage

DTC P2153

Cylinder 3 Injector High Control Circuit Low Voltage

DTC P2154

Cylinder 3 Injector High Control Circuit High Voltage

DTC P2156

Cylinder 4 Injector High Control Circuit Low Voltage

DTC P2157

Cylinder 4 Injector High Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Injector 1 Control +	P2147	P0201	P2148	P1248
Fuel Injector 1 Control -	P0261	P0201	P0262, P2148	P1248
Fuel Injector 2 Control +	P2150	P0202	P2151	P1249
Fuel Injector 2 Control -	P0264	P0202	P0265, P2151	P1249
Fuel Injector 3 Control +	P2153	P0203	P2154	P124A
Fuel Injector 3 Control -	P0267	P0203	P0268, P2154	P124A
Fuel Injector 4 Control +	P2156	P0204	P2157	P124B
Fuel Injector 4 Control -	P0270	P0204	P0271, P2157	P124B

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the injector high voltage supply circuits and the fuel injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Conditions for Running the DTC

- DTC P062B is not set.
- The engine is running for greater than or equal to 2 s.
- The ignition voltage is greater than or equal to 11 V.
- The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0201, P0202, P0203, or P0204

The ECM detects the fuel injector control - circuit is open for 2 s.

P0261, P0264, P0267, or P0270

The ECM detects the fuel injector control - circuit is shorted to ground for 2 s.

P0262, P0265, P0268, or P0271

The ECM detects the fuel injector control - circuit is shorted to voltage for 2 s.

P1248, P1249, P124A, or P124B

The ECM detects the fuel injector control + circuit is shorted to the fuel injector control - circuit for 2 s.

P2147, P2150, P2153, or P2156

The ECM detects the fuel injector control + circuit is shorted to ground for 2 s.

P2148, P2151, P2154, or P2157

The ECM detects the fuel injector control + circuit is shorted to voltage for 2 s.

Action Taken When the DTC Sets

DTCs P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, and P2157 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, and P2157 are Type A DTCs.

Diagnostic Aids

- Performing the Fuel Injector Diagnosis may help isolate an intermittent condition. Refer to [Fuel Injector Diagnosis](#).
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0685 or P1682 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

- **If none of the DTCs are set**

3. Verify DTC P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157 is not set.

- **If any of the DTCs are set**

Refer to Circuit/System Testing.

- **If none of the DTCs are set**

4. Engine running.
5. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter parameters do not increment.

- **If the Cylinder 1 - 4 Current Misfire Counters increment**

Refer to Circuit/System Testing.

- **If the Cylinder 1 - 4 Current Misfire Counters do not increment**

6. Verify the scan tool Cylinder 1 - 4 Injector Control Circuit Status parameters display OK.

- **If the Cylinder 1 - 4 Injector Control Circuit Status parameters do not display OK**

Refer to Circuit/System Testing.

- **If the Cylinder 1 - 4 Injector Control Circuit Status parameters display OK**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate Q17 Fuel Injector, vehicle in Service Mode.
2. Test for 1/2 of battery voltage $\hat{A} \pm 0.5$ V between the control + circuit terminal 1 and ground.

- **If less than 1/2 of battery voltage $\hat{A} \pm 0.5$ V**

1. Vehicle OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control + circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control + circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Test for infinite resistance between the control + circuit terminal 1 and the control - circuit terminal 2.
 - If less than infinite resistance, repair the short between the circuits.
 - If infinite resistance, replace the K20 Engine Control Module.
- **If 1/2 of battery voltage $\hat{A} \pm 0.5$ V**
3. Vehicle OFF, connect a test lamp between the control + circuit terminal 1 and the control - circuit terminal 2.
4. Vehicle in Service Mode, engine running.
5. Verify the test lamp flashes ON and OFF.
 - **If the test lamp does not flash**
 1. Vehicle OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control - circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control - circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Vehicle in Service Mode.
 5. Test for less than 1 V between the control - circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp flashes**
6. Test or replace the Q17 Fuel Injector.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuel Injector Replacement**
- **Control Module References** for ECM replacement, programming, and setup

DTC P0231, P0232, OR P023F: FUEL PUMP CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0231

Fuel Pump Control Circuit Low Voltage

DTC P0232

Fuel Pump Control Circuit High Voltage

DTC P023F

Fuel Pump Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Supply Voltage	P0171, P0232, P023F	P0171, P0232, P023F	P0171, P0232, P023F	P023F, P2635
Low Reference	-	P0232, P023F, P0506	P0232, P023F, P0506	P023F, P2635

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump driver control module remains active for 2 s, unless the engine is in crank or run. While this voltage is being received, the fuel pump driver control module supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure. The fuel pump driver control module monitors the fuel pump voltage to determine if the fuel pump is functioning as commanded.

Conditions for Running the DTC

P0231

- DTC P129E or P12A8 are not present.
- The ignition voltage is between 9 - 32 V.
- The engine is cranking or running.
- The fuel pump enable circuit is commanded ON.
- The fuel pump driver control module output current is less than 75 A.
- The DTC runs continuously when the conditions above are met.

P0232

- DTC P129E or P12A8 are not present.
- The ignition voltage is between 9 - 32 V.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

P023F

- DTC P1255, P129E, or P12A8 are not present.
- The ignition voltage is between 9 - 32 V.
- The fuel pump commanded duty cycle is between 30 - 60 percent.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

P0231

The fuel pump driver control module detects that the fuel pump control circuit is shorted to ground for 1 s.

P0232

The fuel pump driver control module detects that the fuel pump output circuit voltage is greater than 4 V for 1 s when the voltage should be 0 V.

P023F

The fuel pump driver control module detects that the fuel pump control circuit is open for 1 s.

Action Taken When the DTC Sets

DTCs P0231, P0232, and P023F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0231, P0232, and P023F are Type A DTCs.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

On vehicles equipped with a high pressure mechanical pump on Direct Fuel Injection engines, the vehicle may continue to run even though the pump in the fuel tank is not operating.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the fuel pump turns ON and OFF when commanding the Fuel Pump Enable On and Off with a scan tool.
 - **If the fuel pump does not turn ON and OFF**

Refer to Circuit/System Testing.
 - **If the fuel pump turns ON and OFF**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module and the G12 Fuel Pump inline harness connector X350.
2. Test for less than 2 Ω in the low reference circuit end to end between the following terminals:
 - X350 terminal 16
 - K111 Fuel Pump Driver Control Module terminal 16

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

3. Connect the harness connector at the K111 Fuel Pump Driver Control Module.
4. Vehicle in Service Mode, connect a test lamp between the fuel pump control circuit terminal 1 and the low reference circuit terminal 16 on the body side of connector X350.
5. Verify the test lamp turns ON and OFF when commanding the Fuel Pump Enable On and Off with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
2. Test for infinite resistance between the fuel pump control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the fuel pump control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , test or replace the K111 Fuel Pump Driver Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K111 Fuel Pump Driver Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the fuel pump control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, test or replace the K111 Fuel Pump Driver Control Module.

- **If the test lamp turns ON and OFF**

6. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module and at the G12 Fuel Pump. It may take up to 2 minutes for all vehicle systems to power down.
7. Test for infinite resistance between the low reference circuit and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Test for less than 2 Ω in the low reference circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

9. Test for infinite resistance between the fuel pump control circuit and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

10. Test for less than 2 Ω in the fuel pump control circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

11. Replace the G12 Fuel Pump.

Component Testing

Static Test

1. Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
2. Connect a DMM, set on the diode setting, with the positive lead at terminal 16 and the negative lead at terminal 9 of the K111 Fuel Pump Driver Control Module
3. Test for 0.4 - 0.8 V between terminal 16 and terminal 9.

- **If not between 0.4 - 0.8 V**

Replace the K111 Fuel Pump Driver Control Module.

- **If between 0.4 - 0.8 V**

4. Connect a DMM, set on the diode setting, with the positive lead at terminal 9 and the negative lead at terminal 16 of the K111 Fuel Pump Driver Control Module
5. Test for OL between terminal 9 and terminal 16.

- **If not OL**

Replace the K111 Fuel Pump Driver Control Module.

- **If OL**

6. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel Tank Fuel Pump Module Replacement](#)
- [Control Module References](#) for Fuel Pump Driver Control Module replacement, programming and setup

DTC P0300-P0304: ENGINE/CYLINDER MISFIRE DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0300

Engine Misfire Detected

DTC P0301

Cylinder 1 Misfire Detected

DTC P0302

Cylinder 2 Misfire Detected

DTC P0303

Cylinder 3 Misfire Detected

DTC P0304

Cylinder 4 Misfire Detected

Circuit/System Description

The engine control module (ECM) uses information from the crankshaft position sensor and the camshaft position sensor to determine when a engine cylinder misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM can detect individual cylinder misfire events.

Extreme cylinder misfire events can cause catalytic converter damage. The malfunction indicator lamp (MIL) will flash when the conditions for catalytic converter damage are present. DTCs P0301 through P0304 correspond to cylinders 1 through 4. When the ECM detects that one or more specific cylinders are misfiring, the DTC for the respective misfiring cylinder will set and up to 2 of the corresponding fuel injectors are disabled for a minimum of 30 s. The ECM will then re-enable the fuel injector and, after approximately 200 engine revolutions, will determine if the misfire is still present. If the misfire is still present, the ECM will disable the fuel injector again repeating the process. If the misfire is not present, the fuel injector will remain enabled by the ECM. In Spark Ignition Direct Injection (SIDI) system applications, if a fuel injector fault DTC is set during a misfire event, the ECM will not re-enable the injector.

Conditions for Running the DTC

- DTC P0010, P0011, P0013, P0014, P0016, P0017, P0068, P00C8, P00C9, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0122, P0123, P0191, P0192, P0193, P0222, P0223, P0335, P0336, P0340, P0341, P0365, P0366, P0601, P0604, P0606, P0651, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2227, P2228, P2229, or P2230 is not set.
- The engine speed is less than 1, 000 RPM and DTC P0315 is set.
- The engine speed is greater than 1, 050 RPM.
- The crankshaft position and camshaft position sensors are synchronized.
- The engine coolant temperature (ECT) is between -12 and 127Â°C (10 - 261Â°F).
- If the ECT is colder than -12Â°C (10Â°F) at start-up, this diagnostic will not run until the ECT is between 21 - 127Â°C (70 - 261Â°F).

- The battery voltage is between 9 - 32 V.
- The ECM is not detecting a rough road signal.
- The fuel level is at least 11%.
- The ECM is not in fuel cut-off or deceleration fuel cut-off mode.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0300

The ECM detects a crankshaft rotation speed variation indicating a misfire rate sufficient to cause emissions levels to exceed a predetermined value or a misfire rate high enough to cause catalyst damage.

P0301, P0302, P0303, or P0304

The ECM detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.

Action Taken When the DTC Sets

- DTCs P0300 - P0304 are Type B DTCs.
- Engine idle speed will increase to 2500 RPM.
- The ECM will flash the malfunction indicator lamp (MIL) when a catalyst damaging level of misfire is present.

Conditions for Clearing the DTC

DTCs P0300 - P0304 are Type B DTCs.

Diagnostic Aids

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Inspect for the conditions listed below:
 - A tire or wheel that is out of round or out of balance
 - Variable thickness brake rotors
 - An unbalanced drive shaft
 - Certain rough road conditions
 - Transmission operation
 - A damaged or defective accessory drive component or belt
- High resistance in the circuits of the injectors may set a misfire DTC without setting an injector DTC. Test the injector circuits of the affected cylinder(s) for a high resistance if you suspect a condition.
- If the condition is intermittent, observing the scan tool IC Circuit Test and Fuel Injector Circuit Test Status parameters may help isolate the condition. The circuit test status parameters will change from OK or Not Run to Fault/Malfunction if a condition exists.
- A condition in the heated O2 sensor (HO2S) heater control circuits may set a DTC P0300.

Reference Information

Description and Operation

- [Electronic Ignition System Description](#)
- [Fuel System Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL26792 Spark Tester

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

NOTE: If the hybrid battery is fully charged and the hood is opened, the engine runs at a very low load since the hybrid battery cannot accept any additional charge. At this very low engine load, engine misfire may not be detected. Ensure that the battery state of charge indicator on the IPC is at least 2 bars below fully charged before proceeding.

Before starting the engine, review the freeze frame failure records data to determine if the misfire sets during a cold start or at operating temperature. If there is a cold start condition and the engine is started, the engine will need to be cooled down before the next attempt to start the engine within the fail conditions.

1. Perform the scan tool [Crankshaft Position Variation Learn](#) procedure.
2. Verify no DTCs are set.
 - If any DTCs other than P0300 - P0304 are set
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - If DTC P0300 - P0304 is set
Refer to Circuit/System Testing.
 - If no DTCs are set
3. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter parameters do not increment.
 - If increments
Refer to Circuit/System Testing.

- **If does not increment**

4. Engine Running, perform the Cylinder Power Balance Test with a scan tool.
5. Verify the engine speed changes when each injector is disabled and then enabled.

- **If engine speed does not change**

Refer to Circuit/System Testing.

- **If engine speed does change**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Verify none of the following conditions listed below exist:

- Damage, carbon tracking, or fluid intrusion of the spark plug boots and/or spark plugs
- Vacuum hose splits, kinks, and incorrect connections
- Engine vacuum leaks
- Crankcase ventilation system for vacuum leaks
- Fuel pressure that is too low or too high. Refer to [Fuel System Diagnosis](#) .
- Contaminated fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
- Exhaust system restrictions

- **If a condition exists**

Repair or replace as necessary.

- **If no conditions exist**

NOTE: **An erratic or weak spark is considered a no spark condition.**

2. Vehicle OFF, remove the appropriate T 8 Ignition Coil from the spark plug and connect the **EL 26792** HEI Spark Tester to the spark plug boot.
3. Engine Running momentarily.
4. Verify the spark output.

- **If no output or the output is weak**

Refer to [Electronic Ignition System Diagnosis](#) .

- **If the output is good**

5. Vehicle OFF.

6. Verify the conditions listed below. Refer to [Ignition System Specifications](#) .

- The correct spark plug type
- The correct spark plug gap
- The correct spark plug torque
- **If a condition exists**

Repair or replace as necessary.

- **If no conditions exist**

7. Exchange the suspect spark plug with another cylinder that is operating correctly.

8. Engine Running.

9. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter does not increment for the cylinder where the suspect spark plug was installed.

- **If increments**

Replace the spark plug.

- **If does not increment**

10. Test or inspect for the conditions listed below:

- A lean or rich Q17 Fuel Injector - Refer to [Fuel Injector Diagnosis](#) .
- An engine mechanical condition - Refer to [Symptoms - Engine Mechanical](#) .

Repair Instructions

- [Ignition Coil Replacement](#)
- [Spark Plug Replacement](#)

Repair Verification

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Turn OFF the ignition for 60 s.
5. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and perform the appropriate diagnostic procedure.
6. Engine Running, verify the scan tool Cylinder 1 - 4 Current Misfire Counter parameters do not increment.
 - If the misfire counter parameters increment, a misfire condition still exists.
7. To verify that the performance of the catalytic converter has not been affected by the condition that set this DTC, perform the Repair Verification for DTC P0420. Refer to [DTC P0420](#).

DTC P0315: CRANKSHAFT POSITION SYSTEM VARIATION NOT LEARNED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0315

Crankshaft Position System Variation Not Learned

Circuit/System Description

The crankshaft position variation learn feature is used to calculate reference period errors caused by slight tolerance variations in the crankshaft, and the crankshaft position sensor. The calculated error allows the engine control module (ECM) to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load conditions.

The crankshaft position system variation compensating values are stored in ECM memory after a learn procedure has been performed and the ignition switch is turned to the OFF position for at least 30 s. If the actual variation is not within the crankshaft position system variation compensating values stored in the ECM, DTC P0300 may set.

If the crankshaft position system variation values are not stored in the ECM memory or a proper ECM power down does not occur after completing the Crankshaft Position Learn Procedure, DTC P0315 sets.

Conditions for Running the DTC

Engine is Running.

The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the crankshaft position system variation values are not stored in memory.

Action Taken When the DTC Sets

DTC P0315 is a Type A DTC.

Conditions for Clearing the MIL/DTC

DTC P0315 is a Type A DTC.

Diagnostic Aids

This test procedure requires that the vehicle battery has passed a load test and is completely charged. Refer to [Battery Inspection/Test](#) .

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the scan tool Crankshaft Position Variation Learn procedure.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
3. Verify the DTC is not set.

- **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

4. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for engine control module replacement, programming, and setup

DTC P0324, P0326, OR P06B6: KNOCK SENSOR SYSTEM PERFORMANCE/CONTROL MODULE KNOCK SENSOR PROCESSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P0324

Knock Sensor System Performance

DTC P0326

Knock Sensor Performance

DTC P06B6

Control Module Knock Sensor Processor Performance

Diagnostic Fault Information

Circuit	Short to	Open/High	Short to	Signal
---------	----------	-----------	----------	--------

	Ground	Resistance	Voltage	Performance
High Signal	P0327, P06B6	P0325	P0328	P0324*, P0326**
Low Signal	P0327	P0325	P0328	P0324*, P0326**
* Signal Performance High ** Signal Performance Low				

Circuit/System Description

The knock sensor enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The knock sensor produces an alternating current (AC) voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the knock sensor signal. The ECM learns a minimum knock sensor noise level for all of the engine speed ranges and monitors the normal knock sensor signal. The ECM monitors the internal knock sensor processor test circuits which perform the open circuit diagnostic.

Conditions for Running the DTCs

P0324 or P0326

- Engine is running for 2 s or greater.
- The engine coolant temperature (ECT) is -40Â°C (-40Â°F) or warmer.
- The intake air temperature (IAT) sensor 1 is -40Â°C (-40Â°F) or warmer.

AND

- Engine speed is 8, 500 RPM or less.
- Engine air flow is 2000 mg or less per cylinder.

OR

- Engine speed is 8500 RPM or greater for 200 or more cumulative revolutions.
- Engine air flow is 2000 mg or greater per cylinder.

OR

- Engine speed is 2250 RPM or greater for 75 or more cumulative revolutions.
- Engine air flow is 30 mg or greater per cylinder.

OR

- Engine speed is 8500 RPM or greater for 100 or more cumulative revolutions.
- Engine air flow is 2000 mg or greater per cylinder.

P06B6

- Engine is running for 2 s or greater.
- Engine speed is between 400 - 8, 500 RPM for 150 or more cumulative revolutions.

- Engine air flow is between 20 - 2000 mg per cylinder.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTCs

P0324

The ECM detects that the knock sensor signal performance is out of the normal calibrated range due to excessive engine knock on a per cylinder basis.

P0326

The ECM detects that the knock sensor signal performance is out of the normal calibrated range due to low signal level.

P06B6

The ECM has detected a fault in the knock sensor processor open circuit diagnostic internal test circuit.

Action Taken When the DTCs Set

- DTCs P0324, P0326, and P06B6, are Type C DTCs.
- The ignition timing is retarded to reduce the potential of engine damaging spark knock.

Conditions for Clearing the DTCs

DTCs P0324, P0326, and P06B6 are Type C DTCs.

Diagnostic Aids

A malfunction in the exhaust gas recirculation (EGR) system may cause DTC P0324 to set.

Reference Information

Description and Operation

Electronic Ignition System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running
2. Verify DTC P0325, P0327, P0328, P0401, or P06B6 is not set.
 - If DTC P0325, P0327, or P0328 is set with P06B6

Refer to [DTC P0325, P0327, or P0328](#).

- **If DTC P0401 is set**

Refer to [DTC P0401](#).

- **If only DTC P06B6 is set**

Replace the K20 Engine Control Module.

- **If none of the DTCs are set**

3. Vehicle OFF.

4. Verify none of the conditions listed below exist:

- B68 Knock Sensor or wiring harness damage.
- Incorrect B68 Knock Sensor installation. Refer to [Fastener Specifications](#) .
- B68 Knock Sensor and engine mounting surface burrs, casting flash, and foreign material.
- Close proximity of hoses, brackets, and engine wiring.
- Loose brackets.
- Loose or broken accessory drive belts, brackets, components.
- An engine mechanical condition. Refer to [Symptoms - Engine Mechanical](#) .
- Contaminated or poor quality fuel.
- **If a condition exists**

Repair or replace as necessary.

- **If no conditions exist**

5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Test or replace the B68 Knock Sensor.

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Knock Sensor Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0325, P0327, OR P0328: KNOCK SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0325

Knock Sensor Circuit

DTC P0327

Knock Sensor Circuit Low Voltage

DTC P0328

Knock Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Signal	P0327, P06B6	P0325	P0328	P0324*, P0326**
Low Signal	P0327	P0325	P0328	P0324*, P0326**
* Signal Performance High ** Signal Performance Low				

Circuit/System Description

The knock sensor enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The knock sensor produces an alternating current (AC) voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the knock sensor signal. The ECM learns a minimum knock sensor noise level for all of the engine speed ranges and monitors the normal knock sensor signal. The ECM monitors the internal knock sensor processor test circuits which perform the open circuit diagnostic.

Conditions for Running the DTCs

P0325

- Engine is running for 2 s or greater.
- Engine speed is between 400 - 5, 500 RPM for 75 or more cumulative revolutions.
- Engine air flow is between 20 - 2000 mg per cylinder.
- The engine coolant temperature (ECT) is -40Â°C (-40Â°F) or warmer.
- The intake air temperature (IAT) sensor 1 is -40Â°C (-40Â°F) or warmer.

P0327 or P0328

Engine speed is less than 8, 500 RPM.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTCs

P0325

The ECM detects that a knock sensor signal circuit is open.

P0327

The ECM detects that the knock sensor low signal circuit is out of the calibrated range.

P0328

The ECM detects that the knock sensor high signal circuit is out of the calibrated range.

Action Taken When the DTCs Set

- DTCs P0325, P0327 and P0328 are Type A DTCs.
- The ignition timing is retarded to reduce the potential of engine damaging spark knock.

Conditions for Clearing the DTCs

DTCs P0325, P0327 and P0328 are Type A DTCs.

Diagnostic Aids

The following conditions listed below may cause a knock sensor DTC to set:

- Sensor damage.
- Knock sensor and engine mounting surface burrs, casting flash, and foreign material.
- Close proximity of hoses, brackets, and engine wiring.
- Loose brackets.
- Loose or broken accessory drive belts, brackets, components.
- An engine mechanical condition. Refer to [Symptoms - Engine Mechanical](#) .

Reference Information

Schematic Reference

[Engine Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Electronic Ignition System Description](#)

Electrical Information Reference

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Circuit Testing](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Engine Running
2. Verify DTC P0325, P0327 or P0328 is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. Verify the B68 Knock Sensor mounting bolt is properly tightened. Refer to [Fastener Specifications](#) .
 - **If not tightened to the correct specification**

Repair a necessary.
 - **If tightened to the correct specification**
4. Verify the scan tool parameters listed below display No while moving the related harnesses and connectors of the B68 Knock Sensor.
 - Cylinder 1 Knock Detected
 - Cylinder 2 Knock Detected
 - Cylinder 3 Knock Detected
 - Cylinder 4 Knock Detected
 - **If No is not displayed**

Repair the wiring harness or connectors.
 - **If No is displayed**
5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B68 Knock Sensor, vehicle in Service Mode.
2. Test for 1 - 2 V between the low signal circuit terminal 2 and ground.

- **If less than 1 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the low signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the low signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the low signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If between 1 - 2 V**

3. Test for 2 - 4 V between the high signal circuit terminal 1 and ground.

- **If less than 2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the high signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the high signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 4 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the high signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If between 2 - 4 V**

4. Test or replace the B68 Knock Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Knock Sensor Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0335 OR P0336: CRANKSHAFT POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0335, P0522, P0557, P057C, P0651, P118C	P0335	P0121, P0523, P0558, P0651, P118C	P0336
Signal	P0335, P0506	P0335, P0506	P0335	P0336
Low Reference	-	P0335, P0506	-	P0336

Circuit/System Description

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The crankshaft position sensor is a magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of invisible magnetic segments on the edge of the crankshaft position reluctor ring mounted on the crankshaft. Each magnetic segment on the ring is spaced at a 60 segment spacing with 2 missing spaces for a reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal which represents an image of the crankshaft position reluctor ring to the ECM as each segment on the ring rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft position reluctor ring reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft to control camshaft phasing and to detect cylinder

misfire.

Conditions for Running the DTC

P0335 Condition 1

- DTCs P0101, P0102 and P0103 are not set.

OR

- The drive motor 1 is engaged and the engine control module detects camshaft position sensor pulses.

AND

- The airflow into the engine is greater than 1.5 g/s.

Condition 2

- The engine is running.

Condition 3

- DTCs P0365 or P0366 are not set.
- The engine is running.

P0336 Condition 1

- DTCs P0335 is not set.
- The airflow into the engine is greater than 1.5 g/s.
- Engine speed is greater than 450 RPM.

Condition 2

- The engine is running.

Condition 3

- DTCs P0101, P0102, and P0103 are not set.
- The airflow into the engine is greater than 1.5 g/s.

OR

- The drive motor 1 is engaged and the engine control module detects camshaft position sensor pulses.

Condition 4

- DTCs P0365 or P0366 are not set.
- The engine is running.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0335 Condition 1

The ECM does not detect a crankshaft position sensor pulse for greater than 4 s.

Condition 2

The ECM does not detect a crankshaft position sensor pulse for greater than 0.3 s.

Condition 3

The ECM does not detect a crankshaft position sensor pulse for 2 out of 10 engine revolutions.

P0336 Condition 1

The ECM detects that 10 or more crankshaft resynchronizations have occurred within 10 s.

Condition 2

The ECM does not detect the synchronization gap on the reluctor ring for greater than 0.4 s.

Condition 3

The ECM does not detect the synchronization gap on the reluctor ring for 1.5 s after the drive motor 1 was engaged.

Condition 4

The ECM detects less than 51 or greater than 65 crankshaft position sensor pulses during 1 engine revolution for 8 out of 10 engine revolutions.

Action Taken When the DTC Sets

- DTCs P0335 and P0336 are Type B DTCs.
- The camshaft position sensor is used to determine engine position.
- The camshaft actuators are commanded to the parked position, if applicable.

Conditions for Clearing the DTC

DTCs P0335 and P0336 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0651 is not set.
 - **If the DTC is set**

Refer to [DTC P0641, P0651, P0697, P06A3, or P06D2](#) .
 - **If the DTC is not set**
3. Engine Running.
4. Verify the scan tool Crankshaft Position Active Counter parameter increments.
 - **If the counter does not increment**

Refer to Circuit/System Testing.
 - **If the counter increments**
5. Verify the scan tool Crankshaft Position Resync Counter parameter displays 0 counts and the engine does not stumble or stall while moving the related harness/connectors of the B26 Crankshaft Position Sensor.
 - **If greater than 0 counts and the engine stumbles or stalls**

Refer to Circuit/System Testing.
 - **If 0 counts and the engine does not stumble or stall**
6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
7. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B26 Crankshaft Position Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If 2 Ω or less, replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the 5 V reference and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Test for 11 - 16 V between the signal circuit terminal 3 and ground.

- **If less than 11 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If between 11 - 16 V**

6. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

7. Test for less than 1 V between the signal circuit and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

8. Verify DTC P0336 is not set.

- **If the DTC is set**

NOTE: **The crankshaft position reluctor ring is magnetic and may be functionally damaged if any magnetic object comes in contact with it. This type of damage is not visually detectable but will set the DTC.**

1. Inspect for the conditions listed below:

- Excessive play or looseness of the B26 Crankshaft Position Sensor or the crankshaft position reluctor ring
- Improper installation of the B26 Crankshaft Position Sensor
- Foreign material passing between the B26 Crankshaft Position Sensor and the crankshaft position reluctor ring
- Damaged crankshaft position reluctor ring
- Excessive air gap between the B26 Crankshaft Position Sensor and the crankshaft position reluctor ring
- Timing chain or belt, tensioner, and sprockets for wear or damage
- If a condition is found

Repair or replace as necessary.

- If a condition is not found

2. Replace the B26 Crankshaft Position Sensor.

3. Clear the DTC and test drive the vehicle.

4. Verify the DTC is not set.

- If the DTC is set, replace the crankshaft position reluctor ring.
- If the DTC is not set, all OK.

- **If the DTC is not set**

9. Test or replace the B26 Crankshaft Position Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Crankshaft Position Sensor Replacement**

- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0340, P0341, P0365, OR P0366: INTAKE/EXHAUST CAMSHAFT POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0340

Intake Camshaft Position Sensor Circuit

DTC P0341

Intake Camshaft Position Sensor Performance

DTC P0365

Exhaust Camshaft Position Sensor Circuit

DTC P0366

Exhaust Camshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0452, P0522, P0532, P0641, P2227, P2228	P0340, P0365	P018D, P0193, P0453, P0523, P0641, P2227	-
Signal	P0340, P0365	P0340, P0365	P0340, P0365	P0341, P0366
Low Reference	-	P0340, P0365	P0340, P0365	-

Circuit/System Description

The camshaft position sensors each have 3 circuits consisting of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The camshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 4-tooth reluctor wheel attached to the camshaft. As each reluctor wheel tooth rotates past the camshaft position sensor, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The sensor returns a digital ON/OFF DC voltage pulse of varying frequency with 4 varying width output pulses per camshaft revolution that represent an image of the camshaft reluctor wheel. The frequency of the camshaft position sensor output depends on the velocity of the camshaft. The ECM decodes the narrow and wide tooth pattern to identify camshaft position. This information is then

used to determine the optimum ignition and injection points of the engine. The ECM uses the cylinder 1 exhaust camshaft position sensor to determine injector and ignition system synchronization. The intake and exhaust camshaft position sensors are also used to determine camshaft to crankshaft relationship. The ECM also uses camshaft position sensor output information to determine the camshaft relative position to the crankshaft to control camshaft phasing and limp-home operation.

Conditions for Running the DTC

P0340 or P0365 Condition 1

- DTCs P0101, P0102, and P0103 are not set.
- The airflow into the engine is greater than 1.5 g/s.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

Condition 2

- The engine is running.
- The starter is not engaged.

Condition 3

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.
- The starter is engaged.

Condition 4

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.

P0341 or P0366 Condition 1

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.
- The starter is engaged.

Condition 2

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0340 or P0365 Condition 1

- The ECM does not detect a camshaft position sensor pulse for greater than 5.5 s.

OR

- The ECM does not detect a camshaft position sensor pulse for greater than 4 s since the time the starter has been engaged.

Condition 2

The ECM detects less than 4 camshaft position sensor pulse for greater than 3 s.

Condition 3

The ECM does not detect a camshaft position sensor pulse during the first 2 engine revolutions.

Condition 4

The ECM does not detect a camshaft position sensor pulse during 200 engine revolutions.

P0341 or P0366 Condition 1

- The ECM detects less than 4 camshaft position sensor pulses during 2 engine revolutions.

OR

- The ECM detects greater than 6 camshaft position sensor pulses during 2 engine revolutions.

Contion 2

The ECM detects less than 398 or greater than 402 camshaft position sensor pulses during 200 engine revolutions.

Action Taken When the DTC Sets

- DTCs P0340, P0341, P0365, and P0366 are Type B DTCs.
- The camshaft position actuator is commanded to the Home or Parked position.
- The ignition system defaults to a failed camshaft position sensor limp home mode.

Conditions for Clearing the MIL/DTC

DTCs P0340, P0341, P0365, and P0366 are Type B DTCs.

Diagnostic Aids

- With a DTC set, the engine may crank for an extended period of time at start-up
- The exhaust camshaft position sensor is used for injector and ignition system synchronization. A stalling condition will occur if the camshaft position sensor signal is intermittent and a DTC may not set. Inspect all camshaft position sensor circuits for poor connections.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0641 or P0651 is not set.

- **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697, P06A3, or P06D2** .

- **If none of the DTCs are set**

3. Engine Running.
4. Verify the scan tool parameters listed below increment:
 - Exhaust Camshaft Position Active Counter
 - Intake Camshaft Position Active Counter
 - **If any counter does not increment**

Refer to Circuit/System Testing.

- **If all counters increment**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate B23 Camshaft Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If 2 Ω or less, replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8 - 5.2 V**
- 6. Verify DTC P0341 or P0366 is not set.
 - **If any of the DTCs are set**

Inspect for the conditions listed below:

 - Excessive play or looseness of the B23 Camshaft Position Sensor or the reluctor wheel
 - Improper installation of the B23 Camshaft Position Sensor
 - Foreign material passing between the B23 Camshaft Position Sensor and the reluctor wheel
 - Damaged reluctor wheel
 - Excessive air gap between the B23 Camshaft Position Sensor and the reluctor wheel
 - Engine oil for debris
 - Timing chain or belt, tensioner, and sprockets for wear or damage
 - If any of the conditions above are found, repair as necessary.
 - If all components test normal, test or replace the B23 Camshaft Position Sensor.
 - **If none of the DTCs are set**
- 7. Test or replace the B23 Camshaft Position Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Camshaft Position Sensor Replacement - Exhaust](#)
- [Camshaft Position Sensor Replacement - Intake](#)
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, OR P2310: IGNITION COIL CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0351

Ignition Coil 1 Control Circuit

DTC P0352

Ignition Coil 2 Control Circuit

DTC P0353

Ignition Coil 3 Control Circuit

DTC P0354

Ignition Coil 4 Control Circuit

DTC P2300

Ignition Coil 1 Control Circuit Low Voltage

DTC P2301

Ignition Coil 1 Control Circuit High Voltage

DTC P2303

Ignition Coil 2 Control Circuit Low Voltage

DTC P2304

Ignition Coil 2 Control Circuit High Voltage

DTC P2306

Ignition Coil 3 Control Circuit Low Voltage

DTC P2307

Ignition Coil 3 Control Circuit High Voltage

DTC P2309

Ignition Coil 4 Control Circuit Low Voltage

DTC P2310

Ignition Coil 4 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Coil 1 Control	P0300, P2300	P0300, P0351	P0300, P2301	P0300, P0351
Ignition Coil 2 Control	P0300, P2303	P0300, P0352	P0300, P2304	P0300, P0352
Ignition Coil 3 Control	P0300, P2306	P0300, P0353	P0300, P2307	P0300, P0353
Ignition Coil 4 Control	P0300, P2309	P0300, P0354	P0300, P2310	P0300, P0354

Circuit/System Description

The ignition system on this engine uses an individual coil for each cylinder. The engine control module (ECM) controls the spark event for each cylinder through a dedicated ignition control circuit to each coil. When the ECM commands the ignition control circuit ON, electrical current will flow through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM will command the ignition control circuit OFF, interrupting current flow through the primary winding. The magnetic field created by the primary winding will collapse across the secondary coil windings, producing a high voltage across the spark plug electrodes. The ECM uses information from the crankshaft position sensor, and the camshaft position sensor for sequencing and timing of the spark events. The ECM monitors each ignition control circuit for improper voltage levels.

Conditions for Running the DTC

- The engine is cranking or running.
- Ignition voltage greater than 11 V.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.

Action Taken When the DTC Sets

DTCs P0351, P0352, P0353, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, and P2310 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0351, P0352, P0353, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, and P2310 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL 26792 HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

1. Engine Running.
2. Verify the scan tool parameters listed below do not display Malfunction:
 - Ignition Coil 1 - 4 Control Circuit High Voltage Test Status
 - Ignition Coil 1 - 4 Control Circuit Low Voltage Test Status
 - Ignition Coil 1 - 4 Control Circuit Open Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTCs. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an

accurate ground or low reference circuit continuity test can be performed.

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: T8 Ignition Coil
3. Test for less than 10 ohms between the test points: Ground circuit terminal 1/A & Ground
 - **If 10 ohms or greater**
 1. Disconnect the ground connection: Ground terminal
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 1/ A @Component harness & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **If less than 10 ohms**
4. Engine - Running
5. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status does not display Malfunction.
 - **If Malfunction is displayed**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the control circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If Malfunction is not displayed**
6. Verify the appropriate scan tool Ignition Coil Control Circuit High Voltage Test Status does not display Malfunction.
 - **If Malfunction is displayed**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If Malfunction is not displayed**
7. Vehicle OFF, install a 3 A fused jumper wire between the control circuit terminal 3 or C and ground, engine Running.
8. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status displays Malfunction.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the fused jumper, and disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If Malfunction is displayed**

9. Test or replace the T8 Ignition Coil.

Component Test

NOTE: You must perform the **Circuit/System Testing** before proceeding with **Component Testing**.

1. Vehicle OFF, connect the **EL 26792** HEI spark tester to the appropriate T8 Ignition Coil.
2. Engine Running.
3. Verify the spark output of the T8 Ignition Coil.

- **If no output or the output is weak**

Replace the T8 Ignition Coil.

- **If the output is normal**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition Coil Replacement**
- **Control Module References** for engine control module replacement, programming, and setup

DTC P0401: EXHAUST GAS RECIRCULATION (EGR) FLOW INSUFFICIENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0401

Exhaust Gas Recirculation (EGR) Flow Insufficient

Circuit/System Description

The ECM uses the exhaust gas recirculation (EGR) position sensor to determine the position of the EGR valve. The engine control module (ECM) sends a pulse width modulated voltage signal to the EGR input signal circuit. The ECM provides a voltage return path for the sensor through the low reference circuit. A pulse width modulated signal, based on the EGR valve position, is sent from the sensor to the ECM through the EGR output signal circuit. The ECM compares the actual EGR position with the desired EGR position when the EGR valve is commanded open or closed.

Conditions for Running the DTC

- DTC P0068, P0101, P0102, P0103, P010B, P010C, P010D, P0111, P0112, P0113, P0114, P0117, P0118,

P0121, P0178, P0179, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301, P0302, P0303, P0304, P0335, P0336, P0403, P0404, P0405, P0406, P042E, P0489, P0490, P0502, P0503, P0506, P0507, P0604, P0641, P0651, P0722, P0723, P1104, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P1258, P1426, P1437, P2100, P2101, P2102, P2103, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, or P2269 is not set.

- Battery voltage is greater than 11 V.
- Barometric pressure (BARO) is greater than 70 kPa (10 PSI).
- Decel fuel cut-off state does not change for 250 ms.
- Mass air pressure (MAP) change is less than 1 kPa (0.15 PSI).
- MAP is between 20 - 50 kPa (3 - 7 PSI).
- The DTCs run continuously when the above conditions are met for 7 s.

Conditions for Setting the DTC

P0401

The ECM detects the EGR flow is below a calibrated amount when the EGR is commanded ON.

Action Taken When the DTC Sets

DTCs P0401, is a Type A DTC.

Conditions for Clearing the DTC

DTCs P0401 is a Type A DTC.

Diagnostic Aids

A stuck EGR valve or a restriction anywhere in the exhaust gas recirculation system due to excessive coking or debris may cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no other DTCs are set**

3. Verify none of the conditions listed below exist:

- Restrictions in the EGR cooler, valve, pipes, passages, and intake manifold inlet
- Binding, damaged or restricted EGR valve or pipes.
- Exhaust system leaks.
- Exhaust system restrictions.
- Wet or restricted air filter.
- Loose or improperly connected hoses.
- Damaged or missing components.
- **If any of the above conditions exists**

Clean the components as necessary. or Repair or replace the components as necessary.

- **If none of the conditions exist**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Repair or replace the components as necessary. - Exhaust Gas Recirculation Cooler or Exhaust Gas Recirculation Cooler Inlet Pipe or Exhaust Gas Recirculation Cooler Outlet Pipe

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Exhaust Gas Recirculation Cooler Replacement](#)
- [Exhaust Gas Recirculation Cooler Outlet Pipe Replacement](#)

- [Control Module References](#) for engine control module replacement, programming and setup.

DTC P0403, P0489, OR P0490: EXHAUST GAS RECIRCULATION (EGR) CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0403

Exhaust Gas Recirculation (EGR) Control Circuit

DTC P0489

Exhaust Gas Recirculation (EGR) Control Circuit Low Voltage

DTC P0490

Exhaust Gas Recirculation (EGR) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Motor Ignition	P0403, P0489	P0403, P0489	-	-
Motor Ground	-	P0403	-	-
Input Signal	P0403, P0489	P0403, P0489, P046C	P0404, P0490	P0404, P042E
Output Signal	P0406	P0405	P0405	P0404, P042E
Low Reference	-	P0405	-	-

Circuit/System Description

The ECM uses the exhaust gas recirculation (EGR) position sensor to determine the position of the EGR valve. The engine control module (ECM) sends a pulse width modulated voltage signal to the EGR input signal circuit. The ECM provides a voltage return path for the sensor through the low reference circuit. A pulse width modulated signal, based on the EGR valve position, is sent from the sensor to the ECM through the EGR output signal circuit. The ECM compares the actual EGR position with the desired EGR position when the EGR valve is commanded open or closed.

Conditions for Running the DTC

P0403, P0489, or P0490

- The engine is cranking or running.
- The battery voltage is greater than 11 V.

- The EGR control circuit is complete.
- The EGR is commanded on.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0403, P0489

The ECM detects an open circuit of the EGR valve between the signal and controller ground, an open circuit in the motor ignition circuit, or a signal short to ground condition for greater than 30 s.

P0490

The ECM detects a short to voltage condition of the EGR valve signal circuit for greater than 30 s.

Action Taken When the DTC Sets

DTCs P0403, P0489, and P0490 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0403, P0489, and P0490 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify the scan tool parameters listed below display OK:

- EGR Control Circuit Low Voltage Test Status
- EGR Control Circuit Open Voltage Test Status
- EGR Control Circuit High Voltage Test Status
- **If not OK**

Refer to Circuit/System Testing.

- **If OK**

3. Operate the vehicle within the Conditions for Running the DTCs. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve.

2. Test for less than 10 Ω between the motor ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the motor ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Verify a test lamp illuminates between the motor ignition circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the motor ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

NOTE: A short circuit in any component supplied by the fuse may cause the fuse to open and set a DTC when the component is activated.

2. Disconnect all components on the fused circuit.
3. Test for infinite resistance between the motor ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components supplied by the fuse and replace as necessary.
- **If the test lamp illuminates**
5. Vehicle OFF, and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Test for greater than 1 V between the test points:Signal circuit terminal 3 & Ground
 - **If less than 1 V**
 1. Vehicle Off and all vehicle systems Off.
 2. Disconnect the harness connector at the K20 Engine Control Module.
 3. Test for less than 2 Ω in the output signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Test for infinite resistance between the test points:Signal circuit terminal 3 & Ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module
 - **If greater than 1 V**
9. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
10. Test for less than 1 V between the input signal circuit and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
11. Vehicle OFF, connect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
12. Test for greater than 11 V between the test points:Signal circuit terminal 4 & Ground
 - **If less than 11 V**
 1. Vehicle Off and all vehicle systems Off.
 2. Disconnect the harness connector at the K20 Engine Control Module.
 3. Test for less than 2 Ω in the output signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Test for infinite resistance between the test points: Signal circuit terminal 4 & Ground
- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module
- **If greater than 1 V**
13. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
14. Test for less than 1 V between the output signal circuit and ground.
- **If 1 V or greater**, repair the short to voltage on the circuit.
 - **If less than 1 V**
15. Test or replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Exhaust Gas Recirculation Valve Replacement](#)
- [Control Module References](#) for engine control module replacement, programming and setup

DTC P0404 OR P042E: EXHAUST GAS RECIRCULATION OPEN/CLOSED POSITION PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0404

Exhaust Gas Recirculation (EGR) Open Position Performance

DTC P042E

Exhaust Gas Recirculation (EGR) Closed Position Performance

Circuit/System Description

The ECM uses the exhaust gas recirculation (EGR) position sensor to determine the position of the EGR valve. The engine control module (ECM) sends a pulse width modulated voltage signal to the EGR input signal circuit. The ECM provides a voltage return path for the sensor through the low reference circuit. A pulse width modulated signal, based on the EGR valve position, is sent from the sensor to the ECM through the EGR output signal circuit. The ECM compares the actual EGR position with the desired EGR position when the EGR valve is commanded open or closed.

Conditions for Running the DTC

- DTCs P0401, P0403, P0405, P0406, P0489, or P0490 are not set
- The battery voltage is greater than 11 V.
- The engine is running
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0404

The ECM detects the desired position of the EGR valve compared to the actual position value is too large for greater than 12 s.

P042E

The ECM detects the EGR valve is stuck open when commanded closed for greater than 1 s.

Action Taken When the DTC Sets

DTC P0404 and P042E are Type B DTCs.

Conditions for Clearing the DTC

DTC P0404 and P042E are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0401, P0403, P0489, P0490, or P0641 is not set
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If the DTC is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify DTC P0404 or P042E does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

 - **If the DTC does not set**
 5. All OK.

Circuit/System Testing

1. Verify that the conditions listed below are not present at the Q14 Exhaust Gas Recirculation Valve:
 - Stuck Q14 Exhaust Gas Recirculation Valve
 - Any coking, soot build up, debris or damage that can cause the EGR valve to stick partially open or closed
 - **If a condition is present**

Repair as necessary

 - **If no condition is present**
2. Vehicle OFF, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve, vehicle in Service Mode.
3. Verify a test lamp illuminates between the input signal circuit terminal 3 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp.
 2. Disconnect the harness connector at the K20 Engine Control Module.
 3. Test for less than 2 Ω in the input signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 4. Test for infinite resistance between the input signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module
 - **If the test lamp illuminates**
4. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service

Mode.

5. Test for less than 1 V between the input signal circuit and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

6. Vehicle OFF, connect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

7. Verify a test lamp illuminates between the output signal circuit terminal 4 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp.

2. Disconnect the harness connector at the K20 Engine Control Module.

3. Test for less than 2 Ω in the output signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω

4. Test for infinite resistance between the output signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module

- **If the test lamp illuminates**

8. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

9. Test for less than 1 V between the output signal circuit and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

10. Replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Exhaust Gas Recirculation Valve Replacement](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0405 OR P0406: EXHAUST GAS RECIRCULATION (EGR) POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0405

Exhaust Gas Recirculation (EGR) Position Sensor Circuit Low Voltage

DTC P0406

Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Input Signal	P0403, P0489	P0403, P0489, P046C	P0404, P0490	P0404, P042E
Output Signal	P0406	P0405	P0405	P0404, P042E
Low Reference	-	P0405	-	-

Circuit/System Description

The ECM uses the exhaust gas recirculation (EGR) position sensor to determine the position of the EGR valve. The engine control module (ECM) sends a pulse width modulated voltage signal to the EGR input signal circuit. The ECM provides a voltage return path for the sensor through the low reference circuit. A pulse width modulated signal, based on the EGR valve position, is sent from the sensor to the ECM through the EGR output signal circuit. The ECM compares the actual EGR position with the desired EGR position when the EGR valve is commanded open or closed.

Conditions for Running the DTC

- The engine is running for greater than 12 s.
- Battery voltage is greater than 11 V.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0405

The EGR valve position sensor output signal circuit is open or shorted to voltage, or the low reference circuit is open.

P0406

The EGR valve position sensor output signal circuit is shorted to ground.

Action Taken When the DTC Sets

DTCs P0405 and P0406 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0405 and P0406 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTCs P0401, P0403, P0489, P0490, or P0641 is not set.
 - **If a DTC sets**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If a DTC does not set**
3. Operate the vehicle within the Conditions for Running the DTCs. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify a DTC does not set.
 - **If a DTC sets**

Refer to Circuit/System Testing

- **If a DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve, vehicle in Service Mode.
2. Test for greater than 4 V between the test points:Signal circuit terminal 4 & Ground

- **If less than 11 V**

1. Vehicle Off and all vehicle systems Off.
2. Disconnect the harness connector at the K20 Engine Control Module.
3. Test for less than 2 Ω in the output signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
4. Test for infinite resistance between the output signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module

- **If greater than 11 V**

3. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
4. Test for less than 1 V between the output signal circuit and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

5. Test or replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Exhaust Gas Recirculation Valve Replacement](#)
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P040B-P040E OR P041B-P041E: EXHAUST GAS RECIRCULATION (EGR) TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provide an overview of each diagnostic category.

DTC Descriptors

DTC P040B

Exhaust Gas Recirculation (EGR) Temperature Sensor 2 Performance

DTC P040C

Exhaust Gas Recirculation (EGR) Temperature Sensor 2 Circuit Low Voltage

DTC P040D

Exhaust Gas Recirculation (EGR) Temperature Sensor 2 Circuit High Voltage

DTC P040E

Exhaust Gas Recirculation (EGR) Temperature Sensor 2 Circuit Intermittent

DTC P041B

Exhaust Gas Recirculation (EGR) Temperature Sensor 1 Performance

DTC P041C

Exhaust Gas Recirculation (EGR) Temperature Sensor 1 Circuit Low Voltage

DTC P041D

Exhaust Gas Recirculation (EGR) Temperature Sensor 1 Circuit High Voltage

DTC P041E

Exhaust Gas Recirculation (EGR) Temperature Sensor 1 Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Supply Voltage	P040C, P041C	P040D, P041D	P040D, P041D, *	P040B, P041B
Low Reference	-	P040D, P041D	-	P040B, P041B
* Internal ECM or Sensor damage may occur if the circuit is shorted to B+				

Typical Scan Tool Data

EGR Temperature Sensor 1 or 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Ignition ON, engine OFF Parameter Normal Range: Varies depending on current ambient temperature and the vehicle operating conditions			
Supply Voltage	200Â°C (392Â°F)	200Â°C (392Â°F)	200Â°C (392Â°F)
Low Reference	-	200Â°C (392Â°F)	200Â°C (392Â°F)

Circuit/System Description

The exhaust gas recirculation (EGR) temperature sensors are variable resistors that measure the temperature of the exhaust gas. The engine control module (ECM) supplies 5 volts to the EGR temperature sensor signal circuit and a ground for the low reference circuit. When the EGR temperature sensor is cold, the sensor resistance is high. When the EGR temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a higher voltage on the EGR temperature signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the EGR temperature signal circuit.

Conditions for Running the DTC

P040B and P041B

- DTC P262B is not set
- System voltage is greater than 11 V
- Engine OFF for greater than 8 h
- The DTCs run continuously when the above conditions are met.

P040C, P040D, P040E, P041C, P041D, and P041E

- System voltage is greater than 11 V
- The engine is cranking or running
- The EGR temperature sensor is commanded ON
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P040B and P041B

- The ECM detects that the EGR temperature sensor has not changed greater than a calibrated amount for greater than a calibrated amount of time following a cold start
- Above conditions must be met for 10 s

P040C and P041C

- The ECM detects that the EGR temperature sensor resistance is less than 100 Ω
- Above conditions must be met for 7 s

P040D and P041D

- The ECM detects that the EGR temperature sensor resistance is greater than 1,400 Ω
- Above conditions must be met for 7 s

P040E and P041E

- The ECM detects that the EGR temperature sensor resistance change is greater than 10 Ω
- Above conditions must be met for 3 s

Action Taken When the DTC Sets

DTCs P040B, P040C, P040D, P040E, P041B, P041C, P041D, and P041E are Type B DTCs.

Conditions for Clearing the DTC

DTCs P040B, P040C, P040D, P040E, P041B, P041C, P041D, and P041E are Type B DTCs.

Diagnostic Aids

- Inspect the EGR temperature sensor terminals for corrosion.

- If the EGR temperature sensor signal circuit is shorted to a separate 5-volt source, the DTC will set.
- If the engine has cooled for at least 8 hrs, the scan tool EGR Temperature Sensor and the Engine Coolant Temperature Sensor values should display within 3Â°C (5Â°F).
- EGR cooler temperature sensors may fail while operating under extreme temperatures. Review the Freeze Frame/Failure Records to verify the failure criteria.
- With a fault present, the sensor reads a software defaulted value of 200Â°C (392Â°F) and does not change with an expected temperature increase or decrease.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify the scan tool EGR Cooler Temperature Sensor parameter is between -39Â° to +999Â°C (-38Â° to +1, 830Â°F) and changes with engine run time.
 - **If not within the specified range or does not change**

Refer to Circuit/System Testing.
 - **If within the specified range and changes**
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle Off, exchange the suspect harness connector at the B130 Exhaust Gas Recirculation Temperature Sensor with the known functioning Exhaust Gas Recirculation Temperature Sensor, Ignition - On / Vehicle - In Service Mode
2. Verify the DTC related to the known functioning Exhaust Gas Recirculation Temperature Sensor does not set.

- **If the DTC sets**

Test or replace the B130 Exhaust Gas Recirculation Temperature Sensor

- **If the DTC does not set**

3. Vehicle Off, and all vehicle systems Off. Install original harness connector to the known functioning B130 Exhaust Gas Recirculation Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
4. Leave the harness connector at the appropriate B130 Exhaust Gas Recirculation Temperature Sensors disconnected.
5. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 10 Ω**

6. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
7. Test for less than 1 V between the signal circuit and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

8. Test for infinite resistance between the signal circuit terminal 1 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

9. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1](#)
- [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 2](#)
- [Control Module References](#) for ECM replacement, programming, and setup

DTC P0420: CATALYST SYSTEM LOW EFFICIENCY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0420

Catalyst System Low Efficiency

Circuit/System Description

A 3-way catalyst controls emissions of hydrocarbons, carbon monoxide (CO) and nitrogen oxide (NO_x). The catalyst within the converter promotes a chemical reaction, which oxidizes the hydrocarbons and the CO that are present in the exhaust gas. This process converts the hydrocarbons and the CO into water vapor and carbon dioxide (CO₂), and reduces the NO_x, converting the NO_x into nitrogen. The catalyst also stores oxygen. The engine control module (ECM) monitors this process by using heated oxygen sensors (HO₂S) that are in the exhaust stream before and after the 3- way catalyst. The HO₂S produces an output signal that the ECM uses to calculate the oxygen storage capacity of the catalyst. This indicates the ability of the catalyst to convert the exhaust emissions efficiently. The ECM monitors the efficiency of the catalyst by monitoring the HO₂S during an off-idle, decel fuel cut off (DFCO) event. When the catalyst is functioning properly, the post catalyst HO₂S response to the fuel conditions during the DFCO event is slow compared to the response of the pre catalyst HO₂S. When the post HO₂S response is near that of the pre HO₂S, the oxygen storage capability and efficiency of the catalyst may be degraded below an acceptable threshold.

Conditions for Running the DTC

- DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0131, P0132, P0133, P0135, P0137, P0138, P0141, P0171, P0172, P0201, P0202, P0203, P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P16F3, P2101, P2135, P2270, or P2271 is not set.
- Ignition voltage is between 10 - 32 V.
- HO₂S heater resistance is learned.
- Accelerator pedal position is no more than 3%.

- Mass air flow (MAF) is between 2 - 20 g/s.
- Fuel level is greater than 10%.
- Fuel system is in closed loop.
- Evaporative emissions (EVAP) diagnostics are not in control of purge.
- Predicted catalyst temperature is between 550 - 910°C (1,022 - 1,670°F).
- HO2S heater is commanded On for greater than 60 s.
- Engine speed is between 1,900 - 3,500 RPM to initially enable the test.
- Engine speed is between 1,850 - 3,650 RPM to keep the test enabled.
- Vehicle speed is between 66 - 125 km/h (41 - 78 mph) to initially enable the test.
- Vehicle speed is between 58 - 128 km/h (36 - 80 mph) to keep the test enabled.
- Engine is operating in decel fuel cut off (DFCO).

This diagnostic attempts one test during each valid decel fuel cut off period once the above conditions have been met. This diagnostic attempts up to 3 tests during each drive cycle.

Conditions for Setting the DTC

The ECM has detected that the catalyst efficiency has degraded below a calibrated threshold.

Action Taken When The DTC Sets

DTC P0420 is a Type A DTC.

Conditions for Clearing the MIL/DTC

DTC P0420 is a Type A DTC.

Diagnostic Aids

Inspect for the conditions listed below, which may cause a catalyst to degrade:

- Engine misfire
- High engine oil or high coolant consumption
- Retarded spark timing
- Weak or poor spark
- Lean fuel mixture
- Rich fuel mixture
- Damaged oxygen sensor or wiring harness

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

- [Wiring Repairs](#)
- [Heated Oxygen Sensor Wiring Repairs](#)

DTC Types Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify there are no other DTCs set.
 - **If other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**
3. Operate the vehicle within the Conditions for Running the DTC.
 4. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
 - **If Yes is not displayed**

Refer to step 3.

 - **If Yes is displayed**
 5. When the conditions are safe, stop and idle the vehicle in gear if equipped with automatic transmission or neutral if equipped with manual transmission.
 6. Verify the Catalyst Monitor Test Result parameter displays Passed when performing the steps listed below:
 1. Apply the service brake.
 2. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE: When the test has completed, the Catalyst Monitor Test Counter parameter will increment by one and the Catalyst Monitor Test Result parameter will indicate Passed, Failed or No Result.

3. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
 - **If No Result is displayed**

Repeat steps 3 - 6 until the Test Result parameter indicates Passed or Failed

 - **If Failed is displayed**

Refer to Circuit /System Testing

- **If Passed is displayed**

7. All OK.

Circuit/System Testing

1. Verify the conditions listed below do not exist with the catalytic converter:

- Dents
- Severe discoloration caused by excessive temperatures
- Road damage
- Internal rattles caused by damaged catalyst substrate
- Restrictions

- **If a condition is found**

Replace the catalytic converter.

- **If no condition is found**

2. Verify the conditions listed below do not exist with the exhaust system:

- Leaks
- Physical damage
- Loose or missing hardware

- **If a condition is found**

Repair or replace the component as necessary.

- **If no condition is found**

3. Verify the conditions listed below do not exist with the B52B Heated Oxygen Sensor 2:

- Incorrect torque
- Damage

- **If a condition is found**

Replace the B52B Heated Oxygen Sensor 2 or repair the condition as necessary.

- **If no condition is found**

4. Replace the catalytic converter.

Repair Instructions

- **Three-Way Catalytic Converter Replacement**
- **Exhaust Leakage**
- **Heated Oxygen Sensor Replacement - Sensor 2**
- Perform the HO2S Heater Learn procedure with a scan tool after replacing a heated oxygen sensor.
- **Restricted Exhaust**

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn Off the ignition for 60 s
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
 - **If Yes is not displayed**

Refer to step 5.
 - **If Yes is displayed**
7. When the conditions are safe, stop and idle the vehicle in gear if equipped with automatic transmission or neutral if equipped with manual transmission.
8. Verify the Catalyst Monitor Test Result parameter displays Passed when performing the steps listed below:
 1. Apply the service brake.
 2. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE: When the test has completed, the Catalyst Monitor Test Counter parameter will increment by one and the Catalyst Monitor Test Result parameter will indicate Passed, Failed or No Result.

3. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
 - **If No Result is displayed**

Repeat steps 5 - 8 until the Test Result parameter indicates Passed or Failed
 - **If Failed is displayed**

Refer to Circuit /System Testing
 - **If Passed is displayed**
9. All OK.

DTC P043E, P043F, OR P145F: EVAPORATIVE EMISSION (EVAP) SYSTEM REFERENCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P043E

Evaporative Emission (EVAP) System Reference Orifice Flow Insufficient

DTC P043F

Evaporative Emission (EVAP) System Reference Orifice Flow Excessive

DTC P145F

Evaporative Emission (EVAP) System Reference Orifice Performance

Circuit/System Description

The evaporative emission (EVAP) system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

The engine control module (ECM) monitors the pressure across the reference orifice with the EVAP leak detection pump pressure sensor. When all conditions are met, the ECM commands the vacuum pump ON and monitors the EVAP leak detection pump pressure sensor. If the ECM detects the pressure is too low, too high, or not stabilized, a DTC sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P0222, P0223, P0449, P0451, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P1221, P1458, P1459, P145A, P145C, P145D, P145E, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P2537, P2610, U0073, U0074, U0140, or U182D is not set.
- The vehicle is OFF.
- The propulsion system is not active.
- The refueling request button is not pressed
- A service bay test is not active
- The purge valve is closed
- The vent solenoid valve is closed
- The EVAP Leak Detection Pump switching valve is in the vent position
- The EVAP Leak Detection Pump vacuum pump is ON
- The odometer is greater than 16 km (10 mi)
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI)
- The fuel level is between 10 - 90%
- The engine coolant temperature is less than 40°C (104°F)
- The intake air temperature is between 4 - 45°C (39 - 113°F)

- The system voltage is greater than 10 V
- The vehicle speed less than 1.6 km/h (1 MPH)
- There are three possible time windows for this test to run. Up to that point, and through this time period, the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 h.

Conditions for Setting the DTC

P043E

- The ECM detects the EVAP leak detection pump pressure is greater than 4 kPa (0.58 PSI) after 6 min.
- OR
- The ECM detects the EVAP leak detection pump pressure is greater than 4.5 kPa (0.65 PSI) after 30 s.

P043F

- The ECM detects the EVAP leak detection pump pressure is less than 1.18 kPa (0.17 PSI) after 6 min.
- OR
- The ECM detects the EVAP leak detection pump pressure is less than 1.18 kPa (0.17 PSI) after 30 s.

P145F

The ECM detects the difference between the first and second EVAP leak detection pump pressure measurement is greater than 0.51 kPa (0.073 PSI).

Action Taken When the DTC Sets

DTCs P043E, P043F and P145F are Type B DTCs.

Conditions for Clearing the DTC

DTCs P043E, P043F and P145F are Type B DTCs.

Diagnostic Aids

- Inspect the tube and clamps from the EVAP leak detection pump to the vent solenoid for damage. A damage/open tube may allow debris to enter the pump and plug the reference orifice.
- Remove the EVAP leak detection pump and look inside the pump opening for any debris that could restrict or plug the reference orifice. The reference orifice is a small opening at the 2 o'clock position in the pump vacuum opening. Inspect for missing or damage O-rings.
- With the fresh air tube removed from the EVAP leak detection pump assembly, blow controlled air, 5 - 10 PSI, into this tube. There should be air escaping from behind the fuel fill pocket indicating this tube and filter are not restricted.
- A switching valve stuck in the pump position can cause insufficient flow.
- This part is not serviceable. It is very important that no debris be found in the pump fresh air inlet or vacuum openings, the tube between the vent solenoid valve and EVAP leak detection pump assembly as this could cause a P043E to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, verify the scan tool EVAP Leak Detection Pump Pressure sensor reading is within the range specified in the **Altitude Versus Barometric Pressure** table.
2. Record the EVAP Leak Detection Pump Pressure sensor reading.
3. Command the EVAP Leak Detection Pump Command ON with the scan tool and monitor the EVAP Leak Detection Pump Pressure.
4. After 6 min record the EVAP Leak Detection Pump Pressure sensor reading. The reading should be 1.18 - 4 kPa (0.17-0.58 PSI) less than the initial reading from step 2.
5. Continue monitoring for an additional 5-10 min and then record the EVAP Leak Detection Pump Pressure sensor reading.
6. The reading should be 1.18 - 4.5 kPa (0.17-0.58 PSI) less than the initial reading from step 2, and the difference between the step 4 and step 5 readings less than 0.51 kPa (.07 PSI)
7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within

the conditions that you observed from the Freeze Frame/Failure Records data.

Circuit/System Testing

NOTE: The reference orifice is a small opening at the 2 o'clock position in the pump vacuum opening.

1. Vehicle OFF, remove the Q63 Evaporative Emission System Leak Detection Pump Assembly.
2. Inspect the reference orifice within the pump for a restriction/blockage. There should be no restriction.
 - **If the reference orifice is restricted**

Inspect and repair any of the conditions listed below:

- The EVAP leak detection pump to the vent solenoid tube and clamps for damage
- A missing or damage EVAP leak detection pump O-rings
- The fresh air tube near the fuel fill pocket for a restriction
- The fresh air tube for a restriction
- **If all components test normal**

Replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for ECM replacement, programming and setup
- **Evaporative Emission System Vacuum Leak Detection Pump Replacement**

DTC P0442 OR P0455: EVAPORATIVE EMISSION (EVAP) SYSTEM

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0442

Evaporative Emission (EVAP) System Small Leak Detected

DTC P0455

Evaporative Emission (EVAP) System Large Leak Detected

Circuit/System Description

This DTC tests the evaporative emission (EVAP) system for a small and large leak when the Vehicle is turned OFF and the correct conditions are met. The propulsion system needs to be OFF for several hours before the

small and large leak tests run. The EVAP leak detection pump creates a vacuum across a 0.51 mm (0.020 in) reference orifice. This reference vacuum is then compared to the vacuum level created in the fuel tank to determine if a leak exists

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP components:

Engine Control Module Command	EVAP Canister Purge Solenoid Valve	EVAP Canister Vent Solenoid Valve	Vacuum Pump	Switch Valve
ON	Open	Open/Venting	Pump Runs	Pump Position/Not Venting
OFF	Closed	Closed/Not Venting	Pump OFF	Vent Position

Conditions for Running the DTC

- DTCs P043E, P043F, P06E4, P0111, P0112, P0113, P0114, P0117, P0118, P0116, P0119, P0128, P0449, P0498, P0499, P1458, P145A, P145C, P145D, P145E, P145F, P0451, P0452, P0453, P0461, P0462, P0463, P0502, P0503, P0722, P0723, P1459, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P2537, P2610, U0140, U182D, U0073, U0074, is not set.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The ECT is less than 40Â°C (104Â°F).
- The IAT is between 4 - 45Â°C (39 - 113Â°F).
- The system voltage is greater than 10 V.
- Vehicle speed less than 1.6 km/h (1 MPH).
- A refueling event needs to be detected prior to running this test - P0455 only.
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 hours.

Conditions for Setting the DTC

P0442

DTC P0442 sets when the EVAP leak detection pump pressure sensor (gauge) vacuum reading is less than the 0.51 mm (0.020 in) reference orifice vacuum measurement plus a calibrated value for greater than 6 min.

P0455

DTC P0455 sets after a refueling event has been detected and the small/large leak diagnostics have not passed. If the EVAP leak detection pump pressure sensor (gauge) vacuum reading is less than the 0.51 mm (0.020 in) reference orifice vacuum measurement and times a calibrated value for greater than 6 min.

Action Taken When the DTC Sets

DTCs P0442 and P0455 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0442 and P0455 are Type B DTCs.

Diagnostic Aids

- The EVAP system can be filled with smoke more quickly and completely by injecting smoke at the purge tube and commanding the vent solenoid valve open. For example, when injecting smoke at the purge tube, remove the filler cap or temporarily leave the vent solenoid valve open until smoke is observed. Close the system and continue testing. If using a fuel cap adapter at the filler neck, disconnect the purge tube at the EVAP purge solenoid valve until smoke is observed.
- To help locate intermittent leaks using the **GE 41413-A** move all EVAP components while observing smoke with the **GE 41413-SPT** .
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with a high intensity white light.
- If a small leak is difficult to find, it may be necessary to remove the EVAP components and test them one at a time using the adapters in the **GE 41413-300** .

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- **Evaporative Emission Control System Description**
- **Hybrid Modes of Operation Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **CH 48096** EVAP Service Access Port Tool
- **GE 41413-300** EVAP Cap And Plug Kit
- **GE 41413-A** Evaporative Emissions System Tester
- **GE 41413-SPT** High Intensity White Light
- **J 41415-30** Fuel Tank Cap Adapter
- **J 41413-311** EVAP Plug (Brass Nozzle)

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

WARNING: Refer to [Fuel and Evaporative Emission Pipe Warning](#) .

CAUTION: Refer to [Clean, Dry, Low Pressure Gas Source Caution](#) .

1. Verify the following conditions do not exist in the EVAP system:
 - Loose, incorrect, missing, or damaged fuel fill cap
 - A damaged EVAP purge solenoid
 - Disconnected, incorrectly routed, kinked, or damaged EVAP pipes and hoses
 - A damaged EVAP vent valve or EVAP canister
 - **If you find any of the above conditions**
Repair as necessary
 - **If none of the above are found**
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
4. All OK.

Circuit/System Testing

NOTE:

- The fuel sender may need to be accessed to inspect some of the EVAP system components.
- Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.
- Introduce smoke at 15 s intervals while testing the system.
- Ensure that the vehicle underbody temperature is similar to the ambient

temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. The system flow will be less with higher temperatures.

- **Refer to the GE 41413-A operation manual for detailed instructions in Evaporative Emission Control System Diagnosis.**

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the purge solenoid valve and install the **CH 48096** .
2. Connect the **GE 41413-A** to the **CH 48096** .
3. Vehicle in Service Mode
4. Verify that there is no leak in the EVAP system using the flow meter on the **GE 41413-A** , calibrated to 0.51 mm (0.020 in).

- **If a leak is detected**

1. Apply smoke to the EVAP system at the service access port adapter with the **GE 41413-A** .
2. Locate the leak using the **GE 41413-SPT** .

- When the leak is located, repair or replace the affected component as necessary.

- **If no leak detected**

NOTE: **The steps below test for a restriction in the purge path.**

5. Connect the **GE 41413-A** nitrogen/smoke hose to the **J 41413-311** .
6. Disconnect the hose at the fuel cap end of the **GE 41415-30** and connect to the **J 41413-311** .
7. Install the **GE 41415-30** , filler neck end only, to the vehicle.
8. Vehicle in Service Mode
9. Command the EVAP Test ON with a scan tool.
10. Verify the vacuum/pressure gauge on the **GE 41413-A** and the scan tool Fuel Tank Pressure Sensor parameter both show vacuum.
 - **If the vacuum/pressure gauge shows vacuum but the Fuel Tank Pressure Sensor parameter does not show vacuum**

Replace the B150 Fuel Tank Pressure Sensor.
 - **If both do not show vacuum**

Repair the restriction in the purge path.
 - **If both show vacuum**
11. Verify that the Fuel Tank Pressure Sensor parameter increases to greater than 3.2 V, and the pressure values are similar between the scan tool Fuel Tank Pressure Sensor and the vacuum/pressure gauge on the **GE 41413-A** .

- **If not within the specified range**

Replace the B150 Fuel Tank Pressure Sensor.

- If within the specified range

12. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- [Evaporative Emission Canister Replacement](#)
- [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
- [Fuel Tank Pressure Sensor Replacement](#)

DTC P0443, P0458, OR P0459: EVAPORATIVE EMISSION (EVAP) PURGE SOLENOID VALVE CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0443

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit

DTC P0458

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit Low Voltage

DTC P0459

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Ignition	P0030, P0036, P0102, P0135, P0138, P0141, P0443, P0458, P0598	P0030, P0036, P0102, P0135, P0138, P0141, P0443, P0458, P0598	-
Control	P0458	P0443	P0459

Circuit/System Description

The evaporative emission (EVAP) purge solenoid valve is used to purge fuel vapor from the EVAP canister to the intake manifold. The EVAP purge solenoid valve is pulse width modulated (PWM). Ignition voltage is supplied directly to the EVAP purge solenoid valve. The engine control module (ECM) controls the solenoid by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback

circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTC

- The vehicle is ON.
- The powertrain relay voltage is greater than 11 V.
- DTCs P0443, P0458 and P0459 run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for a minimum of 5 s.

Action Taken When the DTC Sets

DTCs P0443, P0458 and P0459 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0443, P0458 and P0459 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, command the EVAP Purge Solenoid Valve to 50% with a scan tool. You should hear the solenoid clicking.

- **No clicking heard**

Refer to Circuit/ System testing

- **Clicking heard**

2. Engine running, command the EVAP Purge Solenoid Valve from 0% to 50% and back to 0% with a scan tool.

3. Verify the scan tool parameters listed below do not display Malfunction.

- EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status
- EVAP Purge Solenoid Valve Control Circuit Open Test Status
- EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

4. Verify the EVAP Purge Solenoid Valve Control Circuit parameters above do not display Malfunction when moving the related harnesses and connectors of the Q12 Evaporative Emission Purge Solenoid Valve.

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve,

vehicle in Service Mode.

2. Verify that a test lamp illuminates between the ignition voltage circuit terminal B or 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition voltage circuit for a short and replace as necessary.
 - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the ignition circuit terminal B or 1 and the control circuit terminal A or 2.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter displays OK when commanding the EVAP Purge Solenoid Valve to 50% with a scan tool.
 - **If OK is not displayed**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal A or 2 and the ignition circuit terminal B or 1.
7. Verify the EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter displays Malfunction when commanding the EVAP Purge Solenoid Valve to 50% with a scan tool.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **If Malfunction is displayed**

8. Test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

Component Testing

Static Test

1. Vehicle OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Test for 10-30 Ω between the control terminal A or 2 and the ignition, terminal B or 1.
 - **If not between 10-30 Ω**

Replace the Q12 Evaporative Emission Purge Solenoid Valve.
 - **If between 10-30 Ω**
3. All OK.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

- [**Evaporative Emission Canister Purge Solenoid Valve Replacement**](#)
 - [**Control Module References**](#) for ECM replacement, programming and setup.
-

Article GUID: A00884694

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0446: EVAPORATIVE EMISSION (EVAP) VENT SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0446

Evaporative Emission (EVAP) Vent System Performance

Typical Scan Tool Data

Fuel Tank Pressure Sensor Signal Voltage	Fuel Tank Pressure
2.67 V	Atmospheric Pressure/BARO
Less than 1.5 V	Positive Pressure
More than 1.5 V	Negative Pressure/Vacuum

Circuit/System Description

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path. There are two parts to this test.

- Part one uses the fuel tank pressure sensor to indicate vacuum comes within a calibrated range within a calibrated time.
- The second part of this test looks for excessive vacuum which would indicate a restriction. The duration of this second part of is a function of purge volume through the system.

The table listed below illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP purge and vent solenoid valves.

ECM Command	EVAP Purge Solenoid Valve	EVAP Vent Solenoid Valve
ON (Venting)	Open	Open, Venting
OFF (Not Venting)	Closed	Closed, Not Venting

Conditions for Running the DTC

- DTCs P00C8, P00C9, P00CA, P0068, P0071, P0072, P0073 P0090, P0091, P0092, P0442, P0443, P0449, P0451, P0452, P0453, P0455, P0458, P0459, P0461, P0462, P0463, P0497, P0498, P0499, P0502, P0503, P0606, P0722, P0723, P0191, P0192, P0193, P06A3, P06DB, P06D2, P06DE, P0A1D,

P0601, P0604, P0697, P145D, P145E, P160D, P160E, P1682, P16A0, P16A1, P16A2, P16A7, P16F3, P1104, P127A, P127C, P127D, P15F2, P1221, P2066, P2067, P2068, P2100, P2101, P2102, P2103, P2122, P2123, P2127, P2128, P2135, P2138, P215B, P2176, P2227, P2228, P2229, P2230, P228C, P228D, P2400, P2401, P2402, P2418, P2419, P2420, P2422, P2450, P24B9, P24BA, P24BB, U0073, U0074, U0293, U1817 are not set.

- The EVAP purge solenoid is open.
- The EVAP vent solenoid is open.
- The EVAP leak detection pump is OFF.
- The vehicle service mode voltage is greater than 11 V.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The outside air temperature is between 4 - 35°C (39 - 95°F).
- The engine RPM to enable is between 1500 - 3400.
- The engine RPM to re-enable is between 1500 - 3300.
- The engine vacuum to enable is between 15 - 56 kPa (2.1 - 8.1 PSI).
- The engine vacuum to re-enable is between 16 - 54 kPa (2.3 - 7.8 PSI).
- The engine airflow to enable is between 5 - 29 g/s.
- The engine airflow to re-enable is between 6 - 27 g/s.
- The purge flow to enable is greater than 0.17 g/s.
- The purge flow to re-enable is greater than 0.18 g/s.
- The purge duty cycle to enable is greater than 15%.
- The purge duty cycle to re-enable is greater than 16%.
- The requested purge flow to enable is greater than 2.94%.
- The delivered purge flow to re-enable is greater than 2.89%.
- The delivered purge flow to enable is greater than 2.06%.
- The engine is running.
- The purge is enabled.
- The refueling request button is not pressed.
- The device control is less than 0.5 s.
- The fuel tank protection is not active.

This test will start and run once per trip when propulsion system is active and engine is On.

DTC P0497 has run and passed.

Conditions for Setting the DTC

If fuel tank pressure sensor reading is less than -13 in H₂O (-3.24 kPa) of vacuum for 5 s

Action Taken When the DTC Sets

DTC P0446 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0446 is a Type B DTC.

Diagnostic Aids

An intermittent condition could be caused by:

- A damaged EVAP vent housing
- A temporary blockage at the EVAP vent solenoid valve inlet
- Pinched vent hose
- A blockage in the vent system may also cause a poor fuel fill problem.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- **Evaporative Emission Control System Description**
- **Hybrid Modes of Operation Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- CH-41415-30 Fuel Tank Cap Adapter
- GE-41413-A Evaporative Emissions System Tester

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify DTC P0449 is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If the DTC is not set**

3. Vehicle OFF, remove the fuel tank filler cap. Vehicle in Service Mode.
4. Verify that the Fuel Tank Pressure Sensor voltage parameter is between 2.0 - 3.0 V.

- **If not between the 2.0 - 3.0 V**

Refer to [DTC P0451-P0453](#).

- **If between the 2.0 - 3.0 V**

5. Install the fuel tank filler cap, engine Running at operating temperature for 5 min,
6. Verify the scan tool Fuel Tank Pressure Sensor parameter does not increase to greater than 0.29 V when commanding the EVAP Purge Solenoid Valve to 50%.

- **If greater than 2.5 V**

Refer to Circuit/System Testing.

- **If 2.5 V or less**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

NOTE: Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.

1. Verify a blockage or restriction does not exist in the EVAP system components listed below.
 - Evaporative Emission Vent System Hoses
 - Evaporative Emission Canister
 - Q13 Evaporative Emission Vent Solenoid Valve
 - Evaporative Emission Vent Filter
 - **If a condition exists**

Repair or replace the component as necessary

- **If none of the conditions exist**

2. Reconnect all previously disconnected EVAP hardware.

NOTE: Refer to the **GE-41413-A** operation manual for detailed instructions in **Evaporative Emission Control System Diagnosis**.

3. Remove the fuel fill cap and connect the **CH-41415-30** to the fuel tank filler neck. Connect the **GE-41413-A** to the **CH-41415-30**.

4. Turn the nitrogen/smoke valve on the **GE-41413-A** to nitrogen.

NOTE: **DO NOT** exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.

5. Use the remote switch to activate the **GE-41413-A** and pressurize the fuel tank to 5.0 in H₂O (1.24 kPa).

6. Vehicle in Service Mode

7. Verify the scan tool Fuel Tank Pressure Sensor parameter is 0 in H₂O (0 kPa) when commanding the EVAP Vent Solenoid Valve to ON (Venting).

- **If not 0 in H₂O**

Test for a blockage or a restriction in the EVAP vent hose or inlet. If the inlet or hose test normal, replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If 0 in H₂O**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to step 1 above.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Evaporative Emission Canister Replacement**
- Refer to **Evaporative Emission Canister Vent Solenoid Valve Replacement**
- Refer to **Fuel Tank Pressure Sensor Replacement**

DTC P0449, P0498, OR P0499: EVAPORATIVE EMISSION (EVAP) VENT SOLENOID VALVE CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0449

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit

DTC P0498

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit Low Voltage

DTC P0499

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P0498	P0449, P0498	-
Control	P0498	P0449	P0499

Circuit/System Description

The EVAP vent solenoid valve controls fresh airflow into the EVAP canister. Battery voltage is supplied to the normally closed evaporative emission (EVAP) vent solenoid valve. The ECM grounds the EVAP vent solenoid valve control circuit through an internal switch called a driver. The ECM monitors the status of the driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTC

DTCs P0449, P0498 and P0499 run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 5 s.

Action Taken When the DTC Sets

DTCs P0449, P0498 and P0499 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0449, P0498 and P0499 are Type B DTCs.

Diagnostic Aids

Where multiple DTCs set look for a common root cause like battery feeds, grounds, splices, etc.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, command the EVAP vent solenoid valve to Venting and Not Venting with a scan tool. Listen or feel for a click when the valve operates.
 - **No click heard or felt**

Refer to Circuit/System testing
 - **Click heard or felt**
2. Command the EVAP Vent Solenoid Valve to Venting and Not Venting with a scan tool
3. Verify the following scan tool parameters listed below do not display Malfunction :
 - EVAP Vent Solenoid Valve Output Circuit High Voltage Test Status
 - EVAP Vent Solenoid Valve Output Circuit Open Test Status
 - EVAP Vent Solenoid Valve Output Circuit Low Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the B+ circuit terminal A or 2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the B+ circuit for a short and replace as necessary.

- **If the test lamp illuminates**

4. Verify that a test lamp does not illuminate between the B+ circuit terminal A or 2 and the control circuit terminal B or 1.

- **If the test lamp illuminates**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

5. Remove the test lamp.
6. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter displays OK when commanding the EVAP Vent Solenoid Valve to Venting with a scan tool.

- **If OK is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If OK is displayed**

7. Install a 3 A fused jumper wire between the control circuit terminal B or 1 and the B+ circuit terminal A or 2.
8. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter displays Malfunction when commanding the EVAP Vent Solenoid Valve to Venting with a scan tool.

- **If Malfunction is not displayed**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.

- **If Malfunction is displayed**

9. Test or replace the Q13 Evaporative Emission Vent Solenoid Valve.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
2. Test for 10-30 Ω between the control terminal B or 1 and the B+ circuit terminal A or 2.

- **If not between 10-30 Ω**

Replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If between 10-30 Ω**

3. Test for no air flow through the Q13 Evaporative Emission Vent Solenoid Valve by applying vacuum to the pump side of the valve. It should hold 1 - 2 in. Hg (3 - 7 kPa) for 30 s.

- **If not within the specified range**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If within the specified range**

4. Jumper:
 - The control terminal B or 1 to ground
 - The B+ circuit terminal A or 2 to 12 V battery voltage
5. Apply vacuum to the pump side of the Q13 Evaporative Emission Vent Solenoid Valve. It should not hold vacuum.
 - **If it does hold vacuum**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If it does not hold vacuum**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P0451-P0453: FUEL TANK PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0451

Fuel Tank Pressure Sensor Performance

DTC P0452

Fuel Tank Pressure Sensor Circuit Low Voltage

DTC P0453

Fuel Tank Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P0532, P0641	P0452	P0453, P0533, P0641 *	-
Signal	P0452	P0452	P0453 *	-
Low Reference	-	P0453, P0463, P1458, P145A	-	-
* Internal ECM or fuel tank pressure sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Fuel Tank Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle in Service Mode			

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: 0.15 - 4.85 V			
5 V Reference	0 V	0 - 1.5 V	5 V
Signal	0 V	0 V	3 - 5 V
Low Reference	-	4 - 5 V	-

Circuit/System Description

The fuel tank pressure sensor measures the pressure or vacuum in the evaporative emission (EVAP) system. The engine control module (ECM) supplies a 5 V reference and a low reference circuit to the fuel tank pressure sensor. The fuel tank pressure sensor signal voltage varies depending on EVAP system pressure or vacuum.

The following tables illustrate relationship examples between the fuel tank pressure sensor and the ON and OFF states, and the OPEN or CLOSED states of the EVAP components.

Fuel Tank Pressure Relationship

Fuel Tank Pressure	Fuel Tank Pressure in. H2O/PSI	Fuel Tank Pressure Signal Voltage
Pressure	Positive Value, 14.9 in H2O/0.54 PSI	High, 4.73 V
No Pressure	Near Zero, 0 in H2O/0.001 PSI	2.6 V
Vacuum	Negative Value, - 2.37 in H2O/- 0.08 PSI	Low, 2.3 V

Fuel Tank Pressure to EVAP Leak Detection Pump Assembly Relationship

Fuel Tank Pressure	Fuel Tank Pressure Sensor	EVAP Leak Detection Pump Switch Valve	Vent Valve	EVAP Leak Detection Pump Pressure
Pressure or Vacuum	Positive or Negative Value	Vent	Closed	100 kPa (14.50 PSI) *
Vacuum	Negative Value -1 kPa (0.15 PSI)	Pump/Not Venting	Open	99 kPa (14.36 PSI) **
Pressure	Positive Value -3 kPa (0.44 PSI)	Pump/Not Venting	Open	103 kPa (14.94 PSI) **

* Equivalent to barometric pressure reading.

** The values are examples only. Your readings may vary from this depending on the pressure or vacuum in the system and barometric pressure.

Conditions for Running the DTC

P0451 - Condition 1:

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P0222, P0223, P0449, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P1221, P1459, P145A, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, U0140, U182D, U0073, U0074, P2537 or P2610 is not set.

- DTC P1458 or P145D are not present when the test failed this ignition cycle.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The engine coolant temperature (ECT) is less than 40°C (104°F).
- The intake air temperature (IAT) is between 4°C - 45°C (39°F - 113°F).
- The propulsion system is not active.
- The vehicle is OFF.
- The service bay test is not active.
- The refueling request button is not pressed.
- The battery voltage is greater than 10 V.
- The vehicle speed is less than 1.6 km/h (1 MPH).
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 h.
- The DTC runs once per drive cycle and immediately after a code clear when the above conditions are met.

P0451 - Condition 2:

- DTCs P0068, P0071, P0072, P0073, P010C, P010D, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P012B, P012C, P012D, P0121, P0122, P0123, P0222, P0223, P0442, P0443, P0449, P0452, P0453, P0455, P0458, P0459, P0498, P0499, P0502, P0503, P0722, P0723, P0606, P1104, P1221, P145A, P145D, P145E, P1458, P1459, P16F3, P2100, P2101, P2102, P2103, P2400, P2401, P2402, P2418, P2419, P2420, P2422 or P2450 is not set.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The outside air temperature (OAT) is between 4°C - 35°C (39 - 102°F).
- The engine is running.
- The run/crank voltage is greater than 11 V.
- The EVAP Purge solenoid valve is not enabled.
- The refueling request button is not pressed.
- The DTC runs once per drive cycle when the above conditions are met.

P0452 and P0453

- Vehicle ON or the engine is running.
- DTCs P0452 and P0453 run continually when the above conditions are met.

Conditions for Setting the DTC

P0451

The ECM detects the difference between the fuel tank pressure sensor and the EVAP leak detection pump pressure is greater than 0.747 kPa (0.11 PSI) for greater than 5 s.

P0452

The ECM detects the fuel tank pressure sensor voltage is less than 0.15 V for greater than 8 s.

P0453

The ECM detects the fuel tank pressure sensor voltage is greater than 4.85 V for greater than 8 s.

Action Taken When the DTC Sets

DTCs P0451, P0452 and P0453 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0451, P0452 and P0453 are Type B DTCs.

Diagnostic Aids

- A restriction in the EVAP canister or vent lines that keeps the fuel tank pressure and EVAP leak detection pump sensor from comparing each others value.
- Since this is a sealed system there could be a pressure or vacuum existing in the system.
- A vent valve stuck closed will affect performance.
- A switching valve stuck in the vent position will affect performance.
- Ensure that the reference port on the fuel tank pressure sensor is unobstructed.
- In a sealed system a condition where there is a lot of pressure or vacuum in the fuel tank to start with (fuel tank pressure sensor is outside readable range), in those cases (high vacuum) you will not see any fuel tank pressure sensor movement after purge is commanded on. On the pressure side, it may eventually get into the readable range, but could take significant time. Opening/venting the vent solenoid before testing can relieve any stored pressure or vacuum to help alleviate this.
- A fuel tank pressure sensor that is skewed or does not have a linear transition from low to high may cause these DTC's to set. Scan tool output controls and Review Stored Data can help detect erratic sensor response. To test the sensor signal under vacuum conditions, use Review Stored Data and the EVAP Test function to capture data while commanding purge to 20%, then review stored data to look for erratic sensor operation. A similar test can be done for the pressure side of the sensor operation by applying pressure with the **GE 41413-A** while taking a snapshot.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- [Evaporative Emission Control System Description](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

GE 41413-A Evaporative Emissions System Tester

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

[Circuit/System Verification](#)

NOTE:

- The order of these steps is important. If not followed properly you will be bleeding off any pressure or vacuum in the system and not see any change in the EVAP leak detection pump sensor.
- Read the instructions for P0451 in their entirety before proceeding to understand what is being required.
- Ambient and vehicle component temperature must be above 0Â°C (32Â°F) to command the switching valve or vacuum pump. This prevents erroneous results and damage to the EVAP leak detection pump assembly.

P0451

1. Verify DTC P0449, P0498 or P0499 is not set

- **If the DTC sets**

Refer to: [DTC P0449, P0498, or P0499](#)

- **If the DTC does not set**

2. Verify DTC P0452 or P0453 is not set

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

3. Vehicle in Service Mode.
4. Record the scan tool Fuel Tank Pressure Sensor parameter, pressure or vacuum.
5. Command the EVAP Vent Solenoid Valve to Venting.
6. The Fuel Tank Pressure Sensor parameter should be 0.07 in H₂O, 0.01 kPa (0.00 PSI) after 5 s.

- **If not within the specified range**

Verify the following conditions do not exist:

- A restriction in the EVAP canister or vent lines
- A EVAP vent solenoid valve stuck closed
- The reference port on the fuel tank pressure sensor is obstructed

Repair or replace as necessary

- **If within specified range**

7. Command the EVAP leak detection pump ON using the scan tool EVAP Test. Get the fuel tank pressure sensor parameter to -11.56 in H₂O, -2.88 kPa (-0.42 PSI) or greater. This may take several seconds.

NOTE: Use of any control function other than EVAP Test will not create a vacuum in the system.

NOTE: Vacuum will decay exiting the EVAP Test and going to step 8. This is normal. There should be sufficient vacuum left to perform steps 8 and 9.

8. Record the scan tool EVAP Leak Detection Pump and Fuel Tank Pressure Sensor parameters, reading one.
9. Perform each step listed below in order:
 1. Select scan tool Fuel Tank Pressure Sensor Test.
 2. Command the EVAP Leak Detection Pump Switching Valve Command to Not Venting.
 3. Wait for 3 s.
 4. Command the EVAP Vent Solenoid Valve Command ON.

NOTE: Wait for 15 s while observing the parameters then click the pause button on the scan tool to retain the parameters.

10. Record the scan tool EVAP Leak Detection Pump and Fuel Tank Pressure Sensor parameters, reading two.
11. Press the scan tool Release Control button after recording the parameters.

NOTE: The subtraction results and Fuel Tank Pressure parameter should be negative since a vacuum was pulled on the system.

12. Subtract the EVAP leak detection pump reading 2 from EVAP leak detection pump reading 1. This value equals what the fuel tank pressure sensor, reading two, should be (EVAP leak detection pump reading 2 -

EVAP leak detection pump reading 1 = fuel tank pressure reading 2). The fuel tank pressure sensor should be within 3 in H₂O, 0.749 kPa (0.11 PSI) of the subtraction just performed.

- **If not within the specified range**

Verify the following conditions do not exist:

- A restriction in the EVAP canister or vent lines
- A EVAP vent solenoid valve stuck closed
- The reference port on the fuel tank pressure sensor is obstructed

Repair or replace as necessary

- **If within the specified range**

13. All OK.

P0452 and P0453

1. Request a refueling event.
2. Remove the fuel cap.
3. Vehicle in Service Mode.
4. Verify the scan tool Fuel Tank Pressure Sensor parameter. It should be 2.67 V at 0 kPa (0 PSI).

- **If not within the specified range**

Refer to circuit/system testing.

- **If within the specified range**

5. All OK.

Circuit/System Testing

NOTE: Testing for steps 2 - 6 is performed on the ECM side of the harness connector.

1. Vehicle OFF, all systems OFF. Disconnect the harness connector at the B150 Fuel Tank Pressure Sensor. It may take up to for 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool Fuel Tank Pressure parameter is less than 0.2 V.
 - **If 0.2 V or greater**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Verify the scan tool Fuel Tank Pressure Sensor parameter is greater than 4.7 V.
 - **If 4.7 V or less**
1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.7 V**
8. Test or replace the B150 Fuel Tank Pressure Sensor.

Component Testing

1. Remove the Q63 Evaporative Emission System Leak Detection Pump Assembly
2. Verify none of the conditions listed below exist:

- Poor connection at the X350 or X351 harness connectors
- Open or shorted 5 V reference circuit
- Open or shorted sensor signal circuit
- Open low reference circuit
- **If a condition exists**

Repair as necessary.

- **If no conditions exist**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Tank Pressure Sensor Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P0497: EVAPORATIVE EMISSION (EVAP) SYSTEM NO FLOW DURING PURGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0497

Evaporative Emission (EVAP) System No Flow During Purge

Circuit/System Description

This DTC tests for proper intake manifold vacuum flow to the evaporative emission (EVAP) system. The engine control module (ECM) opens the EVAP purge solenoid valve and the EVAP vent solenoid valve. The ECM then monitors the fuel tank pressure sensor and EVAP leak detection pump pressure sensor to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is less than a predetermined value within a predetermined time, this DTC sets.

Conditions for Running the DTC

- DTCs P0068, P0071, P0072, P0073, P0106, P0107, P0108, P0122, P0123, P0222, P0223, P0442, P0443, P0449, P0451, P0452, P0453, P0455, P0458, P0459, P0498, P0499, P0502, P0503, P0606, P0722, P0723, P16F3, P1104, P145D, P145E, P2100, P2101, P2102, P2103, P2400, P2401, P2402, P2418, P2419, P2420, P2422, P2450, P24B9, P24BA and P24BB is not set.
- The EVAP purge solenoid is open.
- The EVAP vent solenoid is open.
- The EVAP leak detection pump is OFF.

- The vehicle service mode voltage is greater than 11 V.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The outside air temperature is between 4 - 35°C (39 - 95°F).
- The engine RPM to enable is between 1500 - 3400.
- The engine RPM to re-enable is between 1500 - 3300.
- The engine vacuum to enable is between 15 - 56 kPa (2.1 - 8.1 PSI).
- The engine vacuum to re-enable is between 16 - 54 kPa (2.3 - 7.8 PSI).
- The engine airflow to enable is between 5 - 29 g/s.
- The engine airflow to re-enable is between 6 - 27 g/s.
- The purge flow to enable is greater than 0.17 g/s.
- The purge flow to re-enable is greater than 0.18 g/s.
- The purge duty cycle to enable is greater than 15%.
- The purge duty cycle to re-enable is greater than 16%.
- The requested purge flow to enable is greater than 2.94%.
- The delivered purge flow to re-enable is greater than 2.89%.
- The delivered purge flow to enable is greater than 2.06%.
- The engine is running.
- The purge is enabled.
- The refueling request button is not pressed.
- The device control is less than 0.5 s.
- The fuel tank protection is not active.

This test will start and run once per trip with propulsion system active and engine is ON.

Conditions for Setting the DTC

- After an initial time delay of 3 s when the fuel tank pressure sensor reading is greater than 0.39 kPa (0.056 PSI).

Or

- After an initial time delay of 3 s when the fuel tank pressure sensor reading is less than 0.39 kPa (0.056 PSI), plus an EVAP leak detection pump switching valve delay time of 0.2 s.
- If the EVAP leak detection pump pressure sensor, gauge, indicates a vacuum change less than 2 kPa (0.29 PSI) for 20 s, then a low purge flow failure has been detected.

Action Taken When the DTC Sets

DTC P0497 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0497 is a Type B DTC.

Diagnostic Aids

- A temporary blockage in the components listed below could cause an intermittent condition.
 - EVAP purge solenoid valve
 - Purge pipe
 - EVAP canister
- A EVAP vent solenoid valve stuck closed can cause this DTC to set.
- A EVAP leak detection pump switching valve stuck in the vent or pump position can cause this DTC to set.
- A fuel tank fuel pump module assembly not fully seated in the fuel tank can cause this DTC to set.
- A loose fuel cap can cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- Evaporative Emission Control System Description
- Hybrid Modes of Operation Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **CH-48096** EVAP Service Access Port Tool
- **GE-41413-A** Evaporative Emissions System Tester

- **GE-41413-300** EVAP Cap And Plug Kit
- **GE-41413-SPT** High Intensity White Light

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

WARNING: Refer to [Fuel and Evaporative Emission Pipe Warning](#) .

CAUTION: Refer to [Clean, Dry, Low Pressure Gas Source Caution](#) .

NOTE: Refer to **GE-41413-A** operation manual for detailed instructions in **Evaporative Emission Control System Diagnosis**.

1. Verify the following conditions do not exist in the EVAP system:

- A loose, missing, or damaged fuel fill cap.
- A stuck closed, blocked, or restricted EVAP purge solenoid valve.
- A blockage or restriction in the EVAP purge solenoid valve vacuum supply hose, purge pipe, EVAP canister or vapor pipe.

- **If a condition is found**

Repair or replace as necessary.

- **If no conditions are found**

CAUTION: Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) .

2. Connect the **CH-48096** to the EVAP purge solenoid valve.

3. Connect the **GE-41413-A** to **CH-48096**

4. Disconnect the fresh air intake tube from the EVAP leak detection pump.

5. Plug the fresh air port of the EVAP leak detection pump

6. Engine running, observe the **GE-41413-A** vacuum gauge and Fuel Tank Pressure parameter with a scan tool. There should be vacuum present.

- **If no vacuum is detected**

Refer to Circuit System Testing

- **If vacuum is detected**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to Circuit System Testing

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

NOTE: Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.

1. The **GE-41413-A** should still be installed from verification.
2. Engine running, observe the vacuum gauge while commanding the EVAP Purge Solenoid Valve to Increase with the scan tool. Vacuum should be present from 10 - 100%.

- **If no vacuum is present**

Test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

- **If vacuum is present**

3. Install the plug in the fresh air port performed in step 5 of circuit system verification.
4. Observe the Fuel Tank Pressure parameter while commanding the EVAP Purge Solenoid Valve to Increase with the scan tool. The parameter should be greater than 1.50 V within 60 s.

- **If less than the specified range**

Repair the blocked purge path or test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

- **If within specified range**

5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Evaporative Emission Canister Purge Solenoid Valve Replacement**
- Refer to **Evaporative Emission Canister Vent Solenoid Valve Replacement**
- Refer to **Evaporative Emission Canister Replacement**
- Refer to **Evaporative Emission System Vacuum Leak Detection Pump Replacement**

DTC P050D: COLD START ROUGH IDLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P050D

Cold Start Rough Idle

Circuit/System Description

During a cold start, the engine control module (ECM) commands dual-pulse mode during Open Loop operation to improve cold start emissions. In dual-pulse mode, the injectors are energized twice during each injection event. As with misfire diagnosis, in dual-pulse mode the ECM monitors the crankshaft position sensor and the camshaft position sensors to calculate crankshaft rotation speed. In normal operation, optimum fuel delivery during dual-pulse mode produces a steady crankshaft rotation speed. If the variations exceed a calibrated value, the code will be set.

Conditions for Running the DTC

- DTCs P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0101-P0103, P0106-P0108, P010B, P010C, P010D, P0112, P0113, P0117, P0118, P0119, P0122, P0123, P0128, P0192, P0193, P0201-P0204, P0205, P0206, P0207, P0208, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0335, P0336, P0351-P0354, P0355, P0356, P0357, P0358, P0502, P0503, P0506, P0507, P05CC, P05CD, P05CE, P05CF, P0627, P0628, P0629, P0697, P06A3, P0722, P0723, P0806, P0807, P0808, P111E, P1248, P1249, P124A, P127C, P127D, P124B, P128A, P128B, P128F, P16A0, P16A1, P16A2, P16E4, P16E5, P16F3, P182E, P1824, P182A, P182B, P182C, P182D, P182F, P1838, P1839, P1840, P1841, P18B5, P18B6, P18B7, P18B8, P18B9, P18BA, P18BB, P18BC, P18BD, P18BE, P18BF, P18C0, P18C1, P18C2, P18C3, P1915, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321, P2322 are not set.
- The catalyst temperature is less than 350Â°C (662Â°F).
- The engine coolant temperature is between -15 - 56Â°C (5 - 132.8Â°F).
- The barometric pressure is greater than 76 kPa.
- The engine speed is between 450 - 2200 RPM.
- The accelerator pedal position is less than 110%.
- The engine is running for less than 30 s and a cold start has been detected.
- The DTC runs once per cold start.

Conditions for Setting the DTC

This DTC will set if the ECM detects variations in crankshaft rotation speed caused by the lack of adequate fuel delivery during dual-pulse mode.

Action Taken When the DTC Sets

- DTC P050D is a Type B DTC.
- The ECM disables dual pulse mode and energizes the fuel injector as it would for a warm engine.

Conditions for Clearing the DTC

DTC P050D is a Type B DTC.

Diagnostic Aids

- This DTC may be set with a misfire DTC, however the existence of this DTC is a higher priority and indicates the condition to diagnose is related to fuel and/or injectors, not the ignition/spark system.
- A restricted fuel injector may cause this DTC to set.
- High resistance in the circuits of the injectors could set this DTC without setting an injector DTC. Test the injector circuits of the affected cylinders for a high resistance if you suspect a condition.
- A drop in system voltage during cold start may set this DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Circuit/System Verification requires cold start. Do not start vehicle prior to connecting scan tool and preparing to evaluate the condition during engine crank.**

1. Engine running.
2. Verify that the scan tool Cylinder 1-4 Current Misfire Counters are not incrementing during first 500 engine cycles.

- **If incrementing**

Refer to Circuit/System Testing.

- **If not incrementing**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Verify that the fuel pressure is not too low or too high. Refer to [Fuel System Diagnosis](#).

- **If a condition is found**

Repair or replace components as necessary

- **If a condition is not found**

2. Verify that the fuel is not contaminated. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).

- **If the fuel is contaminated**

Clean the fuel system. Refer to [Fuel System Cleaning](#).

- **If the fuel is not contaminated**

3. Replace the appropriate fuel injectors as indicated by high misfire counts.

Repair Instructions

NOTE: Repair Verification requires cold start.

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Fuel Injector Replacement](#)

DTC P057B-P057E: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B, P057E
5 V Reference	P057C P0651	P057C	P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle in Service Mode Normal Range: 0.25 - 4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the engine brake pedal override feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied. When the engine brake pedal override system is active, the ECM reduces engine torque to assist in reducing vehicle speed.

The BPP sensor is a six wire sensor, and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the engine brake pedal override feature. The BPP Sensor for engine brake pedal override communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit, and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake

pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to [Exterior Lighting Systems Description and Operation](#) .

Conditions for Running the DTC

P057B

- DTCs P057C, or P057D are not set.
- Ignition voltage is greater than 10 V.
- Shift lever has been in Park at least once during key ON.
- Shift lever is not in Park.
- Vehicle speed is greater than 8 Km/h (5 mph).
- Accelerator Pedal Position is less than 5%.
- DTC runs once per key cycle when above conditions are met.

P057C, P057D, or P057E

- Ignition voltage is greater than 10 V.
- DTC runs continuously when above condition is met.

Conditions for Setting the DTC

P057B

ECM detects the BPP sensor signal is stuck in a range for greater than 1 s.

P057C

ECM detects the BPP sensor voltage is less than 0.25 V greater than 1 s.

P057D

ECM detects the BPP sensor voltage is greater than 4.75 V greater than 1 s.

P057E

ECM detects the BPP sensor value varies greater than a calibrated value.

Action Taken When the DTC Sets

- P057B, P057C, P057D, and P057E are Type A DTCs.
- Brake Pedal Position Sensor parameter defaults to 0%.

Conditions for Clearing the DTC

P057B, P057C, P057D, and P057E are Type A DTCs

Reference Information

Schematic Reference

- [Engine Controls Schematics](#)
- [Exterior Lights Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: The Brake Pedal Position sensor scan tool data is located in the ECM automatic transmission data list.

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0651, P0697, or P06A3 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Transmission in Park, and service brake pedal released.
4. Verify the scan tool Brake Pedal Position Sensor parameter in the ECM displays released.

- **If released is displayed**

Refer to Circuit/System Testing.

- **If released is not displayed**

5. Verify the scan tool Brake Pedal Position Sensor parameter changes as the brake pedal is applied and displays applied on a scan tool when the brake pedal is fully applied.

- **If applied is displayed**

Refer to Circuit/System Testing.

- **If applied is not displayed**

6. Verify the scan tool Brake Pedal Position Sensor Learned Release Position parameter is within 0.1 V of the Brake Pedal Position Sensor parameter when the brake pedal is fully released.

- **If difference is greater than 0.1 V**

Perform the **Brake Pedal Position Sensor Learn** .

- **If difference is 0.1 V or less**

7. Verify the Brake Pedal Position Sensor parameter transitions smoothly without any spikes or dropouts when slowly applying and releasing the brake pedal.

- **If parameter does not transition smoothly or has spikes or dropouts**

Refer to Circuit/System Testing.

- **If parameter transitions smoothly and there are no spikes or dropouts**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

9. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

10. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification first.

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: All terminal references are for the vehicle harness brake pedal position sensor connector.

2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.

- **If 10 Ω or greater**

1. Disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 10 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 5 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Verify the scan tool Brake Pedal Position Sensor parameter is released.

- **If released is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.
 - If 0.25 V or greater, repair the short to voltage on the circuit.
 - If less than 0.25 V, replace the K20 Engine Control Module.

- **If released is displayed**

6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.

7. Verify the scan tool Brake Pedal Position Sensor parameter is applied.

- **If applied is not displayed**

1. Vehicle OFF, remove the jumper wire, and disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If applied is displayed**

8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Pedal Position Sensor Replacement](#)
- Perform the [Brake Pedal Position Sensor Learn](#) following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, OR P262B: CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062B

Control Module Fuel Injector Control Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P0630

VIN Not Programmed or Mismatched - Engine Control Module (ECM)

DTC P16F3

Control Module Redundant Memory Performance

DTC P262B

Control Module Power Off Timer Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). This diagnostic also addresses if the ECM is not programmed.

The ECM monitors its ability to read and write to the memory. It also monitors a timing function.

Conditions for Running the DTC

P0601, P0602, P0630

- The vehicle is ON.
- These DTCs run continuously when the above condition is met.

P0603, P062F

- The vehicle is ON.
- These DTCs run once per ignition cycle.

P0604

- The vehicle is ON for greater than 30 s.
- DTC P0604 runs continuously when the above condition is met.

P0606, P062B

- The system voltage is greater than 11 V.
- DTC P0606 runs continuously when the above condition is met.

P16F3

- The engine is running.
- DTCs P0101, P0102, P0103, P0106, P0107, or P0108 are not set.
- DTC P16F3 runs continuously when the above conditions are met.

P262B

- Vehicle OFF.
- The ECM is not powered down.
- DTC P262B runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects an internal failure or incomplete programming for more than 10 s.

Action Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.

- DTCs P062F and P262B are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.
- DTCs P062B, P062F and P262B are Type B DTCs.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged. Refer to **Battery Inspection/Test**
- The ECM ground circuits do not have an open or high resistance.
- The ECM power circuits do not have an open, short to ground, or high resistance.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, clear the DTC information with a scan tool.

2. Verify no other DTCs are set.

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If no other DTCs are set**

3. Verify DTC P0602 or P0630 is not set.

- **If any of the DTCs are set**

1. Program the K20 Engine Control Module. Refer to [Control Module References](#).

2. Verify DTC P0602 or P0630 is not set.

- If any of the DTCs are set, replace the K20 Engine Control Module.
- If none of the DTCs are set

3. All OK.

- **If none of the DTCs are set**

4. Verify DTC P0601, P0603, P0604, P0606, P062B, P062F, P16F3, or P262B is not set.

- **If any of the DTCs are set**

Replace the K20 Engine Control Module.

- **If none of the DTCs are set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming, and setup.

DTC P0627-P0629: FUEL PUMP ENABLE CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0627

Fuel Pump Enable Circuit

DTC P0628

Fuel Pump Enable Circuit Low Voltage

DTC P0629

Fuel Pump Enable Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0171, P0506, P0628, P12A6	P0171, P0506, P0627, P12A6	P0629, P12A6	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The ECM enables the fuel pump driver control module as long as the engine is cranking or running, and ignition system reference pulses are received. While this enable voltage is being received, the fuel pump driver control module supplies a varying voltage to the in-tank fuel pump module in order to maintain the desired fuel line pressure.

Conditions for Running the DTC

- The engine speed is greater than 0 RPM.
- The ignition voltage is greater than or equal to 11 V.
- The fuel pump enable circuit is commanded ON.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for 2.5 s.

Action Taken When the DTC Sets

DTCs P0627, P0628, and P0629 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0627, P0628, and P0629 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify DTC P0627, P0628, or P0629 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.
 - **If a DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

[Circuit/System Testing](#)

1. Vehicle OFF, disconnect the K111 Fuel Pump Driver Control Module harness connector.
2. Vehicle in Service Mode for greater than 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.

- **If OK is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If OK is displayed**

6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.

- **If Malfunction is not displayed**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

8. Test or replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Engine Control Module and Fuel Pump Power Control Module replacement, programming, and setup

DTC P0641, P0651, P0697, P06A3, OR P06D2: 5 V REFERENCE 1-5 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0641

5 V Reference 1 Circuit

DTC P0651

5 V Reference 2 Circuit

DTC P0697

5 V Reference 3 Circuit

DTC P06A3

5 V Reference 4 Circuit

DTC P06D2

5 V Reference 5 Circuit

Circuit/System Description

The engine control module (ECM) has 5 internal 5 V reference circuits. Each internal reference circuit provides external 5 V reference circuits for more than one sensor. A short to ground or short to voltage on one external 5 V reference circuit can affect all the components connected to the same internal 5 V reference circuit.

Conditions for Running the DTC

The DTCs run continuously when the ignition voltage is greater than 6.4 V.

Conditions for Setting the DTC

The ECM detects a short to ground or voltage on any of the 5 V reference circuits for greater than 0.5 s.

Action Taken When the DTC Sets

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

Diagnostic Aids

The 5 V reference 1 circuit provides 5 V circuits to the sensors listed below:

- Air conditioning (A/C) refrigerant pressure sensor
- Exhaust camshaft position sensor
- Intake camshaft position sensor
- Fuel tank pressure sensor

The 5 V reference 2 circuit provides 5 V circuits to the sensors listed below:

- Evaporative emission system leak detection pump assembly
- Crankshaft position sensor

The 5 V reference 3 circuit provides 5 V circuits to the sensors listed below:

- Manifold Absolute Pressure Sensor
- Accelerator Pedal Position Sensor 2

The 5 V reference 4 circuit provides 5 V circuits to the sensors listed below:

- Accelerator pedal position sensor 1
- Throttle position sensor 1 and 2

Disconnecting one component at a time from the affected 5 V reference circuit while observing the scan tool 5 V Reference Circuit Status parameter may help locate the fault. The scan tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all 5 V reference components have been disconnected and a fault is still indicated, the fault may exist in the wiring harness.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify all scan tool 5 V Reference Circuit Status parameters do not display Malfunction.
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

NOTE: Additional DTCs will set when disconnecting the components.

1. Vehicle OFF, disconnect the harness connector at all appropriate sensors for the applicable DTC. Refer to Diagnostic Aids.
2. Vehicle in Service Mode.
3. Test for 4.8 - 5.2 V between one of the 5 V reference circuits and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit for each applicable component and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for less than 1 V between the 5 V reference circuit for each applicable component and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**

NOTE: A short to voltage or ground on the signal circuit of certain components may cause this DTC to set.

4. Vehicle in Service Mode.
5. Verify the appropriate scan tool 5 V Reference 1, 2, 3, or 4 Circuit Status parameter displays OK while connecting each component associated with the 5 V reference circuit one at a time.
 - **If OK is not displayed when a component is connected**

Test the signal circuit of that component for a short to ground or voltage. If the circuit tests normal, replace the component.

- **If OK is displayed after all components have been connected**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Accelerator Pedal Replacement](#)
- Refer to [Camshaft Position Sensor Replacement - Intake](#)
- Refer to [Camshaft Position Sensor Replacement - Exhaust](#)
- Refer to [Crankshaft Position Sensor Replacement](#)
- Refer to [Fuel Tank Pressure Sensor Replacement](#)
- Refer to [Manifold Absolute Pressure Sensor Replacement](#)
- Refer to [Throttle Body Assembly Replacement](#)
- Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0650, P263A, OR P263B: MALFUNCTION INDICATOR LAMP (MIL) CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0650

Malfunction Indicator Lamp (MIL) Control Circuit

DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0650	P0650	-	-
Control	P0650, P263A *	P0650, P263A	P263B	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
* The MIL remains ON				

Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the powertrain control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the vehicle is ON and the engine is OFF.

Conditions for Running the DTC

- The ignition is ON or the engine is running.
- The ignition voltage is greater than 11 V.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

DTC P0650 or DTC P263A

The ECM detects low voltage during the MIL control circuit driver OFF state. This indicates either a shorted to ground or an open MIL control circuit.

DTC P263B

The ECM detects high voltage on the MIL control circuit during the driver ON state. This indicates a shorted to voltage MIL control circuit.

Action Taken When the DTC Sets

DTC P0650, P263A, and P263B are type B DTCs, with no MIL request

Conditions for Clearing the DTC

DTC P0650, P263A, and P263B are type B DTCs, with no MIL request.

Diagnostic Aids

If the ECM detects low voltage on the MIL control circuit during the control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

Reference Information

Schematic Reference

- [Engine Controls Schematics](#)
- [Instrument Cluster Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify that the malfunction indicator lamp turns ON and OFF when commanding the Malfunction Indicator Lamp (MIL) On and Off with a scan tool.
 - **If the malfunction indicator lamp does not turn ON and OFF**

Refer to Circuit/System Testing.
 - **If the malfunction indicator lamp turns ON and OFF**
3. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions you observed from the Freeze Frame/Failure Records data.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the P16 Instrument Cluster, vehicle in Service Mode.
2. Verify a test lamp illuminates between the control circuit terminal 16 and B+ when commanding the Malfunction Indicator Lamp (MIL) On and Off with a scan tool.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K20 Engine Control Module.
- **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
 3. Vehicle OFF.
 4. Test for less than 2 Ω between the control circuit end to end.
 - If 2 Ω or greater, repair the open high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If the test lamp turns ON and OFF**
 3. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Instrument Cluster Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P0685-P0690, P1682, P16A7, P16AF, OR P16B3: ENGINE CONTROLS IGNITION RELAY/IGNITION 1 SWITCH CIRCUIT 2

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0685

Engine Controls Ignition Relay Control Circuit

DTC P0686

Engine Controls Ignition Relay Control Circuit Low Voltage

DTC P0687

Engine Controls Ignition Relay Control Circuit High Voltage

DTC P0689

Engine Controls Ignition Relay Feedback Circuit Low Voltage

DTC P0690

Engine Controls Ignition Relay Feedback Circuit High Voltage

DTC P1682

Ignition 1 Switch Circuit 2

DTC P16A7

Engine Controls Ignition Relay Feedback Circuit 2

DTC P16AF

Engine Controls Ignition Relay Feedback Circuit 2 Low Voltage

DTC P16B3

Engine Controls Ignition Relay Feedback Circuit 2 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	P0689, P1682	P0685, P0689, P1682, P16A7, P16AF	-	-
B+ - Relay Switch	P0689, P1682	P0685, P0689, P1682, P16A7, P16AF	-	-
Control - Component	P0689, P1682	P0689, P1682, P16A7, P16AF	P0690, P16B3	-
Control - Relay Coil	P0686, P0690	P0685, P0689, P1682, P16A7, P16AF	P0685, P0687, P0689, P1682*	-

*Internal control module or component damage may occur if the circuit shorts to B+.

Circuit/System Description

Circuit	Description
B+ - Relay Coil	Supplied directly from the battery.
B+ - Relay Switch	Supplied directly from the battery.
Control - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.

Components

Component	Description
-----------	-------------

Component	Description
KR75 Engine Controls Ignition Relay	The powertrain relay is controlled by the Engine Control Module (ECM) depending upon input from the ignition switch. Battery positive voltage is supplied to the relay coil and switch. When the ignition switch is turned to the ON position, the ECM will provide ground on the control circuit of the powertrain relay using a low side driver. This will allow voltage through the relay switch contacts to the components. The ECM monitors the voltage level on the control circuit of the powertrain relay.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

4 ignition voltage circuits supply the ECM. The 4 circuits are supplied by 2 relay(s):

- KR73 Ignition Main Relay
- KR75 Engine Controls Ignition Relay

The ECM monitors and compares the voltages supplied by the relay(s).

Conditions for Running the DTC

P0685, P0686, P0687

Ignition Voltage = Greater than 11 V

DTCs run continuously when the above condition is met.

P0689, P16AF

- Ignition Voltage = Greater than 11 V
- Engine Controls Ignition Relay Command = On

DTC runs continuously when the above conditions are met.

P0690, P16B3

- DTC P0685 = Not set
- Engine Controls Ignition Relay Command = Off - For greater than 2 s

DTC runs continuously when the above conditions are met.

P1682, P16A7

- Engine Controls Ignition Relay Command = On
- Ignition Voltage = Greater than 5.5 V

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0685, P0686, P0687

The commanded state of the driver and the actual state of the control circuit do not match for greater than 2 s.

P0689

Engine Controls Ignition Relay Feedback Circuit = Less than 5 V - For greater than 5 s

P0690

Engine Controls Ignition Relay Feedback Circuit = Greater than 4 V - For greater than 5 s

P1682, P16A7

The following parameters are not within 3 V of each other:

- Ignition 1 Signal
- Engine Controls Ignition Relay Feedback Signal
- Engine Controls Ignition Relay Feedback 2 Signal

P16AF

Engine Controls Ignition Relay Feedback 2 Signal = Less than 5 V - For greater than 5 s

P16B3

Engine Controls Ignition Relay Feedback 2 Signal = Greater than 4 V - For greater than 5 s

Actions Taken When the DTC Sets

- DTCs P0685, P0686, P0687, P0689, P0690, P16AF, P16B3 are Type C DTCs.
- DTCs P1682, P16A7 are Type A DTCs.

Conditions for Clearing the DTC

- DTCs P0685, P0686, P0687, P0689, P0690, P16AF, P16B3 are Type C DTCs.
- DTCs P1682, P16A7 are Type A DTCs.

Diagnostic Aids

If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

- [Engine Controls Schematics](#)
- [Power Distribution Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views](#)
- [Relay Replacement \(Attached to Wire Harness\) Relay Replacement \(Within an Electrical Center\)](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Verify no other DTCs are set.
 - **If other DTCs are set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no other DTCs are set**
3. Ignition/Vehicle - Cycle On and Off

Verify the component produces a clicking sound: KR75 Engine Controls Ignition Relay

- **If the component does not produce a sound**

Refer to: Circuit/System Testing

- **If the component produces a sound**
4. Verify the following parameters are within 3 V of each other:
 - Ignition 1 Signal
 - Engine Controls Ignition Relay Feedback Signal
 - **If not within 3 V of each other**

Refer to: Circuit/System Testing

- **If within 3 V of each other**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Verify a test lamp turns On between the test points:

- B+ circuit terminal 30 & Ground
- B+ circuit terminal 85 & Ground
- **If the test lamp does not turn On**

Replace the component: X50A Fuse Block - Underhood

- **If the test lamp turns On**

4. Ignition - On/Vehicle - In Service Mode
5. Connect a test lamp between the test points: Control circuit terminal 86 & B+ circuit
6. Perform the scan tool control function: KR75 Engine Controls Ignition Relay - On and Off

Verify the test lamp turns On and Off.

- **If the test lamp is always Off**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If the test lamp is always On**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **If the test lamp turns On and Off**
7. Verify the fuse is not open:
 - F4UA Fuse
 - F17UA Fuse
 - **If the fuse is open**
 1. Vehicle Off.
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Output terminal @ Fuse & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **If the fuse is not open**
8. Ignition - On/Vehicle - In Service Mode
9. Verify a test lamp does not turn On between the test points: KR75 Engine Controls Ignition Relay Terminal 87 & Ground
 - **If the test lamp turns On**
10. Disconnect the electrical connector: X1 @ K20 Engine Control Module
11. Test for less than 1 V between the test points:
 - Control circuit terminal 73 @ Control module harness & Ground
 - Control circuit terminal 16 @ Control module harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - **If the test lamp does not turn On**
12. Vehicle Off.
13. Connect a 30 A fused jumper wire between the test points: Control circuit terminal 87 & B+ circuit terminal 30
14. Ignition - On/Vehicle - In Service Mode
15. Verify the scan tool parameter: Engine Controls Ignition Relay Feedback Signal = Within 1 V of the battery voltage
 - **If not within 1 V of the battery voltage**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for less than 2 ohms between the test points:
 - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 73 @ Control module harness
 - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 16 @ Control module

harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If within 1 V of the battery voltage**

16. Test or replace the component: KR75 Engine Controls Ignition Relay

Component Testing

Relay Test

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86

- **If not between 70 and 110 ohms**

Replace the component: KR75 Engine Controls Ignition Relay

- **If between 70 and 110 ohms**

4. Test for infinite resistance between the test points:

- Component terminal 30 & 85
- Component terminal 30 & 86
- Component terminal 30 & 87
- Component terminal 85 & 87

- **If less than infinite resistance**

Replace the component: KR75 Engine Controls Ignition Relay

- **If infinite resistance**

5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & B+

Connect a jumper wire between the test points: Component terminal 85 & Ground

6. Test for less than 2 ohms between the test points: Component terminal 30 & 87

- **If 2 ohms or greater**

Replace the component: KR75 Engine Controls Ignition Relay

- **If less than 2 ohms**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Fuse Block Replacement](#)
- Refer to [Relay Replacement \(Attached to Wire Harness\)](#) [Relay Replacement \(Within an Electrical](#)

Center)

- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P06E4: CONTROL MODULE WAKE-UP CIRCUIT PERFORMANCE (ECM)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P06E4

Control Module Wake-Up Circuit Performance

Circuit/System Description

This DTC can set in either the engine control module (ECM) or the Hybrid/EV Powertrain Control Module 2. These modules share the same circuit for this DTC however the criteria and reasons for setting are different. Whenever the propulsion system goes active, the diagnostic reads its internal timer and evaluates the results from the wake-up events that could have occurred.

For each wake-up event the status can be:

- Pass - the wake-up event occurred within a window 14 V Power Module
- Indeterminate - the ECM was already awake at the time the wake-up event could have occurred
- Fail - the wake-up event occurred outside a window or did not occur at all

If any of the wake-up events indicate a failure then the DTC fails.

Conditions for Running the DTC

- DTC's P0502, P0503, P0722, P0723, P262B, U182D, U0073, U0074 or P2537 is not set.
- Drive distance of greater than 0.1 mi.

Conditions for Setting the DTC

Whenever the propulsion system goes active, the ECM diagnostic reads its internal timer and evaluates the results from the wake-up events that could have occurred. The DTC fails if any of the wake-up events did not occur within a specified window:

- The 5.0 h wake-up event did not occur from 4.3 to 5.8 h.
- The 7.0 h wake-up event did not occur from 6.0 to 8.1 h.
- The 9.5 h wake-up event did not occur from 8.2 to 11.0 h.

Action Taken When the DTC Sets

DTC P06E4 is a type B DTC.

Conditions for Clearing the DTC

DTC P06E4 is a type B DTC.

Reference Information

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P06E4, P24EF, P24F0, or P24F1 is set in the K114B Hybrid/EV Powertrain Control Module 2.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

Replace the K20 Engine Control Module and perform repair verification.

Repair Verification

1. Drive the vehicle for greater than 0.1 mi.
2. Park the vehicle and let it set for a minimum of 6 h. This allows the ECM to request a K114B Hybrid/EV Powertrain Control Module 2 wake-up to occur.
3. Vehicle in Service Mode.
4. Verify DTC P06E4 did not set.

- **If DTC is set**

Replace the K20 Engine Control Module and repeat steps 1 - 4.

- **If no DTC's are set**

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC P1101: INTAKE AIR FLOW SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1101

Intake Air Flow System Performance

Circuit/System Description

This system consists of the following components:

Component	Description
B75C Multifunction Intake Air Sensor	The assembly has several functions: • The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). • The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. • The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. • The intake air temperature sensor 1 varies its resistance depending on the temperature. • Low temperature produces a high resistance: 126.8 kohms @ -60Â°C (-76Â°F) • High temperature produces a low resistance: 62 ohms @ 150Â°C (302Â°F)
B74 Manifold Absolute Pressure Sensor	The sensor is a 3-wire capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q38 Throttle Body	The throttle body contains a contactless inductive position sensor. A fixed transmitter coil excites a movable rotor, which in turn induces a current in a fixed receiver coil. The current varies with the angle of the rotor. Electronics inside the sensor convert the current into digital data which is transmitted via a

Component	Description
	serial data circuit to the ECM.

The ECM compares the measured mass air flow with the calculated air flow based on throttle position and the calculated air flow based on manifold absolute pressure.

Conditions for Running the DTC

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0128, P0335, P0336 = Not set
- Engine Speed = 0 to 5,400 RPM
- Engine Coolant Temperature = -7 to +129Â°C (+19 to +264Â°F)
- Intake Air Temperature Sensor = -20 to +125Â°C (-4 to +257Â°F)

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The difference between the air flow measured by the mass air flow sensor and a calculated value based on the throttle position exceeds the allowed range.

Actions Taken When the DTC Sets

DTC P1101 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1101 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0651, P0697, P06A3 is not set.
 - **If any of the DTCs are set**

Refer to: **DTC P0641, P0651, P0697, P06A3, or P06D2**
 - **If none of the DTCs are set**
3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%
 - **If 90% or greater**

Refer to: **Throttle Body Inspection and Cleaning**
 - **If less than 90%**
4. Perform a component sweep test: Throttle Sweep

Verify the scan tool parameter: Throttle Position Sensors 1 and 2 = Agree
 - **If not the specified state**

Refer to: **DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135**
 - **If the specified state**
5. Determine the current vehicle testing altitude.
6. Verify the scan tool parameter: MAP Sensor = **Altitude Versus Barometric Pressure**
 - **If not in the specified range**

Refer to: **DTC P0106**
 - **If in the specified range**
7. Verify the following conditions do not exist:
 - Vacuum leak at the component:
 - Intake Manifold
 - B74 Manifold Absolute Pressure Sensor
 - Q38 Throttle Body
 - An object is blocking the component:
 - Q38 Throttle Body
 - Restrictions in the intake system.
 - Loose clamps, cracks, or other damages to the intake system.
 - Water intrusion at the mass air flow sensor.
 - Contamination of the measuring element of the mass air flow sensor.

- Missing, restricted or leaking exhaust components. - Refer to: [Symptoms - Engine Exhaust](#)
- An engine mechanical condition. - Refer to: [Symptoms - Engine Mechanical](#)
- **If a condition is found**

Repair or replace component as appropriate.

- **If no condition is found**

8. Engine idling.

9. Verify the scan tool parameter: MAP Sensor = 26 and 52 kPa (3.8 and 7.5 PSI) and changes - The value should change with accelerator pedal input.

- **If not between 26 and 52 kPa (3.8 and 7.5 PSI) or does not change**

Refer to: [DTC P0106](#)

- **If between 26 and 52 kPa (3.8 and 7.5 PSI) and changes**

10. Engine = At normal operating temperature.

11. Engine Speed = 1,375 to 1,425 RPM

12. Verify the scan tool parameter: MAF Sensor = 1,800 and 2,400 Hz

- **If not between 1,800 and 2,400 Hz**

Refer to: [DTC P0101](#)

- **If between 1,800 and 2,400 Hz**

13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

14. Verify that no DTCs are set.

- **If any DTC is set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no DTC is set**

15. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P111E: ENGINE COOLANT TEMPERATURE SENSOR NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P111E

Engine Coolant Temperature Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Signal	P0117	P0118	P0118	P0118	P0128, P111E
Low Reference	-	P0118	P0118	-	P0128

Typical Scan Tool Data

ECT Sensor Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -39 to +120Â°C (-38 to +248Â°F)			
ECT Sensor	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)

Circuit/System Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The engine control module (ECM) supplies 5V to the ECT sensor signal circuit and a ground for the low reference circuit.

The purpose of this diagnostic is to determine if the input from the ECT sensor is skewed warmer than normal. The internal clock of the ECM will record the amount of time the engine is OFF. If the required engine OFF time is met at start-up, the ECM will compare the temperature difference between the actual measured ECT and a calibrated ECT model. The information for this model is derived from the previous drive cycle and includes the accumulated mass air flow (MAF), the engine run time, the ambient air temperature and the ECT at the end of the drive cycle.

If the ECM detects that the temperature difference between the measured and modeled ECT is not within an acceptable operating range of each other, then the ECM will continue to run this diagnostic to determine if a block heater was active during the engine OFF time.

Conditions for Running the DTC

- DTCs P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0502, P0503, P0601, P1621, or P2610 are not set.
- The vehicle has had a minimum ignition OFF time of 8 hours.
- The engine is running.
- The start-up modeled ECT is colder than 50Â°C (+122Â°F).
- The previous accumulated MAF is greater than 6,000 grams.
- The previous engine run time is greater than 600 seconds.

OR

- The vehicle has had a minimum ignition OFF time of 8 hours.
- The engine is running.
- The previous ECT at engine shutdown is warmer than 75°C (+167°F).
- The previous accumulated MAF is greater than 6,000 grams.
- The previous engine run time is greater than 600 seconds.
- This DTC runs once per ignition cycle within the enabling conditions.

Conditions for Setting the DTC

P111E

The ECM detects a temperature difference at initial power-up that indicates that the actual measured ECT is 10°C (18°F) greater than the modeled ECT, and an active block heater has not been detected.

Action Taken When the DTC Sets

DTC P111E is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P111E is a Type B DTC.

Diagnostic Aids

- Engine coolant that is leaking through the sensor will create a high resistance short to ground. This condition results in less voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a warmer ECT.
- The ECM memory which includes the ignition OFF timer is maintained by battery power. If the ECM or the battery are disconnected for less than 15 seconds the proper operation of the ECM memory and the timer can be disrupted. Always disconnect these components for greater than 30 seconds.
- A failed start due to low battery voltage may cause P111E to set when ambient temperature is below -7°C (19°F) and a block heater has been use. If this occurs clear the DTC and operate the vehicle within the Conditions for Running the DTC, if P111E sets refer to Circuit/System Verification.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Verify the cooling system is filled to the correct coolant level. Refer to [Cooling System Leak Testing](#) , and [Cooling System Draining and Filling](#)

- **If the coolant level is not filled to the correct level**

Repair as necessary.

- **If the coolant level is correct**

2. Verify that DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 is not set.

- **If DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 is not set**

3. Vehicle OFF for a minimum of 8 hours.

4. Vehicle in Service Mode

5. Verify with a scan tool that IAT Sensor 1, Radiator Coolant Temperature Sensor, Ambient Temperature Sensor and the ECT Sensor are within 15Â°C (59Â°F) of each other.

- **If the Radiator Coolant Temperature Sensor parameter is not within 15Â°C (59Â°F) of the ECT Sensor and IAT Sensor 1 or ambient temperature.**

Perform the diagnostic for DTC P00B3 or P00B4, Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If the IAT Sensor 1 parameter is not within 15Â°C (59Â°F) of the ECT Sensor and Radiator Coolant Temperature Sensor or ambient temperature.**

Perform the diagnostic for DTC P0112, P0113, or P0114, Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If the ECT Sensor parameter is not within 15Â°C (59Â°F) of the IAT Sensor 1 and Radiator Coolant Temperature Sensor or ambient temperature.**

Refer to Circuit/System Testing.

- **If all the parameters are within 15Â°C (59Â°F) of each other and ambient temperature.**

6. Vehicle OFF.

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the B34 Engine Coolant Temperature Sensor harness connector at the sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool ECT Sensor parameter is colder than -39Â°C (-38Â°F).

- **If warmer than -39Â°C (-38Â°F)**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K20 Engine Control Module

- **If colder than -39Â°C (-38Â°F)**

5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.

6. Verify the scan tool ECT sensor parameter is warmer than 149Â°C (300Â°F).

- **If warmer than 149Â°C (300Â°F)**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

7. Test or replace the B34 Engine Coolant Temperature Sensor.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B34 Engine Coolant Temperature Sensor.
2. Test the ECT sensor by varying the sensor temperature while measuring the sensor resistance. Compare the readings with the [Temperature Versus Resistance \(Engine Coolant Temperature Sensor\)](#) table. The resistance values should be in range of the table values.

- **If not within the specified range**

Replace the B34 Engine Coolant Temperature Sensor.

- **If within the specified range**

3. Test for infinite resistance between each terminal and the sensor housing.

- **If less than infinite resistance**

Replace the B34 Engine Coolant Temperature Sensor.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Engine Coolant Temperature Sensor Replacement - Water Outlet](#)
- Refer to [Control Module References](#) for K20 engine control module (ECM) replacement, programming, and setup.

DTC P1255: FUEL PUMP CONTROL MODULE DRIVER HIGH TEMPERATURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1255

Fuel Pump Control Module Driver High Temperature

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump driver control module remains active

for 2 s, unless the engine is in crank or run. While this voltage is being received, the fuel pump driver control module supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel pressure.

Conditions for Running the DTC

- The ignition voltage is between 9 - 32 V.
- The engine is cranking or running.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The fuel pump driver control module detects a driver temperature greater than or equal to 320°F (160°C) for less than 0.2 s.

Action Taken When the DTC Sets

DTC P1255 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1255 is a Type B DTC.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0231, P0232, or P023F is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If none of the DTCs are set**
3. Verify that the area where the K111 Fuel Pump Driver Control Module is located is free of debris, clutter, or any insulating material that would cause the fuel pump driver control module to overheat.
 - **If any debris, clutter, or other material is found**
 1. Clear the area where the K111 Fuel Pump Driver Control Module is located.
 2. Clear the DTC and test drive the vehicle.
 3. Verify the DTC does not set.
 - If the DTC sets, replace the K111 Fuel Pump Driver Control Module.
 - If the DTC is not set
 4. All OK.
 - **If no debris, clutter, or other material is found**
4. Clear the DTC and test drive the vehicle.
5. Verify the DTC does not set.
 - **If the DTC sets**

Replace the K111 Fuel Pump Driver Control Module.
 - **If the DTC does not set.**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Fuel Pump Power Control Module Replacement**

DTC P127C, P128A-P128D, P128F, P16E4, OR P16E5: FUEL RAIL PRESSURE SENSOR 2-1/FUEL RAIL PRESSURE-TEMPERATURE SENSOR/SENSOR COMMUNICATION CIRCUIT 3 VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P127C

Fuel Rail Pressure Sensor 2 Circuit Low Voltage

DTC P128A

Fuel Rail Pressure Sensor 1 Internal Performance

DTC P128B

Fuel Rail Pressure Sensor 2 Internal Performance

DTC P128C

Fuel Rail Pressure-Temperature Sensor Temperature 1 Message Incorrect

DTC P128D

Fuel Rail Pressure-Temperature Sensor Temperature 2 Message Incorrect

DTC P128F

Fuel Rail Pressure-Temperature Sensor Pressure Message Incorrect

DTC P16E4

Sensor Communication Circuit 3 Low Voltage

DTC P16E5

Sensor Communication Circuit 3 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P06D2, P16E5	P16E4	P06D2, P128A, P128B	P0191
Signal	P16E4	P128C, P128D, P16E5	P16E5	P0191
Low Reference	-	P128C, P128D, P16E5	-	P0191

Typical Scan Tool Data

Fuel Rail Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating with the throttle closed. All accessories OFF. Parameter Normal Range: 2.9-3.2 MPa			
5 V Reference	655.4 MPa	655.4 MPa	655.4 MPa
Signal	655.4 MPa	655.4 MPa	655.4 MPa
Low Reference	-	655.4 MPa	-

Circuit/System Description

The fuel pressure/temperature sensor transmits fuel pressure and temperature information by serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The fuel pressure/temperature sensor internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor. The engine control module (ECM) supplies the fuel pressure/temperature sensor with a 5 V reference circuit, a low reference circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the fuel pressure/temperature sensor to the ECM. The ECM decodes the serial data signal into separate voltages.

Conditions for Running the DTC

P127C, P16E4 or P16E5

- Ignition is ON.
- No DTC clear code.
- The DTCs run continuously when the above conditions are met.

P128A or P128B

- DTC P128F, P16E4 or P16E5 is not set.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

P128C, P128D, or P128F

- DTC P16E4 or P16E5 is not set.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P127C

The engine control module detects the fuel pressure sensor 2 SENT digital read value is less than or equal to 76 for greater than 30 s with the engine running or greater than 10 s with the engine cranking.

P128A

The engine control module detects the fuel pressure sensor 1 SENT digital read value is greater than or equal to 4,089 for greater than 3 s.

P128B

The engine control module detects the fuel pressure sensor 2 SENT digital read value is greater than or equal to 4,089 for greater than 3 s.

P128C

The engine control module detects communication errors on the fuel pressure sensor temperature 1 SENT signal circuit for greater than 1 s.

P128D

The engine control module detects communication errors on the fuel pressure sensor temperature 2 SENT signal circuit for greater than 1 s.

P128F

The engine control module detects fuel pressure sensor SENT signal discrepancies for greater than 3 s.

P16E4

The engine control module detects the fuel pressure sensor SENT signal shorted low for greater than 3 s.

P16E5

The engine control module detects the fuel pressure sensor SENT signal shorted high for greater than 3 s.

Action Taken When the DTC Sets

- DTCs P127C, P128A, P128B, P128F, P16E4, and P16E5 are Type A DTCs.
- DTCs P128C and P128D are Type B DTCs.
- A message center or an indicator displays Propulsion Power is Reduced and Service Stabilitrak.

Conditions for Clearing the DTC

- DTCs P127C, P128A, P128B, P128F, P16E4, and P16E5 are Type A DTCs.
- DTCs P128C and P128D are Type B DTCs.

Diagnostic Aids

- A high resistance condition on the fuel pressure/temperature sensor circuits could cause a DTC to set.
- Inspect for a contaminated fuel system.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component Views

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If none of the DTCs are set**
3. Verify that DTC P0182, P0183, P0187, P0188, P111F, P126E, P126F, P127C, P128A, P128B, P128C, P128D, P128F, P16E4, or P16E5 are not set.

- **If DTC P128A, P128B, P128C, P128D, or P128F are the only DTCs set**

Replace the B310 Fuel Pressure/Temperature Sensor.

- **If DTC P0183, P0184, P0187, P0188, P111F, P126E, P126F, P127C, P16E4, or P16E5 is set with any of the DTCs**

Refer to Circuit/System Testing.

- **If none of the DTCs are set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

NOTE: **Disconnecting the fuel pressure/temperature sensor harness connector causes additional DTCs to set.**

1. Ignition/Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at B310 Fuel Pressure/Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.

- **If 5 Ω or greater**

1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

3. Ignition/Vehicle ON.

4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition/vehicle ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 4.8 - 5.2 V**

5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition/vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
6. Replace the B310 Fuel Pressure/Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement](#) for B310 Fuel Pressure/Temperature Sensor
- Refer to [Control Module References](#) for K20 Engine Control Module replacement, programming, and setup

DTC P129E OR P12A8: FUEL PUMP DRIVER CONTROL MODULE SIGNAL MESSAGE COUNTER INCORRECT/FUEL PUMP CONTROL SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for a overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P129E

Fuel Pump Driver Control Module Signal Message Counter Incorrect

DTC P12A8

Fuel Pump Control Signal Message Counter Incorrect

Circuit/System Description

The fuel pump power control module is in constant communication with the engine control module (ECM) regarding the operating state of the fuel pump power control system. Serial data messages are sent in a continuously repeating series of rolling counts with associated password protect samples. Each count/sample is assigned a value. When the ECM determines that too many of the counts/samples contain an error value, the ECM sets DTC P129E or P12A8.

Conditions for Running the DTC

- The ignition voltage is greater than 7 V.
- The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects an error value for over 1 s.

Action Taken When the DTC Sets

DTC P129E and P12A8 are Type A DTCs.

Conditions for Clearing the DTC

DTC P129E and P12A8 are Type A DTCs.

Diagnostic Aids

An intermittent fault in the CAN circuits will cause the ECM to set DTC P129E or P12A8.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- DTC P129E and P12A8 are informational DTCs.
- Diagnose all other engine control module DTCs prior to DTC P129E or P12A8.

1. Verify that no other DTCs are set except for DTC P129E or P12A8.

- If any other DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- If only DTC P129E or P12A8 is set

2. Replace the K111 Fuel Pump Power Control Module.

3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC sets

Replace the K20 Engine Control Module.

- If DTC does not set

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for K111 Fuel Pump Power Control Module and K20 Engine Control Module replacement, programming, and setup

DTC P129B OR P129C: FUEL PUMP DRIVER CONTROL MODULE SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P129B

Fuel Pump Driver Control Module System Voltage Low Voltage

DTC P129C

Fuel Pump Driver Control Module System Voltage High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P018B, P0506, P129B, P2635, U18A2	P018B, P0506, P129B, P2635, U18A2	P129C

Circuit/System Description

The fuel pump driver control module monitors the battery positive voltage circuit to verify the voltage is between the normal operating range. The DTC can set for a circuit or system voltage out of range.

Conditions for Running the DTC

P129B

- The engine is running.
- The ignition voltage is between 9 - 32 V.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the above conditions are met.

P129C

- The engine is not running.
- The ignition voltage is between 9 - 32 V.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P129B

The fuel pump driver control module detects the battery positive voltage is less than 7 V for 1 s.

P129C

The fuel pump driver control module detects the battery positive voltage is greater than 18 V for 1 s.

Action Taken When the DTC Sets

DTC P129B and P129C are Type C DTCs.

Conditions for Clearing the DTC

DTC P129B and P129C are Type C DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Electrical Center Identification Views**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF.
2. Test for 12.4 - 12.8 V at the battery terminals and record the reading. The battery voltage should stabilize after a few minutes of turning the Vehicle OFF.
 - **If not between 12.4 V - 12.8 V**

Refer to Battery Inspection/Test .
 - **If between 12.4 V - 12.8 V**
3. Engine Running, accessories OFF.
4. Test for 13.4 - 15 V at the battery terminals and record the reading.
 - **If not between 13.4 - 15 V**

Refer to Charging System Test .
 - **If between 13.4 - 15 V**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
7. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 9 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
- **If the test lamp illuminates**
 4. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Fuel Pump Power Control Module replacement, programming, and setup

DTC P129D: FUEL PUMP DRIVER CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P129D

Fuel Pump Driver Control Module Ignition On/Start Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P129D	P129D	-	-

Circuit/System Description

The fuel pump driver control module monitors the ignition voltage circuit in order to determine if the voltage is within the normal operating range.

Conditions for Running the DTC

The DTC runs continuously when the modules are awake.

Conditions for Setting the DTC

The fuel pump driver control module Power Mode does not agree with the engine control module (ECM) Power Mode for 1 s.

Action Taken When the DTC Sets

DTC P129D is a Type B DTC.

Conditions for Clearing the DTC

DTC P129D is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0562 is not set.

- **If the DTC sets**

Refer to DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC .

- **If the DTC does not set**

3. Verify DTC P129D is not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify DTC P129D is not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed first or misdiagnosis may result.**

1. Vehicle OFF, all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp, and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the fuse, Vehicle in Service Mode.
4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.
 - If the fuse is good, all OK.

- **If the test lamp illuminates**

4. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for Fuel Pump Power Control Module replacement, programming, and setup

DTC P12A6: FUEL PUMP DRIVER CONTROL MODULE ENABLE CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P12A6

Fuel Pump Driver Control Module Enable Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Pump Enable	P0171, P0506, P0628, P12A6	P0171, P0506, P12A6	-	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The control module enables the fuel pump driver control module as long as the engine is cranking or running, and ignition system reference pulses are received. While this enable voltage is being received, the fuel pump driver control module supplies a varying voltage to the in-tank fuel pump module in order to maintain the desired fuel line pressure.

Conditions for Running the DTC

- The ignition voltage is greater than or equal to 9 V.
- The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM state of the fuel pump enable circuit does not match the state of the fuel pump enable circuit sensed by the fuel pump driver control module for 1 s.

Action Taken When the DTC Sets

DTC P12A6 is a Type A DTC.

Conditions for Clearing the DTC

DTC P12A6 is a Type A DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P12A6 is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF, all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Vehicle in Service Mode for greater than 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.

- **If OK is not displayed**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If OK is displayed**

6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.

- **If Malfunction is not displayed**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

8. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for ECM and Fuel Pump Power Control Module replacement, setup, and

programming

DTC P135A: IGNITION COIL SUPPLY VOLTAGE CIRCUIT BANK 1

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P135A

Ignition Coil Supply Voltage Circuit Bank 1

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A	P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A	-	-

Circuit/System Description

The ignition system uses an individual ignition coil for each cylinder. The engine control module (ECM) monitors the ignition voltage from the fuse to the individual coils.

Conditions for Running the DTC

- Delay starting at ignition On for 5 engine revolutions.
- Ignition Run/Crank relay voltage is greater than 5 V
- PT relay voltage is greater than 11 V

The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects less than 2.5 V on the ignition coil supply voltage circuit.

Action Taken When the DTC Sets

DTC P135A is a Type B DTC.

Conditions for Clearing the DTC

DTC P135A is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Ignition Coil Supply Voltage parameter displays ON.
 - **If ON is not displayed**

Refer to Circuit/System Testing.
 - **If ON is displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a 3 A fused jumper wire between the control circuit terminal 67 and ground, vehicle in Service Mode.
3. Verify a test lamp illuminates between the ignition circuit terminal 51 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.

1. Vehicle OFF, remove the test lamp, and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the fuse, vehicle in Service Mode.
4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.
 - If the fuse is good, all OK.

- **If the test lamp illuminates**

4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Ignition Coil Replacement**
- Refer to **Control Module References** for engine control module replacement, programming, and setup

DTC P1400: COLD START EMISSION REDUCTION CONTROL SYSTEM

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1400

Cold Start Emission Reduction Control System

Circuit/System Description

The catalyst must be warmed to efficiently reduce the emissions. The cold start strategy is to reduce the amount

of time it takes to warm the catalyst. During a cold start, the engine spark timing is altered to allow the catalyst to warm quickly. This diagnostic monitors the following to build an exhaust energy model:

- Spark advance
- Engine airflow
- Engine coolant temperature
- Engine run time

The actual model is then compared to the expected exhaust energy model.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0201, P0202, P0203, P0204, P0222, P0223, P0300, P0301, P0302, P0303, P0304, P0335, P0336, P0351, P0352, P0353, P0354, P0641, P0651, P0697, P06A3, P2122, P2123, P2127, P2128, P2135, and P2138 are not set.
- The engine coolant temperature (ECT) is between -12 to +56°C (10 - 132°F).
- The calculated 3-way catalyst temperature is colder than 500°C (932°F).
- The barometric (BARO) pressure is greater than 75 kPa.
- The engine control module (ECM) will exit the diagnostic if the calculated 3-way catalyst temperature is greater than 1,000°C (1832°F) when the engine run time is greater than 17 s.
- Vehicle speed is less than 1.6 km/h (1 mph).
- The accelerator pedal is not depressed.
- The ECM will exit the diagnostic if the engine run time is greater than a calibrated value.
- This DTC runs within the first 15 s of start-up. This diagnostic runs once per trip when a cold start has been determined.

Conditions for Setting the DTC

The actual exhaust energy model does not match the expected exhaust energy model.

Action Taken When the DTC Sets

DTC P1400 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1400 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle OFF, allow the engine to cool to be within the temperatures listed in the Conditions for Running the DTC.
2. Engine running.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not set. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Verify that none of the conditions listed below exists with the air intake system:

- Damage, restriction, or modification
- Dirty or deteriorating air filter element
- Crankcase ventilation system for correct operation
- Water intrusion
- Vacuum leak and other unmetered air downstream of the mass air flow (MAF) sensor
- Intake manifold leak
- **If any of the above conditions exist**

Repair as necessary.

- **If none of the conditions exist**

5. Verify that none of the conditions listed below exists with the exhaust system:

- Exhaust leak
- Damaged, restricted, or modified exhaust system - Refer to [Symptoms - Engine Exhaust](#) .
- **If any of the conditions exist**

Repair as necessary.

- **If none of the conditions exist**

If all of the above conditions test normal, inspect for an engine mechanical condition that could alter the air flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#).

- **If the DTC does not set**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P145C OR P145D: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP STUCK OFF/ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P145C

Evaporative Emission (EVAP) System Leak Detection Pump Stuck Off

DTC P145D

Evaporative Emission (EVAP) System Leak Detection Pump Stuck On

Circuit/System Description

The evaporative emission (EVAP) system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

The EVAP leak detection vacuum pump stuck off test is performed by comparing an initial stabilized EVAP leak detection pump pressure sensor, absolute, reading to a second stabilized reading for a short period of time.

The EVAP leak detection vacuum pump stuck on test is performed after the switching valve transitions from vent to not venting, pump, position. If after the second EVAP leak detection pump pressure sensor reading, a difference between the two pressure readings indicates the EVAP leak detection vacuum pump is stuck on.

Conditions for Running the DTC

P145C and P145D

- DTCs P043E, P043F, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0449, P0451, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P111E, P1462, P145C, P145D, P145E, P145F, P2066, P2067, P2068, P2227, P2228, P2229, P2230, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P24BA, P24BB, P24B9, P2537, P262B, U0073, U0074, U0140 and U182D is not set.
- The propulsion system is not active.
- The EVAP purge valve is closed.
- The EVAP vent solenoid valve is closed.
- The EVAP leak detection pump switching valve is in the vent position.
- The EVAP leak detection pump vacuum pump is ON.
- The odometer greater than 16 km (10 mi).
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The engine coolant temperature is less than 40°C (104°F).
- The intake air temperature is between 4 - 45°C (39 - 113°F).
- The system voltage is greater than 10 V.
- The vehicle speed is less than 1.6 km/h (1 MPH).
- No Vehicle ON during test.
- The refueling request button is not pressed.
- A service bay test is not active.
- The device control is not active.
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 hours.

Conditions for Setting the DTC

P145C

The EVAP leak detection pump is commanded ON during the first reference orifice vacuum measurement and the stabilized EVAP leak detection pump pressure sensor vacuum reading is less than 0.1 kPa (0.01 PSI) for greater than 6 min.

Or

The EVAP leak detection pump is commanded ON during the second reference orifice vacuum measurement and the stabilized EVAP leak detection pump pressure sensor vacuum reading is less than 0.1 kPa (0.01 PSI) for greater than 30 s.

P145D

The EVAP leak detection pump is commanded OFF for the first time and the EVAP leak detection pump switching valve has transitioned from vent to not venting, pump position. The difference between an initial EVAP leak detection pump pressure sensor reading and a second EVAP leak detection pump pressure sensor reading is greater than 1 kPa (0.14 PSI) for greater than 8 s.

Or

The EVAP leak detection pump is commanded OFF for the second time and the EVAP leak detection pump pressure sensor vacuum reading is greater than 1.18 kPa (0.17 PSI) for greater than 14 s.

Action Taken When the DTC Sets

DTCs P145C and P145D are Type B DTCs.

Conditions for Clearing the DTC

DTCs P145C and P145D are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool EVAP Leak Detection Pump Pressure parameter compared against the conditions for

setting

- **If not the specified range**

Replace the Q63 Evaporative Emission System Leak Detection Pump Assembly

- **If within specified range**

3. Verify that DTCs P2400, P2401 or P2402 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no DTCs are set .**

4. Inspect for any aftermarket devices added that might have been spliced into the wire harness circuits that control the EVAP leak detection pump.

- **Aftermarket devices found**

Remove or repair as necessary

- **No aftermarket devices found**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

6. Verify the DTC does not set.

- **If the DTCs set**

Refer to Circuit System Testing.

- **If the DTC do not set**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)

DTC P145E: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP TO VENT SOLENOID VALVE LEAK DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P145E

Evaporative Emission (EVAP) System Leak Detection Pump to Vent Solenoid Valve Leak Detected

Circuit/System Description

The EVAP system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

This DTC sets when the ECM detects a 0.51 mm (0.020 in) external leak between the EVAP leak detection pump and the EVAP vent solenoid valve or an internal leak through the EVAP vent solenoid valve.

Conditions for Running the DTC

- DTCs P043E, P043F, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0449, P0451, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P111E, P1462, P145C, P145D, P145F, P2066, P2067, P2068, P2227, P2228, P2229, P2230, P2400, P2401, P2402, P2418, P2419, P2420, P2450, P24BA, P24BB, P24B9, P2537, P262B, U0073, U0074, U0140 and U182D is not set.
- The EVAP purge valve is closed.
- The EVAP vent solenoid valve transitions to closed.
- The EVAP leak detection pump switching valve in not venting, pump position.
- The EVAP leak detection pump vacuum pump is ON.
- The odometer greater than 16 km (10 mi).
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The engine coolant temperature is less than 40Â°C (104Â°F).
- The intake air temperature is between 4 - 45Â°C (39 - 113Â°F).
- The system voltage is greater than 10 V.
- The vehicle speed is less than 4.8 km/h (3 MPH).
- No Vehicle ON during this test
- The refueling request button is not pressed.
- A service bay test is not active.
- The device control is not active.
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 h.

Conditions for Setting the DTC

The ECM detects the vacuum reading is less than the reference vacuum for greater than 30 s.

Action Taken When the DTC Sets

DTC P145E is a Type B DTC.

Conditions for Clearing the DTC

DTC P145E is a Type B DTC.

Diagnostic Aids

- The EVAP system can be filled with smoke at the fresh air side of the vacuum pump using the adapters in the **GE-41413-300** .
- Smoke seen coming out of the fresh air side of the EVAP leak detection pump assembly is not consider a failed part. This includes the electrical connection port as diagnostics will not detect a leak on the fresh air side of the system.
- To help locate intermittent leaks, use the **GE-41413-A** to introduce smoke into the EVAP system. Move all the EVAP components while observing for smoke with the **GE-41413-SPT** .
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **GE-41413-SPT** .
- If a small leak is difficult to find, it may be necessary to remove the EVAP components and test them one at a time using the adapters in the **GE-41413-300** .
- A vent solenoid stuck in the open position will set this DTC. If the solenoid will not respond to the scan tool command, it may be electrically or mechanically inoperable.

Reference Information

Powertrain Component View

Powertrain Component Views

Description and Operation

- [Evaporative Emission Control System Description](#)
- [Hybrid Modes of Operation Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **GE-41413-300** EVAP Cap And Plug Kit
- **GE-41413-A** Evaporative Emissions System Tester
- **GE-41413-SPT** High Intensity White Light

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

WARNING: Refer to [Fuel and Evaporative Emission Pipe Warning](#) .

CAUTION: Refer to Clean, Dry, Low Pressure Gas Source Caution .

1. Verify none of the conditions listed below exist:

- Disconnected, incorrectly routed, kinked, or damaged EVAP pipes, O-rings and hoses
- A damaged EVAP vent solenoid valve - This could be a shorted solenoid or mechanically stuck.

Refer to Component Testing below.

- **If a condition exists**

Repair as necessary

- **If no conditions exist**

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

NOTE: Refer to the GE-41413-A operation manual for detailed instructions in Evaporative Emission Control System Diagnosis.

2. Disconnect the fresh air tube at the quick connector on the Q63 Evaporative Emission System Leak Detection Pump.

3. Using adapters in the GE-41413-300 , specifically GE-41413-323 , connect the GE-41413-A .

NOTE: Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. The system flow will be less with higher temperatures.

4. Use the flow meter on the GE-41413-A calibrated to 0.51 mm (0.020 in) determine if there is a leak.

- **If a leak is detected**

Use the GE-41413-A to apply smoke to the EVAP system until the leak is located.

- **If no leak is detected**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to Circuit System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

NOTE: Ambient and vehicle component temperature must be above 0°C (32°F) to command the switching valve or vacuum pump. This prevents erroneous

results and damage to the EVAP leak detection pump assembly.

1. Record the scan tool EVAP Leak Detection Pump pressure.
2. Command the scan tool EVAP Leak Detection Pump on for 1 min.
 1. Record the scan tool EVAP Leak Detection Pump pressure.
 2. Subtract the value in step 2.1 from the value in step 1 and record this
3. Command the scan tool EVAP Leak Detection Pump to Vent Solenoid Valve Leak Test for 30 s.
 1. Record the scan tool EVAP Leak Detection Pump pressure.
 2. Subtract the value in step 3.1 from the value recorded in step 1.
 - Example: Step 1 value 96.6 kPa (14 PSI)
 - Example: Step 2 value 93.5 kPa (13.6 PSI)
 - Example: Step 2.2 value 3.1 kPa (0.4 PSI)
 - Example: Step 3 value 90.69 kPa (13.15 PSI)
 - Example: Step 3.2 value 5.91 kPa (0.8 PSI)
4. The recommended ratio should be at least 1.50 of the value in step 2.2.
 - Example; step 1 minus step 3 = 5.91 kPa (0.85 PSI)
 - 5.91 kPa (0.85 PSI) divided by 3.1 (0.44 PSI) = 1.90 ratio.
 - **If the ratio fails the recommendation**

Inspect and repair for any of the conditions noted under Circuit/System Verification, step 1

- **If the ratio meets or exceeds the recommendation**

5. All OK

Component Testing

1. Connect **GE-41413-A** using adapter **J-41413-323** that is part of **GE-41413-300** to the fresh air side of the Q63 Evaporative Emission System Leak Detection Pump.
 1. Test the connection between the Q13 Evaporative Emission Vent Solenoid Valve and the Q63 Evaporative Emission System Leak Detection Pump for a leak.
 2. The value should be below the 0.020 in H₂O value established above in Circuit/System Verification, step 4.

NOTE: Smoke seen coming out of the fresh air side of the EVAP leak detection pump assembly is not consider a failed part. This includes the electrical connection port as diagnostics will not detect a leak on the fresh air side of the system.

- 3.

- **If a leak is detected**

Repair the affected component

2. Vehicle OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.

3. Test for 25 - 30 Ω between the control terminal 1 and the battery voltage terminal 2.

- **If not within the specified range**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If within the specified range**

NOTE:

- **Use the scan tool Fuel Tank Pressure sensor parameter as a pressure/vacuum reference source.**
- **Review diagnostic aids listed for P0451-P0453 as these could affect further testing.**

•

4. Connect **J 41413-323** to the pump side of the Q13 Evaporative Emission Vent Solenoid Valve

5. Test for no air flow through the Q13 Evaporative Emission Vent Solenoid Valve by applying vacuum to the pump side of the valve. It should hold 1 - 2 in Hg (3 - 7 kPa) for 30 s.

- **If it does not hold vacuum**

Replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If it does hold vacuum**

6. Reconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve, vehicle in Service Mode.

7. Command the scan tool EVAP Vent Solenoid Valve ON and apply vacuum to the pump side of the valve.

8. Verify the Q13 Evaporative Emission Vent Solenoid Valve does not hold vacuum.

- **If it does hold vacuum**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If it does not hold vacuum**

9. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Evaporative Emission Canister Control Valve Vacuum Hose Replacement](#)
- Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)
- Refer to [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)

DTC P1461: EVAPORATIVE EMISSION (EVAP) SYSTEM PRESSURE INCORRECT DURING FUEL FILL DOOR OPEN REQUEST

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1461

Evaporative Emission (EVAP) System Pressure Incorrect During Fuel Fill Door Open Request

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 (HPCM2) monitors the fuel tank pressure during a fuel fill door open request. If the fuel tank pressure does not fall within a predetermined range within 30 - 120 s this DTC sets.

Conditions for Running the DTC

- The HPCM2 is active.
- The fuel fill door open switch is pressed.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 2 detects the fuel tank pressure sensor reading does not fall within a predetermined value for greater than 30 - 120 s.

Action Taken When the DTC Sets

The DTC P1461 is a type A DTC.

Conditions for Clearing the DTC

The DTC P1461 is a type A DTC.

Diagnostic Aids

- A restriction in the EVAP canister or vent lines that might hold fuel tank pressure could affect this.
- This DTC will not prevent the fuel fill door from opening.
- A vent valve stuck closed could affect this.
- Ensure that the reference port on the fuel tank pressure sensor is unobstructed.
- Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Reference Information

Schematic Reference

- [Engine Controls Schematics](#)
- [Release Systems Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Evaporative Emission Control System Description](#)
- [Hybrid Modes of Operation Description](#)
- [Fuel Fill Door Description and Operation](#) (Fuel Door)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit Verification

1. Vehicle in Service Mode, observe and note the fuel tank pressure with a scan tool.
2. Request a refueling event. The fuel tank pressure reading should be at 0 inches of H₂O.
 - **If not at specification**

Test and repair any vent restriction
 - **If meets specification**
3. All OK

Repair Instructions

- Perform the [Diagnostic Repair Verification](#) after completing the repair.
- Refer to [Fuel Tank Pressure Sensor Replacement](#)
- Refer to [Control Module References](#) for ECM and Hybrid/EV Control Module 2 replacement, programming and setup.

DTC P1462: EVAPORATIVE EMISSION (EVAP) SYSTEM REFERENCE ORIFICE FLOW ERRATIC

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1462

Evaporative Emission (EVAP) System Reference Orifice Flow Erratic

Circuit/System Description

The evaporative emission (EVAP) system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

The engine control module (ECM) monitors the pressure across the reference orifice with the EVAP leak detection pump pressure sensor. When all conditions are met, the ECM commands the vacuum pump ON and monitors the EVAP leak detection pump pressure sensor. If the ECM detects the pressure is not stabilized, the DTC will set.

Conditions for Running the DTC

- DTCs P043E, P043F, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0449, P0451, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P111E, P145C, P145D, P145E, P2066, P2067, P2068, P2227, P2228, P2229, P2230, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P24BA, P24BB, P24B9, P2537, P262B, U0073, U0074, U0140 and U182D is not set.
- The vehicle is OFF.
- The propulsion system is not active.
- The refueling request button is not pressed
- A service bay test is not active
- The purge valve is closed
- The vent solenoid valve is closed
- The EVAP Leak Detection Pump switching valve is in the vent position
- The EVAP Leak Detection Pump vacuum pump is ON
- The odometer is greater than 16 km (10 mi)
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI)
- The fuel level is between 10 - 90%
- The engine coolant temperature is less than 40°C (104°F)
- The intake air temperature is between 4 - 45°C (39 - 113°F)
- The system voltage is greater than 10 V
- The vehicle speed less than 4.8 km/h (3 MPH)
- There are three possible time windows for this test to run. Up to that point, and through this time period, the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 h.

Conditions for Setting the DTC

The ECM detects the EVAP leak detection pump internal reference test did not successfully complete within a calibrated value.

Action Taken When the DTC Sets

DTC P1462 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1462 is a Type B DTC.

Diagnostic Aids

- Inspect the tube and clamps from the EVAP leak detection pump to the vent solenoid for damage. A damage/open tube may allow debris to enter the pump and plug the reference orifice.
- Remove the EVAP leak detection pump and look inside the pump opening for any debris that could restrict or plug the reference orifice. The reference orifice is a small opening at the 2 o'clock position in the pump vacuum opening. Inspect for missing or damage O-rings.
- With the fresh air tube removed from the EVAP leak detection pump assembly, blow controlled air, 5 - 10 PSI, into this tube. There should be air escaping from behind the fuel fill pocket indicating this tube and filter are not restricted.
- A switching valve stuck in the pump position can cause insufficient flow.
- This part is not serviceable. It is very important that no debris be found in the pump fresh air inlet or vacuum openings, the tube between the vent solenoid valve and EVAP leak detection pump assembly as this could cause a P043E to set.

Reference Information

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool EVAP Leak Detection Pump Pressure sensor reading is within the range specified in the **Altitude Versus Barometric Pressure** table.

3. Record the EVAP Leak Detection Pump Pressure sensor reading.
4. Command the scan tool EVAP Leak Detection Pump ON.
5. Record the EVAP Leak Detection Pump Pressure sensor reading after 6 min. The reading should be 1.18 - 4 kPa (0.17-0.58 PSI) less than the initial reading from step 2.

- **If not within the specified range**

Refer to Circuit/System Testing

- **If within specified range**

6. Record the EVAP Leak Detection Pump Pressure sensor reading after monitoring for an additional 5-10 min.
7. The reading should be 1.18 - 4.5 kPa (0.17-0.58 PSI) less than the initial reading from step 2, and the difference between the step 4 and step 5 readings less than 0.51 kPa (.07 PSI)

- **If not within the specified range**

Refer to Circuit/System Testing

- **If within specified range**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
9. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC do not set**

10. All OK.

Circuit/System Testing

NOTE: The reference orifice is a small opening at the 2 o'clock position in the pump vacuum opening.

1. Vehicle OFF, remove the Q63 Evaporative Emission System Leak Detection Pump Assembly.
2. Verify the reference orifice within the pump does not have a restriction.

- **If restricted**

Inspect and repair any of the conditions listed below:

- The EVAP leak detection pump to the vent solenoid tube and clamps for damage
- A missing or damage EVAP leak detection pump O-rings
- The fresh air tube near the fuel fill pocket for a restriction
- The fresh air tube for a restriction
- **If not restricted**

Replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)

DTC P1426: EXHAUST GAS RECIRCULATION (EGR) VALVE INTERNAL PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1426

Exhaust Gas Recirculation (EGR) Valve Internal Performance

Circuit/System Description

The exhaust gas recirculation (EGR) valve internal performance DTC indicates that the smart EGR valve has determined that an internal error exists (internal to the EGR valve).

Conditions for Running the DTC

- Engine speed is between 700 - 5,900 RPM
- The DTC runs continuously when the above conditions are met for greater than 5 s.

Conditions for Setting the DTC

P1426

The EGR valve has broadcast the specific duty cycle to the engine control module to indicate internal error condition exists.

Action Taken When the DTC Sets

DTC P1426 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1426 is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P1426 is not set.
 - **If DTC P1426 is set**

Replace the Q14 Exhaust Gas Recirculation Valve.
 - **If DTC P1426 is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify DTC P1426 does not set.
 - **If DTC P1426 sets**

Replace the Q14 Exhaust Gas Recirculation Valve.
 - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Exhaust Gas Recirculation Valve Replacement**
- Refer to **Control Module References** for ECM replacement, programming, and setup

DTC P1427-P142A OR P1437: EGR TEMPERATURE SENSOR 1 OR 2 - INTAKE AIR TEMPERATURE 1 OR 2 NOT PLAUSIBLE/EXHAUST GAS RECIRCULATION TEMPERATURE SENSOR 1 NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1427

EGR Temperature Sensor 1 - Intake Air Temperature 1 Not Plausible

DTC P1428

EGR Temperature Sensor 1 - Intake Air Temperature 2 Not Plausible

DTC P1429

EGR Temperature Sensor 2 - Intake Air Temperature 1 Not Plausible

DTC P142A

EGR Temperature Sensor 2 - Intake Air Temperature 2 Not Plausible

DTC P1437

Exhaust Gas Recirculation Temperature Sensor 1 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open	High Resistance	Short to Voltage	Signal Performance
Exhaust Gas Temperature Sensor 1 Signal	P040C	P040D	P040D, P1427, P1428	P040D*	P040B, P1427, P1428
Exhaust Gas Temperature Sensor 1 Low Reference	-	P040D	P040D, P1427, P1428	P040D*	P040B, P1427, P1428
Exhaust Gas Temperature Sensor 2 Signal	P041C	P041D	P041D, P1429, P142A	P041D*	P041B, P1429, P142A
Exhaust Gas Temperature Sensor 2 Low Reference	-	P041D	P041D, P1429, P142A	P041D*	P041B, P1429, P142A
* Internal ECM or Sensor damage may occur if the circuit is shorted to B+					

Typical Scan Tool Data

EGT Sensor 1 - 3

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On Parameter Normal Range: -39 - 999Â°C (-38 - 1,830Â°F)			
Exhaust Gas Temperature Sensor 1 or 2 Signal	200Â°C (392Â°F)	200Â°C (392Â°F)	200Â°C (392Â°F)

Circuit	Short to Ground	Open	Short to Voltage
Exhaust Gas Temperature Sensor 1 or 2 Low Reference	-	200Â°C (392Â°F)	200Â°C (392Â°F)

Circuit/System Description

The exhaust gas temperature sensors are variable resistors that measure the temperature of the exhaust gas. The Engine Control Module (ECM) supplies a 5 V bias to the exhaust gas temperature sensor (EGT) signal circuit and supplies a ground to the low reference circuit. When the EGR temperature sensor is cold, the sensor resistance is high. When the EGR temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a higher voltage on the EGR temperature signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the EGR temperature signal circuit. After an 8 hour engine off soak time, the power up temperature of the exhaust gas temperature sensors are compared to the engine coolant temperature sensor (ECT) to determine if the temperature is plausible.

The following table illustrates the relationship between the temperature of the exhaust gas, and the resistance and voltage seen at the EGT sensor.

Temperature	Resistance	Voltage
Low	Low	Low
High	High	High

Conditions for Running the DTC

P1427, P1428, P1429, and P142A

- DTC P00E9, P010B, P0111, P0114, P0116, P0117, P0118, P0119, P0128, P017B, P017C, P017D, P111E, P117B, P117C, P117D, P117E, P117F, or P262B is not set.
- Battery voltage is greater than 11 V
- The engine is off for greater than 8 h
- The engine is cranking or running
- The DTCs run once per drive cycle when the above conditions are met

P1437

- Battery voltage is greater than 11 V
- The engine speed is between 700 - 5,900 RPM
- The engine is cranking or running
- The DTC runs continuously when the above conditions are met for 10 s

Conditions for Setting the DTC

P1427, P1428, P1429, and P142A

The ECM detects the difference between the exhaust gas temperature and the engine coolant temperature is greater than 15Â°C (59Â°F) after an 8 h engine soak.

P1437

The exhaust gas recirculation valve (EGR) determines that a thermal condition exists where the valve should be shut down for protection, but the ECM has determined that the condition is not plausible because none of the other engine hot conditions exist.

Action Taken When the DTC Sets

DTCs P1427, P1428, P1429, P142A, and P1437 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1427, P1428, P1429, P142A, and P1437 are Type B DTCs.

Diagnostic Aids

- If the engine has cooled overnight, all exhaust gas temperature sensors and the engine coolant temperature sensor values should display within 3Â°C (5Â°F).
- After starting a cold engine, the exhaust gas temperature sensors temperature should rise steadily, then stabilize after the engine reaches operating temperature.
- High resistance in either circuit of an exhaust gas temperature sensor could set a DTC.
- After a code clear, with an existing fault, the EGR temperature sensors briefly display the Typical Scan Tool Data chart fault values to indicate a fault type, then default to 200Â°C (392Â°F) after a few seconds.
- With a fault present, the sensor reads a software defaulted value of 200Â°C (392Â°F) and does not change with an expected temperature increase or decrease.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If no other DTCs are set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, exchange the suspect harness connector at the B130 Exhaust Gas Recirculation Temperature Sensor with the known functioning B130 Exhaust Gas Recirculation Temperature Sensor, vehicle in Service Mode.
2. Verify the DTC related to the known functioning B130 Exhaust Gas Recirculation Temperature Sensor does not set.

- **If the DTC sets**

Test or replace the B130 Exhaust Gas Recirculation Temperature Sensor

- **If the DTC does not set**
3. Vehicle OFF, and all vehicle systems OFF, install original harness connector to the known functioning B130 Exhaust Gas Recirculation Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
 4. Test for less than 10 Ω between the appropriate low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 10 Ω**

5. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
6. Test for less than 1 V between the signal circuit and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

7. Test for infinite resistance between the signal circuit terminal 1 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

8. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic repair procedure.

- Refer to [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1](#)
- Refer to [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 2](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P1516, P2101, P2119, OR P2176: THROTTLE ACTUATOR CONTROL (TAC) MODULE THROTTLE ACTUATOR POSITION PERFORMANCE/THROTTLE CLOSED POSITION PERFORMANCE/MINIMUM THROTTLE POSITION NOT LEARNED

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P1516

Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance

DTC P2101

Throttle Actuator Position Performance

DTC P2119

Throttle Closed Position Performance

DTC P2176

Minimum Throttle Position Not Learned

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Close	P1516, P2101	P1516, P2101	P1516, P2101	P1516, P2101, P2176
Control - Open	P1516, P2101, P2119	P1516, P2101	P1516, P2101	P1516, P2101, P2176

Circuit/System Description

Circuit	Description
Control - Close	The output circuit is switched from ground to 12 V to activate the component.
Control - Open	The output circuit is switched from ground to 12 V to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q38 Throttle Body	The throttle valve is actuated by a bidirectional DC motor. A spring pulls the valve to a rest or default position, in which the valve is almost closed. The throttle actuator motor can push against the force of the spring to open or close the valve. The more current flow through the motor, the more the valve moves.

The engine control module (ECM) provides the accelerator pedal interface in which the driver requests a vehicle torque. These driver requests are coordinated and arbitrated within the ECM and the final driver requested torque is sent to the hybrid powertrain control module. The hybrid powertrain control module then determines how the torque output will be distributed between the two electric motors and the engine. The ECM achieves throttle positioning by providing a pulse width modulated voltage to the throttle actuator motor.

Conditions for Running the DTC

P1516

- DTC P1682 = Not set
- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Not Activated

DTC runs continuously when the above conditions are met.

P2101 Condition 1

- DTC P1682 = Not set
- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Not Activated
- Engine = Running

Condition 2

- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Active

Condition 3

- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Active

DTC runs continuously when the above conditions are met.

P2119

- DTC P0122, P0123, P0222, P0223, P06A3 = Not set
- Ignition Voltage = Greater than 6.4 V
- Engine = Not Running

DTC runs continuously when the above conditions are met.

P2176

- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Active

DTC runs continuously when the above conditions are met for greater than 2 s.

Conditions for Setting the DTC

P1516

- The following parameters are not within 2% of each other:
 - Desired Throttle Position
 - Throttle Position

DTC P2101 Condition 1

- The following parameters are not within 10% of each other:
 - Desired Throttle Position
 - Throttle Position

Condition 2

- Throttle Position Learn = Active
- Throttle Position = Greater than 38%

Condition 3

- Throttle Position Learn = Active
- Throttle Position = Greater than 50%

P2119

The throttle blade has not reached the closed position after the engine has been turned off.

P2176

Minimum Throttle Position Not Learned = Exceeded Number of Attempts

Actions Taken When the DTC Sets

- DTC P1516 is a Type B DTC.
- DTCs P2101, P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.
- Reduced Engine Power = Active
- P16 Instrument Cluster = Reduced Engine Power
- Under certain conditions, the control module commands the engine Off.

Conditions for Clearing the DTC

- DTC P1516 is a Type B DTC.
- DTCs P2101, P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.

Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- A weak battery may cause this DTC to set.
- If the throttle blade becomes stuck, a DTC will set. Depending on the position of the throttle blade, the ECM may enter Engine Shutdown Mode. The ECM will disable fuel and de-energize the throttle actuator. If the condition remains present during the next ignition cycle, the ECM may disable engine cranking. Inspect the throttle body assembly for a stuck throttle blade if a throttle actuator DTC is current and the engine won't crank.
- Inspect for a condition in which the throttle blade may have been held open. For example, ice may have formed in the throttle bore causing the throttle blade not to close.
- Under cold start conditions, it might happen briefly that the desired and the actual throttle blade position do not match.

Reference Information

Schematic Reference

[Engine Controls Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Throttle Actuator Control \(TAC\) System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0121, P0122, P0123, P0222, P0223, P0562, P0621, P0622, P16A0-P16A2, P2135 is not set.

- **If any of the DTCs are set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If none of the DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%

- **If 90% or greater**

Refer to: [Throttle Body Inspection and Cleaning](#) .

- **If less than 90%**

4. Clear the DTCs.
5. Vehicle Off and all vehicle systems Off.
6. Vehicle in Service Mode.
7. Perform the scan tool control function: Throttle Sweep

Verify the scan tool parameter: TAC Motor = Enabled

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

8. Verify the scan tool parameter: TAC Motor = Enabled

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: Q38 Throttle Body
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **If the specified state**

9. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

10. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC does not set**

11. All OK.

Circuit/System Testing

1. Vehicle Off.

2. Verify the following conditions do not exist:

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

- The throttle blade has not reached the closed position after the engine has been turned off.
- The throttle blade is not closed by the spring.
- The throttle blade is binding in open or closed position.
- **If a condition exists**

Replace the component: Q38 Throttle Body

- **If no condition exists**

NOTE: Disconnecting the component electrical connector causes additional DTCs to set.

3. Disconnect the electrical connector: Q38 Throttle Body

4. Vehicle in Service Mode.

5. Test for 6 to 8 V between the test points:

- Control circuit terminal 1 & Ground
- Control circuit terminal 2 & Ground
- **If less than 6 V**

1. Vehicle Off.

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Test for infinite resistance between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2 ohms between the test points:

- Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
- Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **If greater than 8 V**

1. Vehicle Off.

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Vehicle in Service Mode.

4. Test for less than 1 V between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

• **If between 6 and 8 V**

6. Vehicle Off.

7. Disconnect the electrical connector: X2 @ K20 Engine Control Module

8. Test for less than 2 ohms between the test points:

- Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
- Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
- **If 2 ohms or greater - Repair the open/high resistance in the circuit.**
- **If less than 2 ohms**

9. Test or replace the component: Q38 Throttle Body

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Throttle Body Assembly Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P15F2: ENGINE TORQUE COMMAND SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F2

Engine Torque Command Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 sends an engine torque requested message to the ECM over the serial data circuits. The ECM monitors the data to verify the indicated engine torque requested calculation is correct. The ECM processor monitors the data to verify that the engine torque command is correct.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is 8 - 18 V.
- DTC U1817 is not set.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F2 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P15F2 is a Type A DTC.

Reference Information

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: Diagnose and repair any communication DTCs prior to performing this testing.

1. Vehicle in Service Mode.
2. Verify DTC P15F2 is not set.
 - **If the DTC is set**
 1. Program the K20 Engine Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K20 Engine Control Module.
 - If the DTC does not set.
 - 3. All OK
3. All OK
 - **If the DTC is not set**

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K20 Engine Control Module replacement, programming, and setup.

DTC P15F9: HYBRID/EV SYSTEM ENGINE SPEED CONTROL INTERVENTION REQUEST TYPE SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for a overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F9

Hybrid/EV System Engine Speed Control Intervention Request Type Signal Message Counter Incorrect

Circuit/System Description

The hybrid/EV powertrain control module is constantly sending serial data messages to the ECM regarding the operating state of the powertrain propulsion system. These messages are sent in a continuously repeating series of rolling counts with associated password protect samples. Each count/sample is assigned a value. The ECM uses the values, during a propulsion system mode shift, to determine when and at what RPM to idle the internal combustion engine. When the ECM determines that too many of the counts/samples contain an error value, the ECM sets DTC P15F9.

Conditions for Running the DTC

- DTC U1817 is not set.
- The engine run time is greater than 0.5 s.
- No other CAN errors are present.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that 10 of 16 counts/samples contain an error value.

Action Taken When the DTC Sets

DTC P15F9 is a Type B DTC

Conditions for Clearing the DTC

DTC P15F9 is a Type B DTC.

Diagnostic Aids

An intermittent fault in the CAN circuits will cause the ECM to set DTC P15F9.

Reference Information

Description and Operation

Hybrid Modes of Operation Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Correct any engine control DTCs before diagnosing hybrid/EV powertrain control module DTCs.**
- **DTC P15F9 is an informational DTC.**

1. Verify there are no engine control or communication DTCs set.

- **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If a DTC is not set**

2. Verify there are no hybrid/EV powertrain control module DTCs set.

- If a DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If a DTC is not set

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- If the DTC sets

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- If the DTC does not set

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P15FB: BRAKE PEDAL POSITION SENSOR SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for a overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15FB

Brake Pedal Position Sensor Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module (EBCM) monitors the brake pedal position sensor in order to provide emission related brake pedal position information to the engine control module (ECM). The EBCM sends the information, via the serial data circuit, to the ECM in a continuously repeating series of 16 rolling counts, with each count assigned a value. When the ECM determines that too many of the counts have an incorrect value, the ECM sets DTC P15FB.

Conditions for Running the DTC

- The vehicle is ON.
- DTC P15FB runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that too many of the rolling counts have an incorrect value.

Action Taken When the DTC Sets

- DTC P15FB is a Type B DTC.
- Brake pedal position is defaulted to 0 for as long as the fault is active.

Conditions for Clearing the DTC

DTC P15FB is a Type B DTC.

Reference Information

Description and Operation

Hybrid Modes of Operation Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

NOTE:

- **DTC P15FB is an informational DTC.**
- **Diagnose all other engine control module DTCs prior to DTC P15FB.**

1. Verify that no other DTCs are set except for DTC P15FB.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If only DTC P15FB is set**

2. Replace the K17 Electronic Brake Control Module.

3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC sets**

Replace the K20 Engine Control Module.

- **If DTC does not set**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Refer to Control Module References for Electronic Brake Control Module and Engine Control Module replacement, programming and setup

DTC P162D: EVAPORATIVE EMISSION (EVAP) SYSTEM ALARM CLOCK SIGNAL NOT

RECEIVED

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P162D

Evaporative Emission (EVAP) System Alarm Clock Signal Not Received

Circuit/System Description

Whenever the propulsion system goes active, the diagnostic reads its internal timer and evaluates the results from the wake-up events that could have occurred. If the ECM did not receive feedback from the Hybrid/EV Powertrain Control Module 2 that the alarm clock was set and the ECM did not wake up, then the DTC will set.

Conditions for Running the DTC

- DTC's P0502, P0503, P0722, P0723, P262B, U0140, U182D, U0073, U0074 or P2537 is not set.
- Drive distance of greater than 0.1 mi
- A service bay test is not active

Conditions for Setting the DTC

The vehicle must sit at least 6 h before the system goes to propulsion system active. At propulsion system active, if the ECM did not receive feedback from the Hybrid/EV Powertrain Control Module 2 that the alarm clock was set, and any one of the three wake-up timer events did not occur, then the DTC fails.

Action Taken When the DTC Sets

- The control modules are never signaled; therefore the specific subsystems will not function.
- The MIL will illuminate after the 2nd ignition cycle.

Conditions for Clearing the DTC

DTC P162D is a type B DTC.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Data Link Communications Description and Operation](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify that DTC P162D is set.

- **If DTC P162D is set along with other DTCs set**

Diagnose all other DTCs first. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If DTC P162D is set without other DTCs set**

Refer to Circuit/System Testing.

- **If DTC P162D is not set**

3. All OK.

[Circuit/System Testing](#)

NOTE: Use the schematics and connector end views to identify the following:

- The control modules that share the K20 Engine Control Module terminals X1 29 and 43 High Speed GMLAN and X1 1 and 15 High Voltage Management and Powertrain Expansion Buss serial data circuits.

1. Vehicle OFF, all systems OFF, all keys at least 3 meters away from vehicle, all access doors closed. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K40 Engine Control Module and K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 2 Ω in the serial data circuits end to end between the K20 Engine Control Module and K114B Hybrid/EV Powertrain Control Module 2.

- **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

Replace the K114B Hybrid/EV Powertrain Control Module 2.

3. Verify that DTC P162D does not set again.

- **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Serial Data Circuit Wiring Repairs](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

DTC P163A: CONTROL MODULE FUEL PRESSURE REGULATOR 1 CONTROL SYSTEM CIRCUITRY PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P163A

Control Module Fuel Pressure Regulator 1 Control System Circuitry Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The ECM monitors the current required to control fuel pressure regulator and compares the current value to calibrated low and high thresholds.

Conditions for Running the DTC

- DTC P0016, P0017, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0365, P0366, P0627, P0628, P0629, or P1682 are not present.
- The engine is running for greater than 10 s.
- Battery voltage is greater than or equal to 11 V.
- Low side fuel pressure is greater than 300 kPa (43.5 PSI).
- Intake air temperature (IAT) is warmer than or equal to -10°C (14°F).

- Barometric pressure is greater than 70 kPa.
- Fuel temperature is between -10°C and +132°C (14°F and 270°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the current used to drive the high pressure fuel pump actuator is 0.1 A or less or 11 A or greater for greater than 11 s.

Action Taken When the DTC Sets

DTC P163A is a Type B DTC.

Conditions for Clearing the DTC

DTC P163A is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Verify DTC P163A is not set.

- **If the DTC is set**

Refer to Circuit/System Testing.

- **If the DTC is not set**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump. It may take up to 2 min for all vehicle systems to power down.

NOTE: **The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.**

2. Test for 1.09 - 1.21 Ω at 20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$) between the high control circuit terminal 2 and the low control circuit terminal 1 on the G18 High Pressure Fuel Pump.

- **If not between 1.09 - 1.21 Ω**

Replace the G18 High Pressure Fuel Pump.

- **If between 1.09 - 1.21 Ω**

3. Vehicle in Service Mode.

4. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the high control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

5. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and ground.

- **If the test lamp illuminates**

1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the low control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If the test lamp does not illuminate**
6. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and B+.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the high control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
7. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and B+.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the low control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
8. Remove the test lamp, connect a 3 A fused jumper wire between the high control circuit terminal 2 and ground.
9. Engine Running.
10. Verify the Fuel Pressure Regulator High Control Circuit Low Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the fused jumper, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the high control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
11. Connect a 3 A fused jumper wire between the low control circuit terminal 1 and B+.
12. Verify the Fuel Pressure Regulator Control Circuit High Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the fused jumper, disconnect the X3 harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If Malfunction is displayed**

13. Test or replace the G18 High Pressure Fuel Pump.

Component Testing

Static Test

1. Vehicle OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump.

NOTE: The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.

2. Test for 1.09 - 1.21 Ω at 20 $^{\circ}$ C (68 $^{\circ}$ F) between the high control circuit terminal 2 and the low control circuit terminal 1.

- **If not between 1.09 - 1.21 Ω**

Replace the G18 High Pressure Fuel Pump.

- **If between 1.09 - 1.21 Ω**

3. Test for infinite resistance between each terminal and the G18 High Pressure Fuel Pump housing.

- **If less than infinite resistance**

Replace the G18 High Pressure Fuel Pump.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Injection Pump Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup

DTC P2096 OR P2097: POST CATALYST FUEL TRIM SYSTEM LOW/HIGH LIMIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2096

Post Catalyst Fuel Trim System Low Limit

DTC P2097

Post Catalyst Fuel Trim System High Limit

Circuit Description

Fuel trim bias is used to keep the post catalyst air/fuel ratio within a predetermined range. This allows optimal catalyst efficiency under various operating conditions. The engine control module (ECM) constantly monitors how lean or rich the fuel trim bias is commanded, to determine if the fuel trim bias is greater than a calibrated amount.

Conditions for Running the DTC

- DTC P0016, P0017, P0030, P0036, P0053, P0054, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P015A, P015B, P0178, P0179, P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P111E, P1133, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P219A, P2227, P2228, P2229, P2230, P2269, P2270, P2271, P2440, P2444, or P2A00 is not set.
- The barometric pressure (BARO) is greater than 70 kPa (10.2 PSI).
- The manifold absolute pressure (MAP) is between 0 - 200 kPa (0 - 29 PSI).
- The intake air temperature (IAT) is between -20Â°C and +200Â°C (-4 and +392Â°F).
- The start up engine coolant temperature is warmer than -20Â°C (-4Â°F).
- The fuel control intrusive diagnostics are not active.
- The engine is operating under light acceleration, heavy acceleration, or cruise conditions.
- DTCs P2096 and P2097 run continuously when the conditions above have been met.

Conditions for Setting the DTC

The correction limit for a condition causing a lean or rich air/fuel ratio has been exceeded.

Action Taken when the DTC Sets

DTCs P2096 and P2097 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P2096 and P2097 are Type B DTCs.

Diagnostic Aids

- The post catalyst fuel trim diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC

to set.

- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other HO2S or fuel trim DTC is set.
 - **If any other HO2S or fuel trim DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no other HO2S or fuel trim DTC is set**
3. Verify DTC P2096 or P2097 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.

5. Verify DTC P2096 or P2097 is not set.

- **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**

6. All OK.

Circuit/System Testing

Inspect for the conditions listed below:

P2096

- Air intake duct collapsed or restricted.
- Air filter dirty or restricted.
- Objects blocking the throttle body.
- Excessive fuel in the crankcase. Change engine oil as necessary.
- Rich fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- Excessive fuel system pressure. Refer to [Fuel System Diagnosis](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Fuel saturation of the evaporative emissions (EVAP) canister
- Stuck open or leaking EVAP purge valve
- Restricted exhaust. Refer to [Symptoms - Engine Exhaust](#) .
- Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .

P2097

- Exhaust system leaks. Refer to [Symptoms - Engine Exhaust](#) .
- Split, kinked, or improperly connected vacuum hoses
- Insufficient fuel in the tank
- Leaks in the air induction system and air intake ducts
- Missing air filter element
- Cracked evaporative canister
- Evaporative pipes plugged, obstructed, or leaking
- Crankcase ventilation system leaking. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Engine vacuum leaks
- Low fuel system pressure. Refer to [Fuel System Diagnosis](#).
- Contaminated fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Lean fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- If a condition is found

Repair as necessary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P2122, P2123, P2127, P2128, OR P2138: ACCELERATOR PEDAL POSITION (APP) SENSOR 1-2 CIRCUIT VOLTAGE/ACCELERATOR PEDAL POSITION (APP) SENSORS 1-2 NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P2122

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

DTC P2123

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

DTC P2127

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

DTC P2128

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

DTC P2138

Accelerator Pedal Position (APP) Sensors 1 - 2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accelerator Pedal Position (APP) Sensor 1 5 V Reference	P06A3	P2122, P2138	P06A3, P2135	P2138
Accelerator Pedal Position (APP) Sensor 2 5 V Reference	P0106, P0107, P0108, P0697	P2127, P2138	P0106, P0107, P0108, P0697	P2138
Accelerator Pedal Position (APP) Sensor 1 Signal	P2122	P2122, P2138	P2123	P2138
Accelerator Pedal Position (APP) Sensor 2 Signal	P2127	P2127, P2138	P2128, P2138	P2138

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accelerator Pedal Position (APP) Sensor 1 Low Reference	-	P2123, P2138	-	P2138
Accelerator Pedal Position (APP) Sensor 2 Low Reference	-	P2128, P2138	-	P2138

Typical Scan Tool Data

APP Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating. Parameter Normal Range: APP Sensor 1 0.88 - 1.08 V			
APP Sensor 1 5 V Reference	0.00 V	0.00 V	2 - 3 V
APP Sensor 1 Signal	0.00 V	0.00 V	4 - 5 V
APP Sensor 1 Low Reference	-	4 - 5 V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating. Parameter Normal Range: APP Sensor 2 0.39 - 0.59 V			
APP Sensor 2 5 V Reference	0.00 V	0.00 V	1 - 3 V
APP Sensor 2 Signal	0.00 V	0.00 V	2 - 5 V
APP Sensor 2 Low Reference	-	4 - 5 V	-

Circuit/System Description

The accelerator pedal assembly contains 2 accelerator pedal position (APP) sensors. The APP sensors are mounted to the accelerator pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to pedal position. The engine control module (ECM) supplies each APP sensor with a 5 V reference circuit, a low reference circuit, and a signal circuit. Both the APP sensors 1 and 2 signal percentages increase as the pedal is depressed, from approximately 0% at rest to above 95% when fully depressed.

The ECM provides the accelerator pedal position or driver torque request to the hybrid powertrain control module. The hybrid powertrain control module determines how the torque output will be distributed between the two electric motors and the engine.

Conditions for Running the DTC

P2122, P2123, P2127, P2128

- DTC P0697 is not set - P2127 or P2128.
- DTC P06A3 is not set - P2122 or P2123.
- The ignition is ON or the engine is running.
- The run/crank voltage is greater than 6.4 V.
- The DTCs run continuously when the above conditions are met.

P2138

- DTCs P06A3, P0697, P2122, P2123, P2127, or P2128 are not set.
- The ignition is ON or the engine is running.
- The run/crank voltage is greater than 6.4 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

The ECM detects that the APP sensor 1 voltage is less than 0.46 V for greater than 1 s.

P2123

The ECM detects that the APP sensor 1 voltage is greater than 4.7 V for greater than 1 s.

P2127

The ECM detects that the APP sensor 2 voltage is less than 0.32 V for greater than 1 s.

P2128

The ECM detects that APP sensor 2 voltage is greater than 2.6 V for greater than 0.5 s.

P2138

The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.
- A message center displays Propulsion Power is Reduced.

Conditions for Clearing the DTC

DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the accelerator pedal sensor circuits could cause a DTC to set.
- Ensure that the in-line harness connector seals are installed correctly. Improper installation could result in water intrusion into the connector and cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Hybrid Modes of Operation Description**
- **Throttle Actuator Control (TAC) System Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0697 or P06A3 is not set.

- **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697, P06A3, or P06D2** for further diagnosis.

- **If none of the DTCs are set**

3. Verify the APP Sensor 1 Circuit Status and APP Sensor 2 Circuit Status displays OK.

- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If OK is displayed**

4. Verify the scan tool APP Sensor 1 and 2 Agree/Disagree parameter displays Agree while performing the tests listed below:

- Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times.
- Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat the procedure several times.
- **If Disagree**

Refer to Circuit/System Testing

- **If Agree**

5. Verify that DTC P2122, P2123, P2127, P2128, or P2138 is not set.

- **If any of the DTCs are set**

Refer to Circuit/System Testing

- **If none of the DTCs set**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify DTC P2122, P2123, P2127, P2128, or P2138 is not set.

- **If any DTC sets**

Refer to Circuit/System Testing

- **If no DTCs set**

8. All OK

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B107 accelerator pedal assembly. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between each low reference circuit terminal listed below and ground.

- Low reference circuit terminal 4 or A
- Low reference circuit terminal 5 or D

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 engine control module.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Test for 4.8 - 5.2 V between each 5 V reference circuit terminal listed below and ground.

- 5 V reference circuit terminal 1 or C
- 5 V reference circuit terminal 2 or F

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 engine control module.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module, vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 engine control module.

- **If between 4.8 - 5.2 V**

5. Verify each APP sensor voltage parameter is less than 0.2 V.

- **If 0.2 V or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal listed below and ground.
 - APP sensor 1 signal circuit terminal 3 or E
 - APP sensor 2 signal circuit terminal 6 or B
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 engine control module.

- **If less than 0.2 V**

6. Install a 3 A fused jumper wire between each signal circuit terminal listed below and the 5 V reference circuit terminal 1.
 - APP sensor 1 signal circuit terminal 3 or E
 - APP sensor 2 signal circuit terminal 6 or B
7. Verify the scan tool APP sensor voltage parameter is greater than 4.8 V.

- **If 4.8 V or less**

1. Vehicle OFF, disconnect the harness connector at the K20 engine control module.
2. Test for infinite resistance between the signal circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 engine control module.

- **If greater than 4.8 V**

8. Test or replace the B107 accelerator pedal assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Accelerator Pedal Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming, and setup

DTC P2199: INTAKE AIR TEMPERATURE (IAT) SENSOR 1-2 NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2199

Intake Air Temperature (IAT) Sensor 1-2 Not Plausible

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P0114, P2199	P0111, P0113, P0114, P2199	P0113*, P0114, P2199	P0111, P2199
Low Reference	-	P0113, P2199, P2227, P2229	P0113*, P0114	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F4, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102, P2199	-	P0096
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient humidity, temperature, and engine bay conditions			
Ignition Voltage	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz 0%	-
Signal	-40Â°C (-40Â°F) 10 Hz 100%	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz* 0%
Ground	-	-40Â°C (-40Â°F) 10 Hz 0%	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F).

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor

- BARO pressure sensor

IAT Sensor 1 - Temperature, Resistance, Voltage Table

IAT Sensor 1	IAT Sensor 1 Resistance	IAT Sensor 1 Signal Voltage
Cold	High	High
Warm	Low	Low

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	45 Hz	-40Â°C (-40Â°F)
Warm	302 Hz	104Â°C (219Â°F)

Conditions for Running the DTC

- The ignition is ON.
- Ignition 1 voltage is at least 11 V.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

The ECM detects that the absolute difference between the IAT sensor 1 and the IAT sensor 2 temperatures is greater than 55Â°C (99Â°F) for longer than 5 s.

Action Taken When the DTC Sets

DTC P2199 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P2199 is a Type B DTC.

Diagnostic Aids

- With the ignition ON, the engine OFF, if the engine is cold, a properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40Â°C (-40Â°F), and there are Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Powertrain Component Views

[Powertrain Component Views](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify that DTC P0097, P0098, P0099, P00F4, P00F5, P00F6, P0102, P0103, P0112, P0113, P0114, P0641, P0651, P0697, P06A3 or P06D2 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If none of the DTCs are set**

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 3 and 4 of this verification procedure only if the ignition has been OFF for 8 hours or more.

3. Ignition ON.
4. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

5. Vehicle ON, verify the following scan tool parameters are between: -38 and +149Â°C (-36 and +300Â°F).

- IAT Sensor 1
- IAT Sensor 2
- **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit/System Testing.

- **If between: -38 and +149Â°C (-36 and +300Â°F)**

6. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Check the integrity of the entire air induction system and verify that none of the following conditions exist:

- A restricted or collapsed air intake duct
- An intake manifold leak
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- **If a condition exists**

Repair or replace component as appropriate.

- **If no condition exists**

2. Vehicle OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω replace the K20 Engine Control Module.

- **If less than 5 Ω**

4. Vehicle OFF, all vehicle systems OFF, test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open or high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

5. Vehicle in Service Mode.

6. Verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp, the fuse for the ignition voltage circuit, and disconnect all components on the circuit.

2. Test for less than 2 Ω in the ignition voltage circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.

2. Test for infinite resistance between the ignition voltage circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test all components connected to the ignition circuit, replace as necessary.

- **If a test lamp illuminates**

7. Vehicle in Service Mode.

8. Verify the scan tool Intake Air Temperature Sensor 1 parameter is colder than -39°C (-38°F).

- **If warmer than -39°C (-38°F).**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If colder than -39°C (-38°F).**

9. Vehicle OFF, install a 3 A fused jumper wire between the IAT 1 signal circuit terminal 1 and the low reference circuit terminal 3, vehicle in Service Mode.

10. Verify the scan tool Intake Air Temperature Sensor 1 parameter is warmer than 148°C (298°F).

- **If colder than 148°C (298°F).**

1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V

3. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If warmer than 148 $^{\circ}$ C (298 $^{\circ}$ F).**

11. Vehicle in Service Mode.

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage near B+ can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

12. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.

- **If 1% or greater**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

- **If less than 1%**

13. Vehicle OFF, install a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3, vehicle in Service Mode.

14. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.

- **If 99% or less**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Vehicle OFF, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V.

3. Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 99%**

15. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air Sensor.
2. Connect a DMM between the IAT sensor 1 signal terminal 1 and the low reference terminal 3

NOTE: A thermometer can be used to test the sensor off the vehicle.

3. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor \(Hitachi sensor\)](#) table for Hitachi Sensors. The resistance values should be in range of the table values.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

4. All OK.

Multifunction Intake Air Sensor

1. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

2. All OK.

Dynamic Testing

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Vehicle OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50% (Normal)
 - Frequency switch to 250 Hz
4. Vehicle in Service Mode.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:

- IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76°C (160 - 166°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

Replace the K20 Engine Control Module.

- **If all the parameters are within the specified range**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P219A: FUEL TRIM CYLINDER BALANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P219A

Fuel Trim Cylinder Balance

Circuit/System Description

The Fuel Trim Cylinder Balance diagnostic detects a rich or lean cylinder to cylinder air/fuel ratio imbalance. The diagnostic monitors the pre-catalyst heated oxygen sensor (HO2S) signal's frequency and amplitude characteristics by calculating an accumulated voltage over a predetermined sample period. An imbalance is indicated when multiple samples of the accumulated voltage are consistently higher than the desired value.

Conditions for Running the DTC

- DTCs P0016, P0017, P0030, P0036, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0019, P0122, P0123, P0128, P0131-P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0171, P0172, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265,

P0267, P0268, P0270, P0271, P0300, P0301-P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0455, P0458, P0496, P111E, P1133, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2270, P2271, P2440, P2444 or P2A00 are not set.

- The evaporative emission system device control and intrusive diagnostics are not active.
- The engine overspeed protection is not active.
- The engine is in closed loop status.
- The system voltage is greater than 11 V.
- The engine coolant temperature (ECT) is warmer than -20Â°C (-4Â°F).
- The engine speed is between 1,200 - 4,000 RPM.
- The mass air flow is between 0 - 100 g/s.
- The secondary air injection pump (if equipped) is not ON.
- The Exhaust Camshaft Position and Intake Camshaft Position are between 0 - 35 degrees.
- Engine run time is greater than 30 s.
- Fuel level is greater than 10% and no fuel level sensor fault is present.
- The DTC runs continuously when the above conditions have been met.

Conditions for Setting the DTC

Multiple samples of the pre-catalyst HO2S accumulated voltage are consistently greater than the desired value.

Action Taken When the DTC Sets

DTC P219A is a Type A DTC.

Conditions for Clearing the MIL/DTC

DTC P219A is a Type A DTC.

Diagnostic Aids

- The fuel trim cylinder balance diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Monitoring the misfire current counters, or misfire graph, may help to isolate the cylinder that is causing the condition.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Troubleshooting with a Test Lamp**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no other DTCs are set**
3. Verify DTC P219A is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.

- **If the DTC is not set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
 5. Verify DTC P219A is not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Engine running, transmission in Park or Neutral.
2. Verify the manifold absolute pressure (MAP) sensor parameter is between 20 - 48 kPa.

- **If not within the specified range .**

Refer to [DTC P0106](#) .

- **If within the specified range**

3. Inspect for the conditions listed below:

- Modified, damaged, leaking, or restricted air induction system components.
- Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Split, kinked, or improperly connected vacuum hoses.
- Restricted, damaged, leaking, or modified exhaust system from the catalytic converter forward. Refer to [Symptoms - Engine Exhaust](#) .
- Improperly operating fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Excessive fuel in the crankcase due to leaking injectors. Change engine oil as necessary.
- Improperly operating ignition system. Refer to [Electronic Ignition System Diagnosis](#).
- **If a condition is found**

Repair as necessary.

- **If no condition is found**

Test the engine for any mechanical conditions such as sticking valves, lifters, etc., which could alter the flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#) .

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P2227-P2230: BAROMETRIC PRESSURE (BARO) SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P2227

Barometric Pressure (BARO) Sensor Performance

DTC P2228

Barometric Pressure (BARO) Sensor Circuit Low Voltage

DTC P2229

Barometric Pressure (BARO) Sensor Circuit High Voltage

DTC P2230

Barometric Pressure (BARO) Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P00C7, P057C, P0651, P2227, P2228, P25BA	P2227, P2228	P0651, P2227, P2229	P2227
Signal	P2227, P2228	P2227, P2229	P2227, P2229	P2227
Low Reference	-	P0113, P0118, P0119, P040D, P040E, P041D, P041E, P2199, P2227, P2229	-	P2227

Typical Scan Tool Data

BARO

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition - On/Vehicle - In Service Mode & Engine - Off Parameter Normal Range: 56 to 105 kPa (8.1 to 15.2 PSI)			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	127 kPa (18.4 PSI)
Signal	0 kPa (0 PSI)	127 kPa (18.4 PSI)	127 kPa (18.4 PSI)
Low Reference	-	127 kPa (18.4 PSI)	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B75C Multifunction Intake Air Sensor	The assembly has several functions:

Component	Description
	- The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). - The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. - The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. - The intake air temperature sensor 1 varies its resistance depending on the temperature. - Low temperature produces a high resistance: 5.6 kohms @ 0°C (32°F) - High temperature produces a low resistance: 187 ohms @ 100°C (212°F)
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Component	Description
B75C Multifunction Intake Air Sensor	The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The barometric pressure sensor is integrated into the multifunction intake air sensor.

Conditions for Running the DTC

P2227 Condition 1

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P1516, P2101, P2135, P2228, P2229 = Not set
- Engine Running = For greater than 30 s

Condition 2

- DTC P0106, P0107, P0108, P2228, P2229, P2230, P2610 = Not set

- Ignition = On
- Engine Off = For greater than 6 min

DTC runs continuously when the above conditions are met.

P2228, P2229

Engine Running = For greater than 30 s

DTC runs continuously when the above condition is met.

P2230

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P1516, P2101, P2135, P2228, P2229 = Not set
- Ignition = On

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2227 Condition 1

BARO & Calculated BARO = Not within 15 kPa (2.2 PSI) of each other.

Condition 2

BARO & Calculated BARO = Not within 20 kPa (3.0 PSI) of each other.

P2228

BARO = Less than 2 V - For greater than 5 s

P2229

BARO = Greater than 4.5 V - For greater than 5 s

P2230

BARO = Signal noisy or erratic - For greater than 5 s

Actions Taken When the DTC Sets

DTCs P2227, P2228, P2229, P2230 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P2227, P2228, P2229, P2230 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Disassembled Views

Description and Operation

Engine Control Module Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0106, P0107, P0108, P0641, P0651, P0697, P06A3 is not set.
 - If any of the DTCs are set
3. Determine the current vehicle testing altitude.
4. Verify the scan tool parameter: MAP Sensor = The value should be within the range listed in the table:

Altitude Versus Barometric Pressure

- **If not in the specified range**

Refer to: [DTC P0106](#)

- **If in the specified range**

5. Verify the scan tool parameter: BARO = The value should be within the range listed in the table: [Altitude Versus Barometric Pressure](#)

- **If not in the specified range**

Refer to: Circuit/System Testing

- **If in the specified range**

6. Verify the scan tool parameter: BARO = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- If the value spikes or drops out

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- If the value does not spike or drop out

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC is not set**

9. All OK.

Circuit/System Testing

NOTE: It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.

1. Vehicle Off and all vehicle systems Off.

2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor

3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 3 & Ground

- **If 10 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & Terminal 43 X2 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If less than 10 ohms**

4. Vehicle in Service Mode.

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 2 & Low Reference circuit terminal 3

- **If less than 4.8 V**

1. Vehicle Off.

2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 2 @ Component harness & Terminal 14 X3 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
1. Vehicle Off.
2. Disconnect the electrical connector: K20 Engine Control Module
3. Vehicle in Service Mode.
4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **If between 4.8 and 5.2 V**
6. Verify the scan tool parameter: BARO = Greater than 4.7 V
 - **If 4.7 V or less**
 - 1. Vehicle Off.
 - 2. Disconnect the electrical connector: K20 Engine Control Module
 - 3. Test for infinite resistance between the test points: Signal circuit terminal 4 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **If greater than 4.7 V**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 4 & Low Reference circuit terminal 3
8. Verify the scan tool parameter: BARO = Less than 0.2 V
 - **If 0.2 V or greater**
 - 1. Vehicle Off, remove jumper wire.
 - 2. Disconnect the electrical connector: K20 Engine Control Module
 - 3. Vehicle in Service Mode.
 - 4. Test for less than 1 V between the test points: Signal circuit terminal 4 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 - 5. Vehicle Off.

6. Test for less than 2 ohms between the test points: Signal circuit terminal 4 @ Component harness & Terminal 46 X3 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If less than 0.2 V**

9. Test or replace the component: B75C Multifunction Intake Air Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Mass Airflow Sensor Replacement](#) - B75C Multifunction Intake Air Sensor
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P2400-P2402: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P2400

Evaporative Emission (EVAP) System Leak Detection Pump Control Circuit

DTC P2401

Evaporative Emission (EVAP) System Leak Detection Pump Control Circuit Low Voltage

DTC P2402

Evaporative Emission (EVAP) System Leak Detection Pump Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P2400, P2419	P2400, P2418	-
Control	P2401	P2400	P2402

Circuit/System Description

The evaporative emission (EVAP) system uses an EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve

- EVAP leak detection pump pressure sensor

The ECM commands the EVAP leak detection pump control circuit through an internal switch called a driver. The ECM monitors the commanded and actual status of the driver. If the ECM detects they do not match a DTC sets.

Conditions for Running the DTC

P2400, P2401

- Voltage low during driver OFF state
- The DTC's run continuously when the above conditions are met

P2402

- Voltage high during driver ON state
- The DTC's run continuously when the above conditions are met

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for a minimum of 0.25 s.

Action Taken When the DTC Sets

DTCs P2400, P2401 and P2402 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P2400, P2401 and P2402 are Type B DTCs.

Diagnostic Aids

- The EVAP leak detection pump is very quiet. You might feel it running rather than hear it.
- The devices have to be in their commanded state.
- Where multiple DTCs set look for a common root cause like battery feeds, grounds, splices, etc.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- [Evaporative Emission Control System Description](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

NOTE: This EVAP leak detection pump is very quiet. You might feel it running rather than hear it.

1. Vehicle in Service Mode.
2. Verify the parameters listed below do not display Malfunction when commanding EVAP Leak Detection Pump ON and OFF with a scan tool.
 - EVAP Leak Detection Pump Output Circuit High Voltage Test Status
 - EVAP Leak Detection Pump Output Circuit Open Test Status
 - EVAP Leak Detection Pump Output Circuit Low Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

[Circuit/System Testing](#)

1. Vehicle OFF, disconnect the harness connector at the Q63 Evaporative Emission System Leak Detection

Pump Assembly.

2. Vehicle in Service Mode,
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the B+ voltage circuit for a short and replace as necessary.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the EVAP Leak Detection Pump Output Circuit High Voltage Test Status is OK when commanding the EVAP Leak Detection Pump ON and OFF with a scan tool.
 - **If OK is not displayed**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 4 and the B+ circuit terminal 3.
7. Verify the EVAP Leak Detection Pump Output Circuit High Voltage Test Status parameter displays Malfunction when commanding the EVAP Leak Detection Pump ON with a scan tool.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω replace the K20 Engine Control Module.
- **If Malfunction is displayed**

8. Test or replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P2418-P2420: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP SWITCHING VALVE CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P2418

Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Control Circuit

DTC P2419

Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Control Circuit Low Voltage

DTC P2420

Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P2400, P2419	P2400, P2418	-
Control	P2419	P2418	P2420

Circuit/System Description

The evaporative emission (EVAP) system uses an EVAP Leak Detection Pump to test for system leaks. The EVAP Leak Detection Pump assembly consists of the following components:

- EVAP Leak Detection Pump with reference orifice
- EVAP Leak Detection Pump pressure sensor
- EVAP Leak Detection Pump switching valve

The engine control module (ECM) commands the EVAP leak detection pump switching valve to vent or not venting, pumping, position by a switch called a driver. The ECM monitors the commanded state of the driver and the actual state of the control circuit. If they do not match it sets a DTC. The switching valve is located inside the EVAP leak detection pump and is non-serviceable.

Conditions for Running the DTC

The DTCs P2418, P2419 and P2420 run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for a minimum of 5 s.

Action Taken When the DTC Sets

DTCs P2418, P2419 and P2420 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P2418, P2419 and P2420 are Type B DTCs.

Diagnostic Aids

- Where multiple DTCs set look for a common root cause like battery feeds, grounds, splices, etc.
- Indeterminate state will display if the device is not in a commanded state. This is not to be considered a failure. Use the scan tool to exercise the device.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the parameters listed below do not display Malfunction when commanding the EVAP Leak Detection Pump Switching Valve On and Off with a scan tool.
 - EVAP Leak Detection Pump Switching Valve Output Circuit High Voltage Test Status
 - EVAP Leak Detection Pump Switching Valve Output Circuit Open Test Status
 - EVAP Leak Detection Pump Switching Valve Output Circuit Low Voltage Test Status
 - **If Malfunction is displayed**
 Refer to Circuit/System Testing
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTCs do not set.
 - **If the DTC sets**
 Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the Q63 Evaporative Emission System Leak Detection Pump Assembly, vehicle in Service Mode.
2. Verify that a test lamp illuminates between the B+ circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to this voltage circuit for a short and replace as necessary.
 - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the B+ circuit terminal 5 and the control circuit terminal 1.
 - **If the test lamp illuminates**
 1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool EVAP Leak Detection Pump Switching Valve Output Circuit High Voltage Test Status parameter displays OK when commanding the EVAP Leak Detection Pump Switching Valve On with a scan tool.
 - **If OK is not displayed**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 1 and the B+ circuit terminal 5.
7. Verify the scan tool EVAP Leak Detection Pump Switching Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Leak Detection Pump Switching Valve On with a scan tool.
 - **If Malfunction is not displayed**
 1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
8. Test or replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Evaporative Emission System Vacuum Leak Detection Pump Replacement**

- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P2422: EVAPORATIVE EMISSION (EVAP) VENT SOLENOID VALVE STUCK CLOSED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P2422

Evaporative Emission (EVAP) Vent Solenoid Valve Stuck Closed

Circuit/System Description

The EVAP vent solenoid valve controls fresh airflow into the EVAP canister. Battery voltage is supplied to the normally closed evaporative emission (EVAP) vent solenoid valve. The ECM commands the solenoid valve open (venting) or closed (not venting) by grounding the EVAP vent solenoid valve output circuit through an internal switch called a driver. The ECM monitors the EVAP leak detection pump pressure sensor, gauge, to determine if a EVAP system pressure (vacuum) is near or above the reference pressure (vacuum) after a calibrated period of time. The ECM uses this reference to determine if the valve is stuck and sets the DTC when the vacuum exceeds a calibrated threshold.

Conditions for Running the DTC

- DTCs P043E, P043, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P145C, P145D, P145E, P0222, P0223, P0449, P0451, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P1221, P1458, P1459, P145A, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P2537, P2610, U0073, U0074, U0140, U182D is not set.
- The EVAP purge valve is closed
- The EVAP vent solenoid transitions from closed to open to closed
- The EVAP leak detection pump switching valve in not venting, pump position
- The EVAP leak detection pump is ON
- The odometer greater than 15.9 km (9.9 mi)
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI)
- The fuel level is between 10 - 90%
- The engine coolant temperature less than 40°C (104°F)
- The intake air temperature is between 4 - 45°C (39 - 113°F)
- The system voltage greater than 10 V
- The vehicle speed less than 4.8 km/h (3 MPH)
- There is no key up during test
- The refueling request button is not pressed

- The service bay test is not active
- The device control exceeds 0.5 s
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 6.0, 8.0 or 11.0 hours.

Conditions for Setting the DTC

Sufficient pressure or vacuum exist in the fuel tank system.

- The fuel tank pressure sensor indicates a pressure greater than 0.697 kPa (0.1 PSI) or a vacuum less than -0.697 kPa (-0.1 PSI) and the vent solenoid is commanded OPEN.
- The change in the fuel tank pressure sensor reading is less than 1 kPa (0.15 PSI) after 10 s.

Or

- No pressure or vacuum exists in the fuel tank system
- The fuel tank pressure sensor indicates a pressure less than 0.697 kPa (0.1 PSI) or a vacuum greater than -0.697 kPa (-0.1 PSI) and the vent solenoid is commanded OPEN
- The EVAP leak detection pump is commanded ON
- The 0.020" reference orifice vacuum measurement minus the EVAP leak detection pump sensor, gauge, vacuum reading is less than 0.3 kPa (0.04 PSI) after 5 s.

Action Taken When the DTC Sets

DTC P2422 is a Type B DTCs.

Conditions for Clearing the DTC

DTC P2422 is a Type B DTCs.

Diagnostic Aids

- A P0451 or P0497 can set with the Vehicle ON, the engine running and a stuck valve.
- A P0451 or P2422 can set with the Vehicle in Service Mode and a stuck valve.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- [Evaporative Emission Control System Description](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- CH 41415-30 Fuel Tank Cap Adapter
- GE 41413-A Evaporative Emissions System Tester

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify DTC P0449, P0498, or P0499 is not set

- **If any of the DTCs are set**

Refer to [DTC P0449, P0498, or P0499](#).

- **If none of the DTCs are set**

3. Verify the parameters listed below do not display Malfunction when commanding the EVAP Vent Solenoid Valve On and Off with a scan tool.

- EVAP Vent Solenoid Valve Output Circuit High Voltage Test Status
- EVAP Vent Solenoid Valve Output Circuit Open Test Status
- EVAP Vent Solenoid Valve Output Circuit Low Voltage Test Status

- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

NOTE: Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.

1. Verify a blockage or restriction does not exist in the EVAP system components listed below.

- Evaporative Emission Vent System Hoses
- Evaporative Emission Canister
- Q13 Evaporative Emission Vent Solenoid Valve
- Evaporative Emission Vent Filter
- **If a condition exists**

Repair or replace the component as necessary

- **If none of the conditions exist**

2. Reconnect all previously disconnected EVAP hardware.

NOTE: Refer to the GE 41413-A operation manual for detailed instructions in Evaporative Emission Control System Diagnosis.

3. Remove the fuel fill cap and connect the CH 41415-30 to the fuel tank filler neck. Connect the GE 41413-A to the CH 41415-30 .

4. Command the EVAP Test function with a scan tool to seal the EVAP system.

5. Turn the nitrogen/smoke valve on the GE 41413-A to nitrogen.

NOTE: DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.

6. Use the remote switch to activate the GE 41413-A and pressurize the fuel tank to 5.0 in H₂O (1.24 kPa).

7. Verify the scan tool Fuel Tank Pressure Sensor parameter is 0 in H₂O (0 kPa) when commanding the EVAP Vent Solenoid Valve to ON.

- **If not 0 in H₂O**

Test for a blockage or a restriction in the EVAP vent hose or inlet. If the inlet or hose test normal, replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If 0 in H₂O**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

- **If the DTC sets**

Refer to step 1 above.

- **If the DTC does not set**

9. All OK.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
2. Test for 25.0-30.0 Ω between the control terminal 1 and the B+ voltage terminal 2.

- **If not within the specified range**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If within the specified range**

3. Verify there is no air flow through the Q13 Evaporative Emission Vent Solenoid Valve by applying vacuum to the pump side of the valve. It should hold 1-2 in. Hg (3-7 kPa) for 30 s.

- **If not within the specified range**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If within the specified range**

4. Reconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
5. Command the Q13 Evaporative Emission Vent Solenoid Valve ON with a scan tool.
6. Apply vacuum to the pump side of the valve. It should not hold vacuum

- **If not within the specified range**

Replace the Q13 Evaporative Emission Vent Solenoid Valve

- **If within the specified range**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Evaporative Emission Canister Vent Solenoid Valve Replacement**
- Refer to **Control Module References** for ECM replacement, setup, and programming

DTC P2450: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP SWITCHING VALVE PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P2450

Evaporative Emission (EVAP) System Leak Detection Pump Switching Valve Performance

Circuit/System Description

The evaporative emission (EVAP) system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of the following components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

When the EVAP leak detection vacuum pump is ON, and the EVAP leak detection pump switching valve transitions from vent to not venting, pump, position, there should be an initial vacuum drop followed by a vacuum increase on a good system. The diagnostic looks for a difference relative to the reference vacuum, either an increase or decrease. No vacuum change indicates a problem with the EVAP leak detection pump switching valve and a P2450 is set. The switching valve is integral to the EVAP leak detection pump assembly and is non serviceable.

Conditions for Running the DTC

- DTCs P043E, P043F, P0451, P1458, P145C, P145D, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P0222, P0223, P0449, P0452, P0453, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P1221, P1459, P145A, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, P2537, P2610, U0073, U0074, U0140, U182D and P2422 is not set.
- The purge solenoid valve is closed.
- The vent solenoid valve is closed.
- The vehicle is OFF.
- The refueling request button pressed.
- A service bay test is not active.
- The EVAP leak detection pump switching valve transitions from vent to not venting, pump position.
- The EVAP leak detection vacuum pump is ON.
- The odometer greater than 16 km (10 mi).
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The engine coolant temperature is less than 40°C (104°F).
- The intake air temperature is between 4 - 45°C (39 - 113°F).
- The system voltage is greater than 10 V.
- The vehicle speed less than 4.8 km/h (3 MPH).
- There are three possible time windows for this test to run. Up to that point, and through this time period, the propulsion system must not be active. These time windows are: 5.0, 8.0 or 11.0 h.

Conditions for Setting the DTC

The EVAP leak detection pump is commanded ON, and the EVAP leak detection pump switching valve transitions from vent to not venting, pump, position. If all conditions are not met after 5 s, then the EVAP leak detection pump switching valve is stuck and the P2450 sets.

Action Taken When the DTC Sets

DTC P2450 is a Type B DTC.

Conditions for Clearing the DTC

DTC P2450 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- **Evaporative Emission Control System Description**
- **Hybrid Modes of Operation Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify the scan tool EVAP Leak Detection Pump Switching Valve parameter does not display Malfunction when commanded to Venting or Not Venting.

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

NOTE: Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure.

1. Vehicle in Service Mode.
2. Verify the following scan tool parameters when commanding the EVAP Test ON.
 - The EVAP Leak Detection Pump Command should show ON.
 - The EVAP Leak Detection Pump Switching Valve Command should change from Venting to Not Venting.
 - **If not within specified range**

Replace the Q63 Evaporative Emission System Leak Detection Pump Assembly
 - **If within specified range**
3. Verify and record the EVAP leak detection pump pressure and fuel tank pressure. Both pressures should drop
 - **If status changes, but no pressure drop**
4. Remove the vent pipe and the fresh air pipe from the EVAP leak detection pump assembly
5. Verify the pump openings for any of the conditions listed below
 - The EVAP leak detection pump to the vent solenoid tube and clamps for damage or restriction
 - Missing or damaged EVAP leak detection pump O-rings
 - The fresh air tube near the fuel fill pocket for a restriction
 - The fresh air tube for a restriction

Repair or replace any of the above components.

- If all components test normal

Replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P2457: EXHAUST GAS RECIRCULATION (EGR) COOLER LOW EFFICIENCY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2457

Exhaust Gas Recirculation (EGR) Cooler Low Efficiency

Circuit/System Description

The exhaust gas recirculation (EGR) cooler has internal coolant passages and metal fins between the passages to help carry away excessive exhaust gas heat. Engine coolant flowing through the EGR cooler helps cool the exhaust gases flowing to the EGR valve. The EGR cooler must remain within a specific temperature range to efficiently reduce emissions. The engine control module (ECM) determines the efficiency of the EGR cooler by monitoring both EGR temperature sensors while the EGR valve is active.

Conditions for Running the DTC

- DTC P0117, P0118, P011B, P01F0, P0128, P0403, P040C, P040D, P040F, P041C, P041D, P046C, P245A, P245B, P245C, P24A5, or P2228 is not set.
- Battery voltage is greater than 11 V.
- Engine speed is between 1,000 - 4,000 RPM.
- Ambient temperature is greater than -7°C (19°F).
- Up stream exhaust gas temperature is between 200 - 370°C (392 - 698°F).
- Barometric pressure (BARO) is greater than 70 kPa (10 psi).
- DTC P2457 runs continuously when the above conditions are met for at least 80 s.

Conditions for Setting the DTC

The ECM detects that the ratio of the downstream EGR cooler temperature and the upstream EGR cooler temperature is not within a calibrated range.

Action Taken When the DTC Sets

DTC P2457 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P2457 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify only DTC P2457 is set.

- **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Verify none of the conditions listed below exist:

- Low engine coolant level.
- Damaged, restricted, or leaking radiator, coolant pipes or hoses.
- Contaminated engine coolant.
- Damaged, restricted or leaking EGR cooler or cooler pipes/hoses.

- **If any of the conditions exist**

Repair or replace the component as necessary.

- **If none of the conditions exist**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.
 - **If the DTC sets**
6. Clean or replace the EGR cooler.
 - **If the DTC does not set**
7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Exhaust Gas Recirculation Valve Replacement](#)
- Refer to [Exhaust Gas Recirculation Cooler Replacement](#)

DTC P24B9-P24BB: EVAPORATIVE EMISSION (EVAP) SYSTEM LEAK DETECTION PUMP PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P24B9

Evaporative Emission (EVAP) System Leak Detection Pump Pressure Sensor Performance

DTC P24BA

Evaporative Emission (EVAP) System Leak Detection Pump Pressure Sensor Circuit Low Voltage

DTC P24BB

Evaporative Emission (EVAP) System Leak Detection Pump Pressure Sensor Circuit High Voltage

Circuit/System Description

The evaporative emission (EVAP) system uses a EVAP leak detection pump to test for system leaks. The EVAP leak detection pump assembly consists of three main components:

- EVAP leak detection pump with reference orifice
- EVAP leak detection pump switching valve
- EVAP leak detection pump pressure sensor

The EVAP leak detection pump pressure sensor performs a correlation to barometric pressure (BARO). After a short delay period, the EVAP leak detection pump pressure sensor, absolute, reading is compared to the BARO. Large deviations will increment the fail counter threshold and sets a P24B9.

There are two different threshold calibrations used in the comparison to the BARO. A smaller threshold is used

when there has been a recent BARO update and then a larger threshold value is used when there has not been a recent BARO update.

Conditions for Running the DTC

P24B9 - Condition 1:

- DTCs P043E, P043F, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P24BB, P145C, P145D, P145E, P145F, P012B, P012C, P012D, P0222, P0223, P0443, P0449, P0451, P0452, P0453, P0458, P0459, P0461, P0462, P0463, P0498, P0499, P0502, P0503, P06E4, P0722, P0723, P1221, P24B9, P24BA, P2066, P2067, P2068, P2400, P2401, P2402, P2418, P2419, P2420, P2421, P2422, P2450, P2537, P2610, U0073, U0074, U0140, U182D is not set.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The fuel level is between 10 - 90%.
- The propulsion system is not active.
- The engine coolant temperature (ECT) is less than 40°C (104°F).
- The intake air temperature (IAT) is between 4 - 45°C (39 - 113°F).
- The battery voltage is greater than 10 V.
- Vehicle speed is less than 1.6 km/h (1 MPH).
- No Vehicle ON during this test.
- No refueling request button is pressed.
- A service bay test is not active.
- The device control exceeds 0.5 s
- There are three possible time windows for this test to run. Up to that point and through this time period the propulsion system must not be active. These time windows are: 5.0, 7.0 or 9.5 h.

P24B9 - Condition 2:

- DTCs P0068, P0071, P0072, P0073, P0101, P0102, P0103, P0106, P0107, P0108, P010C, P010D, P0111, P0112, P0113, P0114, P0121, P0122, P0123, P012B, P012C, P012D, P0222, P0223, P0442, P0443, P0449, P0452, P0453, P0455, P0458, P0459, P0498, P0499, P0502, P0503, P0606, P0722, P0723, P16F3, P1104, P1221, P24B9, P24BA, P24BB, P145D, P145E, P2100, P2101, P2102, P2103, P2400, P2401, P2402, P2418, P2419, P2420, P2422, P2450 is not set.
- The barometric pressure (BARO) is between 70 - 110 kPa (10 - 16 PSI).
- The outside air temperature is between 4 - 35°C (39 - 102°F).
- The propulsion system is active and the engine is running.
- The system voltage is greater than 11 V.
- The purge is not enabled.
- A refueling request button is not pressed.
- The device control exceeds 0.5 s.
- The fuel tank pressure sensor performance diagnostic P0451 is running.
- The EVAP system no purge flow diagnostic P0497 is running.

P24BA and P24BB

Runs any time the engine control module (ECM) is awake and the propulsion system is active or not active.

Conditions for Setting the DTC

P24B9

- When the propulsion system is not active - If the difference between the EVAP system leak detection pump pressure sensor, absolute reading and the BARO value is 3 kPa (0.44 PSI) for 14 s.
- When the propulsion system is active, and after a stabilization time of 10 s - When a recent BARO update has occurred within the last 0.1 km (0.06 mi), if the difference between the EVAP system leak detection pump pressure sensor, absolute, reading and the BARO value from the MAP sensor is 15 kPa (2.17 PSI).
- When a recent BARO update has not occurred within the last 0.1 km (0.06 mi) - If the difference between the EVAP system leak detection pump pressure sensor, absolute, reading and the BARO value from the MAP sensor is 20 kPa (2.9 PSI).

P24BA

The ECM detects that the EVAP system leak detection pump pressure sensor signal is less than 0.7 V for greater than 8 s.

P24BB

The ECM detects that the EVAP system leak detection pump pressure sensor signal is greater than 4.85 V for greater than 8 s.

Action Taken When the DTC Sets

DTCs P24B9, P24BA and P24BB are Type B DTCs.

Conditions for Clearing the DTC

DTCs P24B9, P24BA and P24BB are Type B DTCs.

Diagnostic Aids

- A normal BARO reading of the vehicle's geographic location will help to determine if a BARO sensor is significantly off its reading.
- The diagnostic does not run when purge is enabled because it can influence the EVAP leak detection pump pressure sensor reading if there is any restriction in the fresh air plumbing.
- Test for a plugged 5 micron in-line vent filter between the EVAP system leak detection pump and the fuel fill neck.
- This diagnostic is disabled when P0451 or P0497 is currently running.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component View

Powertrain Component Views

Description and Operation

- **Evaporative Emission Control System Description**
- **Hybrid Modes of Operation Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the BARO reading against the EVAP leak detection pump sensor reading with a scan tool.
Compare this to the Altitude vs. Barometric Pressure Table referenced here **Altitude Versus Barometric Pressure**
 - **A variance of greater than 3 kPa (0.44 PSI)**

Indicates a skewed BARO or EVAP leak detection pump sensor. Refer to: **DTC P2227-P2230**
 - **A variance of less than 3 kPa (0.44 PSI)**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector Q63 Evaporative Emission System Leak Detection Pump Assembly.

NOTE: Test steps 2 - 6 are performed on the ECM side of the harness connector.

2. Vehicle OFF, all systems OFF, disconnect the harness connector at the Q63 Evaporative Emission System Leak Detection Pump Assembly.
3. Test for less than 5 Ω of resistance between the low reference circuit terminal 8 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
4. Vehicle in Service Mode.
5. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 6 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
 - 6. Verify the scan tool EVAP Leak Detection Pump Pressure parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode
 2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.2 V**

7. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the 5 V reference circuit terminal 6.
8. Verify the scan tool EVAP Leak Detection Pump Pressure parameter is greater than 4.7 V.
 - **If 4.7 V or less**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.7 V**
9. Remove the EVAP assembly.
10. Verify none of the conditions listed below exist:
 - Poor connections at the X350 or X351 harness connectors
 - Open or shorted 5 V reference circuit
 - Open or shorted sensor signal circuit
 - Open low reference circuit
 - **If a condition exists**

Repair as necessary.
 - **If no conditions exist**
11. Test or replace the Q63 Evaporative Emission System Leak Detection Pump Assembly.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Evaporative Emission System Vacuum Leak Detection Pump Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P2618: CRANKSHAFT POSITION SIGNAL OUTPUT CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P2618

Crankshaft Position Signal Output Circuit Low Voltage

DTC P2619

Crankshaft Position Signal Output Circuit High Voltage

Conditions for Running the DTC

- Ignition Voltage = Greater than 11 V
- Ignition = On
- Crankshaft Position Sensor Circuit = Active

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P2618

Crankshaft Position Signal Output Circuit = Short to Ground or Open - For greater than 5 s

P2619

Crankshaft Position Signal Output Circuit = Short to Voltage - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type C DTC

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Engine - Running
2. Verify there are no DTCs/symptoms related to the following system/component, if equipped:
 - K71 Transmission Control Module
 - K103 Fuel Injector Control Module
 - T3 Audio Amplifier
 - T6 Power Inverter Module
 - **If a DTC or symptom exists**

Refer to:

- **Diagnostic Trouble Code (DTC) List - Vehicle**

- Symptoms - Vehicle
- If no DTC or symptom exists

3. All OK.

DTC P2635: FUEL PUMP FLOW PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2635

Fuel Pump Flow Performance

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump driver control module remains active for 2 seconds, unless the engine is in crank or run. While this voltage is being received, the fuel pump driver control module closes the ground switch of the fuel pump. The fuel pump driver control module maintains correct fuel pressure based on the information from the fuel pressure sensor and varying the pulse width modulated controlled current to the fuel pump.

Conditions for Running the DTC

- DTC P018B, P018C, P018D, P0231, P0232, P023F, P0641, or P1255 are not active.
- Fuel pump control is enabled and the fuel pump control state is normal.
- The ignition voltage is between 11 - 32 V.
- The engine has been running for greater than or equal to 30 seconds.
- The engine fuel flow is not 0.
- Low fuel level warning not present.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The fuel pump driver control module detects a difference of $\hat{\pm} 60$ kPa at 400 kPa request or $\hat{\pm} 45$ kPa at 300 kPa request between the desired fuel pressure and the actual fuel pressure for approximately 10 s.

Action Taken When the DTC Sets

DTC P2635 is a Type B DTC.

Conditions for Clearing the DTC

DTC P2635 is a Type B DTC.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

On vehicles equipped with a high pressure mechanical pump on Direct Fuel Injection engines, the vehicle may continue to run even though the pump in the fuel tank is not operating.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0074 or U18A2 is not set or stored in history.
 - **If DTC U0074 or U18A2 is set or stored in history**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If DTC U0074 or U18A2 is not set or stored in history**
3. Verify that DTC P018B, P018C, P018D, P0231, P0232, or P023F is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If none of the DTCs are set**

4. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing.

- **If less than 1.5**

5. Command the fuel pressure to 300 kPa (43.5 psi) using the scan tool Control Function: Fuel Pressure Increase/Decrease.

6. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 45 kPa (6.5 psi) of each other at 300 kPa (43.5 psi) request.

- **If greater than 45 kPa (6.5 psi)**

Refer to Circuit/System Testing.

- **If less than 45 kPa (6.5 psi)**

7. Command the Fuel Pressure to 400 kPa (58 psi) using the scan tool Control Function: Fuel Pressure Increase/Decrease.

8. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 60 kPa (8.7 psi) of each other at 400 kPa (58 psi) request.

- **If greater than 60 kPa (8.7 psi)**

Refer to Circuit/System Testing.

- **If less than 60 kPa (8.7 psi)**

9. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

10. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

11. All OK.

Circuit/System Testing

NOTE: Do not replace the fuel pump driver control module based on a history DTC P2635. DTC P2635 may be stored but that does not indicate a failure of the fuel pump driver control module. Refer to [Strategy Based Diagnosis](#) for further history DTC diagnostics.

1. Verify the proper fuel system pressure. Refer to [Fuel System Diagnosis](#).

- **If the fuel pressure is not normal**

Repair the fuel system as necessary.

- **If the fuel pressure is normal**

2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Fuel Feed Pipe Replacement**
- Refer to **Fuel Feed Intermediate Pipe Replacement**
- Refer to **Fuel Injector Replacement**
- Refer to **Fuel Pump Fuel Feed Hose Replacement**
- Refer to **Fuel Tank Fuel Pump Module Replacement**
- Perform the Fuel Pump Trim Reset procedure with a scan tool after the repair.

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn OFF the ignition for 60 s.
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing.

- **If less than 1.5**

7. Command the Fuel Pressure to 300 kPa (43.5 psi) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
8. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 45 kPa (6.5 psi) of each other at 300 kPa (43.5 psi) request.

- **If greater than 45 kPa (6.5 psi)**

Refer to Circuit/System Testing.

- **If less than 45 kPa (6.5 psi)**

9. Command the Fuel Pressure to 400 kPa (58 psi) using the scan tool Control Function: Fuel Pressure Increase/Decrease.
10. Verify the scan tool parameter: Fuel Pressure Sensor & Desired Fuel Pressure are within 60 kPa (8.7 psi) of each other at 400 kPa (58 psi) request.
 - **If greater than 60 kPa (8.7 psi)**

Refer to Circuit/System Testing.

- **If less than 60 kPa (8.7 psi)**

11. All OK.

SYMPTOMS - ENGINE CONTROLS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Symptoms Description

Symptoms cover conditions that are not covered by DTCs. Certain conditions can cause multiple symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause specific symptoms are listed separately under Additional Symptoms Tests.

However, symptoms which affect the internal combustion engine (ICE) of a typical gas powered vehicle may not be noticeable on the Volt ICE. For the Volt ICE, symptoms such as, hesitation, sag, stumble, sluggishness, surging, and even engine stalling, are buffered by the Voltec propulsion system, which is designed to smooth out ICE irregularities. Even when the battery pack is depleted and the ICE is forced to run in order to sustain the charge, the battery pack should still have enough retained power to perform this buffering function. Refer to [Hybrid Modes of Operation Description](#) for more information.

Perform the symptoms testing before using the additional symptoms testing.

Symptoms Definition

Backfire

Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Cuts Out, Misses

A steady pulsation or jerking that follows engine speed. The exhaust has a steady spitting sound.

Detonation/Spark Knock

A mild to severe ping which usually gets worse while under load. The engine makes sharp metallic knocks that change with throttle opening.

Dieseling, Run-On

The engine continues to run after the vehicle is turned OFF.

Engine Control Module (ECM) Commanded Reduced Engine Power

The ECM illuminates the Reduced Engine Power lamp and will limit engine power under potential engine damaging or emissions related conditions. A DTC may be not be set.

Fuel Odor

A noticeable smell of unburned fuel.

Hard Start

Engine does not start for a long time. The engine does eventually run, or may start but immediately stall.

Poor Fuel Economy

Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Rough, Unstable Idle and/or Stalling

The engine runs unevenly. If severe, the engine or the vehicle may shake and the engine may stall.

Symptoms Verification

Before using the Symptom tables, perform the following inspections

- Verify the engine control module (ECM) and the malfunction indicator lamp (MIL) are operating correctly.
- Verify there are no DTCs stored.
- Verify the scan tool data is within the normal operating range.
- Verify there are no Bulletins available for the current symptom.
- Verify the vehicle tires are correctly inflated and meet original equipment specifications.
- Verify the Hybrid/EV Battery Pack state of charge. A low state of charge will force the engine to idle at a higher RPM. Refer to [Plug-In Charging System Description and Operation](#) .
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help to reveal the cause of an intermittent condition.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movements of a component. Refer to the following for a list of issues that may cause an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Incomplete connector mating
- Poor terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness that is too short or tight
- Wire insulation that is chaffed or cut

- High or low ambient temperature
- High or low engine coolant temperature
- High underhood temperature
- Excessive heat in a component or in a circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surfaces
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of aftermarket, add on accessories

Visual/Physical Check

- Verify that the control module grounds are clean, tight, and correctly located.
- Verify that the vacuum hoses are not split or kinked, and are properly routed and connected.
- Verify that the air filter is clean and free from restrictions.
- Verify that there is no water intrusion in connectors, terminals, and components.
- Inspect the air intake ducts for the conditions listed below:
 - Collapsed
 - Damaged areas
 - Looseness
 - Incorrect installation
 - Leaking

If any condition listed above has allowed non-metered air to enter the air induction system, the Q38 THROTTLE BODY: THROTTLE/IDLE LEARN procedure must be performed after the repair is complete.

- Inspect for air leaks at the throttle body mounting area, the mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
 - Poor connections
 - Pinches
 - Cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect the terminals for corrosion and correct contact.

Symptoms Testing

Backfire, Cuts-Out, Misses, Detonation/Spark Knock, Dieseling/Run-On, ECM Commanded Reduced Engine Power, Fuel Odor, Hard Start, Poor Fuel Economy, or Rough, Unstable, or Incorrect Idle and Stalling.

- Test/inspect the fuel system for the conditions listed below:
 - Incorrect system operation or fuel pressure. Refer to [Fuel System Diagnosis](#).
 - Contaminated or poor quality fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Test/inspect the ignition system for the conditions listed below:

NOTE: **Observe the scan tool Cylinder 1 - 4 Current Misfire Counters and the Ignition Coil Control Circuit Status parameters to help isolate an ignition system condition.**

- Spark plugs with incorrect heat range, coolant or oil fouling, or an abnormal condition. Refer to [Spark Plug Inspection](#) , and [Spark Plug Replacement](#) .
- Secondary ignition system component susceptible to moisture. Wet down the secondary ignition system with water from a spray bottle. This may help locate damaged or deteriorated ignition system components. Look/listen for arcing or misfiring as the water is applied.
- Weak spark. Use the **J-26792** HEI Spark Tester for testing and refer to [Electronic Ignition System Diagnosis](#). For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\) Special Tools \(Repair Tools\)](#) .
- Test/inspect for the conditions listed below:
 - Non-metered air flow into the air induction system. If a leak is found, repair as necessary. The Q38 THROTTLE BODY: THROTTLE/IDLE LEARN procedure must be performed when the repair is complete.
 - Items that can cause an engine to run lean or rich. Refer to [DTC P0171 or P0172](#) for additional information.
 - An intermittent crankshaft position sensor condition. Observe the scan tool Crankshaft Position Resync Counter parameter. The Resync Counter parameter should remain at 0 during all operating conditions, and when moving the related harnesses and connectors between the crankshaft position sensor and the ECM.
 - Excessive knock sensor system spark retard activity. Observe the scan tool Knock Retard parameter for activity greater than 0° and refer to [DTC P0324, P0326, or P06B6](#) , and [DTC P0325, P0327, or P0328](#) for further diagnosis.
 - Electromagnetic interference on the reference circuit, which can cause a misfire condition. You can usually detect electromagnetic interference with a scan tool by monitoring the engine speed parameter. A sudden increase in the engine speed parameter with little change in actual engine speed may be an indication that electromagnetic interference is present. Inspect the high voltage components near the ignition control circuit if a condition exists.
 - A heated oxygen sensors (HO2S) that is contaminated from fuel, silicon, or from the incorrect use of RTV sealant. The sensors may have a white powdery coating resulting in a high, but false, signal voltage, which gives a rich exhaust indication.
 - A leaking or restricted positive crankcase ventilation system.
- Inspect the exhaust system components for the conditions listed below:
 - Physical damage or possible internal malfunction.
 - Restricted 3-way catalysts.

For additional information, refer to [Symptoms - Engine Exhaust](#)

- Inspect the engine cooling system for the conditions listed below:
 - A thermostat with incorrect heat range. Refer to [Thermostat Diagnosis](#) .
 - Incorrectly operating engine cooling fans. Refer to [DTC P1485-P1487](#) .
 - Incorrectly operating engine coolant thermostat heater. Refer to [DTC P0597-P0599](#) .
 - Low engine coolant level. Refer to [Cooling System Draining and Filling](#) .

For additional information, refer to [Symptoms - Engine Cooling](#) .

- Inspect the engine for the mechanical conditions listed below:
 - Excessive oil in the combustion chamber or leaking valve seals
 - Incorrect cylinder compression
 - Sticking or leaking valves
 - Worn camshaft lobes
 - Incorrect valve timing
 - Broken valve springs
 - Excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
 - Incorrect engine parts

For additional information, refer to [Symptoms - Engine Mechanical](#)

- If the above conditions do not address the symptom, refer to the additional symptoms tests.

Additional Symptoms Tests

Detonation/Spark Knock

- Test the engine for an overheating condition. Refer to [Engine Overheating](#) .
- Inspect for excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.

ECM Commanded Reduced Engine Power

Under certain conditions the ECM may limit engine power by reducing engine torque and, for some vehicles, fuel pressure as well. For most, but not all of the conditions, the ECM will illuminate the reduced engine power lamp on the instrument panel cluster, however a DTC may not be set.

A repair may not be necessary. Observe the scan tool Reduced Engine Power History parameter or refer to [K20 Engine Control Module: Scan Tool Information](#) to determine the reason for the reduced engine power.

Verify or inspect for the following:

- Vehicle being driven inappropriately. Towing heavy loads up an incline for an extended period of time or operating the vehicle at sustained, excessively high engine speeds may cause the engine oil or coolant to overheat. Inspect the airflow passageways in front of the engine for obstructions and clear away any debris or foreign material that is found. If no obstructions are found, review approved driving habits with the customer. The customer may need to operate the vehicle at a higher engine speed to improve cooling

system performance, or, at a slower engine speed to reduce engine load.

- If the vehicle is equipped with the OnStar® feature, reduced engine power may be due to OnStar® remote command. Verify the vehicle is not in the OnStar® initiated Stolen Vehicle Slowdown mode.
- A cooling system condition which may cause the engine coolant to overheat. Refer to [Hybrid/EV Cooling System Description and Operation](#) to verify correct operation of the cooling system.
- High pressure fuel system condition. Refer to [Fuel System Diagnosis](#), and [Fuel System Description](#) to verify high pressure fuel system operation.
- Intake air temperature too high. Engine running, observe the scan tool IAT Sensor parameter. The readings should be between -40°C and +149°C (-40°F and +300°F). Refer to [DTC P0112, P0113, or P0114](#) for additional information
- Fuel temperature too high.
- A hybrid/EV propulsion system malfunction. Inspect for the following conditions:
 - Hybrid/EV battery pack charge too low. Review the scan tool Hybrid/EV Battery Pack Charge Remaining parameter for a Battery Power Low condition.
 - Drive motor or inverter temperature too high.
 - Engine powered Hybrid/EV battery charging unavailable. The Internal combustion engine (ICE) may be unable to charge the Hybrid/EV battery. Refer to the conditions listed below for a possible cause:
 - ICE has been run out of fuel. Review the scan tool Remaining Fuel in Tank parameter to verify that the engine has an adequate supply of fuel in the fuel tank.
 - Any ICE performance malfunction, such as an incorrectly operating ignition or fuel system. Review the appropriate scan tool parameters to help diagnose the condition.
 - A Hybrid/EV drive motor 1 (A) or 2 (B) malfunction.
 - An incorrectly operating transmission clutch.
 - An incorrectly operating transmission fluid pump. Inspect for the following conditions:
 - Incorrect transmission fluid level
 - Plugged or restricted transmission fluid coolers or pipes
 - For additional information, refer to [Hybrid Modes of Operation Description](#) .

Fuel Odor

- Inspect for leaking, damaged, or deteriorated fuel lines.
- Inspect for a Saturated EVAP canister. Refer to [Evaporative Emission Control System Description](#) .
- Inspect for a condition with the internal components of the fuel tank assembly. Refer to [Fuel System Description](#) .

Hard Start

- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and bore and clean, if necessary. Refer to [Throttle Body Inspection and Cleaning](#) .
- Test the engine coolant temperature (ECT) sensor. Compare the ECT sensor value to the intake air temperature (IAT) sensor value on a cold engine. The ECT and IAT sensor values should be within

approximately 3Â°C (5Â°F). If the ECT sensor is out of range with the IAT sensor, test the resistance of the ECT sensor. Refer to [Temperature Versus Resistance \(Engine Coolant Temperature Sensor\)](#) for resistance specifications. Replace the ECT sensor if the resistance is not within specification. If the sensor is within the specification, test the ECT circuits for a high resistance.

- Test the fuel pump operation. The fuel pump should turn ON for 2 s when attempting to start the engine. Refer to [Fuel System Diagnosis](#).

Poor Fuel Economy

- Inspect for heavy loads being carried or towed.
- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and bore and clean, if necessary. Refer to [Throttle Body Inspection and Cleaning](#).

Rough, Unstable Idle and/or Stalling

- Engine idle speed may be unstable or the engine may stall if the ECM has learned an incorrect idle/airflow compensation value. A DTC may also set. Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. If the throttle body needs cleaning, refer to [Throttle Body Inspection and Cleaning](#).

The actions listed below may also cause the ECM to learn an incorrect idle value.

- The engine control module has been replaced
- The throttle body has been replaced
- The throttle body has been cleaned but the idle learn procedure was not performed after completing the cleaning
- The air induction system was leaking, allowing non-metered air to enter the combustion chamber. The leak was repaired but the idle learn procedure was not performed after repairing the leak

If any of the actions listed above have occurred, the Q38 THROTTLE BODY: THROTTLE/IDLE LEARN procedure must be performed.

- Inspect the engine mounts for looseness, wear, and damage.

ENGINE CRANKS BUT DOES NOT RUN

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The engine cranks but does not run is an organized approach to identify a condition which prevents the engine from starting. This diagnostic directs the technician to the appropriate system diagnosis.

Diagnostic Aids

- When the engine is started, it is cranked by the 300 V drive motor/generator, which can rotate the engine to operating speed within just a few hundred milliseconds. However, it may be difficult to determine the running state of the engine. Observe the scan tool ICE Status parameter to determine the running state of the engine. The parameter will display one of the following values:
 - Engine Stalled
 - Invalid
 - OFF
 - Running
 - Silent Start
 - Stop
 - Start
- Some failure conditions can make the engine appear to start, run briefly, then stall, which results in the following two DIC messages being displayed:
 - Engine Not Available, Service Vehicle Soon
 - Propulsion Power Reduced
- Inspect the engine for good secure electrical grounds.
- Insufficient fuel can prevent the engine from starting. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid, can prevent the engine from starting.
- There may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel for combustion to take place. If the fuel injectors and the injector circuit are OK, and fuel spray is detected, the fuel injector ON time may be inadequate. If the engine control module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate for the engine to start. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known vehicle in good condition.
- Inspect the engine for good secure electrical grounds.
- Water or foreign material in the fuel can prevent the engine from starting. During freezing weather, the water can freeze inside the fuel system. After 30 min in a heated repair shop, the water may melt and allow the engine to start. The malfunction may not recur until parked overnight in freezing temperatures.
- Under extreme weather conditions, or over a period of time, the ignition system may become susceptible to moisture. This condition may become serious enough to prevent the engine from starting. Bring the vehicle into a dry, heated garage and allow it to dry out for several hours. If the engine then starts, inspect for an ignition system that is susceptible to moisture.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

Special Tools

- **CH-48027** Digital Pressure Gauge
- **J 26792** HEI Spark Tester
- **J 34730-2C** Injector Tester
- **J 36012-A** Ignition System Diagnostic Harness

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

NOTE: This diagnostic assumes the following:

- The battery is completely charged. See [Battery Inspection/Test](#) .
- There is adequate fuel in the fuel tank.

1. Attempt to start the engine while observing the DTC information with a scan tool.
2. Verify that DTC P0117, P0118, P018B, P018C, P018D, P0119, P0121, P0122, P0123, P0222, P0223, P0231, P0232, P023F, P025A, P0335, P0336, P0513, P0562, P0563, P0601, P0602, P0603, P0604, P0606, P062F, P0628, P0629, P0633, P0641, P064A, P0685, P0689, P0690, P06A6, P1255, P1516, P1631, P1682, P16F3, P2101, P2119, P2135, P2176, P2610 or P2635 is not set.
 - If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - If none of the DTCs are set
3. Verify the scan tool Engine Speed parameter displays greater than 0 RPM while attempting to start the engine.
 - If 0 RPM

Refer to [DTC P0335 or P0336](#) .

- **If greater than 0 RPM**

4. Vehicle in Service Mode, command the Fuel Pump Enable ON several times with a scan tool.
5. Verify the scan tool circuit parameters listed below do not display Malfunction:

- Fuel Pump Enable Circuit High Voltage Test Status
- Fuel Pump Enable Circuit Open Test Status
- Fuel Pump Enable Circuit Low Voltage Test Status
- **If Malfunction is displayed**

Refer to [Fuel System Diagnosis](#).

- **If Malfunction is not displayed**

6. Vehicle OFF, install the CH-48027 digital pressure gauge.

NOTE:

- **If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Allow the engine coolant temperature to cool to less than 60°C (150°F) before attempting to record fuel pressure.**
- **The fuel pump may need to be commanded ON a few times, in order to obtain the highest possible fuel pressure.**
- **Do NOT start the engine for this test.**

7. Vehicle in Service Mode, command the Fuel Pump Enable ON several times with a scan tool.

Verify the fuel pressure is between 379 - 427 kPa (55 - 62 PSI) with the fuel pump running.

- **If not within the specified range**

Refer to [Fuel System Diagnosis](#).

- **If within the specified range**

8. Vehicle OFF, disconnect the harness connector at a Q17 Fuel Injector.
9. Connect the J 34730-2C injector tester to the fuel injector harness connector.
10. Verify the injector tester flashes or illuminates while attempting to start the engine.

- **If the injector tester does not flash or illuminate**

Refer to [DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157](#) .

- **If the injector tester flashes or illuminates**

NOTE:

It may be necessary to secure the J 36012-A ignition system diagnostic harness to the spark plug boots with electrical tape.

11. Install the J 36012-A ignition system diagnostic harness to the spark plug boots.
12. Connect the J 26792 HEI spark tester between the boot of a spark plug wire and ground.

13. Connect the remaining wires to the appropriate cylinders.

NOTE:

- Perform the spark test on at least 3 of the 4 cylinders.
- An erratic or weak spark is considered a no spark condition.

14. Verify the spark tester sparks while attempting to start the engine.

- If the spark tester does not spark

Refer to [Electronic Ignition System Diagnosis](#).

- If the spark tester sparks

15. Verify none of the conditions listed below exist:

- Air intake duct to the throttle body collapsed
- Air filter and air intake system restricted/obstructed
- Spark plugs gas or coolant fouled
- Skewed manifold absolute pressure (MAP) sensor
- Skewed engine coolant temperature (ECT) sensor
- Restricted exhaust system. Refer to [Restricted Exhaust](#) .
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Engine mechanical condition, for example, worn timing chain or low compression. Refer to [Symptoms - Engine Mechanical](#) .
- If a condition exists

Repair as necessary.

- If no conditions exist

16. All OK.

Repair Verification

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Ignition Coil Replacement](#)
- Refer to [Spark Plug Replacement](#)

MALFUNCTION INDICATOR LAMP (MIL) DIAGNOSIS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has

occurred and the powertrain control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the vehicle is ON and the engine is OFF.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Engine Control Module Description](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Any MIL requesting DTCs that may be set should be diagnosed first.

1. Vehicle Running.
2. Verify the Malfunction Indicator Lamp turns ON and OFF while commanding the Malfunction Indicator Lamp (MIL) On and Off with a scan tool.
 - **If the MIL does not turn ON and OFF**

Refer to Circuit/System Testing.

- **If the MIL turns ON and OFF**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Vehicle in Service Mode.

3. Verify a test lamp illuminates between the ignition voltage circuit terminal 8 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ignition voltage circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, disconnect all components on the circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition voltage circuit and replace as necessary.
 - **If the test lamp illuminates**
4. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for instrument panel cluster replacement, programming, and setup.

FUEL SYSTEM DIAGNOSIS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when power up is commanded. The voltage signal from the ECM to the fuel pump driver control module remains active for 2 s, unless the vehicle is ON or the vehicle is in Service Mode. While this voltage is being received, the fuel pump driver control module closes the ground switch of the fuel pump and also supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure.

The fuel system is an electronic returnless on-demand design. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

The fuel tank stores the fuel supply. An electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank. The fuel pump supplies fuel through the fuel feed pipe to the high pressure fuel pump. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel tank fuel pump module. The function of the venturi pump is to fill the fuel tank fuel pump module reservoir. The fuel tank fuel pump module contains a reverse flow check valve. The check valve maintains fuel pressure in the fuel feed pipe in order to prevent long cranking times.

Diagnostic Aids

Observe the Misfire Counters or perform the Fuel Injector Balance Test to help identify a leaking fuel injector.

Reference Information

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **CH 41769** Fuel Line Quick Disconnect Tool
- **EN 37287** Fuel Line Shut-off Adapter

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

NOTE:

- Repair all fuel system related DTCs, except P2635, before performing this diagnostic.
- Inspect the fuel system for damage or external leaks before proceeding.
- Verify that adequate fuel is in the fuel tank before proceeding.
- The Fuel Pump Enable may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.
- DO NOT perform the Fuel System Diagnosis if the engine coolant temperature is above 60°C (150°F). High fuel pressure readings may result due to hot soak fuel boiling. With the engine OFF, the fuel pressure may increase beyond the pressure relief regulator valve's setting point of 690 kPa (100 psi) ± 5 percent.

1. Vehicle in Service Mode, command the Fuel Pump Enable On and Off several times with a scan tool.
2. Verify that the scan tool Fuel Pressure Sensor parameter is between 345 - 650 kPa (50 - 94 psi).

- **If less than 345 kPa (50 psi)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 650 kPa (94 psi)**

Replace the G12 Fuel Pump.

- **If between 345 - 650 kPa (50 - 94 psi)**

3. Verify that the scan tool Fuel Pressure Sensor parameter, after the fuel pump is turned off, decreases to less than 600 kPa (87 psi).

- **If greater than 600 kPa (87 psi)**

Replace the G12 Fuel Pump.

- **If less than 600 kPa (87 psi)**

4. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease greater than 34 kPa (5 psi) in 1 minute.

- **If greater than 34 kPa (5 psi)**

Refer to Circuit/System Testing - Fuel Pressure Leaks Down.

- **If less than 34 kPa (5 psi)**

5. Engine running.

6. Verify that the scan tool Fuel Pressure Sensor parameter is between 379 - 427 kPa (55 - 62 psi).

- **If less than 379 kPa (55 psi)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 427 kPa (62 psi)**

Replace the G12 Fuel Pump.

- **If between 379 - 427 kPa (55 - 62 psi)**

7. Verify that the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If less than 1.5**

8. Verify that the scan tool Fuel Pressure Sensor and the Desired Fuel Pressure are within 45 kPa (6.5 psi) at 300 kPa (43.5 psi) request or 60 kPa (8.7 psi) at 400 kPa (58 psi) request of each other while operating the vehicle.

- **If greater than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

Refer to Circuit/System Testing - Fuel Pressure Drops Off.

- **If less than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

9. If the fuel system components test normal, refer to [Symptoms - Engine Controls](#), and [Fuel Injector Diagnosis](#).

Circuit/System Testing

Fuel Pressure Low

1. Verify none of the conditions listed below exist:

- Restricted fuel feed pipe
- Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
- **If a condition exists**

Repair as necessary.

- **If no conditions exist**

Replace the G12 Fuel Pump.

Fuel Pressure Leaks Down

1. Vehicle OFF, relieve the fuel pressure. Refer to [Fuel Pressure Relief](#).
2. Install the **EN 37287** Adapter between the chassis fuel feed hose and the engine compartment fuel feed pipe.
3. Open the valve on the **EN 37287** Adapter.
4. Vehicle in Service Mode, command the Fuel Pump Enable On and then Off with a scan tool.
5. Close the valve on the **EN 37287** Adapter.
6. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease more than 34 kPa (5 psi) in 1 min.

- **If greater than 34 kPa (5 psi)**

Replace the G12 Fuel Pump.

- **If less than 34 kPa (5 psi)**

Locate and replace the leaking Q17 Fuel Injector.

Fuel Pressure Drops Off

1. Verify none of the conditions listed below exist:

- Restricted fuel feed pipe
- Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
- **If a condition exists**

Repair as necessary.

- **If no conditions exist**

Replace the G12 Fuel Pump.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Feed Pipe Replacement](#)
- Refer to [Fuel Feed Intermediate Pipe Replacement](#)
- Refer to [Fuel Injector Replacement](#)
- Refer to [Fuel Pump Fuel Feed Hose Replacement](#)
- Refer to [Fuel Tank Fuel Pump Module Replacement](#)
- Perform the Fuel Pump Trim Reset procedure with a scan tool after the repair.

FUEL LEAK DIAGNOSIS

Reference Information

Special Tools

- **J-28428-E** High Intensity Black Light Kit
- **J-42220** Leak Detection Lamp

CAUTION: When performing a Fuel Leak Diagnosis, it is VERY IMPORANT to use only GM approved Oil Dye, Part Number 88861206. If any other oil dye is used, it will cause damage to the fuel injection system components, as well as the emission control components. This will result in necessary replacement of the damaged components.

1. Clean all of the fuel lines in the suspected area using brake cleaning solvent, and let dry.
2. Add 8 ounces of oil dye 88861206 to the fuel tank.
3. Start and idle the engine for 3 - 5 minutes.
4. Using a scan tool, increase the Fuel Rail Pressure, if applicable.
5. Verify there are no fuel leaks with **J-28428-E** or **J-42220** around the:

- Fuel pump
- Fuel rails
- Fuel injector supply lines
- Fuel supply lines
- Fuel return lines, if equipped,
- **High pressure or supply side fuel leak is found**

Repair or replace the leaking component

- **If equipped, return side fuel leak is found.**

1. Verify that the fuel return line is not restricted

- If the fuel return line is restricted, repair or replace as necessary
- If the fuel return line is not restricted, repair or replace the leaking component

- **No fuel leak is found**

6. All OK.

FUEL INJECTOR DIAGNOSIS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies a separate high voltage supply circuit and a high voltage control circuit for each fuel injector. The injector high voltage supply circuit and the high voltage control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit. The ECM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through the injector high voltage supply circuit, allowing for initial injector opening. The injector is then held open with 12 V. A fuel injector coil winding resistance that is too high or too low will affect the engine driveability. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

Diagnostic Aids

- Monitoring the scan tool Cylinder 1-4 Current Misfire Counters may help to isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.

Reference Information

Schematic Reference

Engine Controls Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Fuel Injector Coil Test

NOTE:

- The resistance test must be performed at the fuel injector or mis-diagnosis will occur.
- The DMM and test leads must be calibrated to 0 Ω in order to prevent mis-diagnosis.

1. Vehicle OFF, disconnect the appropriate Q17 Fuel Injector.
2. Test for 1.35 - 1.65 Ω at 20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$) between the control + circuit terminal 1 and the control - circuit

terminal 2 at the Q17 Fuel Injector.

- **If not between 1.35 - 1.65 Ω**

Replace the Q17 Fuel Injector.

- **If between 1.35 - 1.65 Ω**

3. Test for infinite resistance between each terminal at the Q17 Fuel Injector and the Q17 Fuel Injector housing/case.

- **If less than infinite resistance**

Replace the Q17 Fuel Injector.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Fuel Injector Replacement](#)

FUEL INJECTOR CIRCUIT DIAGNOSIS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Injector 1 Control +	P2147	P0201	P2148	P1248
Fuel Injector 1 Control -	P0261	P0201	P0262, P2148	P1248
Fuel Injector 2 Control +	P2150	P0202	P2151	P1249
Fuel Injector 2 Control -	P0264	P0202	P0265, P2151	P1249
Fuel Injector 3 Control +	P2153	P0203	P2154	P124A
Fuel Injector 3 Control -	P0267	P0203	P0268, P2154	P124A
Fuel Injector 4 Control +	P2156	P0204	P2157	P124B
Fuel Injector 4 Control -	P0270	P0204	P0271, P2157	P124B

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the injector high voltage supply circuits and the injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Diagnostic Aids

- Performing the Fuel Injector Diagnosis may help isolate an intermittent condition. Refer to [Fuel Injector Diagnosis](#).
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Do Not perform this procedure unless directed here from the Fuel Injector Balance Test.

1. Vehicle in Service Mode, engine running.
2. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter parameters do not increment.
 - **If the Cylinder 1 - 4 Current Misfire Counters increment**
Refer to Circuit/System Testing.
 - **If the Cylinder 1 - 4 Current Misfire Counters do not increment**
3. Verify the scan tool Cylinder 1 - 4 Injector Control Circuit Status parameters display OK.
 - **If the Cylinder 1 - 4 Injector Control Circuit Status parameters do not display OK**

Refer to Circuit/System Testing.

- **If the Cylinder 1 - 4 Injector Control Circuit Status parameters display OK**

4. All OK.

Circuit/System Testing

1. Vehicle OFF, all vehicle systems OFF, disconnect the X2 harness connector at the K20 Engine Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for infinite resistance between the appropriate Q17 Fuel Injector control + circuit and ground.
 - **If less than infinite resistance**
 1. Disconnect the harness connector of the Q17 Fuel Injector.
 2. Test for infinite resistance between the Q17 Fuel Injector control + circuit and ground.
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for infinite resistance between the Q17 Fuel Injector control - circuit and ground.
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite, replace the Q17 Fuel Injector.
 - **If infinite resistance**
3. Vehicle in Service Mode.
4. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.
 - **If 1 V or greater**
 1. Disconnect the harness connector of the Q17 Fuel Injector, vehicle in Service Mode.
 2. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, repair the short to voltage on the control - circuit.
 - **If less than 1 V**
5. Vehicle OFF.
6. Test for less than 3 Ω between the Q17 Fuel Injector control + circuit and control - circuit.
 - **If 3 Ω or greater**
 1. Disconnect the harness connector of the Q17 Fuel Injector.
 2. Test for less than 2 Ω on the control + circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 3. Test for less than 2 Ω on the control - circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the Q17 Fuel Injector.
 - **If less than 3 Ω**
7. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Fuel Injector Replacement](#)
- Refer to [Control Module References](#) for K20 Engine Control Module replacement, programming, and setup

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10% in non-blended gasoline or greater than 85% with E85 blended gasoline for flexible fuel applications can cause driveability conditions such as hesitation, lack of power, stalling, or no start. Excessive concentrations of ethanol used in vehicles not designed for it may cause fuel system corrosion, deterioration of rubber components, and fuel filter restriction.

Reference Information

Special Tool

CH 44175-A Alcohol Tester Kit, if available

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Verification

1. Remove a sample of fuel from the bottom of the fuel tank and place in a clean, clear container.
2. Place the sample on a level surface for 2 min.
3. Verify the sample is clear and bright in color.
 - **If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample**

Refer to Circuit/System Testing - Particulate Contaminants in Fuel.

- **If alcohol contamination is suspected**

Refer to Circuit/System Testing - Alcohol in Fuel Testing.

- **If the sample remains clear and bright**

4. All OK.

Alcohol in Fuel Testing with Special Tool, if Available

1. Test the fuel composition using **CH 44175 - A Alcohol Tester Kit and Instruction Manual**.
2. Verify no water appears in the fuel sample.
 - **If water appears in the fuel sample**

Clean the fuel system.
 - **If no water appears in the fuel sample**
3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
4. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.
 - **If greater than the specified value**
 1. Add fresh regular gasoline to the vehicle's fuel tank.
 2. Remove a new sample of fuel from the tank.
 3. Test the fuel composition using **CH 44175 - A Alcohol Tester Kit and Instruction Manual**.
 4. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
 5. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.
 - If additional testing indicates that the ethanol percentage is still above 15% for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to [Fuel Tank Draining](#) .
 - If additional testing indicates that the E85 blended gasoline sample still measures above 91%, continue adding fresh, regular gasoline until the ethanol content is 85% or less.
 - **If the specified value or less**
5. All OK.

Alcohol in Fuel Testing without Special Tool

NOTE: This procedure is for non-blended gasoline only. If excessive alcohol content is suspected with E85 fuel add 15% tank volume of fresh, regular gasoline to the fuel tank.

1. Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
2. Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.
3. Shake the cylinder vigorously for 10 - 15 s.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10 - 15 s.
6. Put the cylinder on a level surface for approximately 5 min in order to allow adequate liquid separation. If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and

water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5% alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

7. Verify the non-blended gasoline fuel sample does not measure greater than 15%.

- **If greater than the specified value**

1. Add fresh regular gasoline to the vehicle's fuel tank.

2. Remove a new sample of fuel from the tank.

3. Test the fuel composition of the new sample.

4. Verify the non-blended gasoline fuel sample does not measure greater than 15%.

- If greater than the specified value, drain and replace the vehicle's fuel. Refer to [Fuel Tank Draining](#).

- If the specified value or less, all OK.

- **If the specified value or less**

8. All OK.

Particulate Contaminants in Fuel

1. Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel from the bottom of the fuel tank.

2. Place the container on a level surface for approximately 5 min in order to allow settling of the particulate contamination. Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles.

3. Verify there are no physical contaminants or water present in the fuel sample.

- **If any physical contaminants or water are present**

Clean the fuel system.

- **If no physical contaminants or water are present**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Fuel System Cleaning](#)

- Refer to [Fuel Tank Draining](#)

EVAPORATIVE EMISSION CONTROL SYSTEM DIAGNOSIS

Reference Information

Special Tools

- **EN 41413-VLV** EVAP Service Port Vent Fitting
- **GE 41413-A** Evaporative Emission System Tester (EEST)

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Operating Instructions for the Evaporative Emission System Tester (EEST)

Vehicle Setup

WARNING: In order to reduce the risk of fire and personal injury observe the following items:

- Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes
- Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.
- Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.
- Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

CAUTION: Use the Evaporative Emission (EVAP) System Tester GE 41413-A in order to provide a clean, dry, low pressure nitrogen gas source. Do not substitute any other pressurized source, gas or otherwise. Damage may result to the EVAP system, test equipment or cause a safety risk.

NOTE: A large difference between the vehicle temperature and shop temperature will seriously affect the accuracy of the tests. Always allow enough time, at least 15 m, for the vehicle temperature to adjust to the shop temperature.

NOTE: If the refueling request button is pushed then the vent solenoid valve will remain open for 30 min. The scan tool will be required to manually close the vent solenoid valve prior to testing and before the 30 min time expires. After 30 min the vent solenoid returns to it's natural closed state.

NOTE: If fuel level is 90% or greater it will take longer to fill the system with smoke because the fuel fill tube check valve will be closed and force any smoke to pass through the Onboard Refueling Vapor Recovery (ORVR) pipe and orifice.

1. Vehicle in Service Mode, open the hood. Position a large fan to blow air under the vehicle onto the fuel tank area.
2. Connect the red battery clip from the tester to the positive battery terminal at the underhood auxiliary fuse

block X50B.

NOTE: The vehicle 12 V battery must be fully charged for optimal tester performance and because every module will be awake in this powered mode.

3. Connect the black battery clip of the tester to chassis ground.

Flow Meter Test - Leak Detection

CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- The fuel pipe connections
- The hose connections
- The areas surrounding the connections

1. Open the nitrogen tank valve and turn the nitrogen/smoke valve on the front control panel to nitrogen.
2. Connect the hose to the correct test orifice on the bottom front of the tester. For orifice size, refer to the vehicle specific information found in the service procedures for DTCs that relate to EVAP system leaks.
3. Press and release the remote switch to activate the tester.

NOTE: The tester will time out after about 15 min. You may press the remote switch to reactivate the tester as desired.

4. Position the sliding red flag on the flow meter to align with the floating indicator. When the red flag is set, press and release the remote switch to deactivate the tester.
5. Remove the hose from the test orifice and install the hose onto the vehicle. For proper connection location, and the special tool numbers for any adapters that may be required, refer to the service manual for the vehicle being tested. The vehicle specific information can be found in service procedures for DTCs that relate to EVAP system leaks.
6. Seal the EVAP system per instructions in the service manual. Most systems can be sealed using a scan tool output control for the EVAP canister vent solenoid valve. Other systems require that the system be plugged. Refer to the service manual for the vehicle being tested for specific instructions.

NOTE:

- Larger volume fuel tanks, and/or those with lower fuel levels, may require several minutes to fill with nitrogen.
- Static buildup may cause the float indicator to stick. It may be necessary to tap on the flow meter to free the float.

7. Press and release the remote switch to activate the nitrogen flow and fill the system.
8. Compare the stable floating indicator position to the red flag.
 - Below the red flag, the result is acceptable, Pass. Test complete
 - Above the red flag, the result is unacceptable, Fail. Go to the Smoke Procedure
9. Press and release the remote switch to deactivate the tester.

Smoke Procedure - Locate the Leak

NOTE: It is not recommended to use the tester in an outside repair bay area because wind and sunlight may affect temperature and your ability to see the smoke.

1. Turn OFF any fans that may cause air movement around or near the vehicle.

NOTE: Completely unwind the nitrogen/smoke hose from the bracket for optimal tester performance.

2. Connect the nitrogen/smoke hose to the vehicle as directed in the service manual. Some vehicles require that the nitrogen/smoke hose be connected at the front of the EVAP system at the EVAP service port. An adapter may be necessary. Other vehicles require the connection be made at the rear of the system using an adapter at the fuel fill cap. Consult the service manual for vehicle specific instructions regarding connection location and adapters.
3. Open the nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to smoke.

NOTE: The remote switch operates in a push ON, push OFF fashion.

4. Press and release the remote switch to activate the tester and inject smoke into the EVAP system.
5. Verify smoke has filled the EVAP system by opening the system opposite the end where smoke is injected. When injecting smoke at the service port, remove the fuel fill cap and temporarily leave the EVAP canister vent solenoid valve open, and EVAP leak detection pump switching valve in the vent position, until smoke is observed. Then close the system and continue testing. If using a special tool fuel fill cap adapter at the filler neck, use the **EN 41413-VLV** at the service port until smoke is observed, then remove the **EN 41413-VLV** and continue with the test.

NOTE: Inject smoke in less than 2 min cycles for optimal tester performance.

6. Press and release the remote switch to deactivate the tester.

NOTE: For optimal visual smoke performance, deactivate the smoke flow and allow the system pressure to drop. Allowing the smoke to exit through small holes at a low flow rate greatly enhances visibility.

7. Introduce smoke into the system for an additional 60 s. Continue introducing smoke at 15 s intervals, as necessary.
8. Using a high-intensity white light, inspect the entire EVAP system path, and look for the source of the leak indicated by the exiting smoke. Introduce smoke at 15 s intervals, as needed, until the source of the leak is identified.

Temperature Variation Instructions

The Concern

Ideal circumstances for conducting the EVAP flow meter test require equal temperatures between the nitrogen gas and the vehicle EVAP system. Significant differences in temperature between them can result in a flow or pressure change during testing, causing misleading results. Typically, the evaporative emissions system tester is

stored indoors, approximately 21Â°C (70Â°F). Vehicles brought in for diagnosis may have an EVAP system at significantly different temperatures -40 to +43Â°C (-40 to +110Â°F).

For Example

NOTE: With no temperature difference between the nitrogen gas and EVAP system, the resulting vehicle EVAP system pressure will remain stable at 3.2 kPa, 13 in. H₂O, (0.5 PSI) once pressurized, providing no leaks are present.

When the EVAP flow meter tests are performed with significant differences in temperature between the nitrogen gas and the vehicle EVAP system, the following results can occur:

- An increase in flow during the flow meter test can be caused by a vehicle's warm EVAP system cooling down.
- A decrease in flow during the flow meter test can be caused by a vehicle's cool EVAP system warming up.

The Solution

When working on a vehicle with significant differences in temperature between the vehicle EVAP system and the nitrogen gas, allow the vehicle EVAP system temperature to stabilize as close as possible to the temperature of the nitrogen gas before conducting the Flow Meter Test.

INSPECTION/MAINTENANCE SYSTEM CHECK

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Description

Several states require that a vehicle pass on-board diagnostic (OBD) system tests and inspection/maintenance (I/M) emission inspections in order to renew license plates. This is accomplished by viewing the Inspection/Maintenance System Status or Data display on a scan tool. Using a scan tool, the technician can observe the I/M status in order to verify that the vehicle meets the criteria that complies with the local area requirements.

While testing in the I/M System Status mode, some diagnostic trouble codes (DTCs) may occur that are called I/M Test DTCs. An I/M Test DTC is defined as a DTC that is currently commanding the malfunction indicator lamp (MIL) ON, and is stored in non-volatile memory. The intended use of this data is to prevent vehicles from passing I/M inspection without proper repair to the vehicle. These DTCs are not erasable from any scan tool command or by disconnecting power to the controller. I/M Test DTCs are supported by all emissions related electronic control units (ECUs). For example, engine control modules (ECMs), transmission control modules (TCMs), and fuel pump control modules (FPCMs). An I/M Test DTC will not be stored or erased from the control module except at the end of trip processing which occurs 5 s after vehicle OFF.

Conditions for Updating the I/M System Status

NOTE: New vehicles may not report an Inspection/Maintenance System Check pass or fail status for certain post catalyst oxygen sensor or heated oxygen sensor 2 diagnostics prior to 700 miles. After replacing a catalytic converter on a vehicle with greater than 700 miles, it may require up to an additional 700 miles to prevent a false failure status.

Each system requires at least one, and sometimes several, diagnostic tests. The results of these tests are reported by a DTC. A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or any one of the DTCs comprising the monitor have illuminated the MIL. Once all of the tests are completed, the Inspection/Maintenance System Status or Data will indicate YES in the Completed or Value column.

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has four heated oxygen sensors, either all four heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The Inspection/Maintenance System Status or Data will indicate NO under the Completed or Value column when any of the required tests for that system have not run. The following is a list of conditions that would set the Inspection/Maintenance System Status or Data indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The 12 V battery has been disconnected or discharged below operating voltage.
- The control module power or ground has been interrupted.
- The control module has been reprogrammed.
- The control module DTCs have been cleared as part of a service procedure.

Conditions for Clearing I/M Test DTCs

1. Only the OBD II System can erase I/M Test DTCs. The OBD II system must determine that the malfunction that caused the I/M Test DTC to be stored is no longer present and is not commanding the MIL. Each of the following represents ways to clear an I/M Test DTC:
 - If the MIL goes off due to 3 passing drive cycles, and the scan tool code clear is not used, the I/M Test DTC is erased at power down of the last drive cycle.
 - If a scan tool code clear is used to turn OFF the MIL, the I/M Test DTC is not erased, therefore the DTC must PASS and not FAIL during the drive cycle. The I/M Test DTC is erased at power down of the drive cycle.
 - If the controller is reflashed/reprogrammed, all I/M Test DTCs are erased.
2. For the OBD II System to run a single drive cycle for clearing an I/M Test DTC, all of the following conditions must occur:
 - Vehicle ON, engine run time greater than 600 s.
 - Cumulative vehicle speed is greater than 41 km/h (25 mph) greater than 300 s.
 - Continuous engine running, and vehicle speed is 0 km/h (0 mph) greater than 30 s.
 - Vehicle OFF for 5 s.

Monitored Emission Control Systems

The OBD II system monitors all emission control systems that are on-board, but not all vehicles need every possible emission control system. For example, a vehicle may not be equipped with secondary air injection (AIR) or exhaust gas recirculation (EGR). The OBD II regulations require monitoring of the following; if equipped:

- The air conditioning system
- The catalytic converter efficiency
- Comprehensive component monitoring - Emission related inputs and outputs
- The evaporative emission (EVAP) system
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (O2S or HO2S)
- The oxygen sensor heater system (HO2S heater)

For the specific DTCs required for each system, refer to [Inspection/Maintenance \(I/M\) System DTC Table](#). Systems such as misfire and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

Diagnostic Aids

The Inspection/Maintenance System Status or Data display provides an indication of when the control module has completed the required tests. This does not necessarily mean that the test has passed, only that a decision was made. If the diagnostic fails, a DTC will indicate the failure. If a failure indication is present for a DTC associated with one of the I/M regulated systems, it may prevent other required tests from running. For example, a DTC for the control circuit of the EVAP purge solenoid may not be listed in the Inspection/Maintenance System DTC Table because it is a continuous test. If this DTC is set, the Active Tests for the EVAP system may not run.

The Inspection/Maintenance System Status or Data information may be useful for a technician to determine if diagnostics have run when verifying repairs.

Circuit/System Verification

Vehicle in Service Mode, observe the scan tool Inspection/Maintenance System Status or Data indicators, and the I/M Test DTCs. All I/M System Status indicators should display YES, and no I/M Test DTCs should be present.

Circuit/System Testing

NOTE: Many DTC related repairs will instruct the technician to clear the DTC information. Clearing the DTC will reset the Inspection/Maintenance System Status or Data indicators to NO. Performing the I/M Complete System Set Procedure will set each of the I/M System Status indicators to YES.

1. Observe the Engine DTC information with a scan tool. Verify no I/M DTCs are present.
 - If an I/M DTC is set that would prevent the I/M System Status tests from completing, diagnose that

DTC before continuing. Refer to [Inspection/Maintenance \(I/M\) System DTC Table](#).

2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
 - If a control module re-program or other repair is required, perform the [Inspection/Maintenance Complete System Set Procedure](#).
3. Observe the Inspection/Maintenance System Status or Data indicators.
 - If any Inspection/Maintenance System Status or Data indicators report NO, perform the [Inspection/Maintenance Complete System Set Procedure](#).

INSPECTION/MAINTENANCE COMPLETE SYSTEM SET PROCEDURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Description

The purpose of the Inspection/Maintenance (I/M) complete system set procedure is to satisfy the enable criteria necessary to execute all of the I/M readiness diagnostics and complete the trips for those particular diagnostics. When all I/M monitored diagnostic tests are completed, the I/M System Monitor Indicators are set to YES. Perform the Inspection/Maintenance (I/M) Complete System Set Procedure if any I/M System Monitor indicators are set to NO.

Conditions for Meeting a Cold Start

- Ignition voltage between 10 - 32 V.
- Barometric pressure (BARO) between 10 - 16 psi.
- Engine coolant temperature (ECT) less than 40Â°C (104Â°F).
- Intake air temperature (IAT) between 4 - 45Â°C (39 - 113Â°F).
- Fuel level between 10 and 90%.

Circuit/System Verification

1. Verify that all I/M System Status indicators report YES, and that no I/M Test DTCs are present.
 - **If any I/M Test DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If no I/M Test DTCs are set**
2. All OK.

Inspection/Maintenance (I/M) System Set Procedure

WARNING: Refer to [Road Test Warning](#) .

NOTE: Since the internal combustion engine must run in order for the I/M

monitors to execute, it is suggested that the vehicle state of charge be depleted prior to performing the road test.

1. Vehicle ON, accelerate to a speed greater than 40 km/h (25 MPH) with engine speed greater than 1800 RPM.
2. Maintain the vehicle speed and engine speed until the engine reaches normal operating temperatures.
3. Park vehicle and ensure that the vehicle meets the conditions for a cold start listed above.
4. Allow vehicle to sit undisturbed for a minimum of 8 hours.
5. Vehicle in Service Mode, observe the Inspection/Maintenance (I/M) Monitors with a scan tool. All of the I/M System Monitors should display YES.
 - If any of the I/M System Monitors display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) for the monitor which did not display YES. The I/M System DTC Table identifies the DTCs associated with each I/M System Monitor.

NOTE: An I/M Test DTC will not be stored or erased from the ECU except at the end of trip processing, which occurs 5 s after Vehicle OFF.

6. Observe the I/M Test DTC information with a scan tool. Verify there are no I/M Test DTCs present.
 - If an I/M Test DTC is set, diagnose the DTC using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , and refer to [Inspection/Maintenance System Check](#).
7. Observe the ECM DTC information with a scan tool. Verify no DTCs are present.
 - If a DTC is set, diagnose using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) . After repairs, perform the [Inspection/Maintenance Complete System Set Procedure](#) to verify no further DTCs are set.

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

System	DTCs Required to Set System Status to YES
If an I/M System Status indicator did NOT update to YES during the Inspection/Maintenance Complete System Set Procedure , review each indicator and reference this table to determine each DTC associated with the I/M System Status Indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs which, if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the Conditions for Running for each DTC listed below will allow the I/M System Status Indicators to transition to YES.	
Catalyst	DTC P0420
EVAP	• DTC P043E, P043F, or P145F • DTC P0442 or P0455 • DTC P0451-P0453
Fuel	DTC P219A
Oxygen Sensor	• DTC P0131, P0132, P0137, or P0138 • DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271

System	DTCs Required to Set System Status to YES
Oxygen Sensor Heater	<u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
Camshaft Position	<u>DTC P0011 or P0014</u>

ELECTRONIC IGNITION SYSTEM DIAGNOSIS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

Circuit/System Description

This ignition system uses an individual coil for each cylinder. The engine control module (ECM) controls the spark events by transmitting the timing pulses on the ignition control (IC) circuits to the individual ignition coils in firing order sequence.

Diagnostic Aids

- An open/high resistance on the low reference circuit to the ignition coil may cause a misfire.
- An erratic or weak spark is considered a no spark condition.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Special Tools

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Circuit/System Testing

NOTE: Do not perform this diagnostic procedure unless you were sent here from a misfire DTC or the Engine Cranks But Does Not Run diagnostic.

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 or A and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Test for less than 5 Ω between the low reference circuit terminal 2 or B and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
4. Vehicle in Service Mode.
5. Verify a test lamp illuminates between the ignition circuit terminal 4 or D and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp illuminates**
6. Vehicle OFF, exchange the suspect T8 Ignition Coil with the T8 Ignition Coil of a known functioning cylinder.
7. Engine Running.
8. Verify the scan tool Cylinder 1 - 4 Current Misfire Counter does not increment for the same cylinder that the suspect T8 Ignition Coil was removed from.
 - **If increments**

Replace the K20 Engine Control Module.

- **If does not increment**

9. Test or replace the T8 Ignition Coil.

Component Testing

NOTE: You must perform the Circuit/System Testing before proceeding with Component Testing.

1. Vehicle OFF, connect the **EL 26792** HEI Spark Tester to the appropriate T8 Ignition Coil.
2. Engine Running.
3. Verify the spark output of the T8 Ignition Coil.

- **If no output or the output is weak**

Replace the T8 Ignition Coil

- **If the output is good**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Ignition Coil Replacement**
- Refer to **Control Module References** for engine control module replacement, programming, and setup.

Article GUID: A00884687

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Repair Instructions - Volt

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - ENGINE CONTROLS AND FUEL

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

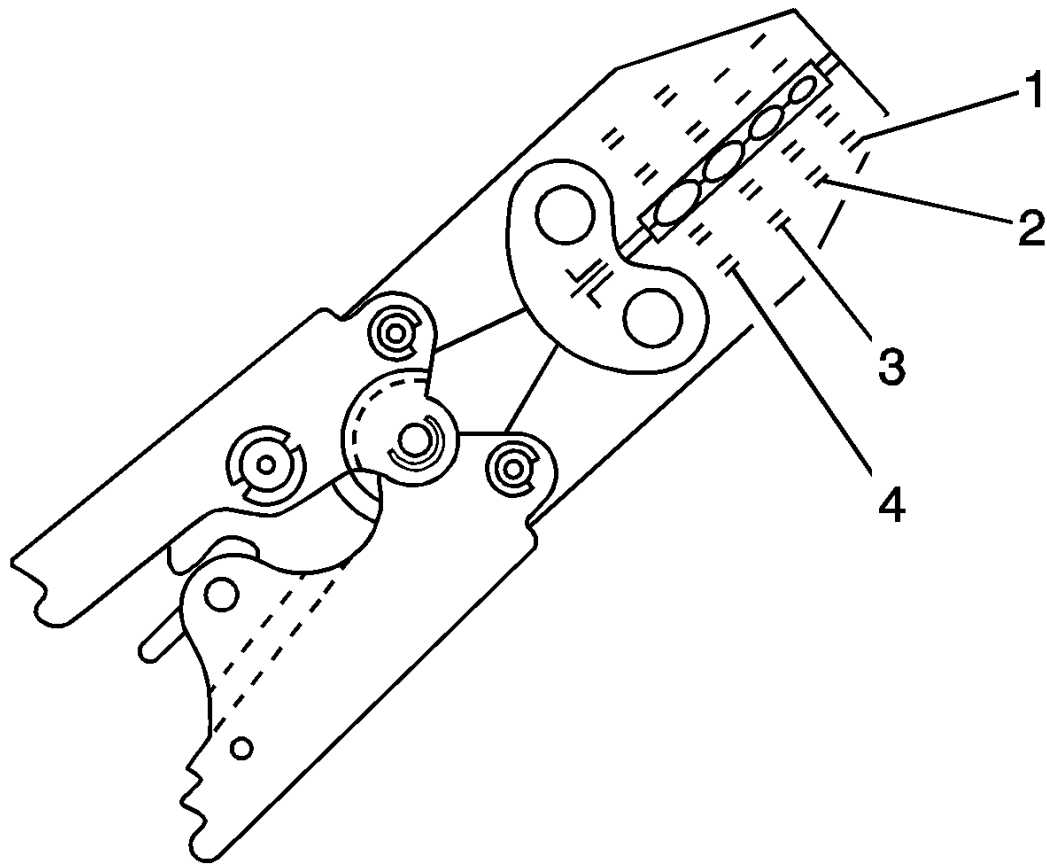


Fig. 1: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

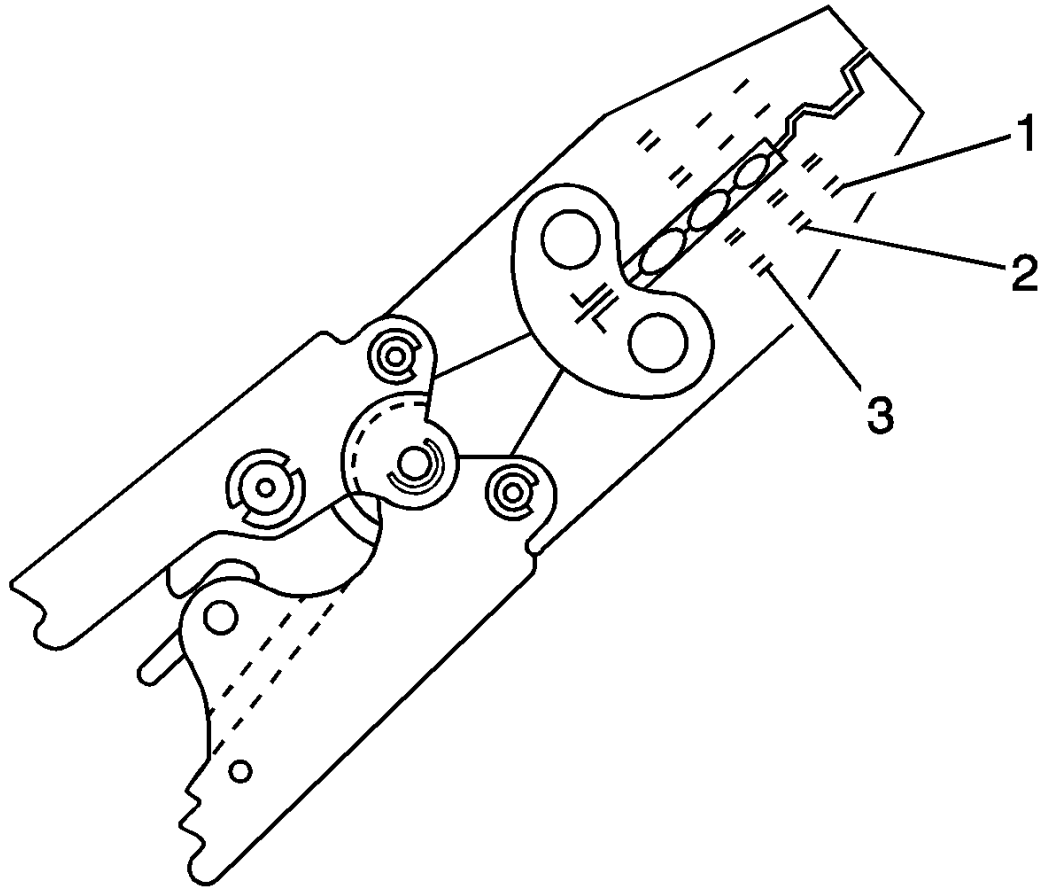


Fig. 2: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

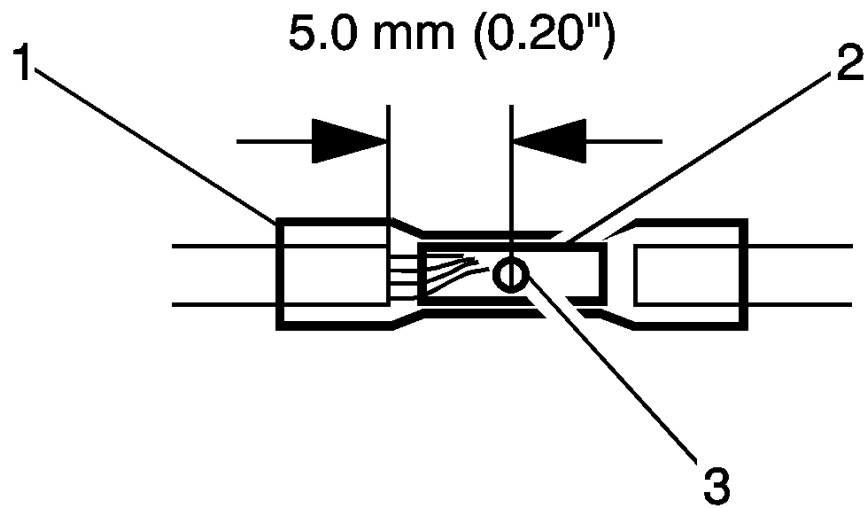


Fig. 3: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 4: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [**Folded-Over Wire Repair**](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 5: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

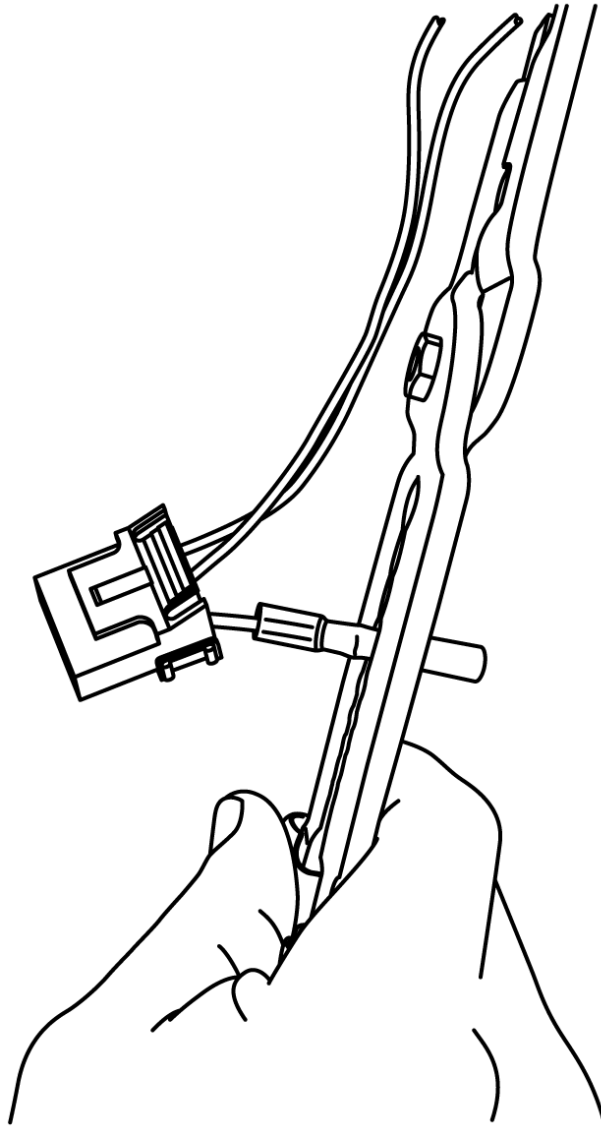


Fig. 6: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

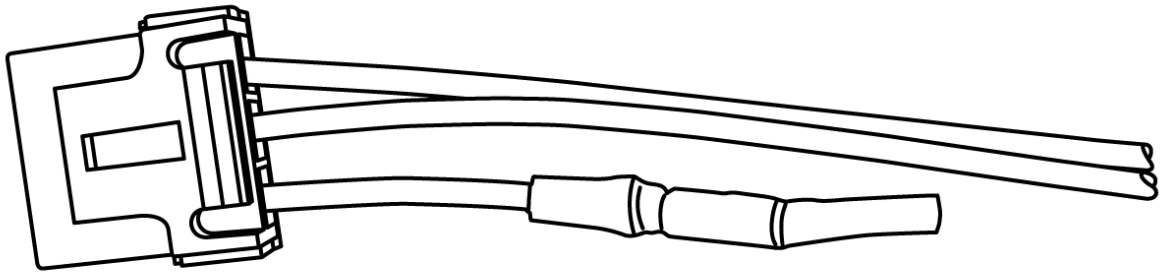


Fig. 7: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

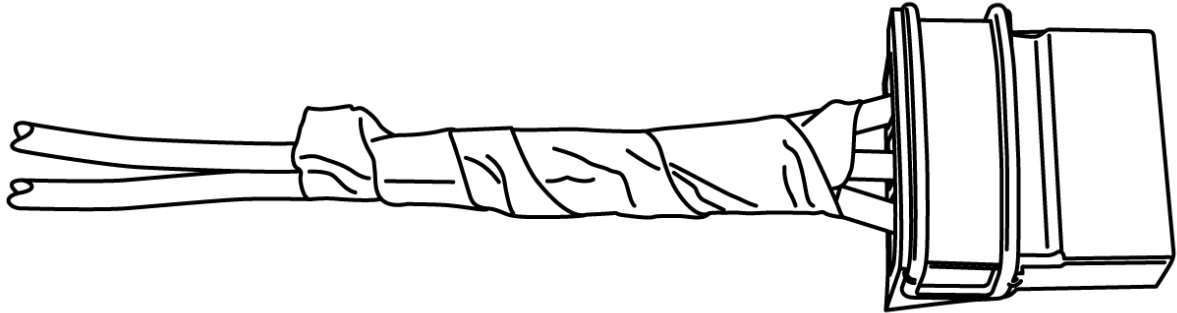


Fig. 8: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - ENGINE CONTROLS AND FUEL

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

BRAKE PEDAL POSITION SENSOR LEARN

Calibration Criteria

NOTE: **Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.**

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), or engine control module (ECM) have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Vehicle in Service Mode, transmission in Park.
3. Clear all DTCs.

4. Perform the scan tool Body Control Module Brake Pedal Position Sensor Learn procedure and follow the on-screen instructions.
5. Verify the scan tool Brake Pedal Position Sensor Learned Released Position parameter displays Yes when Learn is completed.
 - **If Yes is not displayed**

Repeat the procedure.
 - **If Yes is displayed**
6. Perform the scan tool Engine Control Module Brake Pedal Position Sensor Learn procedure and follow the on-screen instructions.
7. Verify the scan tool Brake Pedal Position Fully Released Position Learned parameter displays Yes when Learn is completed.
 - **If Yes is not displayed**

Repeat the procedure.
 - **If Yes is displayed**
8. All OK.

THROTTLE OR IDLE LEARN

Description

The engine control module (ECM) learns the airflow through the throttle body to ensure the correct engine speed. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to learn out the coking. To accelerate the process, the scan tool has the ability to reset all learned values back to zero. A new ECM will also have values set to zero.

The engine speed may be unstable or a DTC may set if the learned values do not match the actual airflow.

Conditions for Running the Throttle Learn Procedure

Reset Procedure

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0171, P0172, P0201, P0202, P0203, P0204, P0222, P0223, P0300, P0351, P0352, P0353, P0354, P0601, P0604, P0606, P060D, P0641, P0651, P0697, P06A3, P1101, P1516, P2101, P2119, P2122, P2123, P2127, P2128, P2135, P2138, or P2176 are not set.
- Vehicle in Service Mode.
- The vehicle speed sensor (VSS) is 0 km/h (0 mph).

Learn Procedure

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0171, P0172, P0201, P0202, P0203, P0204, P0222, P0223, P0300, P0351, P0352, P0353, P0354, P0601, P0604, P0606, P060D, P0641, P0651, P0697, P06A3, P1101, P1516, P2101, P2119, P2122, P2123, P2127, P2128, P2135, P2138, or P2176 are not set.
- The engine speed is between 1, 400 - 4, 000 RPM.
- The manifold absolute pressure (MAP) is greater than 5 kPa.
- The mass air flow (MAF) is greater than 2 g/s.
- The ignition voltage is greater than 10 V.

Throttle Learn

Reset Procedure - Performed after the throttle body is cleaned or replaced

1. Vehicle in Service Mode, perform the Idle Learn Reset with a scan tool.
2. Engine running, monitor the Throttle Body Idle Airflow Compensation parameter with a scan tool. The Throttle Body Idle Airflow Compensation value should equal 0 %.
3. Clear the DTCs and return to the diagnostic that referred you here.

Learn Procedure - Performed after the ECM is programmed or replaced

NOTE: Do NOT perform this procedure if DTCs are set. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

1. Engine running for 3 minutes.
2. Monitor the Engine Speed with a scan tool.
3. The ECM will start to learn the new idle cells and the Engine Speed should start to decrease.
4. Vehicle OFF for 60 s.
5. Engine running for 3 minutes.
6. After the 3 minute run time the engine speed should be normal.
7. Once the engine speed has returned to normal, clear DTCs and return to the diagnostic that referred you here.

METAL COLLAR QUICK CONNECT FITTING SERVICE

Special Tools

- **CH-41769** Fuel Line Disconnect Tool Set
- **CH-44581** Fuel Line Disconnect Tool

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).

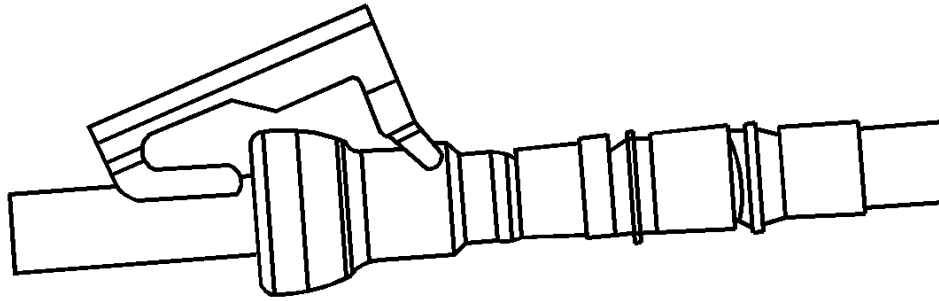


Fig. 9: View Of Quick-Connect Fitting Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Remove the retainer from the quick-connect fitting.

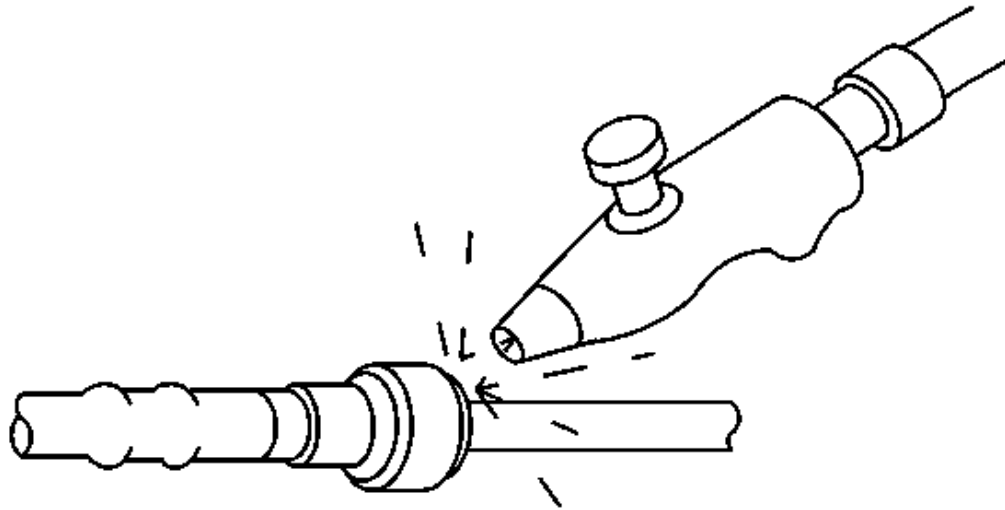


Fig. 10: Blowing Dirt Out Of Fitting (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Blow dirt out of the fitting using compressed air.

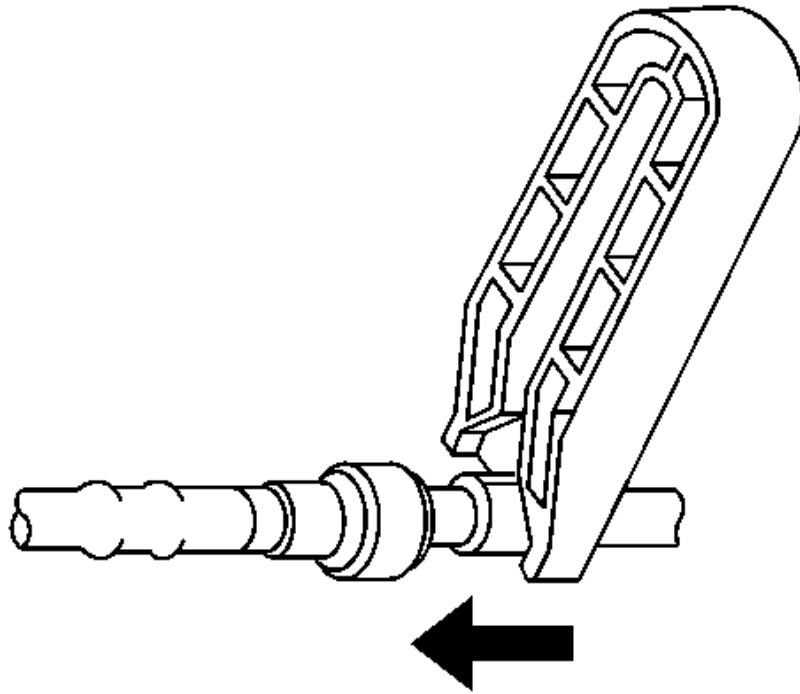


Fig. 11: View Of Quick Connect Locking Tabs (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

4. Depending on the fuel line size and ability to access the fitting, choose the appropriate tool: **CH-41769** fuel line disconnect tool set or **CH-44581** fuel line disconnect tool. Insert the **CH-41769** fuel line disconnect tool set or **CH-44581** fuel line disconnect tool into the female connector, then push inward to release the locking tabs.

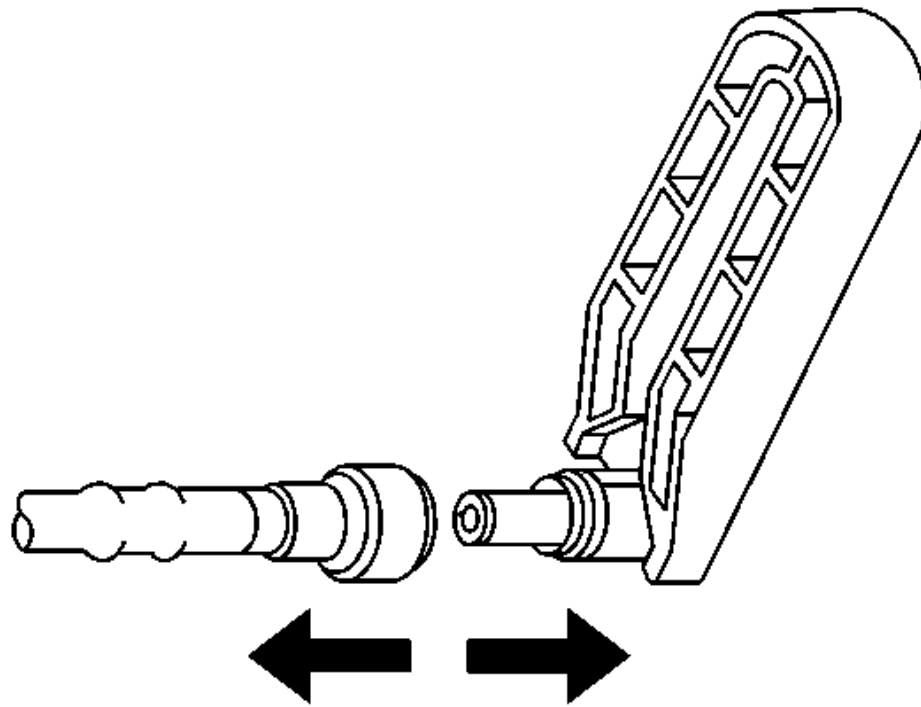


Fig. 12: View Of Quick Connect Locking Tabs (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

5. Pull the connection apart.

CAUTION: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. Using a clean shop towel, wipe off the male pipe end.

7. Inspect both ends of the fitting for dirt and burrs.

8. Clean or replace the components as required.

Installation Procedure

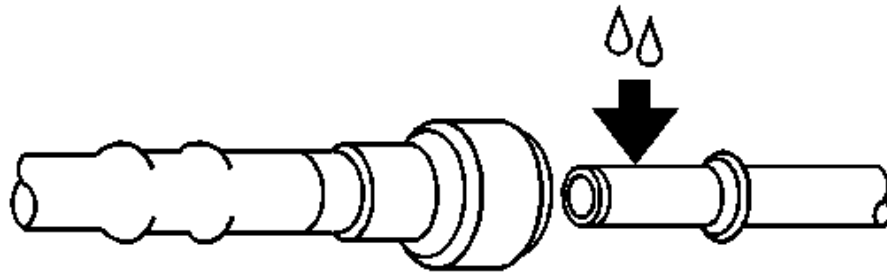


Fig. 13: Oiling Male Pipe Ends (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

WARNING: In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.

This will ensure proper reconnection and prevent a possible fuel leak.

During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male pipe end.

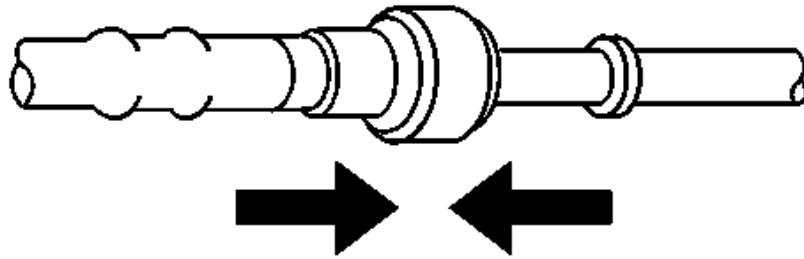


Fig. 14: View Of Connectors (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

2. Push both sides of the quick-connect fitting together to cause the retaining tabs to snap into place.

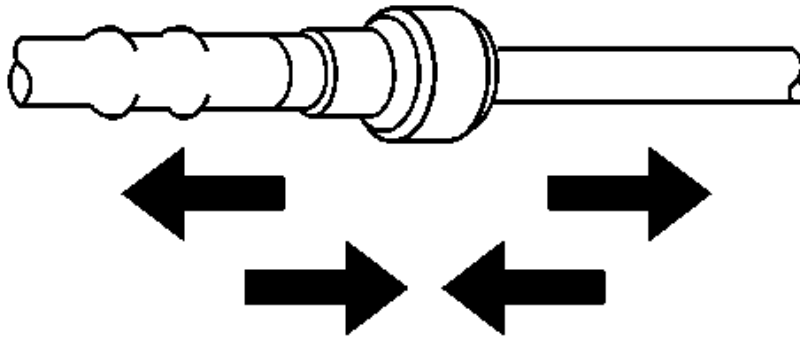


Fig. 15: Ensuring Connection (Metal Collar) Is Secure

Courtesy of GENERAL MOTORS COMPANY

3. Pull on both sides of the quick-connect fitting to make sure the connection is secure.

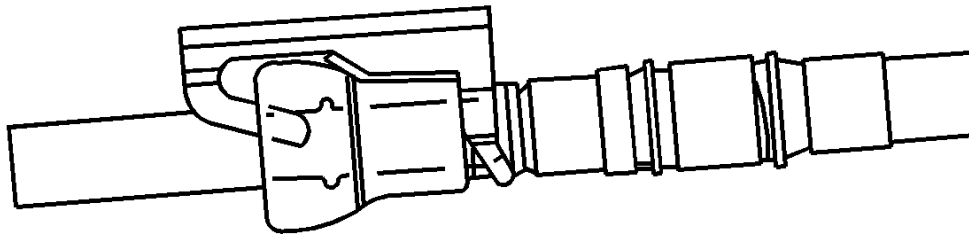


Fig. 16: View Of Fuel Pipe Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install the retainer to the quick-connect fitting.
5. Inspect for leaks using the following procedure:
 1. Turn the ignition ON, with the engine OFF for 2 seconds.
 2. Turn the ignition OFF, for 10 seconds.
 3. Turn the ignition ON, with the engine OFF for 2 seconds.
 4. Turn the ignition OFF.
 5. Inspect for leaks.

PLASTIC COLLAR QUICK CONNECT FITTING SERVICE

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

NOTE: If servicing a fuel system, insure the fuel pressure has been relieved.

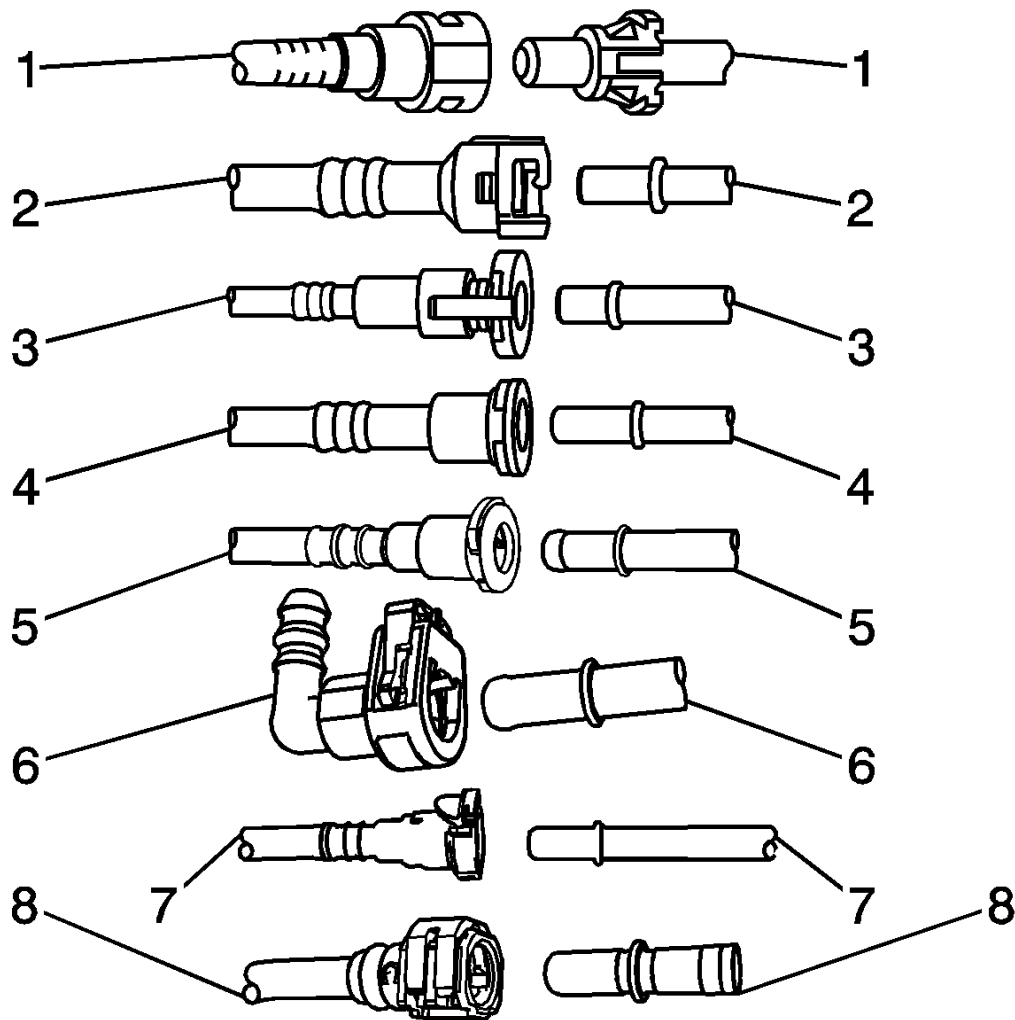


Fig. 17: Plastic Collar Quick Connect Fitting Service

Courtesy of GENERAL MOTORS COMPANY

NOTE:

There are several types of plastic collar fuel and evaporative emission quick connect fittings used on this vehicle.

- Bartholomew (1)
- Q Release (2)
- Squeeze to Release (3)
- Sliding Retainer (4)
- Global Connect (5)
- TI Loc (6)
- Safe Lock (7)
- Plastic Connector (8)

The following instructions apply to all of these types of plastic collar quick connect fittings except where indicated.

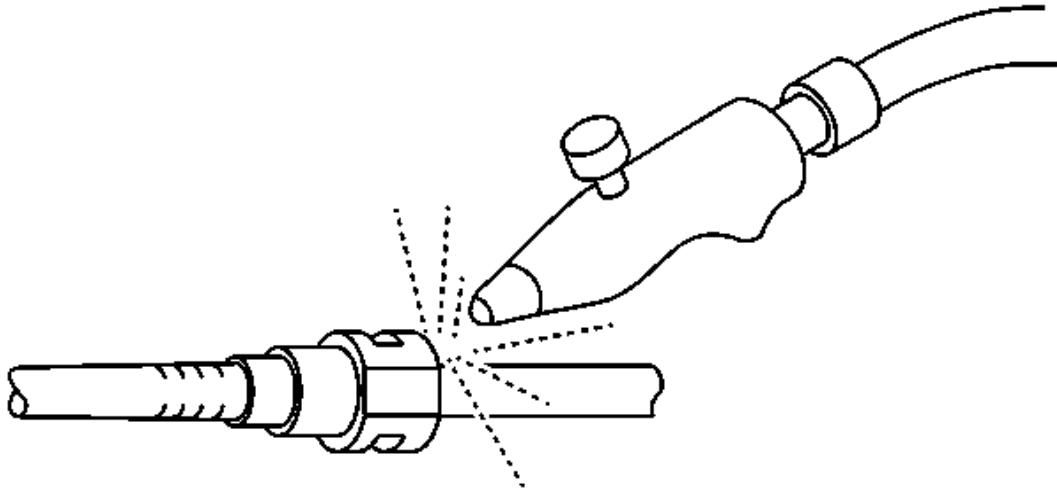


Fig. 18: Blowing Dirt Out Of Fitting (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

1. Using compressed air, blow any dirt out of the quick-connect fitting.

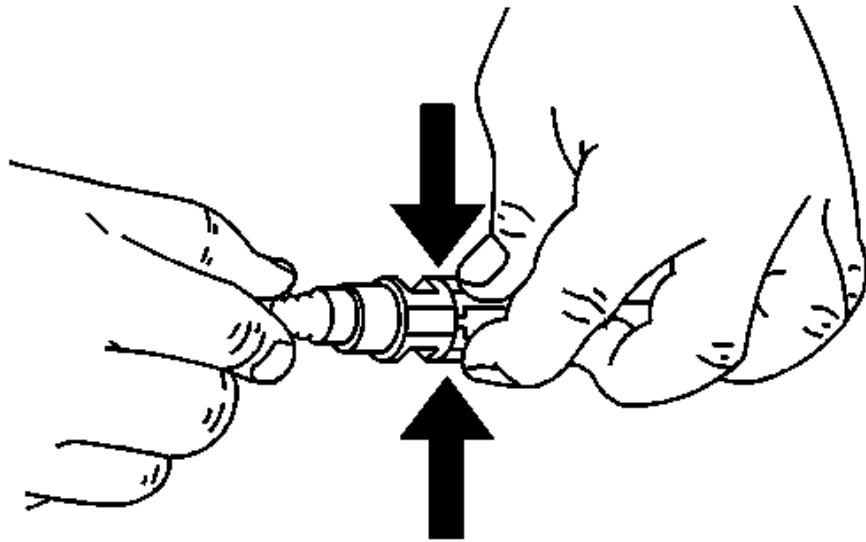


Fig. 19: View Of Quick Connect Fitting Release Tabs (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

2. This step applies to Bartholomew style connectors ONLY. Squeeze the plastic quick-connect fitting release tabs.

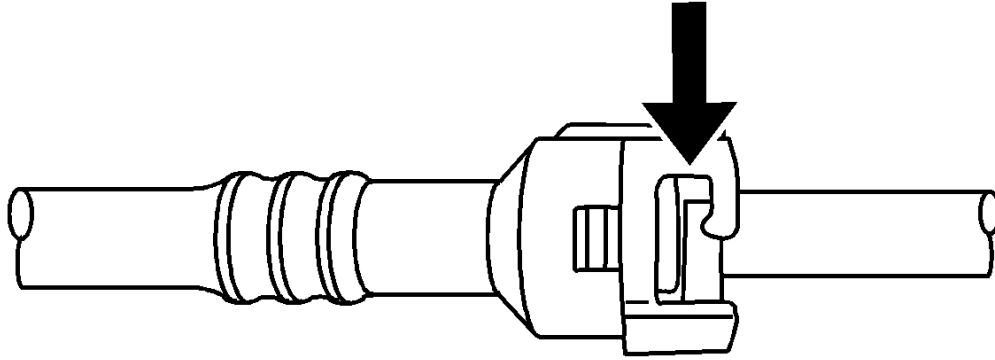


Fig. 20: Releasing Q Release Style Connectors (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

3. This step applies to Q Release style connectors ONLY. Release the fitting by Pushing the tab toward the other side of the slot in the fitting.

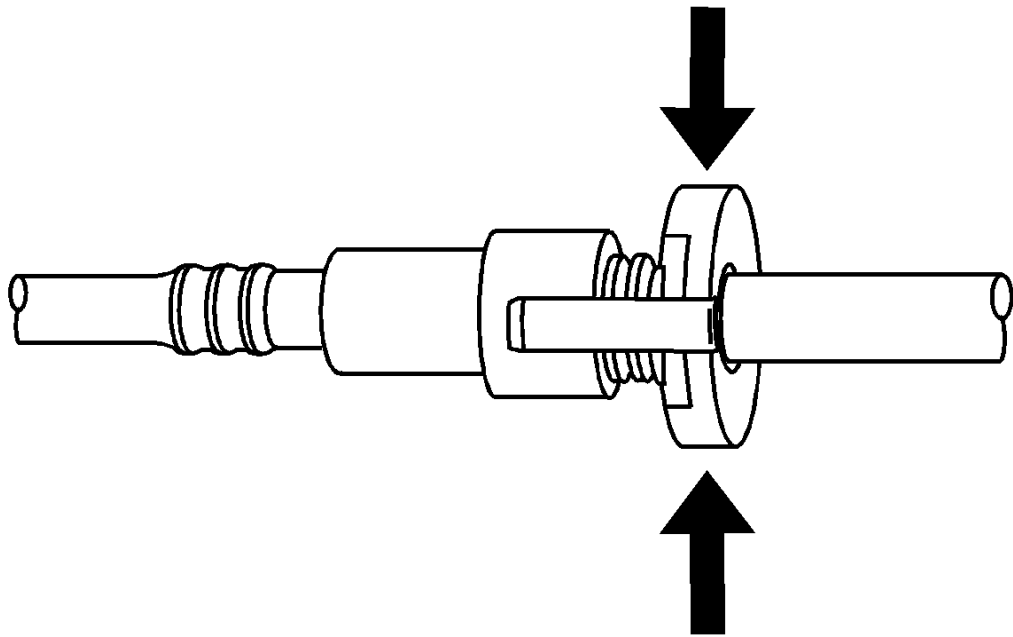


Fig. 21: Disengaging Quick Connect Fitting (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

4. This step applies to Squeeze to Release style connectors ONLY. Squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.

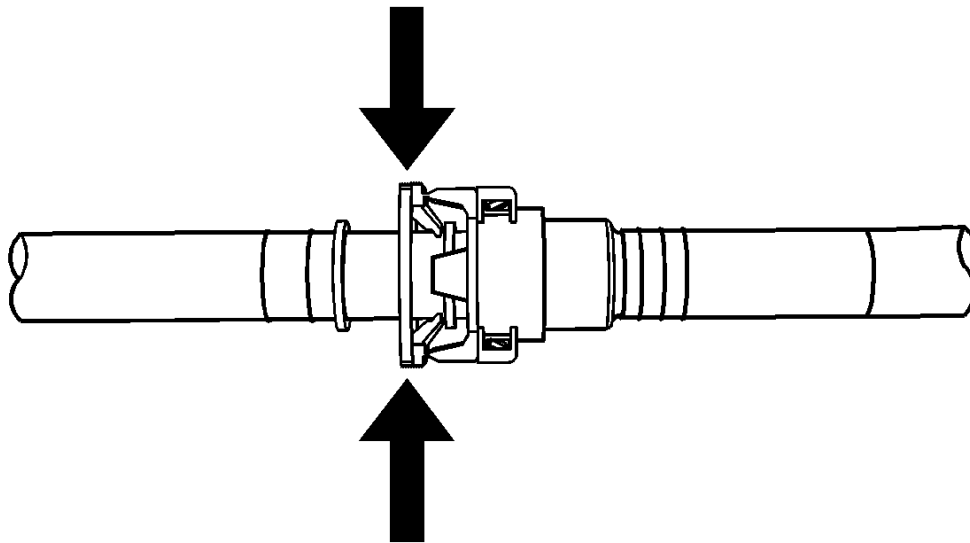


Fig. 22: Pushing In Male Side Of Connector
 Courtesy of GENERAL MOTORS COMPANY

5. This step applies to Squeeze to Release style connectors ONLY. Push in the male side slightly in order to slide the retainer away from the retainers, squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.

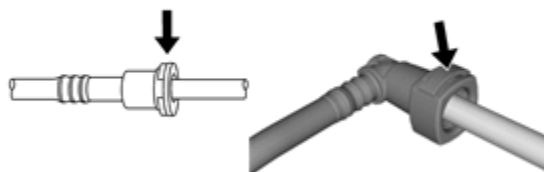


Fig. 23: Variants Of Sliding Retainer Style Connectors
 Courtesy of GENERAL MOTORS COMPANY

NOTE: There are two variants of sliding retainer style connectors shown above, both have the same release and installation procedure.

6. This step applies to Sliding Retainer style connectors ONLY. Release the fitting by pressing on one side of the release tab causing it to push in slightly. If the tab doesn't move try pressing the tab in from the opposite side. The tab will only move in one direction.

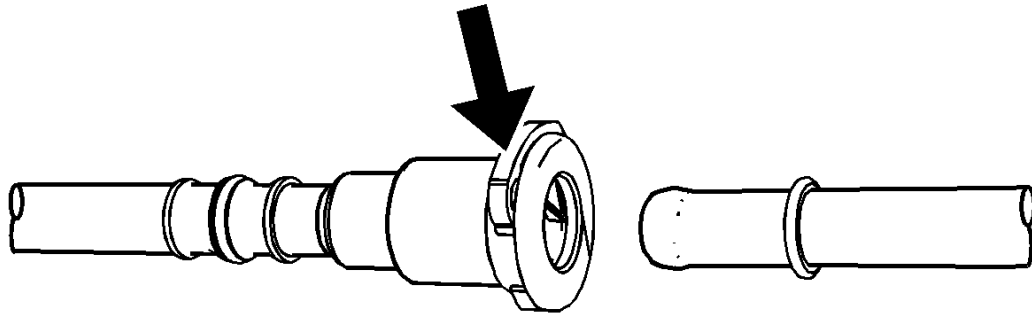


Fig. 24: Global Connector Style

Courtesy of GENERAL MOTORS COMPANY

7. This step applies to the Global Connector style only. Push the connector toward the tube in order to release the pressure. Press and hold down the release mechanism, and pull the connector straight out.

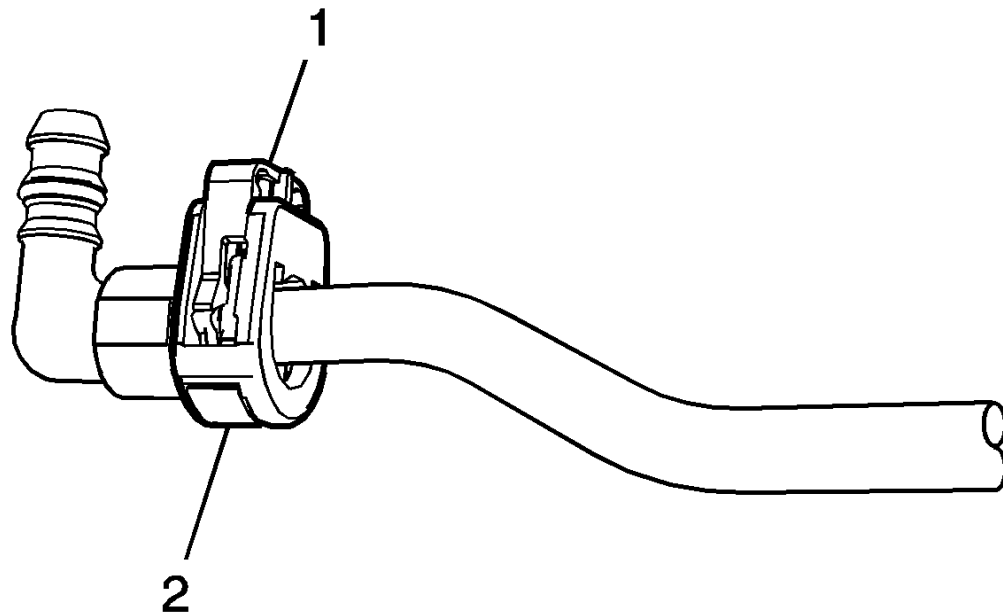


Fig. 25: TI Loc style

Courtesy of GENERAL MOTORS COMPANY

8. This step applies to the TI Loc style only. Push the connector toward the tube in order to release the pressure. Release the redundant latch (1) with two fingers or a flat bladed tool. Then press and hold down the bottom release mechanism (2) and pull the connector straight out.

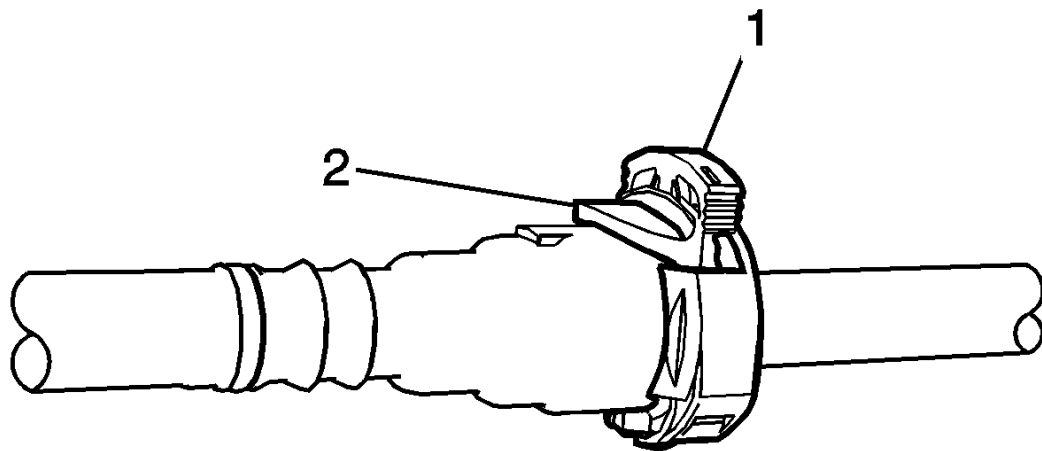


Fig. 26: Safe Lock Style

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Relieving Fuel Pressure Warning](#) .

9. This step applies to the Safe Lock style only. Push the connector toward the tube in order to release the pressure. Release the second latch (1) with two fingers. Then press and hold down the bottom release mechanism (2) and pull the connector straight out.

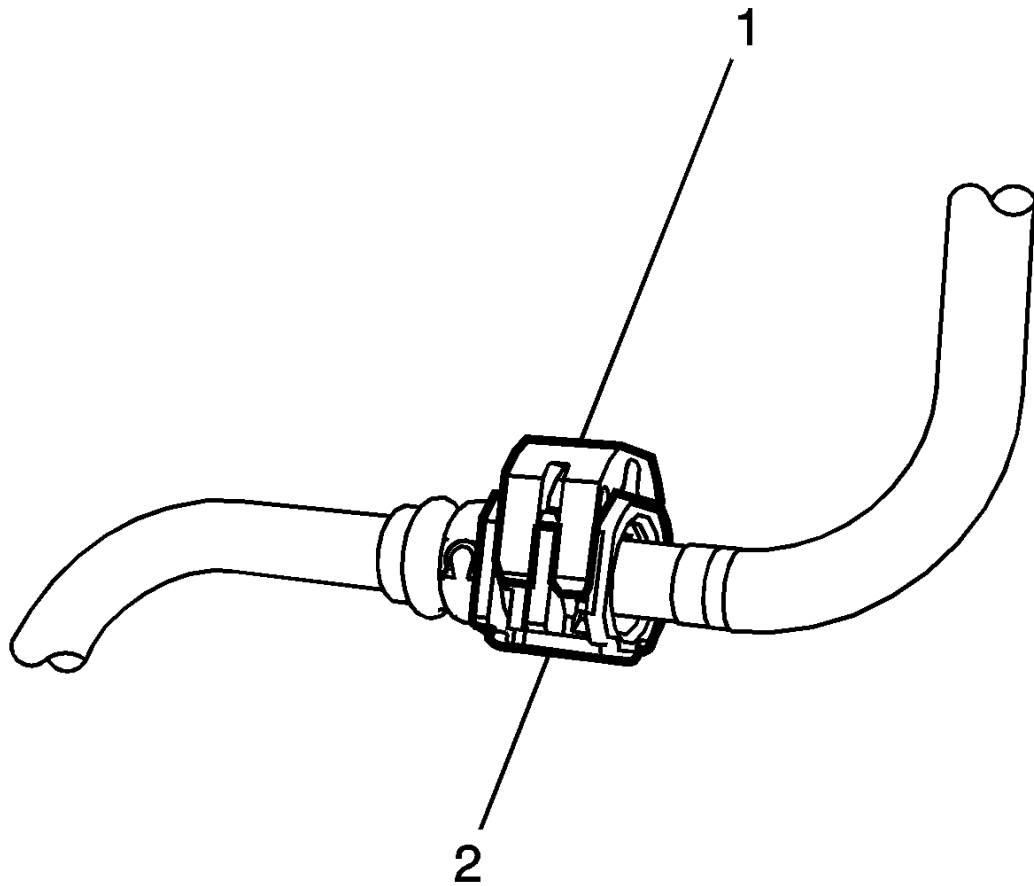


Fig. 27: Latch And Connector Straight Out
Courtesy of GENERAL MOTORS COMPANY

10. This step applies to the Plastic Connector style 8, push the connector toward the tube in order to release the pressure. Press the latch (1) inward in order to release the pipe, while pulling the connector (2) straight out.
11. Using a clean shop towel, wipe off the male pipe end.
12. Inspect both ends of the fitting for dirt and burrs.
13. Clean or replace components as necessary.

Installation Procedure

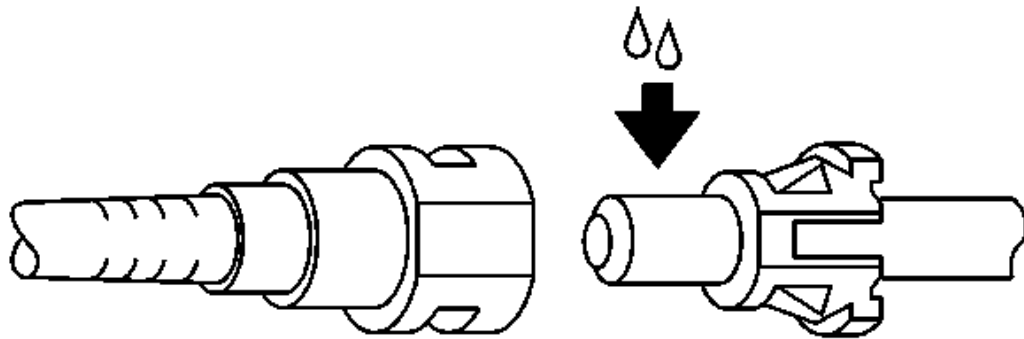


Fig. 28: Lubricating Male Pipe End

Courtesy of GENERAL MOTORS COMPANY

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

1. Apply a few drops of clean engine oil to the male pipe end.

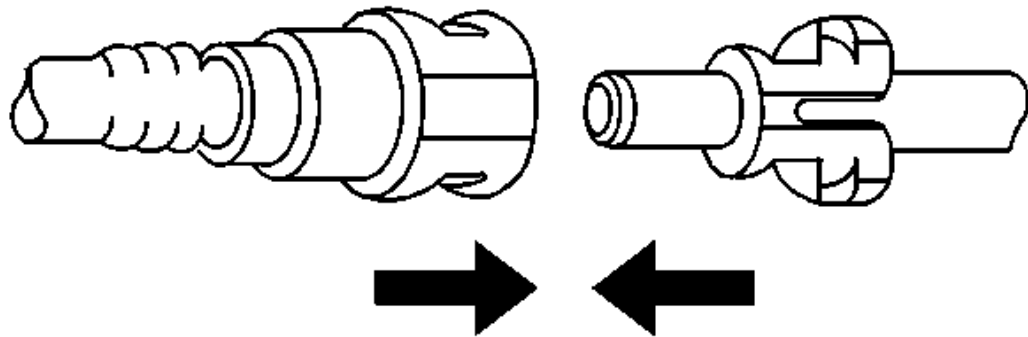


Fig. 29: Connecting Quick-Connect Fittings

Courtesy of GENERAL MOTORS COMPANY

2. Push both sides of the quick-connect fitting together in order to cause the retaining feature to snap into place.

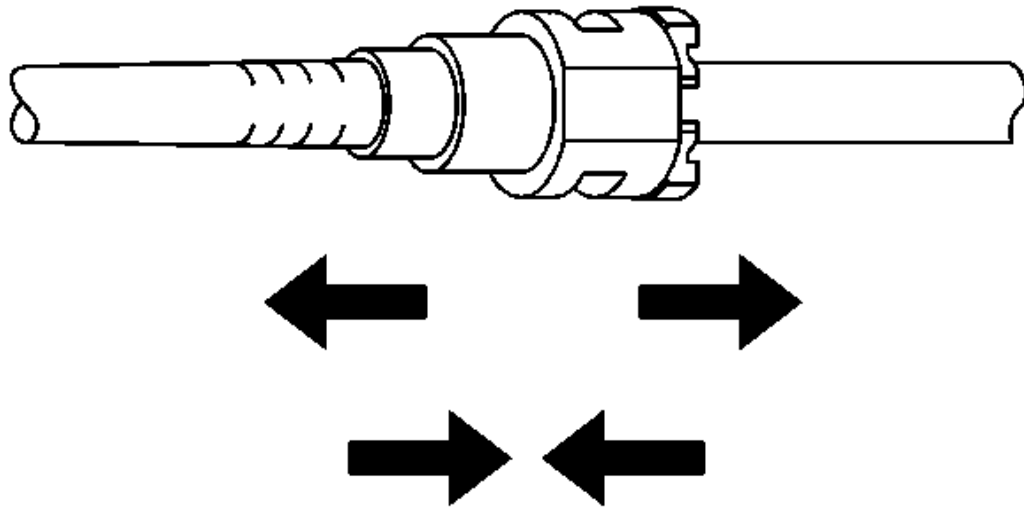


Fig. 30: View Of Quick-Connect Fitting

Courtesy of GENERAL MOTORS COMPANY

3. Pull on both sides of the quick-connect fitting to make sure the connection is secure.

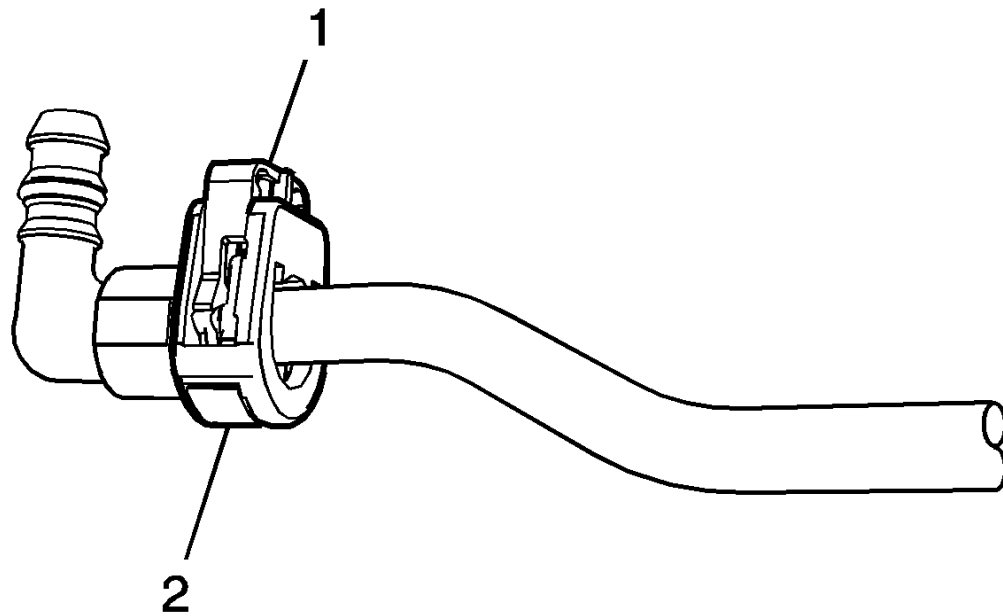


Fig. 31: TI Loc style

Courtesy of GENERAL MOTORS COMPANY

4. Insert the tube in the connector until the retainer snaps in place.
5. Push down on the redundant latch (1) until it is fully engaged and snapped into position.

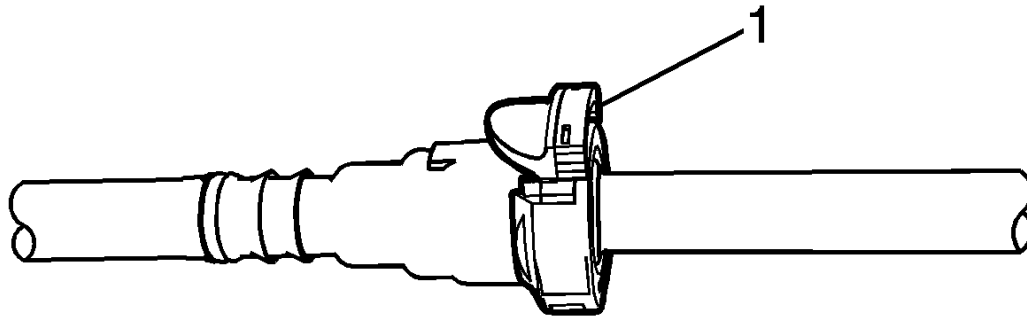


Fig. 32: Redundant Latch

Courtesy of GENERAL MOTORS COMPANY

6. Insert the tube in the connector until the retainer snaps in place.
7. Push down on the second latch (1) in order to secure the connection.

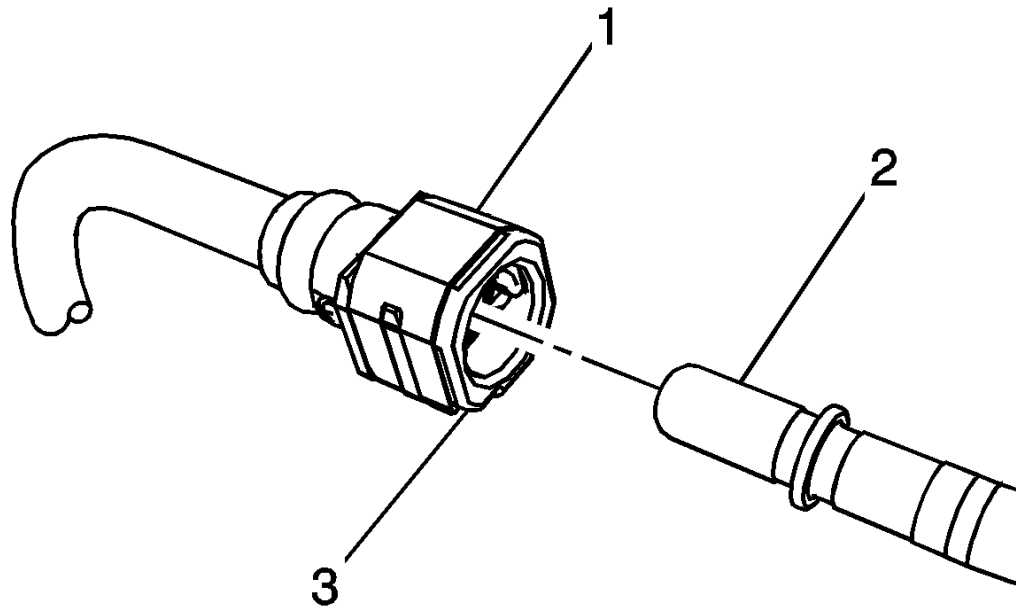


Fig. 33: Latch And Connector

Courtesy of GENERAL MOTORS COMPANY

8. For the plastic connector type 8, depress the latch (1) while inserting the connector (3) on to the pipe (2).
9. Move the latch (1) upward in order to secure the connection.
10. Inspect for leaks using the following procedure:
 1. Turn the ignition ON, with the engine OFF for 2 seconds.
 2. Turn the ignition OFF, for 10 seconds.
 3. Turn the ignition ON, with the engine OFF for 2 seconds.
 4. Turn the ignition OFF.
 5. Inspect for leaks.

EVAPORATIVE EMISSION SYSTEM CLEANING

Special Tools

GE 41413 Evaporative Pressure and Purge Station

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Inspection Procedure

CAUTION: Use the Evaporative Emission (EVAP) System Tester GE 41413-A in order to provide a clean, dry, low pressure nitrogen gas source. Do not substitute any other pressurized source, gas or otherwise. Damage may result to the EVAP system, test equipment or cause a safety risk.

NOTE: Proceed with the following procedure only if referenced by an evaporative emission diagnostic or repair procedure.

1. Turn OFF the ignition.
2. Remove the evaporative canister purge solenoid valve. Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#).
3. Lightly tap the evaporative canister purge valve on a hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
 - If no carbon particles were detected, but a blockage was detected during a diagnostic procedure, install the original evaporative canister purge valve. Continue with the cleaning procedure.
 - If carbon particles are found during the inspection procedure, continue with the cleaning procedure.
 - If a diagnostic procedure directed you to replace the evaporative canister purge valve and no carbon particles were detected, replace the evaporative canister purge valve. Return to the published service procedure.

Cleaning Procedure

1. Remove the evaporative canister. Refer to [Evaporative Emission Canister Replacement](#).
2. Turn OFF the main valve on the **GE 41413** purge station.
3. Disconnect the hose from the diagnostic station pressure regulator.
4. Using a section of vacuum hose, connect one end onto the evaporative pressure/purge diagnostic station pressure regulator.
5. Connect the other end of the vacuum hose to the canister side of the purge pipe.
6. Turn ON the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
7. If the nitrogen does not clear the blockage, replace the purge pipe.
8. Return the evaporative pressure/purge diagnostic station to the stations original condition.
9. Install a new evaporative canister. Refer to [Evaporative Emission Canister Replacement](#).
10. Install a new evaporative canister purge valve. Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#).
11. Return to the diagnostic table that sent you here.

ENGINE CONTROL MODULE REPLACEMENT

Removal Procedure

CAUTION:

- Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control

module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.

- Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.
- In order to prevent any possible electrostatic discharge damage to the control module, do not touch the connector pins or the soldered components on the circuit board.
- Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.
- The replacement control module must be programmed.

NOTE: It is necessary to record the engine oil life percentage remaining. Use the scan tool to reset the engine oil life remaining back to the original percentage recorded.

1. Prepare the engine control module (ECM) for the replacement. Refer to [Control Module References](#).
2. Using a scan tool, retrieve the percentage of remaining engine oil. Record the remaining life engine oil life.
3. Disconnect [Battery Negative Cable Disconnection and Connection](#)
4. Remove [Front Bumper Fascia Removal and Installation](#)

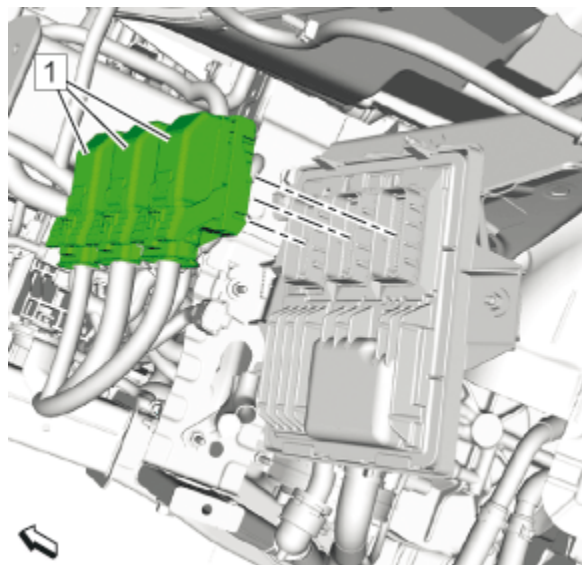


Fig. 34: ECM Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

CAUTION: In order to prevent any possible electrostatic discharge damage to the ECM, do not touch the connector pins.

5. Disconnect the electrical connectors.(1)

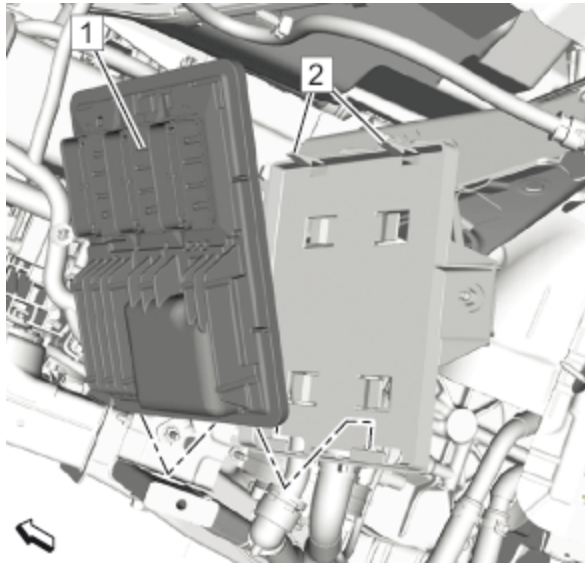


Fig. 35: Engine Control Module And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

6. Remove Engine Control Module (1) - Unlock the retaining tabs.

Installation Procedure

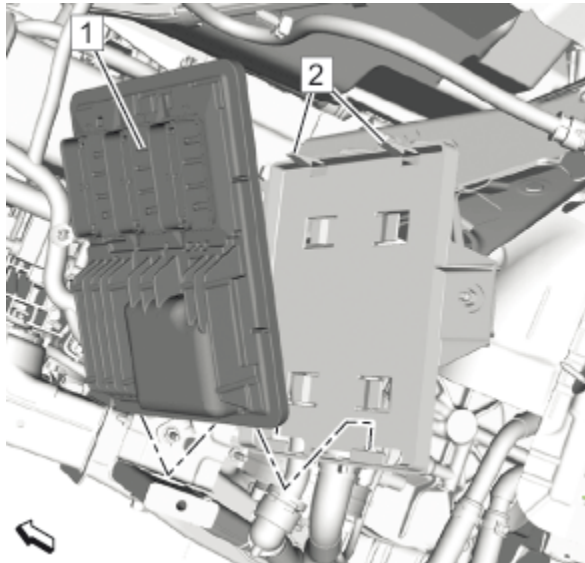


Fig. 36: Engine Control Module And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Control Module (1)

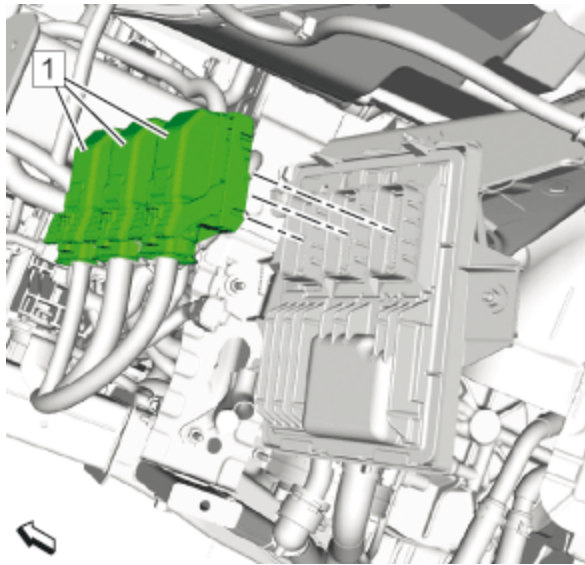


Fig. 37: ECM Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Connect the electrical connectors.(1)
3. Install [Front Bumper Fascia Removal and Installation](#)
4. Connect [Battery Negative Cable Disconnection and Connection](#)
5. Program the ECM. [Control Module References](#)

ENGINE CONTROL MODULE BRACKET REPLACEMENT

Removal Procedure

1. Remove [Engine Control Module Replacement](#)

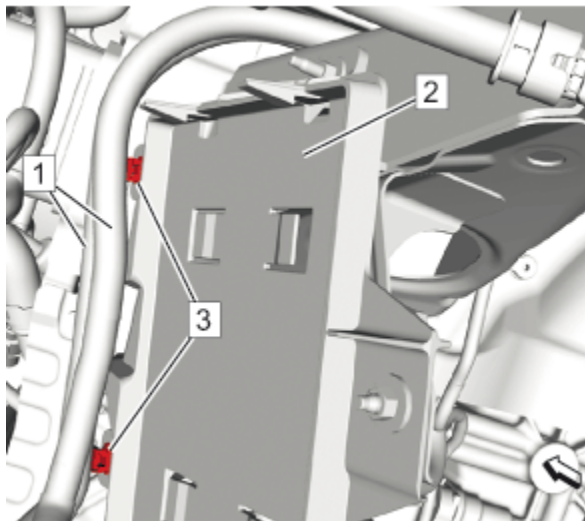


Fig. 38: Engine Control Module Bracket, Wiring Harness And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Unclip Wiring Harness(1) @Engine Control Module Bracket (2)

Release Retainer (3)

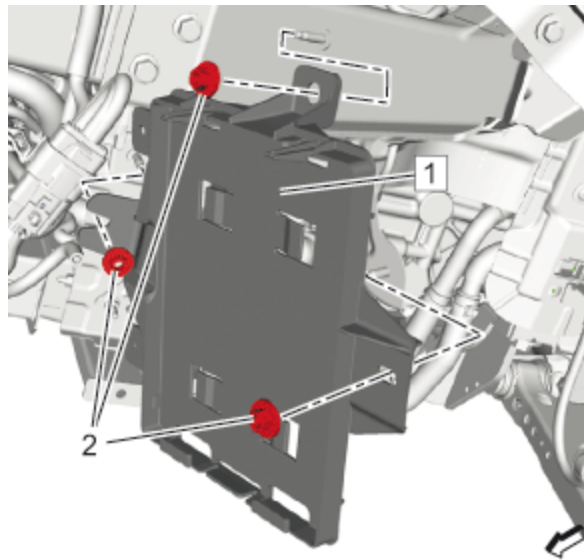


Fig. 39: Engine Control Module Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Nut (2)
4. Remove Engine Control Module Bracket (1)

Installation Procedure

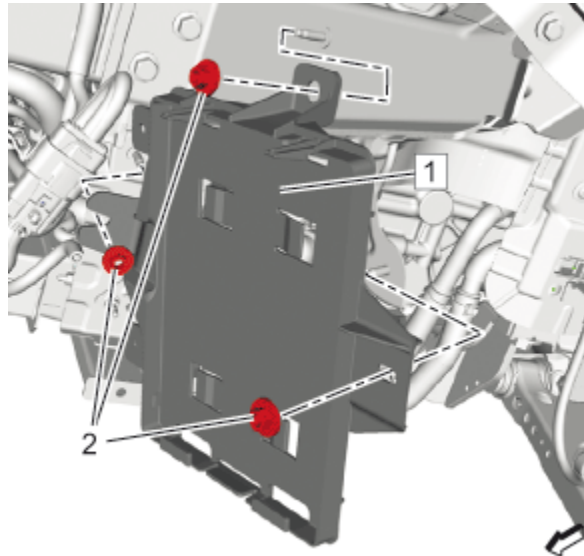


Fig. 40: Engine Control Module Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Control Module Bracket (1)

CAUTION: Fastener Caution

2. Install Nut (2) and tighten 9 N.m (80 lb in).

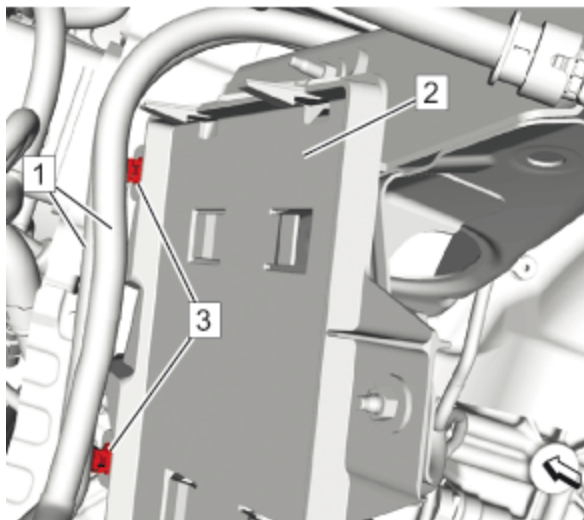


Fig. 41: Engine Control Module Bracket, Wiring Harness And Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install Wiring Harness (1) @Engine Control Module Bracket (2)

Tighten Retainer (3)

4. Install **Engine Control Module Replacement**

CRANKSHAFT POSITION VARIATION LEARN

The Crankshaft Position Variation Learn procedure is required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

- An engine replacement.
- A engine control module (ECM) replacement.
- A crankshaft balancer replacement.
- A crankshaft replacement.
- A crankshaft position sensor replacement.
- Any engine repairs which disturb the crankshaft to crankshaft position sensor relationship.

The ECM monitors certain component signals to determine if all the conditions are met to continue with the Crankshaft Position Variation Learn procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool displays the signals of the components listed below:

- Crankshaft position sensors activity: If there is a crankshaft position sensor condition, refer to the applicable DTC set.
- Camshaft position sensor signal activity: If there is a camshaft position sensor signal condition, refer to the applicable DTC set.
- Engine coolant temperature (ECT): If the engine coolant temperature is not warm enough, idle the engine until the engine coolant temperature reaches the correct temperature.

1. Verify no DTCs are set.

- If any DTCs other than P0300 - P0308, or P0315 are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If DTC P0300 - P0308, P0315, or no DTCs are set

NOTE: The Crankshaft Position Variation Learn may have to be repeated up to 5 times before the procedure is successful.

2. Engine Running at normal operating temperature, perform the scan tool Crankshaft Position Variation Learn procedure and follow the on screen instructions.

3. Verify the scan tool displays Test Passed Successfully when completed.

- **If Test Passed Successfully is not displayed**

Verify that none of the conditions listed below exist:

- The ignition switch is in the ON position until there is insufficient system voltage.
- An ECM power disconnect with the ignition ON that may have erased the crankshaft position system variation values and set DTC P0315.
- Interference in the signal circuit of the crankshaft position sensor.
- Debris between the crankshaft position sensor and the reluctor wheel.
- A damaged or misaligned reluctor wheel.
- Worn crankshaft main bearings.
- Excessive crankshaft runout.
- A damaged crankshaft.
- If a condition is exists, repair or replace as necessary.
- If no conditions exist, replace the K20 Engine Control Module.

- **If Test Passed Successfully is displayed**

4. Clear all DTCs.

5. Engine Running.

6. Verify a DTC is not set.

- **If a DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If a DTC is not set**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for engine control module replacement, programming, and setup.

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - WATER OUTLET

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Heater Outlet Hose Vapor Vent Hose Replacement](#)
3. Remove Radiator Inlet Hose@Water Outlet [Radiator Inlet Hose Replacement](#)

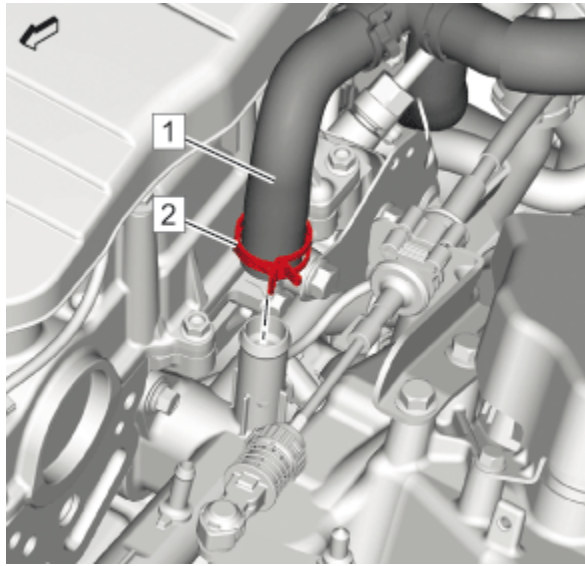


Fig. 42: Heater Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Heater Outlet Hose Clamp (2)
5. Disconnect Heater Outlet Hose (1)

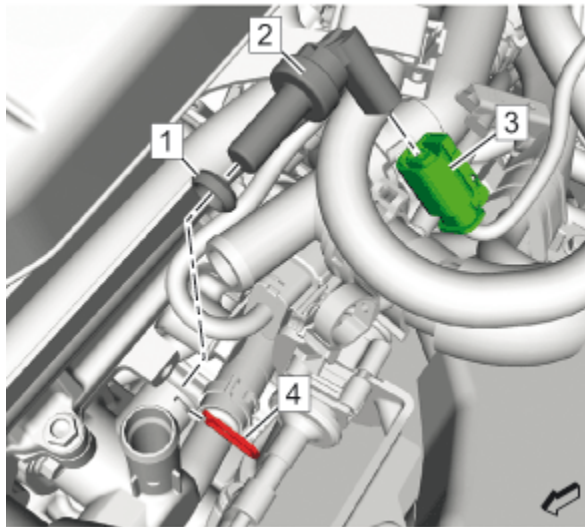


Fig. 43: Engine Coolant Temperature Sensor, Electrical Connector, Retainer And Seal

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the engine coolant temperature sensor electrical connector.(3)
7. Remove Engine Coolant Temperature Sensor Retainer (4)
8. Remove the engine coolant temperature sensor.(2)

9. Remove and DISCARD the seal.(1)

Installation Procedure

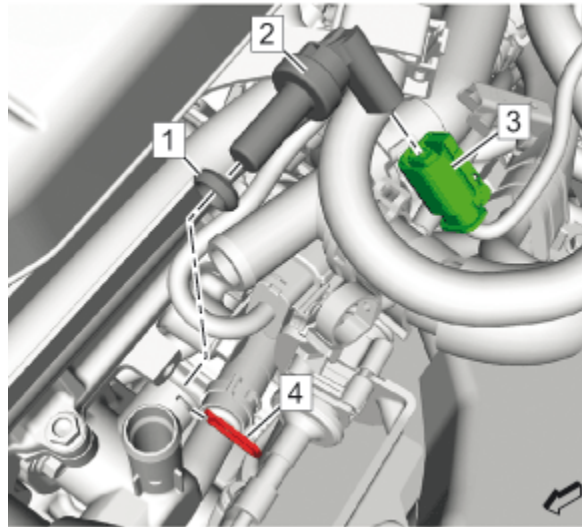


Fig. 44: Engine Coolant Temperature Sensor, Electrical Connector, Retainer And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW seal.(1)
2. Install the engine coolant temperature sensor.(2)
3. Install Engine Coolant Temperature Sensor Retainer (4)
4. Connect the engine coolant temperature sensor electrical connector.(3)

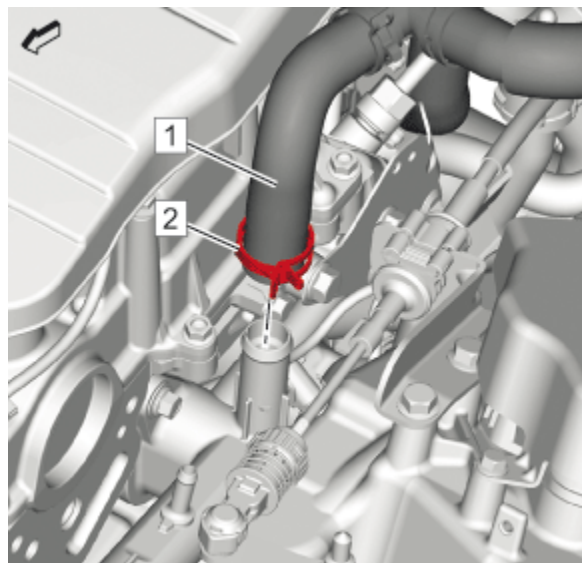


Fig. 45: Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Connect Heater Outlet Hose (1)
6. Tighten Heater Outlet Hose Clamp (2)
7. Install Radiator Inlet Hose@Water Outlet [Radiator Inlet Hose Replacement](#)

8. Install [Heater Outlet Hose Vapor Vent Hose Replacement](#)
9. Fill the cooling system. [Cooling System Draining and Filling](#)

MANIFOLD ABSOLUTE PRESSURE SENSOR REPLACEMENT

Removal Procedure

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)
3. Remove [Air Inlet Grille Panel Replacement](#)
4. Remove [Intake Manifold Cover Replacement](#)
5. Remove [Air Cleaner Outlet Duct Replacement](#)

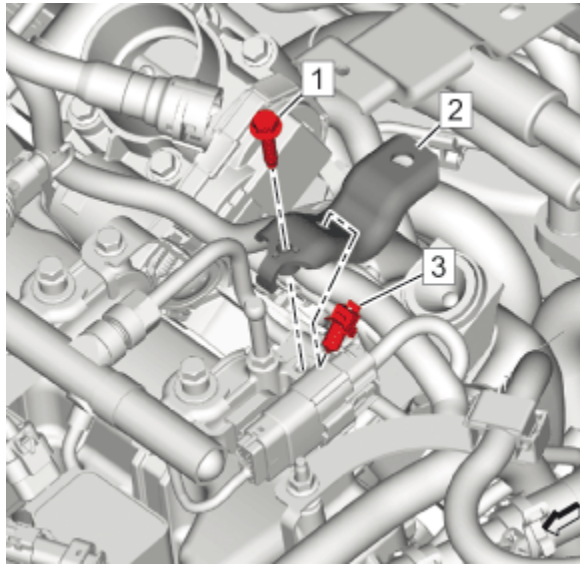


Fig. 46: Air Cleaner Resonator Bracket, Bolt And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Wiring Harness Clip (3)
7. Remove Air Cleaner Resonator Bracket Bolt (1)
8. Remove Air Cleaner Resonator Bracket (2)

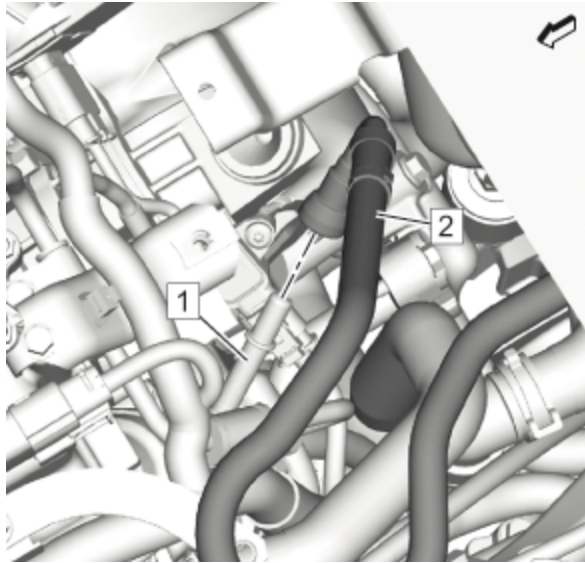


Fig. 47: Fuel Feed Front Pipe And Fuel Injection Pump

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Fuel Feed Front Pipe (2) @Fuel Injection Pump (1)
10. Close all open connections with the EN-6015 plugs.
11. Remove Fuel Feed Front Pipe (2)

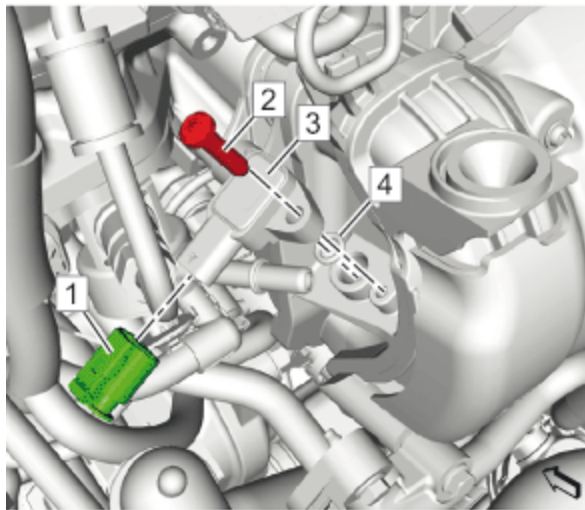


Fig. 48: Manifold Absolute Pressure Sensor, Electrical Connector, Bolt And Seal Ring

Courtesy of GENERAL MOTORS COMPANY

12. Disconnect the electrical connector.(1)
13. Remove the manifold absolute pressure sensor bolt.(2)
14. Remove the manifold absolute pressure sensor.(3)
15. Remove the seal ring.(4)

Installation Procedure

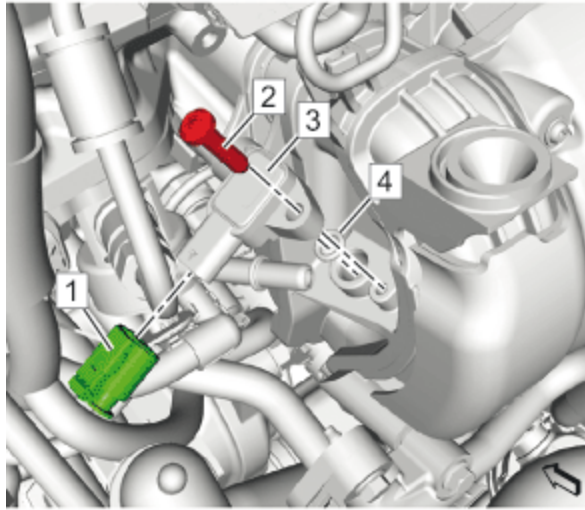


Fig. 49: Manifold Absolute Pressure Sensor, Electrical Connector, Bolt And Seal Ring
Courtesy of GENERAL MOTORS COMPANY

1. Install Seal Ring (4)
2. Install Manifold Absolute Pressure Sensor (3)

CAUTION: **Fastener Caution**

3. Install Manifold Absolute Pressure Sensor Bolt (2) and tighten 10 N.m (89 lb in)
4. Connect the electrical connector.(1)

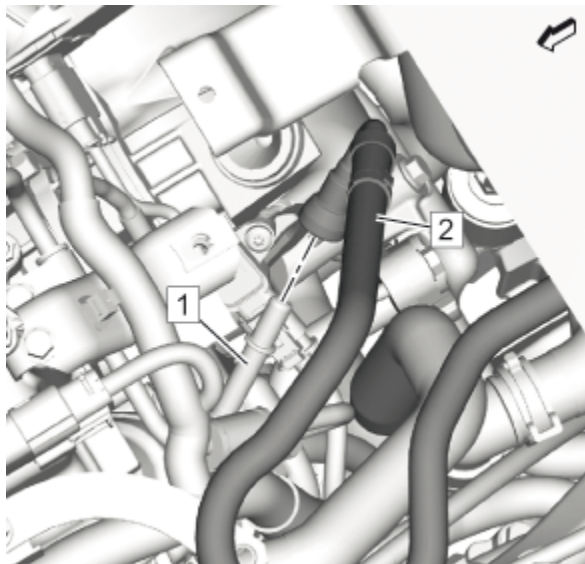


Fig. 50: Fuel Feed Front Pipe And Fuel Injection Pump
Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Feed Front Pipe (2)
6. Remove all **EN-6015** plugs from the connections.
7. Connect Fuel Feed Front Pipe (2) @Fuel Injection Pump (1)

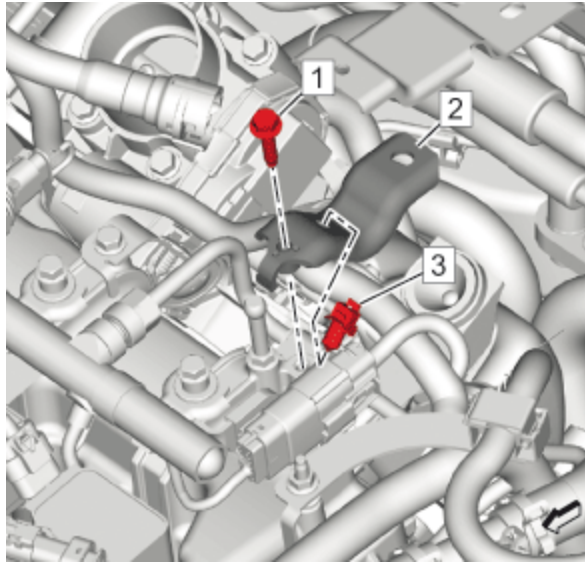


Fig. 51: Air Cleaner Resonator Bracket, Bolt And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

8. Install Air Cleaner Resonator Bracket (2)
9. Install Air Cleaner Resonator Bracket Bolt (1) and tighten 9 N.m (80 lb in)
10. Install Wiring Harness Clip (3)
11. Install [Air Inlet Grille Panel Replacement](#)
12. Install [Intake Manifold Cover Replacement](#)
13. Install [Air Cleaner Outlet Duct Replacement](#)
14. Connect the negative battery cable. [Battery Negative Cable Disconnection and Connection](#)

KNOCK SENSOR REPLACEMENT

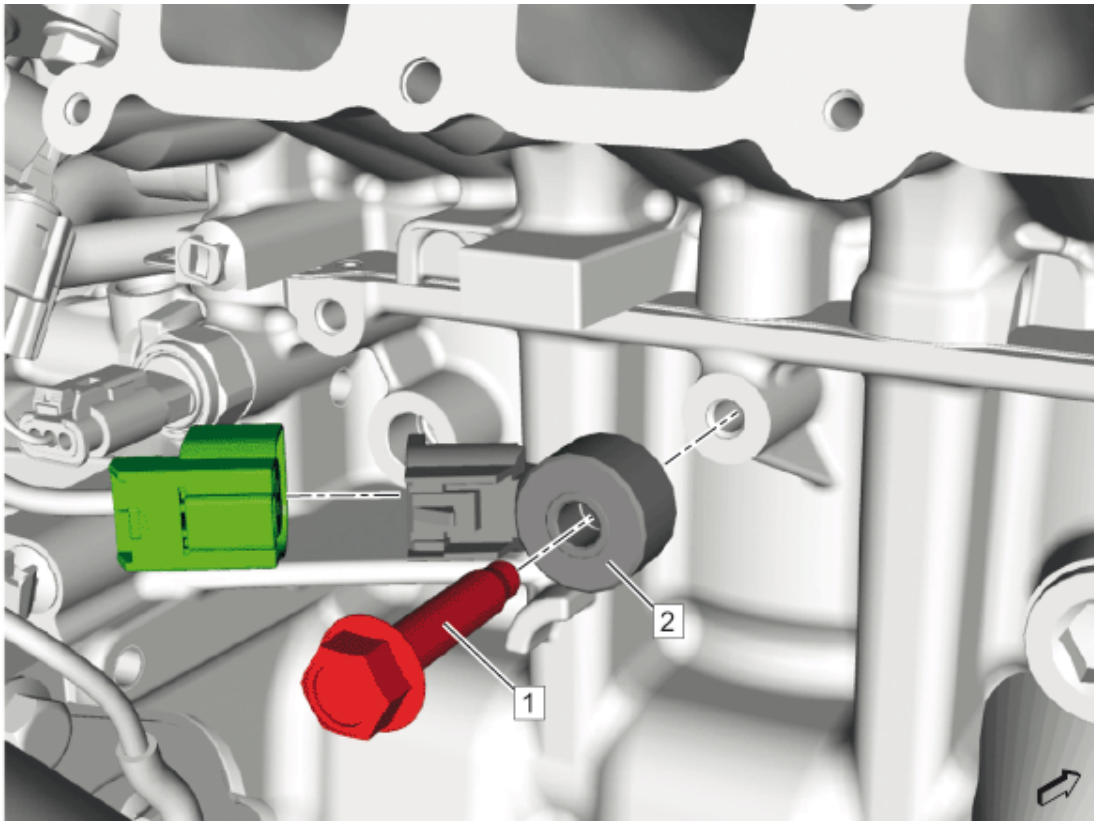


Fig. 52: Knock Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Intake Manifold Replacement</u>	
1	Knock Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Knock Sensor Procedure Disconnect the electrical connector.

EXHAUST GAS RECIRCULATION VALVE REPLACEMENT

Removal Procedure

1. Remove **Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1**
2. Drain the cooling system. **Cooling System Draining and Filling**

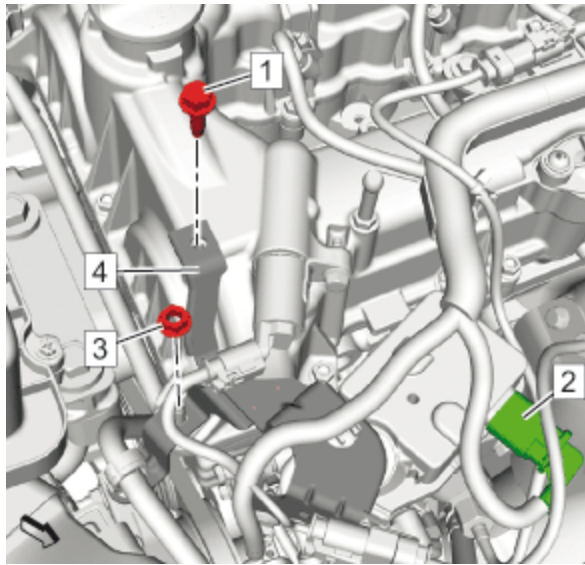


Fig. 53: Engine Wiring Harness Bracket, Bolt, Nut And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Wiring Harness Bracket Bolt (1)
4. Remove Engine Wiring Harness Bracket Nut (3)
5. Position aside Engine Wiring Harness Bracket (4) -
6. Disconnect the electrical connector.(2)

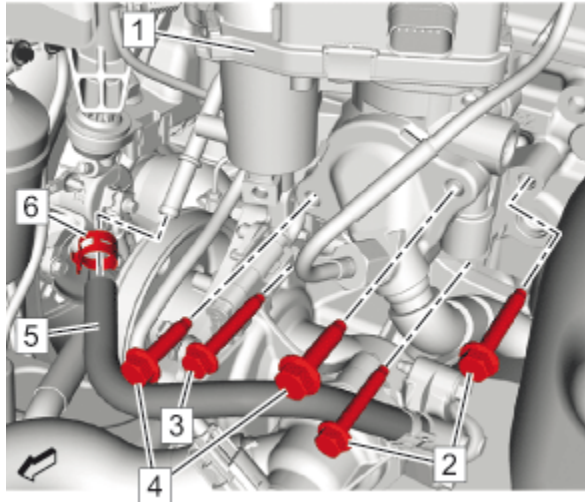


Fig. 54: EGR Valve Bolts, Cooling Return Hose, Clamp And EGR Cooler Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Loosen Clamp (6)
8. Disconnect Exhaust Gas Recirculation Valve Cooling Return Hose (5)
9. Remove Exhaust Gas Recirculation Cooler Bolt (4)
10. Exhaust Gas Recirculation Valve Bolt (2, 3)

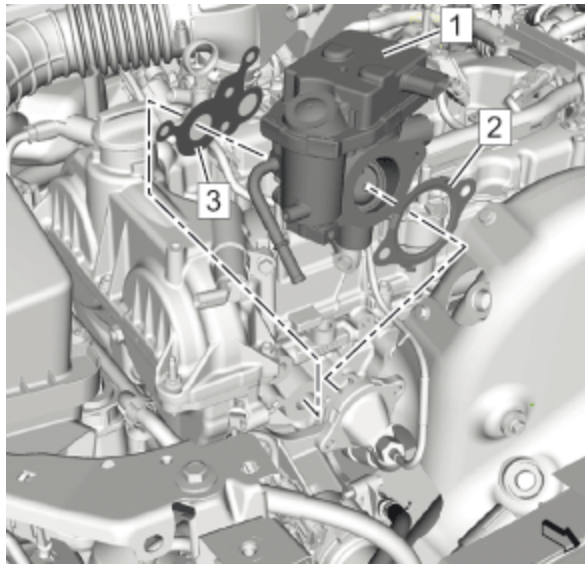


Fig. 55: Exhaust Gas Recirculation Valve And Gaskets

Courtesy of GENERAL MOTORS COMPANY

11. Remove Exhaust Gas Recirculation Valve (1)
12. Remove Gasket (2, 3)

Installation Procedure

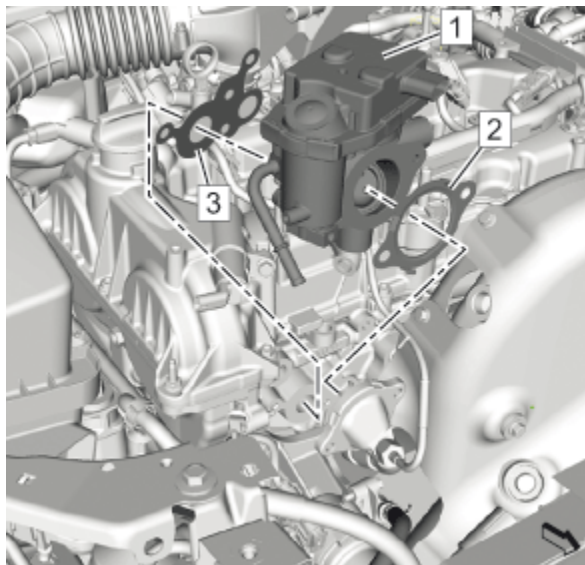


Fig. 56: Exhaust Gas Recirculation Valve And Gaskets

Courtesy of GENERAL MOTORS COMPANY

1. Install Gasket (2, 3)
2. Install Exhaust Gas Recirculation Valve (1)

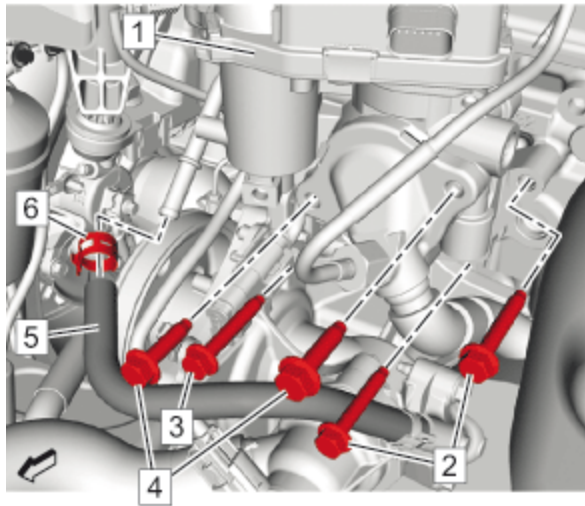


Fig. 57: EGR Valve Bolts, Cooling Return Hose, Clamp And EGR Cooler Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install Exhaust Gas Recirculation Valve Bolt (2, 3)
4. Install Exhaust Gas Recirculation Cooler Bolt (4)

CAUTION: Fastener Caution

5. Exhaust Gas Recirculation Valve Bolt (2, 3) - Tighten 10 N.m (89 lb in)
6. Exhaust Gas Recirculation Cooler Bolt (4) - Tighten 10 N.m (89 lb in)
7. Connect Exhaust Gas Recirculation Valve Cooling Return Hose (5)
8. Tighten Clamp (6)

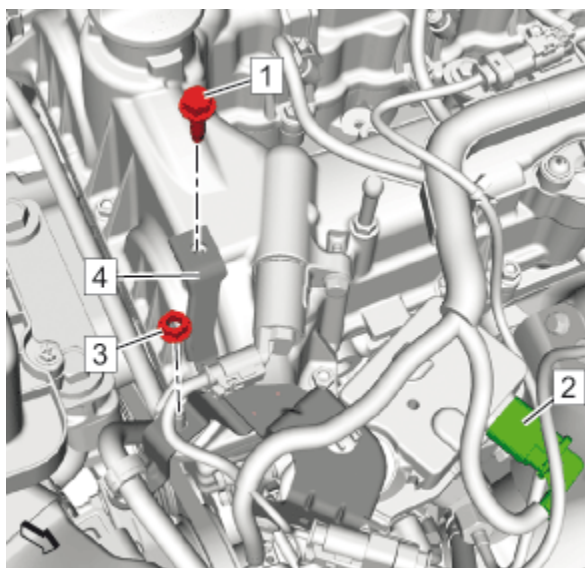


Fig. 58: Engine Wiring Harness Bracket, Bolt, Nut And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Wiring Harness Bracket (4)

10. Connect the electrical connector.(2)
11. Install Engine Wiring Harness Bracket Nut (3) and tighten 9 N.m (80 lb in)
12. Install Engine Wiring Harness Bracket Bolt (1) and tighten 9 N.m (80 lb in)
13. Fill the cooling system. Cooling System Draining and Filling
14. Install Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1

EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 1

Removal Procedure

WARNING: Exhaust Service Warning

1. Disconnect Battery Negative Cable Disconnection and Connection
2. Remove Intake Manifold Cover Replacement

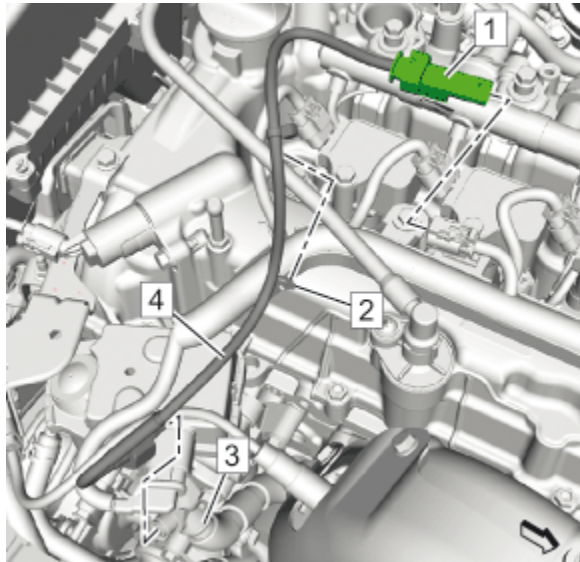


Fig. 59: EGR Cooler Temperature Sensor, Wiring Harness, EGR Cooler, Camshaft Cover Bracket And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector.(1)
4. Remove Exhaust Gas Recirculation Cooler Temperature Sensor Wiring Harness@Camshaft Cover Bracket (2)
5. Remove Exhaust Gas Recirculation Cooler Temperature Sensor (4) @Exhaust Gas Recirculation Cooler (3)

Installation Procedure

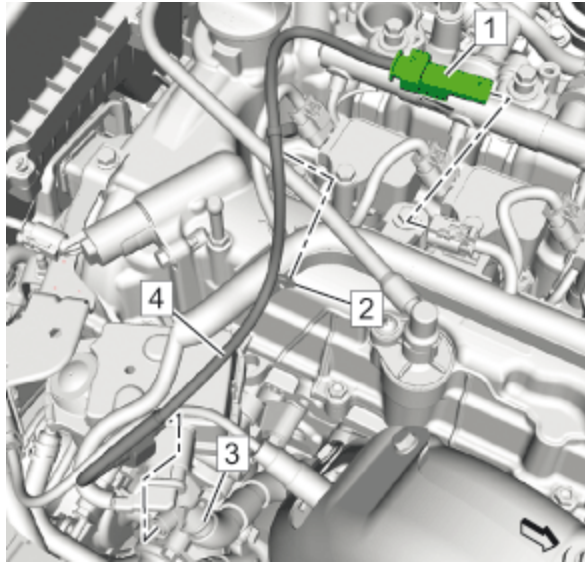


Fig. 60: EGR Cooler Temperature Sensor, Wiring Harness, EGR Cooler, Camshaft Cover Bracket And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

1. Install Exhaust Gas Recirculation Cooler Temperature Sensor (4) and tighten 42 N.m (31 lb ft)
2. Install Exhaust Gas Recirculation Cooler Temperature Sensor Wiring Harness@Camshaft Cover Bracket (2)
3. Connect the electrical connector.(1)
4. Install Intake Manifold Cover Replacement
5. Connect Battery Negative Cable Disconnection and Connection

EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 2

Removal Procedure

WARNING: Exhaust Service Warning

1. Disconnect Battery Negative Cable Disconnection and Connection
2. Remove Intake Manifold Cover Replacement
3. Remove Three-Way Catalytic Converter Replacement

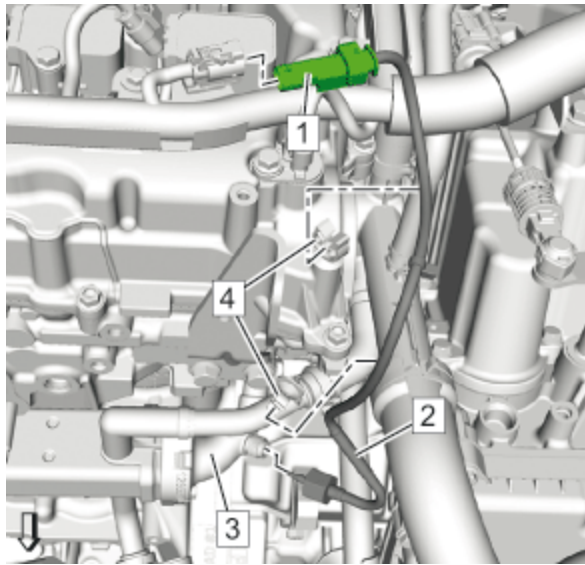


Fig. 61: EGR Cooler Temperature Sensor, EGR Cooler, Wiring Harness Clip And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector.(1)
5. Unclip Exhaust Gas Recirculation Cooler Temperature Sensor (2) @Wiring Harness Clip (4)
6. Remove Exhaust Gas Recirculation Cooler Temperature Sensor (2) @Exhaust Gas Recirculation Cooler (3)

Installation Procedure

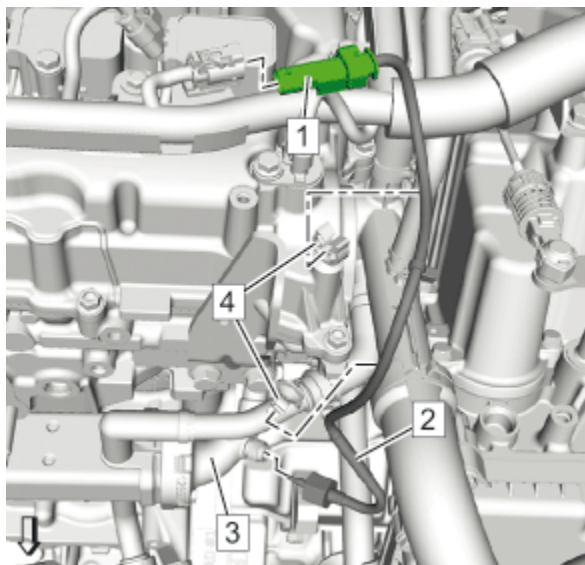


Fig. 62: EGR Cooler Temperature Sensor, EGR Cooler, Wiring Harness Clip And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

1. Install Exhaust Gas Recirculation Cooler Temperature Sensor (2) and tighten 42 N.m (31 lb ft)

2. Exhaust Gas Recirculation Cooler Temperature Sensor (2) @Wiring Harness Clip (4)
3. Connect the electrical connector.(1)
4. Install [Three-Way Catalytic Converter Replacement](#)
5. Install [Intake Manifold Cover Replacement](#)
6. Connect [Battery Negative Cable Disconnection and Connection](#)

EXHAUST GAS RECIRCULATION COOLER OUTLET PIPE REPLACEMENT

Removal Procedure

1. Remove [Dash Upper Extension Panel Opening Cover Replacement](#)
2. Remove [Air Cleaner Outlet Duct Replacement](#)
3. Remove [Water Outlet Replacement](#)
4. Remove [Three-Way Catalytic Converter Replacement](#)

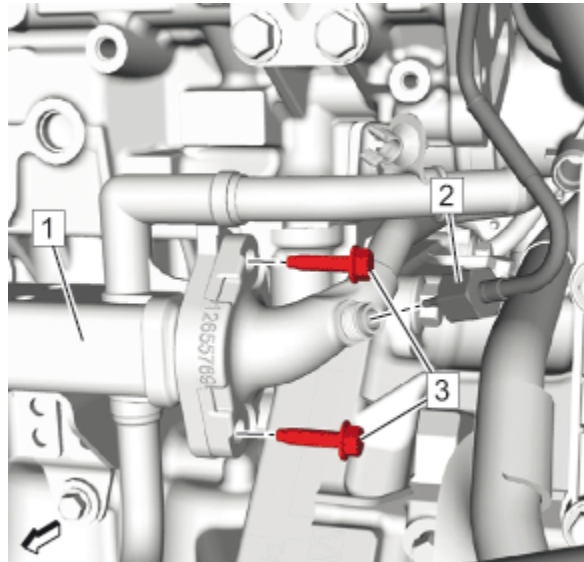


Fig. 63: EGR Temperature Sensor - Position 2, EGR Cooler And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the exhaust gas recirculation temperature sensor - position 2 (2).
6. Remove Exhaust Gas Recirculation Cooler Bolt (3) @Exhaust Gas Recirculation Cooler (1)

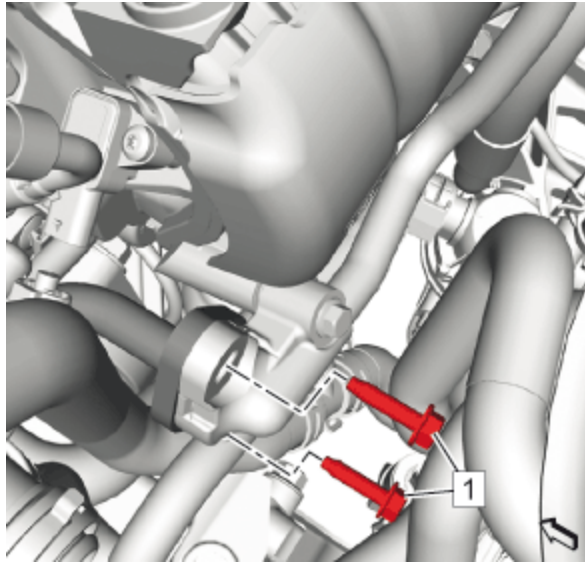


Fig. 64: Exhaust Gas Recirculation Pipe Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Exhaust Gas Recirculation Pipe Bolt (1)

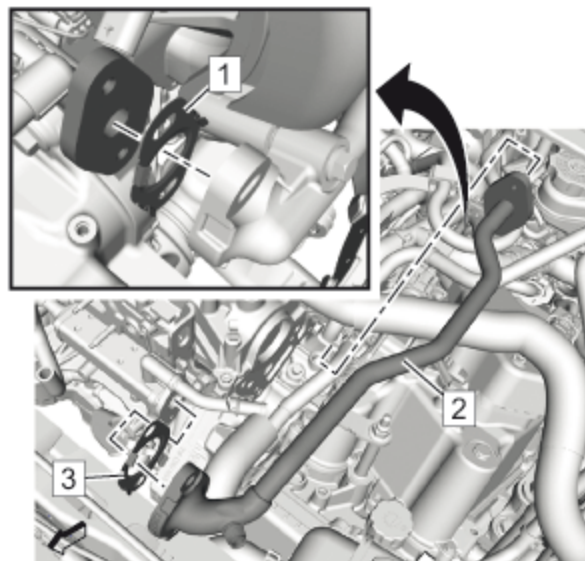


Fig. 65: Exhaust Gas Recirculation Cooler Outlet Pipe And Seals
Courtesy of GENERAL MOTORS COMPANY

8. Remove Exhaust Gas Recirculation Cooler Outlet Pipe (2)
9. Remove Exhaust Gas Recirculation Cooler Outlet Pipe Seal (1, 3) and DISCARD

Installation Procedure

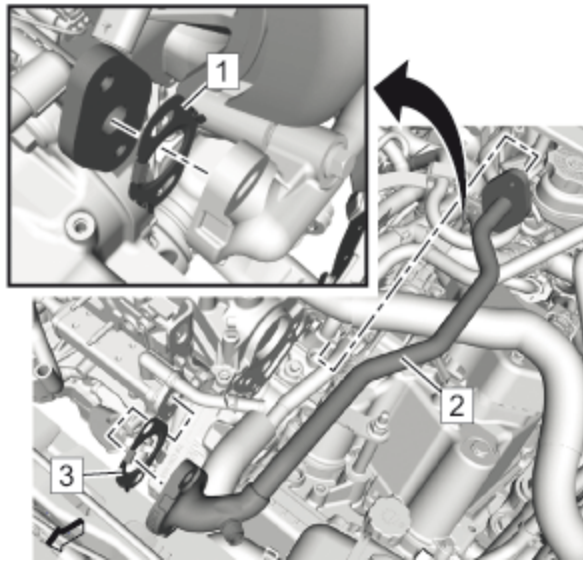


Fig. 66: Exhaust Gas Recirculation Cooler Outlet Pipe And Seals
 Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW seal.(1, 3)
2. Install Exhaust Gas Recirculation Cooler Outlet Pipe (3)

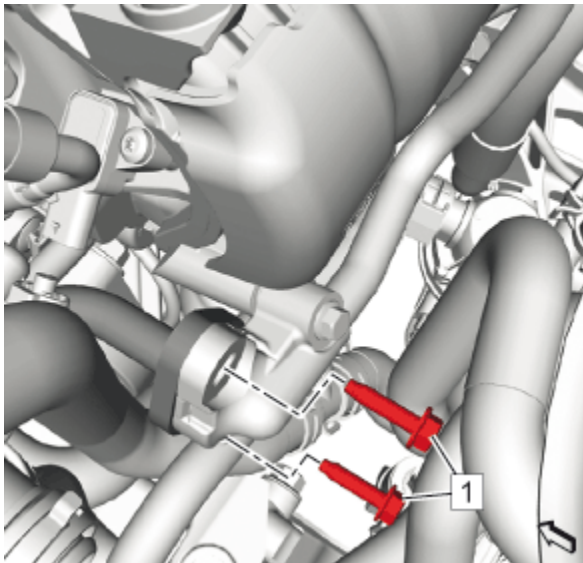


Fig. 67: Exhaust Gas Recirculation Pipe Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten.

3. Install Exhaust Gas Recirculation Pipe Bolt (1)

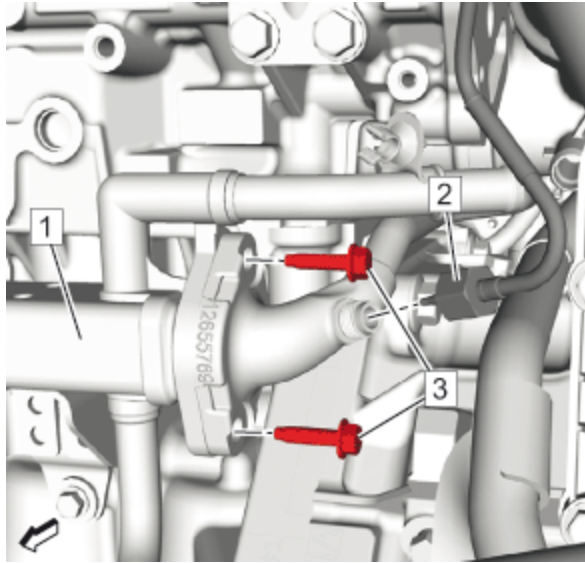


Fig. 68: EGR Temperature Sensor - Position 2, EGR Cooler And Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten.

4. Install Exhaust Gas Recirculation Pipe Bolt (3) @Exhaust Gas Recirculation Cooler (1)

CAUTION: Fastener Caution

5. Exhaust Gas Recirculation Pipe Bolt (3) - Tighten 10 N.m (89 lb in)

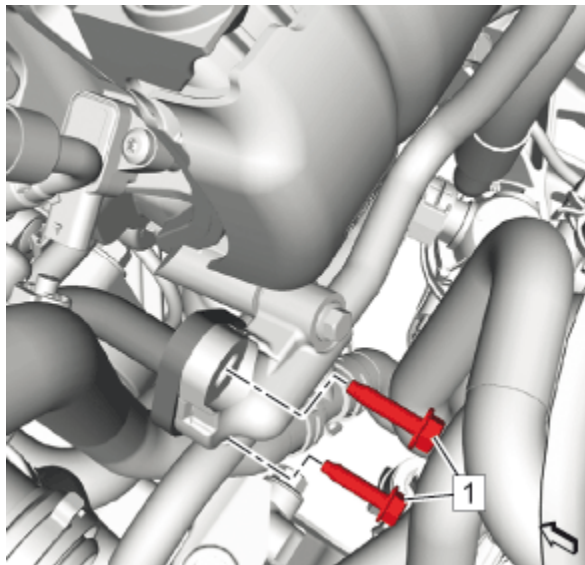


Fig. 69: Exhaust Gas Recirculation Pipe Bolts
 Courtesy of GENERAL MOTORS COMPANY

6. Exhaust Gas Recirculation Cooler Bolt (1) - Tighten 10 N.m (89 lb in)

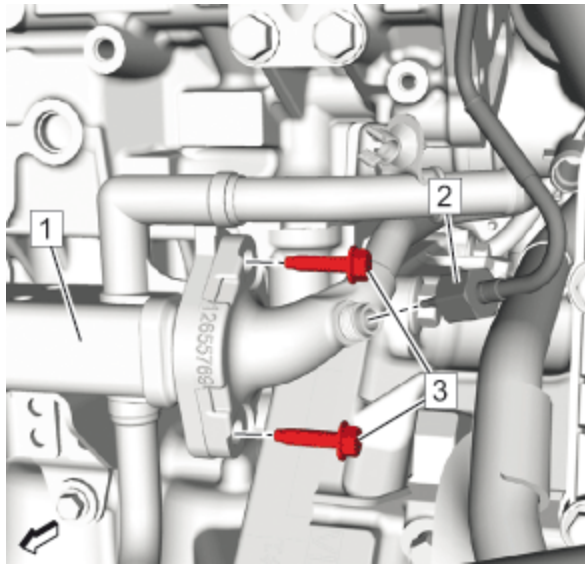
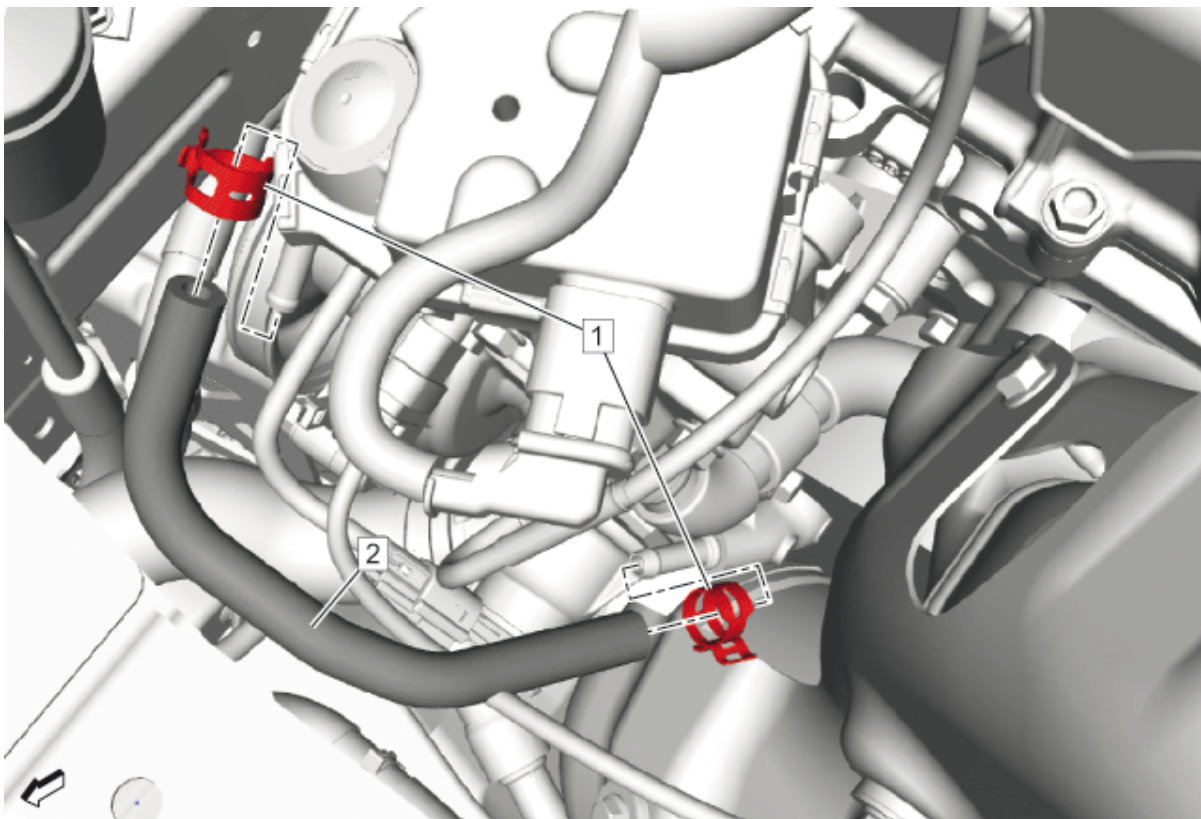


Fig. 70: EGR Temperature Sensor - Position 2, EGR Cooler And Bolts
 Courtesy of GENERAL MOTORS COMPANY

7. Install the exhaust gas recirculation temperature sensor - position 2 (2) and tighten to 42 N.m (31 lb ft).
8. Install [Three-Way Catalytic Converter Replacement](#)
9. Install [Water Outlet Replacement](#)
10. Install [Air Cleaner Outlet Duct Replacement](#)
11. Install [Dash Upper Extension Panel Opening Cover Replacement](#)

EXHAUST GAS RECIRCULATION VALVE COOLING RETURN HOSE REPLACEMENT



Courtesy of GENERAL MOTORS COMPANY

EXHAUST GAS RECIRCULATION COOLER REPLACEMENT

1. Drain the cooling system. **Cooling System Draining and Filling**
2. Remove **Three-Way Catalytic Converter Replacement**



- 66 of 218

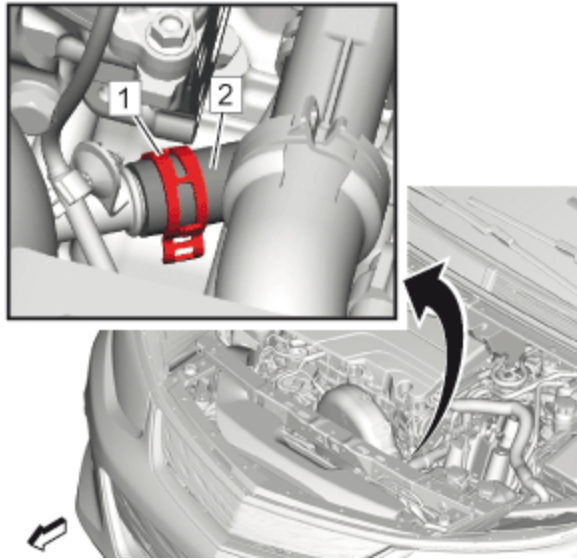


Fig. 73: Thermostat Bypass Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Loosen Thermostat Bypass Hose Clamp (1)
7. Disconnect Thermostat Bypass Hose (2)

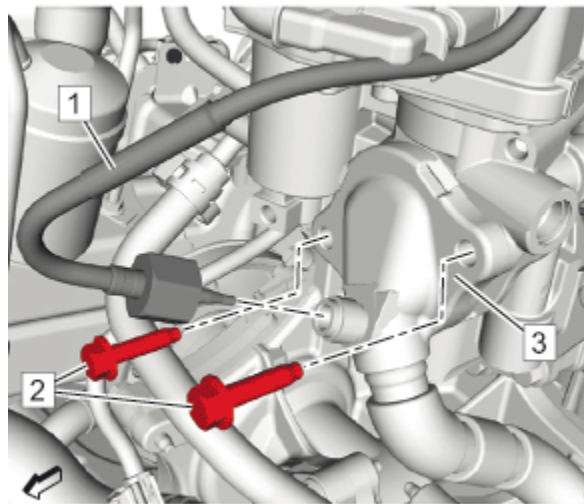


Fig. 74: EGR Temperature Sensor - Position 1, EGR Cooler And Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Remove the exhaust gas recirculation temperature sensor - position 1 (1) from exhaust gas recirculation cooler (3).
9. Remove Exhaust Gas Recirculation Cooler Bolt (2)

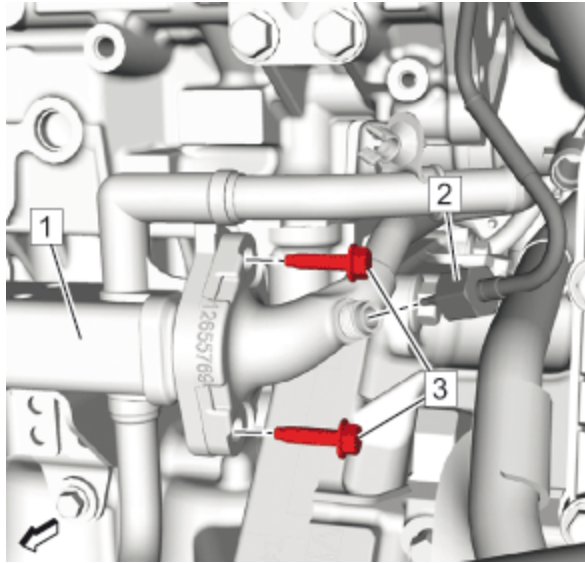


Fig. 75: EGR Temperature Sensor - Position 2, EGR Cooler And Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the exhaust gas recirculation temperature sensor - position 2 (2).
11. Remove Exhaust Gas Recirculation Cooler Bolt (3) @Exhaust Gas Recirculation Cooler (1)

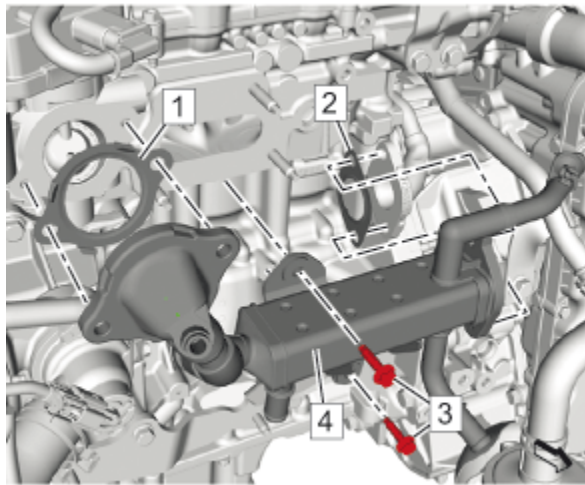


Fig. 76: EGR Cooler, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

12. Remove Exhaust Gas Recirculation Cooler Bolt (3)
13. Remove Exhaust Gas Recirculation Cooler (4)
14. Remove Gasket (1, 2) and DISCARD

Installation Procedure

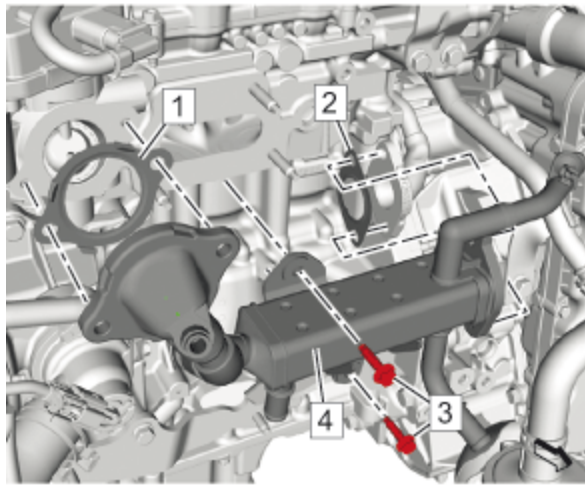


Fig. 77: EGR Cooler, Bolts And Gaskets

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket.(1, 2)
2. Install Exhaust Gas Recirculation Cooler (4)

NOTE: Do NOT tighten.

3. Install Exhaust Gas Recirculation Cooler Bolt (3)

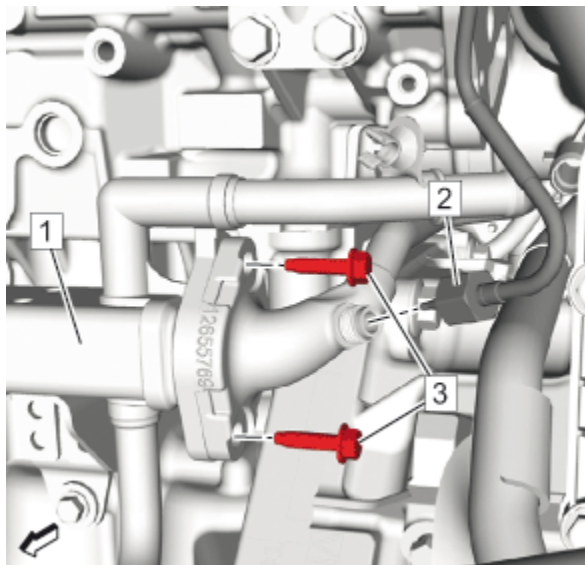


Fig. 78: EGR Temperature Sensor - Position 2, EGR Cooler And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten.

4. Install Exhaust Gas Recirculation Cooler Bolt (3) @Exhaust Gas Recirculation Cooler(1)

CAUTION: Fastener Caution

5. Install the exhaust gas recirculation temperature sensor - position 2 (2) and tighten to 42 N.m (31 lb ft).

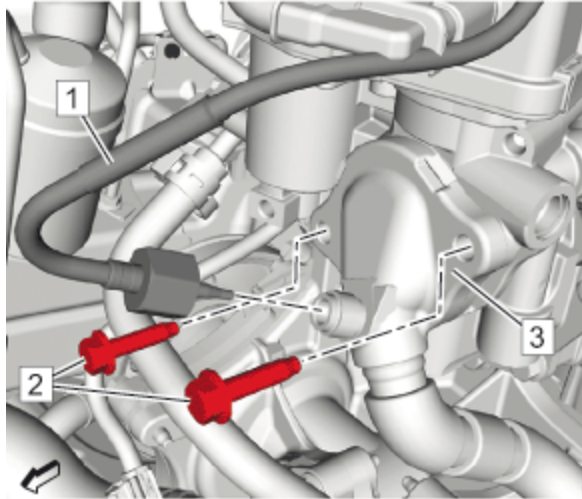


Fig. 79: EGR Temperature Sensor - Position 1, EGR Cooler And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten.

6. Install Exhaust Gas Recirculation Cooler Bolt (2)
7. Install the exhaust gas recirculation temperature sensor - position 1 (1) to the exhaust gas recirculation cooler (3) and tighten to 42 N.m (31 lb ft).
8. Tighten all 6 exhaust gas recirculation cooler bolts to 10 N.m (89 lb in)

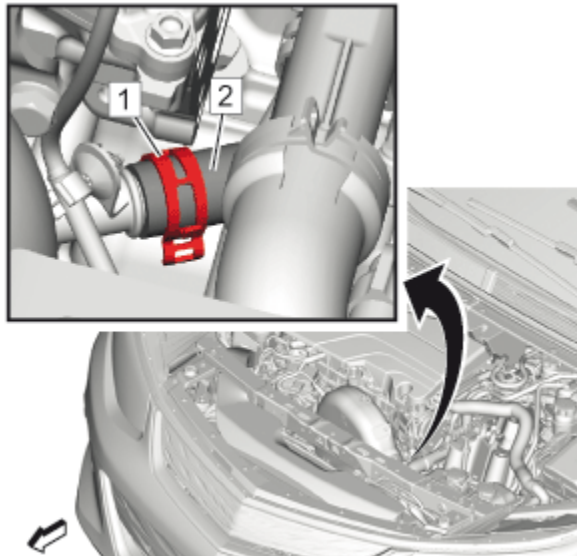


Fig. 80: Thermostat Bypass Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

9. Connect Thermostat Bypass Hose (2) -
10. Tighten Thermostat Bypass Hose Clamp (1) - Tighten

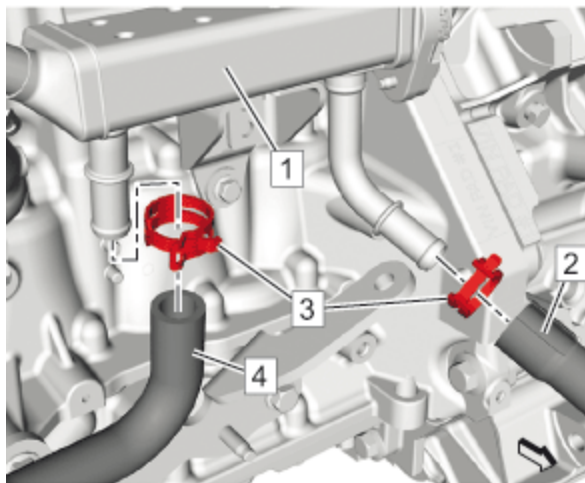


Fig. 81: EGR Cooler, EGR Cooler Water Bypass Outlet Hose, Heater Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

11. Connect Heater Inlet Hose (2) @Exhaust Gas Recirculation Cooler (1)
12. Connect Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (4) @Exhaust Gas Recirculation Cooler (1)
13. Clamp (3) - Tighten
14. Install [Three-Way Catalytic Converter Replacement](#)
15. Fill the cooling system. [Cooling System Draining and Filling](#)

EXHAUST GAS RECIRCULATION PIPE REPLACEMENT

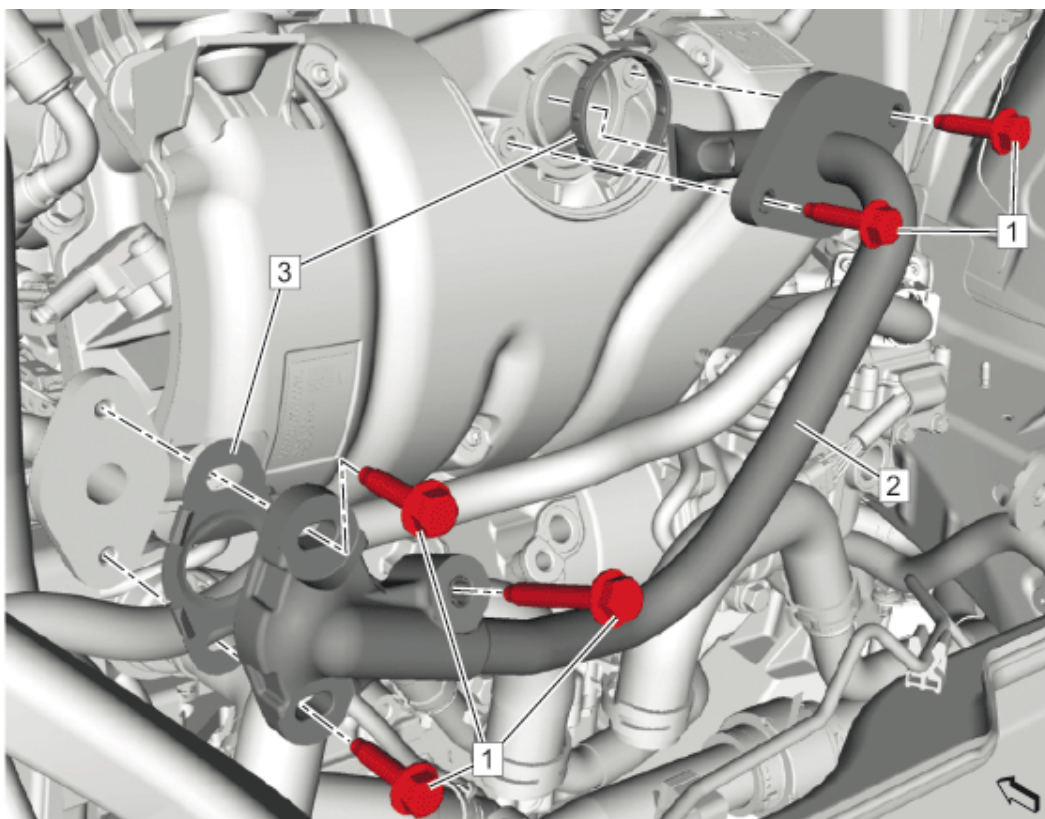


Fig. 82: Exhaust Gas Recirculation Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Air Cleaner Outlet Duct Replacement</u>	
1	Exhaust Gas Recirculation Pipe Bolt (Qty: 5) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
2	Exhaust Gas Recirculation Pipe
3	Exhaust Gas Recirculation Pipe Gasket (Qty: 2)

THROTTLE BODY ASSEMBLY REPLACEMENT

Removal Procedure

- 1. Disable the high voltage system. [High Voltage Disabling](#)
- 2. Remove Dash Upper Extension Panel Opening Cover [Dash Upper Extension Panel Opening Cover Replacement](#)
- 3. Remove Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)

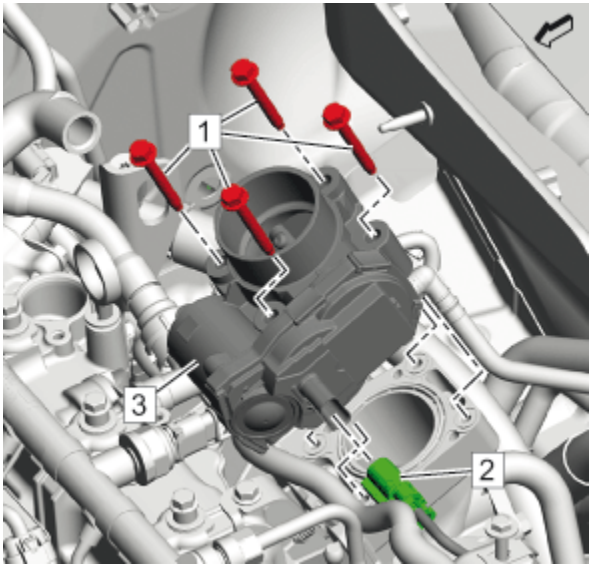


Fig. 83: Throttle Body, Electrical Connector And Bolts
Courtesy of GENERAL MOTORS COMPANY

- 4. Disconnect Electrical Connector (2)
- 5. Remove Throttle Body Bolt (1)

6. Remove Throttle Body (3)

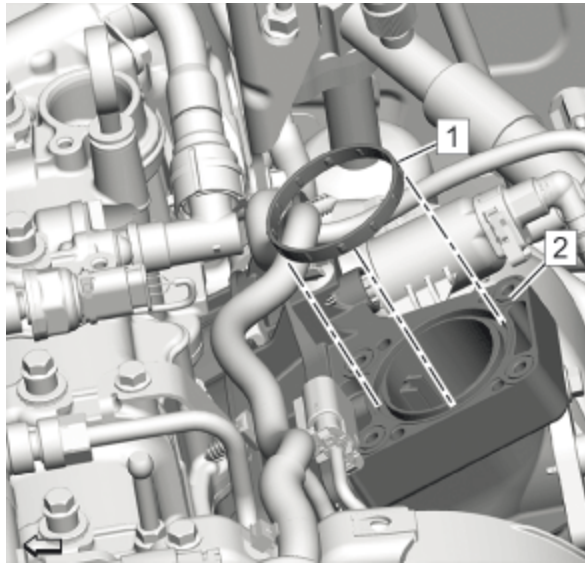


Fig. 84: Gasket And Intake Manifold

Courtesy of GENERAL MOTORS COMPANY

7. Remove Throttle Body Gasket (1)and DISCARD

Installation Procedure

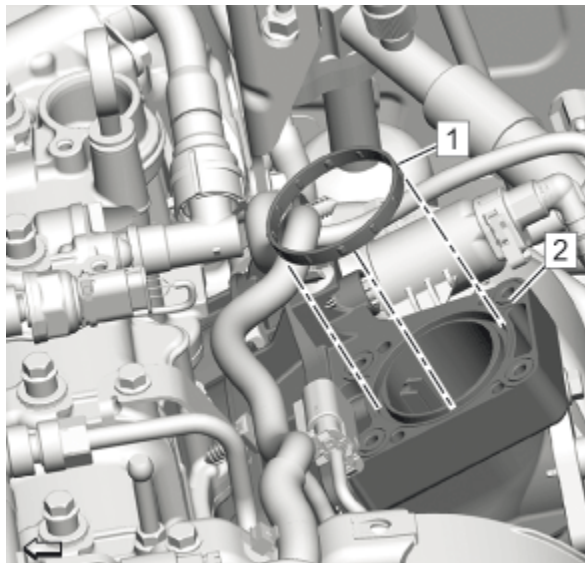


Fig. 85: Gasket And Intake Manifold

Courtesy of GENERAL MOTORS COMPANY

1. Clean the intake manifold mating surfaces.(2)
2. Install NEW Throttle Body Gasket (1)

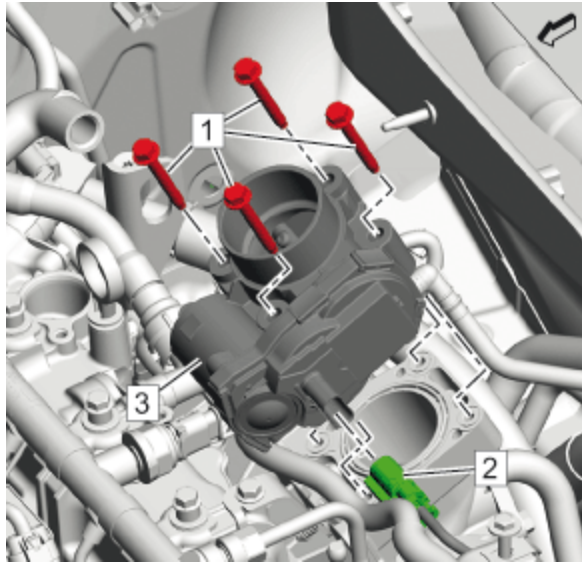


Fig. 86: Throttle Body, Electrical Connector And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install Throttle Body (3)

CAUTION: Refer to [Fastener Caution](#) .

4. Install Throttle Body Bolt (1) and tighten 10 N.m (89 lb in)
5. Connect Electrical Connector (2)
6. Install Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)
7. Install Dash Upper Extension Panel Opening Cover [Dash Upper Extension Panel Opening Cover Replacement](#)
8. Enable the high voltage system. [High Voltage Disabling](#)
9. Perform the throttle or idle learn. [Throttle or Idle Learn](#)

THROTTLE BODY INSPECTION AND CLEANING

1. Remove [Throttle Body Assembly Replacement](#)

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

CAUTION: Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

NOTE: Open the throttle valve in order to inspect all surfaces.

2. Inspect the throttle body bore and the throttle valve plate for deposits.

CAUTION: Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

3. Clean the throttle body bore and the throttle valve plate using a clean shop towel with an appropriate cleaner.
4. Install [Throttle Body Assembly Replacement](#).
5. [Throttle or Idle Learn](#)

FUEL PRESSURE RELIEF

WARNING: Fuel that flows out at high pressure can cause serious injury to the skin and eyes. ALWAYS depressurize the fuel system before removing components that are under high fuel pressure.

WARNING: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

Scan Tool Method - Preferred

1. Install a scan tool and turn the ignition ON.
2. Using the scan tool, command the fuel pump OFF allowing the low pressure fuel pump to shut off.
3. Start the vehicle and allow the engine to idle until the engine stops. The engine will stop in approximately 5-20 seconds.
4. Repeat step 3. Using the scan tool, verify pressure has dropped to a minimal level.
5. Turn the ignition OFF.

Alternate Method - If a scan tool is not available

1. Disable the fuel pump by removing the B+ fuel pump control module fuse. Refer to [Electrical Center Identification Views](#).
2. Start the vehicle and allow the engine to idle until the engine stops. The engine will stop in approximately 5-20 seconds.
3. Attempt to restart the vehicle to ensure pressure has dropped to a minimal level.
4. Turn the ignition OFF.

FUEL TANK DRAINING

Special Tool

CH 45004 Fuel Tank Drain Hose

WARNING: Never drain or store fuel in an open container. Always use an approved fuel storage container in order to reduce the chance of fire or explosion.

WARNING: Place a dry chemical (Class B) fire extinguisher nearby before performing any

on-vehicle service procedures. Failure to follow these precautions may result in personal injury.

1. Remove the fuel fill cap.

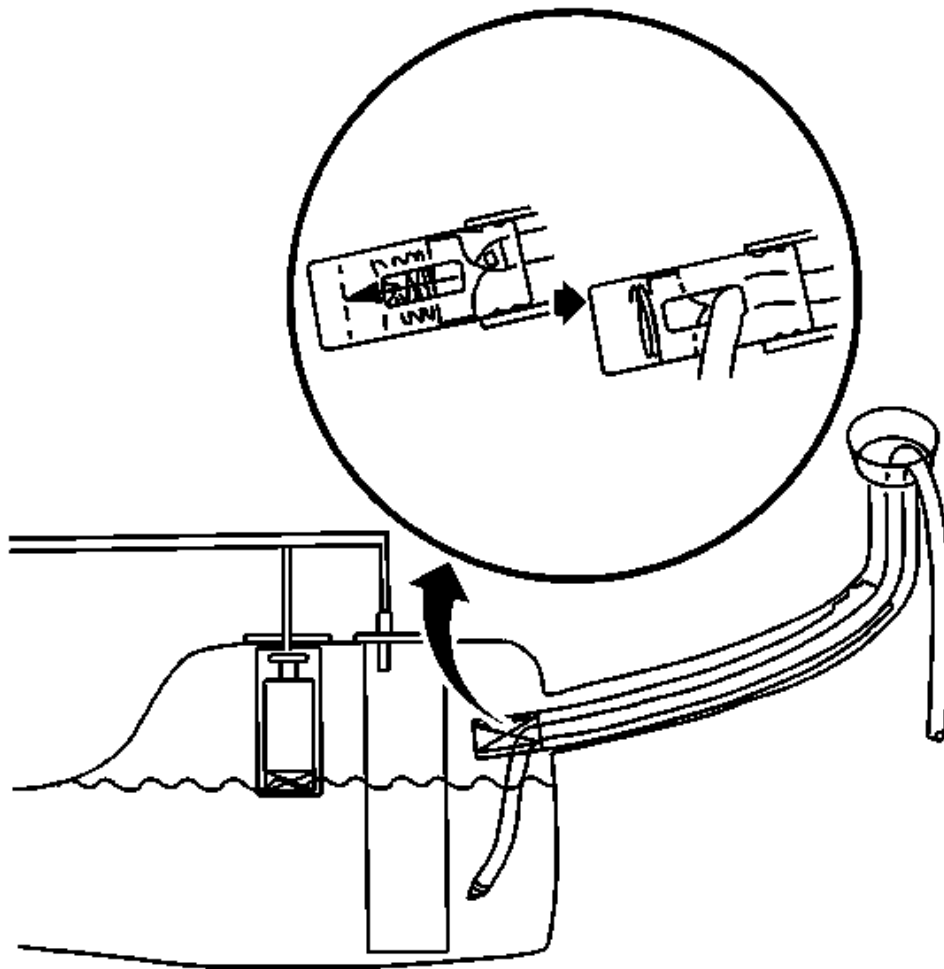


Fig. 87: Draining Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the fuel drain hose with Transjel Lubricant or equivalent to aid in hose insertion.

2. Insert the **CH 45004** hose into the fuel tank until the bottom is reached.
3. Use a hand or air operated pump device in order to drain as much fuel through the fuel fill pipe as possible.

FUEL TANK FILLER PIPE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Drain the fuel tank. [Fuel Tank Draining](#)
3. Remove [Fuel Tank Filler Pipe Housing Replacement](#)



Fig. 88: Fuel Tank Filler Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuel Tank Filler Pipe Bolt (1)
5. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
6. Remove [Rear Wheelhouse Liner Replacement](#) - Right Side

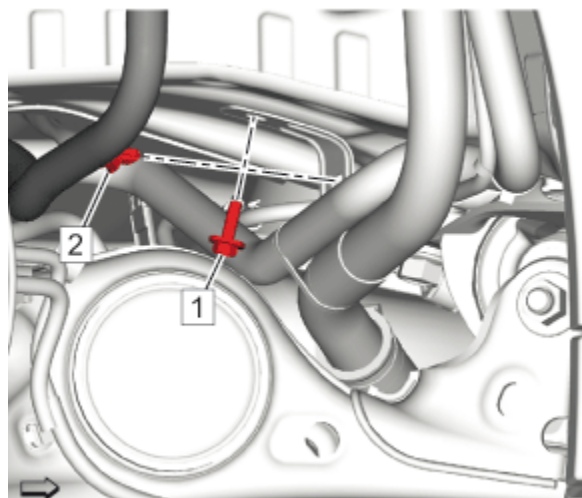


Fig. 89: Fuel Tank Filler Pipe Ground Bolt And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

7. Remove Fuel Tank Filler Pipe Ground Bolt (1)
8. Remove Wiring Harness Clip (2)

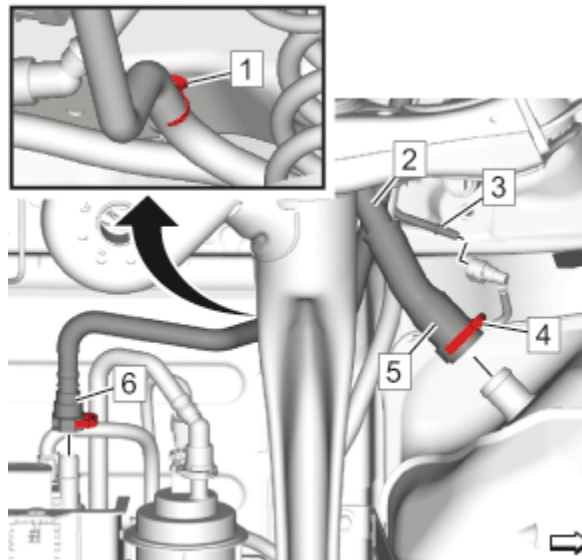


Fig. 90: Evaporative Emission System Vacuum Leak Pump Filter Pipe, Fuel Tank Filler Hose, Vent Pipe, Clamp And Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the evaporative emission system vacuum leak pump filter pipe (6). Refer to [**Plastic Collar Quick Connect Fitting Service**](#).
10. Close all open connections with the **EN-6015** plugs.
11. Disconnect the fuel tank vent pipe (3). Refer to [**Plastic Collar Quick Connect Fitting Service**](#).
12. Close all open connections with the **EN-6015** plugs.
13. Loosen the clamp.(4)
14. Remove Retainer (1)

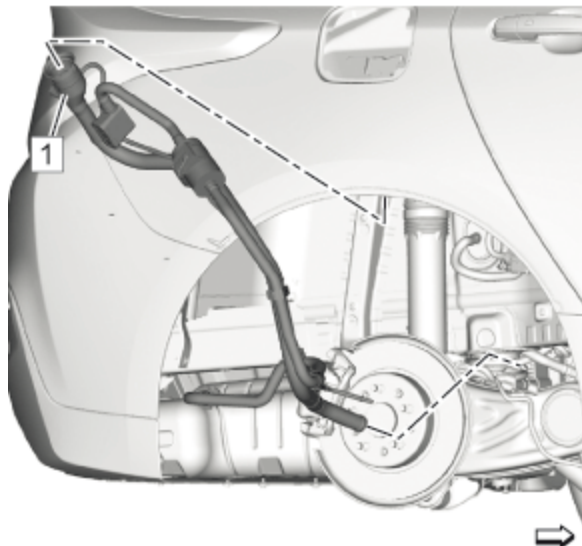


Fig. 91: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

15. Fuel Tank Filler Pipe (1)

Installation Procedure

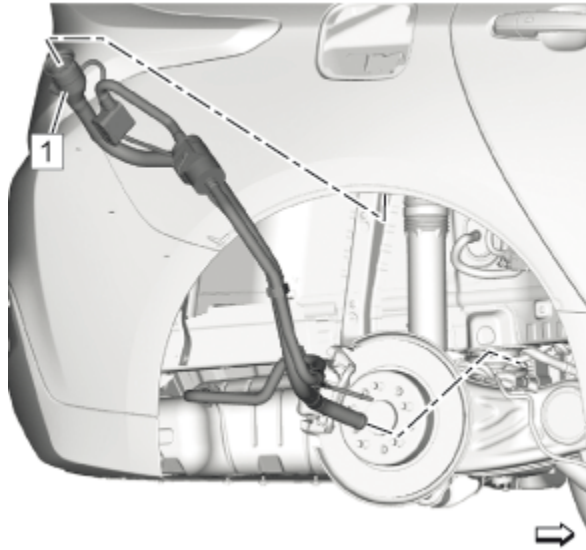


Fig. 92: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Tank Filler Pipe (1)

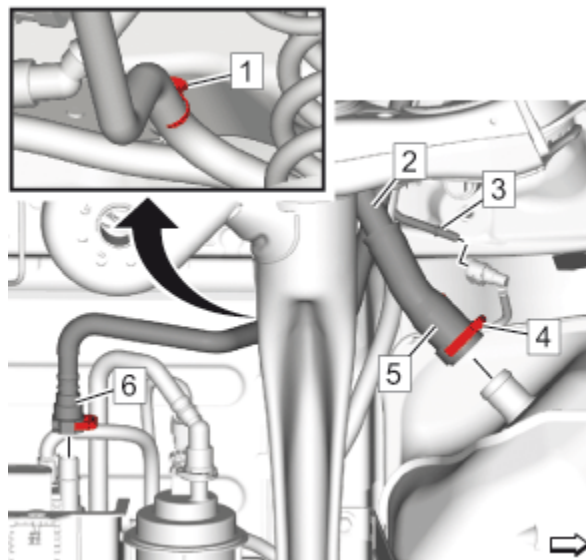


Fig. 93: Evaporative Emission System Vacuum Leak Pump Filter Pipe, Fuel Tank Filler Hose, Vent Pipe, Clamp And Retainer

Courtesy of GENERAL MOTORS COMPANY

2. Install the fuel tank filler hose (5) onto the fuel tank.

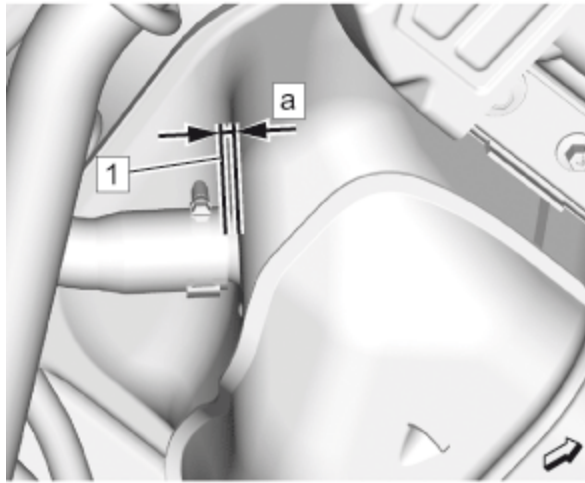


Fig. 94: Ensure Filler Hose Is Fully Seated And Installed Correctly

Courtesy of GENERAL MOTORS COMPANY

3. Make sure that the hose is fully seated on the fuel tank. Filler hose is correctly installed when the end of the hose is even with where the fill spud on the tank increases in diameter. The gap (1) between the tank and the end of hose will be (a) 6 mm (1/4 in) when hose is correctly installed.

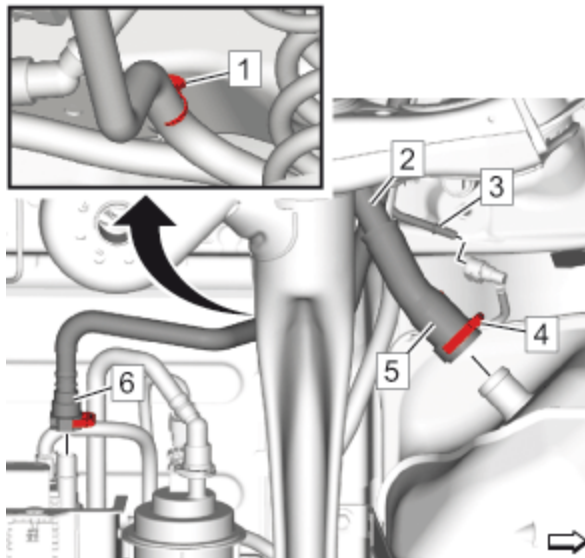


Fig. 95: Evaporative Emission System Vacuum Leak Pump Filter Pipe, Fuel Tank Filler Hose, Vent Pipe, Clamp And Retainer

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Tighten the clamp.(4) 3.5 N.m (31 lb in)
5. Remove all EN-6015 plugs from the connections.
6. Connect the fuel tank vent pipe (3). Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Remove all EN-6015 plugs from the connections.

8. Connect the evaporative emission system vacuum leak pump filter pipe (6). Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Install Retainer (1)

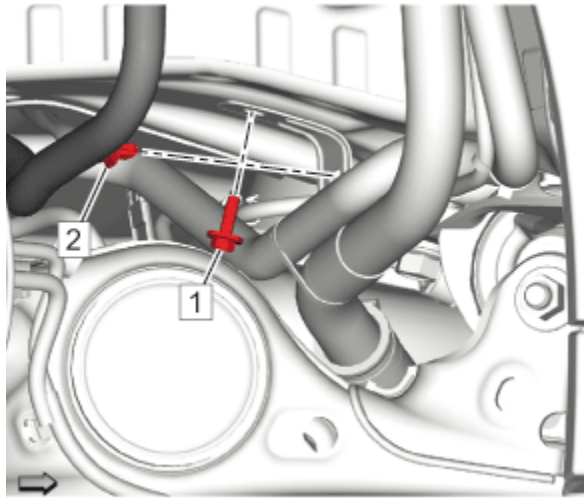


Fig. 96: Fuel Tank Filler Pipe Ground Bolt And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

10. Install Fuel Tank Filler Pipe Ground Bolt (1) and tighten 9 N.m (80 lb in)
11. Install Wiring Harness Clip (2)
12. Install [Rear Wheelhouse Liner Replacement](#) - Right Side
13. Lower the vehicle.



Fig. 97: Fuel Tank Filler Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

14. Install Fuel Tank Filler Pipe Bolt (1) and tighten 9 N.m (80 lb in)
15. Connect [Fuel Tank Filler Pipe Housing Replacement](#)

16. Refill the fuel tank.

17. Connect [Battery Negative Cable Disconnection and Connection](#)

FUEL FEED PIPE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)

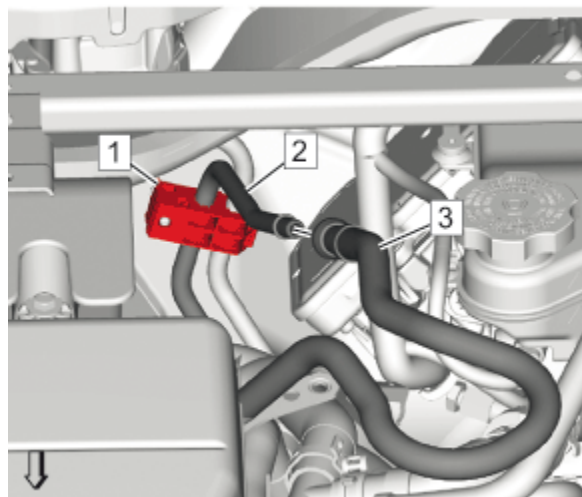


Fig. 98: Fuel Feed Front Pipe, Fuel Feed Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Fuel Feed Front Pipe (3) @Fuel Feed Pipe (2) - [Metal Collar Quick Connect Fitting Service](#)
4. Close all open connections with the EN-6015 plugs.
5. Open the retainer (1).
6. Remove Fuel Feed Pipe (2) @Retainer (1)
7. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
8. Remove [Underbody Rear Air Deflector Replacement](#)
9. Remove [Underbody Front Air Deflector Replacement - Left Side](#)
10. Remove [Drivetrain and Front Suspension Cradle Replacement](#)

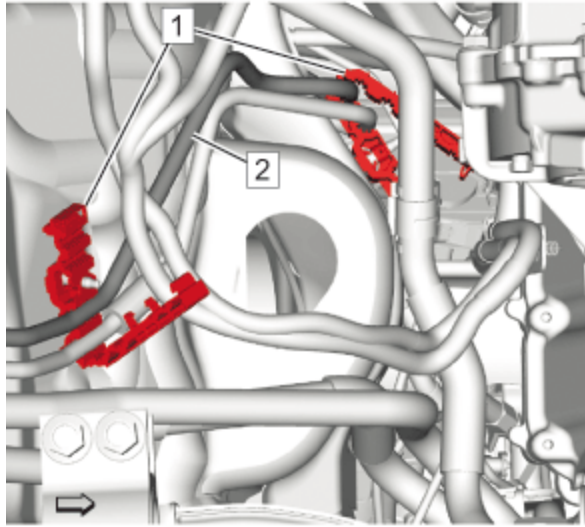


Fig. 99: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

11. Open the 2 retainers (1).
12. Remove Fuel Feed Pipe (2) @Retainer (1)

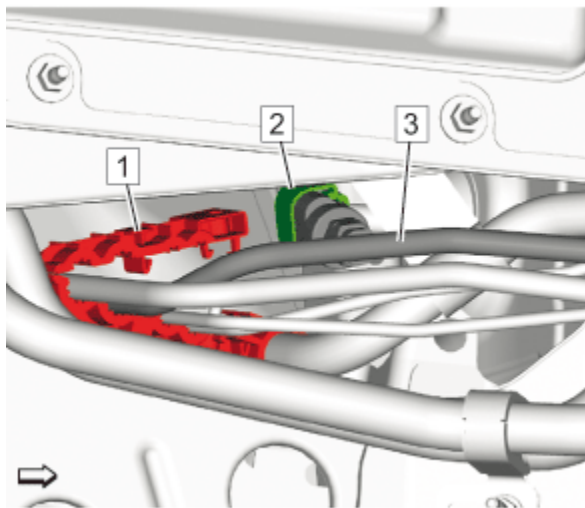


Fig. 100: Fuel Feed Pipe, Retainer And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

13. Open the retainer (1).
14. Fuel Feed Pipe (3) @Retainer (1)
15. Disconnect the electrical connector.(2)

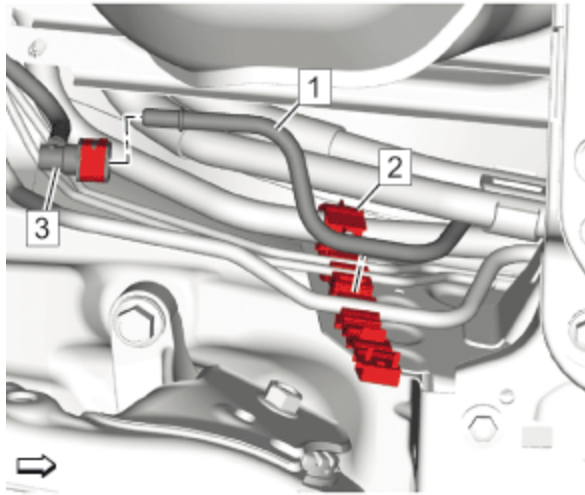


Fig. 101: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

16. Open the retainer (2).
17. Disconnect Fuel Feed Pipe (1) @Fuel Pump Fuel Feed Hose (3) [Plastic Collar Quick Connect Fitting Service](#)
18. Close all open connections with the **EN-6015** plugs.
19. Remove Fuel Feed Pipe (1) @Retainer (2)

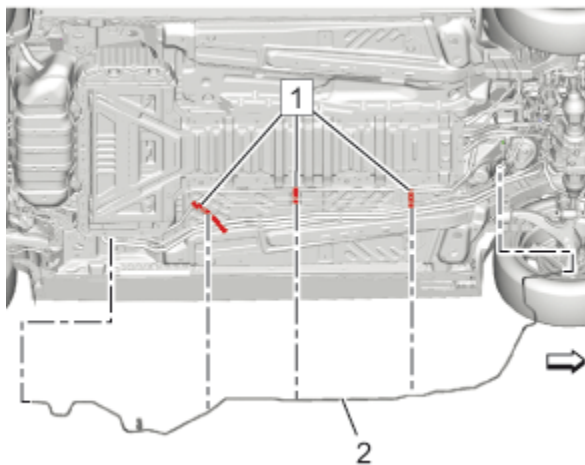


Fig. 102: Fuel Feed Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

20. Open the 3 retainers (1).
21. Remove Fuel Feed Pipe (2) @Retainer (1)
22. Remove the fuel feed pipe (2) from the vehicle.

Installation Procedure

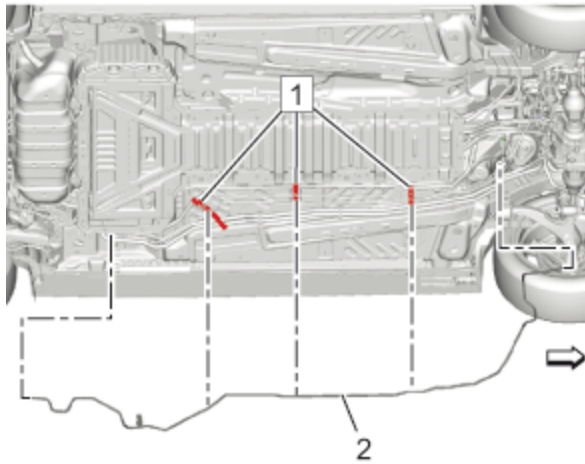


Fig. 103: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel feed pipe (2) to the vehicle.
2. Install Fuel Feed Pipe (2) @ Retainer(1)
3. Close the 3 retainers (1).

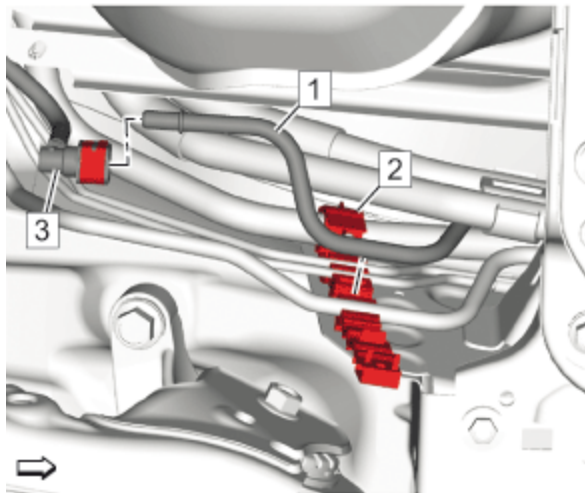


Fig. 104: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install Fuel Feed Pipe(1)@ Retainer(2)
5. Remove all EN-6015 plugs from the connections.
6. Connect Fuel Feed Pipe(1)@ Fuel Pump Fuel Feed Hose(3) **Plastic Collar Quick Connect Fitting Service**
7. Close the retainer (2).

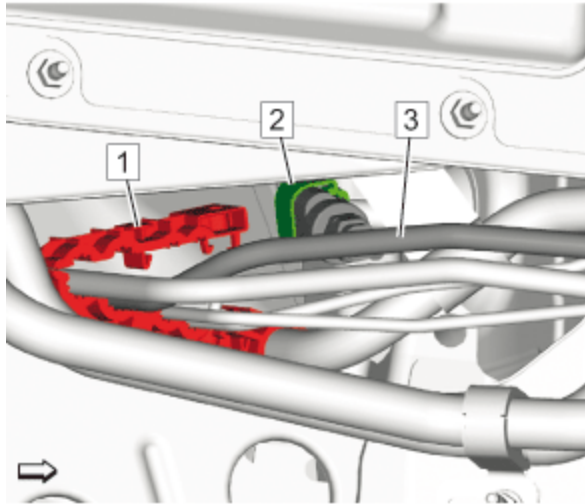


Fig. 105: Fuel Feed Pipe, Retainer And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect the electrical connector.(2)
9. Install Fuel Feed Pipe(3)@Retainer(1)
10. Close the retainer (1).

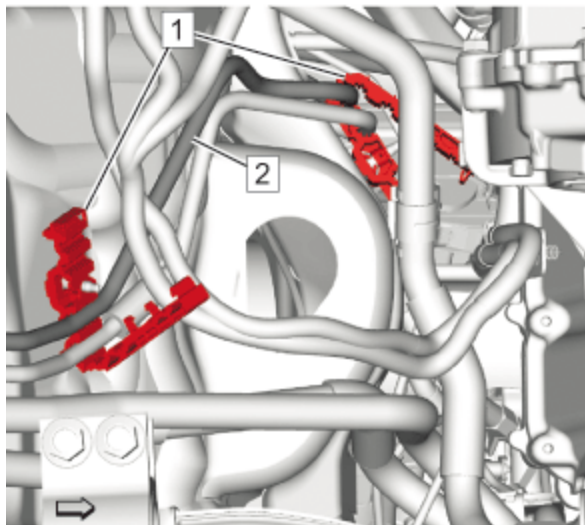


Fig. 106: Fuel Feed Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Install Fuel Feed Pipe(2)@Retainer(1)
12. Close the 2 retainers (1).
13. Install [Drivetrain and Front Suspension Cradle Replacement](#)
14. Install [Underbody Front Air Deflector Replacement - Left Side](#)
15. Install [Underbody Rear Air Deflector Replacement](#)
16. Lower the vehicle.

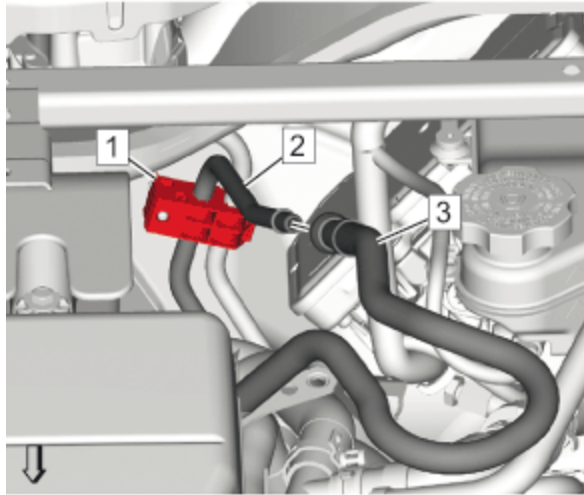


Fig. 107: Fuel Feed Front Pipe, Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

17. Install Fuel Feed Pipe (2) @Retainer (1)
18. Close the retainer (1).
19. Remove all **EN-6015** plugs from the connections.
20. Connect Fuel Feed Front Pipe (3) @Fuel Feed Pipe (2)[**Metal Collar Quick Connect Fitting Service**](#)
21. Connect [**Battery Negative Cable Disconnection and Connection**](#)
22. Cycle the ignition to run the fuel pump and check for fuel leaks.

FUEL TANK FUEL PUMP MODULE REPLACEMENT

Special Tools

CH-45722 Fuel Sender Lock Ring Wrench

Equivalent regional tools:[**Special Tools \(Diagnostic Tools\)**](#) [**Special Tools \(Repair Tools\)**](#)

Removal Procedure

WARNING: [**Safety Goggles and Fuel Warning**](#)

WARNING: [**Diesel/Gasoline Vapors Warning**](#)

WARNING: [**Fuel Vapors in Evaporative Emission Components Warning**](#)

1. Remove [**Fuel Tank Replacement**](#)

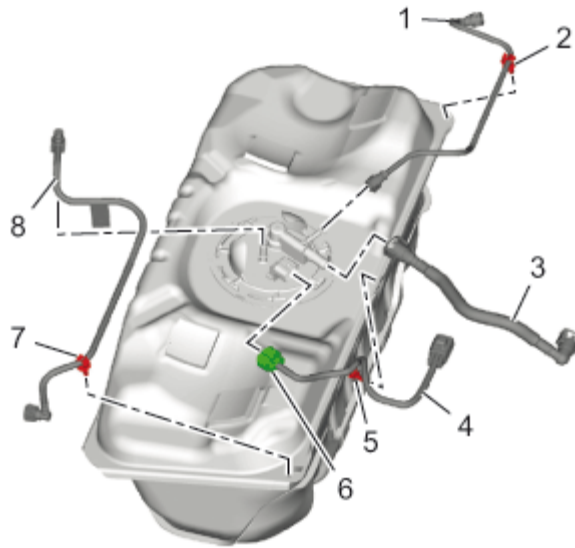


Fig. 108: Fuel Pump Feed Hose, Evaporative Emission Canister Hose, Evaporative Emission Rear Hose, Electrical Connector, Fuel Pump Module Wiring Harness And Retainers
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Retainer (2, 5, 7)
3. Remove Fuel Pump Fuel Feed Hose (8) [Plastic Collar Quick Connect Fitting Service](#)
4. Remove the evaporative emission canister hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Remove Evaporative Emission Rear Hose (3) [Plastic Collar Quick Connect Fitting Service](#)
6. Disconnect the electrical connector (6) and remove the fuel tank fuel pump module wiring harness (4).

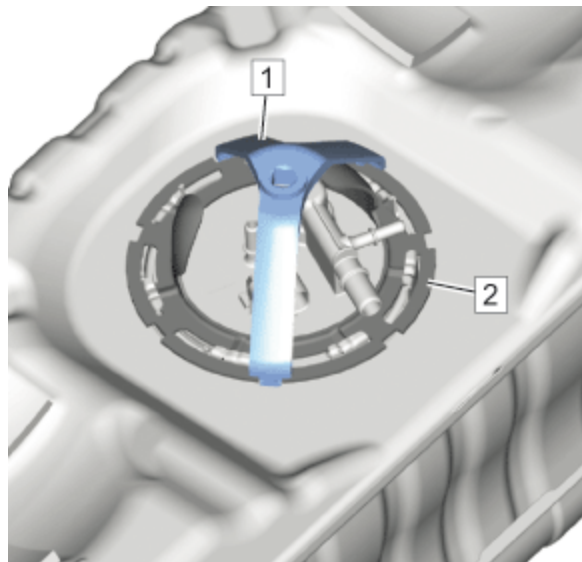


Fig. 109: Fuel Pump Module Lock Ring And Wrench
 Courtesy of GENERAL MOTORS COMPANY

7. Install the CH-45722 wrench (1) to the fuel pump module lock ring (2).

NOTE: DO NOT use impact tools. Significant force will be required to release the

lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

8. Using the **CH-45722** wrench (1) and a long breaker-bar, rotate the lock ring in a counterclockwise direction in order to unlock the lock ring.
9. Remove the **CH-45722** wrench (1).
10. Remove the fuel pump module lock ring (2).

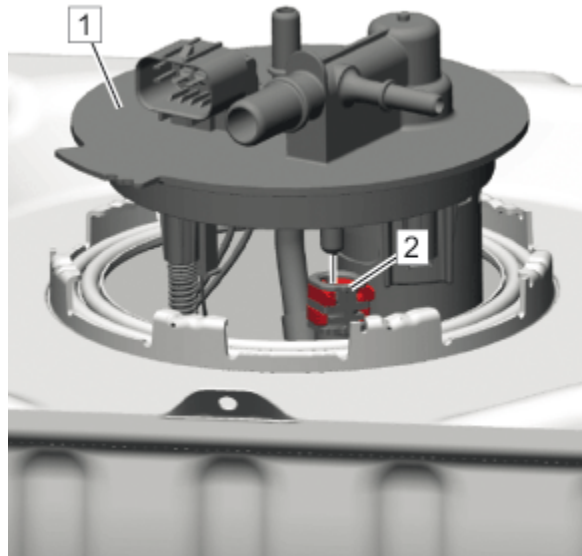


Fig. 110: Fuel Pump Module And Vent Valve Connector
Courtesy of GENERAL MOTORS COMPANY

11. Partially raise the fuel pump module (1) and disconnect the vent valve connector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).

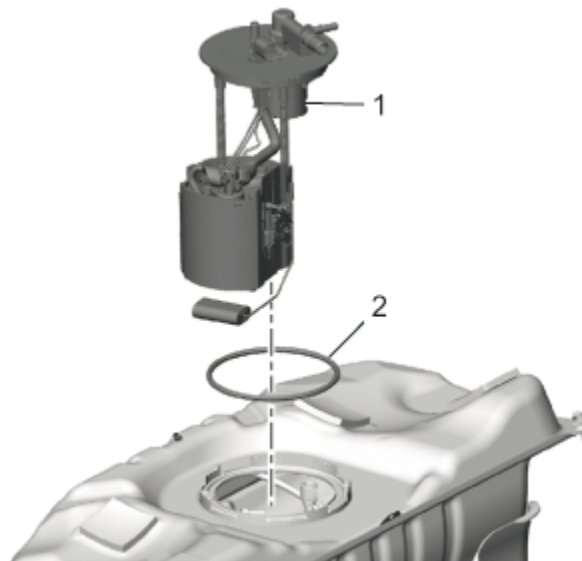


Fig. 111: Fuel Tank Fuel Pump Module And Seal
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lift the fuel tank fuel pump module up slightly. Pay attention to the fuel

level sensor.

12. Remove Fuel Tank Fuel Pump Module (1)
13. Remove and DISCARD the fuel pump module seal (2).

Installation Procedure

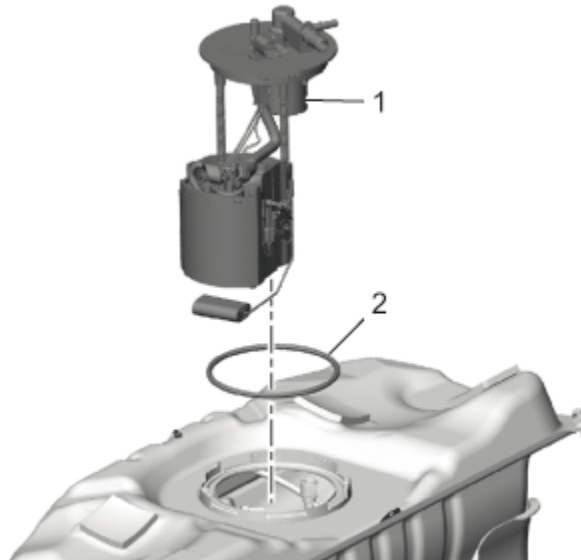


Fig. 112: Fuel Tank Fuel Pump Module And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW fuel pump module seal (2).

NOTE: Pay attention to the fuel level sensor.

2. Install Fuel Tank Fuel Pump Module (1)

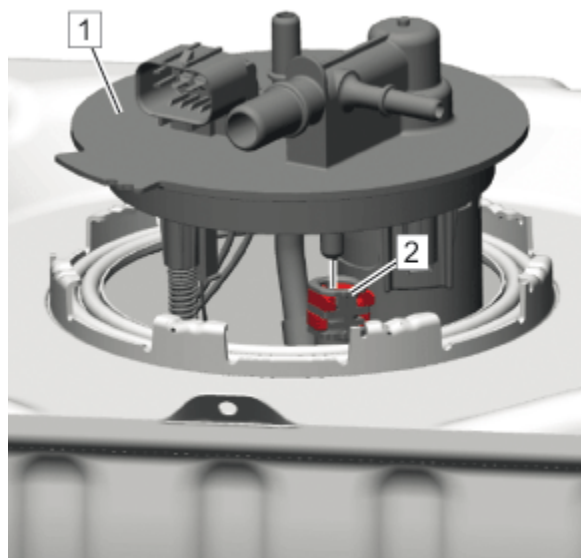


Fig. 113: Fuel Pump Module And Vent Valve Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect the vent valve connector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).

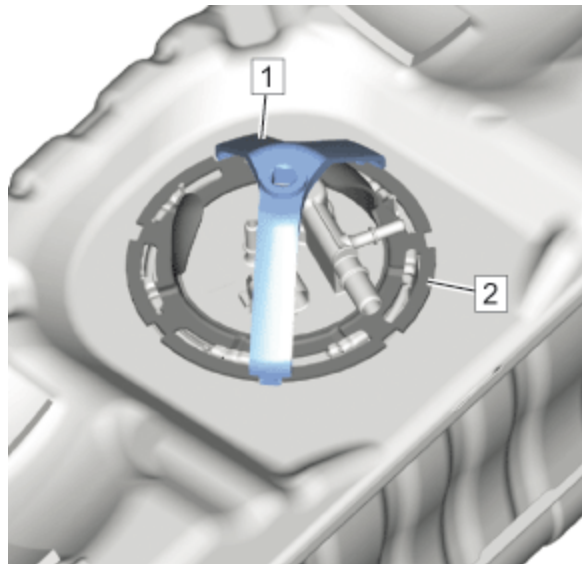


Fig. 114: Fuel Pump Module Lock Ring And Wrench

Courtesy of GENERAL MOTORS COMPANY

4. Install the fuel pump module lock ring (2).
5. Install the **CH-45722** wrench (1) to the fuel pump module lock ring (2).

NOTE: **DO NOT** use impact tools. Significant force will be required to release the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

6. Using the **CH-45722** wrench (1) and a long breaker bar, rotate the lock ring in a clockwise direction in order to lock the lock ring.
7. Remove the **CH-45722** wrench (1).

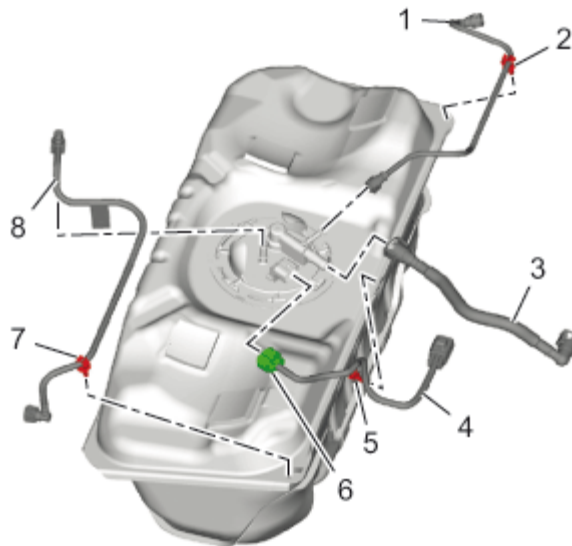


Fig. 115: Fuel Pump Feed Hose, Evaporative Emission Canister Hose, Evaporative Emission Rear Hose, Electrical Connector, Fuel Pump Module Wiring Harness And Retainers

Courtesy of GENERAL MOTORS COMPANY

8. Connect the electrical connector (6).
9. Install Evaporative Emission Rear Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
10. Install the evaporative emission canister hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
11. Install Fuel Pump Fuel Feed Hose (8) - [Plastic Collar Quick Connect Fitting Service](#)
12. Install Retainer(2, 5, 7)
13. Install [Fuel Tank Replacement](#)

FUEL TANK REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Relieve the fuel pressure: [Fuel Pressure Relief](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)
3. [Fuel Tank Draining](#)
4. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
5. Remove [Underbody Rear Air Deflector Replacement](#)
6. Remove [Underbody Front Air Deflector Replacement - Left Side](#)

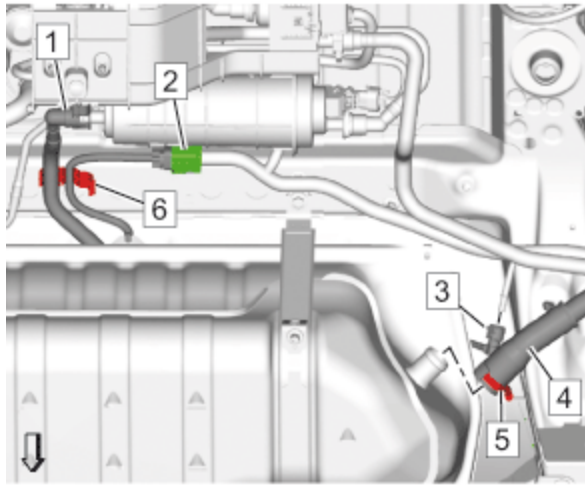


Fig. 116: Evaporative Emission Rear Hose, Fuel Tank Filler Hose, Vent Pipe, Electrical Connector, Retainer And Clamp

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Evaporative Emission Rear Hose (1) - [Plastic Collar Quick Connect Fitting Service](#)
8. Close all open connections with the **EN-6015** plugs.
9. Disconnect the fuel tank fuel pump module wiring harness electrical connector (2).
10. Open the retainer (6).
11. Disconnect Fuel Tank Filler Vent Pipe (3) - [Plastic Collar Quick Connect Fitting Service](#)
12. Close all open connections with the **EN-6015** plugs.
13. Loosen Clamp (5)

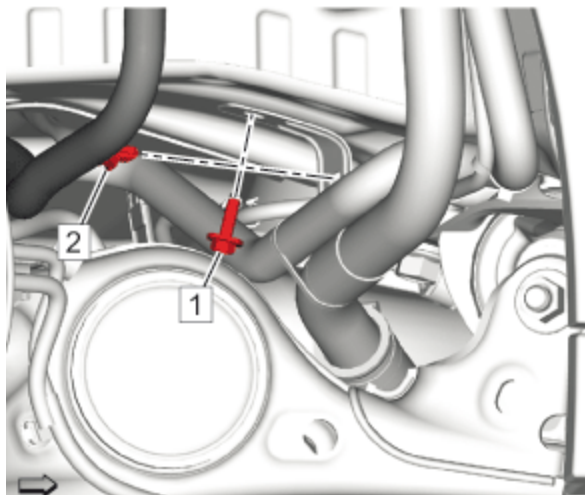


Fig. 117: Fuel Tank Filler Pipe Ground Bolt And Wiring Harness Clip

Courtesy of GENERAL MOTORS COMPANY

14. Remove Fuel Tank Filler Pipe Ground Bolt (1)

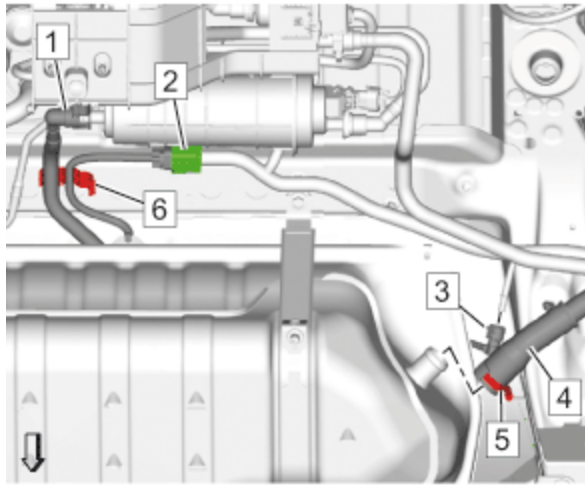


Fig. 118: Evaporative Emission Rear Hose, Fuel Tank Filler Hose, Vent Pipe, Electrical Connector, Retainer And Clamp

Courtesy of GENERAL MOTORS COMPANY

15. Remove Fuel Tank Filler Hose (4)

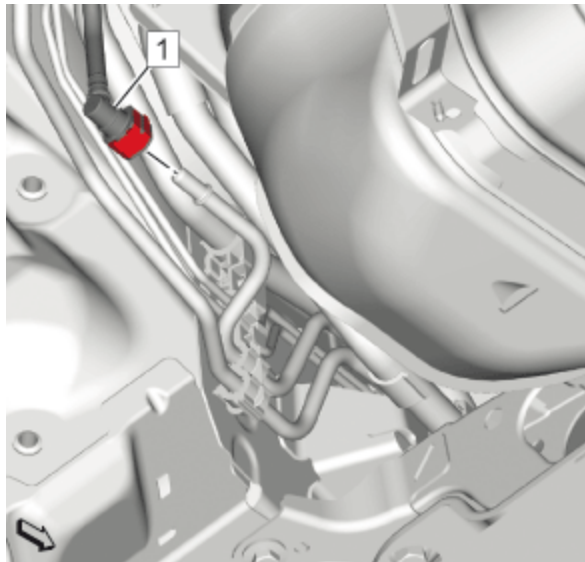


Fig. 119: Fuel Feed Pipe

Courtesy of GENERAL MOTORS COMPANY

16. Disconnect Fuel Feed Pipe (1) - [Plastic Collar Quick Connect Fitting Service](#)
17. Close all open connections with the EN-6015 plugs.
18. Remove rear coil springs. Refer to [Rear Coil Spring Replacement](#)

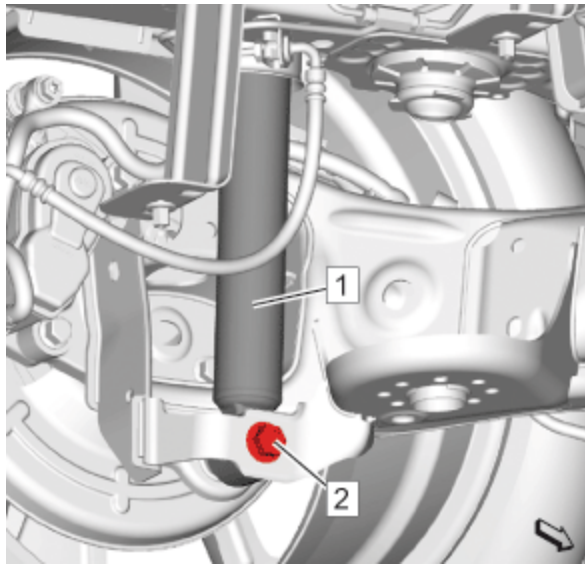


Fig. 120: Shock And Lower Shock Fasteners

Courtesy of GENERAL MOTORS COMPANY

19. Reinstall the lower shock fasteners (2) to the shock (1) without the coil springs.
20. Support the rear axle with a suitable jack stand.

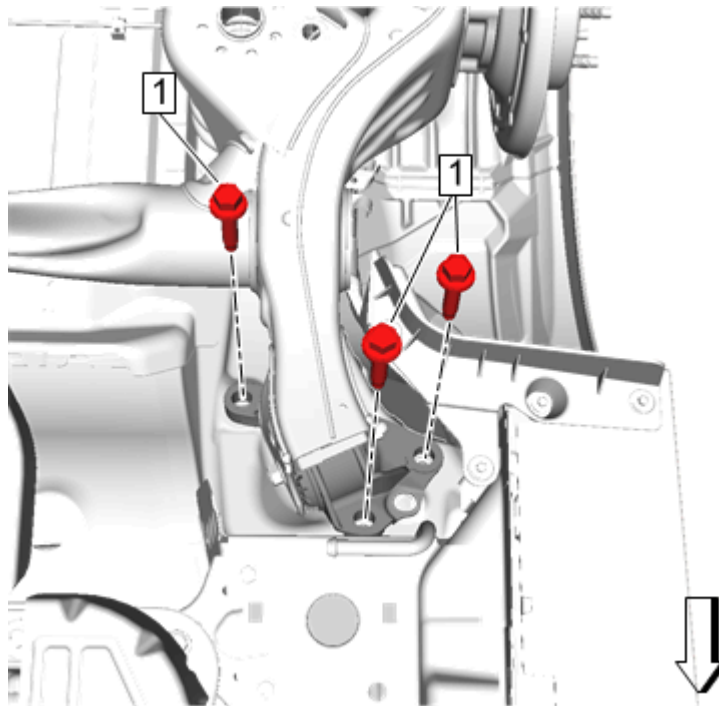


Fig. 121: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

21. Remove and DISCARD the 3 right side axle bracket bolts (1).

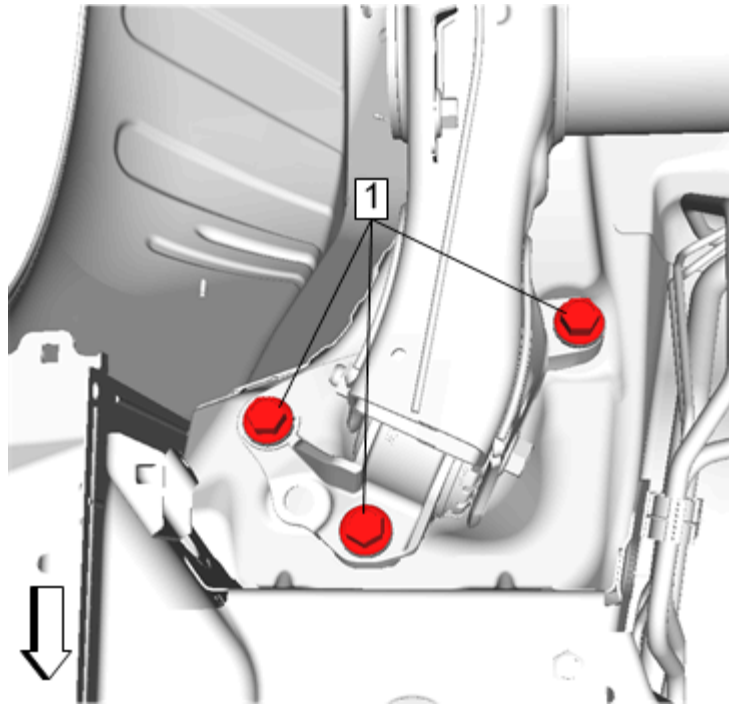


Fig. 122: Left Side Rear Axle Bracket Bolts
 Courtesy of GENERAL MOTORS COMPANY

22. Loosen the 3 left side axle bracket bolts (1). Do not remove the bolts at this time.

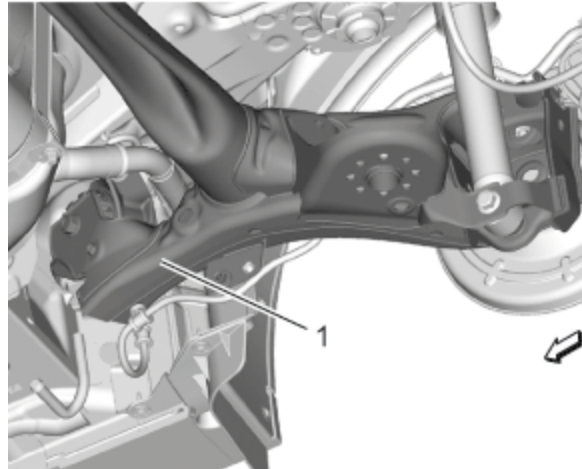


Fig. 123: Front Of Axle
 Courtesy of GENERAL MOTORS COMPANY

23. Lower the front (1) of the axle and position rearward enough to allow the fuel tank to be removed.

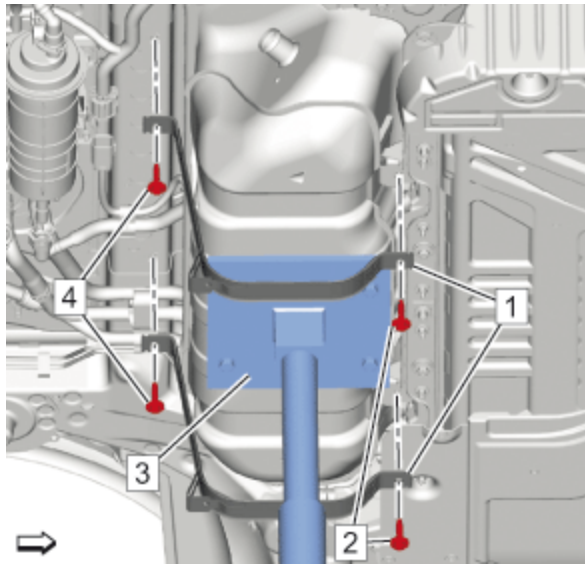


Fig. 124: Fuel Tank Straps

Courtesy of GENERAL MOTORS COMPANY

24. Support the fuel tank with a suitable jack.(3)
25. Remove the 4 fuel tank strap bolts (2, 4).
26. Remove Fuel Tank Strap (1)

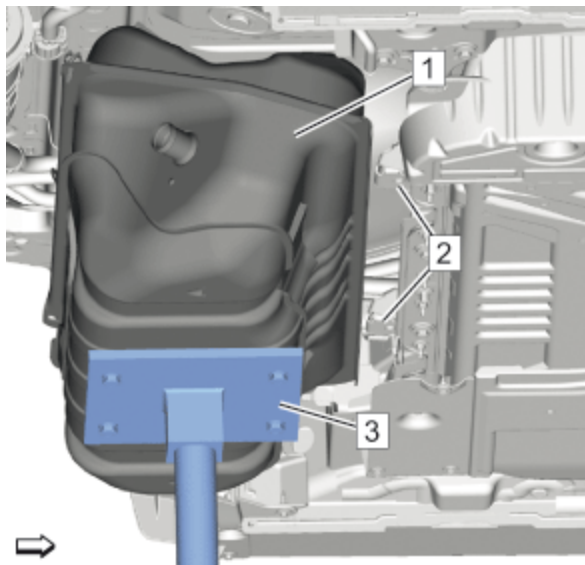


Fig. 125: Fuel Tank And Suitable Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

27. Move the fuel tank (1) rearwards until there is enough space between the fuel tank (1) and the fuel tank strap bracket (2).
28. Lower the fuel tank (1) slowly using the suitable adjustable jack (3).

Disassemble Procedure

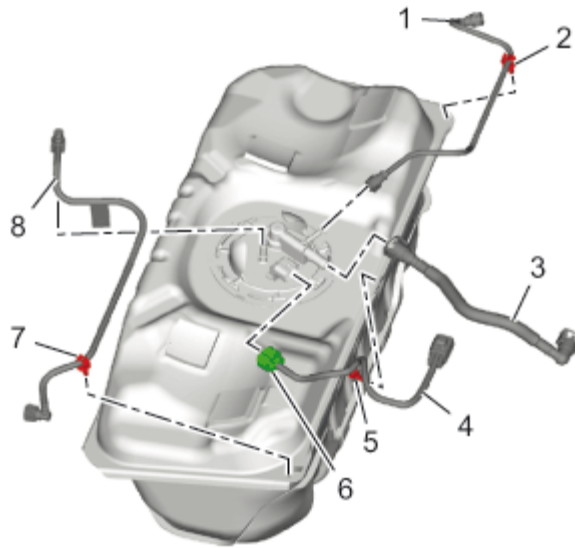


Fig. 126: Fuel Pump Feed Hose, Evaporative Emission Canister Hose, Evaporative Emission Rear Hose, Electrical Connector, Fuel Pump Module Wiring Harness And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Remove Retainer (2, 5, 7)
2. Remove Fuel Pump Fuel Feed Hose (8) -[Plastic Collar Quick Connect Fitting Service](#)
3. Remove the evaporative emission canister hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Remove Evaporative Emission Rear Hose (3) [Plastic Collar Quick Connect Fitting Service](#)
5. Disconnect the electrical connector (6) and remove the fuel tank fuel pump module wiring harness (4).
6. Remove [Fuel Tank Fuel Pump Module Replacement](#)

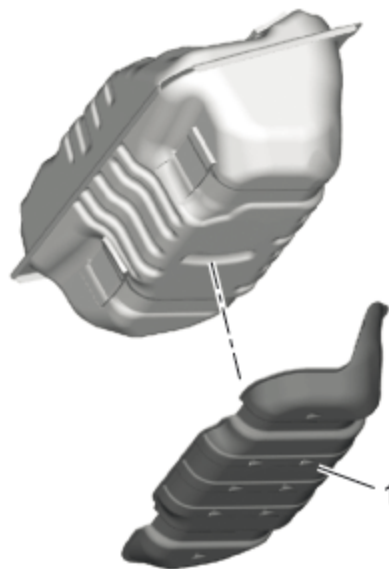


Fig. 127: Fuel Tank Heat Shield

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fuel Tank Heat Shield (1)

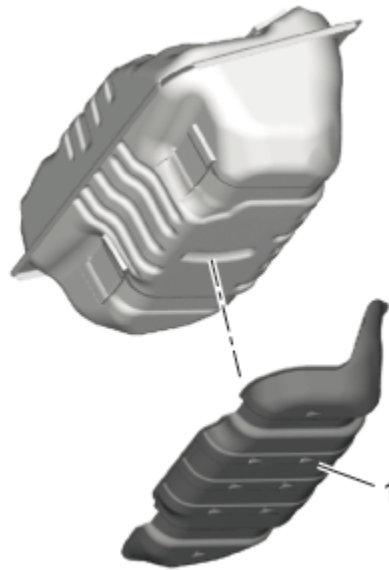


Fig. 128: Fuel Tank Heat Shield

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Tank Heat Shield (1)
2. Install [Fuel Tank Fuel Pump Module Replacement](#)

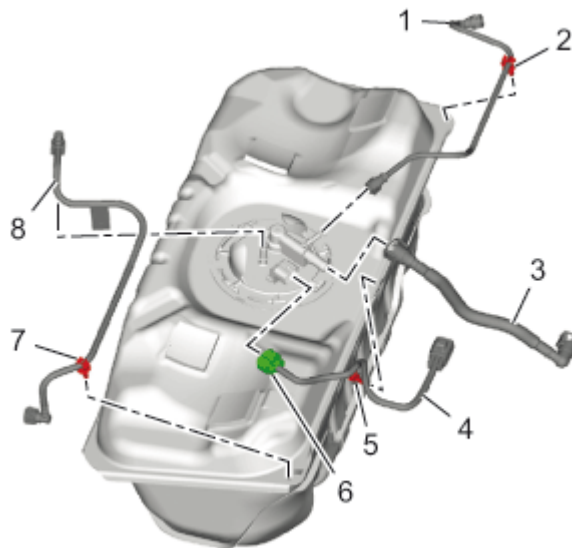


Fig. 129: Fuel Pump Feed Hose, Evaporative Emission Canister Hose, Evaporative Emission Rear Hose, Electrical Connector, Fuel Pump Module Wiring Harness And Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector (6).
4. Install Evaporative Emission Rear Hose (3) [Plastic Collar Quick Connect Fitting Service](#)
5. Install the evaporative emission canister hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Install Fuel Pump Fuel Feed Hose (8) [Plastic Collar Quick Connect Fitting Service](#)

7. Install Retainer (2, 5, 7)

Installation Procedure

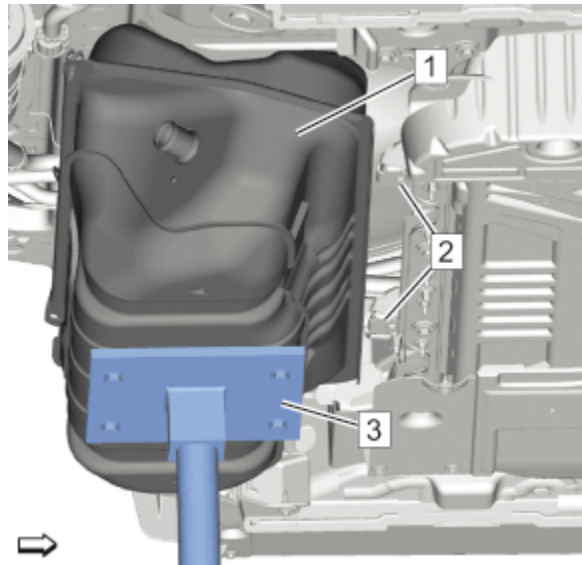


Fig. 130: Fuel Tank And Suitable Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

1. Raise the fuel tank (1) slowly using the suitable adjustable jack (3).
2. Move the fuel tank (1) forwards.

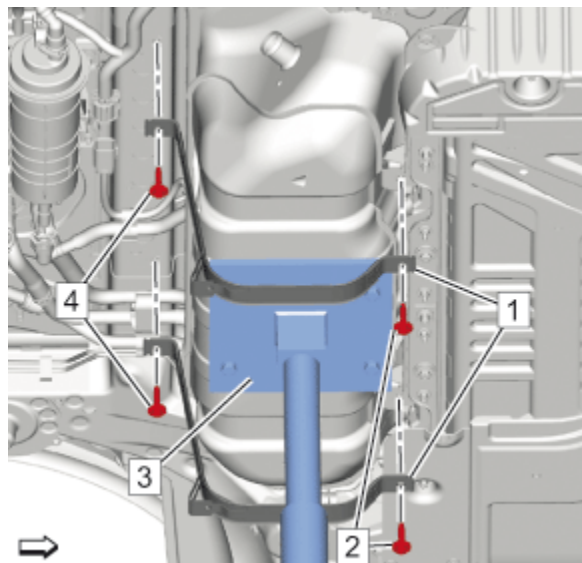


Fig. 131: Fuel Tank Straps

Courtesy of GENERAL MOTORS COMPANY

3. Install Fuel Tank Strap (1)

CAUTION: Fastener Caution

4. Install the 4 fuel tank strap bolts (2, 4) and tighten to 22 N.m (16 lb ft).
5. Remove the suitable jack (3) from the fuel tank.
6. Return the rear axle to its original position.
7. Support the rear axle with a suitable jack stand.

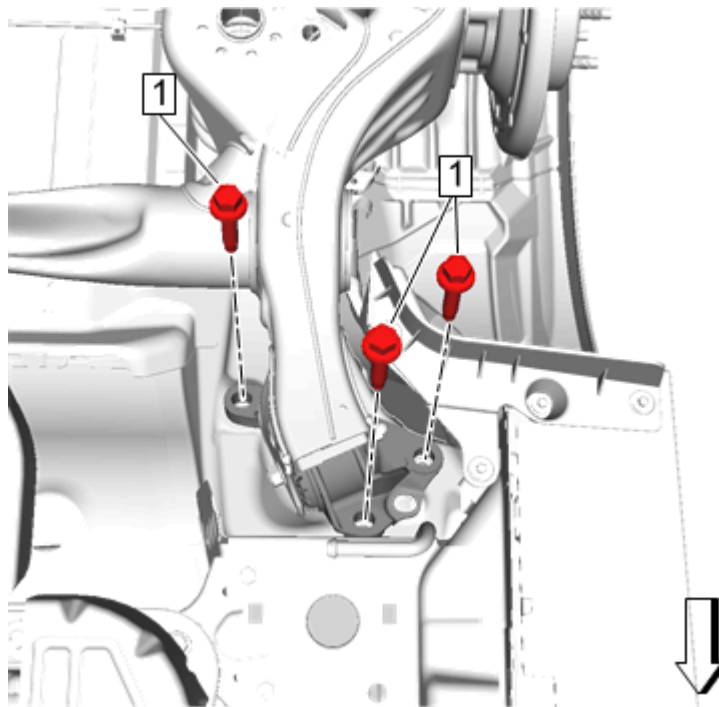


Fig. 132: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Torque-to-Yield Fastener Warning](#) .

CAUTION: [Fastener Caution](#)

8. Install 3 NEW right side axle bracket bolts (1). [Rear Axle Bracket Replacement](#)

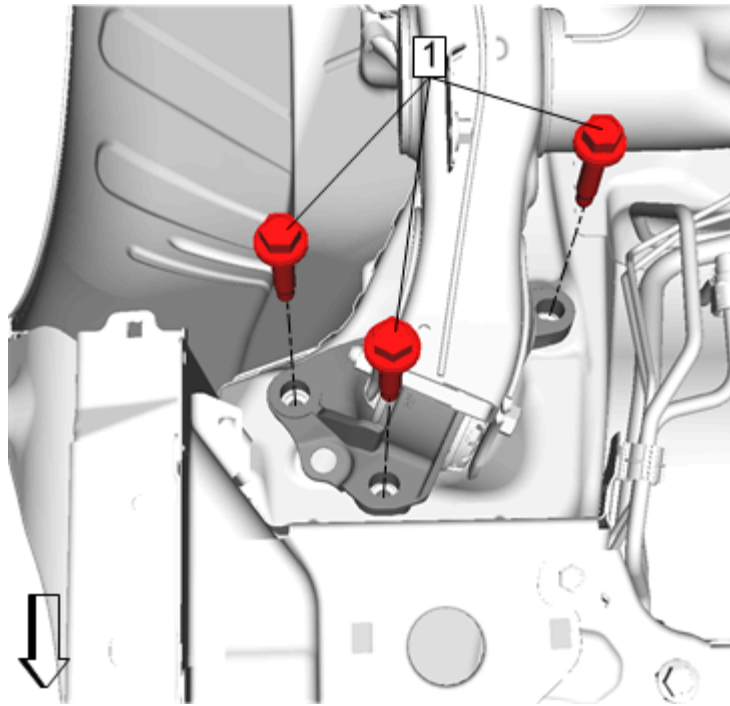


Fig. 133: Left Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Remove and DISCARD the left side axle bracket bolts. Install 3 NEW left side axle bracket bolts (1).

Rear Axle Bracket Replacement

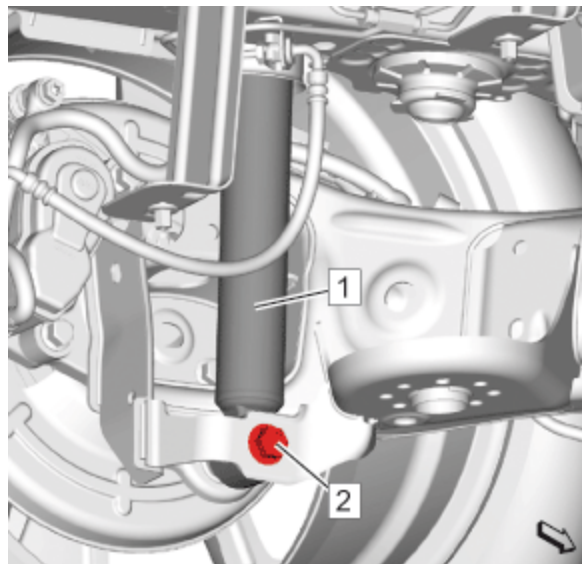


Fig. 134: Shock And Lower Shock Fasteners

Courtesy of GENERAL MOTORS COMPANY

10. Support the rear axle and remove the lower shock bolt (2).
11. Install the rear coil springs. Refer to **Rear Coil Spring Replacement** .

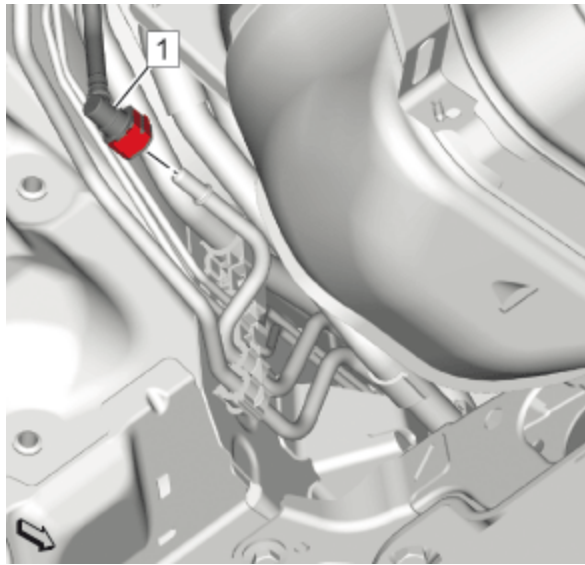


Fig. 135: Fuel Feed Pipe

Courtesy of GENERAL MOTORS COMPANY

12. Remove the EN-6015 plugs.
13. Connect Fuel Feed Pipe (1) [Plastic Collar Quick Connect Fitting Service](#)

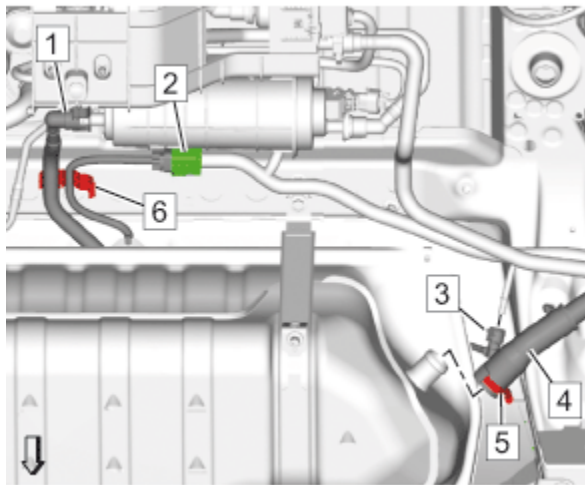


Fig. 136: Evaporative Emission Rear Hose, Fuel Tank Filler Hose, Vent Pipe, Electrical Connector, Retainer And Clamp

Courtesy of GENERAL MOTORS COMPANY

14. Install Fuel Tank Filler Hose (4)

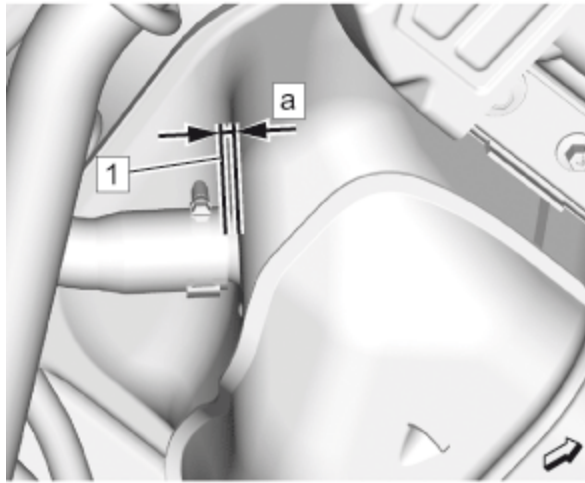


Fig. 137: Ensure Filler Hose Is Fully Seated And Installed Correctly

Courtesy of GENERAL MOTORS COMPANY

15. Make sure that the hose is fully seated on the fuel tank. Filler hose is correctly installed when the end of the hose is even with where the fill spud on the tank increases in diameter. The gap (1) between the tank and the end of hose will be (a) 6 mm (1/4 in) when hose is correctly installed.

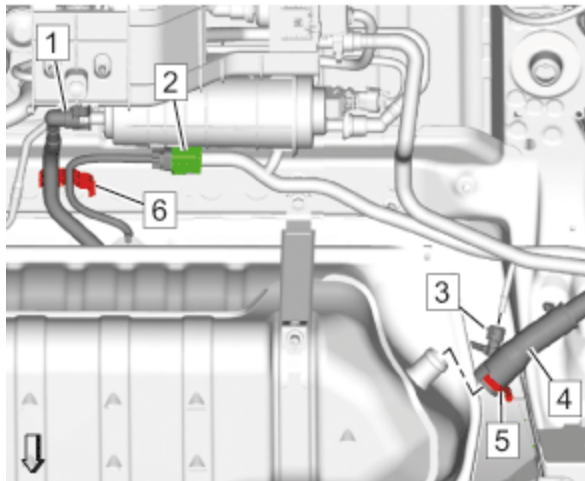


Fig. 138: Evaporative Emission Rear Hose, Fuel Tank Filler Hose, Vent Pipe, Electrical Connector, Retainer And Clamp

Courtesy of GENERAL MOTORS COMPANY

16. Clamp (5) - Tighten 3.5 N.m (31 lb in)

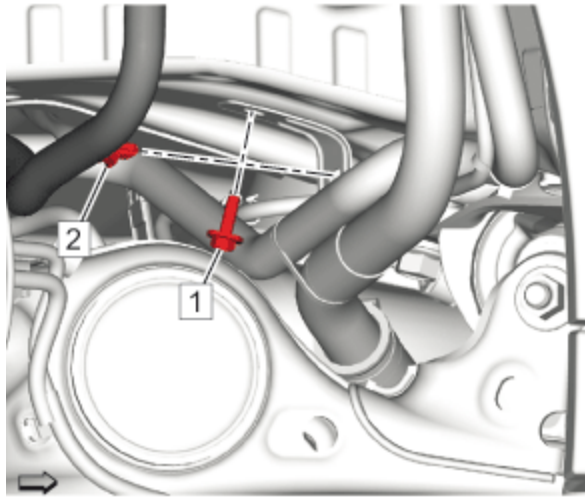


Fig. 139: Fuel Tank Filler Pipe Ground Bolt And Wiring Harness Clip
 Courtesy of GENERAL MOTORS COMPANY

17. Install Fuel Tank Filler Pipe Ground Bolt (1) and tighten 9 N.m (80 lb in)

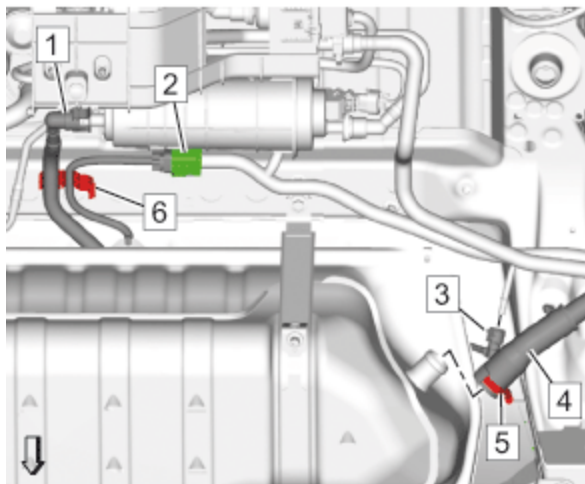


Fig. 140: Evaporative Emission Rear Hose, Fuel Tank Filler Hose, Vent Pipe, Electrical Connector, Retainer And Clamp
 Courtesy of GENERAL MOTORS COMPANY

18. Remove the **EN-6015** plugs.
19. Connect Fuel Tank Filler Vent Pipe (3) [Plastic Collar Quick Connect Fitting Service](#)
20. Close the retainer (6).
21. Connect the fuel tank fuel pump module wiring harness electrical connector (2).
22. Remove the **EN-6015** plugs.
23. Connect Evaporative Emission Rear Hose (1) [Plastic Collar Quick Connect Fitting Service](#)
24. Install [Underbody Front Air Deflector Replacement - Left Side](#)
25. Install [Underbody Rear Air Deflector Replacement](#)

- 26. Lower the vehicle.
- 27. Refill the fuel tank.
- 28. Connect [Battery Negative Cable Disconnection and Connection](#)
- 29. Cycle the ignition to run the fuel pump and check for fuel leaks.

FUEL TANK PRESSURE SENSOR REPLACEMENT

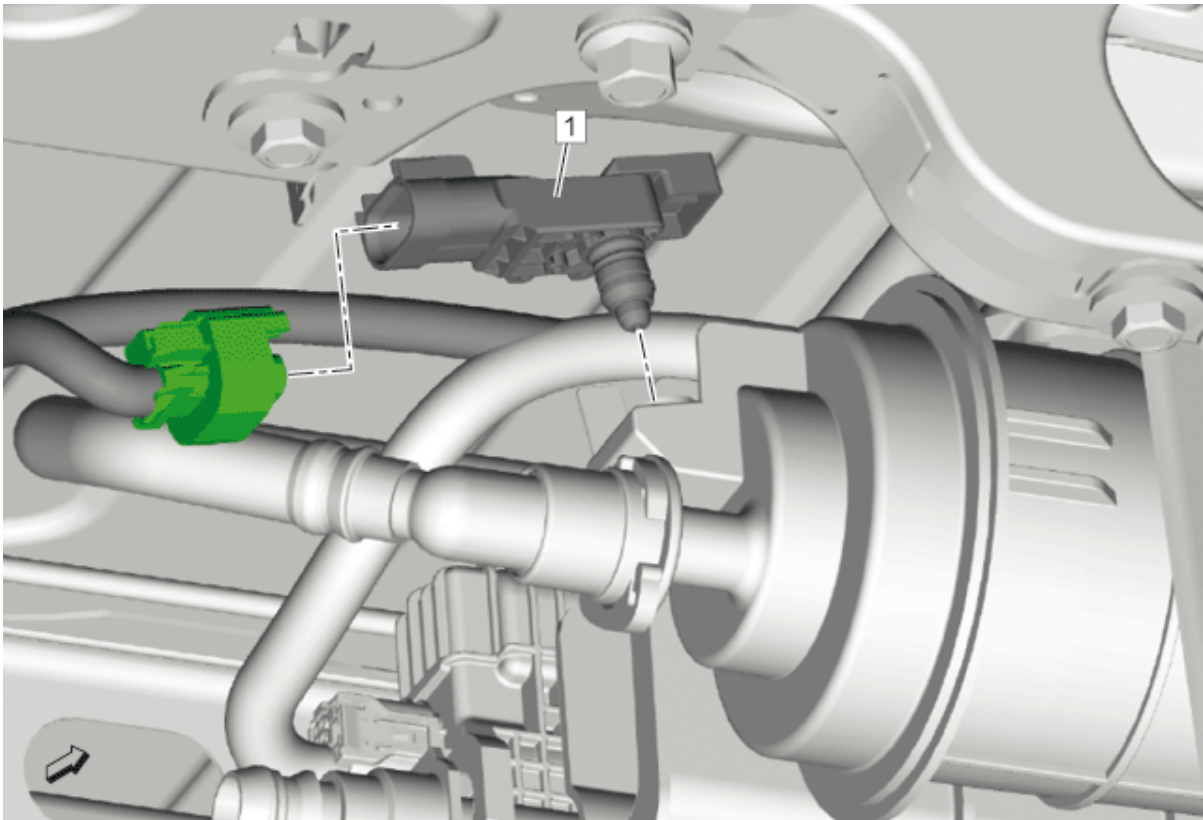


Fig. 141: Fuel Tank Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Battery Negative Cable Disconnection and Connection 2. Underbody Rear Air Deflector Replacement	
1	Fuel Tank Pressure Sensor Procedure Disconnect the electrical connector.

FUEL PUMP FUEL FEED HOSE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. [Battery Negative Cable Disconnection and Connection](#) - Disconnect
3. Lower the fuel tank, to get enough space to remove the fuel pipe. Refer to [Fuel Tank Replacement](#).

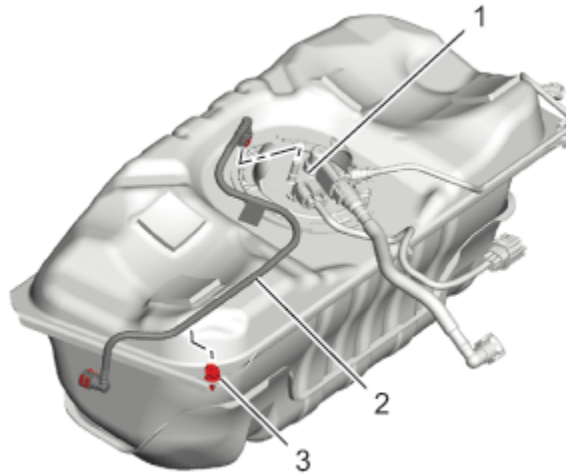


Fig. 142: Fuel Tank Fuel Pump Module, Fuel Pump Fuel Feed Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Fuel Pump Fuel Feed Hose (2) @Fuel Tank Fuel Pump Module (1) -[Plastic Collar Quick Connect Fitting Service](#)
5. Close all open connections with the **EN-6015** plugs.
6. Unclip Fuel Pump Fuel Feed Hose (2) @Retainer (3)

Installation Procedure

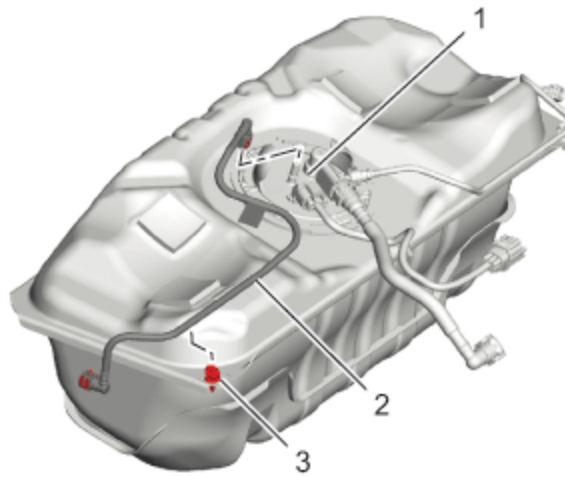


Fig. 143: Fuel Tank Fuel Pump Module, Fuel Pump Fuel Feed Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Pump Fuel Feed Hose (2) @Retainer (3)
2. Remove the **EN-6015** plugs from all connections.
3. Connect Fuel Pump Fuel Feed Hose (2) @Fuel Tank Fuel Pump Module (1) -[Plastic Collar Quick Connect Fitting Service](#)
4. Install [Fuel Tank Replacement](#)
5. Connect [Battery Negative Cable Disconnection and Connection](#)
6. Cycle the ignition to run the fuel pump and check for fuel leaks.

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT

Special Tools

EN-51146 Fuel Injector Removal / Installation Kit

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#) .

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

CAUTION: When working on the fuel rail and fuel injectors, always maintain a clean work surface. Failure to maintain a clean work surface can result in contaminant on the injector seals and cause leaks.

1. Remove [Fuel Injection Fuel Rail Assembly Removal and Installation](#)

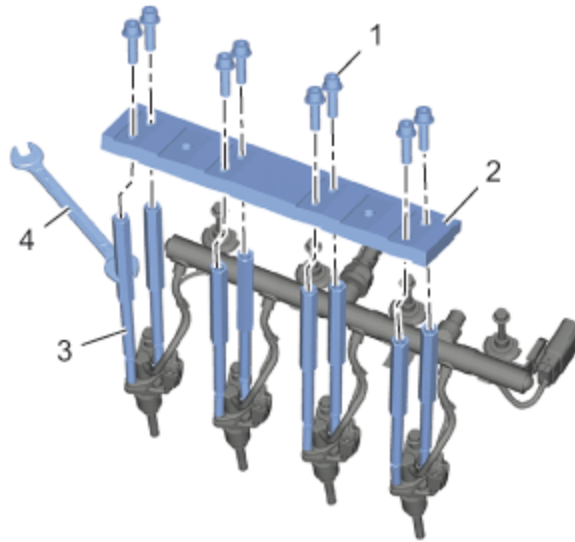


Fig. 144: Plate, Bolts And Supports

Courtesy of GENERAL MOTORS COMPANY

NOTE: The EN-51146 - 2 - 5 calibrations tools must be installed.

2. Remove the 8 plate bolts (1) and remove the **EN-51146-1-2** plate (2), counterhold with a wrench (4) at the **EN-51146-1-1** supports (3).
3. Remove the 8 **EN-51146-1-1** supports (3).

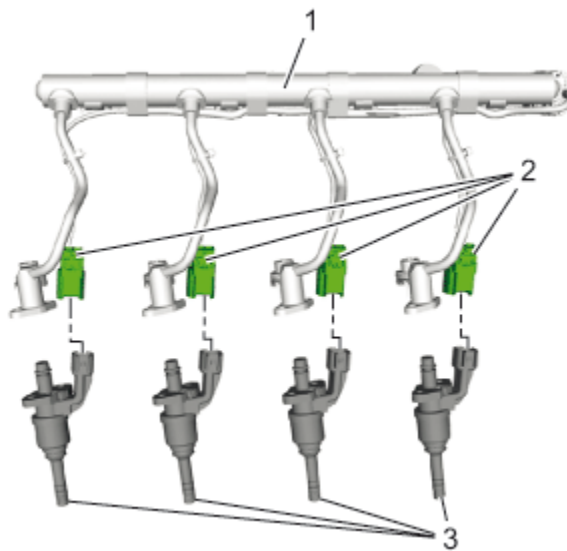


Fig. 145: Fuel Injection Fuel Rail, Fuel Injector And Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Fuel Injector Wiring Harness (2)
5. Remove Fuel Injector (3) @Fuel Injection Fuel Rail (1)

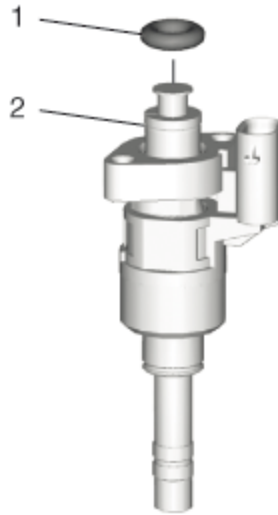


Fig. 146: Fuel Injector And O-Ring

Courtesy of GENERAL MOTORS COMPANY

6. Remove O-Ring (1) @Fuel Injector (2) and DISCARD

Cleaning Procedure

Clean the fuel injector bores. If the fuel injectors will be reused, clean the fuel injectors. [**Fuel Injection Fuel Rail Assembly Removal and Installation.**](#)

Installation Procedure

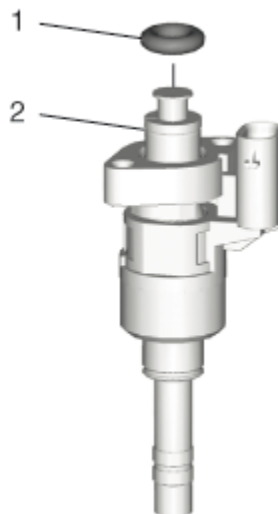


Fig. 147: Fuel Injector And O-Ring

Courtesy of GENERAL MOTORS COMPANY

1. Coat the fuel injector seals with engine oil.(1)

NOTE: The EN-51146 - 2 - 5 calibrations tools must be installed.

2. Install O-Ring (1) @Fuel Injector (2)

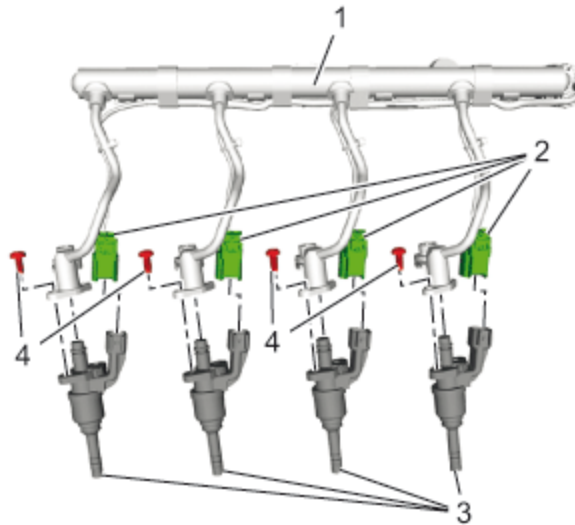


Fig. 148: Fuel Injection Fuel Rail, Fuel Injector Wiring Harness Connectors, Fuel Injectors And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the old bolt.

3. Install Fuel Injector (3) @Fuel Injection Fuel Rail (1)

4. Apply thread locking adhesive to the NEW fuel injector bolts.(4)Adhesives, Fluids, Lubricants, and Sealers

CAUTION: Fastener Caution

NOTE: Install NEW bolts.

5. Install Fuel Injector Bolt (4) @Fuel Injector(3) and tighten 5 N.m (44 lb in)

6. Connect Fuel Injector Wiring Harness (2)

7. Install Fuel Injection Fuel Rail Assembly Removal and Installation

FUEL INJECTOR REPLACEMENT

Special Tools

EN-51146 Fuel Injector Removal / Installation Kit

Equivalent regional tools:Special Tools (Diagnostic Tools) Special Tools (Repair Tools) .

Removal Procedure

WARNING: Diesel/Gasoline Vapors Warning

WARNING: Safety Goggles and Fuel Warning

CAUTION: When working on the fuel rail and fuel injectors, always maintain a clean work surface. Failure to maintain a clean work surface can result in contaminant on the injector seals and cause leaks.

1. Remove Fuel Injection Fuel Rail Assembly Removal and Installation

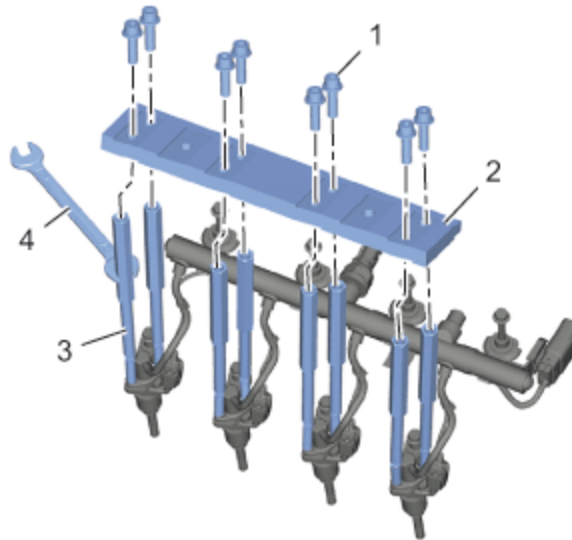


Fig. 149: Plate, Bolts And Supports

Courtesy of GENERAL MOTORS COMPANY

NOTE: The EN-51146 - 2 - 5 calibrations tools must be installed.

2. Remove the 8 plate bolts (1) and remove the EN-51146-1-2 plate (2), counterhold with a wrench (4) at the EN-51146-1-1 supports (3).
3. Remove the 8 EN-51146-1-1 supports (3).

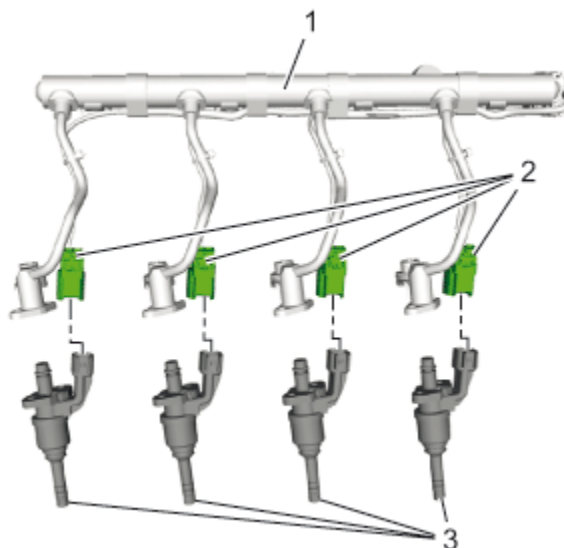


Fig. 150: Fuel Injection Fuel Rail, Fuel Injector And Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Fuel Injector Wiring Harness (2)
5. Remove Fuel Injector(3)@Fuel Injection Fuel Rail(1)

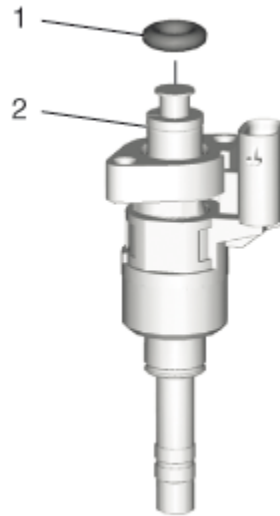


Fig. 151: Fuel Injector And O-Ring

Courtesy of GENERAL MOTORS COMPANY

6. Remove O-Ring (1) @Fuel Injector (2) and DISCARD

Cleaning Procedure

1. Clean the fuel injector bores. If the fuel injectors will be reused, clean the fuel injectors. [**Fuel Injection Fuel Rail Assembly Removal and Installation.**](#)
2. Inspect the NEW fuel injector. [**Fuel Injection Fuel Rail Assembly Removal and Installation.**](#)

Installation Procedure

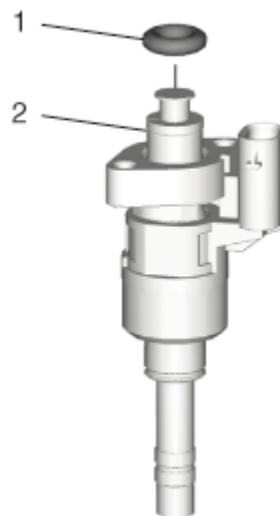


Fig. 152: Fuel Injector And O-Ring

Courtesy of GENERAL MOTORS COMPANY

1. Coat the fuel injector seals with engine oil.(1)

NOTE: The EN-51146 - 2 - 5 calibrations tools must be installed.

2. Install O-Ring (1) @ Fuel Injector (2)

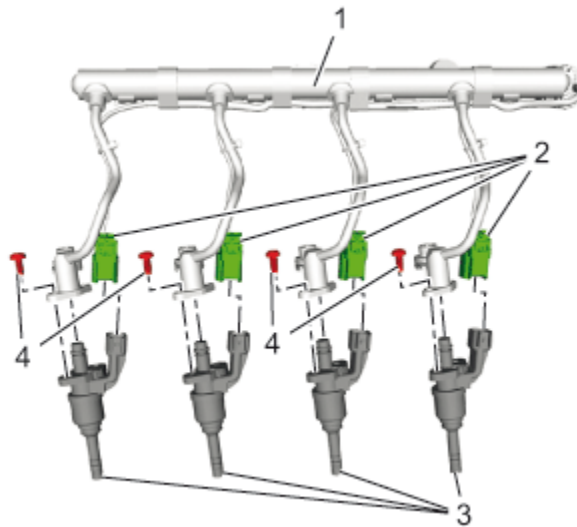


Fig. 153: Fuel Injection Fuel Rail, Fuel Injector Wiring Harness Connectors, Fuel Injectors And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT reuse the old bolt.

3. Install Fuel Injector(3) @Fuel Injection Fuel Rail (1)
4. Apply thread locking adhesive to the NEW fuel injector bolts.(4)Adhesives, Fluids, Lubricants, and Sealers

CAUTION: Fastener Caution

NOTE: Install NEW bolts.

5. Install Fuel Injector Bolt (4) @Fuel Injector (3) and tighten 5 N.m (44 lb in)
6. Connect Fuel Injector Wiring Harness(2)
7. Install Fuel Injection Fuel Rail Assembly Removal and Installation

FUEL INJECTOR WIRING HARNESS REPLACEMENT

Removal Procedure

1. Remove Fuel Injection Fuel Rail Assembly Replacement

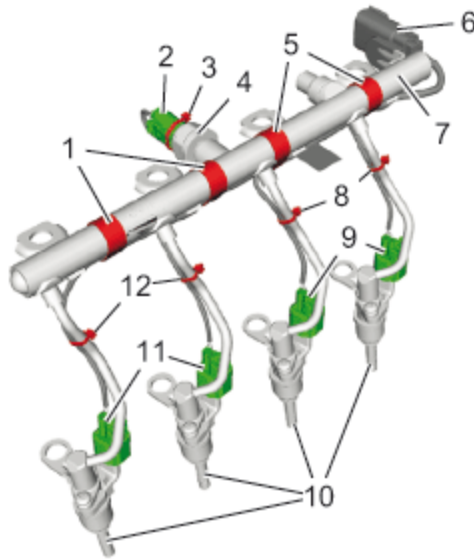


Fig. 154: Fuel Injector Wiring Harness Components

Courtesy of GENERAL MOTORS COMPANY

2. Cut the cable tie (3).
3. Disconnect the fuel injection fuel rail fuel pressure sensor wiring harness electrical connector (2) from the fuel rail fuel pressure sensor (4).
4. Remove and DISCARD the 4 insulating tape stripes (1, 5).
5. Disconnect the 4 fuel injector wiring harness electrical connectors (9, 11) from the fuel injectors (10).
6. Clip out the fuel injector wiring harness (6) from the fuel rail (7).
7. Cut the 4 cable ties (8, 12).

Installation Procedure

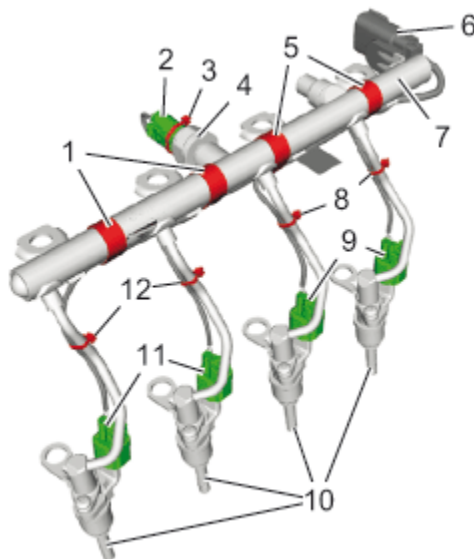


Fig. 155: Fuel Injector Wiring Harness Components

Courtesy of GENERAL MOTORS COMPANY

1. Connect the 4 fuel injector wiring harness electrical connectors (9, 11) to the 4 fuel injectors (10).

2. Clip in the fuel injector wiring harness (6) to the fuel rail (7).
3. Install NEW 4 cable ties (8, 12) to the position where they have been removed.
4. Connect the fuel injection fuel rail fuel pressure sensor wiring harness plug (2) to the fuel rail fuel pressure sensor (4).
5. Install a NEW cable tie (3) to the position where it have been removed.
6. Install 4 NEW insulating tape stripes (1, 5) to the position where it have been removed.
7. Install [Fuel Injection Fuel Rail Assembly Replacement](#)

FUEL INJECTION FUEL RAIL ASSEMBLY REMOVAL AND INSTALLATION

Special Tools

- **EN-51146** Fuel Injector Removal/ Installation Kit
- **EN-51146-100** Adapter Plate
- **EN-51146-150** Injector Remover/Installer Adapters

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

CAUTION: When working on the fuel rail and fuel injectors, always maintain a clean work surface. Failure to maintain a clean work surface can result in contaminant on the injector seals and cause leaks.

1. Remove [Ignition Coil Replacement](#)
2. Remove [Fuel Feed Intermediate Pipe Replacement](#)

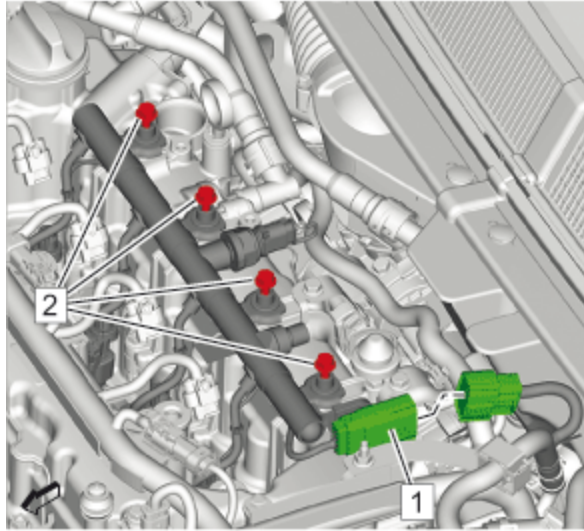


Fig. 156: Fuel Injection Fuel Rail Wiring Harness And Fuel Rail Bolts
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Fuel Injection Fuel Rail Wiring Harness(1)

NOTE: The fuel rail bolts remain with decoupling elements and retainer at the fuel rail assembly.

4. Loosen the 4 fuel rail bolts (2) from the cylinder head completely, but do not remove the bolts.

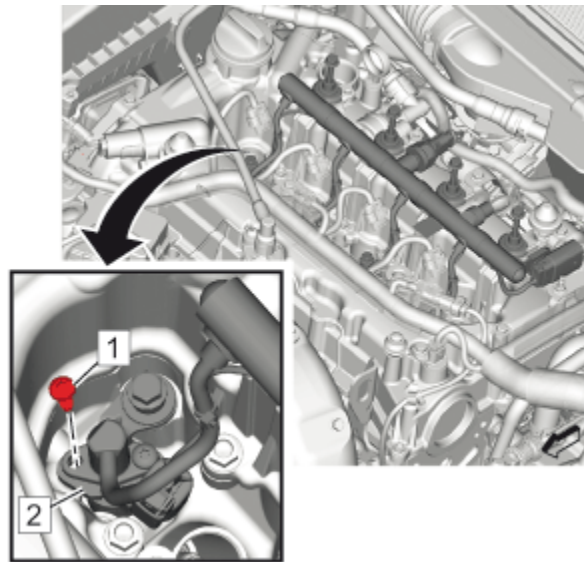


Fig. 157: fuel injector cylinder 1
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Never loosen both bolts at the same time. Failure to follow this caution could cause leaks or malfunction after installation.

NOTE: Pay attention, that the bolt does not fall into the cylinder head slot.

5. Remove the fuel injector bolt (1) from the fuel injector cylinder 1 (2) at the rail side.

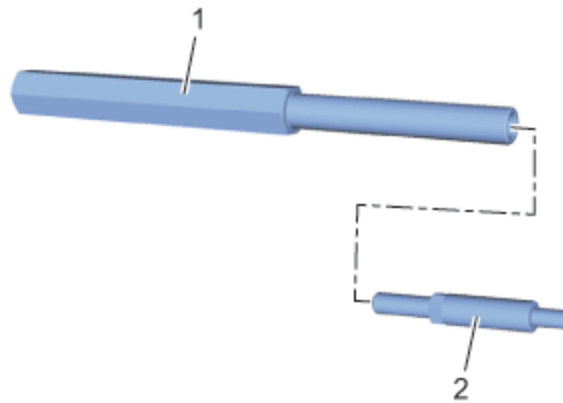


Fig. 158: Demounting Screw And Support

Courtesy of GENERAL MOTORS COMPANY

6. Install the **EN-51146 - 1-150** demounting screw to the **EN-51146-1-1** support (1) and tighten to 7N.m (62 lb in).

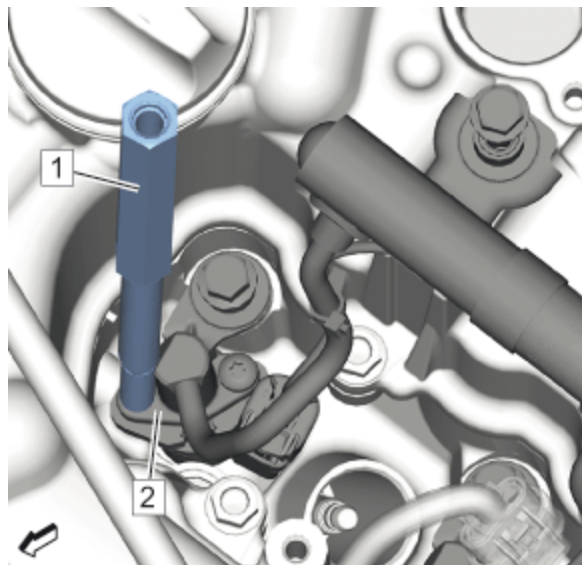


Fig. 159: Support And Cylinder 1 Fuel Injector

Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-51146-1-1** support (1) to the fuel injector cylinder 1 (2) and tighten to 5 N.m (44 lb in).

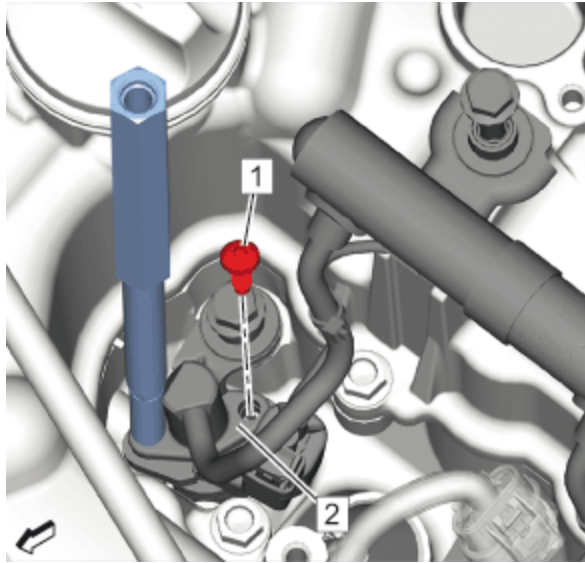


Fig. 160: Fuel Injector Cylinder

Courtesy of GENERAL MOTORS COMPANY

8. Remove the fuel injector bolt (1) from the fuel injector cylinder 1 (2).
9. Install the **EN-51146-1-6** demounting screw or **EN-51146-150** demounting screw to the **EN-51146-1-1** support and tighten to 7 N.m (62 lb in).

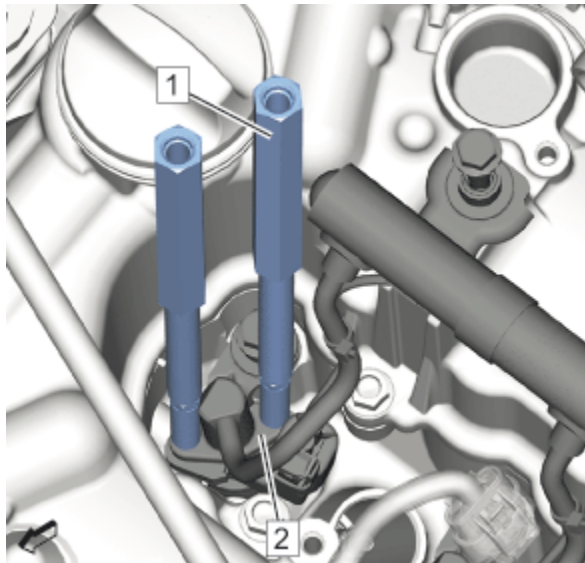


Fig. 161: Support And Cylinder 1 Fuel Injector

Courtesy of GENERAL MOTORS COMPANY

10. Install the **EN-51146-1-1** support (1) to the fuel injector cylinder 1 (2) and tighten to 5 N.m (44 lb in).
11. Repeat the steps 5 - 10 for the other 3 injectors.

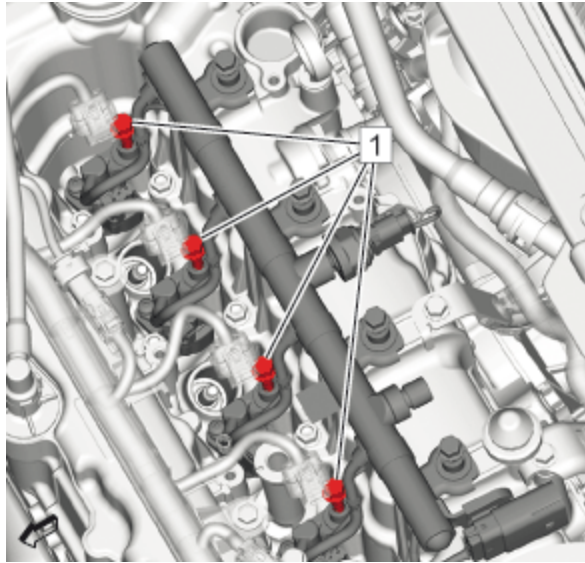


Fig. 162: Fuel Rail Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The fuel rail bolts remain with decoupling elements and retainer at the fuel rail assembly.

12. Loosen the 4 fuel rail bolts (1) completely from the cylinder head, but do not remove the bolts.

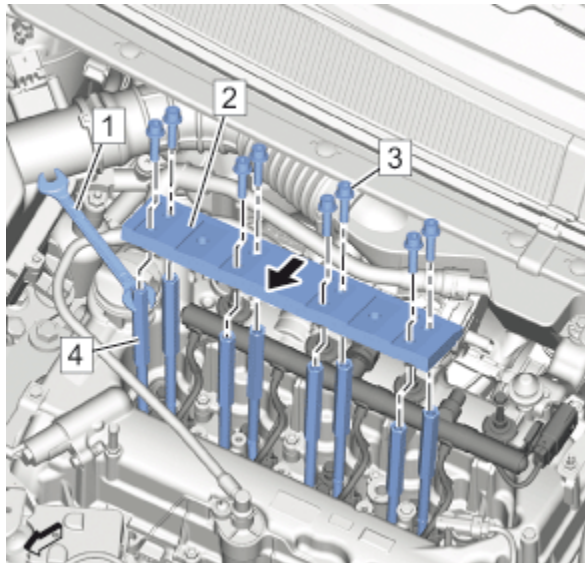


Fig. 163: Plates, Supports And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the arrow on the EN-51146-100 plate. The arrow must show in driving direction.

13. Install the **EN-51146-100** plate (2) to the 8 **EN-51146-1-1** supports (4).

14. Install the 8 plate bolts (3).

15. Tighten the 8 plate bolts (3) and counterhold with a wrench (1) at the **EN-51146-1-1** supports (4).

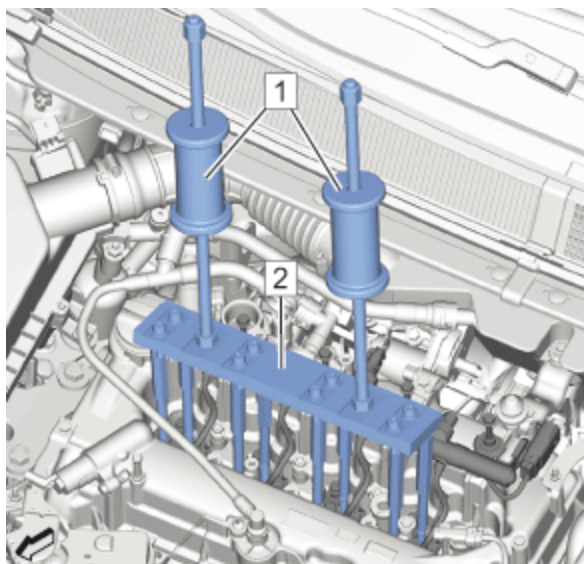


Fig. 164: Slide Hammers And Plate

Courtesy of GENERAL MOTORS COMPANY

16. Install the 2 EN-51146-1-3 sliding hammers (1) to the EN-51146-1-2 plate (2).

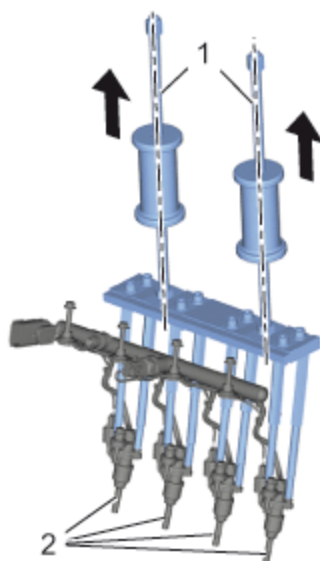


Fig. 165: Removing Injectors

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the fuel injectors do not become tilted. Failure to follow this caution can tilt or bend the injectors and could cause leaks or malfunction after installation.

17. Use the 2 EN-51146-1-3 sliding hammers at first equally to remove the fuel injector rail assembly, if necessary apply additional force to either side as necessary to release the rail evenly.
18. Ensure that the angle of the 2 EN-51146-1-3 sliding hammers (1) accord to the angle of the fuel injectors (2), while removing.

CAUTION: After removal of the fuel injection fuel rail assembly, check the

completeness of the assembly. Check that no decoupling elements, fuel rail bolts or fuel injector seals remain near the fuel injector bores on the cylinder head. Failure to perform this can result in poor engine performance or engine damage.

19. Remove the fuel injector rail assembly.

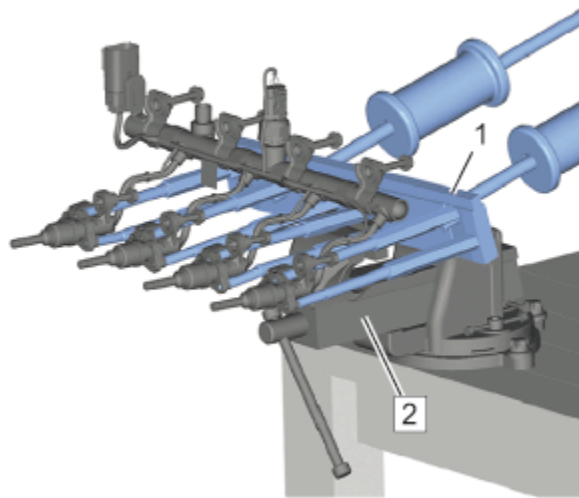


Fig. 166: Plate Installed In Vise

Courtesy of GENERAL MOTORS COMPANY

CAUTION: After removing the fuel rail and injector assembly, do not allow the weight of the assembly to rest on the fuel injectors. Always position the assembly on a clean work surface with the fuel injectors on top. Failure to follow this caution could cause leaks or malfunction after installation.

20. Install the **EN-51146-1-2** plate (1) with the fuel injector assembly to a bench vise (2).

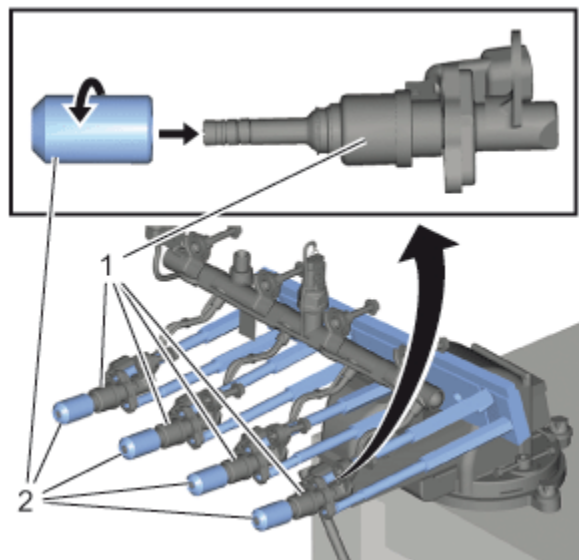


Fig. 167: Calibration Tools And Fuel Injectors

Courtesy of GENERAL MOTORS COMPANY

NOTE: The EN-51146-2-5 calibration tools are also used to protect the fuel injectors.

21. Install the 4 EN-51146-2-5 calibration tools (2) rotary to the fuel injectors (1), as shown in the graphic.
22. Cover the fuel injector bores at the cylinder head, to prevent for dirt.
23. Remove the 2 EN-51146-1-3 sliding hammers.
24. Remove the 4 EN-51146-2-5 calibration tools.

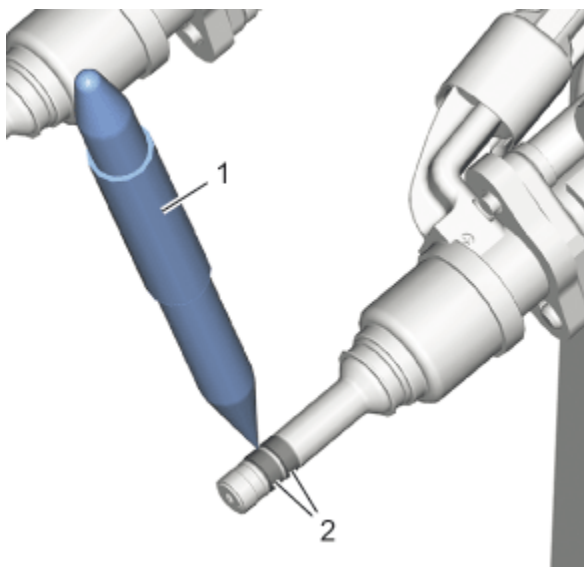


Fig. 168: Combustion Seals And Stylus

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Always use the stylus from the EN-51146 fuel injector kit. Never use a metal tool in place of the stylus. Use of another tool can damage the fuel injector and may cause a leak.

25. Remove the 2 combustion seals (2) each fuel injector, use EN-51146-2-1 stylus (1).
26. Inspect all fuel injectors for damage.

Installation Procedure

1. Clean and inspect the fuel injectors and the fuel injector rail. Do not remove the fuel injector from the fuel rail. Refer to [Fuel Injector and Fuel Injector Bore Cleaning and Inspection](#) .

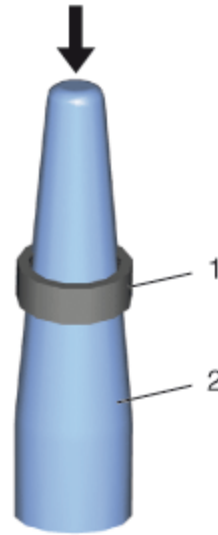


Fig. 169: Combustion Fuel Injector Seal And Long Mounting Sleeve
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW combustion fuel injector seal (1) to the **EN-51146-2-2** mounting sleeve-long (2).

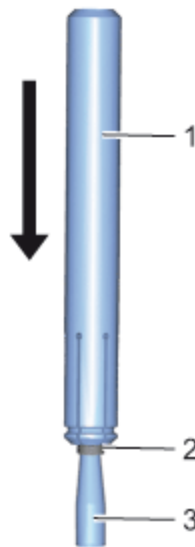


Fig. 170: Installing Combustion Seals
Courtesy of GENERAL MOTORS COMPANY

3. Use the **EN-51146-2-6-1** slider outside (1) to push down the combustion fuel injector seal (2) on the **EN-51146-2-2** mounting sleeve-long (3).

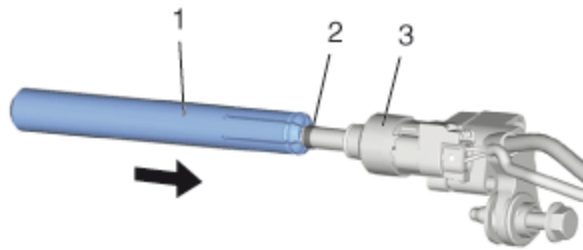


Fig. 171: Installing Combustion Seals

Courtesy of GENERAL MOTORS COMPANY

4. Push the combustion fuel injector seal (2) over the **EN-51146-2-2** mounting sleeve-long, use the **EN-51146-2-6-1** slider outside (1) to the fuel injector (3).
5. Remove the **EN-51146-2-2** mounting sleeve-long with the **EN-51146-2-1** stylus from the **EN-51146-2-6-1** slider outside.
6. Install a NEW combustion fuel injector seal to the **EN-51146-2-3** mounting sleeve-short.
7. Use the **EN-51146-2-6-1** slider outside to push down the combustion fuel injector seal on the **EN-51146-2-2** mounting sleeve-short.
8. Push the combustion fuel injector seal over the **EN-51146-2-3** mounting sleeve-short, use the **EN-51146-2-6-1** slider outside to the fuel injector.
9. Remove the **EN-51146-2-3** mounting sleeve-short with the **EN-51146-2-1** stylus from the **EN-51146-2-6-1** slider outside.

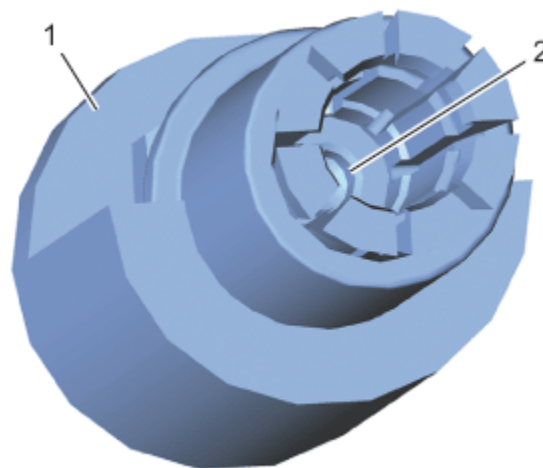


Fig. 172: Fuel Injector Limiter

Courtesy of GENERAL MOTORS COMPANY

10. Before using the **EN-51146-2-4** pre-sizing tool (1), check if the fuel injector limiter (2) is in the right position.

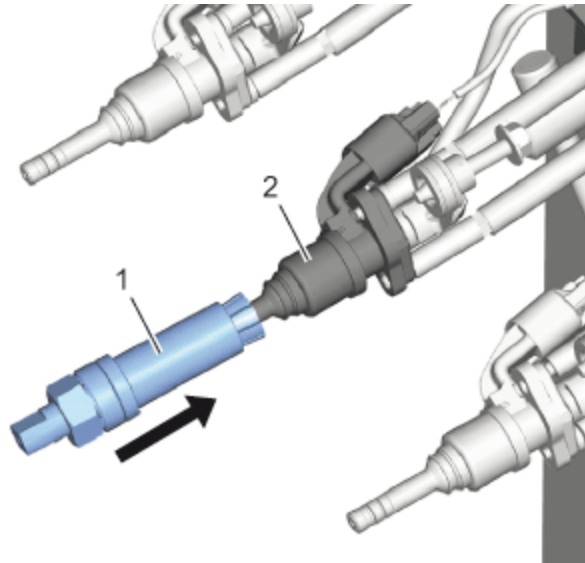


Fig. 173: Pre-Sizing Tool And Fuel Injector
Courtesy of GENERAL MOTORS COMPANY

NOTE: First form the combustion fuel injector seals a bit with finger and thumb.

11. Push the **EN-51146-2-4** pre-sizing tool (1) over the fuel injector (2).

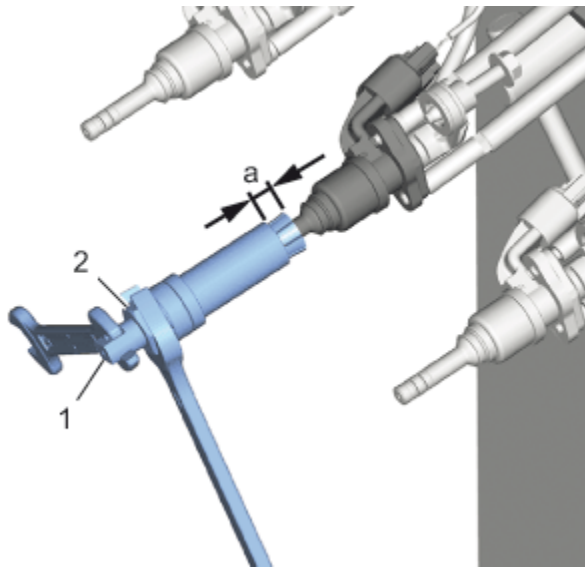


Fig. 174: Pre-Sizing Tool
Courtesy of GENERAL MOTORS COMPANY

12. Tighten the nut (2) and counterhold at the spanner flat of the **EN-51146-2-4** pre-sizing tool thread (1) until the measure (a) of 4.5 mm (0.177 in) is reached.
13. Loosen the nut (2) of the **EN-51146-2-4** pre-sizing tool.

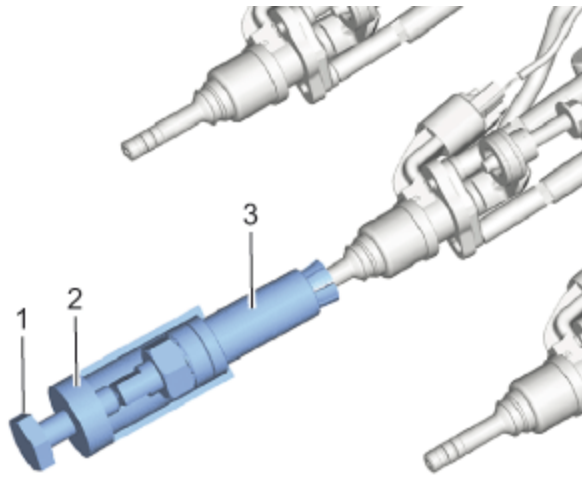


Fig. 175: Take Off Chassis And Pre-Sizing Tool

Courtesy of GENERAL MOTORS COMPANY

14. Install the **EN-51146-2-4-7** take off chassis (2) to the **EN-51146-2-4** pre-sizing tool (3).
15. Install the **EN-51146-2-4-6** screw M10 (1) to the **EN-51146-2-4-7** take off chassis (2), and tighten until the **EN-51146-2-4** pre-sizing tool (3) is loosened.

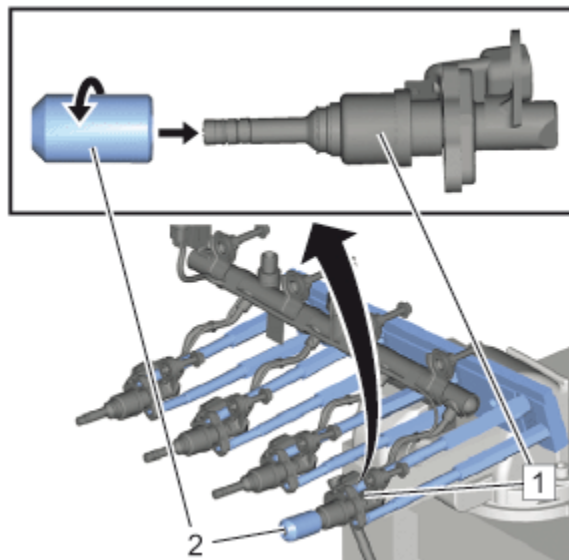


Fig. 176: Calibration Tool And Fuel Injector

Courtesy of GENERAL MOTORS COMPANY

16. Install the **EN-51146-2-5** calibration tool (2) rotary to the fuel injector (1), as shown in the graphic.
17. Remove the **EN-51146-2-5** calibration tool from the fuel injector.

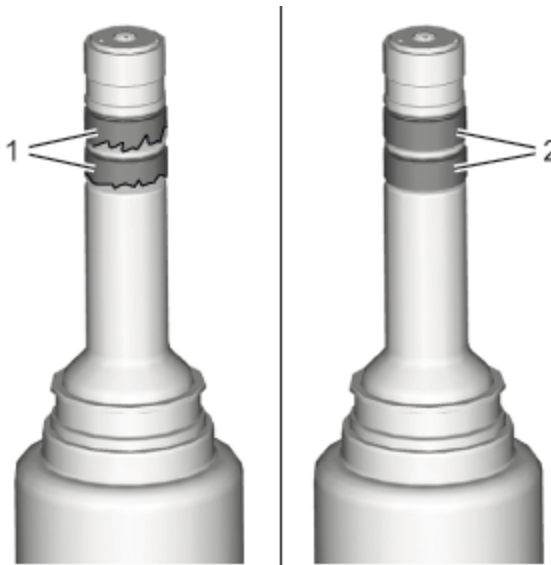


Fig. 177: Installing Seal

Courtesy of GENERAL MOTORS COMPANY

WARNING: The fuel injector seals must fit properly in the relative groove. Overlapping of the fuel injector seals with the external surface of the injector must be avoided. If the seals are installed incorrectly, it could cause leaks and risk of injury.

18. Check the combustion fuel injector seals (2 seals each fuel injector) for correct seat:

- The seal must not be too large, buckled or corrugated (1).
- The seal must be fixed tight and accurate (2).

19. If the seals are installed not correctly, repeat the steps 27 - 29 of the removal procedure and the steps 1 - 19 of the installation procedure.

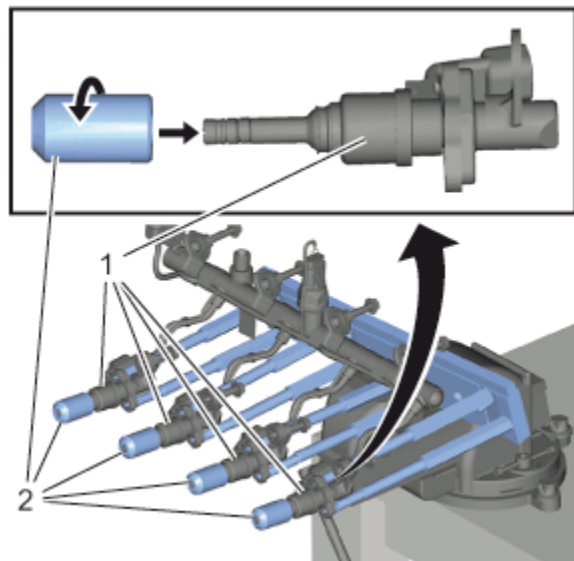


Fig. 178: Calibration Tools And Fuel Injectors

Courtesy of GENERAL MOTORS COMPANY

20. Install the 4 EN-51146-2-5 calibration tools (2) rotary to the fuel injectors (1).

21. Remove the fuel injector assembly with the **EN-51146-100** plate from the bench vise.

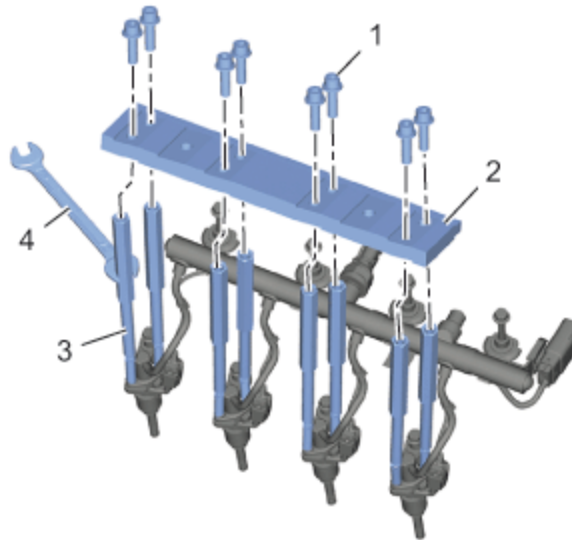


Fig. 179: Plate, Bolts And Supports

Courtesy of GENERAL MOTORS COMPANY

22. Remove the 8 plate bolts (1) and remove **EN-51146-100** plate (2), counterhold with a wrench (4) at the **EN-51146-1-1** supports (3).

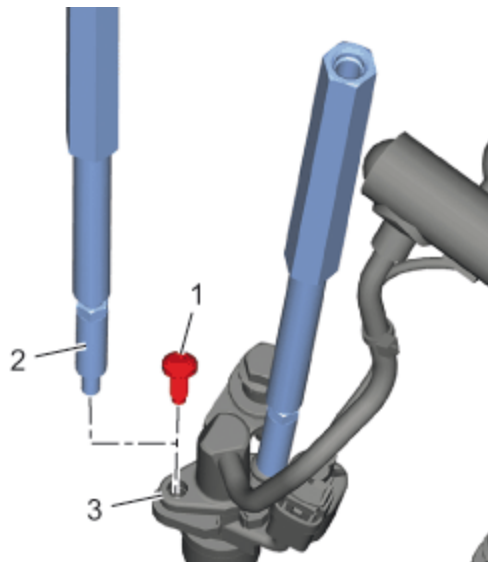


Fig. 180: Support, Fuel Injector And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Never loosen both **EN-51146-1-1** supports at the same time. Failure to follow this caution could cause leaks or malfunction after installation. It is only possible, when the fuel injector will be replaced.

23. Remove one **EN-51146-1-1** support (2) from the fuel injector (3).

NOTE: DO NOT reuse the old fuel injector bolt.

24. Apply thread lock agent to the NEW fuel injector bolt (1).
25. Install NEW fuel injector bolt to the fuel injector and tighten to 5 N.m (44 lb in).

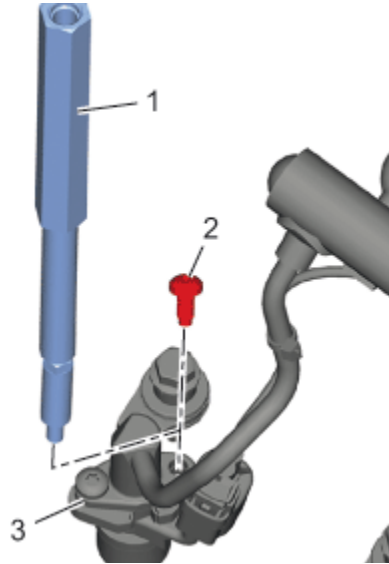


Fig. 181: Support, Fuel Injector And Bolt
Courtesy of GENERAL MOTORS COMPANY

26. Remove the EN-51146-1-1 support (1) from the fuel injector (3).

NOTE: DO NOT reuse the old fuel injector bolt.

27. Apply thread lock agent to the NEW fuel injector bolt (2).
28. Install a NEW fuel injector bolt to the fuel injector and tighten to 5 N.m (44 lb in).
29. Repeat the steps 22 - 27 for the other 3 injectors.
30. Clean the fuel injector bores at the cylinder head. Refer to [Fuel Injector and Fuel Injector Bore Cleaning and Inspection](#) .

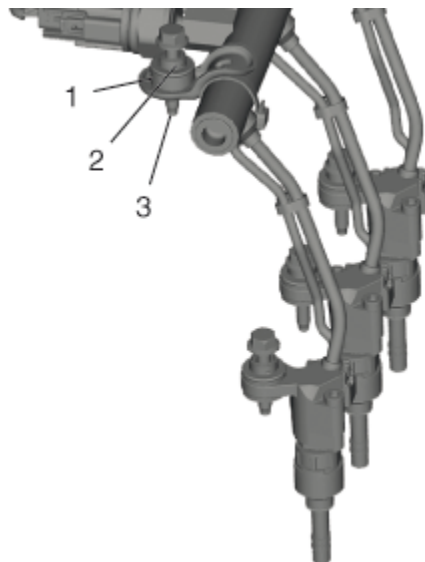


Fig. 182: Fuel Injector Rail Assembly Bolts, Decoupling Elements And Retainer
Courtesy of GENERAL MOTORS COMPANY

31. Inspect the fuel injector rail assembly:

- Check the 4 fuel injector for damage.
- Check the 8 fuel injector seals for correct seat.
- Check if all bolts (3) with decoupling elements (1) and retainer (2) are complete.

32. Remove the 4 **EN-51146-2-5** calibration tools from the fuel injector.

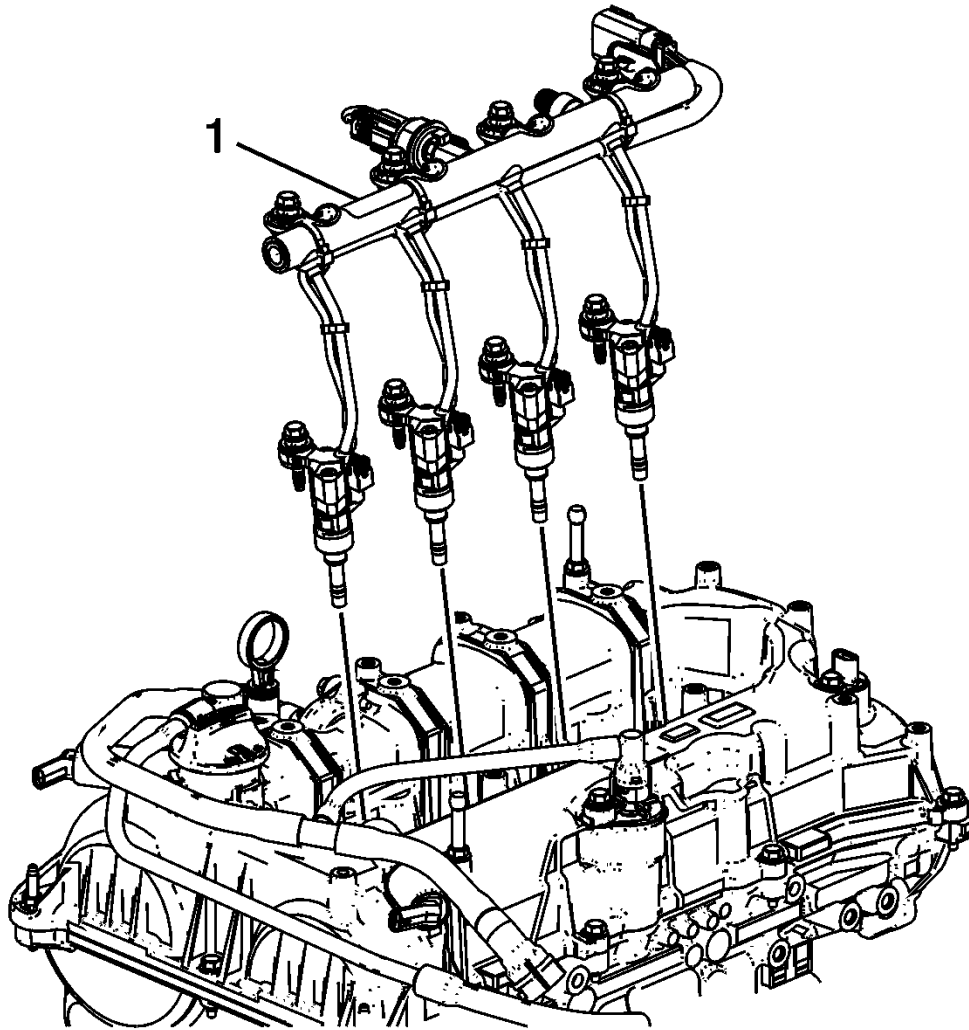


Fig. 183: Fuel Rail Assembly

Courtesy of GENERAL MOTORS COMPANY

CAUTION: During the installation of the fuel rail and injector assembly, ensure that the fuel injectors are positioned straight into the injector opening. Failure to follow this caution can tilt or bend the injectors and could cause leaks or malfunction after installation.

33. Install carefully the fuel rail assembly (1).

34. Push the fuel injectors slightly in their seats.

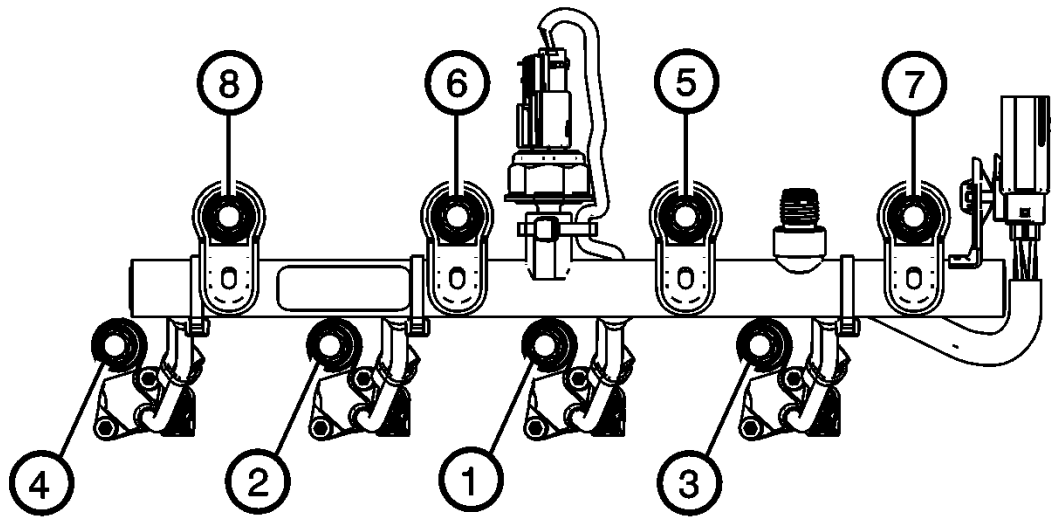


Fig. 184: Fuel Rail Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

35. Tighten the 8 fuel rail bolts in the sequence as shown to 10 N.m (89 lb in).

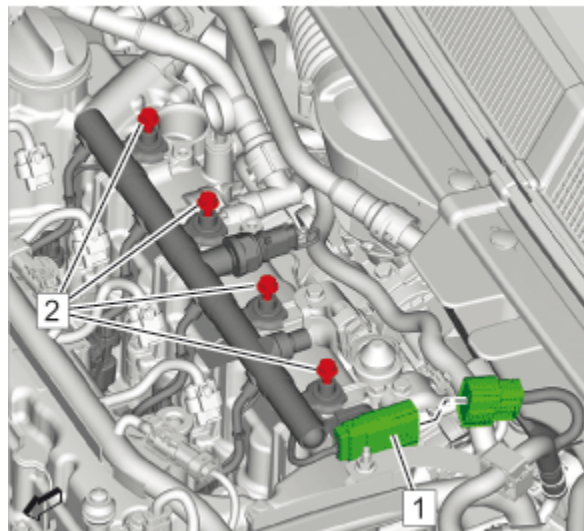


Fig. 185: Fuel Injection Fuel Rail Wiring Harness And Fuel Rail Bolts

Courtesy of GENERAL MOTORS COMPANY

36. Connect Fuel Injection Fuel Rail Wiring Harness(1)
37. Install [Fuel Feed Intermediate Pipe Replacement](#)
38. Install [Ignition Coil Replacement](#)
39. After replacement of any components of the fuel injection systems, use a scan tool to reset functions. Refer to [Control Module References](#) .

WARNING: Fuel escapes - observe safety measures and national legislation. Failure to comply could result in personal injury.

NOTE: Ensure that all work at the engine is finished.

40. Perform a fuel rail assembly leak test.
 1. Start the engine.
 2. Check the fuel system for leaks.

FUEL INJECTION FUEL RAIL FUEL PRESSURE SENSOR REPLACEMENT

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: Fuel/gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

WARNING: Wear safety glasses in order to avoid eye damage.

CAUTION: Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) .

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)
3. Remove Intake Manifold Cover - [Intake Manifold Cover Replacement](#)

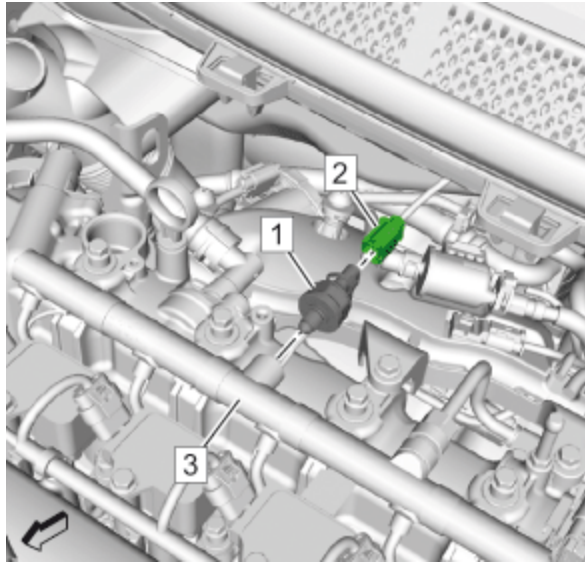


Fig. 186: Fuel Injection Fuel Rail Assembly, Fuel Injection Fuel Rail Pressure Sensor And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector (2).

NOTE:

- Do NOT apply force to the plastic housing of the fuel injection fuel rail fuel pressure sensor. ONLY apply force to the attached hexagon.
- Some fuel may leak from the fuel injection fuel rail orifice after the sensor is removed. Dry the area around the orifice using a lint free cloth.
- After removal, the area around the fuel injection fuel rail sealing surface should be inspected. The surface should be free of fuel, dirt, debris, and burrs.

5. Remove and DISCARD the fuel injection fuel rail fuel pressure sensor (1).

Installation Procedure

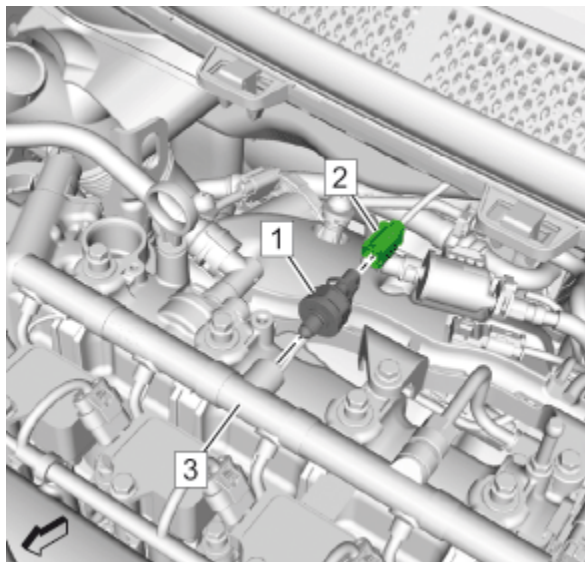


Fig. 187: Fuel Injection Fuel Rail Assembly, Fuel Injection Fuel Rail Pressure Sensor And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

NOTE:

- Do NOT apply force to the plastic housing of the fuel injection fuel rail fuel pressure sensor. ONLY apply force to the attached hexagon.
- BEFORE installation of the fuel injection fuel rail fuel pressure sensor, the fuel injection fuel rail threads MUST be clean and free of any fuel or the sensor will NOT seal properly.

1. To install the NEW fuel injection fuel rail fuel pressure sensor (1) properly, perform the following steps:
 1. Lubricate the sensor threads and sealing surface with one drop of clean engine oil.
 2. Install the sensor and hand tighten.
 3. Remove the sensor.
 4. Re-lubricate the sensor threads and sealing surface with one drop of clean engine oil.
 5. Install the sensor and tighten to 32 N.m (24 lb ft).
2. Connect the electrical connector (2).
3. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)

NOTE: If a fuel leak occurs at the fuel injection fuel rail, the fuel rail will need to be replaced.

4. Inspect for leaks using the following procedure:
 1. Turn ON the ignition with the engine OFF for 2 seconds.
 2. Turn OFF the ignition for 10 seconds.
 3. Turn ON the ignition with the engine OFF.
 4. Inspect for fuel leaks.
5. Install Intake Manifold Cover [Intake Manifold Cover Replacement](#)
6. When the replacement is completed, use a scan tool to perform the appropriate reset functions. [Control Module References](#)

FUEL PRESSURE SENSOR REPLACEMENT

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Remove [Underbody Front Air Deflector Replacement - Left Side](#)

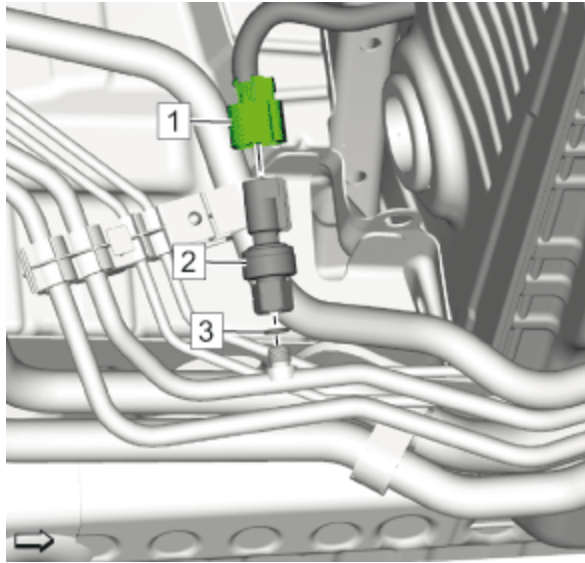


Fig. 188: Fuel Pressure Sensor, Seal Ring And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector.(1)
4. Place a drain pan under the vehicle.
5. Remove Fuel Pressure Sensor(2)
6. Remove Seal Ring(3) and DISCARD

Installation Procedure

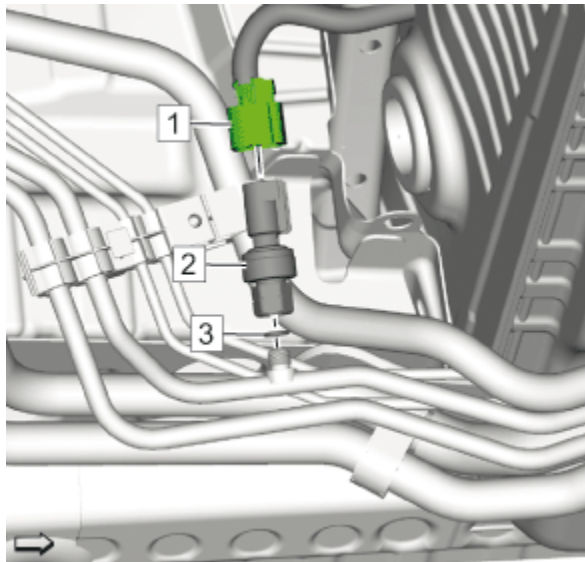


Fig. 189: Fuel Pressure Sensor, Seal Ring And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW seal.(3)

CAUTION: **Component Fastener Tightening Caution**

2. Install Fuel Pressure Sensor (2) and tighten 15 N.m (11 lb ft)

3. Connect the electrical connector.(1)
4. Remove the drain pan.
5. Install [Underbody Front Air Deflector Replacement - Left Side](#)
6. Cycle the ignition to run the fuel pump and check for fuel leaks.

FUEL INJECTION PUMP REPLACEMENT

Special Tools

- **BO-38185** Hose Clamp Pliers
- **EN-51365** High Pressure Fuel Pump Installation Alignment Gauge

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Goggles and Fuel Warning](#) .

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)
3. Drain the cooling system. [Cooling System Draining and Filling](#)
4. Remove Air Inlet Grille Panel [Air Inlet Grille Panel Replacement](#)
5. Remove Intake Manifold Cover [Intake Manifold Cover Replacement](#)
6. Remove Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)

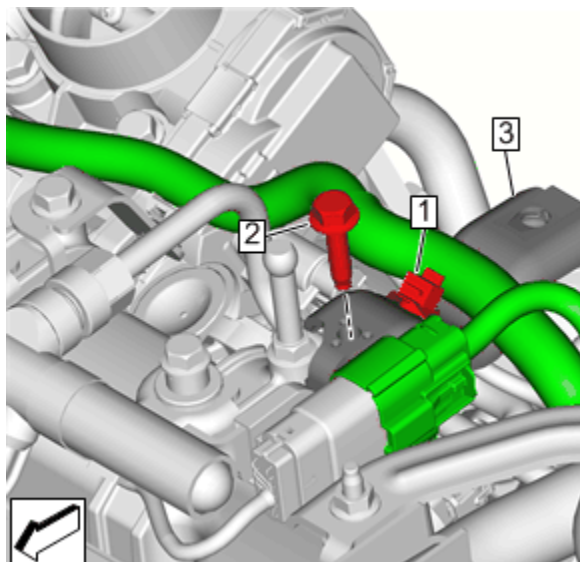


Fig. 190: Air Cleaner Resonator Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove the engine wiring harness clip (1) from the bracket.
8. Remove the air cleaner resonator bracket bolt (2).
9. Remove the air cleaner resonator bracket (3).

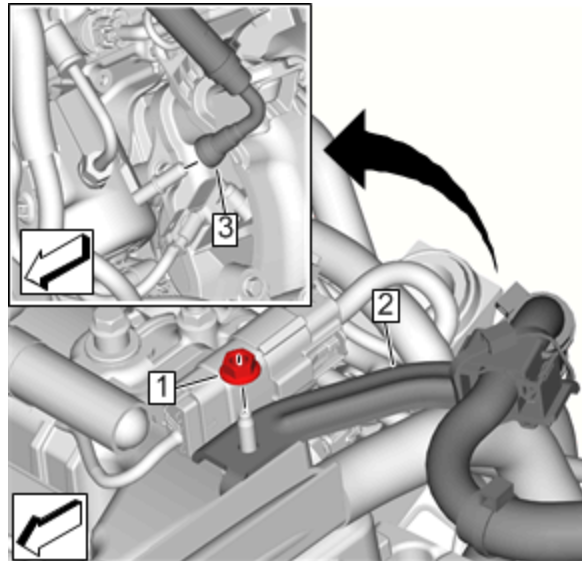


Fig. 191: Fuel Feed Front Pipe Bracket And Nut

Courtesy of GENERAL MOTORS COMPANY

10. Remove the fuel feed front pipe bracket nut (1).
11. Remove the fuel feed front pipe bracket (2) from the stud.
12. Disconnect the fuel feed front pipe (3) from the fuel pump and reposition pipe and bracket as necessary.

Fuel Feed Front Pipe Replacement

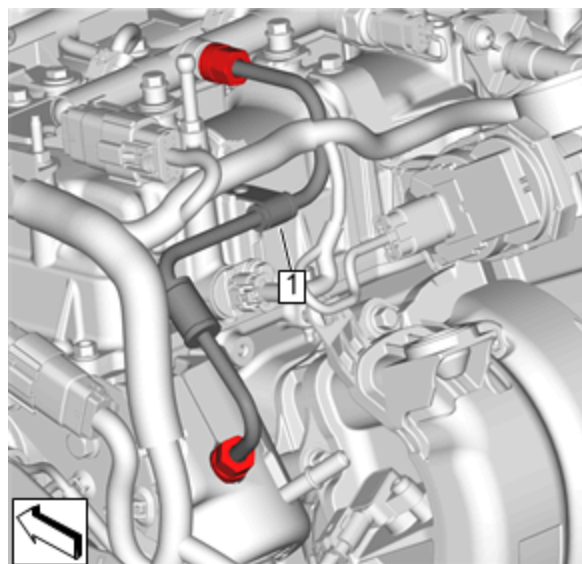


Fig. 192: Fuel Feed Intermediate Pipe

Courtesy of GENERAL MOTORS COMPANY

NOTE: High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened.

13. Remove and DISCARD the fuel feed intermediate pipe. [Fuel Feed Intermediate Pipe Replacement](#)
14. Close all open connections with the EN-6015 plugs.

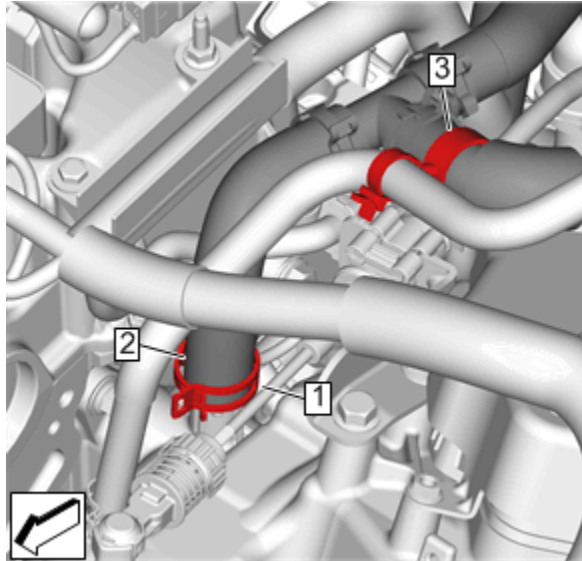


Fig. 193: Heater Water Auxiliary Pump Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

15. Use the **BO-38185** pliers to disengage the heater water auxiliary pump hose clamp (1).
16. Remove the heater water auxiliary pump hose (2) from the water outlet.
17. Remove the heater water auxiliary pump hose (2) from the clip (3) and reposition the hose as necessary.

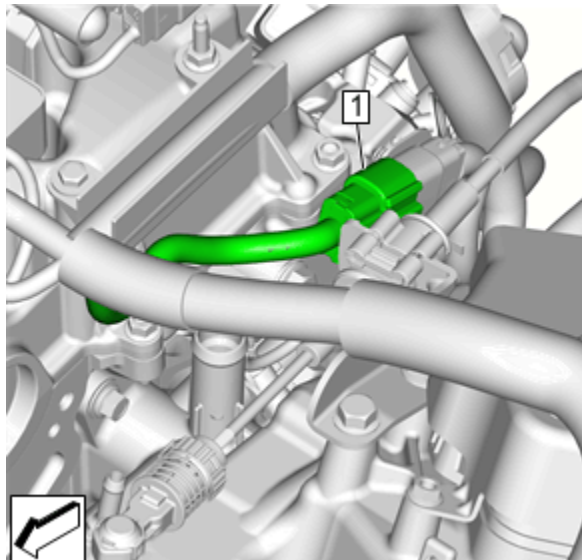


Fig. 194: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

18. Disconnect the electrical connector (1).

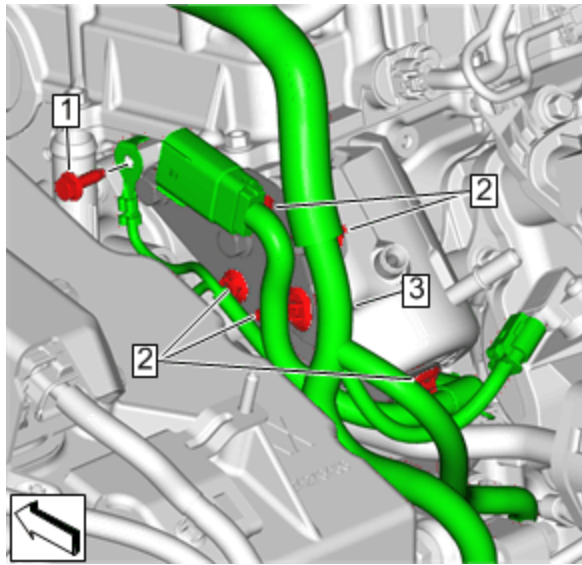


Fig. 195: Engine Wiring Harness Ground Bolt And Harness Clips

Courtesy of GENERAL MOTORS COMPANY

19. Remove the engine wiring harness ground bolt (1).
20. Remove the engine wiring harness clips (2) from the engine wiring harness bracket.

NOTE: Disconnect any engine wiring harness electrical connectors from sensors, including the fuel pump, as necessary, to provide enough space to work in the area around the fuel pump.

21. Reposition the engine wiring harness (3) as necessary.

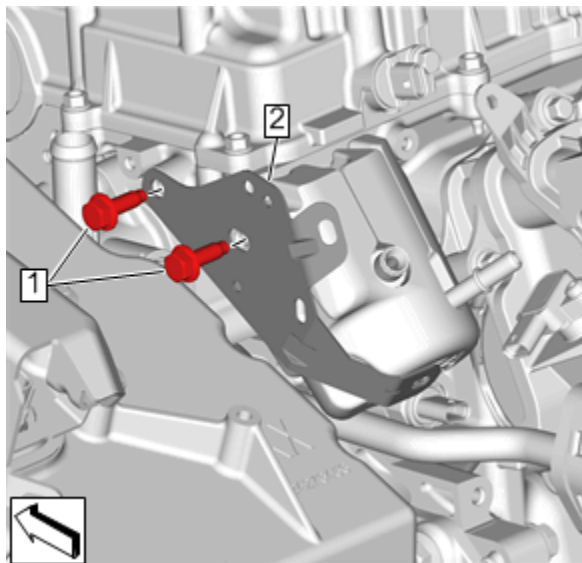


Fig. 196: Engine Wiring Harness Bracket and Bolts

Courtesy of GENERAL MOTORS COMPANY

22. Remove the engine wiring harness bracket bolts (1).
23. Remove the engine wiring harness bracket (2).

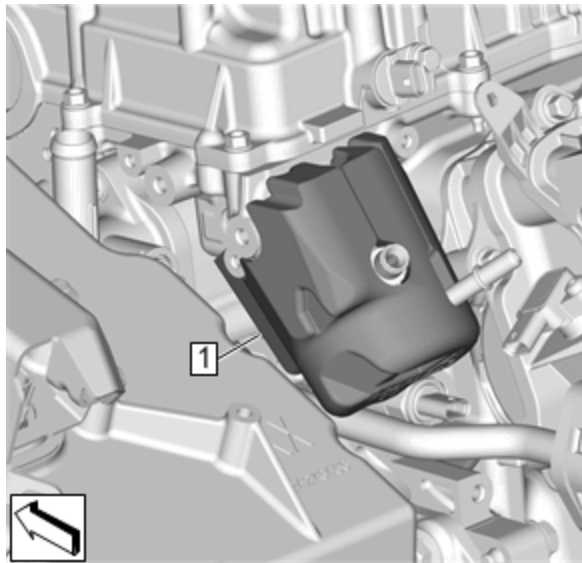


Fig. 197: Fuel Pump Insulator

Courtesy of GENERAL MOTORS COMPANY

24. Remove the fuel pump insulator (1).

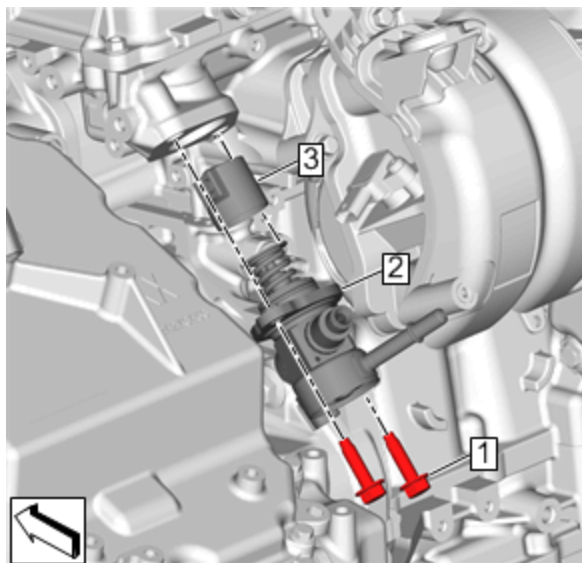


Fig. 198: Fuel Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Alternately loosen the fuel pump bolts one turn at a time until the pump is fully disengaged from fuel pump lifter follower. Trying to remove the pump bolts without even side-to-side loosening may result in pump plunger damage

25. Remove and DISCARD the fuel pump bolts (1).

NOTE: Ensure that during removal of the fuel pump that the valve lifter follower does NOT fall apart.

26. Remove the fuel pump (2).

NOTE:

- The valve lifter follower **MAY** remain in the cylinder head bore after removing the fuel pump.
- If the valve lifter follower does **NOT** pull out of the cylinder head bore with the fuel pump, then remove it afterwards.

27. Remove the valve lifter follower (3).

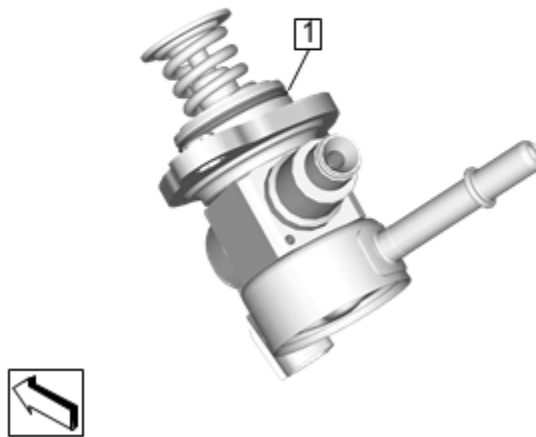


Fig. 199: Fuel Pump Housing Seal

Courtesy of GENERAL MOTORS COMPANY

28. Remove and DISCARD the fuel pump housing seal (1).

Installation Procedure

1. Before continuing, lubricate the cylinder head bore with clean engine oil.

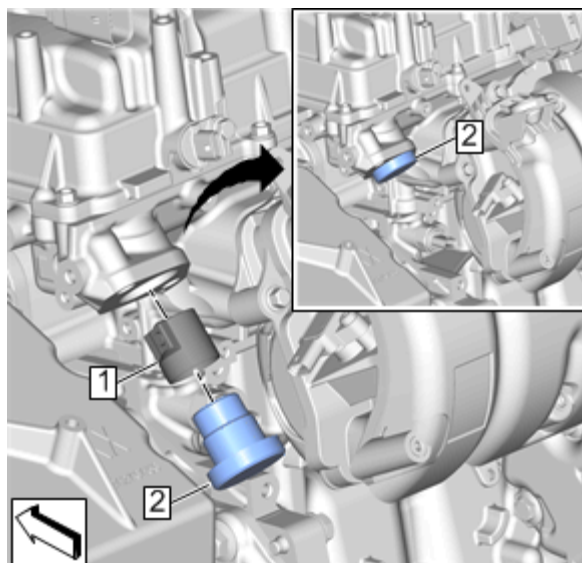


Fig. 200: Valve Lifter Follower

Courtesy of GENERAL MOTORS COMPANY

2. Lubricate the valve lifter follower (1) with clean engine oil and install it into the cylinder head bore.

NOTE:

- The camshaft **MUST** be at the base circle position before the fuel pump is installed.
- At the base circle position, the EN-51365 alignment gauge will sit flush with the cylinder head.

3. Install the **EN-51365** alignment gauge (2) and turn the crankshaft until the camshaft lobe is at the base circle position.

4. Remove the **EN-51365** alignment gauge (2) and valve lifter follower (1).

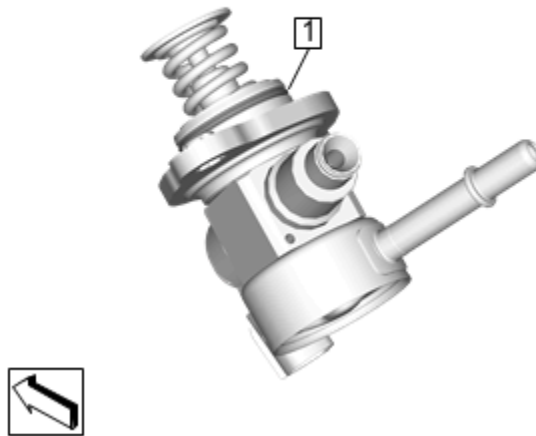


Fig. 201: Fuel Pump Housing Seal

Courtesy of GENERAL MOTORS COMPANY

5. Lubricate the NEW fuel pump housing seal (1) with clean engine oil and install it on the fuel pump.

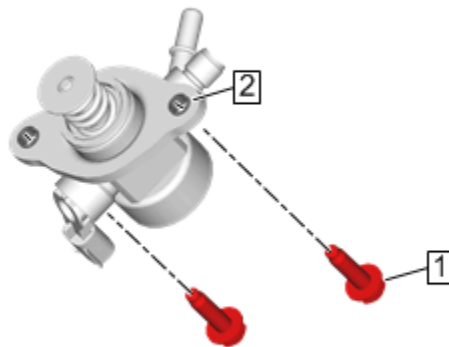


Fig. 202: Fuel Pump Bolts And Fuel Pump Bolt Retainers

Courtesy of GENERAL MOTORS COMPANY

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE:

- ALWAYS make sure the fuel pump bolt retainers are present before installing the fuel pump bolts.
- If ANY fuel pump bolt retainers are missing or NOT suitable for reuse, replace the retainers as necessary.

6. Install the NEW fuel pump bolts (1) through the fuel pump bolt retainers (2).

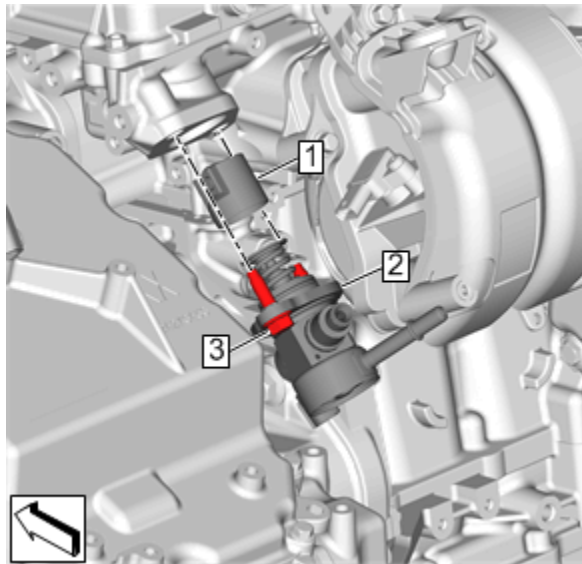


Fig. 203: Valve Lifter Follower

Courtesy of GENERAL MOTORS COMPANY

7. Lubricate the valve lifter follower (1) again with clean engine oil, if necessary, and install it into the cylinder head bore.
8. Install the fuel pump assembly (2) into the cylinder head and start the NEW fuel pump bolts (3) by hand.

CAUTION: Refer to [Fastener Caution](#) .

CAUTION: Alternately hand-tighten the fuel pump bolts one turn at a time until the pump is fully seated. Trying to draw down the pump without even side-to-side tightening may result in pump plunger damage.

9. Tighten the NEW fuel pump bolts (3) to 25 N.m (18 lb ft).

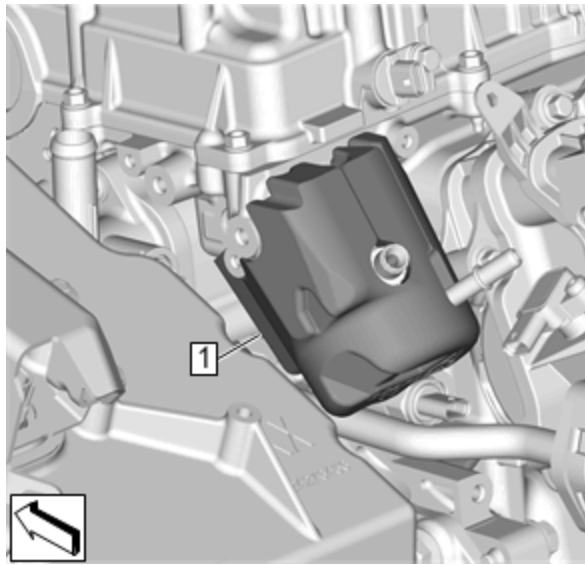


Fig. 204: Fuel Pump Insulator

Courtesy of GENERAL MOTORS COMPANY

10. Install the fuel pump insulator (1).

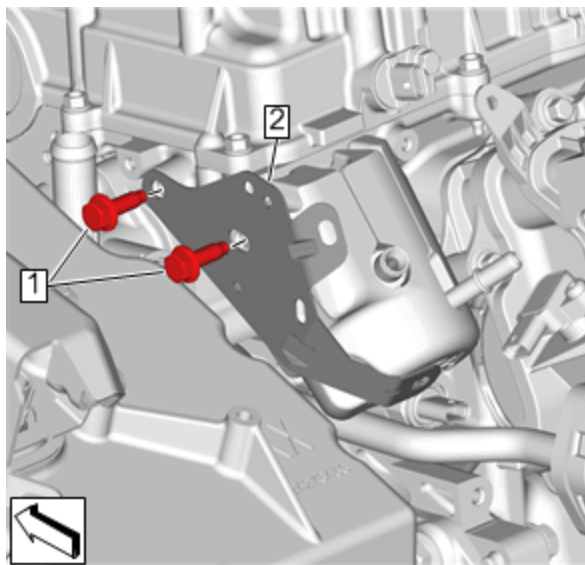


Fig. 205: Engine Wiring Harness Bracket and Bolts

Courtesy of GENERAL MOTORS COMPANY

11. Position the engine wiring harness bracket (2).
12. Install the engine wiring harness bracket bolts (1) and tighten to 25 N.m (18 lb ft).

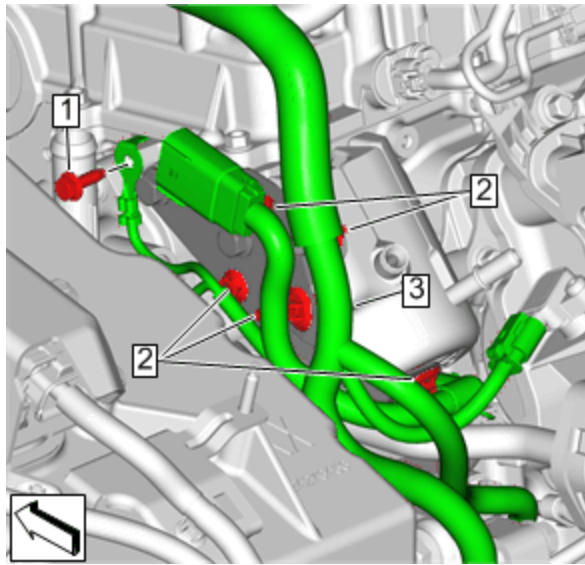


Fig. 206: Engine Wiring Harness Ground Bolt And Harness Clips

Courtesy of GENERAL MOTORS COMPANY

NOTE: Connect any engine wiring harness electrical connectors to sensors, including the fuel pump, that were previously disconnected.

13. Position the engine wiring harness (3).
14. Install the engine wiring harness clips (2) in the engine wiring harness bracket.
15. Install the engine wiring harness ground bolt (1) and tighten to 10 N.m (89 lb in).

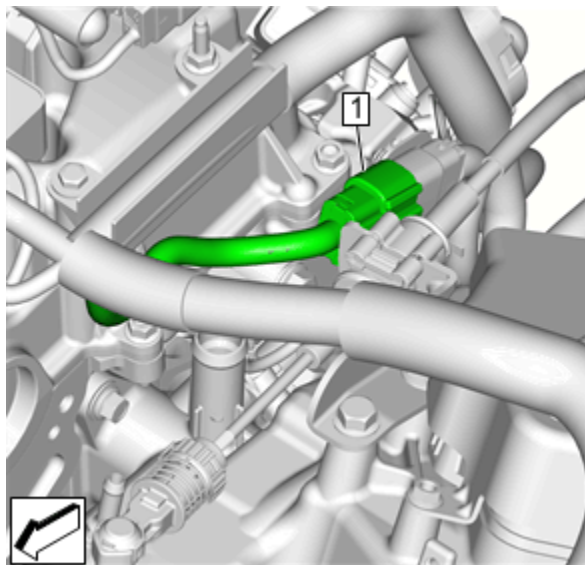


Fig. 207: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

16. Connect the electrical connector (1).

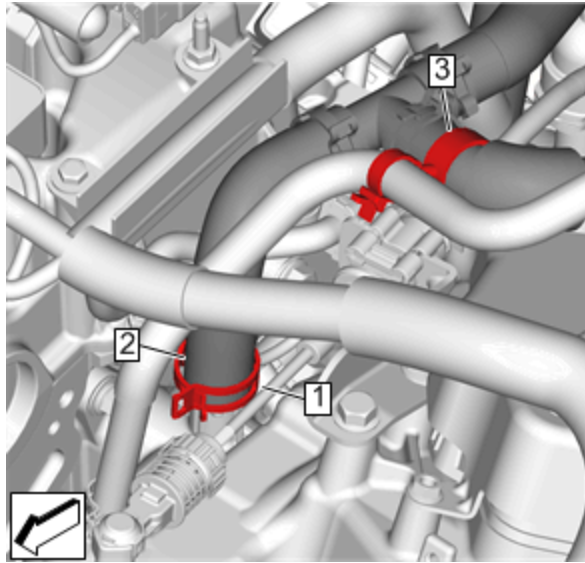


Fig. 208: Heater Water Auxiliary Pump Hose And Clip

Courtesy of GENERAL MOTORS COMPANY

17. Install the heater water auxiliary pump hose (2) to the water outlet.
18. Use the **BO-38185** pliers to engage the heater water auxiliary pump hose clamp (1).
19. Install the heater water auxiliary pump hose (2) in the clip (3).
20. Remove all **EN-6015** plugs.

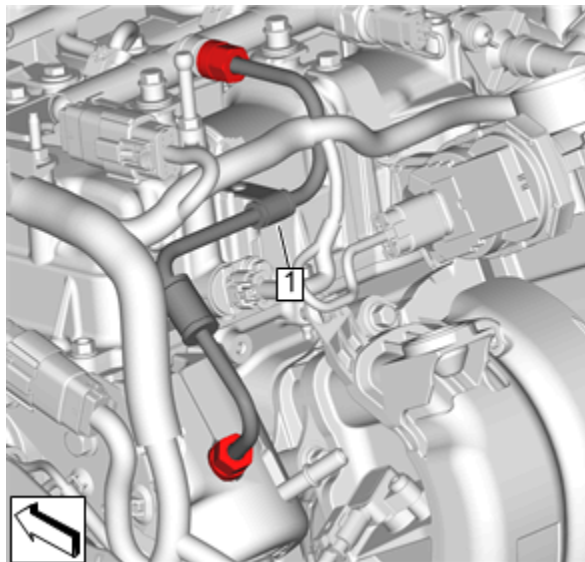


Fig. 209: Fuel Feed Intermediate Pipe

Courtesy of GENERAL MOTORS COMPANY

NOTE: High pressure fuel feed pipes are one time use only. **ALWAYS** install a **NEW** high pressure fuel feed pipe if the pipe is removed **OR** the fittings are loosened.

21. Install the **NEW** fuel feed intermediate pipe. **Fuel Feed Intermediate Pipe Replacement**

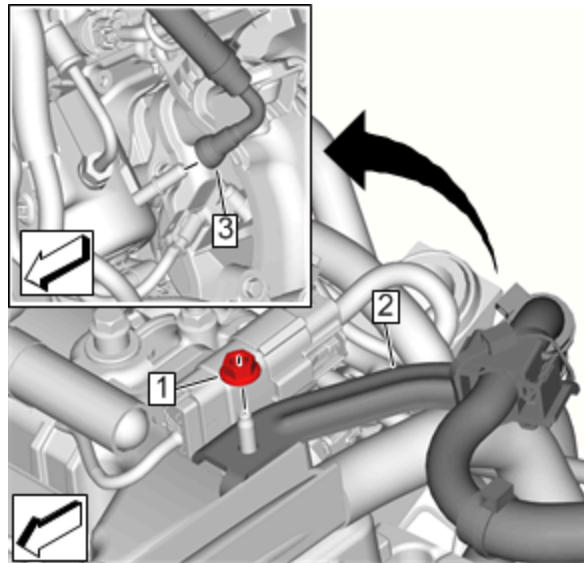


Fig. 210: Fuel Feed Front Pipe Bracket And Nut

Courtesy of GENERAL MOTORS COMPANY

22. Position fuel feed front pipe and bracket as necessary and connect the fuel feed front pipe (3) to the fuel pump. **Fuel Feed Front Pipe Replacement**
23. Position the fuel feed front pipe bracket (2) on the stud.
24. Install the fuel feed front pipe bracket nut (1) and tighten to 9 N.m (80 lb in).

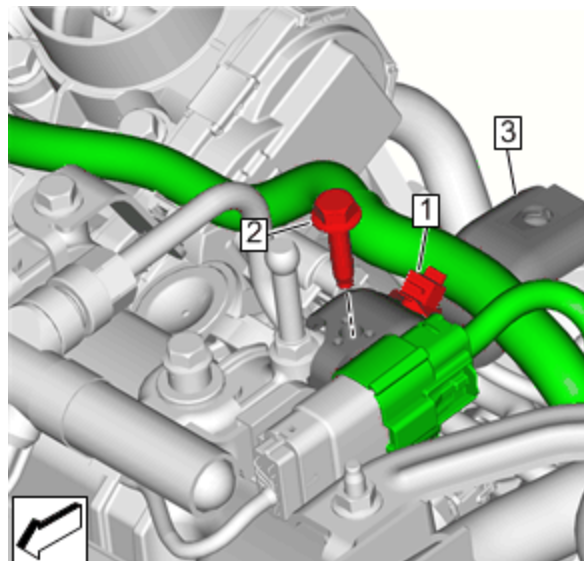


Fig. 211: Air Cleaner Resonator Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

25. Position the air cleaner resonator bracket (3).
26. Install the air cleaner resonator bracket bolt (2) and tighten to 9 N.m (80 lb in).
27. Install the engine wiring harness clip (1) to the bracket.
28. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
29. Inspect for leaks using the following procedure:
 1. Turn ON the ignition with the engine OFF for 2 seconds.

2. Turn OFF the ignition for 10 seconds.
 3. Turn ON the ignition with the engine OFF.
 4. Inspect for fuel leaks.
30. Install Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)
 31. Install Intake Manifold Cover [Intake Manifold Cover Replacement](#)
 32. Install Air Inlet Grille Panel [Air Inlet Grille Panel Replacement](#)
 33. Fill the cooling system. [Cooling System Draining and Filling](#)
 34. When the replacement is completed, use a scan tool to perform the appropriate reset functions. [Control Module References](#)

FUEL SYSTEM CLEANING

WARNING: [Diesel/Gasoline Vapors Warning](#)

The following procedure covers the disassembly and the inspection of the complete fuel supply system. If the fuel system is contaminated, the fuel system can be cleaned. You can usually determine the extent of the fuel system contamination during the disassembly.

1. Remove the fuel tank pump module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
2. Locate the tank in a suitable work area away from any heat, any flame, or any other source of ignition.
3. Perform the following procedures:
 - Inspect the fuel tank pump module strainer. Replace the fuel tank pump module if the strainer is contaminated.

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

NOTE: Only use oil-free compressed air to blow out the fuel pipes.

- Use compressed air in order to apply air pressure to the transfer tube.

NOTE: When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water in accordance with all applicable local, state, and federal laws and regulations.

4. Flush the fuel tank with running hot water for at least five minutes. Pour the water out of the fuel pump module opening. Rock the fuel tank in order to ensure that the removal of the water from the fuel tank is complete.
5. Refer to [Metal Collar Quick Connect Fitting Service](#) in order to disconnect the fuel feed hose/pipe.
6. Use compressed air in order to apply air pressure to the fuel lines in the opposite direction from the normal fuel flow.
7. Remove the fuel rail and the fuel injectors. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#).
8. Clean and inspect the fuel injectors and the fuel rail.

Installation Procedure

Assemble the fuel system as follows:

1. Install the direct fuel injectors and the fuel rail. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#).
2. Install the fuel tank pump module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
3. Refer to [Metal Collar Quick Connect Fitting Service](#) in order to connect the fuel feed hose/pipe.

FUEL FEED FRONT PIPE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)
3. Remove [Air Cleaner Outlet Duct Replacement](#)

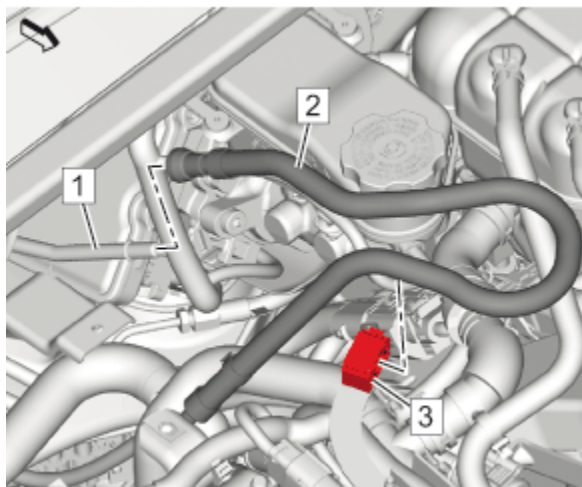


Fig. 212: Fuel Feed Pipe, Fuel Feed Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuel Feed Front Pipe (2) @Retainer(3)
5. Disconnect Fuel Feed Front Pipe(2)@Fuel Feed Pipe(1)[Metal Collar Quick Connect Fitting Service](#)
6. Close all open connections with the **EN-6015** plugs.

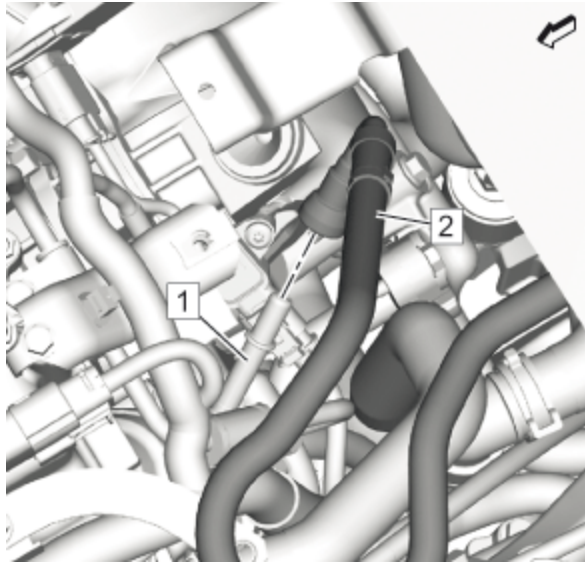


Fig. 213: Fuel Feed Front Pipe And Fuel Injection Pump

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Fuel Feed Front Pipe(2)@Fuel Injection Pump(1) [Metal Collar Quick Connect Fitting Service](#)
8. Close all open connections with the **EN-6015** plugs.
9. Remove Fuel Feed Front Pipe(2)

Installation Procedure

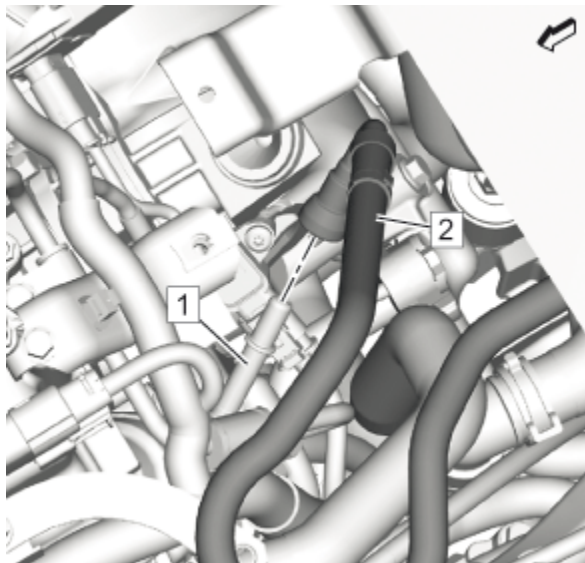


Fig. 214: Fuel Feed Front Pipe And Fuel Injection Pump

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Feed Front Pipe (2)
2. Remove all **EN-6015** plugs from the connections.
3. Connect Fuel Feed Front Pipe (2) @Fuel Injection Pump(1) [Metal Collar Quick Connect Fitting Service](#)

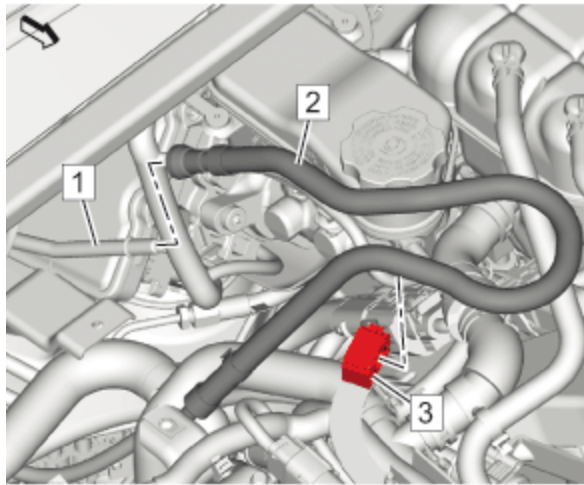


Fig. 215: Fuel Feed Pipe, Fuel Feed Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Remove all **EN-6015** plugs from the connections.
5. Connect Fuel Feed Front Pipe(2)@Fuel Feed Pipe(1)[Metal Collar Quick Connect Fitting Service](#)
6. Install Fuel Feed Front Pipe(2)@Retainer(3)
7. Install [Air Cleaner Outlet Duct Replacement](#)
8. Connect [Battery Negative Cable Disconnection and Connection](#)
9. Cycle the ignition to run the fuel pump and check for fuel leaks.

FUEL FEED INTERMEDIATE PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Goggles and Fuel Warning](#) .

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)
3. Remove Intake Manifold Cover [Intake Manifold Cover Replacement](#)
4. Remove Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)

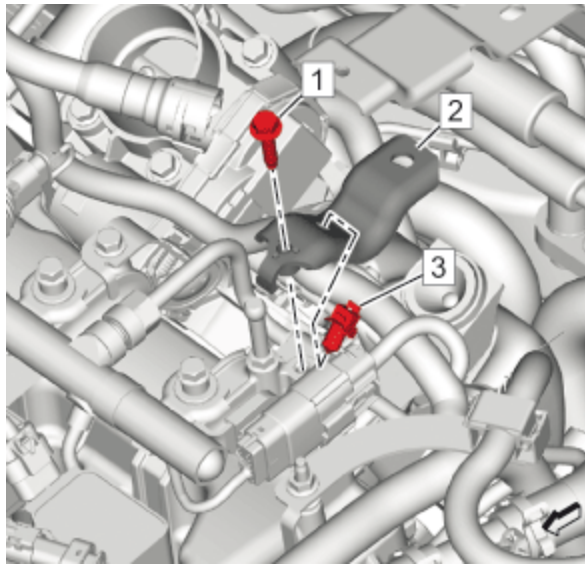


Fig. 216: Air Cleaner Resonator Bracket, Bolt And Wiring Harness Clip
 Courtesy of GENERAL MOTORS COMPANY

5. Unclip Wiring Harness Clip (1)
6. Remove the air cleaner resonator bracket bolt (1).
7. Remove the air cleaner resonator bracket (2).

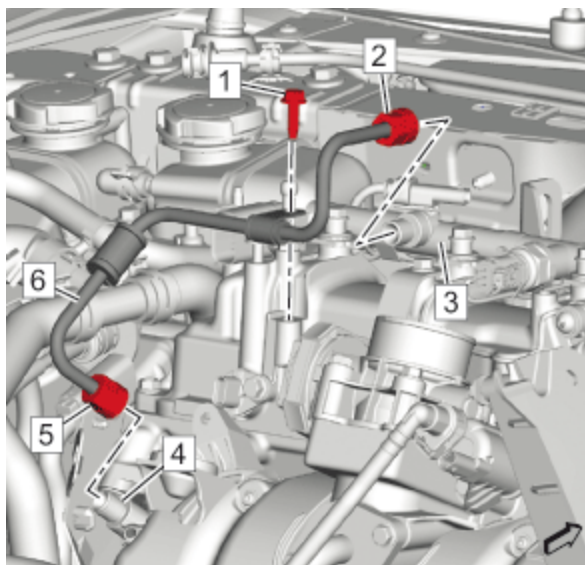


Fig. 217: Fuel Feed Intermediate Pipe, Bolt And Nuts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Lay a lint-free cloth under the fuel feed intermediate pipe to absorb any excess fuel spillage.

8. Remove the fuel feed intermediate pipe bolt (1).
9. Loosen the fuel feed intermediate pipe fittings (2, 5) at the fuel injection fuel rail (3) and the fuel pump (4).

NOTE: High pressure fuel feed pipes are one time use only. ALWAYS install a

NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened.

10. Remove and DISCARD the fuel feed intermediate pipe (6).

Installation Procedure

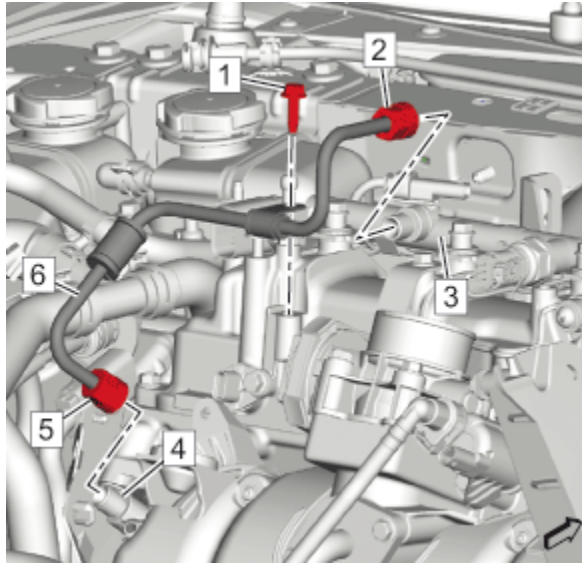


Fig. 218: Fuel Feed Intermediate Pipe, Bolt And Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

NOTE: High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened.

1. To install the NEW fuel feed intermediate pipe (6) perform the following steps:
 1. Hand tighten the fuel feed intermediate pipe fitting (2) to the fuel injection fuel rail (3).
 2. Hand tighten the fuel feed intermediate pipe fitting (5) to the fuel pump (4).
 3. Tighten the fuel feed intermediate pipe fittings (2, 5) to 30 N.m (22 lb ft).

CAUTION: Refer to [Fastener Caution](#) .

2. Install the fuel feed intermediate pipe bolt (1) and tighten to 10 N.m (89 lb in).

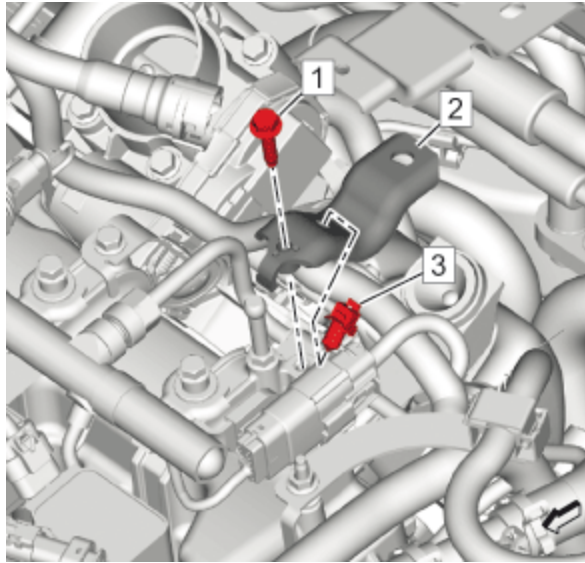


Fig. 219: Air Cleaner Resonator Bracket, Bolt And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

3. Position the air cleaner resonator bracket (2).
4. Install the air cleaner resonator bracket bolt (1) and tighten to 9 N.m (80 lb in).
5. Install Wiring Harness Clip (1)
6. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)

WARNING: Fuel escapes - observe safety measures and national legislation. Failure to comply could result in personal injury.

7. Inspect for leaks using the following procedure:
 1. Turn ON the ignition with the engine OFF for 2 seconds.
 2. Turn OFF the ignition for 10 seconds.
 3. Turn ON the ignition with the engine OFF.
 4. Inspect for fuel leaks.
8. Install Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)
9. Install Intake Manifold Cover [Intake Manifold Cover Replacement](#)

EVAPORATIVE EMISSION CANISTER REPLACEMENT

Removal Procedure

WARNING: [Safety Goggles and Fuel Warning](#)

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

1. Remove [Evaporative Emission Canister Bracket Replacement](#)

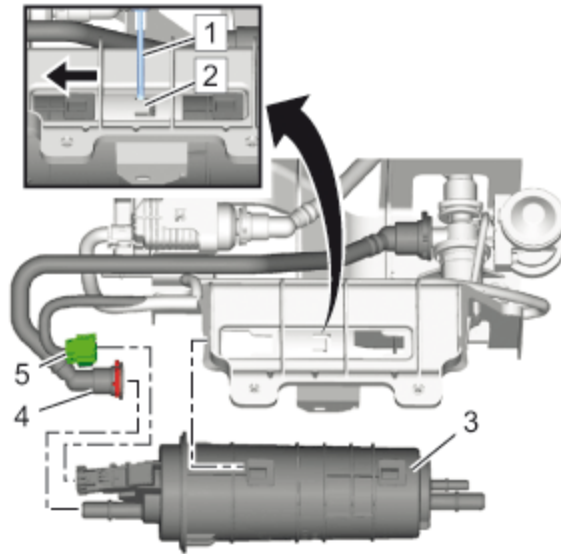


Fig. 220: Evaporative Emission Canister, Control Valve Hose, Electrical Connector And Retaining Tab

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the evaporative emission canister control valve hose (4). Refer to [Plastic Collar Quick Connect Fitting Service](#).
3. Disconnect the electrical connector.(5)
4. Release the retaining tab (2) using a flat bladed tool (1) while simultaneously sliding the canister in direction of arrow.
5. Remove Evaporative Emission Canister(3)

Installation Procedure

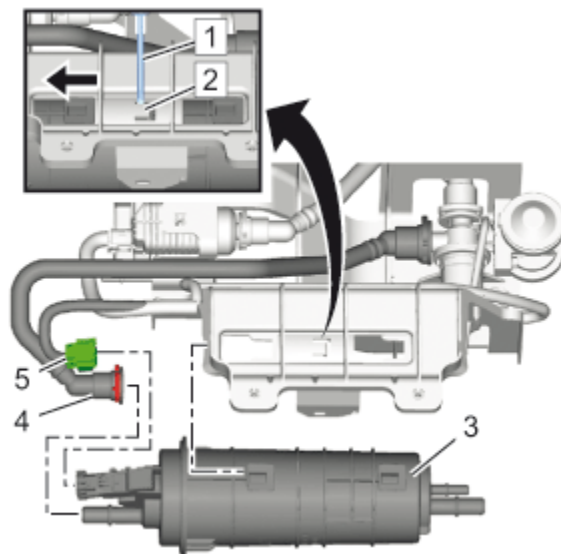


Fig. 221: Evaporative Emission Canister, Control Valve Hose, Electrical Connector And Retaining Tab

Courtesy of GENERAL MOTORS COMPANY

1. Install Evaporative Emission Canister(3) -

2. Slide the evaporative emission canister (3) against the direction of arrow until the retaining tab (2) is locked.
3. Connect the electrical connector.(5)
4. Connect the evaporative emission canister control valve hose (4). Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Install [Evaporative Emission Canister Bracket Replacement](#)

EVAPORATIVE EMISSION CANISTER BRACKET REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Safety Goggles and Fuel Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Remove [Underbody Rear Air Deflector Replacement](#)

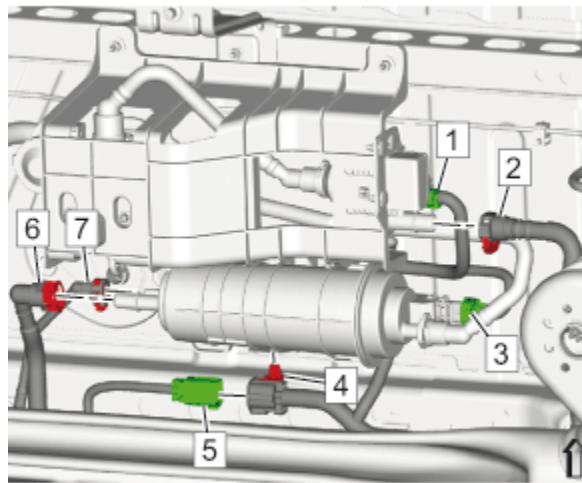


Fig. 222: Electrical Connectors, Evaporative Emission Rear Hose, Evaporative Emission Pipe, Vacuum Leak Pump Filter Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector:
 1. Evaporative Emission System Vacuum Leak Detection Pump (1)
 2. Fuel Tank Pressure Sensor (3)
 3. Fuel Tank Fuel Pump Module Wiring Harness (5).

5. Disconnect Evaporative Emission Rear Hose (6)[Plastic Collar Quick Connect Fitting Service](#)
6. Disconnect Evaporative Emission Pipe (7)[Plastic Collar Quick Connect Fitting Service](#)
7. Disconnect the evaporative emission system vacuum leak pump filter pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Close all open connection with the **EN-6015** plugs.
9. Remove Retainer (4)

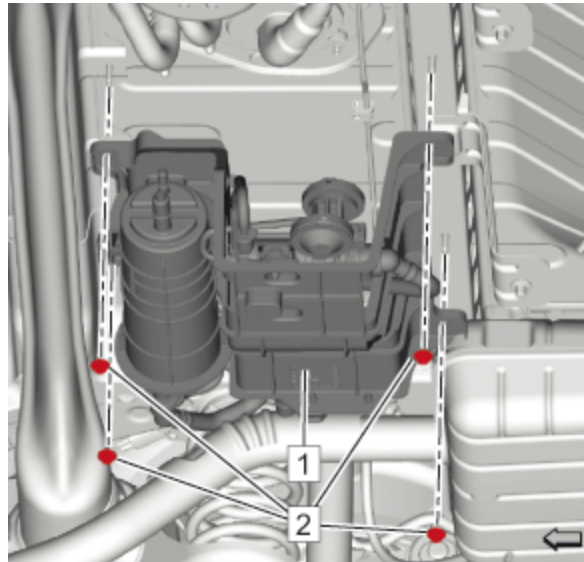


Fig. 223: Evaporative Emission Canister Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the 4 evaporative emission canister bracket nuts (2).

NOTE: A second technician is required.

11. Lower the evaporative emission canister bracket (1) until the evaporative emission canister control valve wiring harness is accessible.

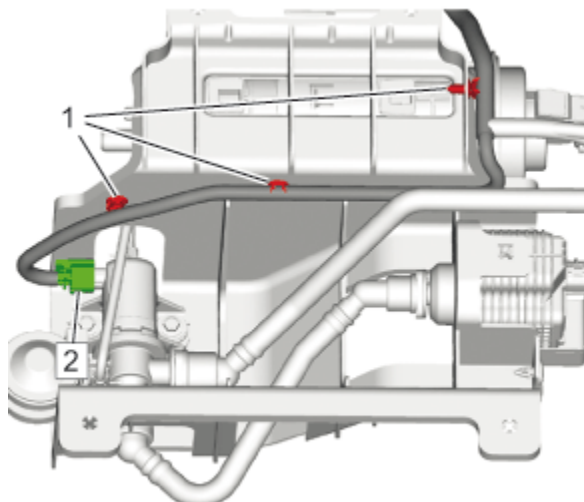


Fig. 224: Electrical Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

12. Disconnect the electrical connector.(2)
13. Remove Retainer(1)
14. Lay the evaporative emission canister bracket on a bench.

Disassemble Procedure

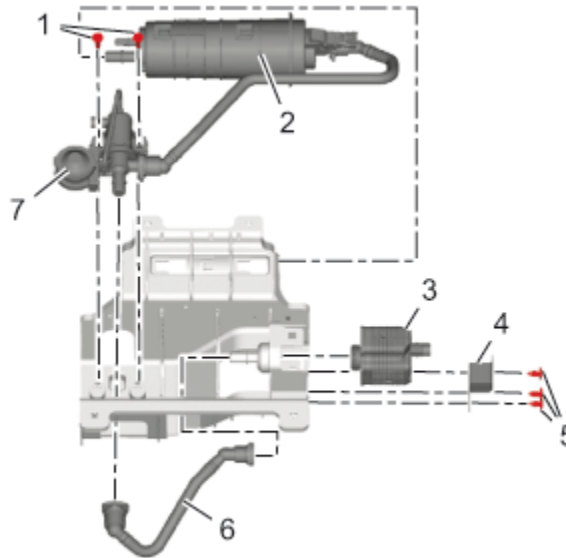


Fig. 225: Evaporative Emission Canister And Vacuum Leak Pump Components

Courtesy of GENERAL MOTORS COMPANY

1. Remove Retainer(1)
2. Remove the evaporative emission system vacuum leak pump cover (4).

NOTE: Use a flat bladed tool to release the 2 retaining tabs.

3. Remove the evaporative emission system vacuum leak pump (3).
4. Remove the evaporative emission canister control valve vacuum hose (6). Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Remove the 2 evaporative emission canister vent solenoid valve bolts (1).
6. Remove the evaporative emission canister (2) along with the evaporative emission canister vent solenoid valve (7) and the evaporative emission canister hose. Refer to [Evaporative Emission Canister Replacement](#).

Assemble Procedure

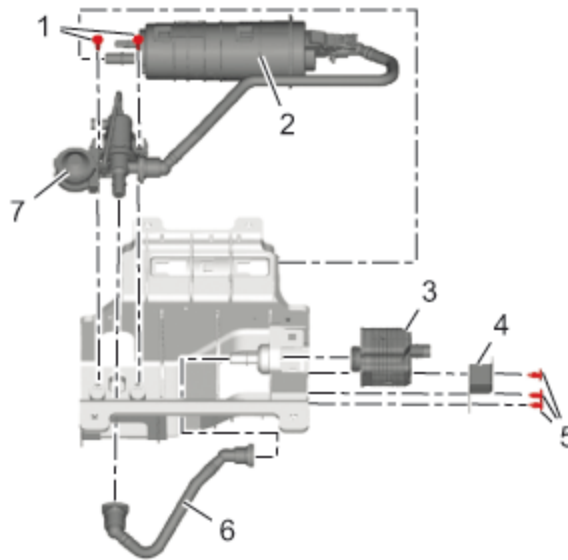


Fig. 226: Evaporative Emission Canister And Vacuum Leak Pump Components

Courtesy of GENERAL MOTORS COMPANY

1. Install the evaporative emission canister (2) along with the evaporative emission canister vent solenoid valve (7) and the evaporative emission canister hose. Refer to [Evaporative Emission Canister Replacement](#).

CAUTION: [Fastener Caution](#)

2. Install the 2 evaporative emission canister vent solenoid valve bolts (1) and tighten to 7 N.m (62 lb in).
3. Install the evaporative emission canister control valve vacuum hose (6). Refer to [Plastic Collar Quick Connect Fitting Service](#).

NOTE: **There must be 2 noticeable click noises.**

4. Install the evaporative emission system vacuum leak pump (3).
5. Install the evaporative emission system vacuum leak pump cover (4).
6. Install Retainer(5)

Installation Procedure

NOTE: **A second technician is required.**

1. Raise the evaporative emission canister bracket until the evaporative emission canister control valve wiring harness is accessible.

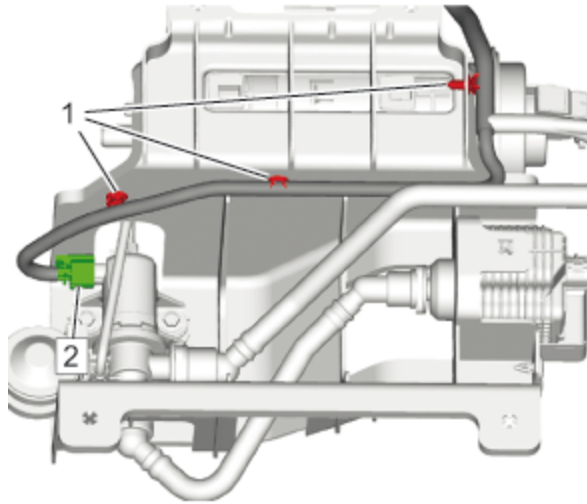


Fig. 227: Electrical Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Install Retainer(1)
3. Connect the electrical connector.(2)

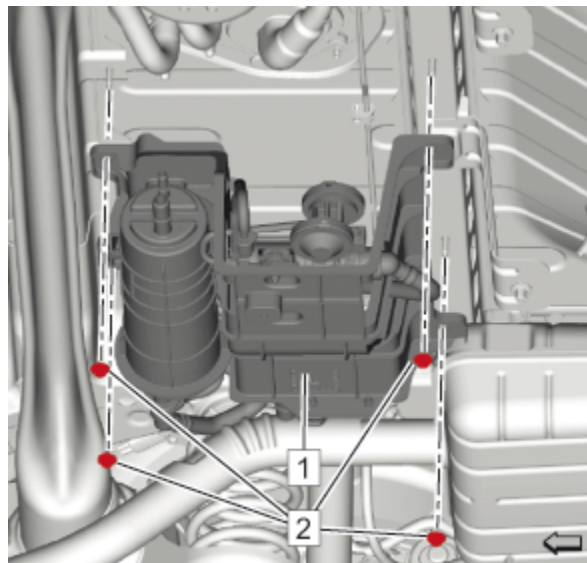


Fig. 228: Evaporative Emission Canister Bracket And Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Raise the evaporative emission canister bracket (1) completely.
5. Install the 4 evaporative emission canister bracket nuts (2) and tighten to 9 N.m (80 lb in).

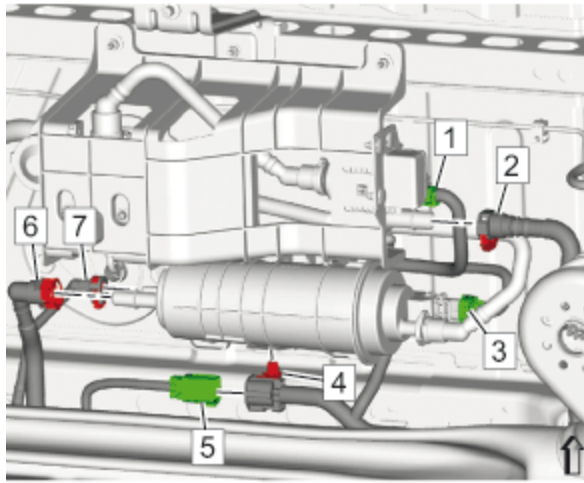


Fig. 229: Electrical Connectors, Evaporative Emission Rear Hose, Evaporative Emission Pipe, Vacuum Leak Pump Filter Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

6. Install Retainer(4)
7. Remove the **EN-6015** plugs from all connections.
8. Connect the evaporative emission system vacuum leak pump filter pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Connect Evaporative Emission Pipe (7)[Plastic Collar Quick Connect Fitting Service](#)
10. Connect Evaporative Emission Rear Hose (6)[Plastic Collar Quick Connect Fitting Service](#)
11. Connect the electrical connector:
 1. Evaporative Emission System Vacuum Leak Detection Pump (1)
 2. Fuel Tank Pressure Sensor (3)
 3. Fuel Tank Fuel Pump Module Wiring Harness (5).
12. Install [Underbody Rear Air Deflector Replacement](#)
13. Lower the vehicle.
14. Connect [Battery Negative Cable Disconnection and Connection](#)

EVAPORATIVE EMISSION CANISTER HOSE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Lower the fuel tank, to get enough space to remove the fuel pipe. Refer to [Fuel Tank Replacement](#).

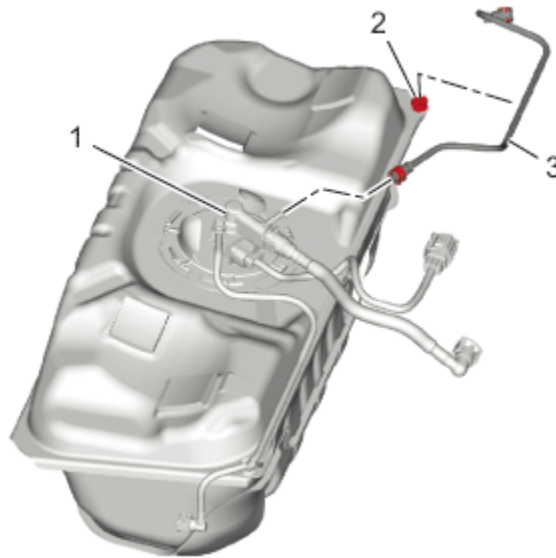


Fig. 230: Evaporative Emission Canister Hose, Fuel Tank Fuel Pump Module And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the evaporative emission canister hose (3) from the fuel tank fuel pump module (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Close all open connections with the EN-6015 plugs.
5. Unclip the evaporative emission canister hose (3) from the retainer (2).

Installation Procedure

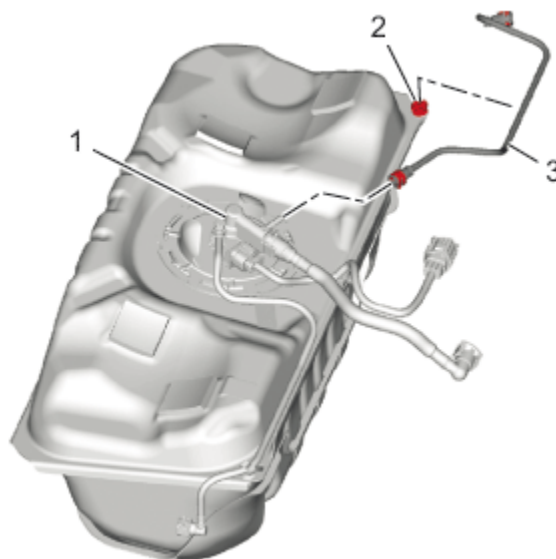


Fig. 231: Evaporative Emission Canister Hose, Fuel Tank Fuel Pump Module And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install the evaporative emission canister hose (3) to the retainer (2).
2. Remove the EN-6015 plugs from all connections.

3. Connect the evaporative emission canister hose (3) to the fuel tank fuel pump module (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Install [Fuel Tank Replacement](#)
5. Connect [Battery Negative Cable Disconnection and Connection](#)

EVAPORATIVE EMISSION CANISTER CONTROL VALVE VACUUM HOSE REPLACEMENT

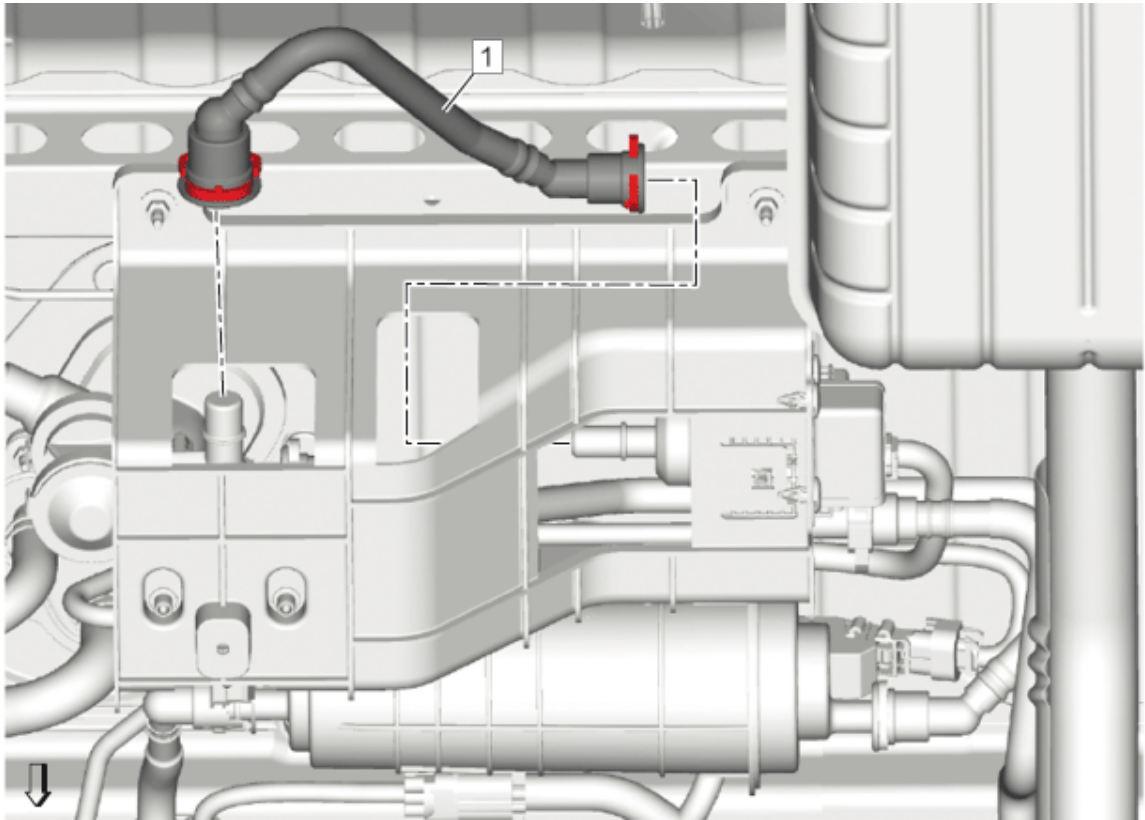


Fig. 232: Evaporative Emission Canister Control Valve Vacuum Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Battery Negative Cable Disconnection and Connection 2. Underbody Rear Air Deflector Replacement	
1	Evaporative Emission Canister Control Valve Vacuum Hose Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Safety Goggles and Fuel Warning](#)

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Remove [Air Cleaner Outlet Duct Replacement](#)

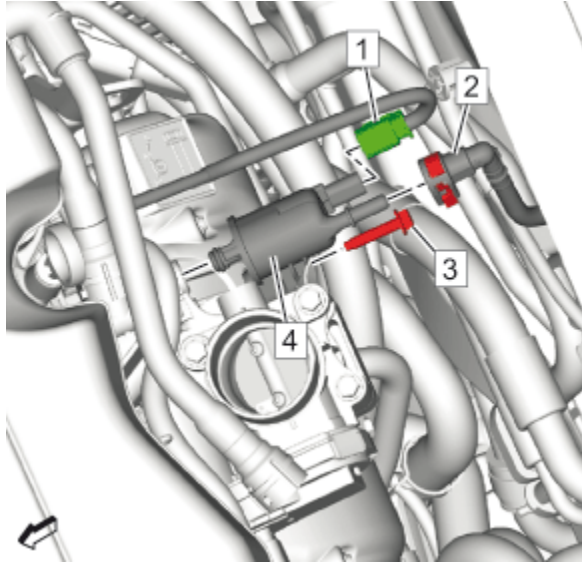


Fig. 233: Evaporative Emission Pipe, Evaporative Emission Canister Purge Solenoid Valve, Bolt And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector.(1)
4. Disconnect Evaporative Emission Pipe (2)[Plastic Collar Quick Connect Fitting Service](#)
5. Close all open connection with the **EN-6015** plugs.
6. Remove Evaporative Emission Canister Purge Solenoid Valve Bolt (3)
7. Remove Evaporative Emission Canister Purge Solenoid Valve (4)

Installation Procedure

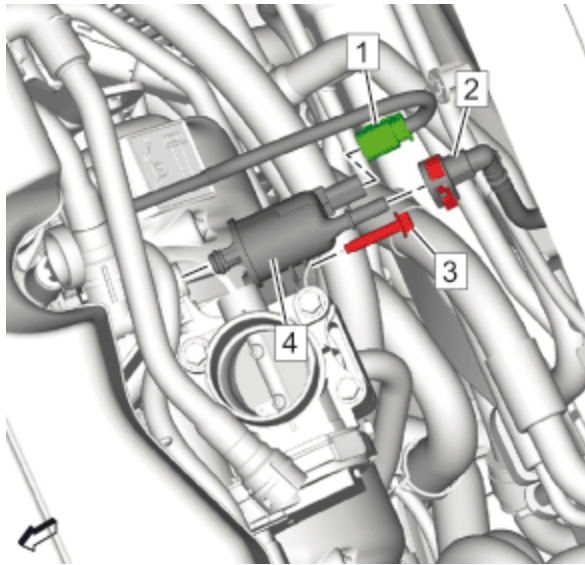


Fig. 234: Evaporative Emission Pipe, Evaporative Emission Canister Purge Solenoid Valve, Bolt And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

1. Install Evaporative Emission Canister Purge Solenoid Valve (4)

CAUTION: Fastener Caution

2. Install Evaporative Emission Canister Purge Solenoid Valve Bolt (3) and tighten 10 N.m (89 lb in)
3. Remove all EN-6015 plugs.
4. Connect Evaporative Emission Pipe (2) Plastic Collar Quick Connect Fitting Service
5. Connect the electrical connector.(1)
6. Install Air Cleaner Outlet Duct Replacement
7. Connect Battery Negative Cable Disconnection and Connection

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT

Removal Procedure

WARNING: Safety Goggles and Fuel Warning

WARNING: Fuel Vapors in Evaporative Emission Components Warning

1. Remove Evaporative Emission Canister Bracket Replacement

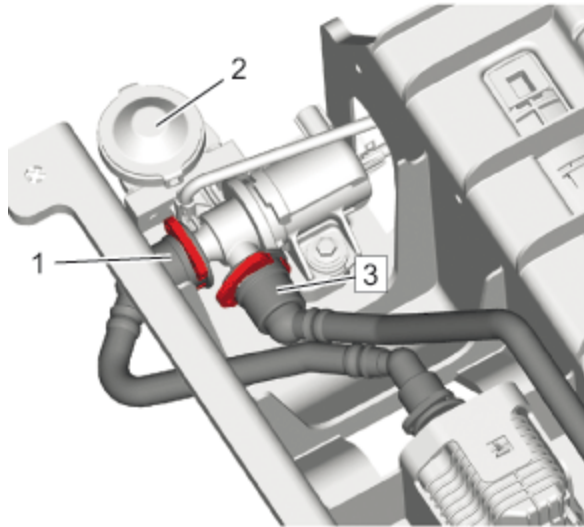


Fig. 235: Evaporative Emission Canister Control Valve Vacuum Hose And Evaporative Emission Canister Vent Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the evaporative emission canister control valve vacuum hose (1) from the evaporative emission canister vent solenoid valve (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).
3. Disconnect the evaporative emission canister hose (3) from the evaporative emission canister vent solenoid valve (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).

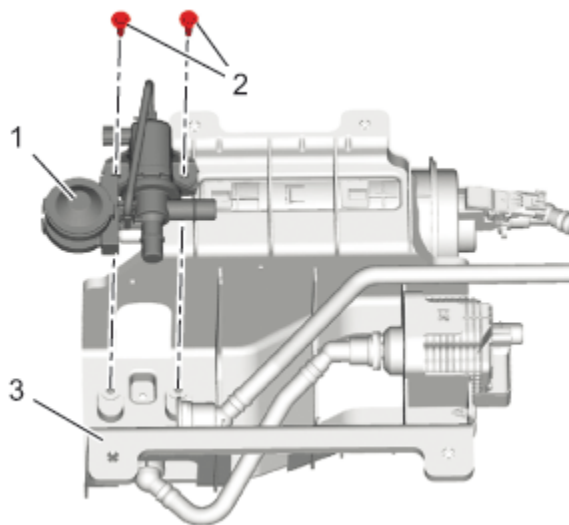


Fig. 236: Evaporative Emission Canister Vent Solenoid Valve, Canister Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 2 evaporative emission canister vent solenoid valve bolts (2).
5. Remove the evaporative emission canister vent solenoid valve (1) from the evaporative emission canister bracket (3).

Installation Procedure

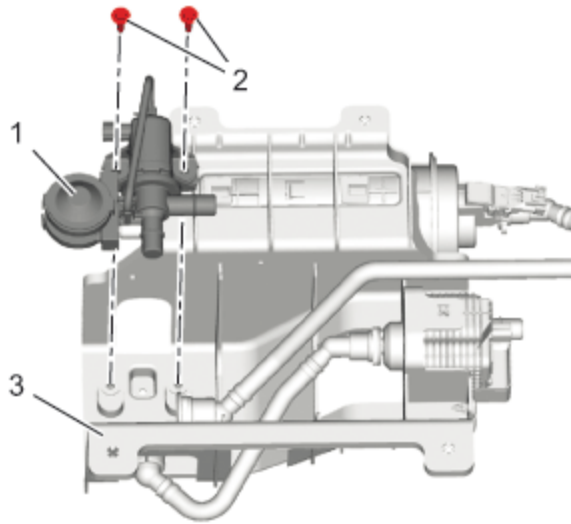


Fig. 237: Evaporative Emission Canister Vent Solenoid Valve, Canister Bracket And Bolts
 Courtesy of GENERAL MOTORS COMPANY

1. Install the evaporative emission canister vent solenoid valve (1) to the evaporative emission canister bracket (3).

CAUTION: Fastener Caution

2. Install the 2 evaporative emission canister vent solenoid valve bolts (2) and tighten to 7 N.m (62 lb in).

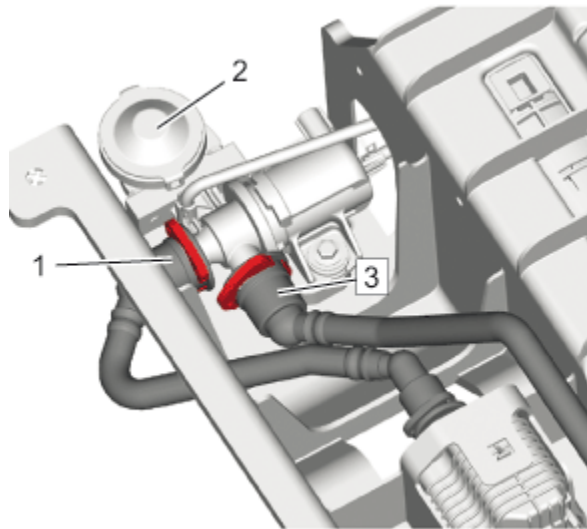


Fig. 238: Evaporative Emission Canister Control Valve Vacuum Hose And Evaporative Emission Canister Vent Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

3. Connect the evaporative emission canister hose (3) to the evaporative emission canister vent solenoid valve (2). Refer to Plastic Collar Quick Connect Fitting Service.
4. Connect the evaporative emission canister control valve vacuum hose (1) to the evaporative emission canister vent solenoid valve (2). Refer to Plastic Collar Quick Connect Fitting Service.

5. Install [Evaporative Emission Canister Bracket Replacement](#)

EVAPORATIVE EMISSION PIPE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Disconnect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)
2. Remove Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)

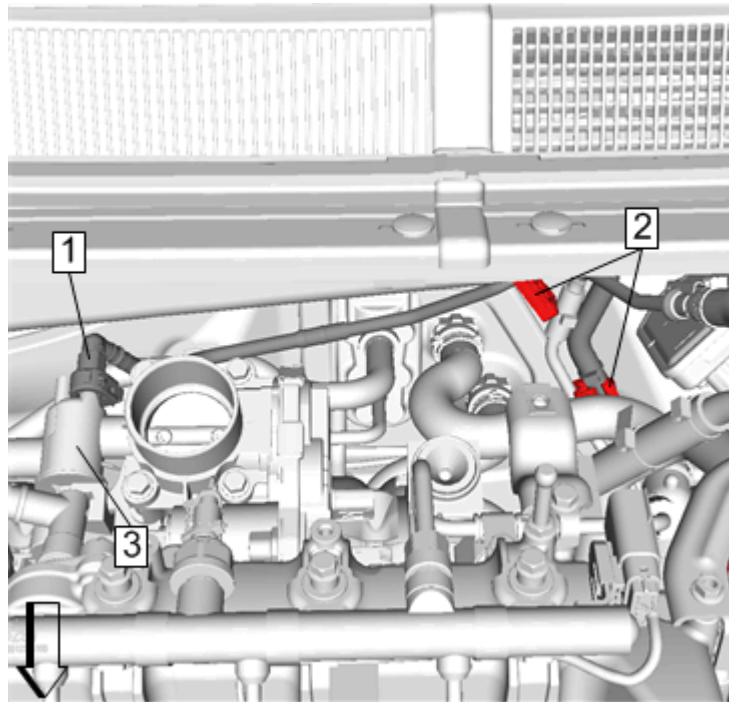


Fig. 239: Evaporative Emission Pipe And Evaporative Emission Canister Purge Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Evaporative Emission Pipe (1)@Evaporative Emission Canister Purge Solenoid Valve(3)
[Plastic Collar Quick Connect Fitting Service](#)
4. Close all open connections with the EN-6015 plugs.
5. Open Retainer(2)
6. Remove Evaporative Emission Pipe(1)@Retainer (2)

7. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
8. Remove Drivetrain and Front Suspension Cradle [Drivetrain and Front Suspension Cradle Replacement](#)

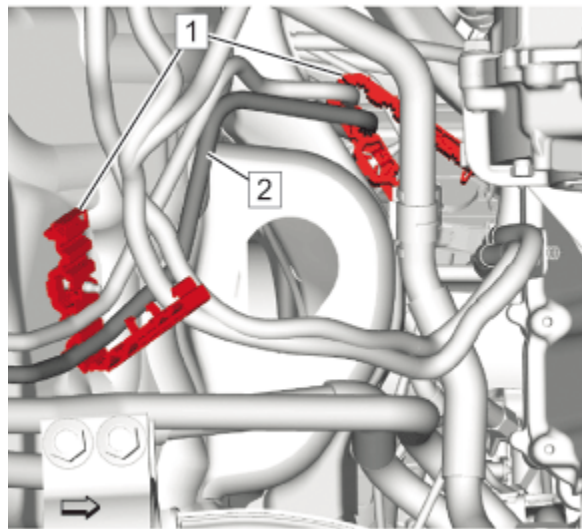


Fig. 240: Evaporative Emission Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

9. Open the 2 retainers (1).
10. Remove Evaporative Emission Pipe (2) @ Retainer (1)
11. Remove Rear Axle [Rear Axle Replacement](#)
12. Remove Floor Panel Number 4 Cross Bar [Floor Panel Number 4 Cross Bar Replacement](#)

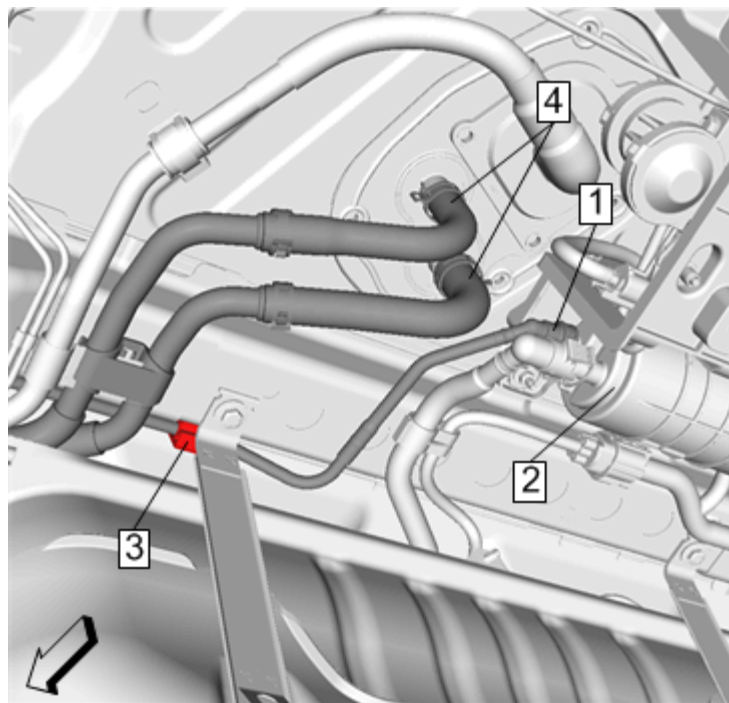


Fig. 241: Drive Motor Generator Control Module Cooling Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

13. Remove Drive Motor Generator Control Module Cooling Outlet Hose(4)[Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\) Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)
14. Open the retainer (3).
15. Remove Evaporative Emission Pipe (1) @Retainer (3)
16. Disconnect Evaporative Emission Pipe(1)@Evaporative Emission Canister(2) [Plastic Collar Quick Connect Fitting Service](#)
17. Close all open connections with the **EN-6015** plugs.

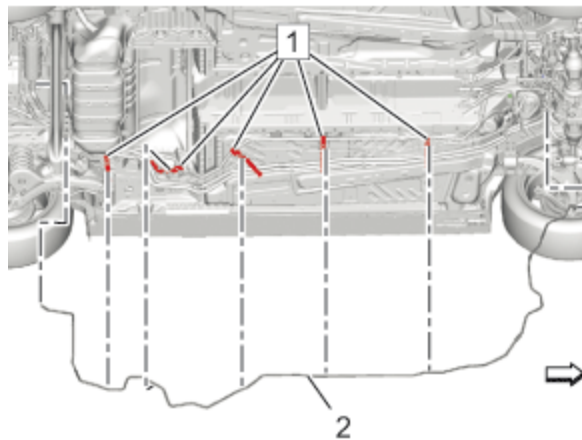


Fig. 242: Evaporative Emission Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

18. Open the 5 retainers (1).
19. Remove Evaporative Emission Pipe (2) @Retainer (1)

NOTE: Manipulate the line removing the rear first to remove from the vehicle.

20. Remove the evaporative emission pipe (2) from the vehicle.

Installation Procedure

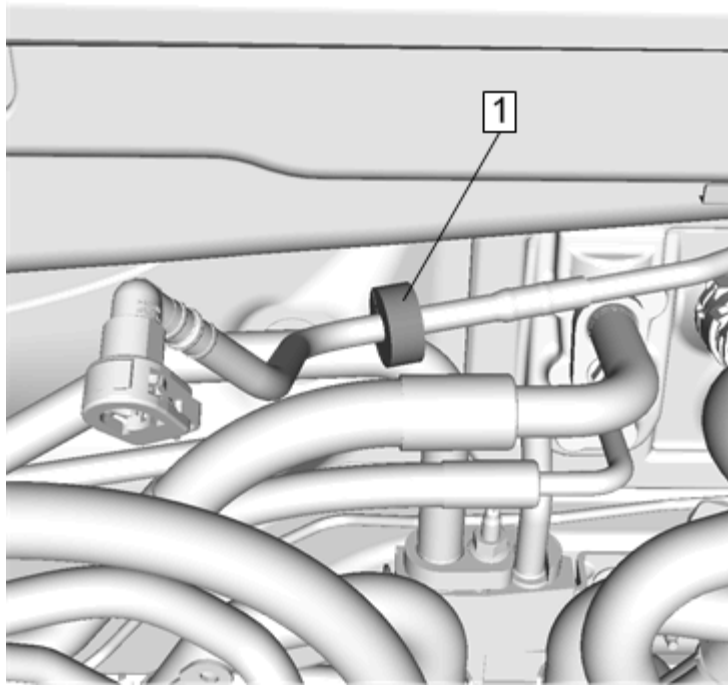


Fig. 243: Bumper

Courtesy of GENERAL MOTORS COMPANY

1. If replacing the evaporative emissions pipe with a new pipe, position the new bumper (1) on the new replacement pipe, after installation, as shown. If the old pipe is being reinstalled, position a new bumper (1) on the existing pipe, after installation, as shown.

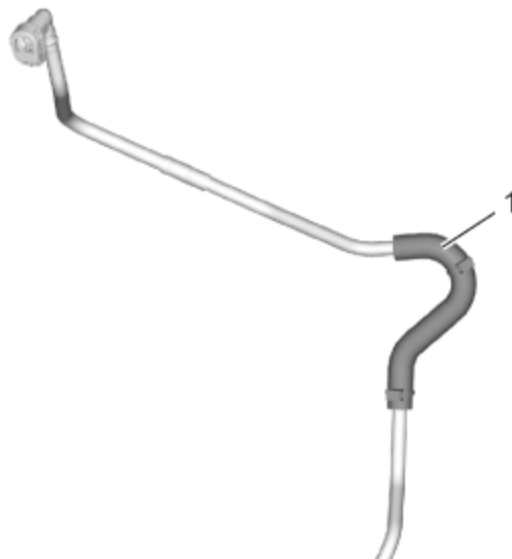


Fig. 244: Evaporative Emission Pipe Sleeve

Courtesy of GENERAL MOTORS COMPANY

NOTE: Check sleeve for proper position after pipe installation.

2. If replacing the evaporative emissions pipe with a new pipe and the new pipe does not have a sleeve (1) on it, transfer the sleeve (1) from the old pipe to the new one.

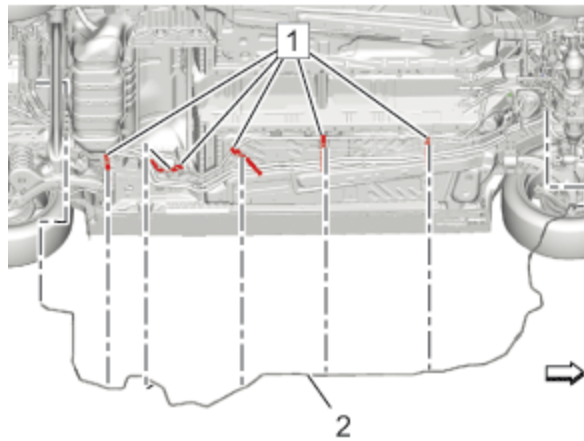


Fig. 245: Evaporative Emission Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Install the evaporative emission pipe (2) to the vehicle.
4. Install Evaporative Emission Pipe(2)@Retainer(1)
5. Close the 5 retainers (1).

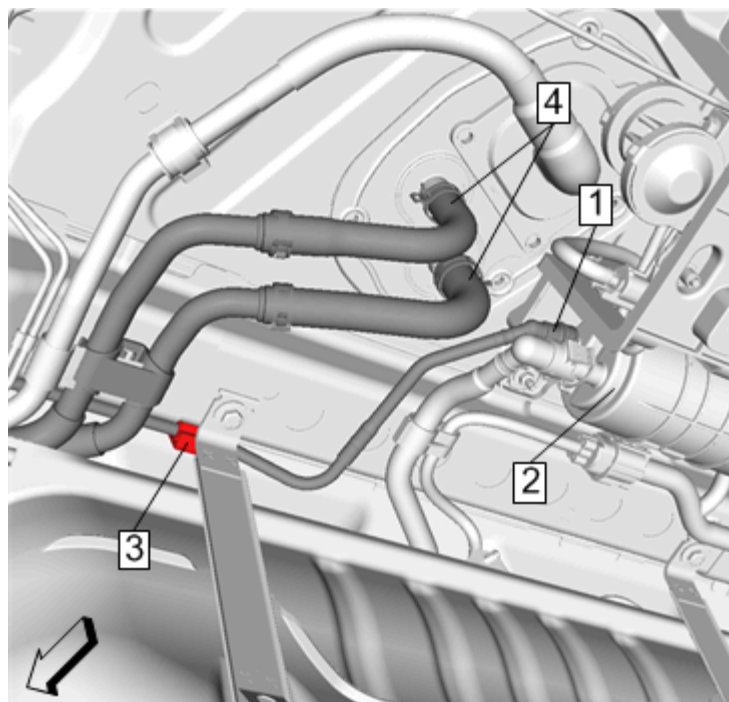


Fig. 246: Drive Motor Generator Control Module Cooling Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

6. Remove all EN-6015 plugs from the connections.
7. Connect Evaporative Emission Pipe (1) @Evaporative Emission Canister(2)[Plastic Collar Quick Connect Fitting Service](#)
8. Install Drive Motor Generator Control Module Cooling Outlet Hose(4)[Drive Motor Generator Control](#)

**Module Cooling Outlet Hose Replacement (Underbody Line) Drive Motor Generator Control
Module Cooling Outlet Hose Replacement (Underbody Line to Traction Power Inverter Module
Inlet)**

9. Install Evaporative Emission Pipe (1) @Retainer (3)
10. Close the retainer (3).
11. Install Floor Panel Number 4 Cross Bar **Floor Panel Number 4 Cross Bar Replacement**
12. Install Rear Axle **Rear Axle Replacement**

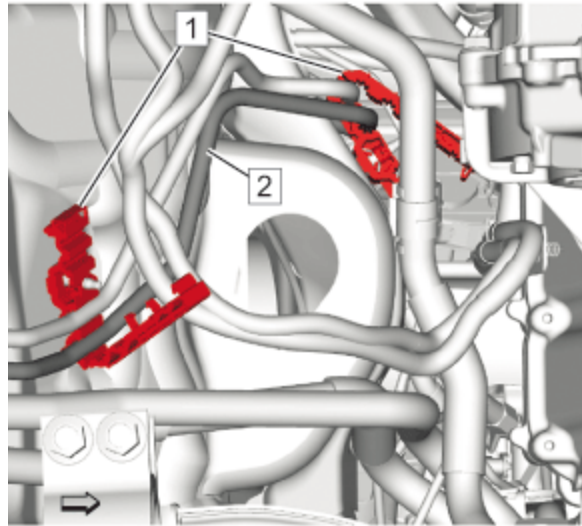


Fig. 247: Evaporative Emission Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

NOTE: Inspect bulkhead cross car brake line and retainers as required after line installation.

13. Install Evaporative Emission Pipe(2)@Retainer(1)
14. Close the 2 retainers (31).
15. Install Drivetrain and Front Suspension Cradle **Drivetrain and Front Suspension Cradle Replacement**
16. Lower the vehicle.

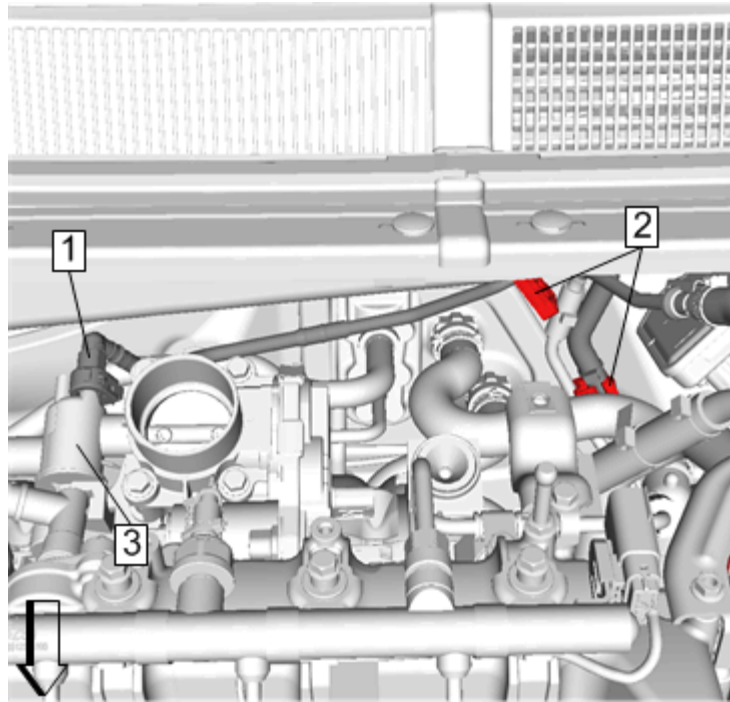


Fig. 248: Evaporative Emission Pipe And Evaporative Emission Canister Purge Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

17. Install Evaporative Emission Pipe(1)@Retainer(2)
18. Close Retainer(2)
19. Remove all **EN-6015** plugs from the connections.
20. Connect Evaporative Emission Pipe(1)@Evaporative Emission Canister Purge Solenoid Valve(3) [Plastic Collar Quick Connect Fitting Service](#)
21. Install Air Cleaner Outlet Duct [Air Cleaner Outlet Duct Replacement](#)
22. Connect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)

EVAPORATIVE EMISSION REAR HOSE REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Diesel/Gasoline Vapors Warning](#)

WARNING: [Safety Goggles and Fuel Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Lower the fuel tank, to get enough space to remove the evaporative emission pipe. Refer to [Fuel Tank Replacement](#).

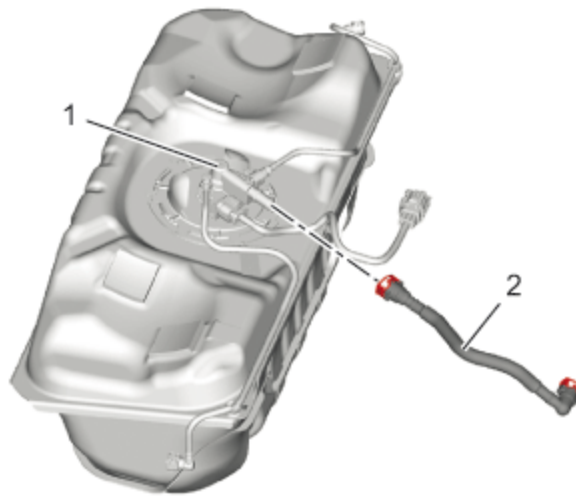


Fig. 249: Evaporative Emission Rear Hose And Fuel Tank Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Evaporative Emission Rear Hose(2)@Fuel Tank Fuel Pump Module(1)[Plastic Collar Quick Connect Fitting Service](#)
4. Close all open connections with the **EN-6015** plugs.

Installation Procedure

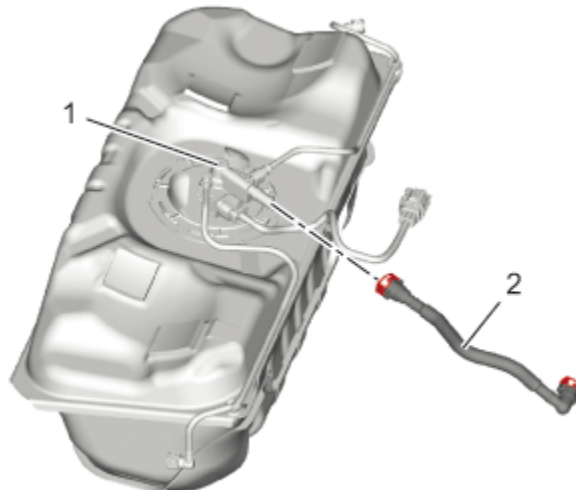


Fig. 250: Evaporative Emission Rear Hose And Fuel Tank Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

1. Remove all **EN-6015** plugs.
2. Connect Evaporative Emission Rear Hose(2)@Fuel Tank Fuel Pump Module(1) [Plastic Collar Quick Connect Fitting Service](#)
3. Install [Fuel Tank Replacement](#)
4. Connect [Battery Negative Cable Disconnection and Connection](#)

EVAPORATIVE EMISSION SYSTEM VACUUM LEAK PUMP SHIELD REPLACEMENT

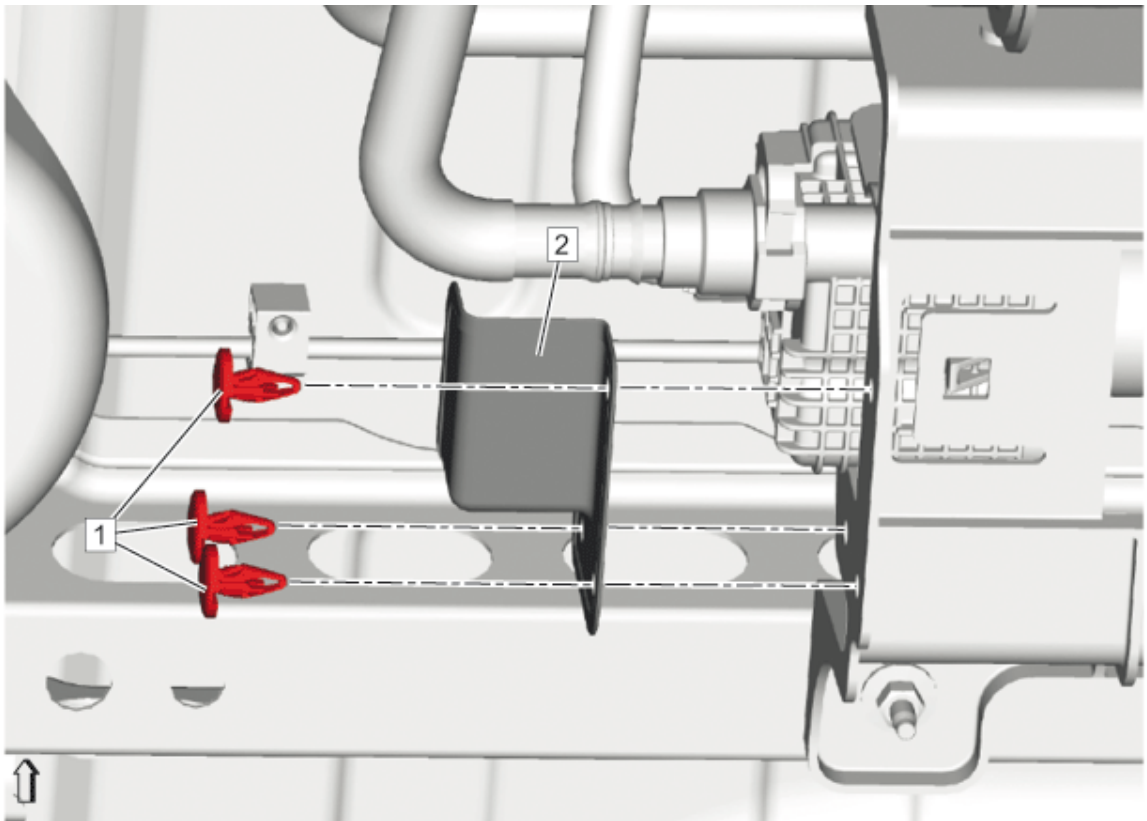


Fig. 251: Evaporative Emission System Vacuum Leak Pump Shield
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Underbody Rear Air Deflector Replacement</u>	
1	Retainer (Qty: 3)
2	Evaporative Emission System Vacuum Leak Pump Shield

EVAPORATIVE EMISSION CANISTER VACUUM LEAK PUMP HARNESS REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools:[Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: [Safety Goggles and Fuel Warning](#)

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

- 1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
- 2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

3. Remove Rear Wheelhouse Liner Replacement

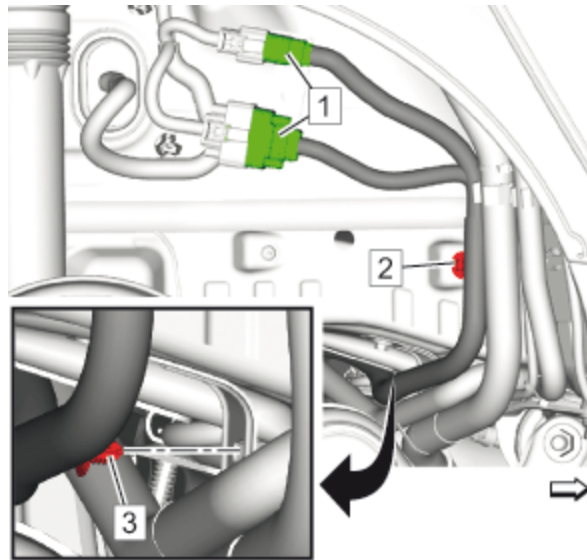


Fig. 252: Electrical Connectors And Wiring Harness Clips
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors.(1)
5. Unclip Wiring Harness Clip(2, 3)
6. Remove Underbody Rear Air Deflector Replacement

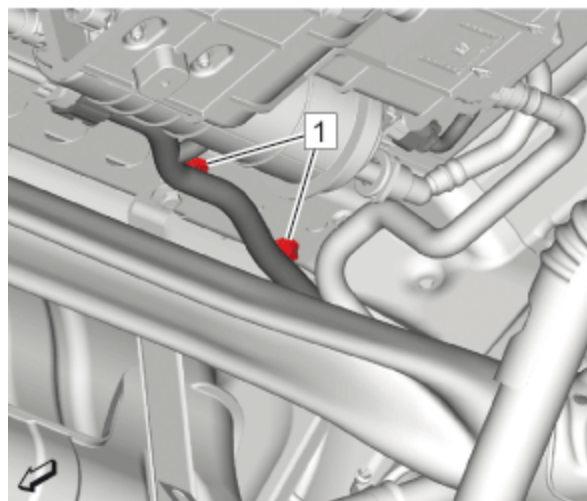


Fig. 253: Wiring Harness Clips
Courtesy of GENERAL MOTORS COMPANY

7. Unclip Wiring Harness Clip(1)

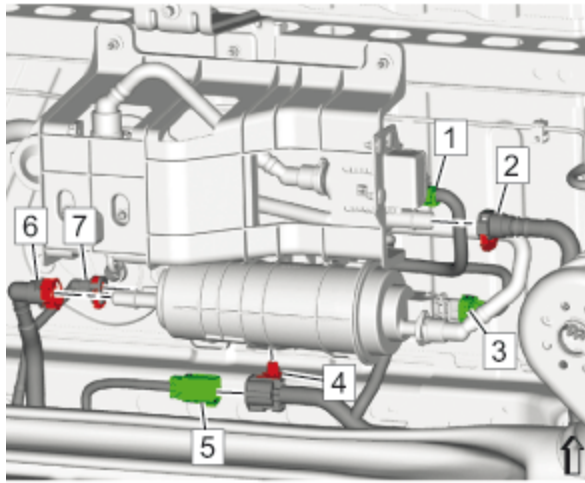


Fig. 254: Electrical Connectors, Evaporative Emission Rear Hose, Evaporative Emission Pipe, Vacuum Leak Pump Filter Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the electrical connector:
 1. Evaporative Emission System Vacuum Leak Detection Pump (1)
 2. Fuel Tank Pressure Sensor(3)
 3. Fuel Tank Fuel Pump Module Wiring Harness (5).
9. Disconnect Evaporative Emission Rear Hose (6)[Plastic Collar Quick Connect Fitting Service](#)
10. Disconnect Evaporative Emission Pipe(7) [Plastic Collar Quick Connect Fitting Service](#)
11. Disconnect the evaporative emission system vacuum leak pump filter pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).
12. Close all open connection with the **EN-6015** plugs.
13. Remove Retainer(4)

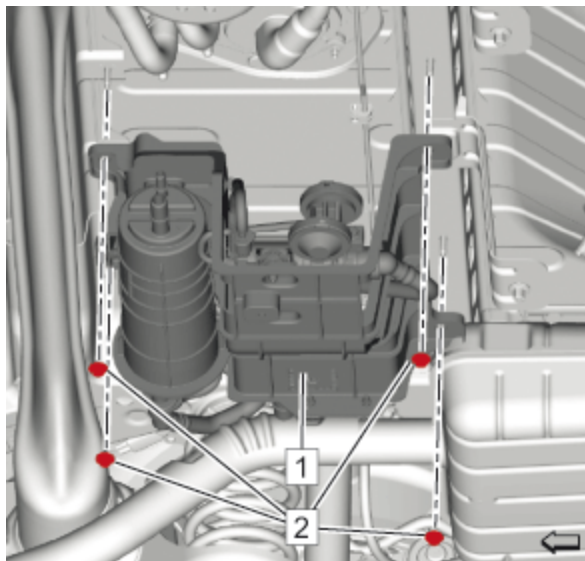


Fig. 255: Evaporative Emission Canister Bracket And Nuts

Courtesy of GENERAL MOTORS COMPANY

14. Remove the 4 evaporative emission canister bracket nuts (2).
15. Remove the evaporative emission canister bracket (1) and put it on a workbench.

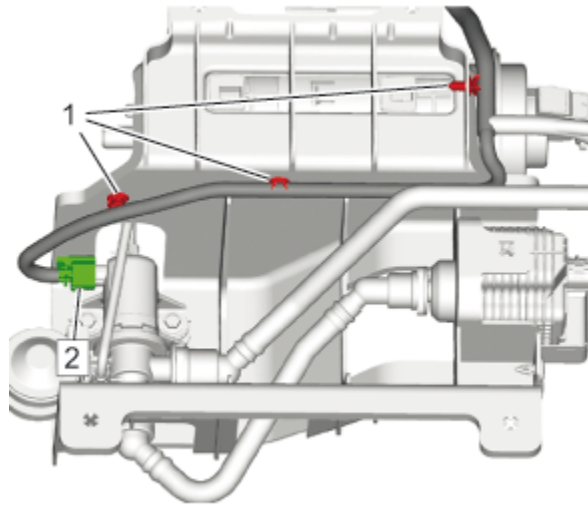


Fig. 256: Electrical Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

16. Disconnect the electrical connector.(2)
17. Remove Retainer(1)
18. Remove the evaporative emission canister vacuum leak pump wiring harness.

Installation Procedure

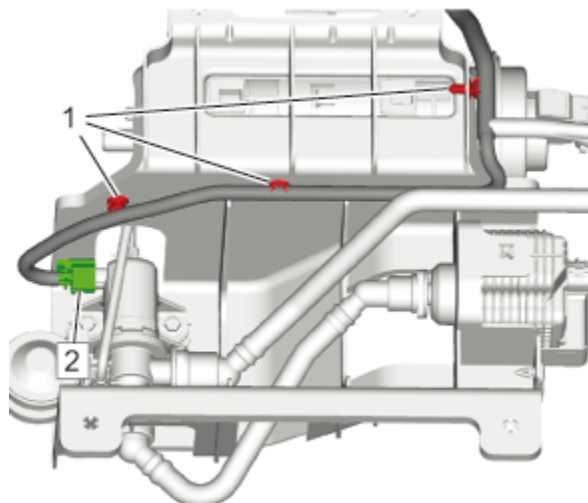


Fig. 257: Electrical Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Install the evaporative emission canister vacuum leak pump wiring harness.

2. Install Retainer
3. Connect the electrical connector.

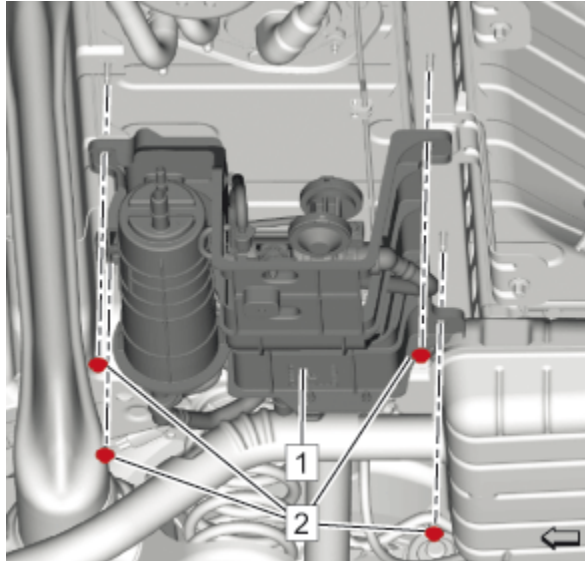


Fig. 258: Evaporative Emission Canister Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Install the evaporative emission canister bracket (1).

CAUTION: Fastener Caution

5. Install the 4 evaporative emission canister bracket nuts (2) and tighten to 9 N.m (80 lb in).

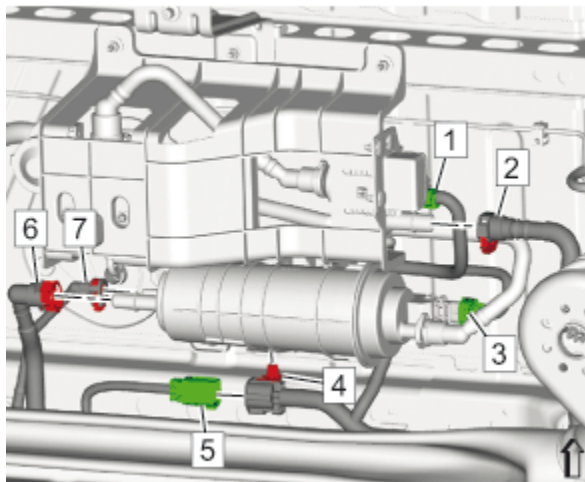


Fig. 259: Electrical Connectors, Evaporative Emission Rear Hose, Evaporative Emission Pipe, Vacuum Leak Pump Filter Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Install Retainer(4)
7. Remove the **EN-6015** plugs from all connections.

8. Connect the evaporative emission system vacuum leak pump filter pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Connect Evaporative Emission Pipe (7) [Plastic Collar Quick Connect Fitting Service](#)
10. Connect Evaporative Emission Rear Hose (6) [Plastic Collar Quick Connect Fitting Service](#)
11. Connect the electrical connector:
 1. Evaporative Emission System Vacuum Leak Detection Pump (1)
 2. Fuel Tank Pressure Sensor(3)
 3. Fuel Tank Fuel Pump Module Wiring Harness (5).

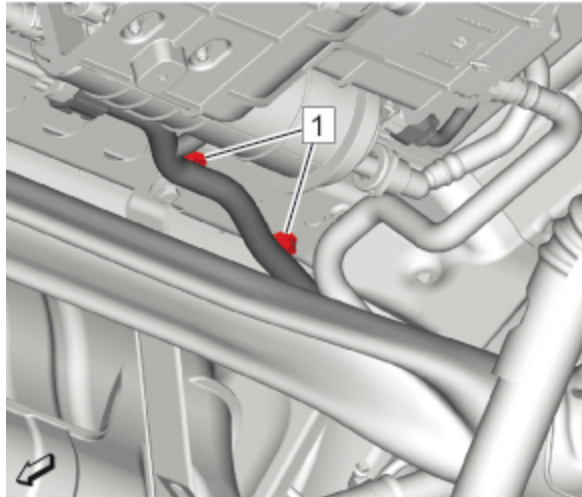


Fig. 260: Wiring Harness Clips

Courtesy of GENERAL MOTORS COMPANY

12. Install Wiring Harness Clip(1)
13. Install [Underbody Rear Air Deflector Replacement](#)

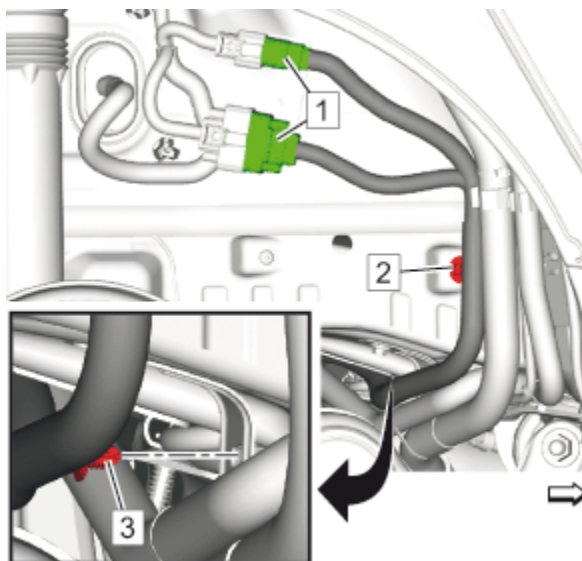


Fig. 261: Electrical Connectors And Wiring Harness Clips

Courtesy of GENERAL MOTORS COMPANY

14. Install Wiring Harness Clip(2, 3)
15. Connect the electrical connectors.(1)
16. Install Rear Wheelhouse Liner Replacement
17. Lower the vehicle.
18. Connect Battery Negative Cable Disconnection and Connection

EVAPORATIVE EMISSION SYSTEM VACUUM LEAK PUMP FILTER REPLACEMENT

Removal Procedure

1. Remove Fuel Tank Filler Pipe Replacement

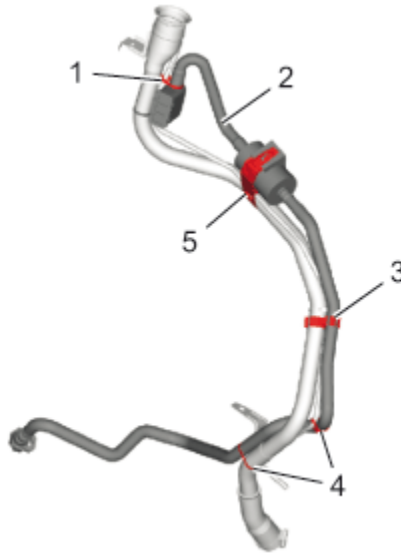


Fig. 262: Evaporative Emission System Vacuum Leak Pump Filter, Bracket, Cable Straps And Clip
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 3 cable straps (1, 4).
3. Remove Clip (3)
4. Unclip the evaporative emission system vacuum leak pump filter (2) from the bracket (5).

Installation Procedure

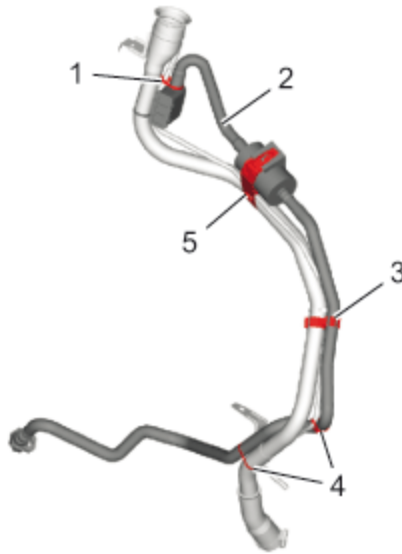


Fig. 263: Evaporative Emission System Vacuum Leak Pump Filter, Bracket, Cable Straps And Clip
Courtesy of GENERAL MOTORS COMPANY

1. Install the evaporative emission system vacuum leak pump filter (2) to the bracket (5).
2. Install Clip (3)
3. Install the 3 cable straps (1, 4).
4. Install [Fuel Tank Filler Pipe Replacement](#)

EVAPORATIVE EMISSION SYSTEM VACUUM LEAK DETECTION PUMP REPLACEMENT

Removal Procedure

WARNING: [Safety Goggles and Fuel Warning](#)

WARNING: [Fuel Vapors in Evaporative Emission Components Warning](#)

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Remove [Underbody Rear Air Deflector Replacement](#)

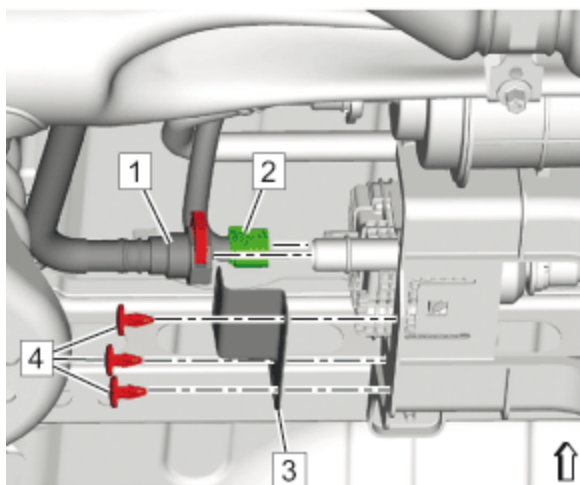


Fig. 264: Evaporative Emission System Vacuum Leak Pump Cover, Filter Pipe, Retainers And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Remove Retainer (4)
5. Remove the evaporative emission system vacuum leak pump cover (3).
6. Disconnect the evaporative emission system vacuum leak pump filter pipe (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Disconnect the electrical connector.(2)

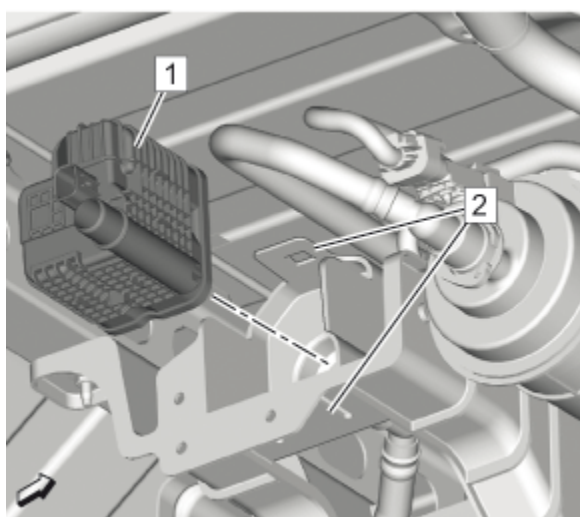


Fig. 265: Evaporative Emission System Vacuum Leak Pump And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a flat bladed tool to release the 2 retaining tabs (2).

8. Remove the evaporative emission system vacuum leak pump (1).

Installation Procedure

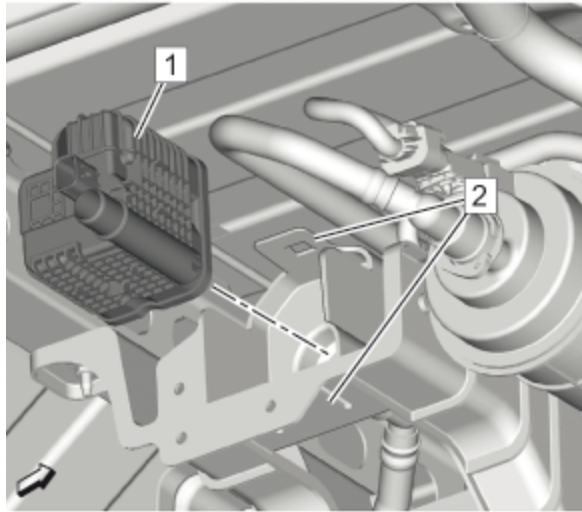


Fig. 266: Evaporative Emission System Vacuum Leak Pump And Retaining Tabs
 Courtesy of GENERAL MOTORS COMPANY

NOTE: There must be 2 noticeable click noises.

1. Install the evaporative emission system vacuum leak pump (1).

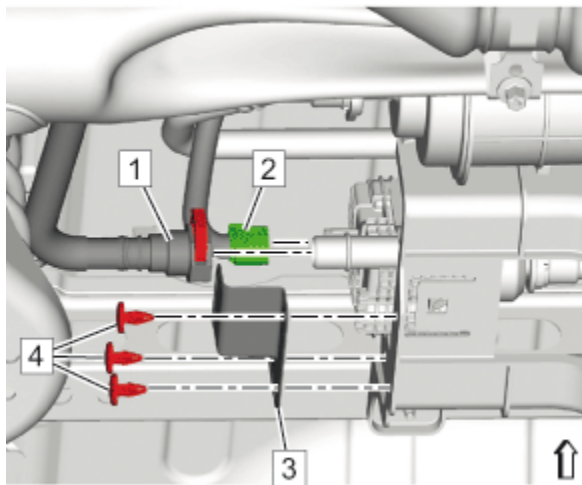


Fig. 267: Evaporative Emission System Vacuum Leak Pump Cover, Filter Pipe, Retainers And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

2. Connect the electrical connector.(2)
3. Connect the evaporative emission system vacuum leak pump filter pipe (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Install the evaporative emission system vacuum leak pump cover (3).
5. Install Retainer(4)
6. Lower the vehicle.

7. Install [Underbody Rear Air Deflector Replacement](#)
8. Connect [Battery Negative Cable Disconnection and Connection](#)

IGNITION COIL REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover [Intake Manifold Cover Replacement](#)

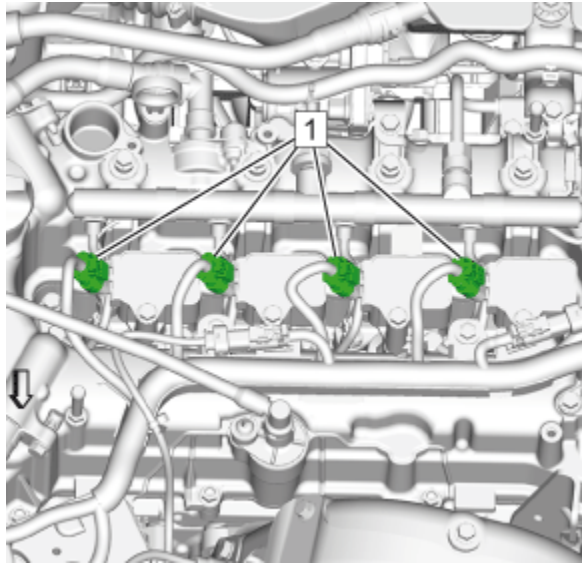


Fig. 268: Ignition Coil Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Ignition Coil Electrical Connector (1)

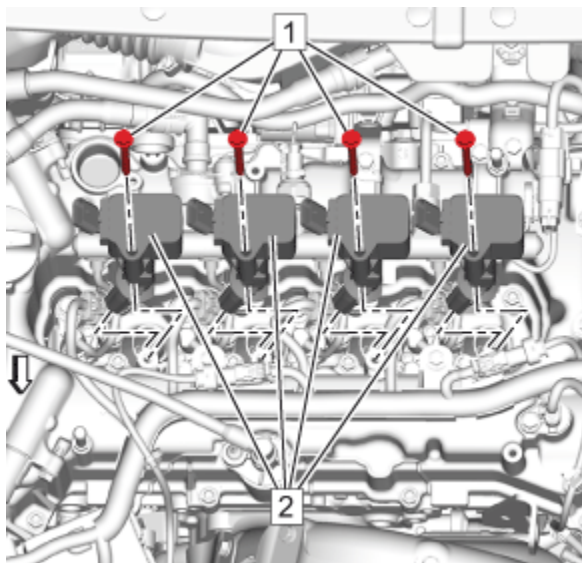


Fig. 269: Ignition Coils And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Ignition Coil Bolt (1)
4. Remove Ignition Coil (2)

Installation Procedure

1. Inspect the inside of the ignition coil boot for a thin, even coat of dielectric grease. If there is no grease present or additional grease is necessary, continue to the next step.
2. Apply a thin coating of dielectric grease to the inside of the ignition coil boot up to a depth of 15 mm (0.60 in) from the end of the boot.
3. Remove any excess dielectric grease from around the end of the ignition coil boot and ensure there is not an excessive amount within the boot.

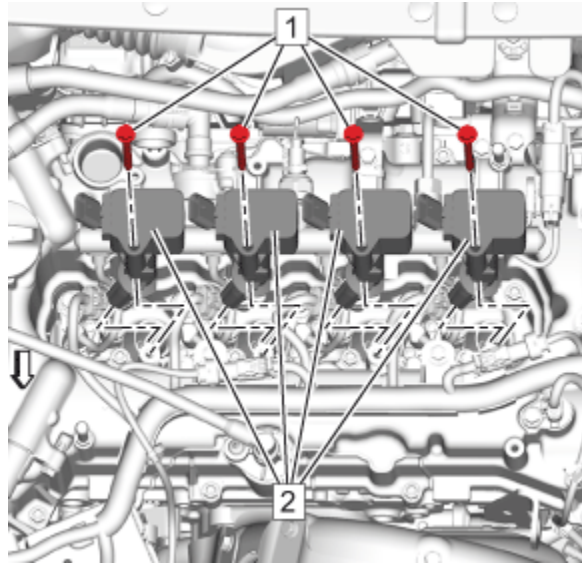


Fig. 270: Ignition Coils And Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Install Ignition Coil (2)

CAUTION: Refer to [Fastener Caution](#) .

5. Install Ignition Coil Bolt (1) and tighten 10 N.m (89 lb in)

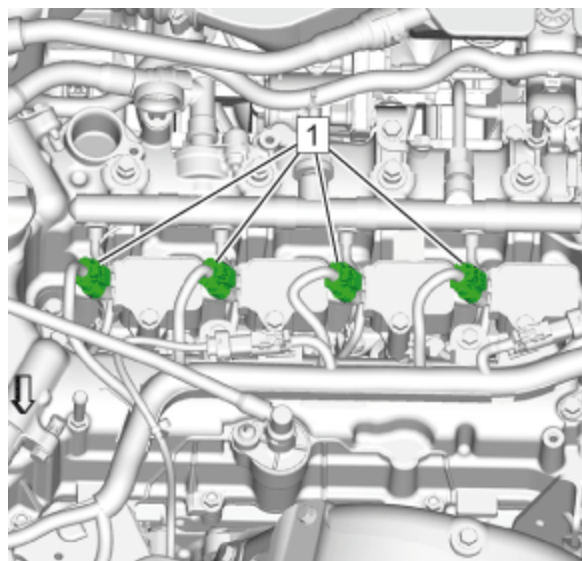


Fig. 271: Ignition Coil Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

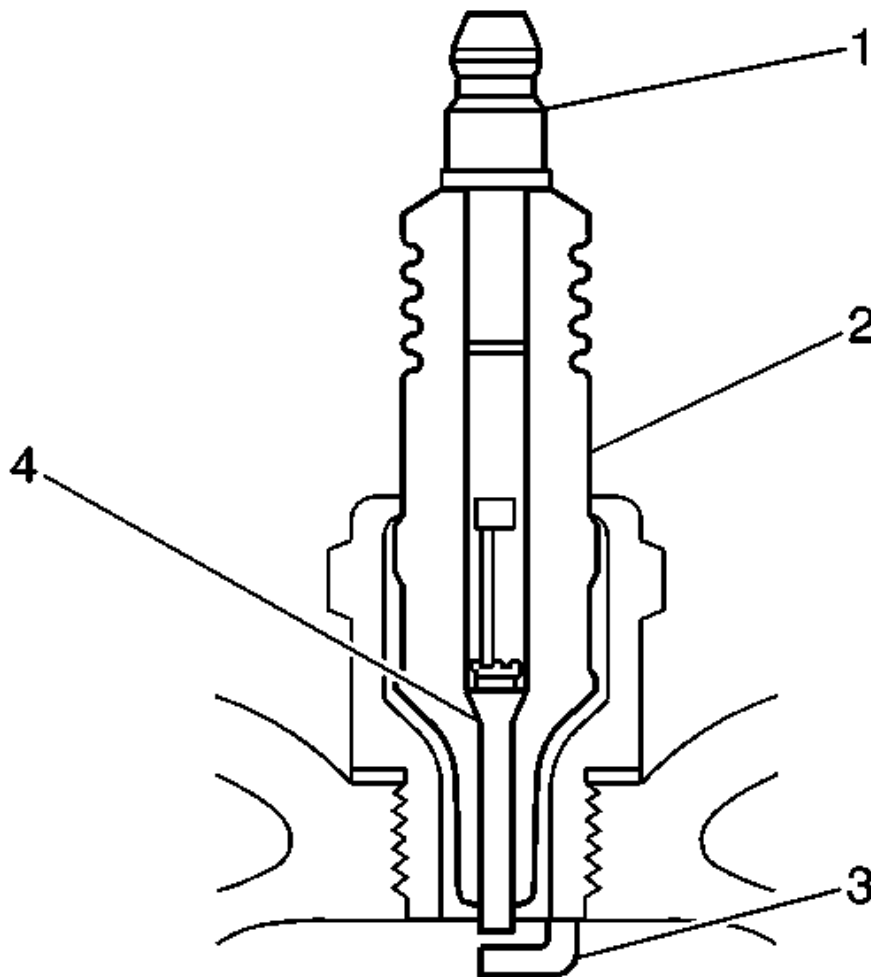
6. Connect Ignition Coil Electrical Connector (1)
7. Install Intake Manifold Cover [Intake Manifold Cover Replacement](#)

SPARK PLUG INSPECTION

Spark Plug Usage

1. Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to [Ignition System Specifications](#) for the correct spark plug.
2. Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
 - Spark plug fouling - Colder plug
 - Pre-ignition causing spark plug and/or engine damage - Hotter plug

Spark Plug Inspection



[Fig. 272: Cross Sectional View Of Spark Plug](#)

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the terminal post (1) for damage.

- Inspect for a bent or broken terminal post (1).
- Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.

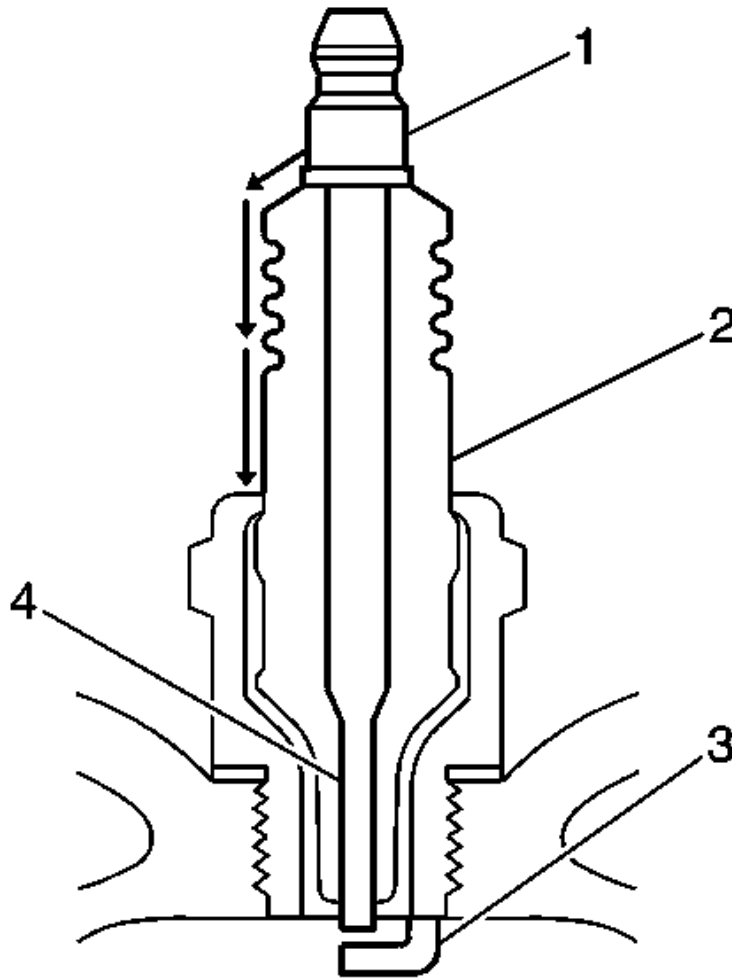


Fig. 273: Inspecting Spark Plug For Flashover Or Carbon Tracking Soot

Courtesy of GENERAL MOTORS COMPANY

2. Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:

- Inspect the spark plug boot for damage.
- Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.

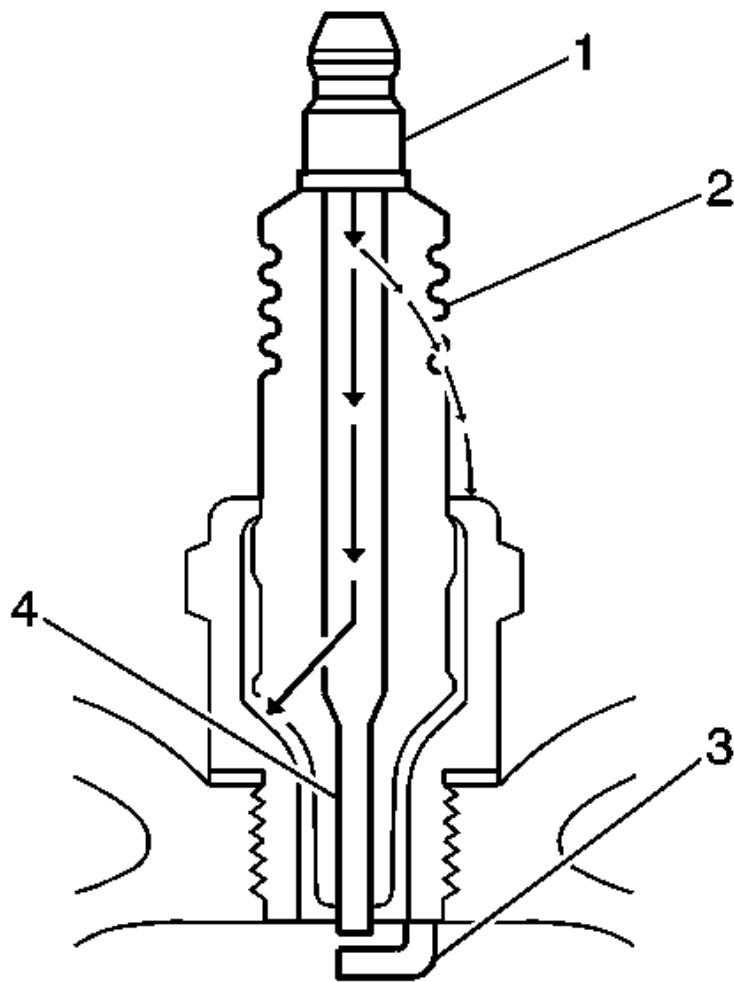


Fig. 274: Inspecting Spark Plug Insulator

Courtesy of GENERAL MOTORS COMPANY

3. Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).

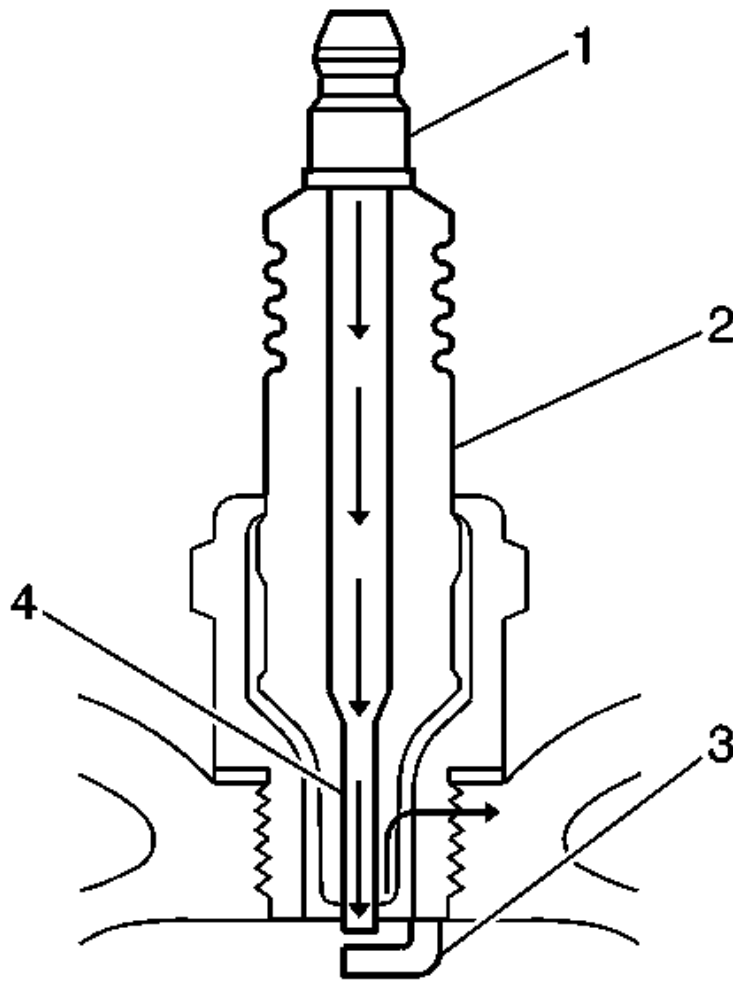


Fig. 275: Cutaway/Description View Of Spark Plug

Courtesy of GENERAL MOTORS COMPANY

4. Inspect for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to [Ignition System Specifications](#) . An excessively wide electrode gap can prevent correct spark plug operation.
 - Inspect for the correct spark plug torque. Insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
 - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
 - Inspect for a broken or worn side electrode (3).
 - Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
5. A rattling sound indicates internal damage.
6. A loose center electrode (4) reduces the spark intensity.
 - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
 - Inspect for worn or missing platinum pads on the electrodes (3, 4) If equipped.

- Inspect for excessive fouling.
- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

1. Normal operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
2. Carbon Fouled - Dry, fluffy black carbon, or soot caused by the following conditions:
 - Rich fuel mixtures
 - Leaking fuel injectors
 - Excessive fuel pressure
 - Restricted air filter element
 - Incorrect combustion
 - Reduced ignition system voltage output
 - Weak coils
 - Worn ignition wires
 - Incorrect spark plug gap
 - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
 - Deposit Fouling - Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

SPARK PLUG REPLACEMENT

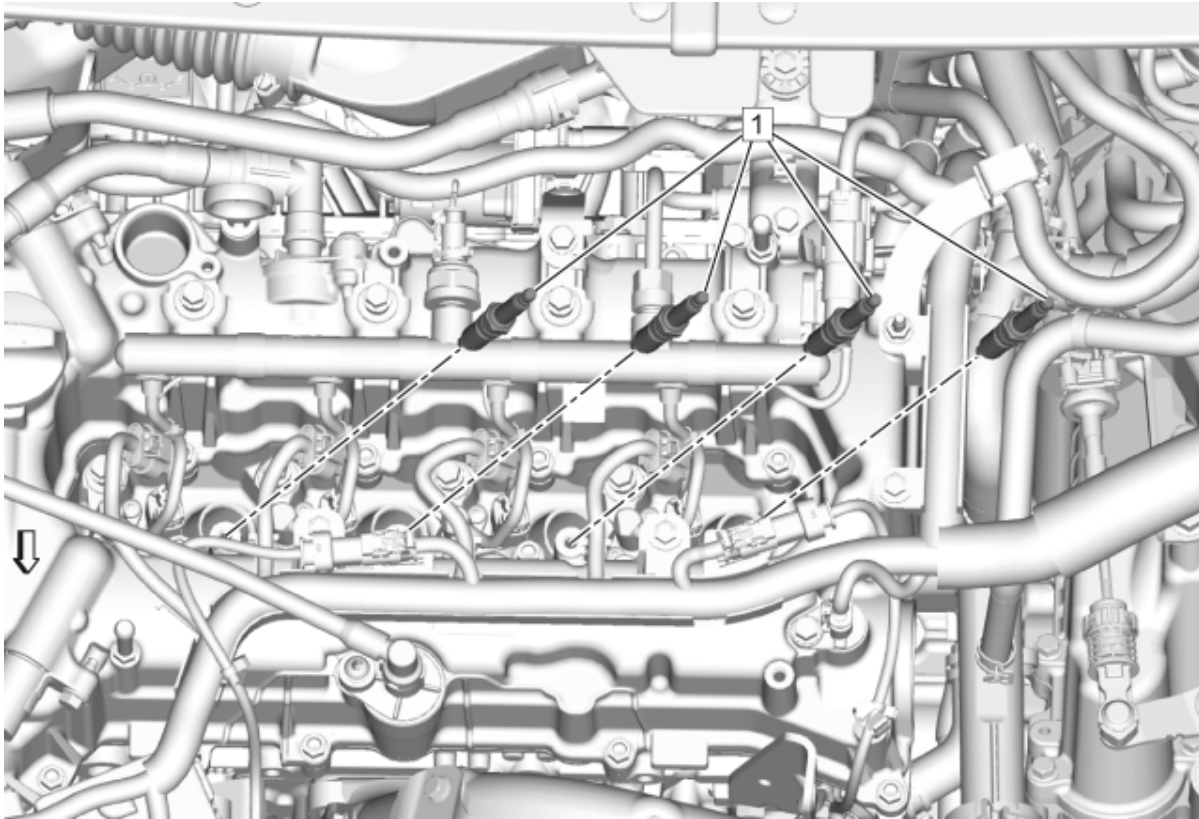


Fig. 276: Spark Plugs

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Ignition Coil Replacement</u>	
1	Spark Plug (Qty: 4) CAUTION: Refer to:<u>Component</u> <u>Fastener</u> <u>Tightening</u> <u>Caution</u> Tighten 17 N.m (13 lb ft)

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT - INTAKE

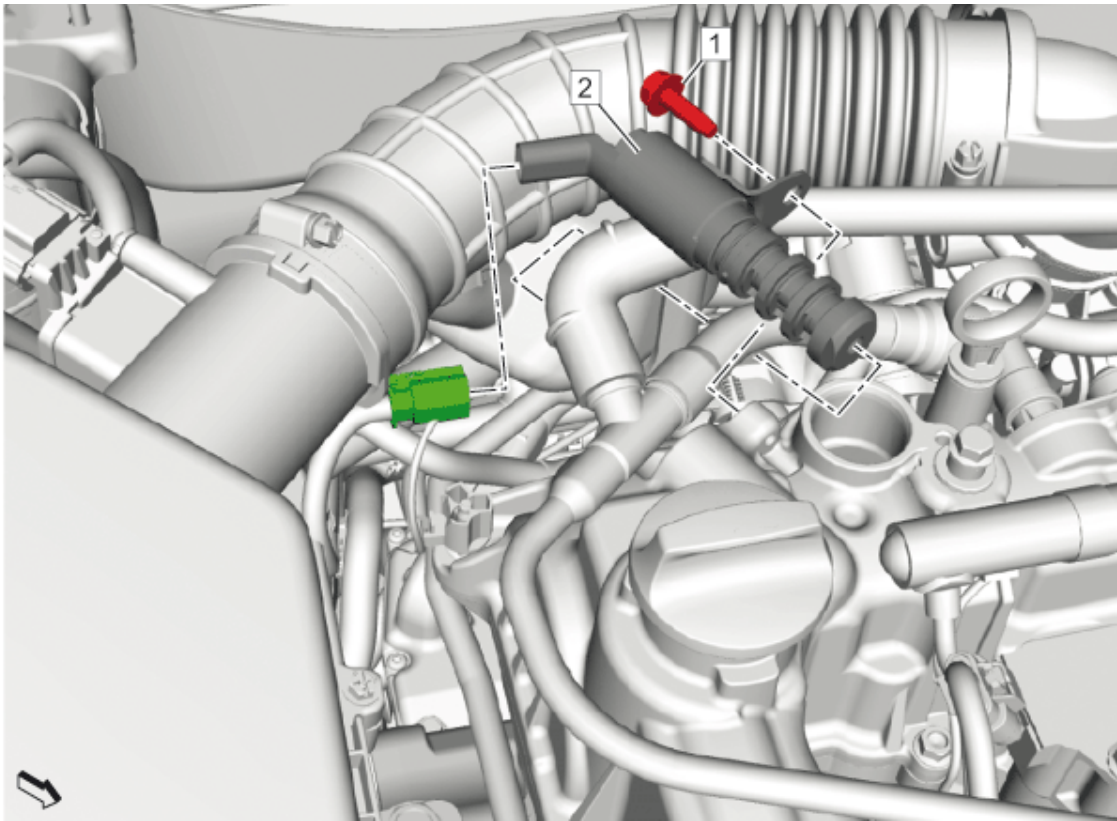


Fig. 277: Camshaft Position Actuator Solenoid Valve - Intake

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Actuator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Actuator Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Install a NEW O-ring seal.

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT - EXHAUST

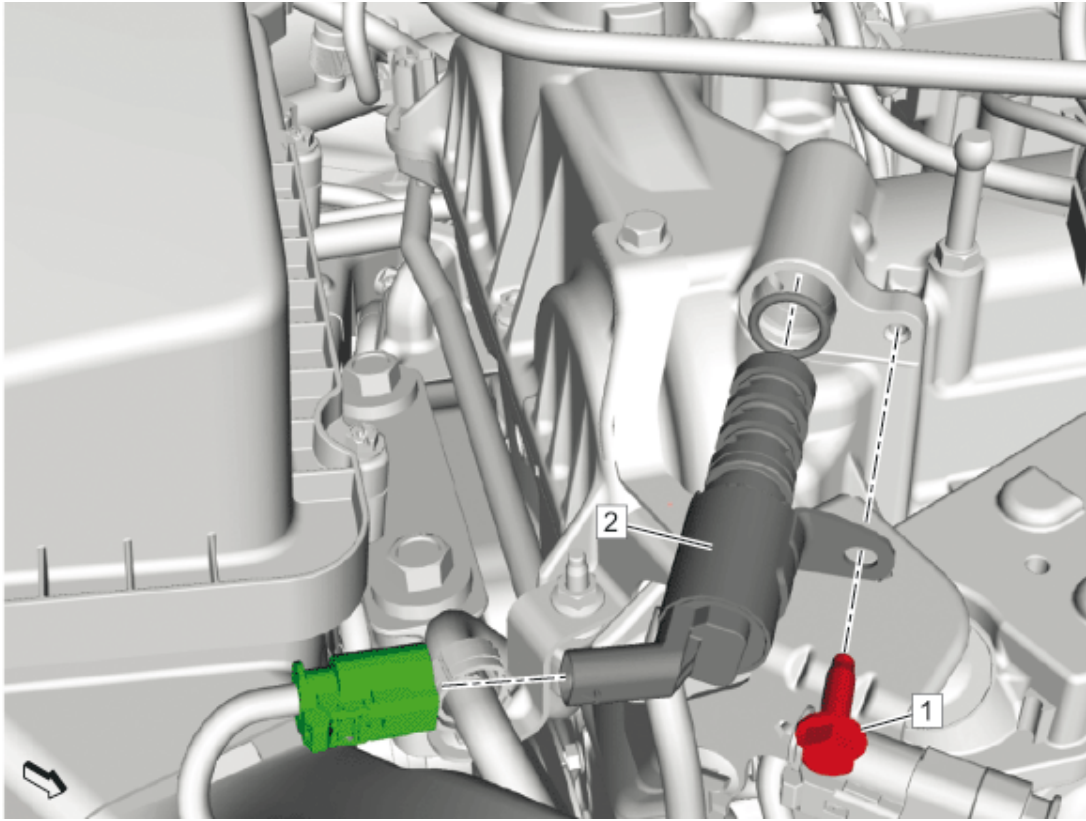


Fig. 278: Camshaft Position Actuator Solenoid Valve - Exhaust

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Actuator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Actuator Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Install a NEW O-ring seal.

CRANKSHAFT POSITION SENSOR REPLACEMENT

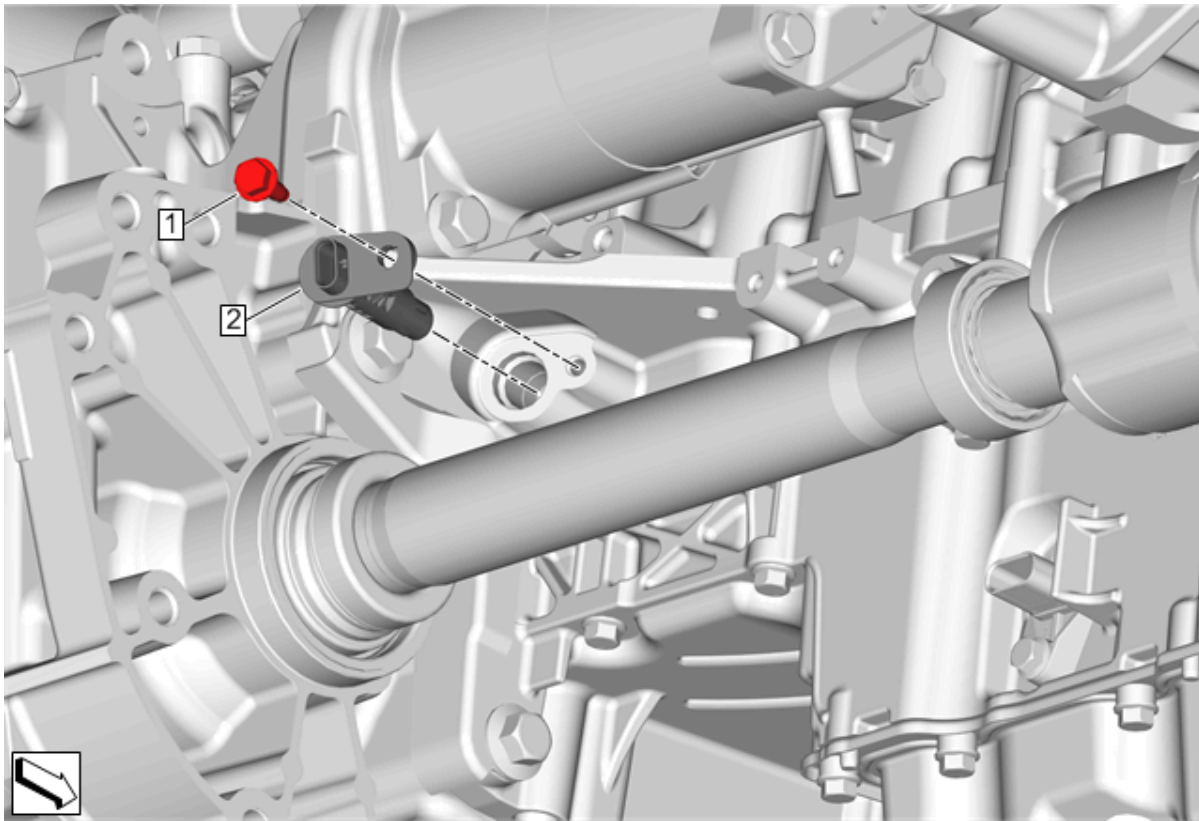


Fig. 279: Crankshaft Position Sensor (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Disconnect the electrical connector.	
1	Crankshaft Position Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Crankshaft Position Sensor Procedure Perform the crankshaft position variation learn. Crankshaft Position Variation Learn

CAMSHAFT POSITION SENSOR REPLACEMENT - INTAKE

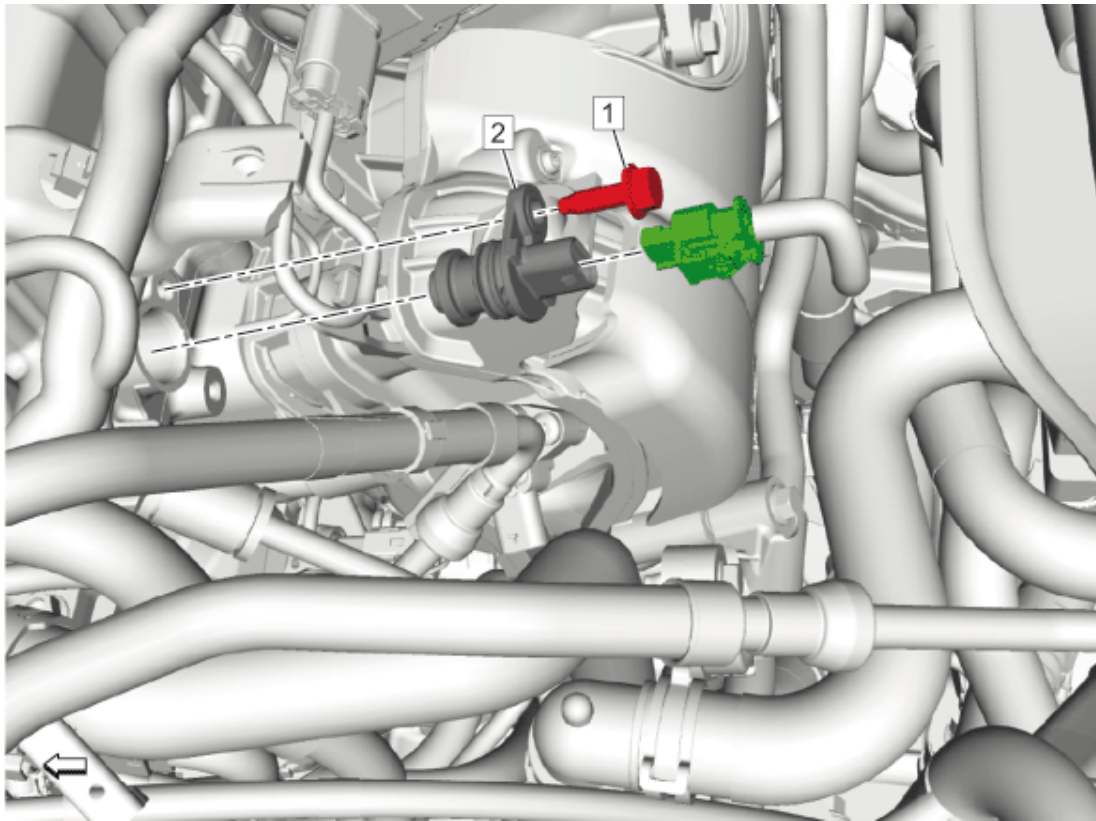


Fig. 280: Camshaft Position Sensor - Intake

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Intake Manifold Cover Replacement</u> <u>Air Cleaner Outlet Duct Replacement</u>	
1	Camshaft Position Sensor Bolt CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 10 N.m (89 lb in)
2	Camshaft Position Sensor Procedure Disconnect the electrical connector.

CAMSHAFT POSITION SENSOR REPLACEMENT - EXHAUST

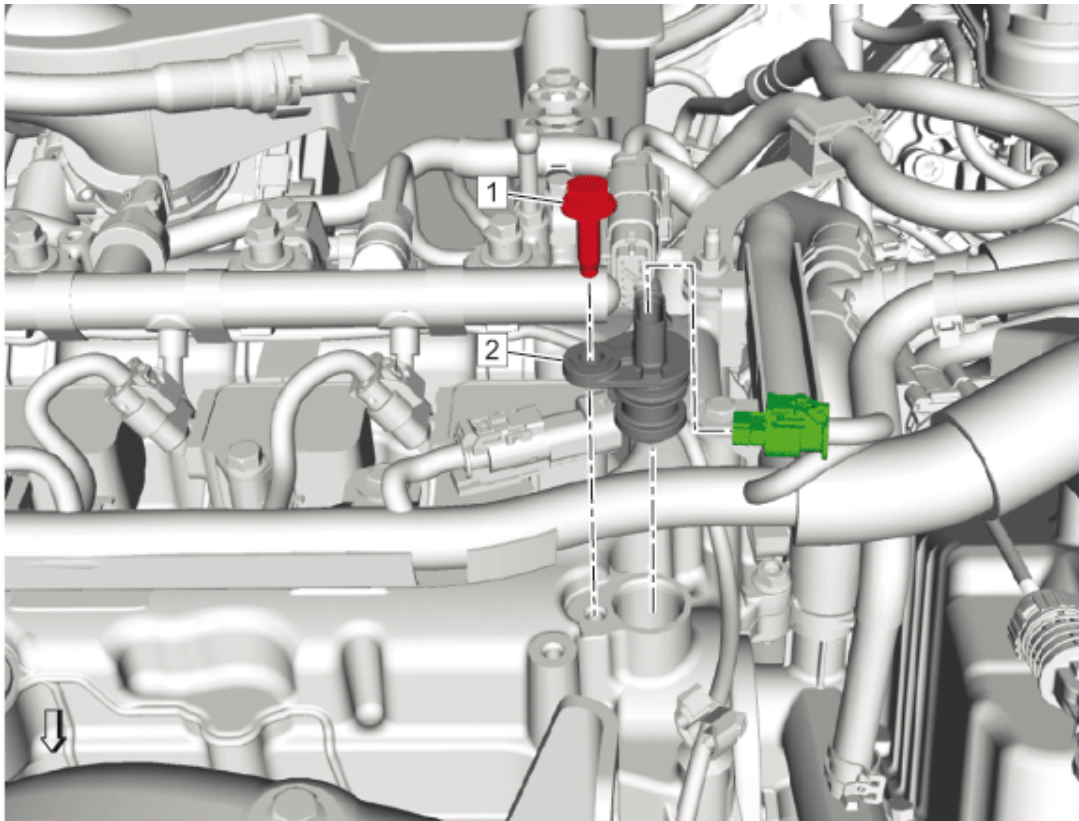


Fig. 281: Camshaft Position Sensor - Exhaust
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Sensor Bolt CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 10 N.m (89 lb in)
2	Camshaft Position Sensor Procedure Disconnect the electrical connector.

AIR CLEANER ASSEMBLY REPLACEMENT

Removal Procedure

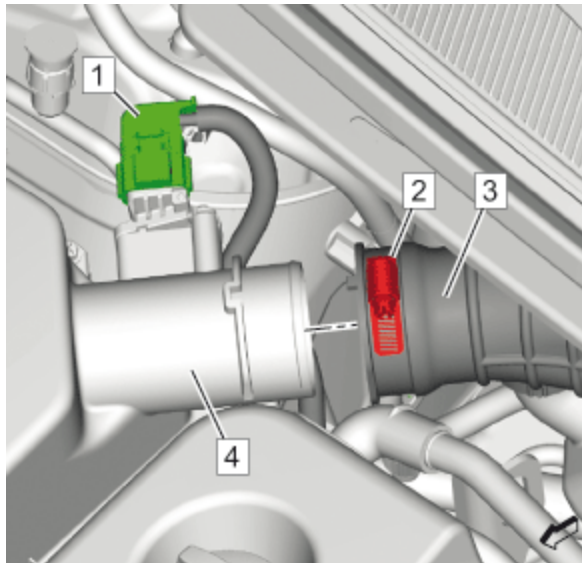


Fig. 282: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the electrical connector.(1)
2. Loosen Air Cleaner Outlet Duct Clamp (2)
3. Remove Air Cleaner Outlet Duct (3) @Air Cleaner Assembly (4)

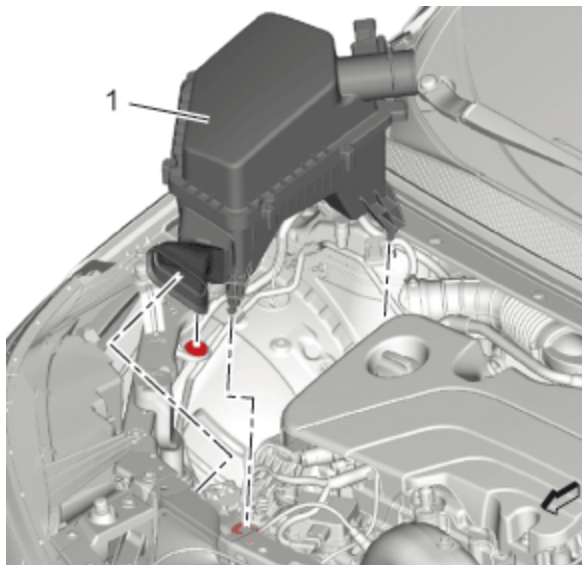


Fig. 283: Air Cleaner Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Remove Air Cleaner Assembly (1)
5. Transfer parts as necessary.

Installation Procedure

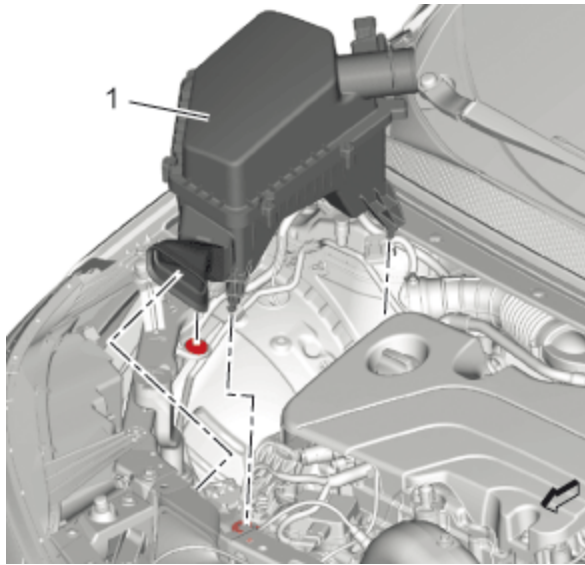


Fig. 284: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

1. Install Air Cleaner Assembly (1)

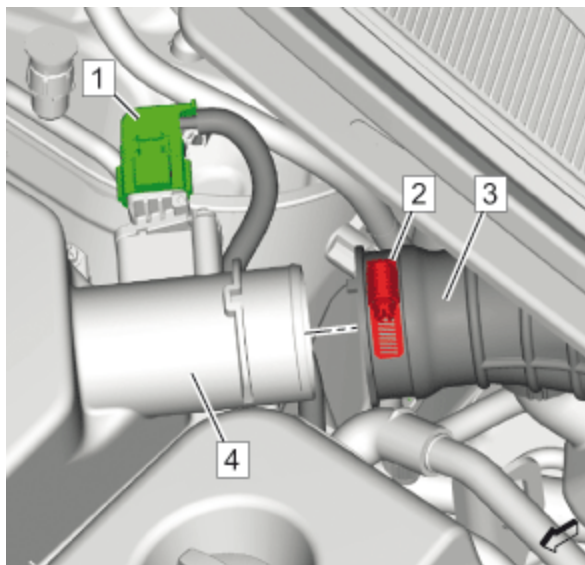


Fig. 285: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

2. Install Air Cleaner Outlet Duct (3) @Air Cleaner Assembly (4)

CAUTION: Refer to:[Fastener Caution](#)

3. Air Cleaner Outlet Duct Clamp (2) - Tighten 2.5 N.m (22 lb in)
4. Connect the electrical connector.(1)

AIR CLEANER ELEMENT REPLACEMENT

Removal Procedure

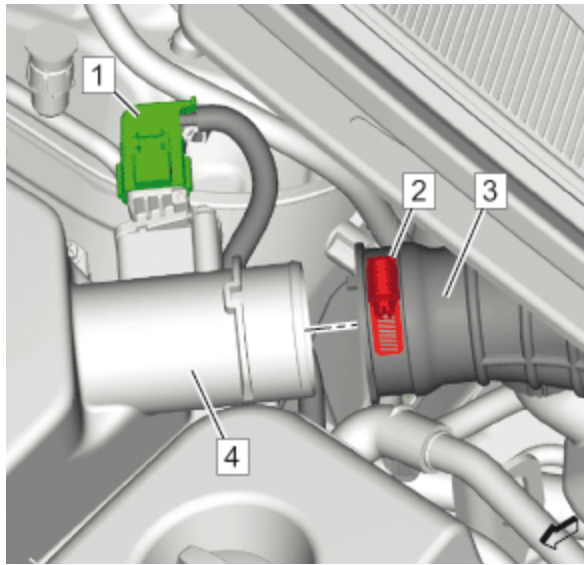


Fig. 286: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the electrical connector.(1)
2. Loosen Air Cleaner Outlet Duct Clamp (2)
3. Remove Air Cleaner Outlet Duct (3) @Air Cleaner Assembly (4)

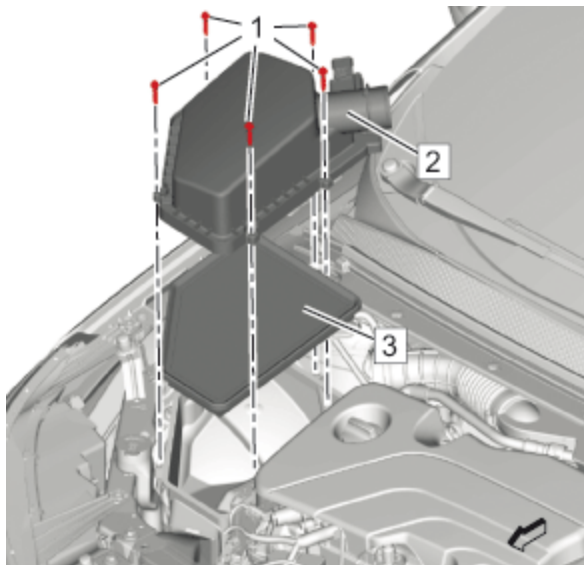


Fig. 287: Air Cleaner Upper Housing, Air Cleaner Element And Bolt
 Courtesy of GENERAL MOTORS COMPANY

4. Remove Air Cleaner Upper Housing Bolt (1)
5. Remove Air Cleaner Upper Housing (2)
6. Remove Air Cleaner Element (3)

Installation Procedure

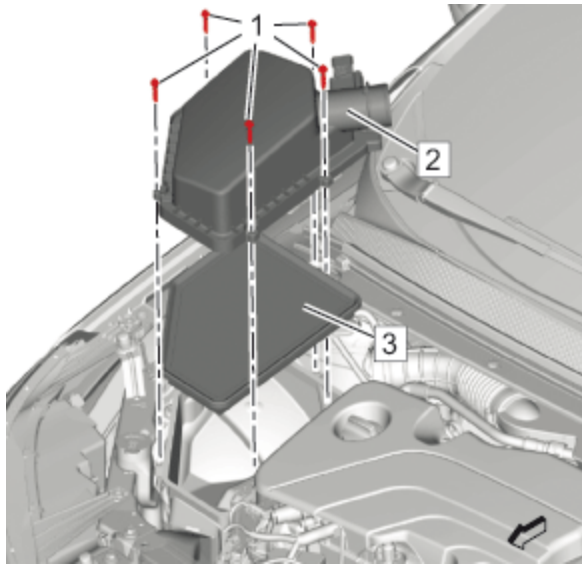


Fig. 288: Air Cleaner Upper Housing, Air Cleaner Element And Bolt
 Courtesy of GENERAL MOTORS COMPANY

1. Install Air Cleaner Element(3)
2. Install Air Cleaner Upper Housing(2)

CAUTION: Fastener Caution

3. Install Air Cleaner Upper Housing Bolt(1) and tighten 2.5 N.m (22 lb in)

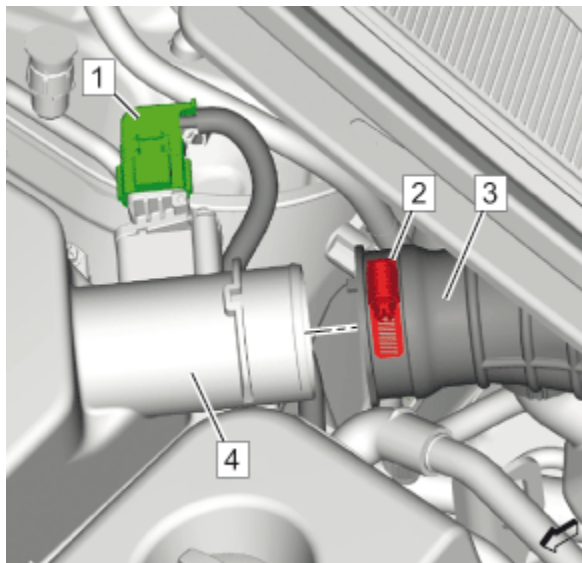


Fig. 289: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Install Air Cleaner Outlet Duct (3)@Air Cleaner Assembly (4)
5. Air Cleaner Outlet Duct Clamp (2) - Tighten 2.5 N.m (22 lb in)
6. Connect the electrical connector.(1)

AIR CLEANER OUTLET DUCT REPLACEMENT

Removal Procedure

1. Remove [Intake Manifold Cover Replacement](#)
2. Remove [Dash Upper Extension Panel Opening Cover Replacement](#)

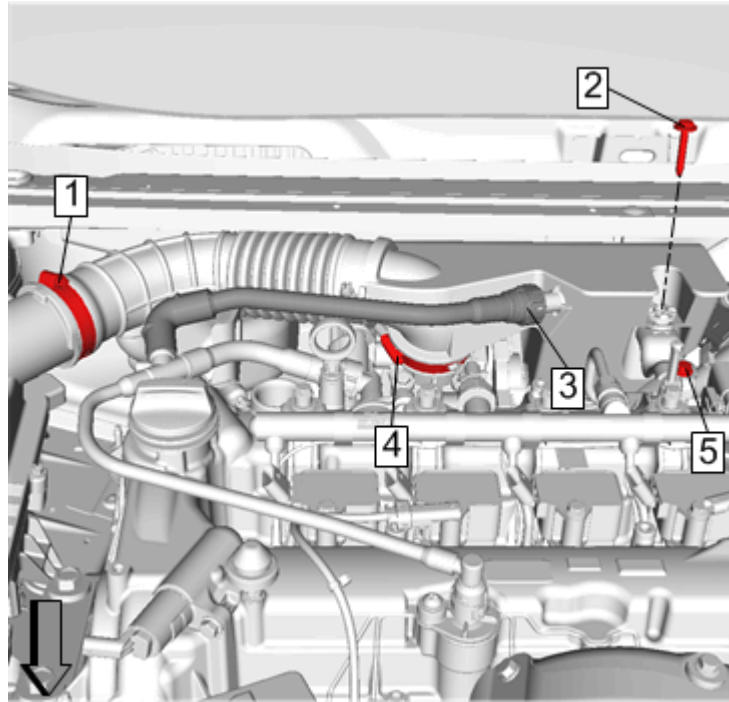


Fig. 290: Air Cleaner Outlet Duct Clamp

Courtesy of GENERAL MOTORS COMPANY

3. Loosen Air Cleaner Outlet Duct Clamp (1, 4)
4. Remove Air Cleaner Outlet Duct Fastener (2)
5. Loosen Air Cleaner Outlet Duct Bracket Bolt (5)
6. Disconnect Positive Crankcase Ventilation Tube (3) [Plastic Collar Quick Connect Fitting Service](#)

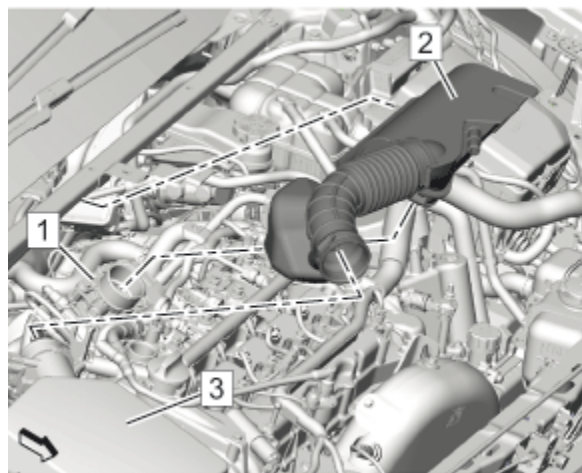


Fig. 291: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body

Courtesy of GENERAL MOTORS COMPANY

7. Remove Air Cleaner Outlet Duct (2) @Air Cleaner Assembly (3)
8. Remove Air Cleaner Outlet Duct (2) @Throttle Body (1)

Installation Procedure

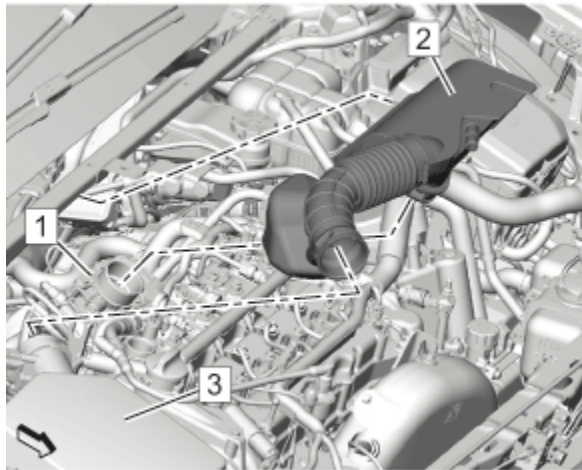


Fig. 292: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body
Courtesy of GENERAL MOTORS COMPANY

1. Install Air Cleaner Outlet Duct(2)@Throttle Body(1)
2. Install Air Cleaner Outlet Duct(2)@Air Cleaner Assembly(3)

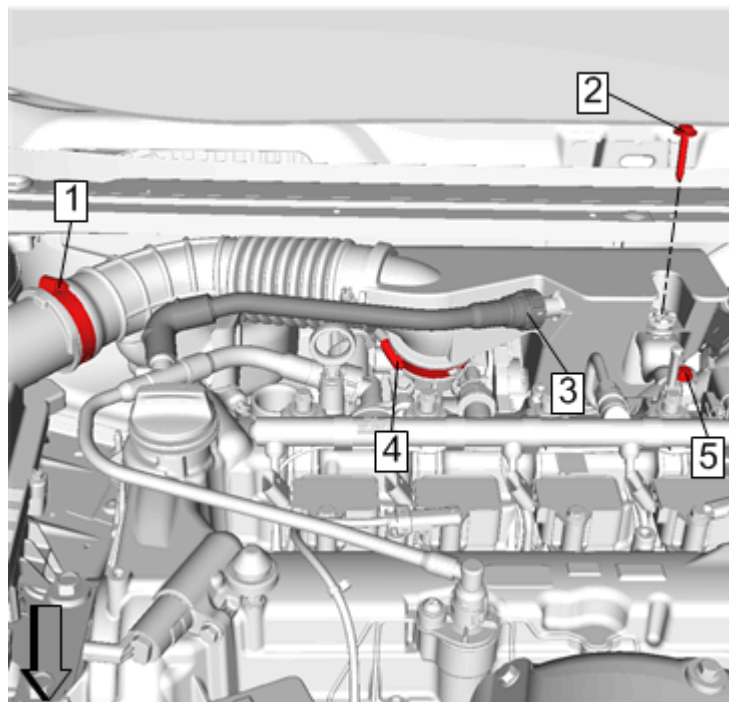


Fig. 293: Air Cleaner Outlet Duct Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Connect Positive Crankcase Ventilation Tube(3) [Plastic Collar Quick Connect Fitting Service](#)

CAUTION: [Fastener Caution](#)

NOTE: Ensure the outlet duct is fully seated to the mating surfaces before clamping. Verify that the cuff is not rolled under.

- 4. Air Cleaner Outlet Duct Clamp(1, 4) - Tighten 2.5 N.m (22 lb in)
- 5. Air Cleaner Outlet Duct Bracket Bolt(5) - Tighten 9 N.m (80 lb in)
- 6. Install Air Cleaner Outlet Duct Fastener (2) and tighten 9 N.m (80 lb in)
- 7. Install [Dash Upper Extension Panel Opening Cover Replacement](#)
- 8. Install [Intake Manifold Cover Replacement](#)

ACCELERATOR PEDAL REPLACEMENT

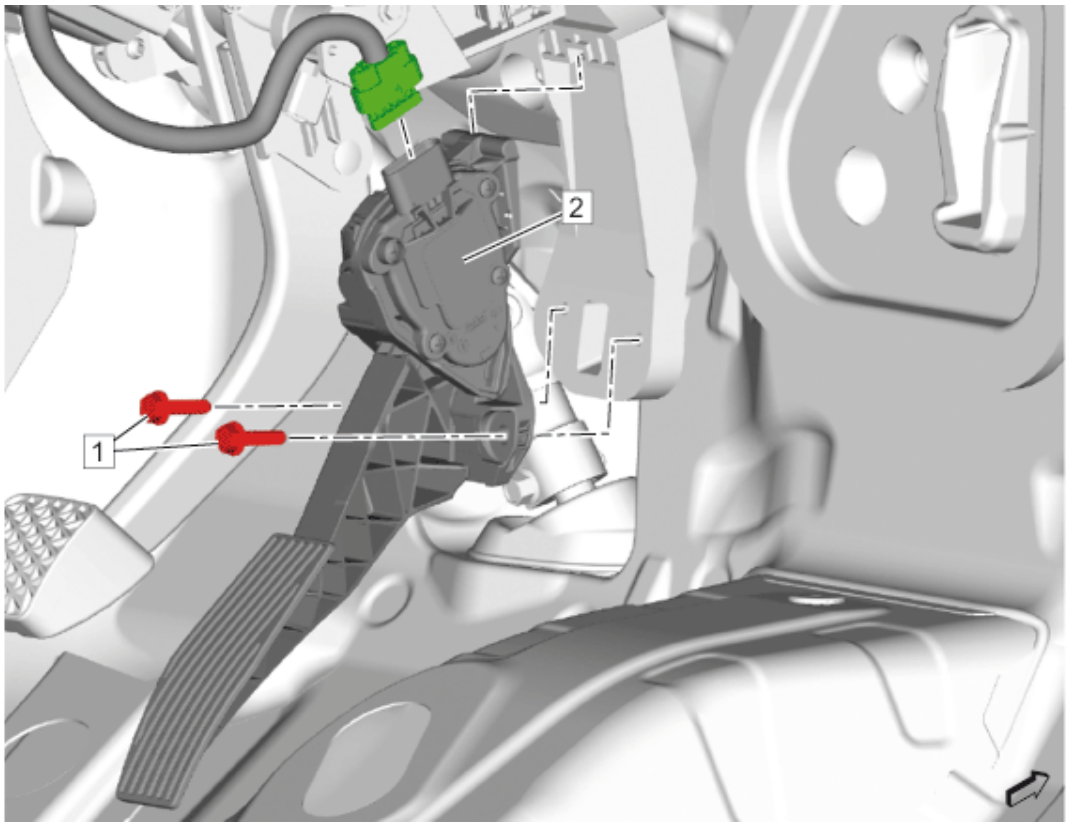


Fig. 294: Accelerator Pedal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Accelerator Pedal Fastener (Qty: 2) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 6 N.m (53 lb in)
2	Accelerator Pedal Assembly Procedure Disconnect the electrical connector.

FUEL LEVEL SENSOR REPLACEMENT

Removal Procedure

1. Remove Fuel Tank Fuel Pump Module Replacement

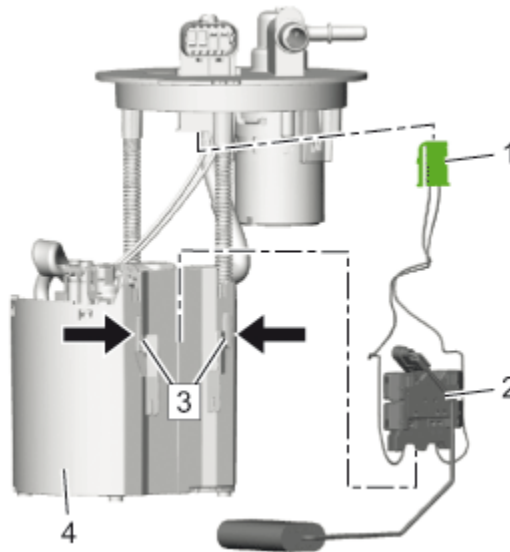


Fig. 295: Fuel Level Sensor, Fuel Pump Module, Retaining Brackets And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connector.(1)
3. Push the 2 retaining brackets (3) in direction of arrows.
4. While holding the 2 retaining brackets (3) move the fuel level sensor (2) upwards and remove the fuel level sensor (2) from the fuel pump module (4).

Installation Procedure

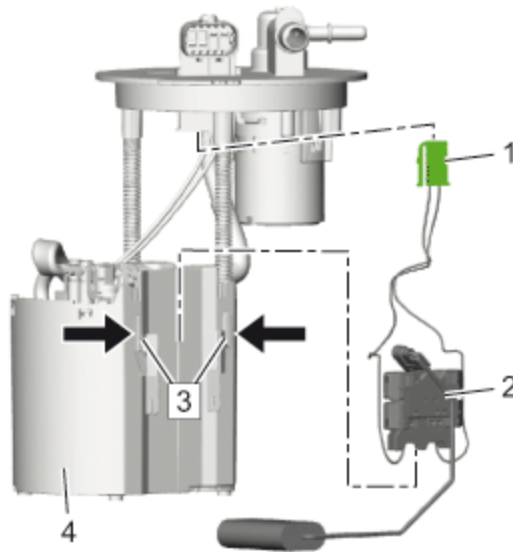


Fig. 296: Fuel Level Sensor, Fuel Pump Module, Retaining Brackets And Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

NOTE: There must be 2 noticeable click noises.

1. Install the fuel level sensor (2) to the fuel pump module (4).
2. Connect the electrical connector.(1)
3. Install [Fuel Tank Fuel Pump Module Replacement](#)

FUEL PUMP POWER CONTROL MODULE REPLACEMENT

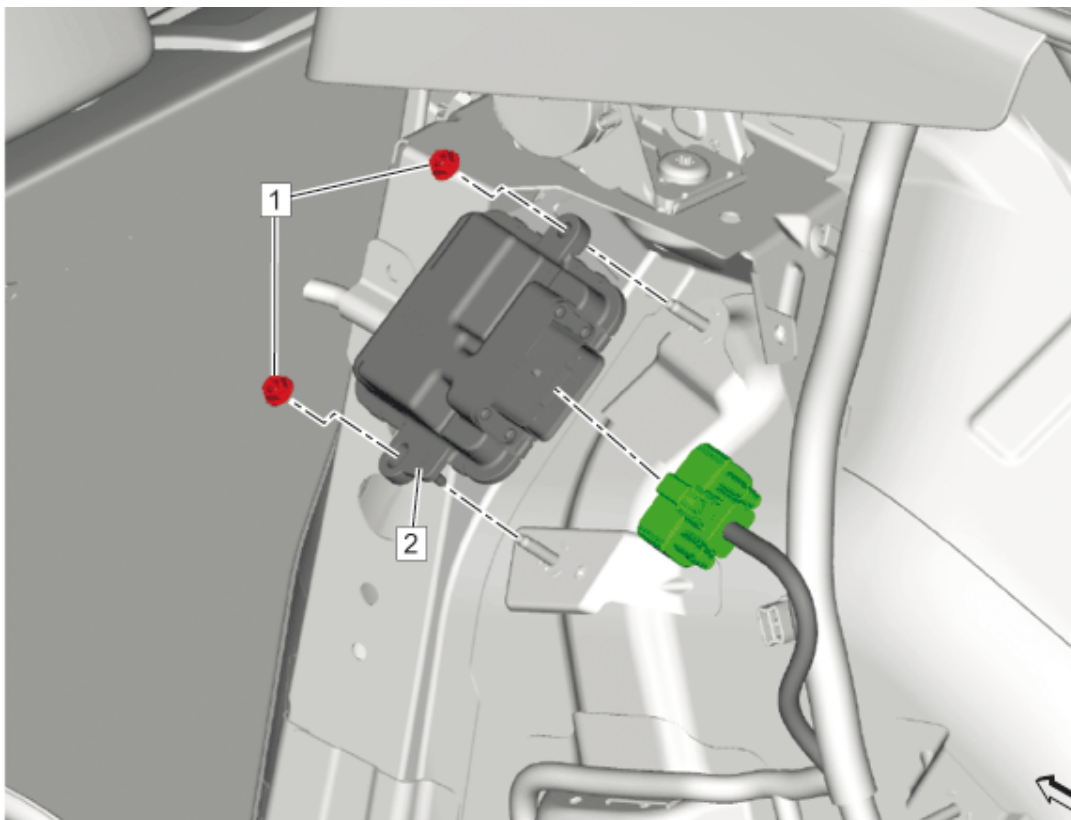


Fig. 297: Fuel Pump Power Control Module

Callout	Component Name
Preliminary Procedures <u>Quarter Lower Rear Trim Panel Replacement (Left Side)</u> <u>Quarter Lower Rear Trim Panel Replacement (Right Side)</u>	
1	Fuel Pump Power Control Module Nut (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 9 N.m 80 lb in)
2	Fuel Pump Power Control Module Procedure 1. Disconnect the electrical connector. 2. When the replacement is completed, use a scan tool to perform the appropriate reset functions. <u>Control Module References</u> .

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 1

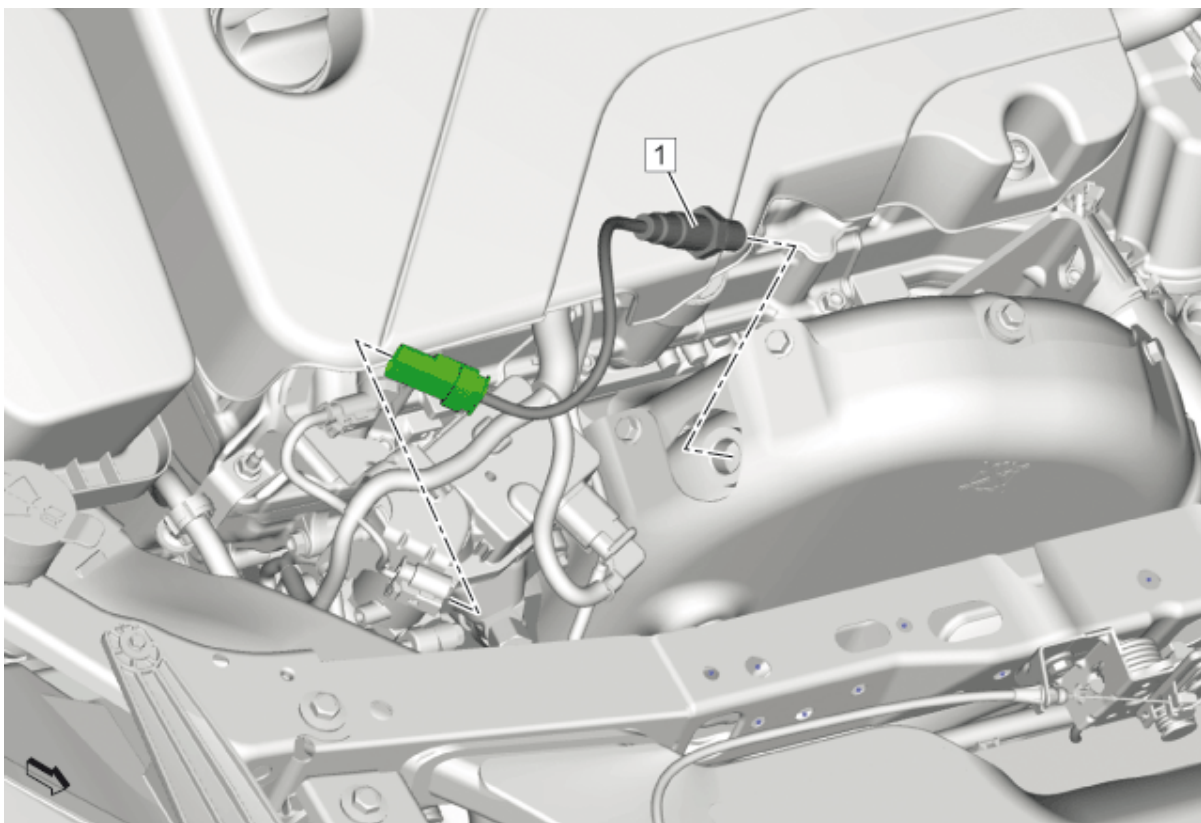


Fig. 298: Heated Oxygen Sensor-Sensor 1

Callout	Component Name
WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool. WARNING: Avoid contact with HOT components. Wear safety glasses and protective gloves to avoid personal injury. Preliminary Procedure Disconnect the battery negative cable. <u>Battery Negative Cable Disconnection and Connection</u>	
1	Heated Oxygen Sensor CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . CAUTION: Refer to <u>Heated Oxygen and Oxygen Sensor Caution</u> .

Callout	Component Name
	CAUTION: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution . CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure 1. Disconnect the electrical connector. 2. Programming and Setup Control Module References Tighten 42 N.m (31 lb ft) Special Tools J-39194 Oxygen Sensor Wrench Equivalent regional tools: Special Tools (Diagnostic Tools) Special Tools (Repair Tools)

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 2

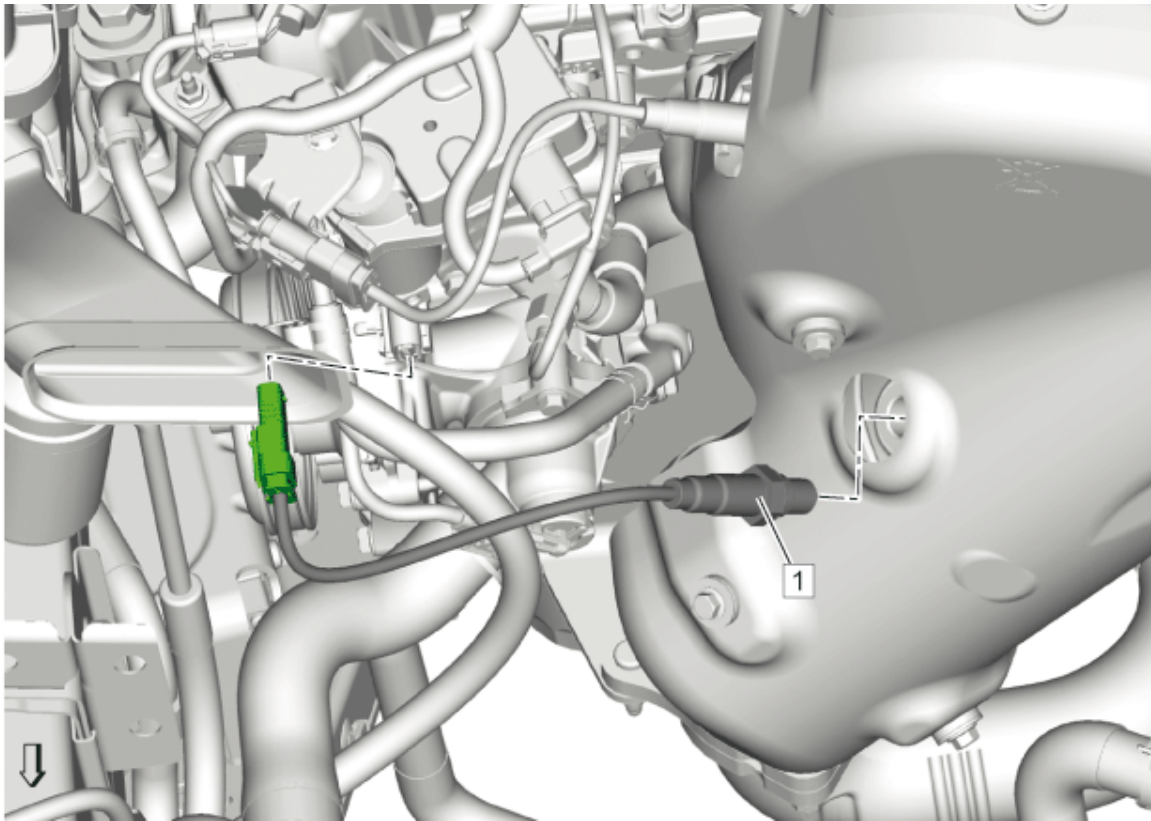


Fig. 299: Heated Oxygen Sensor-Sensor 2

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool. WARNING: Avoid contact with HOT components. Wear safety glasses and protective gloves to	

Callout	Component Name
avoid personal injury. Preliminary Procedure Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection	
1	Heated Oxygen Sensor CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: Refer to Heated Oxygen and Oxygen Sensor Caution . CAUTION: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution . CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure 1. Disconnect the electrical connector. 2. Programming and Setup Control Module References

Callout	Component Name
	Tighten 42 N.m (31 lb ft) Special Tools J-39194 Oxygen Sensor Wrench Equivalent regional tools: Special Tools (Diagnostic Tools) Special Tools (Repair Tools)

MASS AIRFLOW SENSOR REPLACEMENT

Removal Procedure

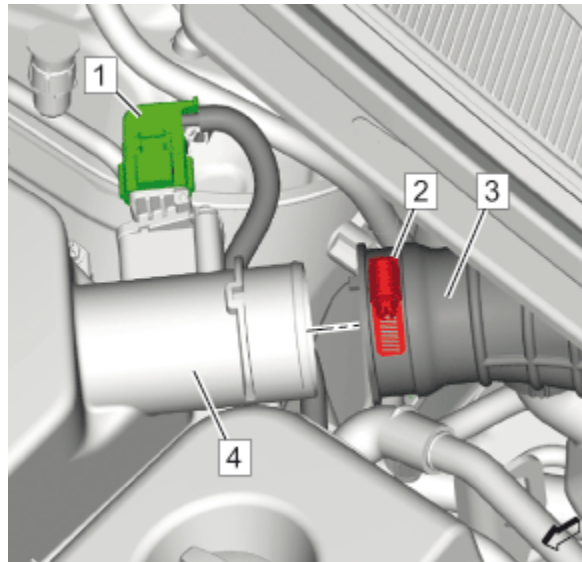


Fig. 300: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the electrical connector.(1)
2. Loosen Air Cleaner Outlet Duct Clamp(2)
3. Remove Air Cleaner Outlet Duct(3)@Air Cleaner Assembly(4)

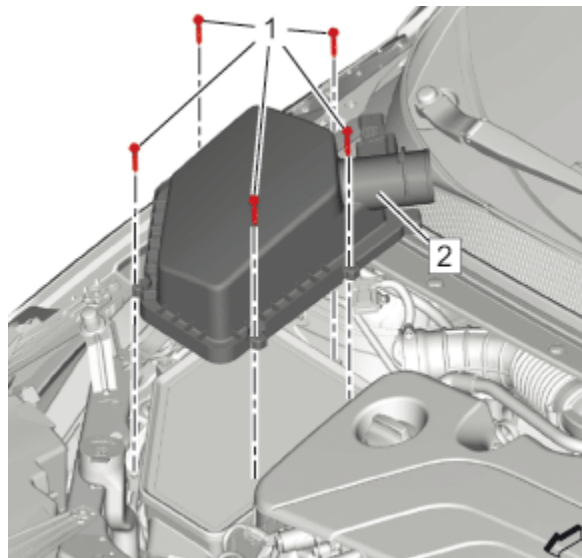


Fig. 301: Air Cleaner Upper Housing And Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove Air Cleaner Upper Housing Bolt(1)
5. Remove Air Cleaner Upper Housing(2)

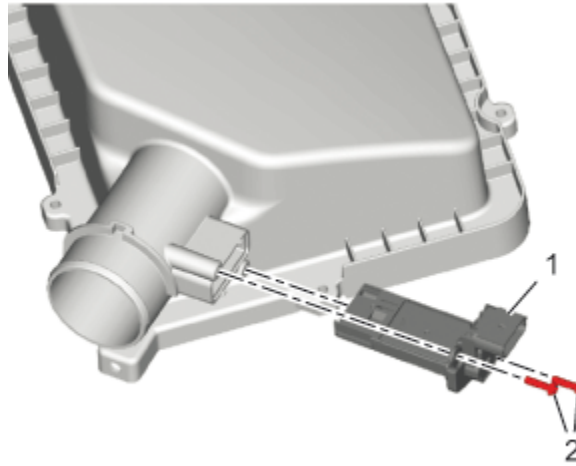


Fig. 302: Mass Airflow Sensor And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Remove Mass Airflow Sensor Bolt(2)
7. Remove Mass Airflow Sensor(1)

Installation Procedure

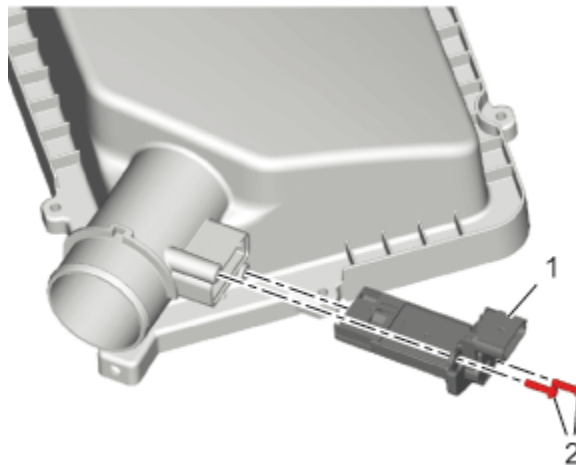


Fig. 303: Mass Airflow Sensor And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Mass Airflow Sensor(1)

CAUTION: Fastener Caution

2. Install Mass Airflow Sensor Bolt (2) and tighten 2.5 N.m (22 lb in)

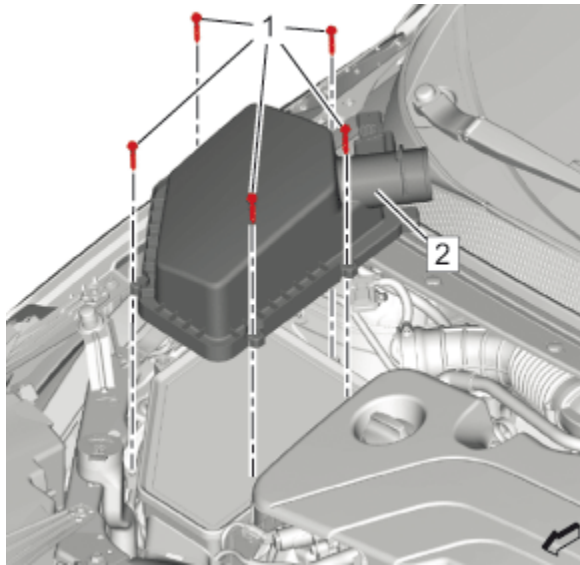


Fig. 304: Air Cleaner Upper Housing And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install Air Cleaner Upper Housing(2)
4. Install Air Cleaner Upper Housing Bolt(1) and tighten 2.5 N.m (22 lb in)

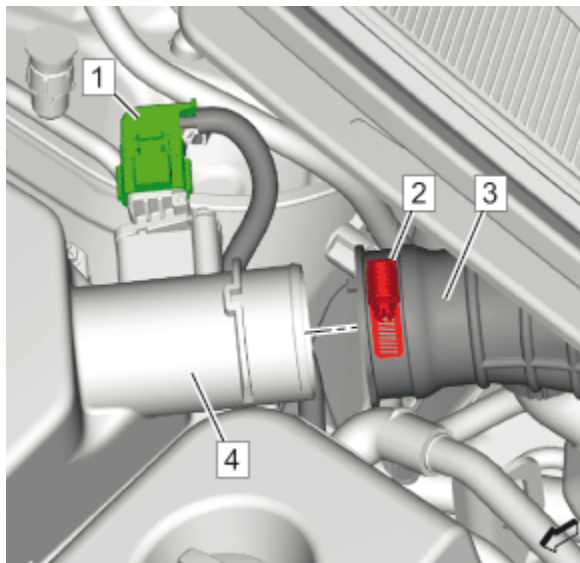


Fig. 305: Air Cleaner Outlet Duct, Air Cleaner Assembly, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Install Air Cleaner Outlet Duct(3)@Air Cleaner Assembly(4)
6. Air Cleaner Outlet Duct Clamp(2) - Tighten 2.5 N.m (22 lb in)
7. Connect the electrical connector.(1)
8. When the replacement is completed, use a scan tool to perform the appropriate reset functions. Control Module References

ENGINE OIL PRESSURE SENSOR REPLACEMENT

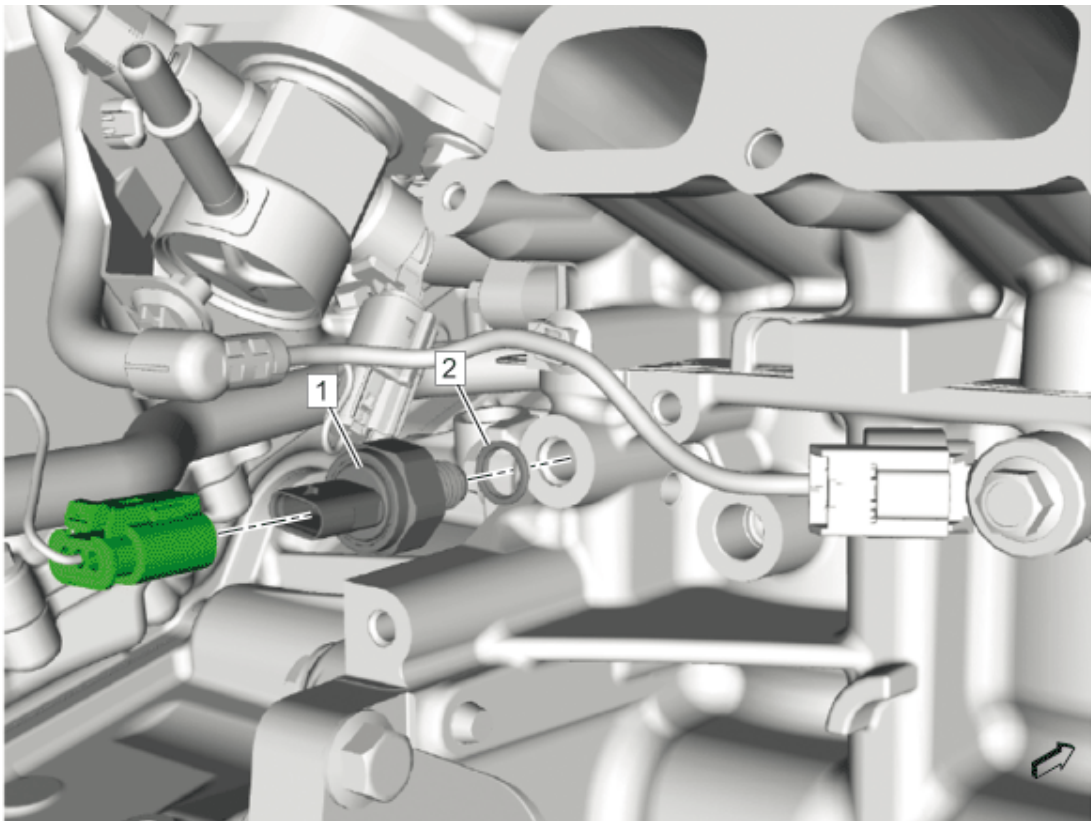


Fig. 306: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Intake Manifold Replacement</u>	
1	Engine Oil Pressure Sensor CAUTION: <u>Fastener</u> <u>Caution</u> Procedure Disconnect the electrical connectors. Tighten 35 N.m (26 lb ft)
2	Engine Oil Pressure Sensor Seal

FRONT INTAKE AIR DUCT REPLACEMENT

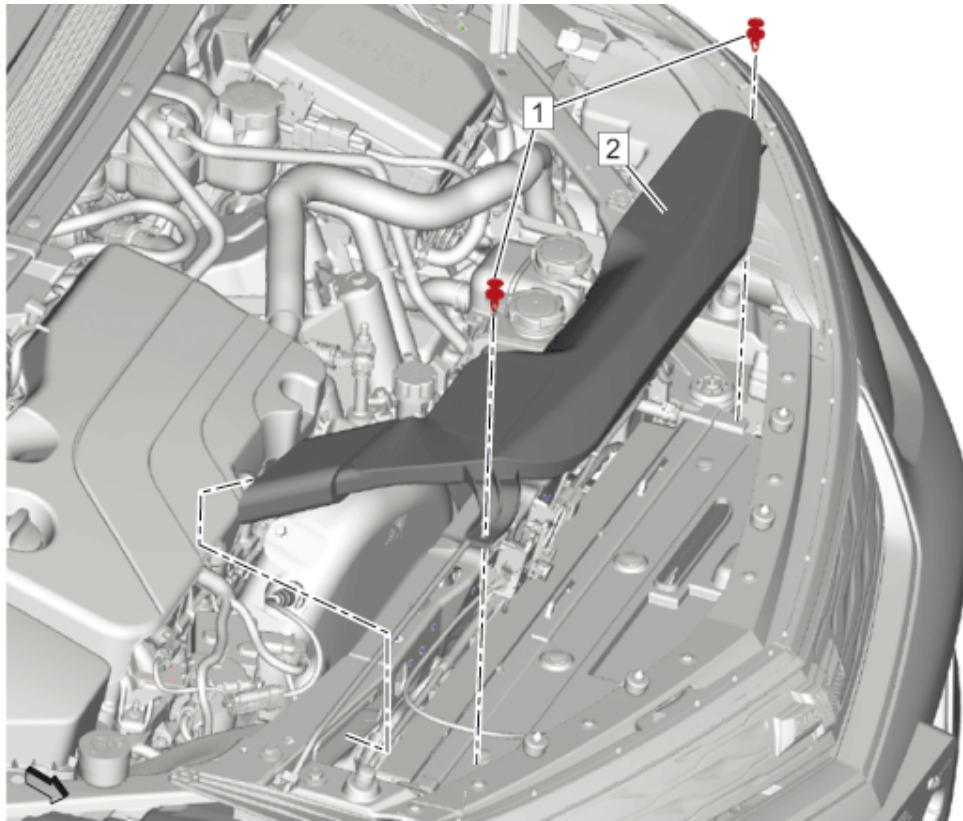


Fig. 307: Front Intake Air Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Front Bumper Fascia Center Support Replacement</u>	
1	Clip (Qty: 2)
2	Front Intake Air Duct

Article GUID: A00884685

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Schematic and Routing Diagrams - Engine Controls Schematics - Volt

SCHEMATIC WIRING DIAGRAMS

ENGINE CONTROLS WIRING SCHEMATICS

Power, Ground, MIL and Data Communication

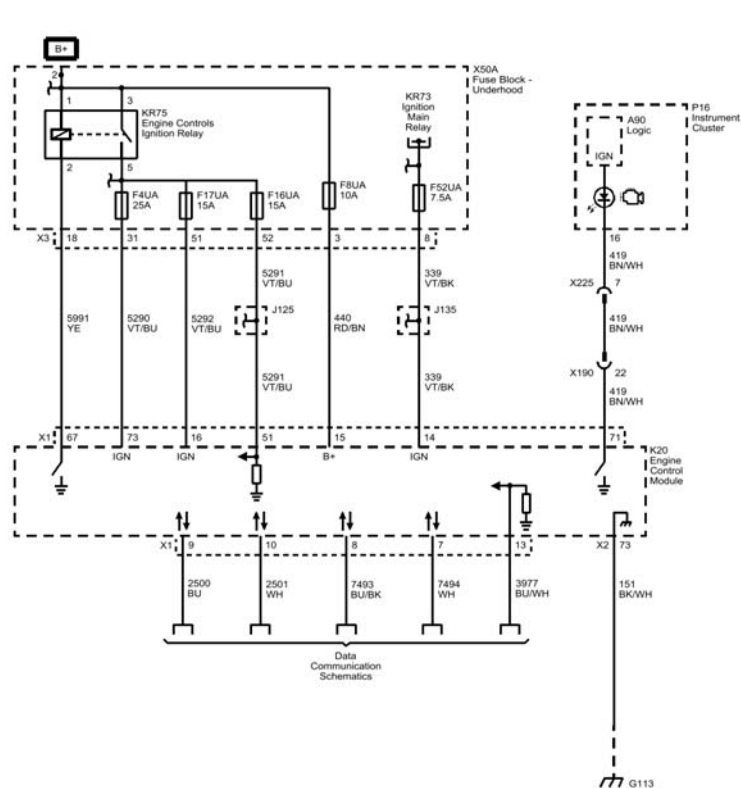


Fig. 1: Power, Ground, MIL and Data Communication

Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Oxygen Sensors

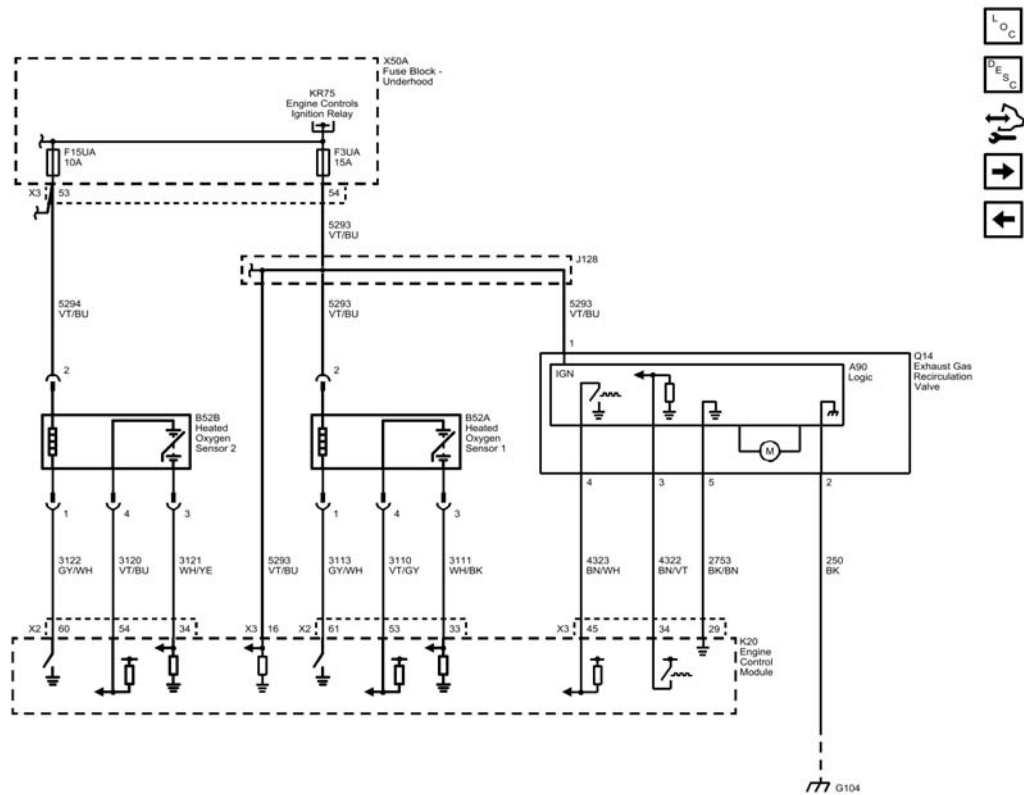


Fig. 2: Engine Data Sensors - Oxygen Sensors
 Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Evaporative Emission Controls

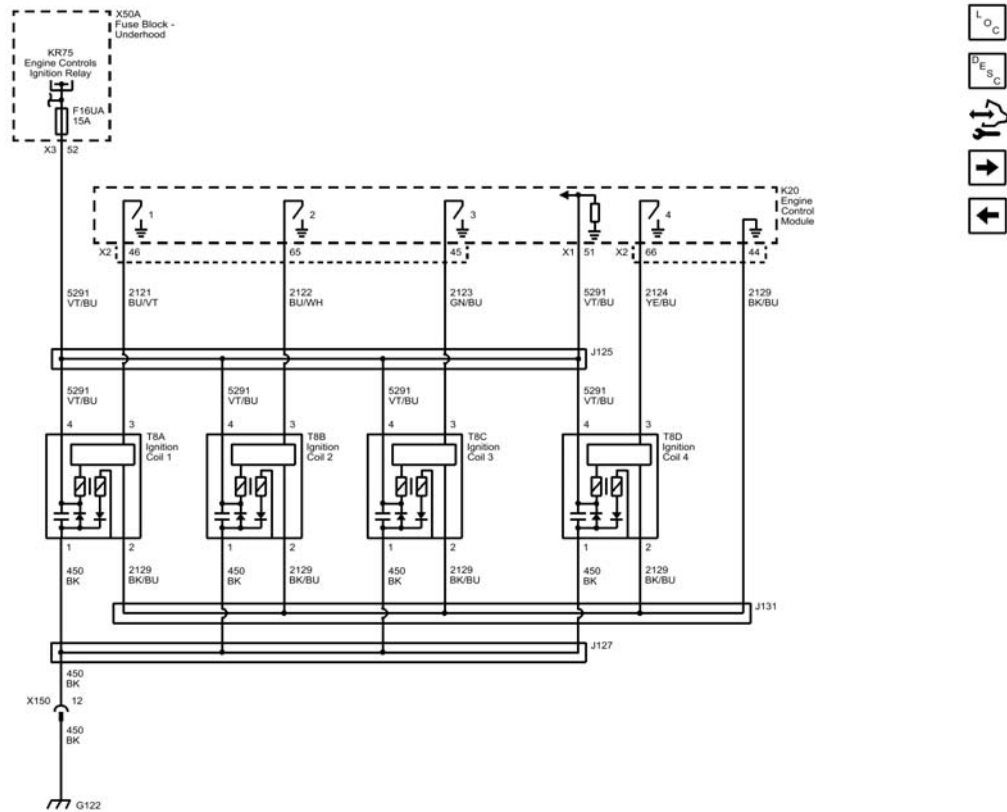


Fig. 5: Ignition Controls - Ignition System
 Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Injectors

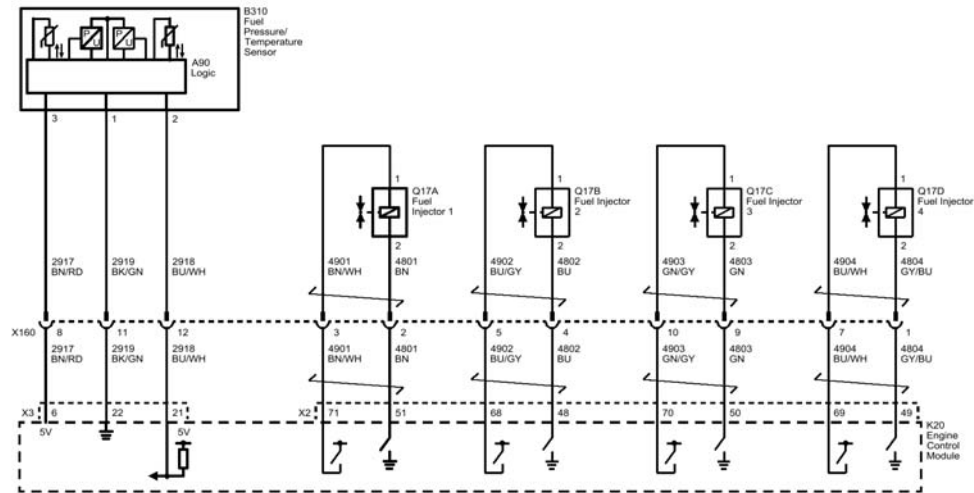


Fig. 6: Fuel Controls - Fuel Injectors
 Courtesy of GENERAL MOTORS COMPANY

Ignition Controls - Sensors and Camshaft Actuators

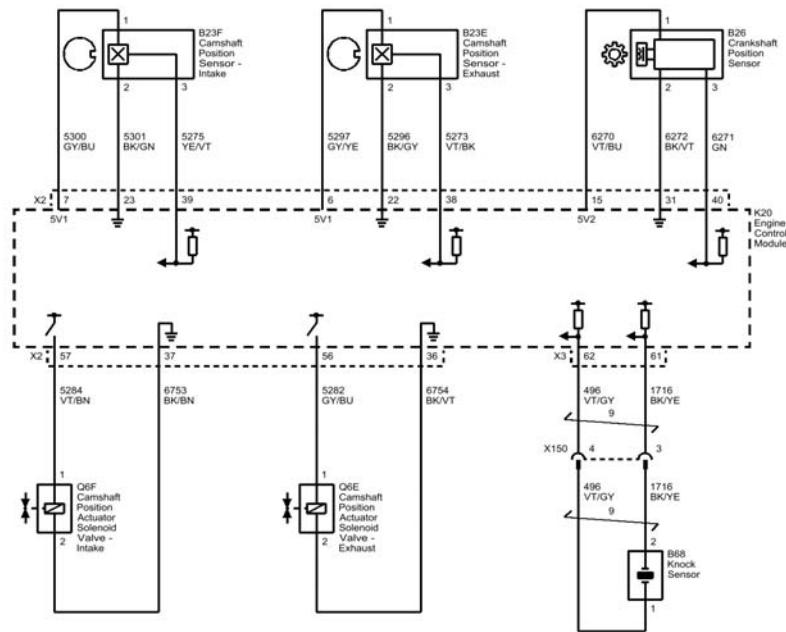


Fig. 7: Ignition Controls - Sensors and Camshaft Actuators
 Courtesy of GENERAL MOTORS COMPANY

Engine Data Sensors - Throttle Controls

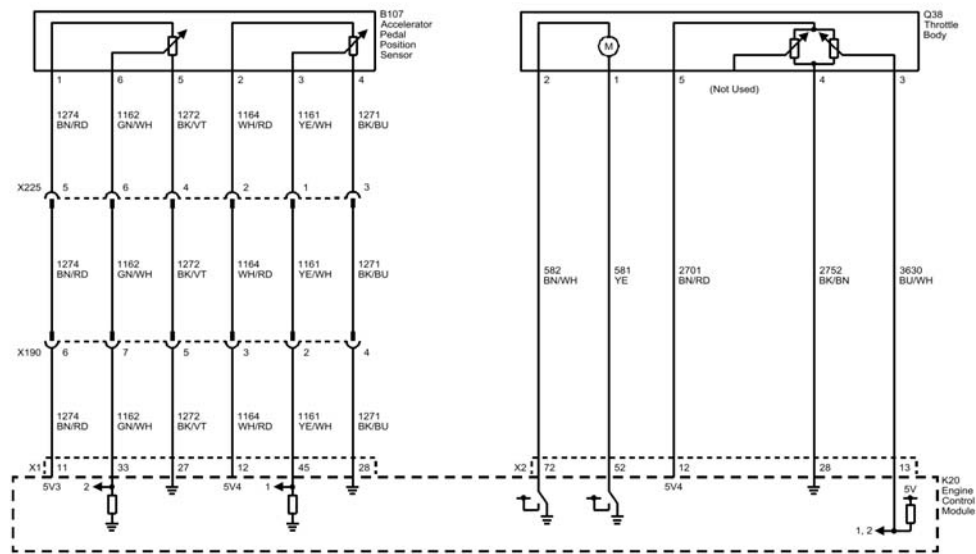


Fig. 8: Engine Data Sensors - Throttle Controls
 Courtesy of GENERAL MOTORS COMPANY

Fuel Controls - Fuel Pump Controls

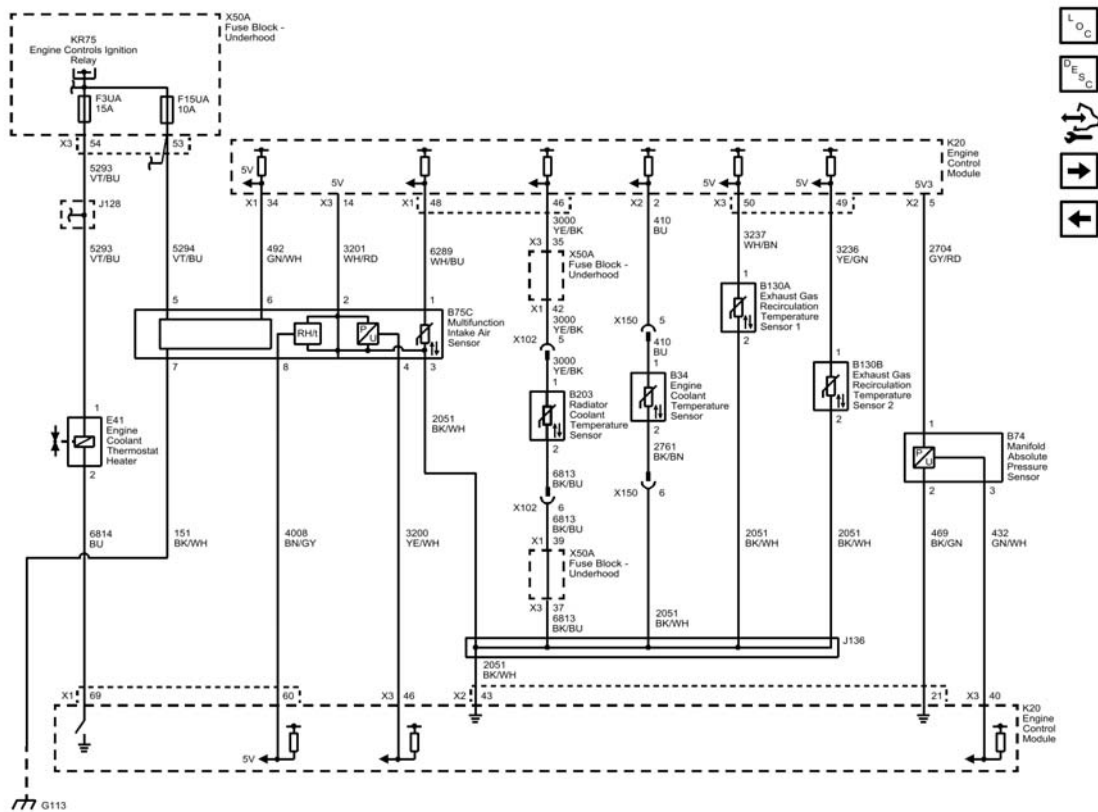


Fig. 10: Engine Data Sensors - Pressure and Temperature
Courtesy of GENERAL MOTORS COMPANY

Controlled/Monitored Subsystem References

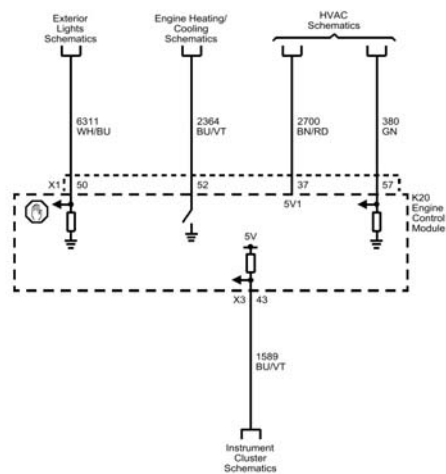
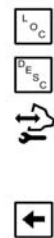


Fig. 11: Controlled/Monitored Subsystem References
Courtesy of GENERAL MOTORS COMPANY

Article GUID: A00884684

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Special Tools and Equipment - Volt

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS (DIAGNOSTIC TOOLS)

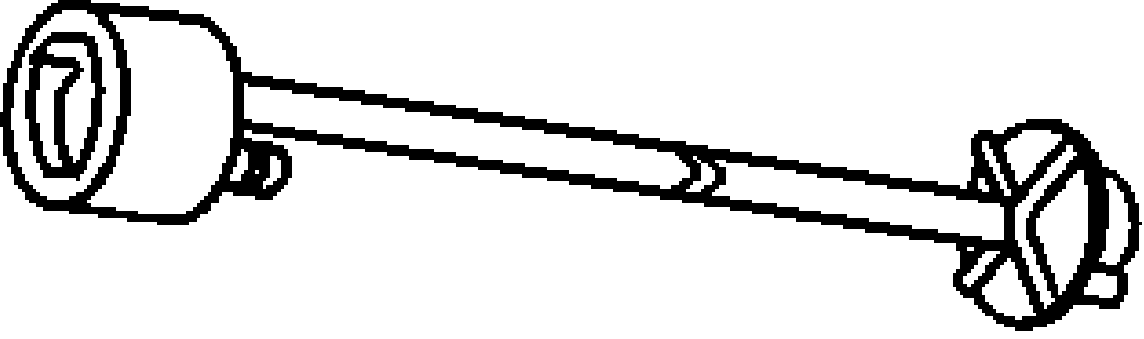
Illustration	Tool Number/Description
	CH-41415-30 GE-41415-30 J-41415-30 Fuel Tank Cap Adapter

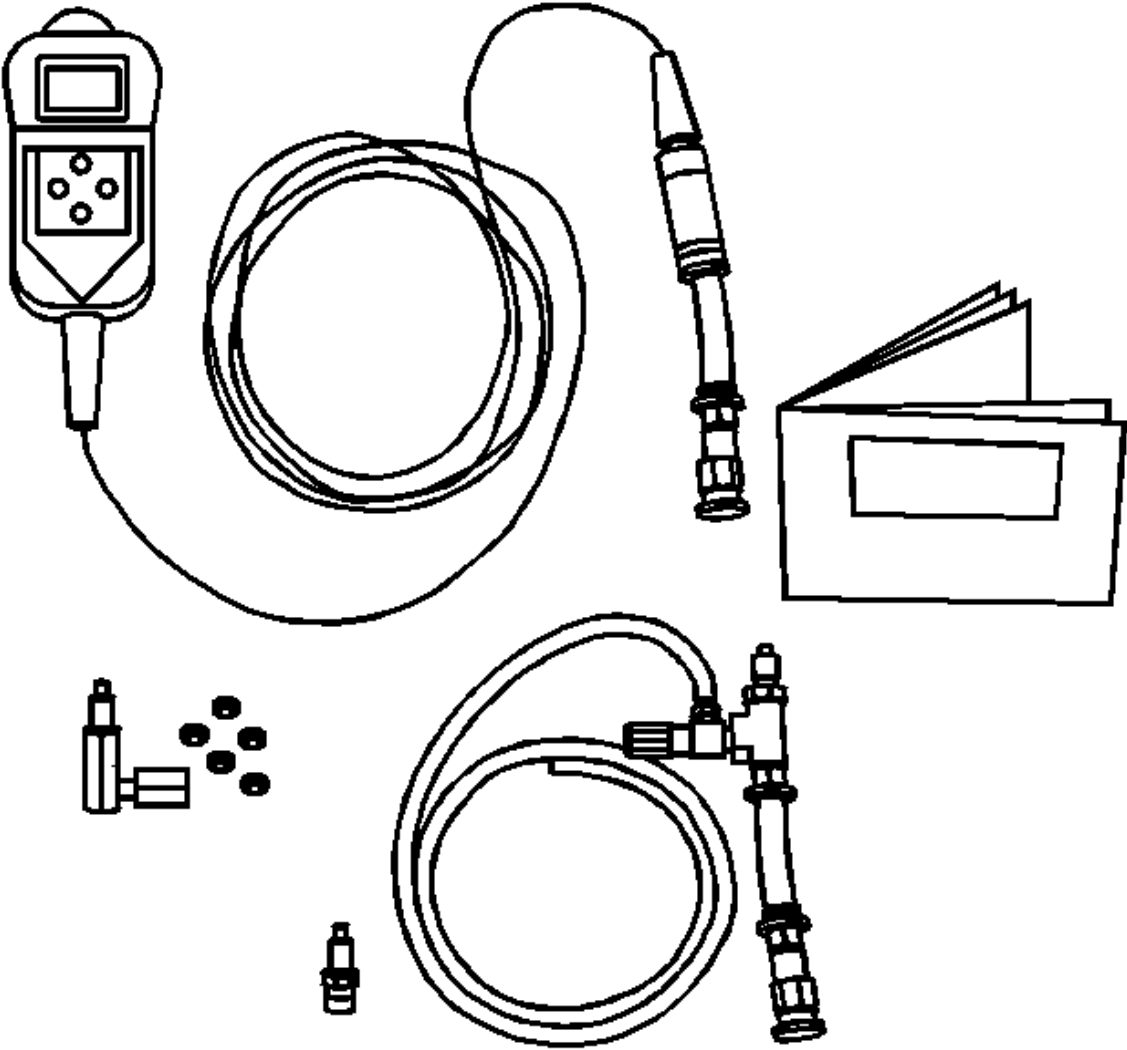
Illustration	Tool Number/Description
	CH-48027 Fuel Pressure Gauge

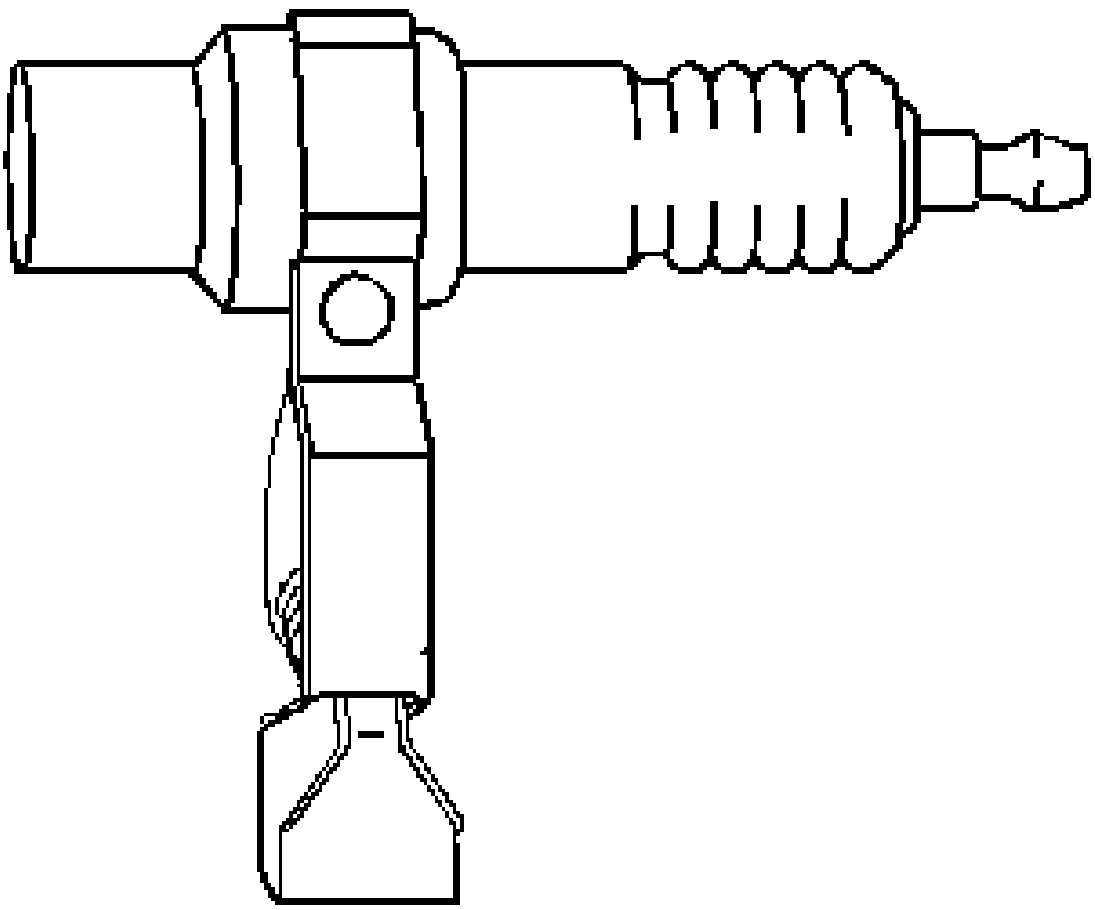
Illustration	Tool Number/Description
	EL-26792 J-26792 HEI Spark Tester

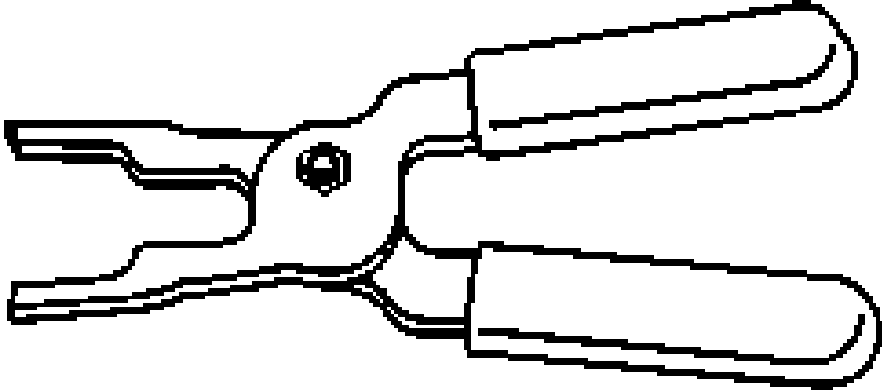
Illustration	Tool Number/Description
	EL-43244 J-43244 Relay Puller Pliers

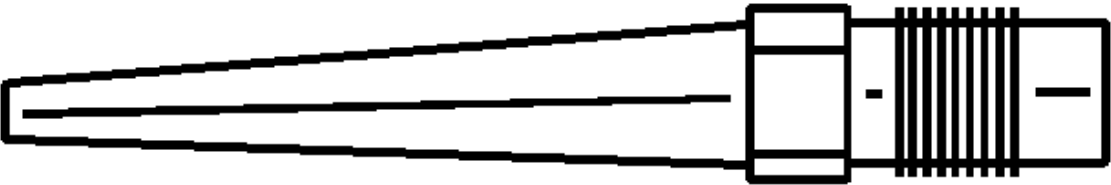
Illustration	Tool Number/Description
	EN-41413-311 J-41413-311 EVAP Plug

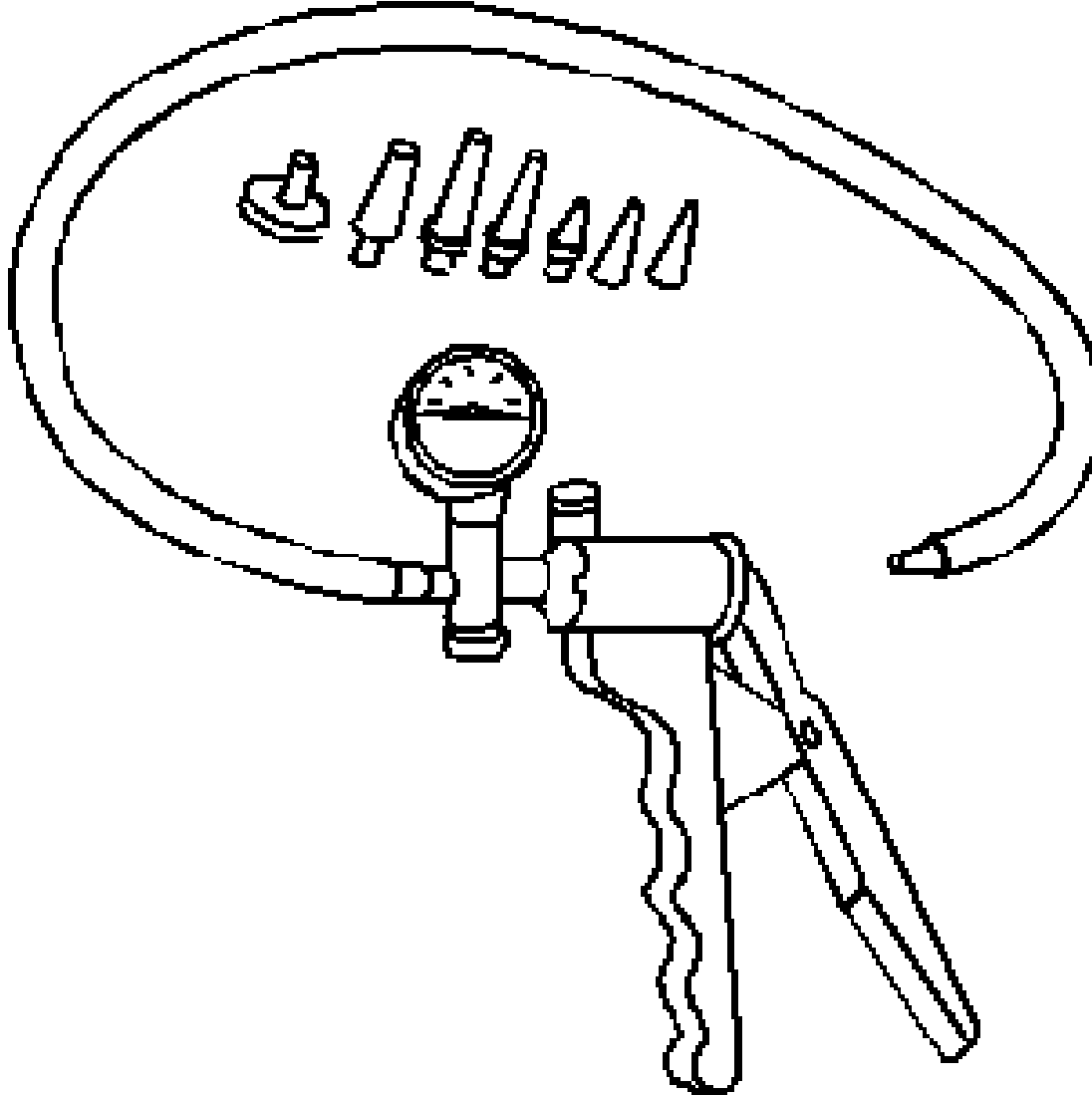
Illustration	Tool Number/Description
	GE-23738-A J-23738-A Vacuum Pump

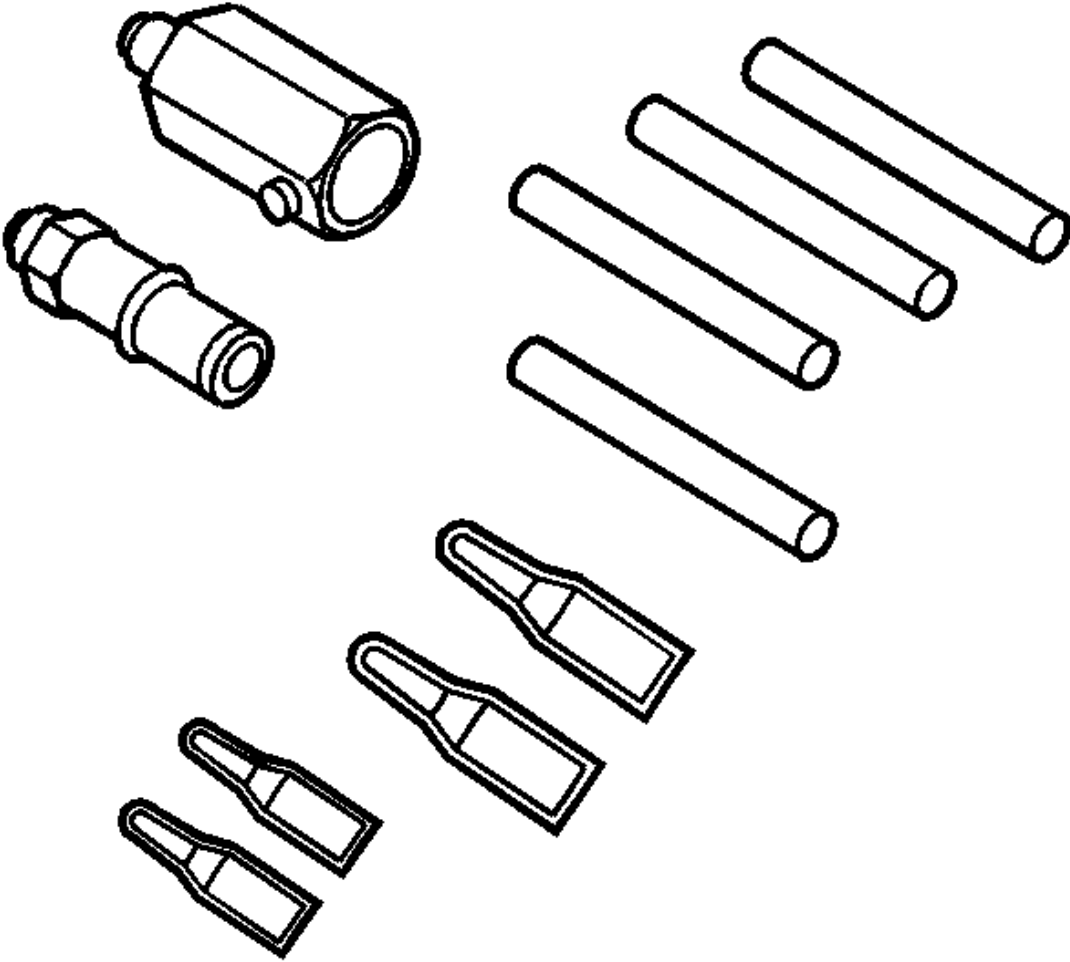
Illustration	Tool Number/Description
	GE-41413-300 EN-41413-300 J-41413-300 EVAP Cap and Plug Kit

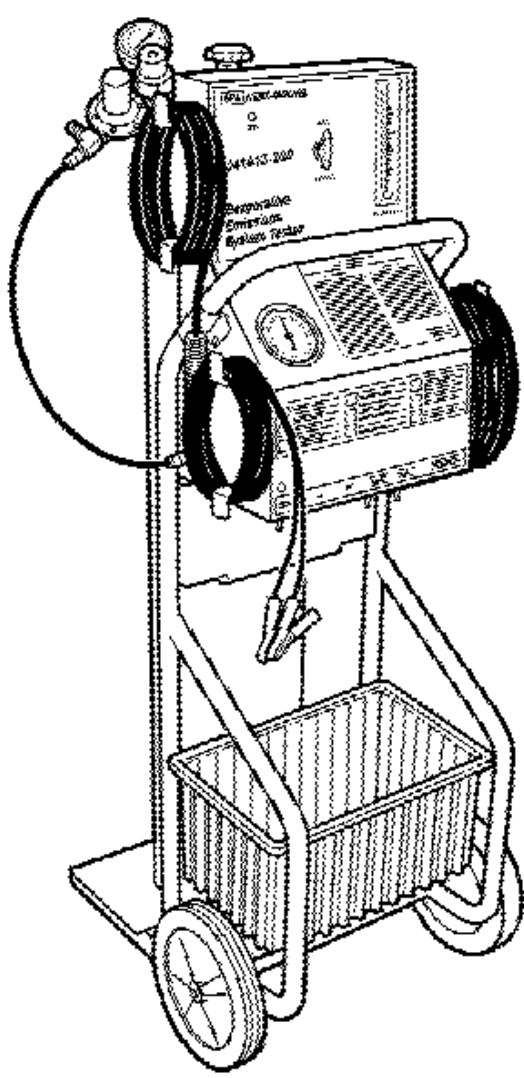
Illustration	Tool Number/Description
	GE-41413-A EN-41413-A J-41413-A Evaporative Emissions System Tester (EEST)

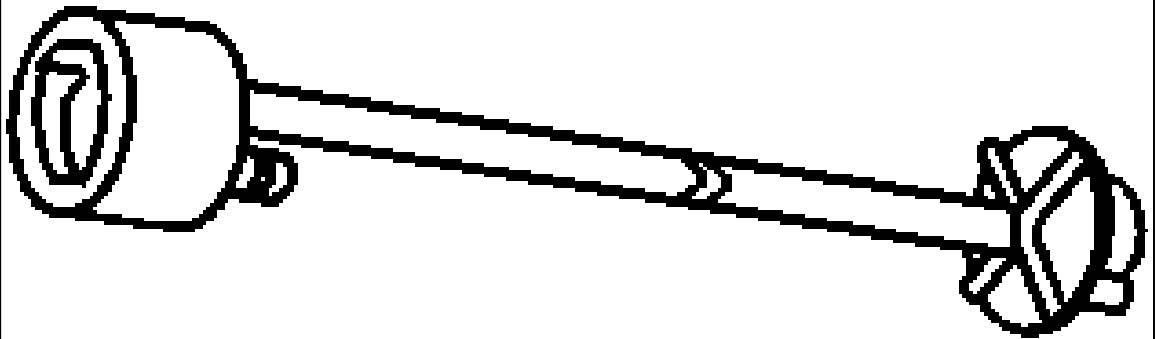
Illustration	Tool Number/Description
	GE-41415-50 J-41415-50 Fuel Tank Cap Adapter

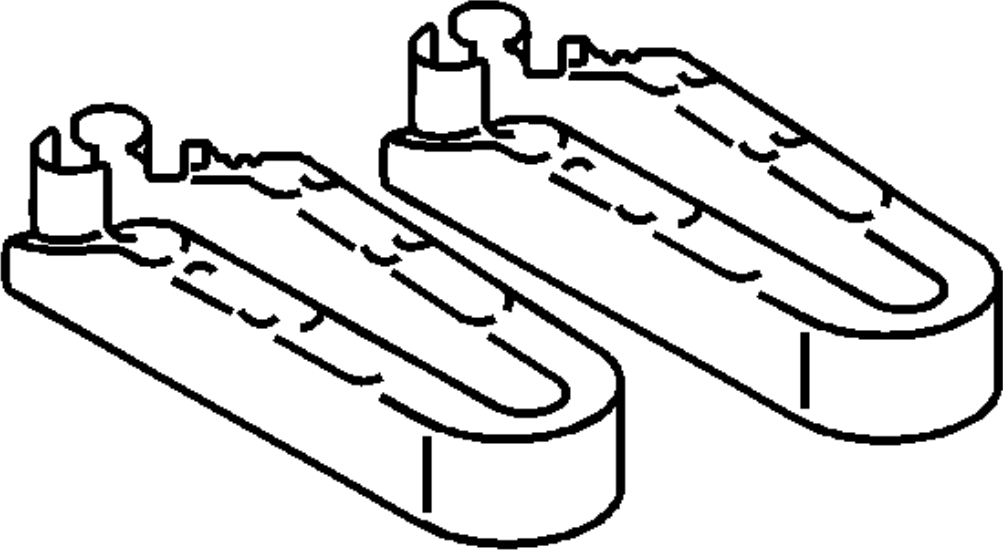
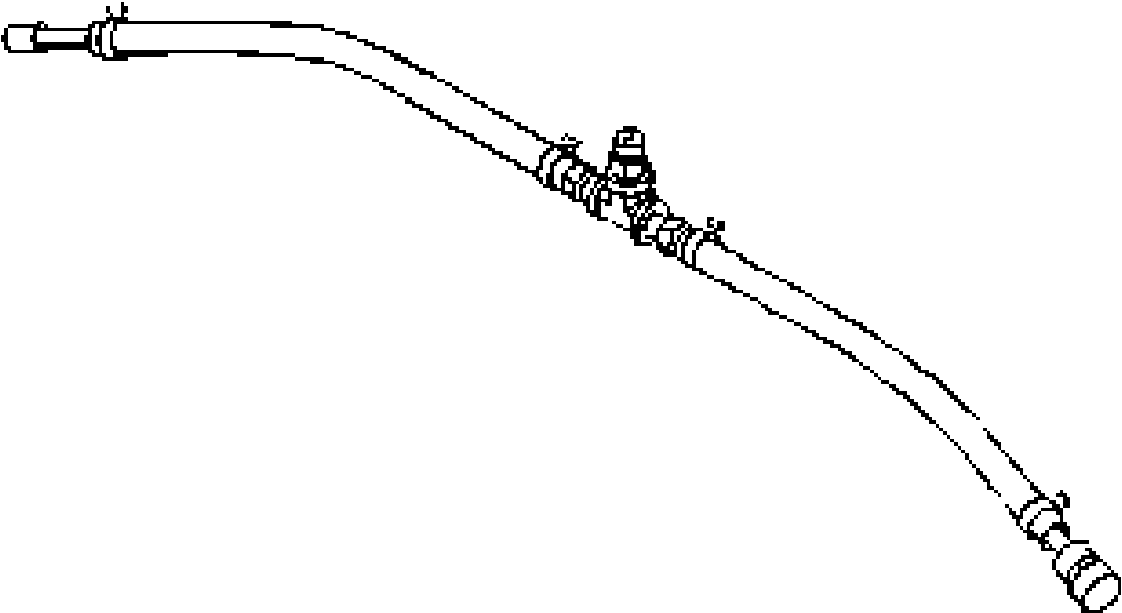
Illustration	Tool Number/Description
	J-41769 Quick Connect Release Tool

Illustration	Tool Number/Description
	J-42982 Fuel Pressure Gauge Adapter

SPECIAL TOOLS (REPAIR TOOLS)

Illustration	Tool Number/Description
--------------	----------------------------

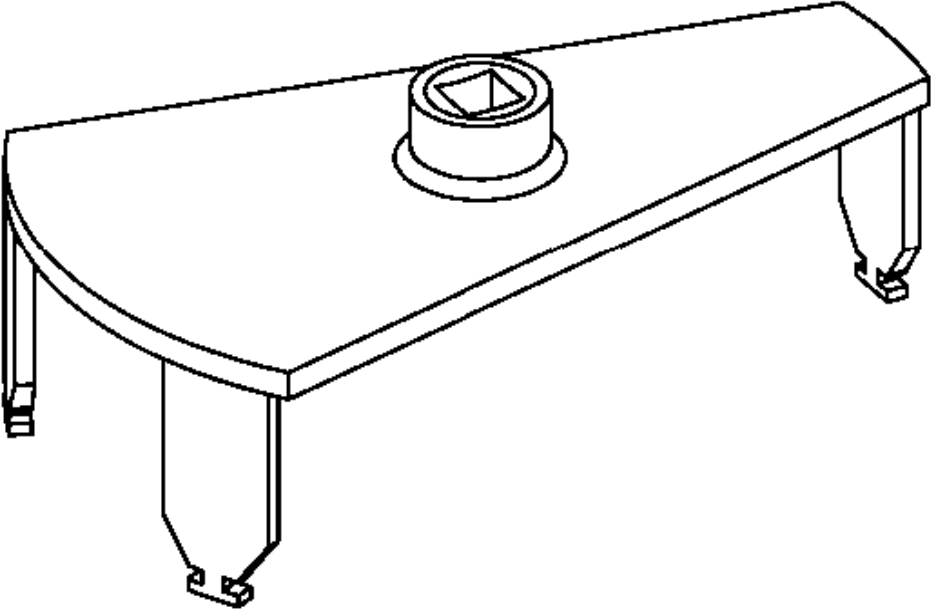
Illustration	Tool Number/Description
	CH-48279 EN-48279 CH-45722 J-45722 CH-797 Main Fuel Pump Locking Ring Remover/Installer

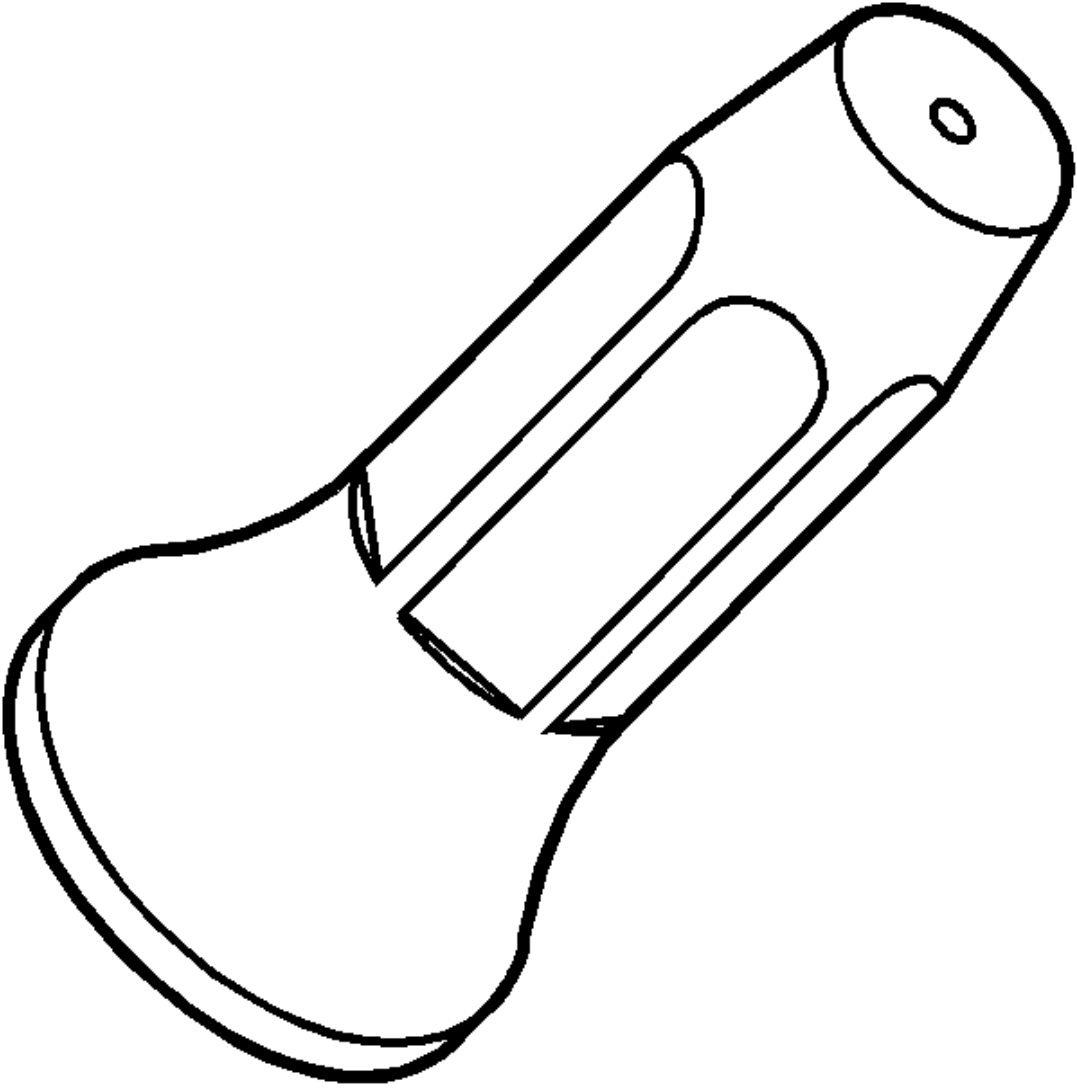
Illustration	Tool Number/Description
	DT-45866 J-45866 Seal Installer

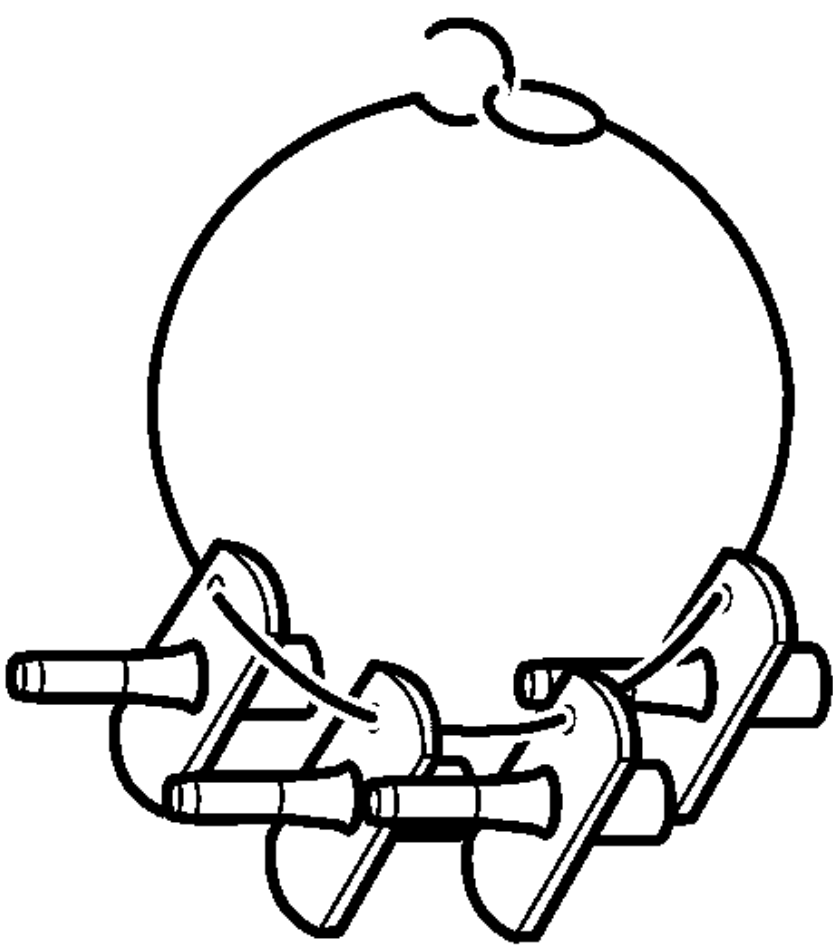
Illustration	Tool Number/Description
	EN-6015 KM-6015 Closure Plugs

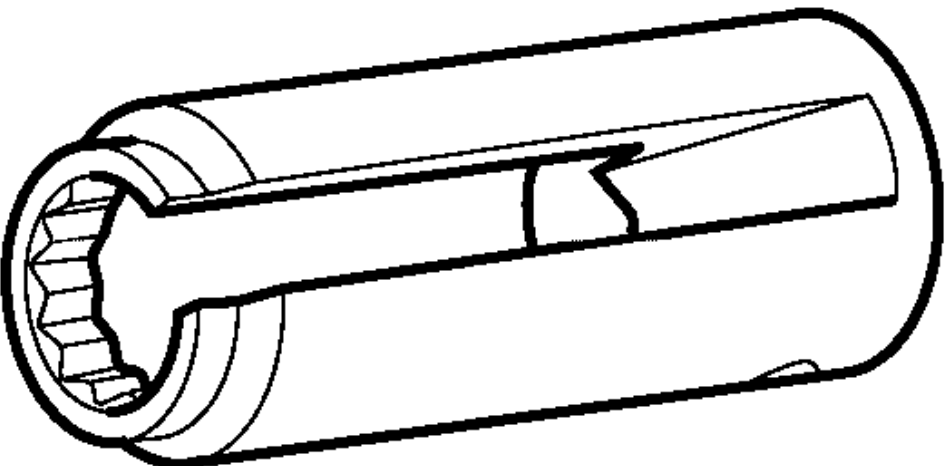
Illustration	Tool Number/Description
	EN-6179 KM-6179 J-44626 Oxygen Sensor Installer/Remover

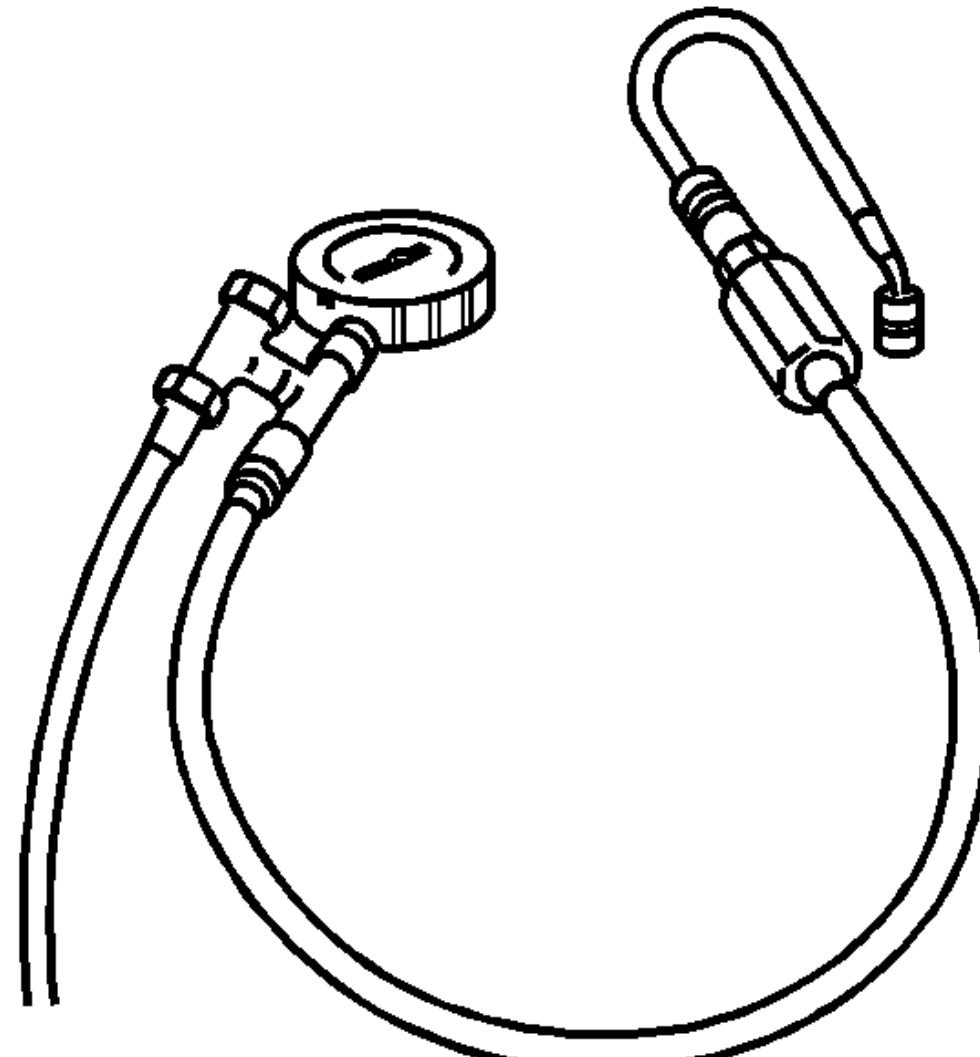
Illustration	Tool Number/Description
	EN-34730-91 KM-34730-91 J-34730-91 Pressure Tester

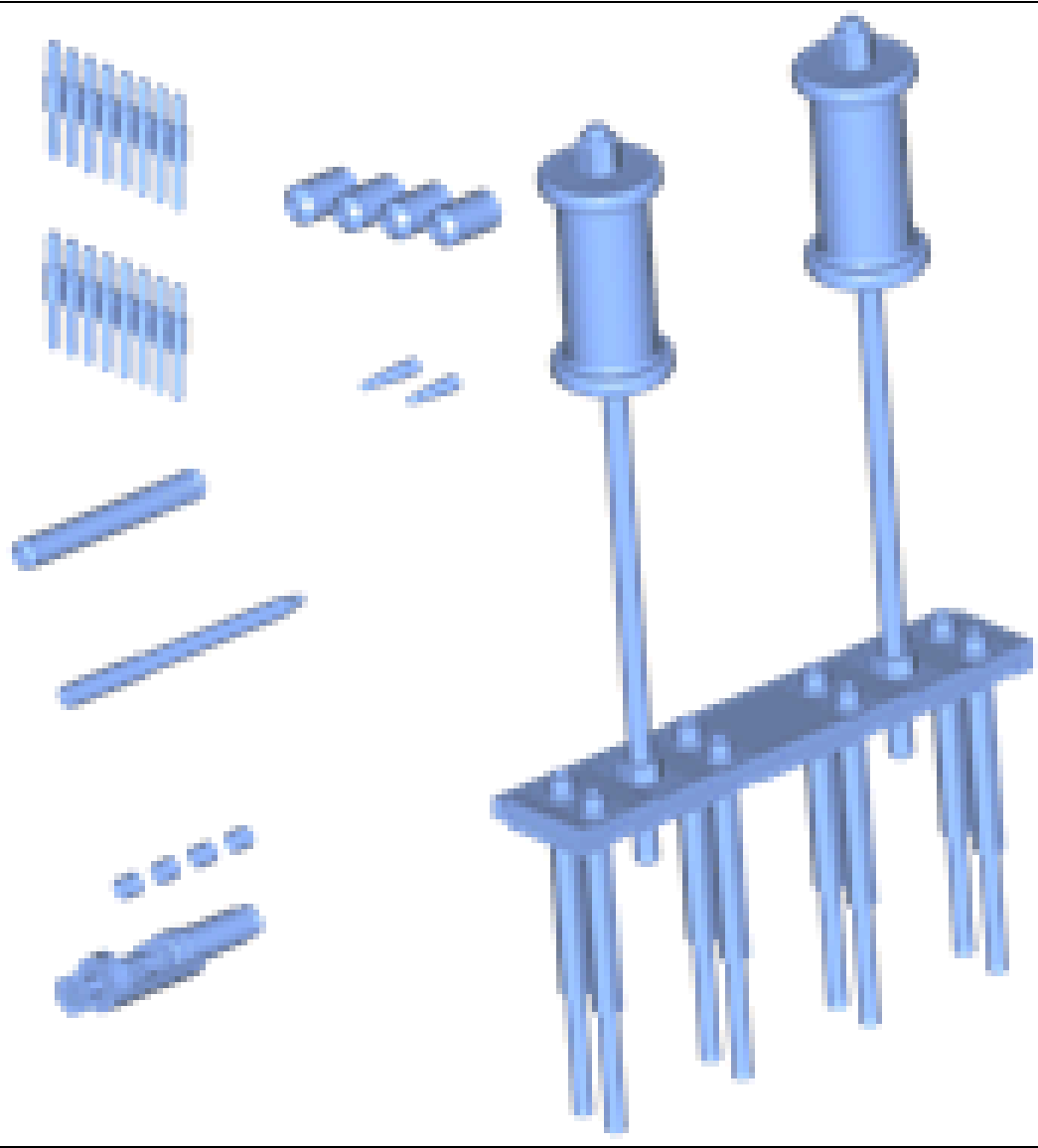
Illustration	Tool Number/Description
	EN-51146 Fuel Injector Removal/Installation Kit

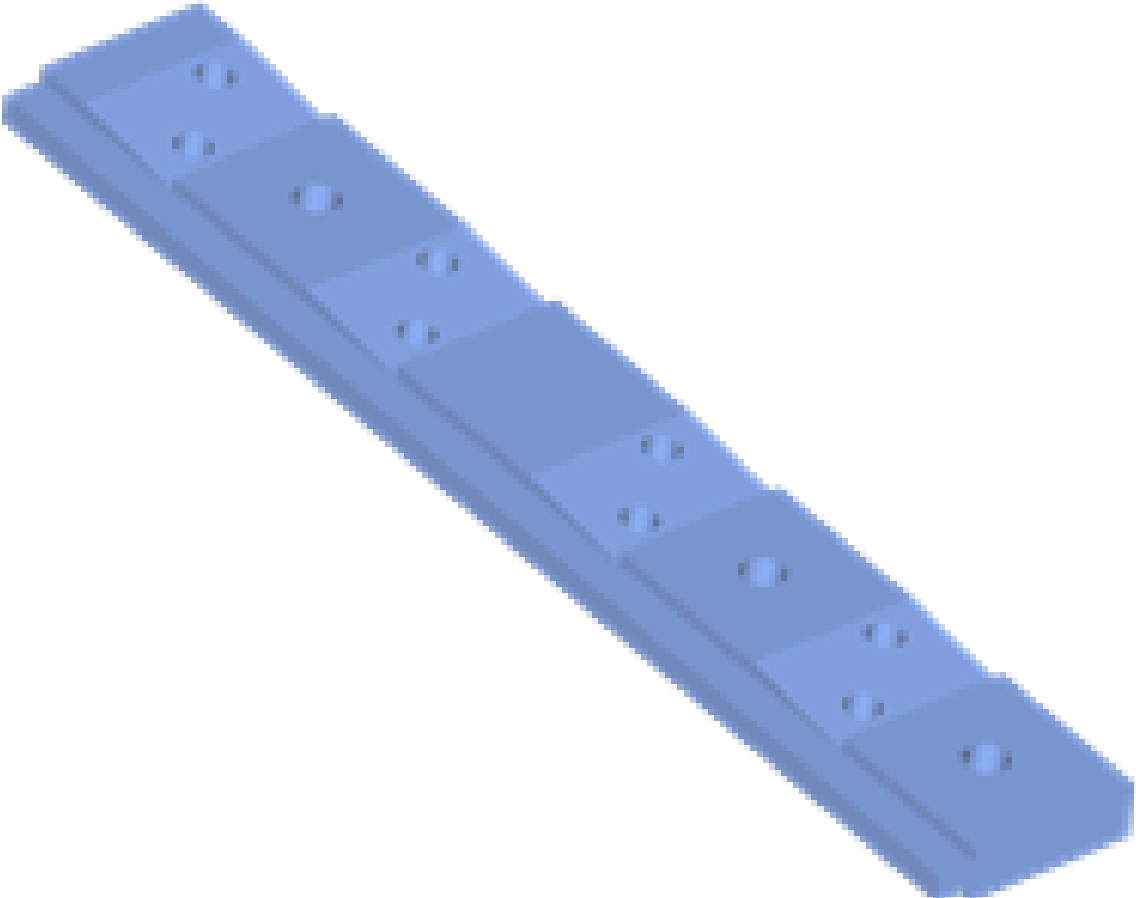
Illustration	Tool Number/Description
	EN-51146-100 Fuel Injector Removal Plate

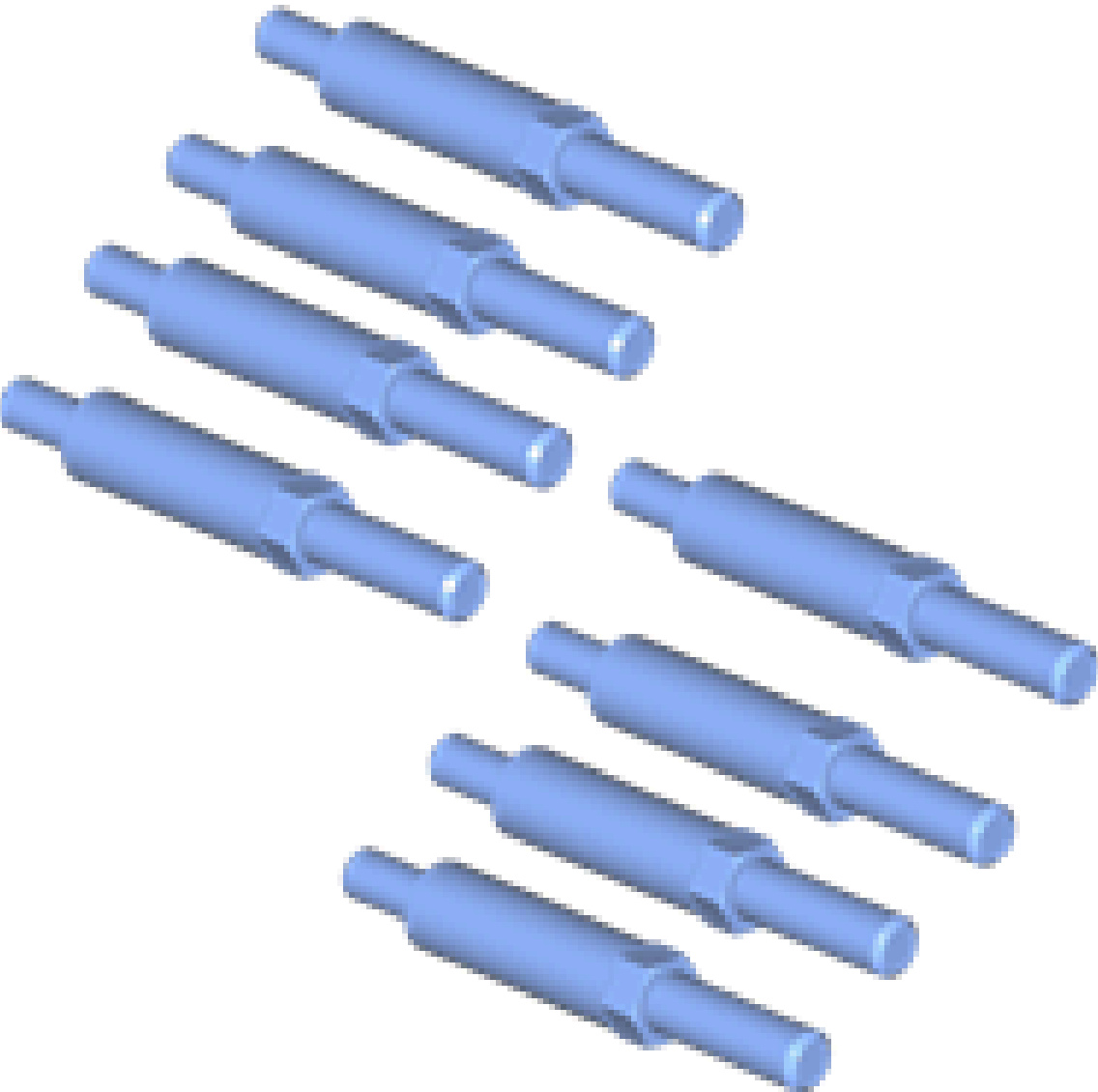
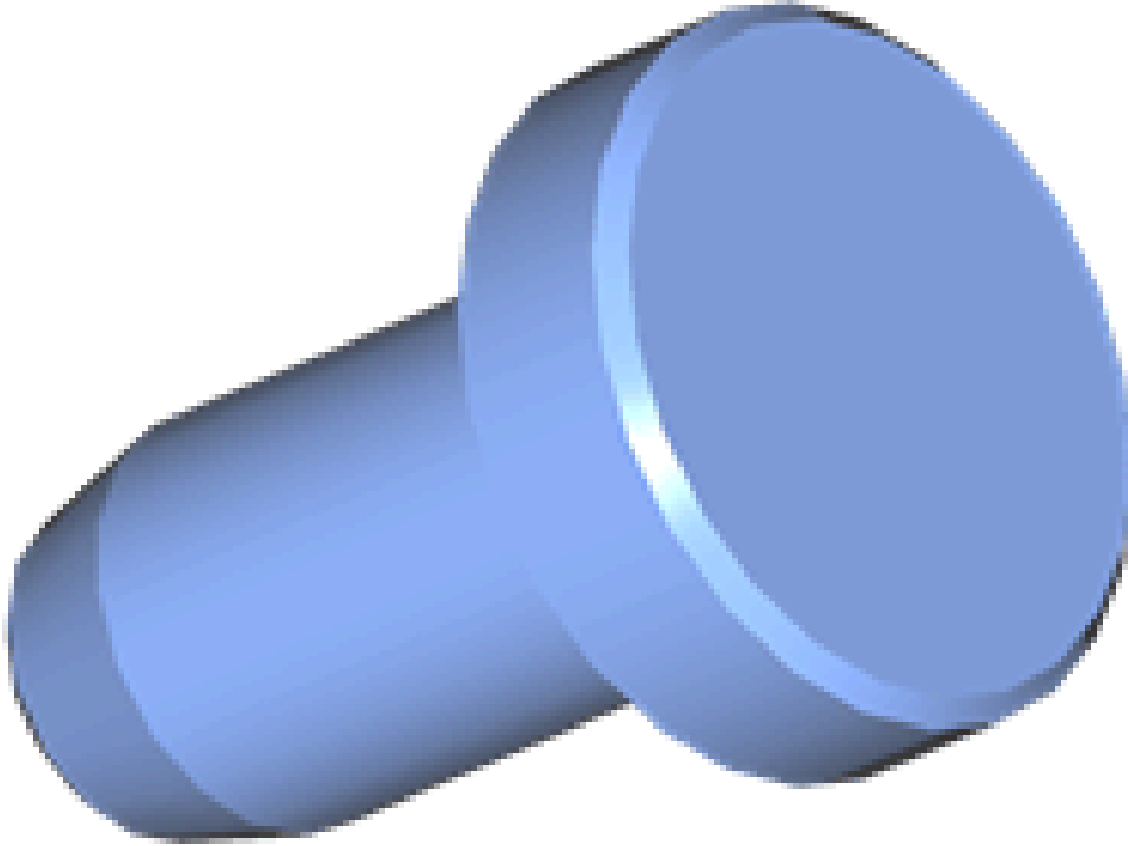
Illustration	Tool Number/Description
	EN-51146-150 Injector Remover/Installer Adapters

Illustration	Tool Number/Description
	EN-51365 High Pressure Fuel Pump Installation Alignment Gauge

Article GUID: A00884658

ENGINE PERFORMANCE

Engine Controls and Fuel - 1.5L (L3A) - Specifications - Volt

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE (ENGINE COOLANT TEMPERATURE SENSOR)

Temperature	Resistance
150°C (302°F)	47 to 49 ohms
140°C (284°F)	58 to 62 ohms
130°C (266°F)	76 to 80 ohms
120°C (248°F)	98 to 104 ohms
110°C (230°F)	130 to 136 ohms
100°C (212°F)	174 to 182 ohms
90°C (194°F)	237 to 247 ohms
80°C (176°F)	327 to 341 ohms
70°C (158°F)	459 to 479 ohms
60°C (140°F)	656 to 686 ohms
50°C (122°F)	958 to 1002 ohms
45°C (113°F)	1167 to 1223 ohms
40°C (104°F)	1430 to 1500 ohms
35°C (95°F)	1763 to 1849 ohms
30°C (86°F)	2185 to 2295 ohms
25°C (77°F)	2725 to 2865 ohms
20°C (68°F)	3418 to 3604 ohms
15°C (59°F)	4318 to 4564 ohms
10°C (50°F)	5493 to 5823 ohms
5°C (41°F)	7041 to 7485 ohms
0°C (32°F)	9097 to 9701 ohms
-5°C (23°F)	11844 to 12678 ohms
-10°C (14°F)	15540 to 16700 ohms
-15°C (5°F)	20559 to 22183 ohms
-20°C (-4°F)	27439 to 29725 ohms
-30°C (-22°F)	50264 to 54924 ohms
-40°C (-40°F)	95953 to 105777 ohms

TEMPERATURE VERSUS RESISTANCE - INTAKE AIR TEMPERATURE SENSOR (HITACHI SENSOR)

Temperature C°/F°	Resistance Minimum Ohms	Resistance Maximum Ohms
Hitachi Intake Air Temperature (IAT) Sensor		

Temperature CÂ°/FÂ°	Resistance Minimum Ohms	Resistance Maximum Ohms
Hitachi Intake Air Temperature (IAT) Sensor		
-40/-40	37, 527	49, 882
-20/-4	13, 110	16, 329
-10/14	8, 145	9, 851
0/32	5, 205	6, 122
20/68	2, 298	2, 570
25/77	1, 900	2, 100
40/104	1, 073	1, 226
60/140	537	639
80/176	289	356
100/212	165	210
120/248	99	129
140/284	62	83
150/302	49	67

ALTITUDE VERSUS BAROMETRIC PRESSURE

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)	Barometric Pressure Measured in Pounds Per Square Inch (PSI)
Determine your altitude by contacting a local weather station or by using another reference source.			
4, 267	14, 000	56 - 64	8.1 - 9.3
3, 962	13, 000	58 - 66	8.4 - 9.6
3, 658	12, 000	61 - 69	8.8 - 10.0
3, 353	11, 000	64 - 72	9.3 - 10.4
3, 048	10, 000	66 - 74	9.6 - 10.7
2, 743	9, 000	69 - 77	10.0 - 11.2
2, 438	8, 000	71 - 79	10.3 - 11.5
2, 134	7, 000	74 - 82	10.7 - 11.9
1, 829	6, 000	77 - 85	11.2 - 12.3
1, 524	5, 000	80 - 88	11.6 - 12.8
1, 219	4, 000	83 - 91	12.0 - 13.2
914	3, 000	87 - 95	12.6 - 13.8
610	2, 000	90 - 98	13.1 - 14.2
305	1, 000	94 - 102	13.6 - 14.8
0	0 Sea Level	96 - 104	13.9 - 15.1
-305	-1, 000	101 - 105	14.6 - 15.2

IGNITION SYSTEM SPECIFICATIONS

Application	Specification
-------------	---------------

Application	Specification
Ignition Type	Individual Ignition Coils
Firing Order	1 - 3 - 4 - 2
Spark Plug Torque	Refer to Fastener Specifications
Spark Plug Gap	Refer to Engine Mechanical Specifications
Spark Plug Type	Refer to Electronic Parts Catalog

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Camshaft Position Actuator Solenoid Valve Seal	
Combustion Fuel Injector Seal	
Engine Coolant Temperature Sensor Seal	
Evaporative Emission System Vacuum Leak Pump Filter Cable Strap	
Exhaust Gas Recirculation Cooler Gasket	
Exhaust Gas Recirculation Cooler Outlet Pipe Seal	
Fuel Injector O-ring	
Fuel Injector Wiring Harness Cable Tie	
Fuel Injector Wiring Harness Tape	
Fuel Pump Housing Seal	
Fuel Pressure Sensor Seal	
Fuel Tank Fuel Pump Module Seal	
Throttle Body Gasket	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Fuel Feed Intermediate Pipe/Fitting	30 N.m (22 lb ft)
Fuel Injection Fuel Rail Fuel Pressure Sensor (In Sequence)	32 N.m (24 lb ft)
Fuel Injector Bolt (In Sequence)	5 N.m (44 lb in)
Fuel Pump Bolt (In Sequence)	25 N.m (18 lb ft)

Reusable Threaded Fastener Tightening Specifications**NOTE:**

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Accelerator Pedal Fastener	6 N.m (53 lb in)
Air Cleaner Outlet Duct Bracket Bolt	9 N. m (80 lb in)
Air Cleaner Outlet Duct Clamp	2.5 N.m (22 lb in)
Air Cleaner Outlet Duct Fastener	9 N.m (80 lb in)
Air Cleaner Resonator Bracket Bolt	9 N.m (80 lb in)
Air Cleaner Upper Housing Bolt	2.5 N.m (22 lb in)
Camshaft Position Actuator Solenoid Valve Fastener	10 N.m (89 lb in)
Camshaft Position Sensor Bolt	10 N.m (89 lb in)
Crankshaft Position Sensor Bolt	10 N.m (89 lb in)
Engine Control Module Bracket Nut	9 N.m (80 lb in)
Engine Oil Pressure Sensor	35 N.m (26 lb ft)
Engine Wiring Harness Bracket Bolt @ Exhaust Gas Recirculation Valve	9 N.m (80 lb in)
Engine Wiring Harness Bracket Bolt @ Fuel Pump	25 N.m (18 lb ft)
Engine Wiring Harness Bracket Nut @ Exhaust Gas Recirculation Valve	9 N.m (80 lb in)
Engine Wiring Harness Ground Bolt	10 N.m (89 lb in)
Evaporative Emission Canister Bracket Nut	9 N.m (80 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification	
	Metric (English)	
Evaporative Emission Canister Purge Solenoid Valve Bolt	10 N.m (89 lb in)	
Evaporative Emission Canister Vent Solenoid Valve Bolt	7 N.m (62 lb in)	
Exhaust Gas Recirculation Cooler Bolt	10 N.m (89 lb in)	
Exhaust Gas Recirculation Cooler Temperature Sensor	42 N.m (31 lb ft)	
Exhaust Gas Recirculation Pipe Bolt	10 N.m (89 lb in)	
Exhaust Gas Recirculation Valve Bolt	10 N.m (89 lb in)	
Fuel Feed Front Pipe Bracket Nut	9 N.m (80 lb in)	
Fuel Feed Intermediate Pipe Bracket Bolt	10 N.m (89 lb in)	
Fuel Injection Fuel Rail Bolt (In Sequence)	10 N.m (89 lb in)	
Fuel Pressure Sensor	15 N.m (11 lb ft)	
Fuel Pump Power Control Module Nut	9 N.m (80 lb in)	
Fuel Tank Filler Pipe Bolt	9 N.m (80 lb in)	
Fuel Tank Filler Pipe Clamp	3.5 N.m (31 lb in)	
Fuel Tank Filler Pipe Ground Bolt	9 N.m (80 lb in)	
Fuel Tank Strap Bolt	22 N.m (16 lb ft)	
Ground Cable Bolt	10 N.m (89 lb in)	
Heated Oxygen Sensor	42 N.m (31 lb ft)	
Ignition Coil Bolt	10 N.m (89 lb in)	
Knock Sensor Bolt	25 N.m (18 lb ft)	
Manifold Absolute Pressure Sensor Bolt	10 N.m (89 lb in)	
Mass Airflow Sensor Bolt	2.5 N.m (22 lb in)	
Spark Plug	17 N.m (13 lb ft)	
Throttle Body Bolt	10 N.m (89 lb in)	

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
Fuel Tank Capacity	33.7 liters	8.9 gallons

Article GUID: A00884696

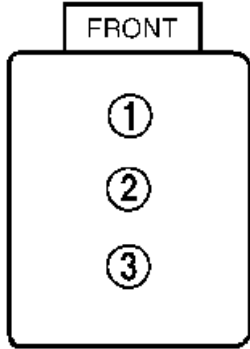
ENGINE PERFORMANCE

Firing Order & Cylinder Identification - GM, & Saturn - All Models

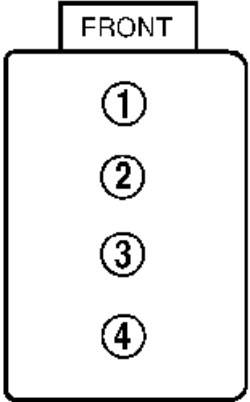
FIRING ORDER & CYLINDER IDENTIFICATION

NOTE: This information is intended as a quick reference for firing order and cylinder identification only. The information provided covers many vehicles and may include some information that does not apply to the vehicle you have currently selected.

3 CYLINDER ENGINE

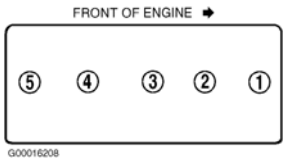
Engine Configuration	Firing Order	Cylinder Identification
In-Line 3	1-3-2	 G00016199

4 CYLINDER ENGINE

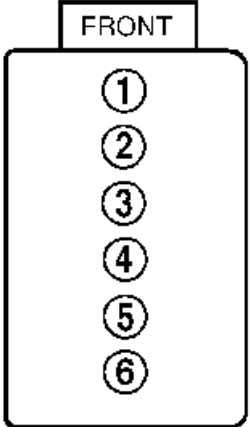
Engine Configuration	Firing Order	Cylinder Identification
In-Line 4	1-3-4-2	 G00016200

5 CYLINDER ENGINE

Engine Configuration	Firing Order	Cylinder Identification
----------------------	--------------	-------------------------

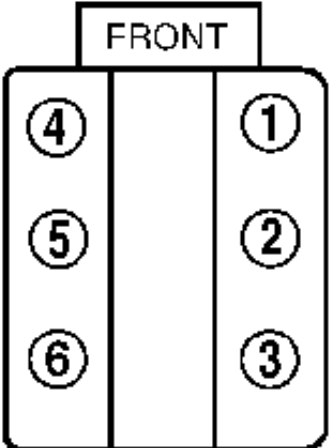
Engine Configuration	Firing Order	Cylinder Identification
In-Line 5	1-3-5-4-2	

IN-LINE 6 ENGINE

Engine Configuration	Firing Order	Cylinder Identification
In-Line 6	1-5-3-6-2-4	

V6 ENGINE

3.5L VIN 4 V6 Engine

Engine Configuration	Firing Order	Cylinder Identification
3.5L VIN 4	1-4-2-5-3-6	

3.8L & 4.3L V6 Engines

Engine Configuration	Firing Order	Cylinder Identification
----------------------	--------------	-------------------------

Engine Configuration	Firing Order	Cylinder Identification
3.8L & 4.3L	1-6-5-4-3-2	G00016202

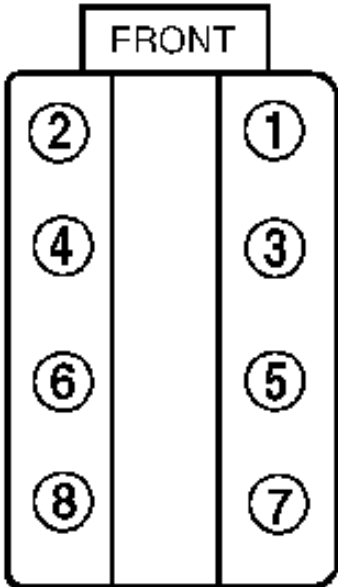
All Other V6 Engines Except 3.5L (VIN 4), 3.8L & 4.3L

Engine Configuration	Firing Order	Cylinder Identification
All Others	1-2-3-4-5-6	G00016203

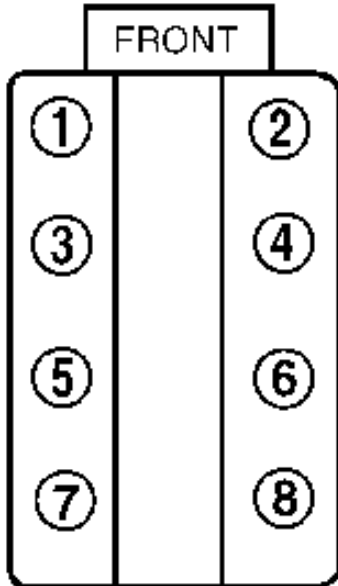
8 CYLINDER ENGINE

4.0L, 4.4L & 4.6L V8 Engines

Engine Configuration	Firing Order	Cylinder Identification
----------------------	--------------	-------------------------

Engine Configuration	Firing Order	Cylinder Identification
4.0L, 4.4L, 4.6L	1-2-7-3-4-5-6-8	 G00016206

5.0L, 5.7L (VIN R & VIN K) & 7.4L V8 Engines

Engine Configuration	Firing Order	Cylinder Identification
5.0L, 5.7L (VIN R & K), 7.4L	1-8-4-3-6-5-7-2	 G00016205

6.6L Diesel V8 Engine

Engine Configuration	Firing Order	Cylinder Identification
----------------------	--------------	-------------------------

Engine Configuration	Firing Order	Cylinder Identification
6.6L Diesel	1-2-7-8-4-5-6-3	FRONT ② ④ ⑥ ⑧ ① ③ ⑤ ⑦ G00016206

All Other V8 Engines Except 4.0L, 4.4L, 4.6L, 5.0L, 5.7L (VIN R & K), 7.4L & 6.6L

Engine Configuration	Firing Order	Cylinder Identification
All Others	1-8-7-2-6-5-4-3	FRONT ① ③ ⑤ ⑦ ② ④ ⑥ ⑧ G00016205

GENERAL INFORMATION
State Emission Standards - Gasoline

ALASKA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

NOTE: As of March 1, 2012, Alaska is not testing for tailpipe emissions.

ALASKA EMISSION STANDARDS - ANCHORAGE & FAIRBANKS (2-SPEED IDLE TEST)

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Passenger Cars ⁽¹⁾		
1968-71	1000 (5.0)	1000 (4.0)
1972-74	1000 (4.0)	1000 (3.0)
1975-80	1000 (2.0)	1000 (2.0)
1981-83	1000 (1.0)	1000 (1.0)
1984-93	750 (1.0)	750 (1.0)
1994-	200 (0.5)	200 (0.5)
Light & Medium Duty Trucks ⁽¹⁾		
1968-72	1000 (5.0)	1000 (4.0)
1973-78	1000 (4.0)	1000 (3.0)
1979-83	1000 (2.0)	1000 (2.0)
1984-93	750 (1.0)	750 (1.0)
1994-	220 (0.5)	220 (0.5)
Heavy Duty Vehicles ⁽²⁾		
1968-73	1000 (5.0)	1000 (5.0)
1974-93	1000 (4.0)	1000 (4.0)
1994-	220 (1.0)	220 (1.0)
(1) 8500 GVWR or less. (2) 8500 GVWR or more.		

ARIZONA

NOTE: Curb idle only test are for vehicles with full-time 4WD, non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on 1967-80 light-duty gasoline powered vehicles and all heavy-duty gasoline powered vehicles.

ARIZONA EMISSION STANDARDS - PHOENIX AREA (CURB IDLE & LOADED CRUISE TESTS)

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC
----------------------------	--------------------	---------------------------------

		ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	500 (4.20)
1967-71 More Than 4-Cyl.	450 (5.00)	450 (3.75)
1972-74 4-Cyl. Or Less	400 (5.50)	400 (4.20)
1972-74 More Than 4-Cyl.	400 (5.00)	400 (3.75)
1975-78 4-Cyl. Or Less	250 (2.20)	250 (1.65)
1975-78 More Than 4-Cyl.	250 (2.00)	250 (1.50)
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.20)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.00)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....
(1) 4-stroke engines only.		
(2) Except AWD, non-defeatable traction control and motorcycles.		
(3) Same as light duty vehicles.		

ARIZONA EMISSION STANDARDS - PHOENIX AREA (IM147 TEST)

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1981-82	3.0 (25.0)	3.5
1983-85	2.4 (20.0)	3.5
1986-89	1.6 (15.0)	2.5
1990-93	1.0 (12.0)	2.5
1994 & Newer	0.8 (12.0)	2.0
Light Trucks (6000 GVWR Or Less)		

Application	HC gpm (CO gpm)	NOx gpm
1981-85	4.0 (40.0)	5.5
1986-89	3.0 (25.0)	4.5
1990-93	2.0 (20.0)	4.0
1994 & Newer	1.6 (20.0)	3.0
Light Duty Trucks (6000-8500 GVWR)		
1981-85	4.4 (48.0)	7.0
1986-87	4.0 (40.0)	5.5
1988-89	3.0 (25.0)	5.5
1990-93	3.0 (25.0)	5.0
1994 & Newer	2.4 (25.0)	4.0

NOTE: Curb idle test only for 1967-80 light-duty gasoline vehicles, all vehicles with full-time 4WD and/or non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on all 1981 and later vehicles except those with full-time 4WD and/or non-defeatable traction control.

ARIZONA EMISSION STANDARDS - TUCSON AREA (CURB IDLE & LOADED CRUISE TESTS)

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	.....
1967-71 More Than 4-Cyl.	450 (5.00)	.....
1972-74 4-Cyl. Or Less	400 (5.50)	.....
1972-74 More Than 4-Cyl.	400 (5.00)	.....
1975-78 4-Cyl. Or Less	250 (2.20)	.....
1975-78 More Than 4-Cyl.	250 (2.00)	.....
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.20)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	⁽³⁾	⁽³⁾
Light Duty Trucks (6001-8500 GVWR)		
1967-74	⁽³⁾	⁽³⁾
1975-78	350 (4.00)	.....
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.00)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	⁽³⁾	⁽³⁾

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC ppm (CO %)
1975-78	350 (4.00)	.....
1979-80	300 (4.00)	.....
1981 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....
(1) 4-stroke engines only. (2) Except AWD, non-defeatable traction control and motorcycles. (3) Same as light duty vehicles.		

CALIFORNIA

CALIFORNIA EMISSION STANDARDS ASM TESTS

Specific vehicle cutpoints are available on the California BAR web site at www.bar.ca.gov under the Industry tab, then Cutpoints Application.

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)				PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
						ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO				
1	1974-	X	X	X	A	235.4	2.56	1301.5	185.4	2.36	1161.5	435.4	4.26	2659.3	385.4	4.06	2459.3
					B	436041.7	4453.19	1192593.0	436041.7	4453.19	1192593.0	436041.7	4453.19	1703703.7	436041.7	4453.19	1703703.7
2	1975-1980	X			A	123.0	0.91	1016.3	90.3	0.71	876.3	315.3	2.51	2051.9	265.3	2.31	1851.9
					B	273316.7	1362.96	1043519.0	273316.7	1362.96	1043519.0	273316.7	1362.96	1490740.7	273316.7	1362.96	1490740.7
3	1981-1983	X			A	63.2	0.64	850.0	42.1	0.44	680.0	253.1	2.14	1844.4	192.4	1.94	1644.4
					B	234259.3	1064.81	894444.5	212963.0	1064.81	894444.5	234259.3	1064.81	1277777.8	212963.0	1064.81	1277777.8
4	1984-1986	X			A	67.0	0.52	850.0	42.1	0.32	680.0	242.4	2.02	1744.4	192.4	1.82	1544.4
					B	212963.0	979.63	894444.5	212963.0	979.63	894444.5	212963.0	979.63	1277777.8	212963.0	979.63	1277777.8
5	1987-1992	X			A	57.0	0.48	608.0	31.7	0.32	547.0	231.7	1.98	1729.6	181.7	1.82	1529.6
					B	191666.7	851.85	596296.3	191666.7	851.85	596296.3	191666.7	851.85	851851.9	191666.7	851.85	851851.9
6	1993-1995	X			A	59.0	0.29	617.1	24.3	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	89951.3	724.07	271314.8	89951.3	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
7	1996-2000	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
8	2001-2003	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
9	2004+	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
10	1975-1978		X		A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
					B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
11	1979-1983		X		A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
12	1984-1987		X		A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
13	1988-1992		X		A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
14	1993-1995		X		A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
15	1996-2000		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
16	2001-2003		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
17	2004+		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
18	1975-1978			X	A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
					B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
19	1979-1983			X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
20	1984-1987			X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
21	1988-1992			X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
22	1993-1995			X	A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
23	1996-2000			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
24	2001-2003			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
25	2004+			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
26	1978-			X	A	173.3	2.90	1703.3	123.3	2.70	1563.3	423.3	5.40	3233.3	373.3	5.20	3033.3
					B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	2333333.3	583333.3	3500.00	2333333.3
27	1979-1983			X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
28	1984-1987			X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
29	1988-1992			X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
30	1993-1995			X	A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
31	1996-2000			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
32	2001-2003			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
33	2004+			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0

Fig. 1: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Light & Medium Duty Vehicles (ASM Test)

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)						PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
		PC	LDT1	LDT2	MDV	HDV		ASM 5015			ASM 2525			ASM 5015			ASM 2525		
								HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
								A	B	A	B	A	B	A	B	A	B	A	B
46	1978-					X		243.8	3.92	2015.8	199.8	3.92	2770.8	594.9	7.29	4970.0	605.4	7.57	5375.4
								583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3
47	1979 - 1983					X		205.5	2.16	2250.0	106.0	1.96	2400.6	454.2	6.62	4231.1	338.1	6.54	4667.2
								225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3
48	1984 - 1987					X		143.0	1.80	2162.5	78.0	1.80	1975.0	307.5	6.87	4238.5	250.0	6.48	3989.5
								150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0
49	1988 - 1992					X		105.0	1.01	2112.5	78.0	1.24	2062.5	300.0	5.87	3865.9	250.0	4.98	3929.9
								150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0
50	1993 - 1995					X		105.0	0.49	1912.5	75.0	1.22	1862.5	300.0	2.61	3825.0	250.0	3.49	3929.9
								150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
51	1996 - 2000					X		105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
								150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
52	2001+					X		105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
								150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0

Fig. 2: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Heavy Duty Vehicles (ASM Test)

LEGEND

ESC - Emission Standard Category

GVWR - Manufacture's Gross Vehicle Weight Rating

LVW - Loaded Vehicle Weight

PC - Passenger Car

LDT1 - Light-Duty Truck up through 3750 LVW and GVWR no greater than 6000 lbs.

LDT2 - Light-Duty Truck greater than 3750 LVW and GVWR no greater than 6000 lbs.

MDV - Medium-Duty Vehicle, GVWR from 6001 to 8500 lbs.

HC - Hydrocarbon, ppm

CO - Carbon Monoxide, %

NO - Nitric Oxide, ppm

PASS/FAIL EMISSION STANDARDS = A+B / VTW

PASS/FAIL STANDARDS - Emission standards used to determine if a vehicle passes the emission inspection. A vehicle passes if the emission levels are equal to or less than the standards for HC, CO and NO for ASM 5015 and ASM 2525.

GROSS POLLUTER STANDARDS - Emission standards used to designate a vehicle as a gross polluter. A vehicle is designated as a gross polluter if the emission levels at the time of the initial inspection, before repairs are greater than the gross polluter standards for HC, CO or NO for ASM 5015 or ASM 2525.

NOTE: If test data on emission pass/fail rates or gross polluter identification rates indicate adjustments are required, the emission standards may be increased or decreased by the bureau by 30% or by the following tolerances, or standards may be set for any specific vehicle and engine configuration which the bureau determines has excessive errors of commission or omission, whichever is necessary to comply with Section 44001.5 of the Health and Safety Code.

COLORADO

COLORADO EMISSION STANDARDS - ENHANCED PROGRAM (IM240)

Application	HC gpm	CO gpm	NOx gpm
Passenger Cars			
1982	3.5	45	5.0
1983	3.5	30	4.5
1984	3.0	30	4.5
1985	2.5	20	4.5
1986	2.5	20	4.5
1987	2.5	20	4.0
1988 & 1989	2.0	20	4.0
1990	2.0	20	3.5
1991	1.5	20	3.5
1992	1.5	15	3.5
1993	1.5	15	3.5
1994	1.2	15	3.0
1995	1.2	15	2.5
1996	1.2	15	2.0
1997	1.2	15	2.0
1998 & Newer	1.2	15	1.5
Light Duty Vehicles			
1982	6.0	65	6.0
1983	6.0	65	6.0
1984	5.0	55	6.0
1985	4.5	45	6.0
1986	4.0	40	6.0
1987	3.5	30	5.5
1988 & 1989	3.0	25	5.0
1990	3.0	25	5.0
1991	2.5	25	4.5
1992	2.5	25	4.5
1993	2.5	25	4.5
1994	2.0	20	4.0
1995	2.0	20	4.0
1996	1.2	15	3.5
1997	1.2	15	3.0
1998	1.2	15	2.0
1999 & Newer	1.2	15	2.0

COLORADO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm	CO %
Passenger Cars & Light Duty Trucks		
1970 & Earlier	1000	3.5

Application	HC ppm	CO %
1971	1000	3.0
1972	1000	3.0
1973	1000	3.0
1974	1000	3.0
1975	600	2.0
1976	600	2.0
1977	400	1.5
1978	400	1.5
1979	400	1.5
1980	400	1.5
1981 & Newer	220	1.2
Heavy Duty Trucks (6000 GVWR Or Greater)		
1967 Or Earlier	1500	7.0
1968-69	1200	6.5
1969	1200	6.5
1970	1000	5.5
1971	1000	5.5
1972	1000	5.5
1973	1000	5.5
1974	1000	5.5
1975	1000	5.5
1976	1000	5.5
1977	1000	5.5
1978	1000	5.5
Heavy Duty Trucks (8501 GVWR Or Greater)		
1979	800	4.0
1980	800	3.5
1981	600	3.0
1982	600	3.0
1983	600	3.0
1984	600	3.0
1985	600	3.0
1986 & Newer	300	2.0

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO)
10,000 GVWR Or Less	
1979	250 (2.1)
1980	225 (2.0)

Application	HC ppm (CO)
1981-82	200 (1.2)
1983	175 (1.0)
1984-87	150 (1.0)
1988 & Newer	125 (1.0)

DELAWARE

DELAWARE EMISSION STANDARDS - KENT, NEW CASTLE & SUSSEX COUNTIES (IDLE TEST)

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-70	900 (9.0)
1971-74	600 (6.0)
1975-79	400 (4.0)
1980	220 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1970-72	900 (9.0)
1973-78	600 (6.0)
1979-83	400 (4.0)
1984 & Newer	220 (1.2)

DISTRICT OF COLUMBIA

DISTRICT OF COLUMBIA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles & Trucks (26000 GVWR Or Less)	
1968-70	1250 (11.0)
1971-74	1200 (9.0)
1975-79	600 (6.5)
1980	300 (1.5)
1981 & Newer	220 (1.2)

GEORGIA

NOTE: The Georgia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and older model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

GEORGIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application ⁽¹⁾	HC ppm (CO %)
1979	500 (5.0)
1980	350 (3.5)

Application ⁽¹⁾	HC ppm (CO %)
1981-83	250 (1.5)
1984 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

IDAHO

IDAHO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles	
8500 GVWR Or Less	
1965-74	900 (5.0)
1975-79	700 (3.0)
1980	400 (1.5)
1981 & Newer	220 (1.2)
Heavy Duty Trucks	
8501 GVWR Or More	
1965-74	900 (6.0)
1975-80	700 (5.0)
1981 & Newer	500 (3.0)

ILLINOIS

ILLINOIS EMISSION STANDARDS - IM240 TEST

Application	HC gpm	CO gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	2.00	60.0
1983-87	2.00	30.0
1988-95	0.80	15.0
1996 & Newer	0.60	10.0
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (3750 LVW Or More) ⁽¹⁾	0.80	13.0
1996 & Newer (3750 LVW Or Less) ⁽¹⁾	0.60	10.0
Light Duty Trucks (6001-6500 GVWR)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (5750 ALVW Or More)	0.80	15.0
1996 & Newer (5750 ALVW Or Less)	0.80	13.0

Application	HC gpm	CO gpm
(1) Loaded Vehicle Weight (LVW) is vehicle curb weight plus 300 lbs.		

ILLINOIS EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Vehicles (6000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-77	700 (7.0)
1978-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Light Duty Vehicles (8000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-78	700 (7.0)
1979-80	600 (6.0)
1981-83	300 (3.0)
1984 & Newer	220 (1.2)
Heavy Duty Vehicles (8001 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

INDIANA

INDIANA EMISSION STANDARDS - IM93 TEST

Application	HC gpm (CO gpm)	NOx (gpm)
Passenger Cars		
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-90	1.4 (20)	3.0
1991-95	0.8 (15)	2.5
1996 & Newer	0.6 (10)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	3.5
1991-95	1.6 (40)	3.0
1996 & Newer	0.8 (20)	3.0
Light Duty Trucks (6001-8500 GVWR)		

Application	HC gpm (CO gpm)	NO _x (gpm)
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	5.0
1991-96	1.6 (40)	4.5
1997 & Newer	0.8 (20)	4.5
Heavy Duty Trucks (8501-9000 GVWR)		
1981-82	7.5 (100)	8.0
1983-84	6.0 (100)	8.0
1985-86	5.0 (75)	8.0
1987-90	3.0 (60)	8.0
1991-97	2.4 (40)	8.0
1998 & Newer	2.0 (30)	6.0

INDIANA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1976-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)

KENTUCKY

NOTE: Currently, there is no emission testing in Kentucky.

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (IDLE TEST)

Application	HC ppm (CO)
Passenger Cars (Automobiles)	
1968	950 (8.5)
1969	900 (8.5)
1970	850 (8.1)
1972	800 (8.0)
1973	800 (7.8)
1974	800 (7.6)

Application	HC ppm (CO)
1975	700 (7.5)
1976	700 (6.5)
1977	650 (6.3)
1978	600 (5.5)
1979	600 (4.5)
1980	250 (2.5)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968	1300 (8.0)
1969	1200 (8.0)
1970-71	1100 (8.0)
1972-73	1000 (7.8)
1974	950 (7.8)
1975	900 (7.0)
1976-77	700 (7.0)
1978	700 (6.3)
1979	450 (5.5)
1980	450 (4.0)
1981	350 (1.7)
1982 & Newer	220 (1.2)
Light Duty Trucks (6001-10,000 GVWR)	
1969	1500 (9.0)
1970	1100 (8.0)
1971	1000 (8.0)
1972-75	950 (7.5)
1976	900 (7.5)
1977	850 (7.5)
1978	700 (6.0)
1979	650 (5.5)
1980	550 (5.0)
1981	450 (4.0)
1982	400 (2.5)
1983	350 (2.0)
1984	220 (1.5)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (10,001-18,000 GVWR)	
1968	1500 (9.0)
1969-70	1300 (8.5)
1971	1200 (8.5)
1972-76	1000 (7.0)
1977-80	900 (6.5)

Application	HC ppm (CO)
1982-83	400 (3.0)
1984 & Newer	250 (1.5)

MARYLAND

MARYLAND EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1984-87	1.80 (30.0)	2.8
1988-90	1.40 (30.0)	2.5
1991-93	1.00 (20.0)	2.2
1994-95	0.90 (20.0)	2.1
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	2.80 (80.0)	5.8
1988-90	2.40 (80.0)	3.0
1991-93	2.00 (60.0)	2.7
1994-95	1.80 (60.0)	2.6
Light Duty Trucks (6001-8500 GVWR)		
1984-87	2.90 (80.0)	6.6
1988-90	2.40 (80.0)	4.2
1991-93	2.00 (60.0)	4.0
1994-95	1.80 (60.0)	3.7
Heavy Duty Trucks (8501-9999 GVWR)		
1984	5.80 (100.0)	7.7
1985-86	4.70 (80.0)	7.7
1987	3.00 (80.0)	7.7
1988-90	2.60 (80.0)	7.0
1991-97	2.50 (60.0)	5.5
1998 & Newer	2.20 (60.0)	4.0

MARYLAND EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1977	500 (6.0)
1978	430 (5.5)
1979	400 (4.0)
1980	220 (1.7)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-9999 GVWR)	
1977	580 (7.0)
1978	550 (6.7)
1979	470 (5.0)

Application	HC ppm (CO %)
1980	350 (5.0)
1981	250 (3.0)
1982	220 (2.5)
1983	220 (1.5)
1984 & Newer	220 (1.2)
Heavy Duty Trucks (10,000-26,000 GVWR)	
1977-78	650 (7.0)
1979	650 (6.5)
1980-82	500 (6.0)
1983	500 (3.5)
1984-85	440 (3.0)
1986	280 (2.5)
1987 & Newer	220 (1.2)

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - MA31 TEST

Application	HC gpm (CO gpm)	NOx gpm
Passenger Cars		
1984-90	2.0 (30)	3.0
1991-95	1.2 (20)	2.5
1996 & Newer	0.8 (13)	2.0
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	3.2 (80)	7.0
1988-1990	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
1996 & Newer (3750 LVW <u>(1)</u> Or Less)	0.8 (15)	2.0
1996 & Newer (3751 LVW <u>(1)</u> Or Greater)	1.0 (20)	2.5
Light Duty Trucks (6001-8500 GVWR)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer (5750 ALVW <u>(2)</u> Or Less)	1.0 (20)	2.5
1996 & Newer (5751 ALVW <u>(2)</u> Or Greater)	2.4 (60)	4.0
Heavy Duty Trucks (8501-10,000 Or Greater)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer	2.4 (60)	4.0

Application	HC gpm (CO gpm)	NOx gpm
(1) Loaded Vehicle Weight (LVW).		
(2) Adjusted Loaded Vehicle Weight (ALVW).		

MASSACHUSETTS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
All Vehicles	
1984-86	220 (0.80)
1987 & Newer	100 (0.60)

MISSOURI

MISSOURI EMISSION STANDARDS - JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	0.80 (30.0)	2.0
1983-95	0.80 (15.0)	2.0
1996 & Newer	0.60 (10.0)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	3.40 (70.0)	4.5
1984-87	1.60 (40.0)	4.5
1988-95	1.60 (40.0)	2.5
1996 & Newer (Less Than 3750 LVW)	0.80 (13.0)	1.8
1996 & Newer (3750 LVW Or Less)	0.60 (10.0)	1.5
Light Duty Trucks (6001-8500 GVWR)		
1981-83	3.4 (70.0)	4.5
1984-87	1.6 (40.0)	4.5
1988-95	1.60 (40.0)	3.5
1996 & Newer (5750 ALVW Or Less)	0.80 (13.0)	1.8
1996 & Newer (5750 ALVW Or More)	0.80 (15.0)	2.0

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IDLE TEST

Application ⁽¹⁾	HC ppm (CO %)
1971-74	700 (7.0)
1975-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - REMOTE SENSING CLEAN SCREEN TEST

Application ⁽¹⁾	HC ppm (CO %)	NOx ppm
All Vehicles (8500 GVWR Or Less)		
1971 & Newer	200 (0.5)	2000
(1) 8500 GVWR or less.		

NEVADA

NEVADA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1968-69	800 (4.0)
1970-74	700 (3.5)
1975-78	500 (2.5)
1979-80	500 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1400 (7.0)
1970-78	1400 (6.0)
1979	1000 (5.0)
1980	1000 (4.0)
1981 & Newer	1000 (3.5)

NEW JERSEY

NOTE: The New Jersey program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

NEW JERSEY EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)		
1967 & Earlier	1400 (8.5)	.....
1968-70	700 (7.0)	.....
1971-74	500 (5.0)	.....
1975-80	300 (3.0)	.....
1981 & Newer	220 (1.2)	100 (0.5)
Heavy Duty Vehicles (8501 GVWR Or Greater)		
1967 & Earlier	1400 (8.5)	.....
1968-70	1200 (8.5)	.....
1971-74	700 (6.0)	.....
1975-78	500 (4.0)	.....
1979 & Earlier	300 (3.0)	.....

NEW MEXICO

NEW MEXICO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1975-78	500 (5.0)	500 (5.0)
1979-80	400 (4.0)	400 (4.0)
1981-85	220 (1.2)	220 (1.2)
1986-90	200 (1.2)	200 (1.2)
1991-95	180 (1.2)	180 (1.2)
Light Duty Trucks (6001-8000 GVWR)		
1975-78	600 (6.0)	600 (6.0)
1979-80	600 (4.5)	600 (4.5)
1981-82	400 (2.7)	400 (3.0)
1983-88	300 (1.2)	300 (3.0)
1989-95	220 (1.2)	220 (1.2)
Medium Duty Trucks (8001-10,000 GVWR)		
1975 & Newer	650 (6.5)	650 (6.5)

NEW YORK

NEW YORK EMISSION STANDARDS - IM240 TEST

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
Light Duty Vehicles					
1981-82	0.80	0.50	30.0	24.0	2.0
1983-95	0.80	0.50	15.0	12.0	2.0
1996 & Newer	0.60	0.40	10.0	8.0	1.5
Light Duty Trucks (6000 GVWR Or Less)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	2.5
1996 & Newer (3750 LVW Or Less)	0.60	0.40	10.0	8.0	1.5
1996 & Newer (3751 LVW Or More)	0.80	0.50	13.0	10.0	1.8
Light Duty Trucks (6501-8500 GVWR)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	3.5
1996 & Newer (5750 ALVW Or Less)	0.80	0.50	13.0	10.0	1.8

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
1996 & Newer (5751 ALVW Or More)	0.80	0.50	15.0	12.0	2.0

NEW YORK EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1978	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1978	600 (4.5)
1979 & Newer	300 (3.0)

NORTH CAROLINA

NORTH CAROLINA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1977	450 (4.5)
1978-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	250 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1977-78	500 (5.0)
1979 & Newer	400 (4.0)

OHIO

NOTE: The Ohio program incorporates original U.S. EPA recommended start-up ASM2525 standards for all model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

OHIO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)

OREGON

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND ENHANCED AREA - BAR31

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Passenger Cars		
1981-82	2.0 (64)	3.70
1983-89	2.0 (32)	3.70
1990-95	1.2 (30)	3.00
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	4.62
1990-95	2.4 (80)	3.75
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6001-8500 GVWR)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	6.47
1990-95	2.4 (80)	5.25
1996 & Newer	OBD-II Test	OBD-II Test

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA
BASIC TEST - 2-SPEED IDLE TEST**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Passenger Cars (6000 GVWR Or Less)		
1975-80 (No Catalyst)	300 (2.5)	-
1975-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1975 & Newer (2-Stroke)	n/a (7.0)	-
Light Duty Trucks (6001-8500 GVWR)		
1975-78 (All)	350 (2.5)	-
1979-80 (No Catalyst)	300 (2.5)	-
1979-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1996 & Newer (3750 LVW Or Less)	0.9 (20)	2.25
Heavy Duty Trucks (8501 GVWR Or More)		
1975-78 (Carbureted)	500 (4.0)	n/a (3.0)
1975-78 (Fuel Injection)	500 (4.0)	-
1979-84 (Carbureted)	350 (3.0)	n/a (3.0)
1979-84 (Fuel Injection)	350 (3.0)	-
1985 & Newer (No Catalyst)	350 (3.0)	n/a (3.0)
1985 & Newer (W/Catalyst)	220 (1.0)	220 (1.0)

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA
BASIC TEST - EXHAUST OPACITY TEST**

Application	Opacity % @ Idle	Opacity % @ High Idle
1975 & Newer		
2-Cycle Engines	20	.....
Gasoline Engines	0	0

PENNSYLVANIA

NOTE: The Pennsylvania (in Philadelphia area) program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

**PENNSYLVANIA EMISSION STANDARDS - PITTSBURGH & OLDER PHILADELPHIA VEHICLES
- IDLE TEST**

Application	HC ppm (CO %)
6000 GVWR Or Less	
1975-79	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	130 (1.0)
6001-9000 GVWR	
1975-78	650 (6.0)
1979	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	180 (1.0)

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - RI2000 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1974 & Earlier	15.92 (132.44)	14.92
1975-76	6.74 (96.21)	9.92
1977-79	6.74 (96.21)	6.59
1980	2.25 (45.48)	6.59
1981-82	2.25 (45.48)	3.25
1983-95	2.25 (23.74)	3.25
1996 & Newer	1.84 (16.50)	2.42
Light Duty Trucks (6000 GVWR Or Less)		
1975 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92

Application	HC gpm (CO gpm)	NOx gpm
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1988-90	3.88 (59.97)	4.09
1991-95	3.88 (59.97)	4.09
1996 & Newer (3750 LVW Or Less)	1.84 (16.50)	2.42
1996 & Newer (3751 LVW Or More)	2.25 (20.84)	2.92
Light Duty Trucks (6001-8500 GVWR)		
1974 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1989-90	3.88 (59.97)	5.75
1991-95	3.88 (59.97)	5.75
1996 & Newer (5750 LVW Or Less)	2.25 (20.84)	2.92
1996 & Newer (5751 LVW or More)	5.51 (23.74)	3.25

RHODE ISLAND EMISSION STANDARDS - 2-SPEED IDLE TEST

Application Idle ⁽¹⁾	HC ppm (CO %)
1967 & Earlier	800 (7.0)
1968-74	700 (6.0)
1975-78	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

TENNESSEE

TENNESSEE EMISSION STANDARDS - MEMPHIS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (9000 GVWR Or Less)	
1971 & Older	900 (8.9)
1972-74	700 (8.2)
1975-79	600 (7.5)
1980	400 (4.7)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (9001-25,999 GVWR)	
1971 & Older	1000 (8.9)
1972-74	1000 (8.2)
1975-79	1000 (8.0)
1980	800 (6.0)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - DAVIDSON & NASHVILLE COUNTIES - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - FOUR COUNTY AREA SURROUNDING NASHVILLE - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TEXAS

NOTE: The Texas program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

TEXAS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1979	600 (6.0)
1980	400 (4.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1979-81	700 (7.0)
1982-84	500 (5.0)

Application	HC ppm (CO %)
1985 & Newer	300 (3.0)

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DC98 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1989-90	2.00 (30)	3.0
1991-95	1.2 (20)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1989-90	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1989-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5

UTAH EMISSION STANDARDS - DAVIS COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Vehicles (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

NOTE: The Salt Lake County program incorporates California style ASM2525 and ASM5015 standards for 1968 and newer model year vehicles; however, actual cutpoints are unique to this program and current information is not available at this time.

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

UTAH EMISSION STANDARDS - UTAH & WEBER COUNTIES - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)

Application	HC ppm (CO %)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

VIRGINIA

NOTE: The Virginia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

VIRGINIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
8500 GVWR Or Less	
1975-90	400 (4.0)
1980	220 (2.0)
1981-89	220 (1.2)
1990-95	125 (1.0)
1996 & Newer	100 (0.75)
8501-10,000 GVWR	
1975-79	400 (4.0)
1980	220 (2.0)
1981-90	220 (1.2)
1991-96	150 (1.0)
1997 & Newer	125 (0.75)

WASHINGTON

WASHINGTON EMISSION STANDARDS - ASM2525 TEST

Application	HC ppm (CO %)
1980 & Earlier (Light-Duty Vehicles)	
1750 GVWR	400 (4.2)
1875 GVWR	380 (4.0)

Application	HC ppm (CO %)
2000 GVWR	350 (3.8)
2125 GVWR	340 (3.6)
2250 GVWR	320 (3.4)
2375 GVWR	300 (3.2)
2500 GVWR	290 (3.0)
2625 GVWR	270 (2.9)
2750 GVWR	260 (2.8)
2875 GVWR	250 (2.7)
3000 GVWR	240 (2.6)
3125 GVWR	230 (2.5)
3250 GVWR	220 (2.4)
3375 GVWR	220 (2.3)
3500 GVWR	210 (2.2)
3625 GVWR	200 (2.1)
3750 Or Greater GVWR (Passenger Cars Only)	200 (2.1)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)
1981 & Newer (Light-Duty Vehicles)	
1750 GVWR	250 (1.8)
1875 GVWR	240 (1.7)
2000 GVWR	220 (1.6)
2125 GVWR	210 (1.5)
2250 GVWR	200 (1.5)
2375 GVWR	190 (1.4)
2500 GVWR	180 (1.3)
2625 GVWR	180 (1.3)
2750 GVWR	171 (1.2)
2875 GVWR	160 (1.2)
3000 GVWR	160 (1.1)
3125 GVWR	150 (1.1)
3250 GVWR	150 (1.0)
3375 GVWR	150 (1.0)
3500 GVWR	150 (1.0)
3625 GVWR	150 (1.0)
3750 Or Greater GVWR (Passenger Cars Only)	150 (1.0)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)

WASHINGTON EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle/2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1980 & Earlier	600 (3.0)
1981 & Newer	220 (1.2)

Application	Idle/2500 RPM HC ppm (CO %)
Heavy Duty Trucks (8500 GVWR Or More)	
1981 & Newer	400 (3.0)

WISCONSIN

WISCONSIN EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-76	3.0 (65)	6.0
1977-79	3.0 (65)	4.0
1980	2.0 (60)	4.0
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-93	0.8 (15)	2.0
1991-95	0.8 (15)	2.0
1996 & Newer	0.6 (10)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1987	1.6 (40)	4.5
1988-95	1.6 (40)	2.5
1996 & Newer (3750 LVW Or Less)	0.6 (10)	1.5
1996 & Newer (3751 LVW Or More)	0.8 (13)	1.8
Light Duty Trucks (6001-8500 GVWR)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1988-96	1.6 (40)	3.5
1997 & Newer (5750 ALVW Or Less)	0.8 (13)	1.8
1997 & Newer (5751 ALVW Or More)	0.8 (15)	2.0
Heavy Duty Trucks (8501-10,000 GVWR)		
1968-69	20.0 (200)	15.0
1970-73	10.0 (175)	10.0
1974-78	10.0 (150)	10.0

Application	HC gpm (CO gpm)	NOx gpm
1979-84	7.5 (100)	8.0
1985-86	5.0 (80)	8.0
1987-90	2.0 (40)	6.0
1991-97	2.0 (40)	5.0
1998 & Newer	2.0 (30)	4.0
Heavy Duty Trucks (10,001 GVWR or More)		
1968-69	24.0 (250)	30.0
1970-73	13.0 (175)	20.0
1974-78	13.0 (150)	20.0
1979-84	11.5 (150)	16.0
1985-86	10.0 (150)	16.0
1987-90	3.5 (70)	11.0
1991-97	3.5 (70)	9.0
1998 & Newer	3.5 (60)	7.0

WISCONSIN EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1968-71	800 (8.0)
1972-74	550 (7.0)
1975-77	450 (5.5)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-71	800 (8.0)
1972-74	700 (7.0)
1975-77	500 (6.0)
1978	450 (5.0)
1979	300 (3.0)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1450 (9.0)
1970-71	800 (8.0)
1972-74	700 (7.0)
1975-77	550 (6.5)
1978	450 (5.5)
1979	300 (3.0)

Application	HC ppm (CO %)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-76 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4980
1875	729 (3.70)	4990	717 (5.14)	4906
2000	688 (3.49)	4919	676 (4.85)	4838
2125	650 (3.31)	4853	638 (4.58)	4776
2250	615 (3.13)	4792	604 (4.34)	4720
2375	583 (2.98)	4736	573 (4.12)	4668

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2500	554 (2.83)	4685	544 (3.91)	4620
2625	528 (2.70)	4639	518 (3.73)	4577
2750	503 (2.58)	4596	495 (3.56)	4374
2875	481 (2.47)	4484	473 (3.41)	4176
3000	461 (2.37)	4290	453 (3.27)	3996
3125	443 (2.28)	4114	435 (3.14)	3832
3250	426 (2.20)	3952	419 (3.02)	3681
3375	411 (2.12)	3804	404 (2.91)	3544
3500	397 (2.05)	3669	390 (2.82)	3418
3625	384 (1.99)	3544	377 (2.73)	3302
3750	372 (1.93)	3429	365 (2.64)	3195
3875	361 (1.87)	3323	355 (2.57)	3096
4000	351 (1.82)	3224	345 (2.49)	3003
4125	341 (1.77)	3131	335 (2.43)	2917
4250	332 (1.73)	3044	326 (2.36)	2836
4375	323 (1.68)	2961	318 (2.31)	2759
4500	315 (1.64)	2883	310 (2.25)	2686
4625	308 (1.61)	2807	302 (2.19)	2616
4750	300 (1.57)	2735	295 (2.14)	2549
4875	293 (1.53)	2665	288 (2.09)	2483
5000	286 (1.50)	2597	281 (2.04)	2420
5125	279 (1.46)	2530	274 (2.00)	2359
5250	272 (1.43)	2466	267 (1.95)	2298
5375	266 (1.40)	2403	261 (1.90)	2240
5500	259 (1.37)	2341	255 (1.86)	2183
5625	253 (1.34)	2282	248 (1.82)	2127
5750	247 (1.31)	2224	243 (1.78)	2074
5875	241 (1.28)	2168	237 (1.74)	2022
6000	236 (1.25)	2116	232 (1.70)	1973
6125	231 (1.23)	2066	227 (1.66)	1927
6250	226 (1.20)	2020	222 (1.63)	1884
6375	222 (1.18)	1979	218 (1.60)	1846
6500	218 (1.16)	1943	214 (1.57)	1813
6625	215 (1.15)	1913	211 (1.55)	1785
6750	213 (1.14)	1890	209 (1.54)	1764
6875	211 (1.13)	1875	207 (1.52)	1750
7000	211 (1.12)	1870	207 (1.52)	1745
7125 Or More	211 (1.12)	1874	206 (1.52)	1745

U.S. EPA ASM EMISSION STANDARDS - 1977-79 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4950
1875	729 (3.70)	4990	717 (5.14)	4655
2000	688 (3.49)	4707	676 (4.85)	4384
2125	650 (3.31)	4441	638 (4.58)	4136
2250	615 (3.13)	4197	604 (4.34)	3909
2375	583 (2.98)	3974	573 (4.12)	3701
2500	554 (2.83)	3771	544 (3.91)	3512
2625	528 (2.70)	3585	518 (3.73)	3339
2750	503 (2.58)	3416	495 (3.56)	3181
2875	481 (2.47)	3261	473 (3.41)	3037
3000	461 (2.37)	3120	453 (3.27)	2906
3125	443 (2.28)	2992	435 (3.14)	2787
3250	426 (2.20)	2874	419 (3.02)	2677
3375	411 (2.12)	2767	404 (2.91)	2577
3500	397 (2.05)	2668	390 (2.82)	2486
3625	384 (1.99)	2578	377 (2.73)	2401
3750	372 (1.93)	2494	365 (2.64)	2323
3875	361 (1.87)	2417	355 (2.57)	2251
4000	351 (1.82)	2345	345 (2.49)	2184
4125	341 (1.77)	2277	335 (2.43)	2122
4250	332 (1.73)	2214	326 (2.36)	2063
4375	323 (1.68)	2154	318 (2.31)	2007
4500	315 (1.64)	2096	310 (2.25)	1953
4625	308 (1.61)	2042	302 (2.19)	1903
4750	300 (1.57)	1989	295 (2.14)	1854
4875	293 (1.53)	1938	288 (2.09)	1806
5000	286 (1.50)	1889	281 (2.04)	1760
5125	279 (1.46)	1840	274 (2.00)	1715
5250	272 (1.43)	1793	267 (1.95)	1672
5375	266 (1.40)	1747	261 (1.90)	1629
5500	259 (1.37)	1703	255 (1.86)	1587
5625	253 (1.34)	1659	248 (1.82)	1547
5750	247 (1.31)	1617	243 (1.78)	1508
5875	241 (1.28)	1577	237 (1.74)	1471
6000	236 (1.25)	1539	232 (1.70)	1435
6125	231 (1.23)	1503	227 (1.66)	1401
6250	226 (1.20)	1469	222 (1.63)	1371
6375	222 (1.18)	1439	218 (1.60)	1343

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	218 (1.16)	1413	214 (1.57)	1318
6625	215 (1.15)	1391	211 (1.55)	1298
6750	213 (1.14)	1374	209 (1.54)	1283
6875	211 (1.13)	1364	207 (1.52)	1273
7000 Or More	211 (1.12)	1360	207 (1.52)	1269

U.S. EPA ASM EMISSION STANDARDS - 1980 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	4990	282 (3.64)	4950
1875	275 (2.63)	4990	266 (3.43)	4655
2000	260 (2.48)	4707	252 (3.24)	4384
2125	246 (2.35)	4441	239 (3.06)	4136
2250	234 (2.23)	4197	227 (2.90)	3909
2375	223 (2.12)	3974	216 (2.76)	3701
2500	212 (2.02)	3771	206 (2.62)	3512
2625	203 (1.92)	3585	197 (2.50)	3339
2750	194 (1.84)	3416	189 (2.39)	3181
2875	187 (1.76)	3261	181 (2.29)	3037
3000	180 (1.69)	3120	174 (2.19)	2906
3125	173 (1.63)	2992	168 (2.11)	2787
3250	167 (1.57)	2874	162 (2.03)	2677
3375	162 (1.52)	2767	157 (1.96)	2577
3500	157 (1.47)	2668	152 (1.89)	2486
3625	152 (1.42)	2578	148 (1.84)	2401
3750	148 (1.38)	2492	144 (1.78)	2323
3875	144 (1.34)	2417	140 (1.73)	2251
4000	140 (1.31)	2345	137 (1.68)	2184
4125	137 (1.27)	2277	133 (1.64)	2122
4250	134 (1.24)	2214	130 (1.60)	2063
4375	131 (1.21)	2154	127 (1.56)	2007
4500	128 (1.18)	2096	124 (1.52)	1953
4625	125 (1.15)	2042	122 (1.48)	1903
4750	122 (1.13)	1989	119 (1.45)	1854
4875	120 (1.10)	1938	117 (1.42)	1806
5000	117 (1.08)	1889	114 (1.38)	1760
5125	115 (1.05)	1840	112 (1.35)	1715
5250	112 (1.03)	1793	110 (1.32)	1672

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5375	110 (1.01)	1747	107 (1.29)	1629
5500	108 (0.99)	1703	105 (1.26)	1587
5625	106 (0.97)	1659	103 (1.24)	1547
5750	104 (0.94)	1617	101 (1.21)	1508
5875	102 (0.92)	1577	99 (1.18)	1471
6000	100 (0.91)	1539	97 (1.16)	1435
6125	98 (0.89)	1503	95 (1.13)	1401
6250	96 (0.87)	1469	94 (1.11)	1371
6375	95 (0.86)	1439	92 (1.09)	1343
6500	93 (0.84)	1413	91 (1.08)	1318
6625	92 (0.83)	1391	90 (1.06)	1298
6750	91 (0.82)	1374	89 (1.05)	1283
6875	91 (0.82)	1364	89 (1.04)	1273
7000	91 (0.82)	1360	88 (1.04)	1269
7125 Or More	90 (0.81)	1360	88 (1.04)	1269

U.S. EPA ASM EMISSION STANDARDS - 1981-82 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	2272	282 (3.64)	2114
1875	275 (2.63)	2181	266 (3.43)	1991
2000	260 (2.48)	2058	252 (3.24)	1877
2125	246 (2.35)	1944	239 (3.06)	1774
2250	234 (2.23)	1839	227 (2.90)	1678
2375	223 (2.12)	1744	216 (2.76)	1592
2500	212 (2.02)	1657	206 (2.62)	1512
2625	203 (1.92)	1577	197 (2.50)	1440
2750	194 (1.84)	1504	189 (2.39)	1374
2875	187 (1.76)	1438	181 (2.29)	1313
3000	180 (1.69)	1378	174 (2.19)	1258
3125	173 (1.63)	1323	168 (2.11)	1208
3250	167 (1.57)	1273	162 (2.03)	1163
3375	162 (1.52)	1227	157 (1.96)	1121
3500	157 (1.47)	1184	152 (1.89)	1082
3625	152 (1.42)	1146	148 (1.84)	1047
3750	148 (1.38)	1110	144 (1.78)	1014
3875	144 (1.34)	1077	140 (1.73)	984
4000	140 (1.31)	1046	137 (1.68)	956

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4125	137 (1.27)	1017	133 (1.64)	930
4250	134 (1.24)	990	130 (1.60)	905
4375	131 (1.21)	964	127 (1.56)	882
4500	128 (1.18)	939	124 (1.52)	859
4625	125 (1.15)	916	122 (1.48)	838
4750	122 (1.13)	893	119 (1.45)	818
4875	120 (1.10)	872	117 (1.42)	798
5000	117 (1.08)	850	114 (1.38)	778
5125	115 (1.05)	830	112 (1.35)	760
5250	112 (1.03)	810	110 (1.32)	741
5375	110 (1.01)	790	107 (1.29)	723
5500	108 (0.99)	771	105 (1.26)	706
5625	106 (0.97)	752	103 (1.24)	689
5750	104 (0.94)	734	101 (1.21)	673
5875	102 (0.92)	717	99 (1.18)	657
6000	100 (0.91)	701	97 (1.16)	642
6125	98 (0.89)	685	95 (1.13)	628
6250	96 (0.87)	671	94 (1.11)	615
6375	95 (0.86)	658	92 (1.09)	604
6500	93 (0.84)	647	91 (1.08)	593
6625	92 (0.83)	638	90 (1.06)	585
6750	91 (0.82)	631	89 (1.05)	578
6875	91 (0.82)	626	89 (1.04)	574
7000	91 (0.82)	624	88 (1.04)	573
7125 Or More	90 (0.81)	625	88 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1983-90 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (1.64)	2272	282 (1.83)	2114
1875	275 (1.55)	2181	266 (1.72)	1991
2000	260 (1.47)	2058	252 (1.63)	1877
2125	246 (1.39)	1944	239 (1.54)	1774
2250	234 (1.31)	1839	227 (1.47)	1678
2375	223 (1.26)	1744	216 (1.39)	1592
2500	212 (1.20)	1657	206 (1.33)	1512
2625	203 (1.15)	1577	197 (1.27)	1440
2750	194 (1.10)	1504	189 (1.21)	1374

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2875	187 (1.05)	1438	181 (1.16)	1313
3000	180 (1.01)	1378	174 (1.12)	1258
3125	173 (0.98)	1323	168 (1.08)	1208
3250	167 (0.94)	1273	162 (1.04)	1163
3375	162 (0.91)	1227	157 (1.00)	1121
3500	157 (0.88)	1184	152 (0.97)	1082
3625	152 (0.86)	1146	148 (0.94)	1047
3750	148 (0.83)	1110	144 (0.92)	1014
3875	144 (0.81)	1077	140 (0.89)	984
4000	140 (0.79)	1046	137 (0.87)	956
4125	137 (0.77)	1017	133 (0.85)	930
4250	134 (0.75)	990	130 (.83)	905
4375	131 (0.74)	964	127 (0.81)	882
4500	128 (0.72)	939	124 (0.79)	859
4625	125 (0.70)	916	122 (0.77)	838
4750	122 (0.69)	893	119 (0.76)	818
4875	120 (0.67)	872	117 (0.74)	798
5000	117 (0.66)	850	114 (0.73)	778
5125	115 (0.65)	830	112 (0.71)	760
5250	112 (0.63)	810	110 (0.70)	741
5375	110 (0.62)	790	107 (0.68)	723
5500	108 (0.61)	771	105 (0.67)	706
5625	106 (0.59)	752	103 (0.65)	689
5750	104 (0.58)	734	101 (0.64)	673
5875	102 (0.57)	717	99 (0.63)	657
6000	100 (0.56)	701	97 (0.62)	642
6125	98 (0.55)	685	95 (0.61)	628
6250	96 (0.54)	671	94 (0.60)	615
6375	95 (0.53)	658	92 (0.59)	604
6500	93 (0.52)	647	91 (0.58)	593
6625	92 (0.52)	638	90 (0.57)	585
6750	91 (0.51)	631	89 (0.57)	578
6875	91 (0.51)	626	89 (0.56)	574
7000	91 (0.51)	624	88 (0.56)	573
7125	90 (0.51)	625	88 (0.56)	573
7250 Or More	90 (0.50)	625	88 (0.56)	573

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY VEHICLES

Test Weight	ASM5015	ASM2525
-------------	---------	---------

	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466

6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 & NEWER + TIER 1 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	2725	381 (4.85)	2587
1875	368 (3.34)	2649	359 (4.57)	2435
2000	348 (3.16)	2499	339 (4.31)	2295
2125	329 (2.99)	2360	321 (4.08)	2167
2250	312 (2.83)	2232	305 (3.86)	2050
2375	297 (2.69)	2115	290 (3.66)	1943
2500	283 (2.56)	2009	276 (3.48)	1845
2625	270 (2.44)	1912	263 (3.32)	1756
2750	258 (2.33)	1823	252 (3.17)	1675
2875	247 (2.23)	1742	241 (3.03)	1601
3000	237 (2.14)	1668	232 (2.91)	1533
3125	228 (2.06)	1601	223 (2.79)	1471
3250	220 (1.99)	1539	215 (2.69)	1415
3375	213 (1.92)	1483	208 (2.60)	1363
3500	206 (1.86)	1432	201 (2.51)	1316
3625	200 (1.80)	1384	195 (2.43)	1273
3750	194 (1.74)	1340	189 (2.36)	1233
3875	188 (1.69)	1300	184 (2.29)	1195

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4000	183 (1.65)	1262	179 (2.22)	1161
4125	179 (1.61)	1227	175 (2.16)	1126
4250	174 (1.56)	1194	170 (2.11)	1098
4375	170 (1.53)	1162	166 (2.06)	1069
4500	166 (1.49)	1132	162 (2.01)	1042
4625	162 (1.46)	1104	159 (1.96)	1015
4750	159 (1.42)	1076	155 (1.91)	990
4875	155 (1.39)	1049	152 (1.87)	966
5000	152 (1.36)	1023	148 (1.82)	942
5125	148 (1.33)	998	145 (1.78)	919
5250	145 (1.30)	974	142 (1.74)	896
5375	142 (1.27)	950	139 (1.70)	874
5500	139 (1.24)	926	136 (1.66)	853
5625	136 (1.12)	904	133 (1.62)	832
5750	133 (1.19)	882	130 (1.59)	812
5875	130 (1.16)	860	127 (1.55)	793
6000	127 (1.14)	840	124 (1.52)	774
6125	125 (1.11)	822	122 (1.49)	757
6250	123 (1.09)	804	120 (1.46)	741
6375	120 (1.07)	788	118 (1.43)	727
6500	119 (1.06)	775	116 (1.41)	714
6625	117 (1.04)	763	114 (1.39)	704
6750	116 (1.03)	755	113 (1.37)	696
6875	115 (1.02)	749	113 (1.36)	691
7000 Or More	115 (1.02)	747	112 (1.36)	689

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	2272	315 (3.64)	2114
1875	306 (2.63)	2181	297 (3.43)	1991
2000	289 (2.48)	2058	281 (3.24)	1877
2125	274 (2.35)	1944	267 (3.06)	1774
2250	260 (2.23)	1839	253 (2.90)	1678
2375	247 (2.12)	1744	241 (2.76)	1592
2500	236 (2.02)	1657	230 (2.62)	1512
2625	225 (1.92)	1577	219 (2.50)	1440
2750	216 (1.84)	1504	210 (2.39)	1374

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2875	207 (1.76)	1438	210 (2.29)	1313
3000	199 (1.69)	1378	194 (2.19)	1258
3125	191 (1.63)	1323	186 (2.11)	1208
3250	185 (1.57)	1273	180 (2.03)	1163
3375	179 (1.52)	1227	174 (1.96)	1121
3500	173 (1.47)	1184	169 (1.89)	1082
3625	168 (1.42)	1146	164 (1.84)	1047
3750	163 (1.38)	1110	159 (1.78)	1014
3875	159 (1.34)	1077	155 (1.73)	984
4000	155 (1.31)	1046	151 (1.68)	956
4125	151 (1.27)	1017	147 (1.64)	930
4250	147 (1.24)	990	143 (1.60)	905
4375	144 (1.21)	964	140 (1.56)	882
4500	141 (1.18)	939	137 (1.52)	859
4625	137 (1.15)	916	134 (1.48)	838
4750	134 (1.13)	893	131 (1.45)	818
4875	132 (1.10)	872	128 (1.42)	798
5000	129 (1.08)	850	126 (1.38)	778
5125	126 (1.05)	830	123 (1.35)	760
5250	123 (1.03)	810	120 (1.32)	741
5375	121 (1.01)	790	118 (1.29)	723
5500	118 (0.99)	771	115 (1.26)	706
5625	116 (0.97)	752	113 (1.24)	689
5750	113 (0.94)	734	111 (1.21)	673
5875	111 (0.92)	717	108 (1.18)	657
6000	109 (0.91)	701	106 (1.16)	642
6125	107 (0.89)	685	104 (1.13)	628
6250	105 (.087)	671	102 (1.11)	615
6375	103 (0.86)	658	101 (1.09)	604
6500	102 (0.84)	647	99 (1.08)	593
6625	101 (0.83)	638	98 (1.06)	585
6750	100 (0.82)	631	97 (1.05)	578
6875	99 (0.82)	626	97 (1.04)	574
7000	99 (0.82)	624	96 (1.04)	573
7125 Or More	98 (0.81)	625	96 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3750 LVW OR LESS)

Test Weight	ASM5015	ASM2525
-------------	---------	---------

	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311

6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2640
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4084	381 (4.85)	4005
1875	368 (3.34)	4054	359 (4.57)	3767
2000	348 (3.16)	3824	339 (4.31)	3548
2125	329 (2.99)	3609	321 (4.08)	3348
2250	312 (2.83)	3411	305 (3.86)	3165
2375	297 (2.69)	3231	290 (3.66)	2998
2500	283 (2.56)	3066	276 (3.48)	2845
2625	270 (2.44)	2916	263 (3.32)	2706
2750	258 (2.33)	2779	252 (3.17)	2579
2875	247 (2.23)	2654	241 (3.03)	2463
3000	237 (2.14)	2539	232 (2.91)	2357
3125	228 (2.06)	2435	223 (2.79)	2260
3250	220 (1.99)	2340	215 (2.69)	2172

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3375	213 (1.92)	2253	208 (2.60)	2092
3500	206 (1.86)	2174	201 (2.51)	2018
3625	200 (1.80)	2100	195 (2.43)	1950
3750	194 (1.74)	2033	189 (2.36)	1887
3875	188 (1.69)	1970	184 (2.29)	1829
4000	183 (1.65)	1912	179 (2.22)	1775
4125	179 (1.61)	1857	175 (2.16)	1724
4250	174 (1.56)	1806	170 (2.11)	1677
4375	170 (1.53)	1757	166 (2.06)	1632
4500	166 (1.49)	1711	162 (2.01)	1589
4625	162 (1.46)	1666	159 (1.96)	1548
4750	159 (1.42)	1624	155 (1.91)	1508
4875	155 (1.39)	1583	152 (1.87)	1470
5000	152 (1.36)	1542	148 (1.82)	1433
5125	148 (1.33)	1503	145 (1.78)	1397
5250	145 (1.30)	1465	142 (1.74)	1362
5375	142 (1.27)	1428	139 (1.70)	1327
5500	139 (1.24)	1392	136 (1.66)	1294
5625	136 (1.12)	1357	133 (1.62)	1261
5750	133 (1.19)	1323	130 (1.59)	1230
5875	130 (1.16)	1290	127 (1.55)	1199
6000	127 (1.14)	1259	124 (1.52)	1171
6125	125 (1.11)	1230	122 (1.49)	1144
6250	123 (1.09)	1203	120 (1.46)	1119
6375	120 (1.07)	1179	118 (1.43)	1096
6500	119 (1.06)	1158	116 (1.41)	1077
6625	117 (1.04)	1140	114 (1.39)	1060
6750	116 (1.03)	1127	113 (1.37)	1048
6875	115 (1.02)	1118	113 (1.36)	1040
7000 Or More	115 (1.02)	1115	112 (1.36)	1037

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3631	315 (3.64)	3532
1875	306 (2.63)	3586	297 (3.43)	3323
2000	289 (2.48)	3383	281 (3.24)	3131
2125	274 (2.35)	3192	267 (3.06)	2955

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	260 (2.23)	3018	253 (2.90)	2794
2375	247 (2.12)	2859	241 (2.76)	2646
2500	236 (2.02)	2714	230 (2.62)	2512
2625	225 (1.92)	2581	219 (2.50)	2389
2750	216 (1.84)	2460	210 (2.39)	2277
2875	207 (1.76)	2350	210 (2.29)	2175
3000	199 (1.69)	2249	194 (2.19)	2082
3125	191 (1.63)	2157	186 (2.11)	1997
3250	185 (1.57)	2073	180 (2.03)	1920
3375	179 (1.52)	1997	174 (1.96)	1849
3500	173 (1.47)	1926	169 (1.89)	1784
3625	168 (1.42)	1862	164 (1.84)	1724
3750	163 (1.38)	1802	159 (1.78)	1669
3875	159 (1.34)	1747	155 (1.73)	1618
4000	155 (1.31)	1695	151 (1.68)	1570
4125	151 (1.27)	1647	147 (1.64)	1526
4250	147 (1.24)	1602	143 (1.60)	1484
4375	144 (1.21)	1559	140 (1.56)	1444
4500	141 (1.18)	1518	137 (1.52)	1406
4625	137 (1.15)	1479	134 (1.48)	1370
4750	134 (1.13)	1441	131 (1.45)	1336
4875	132 (1.10)	1405	128 (1.42)	1302
5000	129 (1.08)	1369	126 (1.38)	1269
5125	126 (1.05)	1335	123 (1.35)	1237
5250	123 (1.03)	1031	120 (1.32)	1206
5375	121 (1.01)	1269	118 (1.29)	1176
5500	118 (0.99)	1237	115 (1.26)	1147
5625	116 (0.97)	1206	113 (1.24)	1118
5750	113 (0.94)	1176	111 (1.21)	1090
5875	111 (0.92)	1147	108 (1.18)	1064
6000	109 (0.91)	1120	106 (1.16)	1039
6125	107 (0.89)	1094	104 (1.13)	1015
6250	105 (.087)	1070	102 (1.11)	993
6375	103 (0.86)	1049	101 (1.09)	973
6500	102 (0.84)	1030	99 (1.08)	956
6625	101 (0.83)	1014	98 (1.06)	941
6750	100 (0.82)	1003	97 (1.05)	931
6875	99 (0.82)	995	97 (1.04)	924
7000	99 (0.82)	992	96 (1.04)	921

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	98 (0.81)	992	96 (1.04)	921

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3178	315 (3.64)	3060
1875	306 (2.63)	3117	297 (3.43)	2879
2000	289 (2.48)	2941	281 (3.24)	2713
2125	274 (2.35)	2776	267 (3.06)	2561
2250	260 (2.23)	2625	253 (2.90)	2422
2375	247 (2.12)	2487	241 (2.76)	2295
2500	236 (2.02)	2361	230 (2.62)	2179
2625	225 (1.92)	2246	219 (2.50)	2073
2750	216 (1.84)	2142	210 (2.39)	1976
2875	207 (1.76)	2046	210 (2.29)	1888
3000	199 (1.69)	1959	194 (2.19)	1808
3125	191 (1.63)	1879	186 (2.11)	1734
3250	185 (1.57)	1806	180 (2.03)	1667
3375	179 (1.52)	1740	174 (1.96)	1606
3500	173 (1.47)	1679	169 (1.89)	1550
3625	168 (1.42)	1623	164 (1.84)	1498
3750	163 (1.38)	1571	159 (1.78)	1451
3875	159 (1.34)	1523	155 (1.73)	1407
4000	155 (1.31)	1479	151 (1.68)	1365
4125	151 (1.27)	1437	147 (1.64)	1327
4250	147 (1.24)	1398	143 (1.60)	1291
4375	144 (1.21)	1360	140 (1.56)	1257

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4500	141 (1.18)	1325	137 (1.52)	1224
4625	137 (1.15)	1291	134 (1.48)	1193
4750	134 (1.13)	1259	131 (1.45)	1163
4875	132 (1.10)	1227	128 (1.42)	1134
5000	129 (1.08)	1196	126 (1.38)	1106
5125	126 (1.05)	1167	123 (1.35)	1078
5250	123 (1.03)	1138	120 (1.32)	1051
5375	121 (1.01)	1109	118 (1.29)	1025
5500	118 (0.99)	1082	115 (1.26)	1000
5625	116 (0.97)	1055	113 (1.24)	975
5750	113 (0.94)	1029	111 (1.21)	951
5875	111 (0.92)	1004	108 (1.18)	928
6000	109 (0.91)	980	106 (1.16)	906
6125	107 (0.89)	958	104 (1.13)	886
6250	105 (.087)	937	102 (1.11)	867
6375	103 (0.86)	919	101 (1.09)	850
6500	102 (0.84)	902	99 (1.08)	835
6625	101 (0.83)	889	98 (1.06)	823
6750	100 (0.82)	879	97 (1.05)	813
6875	99 (0.82)	872	97 (1.04)	807
7000	99 (0.82)	870	96 (1.04)	805
7125 Or More	98 (0.81)	870	96 (1.04)	805

U. S. EPA REVISED FINAL ASM EMISSION STANDARDS (ASM5015 & ASM2525)

NOTE: EPA has not published a revised final standards for High Altitude, Light Duty Trucks 2 (6000-8500 GVWR), or vehicles older than 1980 model year. EPA guidance as of February 2003 states that a program may choose to use combinations of the Original and the Revised Final Standards.

U.S. EPA REVISED FINAL ASM EMISSION STANDARDS

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
Passenger Cars				
1980	275 (1.3)	8500	500 (2.3)	4750
1981-82	275 (1.3)	3600	500 (2.3)	3500

Application	ASM5015		ASM2525	
HC ppm (CO %)		NOx ppm	HC ppm (CO %)	NOx ppm
1983-89	275 (1.1)	3600	500 (1.6)	3500
1990 & Newer	275 (1.1)	3600	300 (1.6)	3500
Light Duty Trucks (Less Than 6000 GVWR)				
1980-83	1140 (9.7)	14,145	340 (23.28)	32,200
1984-87	537 (5.4)	14,145	160 (12.96)	32,200
1988-95	537 (5.4)	7380	160 (12.96)	16,800
1996 & Newer	275 (1.1)	6150	82 (4.40)	14,000

U.S. EPA IM240 EMISSION STANDARDS

START-UP STANDARDS

Start-up standards should be used during the first 2 years of program operation. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles certified to Tier 1 standards as well.

U.S. EPA IM240 HYDROCARBONS EMISSION START-UP STANDARDS

Application	Hydrocarbons (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	0.80	0.50
1991-95	1.20	0.75
1983-90	2.00	1.25
1980-82	2.00	1.25
1975-79	7.50	5.00
1968-74	10.0	6.00
High Altitude Light Duty Vehicles		
1983-84	2.00	1.25
1982	2.00	1.25
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.80	0.50
1996 & Newer (More Than 3750 LVW)	1.00	0.63
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00

Application	Hydrocarbons (Grams/Mile)	
Composite		Phase 2
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.00	0.63
1996 & Newer (More Than 5750 ALVW)	2.40	1.50
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	3.00	1.90
1985-86	5.00	3.10
1979-84	6.00	3.80
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION START-UP STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite		Phase 2
Light Duty Vehicles		
1996 & Newer	15.0	12.0
1991-95	20.0	16.0
1983-90	30.0	24.0
1980-82	60.0	48.0
1975-79	90.0	72.0
1968-74	150.0	120.0
High Altitude Light Duty Vehicles		
1983-84	60.0	48.0
1982	75.0	60.0
Light Duty Trucks (0-6000 Lbs. GVWR)		

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	
1996 & Newer (Less Than 3750 LVW)	15.0	12.0
1996 & Newer (More Than 3750 LVW)	20.0	16.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	20.0	16.0
1996 & Newer (More Than 5750 ALVW)	60.0	48.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	60.0	48.0
1985-86	75.0	60.0
1979-84	100.0	80.0
1974-78	150.00	120.0
1970-73	175.00	140.00
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION START-UP STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	2.0	2.0
1991-95	2.5	2.5
1981-90	3.0	3.0
1977-80	6.0	6.0

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
1973-76	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Vehicles		
1982-84	3.0	3.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	2.0	2.0
1996 & Newer (More Than 3750 LVW)	2.5	2.5
1991-95	3.0	3.0
1988-90	3.5	3.5
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.0	3.0
1988-90	3.5	3.5
1982-87	7.0	7.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	2.5	2.5
1996 & Newer (More Than 5750 ALVW)	4.0	4.0
1991-95	4.5	4.5
1988-90	5.0	5.0
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	4.5	4.5
1988-90	5.0	5.0
1982-87	7.0	7.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	6.0	6.0
1979-90	8.0	8.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

FINAL STANDARDS

Final standards are recommended for vehicles tested in calendar years 1997 and later. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles.

U.S. EPA IM240 HYDROCARBONS EMISSION FINAL STANDARDS

Application	Hydrocarbons (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	0.60	0.40
1980-95	0.80	0.50
1975-79	3.00	2.00
1968-74	7.00	4.50
High Altitude Light Duty Vehicles		
1982-84	1.20	0.75
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.60	0.40
1996 & Newer (More Than 3750 LVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	0.80	0.50
1996 & Newer (More Than 5750 ALVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	2.00	1.30
1985-86	3.00	1.90
1979-84	5.00	3.10
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION FINAL STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	10.0	8.0
1983-95	15.0	12.0
1980-82	30.0	24.0
1975-79	65.0	52.0
1968-74	120.0	96.0
High Altitude Light Duty Vehicles		
1983-84	30.0	24.0
1982	45.0	36.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	10.0	8.0
1996 & Newer (More Than 3750 LVW)	13.0	10.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	60.0	48.0
1984-87	60.0	48.0
1982-83	90.0	72.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	13.0	10.0
1996 & Newer (More Than 5750 ALVW)	15.0	12.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1984 & Newer	60.0	48.0
1982-83	90.0	72.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	40.0	32.0
1985-86	50.0	40.0
1979-84	75.0	60.0
1974-78	150.0	120.0
1970-73	175.0	140.0
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION FINAL STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	1.5	1.5
1981-95	2.0	2.0
1977-80	4.0	4.0
1973-76	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Vehicles		
1982-84	2.0	2.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	1.5	1.5
1996 & Newer (More Than 3750 LVW)	1.8	1.8
1988-95	2.5	2.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.5	2.5
1982-87	4.5	4.5
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.8	1.8
1996 & Newer (More Than 5750 ALVW)	2.0	2.0
1988-95	3.5	3.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	3.5	3.5
1982-87	4.5	4.5
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	5.0	5.0
1979-90	6.0	6.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

Article GUID: A00157750

GENERAL INFORMATION
State Emission Standards

ARIZONA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL OPACITY LOADED CRUISE TEST)

Application		Altitude (Feet)	Opacity (% For 10 Seconds)
Light Duty Vehicles (8500 GVWR Or Less)			
All Years		Less Than 2000	20 Or Less
Â	Â	2001-4000	30 Or Less
Â	Â	Greater Than 4000	40 Or Less

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL J1667 SNAP IDLE TEST)

Application		Altitude (Feet)	Opacity (% For 10 Seconds)
Heavy Duty Vehicles (8500 GVWR Or Greater)			
1990 & Earlier		All	55
1991 & Newer		All	40

COLORADO

COLORADO EMISSION STANDARDS - DIESEL OPACITY

Application		Opacity %
14,000 GVWR Or Less		
Non-Turbo		40
Turbo		35
14,000 GVWR Or More		
Non-Turbo		35
Turbo		20

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - DIESEL OPACITY

Application		Opacity %
10,000 GVWR Or Less		
1979 & Newer		20
26,000 GVWR Or More		

Application	Opacity %
1974 & Earlier	70
1974-90	55
1991 & Newer	40

IDAHO

IDAHO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
All Weight Range	
1965-74	70
1975-91	55
1992 & Newer	40

KENTUCKY

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (DIESEL OPACITY)

Application	Opacity
18,000 GVWR Or Less	
All Years	10% @ Idle

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
Light Duty (8500 GVWR Or Less)	
1984 & Newer	20
Light Duty (8501-10,000 GVWR Or Less)	
1984 & Newer	40
Heavy Duty Buses (10,000 GVWR Or More)	
1984-93	40
1994 & Newer	30
Heavy Duty Trucks (10,000 Or Less GVWR)	
1984-90	55
1991 & Newer	40

NEW YORK

NEW YORK EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Heavy Duty Vehicles (8500 GVWR Or More)	
1973 & Earlier	70
1974-90	55

Application	Opacity %
1991 & Newer	40

OHIO

OHIO EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel	20

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
All Model Years (8500 GVWR Or Less)	20

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel - Turbo (16,000 GVWR Or Less)	30
Light Duty Diesel - Non-Turbo (16,000 GVWR Or Less)	35
Heavy Duty Diesel (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - UTAH COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

WASHINGTON

WASHINGTON EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel (8500 GVWR Or Less)	
All Model Years	20
Heavy Duty Diesel (8500 GVWR Or More)	
1991 & Earlier	55
1992 & Newer	40

ELECTRICAL

12 V Starting and Charging - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Battery Hold Down Retainer Bolt	18 N.m (13 lb ft)
Battery Negative Ground Cable Bolt	22 N.m (16 lb ft)
Battery Negative Pole Clamp Nut	9 N.m (80 lb in)
Battery Positive and Negative Cable (Accessory Power Module Ground Cable) Bolt	22 N.m (16 lb ft)
Battery Positive and Negative Cable (APM Ground Cable) Nut	22 N.m (16 lb ft)
Battery Positive and Negative Cable (B+ APM Module to Battery Fuse Block) Nut (APM Module Side)	22 N.m (16 lb ft)
Battery Positive and Negative Cable (B+ APM Module to Battery Fuse Block) Nut (Fuse Block Side)	15 N.m (11 lb ft)
Battery Positive Cable Fuse Block Nut	9 N.m (80 lb in)
Battery Positive Pole Clamp Nut	9 N.m (80 lb in)
Engine Ground Strap Bolt	25 N.m (18 lb ft)
Engine Wiring Harness Junction Block Bolt	7 N.m (62 lb in)
Engine Wiring Harness Junction Block Supply Nut (M5)	4.7 N.m (42 lb in)
Engine Wiring Harness Junction Block Supply Nut (M8)	9 N.m (80 lb in)
Panel Trim Nut	6 N.m (13 lb in)

SCHEMATIC WIRING DIAGRAMS

STARTING AND CHARGING WIRING SCHEMATICS

12V Battery Management

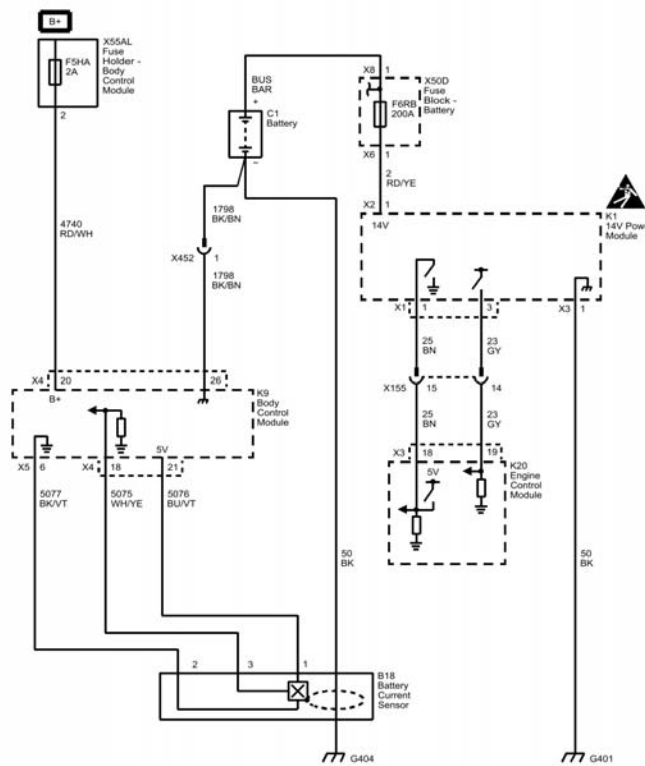


Fig. 1: 12V Battery Management

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, OR P1EFC: DEVICE POWER CIRCUIT/BATTERY VOLTAGE/SYSTEM VOLTAGE/BATTERY/ ENERGY CONTROL MODULE SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1325 03

Device Power Circuit Voltage Below Threshold

DTC B1325 07

Device Power Circuit Voltage Above Threshold

DTC B1330 03

Device Power 2 Circuit Voltage Below Threshold

DTC B1330 04

Device Power 2 Circuit Voltage Open Circuit

DTC B1517 03

Battery Voltage Below Threshold

DTC B1517 07

Battery Voltage Above Threshold

DTC B1517 5A

Battery Voltage Plausibility Failure

DTC C0800 03

Device Power 1 Circuit Voltage Below Threshold

DTC C0800 07

Device Power 1 Circuit Voltage Above Threshold

DTC C0800 11

Device Power 1 Circuit High Input

DTC C0800 0D

Device Power 1 Circuit High Resistance

DTC C0899 00

Device Voltage Low

DTC C0899 03

Device Voltage Low

DTC C0900 00

Device Voltage High

DTC C0900 07

Device Voltage Above Threshold

DTC C12E1

Electronic Brake Control Module Supply Circuit Low Voltage

DTC C12E2

Electronic Brake Control Module Supply Circuit High Voltage

DTC P0561

System Voltage Performance

DTC P0562

System Voltage Low Voltage

DTC P0563

System Voltage High Voltage

DTC P1A0C

Battery Energy Control Module System Voltage Low Voltage

DTC P1A0D

Battery Energy Control Module System Voltage High Voltage

DTC P1EFC

Battery Charger Control Module System Voltage Low Voltage

Circuit/System Description

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 9 V or greater than 18 V for approximately 5 seconds.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the 12 V charging system.
- A possible cause of this DTC could be overcharging with a 12 V battery charger or jump starting.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF, disconnect the drive motor battery charger cable from the X98 Hybrid/EV Battery Charger Receptacle. Measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.
 - **If battery voltage is less than 12.4 V or more than 12.8 V**

Refer to Battery Inspection/Test.

- **If battery voltage is between 12.4 and 12.8 V**
3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
 4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
 - **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

Refer to DC Power Conversion Test .

- **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**
5. Verify the appropriate control module battery voltage and ignition voltage parameters are available in the scan tool.
 - **If parameters are not available in the scan tool**

Refer to Circuit/System Testing

- **If parameters are available in the scan tool**

6. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing

- **If within 1 V of the battery voltage**

7. All OK.

Circuit/System Testing

NOTE: Use the schematic to identify the following:

- **Control modules the vehicle is equipped with**
- **The control module's ground, B+, and Ignition circuit terminal IDs and connectors**

NOTE: Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 10 Ω . In most cases the readings will drop below 20 Ω within 1 min indicating the control module is going to sleep.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the appropriate control module.

- **If the test lamp illuminates**

4. Ignition ON.

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the appropriate control module.

- **If the test lamp illuminates**

6. Replace the control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup

DTC B1516: BATTERY CURRENT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B1516 08

Battery Current Sensor Signal Invalid

DTC B1516 66

Battery Current Sensor Wrong Mounting Position

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1516 08	B1516 08	B1516 08	-
Signal	B1516 08	B1516 08	B1516 08	B1516 08, B1516 66
Low Reference	-	B1516 08	-	-

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The body control module (BCM) supplies 5 V and ground to the battery current sensor. The battery current sensor measures the amount of current flowing to or from the battery, and supplies a pulse width modulation (PWM) signal to the BCM.

Conditions for Running the DTC

B1516 08

The BCM is awake.

B1516 66

- The BCM is awake.
- The engine is OFF.

Conditions for Setting the DTC

B1516 08

The battery current signal is less than 4 percent or greater than 96 percent duty cycle for 2 minutes.

B1516 66

The battery current polarity is positive for 2 minutes.

Action Taken When the DTC Sets

The regulated voltage control (RVC) is disabled.

Conditions for Clearing the DTC

The DTC passes when the battery current returns to the normal range for 15 seconds.

Diagnostic Aids

DTC B1516 08 could be set by overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

B1516 08

1. Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the B18 Battery Current Sensor.
It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal 2 and ground.
 - **If 30 Ω or greater**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If less than 30 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

• **If between 4.8 - 5.2 V**

6. Test or replace the B18 Battery Current Sensor.

B1516 66

1. Verify that the B18 Battery Current Sensor is installed securely around the negative battery cable, with the tape tab pointing away from the negative terminal on the C1 Battery.

• **If the B18 Battery Current sensor is not installed correctly**

Remove and reinstall the B18 Battery Current Sensor properly.

• **If the B18 Battery Current Sensor is installed correctly**

2. Replace the B18 Battery Current Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for BCM replacement, setup, and programming

DTC B151A: LOW BATTERY CAPACITY DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B151A 58

Low Battery Capacity Detected

Circuit/System Description

The body control module (BCM) monitors the battery voltage level during an engine crank event to detect a low battery voltage condition.

Conditions for Running the DTC

The vehicle is ON

Conditions for Setting the DTC

A minimum crank battery voltage is less than the minimum crank battery voltage threshold for 16 consecutive crank events.

Action Taken When the DTC Sets

A driver information center message is displayed.

Conditions for Clearing the DTC

The DTC will clear if the minimum crank voltage is greater than the minimum crank voltage threshold during a crank event.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Refer to the Battery Inspection/Test.
- Refer to the Charging System Test.

DTC B1527: PARASITIC LOAD

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1527 00

Parasitic Load

Circuit/System Description

The body control module (BCM) monitors the state of charge of the electrical system.

Conditions for Running the DTC

The ignition is in Accessory or Run mode.

Conditions for Setting the DTC

The state of charge at ignition ON is 30% lower than when the engine was running and battery drain is more than 2 A.

Action Taken When the DTC Sets

There is no battery telltale illuminated or DIC message displayed.

Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run state of charge is greater than or equal to 80%.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Refer to **Battery Electrical Drain/Parasitic Load Test**.

DTC P0A8D: 14V POWER MODULE SYSTEM VOLTAGE LOW VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A8D

14V Power Module System Voltage Low Voltage

Circuit/System Description

The 14V power module, often referred to as the accessory DC power control module, converts the high voltage (360V) direct current (DC) to low voltage (14V) DC to charge the 12V battery and to operate the power accessories. The ECM controls the 14V power module by supplying a 5V pulse width modulated (PWM) signal through a control circuit. The ECM monitors 12V battery voltage to ensure the 14V power module is maintaining the desired voltage.

Conditions for Running the DTC

14V power module is commanded ON.

Conditions for Setting the DTC

The ECM monitored battery voltage is less than or equal to 11V for 8 s within a 10 s window.

Action Taken When the DTC Sets

- The charge indicator is illuminated.
- The 14V power module stops supplying power to the 12V system.
- DTC P0A8D is a Type C DTC.

Conditions for Clearing the DTC

DTC P0A8D is a Type C DTC.

Diagnostic Aids

An improperly fastened 200-amp in-line mega-fuse may cause this DTC to set.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- If the DTC is not set

2. Perform the [DC Power Conversion Test](#) .

DTC P1F5D OR P1F5E: 14 VOLT POWER MODULE L-TERMINAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1F5D

14 Volt Power Module L-Terminal Circuit Low Voltage

DTC P1F5E

14 Volt Power Module L-Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module. The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14V power module. The duty cycle controls the 14V power module output. The ECM monitors the state of the 14V power module control circuit. The ECM will detect faults on the 14V power module control circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5D: The ECM detects a low voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.
- P1F5E: The ECM detects a high voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.

Action Taken When the DTC Sets

DTCs P1F5D and P1F5E are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F5D and P1F5E are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [Hybrid/EV Controls Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#) for Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Do not have a 12V battery charger connected during the testing.

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K1 14V Power Module, Vehicle On
2. Test for 3.0 - 5.5 V between the signal circuit terminal 1 X1 and ground.

- **If less than 3.0 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If greater the 2 Ω , repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.

- **If greater than 5.5 V**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit 1 X1 and ground.

- If greater than 1 V, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

- **If between 3.0 - 5.5 V**

3. Test or replace the K1 14V Power Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming, and setup

DTC P1F59, P1F5A, OR P1F5B: 14 VOLT POWER MODULE STATUS TERMINAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1F59

14 Volt Power Module Status Terminal Circuit Performance

DTC P1F5A

14 Volt Power Module Status Terminal Circuit Low Voltage

DTC P1F5B

14 Volt Power Module Status Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14V power module applies a duty cycled voltage to the ECM. The duty cycle indicates 14V power module internal temperature and operational condition. The ECM will detect faults on the 14V power module status circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5A: The ECM detects a 5% or lower PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F5B: The ECM detects a 96% or higher PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F59: The status circuit PWM signal is not in a valid range.

Action Taken When the DTC Sets

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Reference Information

Schematic Reference

- [Starting and Charging Schematics](#)
- [Hybrid/EV Controls Schematics](#)
- [Hybrid/EV Energy Storage Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle OFF. Connect the vehicle to an AC supply to begin charging
2. Vehicle in Service Mode
3. Verify that DTC P0D26 is not set and that the vehicle will charge
 - **If the DTC is set or the vehicle will not charge**

Refer to DTC P0D26

- **If the DTC is not set**

NOTE: Do not have a 12V battery charger connected during the testing.

- 4.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing, specific to the DTC(s) set
 - **If the DTC does not set**
7. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

- 1.

DTC P1F5A or P1F5B, without P1F59 Diagnosis

1. Vehicle OFF, disconnect the X3 harness connector at the K20 Engine Control Module, Vehicle On
2. Test for 4.6 V - 7.0 V between the signal circuit terminal 19 X3 and ground.
 - **If less than 4.6 V**
 1. Vehicle OFF, disconnect the harness connector at the K1 14V Power Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If greater the 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K1 14V Power Module.
 - **If greater than 7.0 V**
 1. Vehicle OFF, disconnect the harness connector at the K1 14V Power Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit 19 X3 and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K1 14V Power Module..
 - **If between 4.6 V - 7.0 V**
 3. Test or replace the K20 Engine Control Module.

DTC P1F59 Diagnosis

NOTE: You must perform Circuit/System Verification first

1. Disable the high voltage system for servicing the T18 Battery Charger, K1 14V Power Module and the A4 Hybrid/EV Battery Pack. Refer to High Voltage Disabling
2. Disconnect the X3 connector at the T18 Battery Charger, the X4 connector at the K1 14V Power Module and the X6 connector at the A28 Hybrid/EV Battery Contactor Assembly
3. Verify that all HV harness connector and the mating module connector terminals are free from moisture, corrosion, and arc flash damage.

- **If any terminals show signs of damage**

Replace the HV wiring harness and affected modules as necessary

- **If no arc flash damage, moisture, or corrosion is found**

4. Test the following HV harness terminals for less than 2 Ω end to end:

- X6-1 to X4-B
- X6-1 to X3-1
- X6-2 to X4-A
- X6-2 to X3-2

- **If greater than 2 Ω**

Replace the HV wiring harness

- **If less than 2 Ω**

Replace the K1 14V Power Module

5. Enable high voltage. Refer to High Voltage Enabling
6. Verify the DTC does not set

- **If the DTC sets**

Replace the K20 Engine Control Module

- If the DTC does not set

7. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Charger Receptacle, Accessory DC Power Control Module, and Drive Motor Battery Charger

[Control Module References](#) for control module replacement, programming, and setup

DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, OR U3500-U350B: BATTERY VOLTAGE/CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC U3001

Control Module Improper Shutdown

DTC U3003

Battery Voltage

DTC U3006

Control Module Input Power 1

DTC U3007

Control Module Supply Circuit 2

DTC U3008

Control Module Ground 1

DTC U3009

Control Module Ground 2

DTC U3013

Control Module Input Power 3

DTC U3014

Control Module Input Power 4

DTC U3018

Control Module Supply Circuit 1-2 Not Plausible

DTC U3019

Control Module Supply Circuit 3-4 Not Plausible

DTC U3500

Control Module Input Power "A" Circuit Range/Performance

DTC U3501

Control Module Supply Circuit 1 Low Voltage

DTC U3502

Control Module Supply Circuit 1 High Voltage

DTC U3503

Control Module Input Power "A" Circuit Intermittent/Erratic

DTC U3504

Control Module Input Power "B" Circuit Range/Performance

DTC U3505

Control Module Supply Circuit 2 Low Voltage

DTC U3506

Control Module Supply Circuit 2 High Voltage

DTC U3507

Control Module Input Power "B" Circuit Intermittent/Erratic

DTC U3508

Control Module Input Power "C" Circuit Range/Performance

DTC U3509

Control Module Supply Circuit 3 Low Voltage

DTC U350A

Control Module Supply Circuit High Voltage

DTC U350B

Control Module Input Power "C" Circuit Intermittent/Erratic

Circuit/System Description

The vehicle control module monitors the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 7.5 V or greater than 16 V for approximately 5 seconds.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the 12 V charging system.
- A possible cause of this DTC could be overcharging with a 12 V battery charger or jump starting.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF, disconnect the drive motor battery charger cable from the X98 Hybrid/EV Battery Charger Receptacle. Measure and record the 12 V battery voltage at the battery terminals. The battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the Vehicle OFF.
 - **If battery voltage is not between 12.4 and 12.8 V**

Refer to [Battery Inspection/Test](#).
 - **If battery voltage is between 12.4 and 12.8 V**
2. Vehicle ON, accessories OFF, measure and record the battery voltage at the battery terminals.
3. Verify the voltage is at least 1 V greater than the minimum voltage measured in step 1, but less than 15 V.
 - **If the voltage is not at least 1 V greater than the minimum voltage measured in step 1 or is greater than 15 V.**

Refer to [DC Power Conversion Test](#).
 - **If the voltage is at least 1 V greater than the minimum voltage measured in step 1, but less than 15 V.**
4. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.
 - **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing.
 - **If within 1 V of the battery voltage**
5. All OK.

Circuit/System Testing

NOTE: Use the schematic to identify the following:

- **Which control modules the vehicle is equipped with**
 - **The control modules ground, B+, and Ignition circuit terminal IDs and connectors**
1. Vehicle OFF, and all vehicle systems off, disconnect the scantool and harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.
 2. Test for less than 10 Ω between each ground circuit terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 3. Verify a test lamp illuminates between each B+ circuit terminal and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.

• **If the test lamp illuminates**

4. Vehicle ON.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , refer to [Power Mode Mismatch](#).

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the appropriate control module.

• **If the test lamp illuminates**

6. Replace the appropriate control module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming and setup.

SYMPTOMS - ENGINE ELECTRICAL

The following steps must be completed before using the symptom tables.

- Perform [Diagnostic System Check - Vehicle](#) before using the Symptom Tables in order to verify that all of the following are true:
 - The power modes are correct.
 - The control modules can communicate via the serial data link.
 - There are no DTCs set.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
 - [Battery Description and Operation](#)
 - [Charging System Description and Operation](#)

- **Starting System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the 12 V charging system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Battery Inspection/Test**
- **Battery Charging**
- **Battery Electrical Drain/Parasitic Load Test**
- **Charging System Test**

BATTERY INSPECTION/TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

NOTE: For Warranty repairs -

You must use regionally required battery test equipment for warranty repairs.

For accurate test results the battery must be disconnected from the vehicle and the equipment connected directly to the battery posts. When setting up the equipment, select "Out of Vehicle" and then the correct battery type (Flooded, AGM or Stop/Start AGM) and rated CCA (both from the battery label) must be entered.

- **Failure to obtain the correct connections during the test may result in a failed test on a good battery.**
- **Use the Out of Vehicle test (battery disconnected with test equipment connected directly to the posts) for each battery when testing a vehicle with dual batteries.**

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Starting System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL 50313 Battery Tester For equivalent regional tools, refer to [Special Tools](#)

Circuit/System Testing

WARNING: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

1. Verify the C1 Battery or C1B Battery - Auxiliary (if equipped) case is not cracked, broken, or damaged, which may be indicated by battery acid leakage.
 - If there is any apparent damage

Replace the C1 Battery or C1B Battery - Auxiliary.

- **If there is no damage**

2. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in [Fastener Specifications](#).

- **If the battery cables need to be cleaned or tightened**

Clean as required and tighten as specified.

- **If the battery cables are clean and tight**

3. Disconnect battery from the vehicle. There is no need to remove the battery from the vehicle.
4. Connect the EL-50313 directly to the battery terminal posts.
5. Select "Charging," "Diagnostic" and "Out of Vehicle" when setting up the test.
6. Select the proper battery type, Flooded, AGM or Stop/Start AGM.
7. Enter the CCA as shown on the battery label.
8. Verify the test result is not REPLACE BATTERY or BAD CELL-REPLACE

NOTE: Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the Out of Vehicle test.

- **If the test result is REPLACE BATTERY or BAD CELL-REPLACE**

Replace the C1 Battery or C1B Battery - Auxiliary.

- **If the test result is not REPLACE BATTERY or BAD CELL-REPLACE**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Battery Replacement

BATTERY CHARGING

12 V Battery

The following procedure is for the 12 V battery only.

Special Tools

EL 50313 Midtronics GR8 Battery Tester Charger

For equivalent regional tools, refer to [Special Tools](#).

Diagnostic Aids

NOTE: This vehicle is equipped with an Absorbent Glass Matt Battery. This type of battery

requires different charging and testing parameters than the more common regular flooded lead acid type battery. ANY time you perform charging and or testing you MUST set up the charging/testing equipment or permanent damage to the battery may result.

- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the EL 50313 before charging.
- An AGM battery may be damaged if charged to more than 14.5 V.
- A Flooded Cell battery may be damaged if charged to more than 16.5 V.
- Vehicles with dual batteries must be charged individually which will result in two printouts.

Battery State of Charge

NOTE: Using voltage to determine the battery's state of charge is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery state of charge will only be an estimate.

The maintenance-free batteries state of charge is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the battery's state of charge:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
 - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
 - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

NOTE: The table is accurate to 10 percent only after the battery has been at rest for 12 hours.

4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the state of charge according to the estimated battery temperature:

Battery Voltage	% Charge at 0Â°C (32Â°F)	% Charge at 25Â°C (75Â°F)
12.75 V	100%	100%
12.7 V	100%	90%
12.6 V	90%	75%
12.45 V	75%	65%
12.2 V	65%	45%
12.0 V	40%	20%

Use the state of charge information as follows:

- A battery with a state of charge that is below 65 percent must always be recharged before returning it to service or continuing storage.
- A battery with a state of charge that is 65 percent or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90 percent, before returning it to service or continuing storage.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity - The higher the charger amperage, the less time it will take to charge the battery.
- The state of charge of the battery - A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 V, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery - The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

CAUTION: Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the ECM/PCM or other electronic components.

CAUTION: Refer to [Fastener Caution](#) .

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

Use the following procedure to charge the battery:

1. Ensure that all of the battery terminal connections are clean and tight.
2. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

CAUTION: Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.

3. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
4. Select "Charging," "PDI" and "In Vehicle" when setting up the charger.

5. Select the proper battery type, Flooded, AGM, Spiral AGM or Stop/Start AGM.
6. Enter the CCA as shown on the battery label.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

12 V Battery

The following procedure is for the 12 V battery only.

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

Components most likely to cause a parasitic draw on the vehicle's battery are switches, relays, and control modules. After the vehicle is turned OFF the control modules will begin to go to sleep (shut OFF). All control modules do not go to sleep at the same time, some may take up to 30 minutes or longer after turning the Vehicle OFF before going to sleep, like the HVAC and body control modules. Others such as the telematics communication interface control module and remote control door lock receiver may periodically wake up then go back to sleep. These are all normal conditions.

Diagnostic Aids

- Rule out any possible aftermarket equipment causing an unacceptable parasitic current drain. Aftermarket accessories installed into the courtesy lamp circuit can cause the inadvertent power timer in the body control module (BCM) to keep resetting. This would cause the BCM to remain awake and cause a current drain on the battery.
- Rule out customer driving habits such as regular short trips that do not allow enough time to properly charge the battery. Refer to [Battery Description and Operation](#).
- Verify that the battery and charging system are in proper working order. Refer to [Battery Charging](#), and [Charging System Test](#).
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStar[®], and regulated voltage control, if equipped, are designed to wake-up, perform a task, and go back asleep at regular intervals. Refer to [Body Control System Description and Operation](#) for the system or modules description and operation.
- An engine off natural vacuum evaporative test can occur if the engine control module (ECM) determines the drive cycle has met the appropriate criteria immediately after key off. The ECM will stay awake and the vent solenoid will stay energized for as long as 45 minutes. The typical current draw for this is about 1 A.
- The telematics communication interface control module current draw is very low, less than 40 mA, so the OnStar system is left in that "awake" state for up to the first 48 hours. Parasitic draw of up to 40 mA with an occasional spike as high as 80 mA through the telematics communication interface control module for the first 48 hours is normal.
- Some automatic climate control systems can remain in a semi-awake state for up to three hours, actual draw amounts vary by vehicle platform but are typically not greater than 50 mA.
- An extremely low mA current level is consumed by the RKE receiver for monitoring purposes, actual system wake up only occurs when the fobs for the vehicle are used. When other devices on the same RKE operating

frequency are activated, such as the 4 tire pressure monitoring sensors and other vehicle transmitters in the vicinity, the RKE receiver will have a 100 mA spike. These spikes are normal and occur too briefly to have a significant effect on battery drain. Competing signals may cause RKE performance issues such as jamming but should not cause excessive battery draw.

- If an excessive current draw is not present during initial testing, continue periodic testing over a 1-2 hour period to see if the current draw increases and stays above an unacceptable level.

NOTE: The battery specification listed below is a generic specification. Refer to the label on the original battery when testing the battery.

- The battery run down time will vary depending on the batteries reserve capacity. If the reserve capacity is higher, then the battery run down time would be longer. If the reserve capacity is lower, then the battery run down time would be shorter. The graph below indicates roughly how many days a 690 cold cranking amp battery with a 110 minute reserve capacity starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery reserve capacity and temperature will affect the results.

Current Drain	Days
25 mA	33
50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 38758 Parasitic Draw Test Switch

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

NOTE:

- Most vehicle systems will go to sleep within 30 minutes but it can take up to 2 hours before all systems power down allowing the parasitic draw test to pass. An occasional increase in the parasitic draw is normal as long as it returns within 1 second.
- Closing the door latches/ajar switch while leaving the doors open is recommended, this allows the vehicle systems to perform in a "doors closed" mode while allowing vehicle interior access that may be needed to complete the diagnostic steps.
- Locking doors will arm the vehicle content theft deterrent system if equipped. Failure to arm the system may cause a theft system fault to not be present during testing.
- There are many things that can prevent the vehicle from completely going to sleep and passing the parasitic draw test. Make sure all the conditions listed below are met before performing the parasitic current draw test.
 - Vehicle OFF
 - Retained Accessory Power RAP OFF - open and close the driver door after Vehicle OFF
 - Scan tool not communicating with a vehicle control module - in some cases it may need to be disconnected from the data link connector.
 - All access doors closed
 - Headlamps OFF - auto headlamps disabled
 - Any delay lighting OFF
 - If equipped with an under hood lamp disable it
 - HVAC after blow OFF
 - Any accessory that can work with Vehicle OFF inactive or OFF
 - Wait up to 2 minutes or longer, after all other listed conditions are met

Using an Inductive Pickup Probe

1. Connect an inductive pickup probe to the negative battery cable that can read down to 1 mA.
2. Vehicle OFF, as the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Using the EL 38758 Parasitic Draw Test Switch

WARNING: Refer to [Battery Disconnect Warning](#) .

CAUTION: When a fused jumper wire or digital multimeter is connected to the test switch terminals, always turn the test switch ON before opening any access door, turning the ignition on, or turning any accessory on. This is to prevent damaging the jumper wire or digital multimeter fuse.

NOTE: The switch knob on the EL 38758 switch is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.

1. Vehicle OFF, disconnect the battery negative cable from the battery. Refer to [Battery Negative Cable Disconnection and Connection](#).
2. Turn the EL 38758 switch knob to the OFF position.
3. Install the male end of the EL 38758 switch to the battery ground terminal.
4. Install the battery negative cable to the female end of the EL 38758 switch.
5. Turn the EL 38758 switch knob to the ON position.
6. Road test the vehicle and activate all of the accessories such as the radio and air conditioning.
7. Vehicle OFF, connect a 10 A fused jumper wire to the test switch tool terminals.
8. Turn the EL 38758 switch knob to the OFF position. The current now flows through the jumper wire.
9. Check the fuse in the jumper wire. The fuse should be OK.
 - Failed: If the jumper wire fuse is blown, refer to Circuit/System Testing.
 - Passed
10. Turn the EL 38758 switch knob to the ON position. Remove the fused jumper wire.
11. Connect a digital multimeter set to the 10 A DC scale between the test switch tool terminals.
12. Turn the EL 38758 switch knob to the OFF position. The current now flows through the DMM.
13. As the vehicle systems shut down test for less than 30 mA of parasitic current drain.
 - If greater than the specified range, refer to Circuit/System Testing.

Circuit/System Testing

- NOTE:**
- Removing or installing a fuse, relay, or connector, to determine the area causing high parasitic draw may wake up control modules. You must wait for the control modules to go back to sleep before retesting. It is best to install any removed or disconnected components after the diagnosis is completed.
 - Fuses for power mode master components such as the BCM should be removed last to avoid misdiagnosis.
 - If a scan tool is connected to the DLC, either disconnect it or subtract the scan tool current draw from the DMM reading to get the actual vehicle parasitic current draw.

If the vehicle has an unacceptable amount of parasitic current draw, remove each fuse one at a time until the current draw falls to an acceptable level. A drop of more than 10-20 mA, when disabling a single system or circuit, is an indication of an overly high current draw that could be causing the battery drain. Refer to [Power Distribution Schematics](#) to diagnose exactly which circuit of the suspect system is causing the high parasitic drain. The follow is a list of common components that could cause a high current draw:

- Stuck switch
- Stuck relay
- Control module

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for control module replacement, programming and setup

CHARGING SYSTEM TEST

The accessory power module (APM) supplies the energy that flows between the high voltage (300 volt) direct current (DC) and low voltage (14 volt) DC to charge the 12 volt battery and power accessories. To test the charging system, refer to [DC Power Conversion Test](#).

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

Removal Procedure

1. Ensure that all lamps and accessories are turned off.
2. Turn the ignition OFF and remove the ignition key.
3. Disconnect and remove all 12V battery chargers and the AC charger cable from the hybrid battery charger receptacle.

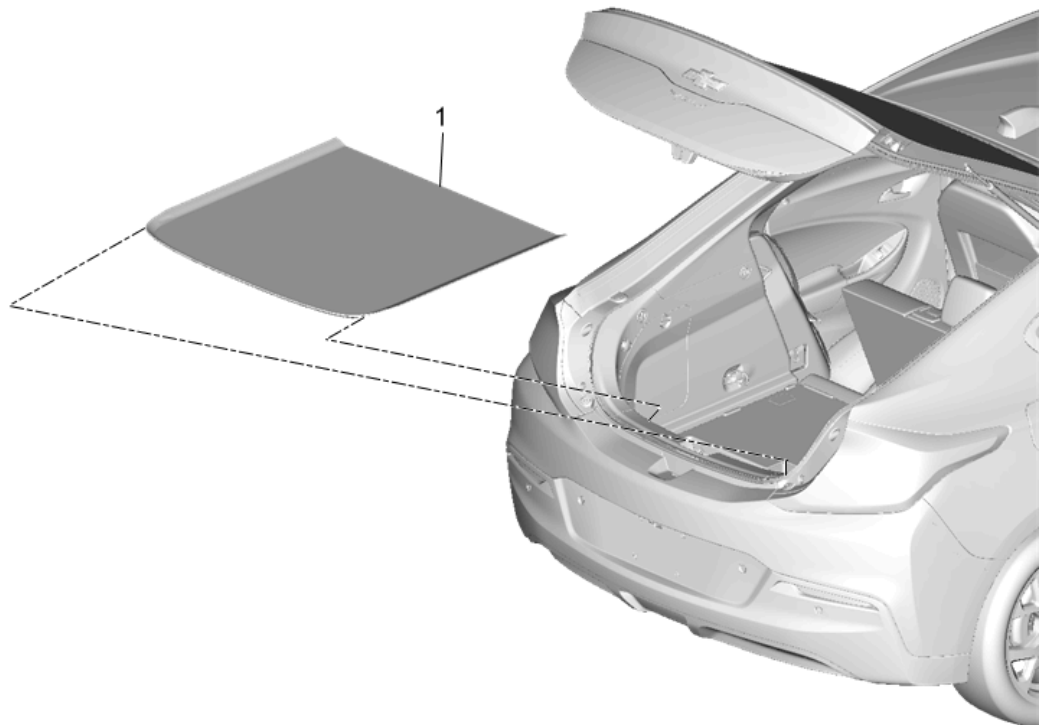


Fig. 2: Rear Compartment Floor Panel Trim

Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Compartment Floor Panel Trim (1) [Rear Compartment Floor Panel Trim Replacement](#)

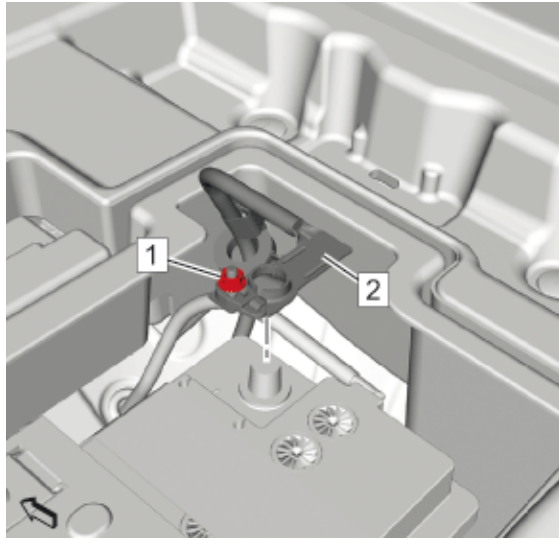


Fig. 3: Battery Negative Post Clamp And Nut
Courtesy of GENERAL MOTORS COMPANY

WARNING: Battery Disconnect Warning

5. Loosen the battery negative post clamp nut (1).
6. Disconnect the battery negative post clamp (2).

Installation Procedure

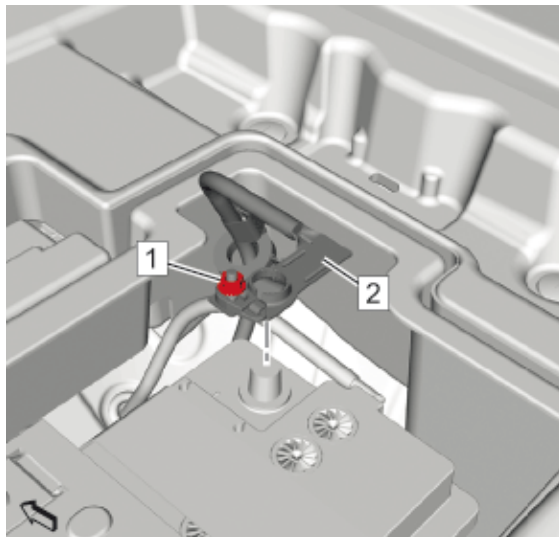


Fig. 4: Battery Negative Post Clamp And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Connect the battery negative post clamp (2).

CAUTION: Fastener Caution

2. Tighten the battery negative post clamp nut (1) to 9 N.m (80 lb in)

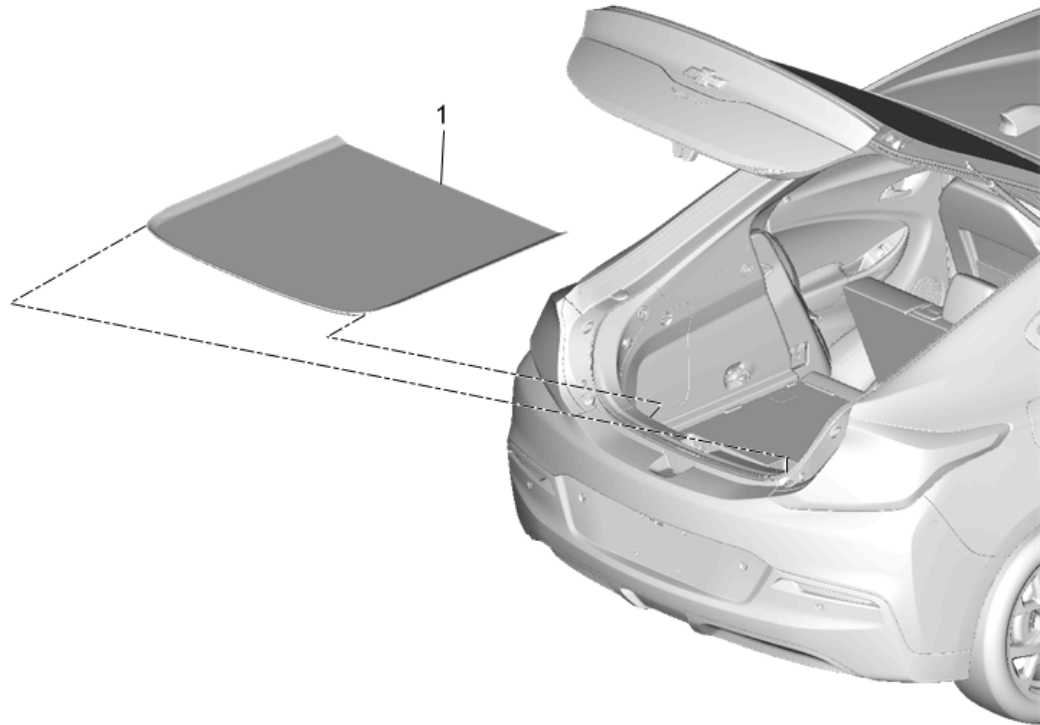


Fig. 5: Rear Compartment Floor Panel Trim
 Courtesy of GENERAL MOTORS COMPANY

3. Install Rear Compartment Floor Panel Trim (1) [Rear Compartment Floor Panel Trim Replacement](#)

BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (12 V BATTERY TO ACCESSORY DC POWER CONTROL MODULE)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. [High Voltage Disabling](#)
2. Remove Rear Compartment Floor Stowage Trim Compartment [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
3. Disconnect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)

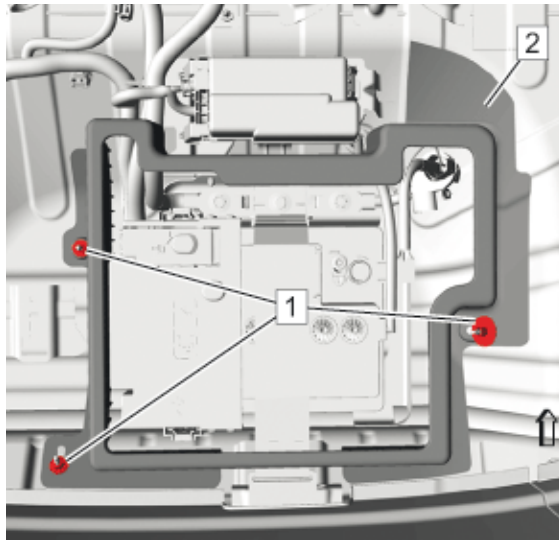


Fig. 6: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the 3 panel trim nuts (1).
5. Remove the panel trim (2).

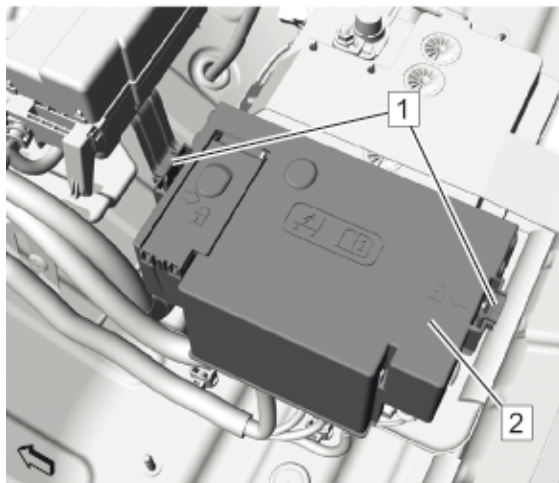


Fig. 7: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

6. Release the retaining tabs.(1)
7. Remove Battery Fuse Block Cover(2)

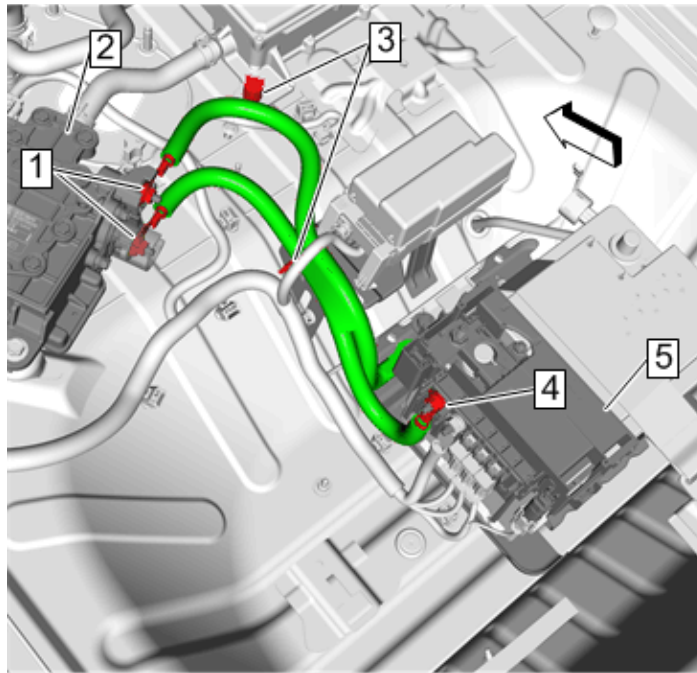


Fig. 8: Battery Positive Cable And Nut

Courtesy of GENERAL MOTORS COMPANY

8. Remove Battery Positive Cable Nut (4) @Battery Distribution Fuse Block (5)
9. Remove Battery Positive Cable Nut (1) @Accessory DC Power Control Module (2)
10. Disengage Retainer (3)

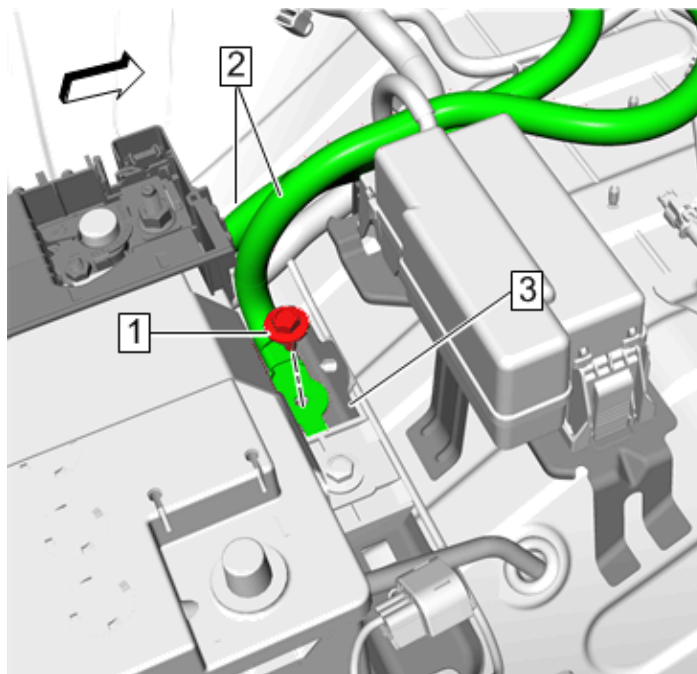


Fig. 9: Battery Negative Cable Ground Fastener

Courtesy of GENERAL MOTORS COMPANY

11. Remove Battery Negative Cable Ground Fastener (1) @Battery Tray (3)
12. Remove Battery Positive and Negative Cable (2)

Installation Procedure

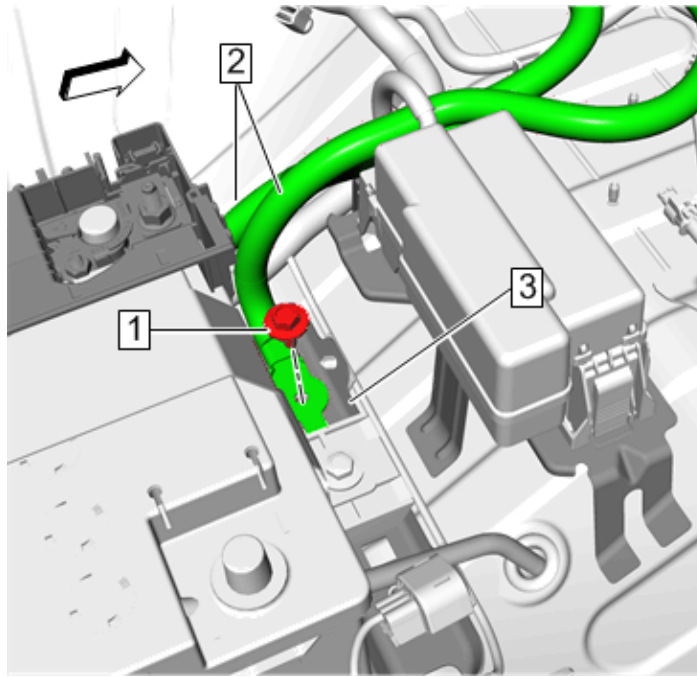


Fig. 10: Battery Negative Cable Ground Fastener

Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Positive and Negative Cable (2)

CAUTION: Fastener Caution

2. Install Battery Negative Cable Ground Fastener (1) @Battery Tray (3) and tighten 22 N.m (16 lb ft)

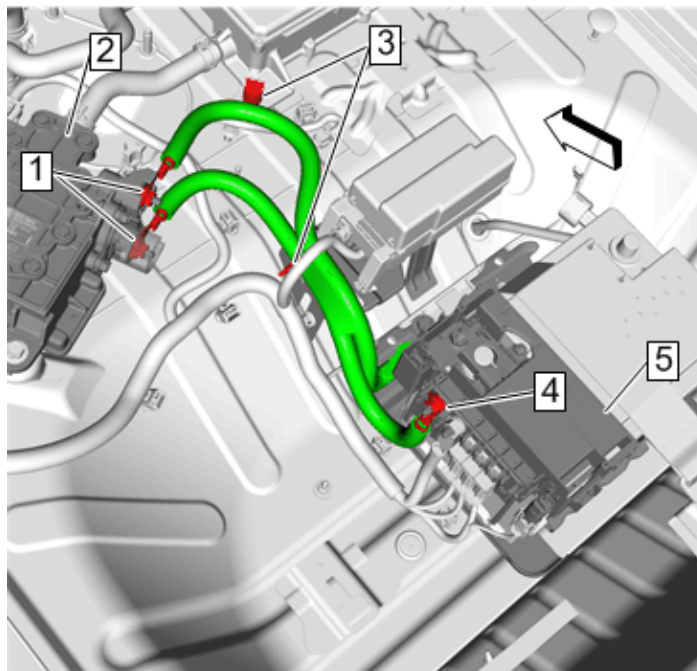


Fig. 11: Battery Positive Cable And Nut

Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Positive Cable Nut (4) @Battery Distribution Fuse Block (5) and tighten 15 N.m (133 lb in)
4. Install Battery Positive Cable Nut (1) @Accessory DC Power Control Module and tighten 22 N.m (16 lb ft)
5. Engage Retainer (3)

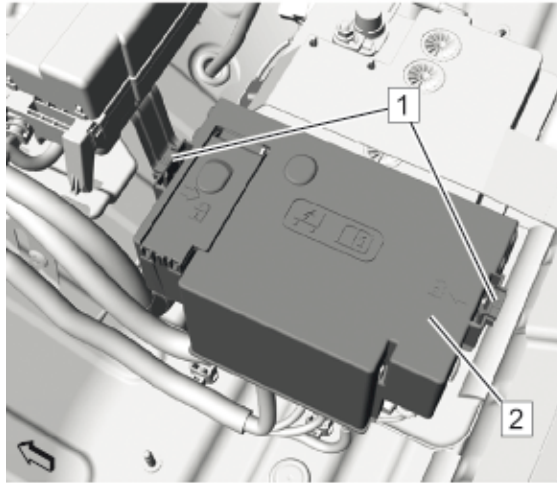


Fig. 12: Battery Fuse Block Cover And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

6. Install Battery Fuse Block Cover (2)
7. Check the 2 locked retaining tabs (1).

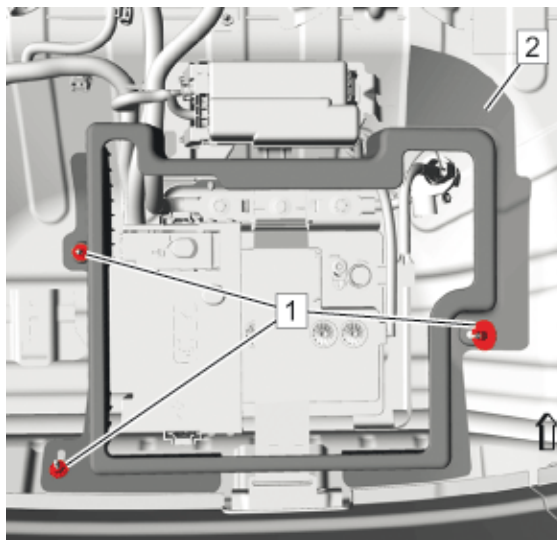


Fig. 13: Panel Trim And Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Install the panel trim (2).
9. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
10. Connect Battery Negative Cable [Battery Negative Cable Disconnection and Connection](#)
11. Install Rear Compartment Floor Stowage Trim Compartment [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
12. Enable the high voltage system. [High Voltage Enabling](#)

BATTERY NEGATIVE CABLE REPLACEMENT

Removal Procedure

1. Record all of the radio station presets.
2. Ensure that all lamps and accessories are turned off.
3. Turn the ignition OFF and remove the ignition key.
4. Remove Rear Compartment Floor Panel Trim Replacement

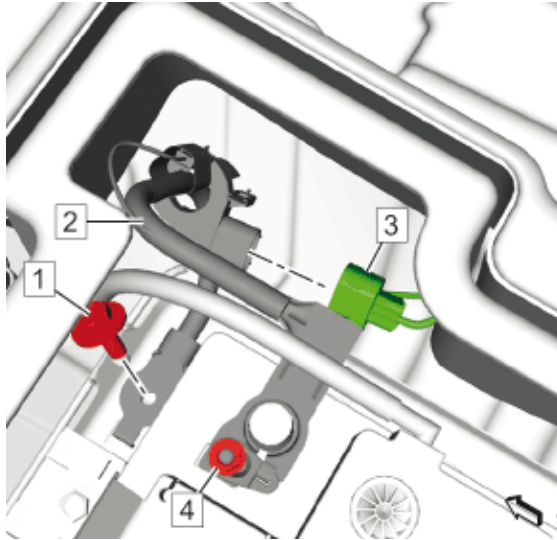


Fig. 14: Battery Negative Pole Clamp Nut And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

WARNING: Battery Disconnect Warning

5. Loosen the battery negative pole clamp nut (4).
6. Disconnect the battery negative pole clamp.
7. Disconnect Electrical Connector (3)
8. Remove the battery negative ground cable bolt (1).
9. Remove Battery Negative Cable (2)

Installation Procedure

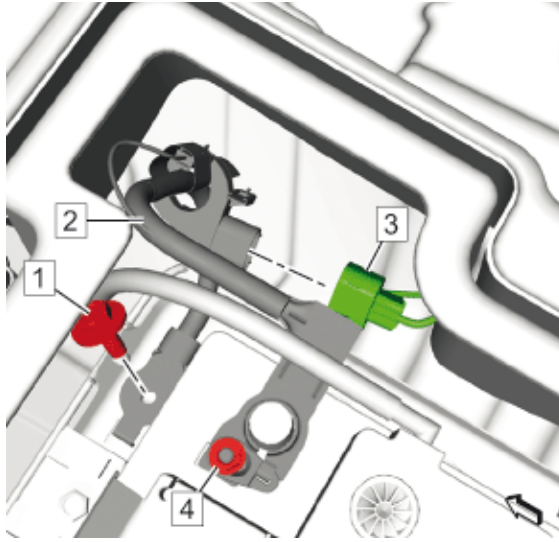


Fig. 15: Battery Negative Pole Clamp Nut And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Install Battery Negative Cable (2)

CAUTION: Fastener Caution

2. Install the battery negative ground cable bolt (1) and tighten to 22 N.m (16 lb ft).
3. Connect Electrical Connector (3)
4. Connect the battery negative pole clamp.
5. Tighten the battery negative pole clamp nut (4) to 9 N.m (80 lb in).
6. Install Rear Compartment Floor Panel Trim Replacement
7. Insert the ignition key and turn the ignition to the ON position.
8. Program all of the customer's radio station presets and set the radio clock to the current time.

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

1. Remove Rear Compartment Floor Stowage Trim Compartment Replacement
2. Disconnect Battery Negative Cable Disconnection and Connection

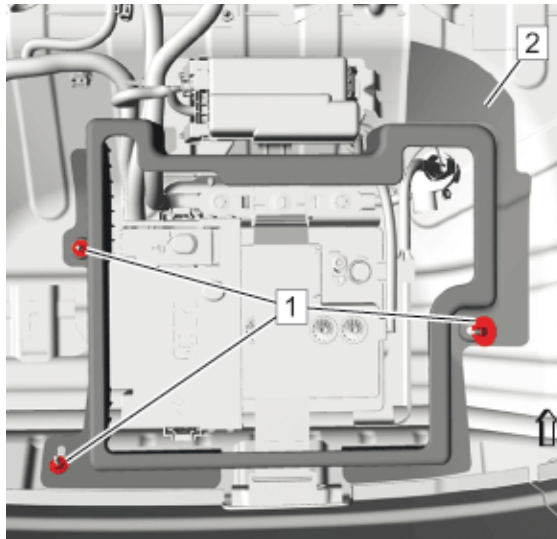


Fig. 16: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the 3 panel trim nuts (1).
4. Remove the panel trim (2).

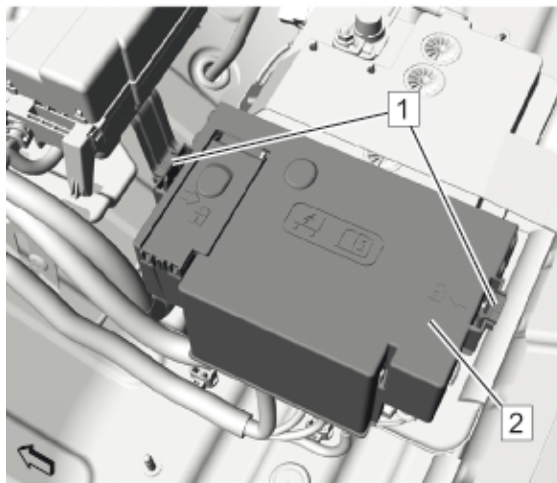


Fig. 17: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

5. Release the retaining tabs.(1)
6. Remove Battery Fuse Block Cover (2)

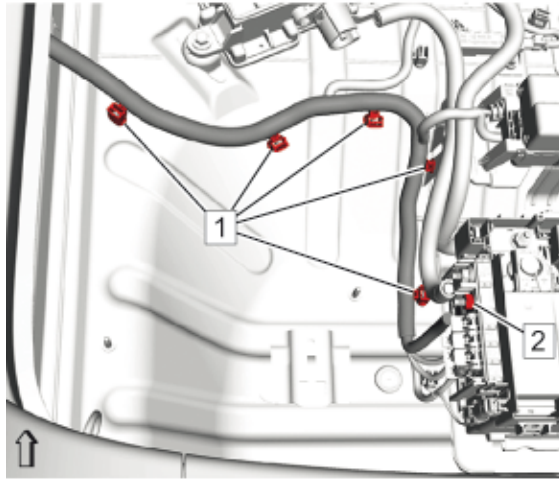


Fig. 18: Battery Positive Cable Fuse Block Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery positive cable fuse block nut (2).
8. Unclip Retainer(1)
9. Remove **Quarter Lower Rear Trim Panel Replacement (Left Side)** **Quarter Lower Rear Trim Panel Replacement (Right Side)**

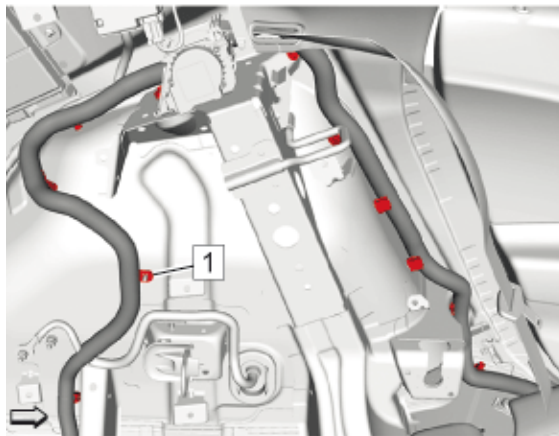


Fig. 19: Retainer
Courtesy of GENERAL MOTORS COMPANY

10. Unclip Retainer (1)
11. Unclip **Center Pillar Lower Trim Panel Replacement**

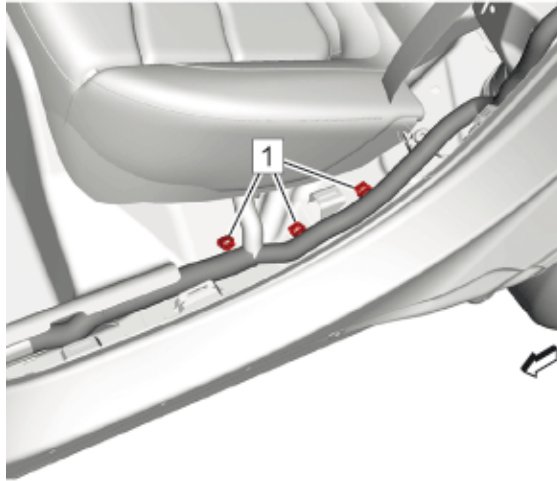


Fig. 20: Retainer

Courtesy of GENERAL MOTORS COMPANY

12. Unclip Retainer (1)

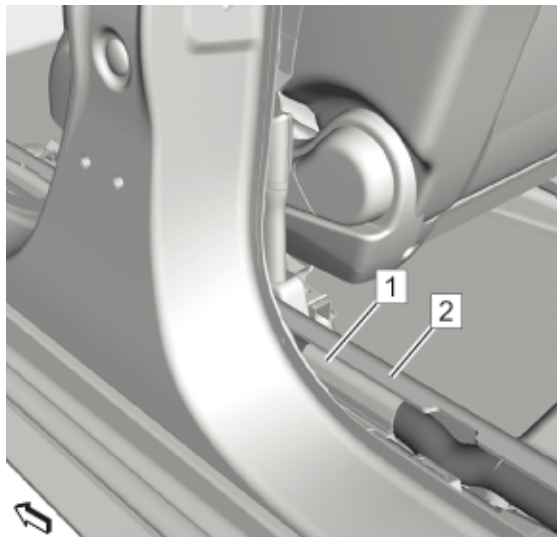


Fig. 21: Battery Positive Cable And Floor Carpet

Courtesy of GENERAL MOTORS COMPANY

13. For a better access, fold the floor carpet (2) aside.
14. Remove the battery positive cable (1) from the left channel.

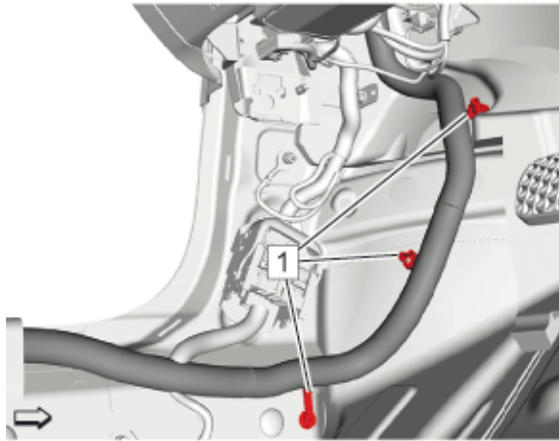


Fig. 22: Retainer

Courtesy of GENERAL MOTORS COMPANY

15. For a better access, fold the floor carpet aside.
16. Unclip Retainer (1)
17. Remove [Dash Upper Extension Panel Opening Cover Replacement](#)
18. Remove [Windshield Wiper System Module Replacement](#)
19. Remove [Engine Wiring Harness Junction Block Replacement](#)

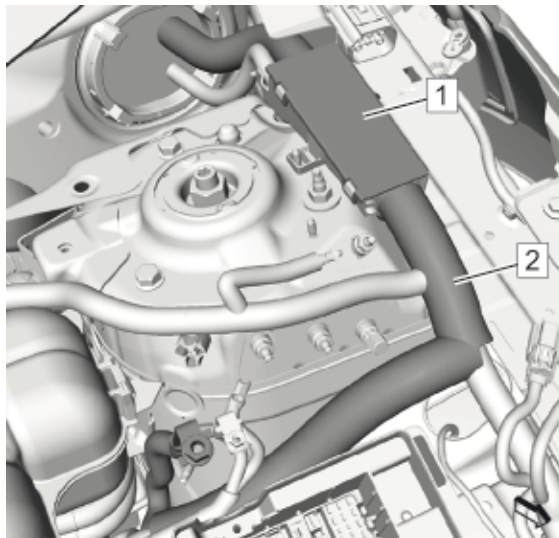


Fig. 23: Battery Positive Cable And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

20. Release the 2 retaining tabs to open the cover (1).
21. Pull the battery positive cable (2) through the harness grommet into the passenger compartment.
22. Separate the battery positive cable from the body harness.
23. Remove the battery positive cable from the vehicle.

Installation Procedure

1. Position the battery positive cable to the vehicle.
2. Insert the battery positive cable to the body harness.
3. Push the battery positive cable terminal through the grommet into the front engine compartment.

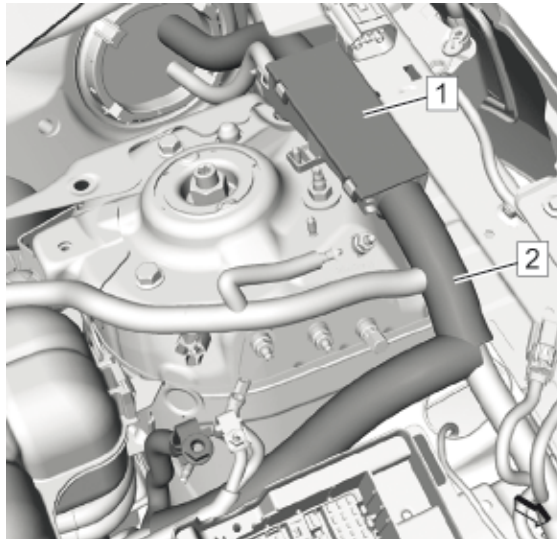


Fig. 24: Battery Positive Cable And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

4. Close the cover (1).
5. Install [Engine Wiring Harness Junction Block Replacement](#)
6. Install [Windshield Wiper System Module Replacement](#)
7. Install [Dash Upper Extension Panel Opening Cover Replacement](#)

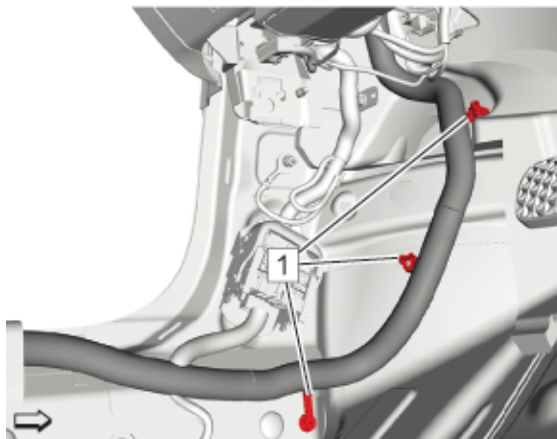


Fig. 25: Retainer

Courtesy of GENERAL MOTORS COMPANY

8. For a better access, fold the floor carpet aside.
9. Install Retainer (1)

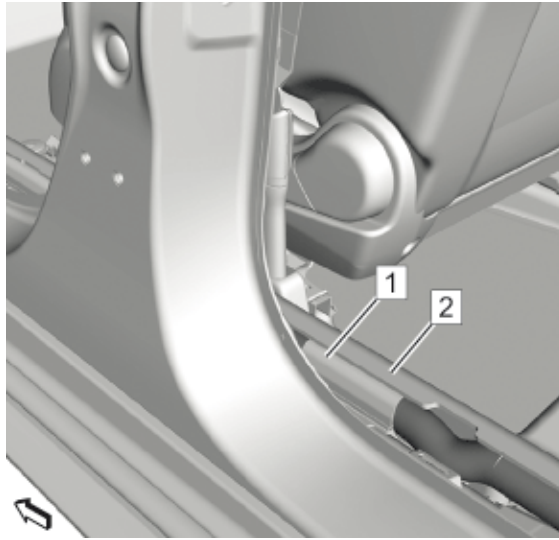


Fig. 26: Battery Positive Cable And Floor Carpet
Courtesy of GENERAL MOTORS COMPANY

10. For a better access, fold the floor carpet (2) aside.
11. Install the battery positive cable (1) to the left channel.

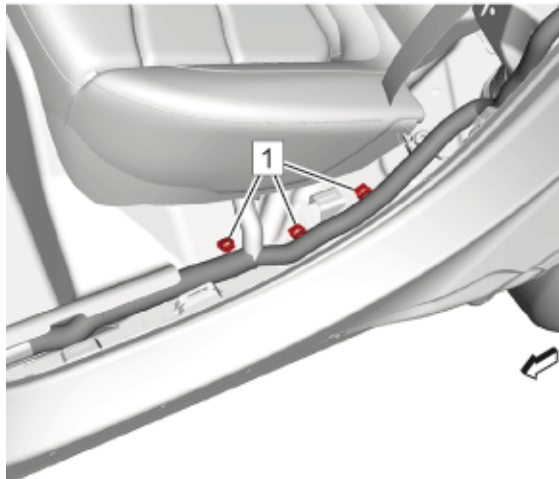


Fig. 27: Retainer
Courtesy of GENERAL MOTORS COMPANY

12. Install Retainer (1)
13. Install **Center Pillar Lower Trim Panel Replacement**

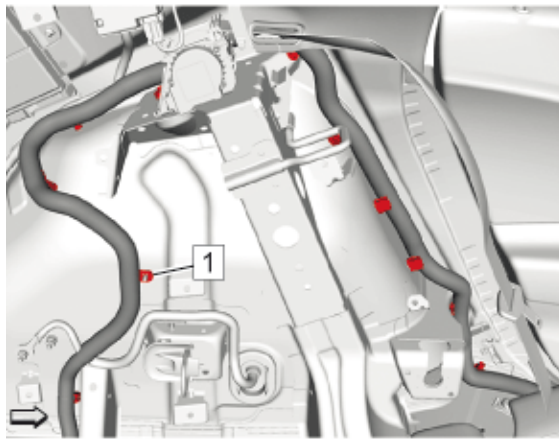


Fig. 28: Retainer

Courtesy of GENERAL MOTORS COMPANY

14. Install Retainer (1)
15. Install Quarter Lower Rear Trim Panel Replacement (Left Side) Quarter Lower Rear Trim Panel Replacement (Right Side)

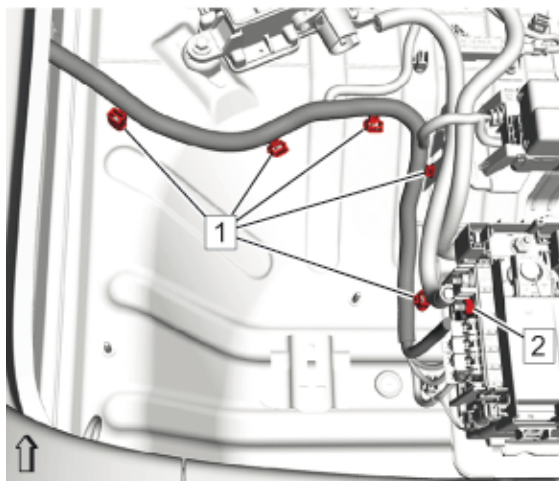


Fig. 29: Battery Positive Cable Fuse Block Nut

Courtesy of GENERAL MOTORS COMPANY

16. Install Retainer (1)

CAUTION: Fastener Caution

17. Install the battery positive cable fuse block nut (2) and tighten to 9 N.m (80 lb in).

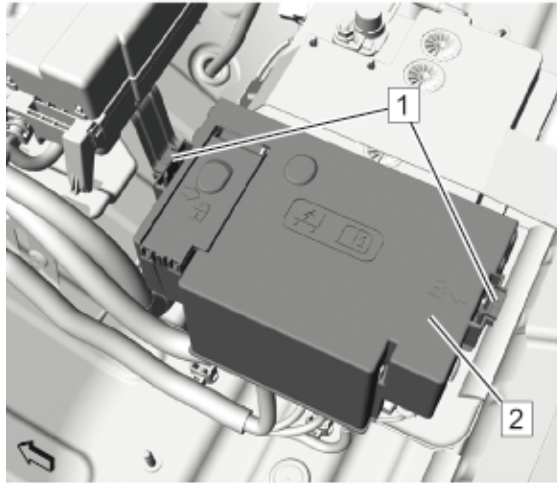


Fig. 30: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

18. Install Battery Fuse Block Cover (2)
19. Lock the 2 retaining tabs (1).

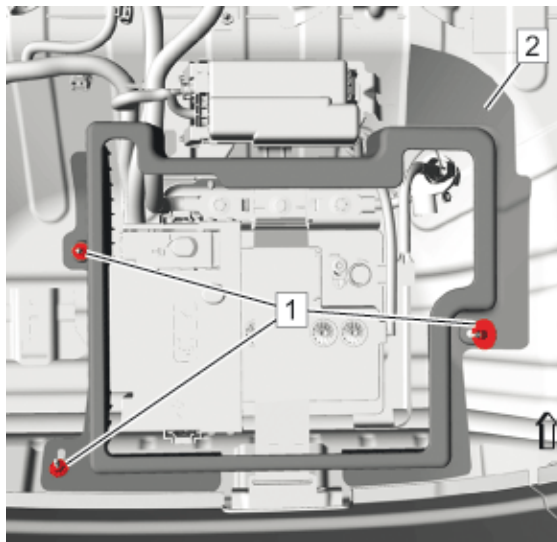


Fig. 31: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

20. Install the panel trim (2).
21. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
22. Connect **Battery Negative Cable Disconnection and Connection**
23. **Rear Compartment Floor Stowage Trim Compartment Replacement**

ENGINE WIRING HARNESS JUNCTION BLOCK REPLACEMENT

Removal Procedure

1. Disconnect **Battery Negative Cable Disconnection and Connection**

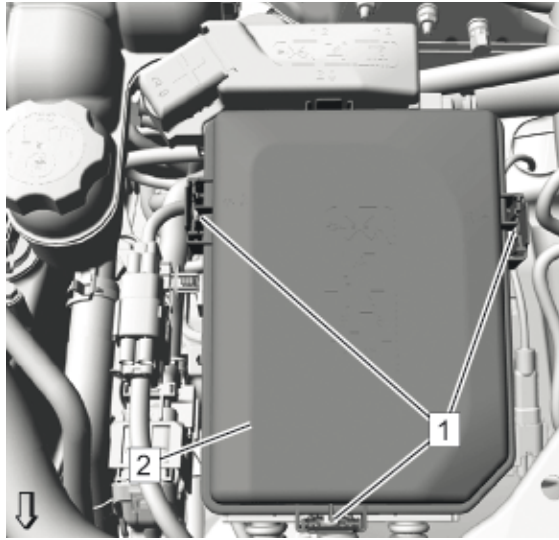


Fig. 32: Plastic Quick Connect Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

2. Squeeze the 3 plastic quick connect fitting release tabs (1) to remove the cover (2).

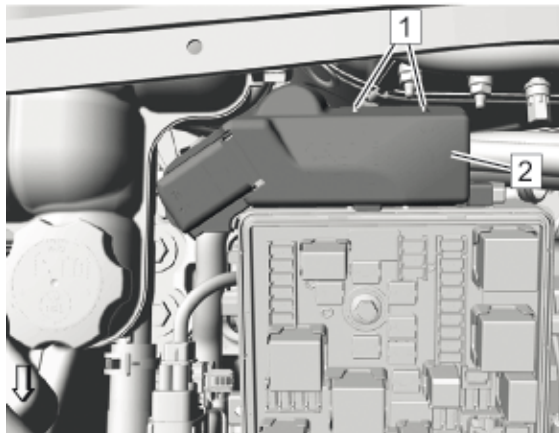


Fig. 33: Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

3. Release the 2 tabs (1).
4. Remove the cover (2).

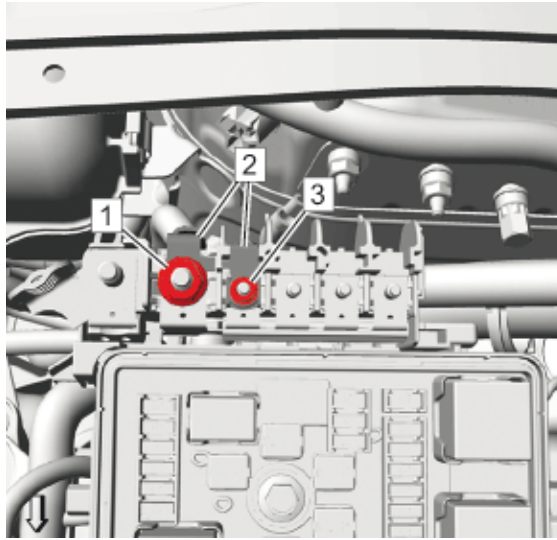


Fig. 34: Engine Wiring Harness Junction Block Supply Nuts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 engine wiring harness junction block supply nuts (1, 3).
6. Remove the 2 engine wiring harness junction block supply (2).

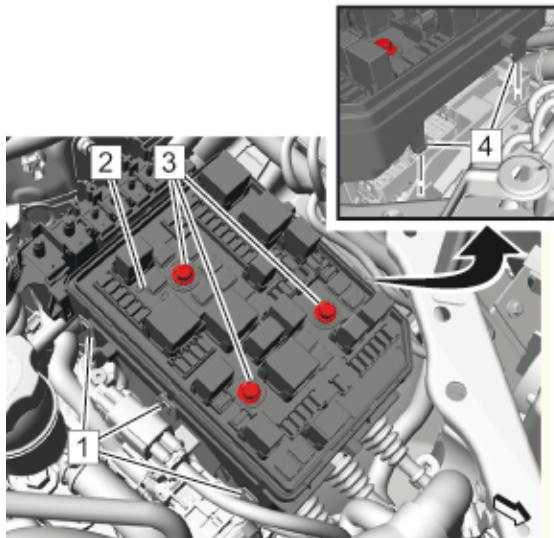


Fig. 35: Engine Wiring Harness Junction Block Bolts And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

NOTE: Bolts (3) are encapsulated on the end of threads so that they can not be removed from the fuse block.

7. Loosen the 3 engine wiring harness junction block bolts (3).
8. Unlock the 3 retaining tabs (1) and the retaining tabs (4) and remove the engine wiring harness junction block (2).

Installation Procedure

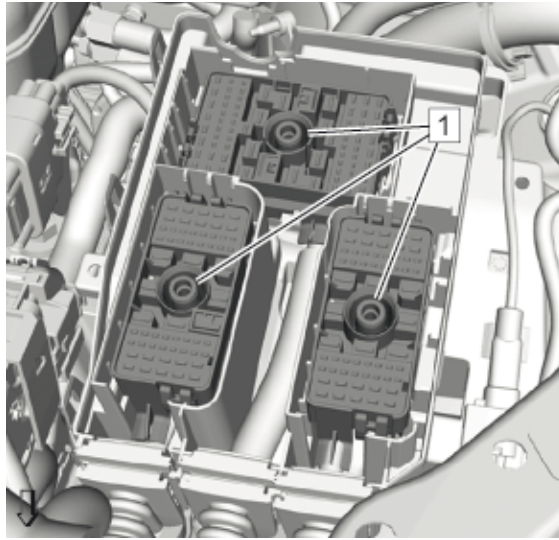


Fig. 36: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

1. Push down the 3 electrical connectors (1) before installation of the engine wiring harness junction block.

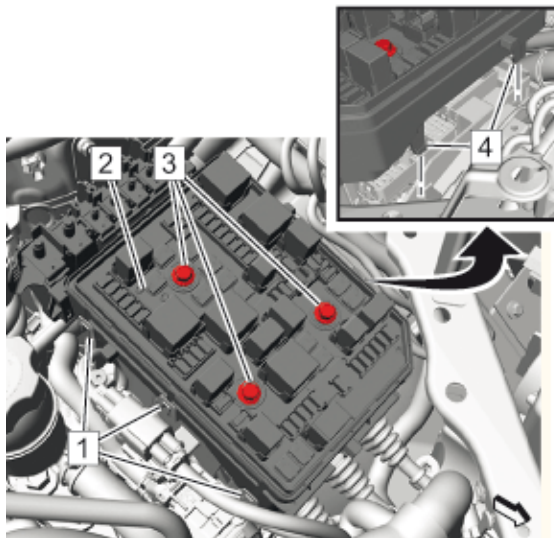


Fig. 37: Engine Wiring Harness Junction Block Bolts And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

2. Install the engine wiring harness junction block (2):
 1. Lock the 3 retaining tabs (1) and the retaining tabs (4).

CAUTION: Fastener Caution

2. Tighten the 3 engine wiring harness junction block bolts (3) to 7 N.m (62 lb in).

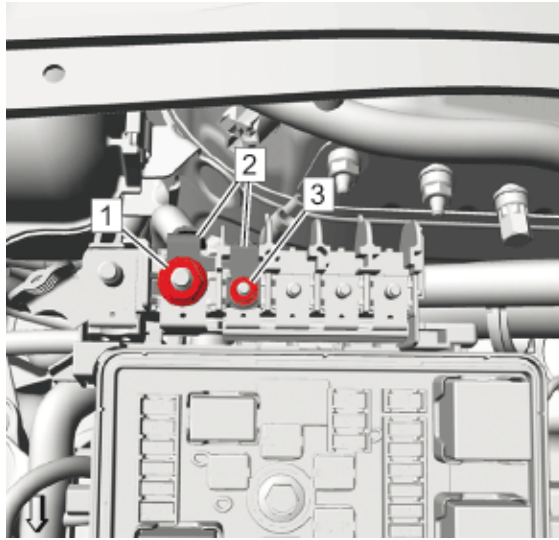


Fig. 38: Engine Wiring Harness Junction Block Supply Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Install the 2 engine wiring harness junction block supply (2).
4. Install the engine wiring harness junction block supply nut (1) and tighten to 15 N.m (11 lb ft).
5. Install the engine wiring harness junction block supply nut (3) and tighten to 5 N.m (44 lb in).

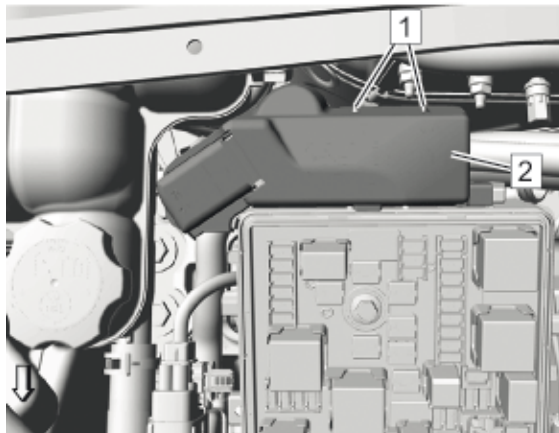


Fig. 39: Fitting Release Tabs And Cover

Courtesy of GENERAL MOTORS COMPANY

6. Install the cover (2).
7. Check the locked tabs (1).

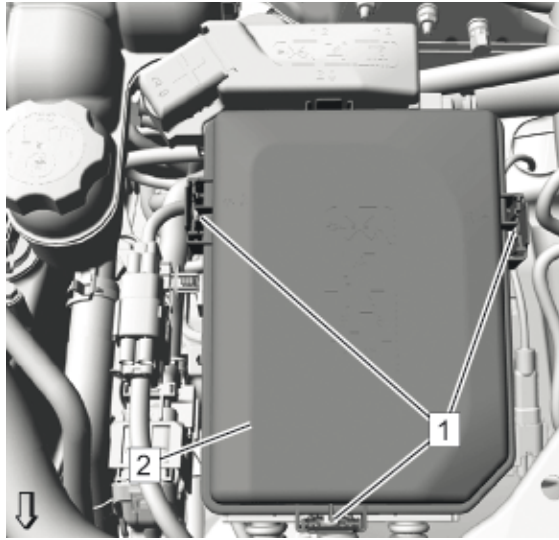


Fig. 40: Plastic Quick Connect Fitting Release Tabs And Cover
Courtesy of GENERAL MOTORS COMPANY

8. Install the cover (2). Check the locked 3 plastic quick connect fitting tabs (1).
9. Connect [Battery Negative Cable Disconnection and Connection](#)

BATTERY REPLACEMENT

Removal Procedure

1. Remove [Rear Compartment Floor Stowage Trim Compartment Replacement](#)
2. Disconnect [Battery Negative Cable Disconnection and Connection](#)

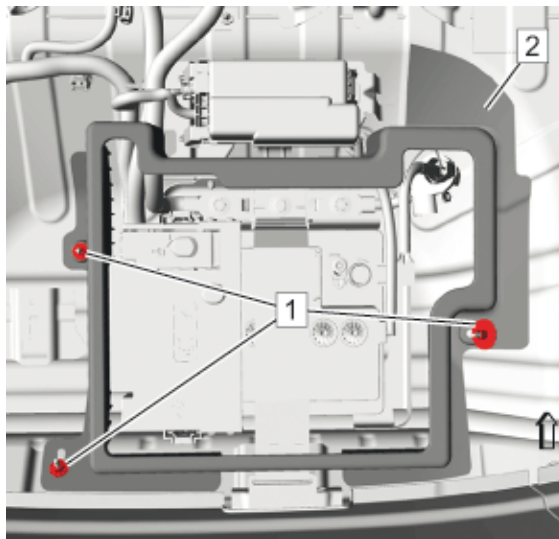


Fig. 41: Panel Trim And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 3 panel trim nuts (1).
4. Remove the panel trim (2).

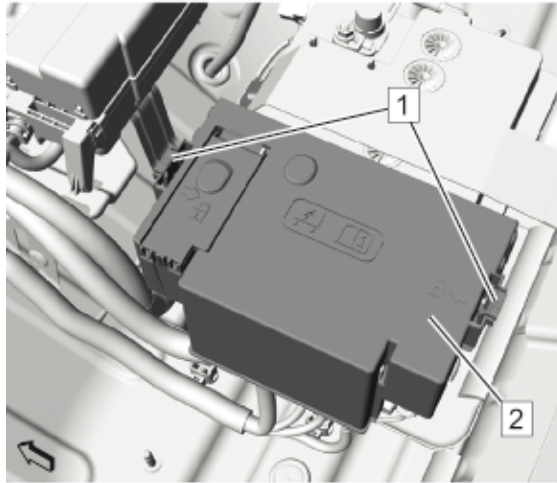


Fig. 42: Battery Fuse Block Cover And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

5. Remove Release the retaining tabs.(1)
6. Remove Battery Fuse Block Cover (2)

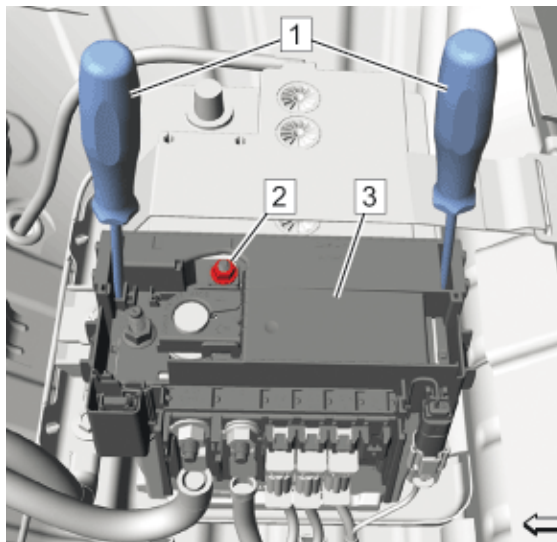


Fig. 43: Battery Positive Pole Clamp Nut
Courtesy of GENERAL MOTORS COMPANY

7. Loosen the battery positive pole clamp nut (2).
8. Use a screwdriver (1) to unclip the 2 battery fuse block retainer tabs from the battery and remove the battery fuse block (3) along with the battery positive cables.

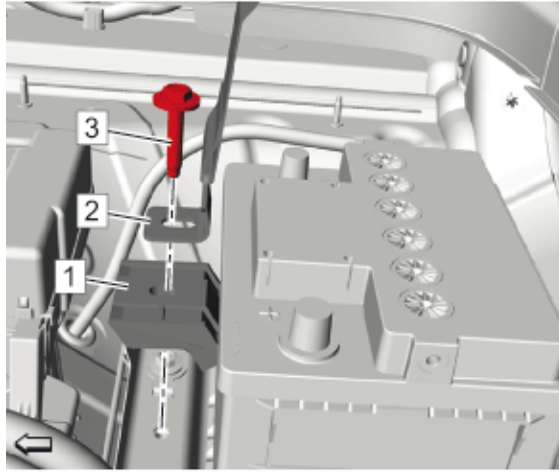


Fig. 44: Battery Hold Down Retainer Bolt

Courtesy of GENERAL MOTORS COMPANY

9. Remove the battery hold down retainer bolt (3).
10. Remove the battery retainer strap (2).
11. Remove Battery Hold Down Retainer(1)

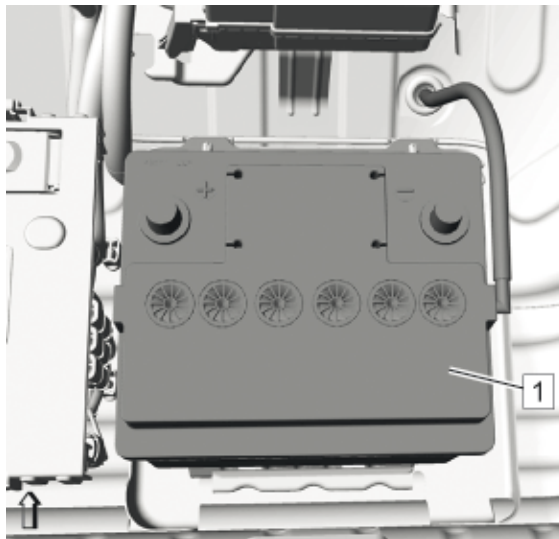


Fig. 45: View Of Battery

Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery (1) from the rear compartment area along with their vent hose.

Installation Procedure

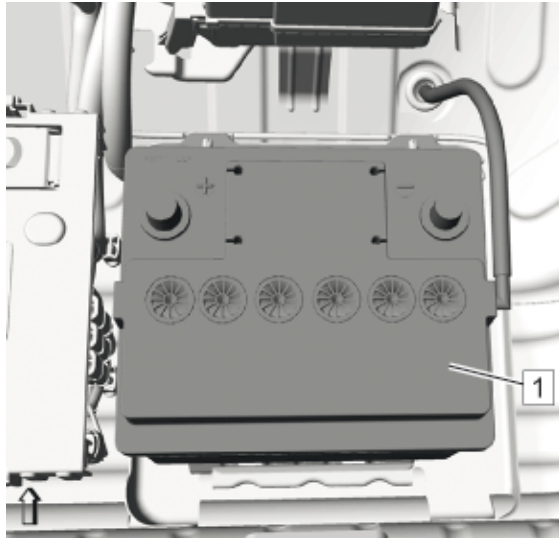


Fig. 46: View Of Battery

Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean any existing corrosion from the battery terminal and the battery cable end.

1. Position the battery (1) onto the tray to the rear of the vehicle as shown in the graphic.
2. Install the vent hose through the body.

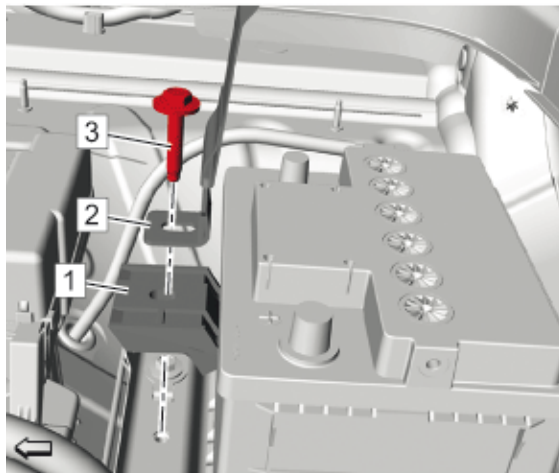


Fig. 47: Battery Hold Down Retainer Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Hold Down Retainer (1)
4. Install the battery retainer strap (2).

CAUTION: Fastener Caution

5. Install the battery hold down retainer bolt (3) and tighten to 18 N.m (13 lb ft).

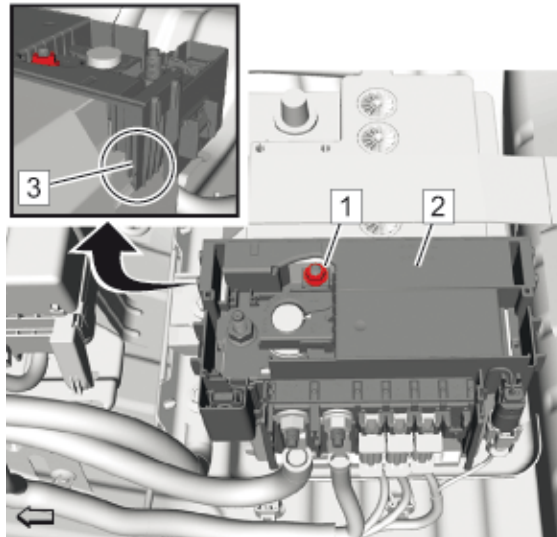


Fig. 48: Battery Fuse Block

Courtesy of GENERAL MOTORS COMPANY

6. Install the battery fuse block (2) along with the battery positive cables to the battery:
 1. Align the rear side of the battery fuse block exactly to the battery housing.
 2. Clip in the 2 battery fuse block retainer tabs (3).
 3. Tighten the battery positive pole clamp nut (1) to 9 N.m (80 lb in).

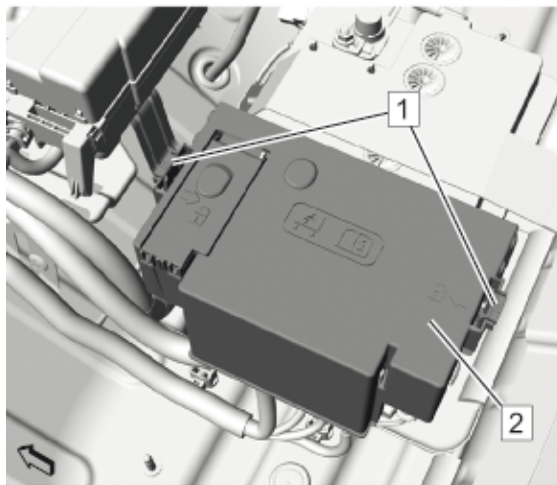


Fig. 49: Battery Fuse Block Cover And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

7. Install Battery Fuse Block Cover (2)
8. Check the locked 2 retaining tabs (1).

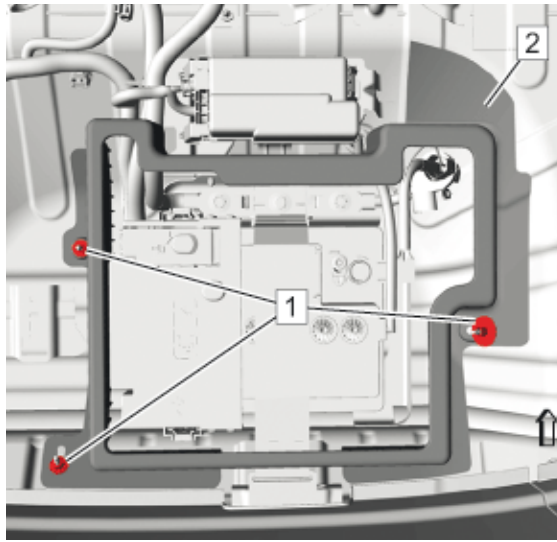


Fig. 50: Panel Trim And Nuts

Courtesy of GENERAL MOTORS COMPANY

9. Install the panel trim (2).
10. Install the 3 panel trim nuts (1) and tighten to 6 N.m (53 lb in).
11. Connect [Battery Negative Cable Disconnection and Connection](#)
12. Install [Rear Compartment Floor Stowage Trim Compartment Replacement](#)

ENGINE GROUND STRAP REPLACEMENT

Removal Procedure

1. Disconnect [Battery Negative Cable Disconnection and Connection](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

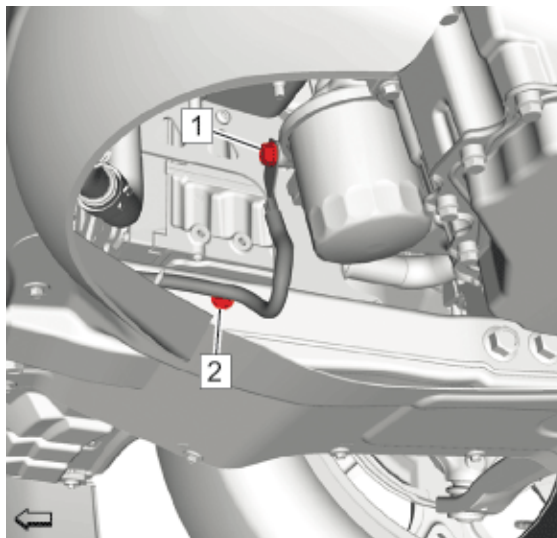


Fig. 51: Engine Ground Strap Bolt And Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Remove the engine ground strap bolt (1).
4. Unclip Retainer(2)

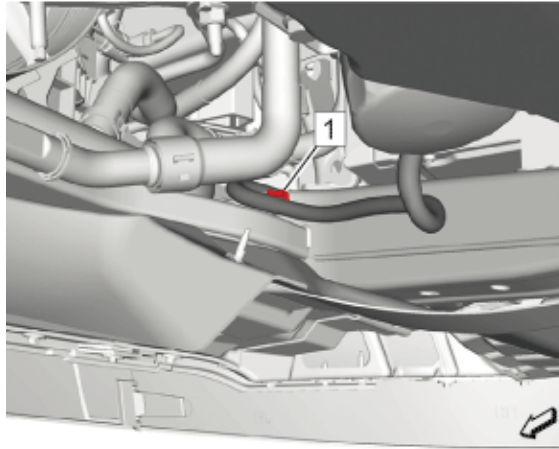


Fig. 52: Retainer

Courtesy of GENERAL MOTORS COMPANY

5. Unclip Retainer(1)
6. Remove **Front Wheelhouse Liner Replacement (Left Side)** **Front Wheelhouse Liner Replacement (Right Side)**

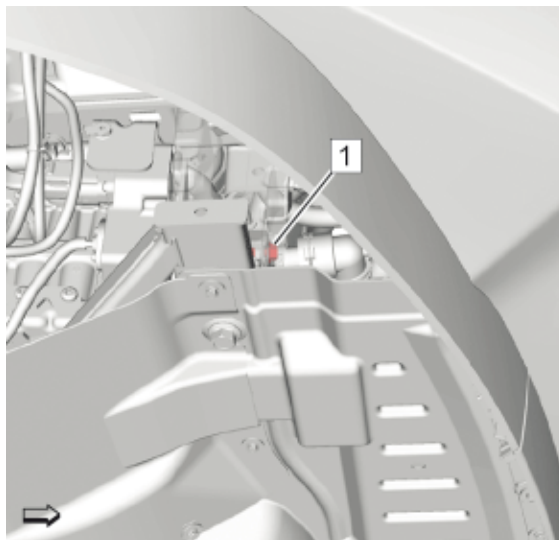


Fig. 53: Engine Ground Strap Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: The bolt is behind the body plate.

7. Remove the engine ground strap bolt (1).

Installation Procedure

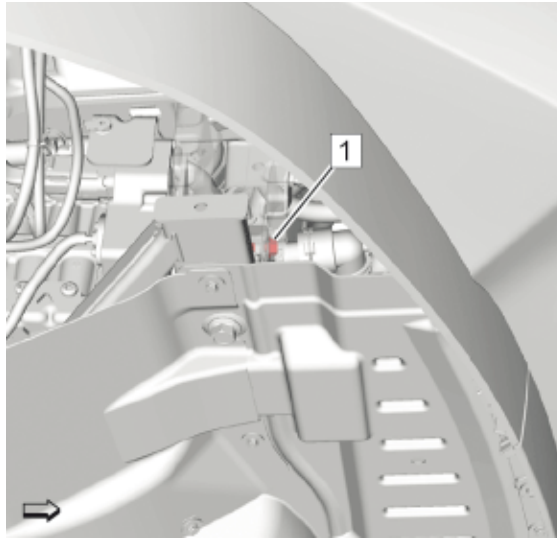


Fig. 54: Engine Ground Strap Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

NOTE: The bolt is behind the body plate.

1. Install the engine ground strap bolt (1) and tighten to 25 N.m (18 lb ft).
2. Install Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)

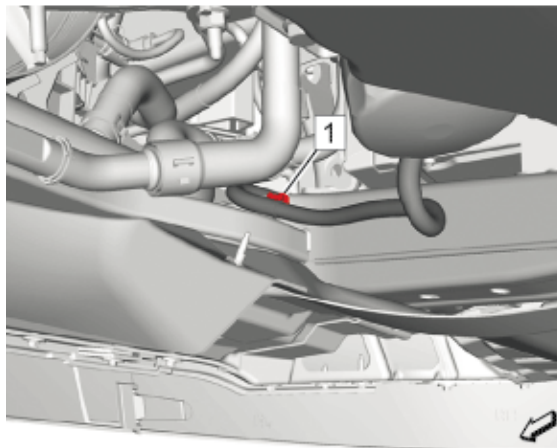


Fig. 55: Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Install Retainer(1)

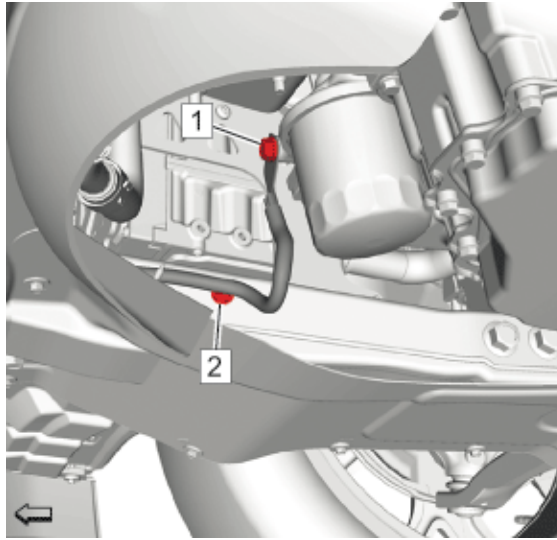


Fig. 56: Engine Ground Strap Bolt And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install the engine ground strap bolt (1) and tighten to 25 N.m (18 lb ft).
5. Install Retainer(2)
6. Lower the vehicle.
7. Connect [Battery Negative Cable Disconnection and Connection](#)

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

300 V Battery

For information about the 355 V hybrid drive motor battery, refer to [Drive Motor Battery System Description](#) .

Absorbent Glass Mat Battery

This vehicle is equipped with an absorbent glass mat battery. This is similar to current vehicle lead acid flood batteries, except they use glass mats that absorb electrolytes that are pressed between the plates instead of immersing the plates in electrolytes. This allows a smaller, lighter battery with the same amount of power and is less susceptible to heat.

The maximum permissible voltage allowed for the absorbent glass mat battery is 14.8 V (at room temperature).

12 V Battery

WARNING: Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- Always shield your eyes and avoid leaning over the battery whenever possible.
- Do not expose the battery to open flames or sparks.
- Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.

- Follow each step of the jump starting procedure in order.
- Treat both the booster and the discharged batteries carefully when using the jumper cables.

NOTE: Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

Battery Ratings

A battery has 2 ratings:

- Cold cranking amperage
- Amp hours

When a battery is replaced use a battery with similar ratings. Refer to the battery specification label on the original battery.

Amp Hours

The amp hour rating tells you how much amperage is available when discharged evenly over a 20 hour period. The amp hour rating is cumulative, so in order to know how many constant amps the battery will output for 20 hours, you have to divide the amp hour rating by 20. Example: If a battery has an amp hour rating of 74, dividing by 20 = 3.75. Such a battery can carry a 3.75 A load for 20 hours before dropping to 10.5 V. (10.5 V is the fully discharged level, at which point the battery needs to be recharged.) A battery with an amp hour rating of 55 will carry a 2.75 A load for 20 hours before dropping to 10.5 V.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 V. Refer to the battery specification label on the original battery for the cold cranking amperage rating for this vehicle.

CHARGING SYSTEM DESCRIPTION AND OPERATION

12 V Battery

The following information is for the 12 V battery only.

For information about charging the high voltage drive motor batteries, refer to [**Drive Motor Battery System Description**](#) .

Electrical Power Management Overview

The electrical power management system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems. This electrical power management system primarily utilizes existing on-board computer capability to maximize the effectiveness of the charging system, manage the load, improve battery state of charge and life, and minimize the system's impact on fuel economy. The electrical power management system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during Vehicle OFF and during Vehicle in Service Mode. During Vehicle OFF the state of charge of the battery is determined by measuring the open-circuit voltage. The state of charge is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The state of charge can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. During Vehicle ON mode, the algorithm continuously estimates state of charge based on adjusted net amp hours, battery capacity, initial state of charge, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the electrical power management function is designed to perform regulated voltage control to improve battery state of charge, battery life, and fuel economy. This is accomplished by using knowledge of the battery state of charge and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

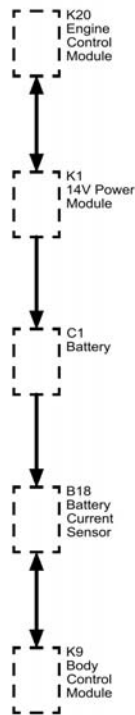


Fig. 57: Charging Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K1	K1 14V Power Module
C1	C1 Battery
B18	B18 Battery Current Sensor
K20	K20 Engine Control Module
K9	K9 Body Control Module

Charging System Components

Drive Motor/Generators

The drive motor/generators are serviceable components located within the transmission housing. When the rotors are spun, an alternating current (AC) is induced into the stator windings. This AC voltage is then sent to the drive motor generator power inverter module (PIM) where it is converted to high voltage direct current (DC) power. The output of the PIM is converted into low voltage electrical power by the accessory DC power converter module (APM) for use by the vehicle's electrical system to maintain electrical loads and battery charge.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster for electrical power management operation. The BCM determines the desired voltage set point and sends the information to the APM. The BCM monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5 V pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0 - 100 percent. Normal duty cycle is between 5 - 95 percent. Between 0 - 5 percent and 95 - 100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM receives control decisions based on messages from the BCM.

Instrument Panel Cluster

The instrument panel cluster provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of notification, a charge indicator and a driver information center message of SERVICE BATTERY CHARGING SYSTEM.

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Battery Sulfation Mode
- Normal Mode
- Fuel Economy Mode
- Headlamp Mode
- Voltage Reduction Mode
- Plant Assembly Mode

Battery Sulfation Mode

Battery sulfation mode is used to help maintain the battery life. The charging system will enter a battery sulfation mode which tries to increase the vehicle charging when the charging system voltage is less than 13.2 V for about 30 minutes. Once in this mode, the BCM will set a targeted output voltage between 13.9 - 15.5 V for about 5 minutes. Following this 5 minutes, the BCM will then determine which mode to enter depending on the system voltage requirements.

Normal Mode

The BCM will enter Normal Mode whenever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN Climate Control Voltage Boost Mode Request is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0°C (32°F).
- Vehicle Speed is greater than 145 km/h (90 mph)
- Current Sensor Fault Exists
- System Voltage was determined to be below 12.56 V
- Tow/Haul Mode is enabled

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9 - 15.5 V, depending on the battery state of charge and estimated battery temperature.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the ambient air temperature is at least 0°C (32°F) but less than or equal to 80°C (176°F), the calculated battery current is greater than -8 A but less than 5 A, and the battery state of charge is greater than or equal to 85 percent. Its targeted APM set-point voltage is the open circuit voltage of the battery and can be between 12.6 - 13.2 V. The BCM will exit this mode and enter Normal Mode when any of the conditions described above are present.

Headlamp Mode

The BCM will enter Headlamp Mode whenever the high or low beam headlamps are ON. Voltage will be regulated between 13.9 - 14.5 V.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated battery temperature is above 0°C (32°F) and the calculated battery current is greater than -7 A but less than 1 A. Its targeted APM set-point voltage is 12.9 - 13.2 V. The BCM will exit this mode once the criteria are met for Normal Mode.

Plant Assembly Mode

The BCM will increase charging voltage for the first 500 miles of operation in an effort to ensure that the 12 V battery is fully charged when the vehicle is delivered to the customer.

Instrument Panel Cluster Operation

Charge Indicator Operation

The instrument panel cluster illuminates the charge indicator and displays a charging system warning message in the driver information center when the one or more of the following occurs:

- The engine control module (ECM) detects system voltage less than 11 V or greater than 16 V. The instrument panel cluster receives a GMLAN message from the ECM requesting illumination.
- The BCM determines that the system voltage is less than 11 V or greater than 16 V.
- The instrument panel cluster receives a GMLAN message from the BCM indicating there is a system voltage range concern.
- The instrument panel cluster performs the displays test at the start of each Vehicle ON cycle. The indicator illuminates for approximately 3 seconds.
- Vehicle ON, with the engine OFF.

Battery Voltage Gauge Operation

The instrument panel cluster displays the system voltage as received from the BCM over the GMLAN serial data circuit. If there is no communication with the BCM then the gauge will indicate minimum.

This vehicle is equipped with a regulated voltage control system. This will cause the voltmeter to fluctuate between 12 - 14 V, as opposed to non-regulated systems which usually maintain a more consistent reading of 14 V. This fluctuation with the regulated voltage control system is normal system operation and NO repairs should be attempted.

SERVICE BATTERY CHARGING SYSTEM

The BCM and the ECM will send a GMLAN message to the driver information center for the SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is displayed whenever the charge indicator is commanded ON due to a failure.

STARTING SYSTEM DESCRIPTION AND OPERATION

The HQ1 hybrid system does not use a conventional starter. Refer to [Hybrid Modes of Operation Description](#) for information about the starting system.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

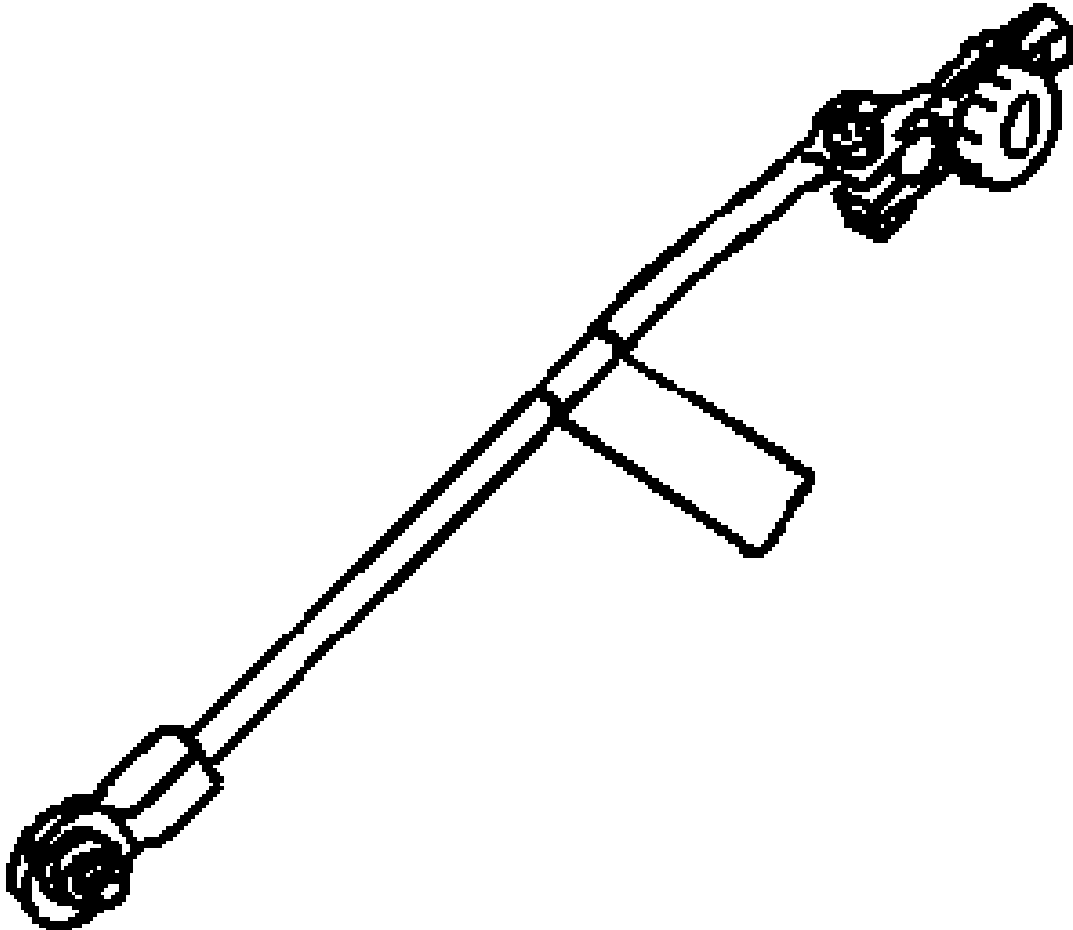
Illustration	Tool Number/Description
	EL 38758 EL 50074 J 38758 Parasitic Draw Test Switch

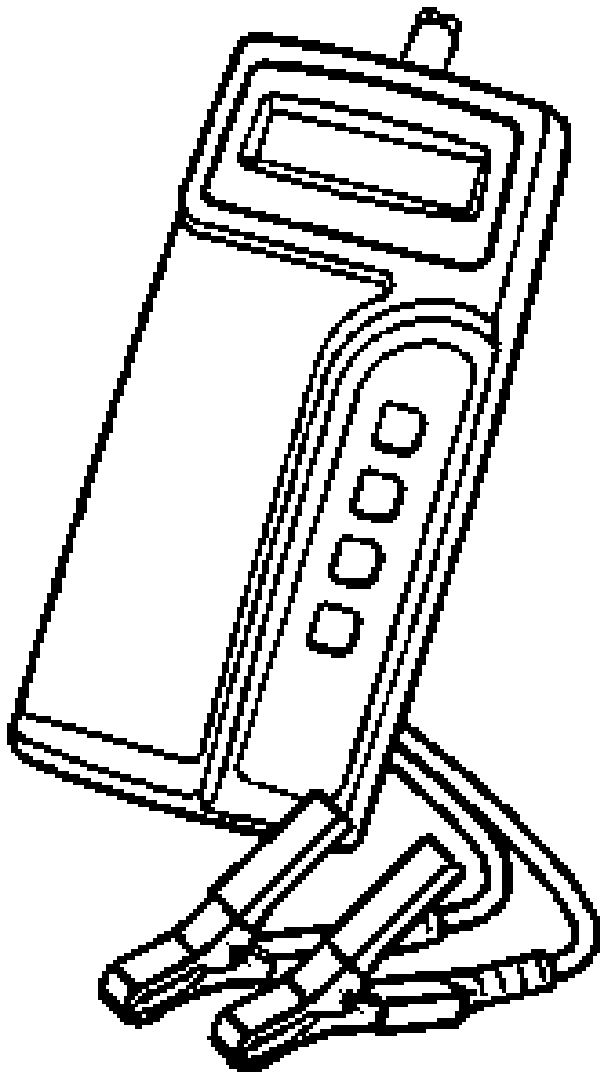
Illustration	Tool Number/Description
	J 42000 Battery Tester

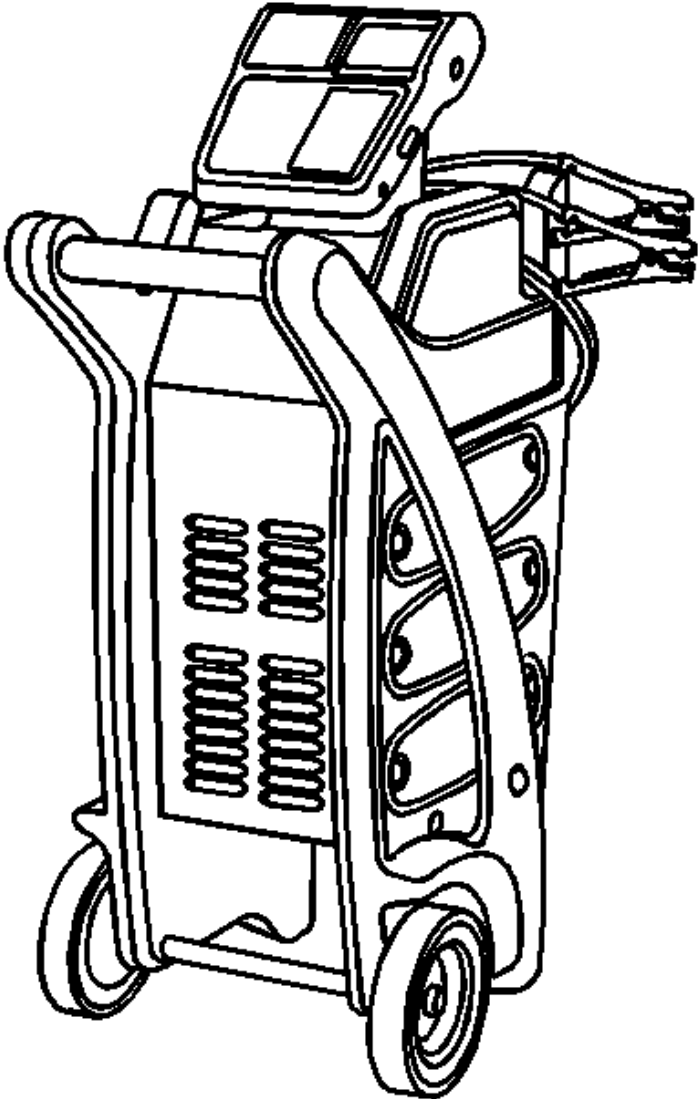
Illustration	Tool Number/Description
	EL 50313 EL 42000 EL 50076 Battery Tester

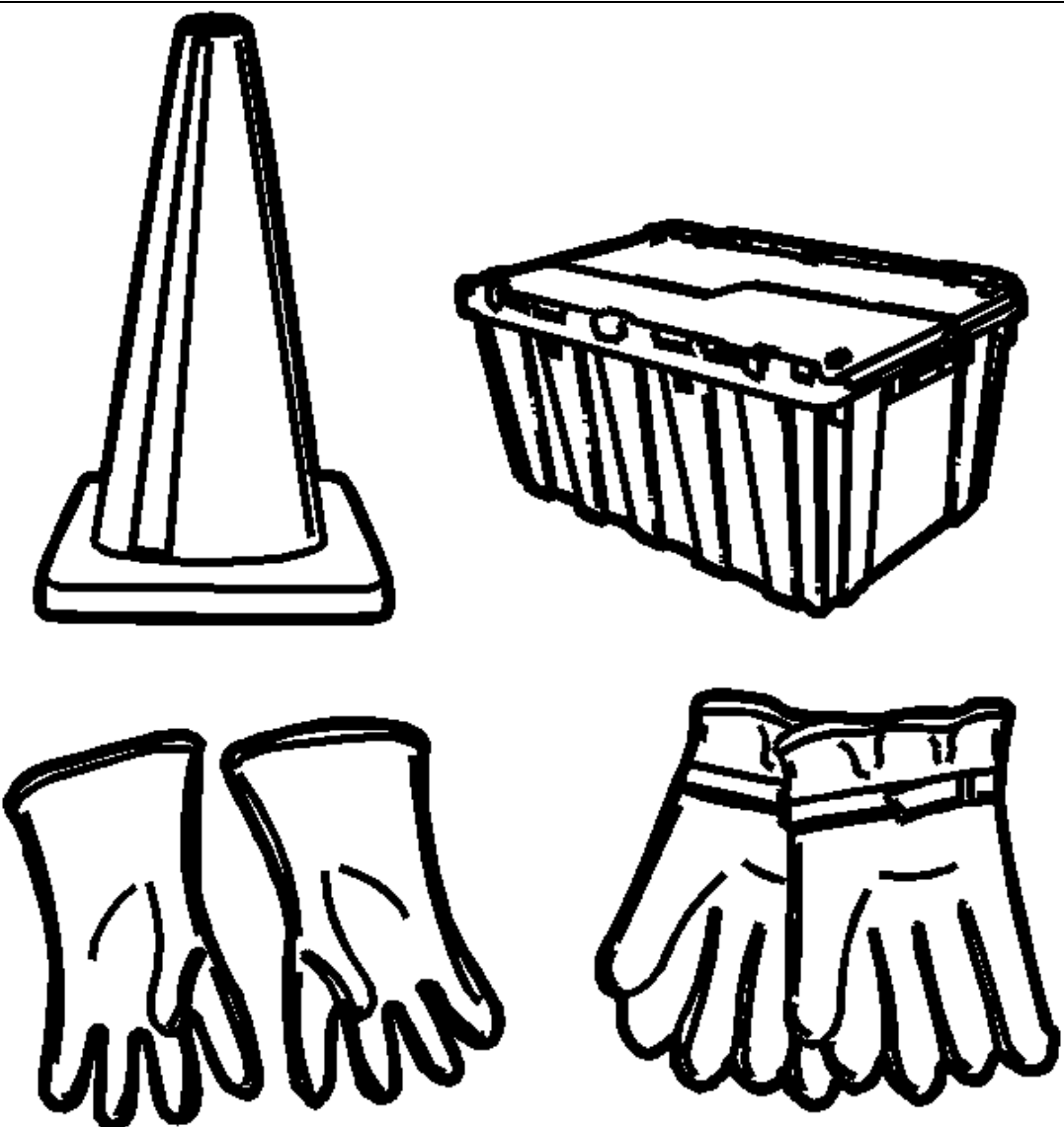
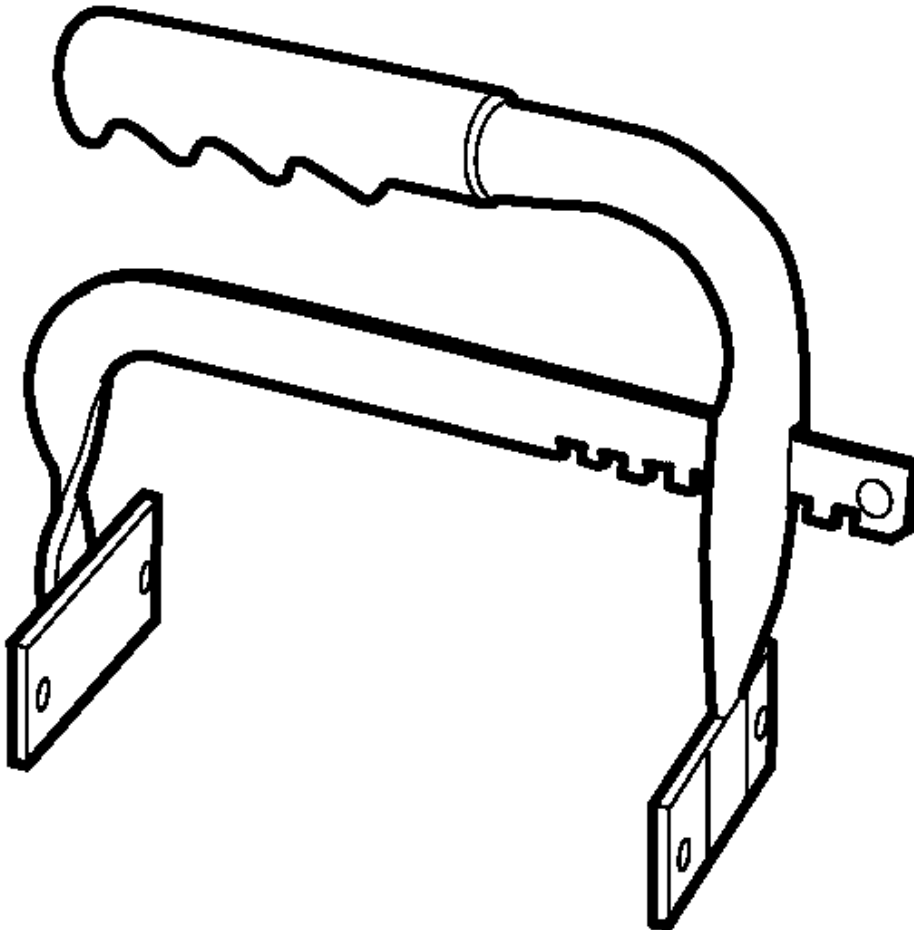
Illustration	Tool Number/Description
 The illustration shows four items: a traffic cone in the top left, a rectangular storage bin with a lid and latches in the top right, a pair of work gloves in the bottom left, and another pair of work gloves in the bottom right. All items are drawn in a simple, black-and-white line-art style.	EL-48900 HEV Safety Kit

Illustration	Tool Number/Description
	GE-49379 Battery Remover / Installer

Article GUID: A00884656

ENGINE

Engine Heating and Cooling - Volt

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE (RADIATOR COOLANT TEMPERATURE SENSOR)

Temperature	Resistance
150°C (302°F)	47 to 49 ohms
140°C (284°F)	58 to 62 ohms
130°C (266°F)	76 to 80 ohms
120°C (248°F)	98 to 104 ohms
110°C (230°F)	130 to 136 ohms
100°C (212°F)	174 to 182 ohms
90°C (194°F)	237 to 247 ohms
80°C (176°F)	327 to 341 ohms
70°C (158°F)	459 to 479 ohms
60°C (140°F)	656 to 686 ohms
50°C (122°F)	958 to 1002 ohms
45°C (113°F)	1167 to 1223 ohms
40°C (104°F)	1430 to 1500 ohms
35°C (95°F)	1763 to 1849 ohms
30°C (86°F)	2185 to 2295 ohms
25°C (77°F)	2725 to 2865 ohms
20°C (68°F)	3418 to 3604 ohms
15°C (59°F)	4318 to 4564 ohms
10°C (50°F)	5493 to 5823 ohms
5°C (41°F)	7041 to 7485 ohms
0°C (32°F)	9097 to 9701 ohms
-5°C (23°F)	11844 to 12678 ohms
-10°C (14°F)	15540 to 16700 ohms
-15°C (5°F)	20559 to 22183 ohms
-20°C (-4°F)	27439 to 29725 ohms
-30°C (-22°F)	50264 to 54924 ohms
-40°C (-40°F)	95953 to 105777 ohms

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

**All
fasteners/components**

***listed in this table
MUST BE
DISCARDED and
replaced with NEW
after removal.***

Application
Engine Coolant Thermostat Housing Gasket
Water Outlet Gasket
Water Pump Gasket
Water Pump Housing Gasket

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

***All
fasteners/components
listed in this table
MUST BE
DISCARDED and
replaced with NEW
after removal.***

Application	Specification
	Metric (English)
Water Pump Bolt	25 N.m (18 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE:

***All fasteners
listed in this
table can be
reused after
removal.***

Application	Specification
	Metric (English)
Drive Motor Battery Coolant Pump Bracket Stud	9 N.m (80 lb in)
Engine Coolant Fan Shroud Bolt	5 N.m (44 lb in)
Engine Coolant Thermostat Housing Bolt	10 N.m (89 lb in)
Ground Cable Nut	9 N.m (80 lb in)
Heat Shield Nut	9 N.m (80 lb in)
Radiator Air Lower Baffle Bolt	9 N.m (80 lb in)
Radiator Surge Tank Bracket Bolt	22 N.m (16 lb ft)
Radiator Upper Insulator Bolt	22 N.m (16 lb ft)
Water Outlet Bolt	12 N.m (106 lb in)
Water Pump Housing Bolt	10 N.m (89 lb in)
Water Pump Inlet Adapter Bolt	10 N.m (89 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System Filling		
Engine Cooling	7.0 liters	7.4 quarts
High Voltage Battery Pack Cooling	3.8 liters	4.0 quarts
Power Electronics Cooling	4.2 liters	4.4 quarts

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
DEX-COOLÂ® (Premix 50/50 with De-Ionized Water)	Engine Coolant	12378390	10953456

SCHEMATIC WIRING DIAGRAMS

ENGINE HEATING/COOLING WIRING SCHEMATICS

Engine Cooling Fans

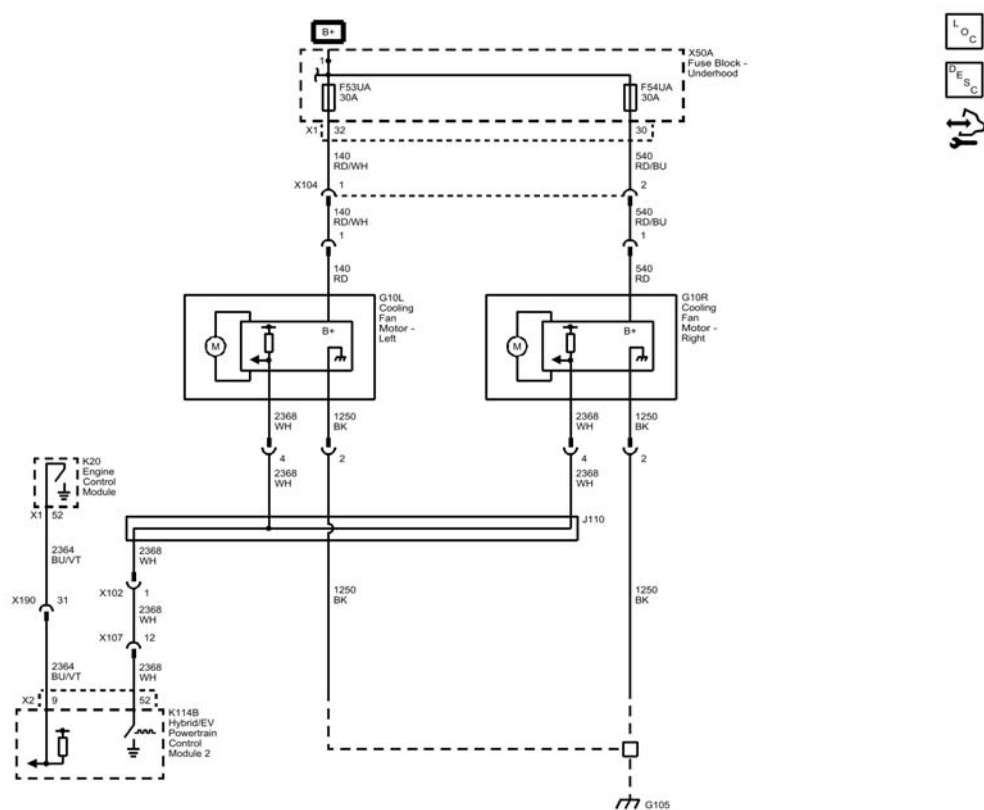


Fig. 1: Engine Cooling Fans
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P00B3 OR P00B4: RADIATOR COOLANT TEMPERATURE (RCT) SENSOR CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P00B3

Radiator Coolant Temperature (RCT) Sensor Circuit Low Voltage

DTC P00B4

Radiator Coolant Temperature (RCT) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P00B6
Low Reference	-	P00B4	P00B4*	P00B6
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Radiator Coolant Temperature Sensor Signal	140Â°C (284Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit/System Description

NOTE: The radiator coolant temperature sensor is referred to as B203 Engine Coolant Temperature Sensor 2 in schematics and other areas.

The radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. The engine control module (ECM) supplies 5 volts to the RCT signal circuit and supplies a ground to the low reference circuit.

The following table illustrates the difference between temperature, resistance, and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P00B3

- The engine run time is greater than 10 s.
- The intake air temperature (IAT) is colder than 70°C (158°F).
- The DTC runs continuously when the above conditions are met.

P00B4

- The engine run time is greater than 60 s.
- The intake air temperature (IAT) is warmer than -7°C (19°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P00B3

The ECM detects that the RCT sensor is warmer than 149°C (300°F) for greater than 10 s.

P00B4

NOTE: The scan tool only displays to -40°C (-40°F).

The ECM detects that the RCT sensor is colder than -60°C (-76°F) for greater than 10 s.

Action Taken When the DTC Sets

- DTCs P00B3 and P00B4 are Type B DTCs.
- The cooling fans will be commanded ON by the ECM.
- The Engine Coolant Temperature Gauge is inoperative.
- The AC compressor will be commanded OFF.

Conditions for Clearing the MIL/DTC

DTC P00B3 and P00B4 are Type B DTCs.

Diagnostic Aids

NOTE: The engine coolant temperature (ECT) sensor is mounted on the engine and the radiator coolant temperature (RCT) sensor is mounted on the radiator.

- As the thermostat opens, the RCT sensor temperature should rise steadily, then stabilize once the

thermostat opens completely.

- Test the RCT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor.
- If the vehicle has sat for greater than 8 hours, the RCT sensor and the ECT sensor values should display within 3Â°C (5Â°F).

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to + 120Â°C (-38 to +248Â°F) and changes with engine run time.
 - **If not between -39 to + 120Â°C (-38 to +248Â°F) or does not change**

Refer to Circuit/System Testing.
 - **If between -39 to + 120Â°C (-38 to +248Â°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle Off, disconnect the harness connector at the B203 Engine Coolant Radiator Temperature Sensor.
It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 2 Ω between the low reference circuit terminal 2 and ground.
 - **If 2 Ω or greater**
 1. Vehicle Off, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 2 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Vehicle Off, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Radiator Coolant Temperature Sensor parameter is warmer than 140°C (284°F).
 - **If colder than the 140°C (284°F)**
 1. Vehicle Off, disconnect the X1 harness connector at the K20 Engine Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - **If warmer than 140°C (284°F)**
7. Test or replace the B203 Engine Coolant Radiator Temperature Sensor.

Component Testing

1. Vehicle Off, remove the B203 Engine Coolant Radiator Temperature Sensor.

NOTE: A thermometer can be used to test the sensor off the vehicle.

2. Test the B203 Engine Coolant Radiator Temperature Sensor by varying the sensor temperature while measuring the sensor resistance. Compare the readings with the [Temperature Versus Resistance \(Radiator Coolant Temperature Sensor\)](#) table and verify that the resistance is within 5 percent of the specification.

- If not within the specified range, replace the B203 Engine Coolant Radiator Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Temperature Sensor Replacement - Water Outlet](#)

for Radiator Coolant Temperature Sensor replacement.

- [Control Module References](#) for ECM replacement, programming, and setup.

DTC P00B7: ENGINE COOLANT FLOW INSUFFICIENT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P00B7

Engine Coolant Flow Insufficient

Circuit Description

The engine control module (ECM) monitors the temperature of the engine radiator coolant. The ECM controls the thermostat with a pulse width modulated (PWM) signal. The ECM compares the radiator coolant temperature to the engine coolant temperature in order to determine if there sufficient coolant flow through the thermostat.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0116, P0117, and P0118 are not set.
- The engine run time is greater than 45 s.
- The engine coolant temperature is greater than 70°C (158°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and + 150Â°C (-40 and +302Â°F).

The ECM detects the difference between the RCT sensor and the ECT sensor is greater than 45Â°C (81Â°F) when the ECT sensor is warmer than 117Â°C (242Â°F) for greater than 5 s.

Action Taken When the DTC Sets

DTC P00B7 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P00B7 is a Type B DTC.

Diagnostic Aids

- The thermostat has a mechanical fail-safe in case of an electrical condition with the thermostat heater. The mechanical thermostat will open at approximately 80Â°C (176Â°F). The mechanical thermostat will cycle from approximately 85Â°C (185Â°F) to approximately 102Â°C (215Â°F).
- A resistance condition in the RCT sensor circuits may cause this DTC. This condition results in a greater voltage on the RCT sensor signal circuit, which is interpreted by the ECM as a colder RCT.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify DTC P00B3, P00B4, P00B6, P0116, P0117 or P0118 is not set.
 - **If the DTC is set.**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.
 - **If the DTC is not set.**
3. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.
 - **If a condition is found.**

Refer to Cooling System Draining and Filling, and Loss of Coolant.
 - **If a condition is not found.**
4. Verify the engine cooling fan operates when commanding the cooling fan to 90% and back to 20% with a scan tool.
 - **If the cooling fan does not operate**

Refer to [DTC P1485-P1487](#).

- **If the cooling fan operates**

5. Engine Running for 15 min with the A/C OFF.

NOTE: Depending on ambient temperature, it may take up to 4 minutes for the temperature to decrease less than the specified value.

6. Command the Engine Coolant Thermostat Heater to 100 percent with a scan tool, depress the accelerator pedal.

7. Verify the scan tool ECT Sensor parameter decreases to less than 85°C (185°F).

- **If ECT is warmer than 85°C (185°F)**

Refer to Circuit/System Testing.

- **If ECT is colder than 85°C (185°F)**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

9. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

10. All OK.

Circuit/System Testing

1. Vehicle OFF, inspect the cooling system for the conditions below. Refer to [Symptoms - Engine Cooling](#).

- Weak coolant solution
- Obstructed radiator air flow or bent radiator fins
- Blocked cooling system passages
- Radiator hoses that are restricted, collapsed, or deteriorated
- Damaged water pump and or belt
- Loss of cooling system pressure
 - Leaking surge tank cap
 - Radiator hoses
- Cylinder head or an engine block that is cracked or plugged
- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. Replace the Engine Coolant Thermostat.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Engine Coolant Thermostat Housing Replacement](#) for engine coolant thermostat replacement.

DTC P0597-P0599: ENGINE COOLANT THERMOSTAT HEATER CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0597

Engine Coolant Thermostat Heater Control Circuit

DTC P0598

Engine Coolant Thermostat Heater Control Circuit Low Voltage

DTC P0599

Engine Coolant Thermostat Heater Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0598*	P0030, P0036, P0102, P0135, P0137, P0141, P0458, P0598	-	-
Control	P0030, P0036, P0102, P0135, P0137, P0141, P0458, P0598	P0597	P0599, P0690	-

*Opens the fuse that supplies voltage to the engine coolant thermostat

Circuit/System Description

A wax pellet-type thermostat controls the flow of the engine coolant through the engine cooling system. The wax element of the thermostat expands and opens the thermostat when it is heated. The engine coolant thermostat heater uses an electric heating element to help heat the wax pellet opening the thermostat to increase cooling system performance during certain operation conditions. Ignition voltage is supplied directly to the thermostat heater through a fuse. If certain driving conditions are met the engine control module (ECM) controls the thermostat heater by providing a pulse width modulated (PWM) ground.

Conditions for Running the DTCs

- The ignition is ON, or the engine is running.
- The DTCs run continuously once the above condition is met

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 15 seconds.

Action Taken When the DTC Sets

- DTCs P0597, P0598, and P0599 are Type B DTCs.
- The engine control module commands the engine cooling fans ON.

Conditions for Clearing the DTC

DTCs P0597, P0598, and P0599 are Type B DTCs.

Diagnostic Aids

- A low engine coolant level could cause the thermostat heater to overheat and set a DTC.
- Without electric assist the wax pellet thermostat begins to open at 103Â° C (217Â° F) and is fully open at 117Â° C (243Â° F) when the electric energy not assisted.

The mechanical thermostat will open at approximately 80Â°C (176Â°F). The mechanical thermostat will cycle from approximately 85Â°C (185Â°F) to approximately 102Â°C (215Â°F).

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.

- **If a condition is found**

Refer to **Cooling System Draining and Filling**, and **Loss of Coolant**.

- **If a condition is not found**

2. Vehicle in Service Mode.
3. Verify the parameters listed below do not display Malfunction when commanding the Engine Coolant Thermostat Heater 0% - 100% with a scan tool.

- Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status
- Engine Coolant Thermostat Heater Control Circuit Open Test Status
- Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

4. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
5. Verify the DTC does not set.

- **If any DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the E41 Engine Coolant Thermostat Heater.
2. Vehicle in Service Mode
3. Verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.

-

1. Vehicle OFF, remove the test lamp, and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition circuit and ground
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
3. Replace the fuse, vehicle in Service Mode.
4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.
 - If the fuse is good, all OK.

- **If the test lamp illuminates**

4. Connect a test lamp between the ignition circuit terminal 1 and the control circuit terminal 2, command the Engine Coolant Thermostat Heater to Increase to 100 % and Decrease to 0 % with a scan tool.
5. Verify that a test lamp turns ON and OFF.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module

- **If the test lamp turns ON and OFF**

6. Test or replace the E41 Engine Coolant Thermostat Heater.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Coolant Thermostat Housing Replacement**
- **Control Module References** for control module replacement, programming, and setup

DTC P112F: RADIATOR COOLANT TEMPERATURE SENSOR NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P112F

Radiator Coolant Temperature Sensor Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00B3	P00B4	P00B4*	P112F
Low Reference	-	P00B4	P00B4*	P112F
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Radiator Coolant Temperature Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running in Closed Loop			
Parameter Normal Range: Varies with ambient temperature			
Signal	140Â°C (284Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The engine coolant radiator temperature sensor is a variable resistor that measures the temperature of the engine coolant in the radiator. The engine control module (ECM) supplies 5 volts to the engine coolant radiator temperature signal circuit and supplies a ground to the low reference circuit. The purpose of this diagnostic is to determine if the input from the RCT sensor is skewed warmer than normal. The internal clock of the ECM will record the amount of time the engine is OFF. If the required engine OFF time is met at start-up, the ECM will compare the temperature difference between the actual measured RCT and ECT sensors.

The following table illustrates the difference between temperature, resistance, and voltage:

RCT	RCT Resistance	RCT Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

- DTCs P00B3, P00B4, P0112, P0113, P0117, P0118, P0502, P0503, P111E or P2610 are not set.
- The vehicle has been OFF for greater than 8 hours before vehicle ON.

- The engine is running.
- The intake air temperature (IAT) is warmer than -7Â°C (19Â°F).
- The fuel level is greater than 10 percent.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM determines the absolute difference of temperature between the RCT start up temperature and ECT start up temperature is greater than 20Â°C (68Â°F).

Action Taken When the DTC Sets

DTC P112F is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P112F is a Type B DTC.

Diagnostic Aids

- As the thermostat opens, the radiator coolant temperature sensor signal should rise steadily, then stabilize once the thermostat opens completely.
- Inspect for the correct operation of the engine cooling system and verify the correct coolant level.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Radiator Coolant Temperature Sensor parameter is between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) and changes with engine run time.
 - **If not between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) or does not change**

Refer to Circuit/System Testing.

- **If between -39 to $+120^{\circ}\text{C}$ (-38 to $+248^{\circ}\text{F}$) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B203 Engine Coolant Radiator Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than $5\ \Omega$ between the low reference terminal 2 and ground.
 - **If $5\ \Omega$ or greater**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than $2\ \Omega$ in the low reference circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **If less than $5\ \Omega$**
3. Vehicle in Service Mode.
4. Verify the scan tool Radiator Coolant Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2, Vehicle in Service Mode.
6. Verify the scan tool Radiator Coolant Temperature Sensor parameter is warmer than 140°C (284°F).
 - **If colder than the 140°C (284°F)**
 1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If warmer than 140 $^{\circ}$ C (284 $^{\circ}$ F)**
7. Test or replace the B203 Engine Coolant Radiator Temperature Sensor.

Component Testing

1. Vehicle OFF, remove the B203 Engine Coolant Radiator Temperature Sensor.

NOTE: A thermometer can be used to the used to test the sensor off the vehicle.

2. Test the engine coolant radiator temperature sensor by varying the sensor temperature while measuring the sensor resistance. Compare the readings with the [Temperature Versus Resistance \(Radiator Coolant Temperature Sensor\)](#) table and verify that the resistance is within 5 percent of the specification.
 - If not within the specified range, replace the B203 Engine Coolant Radiator Temperature Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Engine Coolant Temperature Sensor Replacement - Radiator](#)
- [Control Module References](#) for control module replacement, setup, and programming

DTC P1485-P1487: COOLING FAN OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1485

Cooling Fan Output Circuit

DTC P1486

Cooling Fan Output Circuit Low Voltage

DTC P1487

Cooling Fan Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Output Circuit	P148B, P1486	P148A, P1485	P148C, P1487	-

Circuit/System Description

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. When propulsion is active, the engine control module (ECM) processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The ECM decides if and at what speed the cooling fans should operate. The ECM sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans without ECM intervention.

The ECM communicates the fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan speed signal circuit/hardwire circuit and also sends a redundant serial data signal. Since the hardwire circuit is an output from the ECM but an input to the hybrid/EV powertrain control module 2, each module has unique DTCs to monitor the same circuit.

Conditions for Running the DTC

- DTC P2537 is not set.
- The 12 V battery voltage is equal to or greater than 11 V.
- The accessory circuit is active for greater than 5 s.
- The DTCs run continuously when the conditions above are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the output circuit do not match for greater than 5 s.

Action Taken When the DTC Sets

DTCs P1485, P1486 and P1487 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1485, P1486 and P1487 are Type B DTCs.

Diagnostic Aids

DTCs P1485, P1486 and P1487 will not keep the cooling fans from operating. If one of these DTCs is set the HPCM 2 will command the cooling fans to 90%. If the cooling fans do not operate, refer to **DTC P148A-P148C** for further diagnosis.

Reference Information

Schematic Reference

Engine Heating/Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Hybrid Modes of Operation Description
- Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1485, P1486, P1487, P148A, P148B, or P148C is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.

NOTE: The cooling fan circuit is pulled up to a voltage within the ECM. 3 - 4 V measured on this circuit with the hybrid/EV powertrain control module 2 disconnected is normal.

2. Test for 3 - 4 V between the cooling fan circuit terminal 9 and ground.

- **If less than 3 V**

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the cooling fan circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If 4V or greater**

1. Vehicle OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the cooling fan circuit and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If 1 V or less, replace the K20 Engine Control Module.

- **If 3 - 4 V**

3. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
4. Reconnect the K114B Hybrid/EV Powertrain Control Module 2 connector X2.
5. Vehicle in Service Mode. Test for greater than 10 V between the signal circuit and ground.

- **If 10 V or less**

Replace the Hybrid/EV Powertrain Control Module 2.

- **If greater than 10 V**

6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for engine control module or hybrid powertrain control module 2 replacement, programming and setup

DTC P2181: ENGINE COOLING SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P2181

Engine Cooling System Performance

Circuit/System Description

The engine control module (ECM) monitors temperature difference between the engine coolant temperature (ECT) sensor and the radiator coolant temperature (RCT) sensor during a cold start-up. The purpose of this diagnostic is to analyze the engine coolant thermostat for being stuck open.

Conditions for Running the DTC

- DTCs P00B3, P00B4, P00B6, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117 or P0118 are not set.
- The vehicle has had a minimum ignition OFF time of 7 h.
- The engine run time is between 50 s and 23 min.
- The engine coolant temperature (ECT) sensor at start-up is between -10°C and 59°C (14°F and 138°F).
- The intake air temperature (IAT) sensor is between -7°C and 60°C (19°F and 140°F).
- The Engine Coolant Thermostat Heater Command is less than 50 %.
- The Ethanol in the fuel is less than 87 %.
- The airflow into the engine is between 1 and 100 g/s.
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

The ECM detects the engine coolant thermostat is stuck open for at least 2.5 min.

Action Taken When the DTC Sets

DTC P2181 is a Type B DTC

Conditions for Clearing the DTC

DTC P2181 is a Type B DTC

Diagnostic Aids

- Insufficient vehicle interior heating is an indication of improper thermostat operation.
- The scan tool Desired ECT Sensor and the ECT Sensor parameters should be within 5°C (41°F) when the engine is at operating temperature.
- A resistance condition in the ECT sensor circuits may cause this DTC. This condition results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Cooling System Description and Operation](#)
- [Hybrid Modes of Operation Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify DTC P00B3, P00B4, P00B6, P0116, P0117, P0118, or P0119 is not set.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **If the DTC is not set**
3. Verify the coolant in the radiator surge tank is at the correct level and there are no engine coolant leaks.
 - **If a condition is found**

Refer to [Cooling System Draining and Filling](#), and [Loss of Coolant](#).
 - **If a condition is not found**
4. Engine Running for 15 min with the A/C OFF.
5. Command the Engine Coolant Thermostat Heater to 0 % with a scan tool, depress the accelerator pedal for 5 min.
6. Verify the scan tool ECT Sensor parameter is between 80Â° C and 102Â° C (176Â° F and 215Â° F).
 - **If ECT sensor parameter is not between 80Â° C and 102Â° C (176Â° F and 215Â° F)**

Replace the engine coolant thermostat.
 - **If ECT sensor parameter is between 80Â° C and 102Â° C (176Â° F and 215Â° F)**
7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
8. Verify the DTC does not set.

- **If the DTC sets**

Refer to step 1.

- **If the DTC does not set**

9. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Engine Coolant Thermostat Housing Replacement](#) for engine coolant thermostat replacement.

SYMPTOMS - ENGINE COOLING

Important Preliminary Inspections Before Starting

Before using the Symptom diagnosis, perform the following:

- Perform [Diagnostic System Check - Vehicle](#) and verify all of the following items:
 - Ensure that the engine control module (ECM) and indicator lamp are operating correctly.
 - Ensure that there are no diagnostic trouble codes (DTCs) that are stored.
 - Scan tool data is within a normal operating range.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.
- Locate the correct symptom. Perform the tests and inspections associated with the symptom.

Review the entire cooling system operation in order to familiarize yourself with the system functions. Refer to [Cooling System Description and Operation](#), and [Hybrid/EV Cooling System Description and Operation](#).

Visual/Physical Inspection

CAUTION: Use the connector test adapter kit EL-35616-F for any test that requires probing the following items:

- **The control module harness connectors**
- **The electrical center fuse/relay cavities**
- **The component terminals**
- **The component harness connector**

Using this kit will prevent damage caused by the improper probing of connector terminals.

Several of the symptom procedures call for a careful visual and physical inspection. This can lead to correcting a condition without further tests and can save time. This inspection should include the following areas:

- Ensure that all control module grounds are clean, tight, and correctly located.

- Inspect cooling system hoses and pipes for splits, kinks, and proper connections. Inspect thoroughly for any type of a leak or a restriction.
- Inspect for a dirty or restricted engine cooling radiator and HVAC condenser.
- Inspect for aftermarket devices which could affect the operation of the Cooling System.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the surge tank reservoirs for the proper coolant level.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movement of a component. Refer to the following for a list to help isolate an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Connector mating
- Terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness' that are routed too tight, or chaffed circuits
- High or low ambient temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surface
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of non-factory, aftermarket, and after factory add on accessories

If an intermittent is detected, refer to [**Testing for Intermittent Conditions and Poor Connections**](#) for specific strategies in diagnosing intermittent conditions.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [**DTC P148A-P148C**](#)
- [**Engine Overheating**](#)
- [**Loss of Coolant**](#)
- [**Thermostat Diagnosis**](#)
- [**Engine Fails To Reach Normal Operating Temperature**](#)

COOLING FAN INOPERATIVE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

The engine cooling fan system is composed of one electric cooling fan and a cooling fan control module. The engine control module (ECM) controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module. The cooling fan control module varies the voltage drop across the cooling fan motor in relation to the pulse width modulated signal, which enables cooling fan operation at variable speeds. The ECM will only operate the cooling fan at certain percentages to prevent undesirable noise and vibration. The cooling fan control module is thermally protected to prevent module damage in the case of a short circuit condition in the cooling fan motor.

Diagnostic Aids

- The cooling fan will not operate when the scan tool Cooling Fan Motor Command parameter displays less than 4 %. This is a normal condition.
- A delay or ramp up of approximately 12 seconds may occur before the cooling fan activates or changes speed when being commanded with a scan tool.
- The cooling fan Control Function operates as described below when the ignition is ON, and engine is OFF:
 - Command State 1 operates the cooling fan at approximately 18 %
 - Command State 2 operates the cooling fan at approximately 54 %
 - Command State 3 operates the cooling fan at approximately 67 %
 - Command State 4 operates the cooling fan at approximately 85 %
 - Command State 5 operates the cooling fan at approximately 90 %
- During normal operating conditions the ECM may initially activate the cooling fan at 4 or 5 % and then increase to the percentages indicated above, as needed, to satisfy powertrain cooling requirements. Generally, the ECM will operate the cooling fan at the specified percentages but, may scale the percentages either higher or lower in response to generator demand.
- When operating the cooling fan with a scan tool, the Commanded States 1 - 5 should be exercised in order, from OFF to High or High to OFF. The cooling fan control module may disable the cooling fan if a Commanded State is skipped.

Reference Information

Schematic Reference

[Engine Heating/Cooling Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Cooling Fan Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P01485 - P1487

- **If a DTC is set**

Refer to **DTC P1485-P1487**.

- **If no DTC is set.**

NOTE: A slight delay may occur before the cooling fan activates.

3. Verify the G10 Cooling Fan Motor activates and increases in speed with each command using a scan tool.
- **The cooling fan does not activate or increase in speed**

Refer to Circuit/System Testing

- **The cooling fan activates and increases in speed**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector G10 Cooling Fan Motor.
2. Verify that a test lamp illuminates between the ground circuit terminal 2 and B+.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If the test lamp illuminates**
3. Test or replace the G10 Cooling Fan Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [Engine Coolant Fan Shroud Replacement](#) for G10 Cooling Fan Motor replacement.
- [Control Module References](#)

ENGINE OVERHEATING

Step	Action	Yes	No
DEFINITION: The engine temperature lamp comes on and stays on, or temperature gauge shows hot, or coolant overflows from the coolant recovery reservoir onto the ground while the engine is running. Special Tools GE-26568 Coolant and Battery Fluid Tester Equivalent regional tools: Special Tools			
1	Check the condenser, radiator, and auxiliary coolers for any obstructions or bent fins that would prevent air flow through the radiator. Is there any airflow obstruction or bent fins?	Go to Step 2	Go to Step 3
2	1. Remove any debris that may cause an air flow obstruction. 2. Remove or relocate aftermarket add-on components that block air flow to the radiator. Does the engine still overheat?	Go to Step 3	System OK
3	Check for loose, missing, or damaged radiator air seals or deflectors. Are there any loose, missing, or damaged radiator air seals or deflectors?	Go to Step 4	Go to Step 5
4	Repair or replace any loose, missing, or damaged radiator air seals or deflectors. Does the engine still overheat?	Go to Step 5	System OK
5	Check for an inoperative cooling fan. Is the cooling fan inoperative?	Go to Step 6	Go to Step 7
6	Repair or replace the cooling fan(s) as necessary. Refer to Engine Coolant Fan Shroud Replacement . Does the engine still overheat?	Go to Step 7	System OK
7	Check for a loss of coolant. Refer to Loss of Coolant . Does the engine still overheat?	Go to Step 8	System OK
8	Check for kinked or pinched cooling hoses. Does the engine still overheat?	Go to Step 9	Go to Step 10
9	1. Relieve any kinks by rerouting the hoses. 2. Replace the hoses, if necessary. Does the engine still overheat?	Go to Step 10	System OK

Step	Action	Yes	No
10	Using GE-26568 Coolant and Battery Fluid Tester, check the coolant concentration. Does the coolant concentration test correctly?	Go to Step 12	Go to Step 11
11	Replace the coolant, if necessary. Refer to Cooling System Draining and Filling . Does the engine still overheat?	Go to Step 12	System OK
12	Check for any blocked cooling system passages. Are there blocked cooling system passages?	Go to Step 13	Go to Step 14
13	Remove any obstructions by flushing the cooling system. Refer to Flushing . Does the engine still overheat?	Go to Step 14	Go to Step 19
14	Inspect the water pump drive belt. Does the engine still overheat?	Go to Step 15	System OK
15	Check for a faulty thermostat. Refer to Thermostat Diagnosis . Does the engine still overheat?	Go to Step 16	System OK
16	Replace the radiator. Refer to Radiator Replacement . Does the engine still overheat?	Go to Step 17	System OK
17	Check for a faulty water pump. The impeller blades may be eroded or broken. Is the water pump faulty?	Go to Step 18	-
18	Replace the water pump. Refer to Water Pump Replacement . Does the engine still overheat?	Go to Step 19	-
19	Operate the system to verify the repair. Did you correct the condition?	System OK	-

LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The cooling system is losing coolant either internally or externally.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - Engine Cooling
2	Repair any present DTCs. Refer to Diagnostic System Check - Vehicle . Is the action complete?	Go to Step 3	-
3	Inspect the coolant level. Is the coolant at the proper level?	Go to Step 5	Go to Step 4
4	Fill the cooling system to the proper level. Refer to Cooling System Draining and Filling . Is the action complete?	Go to Step 5	-
5	If the engine is suspected to have a coolant leak into a cylinder, the coolant can hydraulically lock the engine. Does the engine crankshaft rotate?	Go to Step 6	Go to Step 27

Step	Action	Yes	No
6	Engine overheating can cause a loss of coolant. Is the engine overheating?	Go to Step 28	Go to Step 7
7	Extended operation with a low coolant level can cause engine internal component failure. Is the engine knocking?	Go to Step 30	Go to Step 8
8	1. Idle the engine at normal operating temperature. 2. Inspect for heavy white smoke coming out of the exhaust pipe. Is a heavy white smoke present from the exhaust pipe?	Go to Step 9	Go to Step 10
9	Coolant in the exhaust system creates a distinctive, burning coolant odor in the exhaust. Condensation in the exhaust system can cause an odorless white smoke during engine warm up. Does the white smoke have a burning coolant type odor?	Go to Step 29	Go to Step 10
10	WARNING: Refer to <u>Moving Parts and Hot Surfaces Warning</u> . With the engine idling, inspect the coolant recovery system. Does the coolant recovery system discharge coolant while the engine is idling?	Go to Step 15	Go to Step 11
11	Visually inspect the hoses, pipes and hose clamps at the following locations: • The coolant surge tank • The heater core • The radiator Are any of the hoses, clamps or pipes leaking?	Go to Step 21	Go to Step 12
12	Visually inspect the following components: • The coolant pressure cap • The core plugs • The cylinder head gaskets • The engine block • The intake manifold • The radiator • The thermostat housing	Go to Step 21	Go to Step 13

Step	Action	Yes	No
	The water pump Are any of the listed components leaking?		
13	1. Pressure test the cooling system. Refer to Cooling System Leak Testing. 2. With the cooling system pressurized, visually inspect the components listed in steps 11 and 12. Are any leaks present?	Go to Step 21	Go to Step 14
14	Pressure test the coolant pressure cap. Does the coolant pressure cap hold pressure?	Go to Step 16	Go to Step 22
15	Pressure test the coolant pressure cap. Does the coolant pressure cap hold pressure?	Go to Step 31	Go to Step 22
16	Inspect for the following conditions: - A coolant smell inside of the vehicle - Coolant in the HVAC module drain tube - Coolant on the vehicle floor covering near the HVAC module Is coolant present?	Go to Step 23	Go to Step 17
17	Check the carbon dioxide in the cooling water. Refer to Cooling System Leak Testing. Are any leaks present?	Go to Step 29	Go to Step 18
18	Inspect the underside of the engine oil fill cap for a gray/white milky substance. Is a milky substance under the oil fill cap?	Go to Step 19	Go to Step 20
19	Inspect the engine oil fluid level indicator for a gray/white milky substance. Is a milky substance on the engine oil fluid level indicator?	Go to Step 29	Go to Step 20
20	Inspect the automatic transmission oil fluid level indicator, if equipped, for a gray/white milky substance. Is there a milky substance on the automatic transmission fluid level indicator?	Go to Step 24	Go to Step 32
21	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to Step 32	-
22	Replace the coolant pressure cap. Is the repair complete?	Go to Step 32	-

Step	Action	Yes	No
23	Replace the heater core. Refer to Heater Core Replacement . Is the repair complete?	Go to Step 32	-
24	1. Remove the transmission oil cooler lines from the radiator. 2. Pressure test the cooling system. Refer to Cooling System Leak Testing . 3. Inspect the transmission oil cooler for coolant. Is coolant present?	Go to Step 25	Go to Step 26
25	1. Replace the radiator. Refer to Radiator Replacement . 2. Service the automatic transmission. Is the repair complete?	Go to Step 32	-
26	Install the cooler lines to the radiator. Is the action complete?	Go to Step 32	-
27	Repair the engine no crank condition. Is the repair complete?	Go to Step 32	-
28	Repair the engine overheating condition. Is the repair complete?	Go to Step 32	-
29	Repair the engine internal coolant leak. Is the repair complete?	Go to Step 32	-
30	Repair the engine knock. Is the repair complete?	Go to Step 32	-
31	Repair the combustion pressure in the cooling system problem. Is the repair complete?	Go to Step 32	-
32	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

THERMOSTAT DIAGNOSIS

Step	Action	Values	Yes	No
The Procedure is ONLY valid for a mechanical opening without a electrical heating.				
1	1. Pressure test the cooling system and the cap for leaks. 2. Repair any leaks before proceeding. These engines use a 97Â°C (207Â°F) thermostat. The ambient temperatures should be within the specified range given. 3. Set the HVAC controls in the OFF position.	13 - 38Â°C (55 - 100Â°F)	System OK	Go to Step 2

Step	Action	Values	Yes	No
	4. Run the cold engine at idle 20Â°C - 21Â°C (68 - 70Â°F) for 15-20 minutes before checking the engine temperature. 5. Check the engine coolant temperature at idle with the scan tool. Is the engine coolant temperature (ECT) between 97 - 112Â°C (207 - 234Â°F)?			
2	Is the ECT below 97Â°C (207Â°F)?	-	Go to Step 3	Go to Step 4
3	The thermostat is opening early, or the thermostat seal is leaking. Replace the thermostat and the thermostat seal. Is the repair complete?	-	System OK	-
4	Is the ECT over 112Â°C (234Â°F)?	-	Go to Step 5	-
5	Is the radiator inlet hot?	-	Go to Step 6	Go to Step 7
6	1. Turn ON the heater. 2. Check if hot air is coming from the heater outlets. Is the air hot?	-	Go to Step 11	Go to Step 12
7	There may be air in the system. 1. Add coolant to the surge tank if the coolant level is low. Refer to Cooling System Draining and Filling. 2. Recheck the radiator inlet hose. Is the inlet hose hot?	-	Go to Step 6	Go to Step 8
8	Inspect for blockage in the following areas: • The cylinder head • The radiator • The radiator hoses Is there a blockage?	-	Go to Step 9	Go to Step 10
9	1. Repair the blockage. 2. Recheck the coolant temperature with the scan tool. Is the repair complete?	-	System OK	-
10	1. Replace the thermostat housing. Refer to Engine Coolant Thermostat Housing	-	System OK	-

Step	Action	Values	Yes	No
	<u>Replacement.</u> 2. Recheck the coolant temperature with the scan tool. Is the repair complete?			
11	Inspect for blockage in the radiator. Is there any blockage?	-	Go to Step 9	Go to Step 10
12	1. Accelerate the engine several times in order to remove any air from the system. 2. Inspect for blockage in the heater circuit. 3. Inspect for any pinched or buckled hoses. Is there any blockage?	-	Go to Step 9	Go to Step 13
13	Is the repair complete?	Å	System OK	-

ELECTRICALLY HEATED THERMOSTAT DIAGNOSIS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The engine cooling system electrically heated thermostat is an integrated part of the thermostat housing. It is not serviced separately. The thermostat contains a wax pellet which expands when electrically energized. The ECM energizes the wax pellet during full load driving, or, when the engine coolant or the ambient temperature is higher. This causes the thermostat to open earlier than it would without electrical assistance.

During normal engine operation, the thermostat begins to open mechanically at 78Å° C (172Å° F). When coolant temperature reaches or exceeds 80Å° C (176Å° F), the ECM begins to energize the wax pellet to try to maintain coolant temperature at 78Å° C (172Å° F).

Diagnostic Aids

- A radiator or AC condenser with bent fins or obstructed air flow passages may cause the engine coolant temperature to be too hot.
- An incorrect engine coolant mixture may cause the engine coolant to boil at low temperature.
- An engine coolant mixture that is contaminated with debris may adversely affect the operation of the cooling system components. Verify that the coolant mixture is not contaminated.
- An engine cooling system that has been incorrectly filled or serviced may have air trapped within the system. If the system contains air, the coolant level may appear to be correct while it is actually incorrect. To avoid misdiagnosis, it may be necessary to verify that no conditions have occurred that may cause the cooling system to contain trapped air.
- For accurate test results, allow the vehicle to stabilize in an environment where ambient temperature is

between 10 - 27Â° C (50 - 80Â° F) for 8 hours prior to testing.

Reference Information

Schematic Reference

- [Engine Controls Schematics](#)
- [Engine Heating/Cooling Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cooling System Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition ON/ Vehicle in Service Mode.
2. Verify that DTC P00B3, P00B4, P00B6, P00B7, P0116, P0117, P0018, P0119, P0128, P0597, P0598, P0599, or P2181 is not set.
 - **If DTC P00B3, P00B4, P00B6, P00B7, P0116, P0117, P0018, P0119, P0128, P0597, P0598, P0599, or P2181 is set.**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If DTC P00B3, P00B4, P00B6, P00B7, P0116, P0117, P0018, P0119, P0128, P0597, P0598, P0599, or P2181 is not set.**
3. Verify the coolant reservoir contains the correct level of engine coolant.
 - **If the coolant level is low**

Fill the coolant reservoir to the correct level and pressure test the cooling system and the coolant reservoir cap for a leak. Refer to [Cooling System Draining and Filling](#), and [Cooling System Leak Testing](#). If a leak is found, repair as necessary.
 - **If the coolant level is not low**
 4. Verify the G10 Cooling Fan Motor activates in each available speed when commanding the cooling fan

ON with a scan tool. The cooling fan speed should increase with each command.

- **If the cooling fan does not activate or increase in speed as commanded**

Refer to [Cooling Fan Inoperative](#)

- **If the cooling fan activates and increases in speed as commanded**

5. Close the hood and set the HVAC controls to the OFF position.
6. Start the engine and warm the engine up to operating temperature.
7. Verify the scan tool ECT Sensor parameter displays between 101 - 120Â° C (214 - 248Â° F) while the engine is running.

- **If 121Â° C (249Â° F) or greater**

Refer to Circuit/System Testing - Engine Coolant Temperature too High.

- **If 90Â° C (194Â° F) or less.**

Refer to Circuit/System Testing - Engine Coolant Temperature too Low.

- **If between 101 - 120Â° C (214 - 248Â° F).**

8. All OK.

Circuit/System Testing

NOTE: For accurate test results, allow the vehicle to stabilize in an environment where ambient temperature is between 10 - 27Â° C (50 - 80Â° F) for 8 hours prior to testing.

Engine Coolant Temperature too High

1. Start the engine and verify the HVAC controls are set to the OFF position.

NOTE: The cooling fan should automatically turn ON when you select Engine Coolant Thermostat Heater.

2. With the scan tool, navigate to Control Functions and select Engine Coolant Thermostat Heater and Cooling Fan. Verify the engine cooling fan turns ON when Engine Coolant Thermostat is selected.
3. Verify the hood is closed.
4. Engine running at 1, 600 RPM, note or record the ECT Sensor parameter value.

NOTE:

- An engine cooling system that has been incorrectly filled or serviced may have air trapped within the system. If the system contains air, the coolant level may appear to be correct while it is actually incorrect. For accurate test results, it may be necessary to verify that no conditions have occurred that may cause the system to contain trapped air.
- Depending on ambient temperature, it may take up to 4 minutes for the temperature to decrease 10Â°C (18Â°F) or greater.

- The ECT Sensor parameter value may increase between 3 - 5°C (2 - 9°F) at first. It should then decrease 10°C (18°F) or greater and stabilize.

5. Engine at 2,000 RPM, verify the ECT Sensor parameter decreases by 10°C (18°F) or greater while commanding the scan tool Engine Coolant Thermostat Heater to 100 %.

- If the parameter does not decrease by 10°C (18°F) or greater

Inspect for the conditions listed below and repair as necessary. Refer to [Symptoms - Engine Cooling](#) for additional information.

- Restricted/plugged radiator
- Restricted/plugged radiator hoses
- Restricted/plugged cylinder head
- Restricted/plugged heater core or heater hoses
 - If none of the conditions listed above exist, replace the E41 Engine Coolant Thermostat.

NOTE: If the thermostat is intermittently sticking closed, it may be necessary to repeat the Circuit/System Verification and Circuit/System Testing.

- If the parameter decreases by 10°C (18°F) or greater

6. All OK.

Engine Coolant Temperature too Low

NOTE: For accurate test results, allow the vehicle to stabilize in an environment where ambient temperature is between 10 - 27°C (50 - 80°F) for 8 hours prior to testing.

NOTE: Information for the following test may be in GDS stored data from the Circuit/System Verification.

1. Verify the hood is closed.
2. Start the engine and set the HVAC controls to the OFF position.
3. Engine idling, verify the scan tool ECT Sensor parameter reaches between 90 - 100°C (194 - 212°F) within the guidelines listed below:
 - At 27°C (80°F) ambient temperature, the parameter should reach 85°C (185°F) in 18 minutes or less.
 - At 20°C (68°F) ambient temperature, the parameter should reach 85°C (185°F) in 22 minutes or less.
 - At 10°C (50°F) ambient temperature, the parameter should reach 85°C (185°F) in 26 minutes or less.
 - If the parameter does not display 85°C (185°F) within the guidelines listed above

Replace the E41 Engine Coolant Thermostat.

- If the parameter displays between 85Â° C (185Â° F) within the guidelines listed above

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Engine Coolant Thermostat Housing Replacement

ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE

Step	Action	Yes	No
1	Check the coolant level in the radiator surge tank. Refer to Cooling System Draining and Filling . Is the coolant at the proper level?	Go to Step 3	Go to Step 2
2	Add coolant to the radiator surge tank as necessary. Does the engine still fail to reach normal operating temperatures?	Go to Step 3	System OK
3	Check for a blockage in the coolant passages. Are there any blockages in the coolant passages?	Go to Step 4	Go to Step 5
4	Flush the cooling system or flow check the radiator. Does the engine still fail to reach normal operating temperatures?	Go to Step 5	System OK
5	Check to see if the incorrect thermostat was installed or if it is stuck or sticks in the open position. Was the incorrect thermostat installed, or is it stuck or does it stick in the open position?	Go to Step 6	-
6	Replace the thermostat. Refer to Engine Coolant Thermostat Housing Replacement . Does the engine still fail to reach normal operating temperature?	-	System OK

PRESSURE CAP TESTING

Special Tools

- GE-42401-A Radiator Cap and Surge Tank Test Adapter
- EN-24460-A Cooling System Pressure Tester

Equivalent regional tools:[Special Tools](#)

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

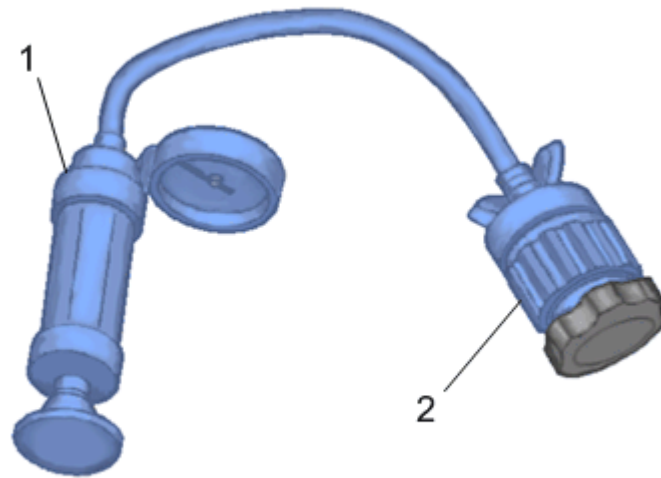


Fig. 2: Identifying Pressure Cap Tester

Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate GE-42401-A radiator cap and surge tank test adapter and pressure cap O-rings with coolant and press cap to seat O-ring on GE-42401-A radiator cap and surge tank test adapter before turning to engage threads.

3. Use the **EN-24460-A** cooling system pressure tester (1) with **GE-42401-A** radiator cap and surge tank test adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
 - Pressure release when the **EN-24460-A** cooling system pressure tester exceeds the pressure rating of the pressure cap.
 - Maintain the rated pressure for at least 10 seconds.Note the rate of pressure loss.
5. Replace the pressure cap under the following conditions:
 - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
 - The pressure cap does not hold the rated pressure.

COOLING SYSTEM LEAK TESTING

Special Tools

GE-42401-A Radiator Cap and Surge Tank Test Adapter

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.

WARNING: In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to [Pressure Cap Testing](#).
3. Wash the pressure cap mating surface with water.

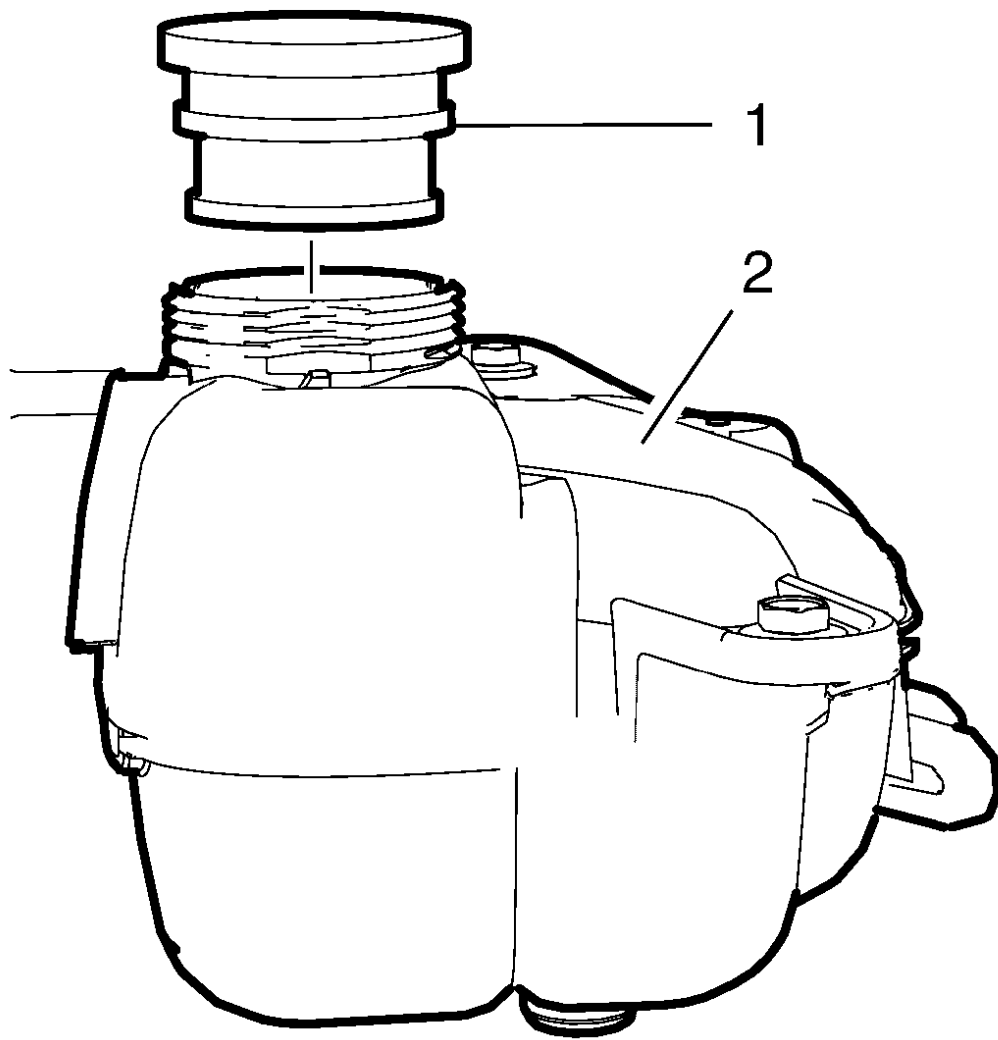


Fig. 3: J-42401-2 Pressure Test Adapter And Coolant Recovery Reservoir
Courtesy of GENERAL MOTORS COMPANY

4. Install the **GE-42401-2** pressure test adapter (1) to the coolant recovery reservoir (2) to plug the reservoir bleeder gallery.

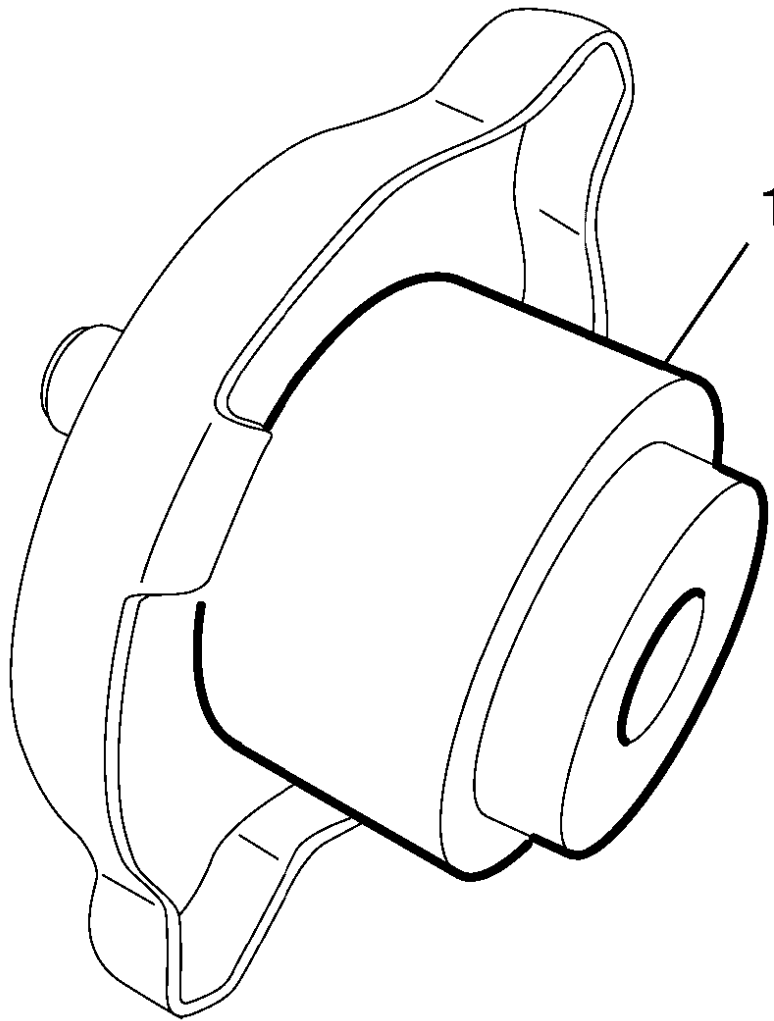


Fig. 4: Cooling System Pressure Adapter

Courtesy of GENERAL MOTORS COMPANY

5. Use a commercial cooling system pressure adapter (1) and moisten the rubber with coolant fluid.

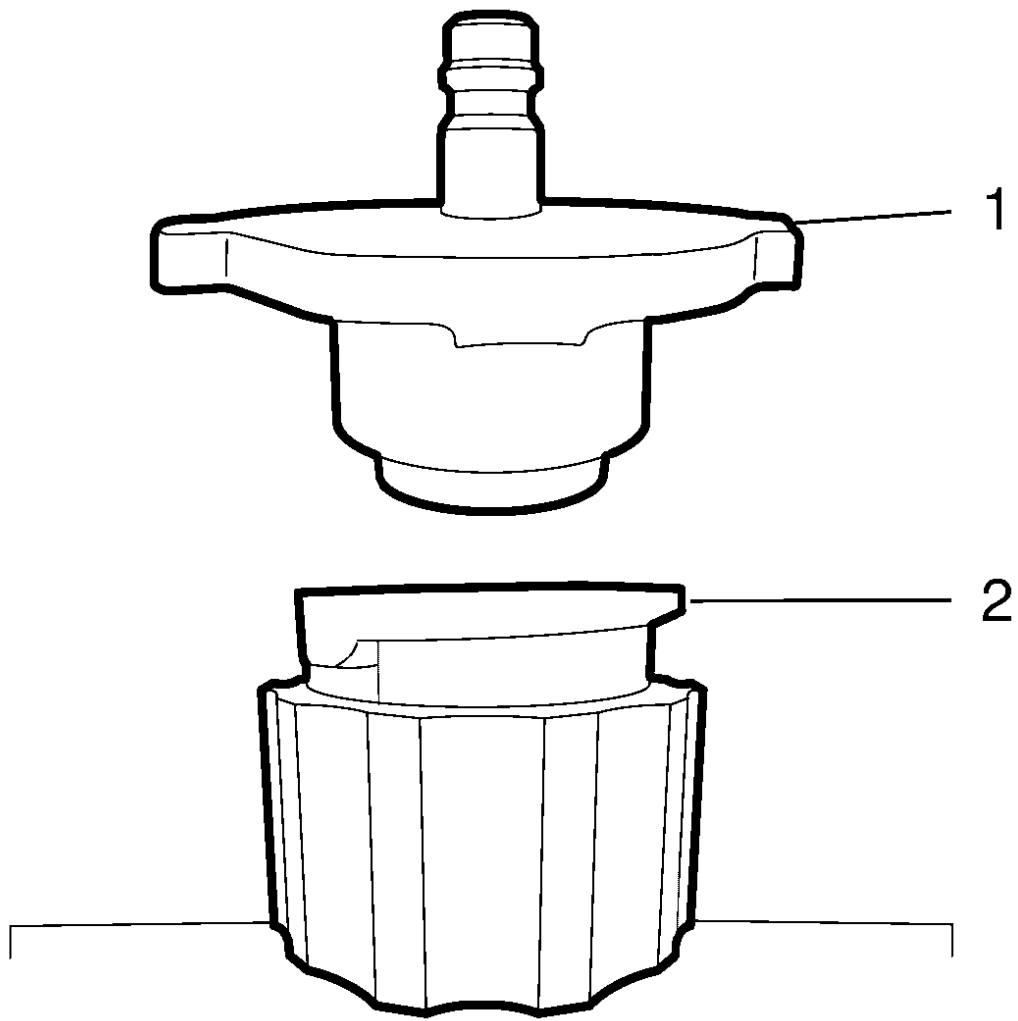


Fig. 5: Commercial Adapter And Adapter

Courtesy of GENERAL MOTORS COMPANY

6. Install the commercial adapter (1) to the **GE-42401-3** adapter (2). Use a suitable underlay to be able to use enough force. Inspect the assembly for proper seat then.

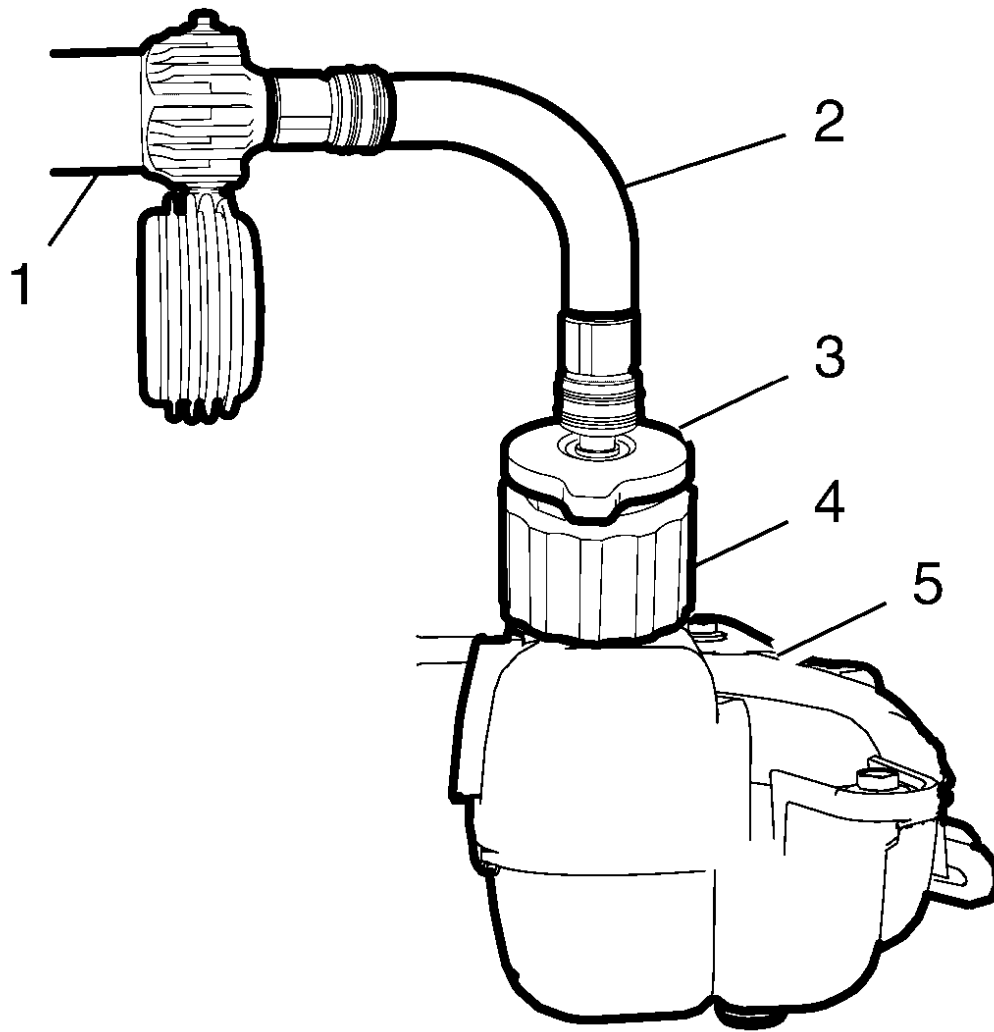


Fig. 6: Commercial Cooling System Pressure Tester, Assembled Adapters and Coolant Recovery Reservoir

Courtesy of GENERAL MOTORS COMPANY

7. Install the assembled adapters (3, 4) to the coolant recovery reservoir (5).
8. Install a commercial cooling system pressure tester (1, 2) to the commercial adapter.

NOTE: Do NOT exceed the pressure cap rating.

9. Using the pressure tester apply pressure to the cooling system.
10. Observe the gage of the pressure tester for any loss.
11. The cooling system should hold the rated pressure for at least 2 minutes.
12. Repair any leaks as required.

REPAIR INSTRUCTIONS

HOSE CLAMP REPLACEMENT GUIDELINES - SPRING TYPE

Special Tools

- **BO-38185** Hose Clamp Pliers
- **GE-47622** Hose Clamp Pliers.

Equivalent regional tools: [Special Tools](#)

Spring Type Hose Clamp Replacement Guidelines

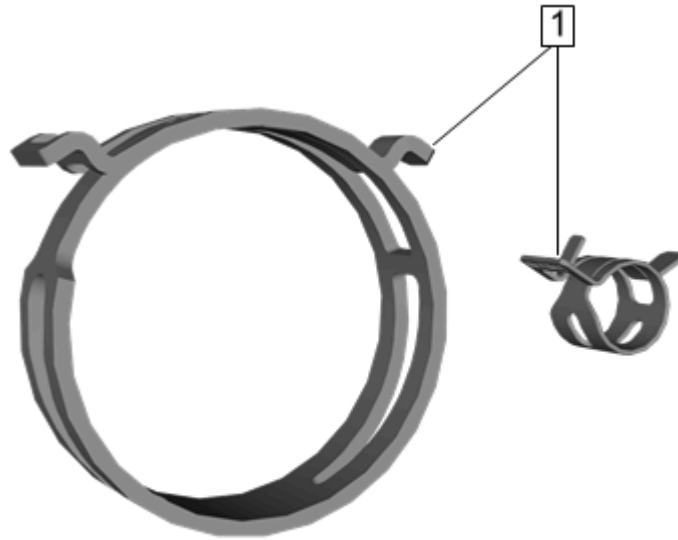


Fig. 7: Spring Type Hose Clamps

Courtesy of **GENERAL MOTORS COMPANY**

Vehicles utilize spring type hose clamps (1) to secure joints in which fluids, gases, or engine vacuum can travel to various vehicle systems. Spring type hose clamps are engineered to provide the proper amount of tension to maintain a leak & maintenance free joint for the life of the vehicle.

Spring type hose clamps have a special coating applied to the exterior of the clamp that is engineered to resist rust/corrosion, improve durability and increase the life of the hose clamp. If the coating is damaged, rust/corrosion could form resulting in the need to replace the hose clamp.

Many spring type hose clamps within GM utilize a small amount of adhesive placed directly on the hose clamp to secure the clamp to the mating hose for manufacturing purposes. Over time the strength of the adhesive will deteriorate. It is extremely important when a technician is attempting to service a joint or remove the hose clamp, that the clamp is not rotated or repositioned so that it tears and/or damages the hose. In this case, the hose and clamp must both be replaced.

When repairing a vehicle it is very important to observe the condition of both the hose and the spring type hose clamp as well as the orientation of the clamp to the hose.

If the spring type hose clamp(s) have any of the following conditions on any area of the clamp, replace the

clamp(s) immediately.

- Rust/Corrosion
- Cracks
- Physical damage
- Leakage attributed to the retention of the clamp

Removing The Spring Type Hose Clamp

While keeping the hose stationary, use BO-38185 Hose Clamp Pliers or GE-47622 Hose Clamp Pliers and release the spring type hose clamp tension while attempting to separate the hose clamp from the hose.

- If the spring type hose clamp will not easily separate from the hose and/or the clamp tears or damages the hose, both the hose and hose clamp must be replaced
- If the spring type hose clamp is easily removed from the hose, the clamp can be reused provided that the clamp does not have any of the conditions as noted above.

If The Spring Type Hose Clamp Is Being Reused

It is extremely important that the spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Reusing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Reusing The Spring Type Hose Clamp with an Existing Hose

Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where the hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

If The Spring Type Hose Clamp Is Being Replaced

If the hose clamp needs to be replaced, always replace the hose as part of the service repair. It is extremely important that a new spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Replacing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Replacing The Spring Type Hose Clamp with an Existing Hose

Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where a hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

COOLING SYSTEM DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **GE-42401-A** Radiator Cap and Surge Tank Test Adapter

Equivalent regional tools: [Special Tools](#)

Draining Procedure

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

1. To drain the engine radiator, remove the radiator drain cock from the radiator. Refer to [Radiator Drain Cock Replacement](#).

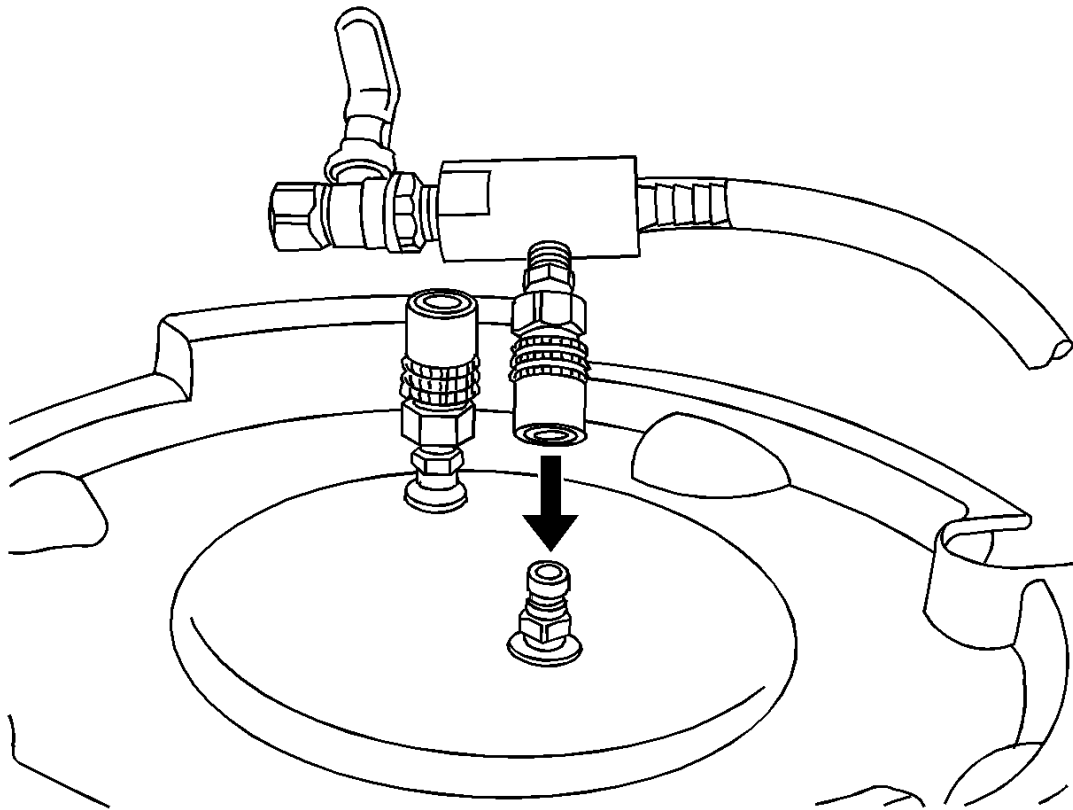


Fig. 8: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

2. Attach the venturi assembly to the vacuum tank.

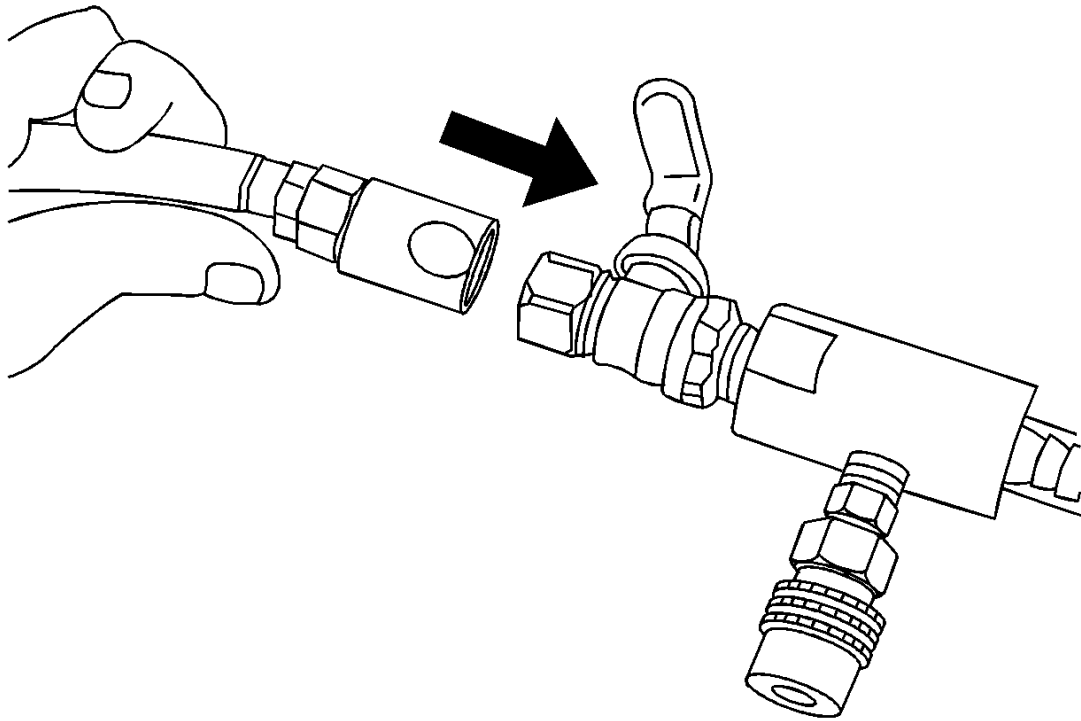


Fig. 9: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Attach a shop air hose to the venturi assembly.

Ensure the valve on the venturi assembly is closed.

4. Attach the vacuum hose to the vacuum tank.

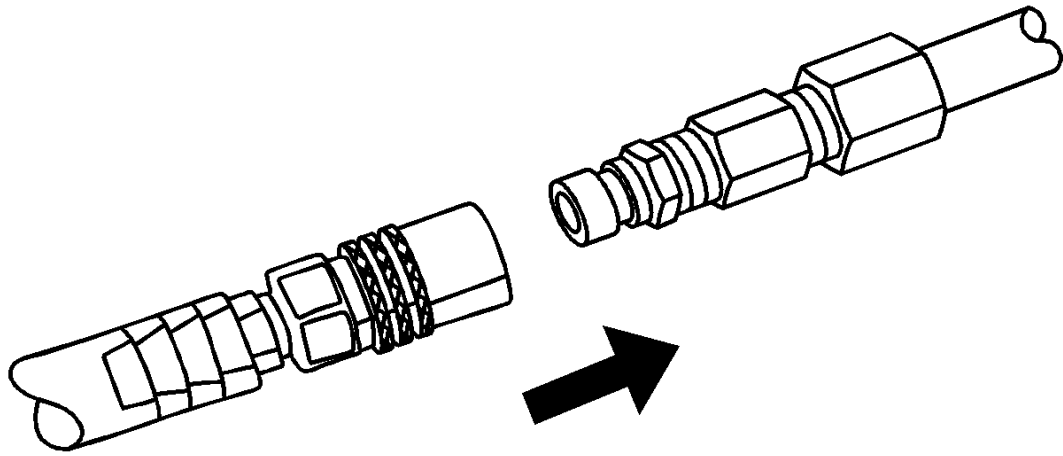


Fig. 10: Attaching Extraction Hose To Vacuum Hose

Courtesy of GENERAL MOTORS COMPANY

5. Attach the extraction hose to the vacuum hose.
6. Insert the extraction hose into the radiator outlet front hose until the extraction hose contacts the bottom of the radiator outlet hose.

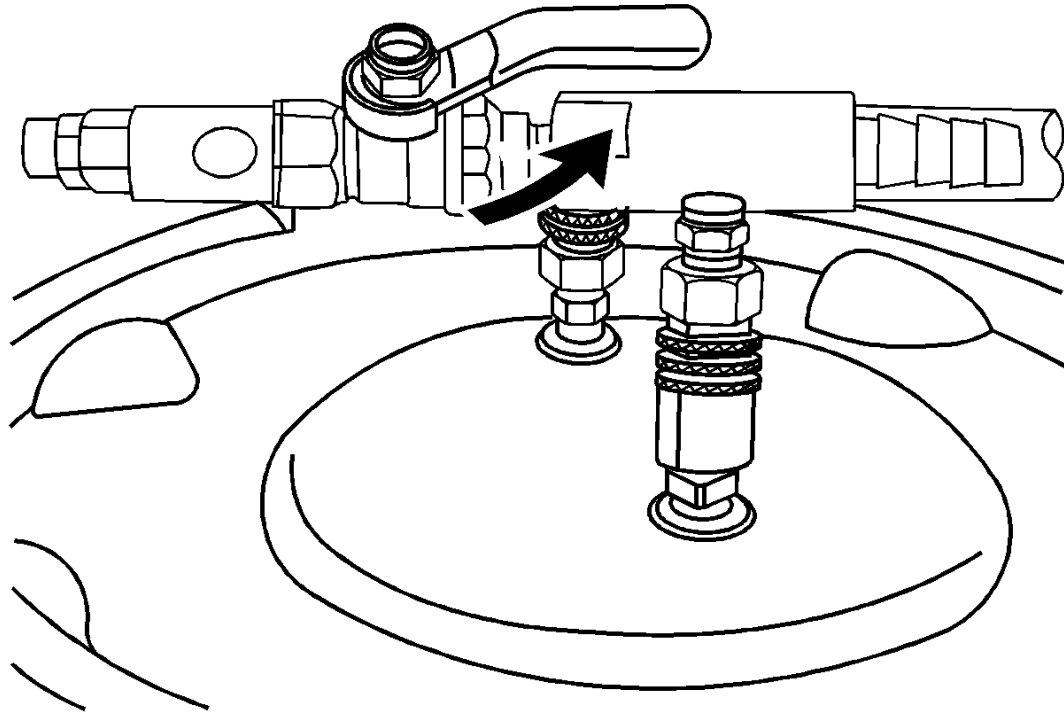


Fig. 11: Identifying Valve On Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

7. Open the valve on the venturi assembly to start a vacuum draw.
8. Use the extraction hose to draw out coolant until the radiator is empty.
9. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.
10. If a complete engine block drain is required, remove the engine block drain plug.
11. To drain the heater cooling loop, remove the heater inlet hose from the heater cooling heater. Refer to [Heater Inlet Hose Replacement](#) .
12. Inspect the coolant.
13. Follow the appropriate procedure based on the condition of the coolant.
 - Normal in appearance--Follow the filling procedure.
 - Discolored--Follow the flush procedure. Refer to [Flushing](#)
14. After draining the system:
 1. Install [Radiator Drain Cock Replacement](#)
 2. Install [Heater Inlet Hose Replacement](#)

Vac-N-Fill Procedure

WARNING: To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.

NOTE: To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49°C (120°F). The tool will not operate properly when the coolant is boiling.

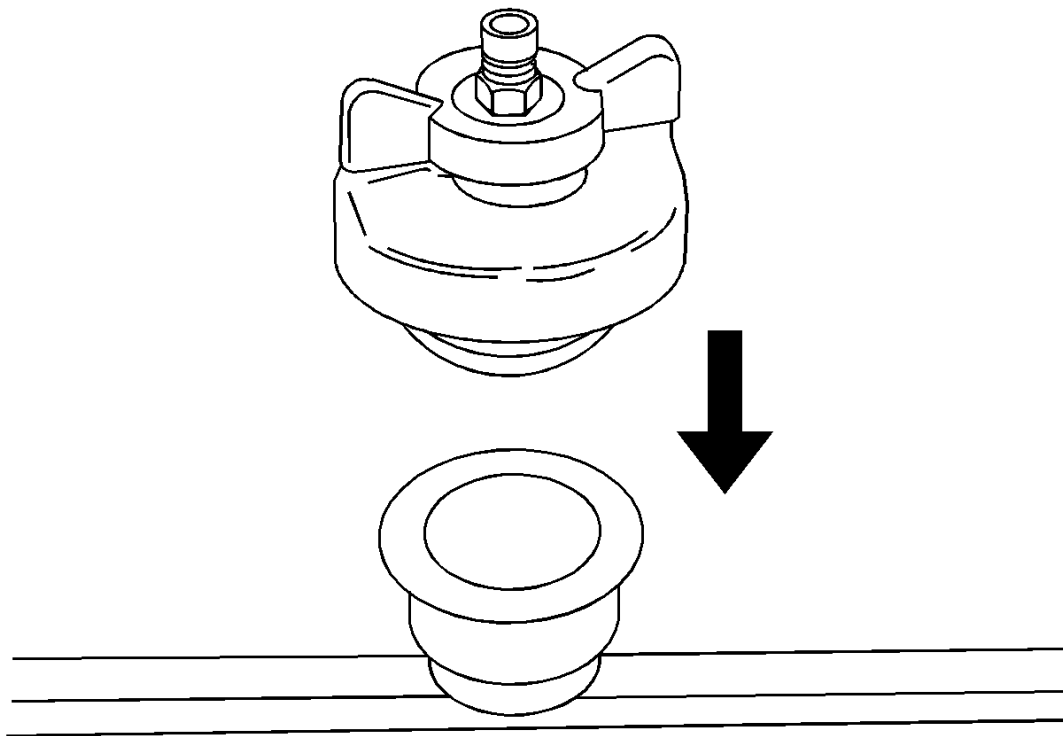


Fig. 12: Identifying Vac-N-Fill Cap

Courtesy of GENERAL MOTORS COMPANY

1. Install **GE-42401-2** Radiator Cap and Surge Tank Test Adapter into the surge tank fill neck.
2. Install **GE-42401-3** Radiator Cap and Surge Tank Test Adapter to the surge tank fill neck.
3. Attach the Vac N Fill cap to the **GE-42401-3** Radiator Cap and Surge Tank Test Adapter.

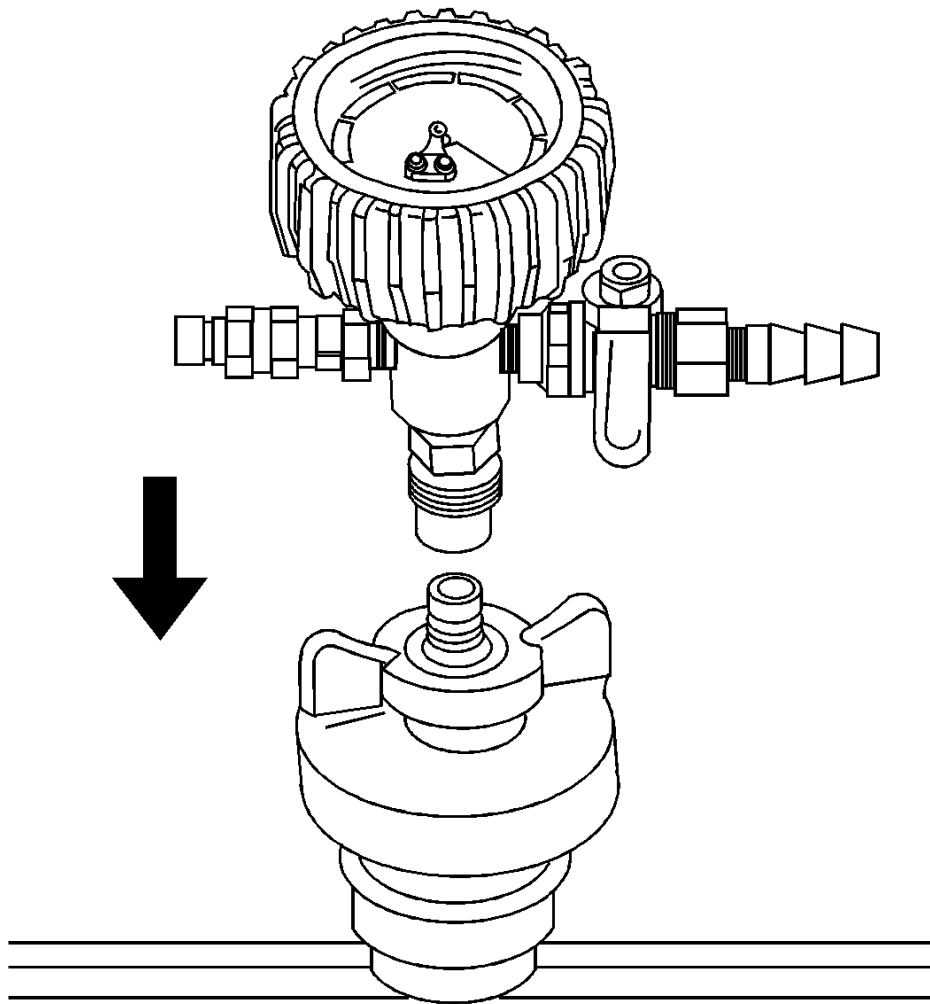


Fig. 13: Attaching The Vacuum Gage Assembly To The Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

4. Attach the vacuum gauge assembly to the Vac N Fill cap.

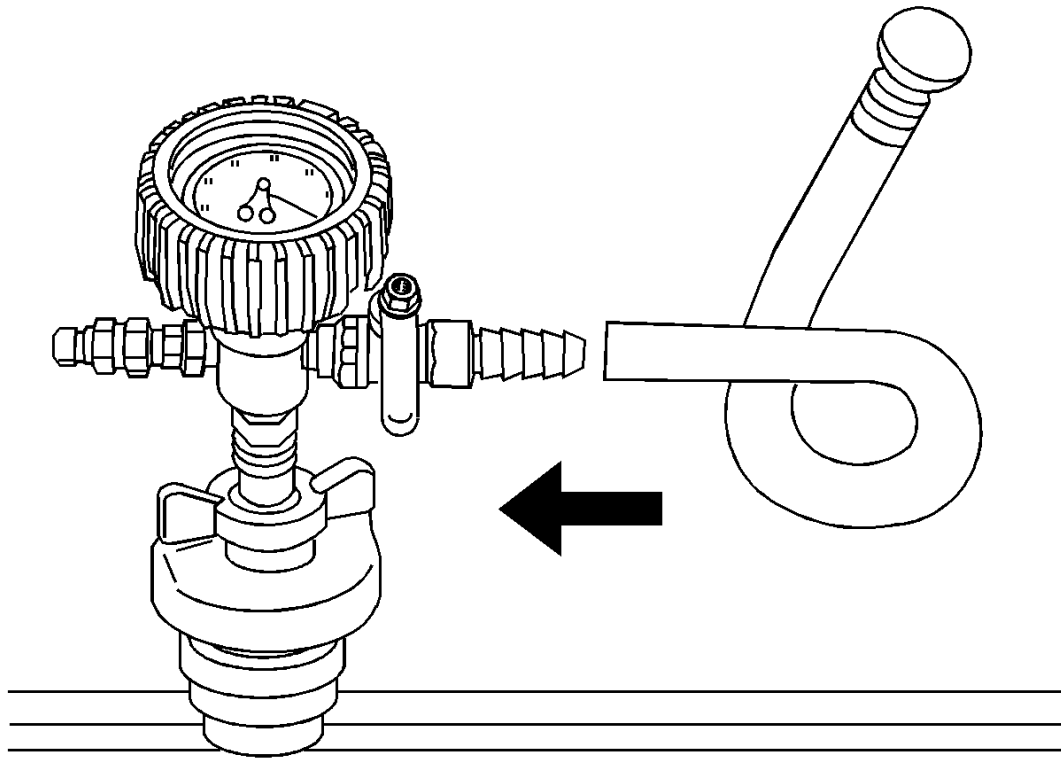


Fig. 14: Attaching Fill Hose To Barb Fitting On Vacuum Gage Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Attach the fill hose to the barb fitting on the vacuum gauge assembly.

Ensure that the valve is closed.

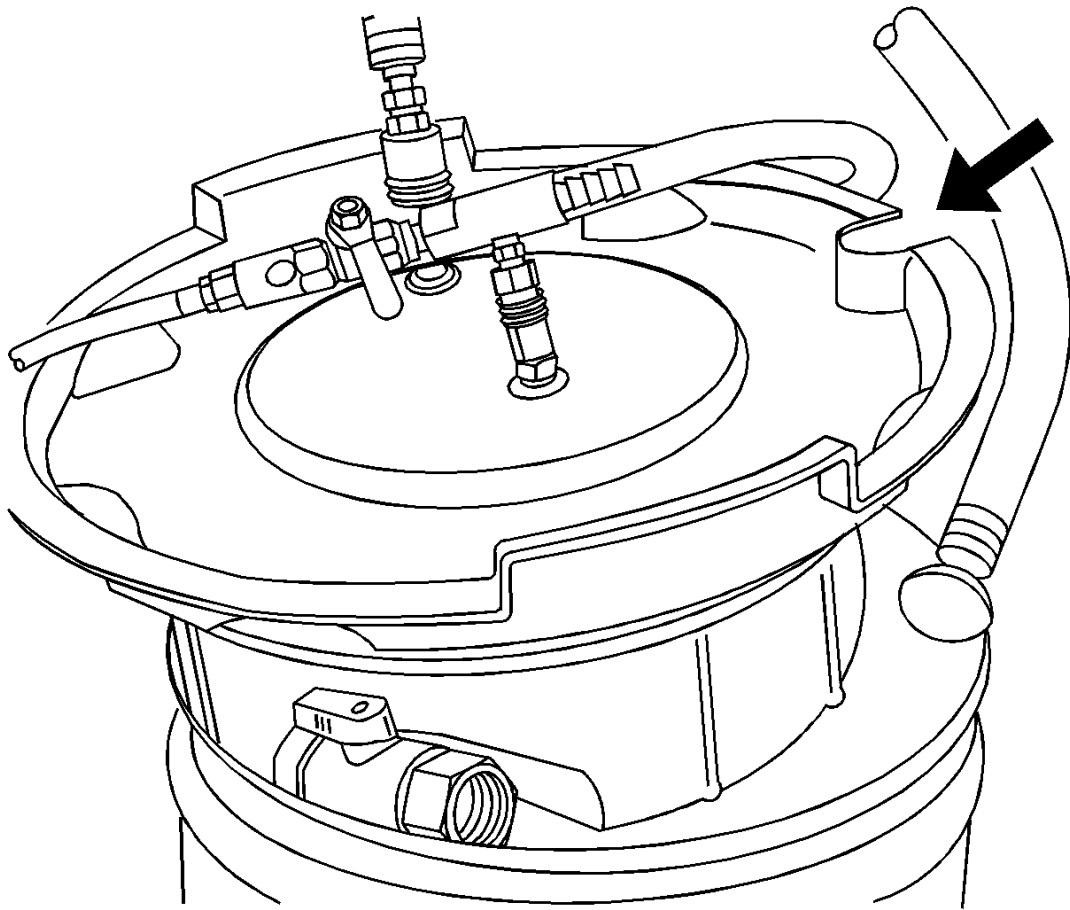


Fig. 15: View Of Graduated Reservoir & Hose
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a 50/50 mixture of DEX-COOL antifreeze and de-ionized water.

Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

6. Pour the coolant mixture into the graduated reservoir.
7. Place the fill hose in the graduated reservoir.

NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

8. Install the vacuum tank on the graduated reservoir with the fill hose routed through the cut-out area in the vacuum tank.

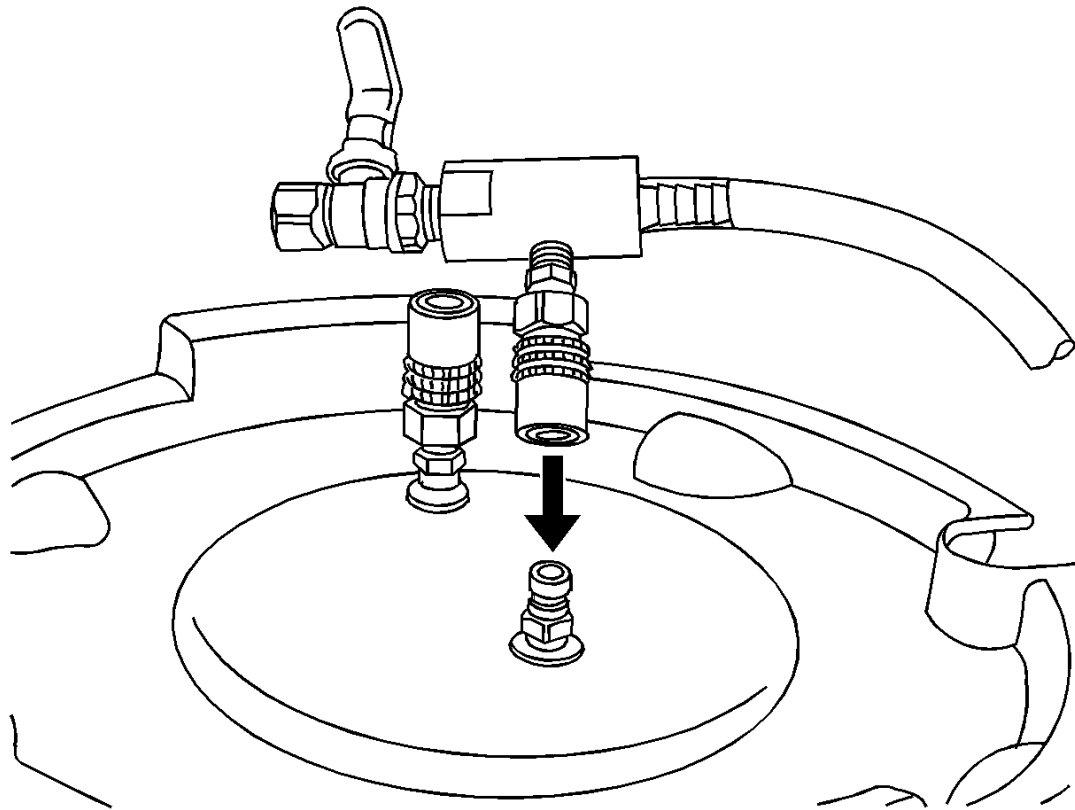


Fig. 16: View Of Venturi Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

9. Attach the venturi assembly to the vacuum tank.

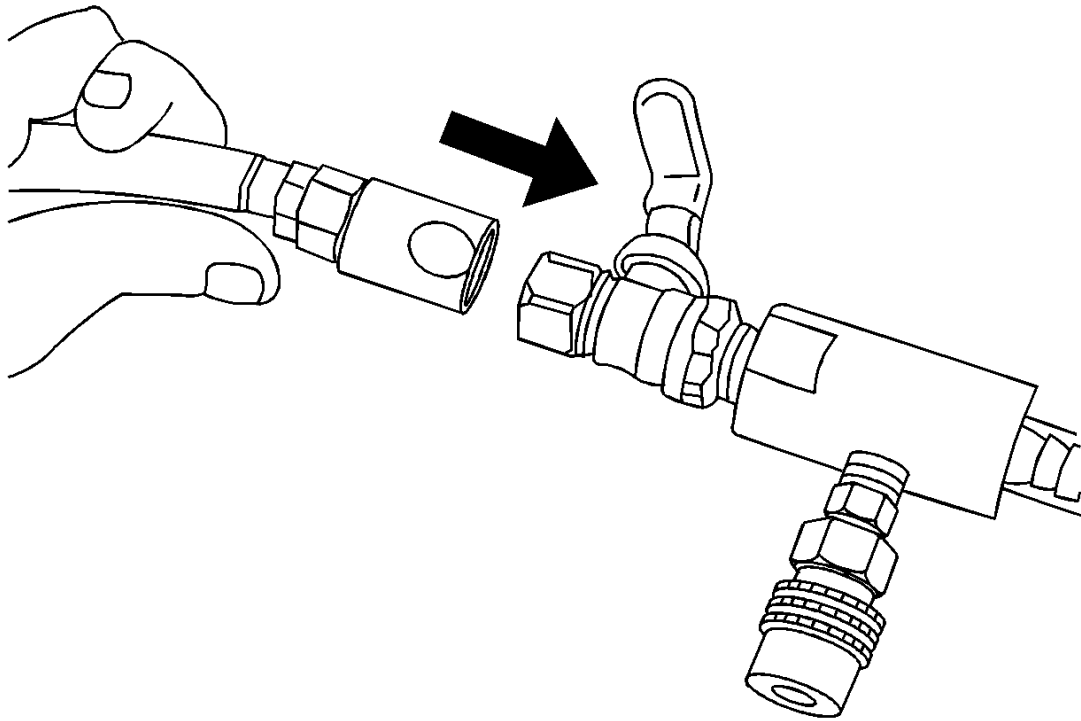


Fig. 17: View Of Shop Air Hose & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Attach a shop air hose to the venturi assembly.

Ensure the valve on the venturi assembly is closed.

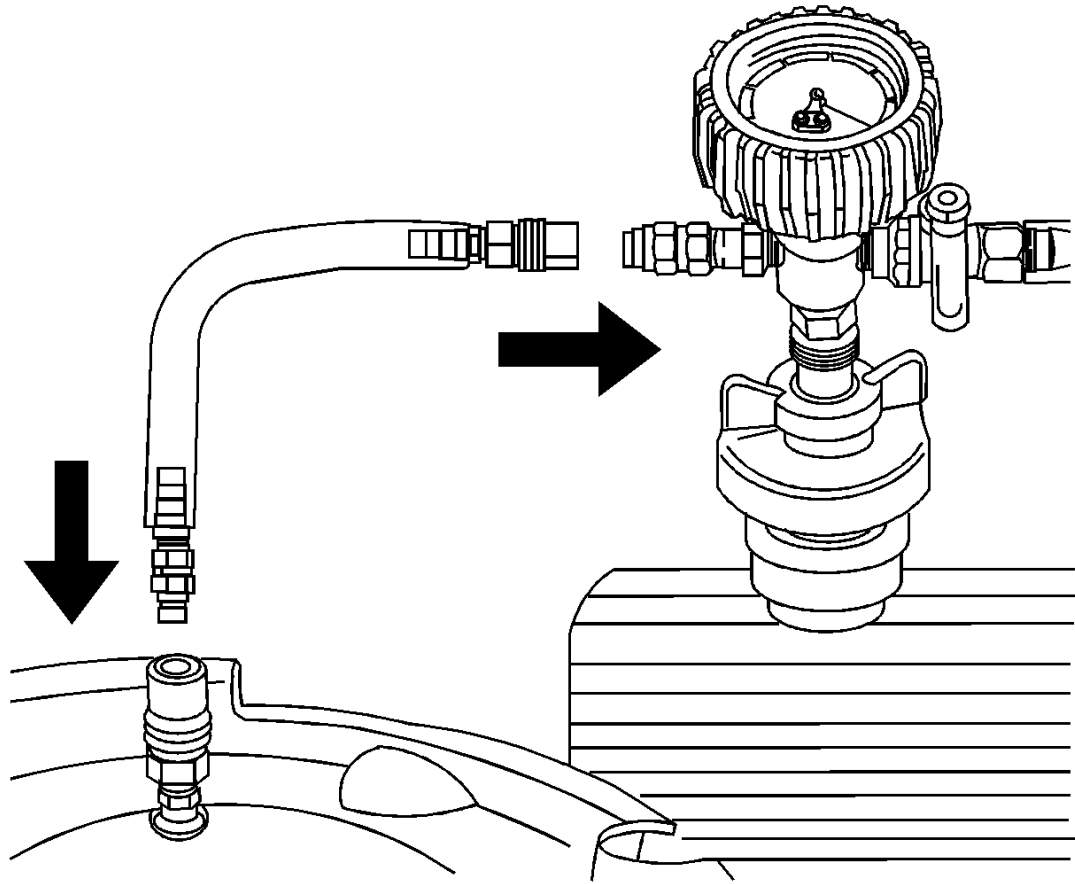


Fig. 18: Attaching Vacuum Hose To Vacuum Gauge Assembly & Vacuum Tank
Courtesy of GENERAL MOTORS COMPANY

11. Attach the vacuum hose to the vacuum gauge assembly and the vacuum tank.
12. Position the passenger compartment heater coolant control solenoid valve to normal using GDS. The hybrid powertrain control module 2 controls the passenger compartment heater coolant control solenoid Valve

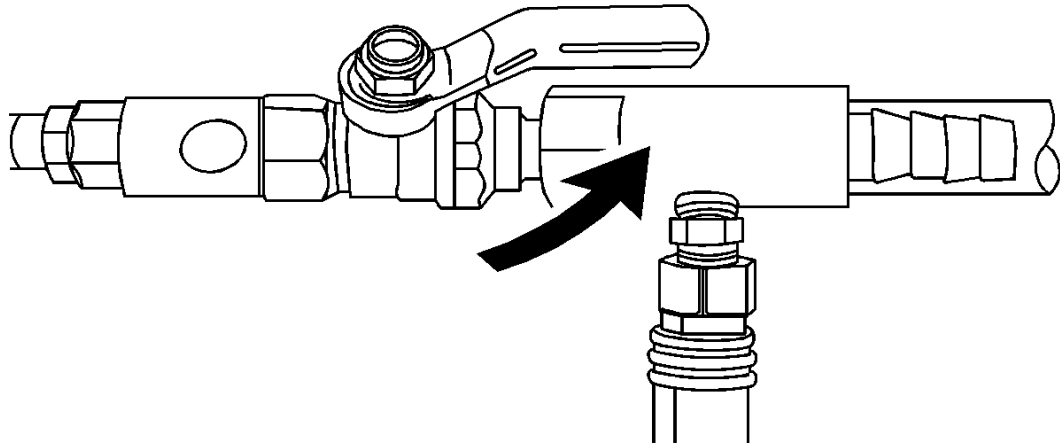


Fig. 19: Identifying Valve On Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Open the valve on the venturi assembly. The vacuum gauge will begin to rise and a hissing noise will be present.

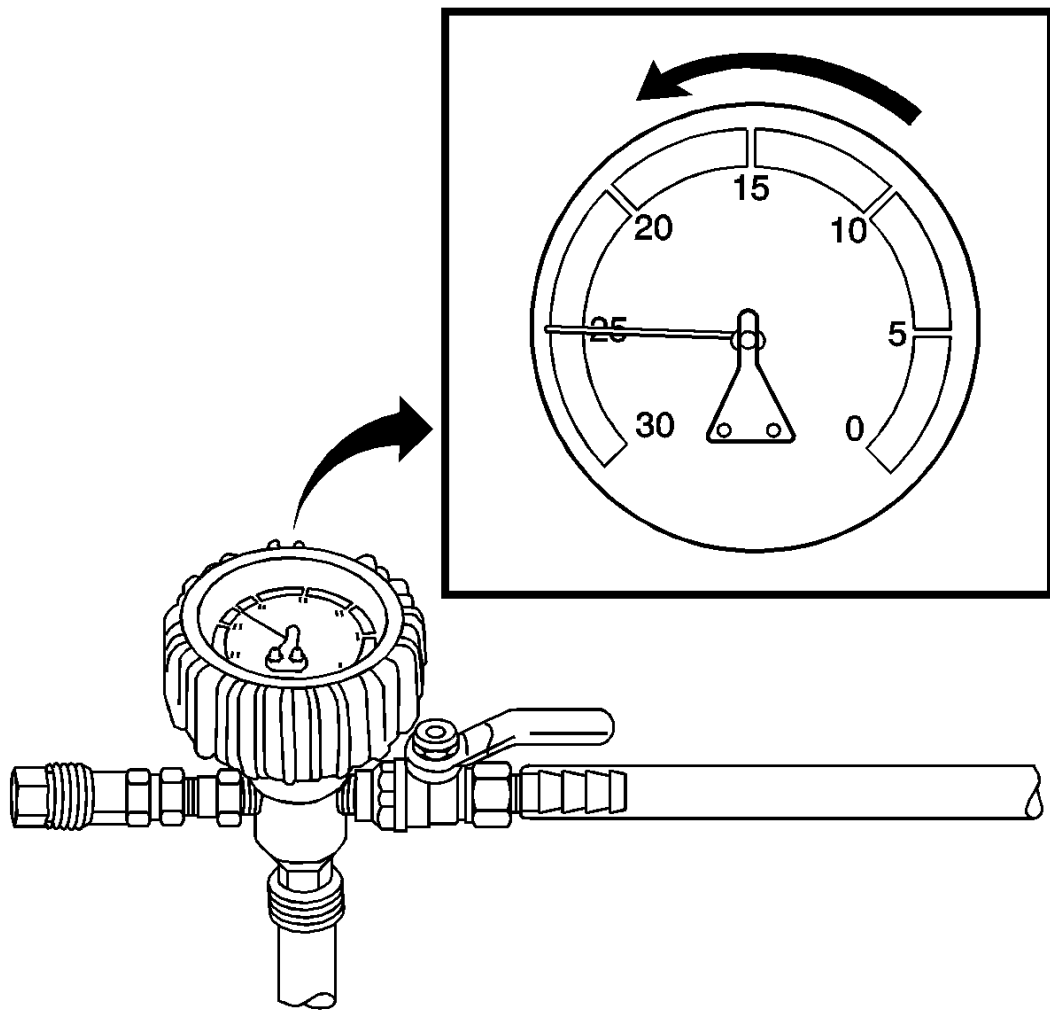


Fig. 20: View Of Vacuum Gauge

Courtesy of GENERAL MOTORS COMPANY

14. Continue to draw vacuum until the needle stops rising. This should be 610-660 mm Hg (24-26 in Hg).

Cooling hoses may start to collapse. This is normal due to vacuum draw.

15. To aid in the fill process, position the graduated reservoir above the coolant fill port.

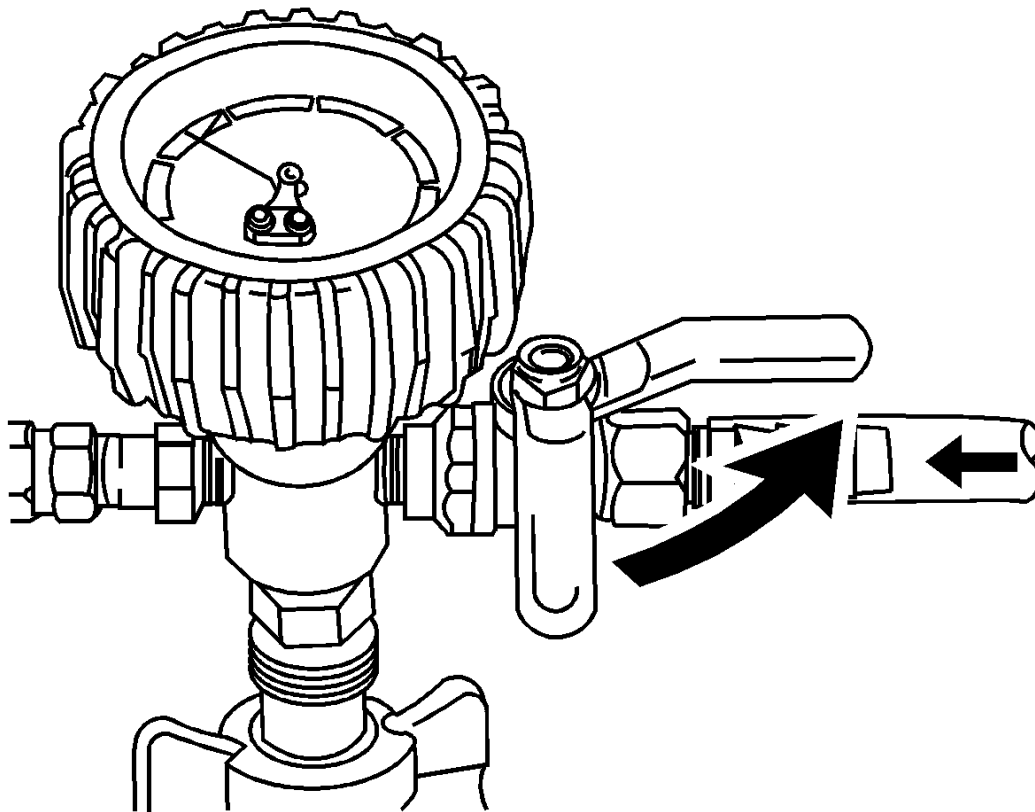


Fig. 21: Identifying Valve On Vacuum Gage Assembly

Courtesy of GENERAL MOTORS COMPANY

16. Slowly open the valve on the vacuum gauge assembly. When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
17. Close the valve on the venturi assembly.
18. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

If vacuum loss is observed, refer to **Loss of Coolant**.

19. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

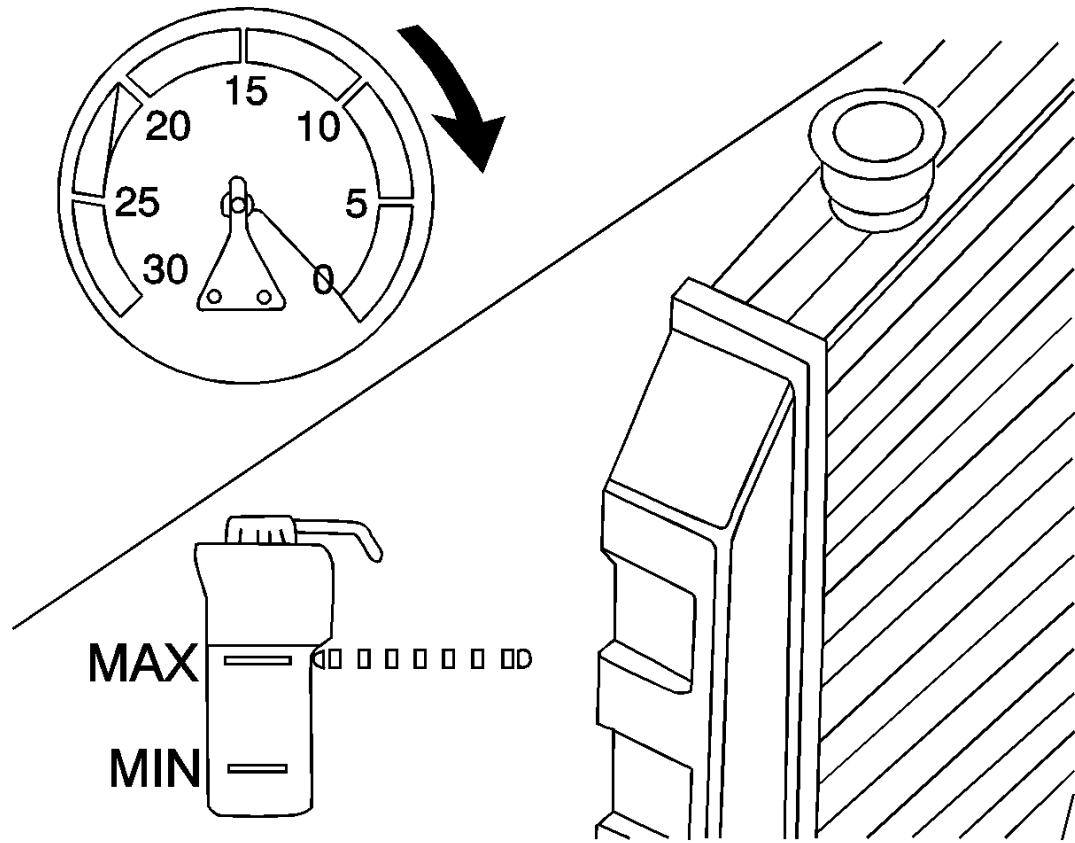


Fig. 22: View Of Vacuum Gauge & Radiator
Courtesy of GENERAL MOTORS COMPANY

20. Once the vacuum gauge reaches zero, close the valve on the vacuum gauge.
21. Repeat steps 14-21 twice.

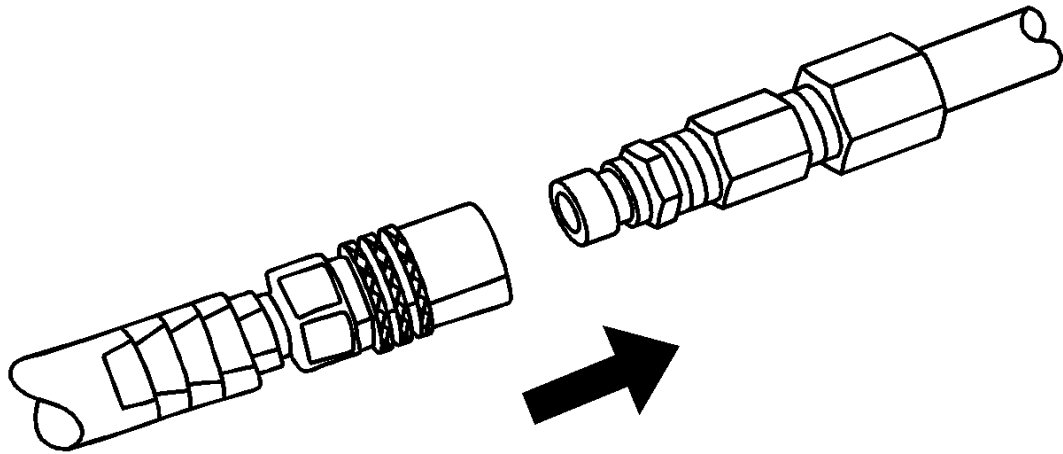


Fig. 23: Attaching Extraction Hose To Vacuum Hose
Courtesy of GENERAL MOTORS COMPANY

22. Detach the Vac N Fill cap from the **GE-42401-3** Radiator Cap and Surge Tank Test Adapter.
23. Remove **GE-42401-2** Radiator Cap and Surge Tank Test Adapter from the surge tank fill neck.
24. Add coolant to the system as necessary.
25. Turn on the auxiliary coolant pump for 2 minutes using the GDS. The remote HVAC module controls the auxiliary coolant pump.
26. Start the engine.
27. Using GDS, increase the speed to 2000 rpm until the thermostat opens (approximately 100C).

NOTE: Do not allow engine coolant temperature to exceed 110C or damage to the Coolant Heater Control Module could occur.

28. Turn engine off.
29. Turn on the auxiliary coolant pump for 1 minute using GDS.
30. Turn off the auxiliary coolant pump and wait 5 minutes.
31. Repeat steps 24-30, three times.

32. Inspect the concentration of the coolant mixture using **GE-26568** Coolant and Battery Tester.

NOTE: After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.

33. Detach the vacuum hose from the vacuum gauge assembly.

34. Attach the extraction hose to the vacuum hose.

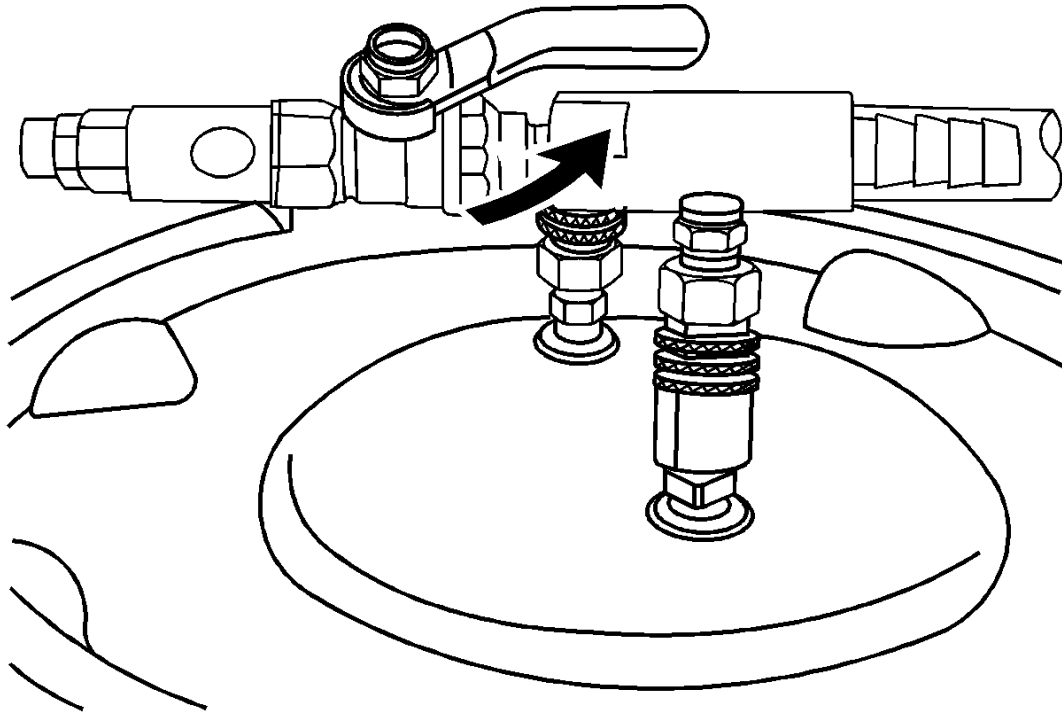


Fig. 24: Identifying Valve On Venturi Assembly

Courtesy of GENERAL MOTORS COMPANY

35. Open the valve on the venturi assembly to start a vacuum draw.

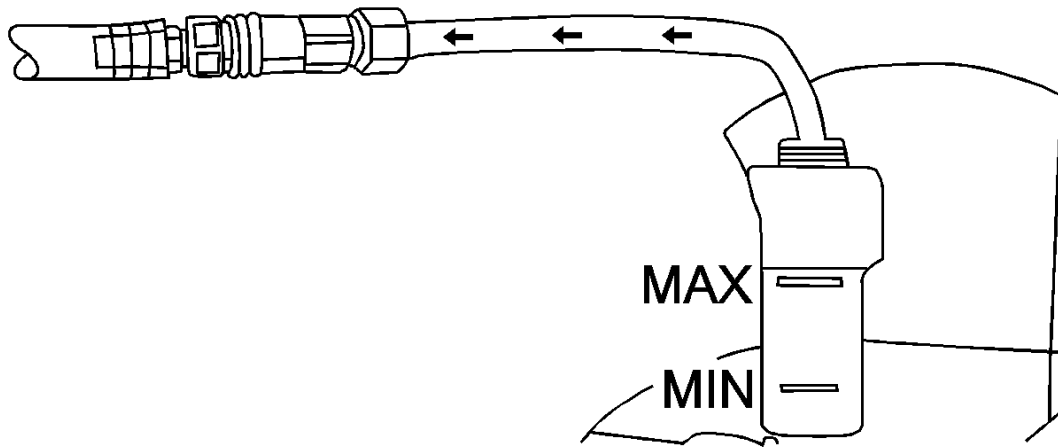


Fig. 25: Using Extraction Hose To Draw Out Coolant
Courtesy of GENERAL MOTORS COMPANY

36. Use the extraction hose to draw out coolant to the proper level.
37. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

FLUSHING

NOTE:

- This procedure is intended for the engine cooling system only. Never use this procedure to flush the hybrid cooling system.
- When the cooling system becomes contaminated, the cooling system should be flushed thoroughly to remove the contaminants before the engine is seriously damaged.
- This procedure is effective in removing contaminants caused by the use of improper coolants, coolant at the end of its life, or some liquid chemical flushing agents. This procedure is NOT effective for removing debris contamination caused by component failure, or the use of 'stop leak' additives. When the system is contaminated by this type of debris, use the

system flow diagrams to identify components that may need replacement to restore proper system flow.

- Do not use chemical flush agents.
- Store used coolant in the proper manner, such as in a used engine coolant holding tank. Do not pour used coolant down a drain. Ethylene glycol antifreeze is a very toxic chemical. Do not dispose of coolant into the sewer system or ground water. This is illegal and ecologically unsound.
- Various methods and equipment can be used to flush the cooling system. If special equipment is used, such as a back flusher, follow the manufacturer's instruction. Always remove the thermostat before flushing the cooling system.

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Radiator Surge Tank Replacement](#)
3. Clean and flush the coolant recovery reservoir with clean, drinkable water.
4. Install [Radiator Surge Tank Replacement](#)
5. Follow the drain and fill procedure using only clean, drinkable water. Refer to [Cooling System Draining and Filling](#).
6. Run the engine for 20 minutes.
7. Stop the engine.
8. Drain the cooling system. [Cooling System Draining and Filling](#)
9. Repeat the procedure if necessary, until the fluid is nearly colorless.
10. Fill the cooling system. [Cooling System Draining and Filling](#)

RADIATOR CLEANING

WARNING: NEVER spray water on a hot heat exchanger. The resulting steam could cause personal injury.

CAUTION: The heat exchanger fins are necessary for good heat transfer. Do not brush the fins. This may cause damage to the fins, reducing heat transfer.

NOTE: Remove bugs, leaves, dirt and other debris by blowing compressed air through the engine side of the radiator.

- Some conditions may require the use of warm water and a mild detergent.
- Clean the A/C condenser fins.
- Clean between the A/C condenser and radiator.
- Clean the radiator cooling fins.
- Straighten any damaged cooling fins.

RADIATOR SURGE TANK REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)

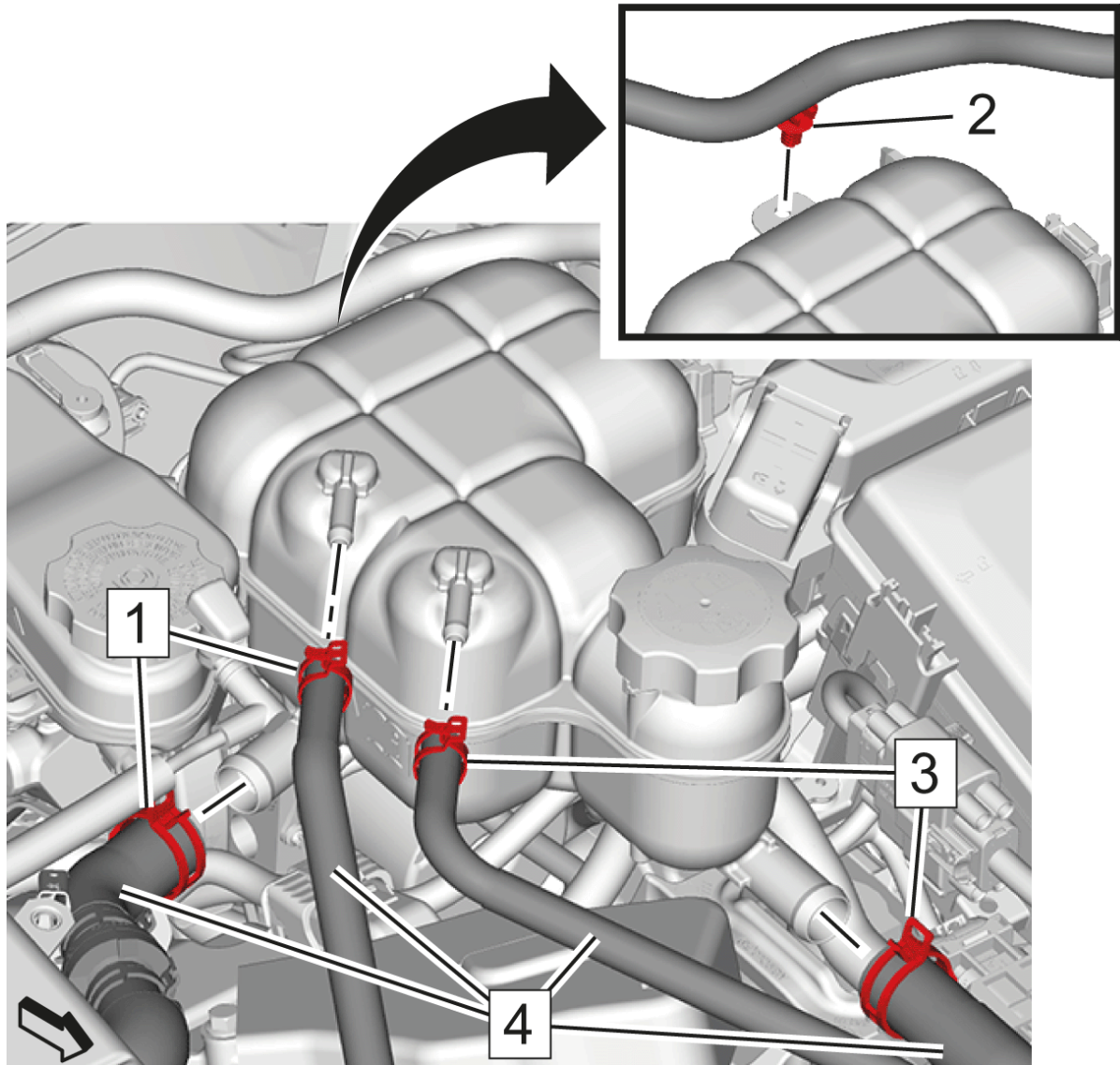


Fig. 26: Coolant Hose And Wiring Harness Clip

Courtesy of GENERAL MOTORS COMPANY

2. Loosen Clamp (1, 3) **BO-38185** pliers
3. Remove Coolant Hose (4)
4. Unclip Wiring Harness Clip(2)

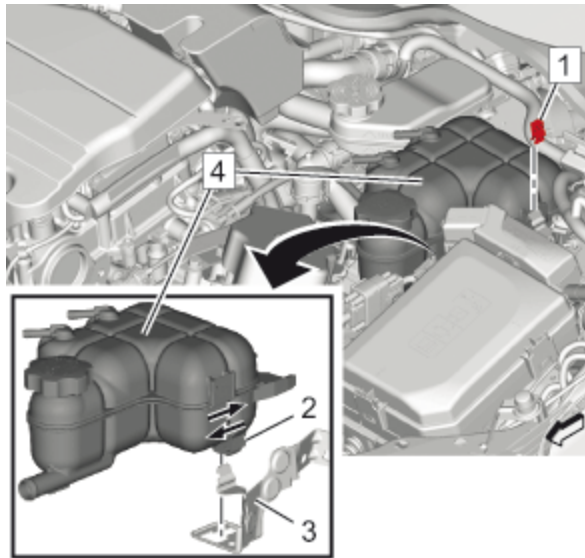


Fig. 27: Radiator Surge Tank, Bracket And Clips

Courtesy of GENERAL MOTORS COMPANY

5. Remove Radiator Surge Tank Clip(1)

NOTE: To remove the radiator surge tank from the radiator surge tank bracket move it in driving direction.

6. Move the radiator surge tank (4) in arrow direction to release the radiator surge tank clip (2) from the radiator surge tank bracket (3).

Installation Procedure

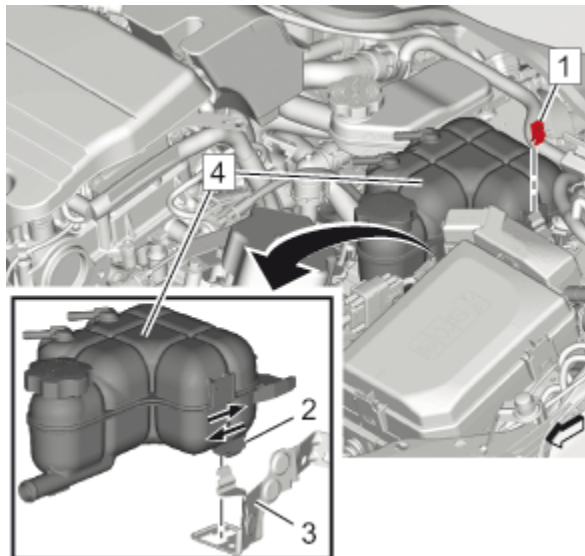


Fig. 28: Radiator Surge Tank, Bracket And Clips

Courtesy of GENERAL MOTORS COMPANY

NOTE: To install the radiator surge tank to the radiator surge tank bracket move it against driving direction.

1. Move the radiator surge tank (4) in arrow direction to clip in the radiator surge tank clip (2) into the radiator surge tank bracket (3).
2. Install Radiator Surge Tank Clip (1)

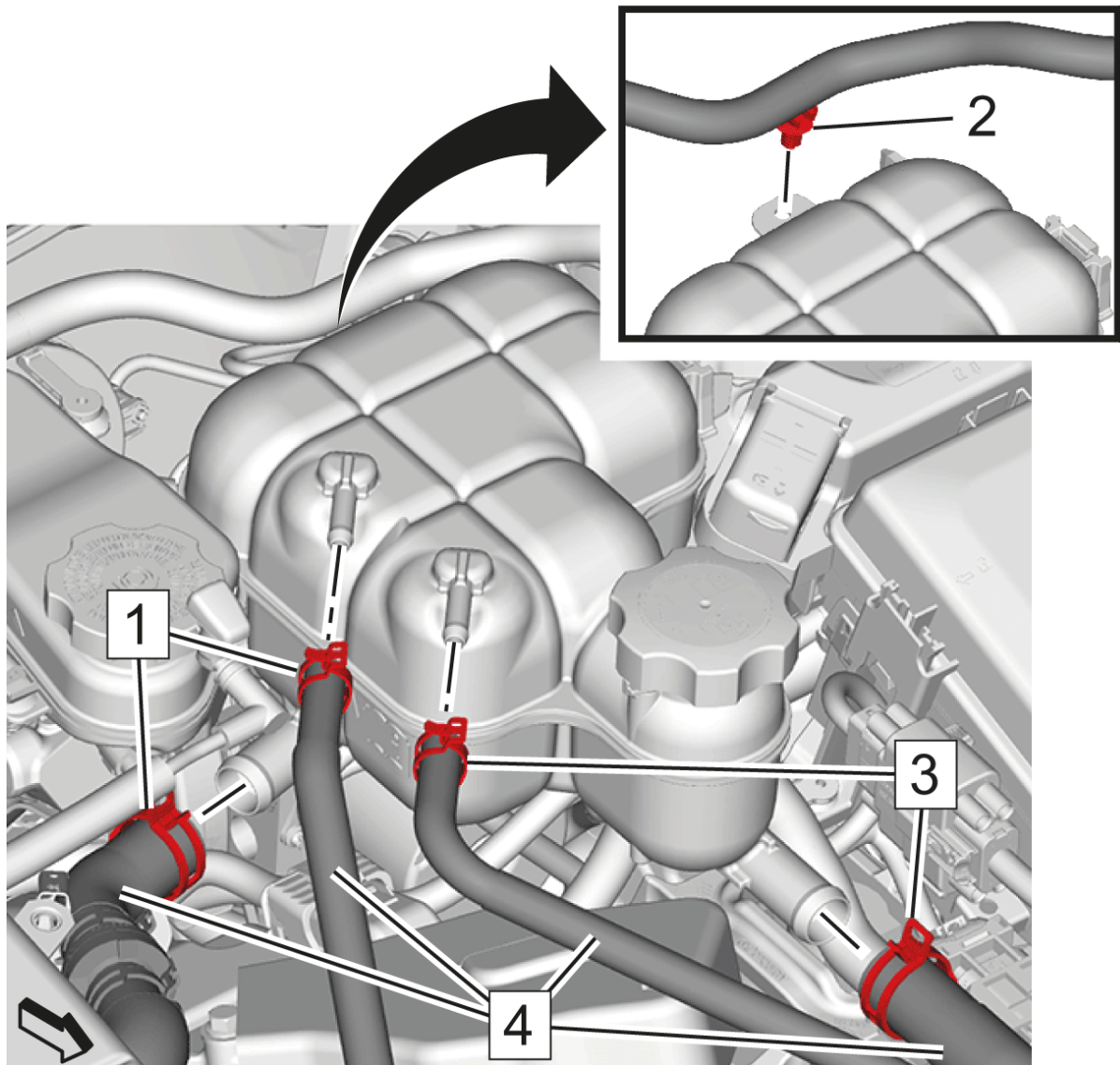


Fig. 29: Coolant Hose And Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install Wiring Harness Clip (2)
4. Install Coolant Hose(4)
5. Install Clamp(1, 3) **BO-38185** pliers
6. Fill the cooling system. **Cooling System Draining and Filling**

RADIATOR INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools:**Special Tools**

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)

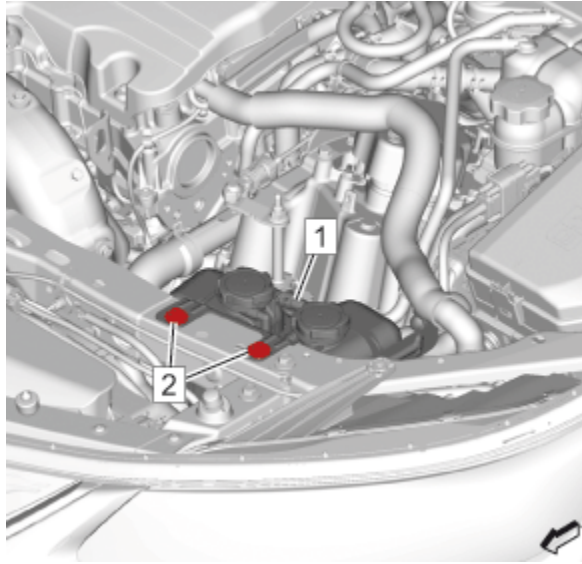


Fig. 30: Radiator Surge Tank Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not remove any coolant hoses from the surge tanks.

2. Remove the 2 radiator surge tank bracket bolts (2).
3. To gain access to the second radiator inlet hose clamp, lay the radiator surge tank assembly (1) aside.

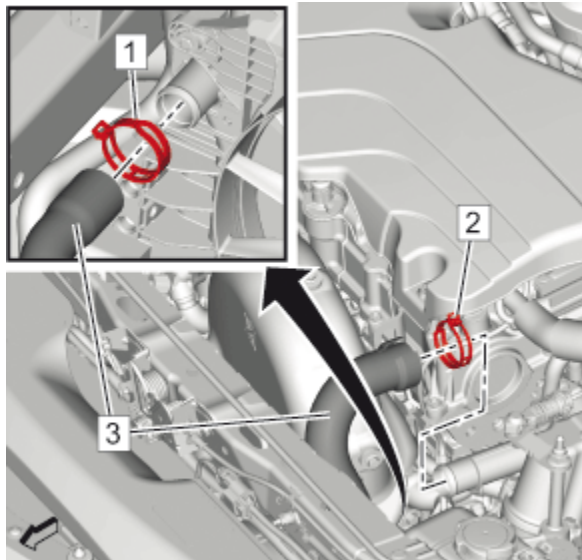


Fig. 31: Radiator Inlet Hose Clamp And Radiator Inlet Hose

Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Inlet Hose Clamp (1, 2) **BO-38185** pliers
5. Remove Radiator Inlet Hose (3)

Installation Procedure

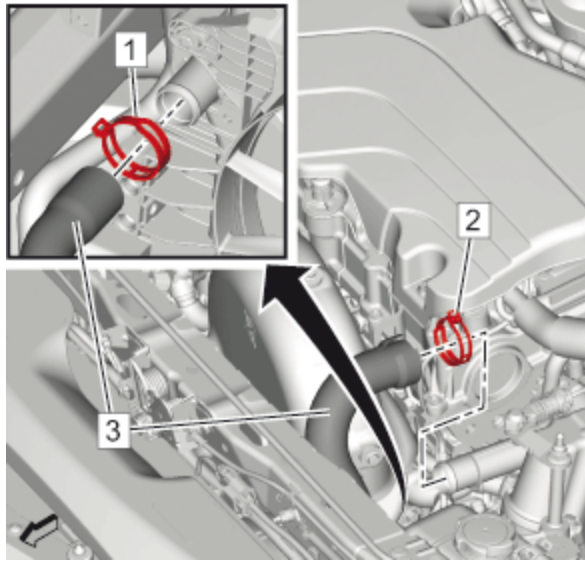


Fig. 32: Radiator Inlet Hose Clamp And Radiator Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Inlet Hose (3)
2. Install Radiator Inlet Hose Clamp (1, 2) **BO-38185** pliers

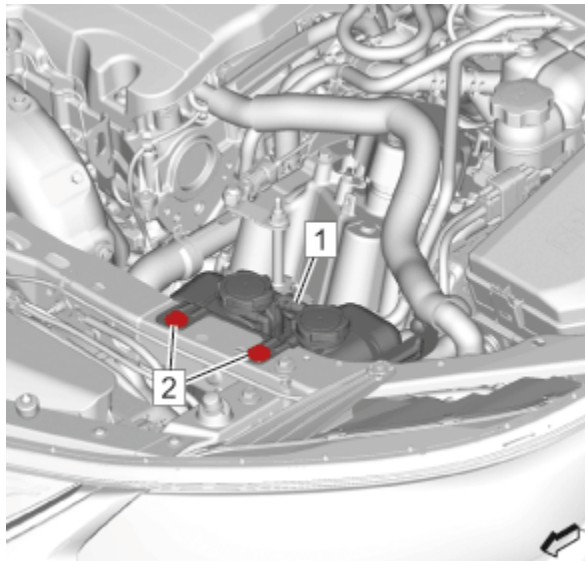


Fig. 33: Radiator Surge Tank Bracket Bolts
 Courtesy of GENERAL MOTORS COMPANY

3. Reposition the radiator surge tank assembly (1).

CAUTION: Fastener Caution

4. Install the 2 radiator surge tank bracket bolts (2) and tighten to 22 N.m (16 lb ft).
5. Fill the cooling system. Cooling System Draining and Filling

RADIATOR OUTLET HOSE REPLACEMENT

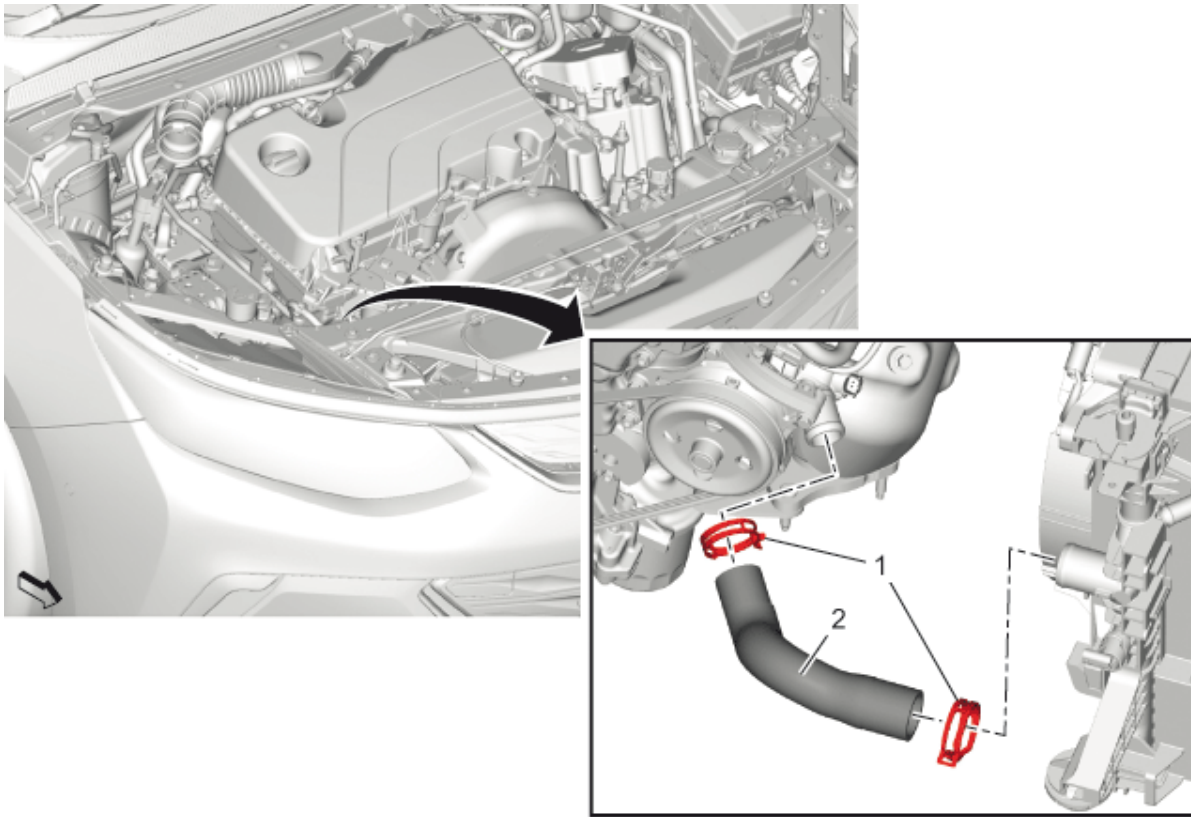


Fig. 34: Radiator Outlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Air Cleaner Assembly Replacement Cooling System Draining and Filling	
1	Radiator Outlet Hose Clamp (Qty: 2) Special Tool BO-38185 Hose Clamp Pliers Equivalent regional tools: Special Tools
2	Radiator Outlet Hose

RADIATOR VENT OUTLET HOSE REPLACEMENT

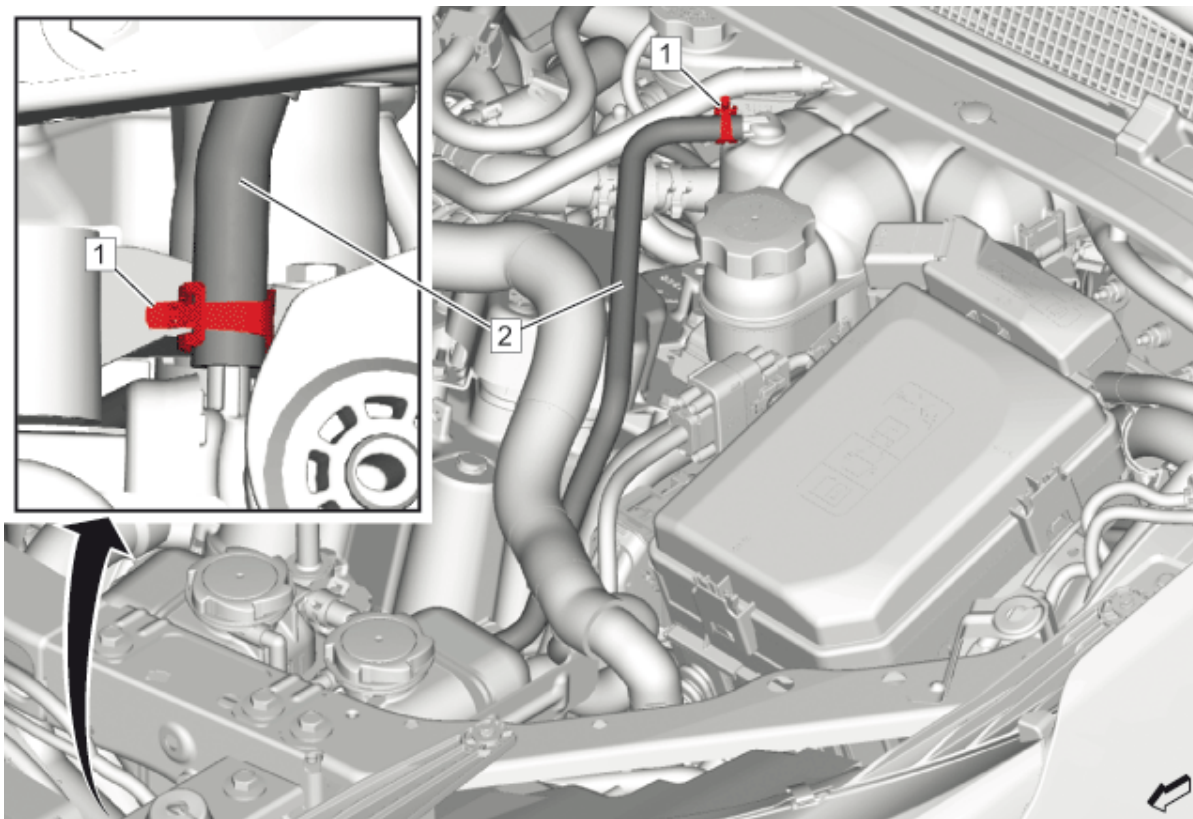


Fig. 35: Radiator Vent Outlet Hose

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Radiator Vent Outlet Hose Clamp (Qty: 2) Special Tools BO-38185 Hose Clamp Pliers Equivalent regional tools: Special Tools
2	Radiator Vent Outlet Hose Procedure When the replacement is completed, check and correct the engine coolant level. Cooling System Draining and Filling

EXHAUST GAS RECIRCULATION COOLER WATER BYPASS OUTLET HOSE REPLACEMENT

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Three-Way Catalytic Converter Replacement](#)

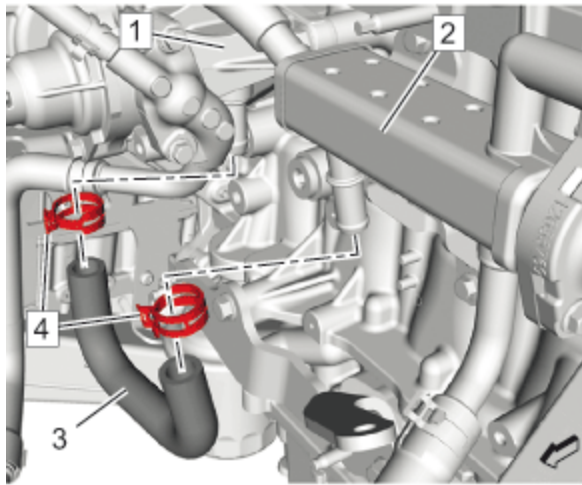


Fig. 36: Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Remove Clamp (4)
4. Disconnect Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (3) @Water Pump (1)
5. Disconnect Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (3) @Exhaust Gas Recirculation Cooler (2)
6. Remove Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (3)

Installation Procedure

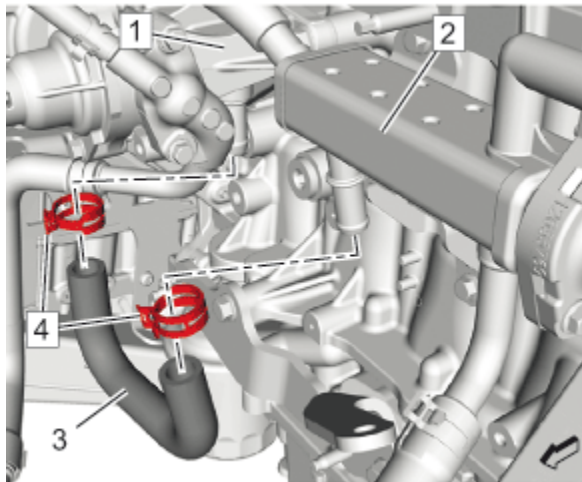


Fig. 37: Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (3)
2. Connect Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose (3) @Exhaust Gas Recirculation Cooler (2)
3. Connect Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose(3)@Water Pump(1)

4. Install Clamp (4)
5. Install [Three-Way Catalytic Converter Replacement](#)
6. Fill the cooling system. - [Cooling System Draining and Filling](#)

THERMOSTAT BYPASS HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Heater Outlet Hose Vapor Vent Hose Replacement](#)
3. Remove Radiator Inlet Hose@Water Outlet [Radiator Inlet Hose Replacement](#)

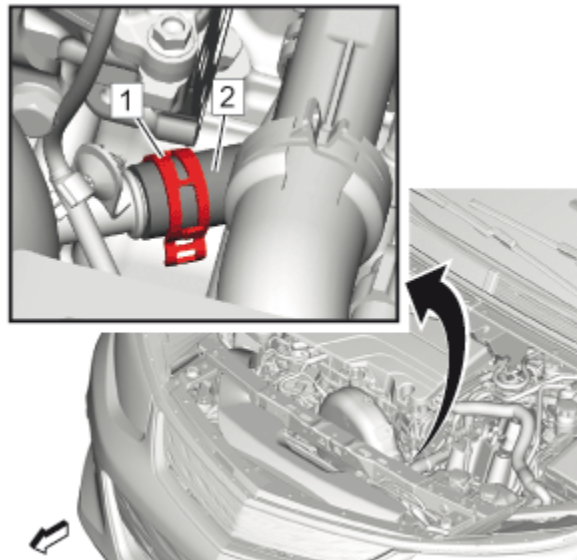


Fig. 38: Thermostat Bypass Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Thermostat Bypass Hose Clamp (1) **BO-38185** pliers
5. Disconnect Thermostat Bypass Hose(2)

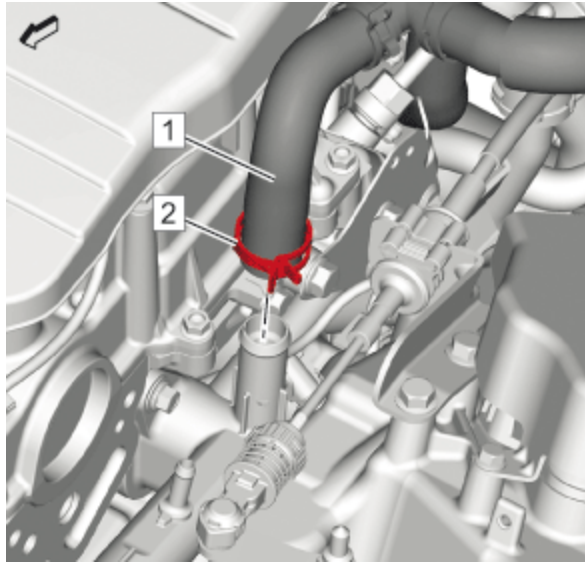


Fig. 39: Heater Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Loosen Heater Outlet Hose Clamp(2) **BO-38185** pliers
7. Disconnect Heater Outlet Hose (1)

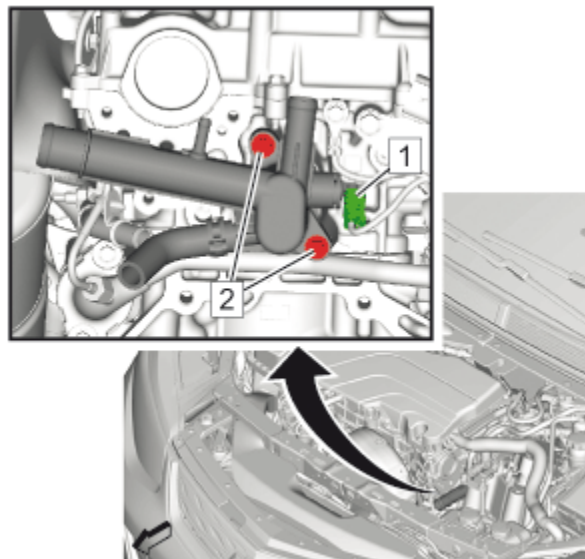


Fig. 40: Engine Coolant Temperature Sensor Electrical Connector And Water Outlet Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the engine coolant temperature sensor electrical connector.(1)
9. Remove the water outlet bolts.(2)

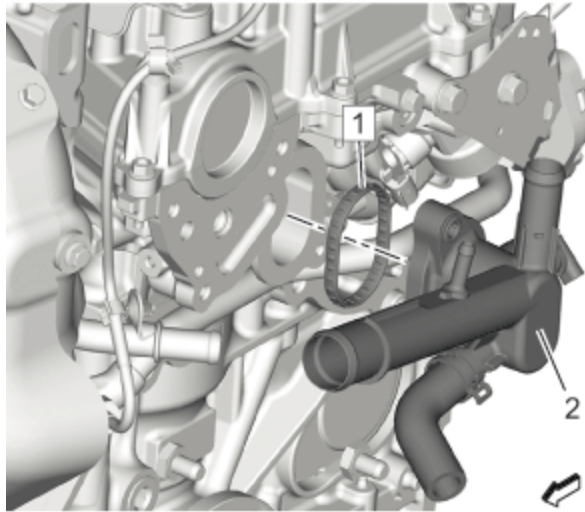


Fig. 41: Water Outlet And Gasket

Courtesy of GENERAL MOTORS COMPANY

10. Remove the water outlet.(2)
11. Remove Water Outlet Gasket (1) and DISCARD

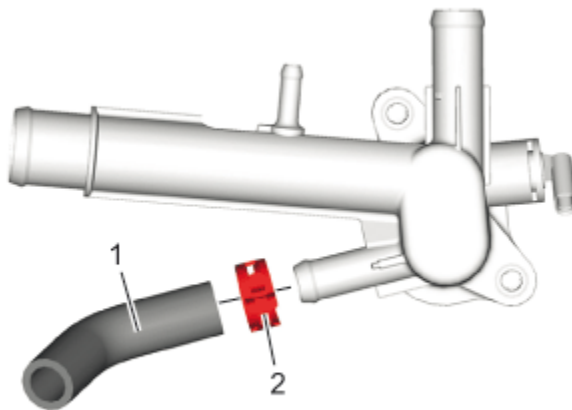


Fig. 42: Thermostat Bypass Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

12. Remove Thermostat Bypass Hose Clamp (2) **BO-38185** pliers
13. Remove Thermostat Bypass Hose(1)

Installation Procedure

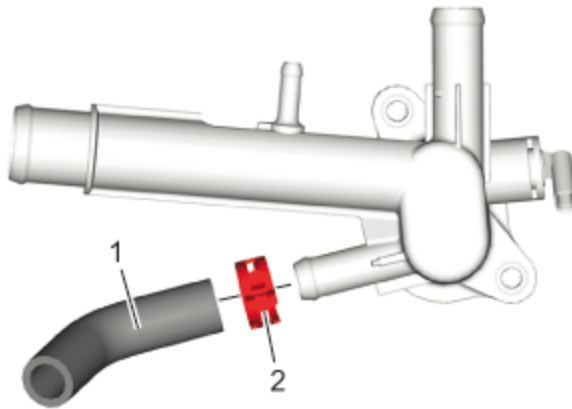


Fig. 43: Thermostat Bypass Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

1. Install Thermostat Bypass Hose (1)
2. Install Thermostat Bypass Hose Clamp (2) **BO-38185** pliers

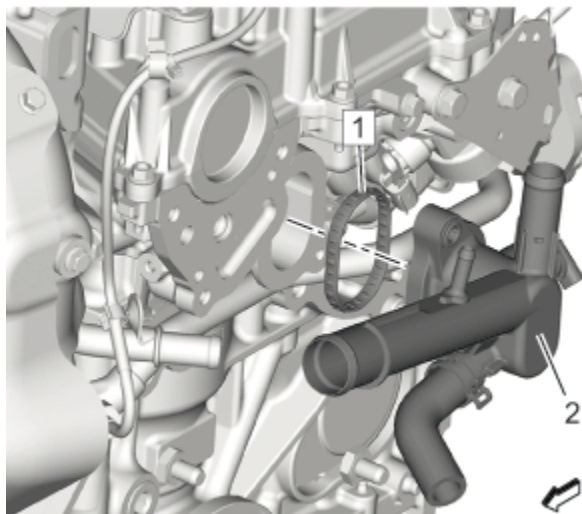


Fig. 44: Water Outlet And Gasket
 Courtesy of GENERAL MOTORS COMPANY

3. Install a NEW gasket to the water outlet.(1)
4. Install the water outlet.(2)

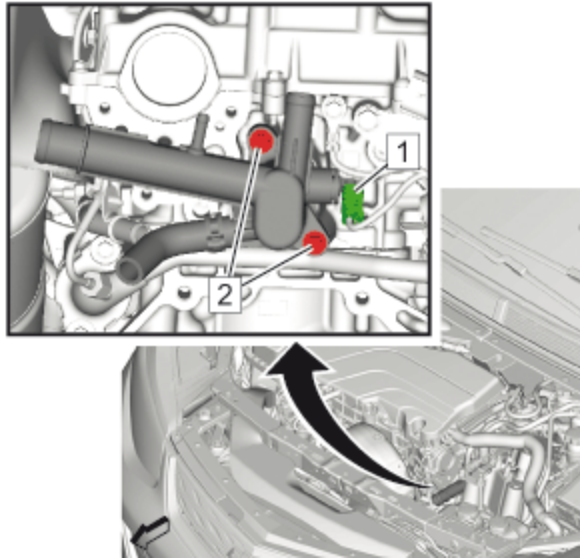


Fig. 45: Engine Coolant Temperature Sensor Electrical Connector And Water Outlet Bolts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Install Water Outlet Bolt (2) and tighten 12 N.m (106 lb in)
6. Connect the engine coolant temperature sensor electrical connector.(1)

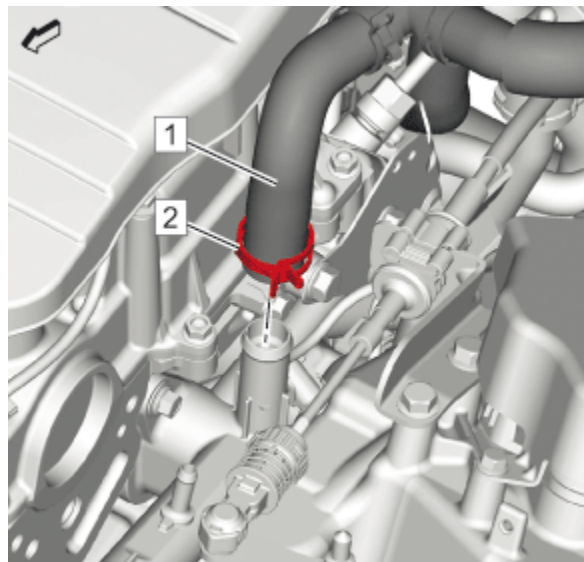


Fig. 46: Heater Outlet Hose Clamp
 Courtesy of GENERAL MOTORS COMPANY

7. Install Heater Outlet Hose (1)
8. Install Heater Outlet Hose Clamp (2) **BO-38185** pliers

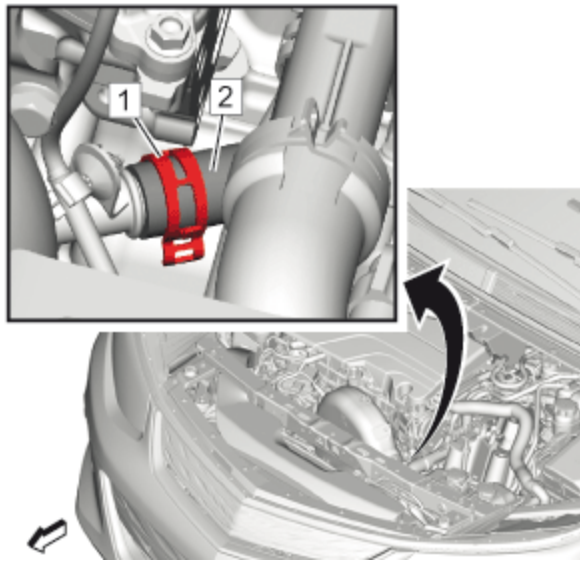


Fig. 47: Thermostat Bypass Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

9. Install Thermostat Bypass Hose (2)
10. Install Thermostat Bypass Hose Clamp (1) **BO-38185** pliers
11. Install Radiator Inlet Hose@Water Outlet [Radiator Inlet Hose Replacement](#)
12. Install [Heater Outlet Hose Vapor Vent Hose Replacement](#)
13. Fill the cooling system. [Cooling System Draining and Filling](#)

WATER PUMP INLET ADAPTER REPLACEMENT

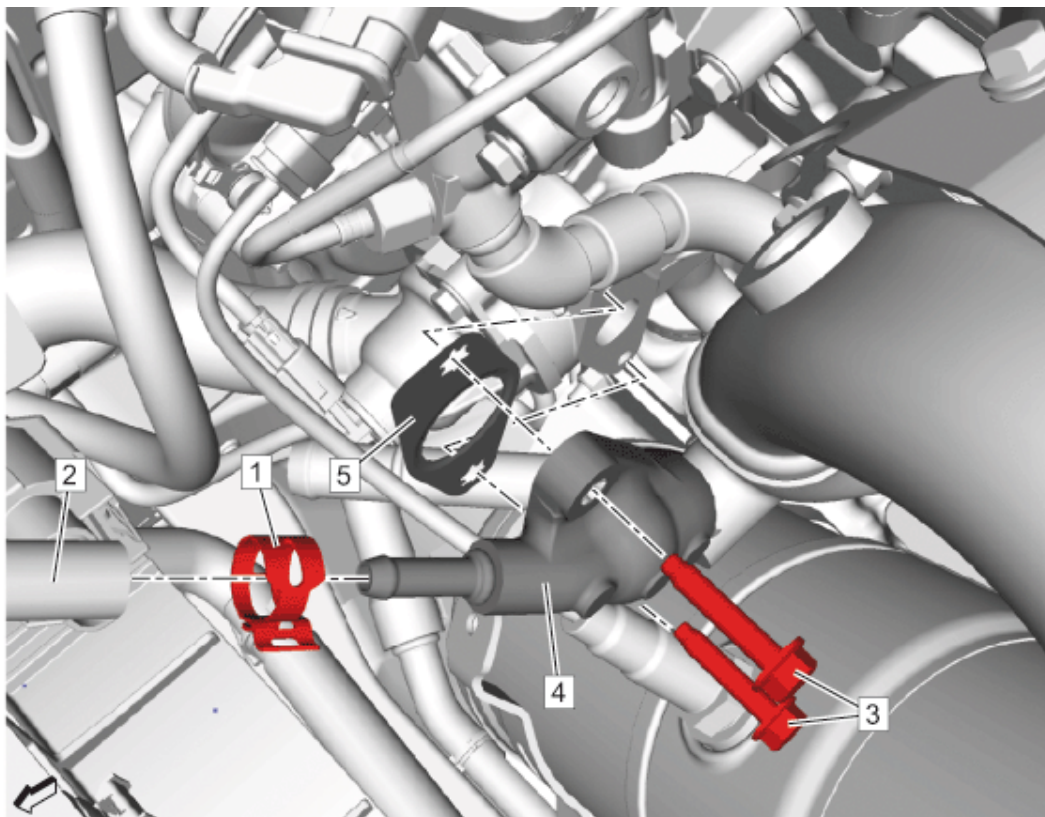


Fig. 48: Water Pump Inlet Adapter

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Cooling System Draining and Filling 2. Catalytic Converter Heat Shield Replacement 3. Heater Water Auxiliary Pump Inlet Hose Replacement	
1	Clamp
2	Exhaust Gas Recirculation Valve Cooling Return Hose
3	Water Pump Inlet Adapter Bolt (Qty: 2) CAUTION: Fastener Caution Tighten 10 N.m (89 lb in)
4	Water Pump Inlet Adapter
5	Water Pump Inlet Adapter Gasket

ENGINE COOLANT THERMOSTAT HOUSING REPLACEMENT

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove Radiator Outlet Hose@Engine Coolant Thermostat Housing [Radiator Outlet Hose Replacement](#)

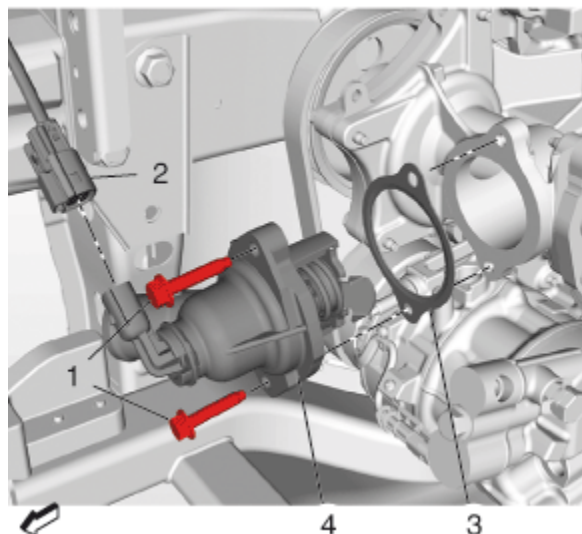


Fig. 49: Electrical Connector And Engine Coolant Thermostat Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector (2) @Engine Coolant Thermostat Housing (4)
4. Remove Engine Coolant Thermostat Housing Bolt (1)
5. Remove Engine Coolant Thermostat Housing (4)
6. Remove Engine Coolant Thermostat Gasket (3) and DISCARD

Installation Procedure

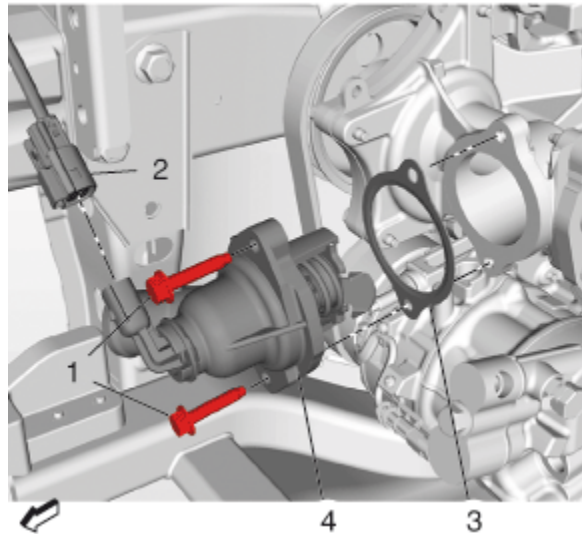


Fig. 50: Electrical Connector And Engine Coolant Thermostat Housing Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket.(3)
2. Install Engine Coolant Thermostat Housing (4)

CAUTION: Fastener Caution

3. Install Engine Coolant Thermostat Housing Bolt (1) and tighten 10 N.m (89 lb in)
4. Connect Electrical Connector(2)@Engine Coolant Thermostat Housing(4)
5. Radiator Outlet Hose@Engine Coolant Thermostat Housing Radiator Outlet Hose Replacement
6. Fill the cooling system. Cooling System Draining and Filling

WATER OUTLET REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools:Special Tools

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Heater Outlet Hose Vapor Vent Hose Replacement](#)
3. Remove Radiator Inlet Hose@Water Outlet [Radiator Inlet Hose Replacement](#)

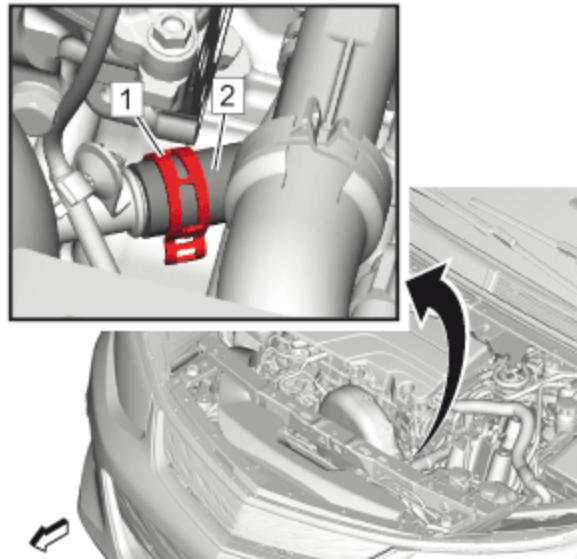


Fig. 51: Thermostat Bypass Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Loosen Thermostat Bypass Hose Clamp (1) **BO-38185** pliers
5. Disconnect Thermostat Bypass Hose (2)

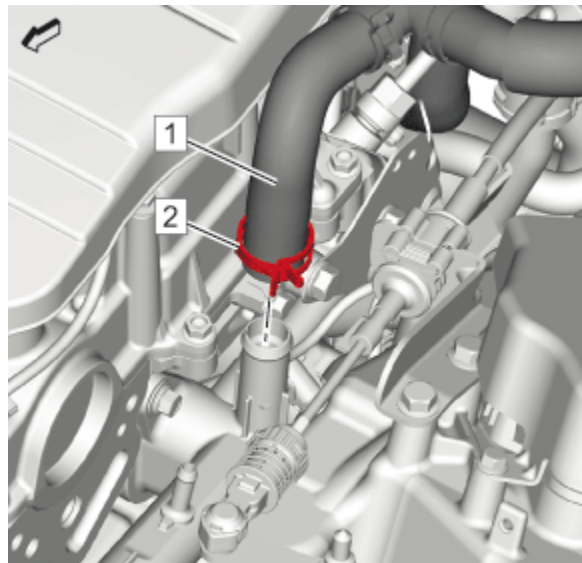


Fig. 52: Heater Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Loosen Heater Outlet Hose Clamp (2)**BO-38185** pliers
7. Disconnect Heater Outlet Hose (1)

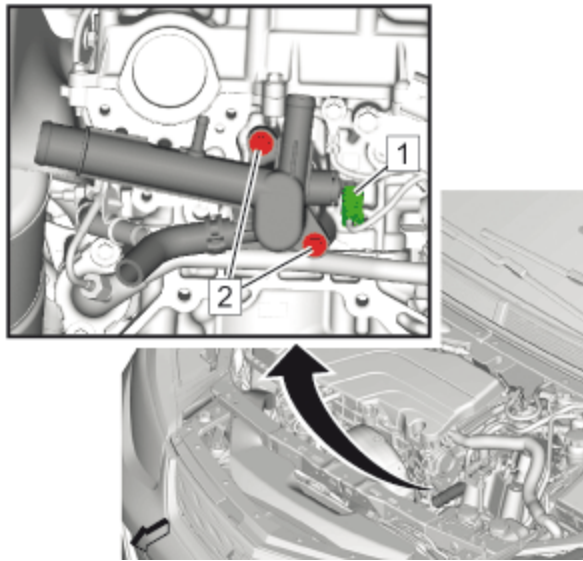


Fig. 53: Engine Coolant Temperature Sensor Electrical Connector And Water Outlet Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the engine coolant temperature sensor electrical connector.(1)
9. Remove the water outlet bolts.(2)

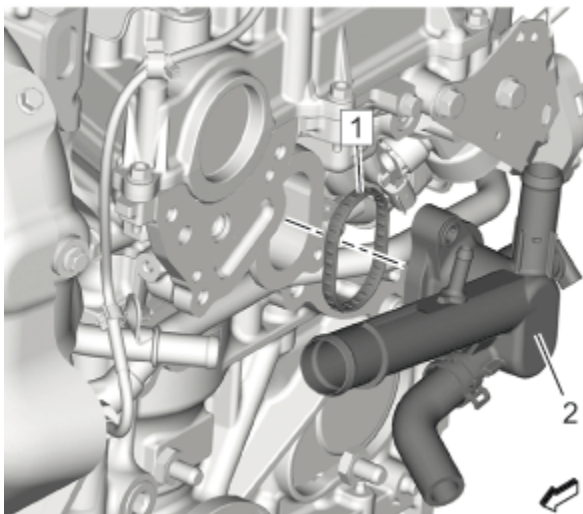


Fig. 54: Water Outlet And Gasket
Courtesy of GENERAL MOTORS COMPANY

10. Remove the water outlet.(2)
11. Remove Water Outlet Gasket (1) and DISCARD

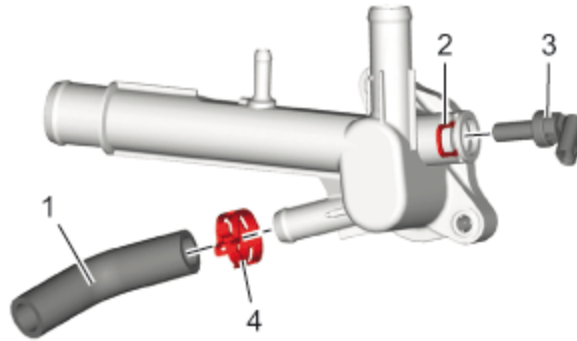


Fig. 55: Thermostat Bypass Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

12. Remove Thermostat Bypass Hose Clamp (4) **BO-38185** pliers
13. Remove Thermostat Bypass Hose (1)
14. Remove Engine Coolant Temperature Sensor Retainer(2)
15. Remove the engine coolant temperature sensor.(3)

Installation Procedure

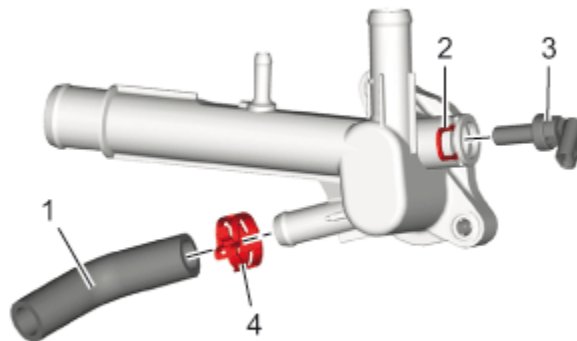


Fig. 56: Thermostat Bypass Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

1. Install the engine coolant temperature sensor.(3)
2. Install Engine Coolant Temperature Sensor Retainer(2)
3. Install Thermostat Bypass Hose (1)
4. Install Thermostat Bypass Hose Clamp (4)**BO-38185** pliers

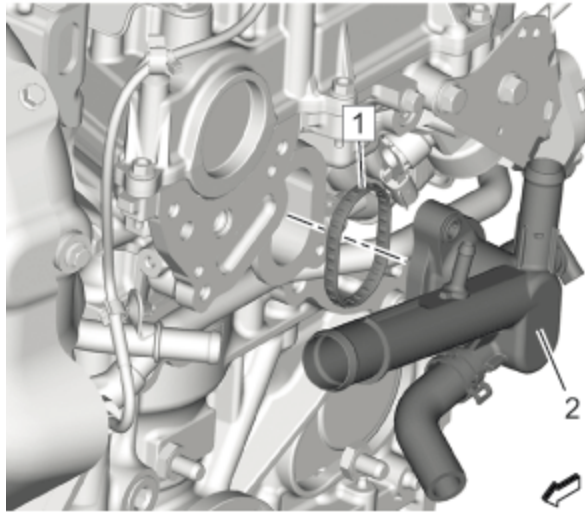


Fig. 57: Water Outlet And Gasket

Courtesy of GENERAL MOTORS COMPANY

5. Install a NEW gasket to the water outlet.(1)
6. Install the water outlet.(2)

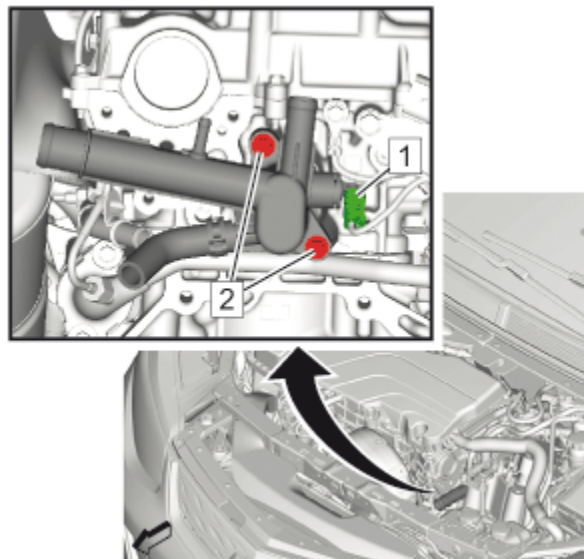


Fig. 58: Engine Coolant Temperature Sensor Electrical Connector And Water Outlet Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

7. Install Water Outlet Bolt (2) and tighten 12 N.m (106 lb in)
8. Connect the engine coolant temperature sensor electrical connector.(1)

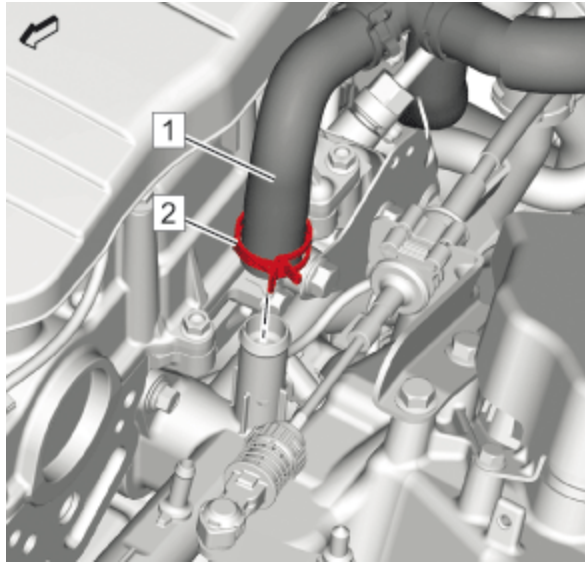


Fig. 59: Heater Outlet Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

9. Install Heater Outlet Hose (1)
10. Install Heater Outlet Hose Clamp (2) **BO-38185** pliers

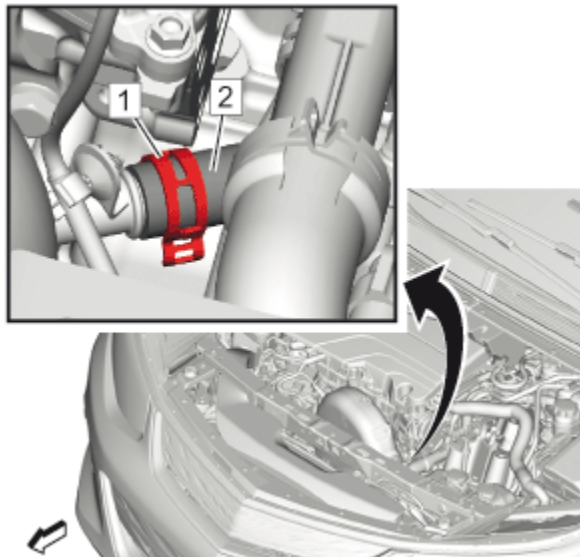


Fig. 60: Thermostat Bypass Hose Clamp

Courtesy of GENERAL MOTORS COMPANY

11. Install Thermostat Bypass Hose (2)
12. Install Thermostat Bypass Hose Clamp (1) **BO-38185** pliers
13. Install Radiator Inlet Hose @ Water Outlet [Radiator Inlet Hose Replacement](#)
14. Install [Heater Outlet Hose Vapor Vent Hose Replacement](#)
15. Fill the cooling system. [Cooling System Draining and Filling](#)

WATER PUMP BELT REPLACEMENT

Removal Procedure

1. Remove [Front Compartment Air Deflector Replacement](#)
2. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#) - Right Side
3. Remove Heater Inlet Hose@Heater Coolant Heater [Heater Inlet Hose Replacement](#)
4. Remove Heater Inlet and Outlet Pipe@Heater Coolant Heater [Heater Inlet And Outlet Pipe Replacement](#)

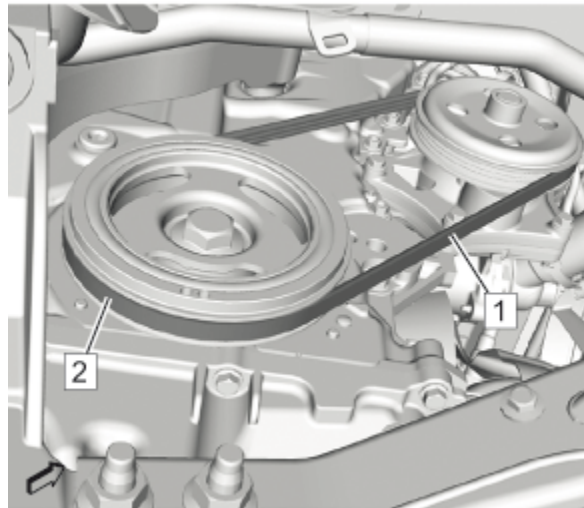


Fig. 61: Water Pump Belt

Courtesy of GENERAL MOTORS COMPANY

5. Cut the water pump belt (2) with a appropriate cutting tool at position (1).
6. Remove Water Pump Belt (2) and DISCARD

Installation Procedure

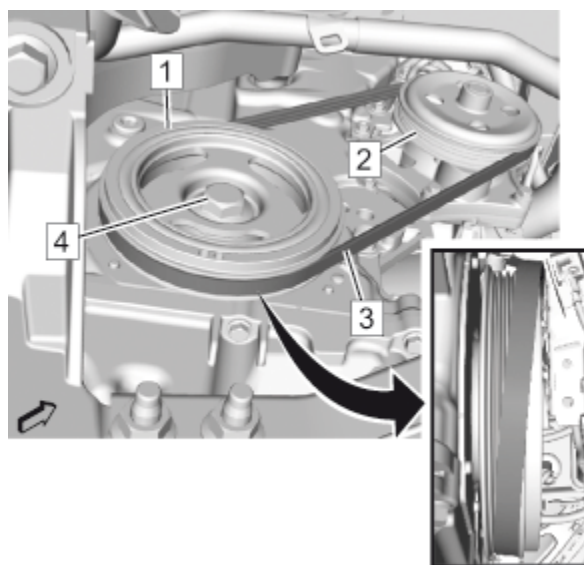


Fig. 62: Water Pump Belt

Courtesy of GENERAL MOTORS COMPANY

1. Position a NEW water pump belt (3) on the water pump pulley (2) and partially install it on the crankshaft balancer (1) in preparation to walk the belt on the crankshaft pulley.
2. Rotate the crankshaft on the crankshaft balancer bolt (4) slowly clockwise until the belt is fully installed on the crankshaft balancer (1).
3. After the belt is on the crankshaft balancer, rotate the crankshaft an additional complete revolution and ensure the water pump belt is fully seated on the crankshaft balancer and water pump pulley.
4. Install Heater Inlet and Outlet Pipe@Heater Coolant Heater [Heater Inlet And Outlet Pipe Replacement](#)
5. Install Heater Inlet Hose@Heater Coolant Heater [Heater Inlet Hose Replacement](#)
6. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#) - Right Side
7. Install [Front Compartment Air Deflector Replacement](#)

WATER PUMP REPLACEMENT

Removal Procedure

1. Remove [Water Pump Belt Replacement](#)
2. Remove [Exhaust Gas Recirculation Cooler Replacement](#)
3. Remove [Water Pump Inlet Adapter Replacement](#)
4. Remove [Radiator Outlet Hose Replacement](#)
5. Disconnect Electrical Connector@Heated Oxygen Sensor [Heated Oxygen Sensor Replacement - Sensor 1](#)

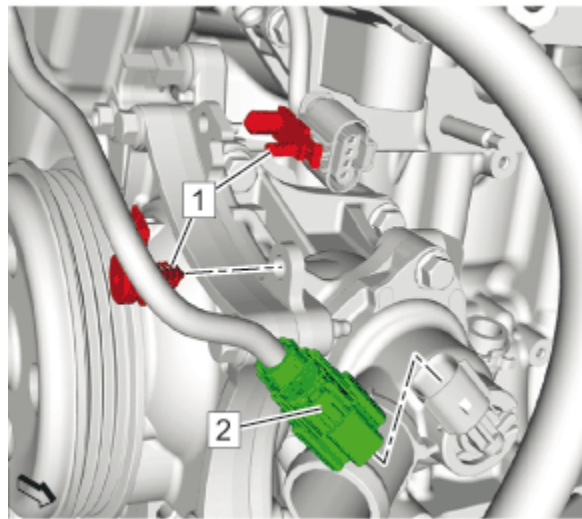


Fig. 63: Electrical Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Retainer (1)
7. Disconnect Electrical Connector (2) @Engine Coolant Thermostat Housing

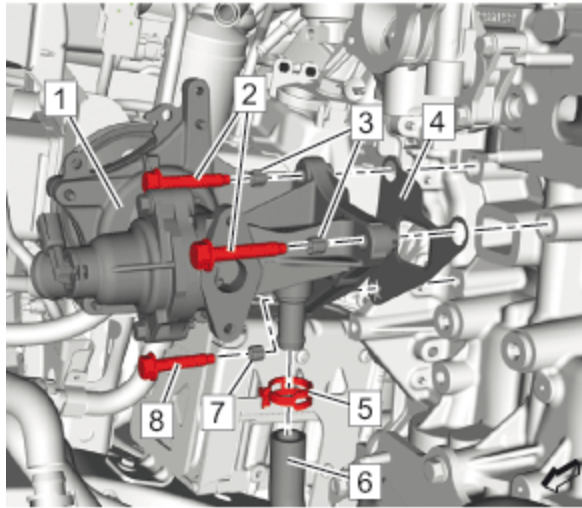


Fig. 64: Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose And Water Pump
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Clamp (5)
9. Remove the exhaust gas recirculation cooler water bypass outlet hose (6) from the water pump (1).

NOTE: Take note that there are different bolt lengths.

10. Remove Water Pump Bolt (2, 8)
11. Remove the 3 bolt retainers (3, 7).
12. Remove Water Pump (1)
13. Remove Water Pump Gasket (4) and DISCARD

Installation Procedure

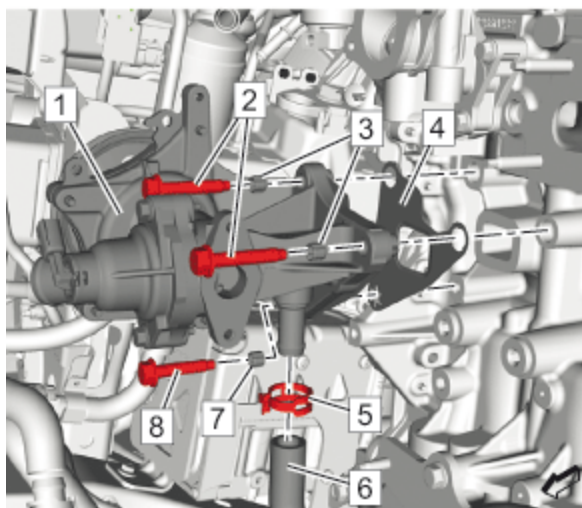


Fig. 65: Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose And Water Pump
 Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket.(4)
2. Install Water Pump (1)

NOTE: Take note that there are different bolt lengths.

3. Install Water Pump Bolt(2, 8)

CAUTION: Fastener Caution

4. Tighten the NEW water pump bolts.25 N.m (18 lb ft)
5. Install the exhaust gas recirculation cooler water bypass outlet hose (6) to the water pump (1).
6. Install Clamp (5)

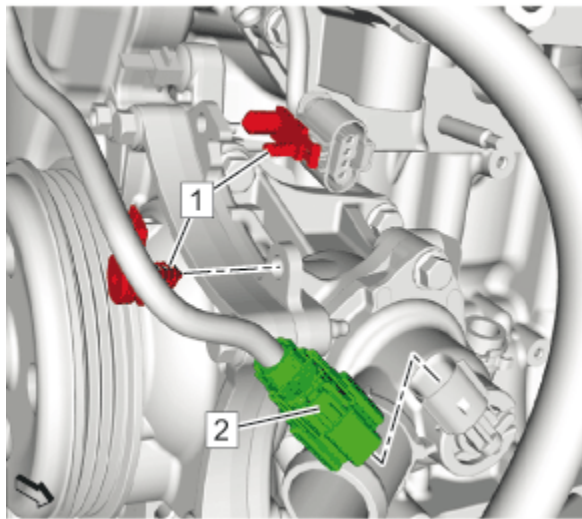


Fig. 66: Electrical Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Install Retainer(1)
8. Connect Electrical Connector (2) @Engine Coolant Thermostat Housing
9. Connect Electrical Connector@Heated Oxygen Sensor Heated Oxygen Sensor Replacement - Sensor 1
10. Install Exhaust Gas Recirculation Cooler Replacement
11. Install Water Pump Inlet Adapter Replacement
12. Install Radiator Outlet Hose Replacement
13. Install Water Pump Belt Replacement

WATER PUMP HOUSING REPLACEMENT

Removal Procedure

1. Drain the cooling system. Cooling System Draining and Filling
2. Remove Water Pump Belt Replacement

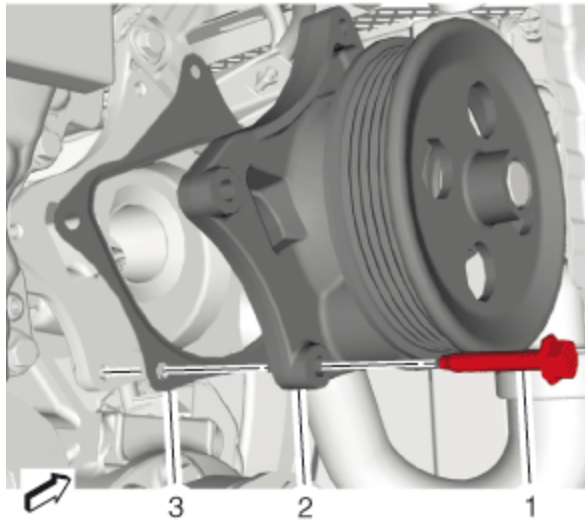


Fig. 67: Water Pump Housing And Water Pump Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove Water Pump Bolt (1)
4. Remove Water Pump Housing (2)
5. Remove Water Pump Housing Gasket (3) and DISCARD
6. Remove the old gasket material from the water pump sealing surfaces.

Installation Procedure

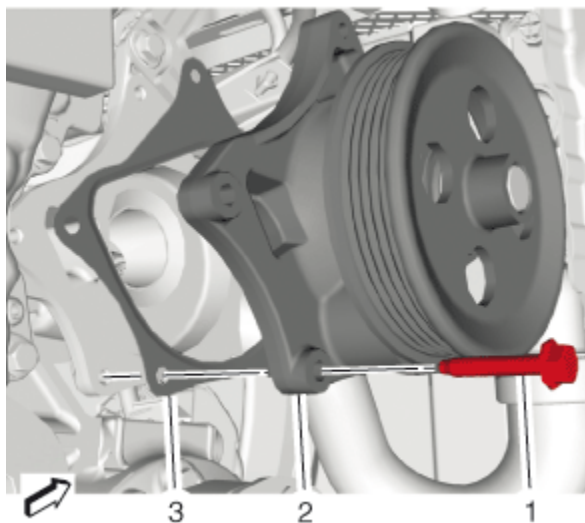


Fig. 68: Water Pump Housing And Water Pump Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install a New Water Pump Housing Gasket (3).
2. Install Water Pump Housing (2)

CAUTION: **Fastener Caution**

- 3. Install Water Pump Bolt (1) and tighten 10 N.m (89 lb in)
- 4. Install [Water Pump Belt Replacement](#)
- 5. Fill the cooling system. [Cooling System Draining and Filling](#)

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - RADIATOR

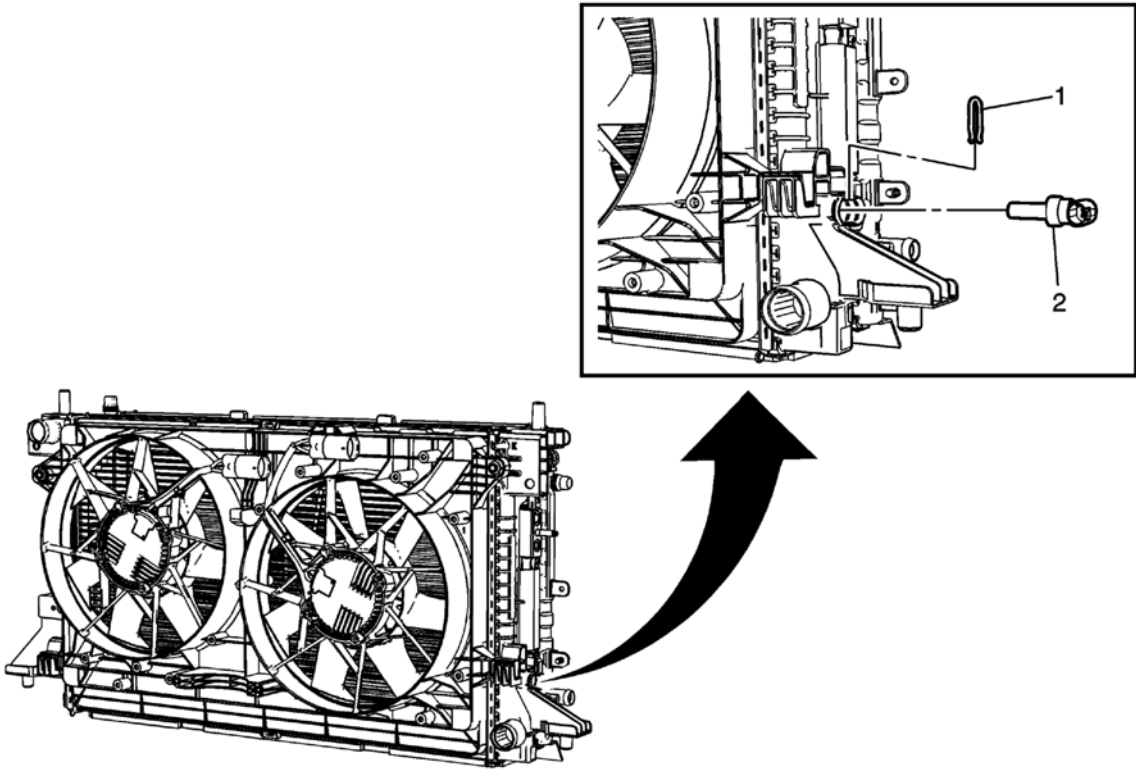


Fig. 69: Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Drain the coolant. Cooling System Draining and Filling	
2. Disconnect the engine coolant temperature sensor electrical connector.	
1	Engine Coolant Temperature Sensor Retainer
2	Engine Coolant Temperature Sensor

RADIATOR DRAIN COCK REPLACEMENT

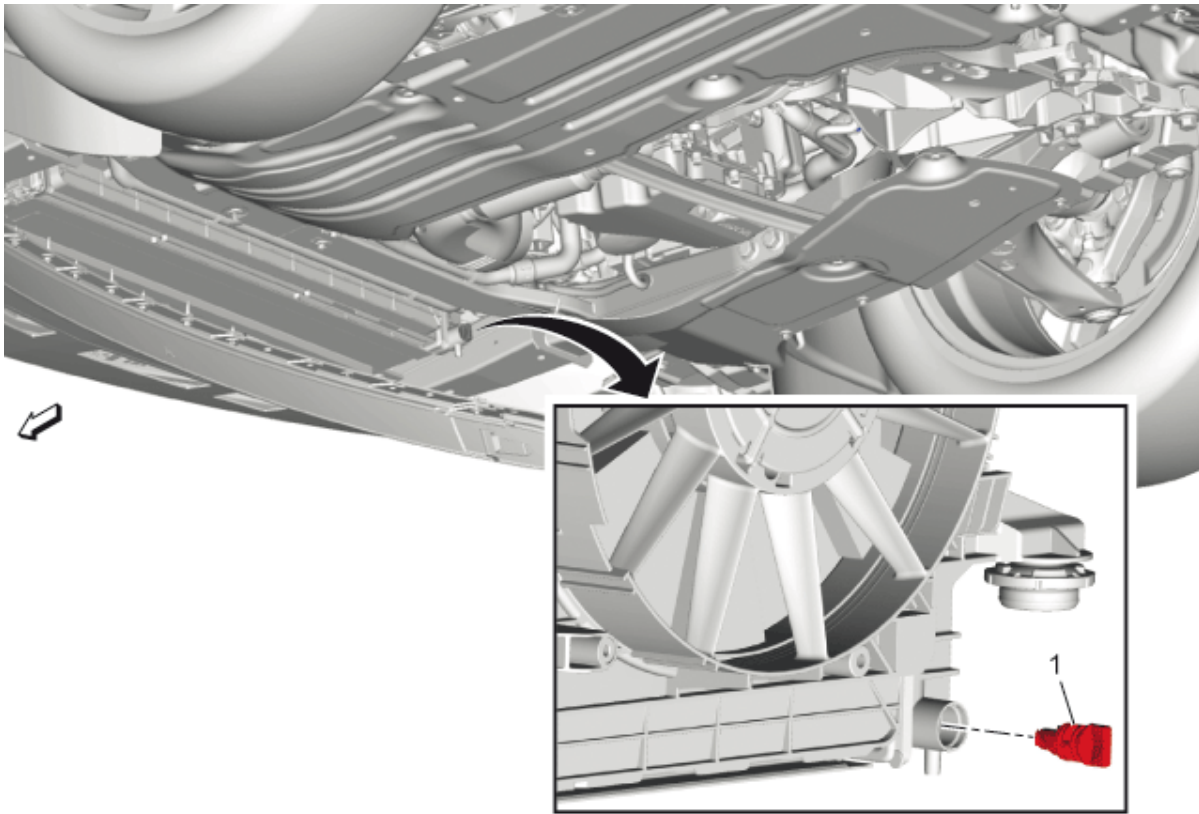


Fig. 70: Radiator Drain Cock
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. <u>Front Underbody Air Deflector Replacement</u> 2. <u>Cooling System Draining and Filling</u>	
1	Radiator Drain Cock

ENGINE COOLANT FAN SHROUD REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools:[Special Tools](#)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#)
2. Remove [Hood Primary and Secondary Latch Replacement](#)
3. Remove [Front Intake Air Duct Replacement](#)
4. Remove [Transmission Fluid Auxiliary Cooler Replacement](#)
5. Remove Radiator Inlet Hose@Radiator [Radiator Inlet Hose Replacement](#)
6. Remove Radiator Outlet Hose@Radiator [Radiator Outlet Hose Replacement](#)

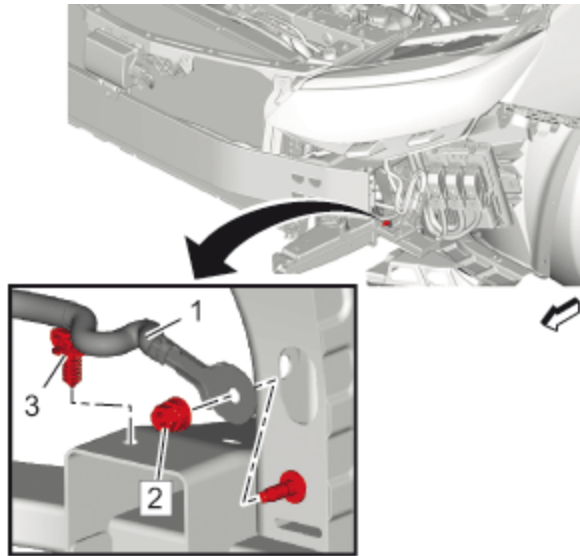


Fig. 71: Ground Cable Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Ground Cable Nut (2)
8. Remove Ground Cable (1)
9. Unclip Wiring Harness Clip (3)

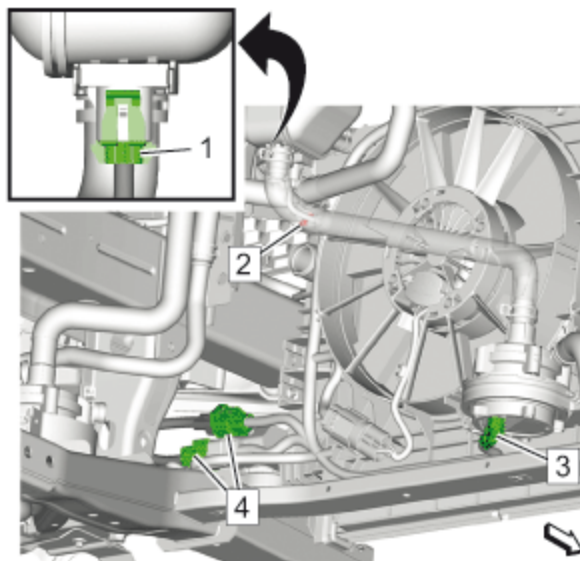


Fig. 72: Electrical Connector And Cable Tie
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the electrical connector.(1, 3, 4)
11. Remove Cable Tie (2)

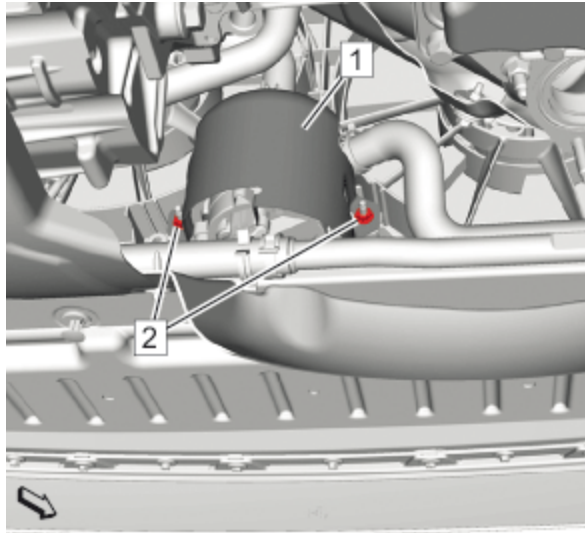


Fig. 73: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

12. Remove Heat Shield Nut (2)
13. Remove Heat Shield (1)

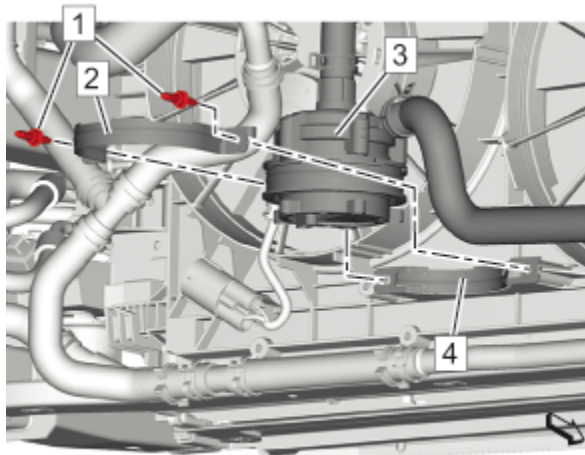


Fig. 74: Drive Motor Battery Coolant Pump Bracket Studs

Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the position of the pump and the bracket.

14. Remove the 2 drive motor battery coolant pump bracket studs (1).

NOTE: It is not necessary to remove any coolant hoses from the drive motor battery coolant pump.

15. Remove the drive motor battery coolant pump (3) and hang aside.
16. Remove the 2 drive motor battery coolant pump brackets (2, 4).

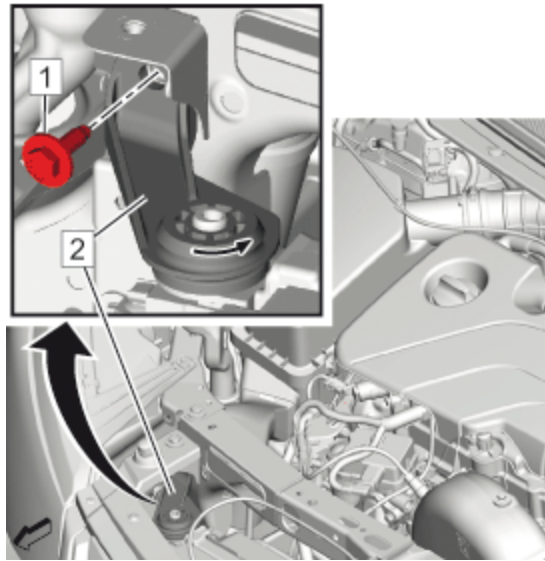


Fig. 75: Radiator Upper Insulator And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

17. Remove the radiator upper insulator bolt (1).
18. Remove the radiator upper insulator (2) by rotating in arrow direction.
19. Repeat the procedure for the other side.

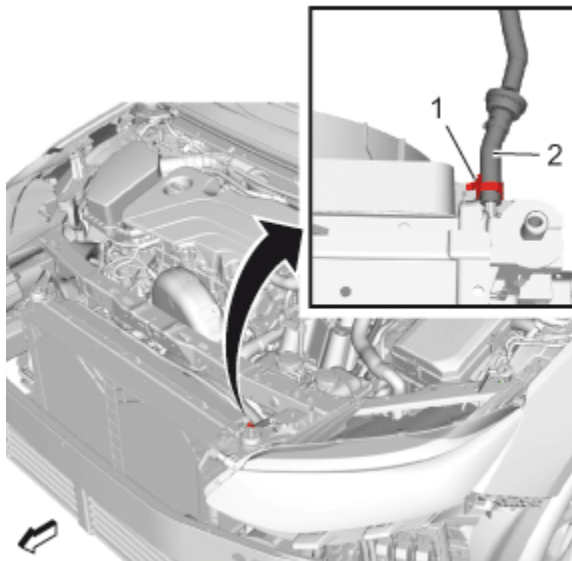


Fig. 76: Radiator Vent Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

20. Remove Clamp (1)- **BO-38185** pliers
21. Remove the radiator vent hose (2) from the radiator.

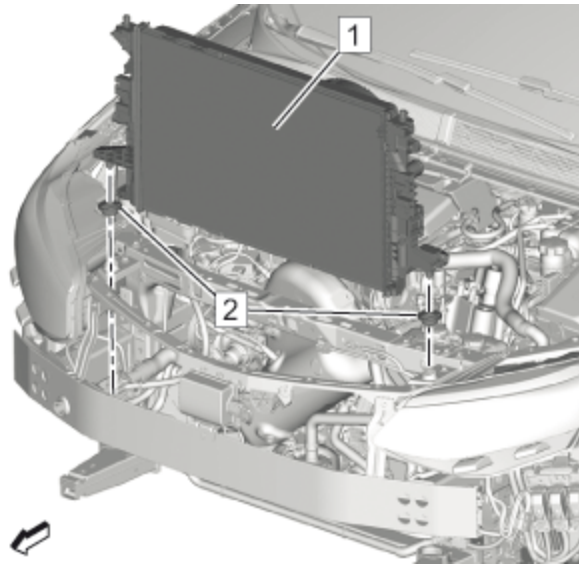


Fig. 77: Radiator And Radiator Insulators

Courtesy of GENERAL MOTORS COMPANY

22. Remove the radiator (1) along with the fan shroud carefully in top direction from the radiator support brackets.
23. Remove the 2 radiator insulators (2).

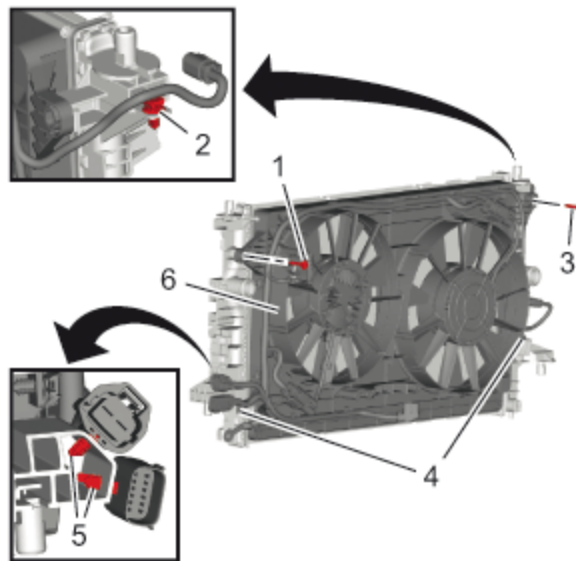


Fig. 78: Wiring Harness Clip And Engine Coolant Fan Shroud Bolt

Courtesy of GENERAL MOTORS COMPANY

24. Unclip Wiring Harness Clip (2, 5)
25. Remove Engine Coolant Fan Shroud Bolt (1, 3)
26. Unclip Retainer(4)
27. Remove Engine Coolant Fan Shroud (6) @Radiator

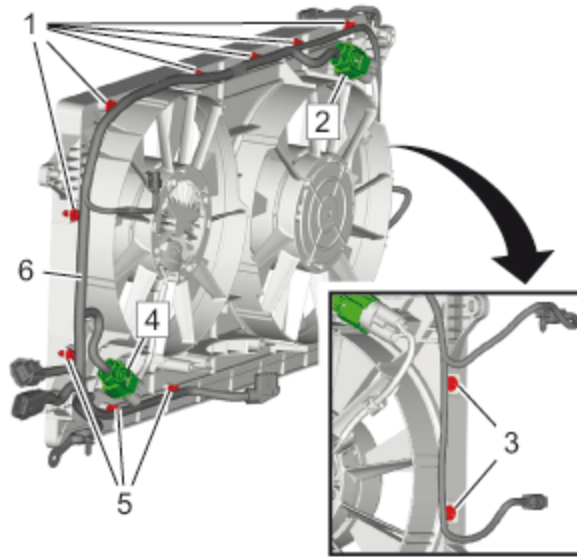


Fig. 79: Wiring Harness Clip And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

28. Disconnect the electrical connector.(2, 4)
29. Unclip Wiring Harness Clip (1, 3, 5)
30. Remove Wiring Harness (6) @Engine Coolant Fan Shroud

Installation Procedure

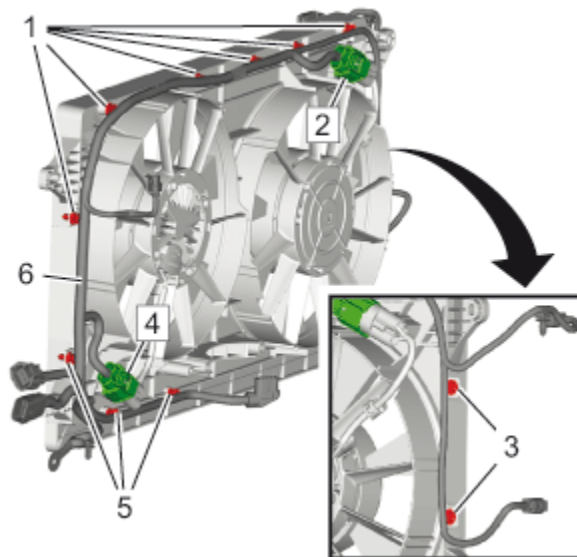


Fig. 80: Wiring Harness Clip And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Wiring Harness (6) @Engine Coolant Fan Shroud
2. Install Wiring Harness Clip (1, 3, 5)
3. Connect the electrical connector.(2, 4)

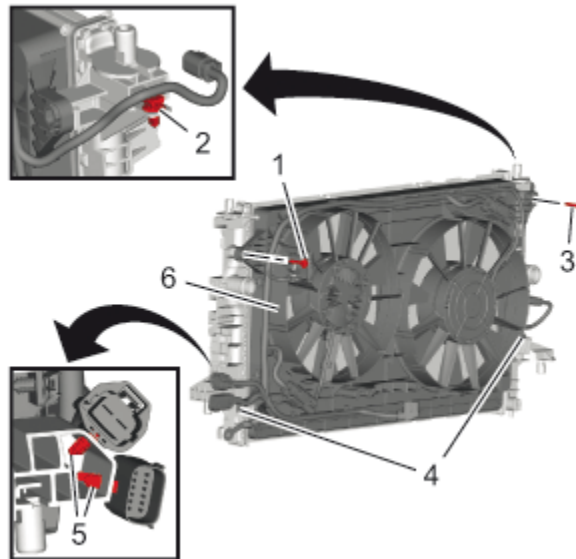


Fig. 81: Wiring Harness Clip And Engine Coolant Fan Shroud Bolt
 Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Coolant Fan Shroud (6) @Radiator
5. Install Retainer(4)

CAUTION: Fastener Caution

6. Install Engine Coolant Fan Shroud Bolt (1, 3) and tighten 5 N.m (44 lb in)
7. Install Wiring Harness Clip

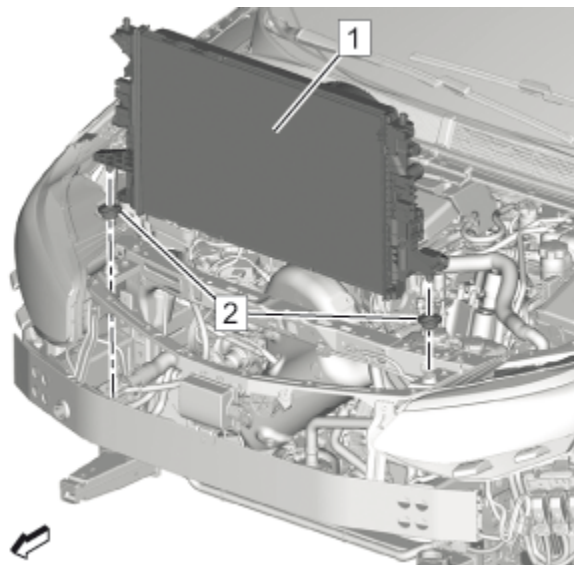


Fig. 82: Radiator And Radiator Insulators
 Courtesy of GENERAL MOTORS COMPANY

8. Install the 2 radiator insulators (2).
9. Install the radiator (1) along with the fan shroud carefully to the radiator support brackets.

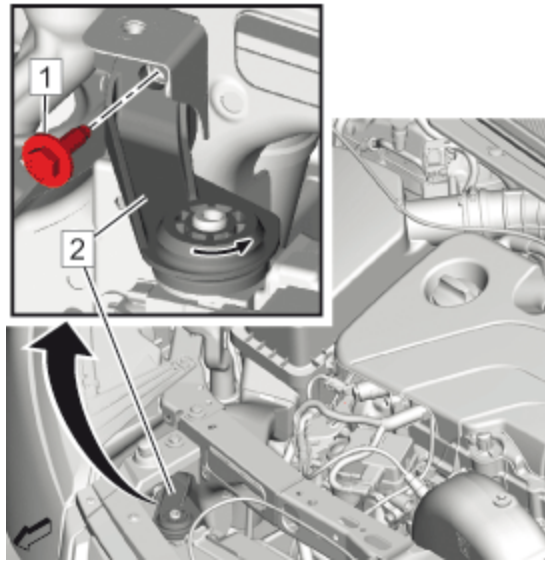


Fig. 83: Radiator Upper Insulator And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

10. Install the radiator upper insulator (2) by rotating against arrow direction.
11. Install the radiator upper insulator bolt (1) and tighten to 22 N.m (16 lb ft).
12. Repeat the procedure for the other side.

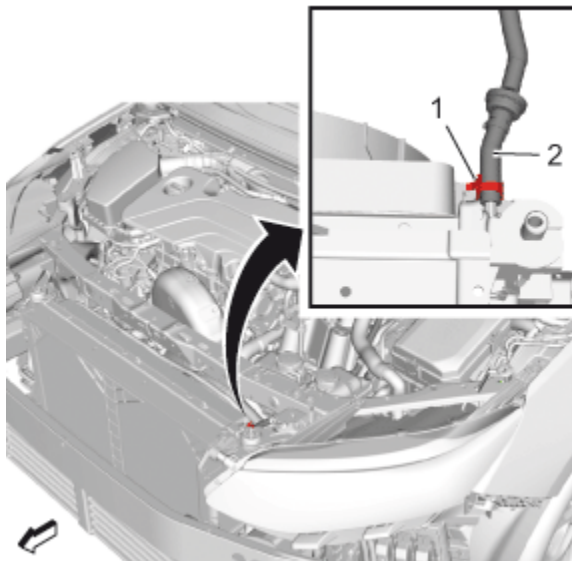


Fig. 84: Radiator Vent Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

13. Install the radiator vent hose (2) to the radiator.
14. Install Clamp (1) **BO-38185** pliers

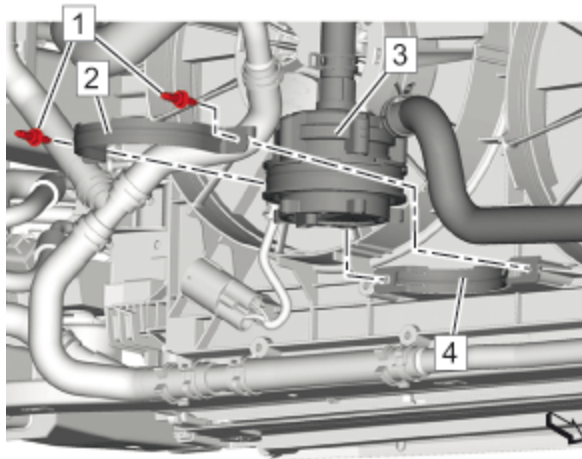


Fig. 85: Drive Motor Battery Coolant Pump Bracket Studs

Courtesy of GENERAL MOTORS COMPANY

15. Install the drive motor battery coolant pump bracket (4).
16. Install the drive motor battery coolant pump (3).

NOTE: Check the pump and the bracket for the correct original position.

17. Install the drive motor battery coolant pump bracket (2).
18. Install the 2 drive motor battery coolant pump bracket studs (1) and tighten to 9 N.m (80 lb in).

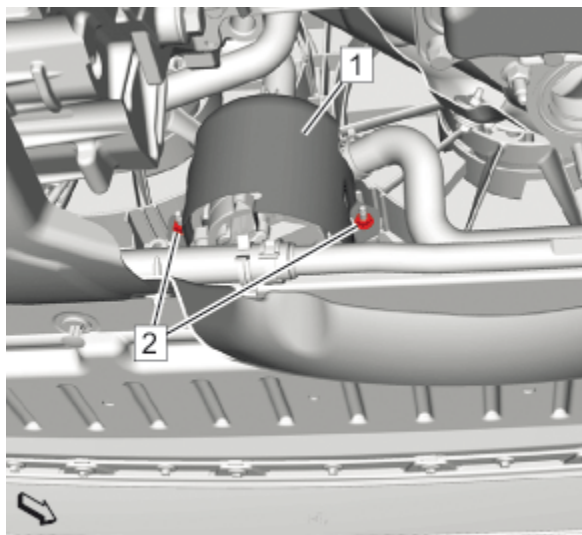


Fig. 86: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

19. Install Heat Shield (1)
20. Install Heat Shield Nut (2) and tighten 9 N.m (80 lb in)

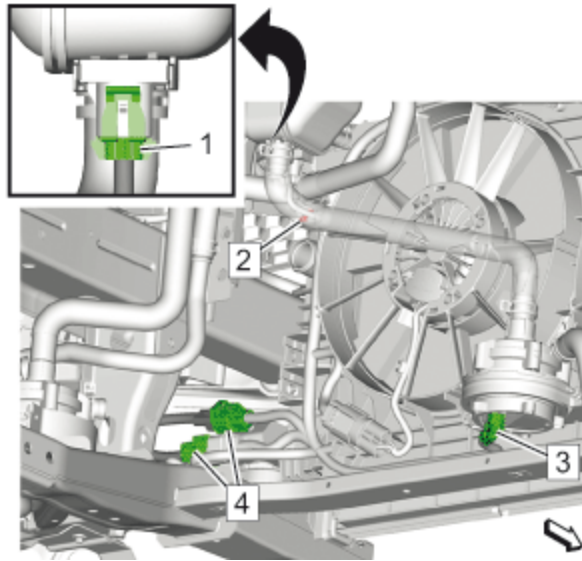


Fig. 87: Electrical Connector And Cable Tie
Courtesy of GENERAL MOTORS COMPANY

21. Connect the electrical connector.(1, 3, 4)
22. Install NEW cable ties.(2)

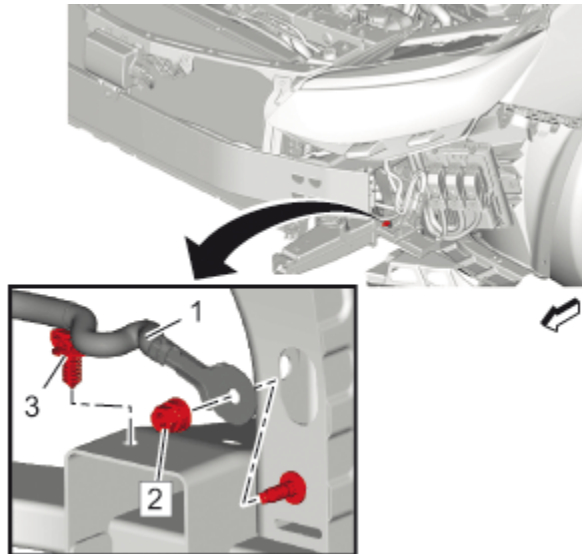


Fig. 88: Ground Cable Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

23. Install Ground Cable (1)
24. Install Ground Cable Nut (2) and tighten 9 N.m (80 lb in)
25. Install Wiring Harness Clip (3)
26. Install Radiator Outlet Hose@Radiator [Radiator Outlet Hose Replacement](#)
27. Install Radiator Inlet Hose@Radiator [Radiator Inlet Hose Replacement](#)
28. Install [Transmission Fluid Auxiliary Cooler Replacement](#)
29. Install [Hood Primary and Secondary Latch Replacement](#)
30. Install [Front Intake Air Duct Replacement](#)

31. Fill the cooling system. [Cooling System Draining and Filling](#)

RADIATOR REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. [Cooling System Draining and Filling](#).
2. Remove [Hood Primary and Secondary Latch Replacement](#)
3. Remove [Front Intake Air Duct Replacement](#)
4. Remove [Transmission Fluid Auxiliary Cooler Replacement](#)
5. Remove Radiator Inlet Hose@Radiator [Radiator Inlet Hose Replacement](#)
6. Remove Radiator Outlet Hose@Radiator [Radiator Outlet Hose Replacement](#)

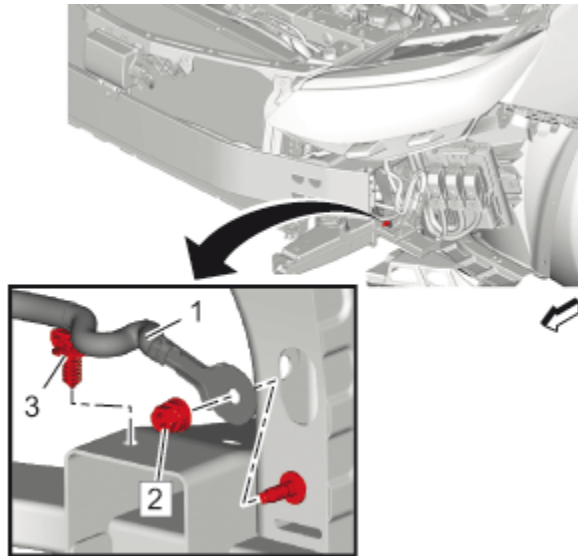


Fig. 89: Ground Cable Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Ground Cable Nut (2)
8. Remove Ground Cable (1)
9. Unclip Wiring Harness Clip (3)

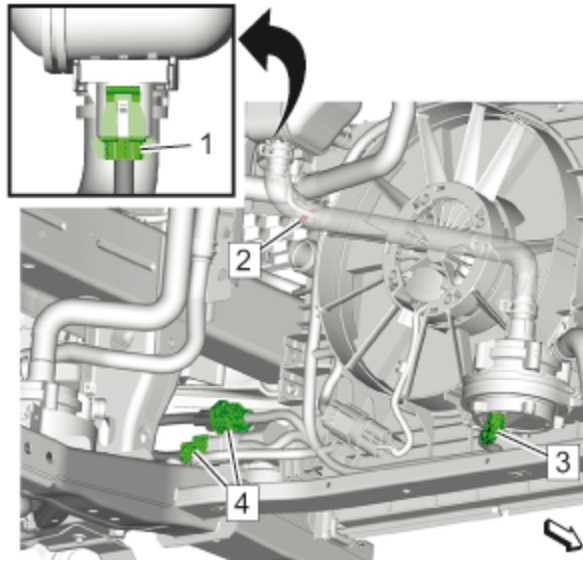


Fig. 90: Electrical Connector And Cable Tie

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the electrical connector.(1, 3, 4)
11. Remove Cable Tie (2)

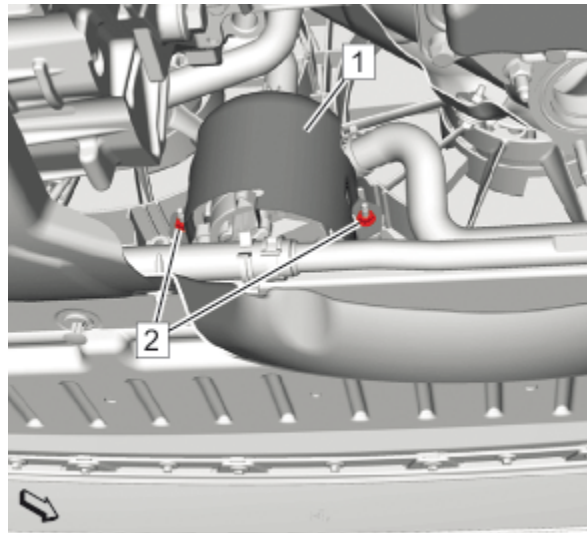


Fig. 91: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

12. Remove Heat Shield Nut (2)
13. Remove Heat Shield (1)

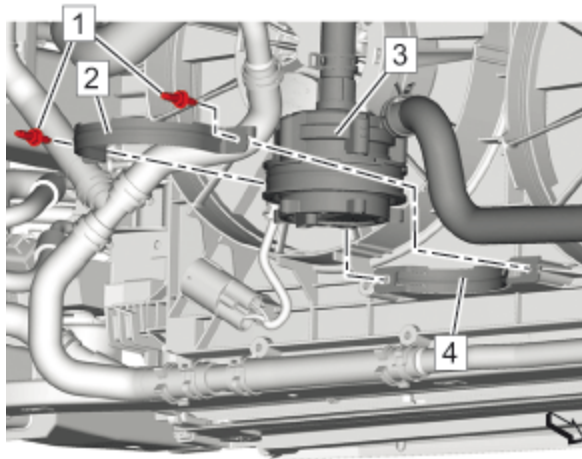


Fig. 92: Drive Motor Battery Coolant Pump Bracket Studs

Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the position of the pump and the bracket.

14. Remove the 2 drive motor battery coolant pump bracket studs (1).

NOTE: It is not necessary to remove any coolant hoses from the drive motor battery coolant pump.

15. Remove the drive motor battery coolant pump (3) and hang aside.

16. Remove the 2 drive motor battery coolant pump brackets (2, 4).

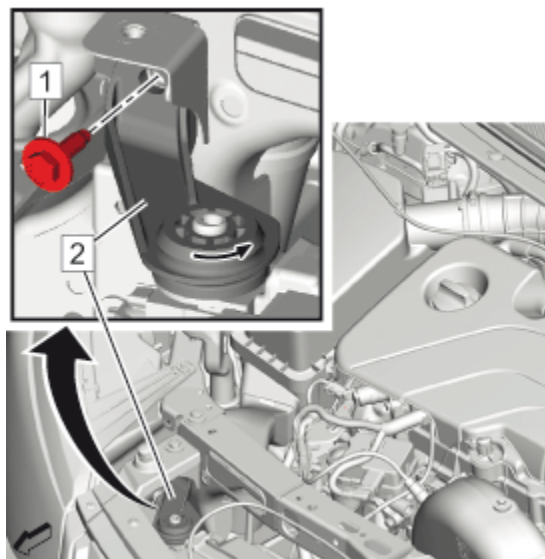


Fig. 93: Radiator Upper Insulator And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

17. Remove the radiator upper insulator bolt (1).
18. Remove the radiator upper insulator (2) by rotating in arrow direction.
19. Repeat the procedure for the other side.

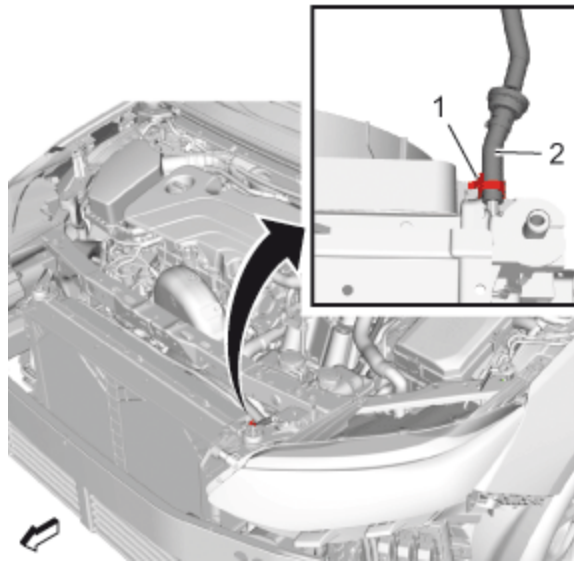


Fig. 94: Radiator Vent Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

20. Remove Clamp (1) **BO-38185** pliers
21. Remove the radiator vent hose (2) from the radiator.

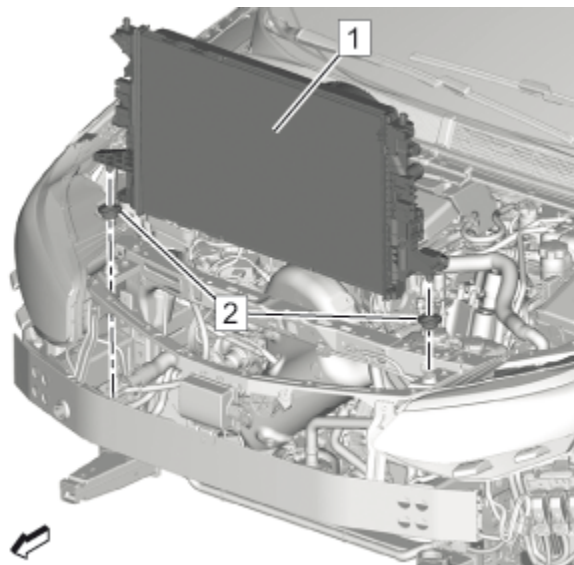


Fig. 95: Radiator And Radiator Insulators
Courtesy of GENERAL MOTORS COMPANY

22. Remove the radiator (1) along with the fan shroud carefully in top direction from the radiator support brackets.
23. Remove the 2 radiator insulators (2).

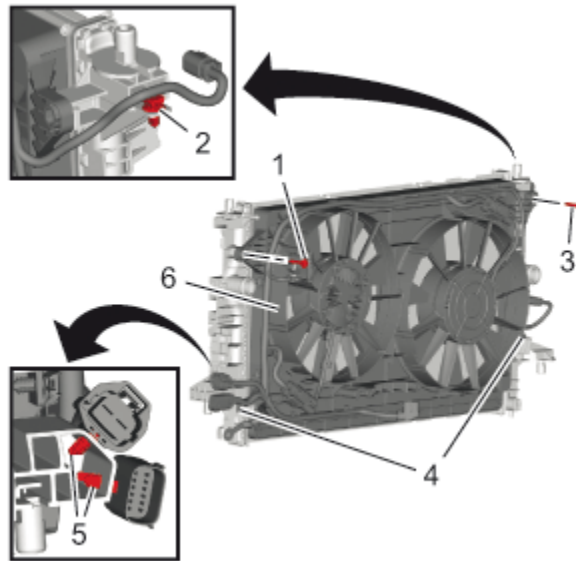


Fig. 96: Wiring Harness Clip And Engine Coolant Fan Shroud Bolt
Courtesy of GENERAL MOTORS COMPANY

24. Unclip Wiring Harness Clip (2, 5)
25. Remove Engine Coolant Fan Shroud Bolt (1, 3)
26. Unclip Retainer(4)
27. Remove Engine Coolant Fan Shroud (6) @Radiator

Disassemble Procedure

1. Remove **Engine Coolant Temperature Sensor Replacement - Radiator**
2. Remove **Radiator Drain Cock Replacement**

Assemble Procedure

1. Install **Radiator Drain Cock Replacement**
2. Install **Engine Coolant Temperature Sensor Replacement - Radiator**

Installation Procedure

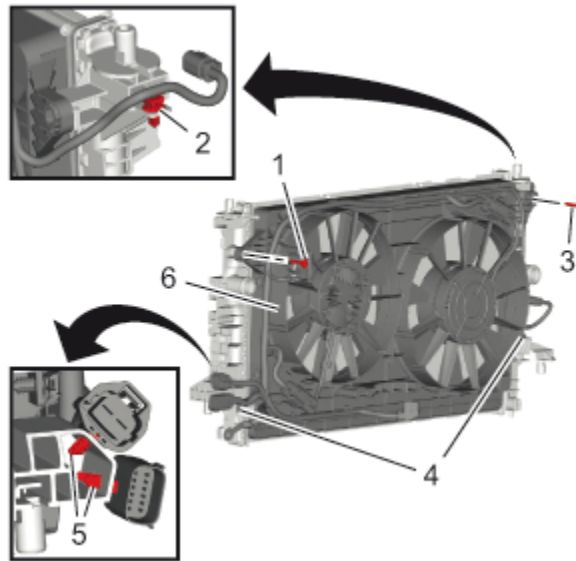


Fig. 97: Wiring Harness Clip And Engine Coolant Fan Shroud Bolt
 Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Coolant Fan Shroud (6) @Radiator
2. Install Retainer(4)

CAUTION: Fastener Caution

3. Install Engine Coolant Fan Shroud Bolt (1, 3) and tighten 5 N.m (44 lb in)
4. Install Wiring Harness Clip

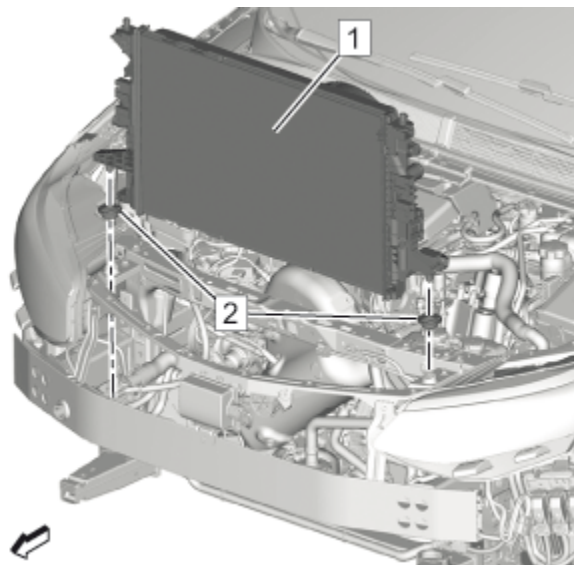


Fig. 98: Radiator And Radiator Insulators
 Courtesy of GENERAL MOTORS COMPANY

5. Install the 2 radiator insulators (2).
6. Install the radiator (1) along with the fan shroud carefully to the radiator support brackets.

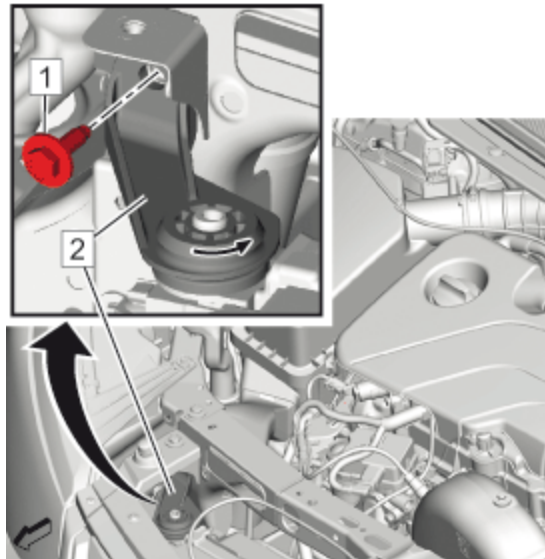


Fig. 99: Radiator Upper Insulator And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

7. Install the radiator upper insulator (2) by rotating against arrow direction.
8. Install the radiator upper insulator bolt (1) and tighten to 22 N.m (16 lb ft).
9. Repeat the procedure for the other side.

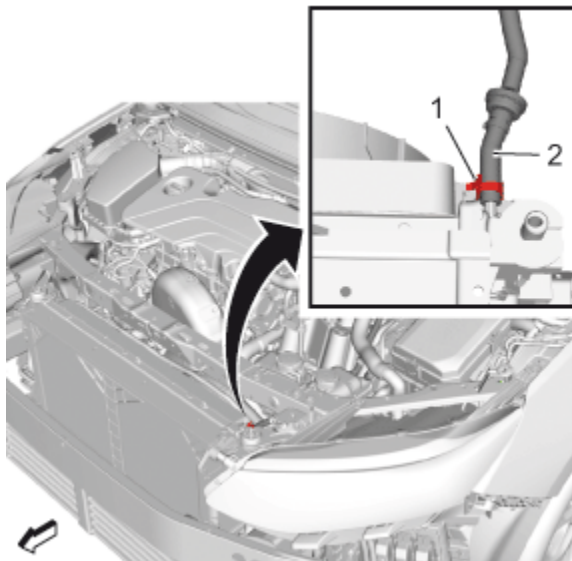


Fig. 100: Radiator Vent Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

10. Install the radiator vent hose (2) to the radiator.
11. Install Clamp (1) **BO-38185** pliers

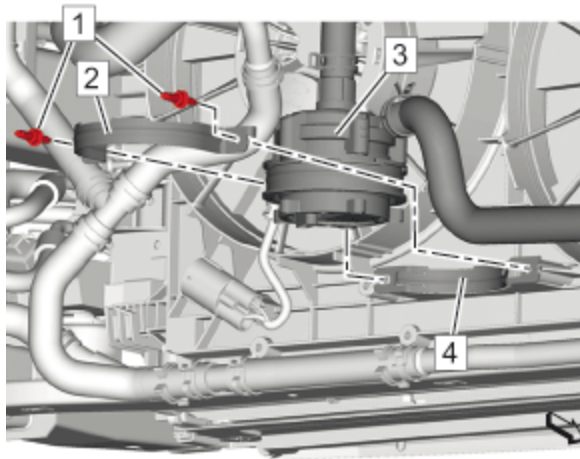


Fig. 101: Drive Motor Battery Coolant Pump Bracket Studs

Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery coolant pump bracket (4).
13. Install the drive motor battery coolant pump (3).

NOTE: Check the pump and the bracket for the correct original position.

14. Install the drive motor battery coolant pump bracket (2).
15. Install the 2 drive motor battery coolant pump bracket studs (1) and tighten to 9 N.m (80 lb in).

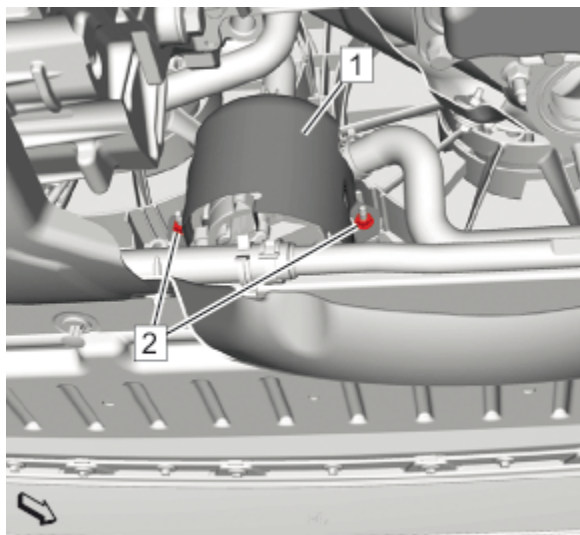


Fig. 102: Heat Shield

Courtesy of GENERAL MOTORS COMPANY

16. Install Heat Shield (1)
17. Install Heat Shield Nut (2) and tighten 9 N.m (80 lb in)

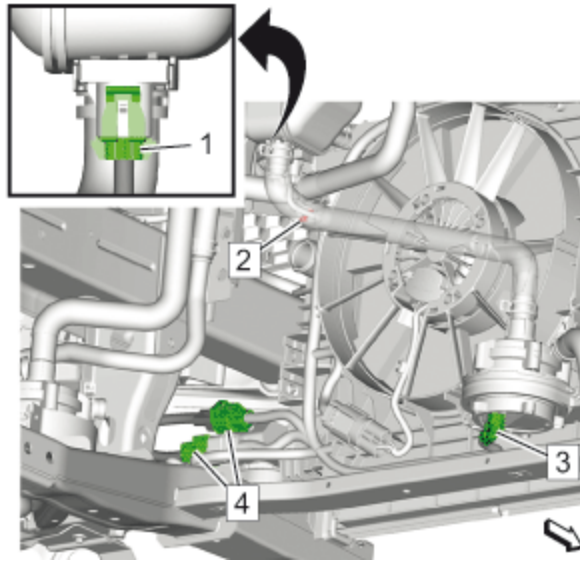


Fig. 103: Electrical Connector And Cable Tie
Courtesy of GENERAL MOTORS COMPANY

18. Connect the electrical connector.(1, 3, 4)
19. Install NEW cable ties.(2)

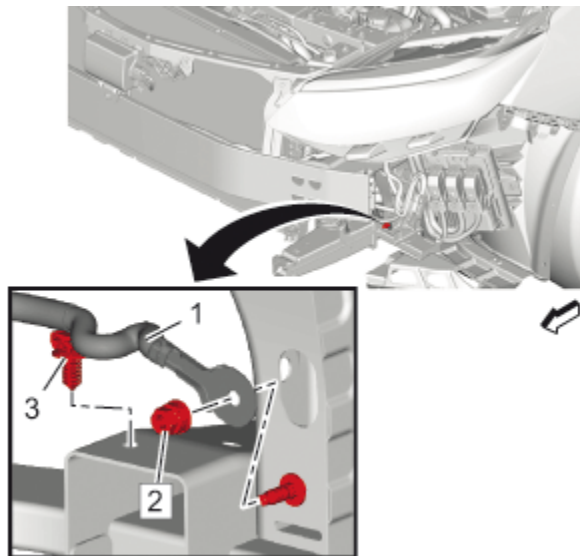


Fig. 104: Ground Cable Nut And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

20. Install Ground Cable (1)
21. Install Ground Cable Nut (2) and tighten 9 N.m (80 lb in)
22. Install Wiring Harness Clip (3)
23. Install Radiator Outlet Hose@Radiator [Radiator Outlet Hose Replacement](#)
24. Install Radiator Inlet Hose@Radiator [Radiator Inlet Hose Replacement](#)
25. Install [Transmission Fluid Auxiliary Cooler Replacement](#)
26. [Hood Primary and Secondary Latch Replacement](#)
27. [Front Intake Air Duct Replacement](#)

28. Fill the cooling system. Cooling System Draining and Filling

RADIATOR UPPER INSULATOR REPLACEMENT

Removal Procedure

1. Remove Front Intake Air Duct Replacement

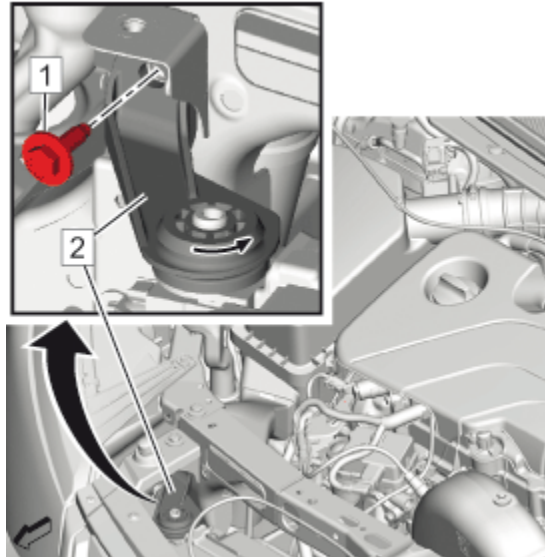


Fig. 105: Radiator Upper Insulator And Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

2. Remove Radiator Upper Insulator Bolt (1)
3. Remove the radiator upper insulator (2) by rotating in arrow direction.

Installation Procedure

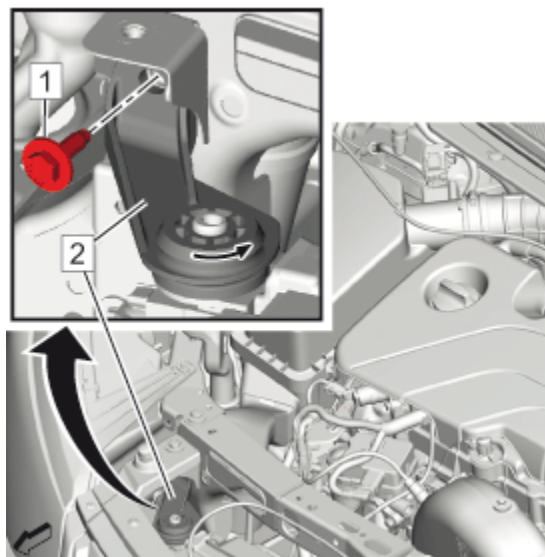


Fig. 106: Radiator Upper Insulator And Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator upper insulator right side. Procedure is also valid for the left side.

1. Install the radiator upper insulator (2) by rotating it against arrow direction.

CAUTION: Fastener Caution

2. Install Radiator Upper Insulator Bolt (1) and tighten 22 N.m (16 lb ft)
3. Install Front Intake Air Duct Replacement

RADIATOR AIR LOWER BAFFLE AND DEFLECTOR REPLACEMENT

Removal Procedure

1. Remove Front Bumper Fascia Removal and Installation
2. Remove Front Bumper Shutter Replacement

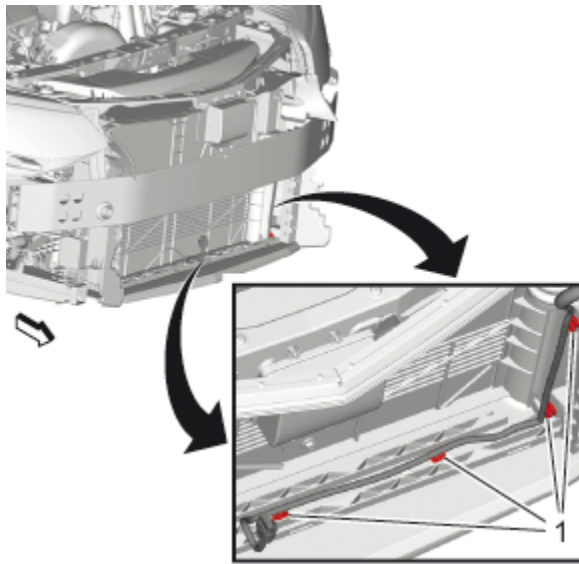


Fig. 107: Wiring Harness Clip
Courtesy of GENERAL MOTORS COMPANY

3. Unclip Wiring Harness Clip (1)

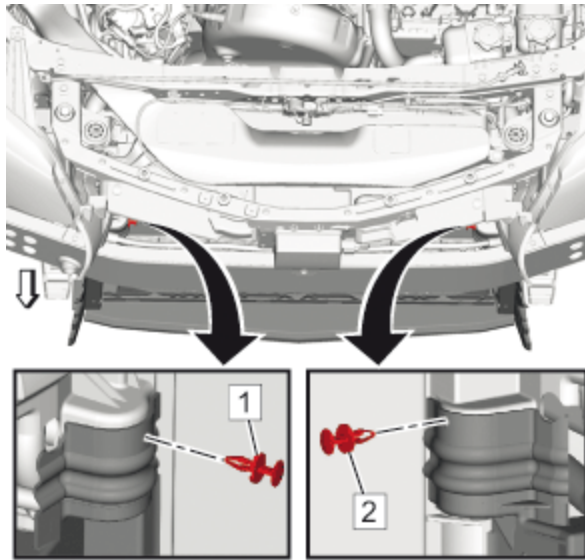


Fig. 108: Clip

Courtesy of GENERAL MOTORS COMPANY

4. Unclip Clip (1, 2)

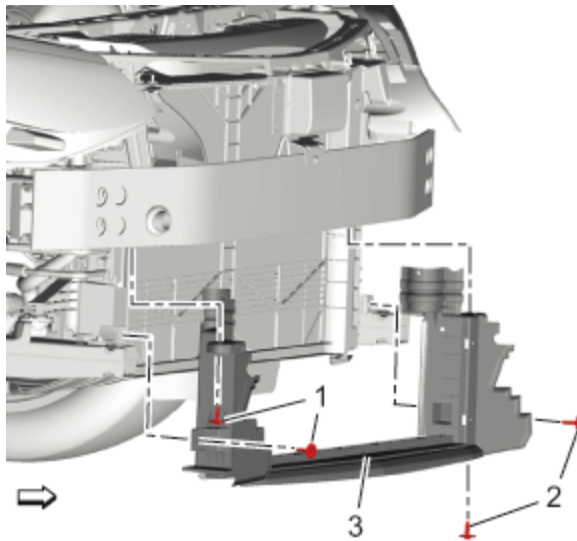


Fig. 109: Radiator Air Lower Baffle Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Remove the 4 radiator air lower baffle bolts (1, 2).
6. Remove Radiator Air Lower Baffle (3)

Installation Procedure

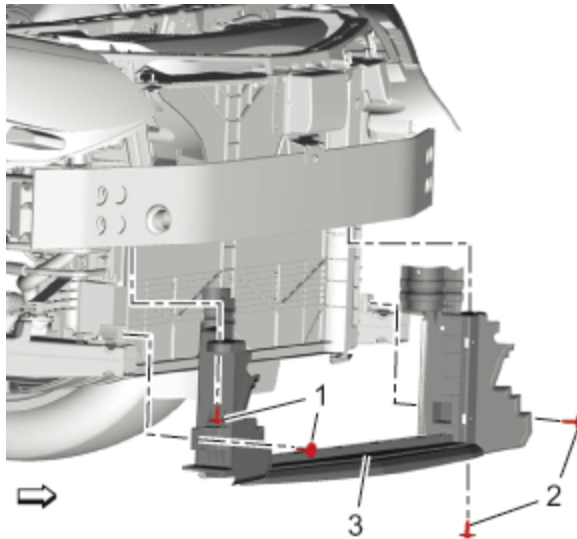


Fig. 110: Radiator Air Lower Baffle Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

1. Install Radiator Air Lower Baffle (3)

Install the 4 radiator air lower baffle bolts (1, 2) and tighten to 9 N.m (80 lb in).

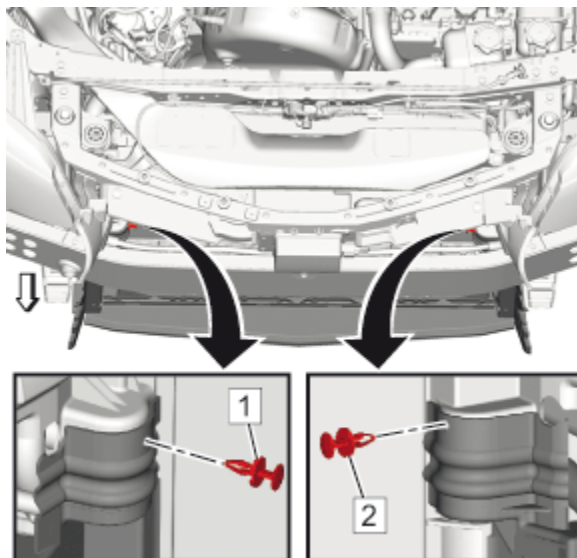


Fig. 111: Clip

Courtesy of GENERAL MOTORS COMPANY

2. Install Clip (1, 2)

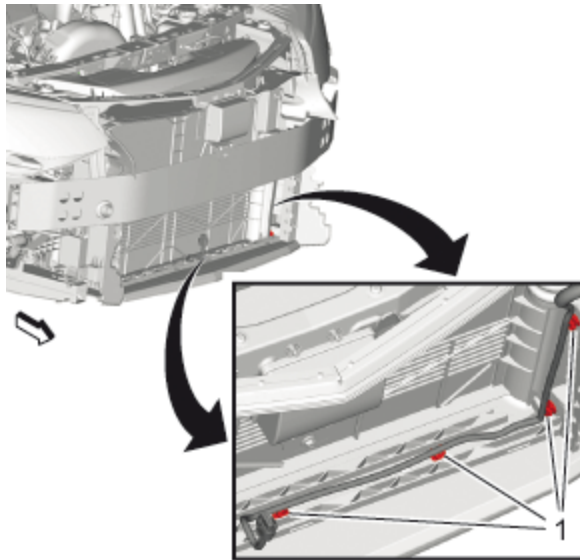


Fig. 112: Wiring Harness Clip

Courtesy of GENERAL MOTORS COMPANY

3. Install Wiring Harness Clip (1)
4. Install [Front Bumper Shutter Replacement](#)
5. Install [Front Bumper Fascia Removal and Installation](#)

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT

Removal Procedure

1. Remove [Front Intake Air Duct Replacement](#)
2. Remove [Pedestrian Sound Alert Speaker Replacement](#)

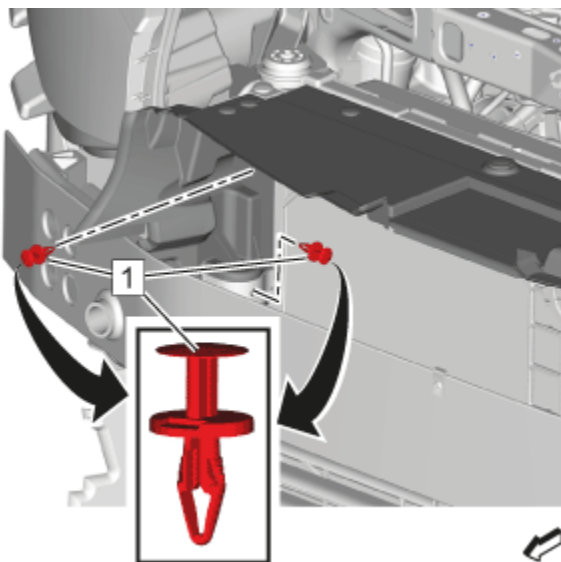


Fig. 113: Clip

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator air upper baffle and deflector right side.

Procedure is also valid for the left side.

3. Unclip Clip (1)
4. Repeat the procedure for the other side.

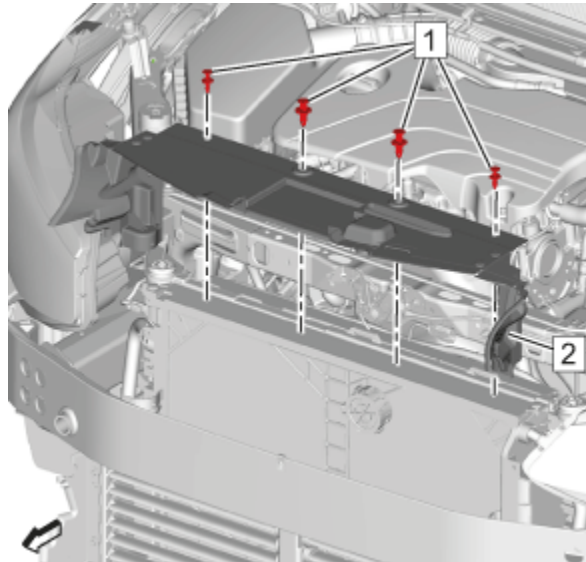


Fig. 114: Clip

Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the different clip size.

5. Unclip Clip (1)
6. Remove Radiator Air Upper Baffle and Deflector (2)

Installation Procedure

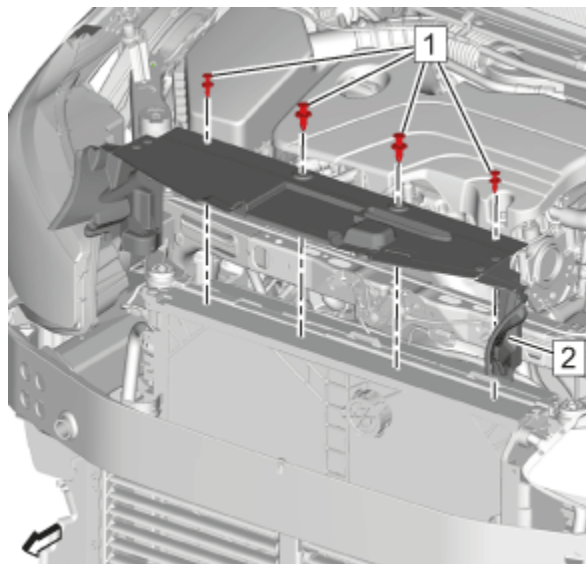


Fig. 115: Clip

Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Air Upper Baffle and Deflector (2)

NOTE: Mind the different clip size.

2. Install Clip (1)

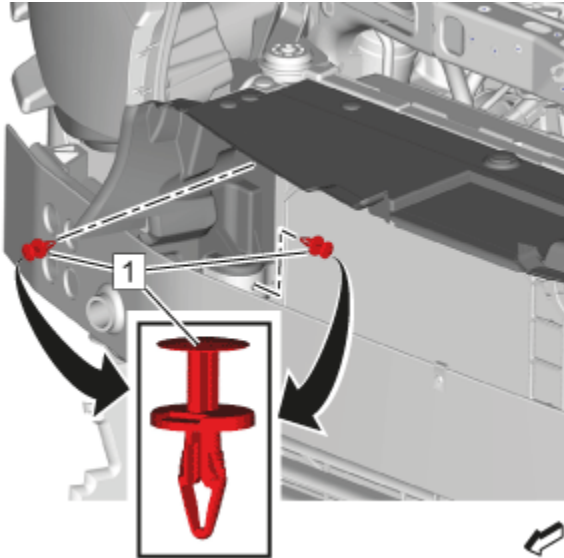


Fig. 116: Clip

Courtesy of GENERAL MOTORS COMPANY

NOTE: Graphic shows the radiator air upper baffle and deflector right side. Procedure is also valid for the left side.

3. Install Clip (1)
4. Repeat the procedure for the other side.
5. Install [Pedestrian Sound Alert Speaker Replacement](#)
6. Install [Front Intake Air Duct Replacement](#)

DESCRIPTION AND OPERATION

COOLING FAN DESCRIPTION AND OPERATION

Cooling Fan Control

The engine cooling fan(s) system is composed of 2 electric cooling fan(s), 2 fan motor(s) and 2 control module. The Hybrid/EV Powertrain Control Module 2 controls the fan speed by sending a pulse width modulated (PWM) signal to the cooling fan control module(s). The cooling fan control module(s) varies the voltage drop across the cooling fan motor(s) in relation to the pulse width modulated signal, which allows the cooling fan(s) to operate at variable speeds.

The cooling fan speed is effected by many different conditions and the Hybrid/EV Powertrain Control Module 2 will adjust the duty cycle from 0 - 100 percent based on cooling system requirements. The scan tool output control is only capable of operating the cooling fan(s) increments, between 10 - 90 percent. 90 percent is considered high speed fan. When multiple cooling fan speed requests are received, the Hybrid/EV Powertrain

Control Module 2 operates the fan(s) at the highest of speed requests. The ECM commands the fans ON under the following conditions:

- The engine coolant temperature is warmer than a predetermined temperature.
- The engine oil temperature is warmer than a predetermined temperature.
- The A/C pressure reaches a predetermined pressure.
- If the engine coolant temperature at key-off is warmer than a predetermined value, or the A/C pressure is greater than a predetermined value, the cooling fan(s) will operate at a low speed. The fan(s) will shut OFF if the temperature or pressure drops below the predetermined value, but will only operate for 2 minutes, regardless of the coolant temperature or A/C pressure.

Cooling System Electronic Component Description and Operation

Engine or Radiator Coolant Temperature Sensor

The engine coolant temperature (ECT) sensor or radiator coolant temperature (RCT) sensor is a variable resistor that measures the temperature of the engine or radiator coolant. The ECM supplies 5 V to the sensor signal circuit and a ground for the low reference circuit.

Engine Coolant Thermostat Heater

The ECM controls the pulse width modulated (PWM) thermostat heater circuit. The engine coolant thermostat heater helps control coolant flow and regulates the engine operating temperature. The ignition relay supplies 12 V to the thermostat through a fuse. The ECM controls the engine coolant thermostat heater by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

COOLING SYSTEM DESCRIPTION AND OPERATION

This vehicle is equipped with three fully independent cooling systems. The power electronics cooling system is dedicated to cooling the battery charger and the power inverter module. The battery cooling system is dedicated to cooling and heating the high voltage battery. The engine cooling system is dedicated to cooling the engine and providing heat to the passenger compartment.

Engine Cooling System Description and Operation

The engine cooling system consists of a radiator, two 12 volt pulse width modulated (PWM) radiator fans, a 12 volt coolant pump, a coolant flow control valve, a high voltage heater and a heater core.

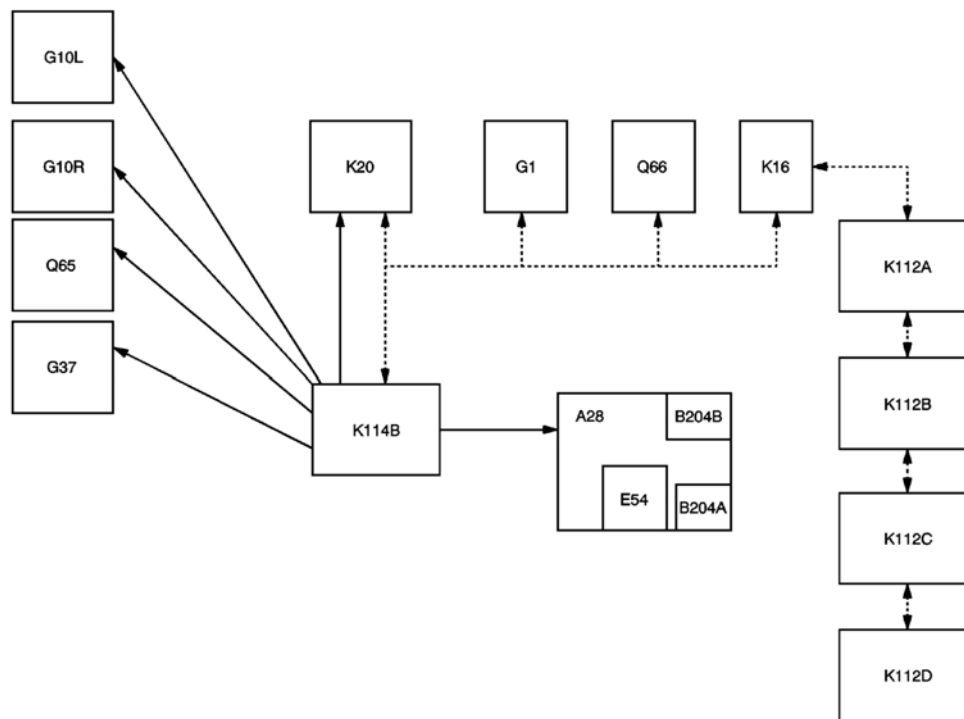


Fig. 117: Hybrid Cooling System Chart
Courtesy of GENERAL MOTORS COMPANY

The hybrid/EV powertrain control module 2 controls the radiator cooling fans. The cooling fans are controlled with a Pulse Width Modulated (PWM) signal. The hybrid/EV powertrain control module 2 diagnoses any faults with the hardwire circuit to the engine control module. The engine control module sends a fan request PWM signal to the hybrid/EV powertrain control module 2 through a hardwire circuit. The hybrid/EV powertrain control module 2 operates in a pass-through mode for the engine control module fan request. The higher the duty cycle the higher the cooling fan speed.

The hybrid/EV powertrain control module 2 sends a request to the engine control module for the cooling fans to be turned on. The engine control module uses this request and other vehicle inputs to decide if and what speed the cooling fans should operate. The engine control module sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed.

If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate, if the engine control module is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans. If active cooling is needed, the engine control module wakes up to operate the air conditioning control module and then the engine control module is the master controller for the fans.

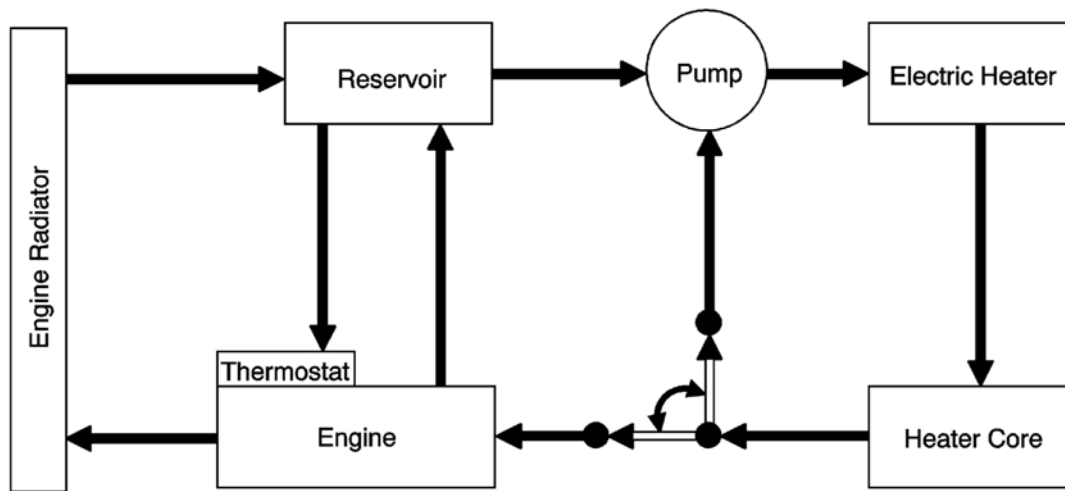


Fig. 118: Engine Cooling System Flow Chart
 Courtesy of GENERAL MOTORS COMPANY

The HVAC Control Module turns on the coolant pump and monitors the temperature sensors in the passenger compartment, engine radiator, high voltage heater and the engine to determine the position of the coolant flow control valve and if the high voltage heater is needed. Passenger compartment heat is provided by air flowing through the heater core. The heater core is heated by coolant from either the engine or the high voltage heater.

The engine cooling system circulates a 50/50 mixture of DEX-COOL and distilled water.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	--------------------------------

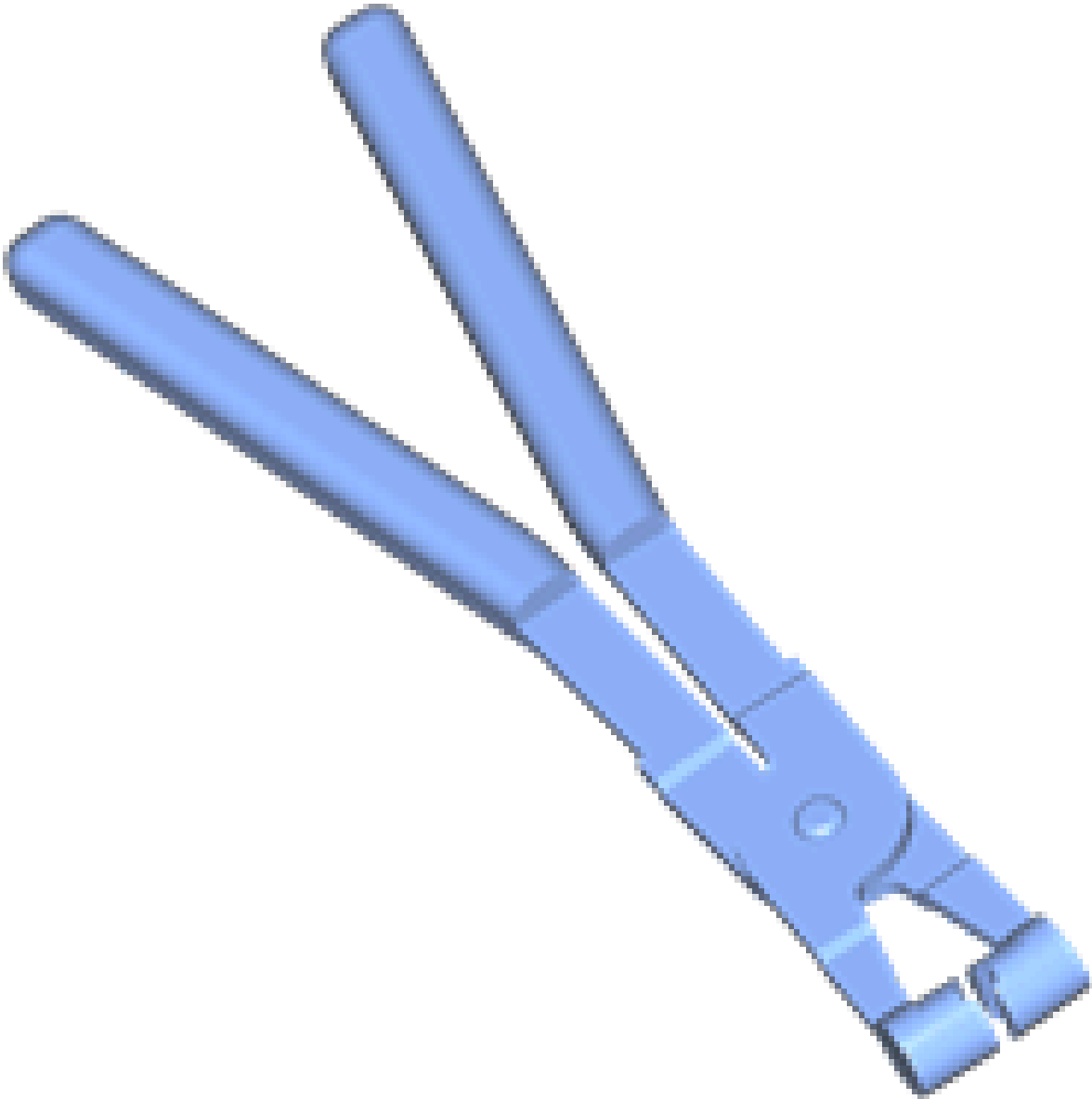
Illustration	Tool Number/ Description
 A 3D illustration of a pair of blue hose clamp pliers. The tool consists of two long, tapered handles that meet at a central pivot point. The handles are made of a solid blue material. The jaws of the pliers are located at the bottom of the handles, featuring a curved, notched design for gripping hose clamps. The entire tool is rendered in a uniform blue color with some shading to indicate its three-dimensional form.	BO-38185 J-38185 Hose Clamp Pliers

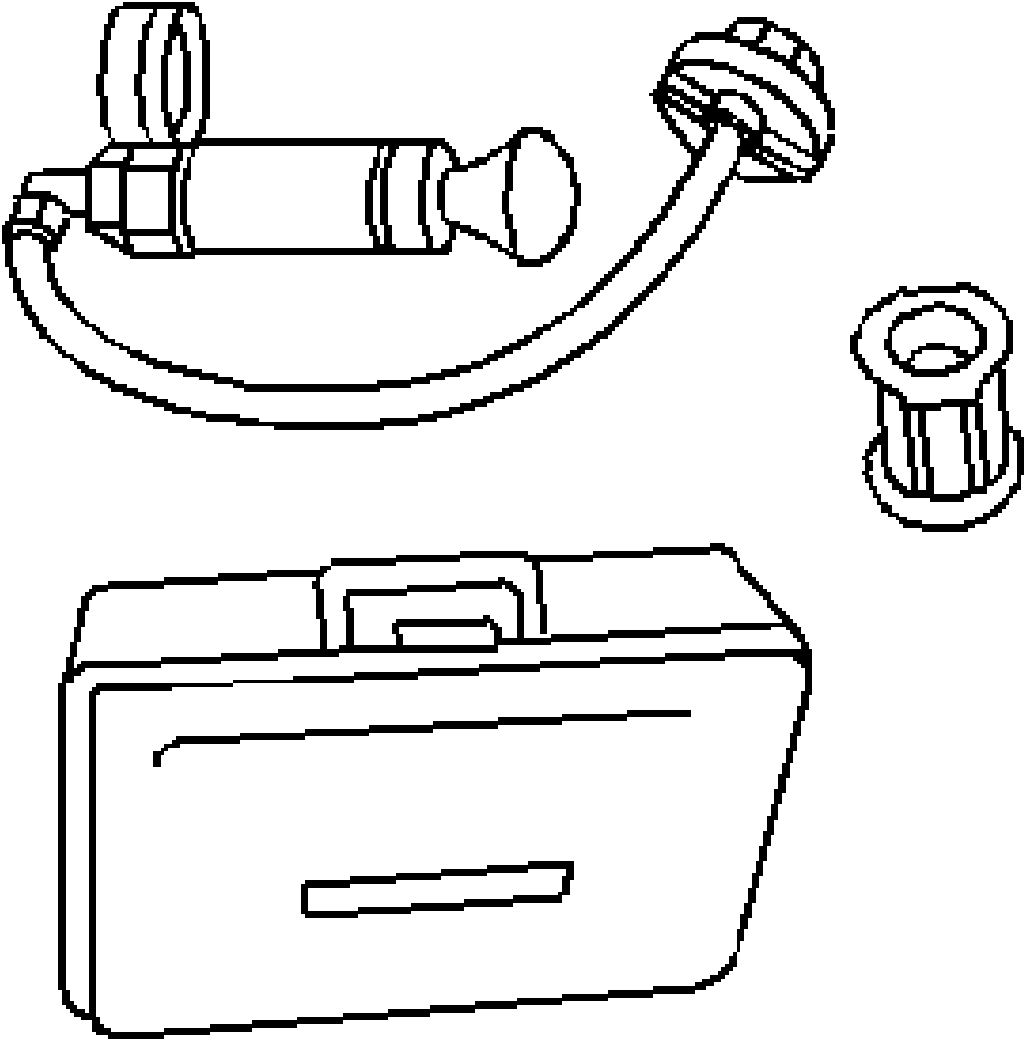
Illustration	Tool Number/ Description
	EN-24460-A J-24460-A Cooling System Pressure Tester

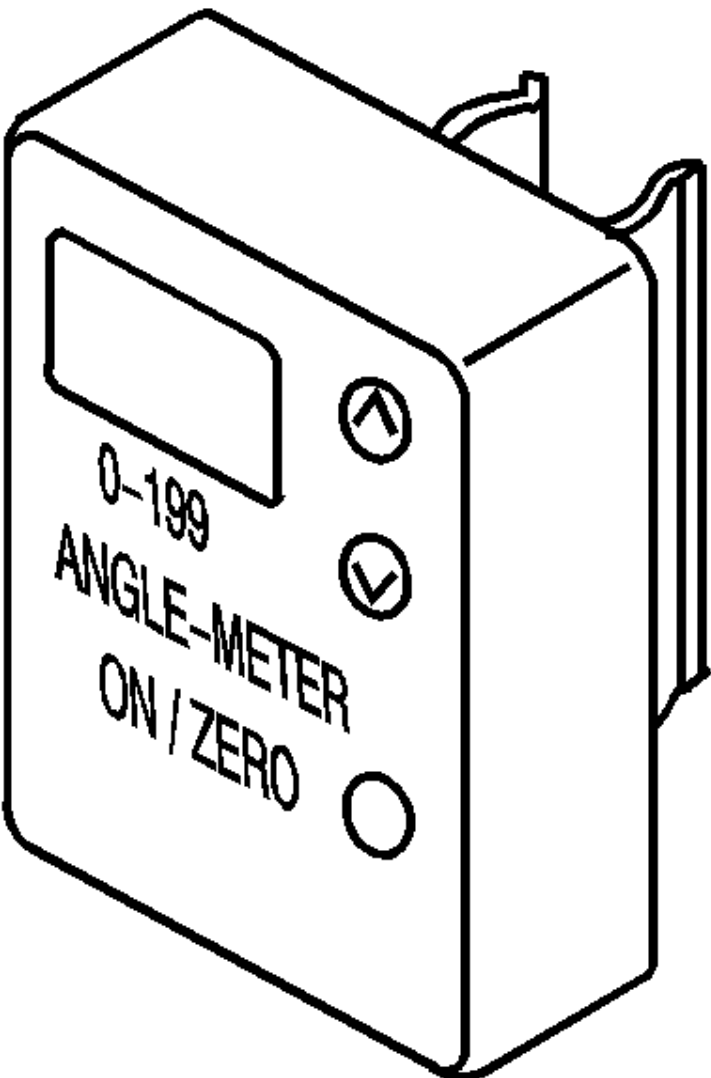
Illustration	Tool Number/ Description
	EN-45059 Torque Angle Sensor Kit

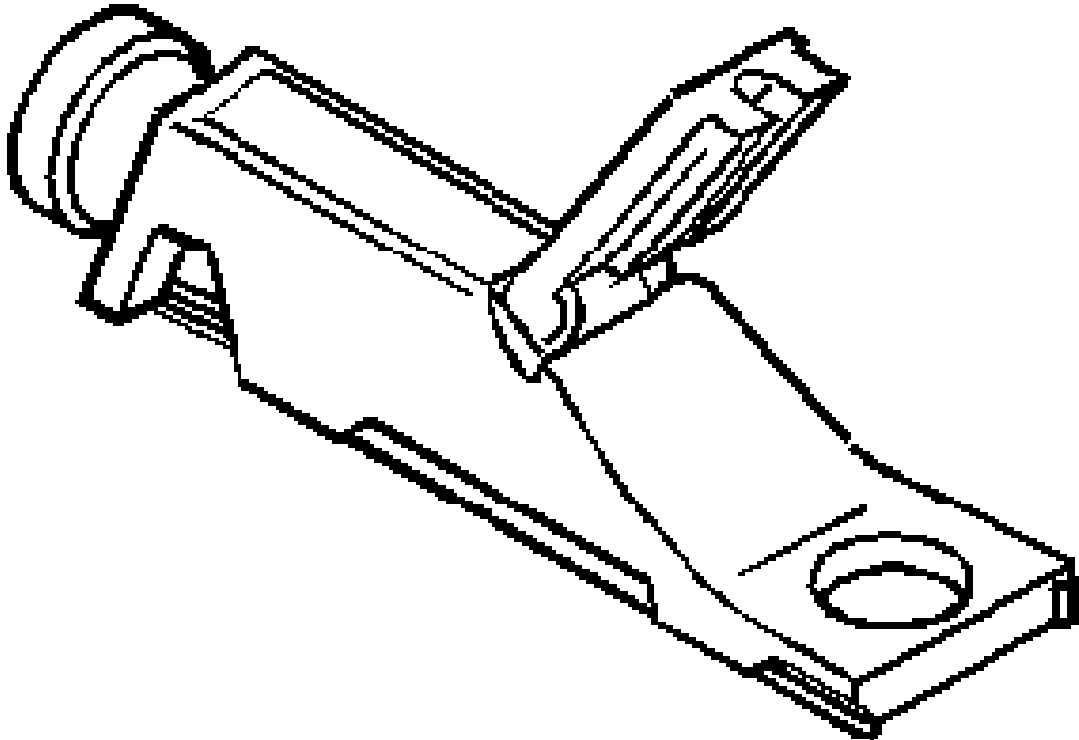
Illustration	Tool Number/ Description
	GE-26568 J-26568 Coolant and Battery Tester

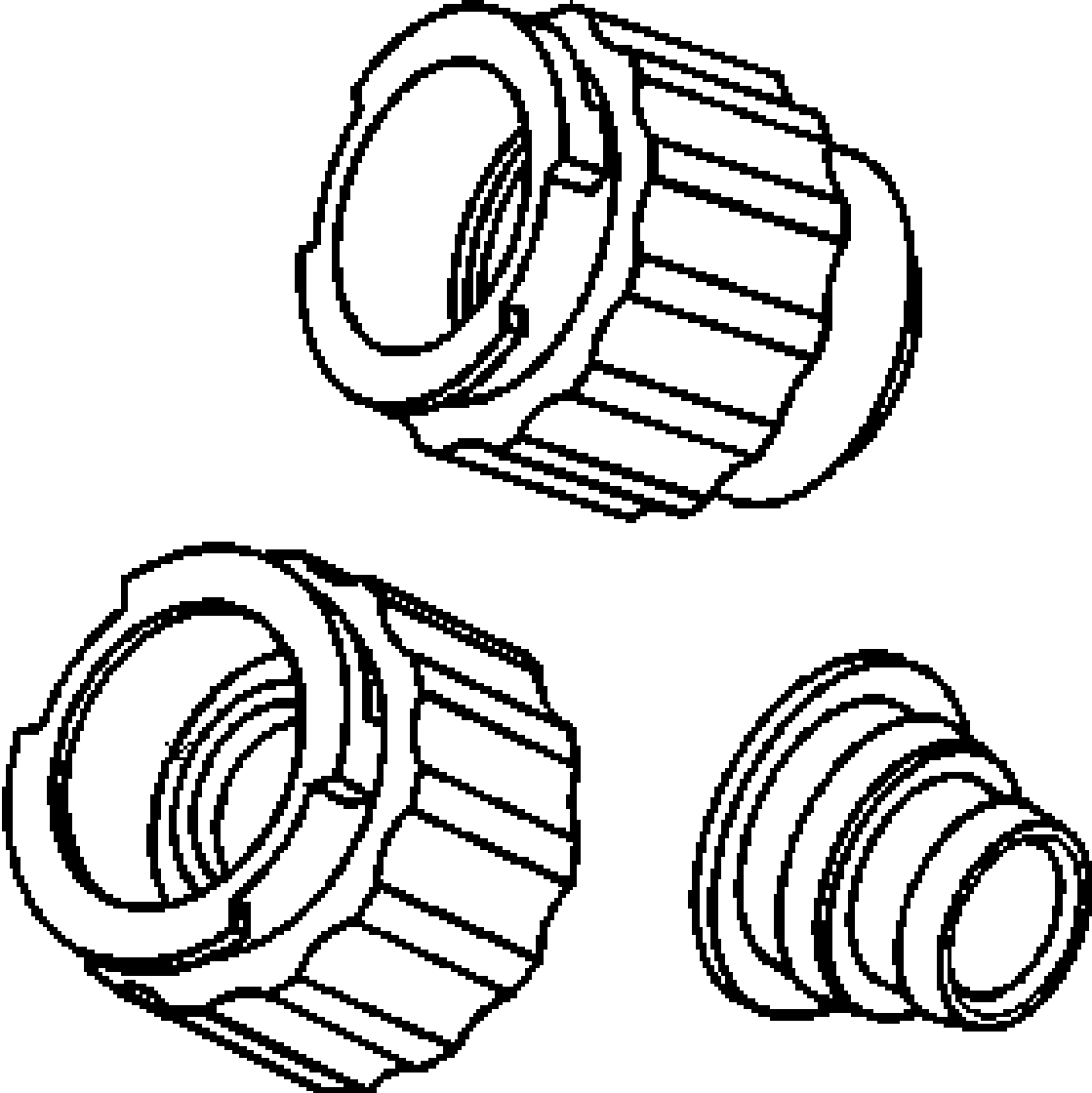
Illustration	Tool Number/ Description
 The illustration contains three separate line drawings of mechanical parts. The top drawing is a large, cylindrical cap with a wide, flat flange at one end and a series of vertical ridges or fins along its body. The bottom-left drawing is a smaller version of the same cap design. The bottom-right drawing is a different component, a cylindrical test adapter with multiple concentric rings and a flange at one end, suggesting it has multiple ports or connection points.	GE-42401-A J-42401-A Radiator Cap and Surge Tank Test Adapter

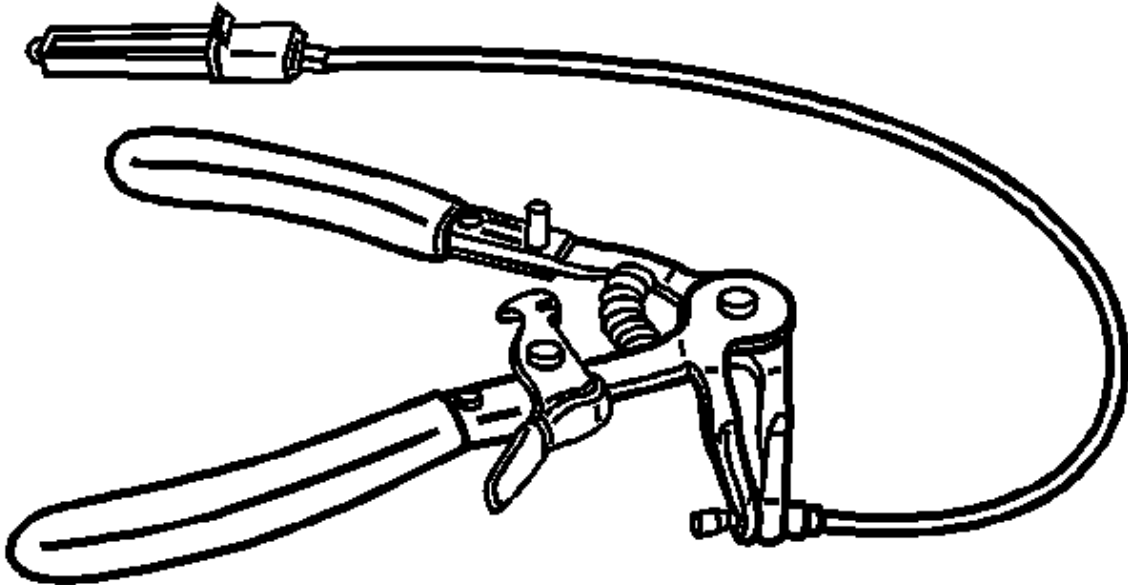
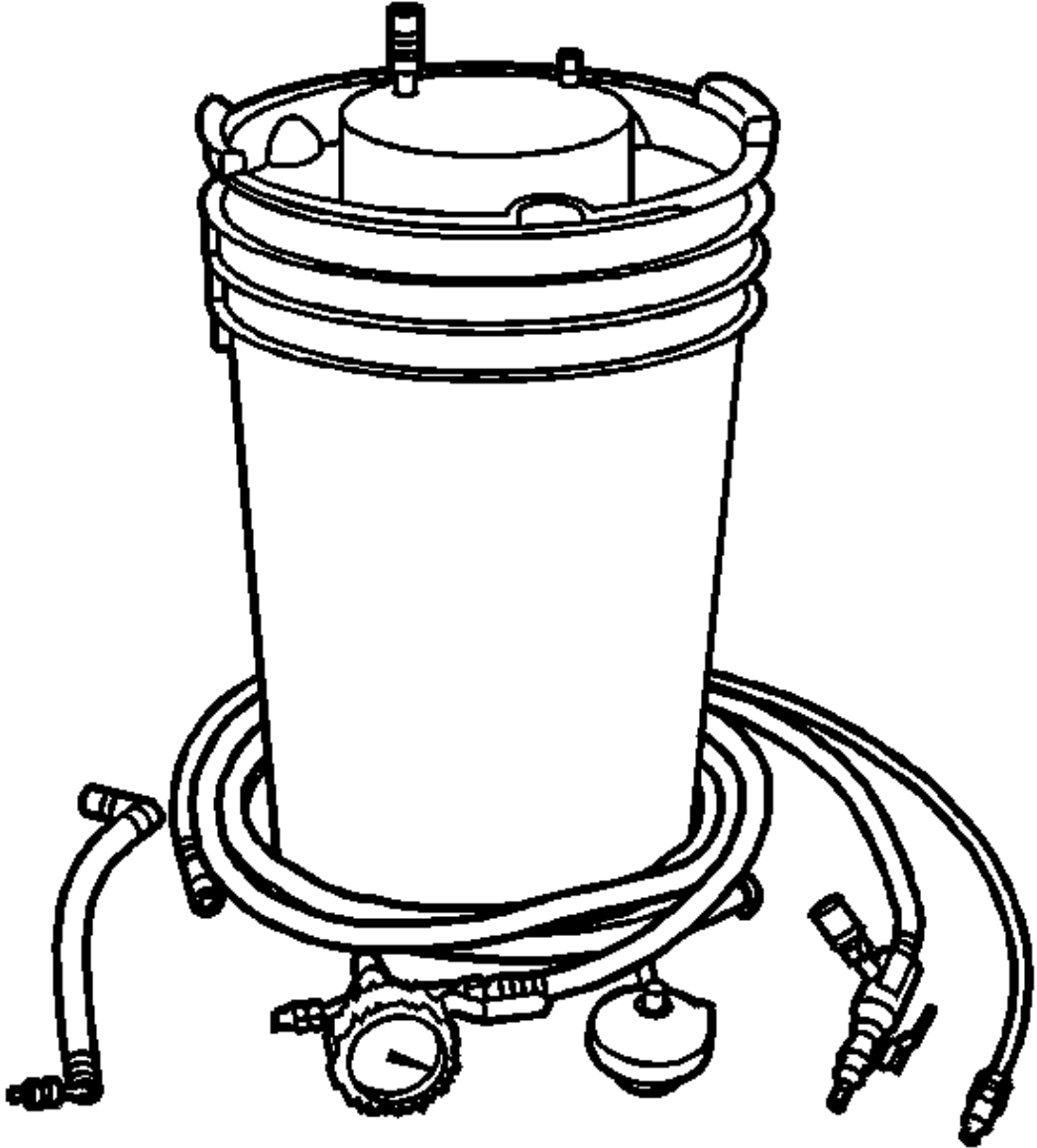
Illustration	Tool Number/ Description
	GE-47622 Hose Clamp Pliers

Illustration	Tool Number/ Description
	GE-47716 Vac-N-Fill Coolant Refill Tool

Article GUID: A00884663

ENGINE

Engine Mechanical - 1.5L (L3A) - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Camshaft Cover Gasket
Connecting Rod Bearing
Crankshaft Front Oil Seal
Exhaust Gas Recirculation Cooler Inlet Pipe Gasket
Exhaust Gas Recirculation Cooler Outlet Pipe Gasket
Exhaust Gas Recirculation Pipe Gasket
Exhaust Gas Recirculation Valve Gasket
Fuel Injector Seal
Intake Manifold Gasket
Oil Pan Drain Plug Seal
Positive Crankcase Ventilation Tube with Positive Crankcase Ventilation Valve - Fresh Air
Throttle Body Gasket
Valve Stem Oil Seal
Water Outlet Gasket
Water Pump Housing Gasket

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English (USA))
Automatic Transmission Flex Plate Bolt	
• First Pass:	30 N.m (22 lb ft)

NOTE:

**All
fasteners/components
listed in this table
MUST BE
DISCARDED and
replaced with NEW
after removal.**

Application	Specification
	Metric (English (USA))
• Final Pass:	70 Degrees
Camshaft Position Actuator Bolt	
• First Pass:	20 N.m (15 lb ft)
• Final Pass:	90 Degrees
Catalytic Converter Stud ¹	10 N.m (89 lb in) ¹
Connecting Rod Bolt	
• First Pass:	25 N.m (18 lb ft)
• Final Pass:	75 Degrees
Crankshaft Balancer Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	180 Degrees
Cylinder Head Bolt	
• First Pass:	30 N.m (22 lb ft)
• Final Pass:	240 Degrees
Engine Mount Bracket Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	90 - 105 Degrees
Engine Mount Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	60 - 75 Degrees
Fuel Feed Intermediate Pipe	30 N.m (22 lb ft)
Fuel Pump Bolt	25 N.m (18 lb ft)
Lower Crankcase Bolt	

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English (USA))
• First Pass:	15 N.m (11 lb ft)
• Final Pass:	180 Degrees
Oil Filter	3/4 to 1 full turn after gasket makes contact with the sealing surface on the filter mounting flange
Positive Crankcase Ventilation Valve Bolt	10 N.m (89 lb in)

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: All fasteners listed in this table can be reused after removal.	
Air Conditioning Compressor Bolt	19 - 25 N.m (14 - 18 lb ft)
Air Conditioning Compressor Bracket Bolt	19 - 25 N.m (14 - 18 lb ft)
Air Conditioning Compressor Bracket Stud	5 - 11 N.m (44 - 97 lb in)
Air Conditioning Compressor Nut	19 - 25 N.m (14 - 18 lb ft)
Air Conditioning Compressor Stud	8 N.m (71 lb in)
Balance Chain Guide Bolt	10 N.m (89 lb in)
Belt Idler Pulley Bracket Bolt	19 - 25 N.m (14 - 18 lb ft)
Camshaft Bearing Cap Bolt	12 N.m (106 lb in)
Camshaft Bearing Front Cap Bolt	12 N.m (106 lb in)
Camshaft Cover Bolt	15 N.m (11 lb ft)
Camshaft Housing Cover Stud	10 N.m (89 lb in)
Camshaft Cover Stud	15 N.m (11 lb ft)
Camshaft Position Actuator Solenoid Valve Bolt	10 N.m (89 lb in)
Camshaft Position Sensor Bolt	10 N.m (89 lb in)
Catalytic Converter Brace Bolt	22 N.m (16 lb ft)
Catalytic Converter Brace Bracket Bolt	22 N.m (16 lb ft)
Catalytic Converter Heat Shield Bolt	9 N.m (80 lb in)
Catalytic Converter Nut	25 N.m (18 lb ft)
Crankshaft Oil Deflector Bolt	10 N.m (89 lb in)

Application	Specification
	Metric (English)
Crankshaft Position Sensor Bolt	10 N.m (89 lb in)
Cylinder Head Core Hole Plug	25 N.m (18 lb ft)
Cylinder Head Core Hole Plug	75 N.m (55 lb ft)
Engine Block Oil Gallery Plug	45 N.m (33 lb ft)
Engine Block Oil Gallery Plug	65 N.m (48 lb ft)
Engine Block Coolant Drain Hole Plug	60 N.m (44 lb ft)
Engine Coolant Thermostat Housing Bolt	10 N.m (89 lb in)
Engine Control Module (ECM) Wiring Harness Ground Bolt	10 N.m (89 lb in)
Engine Front Cover Bolt - M6	15 N.m (11 lb ft)
Engine Front Cover Bolt - M10	58 N.m (43 lb ft)
Engine Front Cover Bolt - M14	58 N.m (43 lb ft)
Engine Front Cover Hole Plug	50 N.m (37 lb ft)
Engine Front Cover Stud	15 N.m (11 lb ft)
Engine Lift Bracket Bolt	25 N.m (18 lb ft)
Engine Oil Pressure Sensor	35 N.m (29 lb ft)
Engine Wiring Harness Bracket Bolt	25 N.m (18 lb ft)
Engine Wiring Harness - Wiring Harness Connector Bolt	10 N.m (89 lb in)
Evaporative Emission Canister Purge Solenoid Valve Bolt	10 N.m (89 lb in)
Exhaust Gas Recirculation Cooler Bolt	10 N.m (89 lb in)
Exhaust Gas Recirculation Cooler Inlet Pipe Bolt	10 N.m (89 lb in)
Exhaust Gas Recirculation Cooler Outlet Pipe Bolt	10 N.m (89 lb in)
Exhaust Gas Recirculation Cooler Temperature Sensor	42 N.m (31 lb ft)
Exhaust Gas Recirculation Valve Bolt	10 N.m (89 lb in)
Fuel Feed Intermediate Pipe Bolt	10 N.m (89 lb in)
Fuel Injection Fuel Rail Bolt	10 N.m (89 lb in)
Ignition Coil Bolt	10 N.m (89 lb in)
Intake Manifold Bolt	12 N.m (106 lb in)
Intake Manifold Cover Bolt	7 N.m (62 lb in)
Intake Manifold - Upper Intake Manifold Cover Bolt	8 N.m (71 lb in)
Knock Sensor Bolt	25 N.m (18 lb ft)
Lower Crankcase Bolt - Perimeter	
• First Pass:	5 N.m (44 lb in)
• Final Pass:	10 N.m (89 lb in)
Manifold Absolute Pressure Sensor Bolt	10 N.m (89 lb in)
Oil Filter Fitting	55 N.m (41 lb ft)
Oil Pan Drain Plug	25 N.m (18 lb ft)
Oil Pan - Lower Oil Pan Bolt	10 N.m (89 lb in)
Oil Pan - Upper Oil Pan Bolt	10 N.m (89 lb in)
Oil Pump Bolt	10 N.m (89 lb in)
Oil Pump Drive Chain Tensioner Bolt	10 N.m (89 lb in)
Oil Pump Sprocket Bolt	

Application	Specification
	Metric (English)
• First Pass:	10 N.m (89 lb in)
• Final Pass:	60 Degrees
Oil Pump Suction Pipe Bolt	10 N.m (89 lb in)
Piston Oil Nozzle Bolt	10 N.m (89 lb in)
Positive Crankcase Ventilation Oil Separator Drain Pipe Bolt	10 N.m (89 lb in)
Spark Plug	17 N.m (13 lb ft)
Starter Opening Cover Bolt	25 N.m (18 lb ft)
Thermostat Bypass Pipe Bolt	10 N.m (89 lb in)
Throttle Body Bolt	10 N.m (89 lb in)
Timing Chain Guide Bolt	10 N.m (89 lb in)
Timing Chain Oil Nozzle	15 N.m (11 lb ft)
Timing Chain Tensioner Bolt	25 N.m (18 lb ft)
Timing Chain Tensioner Shoe Bolt	25 N.m (18 lb ft)
Water Outlet Bolt	12 N.m (106 lb in)
Water Pump Bolt	25 N.m (18 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
L3A, L3G, LE1, LE2, LFV, LV7		
Oil Capacity	4.0 L	4.23 quarts

ENGINE MECHANICAL SPECIFICATIONS

Application	Specification	
	Metric	English
General Data		
• Engine Type	4-Cylinder Inline	
• Displacement	1.5L	92 CID
• RPO	L3A	
• Valves	16	
• Bore	74 mm	2.91 in
• Stroke	86.6 mm	3.409 in
• Compression Ratio	12.5:1	
• Spark Plug Gap	0.60 - 0.70 mm	0.024 - 0.028 in

Application	Specification	
	Metric	English
Firing Order	1 - 3 - 4 - 2	
Block		
Crankshaft Main Bearing Bore Diameter	51.868 - 51.882 mm	2.0420 - 2.0426 in
Cylinder Bore Diameter	73.992 - 74.008 mm	2.913 - 2.914 in
Cylinder Bore Out-of-Round - Maximum	0.013 mm	0.0005 in
Cylinder Head Deck Surface Flatness - over 25 mm length	0.025 mm	0.0010 in
Cylinder Head Deck Surface Flatness - over 150 mm length	0.050 mm	0.0020 in
Engine Block to Bedplate Flatness - overall	0.1 mm	0.004 in
Engine Block to Bedplate Flatness - straightness	0.050 - 0.100 mm	0.0020 - 0.0040 in
Piston Deck Height - Below Deck	0.54 - 0.74 mm	0.021 - 0.029 in
Camshaft		
Camshaft End Play	0.040 - 0.660 mm	0.0016 - 0.0260 in
Camshaft Journal Clearance	0.040 - 0.085 mm	0.0016 - 0.0033 in
Camshaft Journal Diameter - Journal 1	30.935 - 30.960 mm	1.2179 - 1.2189 in
Camshaft Journal Diameter - Journal 2 - 6	23.935 - 23.960 mm	0.9423 - 0.9433 in
Camshaft Thrust Width - Camshaft with Phaser installed	33.175 - 33.525 mm	1.3061 - 1.3199 in
Camshaft Thrust Width - Cylinder Head	32.865 - 33.135 mm	1.2939 - 1.3045 in
Connecting Rod		
Connecting Rod Bearing to Crankpin Clearance	0.013 - 0.068 mm	0.0005 - 0.0027 in
Connecting Rod Bore Diameter - Bearing End	47.186 - 47.202 mm	1.8577 - 1.8583 in
Connecting Rod Bore Diameter - Pin End w/Bushing	18.007 - 18.017 mm	0.7089 - 0.7093 in
Connecting Rod Side Clearance	0.090 - 0.350 mm	0.0035 - 0.0138 in
Connecting Rod Straightness - Bend - Maximum	0.017 mm	0.0007 in
Connecting Rod Straightness - Twist - Maximum	0.040 mm	0.0016 in
Crankshaft		

Application	Specification	
	Metric	English
• Connecting Rod Journal Diameter	43.992 - 44.008 mm	1.7320 - 1.7326 in
• Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
• Crankshaft End Play	0.15 - 0.38 mm	0.0059 - 0.0150 in
• Crankshaft Main Bearing Clearance #1 Bearing	0.011 - 0.070 mm	0.0004 - 0.0028 in
• Crankshaft Main Bearing Clearance # 2, 3, 4 and 5 Bearings	0.012 - 0.067 mm	0.0005 - 0.0026 in
• Crankshaft Main Journal Diameter	46.992 - 47.008 mm	1.8501 - 1.8507 in
• Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
Cylinder Head		
• Surface Flatness - Block Deck - in 25 mm	0.025 mm	0.0010 in
• Surface Flatness - Block Deck - in 150 mm	0.050 mm	0.0020 in
• Surface Flatness - Block Deck - between bolts	0.030 mm	0.0012 in
• Surface Flatness - Block Deck - Overall	0.100 mm	0.0039 in
• Valve Guide Bore - Exhaust	5.000 - 5.020 mm	0.1968 - 0.1976 in
• Valve Guide Bore - Intake	5.000 - 5.020 mm	0.1968 - 0.1976 in
• Valve Lifter Bore Diameter - Stationary Lash Adjusters	12.008 - 12.030 mm	0.4728 - 0.4736 in
• Valve Seat Angle - Relief Surface	50 Degrees	
• Valve Seat Angle - Seating Surface	90 Degrees	
• Valve Seat Angle - Undercut Surface	120 Degrees	
• Valve Seat Runout - Maximum	0.080 mm	0.0031 in
Lubrication System		
• Oil Pressure - @ 1500 RPM 100Â°C	200 - 250 kPa	29 - 36 psi
Piston Rings		
• Piston Ring End Gap - Top	0.25 - 0.40 mm	0.010 - 0.016 in

Application	Specification	
	Metric	English
• Piston Ring End Gap - Second	0.40 - 0.60 mm	0.016 - 0.024 in
• Piston Ring End Gap - Oil Control	0.25 - 0.75 mm	0.010 - 0.030 in
• Piston Ring to Groove Clearance - Top	0.03 - 0.08 mm	0.001 - 0.003 in
• Piston Ring to Groove Clearance - Second	0.03 - 0.07 mm	0.001 - 0.003 in
• Piston Ring to Groove Clearance - Oil Control	0.050 - 0.190 mm	0.0020 - 0.0075 in
• Piston Ring Thickness - Top	1.17 - 1.19 mm	0.046 - 0.047 in
• Piston Ring Thickness - Second	1.17 - 1.19 mm	0.046 - 0.047 in
• Piston Ring Thickness - Oil Control - Rail	0.045 - 0.47 mm	0.0018 - 0.0019 in
• Piston Ring Thickness - Oil Control - Spacer	1.67 - 1.79 mm	0.066 - 0.071 in
Pistons and Pins		
• Pin - Piston Pin Clearance to Connecting Rod Bore	0.007 - 0.020 mm	0.0003 - 0.0008 in
• Pin - Piston Pin Clearance to Piston Pin Bore	0.002 - 0.010 mm	0.0001 - 0.0004 in
• Pin - Piston Pin Diameter	17.997 - 18.000 mm	0.7085 - 0.7087 in
• Pin - Piston Pin End Play	0.18 - 0.79 mm	0.0071 - 0.0311 in
• Piston - Piston Diameter - @ 38 mm up from crown	73.957 - 73.971 mm	2.9117 - 2.9122 in
• Piston - Piston Pin Bore Diameter	18.002 - 18.010 mm	0.7087 - 0.7091 in
• Piston - Piston Ring Groove Width - Top	1.23 - 1.25 mm	0.0484 - 0.0492 in
• Piston - Piston Ring Groove Width - Second	1.23 - 1.25 mm	0.0484 - 0.0492 in
• Piston - Piston Ring Groove Width - Oil Control	2.03 - 2.05 mm	0.0799 - 0.0807 in
• Piston - Piston to Bore Clearance - w/Polymer	-0.017 mm to +0.029 mm	-0.0007 in to +0.0011 in
Valve System		
• Valves - Valve Face Angle	90 Degrees	
• Valves - Valve Face Runout - Maximum	0.050 mm	0.0020 in

Application	Specification	
	Metric	English
• Valves - Valve Seat Runout - Maximum	0.080 mm	0.0031 in
• Valves - Valve Seat Gauge Ball Height - Exhaust	8.85 - 9.09 mm	0.3484 - 0.3579 in
• Valves - Valve Seat Gauge Ball Height - Intake	9.47 - 9.71 mm	0.3728 - 0.3823 in
• Valves - Valve Stem Diameter - Exhaust	4.945 - 4.965 mm	0.1947 - 0.1955 in
• Valves - Valve Stem Diameter - Intake	4.955 - 4.975 mm	0.1951 - 0.1959 in
• Valves - Valve Stem Installed Height	Check and Record	
• Valves - Valve Stem to Guide Clearance - Exhaust	0.035 - 0.075 mm	0.0014 - 0.0030 in
• Valves - Valve Stem to Guide Clearance - Intake	0.025 - 0.065 mm	0.0010 - 0.0026 in
• Valve Lash Adjusters - Valve Lash Adjuster Diameter - Stationary Lash Adjuster	11.986 - 12.000 mm	0.4719 - 0.4724 in
• Valve Lash Adjusters - Valve Lash-Adjuster-to-Bore Clearance - Stationary Lash Adjuster	0.008 - 0.044 mm	0.0003 - 0.0017 in
• Valve Springs - Valve Spring Installed Height	34.50 - 35.50 mm	1.358 - 1.398 in
• Valve Springs - Valve Spring Load - Closed - @ 35 mm	215 - 255 N	48 - 57 lb
• Valve Springs - Valve Spring Load - Open - @ 24 mm	405 - 445 N	91 - 100 lb

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Camshaft Cover ¹	Sealant	12378521	88901148
Camshaft Lobes	5W-20*	19259486	88863951
Crankshaft Sensor O-Ring	5W-20*	19259486	88863951
Cylinder Bores	5W-20*	19259486	88863951
Cylinder Head Plugs	Threadlocker	19333511	10953489
Engine Block Plugs	Sealant	12346004	10953480
Engine Front Cover ¹	Sealant	12378521	88901148
Engine Oil	5W-20*	19259486	88863951
Engine Oil - Alternate	0W-20	19259487	19259784
Fuel Injector O-Rings	5W-20*	19259486	88863951
Hydraulic Lash Adjusters	5W-20*	19259486	88863951
Ignition Coils	Lubricant	19260901	19260902

Application	Type of Material	GM Part Number	
		United States	Canada
Intake and Exhaust Valve Stems	5W-20*	19259486	88863951
Lower Crankcase ¹	Sealant	12378521	88901148
Lower Crankcase Bolt	Threadlocker	19333511	10953489
Main Bearings	5W-20*	19259486	88863951
Oil Filter	5W-20*	19259486	88863951
Oil Level Indicator Tube O-Ring	Lubricant	88862586	88862827
Oil Pan ¹	Sealant	12378521	88901148
Oil Pan Bolt	Threadlocker	19333511	10953489
Oil Pump - Pump Elements	5W-20*	19259486	88863951
Oxygen Sensor	Anti-seize	88862477	88862478
Piston Pin to Piston/Rod - Pin Bores of Piston and Rod	5W-20*	19259486	88863951
Rod Bearings - Rod Pins of Crankshaft	5W-20*	19259486	88863951
Thread Repair Cutting Oil	Lubricant	1052864	992881
Thread Repair	Cleaner	88862650	88901247
Timing Chain Guide Bolt Access Hole Plug	Threadlocker	19333511	10953489
Valves	Parts Immersion Solvent	12345368	10953514
Valve Rocker Arm/Valve Tip	5W-20*	19259486	88863951
Water Feed Tube O-Rings	Lubricant	19260901	19260902
Water Pump Drain Plug	Sealant	12346004	10953480
*0W-20 is an approved alternate engine oil for 5W-20, see Engine Oil - Alternate			
¹ Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant			

THREAD REPAIR SPECIFICATIONS

Engine Block - Front View

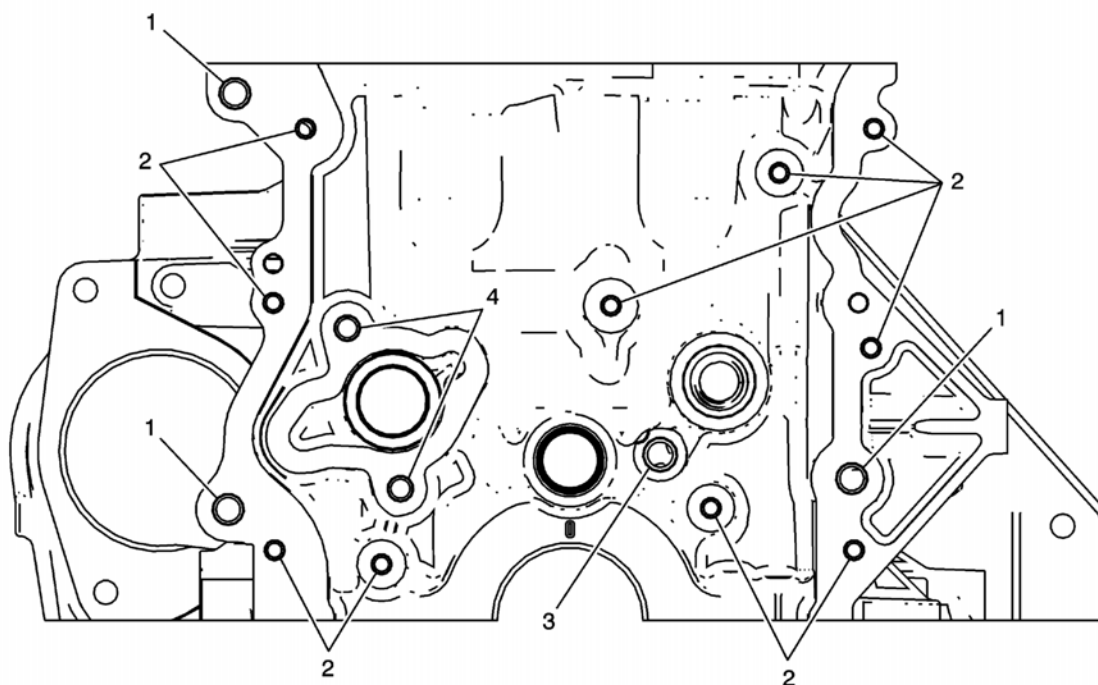


Fig. 1: Engine Block - Front View

Courtesy of GENERAL MOTORS COMPANY

Engine Block - Front View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M10x1.5	420	211	212	213	214	27.0	1.063	27.0	1.063
2	M6x1.0	205	201	202	203	204	20.0	0.787	20.0	0.787
3	Not Serviced									
4	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142

Engine Block - Rear View

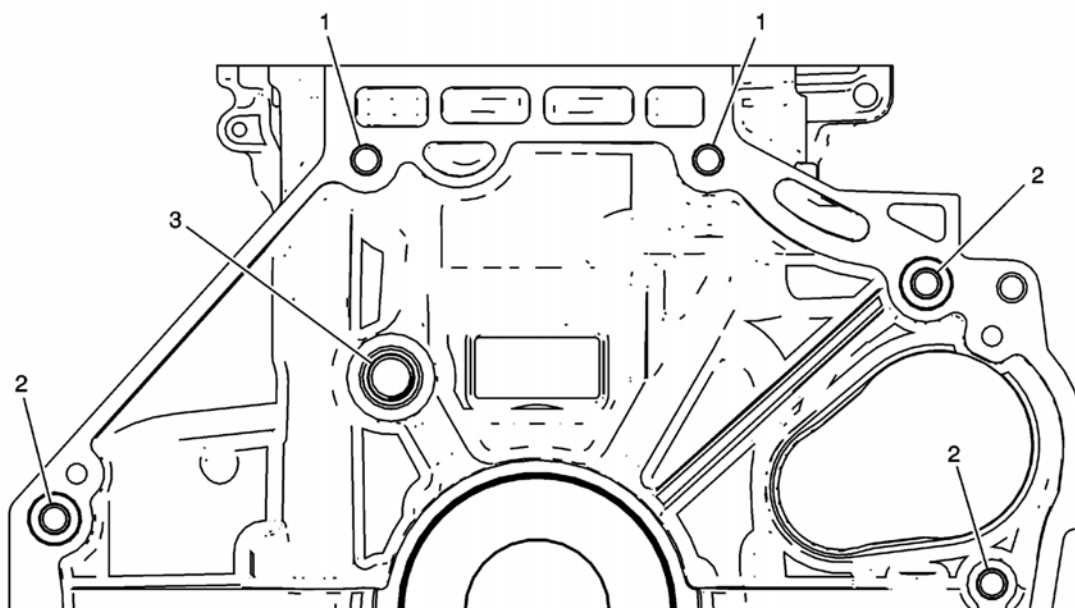


Fig. 2: Engine Block - Rear View

Courtesy of GENERAL MOTORS COMPANY

Engine Block - Rear View

Engine Block - Rear View										
Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M10x1.5	904	211	212	213	903	36.0	1.417	36.0	1.417
2	M10x1.5	215	211	212	213	214	25.0	0.984	25.0	0.984
3	Not Serviced									

Engine Block - Right Side View

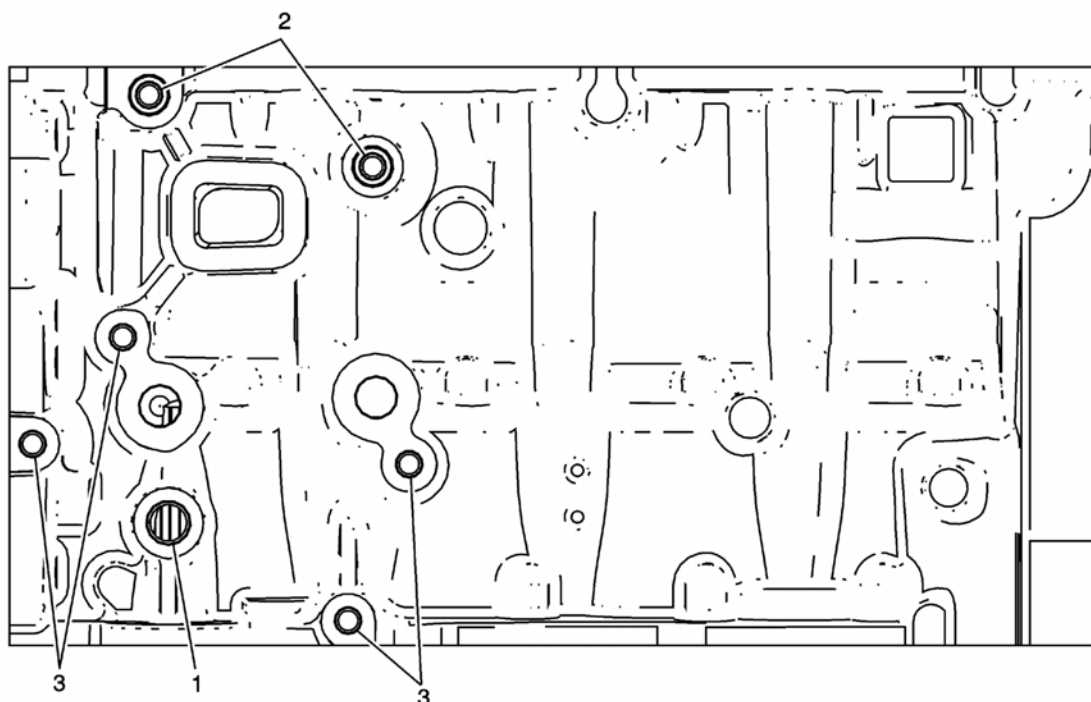


Fig. 3: Engine Block - Right Side View
 Courtesy of GENERAL MOTORS COMPANY

Engine Block - Right Side View

Engine Block Right Side View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M14x1.5	735	409	410	411	412	20.0	0.787	20.0	0.787
2	M8x1.25	210	206	207	208	209	37.0	1.457	37.0	1.457
3	M8x1.25	61	206	207	208	209	29.0	1.141	29.0	1.141

Engine Block - Left Side View

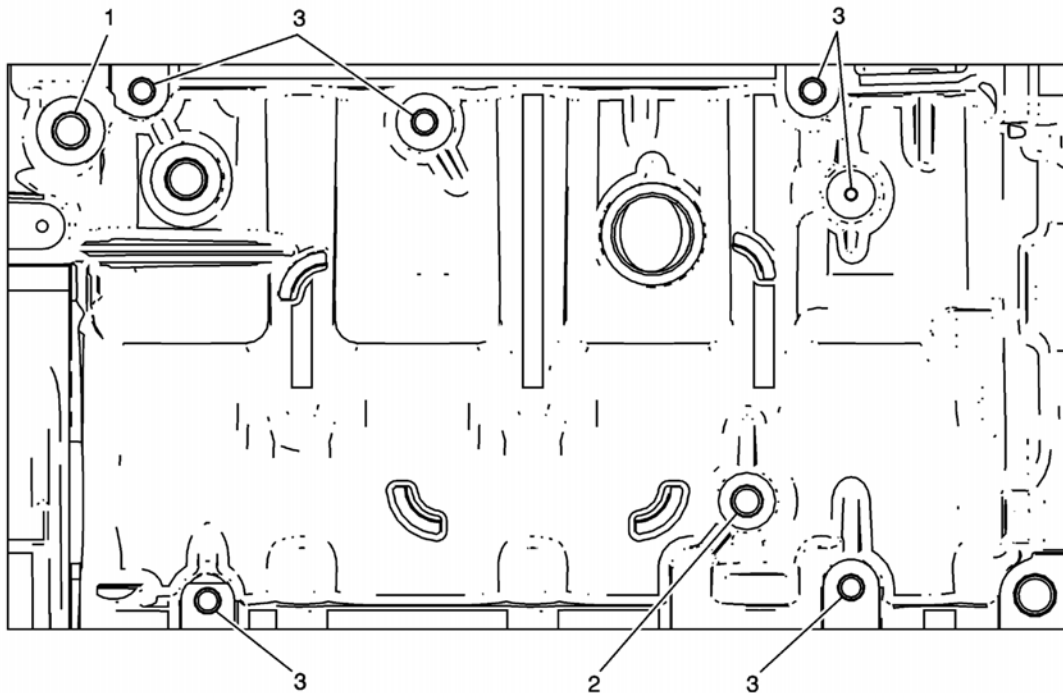


Fig. 4: Engine Block - Left Side View
 Courtesy of GENERAL MOTORS COMPANY

Engine Block - Left Side View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
							MM	(IN)	MM	(IN)
EN 42385-400										
1	M12x1.75	865	856	857	858	859	24.0	0.944	24.0	0.944
2	M10x1.5	420	211	212	213	214	34.0	1.338	34.0	1.338
3	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142

Engine Block - Bottom View

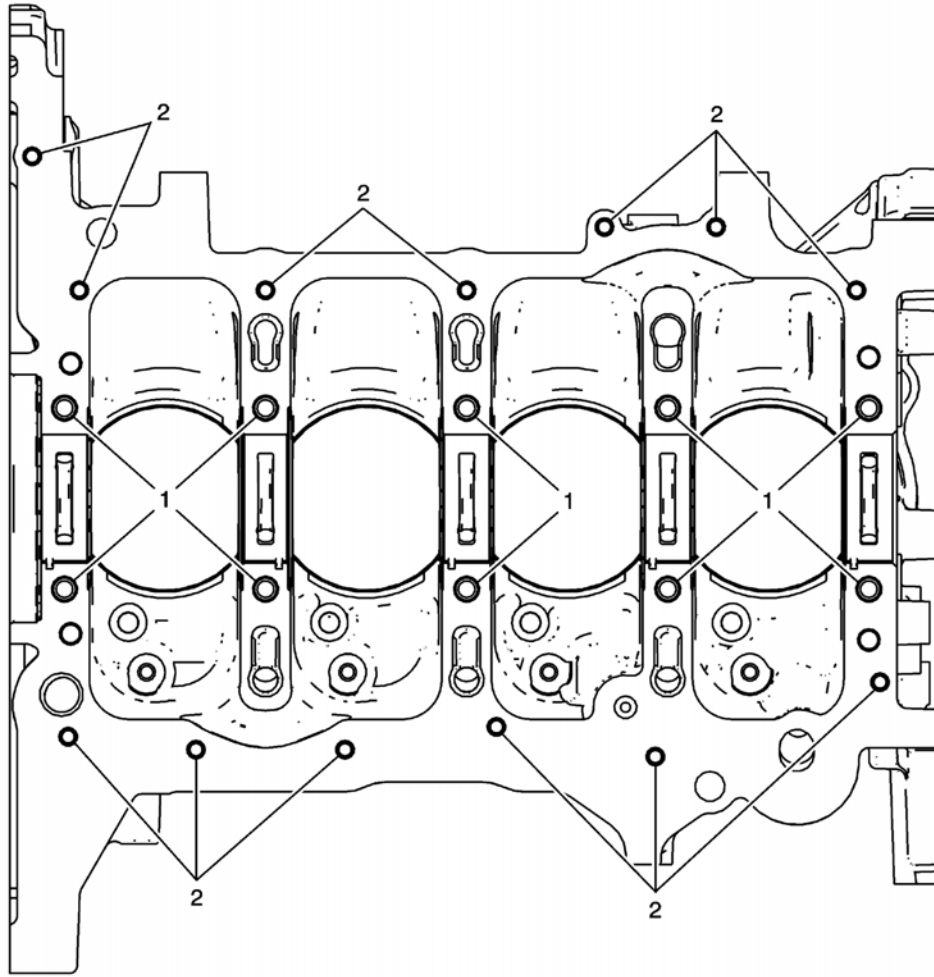


Fig. 5: Engine Block - Bottom View
 Courtesy of GENERAL MOTORS COMPANY

Engine Block - Bottom View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	Not Serviceable									
2	M6x1.0	205	201	202	203	204	22.0	0.866	22.0	0.866

Engine Block - Top View

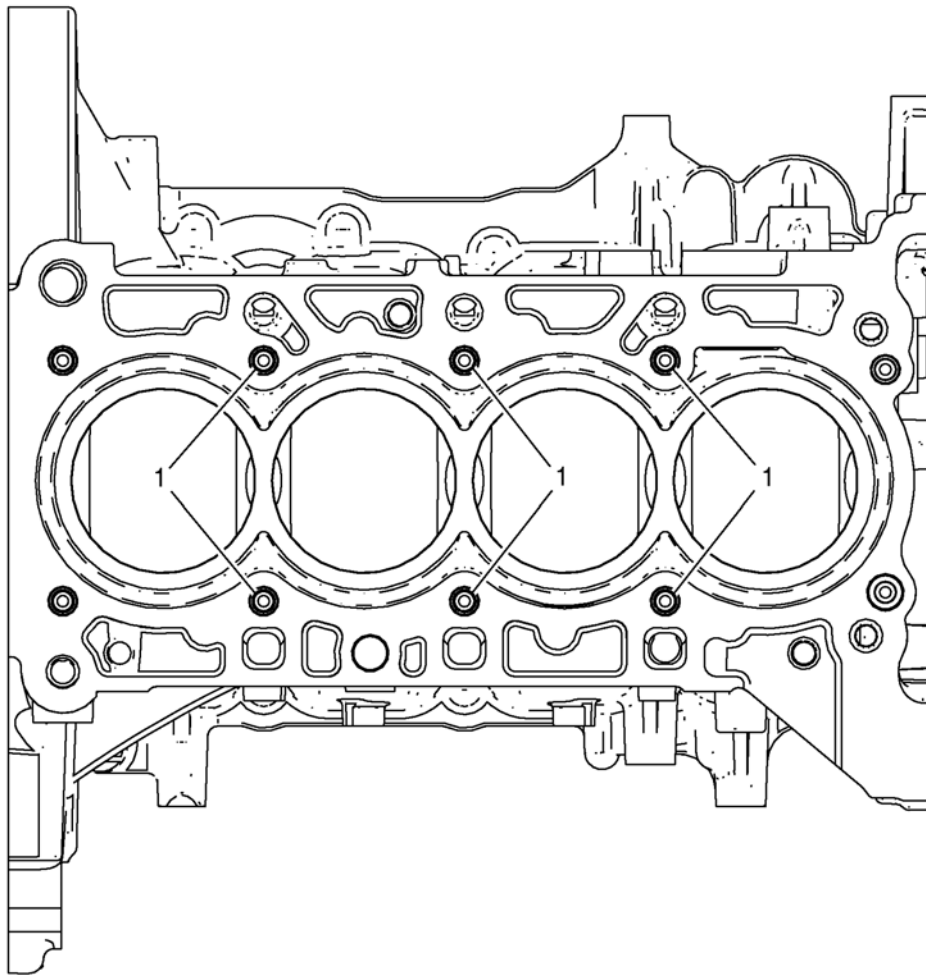


Fig. 6: Engine Block - Top View
 Courtesy of GENERAL MOTORS COMPANY

Engine Block - Top View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-900							MM	(IN)	MM	(IN)
1	M10x1.5	904	901	901	903	904	86.38	3.40	86.38	3.40

Lower Crankcase - Front View

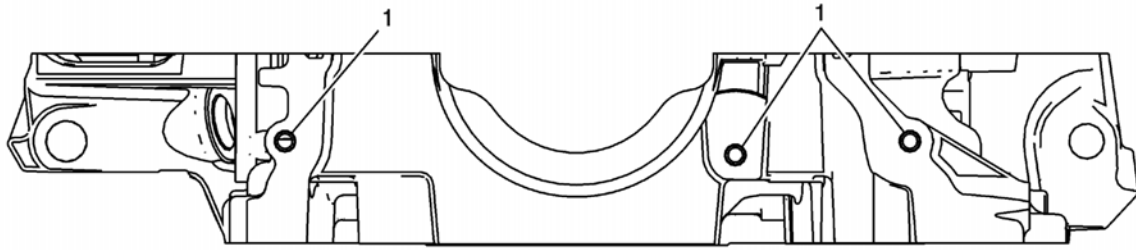


Fig. 7: Lower Crankcase - Front View
 Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase - Front View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	20.0	0.787	20.0	0.787

Lower Crankcase - Bottom View

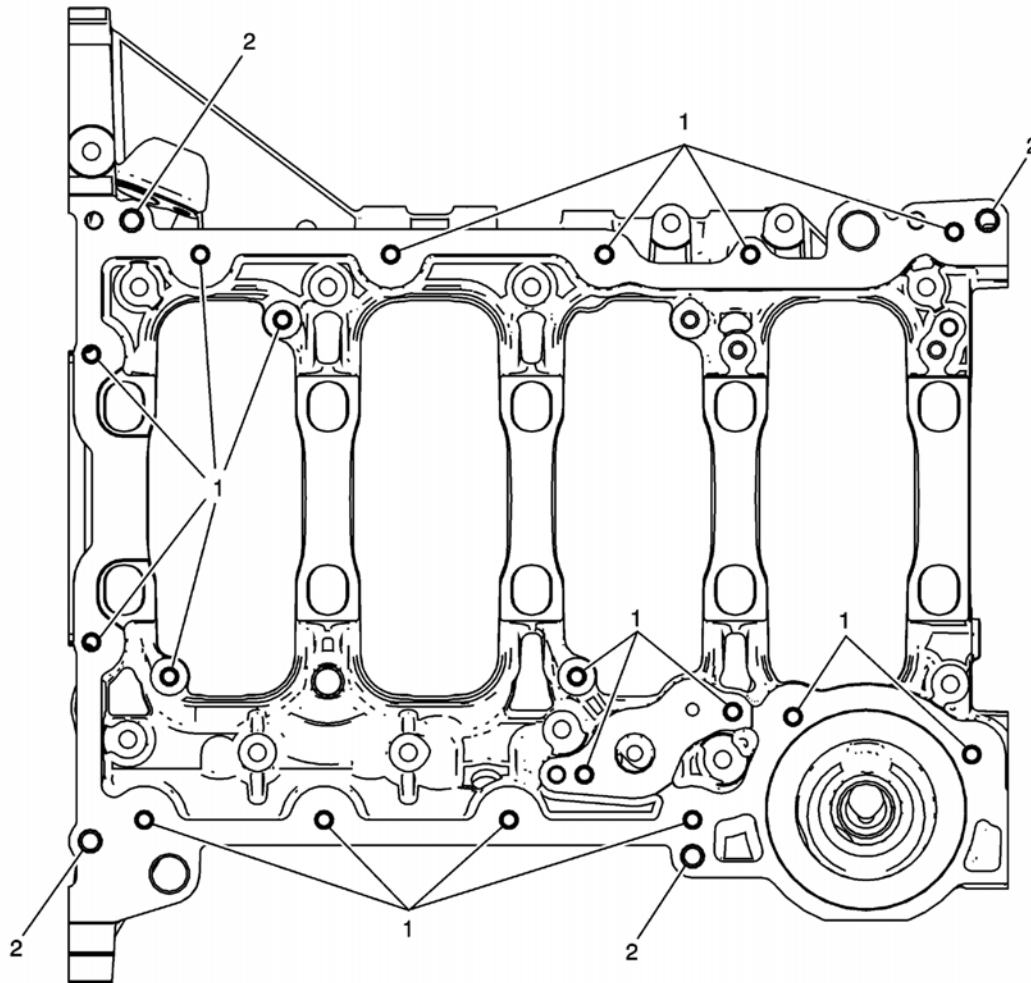


Fig. 8: Lower Crankcase - Bottom View
 Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase - Bottom View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	23.0	0.905	23.0	0.905
2	M8x1.25	210	206	207	208	209	24.0	0.945	24.0	0.945

Lower Crankcase - Right Side View

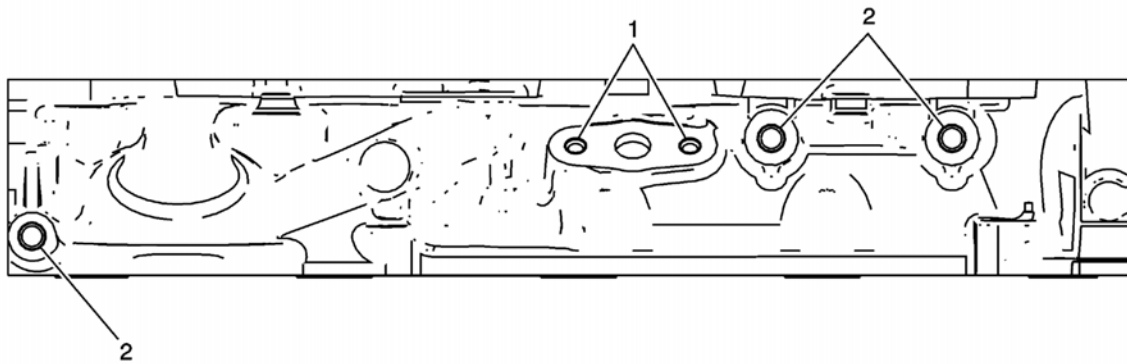


Fig. 9: Lower Crankcase - Right Side View

Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase - Right Side View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
2	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142

Lower Crankcase - Left Side View

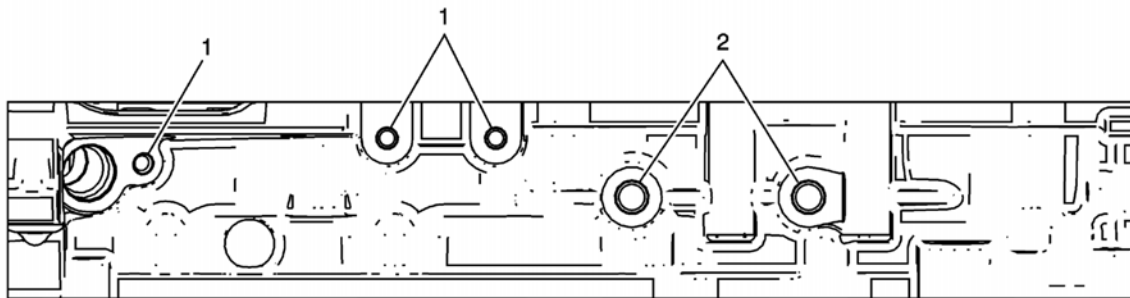


Fig. 10: Lower Crankcase - Left Side View

Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase - Left Side View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
2	M10x1.5	420	211	212	213	214	34.0	1.338	34.0	1.338

Cylinder Head - Top View

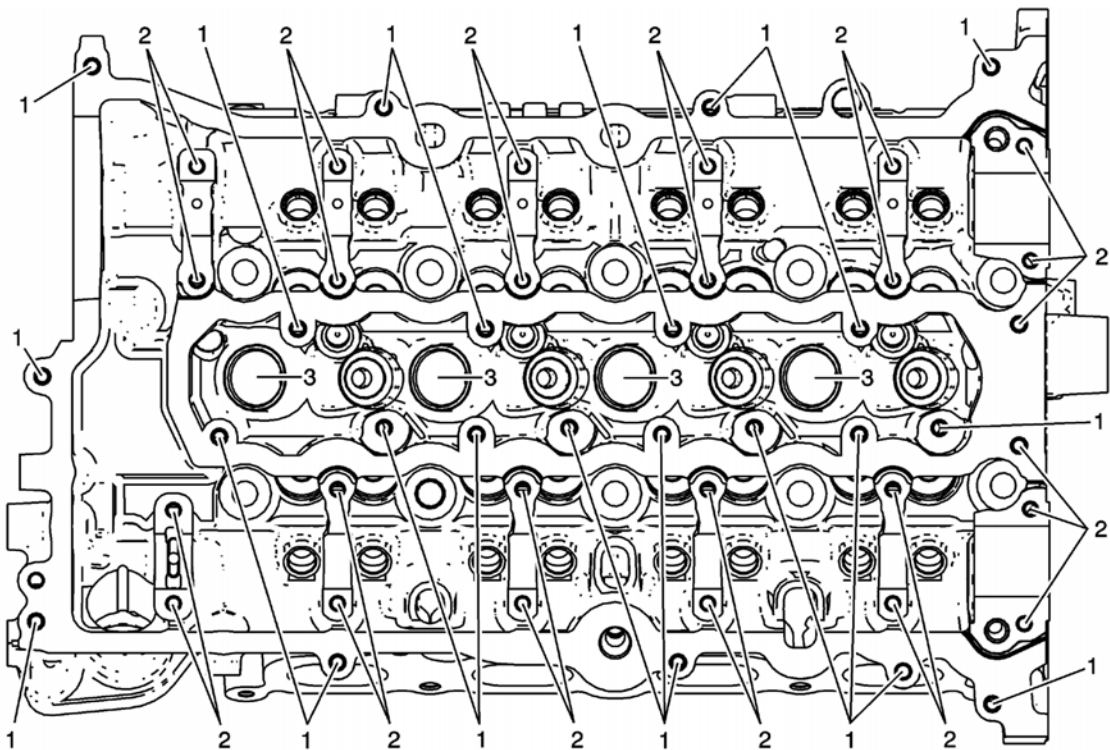


Fig. 11: Cylinder Head - Top View
 Courtesy of GENERAL MOTORS COMPANY

Cylinder Head - View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	205	201	202	203	204	22.0	0.865	22.0	0.865
2	M6x1.0	63	201	852 core drill as c bore	203	204	22.0	0.865	22.0	0.865
3	Not Serviceable									

Cylinder Head - Intake Manifold Deck View

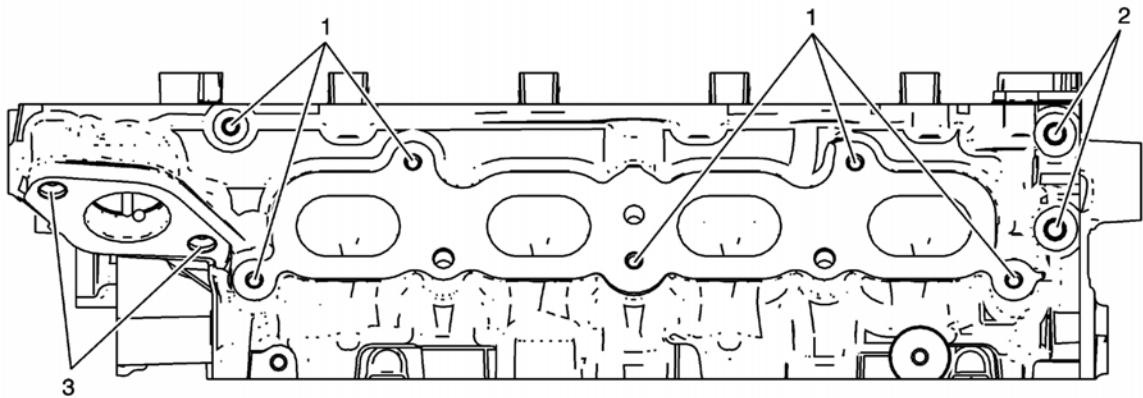


Fig. 12: Cylinder Head - Intake Manifold Deck View
 Courtesy of GENERAL MOTORS COMPANY

Cylinder Head - Intake Manifold Deck View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
2	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142
3	M8x1.25	210	206	207	208	209	29.0	1.142	29.0	1.142

Cylinder Head - Exhaust Side View

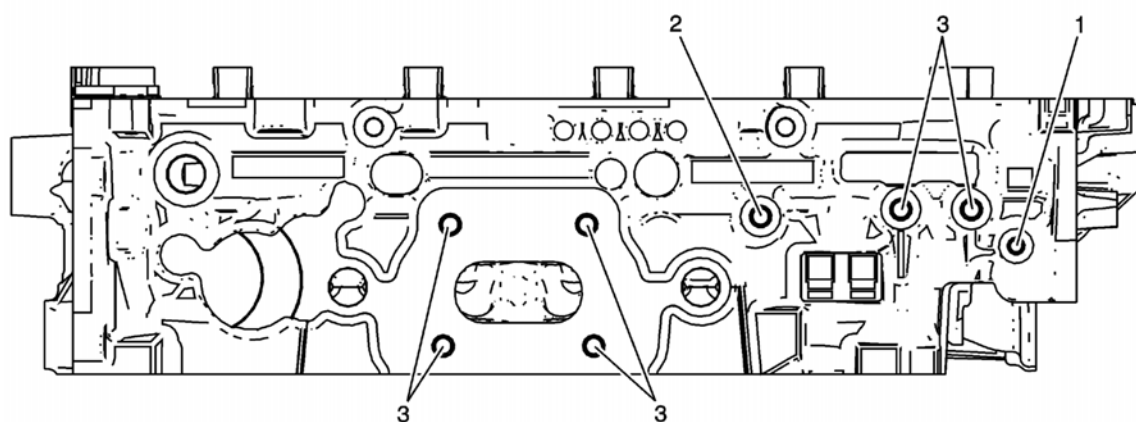


Fig. 13: Cylinder Head - Exhaust Side View

Courtesy of GENERAL MOTORS COMPANY

Cylinder Head - Exhaust Side View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
EN 42385-400							MM	(IN)	MM	(IN)
1	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
2	M8x1.25	906	206	207	208	209	29.0	1.142	29.0	1.142
3	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142

Cylinder Head - Front View

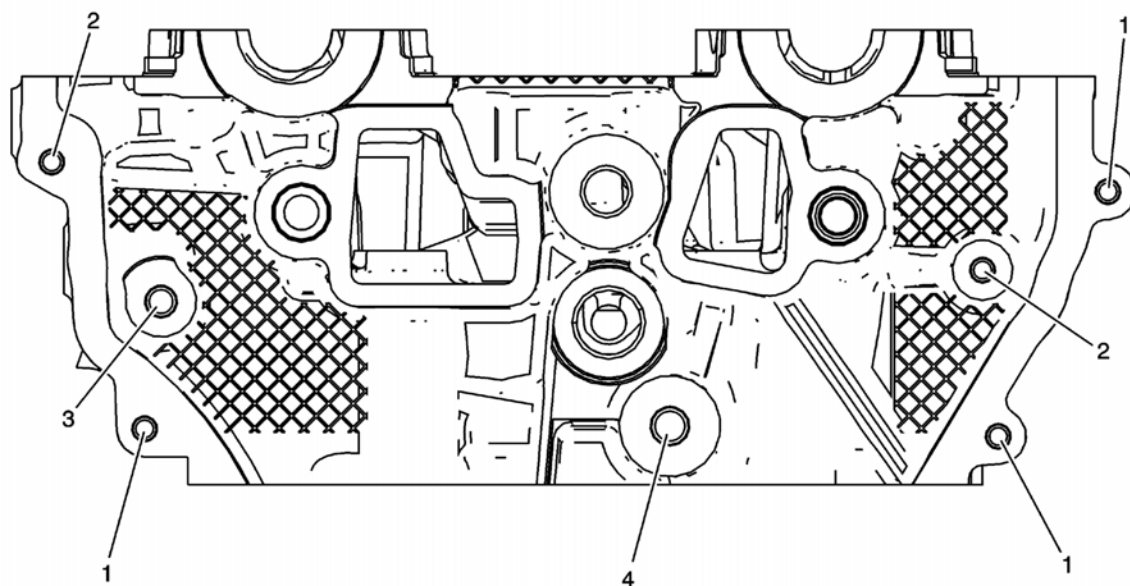


Fig. 14: Cylinder Head - Front View

Courtesy of GENERAL MOTORS COMPANY

Cylinder Head - Front View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
							MM	(IN)	MM	(IN)
EN 42385-400										
1	M6x1.0	205	201	202	203	204	19.0	0.747	19.0	0.747
2	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
3	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142
4	M10x1.5	420	211	212	213	214	32.0	1.260	32.0	1.260

Cylinder Head - Back View

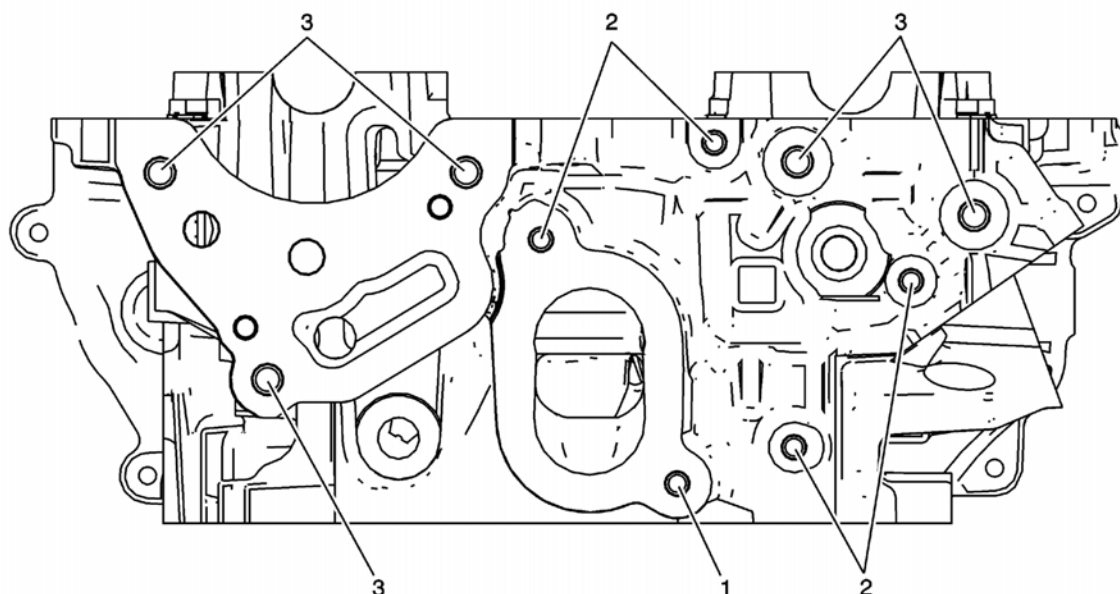


Fig. 15: Cylinder Head - Back View
 Courtesy of GENERAL MOTORS COMPANY

Cylinder Head - Back View

Service Call Out	Thread Size	Insert	Drill	Counterbore Tool	Tap	Driver	Drill Depth (Maximum)		Tap Depth (Maximum)	
							MM	(IN)	MM	(IN)
EN 42385-400										
1	M6x1.0	205	201	202	203	204	19.0	0.747	19.0	0.747
2	M6x1.0	63	201	202	203	204	22.0	0.865	22.0	0.865
3	M8x1.25	61	206	207	208	209	29.0	1.142	29.0	1.142

SCHEMATIC WIRING DIAGRAMS

ENGINE MECHANICAL WIRING SCHEMATICS

Engine Oil Pressure Control Solenoid Valve

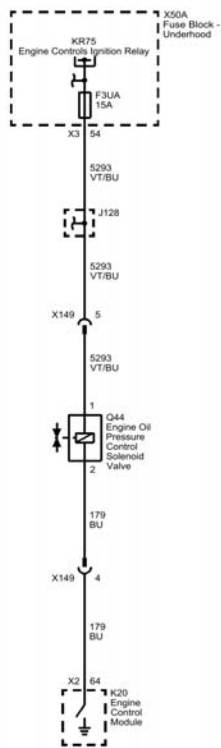


Fig. 16: Engine Oil Pressure Control Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Camshaft Cover and Components

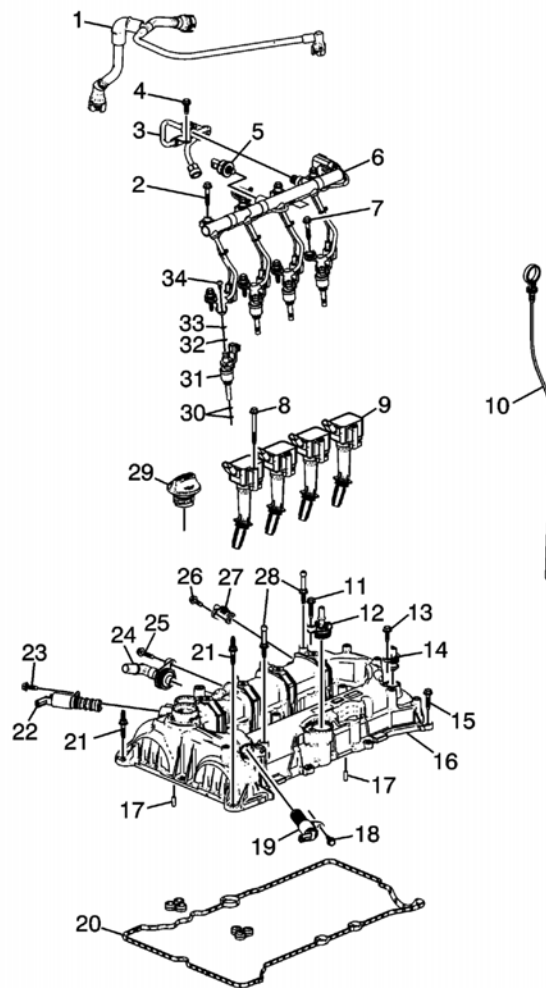


Fig. 17: Camshaft Cover And Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Positive Crankcase Ventilation Tube
2	Fuel Injection Fuel Rail Bolt (Qty: 4)
3	Fuel Feed Intermediate Pipe
4	Fuel Feed Intermediate Pipe Bolt
5	Fuel Injection Fuel Rail Fuel Pressure Sensor
6	Fuel Injection Fuel Rail
7	Fuel Injection Fuel Rail Bolt (Qty: 4)
8	Ignition Coil Bolt (Qty: 4)
9	Ignition Coil (Qty: 4)
10	Oil Level Indicator
11	Positive Crankcase Ventilation Valve Bolt
12	Positive Crankcase Ventilation Valve
13	Camshaft Position Sensor Bolt
14	Exhaust Camshaft Position Sensor
15	Camshaft Cover Bolt
16	Camshaft Cover
17	Camshaft Cover Locating Pin

Callout	Component Name
18	Camshaft Position Actuator Solenoid Valve Bolt
19	Exhaust Camshaft Position Actuator Solenoid Valve
20	Camshaft Cover Gasket
21	Camshaft Cover Stud (Qty: 2)
22	Intake Camshaft Position Actuator Solenoid Valve
23	Camshaft Position Actuator Solenoid Valve Bolt
24	Positive Crankcase Ventilation Valve
25	Positive Crankcase Ventilation Valve Bolt
26	Camshaft Position Sensor Bolt
27	Intake Camshaft Position Sensor
28	Camshaft Housing Stud
29	Oil Filler Cap
30	Combustion Fuel Injector Seal
31	Fuel Injector (Qty: 4)
32	Fuel Injector Spacer
33	Fuel Injector Seal Ring
34	Fuel Injector Fastener (Qty: 8)

Cylinder Head and Components

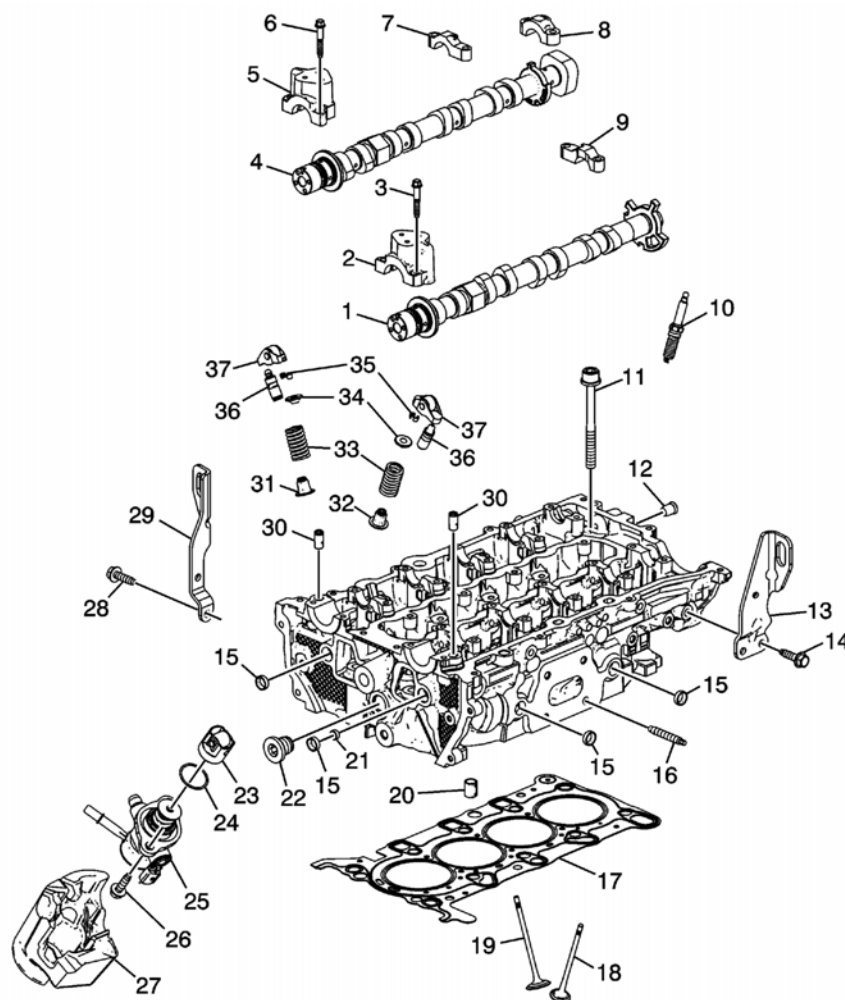


Fig. 18: Cylinder Head And Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Camshaft
2	Camshaft Bearing Front Exhaust Cap
3	Camshaft Bearing Cap Bolt - Exhaust (Qty: 12)
4	Intake Camshaft
5	Camshaft Bearing Front Intake Cap
6	Camshaft Bearing Cap Bolt - Intake (Qty: 12)
7	Camshaft Bearing Cap - Intake (Qty: 4)
8	Camshaft Bearing Rear Cap
9	Camshaft Bearing Cap - Exhaust (Qty: 5)
10	Spark Plug (Qty: 4)
11	Cylinder Head Bolt (Qty: 10)
12	Cylinder Head Core Hole Plug
13	Engine Lift Rear Bracket
14	Engine Lift Bracket Bolt (Qty: 2)
15	Cylinder Head Water Jacket Hole Plug (Qty: 4)
16	Catalytic Converter Stud (Qty: 4)
17	Cylinder Head Gasket
18	Exhaust Valve (Qty: 8)
19	Intake Valve (Qty: 8)
20	Cylinder Head Locating Pin
21	Cylinder Head Oil Gallery Restrictor
22	Cylinder Head Core Hole Plug
23	Valve Lifter Follower
24	Fuel Pump O-Ring
25	Fuel Pump
26	Fuel Pump Bolt (Qty: 2)
27	Fuel Pump Insulator
28	Engine Lift Bracket Bolt (Qty: 2)
29	Engine Lift Front Bracket
30	Engine Oil Manifold Check Valve (Qty: 2)
31	Valve Stem Oil Seal - Intake (Qty: 8)
32	Valve Stem Oil Seal - Exhaust (Qty: 8)
33	Valve Spring (Qty: 16)
34	Valve Spring Retainer (Qty: 16)
35	Valve Stem Key (Qty: 32)
36	Hydraulic Valve Lash Adjuster (Qty: 16)
37	Hydraulic Valve Lash Adjuster Arm (Qty: 16)

Engine Block and Components

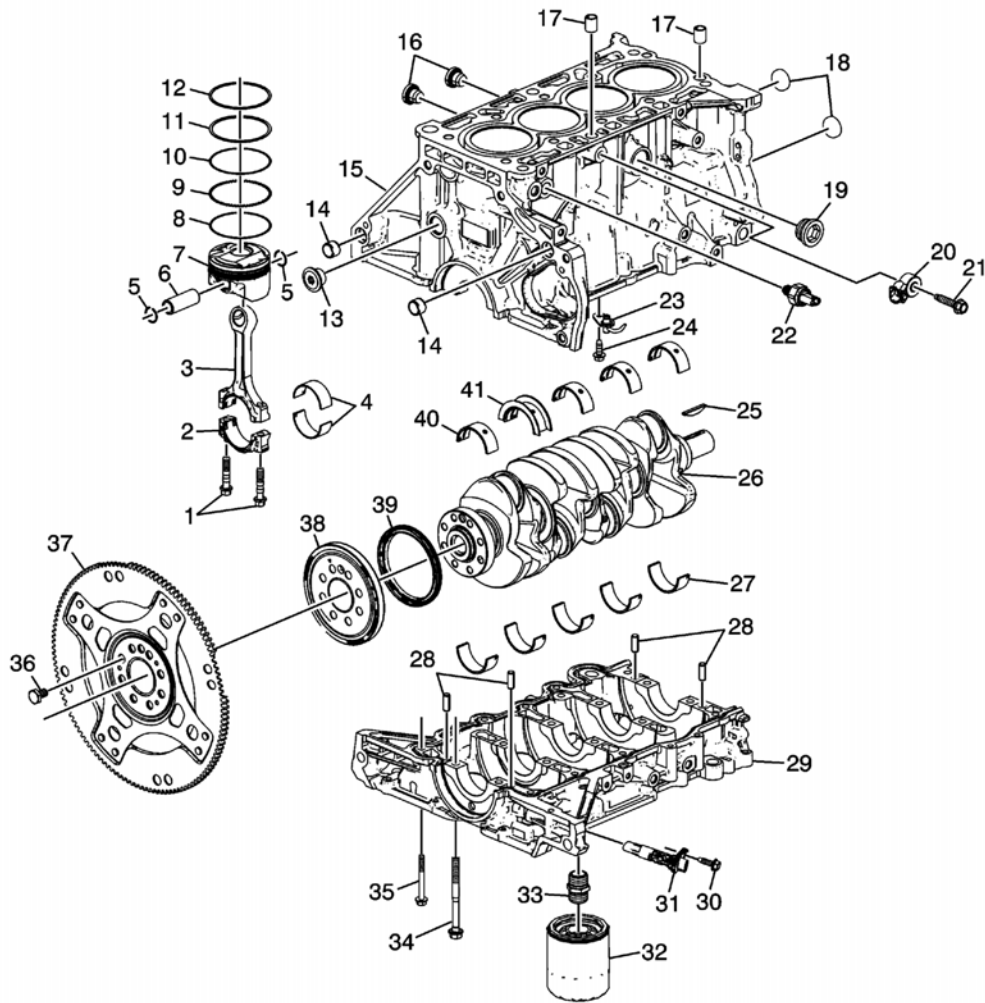


Fig. 19: Engine Block And Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Connecting Rod Bolt (Qty: 8)
2	Connecting Rod Cap
3	Connecting Rod
4	Connecting Rod Bearing (Qty: 4)
5	Piston Pin Retainer
6	Piston Pin
7	Piston
8	Piston Oil Ring Rail
9	Piston Oil Ring Rail Spacer
10	Piston Oil Ring Rail
11	Piston Compression Lower Ring
12	Piston Compression Upper Ring
13	Engine Block Oil Gallery Plug
14	Transmission Locating Pin (Qty: 2)
15	Engine Block
16	Engine Block Oil Gallery Plug (Qty: 2)
17	Cylinder Head Locating Pin (Qty: 2)

Callout	Component Name
18	Engine Block Core Hole Plug (Qty: 2)
19	Engine Block Coolant Drain Hole Plug
20	Knock Sensor
21	Knock Sensor Bolt
22	Engine Oil Pressure Sensor
23	Piston Oil Nozzle (Qty: 4)
24	Piston Oil Nozzle Bolt (Qty: 4)
25	Crankshaft Balancer Key
26	Crankshaft
27	Crankshaft Lower Bearing (Qty: 5)
28	Lower Crankcase Locating Pin (Qty: 4)
29	Lower Crankcase
30	Crankshaft Position Sensor Bolt
31	Crankshaft Position Sensor
32	Oil Filter
33	Oil Filter Fitting
34	Lower Crankcase Bolt (Qty: 10)
35	Lower Crankcase Bolt (Qty: 13)
36	Automatic Transmission Flex Plate Bolt (Qty: 8)
37	Automatic Transmission Flex Plate
38	Crankshaft Position Sensor Reluctor Ring
39	Crankshaft Rear Oil Seal
40	Crankshaft Upper Bearing (Qty: 4)
41	Crankshaft Thrust Upper Bearing

Engine Front Cover and Components

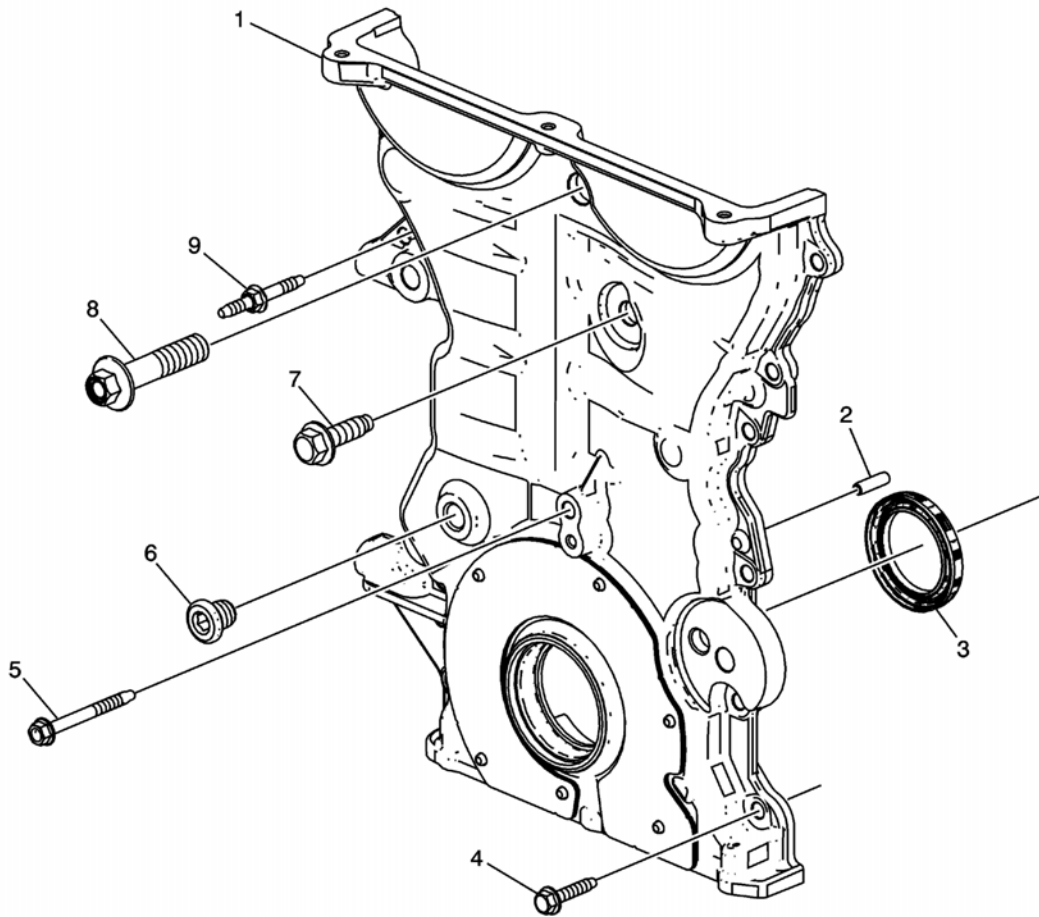


Fig. 20: Engine Front Cover and Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Front Cover
2	Engine Front Cover Locating Pin
3	Crankshaft Front Oil Seal
4	Engine Front Cover Bolt - M6 (Qty: 11)
5	Engine Front Cover Bolt - M6 (Qty: 1)
6	Engine Front Cover Hole Plug
7	Engine Front Cover Bolt - M14 (Qty: 1)
8	Engine Front Cover Bolt - M14 (Qty: 1)
9	Engine Front Cover Stud (Qty: 1)

Catalytic Converter and Components

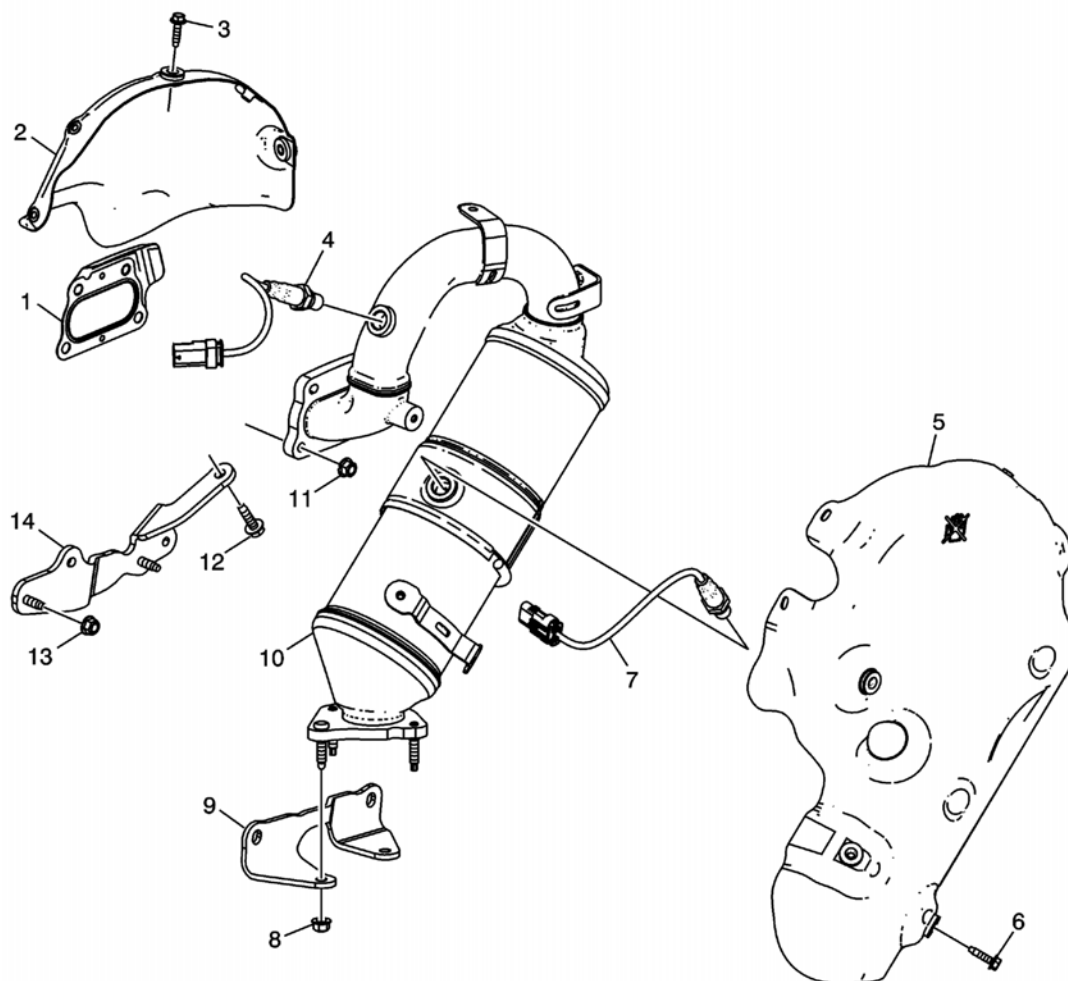


Fig. 21: Catalytic Converter And Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Catalytic Converter Gasket
2	Catalytic Converter Heat Shield
3	Catalytic Converter Heat Shield Bolt (Qty: 2)
4	Heated Oxygen Sensor
5	Catalytic Converter Heat Shield
6	Catalytic Converter Heat Shield Bolt (Qty: 6)
7	Heated Oxygen Sensor
8	Catalytic Converter Brace Bracket Nut (Qty: 2)
9	Catalytic Converter Brace Bracket
10	Catalytic Converter
11	Catalytic Converter Nut (Qty: 4)
12	Catalytic Converter Brace Bracket Bolt (Qty: 3)
13	Catalytic Converter Brace Bracket Nut (Qty: 2)
14	Catalytic Converter Brace Bracket

Exhaust Gas Recirculation Components

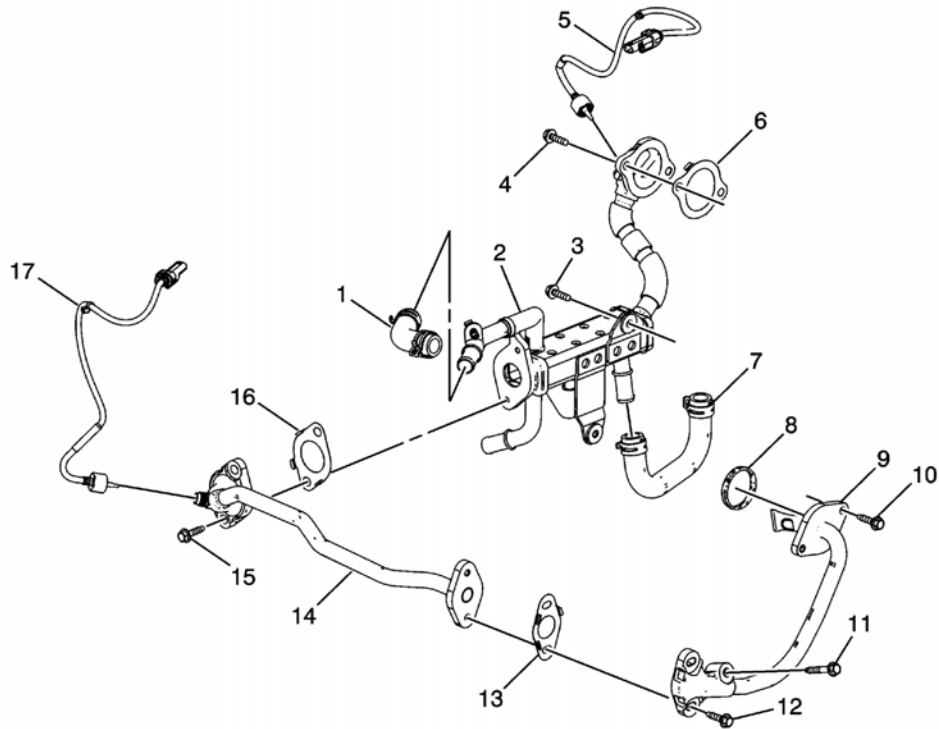


Fig. 22: Exhaust Gas Recirculation Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Thermostat Bypass Hose
2	Exhaust Gas Recirculation Cooler
3	Exhaust Gas Recirculation Cooler Bolt
4	Exhaust Gas Recirculation Cooler Bolt (Qty: 2)
5	Exhaust Gas Recirculation Cooler Temperature Sensor
6	Exhaust Gas Recirculation Cooler Inlet Pipe Gasket
7	Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose
8	Exhaust Gas Recirculation Pipe Gasket
9	Exhaust Gas Recirculation Pipe
10	Exhaust Gas Recirculation Pipe Bolt (Qty: 2)
11	Exhaust Gas Recirculation Pipe Bolt
12	Exhaust Gas Recirculation Pipe Bolt (Qty: 2)
13	Exhaust Gas Recirculation Pipe Gasket
14	Exhaust Gas Recirculation Cooler Outlet Pipe
15	Exhaust Gas Recirculation Cooler Outlet Pipe Bolt (Qty: 2)
16	Exhaust Gas Recirculation Cooler Outlet Pipe Gasket
17	Exhaust Gas Recirculation Cooler Temperature Sensor

Water Pump and Components

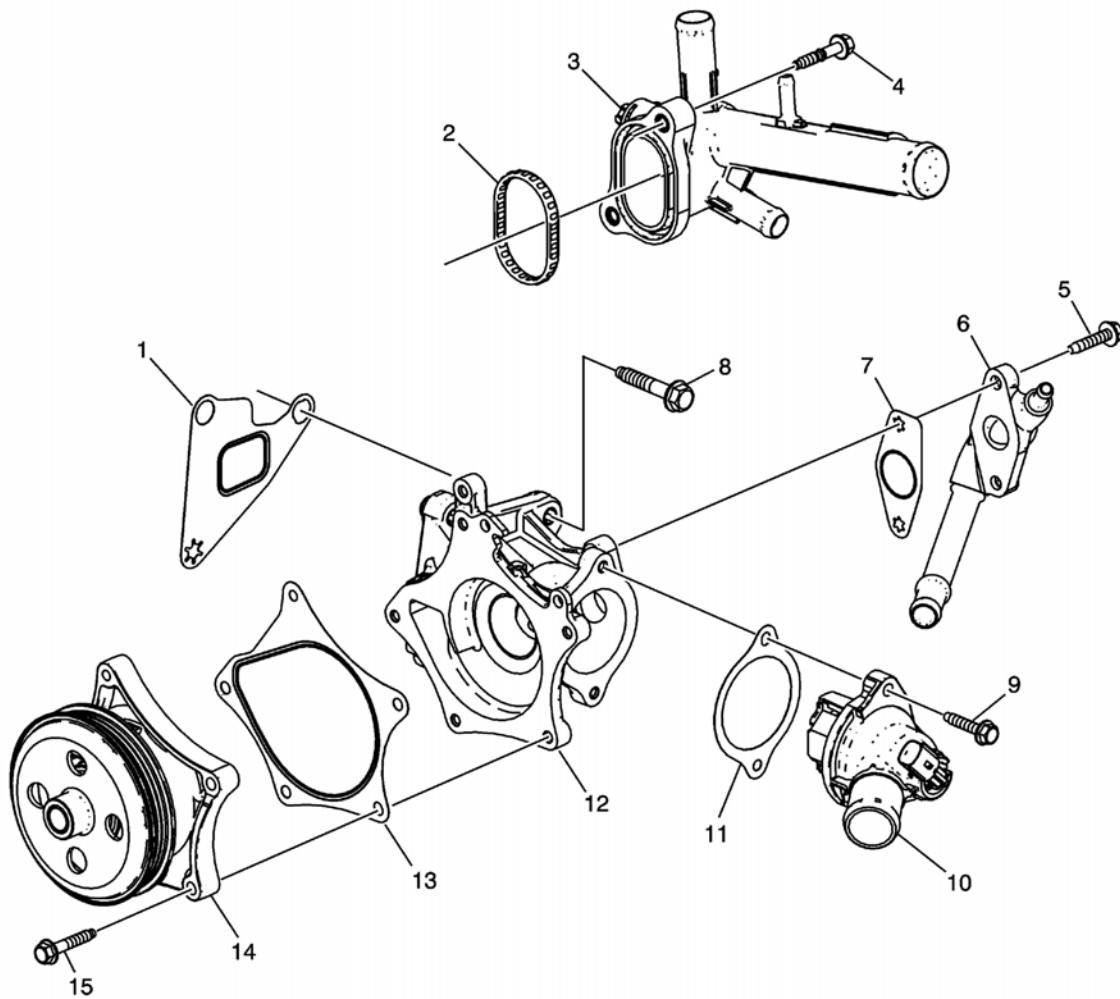


Fig. 23: Water Pump And Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Water Pump Housing Gasket
2	Water Outlet Gasket
3	Water Outlet
4	Water Outlet Bolt (Qty: 2)
5	Thermostat Bypass Pipe Bolt
6	Water Pump Inlet Hose Fitting
7	Thermostat Bypass Pipe Gasket
8	Water Pump Housing Bolt (Qty: 3)
9	Engine Coolant Thermostat Housing Bolt (Qty: 2)
10	Engine Coolant Thermostat Housing
11	Engine Coolant Thermostat Housing Gasket
12	Water Pump Rear Housing
13	Water Pump Gasket
14	Water Pump Housing
15	Water Pump Bolt (Qty: 5)

Intake Manifold and Components

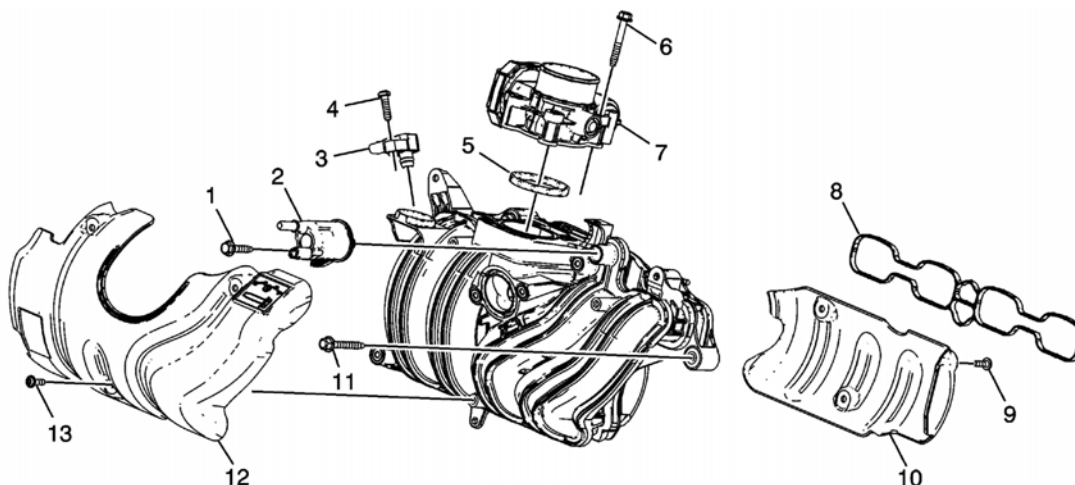


Fig. 24: Intake Manifold And Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Evaporative Emission Canister Purge Solenoid Valve Bolt
2	Evaporative Emission Canister Purge Solenoid Valve
3	Manifold Absolute Pressure Sensor
4	Manifold Absolute Pressure Sensor Bolt
5	Throttle Body Gasket
6	Throttle Body Bolt (Qty: 4)
7	Throttle Body
8	Intake Manifold Gasket
9	Intake Manifold Cover Bolt (Qty: 3)
10	Lower Intake Manifold Cover
11	Intake Manifold Bolt (Qty: 5)
12	Upper Intake Manifold Cover
13	Upper Intake Manifold Cover Bolt (Qty: 3)

Oil Pan and Components

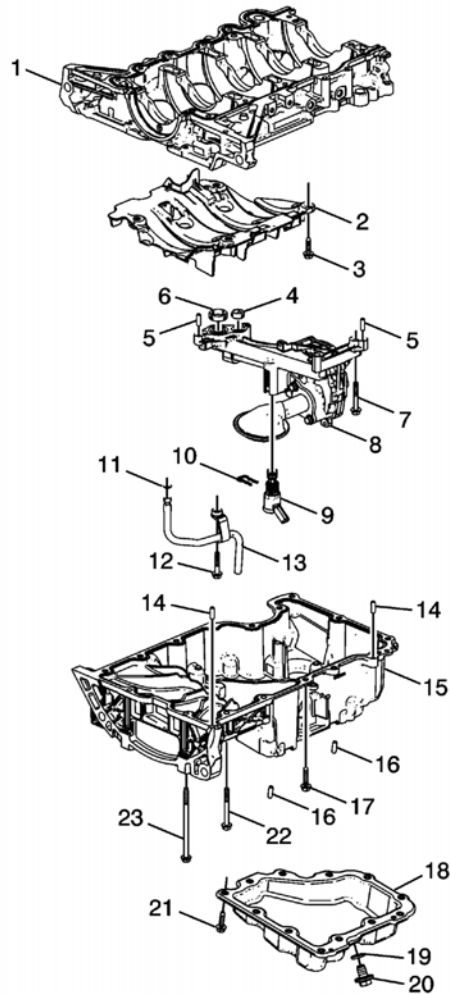


Fig. 25: Oil Pan and Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Lower Crankcase
2	Crankshaft Oil Deflector
3	Crankshaft Oil Deflector Bolts (Qty: 3)
4	Oil Pump Gasket
5	Oil Pump Assembly Locating Pin
6	Oil Pump Gasket
7	Oil Pump Assembly Bolt (Qty: 4)
8	Oil Pump Assembly
9	Oil Pump Flow Control Solenoid Valve
10	Oil Pump Flow Control Solenoid Valve Retainer
11	Positive Crankcase Ventilation Oil Separator Drain Pipe O-ring
12	Positive Crankcase Ventilation Oil Separator Drain Pipe Bolt
13	Positive Crankcase Ventilation Oil Separator Drain Pipe
14	Upper Oil Pan Locating Pin (Qty: 2)
15	Upper Oil Pan Assembly
16	Lower Oil Pan Locating Pin (Qty: 2)
17	Upper Oil Pan Bolt (Qty: 12)

Callout	Component Name
18	Lower Oil Pan
19	Oil Drain Plug O-ring
20	Oil Pan Drain Plug
21	Lower Oil Pan Bolt (Qty: 12)
22	Upper Oil Pan Bolt (Qty: 2)
23	Upper Oil Pan Bolt (Qty: 2)

Timing Chain and Components

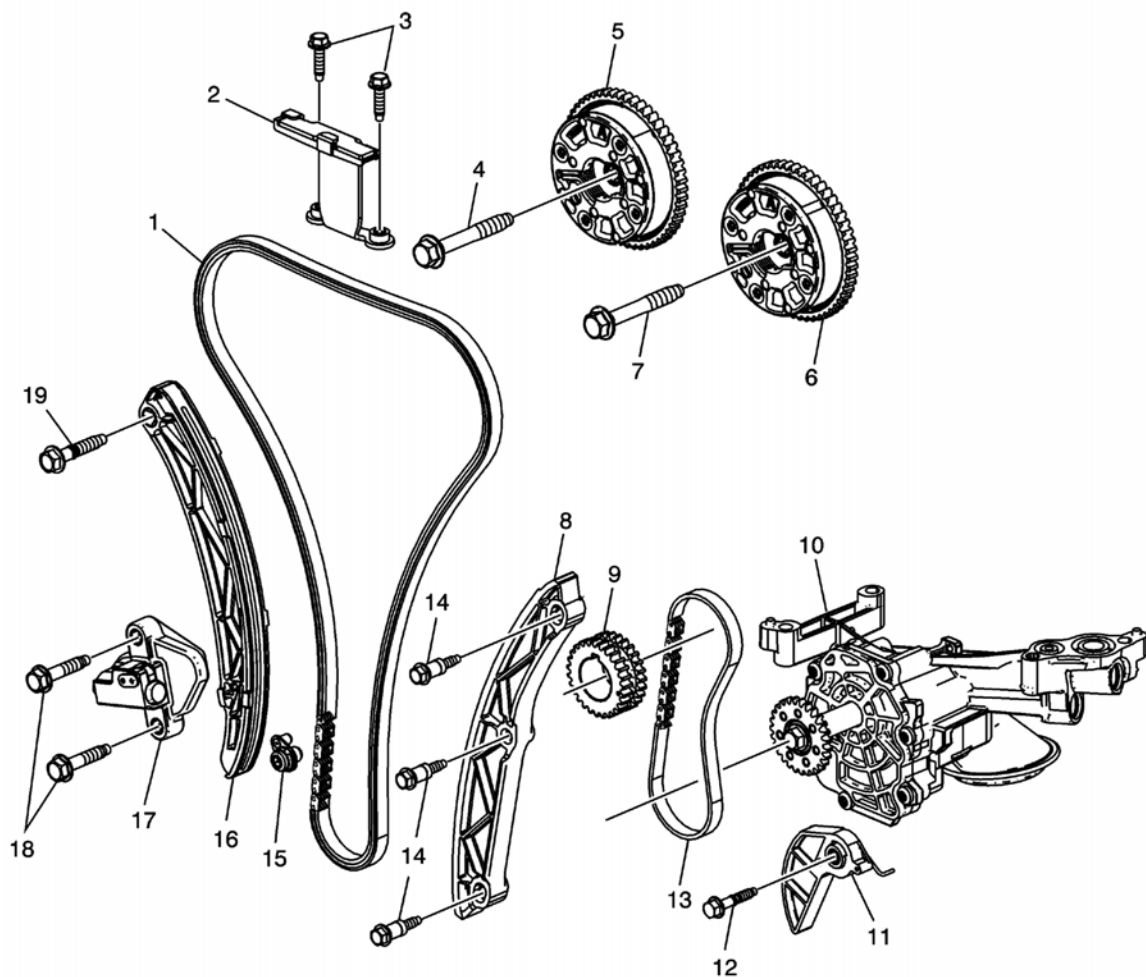


Fig. 26: Timing Chain and Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Timing Chain
2	Timing Chain Guide - to Cylinder Head
3	Timing Chain Guide Bolt
4	Camshaft Position Actuator Bolt
5	Camshaft Position Actuator Assembly - Intake
6	Camshaft Position Actuator Assembly - Exhaust
7	Camshaft Position Actuator Bolt
8	Timing Chain Guide - Exhaust Side

Callout	Component Name
9	Crankshaft Sprocket
10	Oil Pump Assembly
11	Oil Pump Drive Chain Tensioner Assembly
12	Oil Pump Drive Chain Tensioner Bolt
13	Oil Pump Drive Chain
14	Timing Chain Guide Bolt (Qty: 3)
15	Timing Chain Oil Nozzle
16	Timing Chain Tensioner Shoe Assembly
17	Timing Chain Tensioner Assembly
18	Timing Chain Tensioner Bolt
19	Timing Chain Tensioner Shoe Bolt

ENGINE IDENTIFICATION

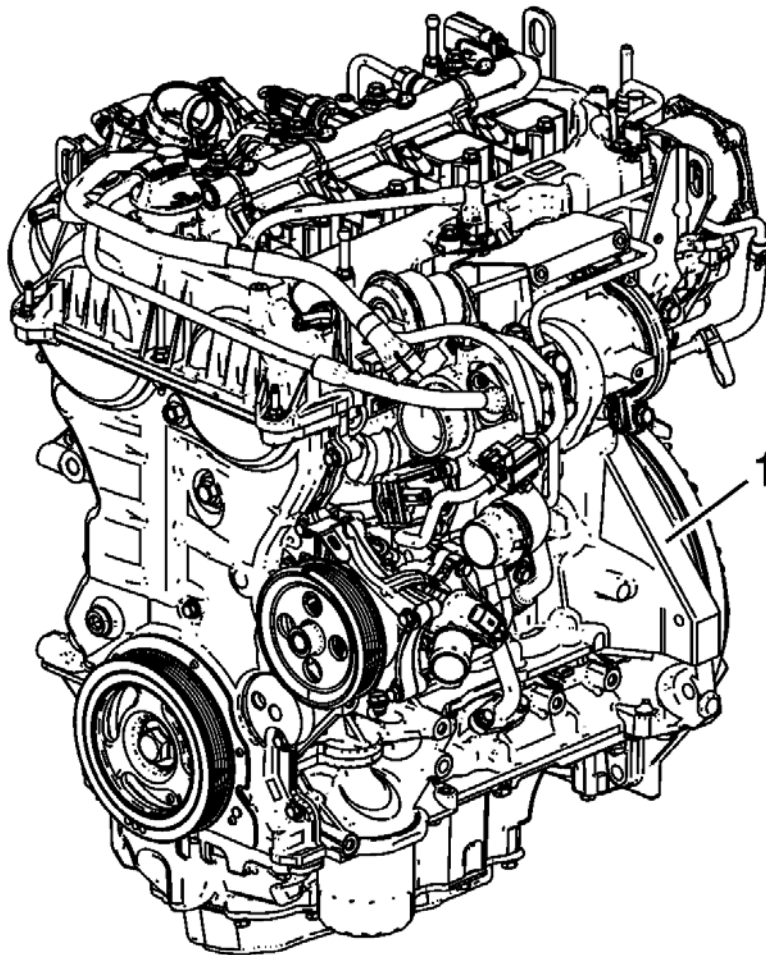


Fig. 27: Engine Identification Code

Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine identification number must be stamped to the cylinder block in case of engine replacement.

The engine identification code (1) is stamped on the flattened area of the cylinder block, at the transmission side.

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P06DA-P06DE: ENGINE OIL PRESSURE CONTROL SOLENOID VALVE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P06DA

Engine Oil Pressure Control Solenoid Valve Control Circuit

DTC P06DB

Engine Oil Pressure Control Solenoid Valve Control Circuit Low Voltage

DTC P06DC

Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage

DTC P06DD

Engine Oil Pressure Control Solenoid Valve Stuck Off

DTC P06DE

Engine Oil Pressure Control Solenoid Valve Stuck On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P06DA, P06DB*	P06DA, P06DB	-	-
Control	P06DB	P06DA	P06DC	P06DD, P06DE
*Additional DTCs may set.				

Circuit/System Description

Circuit	Description
Ignition	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Component	Description
Q44 Engine Oil Pressure Control Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid.

The engine oil pressure control solenoid valve is used to control engine oil pressure inside the mechanical engine oil pump. The control module controls the commanded state of the solenoid valve based on the following inputs:

- Engine Speed
- Calculated Engine Oil Temperature
- Engine Oil Pressure
- Engine Run Time

When the solenoid valve is commanded Off, oil pressure is higher. When the solenoid valve is commanded On, oil pressure is lower.

Conditions for Running the DTC

DTC P06DA, P06DB, P06DC

- Ignition Voltage = Greater than 11 V
- Engine = Running

DTCs run continuously when the above conditions are met.

DTC P06DD

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0335, P0336, P0521, P0522, P0523, P06DA, P06DB, P06DC, P06DD, P06DE, P111E, P2227, P2228, P2229, P2230 = Not set
- Engine Speed = 1,500 to 2,500 RPM

DTCs run continuously when the above conditions are met.

DTC P06DE

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0335, P0336, P0521, P0522, P0523, P06DA, P06DB, P06DC, P06DD, P06DE, P111E, P2227, P2228, P2229, P2230 = Not set
- Engine = Running - For greater than 1.5 s
- Engine Speed = 1,500 to 2,500 RPM
- Engine Oil Pressure Control Solenoid Valve = On - For greater than 1.5 s

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

DTC P06DA, P06DB, P06DC

Control Circuit = Commanded state does not match the actual state - For 1 s

DTC P06DD

Engine Oil Pressure = Less than a predefined threshold

DTC P06DE

Engine Oil Pressure = Greater than a predefined threshold

Actions Taken When the DTC Sets

- DTCs P06DB, P06DE are Type A DTCs.
- DTCs P06DA, P06DC, P06DD are Type B DTCs.
- Engine Oil Pressure Control Solenoid Valve = Off
- Reduced Engine Power = Active

Conditions for Clearing the DTC

- DTCs P06DA, P06DC, P06DD are Type B DTCs.
- DTCs P06DB, P06DE are Type A DTCs.

Reference Information

Schematic Reference

Engine Mechanical Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: The engine oil level and condition is critical to the correct operation of the system.

1. Ignition - On/Vehicle - In Service Mode
2. Verify there are no DTCs set related to the following system/component:
 - B35B Engine Oil Level Sensor

- B37B Engine Oil Pressure Sensor
- B37 Engine Oil Pressure Switch
- **If other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If no other DTCs are set**

3. Verify the condition does not exist:

- Low Engine Oil Level
- Dirty or contaminated oil
- **If a condition exists**

Repair as necessary

- **If no condition exists**

4. Perform the scan tool control function: Engine Oil Pressure Control Solenoid Valve - Low Pressure - High Pressure

Verify the scan tool parameter:

- Engine Oil Pressure Control Solenoid Valve Control Circuit Low Voltage Test Status = OK or Not Run
- Engine Oil Pressure Control Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

5. Engine running.

6. Perform the following steps:

1. Increase the engine speed slowly to 1,800 RPM.

NOTE: Using the scan tool line graph function may make it easier to identify if the value changes.

2. Perform the scan tool control function: Engine Oil Pressure Control Solenoid Valve - Low Pressure

Verify the scan tool parameter: Engine Oil Pressure = Change is greater than 30 kPa (4 PSI)

- If the change is 30 kPa (4 PSI) or less - Replace the component: Q44 Engine Oil Pressure Control Solenoid Valve
- If the change is greater than 30 kPa (4 PSI)

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC is not set**

8. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: Inline Harness Connector
3. Ignition - On/Vehicle - In Service Mode

NOTE: **Testing for steps 4 to 9 is performed on the control module K20 side of the inline harness connector.**

4. Verify a test lamp turns On between the test points: Ignition circuit terminal 5 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: Ignition circuit terminal 5 & Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp

NOTE: **The ignition circuit supplies voltage to other components. Test all circuits for a short to ground or test all components for being shorted.**

2. Test for infinite resistance between the test points: Ignition circuit terminal 5 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Refer to: Step 10

- **If the test lamp turns On**

5. Verify a test lamp does not turn On between the test points: Control circuit terminal 4 & B+

- **If the test lamp turns On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Inline Harness Connector Control circuit terminal 4 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **If the test lamp does not turn On**

6. Remove - Test Lamp

7. Perform the scan tool control function: Engine Oil Pressure Control Solenoid Valve - Low Pressure

Verify the scan tool parameter: Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for less than 1 V between the test points: Inline Harness Connector Control circuit terminal 4 &

Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

- **If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 4 & Ignition circuit terminal 5
9. Perform the scan tool control function: Engine Oil Pressure Control Solenoid Valve - Low Pressure

Verify the scan tool parameter: Engine Oil Pressure Control Solenoid Valve Control Circuit High Voltage Test Status = Malfunction

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Inline Harness Connector Control circuit terminal 4 & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If the specified state**

NOTE: **Testing for steps 10 to 12 is performed on the component side of the inline harness connector: Q44 Engine Oil Pressure Control Solenoid Valve**

10. Test for 10 to 30 ohms between the test points: Control circuit terminal 4 & Ignition circuit terminal 5

- **If not between 10 and 30 ohms**

1. Disconnect the electrical connector: Q44 Engine Oil Pressure Control Solenoid Valve
2. Test for less than 2 ohms between the test points:
 - Ignition circuit terminal 5 & The other end of the circuit
 - Control circuit terminal 4 & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Test or replace the component: Q44 Engine Oil Pressure Control Solenoid Valve

- **If between 10 and 30 ohms**

11. Test for infinite resistance between the test points:

- Ignition circuit terminal 5 & Ground
- Control circuit terminal 4 & Ground
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

12. Test for less than 1 V between the test points:

- Ignition circuit terminal 5 & Ground
- Control circuit terminal 4 & Ground
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

13. Test or replace the component: Q44 Engine Oil Pressure Control Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q44 Engine Oil Pressure Control Solenoid Valve
3. Test for 10 to 30 ohms between the test points: Control terminal 2/B & Ignition terminal 1/A
 - **If not between 10 and 30 ohms**
Replace the component: Q44 Engine Oil Pressure Control Solenoid Valve
 - **If between 10 and 30 ohms**
4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**
Replace the component: Q44 Engine Oil Pressure Control Solenoid Valve
 - **If infinite resistance**
5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q44 Engine Oil Pressure Control Solenoid Valve
3. Connect a 10 A fused jumper wire between the test points: Ignition terminal 1/A & 12 V

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2/B & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q44 Engine Oil Pressure Control Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q44 Engine Oil Pressure Control Solenoid Valve

- **If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [Oil Pump Flow Control Solenoid Valve Replacement](#) - Q44 Engine Oil Pressure Control Solenoid Valve
- For control module replacement, programming, and setup refer to: [Control Module References](#)

SYMPTOMS - ENGINE MECHANICAL

Strategy Based Diagnostics

Perform the **Diagnostic System Check - Vehicle** .

All diagnosis on a vehicle should follow a logical process. Strategy based diagnostics is a uniform approach for repairing all systems. The diagnostic flow may always be used in order to resolve a system condition. The diagnostic flow is the place to start when repairs are necessary.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the engine.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for the correct oil level, proper oil viscosity, and correct filter application.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, ambient temperature, engine temperature, amount of engine warm-up time, and other specifics.
- Compare the engine sounds, if applicable, to a known good engine and make sure you are not trying to correct a normal condition.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating properly.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Engine Noise Under Load**
- **Base Engine Misfire without Internal Engine Noises**
- **Base Engine Misfire with Abnormal Internal Lower Engine Noises**
- **Base Engine Misfire with Abnormal Valve Train Noise**
- **Base Engine Misfire with Coolant Consumption**
- **Base Engine Misfire with Excessive Oil Consumption**
- **Engine Noise on Start-Up, but Only Lasting a Few Seconds**
- **Upper Engine Noise, Regardless of Engine Speed**
- **Lower Engine Noise, Regardless of Engine Speed**
- **Engine Will Not Crank - Crankshaft Will Not Rotate**
- **Coolant in Engine Oil**
- **Engine Compression Test**
- **Oil Consumption Diagnosis**
- **Oil Pressure Diagnosis and Testing**
- **Oil Leak Diagnosis**

OIL PRESSURE DIAGNOSIS AND TESTING

Special Tools

- **CH-48027** Digital Pressure Gauge

- **EN-21867-850** Oil Pressure Gauge Adapter

For equivalent regional tools, refer to [Special Tools](#).

Procedure

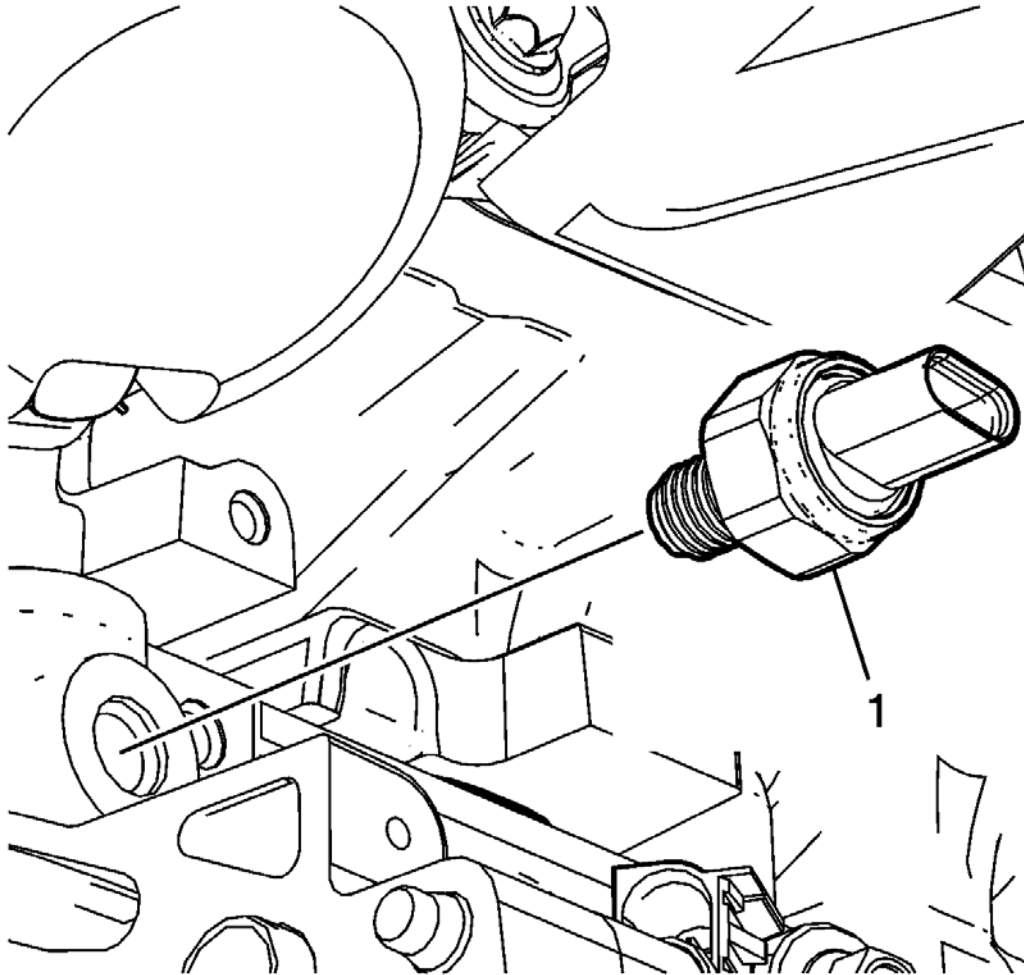


Fig. 28: Engine Oil Pressure Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Remove the engine oil pressure sensor (1).

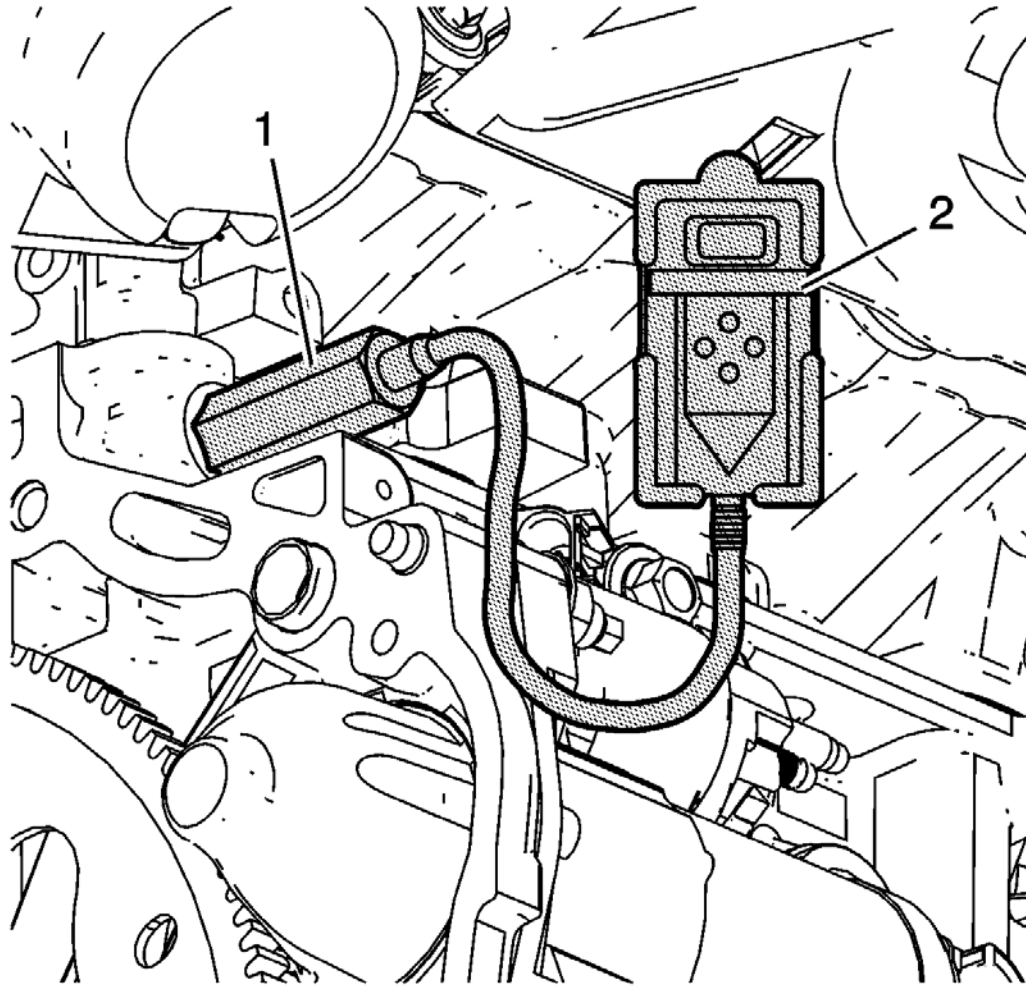


Fig. 29: Adapter And Gauge

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-21867-850** adapter (1).
3. Install the **CH-48027** gauge (2).
4. Start the engine.
5. Check oil pressure.
6. At idling speed, the oil pressure must be greater than 180 kPa (26.11 psi) and the oil temperature must be 85°C (185°F) or more.
7. Remove the **CH-48027** gauge (2).
8. Remove the **EN-21867-850** adapter (1).
9. Turn off the engine.

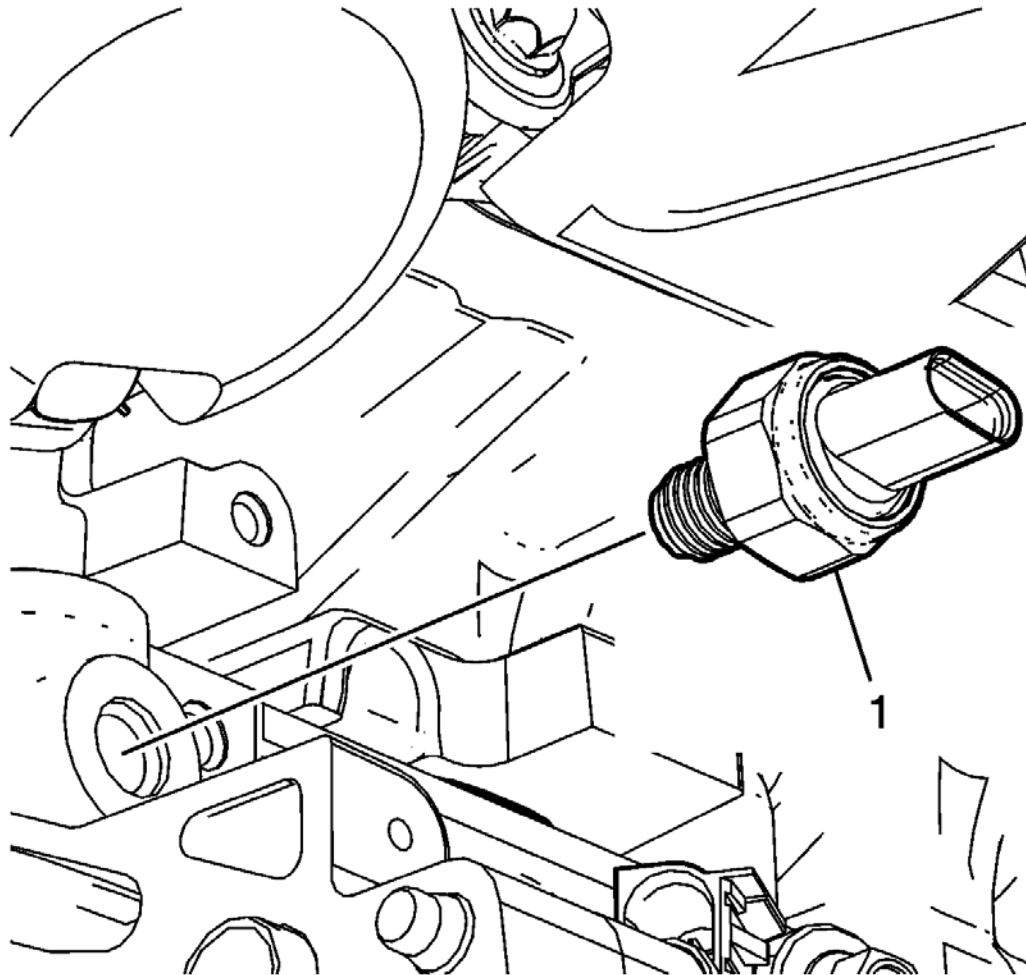


Fig. 30: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

10. Install the engine oil pressure sensor (1).
11. Tighten the sensor to 35 N.m (26 lb ft).
12. Check the engine oil level.

OIL LEAK DIAGNOSIS

Step	Action	Yes	No
DEFINITION: You can repair most fluid leaks by first, visually locating the leak, repairing or replacing the component, or by resealing the gasket surface. Once the leak is identified, determine the cause of the leak. Repair the leak and the cause of the leak.			
1	1. Operate the vehicle until it reaches normal operating temperature. Refer to <u>Engine Mechanical Specifications</u>. 2. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 3. Wait 15 minutes. 4. Inspect for drippings.		
	Are drippings present?	Go to Step 2	System OK

Step	Action	Yes	No
2	Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 3
3	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 4
4	1. Completely clean the entire engine and surrounding components. 2. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 3. Park the vehicle on a level surface over a large sheet of paper or other clean surface. 4. Wait 15 minutes. 5. Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 5
5	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 6
6	1. Completely clean the entire engine and surrounding components. 2. Apply an aerosol-type powder, for example, baby powder or foot powder, to the suspected area. 3. Operate the vehicle for several miles at normal operating temperature and at varying speeds. 4. Identify the type of fluid and the approximate location of the leak from the discolorations in the powder surface. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 7
7	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas.	Go to Step 10	Go to Step 8

Step	Action	Yes	No
	2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?		
8	Identify the type of fluid and the approximate location of the leak. Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	Go to Step 9
9	1. Visually inspect the suspected area. Use a small mirror to assist in looking at hard to see areas. 2. Inspect for leaks at the following locations: • Sealing surfaces • Fittings • Cracked or damaged components Can you identify the type of fluid and the approximate location of the leak?	Go to Step 10	System OK
10	1. Inspect the engine for mechanical damage. Special interest should be shown to the following areas: • Higher than recommended fluid levels • Higher than recommended fluid pressures • Plugged or malfunctioning fluid filters or pressure bypass valves • Plugged or malfunctioning engine ventilation system • Improperly tightened or damaged fasteners • Cracked or porous components • Improper sealants or gaskets, where required • Improper sealant or gasket installation • Damaged or worn gaskets or seals • Damaged or worn sealing surfaces 2. Inspect the engine for customer modifications. Is there mechanical damage or customer modifications to the engine?	Go to Step 11	System OK
11	Repair or replace all damaged or modified components. Did you complete the repair?	Go to Step 1	-

OIL CONSUMPTION DIAGNOSIS

Excessive oil consumption, not due to leaks, is the use of 0.9 L (1 quart) or greater of engine oil within 3,200 kilometers (2,000 miles). The causes of excessive oil consumption include the following conditions:

- External oil leaks

Tighten bolts and/or replace gaskets and oil seals as necessary.

- Incorrect oil level or improper reading of oil level indicator

With the vehicle on a level surface, allow adequate drain down time and inspect for the correct oil level.

- Improper oil viscosity

Use recommended SAE viscosity for the prevailing temperatures.

- Continuous high speed driving and/or severe usage
- Crankcase ventilation system restrictions or malfunctioning components
- Valve guides and/or valve stem oil seals worn, or the seal omitted

Ream guides and install oversize service valves and/or new valve stem oil seals.

- Piston rings broken, improperly installed, worn, or not seated properly

Allow adequate time for rings to seat. Replace broken or worn rings, as necessary.

- Piston improperly installed or mis-fitted.

COOLANT IN COMBUSTION CHAMBER

Cause	Correction
DEFINITION: Excessive white smoke and/or coolant type odor coming from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an overheating condition which may cause engine component damage.	
NOTE: While not always conclusive, use of hydrocarbon block test kits may reveal hydrocarbons indicating combustion chamber gases in cooling system. It is important to follow the kit instructions. This is not a substitute for service information. Combustion	

Cause	Correction
leak tests are available from a wide variety of aftermarket suppliers. 1. A slower than normal cranking speed may indicate coolant entering the combustion chamber. Refer to Engine Will Not Crank - Crankshaft Will Not Rotate. 2. Remove the spark plugs and inspect for spark plugs saturated by coolant or coolant in the cylinder bore. 3. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the coolant may indicate a faulty gasket or damaged component. 4. Inspect by performing a cylinder compression test. Two cylinders side-by-side on the engine block, with low compression, may indicate a failed cylinder head gasket. Refer to Engine Compression Test.	
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to Cylinder Head Cleaning and Inspection , and Cylinder Head Replacement .
Warped cylinder head	Replace the cylinder head and gasket. Refer to Cylinder Head Replacement .
Cracked cylinder head	Replace the cylinder head and gasket. Refer to Cylinder Head Replacement .
Cracked cylinder liner	Replace the components as required.
Cylinder head or block porosity	Replace the components as required.

COOLANT IN ENGINE OIL

Cause	Correction
DEFINITION: Foamy or discolored oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative cooling fan, or a faulty thermostat may lead to an overtemperature condition which may cause engine component damage. Contaminated engine oil and oil filter should be changed. 1. Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not properly lubricate the crankshaft bearings and may lead to component damage. Refer to Lower Engine Noise, Regardless of Engine Speed. 2. Inspect by performing a cylinder leak-down test. During this test, excessive air bubbles within the cooling system may indicate a faulty gasket or damaged component. 3. Inspect by performing a cylinder compression test. Two cylinders side-by-side on the engine block with low compression may indicate a failed cylinder head gasket. Refer to Engine Compression Test.	
Faulty cylinder head gasket	Replace the head gasket and components as required. Refer to Cylinder Head Replacement .
Warped cylinder head	Replace the cylinder head and gasket. Refer to Cylinder Head Replacement .
Cracked cylinder head	Replace the cylinder head and gasket. Refer to Cylinder Head Replacement .
Cracked cylinder liner	Replace the components as required.
Cylinder head or block porosity	Replace the components as required.

ENGINE NOISE UNDER LOAD

Cause	Correction
Low oil pressure	1. Perform an oil pressure test. Refer to Oil Pressure Diagnosis and Testing. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition. Refer to Symptoms - Engine Controls .
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair as required.
Cracked flywheel - automatic transmission	1. Inspect the flywheel bolts and flywheel. 2. Repair as required.
Excessive connecting rod bearing clearance	Inspect the following components and repair as required: • The connecting rod bearings • The connecting rods • The crankshaft
Excessive crankshaft bearing clearance	Inspect the following components and repair as required: • The crankshaft bearings • The crankshaft journals • The cylinder block crankshaft bearing bore

ENGINE NOISE ON START-UP, BUT ONLY LASTING A FEW SECONDS

Cause	Correction
Incorrect oil filter without anti-drainback feature	Install the correct oil filter.
Incorrect oil viscosity	1. Drain the oil. 2. Install the correct viscosity oil.
High valve lash adjuster leak down rate	Replace the lash adjusters as required.
Worn crankshaft thrust bearing	1. Inspect the thrust bearing and crankshaft. 2. Repair or replace as required.
Damaged or faulty oil filter by-pass valve	1. Inspect the oil filter by-pass valve for proper operation. 2. Repair or replace as required.
Malfunctioning camshaft position actuators - improper oil viscosity or contamination. The result is camshaft actuator locking pin does not lock	1. Verify correct engine oil viscosity by changing the engine oil and filter. Reevaluate the concern. 2. Isolate the noise to a specific camshaft position

Cause	Correction
	actuator. 3. Replace the camshaft actuator, oil and filter.

BASE ENGINE MISFIRE WITHOUT INTERNAL ENGINE NOISES

Cause	Correction
Abnormalities, severe cracking, bumps, or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations and lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components, and repair or replace as required.
A loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
Restricted exhaust system A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions include collapsed or dented pipes or plugged mufflers and/or catalytic converters.	Repair or replace as required.
Improperly installed or damaged vacuum hoses	Repair or replace as required.
Improper sealing between the intake manifold and cylinder heads or throttle body	Replace the intake manifold, gaskets, cylinder heads, and/or throttle body as required.
Improperly installed or damaged manifold absolute pressure (MAP) sensor The sealing grommet of the MAP sensor should not be torn or damaged.	Repair or replace the MAP sensor as required.
Damage to the MAP sensor housing	Replace the intake manifold.
Worn rocker arms	Replace the valve rocker arms as required.
Stuck valves Carbon buildup on the valve stem can cause the valve not to close properly.	Repair or replace as required.
Excessively worn or mis-aligned timing chain	Replace the timing chain and sprockets as required.
Worn camshaft lobes	Replace the camshaft and valve lifters.
Excessive oil pressure A lubrication system with excessive oil pressure may lead to excessive valve lifter pump up and loss of compression.	• Perform an oil pressure test. Refer to Oil Pressure Diagnosis and Testing. • Repair or replace the oil pump as required.
Faulty cylinder head gaskets and/or cracking or other damage to the cylinder heads and engine block cooling system passages	• Inspect for spark plugs saturated by coolant. • Inspect the cylinder heads, engine block, and/or head gaskets.

Cause	Correction
Coolant consumption may or may not cause the engine to overheat.	• Repair or replace as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to Engine Compression Test. • Perform cylinder leak down and compression testing to identify the cause. • Repair or replace as required.
A damaged crankshaft reluctor wheel A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. • Systems with electronic communications, DIS or coil per cylinder, and severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position. • Systems with electronic communication, DIS or coil per cylinder, and slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur. However, a DTC P0300 may be set. • Systems with mechanical communications, high voltage switch, and severe reluctor ring damage may cause additional pulses and effect fuel and spark delivery to the point of generating a DTC P0300 or P0336.	Replace the sensor and/or crankshaft as required.

BASE ENGINE MISFIRE WITH ABNORMAL INTERNAL LOWER ENGINE NOISES

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine, and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.

Cause	Correction
Worn piston rings Oil consumption may or may not cause the engine to misfire.	- Inspect the spark plugs for oil deposits. - Inspect the cylinders for a loss of compression. Refer to Engine Compression Test. - Perform cylinder leak down and compression testing to determine the cause. - Repair or replace as required.
Worn crankshaft thrust bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft, and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH ABNORMAL VALVE TRAIN NOISE

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt Abnormalities in the accessory drive system and/or components may cause engine RPM variations, noises similar to a faulty lower engine, and also lead to a misfire condition. A misfire code may be present without an actual misfire condition.	Replace the drive belt.
Worn, damaged, or mis-aligned accessory drive components or excessive pulley runout A misfire code may be present without an actual misfire condition.	Inspect the components, repair or replace as required.
Loose or improperly installed engine flywheel or crankshaft balancer A misfire code may be present without an actual misfire condition.	Repair or replace the flywheel and/or balancer as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	- Inspect the spark plugs for oil deposits. - Inspect the cylinders for a loss of compression. Refer to Engine Compression Test. - Perform cylinder leak down and compression testing to determine the cause. - Repair or replace as required.
Worn crankshaft thrust bearings Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft, and create a DTC without an actual misfire condition.	Replace the crankshaft and bearings as required.

BASE ENGINE MISFIRE WITH COOLANT CONSUMPTION

Cause	Correction
Faulty cylinder head gasket and/or cracking, or other damage to the cylinder head and engine block cooling	Inspect for spark plugs saturated by coolant.

Cause	Correction
system passages. Coolant consumption may or may not cause the engine to overheat.	• Perform a cylinder leak down test. • Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.

BASE ENGINE MISFIRE WITH EXCESSIVE OIL CONSUMPTION

Cause	Correction
Worn valves, valve guides, and/or valve stem oil seals	• Inspect the spark plugs for oil deposits. • Repair or replace as required.
Worn piston rings Oil consumption may or may not cause the engine to misfire.	• Inspect the spark plugs for oil deposits. • Inspect the cylinders for a loss of compression. Refer to Engine Compression Test. • Perform cylinder leak down and compression testing to determine the cause. • Repair or replace as required.

UPPER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Cause	Correction
Low oil pressure	• Perform an oil pressure test. Refer to Oil Pressure Diagnosis and Testing. • Repair or replace as required.
Worn valve rocker arm	Replace the valve rocker arm.
Improper lubrication to the valve rocker arms	Inspect the following components and repair or replace as required: • The valve rocker arm • The valve lifter • The oil filter bypass valve • The oil pump and pump screen • The engine block oil galleries
Broken valve spring	Replace the valve spring.
Worn or dirty valve lifters	Replace the valve lifters.
Stretched timing chain and/or damaged sprocket teeth	Replace the timing chain and sprockets.
Worn, damaged, or faulty timing chain tensioner	Replace the tensioner.
Worn engine camshaft lobes	• Inspect the engine camshaft lobes. • Replace the camshaft and valve lifters as required.

Cause	Correction
Worn valve guides or valve stems	Inspect the following components, and repair as required: • The valves • The valve guides
Stuck valves Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the following components and repair as required: • The valves • The valve guides

LOWER ENGINE NOISE, REGARDLESS OF ENGINE SPEED

Cause	Correction
Low oil pressure	• Perform an oil pressure test. Refer to Oil Pressure Diagnosis and Testing. • Repair or replace damaged components as required.
Worn accessory drive components - abnormalities, such as severe cracking, bumps, or missing areas in the accessory drive belt and/or misalignment of system components	1. Inspect the accessory drive system. 2. Repair or replace as required.
Loose or damaged crankshaft balancer	1. Inspect the crankshaft balancer. 2. Repair or replace as required.
Detonation or spark knock	Verify the correct operation of the ignition system. Refer to Symptoms - Engine Controls .
Loose torque converter bolts	1. Inspect the torque converter bolts and flywheel. 2. Repair or replace as required.
Loose or damaged flywheel	Repair or replace the flywheel.
Damaged oil pan, contacting the oil pump screen An oil pan that has been damaged, may improperly position the oil pump screen, preventing proper oil flow to the oil pump.	1. Inspect the oil pan. 2. Inspect the oil pump screen. 3. Repair or replace as required.
Oil pump screen loose, damaged or restricted	1. Inspect the oil pump screen. 2. Repair or replace as required.
Excessive piston-to-cylinder bore clearance	1. Inspect the piston and cylinder bore. 2. Repair as required.
Excessive piston pin-to-bore clearance	1. Inspect the piston, piston pin, and the connecting rod. 2. Repair or replace as required.

ENGINE WILL NOT CRANK - CRANKSHAFT WILL NOT ROTATE

Cause	Correction
Seized accessory drive system component	1. Remove accessory drive belts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector. 5. Inspect for cracked cylinder wall.
Seized automatic transmission torque converter	1. Remove the torque converter bolts. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Seized manual transmission	1. Disengage the clutch. 2. Rotate crankshaft by hand at the balancer or flywheel location.
Broken timing chain and/or gears	• Inspect timing chain and gears. • Repair as required.
Seized balance shaft	• Inspect balance shaft. • Repair as required.
Material in cylinder • Broken valve • Piston material • Foreign material • Cracked cylinder wall	• Inspect cylinder for damaged components and/or foreign materials. • Inspect for fallen cylinder wall. • Repair or replace as required.
Seized crankshaft or connecting rod bearings	• Inspect crankshaft and connecting rod bearings. • Inspect for fallen cylinder wall. • Repair as required.
Bent or broken connecting rod	• Inspect connecting rods. • Repair as required.
Broken crankshaft	• Inspect crankshaft. • Repair as required.

Cause	Correction
Seized automatic transmission - hybrid	Seized Engine or Transmission Separation

ENGINE COMPRESSION TEST

Special Tools

EN-51749 Compression Gauge Tester Kit

For equivalent regional tools, refer to [Special Tools](#).

Removal Procedure

NOTE: DO NOT leave vehicle connected to charge port or theft deterrent system will be active and compression test will not run.

1. Bring vehicle into service bay and make sure vehicle has at least 50% charge.
2. Remove the ignition coils. Refer to [Ignition Coil Replacement](#).
3. Remove the spark plugs. Refer to [Spark Plug Replacement](#).

Diagnostic Procedure

NOTE: In order to perform the compression test it will be necessary to use GDS in order to crank engine.

1. Place vehicle into service mode and connect GDS.

NOTE: The drivers door must remain open and vehicle is turned off. This will ensure that the theft deterrent feature is not active.

2. Once vehicle VIN is recorded and you are at the vehicle selection screen select "Enter" and then select "Module Diagnostics" - "Engine Control Module" then "Control Functions" on the menu screens DO NOT select "Compression Test" at this time. When you reach this point stop and turn off vehicle and leave the drivers door open.

NOTE: You must select crank on the compression test diagnostic screen within 10 seconds of turning key on or the theft deterrent feature will be enabled and the compression test will not run. If this occurs it will be necessary to turn off vehicle for at least one minute and then back on to reset this feature.

3. Without compression gauge attached put vehicle back into service mode then select compression test and then select crank on the GDS menu screens. The engine will now crank to allow any foreign substances to be removed from the cylinders. Once vehicle has performed crank function turn vehicle off.
4. After one minute the "Lost Communication with Vehicle" screen will now be displayed.
5. Install EN-51749 gauge in the spark plug bore for the cylinder that is being checked.
6. Put vehicle into service mode then select OK and then select crank on the GDS menu screens. The engine will now crank and then stop. Turn vehicle off.
7. Record the compression reading for the cylinder just tested.

NOTE: It is important to wait at least one minute with key off between checking each cylinder to ensure the theft deterrent feature is not active and the "lost Communication with Vehicle" screen appears.

8. Repeat starting at step 7 for all remaining cylinders. All 4 cylinders must be tested to obtain valid test results. Record the readings.

Installation Procedure

1. Remove EN-51749 gauge.
2. Install the spark plugs. Refer to [Spark Plug Replacement](#) .
3. Install the ignition coils. Refer to [Ignition Coil Replacement](#) .

CYLINDER LEAKAGE TEST

Special Tools

EN-51749 Compression Gauge Tester Kit

For equivalent regional tools, refer to [Special Tools](#).

NOTE: A leakage test may be performed in order to measure cylinder/combustion chamber leakage. High cylinder leakage may indicate one or more of the following conditions:

- Worn or burnt valves
- Broken valve springs
- Stuck valve lifters
- Incorrect valve lash
- Damaged piston
- Worn piston rings
- Worn or scored cylinder bore
- Damaged cylinder head gasket
- Cracked or damaged cylinder head
- Cracked or damaged engine block

WARNING: Refer to [Battery Disconnect Warning](#) .

1. Disconnect the battery ground negative cable.
2. Remove the spark plugs. Refer to [Spark Plug Replacement](#) .
3. Rotate the crankshaft to place the piston in the cylinder being tested at top dead center (TDC) of the compression stroke.
4. Install the EN-51749 gauge according to the manufacturers instructions.

NOTE: It may be necessary to hold the crankshaft balancer bolt to prevent the crankshaft from rotating.

5. Apply shop air pressure and adjust according to the manufacturers instructions.
6. Record the cylinder leakage value. Cylinder leakage that exceeds 25 percent is considered excessive and may require component service. In excessive leakage situations, inspect for the following conditions:
 - Air leakage noise at the throttle body or air inlet hose that may indicate a worn or burnt intake valve or a broken valve spring.
 - Air leakage noise at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a

broken valve spring.

- Air leakage noise from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head.
- Air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.

7. Perform the leakage test on the remaining cylinders and record the values.

CRANKCASE VENTILATION SYSTEM INSPECTION/DIAGNOSIS

Symptom	Correction
External oil leak	Inspect for any of the following conditions: • Restricted or kinked PCV hose or engine vent hose • Damaged, incorrect, or incorrectly installed PCV hose • Excessive crankcase pressure
Rough Idle	Inspect for any of the following conditions: • Restricted or kinked PCV hose or engine vent hose • Leaking (damaged) PCV hose • Vacuum hoses worn or not properly installed
Stalling or slow idle speed	Inspect for any of the following conditions: • Restricted or kinked engine vent hose • Leaking (damaged) PCV hose
High idle speed	Inspect for a leaking (damaged) PCV hose
Sludge in the engine	Inspect for restricted or kinked PCV hose or engine vent hose

REPAIR INSTRUCTIONS - ON VEHICLE

CAMSHAFT COVER REPLACEMENT

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

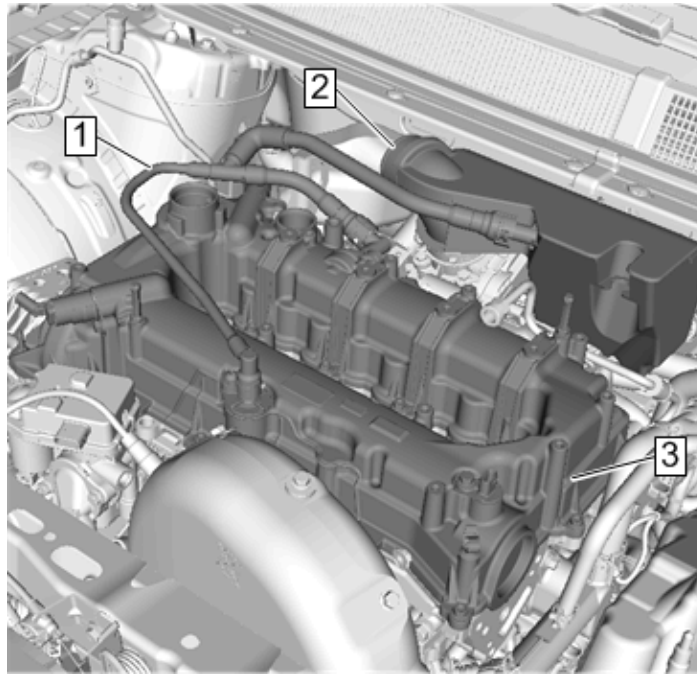


Fig. 31: Camshaft Cover, Air Cleaner Outlet Duct And Positive Crankcase Ventilation Pipe
Courtesy of GENERAL MOTORS COMPANY

CAUTION: The Positive Crankcase Ventilation (PCV) line is tamper resistant and must always be replaced once it is removed. The fittings connected to the PCV line must also be replaced if they are damaged when the PCV line is removed. To reduce the risk of damage to the fittings, use a suitable cutting tool and carefully cut the connections away.

NOTE: If reinstalling the camshaft cover (3), DO NOT cut the PCV line (1). The air cleaner outlet duct (2), camshaft cover (3) and positive crankcase ventilation pipe (1) should be removed together as shown.

2. If replacing the camshaft cover, remove and discard the positive crankcase ventilation tube. Refer to [Positive Crankcase Ventilation Tube Replacement](#)
3. Remove Fuel Feed Intermediate Pipe. Refer to [Fuel Feed Intermediate Pipe Replacement](#)
4. Remove Fuel Injection Fuel Rail Assembly. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#)

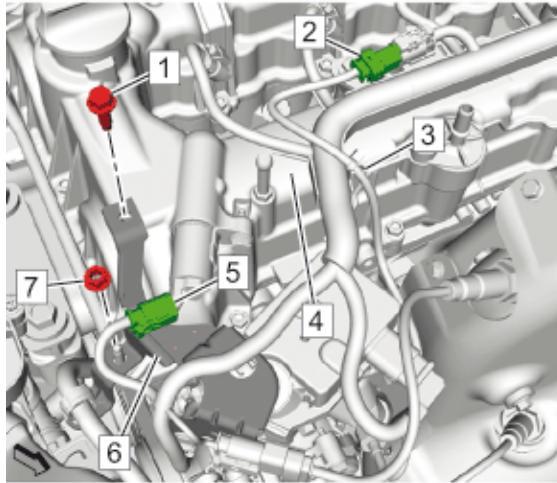


Fig. 32: Bolt, Electrical Connectors, Retainer, Nut And Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Remove Bolt (1) @ Camshaft Cover
6. Disconnect Electrical Connector (2) @ Exhaust Gas Recirculation Cooler Temperature Sensor
7. Unclip the exhaust gas recirculation cooler temperature sensor from the camshaft cover retainer (3).
8. Disconnect Electrical Connector (5) @ Camshaft Position Actuator Solenoid Valve
9. Remove Nut (7) @ Engine Wiring Harness Bracket (6)
10. Position aside Engine Wiring Harness Bracket (6)

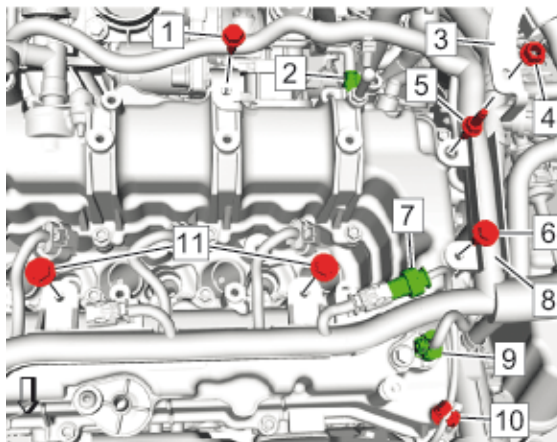


Fig. 33: Bolts, Electrical Connectors, Nut, Fuel Pipe Bracket, Engine Stud, Clip And Engine Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 3 engine wiring harness support bolts (6, 11)
12. Remove Engine Wiring Harness Bracket Bolt (1)
13. Disconnect Electrical Connector (2) @ Intake Camshaft Position Sensor
14. Remove Nut (4)
15. Lay fuel pipe bracket (3) aside.

16. Remove the engine wiring harness stud (5).
17. Disconnect Electrical Connector (7) @ Exhaust Gas Recirculation Cooler Temperature Sensor
18. Remove the exhaust temperature sensor clip (10).
19. Disconnect Electrical Connector (9) @ Exhaust Camshaft Position Sensor
20. Position aside Engine Wiring Harness (8)

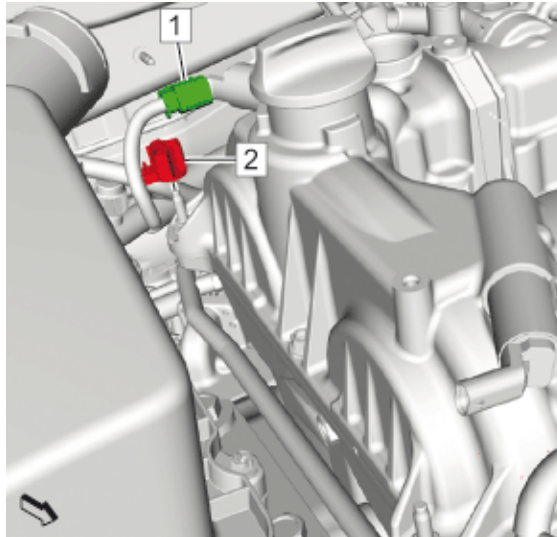


Fig. 34: Electrical Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

21. Disconnect Electrical Connector (1) @ Camshaft Position Actuator Solenoid Valve
22. Remove Retainer (2)

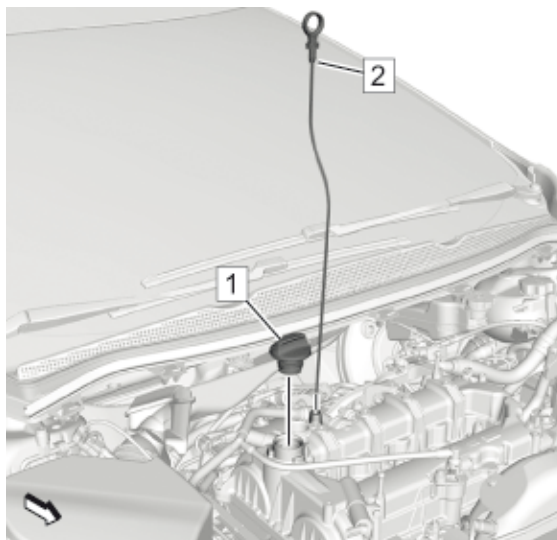


Fig. 35: Oil Filler Cap And Oil Level Indicator Handle
Courtesy of GENERAL MOTORS COMPANY

23. Remove Oil Filler Cap (1)
24. Remove the oil level indicator handle (2).

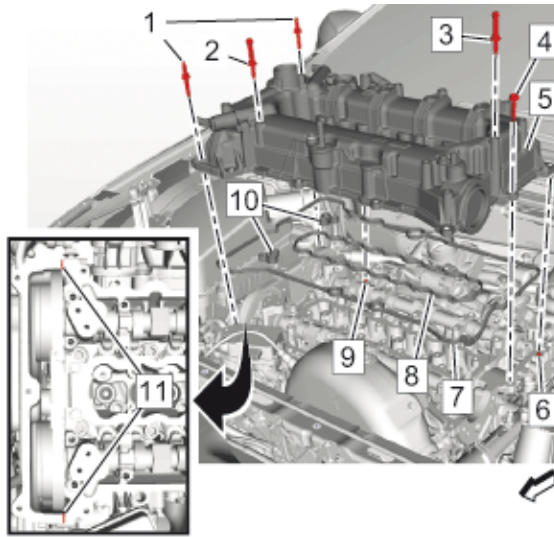


Fig. 36: Camshaft Cover, Studs, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

25. Remove Camshaft Cover Studs (1) (Qty: 2)
26. Remove Camshaft Cover Bolts (4) (Qty: 18)
27. Remove Camshaft Cover (2)
28. Remove and DISCARD the outer camshaft cover gasket (7).
29. Remove and DISCARD the inner camshaft cover gasket (8).
30. Remove and DISCARD the 2 camshaft position actuator solenoid valve gaskets (10).
31. Remove Camshaft Cover Studs (2, 3) (Qty: 2)

Disassemble Procedure

1. Remove Camshaft Position Sensor - Exhaust. Refer to [Camshaft Position Sensor Replacement - Exhaust](#)
2. Remove Camshaft Position Sensor - Intake. Refer to [Camshaft Position Sensor Replacement - Intake](#)
3. Remove Camshaft Position Actuator Solenoid Valve - Intake. Refer to [Camshaft Position Actuator Solenoid Valve Replacement - Intake](#)
4. Remove Camshaft Position Actuator Solenoid Valve - Exhaust. Refer to [Camshaft Position Actuator Solenoid Valve Replacement - Exhaust](#)
5. Remove Positive Crankcase Ventilation Valve - Fresh Air. Refer to [Positive Crankcase Ventilation Valve Replacement - Fresh Air](#)
6. Remove Positive Crankcase Ventilation Valve - Secondary. Refer to [Positive Crankcase Ventilation Valve Replacement - Secondary](#)

Assemble Procedure

1. Install Positive Crankcase Ventilation Valve - Fresh Air. Refer to [Positive Crankcase Ventilation Valve Replacement - Fresh Air](#)
2. Install Positive Crankcase Ventilation Valve - Secondary. Refer to [Positive Crankcase Ventilation Valve Replacement - Secondary](#)
3. Install Camshaft Position Actuator Solenoid Valve - Exhaust. Refer to [Camshaft Position Actuator Solenoid Valve Replacement - Exhaust](#)
4. Install Camshaft Position Actuator Solenoid Valve - Intake. Refer to [Camshaft Position Actuator Solenoid Valve Replacement - Intake](#)

5. Install Camshaft Position Sensor - Intake. Refer to [Camshaft Position Sensor Replacement - Intake](#)
6. Install Camshaft Position Sensor - Exhaust. Refer to [Camshaft Position Sensor Replacement - Exhaust](#)

Installation Procedure

1. Clean all camshaft cover sealing surfaces.

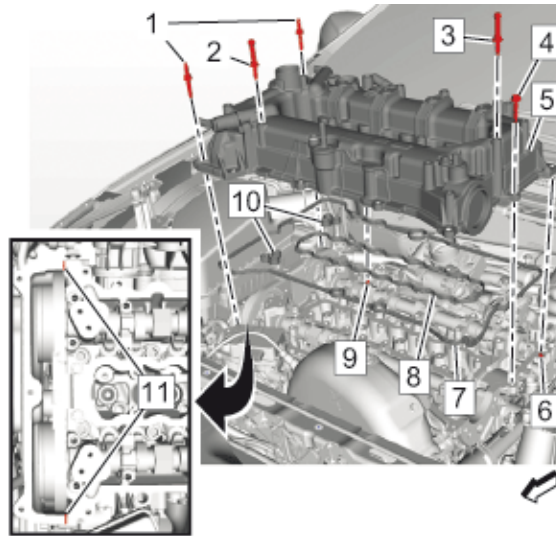


Fig. 37: Camshaft Cover, Studs, Bolts And Gaskets

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

2. Install and tighten Camshaft Cover Studs (2, 3) (Qty: 2) to 10 N.m (89 lb in)

NOTE: Ensure that the gaskets are located in the retaining grooves in the camshaft cover.

3. Apply approximately a 5 mm (0.2 in) thick bead of camshaft cover sealant (11) on both sides between the cylinder head and the engine front cover. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
4. Install 2 NEW camshaft position actuator solenoid valve gaskets (10).
5. Install a NEW camshaft cover inner gasket (8).
6. Install a NEW camshaft cover outer gasket (7).

NOTE: If reinstalling the original camshaft cover, install the camshaft cover, air cleaner outlet duct and positive crankcase ventilation tube as an assembly.

7. Install the camshaft cover (5) along with the pins (6, 9).
8. Hand tighten the 2 camshaft cover double end studs (1).
9. Tighten the Camshaft Cover Bolts (4) (Qty: 18) bolts by hand.

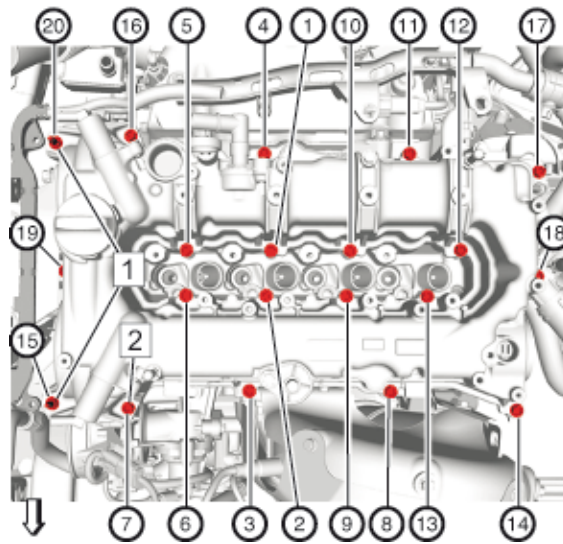


Fig. 38: Camshaft Cover Stud And Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

10. Tighten the 2 camshaft cover double end studs (1) and the 18 camshaft cover bolts (2) in sequence as shown to 15 N.m (11 lb ft).

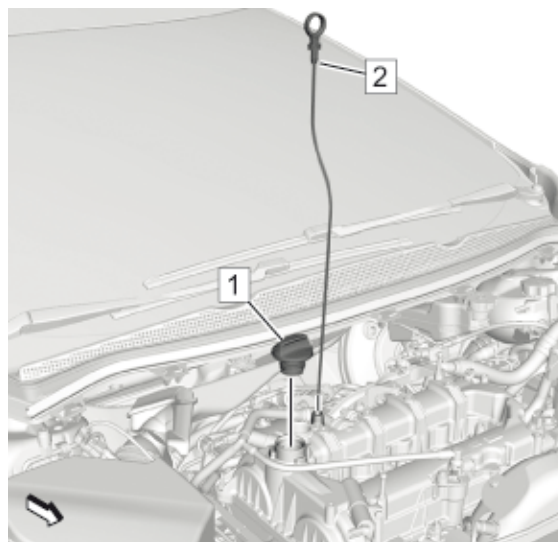


Fig. 39: Oil Filler Cap And Oil Level Indicator Handle
Courtesy of GENERAL MOTORS COMPANY

11. Install the oil level indicator handle (2).
12. Install Oil Filler Cap (1)

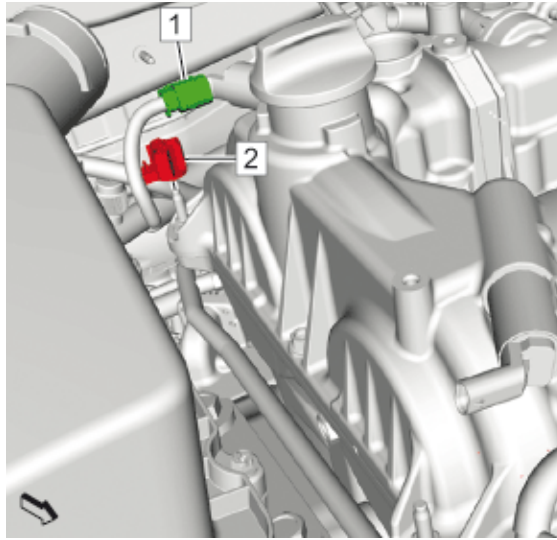


Fig. 40: Electrical Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

13. Connect Electrical Connector (1) @ Camshaft Position Actuator Solenoid Valve
14. Install Retainer (2)

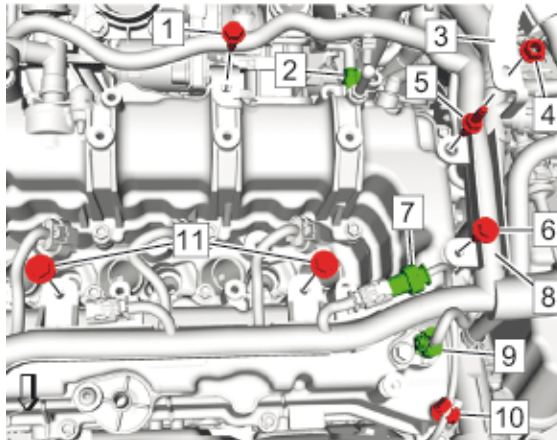


Fig. 41: Bolts, Electrical Connectors, Nut, Fuel Pipe Bracket, Engine Stud, Clip And Engine Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

15. Position the engine wiring harness (8).
16. Connect Electrical Connector (9) @ Exhaust Camshaft Position Sensor
17. Install the exhaust temperature sensor clip (10).
18. Connect Electrical Connector (7) @ Exhaust Gas Recirculation Cooler Temperature Sensor
19. Install the engine wiring harness stud (5) and tighten to 9 N.m (80 lb in).
20. Install fuel pipe bracket (3).
21. Install and tighten Nut (4) to 9 N.m (80 lb in)
22. Install the 3 engine wiring harness support bolts (6, 11) and tighten to 9 N.m (80 lb in).
23. Install and tighten Engine Wiring Harness Bracket Bolt (1) to 9 N.m (80 lb in)

24. Connect Electrical Connector (2) @ Intake Camshaft Position Sensor

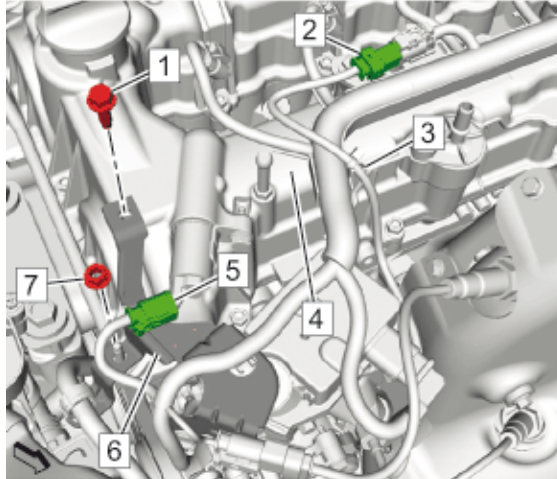


Fig. 42: Bolt, Electrical Connectors, Retainer, Nut And Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

25. Install the engine wiring harness bracket (6).
26. Connect Electrical Connector (2) @ Exhaust Gas Recirculation Cooler Temperature Sensor
27. Clip in exhaust gas recirculation cooler temperature sensor to the camshaft cover retainer (3).
28. Connect Electrical Connector (5) @ Camshaft Position Actuator Solenoid Valve
29. Install and tighten Nut (7) @ Engine Wiring Harness Bracket (6) to 9 N.m (80 lb in)
30. Install and tighten Bolt (1) @ Camshaft Cover to 9 N.m (80 lb in)
31. Install Positive Crankcase Ventilation Tube. Refer to [Positive Crankcase Ventilation Tube Replacement](#)
32. Install Fuel Injection Fuel Rail Assembly. Refer to [Fuel Injection Fuel Rail Assembly Replacement](#)
33. Install Fuel Feed Intermediate Pipe. Refer to [Fuel Feed Intermediate Pipe Replacement](#)
34. Enable high voltage system. Refer to [High Voltage Enabling](#)

CAMSHAFT POSITION ACTUATOR REPLACEMENT

Special Tools

- **EN-45059** Angle Meter
- **EN-51367** Camshaft Holder
- **EN-51397-1** Timing Chain Retainer
- **EN-51397-2** Timing Chain Retainer

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling](#) -
3. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
4. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)

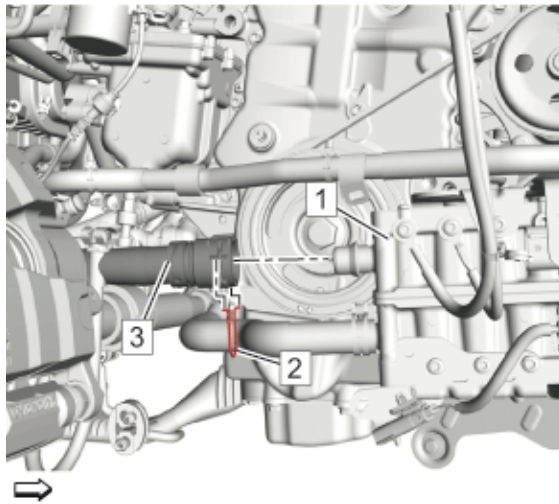


Fig. 43: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)
6. Disconnect Heater Inlet Hose (3) @ Heater Coolant Heater (1)
7. Remove Heater Inlet Hose (3)

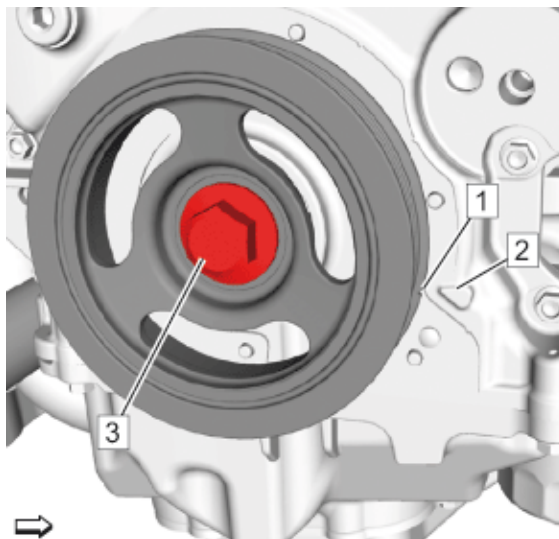


Fig. 44: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

8. Adjust the engine to cylinder 1 top dead center (TDC) of combustion stroke. Set crankshaft in direction of engine rotation until the markings (1, 2) line up. Rotate at the crankshaft balancer bolt (3).
9. Lower the vehicle.

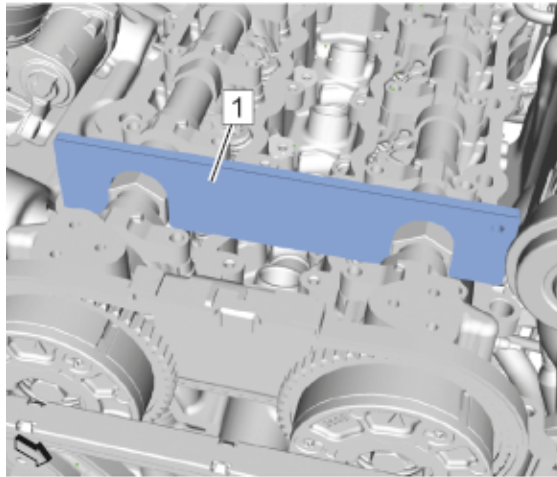


Fig. 45: Camshaft Holder

Courtesy of GENERAL MOTORS COMPANY

10. Install the EN-51367 holder (1).
11. Remove Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)

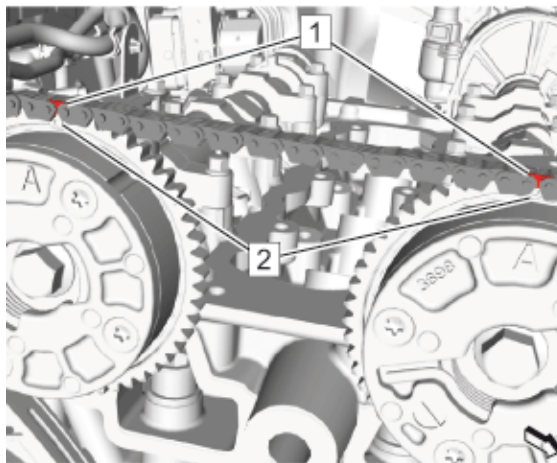


Fig. 46: Camshaft Position Actuator Marks And Timing Chain Marks

Courtesy of GENERAL MOTORS COMPANY

NOTE: The actuator marks stands at 12 o'clock, if the cylinder 1 are on top dead center.

12. Check camshaft position actuator marks (1).
13. Apply a color marking to the camshaft timing chain (1) marking to corresponding timing chain link.

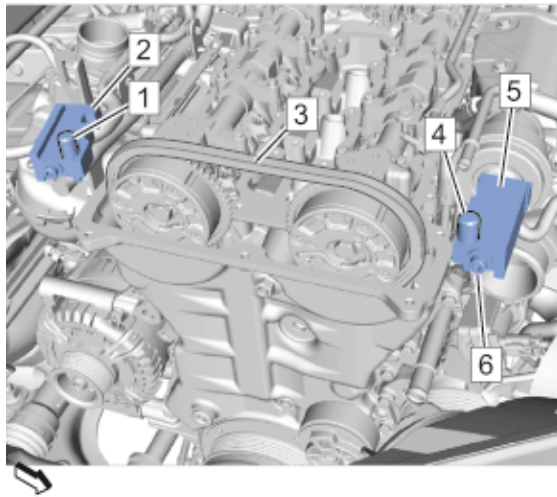


Fig. 47: Camshaft Timing Chain, Retainers, Thumb Wheels And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Pre-Install the **EN-51397-2** retainer (2) to the intake side of the camshaft timing chain (3).
15. Install the **EN-51397-1** retainer (5) to the exhaust side of the camshaft timing chain.
16. Hand tighten the thumb wheels (1, 4) securely.

CAUTION: Refer to **Fastener Caution**

17. Tighten Bolts (6) (Qty: 2) to 5 N.m (44 lb in)

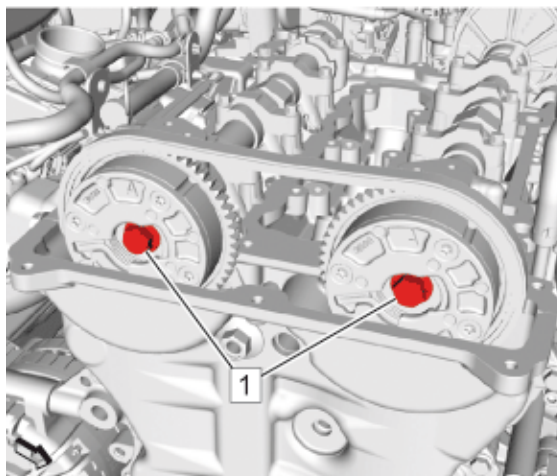


Fig. 48: Camshaft Position Actuator Bolts
Courtesy of GENERAL MOTORS COMPANY

18. Loosen Bolts (1) (Qty: 2) @ Camshaft Position Actuator
19. Remove the **EN-51367** holder.

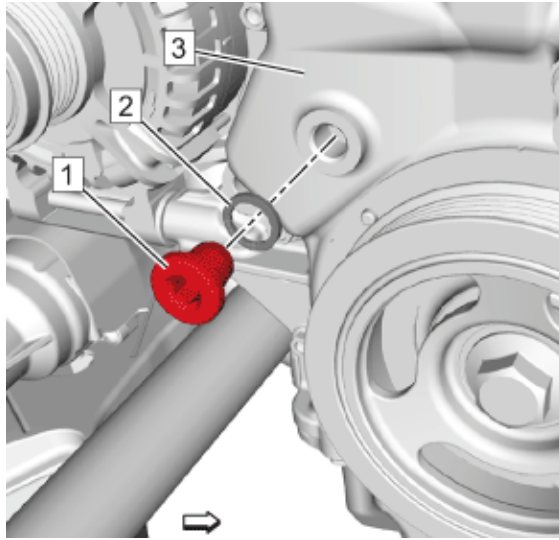


Fig. 49: Engine Front Cover, Hole Plug And Seal Ring
Courtesy of GENERAL MOTORS COMPANY

20. Remove Engine Front Cover Hole Plug (1) @ Engine Front Cover
21. Remove Seal Ring (2)

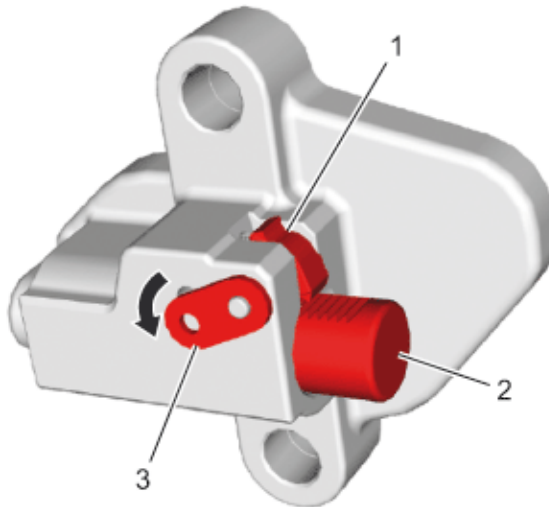


Fig. 50: Releasing Tension From Piston
Courtesy of GENERAL MOTORS COMPANY

NOTE: Step 22 - 26 explain how to adjust and fix the timing chain tensioner in the service position and should be used for reference.

22. Slightly release tension from the piston (2) until bar (1) can be unlocked by rotating the lever (3) in direction of arrow.

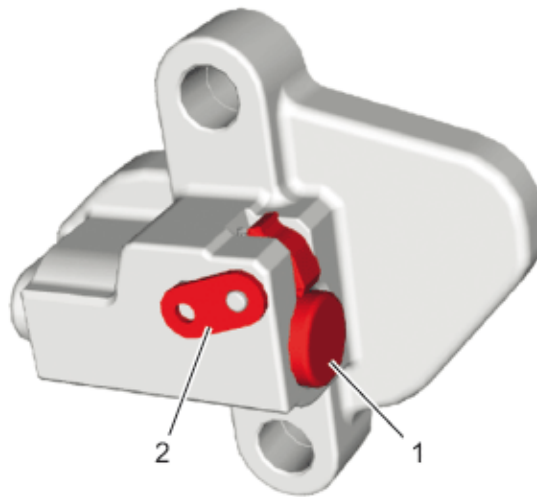


Fig. 51: Piston And Tensioner Lever
Courtesy of GENERAL MOTORS COMPANY

23. Entirely push back the piston (1) until the tensioner Lever (2) cannot be locked in this position.

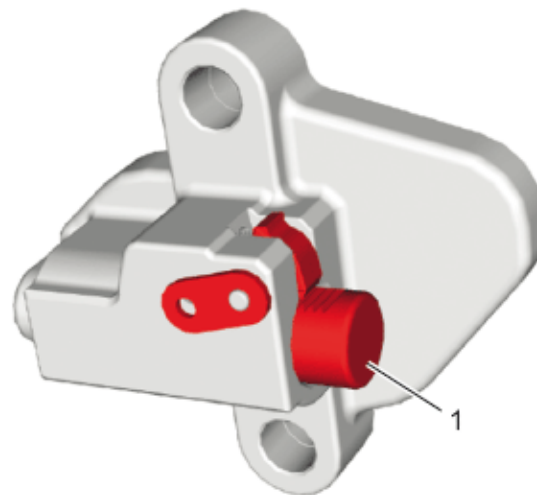


Fig. 52: Piston
Courtesy of GENERAL MOTORS COMPANY

24. Release tension from the piston (1) until it releases for three ratchets. The three ratchets can be noticed by the click noises.

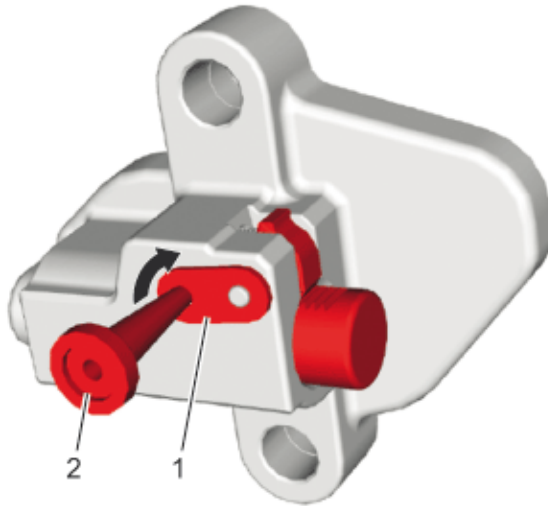


Fig. 53: Lever And Fixing Pin

Courtesy of GENERAL MOTORS COMPANY

25. Apply tension to the piston until the lever (1) is rotated back into the locking position where the bore in the lever aligns with the bore in the tensioner housing.
26. Fix the lever in this position with a suitable fixing pin (2).

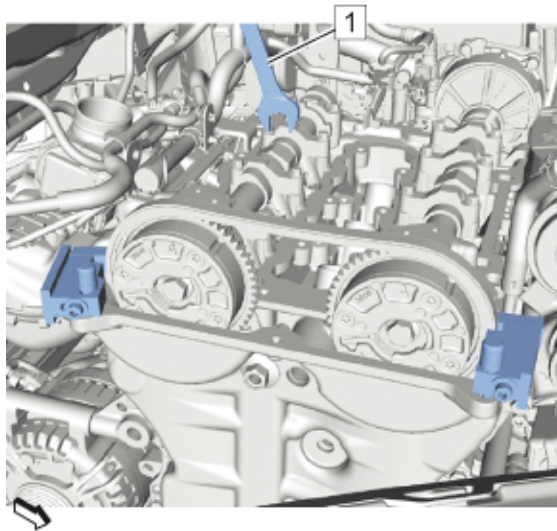


Fig. 54: Wrench On Camshaft

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The tightening force must be applied gently to the wrench. Using too much force will lead to an overlap of the timing chain that will cause severe engine damages.

NOTE: A second technician is required.

Follow Step 22 - 26 during rotation of the intake camshaft

27. Install a suitable wrench (1) to the intake camshaft.
28. Apply tension to the chain tensioner by slightly rotating the intake camshaft clockwise.

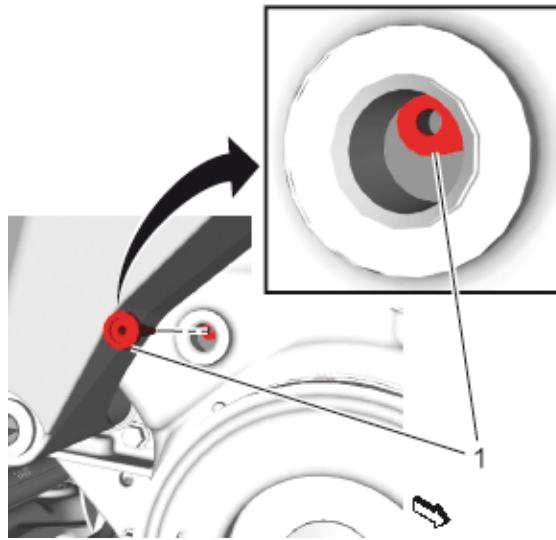


Fig. 55: Timing Chain Tensioner In Lock Position
 Courtesy of GENERAL MOTORS COMPANY

NOTE: The timing chain tensioner has now the lock position (1).

29. Secure the timing chain tensioner design 1 with a suitable fixing pin 3 mm (0.118 in).

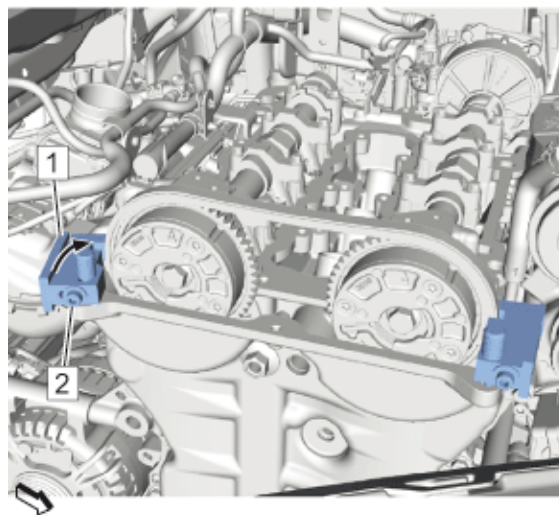


Fig. 56: Bolt And Retainer
 Courtesy of GENERAL MOTORS COMPANY

30. Fix the **EN-51397-2** retainer (1) to the intake side of the camshaft timing chain.

31. Tighten the bolt (2) of the **EN-51397-2** retainer to 5 N.m (44 lb in).

32. Remove the wrench.

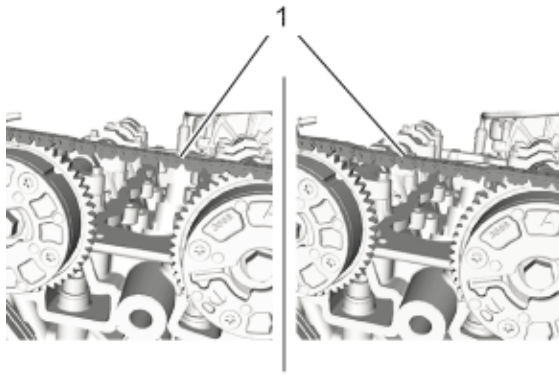


Fig. 57: Checking Chain Slack

Courtesy of GENERAL MOTORS COMPANY

NOTE: The timing chain can be moved up and down between both camshaft position actuators.

33. Check chain slack, if not enough slack is gained, refer to detailed chain tensioner description from step 22 to 26. Apply and release tension to the chain tensioner.

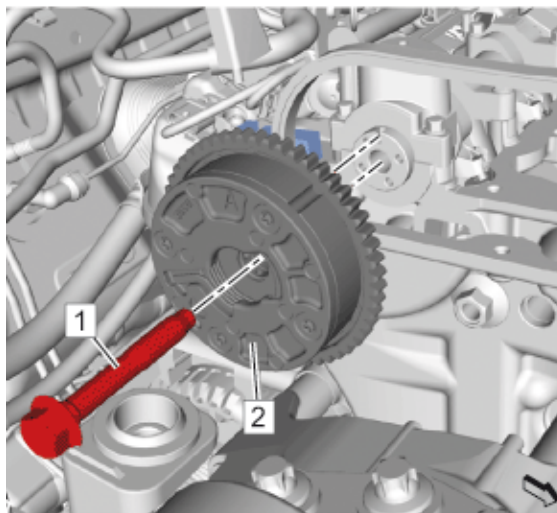


Fig. 58: Intake Camshaft Position Actuator And Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Only if the timing chain tensioner is fixed in the service position as described above, the timing chain is properly free from tension. Removing the camshaft actuator in another position of the tensioner will make the reinstallation impossible and removal of the engine front cover will be required.

34. Remove and DISCARD the intake camshaft position actuator bolt (1).

NOTE: The camshaft timing chain will be hold by EN-51397-1 retainer.

35. Remove the intake camshaft position actuator (2).

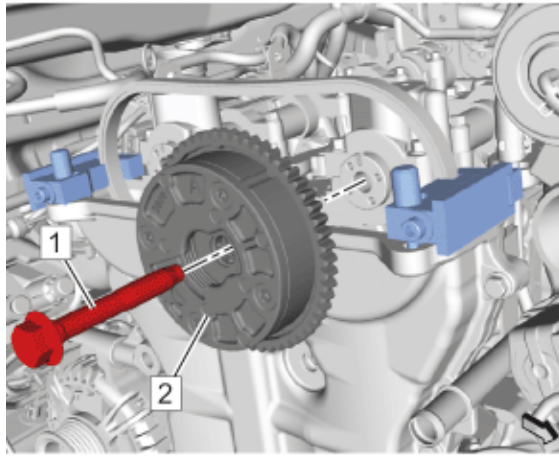


Fig. 59: Exhaust Camshaft Position Actuator And Bolt
Courtesy of GENERAL MOTORS COMPANY

36. Remove and DISCARD the exhaust camshaft position actuator bolt (1).

NOTE: The camshaft timing chain will be hold by EN-51397-1 retainer.

37. Remove the exhaust camshaft position actuator (2).

Installation Procedure



Fig. 60: Camshaft Position Actuator Marks And Timing Chain Marks
Courtesy of GENERAL MOTORS COMPANY

1. The marks of the camshaft position actuators (2) must be set to the marks of the camshaft timing chain (1).

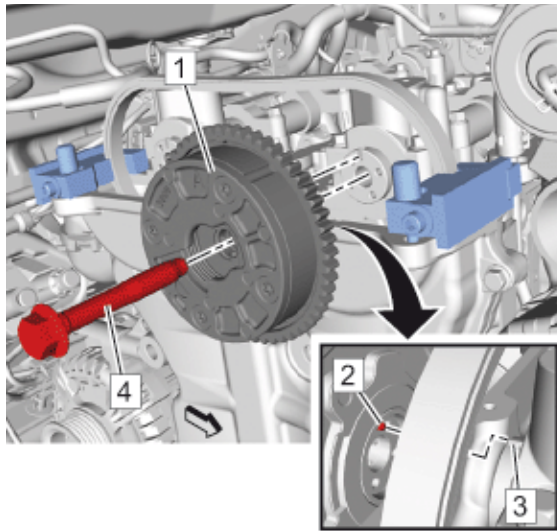


Fig. 61: Exhaust Camshaft Position Actuator, Dowel Pin, Camshaft And Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install the exhaust camshaft position actuator (1).
3. Readjust the camshaft until the dowel pin (2) engage to camshaft (3).

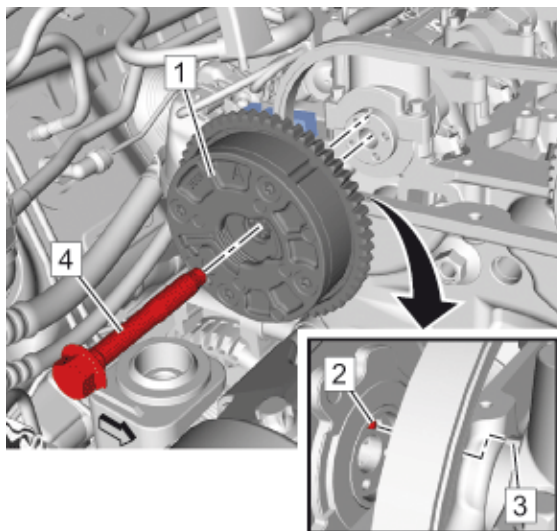


Fig. 62: Intake Camshaft Position Actuator, Dowel Pin, Camshaft And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the exhaust camshaft position actuator (1).
5. Readjust the camshaft until the dowel pin (2) engage to camshaft (3).

NOTE: **Counterhold the camshaft with a suitable tool.**

6. Install the intake camshaft position actuator bolt (4) but do not tighten yet.

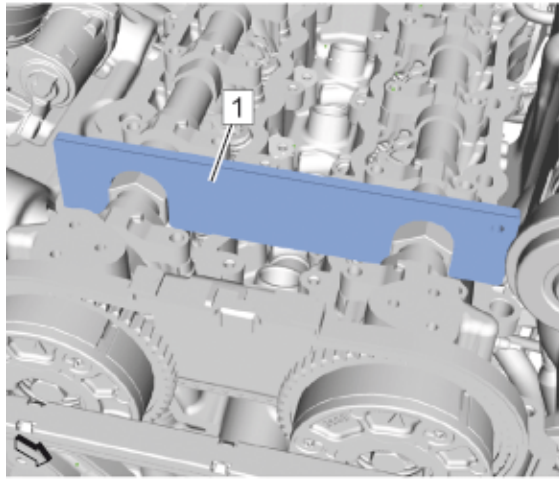


Fig. 63: Camshaft Holder

Courtesy of GENERAL MOTORS COMPANY

7. Install the EN-51367 holder (1).

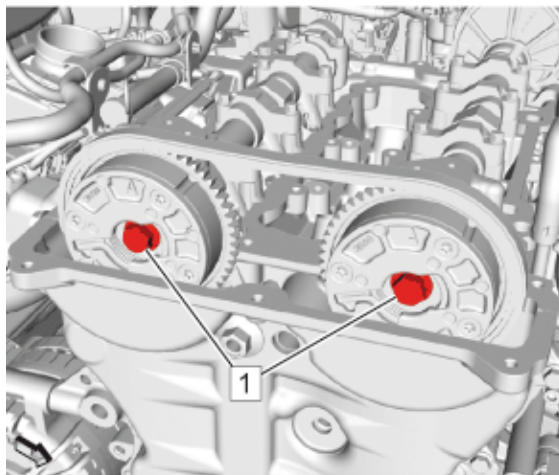


Fig. 64: Camshaft Position Actuator Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

NOTE: Counterhold the camshaft with a suitable tool.

8. Tighten the 2 to camshaft position actuator bolts (1) to:
 1. First Pass: 20 N.m (15 lb ft).
 2. Final Pass: 90 degrees use the EN-45059 meter.
9. Remove the EN-51367 holder (1).

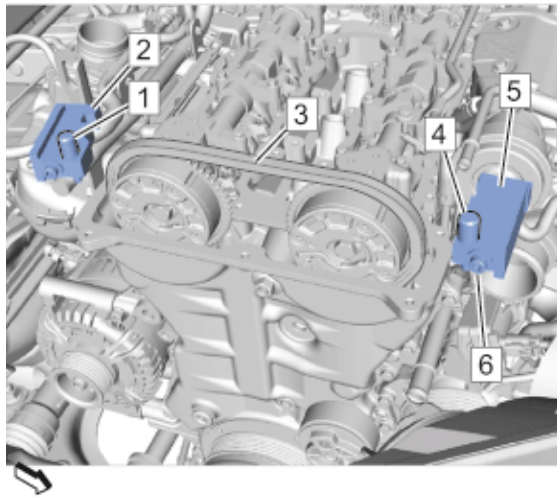


Fig. 65: Camshaft Timing Chain, Retainers, Thumb Wheels And Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Loosen the bolts. (6) (Qty: 2)
11. Loosen the bolts. (1, 4) (Qty: 2)
12. Remove **EN-51397-2** retainer (2).
13. Remove **EN-51397-1** retainer (5).

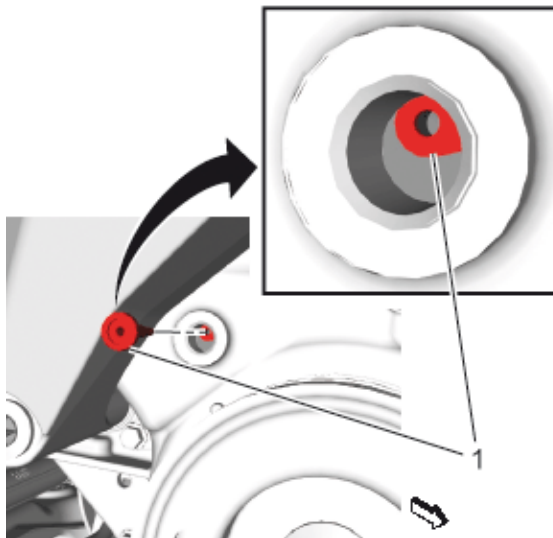


Fig. 66: Timing Chain Tensioner In Lock Position
Courtesy of GENERAL MOTORS COMPANY

NOTE: The following step shows the tensioner design 1.

14. Remove the pin from the timing chain tensioner (1).
15. Install Timing Chain Upper Guide. Refer to [**Timing Chain Upper Guide Replacement**](#)
16. Check the position of the crankshaft, camshaft and camshaft position actuator.

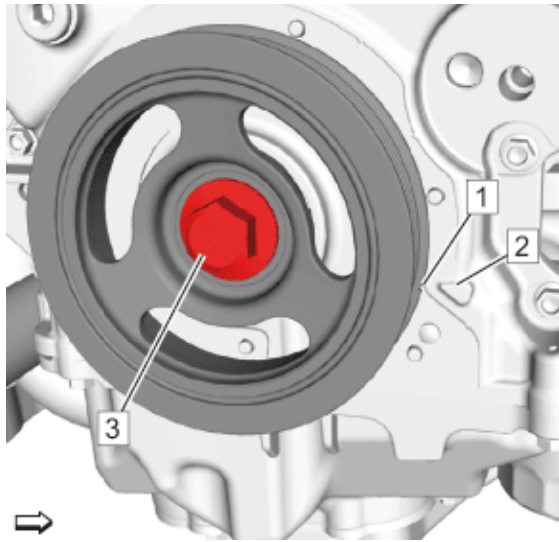


Fig. 67: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

17. Turn crankshaft 720 degrees in the direction of engine rotation by the crankshaft balancer bolt (3).
18. Adjust the engine to cylinder 1 TDC of combustion stroke. Set crankshaft in direction of engine rotation until the markings (1, 2) line up. Rotate at the crankshaft balancer bolt (3).

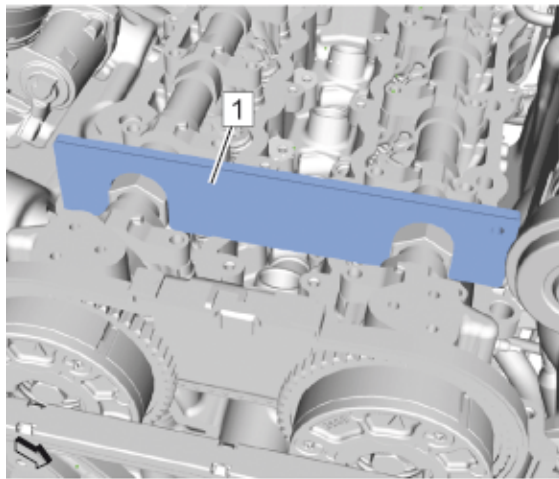


Fig. 68: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

19. Install the **EN-51367** holder (1).
20. If the **EN-51367** holder (1) can be installed, the engine timing is properly adjusted.

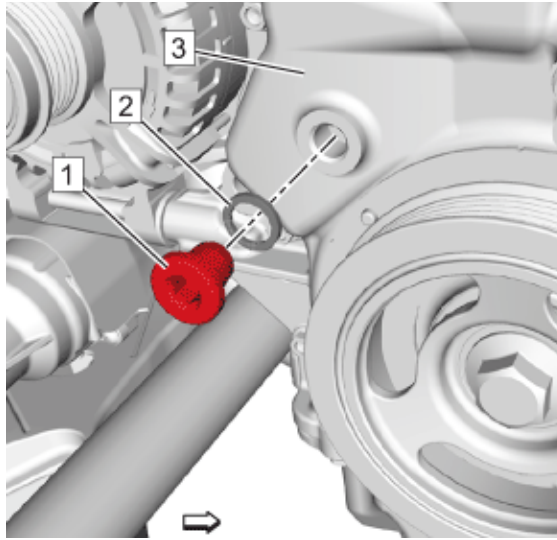


Fig. 69: Engine Front Cover, Hole Plug And Seal Ring
Courtesy of GENERAL MOTORS COMPANY

21. Install Seal Ring (2)
22. Install and tighten Engine Front Cover Hole Plug (1) to 50 N.m (37 lb ft)
23. Raise the vehicle.

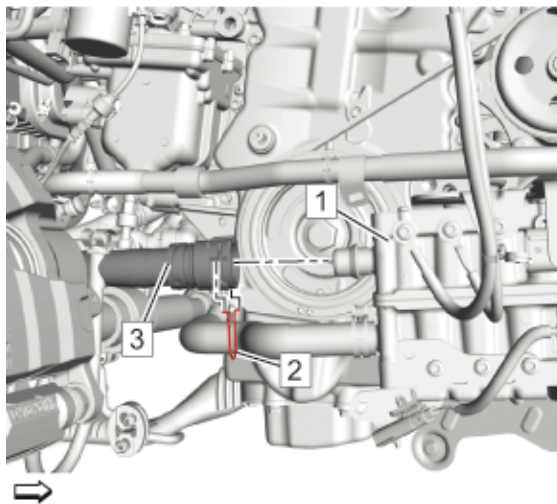


Fig. 70: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

24. Install Heater Inlet Hose (3) @ Heater Coolant Heater (1)
25. Connect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)
26. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
27. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
28. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)
29. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)

EXHAUST CAMSHAFT REPLACEMENT

Removal Procedure

1. Remove Camshaft Position Actuator. Refer to [Camshaft Position Actuator Replacement](#)

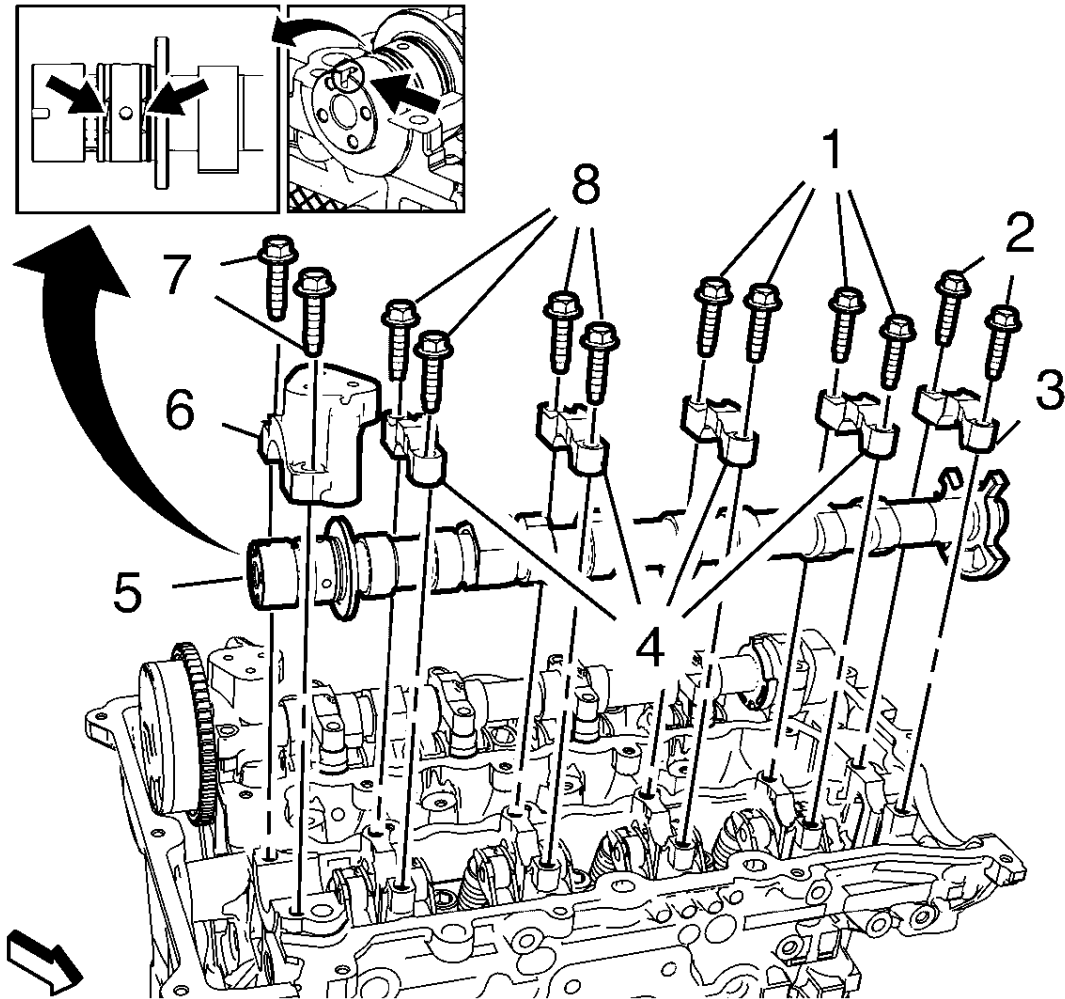


Fig. 71: Exhaust Camshaft, Bearing Caps And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces.

2. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.
3. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.
4. Loosen the 12 camshaft bearing cap bolts (1, 2, 7, 8), working from outside to inside in a spiral in steps of 1/2 turn.

NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location.

5. Remove the 12 camshaft bearing cap bolts (1, 2, 7, 8).
6. Remove Camshaft Bearing Cap (3, 4, 6) (Qty: 6) @ Cylinder Head Assembly
7. Remove Exhaust Camshaft (5)

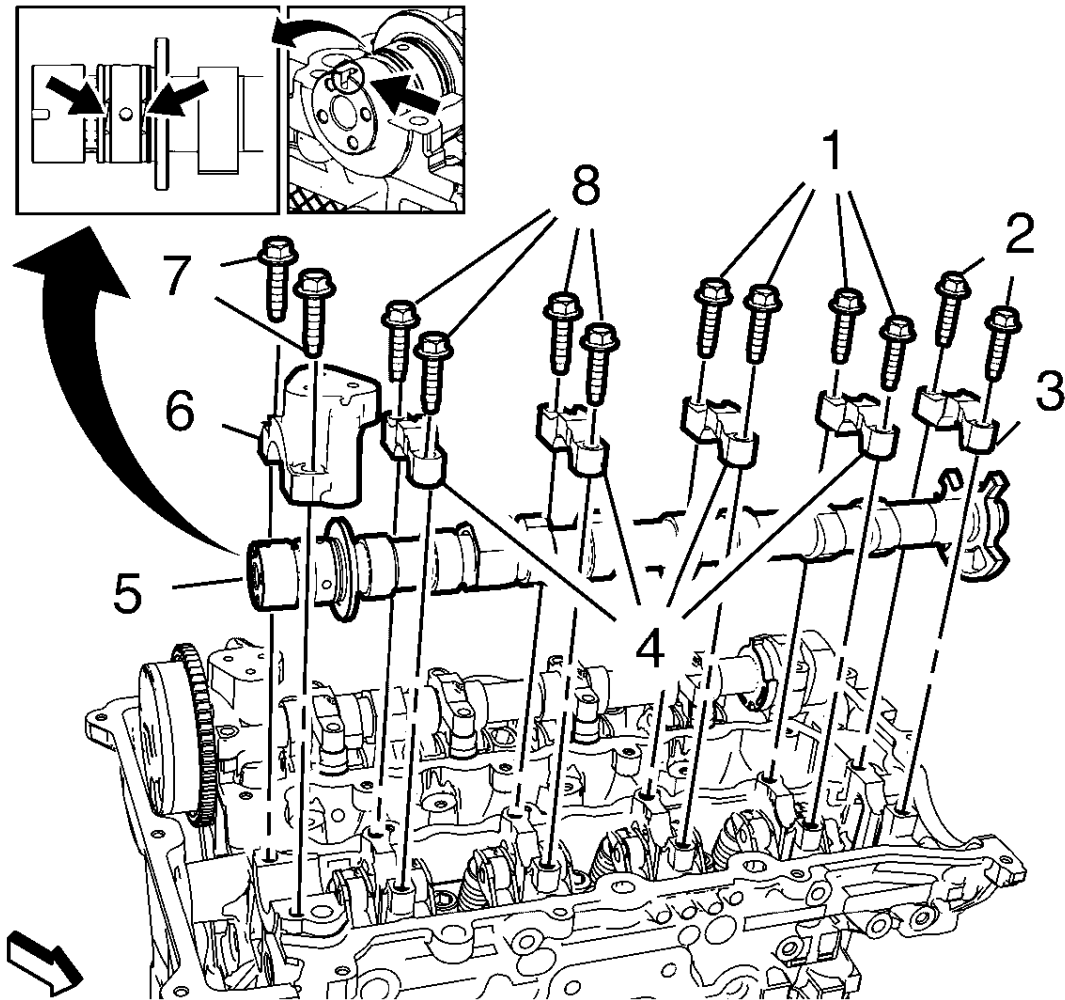


Fig. 72: Exhaust Camshaft, Bearing Caps And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Coat the intake camshaft with lubricant. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
2. Install Exhaust Camshaft (5)
3. Ensure that the camshaft notch at the front of the camshaft is in the 12 o'clock position before installing the camshaft caps.
4. Rotate the oil seal in the groove of the number one camshaft journal so the split line is at approximately the 12 o'clock position before installing the camshaft caps.

NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. Ensure the caps are installed in the original location and position.

5. Lubricate the 6 camshaft bearing caps (3, 4, 6) and the 12 camshaft bearing cap bolts (1, 2, 7, 8). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
6. Install Camshaft Bearing Caps (4) (Qty: 4)
7. Install the camshaft bearing rear cap (3).

8. Install the camshaft bearing front cap (6).
9. Loosely install the 12 camshaft bearing cap bolts (1, 2, 7, 8).

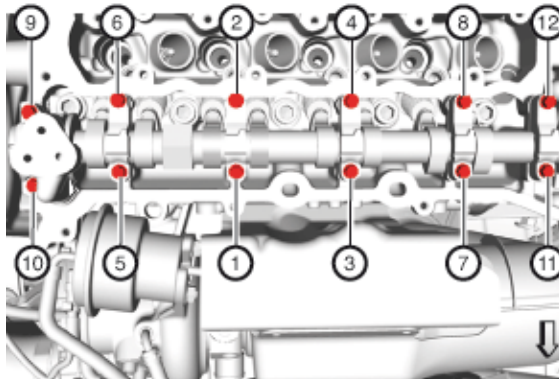


Fig. 73: Exhaust Camshaft Bearing Cap Bolt Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

10. Tighten the camshaft bearing cap bolts (1, 2, 7, 8) in increments of 3 turns until they are seated.
11. Tighten the bearing cap bolts in sequence as shown to 12 N.m (106 lb in).
12. Install Camshaft Position Actuator. Refer to [Camshaft Position Actuator Replacement](#)

INTAKE CAMSHAFT REPLACEMENT

Removal Procedure

1. Remove Camshaft Position Actuator. Refer to [Camshaft Position Actuator Replacement](#)
2. Remove Fuel Injection Pump. Refer to [Fuel Injection Pump Replacement](#)

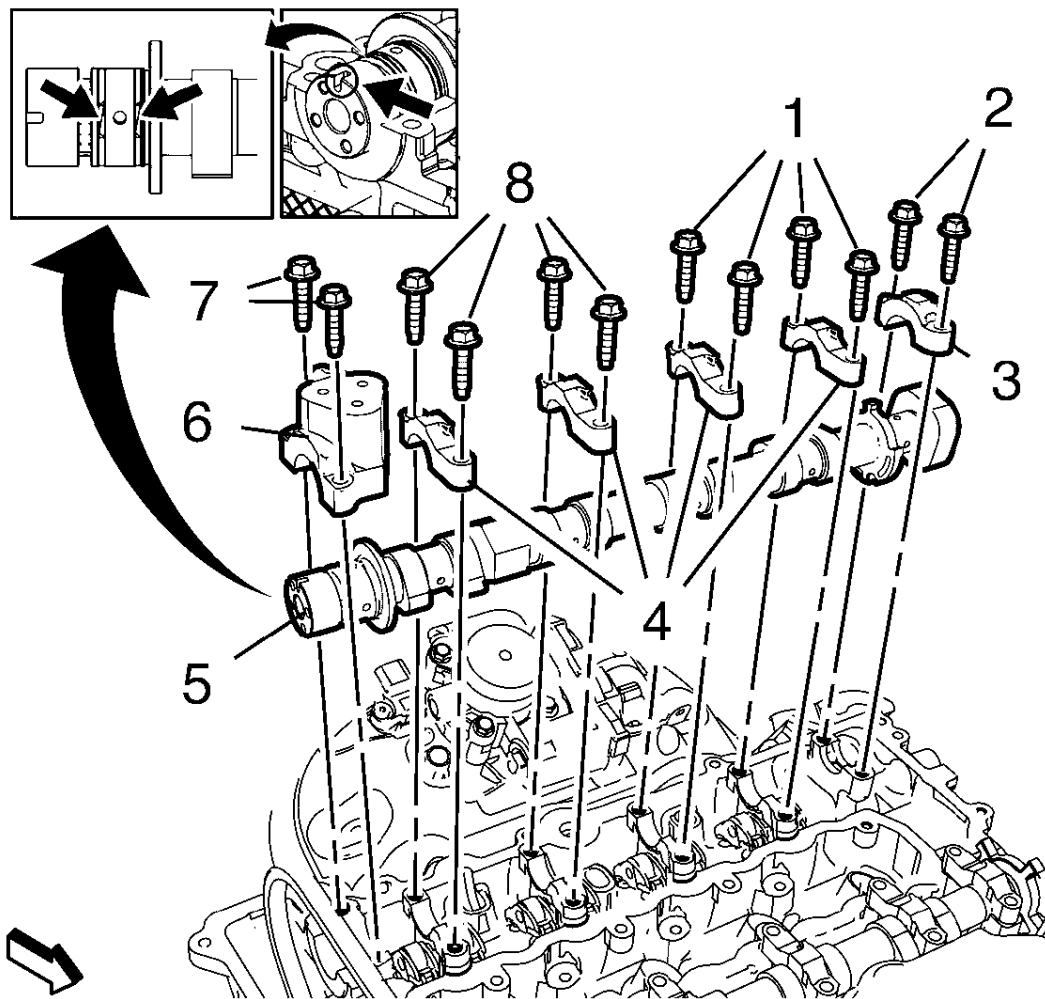


Fig. 74: Intake Camshaft, Bearing Caps And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces.

3. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.
4. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.
5. Loosen the 12 camshaft bearing cap bolts (1, 2, 7, 8), working from outside to inside in a spiral in steps of 1/2 turn.

NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location.

6. Remove the 12 camshaft bearing cap bolts (1, 2, 7, 8).
7. Remove Camshaft Bearing Caps (3, 4, 6) (Qty: 6) @ Cylinder Head Assembly
8. Remove Intake Camshaft (5)

Installation Procedure

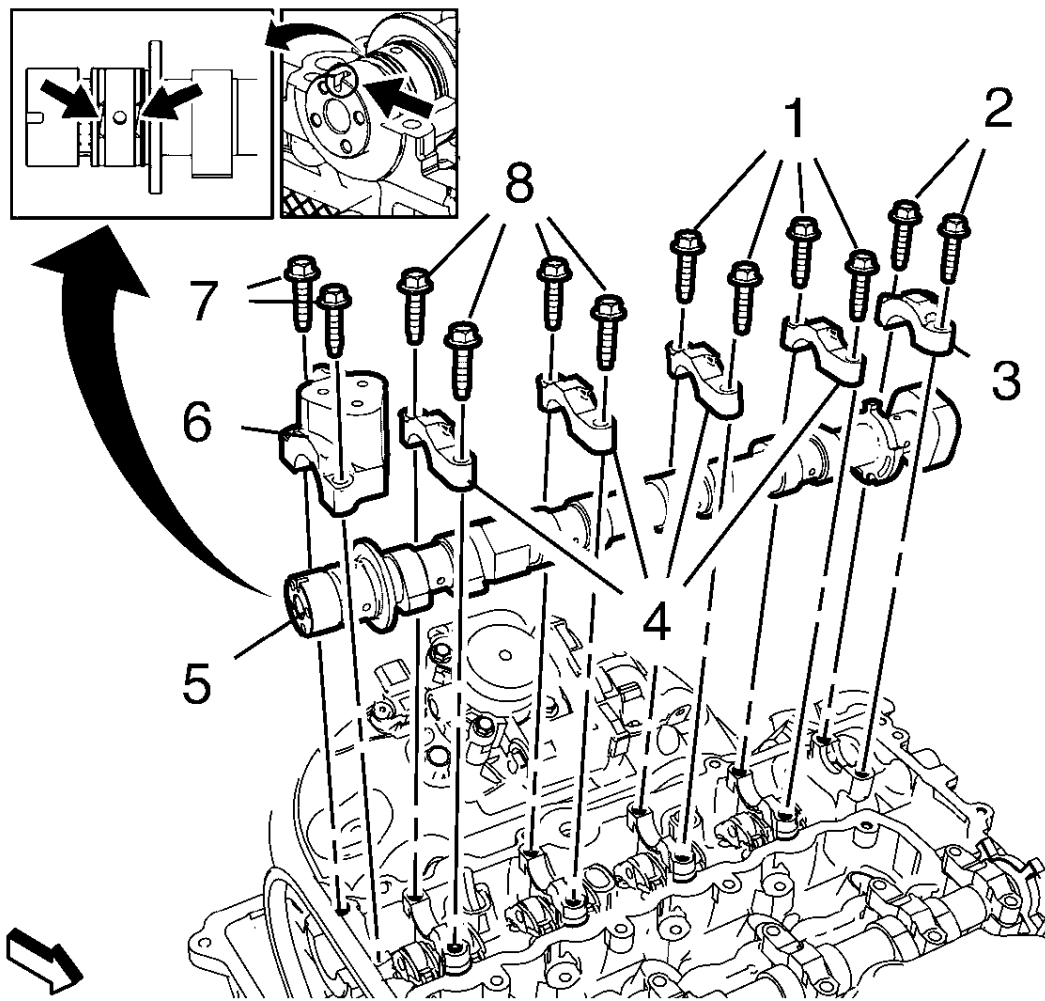


Fig. 75: Intake Camshaft, Bearing Caps And Bolts
 Courtesy of GENERAL MOTORS COMPANY

1. Coat the intake camshaft with lubricant. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
2. Install Intake Camshaft (5)
3. Ensure that the camshaft notch at the front of the camshaft is in the 12 o'clock position before installing the camshaft caps.
4. Rotate the oil seal in the groove of the number one camshaft journal so the split line is at approximately the 12 o'clock position before installing the camshaft caps.

NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. Ensure the caps are installed in the original location and position.

5. Lubricate the 6 camshaft bearing caps (3, 4, 6) and the 12 camshaft bearing cap bolts (1, 2, 7, 8). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
6. Install the 4 camshaft bearing caps (4).
7. Install the camshaft bearing rear cap (3).
8. Install the camshaft bearing front cap (6).
9. Loosely install the 12 camshaft bearing cap bolts (1, 2, 7, 8).

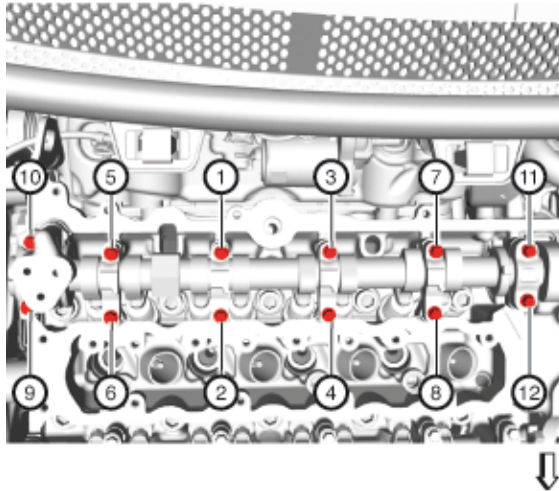


Fig. 76: Intake Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

10. Tighten the camshaft bearing cap bolts (1, 2, 7, 8) in increments of 3 turns until they are seated.
11. Tighten the bearing cap bolts in sequence as shown to 12 N.m (106 lb in).
12. Install Fuel Injection Pump. Refer to [Fuel Injection Pump Replacement](#)
13. Install Camshaft Position Actuator. Refer to [Camshaft Position Actuator Replacement](#)

CAMSHAFT TIMING CHAIN REPLACEMENT

Special Tools

EN-51367 Camshaft Holder

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)
2. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
3. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)

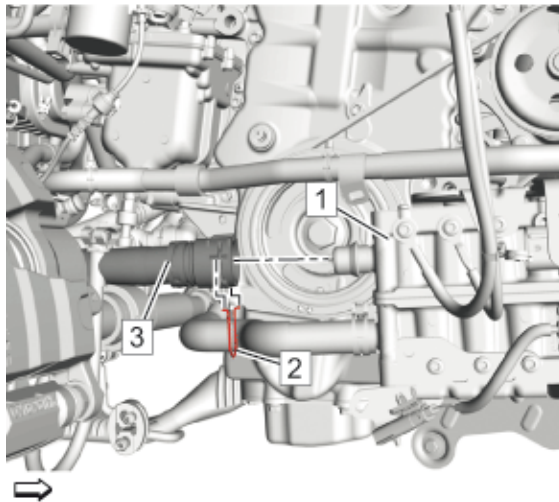


Fig. 77: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)
5. Disconnect Heater Inlet Hose (3) @ Heater Coolant Heater (1)

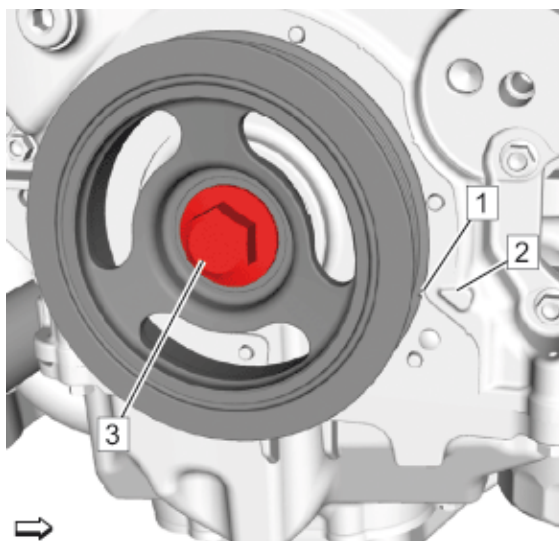


Fig. 78: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

6. Adjust the engine to cylinder 1 top dead center (TDC) of combustion stroke. Set crankshaft in direction of engine rotation until the markings (1, 2) line up. Rotate at the crankshaft balancer bolt (3).

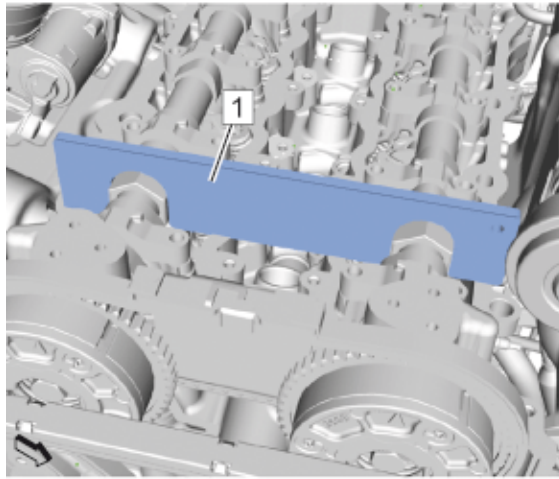


Fig. 79: Camshaft Holder

Courtesy of GENERAL MOTORS COMPANY

7. Install the **EN-51367** holder (1).
8. Remove Engine Front Cover. Refer to [Engine Front Cover Replacement](#)
9. Remove Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)

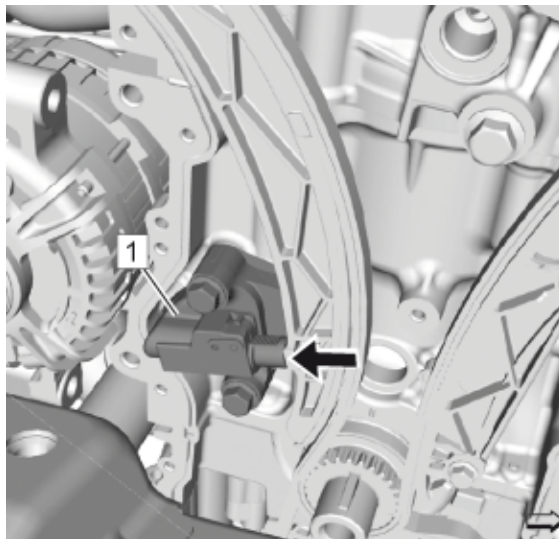


Fig. 80: Timing Chain Tensioner In Service Position

Courtesy of GENERAL MOTORS COMPANY

10. Fix the timing chain tensioner (1) in service position:

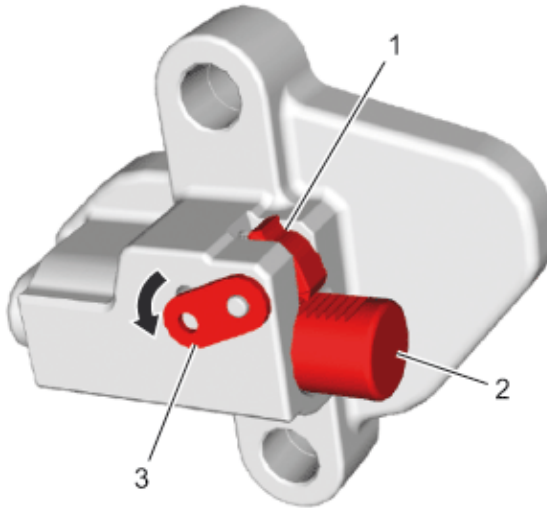


Fig. 81: Releasing Tension From Piston

Courtesy of GENERAL MOTORS COMPANY

1. Slightly release tension from the piston (2) until bar (1) can be unlocked by rotating the lever (3) in direction of arrow.

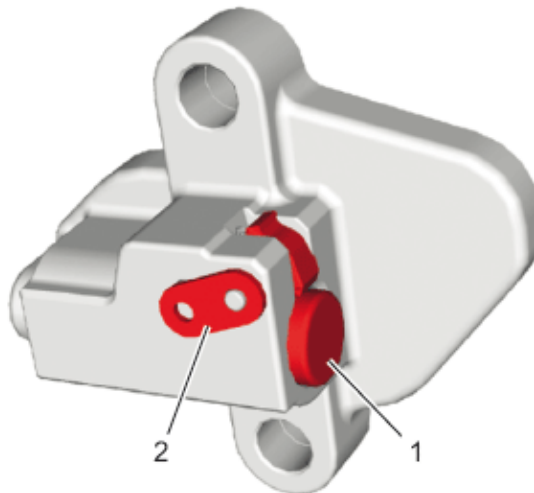


Fig. 82: Piston And Tensioner Lever

Courtesy of GENERAL MOTORS COMPANY

2. Entirely push back the piston (1) until the tensioner lever (2) cannot be locked in this position.

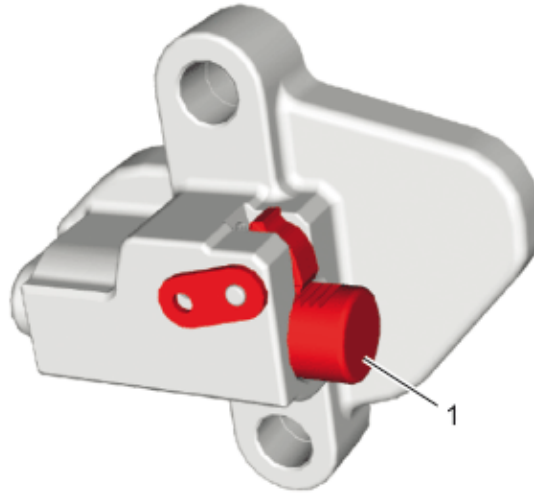


Fig. 83: Piston

Courtesy of GENERAL MOTORS COMPANY

3. Release tension from the piston (1) until it releases for three ratchets. The three ratchets can be noticed by the click noises.

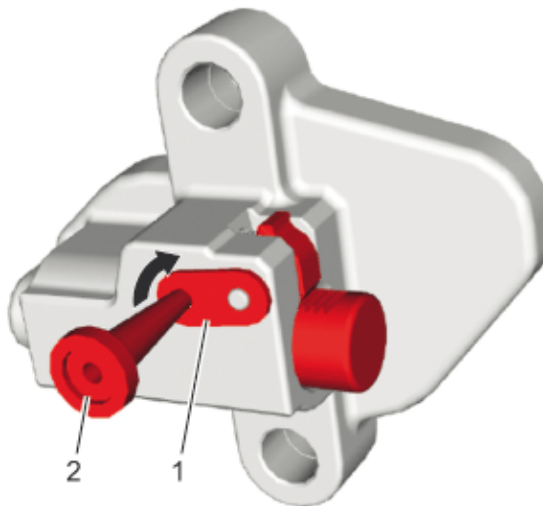


Fig. 84: Lever And Fixing Pin

Courtesy of GENERAL MOTORS COMPANY

4. Apply tension to the piston until the lever (1) is rotated back into the locking position where the bore in the lever aligns with the bore in the tensioner housing.
5. Fix the lever in this position with a suitable fixing pin (2).

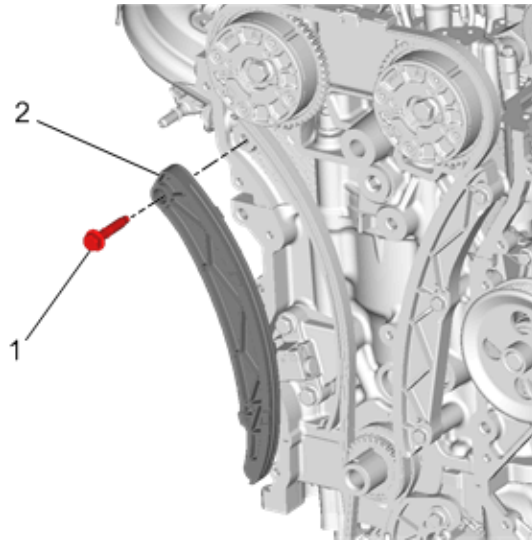


Fig. 85: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Remove Timing Chain Tensioner Shoe Bolt (1)
12. Remove Timing Chain Tensioner Shoe (2)

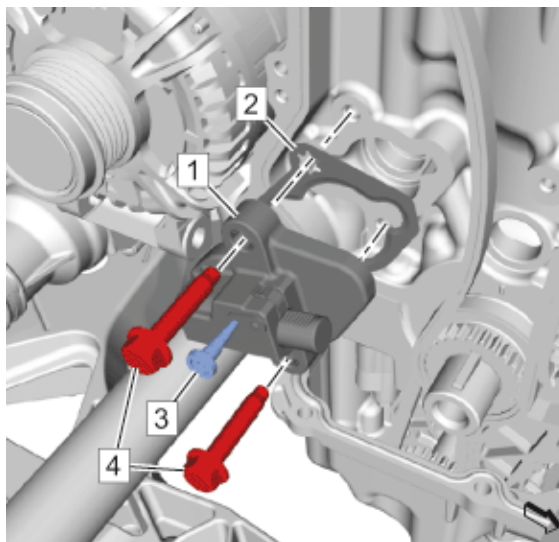


Fig. 86: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

13. Ensure the correct fixation of the tool (3).
14. Remove Timing Chain Tensioner Bolts (4) (Qty: 2)
15. Remove Timing Chain Tensioner (1)
16. Remove and DISCARD the gasket. (2)

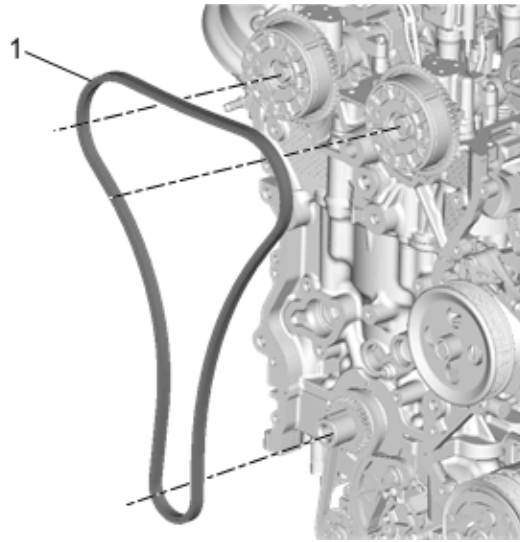


Fig. 87: Timing Chain

Courtesy of GENERAL MOTORS COMPANY

17. Remove Timing Chain (1)

Installation Procedure

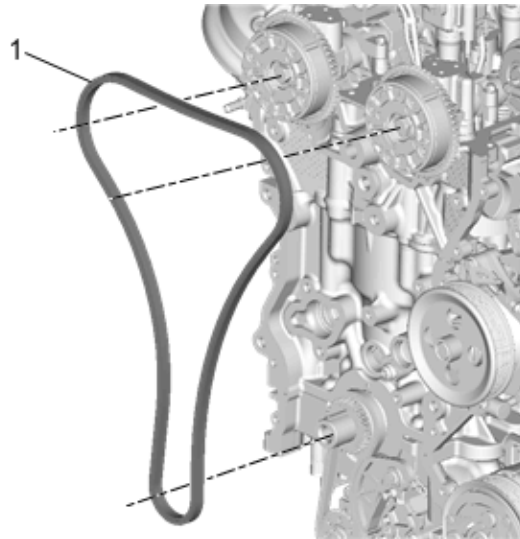


Fig. 88: Timing Chain

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the actuator timing marks are approximately the 12 o'clock position.

1. Install Timing Chain (1) - Install

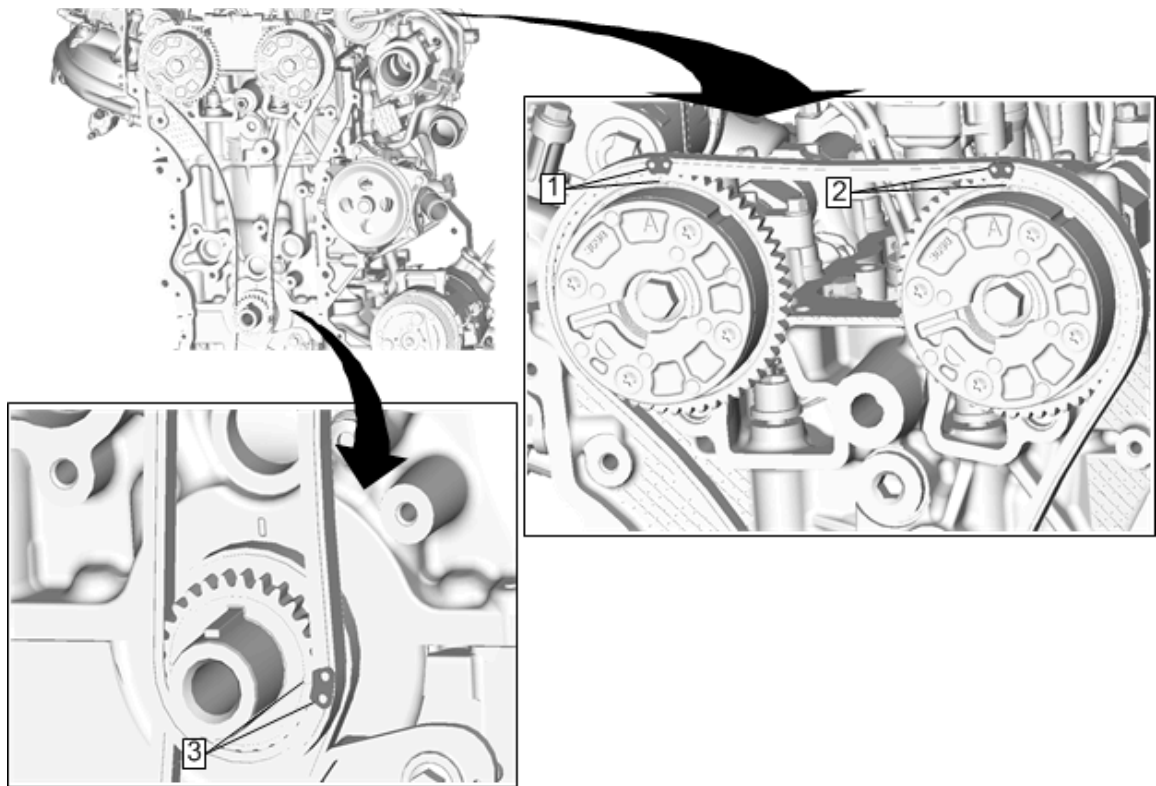


Fig. 89: Timing Chain Marks

Courtesy of GENERAL MOTORS COMPANY

2. Ensure that the colored link (3) matches to the arrow on the crankshaft sprocket.
3. Ensure that the colored links (1, 2) match to the marks on the camshaft position adjuster actuators.

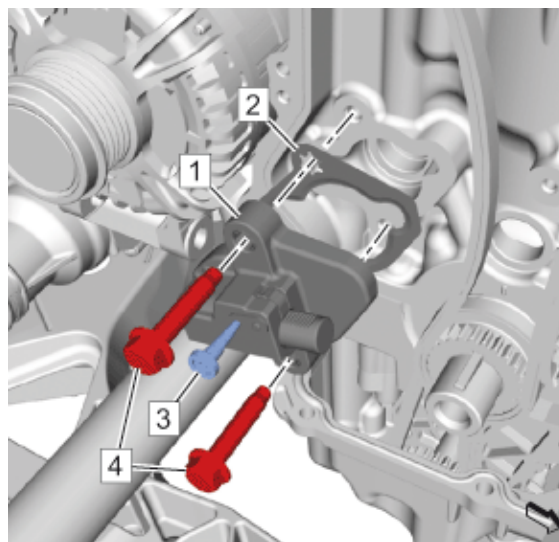


Fig. 90: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket

Courtesy of GENERAL MOTORS COMPANY

4. Install a NEW gasket. (2)
5. Install Timing Chain Tensioner (1)

CAUTION: Refer to **Fastener Caution**

6. Install and tighten Timing Chain Tensioner Bolts (4) (Qty: 2) to 25 N.m (18 lb ft)

7. Remove the suitable tool (3) from the timing chain tensioner.

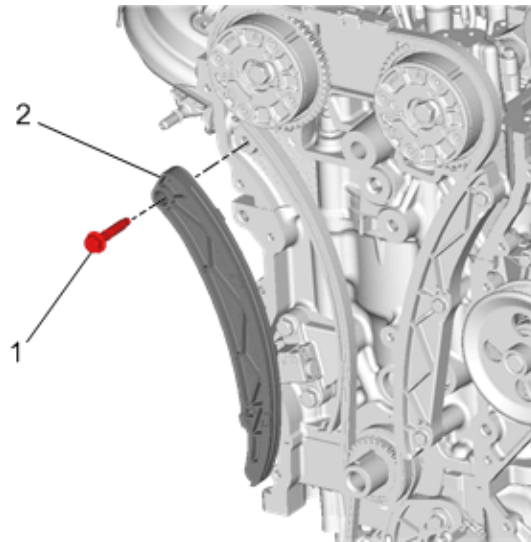


Fig. 91: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install Timing Chain Tensioner Shoe (2)

9. Install and tighten Timing Chain Tensioner Shoe Bolt (1) to 25 N.m (18 lb ft)

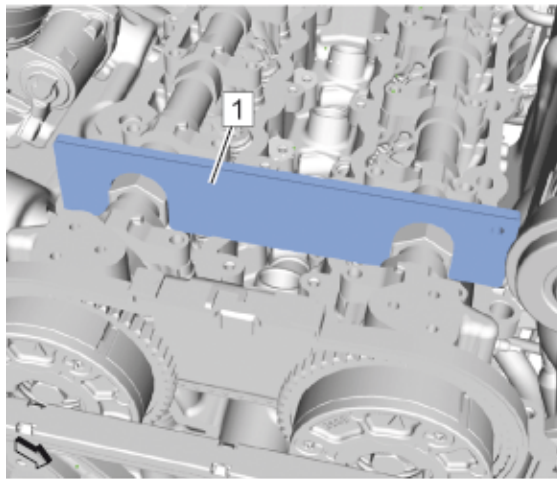


Fig. 92: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

10. Remove the **EN-51367** holder (1).

11. Install Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)

12. Check the position of the crankshaft, camshaft and camshaft position actuator adjuster.

1. Install the engine front cover with 4 bolts and the crankshaft balancer.

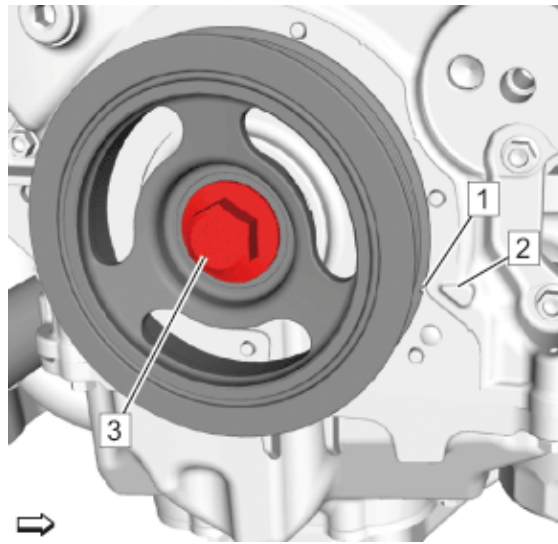


Fig. 93: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

2. Turn crankshaft 720 degrees in the direction of engine rotation by the crankshaft balancer bolt (2).

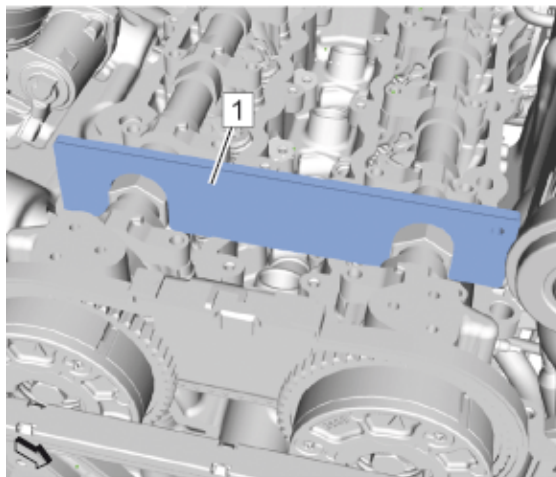


Fig. 94: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

13. Install the **EN-51367** holder (1).
14. If the **EN-51367** holder (1) can be installed, the engine timing is properly adjusted.
15. Remove the **EN-51367** holder.
16. Remove the engine front cover and crankshaft balancer.

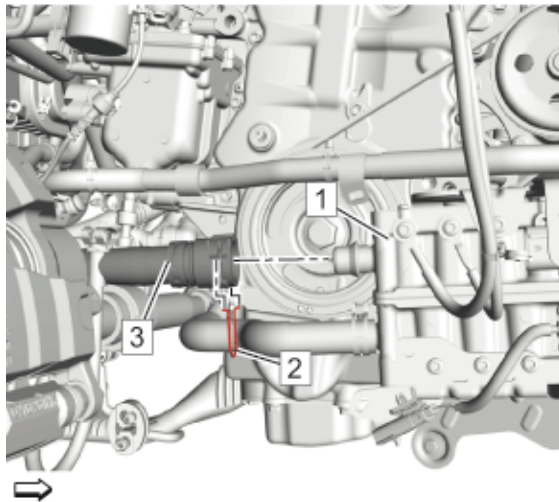


Fig. 95: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

17. Install Heater Inlet Hose (3) @ Heater Coolant Heater (1)
18. Connect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)
19. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
20. Install Engine Front Cover. Refer to [Engine Front Cover Replacement](#)
21. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
22. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)

TIMING CHAIN OIL NOZZLE REPLACEMENT

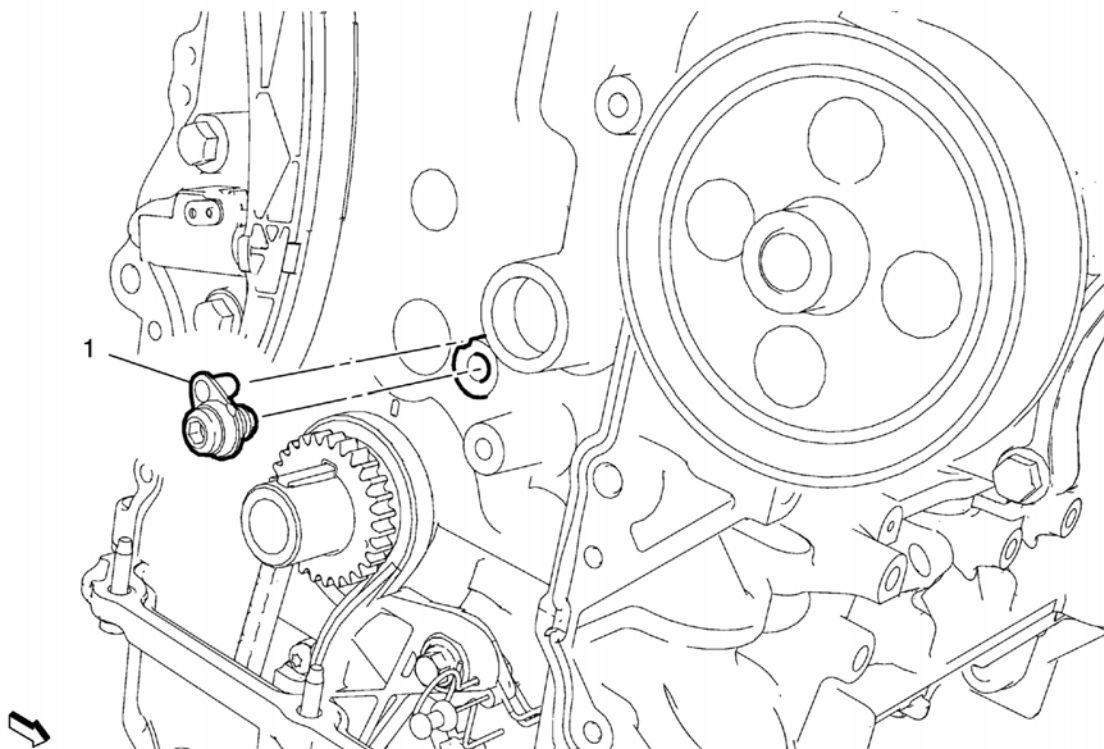


Fig. 96: Timing Chain Oil Nozzle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Timing Chain Guide - Right Side. Refer to Timing Chain Guide Replacement - Right Side	
1	Timing Chain Oil Nozzle CAUTION: Refer to Fastener Caution . Tighten 15 N.m (11 lb ft)

HYDRAULIC VALVE LASH ADJUSTER ARM REPLACEMENT

Removal Procedure

1. Remove Intake Camshaft. Refer to [Intake Camshaft Replacement](#)
2. Remove Exhaust Camshaft. Refer to [Exhaust Camshaft Replacement](#)

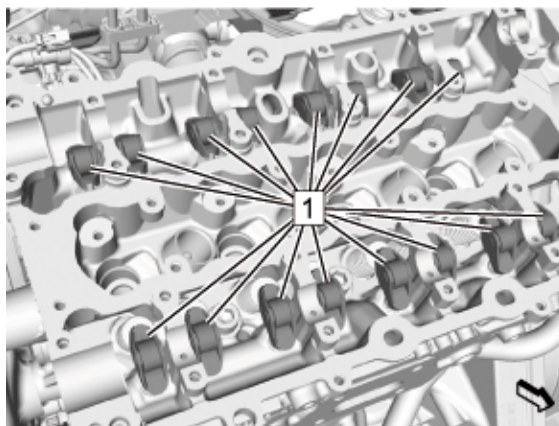


Fig. 97: Hydraulic Valve Lash Adjuster Arms
Courtesy of GENERAL MOTORS COMPANY

NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces.

3. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.
4. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.
5. Remove Hydraulic Valve Lash Adjuster Arms (1) (Qty: 16)

Installation Procedure

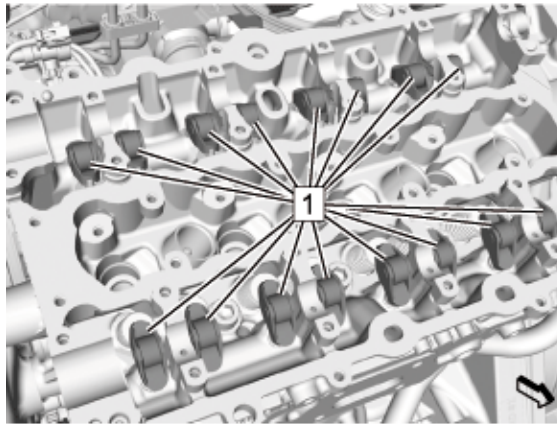


Fig. 98: Hydraulic Valve Lash Adjuster Arms
Courtesy of GENERAL MOTORS COMPANY

NOTE: Used lash adjuster arms must be returned to the original position on the camshaft. If the camshaft is being replaced, the lash adjuster arms actuated by the camshaft must also be replaced.

1. Apply lubricant to the valve tips. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
2. Position the 16 hydraulic lash adjuster arms (1) on the tip of the valve stems and on the lash adjusters.
3. Apply lubricant to the 16 hydraulic lash adjuster arms (1). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
4. Install Exhaust Camshaft. Refer to [Exhaust Camshaft Replacement](#)
5. Install Intake Camshaft. Refer to [Intake Camshaft Replacement](#)

HYDRAULIC VALVE LASH ADJUSTER REPLACEMENT

Removal Procedure

1. Remove Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)

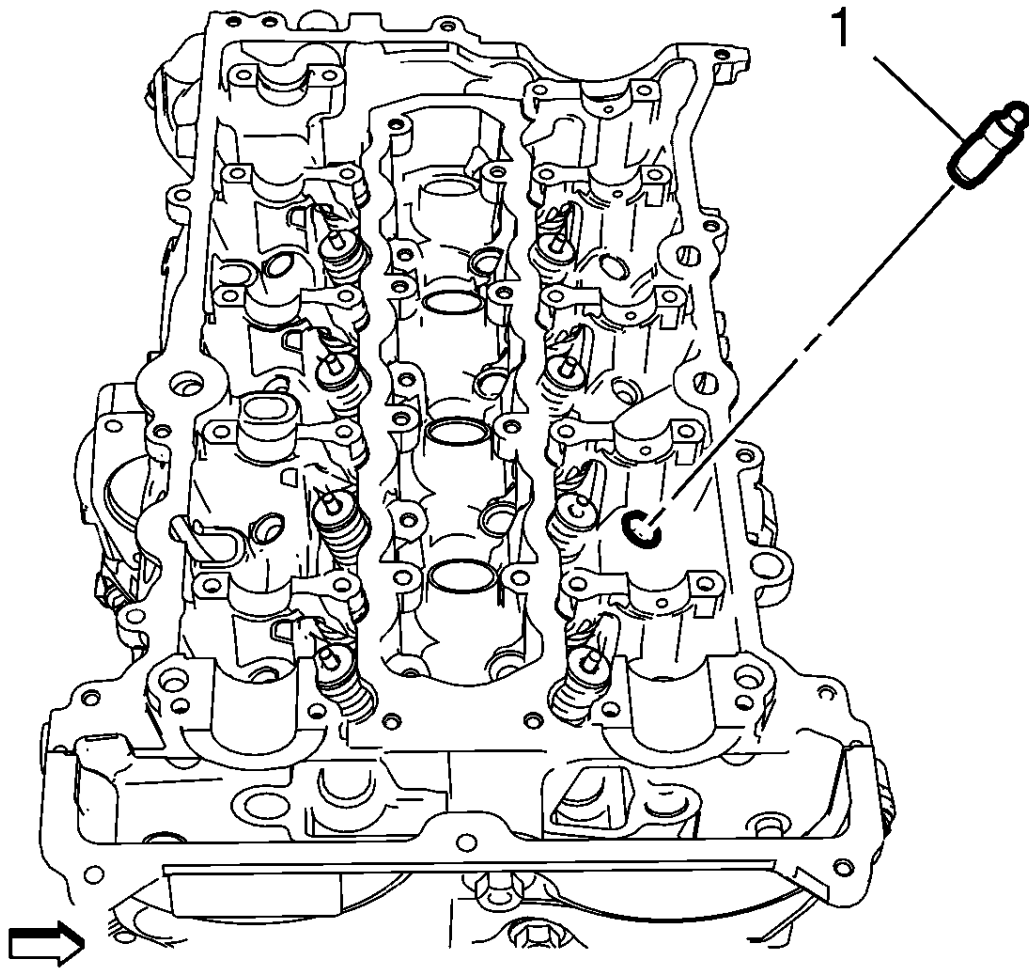


Fig. 99: Hydraulic Valve Lash Adjusters

Courtesy of GENERAL MOTORS COMPANY

NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces.

2. Components **MUST** be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.
3. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.
4. Remove the 16 hydraulic valve lash adjusters (1).

Installation Procedure

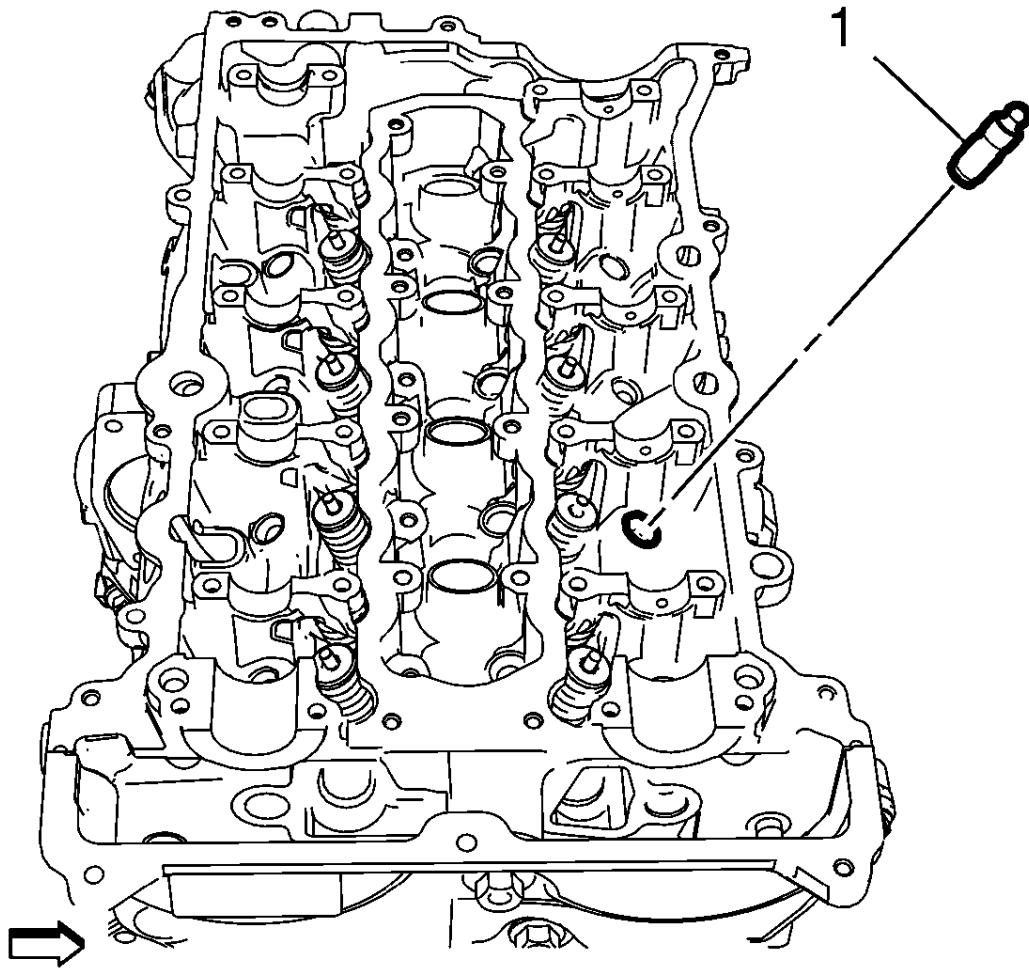


Fig. 100: Hydraulic Valve Lash Adjusters
Courtesy of GENERAL MOTORS COMPANY

1. Install the 16 hydraulic valve lash adjusters (1) in the bores in the cylinder head.
2. Apply lubricant to the 16 hydraulic valve lash adjusters (1). Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
3. Install Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

Special Tools

- EN-46116 Valve Stem Seal Remover
- EN-50717 Universal Valve Spring Compressor Kit
- EN-51511 Injector Port Service Plug

Equivalent regional tools: [Special Tools](#).

Removal Procedure

1. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
2. Remove Spark Plugs (Qty: 4). Refer to [Spark Plug Replacement](#)

3. Remove Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)

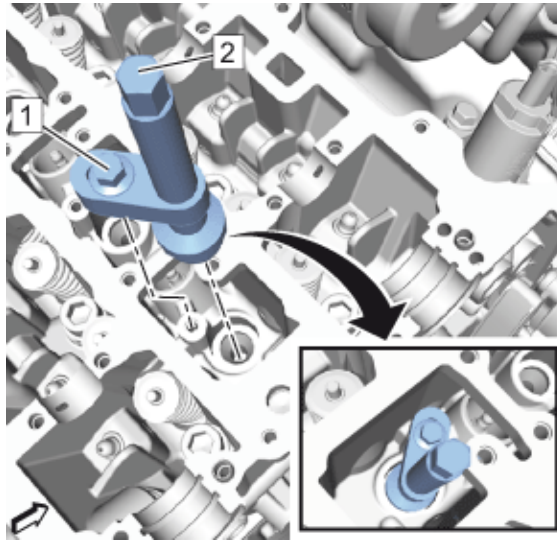


Fig. 101: Injector Port Service Plug

Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-51511** Plug (2) into the injector bore to prevent air leaks in the cylinder.

5. Tighten Bolt (1)

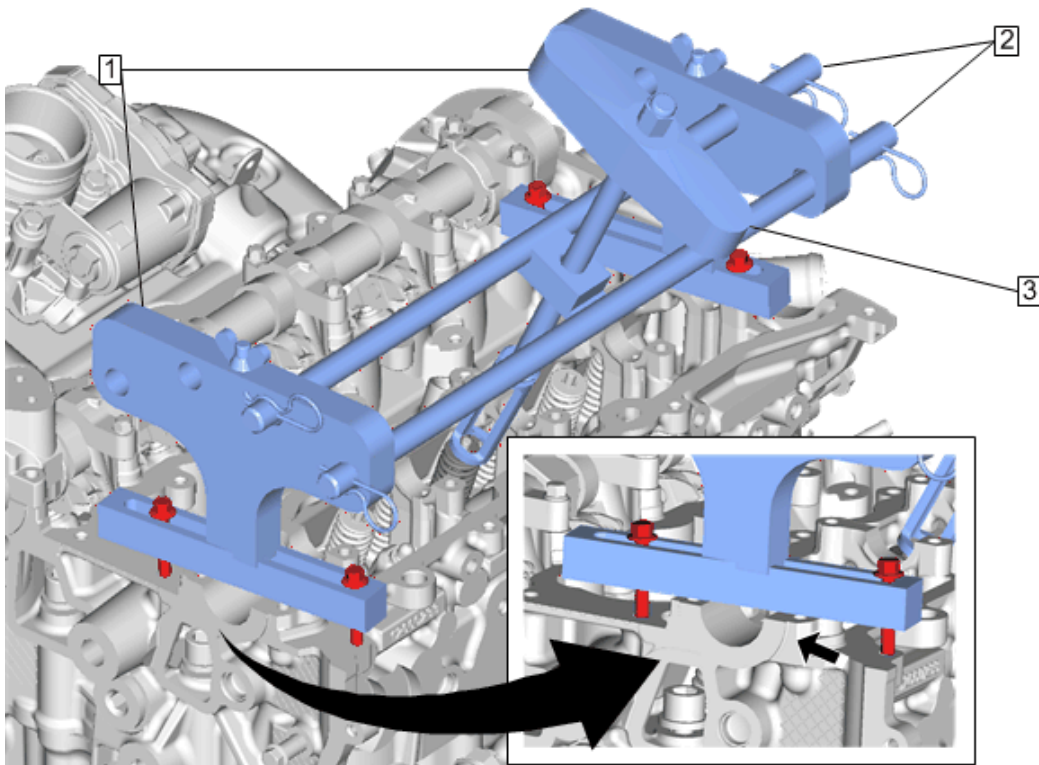


Fig. 102: Valve Spring Compressor Kit, Cross Bars And Locks

Courtesy of GENERAL MOTORS COMPANY

6. Install the **EN-50717** compressor kit (1) to the front and rear of the cylinder head as shown.

7. Install the cross bars and locks (2) of the **EN-50717** compressor kit to the valve spring compressor adapters.

8. Install an air hose adapter into the spark plug hole.

9. Position the **EN-50717-2** compressor (3) so that its adapter proper contacts the valve spring retainer and pretension the compressor.

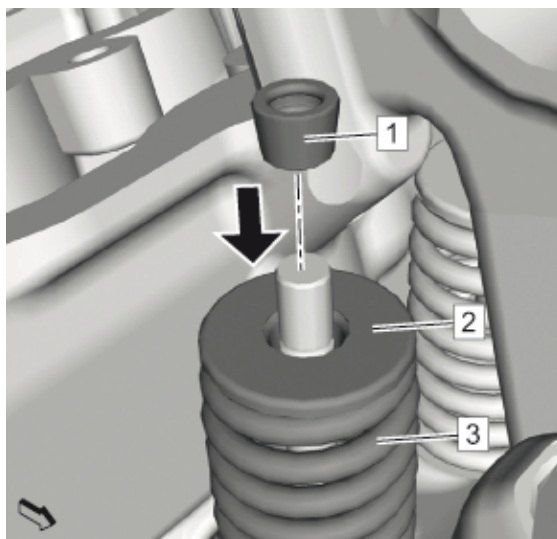


Fig. 103: Valve Spring, Retainer And Valve Key
Courtesy of GENERAL MOTORS COMPANY

WARNING: Valve springs can be tightly compressed. Use care when removing the retainers and plugs. Personal injury could result.

10. Apply pressure to the **EN-50717-2** compressor to push down the valve spring retainer (2) and compress the valve spring (3) until the valve keys (1) are free from tension.
11. Carefully remove the valve keys then.
12. Release the tension from the **EN-50717-2** compressor.

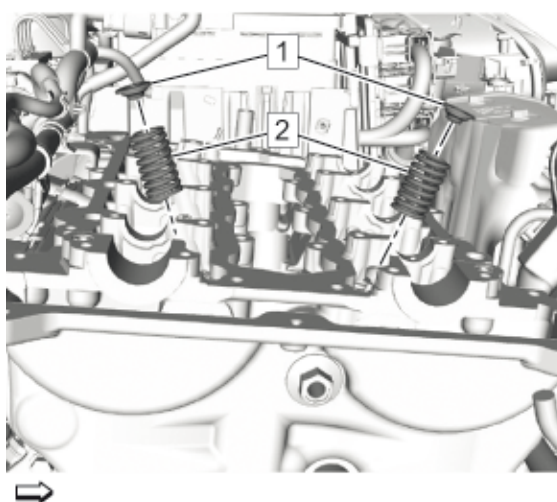


Fig. 104: Valve Spring And Retainer
Courtesy of GENERAL MOTORS COMPANY

13. Remove the valve spring retainer (1) and the exhaust valve spring or intake valve spring (2).

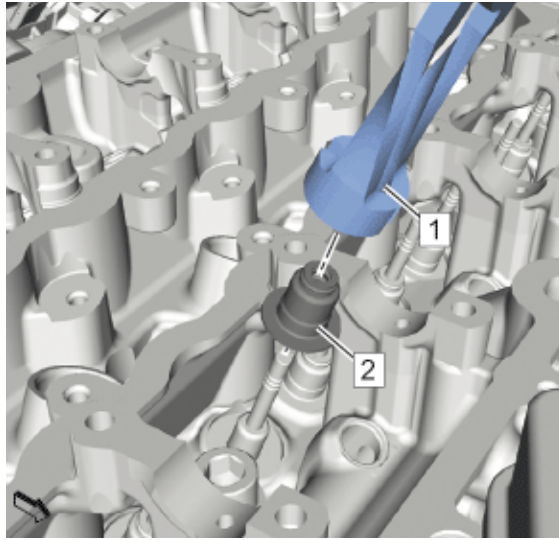


Fig. 105: Valve Stem Oil Seal And Special Tool
Courtesy of GENERAL MOTORS COMPANY

14. Remove and DISCARD the valve stem oil seal (2). Use the **EN-46116** remover (1).

Installation Procedure

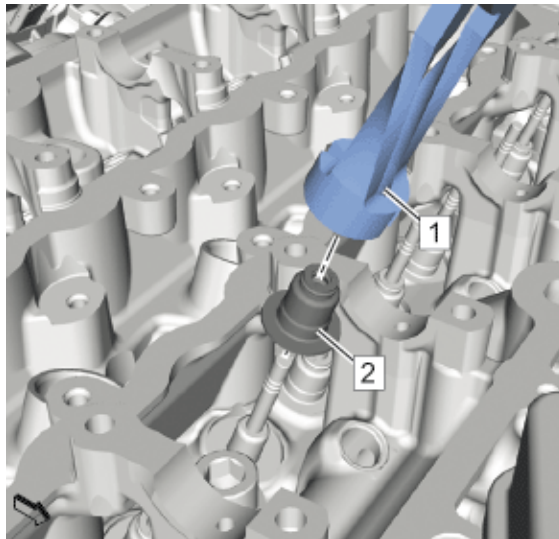


Fig. 106: Valve Stem Oil Seal And Special Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: Valve stem oil seal sets will contain 2 different colored seals, black and green. The set of 8 seals that are green have to installed to the exhaust valves.

1. Install NEW valve stem oil seal (2). Use the **EN-46116** installer (1).

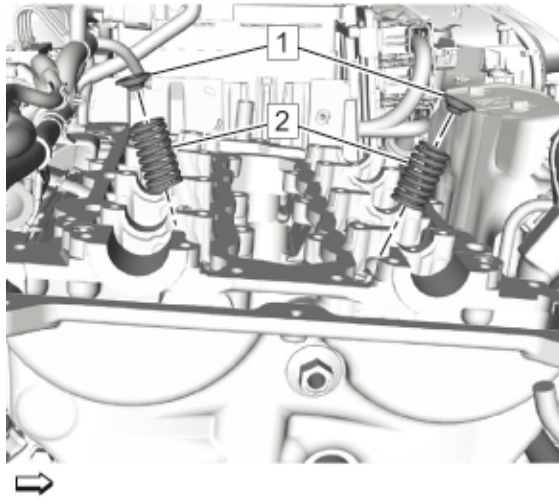


Fig. 107: Valve Spring And Retainer
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Make sure that the valve springs and the valve spring retainers will be installed in their original position.

2. Install the exhaust or the intake valve spring (2) and the upper valve spring retainer (1). Which valve spring is to be installed, depends on the installation progress.

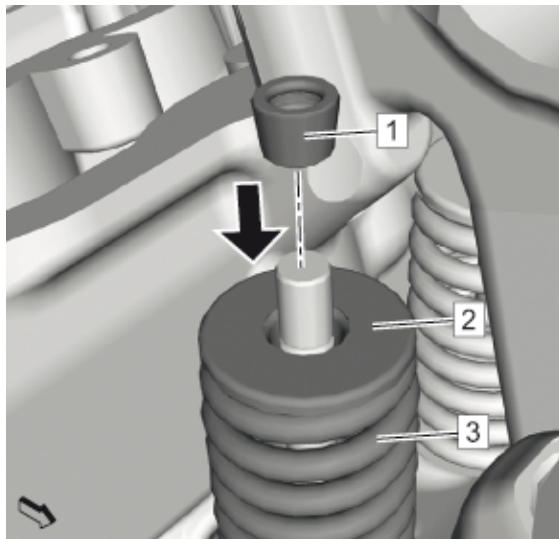


Fig. 108: Valve Spring, Retainer And Valve Key
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: The valve stem keys must correctly seat in the valve spring cap. Engine damage may occur by not installing properly.

3. Using the **EN-50717-2** compressor, push down the valve spring retainer (2) and compress the valve spring (3) until the valve keys (1) can be inserted. Carefully insert the valve keys then, so that they are proper installed to the valve stem grooves.
4. Carefully release the tension from the **EN-50717-2** compressor.
5. Inspect the valve keys and valve spring retainer for proper seat.

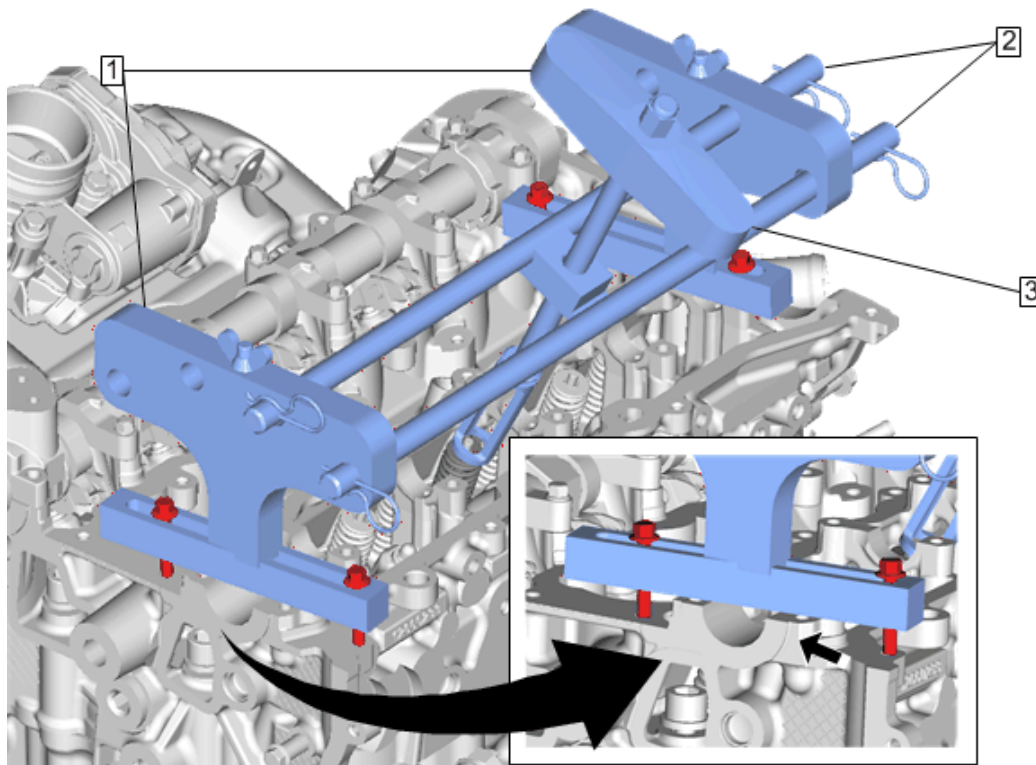


Fig. 109: Valve Spring Compressor Kit, Cross Bars And Locks
Courtesy of GENERAL MOTORS COMPANY

6. Repeat the procedure with the remaining valves and cylinders.
7. Transfer the **EN-50717** compressor kit (1, 2, 3) and the **EN-51511** plug as needed.
8. Take care that air pressure is always applied to the combustion chamber of the treated cylinder.
9. Remove **EN-50717** compressor kit from the cylinder head.

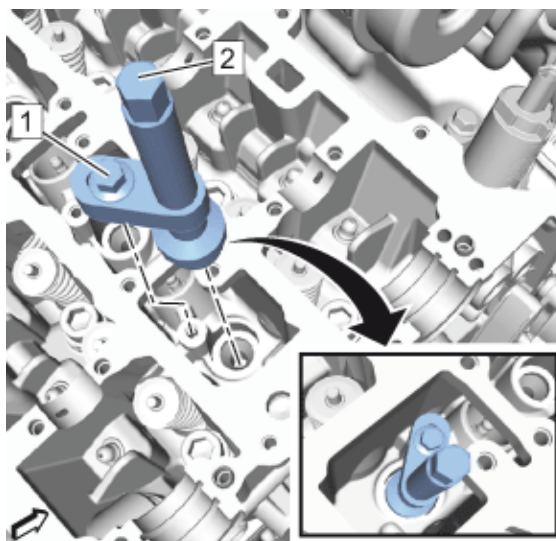


Fig. 110: Injector Port Service Plug
Courtesy of GENERAL MOTORS COMPANY

10. Loosen the bolt. (1)
11. Remove the **EN-51511** plug (2) from the injector bores.
12. Install Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)

- 13. Install Spark Plugs (Qty: 4). Refer to [Spark Plug Replacement](#)
- 14. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)

POSITIVE CRANKCASE VENTILATION TUBE REPLACEMENT

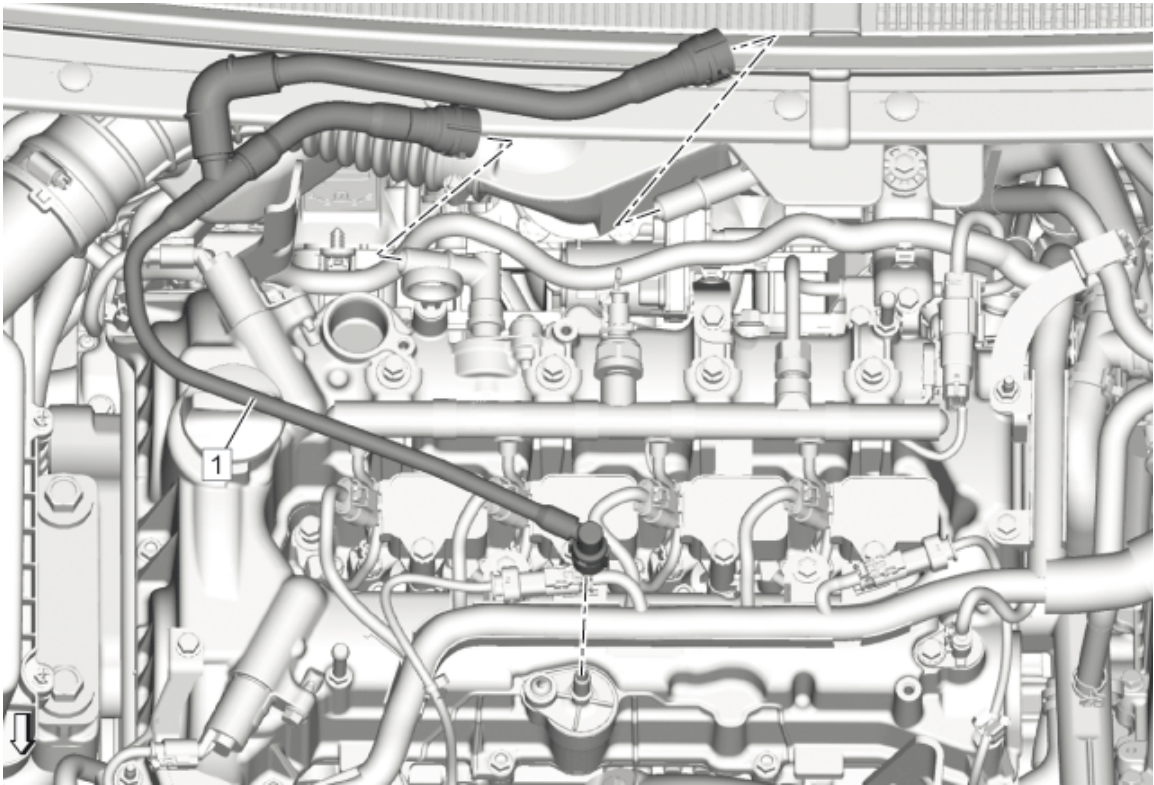


Fig. 111: Positive Crankcase Ventilation Tube
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Intake Manifold Cover. Refer to Intake Manifold Cover Replacement	
1	Positive Crankcase Ventilation Tube CAUTION: The Positive Crankcase Ventilation (PCV) line is tamper resistant and must always be replaced once it is removed. The fittings connected to the PCV line must also be replaced if they are

Callout	Component Name
	damaged when the PCV line is removed. To reduce the risk of damage to the fittings, use a suitable cutting tool and carefully cut the connections away. Procedure Using a suitable cutting tool, carefully cut the PCV tube away from the fittings at the air cleaner outlet duct and the camshaft cover. If any damage occurs to either the air cleaner outlet duct or camshaft cover fitting, they must be replaced. Refer to Air Cleaner Outlet Duct Replacement

POSITIVE CRANKCASE VENTILATION VALVE REPLACEMENT - FRESH AIR

Special Tools

EN-50956 Tamper Proof Drive Bit

Equivalent regional tools: [Special Tools](#)

Removal Procedure

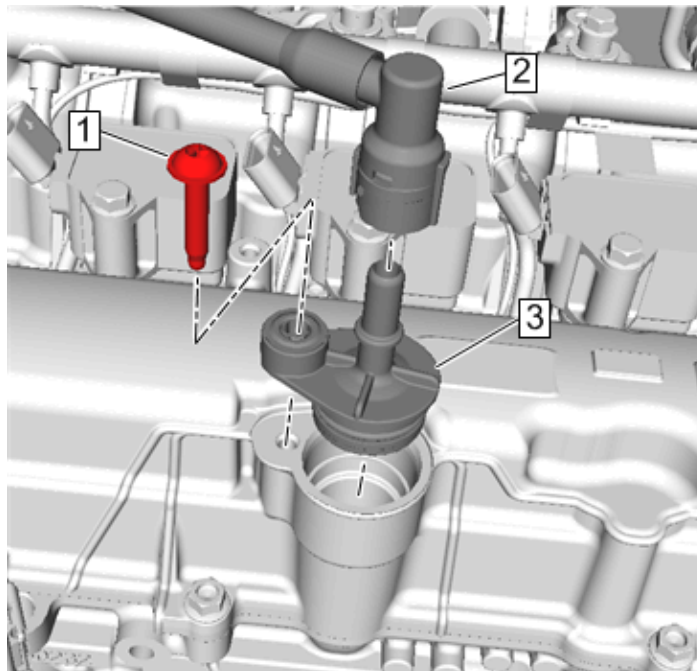


Fig. 112: Positive Crankcase Ventilation Valve, Tube And Bolt

Courtesy of GENERAL MOTORS COMPANY

1. Remove and DISCARD Positive Crankcase Ventilation Tube (2). Refer to [Positive Crankcase Ventilation Tube Replacement](#)
2. Using a suitable tool, cut a slot in the tamper-resistant positive crankcase ventilation fresh air bolt head (1) and remove with a flat-bladed tool. DISCARD the bolt.
3. Remove Positive Crankcase Ventilation Valve (3)

Installation Procedure

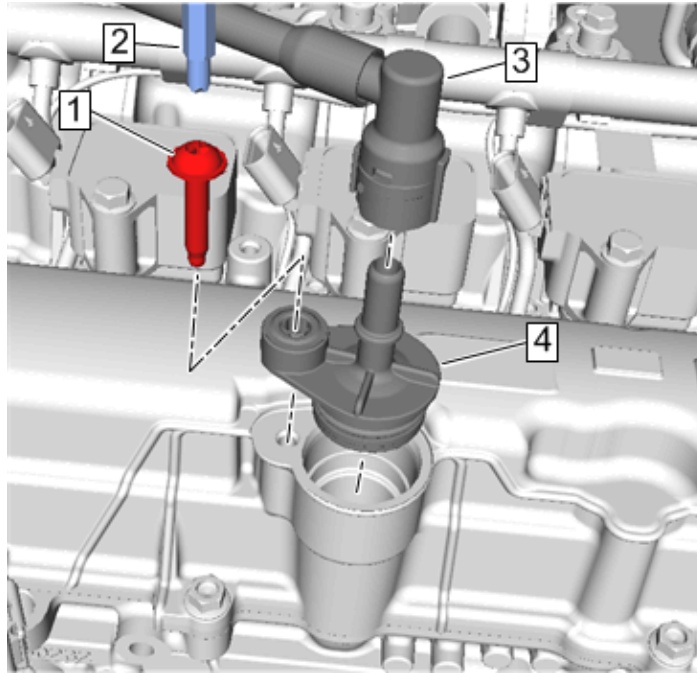


Fig. 113: Positive Crankcase Ventilation Valve, Tube, Bolt And Special Tool

Courtesy of GENERAL MOTORS COMPANY

1. Install Positive Crankcase Ventilation Valve (4)

CAUTION: Refer to [Fastener Caution](#)

2. Install the NEW positive crankcase ventilation valve fresh air bolt (1) using EN-50956 bit (2), and tighten to 10 N.m (89 lb in).

NOTE: Install a new tube.

3. Install NEW Positive Crankcase Ventilation Tube (3). Refer to [Positive Crankcase Ventilation Tube Replacement](#)

POSITIVE CRANKCASE VENTILATION VALVE REPLACEMENT - SECONDARY

Special Tools

EN-50956 Tamper Proof Drive Bit

Equivalent regional tools: [Special Tools](#)

Removal Procedure

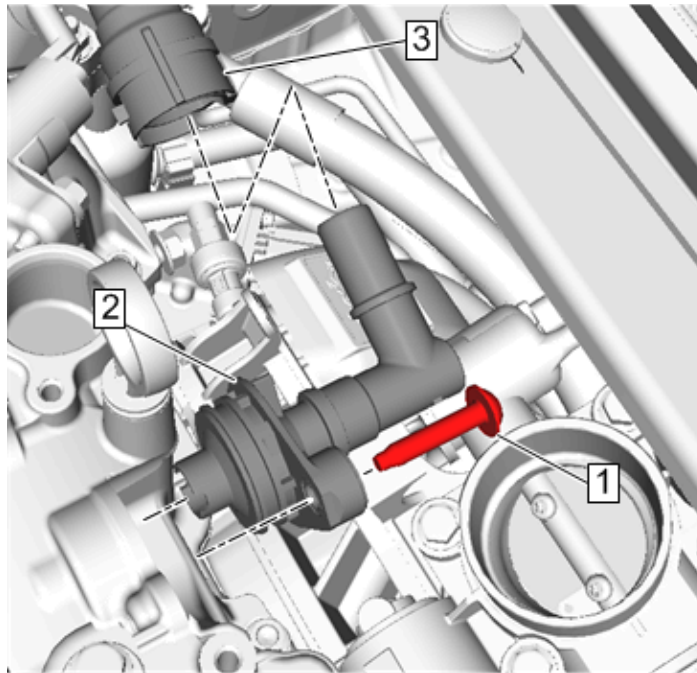


Fig. 114: Positive Crankcase Ventilation Valve, Tube And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Remove and DISCARD Positive Crankcase Ventilation Tube (3). Refer to [Positive Crankcase Ventilation Tube Replacement](#)
2. Using a suitable tool, cut a slot in the tamper-resistant positive crankcase ventilation fresh air bolt head (1) and remove with a flat-bladed tool. DISCARD the bolt.
3. Remove Positive Crankcase Ventilation Valve (2)

Installation Procedure

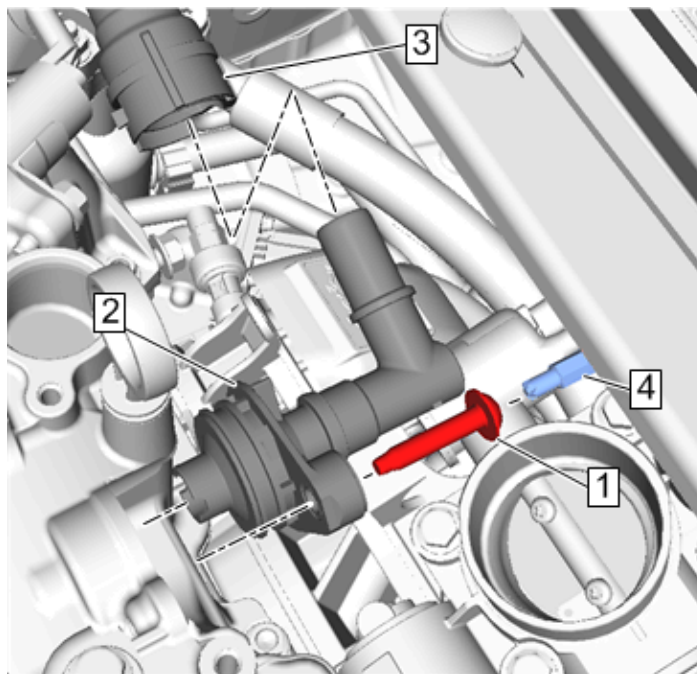


Fig. 115: Positive Crankcase Ventilation Valve, Tube, Bolt And Special Tool
Courtesy of GENERAL MOTORS COMPANY

1. Install Positive Crankcase Ventilation Valve (2)

CAUTION: Refer to [Fastener Caution](#)

2. Install the NEW positive crankcase ventilation valve fresh air bolt (1) using **EN-50956** bit (4), and tighten to 10 N.m (89 lb in).

NOTE: Install a new tube.

3. Install NEW Positive Crankcase Ventilation Tube (3). Refer to [Positive Crankcase Ventilation Tube Replacement](#)

TIMING CHAIN UPPER GUIDE REPLACEMENT

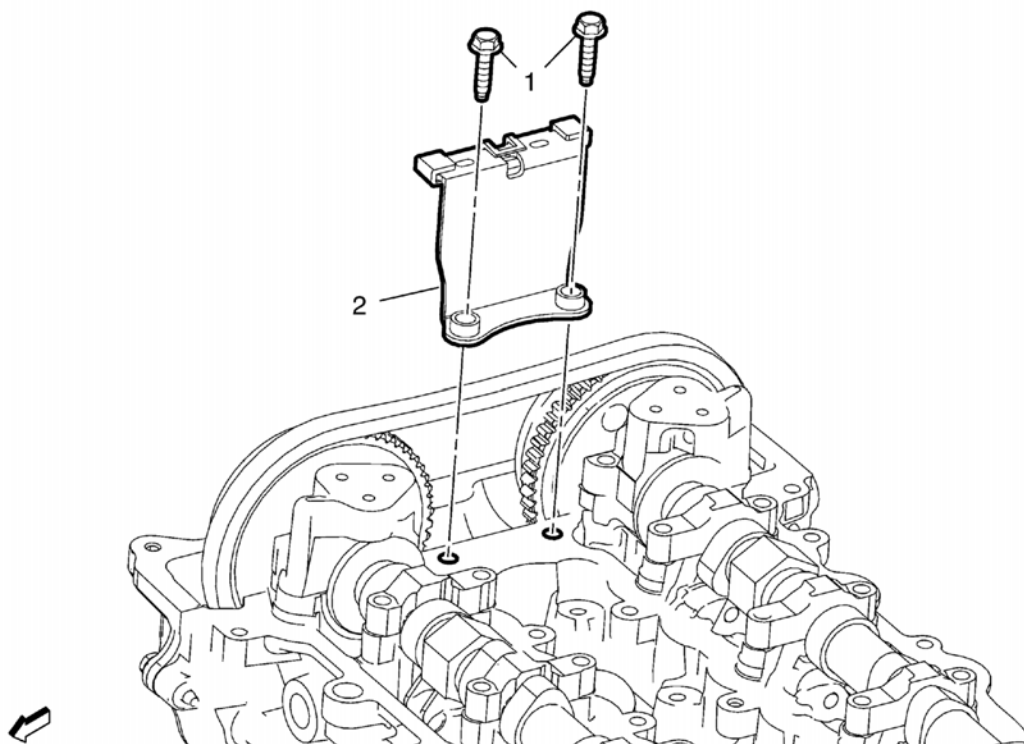


Fig. 116: Timing Chain Upper Guide

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Camshaft Cover. Refer to Camshaft Cover Replacement	
1	Timing Chain Guide Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)

Callout	Component Name
2	Upper Timing Chain Guide

TIMING CHAIN GUIDE REPLACEMENT - RIGHT SIDE

Removal Procedure

1. Remove Camshaft Timing Chain. Refer to [Camshaft Timing Chain Replacement](#)

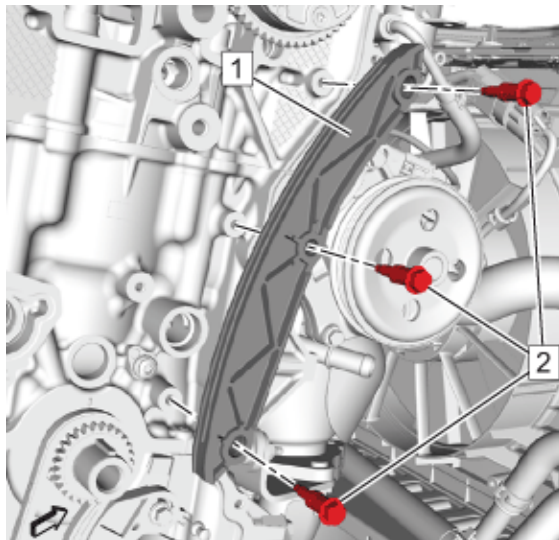


Fig. 117: Right Side Timing Chain Guide And Bolts
 Courtesy of GENERAL MOTORS COMPANY

2. Remove the 3 timing chain guide bolts (2).
3. Remove the timing chain guide - right side (1).

Installation Procedure

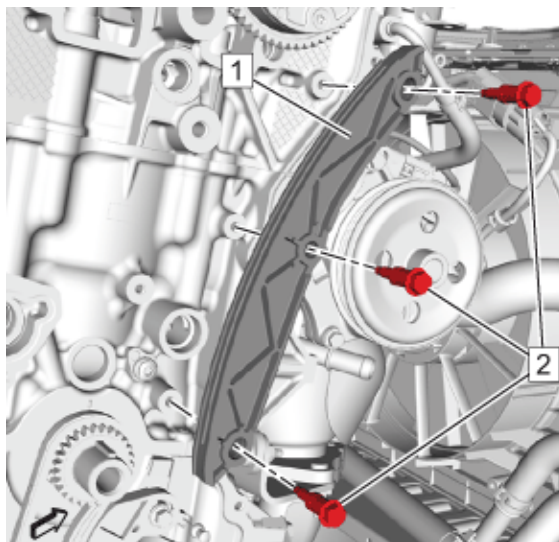


Fig. 118: Right Side Timing Chain Guide And Bolts
 Courtesy of GENERAL MOTORS COMPANY

1. Install the timing chain guide - right side (1).

CAUTION: Refer to [Fastener Caution](#) .

2. Install the 3 timing chain guide bolts (2) and tighten to 10 N.m (89 lb in).
3. Install Camshaft Timing Chain. Refer to [Camshaft Timing Chain Replacement](#)

TIMING CHAIN TENSIONER REPLACEMENT

Special Tools

EN-51367 Camshaft Holder

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)

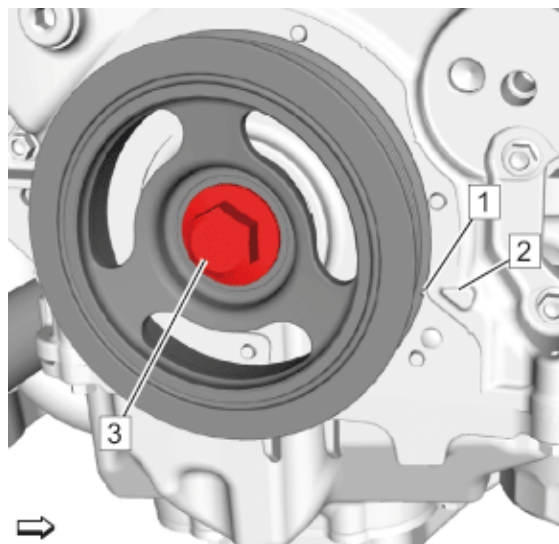


Fig. 119: Crankshaft Balancer Markings

Courtesy of GENERAL MOTORS COMPANY

2. Adjust the engine to cylinder 1 top dead center (TDC) of combustion stroke. Set crankshaft in direction of engine rotation until the markings (1, 2) line up. Rotate at the crankshaft balancer bolt (3).

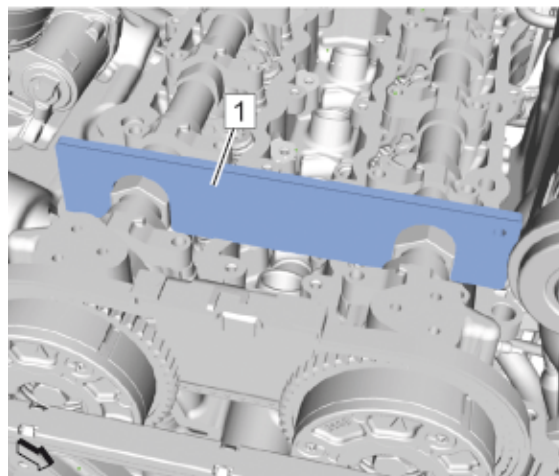


Fig. 120: Camshaft Holder

Courtesy of GENERAL MOTORS COMPANY

3. Install the EN-51367 holder (1).
4. Remove Engine Front Cover. Refer to [Engine Front Cover Replacement](#)
5. Remove Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)

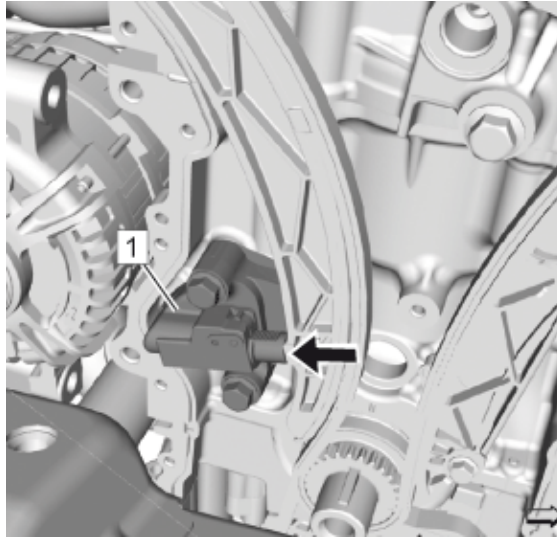


Fig. 121: Timing Chain Tensioner In Service Position

Courtesy of GENERAL MOTORS COMPANY

6. Fix the timing chain tensioner with design 1 (1) in service position:

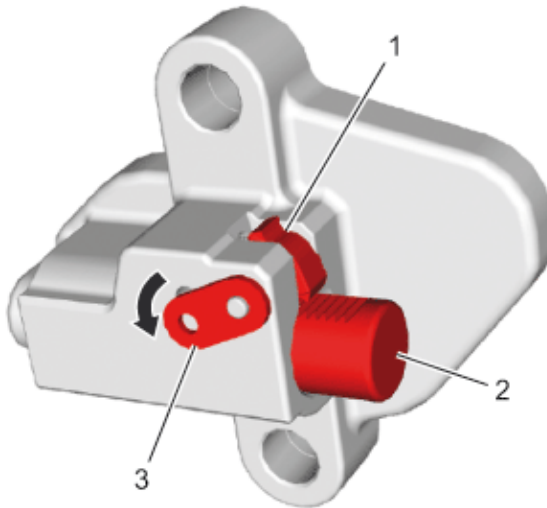


Fig. 122: Releasing Tension From Piston

Courtesy of GENERAL MOTORS COMPANY

1. Slightly release tension from the piston (2) until bar (1) can be unlocked by rotating the lever (3) in direction of arrow.

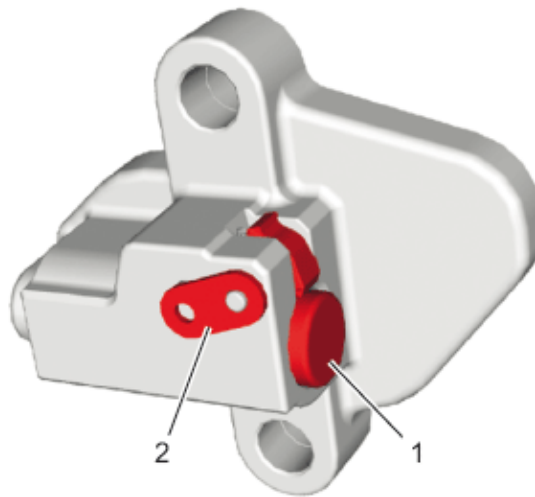


Fig. 123: Piston And Tensioner Lever
Courtesy of GENERAL MOTORS COMPANY

2. Entirely push back the piston (1) until the tensioner lever (2) cannot be locked in this position.

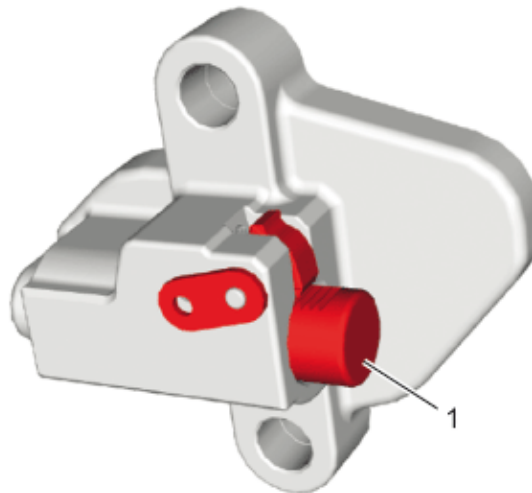


Fig. 124: Piston
Courtesy of GENERAL MOTORS COMPANY

3. Release tension from the piston (1) until it releases for three ratchets. The three ratchets can be noticed by the click noises.

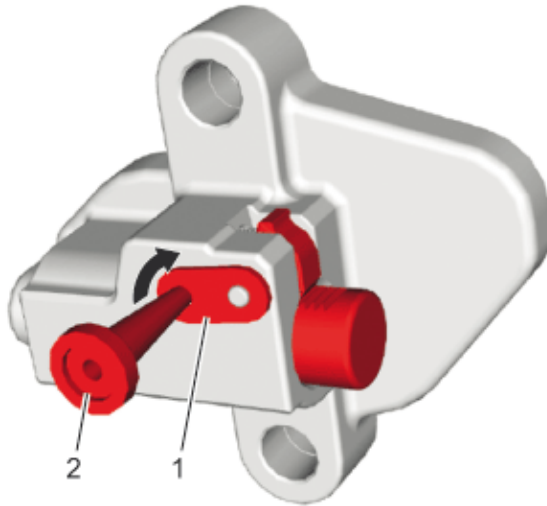


Fig. 125: Lever And Fixing Pin

Courtesy of GENERAL MOTORS COMPANY

4. Apply tension to the piston until the lever (1) is rotated back into the locking position where the bore in the lever aligns with the bore in the tensioner housing.
5. Fix the lever in this position with a suitable fixing pin (2).

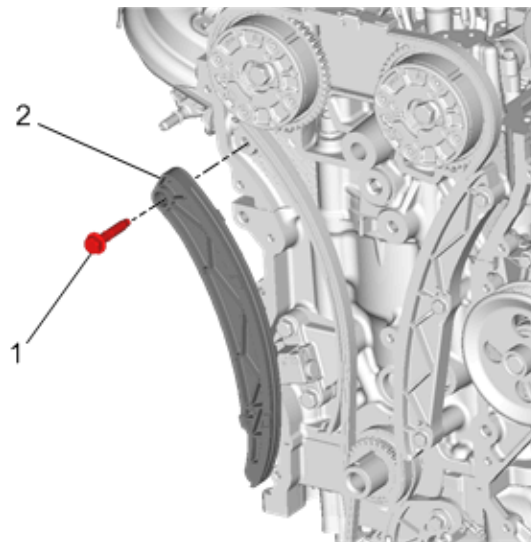


Fig. 126: Timing Chain Tensioner Shoe And Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove Timing Chain Tensioner Shoe Bolt (1)
8. Remove Timing Chain Tensioner Shoe (2)

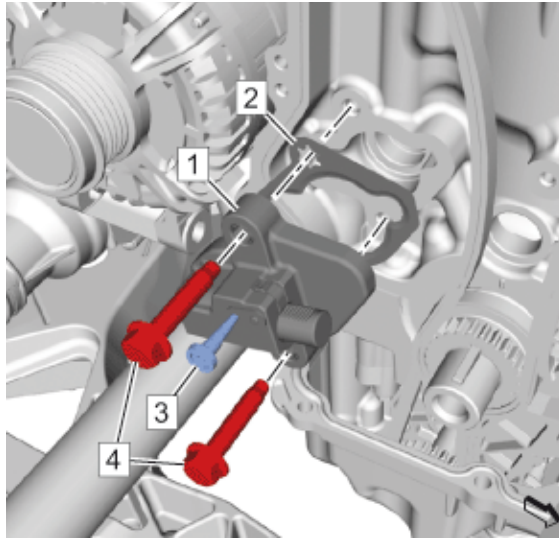


Fig. 127: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

9. Ensure the correct fixation of the tool (3).
10. Remove Timing Chain Tensioner Bolts (4) (Qty: 2)
11. Remove Timing Chain Tensioner (1)
12. Remove and DISCARD the gasket. (2)

Installation Procedure

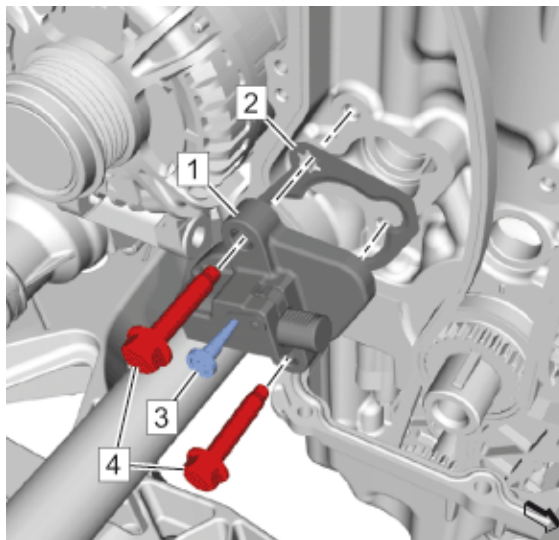


Fig. 128: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket. (2)
2. Install Timing Chain Tensioner (1)

CAUTION: Fastener Caution

3. Install and tighten Timing Chain Tensioner Bolts (4) (Qty:) to 25 N.m (18 lb ft)

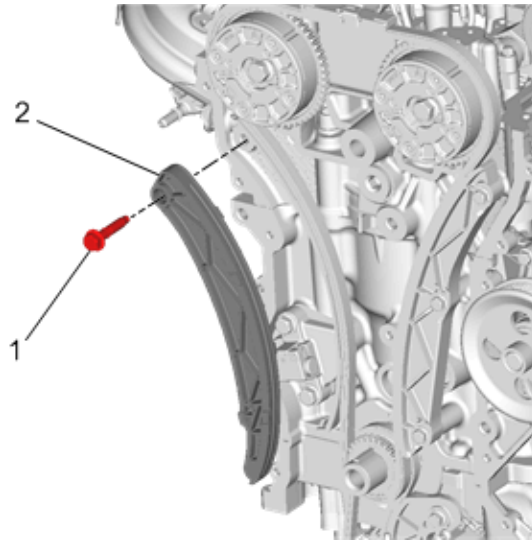


Fig. 129: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install Timing Chain Tensioner Shoe (2)
5. Install and tighten Timing Chain Tensioner Shoe Bolt (1) to 25 N.m (18 lb ft)
6. Remove the suitable tool from the timing chain tensioner.

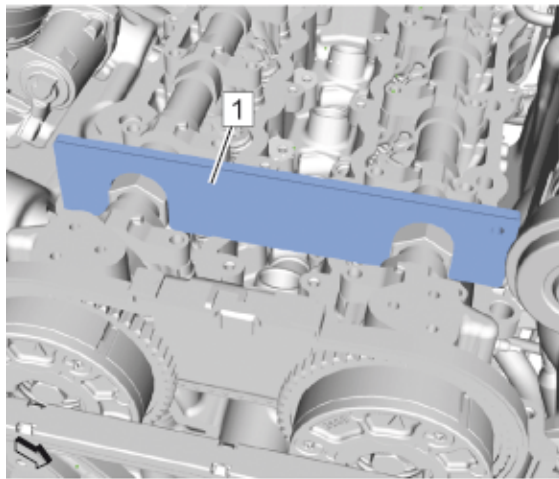


Fig. 130: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

7. Remove the EN-51367 holder (1).
8. Install Timing Chain Upper Guide. Refer to [**Timing Chain Upper Guide Replacement**](#)
9. Check the position of the crankshaft, camshaft and camshaft position actuator adjuster:
 1. Install the engine front cover with 4 bolts and the crankshaft balancer.

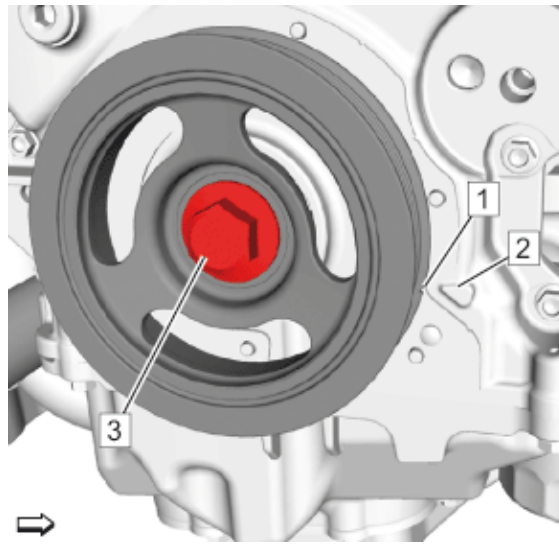


Fig. 131: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

2. Turn crankshaft 720 degrees in the direction of engine rotation by the crankshaft balancer bolt (3).

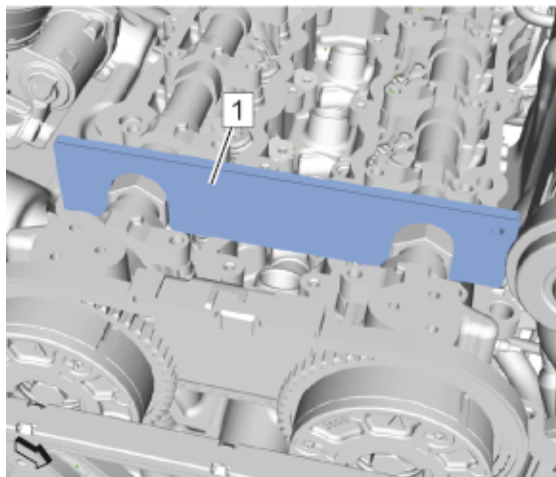


Fig. 132: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

10. Install the **EN-51367** holder (1).
11. If the **EN-51367** holder (1) can be installed, the engine timing is properly adjusted.
12. Remove the **EN-51367** holder.
13. Remove the engine front cover and crankshaft balancer.
14. Install Engine Front Cover. Refer to [Engine Front Cover Replacement](#)
15. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)

TIMING CHAIN TENSIONER SHOE REPLACEMENT

Removal Procedure

1. Release tension from the timing chain tensioner. Refer to [Timing Chain Tensioner Replacement](#).

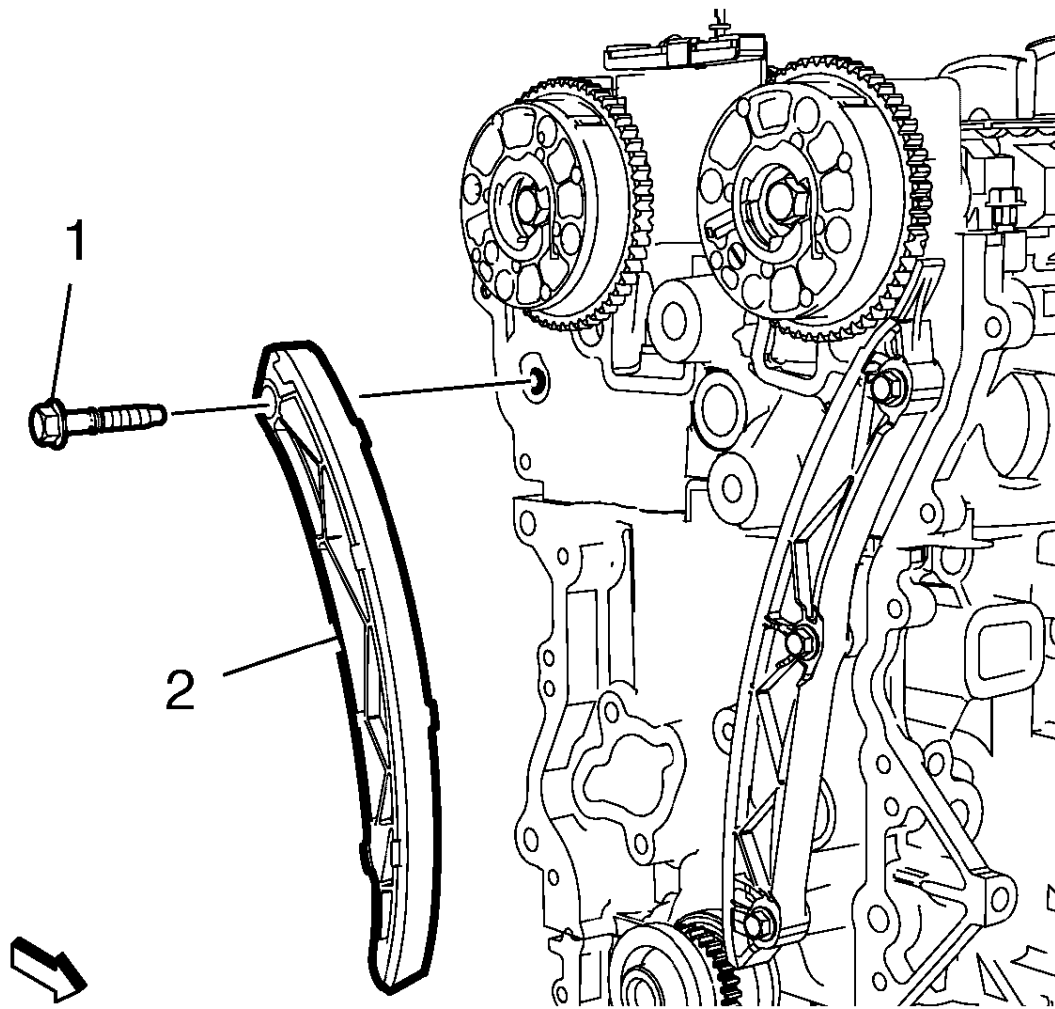


Fig. 133: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Remove Timing Chain Tensioner Shoe Bolt (1)
3. Remove Timing Chain Tensioner Shoe (2)

Installation Procedure

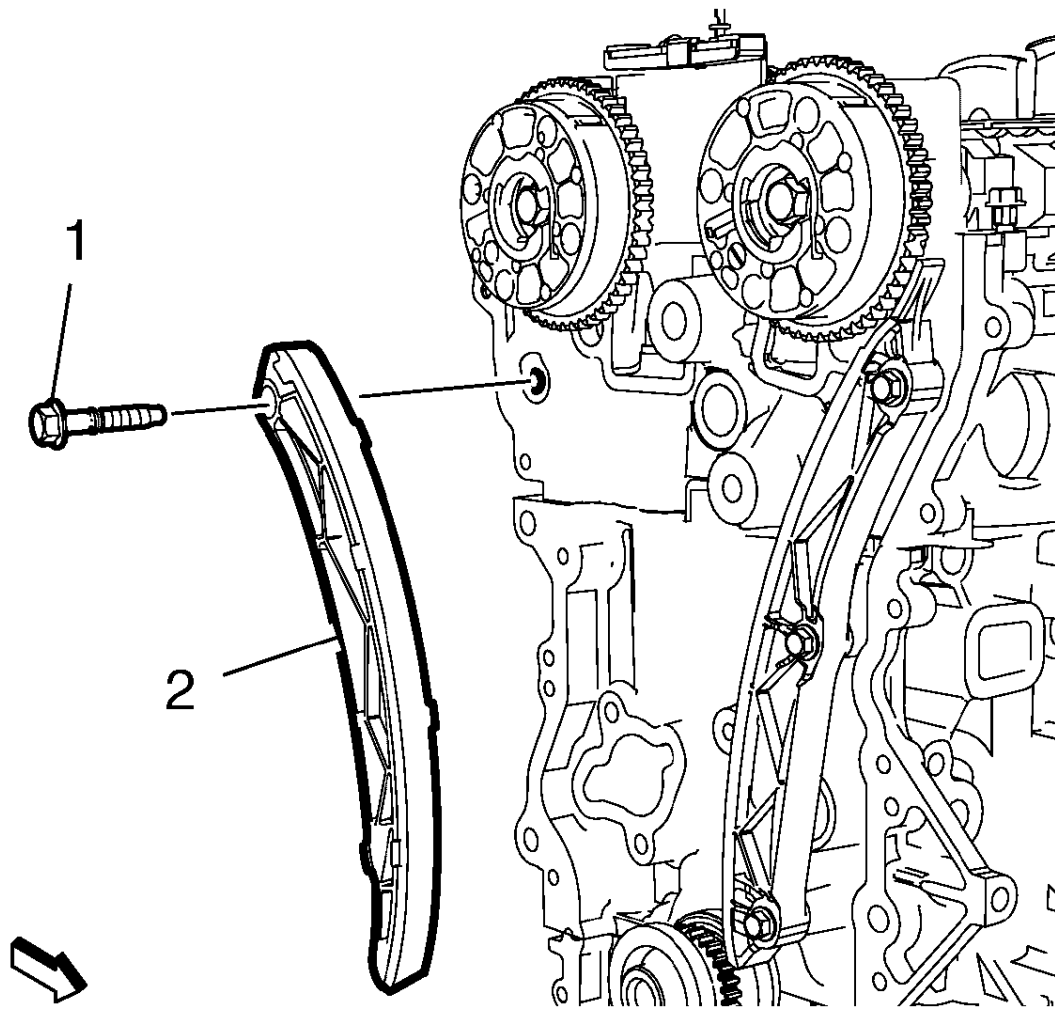


Fig. 134: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install Timing Chain Tensioner Shoe (2)

CAUTION: Refer to [Fastener Caution](#) .

2. Install and tighten Timing Chain Tensioner Shoe Bolt (1) to 25 N.m (18 lb ft)
3. Unlock the timing chain tensioner. Refer to [Timing Chain Tensioner Replacement](#).

INTAKE MANIFOLD COVER REPLACEMENT

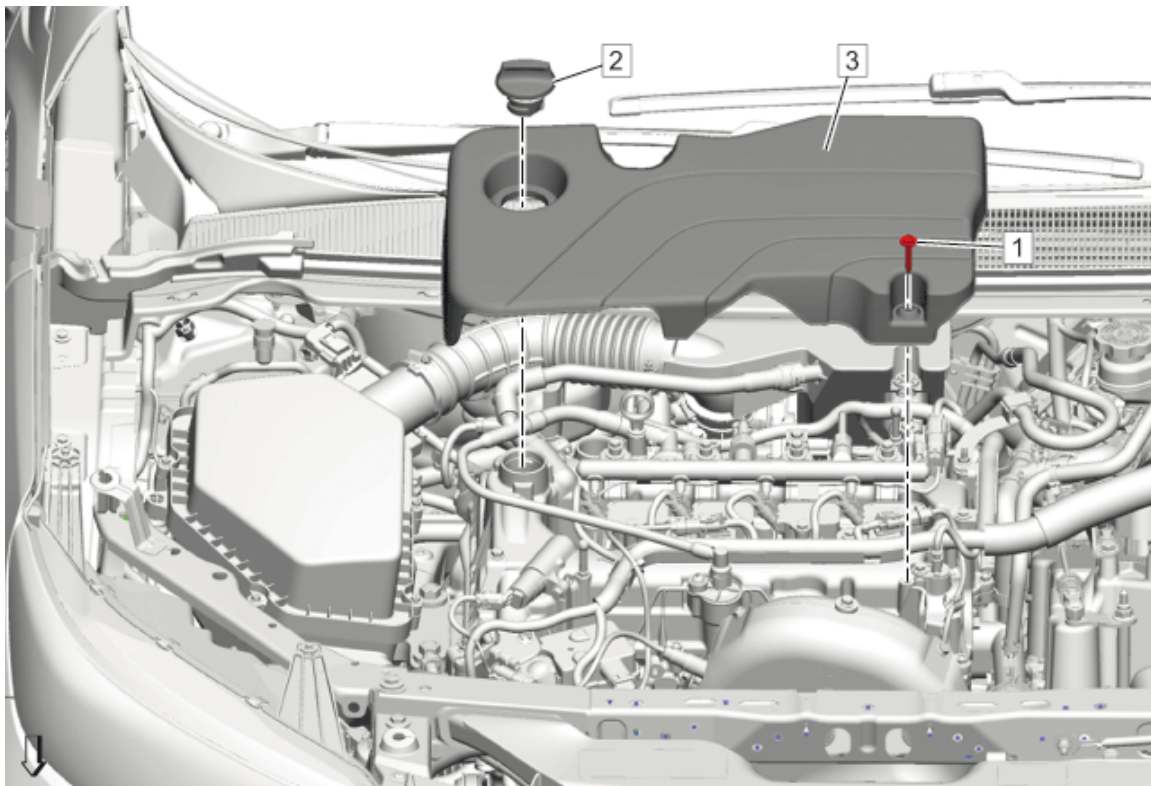


Fig. 135: Intake Manifold Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Upper Intake Manifold Cover Bolt CAUTION: Refer to Fastener Caution Tighten 10 N.m (89 lb in)
2	Engine Oil Filler Cap
3	Upper Intake Manifold Cover Procedure Release the upper intake manifold cover retainers by pulling the upper intake manifold cover upwards.

UPPER INTAKE MANIFOLD COVER REPLACEMENT

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
3. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
4. Remove Exhaust Gas Recirculation Pipe. Refer to [Exhaust Gas Recirculation Pipe Replacement](#)

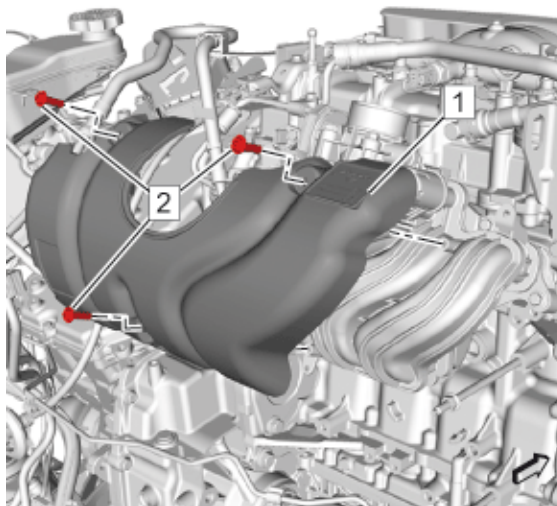


Fig. 136: Upper Intake Manifold Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove Upper Intake Manifold Cover Bolts (2) (Qty: 3)
6. Remove Upper Intake Manifold Cover (1)

Installation Procedure

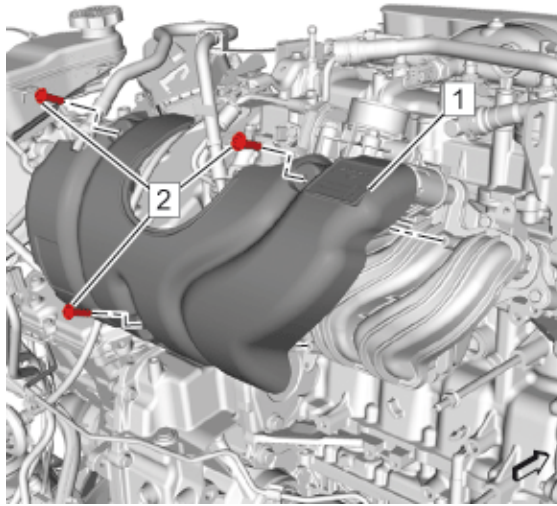


Fig. 137: Upper Intake Manifold Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Upper Intake Manifold Cover (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Upper Intake Manifold Cover Bolts (2) (Qty: 3) to 2.5 N.m (22 lb in)
3. Install Exhaust Gas Recirculation Pipe. Refer to [Exhaust Gas Recirculation Pipe Replacement](#)
4. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
5. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
6. Enable the high voltage system. Refer to [High Voltage Enabling](#)

LOWER INTAKE MANIFOLD COVER REPLACEMENT

Removal Procedure

1. Remove Intake Manifold. Refer to [Intake Manifold Replacement](#)

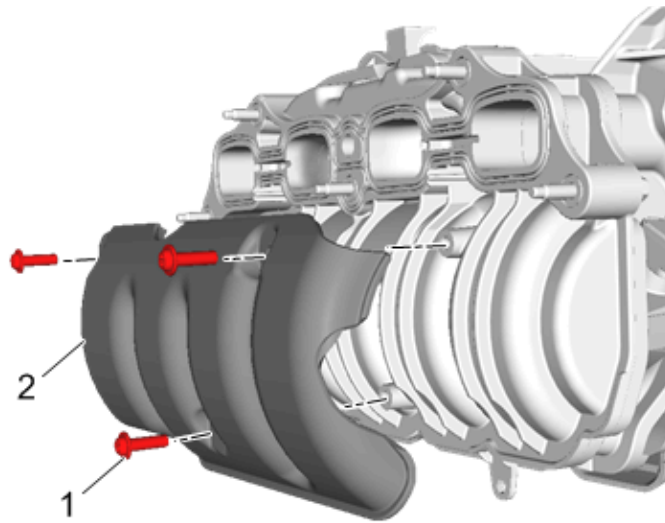


Fig. 138: Lower Intake Manifold Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Upper Intake Manifold Cover Bolts (1) (Qty: 3)
3. Remove Lower Intake Manifold Cover (2)

Installation Procedure

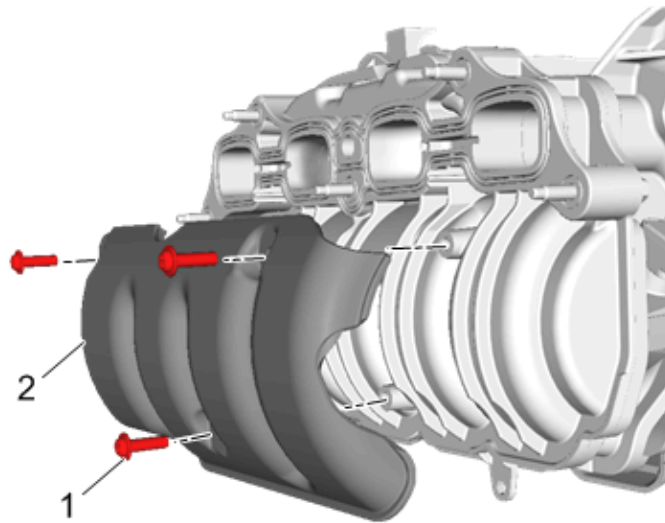


Fig. 139: Lower Intake Manifold Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Lower Intake Manifold Cover (2)

CAUTION: Refer to **Fastener Caution**

2. Install and tighten Upper Intake Manifold Cover Bolts (1) (Qty: 3) to 2.5 N.m (22 lb in)
3. Install Intake Manifold. Refer to [Intake Manifold Replacement](#)

INTAKE MANIFOLD REPLACEMENT

Special Tools

EN-6015 Closure Plugs

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Repair Tools\)](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
3. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
4. Remove Evaporative Emission Canister Purge Solenoid Valve. Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
5. Remove Throttle Body Assembly. Refer to [Throttle Body Assembly Replacement](#)
6. Remove Manifold Absolute Pressure Sensor. Refer to [Manifold Absolute Pressure Sensor Replacement](#)
7. Remove Exhaust Gas Recirculation Pipe. Refer to [Exhaust Gas Recirculation Pipe Replacement](#)

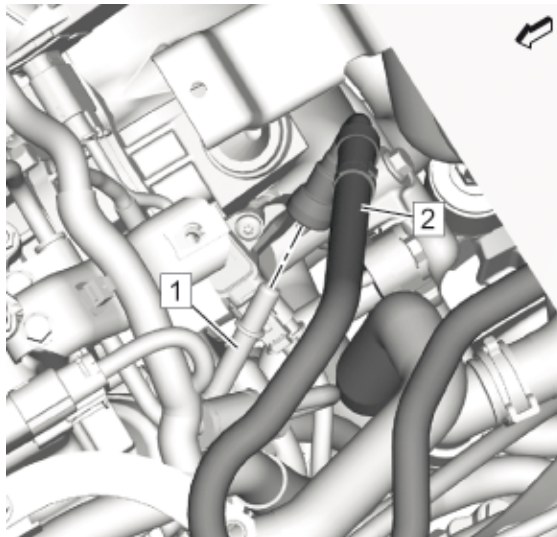


Fig. 140: Fuel Feed Front Pipe And Fuel Injection Pump

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Fuel Feed Front Pipe (2) @ Fuel Injection Pump (1)
9. Close all open connections with the **EN-6015** plugs.

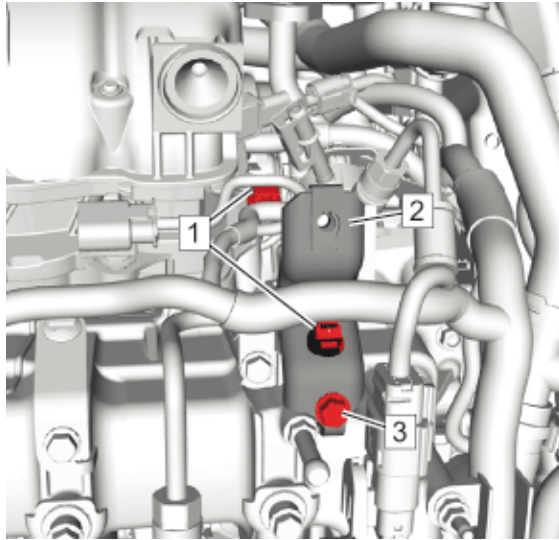


Fig. 141: Air Cleaner Resonator Bracket, Retainers And Bolt

Courtesy of GENERAL MOTORS COMPANY

10. Unclip Retainers (1) (Qty: 2)
11. Remove Bolt (3)
12. Remove the air cleaner resonator bracket (2).

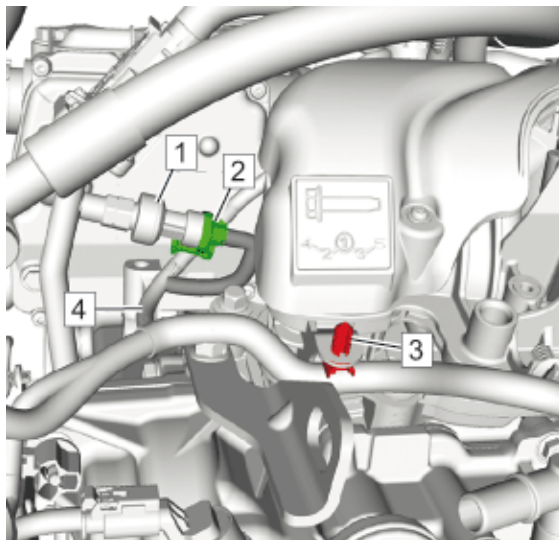


Fig. 142: A/C High Pressure Cutoff Switch, Electrical Connector, Retainer And Engine Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the electrical connector (2) from the air conditioning high pressure cutoff switch (1).
14. Unclip Retainer (3)
15. Position aside Engine Wiring Harness (4)

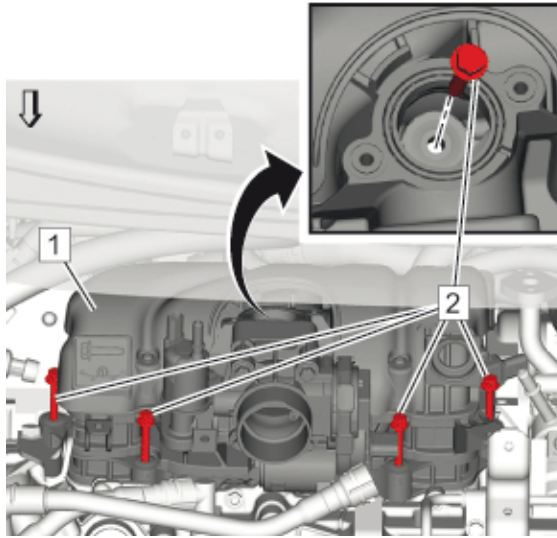


Fig. 143: Intake Manifold And Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Keep the fasteners in position on the assembly.

16. Loosen Bolts (2) (Qty: 5) @ Intake Manifold (1)

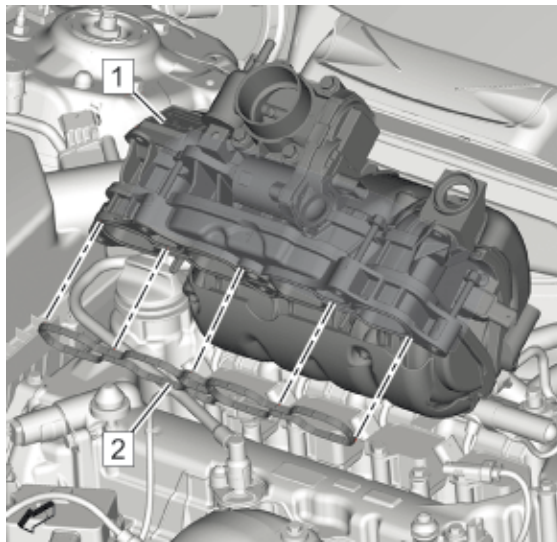


Fig. 144: Intake Manifold And Gasket
 Courtesy of GENERAL MOTORS COMPANY

17. Remove Intake Manifold (1)
18. Remove and DISCARD the gasket. (2)

Disassemble Procedure

1. Remove Upper Intake Manifold Cover. Refer to [Upper Intake Manifold Cover Replacement](#)
2. Remove Lower Intake Manifold Cover. Refer to [Lower Intake Manifold Cover Replacement](#)

Assemble Procedure

1. Install Upper Intake Manifold Cover. Refer to [Upper Intake Manifold Cover Replacement](#)
2. Install Lower Intake Manifold Cover. Refer to [Lower Intake Manifold Cover Replacement](#)

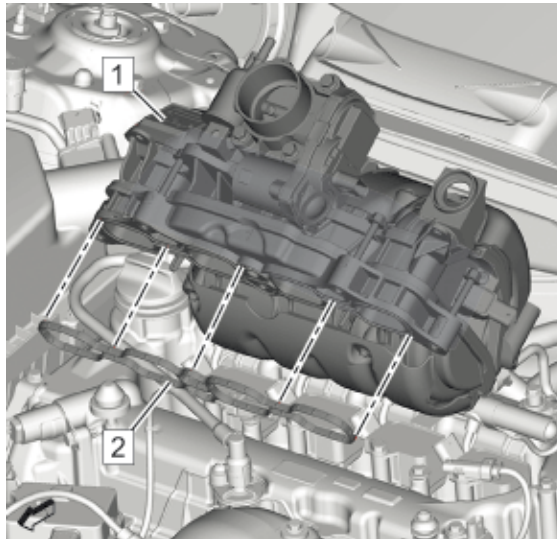


Fig. 145: Intake Manifold And Gasket

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket. (2)
2. Install Intake Manifold (1)

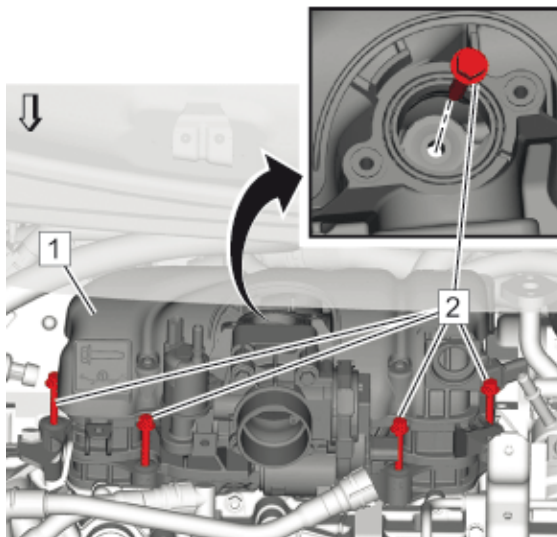


Fig. 146: Intake Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Keep the fasteners in position on the assembly.

3. Install Bolts (2) (Qty: 5) @ Intake Manifold

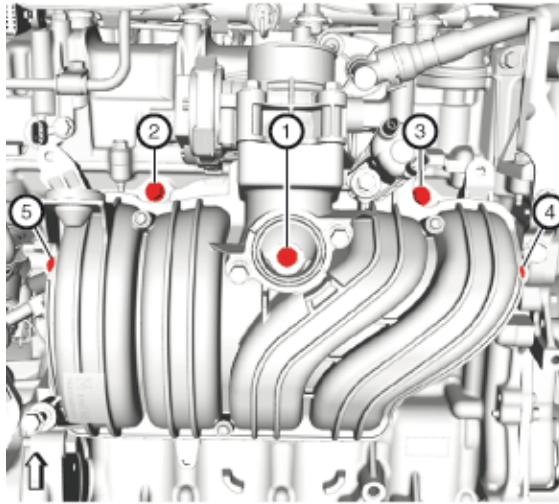


Fig. 147: Intake Manifold Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to: Fastener Caution

4. Tighten the 5 intake Manifold Bolts to 12 N.m (106 lb in) in the sequence as shown.

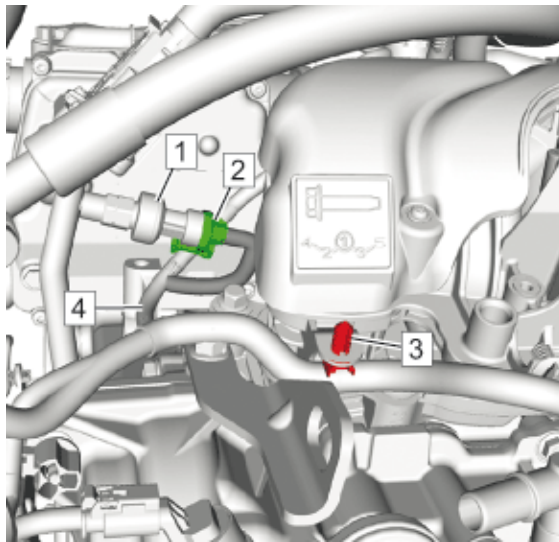


Fig. 148: A/C High Pressure Cutoff Switch, Electrical Connector, Retainer And Engine Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

5. Reposition Engine Wiring Harness (4)
6. Install Retainer (3)
7. Connect the electrical connector (2) to the air conditioning high pressure cutoff switch (1).

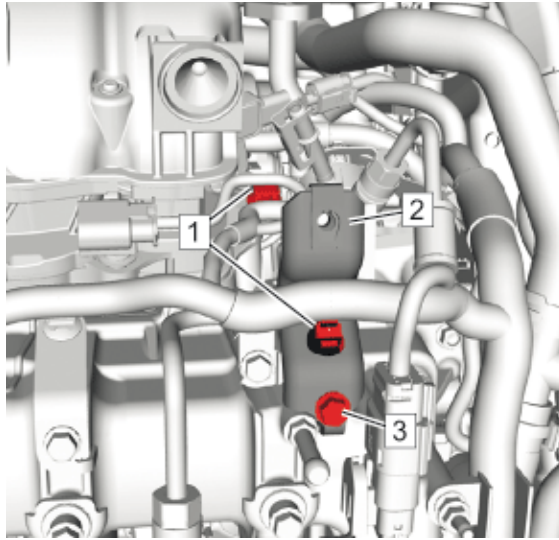


Fig. 149: Air Cleaner Resonator Bracket, Retainers And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install the air cleaner resonator bracket (2).
9. Install and tighten Bolt (3) to 9 N.m (80 lb in)
10. Install Retainers (1) (Qty: 2)

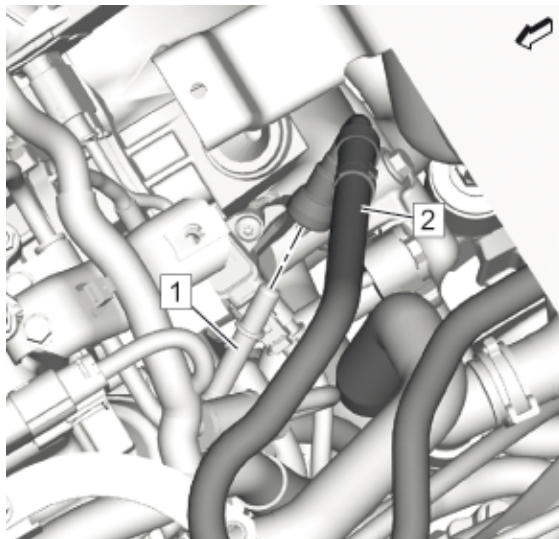


Fig. 150: Fuel Feed Front Pipe And Fuel Injection Pump
Courtesy of GENERAL MOTORS COMPANY

11. Remove all EN-6015 plugs from the connections.
12. Connect Fuel Feed Front Pipe (2) @ Fuel Injection Pump (1)
13. Install Exhaust Gas Recirculation Pipe. Refer to [Exhaust Gas Recirculation Pipe Replacement](#)
14. Install Manifold Absolute Pressure Sensor. Refer to [Manifold Absolute Pressure Sensor Replacement](#)
15. Install Throttle Body Assembly. Refer to [Throttle Body Assembly Replacement](#)
16. Install Evaporative Emission Canister Purge Solenoid Valve. Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
17. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
18. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)

19. Enable the high voltage system. Refer to [High Voltage Enabling](#)

CATALYTIC CONVERTER BRACE BRACKET REPLACEMENT

Removal Procedure

1. Remove Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)

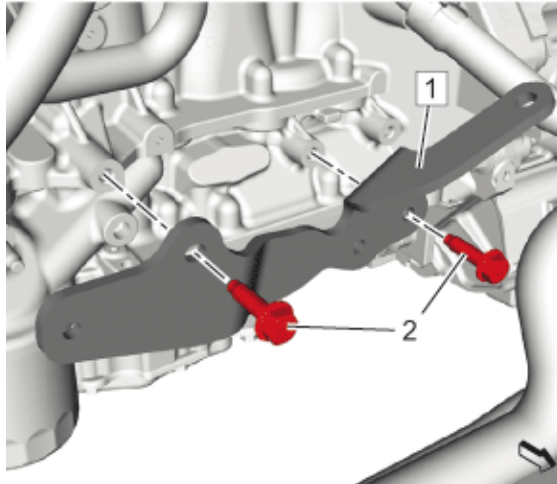


Fig. 151: Catalytic Converter Brace Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Catalytic Converter Brace Bracket Bolts (2) (Qty: 2)
3. Remove Catalytic Converter Brace Bracket (1)

Installation Procedure

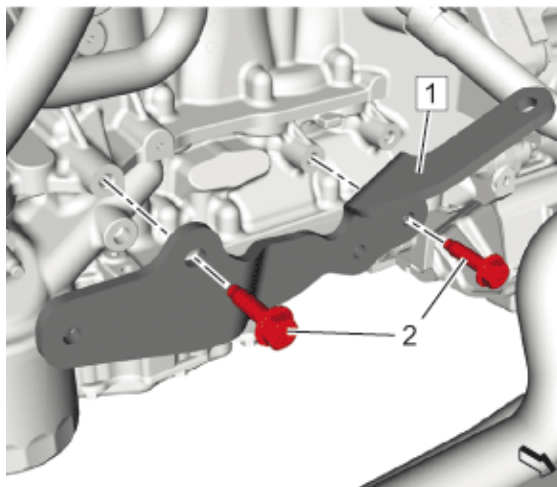


Fig. 152: Catalytic Converter Brace Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Catalytic Converter Brace Bracket (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Catalytic Converter Brace Bracket Bolts (2) (Qty: 2) to 22 N.m (16 lb ft)
3. Install Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)

CATALYTIC CONVERTER BRACKET REPLACEMENT - LOWER

Removal Procedure

1. Remove Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)

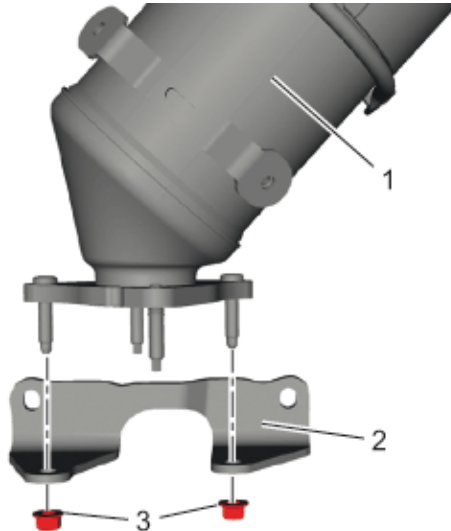


Fig. 153: Catalytic Converter, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Remove the 2 catalytic converter bracket nuts (3).
3. Remove the catalytic converter bracket (2) from the catalytic converter (1).

Installation Procedure

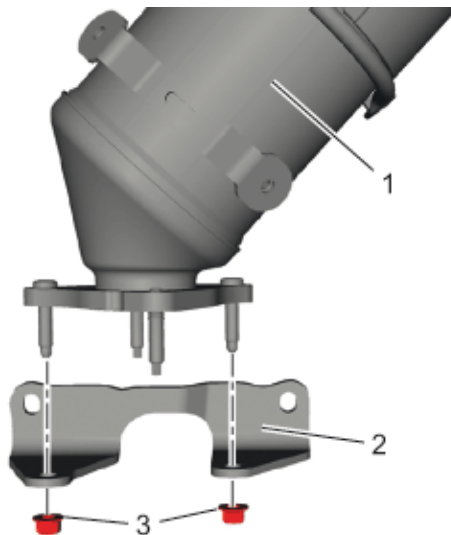


Fig. 154: Catalytic Converter, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Install the catalytic converter bracket (2) to the catalytic converter (1).

CAUTION: Refer to [Fastener Caution](#)

2. Install the catalytic converter bracket nuts (3) (Qty: 2) and tighten to 22 N.m (16 lb ft)
3. Install Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

- EN-44226 Crankshaft Balancer Remover
- EN-44226-5 Crankshaft Protector
- EN-45059 Angle Meter
- EN-51368 Front Crankshaft Seal Installer

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Water Pump Belt. Refer to [Water Pump Belt Replacement](#)

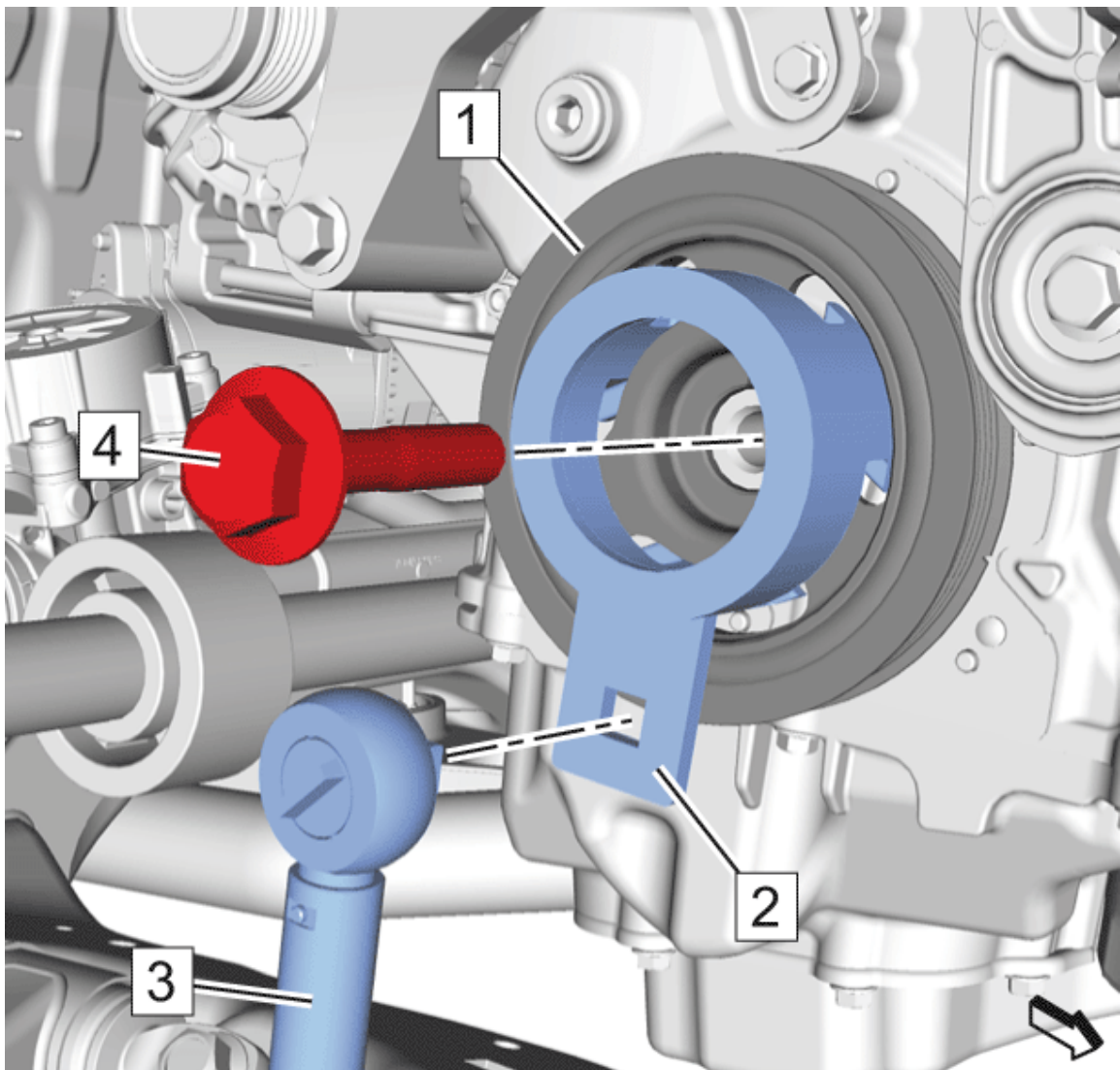


Fig. 155: Crankshaft Balancer, Special Tools And Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-44226-1** remover (2) to the crankshaft balancer (1).
3. Loosen the crankshaft balancer bolt (3) by counter holding the crankshaft balancer (1) with the **EN-44226-1** remover (3) and suitable tool.
4. Remove the **EN-44226-1** remover.
5. Remove Crankshaft Balancer Bolt

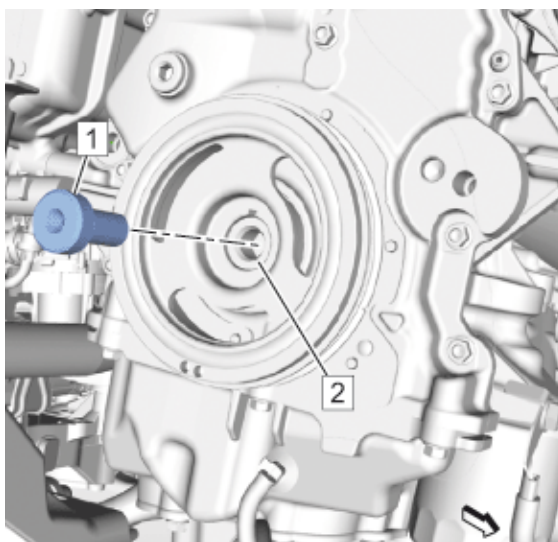


Fig. 156: Protector And Crankshaft
Courtesy of GENERAL MOTORS COMPANY

6. Install the **EN-44226-5** protector (1) to the crankshaft (2).

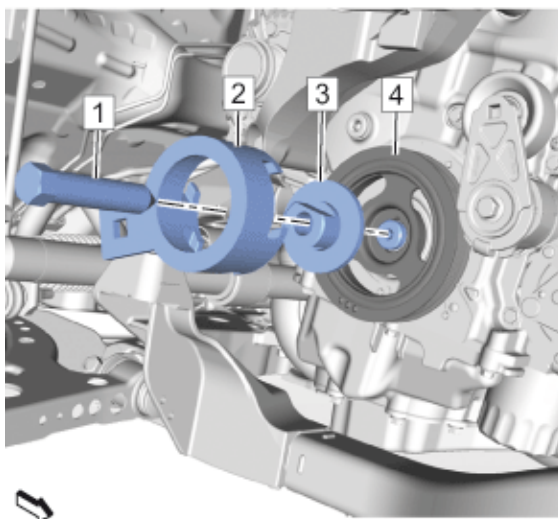


Fig. 157: Remover Plate Assembly And Balancer
Courtesy of GENERAL MOTORS COMPANY

7. Install **EN-44226-1** remover (2) and **EN-44226-2** remover plate (3) onto the balancer (4).
8. Install the **EN-44226-3** remover screw (1) through the **EN-44226-2** remover plate and against the **EN-44226-5** protector.
9. Counter hold the **EN-44226-2** remover plate and turn the **EN-51368** installer screw to remove the balancer.
10. Remove the **EN-44226** remover.
11. Remove the crankshaft balancer (4).

12. Remove the **EN-44226-5** protector.

Installation Procedure

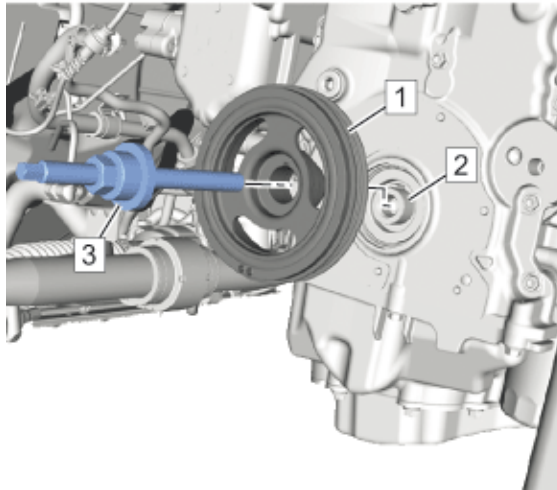


Fig. 158: Crankshaft Balancer And Installer Tool
Courtesy of GENERAL MOTORS COMPANY

1. Install Crankshaft Balancer (1) @ Crankshaft (2)
2. Install the **EN-51368** installer (3).
3. Install the crankshaft balancer by screwing the flange from **EN-51368** installer.
4. Remove the **EN-51368** installer.

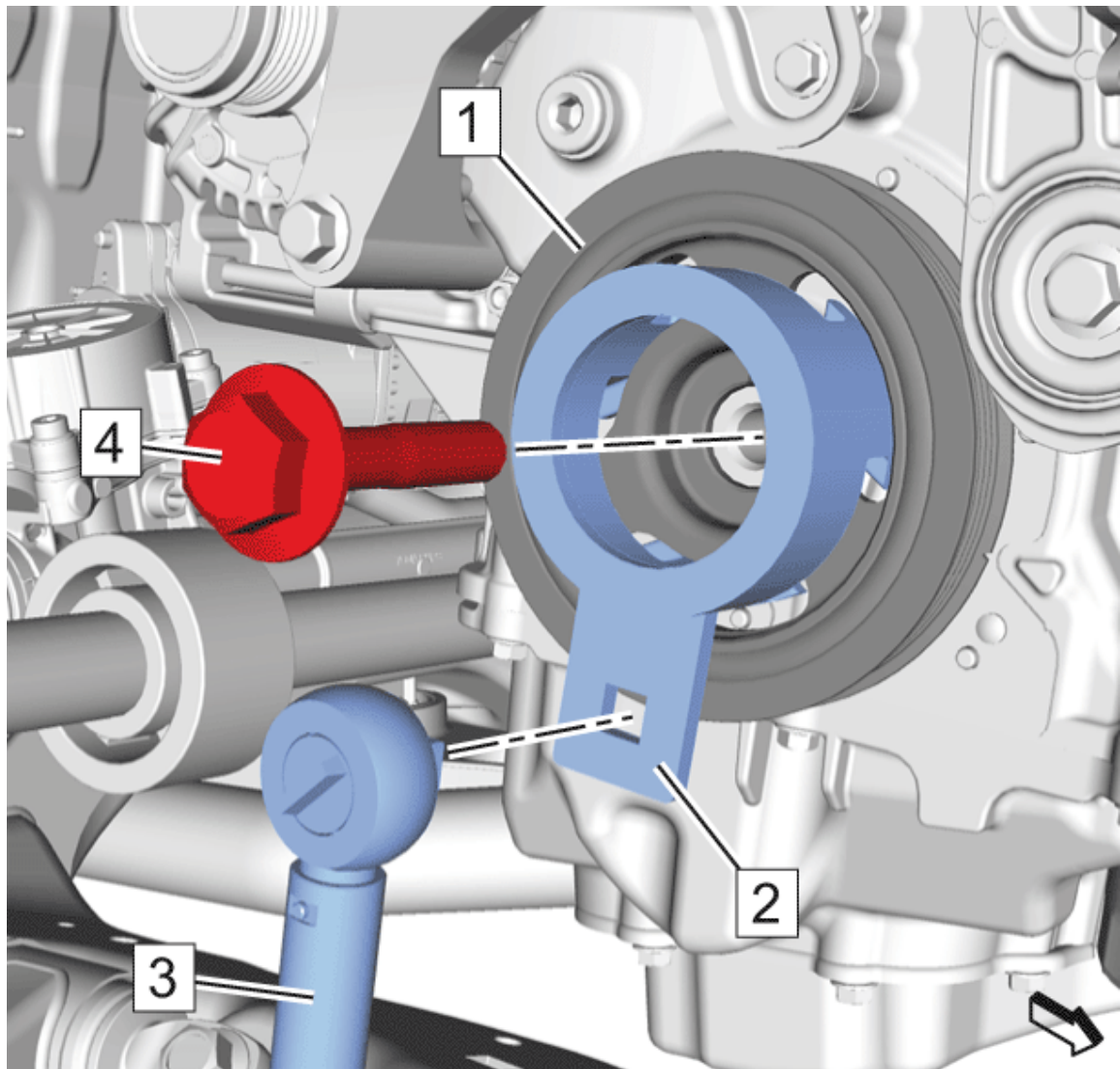


Fig. 159: Crankshaft Balancer, Special Tools And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install and hand tighten the crankshaft balancer bolt (3).
6. Install the EN-44226-1 remover (2) to the crankshaft balancer (1).

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

7. Tighten the crankshaft balancer bolt (3) by counter holding the crankshaft balancer (1) with the EN-44226-1 (3) and torque wrench.
 1. First pass to 100 N.m (74 lb ft).
 2. Loosen the bolt to 360 degrees.
 3. Final pass to an additional 180 degrees, using the EN-45059 meter.
8. Remove EN-44226-1 remover (2) from the crankshaft balancer (1).
9. Install Water Pump Belt. Refer to [Water Pump Belt Replacement](#)

CRANKSHAFT POSITION SENSOR RELUCTOR RING REPLACEMENT

Removal Procedure

1. Remove Automatic Transmission Flex Plate. Refer to [Automatic Transmission Flex Plate Replacement](#)

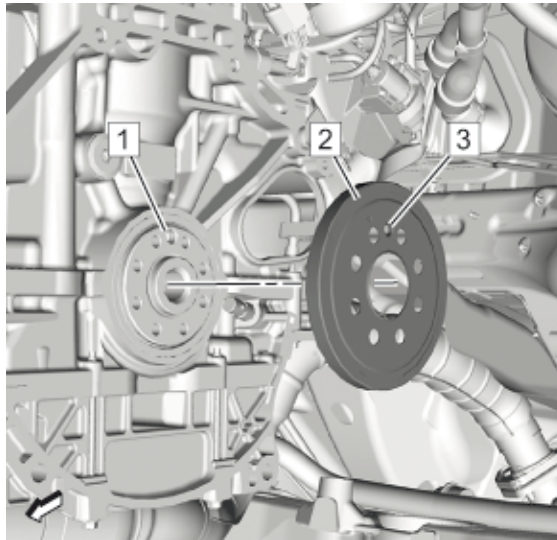


Fig. 160: Crankshaft Position Sensor Reluctor Ring
Courtesy of GENERAL MOTORS COMPANY

2. Remove the crankshaft position sensor reluctor ring. (2)

Installation Procedure

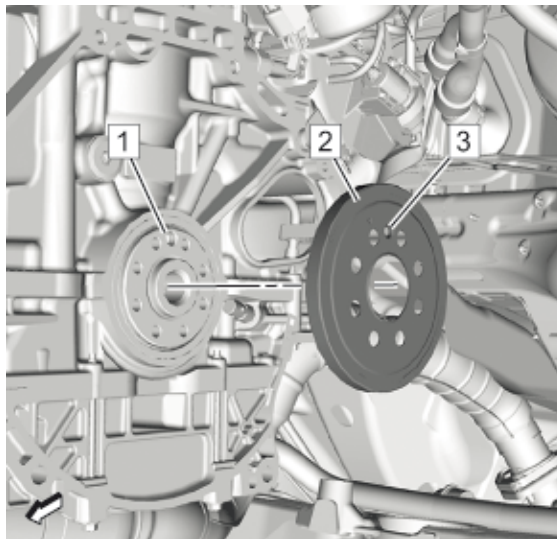


Fig. 161: Crankshaft Position Sensor Reluctor Ring
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Crankshaft Position Sensor Reluctor Ring Caution](#) .

1. Install the crankshaft position sensor reluctor ring. (2)
2. Install the pin (3) into the correct hole (1).
3. Install Automatic Transmission Flex Plate. Refer to [Automatic Transmission Flex Plate Replacement](#)

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tools

- **EN-51368** Front Crankshaft Seal Installer
- **DT-6125-B** Slide Hammer
- **DT-23129** Seal Remover

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)

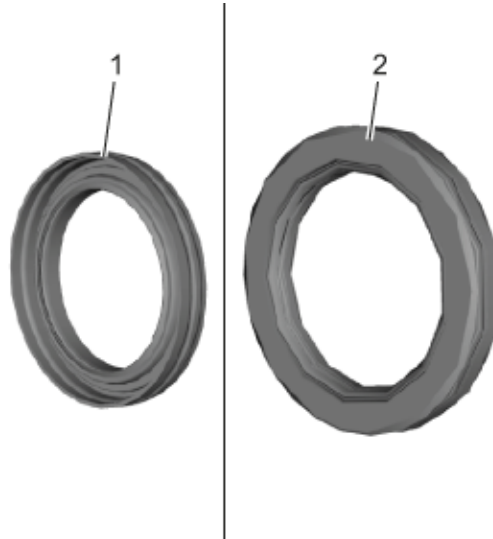


Fig. 162: Identifying Crankshaft Front Oil Seal Designs
Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine can be equipped with two different front oil seal designs.

2. Check which one of crankshaft front oil seals (1, 2) is installed.

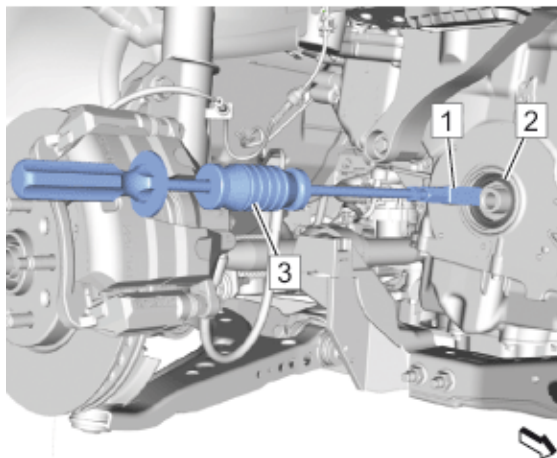


Fig. 163: Crankshaft Front Oil Seal And Removal Tool
Courtesy of GENERAL MOTORS COMPANY

3. Install the **DT-6125-B** hammer (3) to **DT-23129** seal remover (1).
4. Install the **DT-6125-B** hammer with the **DT-23129** seal remover behind the crankshaft front oil seal (2).

5. Remove the crankshaft front oil seal (2), use the **DT-6125-B** hammer.

Installation Procedure

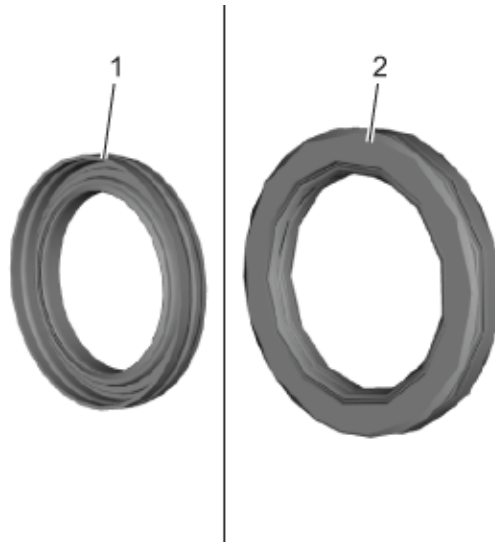


Fig. 164: Identifying Crankshaft Front Oil Seal Designs
Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine can be equipped with two different front oil seal designs.

1. Check which one of crankshaft front oil seals (1, 2) is installed.

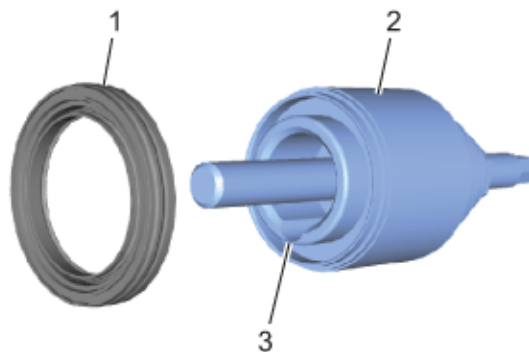


Fig. 165: Crankshaft Front Oil Seal And Installer Tool (First Design)
Courtesy of GENERAL MOTORS COMPANY

2. For front oil seal first design, use the following procedure:

NOTE: The special tool EN-51368 seal installer can be used in two positions, depending which crankshaft front oil seal type is used.

3. Install the crankshaft front oil seal (1) to the **EN-51368** seal installer (2) with the notch on the surface (3).

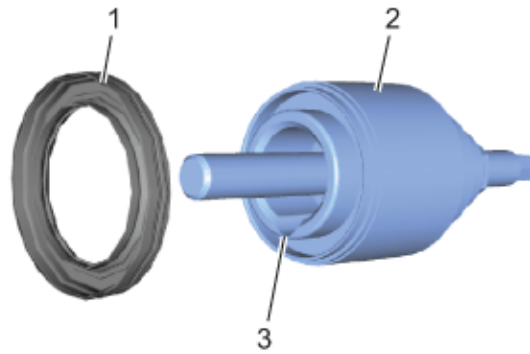


Fig. 166: Crankshaft Front Oil Seal And Installer Tool (Second Design)
 Courtesy of GENERAL MOTORS COMPANY

4. For front oil seal second design, use the following procedure:

NOTE: The special tool EN-51368 seal installer can be used in two positions, depending which crankshaft front oil seal type is used.

5. Install the crankshaft front oil seal (1) to the **EN-51368** seal installer (2) with the plane surface (3).

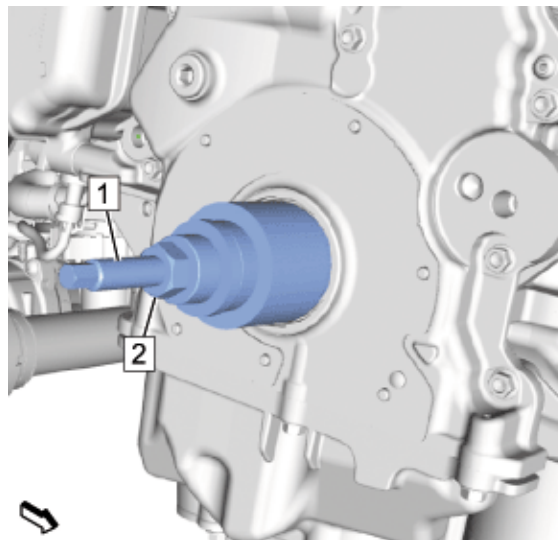


Fig. 167: Installing Crankshaft Front Oil Seal
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Be careful that the crankshaft front oil seal does not deform while installing. Failing to do so may reduce the leak-tightness and could cause damage to the crankshaft.

6. Press the crankshaft front oil seal into the correct seat, by tightening the nut (2) from the **EN-51368** seal installer (1).
7. Remove the **EN-51368** seal installer.
8. Check the correct seat of the crankshaft front oil seal.

9. Install Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Special Tools

EN-51369 Rear Crankshaft Seal Installer

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Crankshaft Position Sensor Reluctor Ring. Refer to [Crankshaft Position Sensor Reluctor Ring Replacement](#)

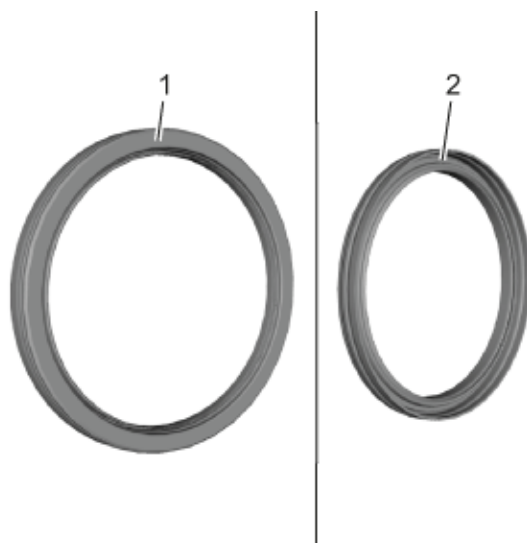


Fig. 168: Identifying Crankshaft Rear Oil Seals
Courtesy of GENERAL MOTORS COMPANY

NOTE: The engine could be equipped with two different rear oil seal designs.

2. Check which of the crankshaft rear oil seals (1, 2) are installed.

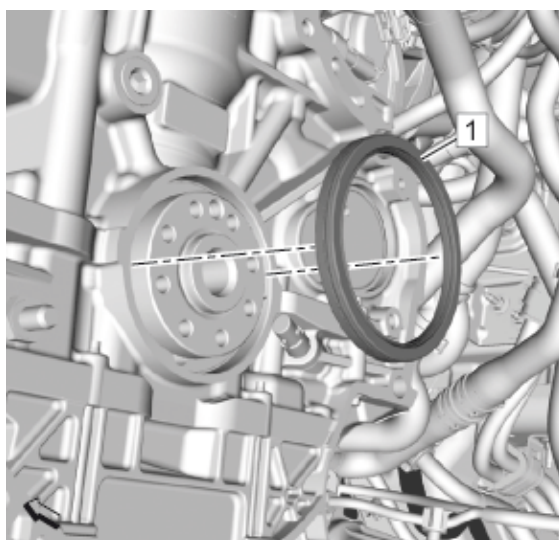


Fig. 169: Removing Crankshaft Rear Oil Seal

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Be careful that the crankshaft will not be damaged while the crankshaft rear oil seal is pulled out. Failing to do so may reduce the leak-tightness and could cause damage to the crankshaft.

3. Use a suitable tool to remove the seal.
4. Remove Crankshaft Rear Oil Seal (1)

Installation Procedure

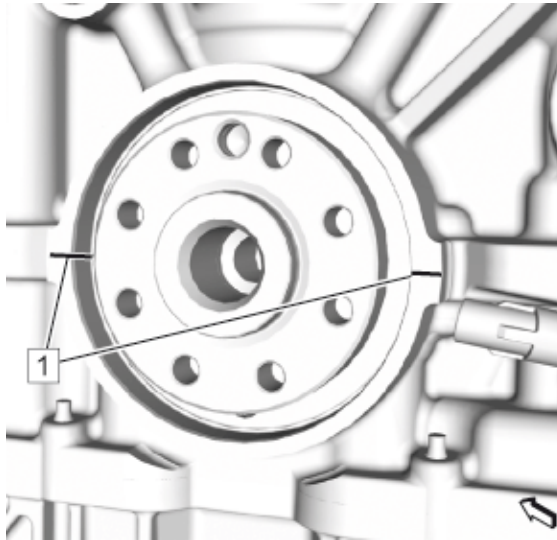


Fig. 170: RTV Sealant Application Points

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the seal recess (1) for excess sealer material at the lower crankcase to engine block mating location.
2. Remove excess sealer, if present.
3. Add RTV sealer at the 2 locations (1) where the bed plate and block join prior to installing the oil seal. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

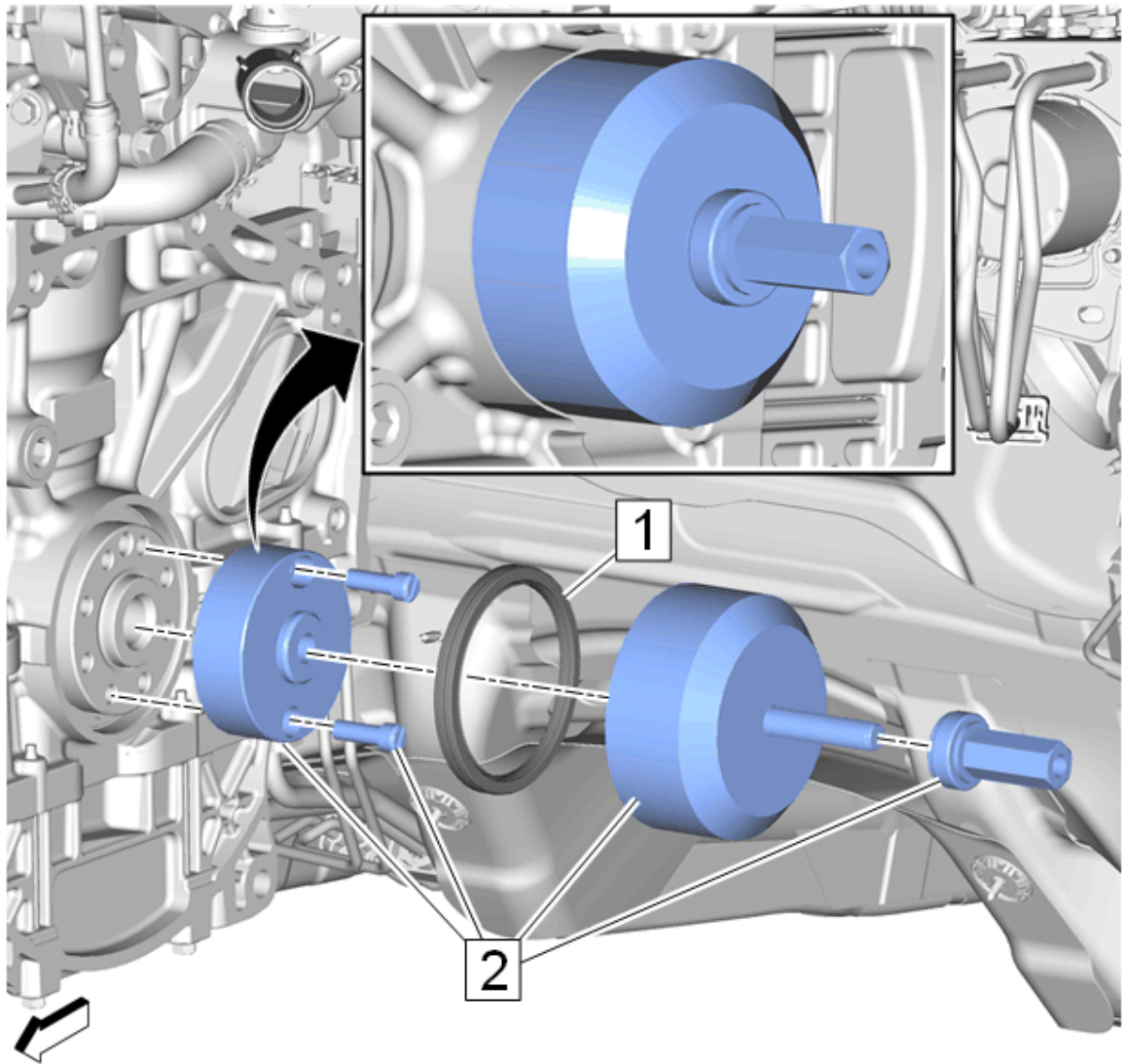


Fig. 171: Oil Seal And Installer

Courtesy of GENERAL MOTORS COMPANY

NOTE: The oil seal must be installed in the correct direction. The side that faces out will have "this side out" printed on it. Depending on seal design, the way the seal is installed on the EN-51369 installer is opposite. Either the seal is installed over the back of the installer, or the seal is installed over the front of the installer. Match the seal design as shown above and install the seal onto the installer in the correct direction.

4. Install the oil seal (1, 2) in the correct direction on the **EN-51369** installer.

NOTE: If the seal is improperly installed on the special tool, it will not install correctly.

5. Inspect the seal on **EN-51369** installer, and ensure that the seal lip is not deformed. If necessary, remove the seal and reinstall on the special tool.

NOTE: The special tool installs and establishes the proper depth of the seal in the crankshaft seal bore.

6. Use **EN-51369** installer to press the new crankshaft seal into the housing.

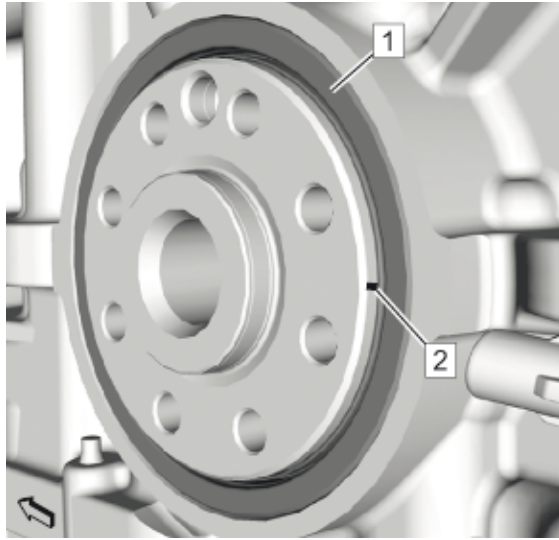


Fig. 172: Crankshaft Rear Oil Seal Installed Properly
Courtesy of GENERAL MOTORS COMPANY

7. Ensure that the crankshaft rear oil seal (1) is installed in the crankshaft seal bore flush to 0.5 mm (0.2 in) depth (2).

CRANKSHAFT SPROCKET REPLACEMENT

Removal Procedure

1. Remove Oil Pump Drive Chain. Refer to [Oil Pump Drive Chain Replacement](#)

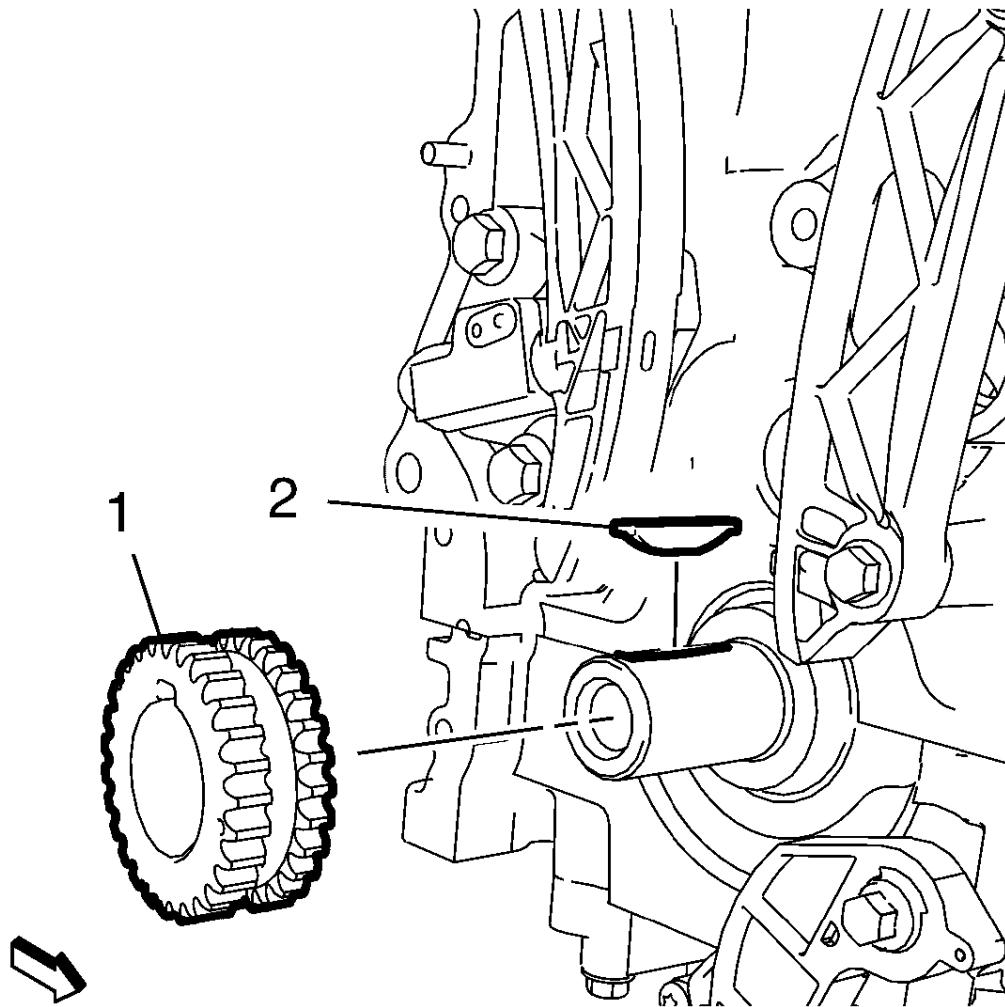


Fig. 173: Crankshaft Sprocket And Balancer Key
Courtesy of GENERAL MOTORS COMPANY

2. Remove Crankshaft Sprocket (1)
3. Remove the crankshaft balancer key. (2)

Installation Procedure

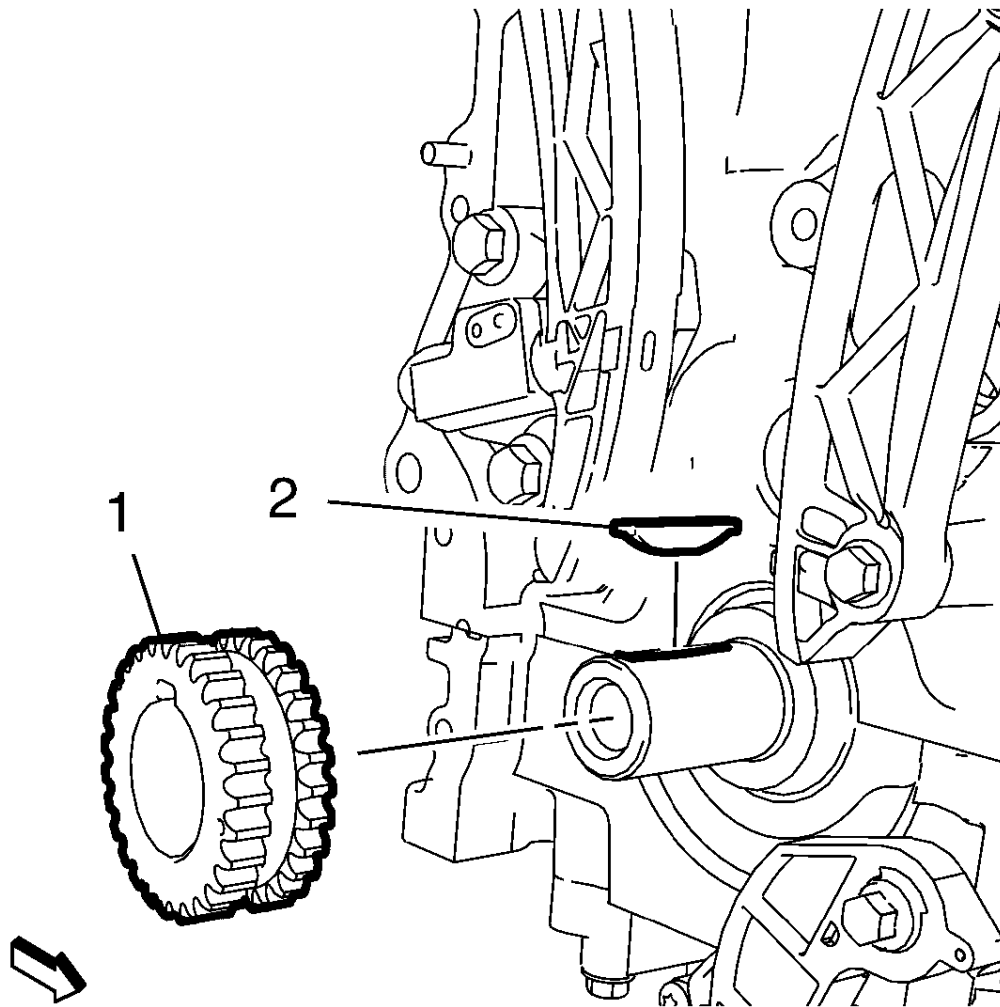


Fig. 174: Crankshaft Sprocket And Balancer Key
Courtesy of GENERAL MOTORS COMPANY

1. Install the crankshaft balancer key (2).
2. Align the keyway of the crankshaft sprocket with the crankshaft balancer key.
3. Install Crankshaft Sprocket (1).
4. Install Oil Pump Drive Chain. Refer to [Oil Pump Drive Chain Replacement](#)

CRANKSHAFT OIL DEFLECTOR REPLACEMENT

Removal Procedure

1. Remove Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)

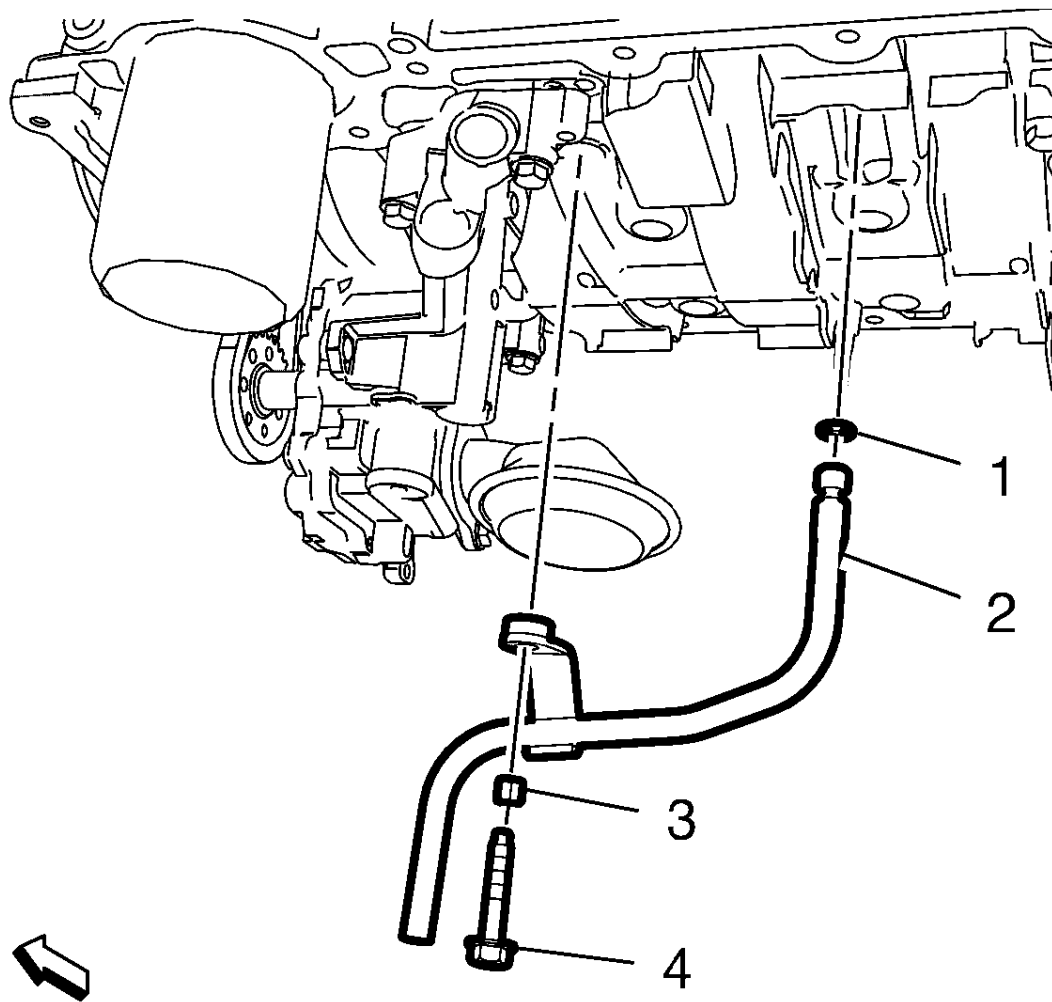


Fig. 175: Positive Crankcase Ventilation Oil Separator Drain Pipe, Bolt And Seal
Courtesy of GENERAL MOTORS COMPANY

2. Remove and DISCARD the positive crankcase ventilation oil separator drain pipe bolt (4).
3. Remove the positive crankcase ventilation oil separator drain pipe (2).
4. Remove and the positive crankcase ventilation oil separator seal (1). Check for damage.

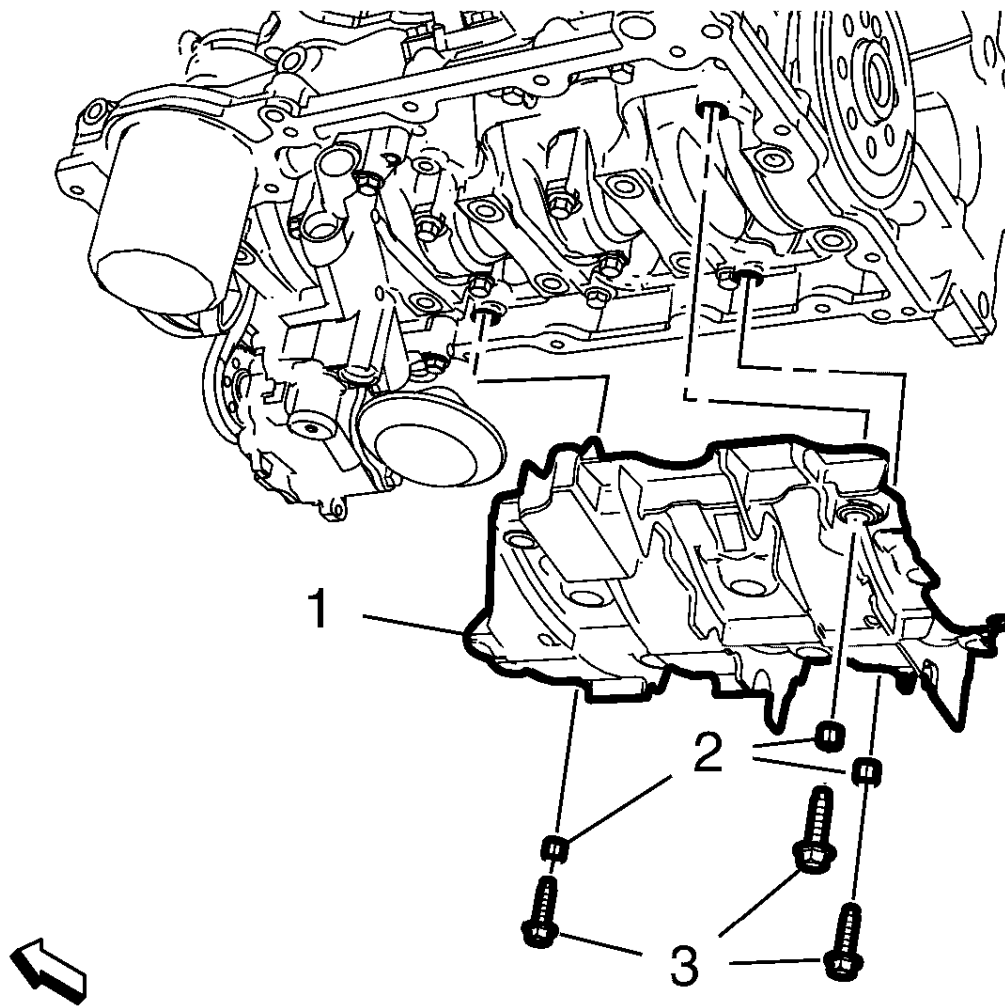


Fig. 176: Crankshaft Oil Deflector And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD the 3 crankshaft oil deflector bolts (3).
6. Remove the crankshaft oil deflector. (1)

Installation Procedure

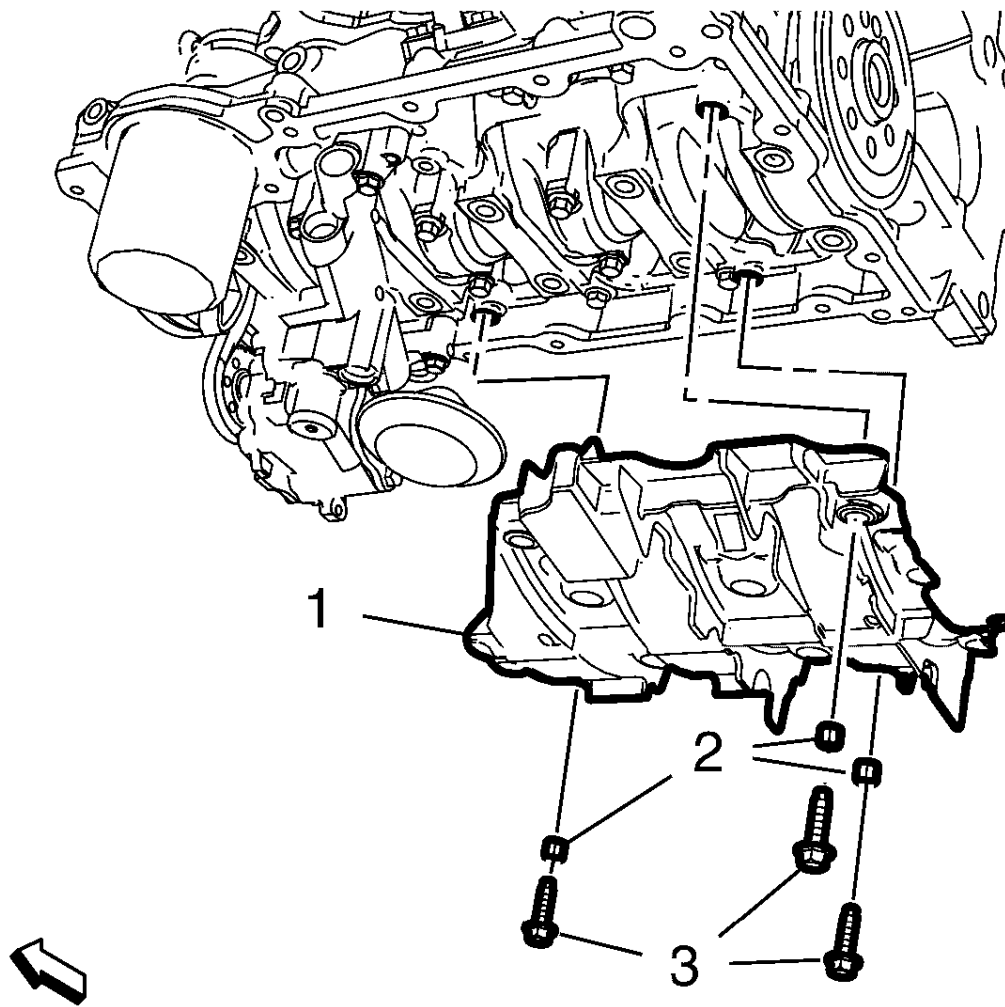


Fig. 177: Crankshaft Oil Deflector And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the crankshaft oil deflector (1).

CAUTION: Refer to [Fastener Caution](#) .

2. Install the 3 NEW crankshaft oil deflector bolts (3) and tighten to 10 N.m (89 lb in).

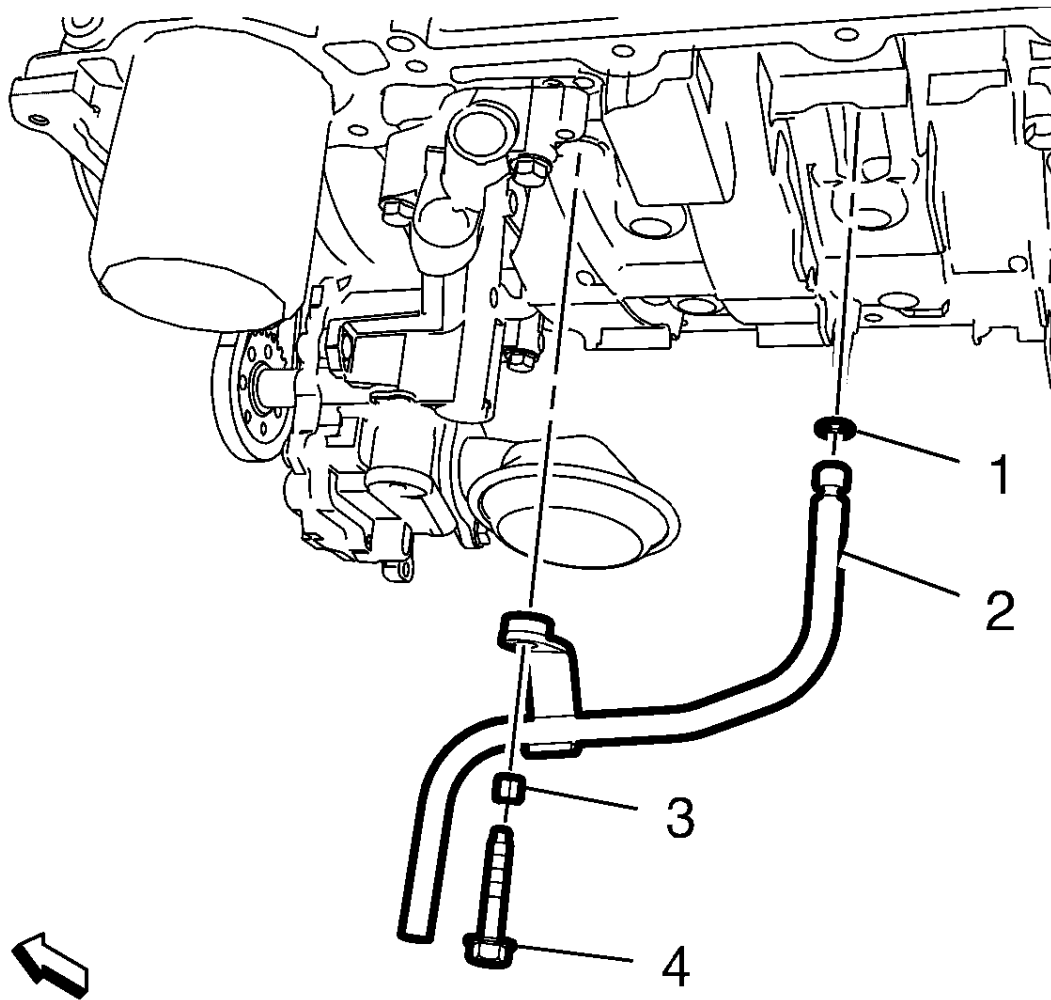


Fig. 178: Positive Crankcase Ventilation Oil Separator Drain Pipe, Bolt And Seal
Courtesy of GENERAL MOTORS COMPANY

3. Install the positive crankcase ventilation oil separator seal (1).
4. Install the positive crankcase ventilation oil separator drain pipe (2).
5. Install the NEW positive crankcase ventilation oil separator drain pipe bolt (4) and tighten to 10 N.m (89 lb in).
6. Install Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)

ENGINE LIFT FRONT BRACKET REPLACEMENT

Removal Procedure

1. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

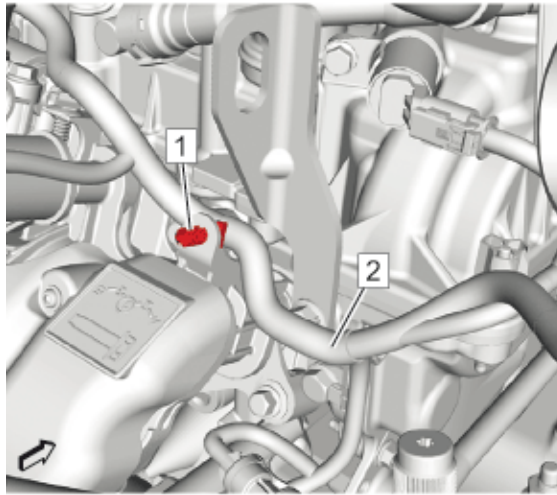


Fig. 179: Engine Wiring Harness And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Remove the retainer that secures the cable to the bracket. (1)
3. Position aside Engine Wiring Harness (2).

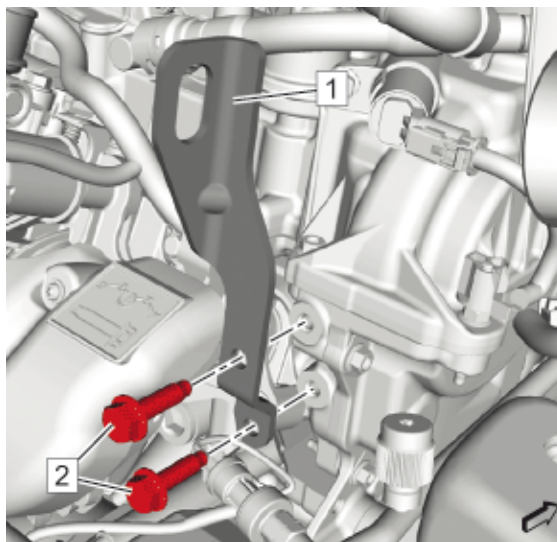


Fig. 180: Engine Lift Bracket Bolt And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Engine Lift Bracket Bolts (2) (Qty: 2)
5. Remove Engine Lift Bracket (1)

Installation Procedure

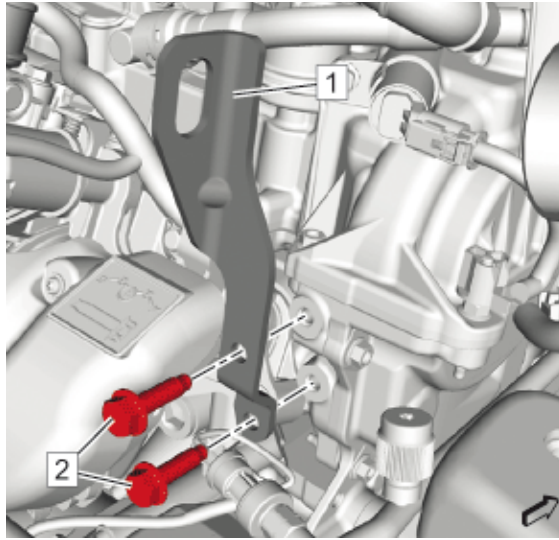


Fig. 181: Engine Lift Bracket Bolt And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Lift Bracket (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Engine Lift Bracket Bolts (2) (Qty: 2) to 25 N.m (18 lb ft)

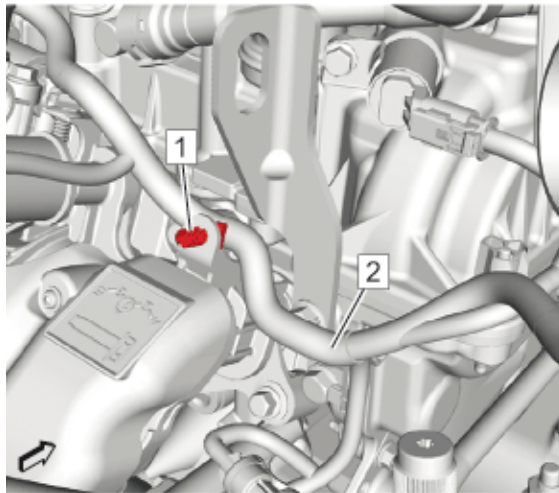


Fig. 182: Engine Wiring Harness And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Reposition Engine Wiring Harness (2)
4. Install the retainer. (1)
5. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

ENGINE LIFT REAR BRACKET REPLACEMENT

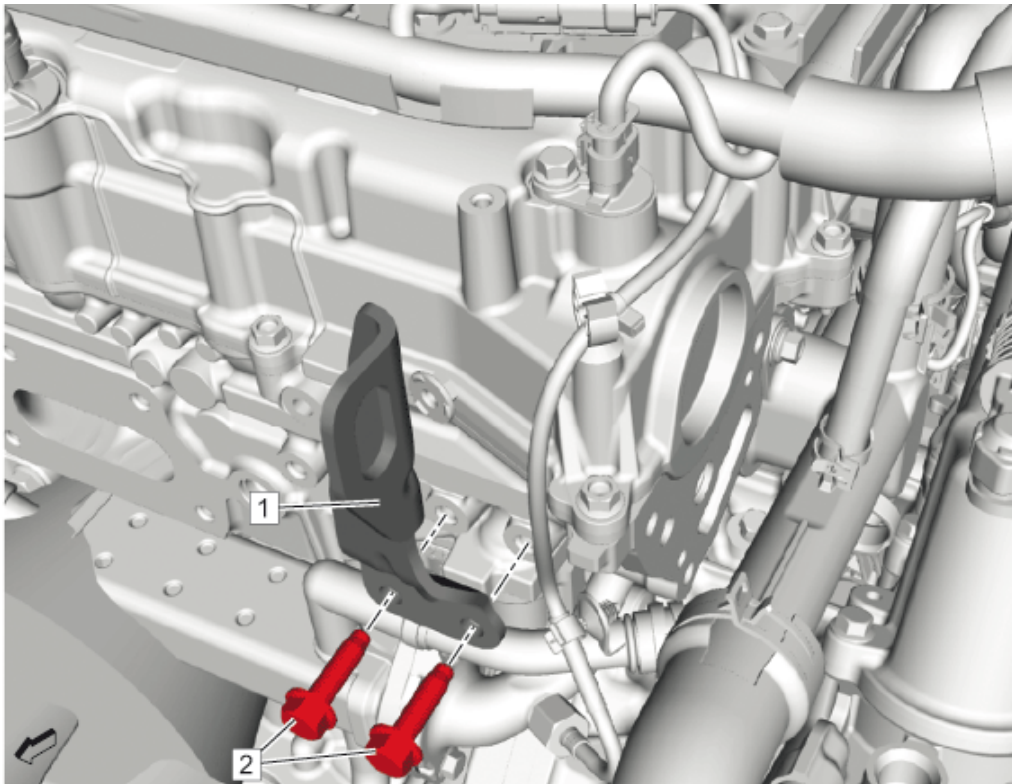


Fig. 183: Engine Lift Rear Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Three-Way Catalytic Converter. Refer to Three-Way Catalytic Converter Replacement	
1	Engine Lift Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution Tighten 25 N.m (18 lb ft)
2	Engine Lift Rear Bracket

CYLINDER HEAD REPLACEMENT

Special Tools

- EN-6015 Closure Plugs
- EN-36857 Engine Lift Bracket
- EN-45059 Angle Meter
- EN-51367 Camshaft Holder

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
3. Remove Exhaust Gas Recirculation Valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#)
4. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
5. Remove Intake Manifold. Refer to [Intake Manifold Replacement](#)
6. Remove Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)
7. Remove Water Outlet. Refer to [Water Outlet Replacement](#)
8. Drain the engine oil. Refer to [Draining Fluids and Oil Filter Removal](#)

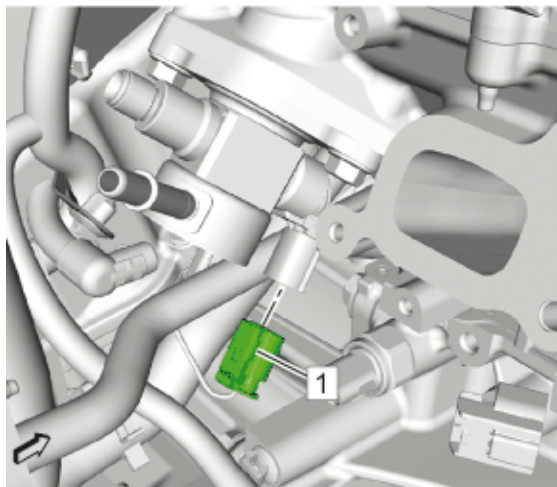


Fig. 184: Electrical Connector And Fuel Injection Pump

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Electrical Connector (1) @ Fuel Injection Pump
10. Remove Water Pump Belt. Refer to [Water Pump Belt Replacement](#)

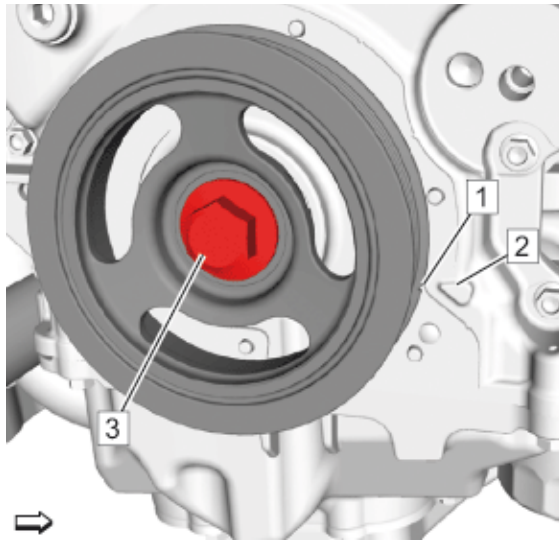


Fig. 185: Crankshaft Balancer Markings

Courtesy of GENERAL MOTORS COMPANY

11. Adjust the engine to cylinder 1 top dead center (TDC) of combustion stroke. Set crankshaft in direction of engine rotation until the markings (1, 2) line up. Rotate at the crankshaft balancer bolt (3).
12. Remove Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)
13. Lower the vehicle.
14. Remove Engine Mount Bracket. Refer to [Engine Mount Bracket Replacement](#)

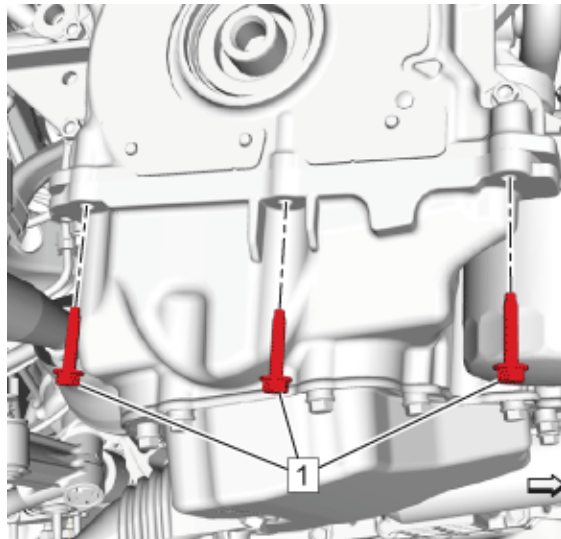


Fig. 186: Oil Pan Bolts And Upper Oil Pan

Courtesy of GENERAL MOTORS COMPANY

15. Remove the 3 oil pan bolts (1) from the upper oil pan.

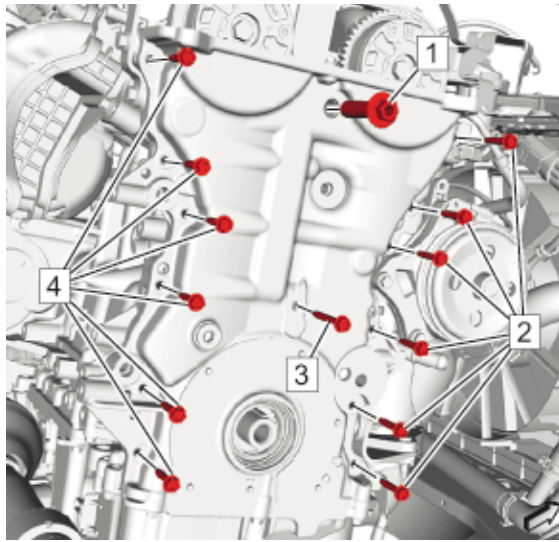


Fig. 187: Engine Front Cover Bolts
 Courtesy of GENERAL MOTORS COMPANY

- 16. Remove Engine Front Cover Bolts (2, 4) (Qty: 12)
- 17. Remove Engine Front Cover Bolt (1)
- 18. Remove Engine Front Cover Bolt (3)

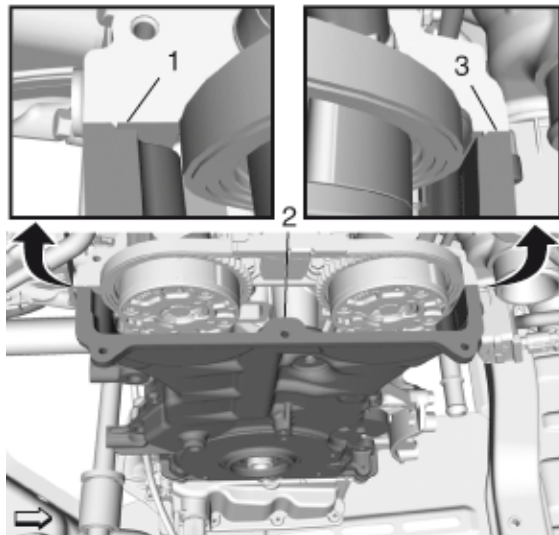


Fig. 188: Engine Front Cover Pry Points
 Courtesy of GENERAL MOTORS COMPANY

- 19. Loosen the engine front carefully from the engine, use a suitable tool at the location as shown to pry (1, 2, 3).

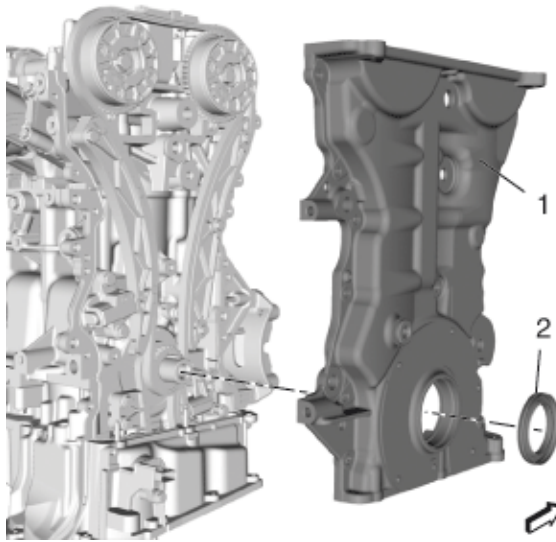


Fig. 189: Engine Front Cover And Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS COMPANY

- 20. Remove Engine Front Cover (1)
- 21. Remove Crankshaft Front Oil Seal (2)

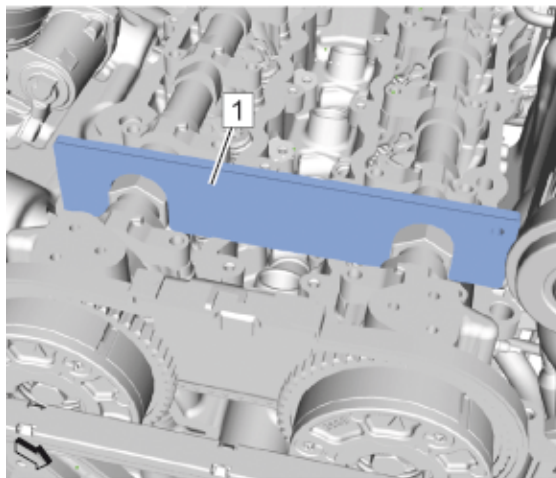


Fig. 190: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

- 22. Install the EN-51367 holder (1).
- 23. Remove Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)

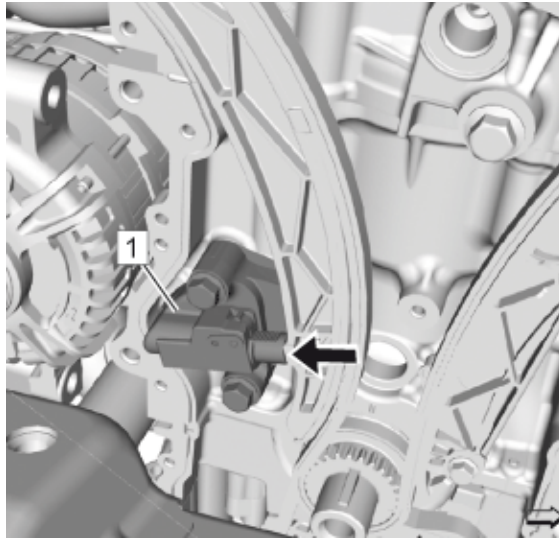


Fig. 191: Timing Chain Tensioner In Service Position
Courtesy of GENERAL MOTORS COMPANY

24. Fix the timing chain tensioner with design (1) in service position:

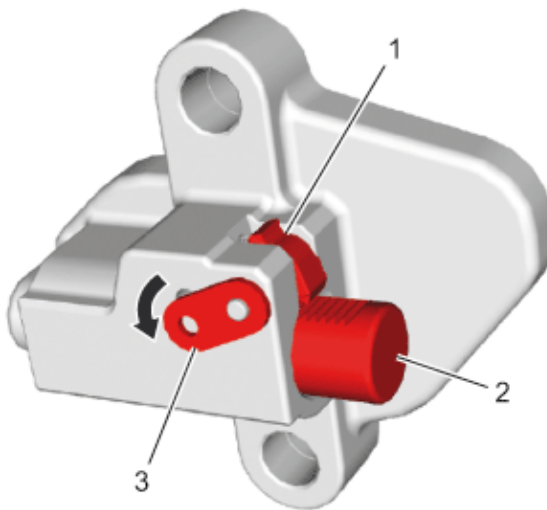


Fig. 192: Releasing Tension From Piston
Courtesy of GENERAL MOTORS COMPANY

1. Slightly release tension from the piston (2) until bar (1) can be unlocked by rotating the lever (3) in direction of arrow.

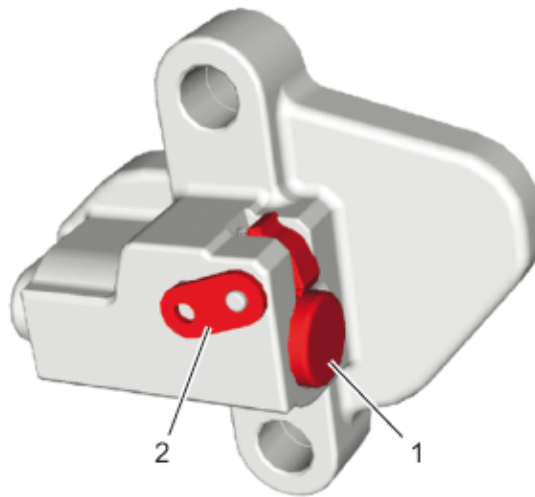


Fig. 193: Piston And Tensioner Lever

Courtesy of GENERAL MOTORS COMPANY

2. Entirely push back the piston (1) until the tensioner lever (2) cannot be locked in this position.

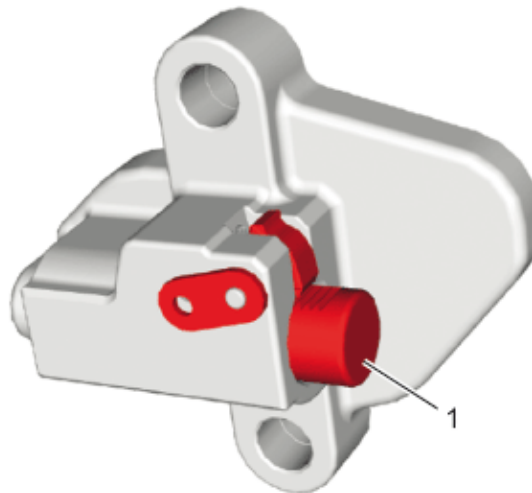


Fig. 194: Piston

Courtesy of GENERAL MOTORS COMPANY

3. Release tension from the piston (1) until it releases for three ratchets. The three ratchets can be noticed by the click noises.

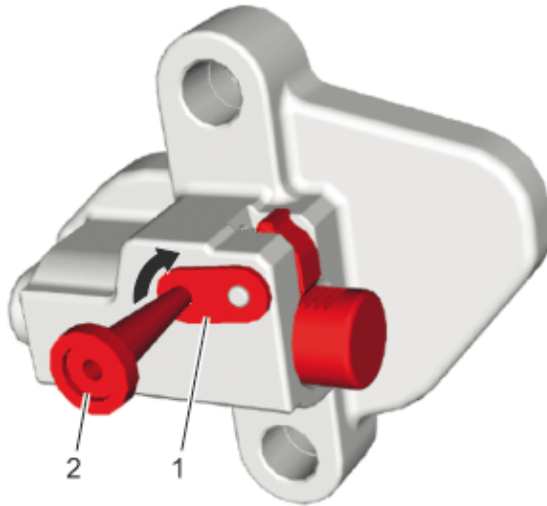


Fig. 195: Lever And Fixing Pin

Courtesy of GENERAL MOTORS COMPANY

4. Apply tension to the piston until the lever (1) is rotated back into the locking position where the bore in the lever aligns with the bore in the tensioner housing.
5. Fix the lever in this position with a suitable fixing pin (2).

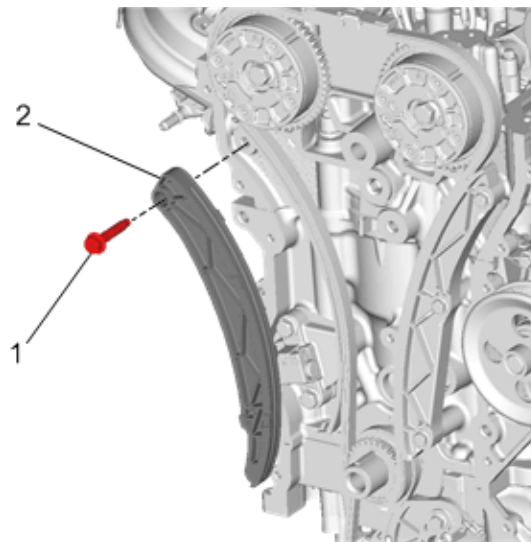


Fig. 196: Timing Chain Tensioner Shoe And Bolt

Courtesy of GENERAL MOTORS COMPANY

25. Remove Timing Chain Tensioner Shoe Bolt (1)
26. Remove Timing Chain Tensioner Shoe (2)

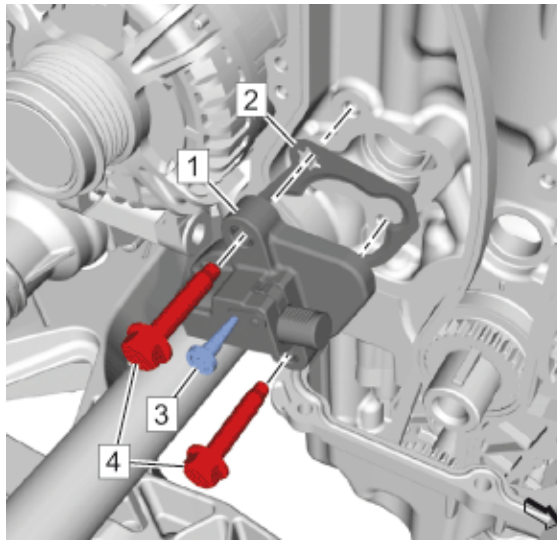


Fig. 197: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

27. Ensure the correct fixation of the tool (3).
28. Remove Timing Chain Tensioner Bolt (4) (Qty: 2)
29. Remove Timing Chain Tensioner (1)
30. Remove and DISCARD the gasket. (2)

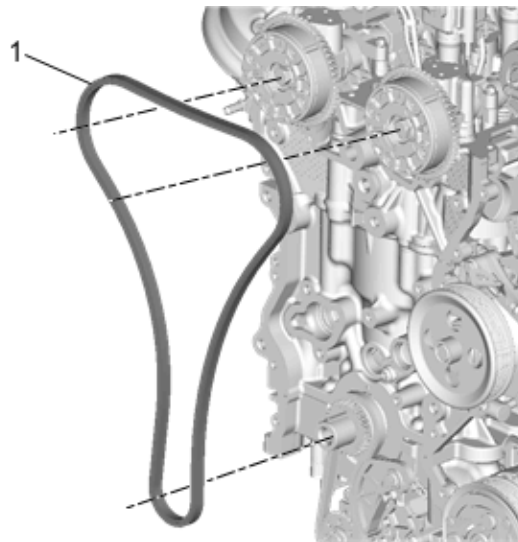


Fig. 198: Timing Chain
Courtesy of GENERAL MOTORS COMPANY

31. Remove Timing Chain (1)

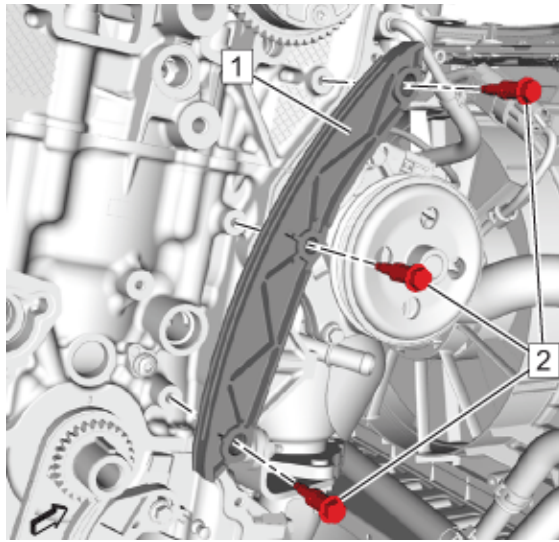


Fig. 199: Right Side Timing Chain Guide And Bolts
Courtesy of GENERAL MOTORS COMPANY

- 32. Remove Timing Chain Guide Bolts (2) (Qty: 3)
- 33. Remove Timing Chain Guide (1)

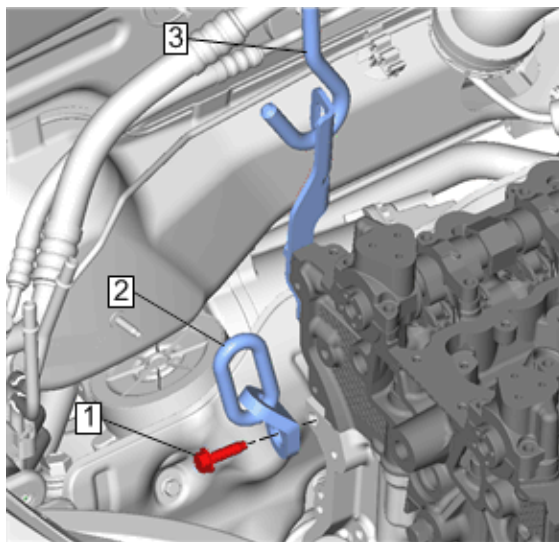


Fig. 200: Engine Lift Bracket, Fixture Hook And Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a device to support the engine while repositioning the lift hook.

- 34. Install the **EN-36857** engine lift bracket (2) then install the fastener (1).
- 35. Reposition the engine support fixture hook (3) to the newly installed **EN-36857** engine lift bracket (2).

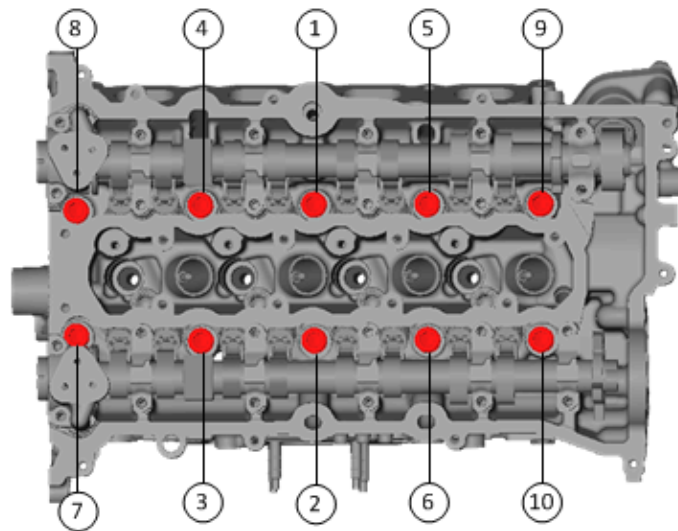


Fig. 201: Cylinder Head Bolt Loosening/Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

36. Loosen the 10 cylinder head bolts in sequence as shown.

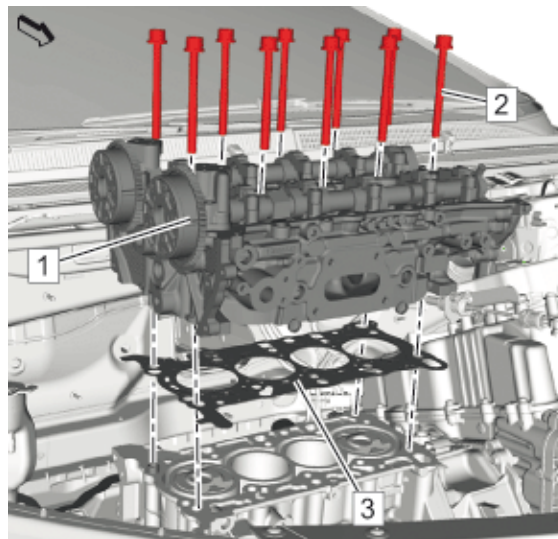


Fig. 202: Cylinder Head, Bolts And Gasket
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: In order to prevent damage to the valves and injectors during cylinder head removal, set the cylinder head on blocks.

37. Remove and DISCARD Cylinder Head Bolts (2) (Qty: 10)
38. Remove Cylinder Head (1)
39. Remove and DISCARD Cylinder Head Gasket (3).
40. In case of re-use, then clean and inspect the cylinder head. Refer to [Cylinder Head Cleaning and Inspection](#).

Disassemble Procedure

1. Remove Fuel Injection Pump. Refer to [Fuel Injection Pump Replacement](#)
2. Remove Engine Lift Front Bracket. Refer to [Engine Lift Front Bracket Replacement](#)
3. Remove Engine Lift Rear Bracket. Refer to [Engine Lift Rear Bracket Replacement](#)
4. Remove Exhaust Camshaft. Refer to [Exhaust Camshaft Replacement](#)
5. Remove Intake Camshaft. Refer to [Intake Camshaft Replacement](#)
6. Remove Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)
7. Remove Hydraulic Valve Lash Adjuster. Refer to [Hydraulic Valve Lash Adjuster Replacement](#)
8. Disassembly cylinder head. Refer to [Cylinder Head Disassemble](#)

Assemble Procedure

1. Assemble cylinder head. Refer to [Cylinder Head Assemble](#)
2. Install Hydraulic Valve Lash Adjuster. Refer to [Hydraulic Valve Lash Adjuster Replacement](#)
3. Install Hydraulic Valve Lash Adjuster Arm. Refer to [Hydraulic Valve Lash Adjuster Arm Replacement](#)
4. Install Intake Camshaft. Refer to [Intake Camshaft Replacement](#)
5. Install Exhaust Camshaft. Refer to [Exhaust Camshaft Replacement](#)
6. Install Engine Lift Rear Bracket. Refer to [Engine Lift Rear Bracket Replacement](#)
7. Install Engine Lift Front Bracket. Refer to [Engine Lift Front Bracket Replacement](#)
8. Install Fuel Injection Pump. Refer to [Fuel Injection Pump Replacement](#)

Installation Procedure

1. Clean all sealing surfaces.
2. Inspect the flatness of cylinder head and the engine block sealing surfaces.

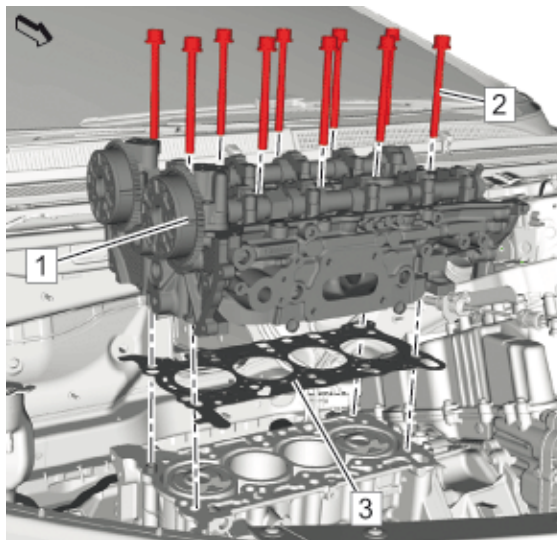


Fig. 203: Cylinder Head, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the cylinder head and the cylinder block sealing surfaces are clear of oil, grease and old gasket material.

3. Install a NEW cylinder head gasket (3).
4. Install Cylinder Head (1)
5. Install, but do NOT tighten NEW Cylinder Head Bolts (2) (Qty: 10) - Use NEW bolts.

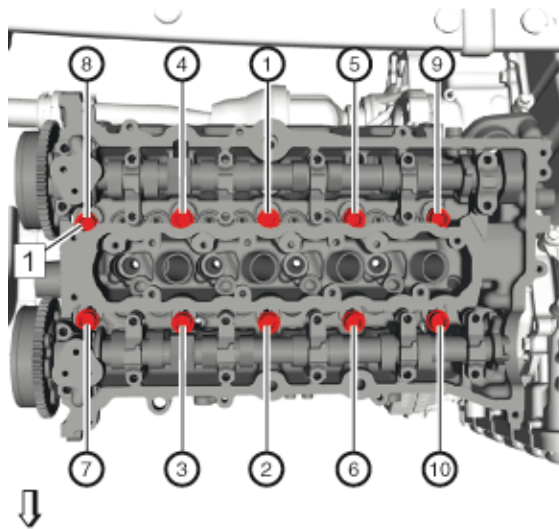


Fig. 204: Cylinder Head Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

CAUTION: Refer to Torque-to-Yield Fastener Caution

6. Tighten Cylinder Head Bolts (2) (Qty: 10) in sequence
 1. First Pass: 25 N.m (18 lb ft).
 2. Second Pass: 30 N.m (22 lb ft)
 3. Final Pass: 240 degrees, use the **EN-45059** meter.

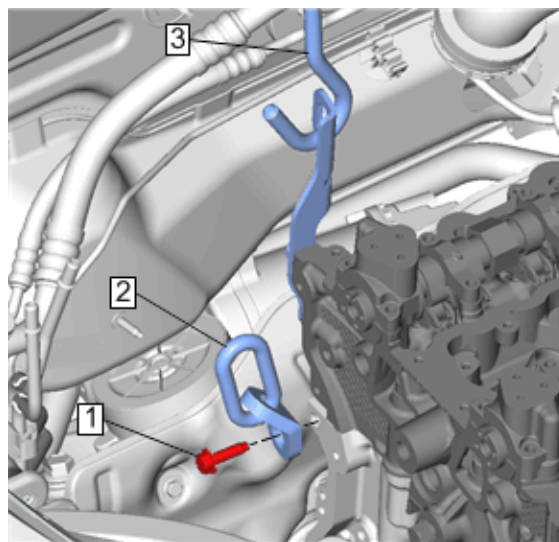


Fig. 205: Engine Lift Bracket, Fixture Hook And Bolt
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a device to support the engine while repositioning the lift hook.

7. Remove Bolt (1)
8. Reposition the lift hook (3) from the **EN-36857** engine lift bracket (2) to the cylinder head lift bracket.
9. Remove **EN-36857** engine lift bracket

10. Remove the suitable device holding the engine during lift hook repositioning.

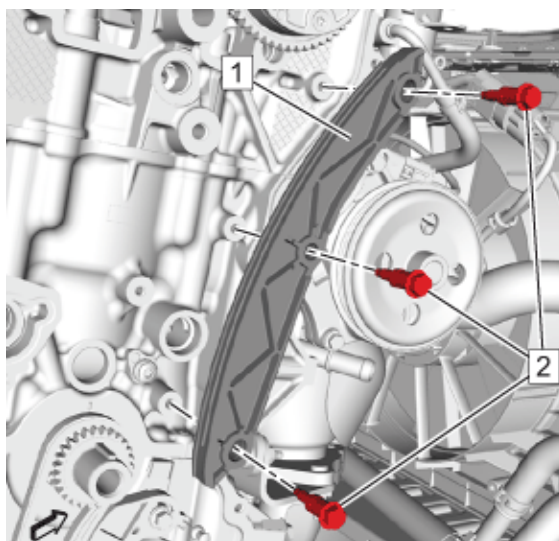


Fig. 206: Right Side Timing Chain Guide And Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Install Timing Chain Guide (1)

12. Install and tighten Timing Chain Guide Bolts (2) (Qty: 3) to 10 N.m (89 lb in)

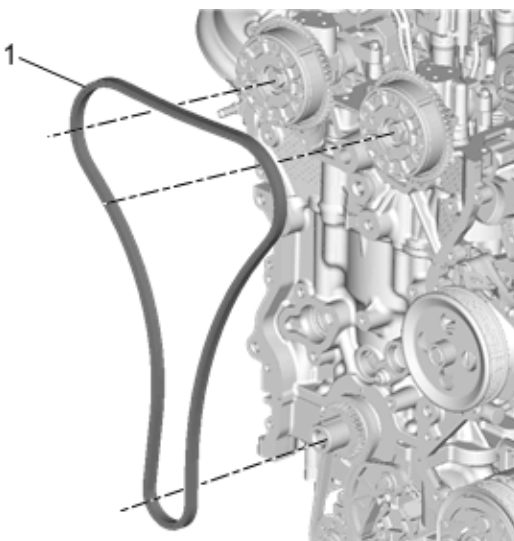


Fig. 207: Timing Chain
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the actuator timing marks are approximately the 12 o'clock position.

13. Install Timing Chain (1)

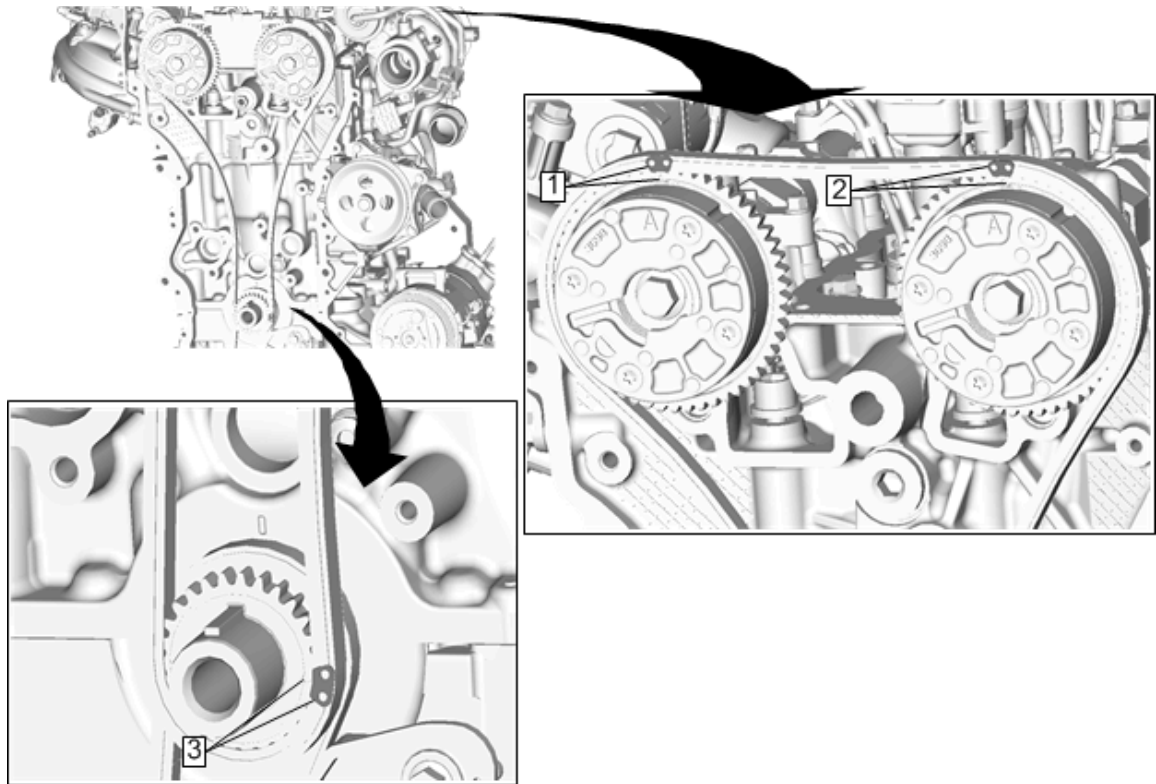


Fig. 208: Timing Chain Marks

Courtesy of GENERAL MOTORS COMPANY

14. Ensure that the colored link (3) matches to the arrow on the crankshaft sprocket.
15. Ensure that the colored links (1, 2) match to the marks on the camshaft position adjuster actuators.

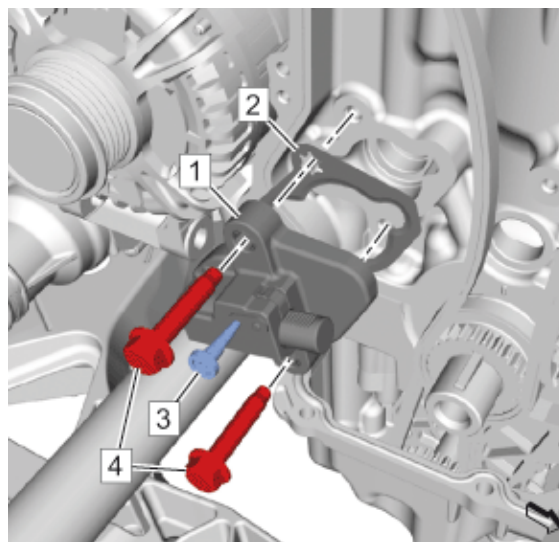


Fig. 209: Timing Chain Tensioner Tool, Timing Chain Tensioner, Bolts And Gasket

Courtesy of GENERAL MOTORS COMPANY

16. Install a NEW gasket. (2)
17. Install Timing Chain Tensioner (1)
18. Install and tighten Timing Chain Tensioner Bolts (4) (Qty: 2) 25 N.m (18 lb ft)

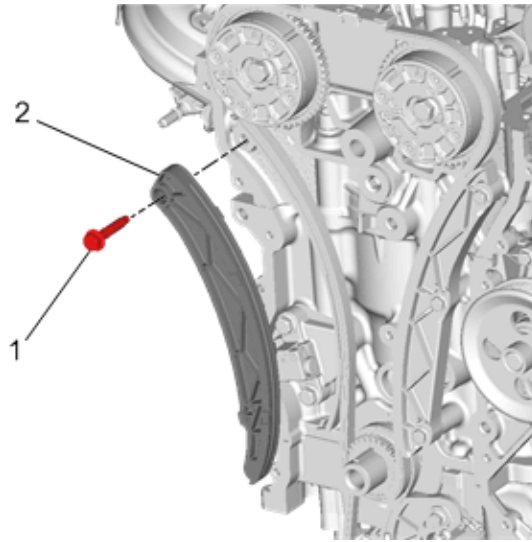


Fig. 210: Timing Chain Tensioner Shoe And Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Install Timing Chain Tensioner Shoe (2)
20. Install and tighten Timing Chain Tensioner Shoe Bolt (1) to 25 N.m (18 lb ft)
21. Remove the suitable tool (3) from the timing chain tensioner.

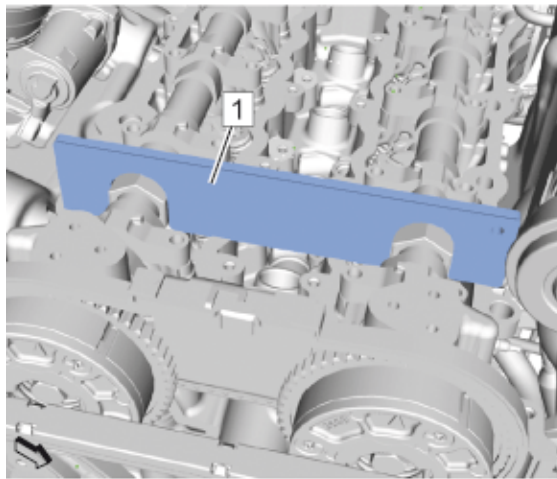


Fig. 211: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

22. Remove the EN-51367 holder (1).
23. Install Timing Chain Upper Guide. Refer to [Timing Chain Upper Guide Replacement](#)
24. Check the position of the crankshaft, camshaft and camshaft position actuator adjuster:
 1. Install the engine front cover with 4 bolts and the crankshaft balancer.

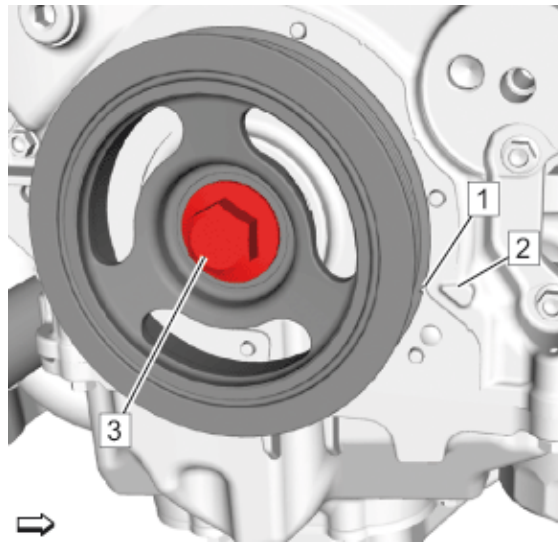


Fig. 212: Crankshaft Balancer Markings
Courtesy of GENERAL MOTORS COMPANY

2. Turn crankshaft 720 degrees in the direction of engine rotation by the crankshaft balancer bolt (3).

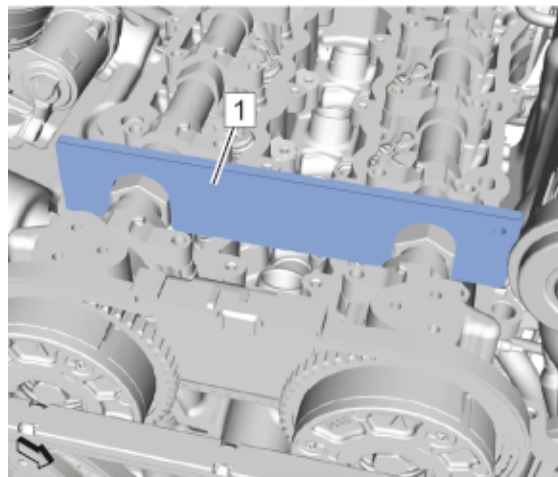


Fig. 213: Camshaft Holder
Courtesy of GENERAL MOTORS COMPANY

25. Install the **EN-51367** holder (1).
26. If the **EN-51367** holder (1) can be installed, the engine timing is properly adjusted.
27. Remove the **EN-51367** holder.
28. Remove the engine front cover and crankshaft balancer.

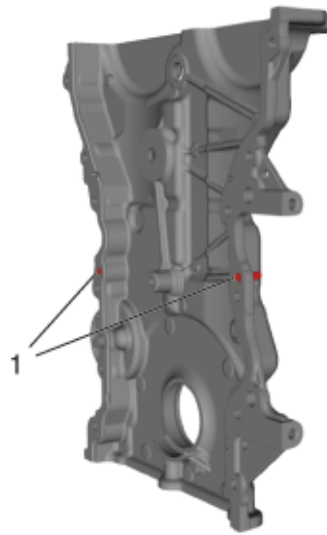


Fig. 214: Coiled Spring Pins And Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

29. Gently tap coiled spring pins (1) back into front cover so they are flush with front cover sealing surface.

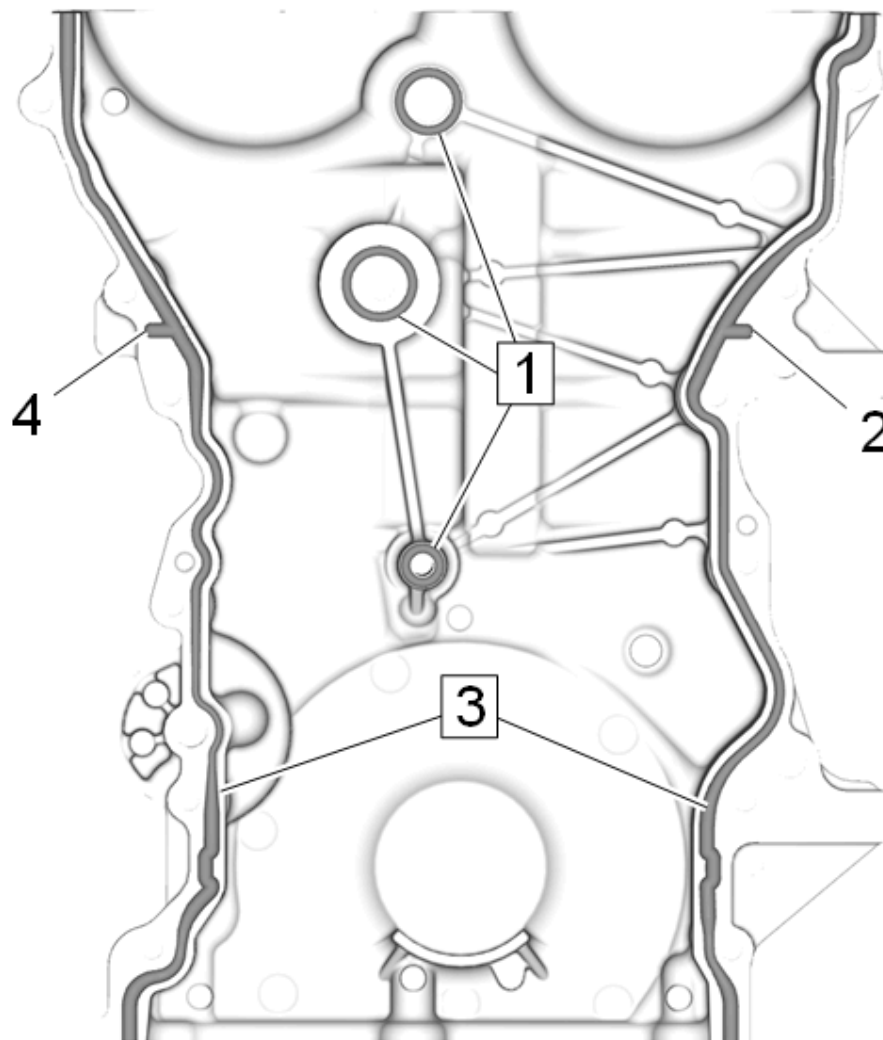


Fig. 215: Engine Front Cover Sealant Application Areas

Courtesy of GENERAL MOTORS COMPANY

NOTE: The lower crankcase and oil pan mating surfaces must be free of contamination prior to applying the sealer.

Install and align the oil pan to block within 20 minutes of applying the sealer.

The oil pan must be fastened to final torque specification within 60 minutes of applying the sealer.

Additional sealant is necessary to reduce the possibility of leakage where the cylinder head to engine block interface along the bead path flange on the front cover.

30. Apply approximately a 4 mm (0.16 in) thick bead of engine front cover sealant (2) to the engine lower front cover. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended sealant.
31. Apply a 3 mm (0.12 in) bead of sealer circling 3 locations (1) on the interior of the engine front cover.

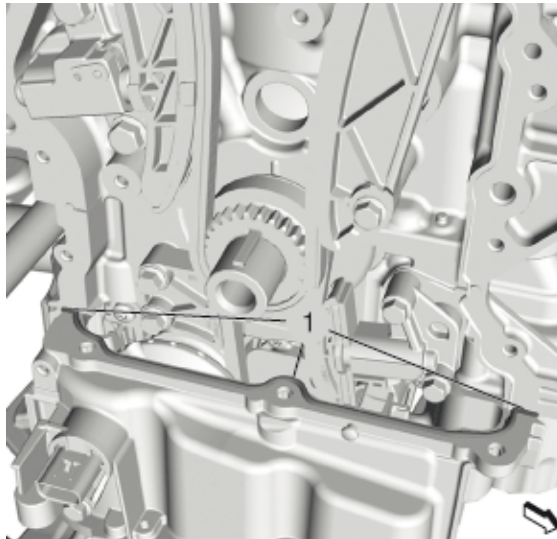


Fig. 216: Oil Pan Sealant Application Areas

Courtesy of GENERAL MOTORS COMPANY

32. Apply a 3 mm (0.12 in) bead of sealer circling 3 locations (1) on the oil pan. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended sealant.

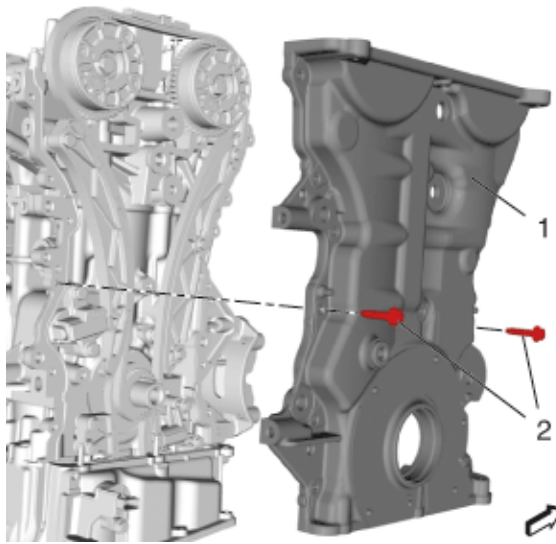


Fig. 217: Engine Front Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

33. Install Engine Front Cover (1)
34. Install Engine Front Cover Bolts (2) (Qty: 2)
35. Hand tighten the bolts.

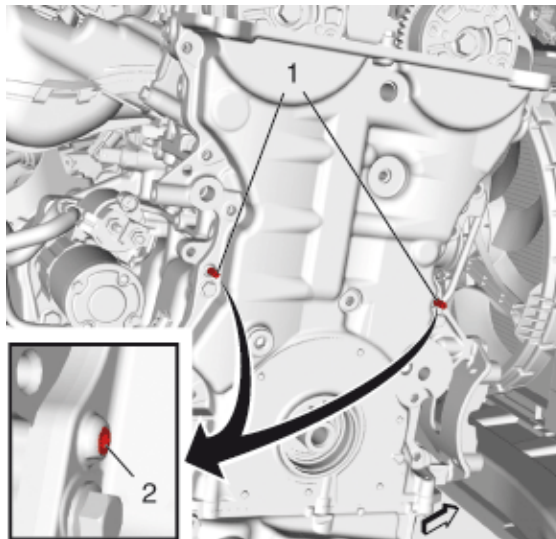


Fig. 218: Coiled Spring Pins And Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

36. Gently tap coiled spring pins (1) back into cover until pins are flush with front cover (2).

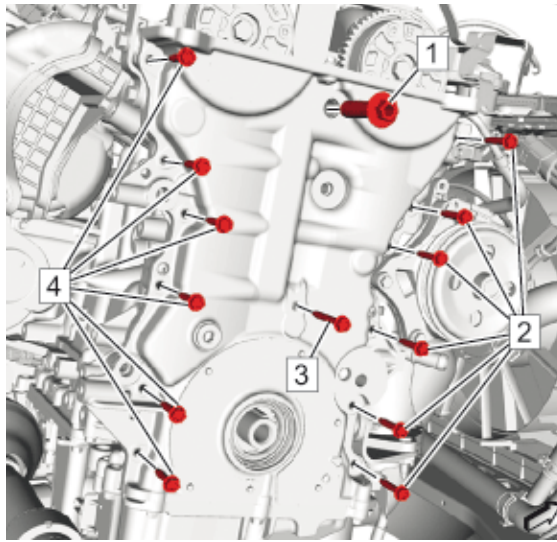


Fig. 219: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

- 37. Install Engine Front Cover Bolt (2, 4) (Qty: 10)
- 38. Install Engine Front Cover Bolt (1)
- 39. Install Engine Front Cover Bolt (3)

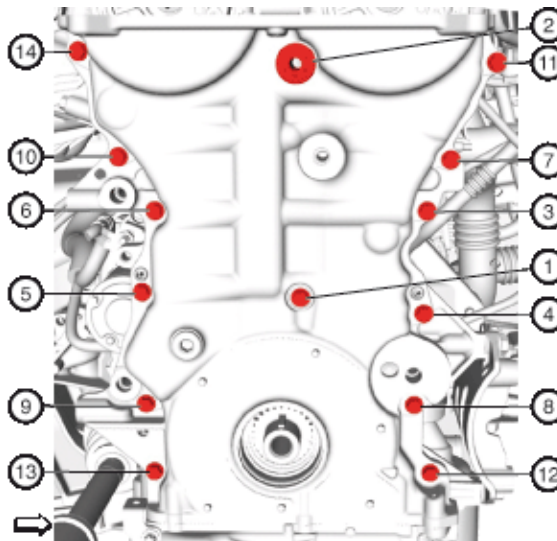


Fig. 220: Engine Front Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

- 40. Tighten the bolts in the sequence shown.
- 41. Tighten Engine Front Cover Bolt (2) to 58 N.m (43 lb ft)
- 42. Tighten all other engine front cover bolts to 15 N.m (11 lb ft).

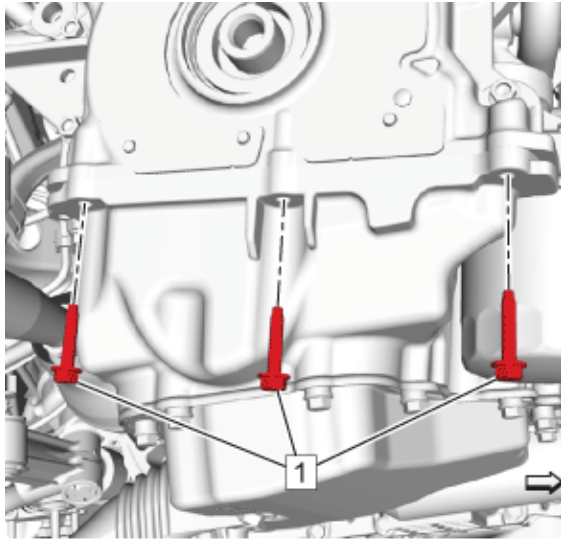


Fig. 221: Oil Pan Bolts And Upper Oil Pan
Courtesy of GENERAL MOTORS COMPANY

43. Install and tighten Oil Pan Bolts (1) (Qty: 3) to 10 N.m (89 lb in).
44. Install Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)
45. Install Water Pump Belt. Refer to [Water Pump Belt Replacement](#)
46. Lower the vehicle.
47. Install Engine Mount Bracket. Refer to [Engine Mount Bracket Replacement](#)

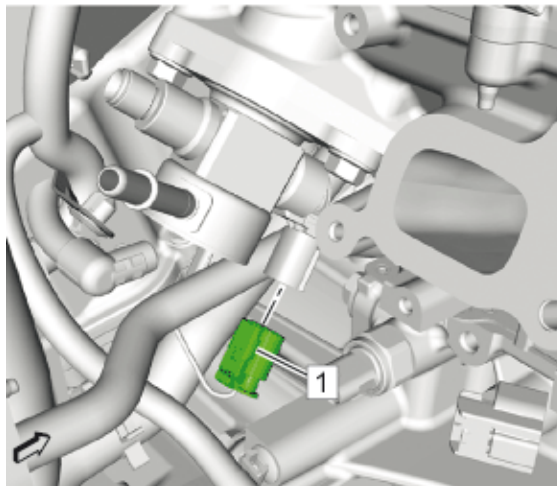


Fig. 222: Electrical Connector And Fuel Injection Pump
Courtesy of GENERAL MOTORS COMPANY

48. Connect Electrical Connector (1) @ Fuel Injection Pump
49. Install Water Outlet. Refer to [Water Outlet Replacement](#)
50. Install Three-Way Catalytic Converter. Refer to [Three-Way Catalytic Converter Replacement](#)
51. Install Intake Manifold. Refer to [Intake Manifold Replacement](#)
52. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
53. Install Exhaust Gas Recirculation Valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#)

54. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
55. Fill the engine oil to the proper level with NEW engine oil. Refer to [Approximate Fluid Capacities](#)
56. Enable the high voltage system. Refer to [High Voltage Enabling](#)

ENGINE FRONT COVER REPLACEMENT

Removal Procedure

1. Remove Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
2. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
3. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
4. Remove Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)

NOTE: Remove the air conditioning and drive motor battery cooling compressor replacement without disconnect any hoses and lines.

5. Reposition away Air Conditioning and Drive Motor Battery Cooling Compressor. Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#)
6. Drain the engine oil. Refer to [Draining Fluids and Oil Filter Removal](#)
7. Remove Engine Mount Bracket. Refer to [Engine Mount Bracket Replacement](#)

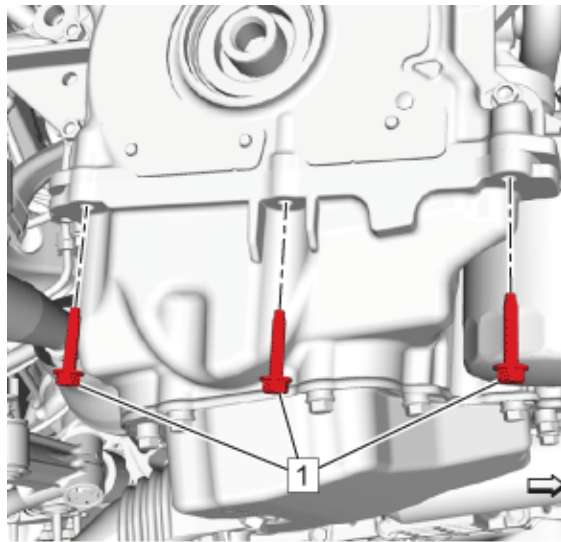


Fig. 223: Oil Pan Bolts And Upper Oil Pan
Courtesy of GENERAL MOTORS COMPANY

8. Remove Oil Pan Bolts (1) (Qty: 3) @ Upper Oil Pan

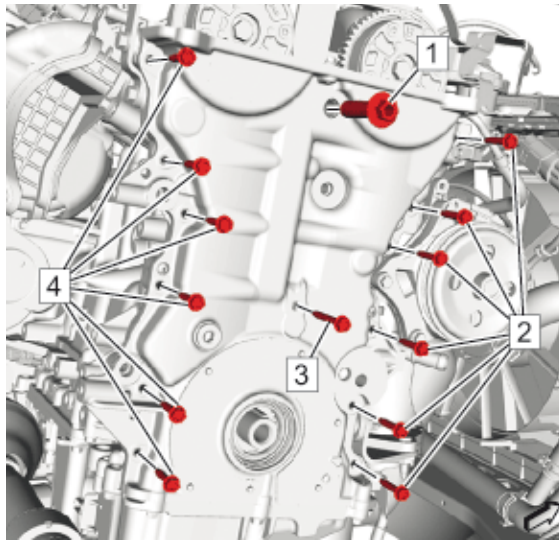


Fig. 224: Engine Front Cover Bolts
 Courtesy of GENERAL MOTORS COMPANY

9. Remove Engine Front Cover Bolts (2, 4) (Qty: 12)
10. Remove Engine Front Cover Bolt (1)
11. Remove Engine Front Cover Bolt (3)

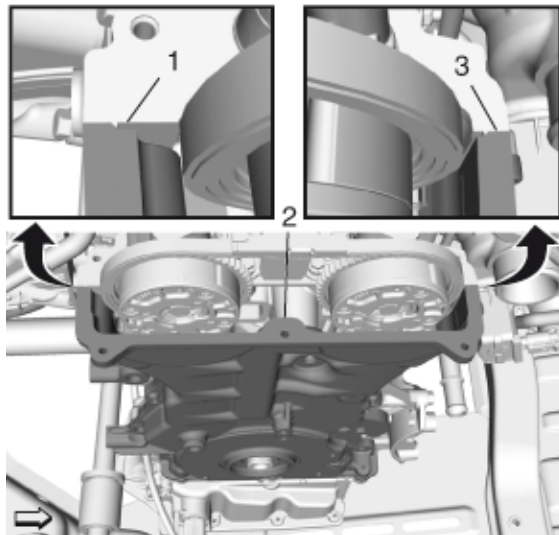


Fig. 225: Engine Front Cover Pry Points
 Courtesy of GENERAL MOTORS COMPANY

12. Loosen the engine front cover carefully from the engine, use a suitable tool at the location as shown to pry (1, 2, 3).

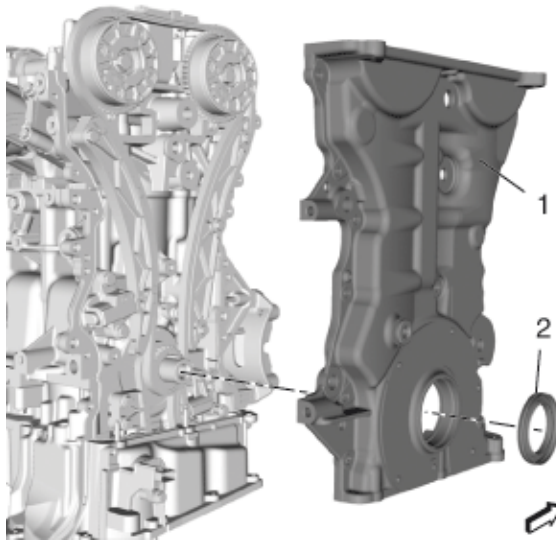


Fig. 226: Engine Front Cover And Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Front Cover (1)
14. Remove Crankshaft Front Oil Seal (2)
15. Clean all sealing surfaces.

Installation Procedure

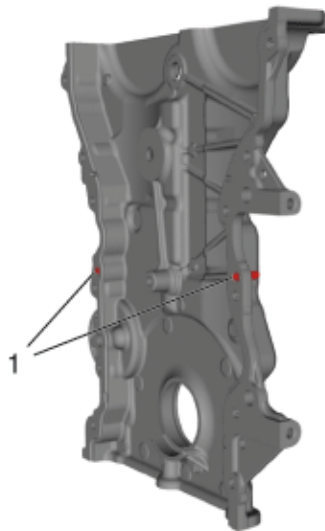


Fig. 227: Coiled Spring Pins And Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

1. Gently tap coiled spring pins (1) back into front cover so they are flush with front cover sealing surface.

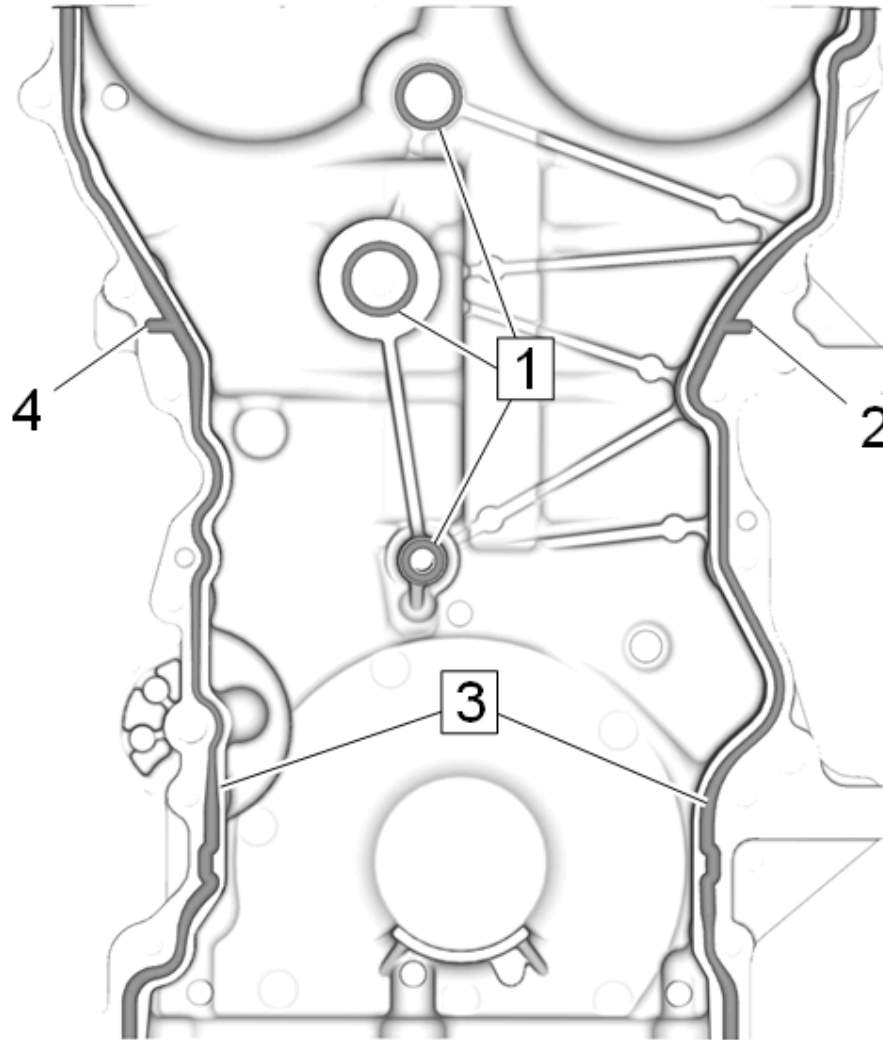


Fig. 228: Engine Front Cover Sealant Application Areas

Courtesy of GENERAL MOTORS COMPANY

NOTE: The lower crankcase and oil pan mating surfaces must be free of contamination prior to applying the sealer.

Install and align the oil pan to block within 20 minutes of applying the sealer.

The oil pan must be fastened to final torque specification within 20 minutes of applying the sealer.

Additional sealant is necessary to reduce the possibility of leakage where the cylinder head to engine block interface along the bead path flange on the front cover.

2. Apply approximately a 4 mm (0.16 in) thick bead of engine front cover sealant (2) to the engine lower front cover. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended sealant.
3. Apply a 3 mm (0.12 in) bead of sealer circling 3 locations (1) on the interior of the engine front cover.

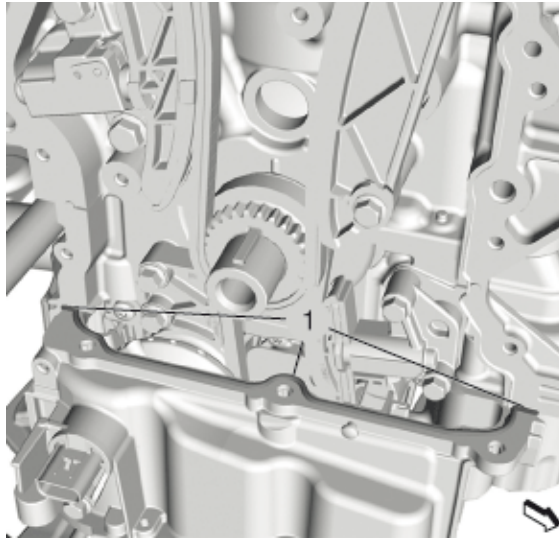


Fig. 229: Oil Pan Sealant Application Areas
Courtesy of GENERAL MOTORS COMPANY

4. Apply a 3 mm (0.12 in) bead of sealer circling 3 locations (1) on the oil pan. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) for the recommended sealant.

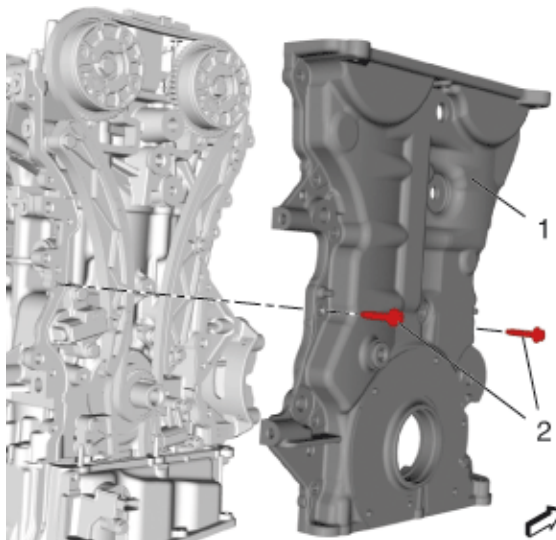


Fig. 230: Engine Front Cover And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install Engine Front Cover (1)
6. Install Engine Front Cover Bolts (2) (Qty: 2)
7. Hand tighten the bolts.

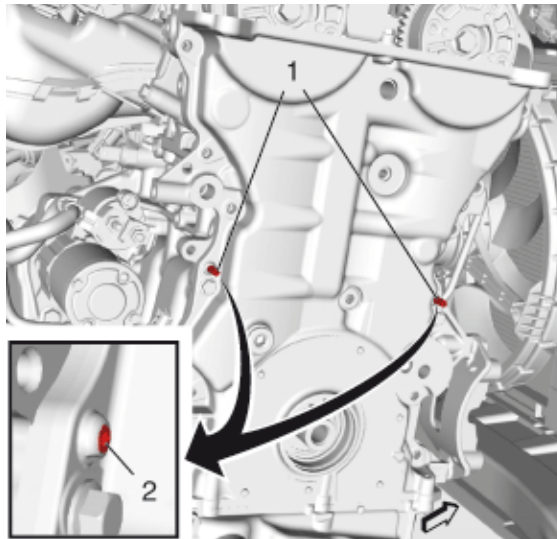


Fig. 231: Coiled Spring Pins And Engine Front Cover
Courtesy of GENERAL MOTORS COMPANY

8. Gently tap coiled spring pins (1) back into cover until pins are flush with front cover (2).

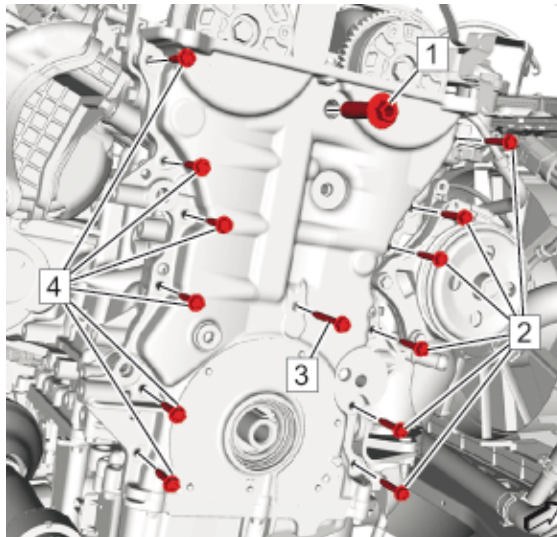


Fig. 232: Engine Front Cover Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Front Cover Bolts (2, 4) (Qty: 10)
10. Install Engine Front Cover Bolt (1)
11. Install Engine Front Cover Bolt (3)

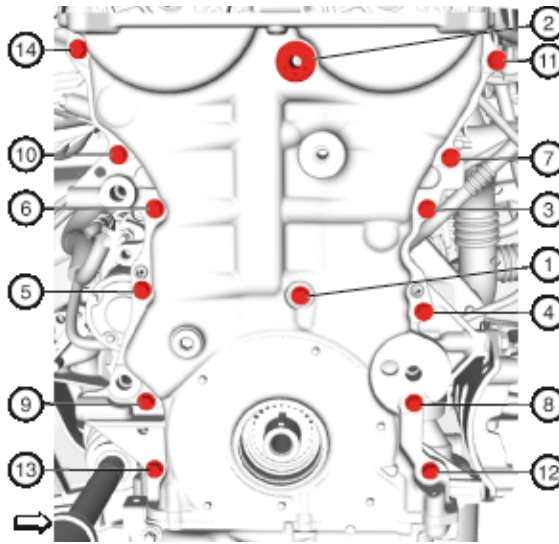


Fig. 233: Engine Front Cover Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

12. Tighten the bolts in the sequence shown.
13. Tighten Engine Front Cover Bolt (2) to 58 N.m (43 lb ft)
14. Tighten all other engine front cover bolts to 15 N.m (11 lb ft).

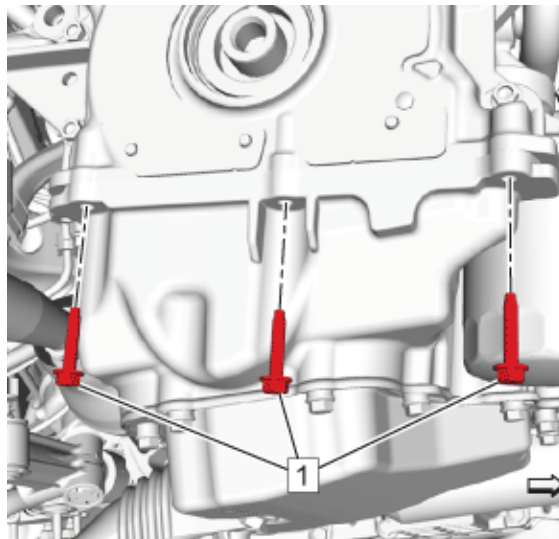


Fig. 234: Oil Pan Bolts And Upper Oil Pan
 Courtesy of GENERAL MOTORS COMPANY

15. Install and tighten Oil Pan Bolts (1) (Qty: 3) to 10 N.m (89 lb in)
16. Install Crankshaft Front Oil Seal. Refer to [Crankshaft Front Oil Seal Replacement](#)
17. Lower the vehicle.
18. Install Engine Mount Bracket. Refer to [Engine Mount Bracket Replacement](#)
19. Install Air Conditioning and Drive Motor Battery Cooling Compressor. Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#)
20. Install Crankshaft Balancer. Refer to [Crankshaft Balancer Replacement](#)

21. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
22. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
23. Install Camshaft Cover. Refer to [Camshaft Cover Replacement](#)
24. Check and correct the engine oil level. Refer to [Approximate Fluid Capacities](#)

ENGINE MOUNT BRACKET REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
3. Lower the vehicle.
4. Install Engine Support Fixture. Refer to [Engine Support Fixture](#)
5. Remove Engine Mount. Refer to [Engine Mount Replacement](#)
6. Adjust the engine support fixture to position the engine as necessary to gain access the engine mount bracket bolts.

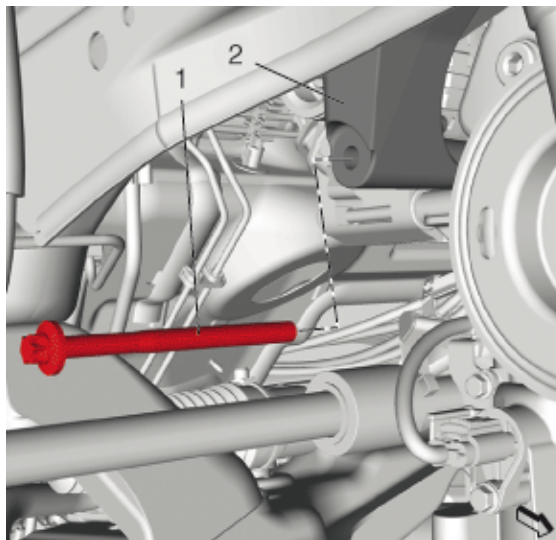


Fig. 235: Engine Mount Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove and DISCARD Engine Mount Bracket Bolt (1) @ Engine Mount Bracket (2)

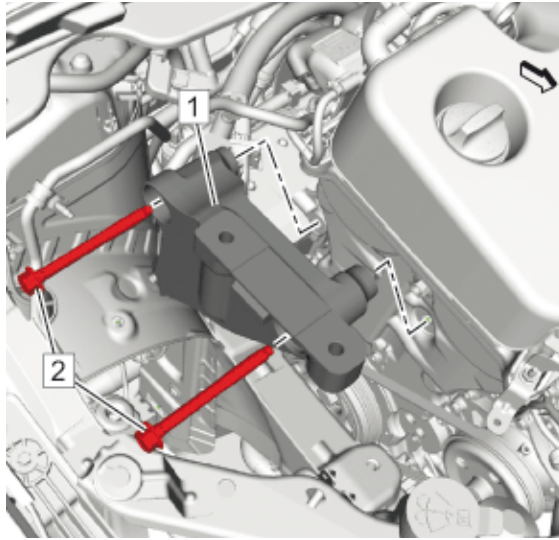


Fig. 236: Engine Mount Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

8. Remove and DISCARD Engine Mount Bracket Bolts (2) (Qty: 2)
9. Remove Engine Mount Bracket (1)

Installation Procedure

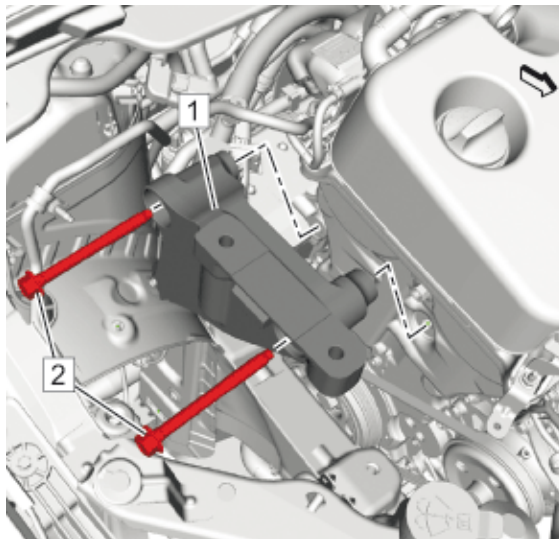


Fig. 237: Engine Mount Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Mount Bracket (1)
2. Install NEW Engine Mount Bracket Bolts (2) (Qty: 2). Use NEW bolts.

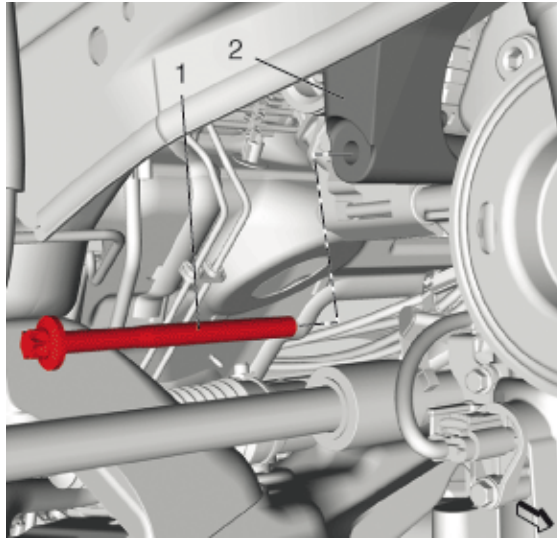


Fig. 238: Engine Mount Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install NEW Engine Mount Bracket Bolt (1). Install a NEW bolt.

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

4. Tighten Engine Mount Bracket Bolts (Qty: 3)
 1. First Pass: 58 N.m (43 lb ft).
 2. Final Pass: 90 - 105 degrees, use the **EN-45059** meter.
5. Install Engine Mount. Refer to [Engine Mount Replacement](#)
6. Remove Engine Support Fixture. Refer to [Engine Support Fixture](#)
7. Raise the vehicle.
8. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
9. Lower the vehicle.

ENGINE MOUNT REPLACEMENT

Special Tools

J-36857 Engine Lift Bracket

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)

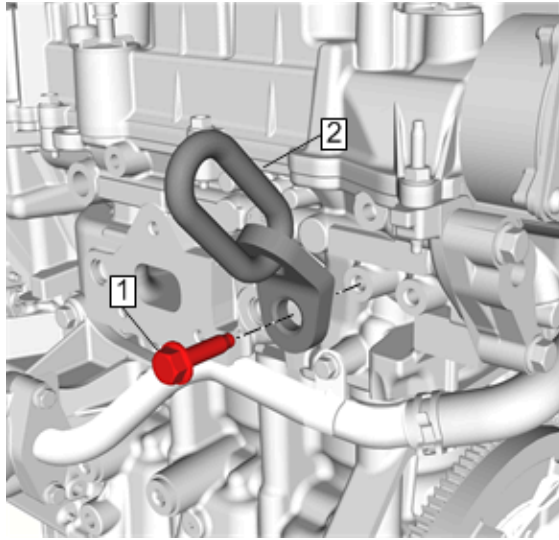


Fig. 239: Engine Lift Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install the J-36857 Bracket (2) into the engine block bore.

CAUTION: Refer to [Fastener Caution](#)

3. Install and tighten Engine Lift Bracket Bolt (1) to 25 N.m (18 lb ft)
4. Using a hydraulic engine lifter, support the engine at the J-36857 Bracket Apply tension to the hydraulic lifter.

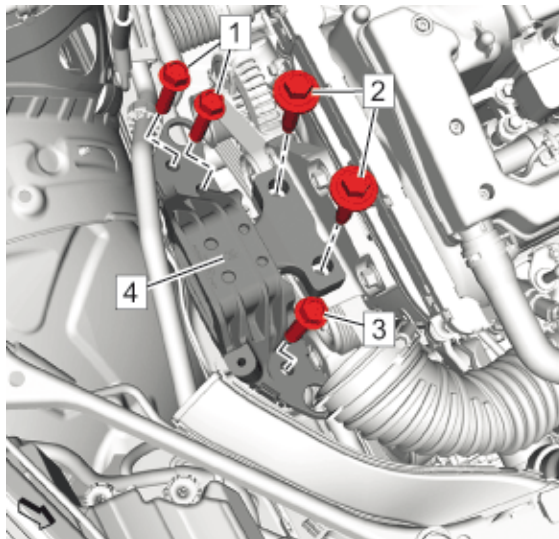


Fig. 240: Engine Mount, Engine Mount Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD the 2 engine mount to engine mount bracket bolts (2).
6. Remove and DISCARD the 3 engine mount to body bolts (1, 3).
7. Remove Engine Mount (4)

Installation Procedure

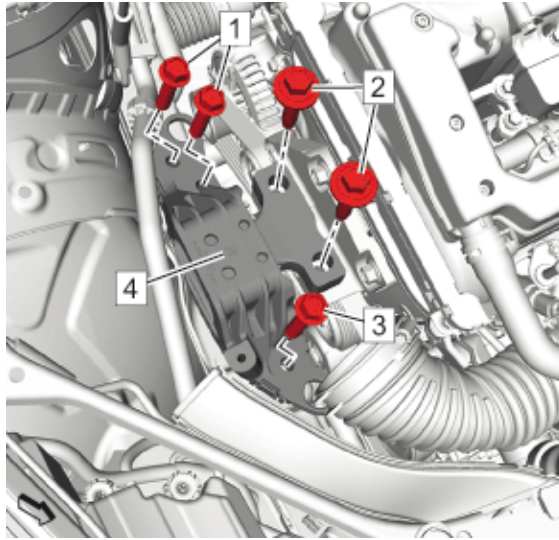


Fig. 241: Engine Mount, Engine Mount Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Engine Mount (4)
2. Install 3 NEW engine mount to body bolts (1, 3) and tighten in two passes:

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: 60 - 75 degrees - **EN-45059** meter
3. Install 2 NEW engine mount to engine mount bracket bolts (2) and tighten in two passes:

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: 60 - 75 degrees - **EN-45059** meter
4. Remove the hydraulic engine lifter from the **J-36857** Bracket.

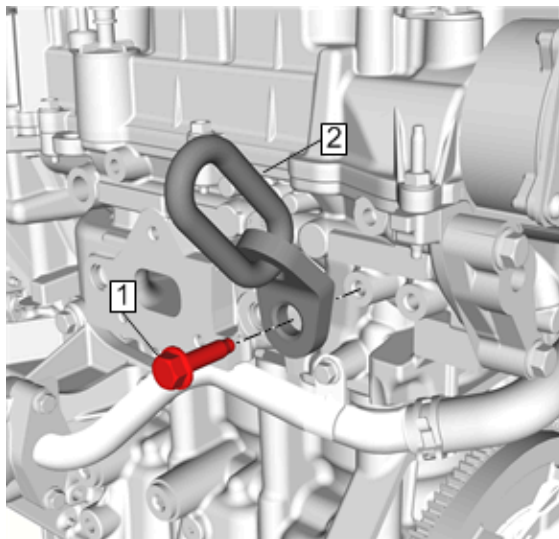


Fig. 242: Engine Lift Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Remove Engine Lift Bracket Bolt (1)
6. Remove the J-36857 Bracket (2).
7. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)

UPPER OIL PAN REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove Front Compartment Air Deflector. Refer to [Front Compartment Air Deflector Replacement](#)
3. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)

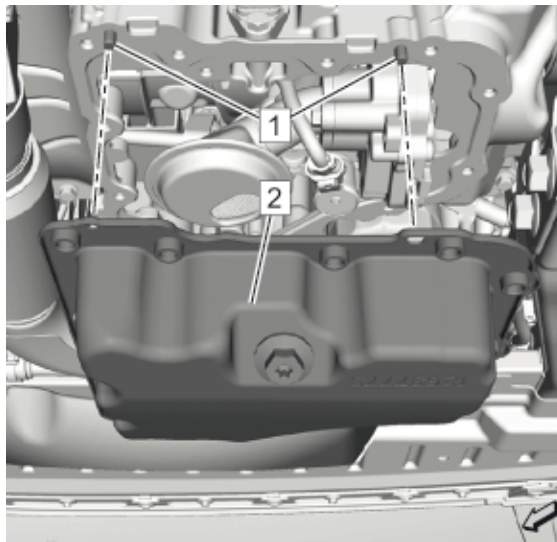


Fig. 243: Lower Oil Pan And Locating Pins

Courtesy of GENERAL MOTORS COMPANY

4. Remove Lower Oil Pan (2). Refer to [Lower Oil Pan Replacement](#)
5. Remove Transmission Mount Strut Bracket. Refer to [Transmission Mount Strut Bracket Replacement](#)
6. Remove Exhaust Muffler. Refer to [Exhaust Muffler Replacement](#)
7. Drain the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#)

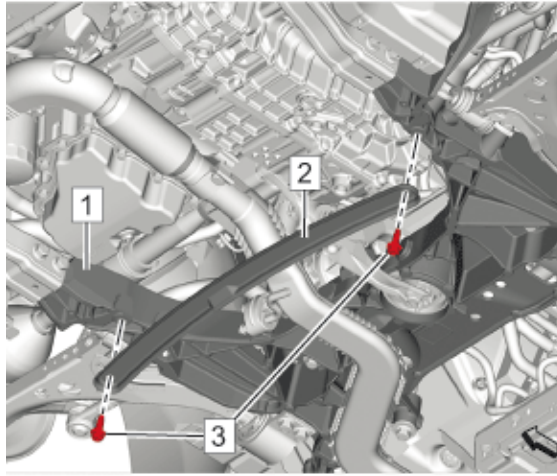


Fig. 244: Drivetrain And Front Suspension Cradle, Brace And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the drivetrain and front suspension brace bolts (3).
9. Remove the drivetrain and front suspension brace (2) from the drivetrain and front suspension cradle (1).

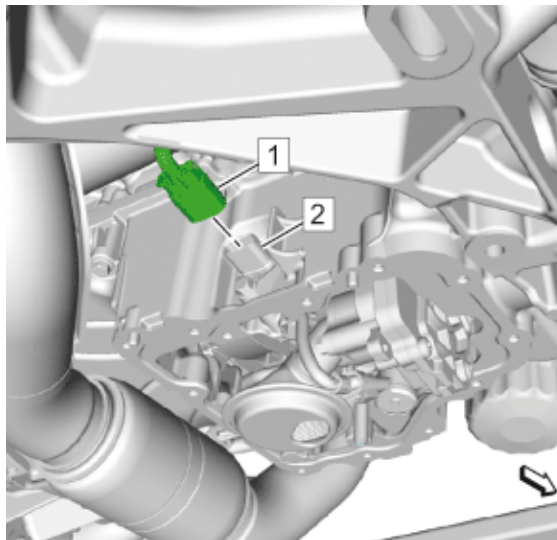


Fig. 245: Engine Oil Level Indicator Control Module Wiring Harness And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Electrical Connector (1) @ Engine Oil Level Indicator Control Module Wiring Harness (2)

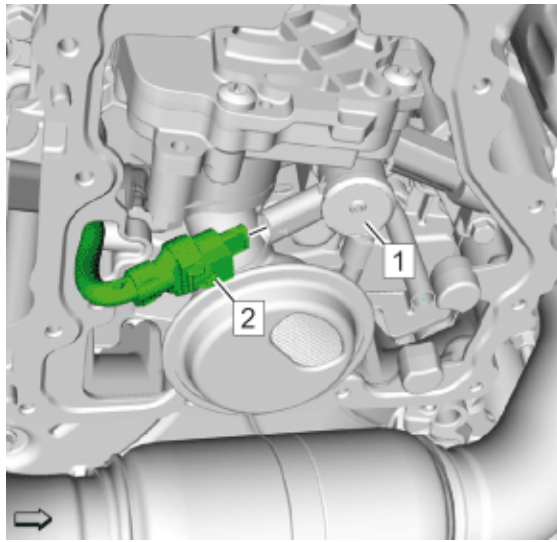


Fig. 246: Oil Pump Flow Control Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Electrical Connector (2) @ Oil Pump Flow Control Solenoid Valve (1)

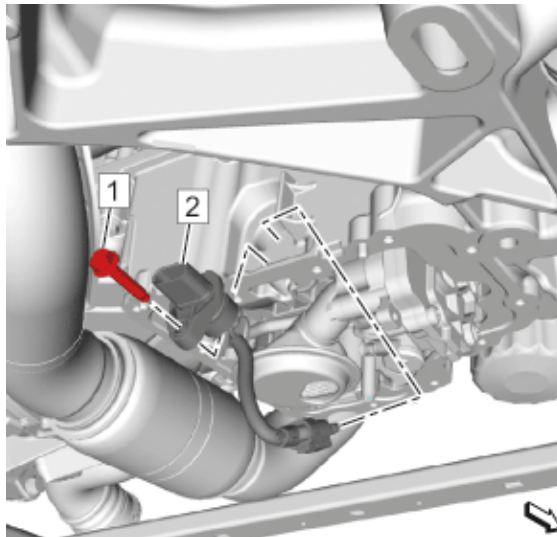


Fig. 247: Engine Oil Level Indicator Control Module, Wiring Harness And Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Remove the oil level indicator control module bolt. (1)
13. Remove Engine Oil Level Indicator Control Module Wiring Harness (2)

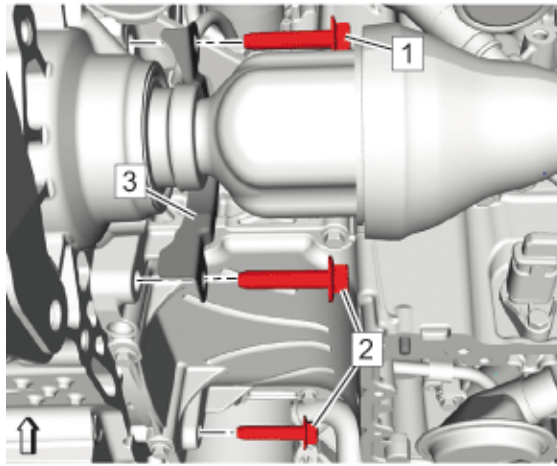


Fig. 248: Transmission Converter Cover And Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove Transmission Bolts (1, 2) (Qty: 3)
15. Remove the transmission converter cover (3).

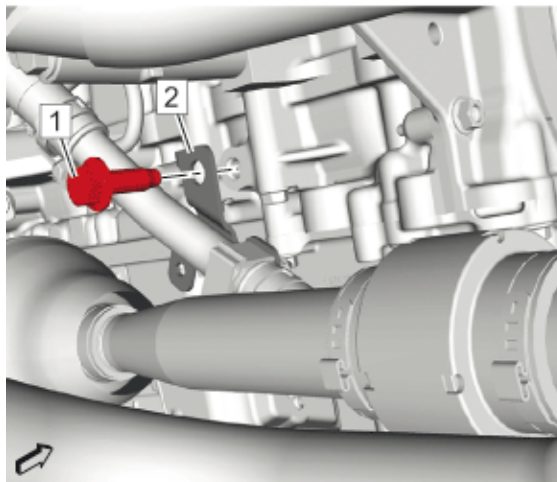


Fig. 249: Heater Inlet And Outlet Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

16. Remove Heater Inlet and Outlet Hose Bracket Bolt (1)
17. Position aside Heater Inlet and Outlet Hose Bracket (2)
18. Lower the vehicle.
19. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
20. Install Engine Support Fixture. Refer to [Engine Support Fixture](#)

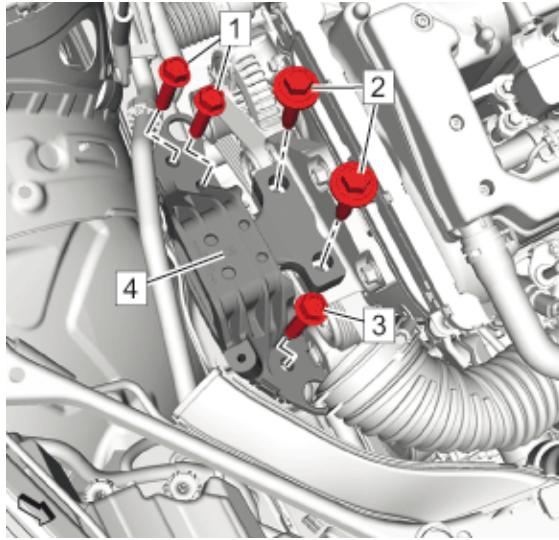


Fig. 250: Engine Mount, Engine Mount Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Remove and DISCARD the 2 engine mount to engine mount bracket bolts (2).
22. Remove and DISCARD the 3 engine mount to body bolts (1, 3).
23. Remove Engine Mount (4)
24. Raise the engine with the engine support fixture to gain enough space for the removal of the upper oil pan.
25. Raise the vehicle.

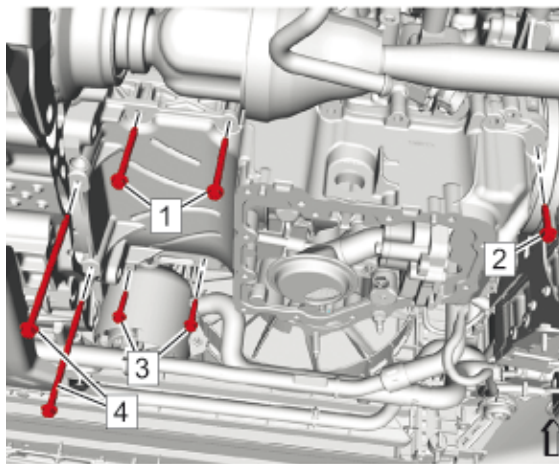


Fig. 251: Oil Pan Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: Take note that there are different bolt lengths.

26. Remove the oil pan bolts. (4) (Qty: 2)
27. Remove the oil pan bolts. (3) (Qty: 2)
28. Remove the oil pan bolts. (1, 2) (Qty: 12)

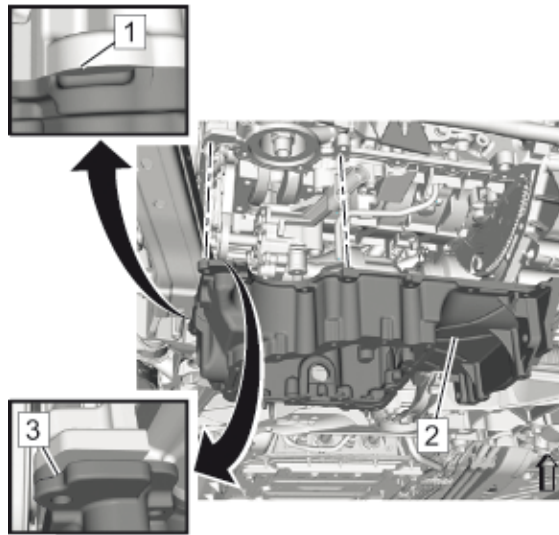


Fig. 252: Upper Oil Pan

Courtesy of GENERAL MOTORS COMPANY

29. Loosen the upper oil pan (2) carefully from the engine block, use a suitable tool at the location as shown to pry (1, 3).
30. Remove Upper Oil Pan (2)

Installation Procedure

NOTE: The lower crankcase and oil pan mating surfaces must be free of contamination prior to applying the sealer.

Install and align the oil pan to block within 20 minutes of applying the sealer.

The oil pan must be fastened to final torque specification within 60 minutes of applying the sealer.

Additional sealant is necessary to reduce the possibility of leakage where the cylinder head to engine block interface along the bead path flange on the front cover.

1. Clean the oil pan sealing surface.

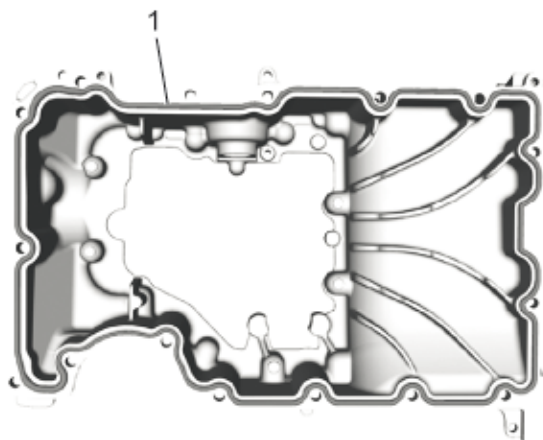


Fig. 253: Upper Oil Pan Sealer Application Areas

Courtesy of GENERAL MOTORS COMPANY

2. Apply a 2.25 mm (0.088 in) bead of sealer (1) around the perimeter of the upper oil pan. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

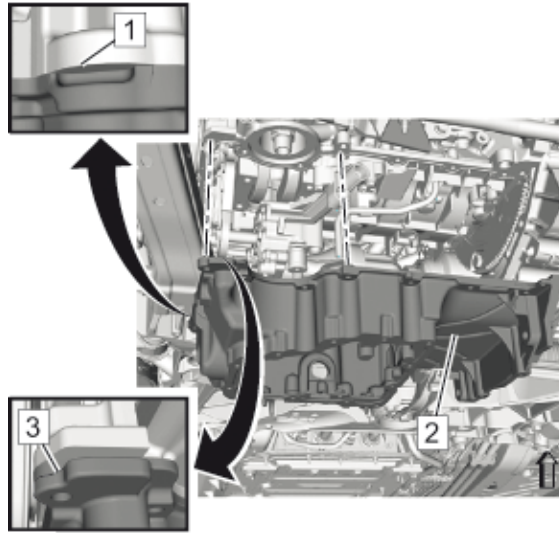


Fig. 254: Upper Oil Pan

Courtesy of GENERAL MOTORS COMPANY

3. Install Upper Oil Pan (2)

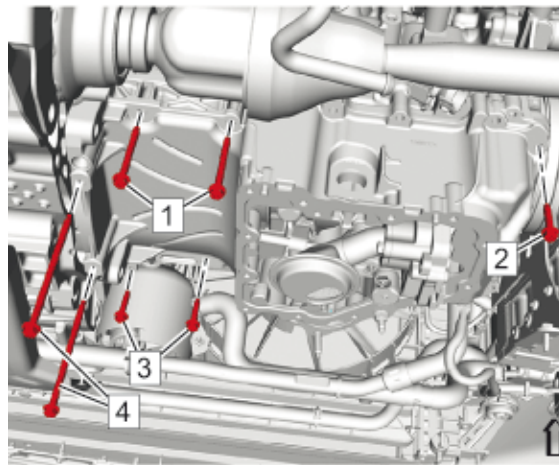


Fig. 255: Oil Pan Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Take note that there are different bolt lengths.

4. Coat the oil pan bolts (1) (2) (3) and (4) with teflon pipe sealant prior to installation. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)
5. Hand tighten Oil Pan Bolts (4) (Qty: 2)
6. Hand tighten Oil Pan Bolts (1) (Qty: 2)
7. Hand tighten Oil Pan Bolts (2, 3) (Qty: 12)

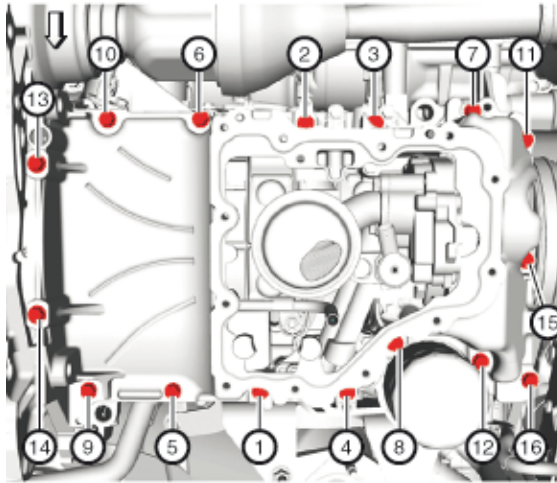


Fig. 256: Upper Oil Pan Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

NOTE: Inspect for excessive sealer around the oil filter mounting area. If extra sealer is present remove and clean accordingly.

8. Tighten Oil Pan Bolts in sequence (Qty: 16) to 10 N.m (89 lb in)
9. Lower the vehicle.
10. Move back the engine into original position.

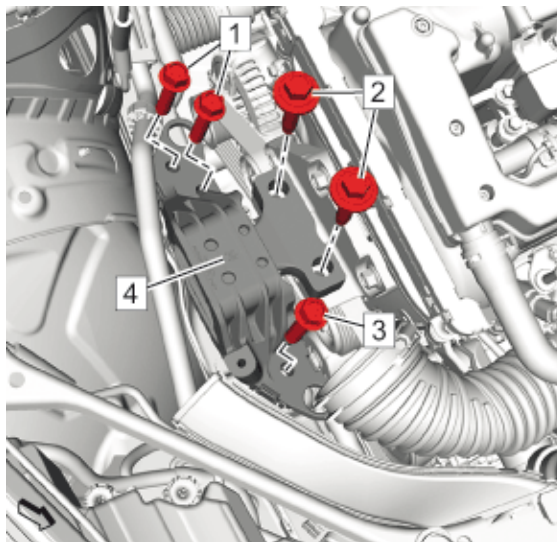


Fig. 257: Engine Mount, Engine Mount Bracket And Bolts
 Courtesy of GENERAL MOTORS COMPANY

11. Install Engine Mount (4)
12. Install 3 NEW engine mount to body bolts (1, 3) and tighten in two passes:

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

1. First Pass: 100 N.m (74 lb ft)

2. Final Pass: 60 - 75 degrees - **EN-45059** meter
13. Install 2 NEW engine mount to engine mount bracket bolts (2) and tighten in two passes:
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 60 - 75 degrees - **EN-45059** meter
14. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
15. Remove Engine Support Fixture. Refer to [Engine Support Fixture](#)
16. Raise the vehicle.

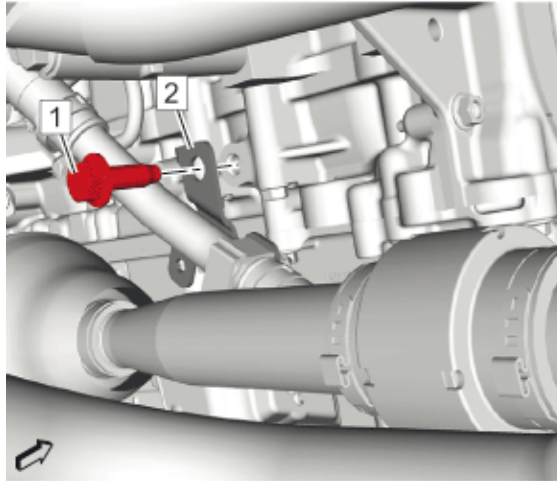


Fig. 258: Heater Inlet And Outlet Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

17. Install Heater Inlet and Outlet Hose Bracket (2)
18. Install and tighten Heater Inlet and Outlet Hose Bracket Bolt (1) to 58 N.m (43 lb ft)

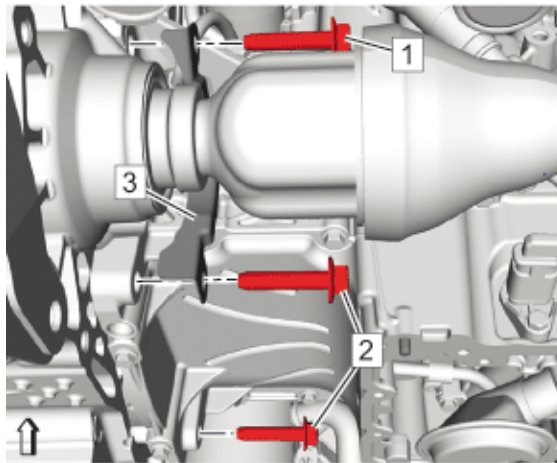


Fig. 259: Transmission Converter Cover And Transmission Bolts
Courtesy of GENERAL MOTORS COMPANY

19. Install the transmission converter cover (3).
20. Install and tighten Transmission Bolts (1, 2) (Qty: 3) to 58 N.m (43 lb ft)

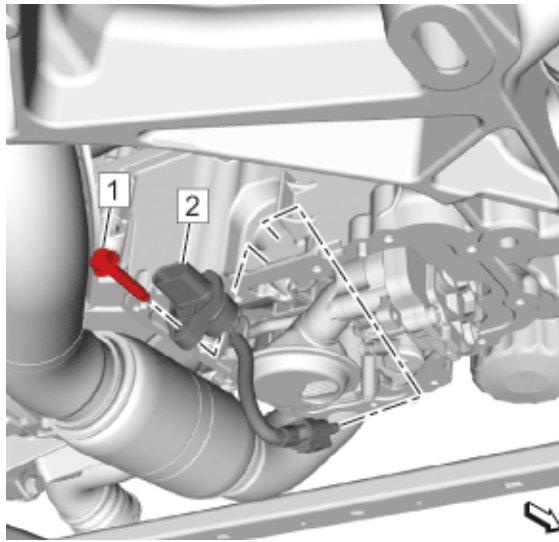


Fig. 260: Engine Oil Level Indicator Control Module, Wiring Harness And Bolt
Courtesy of GENERAL MOTORS COMPANY

21. Install Engine Oil Level Indicator Control Module Wiring Harness (2)
22. Install and tighten the drivetrain and front suspension brace bolts (3) to 10 N.m (89 lb in)

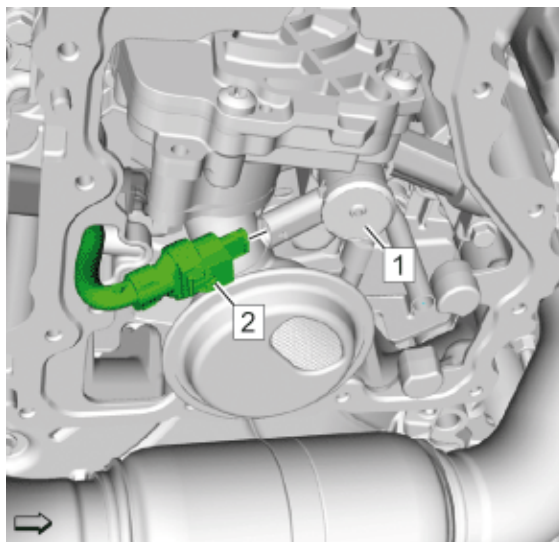


Fig. 261: Oil Pump Flow Control Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

23. Connect Electrical Connector (2) @ Oil Pump Flow Control Solenoid Valve (1)

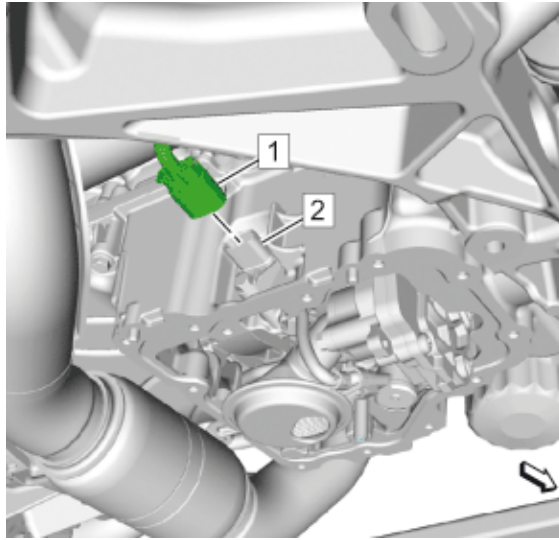


Fig. 262: Engine Oil Level Indicator Control Module Wiring Harness And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

24. Connect Electrical Connector (1) @ Engine Oil Level Indicator Control Module Wiring Harness (2)

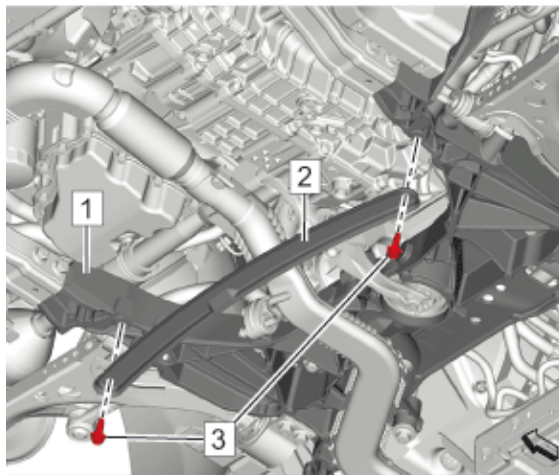


Fig. 263: Drivetrain And Front Suspension Cradle, Brace And Bolts
Courtesy of GENERAL MOTORS COMPANY

25. Install the drivetrain and front suspension brace (2) to the drivetrain and front suspension cradle (1).
26. Install and tighten the drivetrain and front suspension brace bolts (3) to 58 N.m (43 lb ft)
27. Install Exhaust Muffler. Refer to [Exhaust Muffler Replacement](#)
28. Install Transmission Mount Strut Bracket. Refer to [Transmission Mount Strut Bracket Replacement](#)

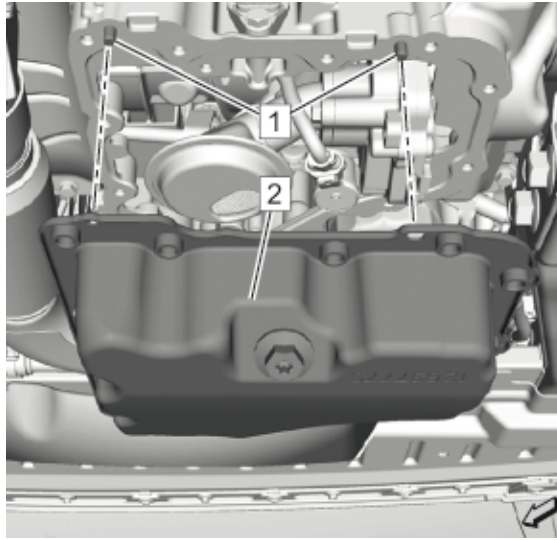


Fig. 264: Lower Oil Pan And Locating Pins
Courtesy of GENERAL MOTORS COMPANY

29. Install Lower Oil Pan (2). Refer to [Lower Oil Pan Replacement](#)
30. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
31. Install Front Compartment Air Deflector. Refer to [Front Compartment Air Deflector Replacement](#)
32. Lower the vehicle.
33. Fill the engine oil to the proper level with NEW engine oil. Refer to [Engine Oil and Oil Filter Replacement](#).

LOWER OIL PAN REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Drain the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#)

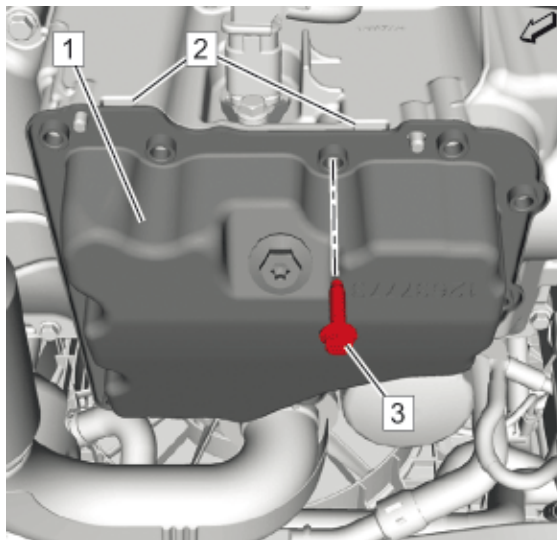


Fig. 265: Lower Oil Pan And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the oil pan bolts. (3) (Qty: 12)
4. Loosen the lower oil pan (1) carefully from the upper oil pan, use a suitable tool to pry at the location as

shown (2).

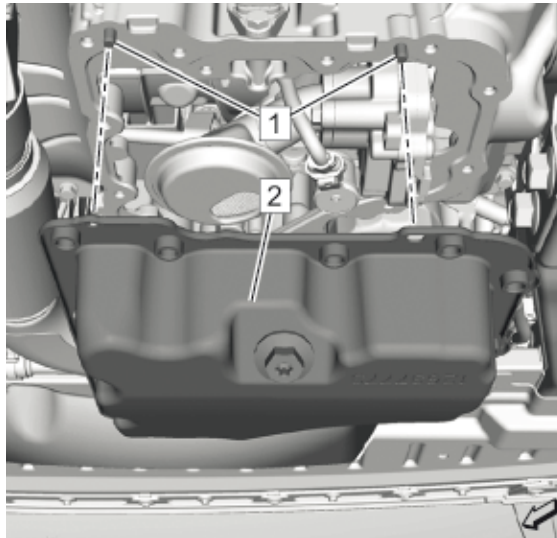


Fig. 266: Lower Oil Pan And Locating Pins
Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD Lower Oil Pan (2)

Installation Procedure

NOTE: The complete installation procedure of the lower oil pan should be completed within 20 minutes.

1. Clean the oil pan sealing surface.



Fig. 267: Lower Oil Pan Sealer Application Areas
Courtesy of GENERAL MOTORS COMPANY

2. Apply a 2.25 mm (0.088 in) bead of sealer (1) around the perimeter of the oil pan. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#)

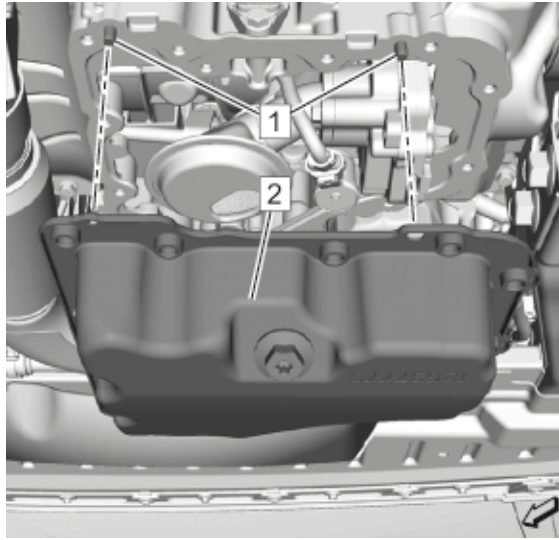


Fig. 268: Lower Oil Pan And Locating Pins
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a NEW oil pan.

3. Install NEW Lower Oil Pan (2)
4. The Pins (1) must fit into the holes.

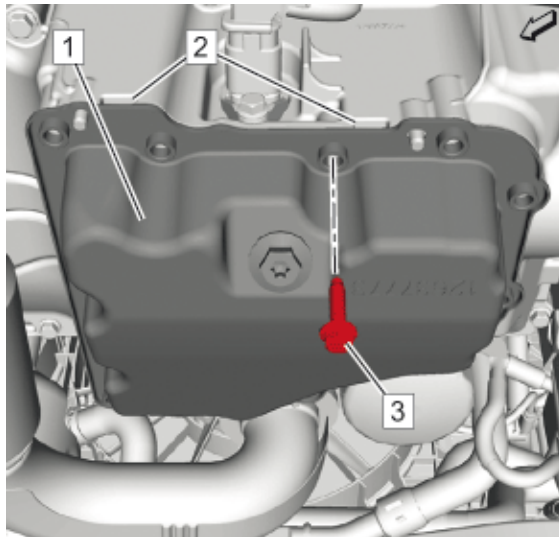


Fig. 269: Lower Oil Pan And Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Install and hand tighten the 12 oil pan bolts (3) to the lower oil pan (1).

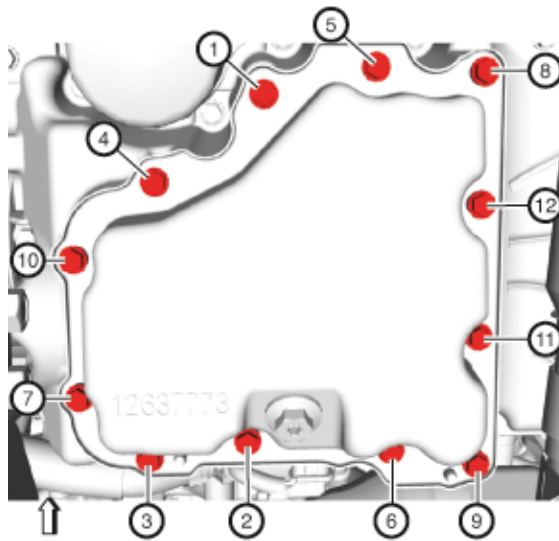


Fig. 270: Lower Oil Pan Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

6. Tighten the 12 lower oil pan bolts in sequence as shown to 10 N.m (89 lb in).
7. Lower the vehicle.
8. Fill and check the engine oil level. Refer to [Engine Oil and Oil Filter Replacement](#).

ENGINE OIL AND OIL FILTER REPLACEMENT

Special Tools

EN-726-A Oil Filter Wrench

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
3. Place a drain pan under the vehicle.

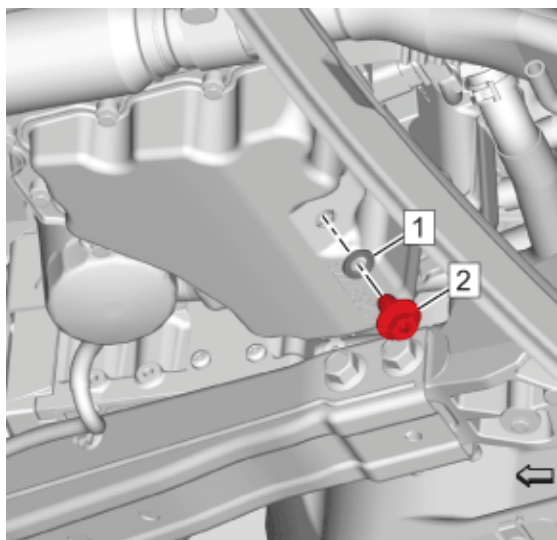


Fig. 271: Oil Pan Drain Plug And Seal

Courtesy of GENERAL MOTORS COMPANY

4. Remove the oil pan drain plug. (2)

NOTE: **Inspect the oil drain plug seal ring, replace only if damaged.**

5. Remove Oil Pan Drain Plug Seal (1)
6. Drain the engine oil into a suitable container.

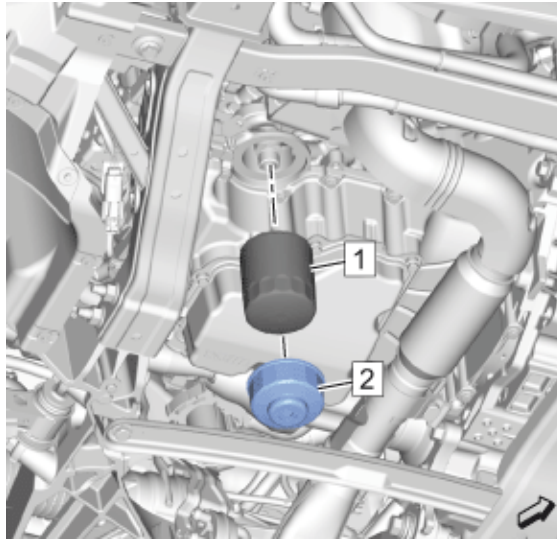


Fig. 272: Oil Filter And Wrench

Courtesy of GENERAL MOTORS COMPANY

7. Install the EN-726-A wrench (2) to the oil filter (1).

NOTE: **Ensure that the old oil filter seal has been removed.**

8. Remove and DISCARD the oil filter. (1)

Installation Procedure

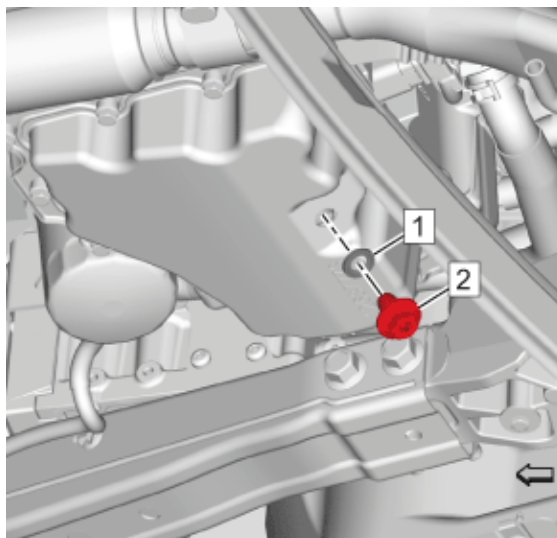


Fig. 273: Oil Pan Drain Plug And Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Clean and inspect the oil pan drain plug, replace if necessary.

1. Install Oil Pan Drain Plug Seal (1)

CAUTION: Refer to [Component Fastener Tightening Caution](#)

2. Install and tighten Oil Pan Drain Plug (2) to 25 N.m (18 lb ft)

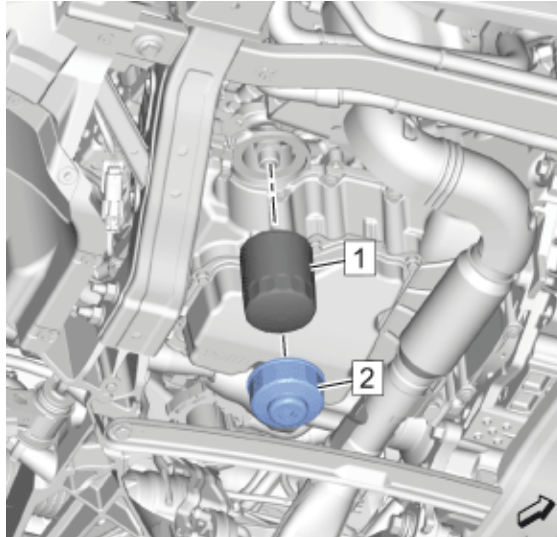


Fig. 274: Oil Filter And Wrench

Courtesy of GENERAL MOTORS COMPANY

3. Clean the engine block sealing surface.
4. Lubricate the NEW oil filter gasket with clean engine oil.
5. Install the **EN-726-A** wrench (2) to the oil filter (1).
6. Install a NEW oil filter and tighten 3/4 to 1 full turn after the gasket makes contact with the sealing surface on the filter mounting flange. (1)
7. Remove the **EN-762-A** wrench (2) from the oil filter (1).
8. Install Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
9. Lower the vehicle.

CAUTION: Using engine oils of any viscosity other than those viscosities recommended could result in engine damage.

10. Fill in NEW engine oil. Refer to [Approximate Fluid Capacities](#).
11. Start the engine and allow it to run until the oil pressure control indicator goes off.
12. Check and correct the engine oil level.
13. Reset the GM oil life system. Refer to [GM Oil Life System Resetting](#) [GM Oil Life System Resetting \(With Scan Tool\)](#) .

OIL PUMP FLOW CONTROL SOLENOID VALVE REPLACEMENT

Removal Procedure

1. Remove Lower Oil Pan. Refer to [Lower Oil Pan Replacement](#)

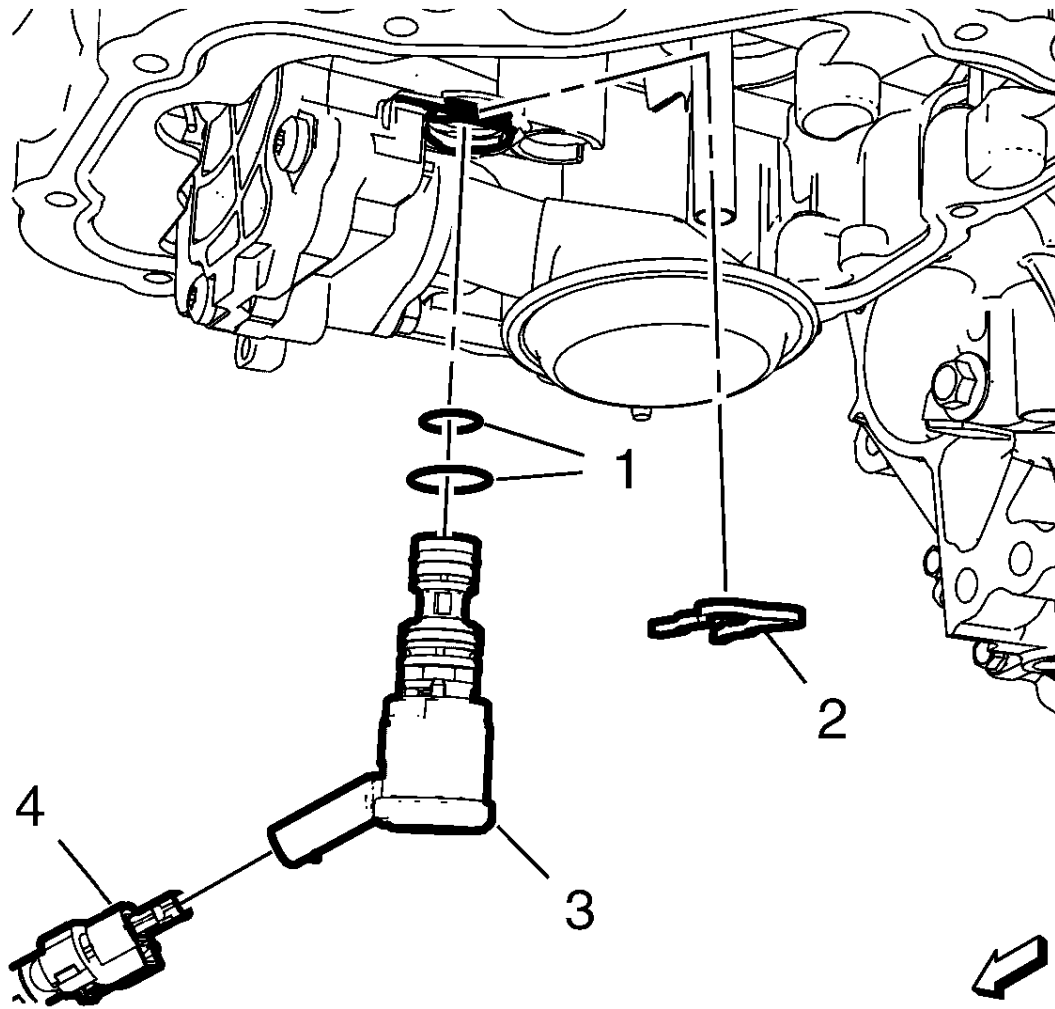


Fig. 275: Oil Pump Flow Control Solenoid Valve, Wiring Harness Plug, Retainer Clamp And Seals
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the wiring harness plug (4) from the oil pump flow control solenoid valve (3)
3. Remove the oil pump flow control solenoid valve retainer clamp (2).
4. Remove the oil pump flow control solenoid valve (3).
5. Remove and DISCARD the 2 oil pump flow control solenoid valve seals (1)

Installation Procedure

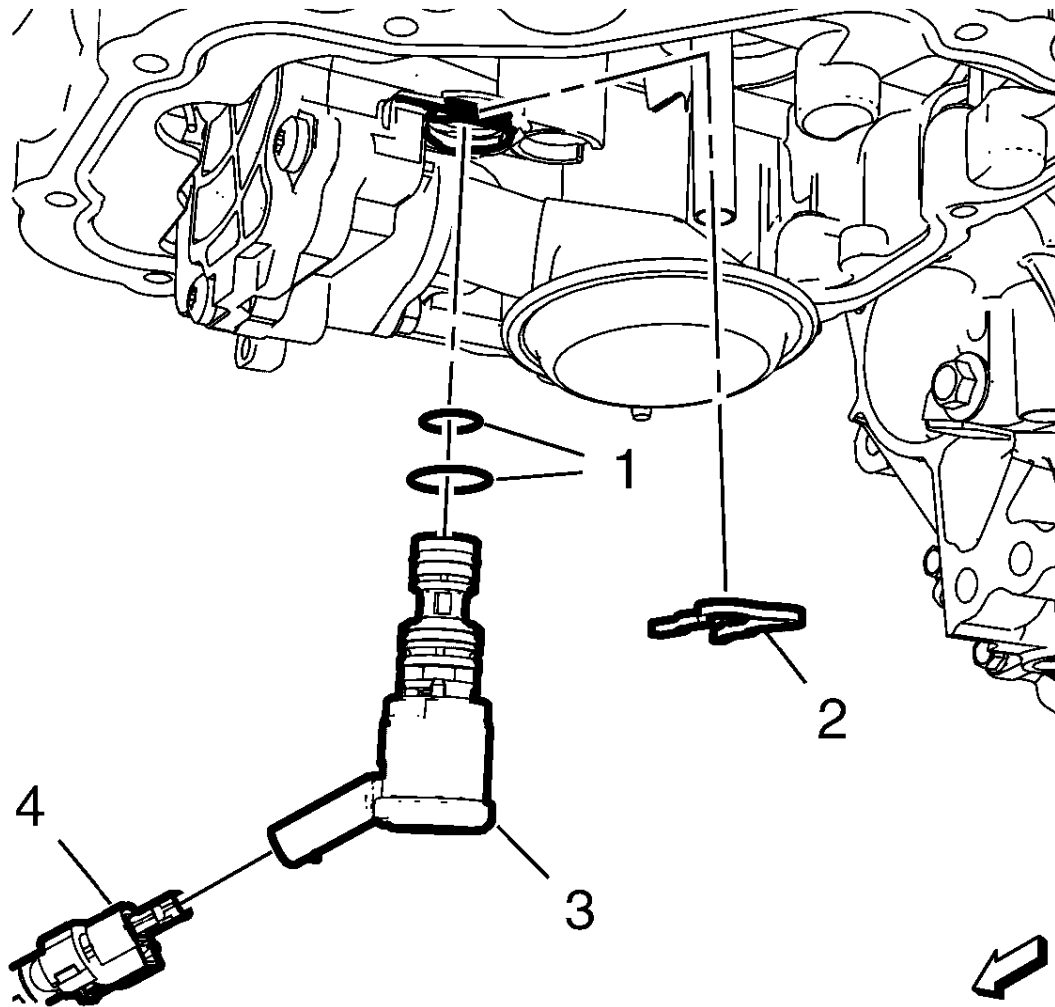


Fig. 276: Oil Pump Flow Control Solenoid Valve, Wiring Harness Plug, Retainer Clamp And Seals
Courtesy of GENERAL MOTORS COMPANY

1. Install 2 NEW oil pump flow control solenoid valve seals (1)
2. Install the oil pump flow control solenoid valve (3).
3. Install the oil pump flow control solenoid valve retainer clamp (2).
4. Connect the wiring harness plug (4) to the oil pump flow control solenoid valve (3)
5. Install Lower Oil Pan. Refer to [Lower Oil Pan Replacement](#)

OIL PUMP DRIVE CHAIN REPLACEMENT

Removal Procedure

1. Remove Camshaft Timing Chain. Refer to [Camshaft Timing Chain Replacement](#)
2. Remove Oil Pump. Refer to [Oil Pump Replacement](#)

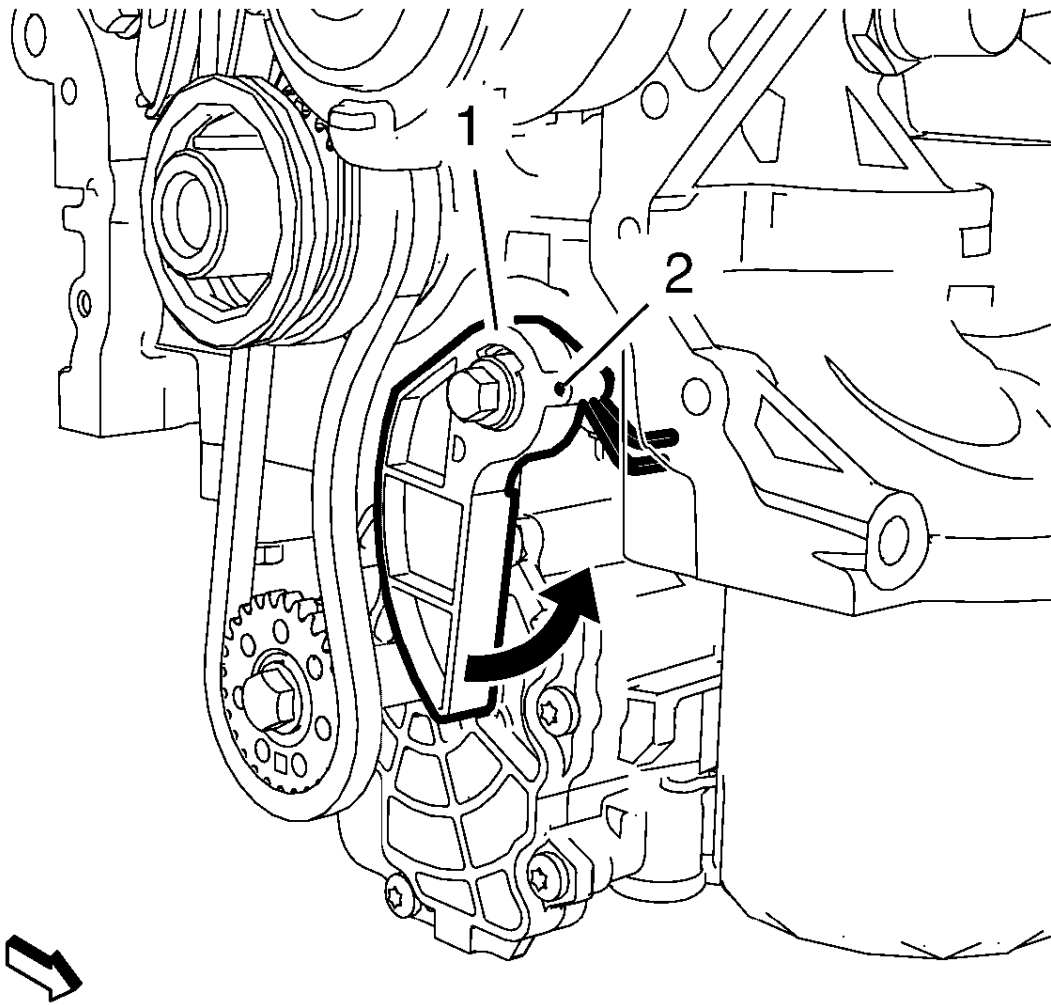


Fig. 277: Oil Pump Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

3. Tension the oil pump drive chain tensioner (1) in direction of the arrow.
4. Install a suitable locking pin tool into the hole of the oil pump drive chain tensioner (1) as shown in pry (2).

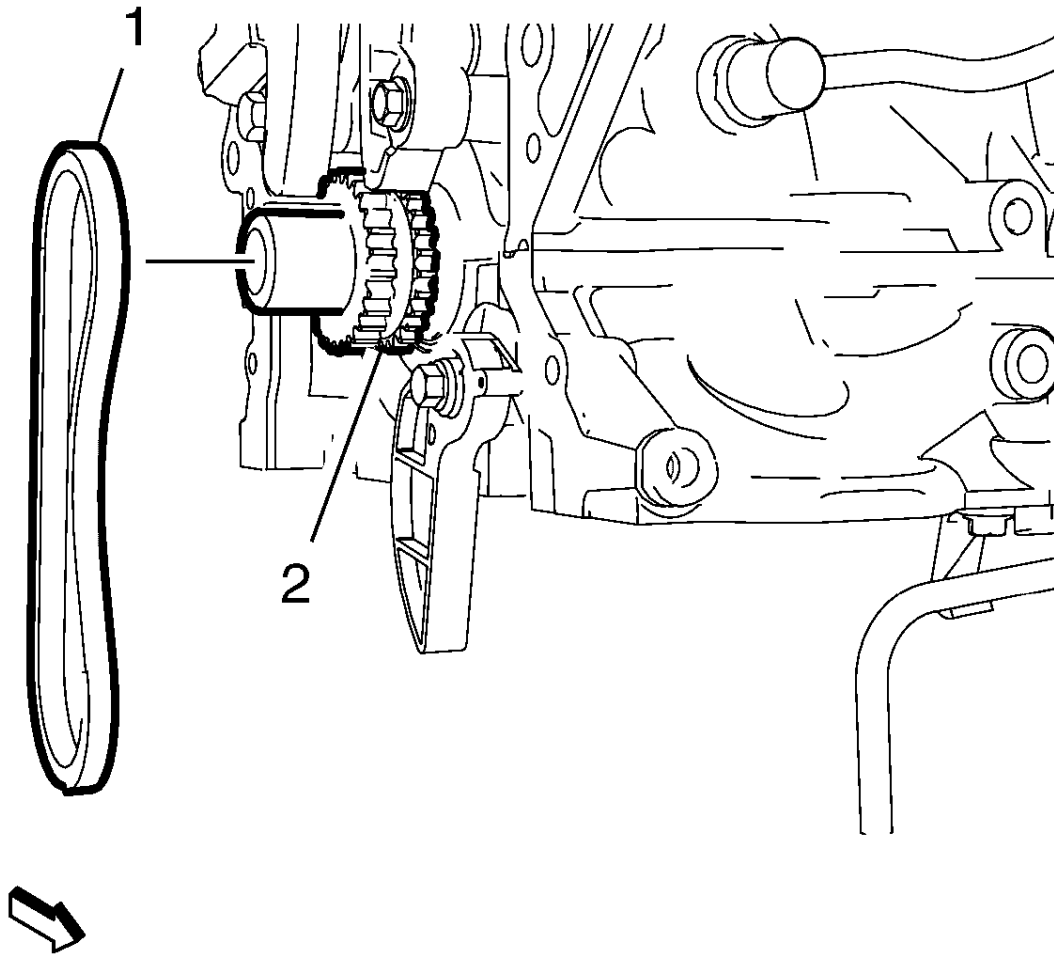


Fig. 278: Oil Pump Drive Chain And Crankshaft Sprocket
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil pump drive chain (1) from the crankshaft sprocket (2).

Installation Procedure

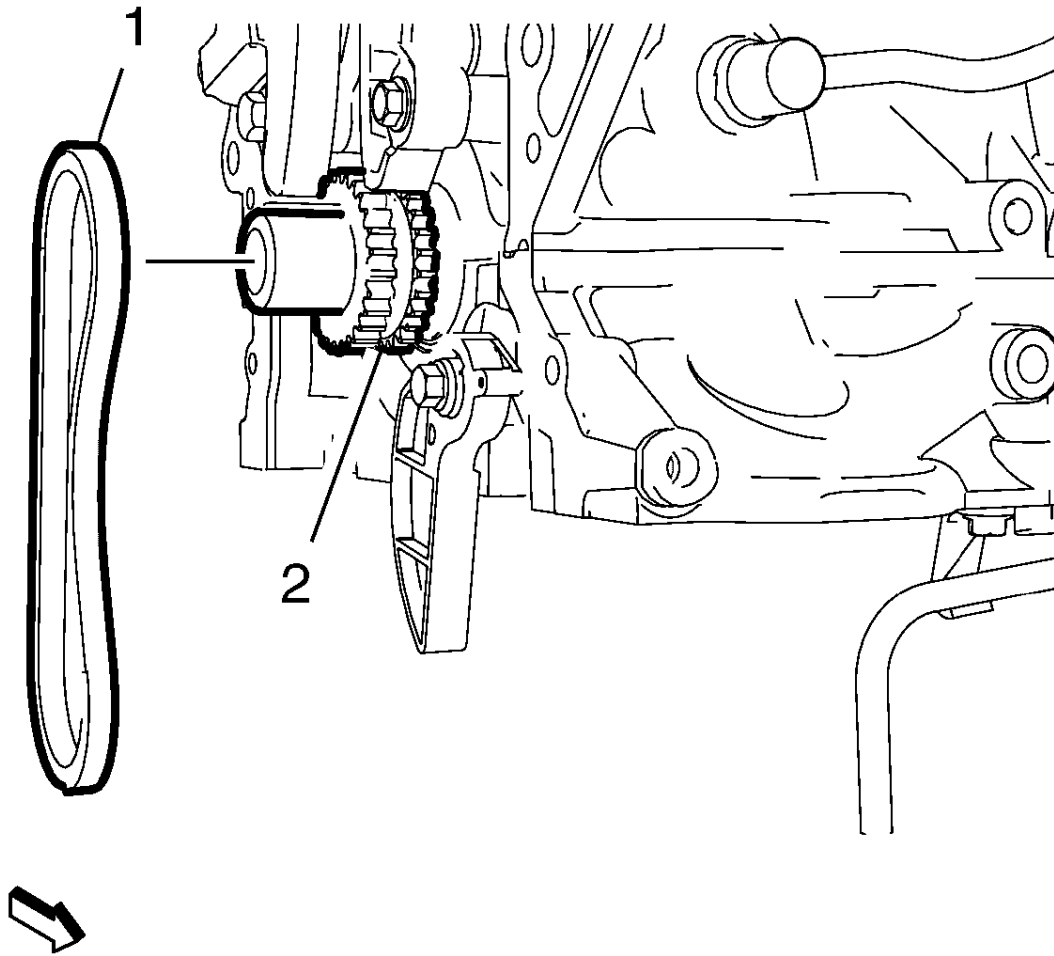


Fig. 279: Oil Pump Drive Chain And Crankshaft Sprocket
Courtesy of GENERAL MOTORS COMPANY

1. Install the oil pump drive chain (1) to the crankshaft sprocket (2).

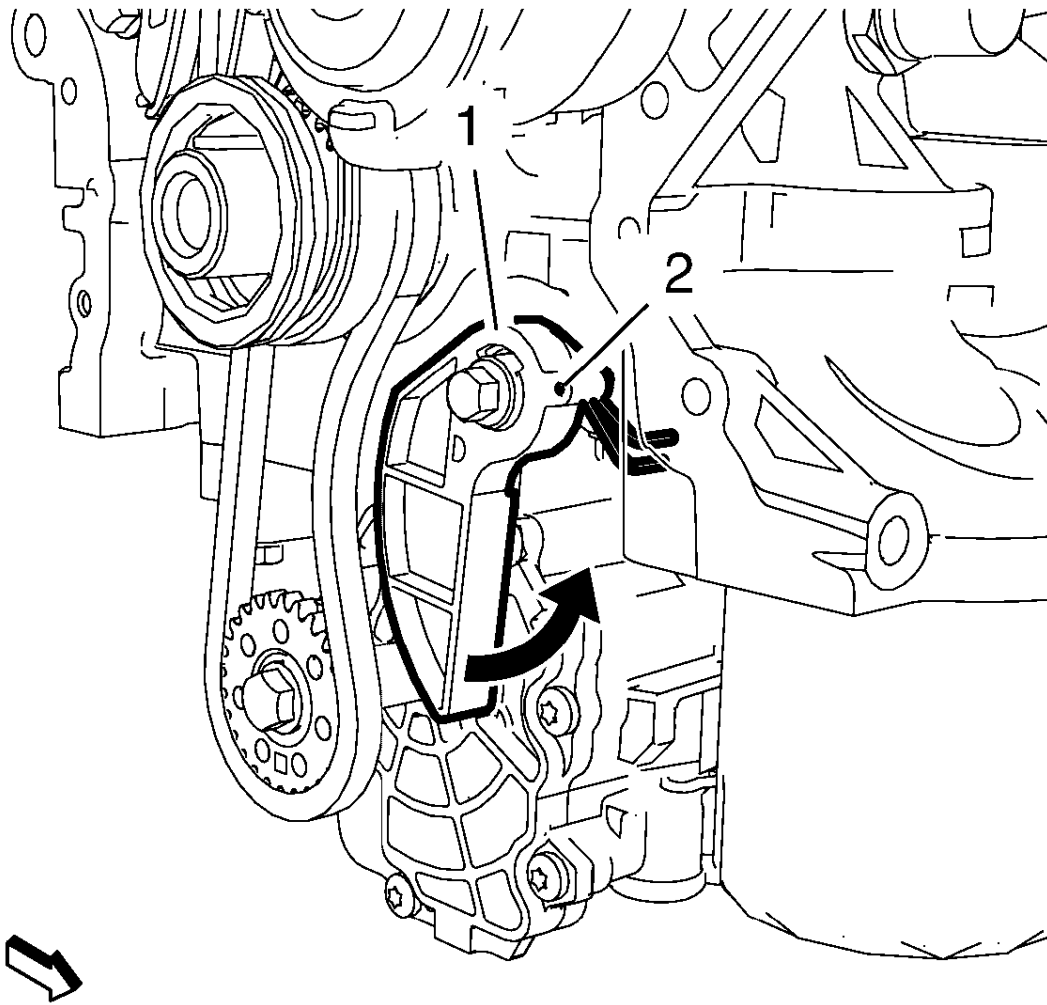


Fig. 280: Oil Pump Drive Chain Tensioner

Courtesy of GENERAL MOTORS COMPANY

2. Remove the suitable locking pin tool from the oil pump drive chain tensioner (1).
3. Install Oil Pump. Refer to [Oil Pump Replacement](#)
4. Install Camshaft Timing Chain. Refer to [Camshaft Timing Chain Replacement](#)

OIL PUMP DRIVE CHAIN TENSIONER REPLACEMENT

Removal Procedure

1. Remove Engine Front Cover. Refer to [Engine Front Cover Replacement](#)
2. Remove Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)

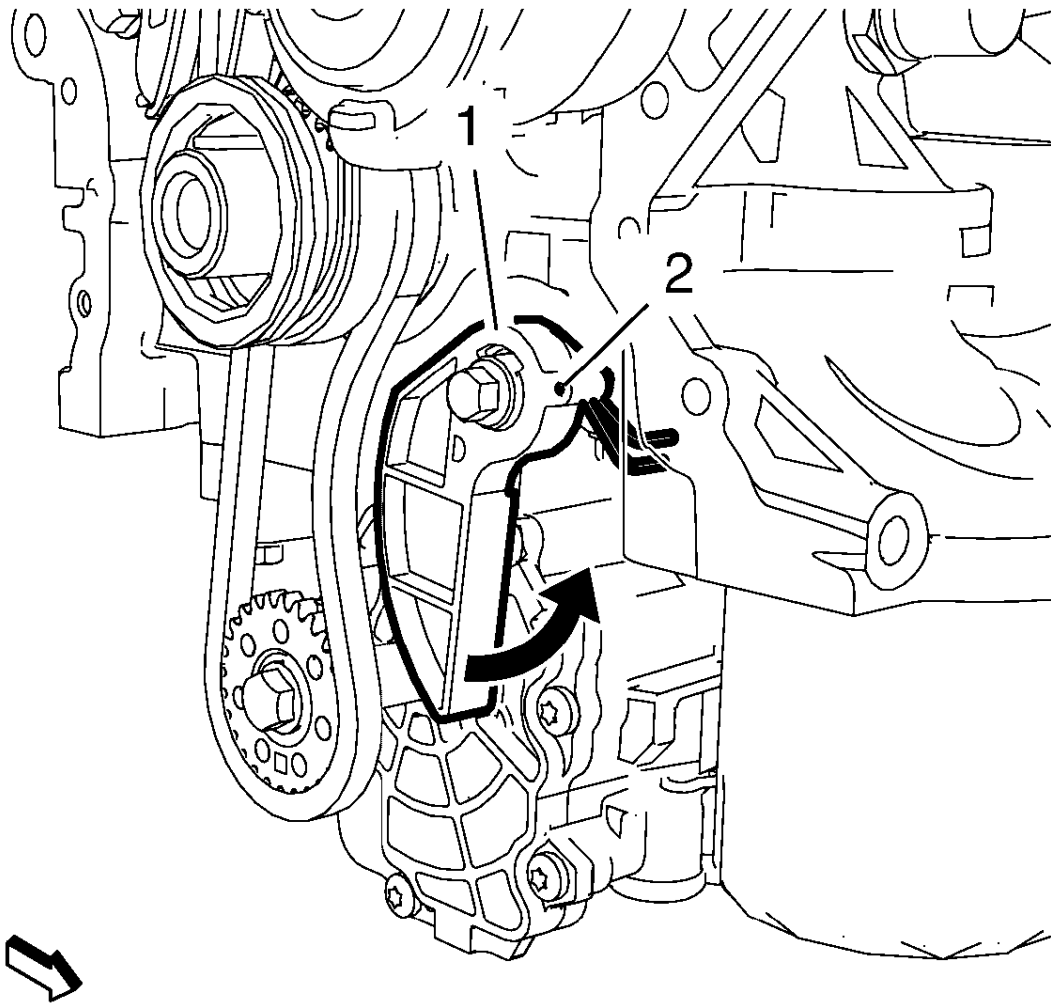


Fig. 281: Oil Pump Drive Chain Tensioner
Courtesy of GENERAL MOTORS COMPANY

3. Tension the oil pump drive chain tensioner (1) in direction of the arrow.
4. Install a suitable locking pin tool into the hole of the oil pump drive chain tensioner as shown in pry (2).

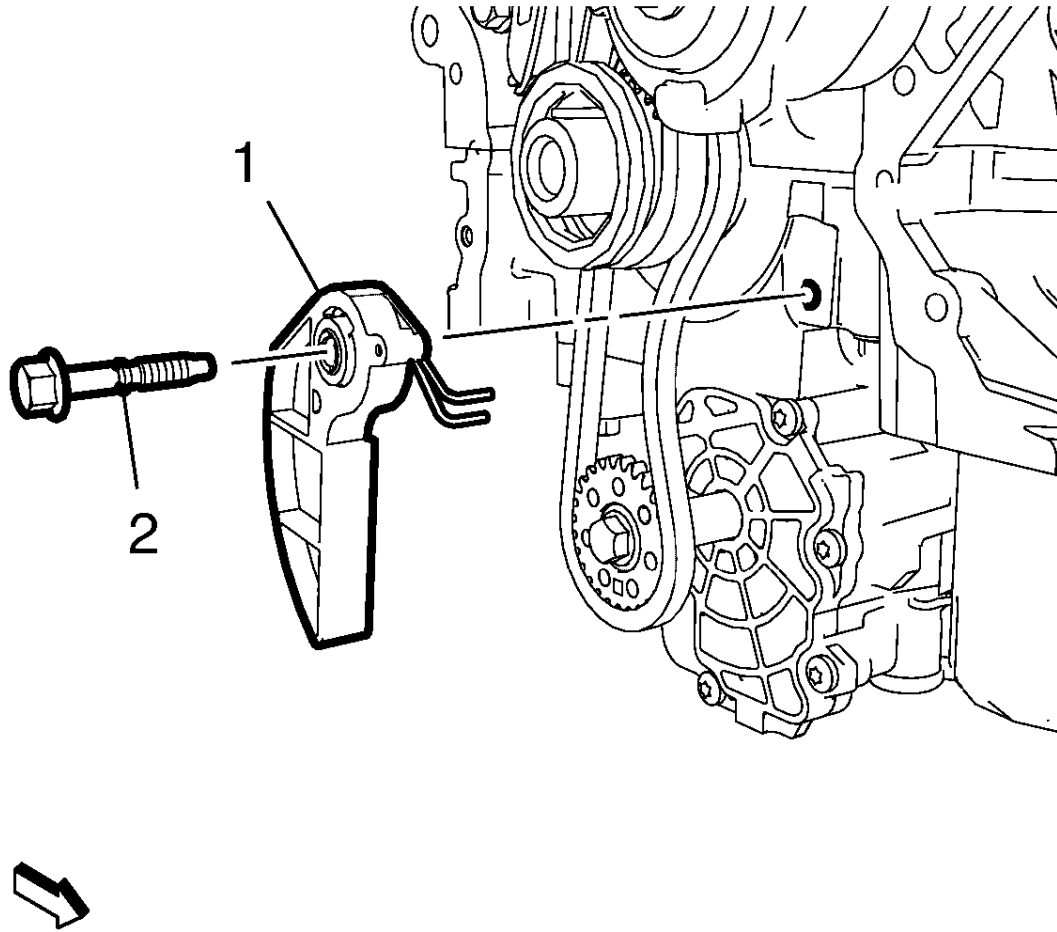


Fig. 282: Oil Pump Drive Chain Tensioner And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the oil pump drive chain tensioner bolt (2).
6. Remove the oil pump drive chain tensioner (1).

Installation Procedure

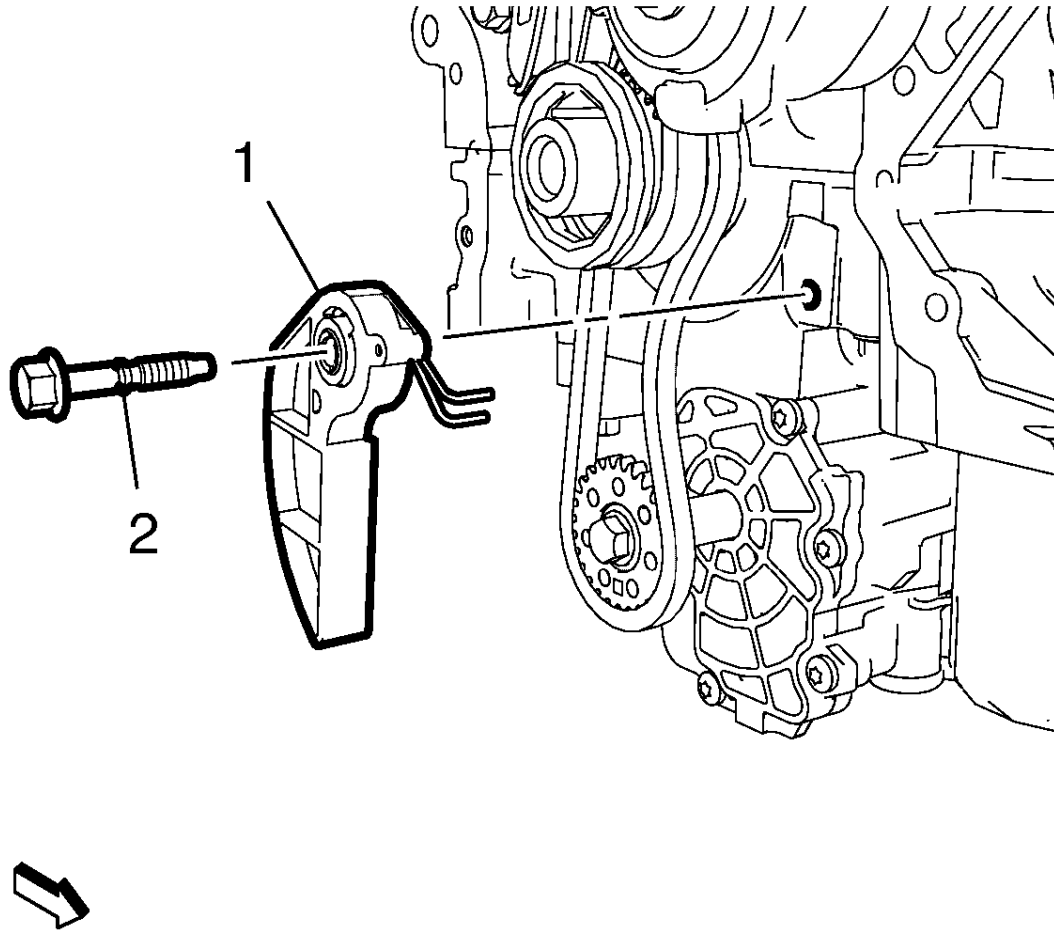


Fig. 283: Oil Pump Drive Chain Tensioner And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the oil pump drive chain tensioner (1).

CAUTION: Refer to [Fastener Caution](#) .

2. Install the oil pump drive chain tensioner bolt (2) and tighten to 10 N.m (89 lb in).
3. Remove the suitable locking pin tool from the oil pump drive chain tensioner.
4. Install Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)
5. Install Engine Front Cover. Refer to [Engine Front Cover Replacement](#)

OIL PUMP REPLACEMENT

Removal Procedure

1. Remove Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)

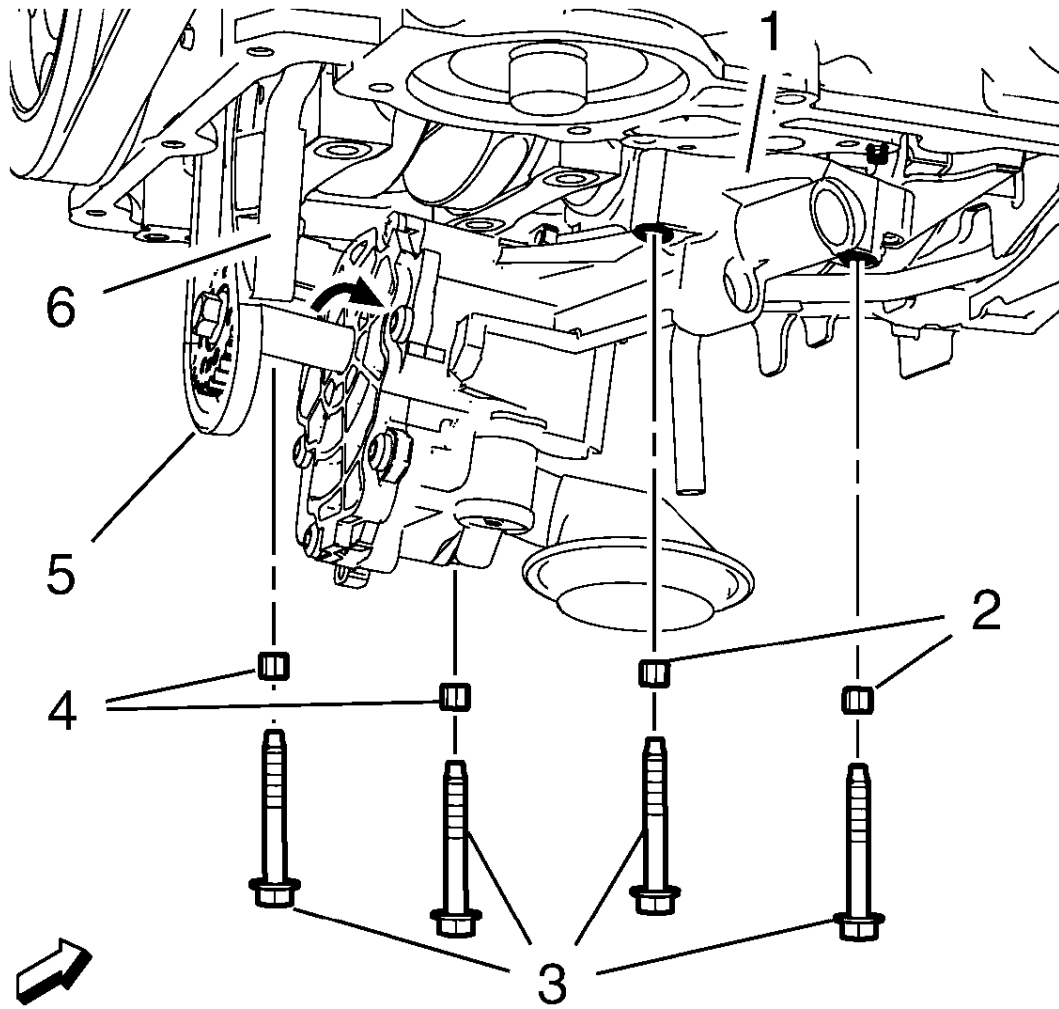


Fig. 284: Oil Pump, Bolts, Retainers, Oil Pump Drive Chain And Tensioner
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the wiring harness plug from the oil pump flow control solenoid valve.
3. Remove Oil Pump Bolts (3) (Qty: 4)
4. Remove and DISCARD the 4 oil pump bolt retainers (2, 4).
5. Release the oil pump drive chain tensioner (6).

NOTE:

- A second technician is required.
- Inspect the correct seat of the oil pump drive chain on the crankshaft sprocket.

6. Move the oil pump assembly (1) in the arrow direction to separate it from the oil pump drive chain (5).

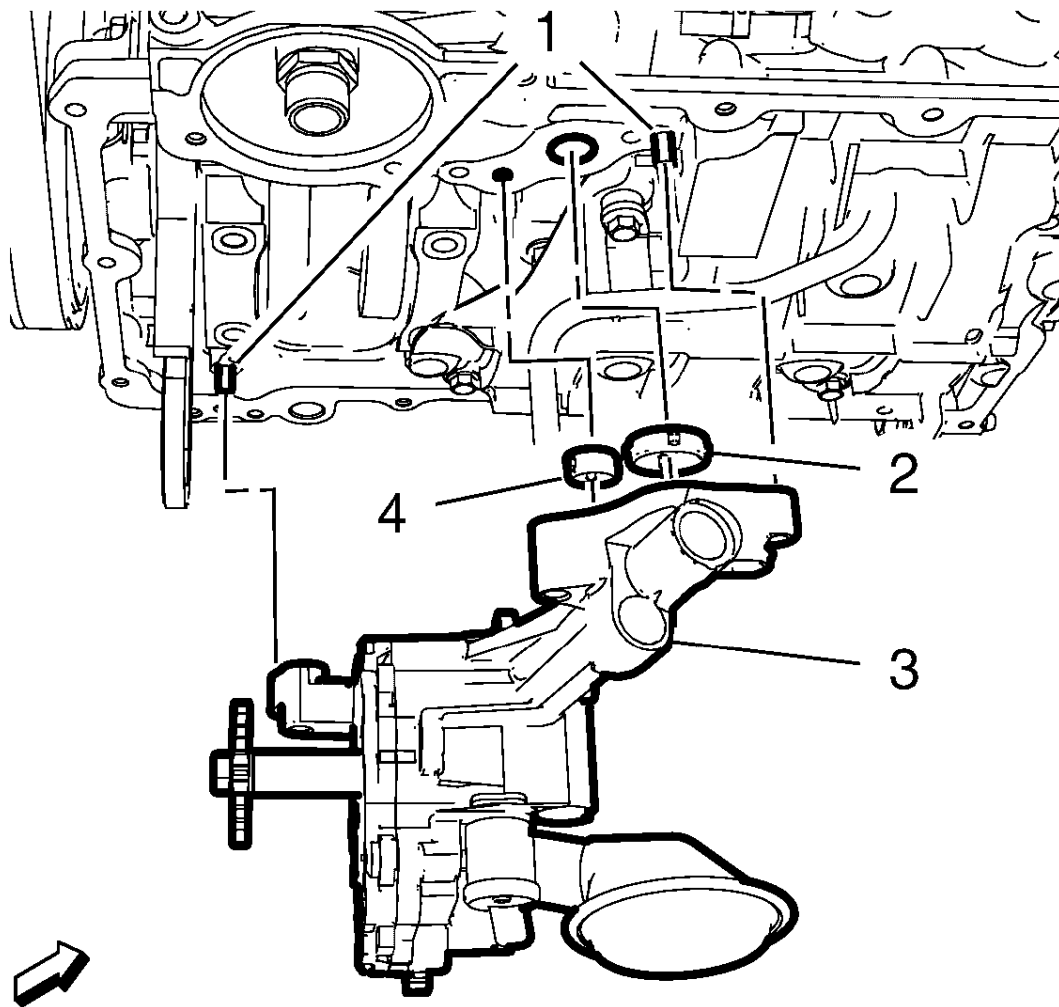


Fig. 285: Oil Pump And Gaskets

Courtesy of GENERAL MOTORS COMPANY

7. Remove and DISCARD the oil pump gasket (2).

8. Remove and DISCARD the oil pump gasket (4).

Disassemble Procedure

Remove Oil Pump Flow Control Solenoid Valve. Refer to [Oil Pump Flow Control Solenoid Valve Replacement](#)

Assemble Procedure

Install Oil Pump Flow Control Solenoid Valve. Refer to [Oil Pump Flow Control Solenoid Valve Replacement](#)

Installation Procedure

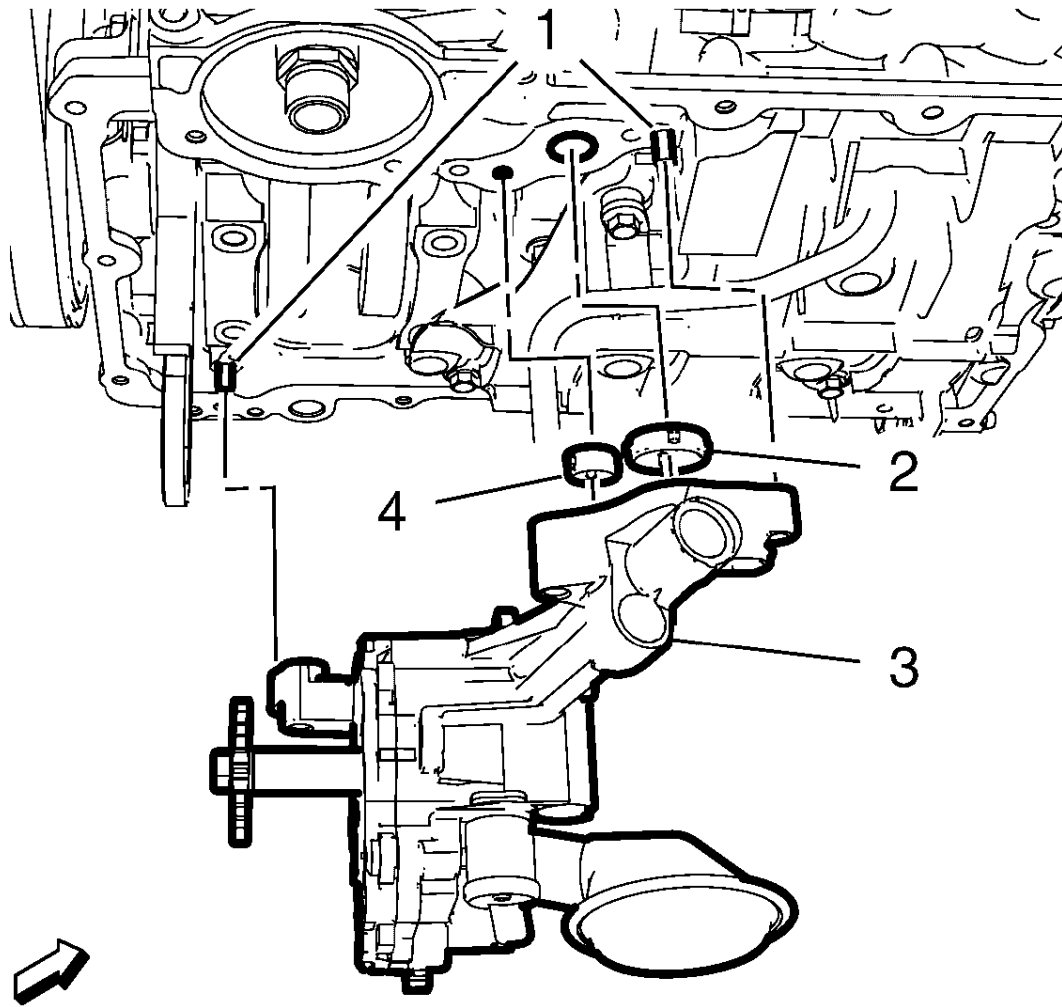


Fig. 286: Oil Pump And Gaskets

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW oil pump gasket (4)
2. Install a NEW oil pump gasket (2)
3. Release the oil pump drive chain tensioner.

NOTE:

- A second technician is required.
- Inspect the correct seat of the oil pump drive chain on the crankshaft sprocket.

4. Install the oil pump assembly (3) with the pins (1).

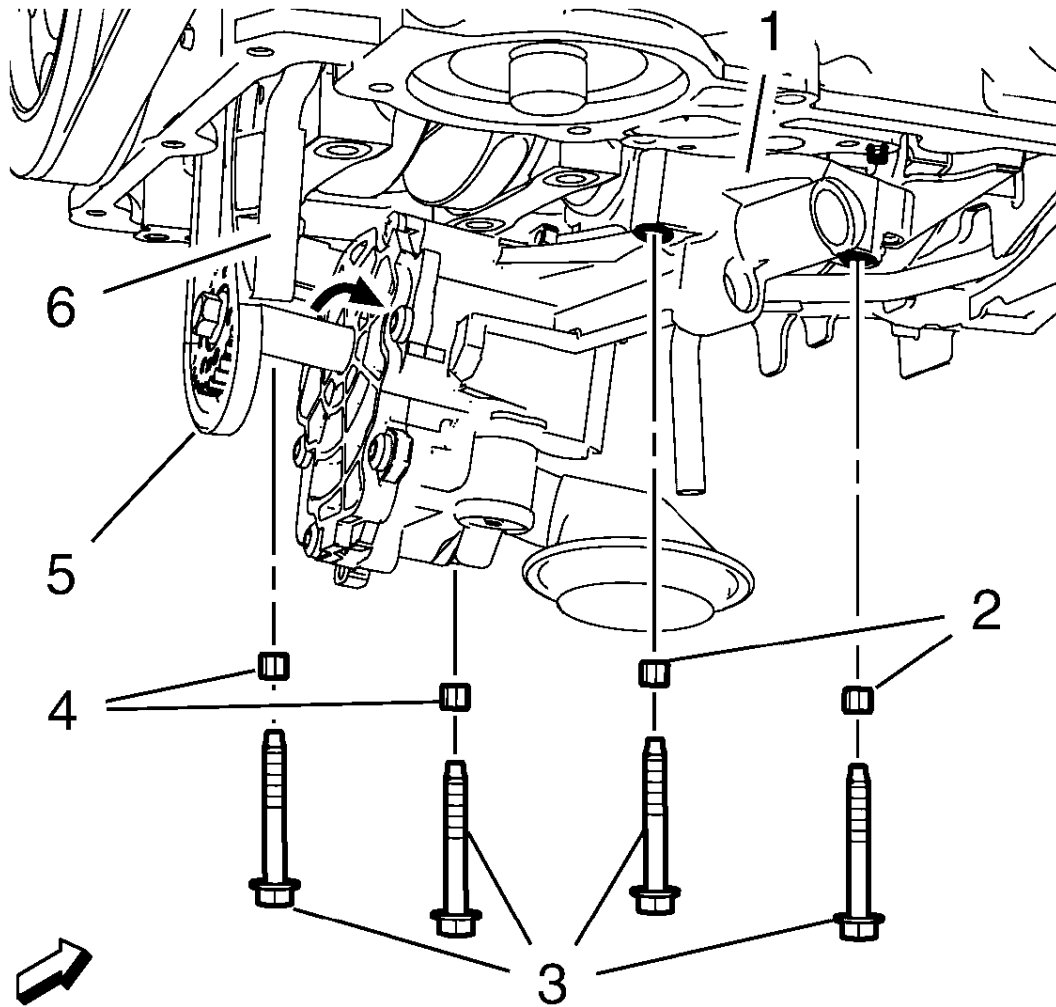


Fig. 287: Oil Pump, Bolts, Retainers, Oil Pump Drive Chain And Tensioner
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

5. Install 4 NEW oil pump bolt retainers (2, 4).
6. Install and tighten Oil Pump Bolts (3) (Qty: 4) to 10 N.m (89 lb in).
7. Connect the wiring harness plug to the oil pump flow control solenoid valve.
8. Install Upper Oil Pan. Refer to [Upper Oil Pan Replacement](#)

ENGINE REPLACEMENT

Special Tools

- **CH-42188-B** Ball Joint Separator
- **CH-51034** Cradle Alignment Guide Pin
- **EN-45059** Angel Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Remove Intermediate Steering Shaft Lower Bolt. Refer to [Intermediate Steering Shaft Replacement](#)
3. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
4. Drain the drive motor battery cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#)
5. Drain the drive motor generator power inverter module cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
6. Drain the coolant. Refer to [Cooling System Draining and Filling](#)
7. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
8. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#)
9. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
10. Remove the radiator surge tank. Refer to [Radiator Surge Tank Replacement](#)
11. Remove 300-Volt Battery Positive and Negative Cable @ Transmission. Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Power Inverter Module and A/C Compressor](#)
12. Remove Engine Wiring Harness Junction Block. Refer to [Engine Wiring Harness Junction Block Replacement](#)

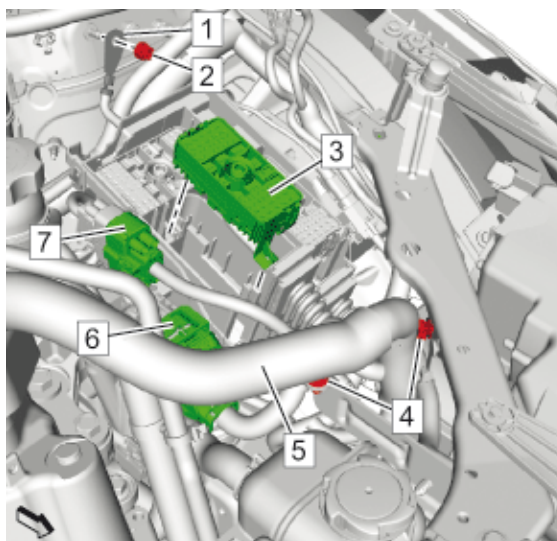


Fig. 288: Ground Cable, Nut, Engine Wiring Harness, Clips And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

13. Remove Ground Cable Nut (2)
14. Remove Ground Cable (1)
15. Remove the electrical connector (3) in top direction from the front compartment fuse block housing.
16. Unclip Engine Wiring Harness (5) @ Clips (4) (Qty: 2)
17. Disconnect the electrical connectors. (6, 7) (Qty: 2)

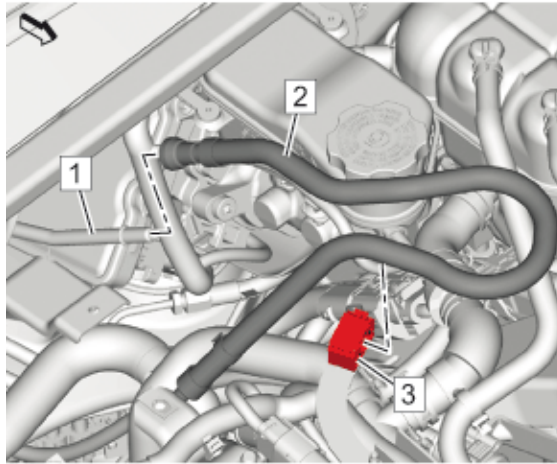


Fig. 289: Fuel Feed Pipe, Fuel Feed Front Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

18. Remove Fuel Feed Front Pipe (2) @ Retainer (3)
19. Disconnect Fuel Feed Front Pipe (2) @ Fuel Feed Pipe (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
20. Close all open connections with the **EN-6015** plugs.

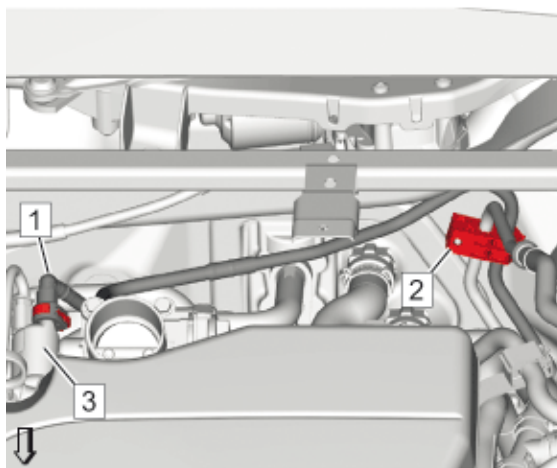


Fig. 290: Evaporative Emission Canister Purge Solenoid Valve And Evaporative Emission Pipe
Courtesy of GENERAL MOTORS COMPANY

21. Disconnect Evaporative Emission Pipe (1) @ Evaporative Emission Canister Purge Solenoid Valve (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)

22. Close all open connections with the **EN-6015** plugs.
23. Remove Heater Water Shutoff Valve Inlet Hose. Refer to [Heater Water Shutoff Valve Inlet Hose Replacement](#)

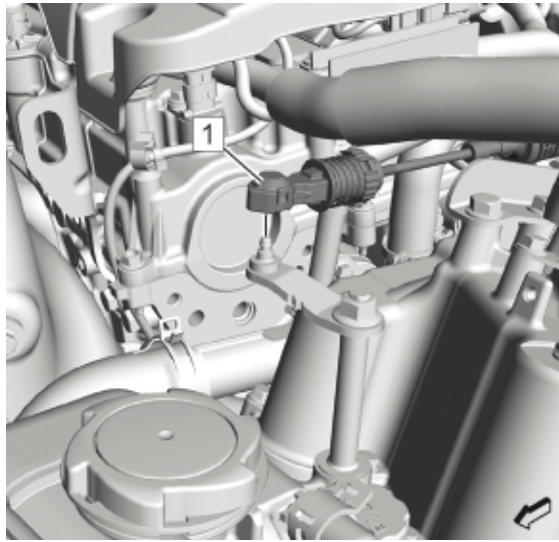


Fig. 291: Range Selector Lever Cable And Range Selector Lever Cable Lever
Courtesy of GENERAL MOTORS COMPANY

24. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

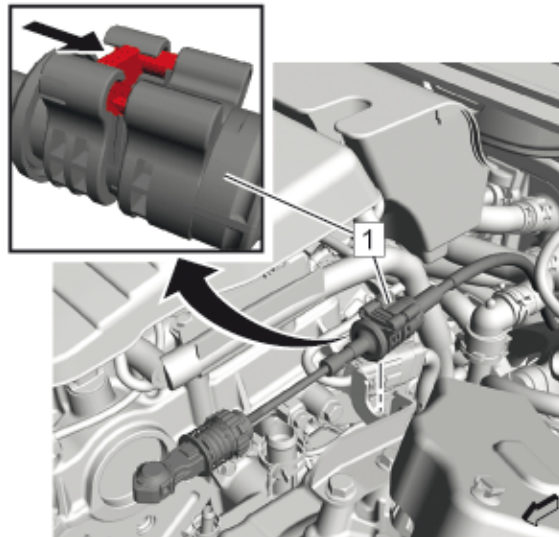


Fig. 292: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

25. Remove Range Selector Lever Cable (1) @ Transmission Range Selector Lever Cable Bracket
26. Release the cable from the bracket by pushing the retainer (arrow).

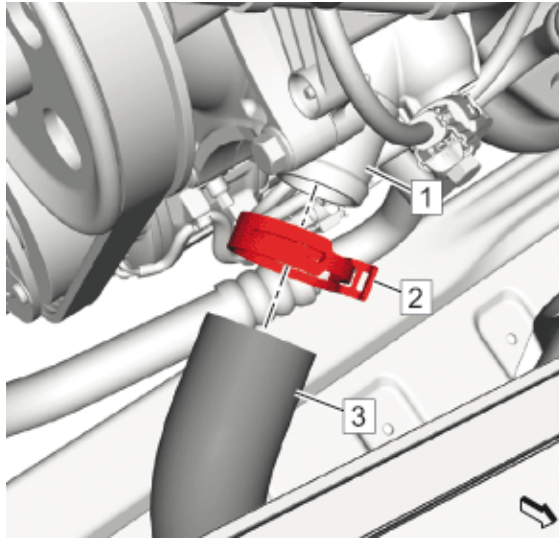


Fig. 293: Engine Coolant Thermostat Housing, Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

- 27. Remove Radiator Outlet Hose Clamp (2)
- 28. Remove Radiator Outlet Hose (3) @ Engine Coolant Thermostat Housing (1)

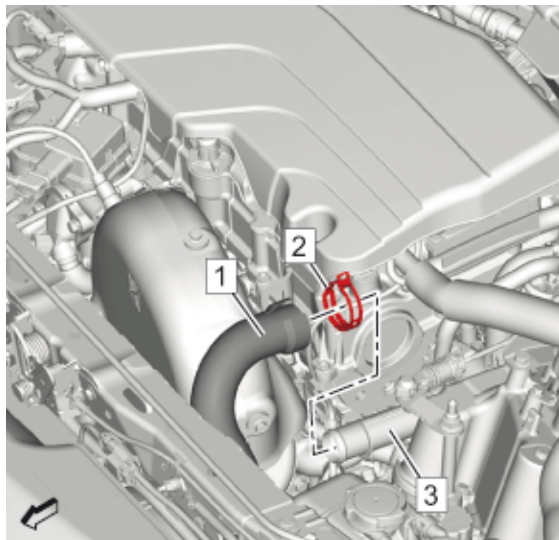


Fig. 294: Water Outlet, Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

- 29. Remove Radiator Inlet Hose Clamp (2)
- 30. Remove Radiator Inlet Hose (1) @ Water Outlet (3)
- 31. Install the engine support fixture. Refer to [**Engine Support Fixture**](#)
- 32. Remove the left side headlamp assembly. Refer to [**Headlamp Replacement**](#)

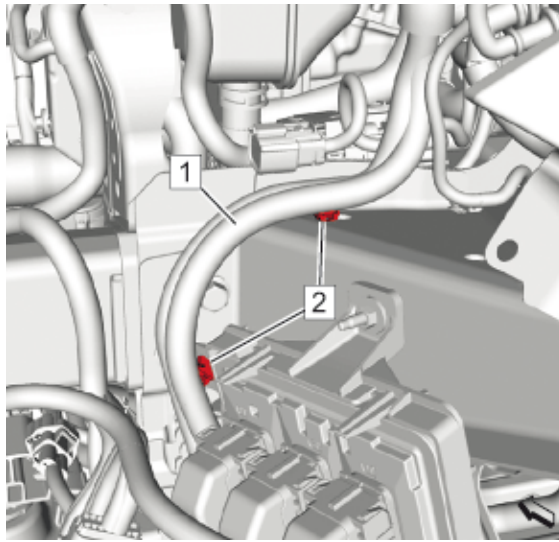


Fig. 295: Engine Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

33. Unclip Engine Wiring Harness (1) @ Wiring Harness Clips (2) (Qty: 2)

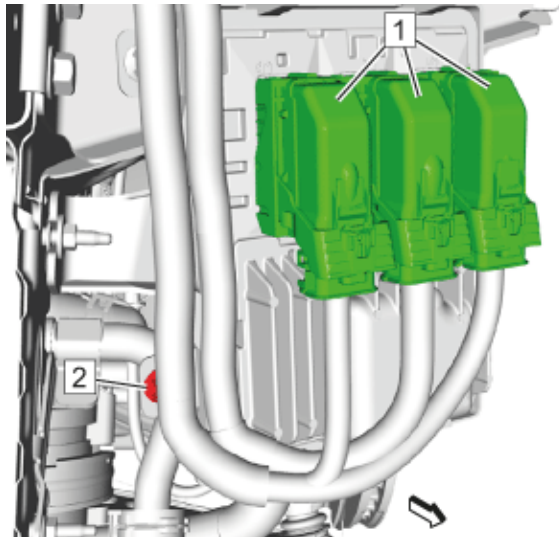


Fig. 296: Wiring Harness Clip And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

34. Unclip Wiring Harness Clip (2)

CAUTION: In order to prevent any possible electrostatic discharge damage to the ECM, do not touch the connector pins.

35. Disconnect the electrical connectors. (1) (Qty: 3)
 36. Place the engine wiring harness at the top of the engine assembly.

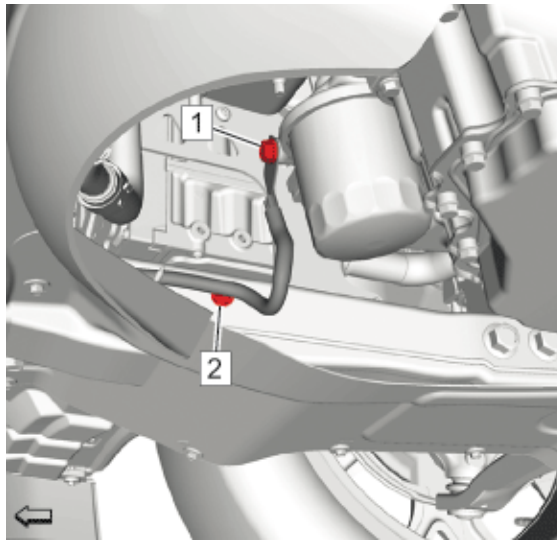


Fig. 297: Engine Ground Strap Bolt And Retainer
Courtesy of GENERAL MOTORS COMPANY

37. Remove the engine ground strap bolt (1).
38. Unclip Wiring Harness Clip (2)
39. Remove Exhaust Muffler. Refer to [Exhaust Muffler Replacement](#)

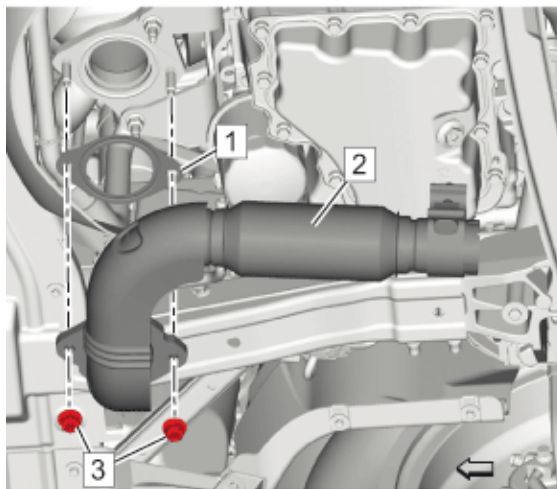


Fig. 298: Exhaust Front Pipe, Nuts And Gasket
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not bend the exhaust flex pipe more than 10 degrees in any direction. Bending of more than 10 degrees or twisting in a range of ± 0.5 degrees will damage the exhaust flex decoupler.

40. Remove Exhaust Front Pipe Nuts (3) (Qty: 2)
41. Remove Exhaust Front Pipe (2)
42. Remove and DISCARD the gasket. (1)

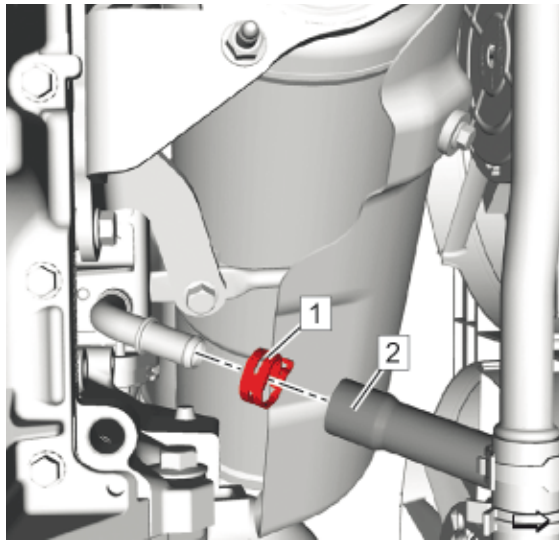


Fig. 299: Heater Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

- 43. Remove Clamp (1)
- 44. Remove Heater Inlet Hose (2)

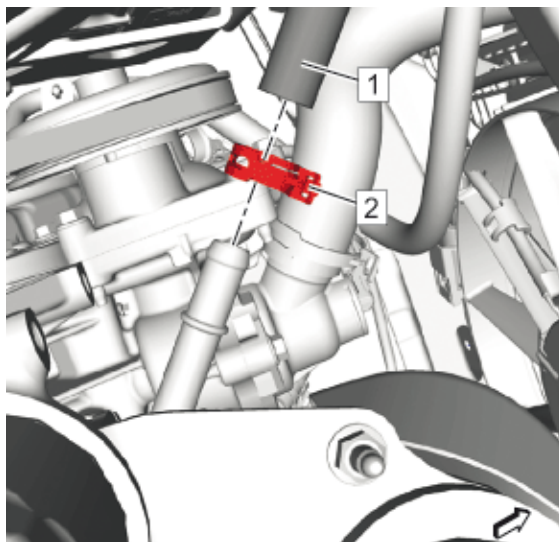


Fig. 300: Heater Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

- 45. Remove Clamp (2)
- 46. Remove Heater Inlet Hose (1)

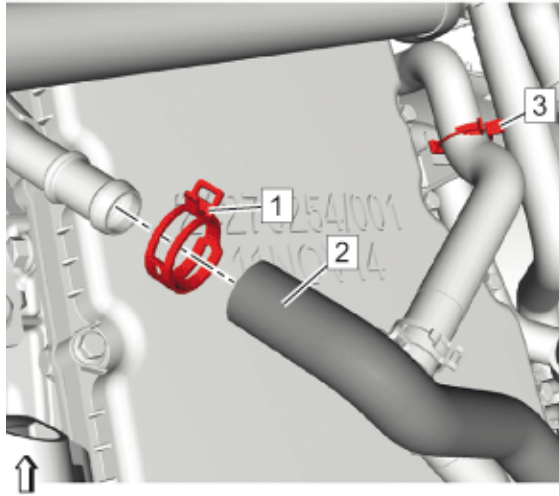


Fig. 301: Heater Inlet Hose, Clamp And Clip
Courtesy of GENERAL MOTORS COMPANY

- 47. Remove Clamp (1)
- 48. Remove Heater Inlet Hose (2)
- 49. Unclip Heater Inlet Hose @ Clip (3)
- 50. Remove Generator Control Module Coolant Pump. Refer to [Generator Control Module Coolant Pump Replacement](#)
- 51. Remove Heater Inlet and Outlet Pipe. Refer to [Heater Inlet And Outlet Pipe Replacement](#)
- 52. Remove Heater Coolant Pump. Refer to [Heater Coolant Pump Replacement](#)
- 53. Remove Heater Coolant Heater. Refer to [Heater Coolant Heater Replacement](#)
- 54. Remove Heater Water Shutoff Valve. Refer to [Heater Water Shutoff Valve Replacement](#)

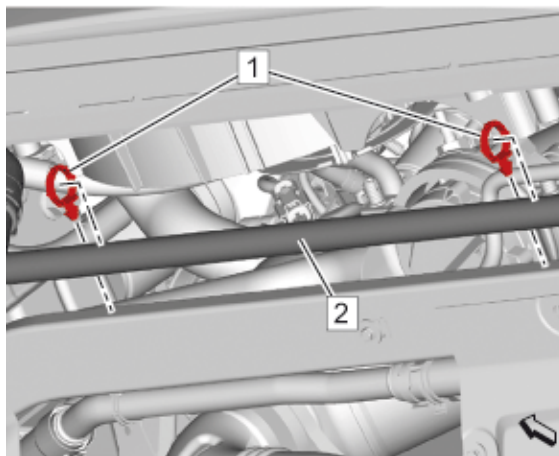


Fig. 302: Coolant Hose And Clips
Courtesy of GENERAL MOTORS COMPANY

- 55. Remove Clip (1) (Qty: 2)
- 56. Remove Coolant Hose (2)

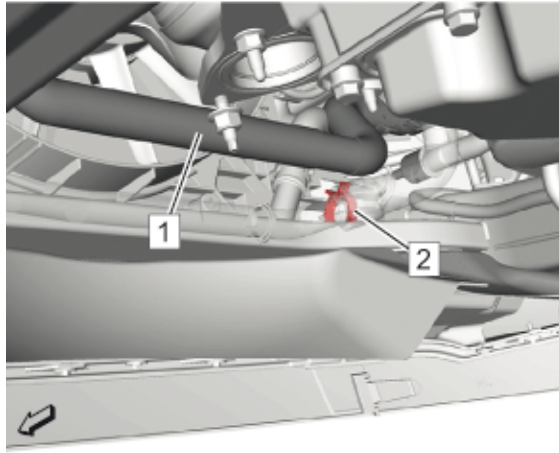


Fig. 303: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

57. Remove the drive motor battery coolant cooler inlet hose (1) from the retainer (2) and reposition.

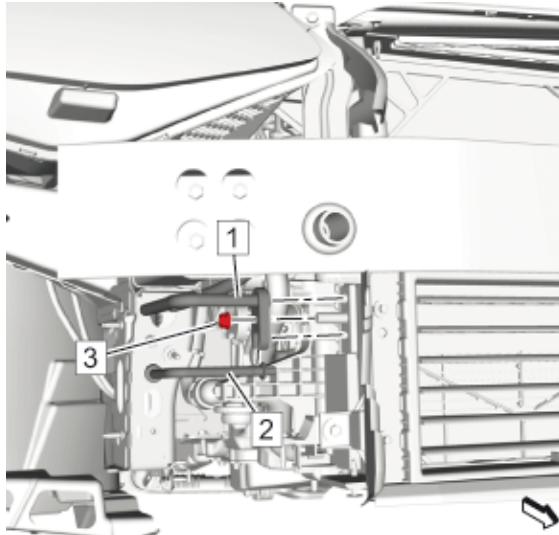


Fig. 304: Air Conditioning Evaporator Tube, Condenser Tube And Nut
Courtesy of GENERAL MOTORS COMPANY

58. Remove the condenser tube nut (3).

59. Remove the air conditioning evaporator tube (1) along with the condenser tube (2) from the condenser.

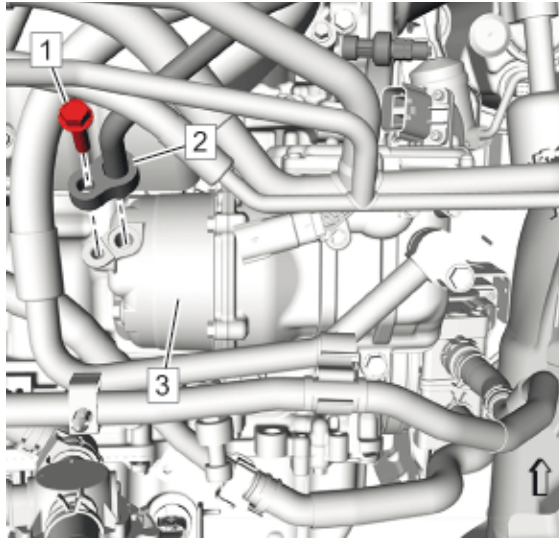


Fig. 305: Air Conditioning Compressor, Condenser Hose And Bolt
Courtesy of GENERAL MOTORS COMPANY

60. Remove the air conditioning compressor and condenser hose bolt (1).
61. Remove the air conditioning compressor and condenser hose (2) from the air conditioning compressor (3).

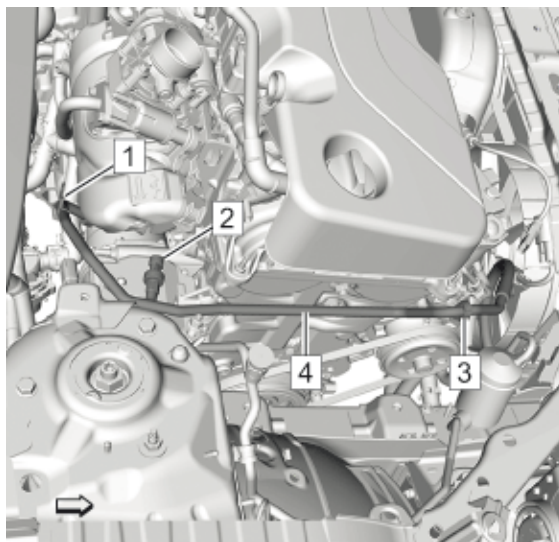


Fig. 306: A/C Compressor And Condenser Hose Tube, Retainer, Wiring Harness And Cycling Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

62. Unclip the retainer (1) holding the air conditioning compressor and condenser hose tube to the engine bracket.
63. Unclip the wiring harness (2) from the air conditioning compressor and condenser hose tube.
64. Disconnect the air conditioning cycling switch electrical connector (3).
65. Remove the air conditioning compressor and condenser hose tube (1).

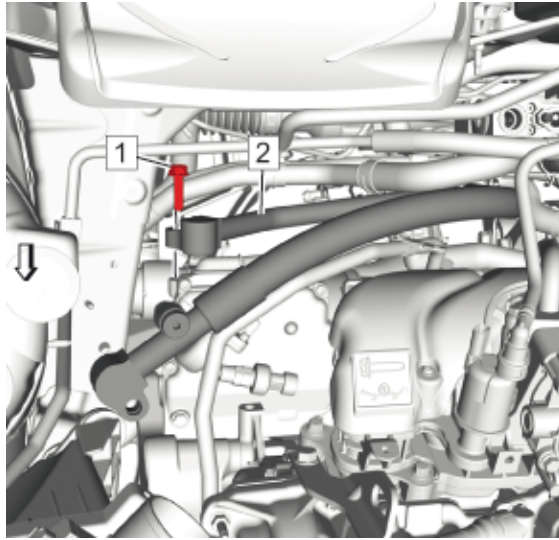


Fig. 307: Air Conditioning Compressor Hose Bolt And Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

- 66. Remove the air conditioning compressor hose bolt (1) from the air conditioning evaporator hose (2).
- 67. Remove Air Conditioning Compressor Hose

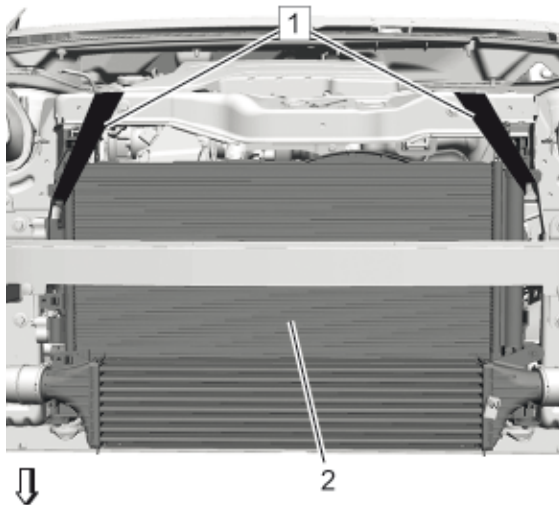


Fig. 308: Radiator And Lashing Straps
Courtesy of GENERAL MOTORS COMPANY

- 68. Secure the radiator (2) using 2 lashing straps (1)
- 69. Remove Underbody Front Air Deflector-Left Side. Refer to [Underbody Front Air Deflector Replacement - Left Side](#)
- 70. Drain the transmission. Refer to [Transmission Fluid Drain and Fill](#)

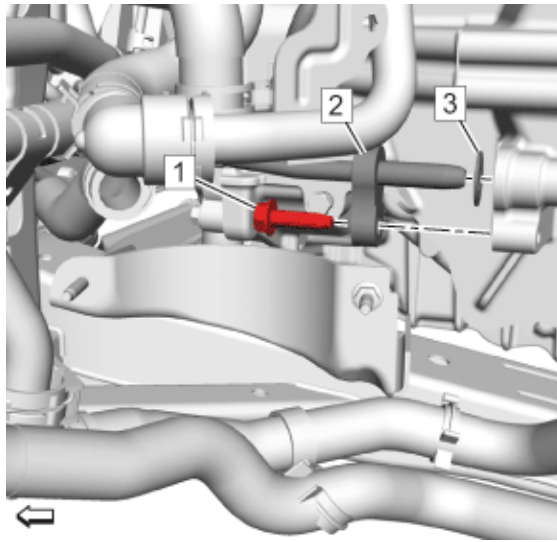


Fig. 309: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

71. Place a container beneath the transmission fluid cooler outlet pipe (2) to catch spilling transmission fluid.
72. Remove Transmission Fluid Cooler Pipe Bolt (1)
73. Disconnect Transmission Fluid Cooler Outlet Pipe (2)
74. Remove and DISCARD Sealing Washer (3)

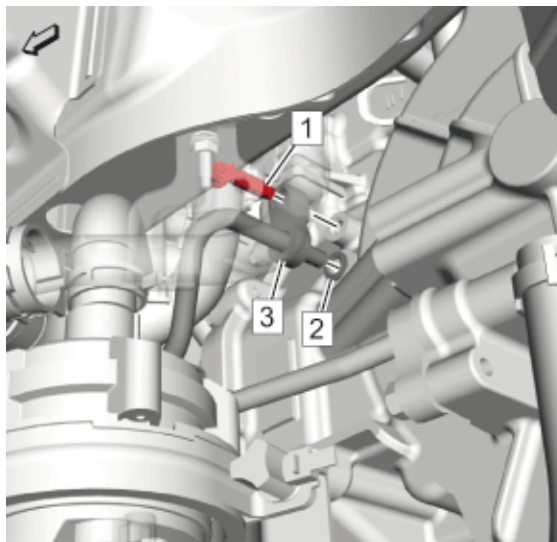


Fig. 310: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

75. Place a container beneath the transmission fluid cooler inlet pipe (3) to catch spilling transmission fluid.
76. Remove Transmission Fluid Cooler Pipe Bolt (1)
77. Disconnect Transmission Fluid Cooler Inlet Pipe (3)
78. Remove and DISCARD Sealing Washer (2)

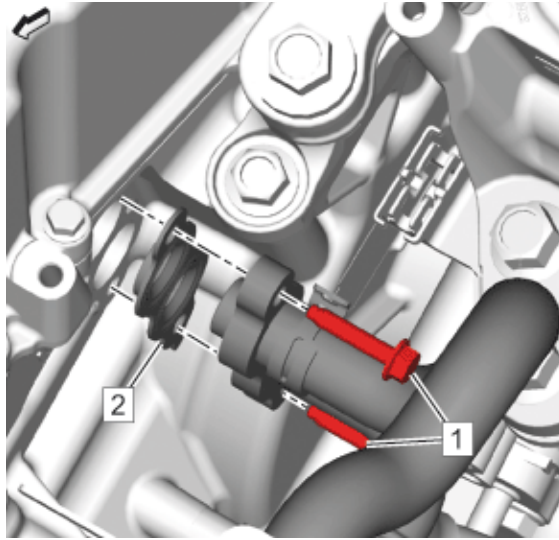


Fig. 311: Drive Motor Generator Control Module Cooling Outlet Hose And Bolts
Courtesy of GENERAL MOTORS COMPANY

- 79. Remove Drive Motor Generator Control Module Cooling Outlet Hose Bolt (1) (Qty: 2)
- 80. Remove and DISCARD Seal (2)

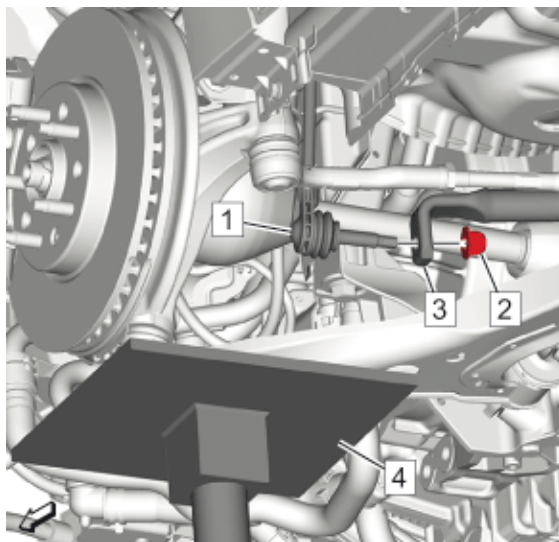


Fig. 312: Stabilizer Shaft Link, Stabilizer Shaft And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to release the nuts. Use a suitable tool.

- 81. Remove and DISCARD Stabilizer Shaft Link Nuts (2) (Qty: 2)
- 82. Disconnect Stabilizer Shaft Links (1) (Qty: 2) @ Stabilizer Shaft (3)

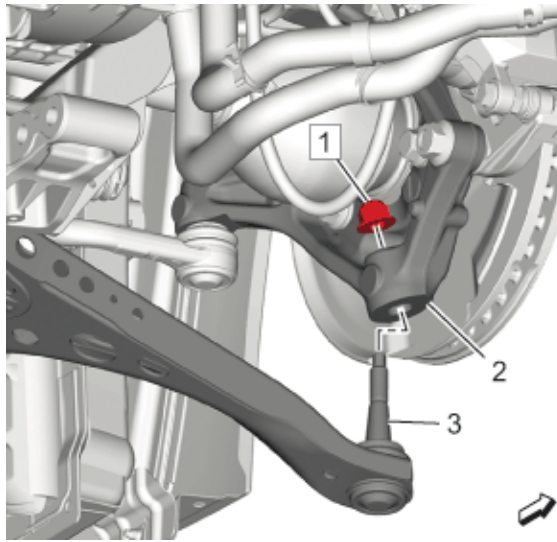


Fig. 313: Steering Knuckle, Lower Ball Joint And Nut
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the front suspension under the front lower control arm ball joint with a hydraulic jack to release the nut.

83. Remove and DISCARD Nuts (1) (Qty: 2)
84. Separate the steering knuckle from the lower ball joint. (Qty: 2)
85. Disconnect the outer tie rod from the steering knuckle (Qty: 2). Refer to [Steering Linkage Outer Tie Rod Replacement](#)
86. Reposition away Front Wheel Drive Shaft @ Transmission. Refer to [Front Wheel Drive Shaft Replacement](#)

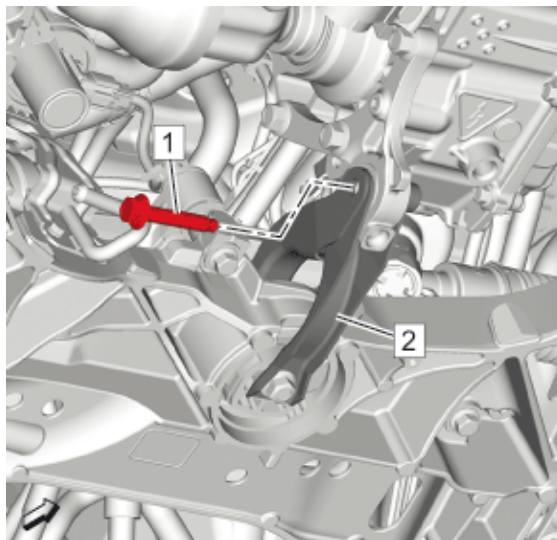


Fig. 314: Transmission Mount Strut Bolt And Transmission Mount Strut
 Courtesy of GENERAL MOTORS COMPANY

87. Remove and DISCARD Transmission Mount Strut Bolt (1) @ Transmission Mount Strut (2).

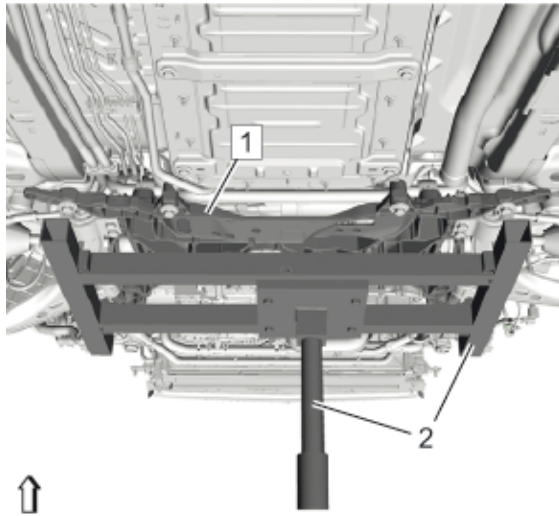


Fig. 315: Drivetrain And Front Suspension Cradle Supported With Suitable Hydraulic Jack
Courtesy of GENERAL MOTORS COMPANY

88. Support the drivetrain and front suspension cradle (1) with a suitable hydraulic jack (2).

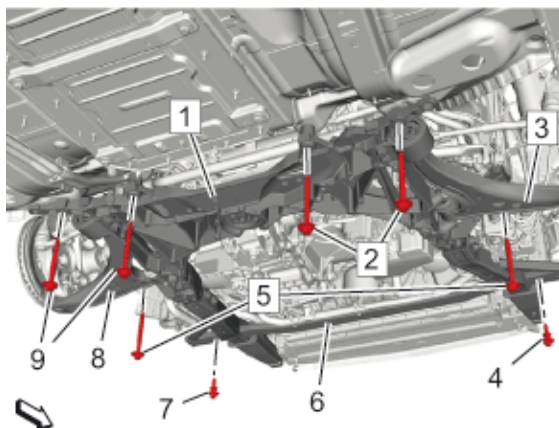


Fig. 316: Drivetrain And Front Suspension Cradle, Crossmember Extension And Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

- 89. Remove and DISCARD Bolts (2, 5, 9) (Qty: 6) @ Drivetrain and Front Suspension Cradle (1)
- 90. Remove and DISCARD Bolts (4, 7) (Qty: 2) @ Drivetrain and Front Suspension Crossmember Extension (6)
- 91. Lower the drivetrain and front suspension cradle along with drivetrain and front suspension crossmember extension and both lower control arm (3, 8) as far as necessary to disconnect the wiring harness.

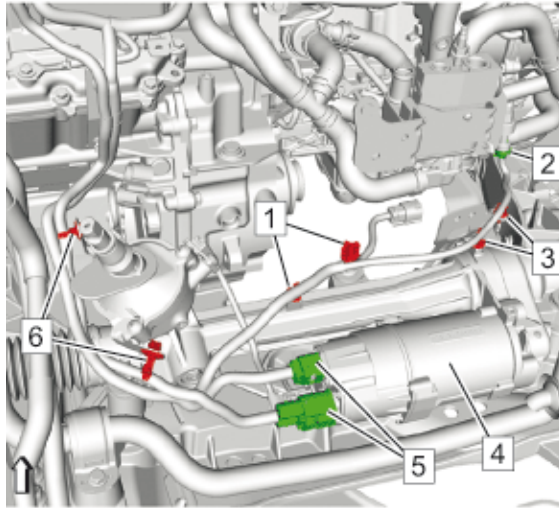


Fig. 317: Power Steering Assist Motor, Electrical Connectors And Wiring Harness Clips
Courtesy of GENERAL MOTORS COMPANY

- 92. Disconnect Electrical Connectors (5) (Qty: 2) @ Power Steering Assist Motor (4)
- 93. Disconnect the electrical connector. (2)
- 94. Unclip Wiring Harness Clip (1, 3, 6) (Qty: 6)

NOTE: **A second technician is required.**

- 95. Carefully lower the drivetrain and front suspension cradle along with drivetrain and front suspension crossmember extension and both lower control arm
- 96. Remove the drivetrain and front suspension cradle along with drivetrain and front suspension crossmember extension and both lower control arm.
- 97. Lower the vehicle.
- 98. Position an engine support table under the powertrain assembly
- 99. Blocks of wood can be used between the front of the frame and the oil pan in order to level the powertrain during the removal.
- 100. With the table positioned, fully raise the table to contact with the powertrain assembly.

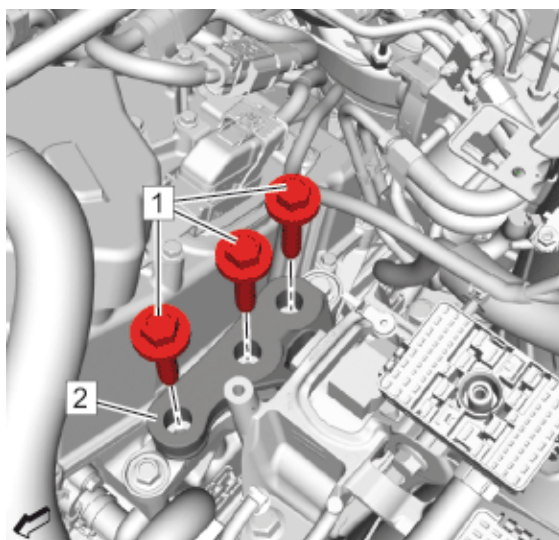


Fig. 318: Transmission Mount And Bolts

Courtesy of GENERAL MOTORS COMPANY

101. Remove and DISCARD Transmission Mount Bolts (1) (Qty: 3) @ Transmission Mount (2)

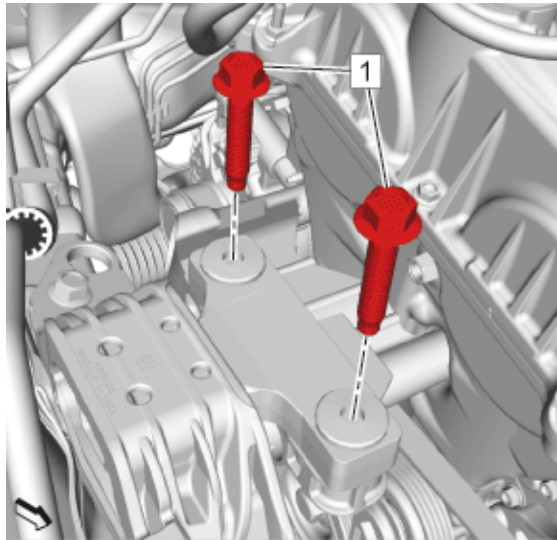


Fig. 319: Engine Mount Bolts

Courtesy of GENERAL MOTORS COMPANY

102. Remove Engine Mount Bolts (1) (Qty: 2)

103. Remove the engine support fixture. Refer to [Engine Support Fixture](#)

104. Slowly and carefully raise the vehicle, ensure the powertrain assembly are free from wiring, hoses and other engine compartment components

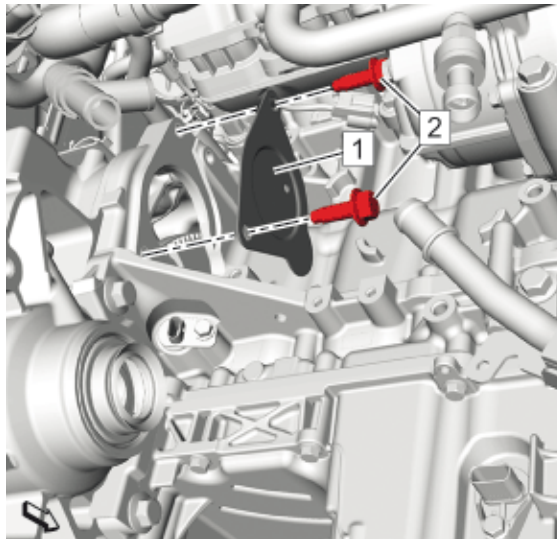


Fig. 320: Starter Opening Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

105. Remove Bolts (2) (Qty: 2)

106. Remove the starter opening cover (1).

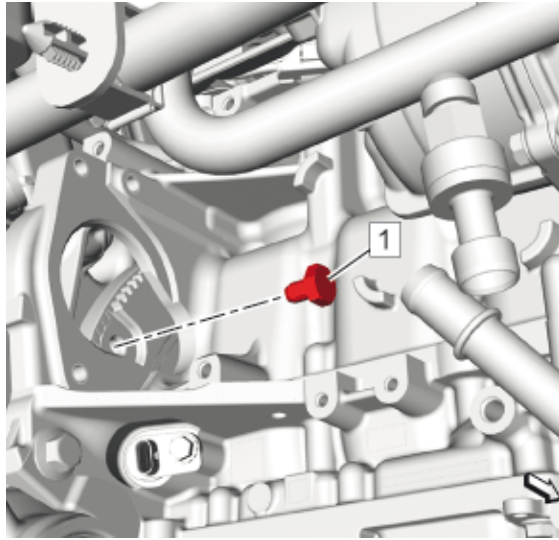


Fig. 321: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

- 107. Remove the torque converter bolts. (1) (Qty: 4)
- 108. Remove the water outlet. Refer to [Water Outlet Replacement](#)
- 109. Remove Heater Inlet Hose. Refer to [Heater Inlet Hose Replacement](#)

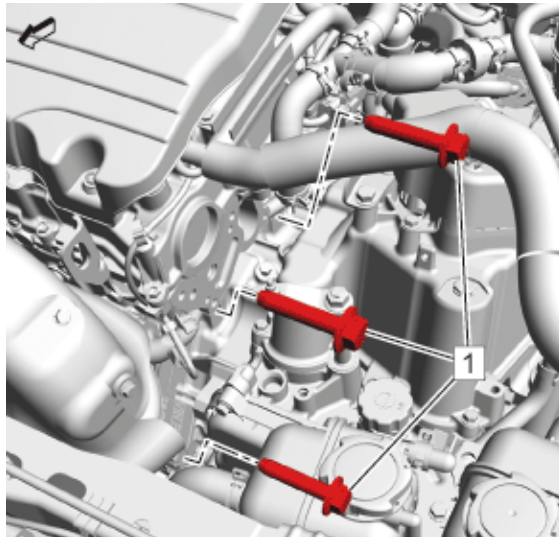


Fig. 322: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

- 110. Remove the transmission bolts. (1) (Qty: 3)

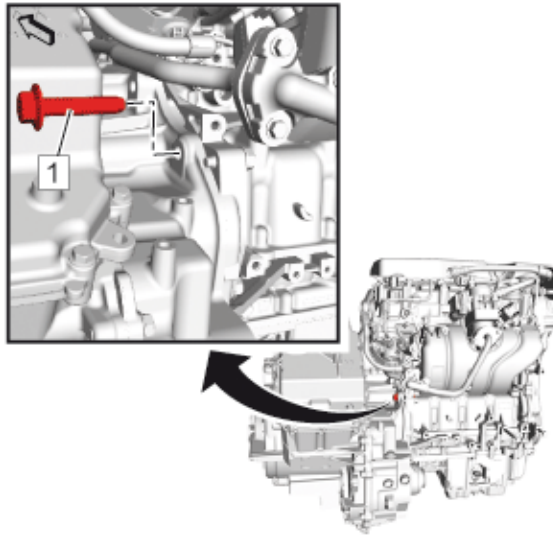


Fig. 323: Transmission Bolt

Courtesy of GENERAL MOTORS COMPANY

111. Remove Transmission Bolt (1)

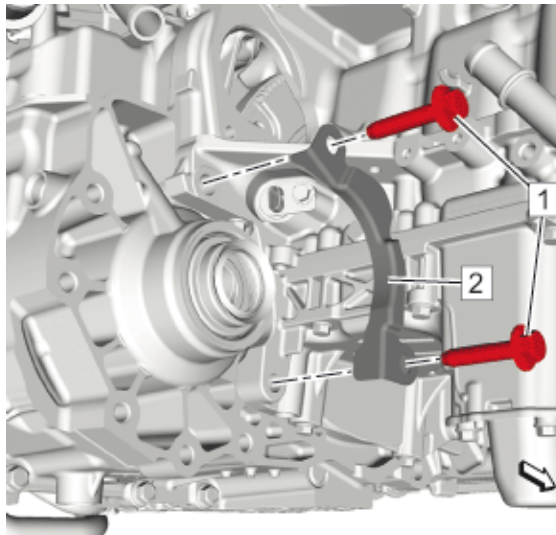


Fig. 324: Transmission Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

112. Remove Transmission Bolts (1) (Qty: 2)

113. Remove Transmission Cover (2)

114. Properly support engine and transmission as necessary.

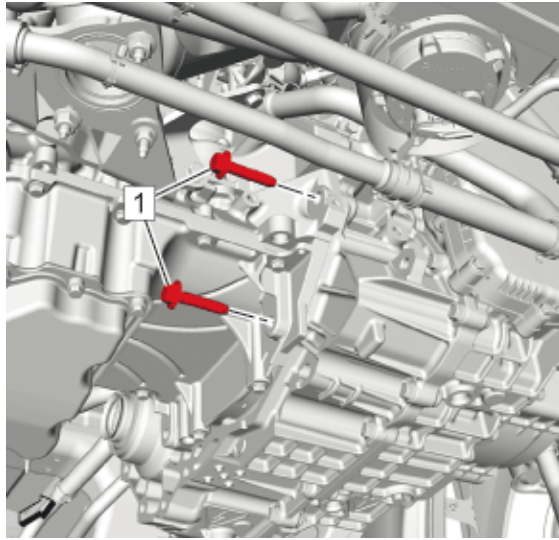


Fig. 325: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: These are the last transmission bolts.

115. Remove Transmission Bolts (1) (Qty: 2)
116. Separate the engine from the transmission.
117. Disconnect Engine Coolant Hose as necessary.
118. Disconnect all electrical connectors.
119. Transfer components as necessary.

Installation Procedure

1. Connect all electrical connectors.
2. Connect engine coolant hoses as necessary

Do not tighten bell housing bolts at this time. There must be a small 1 mm (0.039 in) to 2 mm (0.079 in) mm gap between the engine and transmission to allow rotation for input flange alignment

3. Install two appropriate guide pins into the engine to aid aligning the transmission to the engine.

NOTE: A second technician is required.

4. Align the transmission to the engine leaving a 2 millimeter gap between both.

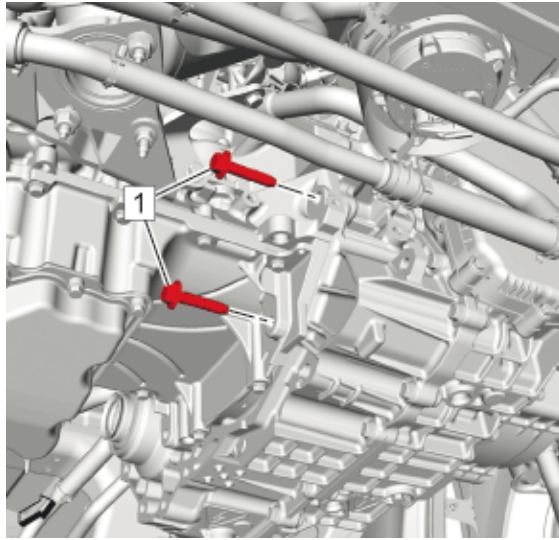


Fig. 326: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the guide pin, then install the 2 transmission bolt (1) and hand tighten, allowing a small 1 mm (0.039 in) to 2 mm (0.079 in) gap between the engine and transmission.

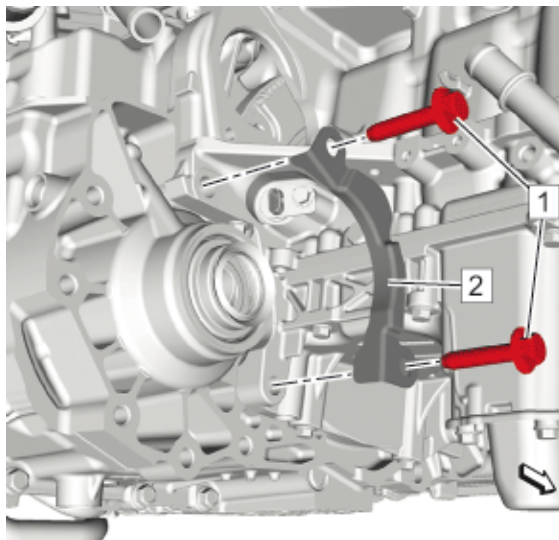


Fig. 327: Transmission Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Install Transmission Cover (2)
7. Install and hand tighten Transmission Bolts (1) (Qty: 2)

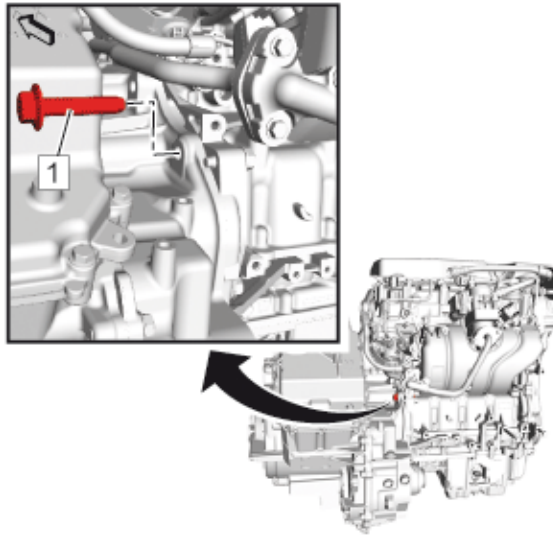


Fig. 328: Transmission Bolt

Courtesy of GENERAL MOTORS COMPANY

8. Install and hand tighten Transmission Bolt (1)

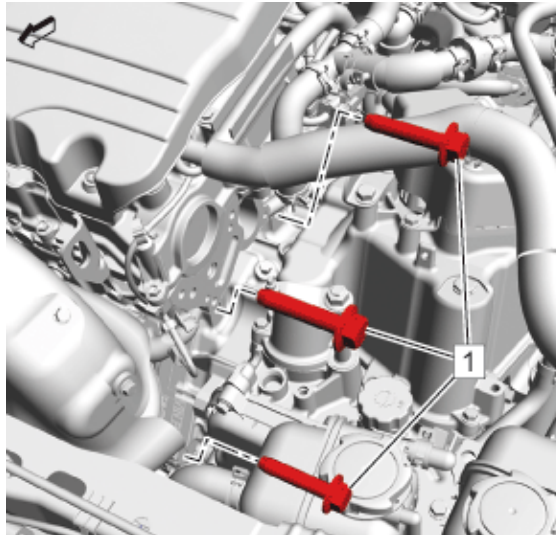


Fig. 329: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

9. Install and hand tighten Transmission Bolts (1) (Qty: 3)

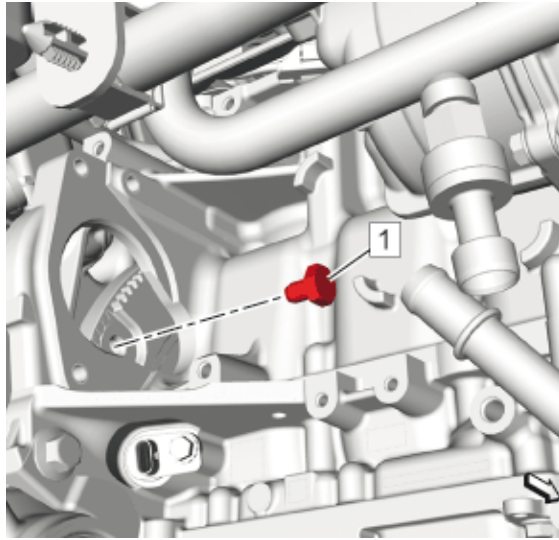


Fig. 330: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

10. Set the engine to TDC allowing the master oblong flexplate bolt hole to appear in the starter hole opening.
11. Install and perform final tightening of the ALL remaining torque convertor bolts and transmission housing to engine bolts as specified in the transmission replacement procedure. Refer to [Transmission Replacement](#)

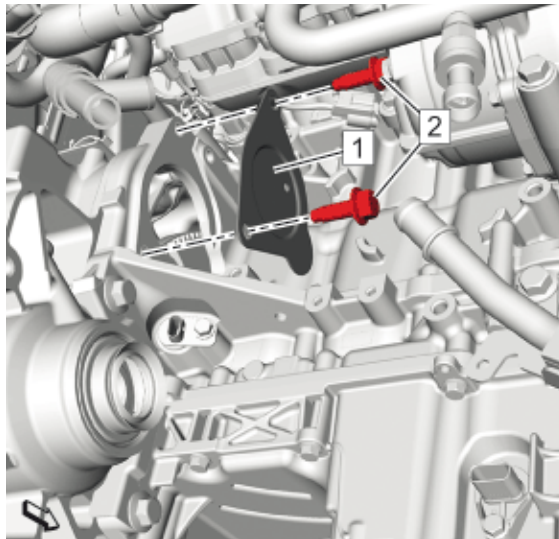


Fig. 331: Starter Opening Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

12. Install the starter opening cover (1).
13. Install and tighten Bolts (2) (Qty: 2). Refer to [Transmission Replacement](#)
14. Install the water outlet. Refer to [Water Outlet Replacement](#)
15. Install Heater Inlet Hose. Refer to [Heater Inlet Hose Replacement](#)
16. Slowly and carefully lower the vehicle, ensure the powertrain assembly are free from wiring, hoses and other engine compartment components

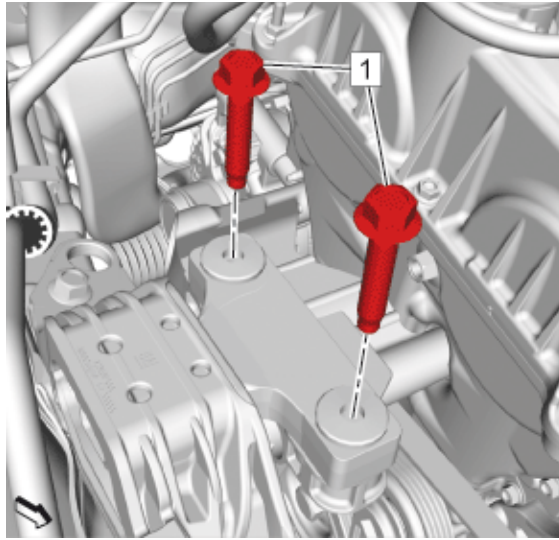


Fig. 332: Engine Mount Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

17. Install and tighten Engine Mount Bolts (1) (Qty: 2). Refer to [Engine Mount Replacement](#)

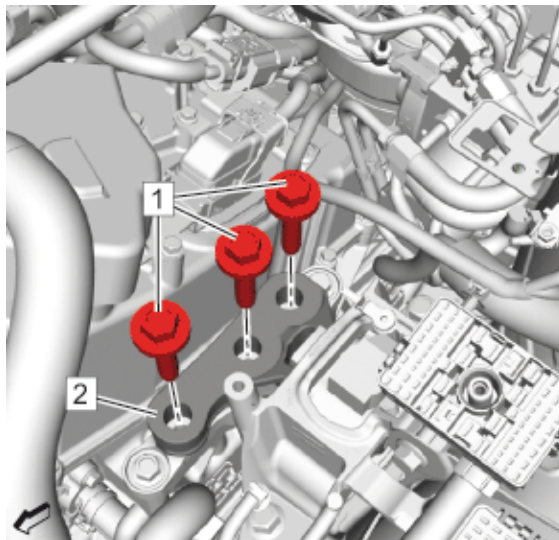


Fig. 333: Transmission Mount And Bolts

Courtesy of GENERAL MOTORS COMPANY

18. Install and tighten Transmission Mount Bolts (1) (Qty: 3) @ Transmission Mount (2). Refer to [Transmission Mount Replacement](#)

19. Install the engine support fixture. Refer to [Engine Support Fixture](#)

20. Raise the vehicle.

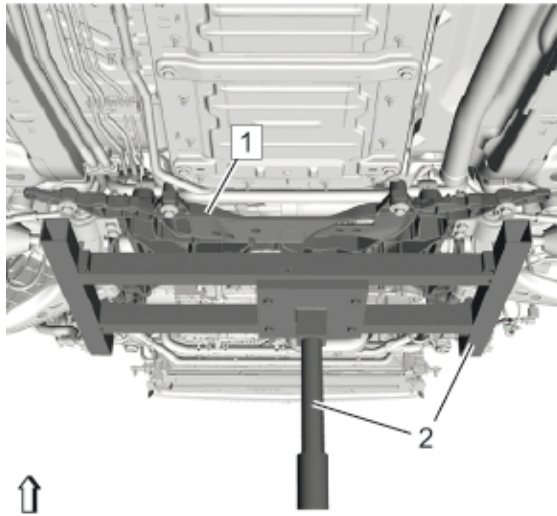


Fig. 334: Drivetrain And Front Suspension Cradle Supported With Suitable Hydraulic Jack
Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

21. Raise the drivetrain and front suspension cradle along with drivetrain and front suspension crossmember extension and both lower control arm (1) with a suitable jack (2) as far as necessary to connect the wiring harness.

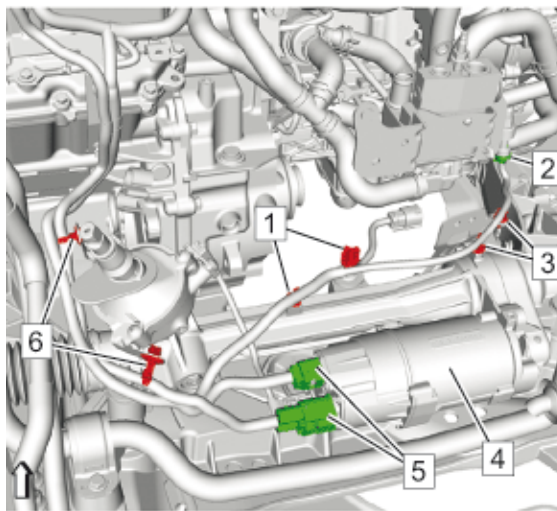


Fig. 335: Power Steering Assist Motor, Electrical Connectors And Wiring Harness Clips
Courtesy of GENERAL MOTORS COMPANY

22. Install Wiring Harness Clips (1, 3, 6) (Qty: 6)
23. Connect the electrical connector. (2)
24. Connect Electrical Connectors (5) (Qty: 2) @ Power Steering Assist Motor (4)

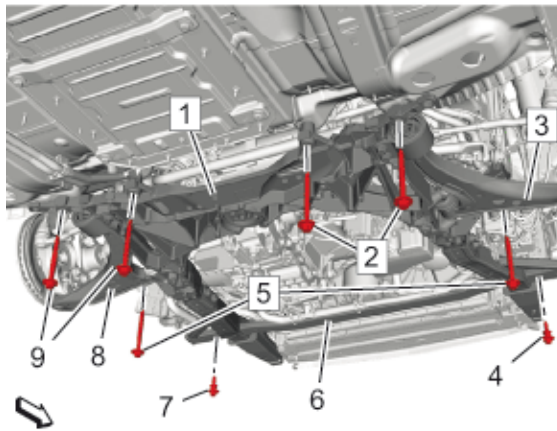


Fig. 336: Drivetrain And Front Suspension Cradle, Crossmember Extension And Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

25. Install the drivetrain and front suspension cradle (1) along with the drivetrain and front suspension crossmember extension (6) and the lower control arm (3, 8) to the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

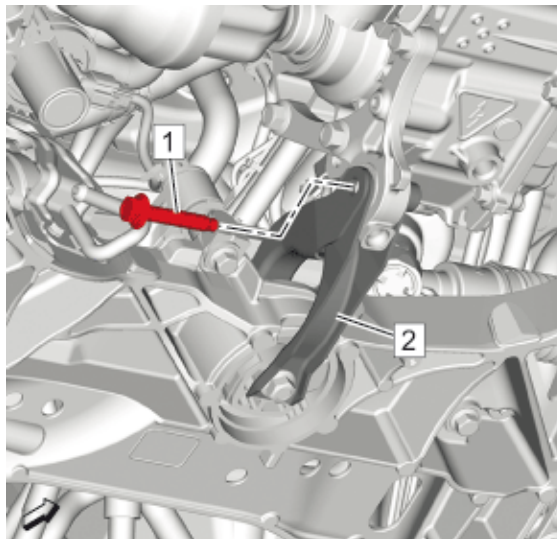


Fig. 337: Transmission Mount Strut Bolt And Transmission Mount Strut
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Torque-to-Yield Fastener Warning](#)

26. Install and tighten NEW Transmission Mount Strut Bolt (1) @ Transmission Mount Strut (2). Refer to [Transmission Mount Strut Bracket Replacement](#)
27. Install Front Wheel Drive Shaft @ Transmission. Refer to [Front Wheel Drive Shaft Replacement](#)
28. Connect the outer tie rod to the steering knuckle (Qty: 2). Refer to [Steering Linkage Outer Tie Rod Replacement](#)

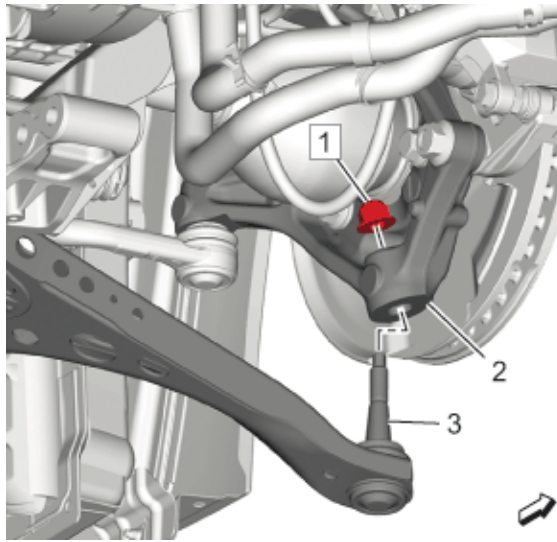


Fig. 338: Steering Knuckle, Lower Ball Joint And Nut
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Support the lower control arm under the ball joint with a hydraulic jack to tighten the nut.

29. Install the 2 lower ball joint (3) to the steering knuckle (2).
30. Install and tighten Nuts (1) (Qty: 2). Refer to [Lower Control Arm Replacement](#)

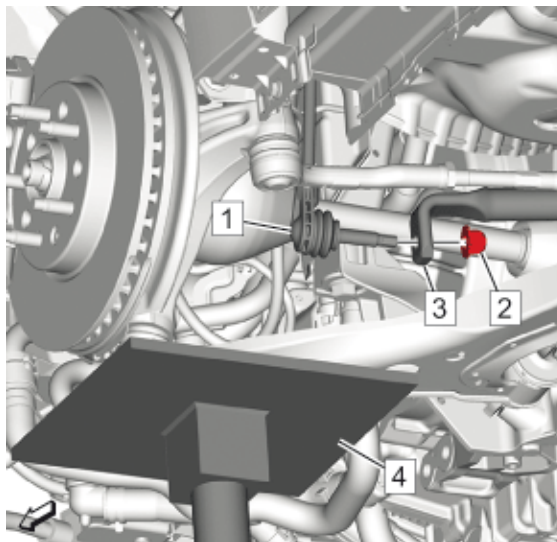


Fig. 339: Stabilizer Shaft Link, Stabilizer Shaft And Nut
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Hold against the hex of the threaded stud to tighten the nuts. Use a suitable tool.

31. Connect Stabilizer Shaft Links (1) (Qty: 2) @ Stabilizer Shaft (3)
32. Install and tighten Stabilizer Shaft Link Nuts (2) (Qty: 2) @ Stabilizer Shaft Link (1). Refer to [Lower Control Arm Replacement](#)

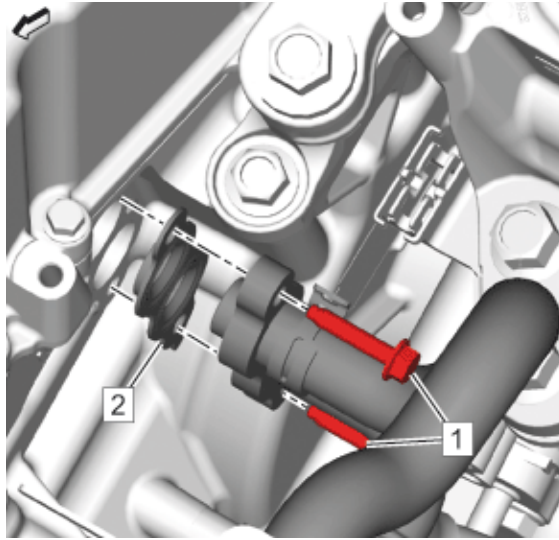


Fig. 340: Drive Motor Generator Control Module Cooling Outlet Hose And Bolts
Courtesy of GENERAL MOTORS COMPANY

33. Install NEW Seal (2). Install a NEW seal.
34. Install and tighten Drive Motor Generator Control Module Cooling Outlet Hose Bolts (1) (Qty: 2). Refer to [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\) Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)

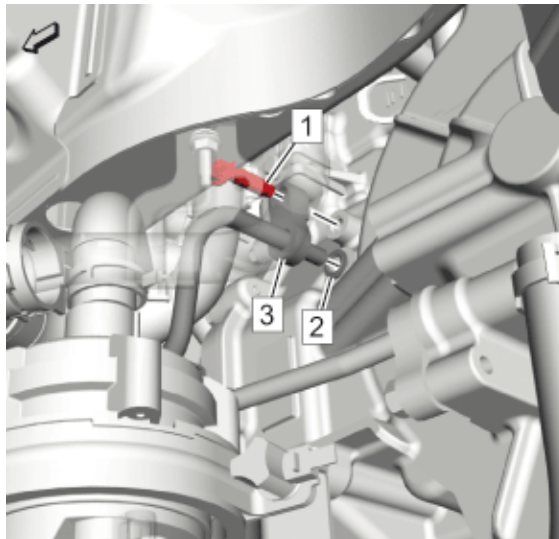


Fig. 341: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

35. Install NEW Sealing Washer (2). Install a NEW seal.
36. Connect Transmission Fluid Cooler Inlet Pipe (3)
37. Install and tighten Transmission Fluid Cooler Pipe Bolt (1). Refer to [Transmission Fluid Cooler Inlet Pipe Replacement](#)

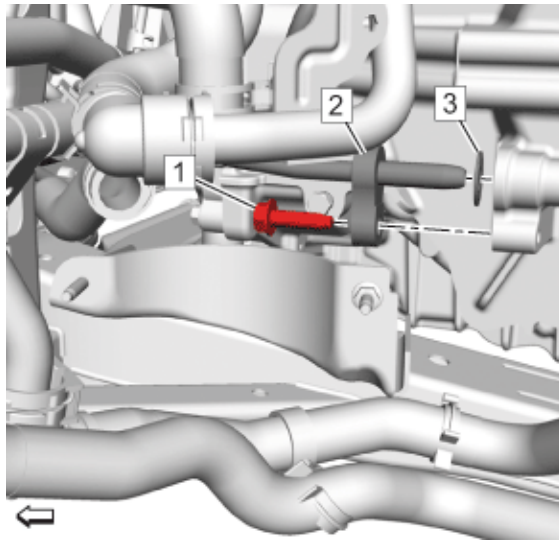


Fig. 342: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

38. Install NEW Sealing Washer (3). Install a NEW seal.
39. Connect Transmission Fluid Cooler Outlet Pipe (2)
40. Install and tighten Transmission Fluid Cooler Pipe Bolt (1). Refer to [Transmission Fluid Cooler Outlet Pipe Replacement](#)
41. Fill Transmission. Refer to [Transmission Fluid Drain and Fill](#)
42. Install Underbody Front Air Deflector-Left Side. Refer to [Underbody Front Air Deflector Replacement - Left Side](#)

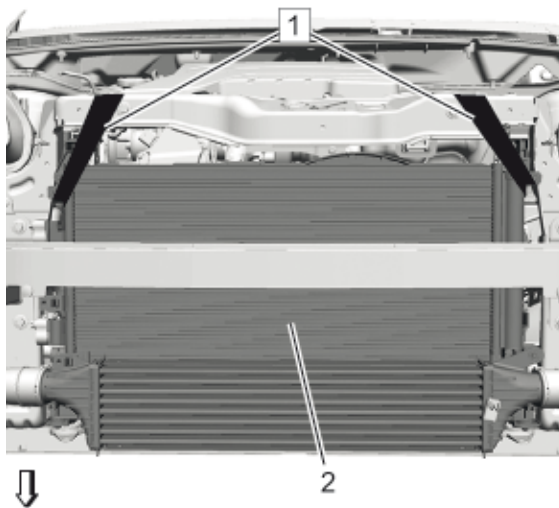


Fig. 343: Radiator And Lashing Straps
Courtesy of GENERAL MOTORS COMPANY

43. Loosen the radiator (2) from the body and remove the ropes (1).

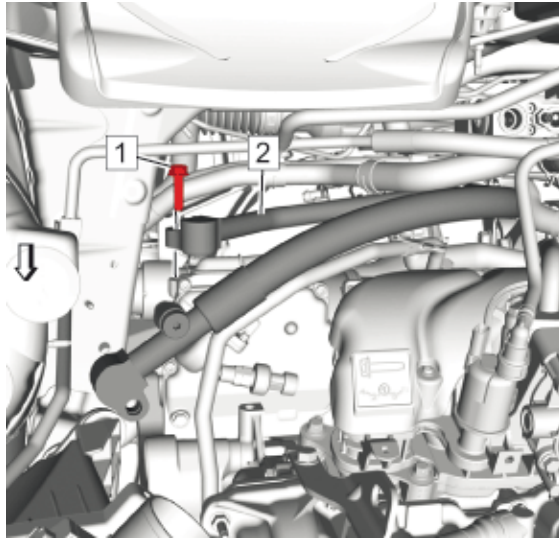


Fig. 344: Air Conditioning Compressor Hose Bolt And Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

44. Install Air Conditioning Compressor Hose
45. Install the air conditioning compressor hose bolt (1) to the air conditioning evaporator hose (2) and tighten.
 Refer to [Air Conditioning Compressor Hose Replacement](#)

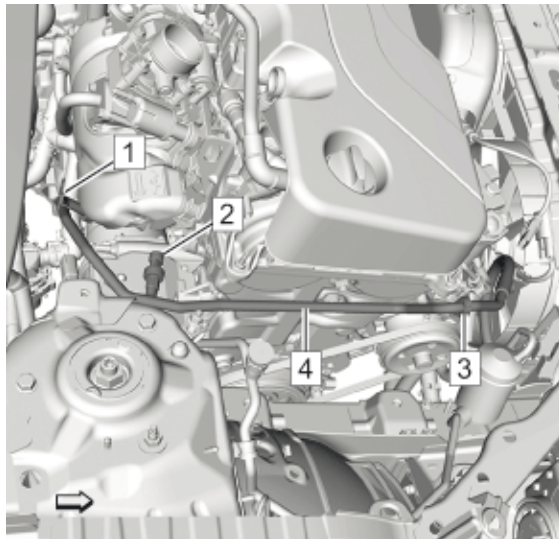


Fig. 345: A/C Compressor And Condenser Hose Tube, Retainer, Wiring Harness And Cycling Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

46. Install the air conditioning compressor and condenser hose tube (1).
47. Connect the air conditioning cycling switch electrical connector (3).
48. Install the wiring harness (2) to the air conditioning compressor and condenser hose tube.
49. Install the retainer (1).

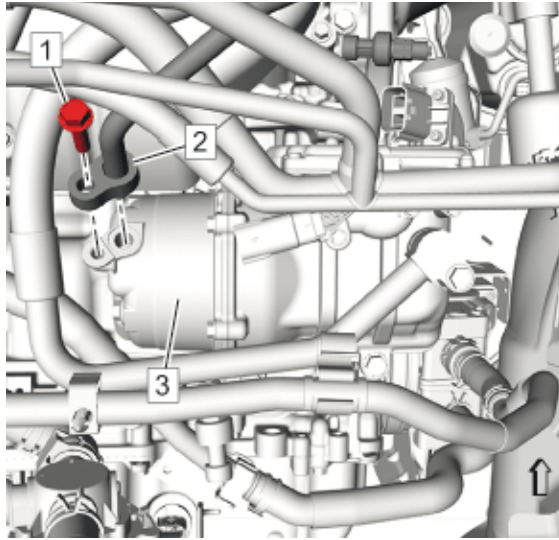


Fig. 346: Air Conditioning Compressor, Condenser Hose And Bolt
Courtesy of GENERAL MOTORS COMPANY

50. Install the air conditioning compressor and condenser hose (2) to the air conditioning compressor (3).
51. Install the air conditioning compressor and condenser hose bolt (1) and tighten. Refer to [Air Conditioning Compressor and Condenser Hose Replacement](#)

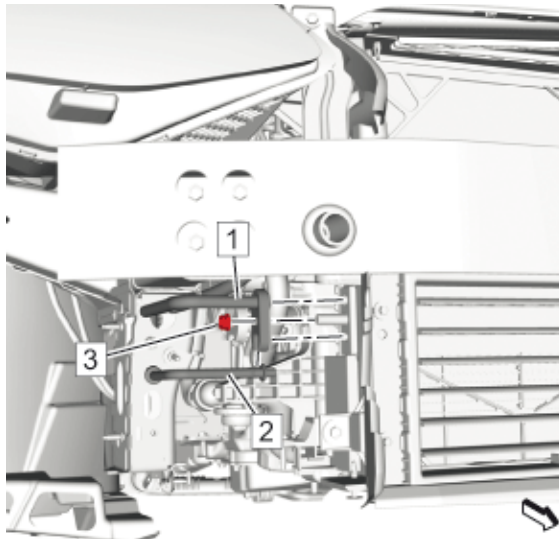


Fig. 347: Air Conditioning Evaporator Tube, Condenser Tube And Nut
Courtesy of GENERAL MOTORS COMPANY

52. Install the air conditioning evaporator tube (1) along with the condenser tube (2) to the condenser.
53. Install the condenser tube nut (3) and tighten. Refer to [Air Conditioning Compressor and Condenser Hose Replacement](#)

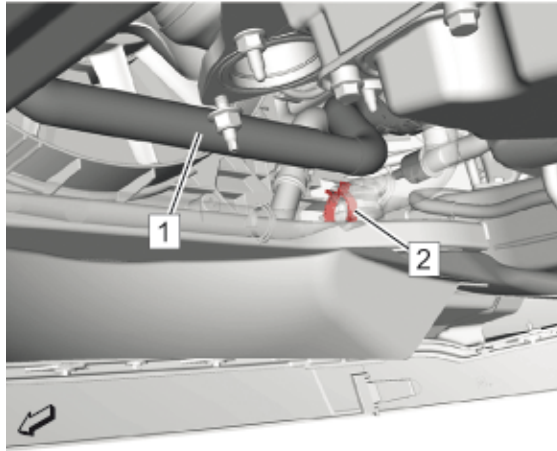


Fig. 348: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

54. Install the drive motor battery coolant cooler inlet hose (1) to the retainer (2).

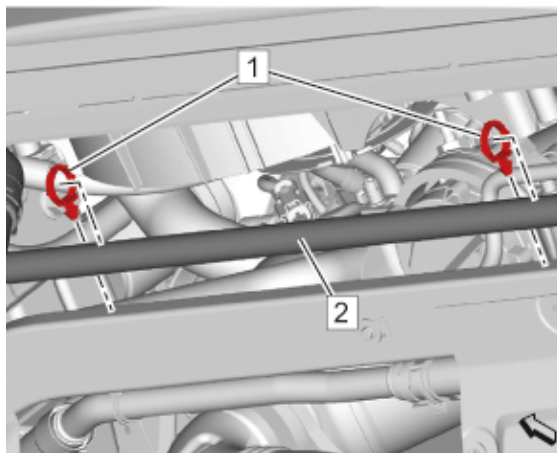


Fig. 349: Coolant Hose And Clips
Courtesy of GENERAL MOTORS COMPANY

- 55. Install Coolant Hose (2)
- 56. Install Clips (1) (Qty: 2)
- 57. Install Heater Water Shutoff Valve. Refer to [Heater Water Shutoff Valve Replacement](#)
- 58. Install Heater Coolant Heater. Refer to [Heater Coolant Heater Replacement](#)
- 59. Install Heater Coolant Pump. Refer to [Heater Coolant Pump Replacement](#)
- 60. Install Heater Inlet and Outlet Pipe. Refer to [Heater Inlet And Outlet Pipe Replacement](#)
- 61. Install Generator Control Module Coolant Pump. Refer to [Generator Control Module Coolant Pump Replacement](#)

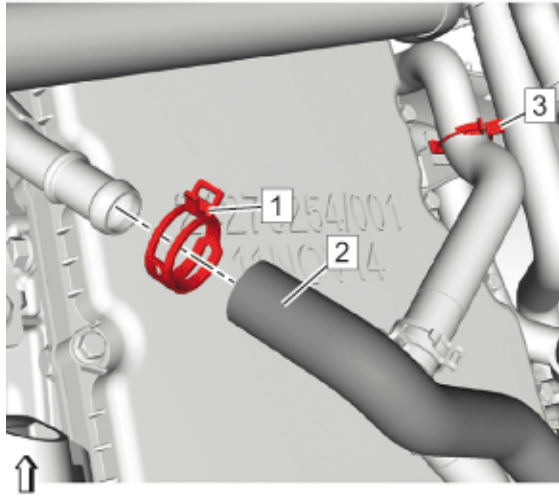


Fig. 350: Heater Inlet Hose, Clamp And Clip
Courtesy of GENERAL MOTORS COMPANY

- 62. Install Heater Inlet Hose (2)
- 63. Install Clamp (1)
- 64. Install Heater Inlet Hose @ Clip (3)

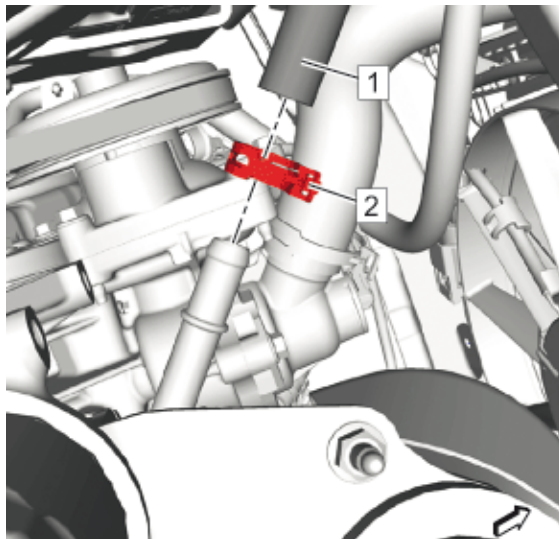


Fig. 351: Heater Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

- 65. Install Heater Inlet Hose (1)
- 66. Install Clamp (2)

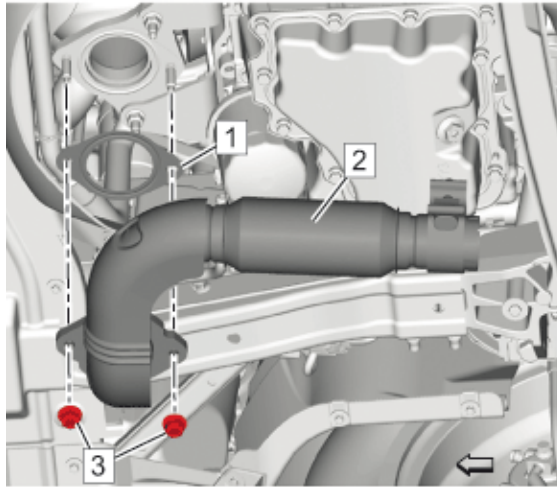


Fig. 352: Exhaust Front Pipe, Nuts And Gasket
Courtesy of GENERAL MOTORS COMPANY

- 67. Install a NEW gasket. (1)
- 68. Install Exhaust Front Pipe (2)
- 69. Install and tighten Exhaust Front Pipe Nuts (3) (Qty: 2). Refer to [Exhaust Front Pipe Replacement](#)
- 70. Install Exhaust Muffler. Refer to [Exhaust Muffler Replacement](#)

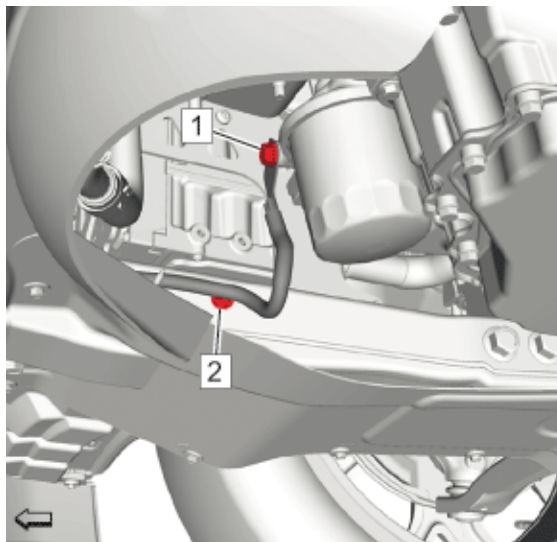


Fig. 353: Engine Ground Strap Bolt And Retainer
Courtesy of GENERAL MOTORS COMPANY

- 71. Install the engine ground strap bolt (1) and tighten to 25 N.m (18 lb ft).
- 72. Install Wiring Harness Clip (2)

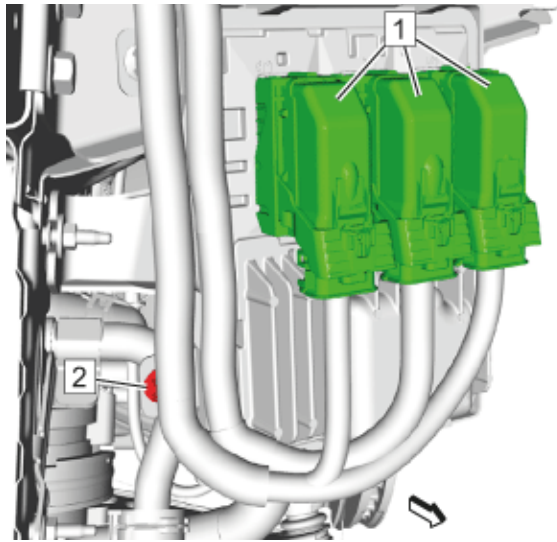


Fig. 354: Wiring Harness Clip And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

- 73. Connect the electrical connectors. (1) (Qty: 3)
- 74. Install Wiring Harness Clip (2)

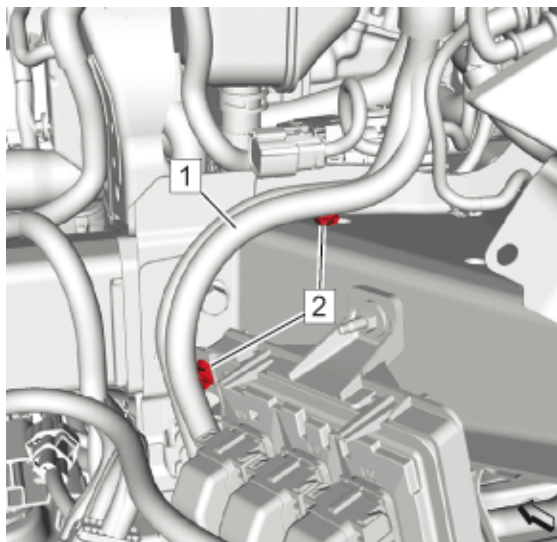


Fig. 355: Engine Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

- 75. Install Engine Wiring Harness (2) @ Wiring Harness Clips (1) (Qty: 2)
- 76. Install Headlamp Left Side. Refer to [Headlamp Replacement](#)
- 77. Lower the vehicle.
- 78. Remove the engine support fixture. Refer to [Engine Support Fixture](#)

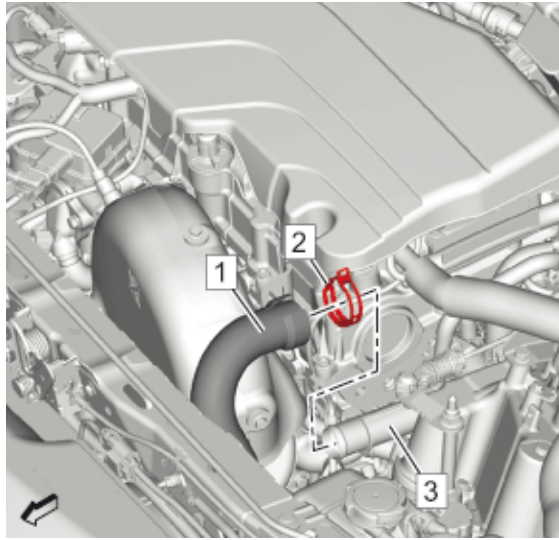


Fig. 356: Water Outlet, Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

- 79. Install Radiator Inlet Hose (1) @ Water Outlet (3)
- 80. Install Radiator Inlet Hose Clamp (2)

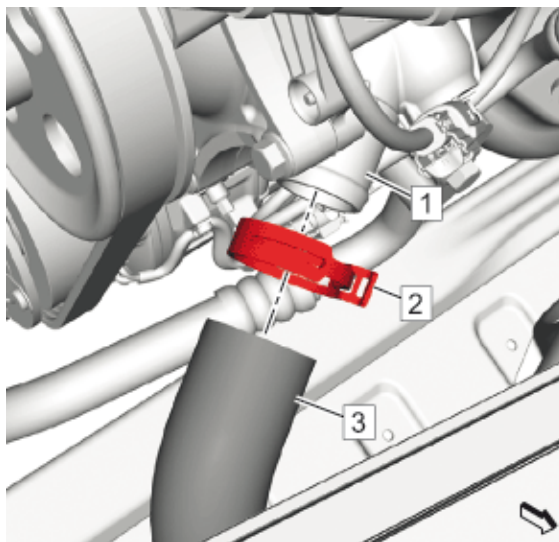


Fig. 357: Engine Coolant Thermostat Housing, Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

- 81. Install Radiator Outlet Hose (3) @ Engine Coolant Thermostat Housing (1)
- 82. Install Radiator Outlet Hose Clamp (2)

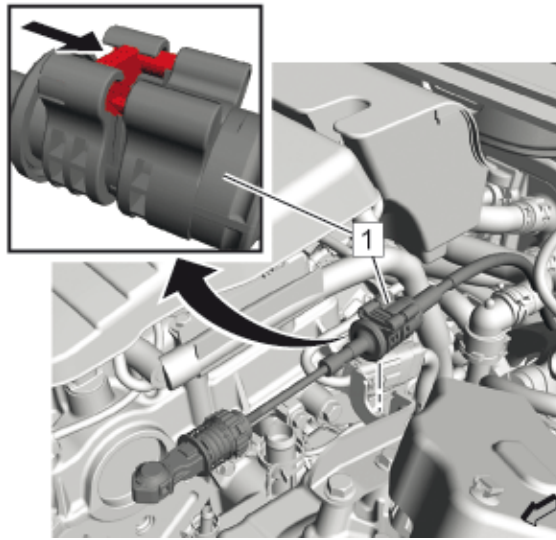


Fig. 358: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

83. Install the range selector lever cable (1) to the range selector lever cable bracket.

The retainer snaps automatically in.

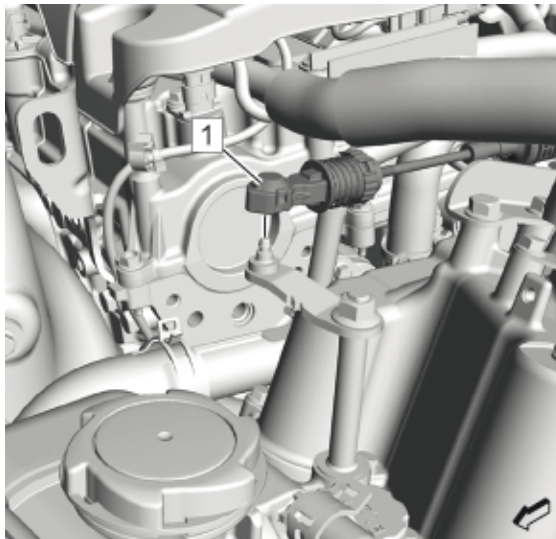


Fig. 359: Range Selector Lever Cable And Range Selector Lever Cable Lever
Courtesy of GENERAL MOTORS COMPANY

84. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

85. Install Heater Water Shutoff Valve Inlet Hose. Refer to [Heater Water Shutoff Valve Inlet Hose Replacement](#)

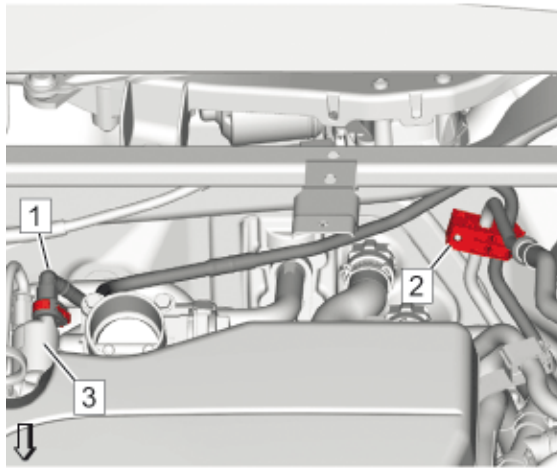


Fig. 360: Evaporative Emission Canister Purge Solenoid Valve And Evaporative Emission Pipe
Courtesy of GENERAL MOTORS COMPANY

86. Remove all **EN-6015** plugs from the connections.
87. Connect Evaporative Emission Pipe (1) @ Evaporative Emission Canister Purge Solenoid Valve (3). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)

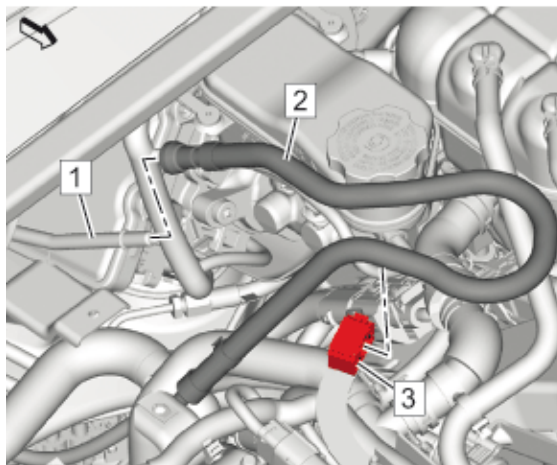


Fig. 361: Fuel Feed Pipe, Fuel Feed Front Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

88. Remove all **EN-6015** plugs from the connections.
89. Connect Fuel Feed Front Pipe (2) @ Fuel Feed Pipe (1). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)
90. Install Fuel Feed Front Pipe (2) @ Retainer (3)

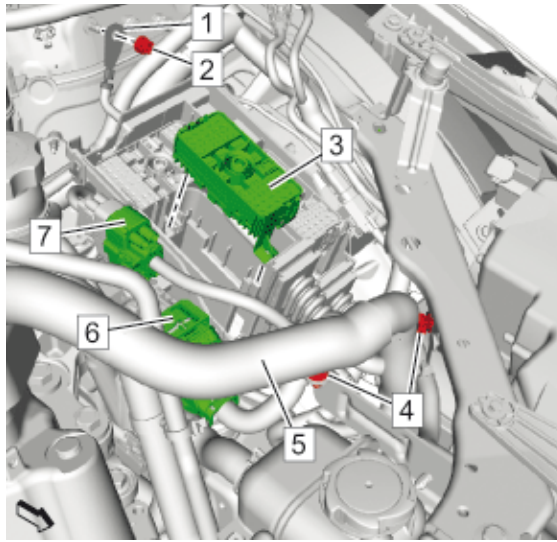


Fig. 362: Ground Cable, Nut, Engine Wiring Harness, Clips And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

91. Install the electrical connector (3) to the front compartment fuse block housing.
92. Install Ground Cable (1)
93. Install and tighten Ground Cable Nut (2) to 9 N.m (80 lb in)
94. Connect the electrical connectors. (6, 7) (Qty: 2)
95. Install Engine Wiring Harness (5) @ Clips (4) (Qty: 2)
96. Install Engine Wiring Harness Junction Block. Refer to [Engine Wiring Harness Junction Block Replacement](#)
97. Install 300-Volt Battery Positive and Negative Cable @ Transmission. Refer to [Battery 300-Volt Positive and Negative Cable Replacement - High Voltage Battery to Power Inverter Module and A/C Compressor](#)
98. Install the radiator surge tank. Refer to [Radiator Surge Tank Replacement](#)
99. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
100. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#)
101. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
102. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#)
103. Install Intermediate Steering Shaft Lower Bolt. Refer to [Intermediate Steering Shaft Replacement](#)
104. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)
105. Fill the drive motor generator power inverter module cooling system. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
106. Fill the drive motor battery cooling system. Refer to [Drive Motor Battery Cooling System Draining and Filling](#) -
107. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
108. Recharge the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
109. Enable the high voltage system. Refer to [High Voltage Enabling](#)

AUTOMATIC TRANSMISSION FLEX PLATE REPLACEMENT

Special Tools

- EN-45059 Angle Meter
- EN-51398 Flywheel Holder

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Transmission. Refer to [Transmission Replacement](#)

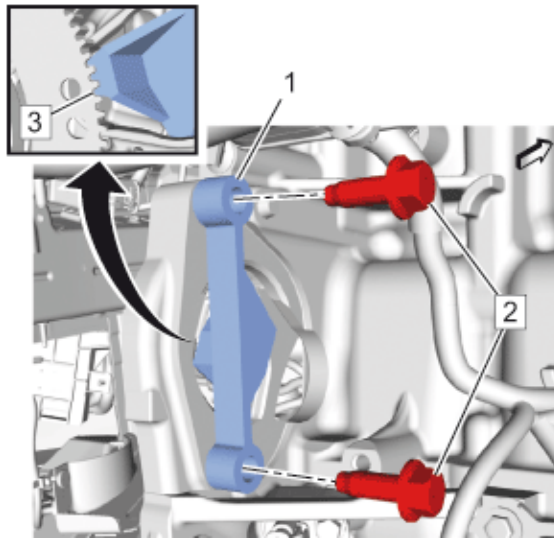


Fig. 363: Flywheel Holder And Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-51398** holder (1), lock the automatic transmission flex plate via the starter ring gear.
3. Ensure that the **EN-51398** holder is engaged into a robust portion of the flex plate (3).
4. Install and tighten the 2 starter opening cover bolts (2).

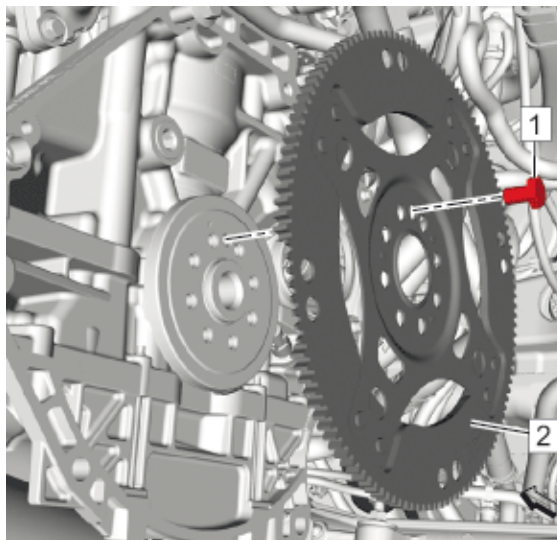


Fig. 364: Automatic Transmission Flex Plate And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD the 8 automatic transmission flex plate bolts (1).
6. Remove Automatic Transmission Flex Plate (2)

Installation Procedure

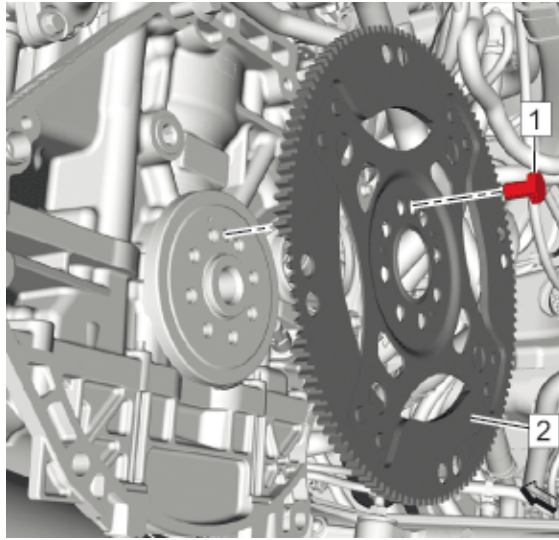


Fig. 365: Automatic Transmission Flex Plate And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Automatic Transmission Flex Plate (2)
2. Install 8 NEW automatic transmission flex plate bolts (1).
3. Hand tighten the bolts.

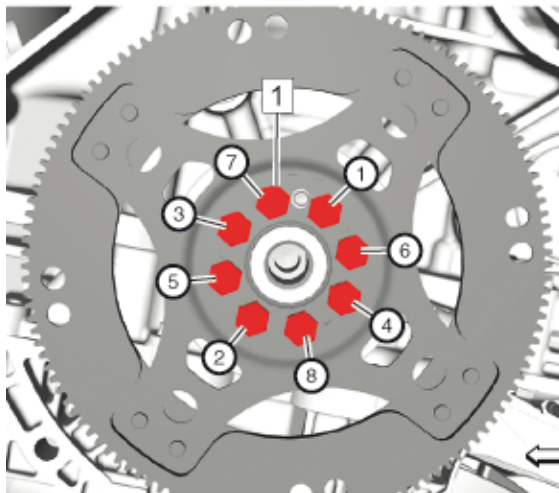


Fig. 366: Automatic Transmission Flex Plate Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#) .

NOTE: The bolts have adhesive patch and must be tightened to final torque within 5 minutes.

4. Tighten Automatic Transmission Flex Plate Bolts in the sequence shown.
 1. First Pass: 20 N.m (15 lb ft).
 2. Second Pass: 30 N.m (22 lb ft).

3. Final Pass: 70 degrees, using the **EN 45059** meter.

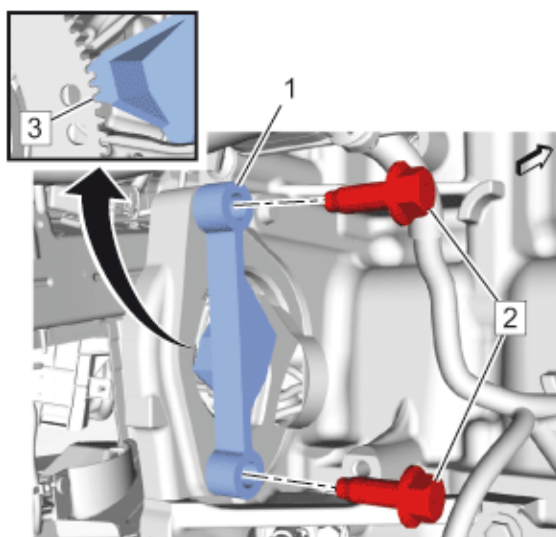


Fig. 367: Flywheel Holder And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 starter opening cover bolts (2).

6. Remove the **EN-51398** holder (1).

7. Install Transmission. Refer to [Transmission Replacement](#)

ENGINE SUPPORT FIXTURE

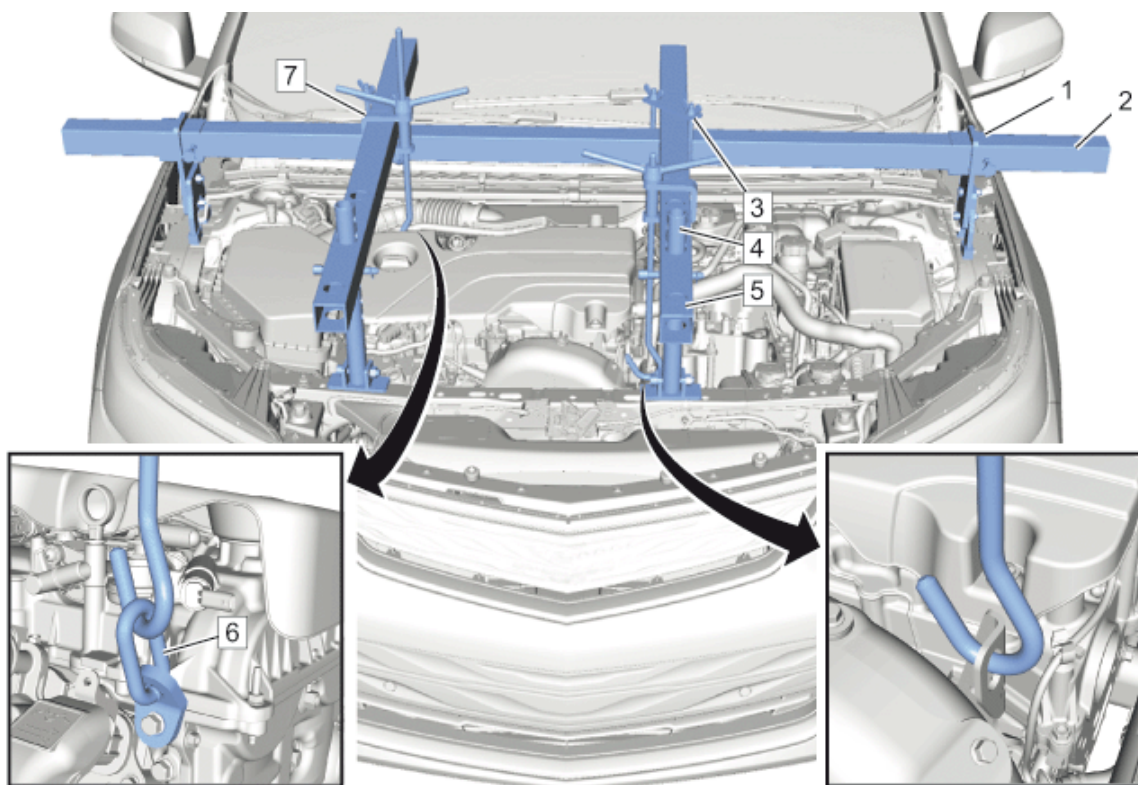


Fig. 368: Engine Support Fixture Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
Preliminary Procedures 1. Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement 2. To gain access for the engine support fixture installation, remove the wiring harness from the front compartment upper side rail. 3. To gain access for the engine lift bracket installation, unclip the engine wiring harness from the intake manifold.	
Special Tools • EN-43405 Engine Support Fixture Adapter • EN-28467-1A Cross Bracket • EN-28467-5A Strut Tower Support Assembly • EN-28467-8A Hook Assembly • EN-28467-2A Radiator Tube Shelf Assembly • EN-36857 Engine Lift Bracket	
Equivalent regional tools: Special Tools	
1	Engine Support Fixture Adapter Leg (Qty: 2) Procedure Install the bracket to fender frame. Do not install on top of fender lip.
2	Main Support Beam
3	Cross Bracket (Qty: 2)
4	Strut Tower Support Assembly (Qty: 2) Procedure Adjust the length of the strut tower support assembly.
5	Radiator Tube Shelf Assembly (Qty: 2)
6	Engine Lift Bracket Procedure Use a grade 10.9 bolt to install the EN-36857 Engine Lift Bracket.
7	Hook Assembly (Qty: 2)

REPAIR INSTRUCTIONS - OFF VEHICLE

DRAINING FLUIDS AND OIL FILTER REMOVAL

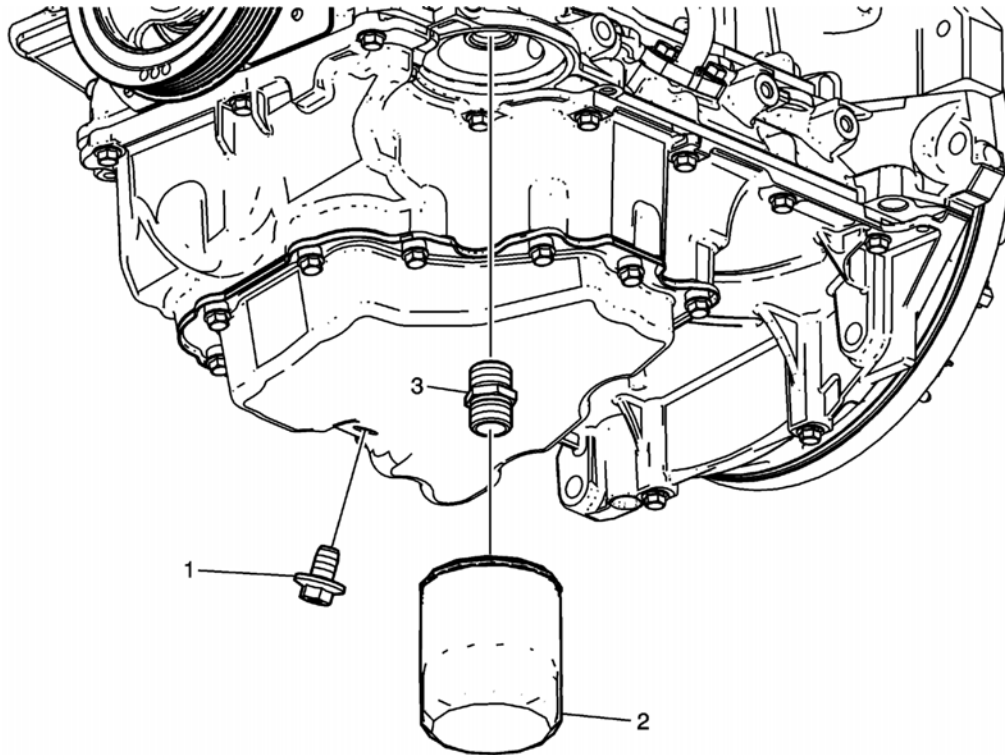


Fig. 369: Draining Fluids and Oil Filter
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Oil Pan Drain Plug CAUTION: Refer to Fastener Caution . NOTE: Place a drip pan underneath. Allow the oil to drain completely.
2	Oil Filter Special Tools EN-726-A Oil Filter Wrench For equivalent regional tools, refer to Special Tools.
3	Oil Filter Fitting

CRANKSHAFT BALANCER REMOVAL

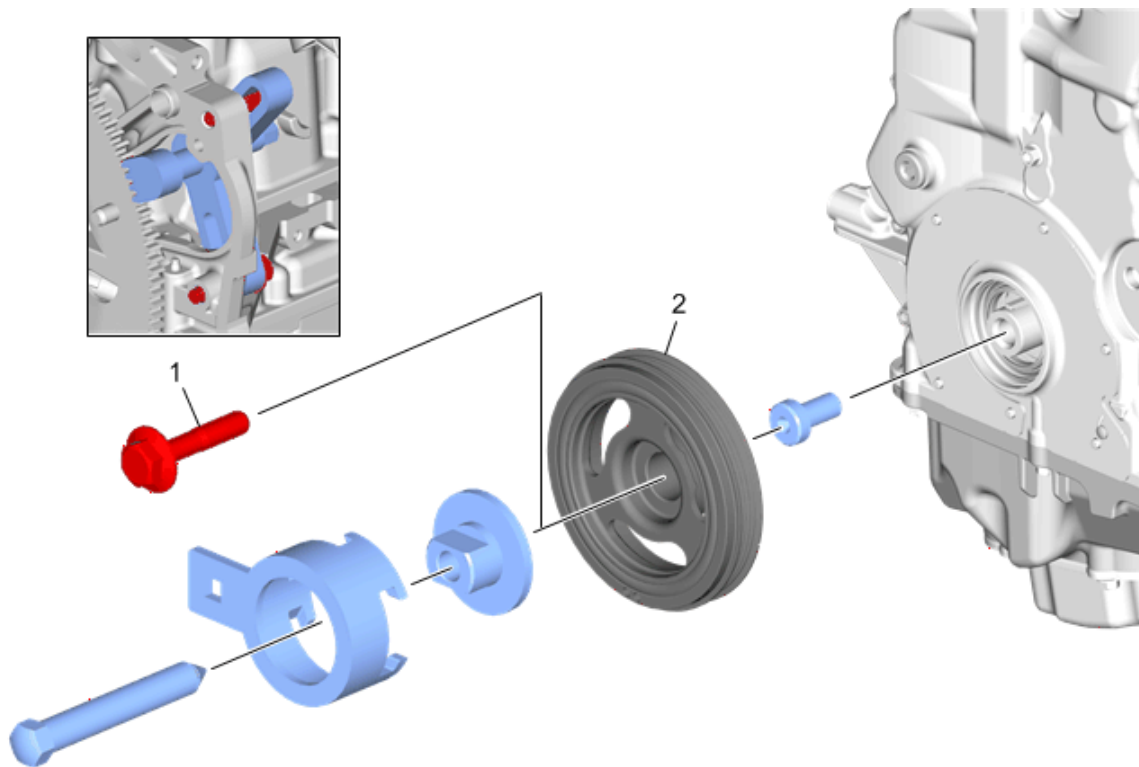


Fig. 370: Crankshaft Balancer

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the starter opening cover. Refer to Engine Block Disassemble. 2. Install the EN-51760 holder, lock the automatic transmission flex plate via the starter ring gear.	
Special Tools EN-51760 Flywheel HolderFor equivalent regional tools, refer to Special Tools .	
1	Crankshaft Balancer Bolt
2	Crankshaft Balancer Procedure 1. Install the EN-44226-5 protector onto the crankshaft. 2. Install EN-44226-1 holding body and EN-44226-2 remover plate with remover bolt onto the balancer. 3. Counter hold the EN-44226-2 remover plate and turn the remover screw to remove the balancer. Special Tools • EN-44226 Crankshaft Balancer Remover • EN-44226-5 Crankshaft Protector

AUTOMATIC TRANSMISSION FLEX PLATE REMOVAL

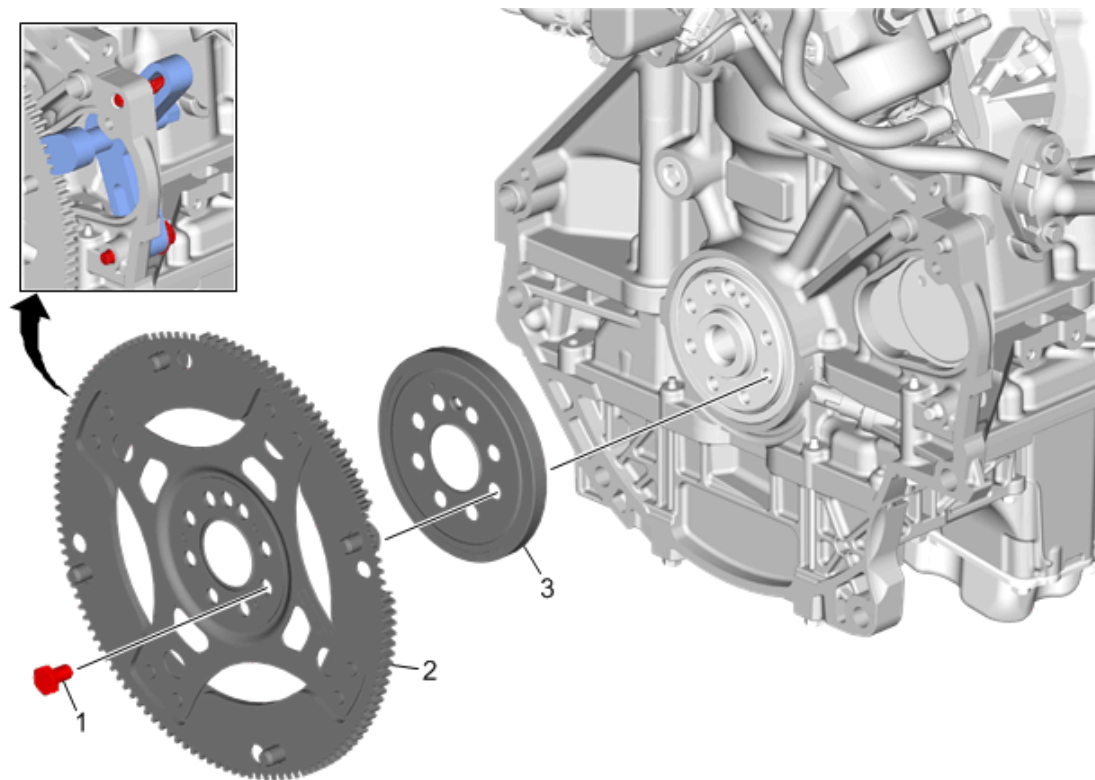


Fig. 371: Automatic Transmission Flex Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the starter opening cover. Refer to Engine Block Disassemble. 2. Install EN-51760 holder, lock the automatic transmission flex plate via the starter ring gear.	
Special Tools EN-51760 Flywheel HolderEquivalent regional tools: Special Tools .	
1	Automatic Transmission Flex Plate Bolt (Qty: 8) NOTE: Discard the bolts.
2	Automatic Transmission Flex Plate
3	Crankshaft Position Sensor Reluctor Ring CAUTION: Refer to Crankshaft Position Sensor Reluctor Ring Caution

EXHAUST GAS RECIRCULATION PIPE REMOVAL

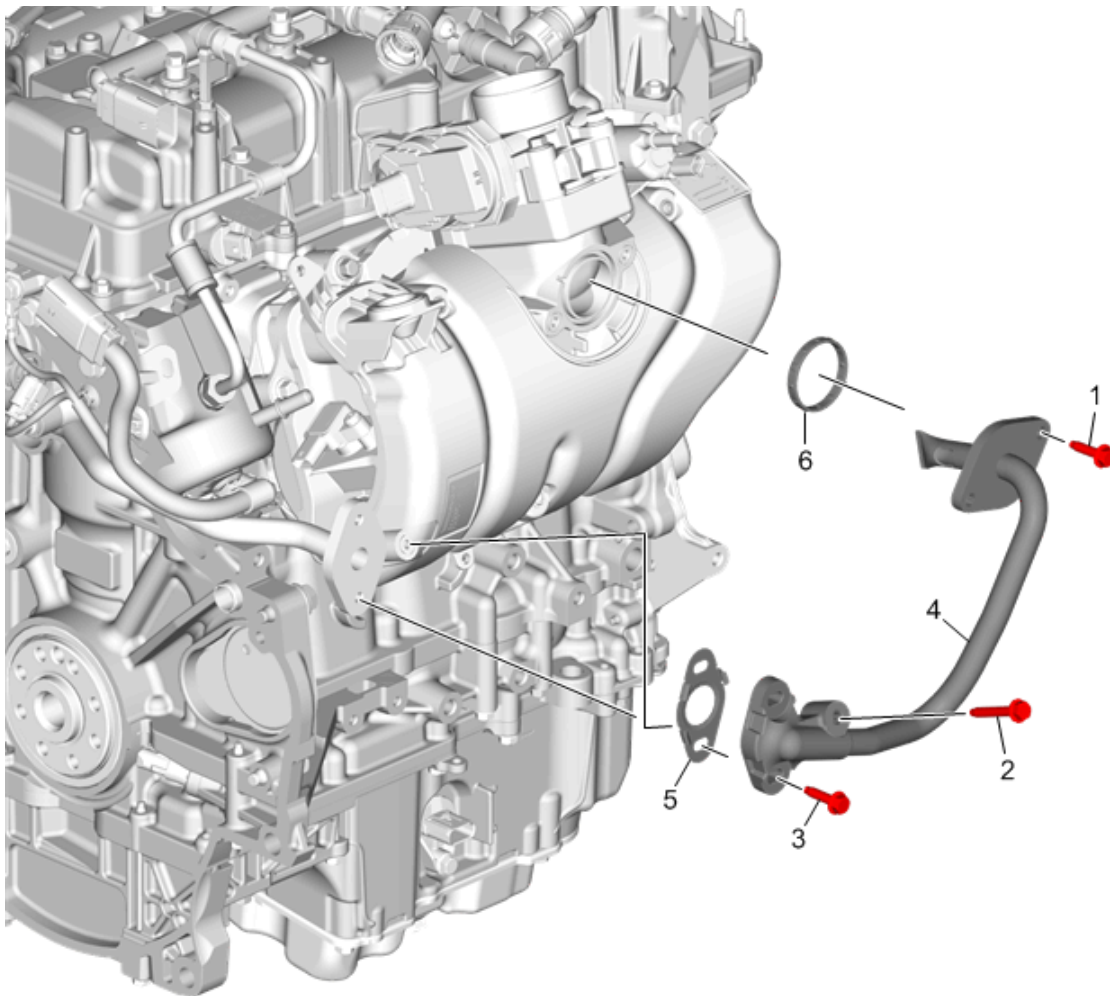


Fig. 372: Exhaust Gas Recirculation Pipe
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Pipe Bolt (Qty: 2)
2	Exhaust Gas Recirculation Pipe Bolt
3	Exhaust Gas Recirculation Pipe Bolt (Qty: 2)
4	Exhaust Gas Recirculation Pipe
5	Exhaust Gas Recirculation Pipe Gasket NOTE: Discard the gasket.
6	Exhaust Gas Recirculation Pipe Gasket NOTE: Discard the gasket.

EXHAUST GAS RECIRCULATION COOLER OUTLET PIPE REMOVAL

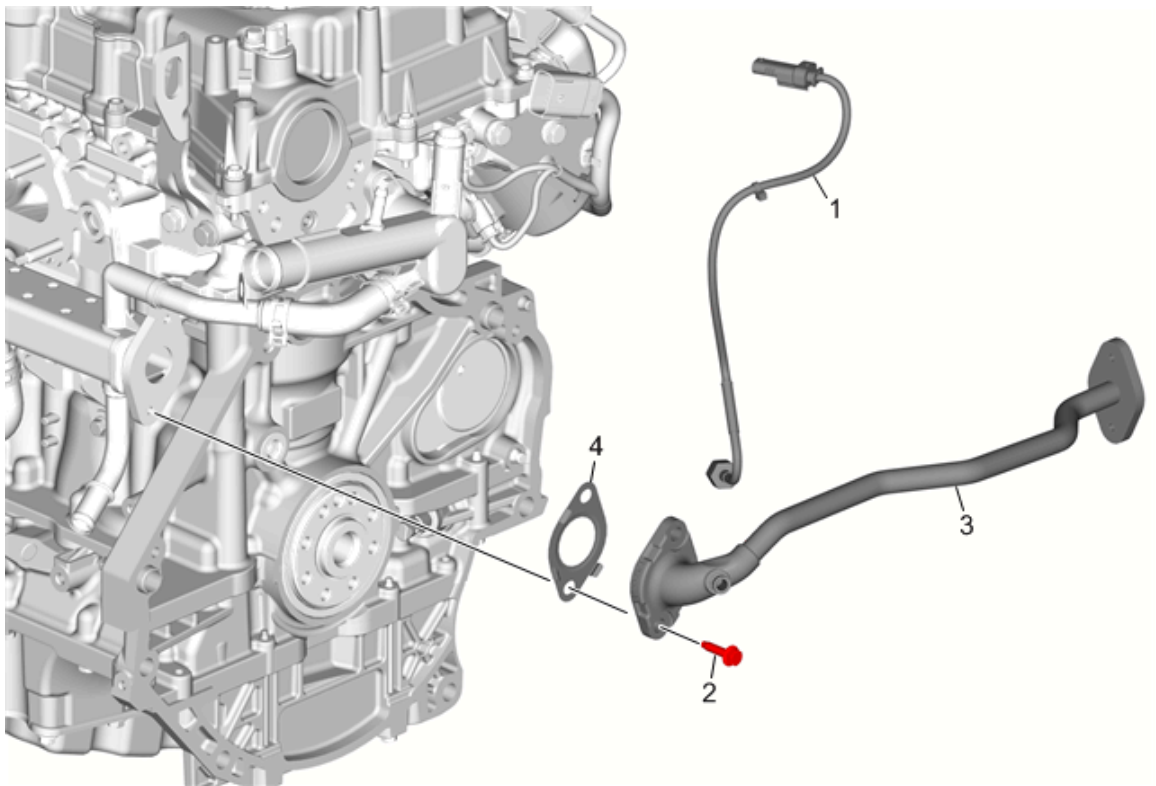


Fig. 373: Exhaust Gas Recirculation Cooler Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Cooler Temperature Sensor Procedure Disconnect the temperature sensor nut at the outlet pipe.
2	Exhaust Gas Recirculation Cooler Outlet Pipe Bolt (Qty: 2)
3	Exhaust Gas Recirculation Cooler Outlet Pipe
4	Exhaust Gas Recirculation Cooler Outlet Pipe Gasket NOTE: Discard the gasket.

EXHAUST GAS RECIRCULATION COOLER REMOVAL

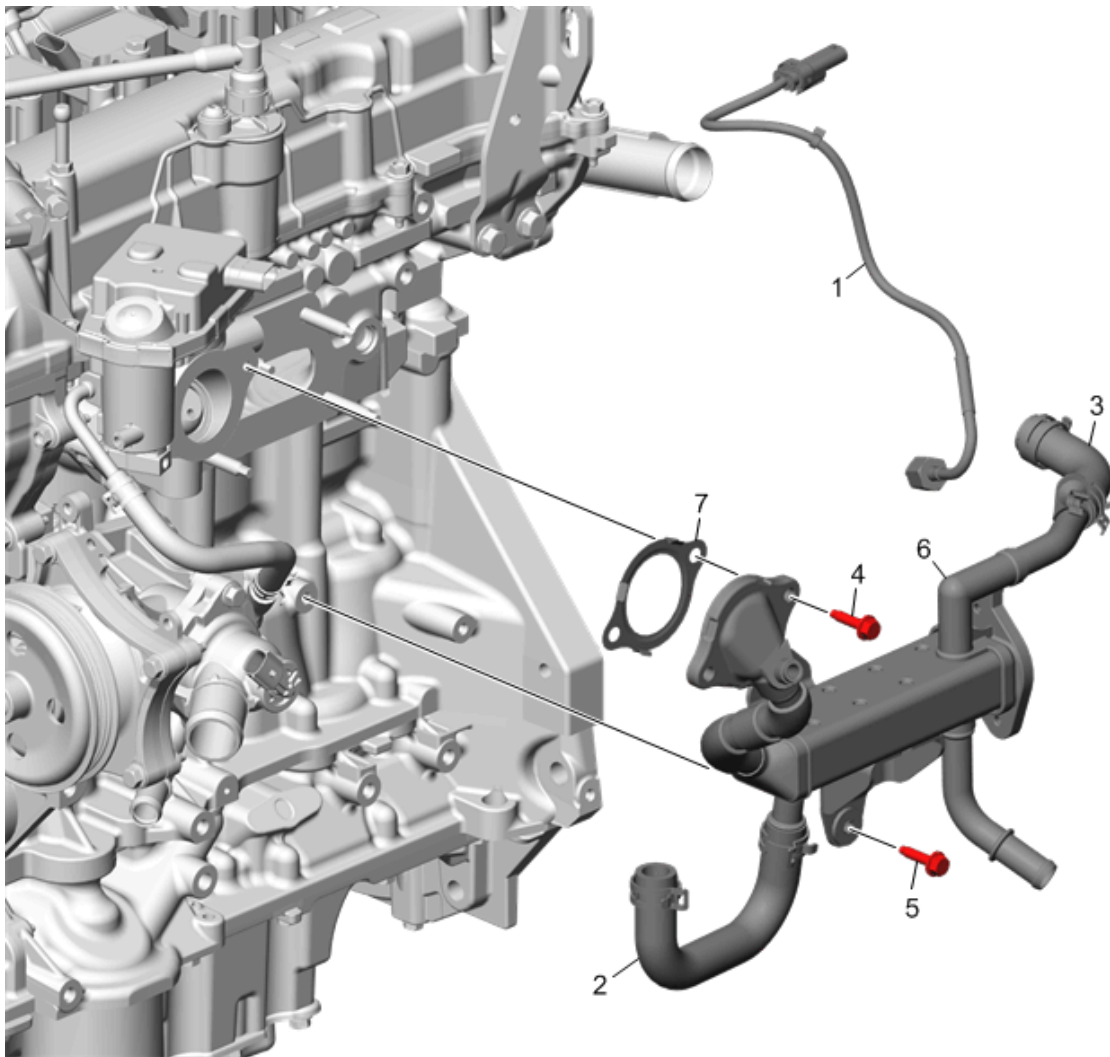


Fig. 374: Exhaust Gas Recirculation Cooler
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Cooler Temperature Sensor Procedure Disconnect the temperature sensor nut at the inlet pipe.
2	Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose Procedure Disconnect the bypass outlet hose at the water pump.
3	Thermostat Bypass Hose Procedure Disconnect the bypass hose at the water outlet.
4	Exhaust Gas Recirculation Cooler Bolt (Qty: 2)
5	Exhaust Gas Recirculation Cooler Bolt
6	Exhaust Gas Recirculation Cooler
7	Exhaust Gas Recirculation Cooler Inlet Pipe Gasket NOTE: Discard the gasket.

EXHAUST GAS RECIRCULATION VALVE REMOVAL

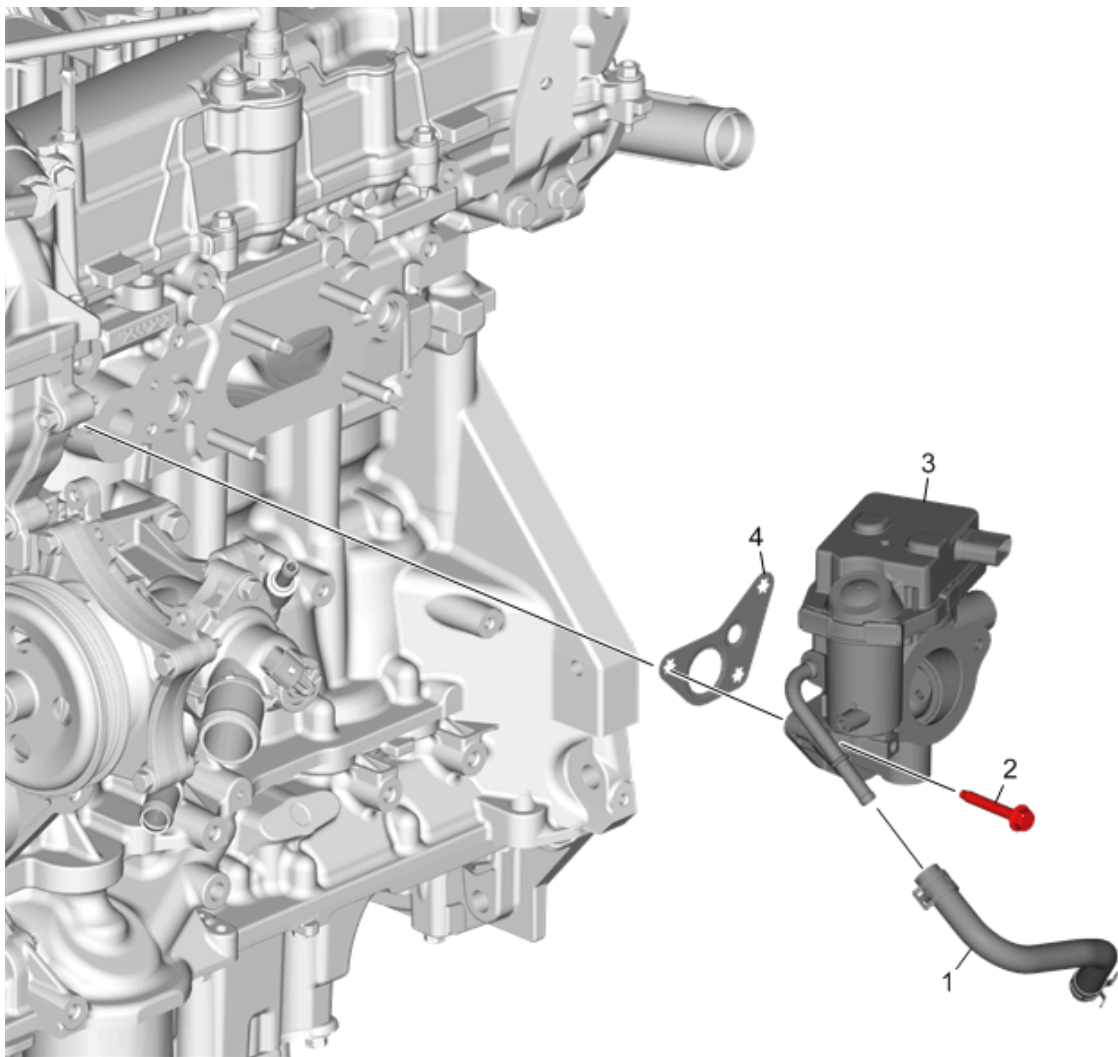


Fig. 375: Exhaust Gas Recirculation Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Valve Cooling Return Hose Procedure Disconnect the cooling return hose at the water pump inlet adapter.
2	Exhaust Gas Recirculation Valve Bolt (Qty: 3)
3	Exhaust Gas Recirculation Valve
4	Exhaust Gas Recirculation Valve Gasket

WATER PUMP REMOVAL

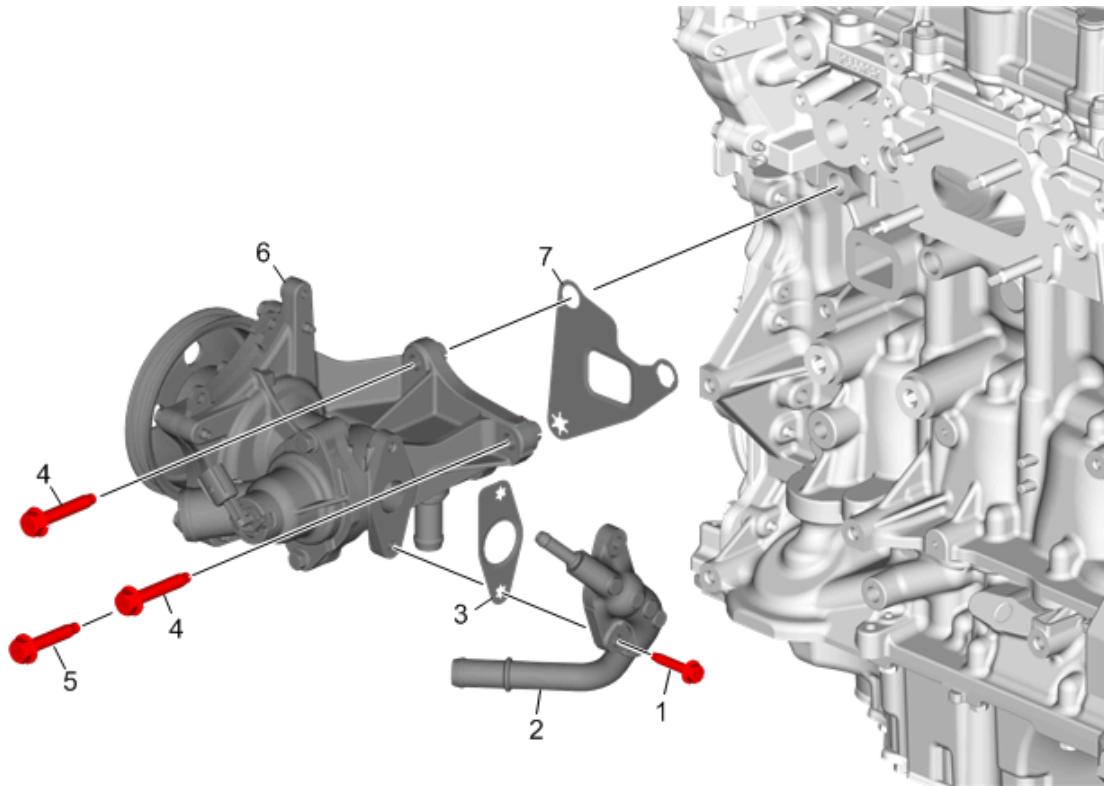


Fig. 376: Water Pump

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Thermostat Bypass Pipe Bolt (Qty: 2)
2	Water Pump Inlet Hose Fitting
3	Thermostat Bypass Pipe Gasket
4	Water Pump Bolt (Qty: 2)
5	Water Pump Bolt
6	Water Pump
7	Water Pump Housing Gasket

ENGINE WIRING HARNESS ASSEMBLY REMOVAL

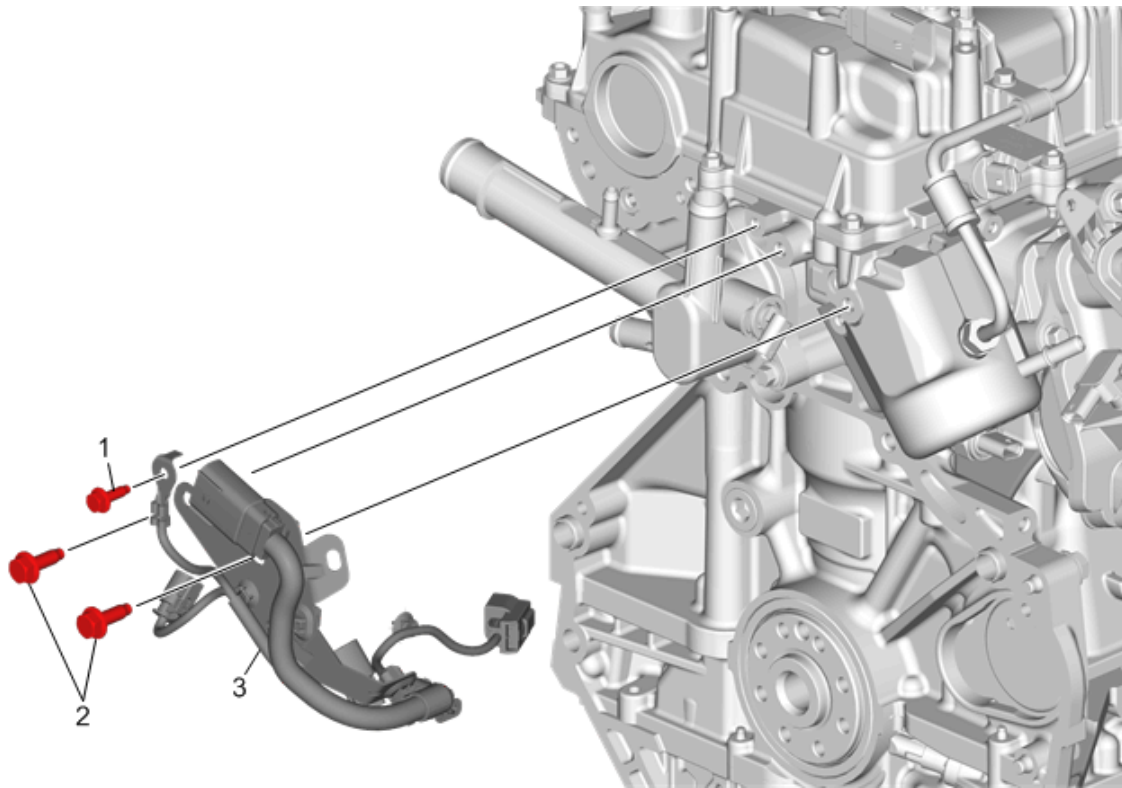


Fig. 377: Engine Wiring Harness Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Wiring Harness Connector Bolt
2	Engine Wiring Harness Bracket Bolt (Qty: 2)
3	Engine Wiring Harness

THROTTLE BODY ASSEMBLY REMOVAL

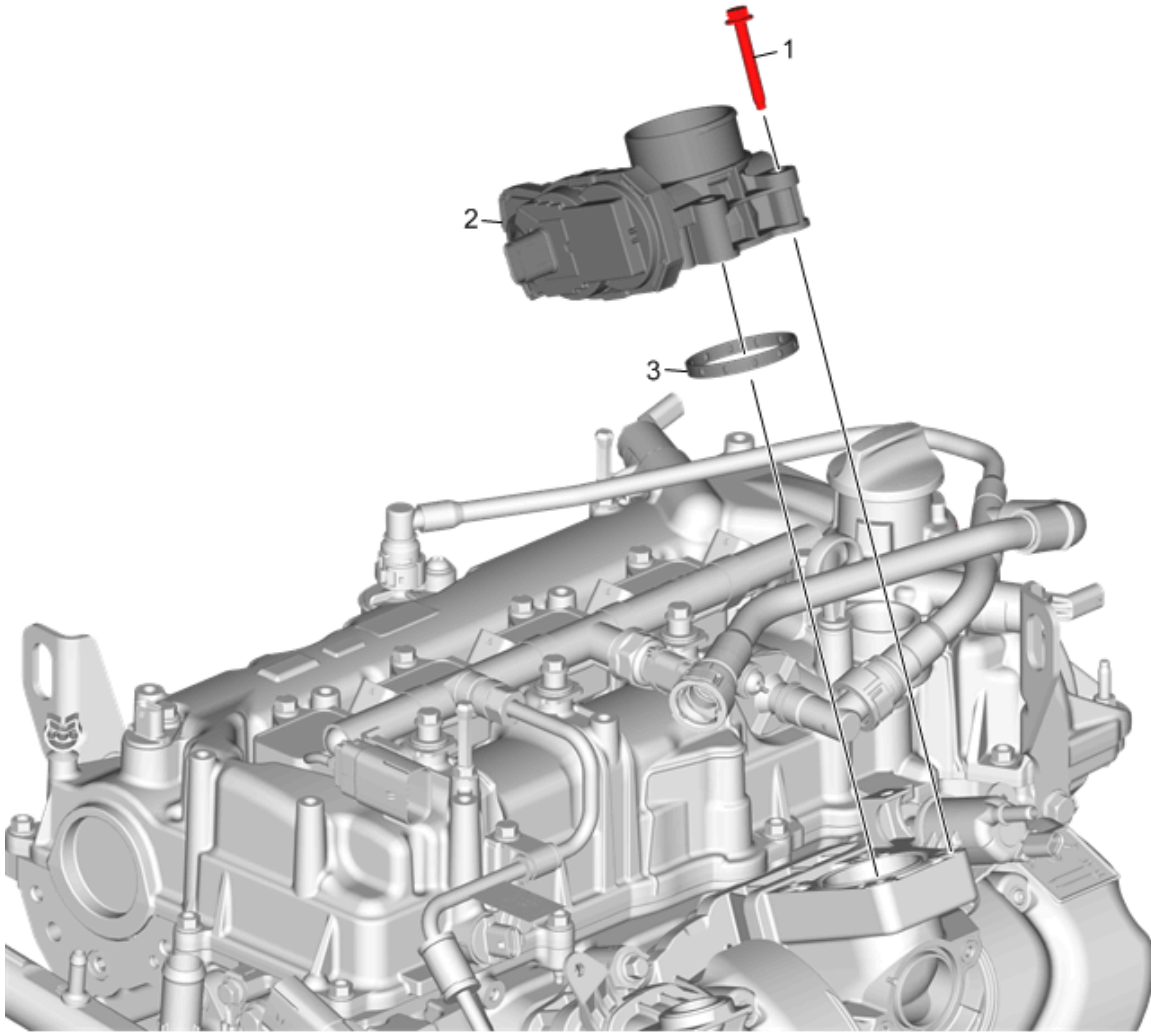


Fig. 378: Throttle Body Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Throttle Body Bolt (Qty: 4)
2	Throttle Body
3	Throttle Body Gasket

INTAKE MANIFOLD REMOVAL

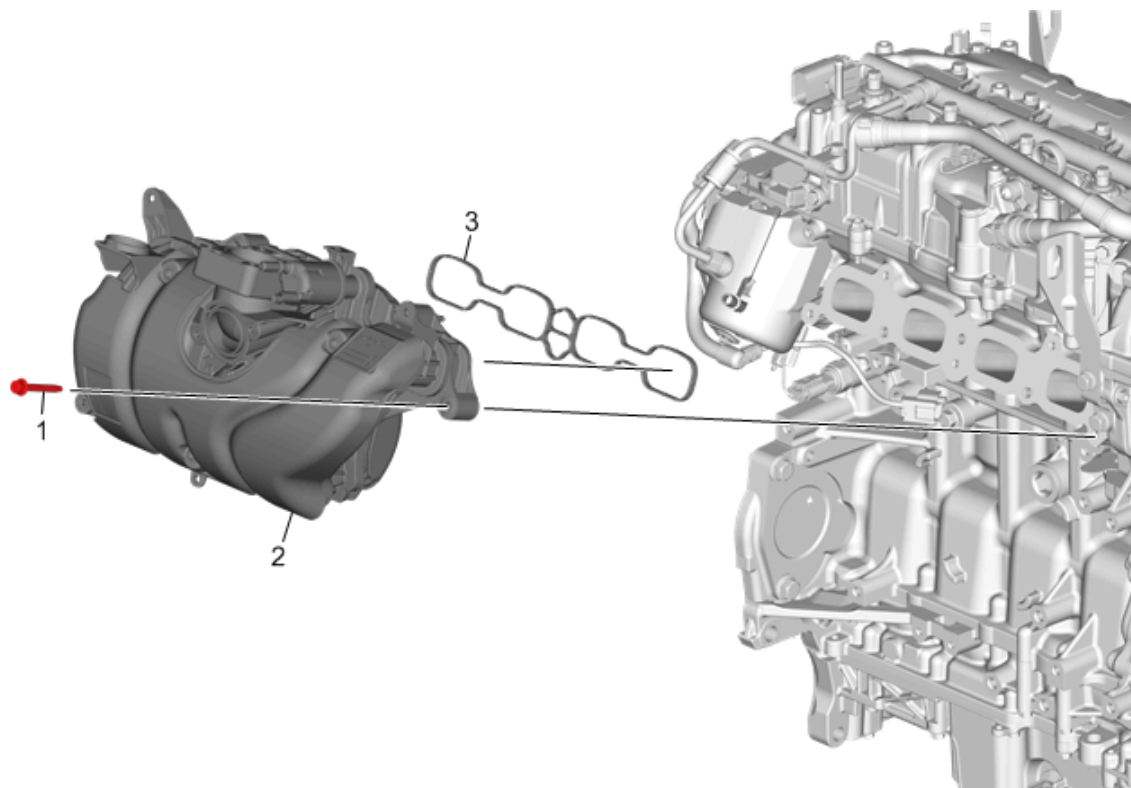


Fig. 379: Intake Manifold

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Intake Manifold Bolt (Qty: 5) NOTE: Bolt retainers keep the bolts in position on the assembly. Procedure Loosen bolts until disengaged from mount location.
2	Intake Manifold
3	Intake Manifold Gasket

FUEL PUMP REMOVAL

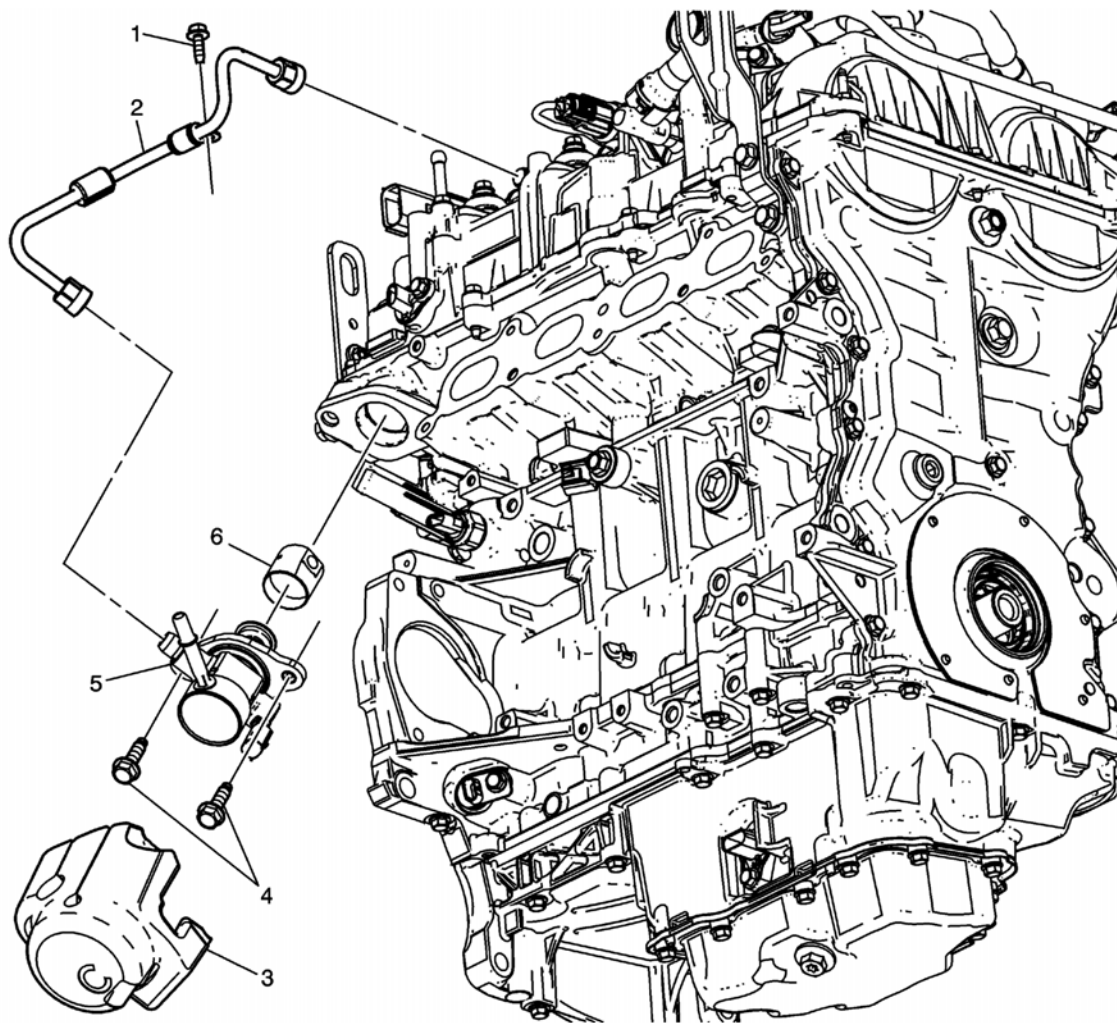


Fig. 380: Fuel Pump

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Fuel Feed Intermediate Pipe Bolt (Qty: 1)
2	Fuel Feed Intermediate Pipe WARNING: Fuel that flows out at high pressure can cause serious injury to the skin and eyes. ALWAYS depressurize the fuel system before removing

Callout	Component Name
	components that are under high fuel pressure. NOTE: Discard the pipe.
3	Fuel Pump Insulator WARNING: The noise cancelling foam component MUST be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.
4	Fuel Pump Bolt (Qty: 2) CAUTION: Alternately loosen the fuel pump bolts one turn at a

Callout	Component Name
	time until the pump is fully disengaged from fuel pump lifter follower. Trying to remove the pump bolts without even side-to-side loosening may result in pump plunger damage Procedure: Remove the fuel injection pump bolts alternating in steps of one turn each. NOTE: Discard the bolts.
5	Fuel Pump
6	Valve Lifter Follower

ENGINE LIFT AND SIGHT SHIELD BRACKET REMOVAL

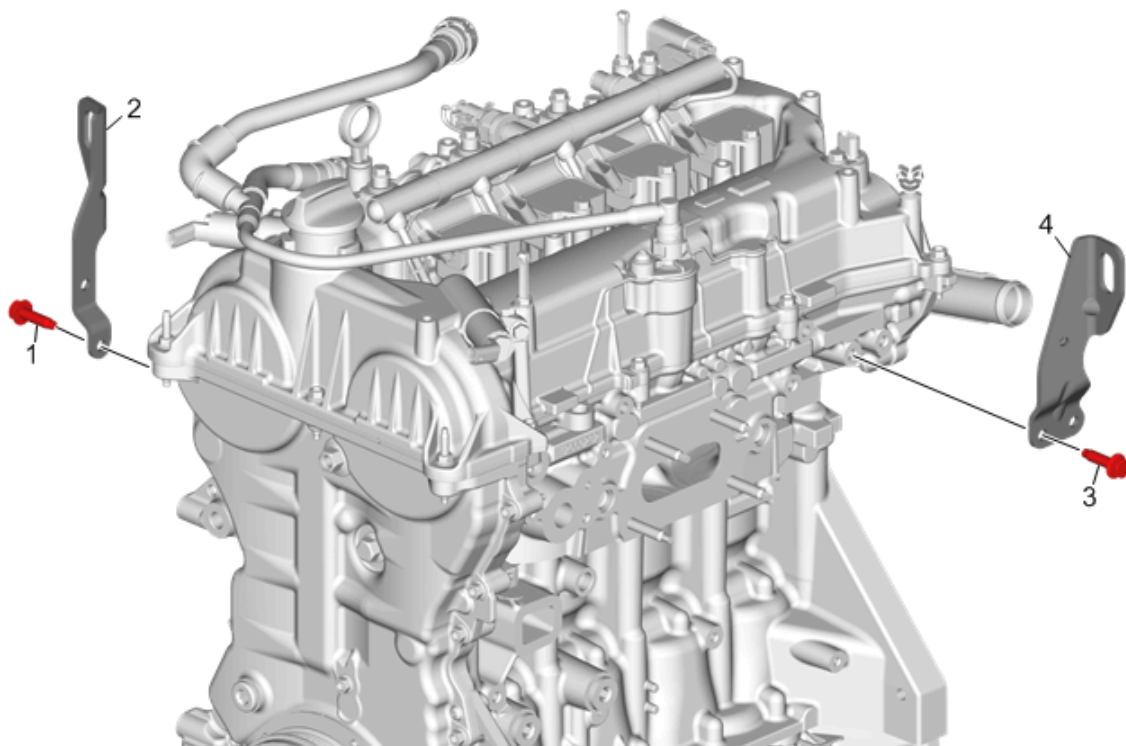


Fig. 381: Engine Lift And Sight Shield Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Lift Bracket Bolt (Qty: 2)
2	Engine Lift Rear Bracket
3	Engine Lift Bracket Bolt (Qty: 2)
4	Engine Lift Front Bracket

WATER OUTLET REMOVAL

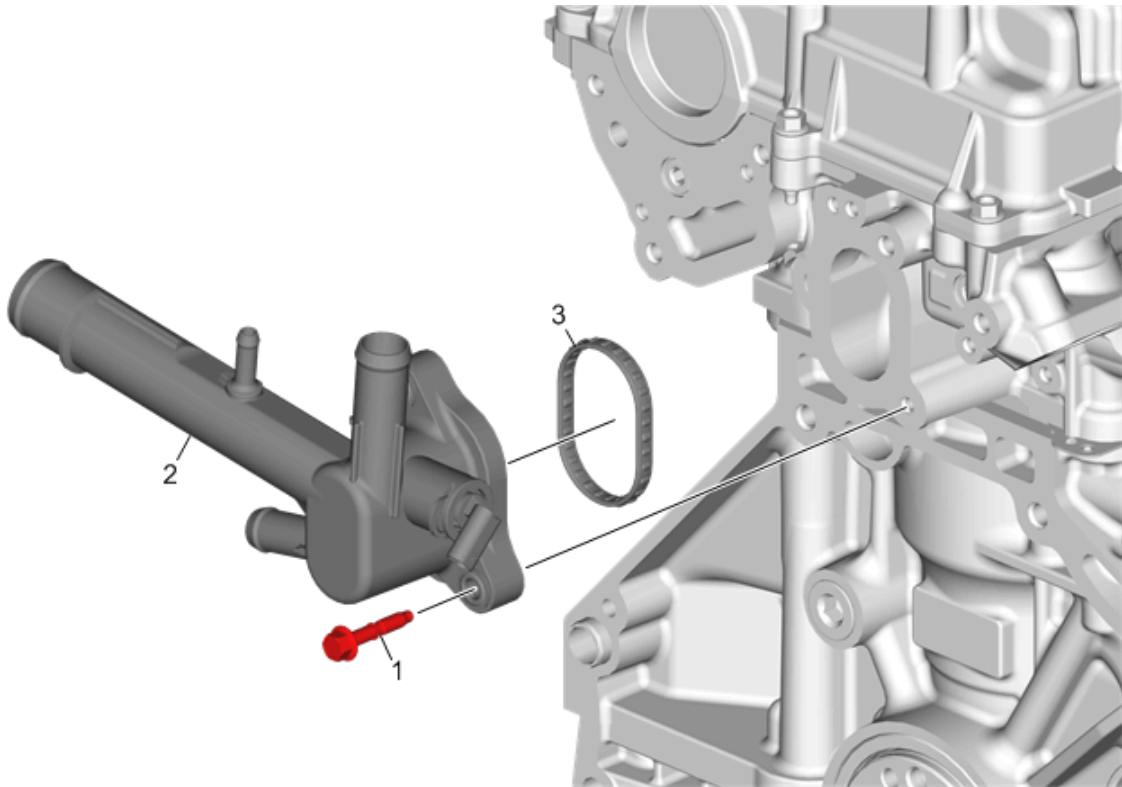


Fig. 382: Water Outlet

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Water Outlet Bolt (Qty: 2)
2	Water Outlet
3	Water Outlet Gasket

IGNITION COIL REMOVAL

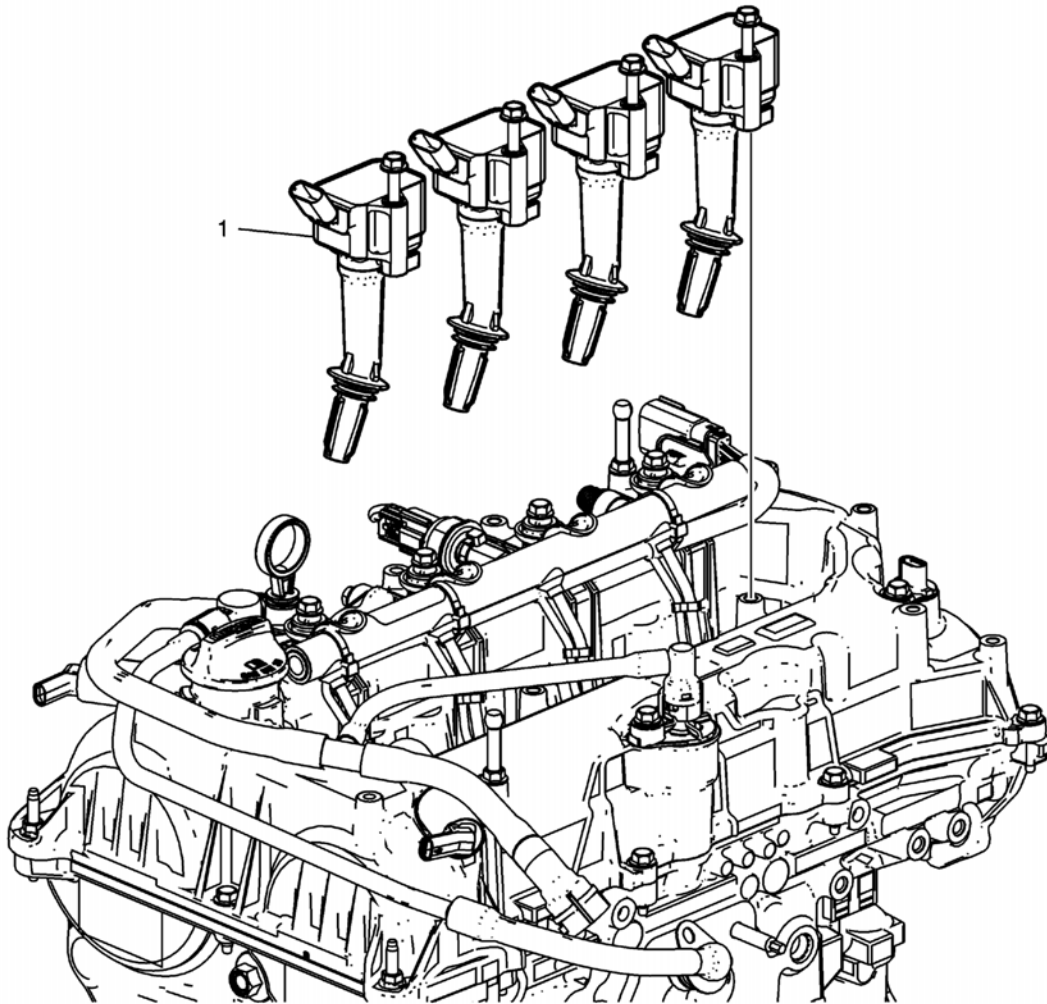


Fig. 383: Ignition Coil

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Ignition Coil Assembly (Qty: 4)

FUEL RAIL AND INJECTORS REMOVAL

Special Tools

- EN-51146 Fuel Injector Removal/Installation Kit
- EN-51146-100 Fuel Injector Removal Plate
- EN-51146-150 Fuel Injector Removal Adapters

For equivalent regional tools, refer to [Special Tools](#).

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Goggles and Fuel Warning](#) .

NOTE: Maintain a clean work surface when working with fuel rail and fuel injectors. Use care to avoid contaminants on the injector seals.

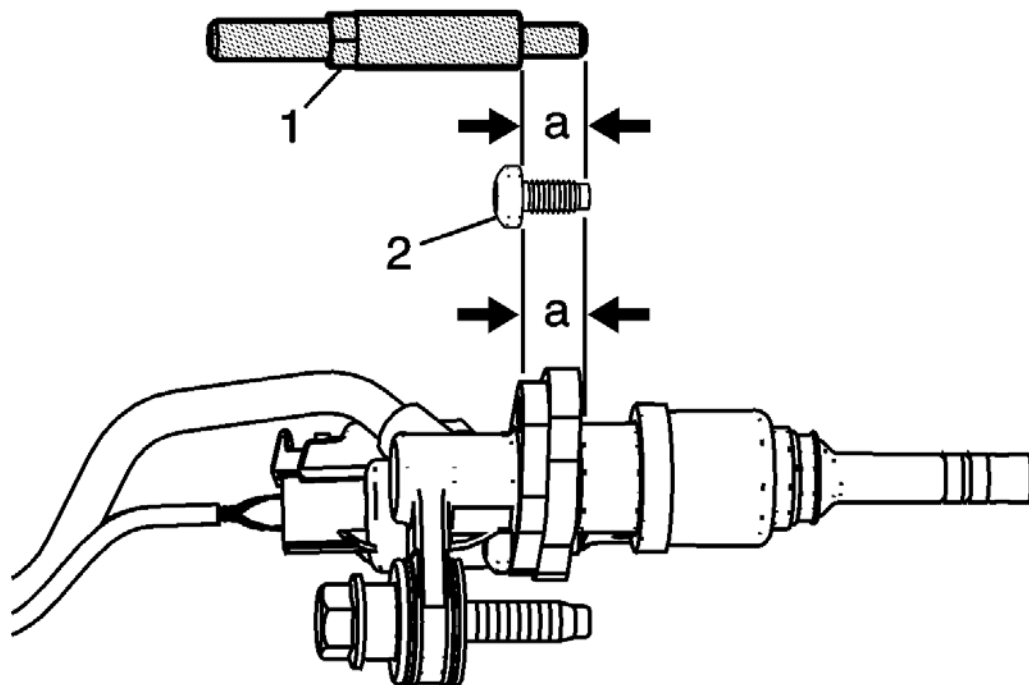


Fig. 384: Fuel Injector Screw And Adapters
Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove only one fuel injector screw (2) to perform the length check.

1. Ensure the **EN-51146-150** fuel injector removal adapters (1) are used with non-turbocharger applications. Match the length (a) of the **EN-51146-150** adapters (1) to the length of the fuel injector screw (2). If the length does not match, refer to the Turbocharger procedure.

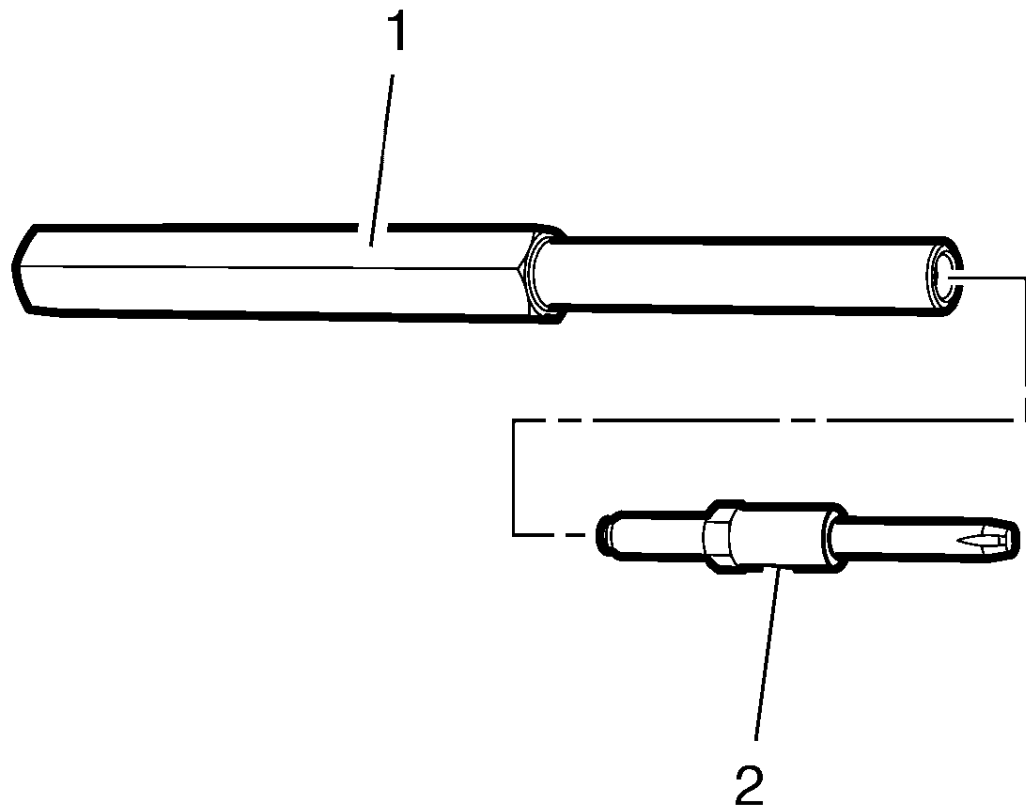


Fig. 385: Adapters And Supports

Courtesy of GENERAL MOTORS COMPANY

2. Install the **EN-51146-150** adapters (2) to the **EN-51146-1-1** supports (1) and tighten to 7 N.m (62 lb in).

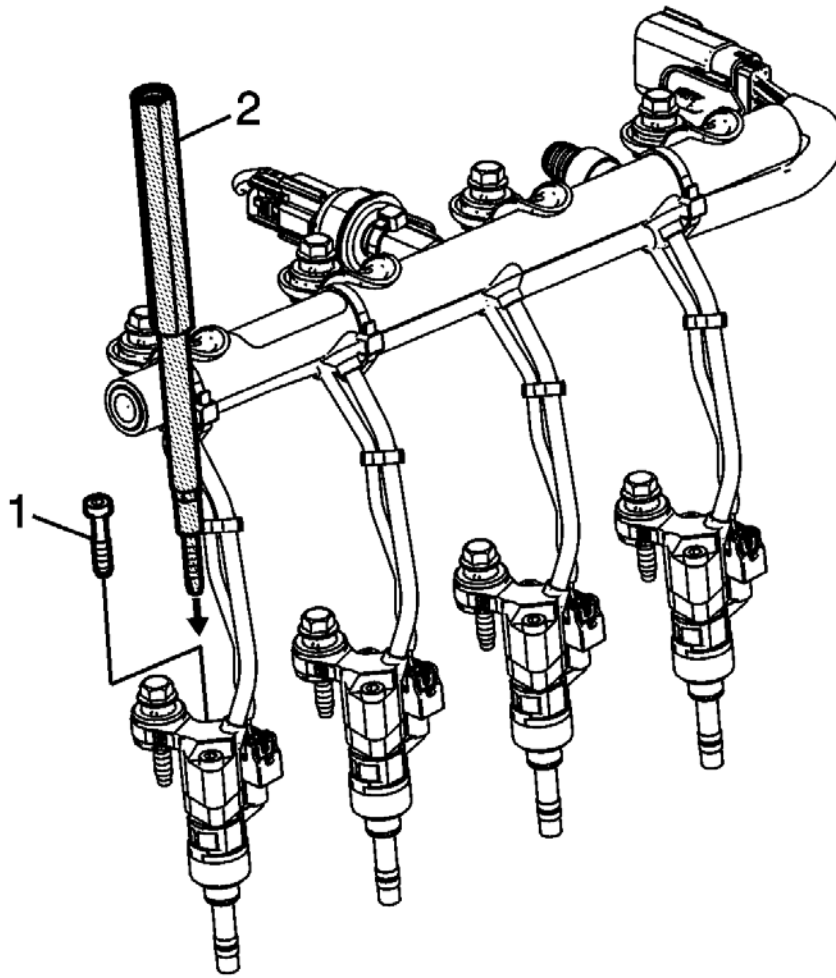


Fig. 386: Inner Fuel Injector Screw

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not loosen or remove both fuel injector screws for an individual fuel injector at the same time. Ensure the EN-51146-150 adapter and EN-51146-1-1 support is properly installed on the inner fuel injector screw location before removing the remaining outer fuel injector screw. Ensure the screws do not fall into the cylinder head slot.

3. Remove the inner fuel injector screw (1).
4. Install one **EN-51146-150** adapter and **EN-51146-1-1** support (2) and tighten to 5 N.m (44 lb in).

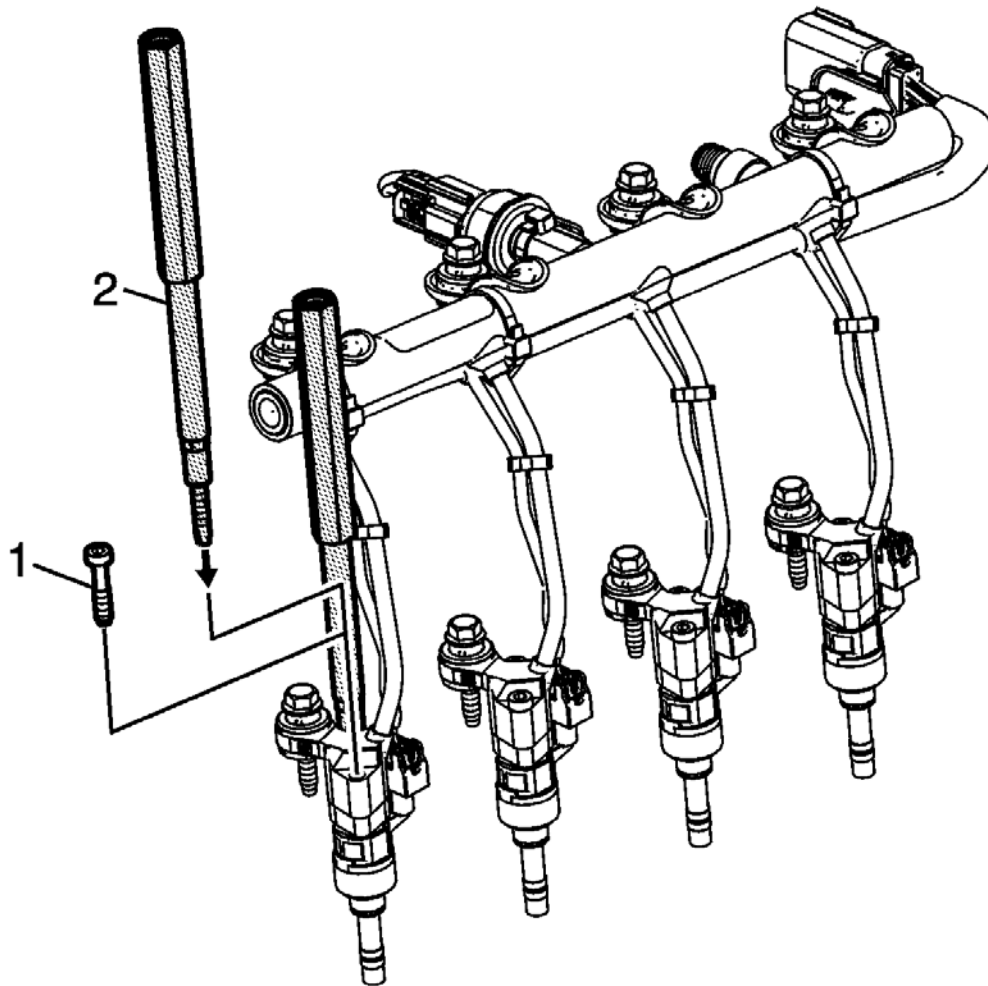


Fig. 387: Outer Fuel Injector Screw
Courtesy of GENERAL MOTORS COMPANY

5. Remove the outer fuel injector screw (1).
6. Install a second **EN-51146-150** adapter and **EN-51146-1-1** support (2) and tighten to 5 N.m (44 lb in).

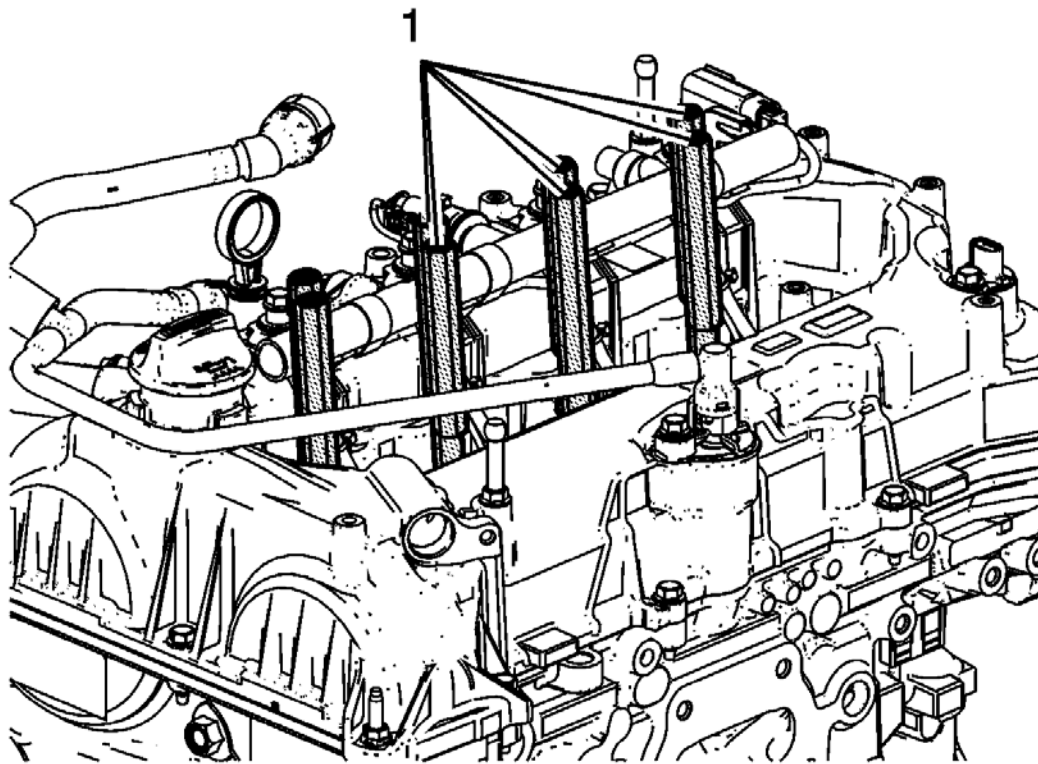


Fig. 388: Supports

Courtesy of GENERAL MOTORS COMPANY

7. Using the same procedure, install the remaining **EN-51146-150** adapters and **EN-51146-1-1** supports (1) for each fuel injector and tighten to 5 N.m (44 lb in).

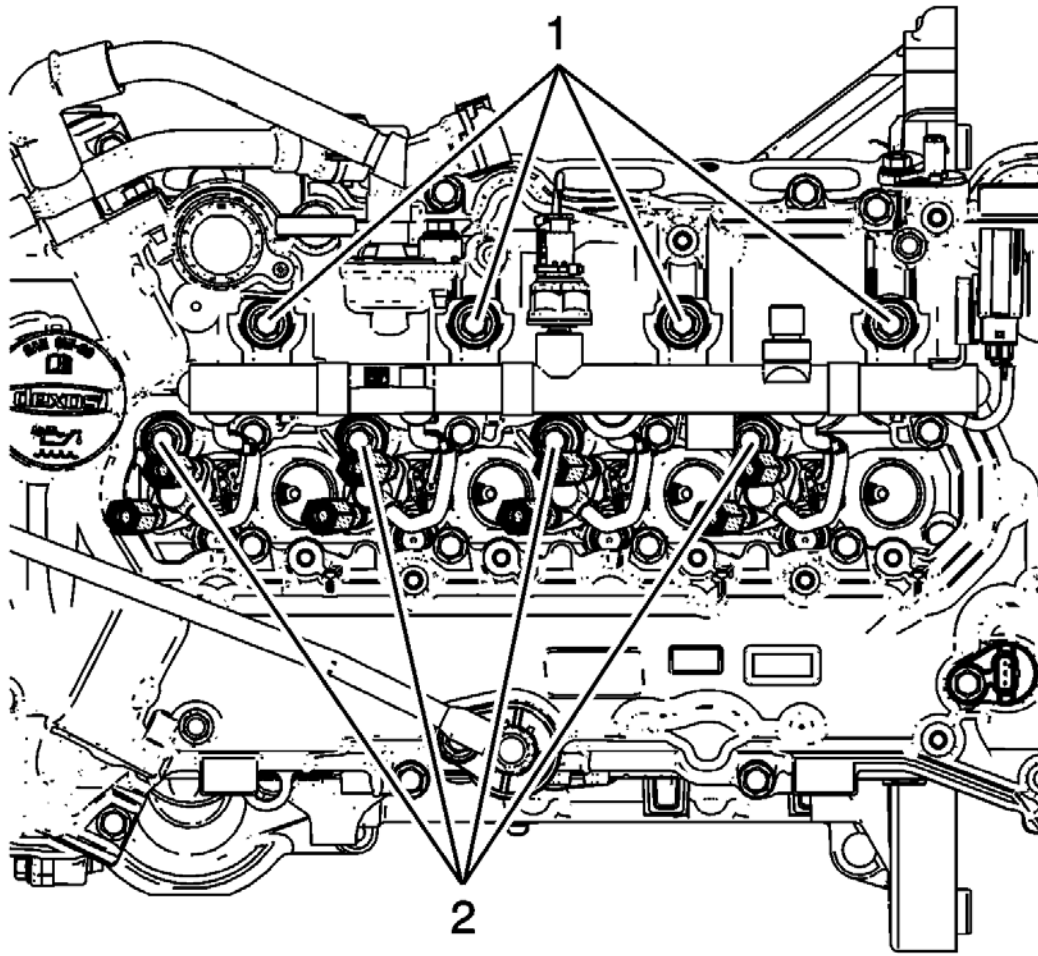


Fig. 389: Upper And Lower Fuel Rail Assembly Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The fuel rail bolts may remain with the decoupling elements and retainer at the fuel rail assembly.

8. Loosen the 4 upper fuel rail assembly bolts (1) completely from the cylinder head, but do not remove the bolts.
9. Loosen the 4 lower fuel rail assembly bolts (2) completely from the cylinder head, but do not remove the bolts.

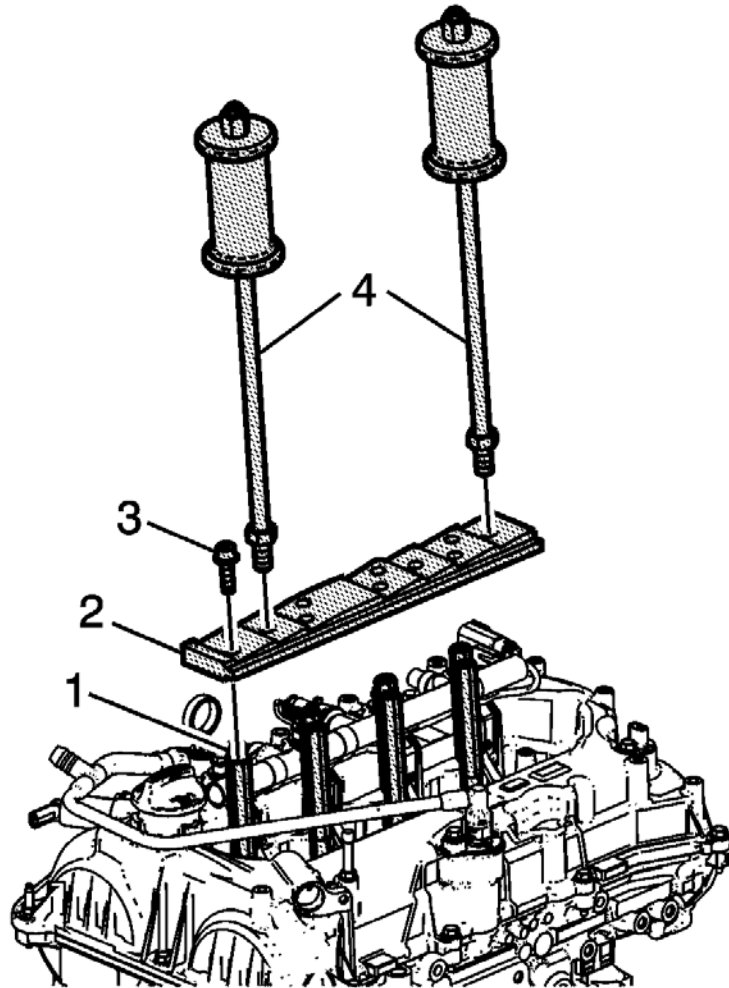


Fig. 390: Plate, Supports, Bolts And Slide Hammers

Courtesy of GENERAL MOTORS COMPANY

10. Install **EN-51146-100** plate (2) to the **EN-51146-1-1** supports (1) using the eight plate bolts (3). Counterhold each support with a wrench while tightening the bolt.
11. Install the **EN-51146-1-3** slide hammers (4) onto the **EN-51146-100** plate (2) using the outer holes.

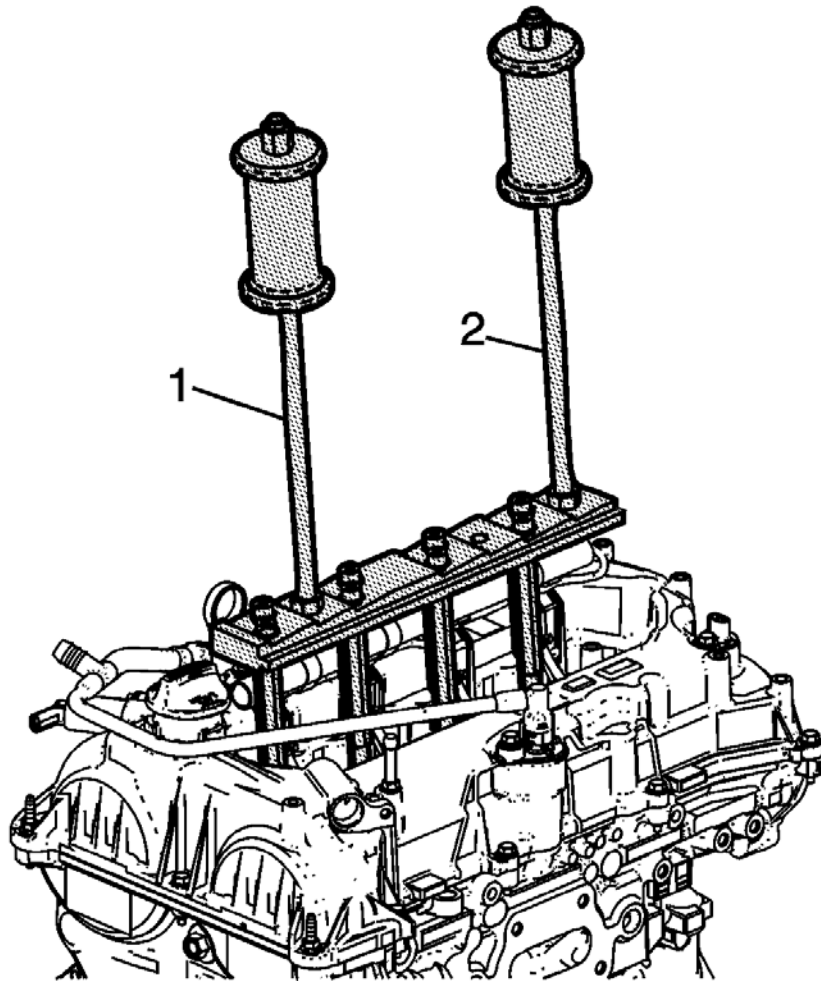


Fig. 391: Removing Fuel Injectors

Courtesy of GENERAL MOTORS COMPANY

NOTE: The alignment of the fuel injectors within the cylinder bores is critical for fuel injection system function. Use equal force on each slide hammer to ensure the fuel injectors are removed without tilting in the injector bore.

12. Using the **EN-51146-1-3** slide hammers (1, 2), begin to remove the fuel injectors by applying slight force equally on both hammers. Observe the alignment of the fuel injectors, and allocate force on the hammers as necessary.

NOTE: After removing the fuel rail and injector assembly, position the assembly on a clean work surface with the fuel injectors on top. Do not allow the weight of the assembly to rest on the fuel injectors.

13. Complete the removal of the fuel rail and injector assembly with the **EN-51146** remover. The slide hammers may then be removed from the plate.
14. Install the **EN-51146-2-5** calibration tools onto the fuel injector tips to protect the injectors.
15. Cover the fuel injector bores at the cylinder head to prevent contamination.

CAMSHAFT COVER REMOVAL

Camshaft Cover and Gasket Removal

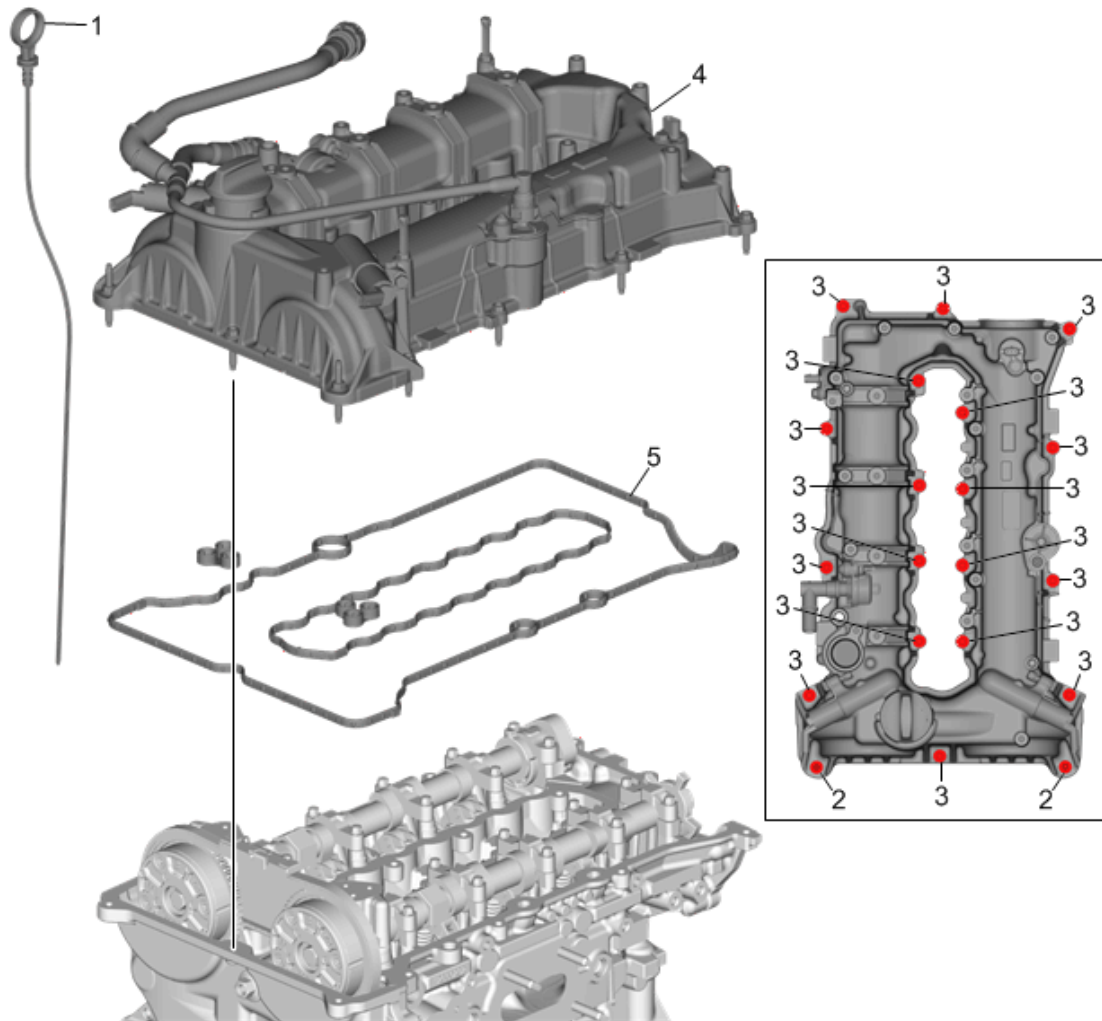


Fig. 392: Camshaft Cover And Gasket

Courtesy of GENERAL MOTORS COMPANY

Camshaft Cover and Gasket Removal

Callout	Component Name
1	Oil Level Indicator
2	Camshaft Cover Stud (Qty: 2)
3	Camshaft Cover Bolt (Qty: 18)
4	Camshaft Cover Procedure Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant
5	Camshaft Cover Gasket

Camshaft Cover Components Removal

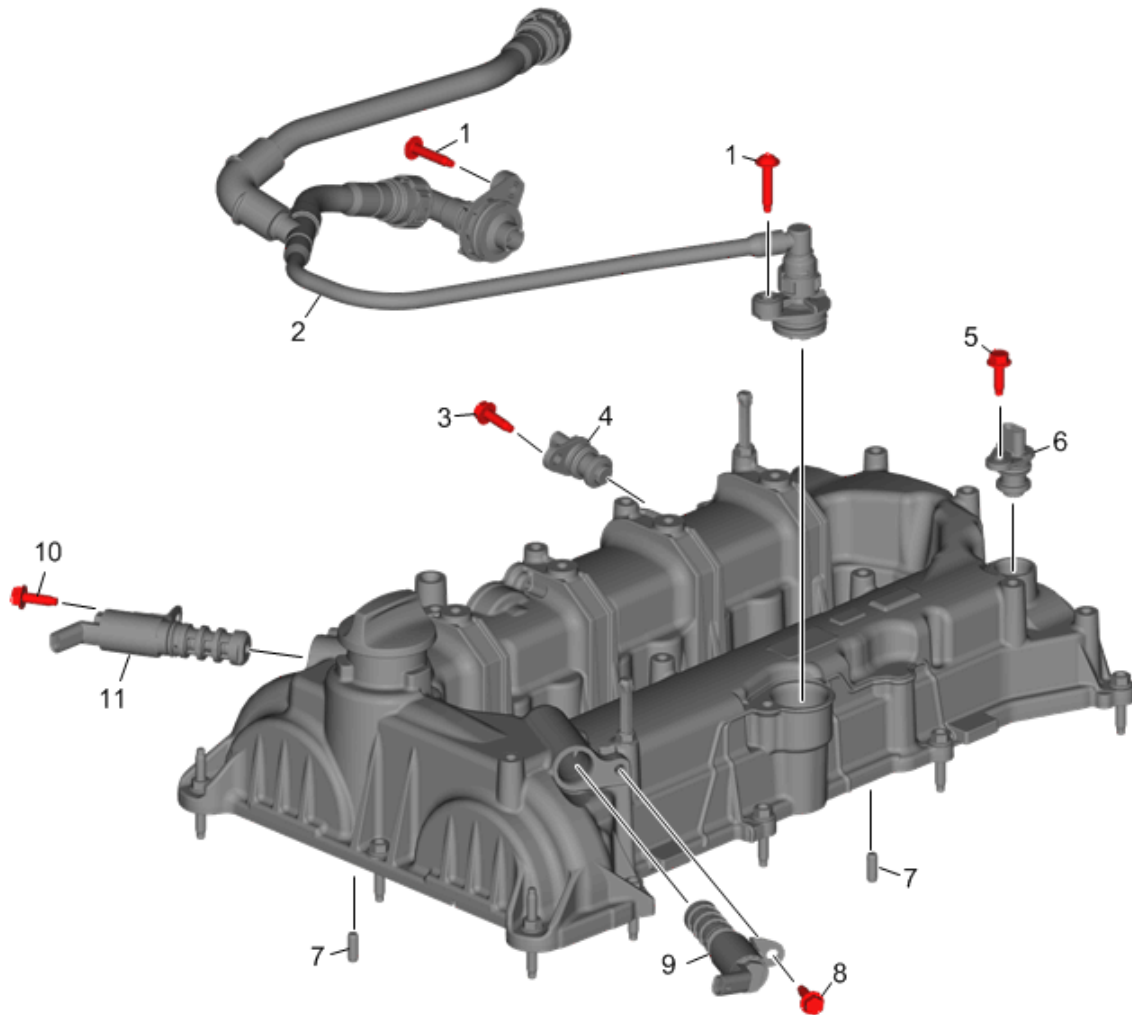


Fig. 393: Camshaft Cover Components

Courtesy of GENERAL MOTORS COMPANY

Camshaft Cover Components Removal

Callout	Component Name
1	Positive Crankcase Ventilation Valve Bolt (Qty: 2) NOTE: Bolts are tamper-proof. Remove the bolts only if inspection of the PCV tube or valves indicates replacement is necessary. Procedure 1. Using a suitable tool, cut a slot in the tamper-proof PCV bolt heads and remove with a

Callout	Component Name
	flat-bladed tool. 2. Discard the bolts.
2	Positive Crankcase Ventilation Tube with Positive Crankcase Ventilation Valve - Fresh Air NOTE: These components have tamper-proof connections and cannot be disassembled. Remove this component only if inspection indicates replacement is necessary. The PCV tube to fresh air inlet duct connection is tamper-proof, and the inlet duct must be replaced when servicing PCV valve components. Procedure 1. Inspect all PCV components and the fresh air inlet duct prior to removal. Do not remove the PCV components or inlet duct unless a diagnostic or inspection procedure indicates replacement is necessary. 2. Complete all camshaft cover inspections prior to inspecting or removing PCV components. If inspection indicates the camshaft cover requires replacement, all PCV components and inlet duct will be replaced with the cover.
3	Camshaft Position Sensor Bolt
4	Intake Camshaft Position Sensor
5	Camshaft Position Sensor Bolt
6	Exhaust Camshaft Position Sensor
7	Camshaft Cover Locating Pin (Qty: 2)
8	Camshaft Position Actuator Solenoid Valve Bolt
9	Camshaft Position Actuator Solenoid Valve
10	Camshaft Position Actuator Solenoid Valve Bolt

Callout	Component Name
11	Camshaft Position Actuator Solenoid Valve

OIL PAN REMOVAL

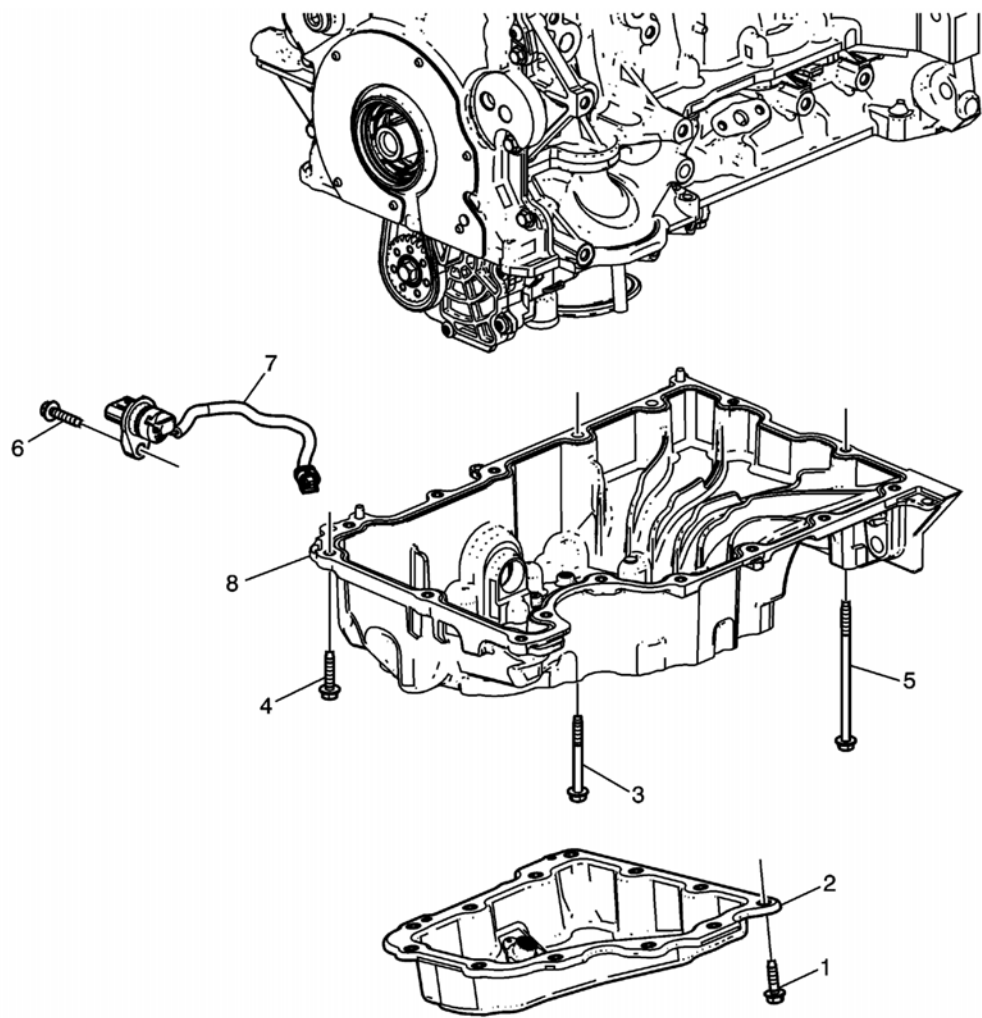


Fig. 394: Oil Pan
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Lower Oil Pan Bolt (Qty: 12)
2	Lower Oil Pan Procedure Remove the oil pan drain plug, if applicable. Discard the lower oil pan.
3	Oil Pan Bolt (Qty: 2)
4	Oil Pan Bolt (Qty: 12)
5	Oil Pan Bolt (Qty: 2)
6	Wiring Harness Connector Bolt
7	Wiring Harness Connector Procedure Disconnect the oil pump control valve connector, then remove through the upper oil pan.
8	Upper Oil Pan Assembly

ENGINE FRONT COVER REMOVAL

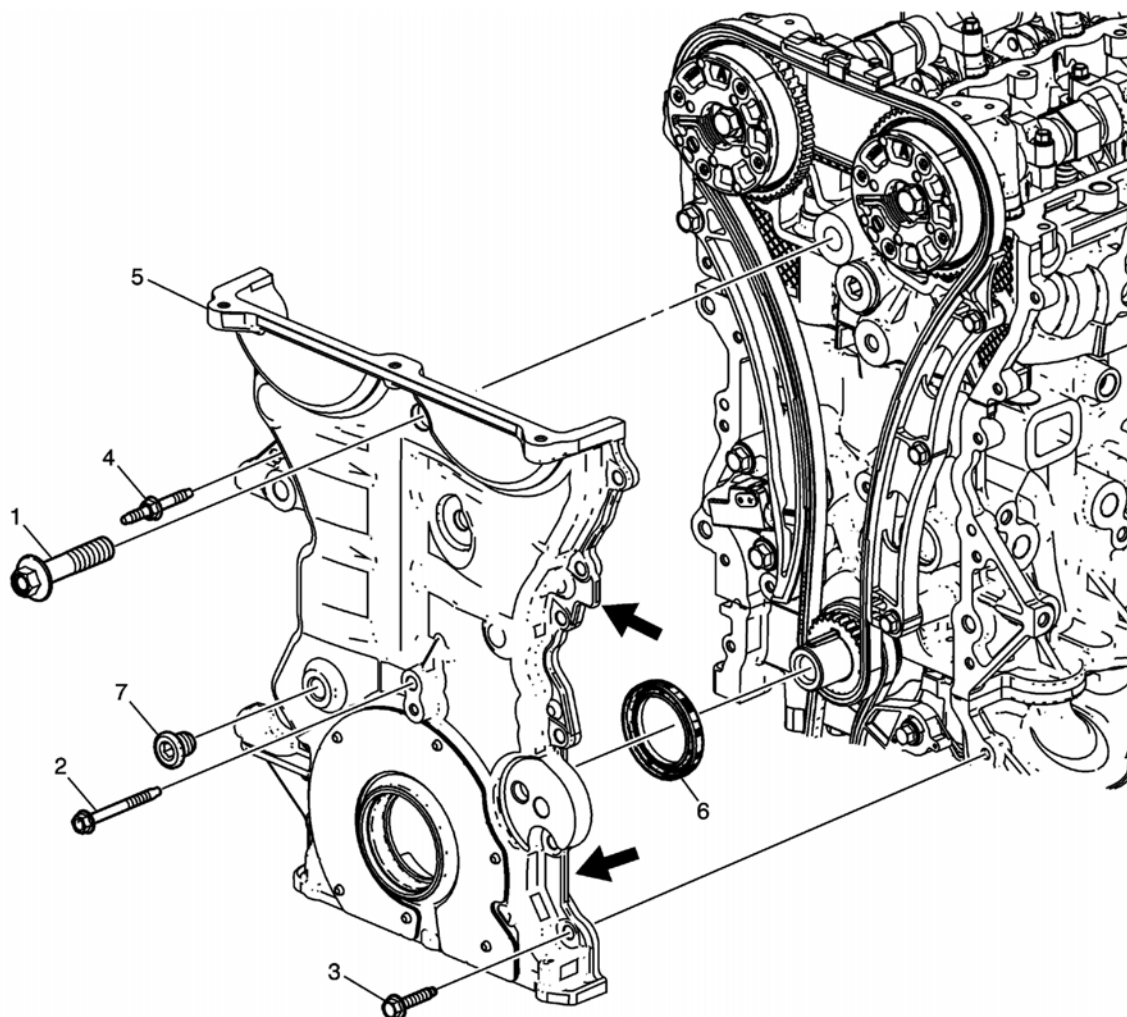


Fig. 395: Engine Front Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Front Cover Bolt (Qty: 1)
2	Engine Front Cover Bolt (Qty: 1)
3	Engine Front Cover Bolt (Qty: 11)
4	Engine Front Cover Stud (Qty: 1)
5	Engine Front Cover Procedure 1. Locate pry-points on the engine front cover to loosen the cover from the engine block. 2. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant 3. Clean and inspect the engine front cover mating surface.
6	Crankshaft Front Oil Seal Procedure Discard the seal. Special Tools EN-51096 Crankshaft Seal Remover For equivalent regional tools, refer to Special Tools.

Callout	Component Name
7	Engine Front Cover Hole Plug

CAMSHAFT TIMING CHAIN REMOVAL

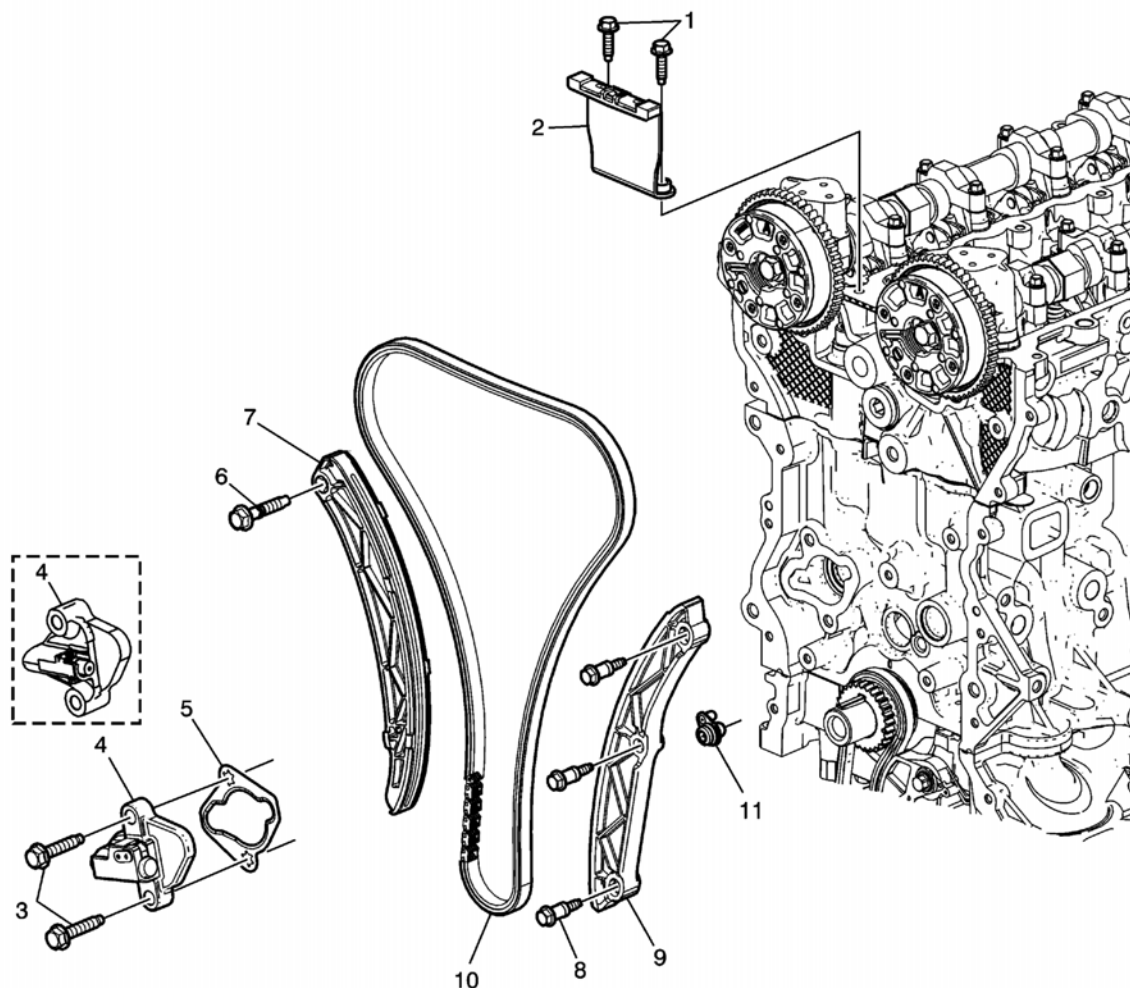


Fig. 396: Camshaft Timing Chain
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Timing Chain Guide Bolt (Qty: 2)
2	Timing Chain Guide - to Cylinder Head
3	Timing Chain Tensioner Bolt (Qty: 2)
4	Timing Chain Tensioner Assembly
5	Timing Chain Tensioner Gasket
6	Timing Chain Tensioner Shoe Bolt (Qty: 1)
7	Timing Chain Tensioner Shoe Assembly
8	Timing Chain Guide Bolt (Qty: 3)
9	Timing Chain Guide - Exhaust Side
10	Timing Chain
11	Timing Chain Oil Nozzle

INTAKE AND EXHAUST CAMSHAFT, BEARING CAP, AND LASH ADJUSTER REMOVAL

Camshaft Actuator Removal

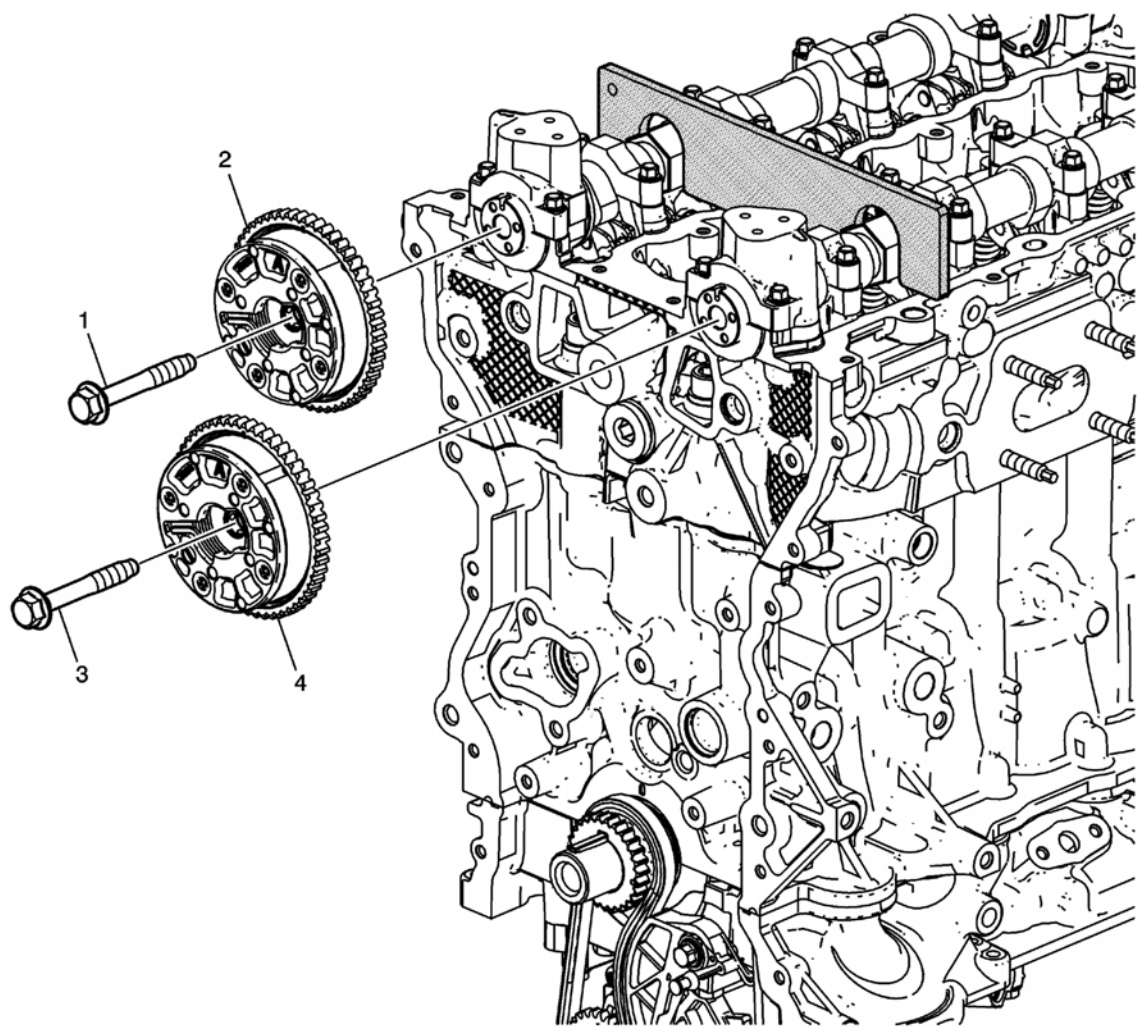


Fig. 397: Camshaft Actuator
Courtesy of GENERAL MOTORS COMPANY

Camshaft Actuator Removal

Callout	Component Name
Preliminary Procedure Install the EN-51367 camshaft locking tool.	
Special Tools EN-51367 Camshaft Locking Tool For equivalent regional tools, refer to Special Tools .	
1	Camshaft Position Actuator Bolt NOTE: Discard bolt.
2	Camshaft Position Actuator - Intake
3	Camshaft Position Actuator Bolt NOTE: Discard bolt.
4	Camshaft Position Actuator - Exhaust

Camshaft Bearings and Camshaft Removal

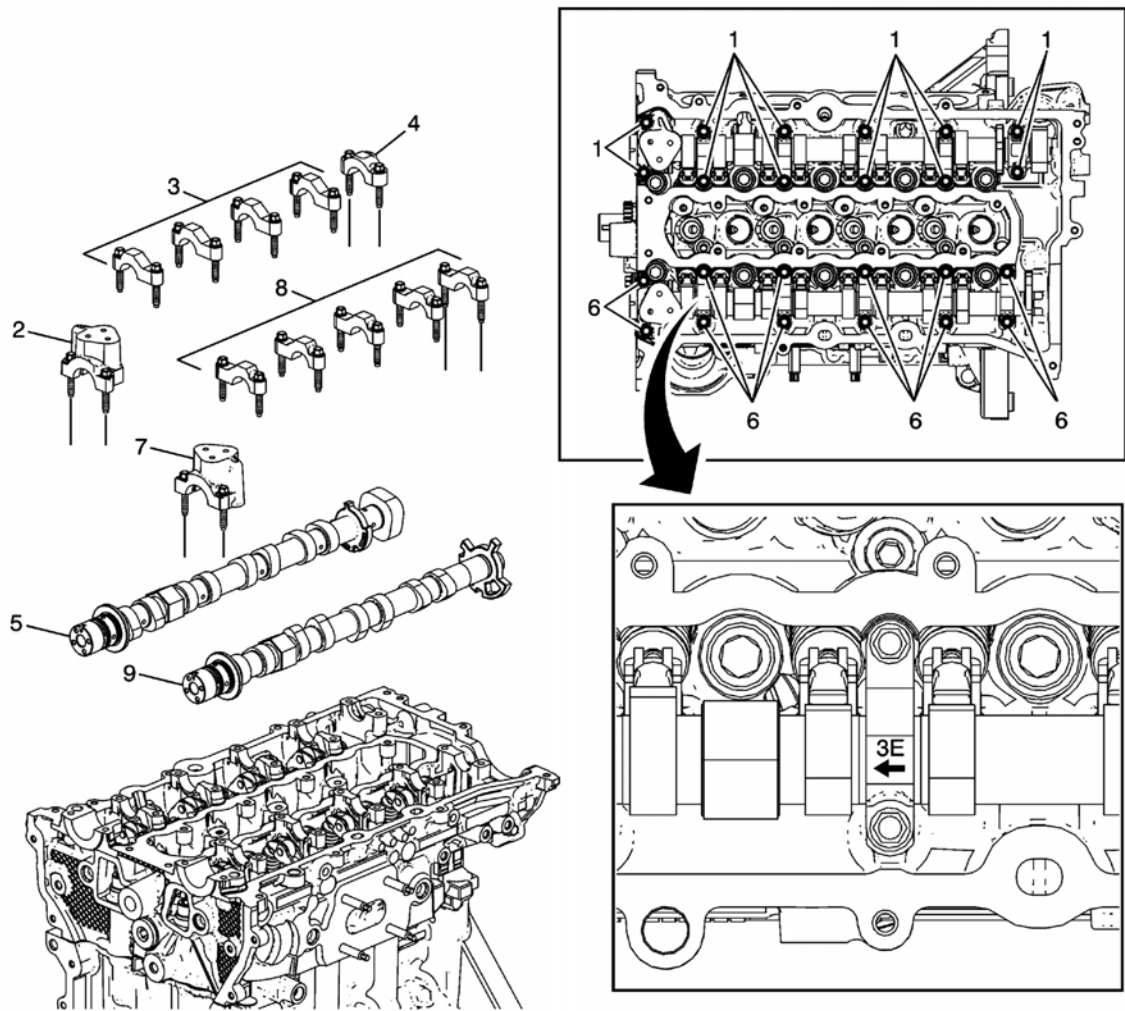


Fig. 398: Camshaft Bearings and Camshaft
Courtesy of GENERAL MOTORS COMPANY

Camshaft Bearings and Camshaft Removal

Callout	Component Name
Preliminary Procedure	
NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces.	
1. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.	

Callout	Component Name
2. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.	
1	Camshaft Bearing Cap Bolt - Intake Side (Qty: 12) Procedure Loosen each bolt 1/2 turn to reduce spring pressure.
2	Camshaft Bearing Front Intake Cap
3	Camshaft Bearing Cap - Intake Side (Qty: 4) NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location.
4	Camshaft Bearing Rear Cap - Intake Side
5	Intake Camshaft Assembly
6	Camshaft Bearing Cap Bolt - Exhaust Side (Qty: 12) Procedure Loosen each bolt 1/2 turn to reduce spring pressure.
7	Camshaft Bearing Front Exhaust Cap.
8	Camshaft Bearing Cap - Exhaust Side (Qty: 5) NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location.
9	Exhaust Camshaft Assembly

Valve Rocker Arm and Lash Adjuster Removal

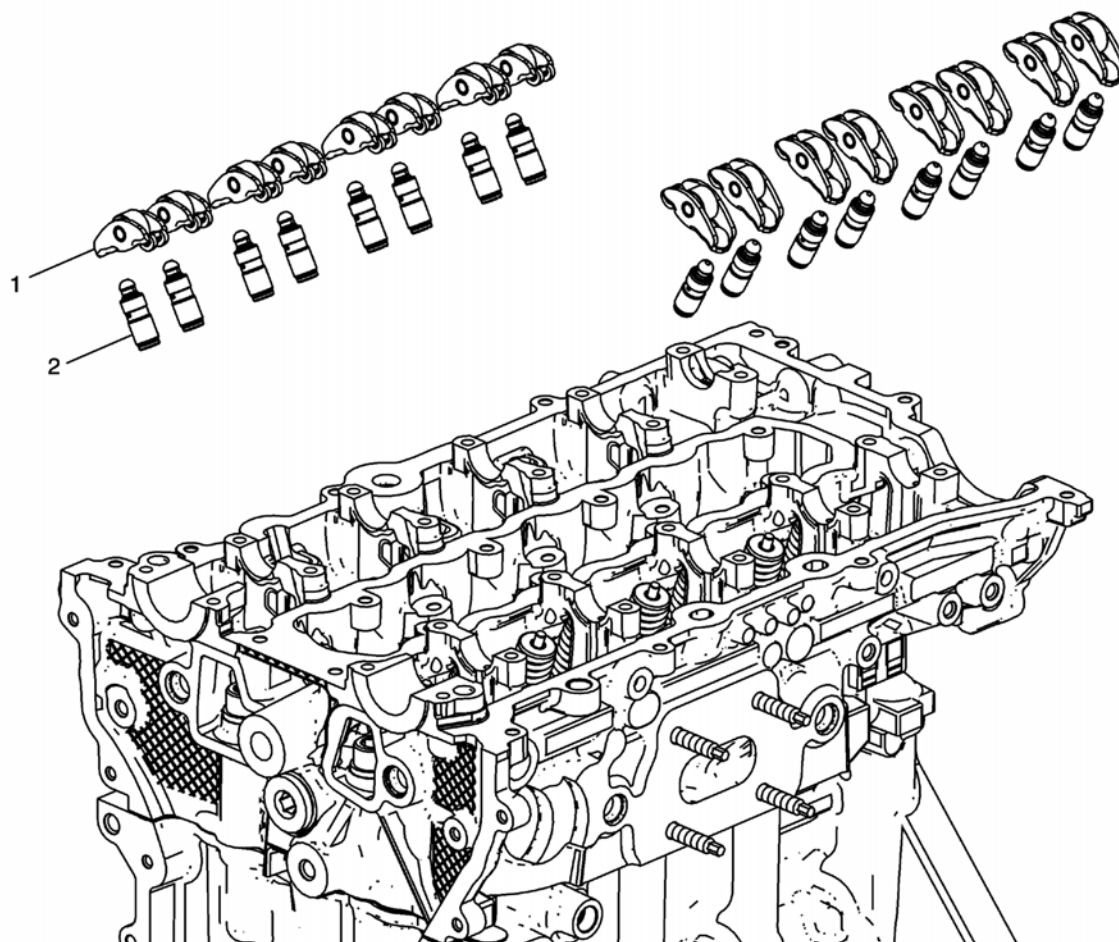


Fig. 399: Valve Rocker Arm and Lash Adjuster
 Courtesy of GENERAL MOTORS COMPANY

Valve Rocker Arm and Lash Adjuster Removal

Callout	Component Name
Preliminary Procedure NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces. 1. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts. 2. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.	

CYLINDER HEAD REMOVAL

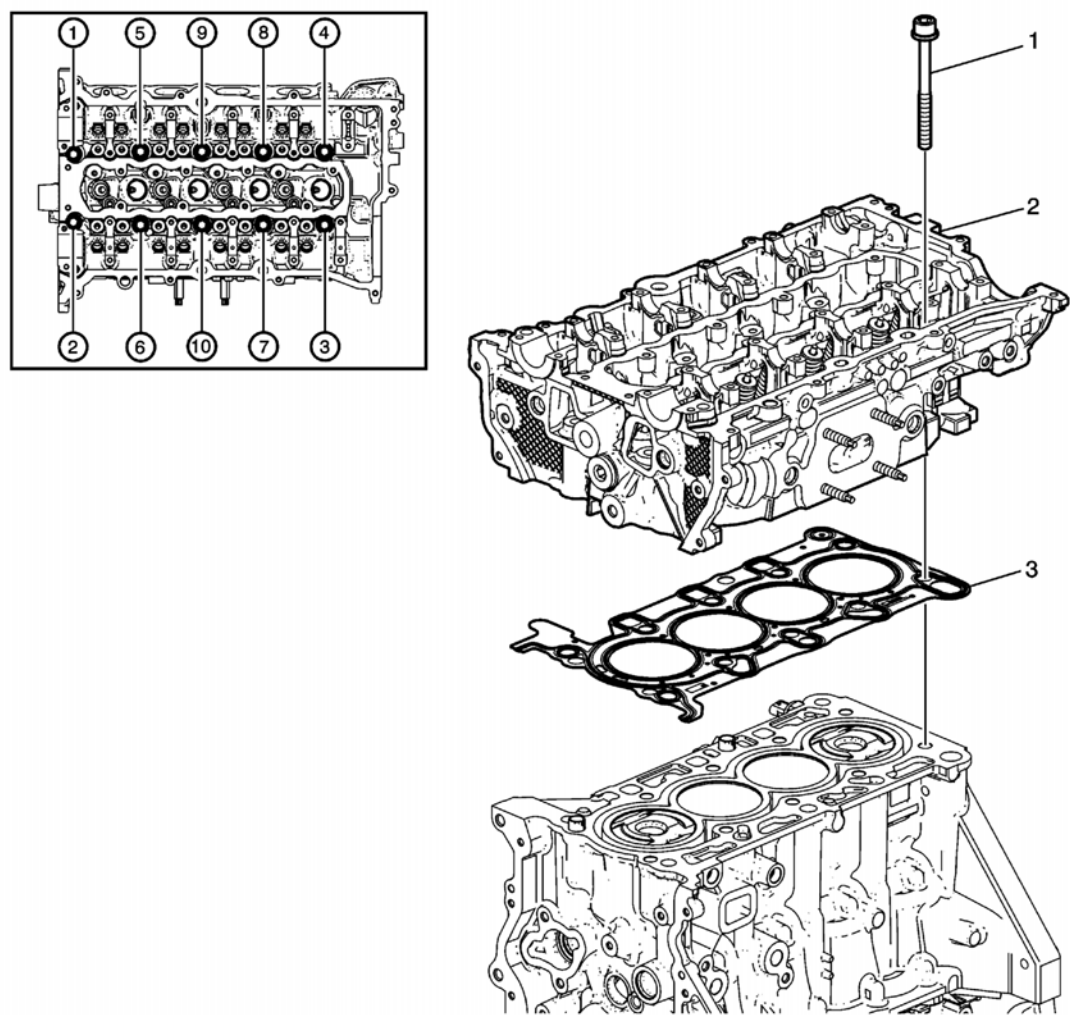


Fig. 400: Cylinder Head (With Loosening/Tightening Sequence)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Cylinder Head Bolt (Qty: 10) Procedure Remove the bolts in sequence. Discard the bolts.
2	Cylinder Head Assembly
3	Cylinder Head Gasket

OIL PUMP DRIVE CHAIN AND OIL PUMP REMOVAL

Oil Pump Drive Chain and Crankshaft Sprocket Removal

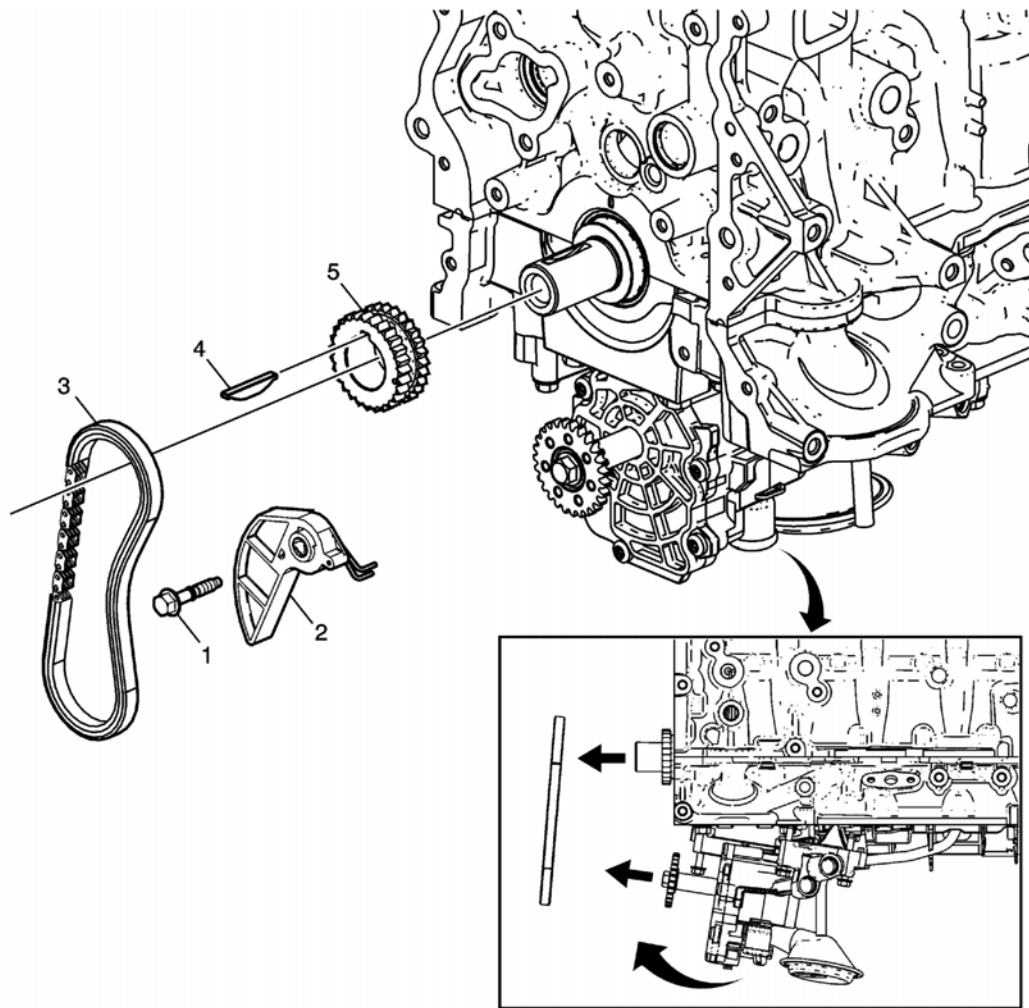


Fig. 401: Oil Pump Drive Chain and Crankshaft Sprocket
 Courtesy of GENERAL MOTORS COMPANY

Oil Pump Drive Chain and Crankshaft Sprocket Removal

Callout	Component Name
1	Oil Pump Drive Chain Tensioner Bolt
2	Oil Pump Drive Chain Tensioner
3	Oil Pump Drive Chain Procedure Loosen the oil pump assembly bolts and tilt the oil pump assembly in order to remove the drive chain.
4	Crankshaft Balancer Key
5	Crankshaft Sprocket

Oil Pump Assembly Removal

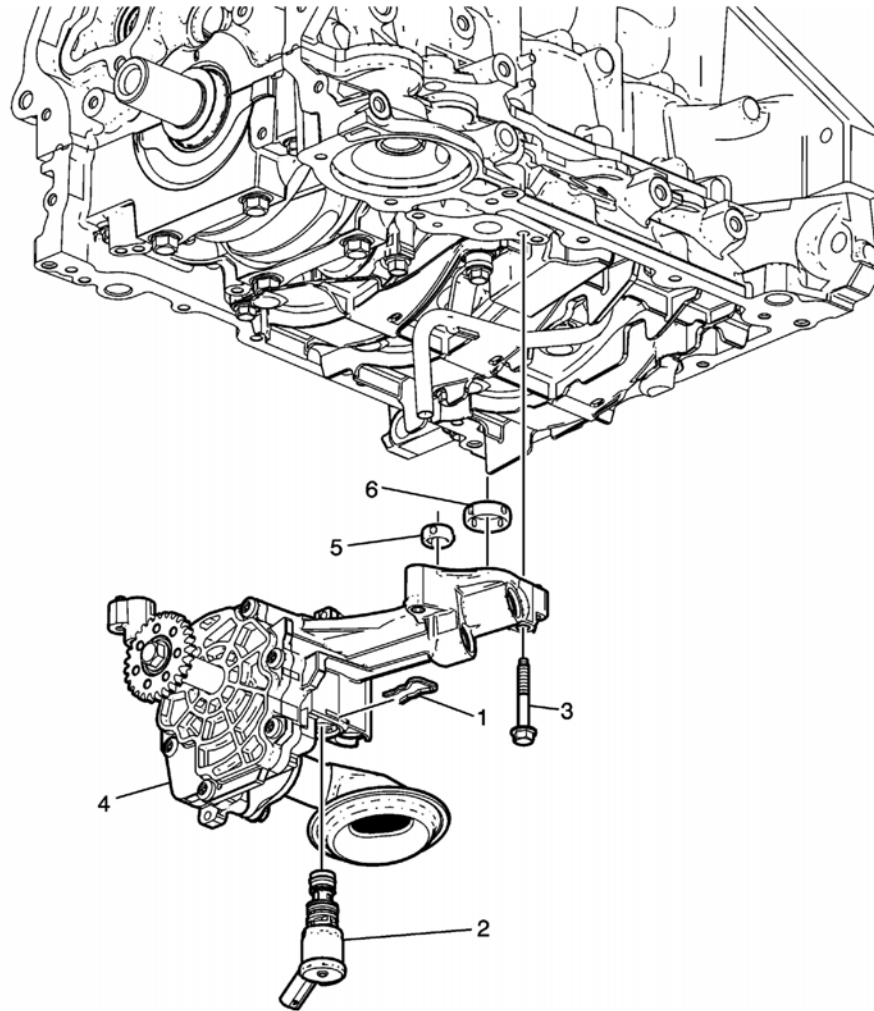


Fig. 402: Oil Pump Assembly

Courtesy of GENERAL MOTORS COMPANY

Oil Pump Assembly Removal

Callout	Component Name
1	Oil Pump Flow Control Solenoid Valve Retainer
2	Oil Pump Flow Control Solenoid Valve
3	Oil Pump Assembly Bolt (Qty: 4)
4	Oil Pump Assembly
5	Oil Pump Gasket
6	Oil Pump Gasket

CRANKSHAFT OIL DEFLECTOR REMOVAL

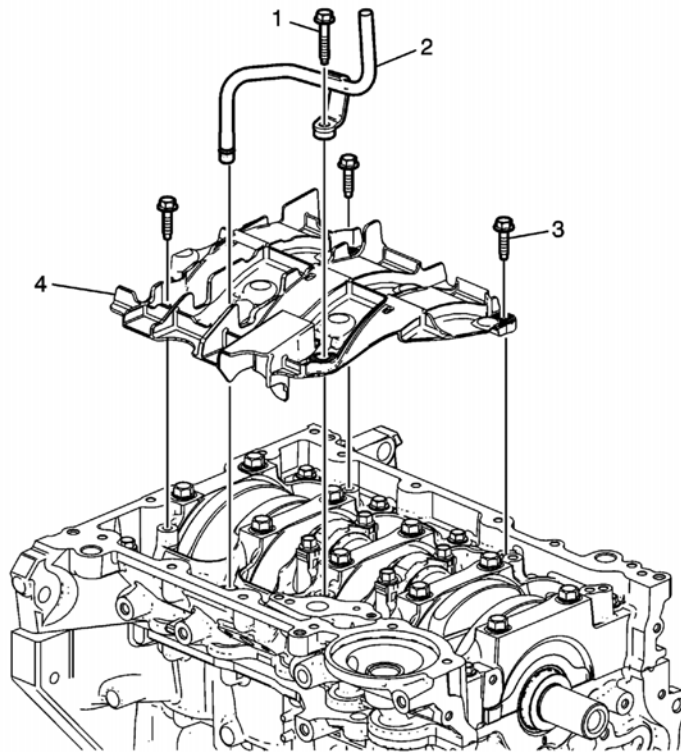


Fig. 403: Crankshaft Oil Deflector

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Positive Crankcase Ventilation Oil Separator Drain Pipe Bolt
2	Positive Crankcase Ventilation Oil Separator Drain Pipe
3	Crankshaft Oil Deflector Bolt (Qty: 3)
4	Crankshaft Oil Deflector

LOWER CRANKCASE REMOVAL

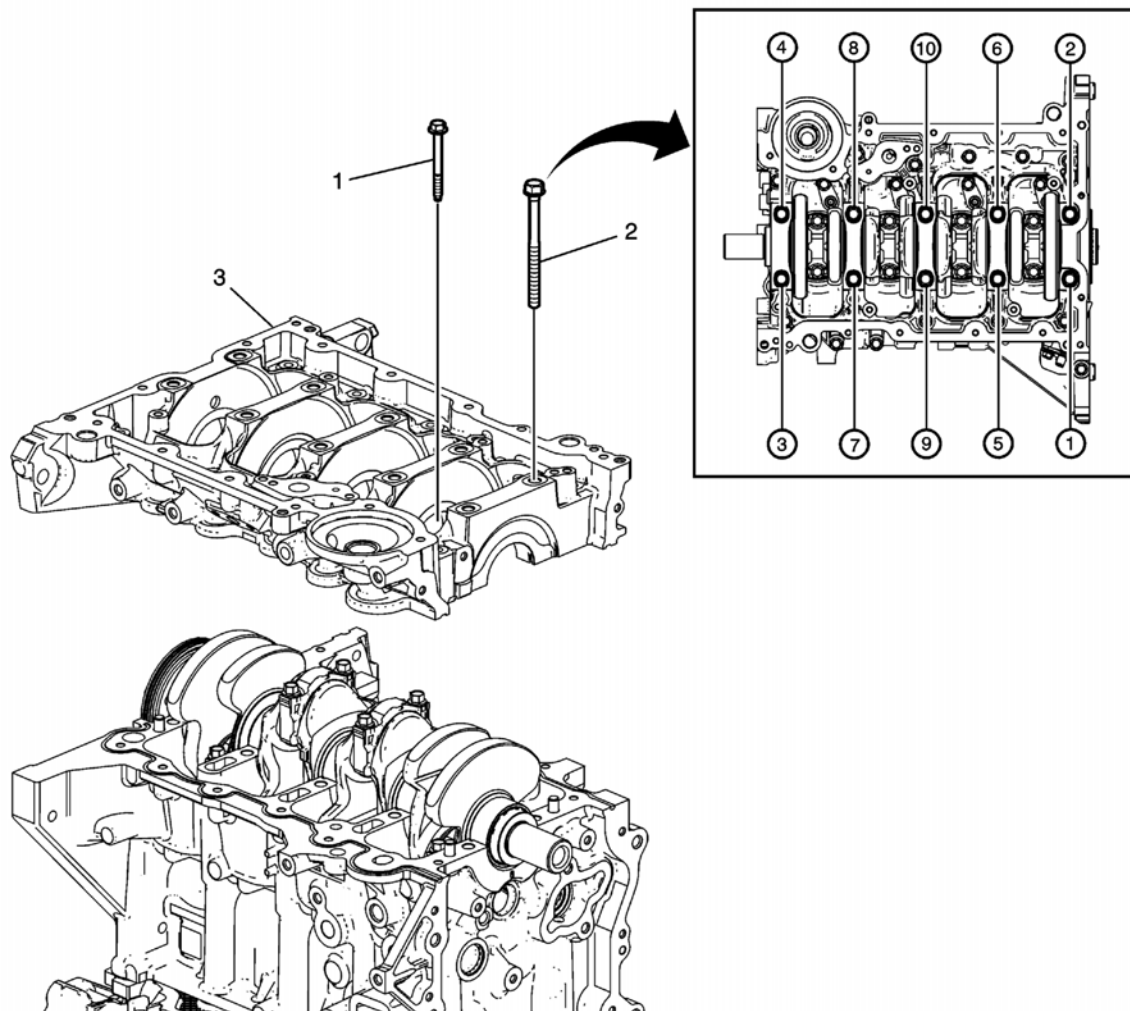


Fig. 404: Lower Crankcase (With Bolt Removal Sequence)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Lower Crankcase Bolt - Perimeter (Qty: 13)
2	Lower Crankcase Bolt (Qty: 10) Procedure Remove bolts in sequence. Discard the bolts.
3	Lower Crankcase

PISTON, CONNECTING ROD, AND BEARING REMOVAL

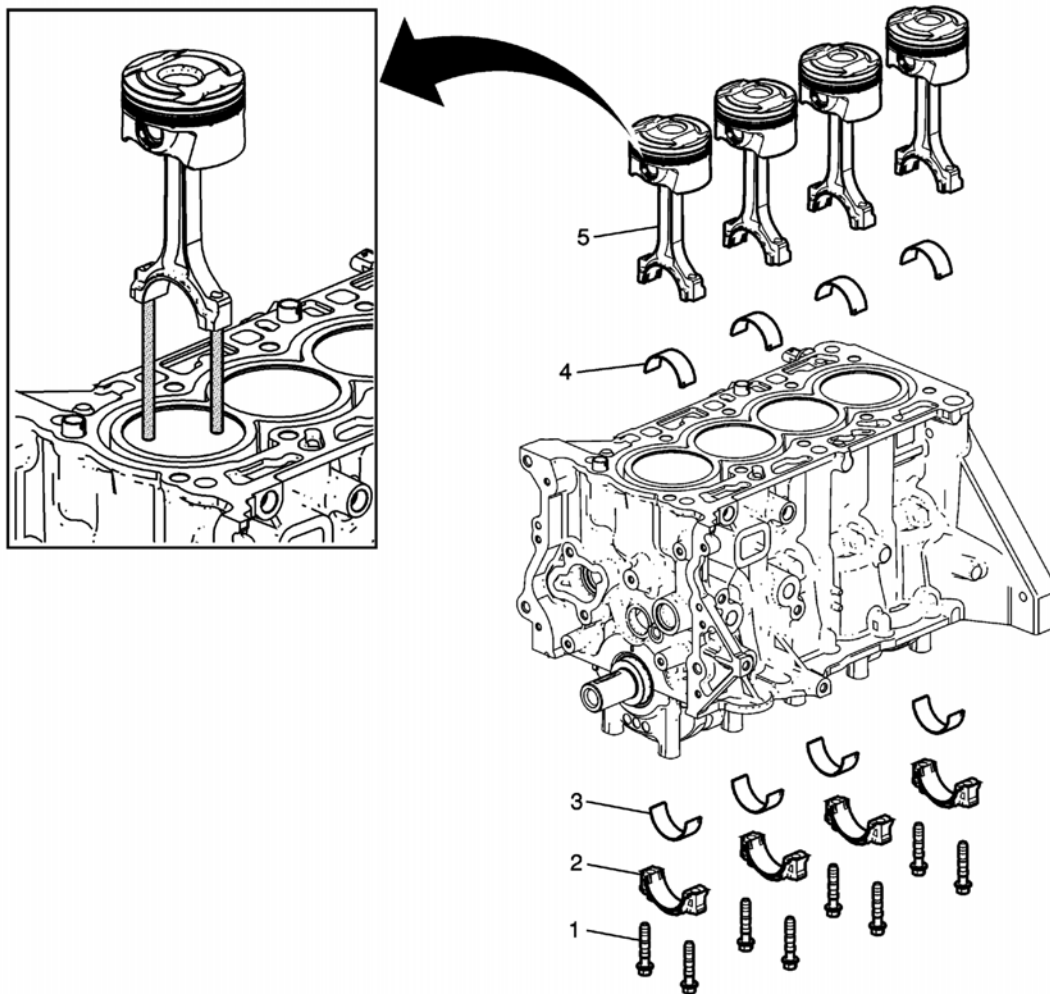


Fig. 405: Piston, Connecting Rod and Bearing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces. 1. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts. 2. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary. 3. Before removing the connecting rods, check the connecting rod side clearance using the following	

Callout	Component Name
	procedure: 1. Tap the connecting rod to one end of the crankshaft journal with a dead-blow or wooden hammer. 2. Using feeler gauges, measure the clearance between the crankshaft counterweight and the connecting rod. 3. The connecting rod side clearance should not exceed specifications. Refer to Engine Mechanical Specifications 4. If the end play exceeds the specified limits, measure the width of the crankpin end of the connecting rod. Refer to Piston, Connecting Rod, and Bearing Cleaning and Inspection. 5. If the connecting rod width is significantly smaller than specified and severe wear is present on the side of the connecting rod, replace the connecting rod. 6. If the connecting rod width is within specification and excessive scoring is present on the crankshaft journals, replace the crankshaft. NOTE: An arrow/dot showing proper piston orientation is located on the top of the piston. 4. Using a marker, number each piston face. Draw an arrow along the centerline of the piston pointing toward the front of the engine. CAUTION: Do not use a stamp, punch or any other method that may distort or stress the connecting rod or connecting rod cap. Extensive engine damage may result from a connecting rod that is distorted or stressed. 5. Mark the cylinder number on the connecting rod and the connecting rod cap with a scribe, paint stick or permanent marker.

Callout	Component Name
1	Connecting Rod Bolt (Qty: 8) CAUTION: Powdered metal connecting rods have rod bolts which yield when torqued. If the rod bolts are loosened or removed the rod bolts must be replaced. Rod bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage. Procedure DO NOT use the bolts for reinstallation. The bolts may be used to keep the parts together and for inspection and specification measurements.
2	Connecting Rod Assembly (Qty: 4) NOTE: The connecting rod caps must remain with the original connecting rod. The caps must be oriented identical to original installation. Procedure

Callout	Component Name
	Mark the side of the rod with a line that crosses the interface of the rod and cap. Use this line to ensure that the cap and rod are reinstalled in the same orientation.
3	Connecting Rod Bearing (Qty: 4) NOTE: If the connecting rod bearings have been used in a running engine, you must replace them with NEW connecting rod bearings for reassembly.
4	Connecting Rod Bearing (Qty: 4) NOTE: If the connecting rod bearings have been used in a running engine, you must replace them with NEW connecting rod bearings for reassembly.
5	Connecting Rod Assembly (Qty: 4) NOTE: Piston assembly attached. Procedure Using the EN-51454 guides, push the connecting rod and piston assembly through the top of the cylinder. DO NOT scratch the crankshaft journal or cylinder wall and DO NOT damage the oil jets when removing the connecting rod and piston assembly. Special Tools EN-51454 Connecting Rod Guides

Callout	Component Name
	For equivalent regional tools, refer to Special Tools .

CRANKSHAFT AND BEARING REMOVAL

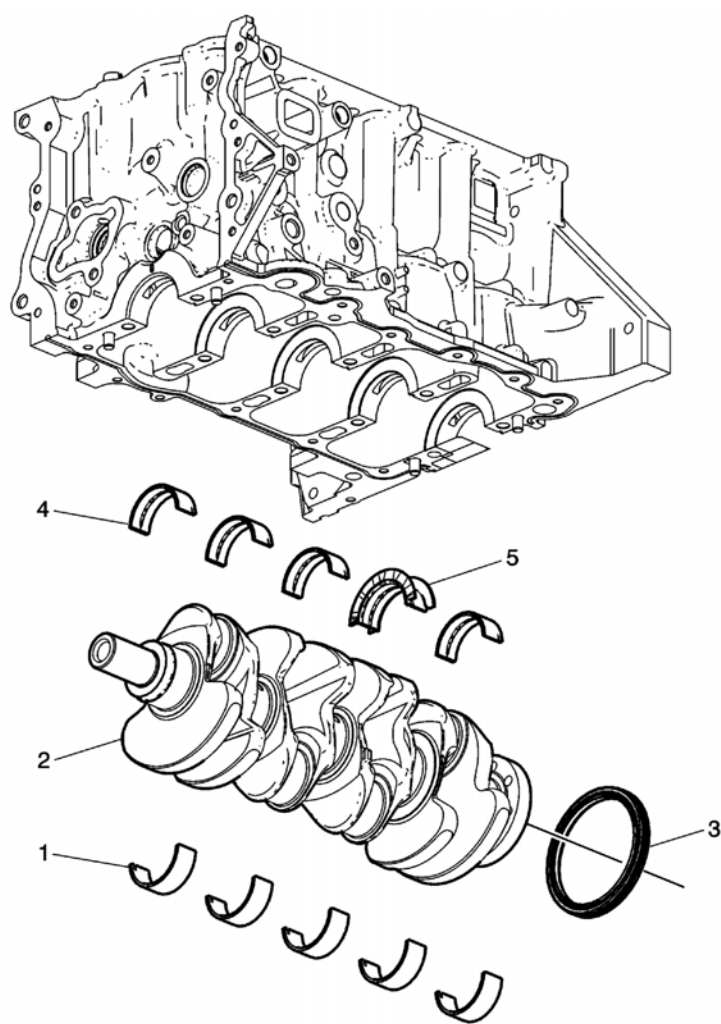


Fig. 406: Crankshaft and Bearing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Lower Bearing (Qty: 5) NOTE: • Crankshaft bearings MUST be separated, marked, or organized in a way to ensure installation to their original

Callout	Component Name
	location and position, when suitable for use. If the lower half of the bearing is worn or damaged, both upper and lower halves should be replaced.
2	Crankshaft Assembly
3	Crankshaft Rear Oil Seal
4	Crankshaft Upper Bearing (Qty: 4)
5	Crankshaft Thrust Upper Bearing

CYLINDER HEAD DISASSEMBLE

Special Tools

- **EN-8062** Valve Spring Compressor
- **EN-43963** Valve Spring Compressor - Off-Car Adapter
- **EN-46116** Valve Seal Remover
- **EN-46122** Camshaft Position Actuator Check-Ball Valve Remover/Installer

For equivalent regional tools, refer to [Special Tools](#).

Intake and Exhaust Valve Components Removal

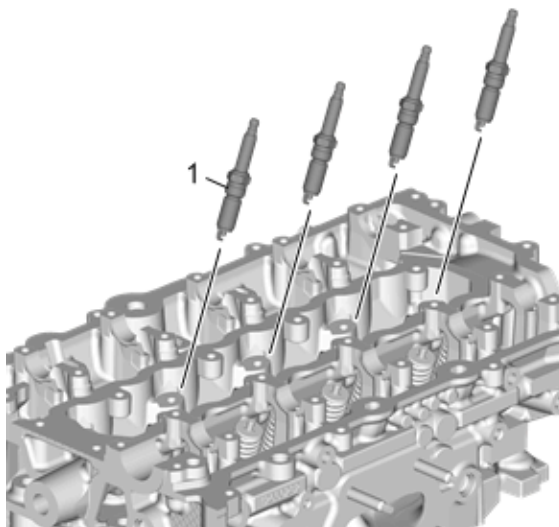


Fig. 407: Spark Plugs

Courtesy of GENERAL MOTORS COMPANY

1. Remove the spark plugs (1).

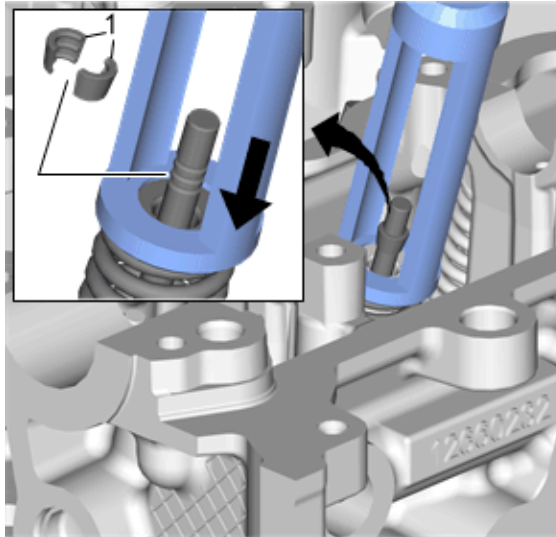


Fig. 408: Special Tool To Remove/Install Valve Stem Keys

Courtesy of GENERAL MOTORS COMPANY

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs less than 25.0 mm (0.984 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

NOTE:

- Many internal engine components will develop specific wear patterns on their friction surfaces.
- Components **MUST** be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.
- Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.

2. Using **EN-8062** compressor and **EN-43963** adapter, compress the upper valve spring retainer down until the valve stem keys are discharged from spring load. Use a suitable tool and a bit of grease to remove the valve stem keys (1).

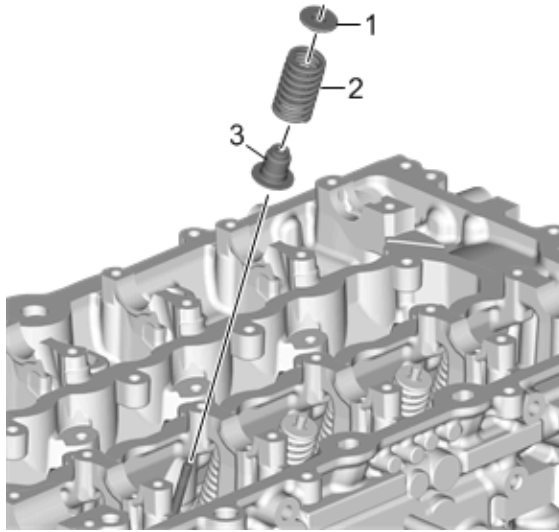


Fig. 409: Valve Spring Retainer, Valve Spring And Oil Seal
 Courtesy of GENERAL MOTORS COMPANY

3. Slowly release the **EN-8062** compressor from the valve spring assembly. Remove the valve spring retainer (1) and the valve spring (2).
4. Repeat the procedure for all valve stem keys, valve spring retainers, and valve springs.

CAUTION: Do not damage the valve guide. Remove any burrs that have formed at the key groove by chamfering the valve stem with an oil stone or a file.

5. Using **EN-46116** remover, remove the valve stem oil seals (3). Discard all used seals and replace with new.

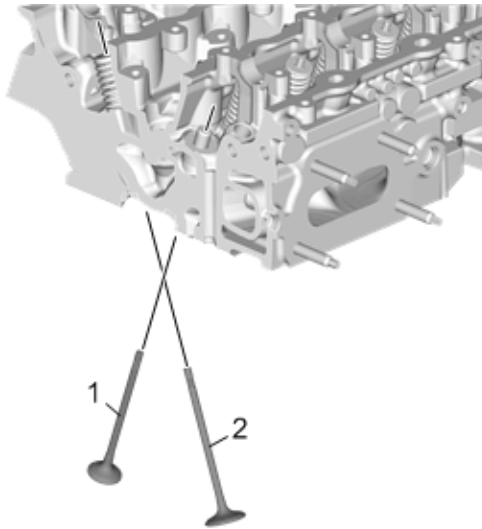


Fig. 410: Exhaust And Intake Valves
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Components **MUST** be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.

6. Remove the 8 exhaust valves (1) and the 8 intake valves (2) from the cylinder head.

Engine Oil Manifold Check Valve Removal

1. Inspect the oil manifold check valves. Damaged, restricted or clogged check valves must be replaced. If check valves are OK, disregard the remaining steps which detail replacing the check valves.

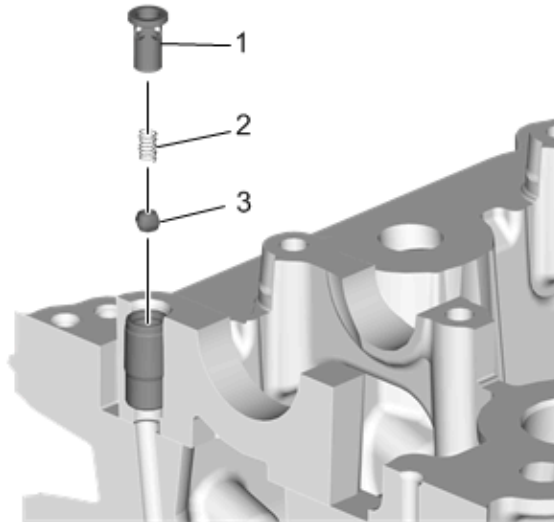


Fig. 411: Oil Manifold Check Valve, Check Ball Spring And Check Ball
Courtesy of GENERAL MOTORS COMPANY

2. Insert a punch or drift into the check valve. With moderate pressure, seat the punch into the inner body of the check valve, and remove the upper part of the valve (1).
3. Remove the check ball spring (2) and check ball (3) from inside of the check valve.

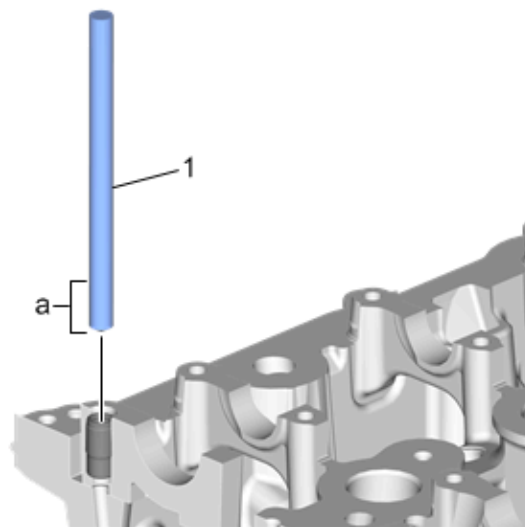


Fig. 412: Setting Depth Gauge On Drill Bit
Courtesy of GENERAL MOTORS COMPANY

4. Using **EN-46122-3** drill bit (1), drill the remainder of check valve sleeve to a depth of approximately 19 mm (0.75 in) (a) by placing tape on drill bit as a depth gauge. It is not necessary or desirable to drill completely through the bottom of the check valve.

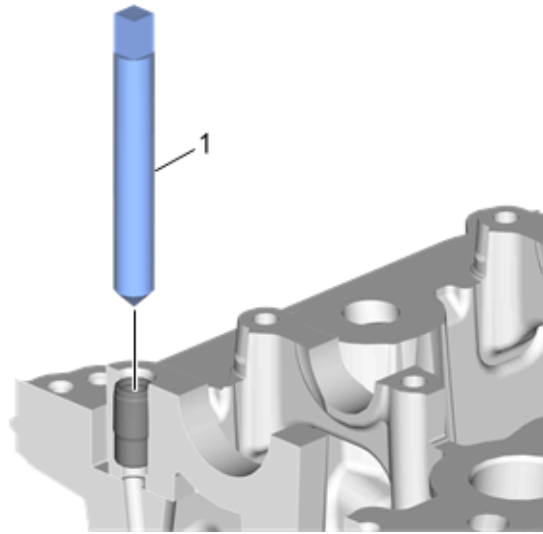


Fig. 413: Tapping Drilled Out Portion Of Oil Manifold Check Valve
Courtesy of GENERAL MOTORS COMPANY

5. Lubricate **EN-46122-4** tap (1) with lubricant. Tap drilled out portion of check valve remaining in cylinder head. Tap to full depth possible until tap bottoms out in head.

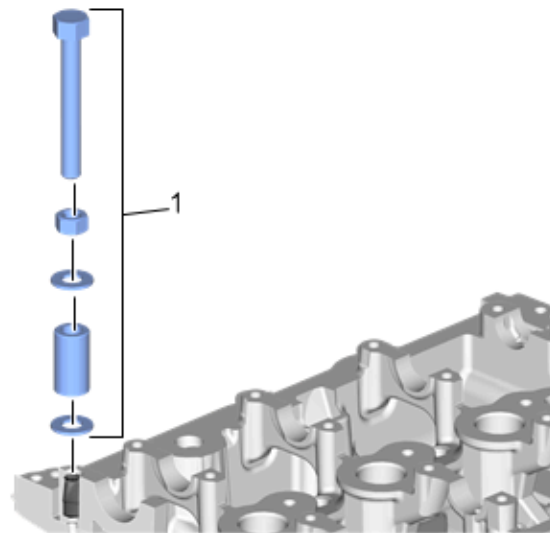


Fig. 414: Special Tool To Remove Oil Manifold Check Valve Sleeve From Cylinder Head
Courtesy of GENERAL MOTORS COMPANY

6. Assemble **EN-46122-2** bolt, nut, washers, and collar (1). Position collar with slightly-larger inside diameter DOWN toward the cylinder head.
7. Screw bolt by hand fully down into threaded check valve sleeve, then lightly tighten nut against washer.
8. Hold bolt with one wrench, and use another to tighten the nut until the check valve sleeve is removed from the cylinder head.
9. Clean check valve bore and related passages thoroughly to remove any drilling chips or other debris.

Cylinder Head Disassemble

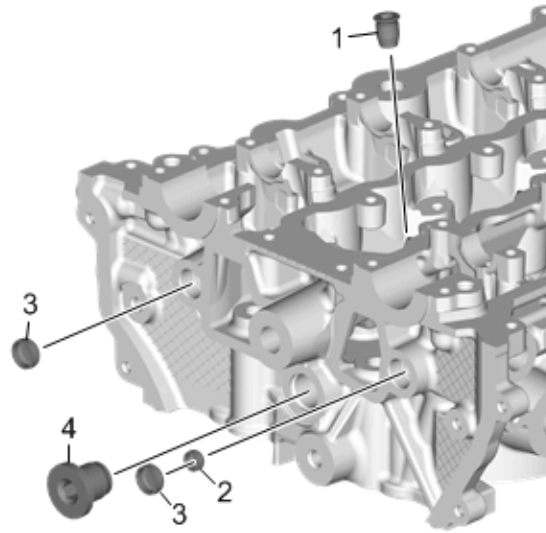


Fig. 415: Cylinder Head Core Hole Plugs, Oil Gallery Plugs And Oil Gallery Restrictor
Courtesy of GENERAL MOTORS COMPANY

1. Remove 4 cylinder head core hole plugs (1) from the top of the cylinder head.
2. Remove 2 cylinder head oil gallery plugs (3).
3. Remove the cylinder head oil gallery restrictor (2).
4. Remove the cylinder head core hole plug (4) from the front of the cylinder head.

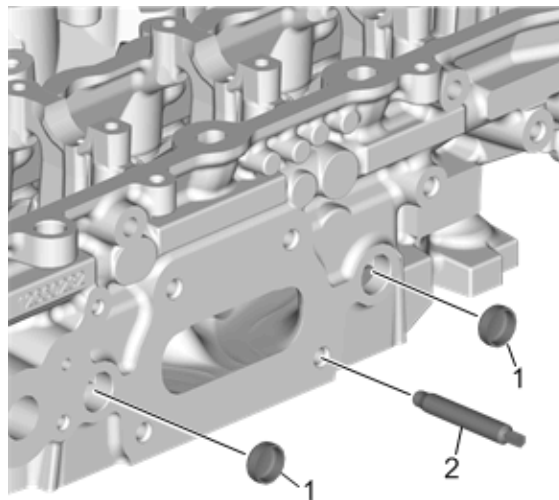


Fig. 416: Side Cylinder Head Oil Gallery Plugs And Studs
Courtesy of GENERAL MOTORS COMPANY

5. Remove 2 cylinder head oil gallery plugs (1) from the side of the cylinder head.
6. Remove 4 catalytic converter studs (2). Discard the studs.

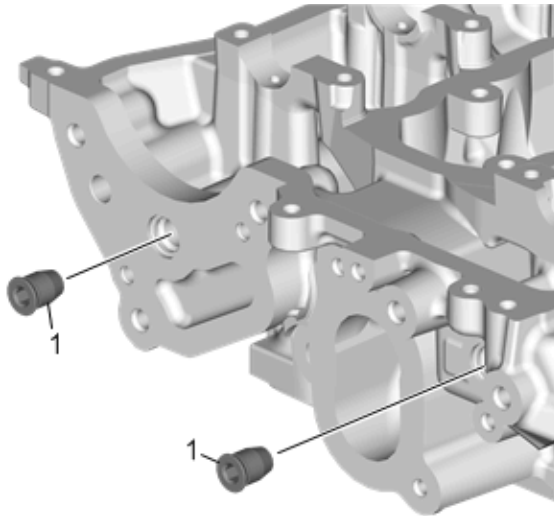


Fig. 417: Cylinder Head Core Hole Plugs

Courtesy of GENERAL MOTORS COMPANY

7. Remove the 2 cylinder head core hole plugs (1) from the rear of the cylinder head.

CYLINDER HEAD CLEANING AND INSPECTION

Special Tools

- **EN-22738-B** Valve Spring Tester
- **EN-28410** Gasket Remover
- **GE-7872** Magnetic Base Dial Indicator

For equivalent regional tools, refer to **Special Tools**.

Valve Cleaning and Inspection

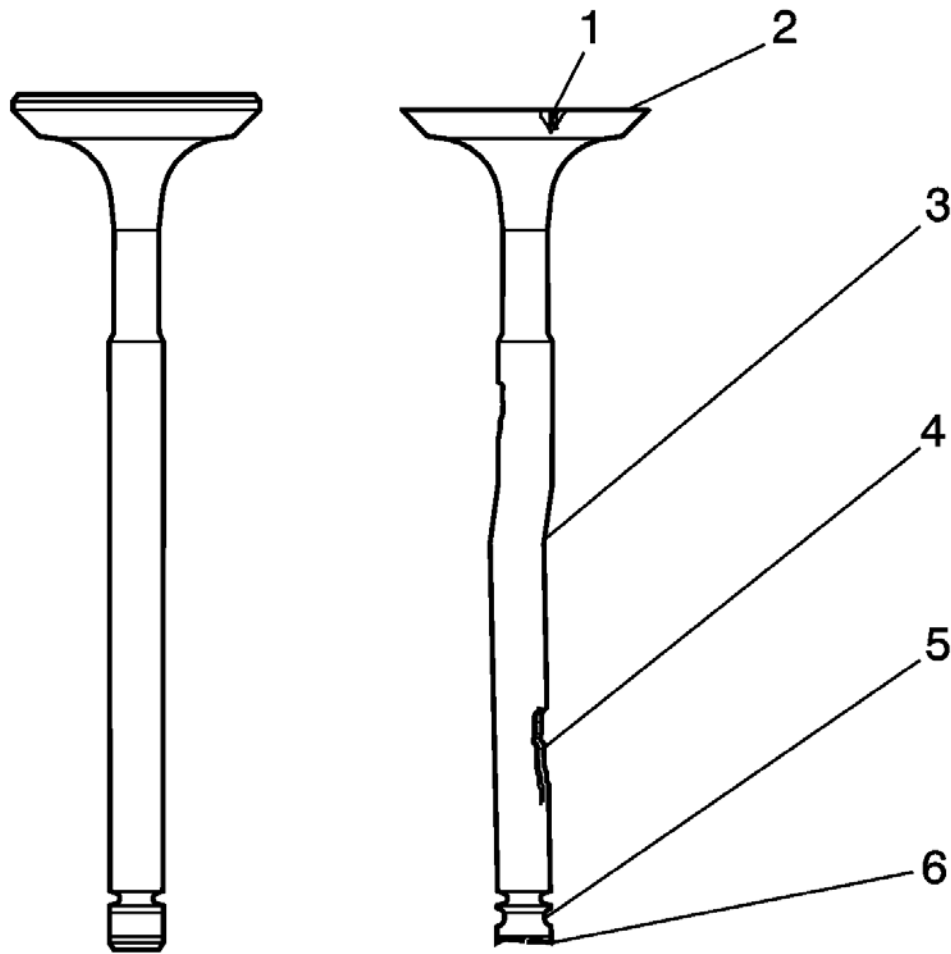


Fig. 418: Valve Inspection Areas

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not use a wire brush on any part of the valve stem.

NOTE: Do not grind or condition the intake valve. If the intake valve is out of specification, replace the valve.

1. Clean the valves of carbon, oil and varnish. Use a soft bristle wire brush to clean any carbon build-up from the valve head. Varnish can be removed by soaking in Parts Immersion Solvent or equivalent. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
2. Clean the valve guides.
3. Inspect the valve stem for pitting or wear (4).
4. Inspect the valve key groove for chipping or wear (5). Replace the valve if chipped or worn.
5. Inspect the valve face for burning or cracking (1). If pieces are broken off, inspect the corresponding piston and cylinder head area for damage.
6. Inspect the valve stem for burrs and scratches. Burrs and minor scratches may be removed with an oil stone.
7. Inspect the valve stem for straightness (3) and the valve head for bending or distortion using V blocks. Bent or distorted valves must be replaced.
8. Clean the deposits from the valve face. Inspect the valve face for grooving.
9. Replace the valve if the face is grooved. Valve faces cannot be machined. If worn, or damaged, the valves must

be replaced.

10. Replace the valve if the valve head O.D. and chamfer (2) is worn or out of specification. Refer to [Valve and Seat Grinding](#).
11. The valves may be lightly lapped to the valve seats.
12. Replace the valve if the valve tip (6) is worn.
13. If no apparent wear, pitting, grooving, or distortion is present, perform the valve measurement and reconditioning procedure to verify valve specification. Refer to [Valve and Seat Grinding](#).

Valve Guide Measurement

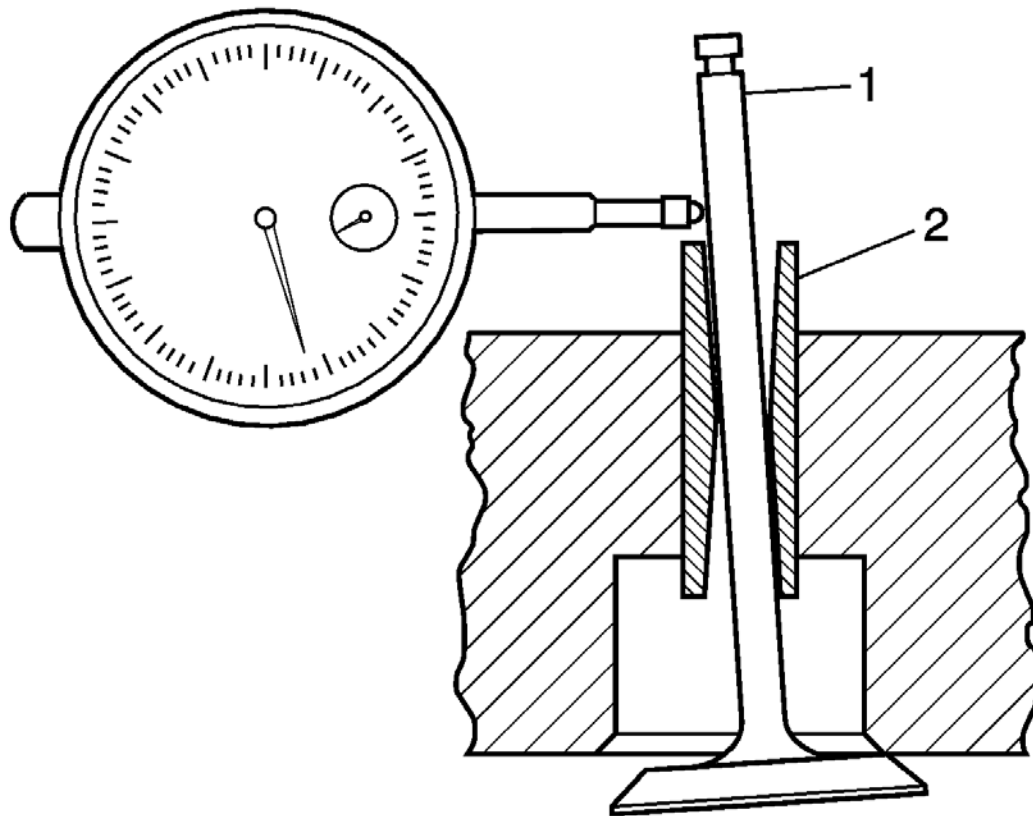


Fig. 419: Inspecting For Excessive Valve Stem To Guide Clearance

Courtesy of GENERAL MOTORS COMPANY

1. Measure the valve stem (1) to-guide (2) clearance. Excessive valve stem-to-guide clearance may cause an excessive oil consumption and may also cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of the valve and will disturb the engine assembly smoothness.
2. Clamp the **GE-7872** indicator to the cylinder head at the camshaft cover rail.
3. Locate the dial indicator so that the movement of the valve stem from side to side, crossways to the cylinder head, will cause a direct movement of the indicator stem. The dial indicator stem must contact the side of the valve stem just above the valve guide.
4. Drop the valve head about 0.064 mm (0.0025 in) off the valve seat.
5. Use light pressure when moving the valve stem from side to side in order to obtain a clearance reading. Refer

to [Engine Mechanical Specifications](#) for proper clearance.

NOTE: Valve guide wear at the bottom 10 mm (0.390 in) of the valve guide is not significant to normal operation.

6. If the clearance for the valve is greater than specifications and a new standard diameter valve stem will not bring the clearance within specifications, replace the cylinder head.

Valve Spring Cleaning and Inspection

1. Clean the valve springs in solvent.

WARNING: Refer to [Safety Glasses Warning](#) .

2. Dry the valve springs with compressed air.
3. Inspect the valve springs for broken coils or coil ends.

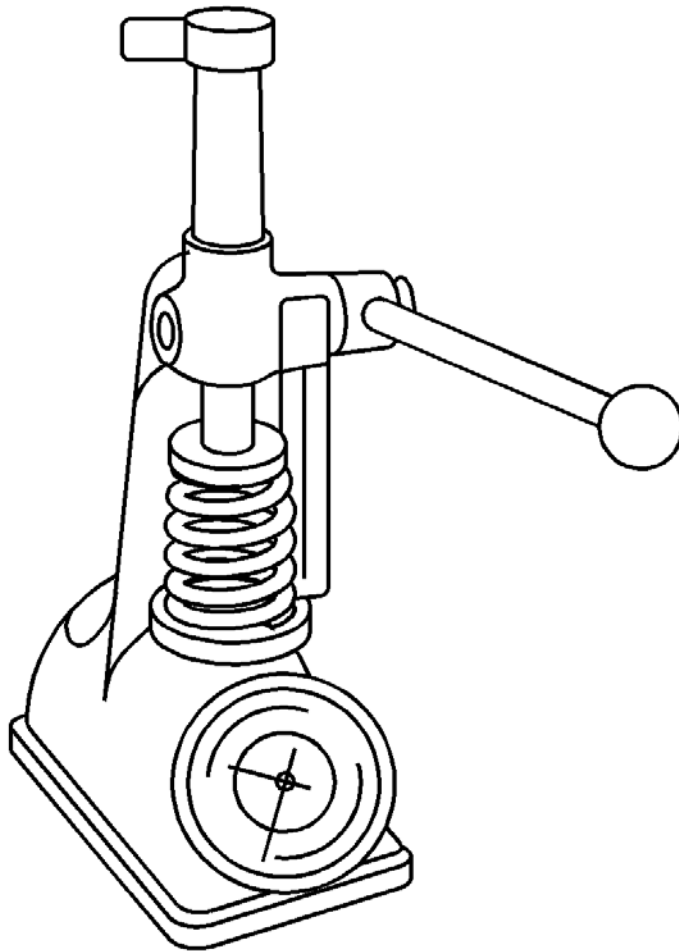


Fig. 420: Measuring Valve Spring Tension

Courtesy of GENERAL MOTORS COMPANY

4. Measure the valve spring tension using the EN-22738-B tester. Refer to [Engine Mechanical Specifications](#)
5. If low valve spring load is found, replace the valve springs. DO NOT use shims to increase spring load. The use of shims can cause the valve spring to bottom out before the camshaft lobe is at peak lift.

Valve Rocker Arm Cleaning and Inspection

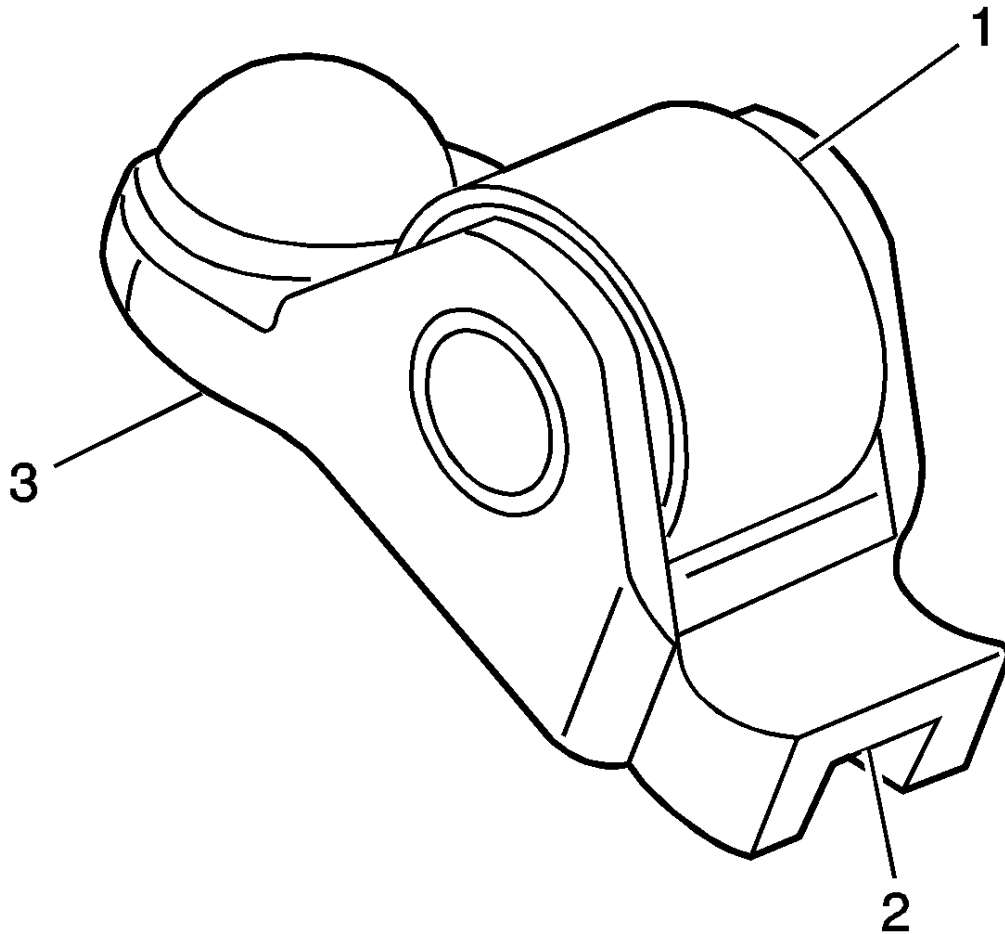


Fig. 421: Inspecting Valve Rocker Arms

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the camshaft follower roller (1) for the following:
 - Flat spots
 - Excessive scoring and pitting
 - Ensure the roller spins freely
2. Inspect the camshaft follower valve tip area (2).
3. Inspect the camshaft follower stationary hydraulic lash adjuster (SHLA) pivot area (3).
4. Replace the camshaft follower or followers as necessary.

Cylinder Head and Gasket Surface Cleaning and Inspection

1. Inspect the cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, use the following faults to determine the cause:
 1. Improper installation
 2. Loose or warped cylinder head
 3. Missing, off location or not fully seated dowel pins

4. Corrosion in the seal area around the coolant passages
5. Chips or debris in the cylinder head bolt holes
6. Bolt holes in the cylinder block not drilled or tapped deep enough

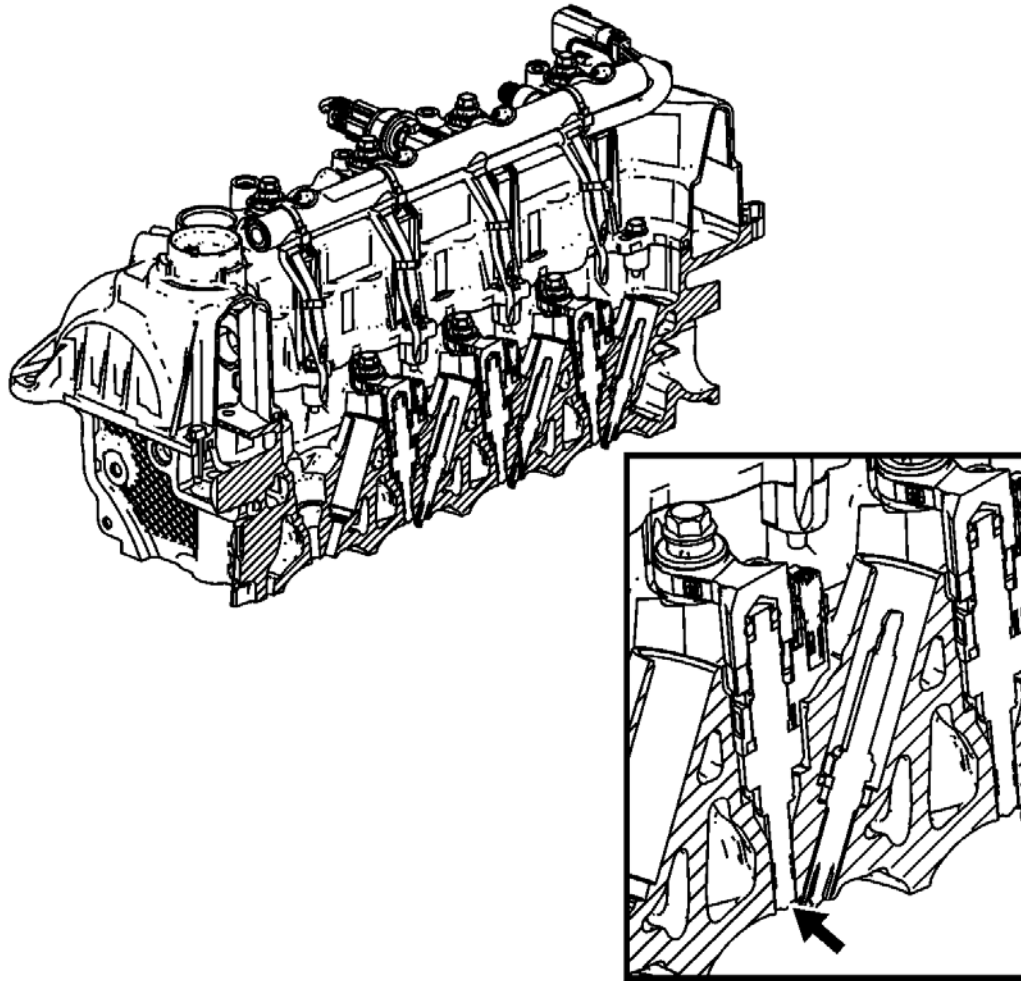


Fig. 422: Inspecting Fuel Injector Bores

Courtesy of GENERAL MOTORS COMPANY

2. Inspect the fuel injector bores and clean, if required. Refer to [Fuel Injector and Fuel Injector Bore Cleaning and Inspection](#).
3. Inspect the cylinder head gasket surface.
 - Cylinder head may be reused if corrosion is found only outside a 4 mm (0.375 in) band around each combustion chamber (1).
 - Replace the cylinder head if the area between the valve seats is cracked (2).
 - Replace the cylinder head if corrosion has been found inside a 4 mm (0.375 in) band around each combustion chamber (3).
4. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to [Use of Room Temperature Vulcanizing \(RTV\) and Anaerobic Sealant](#)

NOTE: Do not use a wire brush on any gasket sealing surface.

5. Clean the cylinder head. Remove all varnish, soot and carbon to the bare metal.
6. Remove any old thread sealant, gasket material or sealant using **EN-28410** remover.

7. Clean all cylinder head surfaces with non-corrosive solvent.
8. Blow out all the oil galleries using compressed air.
9. Clean any debris or build-up from the lifter pockets.
10. Clean the valve guides.
11. Clean the threaded holes. Use a nylon bristle brush.
12. Clean the remains of the sealer from the plug holes.
13. Inspect the cylinder head for cracks. Check between the valve seats and in the exhaust ports.

NOTE: Do not attempt to weld the cylinder head, replace it.

14. Inspect the cylinder head deck for corrosion, sand inclusions and blow holes.
15. Inspect all the threaded holes for damage. Threads may be reconditioned with thread inserts.
16. Inspect the sealing surfaces.
17. Inspect the cylinder head plugs and verify the oil orifice is clear and free of debris.

Cylinder Head Deck Flatness Inspection

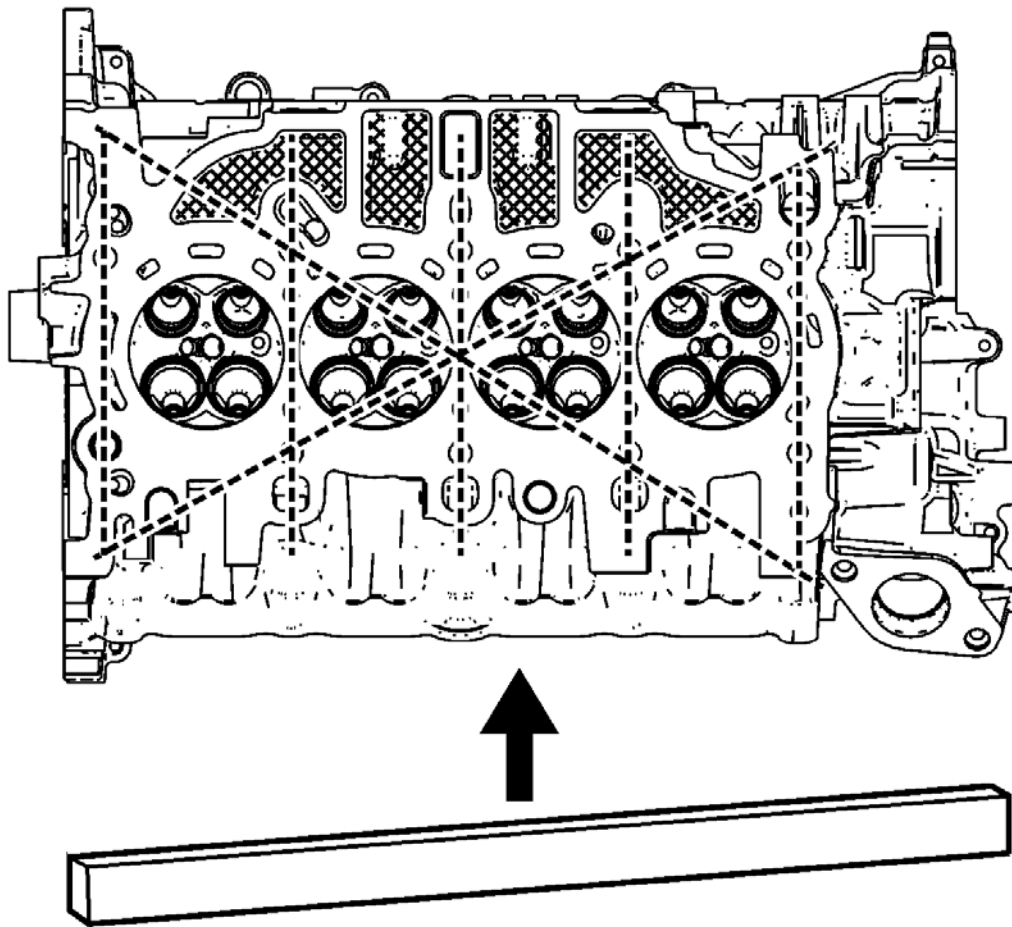


Fig. 423: Inspecting Cylinder Head Deck Surface For Flatness
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the cylinder head decks are clean and free of gasket material.

2. Inspect the surface for any imperfections or scratches that could inhibit proper cylinder head gasket sealing.
3. Using a straight-edge placed diagonally across the deck surface, inspect the cylinder head deck surface for flatness.
4. Measure the clearance between the straight-edge and the cylinder head deck face using a feeler gauge at 4 points along the straight-edge.
5. Refer to [Engine Mechanical Specifications](#) If the cylinder head deck flatness is more than the specified amount, replace the cylinder head.

Camshaft Journal Clearance

1. Install the camshaft bearing cap in the cylinder head without the camshaft.

CAUTION: Refer to [Fastener Caution](#) .

2. Install the camshaft cap bolts and tighten to 10 N.m (89 lb in).
3. Measure the camshaft bearings using an inside micrometer.
4. Subtract the camshaft journal diameter from the camshaft bearing diameter. This will provide the running clearance. If the running clearance exceeds specifications and the camshaft journals are within specification, replace the cylinder head. Refer to [Engine Mechanical Specifications](#)
5. Remove the camshaft bearing caps when measurement is complete.

Camshaft Journal Alignment

1. Ensure the camshafts are serviceable.
2. Inspect the cylinder head camshaft bearing surfaces for any imperfections or scratches that could inhibit proper camshaft clearances. Repair minor imperfections or scratches.
3. Install the camshafts in the cylinder head.
4. Install the camshaft bearing caps.
5. Install the camshaft cap bolts and tighten to 10 N.m (89 lb in).
6. Ensure the camshafts spin freely in the cylinder head. If the camshaft does not run freely, replace the cylinder head.

VALVE AND SEAT GRINDING

Valve Measurement and Reconditioning Overview

- Proper valve service is critical to engine performance. Therefore, all detailed measurement procedures must be followed to identify components that are out of specification.
- If the measurement procedures reveal that the valve or valve seat must be reconditioned, it is critical to perform the measurement procedures after reconditioning.

Valve Seat Width Measurement Procedure

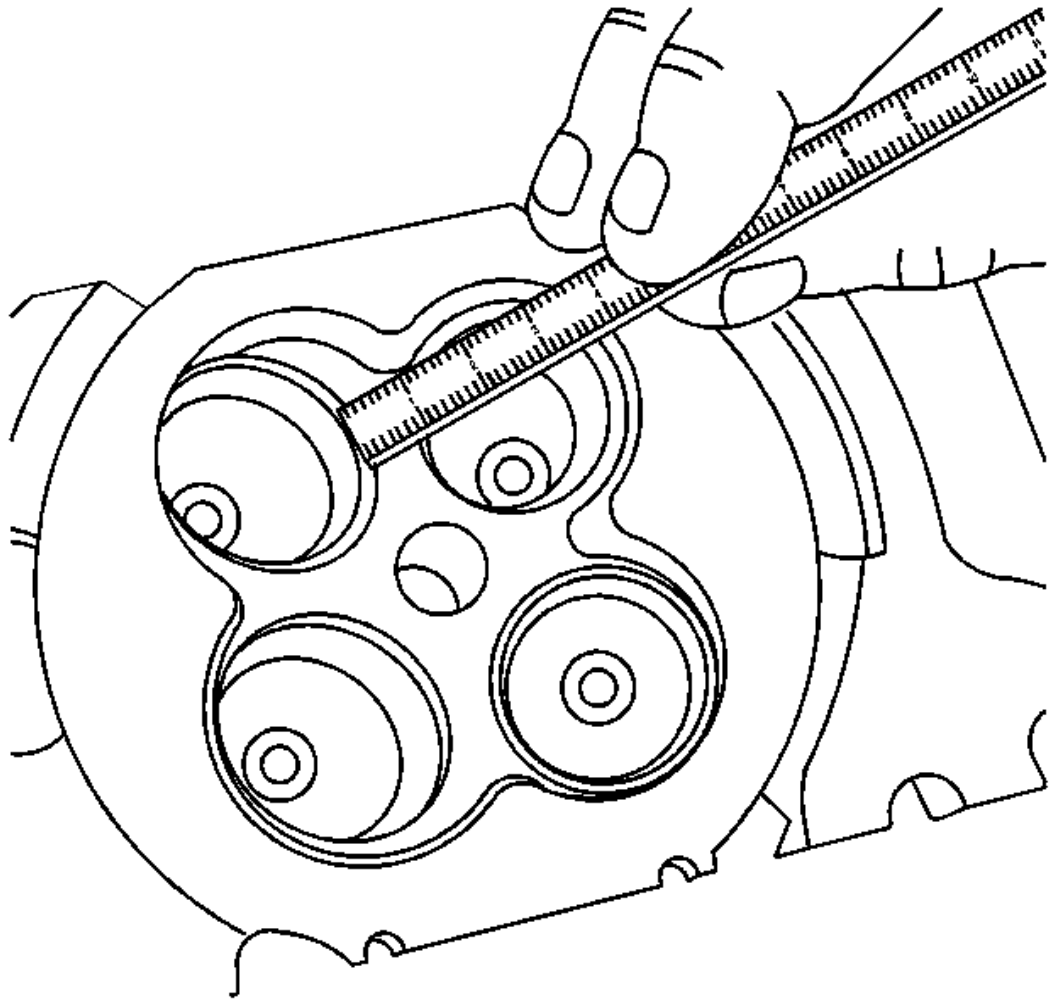


Fig. 424: Measuring Valve Seat Width In Cylinder Head
Courtesy of GENERAL MOTORS COMPANY

1. Measure the valve seat width in the cylinder head using a proper scale.

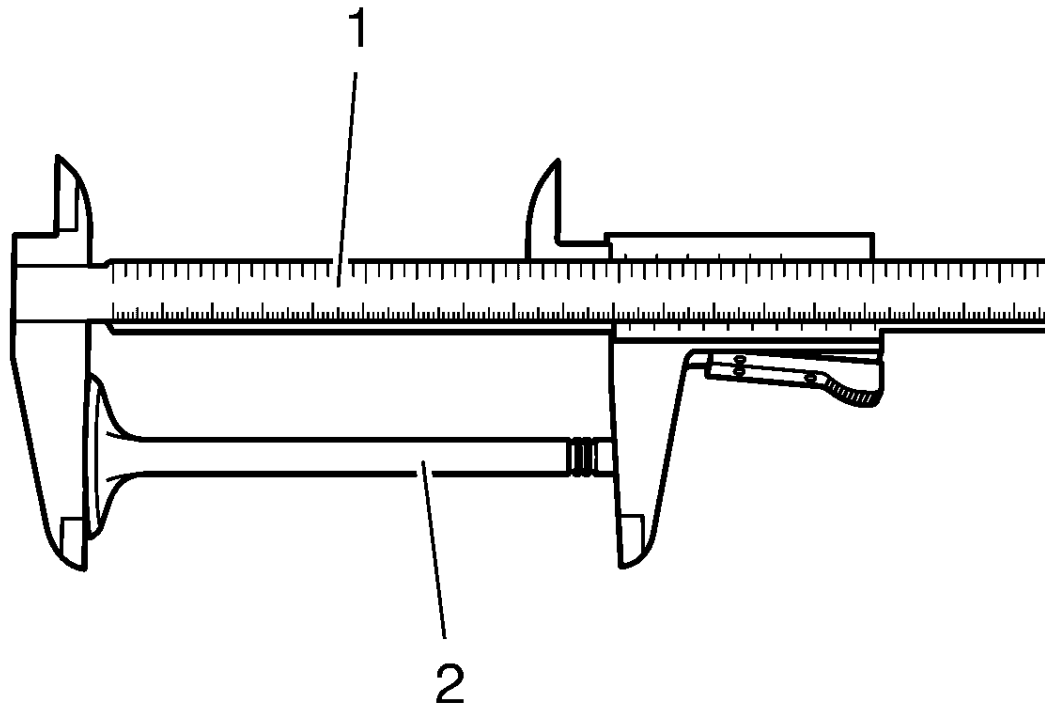


Fig. 425: Measuring Valve Length Using Slide Gauge
Courtesy of GENERAL MOTORS COMPANY

2. Measure the valve length (2). Use a slide gauge (1). Refer to [Engine Mechanical Specifications](#).

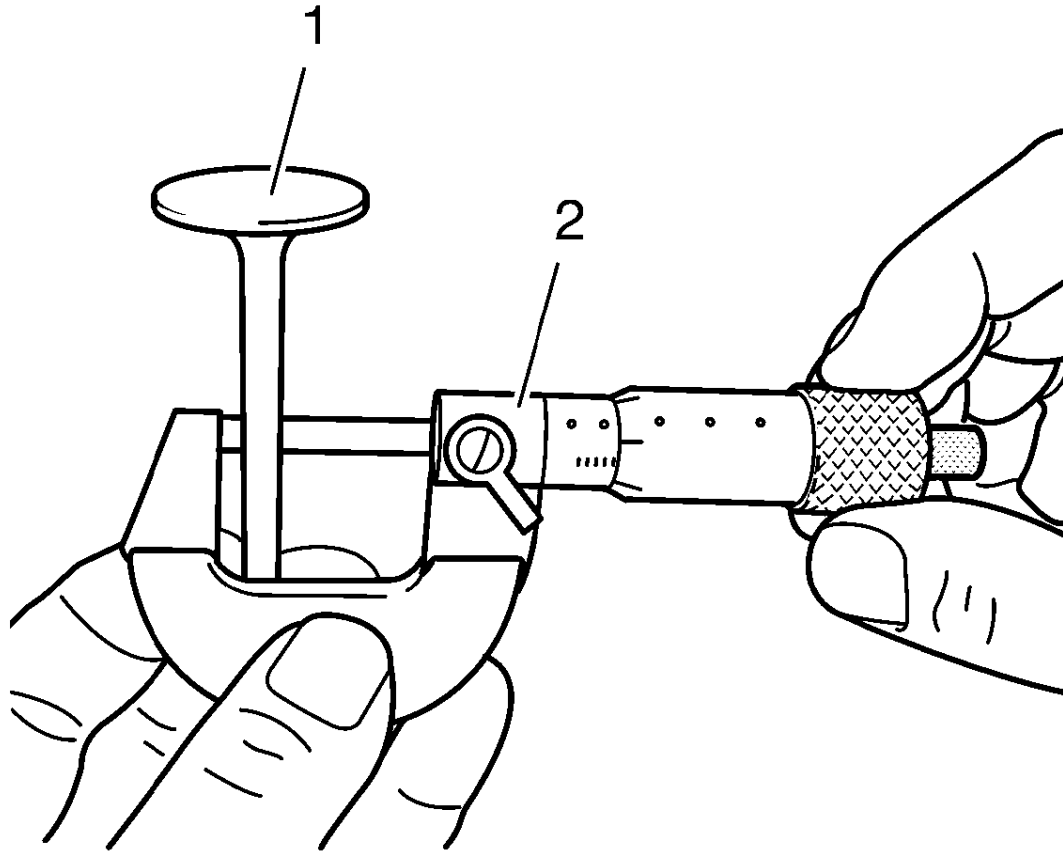


Fig. 426: Measuring Valve Stem Diameter Using Micrometer Gauge
Courtesy of GENERAL MOTORS COMPANY

3. Measure the valve stem diameter (1). Use a micrometer gauge (2). Refer to **Engine Mechanical Specifications**.

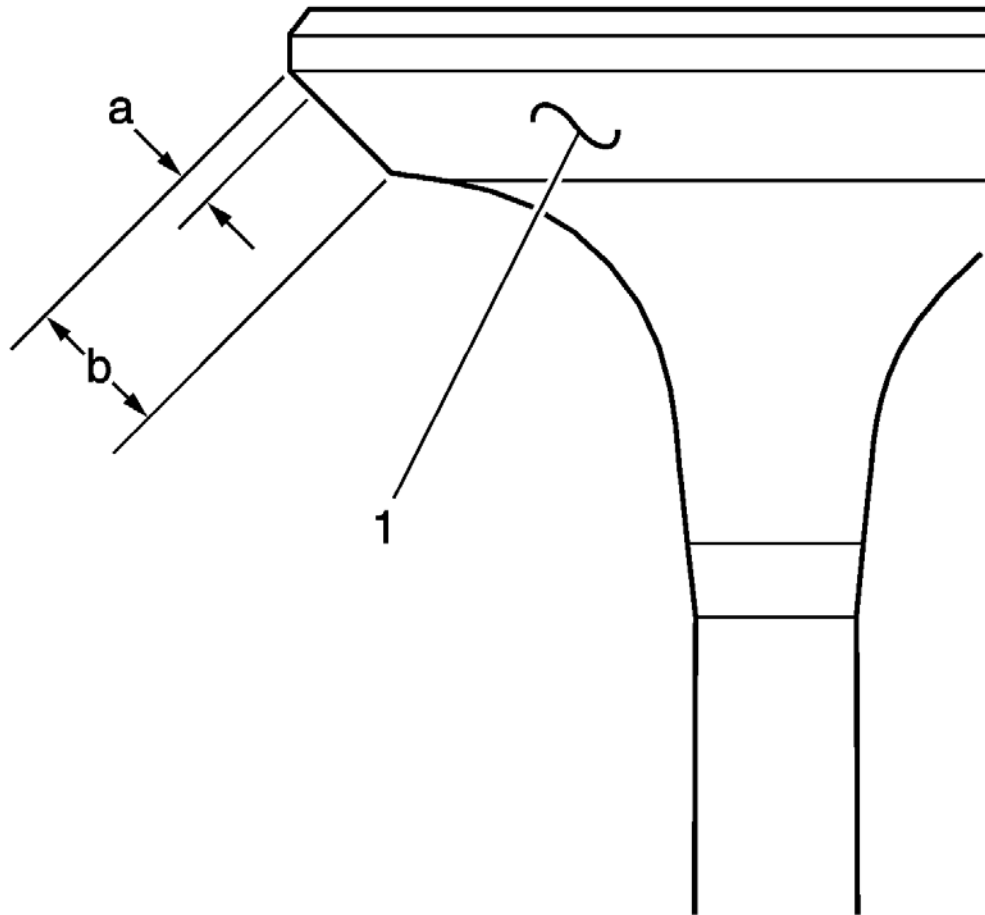


Fig. 427: Valve Face Seat Width

Courtesy of GENERAL MOTORS COMPANY

4. Measure the seat width (b) on the valve face (1) using a proper scale.

NOTE: The seat contact area must be at least 0.5 mm (0.020 in) from the outer diameter, margin (a), of the valve. If the contact area is too close to the margins, the seat must be reconditioned to move the contact area away from the margin.

5. Compare your measurements with the specifications listed in [Engine Mechanical Specifications](#).
6. If the seat widths are acceptable, check the valve seat roundness using the Valve Seat Roundness Measurement Procedure.
7. If the seat width is not acceptable, you must grind the valve seat using the Valve and Seat Reconditioning Procedure to bring the width back into specification. Proper valve seat width is critical to providing the correct amount of valve heat dissipation.

Valve Seat Roundness Measurement Procedure

1. Measure the valve seat roundness using a dial indicator attached to a tapered pilot installed in the guide. The pilot should have a slight bind when installed in the guide.

CAUTION: The correct size pilot must be used. Do not use adjustable diameter pilots.

Adjustable pilots may damage the valve guides.

2. Compare your measurements with the specifications listed in [Engine Mechanical Specifications](#).
3. If the valve seat exceeds the roundness specification, you must grind the valve and valve seat using the Valve and Seat Reconditioning Procedure.
4. If new valves are being used, the valve seat roundness must be within 0.05 mm (0.002 in).

Valve Head O.D. and Chamfer Measurement Procedure

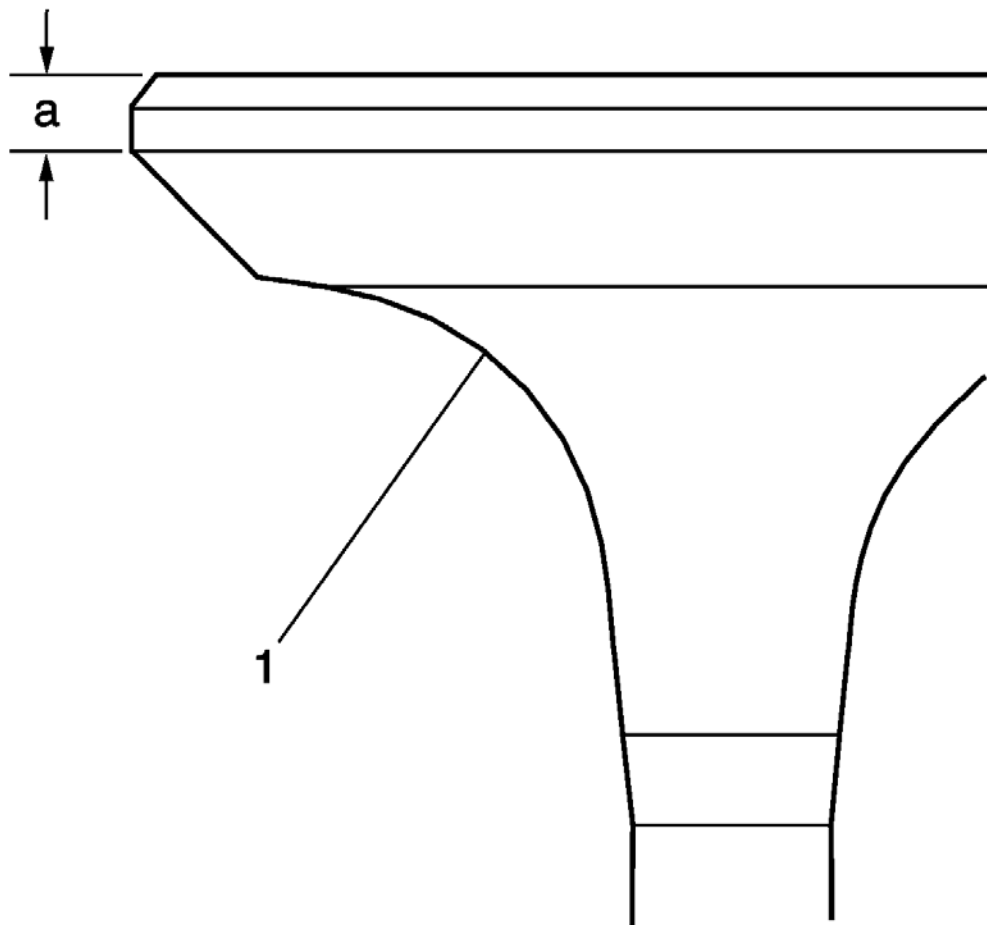


Fig. 428: View Of Valve Head O.D. & Chamfer
Courtesy of GENERAL MOTORS COMPANY

1. Measure the valve head O.D. and chamfer (a) using an appropriate scale. Refer to [Engine Mechanical Specifications](#).
2. If the valve head O.D. and chamfer is within specification, test the valve (1) for seat concentricity using the Valve-to-Seat Concentricity Measurement Procedure. Reinspect the valve head O.D. and chamfer after completing the concentricity measurement if valve seat reconditioning is performed.

Valve-to-Seat Concentricity Measurement Procedure

NOTE:

- Checking the valve-to-seat concentricity determines whether the valve and seat are sealing properly.
- You must measure the valve face and the valve seat to ensure proper

valve sealing.

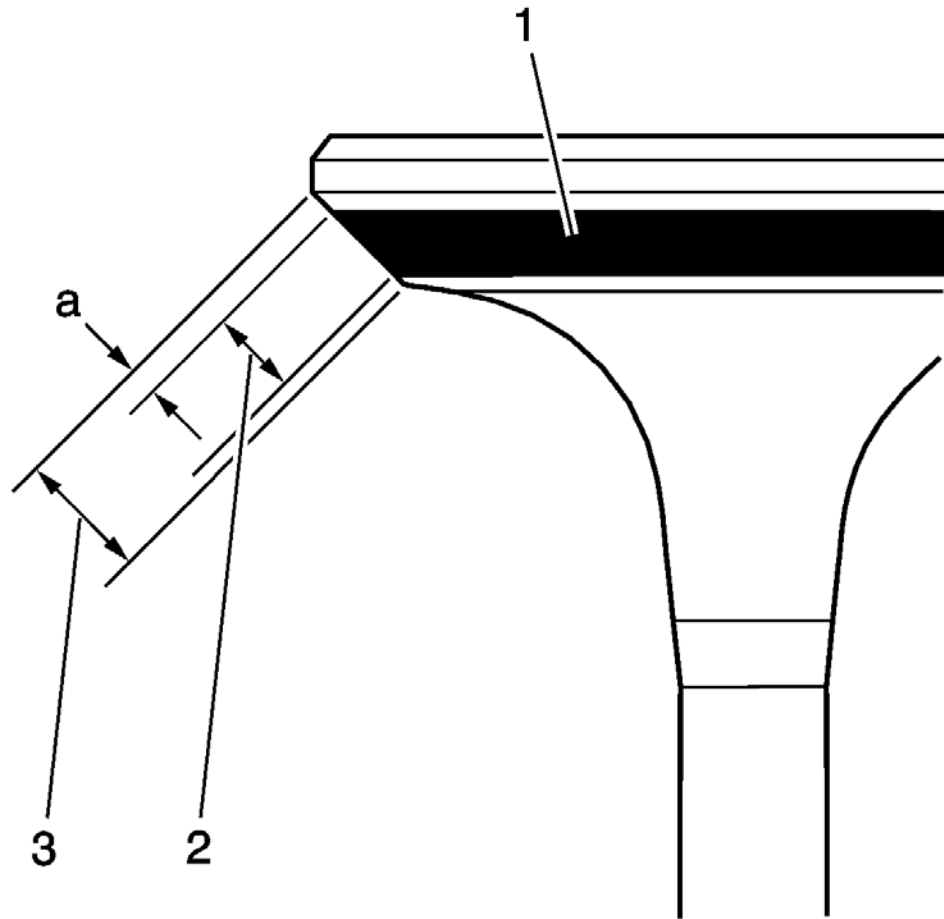


Fig. 429: Inspecting Valve Face

Courtesy of GENERAL MOTORS COMPANY

1. Coat the valve face (3) lightly with blue dye (1).
2. Install the valve in the cylinder head.
3. Turn the valve against the seat with enough pressure to wear off the dye.
4. Remove the valve from the cylinder head.
5. Inspect the valve face.
 - If the valve face is concentric, providing a proper seal, with the valve stem, a continuous mark (2) will be made around the entire face.

NOTE: The wear mark **MUST** be at least 0.5 mm (0.020 in) from the outer diameter, the margin (a), of the valve. If the wear mark is too close to the margin, the seat must be reconditioned to move the contact area away from the margin.

NOTE: Do not grind or condition the intake valve. If the intake valve is out of specification, replace the valve.

- If the face is not concentric with the stem, the mark will NOT be continuous around the valve face. The

valve should be refaced or replaced and the seat must be reconditioned using the Valve and Seat Reconditioning Procedure.

Valve and Seat Reconditioning Procedure

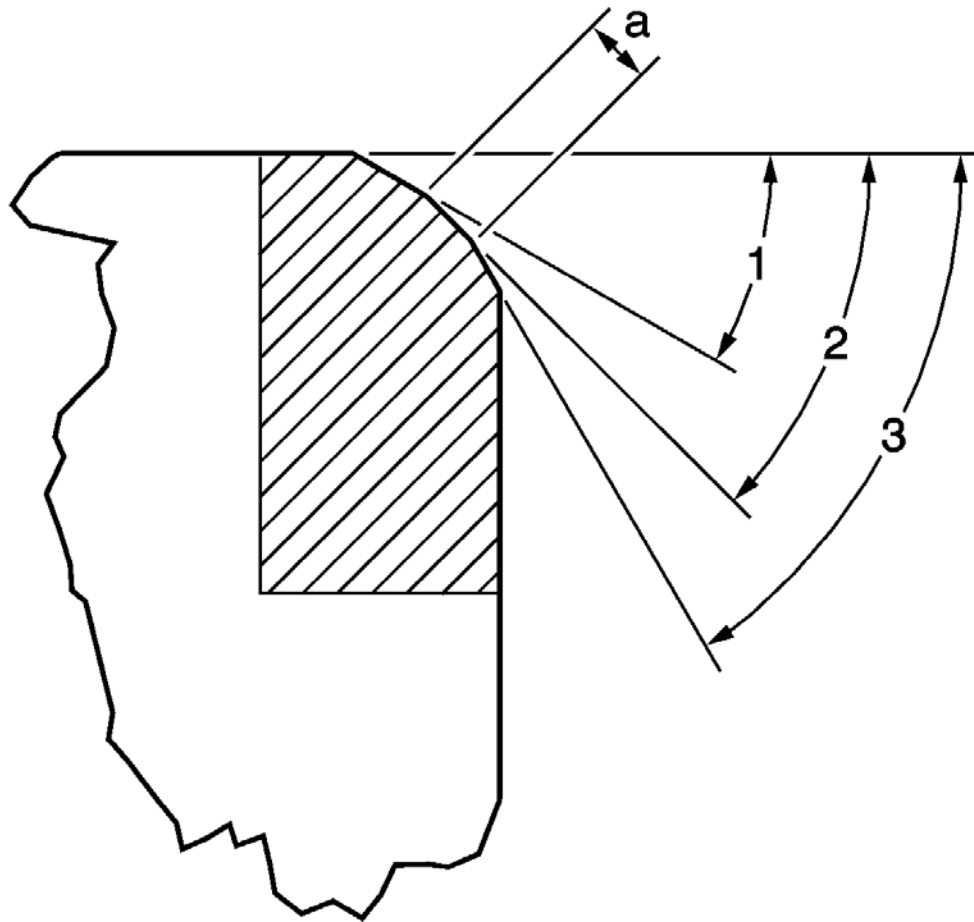


Fig. 430: Valve Seating Surface Angle
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- If the valve seat width, roundness or concentricity is beyond specifications, you must grind the seats in order to ensure proper heat dissipation and prevent the build up of carbon on the seats.
- It is necessary to reface the valve if seat reconditioning is required unless a new valve is used.

1. Grind the valve seating surface (a) to the proper angle specification (2). Refer to [Engine Mechanical Specifications](#).
2. Grind the valve relief surface to the proper angle specification (1) to correctly position the valve seating surface (a) to the valve. Refer to [Engine Mechanical Specifications](#).
3. Grind the valve undercut surface to the proper angle specification (3) to narrow the valve seating surface width (a). Refer to [Engine Mechanical Specifications](#).

NOTE:

Do not grind or condition the intake valve. If the intake valve seat has been

reconditioned, replace the corresponding intake valve.

4. Replace the intake valve if it is out of specification. Refer to [Engine Mechanical Specifications](#).
5. If the original exhaust valve is being used, grind the valve to the specifications listed in [Engine Mechanical Specifications](#). Measure the valve head O.D. and chamfer again after grinding using the Valve Head O.D. and Chamfer Measurement Procedure. Replace the exhaust valve if it is out of specification. New valves do not require grinding.
6. When grinding the valves and seats, grind off as little material as possible. Cutting valve seat results in lowering the valve spring pressure.
7. Install the valve in the cylinder head.
 - If you are using refaced exhaust valves, lap the valves into the seats with a fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that minimal lapping is required. Excessive lapping will groove the valve face and prevent a good seat when hot.
 - Be sure to clean any remaining lapping compound from the valve and seat with solvent and compressed air prior to final assembly.
8. After obtaining the proper valve seat width in the cylinder head, you must re-measure the valve stem height using the Valve Stem Height Measurement Procedure.
9. If the valve stem height is acceptable, test the seats for concentricity using the Valve-to-Seat Concentricity Measurement Procedure.

Valve Stem Height Measurement Procedure

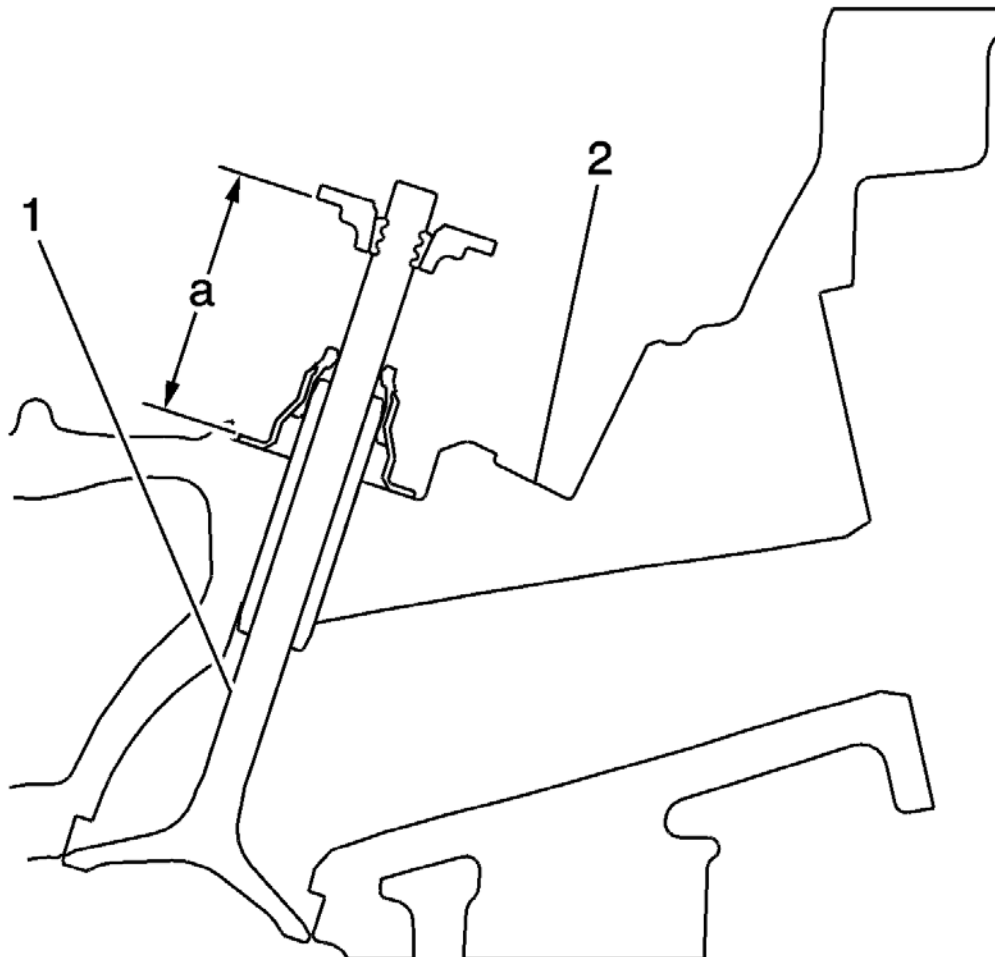


Fig. 431: Valve Stem Height Measurement
Courtesy of GENERAL MOTORS COMPANY

NOTE: To determine the valve stem height measurement, measure from the valve spring seat to the valve spring retainer.

1. Install the valve (1) into the valve guide in the cylinder head (2).
2. Ensure the valve is seated to the cylinder head valve seat.
3. Install the valve stem oil seal.
4. Install the valve spring retainer and valve stem locks.
5. Measure the distance (a) between the valve seal lip to the bottom of the valve spring retainer. Refer to [Engine Mechanical Specifications](#).
6. If the maximum height specification is exceeded, a new valve should be installed and the valve stem height re-measured.

CAUTION: DO NOT grind the valve stem tip. The tip of the valve is hardened and grinding the tip will eliminate the hardened surface causing premature wear and possible engine damage.

CAUTION: DO NOT use shims in order to adjust valve stem height. The use of shims will cause the valve spring to bottom out before the camshaft lobe is at peak lift and engine damage could result.

7. If the valve stem height still exceeds the maximum height specification, the cylinder head must be replaced.

CYLINDER HEAD ASSEMBLE

Special Tools

- **EN-8062** Valve Spring Compressor
- **EN-43963** Valve Spring Compressor - Off-Car Adapter
- **EN-46116** Valve Seal Remover
- **EN-46122** Camshaft Position Actuator Check-Ball Valve Remover/Installer

For equivalent regional tools, refer to [Special Tools](#).

Cylinder Head Assemble

1. Apply sealant to all plugs prior to installation. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

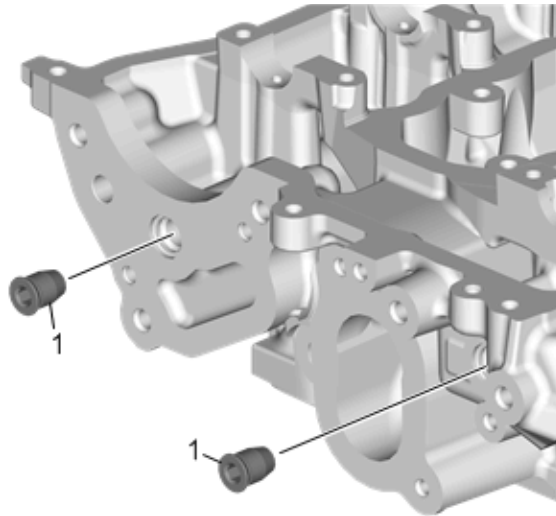


Fig. 432: Cylinder Head Core Hole Plugs

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

2. Install 2 NEW cylinder head core hole plugs (1) in the rear of the cylinder head. Tighten the plug to 25 N.m (18 lb ft).

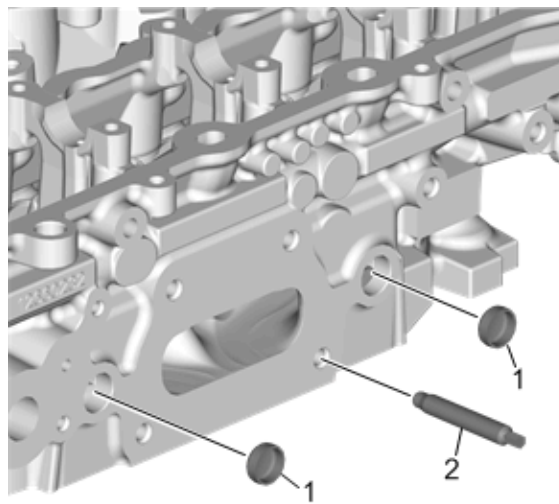


Fig. 433: Side Cylinder Head Oil Gallery Plugs And Studs

Courtesy of GENERAL MOTORS COMPANY

3. Install 2 NEW cylinder head oil gallery plugs (1) in the side of the cylinder head.

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#) .

4. Install 4 NEW catalytic converter studs (2). Tighten the studs to 10 N.m (89 lb in)

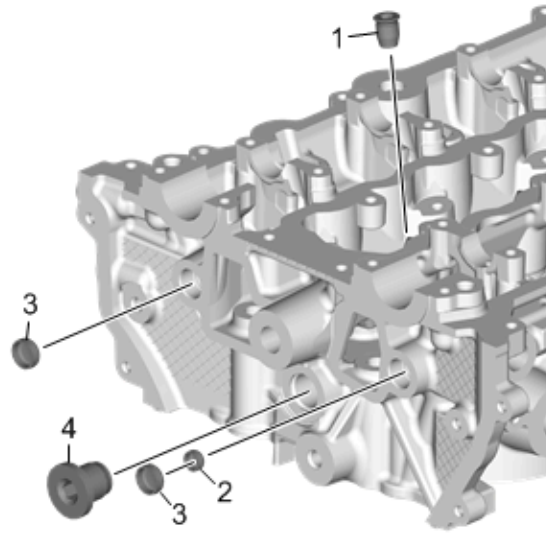


Fig. 434: Cylinder Head Core Hole Plugs, Oil Gallery Plugs And Oil Gallery Restrictor
Courtesy of GENERAL MOTORS COMPANY

5. Install 4 NEW cylinder head core hole plugs (1) in the top of the cylinder head. Tighten the plugs to 25 N.m (18 lb ft).
6. Install a NEW cylinder head oil restrictor (2).
7. Install 2 NEW cylinder head oil gallery plugs (3).
8. Install a NEW cylinder head core hole plug (4). Tighten the plug to 75 N.m (55 lb ft).

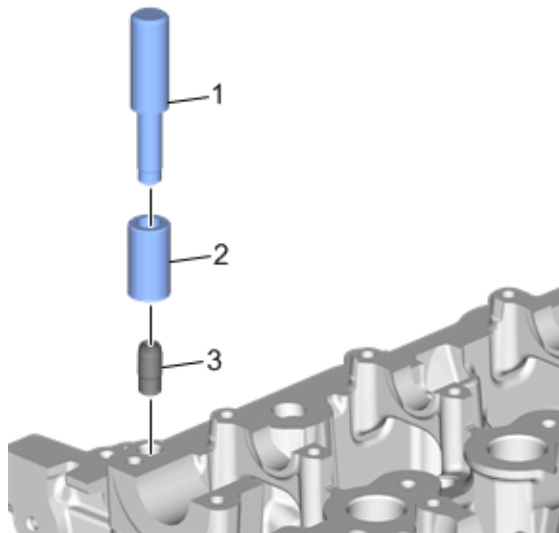


Fig. 435: Engine Oil Manifold Check Valve
Courtesy of GENERAL MOTORS COMPANY

9. If necessary, install new engine oil manifold check valves (3):
 1. Use lubricant included with **EN-46122** remover/installer to lubricate the outside of the new check valve (3).
 2. With the check ball end of the check valve facing **DOWN**, towards the head, insert the NEW check valve into the check valve bore in the cylinder head.
 3. Place **EN-46122-2** collar (2) over the new check valve with the slightly-larger inside diameter of the collar **DOWN** toward the cylinder head.
 4. Using the **EN-46122-1** driver (1), lightly tap the new check valve into place until the driver stops against

the top of the collar.

Intake and Exhaust Valve Components Installation

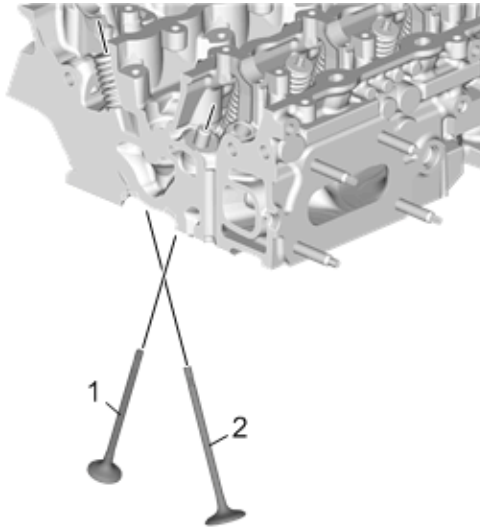


Fig. 436: Exhaust And Intake Valves

Courtesy of GENERAL MOTORS COMPANY

NOTE: Components **MUST** be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts.

1. Ensure that the valve train components will be installed in their original position.
2. Lubricate the valve guides and the valve stems with engine oil.
3. Install the exhaust valves (1) and the intake valves (2) in the cylinder head.

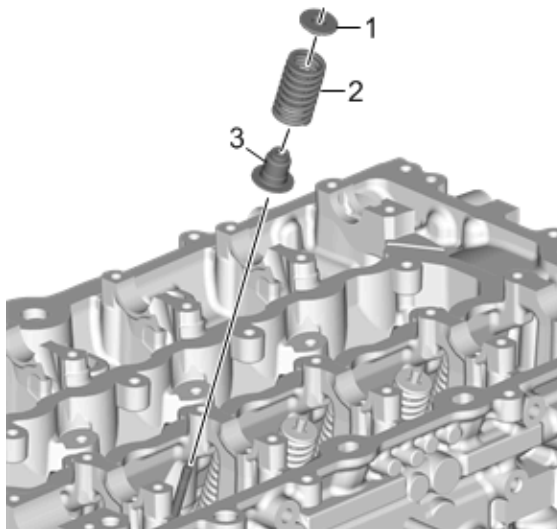


Fig. 437: Valve Spring Retainer, Valve Spring And Oil Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Valve stem oil seal sets will contain 2 different colored seals, black and green. The set of 8 seals that are green go on the exhaust valves.
- Ensure the valve stem oil seals do not deform during installation.

- Force should only be applied to the valve spring contact area of the new valve stem oil seal during installation.

4. Using **EN-46116** installer, carefully push the NEW valve stem oil seals (3) into position, until the seal positively locks on the guide.
5. Lubricate the valve stem and valve guide ID with clean engine oil. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
6. Install the valve spring (2) and the valve spring retainer (1).

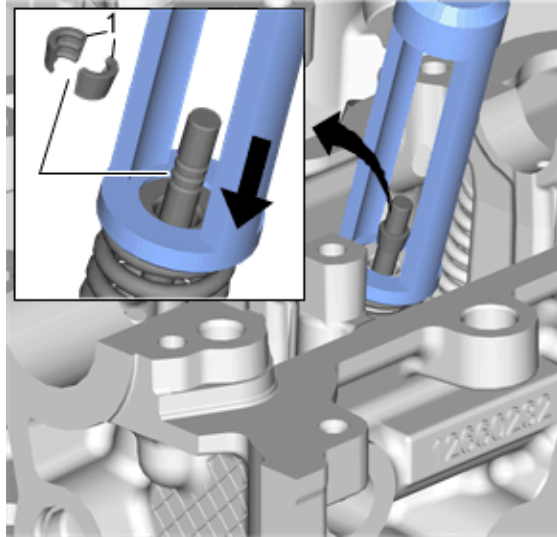


Fig. 438: Special Tool To Remove/Install Valve Stem Keys
Courtesy of GENERAL MOTORS COMPANY

7. Using **EN-8062** compressor, position **EN-43963** adapter properly to the valve spring retainer.

WARNING: Compressed valve springs have high tension against the valve spring compressor. Valve springs that are not properly compressed by or released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

CAUTION: Do not compress the valve springs less than 25.0 mm (0.984 in). Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

8. Using **EN-8062** compressor, compress the valve spring and scale the upper valve spring retainer down until the valve stem keys can be installed. Use a suitable tool and a bit of grease to install the valve stem keys (1).
9. Slowly release the tension on the valve spring.
10. Inspect for proper valve key seating.
11. Repeat the procedure for the remaining valves.

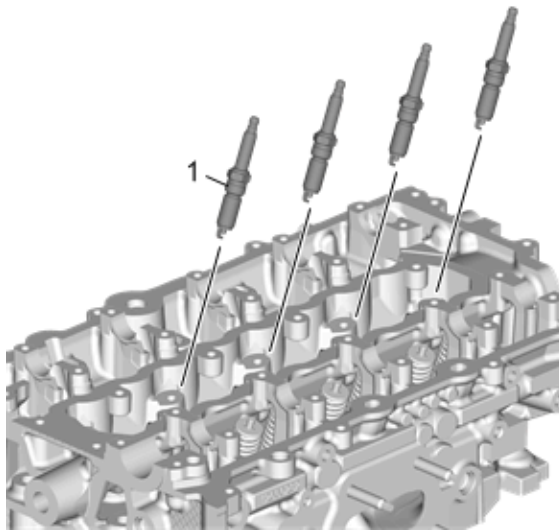


Fig. 439: Spark Plugs

Courtesy of GENERAL MOTORS COMPANY

12. Install the spark plugs (1) and tighten to 17 N.m (13 lb ft).

ENGINE BLOCK DISASSEMBLE

Upper Engine Block Disassemble

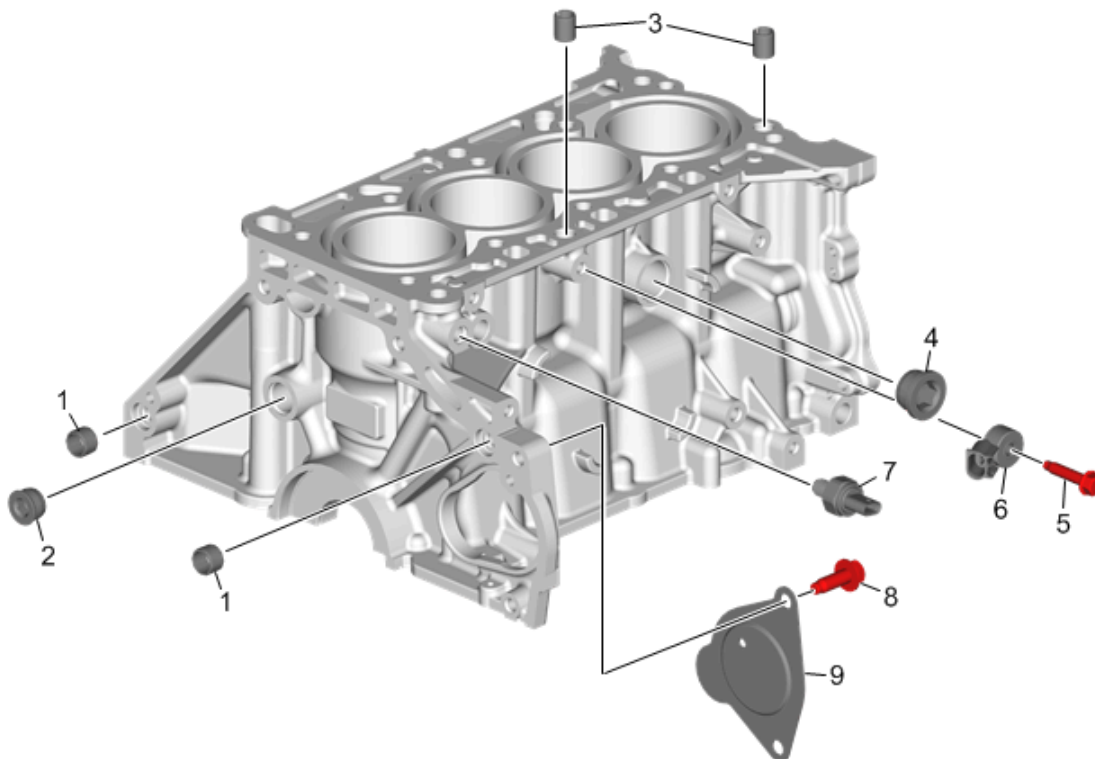


Fig. 440: Upper Engine Block Components

Courtesy of GENERAL MOTORS COMPANY

Upper Engine Block Disassemble 1

Callout	Component Name
1	Transmission Locating Pin (Qty: 2)

Callout	Component Name
2	Engine Block Oil Gallery Plug
3	Cylinder Head Locating Pin (Qty: 2)
4	Engine Block Coolant Drain Hole Plug
5	Knock Sensor Bolt
6	Knock Sensor
7	Engine Oil Pressure Sensor
8	Starter Opening Cover Bolt
9	Starter Opening Cover

Upper Engine Block Disassemble

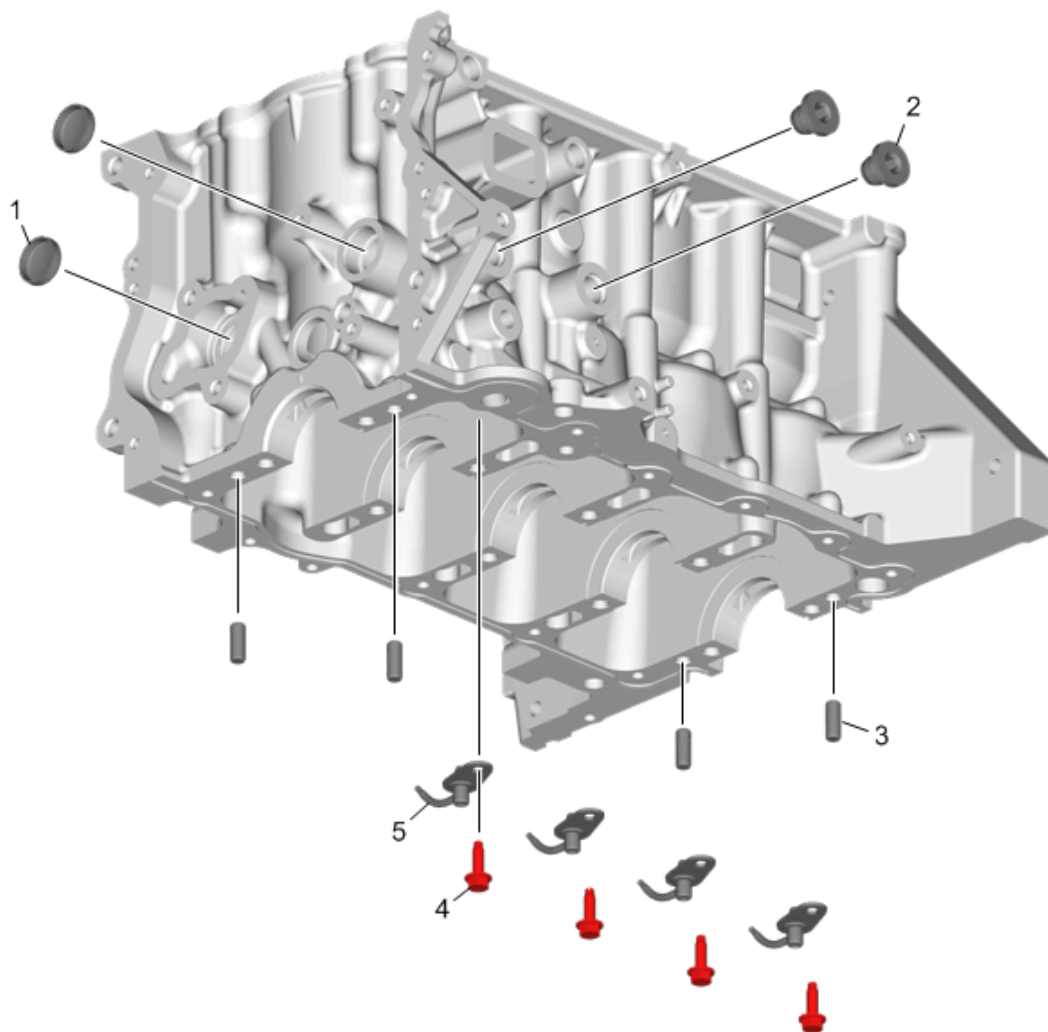


Fig. 441: Upper Engine Block Components
Courtesy of GENERAL MOTORS COMPANY

Upper Engine Block Disassemble 2

Callout	Component Name
1	Engine Block Core Hole Plug
2	Engine Block Oil Gallery Plug (Qty: 2)
3	Lower Crankcase Locating Pin (Qty: 4)
4	Piston Oil Nozzle Bolt (Qty: 4)

Callout	Component Name
5	Piston Oil Nozzle (Qty: 4)

Lower Crankcase Disassemble

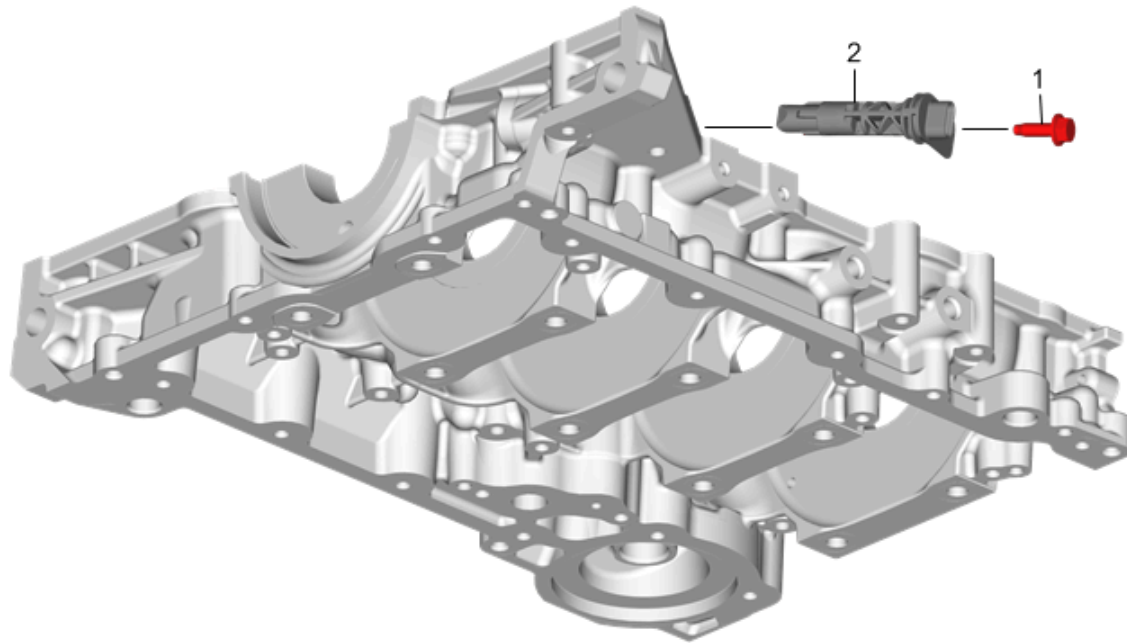


Fig. 442: Lower Crankcase Components
Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase Disassemble

Callout	Component Name
1	Crankshaft Position Sensor Bolt
2	Crankshaft Position Sensor

ENGINE BLOCK CLEANING AND INSPECTION

Special Tools

- **EN-8087** Cylinder Bore Gauge
- **EN-28410** Gasket Remover

For equivalent regional tools, refer to [Special Tools](#).

Cleaning Procedure

1. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to [Use of Room Temperature Vulcanizing \(RTV\) and Anaerobic Sealant](#)
2. Remove any old thread sealant, gasket material or sealant using **EN-28410** remover.
3. Clean all the following areas with solvent:
 - Sealing surfaces
 - Cooling passages

- Oil passages
- Bearing journals

4. Clean all threaded and through holes with solvent.

WARNING: Refer to [Safety Glasses Warning](#) .

5. Dry the engine block with compressed air.

Visual Inspection

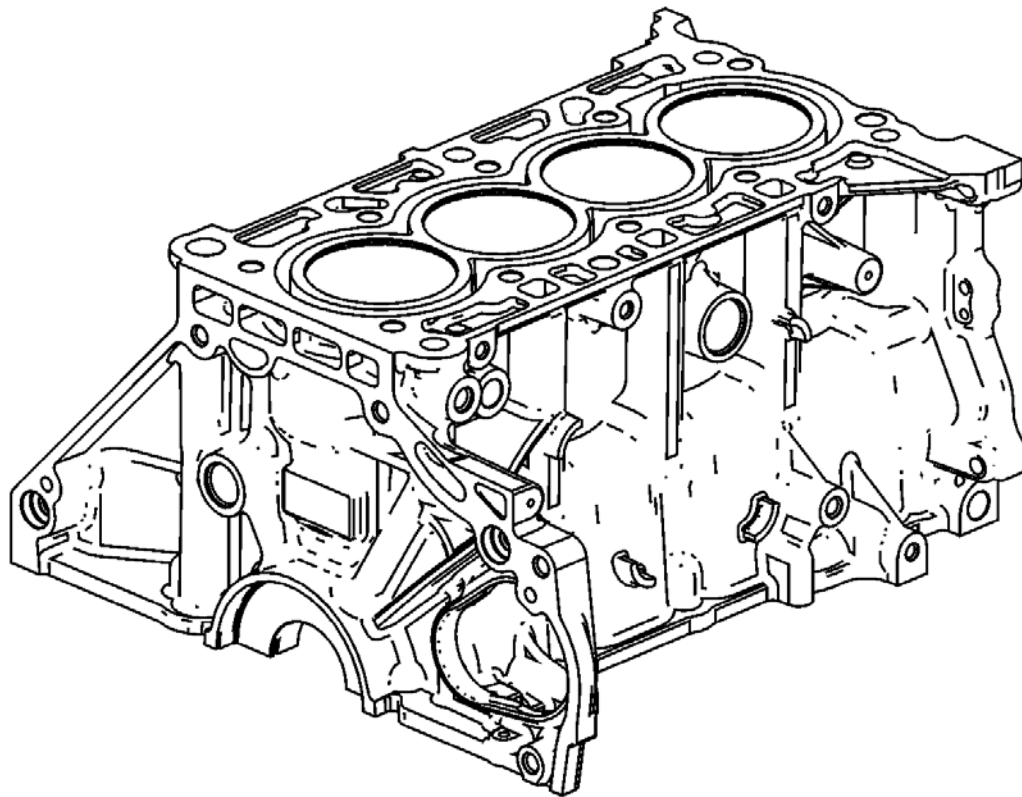


Fig. 443: Block

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the crankshaft bearings journals for damage or spun bearings. The crankshaft bearing journals are not repairable, if the crankshaft bearing journals are damaged the cylinder block assembly must be replaced.
2. Inspect the primary camshaft drive chain tensioner mounting surface on the engine block for burrs or any defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.
3. Inspect all sealing and mating surfaces for damage, repair or replace the cylinder block assembly if necessary.
4. Inspect all threaded and through holes for damage or excessive debris.
5. Inspect all bolts for damage, if damaged replace with NEW bolts only.
6. Check the cylinder condition. Some light vertical marks may be visible on the cylinder wall. In these areas, check that the honing marks are still visible in this marked area. If they are, the cylinder surface has not been

compromised and the engine block can be used.

7. Inspect the cylinder walls for cracks or damage. The cylinder sleeves are not serviced separately, if the cylinders are damaged the cylinder block assembly must be replaced.
8. Inspect the engine block for cracks. Do not repair any cracks. If cracks are found, the cylinder block assembly must be replaced.
9. Repair any damaged threaded holes. Refer to Thread Repair Specifications and Thread Repair.

Measuring Cylinder Bore Diameter

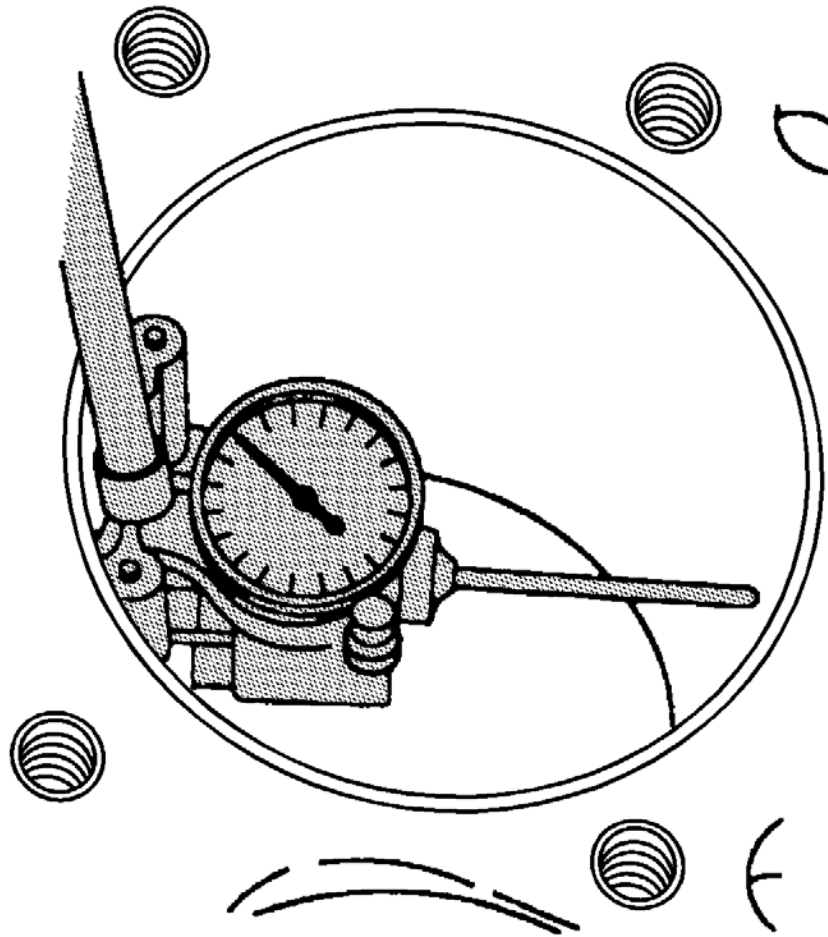


Fig. 444: Measuring Cylinder Bore

Courtesy of GENERAL MOTORS COMPANY

1. Measure the cylinder bore diameter 37 mm (1.457 in) from the deck face using the **EN-8087** gauge.
2. Compare your results with the [Engine Mechanical Specifications](#). If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Measuring Cylinder Bore Taper

1. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centerline, at 10 mm (0.397 in) below the deck surface and record your measurement.
2. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centerline, at 100 mm (3.976 in) below the deck surface and record your measurement.

3. Calculate the difference between the 2 measurements. The result will be the cylinder taper.
4. Compare your results with the [Engine Mechanical Specifications](#). If the cylinders exceed the specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Measuring Cylinder Bore Out-of-Round

1. Measure both the thrust and non-thrust cylinder diameter at 10 mm (0.397 in) below the deck. Record your measurements.
2. Calculate the difference between the 2 measurements. The result will indicate out-of-round at the upper end of the cylinder.
3. Measure both the thrust and non-thrust cylinder diameter at 100 mm (3.976 in) below the deck surface. Record your measurements.
4. Calculate the difference between the 2 measurements. The result will indicate out-of-round at the lower end of the cylinder.
5. Compare your results with the [Engine Mechanical Specifications](#). If the cylinders exceed these specifications, the cylinder block may be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Deck Flatness Inspection

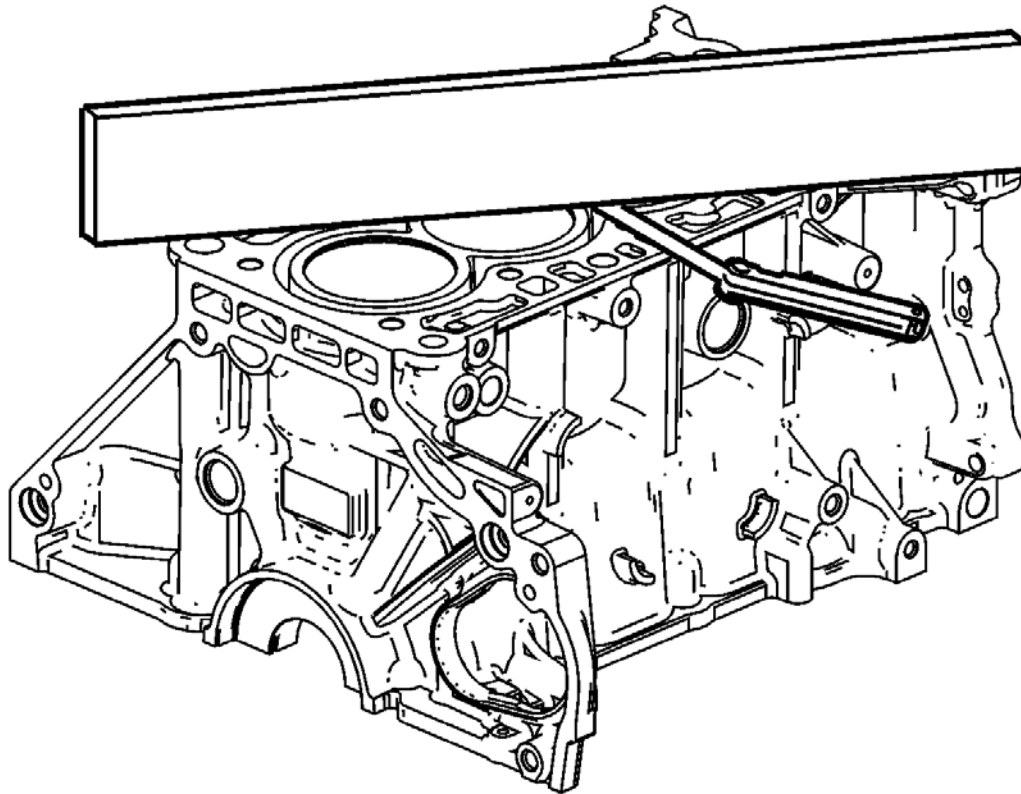


Fig. 445: Checking Deck Flatness
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the engine block decks are clean and free of gasket material.
2. Inspect the surface for any imperfections or scratches that could inhibit proper cylinder head gasket sealing.
3. Place a straight-edge diagonally across the cylinder block deck face surface.
4. Measure the clearance between the straight-edge and the cylinder block deck face using a feeler gauge at 4 points along the straight-edge.
5. If the warpage is less than 0.05 mm (0.002 in), the cylinder block deck surface does not require resurfacing.
6. If the warpage is between 0.05 - 0.20 mm (0.002 - 0.008 in) or any imperfections or scratches that could inhibit proper cylinder head gasket sealing are present, the cylinder block deck surface requires resurfacing.
7. If resurfacing is required the maximum amount that can be removed is 0.25 mm (0.010 in).
8. If the cylinder block deck surface requires more than 0.25 mm (0.010 in) material removal the block must be replaced.

ENGINE BLOCK ASSEMBLE

Lower Crankcase Assemble

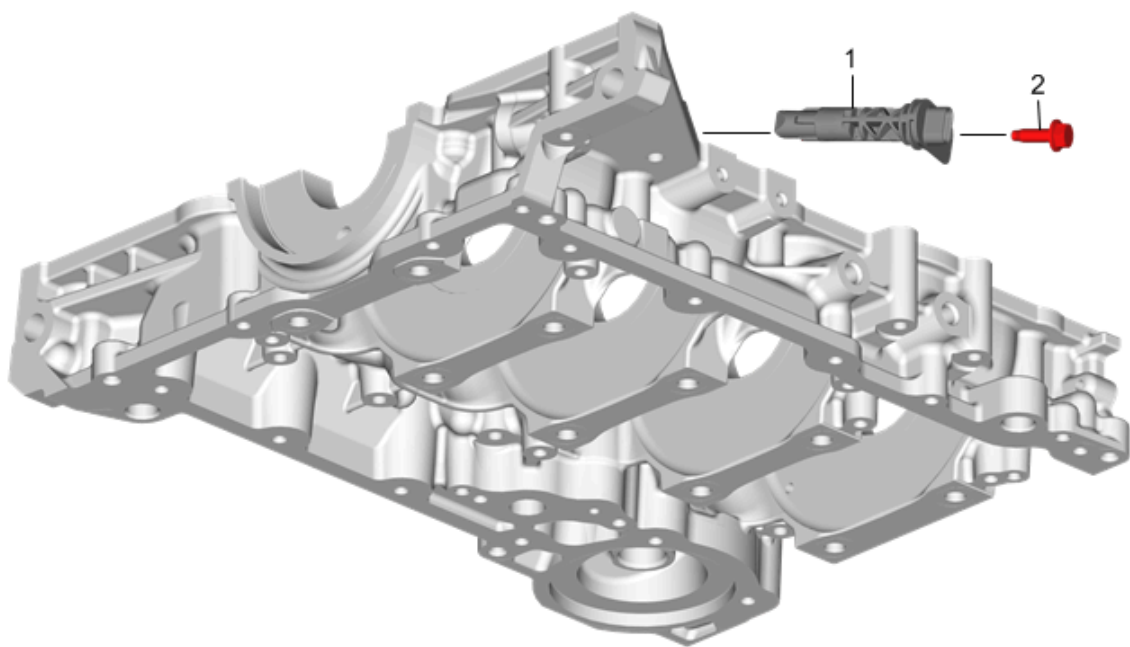


Fig. 446: Lower Crankcase Components
 Courtesy of GENERAL MOTORS COMPANY

Lower Crankcase Assemble

Callout	Component Name
1	Crankshaft Position Sensor
2	Crankshaft Position Sensor Bolt
	CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 10 N.m (89 lb in)

Upper Engine Block Assemble

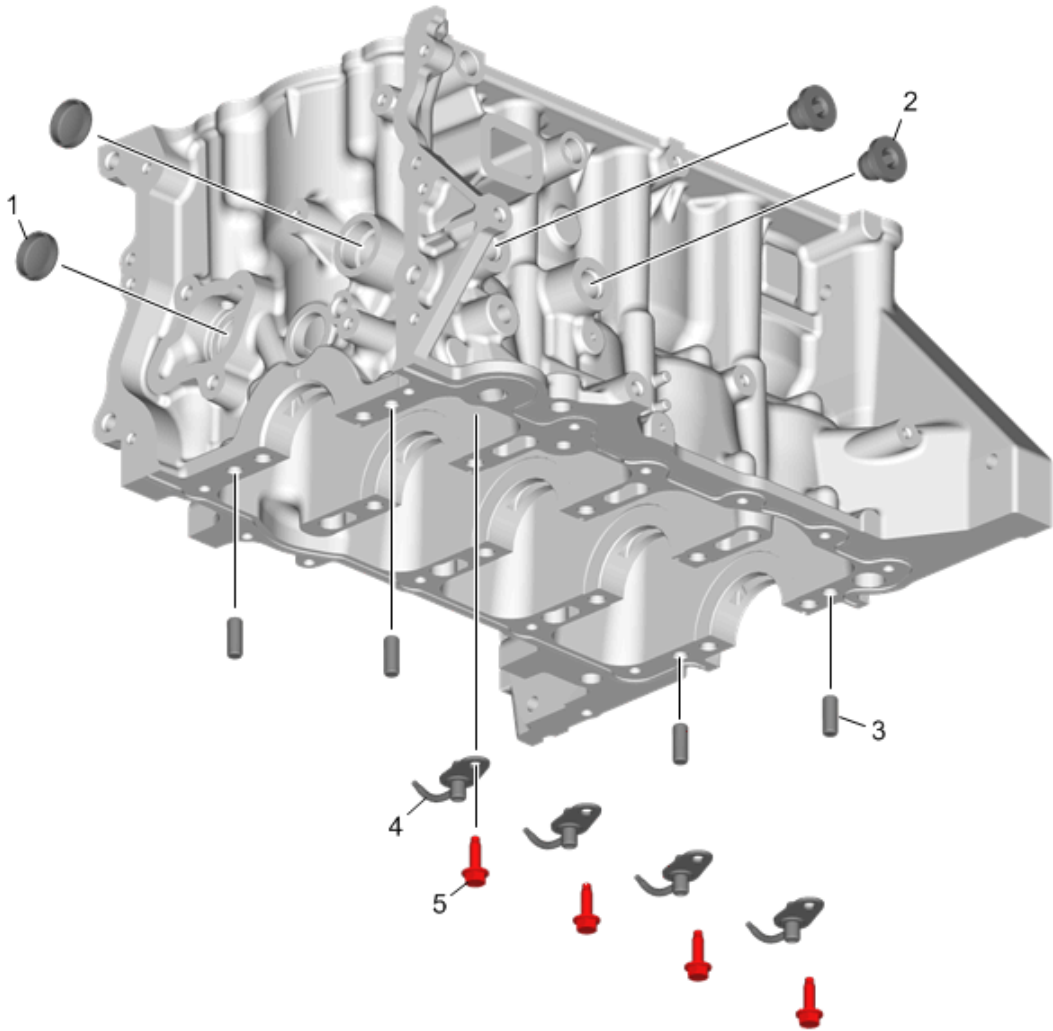


Fig. 447: Upper Engine Block Components
Courtesy of GENERAL MOTORS COMPANY

Upper Engine Block Assemble 1

Callout	Component Name
Preliminary Procedure Apply sealant to all plugs prior to installation. Refer to Adhesives, Fluids, Lubricants, and Sealers .	
1	Engine Block Core Hole Plug (Qty: 2)
2	Engine Block Oil Gallery Plug (Qty: 2) Tighten 65 N.m (48 lb ft)
3	Lower Crankcase Locating Pin (Qty: 4)
4	Piston Oil Nozzle (Qty: 4)

Callout	Component Name
5	Piston Oil Nozzle Bolt (Qty: 4) Tighten 10 N.m (89 lb in)

Upper Engine Block Assemble

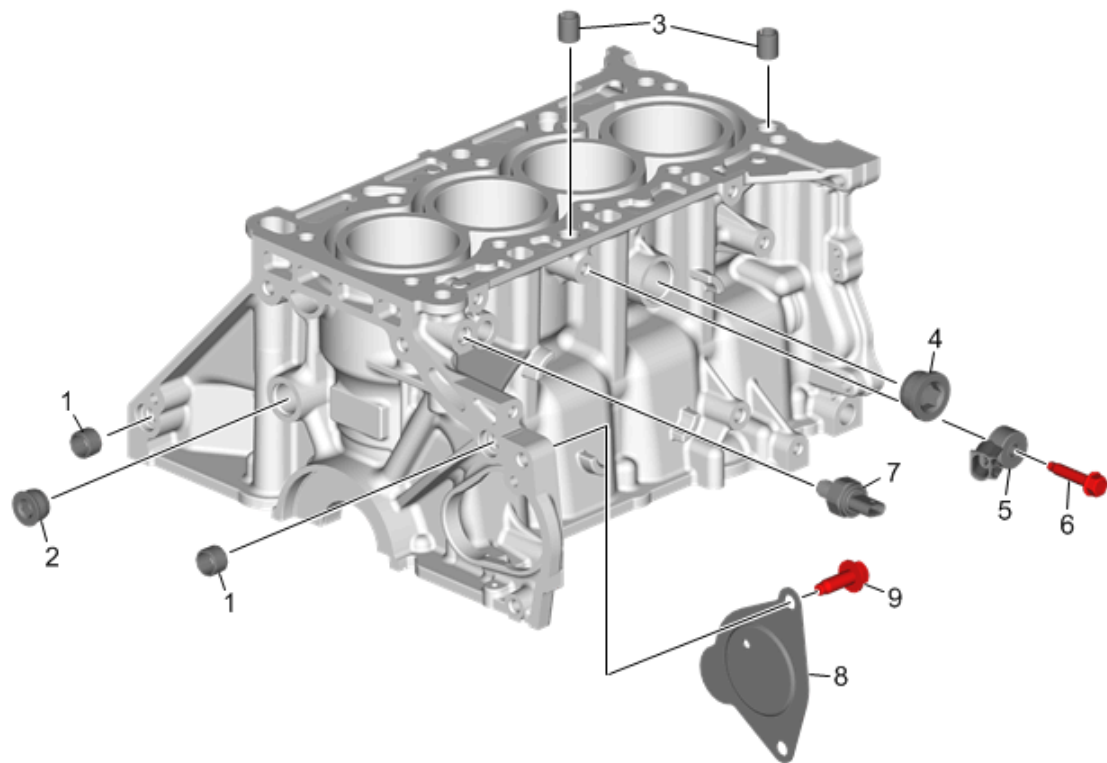


Fig. 448: Upper Engine Block Components
Courtesy of GENERAL MOTORS COMPANY

Upper Engine Block Assemble 2

Callout	Component Name
Preliminary Procedure Apply sealant to all plugs prior to installation. Refer to Adhesives, Fluids, Lubricants, and Sealers .	
1	Transmission Locating Pin (Qty: 2) Procedure Ensure Transmission locating pins are properly seated and not damaged.
2	Engine Block Oil Gallery Plug CAUTION: Refer to Component Fastener Tightening Caution . Tighten 65 N.m (48 lb ft)
3	Cylinder Head Locating Pin (Qty: 2)

Callout	Component Name
4	Engine Block Coolant Drain Hole Plug Tighten 60 N.m (44 lb ft)
5	Knock Sensor
6	Knock Sensor Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 25 N.m (18 lb ft)
7	Engine Oil Pressure Sensor Tighten 35 N.m (29 lb ft)
8	Starter Opening Cover
9	Starter Opening Cover Bolt (Qty: 2) Tighten 25 N.m (18 lb ft)

FUEL INJECTOR AND FUEL INJECTOR BORE CLEANING AND INSPECTION

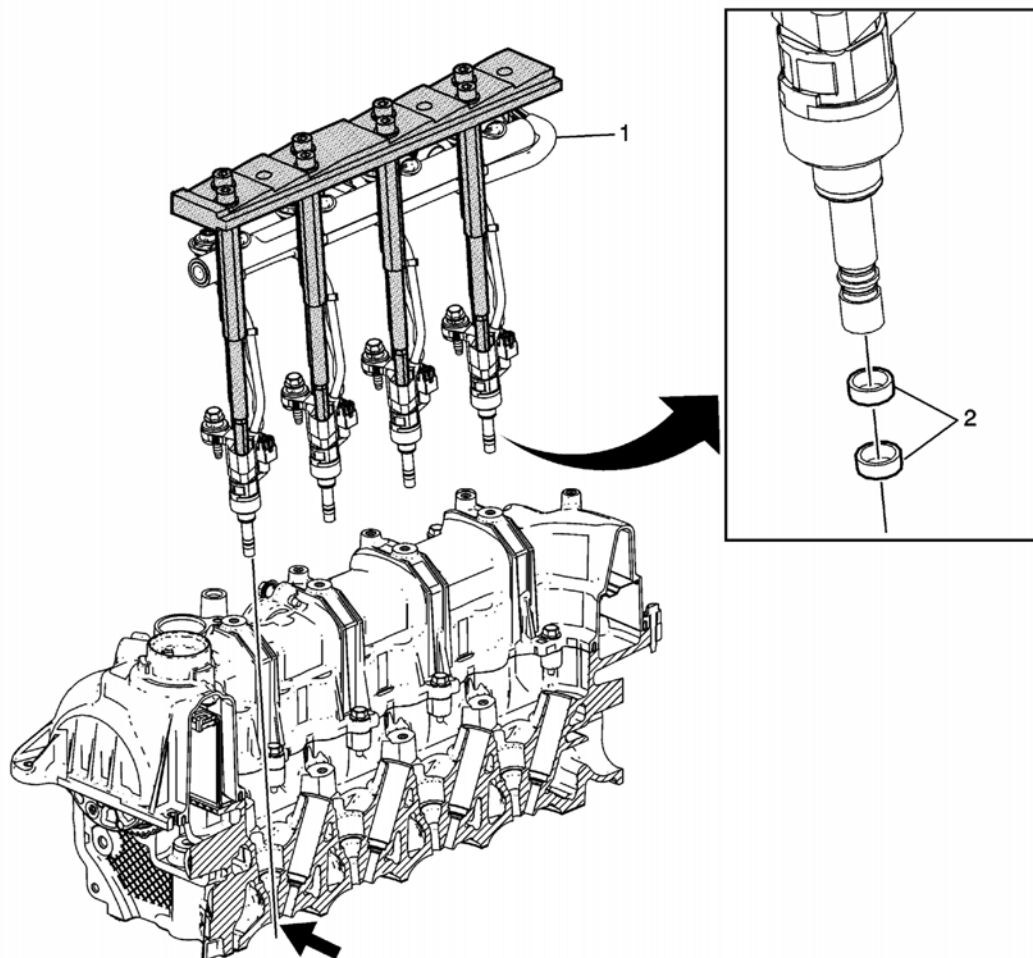


Fig. 449: Fuel Injector and Fuel Injector Bore
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Use EN-47909 cleaning kit to clean the fuel injector bores. NOTE: Do not soak or immerse the fuel rail or injectors in solvent. 2. Clean the exterior of the fuel rail and injectors with solvent. Special Tools EN-47909 Injector Bore and Sleeve Cleaning Kit For equivalent regional tools, refer to Special Tools.	
1	Fuel Rail Assembly NOTE:

Callout	Component Name
	Do not remove the EN-51146 remover unless fuel injector replacement is necessary. Procedure 1. Inspect for damage, debris, or restrictions to the fuel rail and fuel ports. 2. Inspect for damage to the mounting area for the fuel rail. 3. Inspect for damage to the fuel rail mounting bolts. 4. Inspect for damage to the threads on the fuel rail fuel feed fitting. 5. Inspect the fuel rail pressure sensor for damage. 6. Inspect the fuel injector for damage to the harness connector. 7. Inspect the fuel injector tip, tolerance ring, and seal locations.
2	Fuel Injector Combustion Seal NOTE: Discard the seals and use NEW seals upon installation. Procedure 1. If present, remove the calibration tool on the fuel injector tip. 2. Remove and discard the fuel injector combustion seals. 3. Reinspect each fuel injector tip once the seals are removed.

PISTON AND CONNECTING ROD DISASSEMBLE

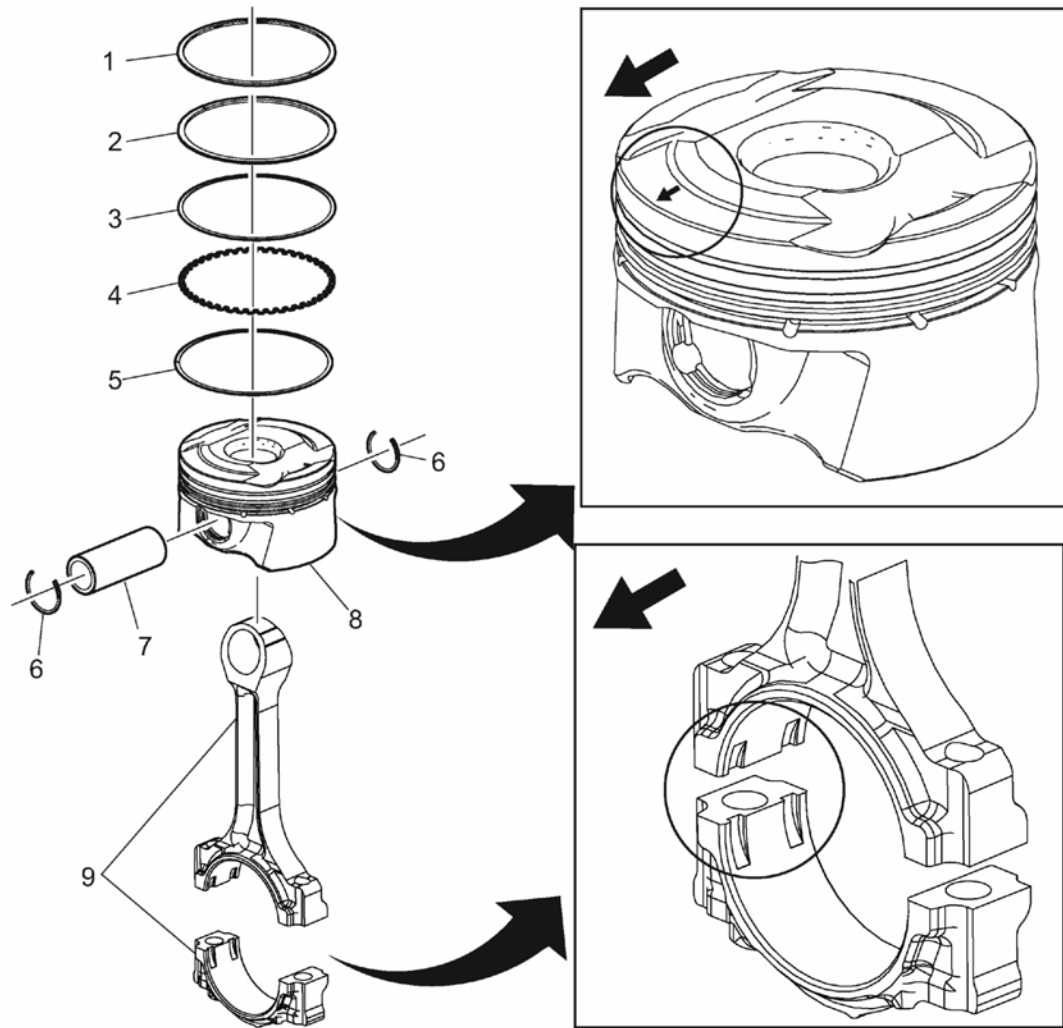


Fig. 450: Piston and Connecting Rod

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure NOTE: Many internal engine components will develop specific wear patterns on their friction surfaces. 1. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts. 2. Tag or mark each part immediately when removed. Indicate location, direction, or orientation when necessary.	

PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION

Piston Cleaning Procedure

NOTE: DO NOT wire brush any part of the piston.

1. Clean the piston skirts and the pins with a cleaning solvent.
2. Clean the piston ring grooves with a groove cleaner. Ensure that the oil ring holes and slots are clean.

WARNING: Refer to [Safety Glasses Warning](#) .

3. Dry the piston with compressed air.

Piston Inspection Procedure

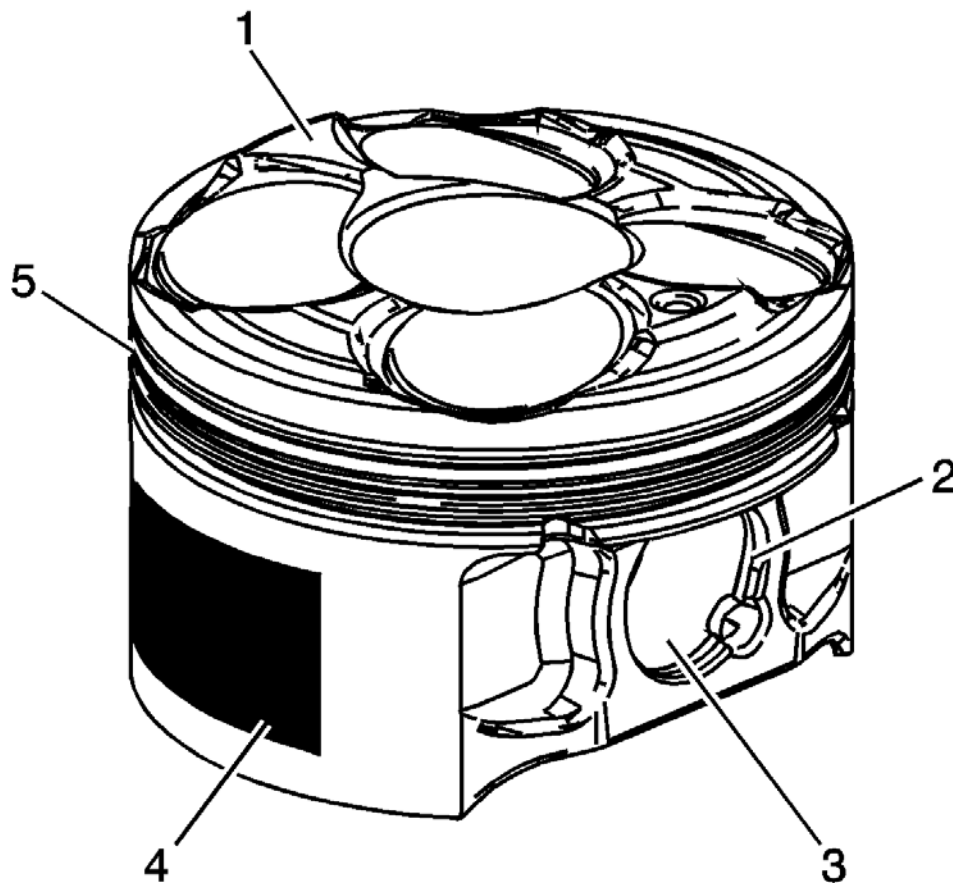


Fig. 451: Identifying Piston Inspection Areas

Courtesy of GENERAL MOTORS COMPANY

1. Inspect the pistons for the following conditions:
 - Cracked ring lands, skirts or pin bosses
 - Ring grooves for nicks, burrs that may cause binding (5)
 - Warped or worn ring lands (5)
 - Piston pin retainer grooves for burrs (2)

- Eroded areas at the top of the piston (1)
- Scuffed or damaged skirt coating (4)
- Worn piston pin bores or worn piston pins (3)

2. Replace pistons that show any signs of damage or excessive wear.

Piston Measurement Procedure

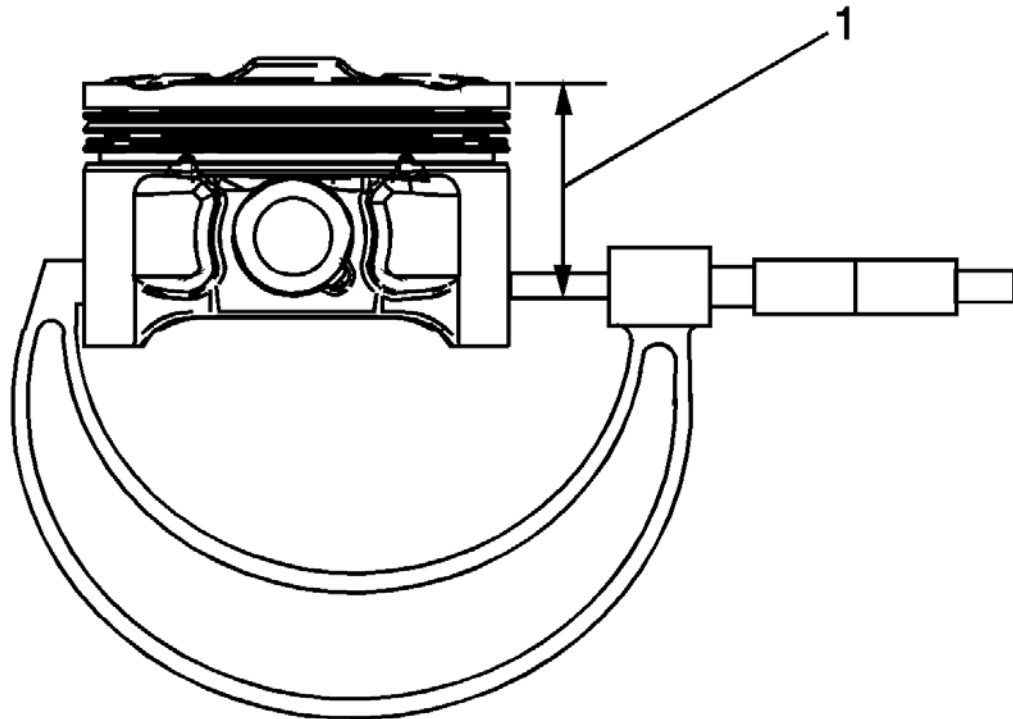


Fig. 452: Measuring Piston Width

Courtesy of GENERAL MOTORS COMPANY

1. Measure piston width using the following procedure:
 1. Using an outside micrometer, measure the width of the piston at 30 mm (1.181 in) below the crown, top, (1) at the thrust surfaces of the piston, perpendicular to the piston pin centerline.
 2. Compare the measurement of the piston to its original cylinder by subtracting the piston width from the cylinder diameter.
 3. Check your measurements. Refer to [Engine Mechanical Specifications](#).
 4. If the clearance obtained through measurement is greater than the provided specifications and the cylinder bores are within specification, replace the piston.

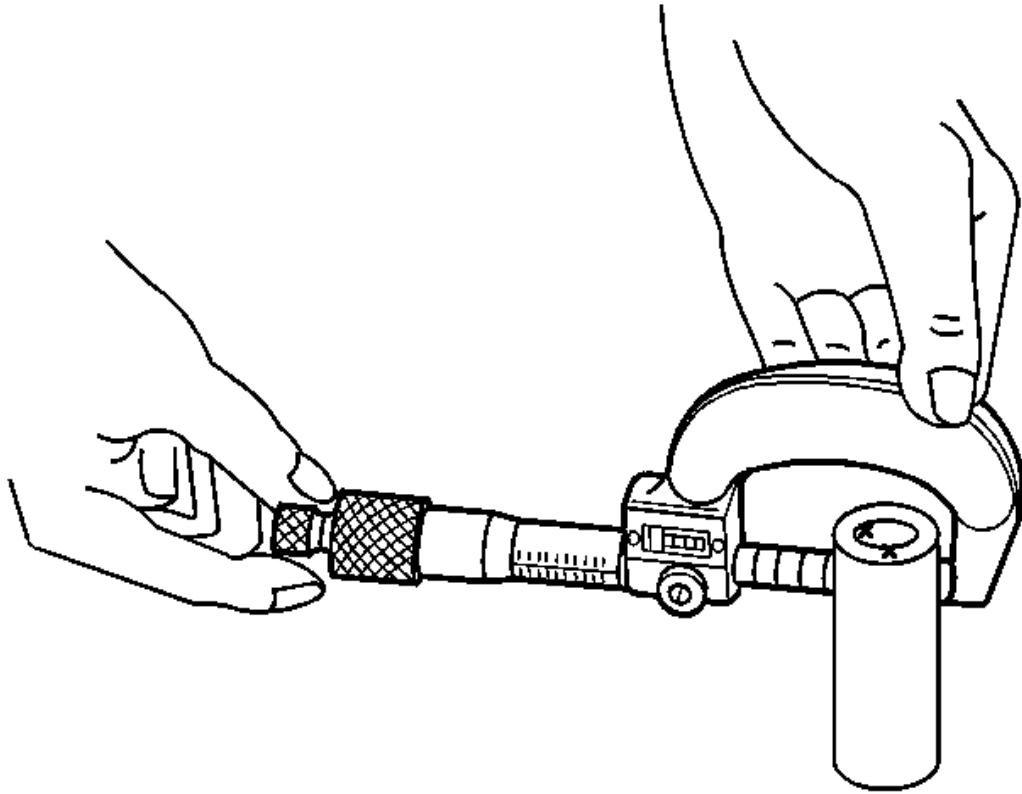


Fig. 453: Measuring Piston Pin Diameter

Courtesy of GENERAL MOTORS COMPANY

2. Measure the piston pin bore to piston pin clearances using the following procedure:
 1. Piston pin bores and pins must be free of varnish or scuffing.
 2. Use an outside micrometer to measure the piston pin in the piston contact areas.

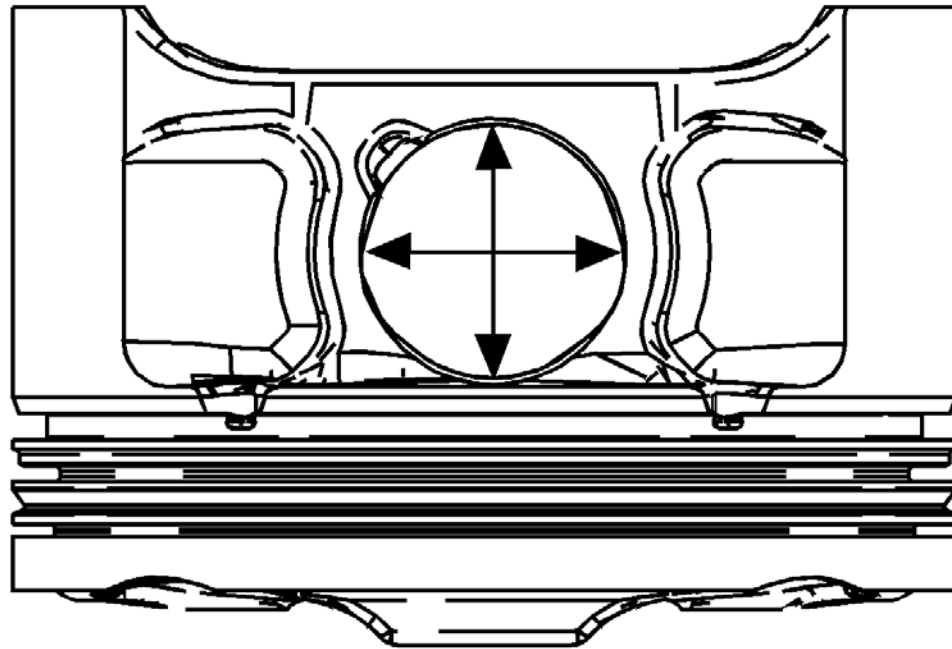


Fig. 454: Measuring Piston Pin Bore
Courtesy of GENERAL MOTORS COMPANY

3. Using an inside micrometer, measure the piston pin bore. Compare your result with the piston pin diameter and piston pin to piston pin bore clearance specification. Refer to [Engine Mechanical Specifications](#).
4. If the clearance is excessive, determine which piece is out of specification and replace as necessary.
5. You must replace the piston if any of its dimensions are out of specification.
6. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only one size of oversized pistons and rings available for service.

Piston Ring Measurement Procedure

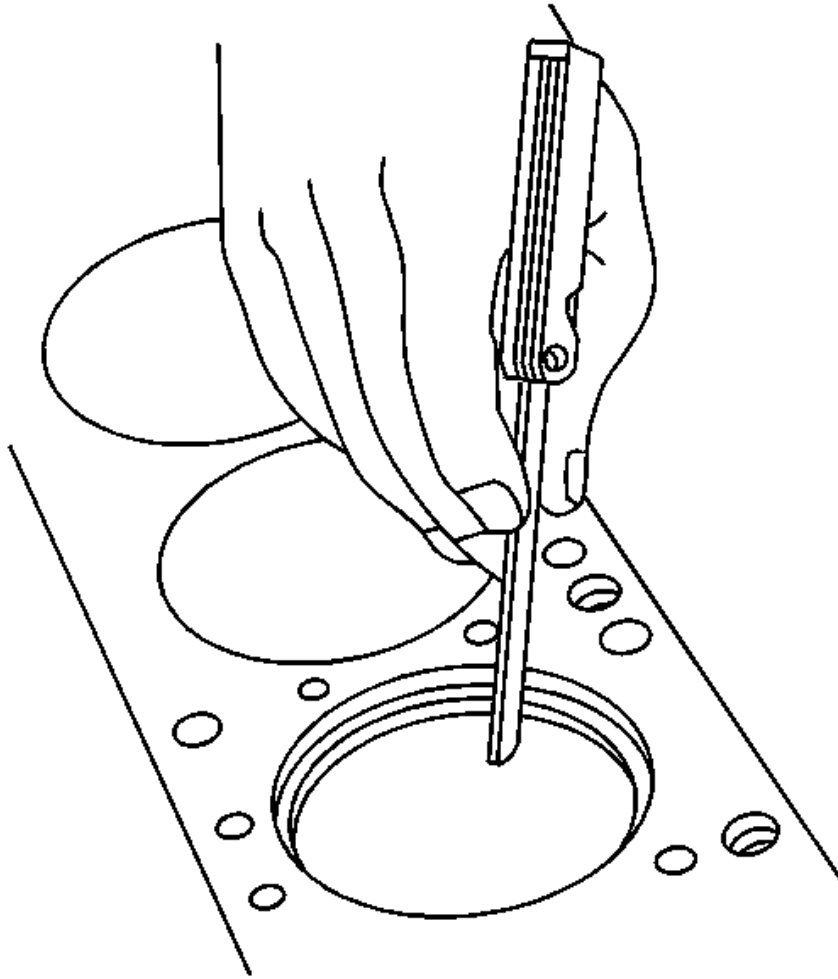


Fig. 455: Measuring Piston Ring End Gap

Courtesy of GENERAL MOTORS COMPANY

1. Measure the piston ring end gap using the following procedure:
 1. Place the piston ring in the area of the bore where the piston ring will travel approximately 25 mm (1 in) down from the deck surface. Ensure that the ring is square with the cylinder bore by positioning the ring with the piston head.
 2. Measure the end gap of the piston ring with feeler gauges. Refer to [Engine Mechanical Specifications](#).
 3. If the clearance exceeds the provided specifications, the piston rings must be replaced.
 4. Repeat the procedure for all the piston rings.

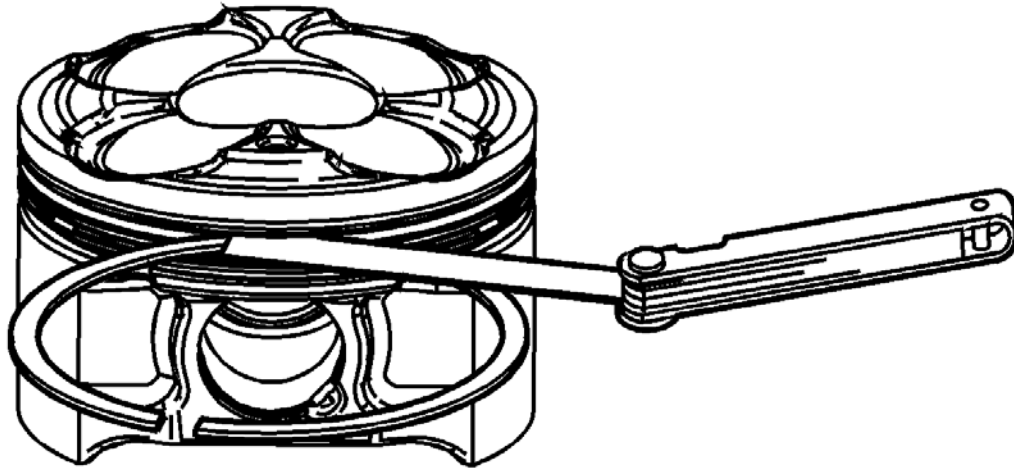


Fig. 456: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS COMPANY

2. Measure the piston ring side clearance using the following procedure:
 1. Roll the piston ring entirely around the piston ring groove. If any binding is caused by the ring groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring, replace the ring.
 2. With the piston ring on the piston, use feeler gauges to check clearance at multiple locations.
 3. Compare the measurements with piston ring side clearance specification. Refer to [Engine Mechanical Specifications](#).
 4. If the clearance is greater than specifications, replace the piston rings.

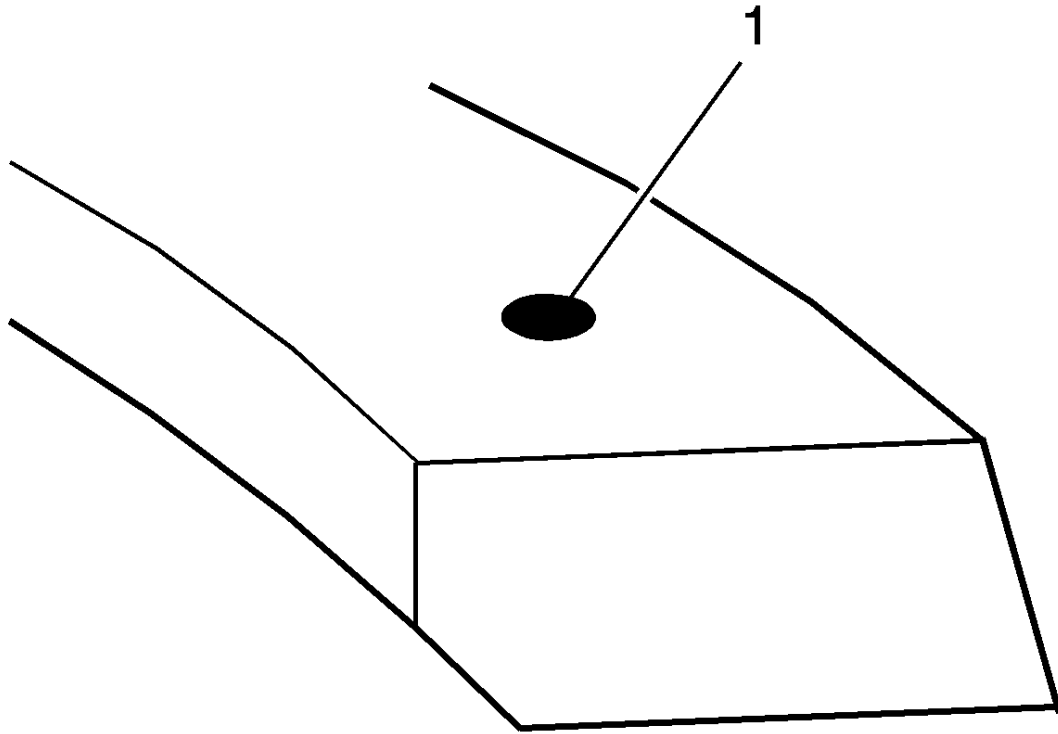


Fig. 457: Compression Ring Locating Dimple
Courtesy of GENERAL MOTORS COMPANY

3. There is a locating dimple (1) on the compression rings near the end for identification. Install the compression rings with the dimple facing up.
4. If the new ring does not reduce the clearance to the proper specification, install a new piston.
5. If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm (0.010 in). There is only 1 size of oversized pistons and rings available for service.

Connecting Rod Cleaning Procedure

1. Clean the connecting rods in solvent.

WARNING: Refer to [Safety Glasses Warning](#) .

2. Dry the connecting rod using compressed air.
3. Remove the connecting rod cap and clean the threads.
4. Remove the connecting rod bearing and discard. Never reuse a connecting rod bearing used in a running engine.

Connecting Rod Visual Inspection Procedure

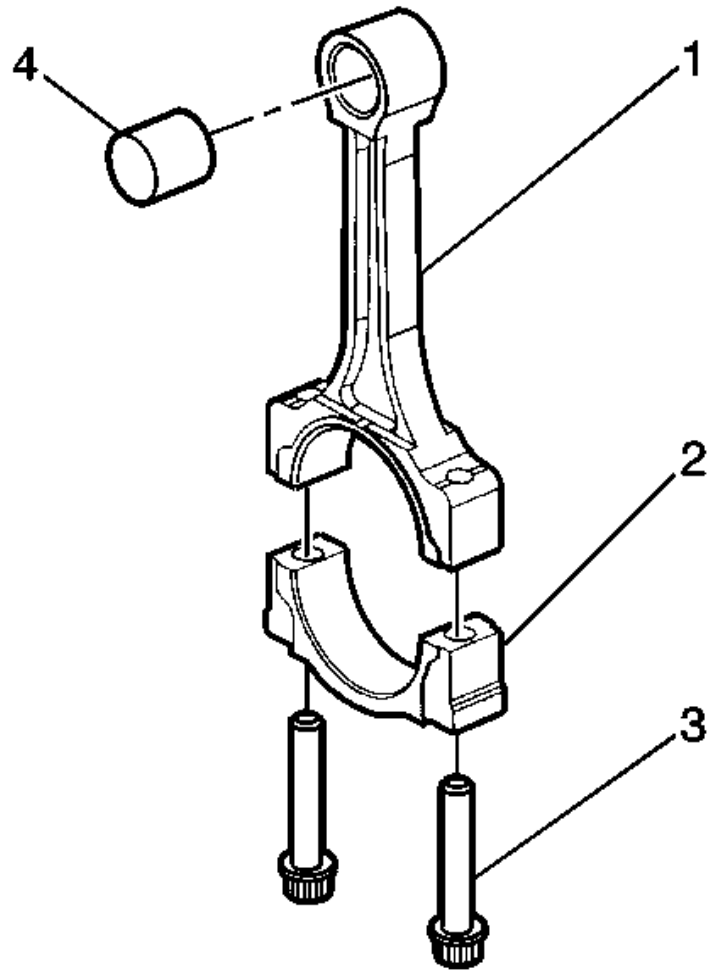


Fig. 458: Inspecting Connecting Rod Components
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the piston pin bushing (4) for scoring or damage.
2. Inspect the connecting rod beam (1) for twisting or bending.
3. Inspect the rod cap (2) for any nicks or damage caused by possible interference.
4. Inspect for scratches or abrasion on the rod bearing seating surface.

NOTE: **DO NOT** scrape the rod or rod cap.

5. If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper. Thoroughly clean the parts and perform a high-pressure wash if an abrasive is used on the bores.

Connecting Rod Measurement Procedure

Piston Pin End

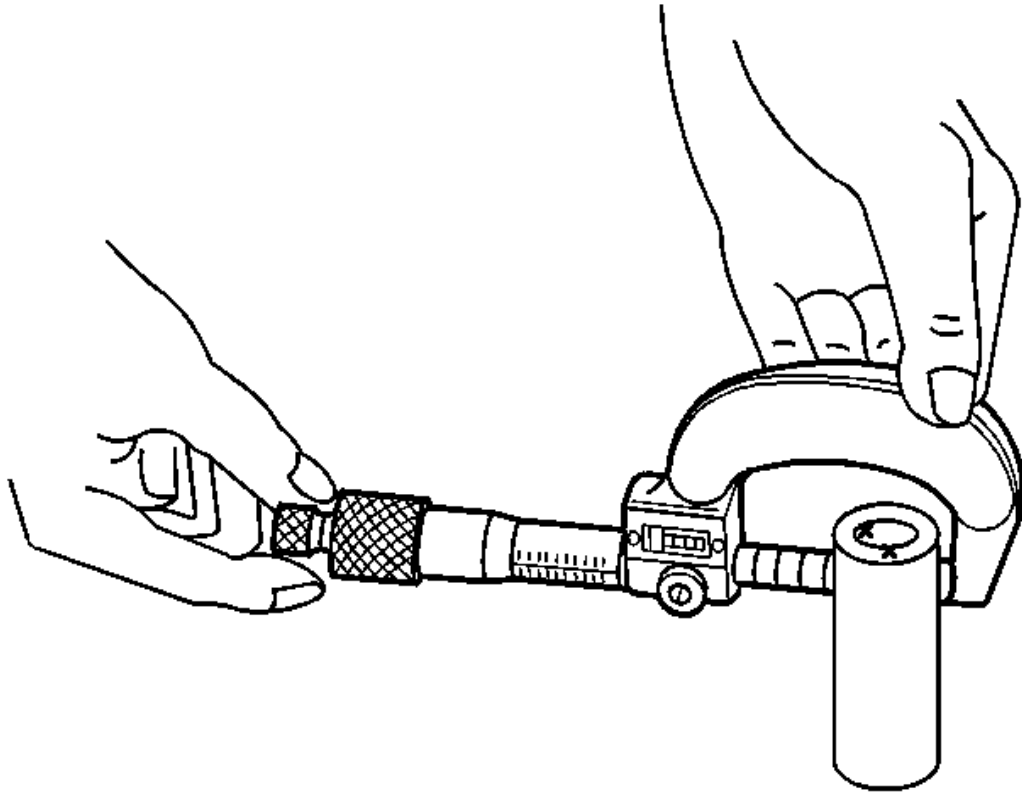


Fig. 459: Measuring Piston Pin Diameter

Courtesy of GENERAL MOTORS COMPANY

NOTE: Measurements of all components should be taken with the components at normal room temperature.

1. Using an outside micrometer, take 2 measurements of the piston pin in the area of the connecting rod contact.

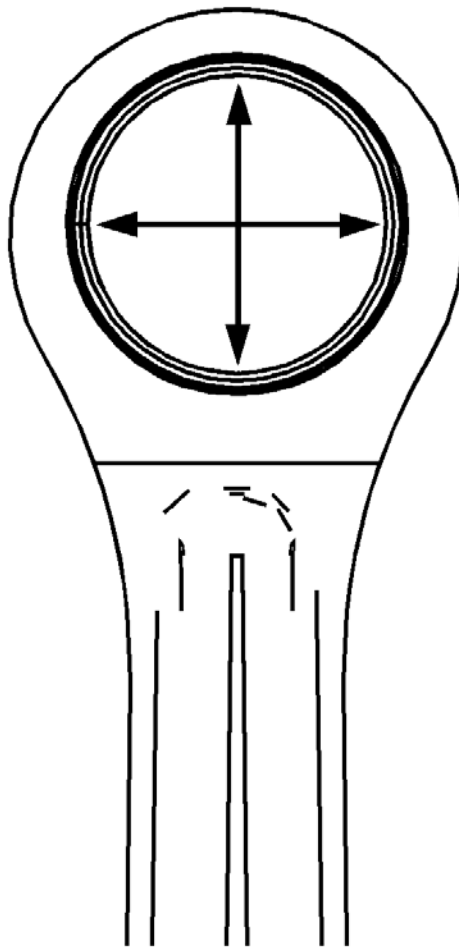


Fig. 460: Checking Connecting Rod Piston Pin Bore Dimensions
Courtesy of GENERAL MOTORS COMPANY

2. Using an inside micrometer, measure the connecting rod piston pin bore.
3. Subtract the piston pin diameter from the piston pin bore.
4. Compare the clearance measurements to the proper specifications. Refer to [Engine Mechanical Specifications](#).
5. If the clearance is excessive, replace the piston pin. If a new pin does not resolve the clearance problem, replace the connecting rod.

Connecting Rod Crankshaft Bearing End

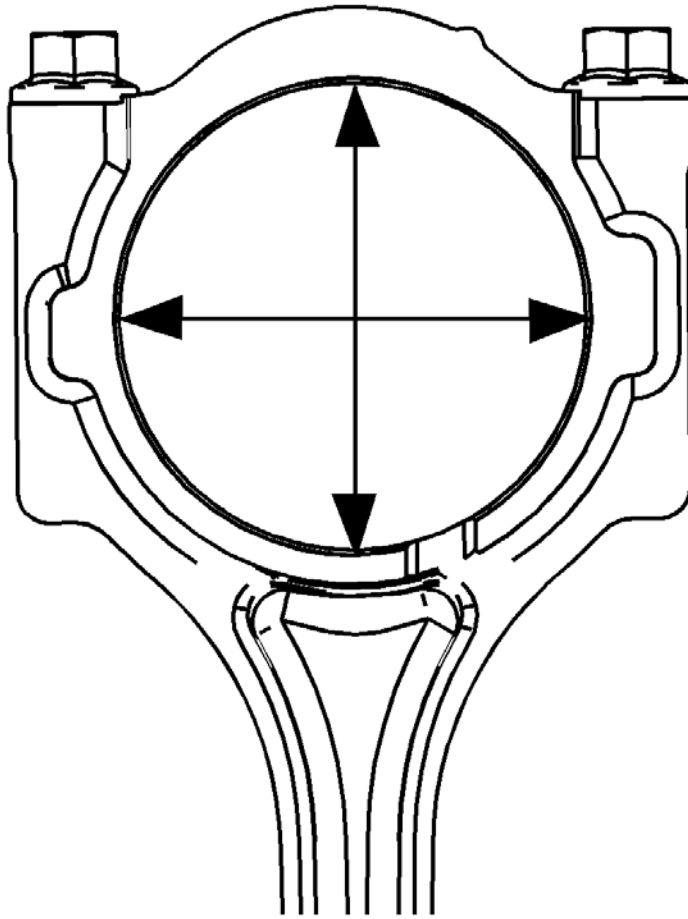


Fig. 461: Measuring Connecting Rod Crankshaft Bearing Bore

Courtesy of GENERAL MOTORS COMPANY

NOTE: Measurements of all components should be taken with the components at normal room temperature.

NOTE: The bore specifications are based on connecting rod bolts at full torque specification.

1. Using the old bolts, tighten the connecting rod cap bolts to 25 N.m (18 lb ft) plus 75 degrees.
2. Using an inside micrometer, measure the connecting rod crankshaft bearing bore.
3. Compare the bore measurements to the proper specifications. Refer to [Engine Mechanical Specifications](#).
4. Replace the connecting rod if the bore is out of specifications. DO NOT recondition the connecting rod.

PISTON AND CONNECTING ROD ASSEMBLE

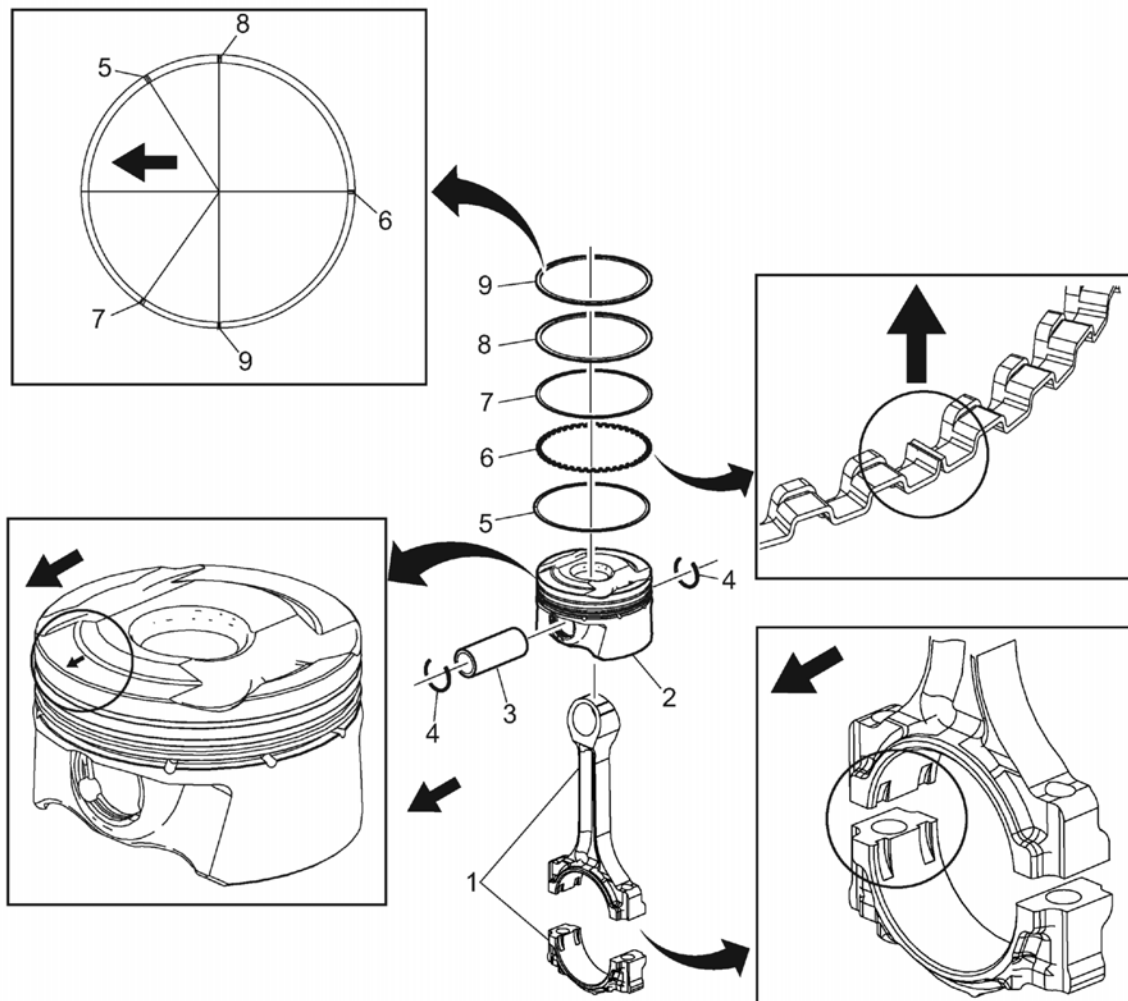


Fig. 462: Piston and Connecting Rod

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Connecting Rod NOTE: Align the connecting rod and piston with the features used to identify the orientation of the component relative to the front of the engine.

Callout	Component Name
2	Piston Procedure 1. Locate the alignment feature or marks on the connecting rod. 2. Locate the alignment feature or marks on the piston. 3. Ensure that the alignment features are in the correct location when assembling the components.
3	Piston Pin
4	Piston Pin Retainer CAUTION: Install the piston pin retainers correctly in the retaining groove during assembly in order to avoid engine damage. Procedure 1. Coat the piston pin with oil. 2. Install one side of one piston pin retainer into the retaining groove using EN-49941 installer. Rotate the retainer until it is fully seated in the groove. 3. Install the piston pin. Push the piston pin until it bottoms in the previously installed retainer. 4. Install the second piston pin retainer, using EN-49941 installer. 5. Ensure that the piston moves freely. Special Tools EN-49941 Piston Pin Retainer Remover and Installer For equivalent regional tools, refer to Special Tools .
5	Piston Oil Ring Rail CAUTION: Use a piston ring expander to install the piston rings. The rings may be damaged if

Callout	Component Name
	expanded more than necessary.
6	Piston Oil Ring Spacer NOTE: Properly orient the oil ring spacer as shown before installation. The ends of the spacer must be facing toward the top of the piston.
7	Piston Oil Ring Rail
8	Piston Compression Lower Ring
9	Piston Compression Upper Ring Procedure Once the rings are installed, set the ring gaps as shown. Use the piston location arrow for reference.

CAMSHAFT CLEANING AND INSPECTION

Special Tools

GE-7872 Magnetic Base Dial Indicator

For equivalent regional tools, refer to [Special Tools](#).

Cleaning Procedure

1. Clean the camshaft in solvent.

WARNING: Refer to [Safety Glasses Warning](#) .

2. Dry the camshaft with compressed air.

Visual Inspection

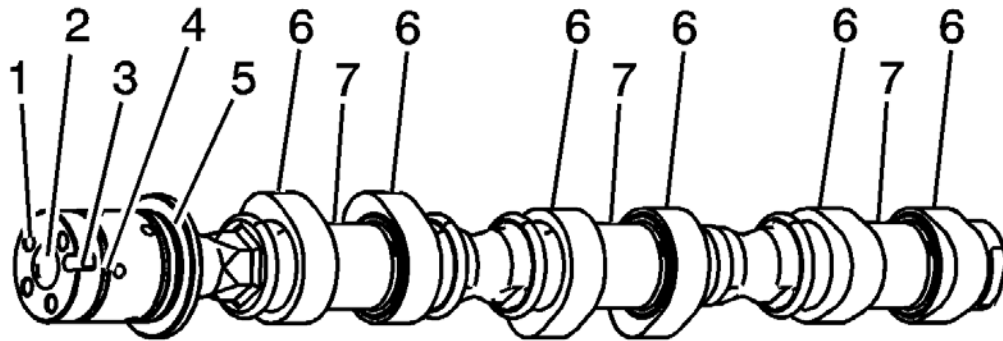


Fig. 463: Identifying Camshaft Inspection Areas
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the camshaft oil feed holes (1) to the camshaft position actuator for dirt, debris or blockage.
2. Inspect the threaded hole (2) for damage.
3. Inspect the camshaft position actuator locating notch (3) for damage or wear.
4. Inspect the camshaft sealing grooves (4) for damage.
5. Inspect the camshaft thrust surface (5) for damage.
6. Inspect the camshaft lobes (6) and journals (7) for the following conditions:
 - Excessive scoring or pitting
 - Discoloration from overheating
 - Deformation from excessive wear, especially the camshaft lobes
7. If any of the above conditions exist on the camshaft, replace the camshaft.

Camshaft Measurement

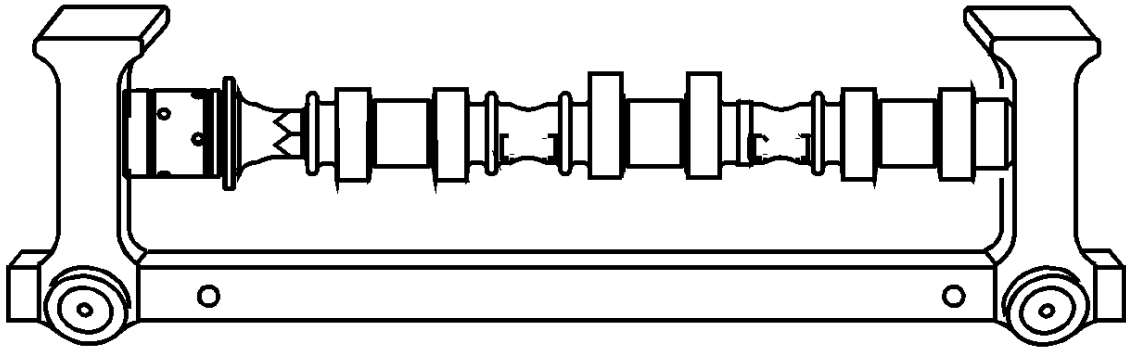


Fig. 464: Supporting Camshaft In Fixture

Courtesy of GENERAL MOTORS COMPANY

1. With the camshaft in a suitable fixture, measure the camshaft for wear.

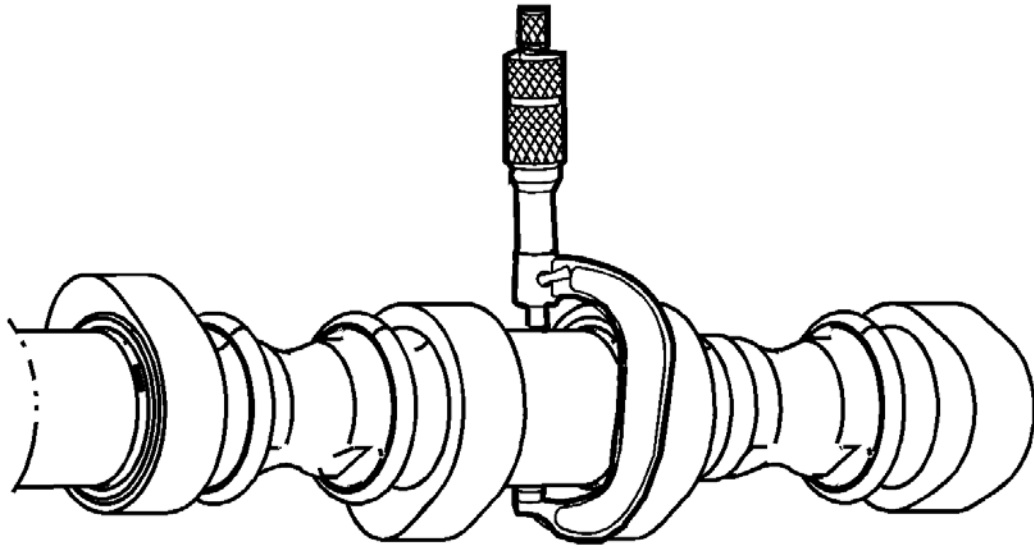


Fig. 465: Measuring Camshaft Journals

Courtesy of GENERAL MOTORS COMPANY

2. Measure the camshaft journals for diameter and out-of-round using an outside micrometer. Refer to [Engine Mechanical Specifications](#).
 - If the diameter is smaller than specifications, replace the camshaft.
 - If the out-of-round exceeds specifications, replace the camshaft.

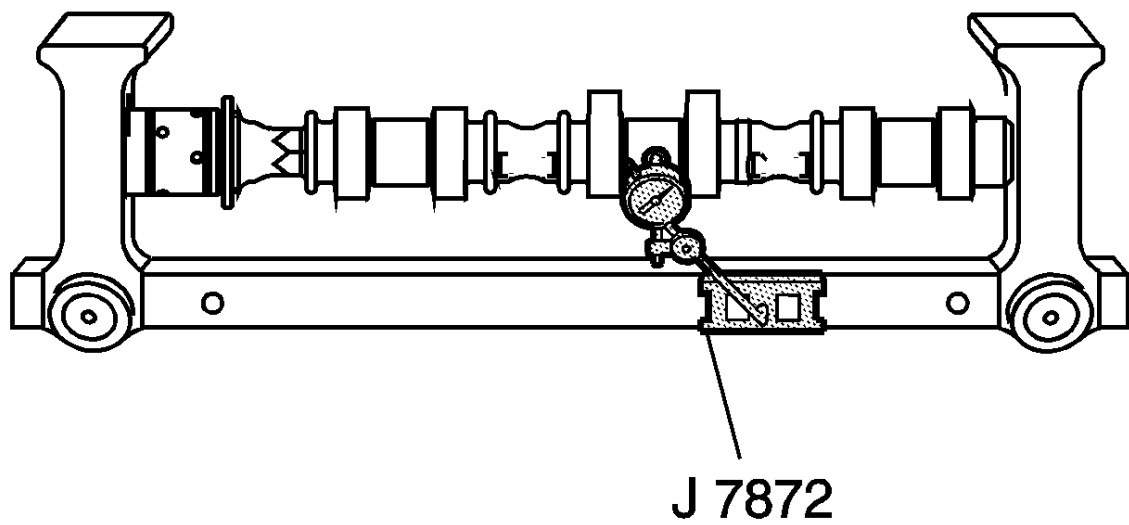


Fig. 466: Checking Camshaft Runout

Courtesy of GENERAL MOTORS COMPANY

3. Measure the camshaft runout using the **GE-7872** indicator. Refer to [Engine Mechanical Specifications](#).

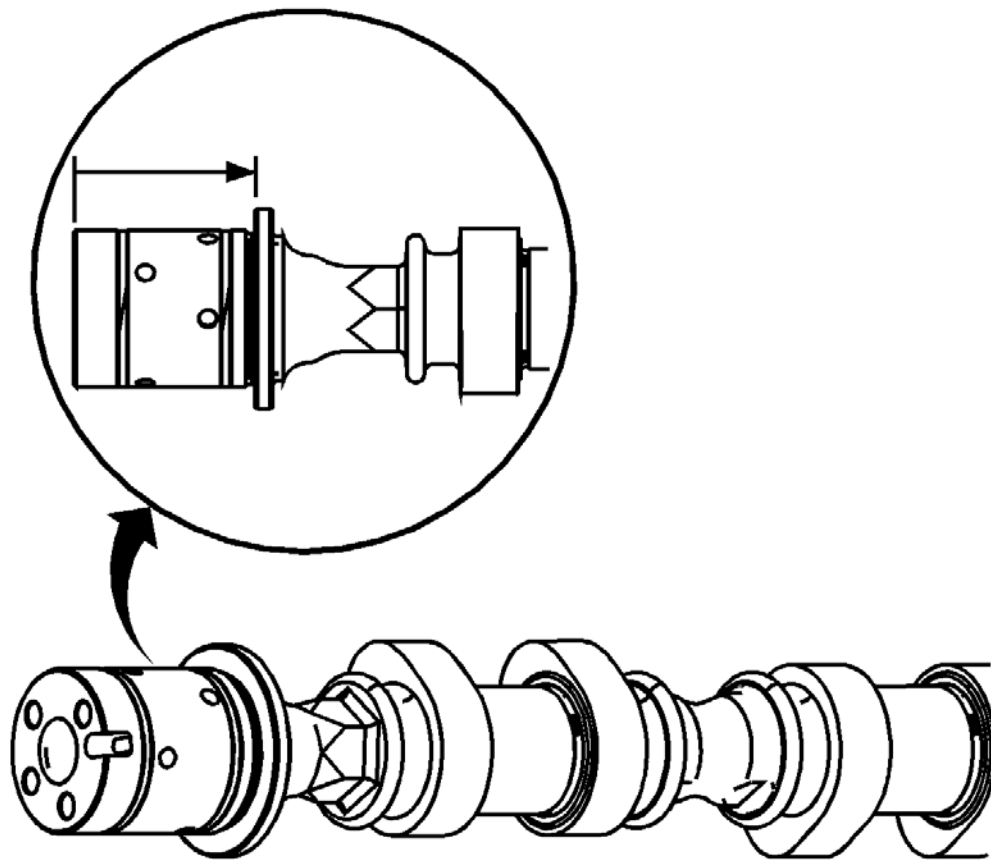


Fig. 467: Measuring Camshaft Thrust Width
Courtesy of GENERAL MOTORS COMPANY

4. Measure the camshaft thrust width for wear using a depth micrometer. Refer to [Engine Mechanical Specifications](#).

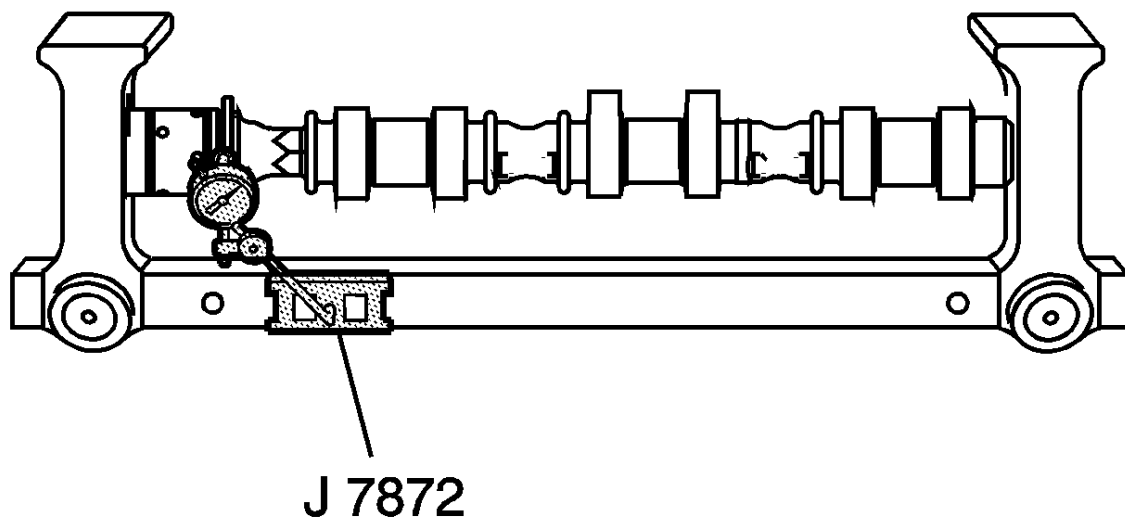


Fig. 468: Measuring Camshaft Thrust Wall Surface For Runout
Courtesy of GENERAL MOTORS COMPANY

5. Measure the camshaft thrust wall surface for runout using **GE-7872** indicator. Refer to [Engine Mechanical Specifications](#).
6. If the camshaft is damaged or worn beyond specifications, replace the camshaft. No machining of the camshaft is allowed.

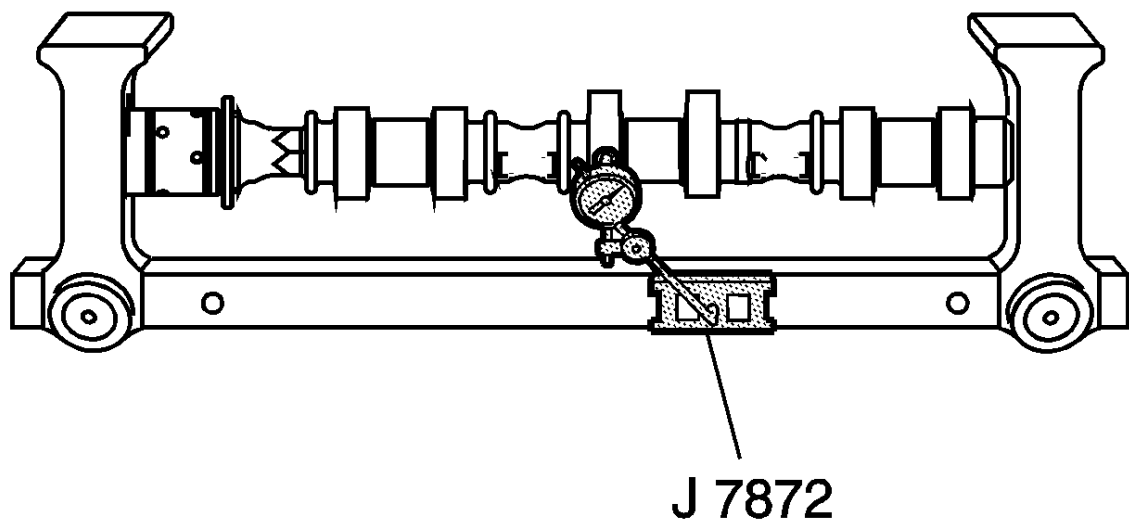


Fig. 469: Measuring Camshaft Lobes For Wear
Courtesy of GENERAL MOTORS COMPANY

7. Measure the camshaft lobes for wear using the **GE-7872** indicator.

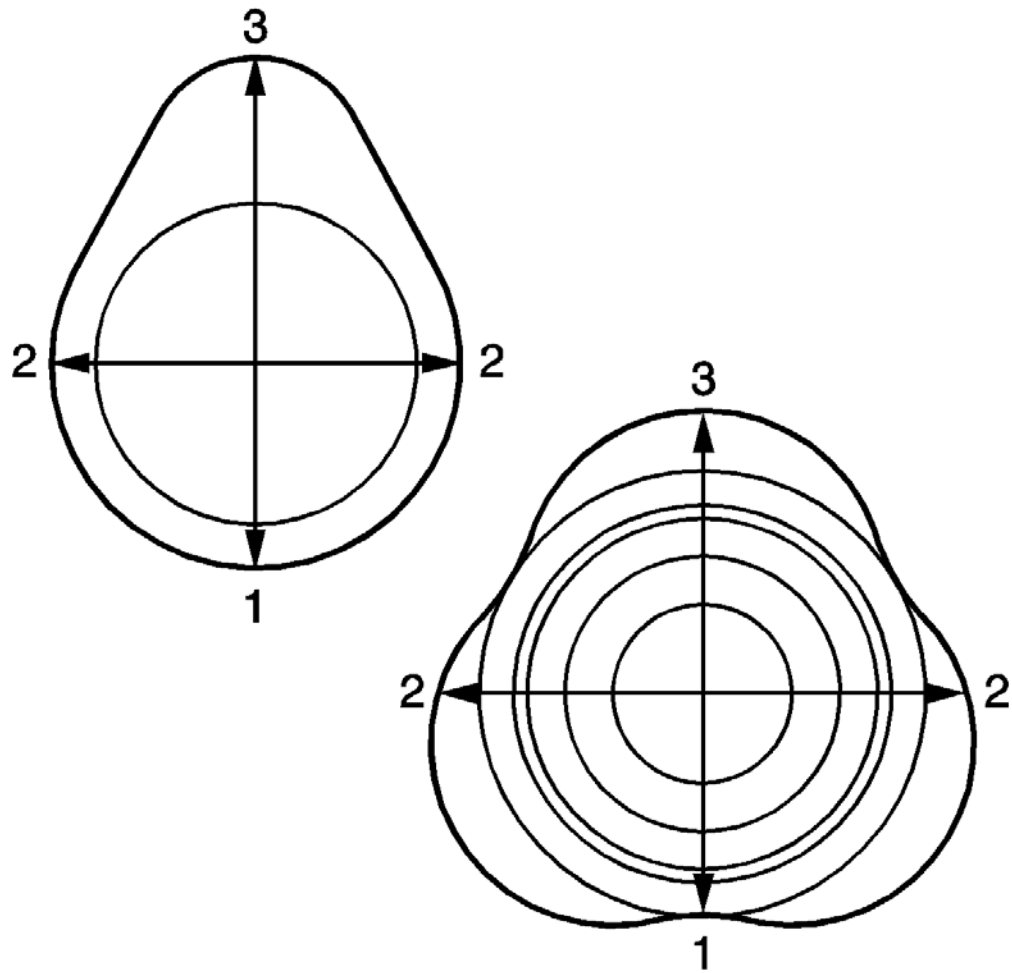


Fig. 470: Measuring Lift Of Camshaft Lobe
Courtesy of GENERAL MOTORS COMPANY

8. Place the **GE-7872** indicator with the indicator tip on the base circle (1) of the camshaft lobe.
 1. Place the **GE-7872** indicator at zero.
 2. Rotate the camshaft until the indicator tip is at the highest point (3) on the lobe. This reading is the lift of the camshaft lobe. Refer to [Engine Mechanical Specifications](#).
 3. If the indicated measurement is significantly lower than these specifications, replace the camshaft or engine performance will be reduced.

CAMSHAFT TIMING CHAIN AND SPROCKET CLEANING AND INSPECTION

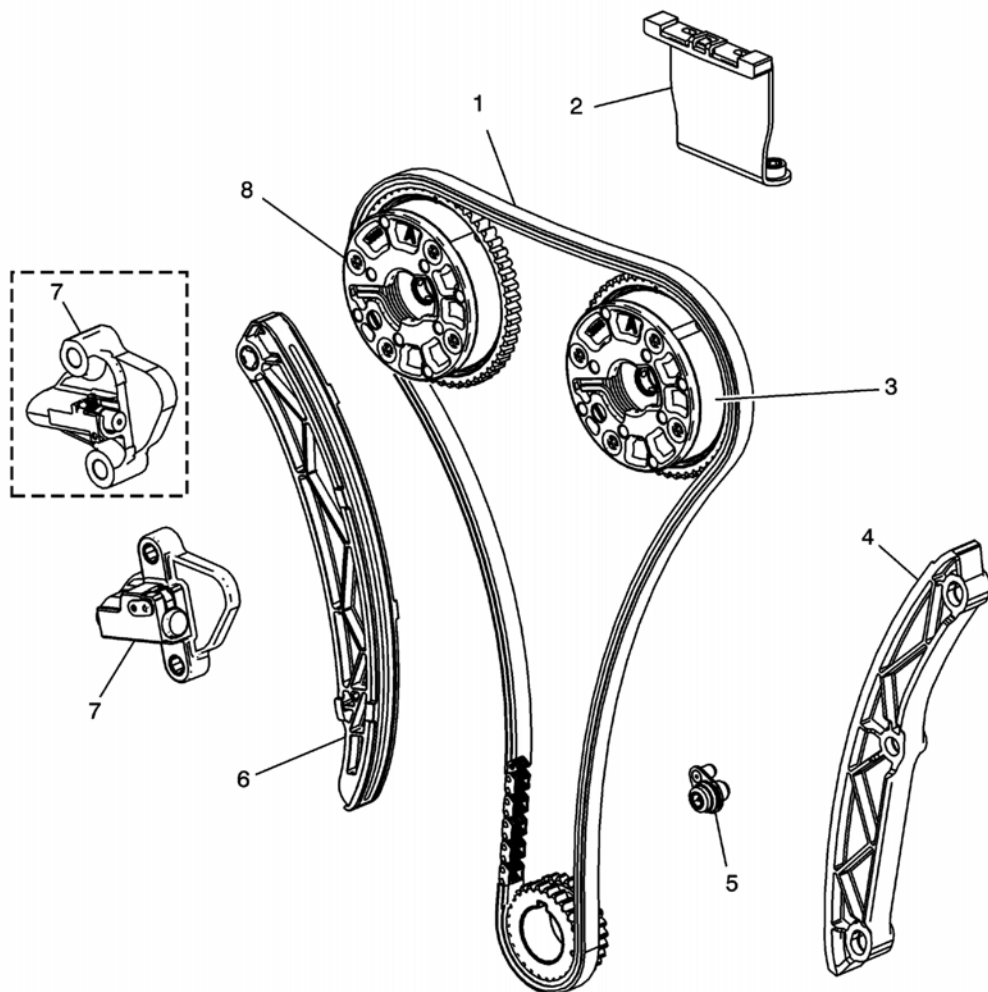


Fig. 471: Camshaft Timing Chain and Sprocket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Timing Chain Procedure 1. Inspect the timing chain for binding or worn links. 2. Inspect the timing chain for loose links. 3. Inspect the timing chain for loose pins. 4. Replace the timing chain if binding, excessive wear, or a loose condition is present.
2	Timing Chain Guide Procedure 1. Inspect the guide for worn guide surface. Replace the timing chain guides if wear exceeds 1.12 mm (0.045 in) depth on the chain guide surface. 2. Inspect the guide for a cracked or broken guide surface. 3. Inspect the guide for a cracked or damaged guide base. 4. Replace the guide if damage is present.

Callout	Component Name
3	Camshaft Position Actuator Assembly - Exhaust Procedure 1. Inspect the camshaft actuator faces for signs of movement. 2. Inspect the camshaft actuator for sprocket damage. 3. Inspect the actuator bolt seating and sealing inner hub flange for damage. 4. Inspect the back of the actuator for locating pin damage. 5. Ensure the actuator housing bolts are not loose or missing. 6. Inspect the back of the actuator for blockage to the oil passages. 7. Replace the actuator if any of these conditions are present.
4	Timing Chain Guide Procedure 1. Inspect the guide for wear to the guide surface. 2. Inspect the guide for cracked or broken guide surface or base. 3. Replace the guide if these conditions are present.
5	Timing Chain Oil Nozzle Procedure 1. Inspect the oil nozzle body for collapse or cracks at the bolt boss. Discard and replace the oil nozzle body if it is damaged. 2. Verify oil nozzle oil flow with compressed air. 3. Replace the nozzle if damage or oil flow restriction is present.
6	Timing Chain Tensioner Shoe Procedure 1. Inspect for worn, cracked, or broken shoe surface. 2. Inspect the shoe for wear at the tensioner contact pad. 3. Replace the shoe if any of these conditions are present.
7	Timing Chain Tensioner Procedure 1. Inspect the tensioner for damage to the plunger-to-shoe contact surface. 2. Inspect the tensioner for a locked or binding condition. Reset the plunger and ensure the plunger moves freely in and out of the tensioner body. • If the tensioner has a lever on the front, press down on the lever and depress the plunger. Insert a suitable tool into the hole in the tensioner body to hold the plunger in the retracted position. • If the tensioner has a retaining clip, press the clip and depress the plunger. Insert a suitable tool into the hole in the tensioner body to hold the plunger in the retracted

Callout	Component Name
	position. 3. Inspect the timing chain tensioner gasket for damage. 4. Replace the tensioner if any of these conditions are present.
8	Camshaft Position Actuator Assembly - Intake Procedure 1. Inspect the camshaft actuator faces for signs of movement. 2. Inspect the camshaft actuator for sprocket damage. 3. Inspect the actuator bolt seating and sealing inner hub flange for damage. 4. Inspect the back of the actuator for locating pin damage. 5. Ensure the actuator housing bolts are not loose or missing. 6. Inspect the back of the actuator for blockage to the oil passages. 7. Replace the actuator if any of these conditions are present.

INTAKE MANIFOLD CLEANING AND INSPECTION

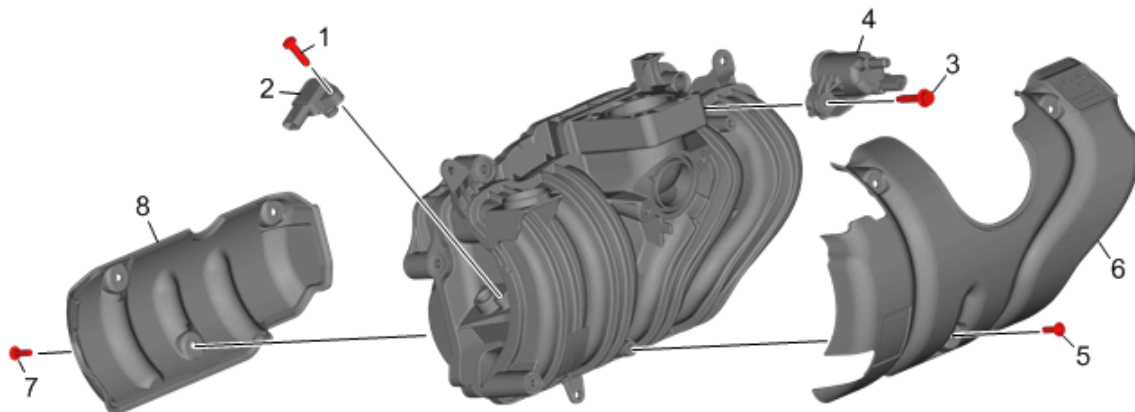


Fig. 472: Intake Manifold

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove all components prior to cleaning and inspection. 2. Inspect each component.	
1	Manifold Absolute Pressure Sensor Bolt CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 10 N.m (89 lb in)
2	Manifold Absolute Pressure Sensor
3	Evaporative Emission Canister Purge Solenoid Valve Bolt Tighten 10 N.m (89 lb in)
4	Evaporative Emission Canister Purge Solenoid Valve
5	Upper Intake Manifold Cover Bolt (Qty: 3) Tighten 8 N.m (71 lb in)
6	Upper Intake Manifold Cover
7	Intake Manifold Cover Bolt (Qty: 3) Tighten 7 N.m (62 lb in)
8	Lower Intake Manifold Cover

CRANKSHAFT AND BEARING CLEANING AND INSPECTION

Special Tools

- **EN-8087** Cylinder Bore Checking Gauge
- **EN-45059** Angle Meter
- **GE-7872** Magnetic Base Dial Indicator Set

For equivalent regional tools, refer to [Special Tools](#).

Crankshaft Cleaning and Inspection

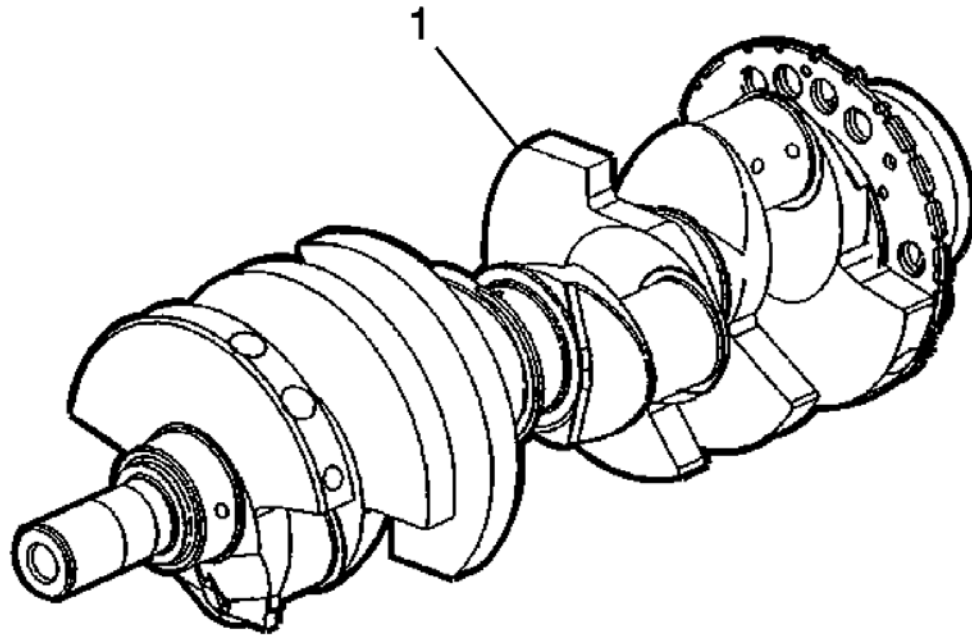


Fig. 473: Crankshaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use care when handling the crankshaft. Avoid damage to the bearing surfaces or the lobes of the crankshaft position reluctor ring. Damage to the teeth of the crankshaft position reluctor ring may affect on-board diagnostic (OBD) II system performance.

1. Clean the crankshaft (1) with solvent.
2. Thoroughly clean all oil passages and inspect for restrictions or burrs.

WARNING: Refer to [Safety Glasses Warning](#) .

3. Dry the crankshaft with compressed air.

NOTE: Reluctor ring teeth should not have imperfections on the rising or falling edges. Imperfections of the reluctor ring teeth may effect OBD II system performance.

4. Perform a visual inspection of the crankshaft for damage.

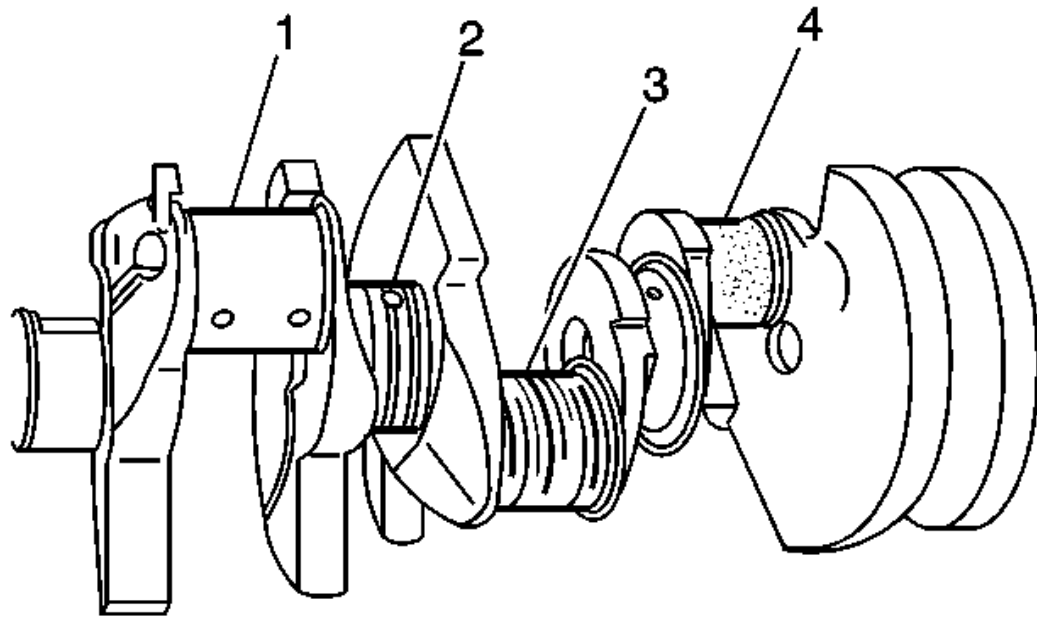


Fig. 474: Identifying Different Crankshaft Journal Wear Patterns
Courtesy of GENERAL MOTORS COMPANY

5. Inspect the crankshaft journals for wear (1). The journals should be smooth, with no signs of scoring, wear, or damage.
6. Inspect the crankshaft journals for grooves or scoring (2).
7. Inspect the crankshaft journals for scratches or wear (3).
8. Inspect the crankshaft journals for pitting or imbedded bearing material (4).

Crankshaft Measurements

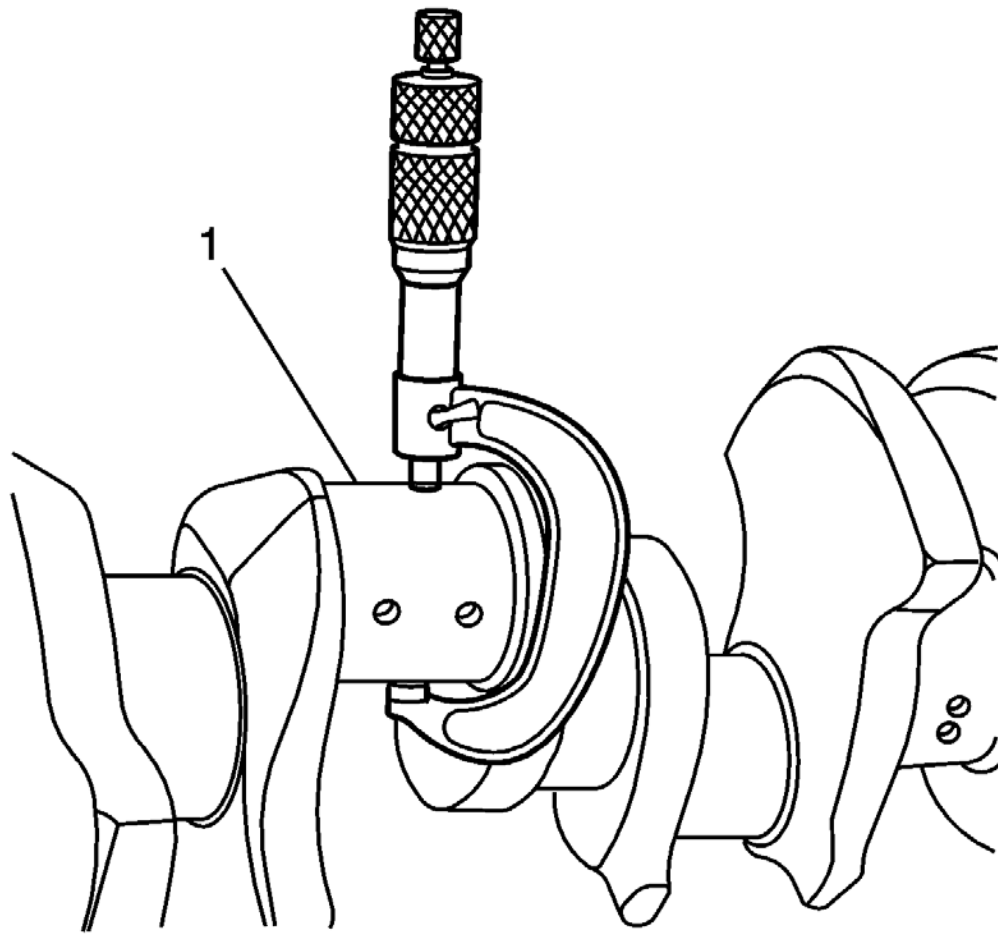


Fig. 475: Measure Crankshaft Journals For Out-Of-Round
Courtesy of GENERAL MOTORS COMPANY

1. Measure the crankshaft journals (1) for out-of-round.
2. Measure the crankshaft journals for taper.

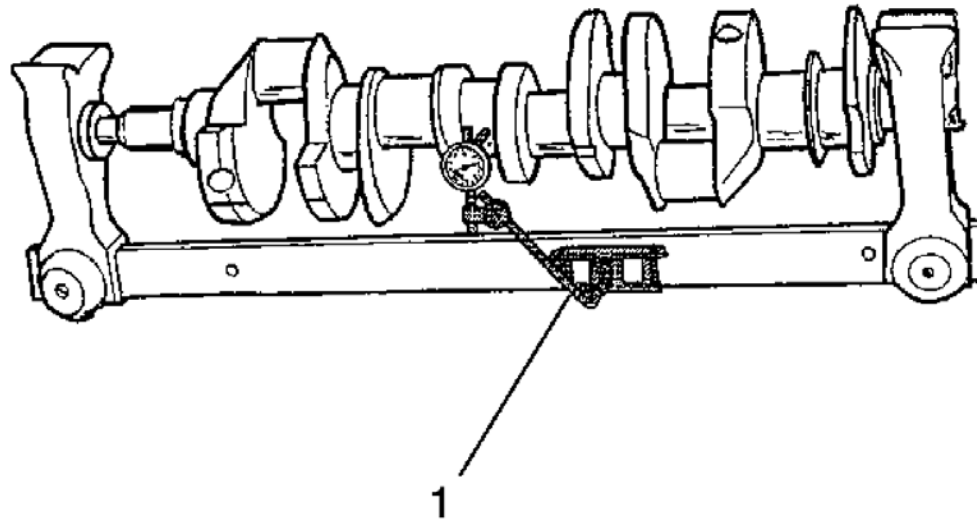


Fig. 476: Measuring Crankshaft Runout
Courtesy of GENERAL MOTORS COMPANY

3. Measure the crankshaft runout.

Using wooden V-blocks, support the crankshaft on the front and rear journals.

4. Use the **GE-7872** indicator (1) in order to measure the crankshaft runout at the front and rear intermediate journals.
5. Use the **GE-7872** indicator in order to measure the runout of the crankshaft rear flange.
6. Replace the crankshaft if the measurements are not within specifications. Refer to [Engine Mechanical Specifications](#).

Crankshaft Bearings Cleaning and Inspection

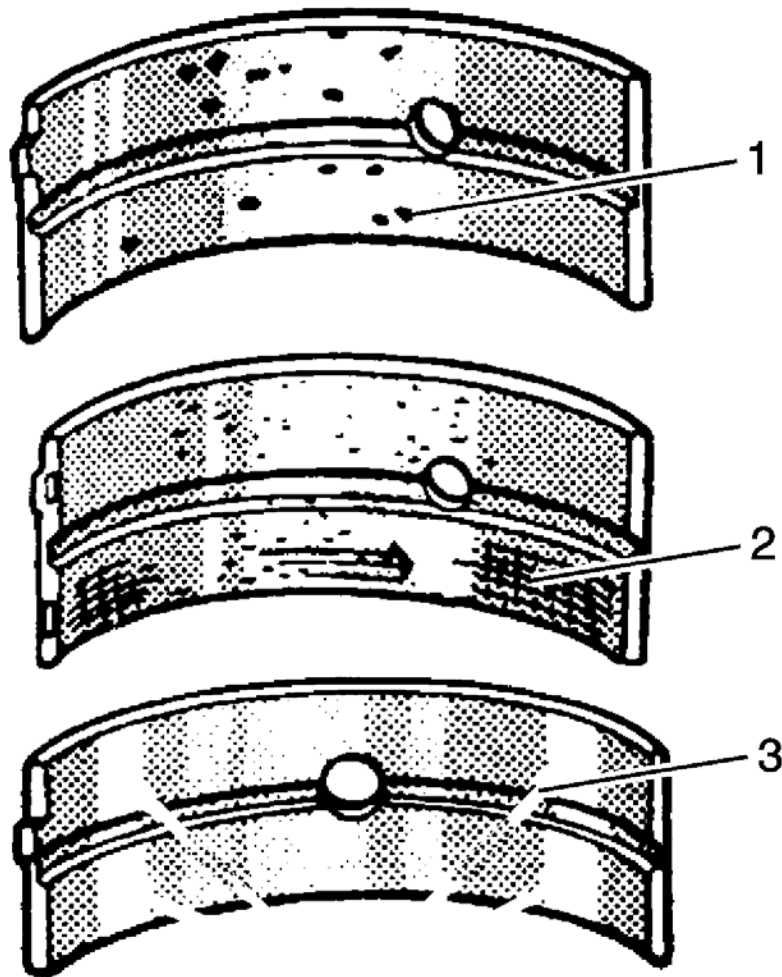


Fig. 477: Identifying Crankshaft Bearing Damage

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Crankshaft bearings **MUST** be separated, marked, or organized in a way to ensure installation to their original location and position, when suitable for use.
- If crankshaft bearing failure is due to other than normal wear, investigate the cause. Inspect the crankshaft or connecting rod bearing bores.

1. Inspect crankshaft bearings for craters or pockets (1). Flattened sections on the bearing halves also indicate fatigue.
2. Inspect the crankshaft bearings for excessive scoring or discoloration (2).
3. Inspect the crankshaft bearings for dirt or debris imbedded into the bearing material.
4. Inspect the crankshaft bearings for improper seating indicated by bright, polished sections of the bearing (3).

If the lower half of the bearing is worn or damaged, both upper and lower halves should be replaced.

Generally, if the lower half is suitable for use, the upper half should also be suitable for use.

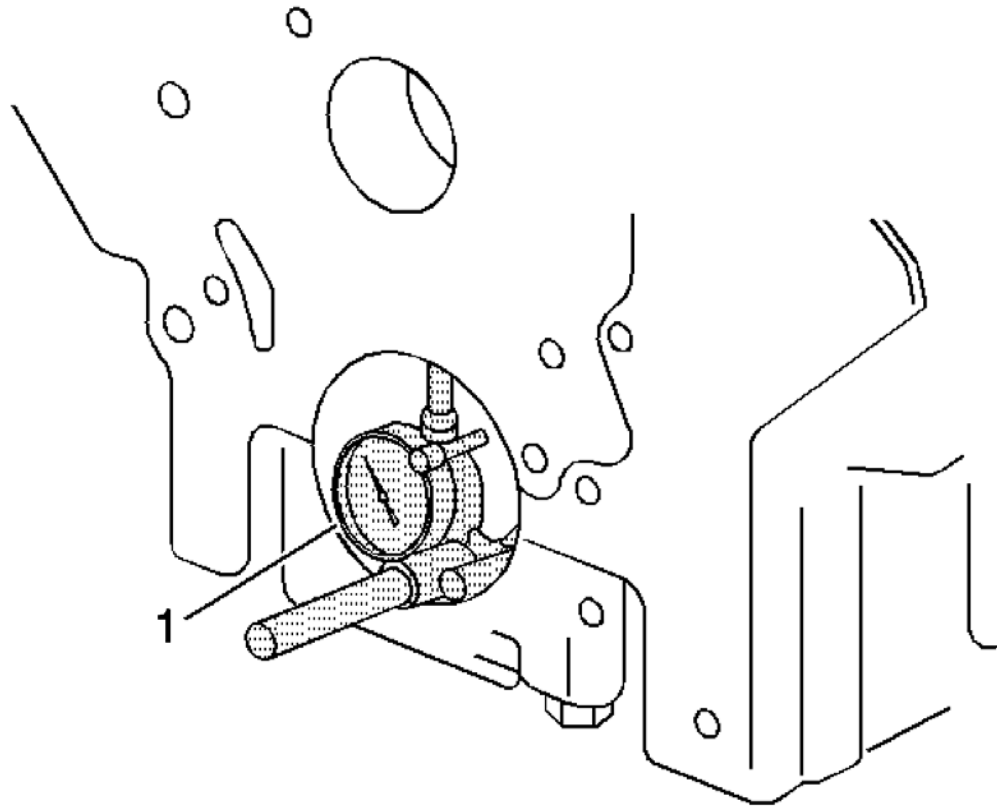


Fig. 478: Measuring Crankshaft Main Bearing Bores
Courtesy of GENERAL MOTORS COMPANY

5. Inspect the connecting rod bearing bores or crankshaft main bearing bores using the following procedure:
 1. Tighten the bedplate to specification using the **EN-45059** meter.
 2. Measure the bearing bore for taper and out-of-round using the **EN-8087** gauge (1).
 3. No taper or out-of-round should exist.

Bearing Selection

1. Measure the bearing clearance to determine the correct replacement bearing insert size. There are 2 methods to measure bearing clearance. Method A gives more reliable results and is preferred.
 - Method A yields measurement from which the bearing clearance can be computed.
 - Method B yields the bearing clearance directly. Method B does not give any indication of bearing run-out.

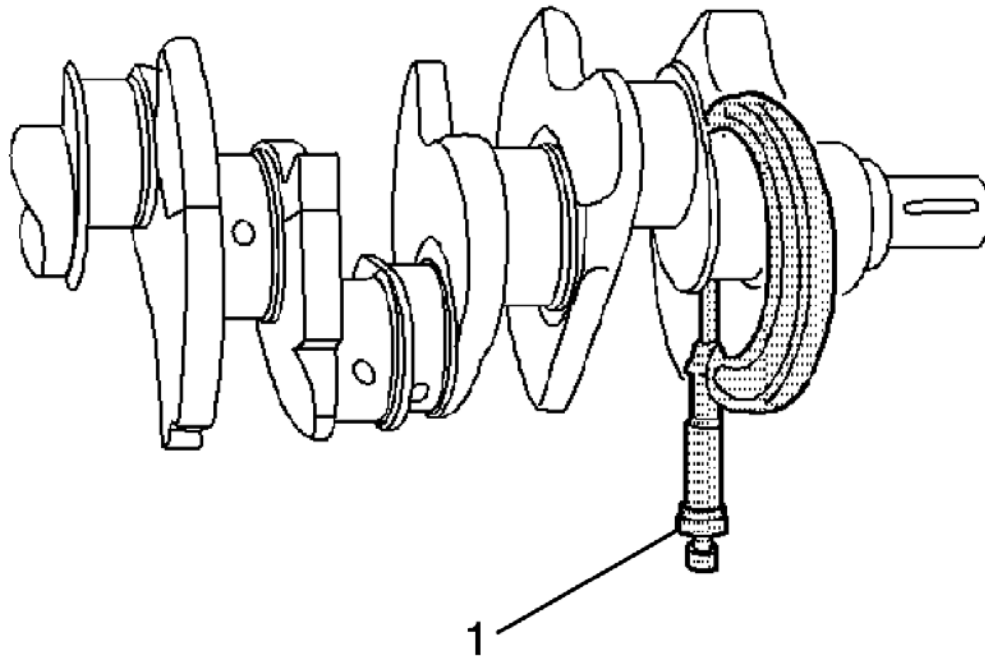


Fig. 479: Measuring Crankshaft Bearing Journal Using Method A
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not mix inserts of different nominal size in the same bearing bore.**

2. To measure bearing clearance using Method A, use the following procedure:
 1. Measure the crankshaft bearing journal diameter with a micrometer (1) in several places, 90 degrees apart. Average the measurements.
 2. Measure the crankshaft bearing journal taper and runout.
 3. Install the lower crankcase and tighten the bearing cap bolts to specification.
 4. Measure bearing inside diameter (ID) in several places 90 degrees apart, average measurements.
 5. Subtract journal measurement from bearing ID measurement to determine clearance.
 6. Determine whether clearance is within specification.
 7. If out of specification, choose different inserts.
 8. Measure the connecting rod inside diameter in the same direction as the length of the rod with an inside micrometer.
 9. Measure the crankshaft main bearing inside diameter with an inside micrometer.

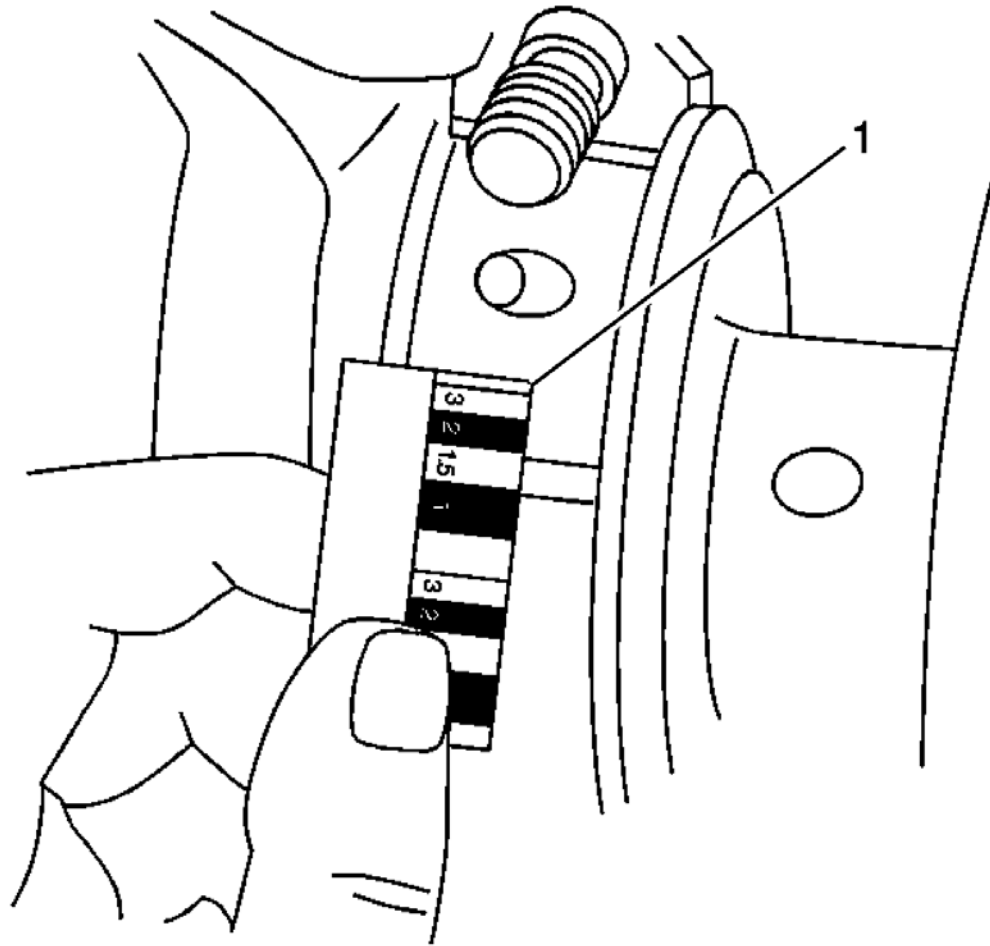


Fig. 480: Measuring Bearing Clearance With Gaging Plastic Using Method B
Courtesy of GENERAL MOTORS COMPANY

3. To measure bearing clearance using Method B, use the following procedure:

1. Clean the used bearing inserts.
2. Install the used bearing inserts.
3. Place a piece of gaging plastic across the entire bearing width.
4. Install the bearing caps.

CAUTION: In order to prevent the possibility of cylinder block or crankshaft bearing cap damage, the crankshaft bearing caps are tapped into the cylinder block cavity using a brass, lead, or a leather mallet before the attaching bolts are installed. Do not use attaching bolts to pull the crankshaft bearing caps into the seats. Failure to use this process may damage a cylinder block or a bearing cap.

5. Install the bearing cap bolts to specification.

NOTE: Do not rotate the crankshaft.

6. Remove the bearing cap, leaving the gauging plastic in place. It does not matter whether the gauging plastic adheres to the journal or to the bearing cap.

- 7. Measure the gauging plastic at its widest point with the scale (1) printed on the gauging plastic package.
- 8. Remove the gauging plastic.

OIL PUMP DRIVE CHAIN TENSIONER AND OIL PUMP DRIVE CHAIN CLEANING AND INSPECTION

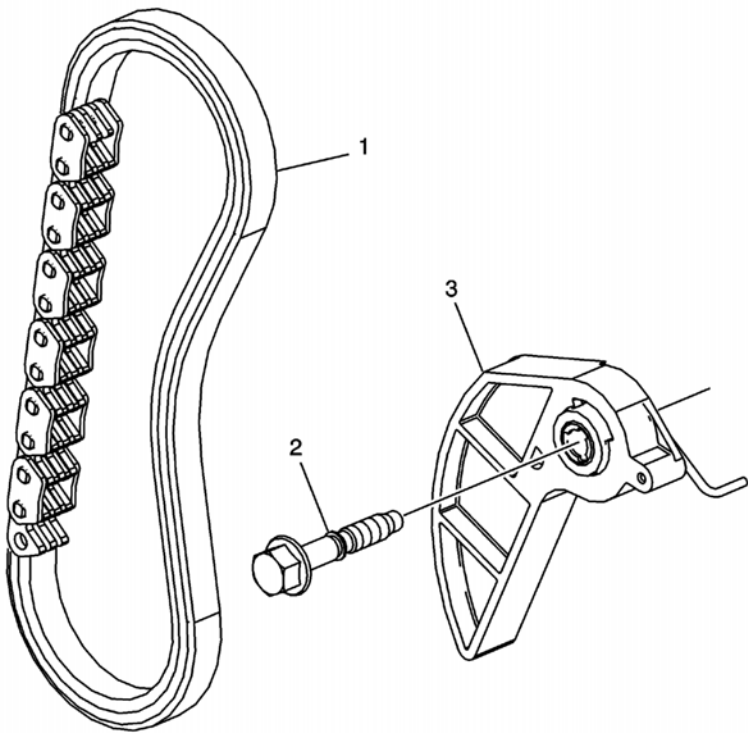


Fig. 481: Oil Pump Drive Chain Tensioner and Oil Pump Drive Chain Cleaning and Inspection
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. Clean all components.	
2. Inspect each component.	
1	Oil Pump Drive Chain
2	Oil Pump Drive Chain Tensioner Bolt
3	Oil Pump Drive Chain Tensioner

OIL PUMP CLEANING AND INSPECTION

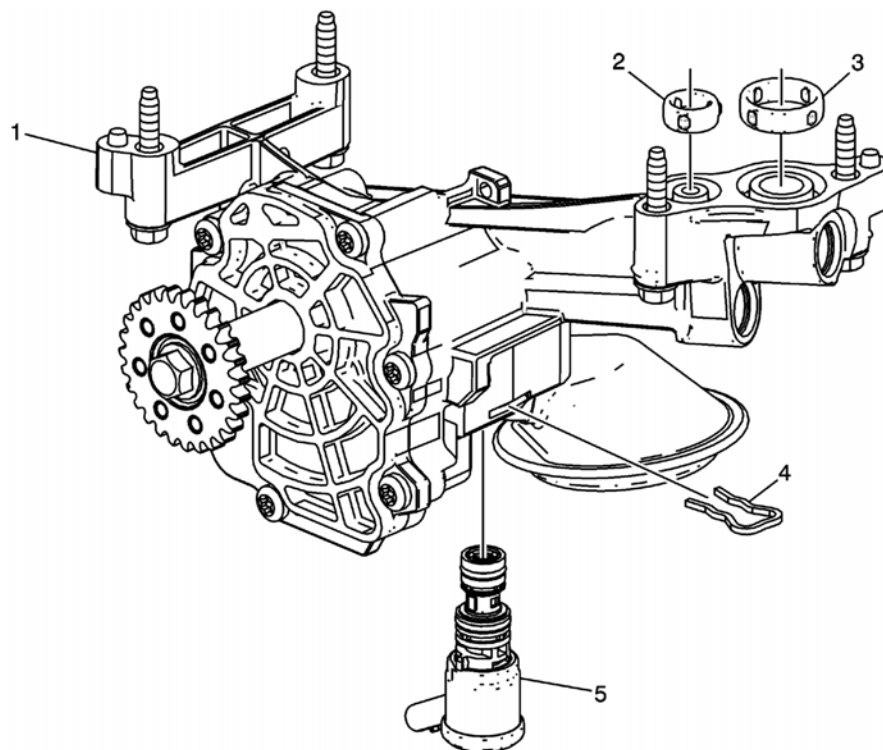


Fig. 482: Oil Pump Cleaning and Inspection
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. Clean all components.	
2. Inspect each component.	
1	Oil Pump
2	Oil Pump Gasket
3	Oil Pump Gasket
4	Oil Pump Flow Control Solenoid Valve Retainer
5	Oil Pump Flow Control Solenoid Valve

OIL PAN CLEANING AND INSPECTION

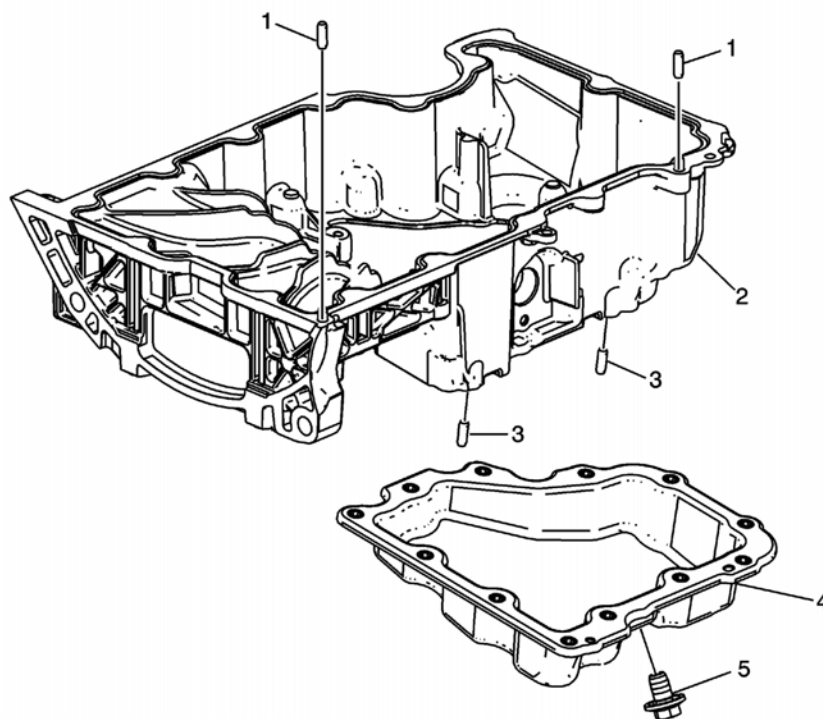


Fig. 483: Oil Pan Cleaning and Inspection
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove all components prior to cleaning. 2. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant 3. Clean all components. 4. Inspect each component.	
1	Upper Oil Pan Locating Pin (Qty: 2)
2	Upper Oil Pan
3	Lower Oil Pan Locating Pin (Qty: 2)
4	Lower Oil Pan NOTE: Use a NEW lower oil pan.
5	Oil Pan Drain Plug

THREAD REPAIR

Special Tools

- EN 42385-307 Drill Bushing
- EN 42385-308 Alignment Pin

- EN 42385-510 Main Attachment Bolt
- EN 42385-900 Head Bolt Thread Repair Kit
- EN 42385-904 Thread Insert

For equivalent regional tools, refer to [Special Tools](#).

General Thread Repair

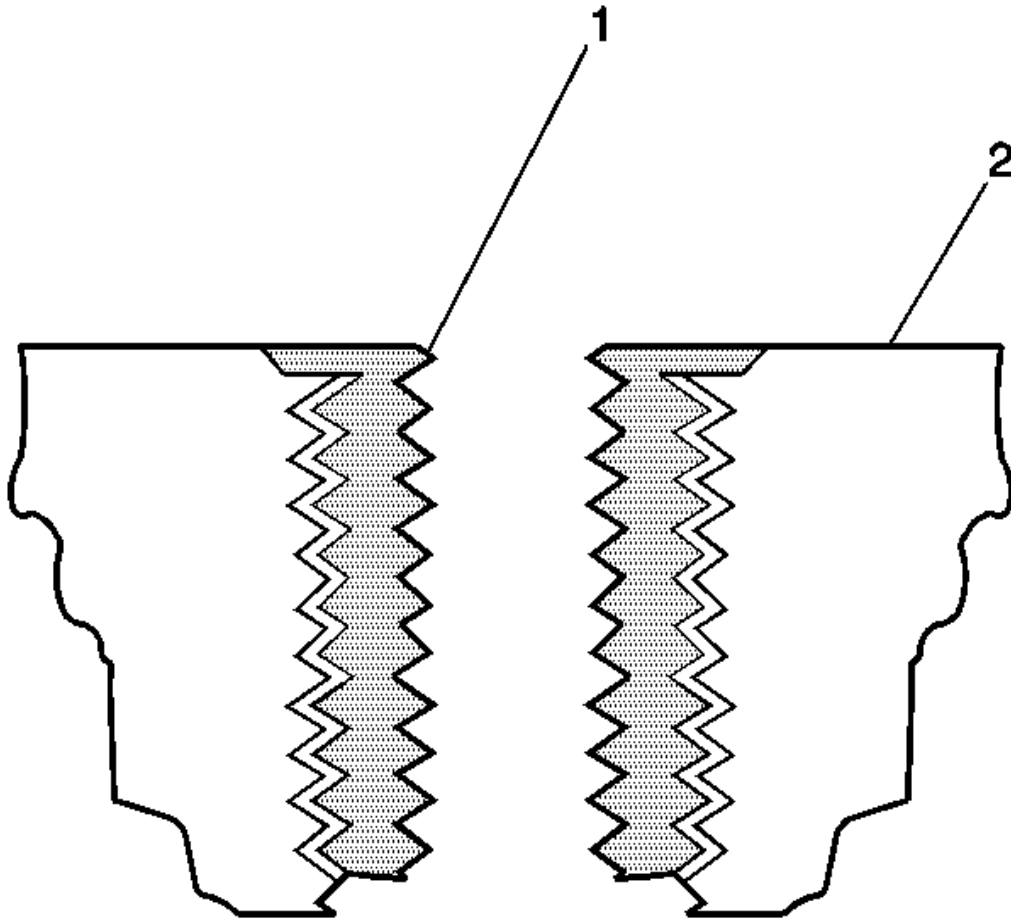


Fig. 484: Bushing Type Insert And Base Material
 Courtesy of GENERAL MOTORS COMPANY

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert (1). During the bushing installation process, the driver tool expands the bottom external threads of the insert into the base material (2). This action mechanically locks the insert in place. Also, when installed to the proper depth, the flange of the insert will be seated against the counterbore of the repaired hole.

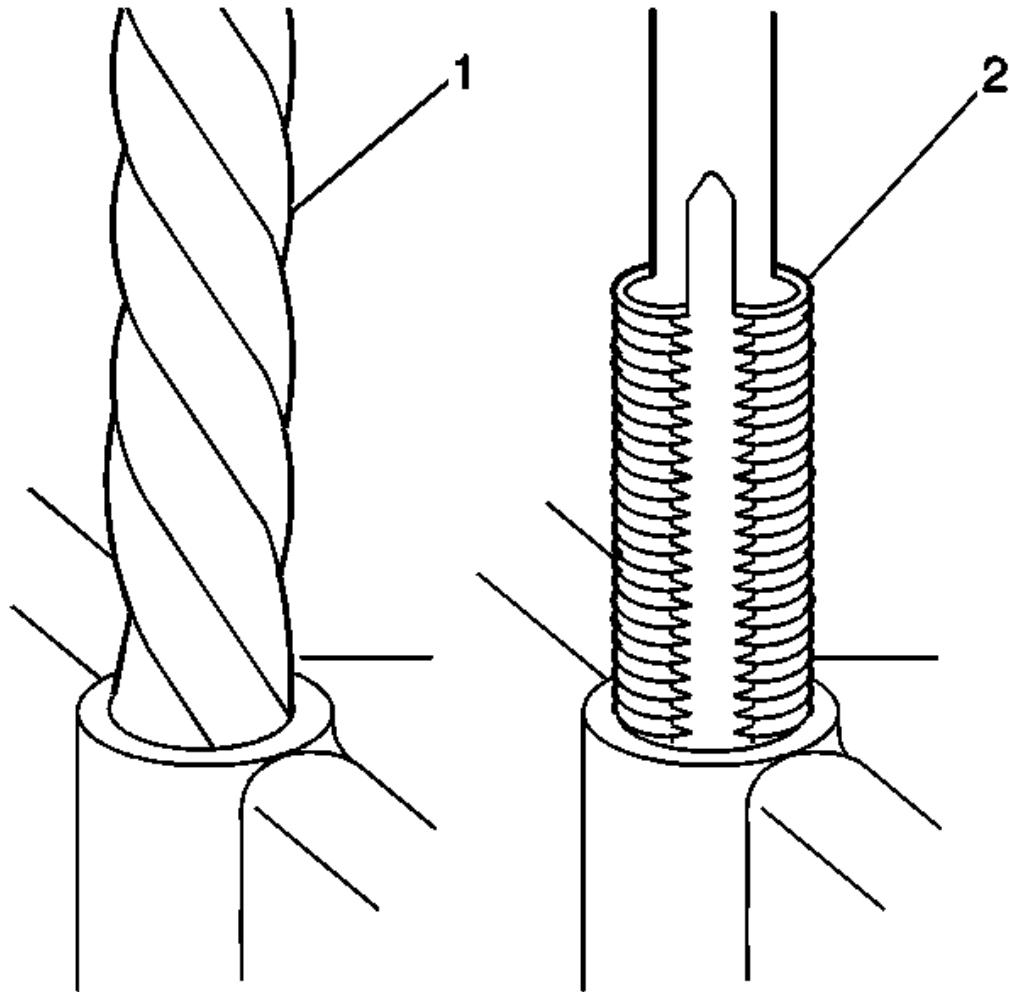


Fig. 485: Drilling And Tapping Threads
Courtesy of GENERAL MOTORS COMPANY

NOTE: The use of a cutting fluid, WD 40® , or equivalent, is recommended when performing the drilling, counterboring, and tapping procedures. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

Driver oil **MUST** be used on the installer driver tool.

The tool kits are designed for use with either a suitable tap wrench or drill motor.

1. Drill out the threads of the damaged hole (1).
 - M6 inserts require a minimum drill depth of 15 mm (0.59 in).
 - M8 inserts require a minimum drill depth of 20 mm (0.79 in).
 - M10 inserts require a minimum drill depth of 23.5 mm (0.93 in).

WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

2. Using compressed air, clean out any chips.

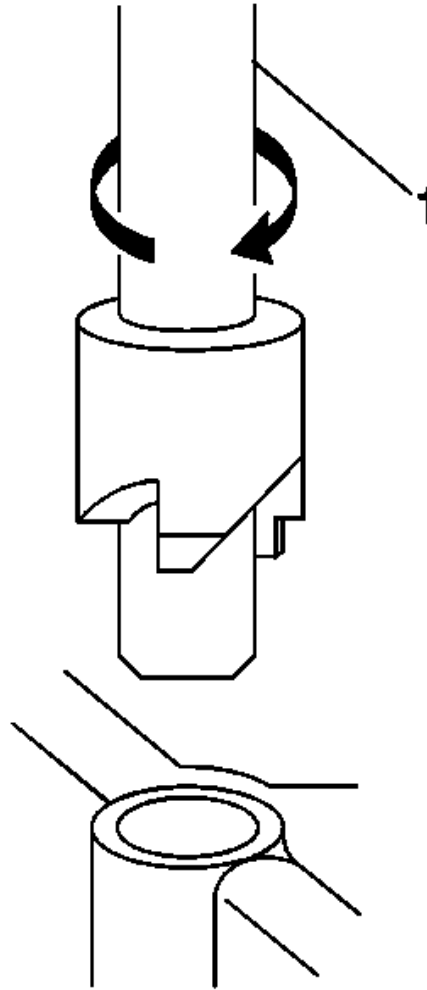


Fig. 486: Identifying Tool Used To Counterbore Hole
Courtesy of GENERAL MOTORS COMPANY

3. Counterbore the hole to the full depth permitted by the tool (1).
4. Using compressed air, clean out any chips.

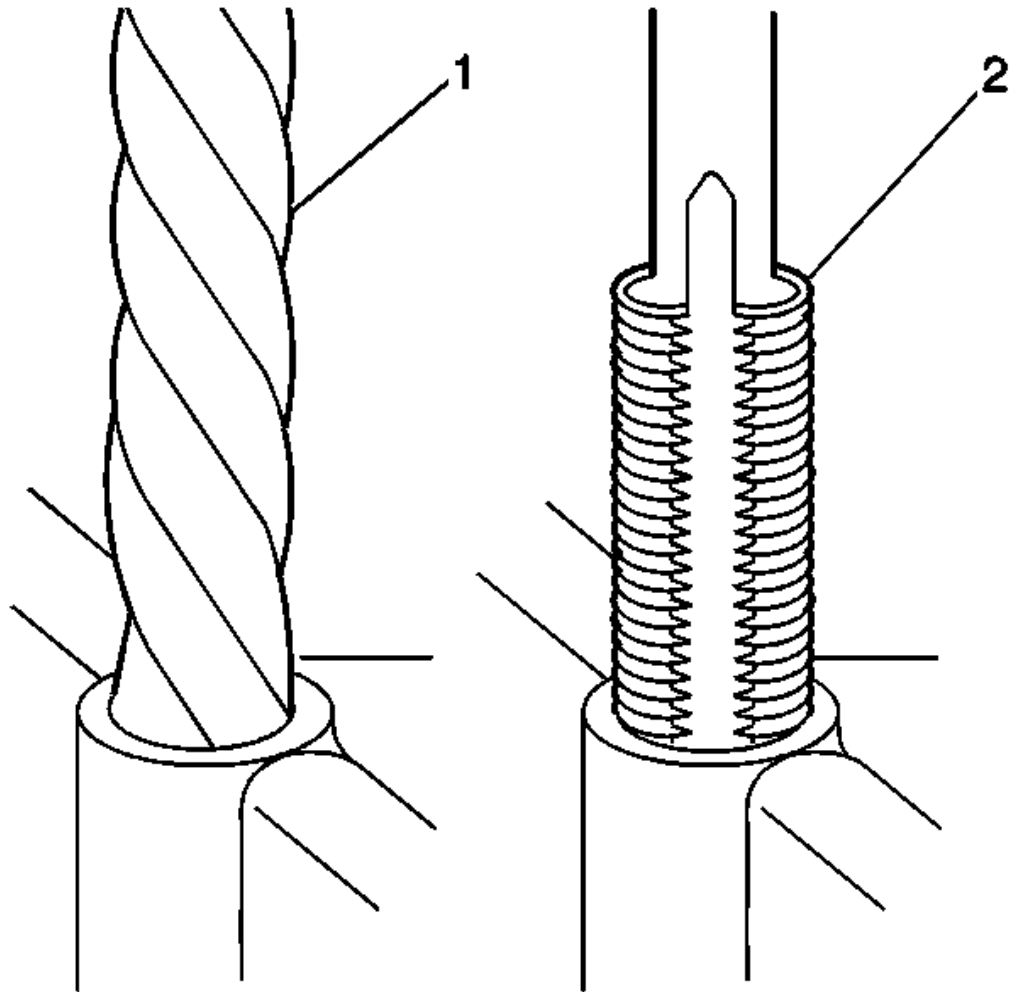


Fig. 487: Drilling And Tapping Threads

Courtesy of GENERAL MOTORS COMPANY

5. Using a tap wrench (2), tap the threads of the drilled hole.
- M6 inserts require a minimum tap depth of 15 mm (0.59 in).
 - M8 inserts require a minimum tap depth of 20 mm (0.79 in).
 - M10 inserts require a minimum tap depth of 23.5 mm (0.93 in).

WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

WARNING: Refer to [Cleaning Solvent Warning](#) .

6. Using compressed air, clean out any chips.
7. Spray cleaner into the hole. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).
8. Using compressed air, clean any cutting oil and chips out of the hole.

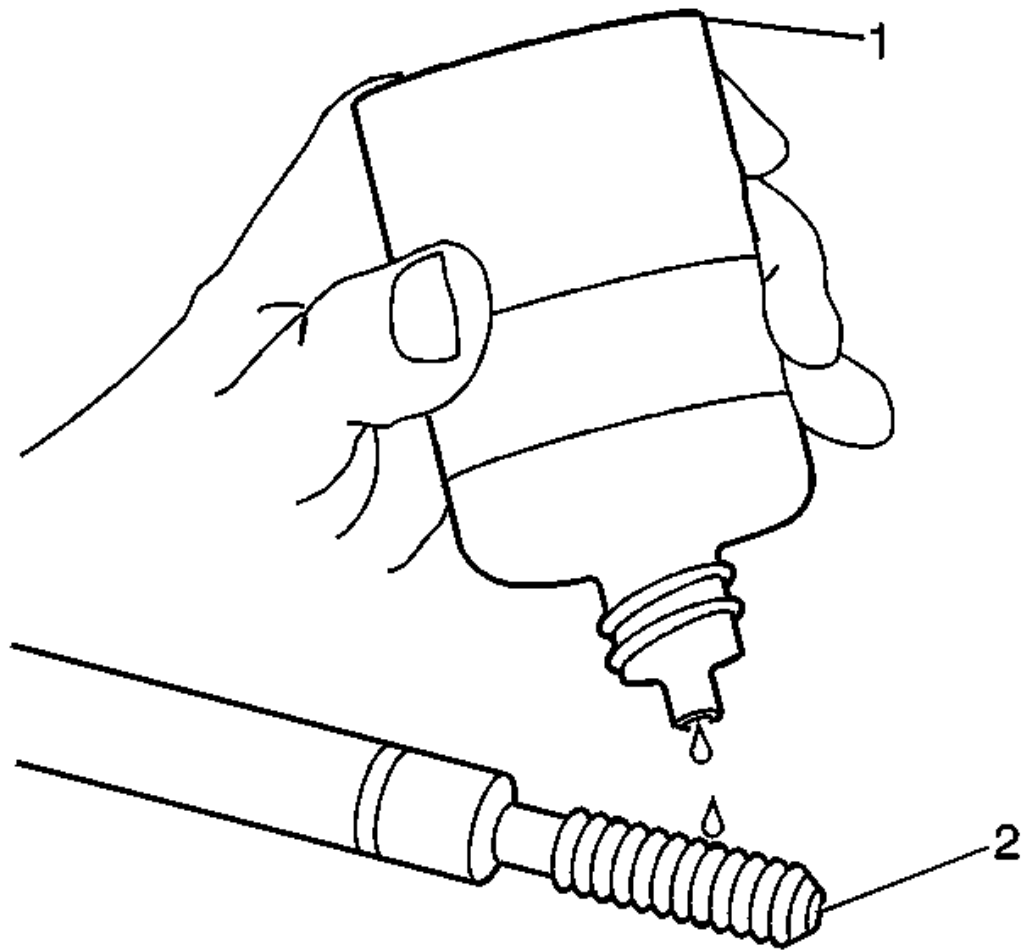


Fig. 488: Lubricating Installer Tool Threads
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

9. Lubricate the threads of the installer tool (2) with the driver oil (1).

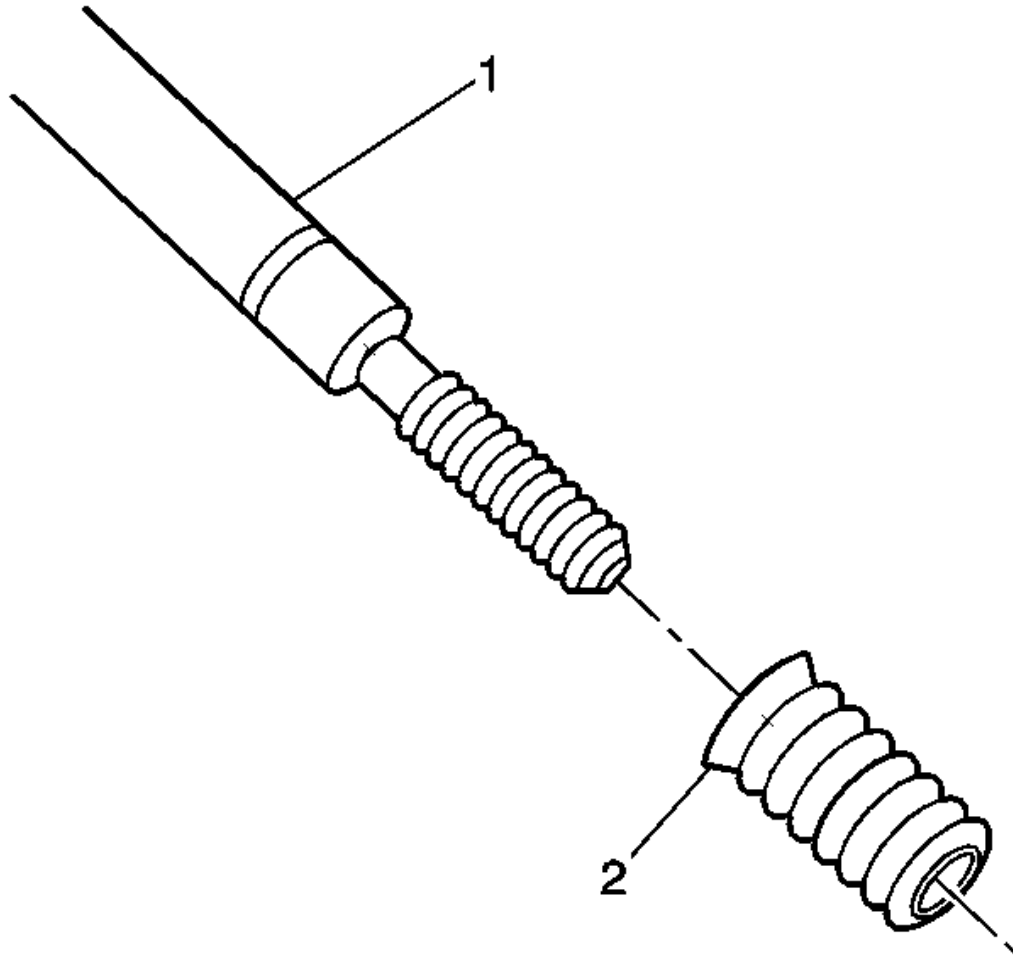


Fig. 489: Driver Tool And Insert

Courtesy of GENERAL MOTORS COMPANY

10. Install the insert (2) onto the driver tool (1).

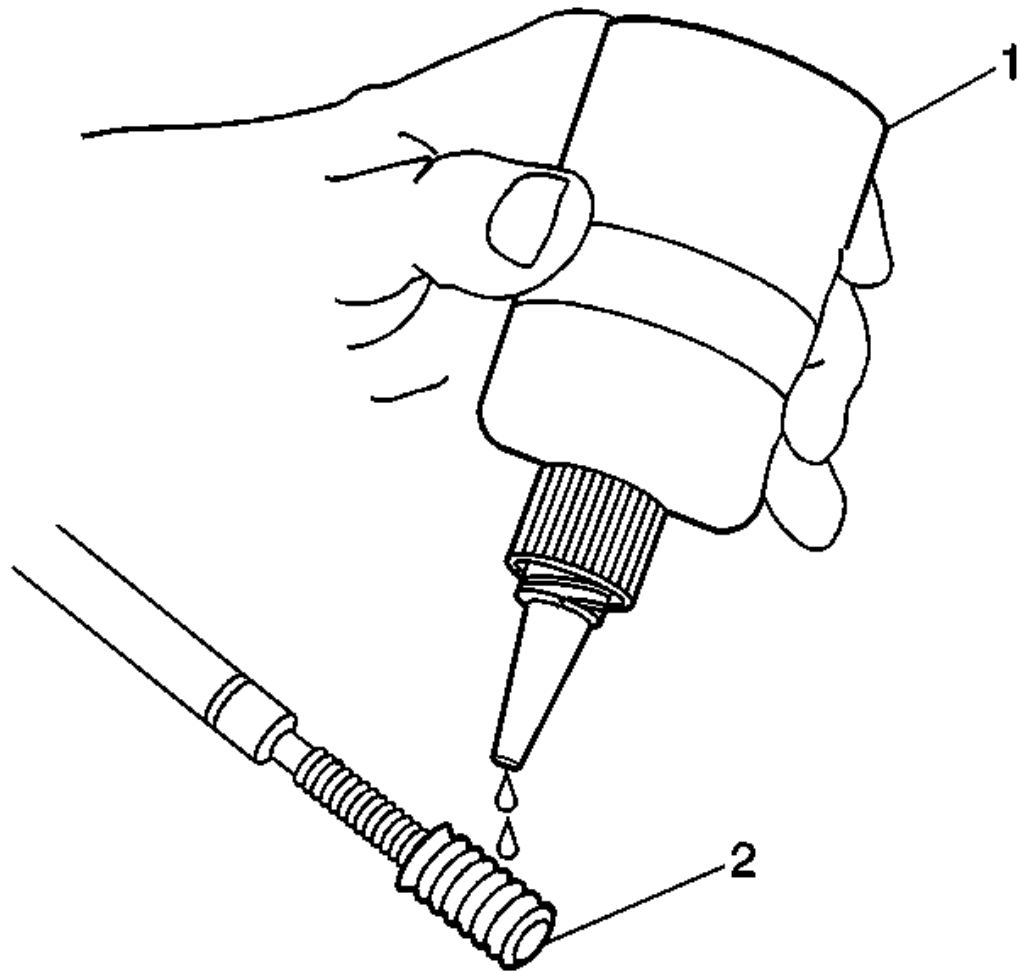


Fig. 490: Applying Threadlock To Insert OD Threads
Courtesy of GENERAL MOTORS COMPANY

11. Apply threadlock LOCTITE™ 277, EN 42385 - 109 (1) loctite, or equivalent to the insert OD threads (2).

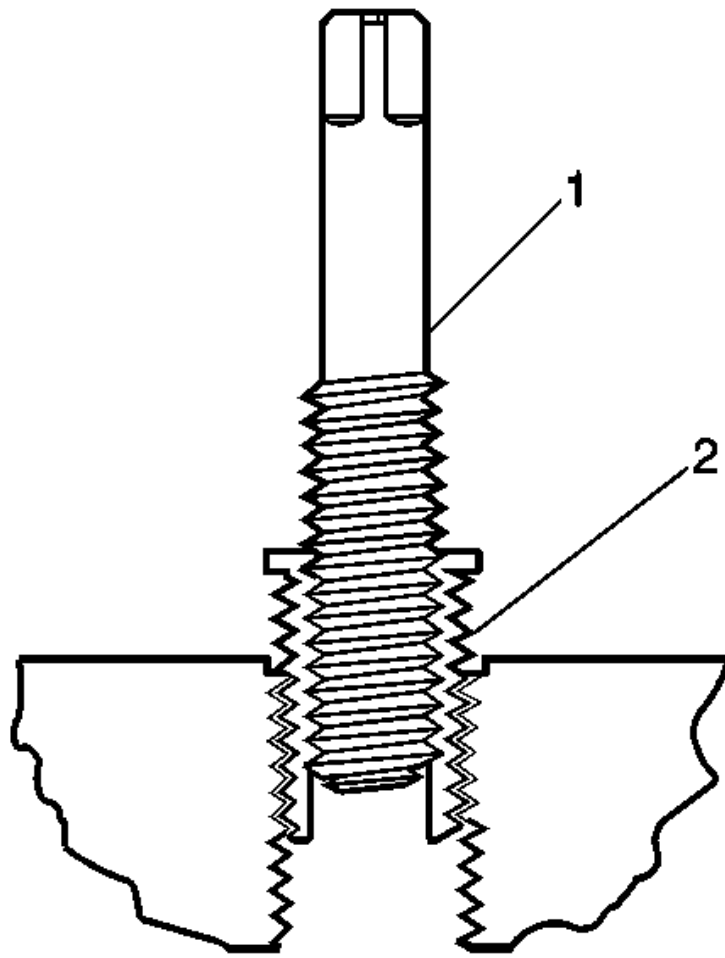


Fig. 491: Installing Insert Into Bolt Hole Using Installer Tool
Courtesy of GENERAL MOTORS COMPANY

12. Install the insert (2) into the hole.

Install the insert until the flange of the insert contacts the counterbored surface. Continue to rotate the installer tool (1) through the insert.

The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

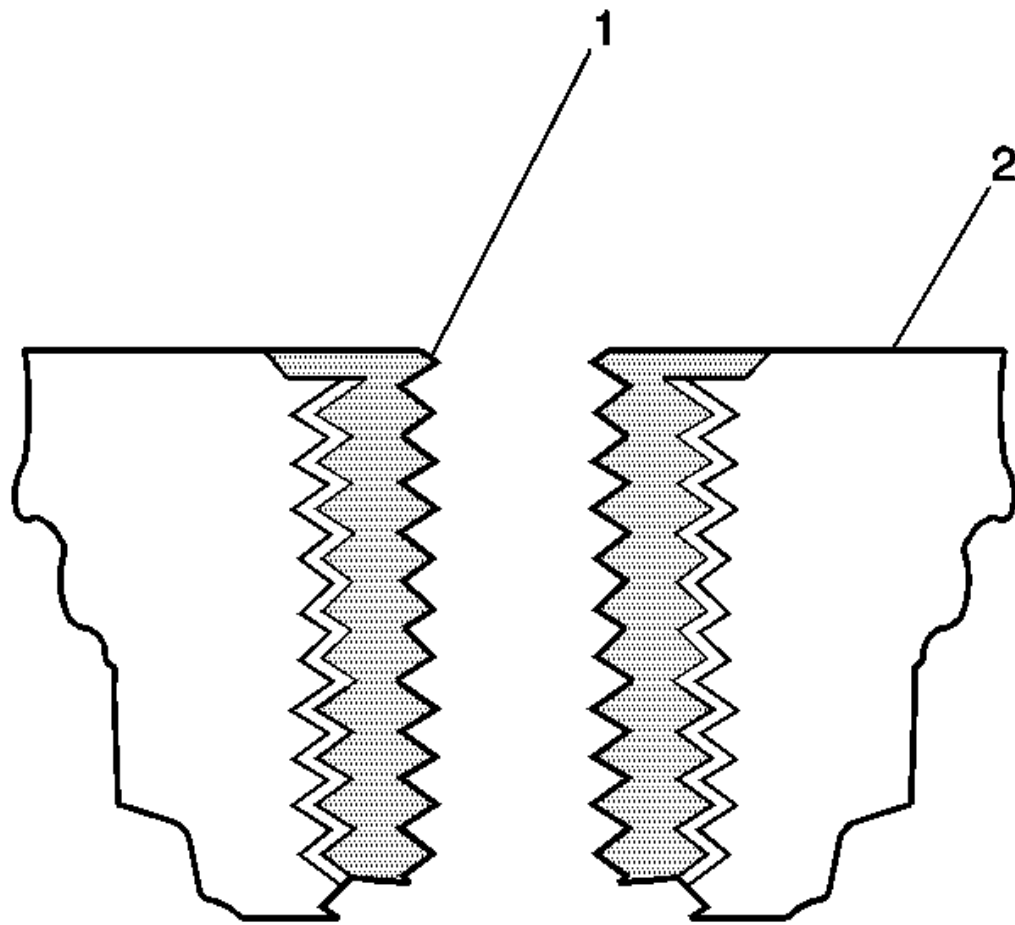


Fig. 492: Bushing Type Insert And Base Material
Courtesy of GENERAL MOTORS COMPANY

13. Inspect the insert for proper installation into the hole.

A properly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

Cylinder Head Bolt Hole Thread Repair

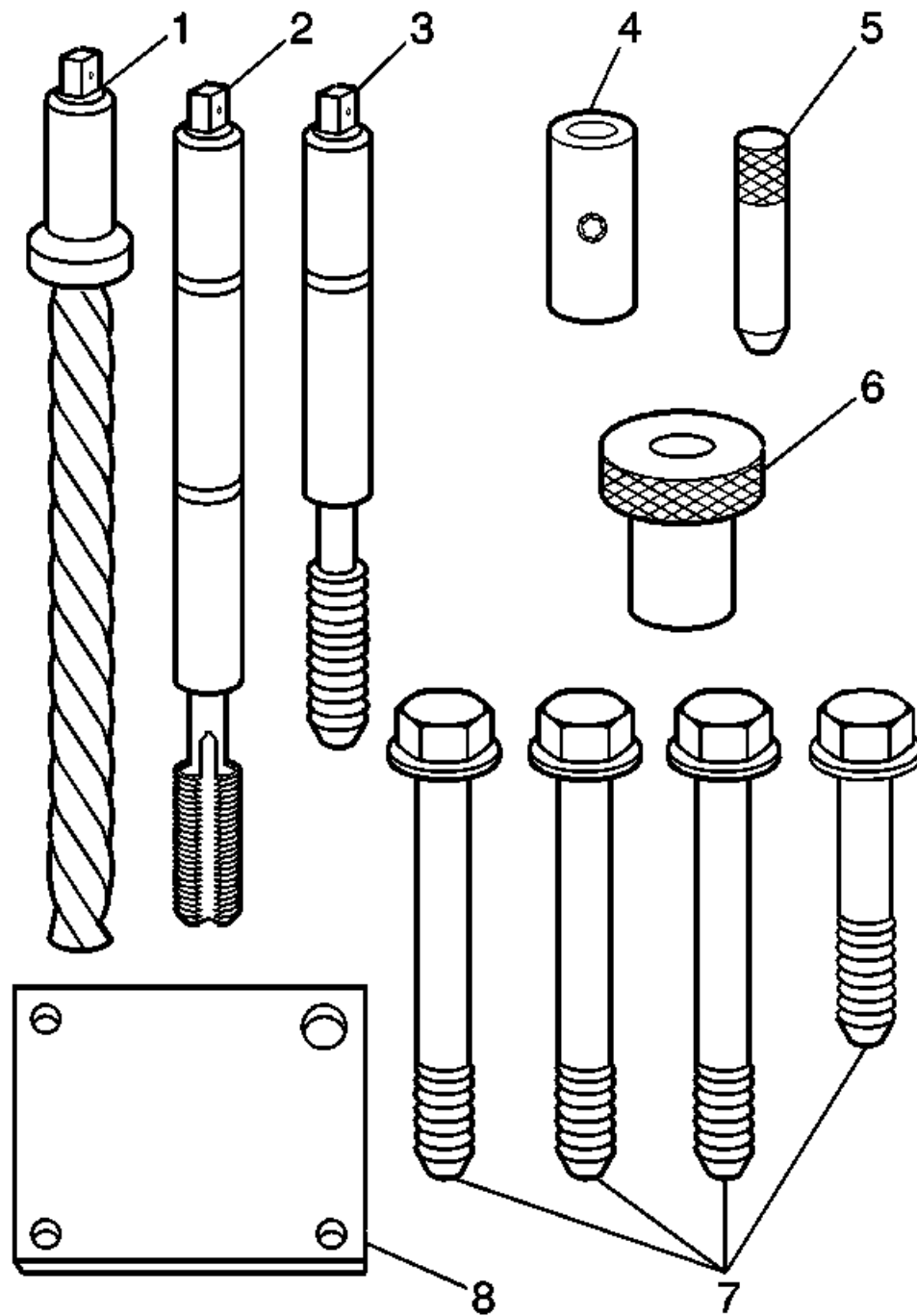


Fig. 493: Cylinder Head Bolt Hole Thread Repair Kit
Courtesy of GENERAL MOTORS COMPANY

NOTE: The tools listed may not necessarily represent the exact tools used for the procedure.

1. The cylinder head bolt hole thread repair kit consists of the following items:
 - Drill (1)
 - Tap (2)

- Installer (3)
- Sleeve (4)
- Alignment Pin (5)
- Bushing (6)
- Bolts (7)
- Fixture Plate (8)

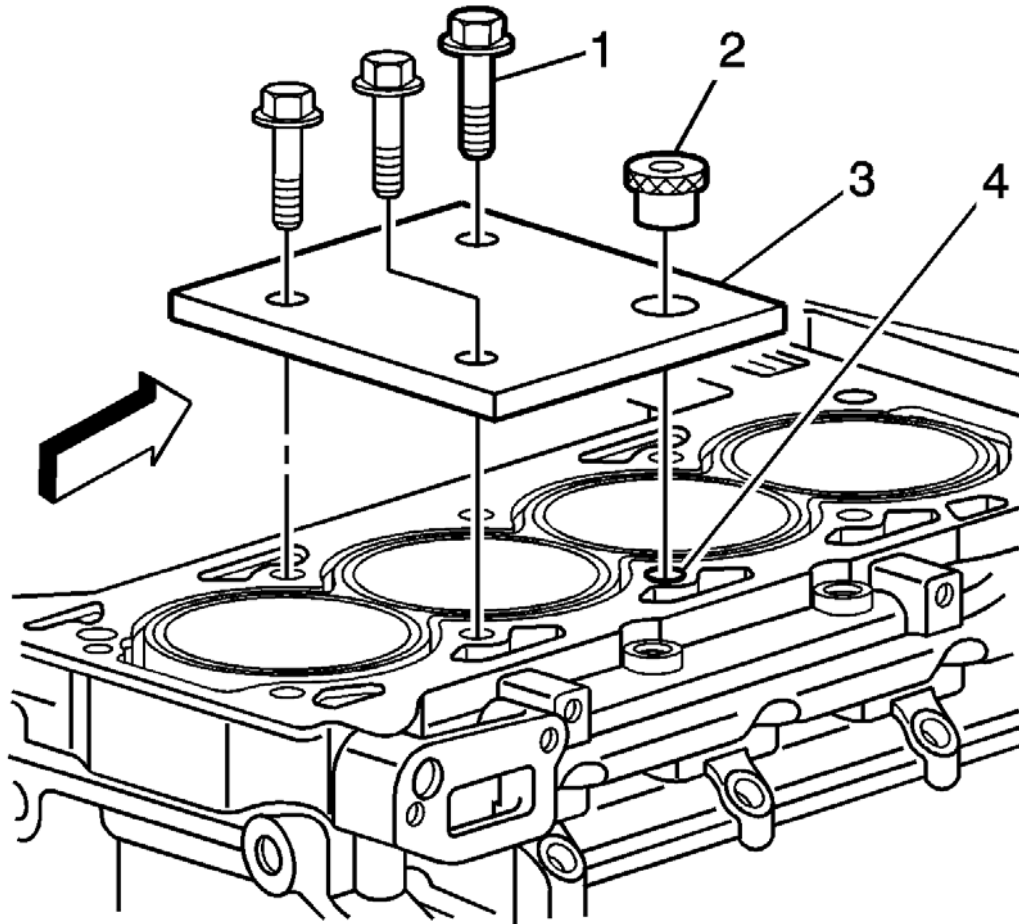


Fig. 494: Fixture Plate, Bolts And Bushing
 Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

NOTE: The use of a cutting fluid, WD 40® , or equivalent, is recommended when performing the drilling and tapping procedures. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

Driver oil **MUST** be used on the installer driver tool.

The tool kits are designed for use with either a suitable tap wrench or drill motor.

2. Install the fixture plate (3), bolts (1), and bushing (2) onto the engine block deck.

Position the fixture plate and bushing over the hole that is to be repaired (4).

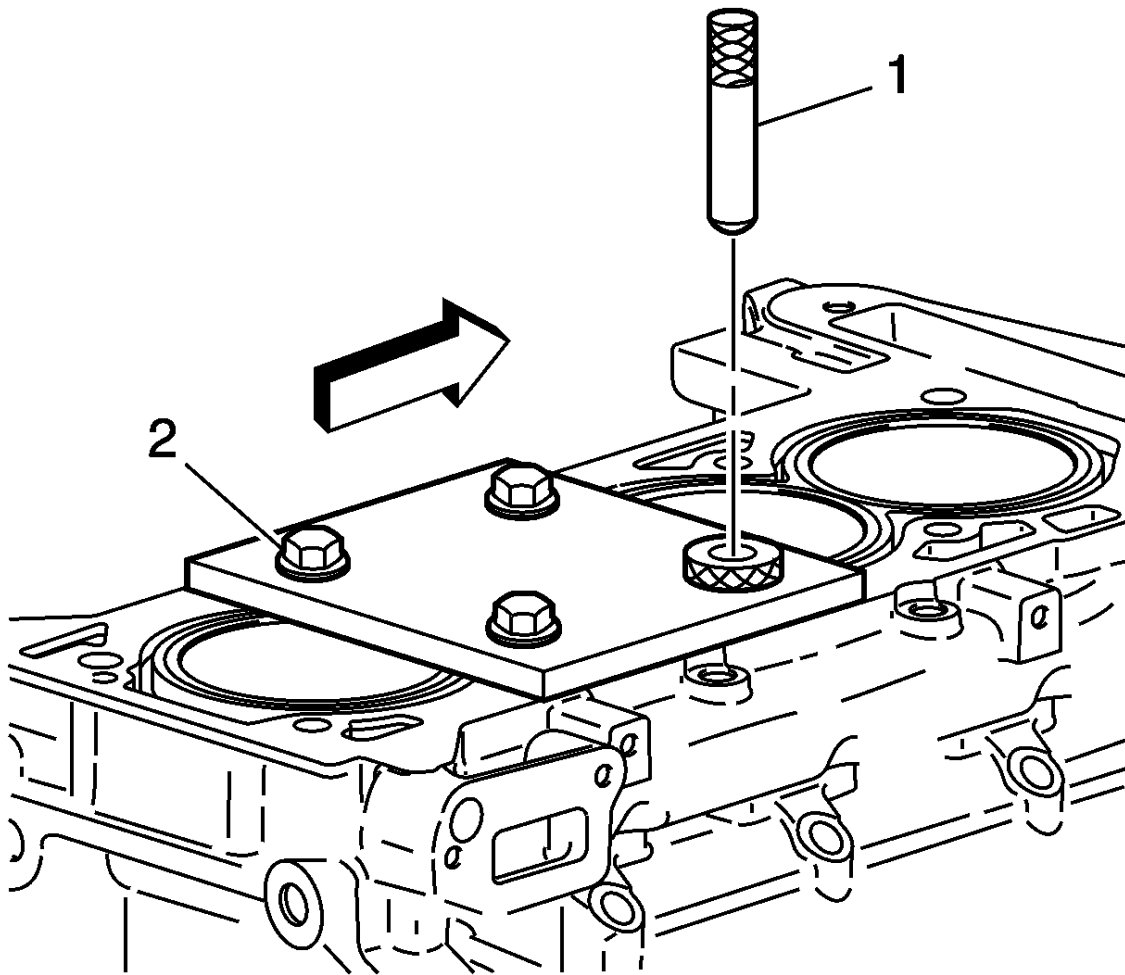


Fig. 495: Alignment Pin & Fixture Retaining Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Position the alignment pin (1) through the bushing and into the hole.
4. With the alignment pin in the desired hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin from the hole.

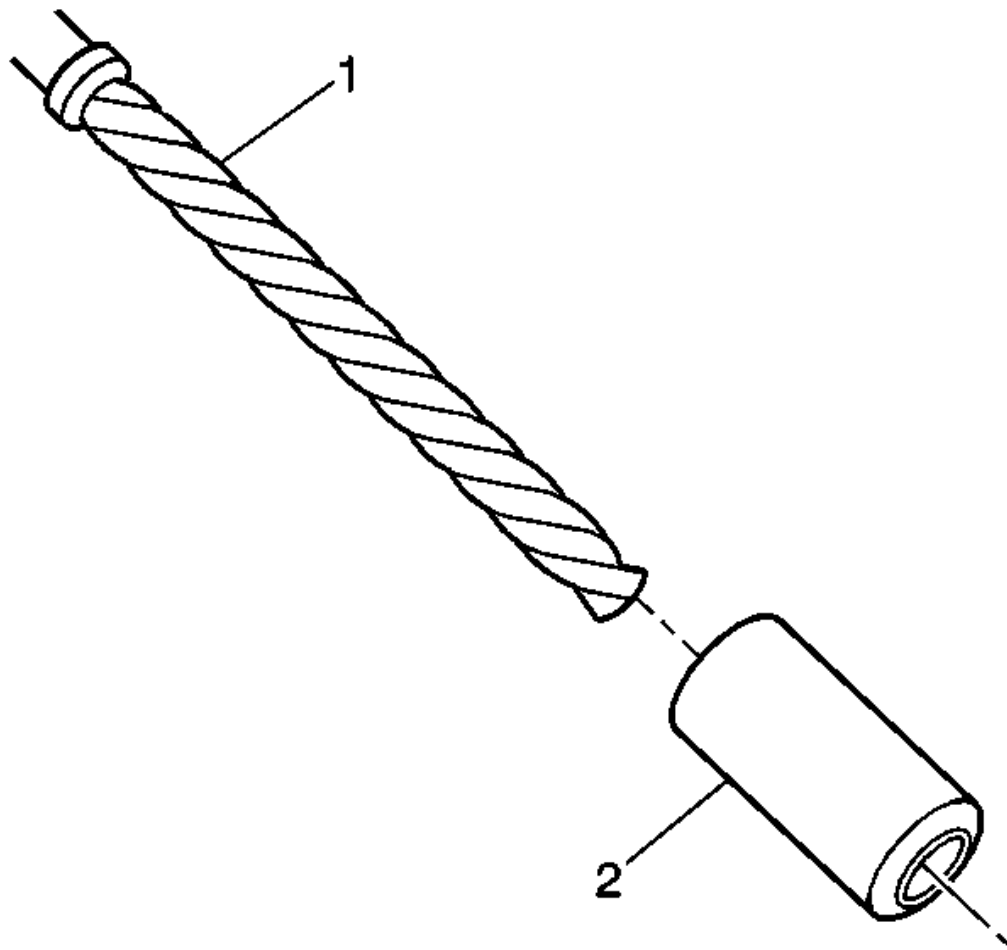


Fig. 496: Installing Sleeve Onto Drill

Courtesy of GENERAL MOTORS COMPANY

6. Install the sleeve (2) onto the drill (1), if required.

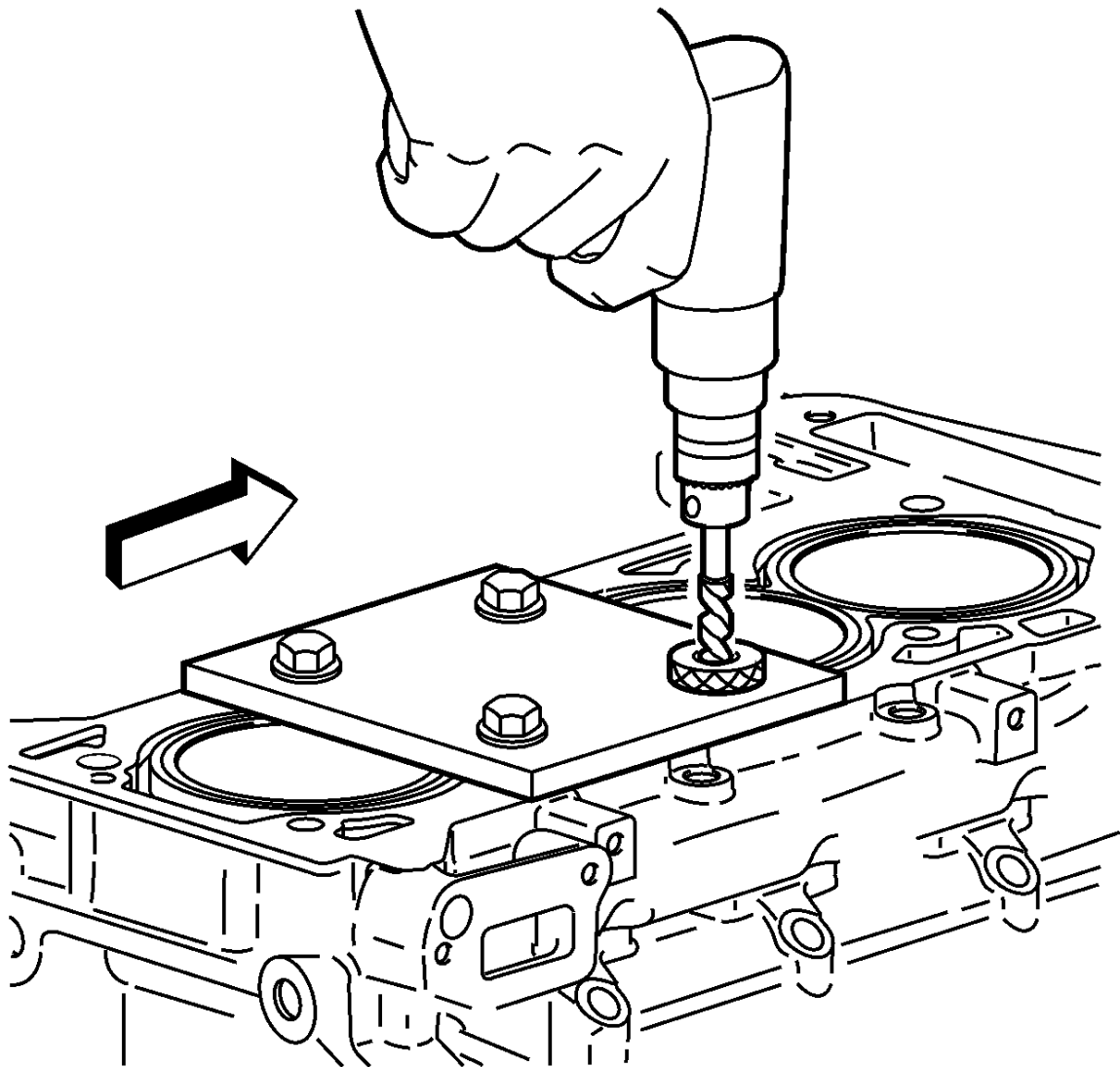


Fig. 497: Drilling Out Threads Of Damaged Hole

Courtesy of GENERAL MOTORS COMPANY

NOTE: During the reaming process, it is necessary to repeatedly remove the drill and clean the chips from the hole.

7. Drill out the threads of the damaged hole.

Drill the hole until the stop collar of the drill bit or the sleeve contacts the bushing.

WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

8. Using compressed air, clean out any chips.

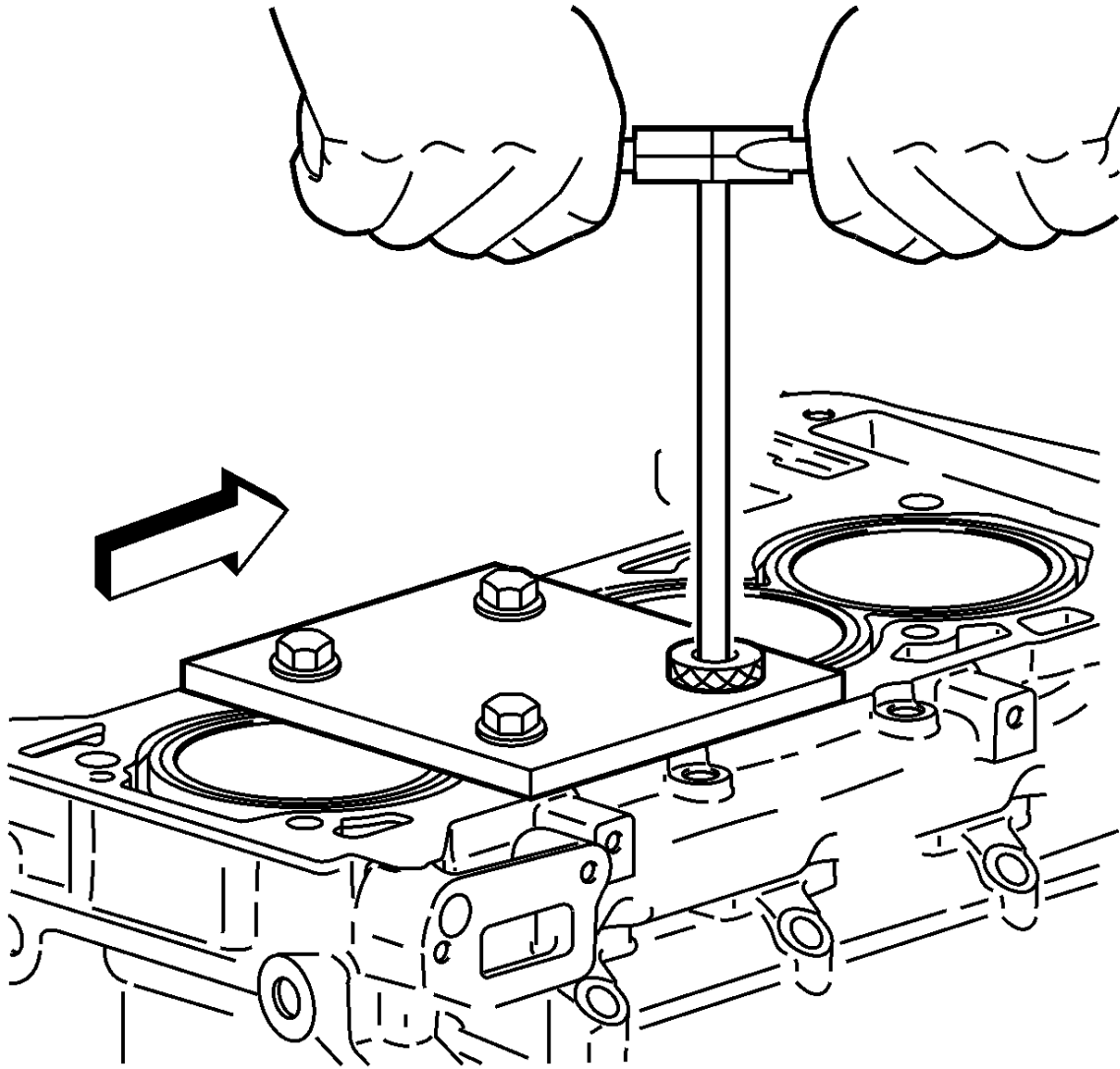


Fig. 498: Tapping Threads Of Drilled Hole With Tap Wrench
Courtesy of GENERAL MOTORS COMPANY

9. Using a tap wrench, tap the threads of the drilled hole.

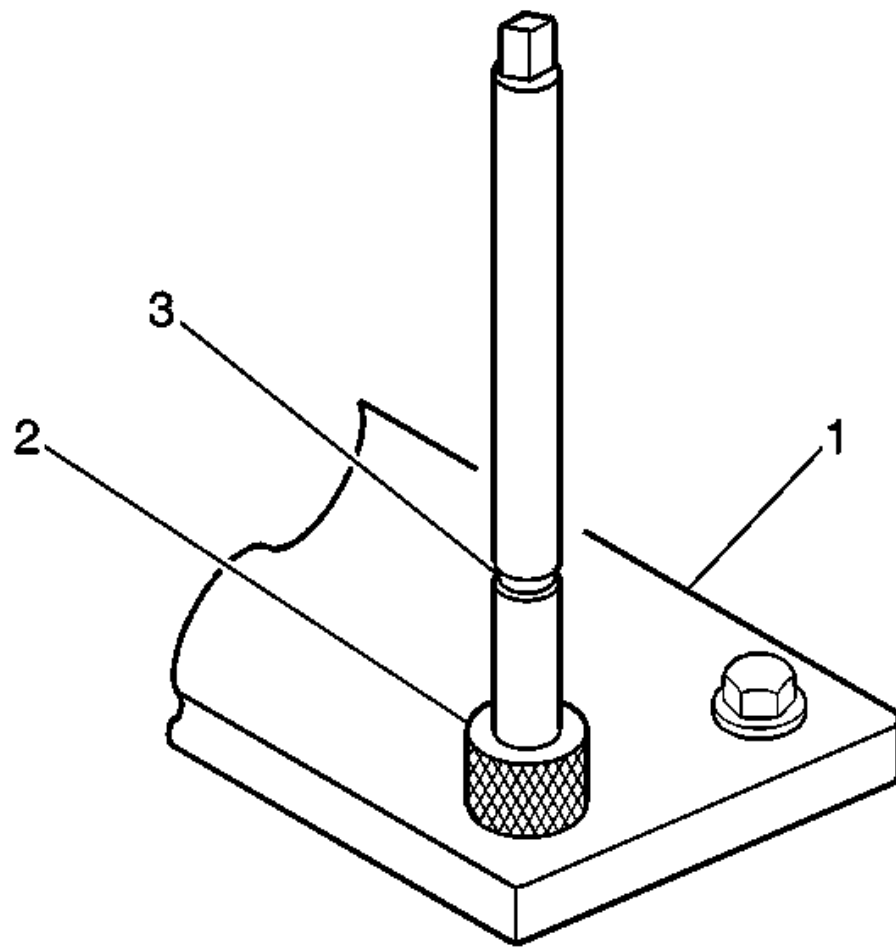


Fig. 499: Fixture Plate, Drill Bushing And Tool Marking
Courtesy of GENERAL MOTORS COMPANY

10. Using a TAP wrench, tap the threads of the drilled hole.

In order to tap the new threads to the proper depth, rotate the tap into the hole until the mark (3) on the tap align with the top of the drill bushing (2).

11. Remove the fixture plate (1), bushing (2), and bolts.

WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

WARNING: Refer to [Cleaning Solvent Warning](#) .

12. Using compressed air, clean out any chips.

13. Spray cleaner into the hole. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

14. Using compressed air, clean any cutting oil and chips out of the hole.

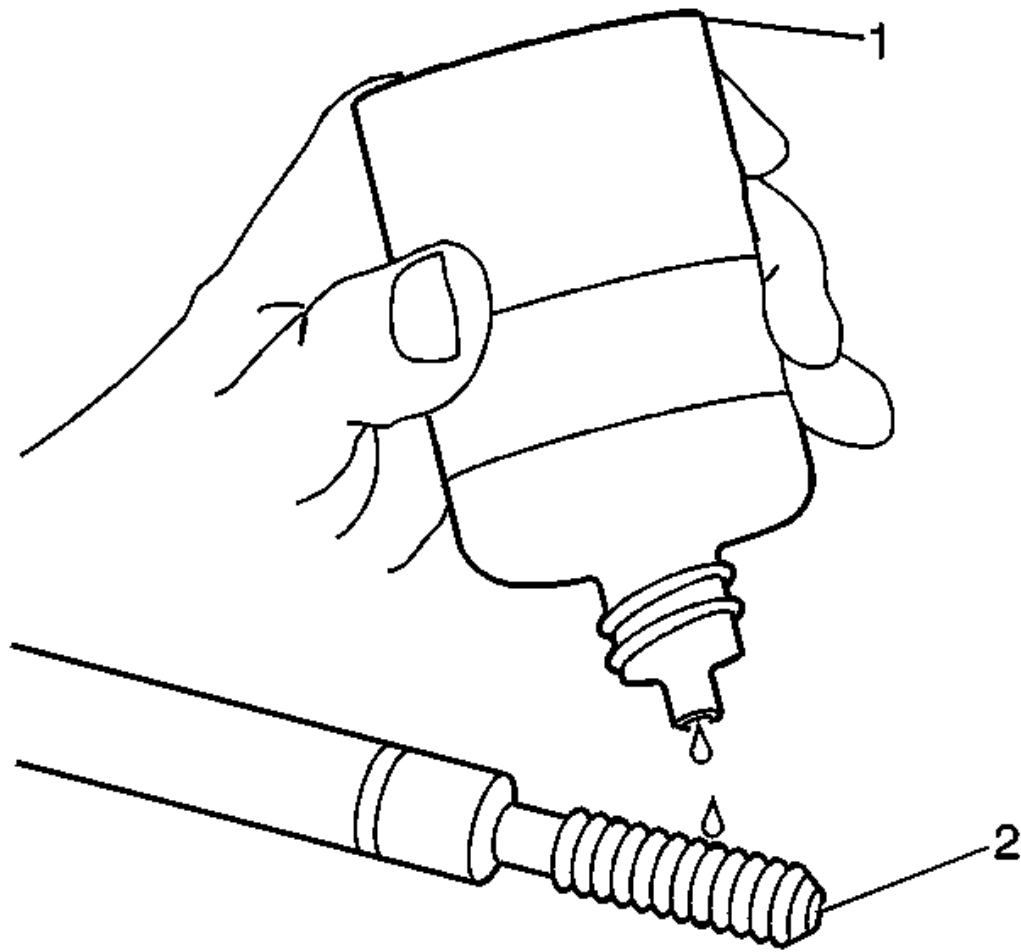


Fig. 500: Lubricating Installer Tool Threads
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

15. Lubricate the threads of the installer tool (2) with the driver oil (1).

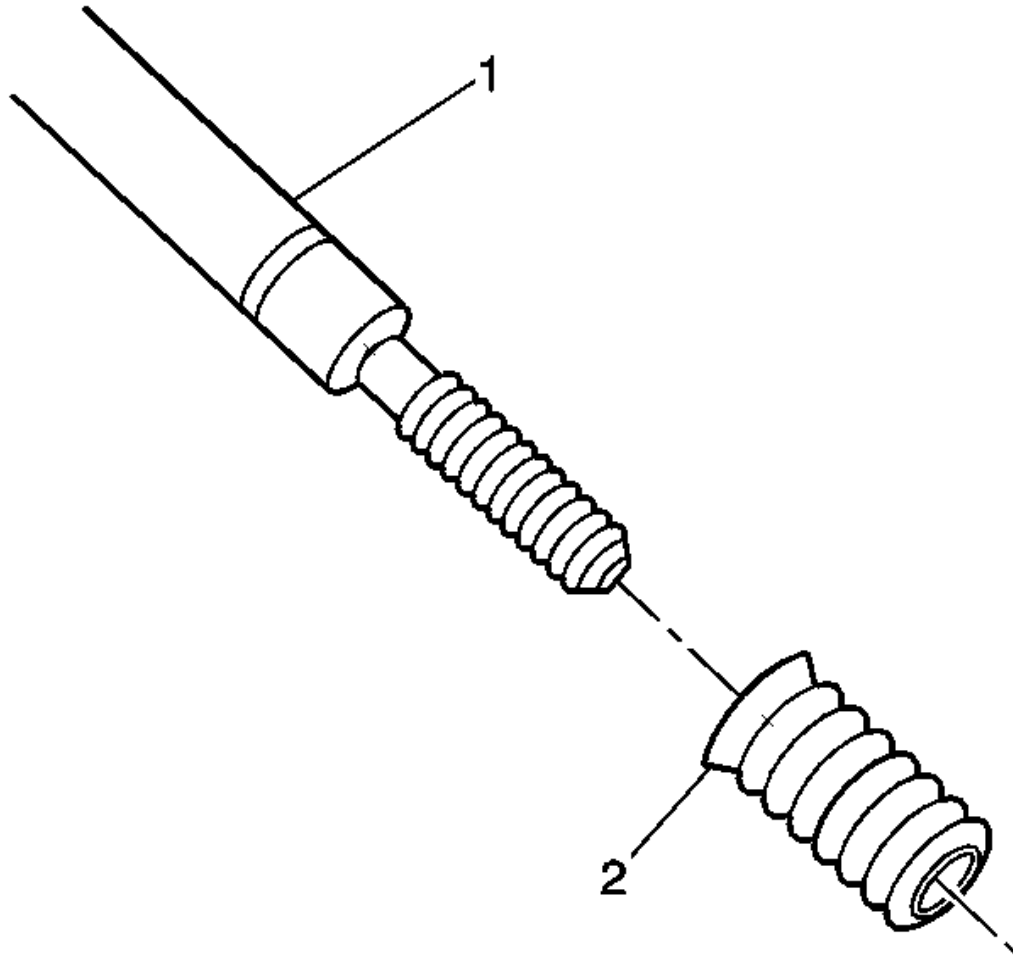


Fig. 501: Driver Tool And Insert

Courtesy of GENERAL MOTORS COMPANY

16. Install the insert (2) onto the driver tool (1).

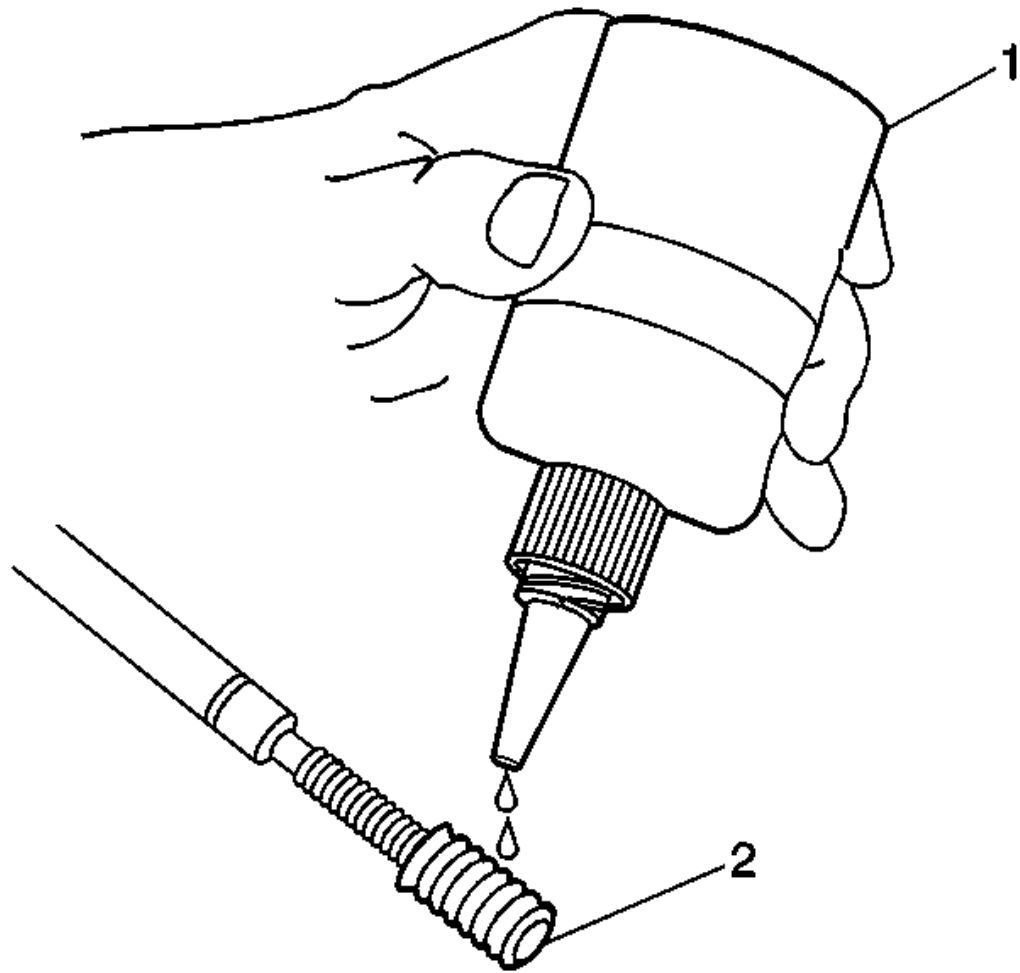


Fig. 502: Applying Threadlock To Insert OD Threads
Courtesy of GENERAL MOTORS COMPANY

17. Apply threadlock LOCTITE™ 277, EN 42385 - 109 loctite (1), or equivalent to the insert OD threads (2).

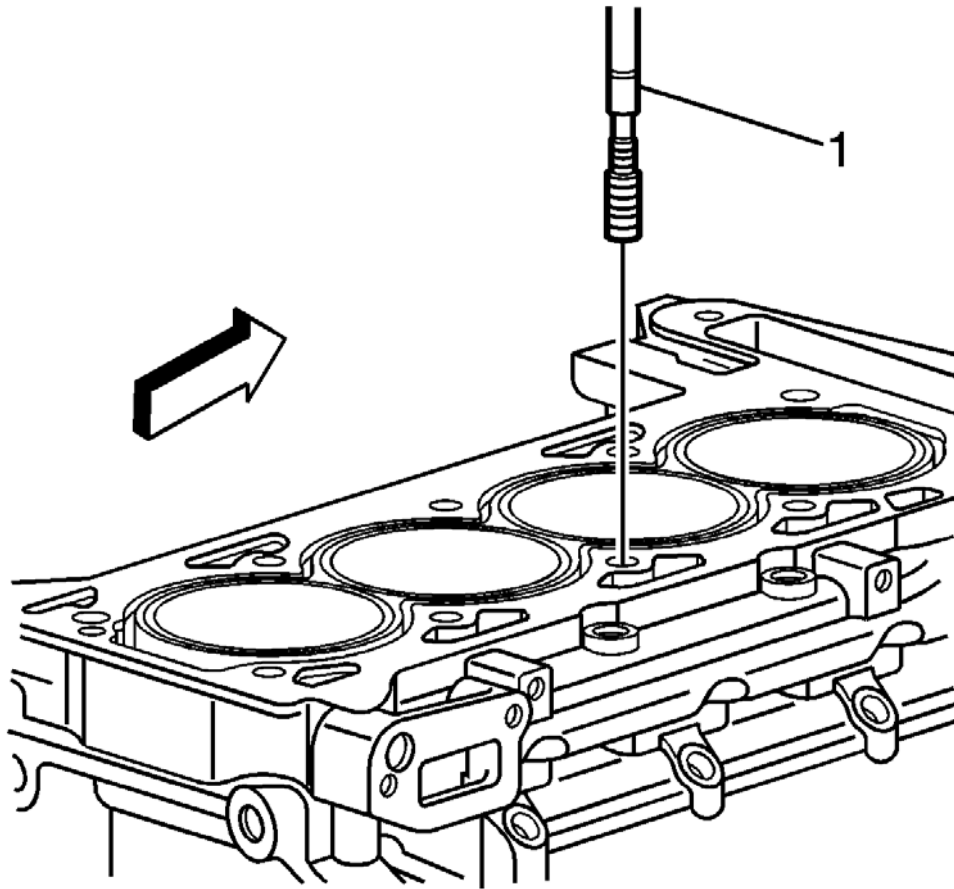


Fig. 503: Installing Insert And Driver Into Hole
Courtesy of GENERAL MOTORS COMPANY

18. Install the insert and driver (1) into the hole.

Rotate the driver tool until the mark on the tool aligns with the deck surface of the engine block.

The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

SERVICE PRIOR TO ASSEMBLY

The importance of cleanliness during assembly cannot be overstated. Dirt or debris will cause engine damage. An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in ten thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly in order to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas are part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Lubricate all moving parts with engine oil or a specified assembly lubricant. This will provide lubrication for initial start up.

CRANKSHAFT AND BEARING INSTALLATION

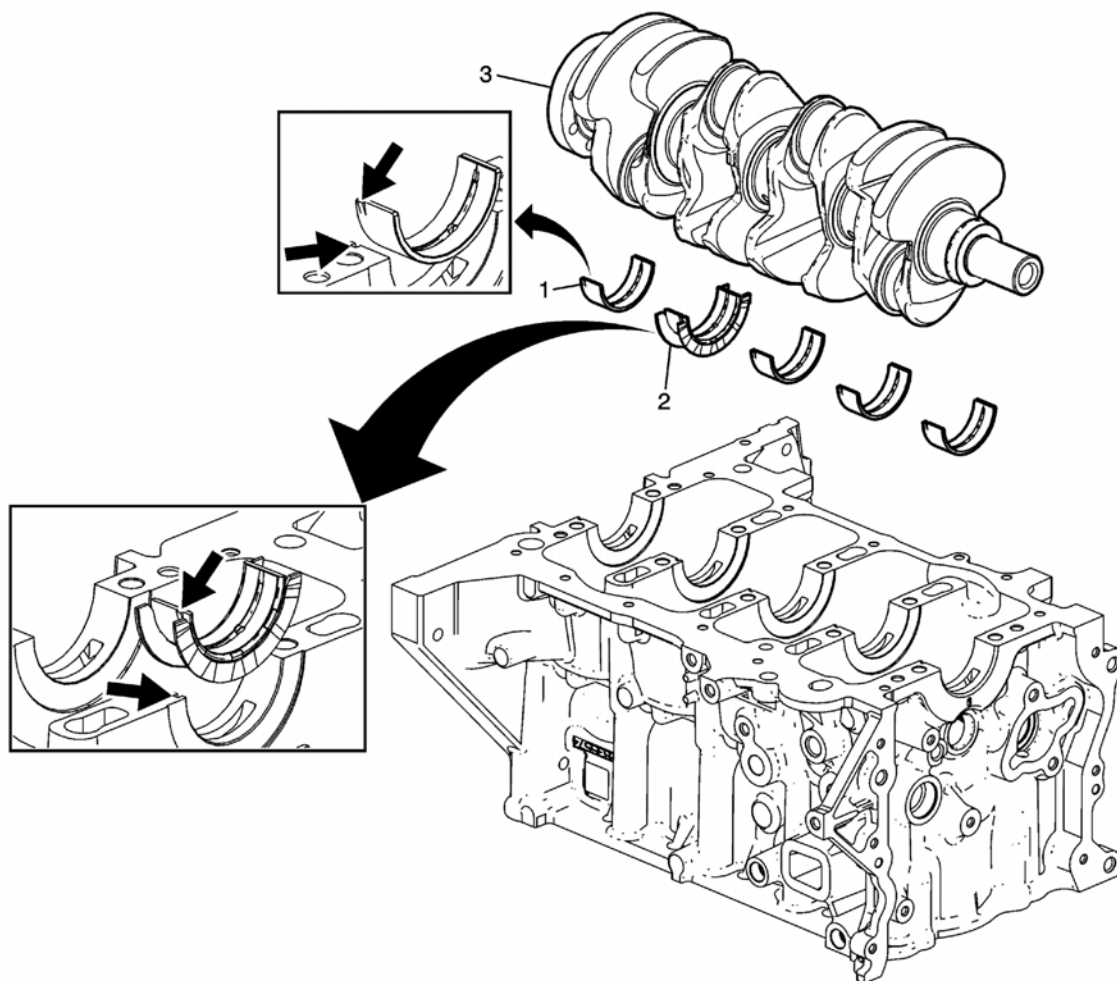


Fig. 504: Crankshaft and Bearing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Upper Bearing (Qty: 4) NOTE: • Crankshaft bearings MUST be separated, marked, or organized in a way to ensure installation to their original location and position, when suitable for

Callout	Component Name
	use. • For vehicles equipped with Start/Stop and Hybrid vehicles, the #1 upper bearing is specifically coated for durability and has a blue coloration. Procedure Ensure that the guide lug on the bearing is properly seated to the notch in the engine block for each bearing. Coat the crankshaft bearing shell with engine oil.
2	Crankshaft Thrust Bearing Procedure Ensure that the guide lug on the bearing is properly seated to the notch in the engine block. Coat the crankshaft bearing shell with engine oil.
3	Crankshaft

LOWER CRANKCASE INSTALLATION

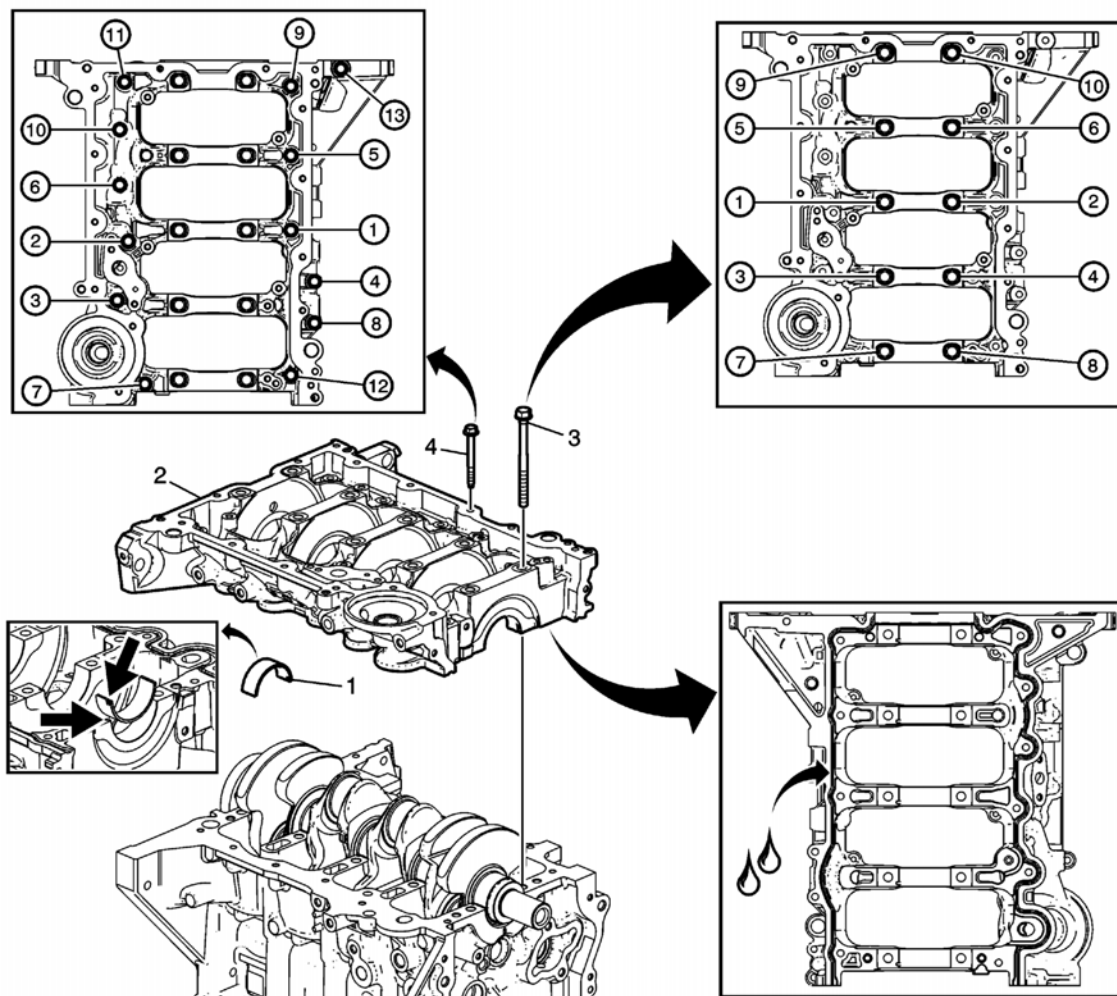


Fig. 505: Lower Crankcase With Bolt Tightening Sequences
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Lower Bearing (Qty: 5) Procedure Install the bearings in the lower crankcase, and ensure that the guide lug on the bearing is properly seated to the notch in the lower crankcase for each bearing. Coat the crankshaft bearing shell with engine oil.
2	Lower Crankcase Procedure 1. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant NOTE: The block assembly surface must be free of contamination prior to

Callout	Component Name
	applying the sealer. • Install and align the bedplate to block within 20 minutes of applying the sealer. • The bedplate must be fastened to final torque specification within 60 minutes of applying the sealer. 2. Apply a 3 mm bead of sealer directly in the groove of the block to bedplate mating surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers. 3. Install the lower crankcase, ensure the lower crankcase is aligned properly on the dowels. Tap gently into place with a suitable tool, if necessary.
3	Lower Crankcase Bolts (Qty: 10) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Tighten the NEW lower crankcase bolts in the sequence shown. 1. Tighten the bolts in sequence a first pass to 15 N.m (11 lb ft). 2. Using the EN 45059 angle meter, tighten the bolts in sequence a final pass to 180 degrees. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

Callout	Component Name
4	Lower Crankcase Bolts (Qty: 13) Procedure 1. Apply sealant to the lower crankcase perimeter bolts. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Tighten the lower crankcase bolts in the sequence shown. 3. Tighten the bolts in sequence a first pass to 5 N.m (44 lb in). 4. Tighten the bolts in sequence a final pass to 10 N.m (89 lb in).

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

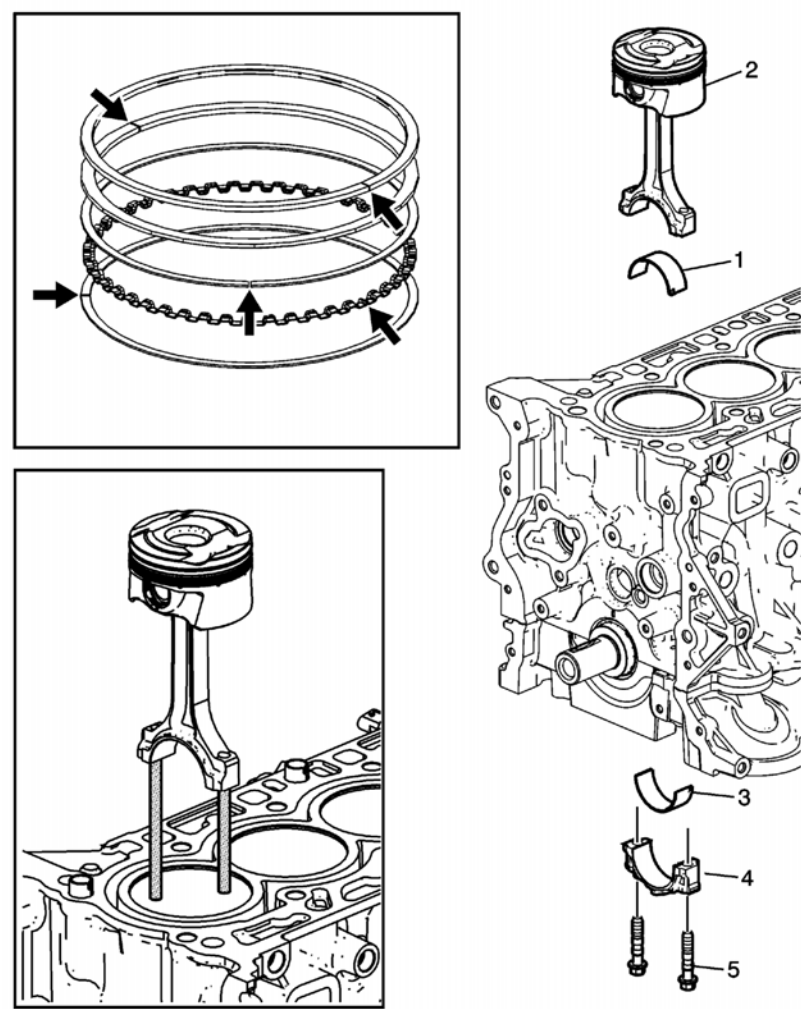


Fig. 506: Piston, Connecting Rod and Bearing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure NOTE: Many internal engine	

Callout	Component Name
	components will develop specific wear patterns on their friction surfaces. 1. Components MUST be separated, marked, or organized in a way to ensure installation to their original location and position. Take precautions in order to prevent interchanging of parts. 2. Ensure all components are adequately marked with location, direction, or orientation when necessary.
1	Connecting Rod Bearing (Qty: 4) NOTE: The connecting rod bearing anti-rotation tab grooves are to point toward the right-hand side of the engine. Procedure Install NEW bearings to the connecting rods and lubricate each bearing with engine oil.
2	Piston and Connecting Rod Assembly (Qty: 4) NOTE: The connecting rods and caps must be installed in the same order and orientation in which they were removed. If new connecting rods are required, the connecting rod is provided as an assembly,

Callout	Component Name
	and the upper rod will need to be disassembled from the lower cap. Procedure 1. Install the EN-51454 guides into the connecting rod bolt holes. This protects the crankshaft journal during piston and connecting rod installation. NOTE: Ensure to stagger each piston ring end gap equally around the piston. NOTE: When installing a piston into a cylinder, use a ring compressor sleeve or equivalent for best results. The following features should be looked for when selecting a ring compressor sleeve: • Hard anodized and Teflon coated for low friction and prolonged wear resistance. • Smooth radius that tapers down to the specific bore size.

Callout	Component Name
	• Sleeve should compress the piston rings smoothly and evenly. • Using a ring compressor sleeve greatly reduces the difficulty with installing thin high-performance oil rings. If a ring compressor sleeve is unavailable, a universal ring compressor will work, but is more difficult to use. 2. Install the ring compressor on the piston. 3. Ensure each piston ring end gap is spaced equally around the piston as shown. 4. Lubricate the piston and the piston rings with engine oil. Do not disturb the piston ring end gap location. 5. Lubricate the correct engine bore for the piston. NOTE: The piston must be installed oriented correctly to the front of the engine. 6. Position the piston so that the arrow mark on the top of the piston points to the front of the engine. 7. Install the ring compressor, the piston, and the connecting rod to the correct bore. 8. Tap the piston into the bore with a hammer handle. Guide the connecting rod to the connecting rod journal while tapping the piston into place. 9. Hold the ring compressor against the engine block until all the rings have entered the cylinder bore.

Callout	Component Name
	10. Remove the connecting rod guides from the connecting rod bolt holes. Special Tools EN-51454 Connecting Rod Guides For equivalent regional tools, refer to Special Tools.
3	Connecting Rod Bearing (Qty: 4) Procedure Install NEW bearings to the connecting rod caps and lubricate each bearing with engine oil.
4	Connecting Rod Cap (Qty: 4) Procedure Ensure that the connecting rod cap is properly oriented on the connecting rod.
5	Connecting Rod Bolts (Qty: 8) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure 1. Install NEW connecting rod bolts and tighten using the EN 45059 angle meter. 1. Tighten the bolts a first pass to 25 N.m (18 lb ft). 2. Tighten the bolts a final pass 75 degrees using EN 45059 angle meter. NOTE: Rotate the crankshaft to ensure that it moves freely and does not bind. 2. Measure the connecting rod side clearance with a feeler gauge. Refer to Engine Mechanical Specifications. 3. Measure the piston deck height. Refer to Engine Mechanical Specifications. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

CRANKSHAFT OIL DEFLECTOR INSTALLATION

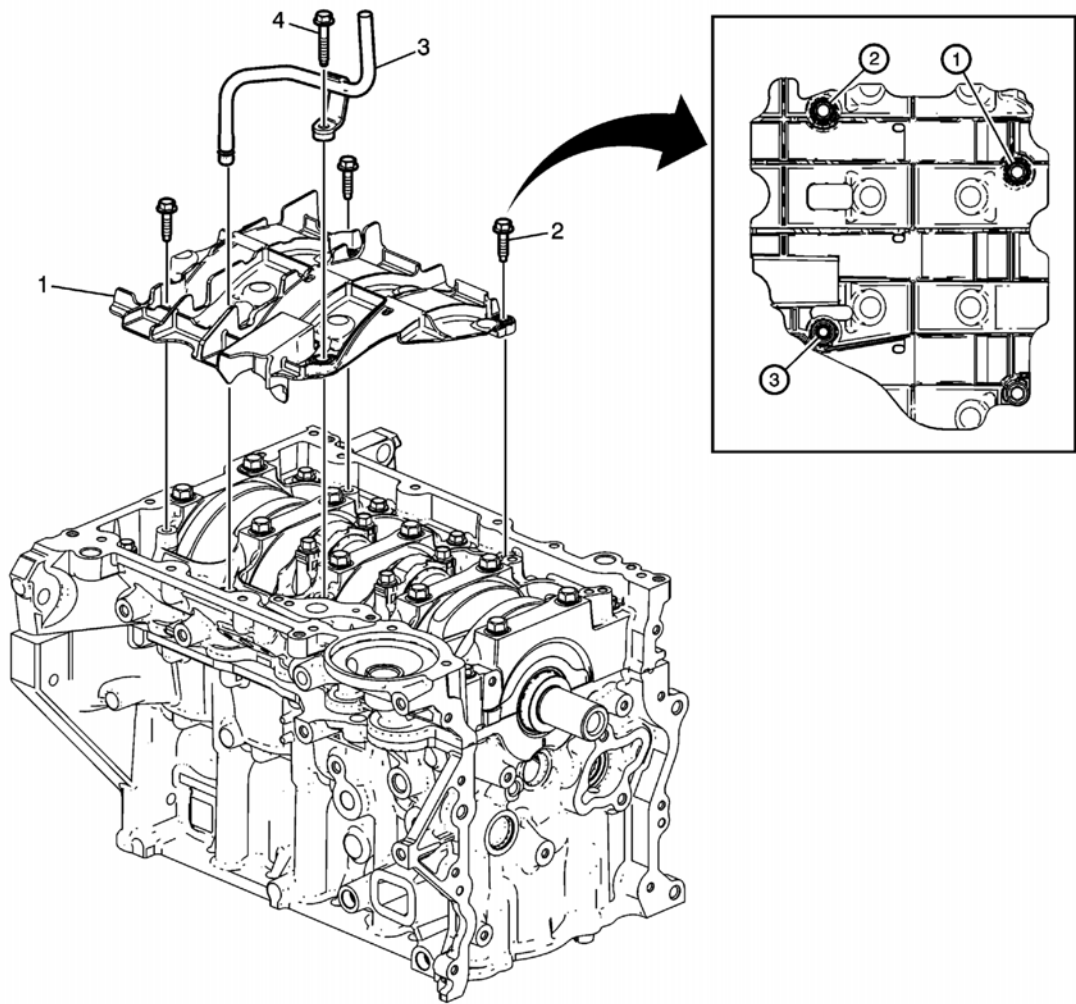


Fig. 507: Crankshaft Oil Deflector (With Bolt Tightening Sequence)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Oil Deflector
2	Crankshaft Oil Deflector Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 10 N.m (89 lb in)
3	Positive Crankcase Ventilation Oil Separator Drain Pipe
4	Positive Crankcase Ventilation Oil Separator Drain Pipe Bolt Tighten 10 N.m (89 lb in)

CRANKSHAFT REAR OIL SEAL INSTALLATION

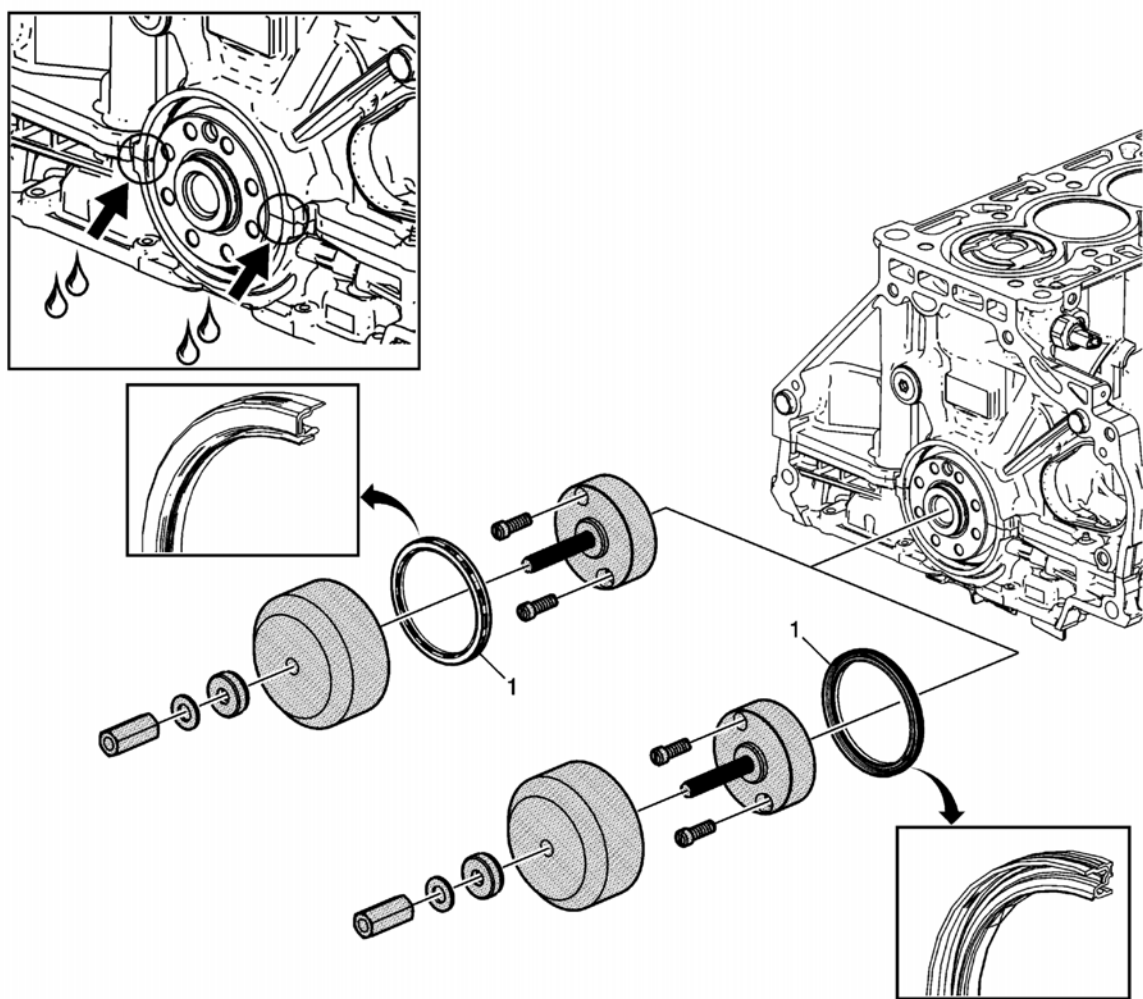


Fig. 508: Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Rear Oil Seal Procedure 1. Inspect the seal recess for excess sealer material at the lower crankcase to engine block mating location. Remove excess sealer, if present. 2. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant 3. Add RTV sealer at 2 locations where the bedplate and block join prior to installing the oil seal. Refer to Adhesives, Fluids, Lubricants, and Sealers. NOTE: The oil seal must be installed in the correct direction.

Callout	Component Name
	The side that faces out will have "this side out" printed on it. Depending on seal design, the way the seal is installed on the EN-51369 installer is opposite. Either the seal is installed over the back of the installer, or the seal is installed over the front of the installer. Match the seal design as shown above and install the seal onto the installer in the correct direction. 4. Install the oil seal in the correct direction on EN-51369 seal installer. NOTE: If the seal is improperly installed on the special tool, it will not install correctly. 5. Inspect the seal on EN-51369 seal installer, and ensure that the seal lip is not deformed. If necessary, remove the seal and reinstall on the special tool. 6. Assemble the EN-51369 seal installer components.

Callout	Component Name
	NOTE: The special tool installs and establishes the proper depth of the seal in the crankshaft seal bore. 7. Use EN-51369 seal installer to press the new crankshaft seal into the housing. Ensure that the seal is installed in the crankshaft seal bore flush to 0.5 mm depth. Special Tools EN-51369 Seal Installer For equivalent regional tools, refer to Special Tools.

OIL PUMP DRIVE CHAIN AND OIL PUMP INSTALLATION

Oil Pump Assembly Installation

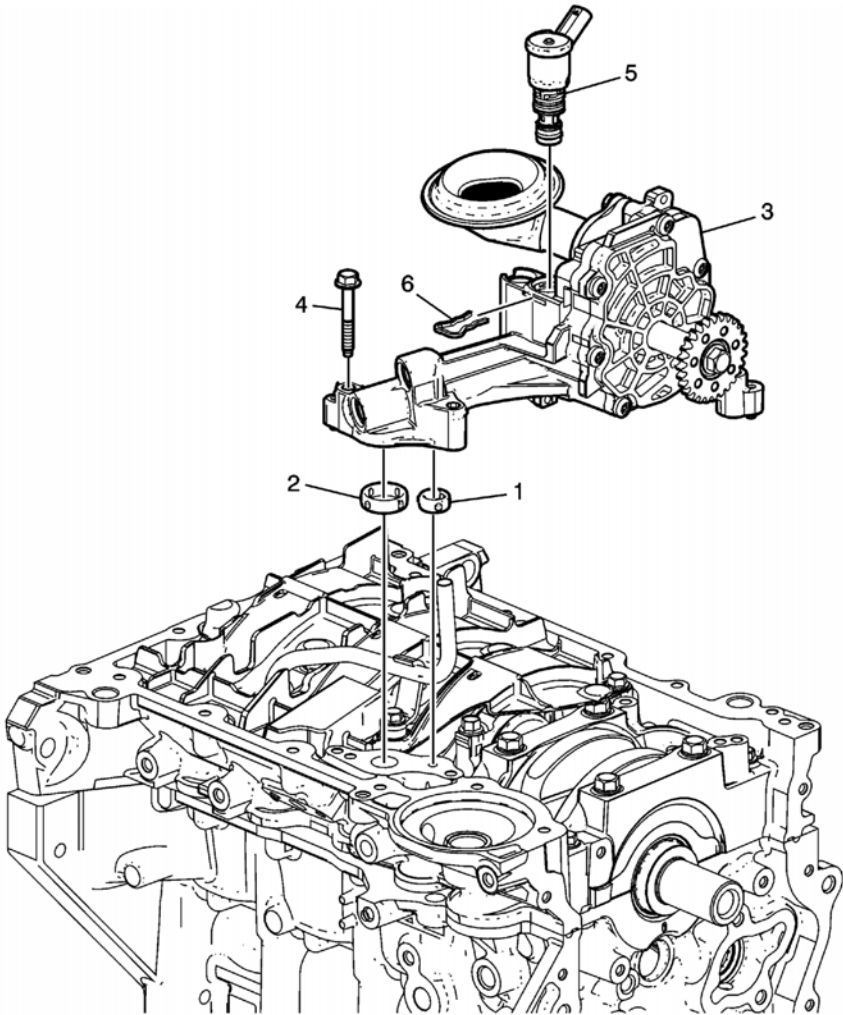


Fig. 509: Oil Pump Assembly
 Courtesy of GENERAL MOTORS COMPANY

Oil Pump Assembly Installation

Callout	Component Name
1	Oil Pump Gasket
2	Oil Pump Gasket
3	Oil Pump Assembly

Callout	Component Name
4	Oil Pump Assembly Bolt (Qty: 4) NOTE: Install the oil pump assembly and bolts loosely onto the engine block. Final torque must be performed after the drive chain is installed.
5	Oil Pump Flow Control Solenoid Valve
6	Oil Pump Flow Control Solenoid Valve Retainer

Crankshaft Sprocket and Oil Pump Drive Chain Installation

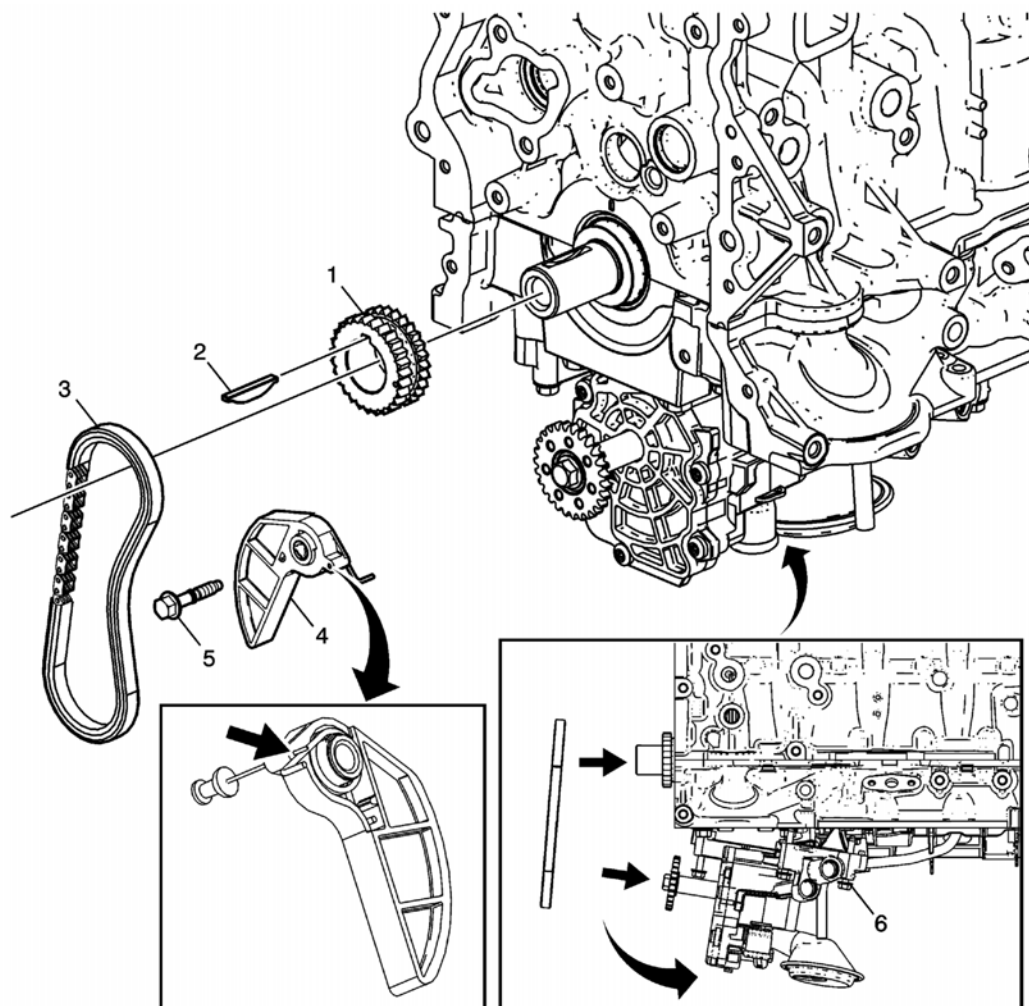


Fig. 510: Crankshaft Sprocket and Oil Pump Drive Chain

Crankshaft Sprocket and Oil Pump Drive Chain Installation

Callout	Component Name
1	Crankshaft Sprocket
2	Crankshaft Balancer Key
3	Oil Pump Drive Chain CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Procedure 1. Tilt the oil pump assembly in order to install the drive chain over the oil pump and crankshaft sprockets. 2. Once the drive chain is correctly positioned on the sprockets, tighten the oil pump assembly bolts to 10 N.m (89 lb in).
4	Oil Pump Drive Chain Tensioner Assembly NOTE: Ensure the tensioner spring is retained in the correct position prior to installation.
5	Oil Pump Drive Chain Tensioner Bolt Tighten 10 N.m (89 lb in)
6	Oil Pump Assembly Bolt Tighten 10 N.m (89 lb in)

CYLINDER HEAD INSTALLATION

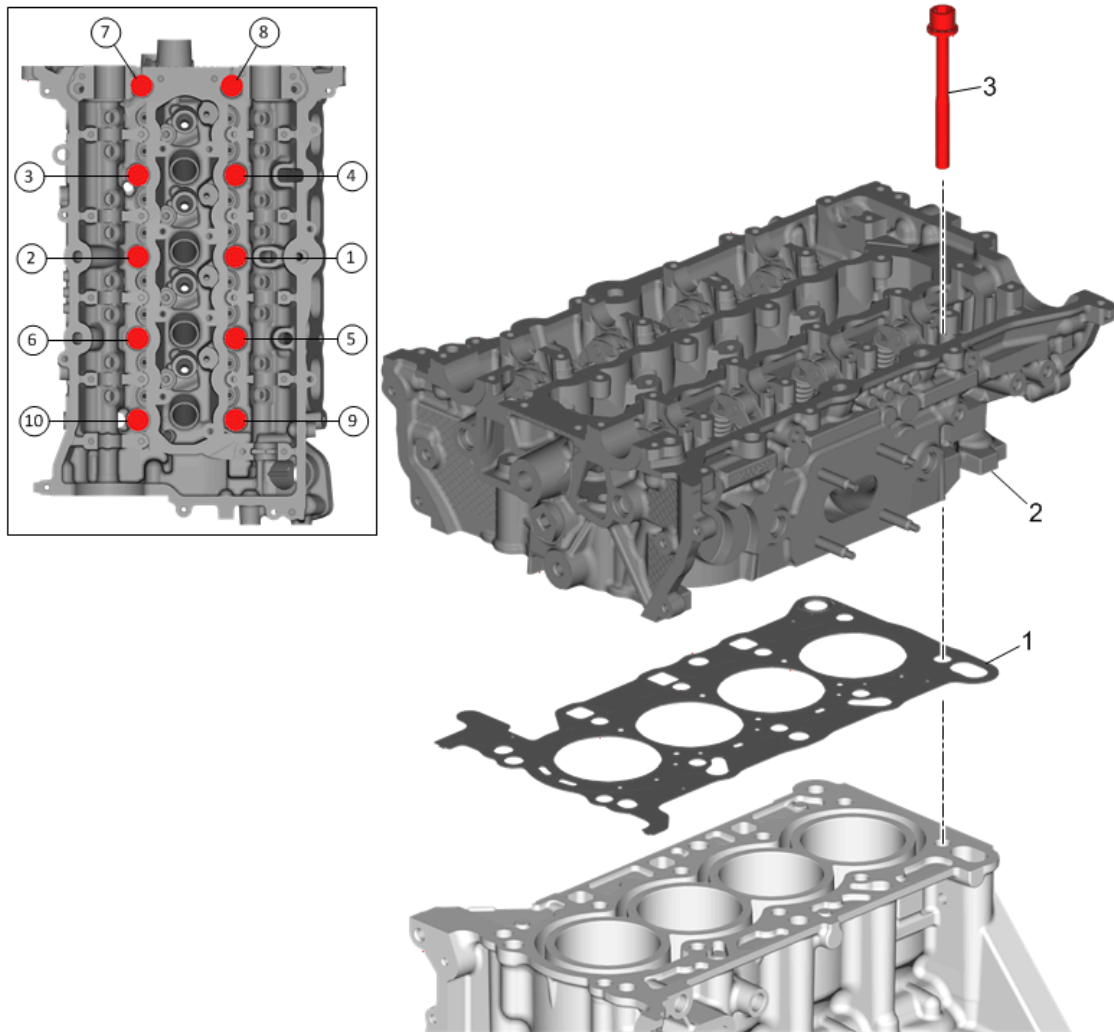


Fig. 511: Cylinder Head With Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Cylinder Head Gasket NOTE: Ensure that the cylinder head and the engine block sealing surfaces are clear of oil, grease, and old gasket material.
2	Cylinder Head Assembly
3	Cylinder Head Bolt (Qty: 10) CAUTION:

Callout	Component Name
	Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Tighten the NEW cylinder head bolts in the sequence shown. 1. Tighten the bolts a first pass to 30 N.m (22 lb ft). 2. Using the EN-45059 angle meter, tighten the bolts a final pass to 240 degrees. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

INTAKE AND EXHAUST CAMSHAFT, BEARING CAP, AND LASH ADJUSTER INSTALLATION

Valve Rocker Arm and Lash Adjuster Installation

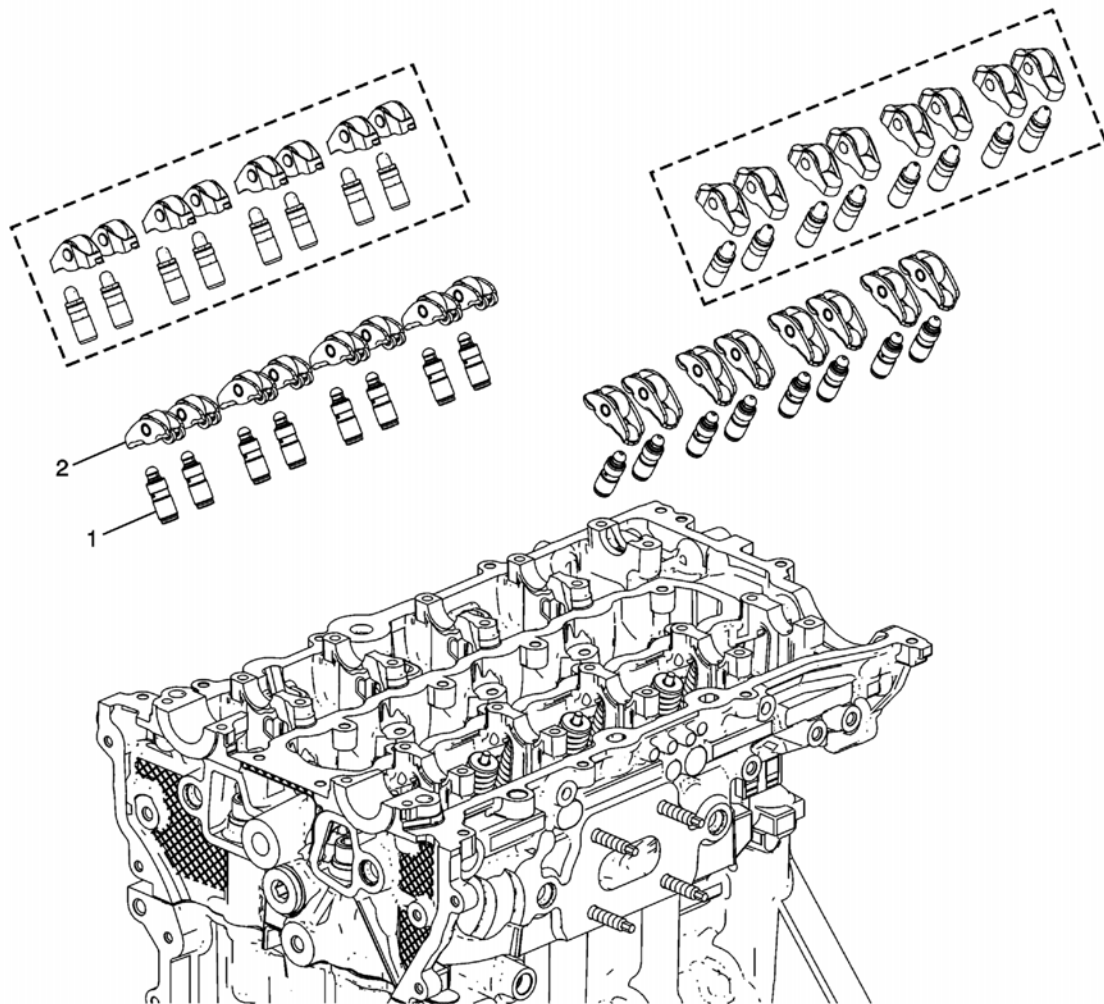


Fig. 512: Valve Rocker Arm and Lash Adjuster
 Courtesy of GENERAL MOTORS COMPANY

Valve Rocker Arm and Lash Adjuster Installation

Callout	Component Name
1	Hydraulic Valve Lash Adjuster Assembly Procedure Install the lash adjusters in the bores in the cylinder head. Apply lubricant to the lash adjusters, refer to Adhesives, Fluids, Lubricants, and Sealers .
2	Hydraulic Valve Lash Adjuster Arm Assembly NOTE: Used lash adjuster arms must be returned to the original position on the camshaft. If the camshaft is being

Callout	Component Name
	replaced, the lash adjuster arms actuated by the camshaft must also be replaced. Procedure 1. Apply lubricant to the valve tips, refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Position the lash adjuster arm on the tip of the valve stem and on the lash adjuster. 3. Apply lubricant to the lash adjuster arms, refer to Adhesives, Fluids, Lubricants, and Sealers.

Camshaft Bearings and Camshaft Installation

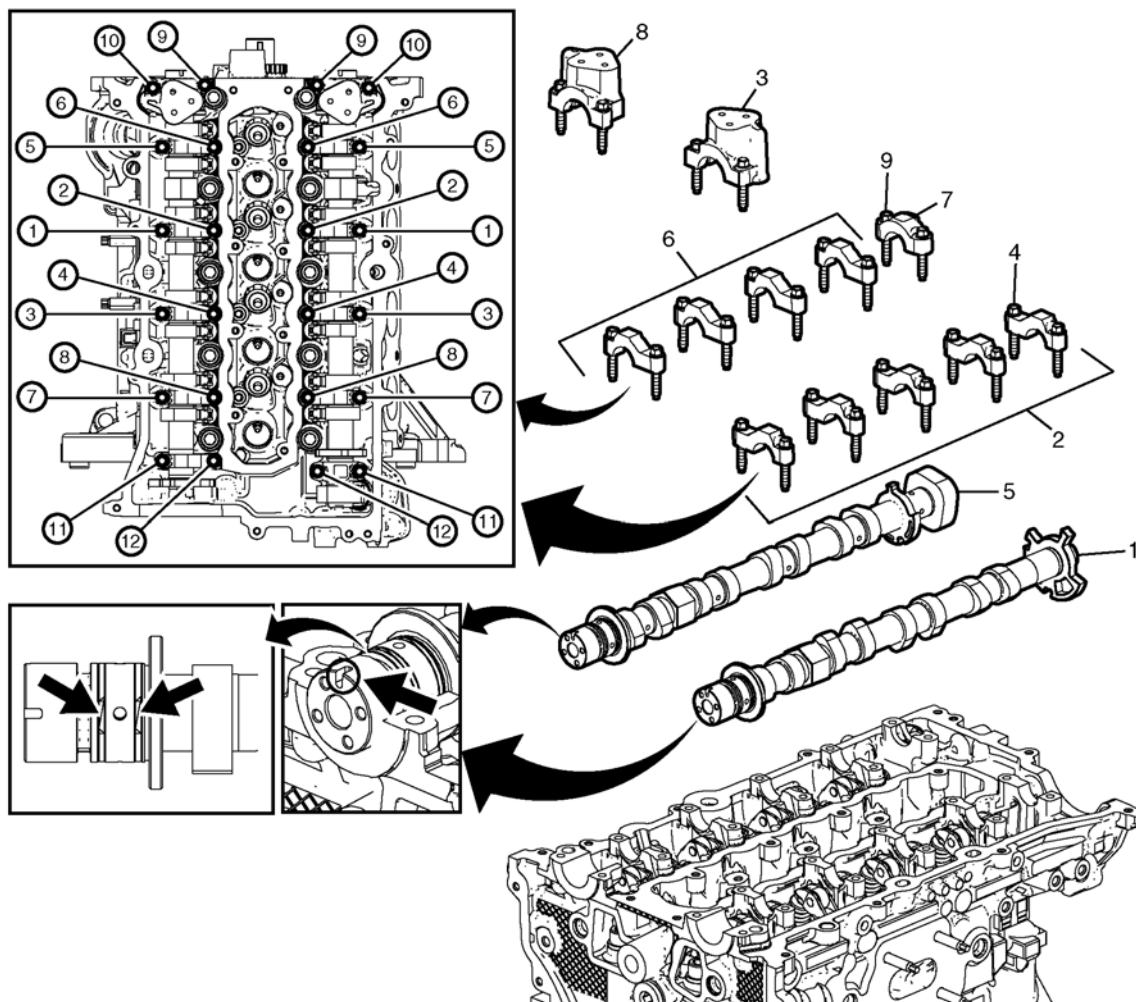


Fig. 513: Camshaft Bearings and Camshaft
Courtesy of GENERAL MOTORS COMPANY

Camshaft Bearings and Camshaft Installation

Callout	Component Name
1	Exhaust Camshaft Assembly Procedure 1. Coat the exhaust camshaft with lubricant. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Install the exhaust camshaft in the cylinder head. 3. Ensure that the camshaft notch at the front of the camshaft is in the 12 o'clock position. 4. Rotate the oil seal in the groove of the number one camshaft journal so the split line is at approximately the 12 o'clock position before installing the camshaft caps.
2	Camshaft Bearing Cap - Exhaust Side (Qty: 5) NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. Ensure the caps are installed in the original location and position. Procedure Install the cap and start the cap bolts by hand.
3	Camshaft Bearing Front Exhaust Cap Procedure Install the cap and start the cap bolts by hand.
4	Camshaft Bearing Cap Bolt - Exhaust Side (Qty: 12) CAUTION: Refer to Fastener Caution. Procedure 1. Lubricate the cap bolts. 2. Tighten the bearing cap bolts in sequence three turns each until the caps are seated. Tighten 12 N.m (106 lb in)

Callout	Component Name
5	Intake Camshaft Assembly Procedure 1. Coat the intake camshaft with lubricant. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Install the intake camshaft in the cylinder head. 3. Ensure that the camshaft notch at the front of the camshaft is in the 12 o'clock position. 4. Rotate the oil seal in the groove of the number one camshaft journal so the split line is at approximately the 12 o'clock position before installing the camshaft caps.
6	Camshaft Bearing Cap - Intake Side (Qty: 4) NOTE: Observe the markings on the bearing caps. Each bearing cap is marked in order to identify its location. Ensure the caps are installed in the original location and position. Procedure Install the cap and start the cap bolts by hand.
7	Camshaft Bearing Rear Cap - Intake Side Procedure Install the cap and start the cap bolts by hand.
8	Camshaft Bearing Front Intake Cap Procedure Install the cap and start the cap bolts by hand.
9	Camshaft Bearing Cap Bolt - Intake Side (Qty: 12) Procedure 1. Lubricate the cap bolts. 2. Tighten the bearing cap bolts in sequence three turns each until the caps are seated. Tighten 12 N.m (106 lb in)

Camshaft Actuator Installation

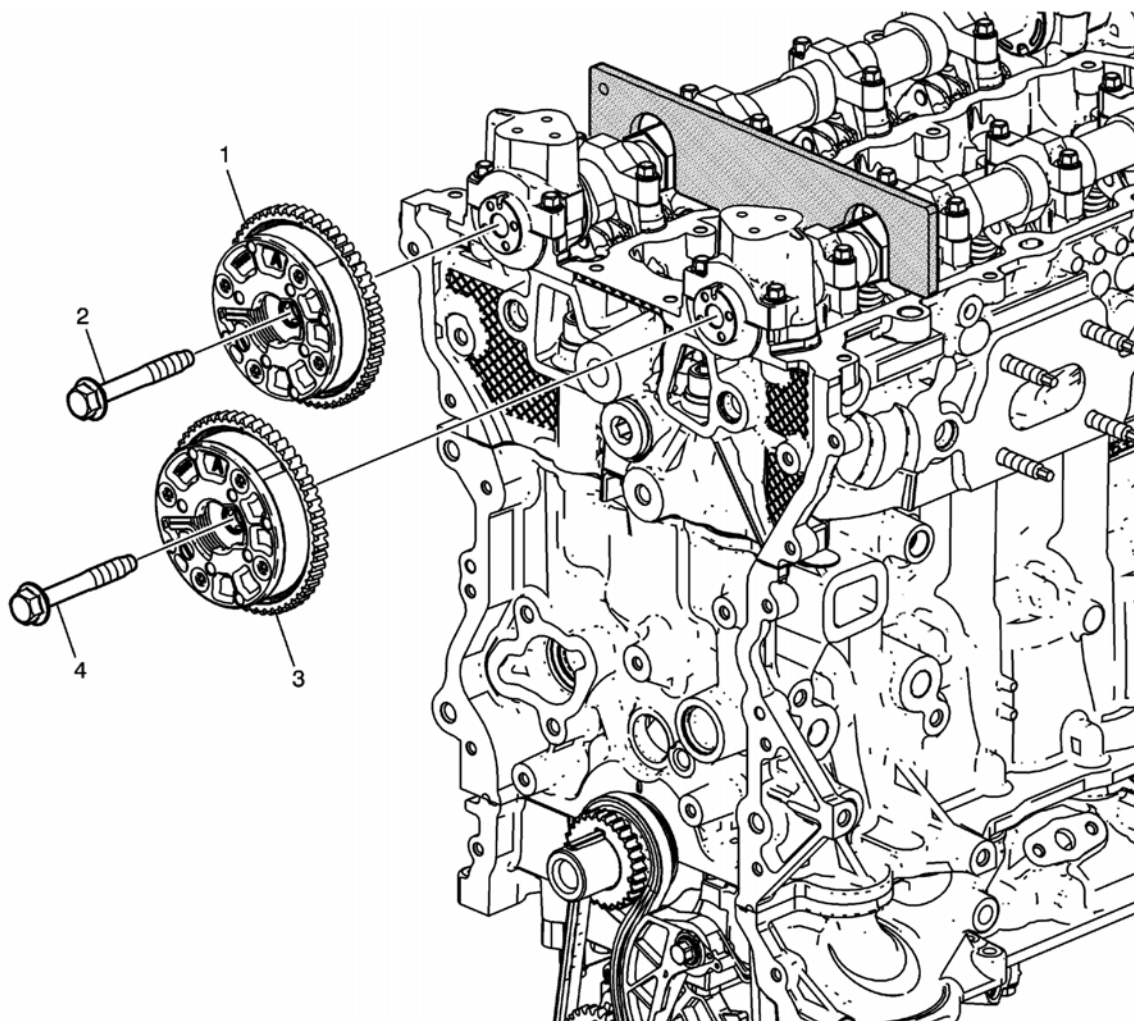


Fig. 514: Camshaft Actuator

Courtesy of GENERAL MOTORS COMPANY

Camshaft Actuator Installation

Callout	Component Name
Preliminary Procedure Install the EN-51367 camshaft locking tool. Remove when the camshaft actuator bolts are tightened to specification.	
Special Tools EN-51367 Camshaft Locking Tool For equivalent regional tools, refer to Special Tools .	
1	Camshaft Position Actuator - Intake NOTE: Align the actuator with the notch in the camshaft.
2	Camshaft Position Actuator Bolt CAUTION:

Callout	Component Name
	Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Tighten the NEW camshaft position actuator bolt in the sequence shown. 1. Tighten the bolt a first pass to 20 N.m (15 lb ft). 2. Using the EN 45059 angle meter, tighten the bolt a final pass to 90 degrees. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.
3	Camshaft Position Actuator - Exhaust NOTE: Align the actuator with the notch in the camshaft.
4	Camshaft Position Actuator Bolt Procedure Tighten the NEW camshaft position actuator bolt in the sequence shown. 1. Tighten the bolt a first pass to 20 N.m (15 lb ft). 2. Using the EN-45059 angle meter, tighten the bolt a final pass to 90 degrees. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

CAMSHAFT TIMING CHAIN INSTALLATION

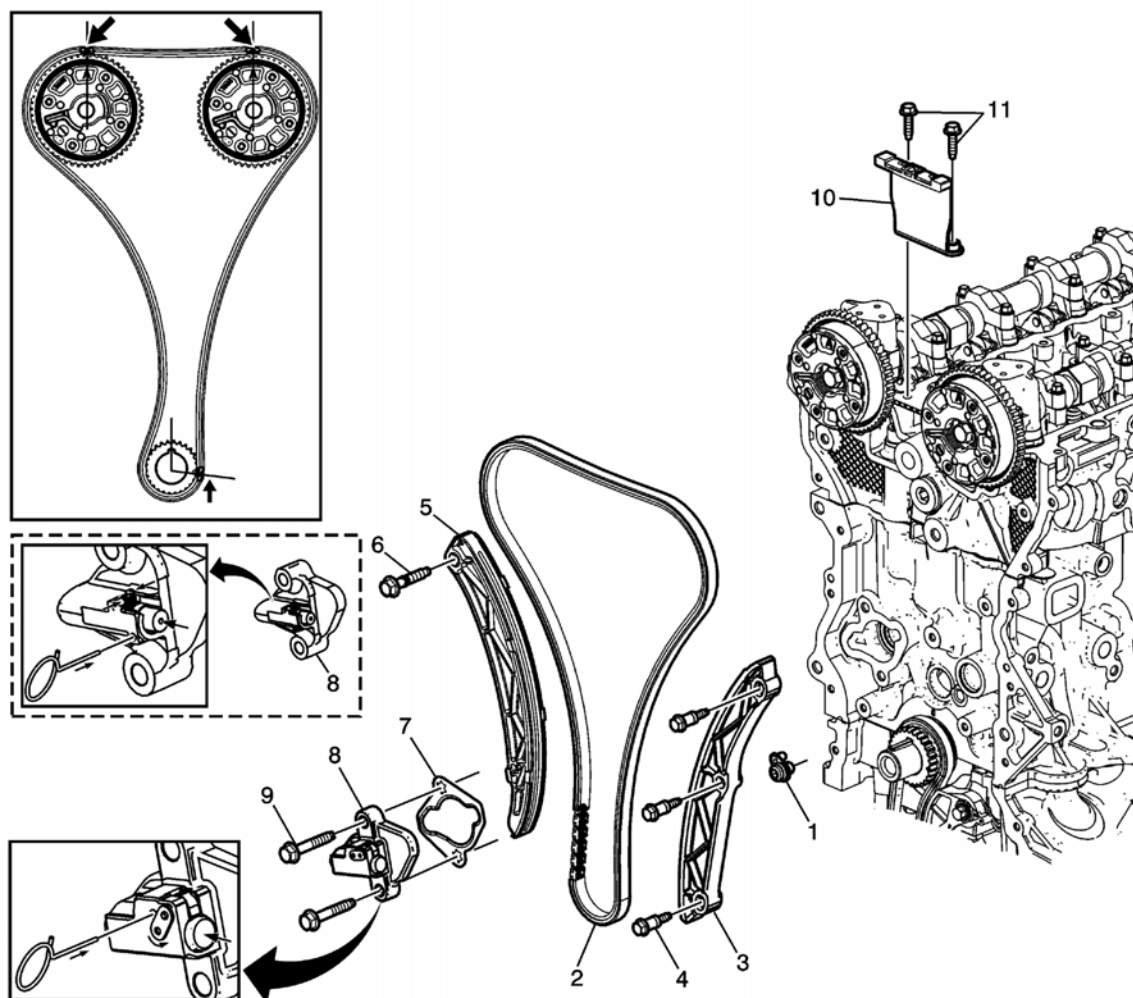


Fig. 515: Camshaft Timing Chain Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Timing Chain Oil Nozzle CAUTION: Refer to Component Fastener Tightening Caution . Tighten 15 N.m (11 lb ft)
2	Timing Chain NOTE: Ensure the actuator timing marks and the

Callout	Component Name
	crankshaft sprocket keyway are at the 12 O'Clock position. Procedure NOTE: Ensure the correct timing link is aligned with the timing mark. The color of the actuator timing links are the same, and the color of the crankshaft sprocket timing link is unique. 1. Align the first timing chain link with the intake actuator timing mark. 2. Align the second timing chain link with the exhaust actuator timing mark. 3. Align the final timing chain link with the crankshaft sprocket timing mark.
3	Timing Chain Guide - Exhaust Side
4	Timing Chain Guide Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
5	Timing Chain Tensioner Shoe Assembly
6	Timing Chain Tensioner Shoe Bolt Tighten 25 N.m (18 lb ft)
7	Timing Chain Tensioner Gasket

Callout	Component Name
8	Timing Chain Tensioner Assembly NOTE: Ensure the tensioner is fully retracted prior to installation. Depending on tensioner model, the procedure to depress and lock the plunger is different. Procedure 1. If the tensioner has a lever on the front, press down on the lever and depress the plunger. Insert a suitable tool into the hole in the tensioner body to hold the plunger in the retracted position. 2. If the tensioner has a retaining clip, press the clip and depress the plunger. Insert a suitable tool into the hole in the tensioner body to hold the plunger in the retracted position.
9	Timing Chain Tensioner Bolt (Qty: 2) Tighten 25 N.m (18 lb ft)
10	Timing Chain Upper Guide - to Cylinder Head
11	Timing Chain Upper Guide Bolt (Qty: 2) Tighten 10 N.m (89 lb in)

ENGINE FRONT COVER INSTALLATION

Engine Front Cover and Components Installation

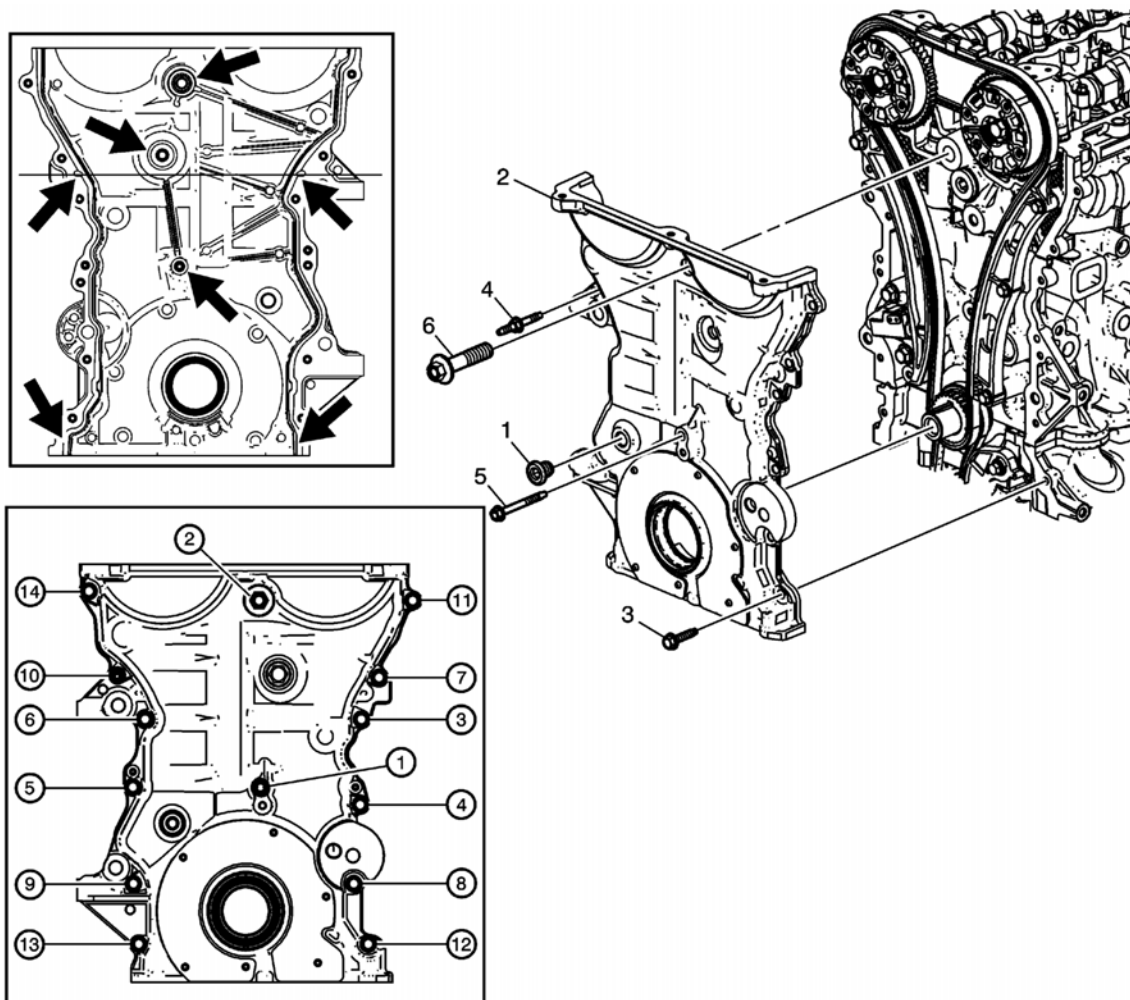


Fig. 516: Engine Front Cover and Components With Bolt Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

Engine Front Cover and Components Installation

Callout	Component Name
1	Engine Front Cover Hole Plug CAUTION: Refer to Fastener Caution . Tighten 50 N.m (37 lb ft)
2	Engine Front Cover Procedure 1. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant NOTE:

Callout	Component Name
	• The engine front cover surface must be free of contamination prior to applying the sealer. • Install and align the cover within 20 minutes of applying the sealer. • The cover must be fastened to final torque specification within 20 minutes of applying the sealer. • Additional sealant is necessary to reduce the possibility of leakage where the cylinder head to engine block interface along the bead path flange on the front cover. 2. Apply a 4 mm bead of sealer directly in the flange of the engine front cover perimeter mating surface. 3. Apply a 3 mm bead of sealer circling 3 locations on the interior of the engine front cover. 4. Apply a 3 mm bead of sealant at the 2 horizontal groove locations along the flange where the cylinder head and engine block mate. Refer to Adhesives, Fluids, Lubricants, and Sealers.
3	Engine Front Cover Bolt - M6 (Qty: 11) NOTE:

Callout	Component Name
	Hand start the engine front cover bolts. Torque to specification when all front cover bolts and the stud are installed hand-tight. Tighten 15 N.m (11 lb ft)
4	Engine Front Cover Stud (Qty: 1) Tighten 15 N.m (11 lb ft)
5	Engine Front Cover Bolt - M6 (Qty: 1) NOTE: This interior M6 bolt is longer than the perimeter M6 bolts. Tighten 15 N.m (11 lb ft)
6	Engine Front Cover Bolt - M14 (Qty: 1) Tighten 58 N.m (43 lb ft) Procedure Tighten all the engine front cover bolts in the sequence shown. 1. Tighten the bolts a first pass to 5 N.m (44 lb in). 2. Tighten the bolts a final pass to final torque specification.

Crankshaft Front Oil Seal Installation

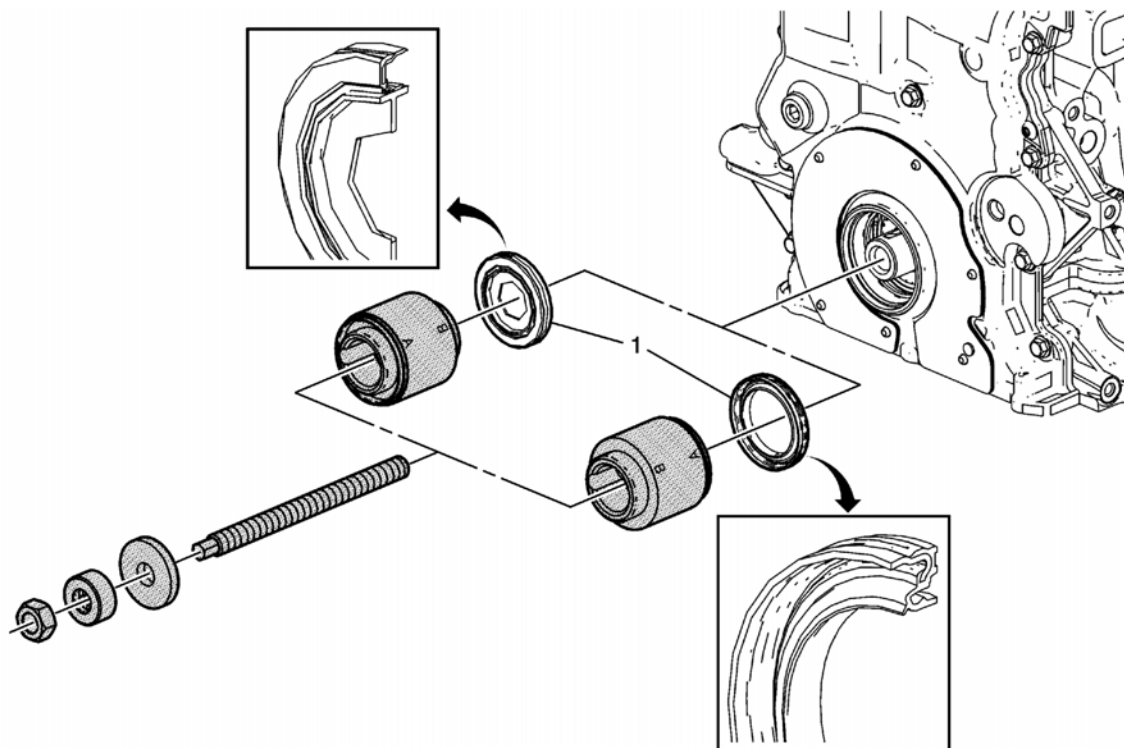


Fig. 517: Crankshaft Front Oil Seal

Courtesy of GENERAL MOTORS COMPANY

Crankshaft Front Oil Seal Installation

Callout	Component Name
1	Crankshaft Front Oil Seal Procedure NOTE: The oil seal must be installed in the correct direction. The side that faces out will have "this side out" printed on it. The design of the seal determines which end of the EN 51368 installer is used. Use the end of the installer that matches

Callout	Component Name
	the design of the seal, as shown. 1. Lubricate the outside diameter of the new crankshaft seal with clean engine oil. 2. Determine which end of the EN-51368 installer will be used and install the seal on it. 3. Install the EN-51368 installer over the crankshaft. 4. Install the EN-51368 screw, large washer, bearing, and nut. 5. Counter-hold the screw, and tighten the nut to install the seal. Special Tools EN-51368 Front Crankshaft Seal Installer For equivalent regional tools, refer to Special Tools.

OIL PAN INSTALLATION

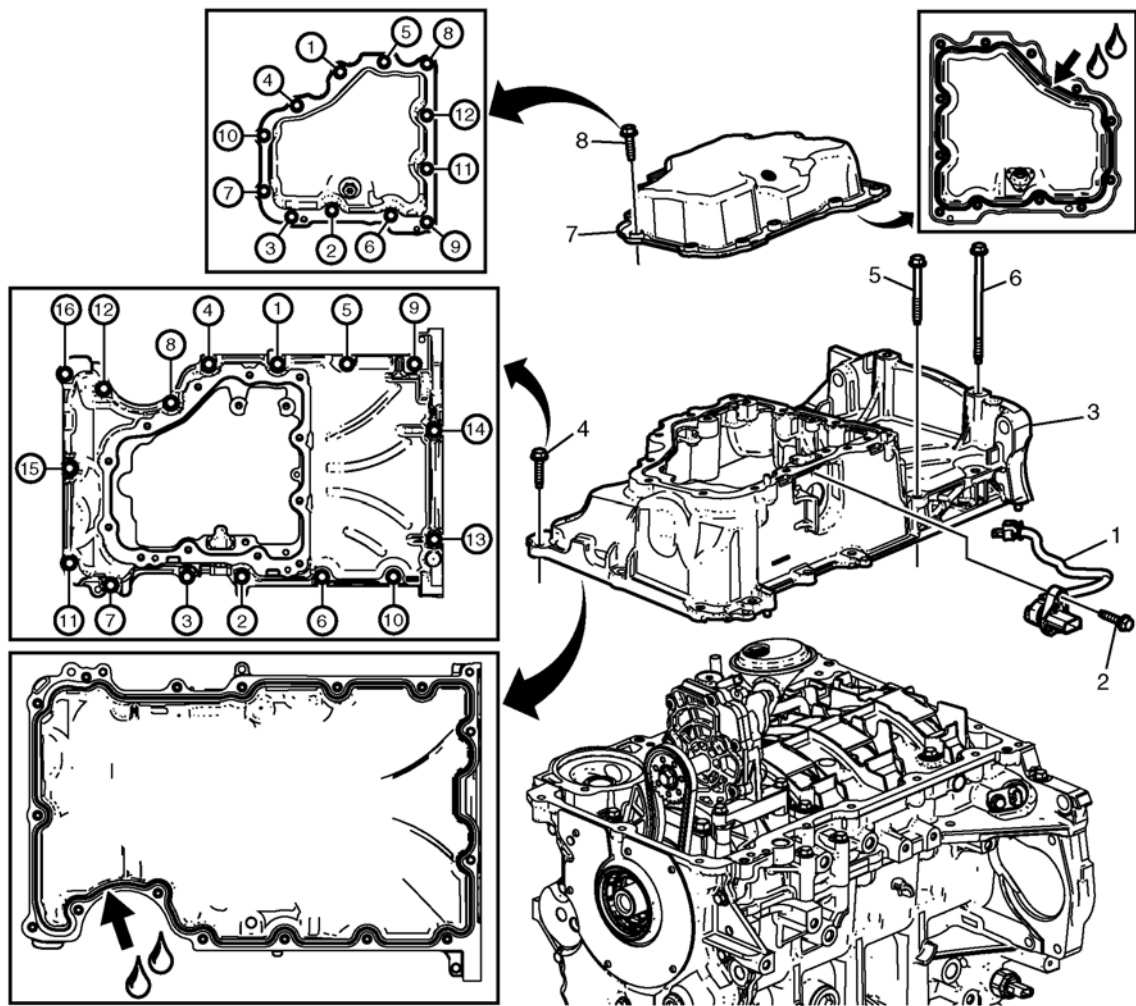


Fig. 518: Oil Pan With Bolt Tightening Sequences
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
1	Engine Oil Level Indicator Control Wiring Harness
2	Wiring Harness Connector Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
3	Upper Oil Pan Assembly Procedure 1. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant NOTE: • The lower crankcase and oil pan mating surfaces must be free of contamination prior to applying the sealer. • Install and align the oil pan to block within 20 minutes of applying the sealer. • The oil pan must be fastened to final torque specification within 60 minutes of applying the sealer. • Additional sealant is necessary to reduce the possibility of

Callout	Component Name
	leakage where the cylinder head to engine block interface along the bead path flange on the front cover. 2. Apply a 3 mm bead of sealer around the perimeter of the oil pan. Refer to Adhesives, Fluids, Lubricants, and Sealers. 3. Install the oil pan on the lower crankcase, ensure the oil pan locating pins align with the lower crankcase.
4	Oil Pan Bolt (Qty: 12) Procedure 1. Apply sealant to the oil pan bolts. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Hand start the oil pan bolts. Torque to specification when all oil pan bolts are installed hand-tight. Tighten 10 N.m (89 lb in)
5	Oil Pan Bolt (Qty: 2) Procedure 1. Apply sealant to the oil pan bolts. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Hand start the oil pan bolts. Torque to specification when all oil pan bolts are installed hand-tight. Tighten 10 N.m (89 lb in)
6	Oil Pan Bolt (Qty: 2) Procedure 1. Apply sealant to the oil pan bolts. Refer to Adhesives, Fluids, Lubricants, and Sealers. 2. Tighten all the oil pan bolts in sequence. 3. Inspect for excessive sealer around the oil filter mounting area when final torque is achieved. If extra sealer is present, remove and clean accordingly. Tighten 10 N.m (89 lb in)

Callout	Component Name
7	Lower Oil Pan Procedure 1. Connect the oil pump control valve wiring harness connector. 2. Use a NEW lower oil pan. 3. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant 4. Apply a 5 mm bead of sealer around the perimeter of the lower oil pan. Refer to Adhesives, Fluids, Lubricants, and Sealers. 5. Install the lower oil pan on the upper oil pan, ensure the oil pan locating pins align with the lower oil pan.
8	Lower Oil Pan Bolt (Qty: 12) Procedure Tighten the oil pan bolts in sequence. Tighten 10 N.m (89 lb in)

CAMSHAFT COVER INSTALLATION

Camshaft Cover Components Installation - Bottom

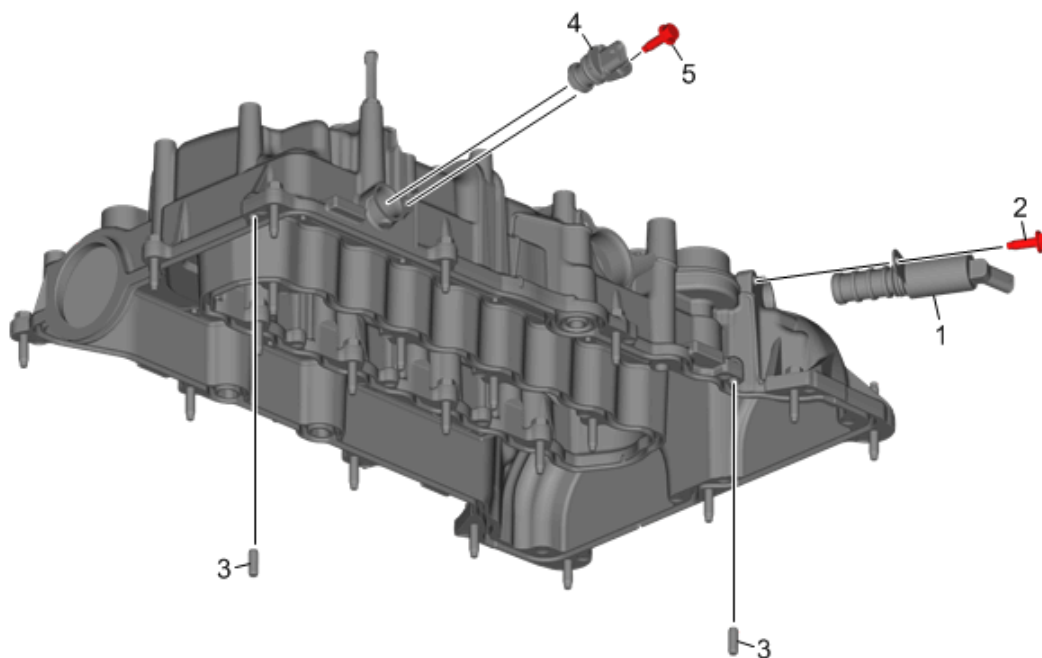


Fig. 519: Camshaft Cover Components - Bottom

Courtesy of GENERAL MOTORS COMPANY

Camshaft Cover Components Installation - Bottom

Callout	Component Name
1	Camshaft Position Actuator Solenoid Valve

Callout	Component Name
2	Camshaft Position Actuator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
3	Camshaft Cover Locating Pin (Qty: 2)
4	Intake Camshaft Position Sensor
5	Camshaft Position Sensor Bolt Tighten 10 N.m (89 lb in)

Camshaft Cover Components Installation - Top

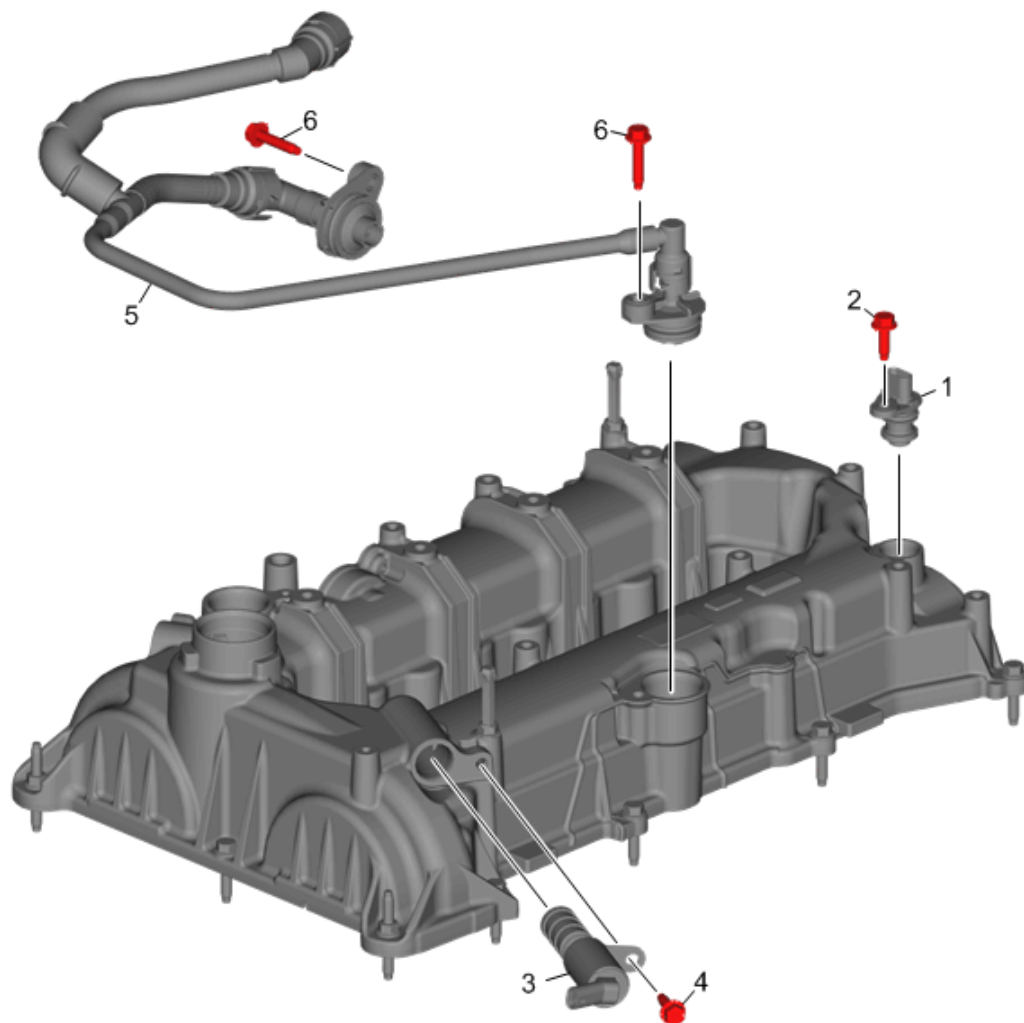


Fig. 520: Camshaft Cover Components - Top
Courtesy of GENERAL MOTORS COMPANY

Camshaft Cover Components Installation - Top

Callout	Component Name
1	Exhaust Camshaft Position Sensor
2	Camshaft Position Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
3	Camshaft Position Actuator Solenoid Valve
4	Camshaft Position Actuator Solenoid Valve Bolt Tighten 10 N.m (89 lb in)
5	Positive Crankcase Ventilation Tube with Positive Crankcase Ventilation Valve - Fresh Air NOTE: These components have tamper-proof connections and cannot be disassembled. The fresh air inlet duct is connected to the PCV Tube with a tamper-proof connection. All components must be replaced once removed. Procedure 1. Assemble a NEW PCV tube with NEW PCV valves and a NEW fresh air inlet duct. 2. Install the PCV valves to the camshaft cover.

Callout	Component Name
6	Positive Crankcase Ventilation Valve Bolt (Qty: 2) NOTE: Bolts are tamper-proof. Procedure Using EN-50956 bit, install NEW bolts. Tighten 10 N.m (89 lb in) Special Tools EN-50956 Tamper-Proof Drive Bit Equivalent regional tools: Special Tools

Camshaft Cover Installation

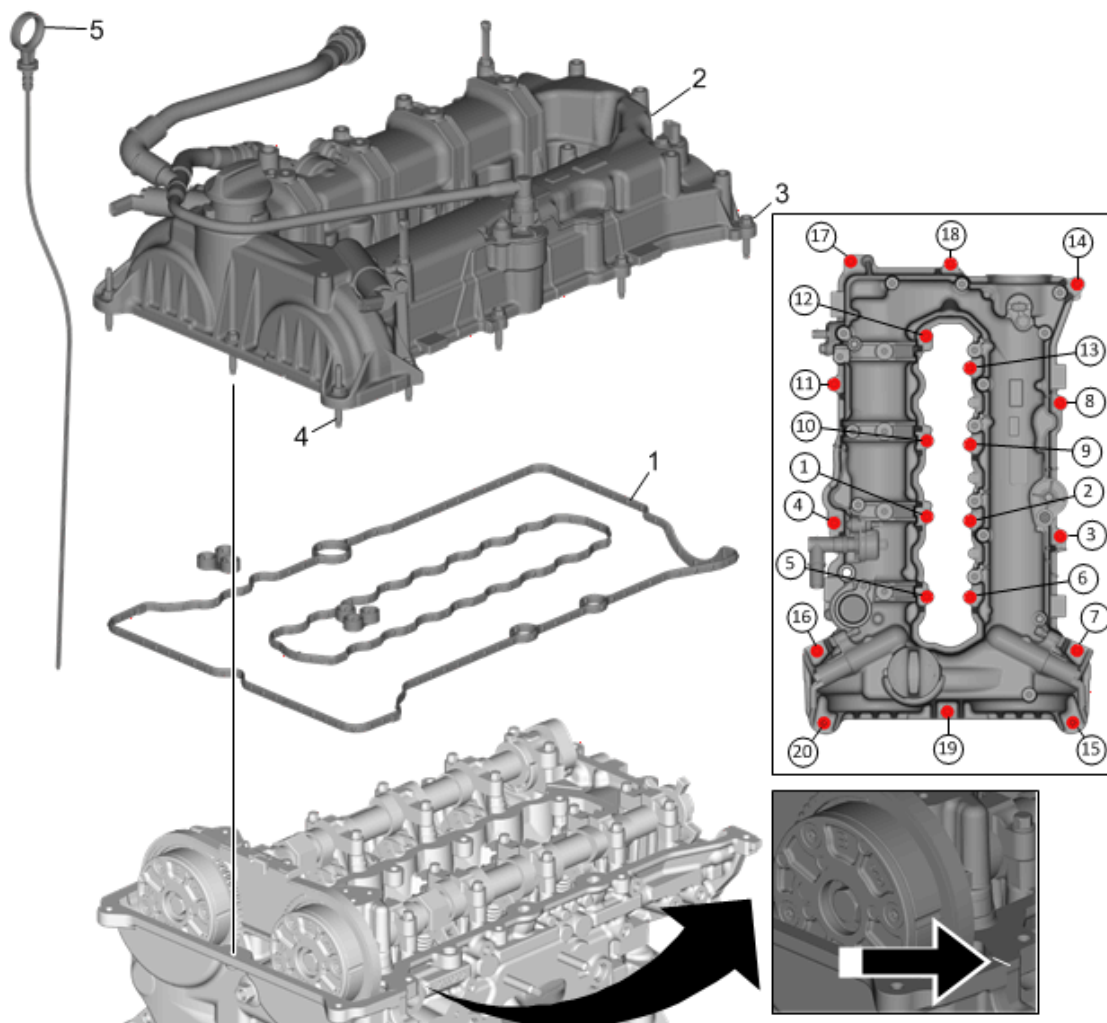


Fig. 521: Camshaft Cover With Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

Camshaft Cover Installation

Callout	Component Name
1	Camshaft Cover Gasket NOTE: Use a NEW gasket. Procedure Assemble the camshaft cover and a NEW gasket. Ensure that the gasket is located in the retaining groove in the camshaft cover.
2	Camshaft Cover Procedure 1. Ensure proper use of room temperature vulcanizing (RTV) sealant. Refer to Use of Room Temperature Vulcanizing (RTV) and Anaerobic Sealant 2. Apply approximately a 5 mm (0.2 in) thick bead of camshaft cover sealant on both sides between the cylinder head and the engine front cover. Refer to Adhesives, Fluids, Lubricants, and Sealers.
3	Camshaft Cover Bolt (Qty: 18) Procedure: Tighten the engine front cover bolts and studs in sequence.
4	Camshaft Cover Stud (Qty: 2) CAUTION: Refer to Fastener Caution . Procedure: Tighten the engine front cover bolts and studs in sequence. Tighten 15 N.m (11 lb ft)
5	Oil Level Indicator

FUEL RAIL AND INJECTORS INSTALLATION

Special Tools

- EN-49245 Fuel Injector Seal Installer/Sizer
- EN-51105 Injector Seal Installer Adapters
- EN-51146 Fuel Injector Removal/Installation Kit
- EN-51146-100 Fuel Injector Removal Plate
- EN-51146-150 Fuel Injector Removal Adapters

For equivalent regional tools, refer to [Special Tools](#).

Fuel Injector Installation Procedure

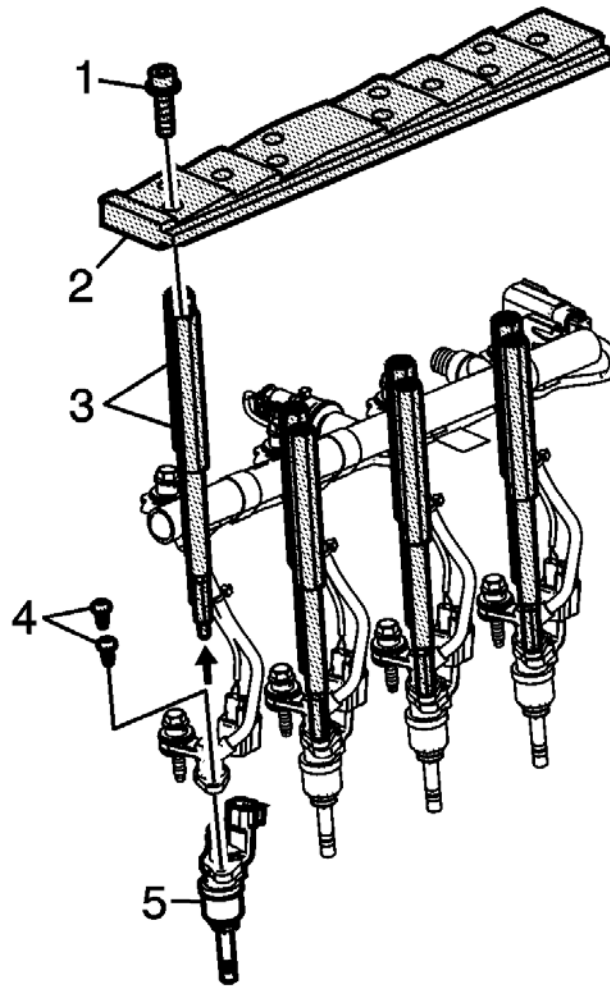


Fig. 522: Installing Fuel Injectors Using Removal/Installation Kit
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not remove the fuel injectors unless inspection indicates replacement is necessary. Do not remove the EN-51146-150 adapter and EN-51146-1-1 support unless the fuel injector is being replaced.

1. If one or more fuel injectors are being replaced, remove the EN-51146-100 plate (2) and bolts (1).
2. Remove the EN-51146-150 adapters and EN-51146-1-1 supports (3) for all fuel injectors that are being replaced.
3. Remove and discard the fuel injectors (5) that are being replaced.
4. Lubricate the O-ring with one drop of clean engine oil. Install a new fuel injector (5).

CAUTION: Refer to [Fastener Caution](#) .

5. Install the NEW fuel injector screws (4) to the NEW fuel injectors (5) and tighten to 5 N.m (44 lb in).
6. Connect the fuel injector wiring harness plugs.

Fuel Injector Combustion Seal Installation Procedure

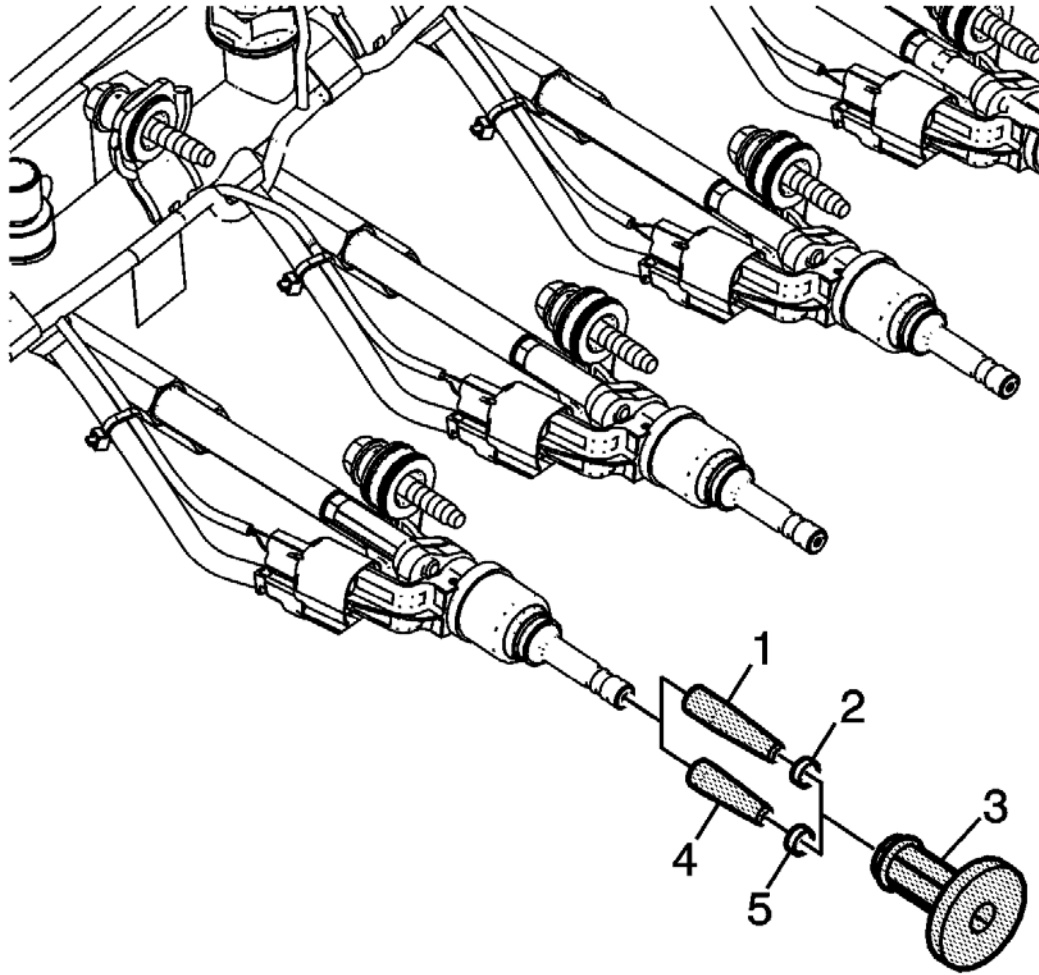


Fig. 523: Installing Combustion Seals

Courtesy of GENERAL MOTORS COMPANY

NOTE: DO NOT use any type of lubricant when installing the NEW combustion seals on the fuel injector tip.

NOTE: The injector tip protectors in the EN-49245 set are too small for some injectors. Ensure EN-51105 is used on injector tips during seal installation. The pusher and final sizer work for all injectors.

1. Install **EN-51105-1** long protector (1) onto the fuel injector tip, covering the first recessed area closest to the tip. Place a NEW seal (2) on **EN-51105-1** long protector (1).
2. Using **EN-49245-3** pusher (3), install the seal (2) into the recessed area of the fuel injector.
3. Compress the seal (2) with your fingers.
4. Install **EN-51105-2** short protector (4) onto the fuel injector tip. Place a NEW seal (5) on **EN-51105-2** short protector (4).
5. Using **EN-49245-3** pusher (3), install the seal (5) into the last recessed area of the fuel injector.
6. Compress the seal (5) with your fingers.

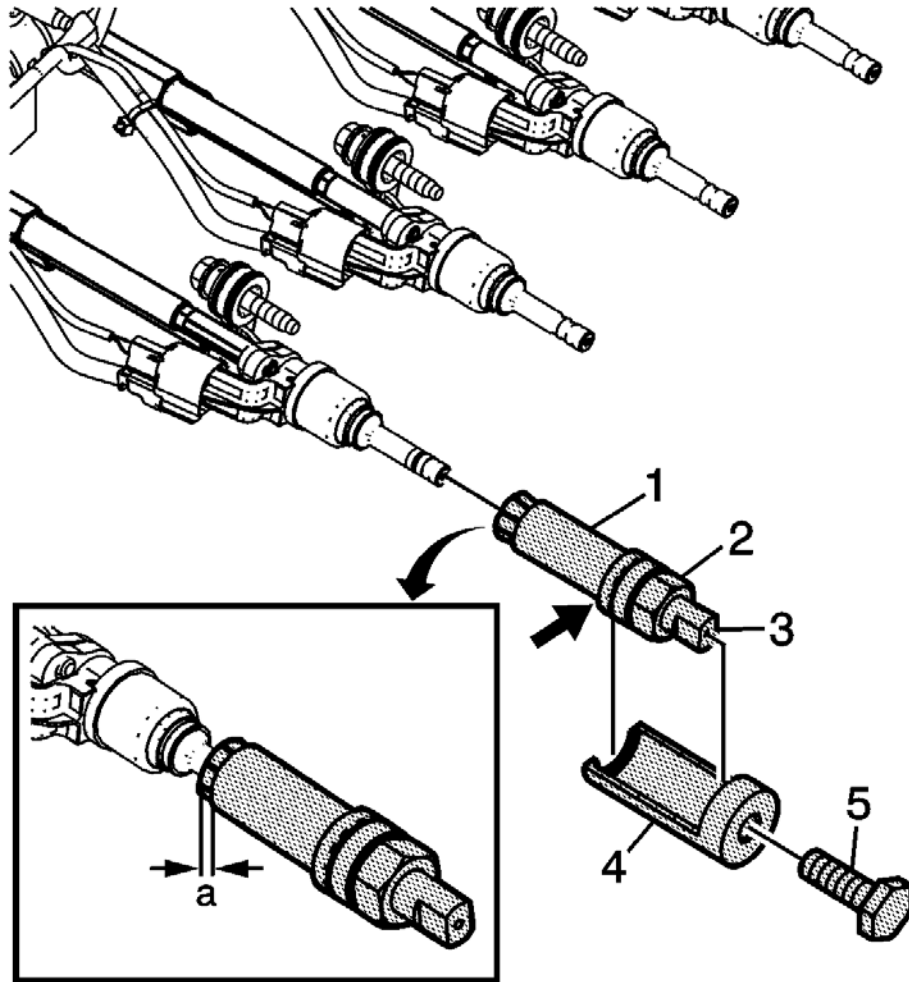


Fig. 524: Pre-Sizing Tool

Courtesy of GENERAL MOTORS COMPANY

7. Push the **EN-51146-2-4** pre-sizing tool (1) over the fuel injector tip.
8. Tighten the nut (2) and counterhold at the spanner flat (3) of the **EN-51146-2-4** pre-sizing tool (1) until the measure (a) of 4.5 mm (0.177 in) is reached.
9. Loosen the nut (2) of the **EN-51146-2-4** pre-sizing tool.
10. Install the **EN-51146-2-4-7** take off chassis (4) to the **EN-51146-2-4** pre-sizing tool (1).
11. Install the **EN-51146-2-4-6** screw M10 (5) to the **EN-51146-2-4-7** take off chassis (4) and tighten until the **EN-51146-2-4** pre-sizing tool (1) is loosened.

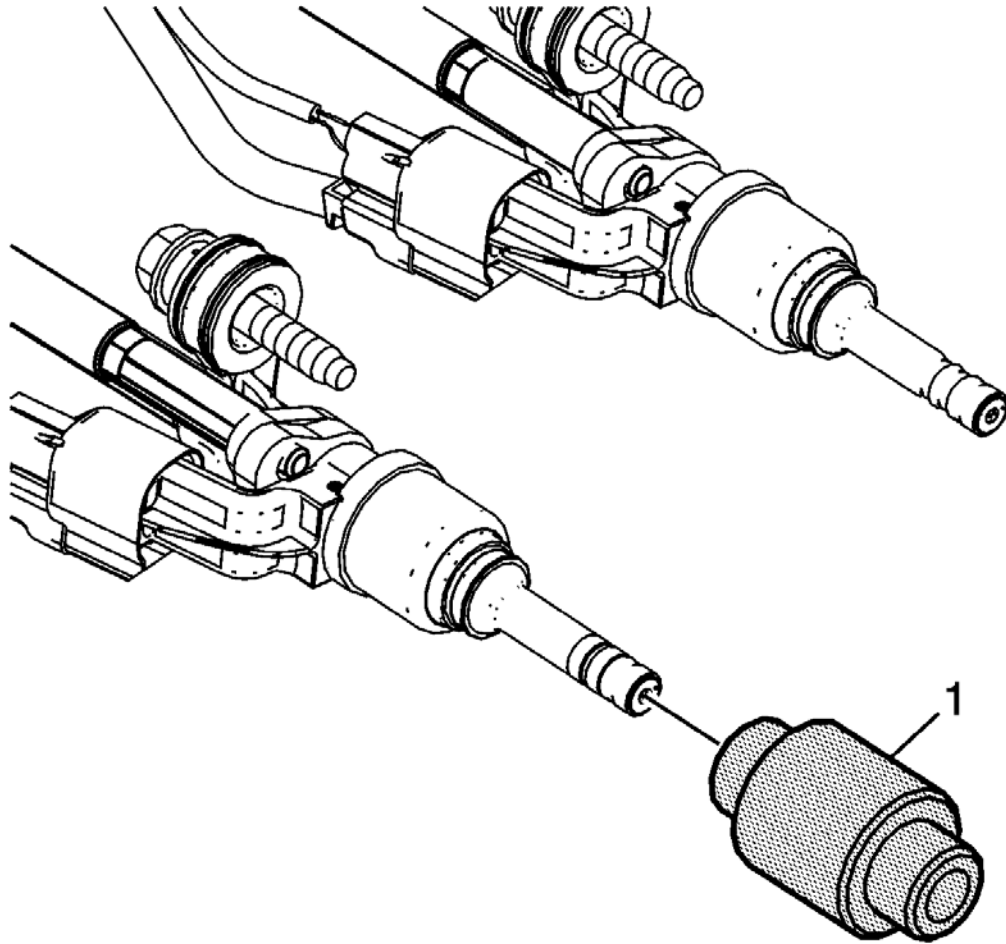


Fig. 525: Sizer

Courtesy of GENERAL MOTORS COMPANY

12. Install the **EN-49245-4** sizer (1) in a rotary motion to the fuel injector tip in order to complete the combustion seal final sizing.

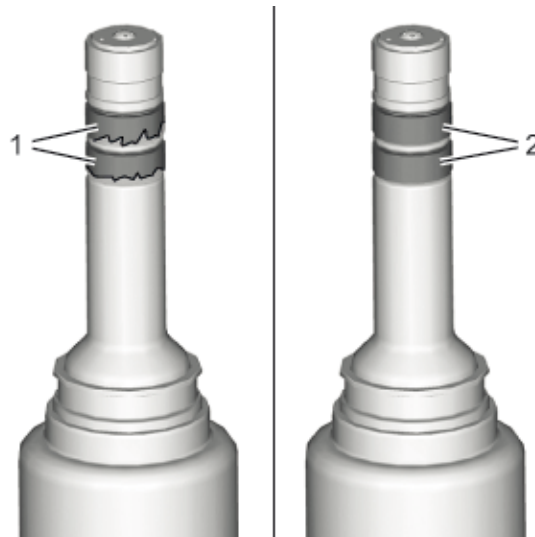


Fig. 526: Ensure Seals Are Installed Correctly

Courtesy of GENERAL MOTORS COMPANY

NOTE: The fuel injector seals must fit properly in the relative groove. Overlapping of the fuel injector seals with the external surface of the injector must be avoided.

13. Check both of the fuel injector combustion seals on each fuel injector for correct seat:

- The seal must not be too large, buckled, or corrugated (1)
- The seal must be fixed tight and accurate (2)

14. If the seals are not installed correctly, remove the incorrect seal and replace with a NEW seal.

Fuel Rail Assembly Installation Procedure

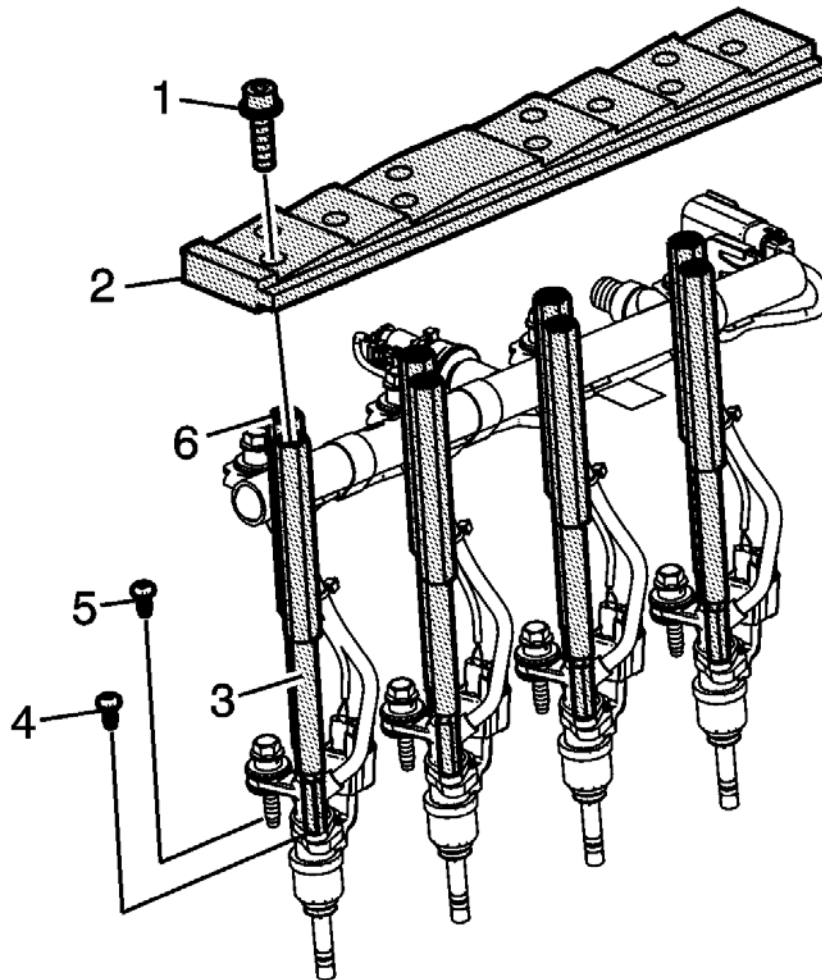


Fig. 527: Installing Fuel Rail Assembly Using Special Tools

Courtesy of GENERAL MOTORS COMPANY

1. If any components of EN-51146 remover are installed to the fuel rail, perform the following procedure:

NOTE: If the plate is not installed on the supports, it is likely one or more fuel injectors have been replaced. Disregard the following steps for fuel injectors that have already been replaced.

1. Remove the bolts (1) and EN-51146-100 plate (2).
2. Remove only the front EN-51146-150 adapter and EN-51146-1-1 support (3) for the first fuel injector.

CAUTION: Refer to [Fastener Caution](#) .

3. Install the fuel injector screw (4) and tighten to 5 N.m (44 lb in).
 4. Remove the rear **EN-51146-150** adapter and **EN-51146-1-1** support (6) for the first fuel injector.
 5. Install the fuel injector screw (5) and tighten to 5 N.m (44 lb in).
 6. Repeat the same procedure for the remaining fuel injectors with **EN-51146-150** adapters and **EN-51146-1-1** supports still attached.
 7. Connect the fuel injector wiring harness plugs, if necessary.
2. Ensure the fuel rail assembly and fuel injector bores have been cleaned prior to installation.

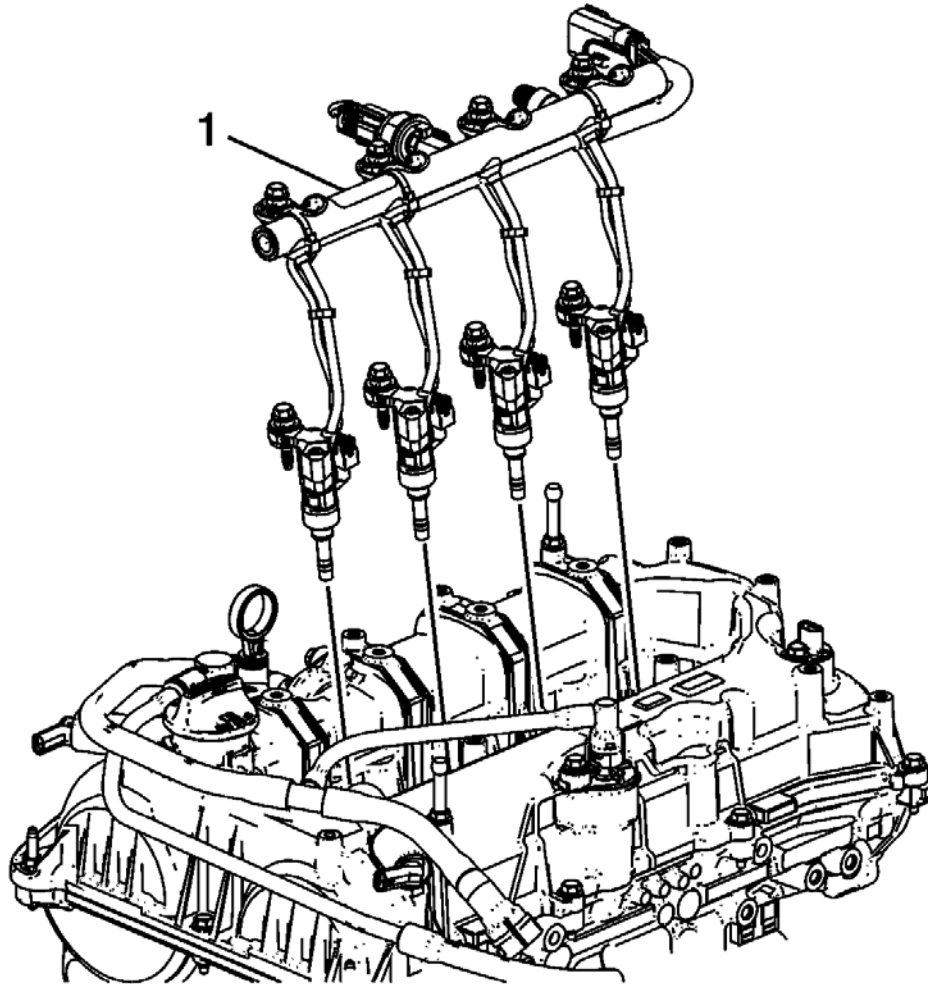


Fig. 528: Fuel Rail Assembly

Courtesy of GENERAL MOTORS COMPANY

NOTE: During the installation of the fuel rail and injector assembly, ensure that the fuel injectors are positioned straight into the injector opening. Failure to follow this caution can tilt or bend the injectors and could cause leaks or malfunction after installation.

3. Carefully install the fuel rail assembly (1).
4. Push the fuel injectors slightly in their seats.

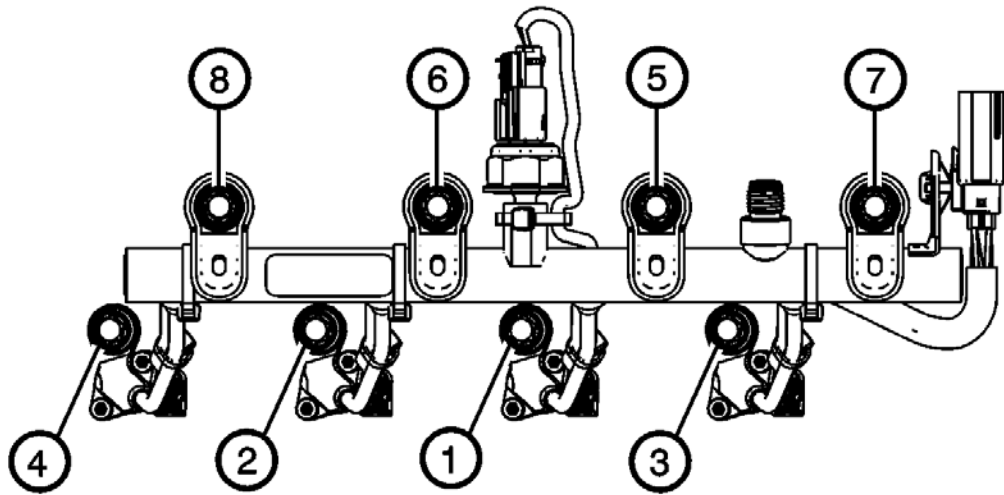


Fig. 529: Fuel Rail Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

5. Tighten the 4 lower fuel rail bolts in increments of 1 turn until they are seated.
6. Tighten the 4 lower fuel rail bolts in sequence to 10 N.m (89 lb in).
7. Tighten the 4 upper fuel rail bolts in sequence to 10 N.m (89 lb in).

IGNITION COIL INSTALLATION

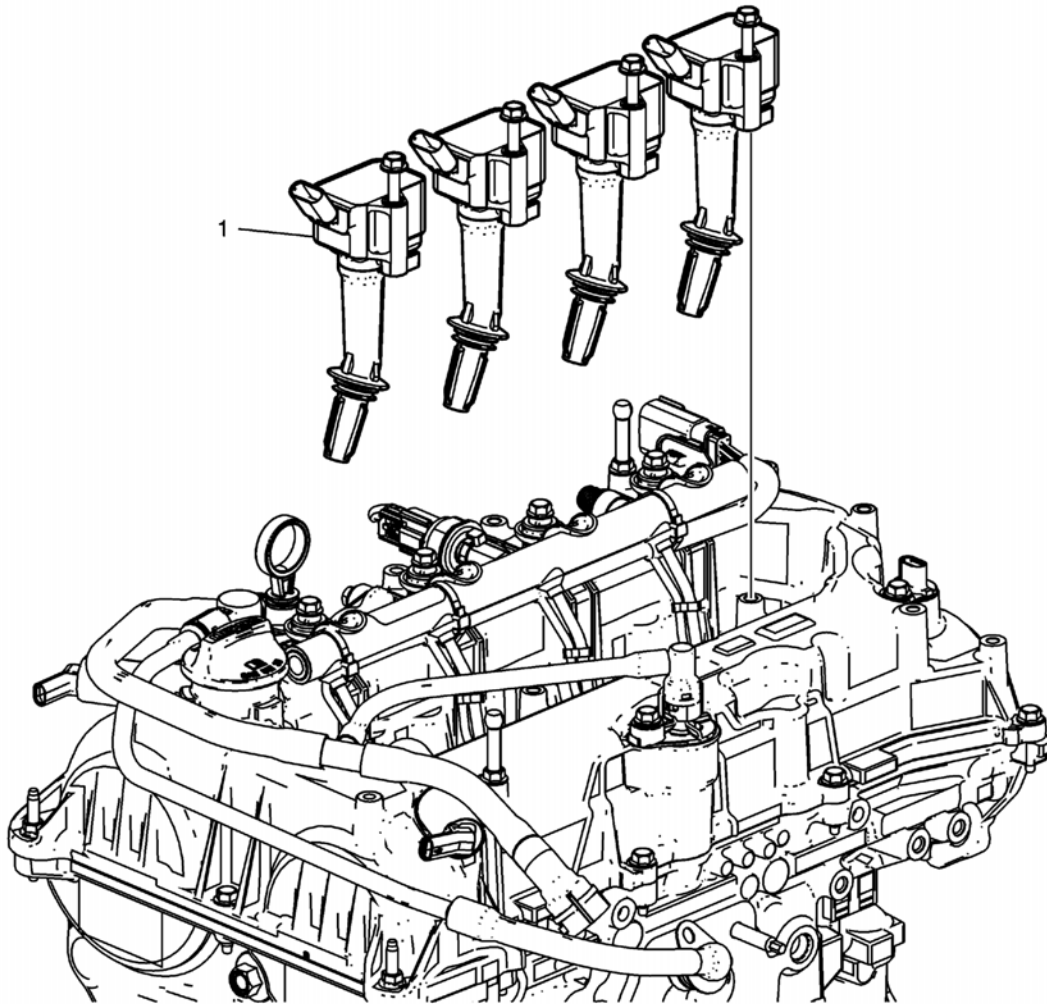


Fig. 530: Ignition Coil

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Inspect the inside of the ignition coil rubber boot for a thin, even coat of grease. 2. If there is no grease present or additional grease is necessary, apply a thin coating of dielectric grease evenly to the inside of the ignition coil rubber boot, up to a depth of 15 mm from the end of the boot. Refer to Adhesives, Fluids, Lubricants, and Sealers. 3. Remove any excess grease from around the end of the boot, and ensure there is not an excessive amount within the boot.	
1	Ignition Coil Assembly (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)

WATER OUTLET INSTALLATION

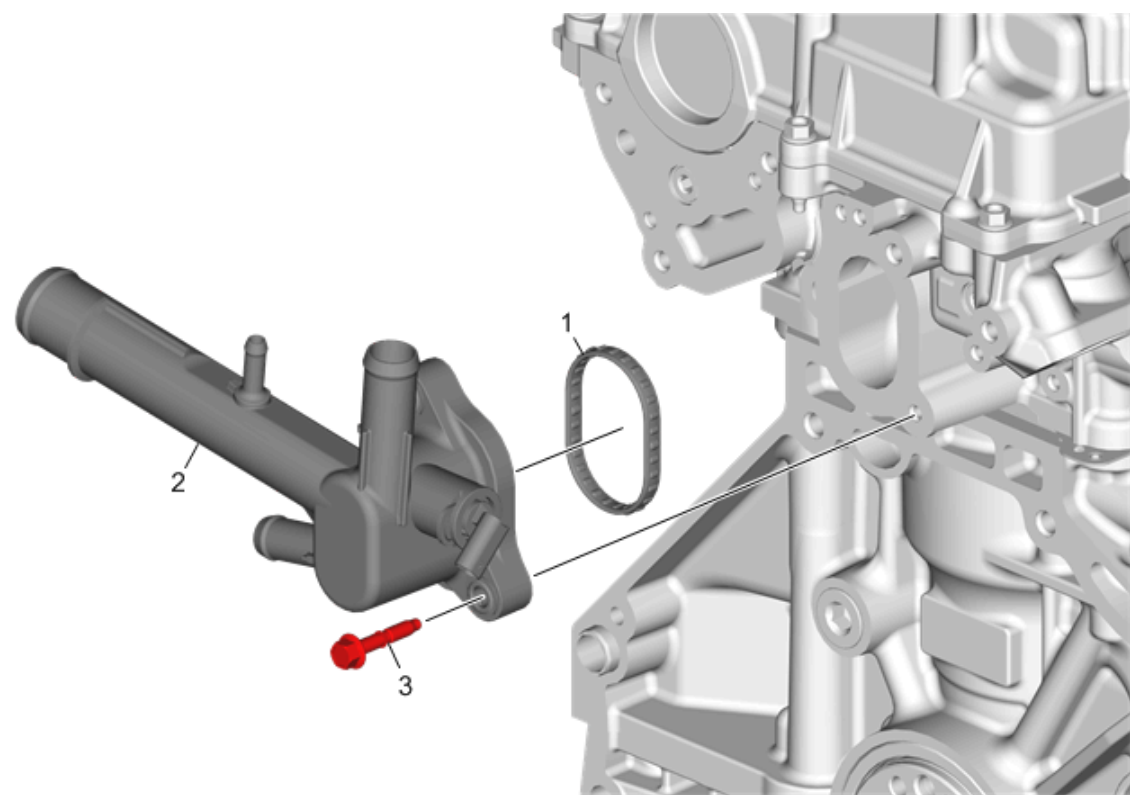


Fig. 531: Water Outlet
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Water Outlet Gasket NOTE: Use a NEW gasket. Ensure the mating surfaces are clean and free of debris.
2	Water Outlet
3	Water Outlet Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 12 N.m (106 lb in)

ENGINE LIFT AND SIGHT SHIELD BRACKET INSTALLATION

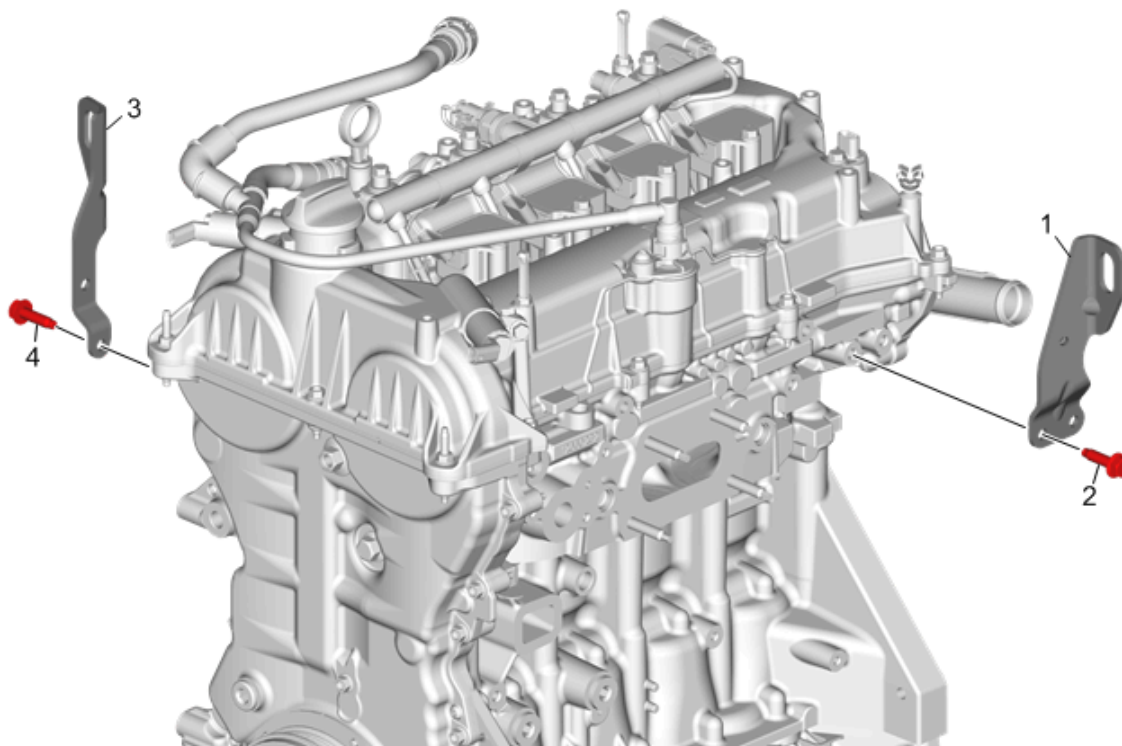


Fig. 532: Engine Lift And Sight Shield Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Lift Rear Bracket
2	Engine Lift Bracket Bolt (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 25 N.m (18 lb ft)
3	Engine Lift Front Bracket
4	Engine Lift Bracket Bolt (Qty: 2) Tighten 25 N.m (18 lb ft)

FUEL PUMP INSTALLATION

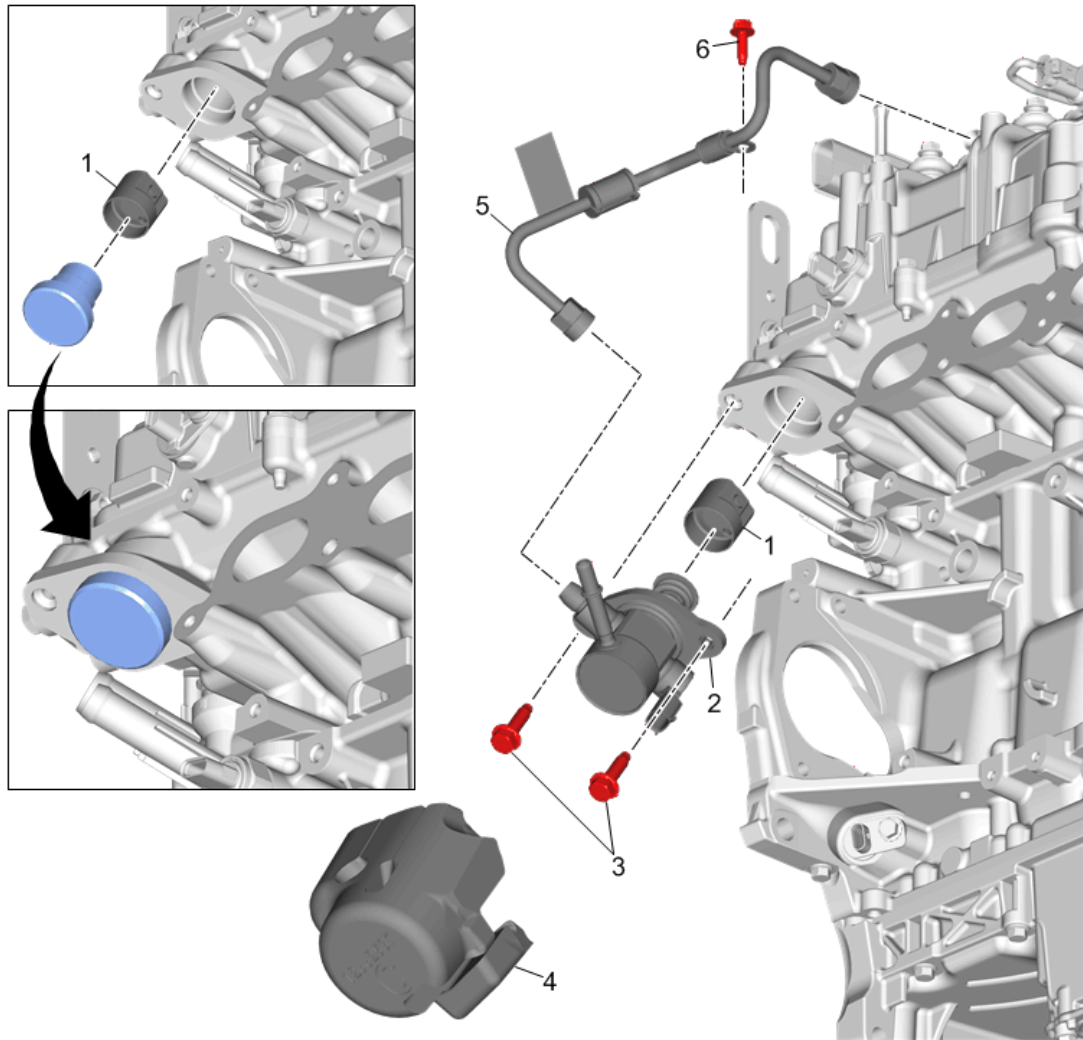


Fig. 533: Fuel Pump

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Valve Lifter Follower NOTE: The camshaft must be in the base circle position before the high pressure fuel pump is installed. Procedure 1. Lubricate the valve lifter follower with engine oil, refer to Adhesives, Fluids, Lubricants, and Sealers.

Callout	Component Name
	NOTE: At the base circle position, the EN-51365 alignment gauge will sit flush with the cylinder head. 2. Install the valve lifter follower. Ensure that the guide pin on the follower is aligned with the groove in the fuel pump bore. Install EN-51365 alignment gauge and rotate the camshaft until the special tool is flush with the cylinder head. This indicates the camshaft lobe is at base circle position. 3. Remove EN-51365 alignment gauge and the valve lifter follower. 4. Lubricate the valve lifter follower again with engine oil. 5. Install the valve lifter follower. Ensure that the guide pin on the follower is aligned with the groove in the fuel pump bore. Special Tools EN-51365 Fuel Pump Installation Gauge For equivalent regional tools, refer to Special Tools.
2	Fuel Pump NOTE: If the fuel pump is not new, replace the fuel pump O-ring seal. Lubricate the O-ring with one drop of clean engine oil.
3	Fuel Pump Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-

Callout	Component Name
	<u>Yield</u> <u>Fastener</u> <u>Caution</u> . CAUTION: Alternately hand-tighten the fuel pump bolts one turn at a time until the pump is fully seated. Trying to draw down the pump without even side-to-side tightening may result in pump plunger damage. Procedure Install NEW fuel injection pump bolts alternating in steps of one turn each until seated to specified torque. Tighten 25 N.m (18 lb ft)
4	Fuel Pump Insulator WARNING: The noise cancelling foam component MUST be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been

Callout	Component Name
	exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.
5	Fuel Feed Intermediate Pipe NOTE: Use a NEW pipe. Procedure NOTE: Do not remove shipping caps from the fuel rail fitting or fuel pump fitting until installation of pipe. Do not remove the fuel pump inlet shipping cap at any time. 1. Remove any fuel pipe shipping caps, if applicable. 2. Finger start the fuel pipe nuts to pump and fuel rail. 3. Finger start the fuel feed intermediate pipe assembly bolt through the pipe bracket. 4. Snug the fuel pipe nut at the pump by hand, 5 full turns minimum. 5. Snug the fuel pipe nut at the fuel rail by hand, 5 full turns minimum. NOTE: Tightening the bracket bolt prior to final torque for the pipe

Callout	Component Name
	nuts helps to align the fuel feed pipe. 6. Tighten the fuel feed intermediate pipe assembly bracket bolt to 10 N.m (22 lb ft). 7. Torque the pipe nut to fuel rail to specification. 8. Torque the pipe nut to pump to specification. Tighten 30 N.m (22 lb ft)
6	Fuel Feed Intermediate Pipe Bolt (Qty: 1) Tighten 10 N.m (89 lb in)

INTAKE MANIFOLD INSTALLATION

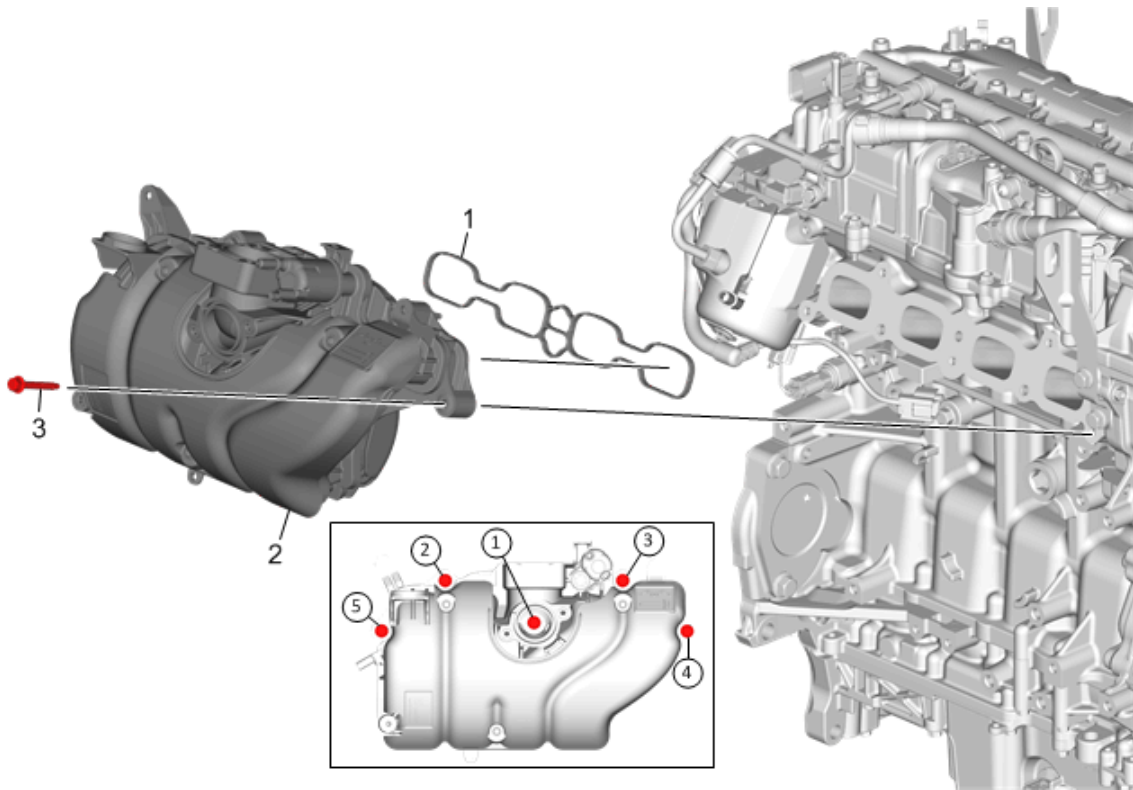


Fig. 534: Intake Manifold With Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Intake Manifold Gasket NOTE: Use a NEW gasket. Ensure the mating

Callout	Component Name
	surfaces are clean and free of debris.
2	Intake Manifold
3	Intake Manifold Bolt (Qty: 5) CAUTION: Refer to Fastener Caution . NOTE: Bolt retainers keep the bolts in position on the assembly. Procedure: Tighten the bolts in sequence. Tighten 12 N.m (106 lb in)

THROTTLE BODY ASSEMBLY INSTALLATION

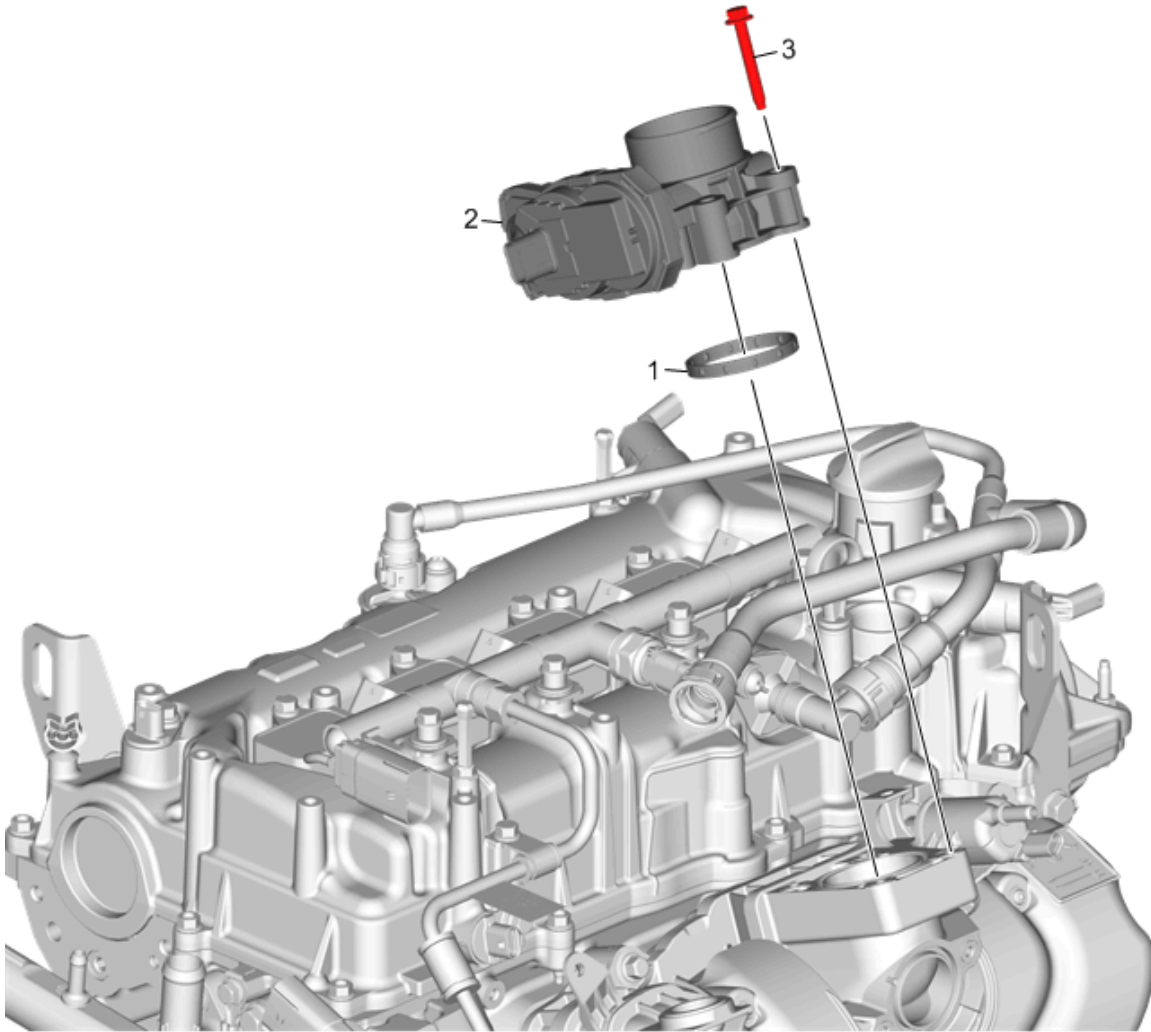


Fig. 535: Throttle Body Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Throttle Body Gasket NOTE: Use a NEW gasket. Ensure the mating surfaces are clean and free of debris.
2	Throttle Body
3	Throttle Body Bolt (Qty: 4) NOTE: Tighten the 4 bolts in a criss-cross

Callout	Component Name
	pattern. CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)

ENGINE WIRING HARNESS ASSEMBLY INSTALLATION

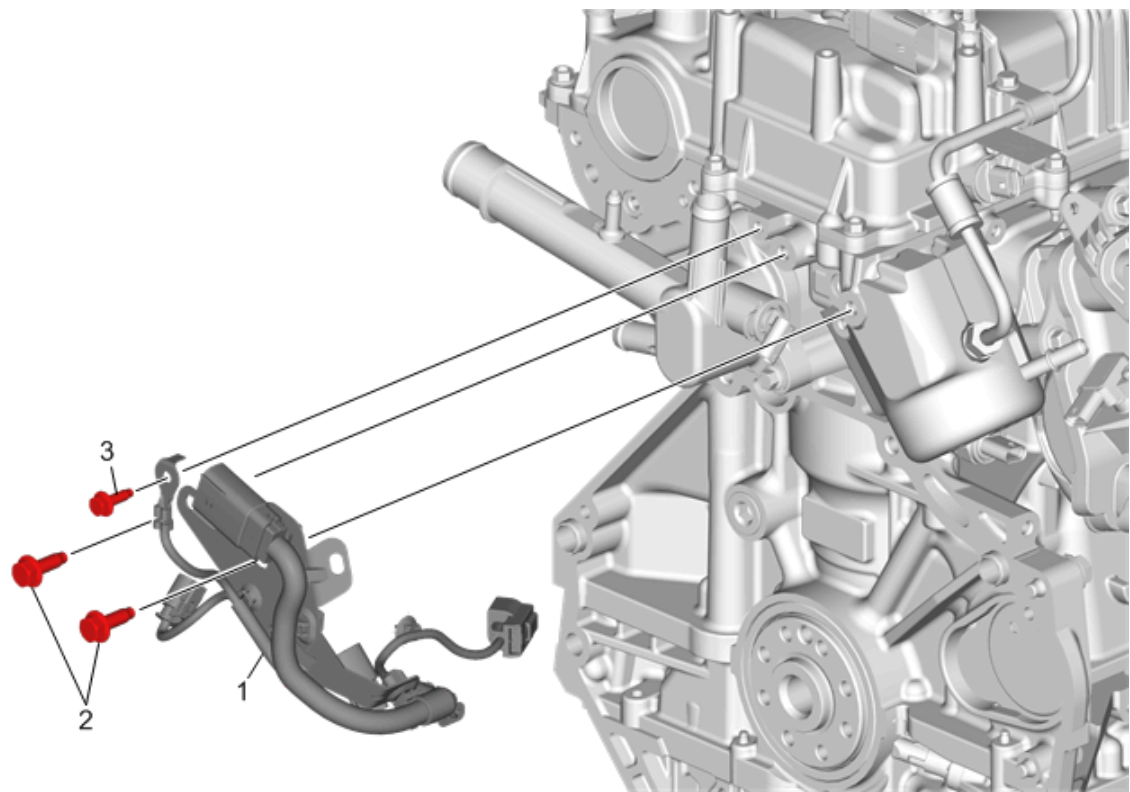


Fig. 536: Engine Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Wiring Harness
2	Engine Wiring Harness Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)

Callout	Component Name
3	Wiring Harness Connector Bolt Tighten 10 N.m (89 lb in)

WATER PUMP INSTALLATION

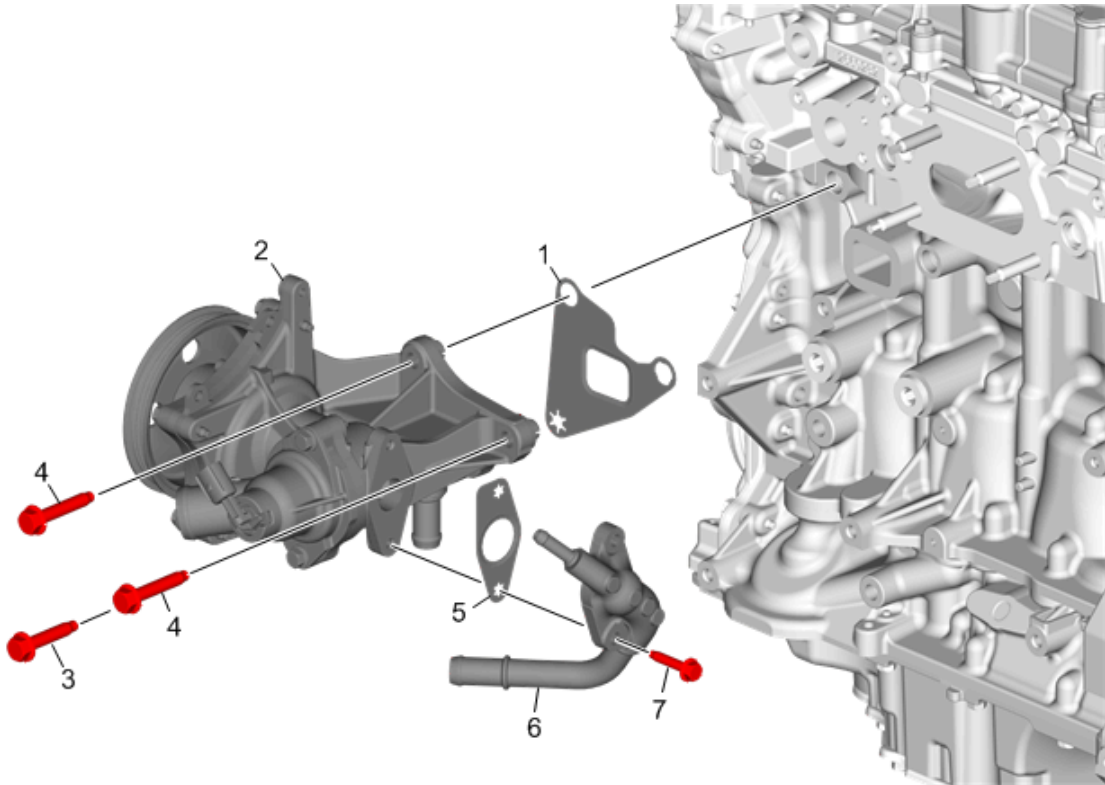


Fig. 537: Water Pump
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Water Pump Housing Gasket NOTE: Use a NEW gasket. Ensure the mating surfaces are clean and free of debris.
2	Water Pump

Callout	Component Name
3	Water Pump Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 25 N.m (18 lb ft)
4	Water Pump Bolt (Qty: 2) Tighten 25 N.m (18 lb ft)
5	Thermostat Bypass Pipe Gasket
6	Water Pump Inlet Hose Fitting
7	Thermostat Bypass Pipe Bolt (Qty: 2) Tighten 10 N.m (89 lb in)

EXHAUST GAS RECIRCULATION VALVE INSTALLATION

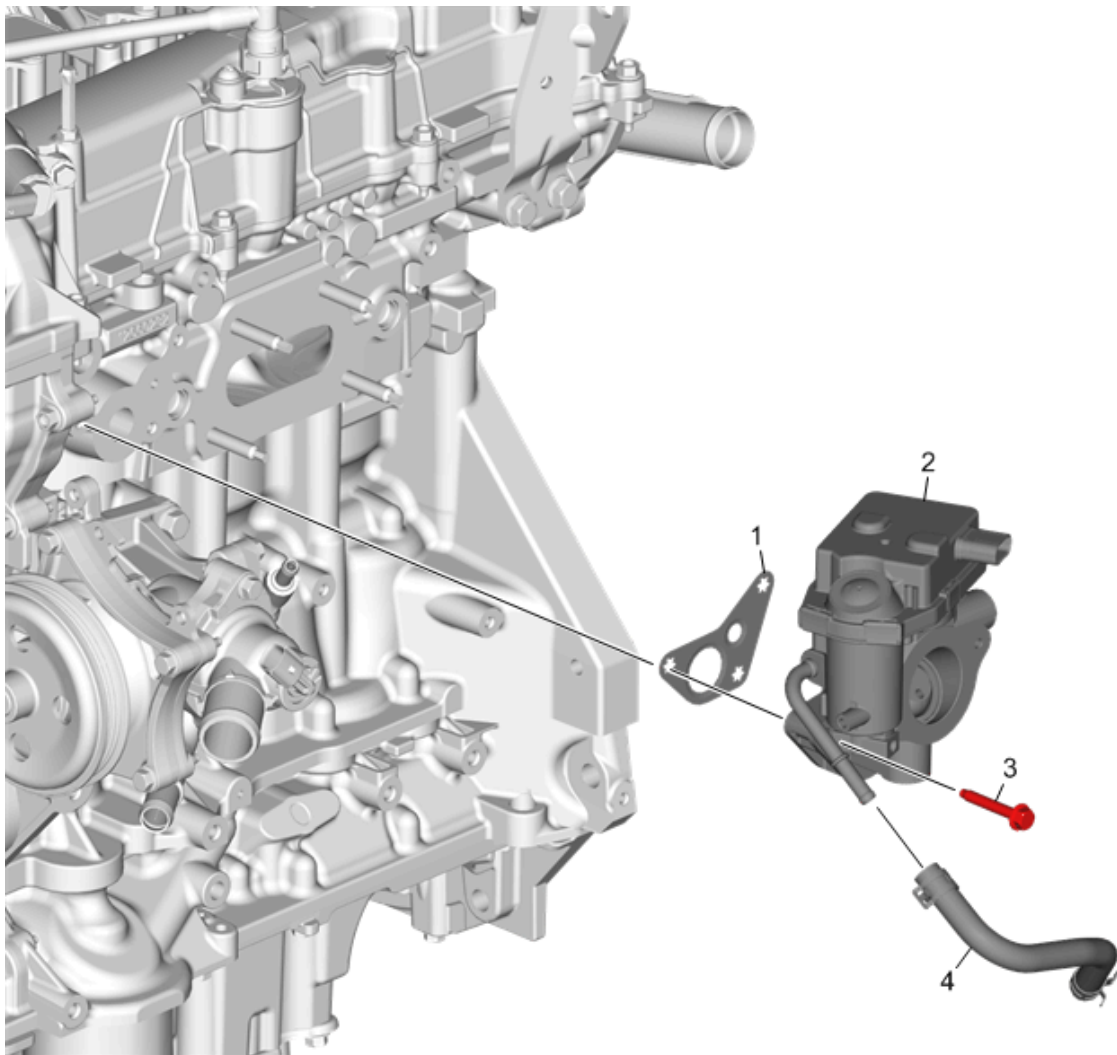


Fig. 538: Exhaust Gas Recirculation Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Valve Gasket NOTE: Use a NEW Gasket.
2	Exhaust Gas Recirculation Valve
3	Exhaust Gas Recirculation Valve Bolt (Qty: 3) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
4	Exhaust Gas Recirculation Valve Cooling Return Hose Procedure 1. Inspect the hose, and replace if necessary. Connect the cooling return hose at the exhaust gas recirculation valve. 2. Connect the cooling return hose at the water pump inlet adapter.

EXHAUST GAS RECIRCULATION COOLER INSTALLATION

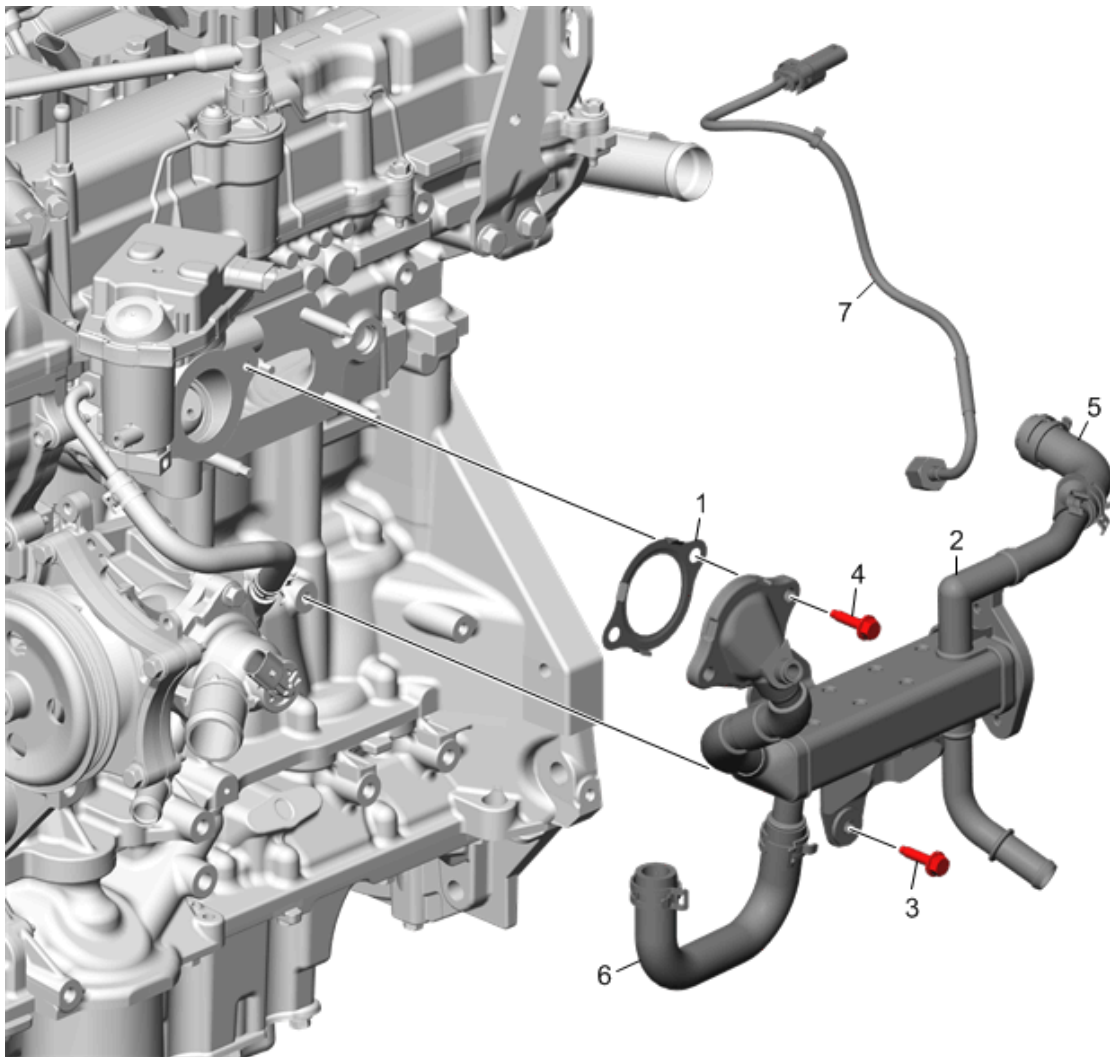


Fig. 539: Exhaust Gas Recirculation Cooler
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Cooler Inlet Pipe Gasket NOTE: Use a NEW gasket.
2	Exhaust Gas Recirculation Cooler
3	Exhaust Gas Recirculation Cooler Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)

Callout	Component Name
4	Exhaust Gas Recirculation Cooler Bolt (Qty: 2) Tighten 10 N.m (89 lb in)
5	Thermostat Bypass Hose Procedure 1. Inspect the bypass hose, and replace if necessary. Connect the bypass hose at the exhaust gas recirculation cooler. 2. Connect the bypass hose at the water outlet.
6	Exhaust Gas Recirculation Cooler Water Bypass Outlet Hose Procedure 1. Inspect the bypass outlet hose, and replace if necessary. Connect the outlet hose at the exhaust gas recirculation cooler. 2. Connect the bypass outlet hose at the water pump.
7	Exhaust Gas Recirculation Cooler Temperature Sensor Procedure Connect the temperature sensor nut at the inlet pipe and tighten. Tighten 42 N.m (31 lb ft)

EXHAUST GAS RECIRCULATION COOLER OUTLET PIPE INSTALLATION

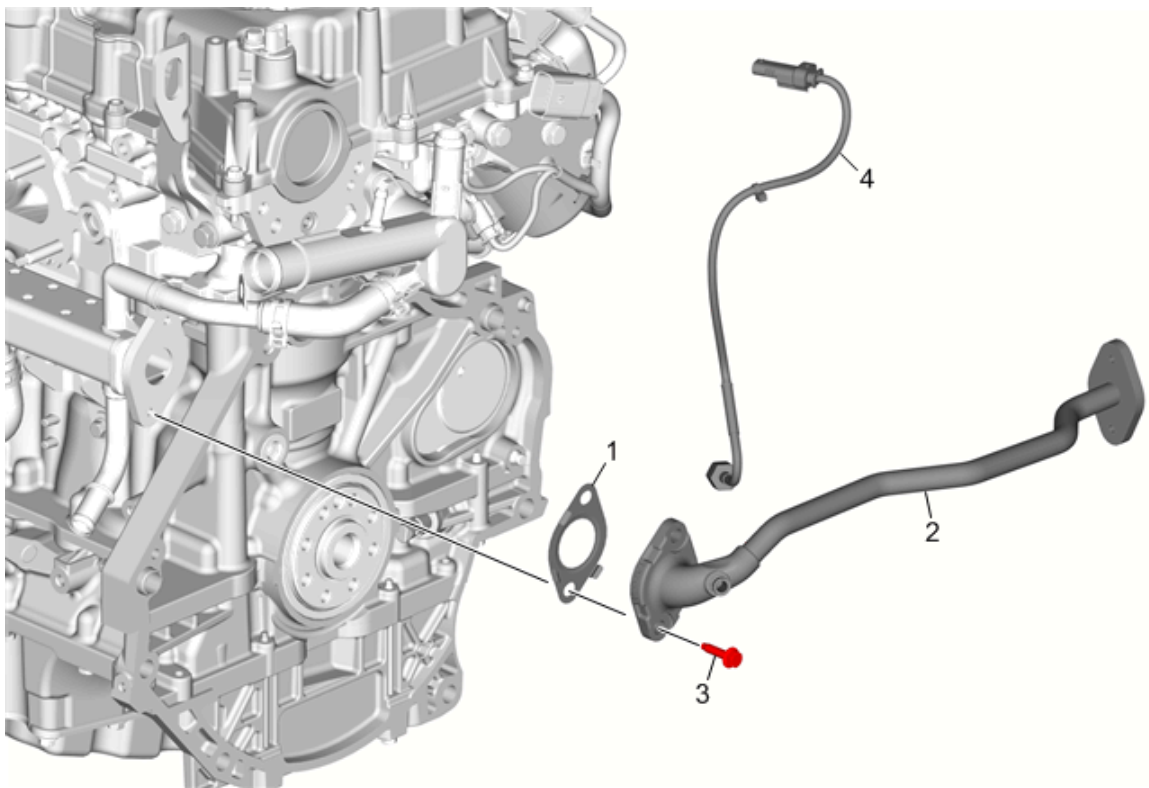


Fig. 540: Exhaust Gas Recirculation Cooler Outlet Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Cooler Outlet Pipe Gasket NOTE: Use a NEW gasket.
2	Exhaust Gas Recirculation Cooler Outlet Pipe
3	Exhaust Gas Recirculation Cooler Outlet Pipe Bolt (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
4	Exhaust Gas Recirculation Cooler Temperature Sensor Procedure Connect the temperature sensor nut at the outlet pipe and tighten. Tighten 42 N.m (31 lb ft)

EXHAUST GAS RECIRCULATION PIPE INSTALLATION

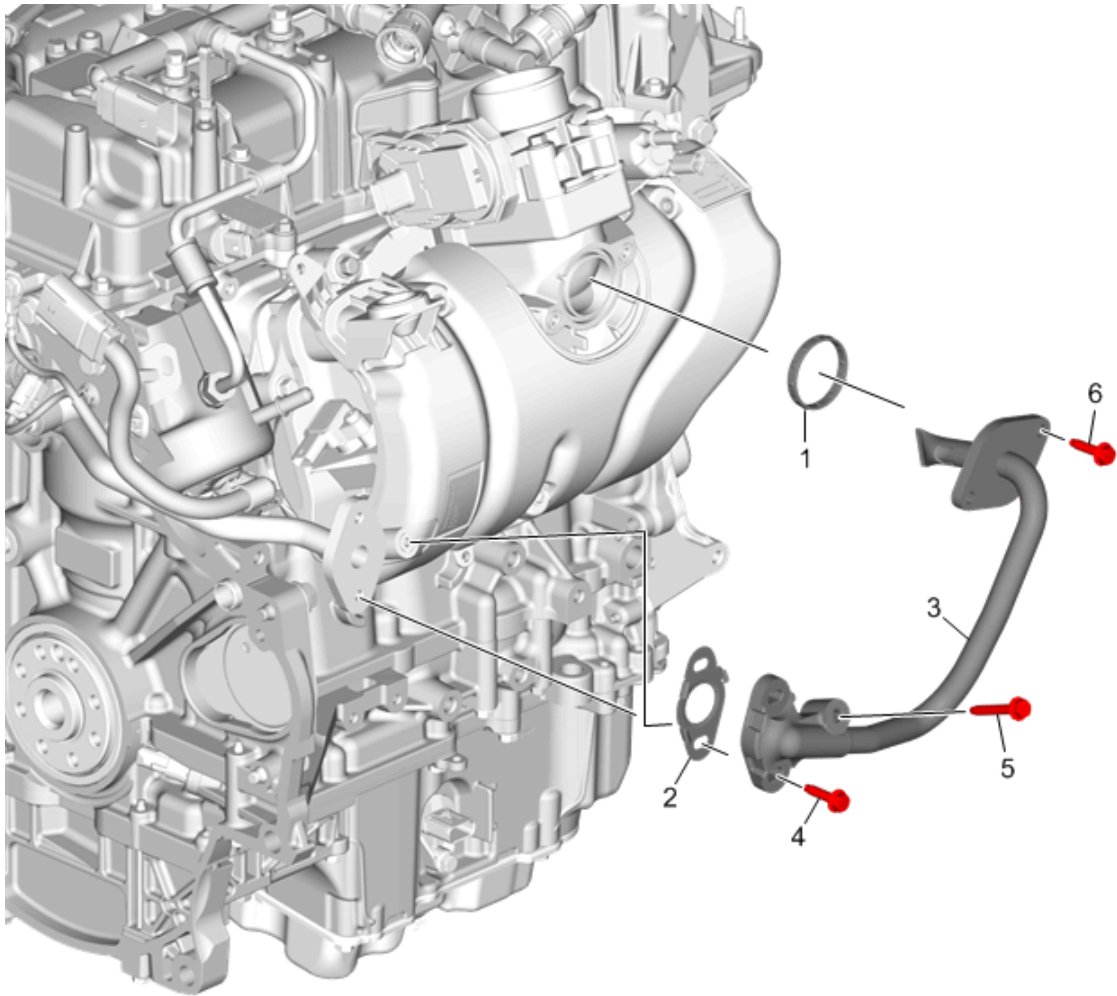


Fig. 541: Exhaust Gas Recirculation Pipe
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Exhaust Gas Recirculation Pipe Gasket NOTE: Use NEW gasket.
2	Exhaust Gas Recirculation Pipe Gasket NOTE: Use NEW gasket.
3	Exhaust Gas Recirculation Pipe

Callout	Component Name
4	Exhaust Gas Recirculation Pipe Bolt (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 10 N.m (89 lb in)
5	Exhaust Gas Recirculation Pipe Bolt Tighten 10 N.m (89 lb in)
6	Exhaust Gas Recirculation Pipe Bolt (Qty: 2) Tighten 10 N.m (89 lb in)

AUTOMATIC TRANSMISSION FLEX PLATE INSTALLATION

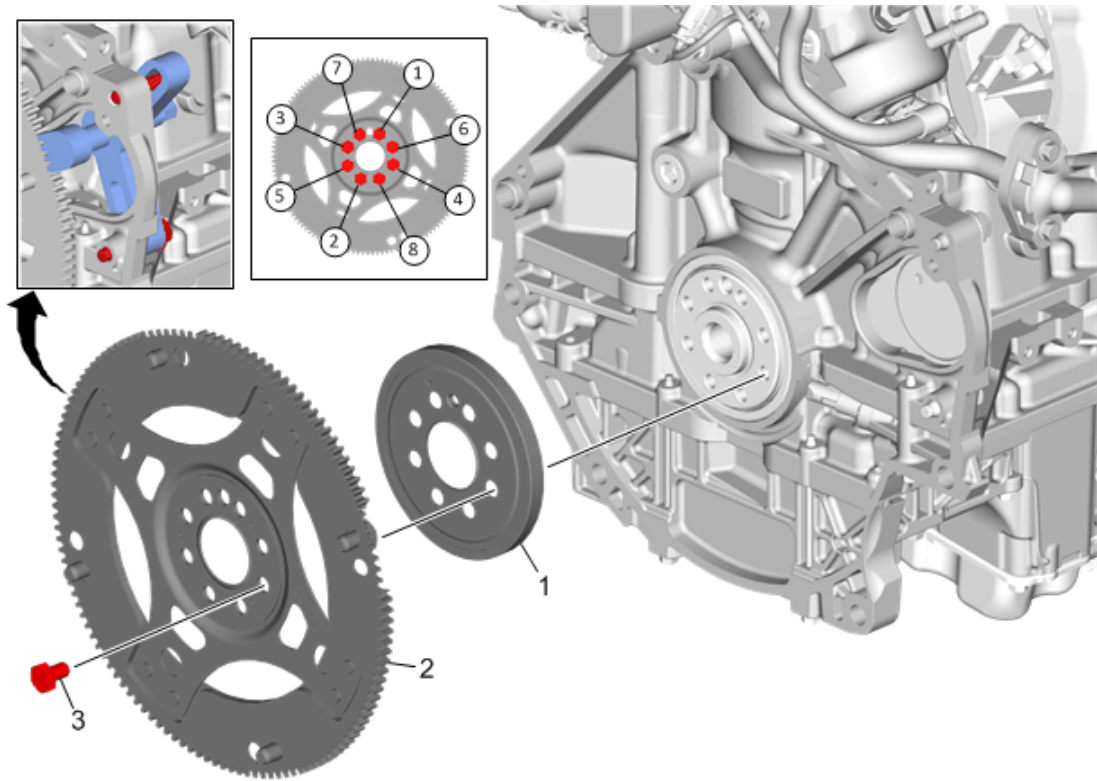


Fig. 542: Automatic Transmission Flex Plate With Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Crankshaft Position Sensor Reluctor Ring CAUTION: Refer to <u>Crankshaft</u>

Callout	Component Name
	Position Sensor Reluctor Ring Caution .
2	Automatic Transmission Flex Plate Procedure 1. Install the flex plate, and install the flex plate bolts hand tight to hold in place. 2. Remove the starter opening cover. Refer to Engine Block Disassemble. 3. Install EN-51760 holder to lock the flywheel via the starter ring gear. Special Tools EN-51760 Flywheel Holder Equivalent regional tools: Special Tools.
3	Automatic Transmission Flex Plate Bolt (Qty: 8) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . NOTE: Bolts have adhesive patch and must be tightened to final torque within 5 minutes. Procedure Tighten the NEW flex plate bolts in the sequence shown. 1. Tighten the bolts a first pass to 20 N.m (15 lb ft). 2. Tighten the bolts a second pass to 30 N.m (22 lb ft). 3. Using the EN-45059 angle meter, tighten the bolt a final pass 70 degrees. 4. Remove EN-51760 holder once final torque is achieved.

Callout	Component Name
	5. Install the starter opening cover. Refer to Engine Block Assemble. Special Tools EN-45059 Angle Meter Equivalent regional tools: Special Tools.

CRANKSHAFT BALANCER INSTALLATION

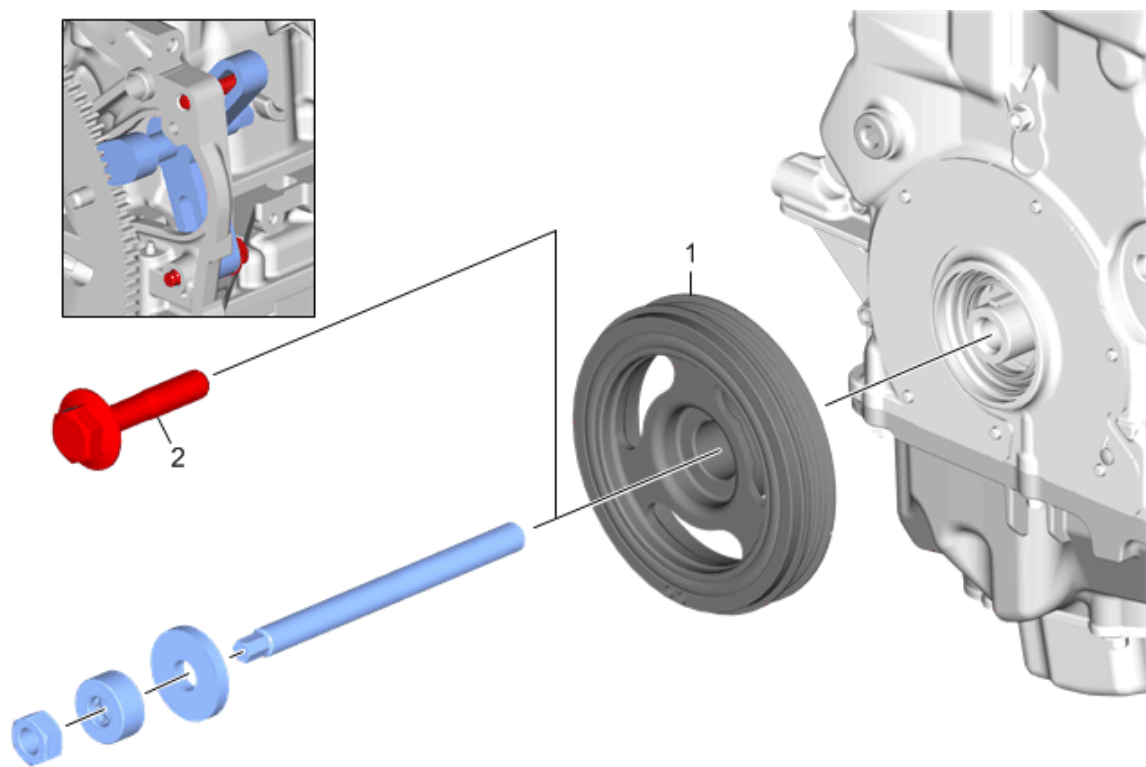


Fig. 543: Crankshaft Balancer
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the starter opening cover. Refer to Engine Block Disassemble. 2. Install EN-51760 holder, lock the automatic transmission flex plate via the starter ring gear. Special Tools EN-51760 Flywheel HolderFor equivalent regional tools, refer to Special Tools.	
1	Crankshaft Balancer Procedure: Using the screw, washer, bearing, and nut from the EN-51368 installer, seat the crankshaft balancer. Special Tools EN-51368 Front Crankshaft Seal Installer For equivalent regional tools, refer to Special Tools .
2	Crankshaft Balancer Bolt CAUTION:

Callout	Component Name
	Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure: Tighten the NEW crankshaft balancer bolt in the sequence shown. 1. Tighten the bolt a first pass to 100 N.m (74 lb ft). 2. Loosen the bolt 360 degrees. 3. Tighten the bolt a second pass to 100 N.m (74 lb ft). 4. Tighten the bolt a final pass 180 degrees using EN-45059 angle meter. 5. Install the starter opening cover. Refer to Engine Block Assemble. Special Tools EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

OIL FILTER INSTALLATION

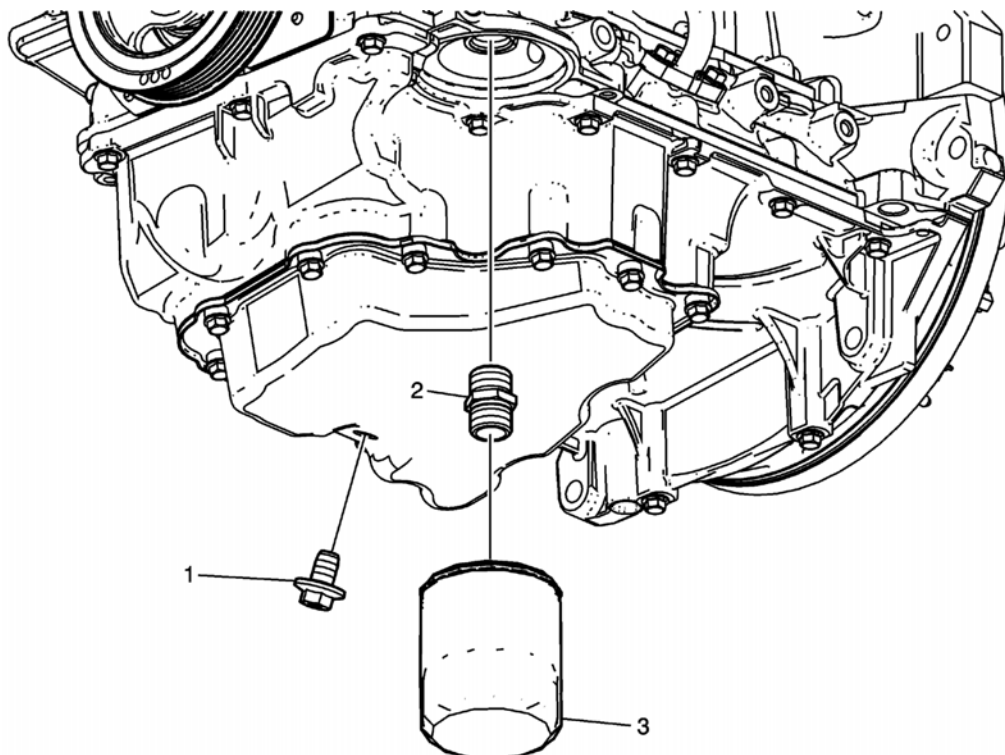


Fig. 544: Oil Filter, Fitting Adapter And Drain Plug

Callout	Component Name
1	Oil Pan Drain Plug CAUTION: Refer to Component Fastener Tightening Caution . NOTE: Use a NEW gasket. Tighten 25 N.m (18 lb ft)
2	Oil Filter Fitting Tighten 55 N.m (41 lb ft)
3	Oil Filter Tighten 3/4 to 1 full turn after gasket makes contact with the sealing surface on the filter mounting flange. Special Tools EN-726-A Oil Filter Wrench For equivalent regional tools, refer to Special Tools.

ENGINE PRELUBING

Special Tools

EN-45299 Engine Preluber

For equivalent regional tools, refer to [Special Tools](#).

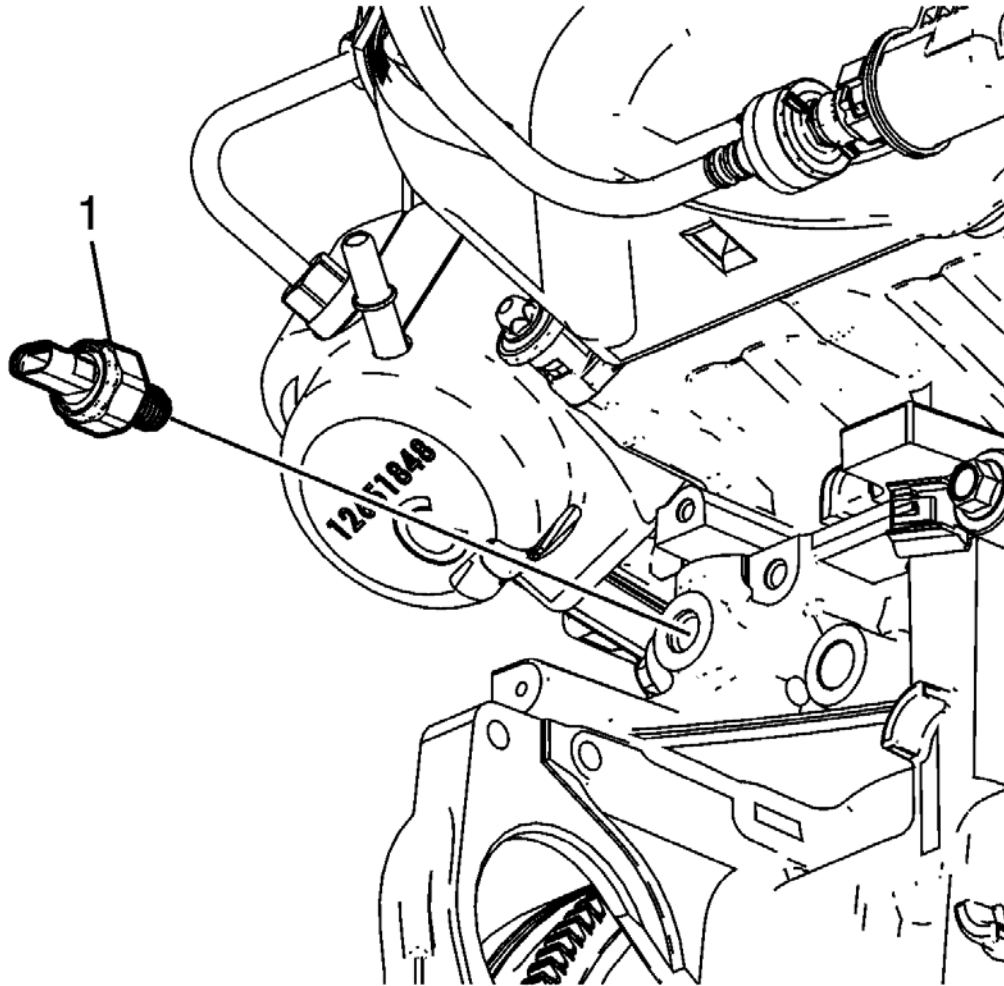


Fig. 545: Oil Pressure Switch

Courtesy of GENERAL MOTORS COMPANY

NOTE: A constant and continuous flow of clean engine oil is required in order to properly prime the engine. Ensure an approved engine oil is used, as specified in the owners manual.

1. Remove the oil pressure switch.
2. Install the M12 x 1.75 adapter (1) P/N 509376.

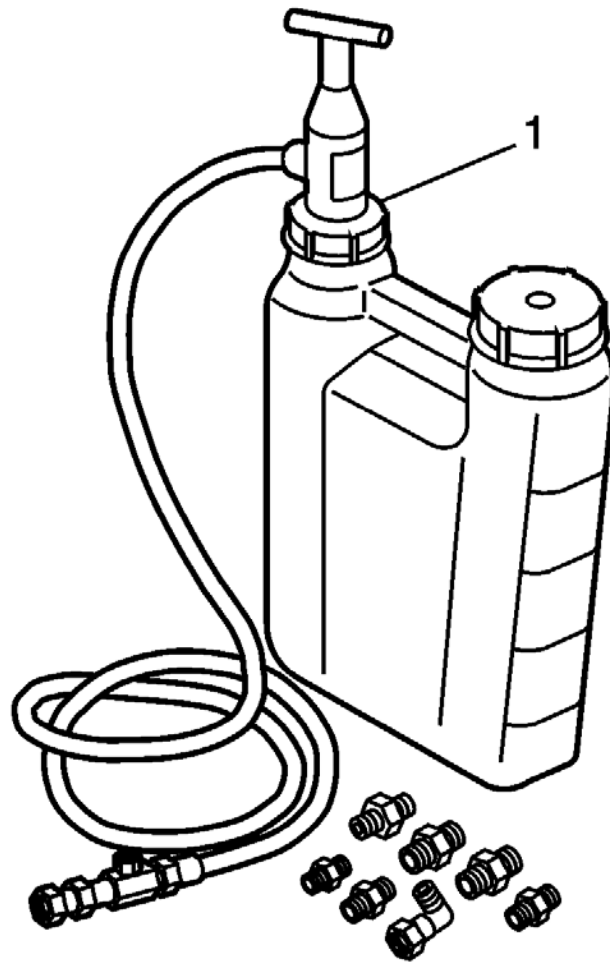


Fig. 546: Flexible Hose, Adapter And Preluber
Courtesy of GENERAL MOTORS COMPANY

3. Install the flexible hose to the adapter and open the valve.
4. Pump the handle on the **EN-45299** preluber (1) in order to flow a minimum of 1 - 1.9 liters (1 - 2 quarts) of engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
5. Close the valve and remove the flexible hose and adapter from the engine.

CAUTION: Refer to [Fastener Caution](#) .

6. Install the oil pressure switch to the engine and tighten to 26 N.m (19 lb ft).
7. Top-off the engine oil to the proper level.

DESCRIPTION AND OPERATION

CRANKCASE VENTILATION SYSTEM DESCRIPTION

Positive Crankcase Ventilation System

The crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting vapors to the atmosphere. Fresh air from the intake system is supplied to the crankcase and mixed with blow-by gases inside the crankcase. Blow-by gases rise to the top of the engine and are picked up into the oil separation chamber in the camshaft cover, where oil is separated from the gases. Blow-by gases are then passed to the intake

manifold to be consumed by normal combustion, through a calibrated orifice inside of the camshaft cover.

Operation

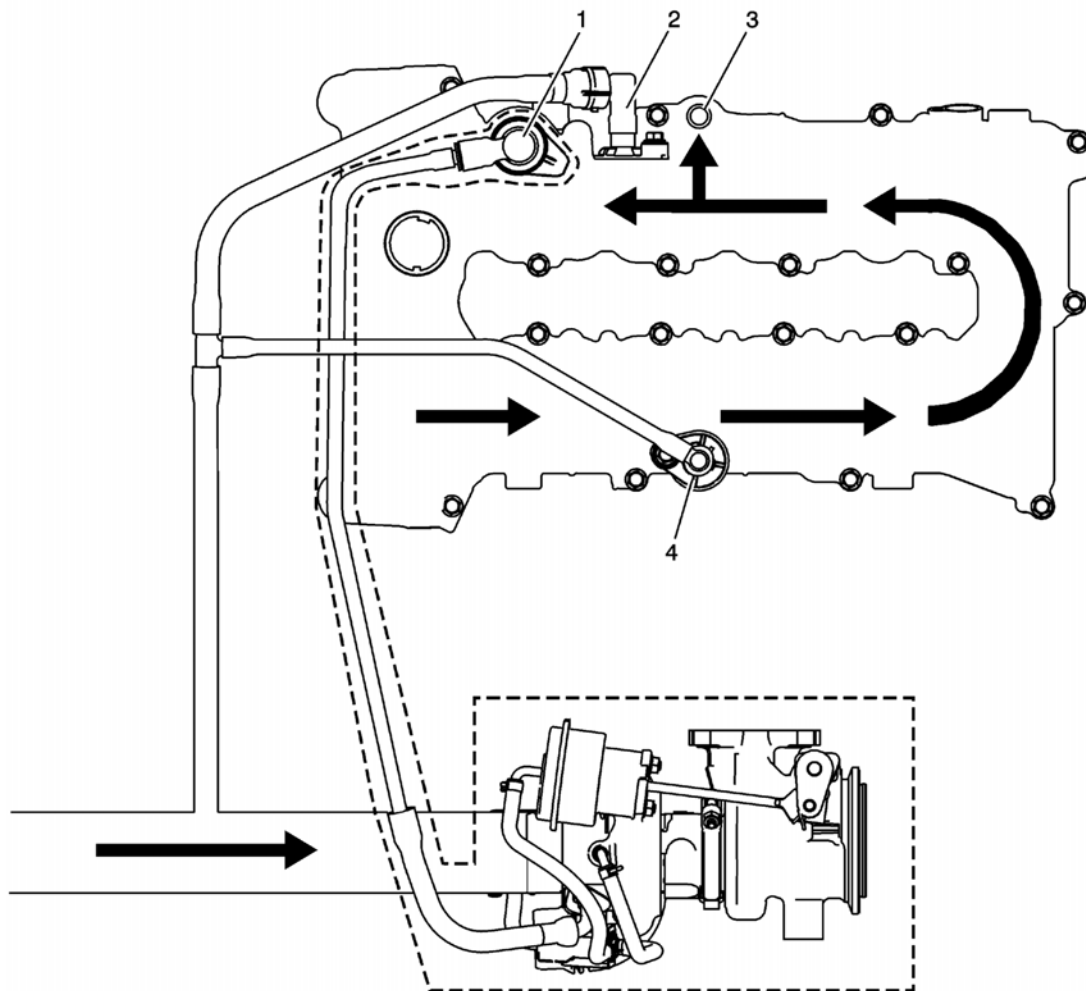


Fig. 547: Crankcase Ventilation System Diagram
Courtesy of GENERAL MOTORS COMPANY

Fresh air is brought into the engine through the positive crankcase ventilation (PCV) valve (4) as long as the crankcase is under vacuum. The primary control is through the PCV orifice (3) which meters the flow into intake manifold, at a rate depending on manifold vacuum. The PCV orifice is an integral part of the camshaft cover. Under certain operating conditions, the system is designed to allow excessive amounts of blow by gases to flow through the PCV valves (1 or 2) depending on if the engine is in boost mode or excessive crankcase pressure is detected and then routed into the intake system to be consumed by normal combustion.

Turbo Applications:

During normal operating conditions the PCV gases are routed using PCV valve (3) and the internal passage within the camshaft cover. When the Turbo is active, check valve (3) is closed and check valve (1) opens and PCV gases are routed back to the turbocharger to be consumed by normal combustion. If the engine sees excessive positive crankcase pressure check valve (2) opens and the pressure is routed to the air inlet to be reintroduced into the engine.

Non-Turbo Applications:

During normal operating conditions the PCV gases are routed using check valve (3) and the internal passage within the camshaft cover. If the engine sees excessive positive crankcase pressure check valve (2) opens and the pressure is

routed to the air inlet. Also for non-turbo applications check valve (1) does not exist.

In any application check valve (2) is only used if the engine sees excessive crankcase pressure.

Results of Incorrect Operation

A plugged orifice may cause the following conditions:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

A leaking orifice may cause the following conditions:

- Rough idle
- Stalling
- High idle speed

ENGINE COMPONENT DESCRIPTION

Engine Description

Cylinder Block

The cylinder block is constructed of aluminum alloy by high-pressure die casting with 4 cast-in-place iron cylinder liners arranged in-line. The block has 5 crankshaft bearings with the thrust bearing located on the second bearing from the rear of the engine. The cylinder block incorporates a bedplate design that forms an upper and lower crankcase. This design promotes cylinder block rigidity and reduced noise and vibration.

Crankshaft

The crankshaft is forged micro alloy steel. It is supported in 5 main journals with main bearings which have oil clearance for lubricating. The thrust bearing is located in the 4th position which controls proper crankshaft axial end play. The crankshaft is also comprised of 8 counterweights that have been scalloped for mass reduction and topped for precise engine balance. A harmonic balancer is used to control torsional vibration.

Piston and Connecting Rod

The pistons are cast aluminum. The pistons use 2 compression rings and 1 oil control ring assembly. The piston is a low friction, lightweight design with a recessed top and barrel shaped skirt. The piston pins are chromium steel and are a full-floating design. The connecting rods are powdered metal. The connecting rods are fractured at the connecting rod journal and then machined for the proper clearance. All applications use a piston with a graphite coated skirt. The piston and pin are to be serviced as an assembly.

Upper Oil Pan

The oil pan is a structural aluminum oil pan with transmission attachment. It includes the oil suction pipe, this pipe is connected with the oil pump. The oil pan is attached at the lower crankcase.

Oil Pump

The oil pump is a crankshaft driven oil pump integrated in pump module. The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. An oil strainer is mounted before the inlet of the oil pump to remove impurities which could clog or damage the oil pump or other engine components. When the

crankshaft rotates, the oil pump driven gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows. At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages.

Cylinder Head

This cylinder head is double over head camshaft (DOHC) type and has 2 camshafts that open 4 valves per cylinder with hydraulic valve lash adjuster. The camshaft sprocket wheels are installed in front of the camshafts. The cylinder head is made of cast aluminum alloy for better strength in hardness with light weight. The combustion chamber of the cylinder head is designed for increasing of squish and swirl efficiency and then this is maximized to gasoline combustion efficiency. The exhaust manifold is integrated into the cylinder head.

Valves

There are 2 intake and 2 exhaust valves per cylinder. Positive valve stem seals are used on all valves.

Valve Lash Adjusters

The valve train uses a roller finger follower acted on by a hydraulic lash adjuster. The roller finger follower reduces friction and noise.

Camshaft Cover

The camshaft cover has a steel crankcase ventilation baffling incorporated. The camshaft cover has mounting locations for the ignition system.

Camshaft/Camshaft Drive

Two camshafts are used, one for all intake valves, the other for all exhaust valves. The camshafts are assembled with steel lobes.

This engine design uses a chain to drive the dual overhead camshafts. The chain is an inverted tooth or silent design with a 6.35 mm pitch to ensure quiet operation and is hydraulically tensioned to be maintenance-free. The tensioner has a ratchet mechanism to reduce chain movement during engine starts to eliminate noise. The lightweight plastic/composite chain guides have a unique grooved face design to reduce friction for optimum efficiency. Both the crank sprocket and cam sprockets are hardened to prevent wear even with extended oil change intervals.

Intake Manifold

The intake manifold is the air flow passage to the cylinder combustion chamber through the throttle body and has an effect on engine torque, power, noise, driveability, emission, fuel economy and performance. It is made of composite plastic. The intake manifold incorporates a distribution and control system for positive crankcase ventilation (PCV) gases.

Turbocharger, If Equipped

The turbocharger consists of turbine and compressor on a common shaft. The shaft bearing is constructed to higher rotation speed and lubricated by engine oil. The turbocharger is water cooled for improved durability. The turbine wheel is driven by exhaust emissions. The compressor wheel compresses the intake air. A wastegate bypass valve regulates the charging pressure for generating a high pressure at low speed as well. At a defined charging pressure it regulates the way of the exhaust emission on bypassing the turbine wheel. The wastegate valve is controlled pneumatic and electric from the pressure in the intake manifold. The pressure of exhaust emission is reduced by opening the wastegate thereby reducing the intake pressure.

Fuel Injection System

The engine is equipped with a central direct injection system. The fuel system consists of 4 separate direct injection fuel injectors, one high pressure fuel rail, and a high pressure fuel feed pipe that connects the high pressure fuel pump to the fuel rail. The injectors are each seated into their individual bores in the cylinder head with two combustion seals to provide sealing. The high pressure fuel pump mounts to the rear of the cylinder head and is driven by the intake camshaft. Motion is transmitted to the pump from a tri-lobe on the rear of the camshaft through a hydraulic roller lifter. Due to the location of the central direct injection system injector location this provides an increase in fuel economy and performance.

SEPARATING PARTS

NOTE:

- **Disassembly of the piston, press fit design piston pin, and connecting rod may create scoring or damage to the piston pin and piston pin bore. If the piston, pin, and connecting rod have been disassembled, replace the components as an assembly.**
- **Many internal engine components will develop specific wear patterns on their friction surfaces.**
- **When disassembling the engine, internal components MUST be separated, marked, or organized in a way to ensure installation to their original location and position.**

Separate, mark, or organize the following components:

- Piston and the piston pin
- Piston to the specific cylinder bore
- Piston rings to the piston
- Connecting rod to the crankshaft journal
- Connecting rod to the bearing cap

A paint stick or etching/engraving type tool are recommended. Stamping the connecting rod or cap near the bearing bore may affect component geometry.

- Crankshaft main and connecting rod bearings
- Camshaft and valve lash adjusters
- Valve lash adjusters, lash adjuster guides, pushrods and rocker arm assemblies
- Valve to the valve guide
- Valve spring and shim to the cylinder head location
- Engine block main bearing cap location and direction
- Oil pump drive and driven gears

LUBRICATION DESCRIPTION

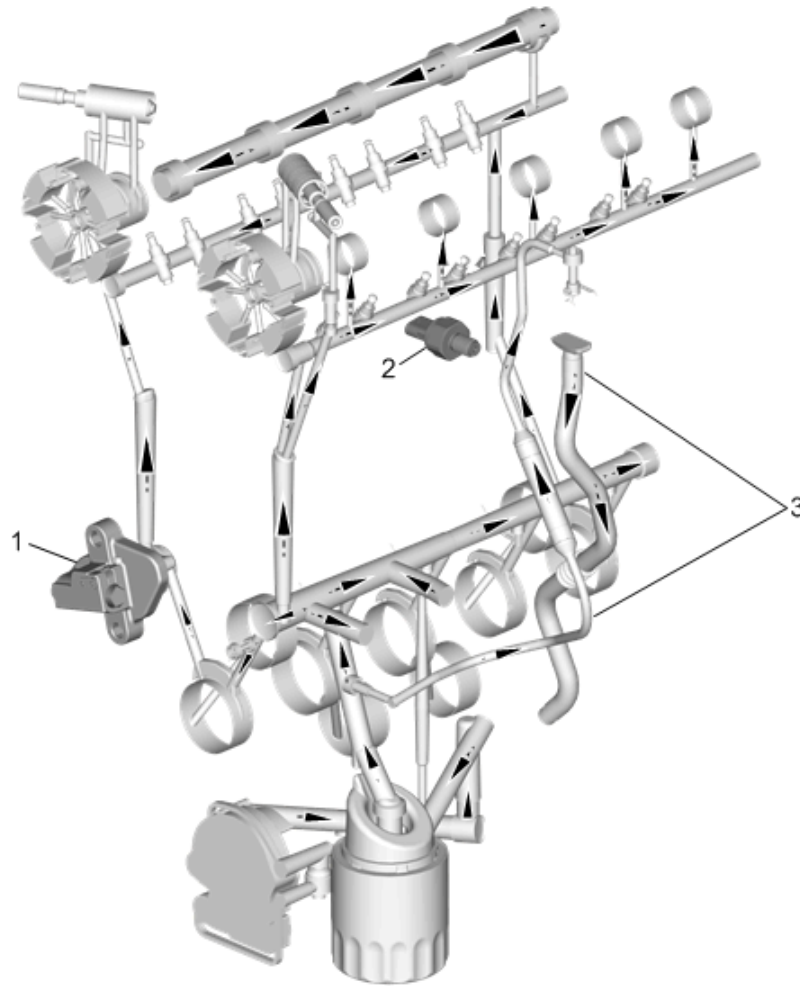


Fig. 548: Cutaway View Of Lubrication System
Courtesy of GENERAL MOTORS COMPANY

Engine lubrication is supplied by a variable displacement two-stage vane-type oil pump assembly. An oil control solenoid valve, controlled by the engine control module (ECM), mounted to the oil pump provides two stage functionality. The oil pump is mounted off-axis on the front of the engine.

All oil passing through the oil pump goes through the oil filter, where contaminants are removed. The oil filter is located on the left front side of the engine block. The oil filter is a spin-on type that mounts directly to the engine block. A bypass valve is incorporated into the oil filter, which permits oil flow in the event the filter becomes restricted.

Oil then enters the gallery where it is distributed to the crankshaft, piston oil nozzles, and timing chain oil nozzle. For turbo applications, oil is also distributed through the turbocharger oil feed and return pipes (3) and engine oil cooler. The connecting rod bearings are oiled by passages through the crankshaft connecting the main journals to the rod journals. A groove around each upper main bearing furnishes oil to the drilled crankshaft passages. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery. Passages feed each hydraulic lash adjuster.

The front feed off the main oil gallery also feeds the timing chain tensioner (1) and the intake and exhaust side phasers and oil control valves.

NOTE: **A mechanical vacuum pump is not used on hybrid engine.**

On the exhaust side, drilled passages feed each camshaft journal surface and the exhaust side head gallery feeds the mechanical vacuum pump. On the intake side, the oil is fed through the hollow camshaft to each camshaft journal surface, and a separate connected gallery feeds the intake side hydraulic lash adjusters.

An engine oil pressure sensor (2) is located on the intake rear side of the engine just below the head gasket interface. Oil returns to the oil pan through passages cast into the cylinder head. The phasers and timing chain drive lubrication drains directly into the oil pan behind the front cover.

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished, and lapped surfaces with tolerances that are measured in ten thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces during initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas are part of the repair procedure. This is considered standard shop practice even if not specifically stated.

When valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

REPLACING ENGINE GASKETS

Special Tools

J 28410 Gasket Remover

For equivalent regional tools, refer to [Special Tools](#).

Gasket Use and Applying Sealants

- Do not use any gasket again unless specified.
- Gaskets that can be used again will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called out in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Remove all gasket and sealing material from the part using the **J 28410** remover or equivalent.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces.
 - These methods of cleaning can cause damage to the component sealing surfaces.
 - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
 - This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

CAUTION: Refer to [Sealant Caution](#) .

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Tighten bolts to specifications. Do not overtighten.

USE OF ROOM TEMPERATURE VULCANIZING (RTV) AND ANAEROBIC SEALANT

Cleaning Mating Part Surfaces for RTV Joints

RTV sealant depends greatly on adhesion to the mating parts in order to form and maintain a robust sealed joint. As with any adhesion system, proper surface preparation of the bonded parts is extremely important to ensure good adhesion over the life of the product.

CAUTION: When cleaning the sealing surfaces of engine components, **DO NOT** use bristle discs, abrasive pads, wire wheels or surface conditioning discs. These types of devices should not be used because they produce a very fine grit that is abrasive and known to cause internal engine damage. The bristle discs and pads are embedded with abrasive material and wear down as they clean, continually exposing fresh abrasive to the surface of the component.

Abrasive pads, wire wheels and bristle discs can remove enough metal to affect the engine front cover, cylinder head, engine block, oil pan rail, and intake manifold runner surface flatness, which can then result in engine coolant leaks, engine oil leaks and air leaks. It takes about 15 seconds to remove 0.203 mm (0.008 in) of metal with an abrasive pad.

Abrasive pads, wire wheels and bristle discs used with high speed grinders produce airborne debris that can travel throughout the shop contaminating other work being performed outside of the immediate work area.

When cleaning engine gasket sealing surfaces and/or cleaning parts from an engine that are to be reused, surface conditioning discs, typically constructed of woven fiber or molded bristles that contain abrasives, such as a high amount of aluminum oxide, should NOT be used. The use of such surface conditioning discs dislodges aluminum oxide from the disk and metal component particles, which can lead to premature engine bearing failure. The presence of aluminum oxide in engine oil has been shown to cause premature engine bearing failure. In some cases, this failure occurs in as little as 1,600 km (1,000 mi) or less after the repair has been made.

Surface conditioning discs may grind the component material and embed it into the disc. This can result when more aggressive grinding of the gasket surface takes place.

General Motors strongly recommends using a plastic razor blade, plastic gasket scraper, a wood scraper or a non-metallic scraper to remove all sealer/gasket material on the surface of engine components that are to be reused. Do not use any other method or technique to remove the sealant or the gasket material from a part.

- Do not gouge or scratch any engine sealing surface during the cleaning process.
- It is not necessary to remove every speck of the old sealer.

To remove the old RTV sealant from the sealing surface, spray GM Low VOC Cleaner or an equivalent, on the mating surfaces and allow it to soak to loosen the old gasket material. Use care to avoid getting GM Low VOC Cleaner in any area other than the mating surface to be cleaned.

Use a plastic razor blade, that mounts in a scraper device or a hand held plastic razor blade, to remove old RTV

sealant from a sealing surface. Use a new blade for each corresponding engine component surface. Hold the blade as parallel to the flat surface as possible.

To properly clean the sealing surfaces prior to reassembly, spray GM Low VOC Cleaner on a folded lint free shop cloth. Wipe the mating surfaces on the engine and front cover and rotate the shop cloth until there are no more visible signs of contamination on the cloth.

After the final cleaning of the parts, allow up to 5 minutes for the components to dry before applying new RTV sealant.

NOTE: After the final cleaning with GM Low VOC Cleaner and before reassembly, DO NOT touch the cleaned surfaces with your hand. Oils from your skin WILL CONTAMINATE the surface and prevent proper bonding of the new RTV sealant.

Typical Applications

This procedure is intended for use in the following operations:

- Building of engines in a manual low volume build process where the use of assembly lubricants and other typical conditions exist which may contaminate the component sealing surfaces in an RTV joint.
- Cleaning of surfaces contaminated with oil or other substance during the assembly operation as a special case event.

In the typical situation, both the part being assembled, and the assembly to which it is to be sealed will be cleaned. An example is an oil pan assembled to a block/front cover/rear cover assembly using an RTV seal applied to the pan or the block. Both the pan and the block assembly should be cleaned prior to RTV application.

Any loose gaskets that are part of the RTV joint should not be cleaned unless it is known that they have been contaminated during the build process. Examples of loose gaskets are intake side and end seals which contact RTV used to seal a T-joint.

Assemblies supplied to GM with gaskets in place should not be cleaned unless they are known to be contaminated during the build process. Examples are rocker/cam covers with press in place gaskets using RTV at corners or T-joints.

Materials Needed

Use clean dry lint free cloths to wipe surface with approved solvent based cleaner. Examples are:

- GM Good Wrench Service Low VOC Brake Parts Cleaner
- AC Delco Non-Chlorinated Brake Parts Cleaner
- Loctite ODC - Free Cleaner & Degreaser

Procedure:

1. Identify the surfaces to which the RTV will come into contact in the assembled joint.
2. Using an approved solvent based cleaner, thoroughly soak an appropriate portion of a clean, dry cloth. Immediately wipe the surfaces with the cloth to remove any residue of oil, soap, etc.
3. Repeat step 2 using a clean portion of the cloth as many times as required until the cleanliness of the cloth after wiping the surface becomes constant in appearance. There is typically some discoloration of the cloth after wiping however a clean surface should produce the same level of discoloration with successive wiping with a clean cloth and solvent.
4. If crevices exist in the joint such that wiping the surface would not be sufficient to clean the crevice, the approved solvent based cleaner should be directly sprayed on the joint to ensure wetting of the surfaces and

removal of the contaminant. DO NOT spray rubber components directly. Care must be used to avoid getting solvent in areas other than necessary to clean the joint. Then continue with step 3.

5. Allow the surfaces to dry for a minimum of 1 minute or longer if necessary for the solvent to evaporate from the surface.
6. Do not touch the cleaned surface with anything prior to RTV application.
7. The surface is now prepared for RTV application.

Sealant Types

NOTE: The correct sealant and amount of sealant must be used in the proper location to prevent oil leaks, coolant leaks, or the loosening of the fasteners. DO NOT interchange the sealants. Use only the sealant, or equivalent, as specified in the service procedure.

The following two major types of sealant are commonly used in engines:

- Room Temperature Vulcanizing (RTV)
- Anaerobic sealant, which include the following:
 - Gasket Eliminator
 - Pipe Sealant
 - Threadlock

Room Temperature Vulcanizing (RTV) Sealer

This type of sealant is used where two components, such as the intake manifold and the engine block, are assembled together.

Use the following information when using RTV sealant:

- Do not use RTV sealant in areas where extreme temperatures are expected. These areas include:
 - The exhaust manifold
 - The head gasket
 - Any other surfaces where a different type of sealant is specified in the service procedure
- Do not use RTV sealant unless the ambient air temperature is at least 18°C (65°F) degrees or higher.
- Always follow all the safety recommendations and the directions that are on the RTV sealant container.
- Use a plastic or wood scraper in order to remove all the RTV sealant from the components.

CAUTION: Do not allow the RTV sealant to enter any blind threaded hole. RTV sealant that is allowed to enter a blind threaded hole can cause hydraulic lock of the fastener when the fastener is tightened. Hydraulic lock of a fastener can lead to damage to the fastener and/or the components. Hydraulic lock of a fastener can also prevent the proper clamping loads to be obtained when the fastener is tightened. Improper clamping loads can prevent proper sealing of the components allowing leakage to occur. Preventing proper fastener tightening can allow the components to loosen or separate leading to extensive engine damage.

- The surfaces to be sealed must be clean and dry.

NOTE: The bead size is critical and is easier to maintain consistency and application

with a RTV dispensing tool. This also helps to eliminate waste.

- Use a RTV sealant bead size as specified in the service procedure.
- Apply the RTV sealant bead to the inside of any bolt holes areas.

NOTE: Do not wait for the RTV sealant to skin over.

- Assemble the components while the RTV sealant is still wet to the touch, within 10 minutes.

NOTE: Do not overtighten the fasteners.

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

Anaerobic Type Gasket Eliminator Sealant

Anaerobic type gasket eliminator sealant cures in the absence of air. This type of sealant is used where two rigid parts, such as castings, are assembled together. When two rigid parts are disassembled and no sealant or gasket is readily noticeable, then the two parts were probably assembled using an anaerobic type gasket eliminator sealant.

Use the following information when using gasket eliminator sealant:

- Always follow all the safety recommendations and directions that are on the gasket eliminator sealant container.
- Apply a continuous bead of gasket eliminator sealant to one flange.
- The surfaces to be sealed must be clean and dry.

CAUTION: Do not allow the sealant to enter a blind hole. The sealant may prevent the fastener from achieving proper clamp load, cause component damage when the fastener is tightened, or lead to component failure.

- Do not allow the gasket eliminator sealed joint to cure more than 5 minutes before torquing to specification. This will result in an incorrect clamp load of assembled components.
- Do not overtighten the fasteners.
 - Apply the gasket eliminator sealant evenly to get a uniform thickness of the gasket eliminator sealant on the sealing surface.
 - Tighten the fasteners in sequence, if specified, and to the proper torque specifications.
 - After properly tightening the fasteners, remove the excess gasket eliminator sealant from the outside of the joint.

Anaerobic Type Threadlock Sealant

Anaerobic type threadlock sealant cures in the absence of air. This type of sealant is used for threadlocking and sealing of bolts, fittings, nuts, and studs. This type of sealant cures only when confined between two close fitting metal surfaces.

Use the following information when using threadlock sealant:

- Always follow all safety recommendations and directions that are on the threadlock sealant container.
- The threaded surfaces to be sealed must be clean and dry.
- Apply the threadlock sealant as specified on the threadlock sealant container.

NOTE:

- Do not allow the threadlock sealant to cure more than 5 minutes before torquing to specification. This will result in an incorrect clamp load of assembled components.
- Do not overtighten the fasteners.

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

Anaerobic Type Pipe Sealant

Anaerobic type pipe sealant cures in the absence of air and remains pliable when cured. This type of sealant is used where two parts are assembled together and require a leak proof joint.

Use the following information when using pipe sealant:

- Do not use pipe sealant in areas where extreme temperatures are expected. These areas include:
 - The exhaust manifold
 - The head gasket
 - Surfaces where a different sealant is specified
- Always follow all the safety recommendations and the directions that are on the pipe sealant container.
- The surfaces to be sealed must be clean and dry.
- Use a pipe sealant bead of the size or quantity as specified in the service procedure.

CAUTION: Do not allow the sealant to enter a blind hole. The sealant may prevent the fastener from achieving proper clamp load, cause component damage when the fastener is tightened, or lead to component failure.

- Apply the pipe sealant bead to the inside of any bolt hole areas.
- Apply a continuous bead of pipe sealant to one sealing surface.

NOTE:

Do not overtighten the fasteners.

- Tighten the fasteners in sequence, if specified, and to the proper torque specifications.

SPECIAL TOOLS AND EQUIPMENT**SPECIAL TOOLS**

Illustration	Tool Number/Description
--------------	----------------------------

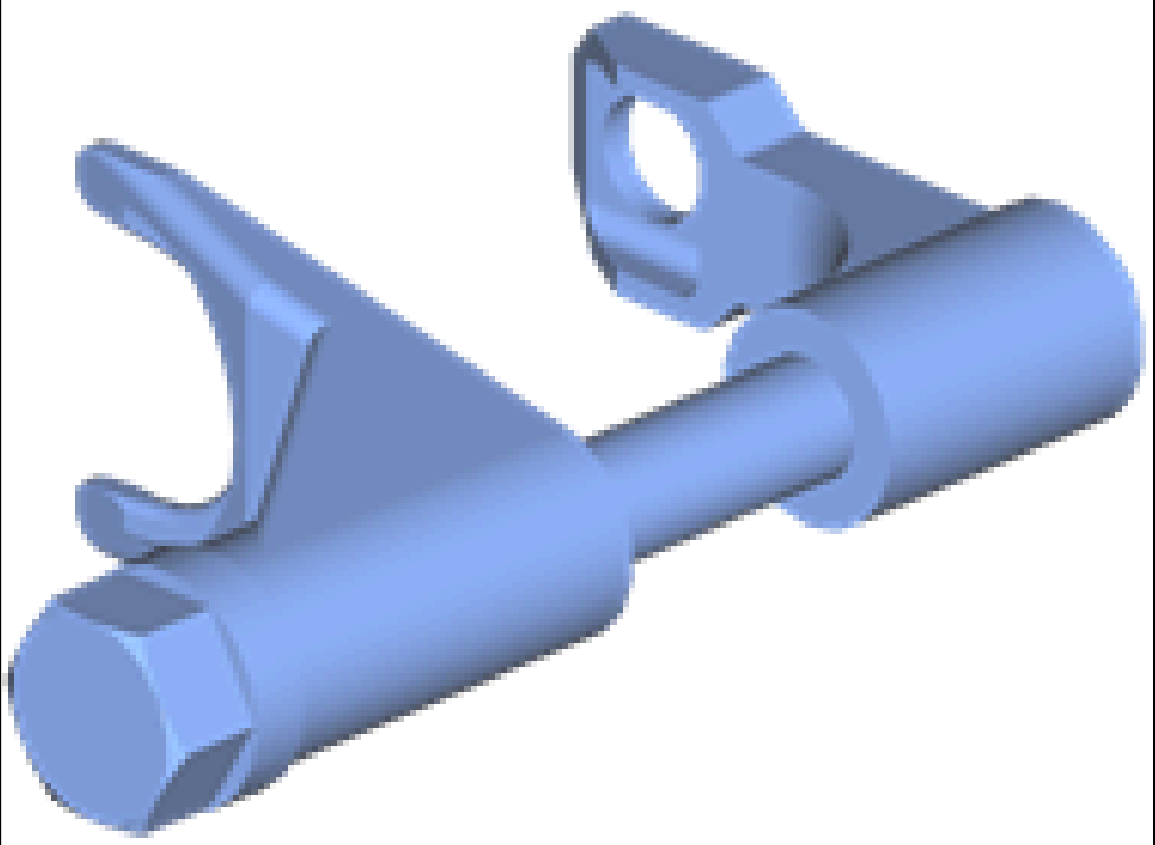
Illustration	Tool Number/Description
	CH-42188-B J-42188-B Ball Joint Separator

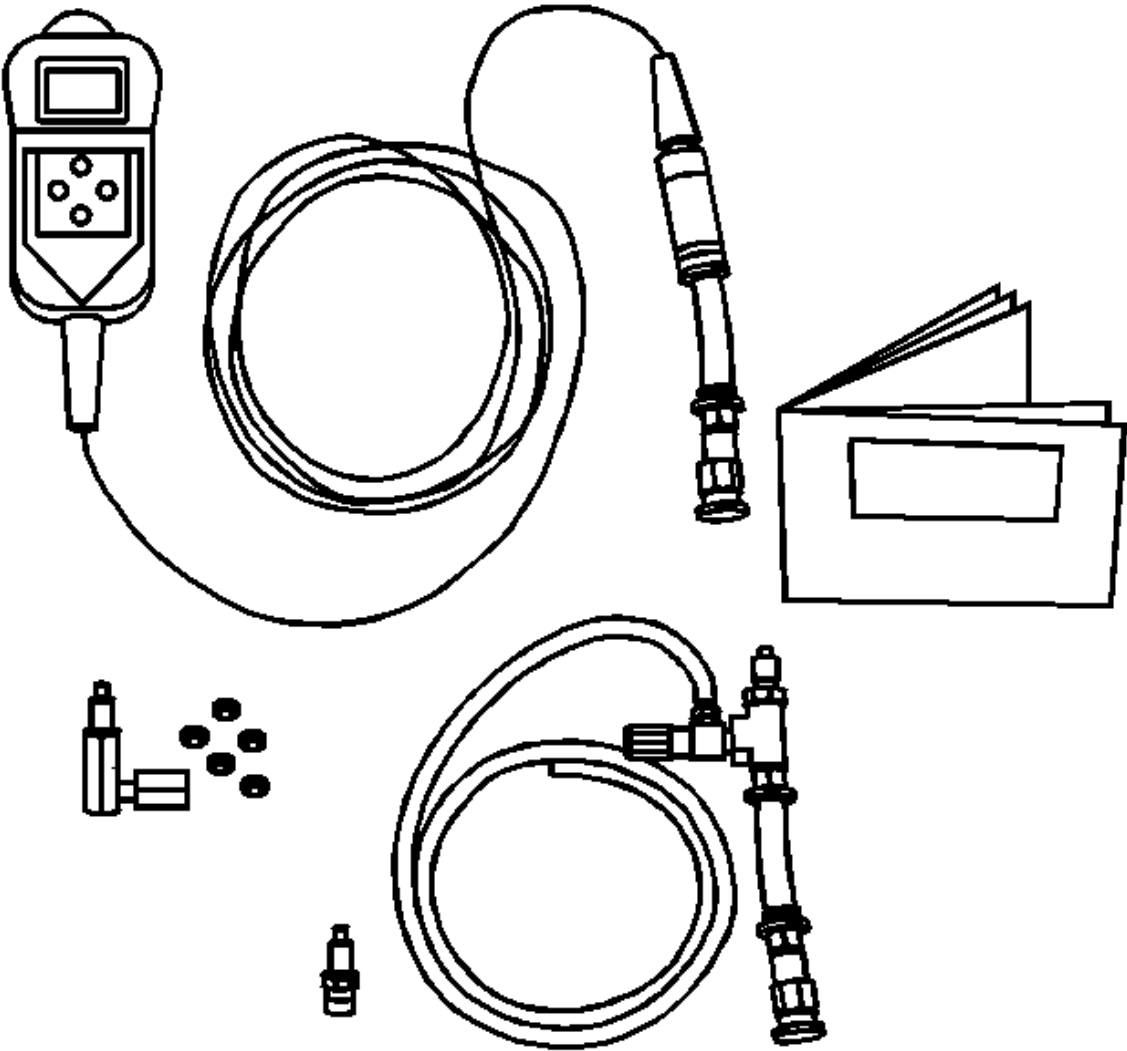
Illustration	Tool Number/Description
	CH-48027 Digital Pressure Gauge

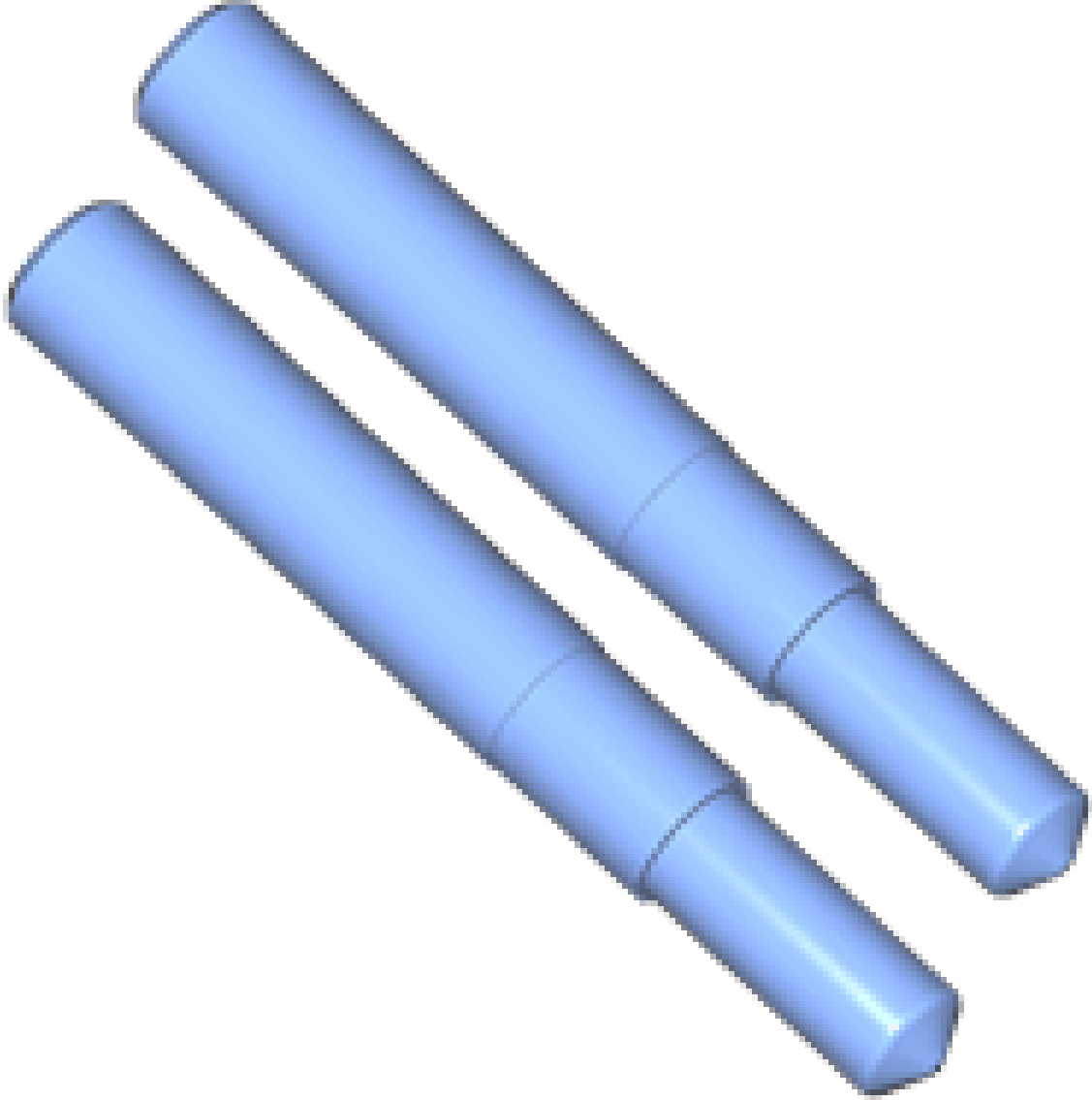
Illustration	Tool Number/Description
 The illustration shows two identical blue cylindrical guide pins. Each pin has a main body with two distinct, slightly wider sections in the middle, creating a three-part appearance. They are positioned diagonally, with one pin slightly above and to the right of the other.	CH-51034 Cradle Alignment Guide Pins

Illustration	Tool Number/Description
	DT-6125-1B J-6125-1B Slide Hammer with Adapter

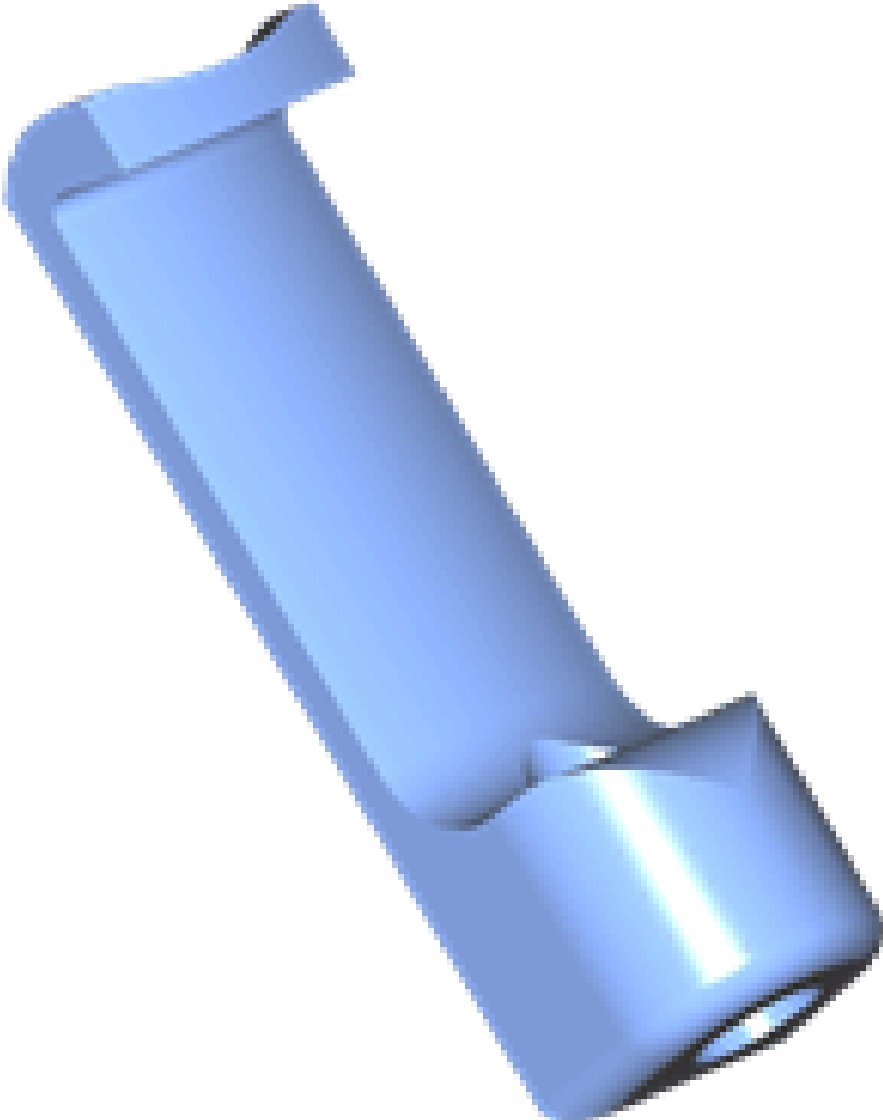
Illustration	Tool Number/Description
	DT-23129 J-23129 KM-586 Universal Seal Remover

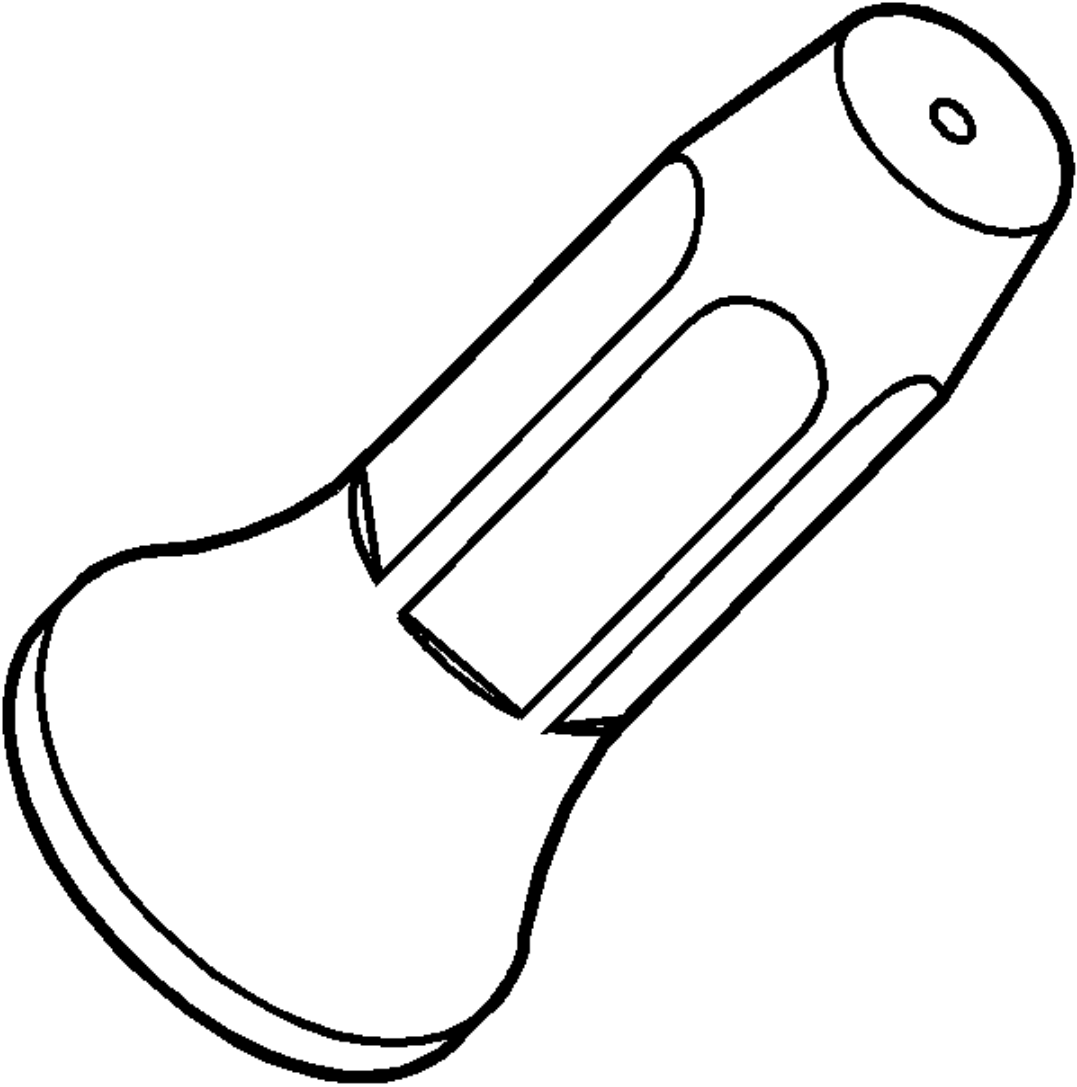
Illustration	Tool Number/Description
	DT-45866 J-45866 Input Shaft Seal Installer

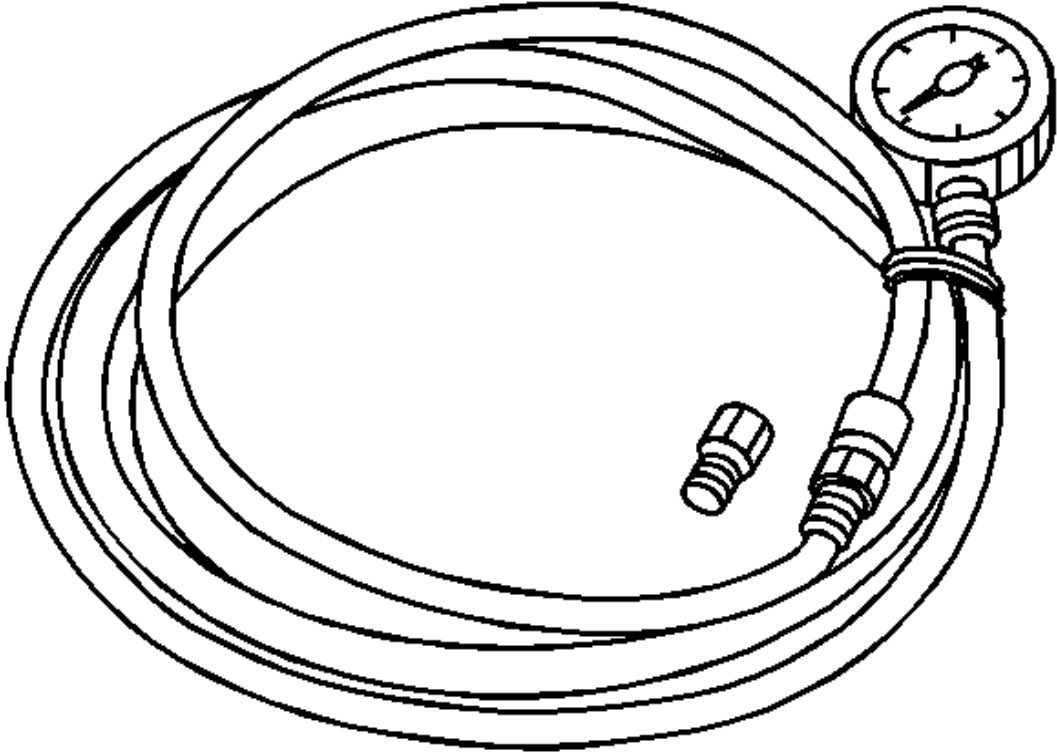
Illustration	Tool Number/Description
	EN-498-B Oil Pressure Gauge

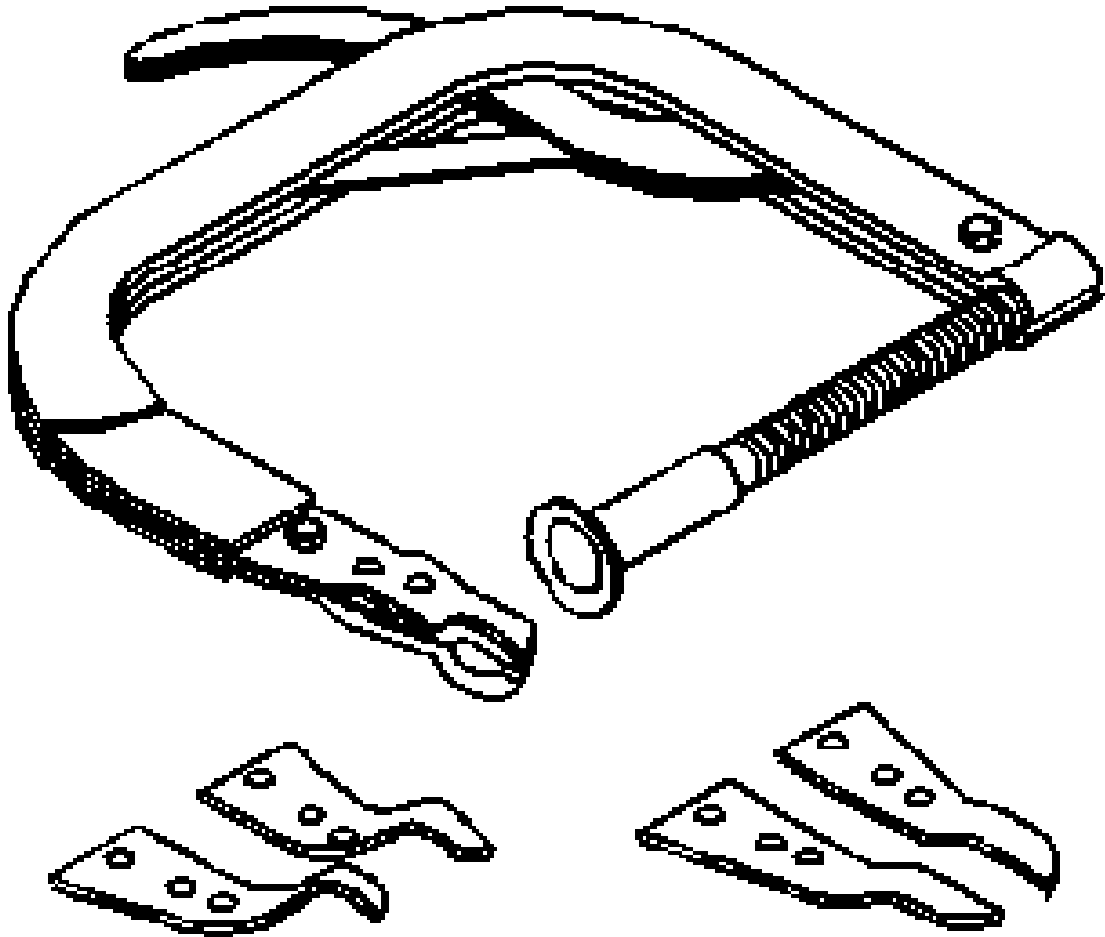
Illustration	Tool Number/Description
	EN-8062 J-8062 KM-348 Valve Spring Compressor - Head Off

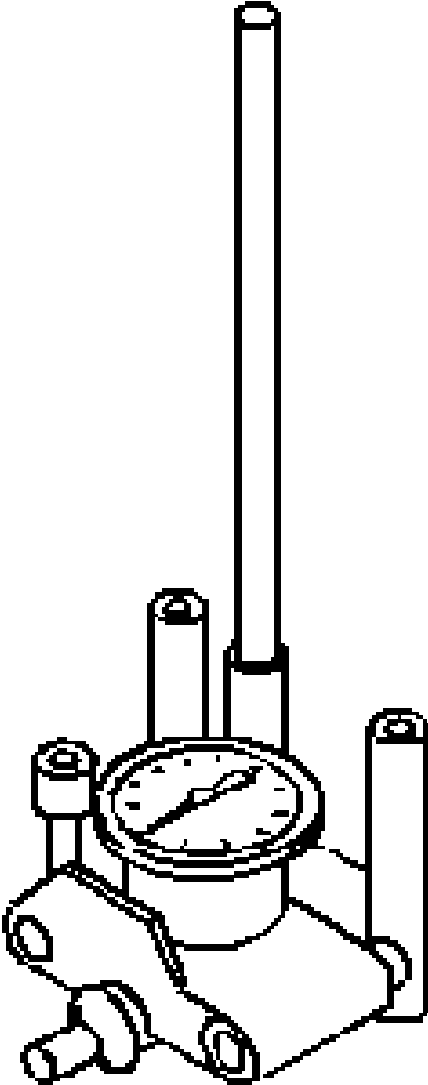
Illustration	Tool Number/Description
	EN-8087 J-8087 Cylinder Bore Gauge

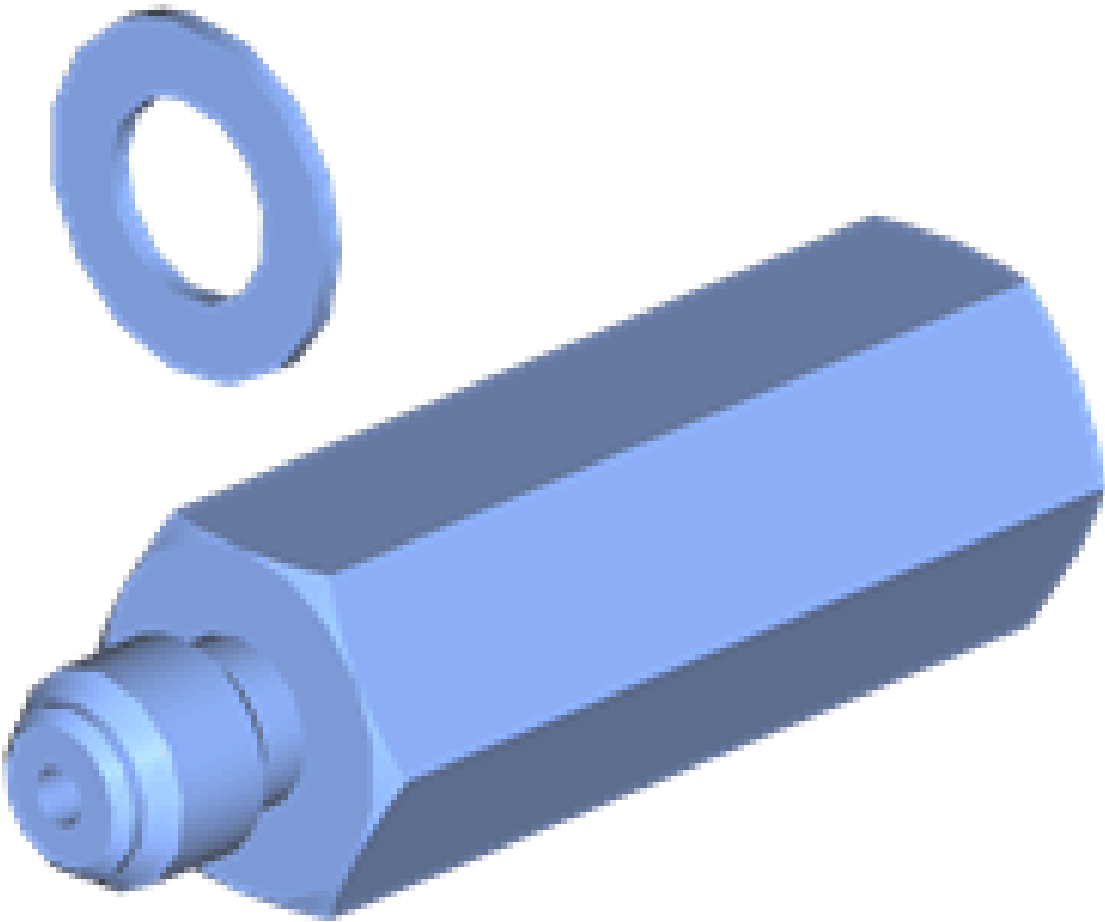
Illustration	Tool Number/Description
	EN-21867-850 J-21867-850 KM-498-B KM-6106 83 93 852 Oil Pressure Gauge Adapter

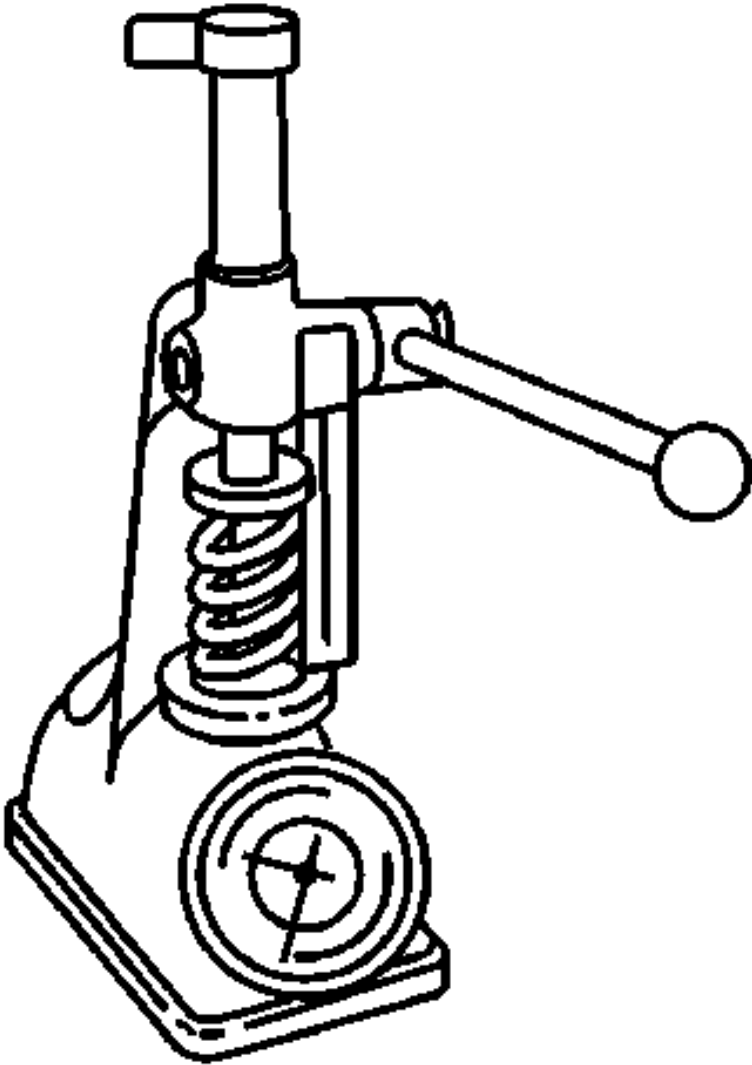
Illustration	Tool Number/Description
	EN-22738-B GE-22738-B J-22738-B J-9666 Valve Spring Tester

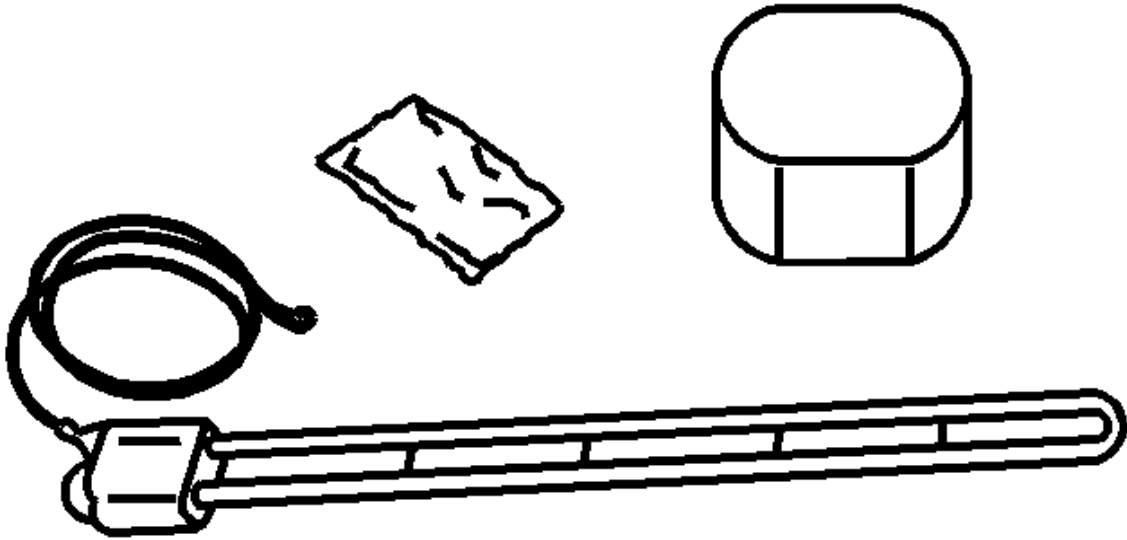
Illustration	Tool Number/Description
	EN-23951 J-23951 Valve Manometer

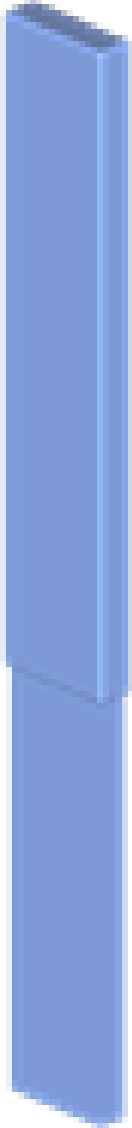
Illustration	Tool Number/Description
	EN-28410 J-28410 Gasket Remover

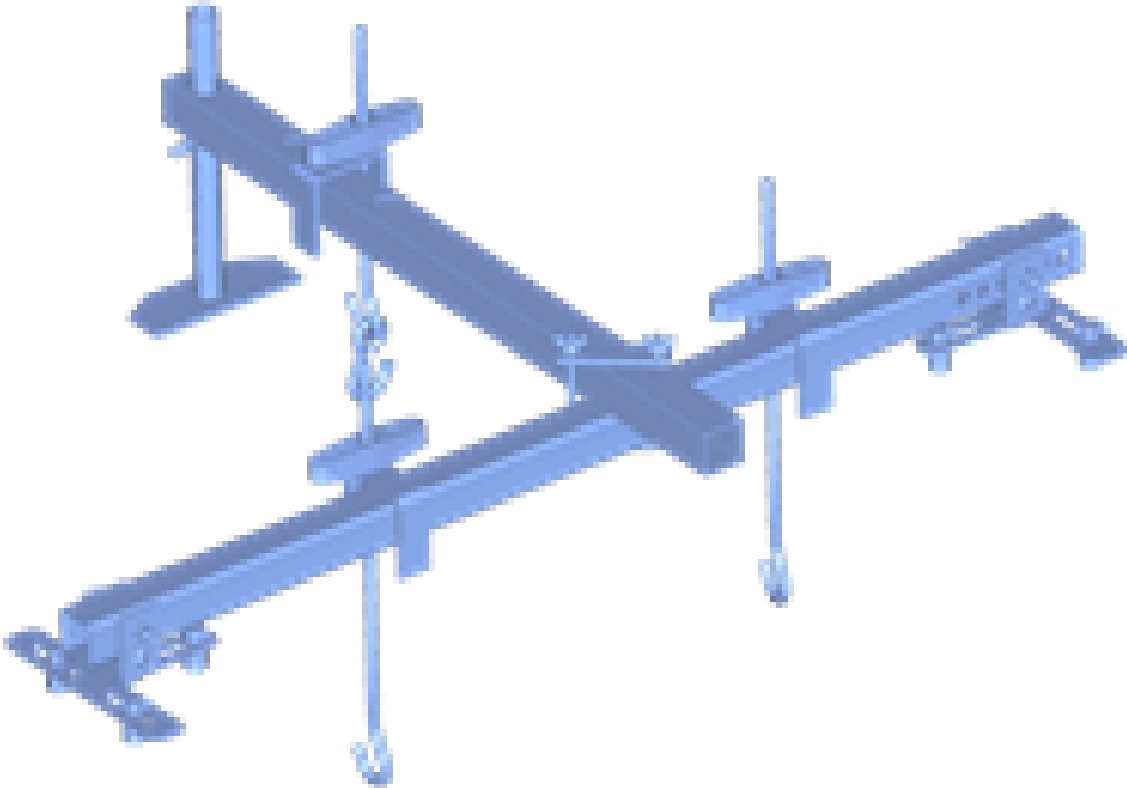
Illustration	Tool Number/Description
	EN-28467-B J-28467-B Universal Engine Support Fixture

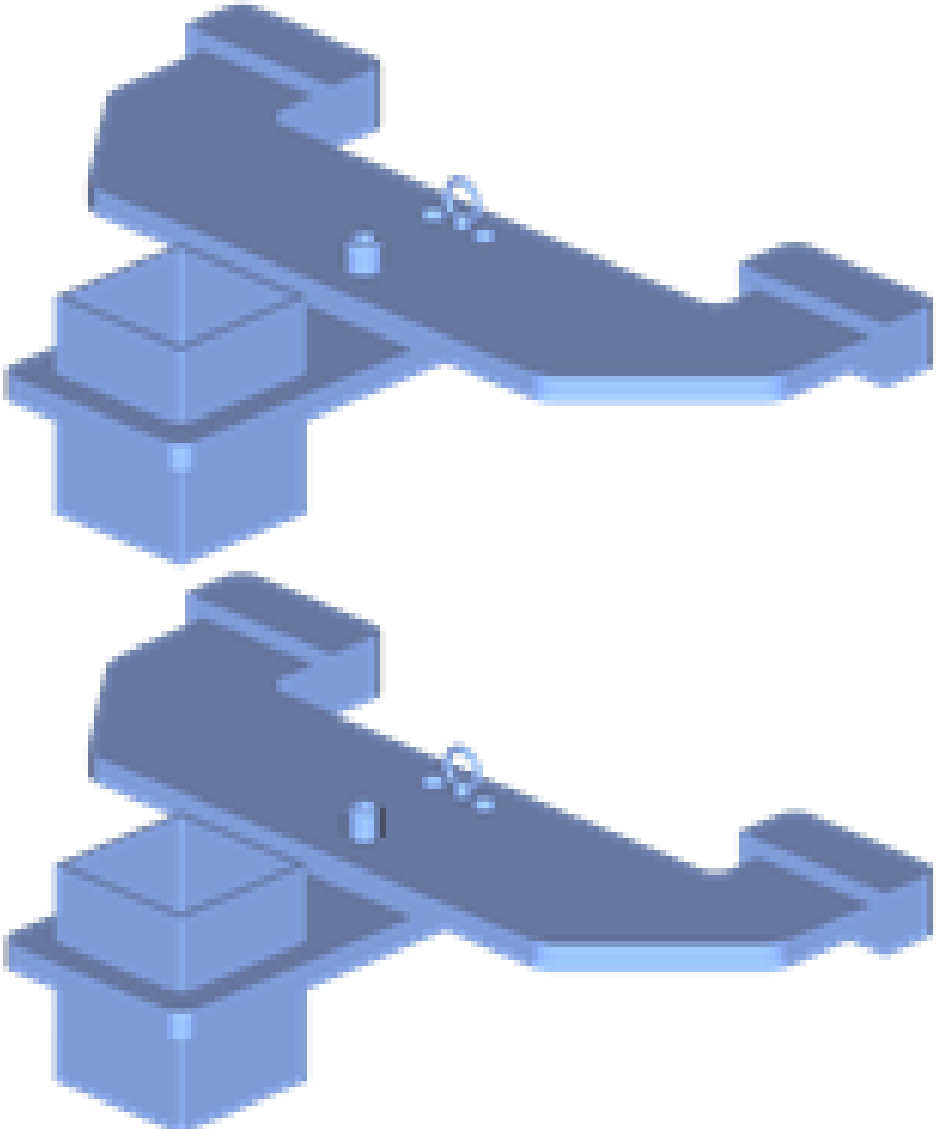
Illustration	Tool Number/Description
	EN-28467-501 J-28467-501 Engine Support Fixture Adapters

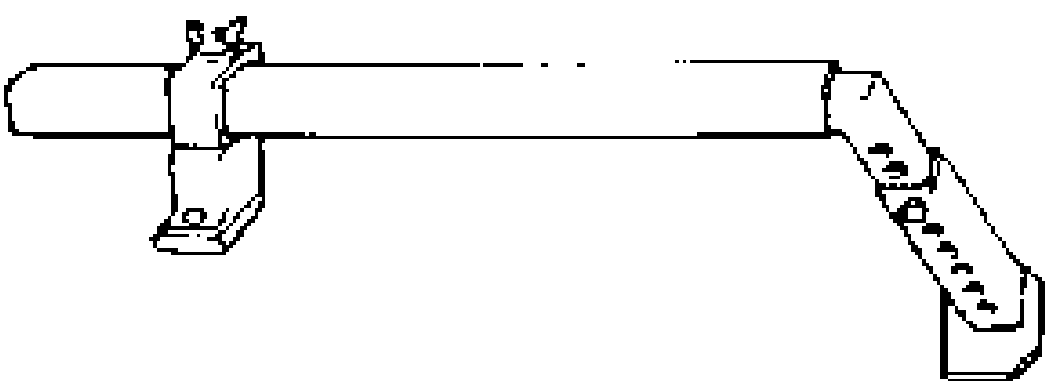
Illustration	Tool Number/Description
	EN-36462-A J-36462-A Engine Support Adapter Leg Set

Illustration	Tool Number/Description
	EN-36857 J-36857 Engine Lift Bracket

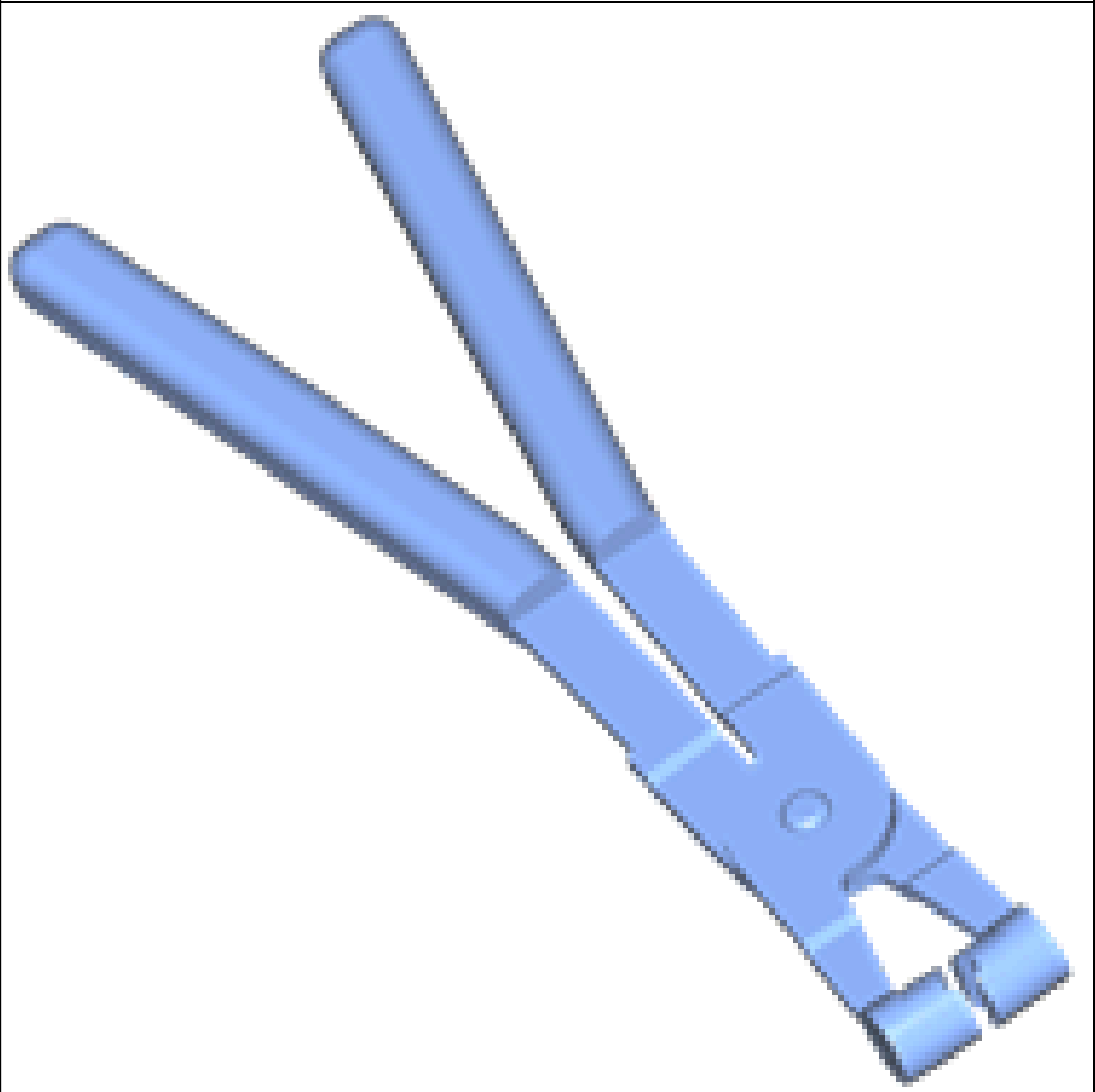
Illustration	Tool Number/Description
	EN-38185 Hose Clamp Pliers

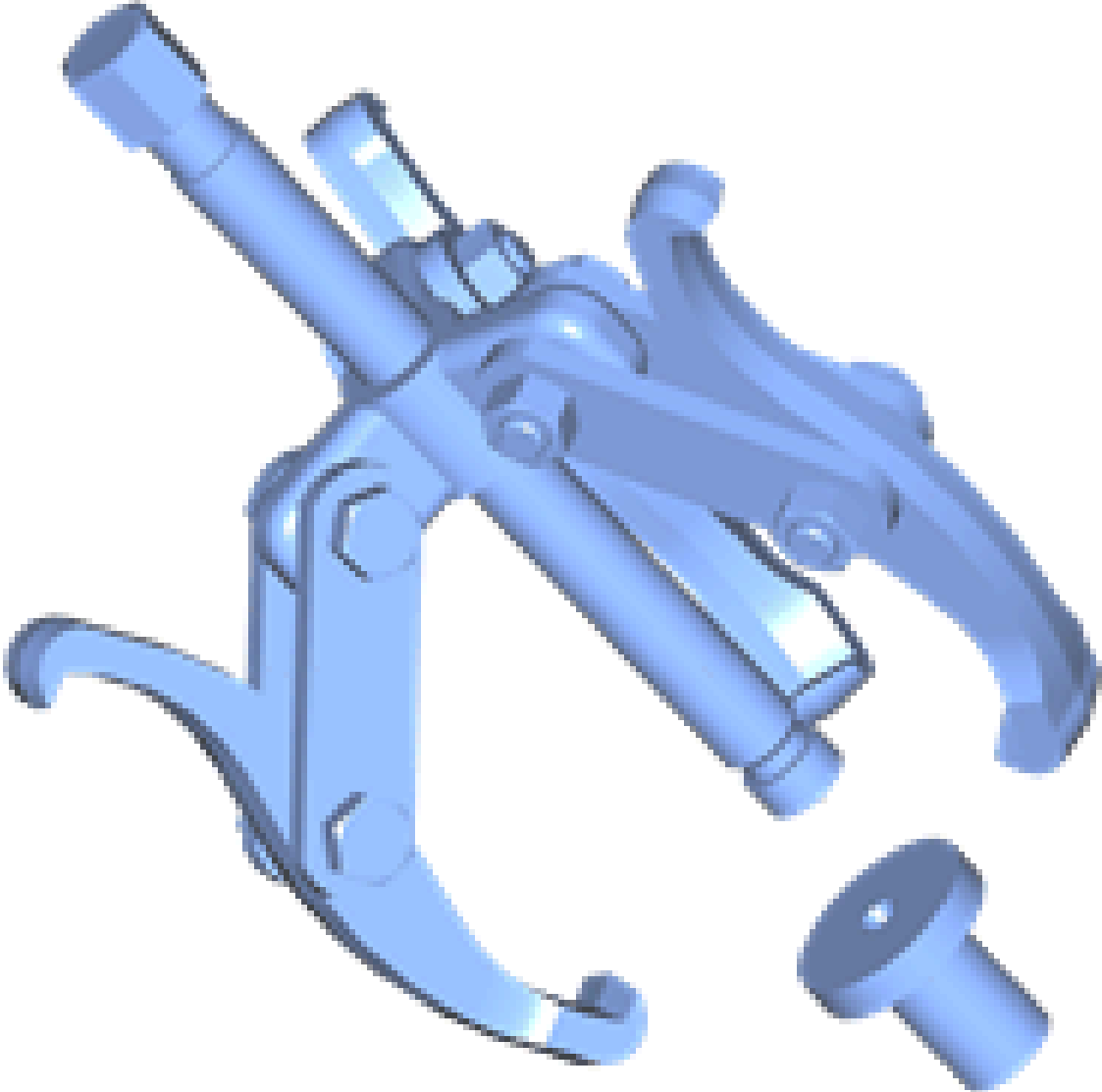
Illustration	Tool Number/Description
	EN-41816 J-41816 Crankshaft Balancer Remover

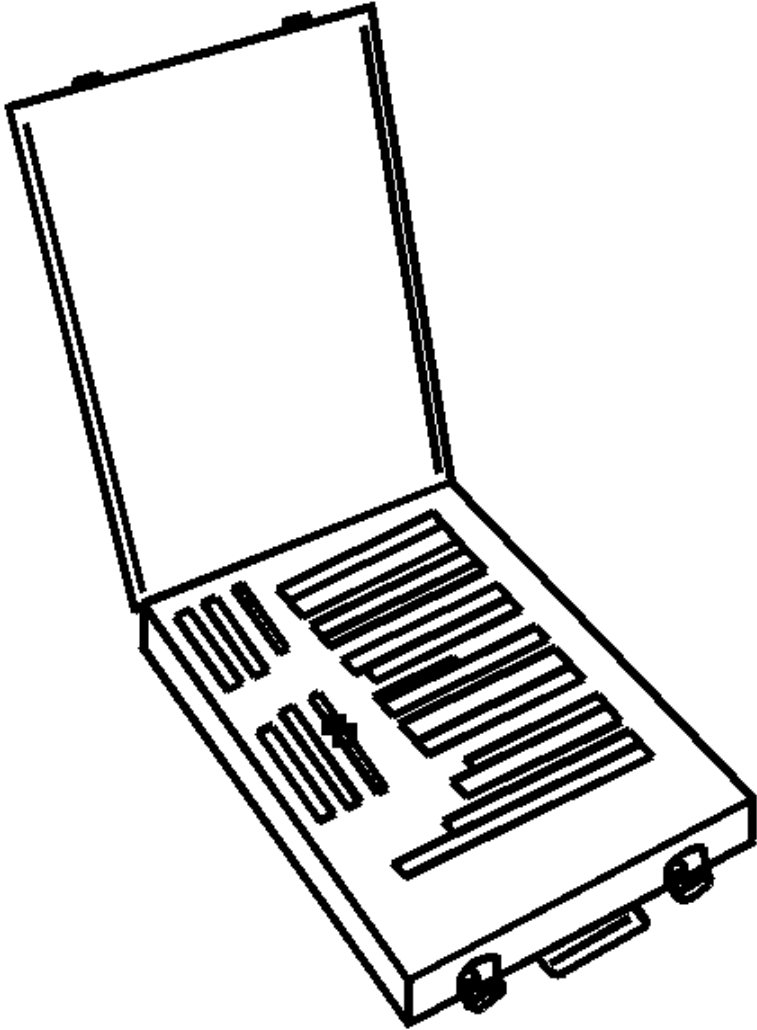
Illustration	Tool Number/Description
	EN-42385-850 J-42385-850 Thread Repair Kit

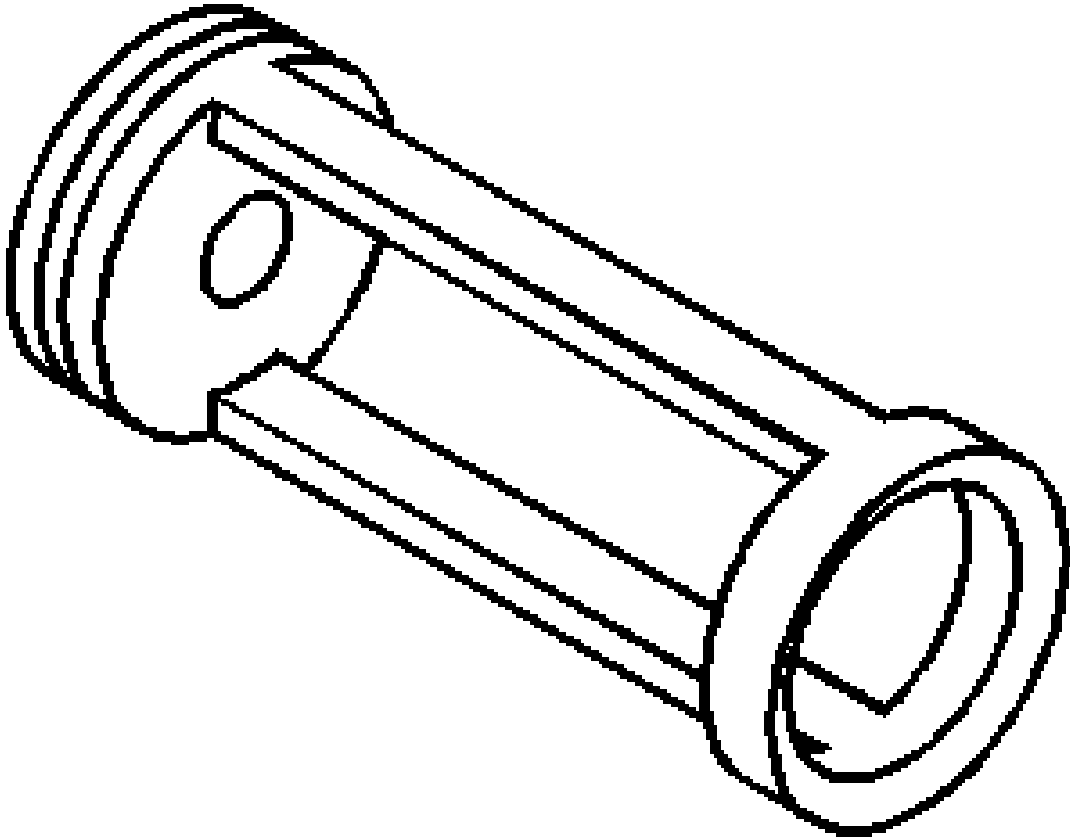
Illustration	Tool Number/Description
	EN-43963 J-43963 KM-6149 Valve Spring Compressor (off car)

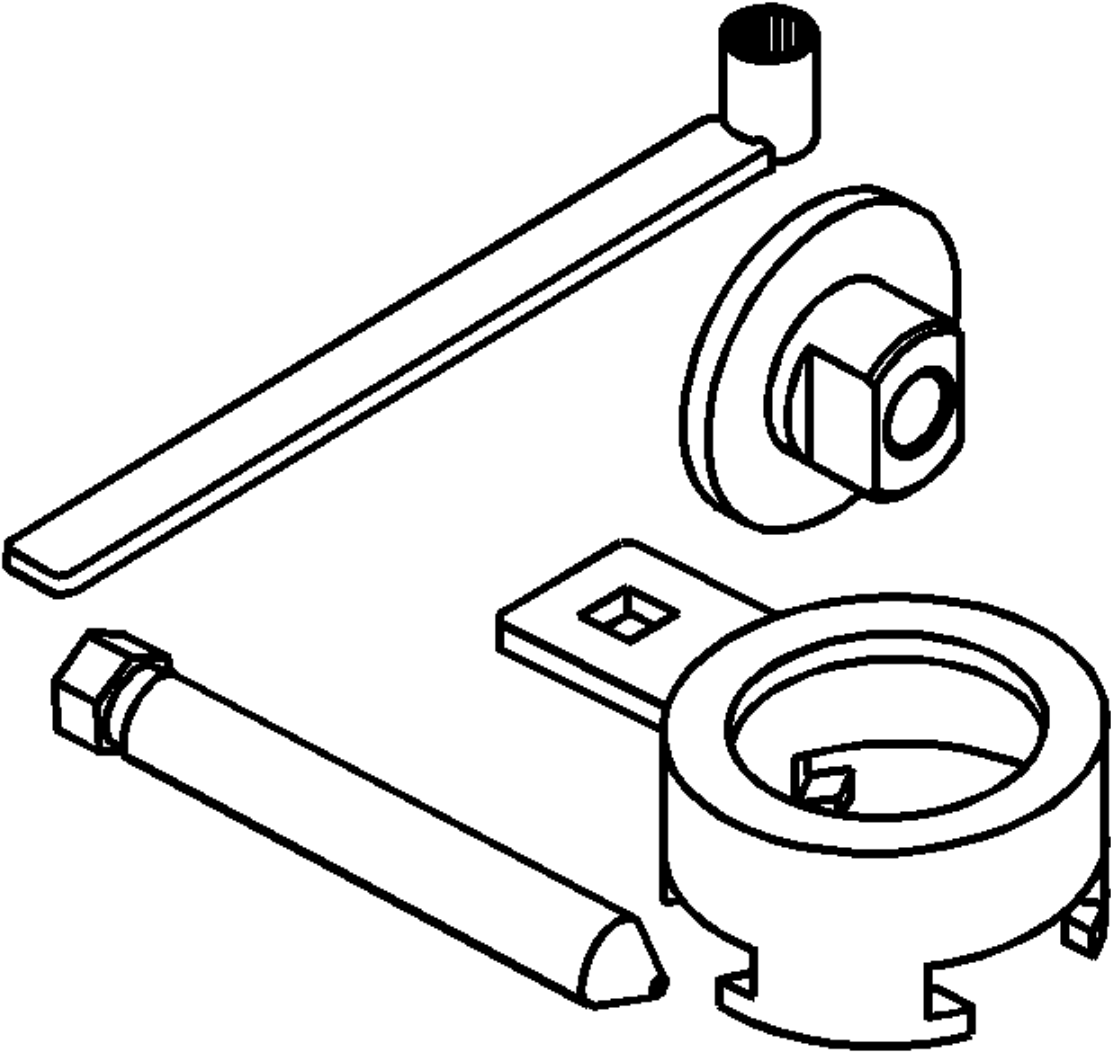
Illustration	Tool Number/Description
	EN-44226 J-44226 Crankshaft Balancer Remover

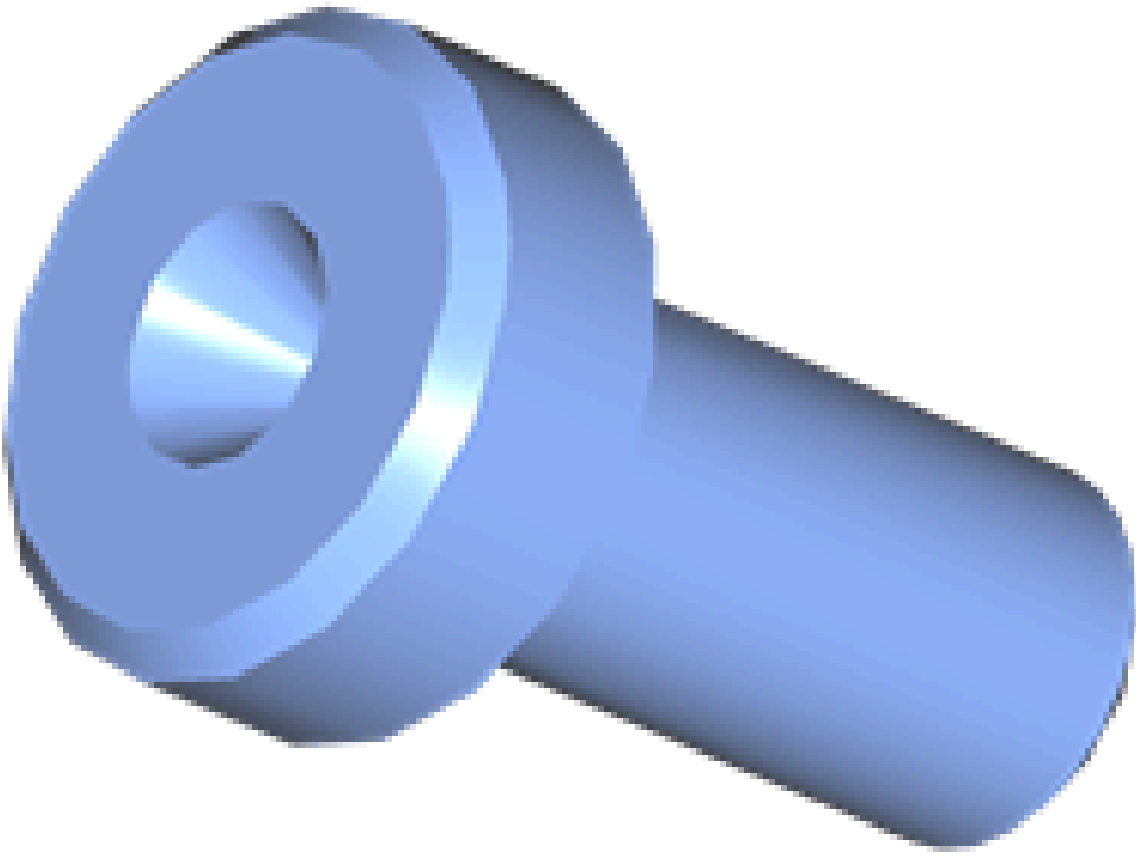
Illustration	Tool Number/Description
	EN-44226-5 Crankshaft Protector

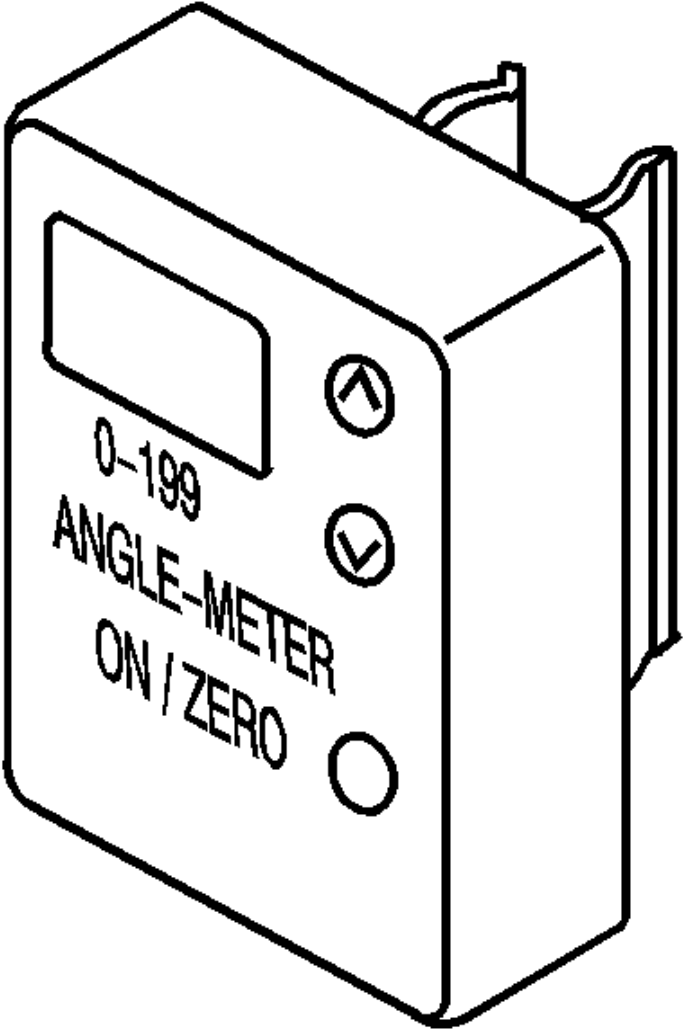
Illustration	Tool Number/Description
	EN-45059 J-45059 Angle Meter

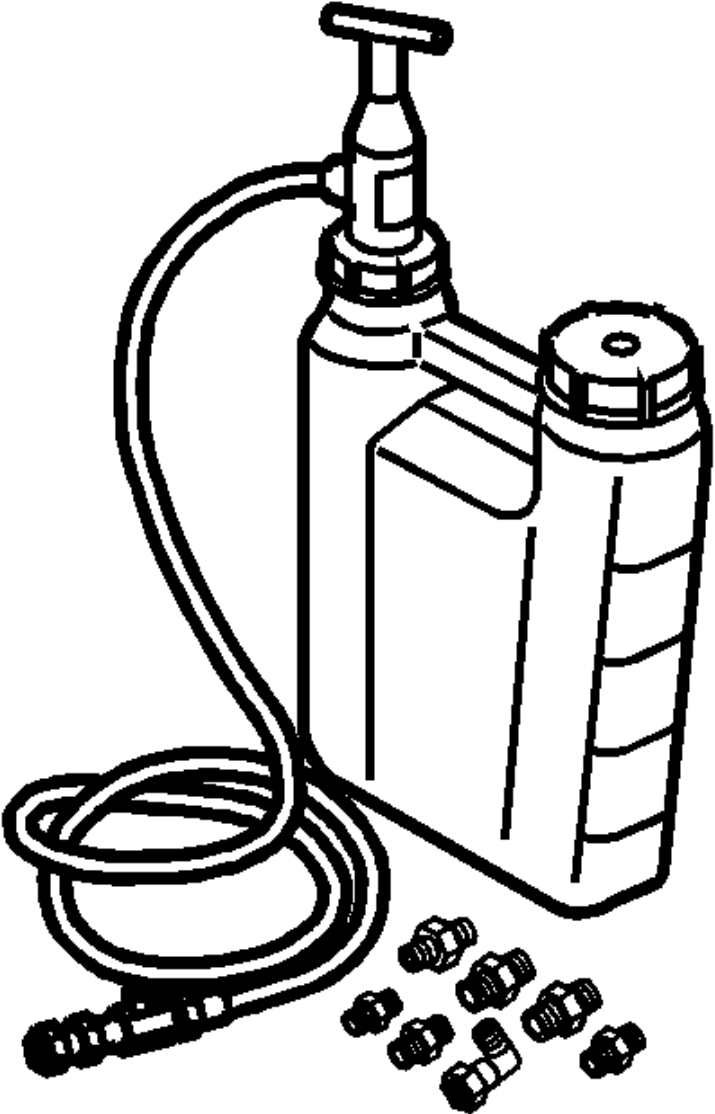
Illustration	Tool Number/Description
	EN-45299 J-45299 Engine Pre-Luber

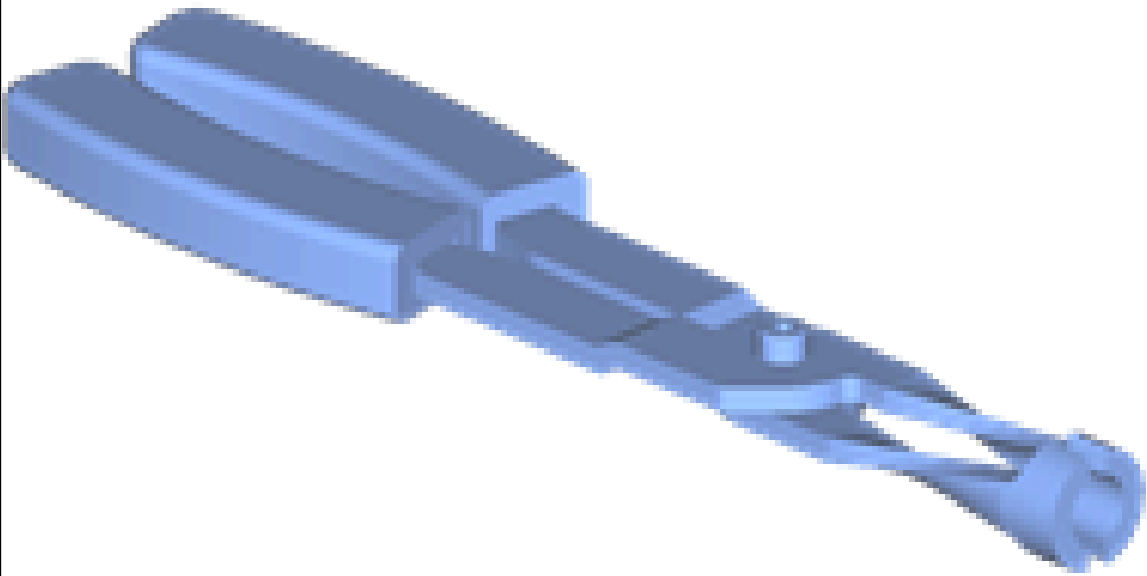
Illustration	Tool Number/Description
	EN-46116 Valve Stem Seal Remover

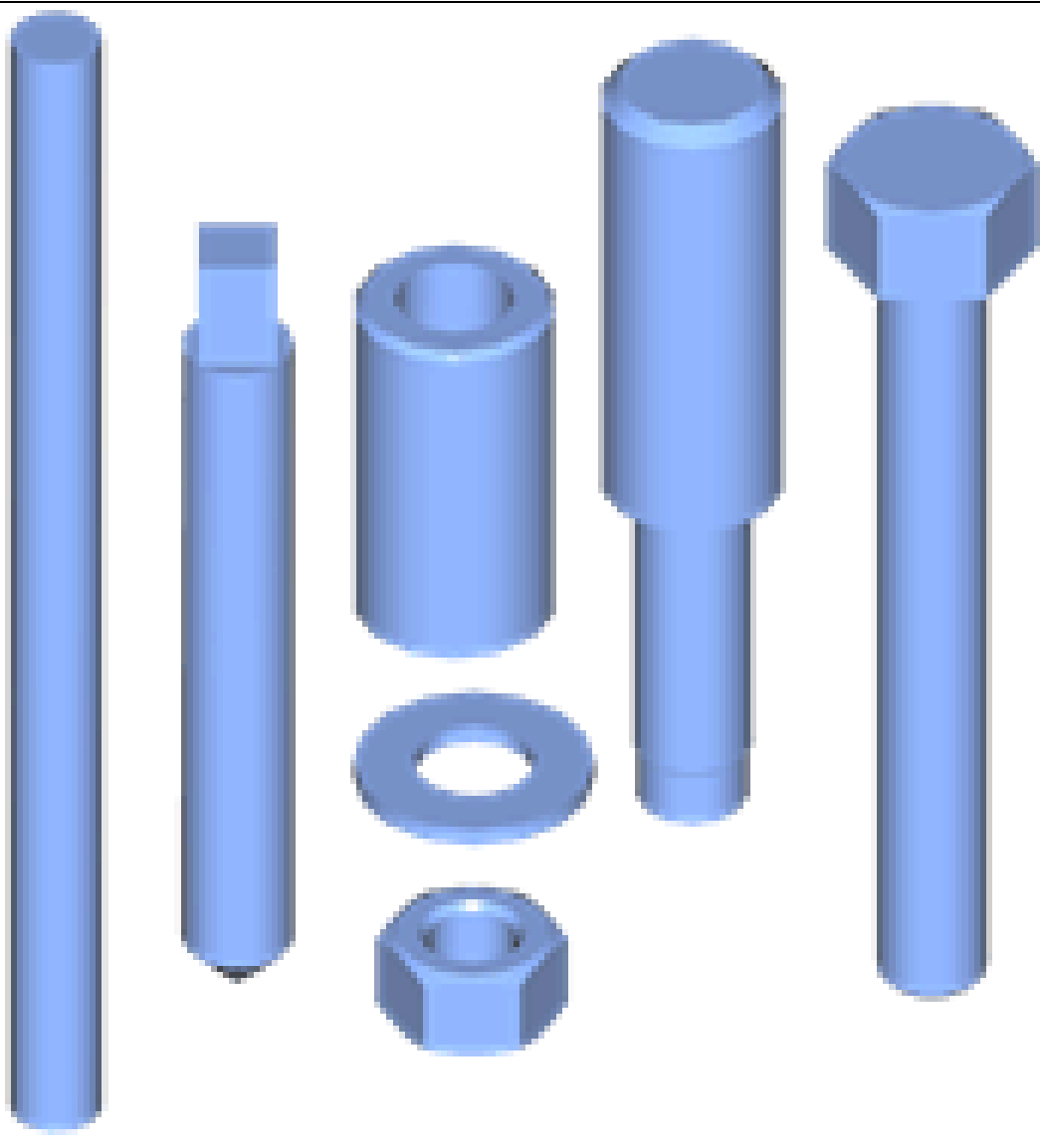
Illustration	Tool Number/Description
	EN-46122 Camshaft Position Actuator Check-Ball Valve Remover/Installer

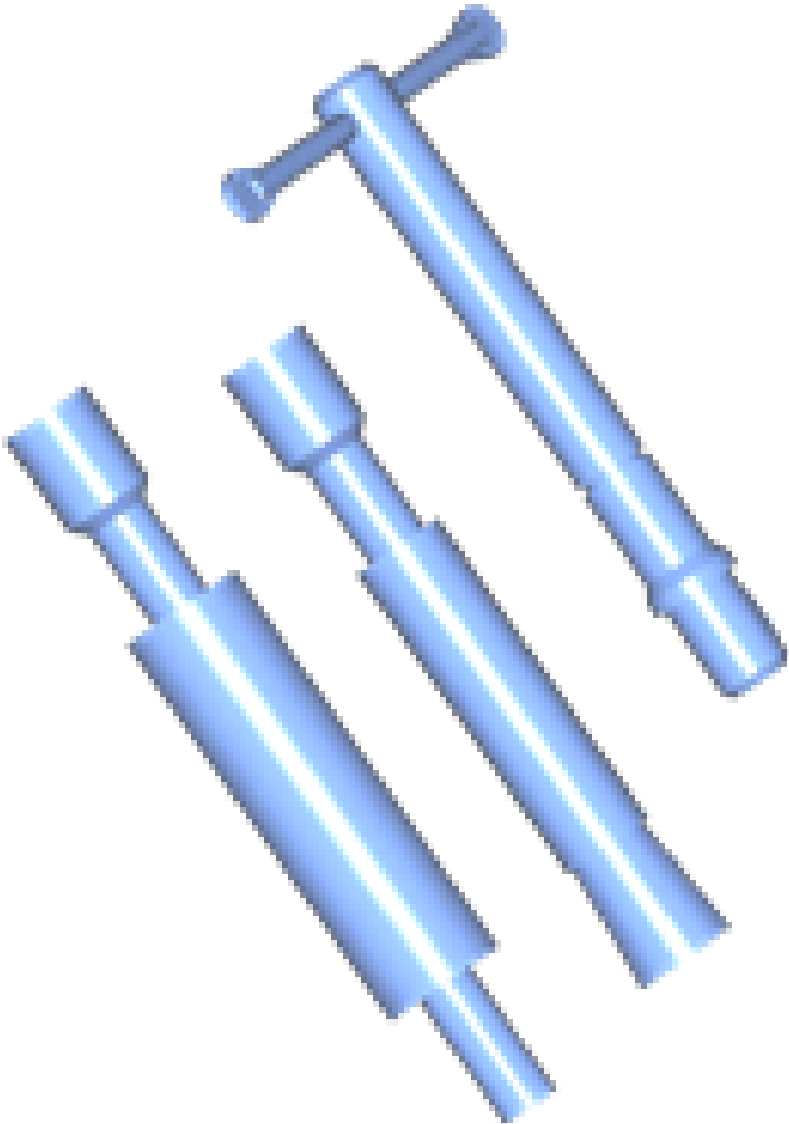
Illustration	Tool Number/Description
	EN-47909 Injector Bore and Sleeve Cleaning Kit

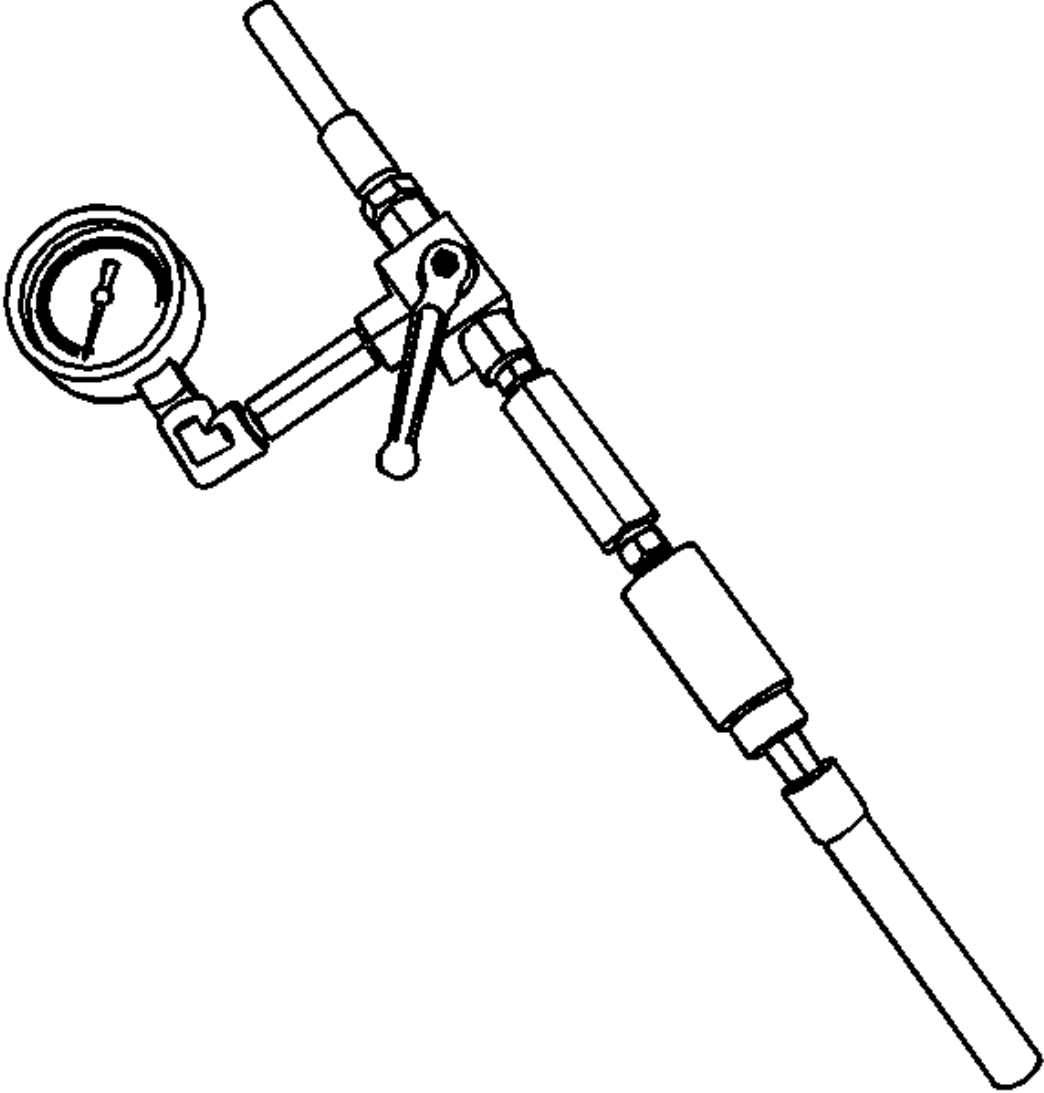
Illustration	Tool Number/Description
	EN-48248 Cylinder Compression Pressure Gauge

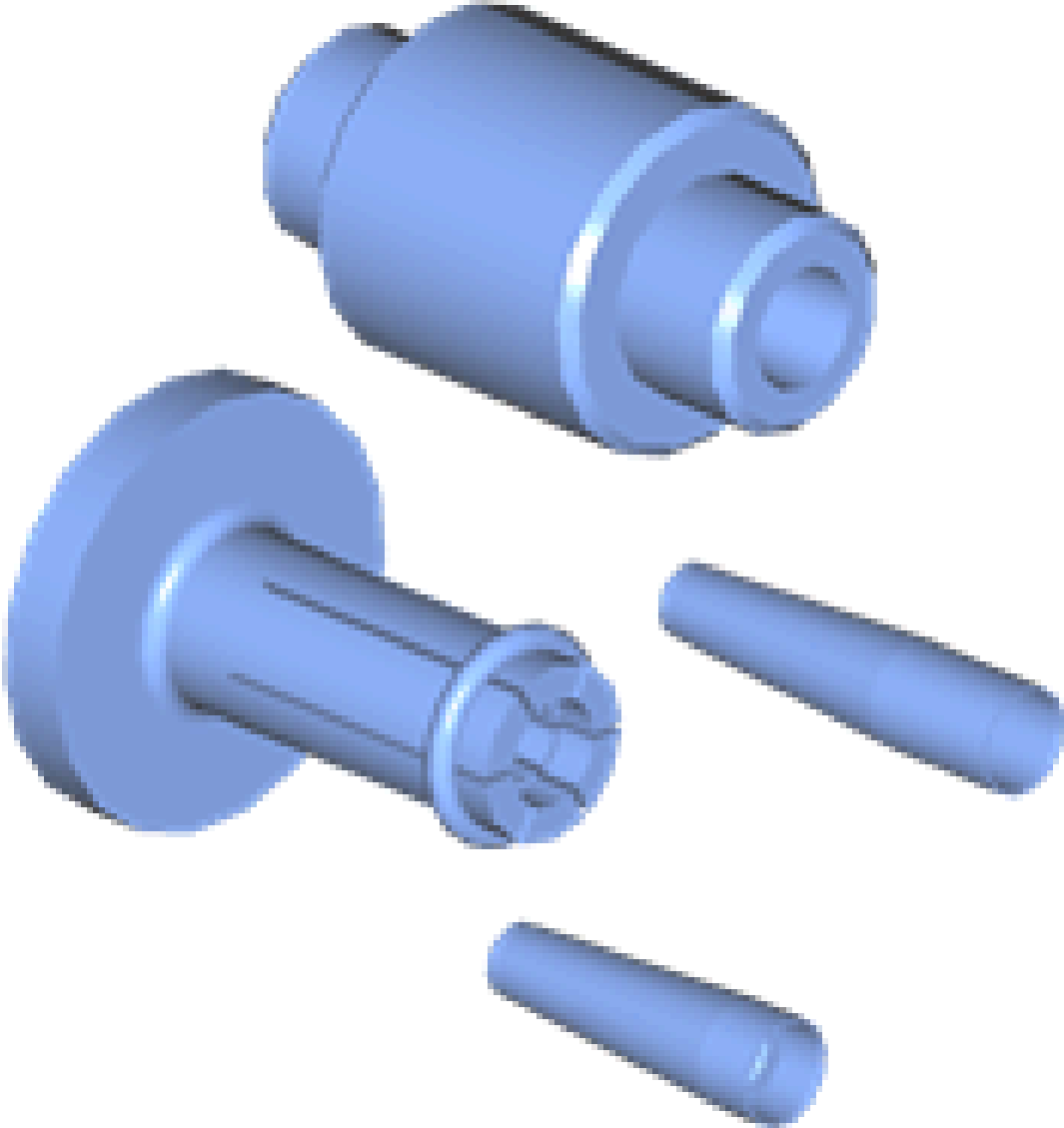
Illustration	Tool Number/Description
 A 3D CAD illustration of fuel injector seal components. It includes a large cylindrical seal with a flange, a smaller cylindrical seal, and two long, thin cylindrical pins. The components are shown in a disassembled state, with the large seal at the top left, the smaller seal at the bottom left, and the two pins at the bottom right.	EN-49245 Fuel Injector Seal Installer/Sizer

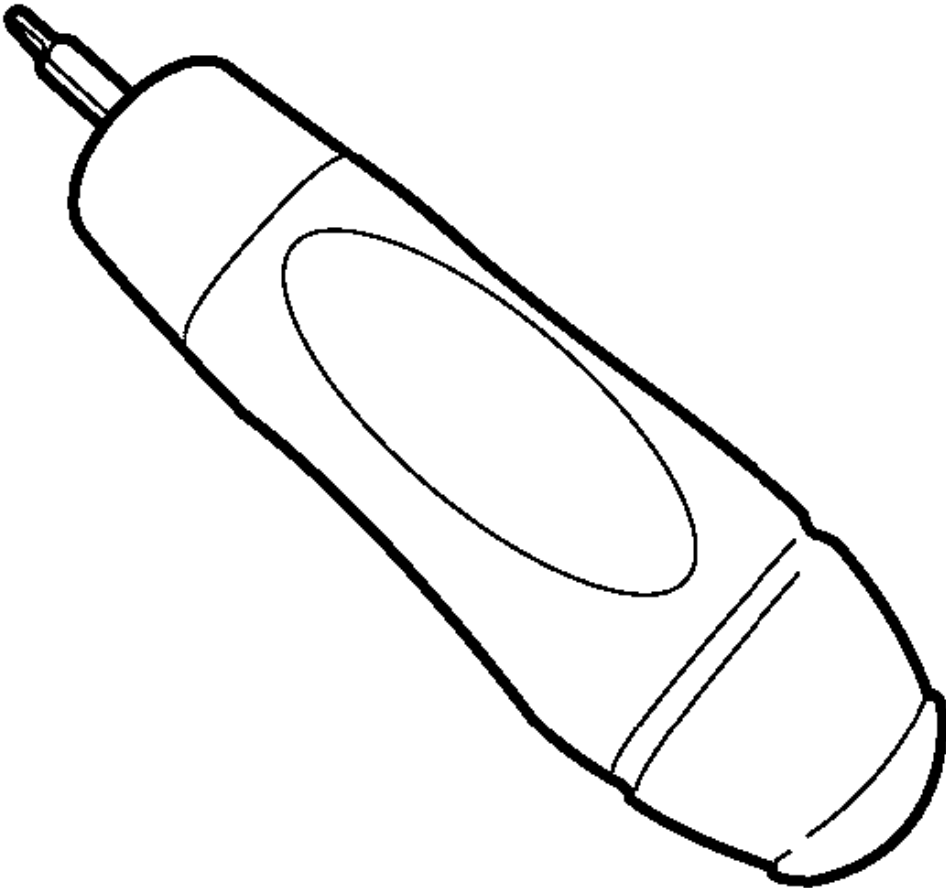
Illustration	Tool Number/Description
	EN-49941 Piston Pin Clip Remover/Installer

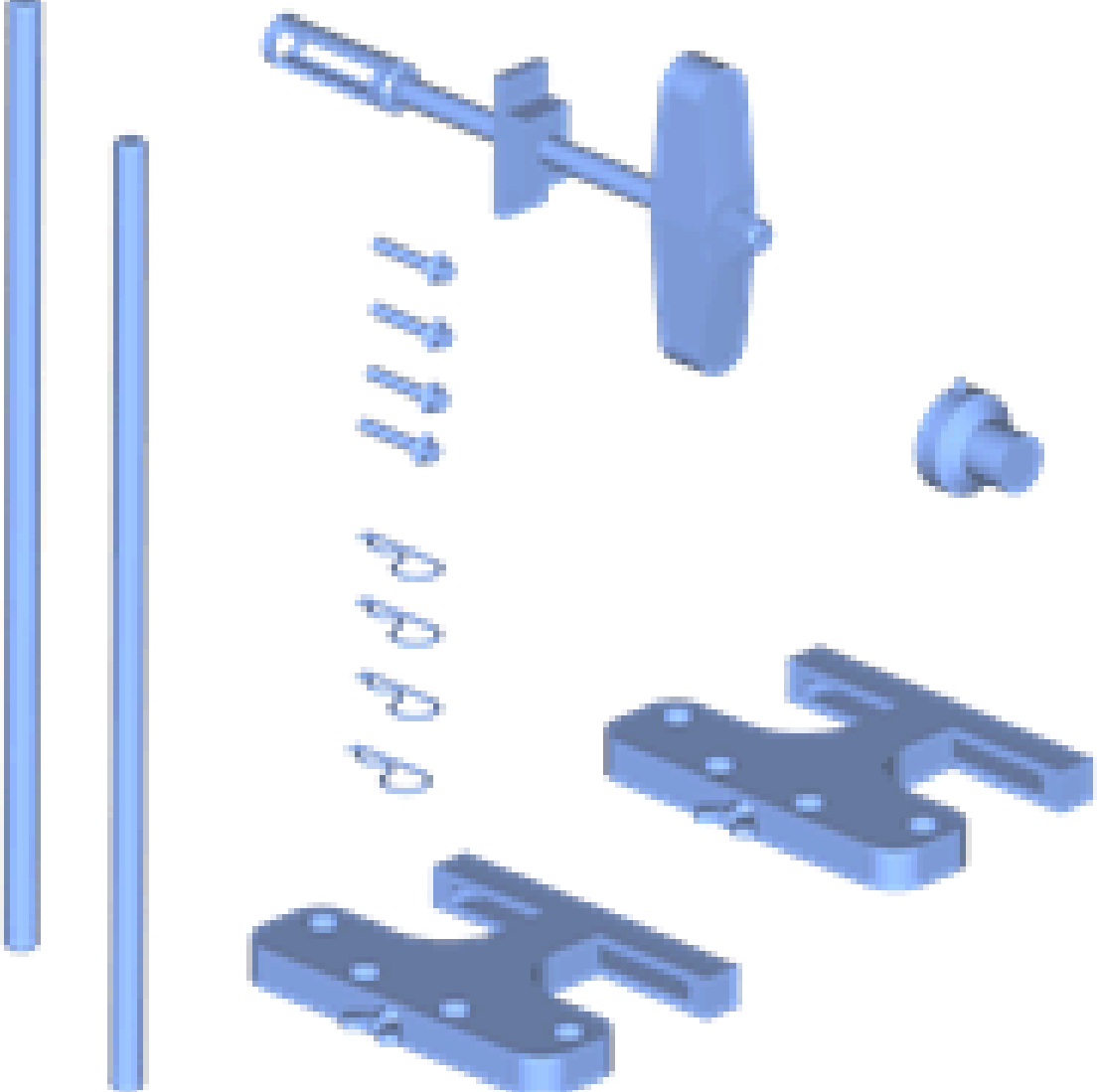
Illustration	Tool Number/Description
 An exploded view diagram of a valve spring compressor tool assembly. The components are shown in a light blue color. On the left are two long, thin rods. In the center is a vertical assembly consisting of a long threaded rod with a handle at the top, a central body with a threaded section, and a base. To the right of this central assembly is a small, cylindrical component. Below the central assembly are two large, L-shaped metal plates with multiple holes. A series of small, cylindrical components are arranged vertically between the central assembly and the L-shaped plates.	EN-50717 Valve Spring Compressor - Head On

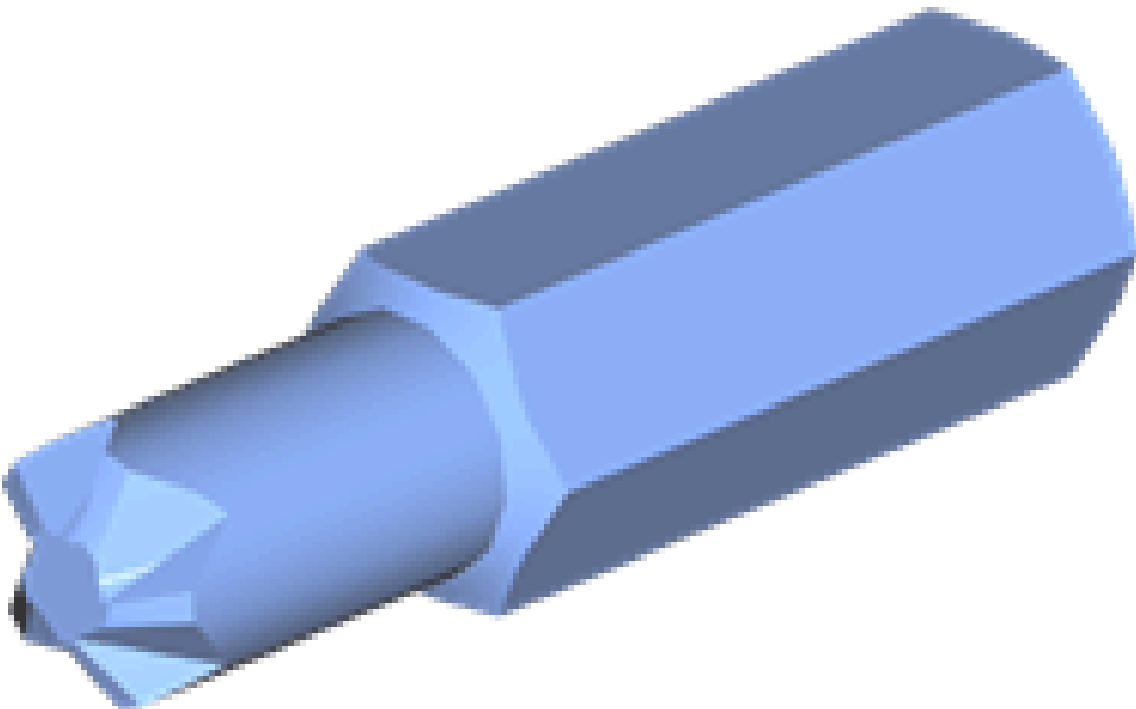
Illustration	Tool Number/Description
	EN-50956 Tamper Proof Drive Bit

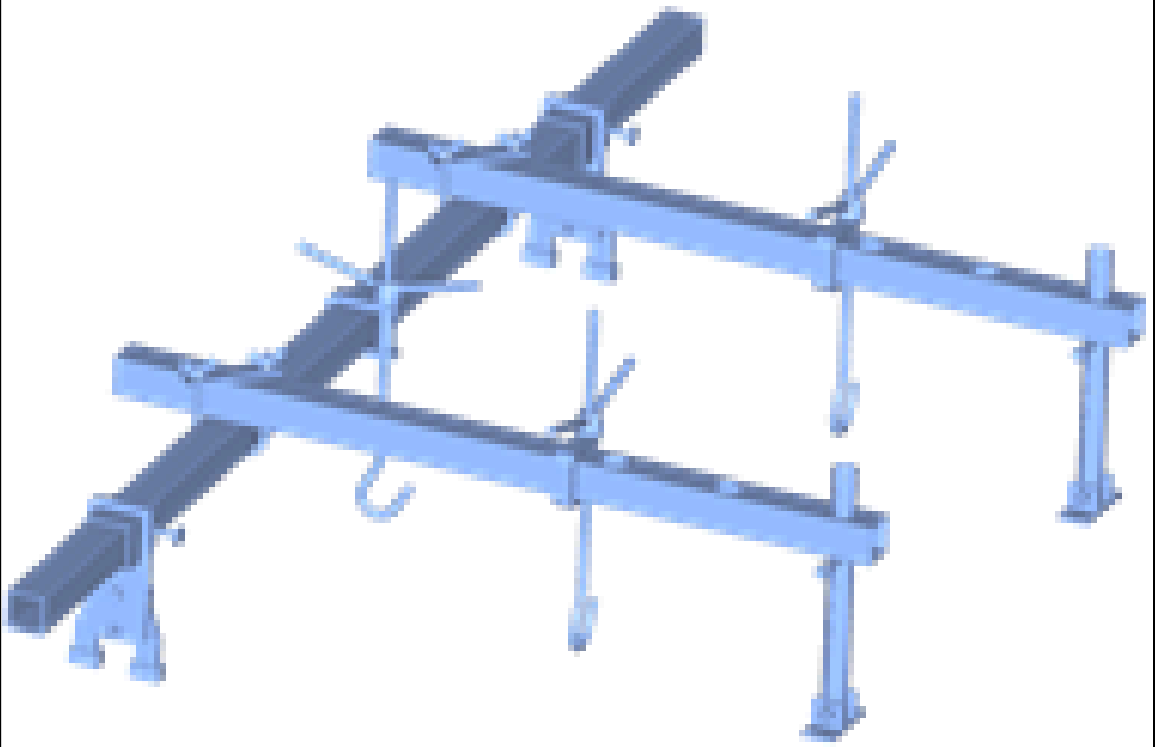
Illustration	Tool Number/Description
	EN-51007 Engine Support Fixture

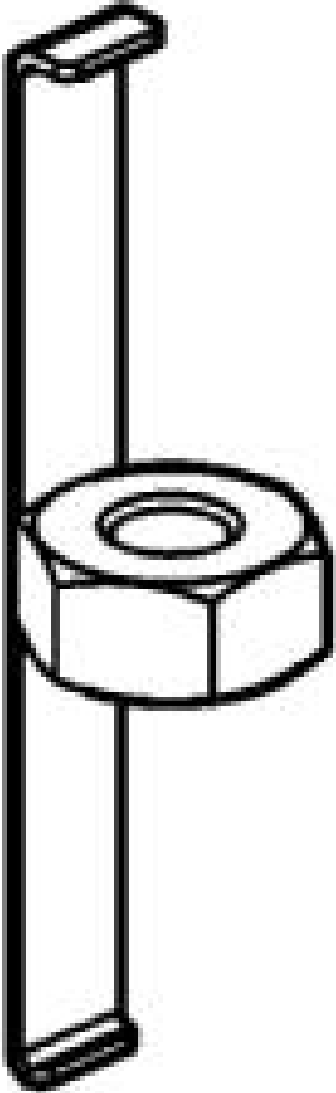
Illustration	Tool Number/Description
	EN-51096 Crankshaft Rear Oil Seal Remover

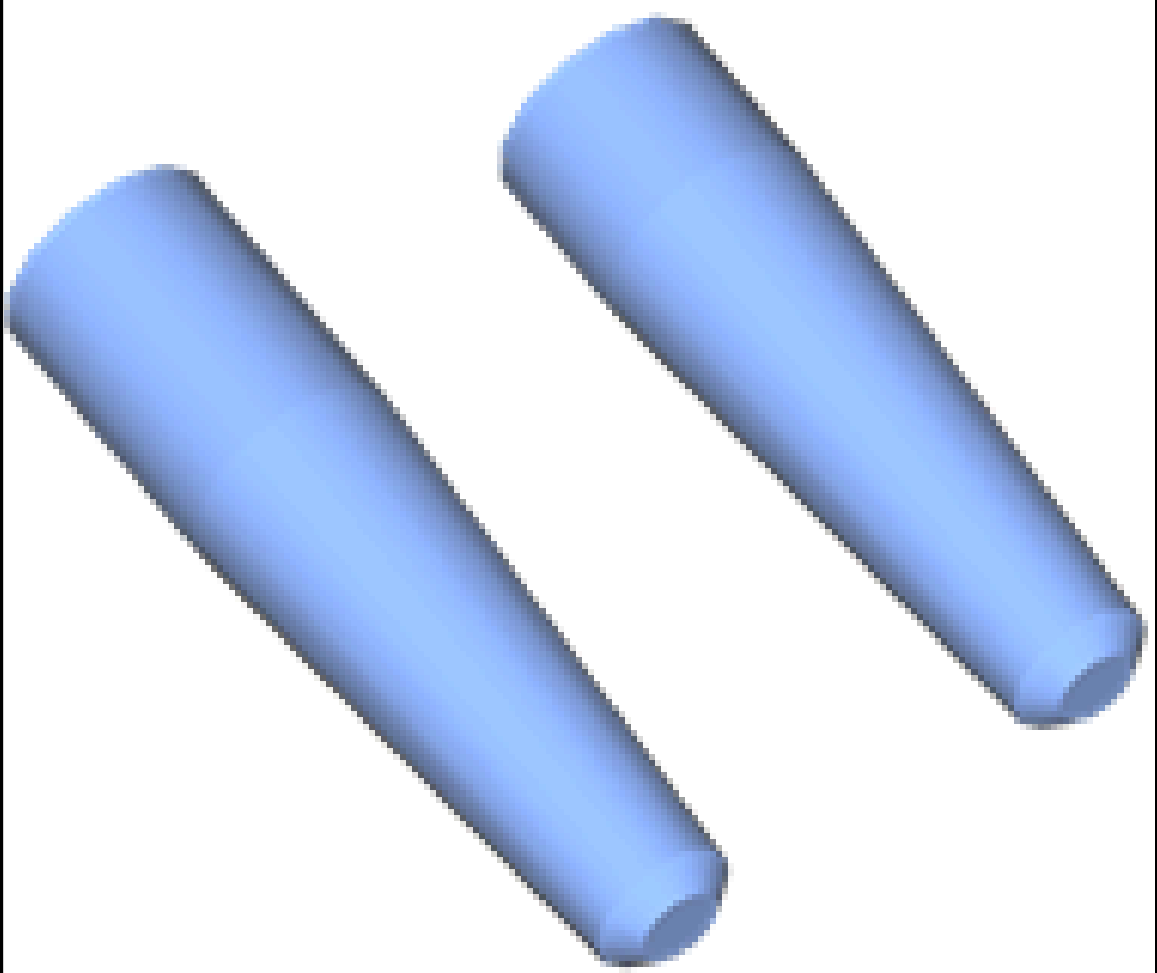
Illustration	Tool Number/Description
 The illustration shows two identical blue cylindrical components, which are injector seal installers. They are positioned diagonally, one below the other, against a white background. Each cylinder has a slightly flared end, suggesting a tapered design for installation.	EN-51105 Injector Seal Installer Adapters

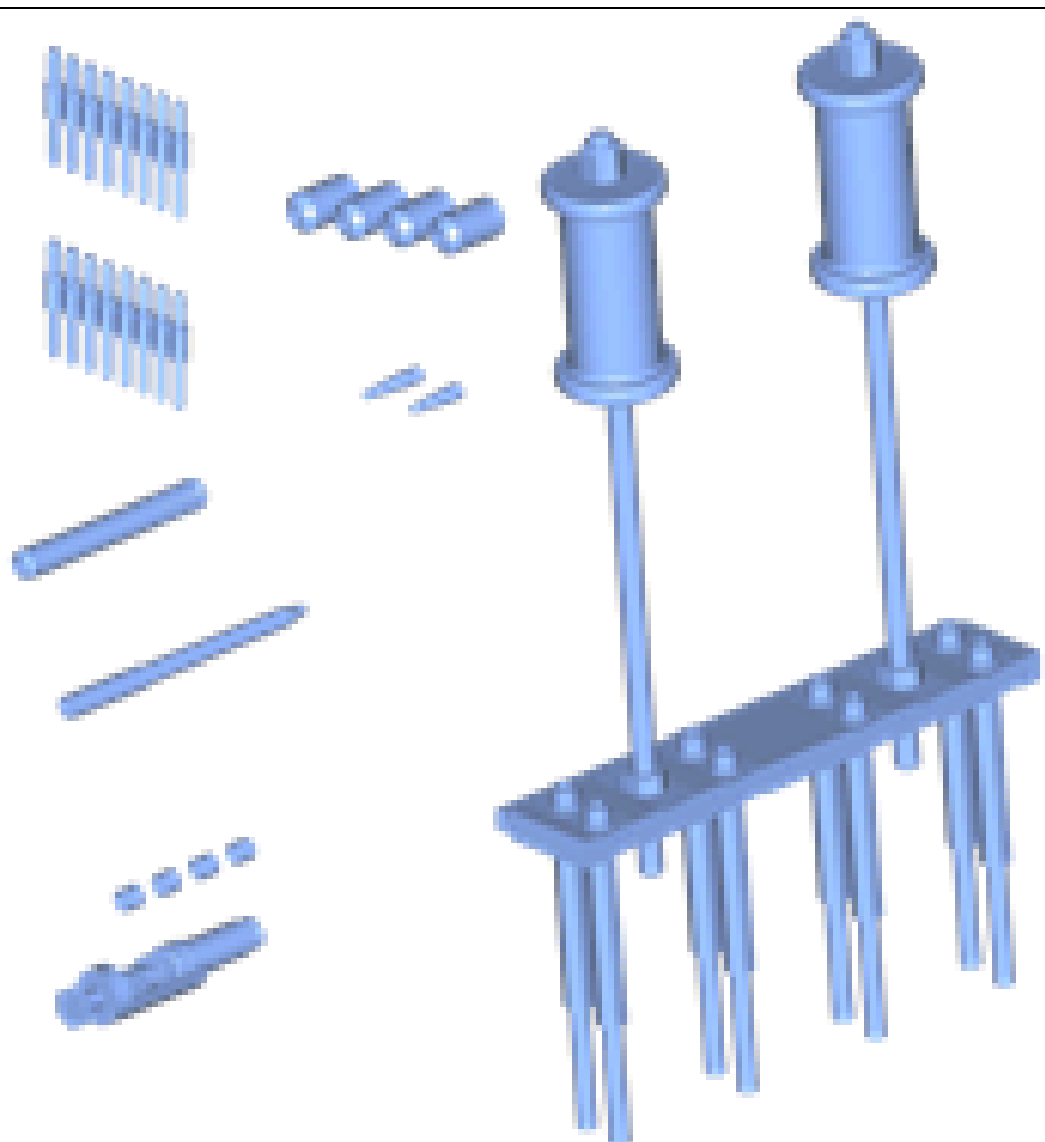
Illustration	Tool Number/Description
 The diagram illustrates the components of the EN-51146 Injector Remover/Installer. The main assembly consists of a base plate with six vertical support rods. Two long vertical rods are positioned on the base plate, each topped with a cylindrical handle. To the left of the main assembly, various components are shown in an exploded view, including two sets of six small pins, four larger pins, two long rods, two short rods, and a set of four small pins with a bracket. The entire assembly is rendered in a light blue color.	EN-51146 Injector Remover/Installer

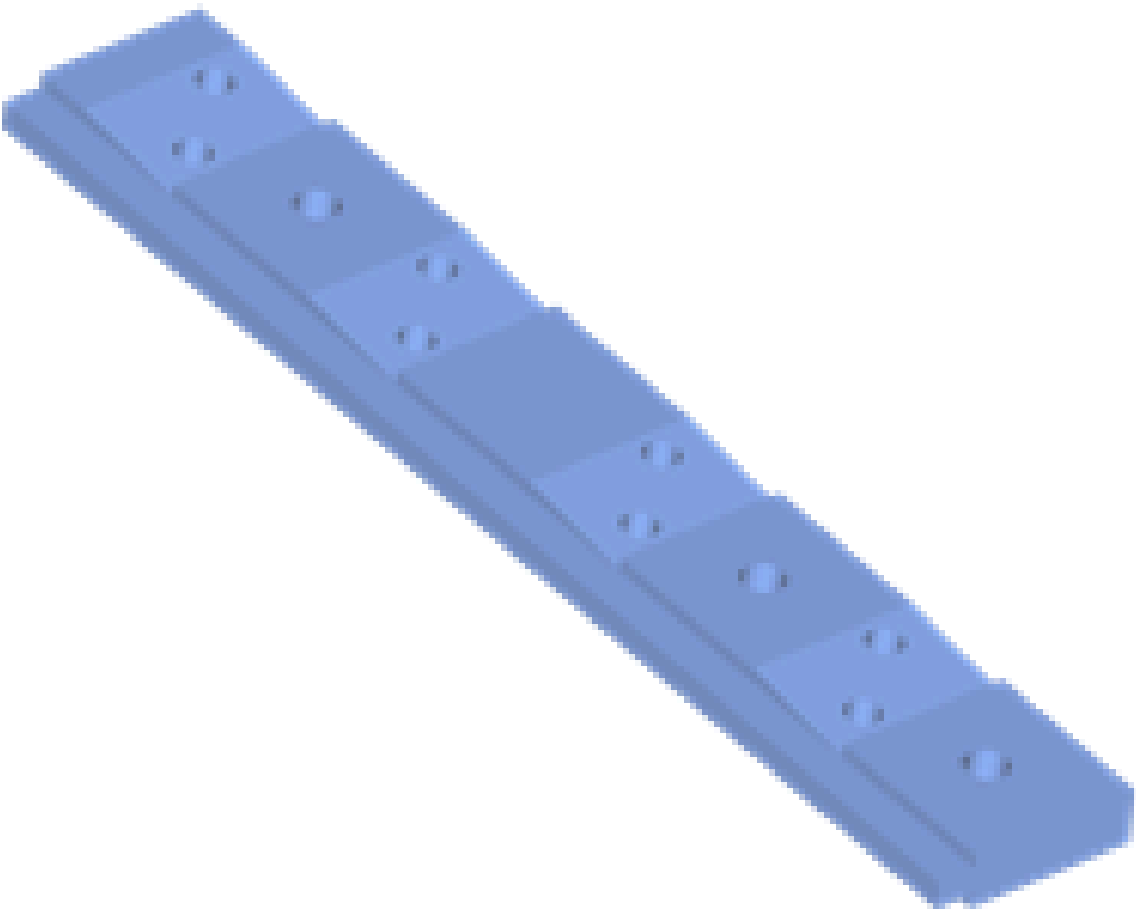
Illustration	Tool Number/Description
	EN-51146-100 Fuel Injector Removal Plate

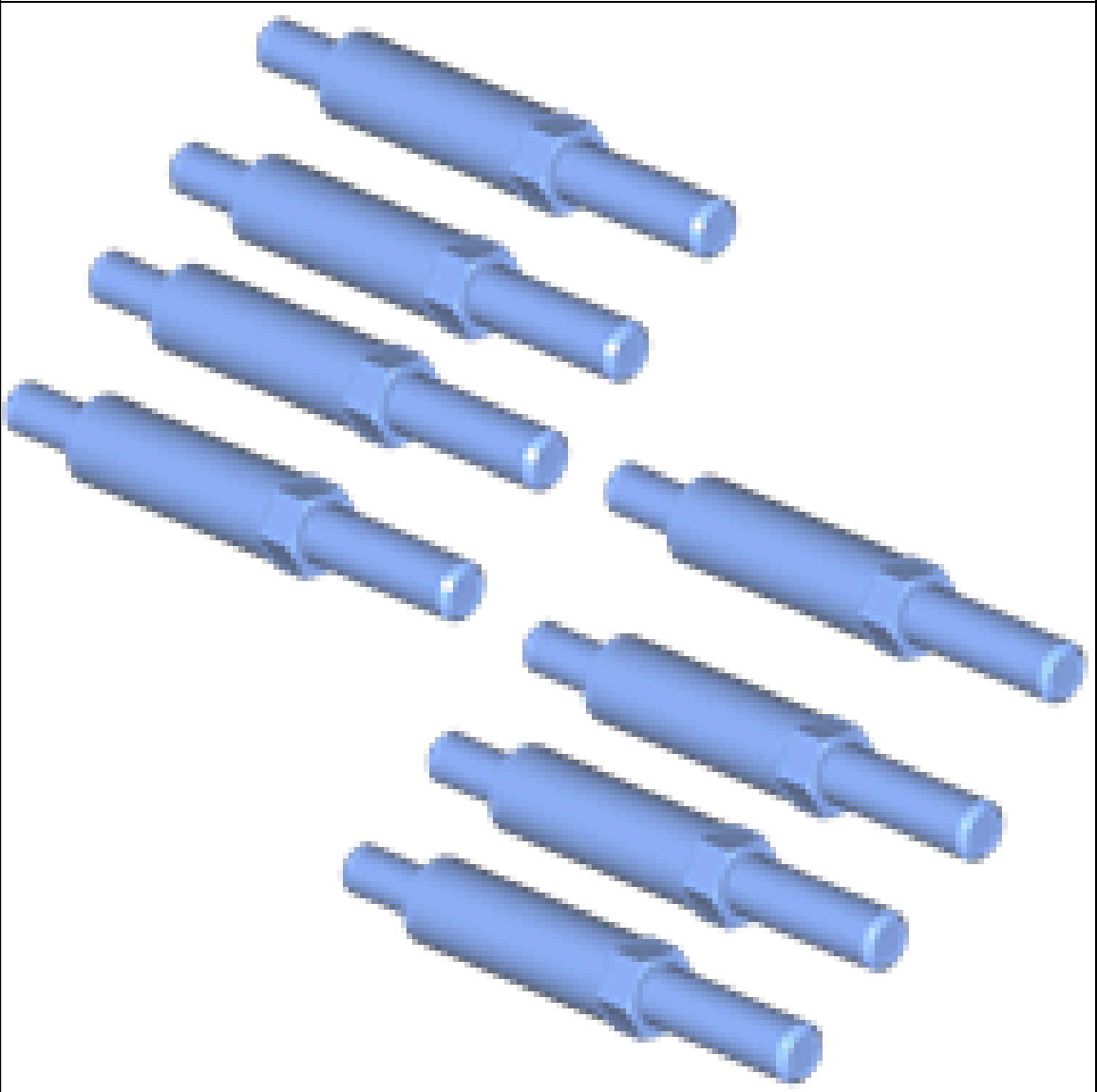
Illustration	Tool Number/Description
	EN-51146-150 Injector Remover/Installer Adapters

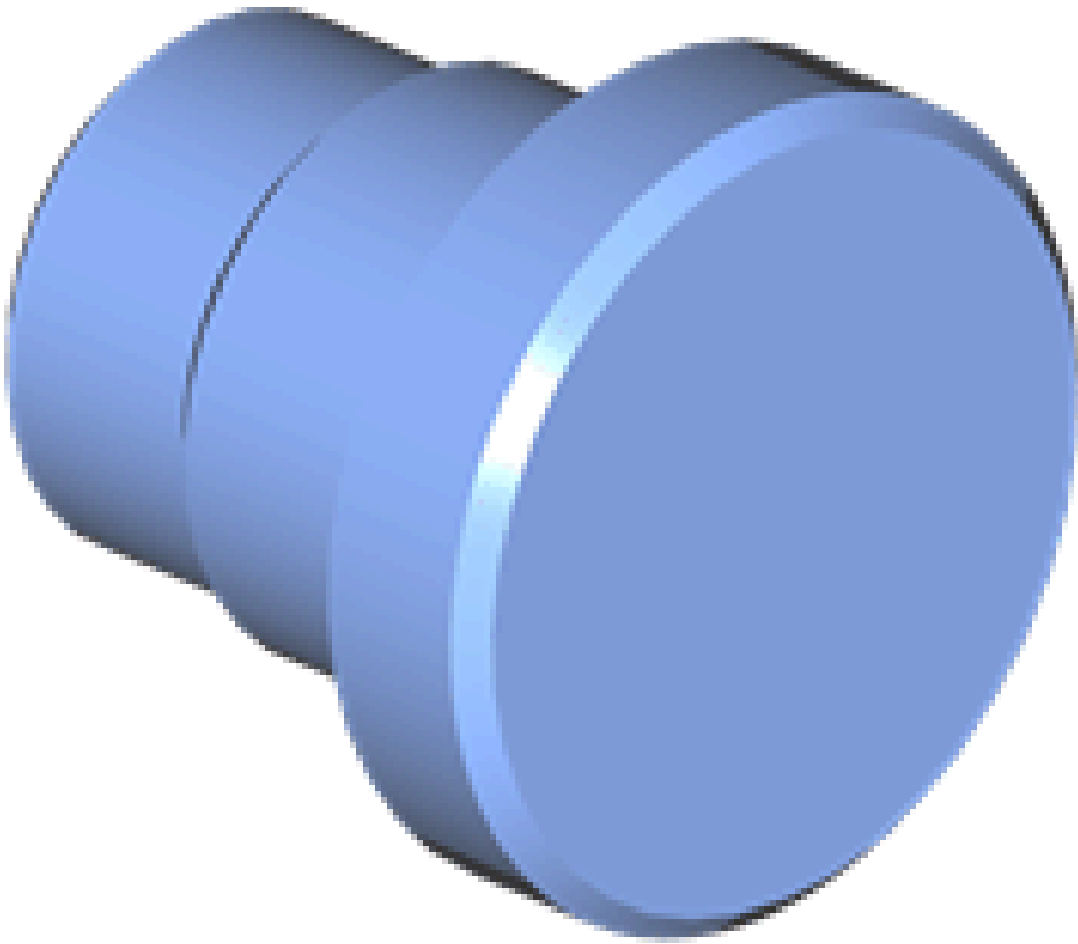
Illustration	Tool Number/Description
	EN-51365 Fuel Pump Installation Gauge

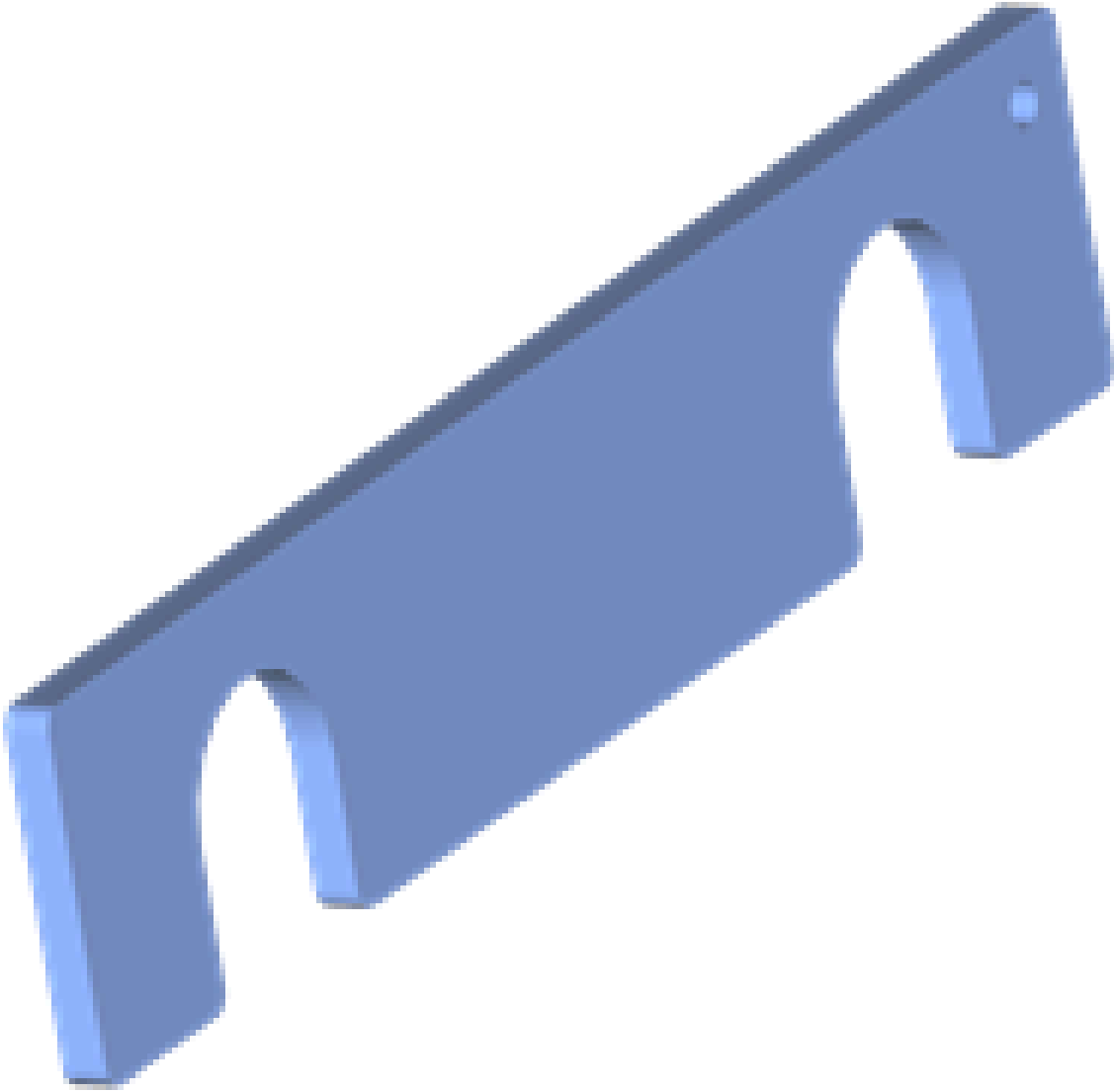
Illustration	Tool Number/Description
	EN-51367 Camshaft Locking Tool

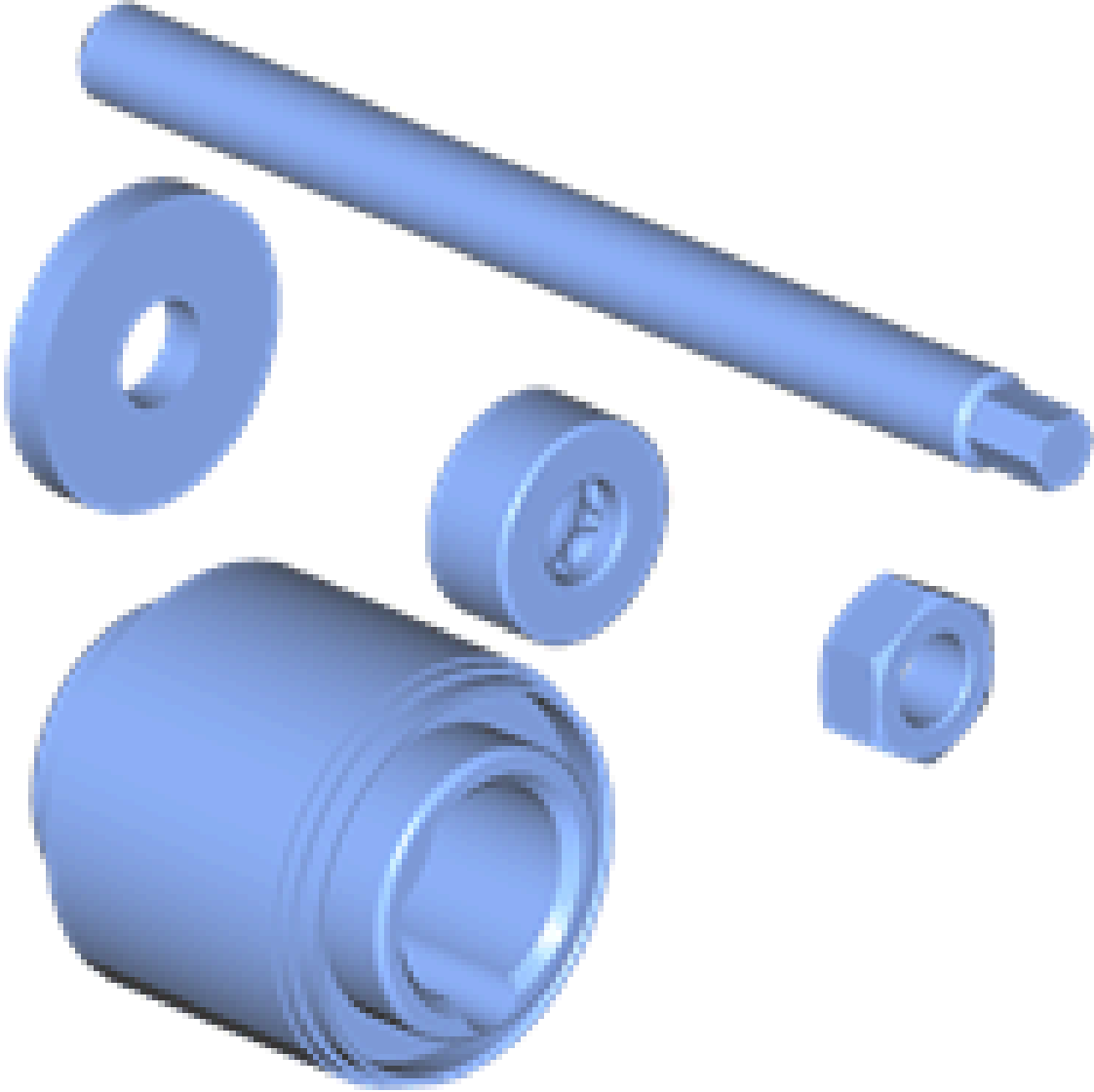
Illustration	Tool Number/Description
 A 3D rendering of the EN-51368 Front Crankshaft Seal Installer tool. The components include a long, blue cylindrical shaft with a hexagonal end, a large blue flange with a central hole, a smaller blue flange with a central hole, a blue hex nut, and a large blue cylindrical housing with a flange.	EN-51368 Front Crankshaft Seal Installer

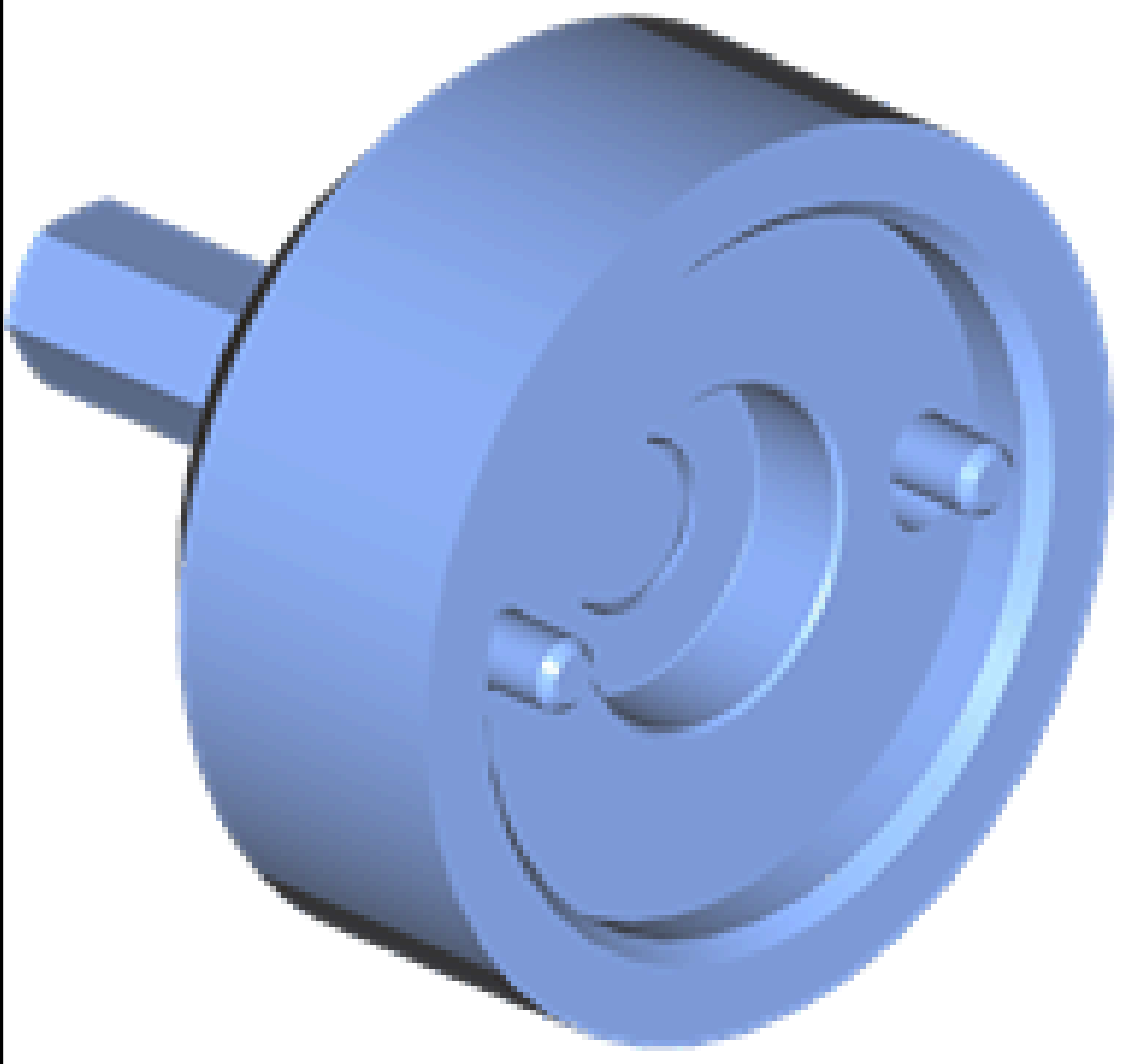
Illustration	Tool Number/Description
	EN-51369 Rear Crankshaft Seal Installer

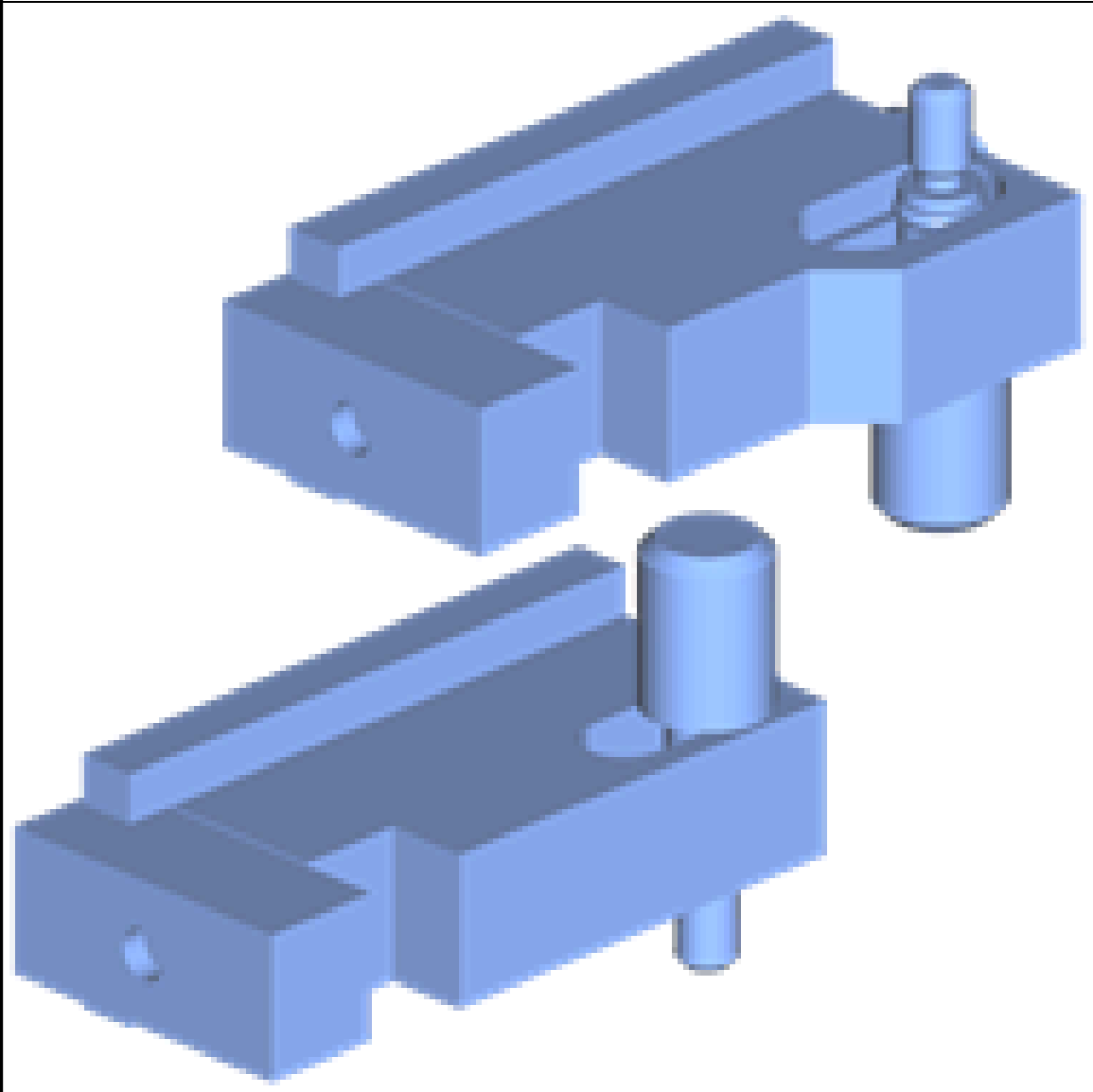
Illustration	Tool Number/Description
	EN-51397 Timing Chain Retainer

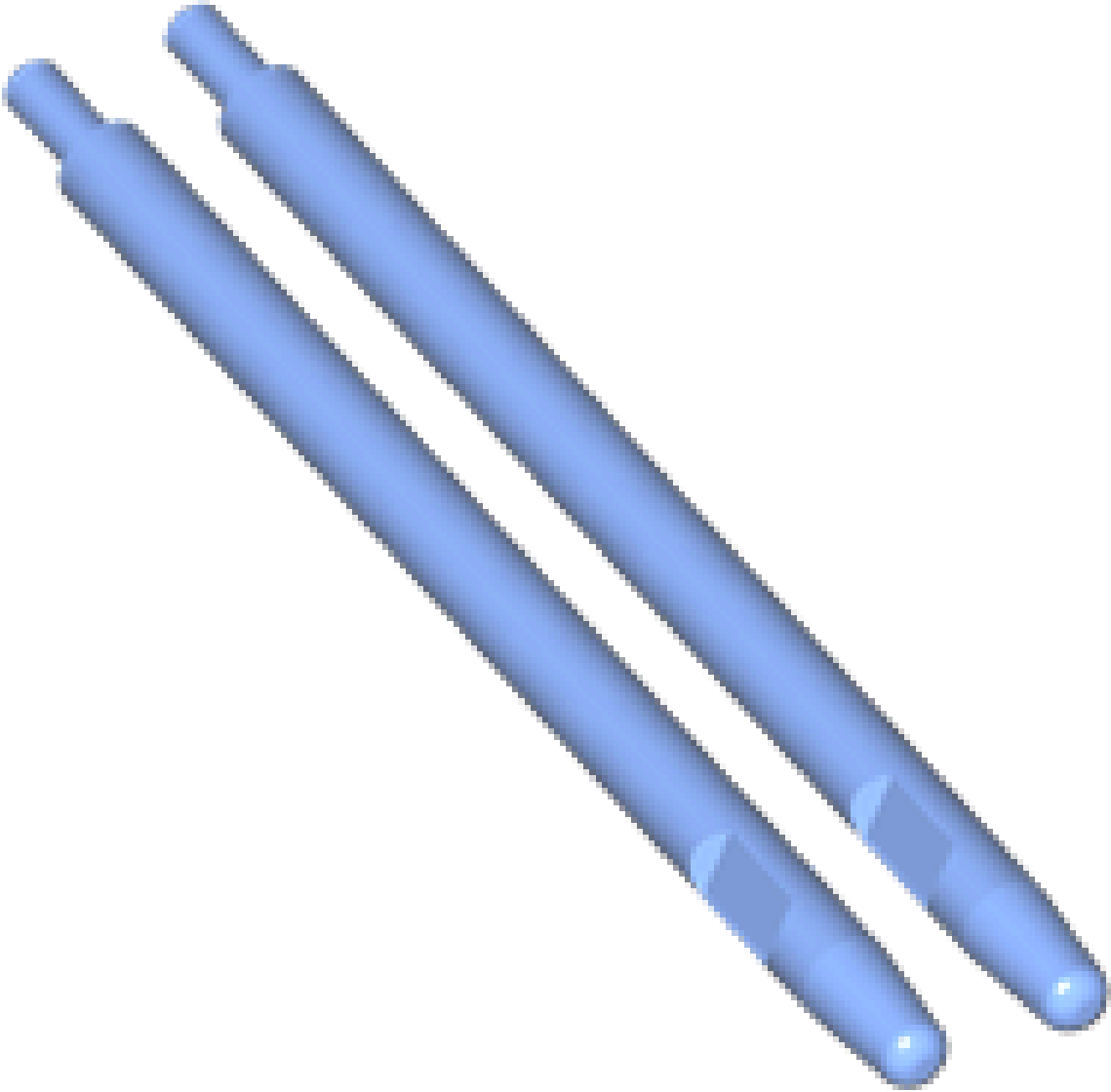
Illustration	Tool Number/Description
 The illustration shows two identical blue connecting rod guides. They are long, cylindrical rods with a slightly tapered end. Each rod has a small, rectangular, lighter blue feature near the tapered end, which appears to be a guide or a stop. The rods are positioned diagonally, with one slightly above and to the left of the other.	EN-51454 Connecting Rod Guides

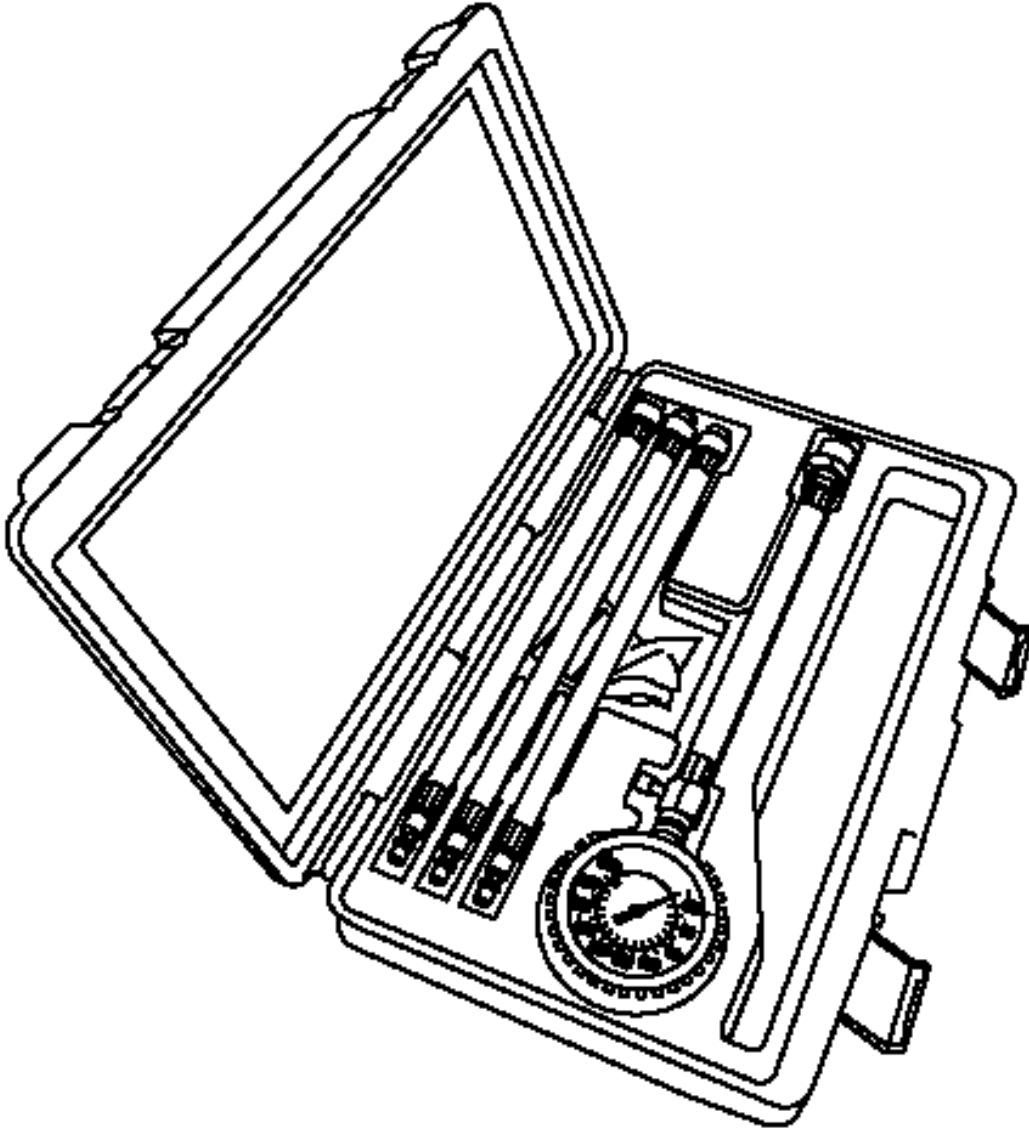
Illustration	Tool Number/Description
	EN-51749 Compression Gauge Tester Kit

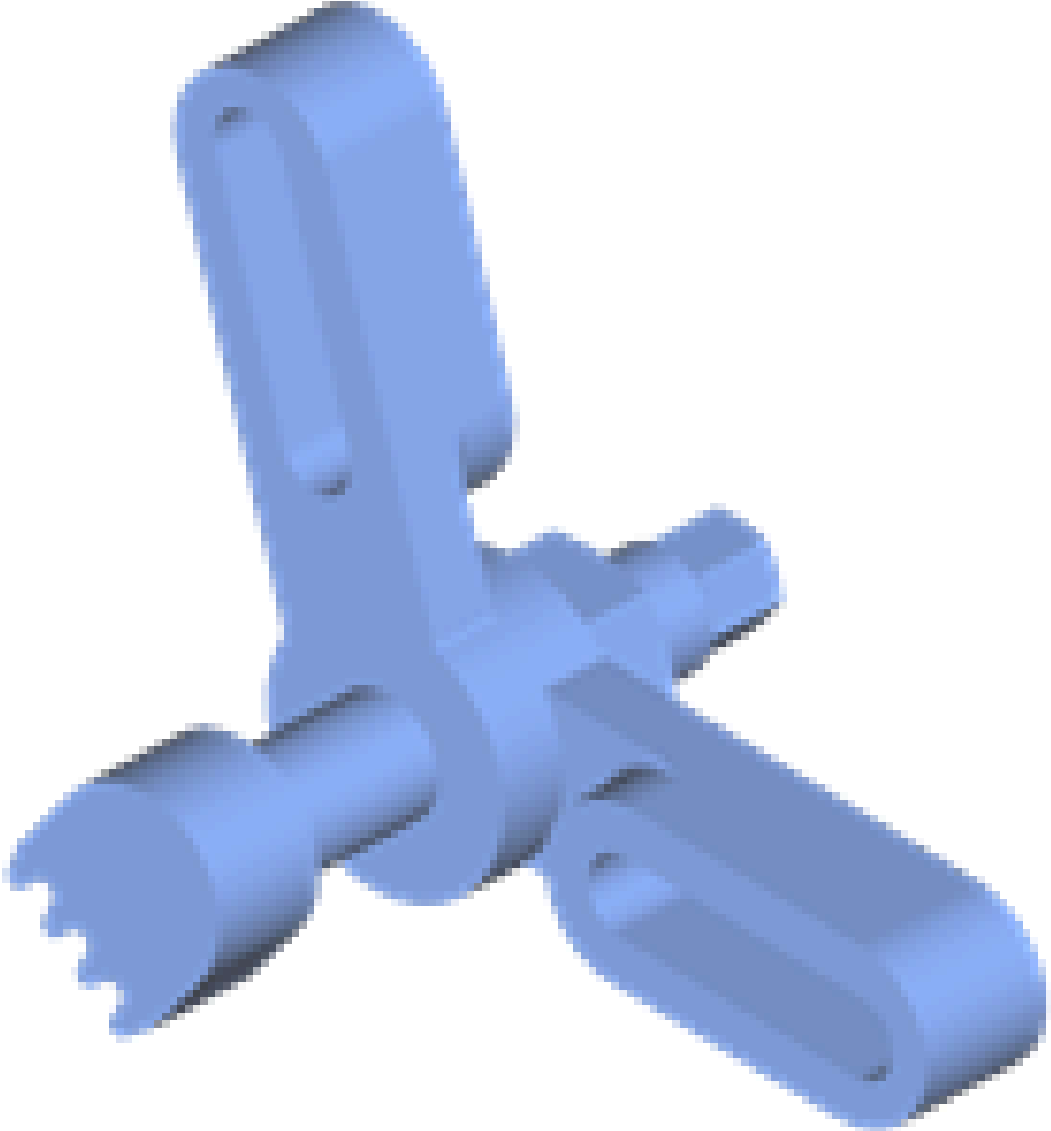
Illustration	Tool Number/Description
	EN-51760 Flywheel Holding Tool

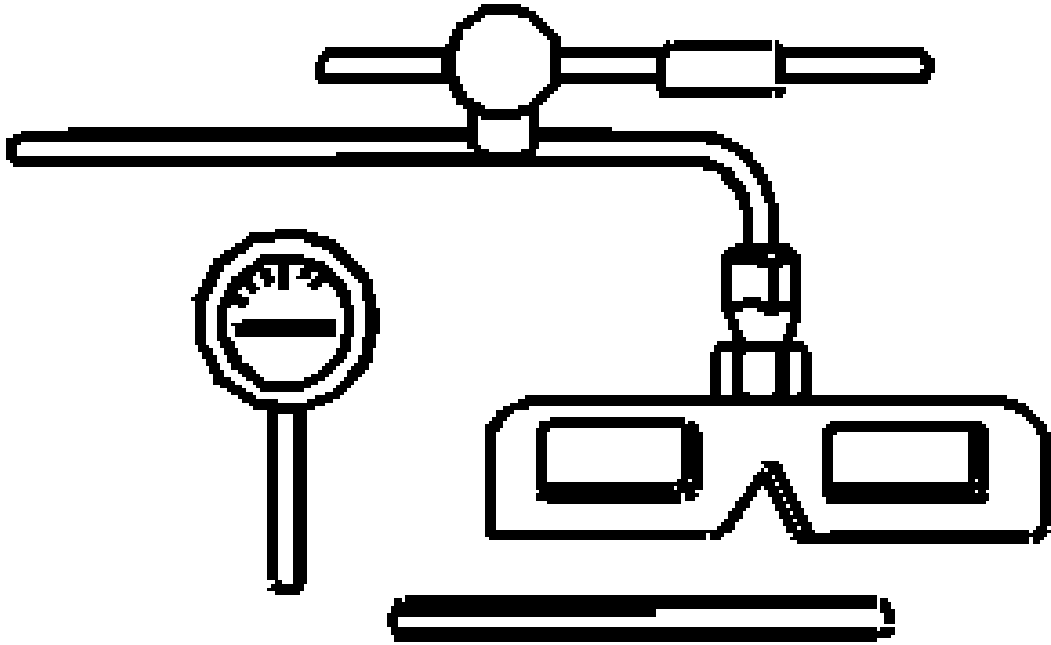
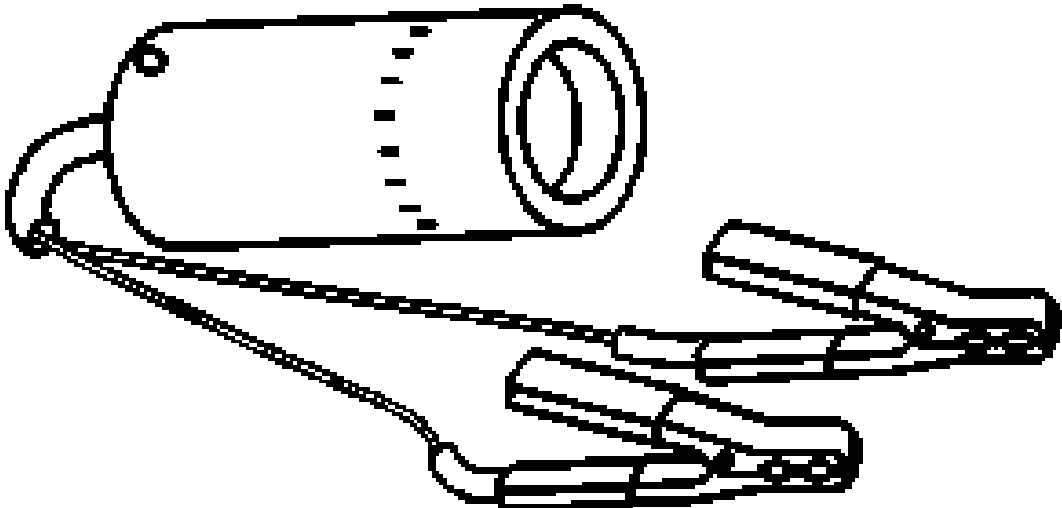
Illustration	Tool Number/Description
	GE-7872 J-7872 Magnetic Base Dial Indicator Set

Illustration	Tool Number/Description
	GE-42220 J-28428-E J-42220 Universal 12V Leak Detection Lamp

Article GUID: A00884686

ENGINE
Exhaust - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Catalytic Converter Gasket	
Exhaust Front Pipe Gasket	
Exhaust Hanger Insulator	
Intermediate Exhaust Hanger Insulator	
Rear Exhaust Hanger Insulator	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Catalytic Converter Nut	22 N.m (16 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification

	Metric (English)
Catalytic Converter Brace Bracket Bolt	22 N.m (16 lb ft)
Catalytic Converter Brace Bracket Nut	22 N.m (16 lb ft)
Catalytic Converter Bracket Nut	22 N.m (16 lb ft)
Catalytic Converter Heat Shield Bolt	9 N.m (80 lb in)
Catalytic Converter Rear Heat Shield Bolt	9 N.m (80 lb in)
Exhaust Front Pipe Nut	22 N.m (16 lb ft)
Exhaust Muffler Insulator Bolt	22 N.m (16 lb ft)
Exhaust Pipe Clamp	55 N.m (41 lb ft)
Rear Body Exhaust Heat Shield Nut	3 N.m (27 lb in)
Underbody Front Air Deflector Nut	3 N.m (27 lb in)

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - ENGINE EXHAUST

- Review the Exhaust System Description and Operation in order to familiarize yourself with the system functions. Refer to [Exhaust System Description](#).
- All diagnostics on a vehicle should follow a logical process. Strategy Based Diagnostics is a uniform approach for repairing all systems. The diagnostic flow is the place to start when repairs are necessary and may always be used in order to resolve a system problem.

Visual/Physical Inspection

- Inspect for aftermarket or non-OEM devices such as, but not including; tailpipe extensions, headers, and exhaust cutouts. This could affect the operation and proper performance of the exhaust system.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, engine temperature, engine load, and frequency of concern.
- Inspect the easily accessible or visible system components for obvious damage or conditions, which could cause any symptom.

Intermittents

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating as designed.

Symptom List

- Loss of power - Refer to [Restricted Exhaust](#).
- Poor acceleration - Refer to [Restricted Exhaust](#).
- Poor fuel economy - Refer to [Restricted Exhaust](#).
- Excessive smoke-diesel - Refer to [Restricted Exhaust](#).
- Exhaust hissing noise - Refer to [Exhaust Leakage](#).
- Exhaust popping noise - Refer to [Exhaust Leakage](#).
- Exhaust rattle noise - Refer to [Exhaust Noise](#).

- Loud Exhaust noise - Refer to [Exhaust Noise](#).
- Exhaust buzz, groan, hum noise - Refer to [Exhaust Noise](#).

RESTRICTED EXHAUST

Diagnostic Aids

A quick check of exhaust flow will help determine for gasoline engines.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3

The exhaust system has very low back pressure under normal conditions. If the exhaust system is restricted, a significant increase in the exhaust pressure is noticed on the exhaust back pressure gauge.

Removing the heated oxygen sensor may set a DTC. When finishing this diagnostic table, be sure to clear all codes.

4

This step will isolate the catalytic converter from the remainder of the exhaust system.

7

Confirming that the condition has been fixed is essential. If the symptom still exists and the vehicle has a dual exhaust system, proceed to Step 2 and repeat diagnostic procedure on the opposite exhaust pipe.

Step	Action	Value(s)	Yes	No
1	Did you verify the customers complaint?	-	Go to Step 2	-
2	Did you review the exhaust symptoms diagnostic information and perform the necessary inspections?	-	Go to Step 3	Go to Symptoms - Engine Exhaust
3	1. Remove the heated oxygen sensor 1. Refer to Heated Oxygen Sensor Replacement - Sensor 1 . 2. Install the gauge in place of the heated oxygen sensor 1. 3. Engine running, increase and monitor the engine speed at 2, 000 RPM. 4. Observe the exhaust system back pressure reading on the gauge. Does the reading exceed the specified value?	14 kPa (2 psi)	Go to Step 4	Go to Step 7
4	1. Vehicle OFF. 2. Remove the gauge.	-	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
	3. Install the heated oxygen sensor 1. Refer to Heated Oxygen Sensor Replacement - Sensor 1 . 4. Remove the heated oxygen sensor 2. Refer to Heated Oxygen Sensor Replacement - Sensor 2 . 5. Install the gauge in place of the heated oxygen sensor 2. 6. Engine running, increase and monitor the engine speed at 2, 000 RPM. 7. Observe the exhaust system back pressure reading on the gauge. Does the reading exceed the specified value?			
5	Inspect the exhaust system for the following conditions: • Damage in the exhaust pipe. • Debris in the exhaust pipe. • Muffler or resonator internal failure. • Two-layer exhaust pipe separation. Did you find and correct the condition?	-	Go to Step 7	-
6	Replace the catalytic converter. Refer to Three-Way Catalytic Converter Replacement . Did you find and correct the condition?	-	Go to Step 7	-
7	1. Remove the gauge. 2. Install the heated oxygen sensor 2. Refer to Heated Oxygen Sensor Replacement - Sensor 2 . 3. Clear any DTCs. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2

EXHAUST LEAKAGE

Problem	Action
WARNING:	

Problem	Action
While engine is operating, the exhaust system will become extremely hot. To prevent burns avoid contacting a hot exhaust system. DEFINITION: An exhaust leak may show stains at the area of the leak. The leak may be felt by holding a hand close to the suspected areas or using a smoke pencil. The leak may make a popping or hissing noise. Refer to Symptoms - Engine Exhaust prior to beginning this table.	
Misaligned or improperly installed exhaust system components	Align and tighten the components to the specifications. Refer to Fastener Specifications .
Exhaust leaks at the following connections: • Catalytic Converter to Cylinder Head • Catalytic Converter to exhaust pipe • Flanges • Pipe clamps	Tighten the components to the specifications. Refer to Fastener Specifications .
Seals or gaskets leaking. • Catalytic converter connection • EGR connections • AIR connections to the exhaust manifold or cylinder head	Replace the leaking seal or gasket. Refer to the affected components procedure for service.
Irregularities at the mating surfaces on the flange connections	Repair as required or replace the affected component. Refer to the affected components procedure for service.
Exhaust system component connection welds leaking	Replace the leaking component. Refer to the affected component's procedure for service.
Muffler damaged or leaking at the seams	Replace the affected muffler. Refer to Exhaust Muffler Replacement .

EXHAUST NOISE

Conditions	Action
DEFINITION: An audible or physical noise due to a faulty component or damaged components causing a loose or misaligned exhaust system resulting in a rattle or vibration noise, i.e. buzz, groan, hum. Refer to Symptoms - Engine Exhaust prior to beginning this table.	
Popping or hissing noise	Exhaust leak. Refer to Exhaust Leakage .
Loud exhaust	1. Compare to a known good vehicle. 2. Inspect for a damaged or failed muffler or pipe. 3. Replace the faulty muffler or pipe. Refer to Exhaust Muffler Replacement, or Exhaust Front Pipe Replacement.
External rattle or vibration noise	1. Inspect for a bent or loose hanger, loose heat shield, or loose clamp. 2. Inspect for an exhaust pipe causing interference. 3. Repair or replace the affected component. Refer to the affected component's service procedure.
Internal rattle	1. Test the components by tapping with a rubber mallet to confirm a rattle. 2. Replace the faulty catalytic converter, or muffler. Refer to one of the following procedures: • Three-Way Catalytic Converter Replacement • Exhaust Muffler Replacement

REPAIR INSTRUCTIONS

EXHAUST FRONT PIPE REPLACEMENT

Removal Procedure

WARNING: [Protective Goggles and Glove Warning](#)

WARNING: [Exhaust Service Warning](#)

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

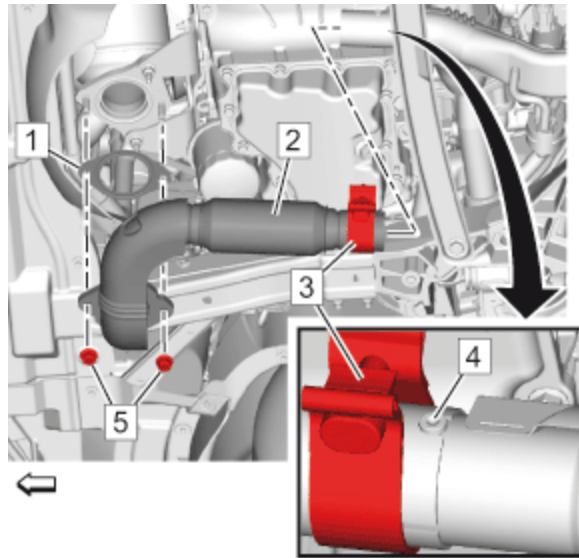


Fig. 1: Exhaust Pipe And Gasket

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not bend the exhaust flex pipe more than 10 degrees in any direction. Bending of more than 10 degrees or twisting in a range of $\hat{A}\pm 0.5$ degrees will damage the exhaust flex decoupler.

2. Remove Exhaust Front Pipe Nut (5)
3. Loosen Exhaust Pipe Clamp (4)
4. Remove Exhaust Front Pipe (2)
5. Remove and DISCARD the gasket.(1)

Installation Procedure

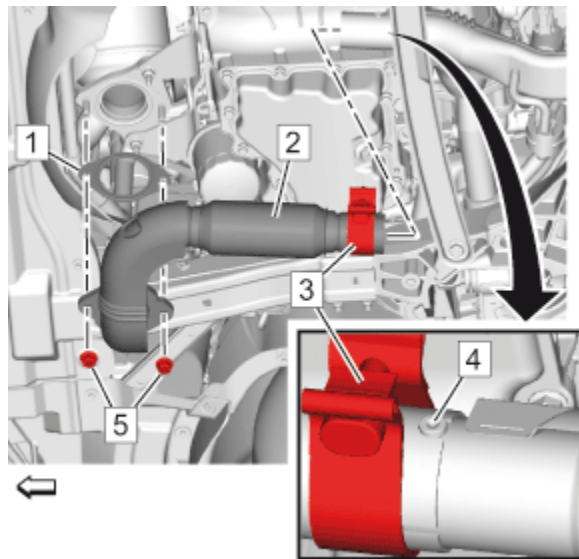


Fig. 2: Exhaust Pipe And Gasket

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket.(1)

NOTE: The knob on the exhaust pipe (4) has to be in the gap of the exhaust front pipe.

2. Install Exhaust Front Pipe (2)

CAUTION: Fastener Caution

3. Install Exhaust Front Pipe Nut (3) and tighten 22 N.m (16 lb ft)

4. Exhaust Pipe Clamp (4) - Tighten 55 N.m (41 lb ft)

5. Lower the vehicle.

THREE-WAY CATALYTIC CONVERTER REPLACEMENT

Removal Procedure

WARNING: Protective Goggles and Glove Warning

WARNING: Exhaust Service Warning

1. Remove Heated Oxygen Sensor Replacement - Sensor 1
2. Remove Heated Oxygen Sensor Replacement - Sensor 2
3. Remove Catalytic Converter Heat Shield Replacement
4. Raise and support the vehicle. Lifting and Jacking the Vehicle

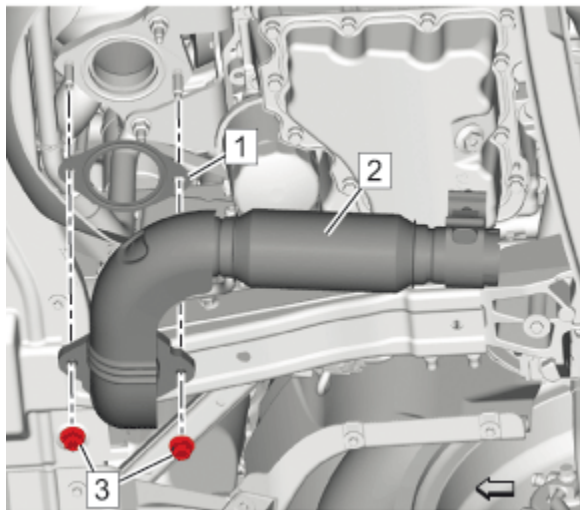


Fig. 3: Exhaust Front Pipe, Nuts And Gasket

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not bend the exhaust flex pipe more than 10 degrees in any direction. Bending of more than 10 degrees or twisting in a range of ± 0.5 degrees will damage the exhaust flex decoupler.

5. Remove Exhaust Front Pipe Nut (3)

6. Remove Exhaust Front Pipe (2)
7. Remove and DISCARD the gasket.(1)

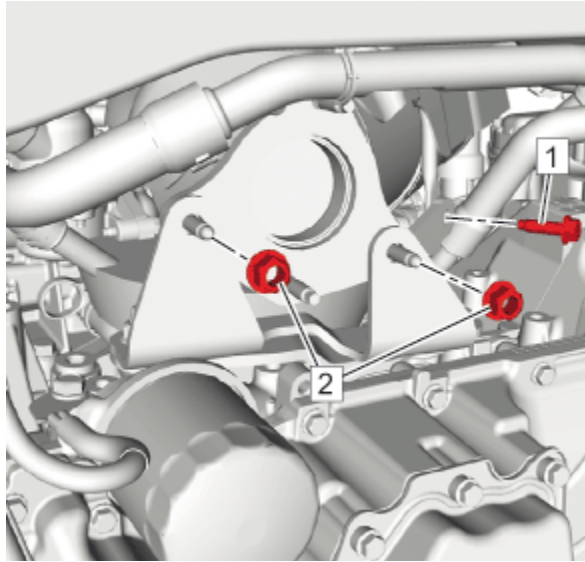


Fig. 4: Catalytic Converter Bracket Nut And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Catalytic Converter Bracket Nut (2)
9. Remove Catalytic Converter Brace Bracket Bolt (1)

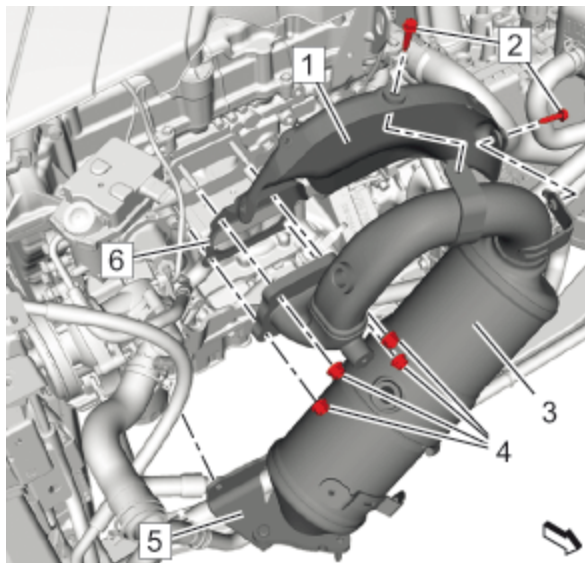


Fig. 5: Catalytic Converter And Catalytic Converter Rear Heat Shield
Courtesy of GENERAL MOTORS COMPANY

10. Lower the vehicle.
11. Remove Catalytic Converter Nut (4) and DISCARD
12. Remove Catalytic Converter (3) & Catalytic Converter Bracket (6)
13. Remove Catalytic Converter Rear Heat Shield Bolt (2)
14. Remove Catalytic Converter Rear Heat Shield (1)

15. Remove the catalytic converter gasket.(6)

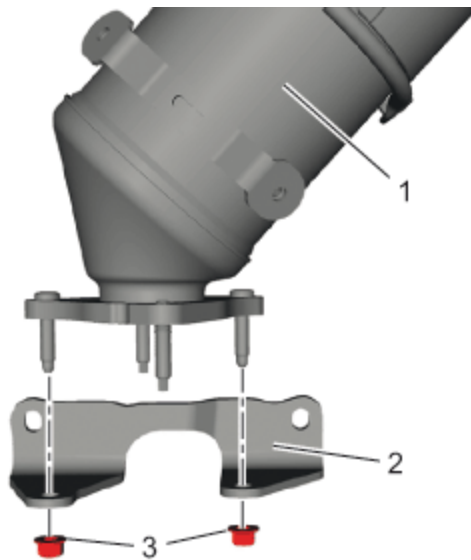


Fig. 6: Catalytic Converter, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

16. Remove Catalytic Converter Brace Bracket Nut (3)

17. Remove Catalytic Converter Bracket (2) @Catalytic Converter (1)

Installation Procedure

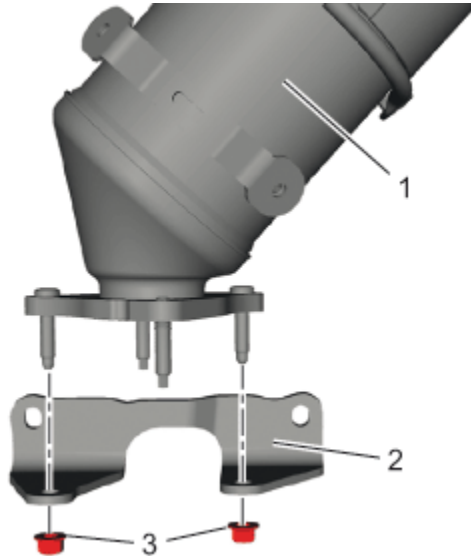


Fig. 7: Catalytic Converter, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Install Catalytic Converter Bracket (2) @Catalytic Converter (1)

CAUTION: Fastener Caution

2. Install Catalytic Converter Brace Bracket Nut (3) and tighten 22 N.m (16 lb ft)

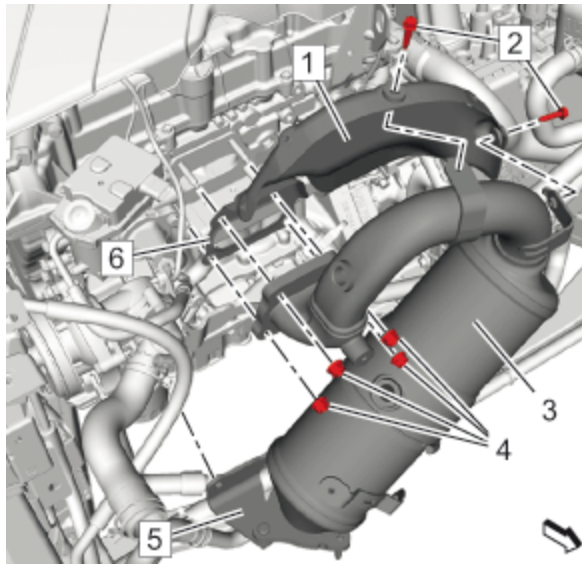


Fig. 8: Catalytic Converter And Catalytic Converter Rear Heat Shield
Courtesy of GENERAL MOTORS COMPANY

3. Install a NEW catalytic converter gasket.(6)
4. Install Catalytic Converter Rear Heat Shield (1)
5. Install Catalytic Converter Rear Heat Shield Bolt (2) and tighten 9 N.m (80 lb in)
6. Install Catalytic Converter (3) & Catalytic Converter Bracket (6)

NOTE: **Install NEW nuts.**

7. Install Catalytic Converter Nut (4) and tighten 22 N.m (16 lb ft)
8. Raise the vehicle.

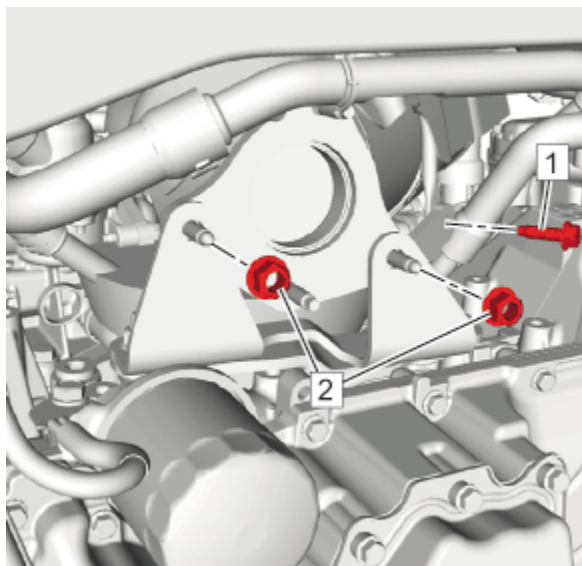


Fig. 9: Catalytic Converter Bracket Nut And Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install Catalytic Converter Bracket Nut (2) and tighten 22 N.m (16 lb ft)

10. Install Catalytic Converter Brace Bracket Bolt (1) and tighten 22 N.m (16 lb ft)

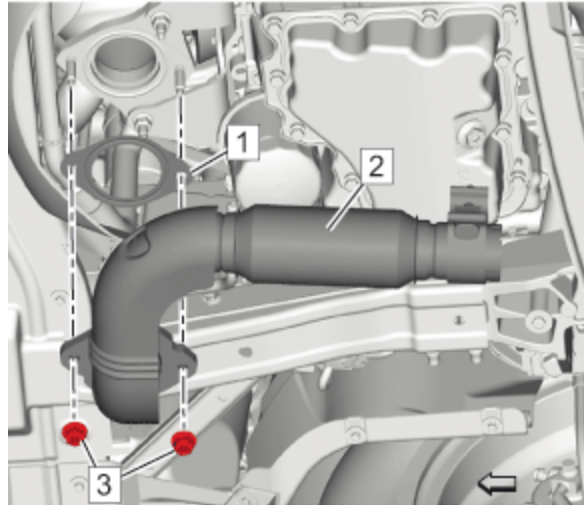


Fig. 10: Exhaust Front Pipe, Nuts And Gasket
Courtesy of GENERAL MOTORS COMPANY

11. Install a NEW gasket.(1)
12. Install Exhaust Front Pipe (2)
13. Install Exhaust Front Pipe Nut (3) and tighten 22 N.m (16 lb ft)
14. Lower the vehicle.
15. Install [Catalytic Converter Heat Shield Replacement](#)
16. Install [Heated Oxygen Sensor Replacement - Sensor 2](#)
17. Install [Heated Oxygen Sensor Replacement - Sensor 1](#)

EXHAUST MUFFLER REPLACEMENT

Removal Procedure

WARNING: [Protective Goggles and Glove Warning](#)

WARNING: [Exhaust Service Warning](#)

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

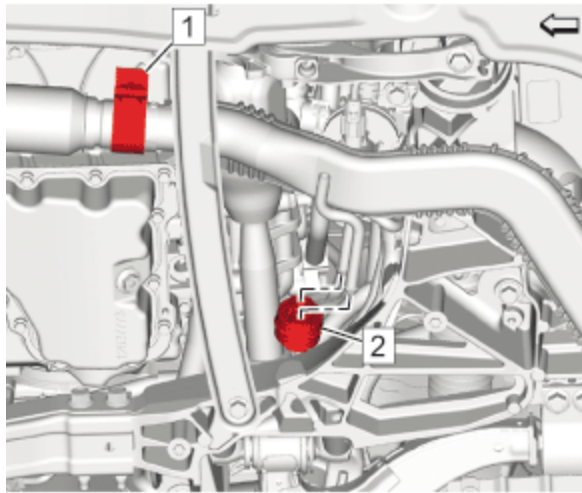


Fig. 11: Exhaust Pipe Clamp And Exhaust Hanger Insulator

Courtesy of GENERAL MOTORS COMPANY

2. Loosen Exhaust Pipe Clamp (1)

NOTE: **Inspect the exhaust hanger insulator for cracks or excessive wear. Replace the insulator if cracked or has excessive wear.**

3. Install Exhaust Hanger Insulator (2)
4. Support the exhaust muffler.

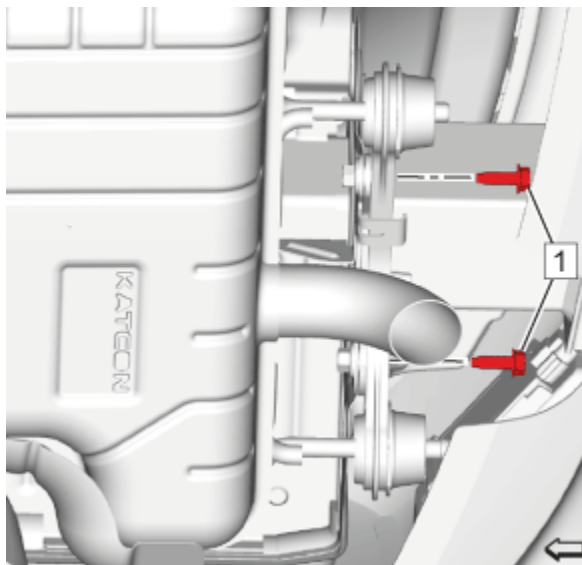


Fig. 12: Exhaust Muffler Insulator Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 exhaust muffler insulator bolts (1).

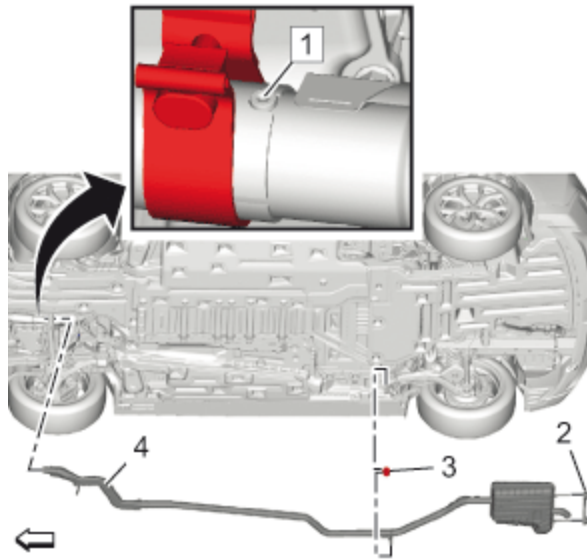


Fig. 13: Intermediate Exhaust Hanger Insulator

Courtesy of GENERAL MOTORS COMPANY

NOTE: Inspect the exhaust hanger insulator for cracks or excessive wear. Replace the insulator if cracked or has excessive wear.

6. Remove the intermediate exhaust hanger insulator (3).

NOTE: A second technician is required.

7. Install Exhaust Muffler (4)

NOTE: Inspect the exhaust hanger insulator for cracks or excessive wear. Replace the insulator if cracked or has excessive wear.

8. Remove the rear exhaust hanger insulator (2).

Installation Procedure

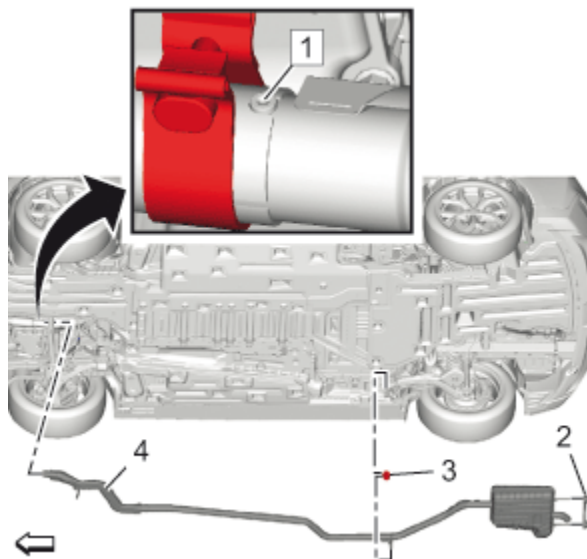


Fig. 14: Intermediate Exhaust Hanger Insulator

Courtesy of GENERAL MOTORS COMPANY

1. Install the rear exhaust hanger insulator (2).

NOTE: A second technician is required.

2. Install Exhaust Muffler (4)
3. Install the intermediate exhaust hanger insulator (3).

NOTE: The knob on the exhaust pipe (1) has to be in the gap of the exhaust front pipe.

4. Align the exhaust system.

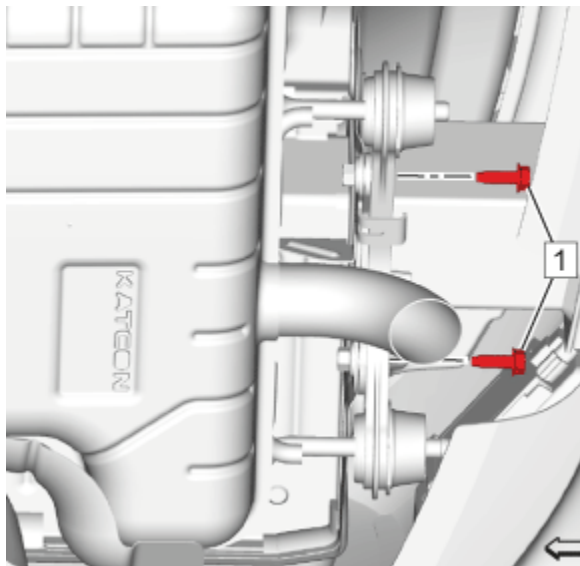


Fig. 15: Exhaust Muffler Insulator Bolt

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Install the 2 exhaust muffler insulator bolts (1) and tighten to 22 N.m (16 lb ft).

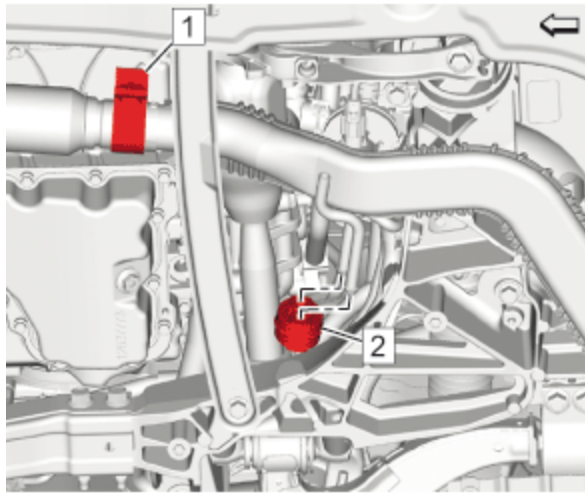


Fig. 16: Exhaust Pipe Clamp And Exhaust Hanger Insulator

Courtesy of GENERAL MOTORS COMPANY

6. Install the exhaust hanger insulator (2).
7. Exhaust Pipe Clamp (1) - Tighten 55 N.m (41 lb ft)
8. Remove the support from the exhaust muffler.
9. Lower the vehicle.

CATALYTIC CONVERTER HEAT SHIELD REPLACEMENT

Removal Procedure

WARNING: Refer to [Exhaust Service Warning](#) .

WARNING: Refer to [Protective Goggles and Glove Warning](#) .

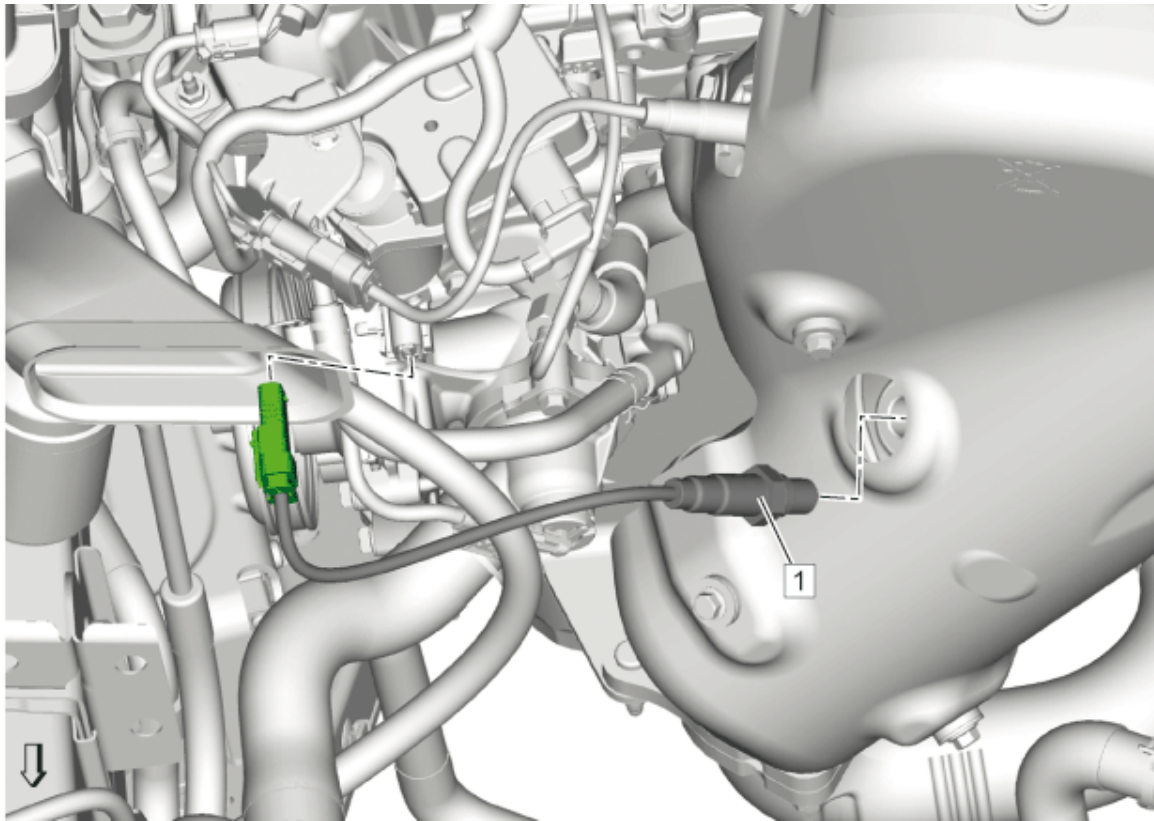


Fig. 17: Heated Oxygen Sensor-Sensor 2

Courtesy of GENERAL MOTORS COMPANY

1. Remove Heated Oxygen Sensor-Sensor 2 (1) [Heated Oxygen Sensor Replacement - Sensor 2](#)

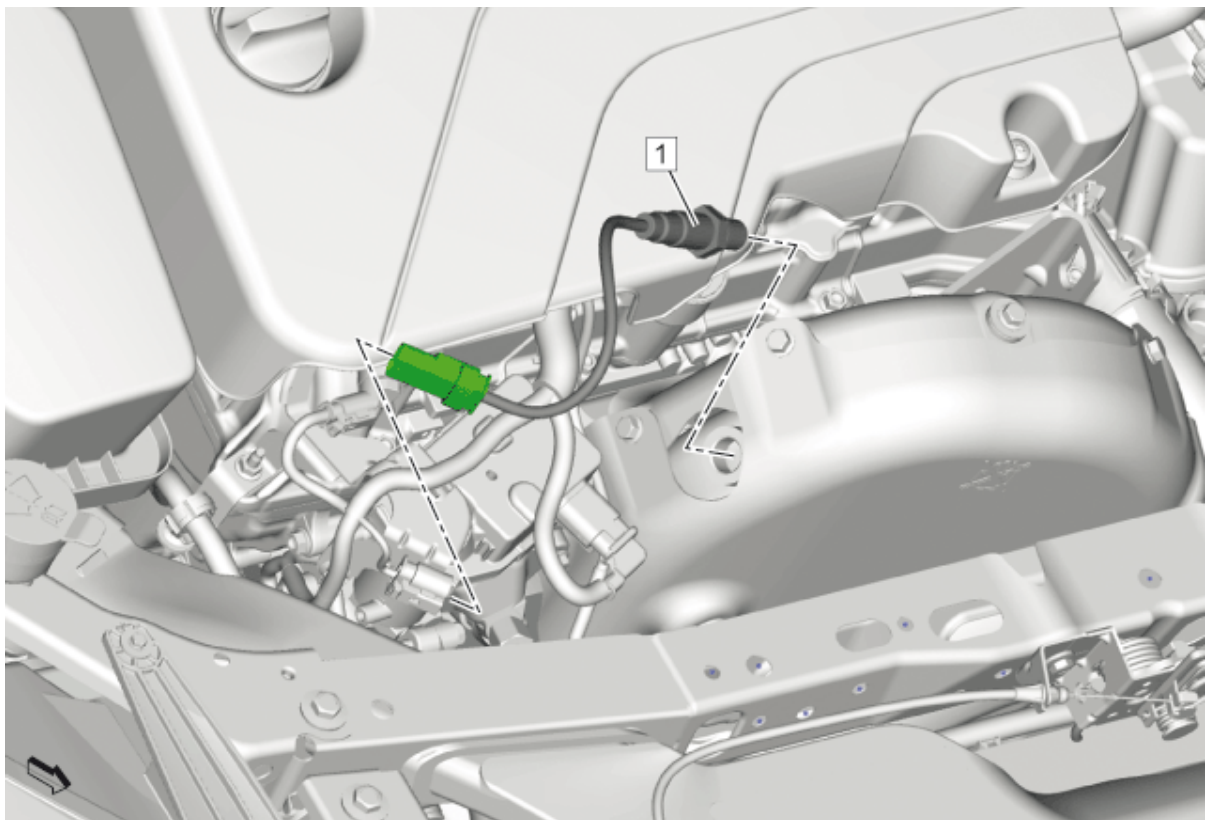


Fig. 18: Heated Oxygen Sensor-Sensor 1
Courtesy of GENERAL MOTORS COMPANY

2. Remove Heated Oxygen Sensor-Sensor 1 (1)[Heated Oxygen Sensor Replacement - Sensor 1](#)

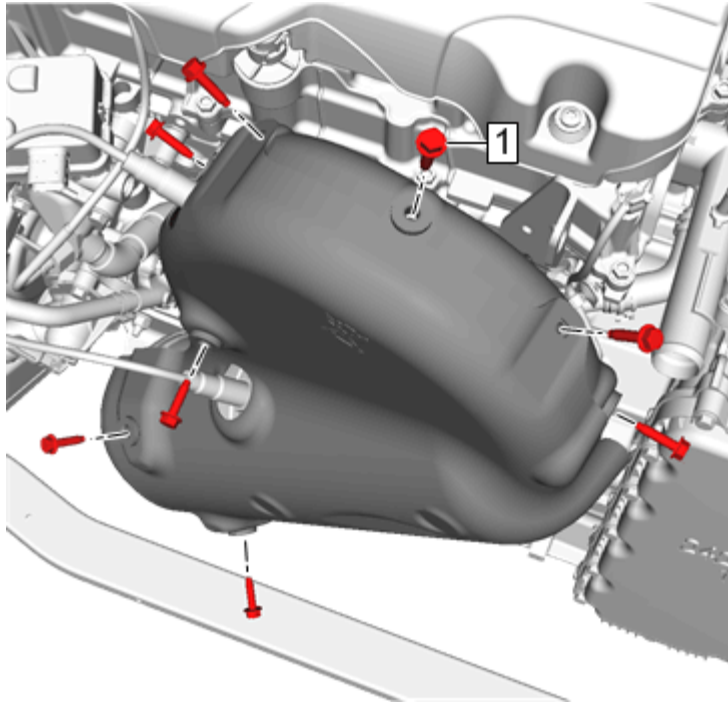


Fig. 19: Catalytic Converter Heat Shield Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove Catalytic Converter Heat Shield Bolt (1)

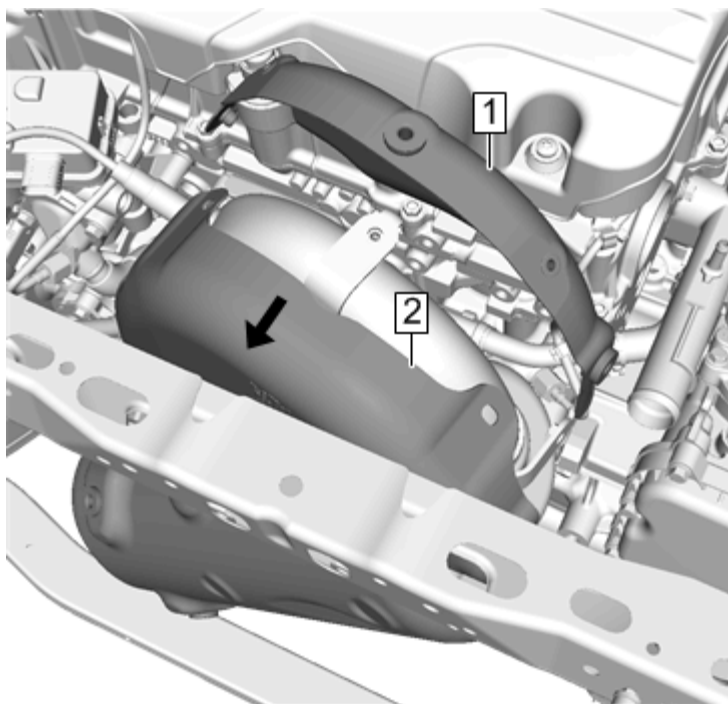


Fig. 20: Catalytic Converter Heat Shield-Rear
Courtesy of GENERAL MOTORS COMPANY

4. Remove Catalytic Converter Heat Shield-Rear (1)
5. Remove Catalytic Converter Heat Shield-Front (2)

Installation Procedure

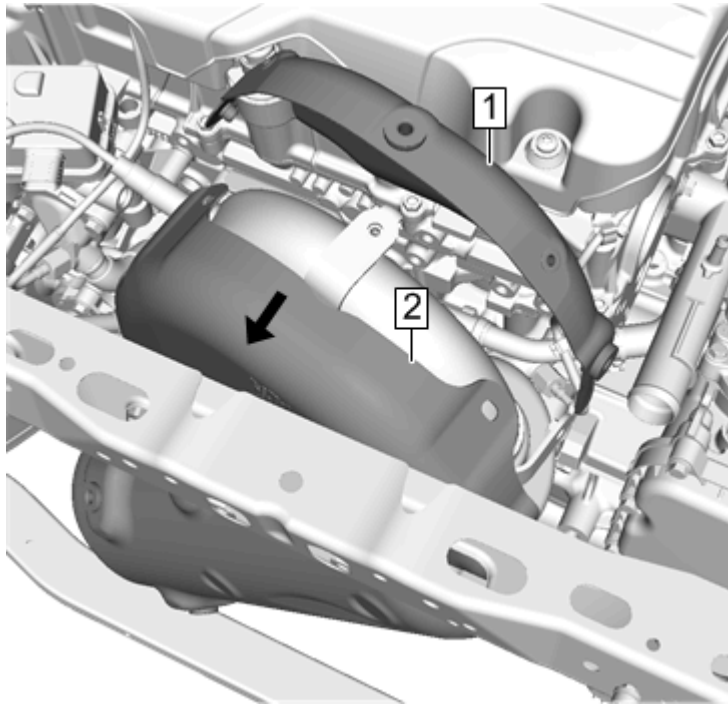


Fig. 21: Catalytic Converter Heat Shield-Rear
Courtesy of GENERAL MOTORS COMPANY

1. Install Catalytic Converter Heat Shield-Front (2)
2. Install Catalytic Converter Heat Shield-Rear (1)

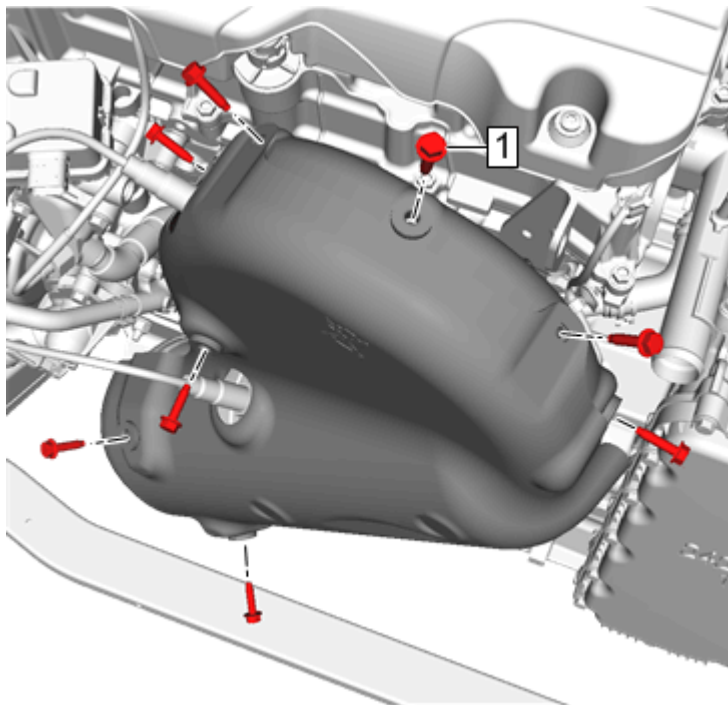


Fig. 22: Catalytic Converter Heat Shield Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Catalytic Converter Heat Shield Bolt (1) and tighten 9 N.m (80 lb in)

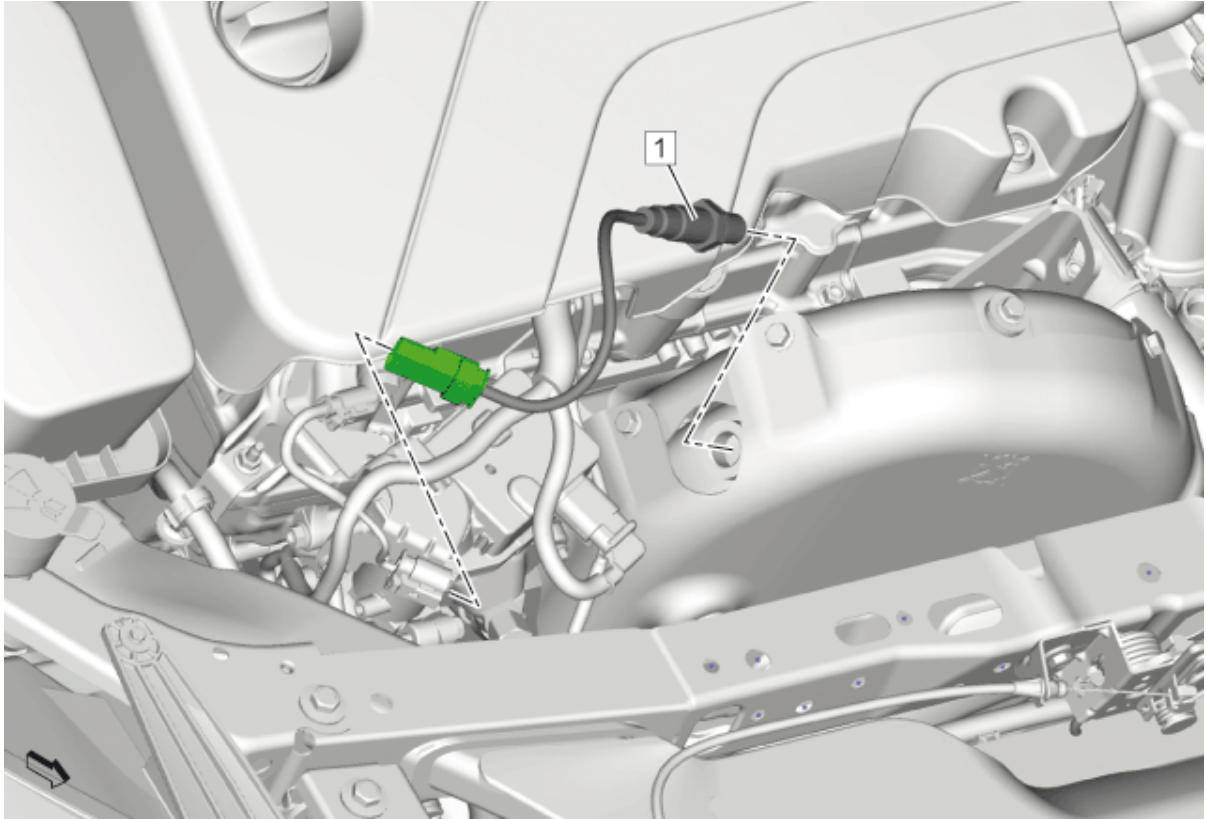


Fig. 23: Heated Oxygen Sensor-Sensor 1
Courtesy of GENERAL MOTORS COMPANY

4. Install Heated Oxygen Sensor-Sensor 1 (1)[Heated Oxygen Sensor Replacement - Sensor 1](#)

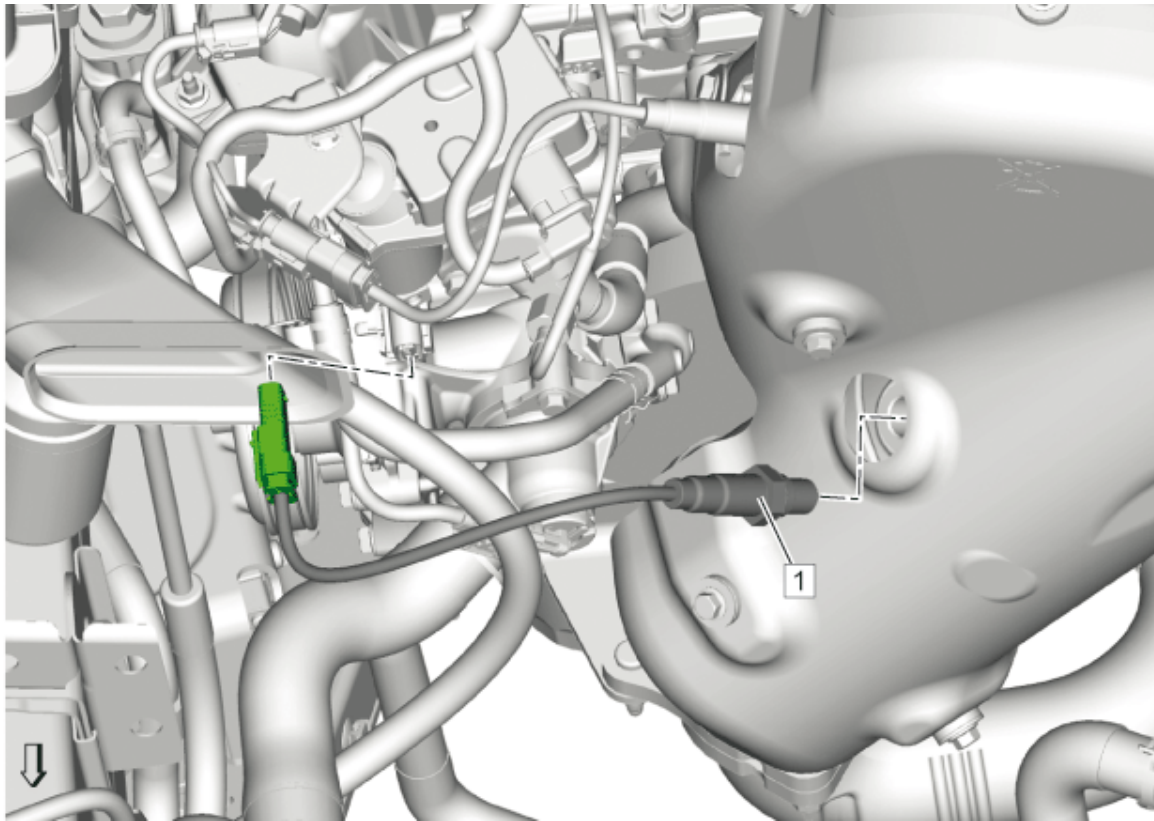


Fig. 24: Heated Oxygen Sensor-Sensor 2

Courtesy of GENERAL MOTORS COMPANY

5. Install Heated Oxygen Sensor-Sensor 2 (1)[Heated Oxygen Sensor Replacement - Sensor 2](#)

REAR BODY EXHAUST HEAT SHIELD REPLACEMENT

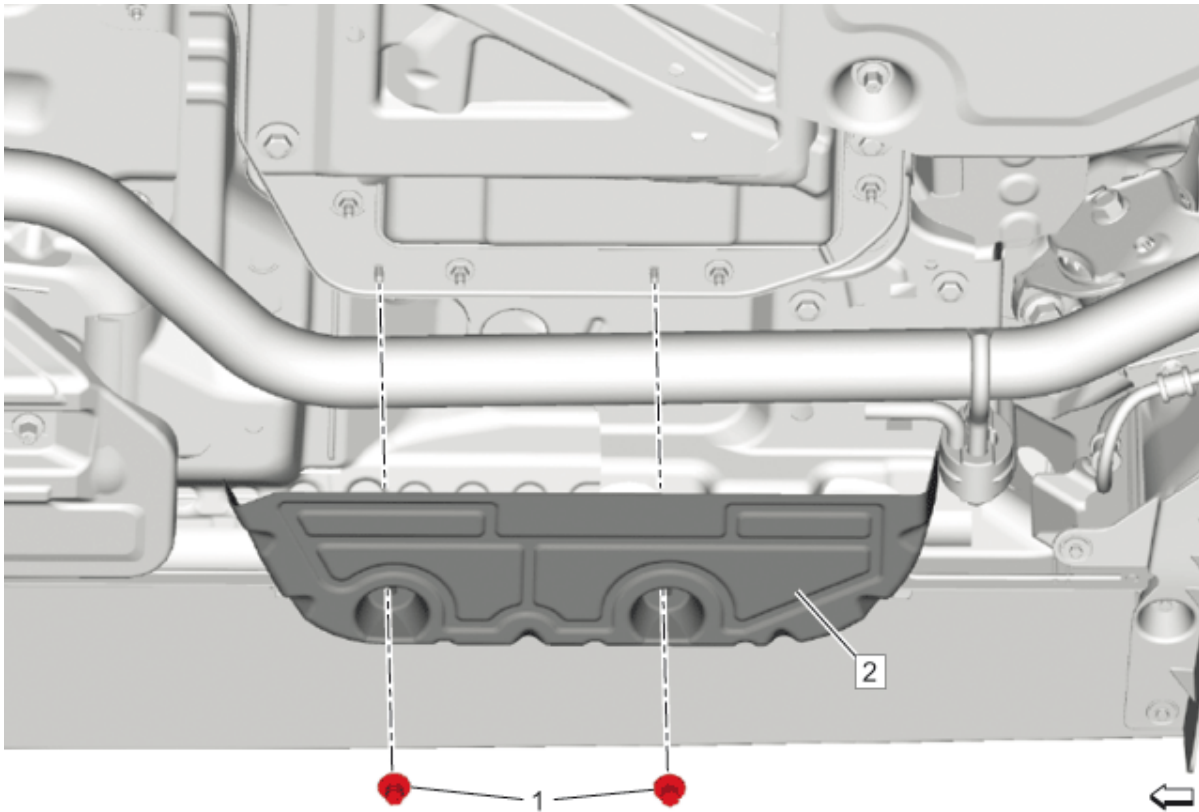


Fig. 25: Rear Body Exhaust Heat Shield
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lifting and Jacking the Vehicle</u>	
1	Rear Body Exhaust Heat Shield Nut (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 3 N.m (27 lb in)
2	Rear Body Exhaust Heat Shield

EXHAUST FRONT UNDERBODY HEAT SHIELD REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Lifting and Jacking the Vehicle
2. Remove Exhaust Muffler Replacement

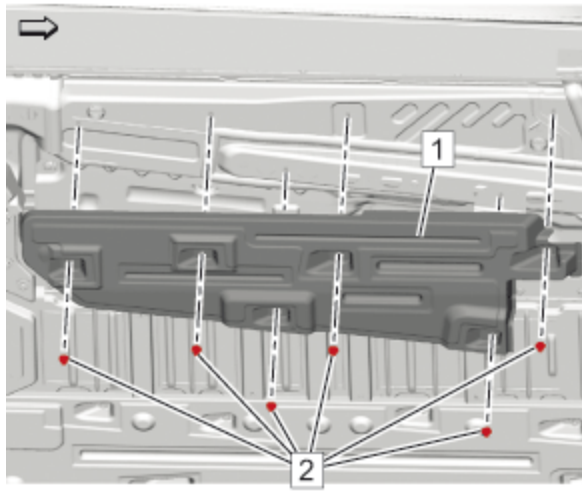


Fig. 26: Underbody Front Air Deflector And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove Underbody Front Air Deflector Nut (2)
4. Remove Underbody Front Air Deflector (1)

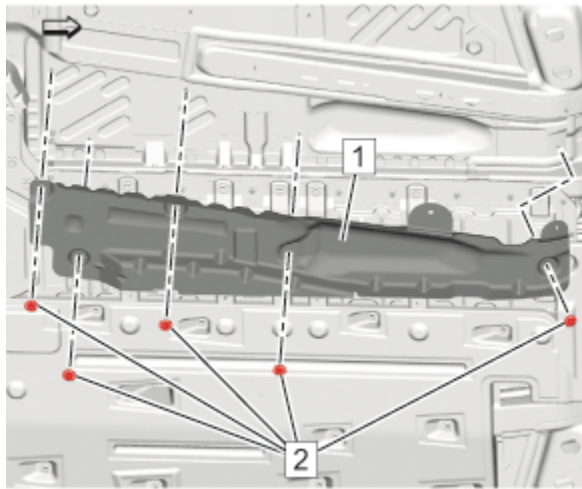


Fig. 27: Exhaust Front Underbody Heat Shield And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Remove Exhaust Front Underbody Heat Shield Retainer (2)
6. Remove Exhaust Front Underbody Heat Shield (1)

Installation Procedure

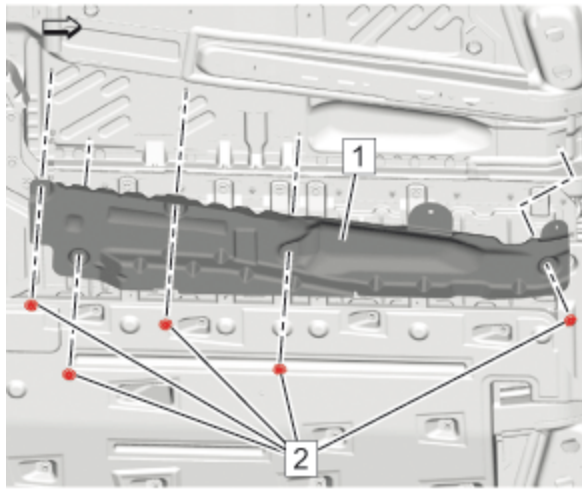


Fig. 28: Exhaust Front Underbody Heat Shield And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install Exhaust Front Underbody Heat Shield (1)
2. Install Exhaust Front Underbody Heat Shield Retainer (2)

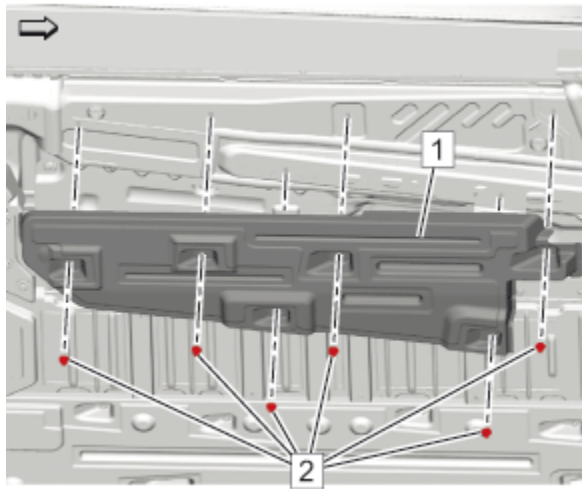


Fig. 29: Underbody Front Air Deflector And Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install Underbody Front Air Deflector (1)

CAUTION: **Fastener Caution**

4. Install Underbody Front Air Deflector Nut (2) and tighten 3 N.m (27 lb in)
5. Install **Exhaust Muffler Replacement**
6. Lower the vehicle.

DESCRIPTION AND OPERATION

EXHAUST SYSTEM DESCRIPTION

NOTE: Use of non-OEM parts may cause driveability concerns.

The exhaust system carries exhaust gases, treated by the catalytic converter, through a resonator, if applicable and into the exhaust muffler where exhaust noise is lessened.

In order to secure the exhaust pipe to the exhaust manifold, a flange and seal-joint coupling is utilized. The exhaust system may utilize a slip-joint coupling design with a clamp and a U-bolt or a flange connection with a gasket.

Exhaust hangers and rubber insulators help to support the weight of the exhaust pipe along with insulating any exhaust system vibration, rattle, or noise.

Exhaust hangers also space the exhaust system away from the underbody of the vehicle and allows the exhaust system to expand as the exhaust system warms up.

Exhaust heat shields are used to protect the body and other components from damage due to the heat from the exhaust system.

The exhaust system may be comprised of the following components:

- Exhaust manifold with Catalytic Converter
- Exhaust pipes
- Catalytic converter
- Exhaust hangers
- Exhaust heat shields
- Exhaust isolators and rods
- Exhaust muffler
- Exhaust resonator, if equipped
- Exhaust tail pipe, if equipped

Resonator

Some exhaust systems are equipped with a resonator. The resonator, located either before or after the muffler, allows the use of mufflers with less back pressure. Resonators are used when vehicle characteristics require specific exhaust tuning.

Catalytic Converter

The catalytic converter is an emission control device added to the engine exhaust system in order to reduce hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) pollutants from the exhaust gas.

The catalytic converter is comprised of a ceramic monolith substrate, supported in insulation and housed within a sheet metal shell. The substrate may be washcoated with 3 noble metals:

- Platinum (Pt)
- Palladium (Pd)

- Rhodium (Rh)

The catalyst in the converter is not serviceable.

Muffler

The exhaust muffler reduces the noise levels of the engine exhaust by the use of tuning tubes. The tuning tubes create channels inside the exhaust muffler that lower the sound levels created by the combustion of the engine.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

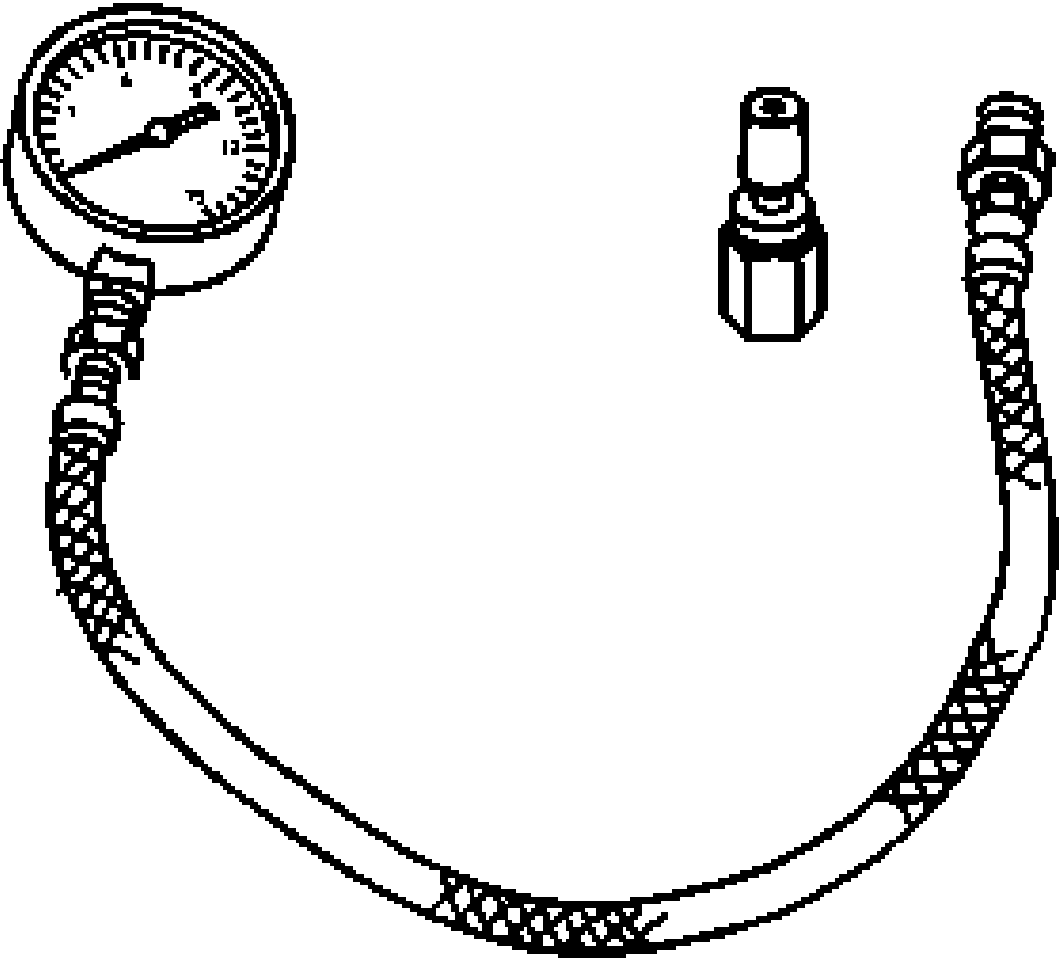
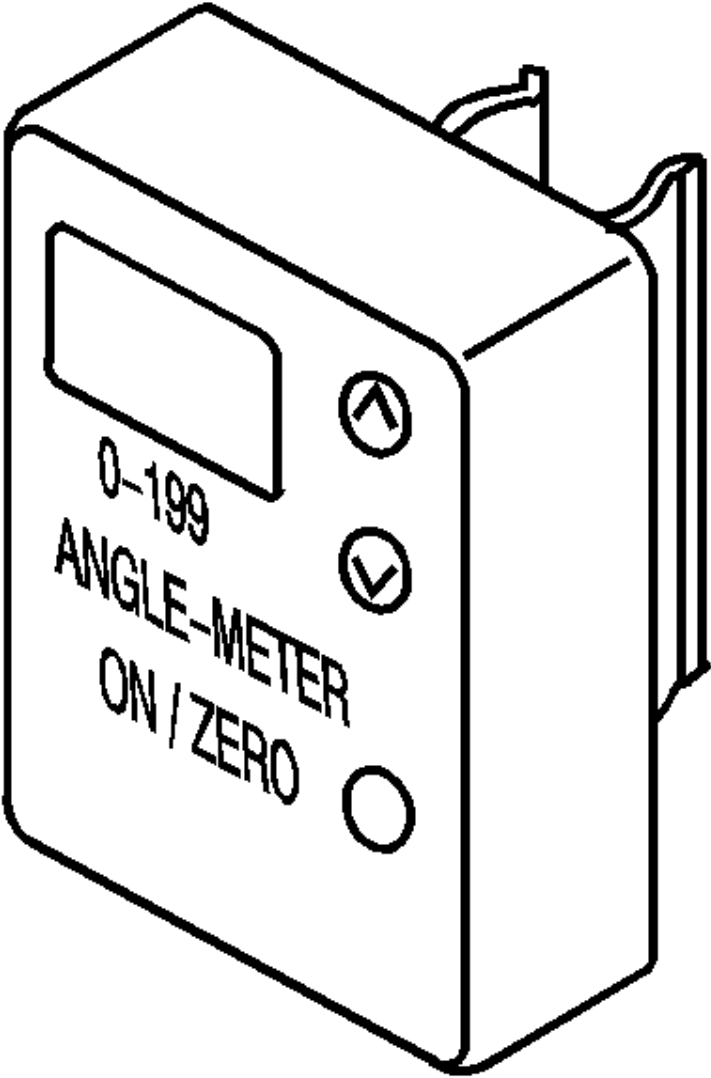
Illustration	Tool Number/ Description
	EN-35314-A J-35314-A Exhaust Back Pressure Gauge

Illustration	Tool Number/ Description
	EN-45059 J-45059 Angle Meter

Article GUID: A00884653

GENERAL INFORMATION

Maintenance and Lubrication - Volt

SPECIFICATIONS

APPROXIMATE FLUID CAPACITIES

Maintenance Procedure	Link
Hydraulic Brake System Capacities	Approximate Fluid Capacities
Engine Heating and Cooling Capacities	Approximate Fluid Capacities
HVAC Capacities	Approximate Fluid Capacities
Hybrid/EV System Heating and Cooling	Approximate Fluid Capacities
Engine Controls and Fuel Capacities - 1.5L (L3A)	Approximate Fluid Capacities
Engine Mechanical - 1.5L (L3A)	Approximate Fluid Capacities
Automatic Transmission Fluid Capacities - 5ET50 (MKV)	Approximate Fluid Capacities

FLUID AND LUBRICANT RECOMMENDATIONS

Usage	Fluid/Lubricant
Engine Oil	Use only engine oil licensed to the dexos1 specification, or equivalent, of the proper SAE viscosity grade. ACDelco dexos1 Synthetic Blend is recommended. Use SAE 5W-20 viscosity grade engine oil. Cold Temperature Operation: In an area of extreme cold, where the temperature falls below -29 Â°C (-20 Â°F), an SAE 0W-30 oil may be used. An oil of this viscosity grade will provide easier cold starting for the engine at extremely low temperatures. When selecting an oil of the appropriate viscosity grade, always select an oil of the correct specification. Refer to Owner's Manual for more information.
Engine Coolant	DEX-COOLÂ® (Premix 50/50 with deionized water)
High Voltage Battery Cooling System	Premix DEX-COOL
Power Electronics Cooling System	Premix DEX-COOL
Hydraulic Brake System	DOT 3 Hydraulic Brake Fluid
Windshield Washer	Automotive windshield washer fluid that meets regional freeze protection requirements.
Electric Drive Unit	DEXRONÂ®-VI Automatic Transmission Fluid
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube
Hood, Hatch, and Rear Folding Seat Hinges	Multi-Purpose Lubricant, Superlube
Weatherstrip Conditioning	Weatherstrip Lubricant or Dielectric Silicone Grease

MAINTENANCE ITEMS

Maintenance Procedure	Link
Approximate Fluid Capacities	<u>Approximate Fluid Capacities</u>
Fluid and Lubricant Recommendations	<u>Fluid and Lubricant Recommendations</u>
Maintenance Replacement Parts	<u>Maintenance Replacement Parts</u>
GM Oil Life System Resetting	<u>GM Oil Life System Resetting</u> <u>GM Oil Life System Resetting (With Scan Tool)</u>
Tire Pressure Indicator Sensor Learn	<u>Tire Pressure Indicator Sensor Learn</u>
Passenger Compartment Air Filter Replacement	<u>Passenger Compartment Air Filter Replacement</u>
Brake Pad Inspection	<u>Brake Pad Inspection</u>
Cooling System Draining and Filling	<u>Cooling System Draining and Filling</u>
Air Cleaner Element Replacement - 1.5L (L3A)	<u>Air Cleaner Element Replacement</u> - 1.5L (L3A)
Spark Plug Replacement - 1.5L (L3A)	<u>Spark Plug Replacement</u> - 1.5L (L3A)
Automatic Transmission Fluid Drain and Fill - 5ET50 (MKV)	<u>Transmission Fluid Drain and Fill</u>

MAINTENANCE REPLACEMENT PARTS

Replacement parts identified below by name, part number, or specification can be obtained from your dealer.

Part	GM Part Number	ACDelco Part Number
Engine Air Cleaner/Filter	20871244	A3148C
Cabin Air Filter	13508023	CF185
Engine Oil Filter	12670058	UPF64R
Spark Plugs	12637197	41-124
Wiper Blades		
• Left - 65 cm (25.6 in)	23251330	-
• Right - 65 cm (25.6 in)	23251332	-

MAINTENANCE

MAINTENANCE SCHEDULE

The Maintenance Schedule information will only be found in the Owner's Manual.

Refer to the Maintenance Schedule subsection of the Owner's Manual, or you may be able to use the Search information function using the words Scheduled Maintenance.

GM OIL LIFE SYSTEM RESETTNG

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which includes engine revolutions and engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed.

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message comes on. Change the oil as soon as possible within the next 1 000 km (600 miles). It is possible that, if driving under the best conditions, the oil life system might indicate that an oil change is not necessary for up to two years. The engine oil and filter must be changed at least once every two years and, at this time, the system must be reset. Your dealer has trained service people who will perform this work using genuine parts and reset the system. It is also important to check the oil regularly over the course of an oil drain interval and keep it at the proper level.

If the system is ever reset accidentally, the oil must be changed at 5 000 km (3, 000 miles) since the last oil change. Remember to reset the oil life system whenever the oil is changed.

How to Reset the Engine Oil Life System

Reset the system whenever the engine oil change is changed so that the system can calculate the next engine oil change. To reset the system:

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

If the Change Engine Oil Soon message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

GM OIL LIFE SYSTEM RESETTING (WITH SCAN TOOL)

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A ENGINE OIL light message will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

(If applicable)With Scan Tool

1. Ignition - On / Vehicle - In Service Mode
 2. Select:Module Diagnostics
 3. Select:K20 Engine Control Module
 4. Select:Configuration/Reset Functions
 5. Select:Reset Functions
 6. Select:Engine Oil Life Reset
 7. Enter the desired value
 8. Select:Continue
-

GENERAL INFORMATION

Anti-Lock Brake Safety Precautions

*** PLEASE READ THIS FIRST ***

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: Failure to depressurize ABS could lead to physical injury.

- NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
- NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
- **DO NOT** attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
- Only use specially designed brake hoses/lines on ABS equipped vehicles.
- **DO NOT** tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
- **DO NOT** mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
- **DO NOT** contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
- When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
- ONLY use recommended brake fluids. **DO NOT** use silicone brake fluids in an ABS equipped vehicle.
- When installing transmission devices (CB's, telephones, etc.) on ABS equipped vehicles, **DO NOT** locate the antenna near the ABS control unit (or any control unit).
- Disconnect all on-board computers, when using electric welding equipment.
- **DO NOT** expose the ABS control unit to prolonged periods of high heat (185 Â°F/85Â°C for 2 hours is generally considered a maximum limit).

Article GUID: A00044069

ATEQ TPMS RESET PROCEDURE

GM - Procedure 28

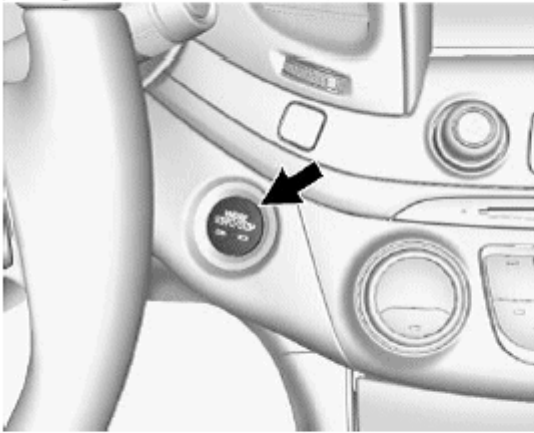
ATEQ TPMS RESET PROCEDURE

NOTE: Unless otherwise stated, on most tire pressure sensor equipped vehicles, low tire pressure indicator lights and messages can be cleared by inflating tires to the specified pressure and driving at least 25 mph or more for a few minutes. A sensor activation tool (TPMS3) can be used in place of driving.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See [Fig. 1](#).
4. Make sure the Tire Pressure info page option is turned on. The info pages on the Driver Information Center (DIC) can be turned on and off through the Settings menu.
5. Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SET/RESET (check mark symbol) button located in the center of the DIC controls.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold the TPMS3 against the side wall of the tire, within 3 inches of the valve stem. Press TEST button on the TPMS3 until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

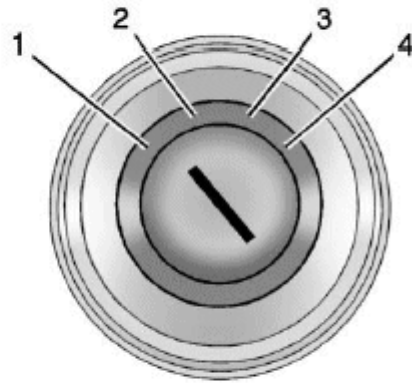
Ignition Positions

Keyless Access



Pressing the button cycles it through three modes: ACC/ACCESSORY, ON/RUN/START, and Stopping the Engine/OFF.

Key Access



The ignition switch has four different positions.

Fig. 1: Ignition Positions (Key & Keyless)

Courtesy of GENERAL MOTORS CORP.

Article GUID: A00859879

CANADIAN MODEL REFERENCE

Canadian-To-U.S. Model Reference Tables

*** PLEASE READ THIS FIRST ***

NOTE: This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.

ACURA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

ACURA MODEL CROSS-REFERENCE

Canadian Model	US Model
1996-2000 1.6EL	Canadian Only (Based on 1996-2000 Japanese Market Honda Domani)
2001-2005 1.7EL	2001-2005 Honda Civic
2004-2005 EL	2004-2005 Honda Civic
2006-2011 CSX	2006-2011 Honda Civic

ASUNA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

ASUNA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-93 Sunfire	1990-92 Isuzu Impulse & 1990-93 Geo Storm ("R" Body)
1993 GT/ SE	1988-93 Pontiac LeMans ("T Body)
1992-93 Sunrunner	1989-99 Geo Tracker ("J" Body)

AUDI

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the

relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

AUDI MODEL CROSS-REFERENCE

Canadian Model	US Model
1985-86 Quattro	Nearest Match: 1984 Quattro Similar To: 1985-86 Coupe
1996-97 S6	Nearest Match: 1996-97 A6

CHRYSLER CORP.

CHRYSLER

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

CHRYSLER MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-93 Daytona	1984-93 Dodge Daytona
1988-93 Dynasty	1988-93 Dodge Dynasty
1993-04 Intrepid	1993-04 Dodge Intrepid
2000-02 Neon	2000-02 Dodge Neon

DODGE

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

DODGE MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 2000	1989-90 Mitsubishi Galant
1992-93 Colt Wagon	1992-93 Plymouth Colt Vista
1994 Colt Wagon	1994 Mitsubishi Expo (LRV)
1987-88 Expo	1987-88 Colt Vista
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
2003-05 SX	2003-05 Neon

EAGLE

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

EAGLE MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-93 2000 GTX	1989-93 Mitsubishi Galant
1989-91 Vista (Sedan/Notchback)	1989-91 Dodge Colt
1992 Vista	1992 Plymouth Colt
1989-91 Vista Wagon	1989-91 Dodge Colt Vista

PLYMOUTH

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

PLYMOUTH MODEL CROSS-REFERENCE

Canadian Model	US Model
1978-81 Caravelle	1978-87 Dodge Diplomat
1982-84 Caravelle	1982-84 Gran Fury Also: Dodge 600
1990-92 Colt 100/200	1990-92 Colt
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
1992-94 Colt Wagon	1992-94 Mitsubishi Expo (LRV)
1987-89 Expo	1987-89 Colt Vista

GENERAL MOTORS

BUICK

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

BUICK MODEL CROSS-REFERENCE

Canadian Model	US Model
2005-09 Allure	2005-09 Buick LaCrosse
1986-87 Somerset Regal	1986-87 Regal (Somerset is a Regal trim level)

CHEVROLET

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

CHEVROLET MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-92 Sprint	1989-92 Geo Metro 1989-92 Suzuki Swift
1989-92 Tracker	1989-92 Geo Tracker 1989-92 Suzuki Sidekick
2004-08 Optra (Sedan/Wagon)	2004-08 Suzuki Forenza
2004-08 Optra5	2004-08 Suzuki Reno
2004-06 Epica	2004-06 Suzuki Verona
2012 Orlando	Canadian Only
2009 Uplander	Canadian Only Best Match: 2008 Uplander

GMC

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

GMC MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-92 Tracker	1989-94 Geo Tracker
2002-05 Jimmy	2002-05 Chevrolet Blazer (Not TrailBlazer)

OLDSMOBILE

NOTE: All information in this product, unless otherwise noted, is written specifically

for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 Delta 88	1989-90 Eighty-Eight

OPTIMA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-91 Optima (Passport)	1988-91 Pontiac LeMans ("T" Body)

PONTIAC

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

PONTIAC MODEL CROSS-REFERENCE

Canadian Model	US Model
1982 Parisienne	Best Match: 1983 Parisienne
1985-89 Firefly	1985-89 Chevrolet Sprint
1990-00 Firefly	1990-00 Suzuki Swift 1998-00 Chevrolet Metro
1987-91 Tempest	1987-91 Chevrolet Corsica
2007 Montana SV6	2007 Buick Terraza 2007 Saturn Relay 2007 Chevrolet Uplander
2008-09 Montana SV6	2008-09 Chevrolet Uplander
1982-83 Grand LeMans	1982-82 Bonneville 1981 Oldsmobile Cutlass
1985-87 Sunburst	1985-87 Chevrolet Spectrum

Canadian Model	US Model
1994-97 Sunrunner	1994-97 Geo Tracker
2005-09 Wave & G3 Wave	2005-09 Chevrolet Aveo
2010 G3	2010 Chevrolet Aveo
2005-08 G5 Pursuit, G5, & Pursuit	2005-08 Chevrolet Cobalt
1982-87 Acadian	1982-87 Chevrolet Chevette

HYUNDAI

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

HYUNDAI MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-87 Pony	Canadian Only
1985-88 Stellar	Canadian Only

JAGUAR

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

JAGUAR MODEL CROSS-REFERENCE

Canadian Model	US Model
1983-92 XJ12	Canadian Only

KIA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

KIA MODEL CROSS-REFERENCE

Canadian Model	US Model
2010-11 Borrego	Canadian Only

Canadian Model	US Model
	Best Match: 2009 Borrego
2001-10 Magentis	2001-10 Optima
2011-12 Rondo	Canadian Only Best Match: 2010 Rondo

MAZDA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

MAZDA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-96 MX3 Precidia	1992-95 MX3
1995 323	1995 Protege
1997 B3000	1997 B4000 1997 Ford Ranger
2010 B-Series Trucks	Canadian Only Best Match: 2009 B-Series Trucks
1993-97 MX6 Mystere	1993-97 MX6 193-97 Ford Probe
1992-95 929 Serenia	1988-95 929
1993-97 626 Cronos	1988-97 626

MERCEDES-BENZ

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

MERCEDES-BENZ MODEL CROSS-REFERENCE

Canadian Model	US Model
1992 350SD / 350SDL	1992 300SD
2006-11 B200	Canadian Only
2008-09 C230	2008-09 C300
2010-11 C250	2010-11 C300
2009 CLK63	Canadian Only Best Match: 2008 CLK63

Canadian Model	US Model
2007 E280	2007 E320
2008-09 E300	2008-09 E350
2009-11 S450	2010-11 S400

MERCURY

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

MERCURY MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Tracer	1987 Mazda 323

MERKUR

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

MERKUR MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Scorpio	Canadian Only Best Match: 1988 Scorpio

MITSUBISHI

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

MITSUBISHI MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Endeavor	Canadian Only Best Match: 2008 Endeavor
2011-13 RVR	2011-13 Outlander Sport

NISSAN

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

NISSAN MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-95 Axxess Wagon	Canadian Only Best Match: 1990 Axxess Wagon
1986-88 Multi Wagon	1986-88 Stanza Wagon
1984 Micra	Canadian Only
2005-06 X-Trail	Canadian Only

RENAULT

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

RENAULT MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-86 LeCar	Canadian Only Best Match: 1983 LeCar

SATURN

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

SATURN MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Astra	Canadian Only Same As: 2008 Astra

SMART

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

SMART MODEL CROSS-REFERENCE

Canadian Model	US Model
2005-07 Fortwo	Canadian Only Best Match: 2008 Fortwo

SUBARU

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

SUBARU MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-89 Chaser	1988-89 GL (Chaser is a hatchback version of the GL)

SUZUKI

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

SUZUKI MODEL CROSS-REFERENCE

Canadian Model	US Model
1986-88 Forsa	1986-88 Chevrolet Sprint
1982-85 Samurai (SJ410)	Canadian Only
2004-08 Swift+	2004-08 Chevrolet Aveo
2009 Swift+	2009 Chevrolet Aveo

TOYOTA

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to

vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

TOYOTA MODEL CROSS-REFERENCE

Canadian Model	US Model
1998-99 Paseo	Canadian Only Best Match: 1997 Paseo
1999 Tercel	Canadian Only Best Match: 1998 Tercel
2006 Yaris	Canadian Only Best Match: 2007 Yaris

VOLKSWAGEN

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

VOLKSWAGEN MODEL CROSS-REFERENCE

Canadian Model	US Model
1995 Corrado	Canadian Only
1992 & 1994 EuroVan (Gas)	Canadian Only Best Match: 1993 Eurovan
1993-97 EuroVan (Diesel)	Canadian Only (No Diesel Eurovans Sold in U.S.)
2007-08 Golf (A5)	Canadian Only Best Match: 2006 Golf
2008-09 Golf (A6)	Canadian Only Best Match: 2010 Golf
1993 GTI	Canadian Only Best Match: 1993 Cabriolet
1994 GTI	Canadian Only Best Match: 1994 Jetta III
1989 Scirocco	Same As: 1988 Scirocco
1985-92 Transporter Van/Pickup	Canadian Only
1993-03 Transporter Van	1993-03 EuroVan

VOLVO

NOTE: All information in this product, unless otherwise noted, is written specifically

for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

VOLVO MODEL CROSS-REFERENCE

Canadian Model	US Model
1987-88 244 & 245	Canadian Only Best Match: 1987-88 240
2007 C30	Canadian Only Best Match: 2007 S40, V50, C70 Are Similar

ALL OTHERS

NOTE: This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.

NOTE: All information in this product, unless otherwise noted, is written specifically for vehicles built for the United States market and may or may not apply to vehicles built for the Canadian market. The purpose of this article is to show the relationships between Canadian and U.S. vehicles and should not be used to determine which repair information applies to vehicles built for the Canadian market.

Information for other vehicles is not available or known.

Article GUID: A00159969

GENERAL INFORMATION

Clutch Trouble Shooting

* PLEASE READ THIS FIRST *

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

ALL MODELS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

CLUTCH TROUBLE SHOOTING

Problem & Possible Cause	Action
Clutch Chatters/Grabs	
Incorrect Pedal Adjustment	Adjust Free Play
Worn Input Shaft Spline	Replace Input Shaft
Binding Pressure Plate	Replace Pressure Plate
Binding Throw-Out Lever	Check Throw-Out Lever, Check Throw-Out Bearing, Check Bearing Retainer
Uneven Pressure Plate Contact With Flywheel	Align/Replace Worn Parts
Transmission Misaligned	Align Transmission
Worn Pressure Plate	Replace Clutch Assembly
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Loose Engine Mounts	Replace Engine Mounts
Clutch Pedal Sticks Down	
Clutch Cable Binding	Replace Clutch Cable
Weak Pressure Plate Springs	Replace Clutch Assembly
Binding Clutch Linkage	Lubricate Linkage
Broken Clutch Pedal Return Spring	Replace Return Spring
Clutch Will Not Release	
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Defective Disc Face	Replace Clutch Assembly
Disc Sticking on Input Shaft Splines	Replace Disc/Input Shaft
Binding Pilot Bearing	Replace Pilot Bearing
Faulty Clutch Master Cylinder	Replace Master Cylinder
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
Blown Clutch Hose	Replace Hose

Problem & Possible Cause	Action
Sticky Throw-Out Bearing Sleeve	Clean/Lube Sleeve
Clutch Cable Binding	Replace Clutch Cable
Broken/Loose Bellhousing	Check Bellhousing
Rattling/Squeaking	
Broken Throw-Out Lever Return Spring	Replace Return Spring
Faulty Throw-Out Bearing	Replace Throw-Out Bearing
Faulty Clutch Disc	Replace Clutch Disc
Faulty Pilot Bearing	Replace Pilot Bearing
Worn Throw-Out Bearing	Replace Throw-Out Bearing
Dry Bearing Retainer Slide For Throw-Out Bearing Sleeve	Lubricate Slide
Slipping	
Faulty Pressure Plate	Replace Clutch Assembly
Worn Clutch Disc	Replace Clutch Assembly
Incorrect Alignment	Realign Clutch Assembly
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
No Pedal Pressure	
Leaky Hydraulic System	Check Clutch Master Cylinder, Check Clutch Slave Cylinder
	Check Clutch Hose
Broken Clutch Cable	Replace Clutch Cable
Faulty Throw-Out Lever	Replace Throw-Out Lever
Broken Clutch Linkage	Repair Clutch Linkage
Noisy Clutch Pedal	
Faulty Safety Switch	Check/Replace Switch
Noisy Self-Adj. Ratchet	Replace Ratchet
Dry Throw-Out Bearing	Replace Throw-Out Bearing
Dry Pilot Bearing	Replace Pilot Bearing
Worn Input Shaft	Replace Input Shaft

Article GUID: A00091461

GENERAL INFORMATION
Commonly Used Abbreviations

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. This information may not apply to all makes and models. Not all abbreviations are covered as manufacturers add new ones every day.

"A"

A

Amperes

ABS

Anti-Lock Brakes

ABRS

Air Bag Restraint System

AC

Alternating Current

A/C

Air Conditioning

ACCS

A/C Cycling Switch

ACCUM

Accumulator

ACCY

Accessory

ACT

Air Charge Temperature Sensor

ADJ

Adjust or Adjustable

ADV

Advance

AFS

Airflow Sensor

AI

Air Injection

AIR or A.I.R.

Air Injection Reactor

AIS

Air Injection System

Alt.

Alternator or Altitude

Amp./amp/amps

Ampere

ASCS

Air Suction Control Solenoid

ASD

Auto Shutdown

ASDM

Air Bag System Diagnostic Module

ASV

Air Suction Valve

A/T

Automatic Transmission/Transaxle

ATC

Automatic Temperature Control

ATDC

After Top Dead Center

ATF

Automatic Transmission Fluid

ATS

Air Temperature Sensor

Aux.

Auxiliary

Avg.

Average

AXOD

Automatic Transaxle Overdrive (Ford Models Only)

"B"

BAC

By-Pass Air Control

BAP

Barometric Absolute Pressure Sensor

BARO

Barometric

Batt.

Battery

Bbl.

Barrel (Example: 4-Bbl.)

BCM

Body Control Module

BHP

Brake Horsepower

BMAP

Barometric and Manifold Absolute Pressure Sensor

BOO

Brake On-Off Switch

B/P

Backpressure

BPS

Barometric Pressure Sensor

BPT

Backpressure Transducer

BTDC

Before Top Dead Center

BTSI

Brake Transmission Shift Interlock

BTU

British Thermal Unit

BVSV

Bimetallic Vacuum Switching Valve

"C"

Â° C

Celsius (Degrees)

Calif.

California

CANP

Canister Purge

CARB

CAT

Catalytic Converter

CB

Circuit Breaker

CBD

Closed Bowl Distributor

cc

cubic centimeter

CCC

Close Coupled Catalyst

CCC

Computer Command Control

CCD

Computer Controlled Dwell

CCOT

Cycling Clutch Orifice Tube

CCW

Counterclockwise

CDI

Capacitor Discharge Ignition

CEC

Computerized Engine Control

CID

Cubic Inch Displacement

cm

Centimeter

CMP

Camshaft Position Sensor

CO

Carbon Monoxide

CO₂

Carbon Dioxide

Cont.

Continued

CONV

Convertible

CP

Canister Purge

CKP

Crankshaft Position Sensor

CTS

Coolant Temperature Sensor

Cu. In.

Cubic Inch

CVC

Constant Vacuum Control

CV

Check Valve or Constant Velocity

CW

Clockwise

CYL or Cyl.

Cylinder

C³ I

Computer Controlled Coil Ignition

C⁴

Computer Controlled Catalytic Converter

"D"

"D"

Drive

DC

Direct Current Or Discharge

DDD

Dual Diaphragm Distributor

Def.

Defrost

Defog.

Defogger

DERM

Diagnostic Energy Reserve Module

DFI

Digital Fuel Injection

Diag.

Diagnostic

DTC

Diagnostic Trouble Code

DIC

Driver Information Center

DIS

Distributorless Ignition System

DIST

Distribution

DLC

Data Link Connector

DOC

Diesel Oxidation Catalyst

DOHC

Double Overhead Cam

DOT

Department of Transportation

DPF

Diesel Particulate Filter

DRB-II

Diagnostic Readout Box

DVOM

Digital Volt-Ohmmeter

"E"

EACV

Electric Air Control Valve

EATX

Electronic Automatic Transaxle

EBCM

Electronic Brake Control Module

EBL

Electronic Back Light

ECM

Engine Control Module

ECT

Engine Coolant Temperature Sensor

EDIS

Electronic Distributorless Ignition System

EEC

Electronic Engine Control

EECS

Evaporative Emission Control System

EEPROM

Electronically Erasable PROM

EFE

Early Fuel Evaporation

EGO

Exhaust Gas Oxygen Sensor

EGR

Exhaust Gas Recirculation

EOT

Engine Oil Temperature

ESA

Electronic Spark Advance

ESC

Electronic Spark Control

EST

Electronic Spark Timing

EVAP

Fuel Evaporative System

EVIC

Electronic Vehicle Information Center

EVP

EGR Valve Position Sensor

EWMA

Exponentially Weighted Moving Average (MODE 6)

Exc.

Except

"F"

Â° F

Fahrenheit (Degrees)

F/B

Fuse Block

Fed.

Federal

FI

Fuel Injection

FICU

Fuel Injection Control Unit

FIPL

Fuel Injector Pump Lever

FLI

Fuel Level Indicator

FPR-VSV

Fuel Pressure Regulator Vacuum Switching Valve

Ft. Lbs.

Foot Pounds

FWD

Front Wheel Drive

"G"

g

grams

Gals.

gallons

GND or GRND

Ground

"H"

HAC

High Altitude Compensation

HC

Hydrocarbons

H/D

Heavy Duty

HO2S

Heated Exhaust Gas Oxygen Sensor

Hg

Mercury

Hgt.

Height

HLDT

Headlight

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HSC

High Swirl Combustion

HSO

High Specific Output

HTR

Heater

Hz

Hertz (Cycles Per Second)

"I"

IAC

Idle Air Control

IACV

Idle Air Control Valve

IAT

Intake Air Temperature

IC

Integrated Circuit

ID

Identification

I.D.

Inside Diameter

IFS

Independant Front Suspension

IFS

Inertia Fuel Shutoff (Ford)

Ign.

Ignition

IMRC

Intake Manifold Runner Control

In.

Inches

INCH Lbs.

Inch Pounds

in. Hg

Inches of Mercury

Inj.

Injector

IP

Instrument Panel

IRS

Independant Rear Suspension

ISC

Idle Speed Control

IVD

Interactive Vehicle Dynamics (Ford)

IVSV

Idle Vacuum Switching Valve

"J"

J/B

Junction Block

"K"

KAPWR

Keep Alive Power

k/ohms

kilo-ohms (1000 ohms)

kg

Kilograms (weight)

kg/cm²

Kilograms Per Square Centimeter

KM/H

Kilometers Per Hour

KOEO

Key On, Engine Off

KOER

Key On, Engine Running

KS

Knock Sensor

kW

Kilowatt

kV

Kilovolt

"L"

L

Liter

lbs. (Lbs. when used in table)

Pounds

LCD

Liquid Crystal Display

L/D

Light Duty

LDP

Leak Detection Pump (Part of EVAP system.)

LED

Light Emitting Diode

LH

Left Hand

"M"

mA

Milliamps

MA or MAF

Mass Airflow

MAFS

Mass Airflow Sensor

MAP

Manifold Absolute Pressure

MAT

Manifold Air Temperature

Mem.

Memory

MEM-CAL

Memory Calibration Chip

mfd.

Microfarads

MFI

Multiport Fuel Injection

MICU

Multiplex Integrated Control Unit (Acura/Honda)

MIL

Malfunction Indicator Light

MPI

Multi-Point (Fuel) Injection

mm

Millimeters

MPH

Miles Per Hour

mV

Millivolts

"N"

NA

Not Available

NAC

NOx Adsorber Catalyst

NCA

No Color Available (Wiring Diagrams)

NGS

New Generation Star

N.m

Newton Meter

No.

Number

Nos.

Numbers

NOx

Oxides of Nitrogen

"O"

O₂

Oxygen

OBD

On-Board Diagnostics

OC

Oxidation Catalyst

OD

Overdrive

O.D.

Outside Diameter

OHC

Overhead Camshaft

OSS

Output Speed Sensor

O/S

Oversize

OZ.

Ounce

OZS.

Ounces

"P"**"P"**

Park

P/C

Printed Circuit

PCM

Powertrain Control Module

PCS

Purge Control Solenoid

PC-SOL

Purge Control Solenoid

PCV

Positive Crankcase Ventilation

PFI

Port Fuel Injection

PGM-FI

Programmed Fuel Injection

PID

Parameter Identification

PIP

Profile Ignition Pick-up

PNP

Park Neutral Position Switch

P/N

Park/Neutral

PRNDL

Park Reverse Neutral Drive Low

PROM

Programmable Read-Only Memory

psi

Pounds Per Square Inch

P/S

Power Steering

PSPS

Power Steering Pressure Switch

PTC

Positive Temperature Coefficient

PTO

Power Take-Off

Pts.

Pints

Pwr.

Power

"Q"

Qts.

Quarts

"R"

RABS

Rear Anti-Lock Brake System

RECIRC

Recirculation

RH

Right Hand

RPM

Revolutions Per Minute

RWAL

Rear Wheel Anti-Lock Brake

RWD

Rear Wheel Drive

"S"

SAS

Steering Angle Sensor

SBC

Single Bed Converter

SBEC

Single Board Engine Controller

SDARS

Satellite Digital Audio Radio Service

SES

Service Engine Soon

SFI

Sequential (Port) Fuel Injection

SIL

Shift Indicator Light

SIR

Supplemental Inflatable Restraint

SOHC

Single Overhead Cam

SOL or Sol.

Solenoid

SPFI

Sequential Port Fuel Injection

SPK

Spark Control

SPOUT

Spark Output

SRI

Service Reminder Indicator

SRS

Supplemental Restraint System (Air Bag)

STAR

Self-Test Automatic Readout

STO

Self-Test Output

SUB-O₂

Sub Oxygen Sensor

Sw.

Switch

Sys.

System

"T"

TAB

Thermactor Air By-Pass

TAC

Throttle Actuator Module

TAD

Thermactor Air Diverter

TBC

Body Control Module (General Motors)

TBI

Throttle Body Injection

TCC

Torque Converter Clutch

TDC

Top Dead Center

Temp.

Temperature

TFI

Thick Film Ignition

THERMAC

Thermostatic Air Cleaner

TPM

Tire Pressure Monitor

TPMS

Tire Pressure Monitor System

TPS

Throttle Position Sensor/Switch

TS

Temperature Sensor

TV

Therموالve

TWC

Three-Way Catalyst

"V"

V

Valve

Vac.

Vacuum

VAF

Vane Airflow

VAPS

Variable Assist Power Steering

VCC

Viscous Converter Clutch

VCRM

Variable Control Relay Module

VIN

Vehicle Identification Number

VM

Vacuum Modulator

Volt.

Voltage

VOM

Volt-Ohmmeter (Analog)

VRV

Vacuum Regulator Valve

VSS

Vehicle Speed Sensor

VSV

Vacuum Switching Valve

"W"

W/

With

W/O

Without

WAC

Wide Open Throttle A/C Switch

WOT

Wide Open Throttle

Article GUID: A00002370

GENERAL INFORMATION

Dangers, Warnings, and Cautions - Volt

INTRODUCTION

DEFINITION OF DANGER, WARNING, CAUTION, AND NOTE

The diagnosis and repair procedures in a GM Service Manual contain both general and specific Dangers, Warnings, Cautions, Notes or Important. GM is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle, however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner. Dangers, Warnings, Cautions and Notes or Important are elements designed to prevent these hazards, however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury or death to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components.
- Any warning or caution that appears in this service category is referenced from the individual service categories.

DANGER Defined

When encountering a DANGER, you will be asked to take a necessary action or not to take a prohibited action. If a DANGER is not heeded, the following consequences may occur:

- Serious bodily injury or death to the technician
- Serious bodily injury or death to other technicians in the workplace area

WARNING Defined

When encountering a WARNING, you will be asked to take a necessary action or not to take a prohibited action. If a WARNING is not heeded, the following consequences may occur:

- Serious bodily injury to the technician
- Serious bodily injury to other technicians in the workplace area
- Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired

CAUTION Defined

CAUTIONS call special attention to a necessary action or to a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

- Damage to the vehicle

- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair
- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids

NOTE or IMPORTANT Defined

NOTE and IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. NOTE or IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

ABS COMPONENT HANDLING WARNING

WARNING: Certain components in the Antilock Brake System (ABS) are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those components with approved removal and installation procedures should be serviced.

ACTIONS TO TAKE WHEN WORKING WITH FUEL WARNING

WARNING: Fuel Vapors can collect while servicing fuel system parts in enclosed areas such as a trunk. To reduce the risk of fire and increased exposure to vapors:

- Use forced air ventilation such as a fan set outside of the trunk.
- Plug or cap any fuel system openings in order to reduce fuel vapor formation.
- Clean up any spilled fuel immediately.
- Avoid sparks and any source of ignition.
- Use signs to alert others in the work area that fuel system work is in process.

APPROVED EQUIPMENT FOR COLLISION REPAIR WARNING

WARNING: To avoid personal injury when exposed to welding flashes or to galvanized (Zinc Oxide) metal toxic fumes while grinding/cutting on any type of metal or sheet molded compound, you must work in a properly ventilated area, wearing an approved respirator, eye protection, earplugs, welding gloves, and protective clothing. In addition when grinding aluminum components, always use an extraction system to remove high dust concentration due to risk of explosion.

ASSISTANT DRIVING WARNING

WARNING: An assistant should drive the vehicle while the technician checks for the location of the reported condition. Otherwise, personal injury could result.

BATTERY DISCONNECT WARNING

WARNING: Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.

For Vehicles equipped with OnStar® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStar® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStar® module). Do not disconnect the main vehicle battery or remove the OnStar® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStar® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStar® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

BRAKE DUST WARNING

WARNING: Avoid taking the following actions when you service wheel brake parts:

- Do not grind brake linings.
- Do not sand brake linings.
- Do not clean wheel brake parts with a dry brush or with compressed air.

Some models or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

BRAKE FLUID IRRITANT WARNING

WARNING: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- If ingested - consult a physician immediately.

CHECKING HOT TRANSMISSION FLUID THROUGH DRAIN PLUG HOLE WARNING

WARNING: The engine must be running when the transmission fluid fill plug is removed, or excessive fluid loss will occur. Transmission fluid may be hot. Since the actual fluid level is unknown, stand clear when removing the fill plug. Have a container ready to capture any lost fluid. Do not turn the engine off with the fill plug removed, as you can be injured by hot transmission fluid being expelled out of the oil fill opening.

CLEANING SOLVENT WARNING

WARNING: Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin.

COLLISION SECTIONING WARNING

WARNING: Sectioning should be performed only in the recommended areas. Failure to do so may compromise the structural integrity of the vehicle and cause personal injury if the vehicle is in a collision.

CRACKED WINDOW WARNING

WARNING: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

DEFROSTER OUTLET WARNING

WARNING: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

DIESEL/GASOLINE VAPORS WARNING

WARNING: Fuel/gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

EXHAUST SERVICE WARNING

WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool.

EXPRESS WINDOW DOWN WARNING

WARNING: Disconnect the power window switch when working inside the door. When operated, the Express Up/Down Feature allows the door window to move very quickly, without stopping, which could cause personal injury.

EYE PROTECTION WARNING

WARNING: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

FOAM SOUND DEADENERS WARNING

WARNING: Foam sound deadeners must be removed from areas within 152.4 mm (6 in) of where flame is to be used for body repairs. When reinstalling foam sound deadeners, avoid inhaling fumes as bodily injury may result.

FUEL AND EVAPORATIVE EMISSION PIPE WARNING

WARNING: In order to reduce the risk of fire and personal injury observe the following items:

- Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes
- Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.
- Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.
- Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)

FUEL GAUGE LEAK WARNING

WARNING: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

FUEL PIPE FITTING WARNING

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

FUEL STORAGE WARNING

WARNING: Do not drain the fuel into an open container. Never store the fuel in an open container due to the possibility of a fire or an explosion.

FUEL VAPORS IN EVAPORATIVE EMISSION COMPONENTS WARNING

WARNING: Do not breathe the air through the EVAP component tubes or hoses. The fuel vapors inside the EVAP components may cause personal injury.

GLASS AND SHEET METAL HANDLING WARNING

WARNING: When working with any type of glass or sheet metal with exposed or rough edges, wear approved safety glasses and gloves in order to reduce the chance of personal injury.

HALOGEN BULB WARNING

WARNING: Halogen bulbs contain gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn off the lamp switch and allow the bulb to cool before changing the bulb.
- Leave the lamp switch OFF until the bulb change is complete.
- Always wear eye protection when changing a halogen bulb.
- Handle the bulb only by its base. Avoid touching the glass.
- Keep dirt and moisture off the bulb.
- Properly dispose of the used bulb.
- Keep halogen bulbs out of the reach of children.

HOOD HOLD-OPEN DEVICE WARNING

WARNING: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.

HOT EXHAUST SYSTEM WARNING

WARNING: While engine is operating, the exhaust system will become extremely hot. To prevent burns avoid contacting a hot exhaust system.

MOVING PARTS AND HOT SURFACES WARNING

WARNING: Avoid contact with moving parts and hot surfaces while working around a

running engine in order to prevent physical injury.

PROTECTIVE GOGGLES AND GLOVE WARNING

WARNING: Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.

RELIEVING FUEL PRESSURE WARNING

WARNING: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

ROAD TEST WARNING

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

SAFETY GLASSES AND COMPRESSED AIR WARNING

WARNING: Wear safety glasses when using compressed air in order to prevent eye injury.

SAFETY GLASSES WARNING

WARNING: Wear safety glasses in order to avoid eye damage.

SAFETY GOGGLES AND FUEL WARNING

WARNING: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

SIR DEPLOYED INFLATOR MODULES ARE HOT WARNING

WARNING: After deployment, the metal surfaces of the SIR component may be very hot. To help avoid a fire or personal injury:

- Allow sufficient time for cooling before touching any metal surface of the SIR component.
- Do not place the deployed SIR component near any flammable objects.

SIR INFLATABLE MODULE DEPLOYMENT OUTSIDE VEHICLE WARNING

WARNING: When you are deploying an inflator module for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

SIR INFLATOR MODULE DISPOSAL WARNING

WARNING: In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflator module as normal shop waste. Undeployed inflator modules contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed inflator module. Failure to observe the following disposal methods may be a violation of appropriate country, regional or local laws.

SIR INFLATOR MODULE HANDLING AND STORAGE WARNING

WARNING: When carrying an undeployed inflator module:

- Do not carry the inflator module by the wires or connector.
- Make sure the air bag opening points away from you.

When storing an undeployed inflator module:

- Make sure the air bag opening points away from the surface on which the inflator module rests.
- Provide free space for the air bag to expand in case of an accidental deployment.
- When storing a steering column, do not rest the column with the air bag opening facing down and the column vertical. Lay the column on its side.

Failure to observe these guidelines may result in personal injury.

SIR SEATBELT PRETENSIONER HANDLING WARNING

WARNING: When carrying an undeployed inflatable restraint seat belt retractor pretensioner:

- Do not carry the seat belt pretensioner by the seat belt webbing or pigtail connector, if equipped.
- Carry the seat belt pretensioner by the housing, keeping hands and fingers away from the seat belt webbing.
- Make sure the opening, from which the seat belt webbing extends, faces downward and the seat belt webbing hangs freely.

Failure to observe these guidelines may result in personal injury.

SIR SPECIAL TOOL WARNING

WARNING: Failure to observe the special tool recommendations and instructions could

cause SIR deployment, personal injury, or unnecessary SIR system repairs.

SIR WARNING

WARNING: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR) System. Failure to follow the correct procedure could cause the following conditions:

- Air bag deployment
- Personal injury
- Unnecessary SIR system repairs

In order to avoid the above conditions, observe the following guidelines:

- Refer to Master Electrical Components List in order to determine if you are performing service on or near the SIR components or the SIR wiring.
- If you are performing service on or near the SIR components or the SIR wiring, disable the SIR system. Refer to Disabling the SIR System.

STEERING ANGLE SENSOR INITIALIZATION WARNING

WARNING: For vehicles with electric power steering (EPS) and without a vehicle stability enhancement program, the steering angle sensor **MUST** always be initialized after the battery has been disconnected. Failure to initialize the steering angle sensor could limit the operation of the EPS system and result in personal injury.

To ensure proper initialization of the EPS system, do the following:

1. The engine should be on with the vehicle stationary.
2. Turn the steering wheel counterclockwise until it stops.
3. Turn the steering wheel clockwise until it stops.

TORQUE-TO-YIELD FASTENER WARNING

WARNING: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fasteners could cause damage to the vehicle, component, or bodily injury.

TRANSMISSION SHIFT CONTROL WARNING

WARNING: After installing the transmission range selector shift cable, pull up and push down on **ALL** connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

WINDOW RETENTION WARNING

WARNING: When replacing stationary windows, only use a single component adhesive kit, or an adhesive system meeting GM Specifications, to maintain original installation integrity. Failure to use the single component adhesive kit will result in poor retention of the window which may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

WORK STALL TEST WARNING

WARNING: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:
 - Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.
 - If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.
 - All persons should stay clear of the rotating components and the balance weight areas in order to avoid possible personal injury.
 - When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and the transmission.
- When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:
 - Support the suspension at normal ride height.
 - Do not apply the brake with the brake rotors removed.
 - Do not place the transmission in PARK with the drive axles spinning.
 - Turn Off the ignition in order to stop the powertrain components from spinning.
- When running an engine in the work stall, use the exhaust removal system to prevent breathing dangerous gases.

AIR IN THE POWER STEERING SYSTEM CAUTION

CAUTION: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

AVOID CHIPPING OR SCRATCHING THE COATING CAUTION

CAUTION: Care should be taken to avoid chipping or scratching the coating when handling the suspension coil spring. Damage to the coating can cause

premature failure.

BALL STUD REMOVAL CAUTION

CAUTION: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result.

BATTERY ENERGY CONTROL MODULE CONNECTOR CAUTION

CAUTION: The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:

1. Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.
2. Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.
3. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.

BELT DRESSING CAUTION

CAUTION: Do not use belt dressing on the drive belt. Belt dressing causes the breakdown of the composition of the drive belt. Failure to follow this recommendation will damage the drive belt.

BRAKE CALIPER CAUTION

CAUTION: Support the caliper with a piece of wire to prevent damage to the brake line.

BRAKE FLUID EFFECTS ON PAINT AND ELECTRICAL COMPONENTS CAUTION

CAUTION: Avoid spilling brake fluid onto painted surfaces, electrical connections, wiring, or cables. Brake fluid will damage painted surfaces and cause corrosion to electrical components. If any brake fluid comes in contact with painted surfaces, immediately flush the area with water. If any brake fluid comes in contact with electrical connections, wiring, or cables, use a clean shop cloth to wipe away the fluid.

CLEAN, DRY, LOW PRESSURE GAS SOURCE CAUTION

CAUTION: Use the Evaporative Emission (EVAP) System Tester GE 41413-A in order to provide a clean, dry, low pressure nitrogen gas source. Do not substitute any other pressurized source, gas or otherwise. Damage may result to the EVAP system, test equipment or cause a safety risk.

CLEARCOAT/ULTRAVIOLET SCREENERS CAUTION

CAUTION: Removing more than 0.5 mils of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

COLLISION REPAIR ANCHORING CAUTION

CAUTION: Proper anchoring of the vehicle is required before pulling on the vehicle structure. The vehicle must be properly anchored at all four corners of the passenger compartment, to keep the HV battery pack from being damaged during the repair. Removal of the HV battery pack is recommended, if the vehicle can not be properly anchored.

COMPONENT FASTENER TIGHTENING CAUTION

CAUTION: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

CRANKSHAFT POSITION SENSOR RELUCTOR RING CAUTION

CAUTION: Do not allow the crankshaft position sensor reluctor ring to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft position sensor reluctor ring. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

DRIVE AXLE CAUTION

CAUTION: Support the lower control arms in the normal horizontal position in order to avoid damage to the drive axles. Do not operate the vehicle in gear with the wheels hanging down at full travel.

ENGINE COOLANT THERMOSTAT HOUSING CAUTION

CAUTION: Use care when performing this procedure. Use of excessive force may damage the coolant thermostat.

EXTERIOR TRIM EMBLEM REMOVAL CAUTION

CAUTION: Use a plastic, flat-bladed tool to prevent paint damage when removing an emblem/name plate.

FASTENER CAUTION

CAUTION: Use the correct fastener in the correct location. Replacement fasteners must be

the correct part number for that application. Do not use paints, lubricants, or corrosion inhibitors on fasteners, or fastener joint surfaces, unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

FUEL AND EVAPORATIVE EMISSION HOSE/PIPE CONNECTION CLEANING CAUTION

CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- The fuel pipe connections
- The hose connections
- The areas surrounding the connections

HEATED OXYGEN AND OXYGEN SENSOR CAUTION

CAUTION: Do not remove the pigtail from either the heated oxygen sensor (HO2S) or the oxygen sensor (O2S). Removing the pigtail or the connector will affect sensor operation.

Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged..

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.
- Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Ensure the sensor or vehicle lead wires are not bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead

wire.

- Do not remove or defeat the oxygen sensor ground wire, where applicable. Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.
- Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using an appropriate crimp and splice seals terminal repair kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.

HEATED OXYGEN SENSOR RESISTANCE LEARN RESET CAUTION

CAUTION: When replacing the HO2S perform the following:

- A code clear with a scan tool, regardless of whether or not a DTC is set
- HO2S heater resistance learn reset with a scan tool, where available

Perform the above in order to reset the HO2S resistance learned value and avoid possible HO2S failure.

HVAC MODULE DRAIN TUBE CAUTION

CAUTION: Always ensure the HVAC module drain tube is properly installed and secure following a repair. Residual moisture/water can collect inside the HVAC module. The residual moisture or water should not contact electrical modules, electrical connections, wiring, cables or carpeting. Use clean and absorbent shop clothes to protect these components while removing or installing the HVAC module drain tube and/or HVAC module. Moisture/water is a by-product of normal A/C system operation and can result in interior odors or corrosion/damage to electrical components.

INSTALLING HOSES WITHOUT TWISTS OR BENDS CAUTION

CAUTION: The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

PAINT DAMAGE CAUTION

CAUTION: To avoid paint damage, protect the area surrounding the part which you are removing or installing.

PIPE WRENCH POSITIONING CAUTION

CAUTION: The pipe wrench must be placed at the valve end of the steering gear and positioned up against the inner tie rod housing. Placing the pipe wrench in any other location will cause damage to the steering gear.

POWER STEERING HOSE DISCONNECTED CAUTION

CAUTION: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, plug or cap all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

RETAINING RING REUSE CAUTION

CAUTION: Do not reuse the retaining ring. Install a NEW retaining ring. Reusing the old retaining ring may cause damage to the clutch assembly.

SEALANT CAUTION

CAUTION: Do not allow the RTV sealant to enter any blind threaded hole. RTV sealant that is allowed to enter a blind threaded hole can cause hydraulic lock of the fastener when the fastener is tightened. Hydraulic lock of a fastener can lead to damage to the fastener and/or the components. Hydraulic lock of a fastener can also prevent the proper clamping loads to be obtained when the fastener is tightened. Improper clamping loads can prevent proper sealing of the components allowing leakage to occur. Preventing proper fastener tightening can allow the components to loosen or separate leading to extensive engine damage.

SEAL REUSE CAUTION

CAUTION: Do not reuse the seals. Replace with NEW seals. Reusing old seals may cause transmission damage.

SILICON CONTAMINATION OF HEATED OXYGEN SENSORS CAUTION

CAUTION: Contamination of the oxygen sensor can result from the use of an inappropriate RTV sealant (not oxygen sensor safe) or excessive engine coolant or oil consumption. Remove the HO2S and visually inspect the portion of the sensor exposed to the exhaust stream in order to check for contamination. If contaminated, the portion of the sensor exposed to the exhaust stream will have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage (rich exhaust indication). The control module will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem. Eliminate the source of contamination before replacing the oxygen sensor.

STEERING COLUMN IN LOCK POSITION CAUTION

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The steering shaft coupling
- The intermediate shaft(s)

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

STEERING GEAR PRELOAD ADJUSTMENT CAUTION

CAUTION: Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

STEERING WHEEL IN THE FULL TURN POSITION CAUTION

CAUTION: Do not hold the steering wheel in the full turn position longer than 5 seconds, as damage to the steering pump may result.

STEERING WHEEL STRAIGHT AND COLUMN LOCKED CAUTION

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

TAPE CORNERS OF PANEL CAUTION

CAUTION: When removing body panels, apply tape to corners of panel and adjacent surfaces to help prevent paint damage.

TEST PROBE CAUTION

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse

block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the EL-35616 GM Approved Terminal Test Probe Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the EL-35616 GM Approved Terminal Test Probe Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the EL-35616 GM Approved Terminal Test Probe Kit label on the inside of the EL-35616 GM Approved Terminal Test Probe Kit for the correct adapter along with the connector end view.

THREE-WAY CATALYTIC CONVERTER DAMAGE CAUTION

CAUTION: In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.

TORQUE REACTION AGAINST TIMING DRIVE CHAIN CAUTION

CAUTION: A wrench must be used on the hex of the camshaft when loosening or tightening in order to prevent component damage. Failure to prevent the torque reaction against the timing drive chain can lead to timing drive chain failure.

TORQUE-TO-YIELD FASTENER CAUTION

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

TRANSMISSION FLUID VENT CAP REMOVAL CAUTION

CAUTION: The fluid vent cap must be removed before checking the fluid level, in order to ensure the proper level. Improper fluid level may damage the transmission.

TRANSMISSION OVERFILL CAUTION

CAUTION: Check the transmission fluid level immediately after adding fluid and before vehicle operation. Do not overfill the transmission. An overfilled transmission may result in foaming or fluid to be expelled out the vent tube when the vehicle is operated. Overfilling will result in possible damage to the transmission.

USING PROPER POWER STEERING FLUID CAUTION

CAUTION: When adding fluid or making a complete fluid change, always use the proper

power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

VALVE LIFTER PRIMING CAUTION

CAUTION: Ensure each valve lifter is filled with clean engine oil and the valve lifter does not tip over (plunger down) before the installation of the valve lifters. The loss of oil in the valve lifter lower pressure chamber or the dry stroking/cycling of the valve lifter plunger will allow air to travel into the high pressure chamber of the valve lifter. Air in the high pressure chamber of the valve lifter may not be purged causing extensive engine component damage.

WINDOW EDGE DAMAGE CAUTION

CAUTION: Avoid damage to the window from impacting objects due to an exposed edge. The window must be 1 mm (0.025 in) below the surface of the sheet metal to avoid window damage.

Article GUID: A00884631

GENERAL INFORMATION

Drive Axle Noise Diagnosis

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

UNRELATED NOISES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires and other parts of the vehicle. Make sure that cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any parts.

NON-DRIVE AXLE NOISES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and trim moldings.

In certain conditions, the pitch of exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow tires, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings can also cause a whistling or whining noise. Ensure that none of these components are causing the noise before disassembling the drive axle.

GEAR NOISE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear

damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

CHUCKLE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough to cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

KNOCK

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

CLUNK

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in drive condition. Hold a chalk marker on side of tire about 12" from

center of wheel. Turn wheel in the opposite direction until it is again felt to be in drive condition.

3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, clunk will not be eliminated by overhauling drive axle.

BEARING WHINE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at driveshaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

BEARING RUMBLE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of driveshaft speed.

CHATTER ON TURNS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

This is a condition where the whole front or rear vibrates when vehicle is moving. The vibration is easily felt and heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates the chatter.

AXLE SHAFT NOISE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes. Noise will persist with transmission in neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts and replace axle bearings. Re-evaluate vehicle for noise before removing any internal components.

VIBRATION

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
 - Resonance vibrations of the body and frame structures caused by rotating of unbalance parts.
 - Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.
-

Article GUID: A00002193

GENERAL INFORMATION

Electrostatic Discharge (ESD) Warning - Basic Information

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

INTRODUCTION

NOTE: This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. [Fig. 1](#) may be used on schematics to indicate which components are ESD sensitive. See [Fig. 1](#). Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.



Fig. 1: Sample ESD Symbol

HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES

NOTE: This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1. Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2. Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3. DO NOT open the package of a new part until it is time to install the part.

4. Before removing the part from its package, ground the package to a known good ground source.

CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES

NOTE: This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.

1. Solid State circuits in electronic devices are shown greatly simplified in schematics. See [Fig. 2](#). Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.

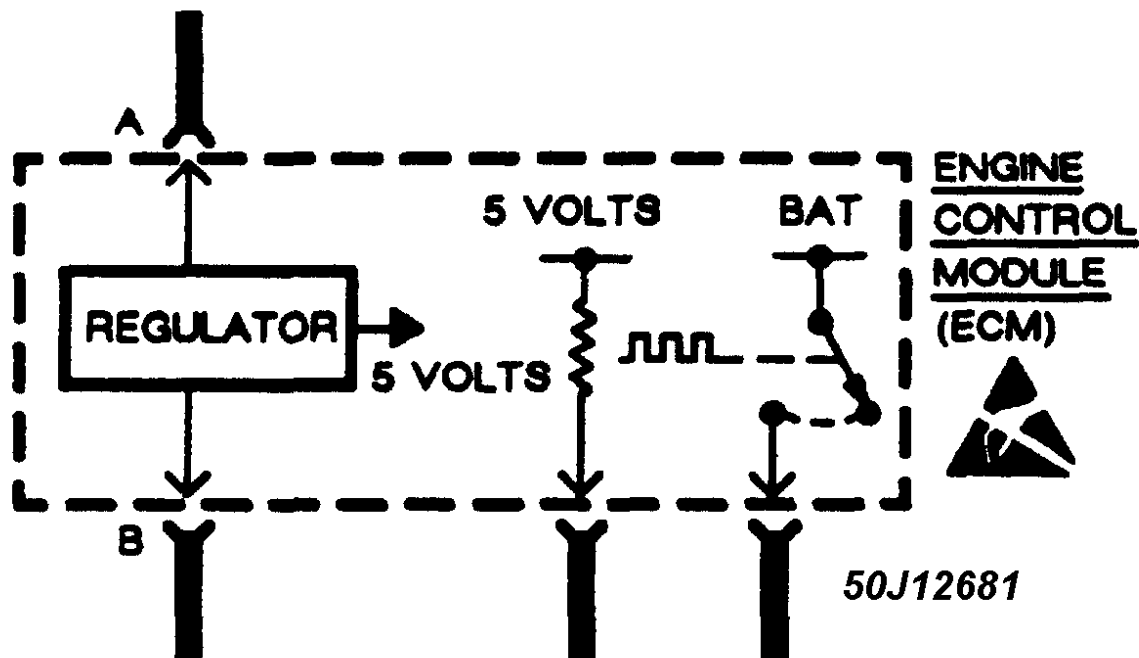


Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device

2. Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3. When using a voltmeter, be sure to connect the ground lead first.

EMISSION CONTROL ABBREVIATIONS

Gasoline & Diesel

"A"

A/C

Air Conditioning

A/C-ISUS

A/C Idle Speed-Up Solenoid

A/F

Air/Fuel

AAI

Air Assist Injector

ACL

Air Cleaner (Thermostatic Air Cleaner)

ACL-BMS

ACL Bimetallic Sensor

ACL-CKV

ACL Check Valve

ACL-DV

ACL Delay Valve

ACL-ESC

Electronic Spark Control

ACL-PVS

ACL Ported Vacuum Switch

ACL-RDV

ACL Reverse Delay Valve

ACL-RDVS

ACL Reverse Delay Valve (Single)

ACL-TCV

ACL Thermal Control Valve

ACL-TS

ACL Temperature Sensor

ACL-TSOV

ACL Temperature Sensor Override Valve

ACL-TVS

ACL Thermal Vacuum Switch

ACL-TVV

ACL Thermal Vacuum Valve

ACL-VCDV

ACL Vacuum Control Delay Valve

ACL-VCV

ACL Vacuum Control Valve

ACL-VM

ACL Vacuum Motor

ACL-WP

ACL Wax Pellet Type Motor

ADS

Anti-Dieseling Solenoid

AFR

Air/Fuel Ratio Sensor

AFS

Air/Fuel Ratio Sensor

AIH

Air Intake Heaters

AIH-TS

AIH Temperature Sensor

AIR

Air Injection System

AIS

Air Injection System

AIS-ACV

AIS Air Control Valve

AIS-AF

Air Injection System Air Filter

AIS-AMV

AIS Air Management Valve

AIS-ASV

AIS Air Switching Valve

AIS-BPV

AIS By-Pass Valve

AIS-CC

AIS Computer Controlled

AIS-CKV

AIS Check Valve

AIS-CSV

AIS Control Solenoid Valve

AIS-CV

AIS Combination Valve

AIS-DV

AIS Diverter Valve

AIS-IMCV

AIS Intake Manifold Change-Over Valve

AIS-MCV

AIS Manifold Change-Over Valve

AIS-OWV

AIS One Way Valve

AIS-PAF

AIS Pulse Air Feeder

AIS-PM

AIS Pump Motor

AIS-PV

AIS Pneumatic Valve

AIS-RV

AIS Relief Valve

AIS-SAV

AIS Secondary Air Valve

AIS-SOL

AIS Solenoid

AIS-SV

AIS Solenoid Valve

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIS-VT

AIS Vacuum Tank

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIV

Air Injection Valve

AIV-SOL

Air Injection Valve Solenoid

ALVW

Adjusted Loaded Vehicle Weight

AMV

Air Management Valve

AP

Air Pump Injection System

AP-ABV

Air Pump Air Bypass Valve

AP-ACV

AP Air Control Valve

AP-AMV

AP Air Management Valve

AP-ASRV

AP Air Switching Relief Valve

AP-ASS

AP Air Switching Solenoid

AP-ASV

AP Air Switching Valve

AP-BP

AP By-Pass Valve

AP-BPV

AP By-Pass Valve

AP-CKV

AP Check Valve

AP-CS

AP Control Solenoid

AP-CV

AIR Cut-Off Valve

AP-DCTO

AP Dual Coolant Temperature Override

AP-DLY

AP Delay Valve

AP-DV

AP Diverter Valve

AP-EADV

AP Electric Air Control Diverter Valve

AP-EAMR

AP Electric Air Management Relay

AP-EAMS

AP Electric Air Management Solenoid

AP-EAP

AP Electric Air Pump

AP-EC

AP Electromagnetic Clutch

AP-ERLY

AP Electric Air Pump Relay

AP/PAIR

Pulsed Secondary Air Injection

AP-RDV

AP Reed Valve

AP-RV

AP Relief Valve

AP-SOL

AP Solenoid

AP-SOV

AP Shut-Off Valve

AP-SV

AP Solenoid Valve

AP-SWV

AP Switchover Valve

AP-TV

AP Transmitting Valve

AP-VCS

AP Vacuum Control Solenoid

AP-VCSV

AP Vacuum Controlled Air Shut-Off Valve

AP-VCV

AP Vacuum Control Valve

AP-VSV

AP Vacuum Switching Valve

A/T

Automatic Transmission

ATCV

Air Temperature Control Valve

"B"

BP/EGR

Backpressure EGR System

BP/EGR-BPS

BP/EGR Backpressure Sensor

BP/EGR-BPT

BP/EGR Backpressure Transducer

BP/EGR-BPV

BP/EGR Backpressure Valve

BP/EGR-BS

BP/EGR Bleed Solenoid

BP/EGR-BVSV

BP/EGR Bimetallic Vacuum Switching Valve

BP/EGR-C

BP/EGR Controller

BP/EGR-CLR

BP/EGR Cooler

BP/EGR-CS

BP/EGR Control Solenoid

BP/EGR-CTO

BP/EGR Coolant Temperature Override

BP/EGR-CV

BP/EGR Control Valve

BP/EGR-DCTO

BP/EGR Dual Coolant Temperature Override

BP/EGR-DS

BP/EGR Diagnostic Solenoid

BP/EGR-DSOL

BP/EGR Duty Solenoid

BP/EGR-DTVSW

BP/EGR Distributor Thermal Vacuum Switch

BP/EGR-DV

BP/EGR Delay Valve

BP/EGR-EET

BP/EGR Electric Transducer

BP/EGR-EPV

BP/EGR External Pressure Valve

BP/EGR-FDV

BP/EGR Forward Delay Valve

BP/EGR-LCV

BP/EGR Vacuum Control Valve

BP/EGR-LC

BP/EGR Load Control Valve

BP/EGR-OVS

BP/EGR Orifice Valve Sensing

BP/EGR-PS

BP/EGR Position Sensor

BP/EGR-PT

BP/EGR Pressure Transducer

BP/EGR-PVS

BP/EGR Ported Vacuum Switch

BP/EGR-RES

BP/EGR Reservoir

BP/EGR-RST

BP/EGR Restrictor

BP/EGR-SOL

BP/EGR Solenoid

BP/EGR-TCTVS

BP/EGR Torque Converter Thermal Vacuum Switch

BP/EGR-TCV

BP/EGR Thermal Control Valve

BP/EGR-TCVLV

BP/EGR Temperature Control Valve

BP/EGR-T

BP/EGR Temperature Sensor

BP/EGR-TS

BP/EGR Temperature Sensor

BP/EGR-TVC

BP/EGR Thermal Control Valve

BP/EGR-TVS

BP/EGR Thermal Vacuum Switch

BP/EGR-TVV

BP/EGR Thermal Vacuum Valve

BP/EGR-VC

BP/EGR Diagnostic Valve

BP/EGR-VCV

BP/EGR Vacuum Control Valve

BP/EGR-VM

BP/EGR Vacuum Modulator

BP/EGR-VRV

BP/EGR Vacuum Regulator Valve

BP/EGR-VS

BP/EGR Vacuum Switch

BP/EGR-VSOL

BP/EGR Vent Solenoid

BP/EGR-VSV

BP/EGR Vacuum Switching Valve

"C"

C-4

Computer Controlled Catalytic Converter

CAC

Charge Air Cooler

CAS

Clean Air System

CB

Crankcase Breather

CB-VC

Crankcase Breather-Vapor Canister

CBPS

Coasting By-Pass System

CBVC

Crankcase Breather Vapor Canister

CCIEV

Coolant Controlled Idle Enrichment Valve

CCO

Computerized Engine Controls

CCS

Controlled Combustion System

CCV

Closed Crankcase Ventilation

CD-REGVLV

Crankcase Depression Regulator Valve

CDRV

Crankcase Depression Relief Valve

CEAB

Cold Engine Air Bleed

CEAB-TVS

CEAB Thermal Vacuum Switch

CEAB-TVV

CEAB Thermal Vacuum Valve

CEC

Computerized Engine Controls

CESS

Cold Engine Sensor Switch

CETS

Cold Engine Temperature Switch

CFI

Continuous Fuel Injection

CMH

Cold Mixture Heater

CNG

Compressed Natural Gas

CO

Carbon Monoxide

CO2

Carbon Dioxide

CPI

Central Port Injection

CRV

Coasting Richer Valve

CSI

Central Sequential Injection

CTAVS

Cold Temperature Activated Vacuum System

CTOX

Continuous Trap Oxidizer

CVOT

Crankcase Ventilation Orifice Tube

CVOT-CKV

Crankcase Ventilation Orifice Tube Check Valve

"D"

DCLV

Deceleration Valve

DCS

Deceleration Control System

DDI

Direct Diesel Injection

DFI

Direct Diesel Injection

DI

Direct Injection

DKV

Deceleration Kick Valve

DLCV

Deceleration Mixture Control Valve

DM-TL

Diagnostic Module Tank Leakage

DMS

Dual Manifold System

DOC

Diesel Oxidation Catalyst

DOHC

Dual Overhead Cam

DPD

Dual Point Distributor

DPF

Diesel Particulate Filter

DPF/TWC

Combination Diesel Particulate Filter and Three Way Catalyst

DPFE

Differential Pressure Feedback EGR Valve

DPFEGR

Differential Pressure Feedback EGR Valve

DTM

Deceleration Throttle Modulator

"E"

EAIR

Electric Air Injection System

EAIR-DV

EAIR Diverter Valve

EC

Computerized Engine Controls

ECM

Electronic Control Module

ECU

Electronic Control Unit

EDC

Electronic Diesel Control

EDS

Electronic Diesel System

EEC

Electronic Engine Control

EFE

Early Fuel Evaporation

EFE-CKV

EFE Check Valve

EFE-CV

EFE Control Valve

EFE-DTVS

EFE Delay Thermal Vacuum Switch

EFE-HTR

EFE Heater

EFE-HCV

EFE Heat Control Valve

EFE-OTS

EFE Oil Temperature Switch

EFE-PTC

EFE Positive Temperature Coefficient (Intake Heater Grid)

EFE-PVS

EFE Ported Vacuum Switch

EFE-SOL

EFE Solenoid

EFE-TVS

EFE Thermal Vacuum Switch

EFE-TVV

EFE Thermal Vacuum Valve

EFE-VSV

EFE Vacuum Switching Valve

EFI

Electronic Fuel Injection

EFI-MA

EFI Mass Airflow Sensor

EFI-MAF

EFI Mass Airflow Sensor

EGR

Exhaust Gas Recirculation System

EGR-BCS

EGR Boost Check Solenoid

EGR-BPBV

EGR By-Pass Backpressure Valve

EGR-BPT

EGR Backpressure Transducer

EGR-BPV

EGR By-Pass Valve

EGR-BS

EGR Bleed Solenoid

EGR-BSSV

EGR Boost Sensor Solenoid Valve

EGR-BV

EGR Bypass Valve

EGR-BVSV

EGR Bimetallic Vacuum Switching Valve

EGR-C

EGR Controller

EGR-CC

EGR Coolant Controlled

EGR-CLR

EGR Cooler

EGR-VSOL

EGR Vacuum Solenoid

EGR-CKV

EGR Check Valve

EGR-CS

EGR Control Solenoid

EGR-CSOL

EGR Cut-Off Solenoid

EGR-CSV

EGR Control Solenoid

EGR-CTO

EGR Coolant Temperature Override

EGR-CTS

EGR Charge Temperature Sensor

EGR-CTSW

EGR Charge Temperature Switch

EGR-CTTS

EGR Coolant Temperature Thermostat

EGR-CV

EGR Control Valve

EGR-CVCV

EGR Constant Vacuum Control Valve

EGR-CVS

EGR Control Vent Solenoid

EGR-DC

EGR Digital Control

EGR-DCTO

EGR Dual Coolant Temperature Override

EGR-DPFE

Differential Pressure Feedback EGR Sensor

EGR-DPFS

EGR Differential Pressure Feedback Sensor

EGR-DS

EGR Diagnostic Solenoid

EGR-DSOL

EGR Duty Solenoid

EGR-DTVS

EGR Delay Thermal Vacuum Switch

EGR-DTVSW

EGR Distributor Thermal Vacuum Switch

EGR-DV

EGR Delay Valve

EGR-EPRS

EGR Exhaust Pressure Regulator Solenoid

EGR-EPRV

EGR Exhaust Pressure Regulator Valve

EGR-EPV

EGR External Pressure Valve

EGR/EVAP-CSV

EGR/EVAP Control Solenoid Valve

EGR-EVR

EGR Vacuum Regulator

EGR-EVRV

EGR Electronic Vacuum Regulator Valve

EGR-FDV

EGR Forward Delay Valve

EGR-FJS

EGR Floor Jet System

EGR-FPS

EGR Feedback Pressure Sensor

EGR-LCV

EGR Load Control Valve

EGR-MAP

EGR Manifold Absolute Pressure Sensor

EGR-PFE

EGR-PFE Sensor

EGR-PS

EGR Position Sensor

EGR-PSW

EGR Pulse Switch

EGR-PVS

EGR Ported Vacuum Switch

EGR-REG

EGR Regulator

EGR-RES

EGR Reservoir

EGR-RST

EGR Restrictor

EGR-SC

EGR Signal Converter

EGR-SEC

EGR, Secondary

EGR-SEN

EGR Sensor

EGR-SM

EGR Stepper Motor

EGR-SOL

EGR Solenoid

EGR-SU

EGR Switchover Valve

EGR-SUB

Sub-EGR Valve

EGR-SV

EGR Switchover Valve

EGR-SVV

EGR Solenoid Vacuum Valve

EGR-T

EGR Temperature Sensor

EGR-TC

EGR Transmission Controlled

EGR-TCTVS

EGR Torque Converter Thermal Vacuum Switch

EGR-TCV

EGR Thermal Control Valve

EGR-TCVLV

EGR Temperature Control Valve

EGR-TRANS

EGR Transducer

EGR-TS

EGR Temperature Sensor

EGR-TSW

EGR Temperature Switch

EGR-TV

EGR Thermal Valve

EGR-TVD

EGR Throttle Valve Diaphragm

EGR-TVS

EGR Thermal Vacuum Switch

EGR-TVSOL

EGR Throttle Valve Solenoid

EGR-TVV

EGR Thermal Vacuum Valve

EGR-V

EGR Valve

EGR-VA

EGR Vacuum Amplifier

EGR-VCV

EGR Vacuum Control Valve

EGR-VM

EGR Vacuum Modulator

EGR-VR

EGR Vacuum Regulator

EGR-VRS

EGR Vacuum Regulator Solenoid

EGR-VRSV

EGR Vacuum Regulator Solenoid Valve

EGR-VRV

EGR Vacuum Regulator Valve

EGR-VS

EGR Vacuum Switch

EGR-VSDV

EGR Vacuum Switch Dump Valve

EGR-VSEN

EGR Vacuum Sensor

EGR-VSOL

EGR Vent Solenoid

EGR-VSS

EGR Vacuum Switching Solenoid

EGR-VST

EGR Vacuum Surge Tank

EGR-VSV

EGR Vacuum Switching Valve

EGR-VVCS

EGR Venturi Vacuum Control System

EGRB

EGR Boost Sensor

EGRC

EGR Control Solenoid

EGRC-BPT

EGR Control Backpressure Transducer

EGRC-SV

EGR Control Solenoid Valve

EHOC

Electronically Heated Oxidation Catalyst

EHTWC

Electronically Heated Three-Way Catalyst

EI

Electronic Ignition System

EIS

Electronic Ignition System

ELB

Electronic Lean Burn

EPR

Exhaust Pressure Regulator

EPR-SOL

EPR Solenoid

ESA

Electronic Spark Advance

ESIM

Evaporative System Integrity Monitor

EVAP

Fuel Evaporative System

EVAP-AAC

EVAP Auxiliary Air Control

EVAP-BPSV

EVAP By-Pass Solenoid Valve

EVAP-BVSV

EVAP Bimetallic Vacuum Switching Valve

EVAP-CAV

EVAP Canister Air Valve

EVAP-CCV

EVAP Control Canister Close Valve

EVAP-CCVSV

EVAP Control Canister Vent Shut Valve

EVAP-CCVVSV

EVAP Closed Canister Valve Vacuum Switching Valve

EVAP-CDCV

EVAP Canister Drain Cut Valve

EVAP-CKV

EVAP Check Valve

EVAP-CPCS

EVAP Canister Purge Control Solenoid

EVAP-CPCSV

EVAP Canister Purge Control Solenoid Valve

EVAP-CPCV

EVAP Canister Purge Control Valve

EVAP-CPRV

EVAP Canister Purge Regulator Valve

EVAP-CPSV

EVAP Canister Vent Shut Valve

EVAP-CPT

EVAP Canister Purge Timer

EVAP-CPTVS

EVAP Canister Purge Thermal Vacuum Switch

EVAP-CPV

EVAP Canister Vent Valve

EVAP-CPVCSV

EVAP Canister Purge Volume Control

EVAP-CPVCV

EVAP Canister Purge Volume Control Valve

EVAP-CPVDV

EVAP Canister Purge Vacuum Delay Valve

EVAP-CPVR

EVAP Canister Purge Valve Resonator

EVAP-CS

EVAP Control Solenoid

EVAP-CSPS

EVAP Control System Pressure Sensor

EVAP-CSPV

EVAP Canister Purge Valve

EVAP-CST

EVAP Canister Surge Tank

EVAP-CSV

EVAP Control Solenoid Valve

EVAP-CT

EVAP Catch Tank

EVAP-CV

EVAP Control Solenoid Valve

EVAP-CVCS

EVAP Canister Vent Control Solenoid

EVAP-CVCSV

EVAP Canister Vent Control Solenoid Valve

EVAP-CVCV

EVAP Canister Vent Control Valve

EVAP-CVS

EVAP Canister Vent Solenoid

EVAP-CVSV

EVAP Carburetor Vent Switching Valve

EVAP-CVV

EVAP Canister Vent Valve

EVAP-DCTO

EVAP Dual Coolant Temperature Override

EVAP-DF

EVAP Drain Filter

EVAP-DPS

EVAP Differential Pressure Sensor

EVAP-DV

EVAP-Drain Valve

EVAP-ESIM

Evaporative System Integrity Monitor

EVAP-EV

EVAP Emission Valve

EVAP-FBVV

EVAP Fuel Bowl Vent Valve

EVAP-FBVS

EVAP Fuel Bowl Vent Solenoid

EVAP-FCV

EVAP Fuel Cut Valve

EVAP-FLS

EVAP Fuel Level Sensor

EVAP-FOLV

EVAP Fuel Overflow Limiter Valve

EVAP-FR/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-FS

EVAP Flow Switch

EVAP-FSV

EVAP Flow Switchover Valve

EVAP-FTCV

EVAP Tank Pressure Control Valve

EVAP-FTEV

EVAP Fuel Tank EVAP Valve

EVAP-FTPCSV

EVAP Fuel Tank Pressure Control Solenoid Valve

EVAP-FTPS

EVAP Fuel Tank Pressure Sensor

EVAP-FTS

EVAP Fuel Temperature Sensor

EVAP-FVCV

EVAP Fuel Vapor Control Valve

EVAP-FVS

EVAP Fuel Vapor Separator

EVAP-FVTS

EVAP Fuel Vapor Temperature Sensor

EVAP-FVV

EVAP Fuel Vent Valve

EVAP-FVVV

EVAP Fuel Vapor Vent Valve

EVAP-FWV

EVAP Fuel Vent Valve

EVAP-IVS

EVAP Inner Vent Solenoid

EVAP-LDAF

EVAP Leak Detection Pump Air Filter

EVAP-LDP

EVAP Leak Detection Pump

EVAP-LDPAF

EVAP Leak Detection Pump Air Filter

EVAP-LDPF

EVAP Leak Detection Pump Filter

EVAP-LDPVV

EVAP Leak Detection Pump Vent Valve

EVAP-LSEP

EVAP Liquid Separator

EVAP-NVLD

EVAP Natural Vacuum Leak Detection

EVAP-ORVR

Evaporative On-Board Refueling Vapor Recovery System

EVAP-ORVRCV

Evaporative On-Board Refueling Vapor Recovery Check Valve

EVAP-ORVRFTVRV

EVAP-ORVR Fuel Tank Vapor Recirculation

EVAP-OVCV

EVAP Outer Vent Control Valve

EVAP-OWV

EVAP One-Way Valve

EVAP-PCDV

EVAP Purge Control Diaphragm Valve

EVAP-PCS

EVAP Purge Control Solenoid Valve

EVAP-PCSV

EVAP Purge Cut-Off Solenoid Valve

EVAP-PFS

EVAP Purge Flow Sensor

EVAP-PFSVVS

EVAP Purge Flow Switching Valve Vacuum Switching Valve

EVAP-PPS

EVAP Proportional Purge Solenoid

EVAP-PR

EVAP Purge Resonator

EVAP-PRRV

EVAP Pressure Relief Rollover Valve

EVAP-PRV

EVAP Pressure Relief Valve

EVAP-PS

EVAP Purge Solenoid

EVAP-PSOL

EVAP Purge Solenoid

EVAP-PSSV

EVAP Pressure Switching Solenoid

EVAP-PSVVS

EVAP Pressure Switching Valve Vacuum Switching Valve

EVAP-PV

EVAP Purge (Frequency) Valve

EVAP-PVS

EVAP Ported Vacuum Switch

EVAP-RV

EVAP Rollover Valve

EVAP-RV/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-RVSV

EVAP Rollover Vapor Separator Valve

EVAP-SNR

EVAP Canister Sensor

EVAP-SOL

EVAP Solenoid

EVAP-SOV

EVAP Shutoff Valve

EVAP-SSV

EVAP Shut-Off Solenoid Valve

EVAP-SV

EVAP Solenoid Valve

EVAP-TC

EVAP Trap Canister

EVAP-TS

EVAP Temperature Switch

EVAP-TPBPV

EVAP Tank Pressure By-Pass Valve

EVAP-TPCS

EVAP Tank Pressure Control Solenoid

EVAP-TPCV

EVAP Tank Pressure Control Valve

EVAP-TRWV

EVAP Tree-Way Valve

EVAP-TV

EVAP Thermal Valve

EVAP-TVS

EVAP Thermal Vacuum Switch

EVAP-TVV

EVAP Thermal Vacuum Valve

EVAP-TWV

EVAP Two-Way Valve

EVAP-VC

EVAP Vapor Canister

EVAP-VCAT

EVAP Vapor Canister Air Tank

EVAP-VCF

EVAP Vapor Canister Filter

EVAP-VCSV

EVAP Vapor Canister Shut-off Valve

EVAP-VCTV

EVAP Vacuum Control Valve

EVAP-VCV

EVAP Vacuum Canister Valve

EVAP-VCVS

EVAP Vapor Canister Vent Solenoid

EVAP-VLFR

EVAP Vent Line Flow Restrictor

EVAP-VM

EVAP Vacuum Motor

EVAP-VMV

EVAP Vapor Management Valve

EVAP-VPS

EVAP Vapor Pressure Sensor

EVAP-VPSVSV

EVAP Vapor Pressure Sensor Vacuum Switching Valve

EVAP-VS

EVAP Vacuum Sensor

EVAP-VSOL

EVAP Ventilation Solenoid

EVAP-VSOL/LDP

EVAP Ventilation Solenoid/Leak Detection Pump

EVAP-VST

EVAP Vacuum Surge Tank

EVAP-VSV

EVAP Vacuum Switching Valve

EVAP-VV

EVAP Ventilation Valve

EVRS

EGR Vacuum Regulator Solenoid

"F"

FBC

Feedback Carburetor

FCOV

Fuel Change Over Valve

FF

Flex Fuel

FF-CKV

Fuel Fill Check Valve

FF-FCV

Fuel Tank Fuel Cut-Off Valve

FF-FLVV

Fuel Tank Fill Limit Vent Valve

FFC-PVRV

Fuel Fill Cap Pressure Vacuum Relief Valve

FGOV

Fuel Gravity/Overflow Valve

FGVV

Fuel Gravity Vent Valve

FI

Fuel Injected

FICD

Fast Idle Control Device

FISR

Fast Idle Solenoid Relay

FLV

Fill Limit Valve

FLVV

Fill Limiting Vent Valve

FP-CKV

Fill Pipe Check Valve

FP-RV

Fill Pipe Rollover Valve

FR

Fill Pipe Restrictor

FT-FLVV

Fuel Tank Fill Limit Vent Valve

FT-GVV

Fuel Tank Grade Vent Valve

FT-OPRV

Fuel Tank Over Pressure Vent Valve

FT-PCV

Fuel Tank Pressure Control Valve

FT-VCV

Fuel Tank Vapor Control Valve

FT-VRV

Fuel Tank Vapor Recirculation Valve

FTCV

Fuel Tank Check Valve

FTDPS

Fuel Tank Differential Pressure Sensor

FTEV

Fuel Tank EVAP Valve

FTPS

Fuel Tank Pressure Sensor

FTT

Fuel Tank Temperature Sensor

FTTS

Fuel Tank Temperature Sensor

FTV/LSV

Fuel Tank Vapor/Liquid Separation Valve

FTVCV

Fuel Tank Vapor Control Valve

FTVPRV

Fuel Tank Ventilation Pressure Retention Valve

FVPS

Fuel Vapor Pressure Sensor

FTVV

Fuel Tank Vent Valve

FVV

Fuel Vapor Valve

"G"

GVWR

Gross Vehicle Weight Rating

"H"

HAC

High Altitude Compensator

HAFS

Heated Air Fuel Ratio Sensor

HAI

Hot Air Intake

HAS

High Altitude System

HC

Hydrocarbons

HCAC-VSV

Hydrocarbon Absorber Catalyst Vacuum Switching Valve

HDC

Heavy Duty Cooling

HDC-CTO

HDC Coolant Temperature Override

HFM-SFI

Hot Film Engine Management SFI

HIC

Hot Idle Compensator

HIM

Heated Intake Manifold

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HP

Horsepower

HPCA

Housing Pressure Cold Advance

HSC

High Swirl Combustion

"I"

IAC

Idle Air Control Valve

IACV-SW

IACV Switch

ICOM

Idle Compensator

IDI

Indirect Diesel Injection

IES

Idle Enrichment System

IMCO

Improved Combustion System

"K"

KS

Knock Sensor

"L"

LH-SFI

Hot Wire Sequential Multiport Fuel Injection

LVFD

Liquid/Vapor Fuel Discriminator

LVW

Loaded Vehicle Weight

"M"

MD-TICS

Timing & Injection rate Control System

MDP

Manifold Differential Pressure sensor

ME-SFI

Motor Electronics Sequential Fuel Injection

MFI

Multiport Fuel Injection

MFI-MAF

MFI Mass Airflow Sensor

MFLS

Main Fuel Level Sensor

MI

Mechanical Fuel Injection

MIL

Malfunction Indicator Light

M/T

Manual Transmission

"N"

NAC

Nitrogen Oxides (NOx) Adsorbing Catalyst

NLV

Non-Linear Valve

NOS

NOx Sensor

NOx

NOx Emission Control

NOxATWC

NOx Adsorptive TWC

NOxC

Nitrogen Oxide Catalyst

NOxS

Nitrogen Oxide Sensor

NO_xTWC

NO_x Adsorptive TWC

NSC

Nitrogen Oxides (NO_x) Storage Catalyst

"O"

OBD

On-Board Diagnostic System

PBD (F)/(P)

Full/Partial On-Board Diagnostic

OC

Oxidation Catalytic Converter

OHC

Overhead Cam

ORVR

On-Board Refueling Vapor Recovery

ORVR-COV

ORVR Cut-Off Valve

ORVR-CV

ORVR Control Valve

ORVR-FAV

ORVR Fresh Air Valve

ORVR-FMV

ORVR Flow Management Valve

ORVR-FTVCV

ORVR Fuel Tank Vapor Control Valve

ORVR-FTVRV

ORVR Fuel Tank Vapor Recirculation Valve

ORVR-FVRS

ORVR Fuel Vapor Recovery System

ORVR-FVV

ORVR Fuel Vent Valve

ORVR-LV

ORVR Leveling Valve

ORVR-OCKV

ORVR Overfill Check Valve

ORVR-RCV

ORVR Refueling Control Valve

ORVR-VCV

ORVR Vapor Cut Valve

ORVR-VRV

ORVR Vapor Recirculating Valve

ORVR-VSV

ORVR Vent Shut Valve

ORVR-VV

ORVR Vent Valve

OVCV

Outer Vent Control Valve

O2S

Oxygen Sensor

"P"

PAIR

Pulsed Secondary Air Injection

PAIR-ABV

PAIR Anti-Backfire Valve

PAIR-ACOV

PAIR Air Cut-Off Valve

PAIR-ACS

PAIR Air Control Solenoid

PAIR-ACV

PAIR Air Control Valve

PAIR-AIV

PAIR Air Injection Valve

PAIR-ASCS

PAIR Air Suction Control Solenoid

PAIR-ASOV

PAIR Air Shutoff Valve

PAIR-ASS

PAIR Air Switching Solenoid

PAIR-ASV

PAIR Air Switching Valve

PAIR-ASVL

PAIR Air Suction Valve

PAIR-AVCS

PAIR Air Valve Control Solenoid

PAIR-CSV

PAIR Control Solenoid Valve

PAIR-CKV

PAIR Check Valve

PAIR-DV

PAIR Diverter Valve

PAIR-PAF

PAIR Pulse Air Feeder

PAIR-PAV

PAIR Pulse Air Valve

PAIR-RES

PAIR Resonator

PAIR-RV

PAIR Reed Valve

PAIR-SCSV

PAIR Swirl Control Solenoid Valve

PAIR-SCV

PAIR Swirl Control Valve

PAIR-SOL

PAIR Solenoid

PAIR-VSV

PAIR Vacuum Switching Valve

PCM

Powertrain Control Module

PCV

Positive Crankcase Ventilation

PCV-DOV

PCV Dual Orifice Valve

PCV-HCB

PCV Heated Crankcase Breather

PCV-HE

PCV Heating Element

PCV-PRV

PCV Pressure Regulator Valve

PCV-SOL

PCV Solenoid

PEVR

Power Enrichment Vacuum Regulator

PPM

Parts Per Million

PTOX

Periodic Trap Oxidizer

PURCV

Purge Crankcase Ventilation

PVCS

Ported Valve Control System

PVCS-A

PVCS Actuator

PVCS-CS

PVCS Control Solenoid

PVLCS

Power Valve Control System

"R"

RC

NOx Reduction Catalyst

ROV

Rollover Valve

"S"

SAI-SV

Secondary Air Injection Shutoff Valve

SAIR-CV

Secondary Air Injection Control Valve

SC

Supercharged or Super Charger

SC MFI

Supercharged Multiport Fuel Injection

SCR

Selective Catalytic Reduction

SCSV

Swirl Control Solenoid Valve

SCV

Swirl Control Valve

SCV-A

SCV Actuator

SFI

Sequential Multiport Fuel Injection

SFI-MAF

SFI Mass Airflow Sensor

SFLS

Sub-Fuel Level Sensor

SOHC

Single Overhead Cam

SPK

Spark Controls

SPK-AVM

SPK Advance Vacuum Modulator

SPK-BVSV

SPK Bimetal Vacuum Switching Valve

SPK-CC

SPK Computer Controlled

SPK-CKV

SPK Check Valve

SPK-CSSA

SPK Cold Start Spark Advance System

SPK-CSSH

SPK Cold Start Spark Hold System

SPK-CTO

SPK Coolant Temperature Override

SPK-DAVS

SPK Distributor Vacuum Advance Solenoid

SPK-DCKV

SPK Distributor Check Valve

SPK-DCTO

SPK Dual Coolant Temperature Override

SPK-DDD

SPK Dual Diaphragm Distributor

SPK-DMV

SPK Distributor Modulator Valve

SPK-DPD

SPK Dual Point Distributor

SPK-DPVS

SPK Distributor Ported Vacuum Switch

SPK-DRCV

SPK Distributor Retard Control Valve

SPK-DRS

SPK Distributor Retard Solenoid

SPK-DSVMV

SPK Distributor Spark Vacuum Modulator Valve

SPK-DTVS

SPK Distributor Thermal Vacuum Switch

SPK-DTVV

SPK Distributor Thermal Vacuum Valve

SPK-DV

SPK Delay Valve

SPK-DVA

SPK Distributor Vacuum Advance

SPK-DVAS

SPK Distributor Vacuum Advance Solenoid

SPK-DVCS

SPK Distributor Vacuum Control Solenoid

SPK-DVCSW

SPK Distributor Vacuum Controlled Switch

SPK-DVCV

SPK Distributor Vacuum Control Valve

SPK-DVDV

SPK Distributor Vacuum Delay Valve

SPK-DVRS

SPK Distributor Vacuum Retard Switch

SPK-DVRV

SPK Distributor Vacuum Regulating Valve

SPK-DVVV

SPK Distributor Vacuum Vent Valve

SPK-EAVS

SPK Electronically Actuated Vacuum Switch

SPK-EDM

SPK Electronic Distributor Modulator

SPK-EI

SPK Electronic Ignition

SPK-ESA

SPK Electronic Spark Advance

SPK-ESC

SPK Electronic Spark Control (Retard)

SPK-ESS

SPK Electronic Spark Selection

SPK-EST

SPK Electronic Spark Timing

SPK-FDV

SPK Forward Delay Valve

SPK-HPCA

SPK Housing Pressure Cold Advance

SPK-ITCS

SPK Ignition Timing Control System

SPK-ITVS

SPK Ignition Timing Vacuum Switch

SPK-NLVR

SPK Non-Linear Vacuum Regulator

SPK-OSAC

SPK Orifice Spark Advance Control

SPK-PVA

SPK Ported Vacuum Advance

SPK-PVS

SPK Ported Vacuum Switch

SPK-RDO

SPK Retard Delay Orifice

SPK-RDV

SPK Reverse Delay Valve

SPK-RDVD

SPK Reverse Delay Valve (Dual)

SPK-RDVLV

SPK Retard Delay Valve

SPK-RDVS

SPK Reverse Delay Valve (Single)

SPK-RETS

SPK Retard Switch

SPK-SC

SPK Speed Controlled

SPK-SDV

SPK Spark Delay Valve

SPK-SOL

SPK Solenoid

SPK-SRRV

SPK Spark Relay Regulator Valve

SPK-TAVIA

SPK Temperature Activated Vacuum Ignition Advance

SPK-TCS

SPK Transmission Controlled Spark

SPK-TCSYS

SPK Timing Control System

SPK-TIDC

SPK Thermostatic Ignition Distributor Control

SPK-TV

SPK Thermal Valve

SPK-TVS

SPK Thermal Vacuum Switch

SPK-VACTO

SPK Vacuum Advance Coolant Temperature Override

SPK-VAS

SPK Vacuum Advance Solenoid

SPK-VAV

SPK Vacuum Advance Valve

SPK-VR

SPK Vacuum Retard

SPK-VRSW

SPK Vacuum Retard Switch

SPK-VSV

SPK Vacuum Switching Valve

SPK-VTCS

SPK Vacuum Timing Control System

SPL

Smoke Puff Limiter

SRI

Service Reminder Indicator

SSCA

Stepped Speed Control Actuator

SSCS

Stepped Speed Control Solenoid

STS

Service Throttle Soon Light

STVS

Secondary Throttle Valve System

SUB-HO2S

Sub-Heated Oxygen Sensor (after CAT)

SUB-O2S

Sub-Oxygen Sensor

SUB-TWC

Sub Three-Way Catalytic Converter

"T"

TAA

Turbo Air-To-Air

TAA

Throttle Actuator Assembly

TAB

Thermactor Air By-Pass

TAD

Thermactor Air Diverter

TAC

Thermostatic Air Cleaner

TBI

Throttle Body Injection

TBPCS

Throttle By-Pass Control System

TC

Turbo Charger

TCC

Torque Converter Clutch

TCCL

Torque Converter Control

TCD

Throttle Closing Dashpot

TC-DV

TC Delay Valve

TC-TVC

TC Thermal Vacuum Switch

TC-VS

TC Vacuum Switch

TD

Thermactor Diverter

TFT

Tank Fuel Temperature Sensor

THOS2

Third Heated Oxygen Sensor

TICV

Thermal Ignition Control Valve

TIV

Thermal Idle Valve

TK

Throttle Kicker

TLUC

Transmission Lock-Up Converter

TLUC-TVS

TLUC Thermal Vacuum Switch

TLUC-VS

TLUC Vacuum Switch

TM

Throttle Modulator

TOS

Throttle Opener System

TP

Throttle Positioner

TPI

Tuned Port Fuel Injection

TPV

Throttle Poppet Valve

TR

Thermal Reactor

TRC

Throttle Return Control

TRCS

Throttle Return Control Solenoid

TRCTL

Throttle Return Control Throttle Lever Actuator

TRSCV

Throttle Return Solenoid Control Valve

TRTVV

Temperature Regulator Thermal Vacuum Valve

TRVV

Transmission Vacuum Valve

TSOL

Throttle Solenoid

TVISD

Throttle Vacuum Idle Speed Diaphragm

TVM

Transmission Vacuum Modulator

TVS

Thermal Vacuum Switch

TWC

Three-Way Catalytic Converter

TWC+OC

Three-Way + Oxidation Catalytic Converter

"V"

VA

Vacuum Advance Unit

VAC-AMP

Vacuum Amplifier

VA-CTO

VA Coolant Temperature Override

VC

Vapor Canister

VCV

Vacuum Cut Valve

VCV-BV

VCV By-Pass Valve

VLFR

Vent Line Flow Restrictor/Anti-Trickle Fill Valve

"W"

WU

Warm-Up Catalyst

WU-OC

Warm-Up Oxidation Converter

WU-TWC

Warm-Up Three-Way Catalytic Converter

Article GUID: A00158541

GENERAL INFORMATION
Engine Displacement Conversion Table

CONVERSION TABLE

LITER/CID CONVERSION

Liter	CID
1.0	59
1.0	60
1.0	61
1.1	66
1.1	68
1.1	70
1.2	71
1.2	72
1.2	73
1.2	76
1.3	77
1.3	78
1.3	79
1.3	80
1.3	81
1.3	82
1.4	85
1.4	85
1.4	86
1.5	89
1.5	90
1.5	91
1.6	94
1.6	95
1.6	96
1.6	97
1.6	98
1.6	99
1.7	102
1.7	103
1.7	105
1.8	107
1.8	109
1.8	110

Liter	CID
1.8	111
1.8	112
1.9	113
1.9	114
1.9	116
1.9	119
2.0	119
2.0	120
2.0	121
2.0	122
2.1	125
2.1	126
2.1	128
2.1	129
2.1	130
2.1	131
2.2	132
2.2	133
2.2	134
2.2	135
2.2	136
2.2	137
2.3	138
2.3	140
2.3	141
2.3	143
2.4	143
2.4	144
2.4	145
2.4	146
2.4	147
2.4	149
2.5	150
2.5	151
2.5	152
2.5	153
2.6	155
2.6	156
2.6	157
2.6	158
2.6	159

Liter	CID
2.7	162
2.7	163
2.7	164
2.7	167
2.8	168
2.8	170
2.8	171
2.8	173
2.9	174
2.9	179
3.0	180
3.0	181
3.0	182
3.0	183
3.0	184
3.1	191
3.1	192
3.2	193
3.2	194
3.2	195
3.2	196
3.2	197
3.2	198
3.3	199
3.3	200
3.3	201
3.3	204
3.4	206
3.4	207
3.4	209
3.5	210
3.5	211
3.5	212
3.5	213
3.5	214
3.5	215
3.6	219
3.6	220
3.7	225
3.7	226
3.7	229

Liter	CID
3.8	229
3.8	230
3.8	231
3.8	232
3.8	234
3.8	238
3.9	239
3.9	240
3.9	241
4.0	241
4.0	242
4.0	243
4.0	244
4.1	250
4.1	252
4.2	255
4.2	258
4.3	259
4.3	260
4.3	262
4.3	263
4.3	266
4.4	266
4.4	267
4.4	268
4.5	273
4.5	274
4.5	276
4.6	278
4.6	279
4.6	281
4.6	283
4.7	284
4.7	285
4.7	287
4.7	289
4.8	290
4.8	292
4.9	300
4.9	301
4.9	302

Liter	CID
5.0	302
5.0	304
5.0	305
5.0	307
5.1	310
5.2	315
5.2	318
5.3	326
5.4	327
5.4	328
5.4	330
5.5	334
5.5	335
5.6	340
5.6	343
5.7	345
5.7	348
5.7	350
5.8	351
5.8	352
5.9	359
5.9	360
5.9	361
5.9	362
6.0	366
6.0	368
6.1	370
6.1	372
6.2	379
6.2	381
6.3	383
6.4	389
6.4	390
6.4	392
6.5	396
6.6	400
6.6	401
6.6	402
6.6	403
6.7	410
6.8	412

Liter	CID
6.8	413
6.8	414
6.8	415
6.9	420
6.9	421
7.0	425
7.0	426
7.0	427
7.0	428
7.0	429
7.0	430
7.1	432
7.2	440
7.4	454
7.5	455
7.5	460
7.6	462
8.0	488
8.2	500
8.8	534
8.8	537
8.8	538
8.9	540
9.0	549
9.1	555
9.3	568
9.3	570
9.6	588
9.8	600
9.9	605
10.0	611

Article GUID: A00158561

GENERAL INFORMATION

Engine Overhaul Procedures

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

DESCRIPTION

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of cleaning, inspection, and assembly processes are included.

ENGINE IDENTIFICATION

Engine may be identified from Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with each manufacturer.

INSPECTION PROCEDURES

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES**

section for complete overhaul procedures and specifications for the vehicle being repaired.

Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.

Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

MAGNETIC PARTICLE INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Magnaflux & Magnaglo

Magnaflux is an inspection technique used to locate material flaws and stress cracks. Component is subjected to a strong magnetic field. Entire component or a localized area can be magnetized. Component is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption of magnetic field. Dry powder method of Magnaflux can be used in normal lighting and crack appears as a bright line.

Fluorescent liquid is used along with a Black light in the Magnaglo Magnaflux system. Darkened room is required for this procedure. The crack will appear as a glowing line. Complete demagnetizing of component upon completion is required on both procedures. Magnetic particle inspection applies to ferrous materials only.

PENETRANT INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Zyglo

The Zyglo process coats material with a fluorescent dye penetrant. Component is often warmed to expand cracks that will be penetrated by the dye. Using darkened room and Black light, component is inspected for cracks. Crack will glow brightly.

Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

Dye Check

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

ULTRASONIC INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

If an expensive part is suspected of internal cracking, ultrasonic testing is used. Sound waves are used for component inspection.

X-RAY INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

This form of inspection is used on highly stressed components. X-ray inspection may be used to detect internal and external flaws in any material.

PRESSURE TESTING

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes of cylinder head and injecting air or water into the open passage.

Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

CLEANING PROCEDURES

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

GENERAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

BEAD BLASTING

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from component after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

CHEMICAL CLEANING

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be left in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

COMPONENT CLEANING

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

SHEET METAL PARTS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle

being repaired.

Examples of sheet metal parts are rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

INTAKE & EXHAUST MANIFOLDS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Using solvent cleaning or bead blasting, clean manifolds for inspection. If intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, sheet metal oil shield must be removed for proper cleaning and inspection. Ensure all manifold parting surfaces are flat and free of burrs.

CYLINDER HEAD REPLACEMENT

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped) should be removed only when engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See [Fig. 1](#). Remove cylinder head.

INSTALLATION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

Install head gasket on cylinder block. Some manufacturers may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so that certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to coolant passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See [Fig. 1](#). Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT.

NOTE: Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

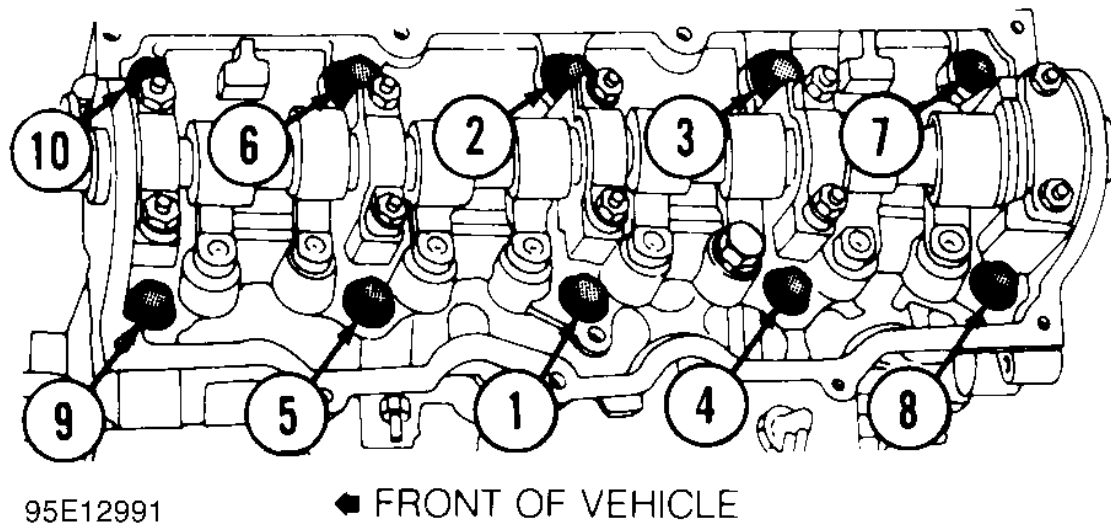


Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence

VALVE ADJUSTMENT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Push rods of different length can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

Overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and

adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at valve end of rocker arm. Ensure valve to be adjusted is riding on heel of cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

CYLINDER HEAD OVERHAUL

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

CYLINDER HEAD DISASSEMBLY

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See [Fig. 2](#).

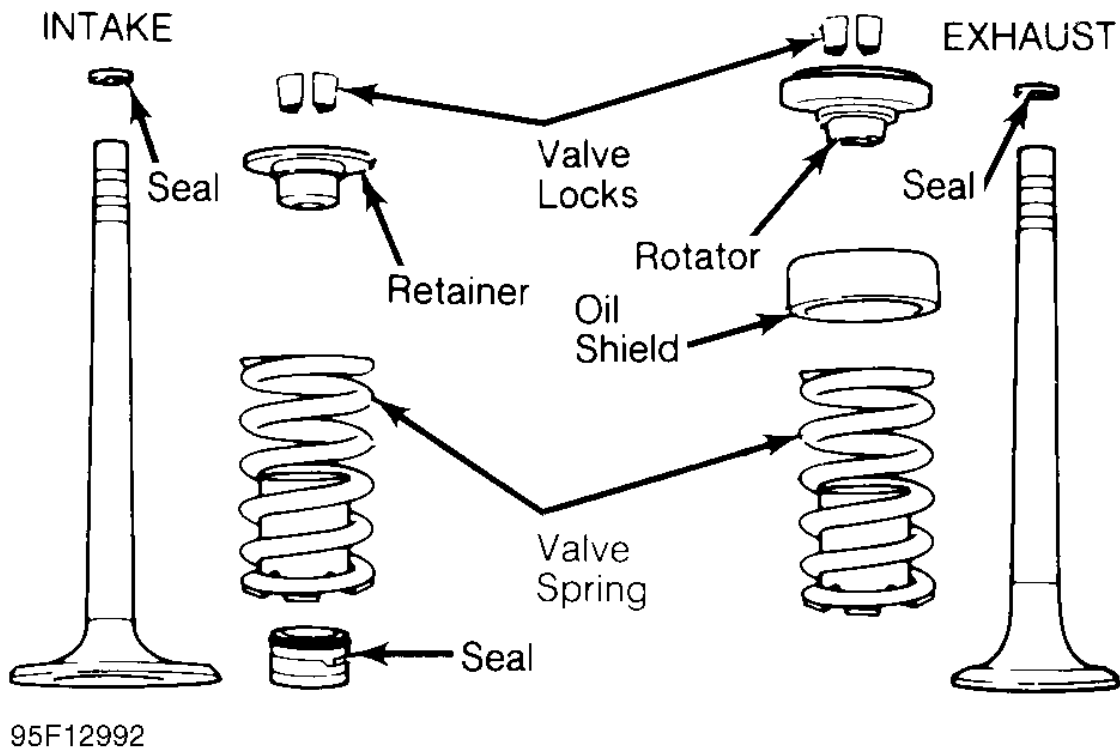


Fig. 2: Exploded View of Valve Assemblies

CYLINDER HEAD CLEANING & INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal center line and across cylinder head at several points. See [Fig. 3](#).

On cast iron cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary by manufacturer. If warpage exceeds specification on some cylinder heads, cylinder head must be replaced.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than the manufacturer's specification.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold. Using oil stone, remove burrs or scratches from all sealing surfaces.

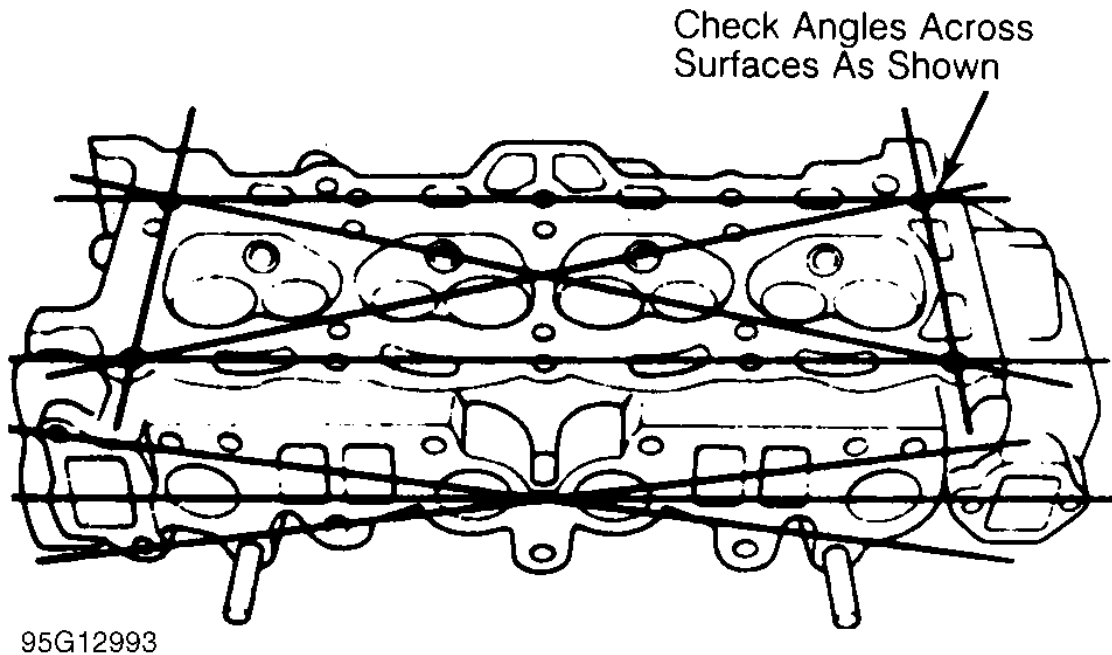


Fig. 3: Checking Cylinder Head for Warpage

VALVE SPRINGS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring indicate that spring surge has occurred. Replace springs showing evidence of these conditions.

Inspect valve springs for squareness using a 90-degree straightedge. See [Fig. 4](#). Replace valve spring if out-of-square exceeds manufacturer's specification.

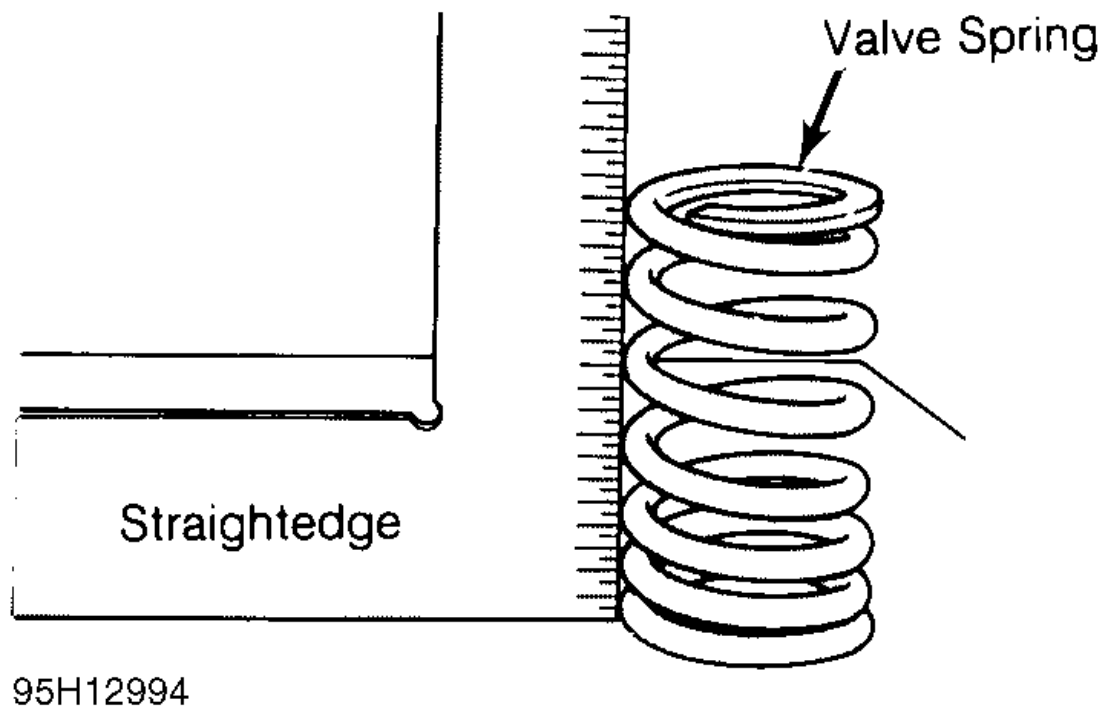


Fig. 4: Checking Valve Spring Squareness

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve spring tester, test valve spring pressure at installed and compressed heights. See [Fig. 5](#).

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head. Valve springs may need to be installed with color coded end or small coils at specified area according to manufacturer.

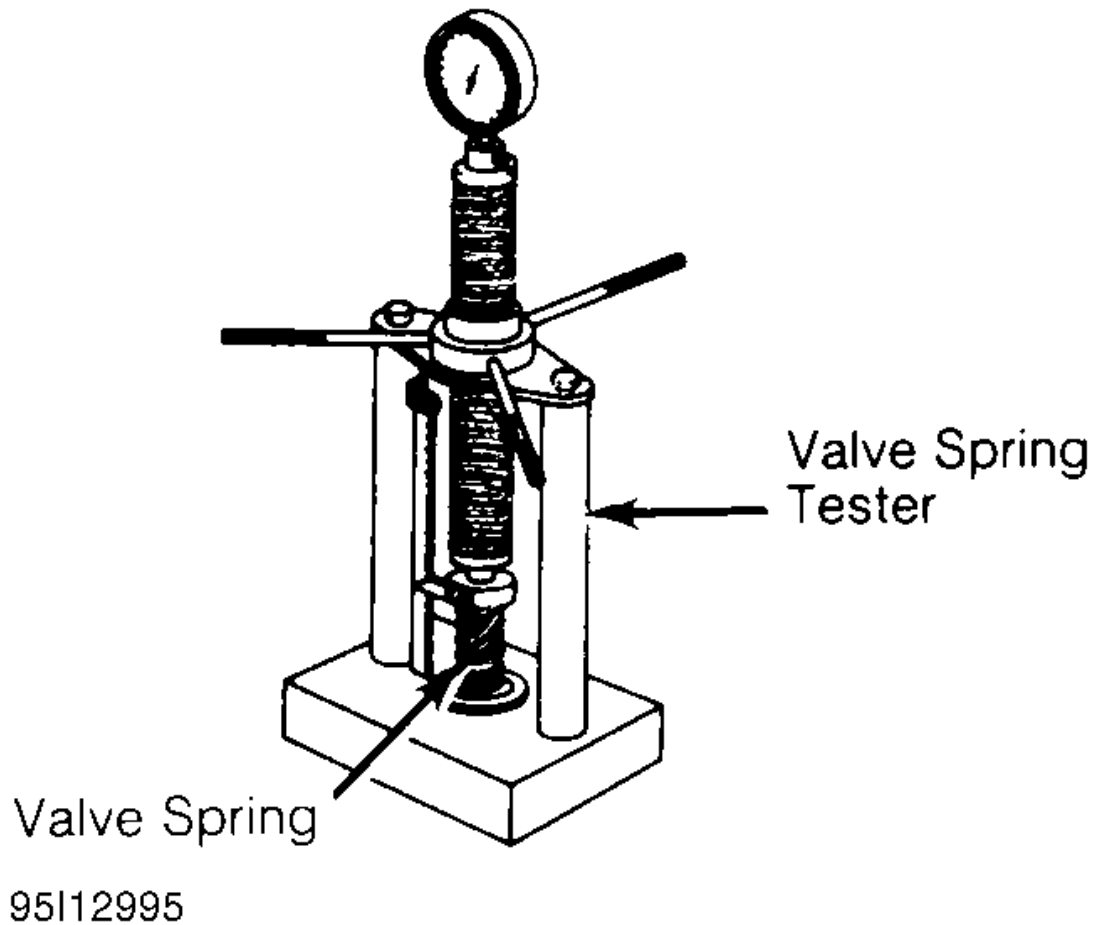


Fig. 5: Checking Valve Spring Pressure

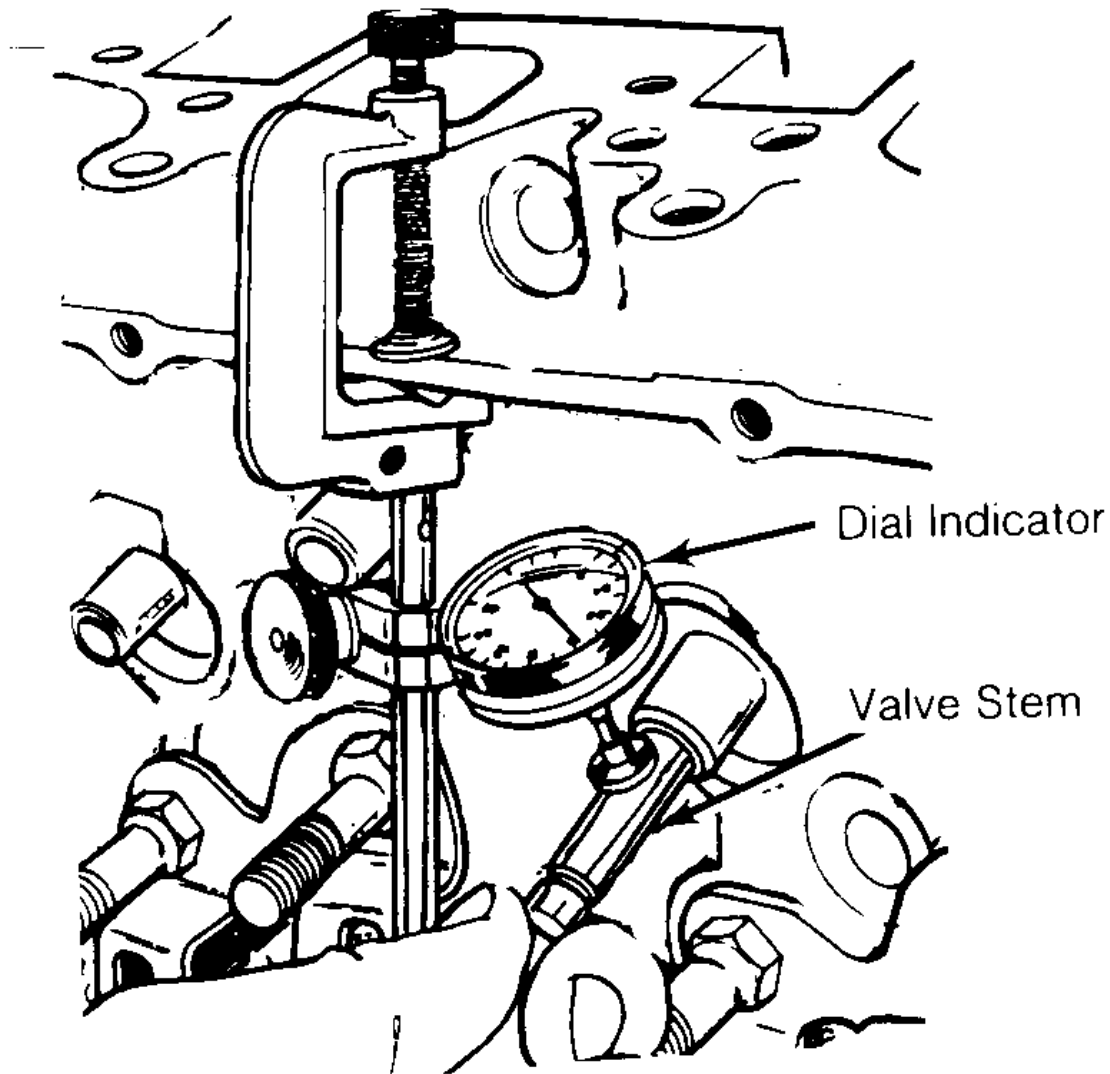
VALVE GUIDE

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Measuring Valve Guide Clearance

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specification. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See [Fig. 6](#).



95J12996

Fig. 6: Measuring Valve Stem-to-Guide Clearance

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used and valve guides are reamed to larger size or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

Reaming Valve Guide

Select proper reamer for size of valve stem. Reamer must be of proper length to provide clean cut through entire

length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See [Fig. 7](#).

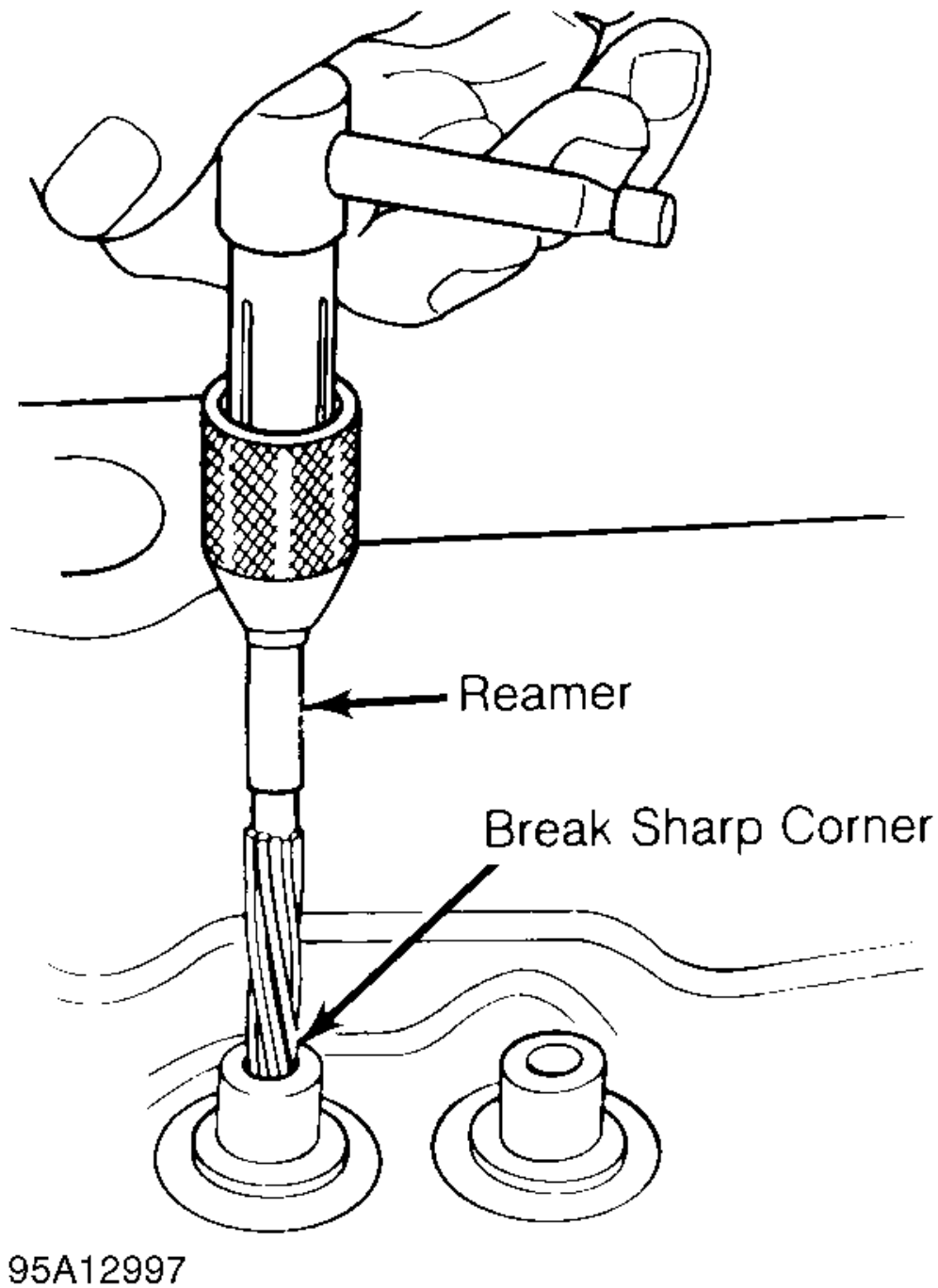


Fig. 7: Reaming Valve Guides

Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in

place, depending upon cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See [Fig. 8](#). Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Valve guide is sometimes cooled in dry ice prior to installation. Combination of a heated cylinder head and cooled valve guide ensures a tight guide fit upon assembly. The new guide must be reamed to specification.

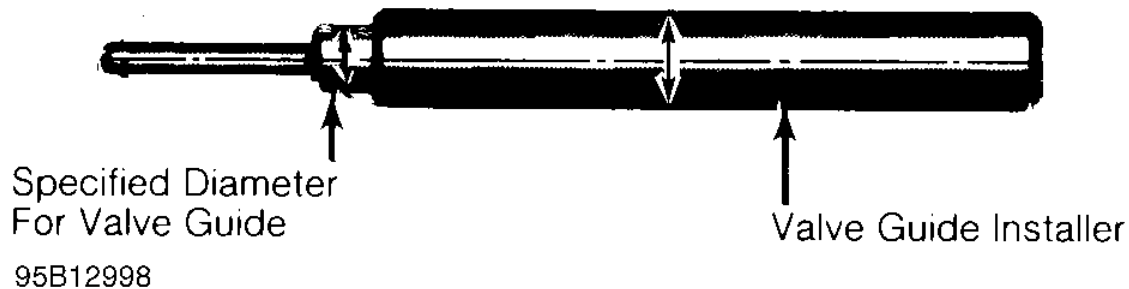


Fig. 8: Typical Valve Guide Remover & Installer

VALVES & VALVE SEATS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be ground. See [Fig. 9](#).

If valve margin is less than specification, the valves will be burned. Valve must be replaced. Due to minimum margin dimensions during manufacture, some new type valves cannot be reground. Some manufacturers use stellite coated valves that must NOT be machined. Valves can only be lapped into valve seat.

CAUTION: Some valves are sodium filled. Extreme care must be used when disposing of damaged or worn sodium-filled valves.

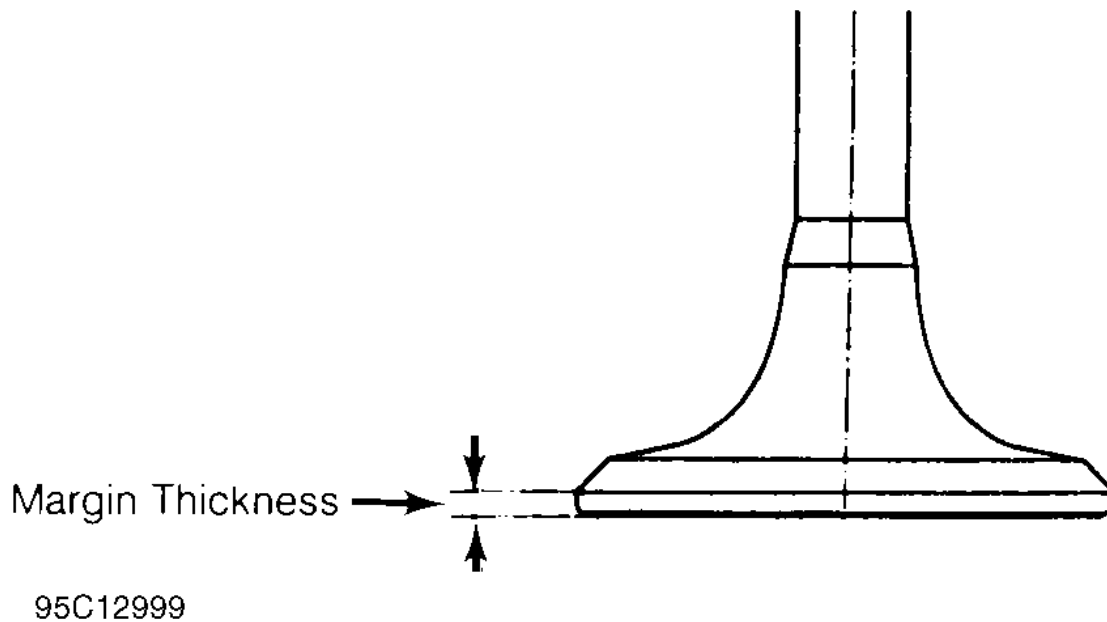


Fig. 9: Measuring Valve Head Margin

Resurface valve to proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle. Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve grinding machine.

Valve Lapping

During valve lapping of recently designed valves, be sure to follow manufacturer's recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve-to-valve seat concentricity should be checked. See **VALVE SEAT CONCENTRICITY**.

CAUTION: Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.

Valve Seat Grinding

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Various angle grinding stones are used to center and narrow the valve seat as required. See [Fig. 10](#).

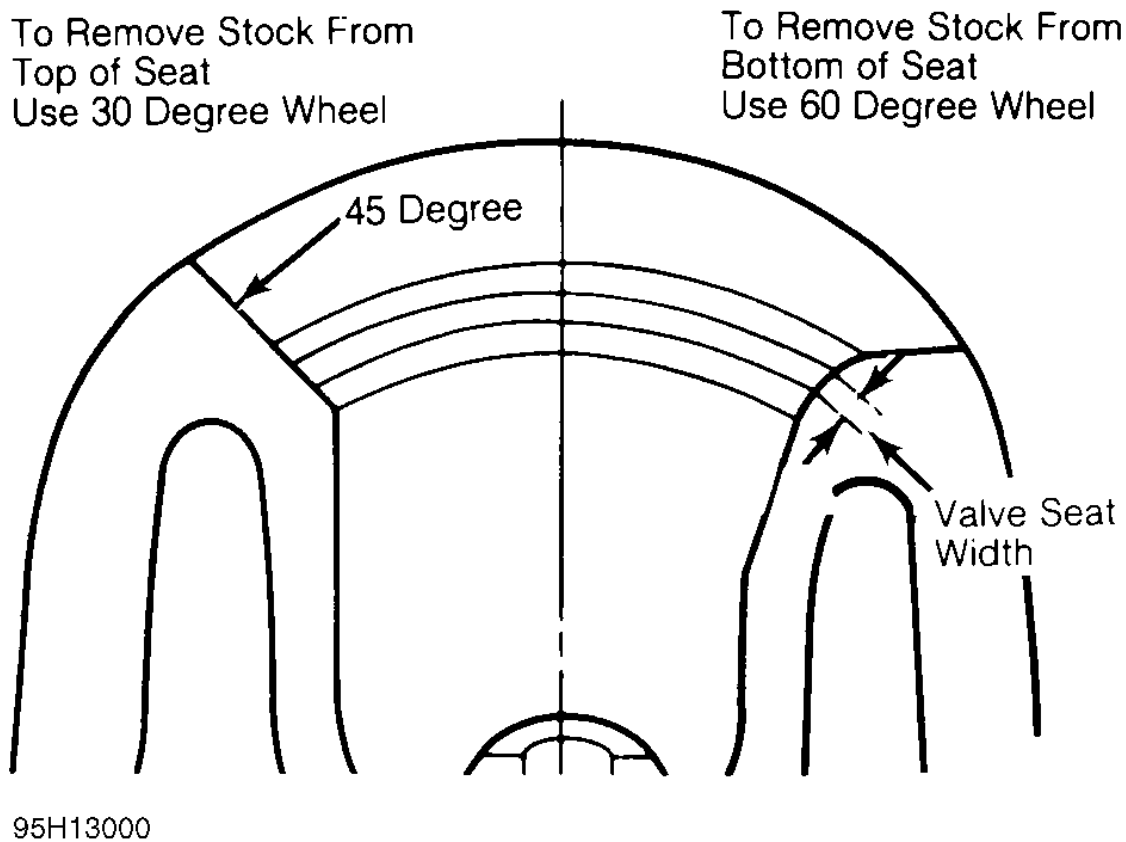


Fig. 10: Adjusting Valve Seat Width

Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out the old insert and machining an oversize insert bore. Replacement oversize insert is usually cooled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with

the valve seat.

CYLINDER HEAD REASSEMBLY

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See [Fig. 11](#). Distance must be within specification to allow sufficient clearance for valve operation.

Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.

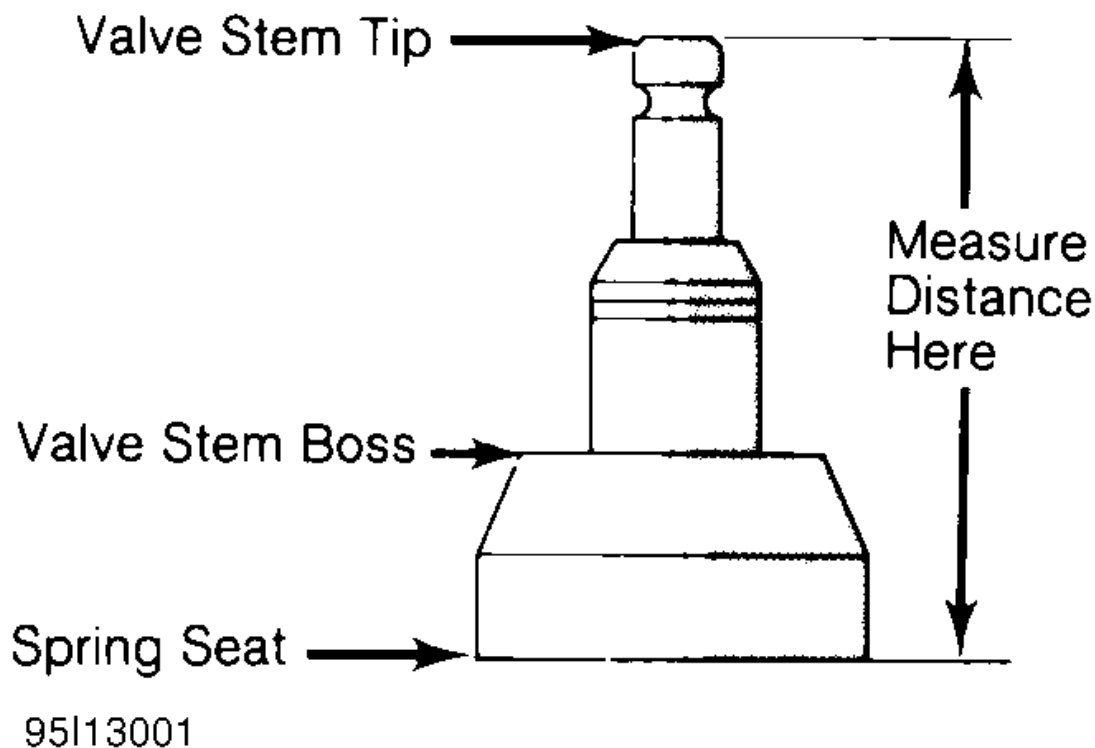


Fig. 11: Measuring Valve Stem Installed Height

VALVE STEM OIL SEALS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve stem oil seals must be installed on valve stem. See [Fig. 2](#). Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Some manufacturers require that special color code or specified height valve stem oil seal be installed in designated area.

Replacement (On-Vehicle)

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Rotate engine until piston is at top of stroke. Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cm²) line pressure to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversize valves have been installed, oversize oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

VALVE SPRING INSTALLED HEIGHT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes

of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specification. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See [Fig. 12](#).

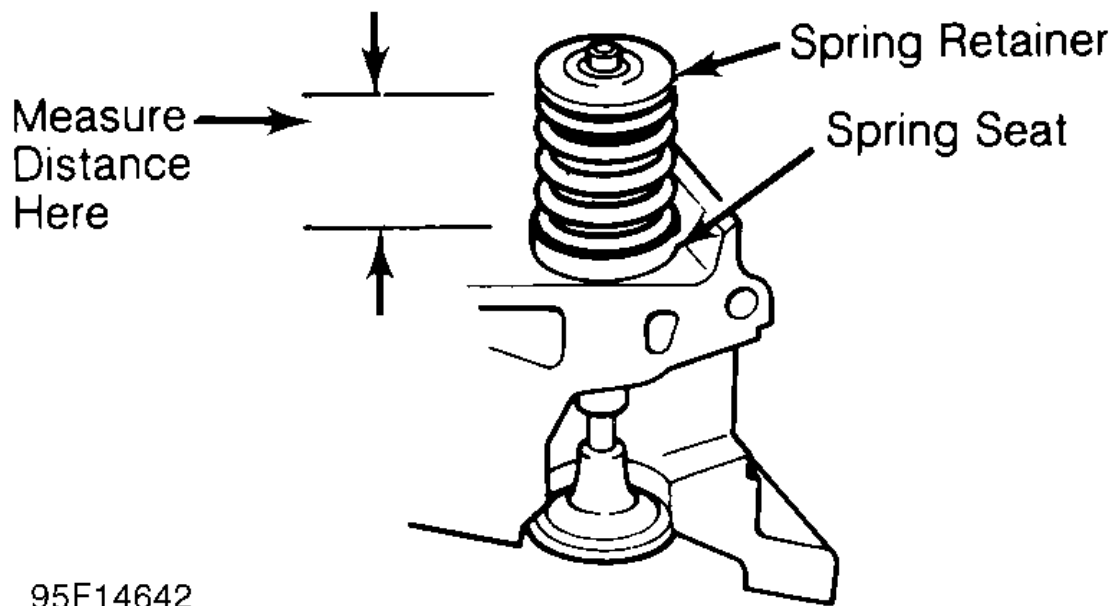


Fig. 12: Measuring Valve Spring Installed Height

ROCKER ARMS & ASSEMBLIES

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat new stud threads with Loctite and install. Tighten to

specification.

Pressed-in stud can be removed using a stud puller. Ream stud bore to proper specification and press in a new oversize stud. Pressed-in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point may be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arm components in original location. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See [**VALVE ADJUSTMENT**](#).

PUSH RODS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow push rods must be internally cleaned to ensure oil passage to rocker arms is cleaned. Check push rods for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect a bent area in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See [**VALVE ADJUSTMENT**](#).

LIFTERS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Also ensure sufficient oil pressure exists. Hydraulic lifters must be installed in original location. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, cylinder head or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See [Fig. 13](#).

On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. Ensure components or oil clearance is within specification. Some models offer oversize lifters. Replace lifter if damaged.

If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See [Fig. 13](#). Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

NOTE: Some manufacturers require that a crankcase conditioner be added to engine oil and engine operated for specified amount of time to aid in lifter break-in procedure if new lifters or camshaft are installed.

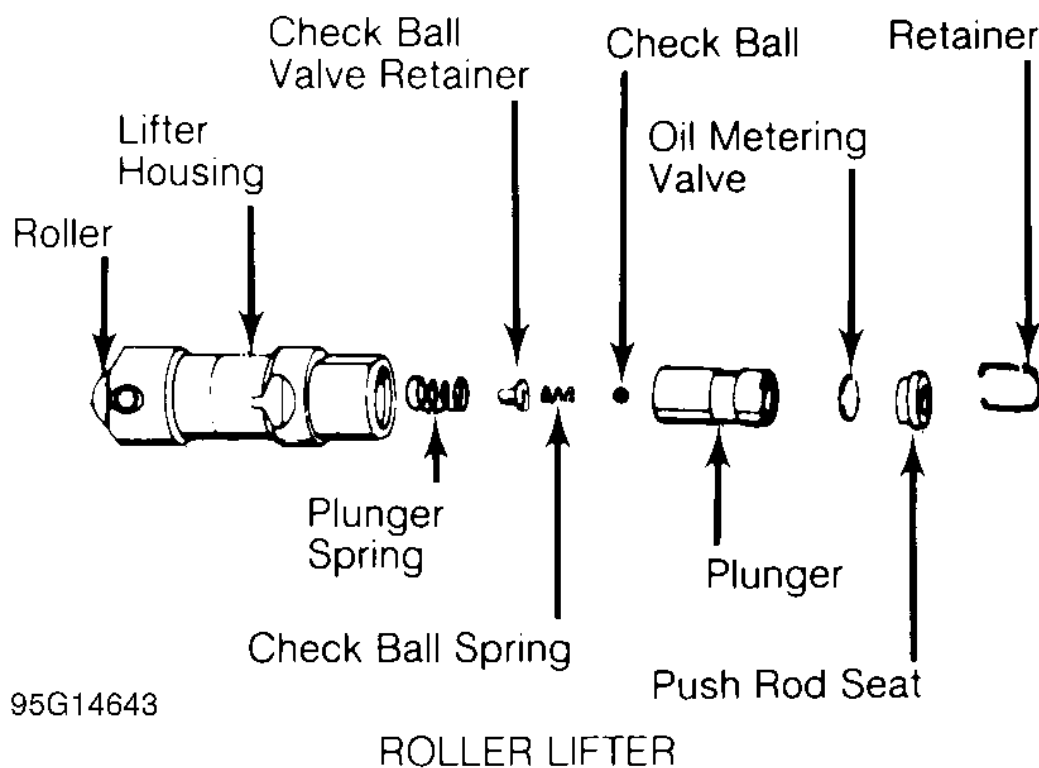
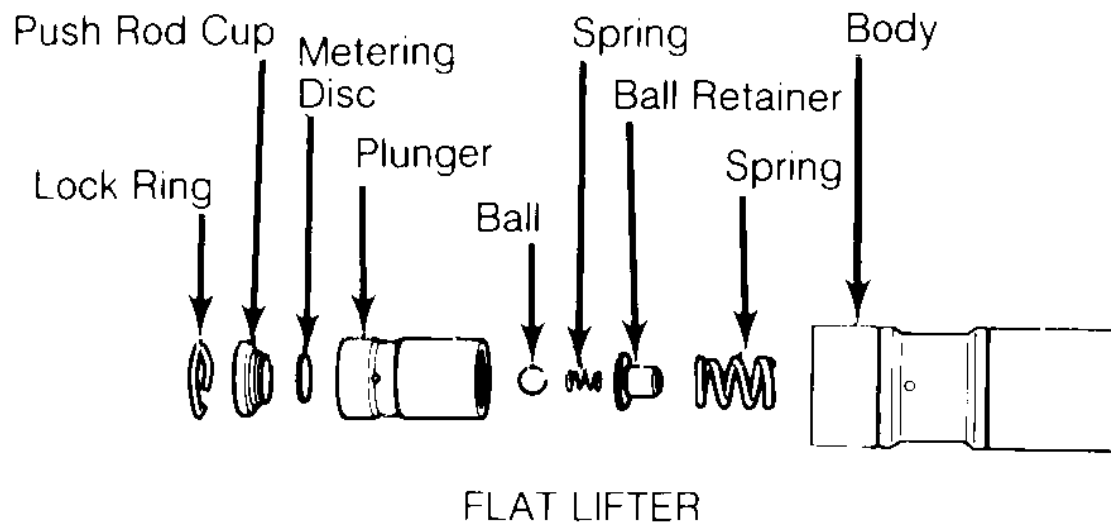


Fig. 13: Typical Hydraulic Valve Lifter Assemblies

Mechanical Lifters

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore

for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See [VALVE ADJUSTMENT](#).

PISTONS, CONNECTING RODS & BEARINGS

* PLEASE READ THIS FIRST *

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

RIDGE REMOVAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring lands or grooves.

With piston at bottom dead center, place rag in bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

PISTON & CONNECTING ROD REMOVAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Note top of piston. Some pistons may contain a notch, arrow or be marked FRONT. Piston must be installed in

proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap. Install tubing protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

PISTON & CONNECTING ROD

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). Note direction of piston installation on connecting rod. On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer's recommendations to avoid piston distortion or breakage.

Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons with wire brush.

Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturer's specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

PISTON & CYLINDER BORE FIT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See [CYLINDER BLOCK](#). Using dial bore gauge, measure cylinder bore.

Measure piston skirt diameter at 90 degree angle to piston pin at specified area by manufacturer. Subtract piston diameter from cylinder bore diameter to determine piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

ASSEMBLING PISTON & CONNECTING ROD

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Install piston on connecting rod for corresponding cylinder. Ensure reference marking on top of piston corresponds with connecting rod and cap number. See [Fig. 14](#).

Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.

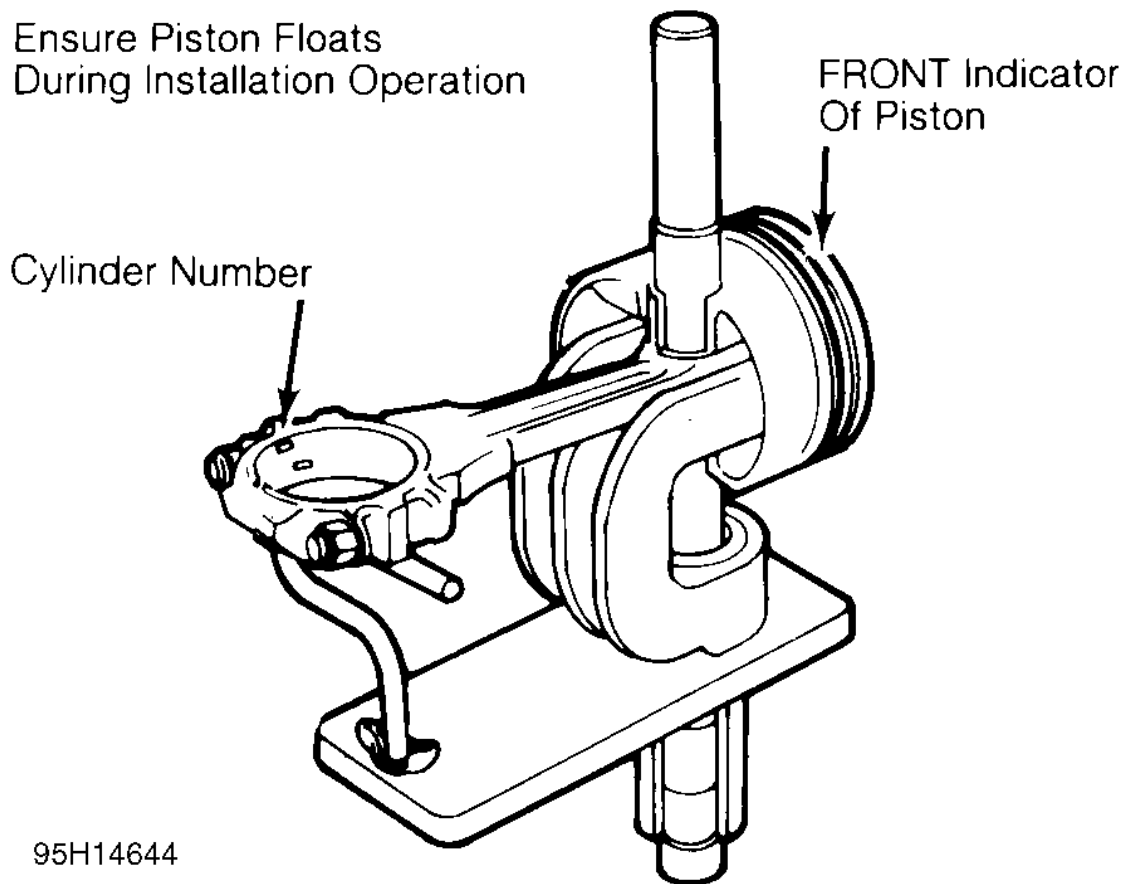


Fig. 14: Installing Typical Piston Pin

CHECKING PISTON RING CLEARANCES

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder in which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

Using feeler gauge, check ring end gap. See [Fig. 15](#). Piston ring end gap must be within specification. Ring breakage will occur if insufficient ring end gap exists.

Some manufacturers permit correcting insufficient ring end gap by using a fine file while other manufacturers

recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.

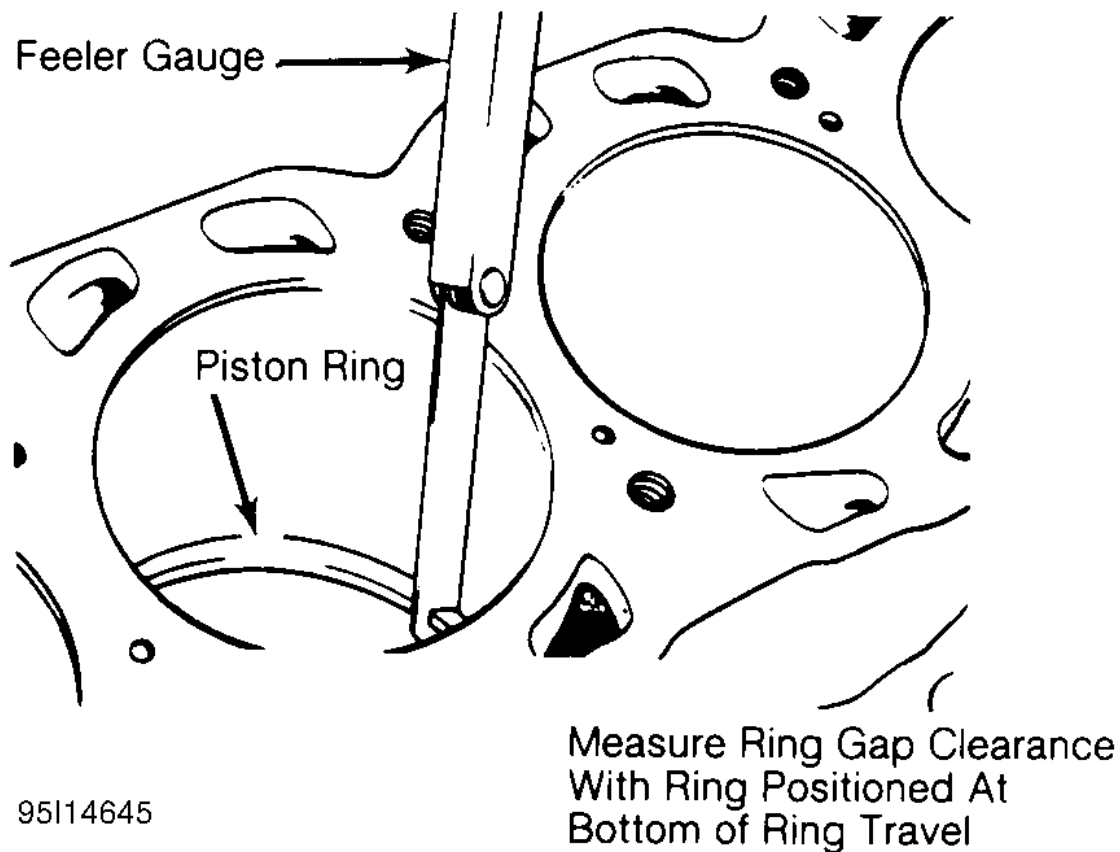


Fig. 15: Checking Piston Ring End Gap

For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversize piston rings (if available). Normal practice is to replace piston.

PISTON & CONNECTING ROD INSTALLATION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Cylinders must be honed prior to piston installation. See [CYLINDER HONING](#) under CYLINDER BLOCK.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturer's recommendations. See [Fig. 16](#). Lubricate pistons, rings and cylinder walls.

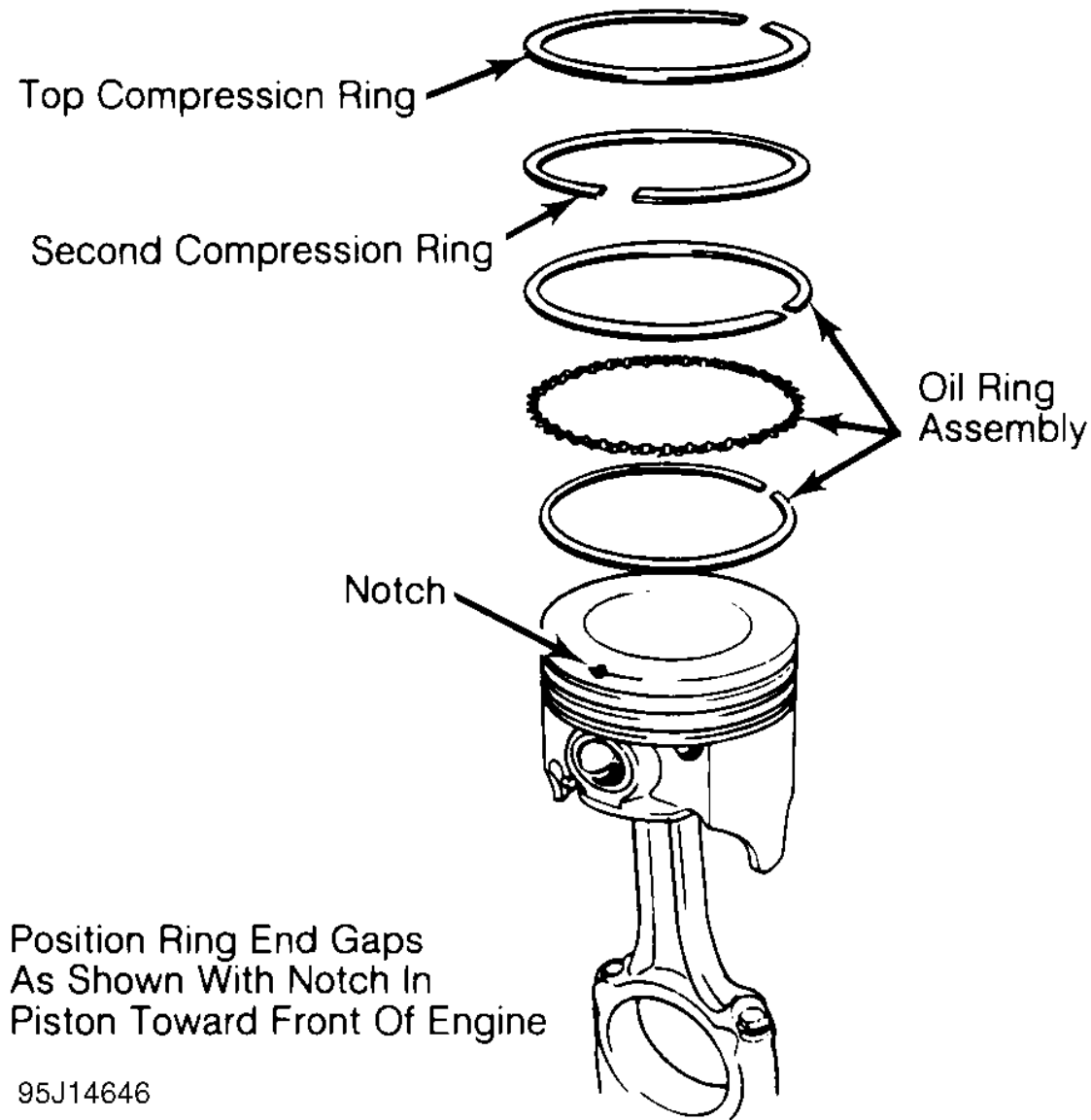


Fig. 16: Positioning Typical Piston Ring End Gap

Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or FRONT mark is toward front of engine. See [Fig. 17](#).

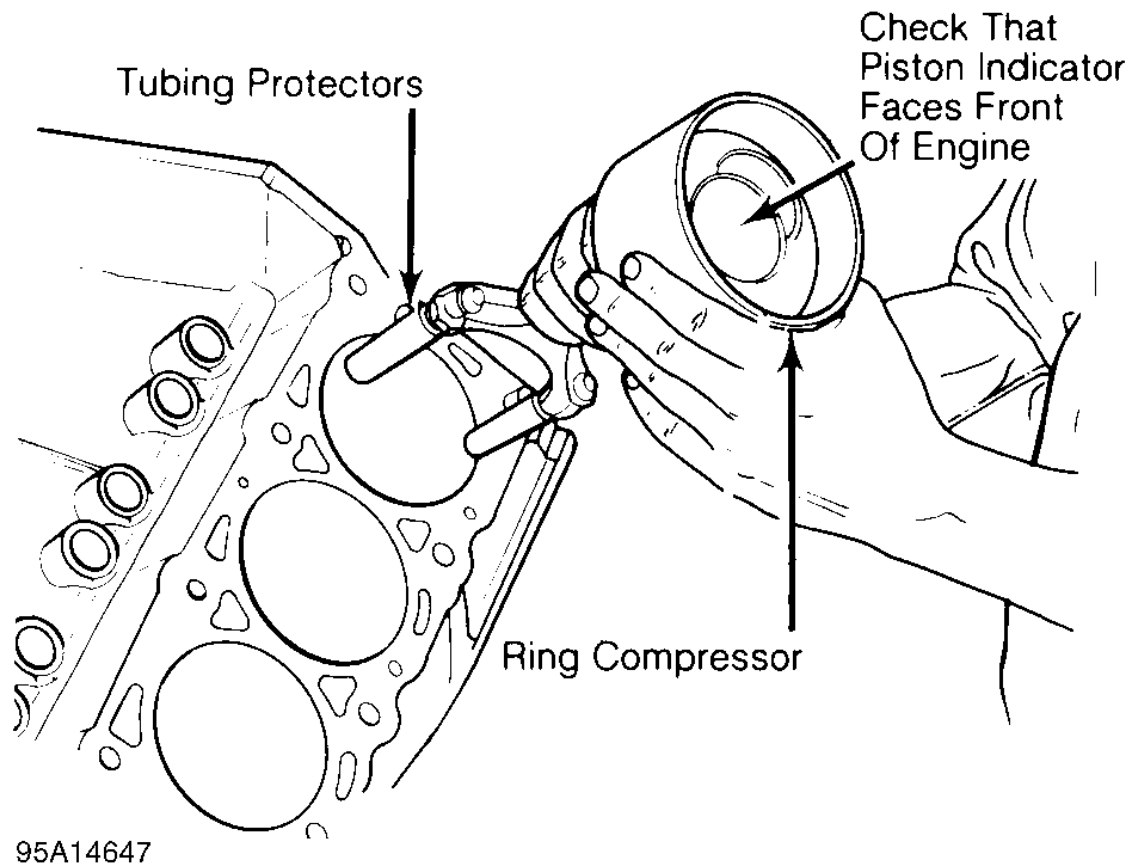


Fig. 17: Installing Piston & Connecting Rod Assembly

Carefully tap piston into cylinder until rod bearing is seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See [MAIN & CONNECTING ROD BEARING CLEARANCE](#).

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See [CONNECTING ROD SIDE CLEARANCE](#).

CONNECTING ROD SIDE CLEARANCE

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance

between side of connecting rod and crankshaft. See [Fig. 18](#). Clearance must be within specification.

Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.

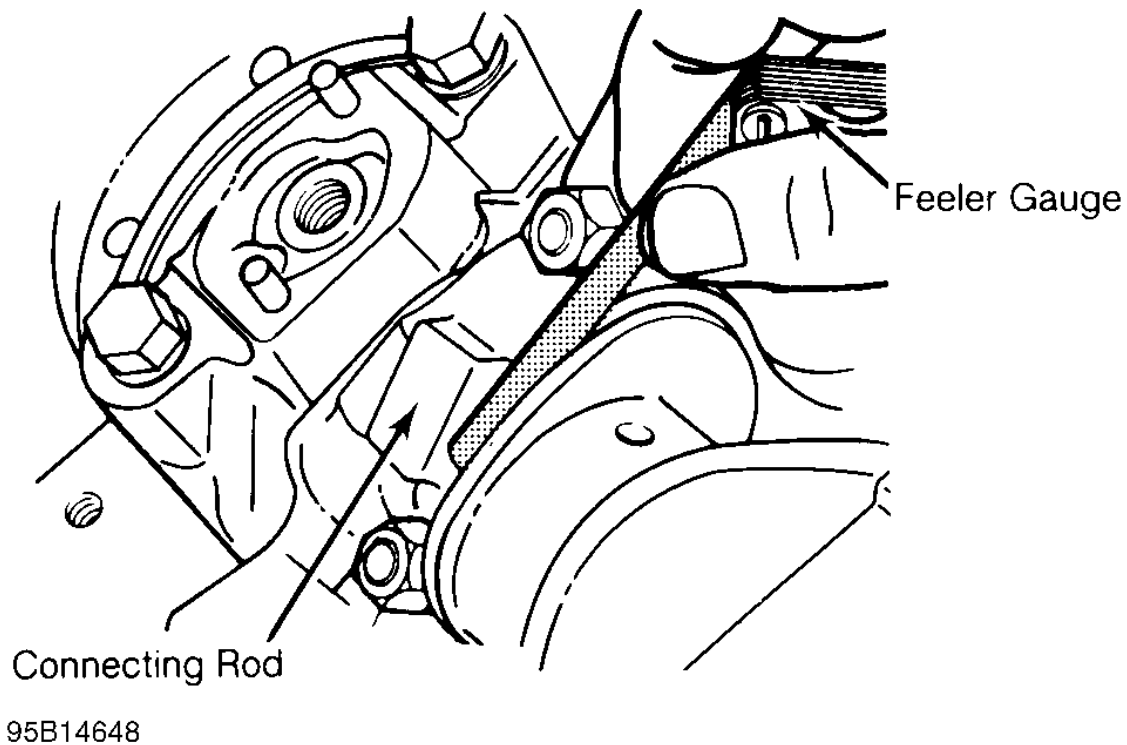


Fig. 18: Measuring Connecting Rod Side Clearance

MAIN & CONNECTING ROD BEARING CLEARANCE

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Plastigage Method

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in

original location. Tighten bolts to specification.

CAUTION: DO NOT rotate crankshaft while Plastigage is installed. Bearing clearance will not be obtained if crankshaft is rotated.

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See [Fig. 19](#). Rotate crankshaft 90 degrees. Repeat procedure. This is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.

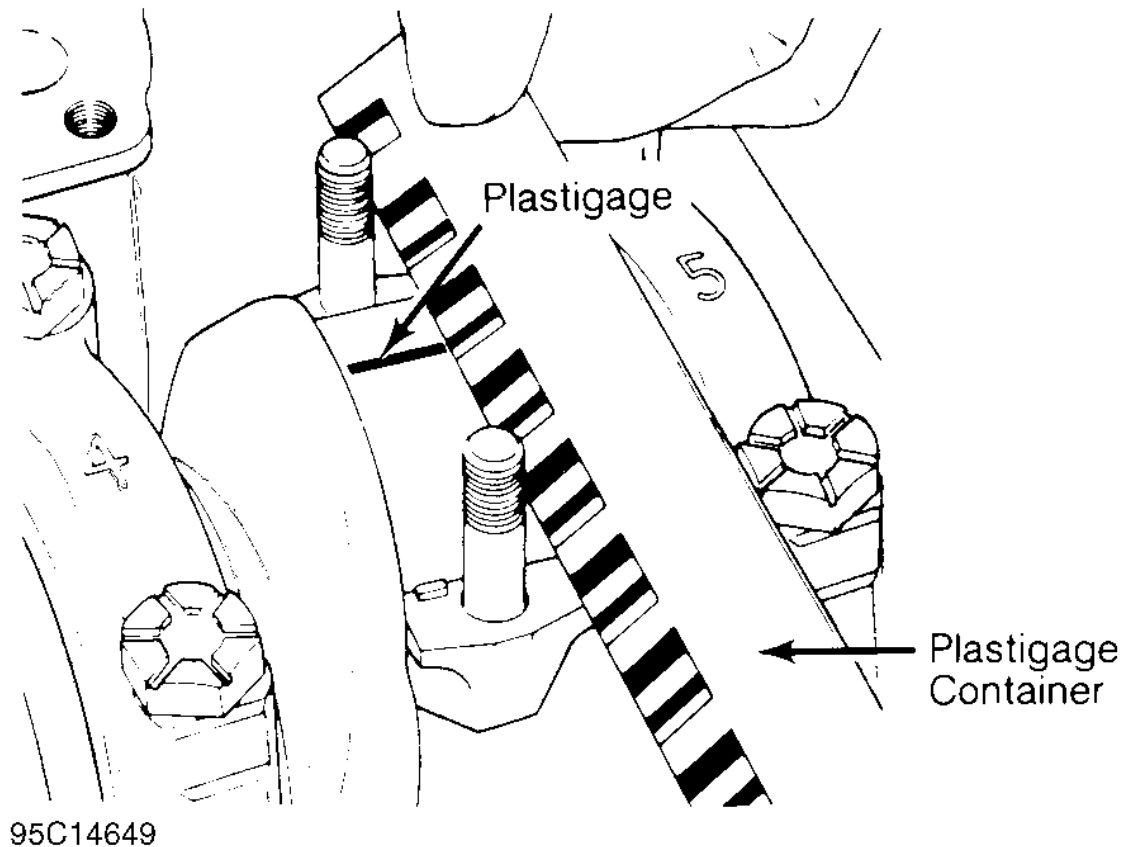


Fig. 19: Measuring Bearing Clearance

Micrometer & Telescopic Gauge Method

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See [CLEANING & INSPECTION](#) under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer, measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bearing bore

diameter. This is the bearing clearance.

CRANKSHAFT & MAIN BEARINGS

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

REMOVAL

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on them. The arrow must face timing belt or timing chain end of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

CLEANING & INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Ensure oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See [Fig. 20](#). Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

A - B = Vertical Taper
C - D = Horizontal Taper
A - C & B - D = Out-Of-Round

Check For Out-Of-Round At Each End Of Journal

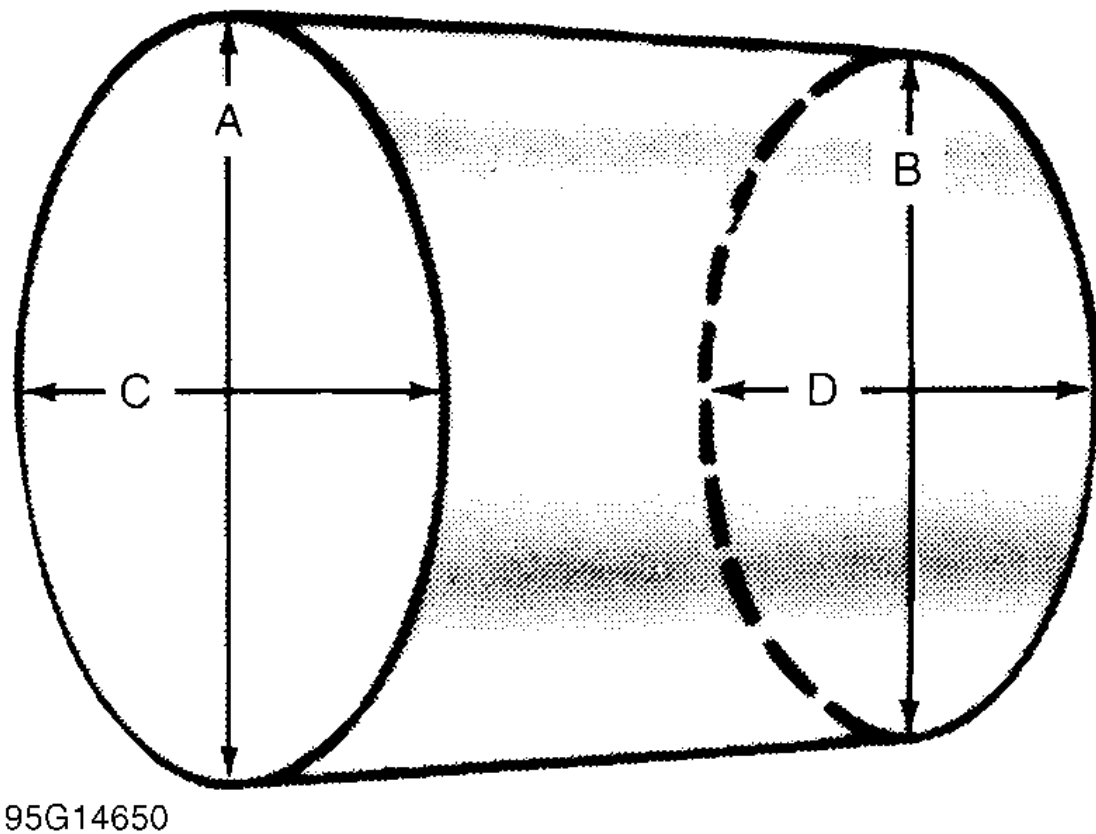


Fig. 20: Measuring Crankshaft Journals

Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator with tip resting on the main bearing journal area. See [Fig. 21](#). Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.

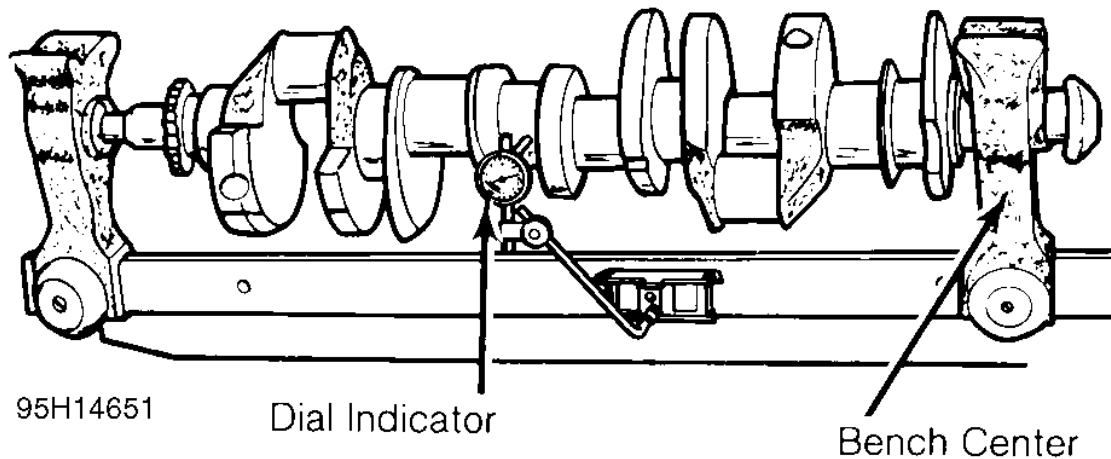


Fig. 21: Measuring Crankshaft Main Bearing Journal Runout

INSTALLATION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See [**MAIN & CONNECTING ROD BEARING CLEARANCE**](#).

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Some models require that thrust bearing be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tightened to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See [**CRANKSHAFT END PLAY**](#).

CRANKSHAFT END PLAY

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

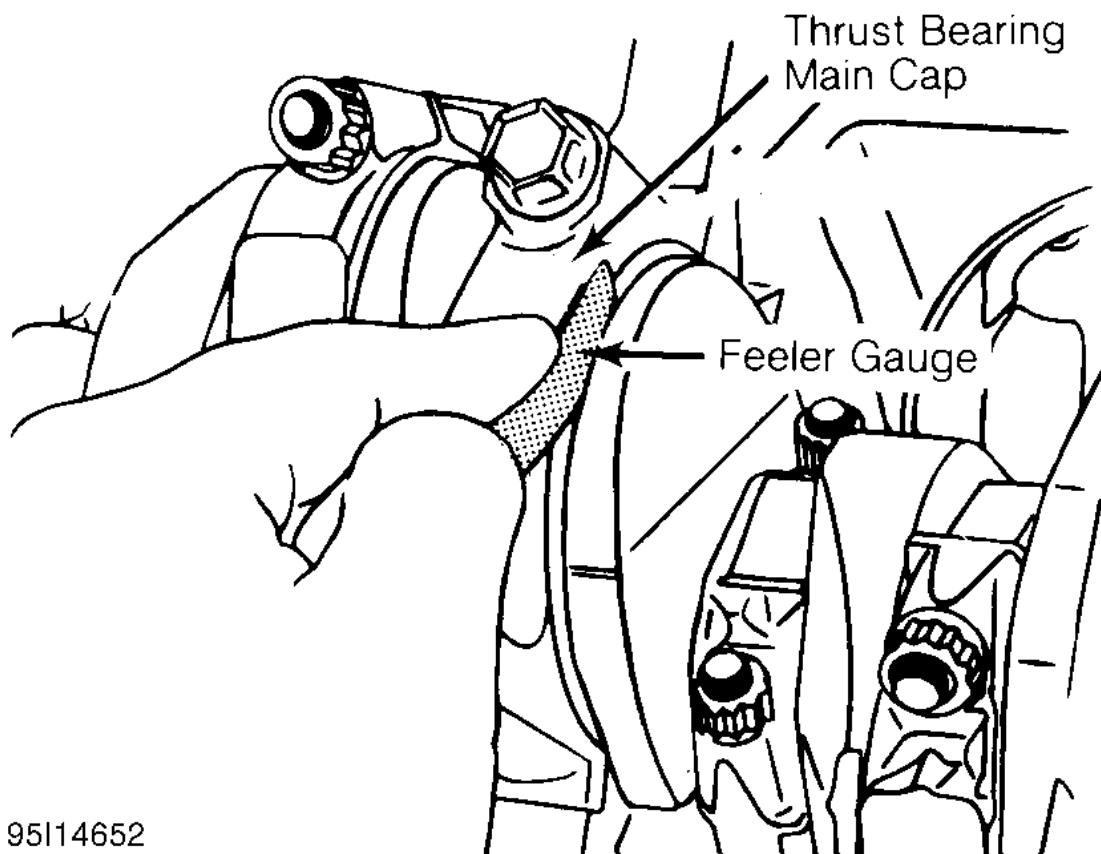
Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero. Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See [Fig. 22](#).



95114652

Fig. 22: Checking Crankshaft End Play

Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

CYLINDER BLOCK

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Block Cleaning

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil gallery plugs, freeze plugs and cam bearings before cleaning block.

Block Inspection

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of cylinders, main bearing saddles, near expansion plugs and between cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

Cylinder Bore Inspection

Inspect bore for scoring or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block center line. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

Cylinder Honing

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20W engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to

produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

Deck Warpage

Check deck for damage or warped gasket surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

NOTE: **Some manufacturers recommend that a total amount of material (cylinder head and cylinder block) can only be removed before components must be replaced.**

Deck Height

Distance from crankshaft center line to block deck is called the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from crankshaft journal to block deck, parallel to cylinder center line.

Add one half of main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specification, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at the same time.

Main Bearing Bore & Alignment

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along center line of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance exists.

Expansion Plug Removal

Drill hole in center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

Expansion Plug Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Using wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

Oil Gallery Plug Removal

Remove threaded oil gallery plugs using appropriate wrench. Soft press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

Oil Gallery Plug Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are installed with a hammer and drift.

CAMSHAFT

* PLEASE READ THIS FIRST *

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

CLEANING & INSPECTION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note camshaft runout reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90-degree angle to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specification. Replace camshaft if cam lobes or bearing journals are not within specification.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

CAMSHAFT BEARINGS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Removal & Installation

Remove camshaft rear plug. Camshaft bearing remover is assembled with shoulder resting against bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as a guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

CAMSHAFT INSTALLATION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. On all applications, check camshaft end play.

CAMSHAFT END PLAY

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Using dial indicator, check camshaft end play. Position dial indicator on front of engine block or cylinder head. Position indicator tip against camshaft. Push camshaft toward rear of cylinder head or engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on each manufacturer.

TIMING CHAINS & BELTS

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING CHAINS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See [Fig. 23](#). Replace timing chain and gears if not within specification.

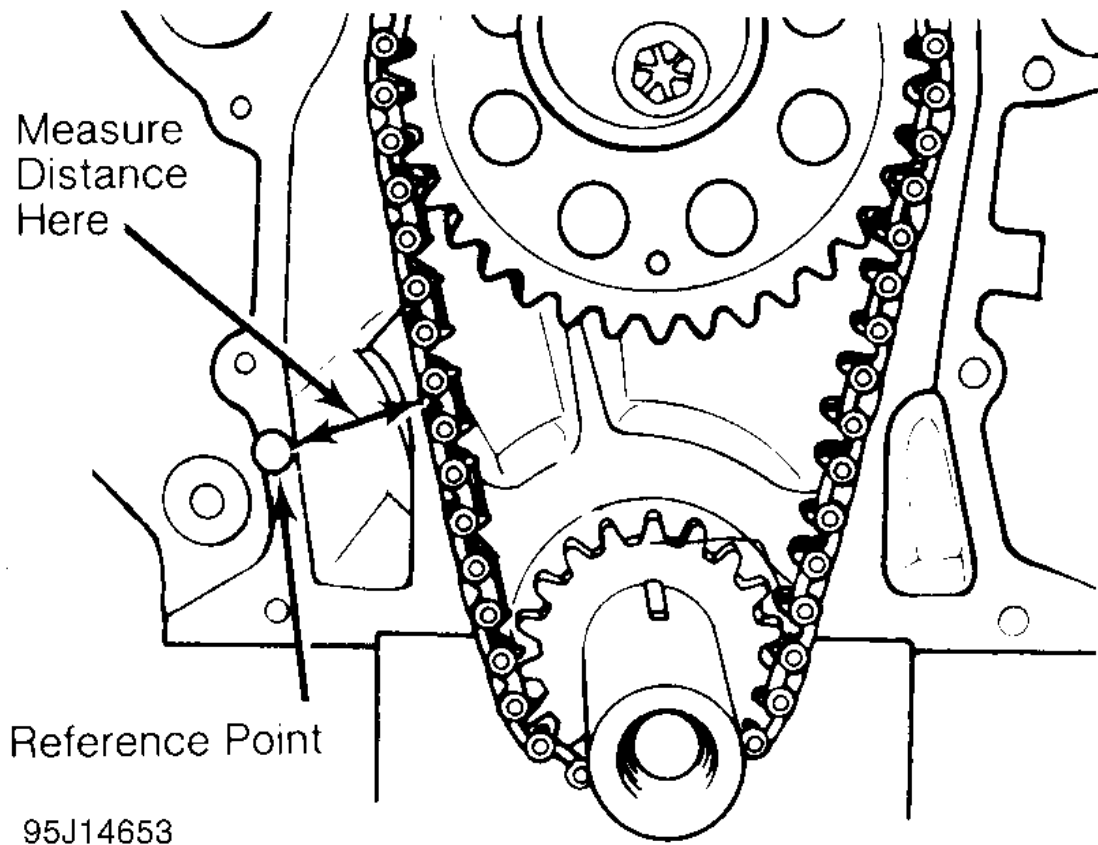


Fig. 23: Measuring Timing Chain Stretch

Timing chains must be installed so timing marks on camshaft gear and crankshaft gear are aligned according to manufacturer. See [Fig. 24](#).

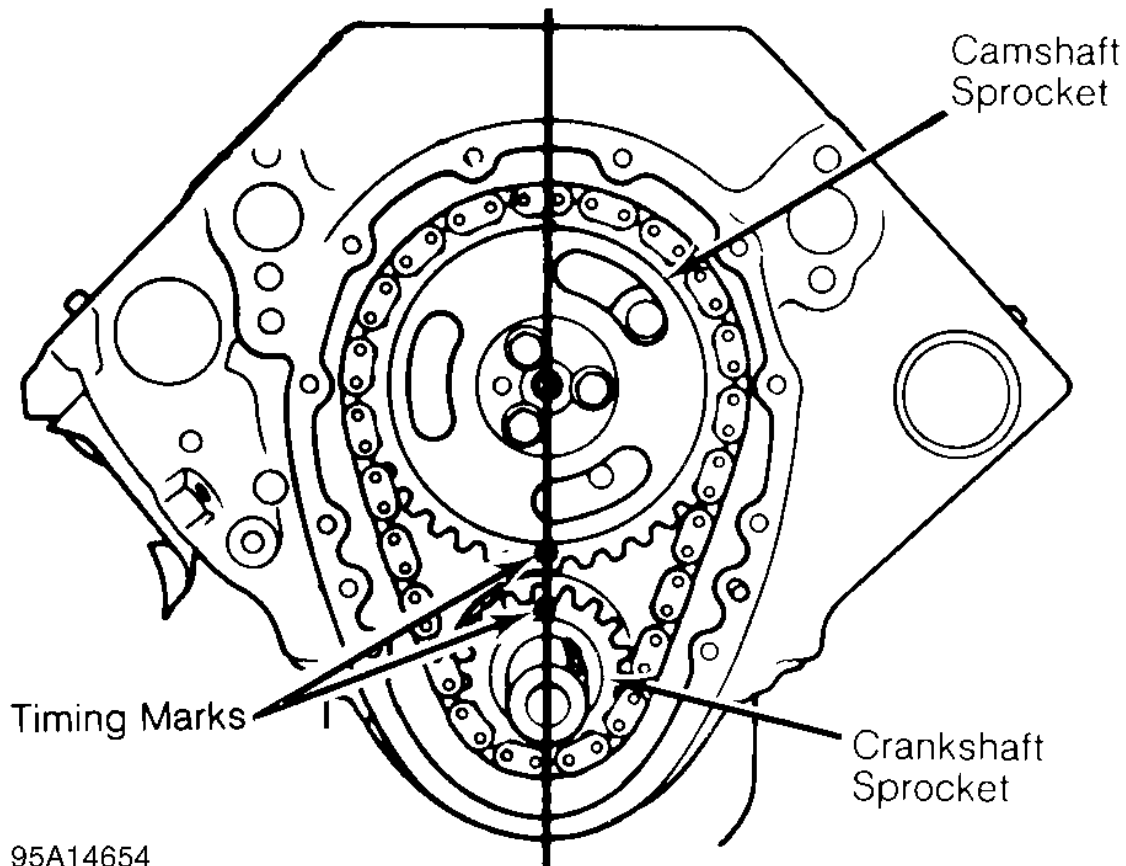


Fig. 24: Typical Gear Timing Mark Alignment

TIMING BELTS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if it is cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head or timing belt cover and then timing belt can be installed. See [Fig. 25](#).

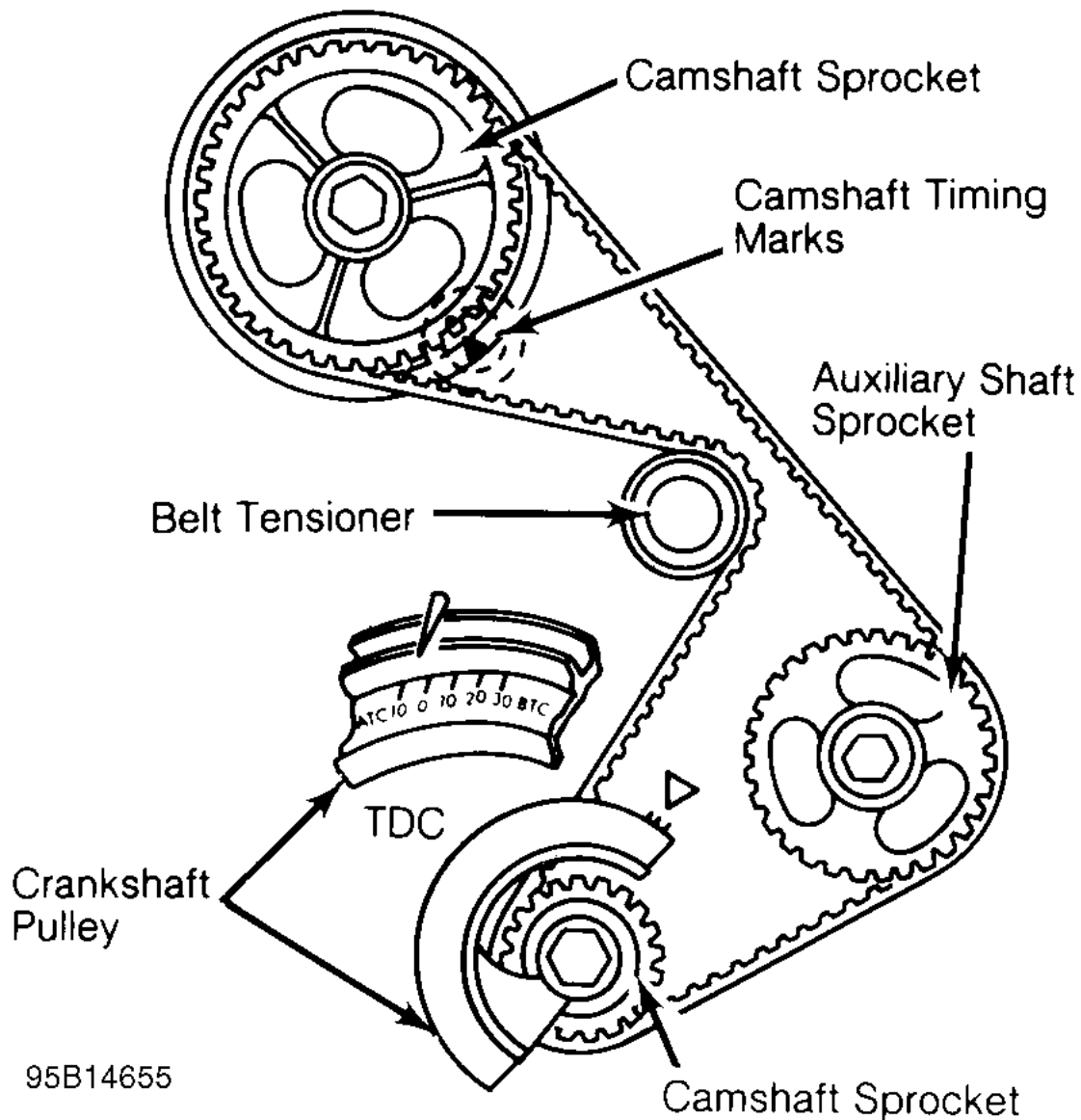


Fig. 25: Typical Camshaft Belt Sprocket Alignment

TENSION ADJUSTMENT

NOTE:

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains.

Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See [Fig. 26](#).

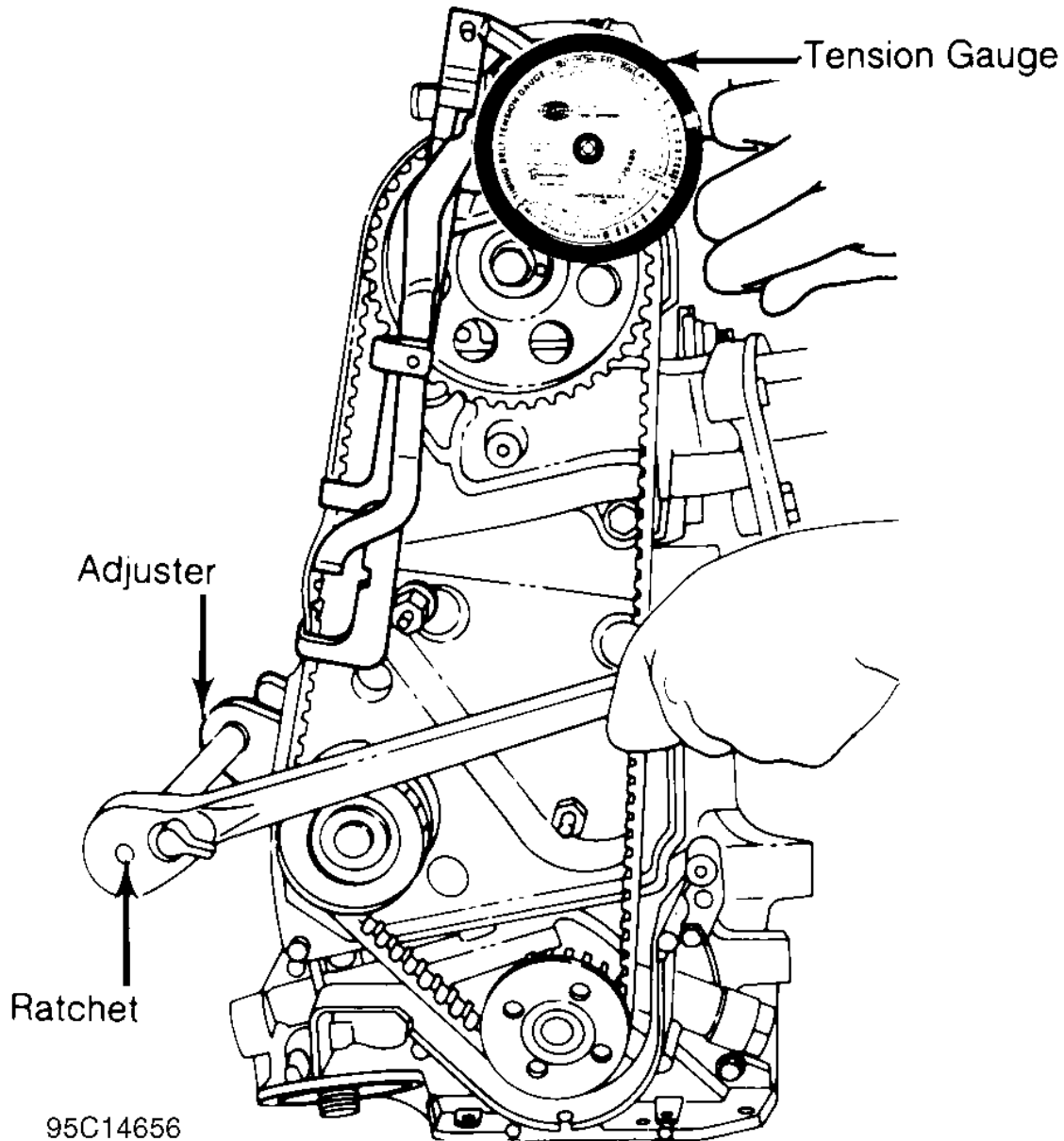


Fig. 26: Adjusting Typical Timing Belt Tension

TIMING GEARS

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate

to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

TIMING GEAR BACKLASH & RUNOUT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceeds specification, replace camshaft and/or crankshaft gear.

REAR MAIN OIL SEAL INSTALLATION

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See [Fig. 27](#).

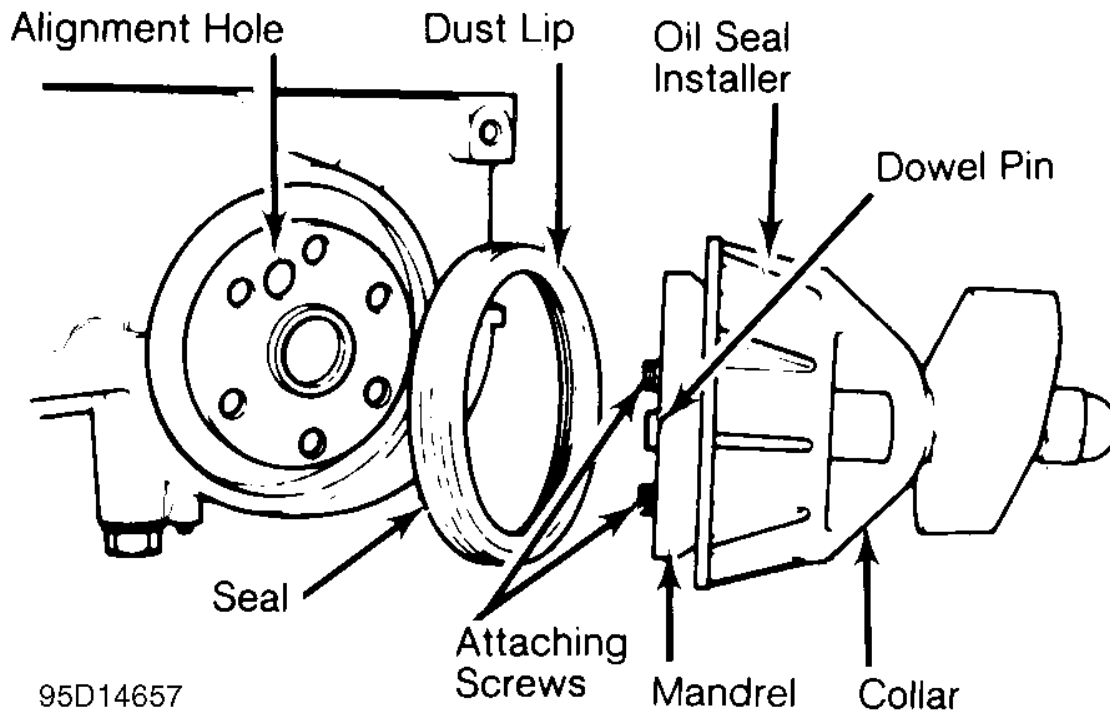


Fig. 27: Installing Typical One-Piece Oil Seal

Rope Type Seal

For rope type rear main oil seal installation, press seal lightly into seat area. Using seal installer, fully seat seal in bearing cap or cylinder block.

Trim seal ends even with cylinder block parting surface. Some applications require sealer to be applied on main bearing cap before installing. See [Fig. 28](#).

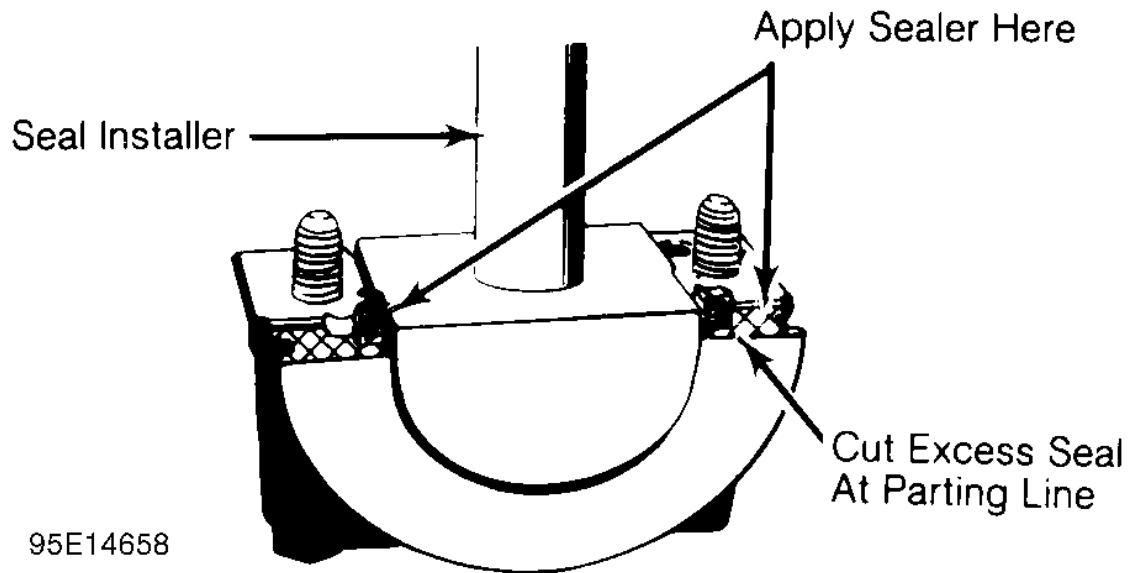


Fig. 28: Installing Typical Rope Seal

Split-Rubber Type Seal

Follow manufacturer's procedures when installing split-rubber type rear main oil seals. Installation procedures vary with manufacturer and engine type. See [Fig. 29](#).

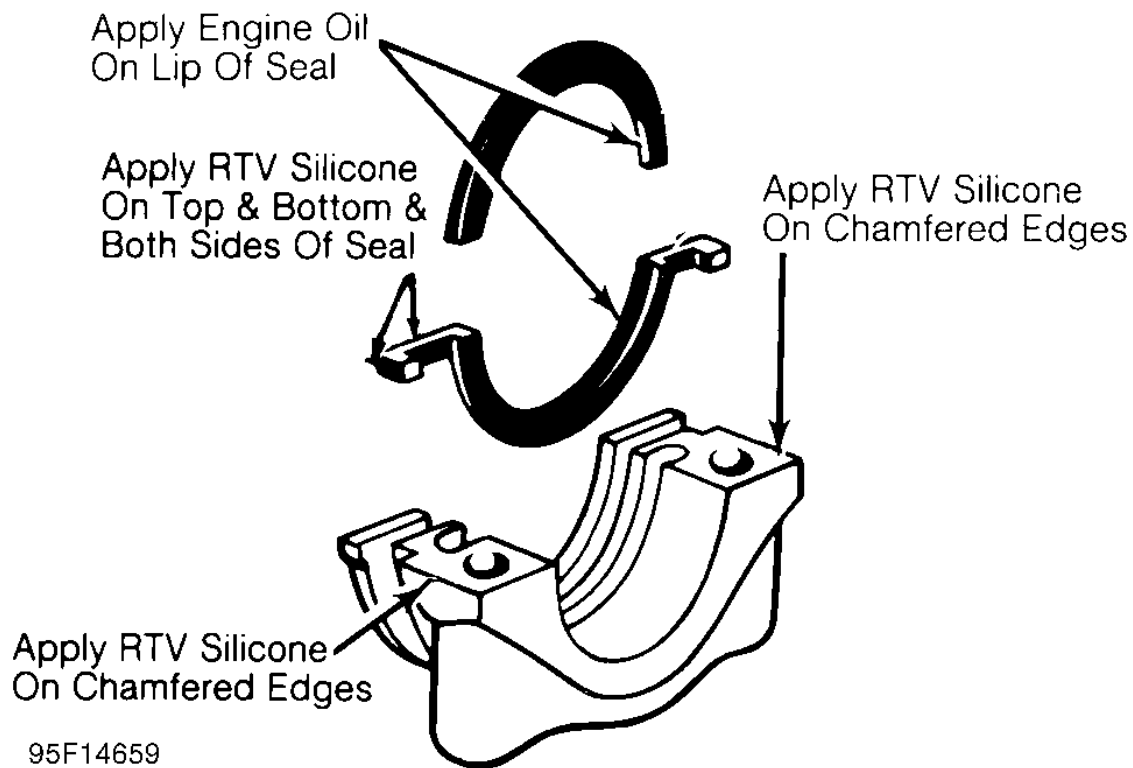


Fig. 29: Installing Typical Split-Rubber Seal

OIL PUMP

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle being repaired.

ROTOR TYPE

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the **ENGINES** section for complete overhaul procedures and specifications for the vehicle

being repaired.

Mark oil pump rotor locations before removing. See [Fig. 30](#). Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace worn or damaged components.

Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See [Fig. 31](#). Replace shaft and both rotors if clearance exceeds specification.

Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.

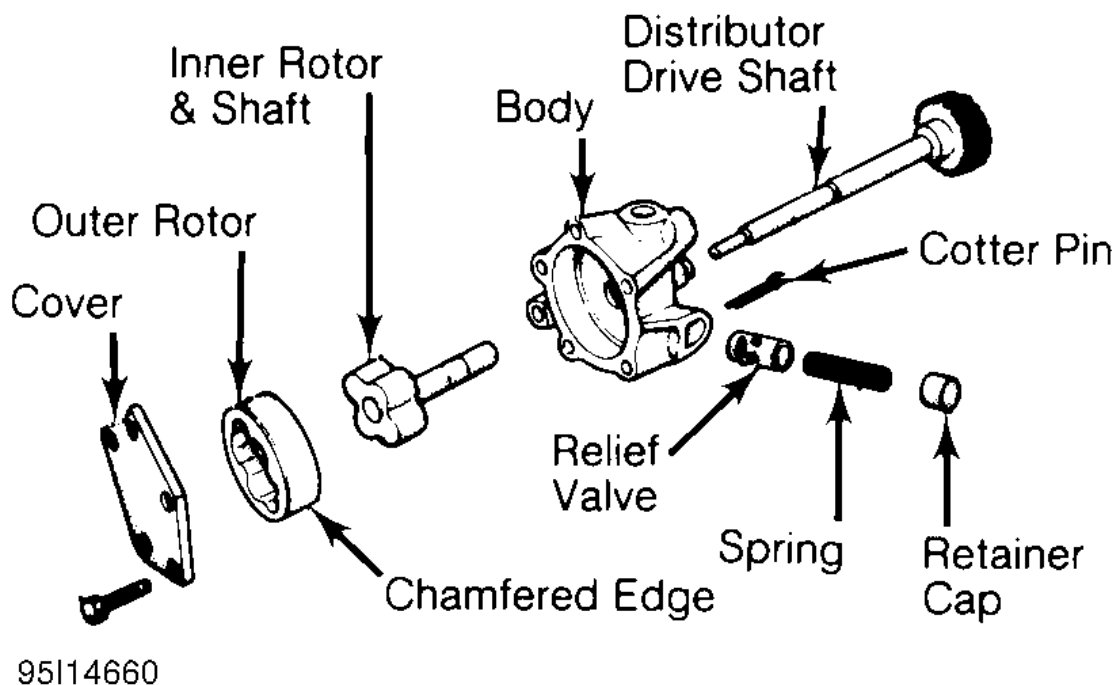


Fig. 30: Typical Rotor Type Oil Pump

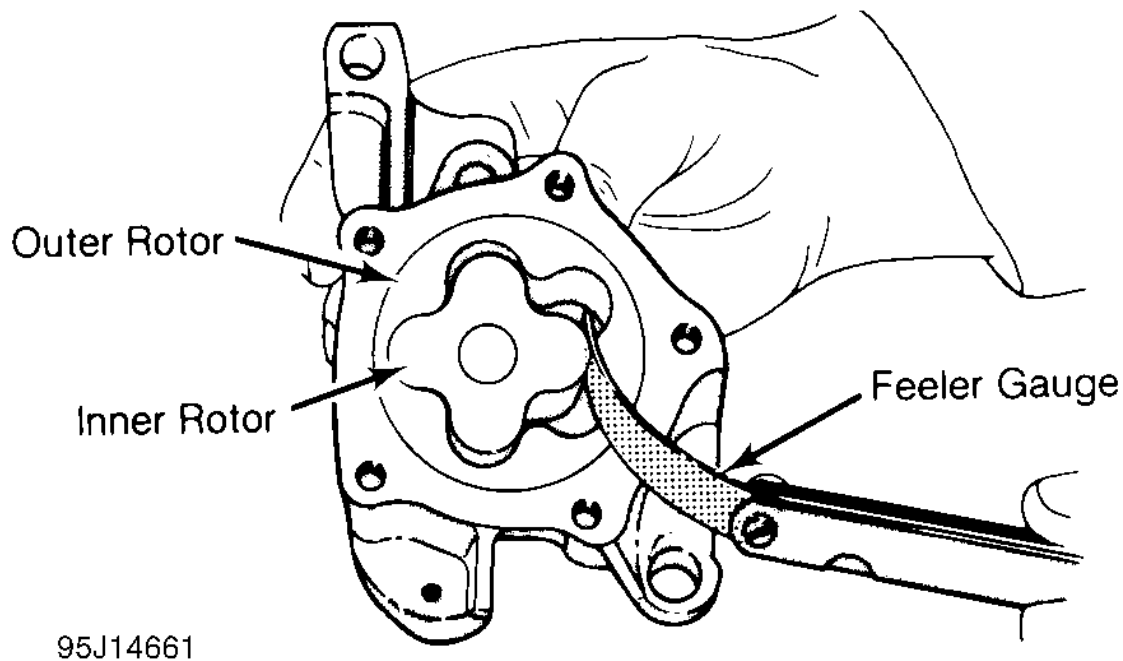


Fig. 31: Measuring Rotor Clearance

GEAR TYPE

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump gear location before removing. See [Fig. 32](#). Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear. Measure gear diameter and length. Measure gear housing cavity depth and diameter. See [Fig. 33](#). Replace worn or damaged components.

Pump cover wear is measured using a straightedge and feeler gauge. Replace pump or components if warpage or wear exceeds specification, or mating surface of pump cover is scratched or grooved.

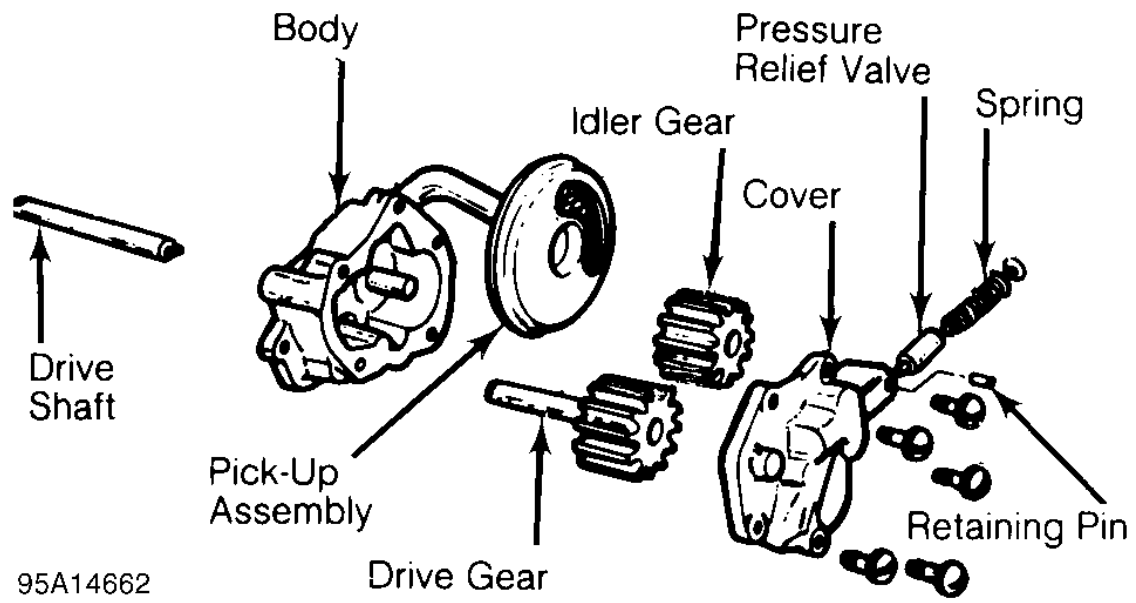
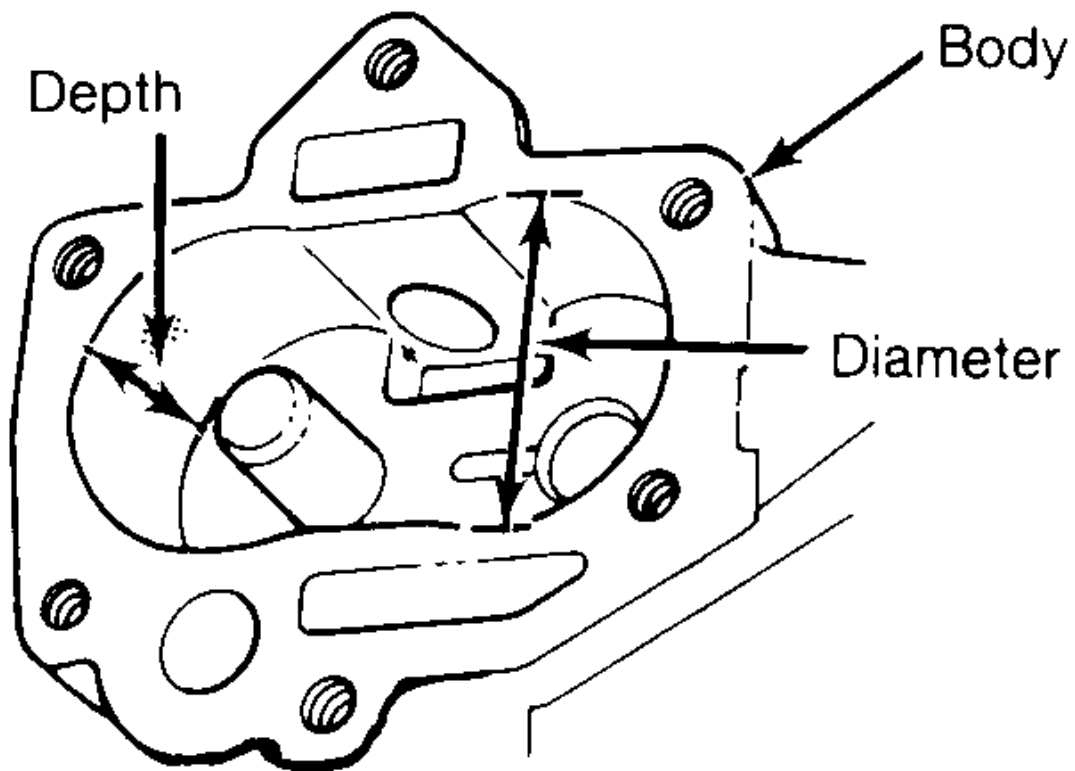


Fig. 32: Typical Gear Type Oil Pump



95B14663

Fig. 33: Measuring Oil Pump Gear Cavity

BREAK-IN PROCEDURE

*** PLEASE READ THIS FIRST ***

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE PRE-OILING

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes

of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Pre-oil engine prior to operation to prevent engine damage. Lightly oiled oil pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. DO NOT crank engine for more than 30 seconds to avoid starter motor damage. Ensure oil pressure has reached the most distant point from the oil pump.

NOTE: If new lifters or camshaft are installed, some manufacturers require that a crankcase conditioner be added to engine oil. The engine should be operated for specified amount of time to aid in lifter break-in procedure.

INITIAL START-UP

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Start engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

CAMSHAFT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Break-in procedure is required when new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturer's recommendations.

PISTON RINGS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer's recommended break-in procedure.

FINAL ADJUSTMENTS

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer's recommended break-in procedure and maintenance schedule for new engines.

NOTE: Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.

Article GUID: A00025128

GENERAL INFORMATION

Engine Performance Diagnostic Routine Outline

*** PLEASE READ THIS FIRST ***

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

WHERE DOES DRIVEABILITY DIAGNOSIS START?

PERFORM BASIC INSPECTION

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Verify Customer Complaint
2. Check for Relevant Technical Service Bulletins (TSBs)
3. Perform Visual Inspection (**See Basic Diagnostic Procedures**)
4. Test Engine Sub-Systems (**See Basic Diagnostic Procedures**)
 - Mechanical Condition (Compression)
 - Ignition Output
 - Fuel Delivery
5. Check Air Induction System For Leaks
6. Check & Adjust Basic Engine Settings(**See On-Vehicle Adjustments**)
 - Ignition Timing
 - Idle Speed

CHECK FOR TROUBLE CODES

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Check for Diagnostic Trouble Codes (DTCs).(See **Self-Diagnostics**)
2. Repair cause of DTCs.
3. Clear PCM memory and repeat self-test.

DIAGNOSE SYMPTOM

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. If no self-diagnostics available, or no trouble codes present, identify symptom.
2. See trouble shooting procedure to identify problem. **(See Trouble Shooting - No Codes)**

TEST SYSTEM

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

1. Perform required tests. **(See Systems & Component Testing)**
2. Verify complaint is repaired.

Article GUID: A00002341

GENERAL INFORMATION

Engine Performance Safety Precautions

- Always refer to Emission Decal in engine compartment before servicing vehicle. If manual and decal differ, always use decal specifications.
- Do not allow or create a condition of misfire in more than one cylinder for an extended period of time. Damage to converter may occur due to loading converter with unburned air/fuel mixture.
- Always turn ignition off and disconnect negative battery cable BEFORE disconnecting or connecting computer or other electrical components.
- DO NOT drop or shock electrical components such as computer, airflow meter, etc.
- DO NOT use fuel system cleaning compounds that are not recommended by the manufacturer. Damage to gaskets, diaphragm materials and catalytic converter may result.
- Before performing a compression test or cranking engine using a remote starter switch, disconnect coil wire from distributor and secure it to a good engine ground, or disable ignition.
- Before disconnecting any fuel system component, ensure fuel system pressure is released.
- Use a shop towel to absorb any spilled fuel to prevent fire.
- DO NOT create sparks or have an open flame near battery.
- If any fuel system components such as hoses or clamps are replaced, ensure they are replaced with components designed for fuel system use.
- Always reassemble throttle body components with new gaskets, "O" rings and seals.
- If equipped with an inertia switch, DO NOT reset switch until fuel system has been inspected for leaks.
- Wear safety goggles when drilling or grinding.
- Wear proper clothing which protects against chemicals and other hazards.

Article GUID: A00002342

GENERAL INFORMATION

English-Metric Conversion Chart

METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to increasing the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple.

Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

- A meter is slightly longer than a yard (about 40 inches).
- An aspirin tablet is about one centimeter across (.4 inches).
- A millimeter is about the thickness of a dime.

VOLUME

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

- A kilogram is about 2.2 pounds.
- A kilogram is about 2.2 pounds.

TORQUE

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long). Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one meter long with force of one Newton applied). Some conversions are:

- A meter kilogram is about 7.2 foot pounds.
- A foot pound is about 1.4 Newton-meters.
- A centimeter kilogram (cmkg) is equal to .9 inch pounds.

PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter (kg/cm^2). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

- Atmospheric pressure at sea level is about 14.7 psi.
- Atmospheric pressure at sea level is about 1 bar.
- Atmospheric pressure at sea level is about 1 kg/cm^2 .
- One pound per square inch is about 7 kPa.

CONVERSION FACTORS

CONVERSION FORMULA

To Convert	To	Multiply By
LENGTH		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Inches	39.37
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers (Km)	Miles	.62137
AREA		
Square Centimeters (cm^2)	Square Inches	.155
Square Inches	Square Centimeters	6.45159
VOLUME		
Cubic Centimeters	Cubic Inches	.06103
Cubic Inches	Cubic Centimeters	16.38703
Liters	Cubic Inches	61.025
Cubic Inches	Liters	.01639
Liters	Quarts	1.05672
Quarts	Liters	.94633
Liters	Pints	2.11344
Pints	Liters	.47317
Liters	Ounces	33.81497
Ounces	Liters	.02957
WEIGHT		
Grams	Ounces	.03527
Ounces	Grams	28.34953
Kilograms	Pounds	2.20462
Pounds	Kilograms	.45359
WORK		

To Convert	To	Multiply By
Centimeter Kilograms	Inch Pounds	.8676
Pounds/Sq. Inch	Kilograms/Sq. Centimeter	.07031
Bar	Pounds/Sq. Inch	14.504
Pounds/Sq. Inch	Bar	.06895
Atmosphere	Pounds/Sq. Inch	14.696
Pounds/Sq. Inch	Atmosphere	.06805
TEMPERATURE		
Centigrade Degrees	Fahrenheit Degrees	$(C \times \frac{9}{5}) + 32$
Fahrenheit Degrees	Centigrade Degrees	$(F - 32) \times \frac{5}{9}$

EQUIVALENCIES

Inches	Decimals	mm
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984
3/32	.094	2.381
7/64	.109	2.778
1/8	.125	3.175
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	.250	6.350
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.992
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509

Inches	Decimals	mm
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	.875	22.225
57/64	.891	22.622
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	1.000	25.400

Release August 2018

Article GUID: A00002345

GENERAL INFORMATION

Gear Tooth Contact Patterns

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

INSPECTION

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing and check backlash at several points around ring gear. Backlash must be within specification at all points. If no defects are found, check gear tooth pattern contact.

NOTE: Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.

GEAR TOOTH CONTACT PATTERN

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

1. Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate gear until clear contact pattern is obtained.
2. Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear pinion must be maintained within specified limits until correct tooth pattern is obtained.

ADJUSTMENTS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

GEAR BACKLASH & PINION SHIM CHANGES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

1. With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.
2. With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.
3. With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Both drive and coast patterns move toward heel and top of tooth.
4. With no change in pinion shim thickness, a decrease in backlash moves ring gear closer to pinion gear. Both drive and coast patterns move toward toe and bottom of tooth.

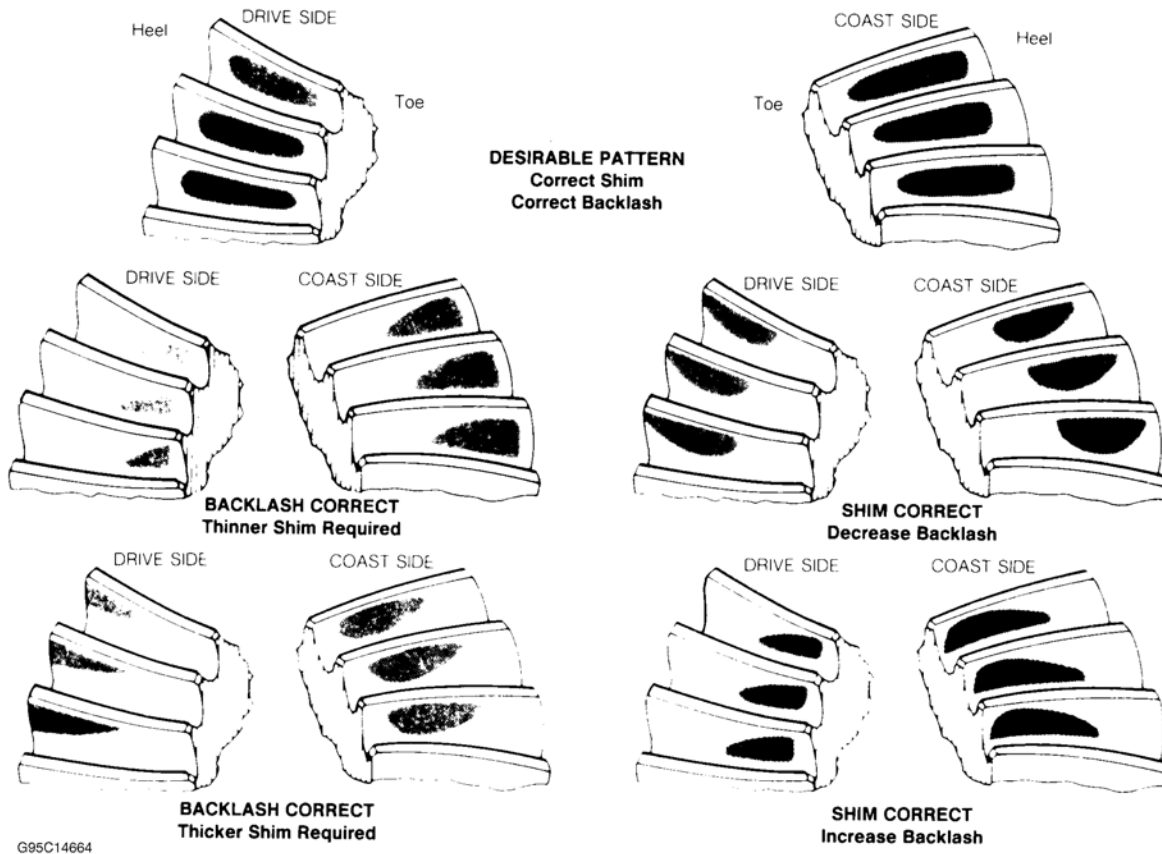


Fig. 1: Drive Axle Gear Tooth Patterns

Article GUID: A00091462

GENERAL INFORMATION

General Cooling System Service

*** PLEASE READ THIS FIRST ***

This article is generic in nature and all information does not apply to all vehicles including those without a liquid cooling system. For vehicle specific information, see the appropriate articles in the ENGINE category.

DESCRIPTION

The liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the engine block and cylinder head.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines have 2, one in each bank of cylinders.

FLUSHING

CAUTION: Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.

Radiator

Connect flushing gun to water outlet of radiator. Disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

Engine Block

To flush engine, remove thermostat. Connect flushing gun to water outlet of radiator. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

TESTING

THERMOSTAT

1. Remove and inspect thermostat for corrosion and proper seating of valve. If okay, suspend thermostat and

thermometer in a 50/50 mixture of coolant and water. See [Fig. 1](#). DO NOT allow thermostat or thermometer to touch bottom or container. Heat water until thermostat begins to open.

2. Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully open temperature. If either reading is not to specification, replace thermostat.

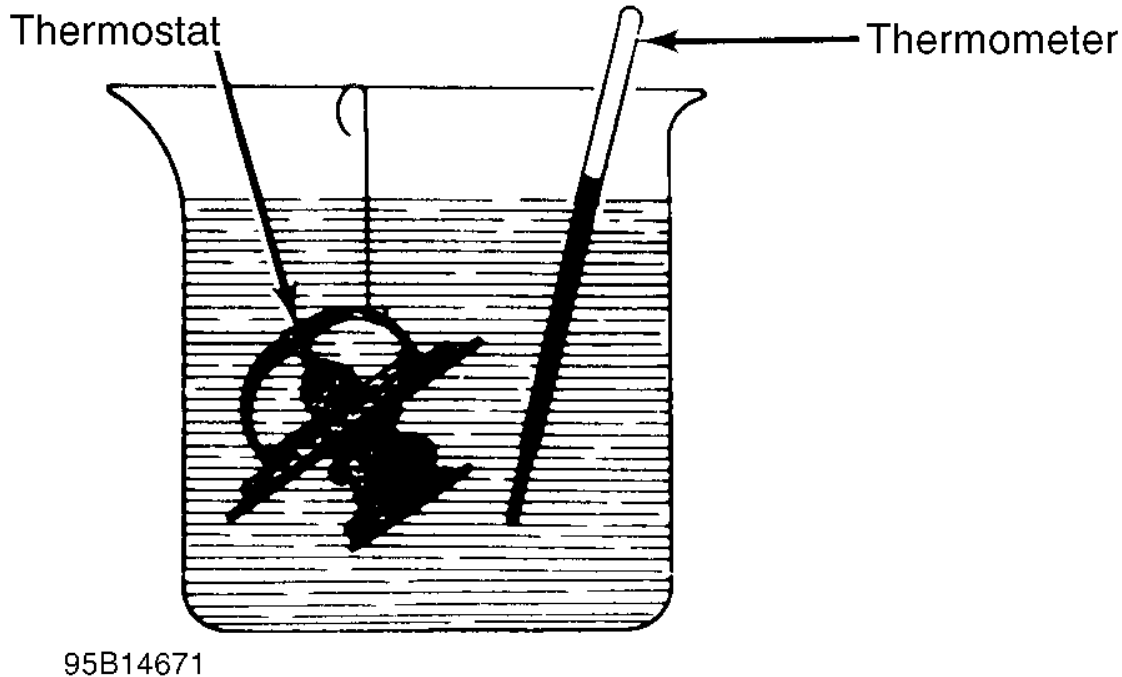


Fig. 1: Testing Thermostat in Coolant/Water Solution

PRESSURE TESTING

A pressure tester is used to check both radiator cap and complete cooling system. Follow pressure tester manufacturer instructions and test components as follows:

Radiator Cap

Visually inspect radiator cap. If cap looks okay, connect pressure tester to cap. See [Fig. 2](#). Pressurize tester to full radiator cap specification. Replace cap if it fails to hold pressure.

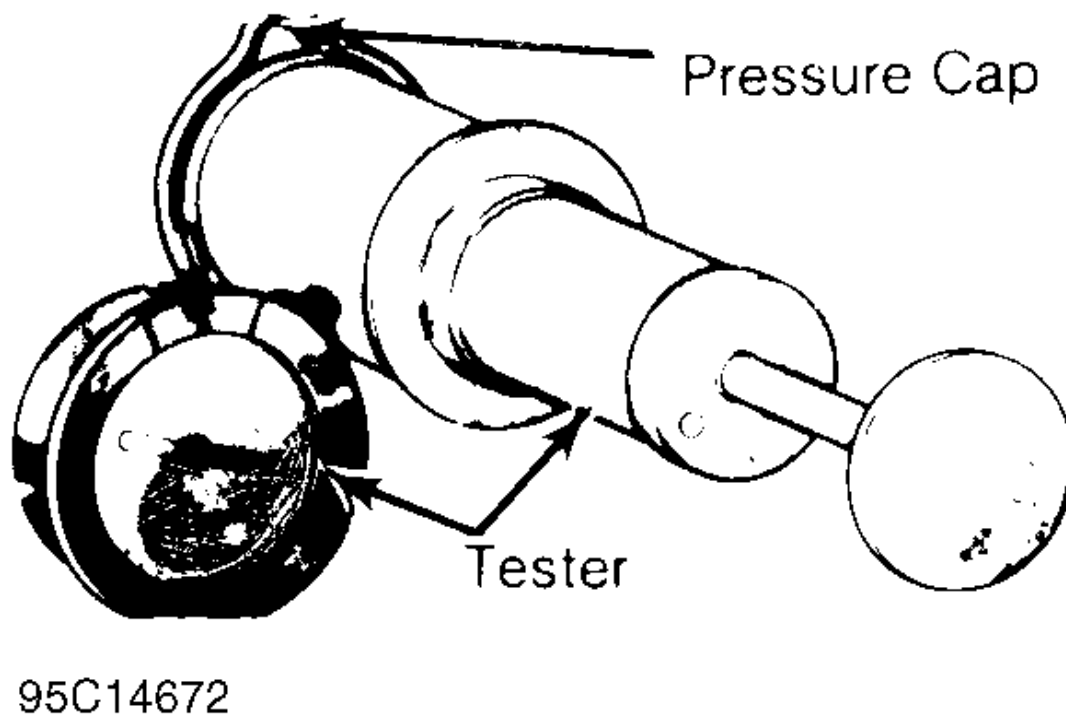


Fig. 2: Pressure Testing Radiator Cap

Cooling System

1. Turn ignition off and allow engine to cool. Ensure radiator is filled to correct level. Remove cap and attach pressure tester to radiator. Pressurize tester to full radiator rating specification.
2. If pressure drops, check for external leaks. If no leaks are found, start engine and allow to idle. If pressure builds up immediately, check cylinder head and block for cracks. If pressure does not build up immediately, go to next step.

CAUTION: DO NOT allow excess pressure to build in cooling system or damage may result.

3. Using pressure tester, pump cooling system up to pressure specified on radiator cap. If pump gauge pointer vibrates, compression or combustion leak into cooling system is indicated. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer vibration will stop or decrease when leaking cylinder is shorted.

GENERAL INFORMATION

General Information - Volt

INTRODUCTION

ARROWS AND SYMBOLS

This service manual uses various symbols in order to describe different service operations.

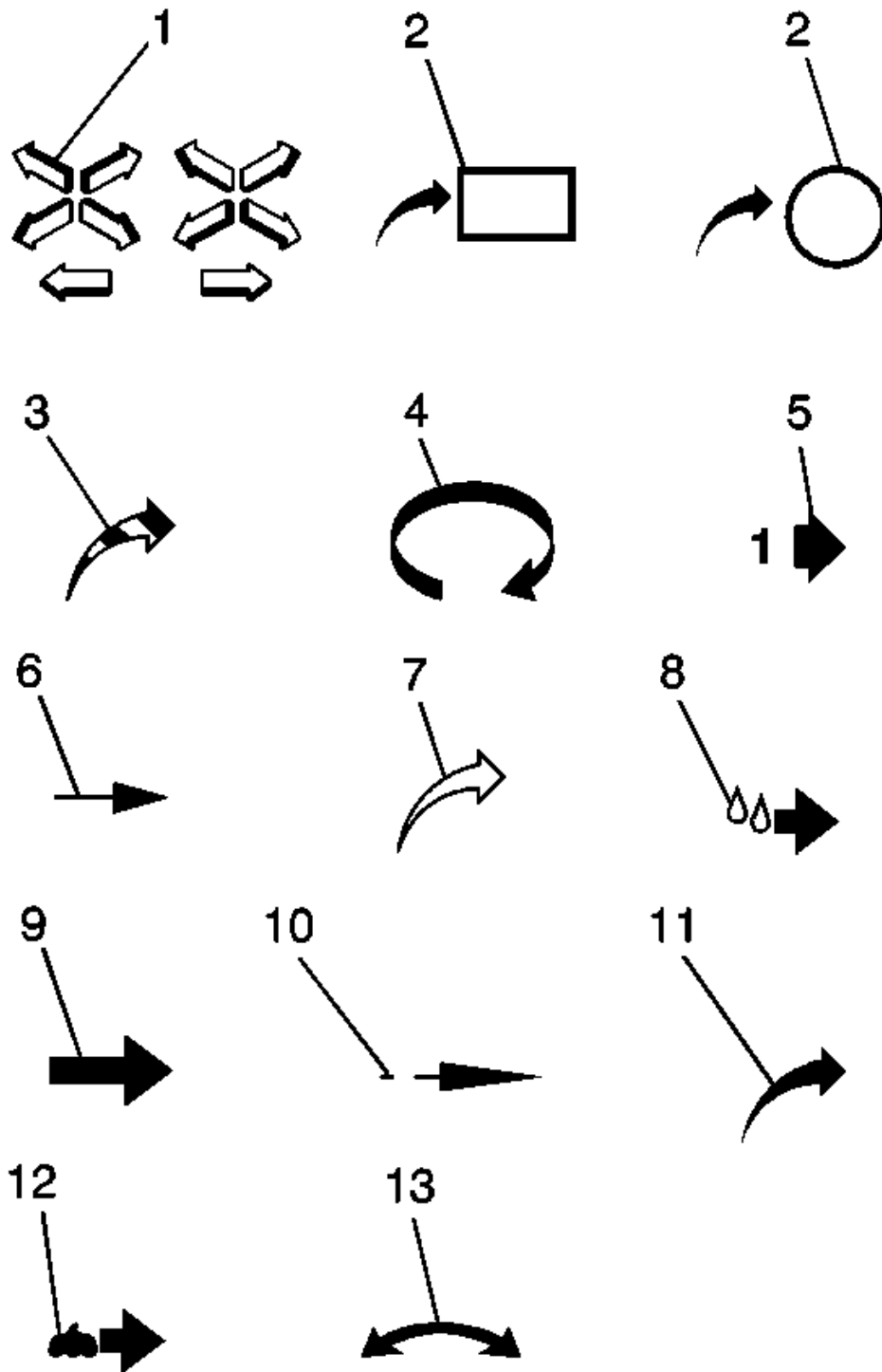


Fig. 1: Identifying Different Service Operations Symbols

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front of Vehicle
2	View Detail

Callout	Component Name
2	View Detail
3	Ambient Air Mixed with Another Gas or Indicate Temperature Change
4	Motion or Direction
5	View Angle
6	Dimension (1:2)
7	Ambient/Clean Air Flow or Cool Air Flow
8	Lubrication Point - Oil or Fluid
9	Task Related
10	Sectioning (1:3)
11	Gas Other Than Ambient Air or Hot Air Flow
12	Lubrication Point - Grease or Jelly
13	Multidirectional Arrow

ACRONYMS AND UNITS

Acronyms

Acronym	Meaning	Definition
2WD	Two-Wheel Drive	Indicates that a vehicle has 2 driven wheels OR that a 4WD vehicle uses only 2 wheels for propulsion. So it can be the description of a vehicle configuration OR the operational mode of the drivetrain.
4WD	Four-Wheel Drive	Four-wheeled vehicle with a drivetrain that allows all four wheels to receive power from the engine simultaneously which provides better control on various surfaces. Can be used to describe the configuration of the vehicle OR as the operational mode of the drivetrain. 4WD vehicles usually can turn 2 wheels off to be in a 2WD mode. See also AWD.
A/C	Air Conditioning	The cooling and dehumidification of indoor air for thermal comfort.
A/D	Analog to Digital	Used in context of converting electrical analog signals to digital signals.
ABS	Antilock Braking System	System on motor vehicles which prevents the wheels from locking while braking which helps the driver maintain control in heavy braking conditions.
AC	Alternating Current	An electrical current whose magnitude and direction vary cyclically.
AM	Amplitude Modulation	Method of impressing data onto an alternating-current (AC) carrier waveform.
APP	Accelerator Pedal Position	A pedal that controls the throttle valve.
AWD	All-Wheel Drive	All-wheel-drive systems are designed to function on all types of surfaces, both on- and off-road, and most of them cannot be switched off. This can also be called full-time four wheel drive. See also 4WD.

Acronym	Meaning	Definition
AWG	American Wire Gauge	American wire gauge is a standardized wire gauge system used since 1857 predominantly in the United States for the diameters of round, solid, nonferrous, electrically conducting wire. E.g. a wire of AWG10 has a diameter of 2.588mm, AWG20 corresponds to a diameter of 0.812mm.
B+	Battery Positive Voltage	The electrical potential on the positive terminal of the battery.
BARO	Barometric Pressure	Atmospheric pressure as measured by a barometer.
BCM	Body Control Module	This module supplies vehicle occupants with visual and audible information and controls various vehicle functions,
BECM	Battery Energy Control Module	Control module used to regulate the battery voltage.
BPP	Brake Pedal Position	Position of the foot pedal that moves a piston in the master brake cylinder.
CAN	Controller Area Network	Serial data connection between control modules by Bosch
CCM	Chassis Control Module	The module that controls various vehicle functions on the Chassis, like Engine/Trans Mount, Active Grille Air Shutter, Load Leveling, etc•••
CD	Compact Disc	A small optical disk on which data such as music, text, or graphic images is digitally encoded.
CNG	Compressed Natural Gas	This a substitute for gasoline or diesel fuel. It is made by compressing natural gas (which is mainly composed by methane (CH ₄), in a percentage range of 70% to 98%)
CO	Carbon Monoxide	This is a product of the incomplete combustion of carbon-containing compounds, at room temperature this is a gas. It consists of one carbon atom covalently bonded to one oxygen atom.
CO ₂	Carbon Dioxide	Chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom.
CPA	Connector Position Assurance	Part of an electrical connector that prevents the connector from moving out of its socket. Usually needs to be pressed to unlock the connector when disconnecting it.
CPP	Clutch Pedal Position	A lever operated with the foot that controls the coupling that connects or disconnects driving and driven parts of a driving mechanism.
CV	Constant Velocity	Used in conjunction with CV joints, which connect two shafts at an angle while both shafts always have the same rotational speed without variations.
CVT	Continuously Variable Transmission	A transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output

Acronym	Meaning	Definition
		shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios which improves fuel economy.
D	Drive	D on the transmission gear selector lever.
DAB	Digital Audio Broadcast	Technology for broadcasting of audio using digital radio (carries information via digital signal) transmission.
DC	Direct Current	Continuous current, constant flow of electric charge.
DLC	Data Link Connector	This is an electronic connector typically located underneath the driver's side dashboard, just above the pedals. The connector has 16 pins.
DMM	Digital Multimeter	Electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.
DOHC	Dual Overhead Camshaft	Dual overhead camshafts (DOHC) are higher performance engines, they produce more power, and can run at higher speeds because they allow an engine to have four valves per cylinder. Each camshaft operates two of the valves, one camshaft handles the intake valves, and one handles the exhaust valves
DPF	Diesel Particulate Filter	Device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
DRL	Daytime Running Lamps	White lights mounted on the front of an automobile that automatically switch on when the key is turned and are intended for daytime use, to increase the visibility of the automobile.
DSCC	Distance Sensing Cruise Control	A type of cruise control that automatically maintains the distance between vehicles.
DSP	Digital Signal Processor	A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.
DTC	Diagnostic Trouble Code	An electronic signal stored in an automotive computer, indicating the presence of a fault detected by that computer.
DVD	DVD	A popular optical disc storage media format the size of a CD. Used mainly for movies but also for data. DVD has no spelled out version (officially it does not mean Digital Video Disc or Digital Versatile Disc, it just means DVD).
EBCM	Electronic Brake Control Module	This module contains a microprocessor and software for antilock braking system operation.

Acronym	Meaning	Definition
ECM	Engine Control Module	This electronic module works with a vehicle's sensors and engine control devices to insure that the engine operates at maximum efficiency and performance. It performs three vital functions. Receives electronic signals from engine sensors. Analyzes the data and makes an engine performance decision (based on the pre-set parameters within the unit). Sends an "output command" to an actuator that adjusts engine performance.
ECT	Engine Coolant Temperature	A measure of how hot or cold the fluid which flows through the engine in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it.
EEPROM	Electrically Erasable Programmable Read-Only Memory	A non-volatile storage chip used in computers and other devices to store small amounts of volatile data, e.g. calibration tables or device configuration.
EGR	Exhaust Gas Recirculation	Is an NOx (nitrogen oxide and nitrogen dioxide) reduction technique used in most gasoline and diesel engines. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders.
EMI	Electromagnetic Interference	Electromagnetic interference (also called radio frequency interference) is a disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source.
ESD	Electrostatic Discharge	The sudden and momentary electric current that flows between two objects at different electrical potentials.
EV	Electric Vehicle	A category of vehicles that only have an electric drive system.
EVAP	Evaporative Emission	A system that controls the fuel fumes in the fuel tank.
FM	Frequency Modulation	In telecommunication this is a way to convey information over a carrier wave by varying its frequency.
FWD	Front-Wheel Drive	A form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only.
GMLAN	General Motors Local Area Network	A local-area network is a computer network covering a small geographic area, like a home or vehicle. This specific type of LAN connects several controllers inside the vehicle and was developed by General Motors.
GPS	Global Positioning System	Satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.

Acronym	Meaning	Definition
GSM	Global System for Mobile Communications	Globally accepted standard for digital cellular communication.
GVW	Gross Vehicle Weight	Maximum total weight of a road vehicle or trailer that is loaded, including the weight of the vehicle itself plus fuel, passengers, cargo, and trailer tongue weight.
HD	Heavy Duty	Robust design to accommodate large work loads.
HID	High Intensity Discharge	A type of light that produces a bright light by using gas filled bulbs. (gas is usually mercury, metal halide, and high-pressure sodium) Uses very little battery power and is a very "cool" light.
HO2S	Heated Oxygen Sensor	Heated oxygen sensors have an internal heater circuit that brings the sensor up to operating temperature more quickly than an unheated sensor. An oxygen sensor must be hot (about 600 - 650°F) before it will generate a voltage signal. The hot exhaust from the engine will provide enough heat to bring an O2 sensor up to operating temperature.
HVAC	Heating Ventilation Air Conditioning	This system is sometimes referred to as climate control. Ventilation air ducts installed throughout a vehicle that supply conditioned air to a room through rectangular or round outlet vents.
I ² C	Inter-Integrated Circuit	Serial data connection between Integrated Circuits (microchips) inside a control module invented by Phillips
IAT	Intake Air Temperature	Temperature of the air entering intake air flow system of the engine.
ICE	Internal Combustion Engine	An engine in which the combustion of fuel and an oxidizer (typically air) occurs in a confined space called a combustion chamber.
ID	Identification	Number or Code that identifies a component or control module. Can be written on the part or be transmitted on a bus or via radio.
ISP	Internet Service Provider	A company that furnishes corporations and individual consumers with various services, mainly access to the Internet.
ISS	Input Shaft Speed	Rotational speed of the input shaft of a transmission.
LAN	Local Area Network	Standard network connection PC's.
LCD	Liquid Crystal Display	A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	Light Emitting Diode	Small light bulbs that fit easily into an electrical circuit they do not have a filament that will burn out, and they do not get especially hot. They are

Acronym	Meaning	Definition
		illuminated solely by the movement of electrons in a semiconductor material.
LIN	Local Interconnect Network	Computer networking bus system used within automotive network architectures. Similar to CAN, but cheaper and less powerful.
LPG	Liquefied Petroleum Gas	A mixture of mainly propane and butane, produced commercially and stored under pressure to keep it in a liquid state.
MAF	Mass Air Flow	The amount of air drawn into the engine
MAP	Manifold Absolute Pressure	Pressure in the engine intake system after the throttle valve referenced to a perfect vacuum.
MDI	Multiple Diagnostics Interface	A device used by GM dealers that enables a PC to communicate with the control modules in a vehicle.
MIL	Malfunction Indicator Lamp	An indicator of the internal status of a car engine.
MOST	Media Oriented Systems Transport	Serial communication bus to transmit audio and video information.
N	Neutral	A state of the transmission in which it is not engaged.
NiMH	Nickel Metal Hydride	A type of rechargeable battery that uses a hydrogen absorbing alloy for the negative electrode.
NOx	Nitrogen Oxides	Refers to any of the following oxygen compounds of nitrogen or a mixture of them. Nitric Oxide, Nitrogen dioxide, Nitrous Oxide, Dinitrogen trioxide, Dinitrogen tetroxide, Dinitrogen pentoxide.
O2	Oxygen	A colorless, odorless, tasteless, gaseous chemical element with the chemical symbol O and atomic number 8.
O2S	Oxygen Sensor	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed.
OBD	On-Board Diagnostic	A generic term referring to a vehicle's self-diagnostic and reporting capability.
OEM	Original Equipment Manufacturer	A producer that provides a product to its customers, who proceed to modify or bundle it before distributing it to their customers.
OSS	Output Shaft Speed	Rotational speed of the output shaft of a transmission.
P	Park	A state in which the transmission is set so one can leave the vehicle.
PCB	Printed Circuit Board	A thin plate on which chips and other electronic components are placed.
PCM	Powertrain Control Module	A control module that features the functions of both, the engine and the transmission control module.
PCMCIA	Personal Computer Memory Card Industry Association	An international standards body and trade association with over 100 member companies that was founded in 1989 to establish standards for Integrated Circuit cards and to promote interchangeability among

Acronym	Meaning	Definition
		mobile computers where ruggedness, low power, and small size were critical.
PIN	Personal Identification Number	A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.
PPE	Personal Protective Equipment	Protective clothing, helmets, goggles, or other garment designed to protect the wearer's body from injury.
PRNDL	Park, Reverse, Neutral, Drive, Low	Park, Reverse, Neutral, Drive, Low (automatic transmission positions).
PTC	Positive Temperature Coefficient	Refers to materials that experience an increase in electrical resistance when their temperature is raised.
PTO	Power Take-Off	A splined driveshaft, usually on a tractor or truck that can be used to provide power to an attachment or separate machine. This mechanism allows implements to draw energy from the tractor's engine.
PVC	Polyvinyl Chloride	A thermoplastic copolymer.
PWM	Pulse Width Modulation	Square shaped type of signal that carries the information in the ratio between on and off times.
R	Reverse	Rearward: directed or moving toward the rear;
RAM	Random Access Memory	A type of computer data storage. It today takes the form of integrated circuits that allow the stored data to be accessed in any order.
RCT	Radiator Coolant Temperature	This is the heat intensity of the radiator coolant measured in degrees. The radiator is a part of the cooling system that removes the engine heat. Coolant is a mixture of water and antifreeze (ethylene glycol) which lowers the freezing point of the water in the coolant system, this fluid also picks up heat from the engine and transfers it to the air.
RDS	Radio Data System	A standard from the European Broadcasting Union for sending small amounts of digital information using conventional FM radio broadcasts.
RF	Radio Frequency	A frequency or rate of oscillation within the range of about 3 Hz and 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves.
ROM	Read-Only Memory	A class of storage media used in computers and other electronic devices. Data stored in ROM cannot be modified.
RPO	Regular Production Option	A three digit/letter code given to parts, assemblies, and systems originally installed on the vehicle. These RPO codes designate options and are assigned by General Motors.

Acronym	Meaning	Definition
RSA	Rear Seat Audio	An auxiliary set of controls that operate the main audio system from the rear seat. Rear passengers can also operate a different media source than the front passengers.
RWD	Rear-Wheel Drive	A common engine/transmission layout in which the engine is in the front of the vehicle, but the front mid-engine, rear mid-engine and rear engine layouts are also used.
SCV	Speed Controlled Volume	The volume control is set for a desired sound level in the vehicle as the vehicle increases its speed, the sound level is adjusted.
SDM	Sensing and Diagnostic Module	The name given to air bag modules used in General Motors vehicles.
SIM	Subscriber Identity Module	Part of a removable smart card Integrated Circuit Card. This is used for mobile cellular telephone devices such as mobile computers and mobile phones. SIM cards securely store the service-subscriber key used to identify a subscriber. The SIM card allows users to change phones by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.
SIR	Supplemental Inflatable Restraint	Technical term for the air bag. Air bag is a stretchable membrane, which inflates during an automobile accident to provide cushioning to the passenger's head and torso to prevent injury to the passengers.
SPI	Serial Peripheral Interface	This is an interface that enables the serial (one bit at a time) exchange of data between two devices. An SPI operates in full duplex mode. This means that data can be transferred in both directions at the same time. It is a standard bus technology like CAN or I2C.
SPS	Service Programming System	System that enables repair facilities to update the software in control modules.
SUV	Sport Utility Vehicle	A passenger vehicle which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan.
SVS	Service Vehicle Soon	Indicator lamp or symbol for a malfunction related to a vehicle component or system.
TA	Traffic Announcement	Message spoken on radio regarding the movement of vehicles or pedestrians through an area or along a route. The buttons on radios that enable this announcements are also often labeled TA.
TAC	Throttle Actuator Control	A motor which moves the engine throttle plate or valve, controlled by the engine control module. A throttle plate limits the amount of air entering a internal combustion gasoline engine.

Acronym	Meaning	Definition
TAP	Transmission Adaptive Pressure	The transmission control module learns each component's characteristics and adjusts fluid pressure accordingly.
TCC	Torque Converter Clutch	Resides in a torque converter to connect an engine to an automatic transmission. The clutch is applied when conditions are correct to achieve a 1:1 ratio of engine crankshaft to transmission input shaft.
TCM	Transmission Control Module	A module that controls electronic automatic transmissions. It uses sensors from the vehicle as well as data provided by the Engine Control Module to calculate how and when to change gears in the vehicle for optimum performance, fuel economy and shift quality.
TDC	Top Dead Center	The piston is in its highest position relative to the combustion chamber.
TIS	Techline Information System	The PC-based global dealership diagnostic software that provides the technician the ability to reference the most recent service information via the service department's computer.
TPA	Terminal Position Assurance	An additional locking mechanism inside an electric connector that holds the pins in place.
TV	Television	A telecommunication system for broadcasting and receiving moving pictures and sound over a distance.
USB	Universal Serial Bus	A type of communication bus connection between a computer and a peripheral device.
VCI	Vehicle Communications Interface	A diagnostic tool that communicates to modules of multiple communication protocols in a vehicle by converting vehicle serial data into PC serial data communication.
VIN	Vehicle Identification Number	Used by manufacturers to uniquely identify motor vehicles using 17 characters.
VSCM	Vehicle Stability Control Module	This module uses information from several sensors to detect a loss of vehicle traction, then works with the antilock brake system to apply individual brakes to help keep the vehicle on its intended path.
VSS	Vehicle Speed Sensor	Sends data regarding how fast the car is traveling at the moment of driving. It is designed to be able to record the rate at which the vehicle's crankshaft is spinning.
WOT	Wide Open Throttle	When the throttle blade or valve is at its maximum open position, allowing maximum air to enter an internal combustion gasoline engine.
WLAN	Wireless Local Area Network	Standard to transmit digital data via radio frequency.

Acronym	Meaning	Definition
XM	XM (Satellite Radio)	XM Satellite Radio Holdings (XM) is one of two satellite radio services in the United States and Canada. XM provides pay-for-service radio, analogous to cable television. Its service includes 73 different music channels, 39 news, sports, talk, and entertainment channels, 21 regional traffic and weather channels and 23 play-by-play sports channels (2008).
XML	Extensible Markup Language	A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Units

Unit	Meaning	Definition
m ²	Square Meter	Area
A	Ampere	Electrical
Ah	Ampere Hour	Electrical
C	Coulomb	Electrical
dBm	Decibel Meter	Electrical
dBmV	Decibel Millivolt	Electrical
mV/DIV	Millivolts per Division	Electrical
mV/s	Millivolts per Second	Electrical
Ω	Ohm	Electrical
V	Volt	Electrical
V/DIV	Volts per Division	Electrical
V/ms	Volts per Millisecond	Electrical
W	Watt	Electrical
mm ³ /stroke	Cubic Millimeters per Stroke	Flow
gal/h	Gallons per Hour	Flow
g/s	grams per second	Flow
g/stroke	Grams per Stroke	Flow
kg/100km	Kilograms per 100 Kilometer	Flow
kg/h	Kilograms per Hour	Flow
km/L	kilometer/liter	Flow
L/100km	Liters per 100 Kilometers	Flow
L/h	Liters per Hour	Flow
L/min	Liters per Minute	Flow
MPG	Miles per Gallon	Flow
mg/s	Milligrams per Second	Flow
mg/stroke	Milligrams per stroke	Flow
ft	feet	Length
in	Inch	Length

Unit	Meaning	Definition
m	Meter	Length
mi	Mile	Length
bar	Bar	Mechanical
bar/min	Bars per Minute	Mechanical
in. H ₂ O	Inches of Water	Mechanical
in. H ₂ O/s	Inches of Water per second	Mechanical
kPa/s	Kilopascals per Second	Mechanical
N	Newton	Mechanical
Â	Newton Meter	Mechanical
Pa	Pascal	Mechanical
Pa/s	Pascals per Second	Mechanical
lb ft	Pound Foot	Mechanical
PSI	Pound-Force per Square Inch	Mechanical
Counts	Counts	Misc.
Cycles	Cycles	Misc.
dB	Decibel	Misc.
Â°	Degree	Misc.
Â°C	Degree Centigrade	Misc.
Â°CA	Degree Crankshaft Angle	Misc.
Â°F	Degree Fahrenheit	Misc.
Â°/s	Degree per Second	Misc.
Hz	Hertz	Misc.
kbit/s	Kilobit per second	Misc.
lx	Lux	Misc.
ppm	Parts per Million	Misc.
%	Percent	Misc.
%/min	Percents per Minute	Misc.
%/sec	Percents per Second	Misc.
Pulses	Pulses	Misc.
:1	Ratio	Misc.
RPM	Revolutions per Minute	Misc.
Steps	Steps	Misc.
W/m ²	Watts per Square Meter	Misc.
g	g (Acceleration)	Movement
km/h	Kilometers per Hour	Movement
m/s	Meters per Second	Movement
m/s ³	Meters per Second Cubed	Movement
m/s ²	Meters per Second Squared	Movement
MPH	Miles per Hour	Movement
mm/s	Millimeters per Second	Movement

Unit	Meaning	Definition
d	Day	Time
h	Hour	Time
hh:mm:ss	Hour:Minute:Second	Time
ms/DIV	Milliseconds per Division	Time
min	Minute	Time
s	Second	Time
s/DIV	Seconds per Division	Time
yy-mm-dd	Year-Month-Day (2 digits)	Time
yyyy-mm-dd	Year-Month-Day (4 digits, preferred)	Time
m ³	Cubic Meter	Volume
gal	Gallon	Volume
L	Liter	Volume
mL	milliliters	Volume
US gal	US Gallon	Volume
US pt	US Pint	Volume
US qt	US Quart	Volume
kg	Kilogram	Weight

TEXT FORMATS AND SYMBOLS

These punctuation marks and symbols are used in the service information to separate information, values, data, and text.

NOTE: In the examples, the punctuation marks and symbols are bold only to highlight them; in the service information, they are not bold.

Punctuation/Symbol	Description
:	Colon separates the "what to do" statement from the "where to do it, how to do it, or which ones" Example: • Disconnect the electrical connector: X3 @ K20 Engine Control Module • Test for less than 10 Ω between the test points: Signal circuit terminal 1 & Ground • Install the following components: • Valve • Bolt [2x] • Nut [2x]
&	Ampersand separates two test points or two or more conditions Example: • Test for less than 10 Ω between the test points: Signal circuit terminal 1 &

Punctuation/Symbol	Description
	Ground Throttle Angle = Greater than 0% & Engine Speed = Less than 1000 RPM
@	At sign separates location information relative to a component. Replaces "from the", "to the" or "at the". Example: - Signal circuit terminal 1 @ Control module harness - Instrument Panel Center Trim Plate Applique @ Instrument Panel - Remove
-	Chevron separates the action/condition/function/object from the object/task /value Example: - Perform the scan tool control function: EVAP Purge Solenoid Valve - 50% - Remove - Test Lamp - Test or replace - B34 Engine Coolant Temperature Sensor - Instrument Panel Center Trim Plate Applique @ Instrument Panel - Remove - If any of the DTCs are set - Repeat Step 5
=	Equal sign separates the observed object from the nominal value or when stating a value Example: - Verify the scan tool parameter: ECT Sensor = <i>Colder than -39Â°C (-38Â°F)</i> - Engine Run Time = Greater than 10 min 0.75 to 1.5 V - A/C Compressor = Off 1.3 to 2.5 V - A/C Compressor = On
-	Hyphen separates the component name from the location information relative to the vehicle (eg. Left, Right, Lower, Upper) Example: Cylinder Head - Left - Remove
-	Minus sign used for negative values Example: Engine Coolant Temperature= Between- 10 and - 5Â°C (14 and 23Â°F)
-	Ndash separates a consecutive numeric range Example: Cylinder 1- 8 Injector
-	Mdash separates additional information at the end of the subject matter Example:

Punctuation/Symbol	Description
	• Engine Controls Ignition Relay Feedback Circuit = Less than 5 V - For greater than 5 s • Switch @ Switch Bezel - Remove - Rotate counterclockwise
/	Forward slash separates conditions or alphanumeric terminals Example: • Screen - Misaligned / Missing / Restricted / Torn • Signal circuit terminal 1/ A @ Control module harness
()	Parenthesis identify a callout reference Example: Instrument Panel Center Trim Plate Applique (1)
[]	Brackets identify a quantity reference Example: Hood Hinge Bolt [2x]
{ }	Curly brackets identify decisional information at the beginning of a subject matter Example: • { If equipped } Instrument Panel Center Trim Plate Applique (1) - Remove • { 2.0L (LHU) } Low Reference circuit terminal 2 & Ground • { 2.4L (LAF) } Low Reference circuit terminal 5 & Ground

GRAPHIC COLORS AND GRAPHIC SYMBOLS

Graphic Colors - General

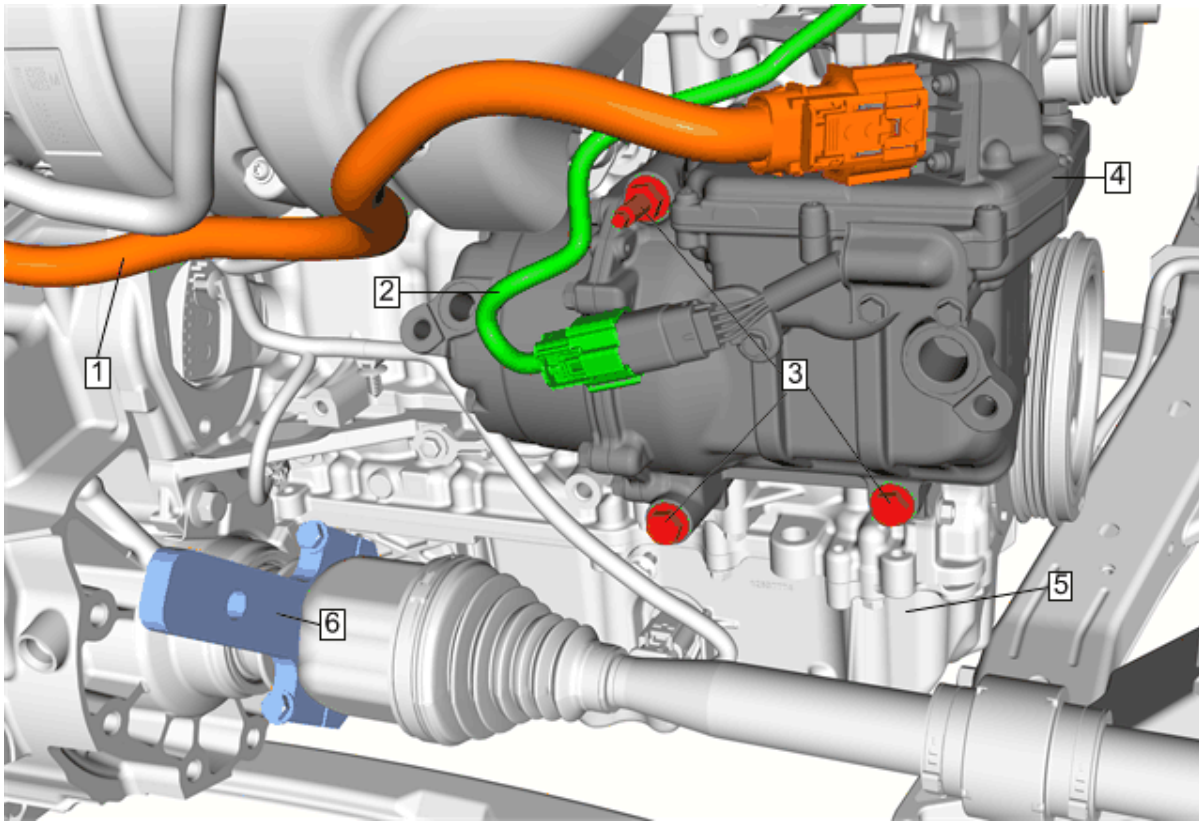


Fig. 2: Graphic Colors - General

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Orange - High voltage electrical connectors and harnesses being removed or installed.
2	Green - Electrical connectors and harnesses being removed or installed.
3	Red - Fasteners being removed or installed.
4	Dark Gray - Standout color that shows the component being removed or installed.
5	Light Gray - Background detail to show component location.
6	Light Blue - Special tool being used.

Graphic Symbols - Collision Repair

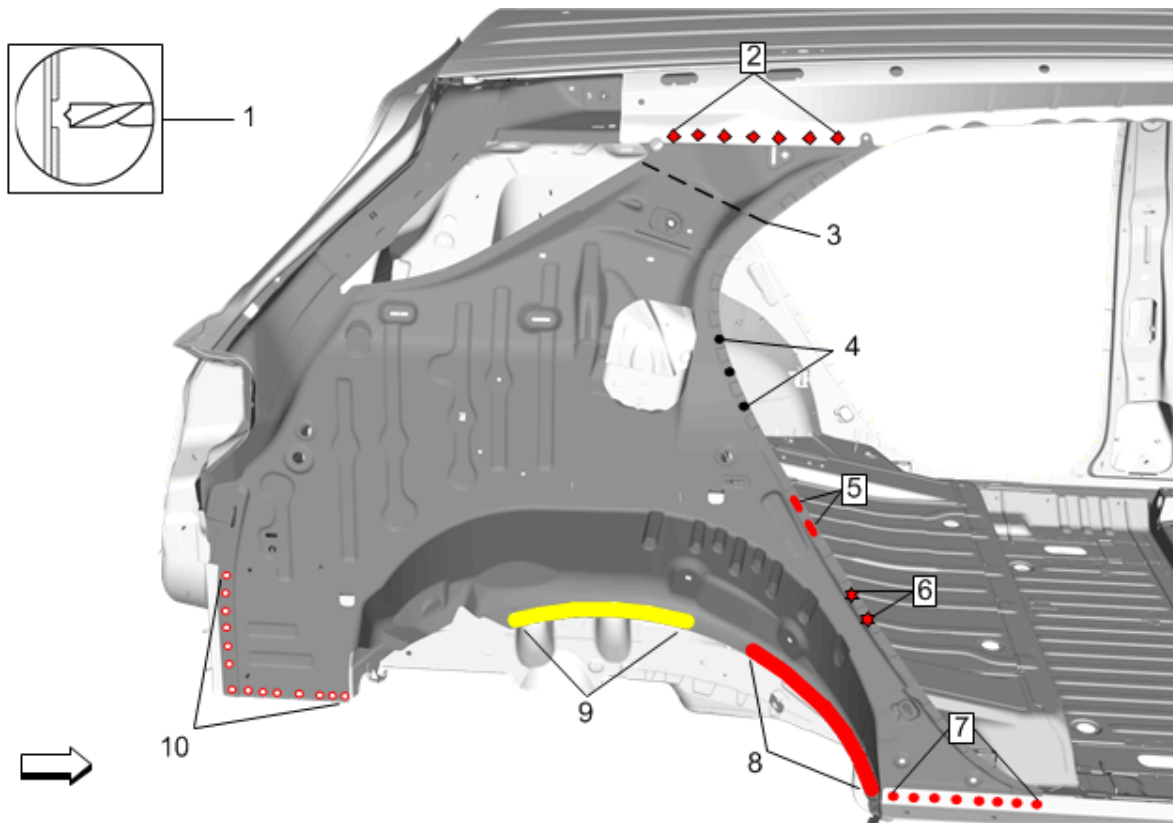


Fig. 3: Graphic Symbols - Collision Repair
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drill through top layer of material only
2	Structural Rivet
3	Sectioning Location
4	Drill Hole
5	Mig Braze Slot
6	Self-Piercing Rivet
7	Mig/Mag Plug Weld
8	Adhesive
9	Apply Heat
10	Resistance Spot Weld

CUSTOMER CONCERN VERIFICATION SHEETS

The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time.

The GM-wide Customer Concern Verification Sheets are available in GM GlobalConnect. The Customer Concern Verification Sheets may be printed and reproduced locally.

TRAINING

Dealers

All U.S. GM Dealers participating in the Center of Learning / GM Service Technical College (STC) Programs can enroll through the Center of Learning website at <https://www.centerlearning.com>. Within the website, there are individual training paths that are designed to assist in planning the training needs for each individual and their job role. Dealers who have questions about Center of Learning Training should contact the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Fleets

GM Fleet customers with GM Warranty In-Shop agreements are able to participate in service technical training through the Center of Learning/GM Service Technical College (STC).

Assistance for GM fleet registered customers using GM STC training is provided by the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Most GM STC course materials have associated charges.

To purchase authentic GM STC Training Materials, contact the GM Training Materials Headquarters at 1-800-393-4831.

Non-GM Dealer Technicians

Technician training for non-GM dealers is available through ACDelco. This training is for ACDelco PSC and Fleet program members employed in the automotive or truck service industry.

ACDelco courses are available at approved GM STC Training Centers. Availability and schedules can be obtained by calling 1-800-825-5886 (prompt 1) or contact us via the web at www.acdelcotechconnect.com and select the Training tab. Seminars are also offered through the ACDelco Warehouse Distribution channel. Contact your Local ACDelco representative or distributor directly for more information.

VEHICLE, ENGINE AND TRANSMISSION ID AND VIN LOCATION, DERIVATIVE AND USAGE

VIN Plate

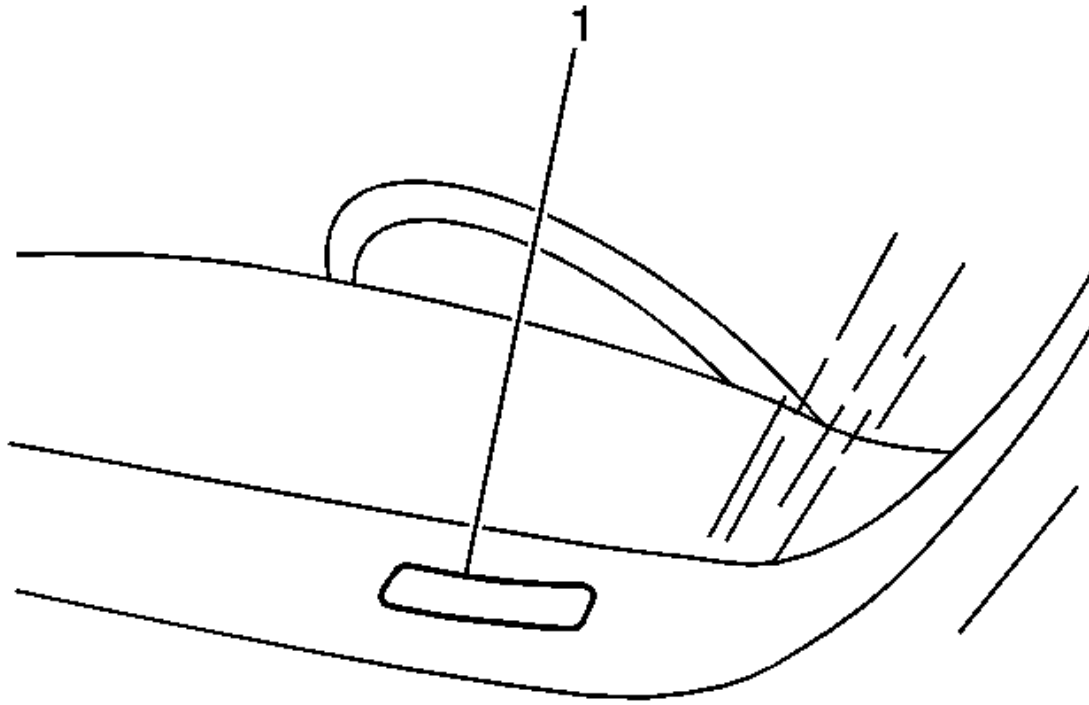


Fig. 4: View Of VIN Plate Location

Courtesy of GENERAL MOTORS COMPANY

The vehicle identification number (VIN) plate (1) is the legal identifier of the vehicle. The VIN plate is located on the upper left corner of the instrument panel (I/P) and can be seen through the windshield from the outside of the vehicle.

VIN Body Stamping

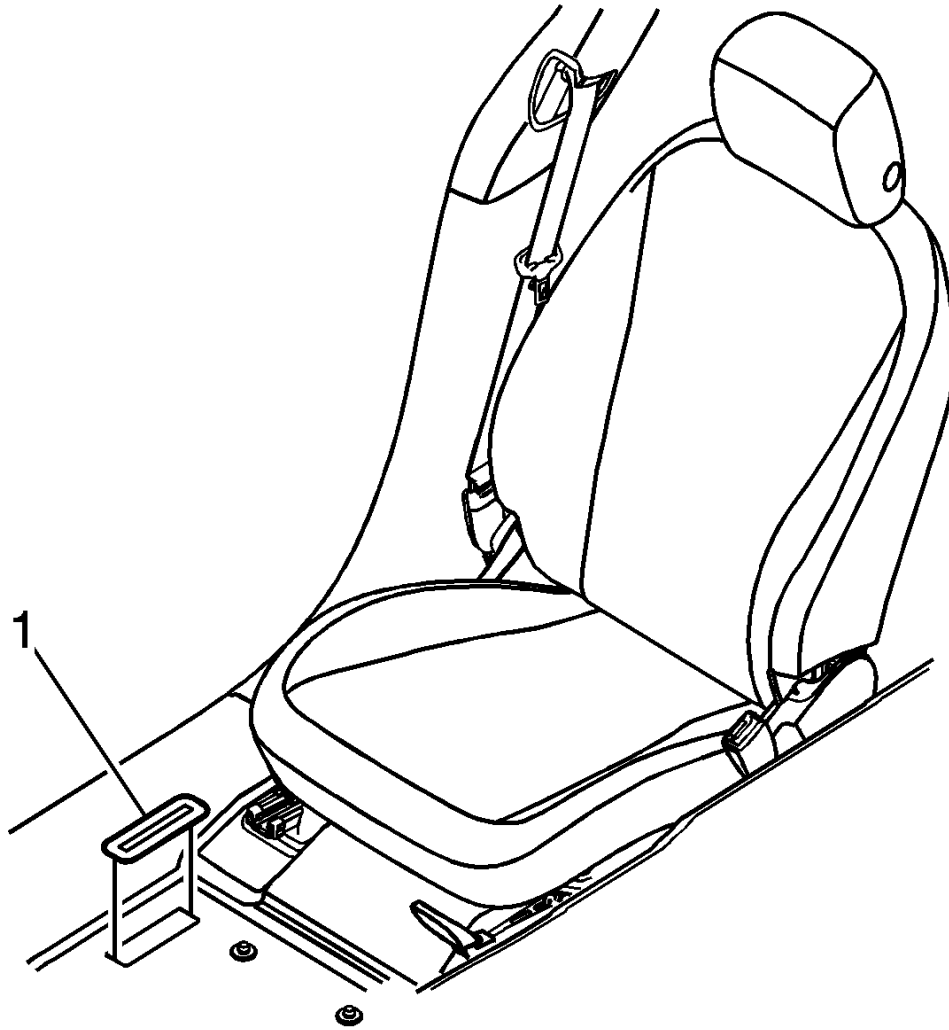


Fig. 5: VIN Body Stamping

Courtesy of GENERAL MOTORS COMPANY

The stamping is located on the front floor panel under the front right-hand floor mat. It can be seen under the VIN Plate Opening Access Cover (1).

Position	Definition	Character	Description
1	Region of Build	1	United States
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet Passenger Car
4-5	Vehicle Line/Series	R/A	Volt LT, Standard Emissions Package
		R/B	Volt Premier, Standard Emissions Package
		R/C	Volt LT, Low Emissions Package
		R/D	Volt Premier, Low Emissions Package
		R/9	Volt (Non US, Non Canada)
6	Body Style	68	Sedan, 4 - Door, 6 Window, Plain Back, (H/Back)

Position	Definition	Character	Description
7	Restraint System	S	AYF - Active Manual Belts, Airbags - Driver & Passenger Front (1st row), Front Seat Side (1st row) & Rear Seat Side (2nd row), Roof Side (all seating rows), Driver & Passenger knee (1st row)
8	Engine Type	5	L3A - ENGINE GAS, 4 CYL, 1.5L, DI, DOHC, VVT, HYBRID, GEN 1
9	VIN Check Digit	Varies	Calculated Check Digit
10	Model Year	H	2017
11	Plant Location	U	Detroit Hamtramack
12 - 17	Production Sequence Number	-	Production Sequence Number

1.5L (L3A) Engine ID and VIN Derivative Location

Refer to [Engine Identification](#) .

Transmission ID and VIN Derivative Location

Refer to [Transmission Identification Information](#) .

VEHICLE CERTIFICATION, TIRE PLACARD, ANTI-THEFT, AND SERVICE PARTS ID LABEL

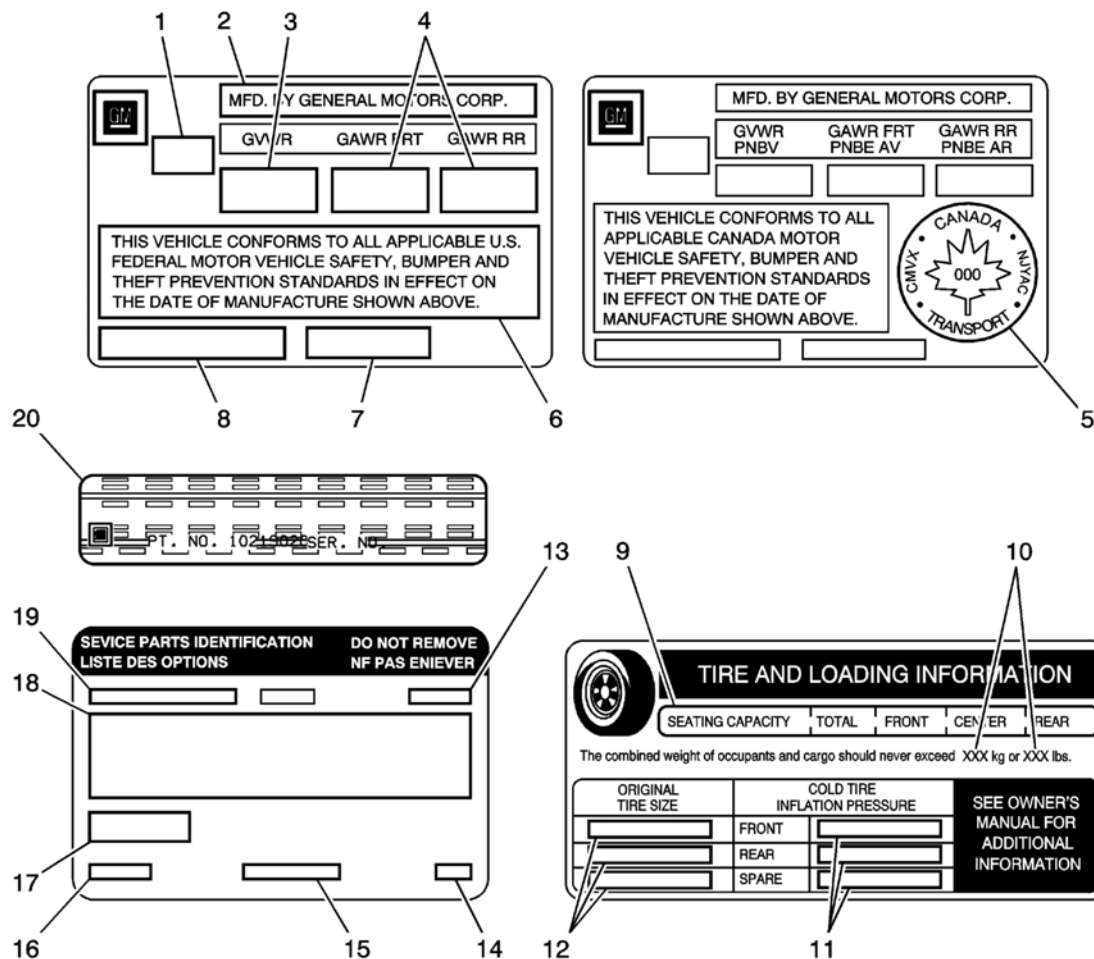


Fig. 6: Identifying Vehicle Certification, Tire Place Card, Anti-Theft & Service Parts ID Labels
 Courtesy of GENERAL MOTORS COMPANY

Callout	Description
Vehicle Certification Label The vehicle certification label is located on the driver side B pillar and displays the following assessments: • Gross Vehicle Weight Rating (GVWR) • Gross Axle Weight Rating (GAWR), front and rear • The gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. The gross vehicle weight must not exceed the Gross Vehicle Weight Rating. Include the following items when figuring the GVW: • The base vehicle weight (factory weight) • The weight of all vehicles accessories • The weight of the driver and the passengers • The weight of the cargo	
1	Name of Manufacturer

Callout	Description
2	Gross Vehicle Weight Rating
3	Gross Axle Weight Rating (Front, Rear)
4	Canadian Safety Mark (w/RPO Z49)
5	Certification Statement
6	Vehicle Class Type (Pass Car, etc.)
7	Vehicle Identification Number
8	Date of Manufacture (Mo/Yr)
Tire Placard	
The tire placard label is located on the driver side B pillar and displays the following assessments:	
9	Specified Occupant Seating Positions
10	Maximum Vehicle Capacity Weight
11	Tire Pressure, Front, Rear, and Spare (Cold)
12	Original Equipment Tires Size
Service Parts ID Label	
The vehicle service parts identification label is located in the rear compartment in the right hand quarter stowage pocket. The label is use to help identify the vehicle original parts and options.	
13	Vehicle Identification Number
14	Engineering Model Number (Vehicle Division, Line, and Body Style)
15	Interior Trim Level and Decor
16	Exterior (Paint Color) WA Number
17	Paint Technology
18	Special Order Paint Colors and Numbers
19	Vehicle Option Content
Anti-Theft Label	
20	The Federal law requires that General Motors label certain body parts on this vehicle with the VIN. The purpose of the law is to reduce the number of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles. Labels are permanently affixed to an interior surface of the part. The label on the replacement part contains the letter R, the manufacturer's logo, and the DOT symbol. The anti-theft label must be covered before any painting, rustproofing procedures, and uncovered after the procedures. Failure to follow the precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard and possible suspicion to the owner that the part was stolen.

RPO CODE DESCRIPTION

RPO	Description
4AA	INTERIOR TRIM-JET BLACK
4EL	INTERIOR TRIM-JET BLACK/BRANDY
4H5	INTERIOR TRIM-DARK ASH GRAY/LIGHT ASH GRAY
5A7	WHEEL SPARE-NONE
5CL	ACCESSORY-CHARGE CORD SET MODE3 CHARGING - KOREAN STANDARD TO TYPE 1 VEHICLE

RPO	Description
5GP	TIRE ALL-215/50R17 SL 91 H BW ALS
5XB	ACCESSORY-CHARGE CORD SET - 110/120V - STANDARD
62G	ACCESSORY-ACCENT LIGHTING - FRONT EXTERIOR
9L3	TIRE SPARE-NONE
A51	SEAT-FRT BKT, CUSTOM
ACO	IDENTIFICATION-ACCESSORY CATALOG OFFERING
AG6	ADJUSTER PASS ST-MANUAL, 4 WAY
AH3	ADJUSTER FRT ST-MANUAL, 4 WAY, DRIVER
AJC	RESTRAINT-HEAD, FRT SEAT, UP/DOWN ADJUSTMENT
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
AXJ	VEHICLE TYPE-PASSENGER CAR
AYF	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER & PASS FRT, FRT SEAT SIDE & RR SEAT SIDE, ROOF SIDE, KNEE
BTT	ALARM-REMOTE PANIC
C68	HVAC SYSTEM-AIR CONDITIONER FRT, AUTO, ELECTRONIC CONTROLS
CV3	COUNTRY-MEXICO
CW1	COUNTRY-KOREA
D31	MIRROR I/S R/V-TILT
D71	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING
DD8	MIRROR I/S R/V-LT SENSITIVE
DEH	PLANT CODE-DETROIT/HAMTRAMCK, MI, USA
DLW	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED
EF7	COUNTRY-UNITED STATES OF AMERICA (USA)
EVS	PROP ENGY STOR PACK-PROPULSION BATTERY, LI, 370V, 50AH, UNDERBODY
EXP	EXPORT-
FE2	SUSPENSION SYSTEM-RIDE, HANDLING
FE9	CERTIFICATION-EMISSION, FEDERAL
FHO	VEHICLE FUEL-GASOLINE E10
FXJ	RATIO-TRANSAXLE FINAL DRIVE 2.64
G1E	PRIMARY COLOR-EXTERIOR, LIMITED ADDICTION RED TINT (405Y)
G1W	PRIMARY COLOR-EXTERIOR, ABALONE WHITE TRICOAT(140X)
GA1	PRIMARY COLOR-EXTERIOR, JADE MET (378A).
GA6	PRIMARY COLOR-EXTERIOR, YOU DRIVE ME GRAZY MET (380A)
GAN	PRIMARY COLOR-EXTERIOR, SWITCHBLADE SILVER MET (G) 636R
GAZ	PRIMARY COLOR-EXTERIOR, SUMMIT WHITE (G) 8624
GB8	PRIMARY COLOR-EXTERIOR, BLACK MEET KETTLE MET (384A)

RPO	Description
GD1	PRIMARY COLOR-BLUE ME AWAY MET (388A)
GMU	PRIMARY COLOR-EXTERIOR, PEPPERDUST MET-2 (441B)
H0Y	INTERIOR TRIM CONFIG-LEATHER, LEVEL 1, JET BLACK
H1T	INTERIOR TRIM CONFIG-CLOTH, LEVEL 1, JET BLACK
H81	INTERIOR TRIM CONFIG-CLOTH, LEVEL 1, DARK ASH GRAY/LIGHT ASH GRAY
H82	INTERIOR TRIM CONFIG-LEATHER LEVEL 1, DARK ASH GRAY/LIGHT ASH GRAY
H83	INTERIOR TRIM CONFIG-LEATHER LEVEL 1, JET BLACK/BRANDY
I17	ENGINEERING YEAR-2017
IO5	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY
IO6	RADIO-INFOTAINMENT SYSTEM - UPLEVEL HMI, ENHANCED CONNECTIVITY, EMBEDDED NAVIGATION
J67	BRAKE SYSTEM-POWER, FRT & RR DISC, ABS, 15"
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
KA1	HEATER SEAT FRT-DRVR & PASS
KA6	HEATER SEAT-REAR
KSG	CRUISE CONTROL-AUTOMATIC, ADAPTIVE, WITH STOP/GO
KTI	KIT, TIRE-INFLATOR
L3A	ENGINE-GAS, 4 CYL, 1.5L, DI, DOHC, VVT, HYBRID, GEN 1
LHD	VEHICLE DRIVE-LEFTHAND DRIVE
MKV	TRANSMISSION-AUTO, ELECTRIC MOTOR, GM, GFE E REV DRIVE UNIT, X40F
N30	STEERING WHEEL-DELUXE
NE1	CERTIFICATION-EMISSION, GEOGRAPHICALLY RESTRICTED REGISTRATION FOR VEHICLES UP TO 14, 000 LBS GVW (USE 2003 MDL YR
NTB	EMISSION SYSTEM-FEDERAL, TIER 3
NU6	EMISSION SYSTEM-CALIFORNIA, PZEV
NUF	EMISSION SYSTEM-CALIFORNIA, ULEV125
NUL	EMISSION SYSTEM-KOREAN, SULEV30
RSB	WHEEL-17 X 7.0, J, ALUMINUM, DESIGN 1
RTN	WHEEL-17 X 7.0, J, ALUMINUM, DESIGN 2
RVW	ACCESSORY-BAG - TRUNK/CARGO AREA ORGANIZER
RWJ	ACCESSORY-COVER - VEHICLE - OUTDOOR, DESIGN 1
RWS	ACCESSORY-FLOOR MATS - CARPET
RWU	ACCESSORY-CARGO AREA ORGANIZER - COLLAPSIBLE
RYT	ACCESSORY-FIRST AID KIT
S08	ACCESSORY-HIGHWAY SAFETY KIT

RPO	Description
S4X	ACCESSORY-MIRROR COVERS/SKULL CAPS - ALTERNATE FINISH - PAINTED
SBZ	ACCESSORY-SPORT PEDAL KIT
SDI	ACCESSORY-TRIANGLE - REFLECTIVE
SFE	ACCESSORY-WHEEL LOCKS
SFJ	ACCESSORY-WINDOW SHADES - REFLECTIVE
SFS	ACCESSORY-SUN SHADES - REAR WINDOW
SFZ	ACCESSORY-EMBLEM - EXTERIOR - DESIGN 1
SH4	ACCESSORY-ILLUMINATED CUPHOLDERS AND FOOT WELLS
SIF	ACCESSORY-RSE - PORTABLE MEDIA CONNECTIVITY PACKAGE
SJH	ACCESSORY-WHEEL - 17 X 7.0 - J - ALUMINUM - DESIGN 1
TDM	MODE-TEEN DRIVER SETTINGS
TQ5	HEADLAMP HIGH BEAM-AUTO CONTROL
U2K	DIGITAL AUDIO SYSTEM-S-BAND
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
UE4	SENSOR INDICATOR-FOLLOWING DISTANCE
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UFG	SENSOR INDICATOR-REAR CROSS TRAFFIC ALERT
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UGN	COLL IMMINENT BRK-ALL SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UHS	DISPLAY INSTRUMENT-DRIVER INFO ENHANCED (MULTI COLOR ENHANCED GRAPHIC)
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UJM	TIRE PRESS INDICATOR-MANUAL LEARN
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
UQA	SPEAKER SYSTEM-PREMIUM AUDIO BRANDED WITH AMPLIFIER
UVC	VISION-REAR VIEW, MONO, ANALOG
UVD	STEERING WHEEL HEAT-MANUAL
UZ6	SPEAKER SYSTEM-6, PREMIUM
V7X	SALES PACKAGE-#1
V7Y	SALES PACKAGE-#2
V8C	VEHICLE STATEMENT-MEXICO
V8D	VEHICLE STATEMENT-US
V8E	VEHICLE STATEMENT-CANADA
V8Y	VEHICLE STATEMENT-KOREA-FTA
VAV	ACCESSORY-FLOOR MATS - ALL WEATHER
VJQ	HOOK-TOW, FRT

RPO	Description
VK3	LICENSE PLATE FRONT-FRT MOUNTING PKG
VKX	ACCESSORY-SPARE WHEEL & TIRE
VLI	ACCESSORY-MAT - TRUNK / CARGO AREA
VMA	LICENSE PLATE FRONT-FRT MOUNTING PKG, KOREA
VPH	VEHICLE PREPARATION-OVERSEAS DELIVERY
VST	ACCESSORY-SILL PLATES - ALTERNATE DESIGN 1
VV4	COMMUNICATION EQUIP-MOBILE INTERNET CONNECTIVITY
VY7	KNOB-TRANS CONT LEVER, LEATHER
VYW	ACCESSORY-FLOOR MATS - PREMIUM CARPET - DESIGN 1
W2D	ACCESSORY-CARGO NET
WMH	VIN MODEL YEAR-2017
XL8	FREQUENCIES RATING-433 MHZ
YF5	CERTIFICATION-EMISSION, CALIFORNIA
YM8	IDENTIFICATION-LIMITED PERSONALIZATION OPTION (LPO)
Z49	COUNTRY-CANADA
Z49	COUNTRY-CANADA

FASTENERS

Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in diameter to equivalent English fasteners. Make replacements using fasteners of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners except cross-recess head screws. The number also indicates the strength of the fastener material. A Posidrive® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in Posidrive® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4 - 20 and 1/4 - 28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification

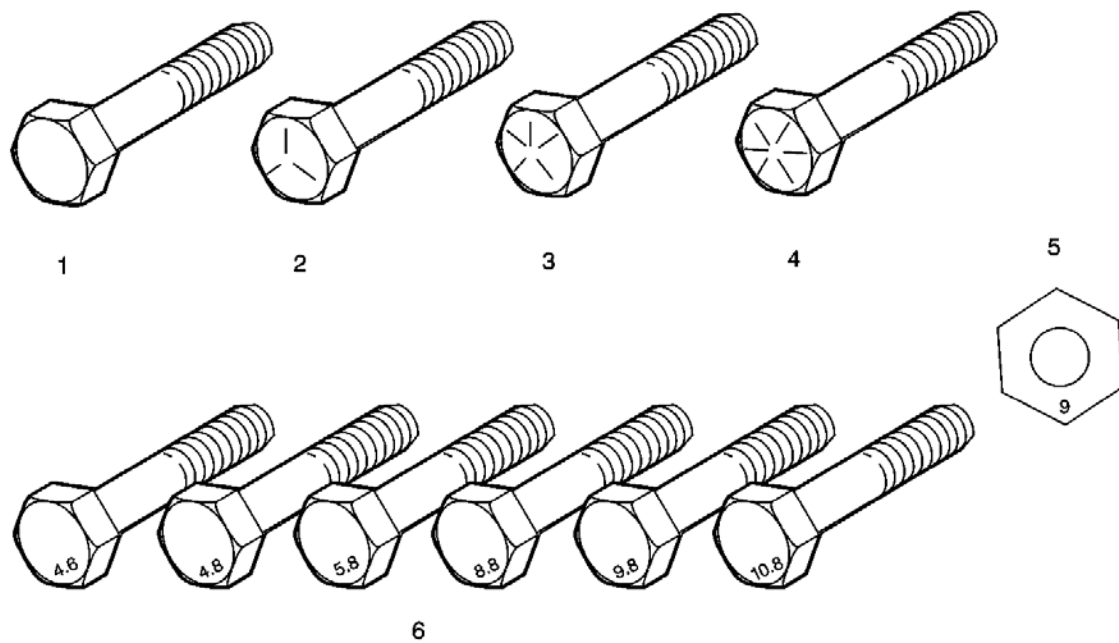


Fig. 7: Identifying Fastener Strength Marks
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	English Bolt, Grade 2 (Strength Class)
2	English Bolt, Grade 5 (Strength Class)
3	English Bolt, Grade 7 (Strength Class)
4	English Bolt, Grade 8 (Strength Class)
5	Metric Nut, Strength Class 9
6	Metric Bolts, Strength Class Increases as Numbers Increase

The most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt. The English, inch strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt in order to identify the strength class. The number of lines on the head of the bolt is 2 lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single digit strength identification number on the nut face.

The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the

common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.

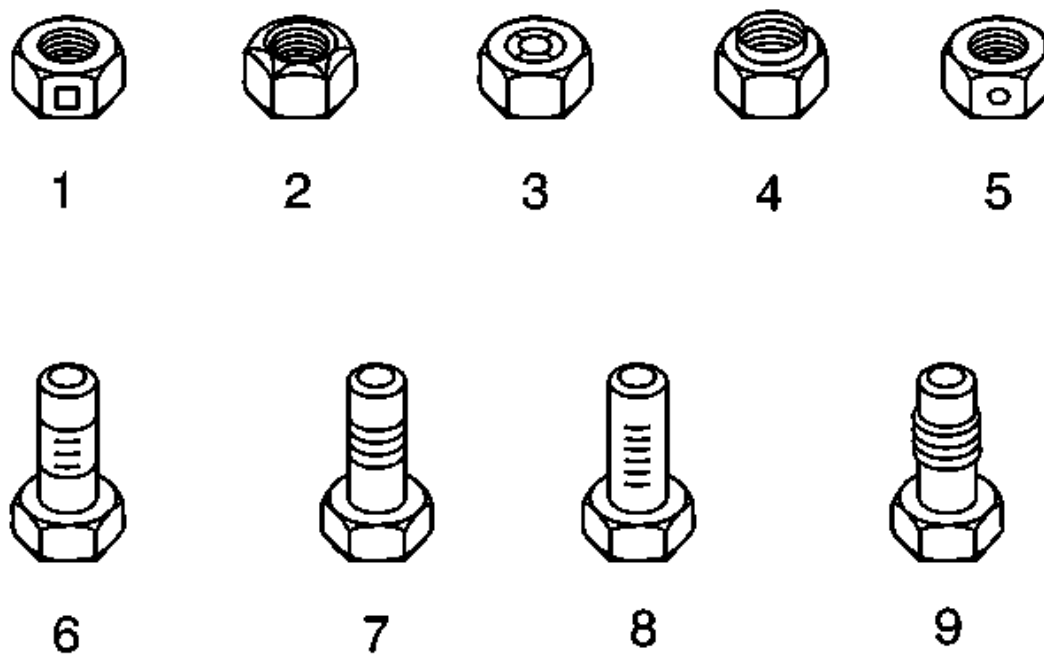


Fig. 8: Identifying Adhesive Coated Fasteners
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Prevailing Torque Nut, Center Lock Type
2	Prevailing Torque Nut, Top Lock Type
3	Prevailing Torque Nut, Nylon Patch Type
4	Prevailing Torque Nut, Nylon Washer Insert Type
5	Prevailing Torque Nut, Nylon Insert Type
6	Prevailing Torque Bolt, Dry Adhesive Coating Type
7	Prevailing Torque Bolt, Thread Profile Deformed Type
8	Prevailing Torque Bolt, Nylon Strip Type
9	Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged

- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 6 mm	0.4 N.m	4 lb in
• 8 mm	0.8 N.m	7 lb in
• 10 mm	1.4 N.m	12 lb in
• 12 mm	2.1 N.m	19 lb in
• 14 mm	3 N.m	27 lb in
• 16 mm	4.2 N.m	37 lb in
• 20 mm	7 N.m	62 lb in
• 24 mm	10.5 N.m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
• 6 mm	0.3 N.m	3 lb in
• 8 mm	0.6 N.m	5 lb in
• 10 mm	1.1 N.m	10 lb in
• 12 mm	1.5 N.m	13 lb in
• 14 mm	2.3 N.m	20 lb in
• 16 mm	3.4 N.m	30 lb in
• 20 mm	5.5 N.m	49 lb in
• 24 mm	8.5 N.m	75 lb in

English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
• 1/4 in	0.5 N.m	4.5 lb in
• 5/16 in	0.8 N.m	7.5 lb in
• 3/8 in	1.3 N.m	11.5 lb in
• 7/16 in	1.8 N.m	16 lb in
• 1/2 in	2.3 N.m	20 lb in
• 9/16 in	3.2 N.m	28 lb in
• 5/8 in	4 N.m	36 lb in
• 3/4 in	7 N.m	62 lb in
Nylon Interface Prevailing Torque Fasteners		
• 1/4 in	0.3 N.m	3 lb in
• 5/16 in	0.6 N.m	5 lb in
• 3/8 in	1 N.m	9 lb in
• 7/16 in	1.3 N.m	12 lb in
• 1/2 in	1.8 N.m	16 lb in
• 9/16 in	2.5 N.m	22 lb in
• 5/8 in	3.4 N.m	30 lb in
• 3/4 in	5 N.m	45 lb in

THREAD INSERTS

General Purpose Thread Repair Kits.

These kits are available commercially.

Repair Procedure

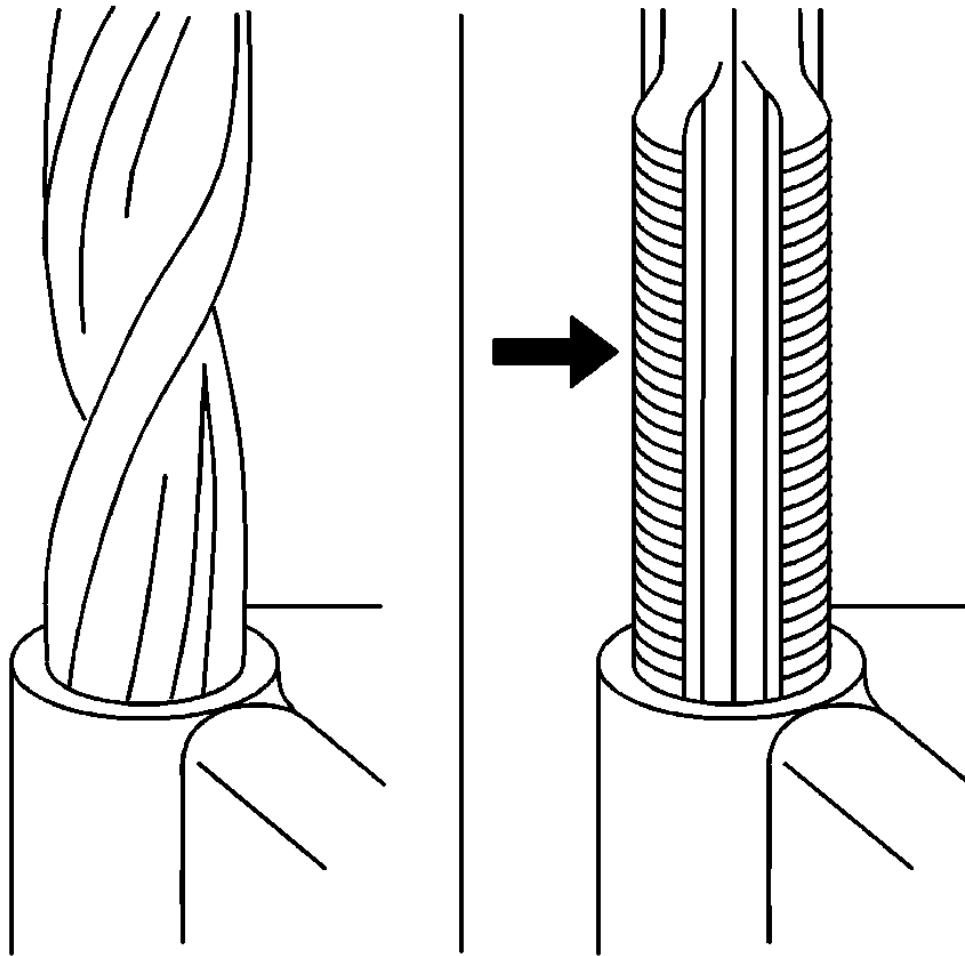


Fig. 9: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Safety Glasses Warning](#) .

NOTE: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.

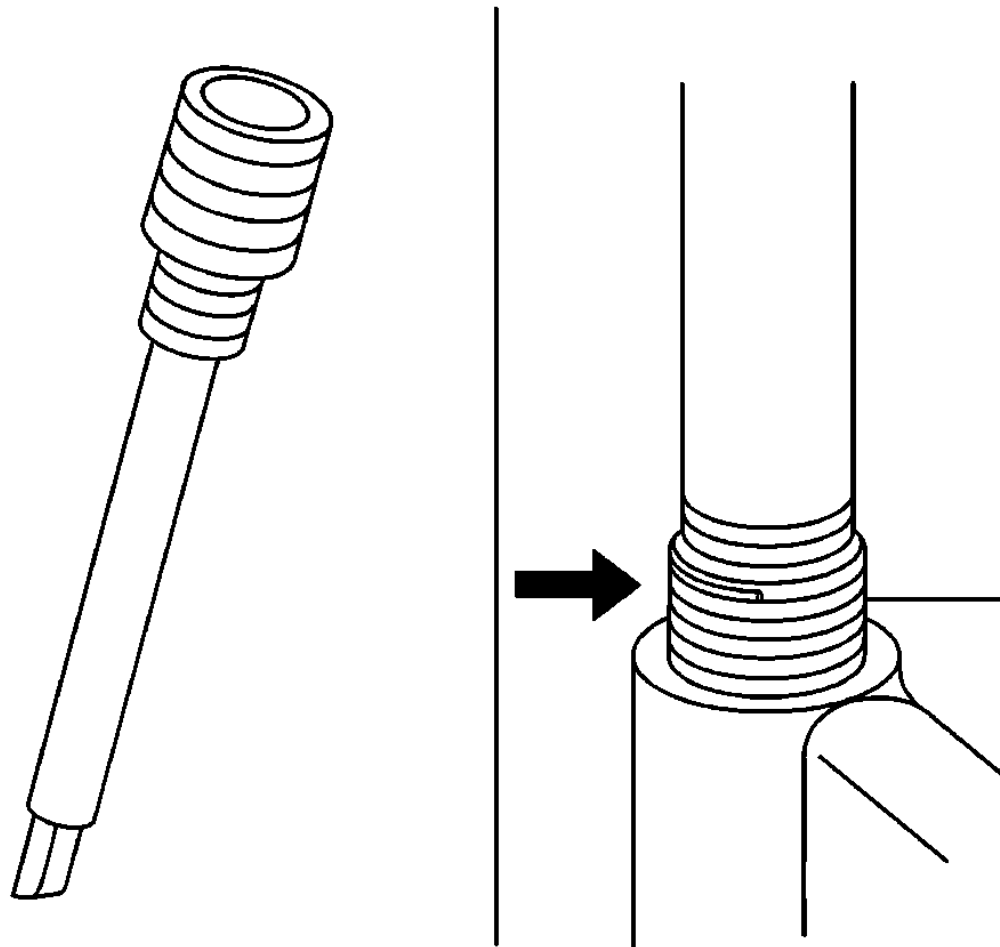


Fig. 10: View Of Thread Insert

Courtesy of GENERAL MOTORS COMPANY

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

NOTE: The insert should be flush to one turn below the surface.

5. Lubricate the insert with light engine oil, except when installing in aluminum and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

REGISTERED AND NON-REGISTERED TRADEMARKS

Listed below are Registered Trademarks (®) or Non-Registered Trademarks (™) which may appear in this service manual.

A
AC®
ACCUTURN®

ACDelco®
Active Fuel Management™
Acuzinc®
Airbank®
Allison®
AMMCO®
AUTOFUSE®
AUTOTRAC®
B
Bendix®
Bluetooth®
BON-AMI®
Bosch®
Bose®
C
Caterpillar®
CAT®
C-Quam®
D
Delco®
Delco Bose®
Delco Electronics®
Delco Freedom®
Delco LOC II®
Delco Moraine®
Delco Remy®
Delco Sound®
Delco Supreme®
Delco Tech®
DELCORE®
Delphi®
DEX-COOL®
DEXOIL®
DEXRON®
DEXSTEER™
DNR®
Dolby®
DR®
Duracell®
Duraguard®
Durastop®
Duramax™

E
Eaton Corporation®
EMD®
ETR®
F
FLO-LITE®
G
General Motors®
GM®
GM Goodwrench Service®
GM Optikleen®
GM Parts™
GM Pass®
GM Ultralite®
GMAC®
Goodwrench®
GTP®
H
Homelink™
HYDRA-MATIC®
I
Illumination®
INSTA-TRAC®
Intune®
L
LOCTITE™
Lord Fusor™
M
MAGNASTEER®
Maxifuse®
Metripack®
Micropack®
Minifuse®
Mr Goodwrench®
N
Northstar®
O
OnStar®
Optikleen®
P
PASS-KEY®
PASS-KEYII®

PASSLOCK™
PK3®
Pozidriv®
Pro®
Q
Quad 4®
R
RAINSENSE™
Rapid Fire®
S
ScotchBrite™
Scotchguard™
Signals®
Sikkens™
Soft-Ray®
Solar-Ray®
Stabiltrak®
Sunrayce®
Superlube®
Syclone®
T
Tech 2®
Techline®
Teflon®
Tefzel®
Theft-IA®
Theftlock®
Tiltmaster®
TORX®
Transjel®
Transguide®
Twilight Sentinel®
U
Ultralite®
V
Velcro®
W
Weatherpack™

DOOR LOCK AND IGNITION LOCK FOLDING AND NON-FOLDING KEY CUTTING

High Security keys are available from the service parts system.

Obtain the key code from the security card or from the GM Dealer World, Parts, Key Code Look Up system.

If you have the key code and access to a Triax-E., BD Laser or other code key cutting machine from the GM Dealer Equipment Catalog, you may cut a new key.

If you have the original key and access to a Matrix S, BD Laser or other key duplicating machine, you may duplicate the key.

If you do not have a high security key cutting machine, order the side cut key from the service parts system. Include the key code in the NOTE field. Indicate the timing and the method of the shipment.

Inspect the new key operation in the lock cylinder. Ensure the new key operates effectively.

FRONT SIDE DOOR LOCK CYLINDER CODING

Special Tools

BO-49753 Assembly Tool

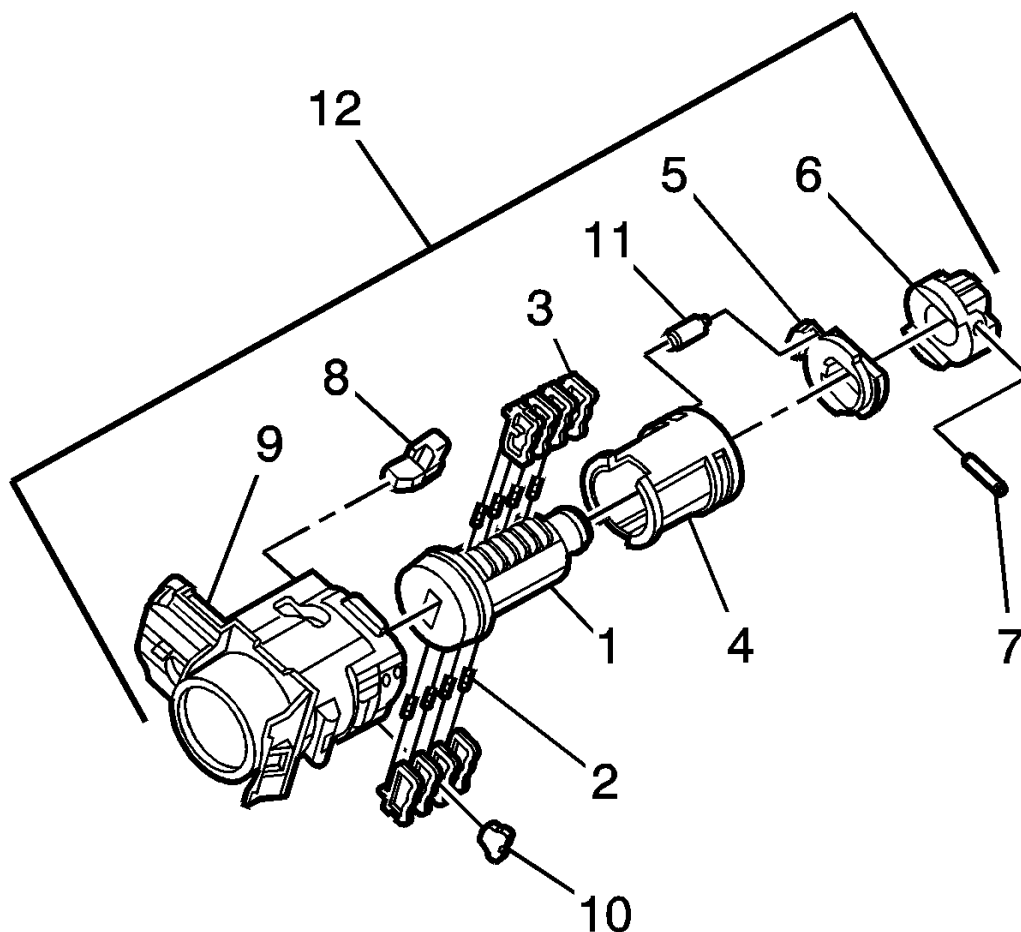


Fig. 11: Identifying Lock Components

Courtesy of GENERAL MOTORS COMPANY

The door lock cylinder uses 8 of the 8 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

NOTE: All lock cylinders for side milled keys have right and left tumblers. The

location of the tooth of the tumbler determines whether it is right or left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.

1. Hold the door lock cylinder (1) so the side with the 4 tumbler spring pockets faces up, pocket nearest to the cylinder head.
2. Insert the tumbler springs (2) into the 4 spring pockets. This side uses left tumblers.
3. Install the tumbler (3) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the side with the 4 tumbler spring wells faces up. This side uses right tumblers.
6. Insert the tumbler springs into the 4 spring pockets.
7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Insert the sleeve (4) onto the cylinder assembly.
11. Insert the clutch (5) and driver (6) onto the cylinder (1).

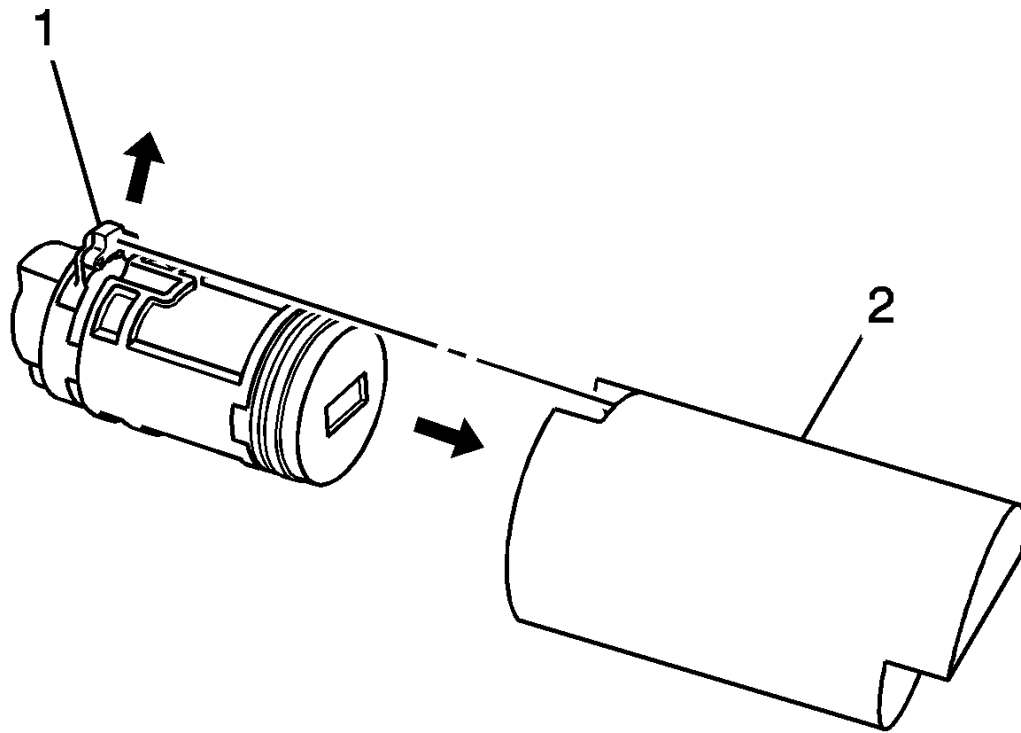


Fig. 12: Loading Cylinder Into Special Tool

Courtesy of GENERAL MOTORS COMPANY

12. Load the cylinder into the **BO-49753** assembly tool so that the clutch (1) indexes with the notch in the opening of the tool (2).

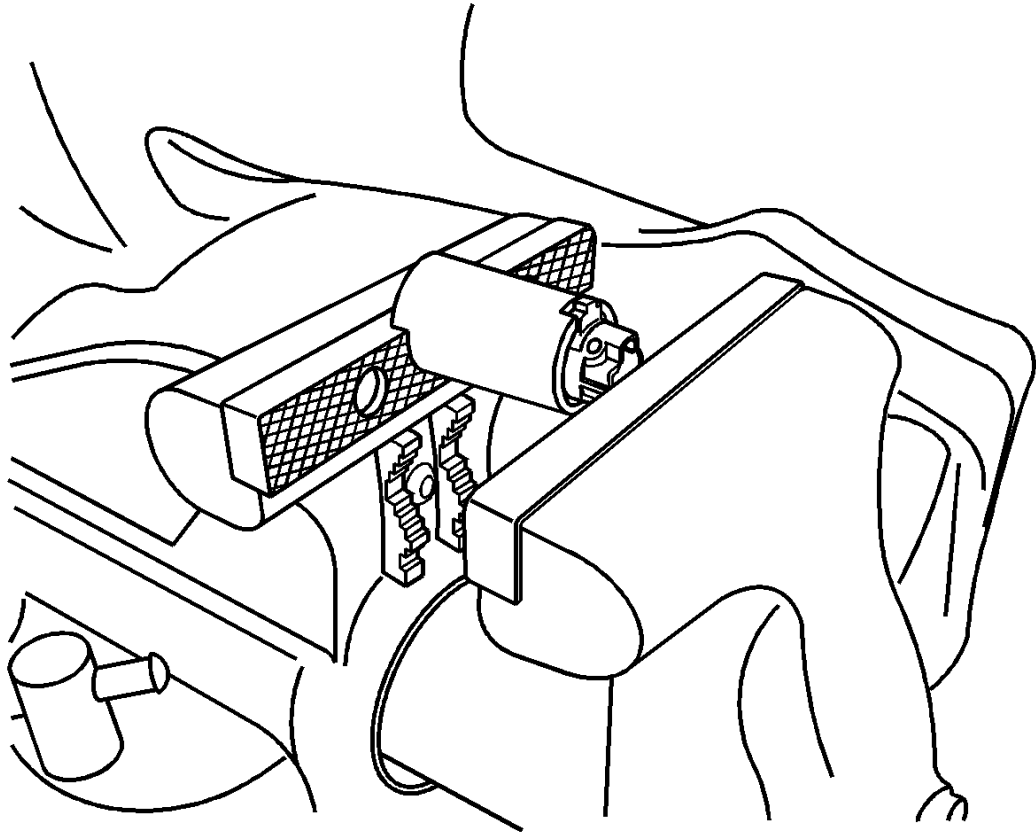


Fig. 13: Loading Assembly Tool Into Vice

Courtesy of GENERAL MOTORS COMPANY

13. Load the assembly tool with the lock cylinder into a vice and tighten the vice ONLY enough to hold the tool and lock the cylinder in place.

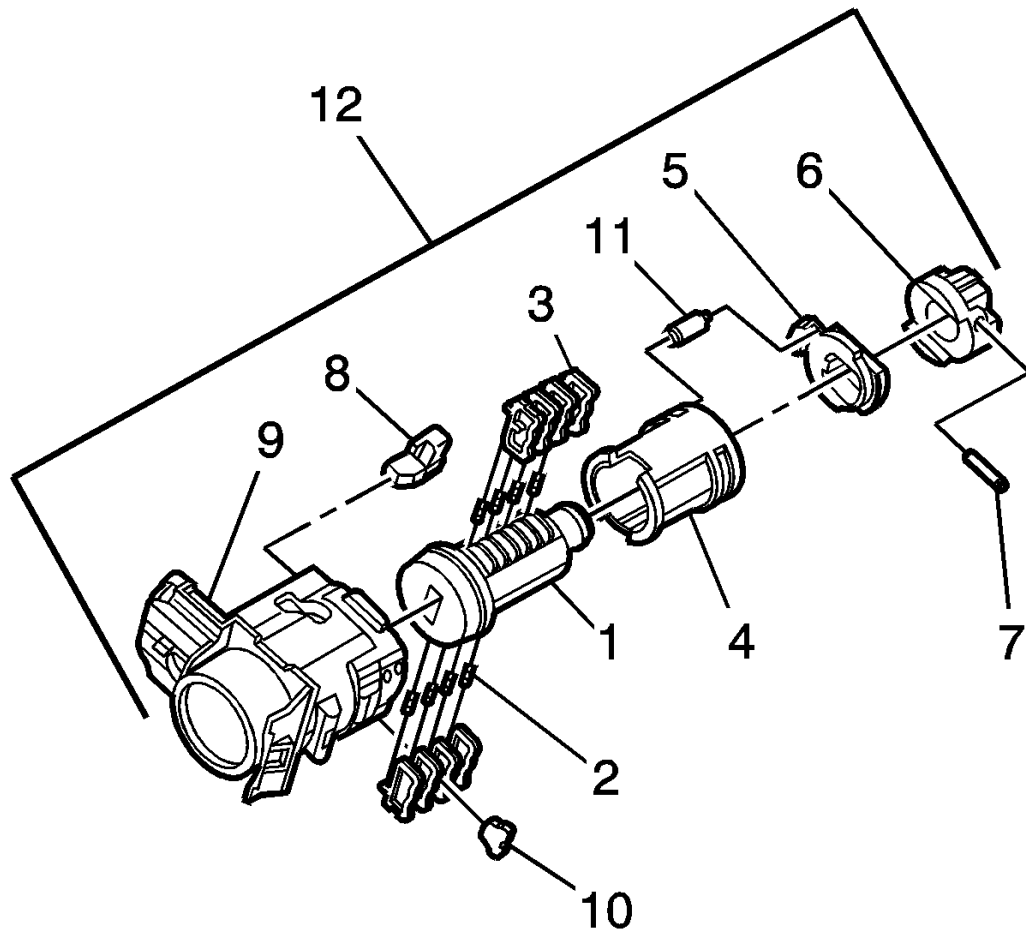


Fig. 14: Identifying Lock Components

Courtesy of GENERAL MOTORS COMPANY

14. Insert the roll pin (7) into the driver (6) and install it using a 1/16 inch pin punch.
15. Insert the buffer (8) in the case (9), verify the buffer is properly seated.
16. Install the free wheel pin (11) in the sleeve (4) and clutch (5) and insert the assembly into the case (9).

17. With the lock cylinder assembly installed in the case (9), install the retainer (10) and stake the retainer in place using a small punch and hammer to peen the case material onto the exposed ends of the installed retainer (10).
18. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

LIFTING AND JACKING THE VEHICLE

NOTE: The use of a **LOW PROFILE LIFT ARMS SYSTEM** may be required to avoid unwanted contact with the vehicle's body and structure depending on lifting equipment used. Refer to the manufacture's recommendation for their applications of low profile lift arms system for their lifting equipment.

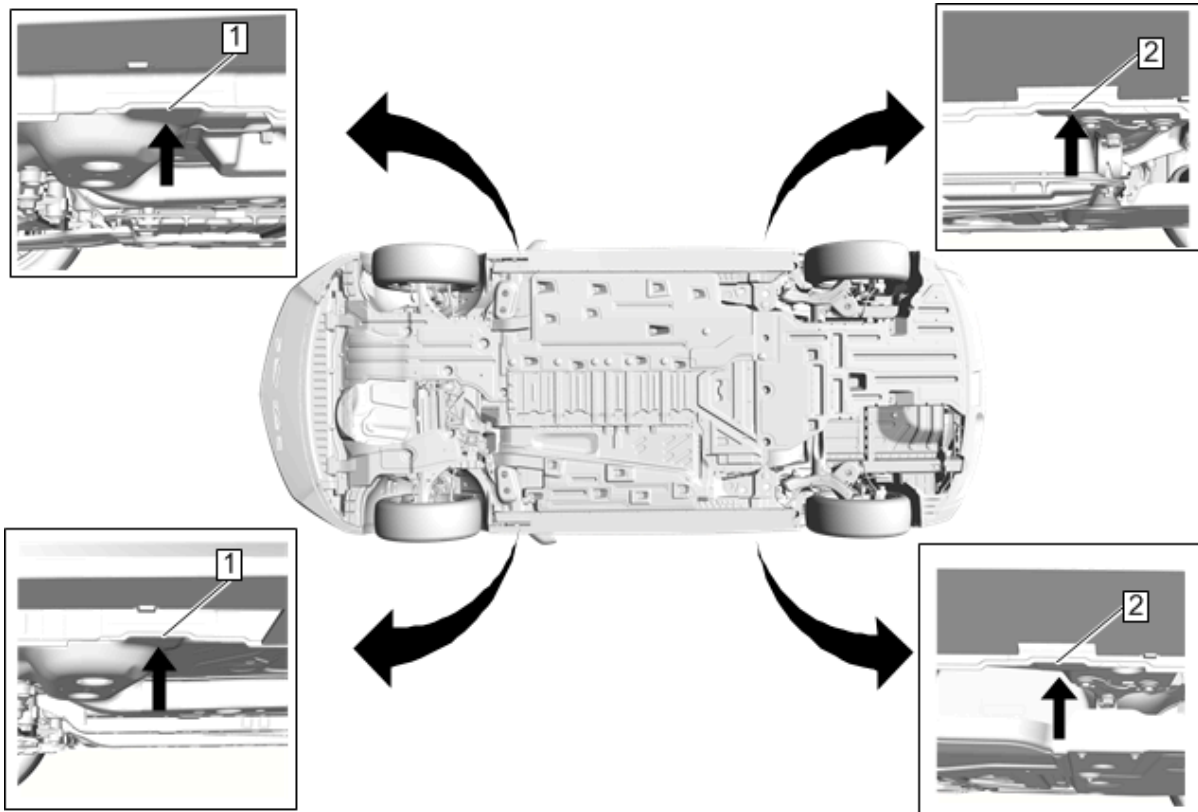


Fig. 15: Lifting And Jacking Points

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Lifting the vehicle improperly can damage the vehicle and result in costly repairs not covered by the warranty.

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.

- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Vehicle Lifting - Frame Contact Lift

WARNING: To avoid any vehicle damage, serious personal injury or death:

- When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.
- When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.

NOTE: The hoist pads must not contact the rocker panel moldings or the underbody air deflectors. Additional clearance may be required for the lifting points.

Front Lift Pads

When lifting the vehicle with a frame-contact lift, place the front lift pads in the recessed area of the rocker flange (1), as shown

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads front lift pads in the recessed area of the rocker flange (2), as shown.

Vehicle Lifting - Service Jack

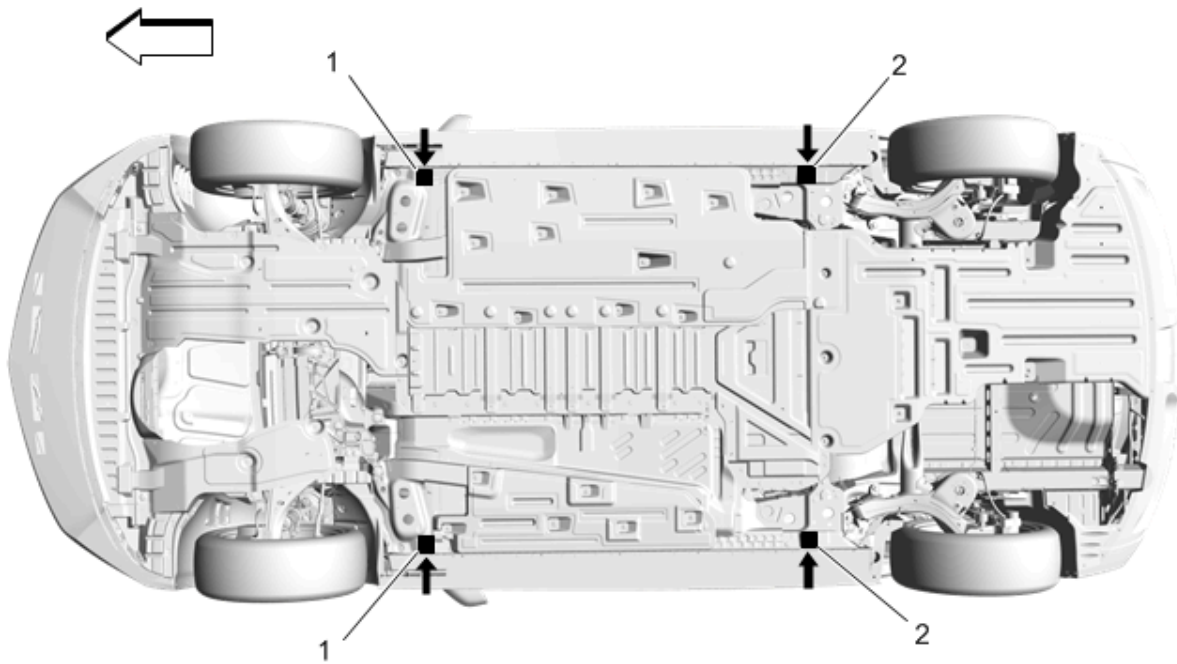


Fig. 16: Service Jack Pad Locations

Courtesy of GENERAL MOTORS COMPANY

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: To avoid any vehicle damage, serious personal injury or death, always use the jackstands to support the vehicle when lifting the vehicle with a jack.

CAUTION: Lifting the vehicle improperly can damage the vehicle and result in costly repairs not covered by the warranty.

CAUTION: When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, rocker molding, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.

NOTE: It may be necessary to put ramps under the Volt's front tires in order to provide necessary clearance for certain service jacks.

Front Service Jack

When lifting the Front of the vehicle with a service jack, only lift the vehicle on the pad location (1), as shown

Rear Service Jack

When lifting the Rear of the vehicle with a service jack, only lift the vehicle on the pad location (2), as shown

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS ORDERING INFORMATION

Special Tools

The special service tools shown in this service manual that have product numbers beginning with J, BO, GE, CH, DT, EN, EL, SA, OR KM are available for worldwide distribution.

US, Canada and Caribbean only:

NOTE: For Special Service tools only - see different location below for diagnostic tools & equipment.

Bosch Automotive Service Solutions

28635 Mound Road

Warren

MI

48092-3499

U.S.A

Phone: 1-800-GM-TOOLS

Monday through Friday

8:00 am - 7:00 pm Eastern Standard Time

Fax: 1-800-578-7375 or 586-578-7321

gmspecialservicetools.service-solutions.com

Mexico, Including Central America:

Bosch Automotive Service Solutions

Mitla No. 442 Col. Vertiz Narvarte

03600 Mexico City

Mexico

Phone: +5255 2595 1630

Fax: +5255 2595 1639

Inquiries can be sent to: herramientas@service-solutions.com

South America, Excluding Brazil:

Bosch Automotive Service Solutions

Mitla No. 442 Col. Vertiz Narvarte

03600 Mexico City

Mexico

Phone: +5255 2595 1630

Fax: +5255 2595 1639

Inquiries can be sent to: herramientas@service-solutions.com

Brazil:

Bosch Automotive Service Solutions

Av. Maria Coelho de Aguiar, 573 - G10

05805-000 São Paulo

Brasil

Phone: +55 11 5851-7477

Fax: +55 11 5853-7479

Inquiries can be sent to: ferramentas@service-solutions.com

Korea, Thailand, Vietnam, Laos, Cambodia:

Robert Bosch Korea Ltd, Service Solution

689-17 Geumjeong-dong, Gunpo-si, Gyeonggi-do, 435-862

Korea

Phone: 82-31-457-9520

sales.korea@servicesolutions.com

Fax: 82-31-427-9522

Greater China, SGM, SGMW, FAW-GM, GM OPEL China:

Bosch Automotive Service Solutions China

333 Fuquan Road North IBP, Changning District

Shanghai 200335 P.R.

Phone: 86-21-22182668

sales.cn@service-solutions.com

Fax: 0086 21 2218 2677

Australia:

Bosch Automotive Service Solutions Australia

1555 Centre Road,

Clayton

Vic. 3168

Phone: 1300 783 031

Fax: (3) 9541 6138

Inquiries can be sent to: customerservice.au@service-solutions.com

Iberica S.A.

Dealers based in Spain, Portugal and Canary Islands:

Bosch Automotive Service Solutions Europe

Nave 72 (Nudo Oeste), 19004 Guadalajara,

Spain

Phone: 34 949 208 337

Fax: 34 949 208 327

shop.service-solutions.com

Europe GmbH

Dealers based in The Netherlands, Belgium and Luxemburg:

Bosch Automotive Service Solutions Europe

Albert Tijsstraat 12, 6471 WX Kerkrade,

Netherlands

Phone: 31 -45 567 8870

Fax: 31-45 567 8871

shop.service-solutions.com

United Kingdom Limited

Dealers based in UK:

Bosch Automotive Service Solutions Europe

Ironstone Way; Brixworth, Northants, NN6 9UD,

Great Britain

Phone: 44 -1327 303 400

Fax: 44 -1327 303 499

shop.service-solutions.com

Italy

Dealers based in Italy:

Bosch Automotive Service Solutions Europe

Via provinciale, 12, 43038 Sala Baganza-PR,

Italy

Phone: 39 -521 837 508

Fax: 39 - 521 335 385

shop.service-solutions.com

Tech 2, MDI Diagnostic Tools and Accessories, Dealer Equipment

US and Canada

Dealer Equipment and Services

5775 Enterprise Drive

Warren

MI, U.S.A

48092-3463

Phone: 1-800-GM-TOOLS

Monday through Friday

8:00 am - 6:00 pm EST

Fax: 1-586-578-7205

www.GMDEsolutions.net (US only) or www.des-canada.ca (Canada only)

Article GUID: A00884652

GENERAL INFORMATION
Maintenance and Lubrication - Volt

SPECIFICATIONS

APPROXIMATE FLUID CAPACITIES

Maintenance Procedure	Link
Hydraulic Brake System Capacities	Approximate Fluid Capacities
Engine Heating and Cooling Capacities	Approximate Fluid Capacities
HVAC Capacities	Approximate Fluid Capacities
Hybrid/EV System Heating and Cooling	Approximate Fluid Capacities
Engine Controls and Fuel Capacities - 1.5L (L3A)	Approximate Fluid Capacities
Engine Mechanical - 1.5L (L3A)	Approximate Fluid Capacities
Automatic Transmission Fluid Capacities - 5ET50 (MKV)	Approximate Fluid Capacities

FLUID AND LUBRICANT RECOMMENDATIONS

Usage	Fluid/Lubricant
Engine Oil	Use only engine oil licensed to the dexos1 specification, or equivalent, of the proper SAE viscosity grade. ACDelco dexos1 Synthetic Blend is recommended. Use SAE 5W-20 viscosity grade engine oil. Cold Temperature Operation: In an area of extreme cold, where the temperature falls below -29 Â°C (-20 Â°F), an SAE 0W-30 oil may be used. An oil of this viscosity grade will provide easier cold starting for the engine at extremely low temperatures. When selecting an oil of the appropriate viscosity grade, always select an oil of the correct specification. Refer to Owner's Manual for more information.
Engine Coolant	DEX-COOLÂ® (Premix 50/50 with deionized water)
High Voltage Battery Cooling System	Premix DEX-COOL
Power Electronics Cooling System	Premix DEX-COOL
Hydraulic Brake System	DOT 3 Hydraulic Brake Fluid
Windshield Washer	Automotive windshield washer fluid that meets regional freeze protection requirements.
Electric Drive Unit	DEXRONÂ®-VI Automatic Transmission Fluid
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube
Hood, Hatch, and Rear Folding Seat Hinges	Multi-Purpose Lubricant, Superlube
Weatherstrip Conditioning	Weatherstrip Lubricant or Dielectric Silicone Grease

MAINTENANCE ITEMS

Maintenance Procedure	Link
Approximate Fluid Capacities	<u>Approximate Fluid Capacities</u>
Fluid and Lubricant Recommendations	<u>Fluid and Lubricant Recommendations</u>
Maintenance Replacement Parts	<u>Maintenance Replacement Parts</u>
GM Oil Life System Resetting	<u>GM Oil Life System ResettingGM Oil Life System Resetting (With Scan Tool)</u>
Tire Pressure Indicator Sensor Learn	<u>Tire Pressure Indicator Sensor Learn</u>
Passenger Compartment Air Filter Replacement	<u>Passenger Compartment Air Filter Replacement</u>
Brake Pad Inspection	<u>Brake Pad Inspection</u>
Cooling System Draining and Filling	<u>Cooling System Draining and Filling</u>
Air Cleaner Element Replacement - 1.5L (L3A)	<u>Air Cleaner Element Replacement - 1.5L (L3A)</u>
Spark Plug Replacement - 1.5L (L3A)	<u>Spark Plug Replacement - 1.5L (L3A)</u>
Automatic Transmission Fluid Drain and Fill - 5ET50 (MKV)	<u>Transmission Fluid Drain and Fill</u>

MAINTENANCE REPLACEMENT PARTS

Replacement parts identified below by name, part number, or specification can be obtained from your dealer.

Part	GM Part Number	ACDelco Part Number
Engine Air Cleaner/Filter	20871244	A3148C
Cabin Air Filter	13508023	CF185
Engine Oil Filter	12670058	UPF64R
Spark Plugs	12637197	41-124
Wiper Blades		
• Left - 65 cm (25.6 in)	23251330	-
• Right - 65 cm (25.6 in)	23251332	-

MAINTENANCE

MAINTENANCE SCHEDULE

The Maintenance Schedule information will only be found in the Owner's Manual.

Refer to the Maintenance Schedule subsection of the Owner's Manual, or you may be able to use the Search information function using the words Scheduled Maintenance.

GM OIL LIFE SYSTEM RESETTNG

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which includes engine revolutions and engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed.

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message comes on. Change the oil as soon as possible within the next 1 000 km (600 miles). It is possible that, if driving under the best conditions, the oil life system might indicate that an oil change is not necessary for up to two years. The engine oil and filter must be changed at least once every two years and, at this time, the system must be reset. Your dealer has trained service people who will perform this work using genuine parts and reset the system. It is also important to check the oil regularly over the course of an oil drain interval and keep it at the proper level.

If the system is ever reset accidentally, the oil must be changed at 5 000 km (3, 000 miles) since the last oil change. Remember to reset the oil life system whenever the oil is changed.

How to Reset the Engine Oil Life System

Reset the system whenever the engine oil change is changed so that the system can calculate the next engine oil change. To reset the system:

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

If the Change Engine Oil Soon message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

GM OIL LIFE SYSTEM RESETTING (WITH SCAN TOOL)

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A ENGINE OIL light message will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

(If applicable)With Scan Tool

1. Ignition - On / Vehicle - In Service Mode
 2. Select:Module Diagnostics
 3. Select:K20 Engine Control Module
 4. Select:Configuration/Reset Functions
 5. Select:Reset Functions
 6. Select:Engine Oil Life Reset
 7. Enter the desired value
 8. Select:Continue
-

REMINDER INDICATOR (RESET PROCEDURES)

GM: Buick / Cadillac / Chevrolet / GMC / Olds / Pontiac - 1980-18

ENGINE OIL REPLACEMENT REMINDER

NOTE: Most 1981-88 General Motors vehicles do not use a Service Reminder Indicator (SRI).

NOTE: To determine the appropriate reset procedure, refer to [ENGINE OIL REPLACEMENT REMINDER RESET INDEX](#). Only vehicles listed in this index have an oil change reminder reset.

ENGINE OIL REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
Alero	
1999-03	Engine Oil Replacement Reminder Reset - Procedure 01
2004	Engine Oil Replacement Reminder Reset - Procedure 03
Acadia	
2007-10	Engine Oil Replacement Reminder Reset - Procedure 16
2011-18	Engine Oil Replacement Reminder Reset - Procedure 06
Allante	
1989-93	Engine Oil Replacement Reminder Reset - Procedure 23
ATS	
2013-18	Engine Oil Replacement Reminder Reset - Procedure 33
Aurora	
1995-99	Engine Oil Replacement Reminder Reset - Procedure 27
2001-03	Engine Oil Replacement Reminder Reset - Procedure 06
Avalanche	
2002-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-13	Engine Oil Replacement Reminder Reset - Procedure 06
Aveo / Wave	
2009-11	Engine Oil Replacement Reminder Reset - Procedure 03
Aztek	
2001-05	Engine Oil Replacement Reminder Reset - Procedure 03
Bravada	
2002-04	Engine Oil Replacement Reminder Reset - Procedure 11
Bonneville	
2003-05	Engine Oil Replacement Reminder Reset - Procedure 06
Brougham	
1992	Engine Oil Replacement Reminder Reset - Procedure 03
Cascada	
2016-18	Engine Oil Replacement Reminder Reset - Procedure 18

Model & Year	Reset Procedure
Camaro	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 01</u>
2010-15	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Canyon	
2004-12	<u>Engine Oil Replacement Reminder Reset - Procedure 10</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Caprice	
1994	<u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2011-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Captiva Sport	
2012-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Century	
1997-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
City Express	
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Classic	
2005	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Cobalt & G5 Pursuit (Canadian)	
2005-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Colorado	
2004-12	<u>Engine Oil Replacement Reminder Reset - Procedure 10</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Corvette	
1990-96	<u>Engine Oil Replacement Reminder Reset - Procedure 05</u>
1997-13	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Cruze	
2011-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Cruze Limited	
2016	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
CT6	
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
CTS	
2003-04	<u>Engine Oil Replacement Reminder Reset - Procedure 20</u>
2005-08	<u>Engine Oil Replacement Reminder Reset - Procedure 22</u>
2009	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2010-11	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
	OR <u>Engine Oil Replacement Reminder Reset - Procedure 19</u>

Model & Year	Reset Procedure
2012-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Cutlass Calais, Cutlass Supreme, Cutlass Ciera, Cutlass Cruiser	
1990-91	<u>Engine Oil Replacement Reminder Reset - Procedure 28</u>
DeVille	
1991-93	<u>Engine Oil Replacement Reminder Reset - Procedure 25</u>
1994-99	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
DeVille Concours	
1994-96	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1997-99	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
DTS	
2006-11	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Eighty Eight & Ninety Eight	
1990-91	<u>Engine Oil Replacement Reminder Reset - Procedure 28</u>
1992-94	<u>Engine Oil Replacement Reminder Reset - Procedure 29</u>
1995-97	<u>Engine Oil Replacement Reminder Reset - Procedure 30</u>
Eldorado	
1989-91	<u>Engine Oil Replacement Reminder Reset - Procedure 24</u>
1992-93	<u>Engine Oil Replacement Reminder Reset - Procedure 26</u>
1994-97	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1997-02	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
ELR	
2014-16	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Enclave	
2008-18	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
Encore	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Envision	
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Envoy Series	
2002-06	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2007-09	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Equinox	
2005-09	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2010-14	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 34</u>
Escalade Series	
2002-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-14	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>

Model & Year	Reset Procedure
Express/ Chevy Express/ Cutaway/ RV	
2003-17	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2018	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Firebird	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Fleetwood	
1991-92	<u>Engine Oil Replacement Reminder Reset - Procedure 25</u>
1993-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Grand Am	
1999-02	<u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
2003-05	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Grand Prix	
1998-03	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2004-08	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
GTO	
2004-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
G5	
2007-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
G6	
2005-10	<u>Engine Oil Replacement Reminder Reset - Procedure 32</u>
G8	
2008-09	<u>Engine Oil Replacement Reminder Reset - Procedure 09</u>
HHR	
2006-11	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Impala	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 08</u>
2007-13	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Impala Limited	
2014-16	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
Intrigue	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
LaCrosse & Allure	
2005-13	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
LeSabre	
1994-99	<u>Engine Oil Replacement Reminder Reset - Procedure 12</u>
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 14</u>
Lucerne	
2006-10	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2011	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>

Model & Year	Reset Procedure
Lumina	
1997-01	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Malibu	
2004-07	<u>Engine Oil Replacement Reminder Reset - Procedure 13</u>
2008-12	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Malibu Limited	
2016	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Montana	
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Monte Carlo	
1997-99	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 08</u>
2007	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Park Avenue	
1991-94	<u>Engine Oil Replacement Reminder Reset - Procedure 15</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 12</u>
1997-05	<u>Engine Oil Replacement Reminder Reset - Procedure 14</u>
Pickup/ C3500/ Cab & Chassis (C/K)	
1996-00	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Rainier	
2004-07	<u>Engine Oil Replacement Reminder Reset - Procedure 17</u>
Regal (All Versions)	
1997-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2011-13	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Rendezvous	
2002-07	<u>Engine Oil Replacement Reminder Reset - Procedure 17</u>
Roadmaster	
1994	<u>Engine Oil Replacement Reminder Reset - Procedure 15</u> or <u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Savana Series/ Cutaway/ RV	
2003-17	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2018	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Seville	
1989-91	<u>Engine Oil Replacement Reminder Reset - Procedure 24</u>
1992-93	<u>Engine Oil Replacement Reminder Reset - Procedure 26</u>
1994-97	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1998-04	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>

Model & Year	Reset Procedure
Sierra Series	
1999-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Silhouette	
2000-01	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2002-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Silverado Series	
2001-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Solstice	
2006-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Sonic	
2012-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Spark	
2013-16	<u>Engine Oil Replacement Reminder Reset - Procedure 35</u>
2017-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
SRX	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 20</u>
2005-06	<u>Engine Oil Replacement Reminder Reset - Procedure 22</u>
2007-09	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2010-12	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2013-16	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
SS	
2014-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
SSR	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2005-06	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
STS	
2005-11	<u>Engine Oil Replacement Reminder Reset - Procedure 07</u>
Suburban	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Tahoe	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Terrain	
2011-18	<u>Engine Oil Replacement Reminder Reset - Procedure 34</u>
Toronado	
1989-92	<u>Engine Oil Replacement Reminder Reset - Procedure 31</u>
Torrent	

Model & Year	Reset Procedure
2006-09	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Trailblazer	
2002-09	<u>Engine Oil Replacement Reminder Reset - Procedure 11</u>
Traverse	
2009-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Trax	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Uplander, Montana SV6 (Canadian)	
2005-08	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Venture	
2000-04	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2005	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Verano	
2012-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Volt	
2011-15	<u>Engine Oil Replacement Reminder Reset - Procedure 21</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
XLR	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2005-09	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
XT5	
2017-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
XTS	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Yukon Series	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 01

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset (on some models a chime will also sound). Reset is complete when OIL CHANGE light goes out.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 02

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. To reset CHANGE OIL light:

1. Remove IP fuse block cover (cover can be seen when driver's door is open).
2. Turn ignition ON, engine OFF.
3. Press OIL RESET button and hold for 5 seconds.
4. If Oil Life light does not reset, repeat procedure with ignition OFF.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 03

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.

1. To reset oil life monitor and turn off CHANGE OIL light (or message), turn ignition to ON position with engine off.
2. Depress accelerator pedal to wide open throttle 3 times within 5 seconds.
3. Turn ignition to LOCK/OFF
4. If light (or message) does not turn off, turn ignition OFF and repeat procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 04

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1, 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

Reset Procedure

1. Turn the ignition key to RUN with the engine OFF.
2. Press the INFO and RESET buttons on the Driver Information Center (DIC) at the same time to enter the personalization menu.
3. Press the INFO button to scroll through the available personalization menu modes until the DIC display shows OIL-LIFE RESET.
4. Press the INFO and RESET buttons at the same time for one second and release.
5. Press and hold the reset button until the DIC display shows ACKNOWLEDGED. This will tell you the system has been reset.
6. Turn the key to LOCK/OFF.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 05

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the oil is nearly worn out. A CHANGE OIL light on left side of instrument cluster is illuminated when it is time to change oil. To reset oil life monitor:

1. Turn ignition on.
2. Depress ENG MET button on trip monitor and release.
3. Within 5 seconds, depress and release ENG MET button again.
4. Within 5 seconds, depress and hold the ENG MET or GAUGES button again. The CHANGE OIL light should flash.
5. Depress and hold the RANGE or GAUGES button until the CHANGE OIL light stops flashing and goes out. When the light goes out, the engine oil life monitor is reset. This should take about 10 seconds.

NOTE: If the light does not reset, turn ignition off and repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 06

The Driver Information Center (DIC) will display a CHANGE OIL message when an oil change is due. The instrument cluster may also have a CHANGE OIL light. To reset the oil life monitor:

Reset Procedure

1. Turn ignition switch to RUN position, with engine off.
2. Press the TRIP (on some models SELECT or SET/RESET) button, located on the DIC, until the OIL LIFE display appears. Message will display percentage of oil life remaining.

NOTE: On models without DIC buttons, use the TRIP/ODOMETER reset stem.

3. Press and hold SET/RESET button (on some models, the check-symbol button) on DIC for at least 5 seconds. The message will change to indicate that the Oil Life has been reset. On some models, 3 chimes will also sound.
4. Turn ignition off.
5. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

NOTE: On some models, if oil life system does not reset, try turning ignition OFF after displaying oil life message. Then press and hold reset button.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 07

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message in the DIC comes on. Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. To reset the system:

1. Press the up or down arrow to scroll the DIC to show OIL LIFE.
2. Once the XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the RESET button until the percentage shows 100%

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 08

The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

1. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 4. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the DISP (on some models, TUNE DISP) button (or knob) on the radio for at least 5 seconds until SETTINGS is displayed.
2. Press the SEEK (on some models, SEEK PTYPE or SEEK PSCAN) up or down arrow to scroll through the main menu. Scroll until OIL LIFE appears on the display. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the DISP/TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the DISP/TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 09

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. Press and hold the TRIP button on the steering wheel while turning on the ignition. Do not start the engine.
2. The instrument panel cluster will prompt to clear the service code.
3. Release the button.
4. Press and hold ENTER Switch on the left side of the steering wheel for approximately one second.
5. Turn off the ignition.

If the CHANGE ENGINE OIL SOON message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 10

1. Turn ignition ON, with engine off.
2. Press and release reset stem on instrument panel while OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold stem in until several beeps will sound. This confirms that oil life system has been reset. Turn ignition off or full LOCK position. If CHANGE OIL messages comes back after starting engine, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 11

Reset Procedure

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

Alternate Method

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 12

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 13

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 14

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 15

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, locate reset button hole under the dash near passenger door. Use a pencil or similar object to push and hold button (inside hole) for 5 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 16

Vehicles WITHOUT Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN, with the engine off. The vehicle must be in P (Park) to access this display. Press the trip odometer reset stem until OIL LIFE REMAINING displays.
2. Press and hold the trip odometer reset stem until OIL LIFE REMAINING shows "100%." Three chimes sound and the CHANGE ENGINE OIL SOON message goes off.
3. Turn the key to LOCK/OFF. If the CHANGE ENGINE OIL SOON message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Vehicles WITH Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN position, with the engine off.
2. Press the VEHICLE INFORMATION BUTTON (i) until OIL LIFE REMAINING displays.
3. Press and hold the SET/RESET button (check-mark symbol) until "100%" is displayed. Three chimes sound (on some models) and the CHANGE ENGINE OIL SOON message goes off.
4. Turn ignition to LOCK/OFF position. If the CHANGE ENGINE OIL SOON message comes back on when engine is started, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 17

Reset Procedure

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the Driver Information Center (DIC) reads OIL LIFE LEFT/HOLD SET TO RESET.
3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.
4. If the CHANGE ENGINE OIL message comes back on when engine is started, the engine oil life system has not reset. Repeat the procedure.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 18

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL message or light will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

Vehicles with DIC (& Steering Wheel Controls)

1. Using the DIC controls on the right side of the steering wheel (see [Fig. 1](#)), display REMAINING OIL LIFE on the driver information center (DIC).
2. Press SEL or SET/CLR (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

NOTE: If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

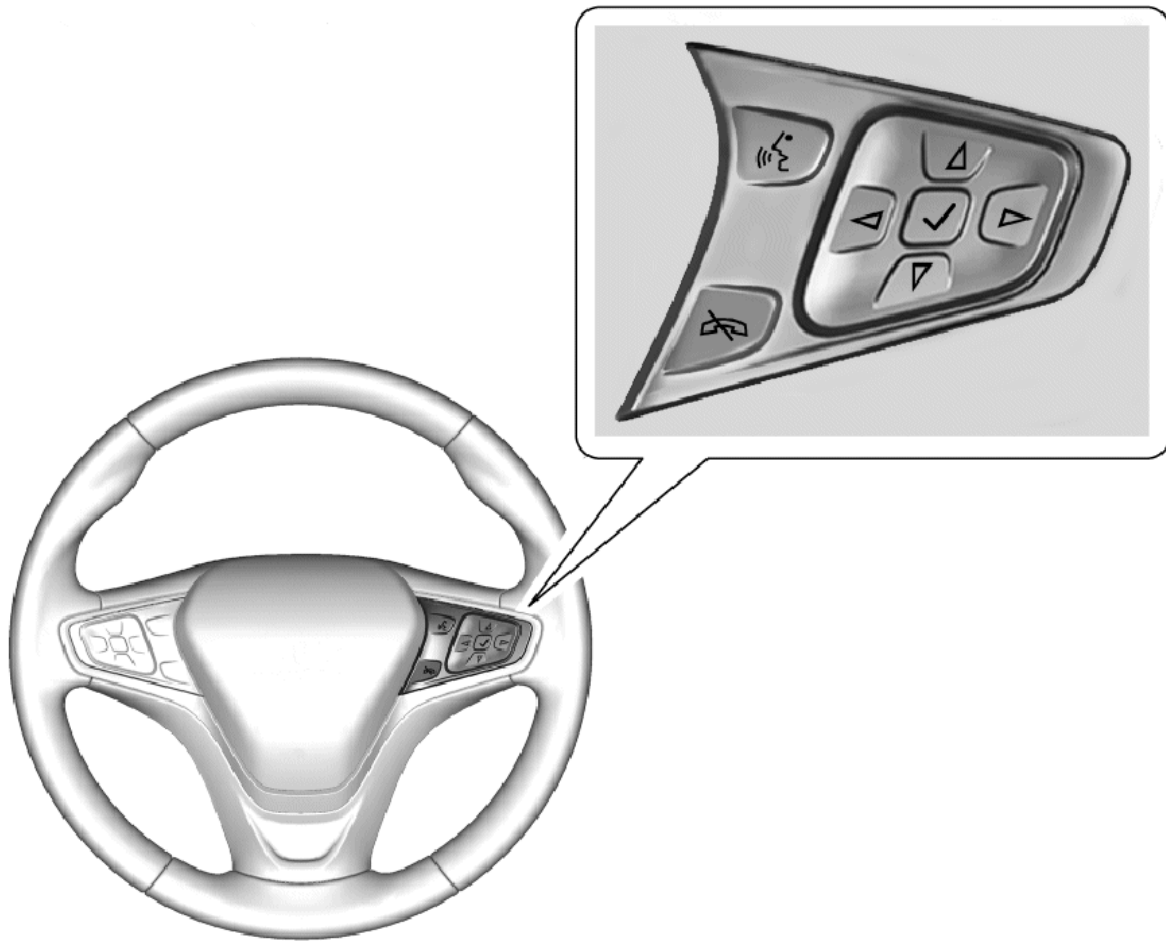


Fig. 1: Identifying DIC Controls (Steering Wheel - Typical)

Courtesy of GENERAL MOTORS COMPANY

Vehicles with DIC (& Turn Signal Lever Controls)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button on the turn signal lever to enter the Vehicle Information Menu. Use the thumbwheel to scroll through the menu items until you reach REMAINING OIL LIFE. See [Fig. 2](#).

NOTE: On vehicles with an Uplevel DIC, the controls are at the right-hand side of the steering wheel.

3. Press the SET/CLR button (on some models, the check-symbol button) while the oil life display is active. After a few seconds, there will be a single chime (on some models) and the oil life will be reset to 100%.
4. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE OIL message is off and the REMAINING OIL LIFE 100% message is displayed.

NOTE: If the CHANGE OIL message comes back on or Code 82 DIC message comes on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

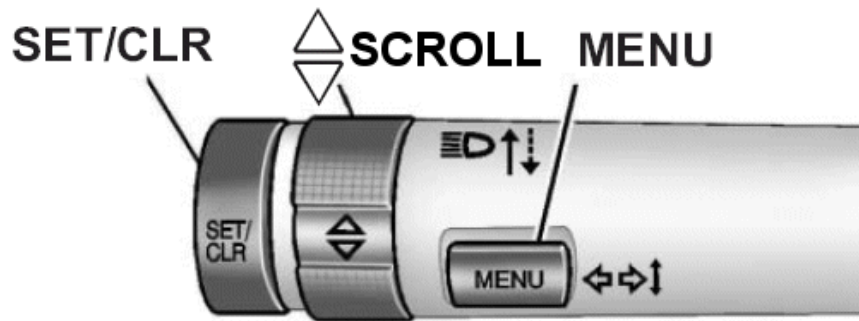


Fig. 2: Identifying DIC Controls (Turn Signal Lever)

Courtesy of GENERAL MOTORS COMPANY

Vehicles without DIC (Some Models)

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

Reset Using Diagnostic Scan Tool (Some Models)

1. Turn on ignition.
2. Connect scan tool.
3. Select Module Diagnosis.
4. Select Engine Control Module.
5. Select Configuration/Reset function.
6. Select Engine Oil System Reset.
7. Push Enter button to run function.
8. Confirm Executed successfully.
9. Turn ignition off and confirm.
10. Turn ignition on and confirm.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 19

1. The Driver Information Center (DIC) will display remaining oil life as a percentage estimate of the useful life of oil.
2. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When oil life expires, display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press INFORMATION (or INFORMATION SKIP) button to display OIL LIFE LEFT. Press and hold RESET (or RESET NO) button until 100 OIL LIFE LEFT (0.0 OIL LIFE LEFT on some early models) is displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 20

With Base Audio System

Press up or down arrow on the INFO button located to right of Driver Information Center (DIC) display to

access DIC menu. Once 100 percent ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. Percentage will return to 100 and oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

With Navigation System

Turn the system on by pressing PWR/VOL knob once. PWR/VOL knob is located to lower left of DIC display. Press INFO button located to left of the display to access Vehicle Information menu. Turn TUNE/SEL knob located to lower right of the display until ENGINE OIL LIFE is highlighted. Press TUNE/SEL knob once to select it. When 100 percent Engine Oil Life is displayed, press multifunction button next to reset prompt in upper right corner of the display. Percentage will return to 100 and the oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 21

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 22

With Base Audio System

1. Press the CLR button located to the right of the driver information center (DIC) display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Press the up or down arrow on the INFO button located to the right of the Driver Information Center (DIC) display to access the DIC menu.
3. Once 100% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
4. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

Without DIC

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

With Navigation System

1. Press the multifunction button, next to the OK prompt in the upper right of the display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Turn the system on by pressing the PWR/VOL knob once. The PWR/VOL knob is located to the lower left of the driver information center (DIC) display.

3. Press the INFO button located to the left of the display to access the Vehicle Information menu.
4. Turn the TUNE/SEL knob located to the lower right of the display until Engine Oil Life is highlighted. Press the knob once to select it.
5. Once the 100% Engine Oil Life is displayed, press the multifunction button next to the Reset prompt in the upper right corner of the display. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
6. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 23

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset service reminder on 1989 models, press RANGE button until OIL LIFE INDEX appears on display. Depress and hold in AVG ECON and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.
4. On 1990-93 models, press RANGE button until OIL LIFE INDEX appears on DIC display. Depress and hold in AVG SPEED and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 24

1. An OIL LIFE INDEX is one of 4 displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. Display will show 100 percent when the system is reset. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When the oil life expires, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press ENG DATA button until OIL LIFE INDEX appears on DIC display. Depress and hold in ENG DATA and RANGE buttons until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 25

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a estimated percentage of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After performing necessary services, reset service reminder.
3. To reset service reminder, turn ignition to on position. Do not start engine. Depress and hold RANGE and FUEL USED buttons until OIL LIFE INDEX appears on DIC display. Depress and hold RANGE and RESET buttons for 5-60 seconds.
4. When CHANGE OIL SOON light flashes 4 times, remaining oil life index is reset to 100 percent. If CHANGE OIL SOON comes on and stays on for 5 seconds, display did not reset. Repeat step [3](#).

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 26

1. Oil change reminder display on the Driver Information Center (DIC) is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset, press INFORMATION button to display OIL LIFE INDEX. Press and hold STORE/RECALL button until 100 is displayed. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 27

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 28

1. An oil change reminder displays estimated percentage of the remaining useful life of the oil. When engine is started, a tone will sound and approximate distance to next oil change will be displayed.
2. When remaining oil life is 10 percent or less, the system will calculate distance to next oil change. When the oil life is 0 percent, the display will show CHANGE OIL NOW. After changing oil, reset oil life display.
3. To reset the display, press and hold in OIL button to select the oil life display. Then, press and hold in RESET and OIL buttons for at least 5 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 29

1. To reset the display, press and release the TEST button.
2. Press and release the OIL button.
3. Press and hold the RESET button for at least 7 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 30

1. To reset the display, press and release RESET button on Driver Information Center (DIC).
2. Press SEL button (with down arrow) to select OIL.
3. Press SEL button (with left and right arrows) to display oil life.
4. Press and hold RESET button for about 5 seconds.
5. A reset message will display, then oil life will display 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 31

With Information Center Display

OIL LIFE INDEX is one of 4 engine data displays used on models with Information Center display. It will display remaining oil life as estimated percentage of the useful life of oil. It will show 100 percent when the system is reset. After changing oil, reset oil life display.

1. To reset the display, press ENG DATA button (1989-90) or OPTIONS button (1991-92) until oil life index is displayed.
2. Then, press and hold in ENG DATA and GAGE buttons (1989) or RESET/ENTER button (1990-92) for at least 5 seconds. This will reset remaining oil life to 100 percent.

With Visual Information Center

OIL LIFE is one of the displays used on models with a Visual Information Center (VIC). It will display data regarding previous oil change. A bar graph display shows full when oil is changed. Bar graph will go down as vehicle is driven and oil ages. When bar graph reaches CHANGE OIL mark, oil should be changed. After changing oil, reset oil life display.

1. To reset the display, press INFO hard key and then OIL LIFE soft key to display oil life index.
2. Press RESET soft key.
3. A reset confirmation page will appear and ask if oil has been changed. Press YES soft key to reset bar graph, and update last oil change date and mileage information.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 32

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. With the CHANGE OIL SOON message displayed, press any of the three driver information center (DIC) buttons to clear the CHANGE OIL SOON message.
2. Display OIL LIFE RESET on the DIC.
3. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has reset.
4. Turn the ignition to OFF.

If the CHANGE ENGINE OIL message comes back on when you start the vehicle the Engine Oil Life System has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 33

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which include engine revolutions, engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed. To reset the system:

Reset Procedure

1. Using the DIC controls on the right side of the steering wheel, display REMAINING OIL LIFE on the driver information center (DIC).

2. Press SEL (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 34

Vehicles with Driver Information Center (DIC)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button, on the center console or right-hand steering wheel controls, to enter the Vehicle Information Menu.
3. Press either the up or down arrows to view REMAINING OIL LIFE.
4. Press the SET/CLR button until 100% is displayed.
5. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE ENGINE OIL SOON message goes off.

NOTE: If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Alternate Method

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, than start the vehicle.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 35

Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. Always reset the engine oil life to 100% after every oil change. It will not reset itself. Use the DIC controls at the right side of the instrument cluster to reset the system.

1. Display remaining oil life (oil can w/ %) on the DIC
2. Press and hold SET/CLR on the DIC for more than five seconds. The oil life will change to 100%.

If the OIL CHANGE DIC message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

EMISSIONS MAINTENANCE REMINDER (REMINDER FLAG)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET](#). Only vehicles listed in this index have an Oxygen Sensor Reminder Flag reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Some Models	
1980	Emissions Maintenance Reminder Reset Procedure

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

- 1. Every 30, 000 miles, a reminder flag appears in speedometer face, indicating service of oxygen sensor is necessary. See [Fig. 3](#). Inspect and service oxygen sensor as necessary and reset flag.
- 2. To reset flag, remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when flag is fully reset.

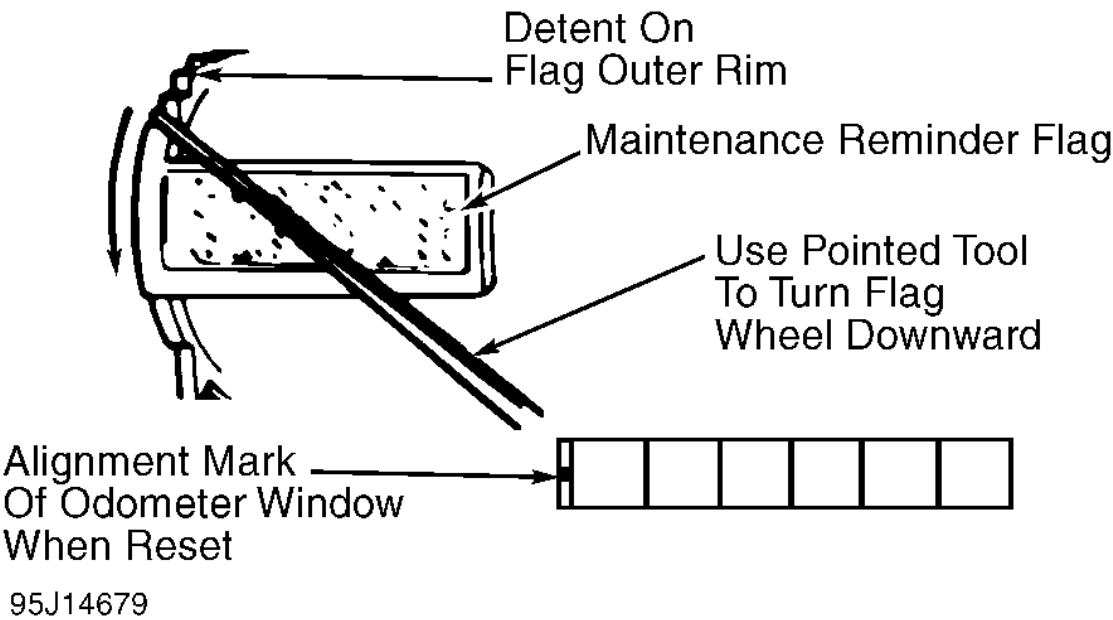


Fig. 3: Resetting Reminder Flag
Courtesy of GENERAL MOTORS CORP.

EMISSIONS MAINTENANCE REMINDER (WARNING LIGHT)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET INDEX](#). Only vehicles listed in this index have an oxygen sensor warning light reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Sprint	
1985-86	<u>Emissions Maintenance Reminder Reset Procedure</u>

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

At 30, 000 mile intervals, a SENSOR light in dash will start flashing, indicating oxygen sensor needs replacement. To reset mileage counter (after sensor replacement), locate SENSOR light cancel switch on right side of fuse box. Return cancel switch to OFF position. Start engine to ensure light remains off.

EMISSIONS MAINTENANCE REMINDER (CHECK ENGINE LIGHT)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET INDEX](#). Only vehicles listed in this index have a check engine light reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Geo Tracker	
1989-94	<u>Emissions Maintenance Reminder Reset Procedure</u>

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

Federal Emissions

1. CHECK ENGINE light functions as a service reminder indicator and emission system service. CHECK ENGINE light will come on each 50, 000 miles (PCV and EGR), each 80, 000 miles (oxygen sensor) and each 100, 000 miles (charcoal canister) to indicate needed emission system service.
2. After servicing and/or replacing components, reset CHECK ENGINE light by sliding cancel switch to its opposite position. See [CHECK ENGINE LIGHT RESET SWITCH LOCATION \(GEO TRACKER\)](#) for switch location.

CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)

Application	Location
1989-91	Behind Access Panel, Directly Below Steering Column
1992-94	⁽¹⁾ Behind Instrument Panel, Next To Left Speaker
(1) See <u>Fig. 4</u> .	

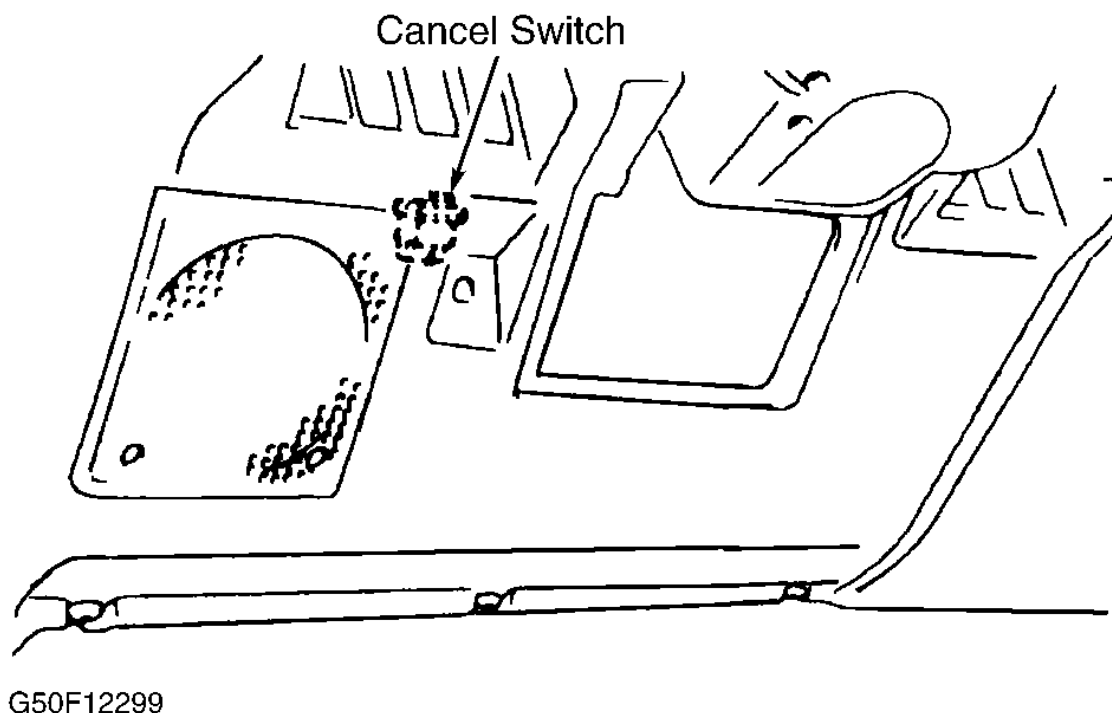


Fig. 4: Check Engine Light Reset Switch Location (1992-94 Geo Tracker - Federal Emissions)

Courtesy of GENERAL MOTORS CORP.

California Emissions

CHECK ENGINE light indicates when it is necessary to have emission system serviced, regardless of mileage. CHECK ENGINE light comes on briefly when starting as a bulb check. If light does not come on or stays on constantly, repair as necessary.

FUEL FILTER REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [Fuel Filter Life Reset Index](#). Only vehicles listed in this index have a fuel filter life reset.

FUEL FILTER REPLACEMENT REMINDER RESET INDEX

Application	Reset Procedure
Some Diesel Models	Fuel Filter Replacement Reminder Reset Procedure

FUEL FILTER REPLACEMENT REMINDER RESET PROCEDURE

NOTE: This procedure applies to some diesel models. Manufacturer does not specify which vehicles are equipped with a Fuel Filter Replacement Reminder.

NOTE: ALWAYS reset the FUEL FILTER LIFE system (if equipped) after a fuel filter change.

"FUEL FILTER LIFE" message will appear when a reset is performed either by using the steering wheel controls or performing manual reset procedure.

1. On vehicles with steering wheel controls, press and hold the select button for 5 seconds while the FUEL FILTER LIFE message is displayed. This message will appear on the Driver Information Center (DIC) for 10 seconds.
2. On vehicles without steering wheel controls, go to next step.
3. Without pressing the pedals, turn the ignition key to the ON position, engine off. Wait 5 seconds.
4. Completely depress the brake and accelerator pedals simultaneously and hold for 10 seconds. The system is now reset. Turn ignition key OFF.
5. On all vehicles, the next time engine is started, the message will no longer be displayed.

MAINTENANCE SERVICE REMINDER

NOTE: To determine the appropriate reset procedure, refer to [MAINTENANCE SERVICE REMINDER RESET INDEX](#). Only vehicles listed in this index have a Service Reminder reset.

MAINTENANCE SERVICE REMINDER RESET INDEX

Model & Year	Reset Procedure
6000 STE	
1987-89	<u>Maintenance Service Reminder Reset - Procedure 01</u>
Bonneville	
1988-91	<u>Maintenance Service Reminder Reset - Procedure 01</u>
Caprice	
2011	<u>Maintenance Service Reminder Reset - Procedure 02</u>

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 01

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

1. To reset service reminder, push DIC button until desired service item is displayed.
2. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles.
3. Release button when desired distance is displayed on the DIC.

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 02

The displayed service reminder is reset using a scan tool or by the following procedure:

1. Turn the ignition to the OFF position.
2. Press and hold the TRIP button.
3. Turn the ignition to the ON position.
4. Release the TRIP button.

5. Once in the Service Reset screen, press and hold the ENTER switch for 3-5 seconds. A confirmation beep will sound upon reset.
6. Turn the ignition to the OFF position.

NOTE: If the service reminder comes back on when you start the vehicle, the Service Reminder Display has not reset. Repeat the procedure.

TIMING BELT REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [TIMING BELT REPLACEMENT REMINDER INDEX](#). Only the vehicles listed in this index have a Timing Belt Replacement Reminder Reset.

CHANGE TIMING BELT MESSAGE INDEX

Model & Year	Reset Procedure
Chevrolet Cruze - 1.8L LUW and LWE Engines (2011-16)	Timing Belt Replacement Reminder Reset Procedure
Chevrolet Sonic - 1.8L LUW and LWE Engines (2012-16)	Timing Belt Replacement Reminder Reset Procedure

TIMING BELT REPLACEMENT REMINDER RESET PROCEDURE

NOTE: Applies to 1.8L LUW and LWE engines.

Description

On LUW and LWE engines, the Instrument Cluster monitors the odometer mileage to determine when a timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100, 000 miles (160, 000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message.

Message Reset

After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster, for two minutes.

- **2011-16 Cruze :** Fuse #21 (F21DA) Underhood ([Fig. 5](#))
- **2012-16 Sonic :** Fuse #F26 (F26DA) Under Dash (lower-left of dash - [Fig. 6](#))

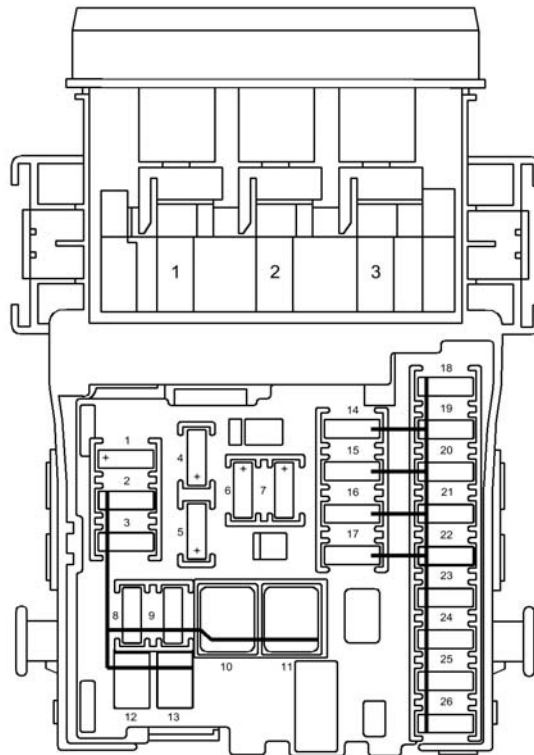


Fig. 5: Underhood Fuses (Cruze)

Courtesy of GENERAL MOTORS CORP.

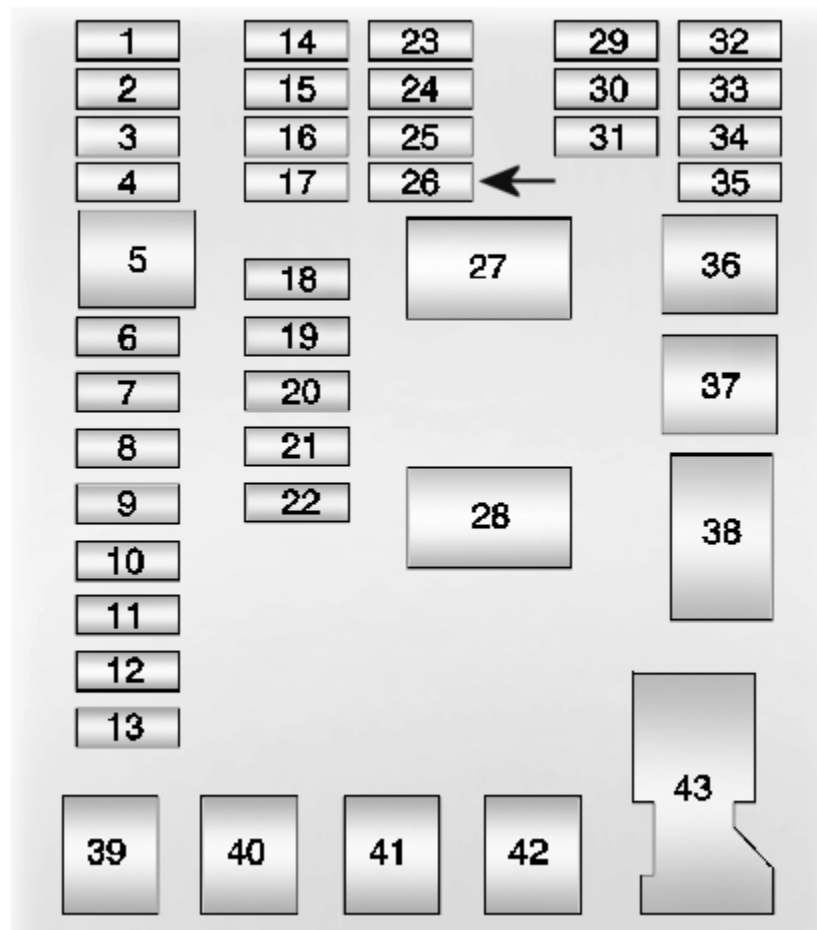


Fig. 6: Instrument Panel Fuses (Sonic)

Courtesy of GENERAL MOTORS CORP.

TRANSMISSION FLUID REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX](#). Only the vehicles listed in this index have a CHANGE TRANS FLUID MESSAGE reset.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
Aurora	
1995-99	<u>Transmission Fluid Replacement Reminder Reset - Procedure 04</u>
Concours	
1994-98	<u>Transmission Fluid Replacement Reminder Reset - Procedure 01</u>
1999	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>
CTS	
2003	<u>Transmission Fluid Replacement Reminder Reset - Procedure 03</u>
2004	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>
DeVille	
1992-97	<u>Transmission Fluid Replacement Reminder Reset - Procedure 01</u>
1998-04	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>
Eldorado	
1992-98	<u>Transmission Fluid Replacement Reminder Reset - Procedure 01</u>
1999-00	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>
2001-02	<u>Transmission Fluid Replacement Reminder Reset - Procedure 01</u>
Seville	
1992-97	<u>Transmission Fluid Replacement Reminder Reset - Procedure 01</u>
1998-04	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>
SRX	
2004	<u>Transmission Fluid Replacement Reminder Reset - Procedure 02</u>

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 01

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Change fluid in both the oil pan and side cover.

1. To reset display, turn ignition ON with engine OFF.
2. On the climate control panel, press and hold OFF and REAR DEFOG buttons until TRANS FLUID RESET message appears in DIC (about 5-20 seconds).

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 02

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Percentage of transaxle fluid life remaining may be checked at any time by pressing INFO button

several times until TRANS FLUID LIFE message appears.

- 1. To reset display, turn ignition key ON with engine OFF.
- 2. Press the INFO button until TRANS FLUID LIFE message appears.
- 3. Press and hold INFO RESET button until display shows 100 percent TRANS FLUID LIFE. Transaxle fluid life index is now reset.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 03

NOTE: The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due.

Resetting With Base Audio System

Press CLR button located to the right of the DIC display to acknowledge the CHANGE TRANS FLUID message. This will clear the message from the display and reset it. To reset transmission fluid life indicator, press up or down arrow on INFO button located to the right of the DIC display to access the DIC menu. Once percentage TRANS FLUID LIFE menu item is highlighted, press and hold CLR button. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

Resetting With Navigation System

Press multifunction button located to the right of the DIC display, next to the OK prompt to acknowledge the CHANGE TRANS FLUID message. This will clear the message form the display and reset it. To reset transmission fluid life indicator, turn system on by pressing PWR/VOL knob once. PWR/VOL knob is located to the lower left of the DIC display. Press INFO button located to the left of the DIC display to access the VEHICLE INFO menu. Turn TUNE/SEL knob located to the lower right of the DIC display until TRANS FLUID LIFE is highlighted. Press knob once to select it. Once percentage TRANS FLUID LIFE is displayed, press multifunction button next to the RESET prompt in the upper right corner of the display. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 04

- 1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of transaxle fluid. When remaining fluid life is 0 percent, the display will show CHANGE TRNS FLUID NOW. After changing transaxle fluid, reset oil life display.
- 2. To reset the display, turn ignition on with engine off. Press ENG button to select the TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
- 3. The word RESET will appear. Then, TRNS FLUID 100 will be displayed.

TIRE PRESSURE MONITOR SYSTEM REMINDER

NOTE: To determine the appropriate reset procedure, refer to **TPMS REMINDER RESET INDEX**. Only vehicles listed in this index have a TPMS Reminder Reset.

TPMS REMINDER RESET INDEX

Model	Application	Procedure
Buick		

Model	Application	Procedure
Allure	2006-09	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Cascada	2016-18	<u>TPMS Reminder Reset - Procedure 25</u>
Century	1999-05	<u>(1) TPMS Reminder Reset - Procedure 21</u>
Enclave	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 09</u>
Encore	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Envision	2016-18	<u>TPMS Reminder Reset - Procedure 26</u>
LaCrosse	2006-09	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2010-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 26</u>
LaSabre	2002-05	<u>(1) TPMS Reminder Reset - Procedure 20</u>
Lucerne	2006	<u>(1) TPMS Reminder Reset - Procedure 22</u>
Â	2007-11	<u>TPMS Reminder Reset - Procedure 02</u>
Park Avenue	1998-05	<u>(1) TPMS Reminder Reset - Procedure 20</u>
Rainier	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Regal	1999-04	<u>(1) TPMS Reminder Reset - Procedure 21</u>
Â	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 26</u>
Regal TourX	2018	<u>TPMS Reminder Reset - Procedure 26</u>
Rendezvous	2003-07	<u>(1) TPMS Reminder Reset - Procedure 24</u>
Verano	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-17	<u>TPMS Reminder Reset - Procedure 25</u>
Cadillac		
ATS	2013-18	<u>TPMS Reminder Reset - Procedure 11</u>
CT6	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
CTS	2004-12	With RPO UH3: <u>TPMS Reminder Reset - Procedure 09</u>
		W/O RPO UH3: <u>TPMS Reminder Reset - Procedure 10</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 11</u>
Deville	2001-05	<u>TPMS Reminder Reset - Procedure 04</u>
DTS	2006-11	<u>TPMS Reminder Reset - Procedure 02</u>
ELR	2014-16	<u>TPMS Reminder Reset - Procedure 11</u>
Escalade Series	2004-06	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 11</u>
Seville	2001-04	<u>TPMS Reminder Reset - Procedure 04</u>

Model	Application	Procedure
SRX	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012-16	<u>TPMS Reminder Reset - Procedure 11</u>
STS	2005-11	<u>TPMS Reminder Reset - Procedure 03</u>
XLR	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
XT5	2017-18	<u>TPMS Reminder Reset - Procedure 11</u>
XTS	2013-18	<u>TPMS Reminder Reset - Procedure 11</u>
Chevrolet		
Avalanche	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Aveo / Wave	2008-11	⁽²⁾ <u>TPMS Reminder Reset - Procedure 07</u>
Bolt EV	2017-18	<u>TPMS Reminder Reset - Procedure 28</u>
Camaro	2010-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-15	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
Caprice	2011-13	<u>TPMS Reminder Reset - Procedure 31</u>
Â	2014-17	<u>TPMS Reminder Reset - Procedure 25</u>
Captiva Sport	2012-15	<u>TPMS Reminder Reset - Procedure 02</u>
City Express	2015-18	<u>TPMS Reminder Reset - Procedure 32</u>
Cobalt	2008-10	<u>TPMS Reminder Reset - Procedure 03</u>
Colorado	2006-12	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2015-18	Base DIC <u>TPMS Reminder Reset - Procedure 25</u> Uplevel DIC <u>TPMS Reminder Reset - Procedure 11</u>
Corvette	1987-96	⁽¹⁾ <u>TPMS Reminder Reset - Procedure 20</u>
Â	1997-04	<u>TPMS Reminder Reset - Procedure 06</u>
Â	2005-06	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2007-13	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 08</u>
Cruze	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	Base DIC <u>TPMS Reminder Reset - Procedure 25</u> Uplevel DIC <u>TPMS Reminder Reset - Procedure 11</u>
Cruze Limited	2016	<u>TPMS Reminder Reset - Procedure 25</u>
Equinox	2007	<u>TPMS Reminder Reset - Procedure 05</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 11</u>

Model	Application	Procedure
Â	2013-14	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 33</u>
Express Van	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 27</u>
HHR	2008-11	<u>TPMS Reminder Reset - Procedure 03</u>
Impala	2000-02	<u>(1) TPMS Reminder Reset - Procedure 13</u>
Â	2003-05	<u>(1) TPMS Reminder Reset - Procedure 14</u>
Â	2006-07	<u>TPMS Reminder Reset - Procedure 05</u>
Â	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 28</u>
Impala Limited	2014-16	<u>TPMS Reminder Reset - Procedure 09</u>
Malibu / Classic	2008-11	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 28</u>
Malibu Limited	2016	<u>TPMS Reminder Reset - Procedure 25</u>
Monte Carlo	2000-02	<u>(1) TPMS Reminder Reset - Procedure 13</u>
Â	2003-05	<u>(1) TPMS Reminder Reset - Procedure 14</u>
Â	2006-07	<u>TPMS Reminder Reset - Procedure 05</u>
Orlando (Canada)	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Silverado Series	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 27</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 26</u>
Sonic	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Spark	2013-15	<u>TPMS Reminder Reset - Procedure 29</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 25</u>
Spark EV	2014-16	<u>TPMS Reminder Reset - Procedure 30</u>
SS	2014-17	<u>TPMS Reminder Reset - Procedure 25</u>
Suburban	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
Tahoe	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>

Model	Application	Procedure
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
TrailBlazer	2006-09	<u>TPMS Reminder Reset - Procedure 01</u>
Traverse	2009-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 09</u>
Trax	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Uplander	2008	<u>TPMS Reminder Reset - Procedure 03</u>
Volt	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-15	<u>TPMS Reminder Reset - Procedure 30</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
GMC		
Acadia	2007-11	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-16	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2017-18	<u>TPMS Reminder Reset - Procedure 11</u>
Acadia Limited	2017	<u>TPMS Reminder Reset - Procedure 09</u>
Canyon	2006-12	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 34</u>
Envoy	2006-09	<u>TPMS Reminder Reset - Procedure 01</u>
Savana Series	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 27</u>
Sierra Series	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 26</u>
Terrain	2010-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012-18	<u>TPMS Reminder Reset - Procedure 12</u>
Yukon Series	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
Oldsmobile		
Alero	1999-00	<u>(1) TPMS Reminder Reset - Procedure 16</u>
Aurora	2001-03	<u>(1) TPMS Reminder Reset - Procedure 17</u>
Pontiac		
Aztek	2003-05	<u>(1) TPMS Reminder Reset - Procedure 23</u>
Bonneville	2000-05	<u>(1) TPMS Reminder Reset - Procedure 15</u>
G3	2009	<u>TPMS Reminder Reset - Procedure 02</u>

Model	Application	Procedure
G5	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
G6	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
G8	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Grand Am	1999-05	<u>(1) TPMS Reminder Reset - Procedure 18</u>
Grand Prix	2008	<u>TPMS Reminder Reset - Procedure 02</u>
Solstice	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
Torrent	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Wave	2008	<u>TPMS Reminder Reset - Procedure 02</u>
Vibe	2005-10	<u>(1) TPMS Reminder Reset - Procedure 19</u>
(1) This is an Indirect TPM System. A tire sensor activation tool is not required for this procedure.		
(2) A tire sensor activation tool cannot be used for this procedure.		

TPMS REMINDER RESET - PROCEDURE 01

NOTE: When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensors.

NOTE: The DIC will display the "SERVICE TIRE MONITOR" message if one or more of the tire pressure sensors has malfunctioned or if all of the sensors have not been programmed successfully. If, after the relearn procedure, the warning indicators are still on, there is a problem in the TPM system.

NOTE: If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, see appropriate manufacturer service information.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF. Apply parking brake.

NOTE: If Learn Mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.

3. To enable Learn Mode, turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.
7. Test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

TPMS REMINDER RESET - PROCEDURE 02

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the TPM system may not function properly:

- If one or more of the tire pressure sensors are missing or inoperable.
- A compact spare tire is used.

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: The relearn procedure must be completed within 15 minutes from when the vehicle is stationary after being driven at 20 mph (32 km/h), or greater, for 10 seconds.

NOTE: The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the RCDLR memory.
- If equipped, the DIC will display dashes instead of tire pressures.

- **DTC C0775 will be set.**

These conditions will now require the learn procedure to be repeated for the system to function properly.

Ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray

IMPORTANT: sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Turn ignition switch to ACC position. Apply parking brake.
2. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
3. To enable Learn Mode:
 - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. On vehicles with DIC, a TIRE LEARN message may be displayed. The left front turn signal will also be illuminated.
 - On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the TIRE LEARN message appears on the DIC display. Press and hold the SET/RESET button until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
4. Ignition ON.
5. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
6. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 03

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: In vehicles without the "UH3" option, each turn signal will illuminate one at a time indicating which location is to be learn.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ACC position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.

NOTE: The left front turn signal will also illuminate to indicate the learn mode has been enabled.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 04

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are

erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.

NOTE: If the TPM Learn Mode cannot be enabled, ensure the TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.

NOTE: If a horn chirp does not sound after 15 seconds, remove, then re-apply TPM sensor relearn magnet.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 05

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 06

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Press RESET button on DIC in order to clear any warning messages.
4. Press and release OPTIONS button until display is blank.
5. Press and hold RESET button for 3 seconds.

NOTE: If the DIC does not display "TIRE TRAINING" message, ensure TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

6. Press and release OPTIONS button until "TIRE TRAINING" is displayed.
7. Press and release RESET button. The DIC should display "LEARN L FRONT TIRE", verifying Learn Mode has been enabled.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.

9. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
10. Turn the ignition switch to OFF position to exit the learn mode.

TPMS REMINDER RESET - PROCEDURE 07

- NOTE:** An OEM scan tool or Pressure Increase/Decrease Method is used to perform this procedure.
- NOTE:** Before proceeding with this process, ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a scan tool, initiate the TPM Learn Mode.
3. Perform the procedure by following the menu selections. A double horn chirp will sound and the IPC tire pressure monitor indicator warning lamp icon will flash indicating Learn Mode is enabled.
4. Starting with the left front tire, active the sensors by one of the following methods:
 - Hold the antenna of the scan tool, aimed upward, against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned.
 - Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached. Once the horn chirp has sounded, the sensor information has been learned.
5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the left rear sensor is learned, a double horn chirp will sound indicating all sensor IDs have been learned and the tire pressure module will exit the Learn mode turning OFF the IPC tire pressure monitor warning indicator lamp icon.
7. Ignition OFF, adjust all tires to the recommended pressures. Refer to the tire placard label.

TPMS REMINDER RESET - PROCEDURE 08

Automatic Sensor Learn Process

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. When a tire is installed, the vehicle must be stationary for about 20 minutes before the system recalculates. The following

relearn process takes up to 10 minutes, driving at a minimum speed of 12 mph (19 km/h). A dash (-) or pressure value will display in the DIC. A warning message displays in the DIC if a problem occurs during the relearn process.

TPMS REMINDER RESET - PROCEDURE 09

- NOTE:** For Cadillac CTS with RPO UH3, use this procedure. For CTS without RPO UH3, see Procedure 10.
- NOTE:** If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.
- NOTE:** When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.
- NOTE:** The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.
- NOTE:** Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to RUN position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled. On some models, a TIRE LEARNING ACTIVE message may also be displayed on the DIC screen.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 10

- NOTE:** For Cadillac CTS without RPO UH3, use this procedure. For CTS with RPO UH3, see Procedure 9.

- NOTE:** If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.
- NOTE:** When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.
- NOTE:** The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.
- NOTE:** Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Depending on ignition type:
 - With standard ignition switch, place the switch in the RUN position.
 - With electronic keyless ignition, place the switch in the ACC position.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 11

NOTE: This procedure is for vehicles with an Uplevel DIC.

When a low tire pressure condition is detected, the TPMS illuminates the low tire pressure warning light on the instrument cluster. A message to check the pressure in a specific tire displays in the Driver Information Center (DIC). The low tire pressure warning light and the DIC warning message come on at each ignition cycle until the tires are inflated to the correct inflation pressure. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go

off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Place the vehicle power mode in ON/RUN/START.
4. Make sure the Tire Pressure info display option is turned on. The info displays on the DIC can be turned on and off through the Settings menu.
5. Use the five-way DIC control on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SEL button located in the center of the five-way DIC control. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Press STOP to turn the ignition off.

TPMS REMINDER RESET - PROCEDURE 12

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Use the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC). Use the arrow keys to scroll to the Tire Pressure screen
5. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
6. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.

8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition to LOCK/OFF.

TPMS REMINDER RESET - PROCEDURE 13

LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or when vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. There are 2 ways to reset the tire inflation monitor. To reset the tire inflation monitor using the exterior or interior lamp controls, go to step 4. To reset tire inflation monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine OFF. Press and hold the TUNE DISP button on the radio for at least 5 seconds until settings is displayed.
2. To scroll through the main menu:
 - On Impala, press the SEEK PTYPE up or down arrow.
 - On Monte Carlo, press the SEEK PSCAN up or down arrow.On all models, scroll until TIRE MON appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. Reset the tire inflation monitor:
 - On Impala, using the interior lighting controls, turn the switch from OFF to ON position 3 times with ignition switch in ON position.
 - On Monte Carlo, using the exterior lighting controls, turn the switch from OFF to parking lamps 3 times with ignition switch in ON position.

TPMS REMINDER RESET - PROCEDURE 14

NOTE: There are 3 different ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.

Using Exterior Lamp Switch

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Cycle the exterior lamp switch from OFF to parking lamps 3 times within 5 seconds.
4. Use the scan tool in order to clear the TPM DTC.

Using RDS Radio, If Equipped

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn the ignition to ACC or ON, with the engine OFF.
3. Turn the radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed.
5. Press the SEEK up or down arrows until TIRE MON is displayed.
6. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
7. Press the DISP button, A chime will sound and DONE will be displayed.
8. Scroll until EXIT is displayed.
9. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit.
10. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.
3. Turn ignition ON with engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. Use the scan tool in order to clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 15

CHECK TIRE PRESSURE or TIRE PRESS message will come on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

NOTE: If vehicle is equipped with Systems Monitor, go to step 2.

1. To recalibrate vehicle equipped with Driver Information Center (DIC), turn ignition ON with engine OFF. Using the MODE and SELECT button on DIC, change display until TIRE PRESSURE appears. Press and hold RESET button for 5 seconds. TIRE PRESSURE RESET should now appear on display. If TIRE PRESSURE RESET does not appear on display after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.
2. To recalibrate vehicle equipped with Systems Monitor, turn ignition ON with engine OFF. Press and hold TIRE PRESS RESET button for 5 seconds. TIRE PRESS light on the Systems Monitor should begin to flash. Release the TIRE PRESS RESET button. TIRE PRESS light should go out and system is now reset. If TIRE PRESS light does not begin to flash after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

TPMS REMINDER RESET - PROCEDURE 16

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting

system.

1. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 17

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

NOTE: When the low tire pressure warning messages appear, immediately check air pressure of all tires and adjust to the specified pressure. If warning messages are still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.
- Only one tire is replaced with a new tire during service.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.
- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press SELECT right arrow button until "GAGE" is displayed.
5. Press SELECT down arrow button until "TIRE PRESSURE" is displayed.
6. Press and hold RESET button until "TIRE PRESSURE RESET" is displayed.
7. Release RESET button. DIC should display "TIRE PRESSURE NORMAL".
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select "SPECIAL FUNCTIONS".
5. Select "TIRE PRESSURE RESET".
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 18

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 mph, 40-70 mph and 70-90 mph.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 19

NOTE: After resetting, the tire pressure monitoring (TPM) system requires 60 minutes or more of driving at a speed of 30 km/h (19 mph) or above to complete the calibration process to have full capability for detecting a tire pressure condition.

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Press and hold the tire pressure warning reset switch until the tire pressure warning indicator blinks 3 times at one second intervals.
4. If the tire pressure warning indicator does not blink, repeat the procedure starting at step 2.
5. Drive the vehicle for 60 minutes or more at a speed of 30 km/h (19 mph).
6. Verify the system has initialized. Turn ignition ON with engine OFF and observe the tire pressure warning indicator.
 - System Initialized: light on for 3 seconds.
 - System not initialized: light on for 4 seconds.

TPMS REMINDER RESET - PROCEDURE 20

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure

has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: When the tire pressure warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning message is still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.
- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold appropriate button (located on left side of steering column) until "TIRE PRESSURE" message appears on display:
 - 1997-99 models: Press and hold GAGES button
 - 2000-05 models: Press and hold GAGES INFO button
5. Press and hold RESET button for 5 seconds. After 5 seconds, "TIRE PRESSURE RESET" message should appear on display.
6. Release RESET button. A "TIRE PRESSURE NORMAL" message should appear on display.
7. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).

- 40-70 mph (64-113 km/h).
- 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select SPECIAL FUNCTIONS.
5. Select TIM RESET.
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 21

Using Reset Button (1999-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
3. The LOW TIRE indicator will flash 3 times, then turn off.
4. Use scan tool to clear the TPM DTC.

Using Scan Tool (2003-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Install scan tool. Turn ignition ON with engine OFF.
3. With scan tool, select Special Functions.
4. Select TIM Reset.
5. Press Reset soft key.
6. LOW TIRE indicator will flash 3 times, then turn OFF.
7. Clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 22

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button chime sounds and "TIRE PRESSURE RESET" is displayed and a chime sounds 3 times.
6. Release SET button and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure. If it does not work after two tries, refer to appropriate service information.

7. After resetting, the TPM system requires up to 5 miles of driving in each of the following speed ranges to complete the calibration process:
 - 25-40 mph (40-64 km/h).
 - 40-60 mph (65-96 km/h).
 - 60-85 mph (96-136 km/h).

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 23

1. Check and adjust air pressure in all 4 tires before resetting system. Refer to tire placard located on the

inside edge of the driver's door. Turn ignition ON, with engine OFF.

2. Press the MODE button on the Driver Information System until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
3. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.
4. Release the SET button and TIRE PRESSURE NORMAL will be displayed.

TPMS REMINDER RESET - PROCEDURE 24

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button until a chime sounds and "TIRE PRESSURE RESET" is displayed.
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure.

7. After resetting, the TPM system requires up to 5 miles (8 km) of flat, smooth road, straight line driving in each of the 4 speed ranges (about 10-20 minutes in each range) to complete the calibration process:
 - 19-40 mph (31-65 km/h).
 - 40-59 mph (65-95 km/h).
 - 59-74.5 mph (95-120 km/h).
 - 74.5-90 mph (120-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Calibration Mode, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Detection Mode, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 25

NOTE: **This procedure is for vehicles with a Base DIC.**

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions using a TPMS relearn tool. There are two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See [Fig. 7](#).
4. Use the MENU button to select the VEHICLE INFORMATION MENU in the Driver Information Center (DIC). See [Fig. 8](#).
5. Use the thumbwheel (or up and down arrows) to scroll to the TIRE PRESSURE MENU item screen.
6. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

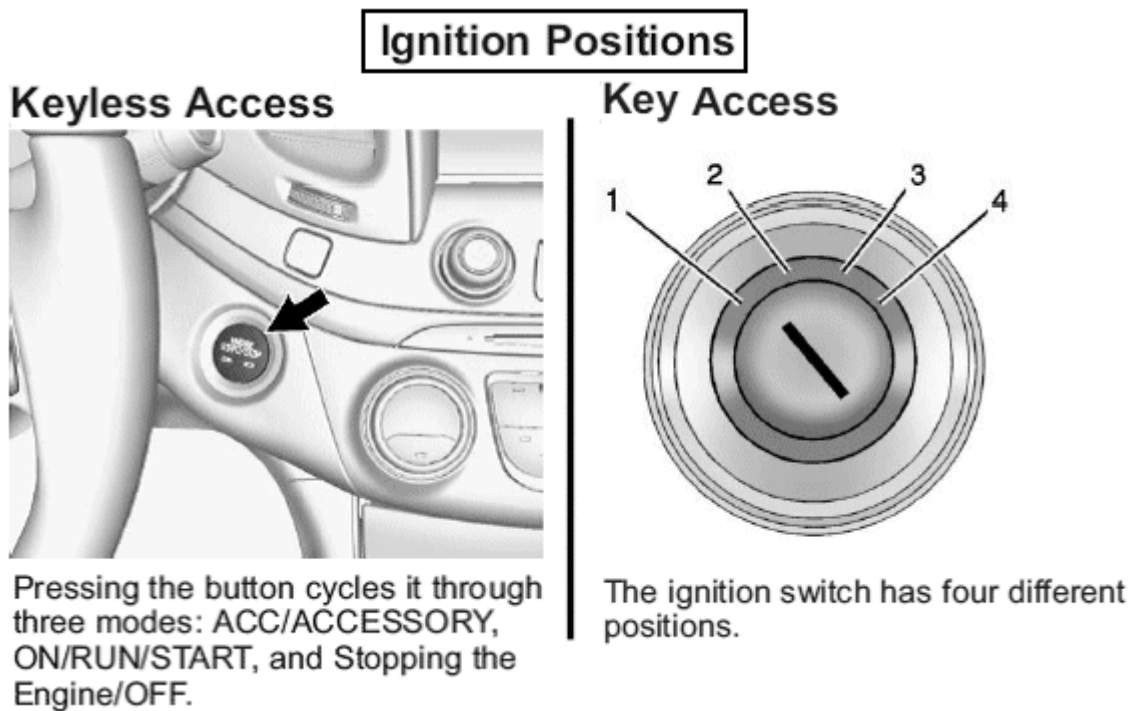


Fig. 7: Ignition Positions (Key & Keyless)
 Courtesy of GENERAL MOTORS CORP.

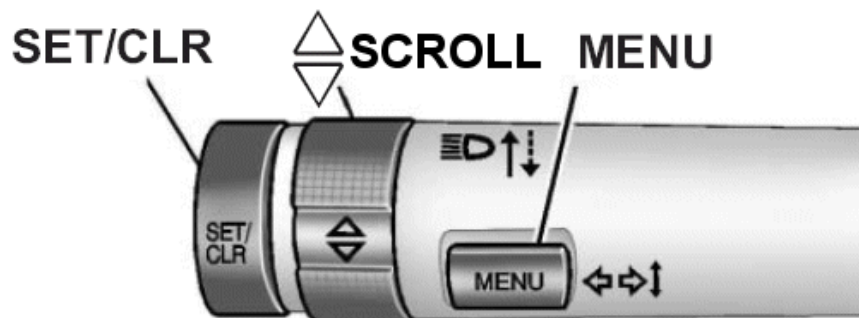


Fig. 8: Identifying DIC Controls (Turn Signal Lever)
 Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 26

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.

4. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
5.
 - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
 - **Base-Level DIC** : Use the TRIP ODOMETER RESET stem to scroll to the TIRE PRESSURE screen.
6.
 - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
 - **Base-Level DIC** : Press and hold the TRIP ODOMETER RESET stem for about five seconds. A message asking if the process should begin should appear. Select YES and press the TRIP ODOMETER RESET stem to confirm the selection.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 27

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ON/RUN position, with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled. The TIRE LEARNING ACTIVE message displays on the DIC screen.

NOTE: If the vehicle does not have RKE, press the Driver Information Center (DIC) vehicle information button until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen. If the vehicle does not have RKE or DIC buttons, press the trip odometer reset stem on the instrument cluster until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS

message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 28

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See [Fig. 7](#).
4. Make sure the Tire Pressure info page option is turned on. The info pages on the Driver Information Center (DIC) can be turned on and off through the Settings menu.
5. Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SET/RESET button (check mark symbol) located in the center of the DIC controls.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 29

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (right-hand side of instrument cluster) once on the Driver Information Center (DIC).
5. Press the up or down arrow button until the Tire Learn screen is displayed.
6. Press and hold the SET/CLR button to begin the sensor matching process.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 30

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Put the vehicle in ON/ RUN and place the vehicle in P (Park).
4. If the Driver Information Center (DIC) display is minimized, press the SELECT knob to maximize it. See [Fig. 9](#).
5. Use the SELECT knob to scroll to the Tire Pressure display screen.
6. Press and hold the SELECT knob for five seconds to begin the sensor matching process. A message displays confirming to begin the process.
7. Use the SELECT knob to select YES with the highlighted selection, and press the SELECT knob again to confirm the selection.

8. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
9. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
10. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
11. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

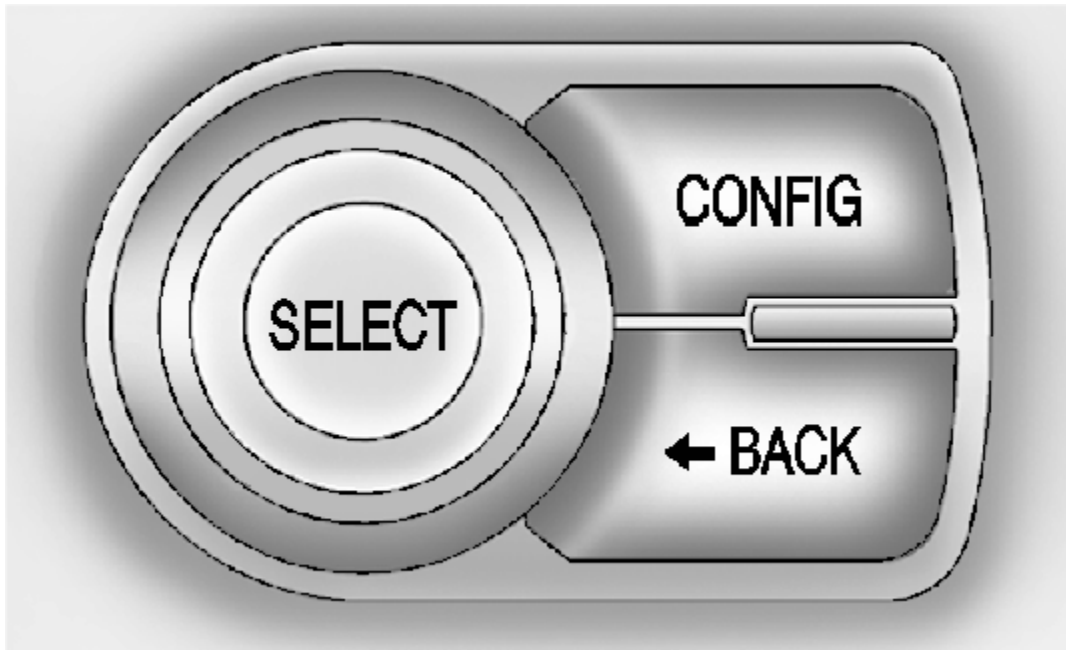


Fig. 9: Identifying DIC Controls (Spark EV)

Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 31

NOTE: You have two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Enter the learn sequence from the TPM Learn screen, located under the Customization Menu in the instrument panel cluster. Press SRCE button until you see Customize Options and then press ENTER (left pointing arrow). Move the thumbwheel up or down to scroll through the available options. Press ENTER to select an item. To exit the current menu, or go back, use the thumbwheel to select BACK (left arrow) at the top of the screen and then press ENTER.
5. Start with the driver side front tire. The driver side front indicator lamp also comes on to indicate that corner's sensor is ready to be learned. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor

identification code has been matched to this tire and wheel position

6. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After the driver side rear TPMS sensor has been learned the horn chirps two times. The driver side rear indicator lamp turns off and the TPMS sensor matching process is done. Turn the ignition switch to LOCK/OFF.

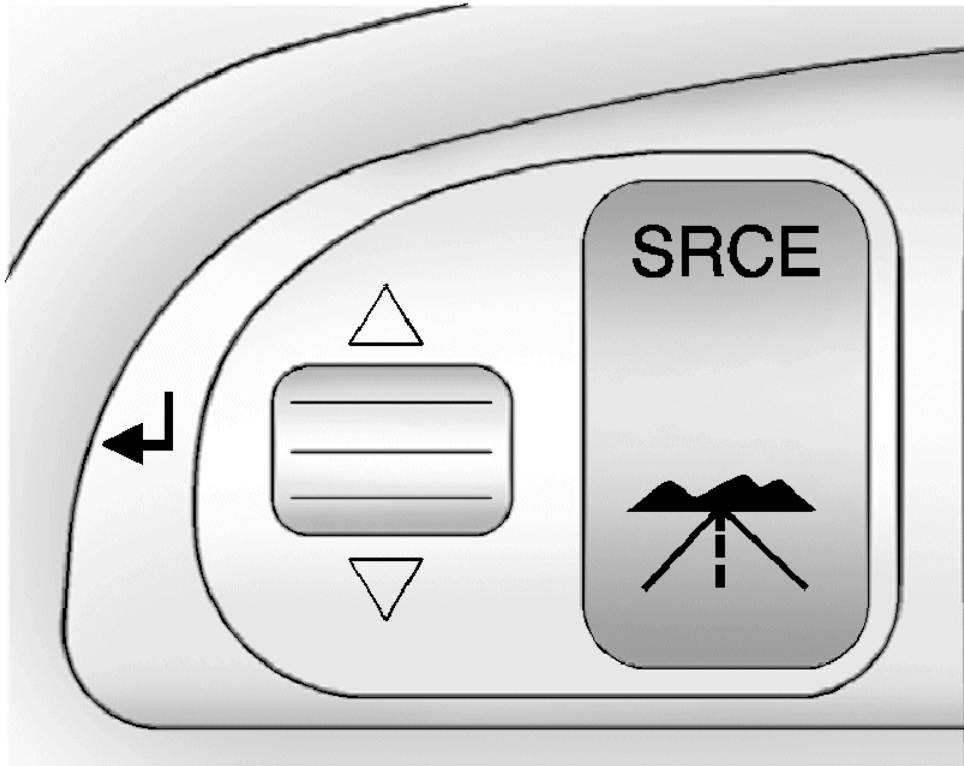


Fig. 10: Identifying DIC Controls

Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 32

NOTE: An OEM or generic TPMS sensor activation tool is used to perform this procedure.

NOTE: The sensor learn procedure must be performed after every tire rotation, tire pressure indicator module replacement, or sensor replacement. Make sure the TPM sensor activation tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. The low tire pressure warning light will start to flash to indicate the learn mode has been enabled. The front and back turn signals will flash twice when a sensor has been learned.

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a sensor activation tool, initiate the TPM Learn Mode.

3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure sensor activation tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for the front and back turn signals to flash twice. If the front and back turn signals do not flash, repeat the sensor activation sequence with the tool. Once the front and back turn signals have flashed twice, the sensor information is learned.

NOTE: Follow the sensor order listed here since there is no visual indicator on the vehicle for the sensor learn order.

4. After the front and back turn signals have flashed twice, repeat step 2 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
5. When the left rear sensor has been learned, the front and back turn signals will flash twice, the learn process is complete and the tire pressure indicator module exits the Learn mode.

TPMS REMINDER RESET - PROCEDURE 33

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC).
5. Use the arrow keys to scroll to the Tire Pressure screen.
6. Press the SET/CLR button to begin the sensor matching process. A message should display requesting acceptance of the process.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 34

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS

receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn the ignition to ON/RUN with the engine OFF. Set the parking brake.
3. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
4.
 - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
 - **Base-Level DIC** : Use the MENU button to select the Vehicle Information menu in the DIC. Use the thumbwheel to scroll to the Tire Pressure Menu item screen. See [Fig. 8](#).
5.
 - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
 - **Base-Level DIC** : Press the SET/CLR button to begin the sensor matching process. A message asking if the process should begin should appear. Press the SET/CLR button again to confirm the selection.
6. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
8. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition switch to LOCK/OFF.
11. Set all four tires to the recommended air pressure level as indicated on the Tire and Loading Information label.

Article GUID: A00161620

GENERAL INFORMATION

Manual Transmission Trouble Shooting

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

INTRODUCTION

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

There are many times when the transmission is incorrectly blamed for shifting problems or noises that are actually caused by other reasons. Shift difficulties are frequently caused by conditions outside of the transmission or transaxle. Typical conditions include: shift linkage, shift cables, alignment of engine to transmission, worn engine mounts or clutch problems. Drive train noises may come from many sources such as tires, road surfaces, wheel bearings, differentials, engine or exhaust system. Repairing or overhauling transmission will not cure these problems.

No manufacturer makes a perfectly quiet transmission. Gear rollover noise is present in most constant mesh transmissions and will tend to disappear when the clutch is disengaged or transmission is placed in gear. If clutch is properly adjusted, clutch release bearing noise will disappear when release bearing is moved enough to slide release bearing away from pressure plate.

Trouble shooting can be helped by driving vehicle on a smooth level road to help eliminate tire and body noise. Note whether noise occurs on acceleration, coasting, deceleration or steady driving conditions. Some problems may only occur when transmission is either hot or cold. Gear lubricant that is too thick can cause hard shifting on cold mornings before engine is warm and vehicle has been driven.

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low Gear Oil Level, Loose Bellhousing Bolts, Worn Bearings Or Gears
Clunk On Deceleration (FWD Only)	Loose Engine Mounts, Worn Inboard CV Joints, Worn Differential Pinion Shaft, Oversized Side Gear Hub Counterbore in Case
Gear Clash When Shifting Forward Gears	Clutch Out Of Alignment, Shift Linkage Damaged Or Out Of Adjustment, Gears Or Synchronizers Damaged, Low Gear Oil Level
Transmission Noisy When Moving (RWD Only); Quiet In Neutral With Clutch Engaged	Worn Rear Output Shaft Bearing
Gear Rattle	Worn Bearings, Worn Gear Oil, Low Gear Oil, Worn Gears

Condition	Possible Cause
Steady Ticking At Idle (Increases With RPM)	Broken Tooth On A Gear
Gear Clash When Shifting Forward Gears	Worn Or Broken Synchronizers, Faulty Clutch
Loud Whine In Reverse	Normal Condition ⁽¹⁾
Noise When Stepping On Clutch	Faulty Release Bearing, Worn Pilot Bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty Release Bearing, Uneven Pressure Plate Fingers
Click Or Snap When Clutch Is Engaged	Worn Clutch Fork, Worn Pivot Ball, Worn Or Broken Front Bearing Retainer
Transmission Shifts Hard	Clutch Not Releasing, Incorrect Gear Oil, Shift Mechanism Binding, Clutch Installed Backward
Will Not Shift Into One Gear, Shifts Into All Others	Bent Shift Fork, Worn Detent Balls
Locked Into Gear, Cannot Shift	Clutch Adjustment, Worn Detent Balls
Transmission Jumps Out Of Gear	Pilot Bearing Worn, Bent Shift Fork, Worn Gear Teeth Or Face, Excessive Gear Train End Play, Worn Synchronizers, Missing Detent Ball Spring, Shift Mechanism Worn Or Out Of Adjustment, Engine Or Transmission Mount Bolts Loose, Transmission Not Aligned
Shift Lever Rattle	Worn Detents Or Shift Lever, Worn Shift Fork, Worn Synchronizer Sleeves
Shift Lever Hops Under Acceleration	Worn Engine Or Transmission Mounts
(1) Most units use spur cut gears in Reverse and are naturally noisy.	

Article GUID: A00010942

GENERAL INFORMATION

Parasitic Load Explanation & Test Procedures

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

GENERAL INFORMATION

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

The term Parasitic Load refers to electrical devices that continue to use or draw current after the ignition switch is turned to OFF position. This small amount of continuous battery draw is expressed in milliamps (mA). On Chrysler vehicles, a typical Parasitic Load should be no more than 30 milliamps (0.030 amps). On Ford Motor Co. and General Motors vehicles produced after 1980, a typical Parasitic Load should be no more than 50 milliamps (0.050 amps).

Vehicles produced since 1980 have memory devices that draw current with ignition off for as long as 20 minutes before shutting down the Parasitic Drain. When Parasitic Load exceeds normal specifications, the vehicle may exhibit dead battery and no-start condition.

Follow test procedure for checking Parasitic Loads to completion. A brief overview of a suggested test procedure is included along with some typical Parasitic Load specifications. Refer to GENERAL MOTORS PARASITIC LOAD TABLE chart.

TESTING FOR PARASITIC LOAD

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

CAUTION: Always turn ignition off when connecting or disconnecting battery cables, battery chargers or jumper cables. **DO NOT** turn test switch to OFF position (which causes current to run through ammeter or vehicle electrical system).

NOTE: Memory functions of various accessories must be reset after the battery is reconnected.

The battery circuit must be opened to connect test switch (shunt) and ammeter into the circuit. When a battery cable is removed, timer circuits within the vehicle computer are interrupted and immediately begin to discharge. If in doubt about the condition of the ammeter fuse, test it with an ohmmeter prior to beginning test. An open fuse will show the same reading (00.00) as no parasitic drain. Begin test sequence with the meter installed and

on the 10-amp scale. Select lower scale to read parasitic draw.

CHRYSLER IGNITION OFF DRAW (IOD) TEST

To test for excessive IOD, verify that all electrical accessories are OFF. Turn off all lights, remove ignition key, and close all doors and decklid. If the vehicle is equipped with electronic accessories (illuminated entry, automatic load leveler, body computer, or high line radio), allow the system to automatically shut off (time out), up to 3 minutes.

1. Raise the hood and disconnect both battery cables, negative first.

CAUTION: IOD greater than 3 amps may damage millampmeter.

2. Reconnect the negative cable and connect a typical 12-volt test light (low wattage bulb) between the positive cable clamp and the positive battery post. Remove the engine compartment lamp bulb. If the test light does not light, proceed to step [3](#). If the test light does light, proceed to step, [4](#). The test light will indicate IOD greater than 3 amps. After higher amperage IOD has been corrected, proceed to step [3](#).
3. With 12-volt test light still connected (not lit), connect an ammeter (milliampere scale) between the positive cable clamp and the positive battery post, disconnect test light, refer to instructions provided with ammeter being used. A reading of 30 milliamperes or less indicates normal electrical draw. If ammeter reads more than 30 milliamperes, excessive IOD must be corrected.
4. Locate the fuse panel and remove fuses or circuit breakers one at a time, and observe ammeter after each fuse or circuit breaker is removed. If test light goes out and the reading drops below 30 milliamperes when a certain fuse or circuit breaker is removed, that circuit may have a defect.
5. If IOD is detected after all fuses and circuit breakers have been removed, disconnect the 60-way connector at the Single Module Engine Control (SMEC), located outboard of the battery.
6. If excessive IOD is detected after all fused circuits and SMEC have been verified, disconnect the B+ terminal from the alternator. If reading drops below 30 milliamperes, reinstall all fuses and circuit breakers, reconnect B+ terminal at alternator, reconnect battery, and perform alternator diagnostics.
7. Install engine compartment lamp bulb.

TEST PROCEDURE USING TEST SWITCH

1. Turn ignition off. Remove negative battery terminal cable. Install Disconnect Tool (J-38758) test switch male end to negative battery cable. Turn test switch knob to OFF position (current through meter). Install negative battery cable to the female end of test switch.
2. Turn test switch knob to ON position (current through switch). Road test vehicle with vehicle accessories on (radio, air conditioner, etc). After road test, turn ignition switch to LOCKED position and remove key. Connect ammeter terminals to test switch terminals. See [Fig. 1](#). Select 10-amp scale.
3. Turn off all electrical accessories. Turn off interior lights, underhood lamp, trunk light, illuminated entry, etc. To avoid damaging ammeter or obtaining a false meter reading, all accessories must be off before turning test switch knob to OFF position.
4. Turn test switch knob to OFF position to allow current to flow through ammeter. If meter reads wrong polarity, turn test switch to ON position and reverse leads. Turn test switch to OFF position. Observe current reading. If reading is less than 2 amps, turn test switch to ON position to keep electrical circuits powered-up.

5. Select low amp scale. Switch lead to the correct meter position. Turn test switch to OFF position and compare results to normal current draw. See [GENERAL MOTORS PARASITIC LOAD TABLE \(MILLIAMPS\)](#). If current draw is unusually high for the vehicle's overall electrical system, remove system fuses one at a time until current draw returns to normal.
6. Turn test switch to ON position each time door is opened or fuse is removed. Turn switch to OFF position to read current draw value through meter. When the cause of excessive current drain has been located and repaired, remove test switch and reconnect negative battery cable to the negative battery terminal.

INTERMITTENT PARASITIC LOAD PROBLEMS

Intermittent parasitic load can occur because of a memory device that does not power down with ignition off. With an intermittent parasitic load, battery draw can be greater than 1.0 amp.

To find an intermittent problem requires that an ammeter and Disconnect Tool (J-38758) test switch be connected and left in the circuit. See [Fig. 1](#). Road test vehicle. After road test, turn ignition off and remove key.

Monitor the milliamps scale for 15-20 minutes after ignition is turned off. This allows monitoring memory devices to determine if they time out and stop drawing memory current. The test switch is needed to protect ammeter when the vehicle is started.

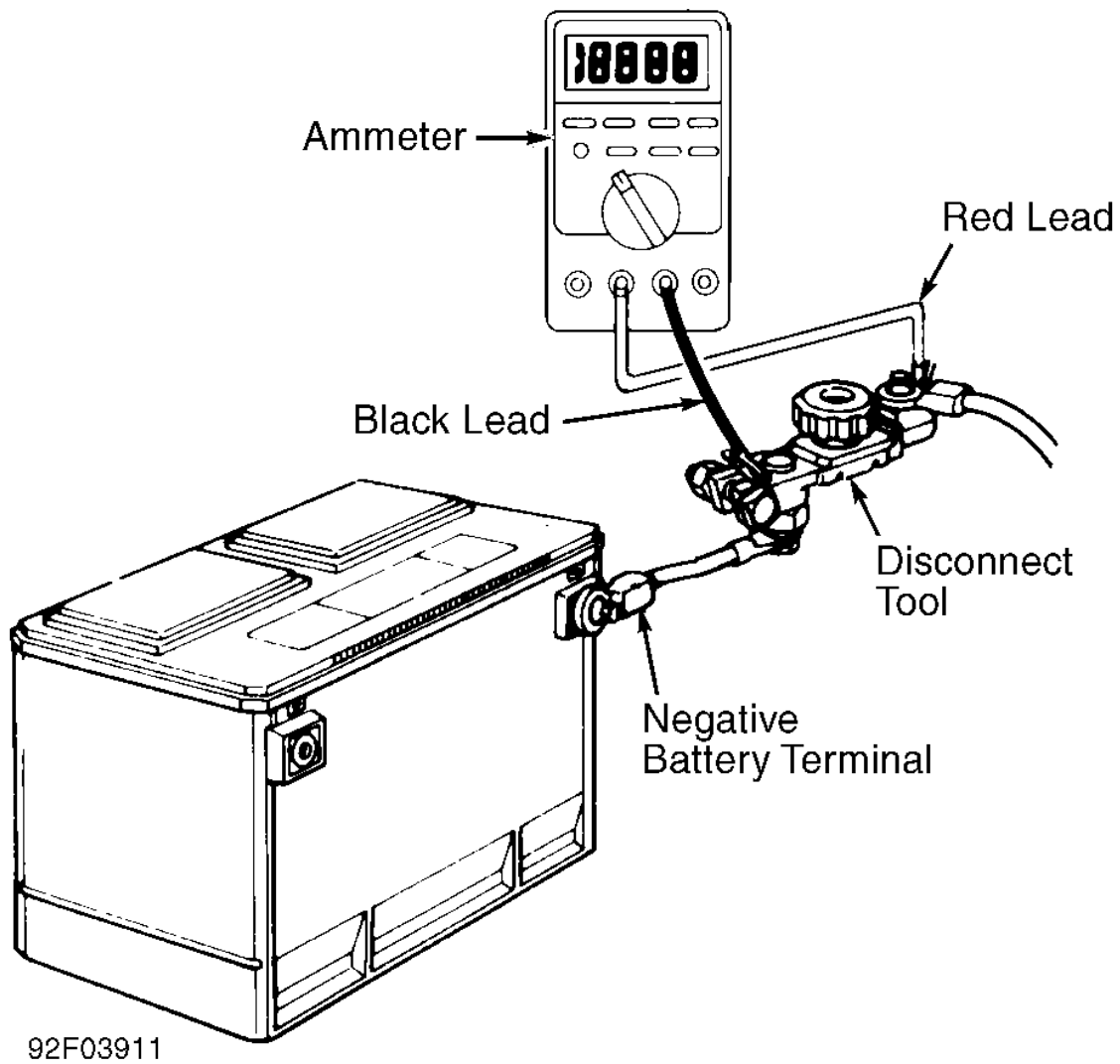


Fig. 1: Connecting Kent-Moore Disconnect Tool (J-38758)

Courtesy of GENERAL MOTORS CORP.

GENERAL MOTORS PARASITIC LOAD

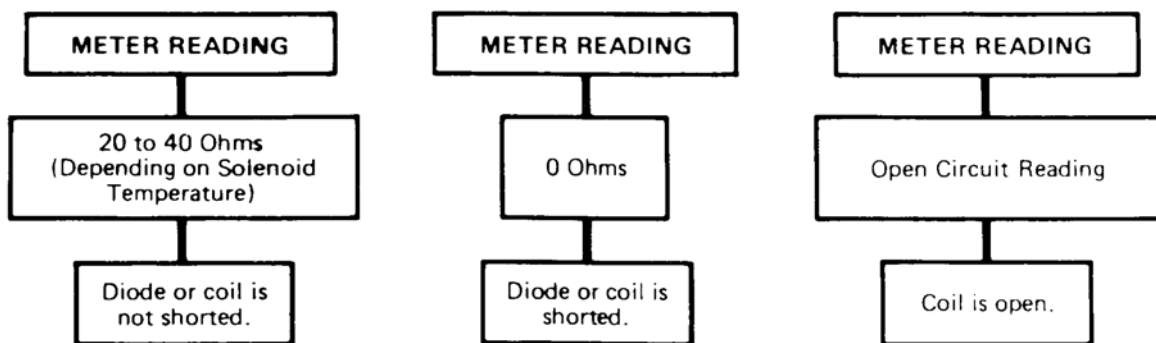
Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Anti-Theft System	0.4	1.0	.....
Auto Door Lock	1.0	1.0	.....
Body Control Module	3.6	12.4	20
Central Processing System	1.6	2.7	20
Electronic Control Module	5.6	10.0	.....
Electronic Level Control	2.0	3.3	20
Heated Windshield Module	0.3	0.4	.....

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
HVAC Power Module	1.0	1.0	.....
Illuminated Entry	1.0	1.0	1
Light Control Module	0.5	1.0	.....
Oil Level Module	0.1	0.1	.....
Multi-Function Chime	1.0	1.0	.....
Pass Key Decoder Module	0.75	1.0	.....
Power Control Module	5.0	7.0	.....
Retained Accessory Power	3.8	3.8	.....
Radio	7.0	8.0	15
Twilight Sentinel Module	1.0	1.0	.....
Voltage Regulator	1.4	2.0	.....

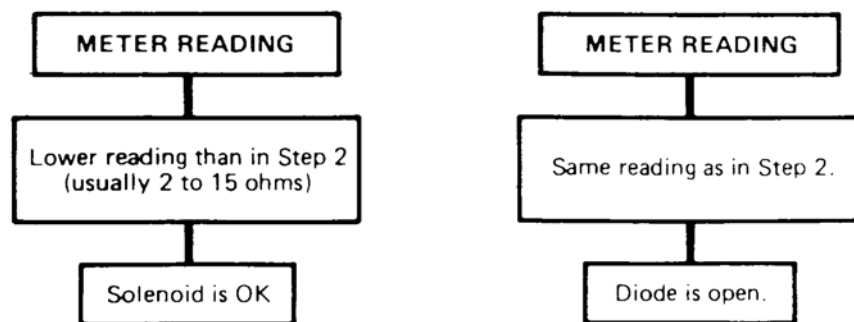
DIODE CHECK & SOLENOID TEST

Step 1) Select the X1 SCALE and zero the needle.

Step 2) Attach the POSITIVE SOLENOID LEAD (Red lead) to the POSITIVE METER LEAD and the NEGATIVE SOLENOID LEAD (Black lead) to the NEGATIVE METER LEAD.



Step 3) Reverse the solenoid lead attachments.



92H03912

Fig. 2: Diode Check & Solenoid Test

Courtesy of GENERAL MOTORS CORP.

QUAD DRIVER TEST

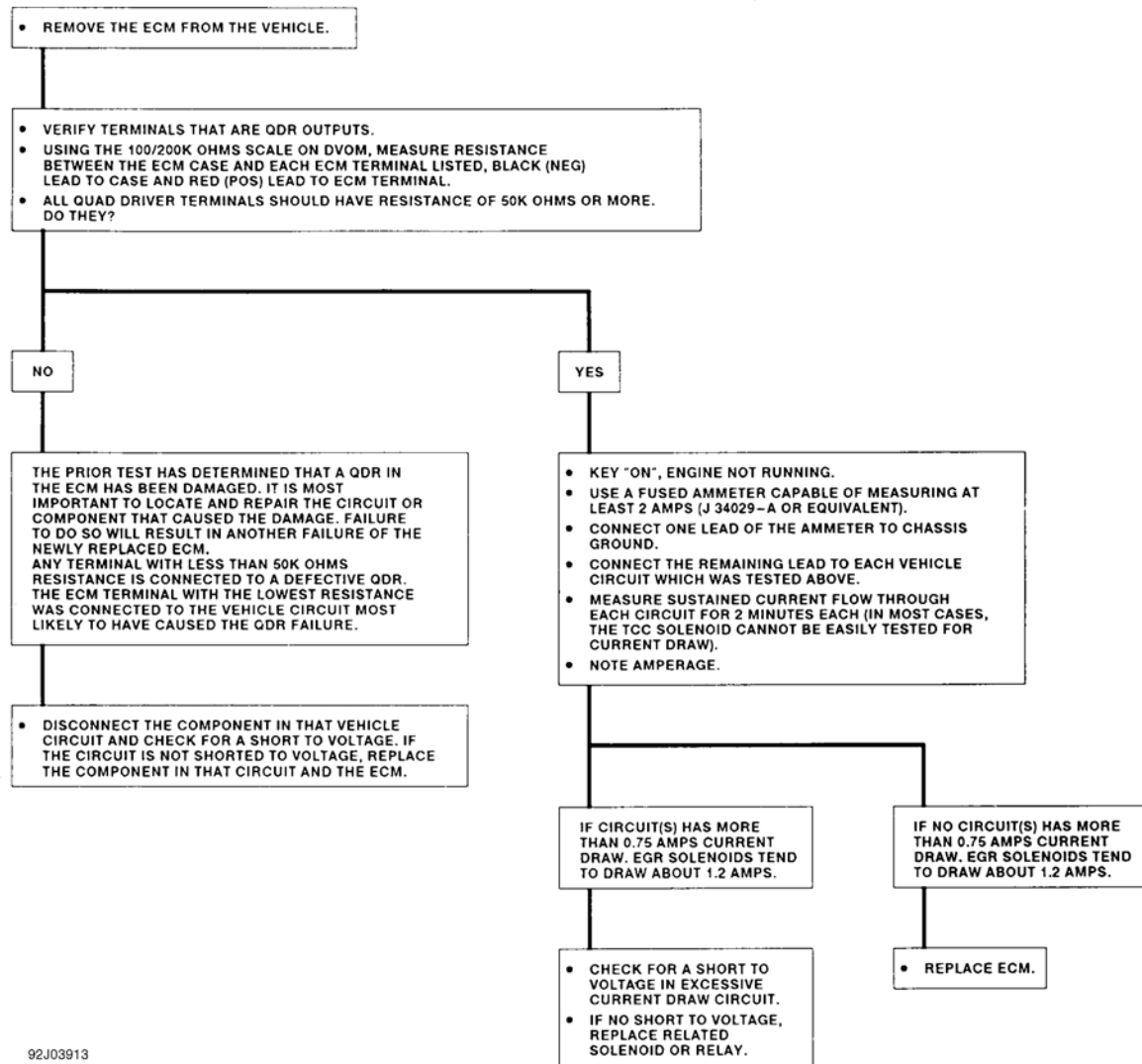


Fig. 3: Quad Driver Test

Courtesy of GENERAL MOTORS CORP.

Article GUID: A00002347

ACCESSORIES & EQUIPMENT

Programming and Setup - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE REFERENCES

Reference Information

- [Data Link References](#)
- [Diagnostic System Check - Vehicle](#)
- [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
- [Symptoms - Vehicle](#)

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
A11	Radio Scan Tool Information	Radio/Navigation System Schematics	Radio Replacement	Radio Programming and Setup
B218L/R	Side Object Sensor Module Scan Tool Information	Object Detection Schematics	Side Object Sensing Alert Module Replacement	Side Object Sensor Module Programming and Setup
E54	Hybrid/EV Battery Pack Coolant Heater	Hybrid/EV Cooling Schematics	Heater Coolant Heater Replacement	Coolant Heater Control Module Programming and Setup
G1	A/C Compressor	HVAC Schematics	Air Conditioning and Drive Motor Battery Cooling Compressor Replacement	Air Conditioning Compressor Control Module Programming and Setup
K1	14 Volt Power Module	Starting and Charging Schematics	Accessory DC Power Control Module Replacement	14 Volt Power Module Accessory DC Power Control Module Programming and Setup
K9	Body Control Module Scan Tool Information	Body Control System Schematics	Body Control Module Replacement	Body Control Module Programming and Setup
K16	Battery Energy Control Module Scan Tool Information	Hybrid/EV Energy Storage Schematics	Battery Energy Control Module Replacement	Battery Energy Control Module Programming and Setup
K17	Electronic Brake Control Module Scan Tool Information	Antilock Brake System Schematics	Electronic Brake Control Module Replacement	Electronic Brake Control Module Programming and Setup

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
				<u>Setup</u>
K20	<u>K20 Engine Control Module: Scan Tool Information</u>	<u>Engine Controls Schematics</u>	<u>Engine Control Module Replacement</u>	<u>K20 Engine Control Module: Programming and Setup</u>
K29	Driver Seat and Passenger Seat Heater Control Module	<u>Heated/Cooled Seat Schematics</u>	<u>Front Seat Heater Control Module Replacement</u>	<u>Seat Heating Control Module Programming and Setup</u>
K29R	Rear Seat Heater Control Module	<u>Heated/Cooled Seat Schematics</u>	<u>Rear Seat Heater Control Module Replacement</u>	<u>Rear Seat Heater Control Module Programming and Setup</u>
K33	<u>Heating, Ventilation and Air Conditioning Control Module Scan Tool Information</u>	<u>HVAC Schematics</u>	<u>Heater and Air Conditioning Remote Control Replacement</u>	<u>HVAC Control Module Programming and Setup</u>
K36	<u>Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Sensing and Diagnostic Module Replacement</u>	<u>Inflatable Restraint Sensing and Diagnostic Module Programming and Setup</u>
K41	<u>Parking Assist Control Module Scan Tool Information</u>	<u>Object Detection Schematics</u>	<u>Parking Assist Control Module Replacement</u>	<u>Parking Assist Control Module Programming and Setup</u>
K43	<u>Power Steering Control Module Scan Tool Information</u>	<u>Power Steering Schematics</u>	<u>Electric Belt Drive Rack and Pinion Steering Gear Replacement</u>	<u>Power Steering Control Module Programming and Setup</u>
K73	<u>Telematics Communication Interface Control Module Scan Tool Information</u>	<u>OnStar/Telematics Schematics</u>	<u>Communication Interface Module Replacement</u>	<u>Telematics Communication Interface Control Module Programming and Setup (with UKF)Telematics Communication Interface Control Module Programming and Setup (with UE1)</u>
K74	<u>Human Machine Interface Control Module Scan Tool Information</u>	<u>Radio/Navigation System Schematics</u>	<u>Human Machine Interface Control Module Replacement</u>	<u>Human Machine Interface Control Module Programming and Setup</u>

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
				<u>Setup</u>
K77	Remote Control Door Lock Receiver	<u>Remote Function Schematics</u>	<u>Remote Control Door Lock Receiver Replacement</u>	<u>Remote Control Door Lock Receiver Programming and Setup</u>
K84	Keyless Entry Control Module	<u>Remote Function Schematics</u>	<u>Keyless Entry Control Module Replacement</u>	<u>Keyless Entry Control Module Programming and Setup</u>
K85	<u>Inflatable Restraint Passenger Presence System Scan Tool Information</u>	<u>SIR Schematics</u>	<u>Airbag Front Passenger Presence Module Replacement</u>	<u>Passenger Presence System Programming and Setup</u>
K89	Immobilizer Control Module	<u>Immobilizer Schematics</u>	<u>Theft Deterrent Module Replacement</u>	<u>Immobilizer Control Module Programming and Setup</u>
K109	Front View Camera Module	<u>Object Detection Schematics</u>	<u>Front View Camera Replacement</u>	<u>Front View Camera Module Programming and Setup</u>
K111	<u>Fuel Pump Power Control Module Scan Tool Information</u>	<u>Engine Controls Schematics</u>	<u>Fuel Pump Power Control Module Replacement</u>	<u>Fuel Pump Power Control Module Programming and Setup</u>
K114B	<u>Hybrid Powertrain Control Module 2 Scan Tool Information</u>	<u>Hybrid/EV Cooling Schematics</u> or <u>Hybrid/EV Energy Storage Schematics</u>	<u>Hybrid Powertrain Control Module 2 Replacement</u>	<u>Hybrid Powertrain Control Module 2 Programming and Setup</u>
K132	<u>Pedestrian Alert Sound Control Module Scan Tool Information</u>	<u>Horn Schematics</u>	<u>Pedestrian Sound Alert Module Replacement</u>	<u>Pedestrian Alert Sound Control Module Programming and Setup</u>
K177	<u>Brake Booster Control Module Scan Tool Information</u>	<u>Hydraulic Brake Schematics</u>	<u>Power Brake Master Cylinder Booster Assembly Replacement</u>	<u>Brake Booster Control Module Programming and Setup</u>
P16	<u>Instrument Cluster Scan Tool Information</u>	<u>Instrument Cluster Schematics</u>	<u>Instrument Cluster Replacement</u>	<u>Instrument Cluster Programming and Setup</u>
T3	Audio Amplifier	<u>Radio/Navigation System Schematics</u>	<u>Radio Speaker Amplifier Replacement</u>	<u>Audio Amplifier Programming and Setup</u>

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
T6	Power Inverter Module • Hybrid Powertrain Control Module Scan Tool Information • Motor Control Module 1 Scan Tool Information • Motor Control Module 2 Scan Tool Information	Hybrid/EV Controls Schematics	Drive Motor Power Inverter Module Removal	Drive Motor Power Inverter Module Programming and Setup
T18/K57	Battery Charger/Battery Charger Control Module	Plug-In Charging Schematics	Drive Motor Battery Charger Replacement	Battery Charger Programming and Setup

REPAIR INSTRUCTIONS

K20 ENGINE CONTROL MODULE: PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector (DLC). If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set

the Inspection/Maintenance (I/M) system status indicators to NO.

- Note the engine oil life remaining percentage.

Replace and Program Control Module

To program a replacement K20 Engine Control Module (ECM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Before removing the old control module, perform the SPS function Prepare Control Module for Removal, if available.

NOTE: The Prepare Control Module for Removal function can only be performed when communication with the old control module is still possible.

4. Replace the ECM.
5. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
 - K20 Engine Control Module and follow on-screen instructions.
6. Clear the DTCs after completing the Programming procedure.
 7. If equipped, Perform the SPS function Immobilizer Learn and follow the on-screen instructions. Refer to [Immobilizer System Component Programming](#).
 8. Perform the following SPS function:
 1. Setup

NOTE: If both controller options below are listed, select K20 Engine Control Module.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
 - K20 Engine Control Module and follow on-screen instructions.
2. Configuration - If applicable
 9. Clear DTCs.

Reprogram Control Module

To reprogram an existing K20 Engine Control Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

4. Clear DTCs after completing the Programming procedure.

NOTE: If vehicle fails to start during Configuration and Setup, perform the SPS Function Immobilizer Learn and follow the on-screen instructions.

5. Perform the following SPS function:

1. Setup

NOTE: If both controller options below are listed, select K20 Engine Control Module.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

2. Configuration - If applicable

6. Clear DTCs.

Unsuccessful Programming Recovery

If programming a control module is not successful, perform the following procedure:

1. Verify the control module, data link connector and programming tool connections are secure and the tool software is up to date.
2. Ignition - On/Vehicle - In Service Mode
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.

4. Verify the control module programming is successful.

• **If the programming is not successful**

1. Ignition/Vehicle - Off - For greater than 1 min
2. Ignition - On/Vehicle - In Service Mode
3. Perform one of the following SPS Programming functions:

NOTE: If both controller options below are listed, select K20/K71 Engine and Transmission Control Modules.

- K20/K71 Engine and Transmission Control Modules and follow the on-screen instructions.
- K20 Engine Control Module and follow on-screen instructions.
- If the programming is not successful, replace the appropriate component: K20 Engine Control Module or K71 Transmission Control Module
- If the programming is successful

4. All OK.

- If the programming is successful

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for ECM replacement, programming and setup

ACCESSORY DC POWER CONTROL MODULE PROGRAMMING AND SETUP

This device requires no programming or setup.

ACTIVE SAFETY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the active safety control module is not properly configured with the correct calibration software, the active safety control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming or programming failure, active safety control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program Active Safety Control Module or Reprogram Active Safety Control Module

To program a replacement or an existing active safety control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Active Safety Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the active safety control module, DLC and programming tool connections are secure and

the SPS software is up to date.

2. Verify the active safety control module can be reprogrammed.

- **If the active safety control module cannot be reprogrammed**

1. Ignition OFF for one minute, ignition ON.

2. Verify the active safety control module can be reprogrammed.

- If the active safety control module cannot be reprogrammed, replace the K124 Active Safety Control Module.
- If the active safety control module can be reprogrammed.

3. All OK.

- **If the active safety control module can be reprogrammed**

3. All OK.

AIR CONDITIONING COMPRESSOR CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.

2. On the SPS Supported Controllers screen, select Electric A/C Compressor Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, vehicle in Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup

AUDIO AMPLIFIER PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

During programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select T3 Audio Amplifier - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

BATTERY CHARGER PROGRAMMING AND SETUP

This device requires no programming or setup.

BATTERY ENERGY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.

- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Battery Energy Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Vehicle OFF for at least one minute.
4. Turn the Vehicle in Service Mode and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

BODY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking,

over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.

- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- **EL-46079** Tire Pressure Monitor Diagnostic Tool or **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement K9 Body Control Module (BCM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE: Make sure the vehicle ignition switch state is in appropriate position for the following step.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle OFF power mode. The Service Programming System will power mode the vehicle.

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.
4. Perform the following for the appropriate ignition type prior to proceeding with the next step:
 - Key Ignition System: Key in the ignition and any additional keys must be away from the vehicle at least 3 m.
 - Push Button Start System: Keyless entry transmitter must be in the programming pocket. Refer to the owner manual for the exact pocket location. All additional transmitters must be away from the vehicle at least 3 m.

NOTE: The following programming step may take between 10 - 12 min and progress will appear to have stopped during this process. This is a normal security timer response and a restart should not be performed. If the DTC B389A set immediately after programming a replacement BCM, the Immobilizer Learn

procedure was not properly completed. The Immobilizer Learn procedure needs to be performed again.

5. On the SPS Supported Controllers screen, select Z1 Immobilizer Learn. On the next screen, select Body Control Module IMMO Learn with Existing Transponder or Remote Key and follow the on-screen instructions. When Immobilizer Learn is complete, press the Unlock button on the keyless entry transmitter to allow the keyless entry transmitter to exit the Immobilizer Learn mode.

NOTE: When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle ON power mode.

6. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
7. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
8. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
9. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
 3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
 4. Use the scan tool to clear the DTCs.

Reprogram Control Module

To program an existing K9 Body Control Module, perform the following procedure:

1. Install EL-49642 SPS programming support tool.

NOTE: Make sure the vehicle ignition switch state is in appropriate position for the following step.

- For Key Ignition System, begin with the ignition in the RUN position.
- For Push Button Start System, begin with the vehicle in vehicle ON power mode.

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.

NOTE: When performing the Tire Pressure Monitor Sensor Learn during BCM setup,

the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.

4. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
5. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
6. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
7. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
 1. Disconnect the scan tool from the X84 Data Link Connector.
 2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
 3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
 4. Use the scan tool to clear the DTCs.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON/Vehicle In Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition/Vehicle OFF for one minute, ignition ON/Vehicle In Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

BRAKE BOOSTER CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during**

programming, programming failure or control module damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program Control Module or Reprogram Control Module

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Brake Booster Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

COOLANT HEATER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming or any setup procedures.

DRIVE MOTOR POWER INVERTER MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Immobilizer Learn - Setup and follow the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Power Inverter Module - MCVN Operations

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module MCVN Operations and follow the

on-screen instructions. Refer to [Solenoid Valve Characterization Reprogramming](#) for additional information.

4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least 1 minute.
4. Turn the vehicle ON and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

ELECTRONIC BRAKE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

3. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Setup while following the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
 3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for Control Module replacement, programming and setup

FRONT VIEW CAMERA MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set

the Inspection/Maintenance (I/M) system status indicators to NO.

- If the windshield was replaced, the Frontview camera module must be calibrated.
- If the Frontview camera module was removed and reinstalled, no action is necessary.

Following Replacement of Windshield

Do not reprogram the frontview camera module when only the windshield is replaced, unless directed by a service procedure, or a service bulletin.

The K109 Frontview Camera Module must be calibrated, refer to [Front View Camera Module Learn](#) .

Front View Camera Module Replacement

If the Front View Camera Module needs to be replaced, the following procedures must be performed:

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to [Front View Camera Module Learn](#) .

Front View Camera Module Reprogramming

Do not reprogram the Front View Camera Module, unless directed by a service procedure, or a service bulletin.

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to [Front View Camera Module Learn](#) .

FUEL PUMP POWER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

GARAGE DOOR OPENER PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming but does require the following setup procedures after a new ECU is installed:

The customer must learn the device they wish to control. This must be done at the device (garage door opener, electric gate, etc.) and cannot be performed at a dealership. Refer to the vehicle owner's manual for programming instructions.

SEAT HEATING CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

HUMAN MACHINE INTERFACE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- During programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependent upon the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

NOTE: **The vehicle must remain in PARK during the programming procedure.**

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module -

Programming and follow the on-screen instructions.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 8.

4. Connect a USB drive to the computer.
5. Access the Service Programming System (SPS) and follow the on-screen instructions.
6. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - USB File Transfer.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 12.
- All existing files on the USB drive will be erased when the new files are copied.

7. Upon completion of the file transfer, remove the USB drive from the computer.
8. Vehicle in Service Mode, infotainment system ON.
9. Connect the USB drive to the USB port in the vehicle.
10. The infotainment system will recognize that update files are available. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
11. Upon completion of programming, remove the USB drive. Follow the infotainment display on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
13. Vehicle OFF, Retained Accessory Power (RAP) OFF, remove the key fob from range of the vehicle, and let the vehicle sit for five minutes. Retest system operation to verify the repair.

Reprogram Control Module

To program an existing control module, perform the following procedure:

NOTE: The vehicle must remain in PARK during the programming procedure.

1. Install the EL-49642 SPS Programming Support Tool.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 6.

2. Connect a USB drive to the computer.
3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - USB File Transfer.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 10.
- All existing files on the USB drive will be erased when the new files are copied.

5. Upon completion of the file transfer, remove the USB drive from the computer.
6. Vehicle in Service Mode, infotainment system ON.

7. Connect the USB drive to the USB port in the vehicle.
8. The infotainment system will recognize that update files are available. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.
9. Upon completion of programming, remove the USB drive. Follow the infotainment display on-screen instructions.
10. Access the Service Programming System (SPS) and follow the on-screen instructions.
11. On the SPS Supported Controllers screen, select K74 Human Machine Interface Control Module - Programming and follow the on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
13. Vehicle OFF, Retained Accessory Power (RAP) OFF, remove the key fob from range of the vehicle, and let the vehicle sit for five minutes. Retest system operation to verify the repair.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

NOTE: If USB programming was interrupted, a 5 minute recovery time period may be necessary before the software will reinitialize. Wait 3 minutes with the vehicle OFF, all access doors closed, and all vehicle systems OFF. Upon restarting the USB portion of the programming, the display will show a countdown timer for up to 5 minutes before proceeding with the USB File Transfer.

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF, all access doors closed, all vehicle systems OFF for one minute, Vehicle in Service Mode.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

HVAC CONTROL MODULE PROGRAMMING AND SETUP

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

NOTE:

- **Do NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Verify the programming tool is equipped with the latest software and is**

securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the below mentioned special tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn Off or disable systems that may put a load on the vehicle's battery. For example, interior lights, daytime running lights, HVAC, and radio.**
- **During the programming procedure, follow the Service Programming System (SPS) prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to No.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Programming an Existing or New Control Module

To program an existing or new control module, perform the following procedure:

1. Install the special tool: EL-49642 SPS Programming Support Tool
2. Ignition - On/Vehicle - In Service Mode
3. Access SPS and follow the on-screen instructions for the control module: K33 HVAC Control Module
4. Perform the SPS function: Programming

Unsuccessful Programming Recovery

If programming a control module is not successful, perform the following procedure:

1. Verify the control module, data link connector and programming tool connections are secure and the tool software is up to date.
2. Ignition - On/Vehicle - In Service Mode
3. Perform the SPS function: Programming

Verify the control module programming is successful.

- **If the programming is not successful**

1. Ignition/Vehicle - Off - For greater than 1 min
2. Ignition - On/Vehicle - In Service Mode
3. Perform the SPS function: Programming
 - If the programming is not successful - Replace the component: K33 HVAC Control Module
 - If the programming is successful

4. All OK.

- If the programming is successful

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

HVAC CONTROLS PROGRAMMING AND SETUP

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

NOTE:

- Do NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Verify the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the below mentioned special tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Turn Off or disable systems that may put a load on the vehicle's battery. For example, interior lights, daytime running lights, HVAC, and radio.
- During the programming procedure, follow the Service Programming System (SPS) prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to No.

Programming an Existing or New Control Module

This control module does not require SPS programming or any setup procedures.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

For control module replacement, programming, and setup refer to: [Control Module References](#)

HYBRID POWERTRAIN CONTROL MODULE 2 PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure

or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.

- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

CAUTION: DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"
5. With a scan tool, perform the [Hybrid/EV Battery Pack Capacity Learn](#) and follow the on-screen instructions.
6. With a scan tool, select the Passenger Compartment Heater Coolant Control Solenoid Valve Learn Procedure and follow the on-screen instructions.
7. With a scan tool, perform the [Clear Secured High Voltage DTCs](#) and follow the on-screen instructions.
8. With a scan tool, Clear All DTCs.
9. With a scan tool, select Hybrid/EV Battery Pack Charging Adaptive Learn Reset in the Hybrid Powertrain Control Module 2 Reset Functions menu and follow the on-screen instructions.

Reprogram Control Module

To program an existing control module, perform the following procedure:

CAUTION: DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for hybrid/EV powertrain control module 2 replacement, programming and setup.

IMMOBILIZER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct power mode.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

The air bag indicator light may remain ON after the body control module (BCM), or SDM is replaced, and during the programming procedure for the BCM until after the procedure is completed. When installing a new SDM, there may be several DTCs set prior to programming. Once programmed, these DTCs should be history and can be cleared.

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing Inflatable Restraint Sensing and Diagnostic Module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K36 Inflatable Restraint Sensing and Diagnostic Module - Programming and Setup and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery**NOTE:**

GMNA Regions: When SPS failure message E4489 occurs during programming or calibration, do not call TCSC immediately. Record at which point the failure occurred before it displayed the E4489 message. When this occurs, proceed to GDS2. Download the appropriate vehicle configuration and select the Inflatable Restraint Sensing and Diagnostic Module. Under Identification Information, look at parameters: Software Module 1 Identifier and Software Module 2 Identifier. If either of these are populated with a value of 1 or more, replace the Inflatable Restraint Sensing and Diagnostic Module. Record these parameter values on the back of the job card.

Non GMNA Regions: When SPS displays message indicating that programming may

fail and the programming event fails at 0%, replace the Inflatable Restraint Sensing and Diagnostic Module. Verify no other DTC's or issues exist with the module prior to replacement. Record all DTCs and relevant information on the back of the job card.

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

INSTRUMENT CLUSTER PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct power mode.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Instrument Cluster - Prepare Control Module for Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Programming and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select Instrument Cluster - Setup and Configuration and follow the

on-screen instructions.

6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

KEYLESS ENTRY CONTROL MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Keyless Entry Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Turn the vehicle to Service Mode and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

RADAR SENSOR MODULE - LONG RANGE PROGRAMMING AND SETUP

NOTE:

- DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the Long Range Radar Sensor Module is not properly configured with the correct calibration software, the Long Range Radar Sensor Module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming or programming failure, Long Range Radar Sensor Module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Replace and Program Radar Sensor Module - Long Range or Reprogram Radar Sensor Module - Long Range

To program a replacement or an existing Long Range Radar Sensor Module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select B233B Radar Sensor Module - Long Range - Programming and follow the on-screen instructions.
3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
4. Following programming, the module alignment must be calibrated.

Refer to [Radar Sensor Module - Long Range Learn](#) .

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for radar sensor module - long range replacement, programming and setup.

PARKING ASSIST CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Sensor Replacement

Following Parking Assist Sensor replacement, the sensors must be calibrated. Refer to [Parking Assist Sensor Learn Calibration](#) .

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. Following Parking Assist Control Module replacement, the sensors must be calibrated. Refer to [**Parking Assist Sensor Learn Calibration**](#) .

Reprogram Control Module

Do not reprogram the parking assist control module, unless directed by a service procedure, or a service bulletin.

To reprogram an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the K182 Parking Assist Control Module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the parking assist control module can be reprogrammed.
 - **If the K182 Parking Assist Control Module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the parking assist control module can be reprogrammed.
 - If the K182 Parking Assist Control Module cannot be reprogrammed, replace the parking assist control module.
 - If the K182 Parking Assist Control Module can be reprogrammed.
 3. All OK.
 - **If the K182 Parking Assist Control Module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

Refer to [**Control Module References**](#) for control module replacement, programming and setup

PASSENGER PRESENCE SYSTEM PROGRAMMING AND SETUP

When the passenger presence system is replaced or serviced, perform the rezeroing procedure for the passenger presence system. Refer to [**Passenger Presence System Rezeroing**](#) for the rezeroing procedure.

PEDESTRIAN ALERT SOUND CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program ECU

To program a replacement control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Reprogram ECU

To reprogram an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for pedestrian alert sound control module replacement, programming and setup

POWER STEERING CONTROL MODULE PROGRAMMING AND SETUP

The following service procedures require either a programming or a setup event performed for a complete repair.

The electronic power steering control module is part of the power steering assist motor assembly and is electronically paired with the steering gear's sensors.

- If the complete steering gear INCLUDING the assist motor assembly was replaced, or for reprogramming of an existing power steering system WITHOUT replacement, refer to the POWER STEERING CONTROL MODULE REPROGRAMMING instructions in this article.
- If ONLY the Power Steering Assist Motor assembly is replaced, follow the POWER STEERING CONTROL MODULE REPLACEMENT instructions.

Replace and Program Control Module

NOTE: During the procedures listed below, critical data is retrieved from vehicle components and stored in the scan tool computer's hard drive. This data is needed during the programming and setup sequences.

Ensure the same scan tool is used and capable of reading, storing, and writing the vehicle's system data.

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. Replace the Power Steering Assist Motor containing the Power Steering Control Module. Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#) .
3. With the Power Steering Assist Motor replaced and reconnected, on the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Electronic Power Steering - Configuration & Setup and follow the on-screen instructions.
5. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
6. Ignition ON.
7. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Power Steering Control Module Reprogramming

Do not program or reprogram the electronic power steering control module unless directed by a service procedure or a service bulletin.

NOTE: This procedure applies to reprogramming of the existing steering gear or the initial programming if the complete steering gear assembly including the assist motor was replaced. If only the power steering control module is replaced, follow the Power Steering Control Module Replacement instructions above.

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-

screen instructions.

3. On the SPS Supported Controllers screen, select Electronic Power Steering - Configuration & Setup and follow the on-screen instructions.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Ignition ON.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Steering Angle Sensor Centering and Software Endstop Learning

For the steering angle sensor centering and software endstop learning, refer to [Power Steering Control Module Calibration](#) .

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

RADIO CONTROL PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

RADIO PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**

- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- If programming of the control module is being performed at the direction of a bulletin or PI, follow the instructions provided in that document.
- During audio system programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependant upon vehicle equipment, the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or have not been received from General Motors in another manner of distribution, the USB update process will not need to be performed.
- The length of time for the USB programming to complete will vary depending on the number and size of the files in the update.
- All data will be erased from the USB device BEFORE the calibration is downloaded onto the device. To ensure important information is NOT erased, always verify that NO information is stored on the device BEFORE beginning the calibration download. If required, transfer important files to another storage device BEFORE beginning the calibration download.
- The XM satellite radio (if equipped) is integrated into the radio. If XM was activated in the previous radio, the replacement radio will require additional activation steps after programming to transfer customer subscription information.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- USB 2.0 flash drive with a minimum capacity of 4 GB.

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.
4. When programming is complete, access the Service Programming System (SPS) and follow the on-screen instructions.

5. Connect a USB drive to the computer.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 8.

6. On the SPS Supported Controllers screen, select A11 Radio - USB File Transfer, and follow the on-screen instructions.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 14.
- All existing files on the USB drive will be erased when the new files are copied.

7. Upon completion of the file transfer, remove the USB drive from the computer.

8. Vehicle in Service Mode, radio ON.

9. Connect the USB drive to the USB port in the vehicle.

10. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted. Programming will take several minutes.

11. When programming is complete, remove the USB device from the vehicle USB port.

12. Access the Service Programming System (SPS) and follow the on-screen instructions.

13. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.

14. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Reprogram Control Module

To reprogram an existing control module, perform the following procedure:

1. Install the **EL-49642** SPS Programming Support Tool.

2. Connect a USB drive to the computer.

NOTE: If using a pre-configured USB drive supplied by General Motors, proceed to step 6.

3. Access the Service Programming System (SPS) and follow the on-screen instructions.

4. On the SPS Supported Controllers screen, select A11 Radio - USB File Transfer, and follow the on-screen instructions.

NOTE:

- If there are no files available for USB transfer via SPS, proceed to step 11.
- All existing files on the USB drive will be erased when the new files are copied.

5. Upon completion of the file transfer, remove the USB drive from the computer.

6. Vehicle in Service Mode, radio ON.

7. Connect the USB drive to the USB port in the vehicle.

8. Using the radio controls, select the following: Config>Radio Settings>Software Versions Menu>Update Radio Software. Follow the infotainment display on-screen instructions and select Update when prompted.

Programming will take several minutes.

9. When programming is complete, remove the USB device from the vehicle USB port.
10. Access the Service Programming System (SPS) and follow the on-screen instructions.
11. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.
12. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

XM Activation (If Equipped)

IMPORTANT: After replacement of an XM receiver, call XM radio to deactivate the receiver that has been removed from the vehicle.

1. Turn the radio ON, tune to the XM channel 0, and record the radio ID. The radio ID will be needed for activation of the receiver.
2. From the USA, Call XM radio at 1-800-556-3600 to activate the receiver. From Canada, call 1-877-438-9677.
3. Park the vehicle outside in an area with an unobstructed view of the southern sky.
4. Leave the vehicle outside with the ignition switch in the ACC position and the radio on for 30 minutes to activate XM service.
5. Once activated, the radio will receive the remaining XM channels.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Vehicle OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

REAR SEAT HEATER CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

REMOTE CONTROL DOOR LOCK RECEIVER PROGRAMMING AND SETUP

Diagnostic Aids

The remote control door lock receiver only functions as an antenna, receiving the signals sent by the keyless entry transmitter and forwarding them to the body control module (BCM). The keyless entry software is contained wholly within the BCM.

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

SIDE OBJECT SENSOR MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select B218R Right Side Object Sensor Module or B218L Left Side Object Detection - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the ECU. The ECU should program.
 - If the ECU still cannot be programmed, replace the ECU.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP (WITH UKF)

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Each of the following service procedures require programming or setup procedures to be performed on the telematics communication interface control module.

Communication Interface Module Replacement

NOTE:

- It is critical to use the service replacement telematics communication interface control module only in the vehicle for which it was ordered.
- Failure to perform the following procedures could result in DTC(s) being set.
- Perform the following procedure only once. Repeat attempts of the procedure may result in a delay of the activation process.

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select ONSU Onstar® Module Setup and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP (WITH UE1)

NOTE:

- **DO NOT** program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.
- Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the **EL-49642** SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. **DO NOT** connect a battery charger.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.
- During the programming procedure, follow the SPS prompts for the correct ignition switch position.
- Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

Diagnostic Aids

- Before beginning any programming first determine which Generation of the Telematics Communication Interface Control Module you are working with. One way to accomplish this is by using a scan tool. The Telematics Communication Interface Control Module Generation will be listed under the Selected Vehicle Configuration section, in addition the Generation (9 or 10) can be determined from the Module ID data table. Additional programming steps may be necessary depending on the generation of the module.
- It is critical to use the service replacement Communication Interface Module only in the vehicle for which it was ordered.
- Failure to perform the following procedures will result in a red LED, DTC(s) being set, and limited or incomplete OnStar® services.
- An OnStar® button press to the OnStar® call center is required to complete the procedure.
- To fully activate an OnStar® module, both the setup and activation request procedures must be completed on all vehicles with and without an active OnStar® subscription to insure the unit has been setup properly for the vehicle it has been installed into and also to update the OnStar® with the correct unit information.
- To initialize the Turn-by-Turn feature, the vehicle must first be driven In open sky condition at speeds greater than 10 mph (16 kph) or more for a minimum of 5 miles (8 km), and perform at least 2 left and 2 right 90 degree turns coming to complete stops prior to each turn.
- On vehicles up fitted with TTY capabilities, it is necessary to perform a power cycle of the OnStar® Interface Module (OTIM), and toggle the TTY mode after completing the Communication Interface Module installation and setup procedures.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to [Special Tools](#).

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

NOTE:

- **Due to a change in SPS you must select 'Reprogram ECU', for Telematics Communication Interface Control Module Programming from the Selected Programming Process even if the unit is being replaced.**
- **If 'Replace and Program ECU' is selected the Telematics Communication Interface Control Module will not be listed in the Supported Controllers screen. You must go back and select 'Reprogram ECU'.**

•

3. In the SPS Supported Controllers screen, select Telematics Communication Interface Control Module Programming and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. After Telematics Communication Interface Control Module Programming and Service Activation, if the

vehicle is equipped with RPO VV4, on the Supported Controllers screen select 'OnStar WiFi Enable (Gen 10 only) Programming' and follow the on-screen instructions.

6. Press the OnStar® Blue Button to call OnStar® and have the system activated. If the customer refused OnStar® services (terms and conditions) and the vehicle is equipped with RPO VV4 have the OnStar® consultant turn off the WiFi demo message that occurs after every ignition on event.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
 - **If the control module cannot be reprogrammed**
 1. Ignition OFF for one minute, ignition ON.
 2. Verify the control module can be reprogrammed.
 - If the control module cannot be reprogrammed, replace the control module.
 - If the control module can be reprogrammed.
 3. All OK.
 - **If the control module can be reprogrammed**
3. All OK.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

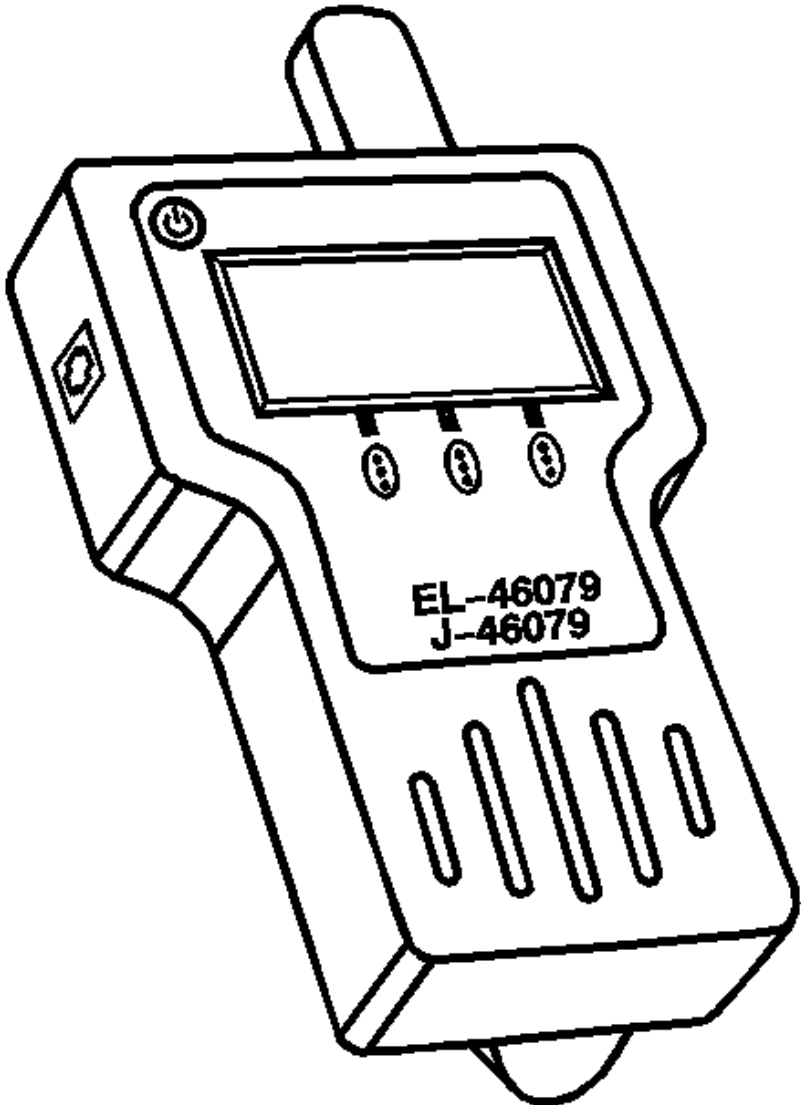
Illustration	Tool Number/Description
	EL 46079 J 46079 Tire Pressure Monitor Diagnostic Tool

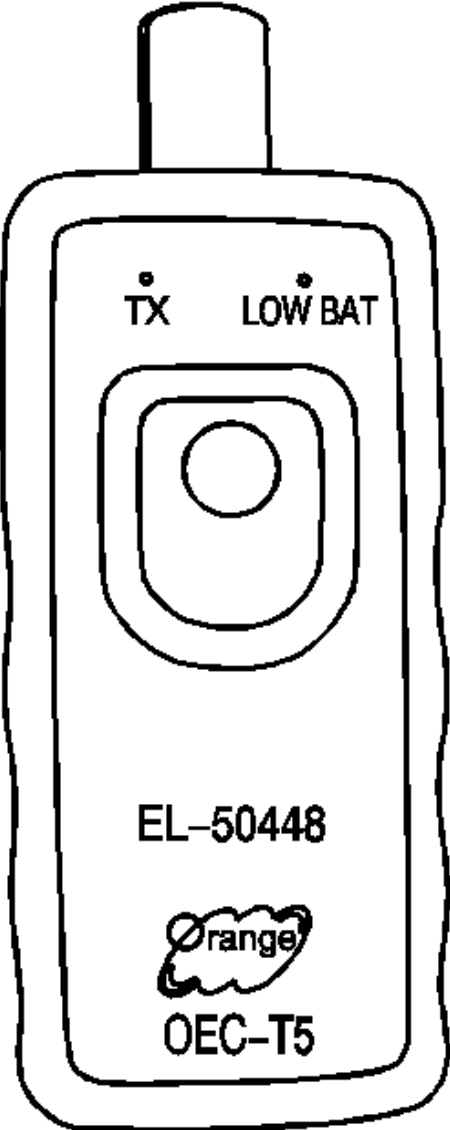
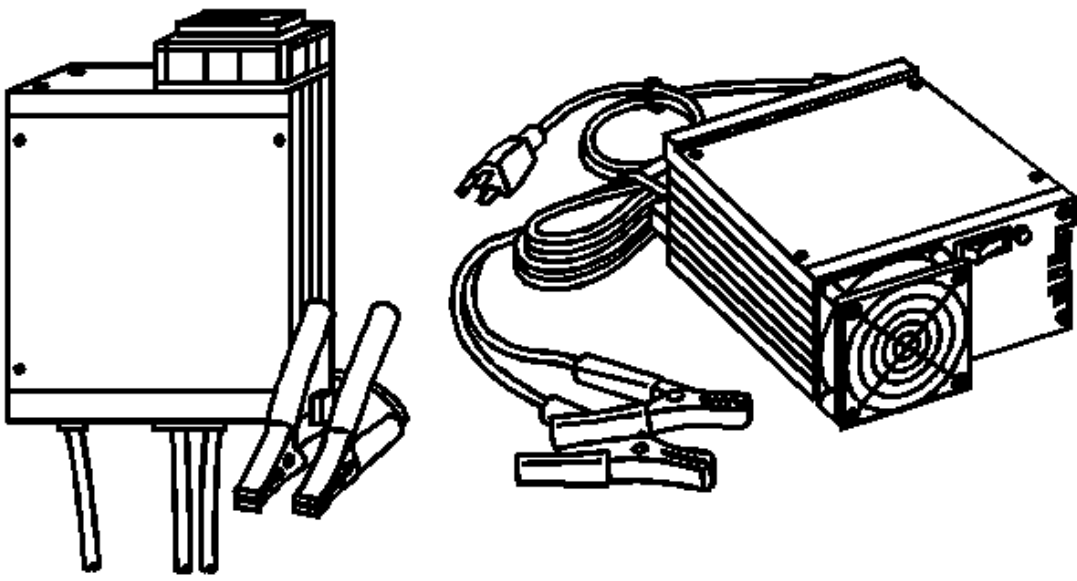
Illustration	Tool Number/Description
	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Illustration	Tool Number/Description
	EL 49642 EL 50113 Europe - Use recommended equivalent workshop equipment SPS Programming Support Tool

Article GUID: A00884642

GENERAL INFORMATION
State Emission Standards - Gasoline

ALASKA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

NOTE: As of March 1, 2012, Alaska is not testing for tailpipe emissions.

ALASKA EMISSION STANDARDS - ANCHORAGE & FAIRBANKS (2-SPEED IDLE TEST)

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Passenger Cars ⁽¹⁾		
1968-71	1000 (5.0)	1000 (4.0)
1972-74	1000 (4.0)	1000 (3.0)
1975-80	1000 (2.0)	1000 (2.0)
1981-83	1000 (1.0)	1000 (1.0)
1984-93	750 (1.0)	750 (1.0)
1994-	200 (0.5)	200 (0.5)
Light & Medium Duty Trucks ⁽¹⁾		
1968-72	1000 (5.0)	1000 (4.0)
1973-78	1000 (4.0)	1000 (3.0)
1979-83	1000 (2.0)	1000 (2.0)
1984-93	750 (1.0)	750 (1.0)
1994-	220 (0.5)	220 (0.5)
Heavy Duty Vehicles ⁽²⁾		
1968-73	1000 (5.0)	1000 (5.0)
1974-93	1000 (4.0)	1000 (4.0)
1994-	220 (1.0)	220 (1.0)
(1) 8500 GVWR or less.		
(2) 8500 GVWR or more.		

ARIZONA

NOTE: Curb idle only test are for vehicles with full-time 4WD, non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on 1967-80 light-duty gasoline powered vehicles and all heavy-duty gasoline powered vehicles.

ARIZONA EMISSION STANDARDS - PHOENIX AREA (CURB IDLE & LOADED CRUISE TESTS)

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC
----------------------------	--------------------	---------------------------------

		ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	500 (4.20)
1967-71 More Than 4-Cyl.	450 (5.00)	450 (3.75)
1972-74 4-Cyl. Or Less	400 (5.50)	400 (4.20)
1972-74 More Than 4-Cyl.	400 (5.00)	400 (3.75)
1975-78 4-Cyl. Or Less	250 (2.20)	250 (1.65)
1975-78 More Than 4-Cyl.	250 (2.00)	250 (1.50)
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.20)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.00)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....
(1) 4-stroke engines only.		
(2) Except AWD, non-defeatable traction control and motorcycles.		
(3) Same as light duty vehicles.		

ARIZONA EMISSION STANDARDS - PHOENIX AREA (IM147 TEST)

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1981-82	3.0 (25.0)	3.5
1983-85	2.4 (20.0)	3.5
1986-89	1.6 (15.0)	2.5
1990-93	1.0 (12.0)	2.5
1994 & Newer	0.8 (12.0)	2.0
Light Trucks (6000 GVWR Or Less)		

Application	HC gpm (CO gpm)	NOx gpm
1981-85	4.0 (40.0)	5.5
1986-89	3.0 (25.0)	4.5
1990-93	2.0 (20.0)	4.0
1994 & Newer	1.6 (20.0)	3.0
Light Duty Trucks (6000-8500 GVWR)		
1981-85	4.4 (48.0)	7.0
1986-87	4.0 (40.0)	5.5
1988-89	3.0 (25.0)	5.5
1990-93	3.0 (25.0)	5.0
1994 & Newer	2.4 (25.0)	4.0

NOTE: Curb idle test only for 1967-80 light-duty gasoline vehicles, all vehicles with full-time 4WD and/or non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on all 1981 and later vehicles except those with full-time 4WD and/or non-defeatable traction control.

ARIZONA EMISSION STANDARDS - TUCSON AREA (CURB IDLE & LOADED CRUISE TESTS)

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	.....
1967-71 More Than 4-Cyl.	450 (5.00)	.....
1972-74 4-Cyl. Or Less	400 (5.50)	.....
1972-74 More Than 4-Cyl.	400 (5.00)	.....
1975-78 4-Cyl. Or Less	250 (2.20)	.....
1975-78 More Than 4-Cyl.	250 (2.00)	.....
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.20)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	⁽³⁾	⁽³⁾
Light Duty Trucks (6001-8500 GVWR)		
1967-74	⁽³⁾	⁽³⁾
1975-78	350 (4.00)	.....
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.00)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	⁽³⁾	⁽³⁾

Application ⁽¹⁾	Idle HC ppm (CO %)	⁽²⁾ Loaded/Cruise HC ppm (CO %)
1975-78	350 (4.00)	.....
1979-80	300 (4.00)	.....
1981 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....
(1) 4-stroke engines only. (2) Except AWD, non-defeatable traction control and motorcycles. (3) Same as light duty vehicles.		

CALIFORNIA

CALIFORNIA EMISSION STANDARDS ASM TESTS

Specific vehicle cutpoints are available on the California BAR web site at www.bar.ca.gov under the Industry tab, then Cutpoints Application.

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)				PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
						ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO				
1	1974-	X	X	X	A	235.4	2.56	1301.5	185.4	2.36	1161.5	435.4	4.26	2659.3	385.4	4.06	2459.3
					B	436041.7	4453.19	1192593.0	436041.7	4453.19	1192593.0	436041.7	4453.19	1703703.7	436041.7	4453.19	1703703.7
2	1975-1980	X			A	123.0	0.91	1016.3	90.3	0.71	876.3	315.3	2.51	2051.9	265.3	2.31	1851.9
					B	273316.7	1362.96	1043519.0	273316.7	1362.96	1043519.0	273316.7	1362.96	1490740.7	273316.7	1362.96	1490740.7
3	1981-1983	X			A	63.2	0.64	850.0	42.1	0.44	680.0	253.1	2.14	1844.4	192.4	1.94	1644.4
					B	234259.3	1064.81	894444.5	212963.0	1064.81	894444.5	234259.3	1064.81	1277777.8	212963.0	1064.81	1277777.8
4	1984-1986	X			A	67.0	0.52	850.0	42.1	0.32	680.0	242.4	2.02	1744.4	192.4	1.82	1544.4
					B	212963.0	979.63	894444.5	212963.0	979.63	894444.5	212963.0	979.63	1277777.8	212963.0	979.63	1277777.8
5	1987-1992	X			A	57.0	0.48	608.0	31.7	0.32	547.0	231.7	1.98	1729.6	181.7	1.82	1529.6
					B	191666.7	851.85	596296.3	191666.7	851.85	596296.3	191666.7	851.85	851851.9	191666.7	851.85	851851.9
6	1993-1995	X			A	59.0	0.29	617.1	24.3	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	89951.3	724.07	271314.8	89951.3	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
7	1996-2000	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
8	2001-2003	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
9	2004+	X			A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
					B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
10	1975-1978		X		A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
					B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
11	1979-1983		X		A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
12	1984-1987		X		A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
13	1988-1992		X		A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
14	1993-1995		X		A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
15	1996-2000		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
16	2001-2003		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
17	2004+		X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
18	1975-1978			X	A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
					B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
19	1979-1983			X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
20	1984-1987			X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
21	1988-1992			X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
22	1993-1995			X	A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
23	1996-2000			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
24	2001-2003			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
25	2004+			X	A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
26	1978-			X	A	173.3	2.90	1703.3	123.3	2.70	1563.3	423.3	5.40	3233.3	373.3	5.20	3033.3
					B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	2333333.3	583333.3	3500.00	2333333.3
27	1979-1983			X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
					B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
28	1984-1987			X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
					B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
29	1988-1992			X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
30	1993-1995			X	A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
					B	150000.0	1725.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
31	1996-2000			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
32	2001-2003			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
33	2004+			X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
					B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0

Fig. 1: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Light & Medium Duty Vehicles (ASM Test)

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)						PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
		PC	LDT1	LDT2	MDV	HDV		ASM 5015			ASM 2525			ASM 5015			ASM 2525		
								HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
46	1978-					X	A	243.8	3.92	2015.8	199.8	3.92	2770.8	594.9	7.29	4970.0	605.4	7.57	5375.4
							B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3
47	1979 - 1983					X	A	205.5	2.16	2250.6	106.0	1.96	2400.6	454.2	6.62	4231.1	338.1	6.54	4667.2
							B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3
48	1984 - 1987					X	A	143.0	1.80	2162.5	78.0	1.80	1975.0	307.5	6.87	4238.5	250.0	6.48	3989.5
							B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0
49	1988 - 1992					X	A	105.0	1.01	2112.5	78.0	1.24	2062.5	300.0	5.87	3865.9	250.0	4.98	3929.9
							B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0
50	1993 - 1995					X	A	105.0	0.49	1912.5	75.0	1.22	1862.5	300.0	2.61	3825.0	250.0	3.49	3929.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
51	1996 - 2000					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
52	2001+					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0

Fig. 2: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Heavy Duty Vehicles (ASM Test)

LEGEND

ESC - Emission Standard Category

GVWR - Manufacture's Gross Vehicle Weight Rating

LVW - Loaded Vehicle Weight

PC - Passenger Car

LDT1 - Light-Duty Truck up through 3750 LVW and GVWR no greater than 6000 lbs.

LDT2 - Light-Duty Truck greater than 3750 LVW and GVWR no greater than 6000 lbs.

MDV - Medium-Duty Vehicle, GVWR from 6001 to 8500 lbs.

HC - Hydrocarbon, ppm

CO - Carbon Monoxide, %

NO - Nitric Oxide, ppm

PASS/FAIL EMISSION STANDARDS = A+B / VTW

PASS/FAIL STANDARDS - Emission standards used to determine if a vehicle passes the emission inspection. A vehicle passes if the emission levels are equal to or less than the standards for HC, CO and NO for ASM 5015 and ASM 2525.

GROSS POLLUTER STANDARDS - Emission standards used to designate a vehicle as a gross polluter. A vehicle is designated as a gross polluter if the emission levels at the time of the initial inspection, before repairs are greater than the gross polluter standards for HC, CO or NO for ASM 5015 or ASM 2525.

NOTE: If test data on emission pass/fail rates or gross polluter identification rates indicate adjustments are required, the emission standards may be increased or decreased by the bureau by 30% or by the following tolerances, or standards may be set for any specific vehicle and engine configuration which the bureau determines has excessive errors of commission or omission, whichever is necessary to comply with Section 44001.5 of the Health and Safety Code.

COLORADO

COLORADO EMISSION STANDARDS - ENHANCED PROGRAM (IM240)

Application	HC gpm	CO gpm	NOx gpm
Passenger Cars			
1982	3.5	45	5.0
1983	3.5	30	4.5
1984	3.0	30	4.5
1985	2.5	20	4.5
1986	2.5	20	4.5
1987	2.5	20	4.0
1988 & 1989	2.0	20	4.0
1990	2.0	20	3.5
1991	1.5	20	3.5
1992	1.5	15	3.5
1993	1.5	15	3.5
1994	1.2	15	3.0
1995	1.2	15	2.5
1996	1.2	15	2.0
1997	1.2	15	2.0
1998 & Newer	1.2	15	1.5
Light Duty Vehicles			
1982	6.0	65	6.0
1983	6.0	65	6.0
1984	5.0	55	6.0
1985	4.5	45	6.0
1986	4.0	40	6.0
1987	3.5	30	5.5
1988 & 1989	3.0	25	5.0
1990	3.0	25	5.0
1991	2.5	25	4.5
1992	2.5	25	4.5
1993	2.5	25	4.5
1994	2.0	20	4.0
1995	2.0	20	4.0
1996	1.2	15	3.5
1997	1.2	15	3.0
1998	1.2	15	2.0
1999 & Newer	1.2	15	2.0

COLORADO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm	CO %
Passenger Cars & Light Duty Trucks		
1970 & Earlier	1000	3.5

Application	HC ppm	CO %
1971	1000	3.0
1972	1000	3.0
1973	1000	3.0
1974	1000	3.0
1975	600	2.0
1976	600	2.0
1977	400	1.5
1978	400	1.5
1979	400	1.5
1980	400	1.5
1981 & Newer	220	1.2
Heavy Duty Trucks (6000 GVWR Or Greater)		
1967 Or Earlier	1500	7.0
1968-69	1200	6.5
1969	1200	6.5
1970	1000	5.5
1971	1000	5.5
1972	1000	5.5
1973	1000	5.5
1974	1000	5.5
1975	1000	5.5
1976	1000	5.5
1977	1000	5.5
1978	1000	5.5
Heavy Duty Trucks (8501 GVWR Or Greater)		
1979	800	4.0
1980	800	3.5
1981	600	3.0
1982	600	3.0
1983	600	3.0
1984	600	3.0
1985	600	3.0
1986 & Newer	300	2.0

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO)
10,000 GVWR Or Less	
1979	250 (2.1)
1980	225 (2.0)

Application	HC ppm (CO)
1981-82	200 (1.2)
1983	175 (1.0)
1984-87	150 (1.0)
1988 & Newer	125 (1.0)

DELAWARE

DELAWARE EMISSION STANDARDS - KENT, NEW CASTLE & SUSSEX COUNTIES (IDLE TEST)

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-70	900 (9.0)
1971-74	600 (6.0)
1975-79	400 (4.0)
1980	220 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1970-72	900 (9.0)
1973-78	600 (6.0)
1979-83	400 (4.0)
1984 & Newer	220 (1.2)

DISTRICT OF COLUMBIA

DISTRICT OF COLUMBIA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles & Trucks (26000 GVWR Or Less)	
1968-70	1250 (11.0)
1971-74	1200 (9.0)
1975-79	600 (6.5)
1980	300 (1.5)
1981 & Newer	220 (1.2)

GEORGIA

NOTE: The Georgia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and older model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

GEORGIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application ⁽¹⁾	HC ppm (CO %)
1979	500 (5.0)
1980	350 (3.5)

Application ⁽¹⁾	HC ppm (CO %)
1981-83	250 (1.5)
1984 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

IDAHO

IDAHO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles	
8500 GVWR Or Less	
1965-74	900 (5.0)
1975-79	700 (3.0)
1980	400 (1.5)
1981 & Newer	220 (1.2)
Heavy Duty Trucks	
8501 GVWR Or More	
1965-74	900 (6.0)
1975-80	700 (5.0)
1981 & Newer	500 (3.0)

ILLINOIS

ILLINOIS EMISSION STANDARDS - IM240 TEST

Application	HC gpm	CO gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	2.00	60.0
1983-87	2.00	30.0
1988-95	0.80	15.0
1996 & Newer	0.60	10.0
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (3750 LVW Or More) ⁽¹⁾	0.80	13.0
1996 & Newer (3750 LVW Or Less) ⁽¹⁾	0.60	10.0
Light Duty Trucks (6001-6500 GVWR)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (5750 ALVW Or More)	0.80	15.0
1996 & Newer (5750 ALVW Or Less)	0.80	13.0

Application	HC gpm	CO gpm
(1) Loaded Vehicle Weight (LVW) is vehicle curb weight plus 300 lbs.		

ILLINOIS EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Vehicles (6000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-77	700 (7.0)
1978-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Light Duty Vehicles (8000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-78	700 (7.0)
1979-80	600 (6.0)
1981-83	300 (3.0)
1984 & Newer	220 (1.2)
Heavy Duty Vehicles (8001 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

INDIANA

INDIANA EMISSION STANDARDS - IM93 TEST

Application	HC gpm (CO gpm)	NOx (gpm)
Passenger Cars		
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-90	1.4 (20)	3.0
1991-95	0.8 (15)	2.5
1996 & Newer	0.6 (10)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	3.5
1991-95	1.6 (40)	3.0
1996 & Newer	0.8 (20)	3.0
Light Duty Trucks (6001-8500 GVWR)		

Application	HC gpm (CO gpm)	NO _x (gpm)
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	5.0
1991-96	1.6 (40)	4.5
1997 & Newer	0.8 (20)	4.5
Heavy Duty Trucks (8501-9000 GVWR)		
1981-82	7.5 (100)	8.0
1983-84	6.0 (100)	8.0
1985-86	5.0 (75)	8.0
1987-90	3.0 (60)	8.0
1991-97	2.4 (40)	8.0
1998 & Newer	2.0 (30)	6.0

INDIANA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1976-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)

KENTUCKY

NOTE: Currently, there is no emission testing in Kentucky.

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (IDLE TEST)

Application	HC ppm (CO)
Passenger Cars (Automobiles)	
1968	950 (8.5)
1969	900 (8.5)
1970	850 (8.1)
1972	800 (8.0)
1973	800 (7.8)
1974	800 (7.6)

Application	HC ppm (CO)
1975	700 (7.5)
1976	700 (6.5)
1977	650 (6.3)
1978	600 (5.5)
1979	600 (4.5)
1980	250 (2.5)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968	1300 (8.0)
1969	1200 (8.0)
1970-71	1100 (8.0)
1972-73	1000 (7.8)
1974	950 (7.8)
1975	900 (7.0)
1976-77	700 (7.0)
1978	700 (6.3)
1979	450 (5.5)
1980	450 (4.0)
1981	350 (1.7)
1982 & Newer	220 (1.2)
Light Duty Trucks (6001-10,000 GVWR)	
1969	1500 (9.0)
1970	1100 (8.0)
1971	1000 (8.0)
1972-75	950 (7.5)
1976	900 (7.5)
1977	850 (7.5)
1978	700 (6.0)
1979	650 (5.5)
1980	550 (5.0)
1981	450 (4.0)
1982	400 (2.5)
1983	350 (2.0)
1984	220 (1.5)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (10,001-18,000 GVWR)	
1968	1500 (9.0)
1969-70	1300 (8.5)
1971	1200 (8.5)
1972-76	1000 (7.0)
1977-80	900 (6.5)

Application	HC ppm (CO)
1982-83	400 (3.0)
1984 & Newer	250 (1.5)

MARYLAND

MARYLAND EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1984-87	1.80 (30.0)	2.8
1988-90	1.40 (30.0)	2.5
1991-93	1.00 (20.0)	2.2
1994-95	0.90 (20.0)	2.1
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	2.80 (80.0)	5.8
1988-90	2.40 (80.0)	3.0
1991-93	2.00 (60.0)	2.7
1994-95	1.80 (60.0)	2.6
Light Duty Trucks (6001-8500 GVWR)		
1984-87	2.90 (80.0)	6.6
1988-90	2.40 (80.0)	4.2
1991-93	2.00 (60.0)	4.0
1994-95	1.80 (60.0)	3.7
Heavy Duty Trucks (8501-9999 GVWR)		
1984	5.80 (100.0)	7.7
1985-86	4.70 (80.0)	7.7
1987	3.00 (80.0)	7.7
1988-90	2.60 (80.0)	7.0
1991-97	2.50 (60.0)	5.5
1998 & Newer	2.20 (60.0)	4.0

MARYLAND EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1977	500 (6.0)
1978	430 (5.5)
1979	400 (4.0)
1980	220 (1.7)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-9999 GVWR)	
1977	580 (7.0)
1978	550 (6.7)
1979	470 (5.0)

Application	HC ppm (CO %)
1980	350 (5.0)
1981	250 (3.0)
1982	220 (2.5)
1983	220 (1.5)
1984 & Newer	220 (1.2)
Heavy Duty Trucks (10,000-26,000 GVWR)	
1977-78	650 (7.0)
1979	650 (6.5)
1980-82	500 (6.0)
1983	500 (3.5)
1984-85	440 (3.0)
1986	280 (2.5)
1987 & Newer	220 (1.2)

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - MA31 TEST

Application	HC gpm (CO gpm)	NOx gpm
Passenger Cars		
1984-90	2.0 (30)	3.0
1991-95	1.2 (20)	2.5
1996 & Newer	0.8 (13)	2.0
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	3.2 (80)	7.0
1988-1990	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
1996 & Newer (3750 LVW <u>(1)</u> Or Less)	0.8 (15)	2.0
1996 & Newer (3751 LVW <u>(1)</u> Or Greater)	1.0 (20)	2.5
Light Duty Trucks (6001-8500 GVWR)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer (5750 ALVW <u>(2)</u> Or Less)	1.0 (20)	2.5
1996 & Newer (5751 ALVW <u>(2)</u> Or Greater)	2.4 (60)	4.0
Heavy Duty Trucks (8501-10,000 Or Greater)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer	2.4 (60)	4.0

Application	HC gpm (CO gpm)	NOx gpm
(1) Loaded Vehicle Weight (LVW).		
(2) Adjusted Loaded Vehicle Weight (ALVW).		

MASSACHUSETTS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
All Vehicles	
1984-86	220 (0.80)
1987 & Newer	100 (0.60)

MISSOURI

MISSOURI EMISSION STANDARDS - JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	0.80 (30.0)	2.0
1983-95	0.80 (15.0)	2.0
1996 & Newer	0.60 (10.0)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	3.40 (70.0)	4.5
1984-87	1.60 (40.0)	4.5
1988-95	1.60 (40.0)	2.5
1996 & Newer (Less Than 3750 LVW)	0.80 (13.0)	1.8
1996 & Newer (3750 LVW Or Less)	0.60 (10.0)	1.5
Light Duty Trucks (6001-8500 GVWR)		
1981-83	3.4 (70.0)	4.5
1984-87	1.6 (40.0)	4.5
1988-95	1.60 (40.0)	3.5
1996 & Newer (5750 ALVW Or Less)	0.80 (13.0)	1.8
1996 & Newer (5750 ALVW Or More)	0.80 (15.0)	2.0

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IDLE TEST

Application ⁽¹⁾	HC ppm (CO %)
1971-74	700 (7.0)
1975-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - REMOTE SENSING CLEAN SCREEN TEST

Application ⁽¹⁾	HC ppm (CO %)	NOx ppm
All Vehicles (8500 GVWR Or Less)		
1971 & Newer	200 (0.5)	2000
(1) 8500 GVWR or less.		

NEVADA

NEVADA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1968-69	800 (4.0)
1970-74	700 (3.5)
1975-78	500 (2.5)
1979-80	500 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1400 (7.0)
1970-78	1400 (6.0)
1979	1000 (5.0)
1980	1000 (4.0)
1981 & Newer	1000 (3.5)

NEW JERSEY

NOTE: The New Jersey program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

NEW JERSEY EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)		
1967 & Earlier	1400 (8.5)	.....
1968-70	700 (7.0)	.....
1971-74	500 (5.0)	.....
1975-80	300 (3.0)	.....
1981 & Newer	220 (1.2)	100 (0.5)
Heavy Duty Vehicles (8501 GVWR Or Greater)		
1967 & Earlier	1400 (8.5)	.....
1968-70	1200 (8.5)	.....
1971-74	700 (6.0)	.....
1975-78	500 (4.0)	.....
1979 & Earlier	300 (3.0)	.....

NEW MEXICO

NEW MEXICO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1975-78	500 (5.0)	500 (5.0)
1979-80	400 (4.0)	400 (4.0)
1981-85	220 (1.2)	220 (1.2)
1986-90	200 (1.2)	200 (1.2)
1991-95	180 (1.2)	180 (1.2)
Light Duty Trucks (6001-8000 GVWR)		
1975-78	600 (6.0)	600 (6.0)
1979-80	600 (4.5)	600 (4.5)
1981-82	400 (2.7)	400 (3.0)
1983-88	300 (1.2)	300 (3.0)
1989-95	220 (1.2)	220 (1.2)
Medium Duty Trucks (8001-10,000 GVWR)		
1975 & Newer	650 (6.5)	650 (6.5)

NEW YORK

NEW YORK EMISSION STANDARDS - IM240 TEST

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
Light Duty Vehicles					
1981-82	0.80	0.50	30.0	24.0	2.0
1983-95	0.80	0.50	15.0	12.0	2.0
1996 & Newer	0.60	0.40	10.0	8.0	1.5
Light Duty Trucks (6000 GVWR Or Less)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	2.5
1996 & Newer (3750 LVW Or Less)	0.60	0.40	10.0	8.0	1.5
1996 & Newer (3751 LVW Or More)	0.80	0.50	13.0	10.0	1.8
Light Duty Trucks (6501-8500 GVWR)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	3.5
1996 & Newer (5750 ALVW Or Less)	0.80	0.50	13.0	10.0	1.8

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
1996 & Newer (5751 ALVW Or More)	0.80	0.50	15.0	12.0	2.0

NEW YORK EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1978	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1978	600 (4.5)
1979 & Newer	300 (3.0)

NORTH CAROLINA

NORTH CAROLINA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1977	450 (4.5)
1978-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	250 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1977-78	500 (5.0)
1979 & Newer	400 (4.0)

OHIO

NOTE: The Ohio program incorporates original U.S. EPA recommended start-up ASM2525 standards for all model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

OHIO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)

OREGON

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND ENHANCED AREA - BAR31

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Passenger Cars		
1981-82	2.0 (64)	3.70
1983-89	2.0 (32)	3.70
1990-95	1.2 (30)	3.00
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	4.62
1990-95	2.4 (80)	3.75
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6001-8500 GVWR)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	6.47
1990-95	2.4 (80)	5.25
1996 & Newer	OBD-II Test	OBD-II Test

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA
BASIC TEST - 2-SPEED IDLE TEST**

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Passenger Cars (6000 GVWR Or Less)		
1975-80 (No Catalyst)	300 (2.5)	-
1975-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1975 & Newer (2-Stroke)	n/a (7.0)	-
Light Duty Trucks (6001-8500 GVWR)		
1975-78 (All)	350 (2.5)	-
1979-80 (No Catalyst)	300 (2.5)	-
1979-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1996 & Newer (3750 LVW Or Less)	0.9 (20)	2.25
Heavy Duty Trucks (8501 GVWR Or More)		
1975-78 (Carbureted)	500 (4.0)	n/a (3.0)
1975-78 (Fuel Injection)	500 (4.0)	-
1979-84 (Carbureted)	350 (3.0)	n/a (3.0)
1979-84 (Fuel Injection)	350 (3.0)	-
1985 & Newer (No Catalyst)	350 (3.0)	n/a (3.0)
1985 & Newer (W/Catalyst)	220 (1.0)	220 (1.0)

**OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA
BASIC TEST - EXHAUST OPACITY TEST**

Application	Opacity % @ Idle	Opacity % @ High Idle
1975 & Newer		
2-Cycle Engines	20	.....
Gasoline Engines	0	0

PENNSYLVANIA

NOTE: The Pennsylvania (in Philadelphia area) program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

**PENNSYLVANIA EMISSION STANDARDS - PITTSBURGH & OLDER PHILADELPHIA VEHICLES
- IDLE TEST**

Application	HC ppm (CO %)
6000 GVWR Or Less	
1975-79	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	130 (1.0)
6001-9000 GVWR	
1975-78	650 (6.0)
1979	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	180 (1.0)

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - RI2000 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1974 & Earlier	15.92 (132.44)	14.92
1975-76	6.74 (96.21)	9.92
1977-79	6.74 (96.21)	6.59
1980	2.25 (45.48)	6.59
1981-82	2.25 (45.48)	3.25
1983-95	2.25 (23.74)	3.25
1996 & Newer	1.84 (16.50)	2.42
Light Duty Trucks (6000 GVWR Or Less)		
1975 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92

Application	HC gpm (CO gpm)	NOx gpm
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1988-90	3.88 (59.97)	4.09
1991-95	3.88 (59.97)	4.09
1996 & Newer (3750 LVW Or Less)	1.84 (16.50)	2.42
1996 & Newer (3751 LVW Or More)	2.25 (20.84)	2.92
Light Duty Trucks (6001-8500 GVWR)		
1974 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1989-90	3.88 (59.97)	5.75
1991-95	3.88 (59.97)	5.75
1996 & Newer (5750 LVW Or Less)	2.25 (20.84)	2.92
1996 & Newer (5751 LVW or More)	5.51 (23.74)	3.25

RHODE ISLAND EMISSION STANDARDS - 2-SPEED IDLE TEST

Application Idle ⁽¹⁾	HC ppm (CO %)
1967 & Earlier	800 (7.0)
1968-74	700 (6.0)
1975-78	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

TENNESSEE

TENNESSEE EMISSION STANDARDS - MEMPHIS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (9000 GVWR Or Less)	
1971 & Older	900 (8.9)
1972-74	700 (8.2)
1975-79	600 (7.5)
1980	400 (4.7)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (9001-25,999 GVWR)	
1971 & Older	1000 (8.9)
1972-74	1000 (8.2)
1975-79	1000 (8.0)
1980	800 (6.0)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - DAVIDSON & NASHVILLE COUNTIES - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - FOUR COUNTY AREA SURROUNDING NASHVILLE - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TEXAS

NOTE: The Texas program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.](#)

TEXAS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1979	600 (6.0)
1980	400 (4.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1979-81	700 (7.0)
1982-84	500 (5.0)

Application	HC ppm (CO %)
1985 & Newer	300 (3.0)

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DC98 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1989-90	2.00 (30)	3.0
1991-95	1.2 (20)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1989-90	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1989-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5

UTAH EMISSION STANDARDS - DAVIS COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Vehicles (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

NOTE: The Salt Lake County program incorporates California style ASM2525 and ASM5015 standards for 1968 and newer model year vehicles; however, actual cutpoints are unique to this program and current information is not available at this time.

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

UTAH EMISSION STANDARDS - UTAH & WEBER COUNTIES - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)

Application	HC ppm (CO %)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

VIRGINIA

NOTE: The Virginia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See [U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS](#).

VIRGINIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
8500 GVWR Or Less	
1975-90	400 (4.0)
1980	220 (2.0)
1981-89	220 (1.2)
1990-95	125 (1.0)
1996 & Newer	100 (0.75)
8501-10,000 GVWR	
1975-79	400 (4.0)
1980	220 (2.0)
1981-90	220 (1.2)
1991-96	150 (1.0)
1997 & Newer	125 (0.75)

WASHINGTON

WASHINGTON EMISSION STANDARDS - ASM2525 TEST

Application	HC ppm (CO %)
1980 & Earlier (Light-Duty Vehicles)	
1750 GVWR	400 (4.2)
1875 GVWR	380 (4.0)

Application	HC ppm (CO %)
2000 GVWR	350 (3.8)
2125 GVWR	340 (3.6)
2250 GVWR	320 (3.4)
2375 GVWR	300 (3.2)
2500 GVWR	290 (3.0)
2625 GVWR	270 (2.9)
2750 GVWR	260 (2.8)
2875 GVWR	250 (2.7)
3000 GVWR	240 (2.6)
3125 GVWR	230 (2.5)
3250 GVWR	220 (2.4)
3375 GVWR	220 (2.3)
3500 GVWR	210 (2.2)
3625 GVWR	200 (2.1)
3750 Or Greater GVWR (Passenger Cars Only)	200 (2.1)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)
1981 & Newer (Light-Duty Vehicles)	
1750 GVWR	250 (1.8)
1875 GVWR	240 (1.7)
2000 GVWR	220 (1.6)
2125 GVWR	210 (1.5)
2250 GVWR	200 (1.5)
2375 GVWR	190 (1.4)
2500 GVWR	180 (1.3)
2625 GVWR	180 (1.3)
2750 GVWR	171 (1.2)
2875 GVWR	160 (1.2)
3000 GVWR	160 (1.1)
3125 GVWR	150 (1.1)
3250 GVWR	150 (1.0)
3375 GVWR	150 (1.0)
3500 GVWR	150 (1.0)
3625 GVWR	150 (1.0)
3750 Or Greater GVWR (Passenger Cars Only)	150 (1.0)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)

WASHINGTON EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle/2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1980 & Earlier	600 (3.0)
1981 & Newer	220 (1.2)

Application	Idle/2500 RPM HC ppm (CO %)
Heavy Duty Trucks (8500 GVWR Or More)	
1981 & Newer	400 (3.0)

WISCONSIN

WISCONSIN EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-76	3.0 (65)	6.0
1977-79	3.0 (65)	4.0
1980	2.0 (60)	4.0
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-93	0.8 (15)	2.0
1991-95	0.8 (15)	2.0
1996 & Newer	0.6 (10)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1987	1.6 (40)	4.5
1988-95	1.6 (40)	2.5
1996 & Newer (3750 LVW Or Less)	0.6 (10)	1.5
1996 & Newer (3751 LVW Or More)	0.8 (13)	1.8
Light Duty Trucks (6001-8500 GVWR)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1988-96	1.6 (40)	3.5
1997 & Newer (5750 ALVW Or Less)	0.8 (13)	1.8
1997 & Newer (5751 ALVW Or More)	0.8 (15)	2.0
Heavy Duty Trucks (8501-10,000 GVWR)		
1968-69	20.0 (200)	15.0
1970-73	10.0 (175)	10.0
1974-78	10.0 (150)	10.0

Application	HC gpm (CO gpm)	NOx gpm
1979-84	7.5 (100)	8.0
1985-86	5.0 (80)	8.0
1987-90	2.0 (40)	6.0
1991-97	2.0 (40)	5.0
1998 & Newer	2.0 (30)	4.0
Heavy Duty Trucks (10,001 GVWR or More)		
1968-69	24.0 (250)	30.0
1970-73	13.0 (175)	20.0
1974-78	13.0 (150)	20.0
1979-84	11.5 (150)	16.0
1985-86	10.0 (150)	16.0
1987-90	3.5 (70)	11.0
1991-97	3.5 (70)	9.0
1998 & Newer	3.5 (60)	7.0

WISCONSIN EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1968-71	800 (8.0)
1972-74	550 (7.0)
1975-77	450 (5.5)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-71	800 (8.0)
1972-74	700 (7.0)
1975-77	500 (6.0)
1978	450 (5.0)
1979	300 (3.0)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1450 (9.0)
1970-71	800 (8.0)
1972-74	700 (7.0)
1975-77	550 (6.5)
1978	450 (5.5)
1979	300 (3.0)

Application	HC ppm (CO %)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-76 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4980
1875	729 (3.70)	4990	717 (5.14)	4906
2000	688 (3.49)	4919	676 (4.85)	4838
2125	650 (3.31)	4853	638 (4.58)	4776
2250	615 (3.13)	4792	604 (4.34)	4720
2375	583 (2.98)	4736	573 (4.12)	4668

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2500	554 (2.83)	4685	544 (3.91)	4620
2625	528 (2.70)	4639	518 (3.73)	4577
2750	503 (2.58)	4596	495 (3.56)	4374
2875	481 (2.47)	4484	473 (3.41)	4176
3000	461 (2.37)	4290	453 (3.27)	3996
3125	443 (2.28)	4114	435 (3.14)	3832
3250	426 (2.20)	3952	419 (3.02)	3681
3375	411 (2.12)	3804	404 (2.91)	3544
3500	397 (2.05)	3669	390 (2.82)	3418
3625	384 (1.99)	3544	377 (2.73)	3302
3750	372 (1.93)	3429	365 (2.64)	3195
3875	361 (1.87)	3323	355 (2.57)	3096
4000	351 (1.82)	3224	345 (2.49)	3003
4125	341 (1.77)	3131	335 (2.43)	2917
4250	332 (1.73)	3044	326 (2.36)	2836
4375	323 (1.68)	2961	318 (2.31)	2759
4500	315 (1.64)	2883	310 (2.25)	2686
4625	308 (1.61)	2807	302 (2.19)	2616
4750	300 (1.57)	2735	295 (2.14)	2549
4875	293 (1.53)	2665	288 (2.09)	2483
5000	286 (1.50)	2597	281 (2.04)	2420
5125	279 (1.46)	2530	274 (2.00)	2359
5250	272 (1.43)	2466	267 (1.95)	2298
5375	266 (1.40)	2403	261 (1.90)	2240
5500	259 (1.37)	2341	255 (1.86)	2183
5625	253 (1.34)	2282	248 (1.82)	2127
5750	247 (1.31)	2224	243 (1.78)	2074
5875	241 (1.28)	2168	237 (1.74)	2022
6000	236 (1.25)	2116	232 (1.70)	1973
6125	231 (1.23)	2066	227 (1.66)	1927
6250	226 (1.20)	2020	222 (1.63)	1884
6375	222 (1.18)	1979	218 (1.60)	1846
6500	218 (1.16)	1943	214 (1.57)	1813
6625	215 (1.15)	1913	211 (1.55)	1785
6750	213 (1.14)	1890	209 (1.54)	1764
6875	211 (1.13)	1875	207 (1.52)	1750
7000	211 (1.12)	1870	207 (1.52)	1745
7125 Or More	211 (1.12)	1874	206 (1.52)	1745

U.S. EPA ASM EMISSION STANDARDS - 1977-79 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4950
1875	729 (3.70)	4990	717 (5.14)	4655
2000	688 (3.49)	4707	676 (4.85)	4384
2125	650 (3.31)	4441	638 (4.58)	4136
2250	615 (3.13)	4197	604 (4.34)	3909
2375	583 (2.98)	3974	573 (4.12)	3701
2500	554 (2.83)	3771	544 (3.91)	3512
2625	528 (2.70)	3585	518 (3.73)	3339
2750	503 (2.58)	3416	495 (3.56)	3181
2875	481 (2.47)	3261	473 (3.41)	3037
3000	461 (2.37)	3120	453 (3.27)	2906
3125	443 (2.28)	2992	435 (3.14)	2787
3250	426 (2.20)	2874	419 (3.02)	2677
3375	411 (2.12)	2767	404 (2.91)	2577
3500	397 (2.05)	2668	390 (2.82)	2486
3625	384 (1.99)	2578	377 (2.73)	2401
3750	372 (1.93)	2494	365 (2.64)	2323
3875	361 (1.87)	2417	355 (2.57)	2251
4000	351 (1.82)	2345	345 (2.49)	2184
4125	341 (1.77)	2277	335 (2.43)	2122
4250	332 (1.73)	2214	326 (2.36)	2063
4375	323 (1.68)	2154	318 (2.31)	2007
4500	315 (1.64)	2096	310 (2.25)	1953
4625	308 (1.61)	2042	302 (2.19)	1903
4750	300 (1.57)	1989	295 (2.14)	1854
4875	293 (1.53)	1938	288 (2.09)	1806
5000	286 (1.50)	1889	281 (2.04)	1760
5125	279 (1.46)	1840	274 (2.00)	1715
5250	272 (1.43)	1793	267 (1.95)	1672
5375	266 (1.40)	1747	261 (1.90)	1629
5500	259 (1.37)	1703	255 (1.86)	1587
5625	253 (1.34)	1659	248 (1.82)	1547
5750	247 (1.31)	1617	243 (1.78)	1508
5875	241 (1.28)	1577	237 (1.74)	1471
6000	236 (1.25)	1539	232 (1.70)	1435
6125	231 (1.23)	1503	227 (1.66)	1401
6250	226 (1.20)	1469	222 (1.63)	1371
6375	222 (1.18)	1439	218 (1.60)	1343

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	218 (1.16)	1413	214 (1.57)	1318
6625	215 (1.15)	1391	211 (1.55)	1298
6750	213 (1.14)	1374	209 (1.54)	1283
6875	211 (1.13)	1364	207 (1.52)	1273
7000 Or More	211 (1.12)	1360	207 (1.52)	1269

U.S. EPA ASM EMISSION STANDARDS - 1980 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	4990	282 (3.64)	4950
1875	275 (2.63)	4990	266 (3.43)	4655
2000	260 (2.48)	4707	252 (3.24)	4384
2125	246 (2.35)	4441	239 (3.06)	4136
2250	234 (2.23)	4197	227 (2.90)	3909
2375	223 (2.12)	3974	216 (2.76)	3701
2500	212 (2.02)	3771	206 (2.62)	3512
2625	203 (1.92)	3585	197 (2.50)	3339
2750	194 (1.84)	3416	189 (2.39)	3181
2875	187 (1.76)	3261	181 (2.29)	3037
3000	180 (1.69)	3120	174 (2.19)	2906
3125	173 (1.63)	2992	168 (2.11)	2787
3250	167 (1.57)	2874	162 (2.03)	2677
3375	162 (1.52)	2767	157 (1.96)	2577
3500	157 (1.47)	2668	152 (1.89)	2486
3625	152 (1.42)	2578	148 (1.84)	2401
3750	148 (1.38)	2492	144 (1.78)	2323
3875	144 (1.34)	2417	140 (1.73)	2251
4000	140 (1.31)	2345	137 (1.68)	2184
4125	137 (1.27)	2277	133 (1.64)	2122
4250	134 (1.24)	2214	130 (1.60)	2063
4375	131 (1.21)	2154	127 (1.56)	2007
4500	128 (1.18)	2096	124 (1.52)	1953
4625	125 (1.15)	2042	122 (1.48)	1903
4750	122 (1.13)	1989	119 (1.45)	1854
4875	120 (1.10)	1938	117 (1.42)	1806
5000	117 (1.08)	1889	114 (1.38)	1760
5125	115 (1.05)	1840	112 (1.35)	1715
5250	112 (1.03)	1793	110 (1.32)	1672

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5375	110 (1.01)	1747	107 (1.29)	1629
5500	108 (0.99)	1703	105 (1.26)	1587
5625	106 (0.97)	1659	103 (1.24)	1547
5750	104 (0.94)	1617	101 (1.21)	1508
5875	102 (0.92)	1577	99 (1.18)	1471
6000	100 (0.91)	1539	97 (1.16)	1435
6125	98 (0.89)	1503	95 (1.13)	1401
6250	96 (0.87)	1469	94 (1.11)	1371
6375	95 (0.86)	1439	92 (1.09)	1343
6500	93 (0.84)	1413	91 (1.08)	1318
6625	92 (0.83)	1391	90 (1.06)	1298
6750	91 (0.82)	1374	89 (1.05)	1283
6875	91 (0.82)	1364	89 (1.04)	1273
7000	91 (0.82)	1360	88 (1.04)	1269
7125 Or More	90 (0.81)	1360	88 (1.04)	1269

U.S. EPA ASM EMISSION STANDARDS - 1981-82 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	2272	282 (3.64)	2114
1875	275 (2.63)	2181	266 (3.43)	1991
2000	260 (2.48)	2058	252 (3.24)	1877
2125	246 (2.35)	1944	239 (3.06)	1774
2250	234 (2.23)	1839	227 (2.90)	1678
2375	223 (2.12)	1744	216 (2.76)	1592
2500	212 (2.02)	1657	206 (2.62)	1512
2625	203 (1.92)	1577	197 (2.50)	1440
2750	194 (1.84)	1504	189 (2.39)	1374
2875	187 (1.76)	1438	181 (2.29)	1313
3000	180 (1.69)	1378	174 (2.19)	1258
3125	173 (1.63)	1323	168 (2.11)	1208
3250	167 (1.57)	1273	162 (2.03)	1163
3375	162 (1.52)	1227	157 (1.96)	1121
3500	157 (1.47)	1184	152 (1.89)	1082
3625	152 (1.42)	1146	148 (1.84)	1047
3750	148 (1.38)	1110	144 (1.78)	1014
3875	144 (1.34)	1077	140 (1.73)	984
4000	140 (1.31)	1046	137 (1.68)	956

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4125	137 (1.27)	1017	133 (1.64)	930
4250	134 (1.24)	990	130 (1.60)	905
4375	131 (1.21)	964	127 (1.56)	882
4500	128 (1.18)	939	124 (1.52)	859
4625	125 (1.15)	916	122 (1.48)	838
4750	122 (1.13)	893	119 (1.45)	818
4875	120 (1.10)	872	117 (1.42)	798
5000	117 (1.08)	850	114 (1.38)	778
5125	115 (1.05)	830	112 (1.35)	760
5250	112 (1.03)	810	110 (1.32)	741
5375	110 (1.01)	790	107 (1.29)	723
5500	108 (0.99)	771	105 (1.26)	706
5625	106 (0.97)	752	103 (1.24)	689
5750	104 (0.94)	734	101 (1.21)	673
5875	102 (0.92)	717	99 (1.18)	657
6000	100 (0.91)	701	97 (1.16)	642
6125	98 (0.89)	685	95 (1.13)	628
6250	96 (0.87)	671	94 (1.11)	615
6375	95 (0.86)	658	92 (1.09)	604
6500	93 (0.84)	647	91 (1.08)	593
6625	92 (0.83)	638	90 (1.06)	585
6750	91 (0.82)	631	89 (1.05)	578
6875	91 (0.82)	626	89 (1.04)	574
7000	91 (0.82)	624	88 (1.04)	573
7125 Or More	90 (0.81)	625	88 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1983-90 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (1.64)	2272	282 (1.83)	2114
1875	275 (1.55)	2181	266 (1.72)	1991
2000	260 (1.47)	2058	252 (1.63)	1877
2125	246 (1.39)	1944	239 (1.54)	1774
2250	234 (1.31)	1839	227 (1.47)	1678
2375	223 (1.26)	1744	216 (1.39)	1592
2500	212 (1.20)	1657	206 (1.33)	1512
2625	203 (1.15)	1577	197 (1.27)	1440
2750	194 (1.10)	1504	189 (1.21)	1374

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2875	187 (1.05)	1438	181 (1.16)	1313
3000	180 (1.01)	1378	174 (1.12)	1258
3125	173 (0.98)	1323	168 (1.08)	1208
3250	167 (0.94)	1273	162 (1.04)	1163
3375	162 (0.91)	1227	157 (1.00)	1121
3500	157 (0.88)	1184	152 (0.97)	1082
3625	152 (0.86)	1146	148 (0.94)	1047
3750	148 (0.83)	1110	144 (0.92)	1014
3875	144 (0.81)	1077	140 (0.89)	984
4000	140 (0.79)	1046	137 (0.87)	956
4125	137 (0.77)	1017	133 (0.85)	930
4250	134 (0.75)	990	130 (.83)	905
4375	131 (0.74)	964	127 (0.81)	882
4500	128 (0.72)	939	124 (0.79)	859
4625	125 (0.70)	916	122 (0.77)	838
4750	122 (0.69)	893	119 (0.76)	818
4875	120 (0.67)	872	117 (0.74)	798
5000	117 (0.66)	850	114 (0.73)	778
5125	115 (0.65)	830	112 (0.71)	760
5250	112 (0.63)	810	110 (0.70)	741
5375	110 (0.62)	790	107 (0.68)	723
5500	108 (0.61)	771	105 (0.67)	706
5625	106 (0.59)	752	103 (0.65)	689
5750	104 (0.58)	734	101 (0.64)	673
5875	102 (0.57)	717	99 (0.63)	657
6000	100 (0.56)	701	97 (0.62)	642
6125	98 (0.55)	685	95 (0.61)	628
6250	96 (0.54)	671	94 (0.60)	615
6375	95 (0.53)	658	92 (0.59)	604
6500	93 (0.52)	647	91 (0.58)	593
6625	92 (0.52)	638	90 (0.57)	585
6750	91 (0.51)	631	89 (0.57)	578
6875	91 (0.51)	626	89 (0.56)	574
7000	91 (0.51)	624	88 (0.56)	573
7125	90 (0.51)	625	88 (0.56)	573
7250 Or More	90 (0.50)	625	88 (0.56)	573

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY VEHICLES

Test Weight	ASM5015	ASM2525
-------------	---------	---------

	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466

6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 & NEWER + TIER 1 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	2725	381 (4.85)	2587
1875	368 (3.34)	2649	359 (4.57)	2435
2000	348 (3.16)	2499	339 (4.31)	2295
2125	329 (2.99)	2360	321 (4.08)	2167
2250	312 (2.83)	2232	305 (3.86)	2050
2375	297 (2.69)	2115	290 (3.66)	1943
2500	283 (2.56)	2009	276 (3.48)	1845
2625	270 (2.44)	1912	263 (3.32)	1756
2750	258 (2.33)	1823	252 (3.17)	1675
2875	247 (2.23)	1742	241 (3.03)	1601
3000	237 (2.14)	1668	232 (2.91)	1533
3125	228 (2.06)	1601	223 (2.79)	1471
3250	220 (1.99)	1539	215 (2.69)	1415
3375	213 (1.92)	1483	208 (2.60)	1363
3500	206 (1.86)	1432	201 (2.51)	1316
3625	200 (1.80)	1384	195 (2.43)	1273
3750	194 (1.74)	1340	189 (2.36)	1233
3875	188 (1.69)	1300	184 (2.29)	1195

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4000	183 (1.65)	1262	179 (2.22)	1161
4125	179 (1.61)	1227	175 (2.16)	1126
4250	174 (1.56)	1194	170 (2.11)	1098
4375	170 (1.53)	1162	166 (2.06)	1069
4500	166 (1.49)	1132	162 (2.01)	1042
4625	162 (1.46)	1104	159 (1.96)	1015
4750	159 (1.42)	1076	155 (1.91)	990
4875	155 (1.39)	1049	152 (1.87)	966
5000	152 (1.36)	1023	148 (1.82)	942
5125	148 (1.33)	998	145 (1.78)	919
5250	145 (1.30)	974	142 (1.74)	896
5375	142 (1.27)	950	139 (1.70)	874
5500	139 (1.24)	926	136 (1.66)	853
5625	136 (1.12)	904	133 (1.62)	832
5750	133 (1.19)	882	130 (1.59)	812
5875	130 (1.16)	860	127 (1.55)	793
6000	127 (1.14)	840	124 (1.52)	774
6125	125 (1.11)	822	122 (1.49)	757
6250	123 (1.09)	804	120 (1.46)	741
6375	120 (1.07)	788	118 (1.43)	727
6500	119 (1.06)	775	116 (1.41)	714
6625	117 (1.04)	763	114 (1.39)	704
6750	116 (1.03)	755	113 (1.37)	696
6875	115 (1.02)	749	113 (1.36)	691
7000 Or More	115 (1.02)	747	112 (1.36)	689

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	2272	315 (3.64)	2114
1875	306 (2.63)	2181	297 (3.43)	1991
2000	289 (2.48)	2058	281 (3.24)	1877
2125	274 (2.35)	1944	267 (3.06)	1774
2250	260 (2.23)	1839	253 (2.90)	1678
2375	247 (2.12)	1744	241 (2.76)	1592
2500	236 (2.02)	1657	230 (2.62)	1512
2625	225 (1.92)	1577	219 (2.50)	1440
2750	216 (1.84)	1504	210 (2.39)	1374

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2875	207 (1.76)	1438	210 (2.29)	1313
3000	199 (1.69)	1378	194 (2.19)	1258
3125	191 (1.63)	1323	186 (2.11)	1208
3250	185 (1.57)	1273	180 (2.03)	1163
3375	179 (1.52)	1227	174 (1.96)	1121
3500	173 (1.47)	1184	169 (1.89)	1082
3625	168 (1.42)	1146	164 (1.84)	1047
3750	163 (1.38)	1110	159 (1.78)	1014
3875	159 (1.34)	1077	155 (1.73)	984
4000	155 (1.31)	1046	151 (1.68)	956
4125	151 (1.27)	1017	147 (1.64)	930
4250	147 (1.24)	990	143 (1.60)	905
4375	144 (1.21)	964	140 (1.56)	882
4500	141 (1.18)	939	137 (1.52)	859
4625	137 (1.15)	916	134 (1.48)	838
4750	134 (1.13)	893	131 (1.45)	818
4875	132 (1.10)	872	128 (1.42)	798
5000	129 (1.08)	850	126 (1.38)	778
5125	126 (1.05)	830	123 (1.35)	760
5250	123 (1.03)	810	120 (1.32)	741
5375	121 (1.01)	790	118 (1.29)	723
5500	118 (0.99)	771	115 (1.26)	706
5625	116 (0.97)	752	113 (1.24)	689
5750	113 (0.94)	734	111 (1.21)	673
5875	111 (0.92)	717	108 (1.18)	657
6000	109 (0.91)	701	106 (1.16)	642
6125	107 (0.89)	685	104 (1.13)	628
6250	105 (.087)	671	102 (1.11)	615
6375	103 (0.86)	658	101 (1.09)	604
6500	102 (0.84)	647	99 (1.08)	593
6625	101 (0.83)	638	98 (1.06)	585
6750	100 (0.82)	631	97 (1.05)	578
6875	99 (0.82)	626	97 (1.04)	574
7000	99 (0.82)	624	96 (1.04)	573
7125 Or More	98 (0.81)	625	96 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3750 LVW OR LESS)

Test Weight	ASM5015	ASM2525
-------------	---------	---------

	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311

6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2640
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4084	381 (4.85)	4005
1875	368 (3.34)	4054	359 (4.57)	3767
2000	348 (3.16)	3824	339 (4.31)	3548
2125	329 (2.99)	3609	321 (4.08)	3348
2250	312 (2.83)	3411	305 (3.86)	3165
2375	297 (2.69)	3231	290 (3.66)	2998
2500	283 (2.56)	3066	276 (3.48)	2845
2625	270 (2.44)	2916	263 (3.32)	2706
2750	258 (2.33)	2779	252 (3.17)	2579
2875	247 (2.23)	2654	241 (3.03)	2463
3000	237 (2.14)	2539	232 (2.91)	2357
3125	228 (2.06)	2435	223 (2.79)	2260
3250	220 (1.99)	2340	215 (2.69)	2172

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3375	213 (1.92)	2253	208 (2.60)	2092
3500	206 (1.86)	2174	201 (2.51)	2018
3625	200 (1.80)	2100	195 (2.43)	1950
3750	194 (1.74)	2033	189 (2.36)	1887
3875	188 (1.69)	1970	184 (2.29)	1829
4000	183 (1.65)	1912	179 (2.22)	1775
4125	179 (1.61)	1857	175 (2.16)	1724
4250	174 (1.56)	1806	170 (2.11)	1677
4375	170 (1.53)	1757	166 (2.06)	1632
4500	166 (1.49)	1711	162 (2.01)	1589
4625	162 (1.46)	1666	159 (1.96)	1548
4750	159 (1.42)	1624	155 (1.91)	1508
4875	155 (1.39)	1583	152 (1.87)	1470
5000	152 (1.36)	1542	148 (1.82)	1433
5125	148 (1.33)	1503	145 (1.78)	1397
5250	145 (1.30)	1465	142 (1.74)	1362
5375	142 (1.27)	1428	139 (1.70)	1327
5500	139 (1.24)	1392	136 (1.66)	1294
5625	136 (1.12)	1357	133 (1.62)	1261
5750	133 (1.19)	1323	130 (1.59)	1230
5875	130 (1.16)	1290	127 (1.55)	1199
6000	127 (1.14)	1259	124 (1.52)	1171
6125	125 (1.11)	1230	122 (1.49)	1144
6250	123 (1.09)	1203	120 (1.46)	1119
6375	120 (1.07)	1179	118 (1.43)	1096
6500	119 (1.06)	1158	116 (1.41)	1077
6625	117 (1.04)	1140	114 (1.39)	1060
6750	116 (1.03)	1127	113 (1.37)	1048
6875	115 (1.02)	1118	113 (1.36)	1040
7000 Or More	115 (1.02)	1115	112 (1.36)	1037

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3631	315 (3.64)	3532
1875	306 (2.63)	3586	297 (3.43)	3323
2000	289 (2.48)	3383	281 (3.24)	3131
2125	274 (2.35)	3192	267 (3.06)	2955

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	260 (2.23)	3018	253 (2.90)	2794
2375	247 (2.12)	2859	241 (2.76)	2646
2500	236 (2.02)	2714	230 (2.62)	2512
2625	225 (1.92)	2581	219 (2.50)	2389
2750	216 (1.84)	2460	210 (2.39)	2277
2875	207 (1.76)	2350	210 (2.29)	2175
3000	199 (1.69)	2249	194 (2.19)	2082
3125	191 (1.63)	2157	186 (2.11)	1997
3250	185 (1.57)	2073	180 (2.03)	1920
3375	179 (1.52)	1997	174 (1.96)	1849
3500	173 (1.47)	1926	169 (1.89)	1784
3625	168 (1.42)	1862	164 (1.84)	1724
3750	163 (1.38)	1802	159 (1.78)	1669
3875	159 (1.34)	1747	155 (1.73)	1618
4000	155 (1.31)	1695	151 (1.68)	1570
4125	151 (1.27)	1647	147 (1.64)	1526
4250	147 (1.24)	1602	143 (1.60)	1484
4375	144 (1.21)	1559	140 (1.56)	1444
4500	141 (1.18)	1518	137 (1.52)	1406
4625	137 (1.15)	1479	134 (1.48)	1370
4750	134 (1.13)	1441	131 (1.45)	1336
4875	132 (1.10)	1405	128 (1.42)	1302
5000	129 (1.08)	1369	126 (1.38)	1269
5125	126 (1.05)	1335	123 (1.35)	1237
5250	123 (1.03)	1031	120 (1.32)	1206
5375	121 (1.01)	1269	118 (1.29)	1176
5500	118 (0.99)	1237	115 (1.26)	1147
5625	116 (0.97)	1206	113 (1.24)	1118
5750	113 (0.94)	1176	111 (1.21)	1090
5875	111 (0.92)	1147	108 (1.18)	1064
6000	109 (0.91)	1120	106 (1.16)	1039
6125	107 (0.89)	1094	104 (1.13)	1015
6250	105 (.087)	1070	102 (1.11)	993
6375	103 (0.86)	1049	101 (1.09)	973
6500	102 (0.84)	1030	99 (1.08)	956
6625	101 (0.83)	1014	98 (1.06)	941
6750	100 (0.82)	1003	97 (1.05)	931
6875	99 (0.82)	995	97 (1.04)	924
7000	99 (0.82)	992	96 (1.04)	921

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	98 (0.81)	992	96 (1.04)	921

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3178	315 (3.64)	3060
1875	306 (2.63)	3117	297 (3.43)	2879
2000	289 (2.48)	2941	281 (3.24)	2713
2125	274 (2.35)	2776	267 (3.06)	2561
2250	260 (2.23)	2625	253 (2.90)	2422
2375	247 (2.12)	2487	241 (2.76)	2295
2500	236 (2.02)	2361	230 (2.62)	2179
2625	225 (1.92)	2246	219 (2.50)	2073
2750	216 (1.84)	2142	210 (2.39)	1976
2875	207 (1.76)	2046	210 (2.29)	1888
3000	199 (1.69)	1959	194 (2.19)	1808
3125	191 (1.63)	1879	186 (2.11)	1734
3250	185 (1.57)	1806	180 (2.03)	1667
3375	179 (1.52)	1740	174 (1.96)	1606
3500	173 (1.47)	1679	169 (1.89)	1550
3625	168 (1.42)	1623	164 (1.84)	1498
3750	163 (1.38)	1571	159 (1.78)	1451
3875	159 (1.34)	1523	155 (1.73)	1407
4000	155 (1.31)	1479	151 (1.68)	1365
4125	151 (1.27)	1437	147 (1.64)	1327
4250	147 (1.24)	1398	143 (1.60)	1291
4375	144 (1.21)	1360	140 (1.56)	1257

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4500	141 (1.18)	1325	137 (1.52)	1224
4625	137 (1.15)	1291	134 (1.48)	1193
4750	134 (1.13)	1259	131 (1.45)	1163
4875	132 (1.10)	1227	128 (1.42)	1134
5000	129 (1.08)	1196	126 (1.38)	1106
5125	126 (1.05)	1167	123 (1.35)	1078
5250	123 (1.03)	1138	120 (1.32)	1051
5375	121 (1.01)	1109	118 (1.29)	1025
5500	118 (0.99)	1082	115 (1.26)	1000
5625	116 (0.97)	1055	113 (1.24)	975
5750	113 (0.94)	1029	111 (1.21)	951
5875	111 (0.92)	1004	108 (1.18)	928
6000	109 (0.91)	980	106 (1.16)	906
6125	107 (0.89)	958	104 (1.13)	886
6250	105 (.087)	937	102 (1.11)	867
6375	103 (0.86)	919	101 (1.09)	850
6500	102 (0.84)	902	99 (1.08)	835
6625	101 (0.83)	889	98 (1.06)	823
6750	100 (0.82)	879	97 (1.05)	813
6875	99 (0.82)	872	97 (1.04)	807
7000	99 (0.82)	870	96 (1.04)	805
7125 Or More	98 (0.81)	870	96 (1.04)	805

U. S. EPA REVISED FINAL ASM EMISSION STANDARDS (ASM5015 & ASM2525)

NOTE: EPA has not published a revised final standards for High Altitude, Light Duty Trucks 2 (6000-8500 GVWR), or vehicles older than 1980 model year. EPA guidance as of February 2003 states that a program may choose to use combinations of the Original and the Revised Final Standards.

U.S. EPA REVISED FINAL ASM EMISSION STANDARDS

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
Passenger Cars				
1980	275 (1.3)	8500	500 (2.3)	4750
1981-82	275 (1.3)	3600	500 (2.3)	3500

Application	ASM5015		ASM2525	
HC ppm (CO %)		NOx ppm	HC ppm (CO %)	NOx ppm
1983-89	275 (1.1)	3600	500 (1.6)	3500
1990 & Newer	275 (1.1)	3600	300 (1.6)	3500
Light Duty Trucks (Less Than 6000 GVWR)				
1980-83	1140 (9.7)	14,145	340 (23.28)	32,200
1984-87	537 (5.4)	14,145	160 (12.96)	32,200
1988-95	537 (5.4)	7380	160 (12.96)	16,800
1996 & Newer	275 (1.1)	6150	82 (4.40)	14,000

U.S. EPA IM240 EMISSION STANDARDS

START-UP STANDARDS

Start-up standards should be used during the first 2 years of program operation. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles certified to Tier 1 standards as well.

U.S. EPA IM240 HYDROCARBONS EMISSION START-UP STANDARDS

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	0.80	0.50
1991-95	1.20	0.75
1983-90	2.00	1.25
1980-82	2.00	1.25
1975-79	7.50	5.00
1968-74	10.0	6.00
High Altitude Light Duty Vehicles		
1983-84	2.00	1.25
1982	2.00	1.25
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.80	0.50
1996 & Newer (More Than 3750 LVW)	1.00	0.63
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00

Application	Hydrocarbons (Grams/Mile)	
Composite		Phase 2
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.00	0.63
1996 & Newer (More Than 5750 ALVW)	2.40	1.50
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	3.00	1.90
1985-86	5.00	3.10
1979-84	6.00	3.80
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION START-UP STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite		Phase 2
Light Duty Vehicles		
1996 & Newer	15.0	12.0
1991-95	20.0	16.0
1983-90	30.0	24.0
1980-82	60.0	48.0
1975-79	90.0	72.0
1968-74	150.0	120.0
High Altitude Light Duty Vehicles		
1983-84	60.0	48.0
1982	75.0	60.0
Light Duty Trucks (0-6000 Lbs. GVWR)		

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	
1996 & Newer (Less Than 3750 LVW)	15.0	12.0
1996 & Newer (More Than 3750 LVW)	20.0	16.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	20.0	16.0
1996 & Newer (More Than 5750 ALVW)	60.0	48.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	60.0	48.0
1985-86	75.0	60.0
1979-84	100.0	80.0
1974-78	150.00	120.0
1970-73	175.00	140.00
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION START-UP STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	2.0	2.0
1991-95	2.5	2.5
1981-90	3.0	3.0
1977-80	6.0	6.0

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
1973-76	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Vehicles		
1982-84	3.0	3.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	2.0	2.0
1996 & Newer (More Than 3750 LVW)	2.5	2.5
1991-95	3.0	3.0
1988-90	3.5	3.5
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.0	3.0
1988-90	3.5	3.5
1982-87	7.0	7.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	2.5	2.5
1996 & Newer (More Than 5750 ALVW)	4.0	4.0
1991-95	4.5	4.5
1988-90	5.0	5.0
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	4.5	4.5
1988-90	5.0	5.0
1982-87	7.0	7.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	6.0	6.0
1979-90	8.0	8.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

FINAL STANDARDS

Final standards are recommended for vehicles tested in calendar years 1997 and later. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles.

U.S. EPA IM240 HYDROCARBONS EMISSION FINAL STANDARDS

Application	Hydrocarbons (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	0.60	0.40
1980-95	0.80	0.50
1975-79	3.00	2.00
1968-74	7.00	4.50
High Altitude Light Duty Vehicles		
1982-84	1.20	0.75
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.60	0.40
1996 & Newer (More Than 3750 LVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	0.80	0.50
1996 & Newer (More Than 5750 ALVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	2.00	1.30
1985-86	3.00	1.90
1979-84	5.00	3.10
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION FINAL STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	

Application	Carbon Monoxide (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	10.0	8.0
1983-95	15.0	12.0
1980-82	30.0	24.0
1975-79	65.0	52.0
1968-74	120.0	96.0
High Altitude Light Duty Vehicles		
1983-84	30.0	24.0
1982	45.0	36.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	10.0	8.0
1996 & Newer (More Than 3750 LVW)	13.0	10.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	60.0	48.0
1984-87	60.0	48.0
1982-83	90.0	72.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	13.0	10.0
1996 & Newer (More Than 5750 ALVW)	15.0	12.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1984 & Newer	60.0	48.0
1982-83	90.0	72.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	40.0	32.0
1985-86	50.0	40.0
1979-84	75.0	60.0
1974-78	150.0	120.0
1970-73	175.0	140.0
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION FINAL STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite	Phase 2	
Light Duty Vehicles		
1996 & Newer	1.5	1.5
1981-95	2.0	2.0
1977-80	4.0	4.0
1973-76	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Vehicles		
1982-84	2.0	2.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	1.5	1.5
1996 & Newer (More Than 3750 LVW)	1.8	1.8
1988-95	2.5	2.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.5	2.5
1982-87	4.5	4.5
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.8	1.8
1996 & Newer (More Than 5750 ALVW)	2.0	2.0
1988-95	3.5	3.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	3.5	3.5
1982-87	4.5	4.5
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	5.0	5.0
1979-90	6.0	6.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

Article GUID: A00157750

GENERAL INFORMATION
State Emission Standards

ARIZONA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL OPACITY LOADED CRUISE TEST)

Application		Altitude (Feet)	Opacity (% For 10 Seconds)
Light Duty Vehicles (8500 GVWR Or Less)			
All Years		Less Than 2000	20 Or Less
Â	Â	2001-4000	30 Or Less
Â	Â	Greater Than 4000	40 Or Less

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL J1667 SNAP IDLE TEST)

Application		Altitude (Feet)	Opacity (% For 10 Seconds)
Heavy Duty Vehicles (8500 GVWR Or Greater)			
1990 & Earlier		All	55
1991 & Newer		All	40

COLORADO

COLORADO EMISSION STANDARDS - DIESEL OPACITY

Application		Opacity %
14,000 GVWR Or Less		
Non-Turbo		40
Turbo		35
14,000 GVWR Or More		
Non-Turbo		35
Turbo		20

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - DIESEL OPACITY

Application		Opacity %
10,000 GVWR Or Less		
1979 & Newer		20
26,000 GVWR Or More		

Application	Opacity %
1974 & Earlier	70
1974-90	55
1991 & Newer	40

IDAHO

IDAHO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
All Weight Range	
1965-74	70
1975-91	55
1992 & Newer	40

KENTUCKY

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (DIESEL OPACITY)

Application	Opacity
18,000 GVWR Or Less	
All Years	10% @ Idle

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
Light Duty (8500 GVWR Or Less)	
1984 & Newer	20
Light Duty (8501-10,000 GVWR Or Less)	
1984 & Newer	40
Heavy Duty Buses (10,000 GVWR Or More)	
1984-93	40
1994 & Newer	30
Heavy Duty Trucks (10,000 Or Less GVWR)	
1984-90	55
1991 & Newer	40

NEW YORK

NEW YORK EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Heavy Duty Vehicles (8500 GVWR Or More)	
1973 & Earlier	70
1974-90	55

Application	Opacity %
1991 & Newer	40

OHIO

OHIO EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel	20

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
All Model Years (8500 GVWR Or Less)	20

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel - Turbo (16,000 GVWR Or Less)	30
Light Duty Diesel - Non-Turbo (16,000 GVWR Or Less)	35
Heavy Duty Diesel (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - UTAH COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

WASHINGTON

WASHINGTON EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel (8500 GVWR Or Less)	
All Model Years	20
Heavy Duty Diesel (8500 GVWR Or More)	
1991 & Earlier	55
1992 & Newer	40

GENERAL INFORMATION

Symptom Check List Worksheets

*** PLEASE READ THIS FIRST ***

NOTE: This article is intended for general information purposes only. It does not apply specifically to one make or model.

PURPOSE

NOTE: This article is intended for general information purposes only. It does not apply specifically to one make or model.

WHY USE THE SYMPTOM CHECK LIST WORKSHEETS?

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

- Reduce "No Trouble Found" problems
- Increase customer involvement
- Customer perceive that "they really care and listen"
- Save time during peak write-up periods
- Reduce recontacting customers for additional information
- Improve night drop information
- Insure all the right questions are asked at write-up

MAKING THE WORKSHEETS A PART OF YOUR NORMAL ROUTINE

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

- HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
- Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
- Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
- Make sure it is attached to the hard copy when it goes to the technician.
- Place a copy with the final repair papers and review it with the customer at delivery.

- Put a new worksheet in the glovebox of all departing customers.
- Require that you personally see a copy of all worksheets filled out for shop comebacks.
- Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

SYMPTOM CHECK LIST WORKSHEETS

CONDENSED VERSION - ALL ON ONE PAGE

NOTE: Have the service adviser fill out this form with the customer whenever possible.

DRIVEABILITY WORKSHEET (To Be Filled Out By Vehicle Owner)	
Name: _____ Date: _____ Make: _____ Model: _____ Year: _____ Engine: _____ Mileage: _____	
FAULT CHARACTERISTICS - SYMPTOMS - DESCRIPTION OF PROBLEM (Please Check All That Apply In All Categories)	
Starting Problems	☐ Will Not Crank ☐ Cranks, But Won't Start ☐ Starts, But Takes A Long Time
Engine Quits/Running Problems	Quits: ☐ Right After Starting ☐ When Put Into Gear ☐ Right After Vehicle Comes To A Stop ☐ During Steady Speed Driving ☐ While Idling ☐ During Acceleration ☐ When Parking
Poor Idling Conditions	Idle Speed: ☐ Is Too Slow At All Times ☐ Is Too Slow With A/C On ☐ Is Too Fast ☐ Is Rough Or Uneven ☐ Fluctuates Up and Down
Poor Running Conditions	☐ Runs Rough ☐ Lacks Power ☐ Hesitates Or Stumbles On Acceleration ☐ Bucks and Jerks ☐ Engine Knocks, Pings, Rattles ☐ Backfires ☐ Poor Fuel Economy ☐ Misfires or Cuts Out ☐ Surges and/or Chuggles ☐ Dieseling or Run-On ☐ Engine Light Always On ☐ Engine Light On Sometimes ☐ Fuel, Gas, or Sulfur Smell
Auto. Transmission Problems	☐ Improper Shifting (early/late) ☐ Changes Gear Randomly On Its Own ☐ Vehicle Does Not Move When In Gear
Poor Handling	☐ Pulls To One Side ☐ Hard Steering ☐ Vehicle Shakes and/or Vibrates While Moving
Noise Problems	Explain: _____
Odor Problems	Explain: _____
Problem Frequency	☐ Always ☐ Often ☐ Occasionally
Usually Occurs	☐ Morning ☐ Afternoon ☐ Anytime
Engine Temp.	☐ Cold ☐ Warm ☐ Hot
Vehicle Speed	☐ Low ☐ Cruising ☐ High
Driving Conditions During Occurrence	☐ Short - Less Than 2 Miles ☐ 2-10 Miles ☐ Long - More Than 10 Miles ☐ Stop & Go ☐ While Turning ☐ While Braking ☐ At Gear Engagement ☐ With A/C Operating ☐ With Headlights On ☐ During Acceleration ☐ During Deceleration ☐ Mostly Downhill ☐ Mostly Uphill ☐ Mostly Level ☐ Mostly Curvy ☐ Rough Road
Driving Habits	☐ Drive Hard Before Engine Is Warmed ☐ Allow Engine To Warm ☐ Mostly City Driving ☐ Highway ☐ Park Vehicle Inside ☐ Outside Drive Per Day: ☐ Less Than 10 Miles ☐ 10-50 ☐ More Than 50 Fuel Octane: ☐ 87 ☐ 89 ☐ 91 ☐ More Than 91 Brand: _____ ☐ Gasohol ☐ Propane Conversion
Outside Weather	☐ Cold ☐ Warm ☐ Hot ☐ Wet/Rainy ☐ Fog ☐ Snow/Hail ☐ Dust/Dirt ☐ Dry ☐ Humid

Fig. 1: Entire Vehicle - Symptom Check List For Customer

FULL VERSION - ALL ON FOUR PAGES

NOTE: Have the service adviser fill out these forms with the customer whenever possible.

Dear Valued Customer:

Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: _____

PHONE NO.: _____

REPAIR ORDER NO.: _____

DIAGNOSTIC WORKSHEET

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION**SYMPTOM (CHECK ALL THAT APPLY)****ENGINE**

- ☐ "Service Engine Soon"/"Malfunction Indicator Light" on
☐ Hard start/no start (cranks OK)
☐ Won't crank
☐ Engine stalls
☐ Engine miss
☐ Miss while driving
☐ Hesitates, stumbles or sags
☐ Rough idle
☐ Idle is too high ☐ Idle is too low
☐ Poor power/performance
☐ Surge or chuggle, buck - jerk - skip
☐ Poor gas mileage ☐ Highway ☐ City
☐ Pings, detonates
☐ Suphur, rotten egg odor
☐ Backfires (popping noise) - underhood/tailpipe
☐ Exhaust smoke ☐ Increased oil consumption
☐ Runs on after key is turned off
☐ Speed fluctuates without moving accelerator
☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

☐ Other: _____**TRANSMISSION**

- ☐ Does not shift properly ☐ Hard shift
☐ Will not shift ☐ Up ☐ Down
☐ Will not shift into overdrive
☐ Engine starts in other than "P" or "N"
☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into gear too early
☐ Overdrive doesn't work with speed control, but is otherwise OK
☐ Highway speed - shudder, surge, etc.
☐ Other: _____

EXPLAIN: _____

OPERATING CONDITIONS (CHECK ALL THAT APPLY)**HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)**

- ☐ Always ☐ Few seconds ☐ Few minutes
☐ Few hours ☐ Few days ☐ Few weeks
☐ Few months ☐ Variable ☐ Only during event
☐ Every _____ to _____ miles ☐ Unknown
☐ Other (explain): _____
☐ Just started ☐ Getting better ☐ Getting worse
☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)**When Engine Temperature is:**

- ☐ Cold ☐ Warm ☐ Hot
☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0 degrees F ☐ Cold - 0 to 32 degrees F
☐ Cool - 32 to 60 degrees F ☐ Warm - 60 to 80 degrees F
☐ Hot - Above 80 degrees F ☐ Any environment
☐ Raining ☐ Dry ☐ Humid
☐ Snow/ice ☐ Wet roads ☐ Other (explain below)

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
☐ Starting ☐ At idle ☐ Decelerating
☐ Over bumps ☐ When shifting ☐ While turning
☐ Cruising steady at _____ MPH ☐ While braking
☐ Anytime ☐ Uphill ☐ Downhill
☐ Highway ☐ City/town ☐ Stop and go
☐ Between _____ MPH and _____ MPH
☐ Only with A/C or Defrost on

What Type of Fuel?

- ☐ Regular UL ☐ Mid range UL ☐ Premium Unleaded
☐ Gasohol ☐ Ethanol ☐ Methanol
☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

What Brand? _____**When Gear Selector is in:**

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Rev/Drive ☐ First/Second
☐ Second/Third ☐ Third/Overdrive

50G15061

Fig. 2: Symptom Check List - Page 1

BRAKES - STEERING - SUSPENSION

SYMPTOM

- | | | |
|--|---|--|
| ☐ Vehicle pulls right - When _____
☐ Vehicle pulls left - When _____
☐ Steering wheel vibrates at _____ MPH
☐ Excessive play in steering
☐ Erratic steering when braking
☐ Poor steering wheel return after cornering | ☐ Suspension bottoms out
☐ Leans or sways in corners
☐ Brake light on
☐ Traction control light on
☐ Uneven tire wear | ☐ Sits uneven
☐ "Dog" tracks
☐ ABS light on
☐ Soft ride |
|--|---|--|

Hard to steer

- ☐
- Effort
- ☐
- Wanders
-
- ☐
- Steering wheel off center

Shimmy/vibration (check box below for location)

- | | | |
|--------------------------------|--------------------------------|--------------------------------------|
| ☐ Front | ☐ Rear | ☐ Don't know |
| ☐ Seat | ☐ Floor | ☐ Other _____ |

Brake pedal

- ☐
- Noise
- ☐
- Pulses
- ☐
- Squeaks
- ☐
- Hard
- ☐
- Mushy
- ☐
- Excessive travel

WHEN DOES IT OCCUR?

- | | | | | |
|--|--|---------------------------------------|---------------------------------------|---------------------------------------|
| ☐ Cold days | ☐ Hot days | ☐ Wet/rain | ☐ All the time | ☐ Intermittent |
| ☐ Parking maneuvers | ☐ At road speed | ☐ Accelerating | ☐ Decelerating | |

EXPLAIN:

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

- | | | | | |
|--|----------------------------------|--------------------------------------|---------------------------------|-------------------------------------|
| ☐ Engine Compartment | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Front Suspension | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Rear Suspension | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Passenger Compartment | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Instrument Panel | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Doors | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Rear seat area | ☐ Console | ☐ Other _____ | | |

NOISE SOUNDS LIKE

- | | | | | | |
|----------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|----------------------------------|--------------------------------|
| ☐ Knocks | ☐ Hard metal | ☐ Light metal | ☐ Roars | ☐ Ticking | ☐ Whine |
| ☐ Squeaks | ☐ Rattles | ☐ Scraping | ☐ Other _____ | | |

HOW OFTEN DOES IT OCCUR?

- ☐
- Continuous
- ☐
- Often
- ☐
- Intermittent
- ☐
- Just started
- ☐
- Since new

WHEN DOES IT OCCUR?

- | | | | | | |
|--|---|--|--|---------------------------------------|---|
| ☐ All the time | ☐ Speed | ☐ RPM | ☐ Only moving | ☐ On turns | ☐ Braking |
| ☐ Hard throttle | ☐ Light throttle | ☐ Decelerate | ☐ Steady speed | ☐ Idle in gear | ☐ Idle out of gear |
| ☐ Hot days | ☐ Cold days | ☐ Humid or rainy | ☐ Temperature _____ | | |
| ☐ Heavy bumps | ☐ Light bumps | ☐ Smooth pavement | | | |

EXPLAIN:

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO.:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50H15062

Fig. 3: Symptom Check List - Page 2

AIR CONDITIONING - HEATER - VENTILATION**SYSTEM OR AREA AFFECTED**

- | | | | | | |
|--|--|------------------------------------|------------------------------------|-----------------------------------|-------------------------------------|
| ☐ Air conditioner | ☐ Heater | ☐ Defroster | ☐ Vent | ☐ Bi-Level | ☐ Fan/blower |
| ☐ Max A/C | ☐ Automatic Temperature Control | | ☐ Mix/blend | ☐ Economy | ☐ All |

SYMPTOM

- | | | | |
|--|--|--|---|
| ☐ Does not work | ☐ Blows wrong temperature air | ☐ No air comes out of vents | ☐ Rapid cycling |
| ☐ Noisy (explain) | ☐ Broken | ☐ Odor | ☐ Air comes from wrong outlets |
| ☐ Leaks | ☐ Insufficient heat or cool | ☐ Other (explain below) | ☐ Blows fuse |

WHEN DOES IT OCCUR?

- | | | | | |
|--|------------------------------|--|---------------------------------------|--|
| ☐ All the time | ☐ Hot | ☐ Cold | ☐ Intermittent | ☐ Right after startup |
| ☐ When change controls only | | ☐ Other (explain below) | | ☐ Fan blower speed High / Med / Low |

EXPLAIN: _____

ELECTRICAL - RADIO - TAPE/CD PLAYER**SYMPTOM - MUSIC SYSTEM**

- | | | | | | |
|---|--------------------------------|-------------------------------------|--|--------------------------------------|---|
| ☐ Does not work | ☐ Noisy | ☐ Static | ☐ Won't load | ☐ Won't eject | ☐ Poor reception |
| ☐ Controls do not work | | ☐ Blows fuse | ☐ Other (explain below) | | |

SYSTEM AFFECTED

- | | | | | |
|--------------------------------------|------------------------------------|---|---|---|
| ☐ Radio only | ☐ AM | ☐ FM | ☐ FM stereo | ☐ Graphic equalizer |
| ☐ Tape player | ☐ CD player | ☐ Whole system | ☐ Steering wheel buttons | ☐ Phone |
| ☐ Speakers | ☐ Front | ☐ Rear | ☐ Left | ☐ Right |
| ☐ Antenna | ☐ Clock | ☐ Radio or player controls | | ☐ Rear seat controls |

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES

Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

- | | | | | |
|-------|---|---------------------------------------|--|----------------------------------|
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |

- | | | | | |
|-------|---|---------------------------------------|--|----------------------------------|
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |

- | | | | | |
|-------|---|---------------------------------------|--|----------------------------------|
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |

WHEN DOES IT OCCUR?

- | | | | |
|--|---|-------------------------------|---|
| ☐ All the time | ☐ Hot | ☐ Cold | ☐ Just after starting - malfunctions for a while |
| ☐ Intermittent | ☐ After runs for _____ minutes | | ☐ Rough roads or bumps only |
| ☐ Other (explain below) | | | |

EXPLAIN: _____

CUSTOMER NAME:**PHONE NO.:****REPAIR ORDER NO:****SHOP USE ONLY:****VIN#:****MILES:****TECHNICIAN:****ADVISOR#:**

50I15063

Fig. 4: Symptom Check List - Page 3

WATER LEAK - WINDNOISE

WATER LEAK

Leak Occurs When?

- ☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

- ☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:

Location:

- ☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

- ☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into _____ gear
☐ Noisy when in _____ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): _____

- ☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

- ☐ All the time ☐ Light load
☐ Heavy load

EXPLAIN: _____

SYMPTOM - CLUTCH

- ☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _____

☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?

When Engine Temperature is:

- ☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

COMMENTS:

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50J15064

Fig. 5: Symptom Check List - Page 4

INDIVIDUAL SYSTEM-BASED CHECK LISTS

NOTE: Have the service adviser fill out these forms with the customer whenever possible.

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY) ENGINE

- ☐ "Service Engine Soon"/Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Ping, detonates
- ☐ Sulphur/rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): _____

(whine, rattle, groan, clunk, etc.)

- ☐ Other: _____

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): _____

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into next gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: _____

EXPLAIN: _____

CUSTOMER NAME:

SHOP USE ONLY:

VIN#:

50H15054

MILES:

PHONE NO.:

TECHNICIAN:

REPAIR ORDER NO:

ADVISOR#:

OPERATING CONDITIONS (CHECK ALL THAT APPLY) HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)

- ☐ Always ☐ Few Seconds ☐ Few minutes
- ☐ Few hours ☐ Few days ☐ Few weeks
- ☐ Few months ☐ Variable ☐ Only during event
- ☐ Every _____ to _____ miles ☐ Unknown
- ☐ Other (explain): _____
- ☐ Just started ☐ Getting better ☐ Getting worse
- ☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission) When Engine Temperature is:

- ☐ Cold ☐ Warm ☐ Hot
- ☐ All the time ☐ Only during warmup

Weather Conditions:

- ☐ Very cold - below 0°F ☐ Cold - 0 to 32°F
- ☐ Cool - 32 to 60°F ☐ Warm - 60 to 80°F
- ☐ Hot - above 80°F ☐ Any environment
- ☐ Raining ☐ Dry ☐ Humid
- ☐ Snow/Ice ☐ Wet roads
- ☐ Other (explain): _____

Driving Conditions:

- ☐ Light throttle ☐ Medium throttle ☐ Hard throttle
- ☐ Starting ☐ At idle ☐ Decelerating
- ☐ Over bumps ☐ When shifting ☐ While turning
- ☐ Cruising - steady at _____ MPH ☐ While braking
- ☐ Anytime ☐ Uphill ☐ Downhill
- ☐ Highway ☐ City/town ☐ Stop and go
- ☐ Between _____ MPH and _____ MPH
- ☐ Only with A/C or Defrost on

What Type of Fuel?

What Brand?

- ☐ Regular UL ☐ Midrange UL ☐ Premium UL
- ☐ Gasohol ☐ Ethanol ☐ Methanol
- ☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

- ☐ Park/Neutral ☐ Reverse ☐ Overdrive
- ☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

- ☐ Park to R or D ☐ Reverse/Drive ☐ First/Second
- ☐ Second/Third ☐ Third/Overdrive

Fig. 6: Engine Driveability & Automatic Transmission

BRAKES - STEERING - SUSPENSION

SYMPTOM

- | | | |
|---|--|---------------------------------------|
| ☐ Vehicle pulls right - When _____ | ☐ Suspension bottoms out | ☐ Sits uneven |
| ☐ Vehicle pulls left - When _____ | ☐ Leans or sways in corners | ☐ "Dog" tracks |
| ☐ Steering wheel vibrates at _____ MPH | ☐ Brake light on | ☐ ABS light on |
| ☐ Excessive play in steering | ☐ Traction control light on | ☐ Soft ride |
| ☐ Erratic steering when braking | ☐ Uneven tire wear | |
| ☐ Poor steering wheel return after cornering | | |

Hard to steer

- ☐ Effort ☐ Wanders
☐ Steering wheel off center

Shimmy/vibration (check box below for location)

- | | | |
|--------------------------------|--------------------------------|--------------------------------------|
| ☐ Front | ☐ Rear | ☐ Don't know |
| ☐ Seat | ☐ Floor | ☐ Other _____ |

Brake pedal

- ☐ Noise ☐ Pulses ☐ Squeaks ☐ Hard ☐ Mushy ☐ Excessive travel

WHEN DOES IT OCCUR?

- | | | | | |
|--|--|---------------------------------------|---------------------------------------|---------------------------------------|
| ☐ Cold days | ☐ Hot days | ☐ Wet/rain | ☐ All the time | ☐ Intermittent |
| ☐ Parking maneuvers | ☐ At road speed | ☐ Accelerating | ☐ Decelerating | |

EXPLAIN: _____

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50C15059

Fig. 7: Brakes, Steering, & Suspension

AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

- | | | | | | |
|--|--|------------------------------------|----------------------------------|-----------------------------------|-------------------------------------|
| ☐ Air conditioner | ☐ Heater | ☐ Defroster | ☐ Vent | ☐ Bi-Level | ☐ Fan/blower |
| ☐ Max A/C | ☐ Automatic Temperature Control | ☐ Mix/blend | ☐ Economy | ☐ All | |

SYMPTOM

- | | | | |
|--|--|--|--|
| ☐ Does not work | ☐ Blows wrong temperature air | ☐ No air comes out of vents | ☐ Rapid cycling |
| ☐ Noisy (explain) | ☐ Broken | ☐ Odor | ☐ Blows fuse |
| ☐ Leaks | ☐ Insufficient heat or cool | ☐ Other (explain below) | |

WHEN DOES IT OCCUR?

- | | | | | |
|--|--|--|---------------------------------------|--|
| ☐ All the time | ☐ Hot | ☐ Cold | ☐ Intermittent | ☐ Right after startup |
| ☐ When change controls only | ☐ Other (explain below) | ☐ Fan blower speed High / Med / Low | | |

EXPLAIN: _____

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50A15057

Fig. 8: Air Conditioning, Heater & Ventilation

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

- | | | | | | |
|---|--------------------------------|-------------------------------------|--|--------------------------------------|---|
| ☐ Does not work | ☐ Noisy | ☐ Static | ☐ Won't load | ☐ Won't eject | ☐ Poor reception |
| ☐ Controls do not work | | ☐ Blows fuse | ☐ Other (explain below) | | |

SYSTEM AFFECTED

- | | | | | |
|--------------------------------------|------------------------------------|---|---|--|
| ☐ Radio only | ☐ AM | ☐ FM | ☐ FM stereo | ☐ Graphic equalizer |
| ☐ Tape player | ☐ CD player | ☐ Whole system | ☐ Steering wheel buttons | ☐ Phone |
| ☐ Speakers | ☐ Front | ☐ Rear | ☐ Left | ☐ Right |
| ☐ Antenna | ☐ Clock | ☐ Radio or player controls | ☐ Rear seat controls | |

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES

Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

- | | | | | |
|-------|---|---------------------------------------|--|----------------------------------|
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |
| _____ | ☐ Inoperable | ☐ Noisy | ☐ No control | ☐ Erratic |
| | ☐ Check light on or flashing | | ☐ Works improperly (explain below) | |
| | ☐ Blows fuse | ☐ Intermittent | ☐ Related system affected (explain below) | |

WHEN DOES IT OCCUR?

- | | | | |
|--|---|--|---|
| ☐ All the time | ☐ Hot | ☐ Cold | ☐ Just after starting - malfunctions for a while |
| ☐ Intermittent | ☐ After runs for _____ minutes | ☐ Rough roads or bumps only | |
| ☐ Other (explain below) | | | |

EXPLAIN: _____

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50B15058

Fig. 9: Electrical, Radio & Tape/CD Player

MANUAL TRANSMISSION - CLUTCH			
SYMPTOM - MANUAL GEAR SHIFT ☐ Hard to shift ☐ Doesn't shift ☐ Grinds going into _____ gear ☐ Noisy when in _____ gear or neutral _____ ☐ Slips/pops out of gear ☐ Noise (describe): _____ _____ _____ ☐ Upshift light stays on ☐ Upshift light doesn't light WHEN DOES IT OCCUR? ☐ All the time ☐ Light load ☐ Heavy load EXPLAIN: _____ _____ _____ _____ _____ _____		SYMPTOM - CLUTCH ☐ Hard to push ☐ Fail to release ☐ Noise when pressing pedal down (describe): _____ _____ _____ ☐ Slips ☐ Chattering (grabbing) ☐ Odor present ☐ Pedal stays on the floor ☐ Squealing sound WHEN DOES IT OCCUR? When Engine Temperature is: ☐ Cold ☐ Hot ☐ Accelerating ☐ Decelerating	
CUSTOMER NAME:	PHONE NO.:	REPAIR ORDER NO:	
SHOP USE ONLY:		MILES:	TECHNICIAN:
VIN#:			ADVISOR#:
50J15056			

Fig. 10: Manual Transmission & Clutch

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

- | | | | | |
|--|----------------------------------|--------------------------------------|---------------------------------|-------------------------------------|
| ☐ Engine Compartment | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Front Suspension | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Rear Suspension | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Passenger Compartment | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Instrument Panel | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Doors | ☐ Left | ☐ Right | ☐ Center | ☐ Don't know |
| ☐ Rear seat area | ☐ Console | ☐ Other _____ | | |

NOISE SOUNDS LIKE

- | | | | | | |
|----------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|----------------------------------|--------------------------------|
| ☐ Knocks | ☐ Hard metal | ☐ Light metal | ☐ Roars | ☐ Ticking | ☐ Whine |
| ☐ Squeaks | ☐ Rattles | ☐ Scraping | ☐ Other _____ | | |

HOW OFTEN DOES IT OCCUR?

- | | | | | |
|-------------------------------------|--------------------------------|---------------------------------------|---------------------------------------|------------------------------------|
| ☐ Continuous | ☐ Often | ☐ Intermittent | ☐ Just started | ☐ Since new |
|-------------------------------------|--------------------------------|---------------------------------------|---------------------------------------|------------------------------------|

WHEN DOES IT OCCUR?

- | | | | | | |
|--|---|--|--|---------------------------------------|---|
| ☐ All the time | ☐ Speed | ☐ RPM | ☐ Only moving | ☐ On turns | ☐ Braking |
| ☐ Hard throttle | ☐ Light throttle | ☐ Decelerate | ☐ Steady speed | ☐ Idle in gear | ☐ Idle out of gear |
| ☐ Hot days | ☐ Cold days | ☐ Humid or rainy | ☐ Temperature _____ | | |
| ☐ Heavy bumps | ☐ Light bumps | ☐ Smooth pavement | | | |

EXPLAIN: _____

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50F15060

Fig. 11: Squeak, Rattle, & Noise Conditions

WATER LEAK - WINDNOISE

WATER LEAK

Leak Occurs When?

- ☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

- ☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:

Location:

- ☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: _____

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

ADVISOR#:

50I15055

Fig. 12: Water Leak & Wind Noise

Article GUID: A00130105

TIRE PRESSURE MONITOR SYSTEMS

GM - Chevrolet - Volt - 2011-18

DESCRIPTION & OPERATION

NOTE: If a tire pressure sensor or the RCDLR is replaced, or if wheels have been rotated, tire pressure sensor must be relearned. See [RESET PROCEDURES](#).

TIRE PRESSURE MONITOR (TPM) SYSTEM

The tire pressure monitor system uses the instrument cluster, body control module (BCM), 4?radio frequency transmitting pressure sensors, and the serial data circuit to perform the tire pressure monitor learn mode functions. The sensor Learn procedure must be performed after every tire rotation, BCM replacement, or sensor replacement. Once the Learn mode has been enabled, each of the sensors unique identification codes can be learned into the BCM memory. When a sensor ID has been learned, the BCM sounds a horn chirp indicating the sensor has transmitted its ID and the BCM has received and learned it. The BCM must learn the sensor ID's in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will individually illuminate indicating which location is to be learned in the proper sequence.

Each sensor has an internal low frequency coil. When the tire pressure monitor special tools are used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in Learn Mode-Remotely Triggered. When the BCM receives a Learn Mode-Remotely Triggered transmission while in tire pressure monitor Learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the RCDLR memory.
- If equipped, the DIC will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the learn procedure to be repeated for the system to function properly.

TIRE PRESSURE MONITOR WARNING INDICATORS

When the TPM system detects a significant loss of tire pressure, the "CHECK TIRE PRESSURE" message is displayed on the DIC and the low tire pressure indicator is displayed on the instrument panel. Both the message and indicator can be cleared by adjusting the tires to their recommended pressures and driving the vehicle above 25 mph (40 km/h) for at least 2 minutes.

The RCDLR has the ability to detect malfunctions within the TPM system. Any malfunctions detected will cause the DIC to display a "SERVICE TIRE MONITOR" warning message. If warning indicators are still on or display shows dashes instead of a value after a completed Relearn procedure, there is a problem in the TPM system. See appropriate manufacturer service information.

TPMS RESET PROCEDURES

NOTE: If a tire pressure sensor or the RCDLR is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

When the TPM system detects a significant loss of tire pressure, the "CHECK TIRE PRESSURE" message is displayed on the DIC and the low tire pressure indicator is displayed on the instrument panel. Both the message and indicator can be cleared by adjusting the tires to their recommended pressures and driving the vehicle above 25 mph (40 km/h) for at least 2 minutes.

TIRE PRESSURE SENSOR LEARN

NOTE: Once the learn mode has been enabled, each of the sensor's unique identification (ID) codes can be learned into the RCDLR's memory. The RCDLR must learn the sensor IDs in the proper order to determine correct sensor location. The first learned ID is assigned to left front, the second to right front, third to right rear and forth to left rear.

NOTE: In the following procedures, a TPM Special Tool (EL-46079 or EL-50448) may be used in place of increasing/decreasing pressures to enable sensor. To use, place activator antenna against the tire sidewall close to the wheel rim at the valve stem location, then press and release the ACTIVATE button.

NOTE: If TPM Special Tool (EL-46079 or EL-50448) is used, and vehicle is having trouble entering relearn mode, check batteries in activation tool. Low batteries may allow some functions to work, but not allow vehicle to perform learn function. When the internal battery is fresh (fully charged), the indicator is "full" or all dark. When the battery is depleted, the indicator shows "empty" or all light. The placement of the TPM Sensor Activation Tool (J-46079) is critical. If the scan tool antenna is not placed perpendicular to the wheel wall and close to tire pressure valve stem, it may not properly activate the tire pressure sensor.

NOTE: The TPM Special Tool (EL-46079 or EL-50448) can be used during the learn procedure. Press and release the "ACTIVATE" key button 1 second, this is will activate the activation cycle. The Activation cycle will force the tire pressure sensor to transmit their IDs.

NOTE: Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously and that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

In the event that a particular sensor's information is displayed on the special tool upon
IMPORTANT: activation, but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Ignition ON, initiate the TPM Learn Mode using one of the following procedures:

- Using a scan tool, initiate the TPM Learn Mode. A double horn chirp will sound indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.

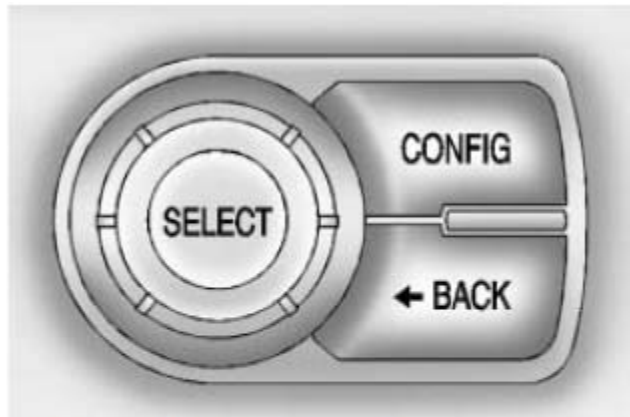
- Using the Driver Information Center (DIC):

2011-15 :

- Set the parking brake.
- Put the vehicle in ON/RUN and place the vehicle in P (Park).
- If the DIC display is minimized, press the SELECT knob to maximize it. See [Fig. 1](#).
- Use the SELECT knob to scroll to the Tire Pressure display screen.
- Press and hold the SELECT knob for five seconds to begin the sensor matching process. A message displays confirming to begin the process.
- Use the SELECT knob to select YES with the highlighted selection, and press the SELECT knob again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
- Proceed to next step.

2016- :

- Set the parking brake.
 - Place the vehicle in ON/RUN.
 - Make sure the Tire Pressure info page option is turned on. The info pages on the DIC can be turned on and off through the Settings menu.
 - Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page. See [Fig. 2](#).
 - Press and hold the Check Mark (Set/ Reset) button located in the center of the DIC controls. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
 - Proceed to next step.
- Starting with the left front tire, active the sensor by holding the antenna of the TPM Sensor Activation Tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the Activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for a horn chirp. If the horn does not chirp, repeat the sensor activation sequence with the tool. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
 - After the horn chirp has sounded and the right front turn signal is illuminated, repeat procedure for the remaining 3 sensors in the following order: Right Front, Right Rear, Left Rear.
 - When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the RCDLR exits the learn mode.



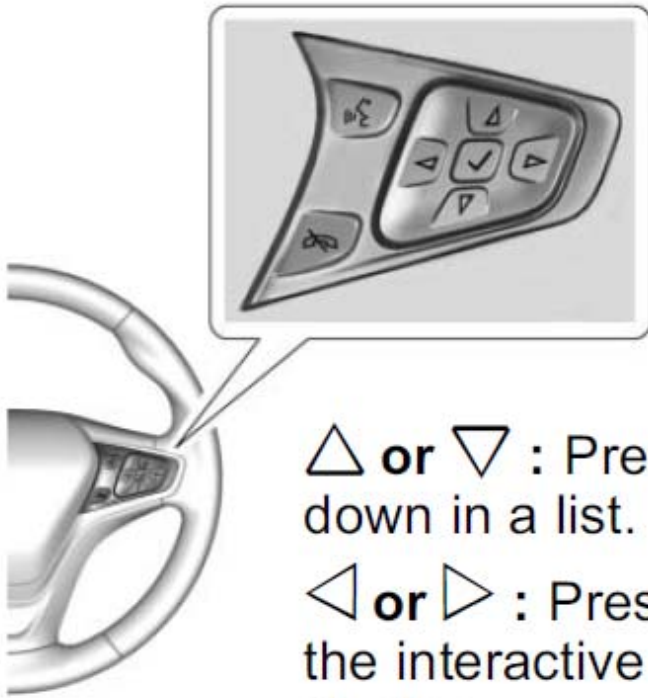
CONFIG: Press to select either the Simple or Enhanced instrument cluster configuration display.

← BACK: Press to return to the previous screen, exit a screen, or return to the main menu. Press **← BACK** to minimize the DIC menu display.

SELECT: Press the center of the knob to select the highlighted item. Turn the knob to scroll through the menu items.

Fig. 1: Identifying Driver Information Center (DIC) Controls (2011-15)

Courtesy of GENERAL MOTORS CORP.



△ or ▽ : Press to move up or down in a list.

◀ or ▶ : Press to move between the interactive display zones in the cluster.

✓ : Press to open a menu or select a menu item. Press and hold to reset values on certain screens.

Fig. 2: Identifying Driver Information Center (DIC) Controls (2016-)

Courtesy of GENERAL MOTORS CORP.

DISMOUNTING/MOUNTING PROCEDURES

CAUTION: The tire should be dismounted from the wheel using the tire changer manufacturer's instructions. Use the following information to avoid damage during the dismounting/mounting procedures.

NOTE: If vehicle's tires are replaced with those not having a TPC Spec number, the TPM system may give an inaccurate low pressure warning. Non-TPC Spec tires may give a low pressure warning that is higher or lower than the proper warning level achieved by TPC Spec numbered tires.

NOTE: If a tire pressure sensor or the RCDLR is replaced, or if wheels have been rotated, tire pressure sensor must be relearned. See [**RESET PROCEDURES**](#).

TIRE PRESSURE SENSOR

CAUTION: DO NOT inject any tire liquid or aerosol tire sealant into tires, as this may cause a malfunction of the tire pressure sensors. If any tire sealant is noted upon tire dismounting, replace the sensor. Also remove all residual liquid sealant from

the inside of the tire and wheel surfaces.

Removal

1. Raise vehicle on a suitable support. Remove tire/wheel assembly from vehicle.
2. Dismount tire from wheel following tire changer manufacturer's instructions while paying special attention to the following to avoid damaging tire pressure sensor:
 - Place the sensor's cap and valve on a dry, clean surface after removal. The cap is aluminum and the valve is nickel-plated to prevent corrosion. DO NOT substitute a cap or valve made of any other material.
 - Position the bead breaking fixture 90 degrees from valve stem when separating tire bead from wheel.
 - Position the mounting/dismounting head so tire iron (or pry bar) can be inserted slightly clockwise of sensor body when prying tire bead up and over the mounting/dismounting head.
 - Using tire machine, rotate tire/wheel assembly clockwise when transferring the tire bead to the outside of the wheel rim.
 - Repeat items for inner bead.
3. Remove the TORX screw (3) from the tire pressure sensor (2) and pull it straight off the tire pressure valve stem (1). See [Fig. 3](#).
4. Remove the tire pressure valve stem by pulling it through the rim.
5. Follow [Installation](#) below, to replace the sensor.

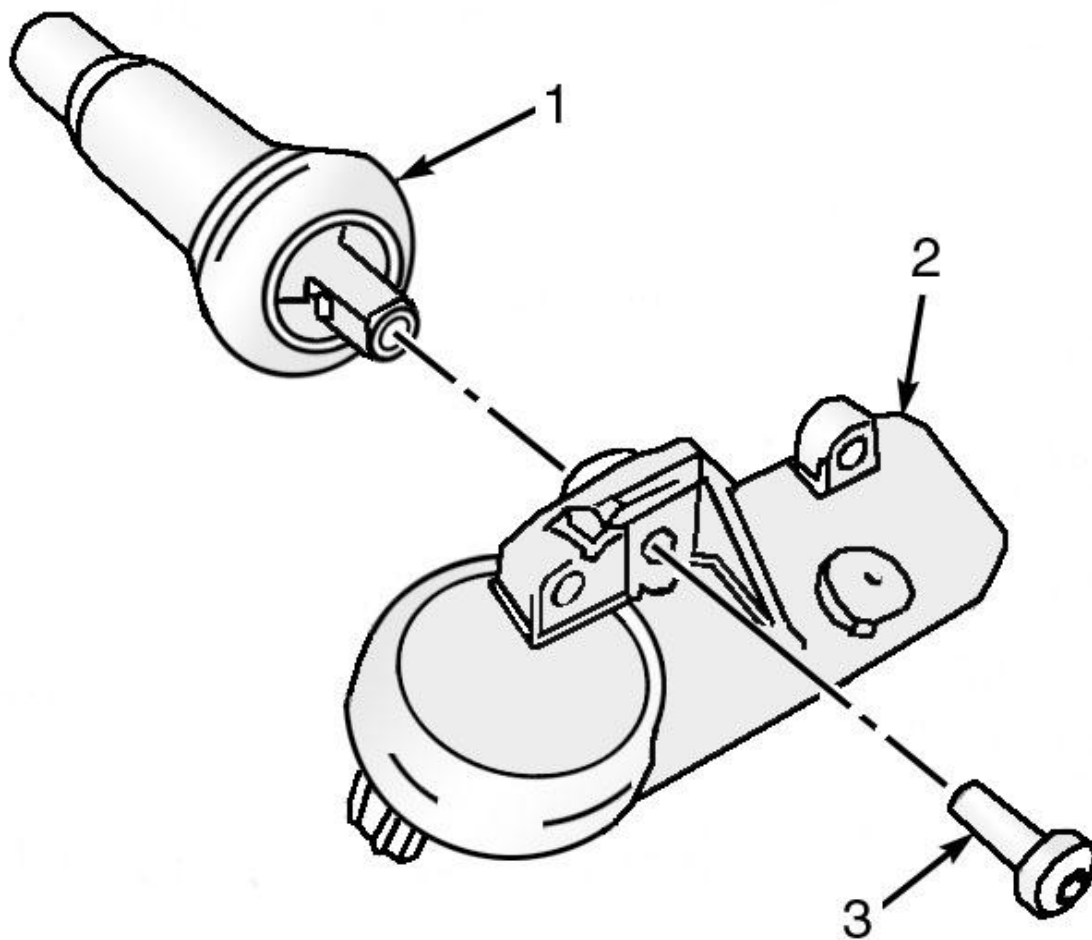


Fig. 3: Exploded View Of Tire Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

Installation

1. Assemble the tire pressure sensor (2) to the valve stem and install the new TORX screw (3). See [Fig. 3](#).
2. Apply tire soap to the rubber portion of the valve stem.
3. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim. See [Fig. 4](#).
4. Before installing tire on the wheel, note the following items to avoid tire pressure sensor damage upon tire mounting:
 - Position the mounting/dismounting head 180 degrees from valve stem.
 - Position the bead transition area 45 degrees counterclockwise of valve stem.
 - Using tire machine, rotate tire/wheel assembly clockwise when transferring tire bead to the inside of the wheel rim.
 - Repeat items for outer bead.
5. Install tire on wheel. Install tire/wheel assembly on vehicle. Retrain tire pressure sensor. See [RESET PROCEDURES](#).

NOTE: TPM sensors are still shipped in the OFF mode. However, the TPM sensor no

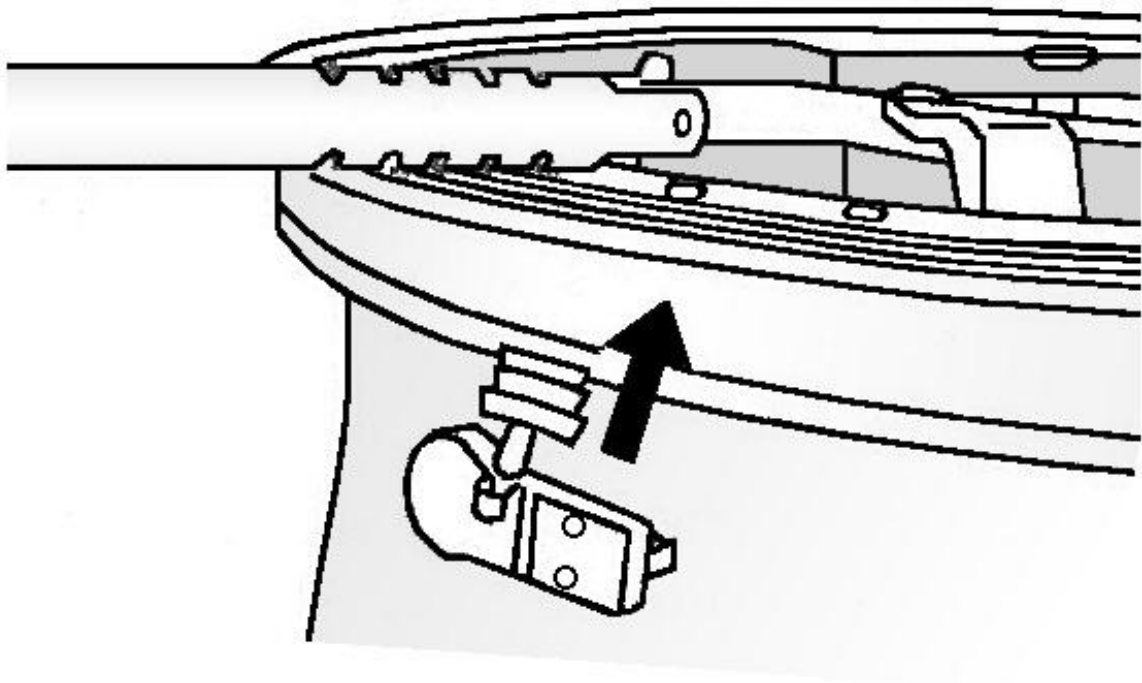


Fig. 4: Installation Of Sensor/Valve Assembly
Courtesy of GENERAL MOTORS CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Component	Ft. Lbs. (N.m)
Wheel Nut	100 (140)
	INCH Lbs. (N.m)
TORX Screw	11.5 (1.3).

Article GUID: A00470429

TRACTION CONTROL, 4WD, & AWD

Chevrolet - 1980-18

TRACTION CONTROL DISABLE

WARNING: Placing a non-compatible vehicle on a single-axle dynamometer could result in a safety hazard to technicians and damage to vehicle. Vehicles which use All-Wheel Drive (AWD) or traction control may not be clearly marked. Use common sense and take all necessary precautions when placing any vehicle on the dynamometer. Determine between full-time 4WD and All-Wheel Drive (AWD) for testing purposes. The following tables include information related to full-time 4WD and AWD vehicles, and how to disable the traction control system (if disengageable).

WARNING: DO NOT operate vehicle on a 2-wheel dynamometer if the DO NOT TEST column is marked.

CHEVROLET - CARS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Camaro							
1994-02	...	X	...	...	...	X <u>(1)</u>	...
2010-17	...	X	...	...	...	X <u>(9)</u>	...
Caprice							
2011-15	...	X	...	...	...	X <u>(7)</u>	...
2016-17	...	X	...	...	...	X <u>(14)</u>	...
Cavalier							
1995-00	X	...	...	...	...	X <u>(2)</u>	...
2001-05	X	...	...	...	...	X <u>(3)</u>	...
Cobalt							
2007-10	X	...	...	...	...	X <u>(4)</u>	...
Corvette							
1992-97	...	X	...	...	...	X <u>(5)</u>	...
1998-04	...	X	...	...	...	X <u>(10)</u>	...
2005-13	...	X	...	...	...	X <u>(10)(11)</u>	...
2014-17	...	X	...	...	...	X <u>(11)(15)</u>	...
Cruze							
2011-17	...	X	...	...	...	X <u>(9)</u>	...
Impala							
2000-10	X	...	...	...	...	X <u>(6)</u>	...

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2011-13	X	...	...	...	...	X <u>(12)</u>	...
2014-17	...	X	...	...	...	X <u>(9)</u>	...
Impala Limited							
2014-16	X	...	...	...	...	X <u>(12)</u>	...
Malibu							
2004-07 (& 2008 Classic)	X	...	...	...	...	X <u>(7)</u>	...
2008-12	X	...	...	...	...	X <u>(12)</u>	...
2013-17	X	...	...	...	...	X <u>(9)</u>	...
Monte Carlo							
2000-07	X	...	...	...	...	X <u>(8)</u>	...
Sonic							
2012-17	X	...	...	...	...	X <u>(9)</u>	...
Spark							
2013-15	X	...	...	...	...	X <u>(9)</u>	...
2016-17	X	...	...	...	...	X <u>(14)</u>	...
SS							
2014-15	...	X	...	...	...	X <u>(9)</u>	...
2016-17	...	X	...	...	...	X <u>(15)</u>	...
Volt							
2011	X	...	...	...	...	X <u>(13)</u>	X
2012-15	X	...	...	...	...	X <u>(14)</u>	...
2016-17	X	...	...	...	...	X <u>(9)</u>	...

- (1) Press ASR button, located on console. ASR OFF indicator light will illuminate when system is disabled.
- (2) ETS system will not operate when A/T selector is in 1 or 2 position. ETS indicator light will stay on when system is disabled.
- (3) Traction control is disabled when transaxle is in 1st or 2nd gear only. TRAC OFF indicator light will illuminate when system is disabled.
- (4) To turn the ETS off, shift to L (Low) or R (Reverse). The ETS indicator/warning light will come on and stay on and the TRACTION OFF message will be displayed when the gear shift is in L (Low).
- (5) Press sliding car icon on the console. The TCS indicator will illuminate when system is disabled.
- (6) Press TRAC OFF button on left side of dash. Chime will sound. SERVICE TRACTION SYSTEM indicator light will illuminate when system is disabled.
- (7) Press TC button near A/C-heater controls or in front of the shift lever. Indicator light will illuminate when system is disabled.
- (8) Press TRAC ON/OFF button on instrument panel or center console. TRACTION CONTROL

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
indicator light will illuminate when system is disabled. (9) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located near the shift lever. (10) The TCS Switch allows the driver to shut off the TCS and Active Handling (RPO JL4 - if equipped), by pressing and releasing the switch. If the vehicle is equipped with Active Handling, the TCS switch can be pressed and held for 5 seconds; this places the system in Competitive driving mode. Competitive driving mode turns the TCS off but still allows Active Handling to be active. The switch is located in the center console. (11) If the Tire Pressure Monitor (TPM) system detects a flat tire and the Driver Information Center (DIC) displays TIRE FLAT, or if the TPM system is malfunctioning and the DIC displays SERVICE TIRE MONITOR, the Active Handling System cannot be turned off by the driver. If the Active Handling System is off, it will be turned back on automatically. (12) The ESC/TCS button is located on the instrument panel or on console. Press and hold the ESC/TCS button briefly to disable both traction control and ESC. TRACTION OFF and ESC OFF messages will appear, and the ESC/TCS light will be on solid. (13) Traction Control system turns on automatically whenever the vehicle is on and cannot be turned off. (14) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located on the overhead console or to the left of the steering wheel. (15) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located on the center console.							

CHEVROLET - TRUCKS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Astro							
1990-05 (AWD)	...	...	...	...	(1)	...	...
Avalanche							
2002-13	...	X	...	...	...	X (2)	...
2003-13	...	...	X (4)	...	...	X (3)	...
Blazer (2002-05 Jimmy Canadian)							
1980-94	...	X	X (4)	...	...	...	...
1995-05 (4WD)	...	X	X (4)	...	...	...	...
1995-98 (AWD)	...	...	...	...	X (1)	...	...
Captiva Sport							
2012-15 (AWD)	...	...	...	...	X	...	X

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2012-15 (FWD)	X	...	...	...	...	X <u>(10)</u>	...
City Express							
2015-17	X	...	...	...	...	X <u>(13)</u>	...
Colorado							
2004-12	...	X	X <u>(4)</u>	...	...	X <u>(3)</u>	...
2015-17	...	X	X <u>(4)</u>	...	...	X <u>(12)</u>	...
Equinox							
2005-17 (AWD)	...	...	...	...	X	...	X
2005-17 (FWD)	X	...	...	...	...	X <u>(9)</u>	...
Express (Chevy Express/ Cutaway/ RV)							
2004-11 (RWD)	...	X	...	...	...	X <u>(9)</u>	...
2003-14 (AWD)	...	...	...	...	X	...	X
2012-17 (RWD)	...	X	...	...	...	X <u>(10)</u>	...
HHR							
2008-10	X	...	...	...	...	X <u>(7)</u>	...
K10-30 & K1500-3500 Series							
1980-00	...	X	X <u>(4)</u>	...	...	...	...
LUV							
1980-82	...	X	X <u>(4)</u>	...	...	...	...
Silverado (All Configurations)							
2003-05 (AWD)	...	...	...	...	X	...	X
1999-17	...	X	X <u>(4)</u>	...	...	X <u>(7)</u>	...
SSR							
2003-06	...	X	...	...	...	X <u>(5)</u>	...
Suburban							
1980-99	...	X	X <u>(4)</u>	...	...	...	...
2000-17	...	X	X <u>(4)</u>	...	...	X <u>(7)</u>	...
Tahoe							
1995-99	...	X	X <u>(4)</u>	...	...	...	...
2000-17	...	X	X <u>(4)</u>	...	...	X <u>(7)</u>	...
Tracker							
1998-04	...	X	X <u>(4)</u>	...	...	...	...
TrailBlazer							
2002-09	...	X	X <u>(4)</u>	...	...	X <u>(8)</u>	...
2006-09 (AWD)	...	...	...	...	X	...	X
Traverse							
2009-17 (AWD)	...	...	...	...	X	...	X

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2009-17 (FWD)	X	...	...	...	...	X ⁽⁸⁾	...
Trax							
2015-17	...	...	...	...	X	...	X
2015-17	X	...	...	...	...	X ⁽¹²⁾	...
T10 & T15 Pickup							
1982-01	...	X	X ⁽⁴⁾	...	...	...	...
Uplander & Montana SV6							
2006-08 (AWD)	...	...	...	...	X	...	X
Venture							
1997-05	X	...	...	...	...	X ⁽⁸⁾	...
2002-05 (AWD)	...	...	...	...	X	...	X
(1) All wheel drive is optional. (2) Press switch with sliding car icon, located left of steering wheel on instrument panel. TRACTION OFF will illuminate when system is disabled. (3) Traction Assist (TAS) or Traction Control (TCS) can be turned off by pressing TAS or TCS button on instrument panel. TCS light on instrument panel will illuminate. (4) 4WD With Shift Lever Selector: Shift transfer case to 2WD or 2H mode. 4WD With A/T or M/T Push Button Shift Selector: Press button on instrument panel to select 2HI position. Switch indicator light will flash until new position is active. Indicator light will stay on. (5) Information from manufacturer is not available. (6) Press TRACTION ASSIST switch located on dashboard, left of steering wheel. TRACTION OFF indicator light will illuminate when system is disabled. (7) To turn off both TCS and StabiliTrak, press and hold the TRACTION OFF button until the traction off light and the StabiliTrak OFF light come on and stay on in the instrument cluster. (8) Press traction control switch located on instrument panel or center console. When the TCS is turned off, the StabiliTrak light goes on, and an appropriate traction control off message will be displayed on the DIC. (9) Press the TRACTION OFF button (located on the instrument panel or center console) for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off. (10) Press the TRACTION OFF button (located on the instrument panel) once to turn off the Traction Control System (TCS). Press and hold the StabiliTrak button for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off. (11) Press TRACTION OFF button located on instrument panel. The appropriate message displays on Driver Information Center (DCI). (12) The button for TCS and StabiliTrak is on the center stack. To turn off only TCS, press and release the TRACTION OFF button. The Traction Off Light displays in the instrument cluster. To turn off both TCS and StabiliTrak, press and hold the TRACTION OFF button until the Traction Off Light							

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
and StabiliTrak Off Light come on and stay on in the instrument cluster. To turn TCS and StabiliTrak on again, press and release the TRACTION OFF button. (13) To turn off TCS and Electronic Stability Control, press and release the TRACTION OFF button. The Electronic Stability Control (ESC) Off Light comes on and stays on in the instrument cluster. The TRACTION OFF button is on the instrument panel, to the left of the steering wheel.							

Article GUID: A00164026

GENERAL INFORMATION

Trouble Shooting - Basic Procedures

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections
Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	

CONDITION & POSSIBLE CAUSE	CORRECTION
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	
Loose drive pulley	Tighten drive pulley attaching nut
Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections
Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

Ignition Secondary Trouble Shooting Chart

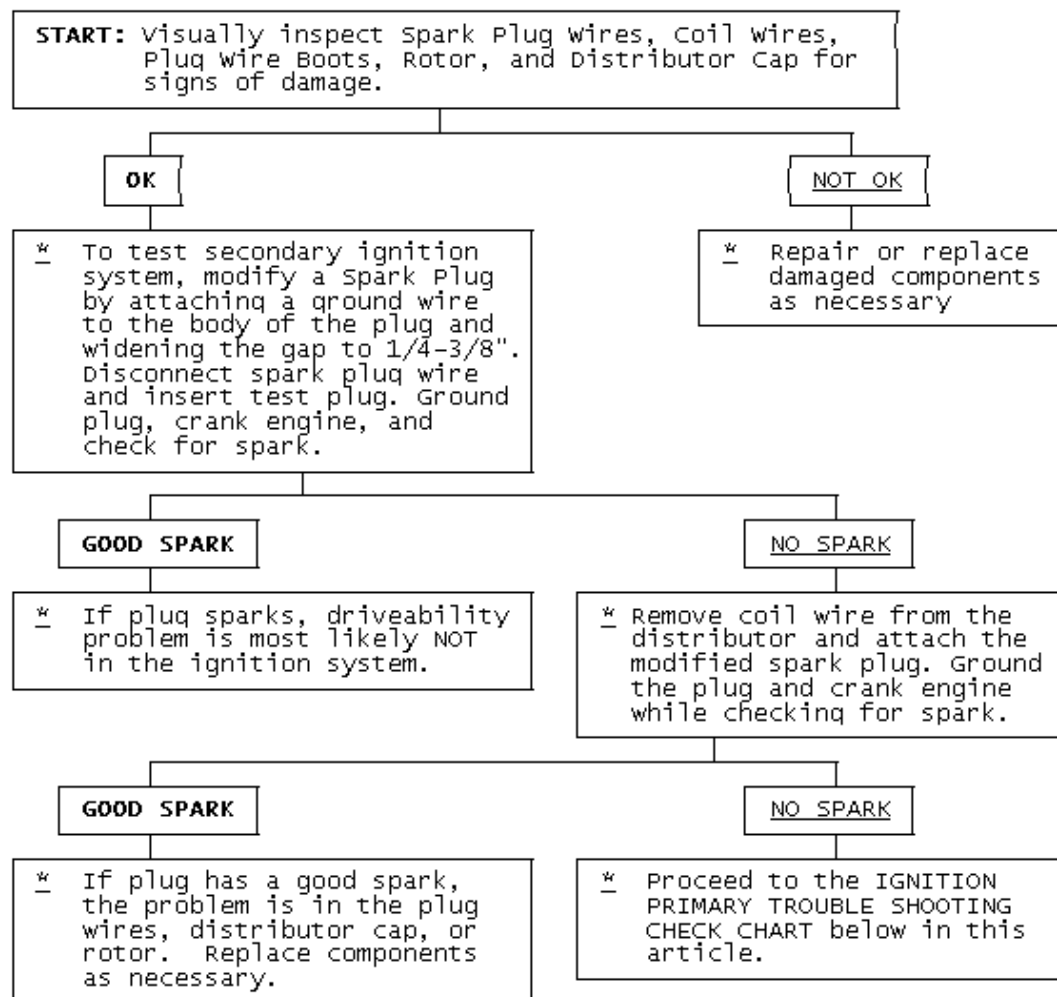


Fig. 1: Ignition Secondary Trouble Shooting Chart

Ignition Primary Trouble Shooting Chart

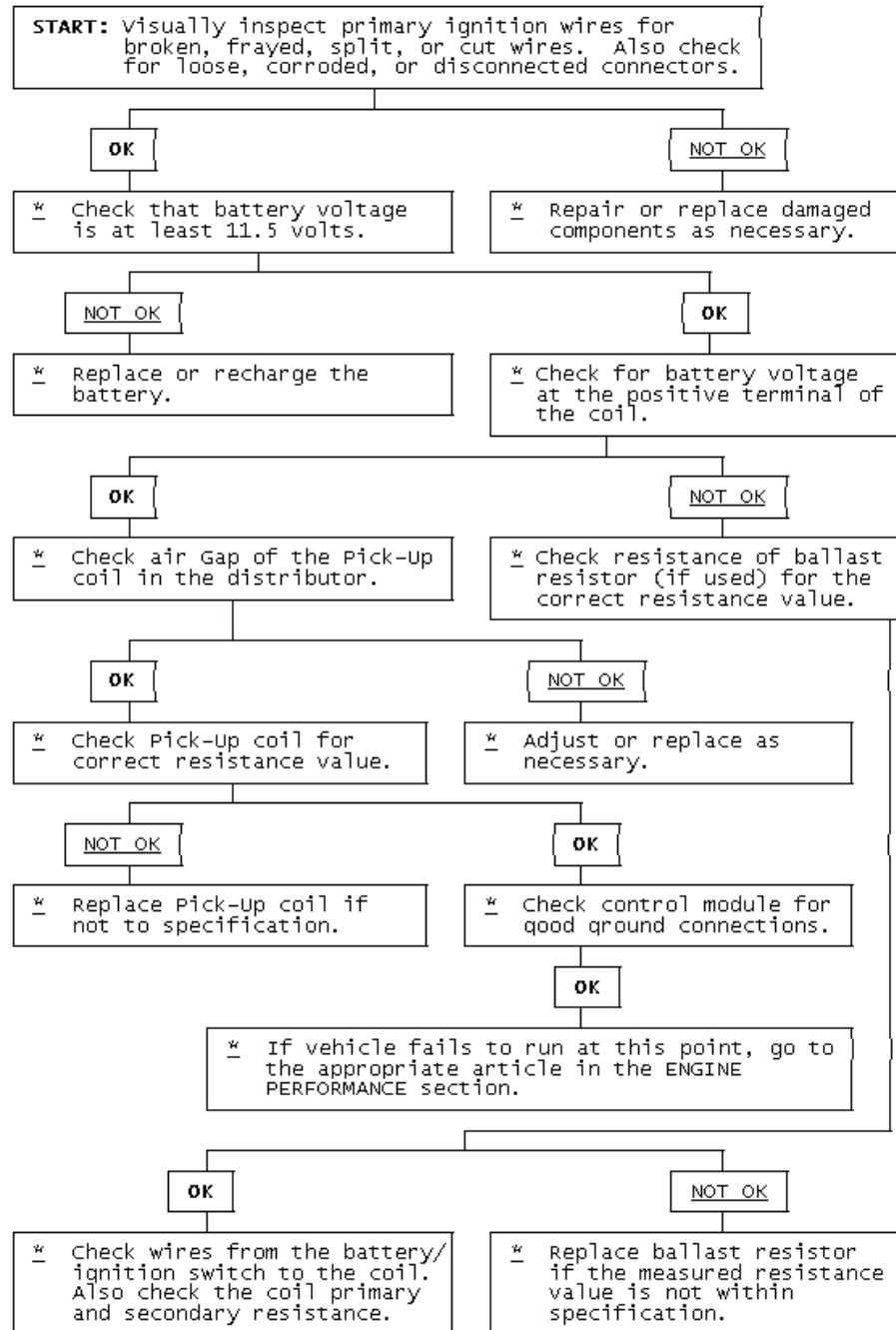


Fig. 2: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem

symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

WARNING: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.
.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.

CONDITION	POSSIBLE CAUSE
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.
.....	Temperature above system capacity.

HEATER SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.

CONDITION	POSSIBLE CAUSE
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.
Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.
.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	

CONDITION & POSSIBLE CAUSE	CORRECTION
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	
Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
Excessive Pedal Travel	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
Incorrect installation of inboard disc pad	Remove and replace correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay
Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	

CONDITION & POSSIBLE CAUSE	CORRECTION
Impurities In Coolant	Clean/Flush System
Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction
Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Worn camshaft lobes	Replace camshaft, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
Faulty Acceleration	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES
Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required
Exhaust system leak	repair exhaust system leak
Engine Detonation	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks
Excessive combustion chamber deposits	Remove built-up deposits

CONDITION & POSSIBLE CAUSE	CORRECTION
Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal
Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES
Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals
Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block
Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
Noisy Valve Train	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES
Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
Burned, Sticking or Broken Valves	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	
Choke vacuum kick setting incorrect	Reset vacuum kick setting, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	
Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
Sag or Stall After Warmup	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	
Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see FUEL

DIESEL ENGINE TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	
Bad battery connections or dead batteries	Check connections and/or replace batteries

CONDITION & POSSIBLE CAUSE	CORRECTION
Bad starter connections or bad starter	Check connections and/or replace starter
Engine Cranks Slowly, Won't Start	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS
Glow plug control not functioning	Check controller, see FUEL SYSTEMS
Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections
Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/Idles Rough W/out Smoke or Noise	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	

CONDITION & POSSIBLE CAUSE	CORRECTION
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Crankes Normally)	
Cold start valve inoperative	Test valve and circuit
Poor connection;vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor High Speed Operation	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor connections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: For additional electronic fuel injection trouble shooting information, see the appropriate article in the **ENGINE PERFORMANCE** section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.

IGNITION SYSTEM TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

Ignition Secondary Trouble Shooting Chart

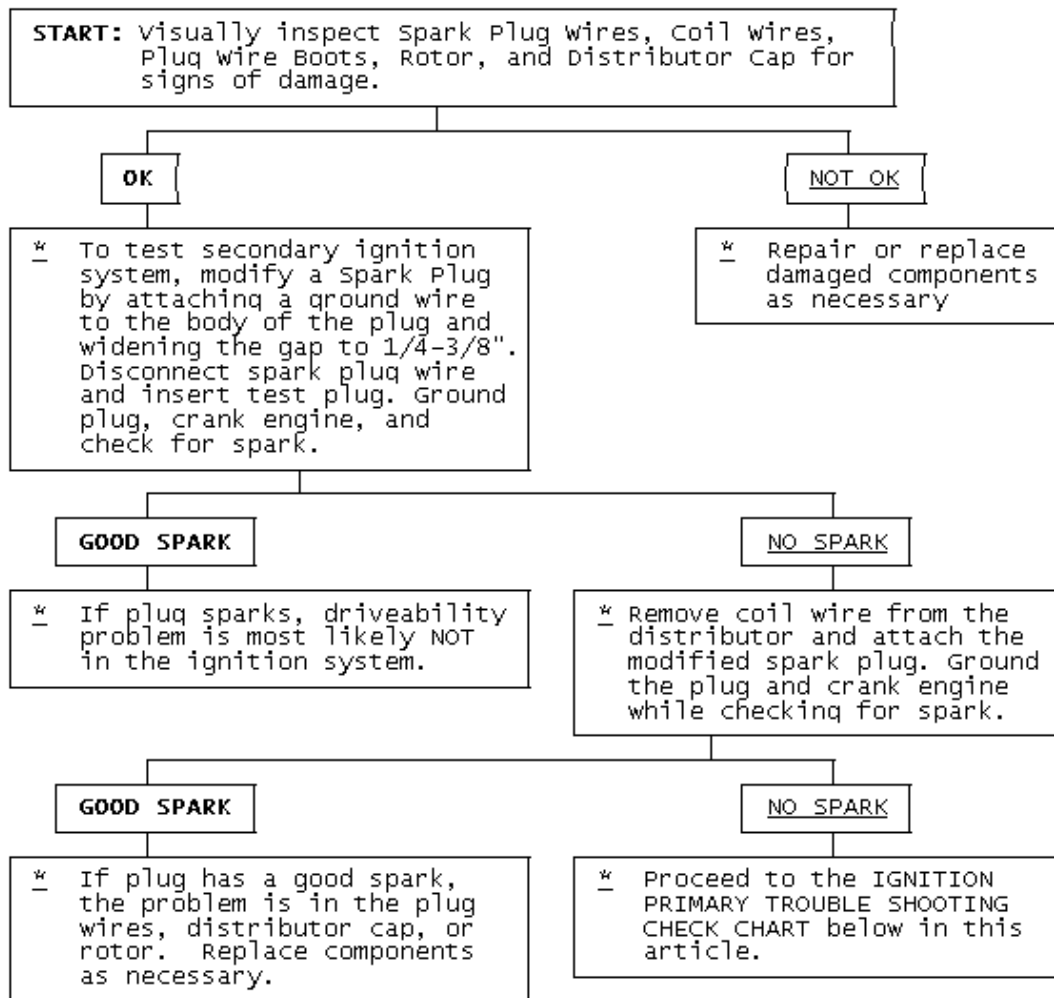


Fig. 3: Ignition Secondary Trouble Shooting Chart

Ignition Primary Trouble Shooting Chart

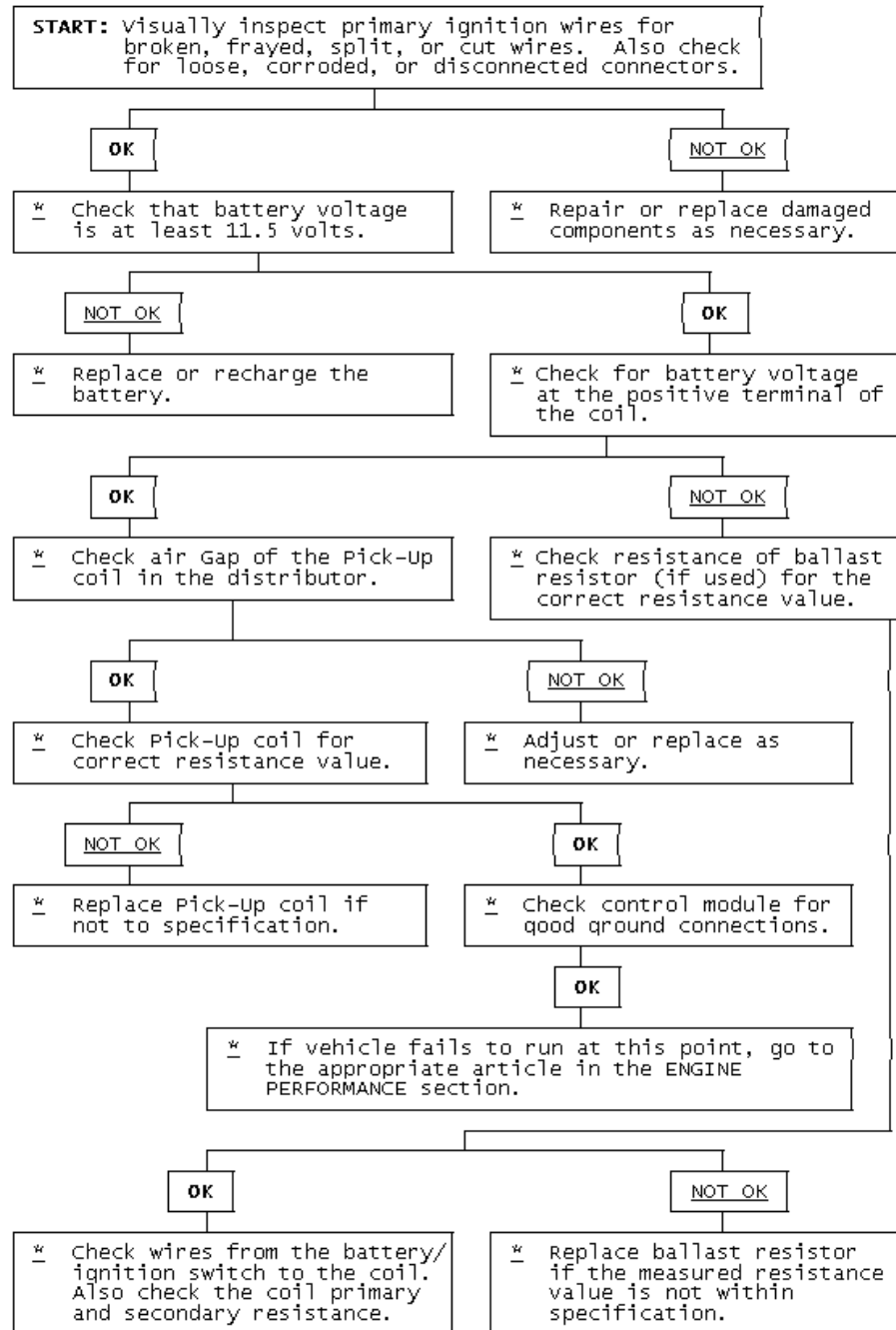


Fig. 4: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem

symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	

CONDITION & POSSIBLE CAUSE	CORRECTION
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	

CONDITION & POSSIBLE CAUSE	CORRECTION
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system
Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	
Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance

CONDITION & POSSIBLE CAUSE	CORRECTION
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	
Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION & POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	
Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs

CONDITION & POSSIBLE CAUSE	CORRECTION
Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Hard Starting	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
Dieseling	
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding
Binding choke linkage or fast idle cam	Eliminate binding

CONDITION & POSSIBLE CAUSE	CORRECTION
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see ENGINE PERFORMANCE
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean, see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	
Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum	Replace vacuum hoses hoses

CONDITION & POSSIBLE CAUSE	CORRECTION
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required
Engine Surges	
Improper PCV valve airflow	Replace PCV valve

CONDITION & POSSIBLE CAUSE	CORRECTION
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs
Binding carburetor power piston	Eliminate binding
Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
Engine Stalls	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

NOTE: Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition (1)
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers

Condition	Possible Cause
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage

CONDITION & POSSIBLE CAUSE	CORRECTION
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
Rattling	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate
Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
Slipping	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	
Worn or damaged release	Replace release bearing
Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area

CONDITION & POSSIBLE CAUSE	CORRECTION
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing
Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused ive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The

lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.
- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing. For definitions of listed noises or sounds, see [DRIVE AXLE - NOISE DIAGNOSIS](#) under **POWERTRAIN**.

DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	

CONDITION & POSSIBLE CAUSE	CORRECTION
Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing
Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates ⁽¹⁾	Replace Clutch Plates
Wrong Differential Lubricant ⁽¹⁾	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange
(1) Limited slip differential only.	

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble

Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts
Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary
Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL ALIGNMENT article

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts
Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article
Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	
Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	

CONDITION & POSSIBLE CAUSE	CORRECTION
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	
Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	
Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article
Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article

CONDITION & POSSIBLE CAUSE	CORRECTION
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension
Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed too low	Adjust to correct setting
Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article
Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Noise in Steering	

CONDITION & POSSIBLE CAUSE	CORRECTION
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
High Steering Shaft Effort	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	
Sheared shift tube joint	Replace as necessary
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN article
Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**,

DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.

BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT
Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION
Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
Abnormal Tire Wear	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace shock absorbers
Scuffed Tires	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers

CONDITION & POSSIBLE CAUSE	CORRECTION
Frame misalignment	Check frame for damage
Spring Noises	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	
Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to **SUBJECT**, **DIAGNOSTIC**, or **TESTING** articles available in the section(s) you are accessing.

BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section

CONDITION & POSSIBLE CAUSE	CORRECTION
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
Pulls to One Side	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section
Hard Steering	
Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	
Strut rod or control arm bushing worn	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	

CONDITION & POSSIBLE CAUSE	CORRECTION
Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	
Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Camber Not Adjustable	
Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

Article GUID: A00027342

GENERAL INFORMATION

TROUBLE SHOOTING

*** PLEASE READ THIS FIRST ***

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

ENGINE PERFORMANCE

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

TUNE-UP TROUBLE SHOOTING

Problem & Possible Cause	Action
Carbon Fouled Plugs	
Clogged Air Filter	Replace Air Filter
Incorrect Idle Speed	Reset Idle Speed
Faulty Ignition Wiring	Replace Ignition Wiring
Sticky Valves/Worn Valve Seal	Check Valve Train
Fuel Injection Operation	Check Fuel Injection
Wet/Oil Fouled Plugs	
Worn Rings/Pistons	Overhaul/Replace Engine
Excessive Cylinder Wear	Overhaul/Replace Engine
Plug Gap Bridged	
Combustion Chamber Carbon Deposits	Clean Combustion Chamber
Blistered Electrode	
Engine Overheating	Check Cooling System
Loose Spark Plugs	Clean/Torque Plugs
Over-Advanced Timing	Reset Timing
Wrong Plug Heat Range	Install Correct Plug
Melted Electrodes	
Incorrect Timing	Reset Timing
Burned Valves	Replace Valves
Engine Overheating	Check Cooling System
Wrong Plug Heat Range	Install Correct Plug
Engine Won't Start	
Loose Connections	Check Connections
No Power	Check Fuses/Battery
Loose/Worn Timing Belt/Chain/Gears	Check Belt/Chain/Gears

Problem & Possible Cause	Action
Engine Runs Rough	
Leaky/Clogged Fuel Injectors	Repair Fuel Injectors
Leaky/Clogged Fuel Lines	Repair Fuel Lines
Clogged Fuel Filter	Replace Fuel Filter
Incorrect Timing	Reset Timing/Check Advance
Faulty Plugs/Wires	Replace Plugs/Wires
Uneven Compression	Overhaul/Replace Engine
Poor Acceleration	
Incorrect Ignition Timing	Reset Timing
Leaky Valves	Check Compression
Component Failure	
Spark Arcing	Replace Faulty Part
Defective Pick-Up Coil	Replace Pick-Up Coil
Defective Ignition Coil	Replace Ignition Coil
Defective Control Unit	Replace Control Unit
Ignition Diagnosis By Scope Pattern	
All Firing Lines Abnormally High	
Retarded Ignition Timing	Reset Ignition Timing
Lean Air/Fuel Mixture	Adjust Fuel Mixture
High Secondary Resistance	Repair Secondary Ignition
All Firing Lines Abnormally Low	
Rich Air/Fuel Mixture	Adjust Air/Fuel Mixture
Arcing Coil Wire	Replace Coil Wire
Cracked Coil	Replace Coil
Low Coil Output	Replace Coil
Low Compression	Check/Repair Engine
Several High Firing Lines	
Fuel Mixture Unbalanced	Check Fuel System
EGR Valve Stuck Open	Clean/Replace EGR Valve
High Plug Wire Resistance	Replace Plug Wire
Cracked/Broken Plugs	Replace Plugs
Intake Vacuum Leak	Repair Leak
Several Low Firing Lines	
Fuel Mixture Unbalanced	Adjust Fuel Mixture
Plug Wires Arcing	Replace Plug Wires
Cracked Coil Arcing	Replace Coil
Uneven Compression	Check/Repair Engine
Faulty Spark Plugs	Replace Plugs
Cylinders Not Firing	
Cracked Distributor Cap	Replace Cap
Shorted Plug Wires	Replace Plug Wires

Problem & Possible Cause	Action
Mechanical Engine Fault	Check/Repair Engine
Spark Plugs Fouled	Replace Plugs
Carbon Track in Distributor Cap	Replace Cap
Hard Starting	
Defective Ignition Coil(s)	Replace Coil(s)
Fouled Spark Plugs	Replace Plugs
Incorrect Timing	Reset Ignition Timing

NOTE: This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the **ENGINE PERFORMANCE** category.

FUEL INJECTION TROUBLE SHOOTING

Problem & Possible Cause	Action
Cold Start Valve Inoperative	Test Cold Start Valve
Poor Vacuum/Electrical Connection	Repair Connections
Contaminated Fuel	Test Fuel for Water/Alcohol
Bad Fuel Pump Relay/Circuit	Test Relay/Wiring
Battery Voltage Low	Charge/Test Battery
Low Fuel Pressure	Test Press. Regulator/Pump
No Distributor Reference Pulse	Repair Ignition System
Coolant Temp. Sensor Defective	Test Temp. Sensor/Circuit
No Power To Injectors	Check Injector Fuse/Relay
Hard Starting	
Defective Idle Air Control (IAC)	Test IAC and Circuit
EGR Valve Open	Test EGR Valve/Control Circuit
Restricted Fuel Lines	Inspect/Replace Fuel Lines
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Engine Stalls During Parking Maneuver	Check P.S. Press. Switch
Rough Idle	
Dirty Fuel Injectors	Clean/Replace Injectors
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Intermittent Fuel Injector Operation	Check Harness Connectors
Erratic Vehicle Speed Sensor Inputs	Harness Too Close to Plug Wires
Poor O ₂ Sensor Signal	Test O ₂ Sensor/Circuit
Faulty PCV System	Check PCV Valve and Hoses
Poor Acceleration	
Weak Fuel Pump	Replace Fuel Pump
Dirty Fuel Injectors	Clean/Replace Injectors
Excessive Intake Valve Deposits	Clean Intake System
Poor High Speed Operation	

Problem & Possible Cause	Action
Low Fuel Pump Volume	Faulty Fuel Pump/Filter
Poor MAP Sensor Signal	Test Speed Sensor/Circuit
Acceleration Ping/Knock	
Faulty EGR System	Check EGR Valve and Hoses
Poor Knock Sensor Signal	Test Knock Sensor/Circuit
Poor Baro Sensor Signal	Test Baro Sensor/Circuit
Improper Ignition Timing	Adjust Timing
Engine Overheating	Check Cooling System
Poor Quality Fuel	Use Different Fuel
Carbon Build-Up	Decarbon Engine

Article GUID: A00002343

GENERAL INFORMATION

Vehicle Diagnostic Information - Diagnostic Information and Procedures - Volt

DIAGNOSTIC INFORMATION AND PROCEDURES

STRATEGY BASED DIAGNOSIS

The goal of Strategy Based Diagnosis is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnosis steps are numbered, you are not required to complete every step in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be Understand and Verify the Customer's Concern. The final step of your diagnostic process should be to Repair and verify the Fix. Refer to the steps listed below for the correct Strategy Based Diagnosis.

NOTE: For additional information on the following steps refer to the corresponding numbered paragraphs listed below.

1. Understand and verify the customers concern.
2. Verify the vehicle is not operating as designed:
 - **If the vehicle is operating as designed review the suggestions listed below:**
 - Check Identical Vehicle
 - Customer Misunderstanding of System - Explain operation to customer or refer to owners or service manual
 - Customer dissatisfaction - Submit a Field Product Report
 - **If the vehicle is not operating as designed**
3. Perform preliminary checks - Visual inspections and operational
 - **If the customers concern is found, refer to step 7**
 - **If the customers concern is not found**
4. Perform the Diagnostic System Check - Vehicle, determine the diagnostic service category to perform.
 - **If the customers concern is found, refer to step 7**
 - **If the customers concern is not found**
5. Check for related Bulletins, Recalls and Preliminary Information.
 - **If the customers concern is found, refer to step 7**
 - **If the customers concern is not found**
6. Follow the diagnostic path listed below:
 1. Current DTC - Follow DTC Diagnostics
 2. Symptom no DTC - Follow Symptom Diagnostics
 3. No published diagnostic - Analyze and develop diagnostics or call Technical Assistance
 4. Intermittent/History DTC - See diagnostic detail below
7. Isolate the root cause then repair and verify the fix.

8. Re-examine the concern.
 - **If the vehicle is not repaired, refer to step 1**
 - **If the vehicle is repaired**
9. All OK.

Additional Information

1. Understand and Verify the Customer's Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.
2. Vehicle Operating as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Compare with another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of the system to the customer. If the customer is dissatisfied submit a Field Product Report.
3. Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.
4. Perform Published Diagnostic System Check - Vehicle: The [Diagnostic System Check - Vehicle](#) verifies the proper operation of the system. This will lead the technician in an organized approach to diagnostics and identify what category of diagnostic to perform.
5. Check for related Bulletins, Recalls and Preliminary Information (PI).
6. Diagnostic categories:
 1. Current DTC: Follow the designated DTC diagnostic in order to make an effective repair. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 2. Symptom - No DTC: Select the appropriate symptom diagnostic. Follow the diagnostic steps or suggestions in order to complete the repair. Refer to [Symptoms - Vehicle](#).
 3. No Published Diagnostics: Analyze the Concern. Develop a plan for the diagnostics. The service manual schematics will help you to see system power, ground, input, and output circuits. You can also identify splices and other areas where multiple circuits are tied together. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, or corrosives (road salt, battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.
 4. Intermittent/History DTC: An intermittent condition is one that does not occur continuously, may be difficult to duplicate, and will only occur when certain conditions are met. Generally, an intermittent is caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/radio frequency interference, driving conditions, or aftermarket equipment. The following approaches/tools may prove to be beneficial in locating and repairing an intermittent condition or history DTC.
 - Combining technicians knowledge with the available service information.
 - Evaluate the symptoms and conditions described by the customer.

North America - The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be

fixed right the first time. The blank CCVS can be found in GM Global Connect under Service, Service Forms.

- Follow the suggestions on [Testing for Intermittent Conditions and Poor Connections](#) .
 - Use a tool with data capturing capabilities like scan tool, digital multi-meter, or (if available) a vehicle data recorder.
7. Isolate the Root Cause then Repair and Verify Fix: After isolating the root cause, make the repairs and validate for the correct operation by performing the [Diagnostic Repair Verification](#). Verifying that the DTC or symptom has been corrected may involve road testing the vehicle.
 8. Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a re-evaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal condition.

DIAGNOSTIC PROCEDURE INSTRUCTIONS

The following is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

Diagnostic Instructions

A link to the [Diagnostic System Check - Vehicle](#) is provided here. This procedure should be performed prior to performing other diagnostic procedures, as this prevents misdiagnosis where there are integrated system dependencies.

A link to the [Strategy Based Diagnosis](#) is provided here. This provides an overview on how a technician should diagnose a vehicle.

A link to the [Diagnostic Procedure Instructions](#) is provided here. This information is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

DTC Descriptor

Describes what DTCs are diagnosed in this procedure. The DTC number, with Symptom Description when applicable, and descriptor are written out.

Diagnostic Fault Information

The diagnostic Fault Information table identifies each circuit that makes up an electrical subsystem and the associated circuit faults. DTCs and symptoms are listed in the table for all circuit fault modes. This information can be used to diagnose an electrical fault, or as a quick visual aid showing how the different symptoms and DTCs apply for the subsystem being diagnosed.

Even though all the DTCs and symptoms are shown in this table it does not mean they will all be diagnosed in the same procedure.

An example table from an engine coolant temperature (ECT) procedure:

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ECT Sensor Signal	P0117	P0118	P0118	P0125, P0128
ECT Low Reference	-	P0118	P0118	P0125, P0128

Typical Scan Tool Data

The Typical Scan Tool Data table identifies a scan tool data parameter and its value in reference to potential circuit faults.

An example table from an ECT procedure:

ECT Sensor Temperature - PCM

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -32 to +130°C (-26 to +275°F)			
ECT Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)
Low Reference	-	-40°C (-40°F)	-40°C (-40°F)*
* Internal ECM damage may occur if shorted to B+			

Circuit/System Description

Circuit/System Description identifies how a circuit/system normally functions.

Conditions for Running the DTC

Conditions for Running the DTC, identifies what conditions must be present to allow the diagnostic to run.

Conditions for Setting the DTC

Conditions for Setting the DTC, identifies the condition(s) that must be present in order to fail the diagnostic and when to set the DTC.

Action Taken When the DTC Sets

Actions Taken When the DTC sets, identifies the default actions taken when a control module sets a DTC.

Conditions for Clearing the DTC

Conditions for Clearing the DTC, identifies the conditions that must be met in order to clear the DTC.

Diagnostic Aids

Diagnostic Aids are suggestions which explain other methods to diagnose the condition. It also provides unique information about the system used to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information for the diagnostic procedure.

For example:

- Schematic Reference
- Connector End View Reference
- Description and Operation
- Electrical Information Reference

- DTC Type Reference
- Scan Tool Reference
- Special Tools Required

Circuit/System Verification

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, performing the Circuit/System Verification category first, aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

This category also serves to route the technician to other diagnostic procedures which should be performed first; for example, a DTC with a higher priority.

NOTE: Any diagnostic step that asks if a DTC is set is referring to a Set, Current, Present, Active DTC status. This does not include any other DTC status. For example History, Not Run, Passed and Failed.

Circuit/System Verification is a non-intrusive procedure outlining how to verify that a system or a portion of a system is functioning correctly. During the verification process, the vehicle is kept intact and tested as a complete system. This verification is used to assist the technician in determining whether a condition is current or intermittent. When a condition is determined to be intermittent, a technician can use the link in Electrical Information Reference: [Testing for Intermittent Conditions and Poor Connections](#) for additional testing information.

The technician should be able to identify if the fault is occurring on the input circuit - signal or on the output circuit - control when applicable. The technician will need to decide from the verification results if the system is working correctly or if further diagnosis needs to be performed in either Circuit/System Testing and/or Component Testing.

To assist the technician in identifying a common part a component code is used. These codes are not translated so they will always be the same even though the part name may have slight variance. The component codes will always be the same once assigned to a unique part name and will be found on the schematics and in the diagnostic procedure categories Circuit/System Verification, Circuit/System Testing, and Component Testing categories.

Component Codes

The component codes used on the schematics will have the base code with an extension to identify location or quantity. For example the ABS wheel speed sensors are identified on the schematic with a base code (B5) and a location extension (LF, RF, LR, and RR) as seen below:

- B5LF Wheel Speed Sensor (WSS)-Left Front
- B5RF Wheel Speed Sensor (WSS)-Right Front
- B5LR Wheel Speed Sensor (WSS)-Left Rear
- B5RR Wheel Speed Sensor (WSS)-Right Rear

B5 is the base code for the wheel speed sensor and the LF, RF, LR, and RR indicate the on vehicle location.

The diagnostic procedures will use the base code (B5) for a wheel speed sensor but may or may not use the extension identifying location (LF, RF, LR, and RR). Example: Vehicle OFF, disconnect the harness connector at the appropriate B5 wheel speed sensor. This is done so the diagnostic procedure can be common for all four wheel speed sensors and not have to take into account part location or quantity.

Where the diagnostic states "the appropriate" it is up to the technician to identify which component is being diagnosed by the symptom stated on the RO (drivers door lock is inoperative) or by the DTC descriptor (DTC C0585 04: Left Rear Actuator Circuit Open).

Circuit/System Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Circuit/System Testing is a step by step, positive-flow, testing sequence which allows the technician to perform each test step, in sequence, until a fault is detected. If the result of a numbered test step is achieved, the normal flow is to proceed to the next numbered test step (indicated by the down pass arrow). If the result of a numbered test step is NOT achieved, the right repair arrow bullet below the failed test will identify what actions need to take place.

Intrusive diagnostics are performed to locate the system fault. System harness connections are disconnected from the module or component to test individual circuit functions. The module or component will be used to assist in verifying the circuit function. When a test does not pass, the repair steps () will indicate what circuit faults to test for example, short to voltage, short to ground or open/high resistance.

When testing for individual circuit faults, the technician is expected to include terminal inspections such as connection surfaces and terminal tension at both the harness and component/module. Additionally, a technician can use the links in Electrical Information Reference: [Testing for Intermittent Conditions and Poor Connections](#) , or [Circuit Testing](#) for additional information.

The control modules and components will also be diagnosed during these test steps. A retest of a control module or component should always be performed before replacement. For example, re-connect all components and modules and retest the system to verify the condition still exists before replacing modules or components.

Component Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Component Testing can offer static and/or dynamic component tests. These tests can be used to verify if a component is operating correctly to avoid unnecessary replacement.

Testing modules in this category will not be offered. In most cases, the module is used to verify the harness circuits in the Circuit/System Testing category and a retest of the module should always be performed before replacement.

Repair Instructions

Repair Instructions provides a link to [Diagnostic Repair Verification](#). This link describes how to verify the vehicle is repaired.

All links to Repair or Replacement procedures are located here.

Repair Verification

Repair Verification describes how to verify the vehicle is repaired when additional instructions are needed beyond what is in Diagnostic Repair Verification.

DIAGNOSTIC SYSTEM CHECK INSTRUCTIONS

The following is an overview of instructions for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure.

Diagnostic Instructions

A link to [Strategy Based Diagnosis](#) is provided as an overview on how a technician should diagnose a vehicle.

A link to the Diagnostic System Check Instructions is provided. This provides an overview of instructions and examples for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure. The examples in this document are intended to give the technician a general idea of what the test step is referring to. They are not intended to list every possible condition or situation.

Diagnostic Systems Check steps are listed by priority to guide the technician to the appropriate diagnostic procedure to correct the customer concern. There are many ways to determine the priority of diagnosing a vehicle concern. Some faults can cause customer perceived symptoms in areas unrelated to the fault. Using an example from the System Check, after reading DTCs, the technician is asked to verify there are no Electronic Control Unit Internal Performance Faults present. It is important that any internal performance issues are addressed prior to continuing through the System Check. There is no benefit addressing other DTCs that could be set due to an internal fault to a control module. If the fault is present, performing the diagnostic procedure for that fault will likely correct the customer perceived concern and possibly eliminate other DTCs that may be set.

Not all steps of the Diagnostic System Check have to be performed. The Diagnostic System Check tries to prioritize the test steps with the highest priority faults first. The technician is then lead to another document to do the actual diagnosis or repair. The strategy is to repair higher level faults that may be the cause of other system or component level symptoms. Additionally, the Diagnostic System Check can only be used for a single fault at a time. If additional faults are present, the technician must perform the diagnostic system check for each concern until all customer concerns are corrected.

Once a repair has been completed, General Motors diagnostic strategy is to always have the technician verify that the customer concern has been corrected. This is to prevent comebacks and to ensure customer satisfaction with their dealership experience. Therefore a link has been provided to [Diagnostic Repair Verification](#) procedure for the technician to verify the customer concern has been corrected.

There are some assumptions made when General Motors prepares service information. They include the following areas which are presumed to function as designed:

- The 12 V battery is fully charged. General Motors assumes the majority of vehicles brought in for repair

will be able to start and be driven into the service stall. If the vehicle has a dead battery, it is slow cranking or for any other reason the technician feels the customer concern may be battery related, a link is provided to [Battery Inspection/Test](#) . This procedure will guide the technician through inspecting and verifying the battery functions properly.

- Fuses should not be open. General Motors does not call out in diagnostic procedures to verify a fuse. The technician is expected to find an open fuse when the diagnostic test step states to check for an open circuit condition. Therefore a link has been provided to [Power Distribution Schematics](#) , and [Electrical Center Identification Views](#) for technicians to reference power sources and fuse locations if they feel there may be loss of power due to an open fuse condition.
- Ground circuits are clean, tight, and in the correct location. General Motors assumes that the original ground circuits have not been compromised. The technician is expected to find a poor ground connection when the diagnostic test step states to test the ground circuit for an open/high resistance. Therefore a link has been provided to [Ground Distribution Schematics](#) , and [Harness Routing Views](#) for technicians to reference ground locations and which ground circuits may be related to the customer concern.
- All connectors/terminals fully seated in the area of concern. General Motors assumes that all connections are properly installed. The technician is expected to find an open or poor connection when the diagnostic test step asks to test the circuit for an open/high resistance. Therefore a link has been provided to [COMPONENT CONNECTOR END VIEWS - INDEX](#) for technicians to reference which connections may be related to the customer concern.
- There are no aftermarket devices that affect the operation of the system. General Motors can only author diagnostic and repair information for vehicle systems and components that are original equipment or genuine GM Accessories. Aftermarket equipment can negatively affect original equipment operation and lead a technician's diagnosis of a concern in the wrong direction. Therefore a link has been provided to [Checking Aftermarket Accessories](#) that guides a technician through the possible causes of vehicle problems related to aftermarket accessories.
- The scan tool powers up. General Motors assumes that power is available at the Data Link Connector and the scan tool will power on. Therefore a link has been provided to [Scan Tool Does Not Power Up](#) if the technician finds that the scan tool does not power on.

Diagnostic System Check

1. VERIFY CUSTOMER CONCERN - This step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? Review the service history of the vehicle for previous repairs that could help diagnose the current concern.

Now that the technician understands the customer concern, they should validate the concern on the vehicle. In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed. Inspect the visible system components for obvious damage or conditions that could cause the concern. Conduct a thorough visual inspection. Detect unusual sounds or odors.

The condition described by the customer may be normal. If the technician finds the vehicle to operate normally, compare with another like vehicle that is operating normally, under the same conditions described by the customer. If this is the case, explain your findings and the operation of the system to the customer. If the customer is dissatisfied, submit a Field Product Report.

2. BULLETIN SEARCH - By searching for related bulletins, recall/field actions and preliminary information documents, a procedure for a known field issue may resolve the customer concern with little or no diagnosis necessary saving the technician diagnostic time.
3. MECHANICAL CONCERNS - This step is designed to take the technician directly to a list of symptom diagnostic procedures. The technician is asked to verify the symptoms exhibited by the system are mechanical in nature and not related to an electrical system, see some examples below. If the technician feels the concern could be related to an electrical system, they should continue through the Diagnostic System Check to verify the electrical functionality of vehicle. If the technician feels the concern is exclusively related to a mechanical system, a link to [Symptoms - Vehicle](#) is provided to select the appropriate symptom diagnostic procedure for the customer concern.

Examples:

- Brake noise or diagnosing irregular pad wear
 - Water leak diagnosis
 - Engine or transmission fluid leak diagnosis
 - Manual window or door lock diagnosis
 - Vehicle vibration diagnosis
 - Exhaust noise or leak diagnosis
4. VEHICLE POWER UP VERIFICATION - The technician is asked in this step to turn the ignition key ON and verify that the vehicle powers up. The technician should look for clues that multiple vehicle systems are receiving vehicle power mode messages, such as the cluster waking up, the radio powers on, the HVAC blower is operational, windshield wipers turn on, etc, with the key ON. This would be a rare condition as both the power mode master and back-up power mode master would have to be inoperable, however, if the vehicle does not power up, a link to [Power Mode Mismatch](#) is provided.
 5. CONTROL MODULE COMMUNICATION and DTC CHECK - The technician is asked in this step to record the following three pieces of data on the Repair Order; any control module that the scan tool determined is not communicating, any DTC and symptom byte set current or history, and the control module that has set the DTC.

This is considered a setup step for the rest of the Diagnostic System Check. The technician is not expected to do anything other than record the three pieces of data provided by the scan tool on the Repair Order. This provides the information needed to complete the rest of the diagnostic system check.

To complete this step, the technician is asked to utilize the scan tool function called Vehicle DTC Information located in Vehicle Control Systems. This function will query every possible control module on the vehicle requesting all DTCs. During the DTC query, the scan tool will try to establish communication with each control module. If the scan tool can communicate with the control module during the DTC request, it will display PRESENT and provide the number of DTCs set in the control module. If the scan tool cannot communicate with a control module, it will only display NOT COMMUNICATING. Since the scan tool cannot determine if a given control module should be present or not, the technician is asked in a future step to verify that the vehicle was not built with control modules listed as NOT COMMUNICATING.

If the scan tool cannot establish communications with ALL of the vehicles control modules, a link to [Data Link References](#) is provided. A faulty control module or fault with the serial data circuit can cause no communication with all of the control modules on the vehicle. If any control module communicates on

the serial data circuit, continue through the Diagnostic System check, as a future step will address any specific non communicating or group of non communicating control modules.

Once the scan tool has completed the routine, the technician should review each control module that has set a DTC and document them on the Repair Order. When reviewing the DTCs, the technician should take notice if any DTCs are powertrain related, and if so, navigate in the scan tool to the Powertrain area and utilize the Capture Info function. This will upload any Freeze Frame/Failure Records stored in the control module to the scan tool in case the data is lost from the control module. As an example, if the technician commands a Clear DTCs function on a powertrain controller, all diagnostic information stored in the controller is erased. This includes Freeze Frame/Failure Records and Inspection/Maintenance System Status indicators, if required for your region.

6. CONTROL MODULE INTERNAL PERFORMANCE FAULTS - The technician is asked to review the DTCs recorded in step 4 and verify there are no control module internal performance faults set current. This type of fault may be the cause of other symptoms or DTCs displayed by the vehicle. By addressing this fault first, the technician may find the other concerns are resolved. The technician should always follow the diagnostic procedure for these types of faults prior to replacing any control module. If the technician finds a control module has an internal performance fault, a link is provided to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) to select the appropriate DTC diagnostic procedure.

Examples:

- B1000 Electronic Control Unit Performance
- B101D ECU Hardware Performance
- C0550 Electronic Control Unit Performance
- C056D ECU Hardware Performance
- C0570 Auxiliary Electronic Control Unit Performance
- P0606 Control Module Internal Performance
- P0607 Control Module Performance

7. CONTROL MODULE COMMUNICATION VERIFICATION - This step is used to ensure the control modules that are NOT COMMUNICATING were not built on the vehicle. To understand if the vehicle was built with that option, we provide a link to the [Data Link References](#) , document where Regular Production Options (RPOs) are listed next to ECU names and can be compared to those the vehicle was built with. If the technician determines that a control that is NOT COMMUNICATING should be present, the technician is asked to follow the appropriate diagnostic procedure listed in the [Data Link References](#) document.

8. COMMUNICATION and POWER MODE FAULTS - This step is asking the technician to look for communication DTCs or DTCs related to control modules powering up based on power mode, communication enable or wake-up circuits. See in the below table some examples of the DTCs the technician should diagnose prior to continuing through the Diagnostic System Check. The technician should review the list of DTCs recorded in step 4 and verify that none of these type of DTCs are present. If so, the technician is referred to the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) to select the appropriate DTC diagnostic procedure.

Examples:

- U0140 Lost Communication With Body Control Module

- U0164 Lost Communication With HVAC Control Module
- U0170 Lost Communication With Passenger Presence Detection Module
- U0402 Invalid Data Received From Transmission Control Module
- U0452 Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
- U1814 Powertrain High Speed Communication Enable Circuit
- B1428 Ignition Switched Power Run/Crank Relay Circuit
- B137B Accessory Power Module Wake Up Circuit
- C0897 Control Module Power Moding
- P2536 Ignition Accessory Switch Circuit

9. **POWER MODE VERIFICATION** - This step verifies the Power Mode Master is receiving the proper output state of the push button switch. The technician should use the main power mode input, which is the push button switch. The test should not be performed using a key fob, if the MIL is illuminated the powertrain controller may disable this input. The technician is asked to perform the test with the driver door open. This ensures the retained accessory power mode is inactive during this test which could result in different scan tool readings. The technician is only asked to verify the current Power Mode parameter in the power mode data display list. If the parameter does not match the actual vehicle power mode state, a link is provided to perform the [Power Mode Mismatch](#) diagnostic procedure.

10. **REMAINING DTC REVIEW** - Here the technician is asked to review any remaining DTCs that were not addressed in previous steps. The technician is asked first to verify there are no control module supply voltage, system voltage or 5 V circuit DTCs present. Control modules, systems or components with insufficient or zero voltage can cause one or multiple symptoms to exist on the vehicle. Control module voltage issues could also be the cause of failures during a programming event. The technician should correct voltage issues prior to addressing any programming or configuration DTCs. The technician should then check for any ECU programming, setup or configuration DTCs. By programming software or configuring a control module, the technician could correct the customer concern unobtrusively. The remaining DTCs, which are usually specific system or component faults, are diagnosed last. They can include ECU input and output circuit DTCs or individual circuit faults that usually cause single symptoms or failure modes on the vehicle and can be fixed following the proper DTC diagnostic procedure. In general, the technician should think about what DTCs or faults could be caused by another DTC or fault. A failed sensor may set a component DTC and then the system may set a DTC indicating the system cannot operate properly. By correcting the sensor fault, the system may now operate properly and the system level DTC will transition to history. Refer to the examples within each category below to understand the differences between these DTCs. If DTCs of these type are current, the technician is referred to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) to choose the correct DTC diagnostic procedure.

1. Voltage DTCs

- B1325 Device Power 1 Circuit
- C0875 Device Voltage Reference Input 2 Circuit
- C1001 Adaptive Cruise Control Indicators Supply Voltage Circuit
- P0641 5 V Reference Circuit
- P0787 Downshift Timing Solenoid Control Circuit Low Voltage

2. Programming, Setup, Configuration or Software Performance DTCs

- B3943 Steering Column Lock has Not Learned Column Integration Module

- B101E ECU Software Performance
- B1019 System Configuration Error
- C0558 Calibration Data Not Programmed
- P0630 VIN Not Programmed or Mismatched - Powertrain Control Module (PCM)

3. Component related DTCs

- B0013 Driver Frontal Deployment Loop Stage 2
- B0163 Passenger Compartment Temp Sensor Circuit
- C0045 Left Rear Wheel Speed Sensor Circuit
- P0565 Cruise Control Switch Circuit
- P0751 1-2 Shift Solenoid (SS) Valve Performance

4. System related DTCs

- B1010 System Sensors Data Mismatch
- C0176 System Thermal Error
- C0561 System Disabled Information Stored
- P1564 Vehicle Acceleration Too High - Cruise Control Disabled
- P1625 Transmission Control Module (TCM) System Reset

5. Any other remaining DTCs - The technician should diagnose and correct any other DTCs that are left that were not from the categories above.

11. EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS - Several regions require that a vehicle pass on-board diagnostic system tests and the inspection/maintenance emission tests in order to renew license plates or vehicle registration. This is accomplished by viewing the Inspection/Maintenance System Status display on a scan tool. Using a scan tool, the technician can observe the Inspection/Maintenance System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements. If inspection and maintenance checks are required in your region, and the customer concern is related to not passing an Inspection/Maintenance test, a link is provided to [Inspection/Maintenance System Check](#) where the technician can choose the appropriate Inspection/Maintenance System Check for the actual engine application being used.
12. SYMPTOM DIAGNOSIS - At this step, the diagnostics are assuming that the only information the technician has available to diagnose the customer concern are symptoms of a problem. There are no DTCs set current or history. There may be a Driver Information Center display message or a system indicator to aid in identifying the root cause. The technician should evaluate the symptoms and conditions described by the customer and perform the symptoms diagnostics for the area of customer concern. A link is provided to [Symptoms - Vehicle](#) which contains a list of all symptoms related to this service manual publication.

DIAGNOSTIC STARTING POINT - VEHICLE

Begin the system diagnosis with [Diagnostic System Check - Vehicle](#). The Diagnostic System Check - Vehicle will provide a complete strategy to locate and repair a mechanical or electrical vehicle fault. Not following this strategy may cause additional diagnostic time and/or misdiagnosis.

The Diagnostic System Check - Vehicle will provide the following strategy:

- When to verify the customer concern and identify related bulletins, recalls and preliminary information

- When to identify a control module that is not communicating, a control module that has set a DTC, and the DTC diagnostic priority
- When to address power mode concerns
- When to verify the engine cranks and runs
- When to diagnose symptom related concerns

DIAGNOSTIC SYSTEM CHECK - VEHICLE

Diagnostic Instructions

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic System Check Instructions](#) to provide an overview of each diagnostic category.
- Continue through the Diagnostic System Check until you are directed to follow a particular diagnostic or repair procedure. Once a repair has been completed, perform the [Diagnostic Repair Verification](#) and verify the customer concern has been corrected.

The diagnostic procedures within this manual are developed on the assumption that the following areas function as designed:

- The 12 V battery is fully charged and cables are clean and tight. Refer to [Battery Inspection/Test](#) .
- Fuses are not open. Refer to [Power Distribution Schematics](#) , and [Electrical Center Identification Views](#) .
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to [Ground Distribution Schematics](#) , and [Harness Routing Views](#) .
- All connectors/terminals fully seated in the area of concern. Refer to [COMPONENT CONNECTOR END VIEWS - INDEX](#) .
- There are no aftermarket devices that affect the operation of the system. Refer to [Checking Aftermarket Accessories](#) .
- The scan tool powers up. Refer to [Scan Tool Does Not Power Up](#) .

Diagnostic System Check

1. **VERIFY CUSTOMER CONCERN** - Understand and validate the customer concern. Inspect the visible system components for obvious damage or conditions that may cause the concern.
2. **BULLETIN SEARCH** - Check for related bulletins, recalls/field actions, and preliminary information.
3. **MECHANICAL CONCERNS** - Verify the symptom is not exclusively a mechanical concern.

- **If the symptom is exclusively a mechanical concern**

Refer to [Symptoms - Vehicle](#).

- **If the symptom is not a mechanical concern**

NOTE: Do not clear any DTCs unless instructed to do so by a diagnostic procedure. If any DTC is Powertrain related, select Capture Info to store DTC and Freeze Frame/Failure Records to the scan tool.

4. **VEHICLE POWER UP VERIFICATION** - Vehicle in Service Mode, verify the vehicle powers up.

- **If the vehicle does not power up**

Refer to [Power Mode Mismatch](#) .

- **If the vehicle powers up**

5. **CONTROL MODULE COMMUNICATION and DTC CHECK** - Using a scan tool, perform the Vehicle DTC Information function and verify at least one control module communicates with the scan tool. Record on the Repair Order the following information:

- Any control module that is not communicating.
- Any DTC, including symptom byte, and the control module that has set the DTC.
- **If the scan tool does not communicate with any control module on the vehicle**

Refer to [Data Link References](#) .

- **If the scan tool communicates with any control module**

6. **CONTROL MODULE INTERNAL PERFORMANCE FAULTS** - Verify there is no current control module Internal Performance DTCs set.

- **If any DTC of this type is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If no DTC of this type is set**

7. **CONTROL MODULE COMMUNICATION VERIFICATION** - Verify the vehicle is not built with any control module listed as not communicating with the scan tool; refer to [Data Link References](#) .

- **If the vehicle is built with a control module that is not communicating**

Refer to [Data Link References](#) .

- **If all control modules the vehicle is built with are communicating**

8. **COMMUNICATION and POWERMODE FAULTS** - Verify there are no current control module Power Mode or Communication DTCs set.

- **If any DTC of this type is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If no DTC of this type is set**

NOTE: The electric propulsion system will be active in the vehicle ON state during this test. Ensure the vehicle is out of gear and the parking brake is applied. Turn the vehicle power mode to vehicle OFF as soon as the vehicle ON power mode parameter has been observed.

9. **POWER MODE VERIFICATION** - Driver door open, observe the scan tool Power Mode parameter while cycling the push button switch through all the power modes. Verify the current Power Mode parameter matches the actual vehicle power mode states.

- **If the Power Mode parameter does not match the vehicle power mode states**

Refer to [Power Mode Mismatch](#) .

- **If the Power Mode parameter matches the vehicle power mode states**

10. **REMAINING DTC REVIEW** - Verify there are no other DTCs set.

- **If other DTCs are set**

Diagnose them in the order listed below. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

1. Voltage DTCs
2. Programming, Setup or Configuration or Software Performance DTCs
3. Component related DTCs
4. System related DTCs
5. Any remaining DTCs

- **If no other DTCs are set**

11. **EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS** - If inspection and maintenance checks are required in your region, verify the customer concern is not related to inspection/maintenance testing.

- **If the customer concern is related to inspection/maintenance testing**

Refer to [Inspection/Maintenance System Check](#).

- **If the customer concern is not related to inspection/maintenance testing**

12. **SYMPTOM DIAGNOSIS** - Diagnose any remaining customer concern. Refer to [Symptoms - Vehicle](#).

POWERTRAIN DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

Emissions Related DTCs

Action Taken When the DTC Sets - Type A

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Action Taken When the DTC Sets - Type B

- The control module illuminates the MIL on the second or third consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.
- The following applies to misfire DTCs - North America Emissions Only:
 - If the control module detects a low level or an emission level misfire condition during 2 consecutive trips, the control module illuminates the MIL.

- If the control module detects a high level or catalyst damaging misfire, the control module flashes the MIL at a rate of once per second.
- If the control module detects a misfire during 2 non-consecutive trips, the stored conditions are compared with the current conditions. The control module illuminates the MIL when the following conditions occur:
 - The engine load is within 20 percent of the previous test that failed.
 - The engine speed is within 375 RPM of the previous test that failed.
 - The engine coolant temperature is in the same range of the previous test that failed.
- The following applies to fuel trim DTCs - North America Emissions Only:
 - If the control module detects a fuel trim condition during 2 consecutive trips, the control module illuminates the MIL.
 - If the control module detects a fuel trim condition during 2 non-consecutive trips, the stored conditions are compared with the current conditions. The control module illuminates the MIL when the following conditions occur:
 - The engine load is within 20 percent of the previous test that failed.
 - The engine speed is within 375 RPM of the previous test that failed.
 - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC - Type A or Type B

- The control module turns OFF the MIL after 3 or 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles. The Drive Cycle consist of the following requirements:
 - Propulsion System Active.
 - Engine Idling for greater than 30 sec.
 - Vehicle Speed is greater than 25 MPH (40 KPH) for greater than 5 min.
 - Engine operating for greater than 10 min.
- Clear the MIL and the DTC with a scan tool.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The MIL will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC - Type C

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles. The drive cycle consist of the following requirements:

- Propulsion System Active.
- Engine Idling for greater than 30 sec.
- Vehicle Speed is greater than 25 MPH (40 KPH) for greater than 5 min.
- Engine operating for greater than 10 min.
- Clear the DTC with a scan tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST - VEHICLE

This master list includes all applicable diagnostic trouble codes in alphanumeric order.

DTC	Diagnostic Procedure
B0012	Supplemental Restraints - DTC B0012 or B0013
B0013	Supplemental Restraints - DTC B0012 or B0013
B0014	Supplemental Restraints - DTC B0014, B0021, B0031, or B0038
B0015	Supplemental Restraints - DTC B0015, B001A, B001B, or B0022
B0016	Supplemental Restraints - DTC B0016, B0018, B0023, or B0025
B0017	Supplemental Restraints - DTC B0017 or B0024
B0018	Supplemental Restraints - DTC B0016, B0018, B0023, or B0025
B0019	Supplemental Restraints - DTC B0019 or B0020
B001A	Supplemental Restraints - DTC B0015, B001A, B001B, or B0022
B001B	Supplemental Restraints - DTC B0015, B001A, B001B, or B0022
B0020	Supplemental Restraints - DTC B0019 or B0020
B0021	Supplemental Restraints - DTC B0014, B0021, B0031, or B0038
B0022	Supplemental Restraints - DTC B0015, B001A, B001B, or B0022
B0023	Supplemental Restraints - DTC B0016, B0018, B0023, or B0025
B0024	Supplemental Restraints - DTC B0017 or B0024
B0025	Supplemental Restraints - DTC B0016, B0018, B0023, or B0025
B0031	Supplemental Restraints - DTC B0014, B0021, B0031, or B0038
B0038	Supplemental Restraints - DTC B0014, B0021, B0031, or B0038
B0052	Supplemental Restraints - DTC B0052
B0072	Seat Belts - DTC B0072 or B0073
B0073	Seat Belts - DTC B0072 or B0073
B0074	Supplemental Restraints - DTC B0074
B0081	Supplemental Restraints - DTC B0081
B0083	Supplemental Restraints - DTC B0083 or B0084
B0084	Supplemental Restraints - DTC B0083 or B0084
B0085	Supplemental Restraints - DTC B0085 or B0088
B0086	Supplemental Restraints - DTC B0086 or B0087
B0087	Supplemental Restraints - DTC B0086 or B0087
B0088	Supplemental Restraints - DTC B0085 or B0088
B010E	Horns and Pedestrian Alerts - DTC B010E
B0158	Displays and Gauges - DTC B0158
B0163	HVAC - Automatic - DTC B0163

DTC	Diagnostic Procedure
B0173	HVAC - Automatic - <u>DTC B0173 or B0178</u>
B0178	HVAC - Automatic - <u>DTC B0173 or B0178</u>
B0183	HVAC - Automatic - <u>DTC B0183</u>
B018A	HVAC - Automatic - <u>DTC B018A, B048C, B048E, or B1395</u>
B0193	HVAC - Automatic - <u>DTC B0193</u>
B0223	HVAC - Automatic - <u>DTC B0223, B0233, B023A, or B0408</u>
B0233	HVAC - Automatic - <u>DTC B0223, B0233, B023A, or B0408</u>
B023A	HVAC - Automatic - <u>DTC B0223, B0233, B023A, or B0408</u>
B0283	Fixed and Moveable Windows - <u>DTC B0283</u>
B0408	HVAC - Automatic - <u>DTC B0223, B0233, B023A, or B0408</u>
B048C	HVAC - Automatic - <u>DTC B018A, B048C, B048E, or B1395</u>
B048E	HVAC - Automatic - <u>DTC B048E</u>
B048F	HVAC - Automatic - <u>DTC B018A, B048C, B048E, or B1395</u>
B0550	Displays and Gauges - <u>DTC B0550</u>
B059A	Seat Belts - <u>DTC B059A</u>
B067F	Supplemental Restraints - <u>DTC B067F or B0680</u>
B0680	Supplemental Restraints - <u>DTC B067F or B0680</u>
B071F	Displays and Gauges - <u>DTC B071F</u>
B094B	Object Detection and Pedestrian Protection - <u>DTC B094B or B094C</u>
B094C	Object Detection and Pedestrian Protection - <u>DTC B094B or B094C</u>
B0954	Object Detection and Pedestrian Protection - <u>DTC B0954, B0955, B0956, or B0957</u>
B0955	Object Detection and Pedestrian Protection - <u>DTC B0954, B0955, B0956, or B0957</u>
B0956	Object Detection and Pedestrian Protection - <u>DTC B0954, B0955, B0956, or B0957</u>
B0957	Object Detection and Pedestrian Protection - <u>DTC B0954, B0955, B0956, or B0957</u>
B0958	Object Detection and Pedestrian Protection - <u>DTC B0958, B0959, B0960, or B0961</u>
B0959	Object Detection and Pedestrian Protection - <u>DTC B0958, B0959, B0960, or B0961</u>
B0960	Object Detection and Pedestrian Protection - <u>DTC B0958, B0959, B0960, or B0961</u>
B0961	Object Detection and Pedestrian Protection - <u>DTC B0958, B0959, B0960, or B0961</u>
B0967	Object Detection and Pedestrian Protection - <u>DTC B0967 or B0968</u>
B0968	Object Detection and Pedestrian Protection - <u>DTC B0967 or B0968</u>
B096B	Object Detection and Pedestrian Protection - <u>DTC B096B</u>
B096C	Object Detection and Pedestrian Protection - <u>DTC B096C or B096D</u>
B096D	Object Detection and Pedestrian Protection - <u>DTC B096C or B096D</u>
B097B	Wiring Systems and Power Management - <u>DTC B097B DTC B097B</u>
B097C	Wiring Systems and Power Management - <u>DTC B097C</u>
B0987	Object Detection and Pedestrian Protection - <u>DTC B0987</u>
B0997	Cellular, Entertainment, and Navigation - <u>DTC B0997</u>
B1000	Data Communications - <u>DTC B1000</u>
B1001	Data Communications - <u>DTC B1001</u>
B1001	Supplemental Restraints - <u>DTC B1001 (Inflatable Restraint Sensing and Diagnostic Module) DTC B1001 (Passenger Presence System)</u>

DTC	Diagnostic Procedure
B1011	Object Detection and Pedestrian Protection - <u>DTC B1011</u>
B1015	Object Detection and Pedestrian Protection - <u>DTC B1015</u>
B1016	Data Communications - <u>DTC B1016</u>
B1019	Supplemental Restraints - <u>DTC B1019</u>
B101D	Data Communications - <u>DTC B101D</u>
B101E	Data Communications - <u>DTC B101E</u>
B1024	Cellular, Entertainment, and Navigation - <u>DTC B1024 (Audio Amplifier)</u> <u>DTC B1024 (Human Machine Interface Control Module)</u>
B1025	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1026	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1027	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1028	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1029	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1030	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1031	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1032	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1033	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1034	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1035	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1036	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1037	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1038	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1039	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1040	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1041	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1042	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1043	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1044	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1045	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1046	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1047	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1048	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1049	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1050	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1051	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1052	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1053	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1054	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1055	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1056	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1057	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>

DTC	Diagnostic Procedure
B1058	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1059	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1060	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1061	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1062	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1063	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1064	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1065	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1066	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1067	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1068	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1069	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1070	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1071	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1072	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1073	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1074	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1075	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1085	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1095	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B1105	Cellular, Entertainment, and Navigation - <u>DTC B1025-B1135</u>
B124B	Cellular, Entertainment, and Navigation - <u>DTC B124B</u>
B124F	Cellular, Entertainment, and Navigation - <u>DTC B124F</u>
B124F	Displays and Gauges - <u>DTC B124F</u>
B125A	Cellular, Entertainment, and Navigation - <u>DTC B125A</u>
B125C	Cellular, Entertainment, and Navigation - <u>DTC B125C</u>
B1271	Cellular, Entertainment, and Navigation - <u>DTC B1271</u>
B127B	Object Detection and Pedestrian Protection - <u>DTC B127B</u>
B127E	Cellular, Entertainment, and Navigation - <u>DTC B127E</u>
B12A8	Cellular, Entertainment, and Navigation - <u>DTC B12A8</u>
B1325	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
B1330	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
B1370	Wiring Systems and Power Management - <u>DTC B1370</u>
B1395	Lighting - <u>DTC B1395</u>
B1395	HVAC - Automatic - <u>DTC B018A, B048C, B048E, or B1395</u>
B1405	Object Detection and Pedestrian Protection - <u>DTC B1405</u>
B1446	Cellular, Entertainment, and Navigation - <u>DTC B1446 or B1447</u>
B1447	Cellular, Entertainment, and Navigation - <u>DTC B1446 or B1447</u>
B144A	Wiring Systems and Power Management - <u>DTC B144A</u>

DTC	Diagnostic Procedure
B144B	Wiring Systems and Power Management - <u>DTC B144B</u>
B1451	Wiring Systems and Power Management - <u>DTC B1451</u>
B1474	Vehicle Access - <u>DTC B1474 or B3849</u>
B1480	Lighting - <u>DTC B1480</u>
B1516	12 V Starting and Charging - <u>DTC B1516</u>
B1517	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
B151A	12 V Starting and Charging - <u>DTC B151A</u>
B1527	12 V Starting and Charging - <u>DTC B1527</u>
B1534	Vehicle Access - <u>DTC B1534 or B1535</u>
B1535	Vehicle Access - <u>DTC B1534 or B1535</u>
B191A	Seat Heating and Cooling - <u>DTC B191A or B191B</u>
B191B	Seat Heating and Cooling - <u>DTC B191A or B191B</u>
B2455	Cellular, Entertainment, and Navigation - <u>DTC B2455</u>
B2462	Cellular, Entertainment, and Navigation - <u>DTC B2462</u>
B2470	Cellular, Entertainment, and Navigation - <u>DTC B2470</u>
B2476	Cellular, Entertainment, and Navigation - <u>DTC B2476 or B2482</u>
B2482	Cellular, Entertainment, and Navigation - <u>DTC B2476 or B2482</u>
B2545	Lighting - <u>DTC B2545</u>
B255D	Lighting - <u>DTC B255D</u>
B2570	Lighting - <u>DTC B2570</u>
B2575	Lighting - <u>DTC B2575 or B2699</u>
B257A	Lighting - <u>DTC B257A</u>
B2580	Lighting - <u>DTC B2580</u>
B2585	Lighting - <u>DTC B2585 or B3867</u>
B2600	Lighting - <u>DTC B2600 or B2605</u>
B2605	Lighting - <u>DTC B2600 or B2605</u>
B2610	Lighting - <u>DTC B2610</u>
B2615	Lighting - <u>DTC B2615</u>
B2625	Lighting - <u>DTC B2625</u>
B2699	Lighting - <u>DTC B2575 or B2699</u>
B270A	Shift Lock Control - <u>DTC B270A</u>
B2745	Antilock Brake System - <u>DTC B2745</u>
B274E	Horns - <u>DTC B274E or B274F</u>
B274F	Horns - <u>DTC B274E or B274F</u>
B291A	Theft Deterrent - <u>DTC B291A</u>
B291B	Theft Deterrent - <u>DTC B291B</u>
B2955	Immobilizer - <u>DTC B2955</u>
B297B	Vehicle Access - <u>DTC B297B or B297C</u>
B297C	Vehicle Access - <u>DTC B297B or B297C</u>
B3006	Bolted Exterior Body Panels and Closures - <u>DTC B3006</u>

DTC	Diagnostic Procedure
B302A	Immobilizer - <u>DTC B302A</u>
B3031	Immobilizer - <u>DTC B3031</u>
B3055	Immobilizer - <u>DTC B3055</u>
B305C	Immobilizer - <u>DTC B305C</u>
B305D	Remote Functions - <u>DTC B305D</u>
B305E	Wiring Systems and Power Management - <u>DTC B305E</u>
B3060	Immobilizer - <u>DTC B3060</u>
B3101	Remote Functions - <u>DTC B3101</u>
B3105	Remote Functions - <u>DTC B3105</u>
B3106	Remote Functions - <u>DTC B3106</u>
B3109	Remote Functions - <u>DTC B3109-B3113</u>
B310D	Remote Functions - <u>DTC B310D-B310F</u>
B310E	Remote Functions - <u>DTC B310D-B310F</u>
B310F	Remote Functions - <u>DTC B310D-B310F</u>
B3110	Remote Functions - <u>DTC B3109-B3113</u>
B3111	Remote Functions - <u>DTC B3109-B3113</u>
B3112	Remote Functions - <u>DTC B3109-B3113</u>
B3113	Remote Functions - <u>DTC B3109-B3113</u>
B3119	Remote Functions - <u>DTC B3119</u>
B3120	Remote Functions - <u>DTC B3120</u>
B3121	Remote Functions - <u>DTC B3121</u>
B3122	Remote Functions - <u>DTC B3122</u>
B3123	Remote Functions - <u>DTC B3123</u>
B3124	Remote Functions - <u>DTC B3124</u>
B3125	Vehicle Access - <u>DTC B3125, B3130, or B3135</u>
B3130	Vehicle Access - <u>DTC B3125, B3130, or B3135</u>
B3135	Vehicle Access - <u>DTC B3125, B3130, or B3135</u>
B3140	Vehicle Access - <u>DTC B3140, B3145, B3150, or B3155</u>
B3145	Vehicle Access - <u>DTC B3140, B3145, B3150, or B3155</u>
B3150	Vehicle Access - <u>DTC B3140, B3145, B3150, or B3155</u>
B3155	Vehicle Access - <u>DTC B3140, B3145, B3150, or B3155</u>
B316B	Fixed and Moveable Windows - <u>DTC B316B, B317A, B318A, or B319A</u>
B317A	Fixed and Moveable Windows - <u>DTC B316B, B317A, B318A, or B319A</u>
B318A	Fixed and Moveable Windows - <u>DTC B316B, B317A, B318A, or B319A</u>
B319A	Fixed and Moveable Windows - <u>DTC B316B, B317A, B318A, or B319A</u>
B3205	Fixed and Moveable Windows - <u>DTC B3205</u>
B3265	Vehicle Access - <u>DTC B3265</u>
B356A	Object Detection and Pedestrian Protection - <u>DTC B356A</u>
B3596	Lighting - <u>DTC B3596</u>
B3600	Lighting - <u>DTC B3600</u>
B3618	Vehicle Access - <u>DTC B3618</u>

DTC	Diagnostic Procedure
B3622	Secondary and Configurable Customer Controls - <u>DTC B3622</u>
B3650	Lighting - <u>DTC B3650</u>
B3715	Wipers and Washers - <u>DTC B3715</u>
B371A	Wipers and Washers - <u>DTC B371A</u>
B371C	Wipers and Washers - <u>DTC B371C</u>
B3794	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
B3806	Lighting - <u>DTC B3806</u>
B3844	HVAC - Automatic - <u>DTC B3844</u>
B3849	Vehicle Access - <u>DTC B1474 or B3849</u>
B3867	Lighting - <u>DTC B2585 or B3867</u>
B3873	Wipers and Washers - <u>DTC B3873</u>
B3881	Lighting - <u>DTC B3881 or B3882</u>
B3882	Lighting - <u>DTC B3881 or B3882</u>
B3883	Lighting - <u>DTC B3883</u>
B3884	Lighting - <u>DTC B3884</u>
B389A	Immobilizer - <u>DTC B389A</u>
B3902	Immobilizer - <u>DTC B3902</u>
B390D	Object Detection and Pedestrian Protection - <u>DTC B390D</u>
B3924	Immobilizer - <u>DTC B3924-B3928</u>
B3925	Immobilizer - <u>DTC B3924-B3928</u>
B3926	Immobilizer - <u>DTC B3924-B3928</u>
B3927	Immobilizer - <u>DTC B3924-B3928</u>
B3928	Immobilizer - <u>DTC B3924-B3928</u>
B3935	Immobilizer - <u>DTC B3935</u>
B3948	Lighting - <u>DTC B3948 or B3949</u>
B3949	Lighting - <u>DTC B3948 or B3949</u>
B3950	Lighting - <u>DTC B3950 or B3951</u>
B3951	Lighting - <u>DTC B3950 or B3951</u>
B3976	Immobilizer - <u>DTC B3976</u>
B3978	Immobilizer - <u>DTC B3978-B3982</u>
B3979	Immobilizer - <u>DTC B3978-B3982</u>
B3980	Immobilizer - <u>DTC B3978-B3982</u>
B3981	Immobilizer - <u>DTC B3978-B3982</u>
B3982	Immobilizer - <u>DTC B3978-B3982</u>
B3984	Immobilizer - <u>DTC B3984</u>
C0010	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0011	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0012	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0013	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0014	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>

DTC	Diagnostic Procedure
C0015	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0016	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0017	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0018	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0019	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C001C	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C001D	Antilock Brake System - <u>DTC C0010-C0019, C001C, or C001D</u>
C0051	Antilock Brake System <u>DTC C0051</u>
C006B	Antilock Brake System - <u>DTC C006B</u>
C0075	Hydraulic Brakes - <u>DTC C0075</u>
C0176	Power Steering - <u>DTC C0176</u>
C0186	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C018B	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C0196	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C019B	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C0277	Lighting - <u>DTC C0277 or C0890</u>
C027E	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C0287	Antilock Brake System - <u>DTC C0186, C018B, C0196, C019B, C027E, or C0287 (with UGN)</u>
C0297	Lighting - <u>DTC C0297</u>
C0460	Power Steering - <u>DTC C0460</u>
C0475	Power Steering - <u>DTC C0475</u>
C0500	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0501	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0502	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0503	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0504	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0506	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0507	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0508	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0509	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0510	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0512	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0513	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0514	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C0515	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>

DTC	Diagnostic Procedure
C0516	Antilock Brake System - <u>DTC C0500-C0504, C0506-C0510, or C0512-C0516</u>
C052B	Antilock Brake System - <u>DTC C052B, C052D, C052F, C055B, or C05AE</u>
C052D	Antilock Brake System - <u>DTC C052B, C052D, C052F, C055B, or C05AE</u>
C052F	Antilock Brake System - <u>DTC C052B, C052D, C052F, C055B, or C05AE</u>
C0545	Power Steering - <u>DTC C0545</u>
C0552	Antilock Brake System - <u>DTC C0552, C10C0, C10C4, or C1251 (Without UGN)</u>
C0555	Antilock Brake System - <u>DTC C0555-C0558</u>
C0556	Antilock Brake System - <u>DTC C0555-C0558</u>
C0557	Antilock Brake System - <u>DTC C0555-C0558</u>
C0558	Antilock Brake System - <u>DTC C0555-C0558</u>
C055B	Antilock Brake System - <u>DTC C052B, C052D, C052F, C055B, or C05AE</u>
C055C	Power Steering - <u>DTC C055C</u>
C0560	Antilock Brake System - <u>DTC C059B or C0560</u>
C0569	Power Steering - <u>DTC C0569</u>
C0569	Tire Pressure Monitoring - <u>DTC C0569</u>
C056D	Data Communications - <u>DTC C056D</u>
C056D	Power Steering - <u>DTC C056D (Power Steering Control Module)</u>
C056E	Data Communications - <u>DTC C056E</u>
C056E	Power Steering - <u>DTC C056E</u>
C0571	Antilock Brake System - <u>DTC C0571, C0572, or C0574</u>
C0572	Antilock Brake System - <u>DTC C0571, C0572, or C0574</u>
C0574	Antilock Brake System - <u>DTC C0571, C0572, or C0574</u>
C0575	Antilock Brake System - <u>DTC C0575, C0576, or C0578</u>
C0576	Antilock Brake System - <u>DTC C0575, C0576, or C0578</u>
C0578	Antilock Brake System - <u>DTC C0575, C0576, or C0578</u>
C0579	Hydraulic Brakes - <u>DTC C0579, C057A, or C057E</u>
C057A	Hydraulic Brakes - <u>DTC C0579, C057A, or C057E</u>
C057E	Hydraulic Brakes - <u>DTC C0579, C057A, or C057E</u>
C057F	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C0580	Hydraulic Brakes - <u>DTC C0580 or C0594</u>
C0582	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C058A	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C0590	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C0591	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C0594	Hydraulic Brakes - <u>DTC C0580 or C0594</u>

DTC	Diagnostic Procedure
C0595	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C0596	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C059B	Antilock Brake System - <u>DTC C059B or C0560</u>
C05A3	Antilock Brake System - <u>DTC C05A3, C05A4, or C10EE</u>
C05A4	Antilock Brake System - <u>DTC C05A3, C05A4, or C10EE</u>
C05AD	Antilock Brake System - <u>DTC C05AD</u>
C05AE	Antilock Brake System - <u>DTC C052B, C052D, C052F, C055B, or C05AE</u>
C05B0	Antilock Brake System - <u>DTC C05B0 or C05B1</u>
C05B1	Antilock Brake System - <u>DTC C05B0 or C05B1</u>
C05B2	Antilock Brake System - <u>DTC C05B2</u>
C0750	Tire Pressure Monitoring - <u>DTC C0750, C0755, C0760, or C0765</u>
C0755	Tire Pressure Monitoring - <u>DTC C0750, C0755, C0760, or C0765</u>
C0760	Tire Pressure Monitoring - <u>DTC C0750, C0755, C0760, or C0765</u>
C0765	Tire Pressure Monitoring - <u>DTC C0750, C0755, C0760, or C0765</u>
C0775	Tire Pressure Monitoring - <u>DTC C0775</u>
C0800	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
C0890	Lighting - <u>DTC C0277 or C0890</u>
C0899	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
C0900	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
C106A	Antilock Brake System - <u>DTC C106A or C106B</u>
C106B	Antilock Brake System - <u>DTC C106A or C106B</u>
C106D	Antilock Brake System - <u>DTC C106D-C106F or C1070</u>
C106E	Antilock Brake System - <u>DTC C106D-C106F or C1070</u>
C106F	Antilock Brake System - <u>DTC C106D-C106F or C1070</u>
C1070	Antilock Brake System - <u>DTC C106D-C106F or C1070</u>
C1072	Hydraulic Brakes - <u>DTC C1072</u>
C10AC	Antilock Brake System - <u>DTC C10AC</u>
C10C0	Antilock Brake System - <u>DTC C0552, C10C0, C10C4, or C1251 (Without UGN)</u>
C10C4	Antilock Brake System - <u>DTC C0552, C10C0, C10C4, or C1251 (Without UGN)</u>
C10EA	Antilock Brake System - <u>DTC C10EA</u>
C10EB	Antilock Brake System - <u>DTC C10EB</u>
C10EE	Antilock Brake System - <u>DTC C05A3, C05A4, or C10EE</u>
C111C	Hydraulic Brakes - <u>DTC C111C</u>
C112B	Antilock Brake System - <u>DTC C112B</u>
C112F	Antilock Brake System - <u>DTC C112F</u>
C1138	Park Brake - <u>DTC C1138</u>

DTC	Diagnostic Procedure
C1148	Park Brake - <u>DTC C1148</u>
C114C	Park Brake - <u>DTC C114C</u>
C1200	Antilock Brake System - <u>DTC C1200</u>
C1203	Antilock Brake System - <u>DTC C1203</u>
C124C	Antilock Brake System - <u>DTC C124C-C124E or C1269</u>
C124D	Antilock Brake System - <u>DTC C124C-C124E or C1269</u>
C124E	Antilock Brake System - <u>DTC C124C-C124E or C1269</u>
C1251	Antilock Brake System - <u>DTC C0552, C10C0, C10C4, or C1251 (Without UGN)</u>
C1259	Antilock Brake System - <u>DTC C1259</u>
C1268	Antilock Brake System - <u>DTC C1268</u>
C1269	Antilock Brake System - <u>DTC C124C-C124E or C1269</u>
C1275	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C1276	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C1277	Hydraulic Brakes - <u>DTC C057E, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277</u>
C1278	Hydraulic Brakes - <u>DTC C1278 or C1279</u>
C1279	Hydraulic Brakes - <u>DTC C1278 or C1279</u>
C1284	Antilock Brake System <u>DTC C1284 or C1285</u>
C1285	Antilock Brake System <u>DTC C1284 or C1285</u>
C1286	Antilock Brake System <u>DTC C1286</u>
C1287	Antilock Brake System <u>DTC C1287</u>
C1288	Antilock Brake System - <u>DTC C1288</u>
C1289	Antilock Brake System - <u>DTC C1289</u>
C12E1	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
C12E2	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
C1436	Power Steering - <u>DTC C1436</u>
C1445	Antilock Brake System - <u>DTC C1445</u>
C1449	Hydraulic Brakes - <u>DTC C1449</u>
C144B	Antilock Brake System - <u>DTC C144B</u>
C1586	Park Brake - <u>DTC C1586</u>
C1587	Park Brake - <u>DTC C1587</u>
C1588	Park Brake - <u>DTC C1588</u>
C158F	Antilock Brake System - <u>DTC C158F or C1590-C1592</u>
C1590	Antilock Brake System - <u>DTC C158F or C1590-C1592</u>
C1591	Antilock Brake System - <u>DTC C158F or C1590-C1592</u>
C1592	Antilock Brake System - <u>DTC C158F or C1590-C1592</u>
C1594	Antilock Brake System - <u>DTC C1594</u>

DTC	Diagnostic Procedure
P0010	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0010, P0013, or P2088-P2091</u>
P0011	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0011 or P0014</u>
P0013	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0010, P0013, or P2088-P2091</u>
P0014	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0011 or P0014</u>
P0016	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0016 or P0017</u>
P0017	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0016 or P0017</u>
P0030	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0031	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0032	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0036	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0037	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0038	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0053	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0054	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0071	Displays and Gauges - <u>DTC P0071-P0074</u>
P0072	Displays and Gauges - <u>DTC P0071-P0074</u>
P0073	Displays and Gauges - <u>DTC P0071-P0074</u>
P0074	Displays and Gauges - <u>DTC P0071-P0074</u>
P0089	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0089, P00C6, P228C, or P228D</u>
P0090	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>
P0091	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>
P0092	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>
P0096	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0096 or P0111</u>
P0097	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0097, P0098, or P0099</u>
P0098	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0097, P0098, or P0099</u>
P0099	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0097, P0098, or P0099</u>
P00B3	Engine Heating and Cooling - <u>DTC P00B3 or P00B4</u>
P00B4	Engine Heating and Cooling - <u>DTC P00B3 or P00B4</u>
P00B7	Engine Heating and Cooling - <u>DTC P00B7</u>
P00C6	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0089, P00C6, P228C, or P228D</u>
P00C7	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00C7</u>
P00C8	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>
P00C9	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>
P00CA	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0090-P0092, P00C8, P00C9, or P00CA</u>

DTC	Diagnostic Procedure
P00F4	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00F4-P00F6</u>
P00F5	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00F4-P00F6</u>
P00F6	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00F4-P00F6</u>
P00FF	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P0101	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0101</u>
P0102	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0102 or P0103</u>
P0103	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0102 or P0103</u>
P0106	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0106</u>
P0107	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0107 or P0108</u>
P0108	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0107 or P0108</u>
P0111	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0096 or P0111</u>
P0112	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0112, P0113, or P0114</u>
P0113	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0112, P0113, or P0114</u>
P0114	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0112, P0113, or P0114</u>
P0117	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0117, P0118, or P0119</u>
P0118	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0117, P0118, or P0119</u>
P0119	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0117, P0118, or P0119</u>
P0121	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P0122	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P0123	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P0128	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0128</u>
P0131	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0131, P0132, P0137, or P0138</u>
P0132	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0131, P0132, P0137, or P0138</u>
P0133	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P0135	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</u>
P0137	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0131, P0132, P0137, or P0138</u>
P0138	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0131, P0132, P0137, or P0138</u>
P013A	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P013B	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P013E	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P013F	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>

DTC	Diagnostic Procedure
P0141	Engine Controls and Fuel - 1.5L (L3A) - DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141
P015A	Engine Controls and Fuel - 1.5L (L3A) - DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271
P015B	Engine Controls and Fuel - 1.5L (L3A) - DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271
P0171	Engine Controls and Fuel - 1.5L (L3A) - DTC P0171 or P0172
P0172	Engine Controls and Fuel - 1.5L (L3A) - DTC P0171 or P0172
P0182	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P0183	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P0187	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P0188	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P018B	Engine Controls and Fuel - 1.5L (L3A) - DTC P018B-P018D
P018C	Engine Controls and Fuel - 1.5L (L3A) - DTC P018B-P018D
P018D	Engine Controls and Fuel - 1.5L (L3A) - DTC P018B-P018D
P0191	Engine Controls and Fuel - 1.5L (L3A) - DTC P0191 or P0192
P0192	Engine Controls and Fuel - 1.5L (L3A) - DTC P0191 or P0192
P0201	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P0202	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P0203	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P0204	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P0222	Engine Controls and Fuel - 1.5L (L3A) - DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135
P0223	Engine Controls and Fuel - 1.5L (L3A) - DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135
P0231	Engine Controls and Fuel - 1.5L (L3A) - DTC P0231, P0232, or P023F
P0232	Engine Controls and Fuel - 1.5L (L3A) - DTC P0231, P0232, or P023F
P023F	Engine Controls and Fuel - 1.5L (L3A) - DTC P0231, P0232, or P023F
P0261	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157

DTC	Diagnostic Procedure
P0262	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0264	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0265	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0267	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0268	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0270	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0271	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P0300	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0300-P0304</u>
P0301	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0300-P0304</u>
P0302	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0300-P0304</u>
P0303	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0300-P0304</u>
P0304	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0300-P0304</u>
P0315	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0315</u>
P0324	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0324, P0326, or P06B6</u>
P0325	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0325, P0327, or P0328</u>
P0326	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0324, P0326, or P06B6</u>
P0327	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0325, P0327, or P0328</u>
P0328	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0325, P0327, or P0328</u>
P0335	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0335 or P0336</u>
P0335	Hybrid/EV Controls - <u>DTC P0335 or P0336</u>
P0336	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0335 or P0336</u>
P0336	Hybrid/EV Controls - <u>DTC P0335 or P0336</u>
P0340	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0340, P0341, P0365, or P0366</u>
P0341	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0340, P0341, P0365, or P0366</u>
P0351	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P0352	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>

DTC	Diagnostic Procedure
P0353	Engine Controls and Fuel - 1.5L (L3A) - DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310
P0354	Engine Controls and Fuel - 1.5L (L3A) - DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310
P0365	Engine Controls and Fuel - 1.5L (L3A) - DTC P0340, P0341, P0365, or P0366
P0366	Engine Controls and Fuel - 1.5L (L3A) - DTC P0340, P0341, P0365, or P0366
P0401	Engine Controls and Fuel - 1.5L (L3A) - DTC P0401
P0403	Engine Controls and Fuel - 1.5L (L3A) - DTC P0403, P0489, or P0490
P0404	Engine Controls and Fuel - 1.5L (L3A) - DTC P0404 or P042E
P0405	Engine Controls and Fuel - 1.5L (L3A) - DTC P0405 or P0406
P0406	Engine Controls and Fuel - 1.5L (L3A) - DTC P0405 or P0406
P040B	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P040C	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P040D	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P040E	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P041B	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P041C	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P041D	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P041E	Engine Controls and Fuel - 1.5L (L3A) - DTC P040B-P040E or P041B-P041E
P0420	Engine Controls and Fuel - 1.5L (L3A) - DTC P0420
P042E	Engine Controls and Fuel - 1.5L (L3A) - DTC P0404 or P042E
P043E	Engine Controls and Fuel - 1.5L (L3A) - DTC P043E, P043F, or P145F
P043F	Engine Controls and Fuel - 1.5L (L3A) - DTC P043E, P043F, or P145F
P0442	Engine Controls and Fuel - 1.5L (L3A) - DTC P0442 or P0455
P0443	Engine Controls and Fuel - 1.5L (L3A) - DTC P0443, P0458, or P0459
P0446	Engine Controls and Fuel - 1.5L (L3A) - DTC P0446
P0449	Engine Controls and Fuel - 1.5L (L3A) - DTC P0449, P0498, or P0499
P0451	Engine Controls and Fuel - 1.5L (L3A) - DTC P0451-P0453
P0452	Engine Controls and Fuel - 1.5L (L3A) - DTC P0451-P0453
P0453	Engine Controls and Fuel - 1.5L (L3A) - DTC P0451-P0453
P0455	Engine Controls and Fuel - 1.5L (L3A) - DTC P0442 or P0455
P0458	Engine Controls and Fuel - 1.5L (L3A) - DTC P0443, P0458, or P0459
P0459	Engine Controls and Fuel - 1.5L (L3A) - DTC P0443, P0458, or P0459
P0461	Displays and Gauges - DTC P0461-P0464
P0462	Displays and Gauges - DTC P0461-P0464
P0463	Displays and Gauges - DTC P0461-P0464
P0464	Displays and Gauges - DTC P0461-P0464
P0480	Hybrid/EV System Heating and Cooling - DTC P0480
P0489	Engine Controls and Fuel - 1.5L (L3A) - DTC P0403, P0489, or P0490
P0490	Engine Controls and Fuel - 1.5L (L3A) - DTC P0403, P0489, or P0490
P0497	Engine Controls and Fuel - 1.5L (L3A) - DTC P0497

DTC	Diagnostic Procedure
P0498	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0449, P0498, or P0499</u>
P0499	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0449, P0498, or P0499</u>
P04B6	Vehicle Access - <u>DTC P04B6</u>
P04B8	Vehicle Access - <u>DTC P04B8-P04BA</u>
P04B9	Vehicle Access - <u>DTC P04B8-P04BA</u>
P04BA	Vehicle Access - <u>DTC P04B8-P04BA</u>
P04BB	Vehicle Access - <u>DTC P04BB, P04BC, or P04C0</u>
P04BC	Vehicle Access - <u>DTC P04BB, P04BC, or P04C0</u>
P04C0	Vehicle Access - <u>DTC P04BB, P04BC, or P04C0</u>
P04C8	Vehicle Access - <u>DTC P04C8, P04CA, or P04CB</u>
P04CA	Vehicle Access - <u>DTC P04C8, P04CA, or P04CB</u>
P04CB	Vehicle Access - <u>DTC P04C8, P04CA, or P04CB</u>
P0506	Hybrid/EV Controls - <u>DTC P0506 or P0507</u>
P0507	Hybrid/EV Controls - <u>DTC P0506 or P0507</u>
P050D	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P050D</u>
P0513	Immobilizer - <u>DTC P0513</u>
P0521	Displays and Gauges - <u>DTC P0521, P0522, or P0523</u>
P0522	Displays and Gauges - <u>DTC P0521, P0522, or P0523</u>
P0523	Displays and Gauges - <u>DTC P0521, P0522, or P0523</u>
P0531	HVAC - Automatic - <u>DTC P0531, P0532, or P0533</u>
P0532	HVAC - Automatic - <u>DTC P0531, P0532, or P0533</u>
P0533	HVAC - Automatic - <u>DTC P0531, P0532, or P0533</u>
P0534	HVAC - Automatic - <u>DTC P0534</u>
P0560	Antilock Brake System - <u>DTC P0560, P0562, or P0563</u>
P0561	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
P0562	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
P0562	Antilock Brake System - <u>DTC P0560, P0562, or P0563</u>
P0563	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
P0563	Antilock Brake System - <u>DTC P0560, P0562, or P0563</u>
P0564	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P0565	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P0567	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P0568	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P056C	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>

DTC	Diagnostic Procedure
P0571	Cruise Control - DTC P0571
P0572	Cruise Control - DTC P0572 or P0573
P0573	Cruise Control - DTC P0572 or P0573
P0575	Cruise Control - DTC P0575
P057B	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P057B	Engine Controls and Fuel - 1.5L (L3A) - DTC P057B-P057E
P057C	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P057C	Engine Controls and Fuel - 1.5L (L3A) - DTC P057B-P057E
P057D	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P057D	Engine Controls and Fuel - 1.5L (L3A) - DTC P057B-P057E
P057E	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P057E	Engine Controls and Fuel - 1.5L (L3A) - DTC P057B-P057E
P0580	Cruise Control - Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C
P0581	Cruise Control - Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C
P0597	Engine Heating and Cooling - DTC P0597-P0599
P0598	Engine Heating and Cooling - DTC P0597-P0599
P0599	Engine Heating and Cooling - DTC P0597-P0599
P059F	Bumpers and Fascias - DTC P059F or P151E
P05DC	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P05DD	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P05DE	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P05DF	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P05E0	Hydraulic Brakes - DTC P057B-P057E, P05DC-P05DE, or P05E0
P05FF	Antilock Brake System - DTC P05FF
P0601	Antilock Brake System - DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)
P0601	Engine Controls and Fuel - 1.5L (L3A) - DTC P0601-P0604, P0606, P062B, P062E, P0630, P16F3, or P262B
P0601	Hybrid/EV Controls - DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)
P0601	Data Communications - DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B
P0601	Hydraulic Brakes - DTC P0601, P0603, P0604, P0606, P060B, or P062F
P0602	Antilock Brake System - DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)
P0602	Engine Controls and Fuel - 1.5L (L3A) - DTC P0601-P0604, P0606, P062B, P062E, P0630, P16F3, or P262B
P0602	Hybrid/EV Controls - DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)

DTC	Diagnostic Procedure
P0602	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P0603	Antilock Brake System - <u>DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)</u>
P0603	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P0603	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P0603	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P0603	Hydraulic Brakes - <u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>
P0604	Antilock Brake System - <u>DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)</u>
P0604	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P0604	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P0604	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P0604	Hydraulic Brakes - <u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>
P0605	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P0606	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P0606	Antilock Brake System - <u>DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)</u>
P0606	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P0606	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P0606	Hydraulic Brakes - <u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>
P0607	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P060A	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P060B	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P060B	Antilock Brake System - <u>DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)</u>
P060B	Hydraulic Brakes - <u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>
P060C	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P061A	Hybrid/EV Controls - <u>DTC P061A or P061B</u>

DTC	Diagnostic Procedure
P061B	Hybrid/EV Controls - <u>DTC P061A or P061B</u>
P0627	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0627-P0629</u>
P0628	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0627-P0629</u>
P0629	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0627-P0629</u>
P062B	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P062F	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P062F	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P062F	Antilock Brake System - <u>DTC P0601-P0604, P0606, P060B, or P062F (Electronic Brake Control Module)</u>
P062F	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P062F	Hydraulic Brakes - <u>DTC P0601, P0603, P0604, P0606, P060B, or P062F</u>
P0630	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P0633	Immobilizer - <u>DTC P0633</u>
P0641	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>
P0642	Hydraulic Brakes - <u>DTC P0642, P06A6, or P06A7</u>
P0650	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0650, P263A, or P263B</u>
P0651	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>
P0658	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0658 or P0659</u>
P0959	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0658 or P0659</u>
P0685	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0686	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0687	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0688	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0689	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0690	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P0697	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>
P069E	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P06A3	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>
P06A6	Hydraulic Brakes - <u>DTC P0642, P06A6, or P06A7</u>
P06A7	Hydraulic Brakes - <u>DTC P0642, P06A6, or P06A7</u>

DTC	Diagnostic Procedure
P06AF	Hybrid/EV Controls - <u>DTC P06AF</u>
P06B1	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06B2	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06B4	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06B5	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06B6	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0324, P0326, or P06B6</u>
P06D2	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0641, P0651, P0697, P06A3, or P06D2</u>
P06DA	Engine Mechanical - 1.5L (L3A) - <u>DTC P06DA-P06DE</u>
P06DB	Engine Mechanical - 1.5L (L3A) - <u>DTC P06DA-P06DE</u>
P06DC	Engine Mechanical - 1.5L (L3A) - <u>DTC P06DA-P06DE</u>
P06DD	Engine Mechanical - 1.5L (L3A) - <u>DTC P06DA-P06DE</u>
P06DE	Engine Mechanical - 1.5L (L3A) - <u>DTC P06DA-P06DE</u>
P06E4	Data Communications - <u>DTC P06E4 (Hybrid/EV Powertrain Control Module 2)</u>
P06E7	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06E8	Hybrid/EV Controls - <u>DTC P06B1, P06B2, P06B4, P06B5, P06E7, or P06E8</u>
P06EC	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P0700	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P0703	Cruise Control - <u>DTC P0703</u>
P0711	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0711-P0713</u>
P0712	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0711-P0713</u>
P0713	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0711-P0713</u>
P0721	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0721</u>
P077B	Automatic Transmission - 5ET50 (MKV) - <u>DTC P077B-P077D</u>
P077C	Automatic Transmission - 5ET50 (MKV) - <u>DTC P077B-P077D</u>
P077D	Automatic Transmission - 5ET50 (MKV) - <u>DTC P077B-P077D</u>
P079A	Automatic Transmission - 5ET50 (MKV) - <u>DTC P079A</u>
P079B	Automatic Transmission - 5ET50 (MKV) - <u>DTC P079B</u>
P079C	Automatic Transmission - 5ET50 (MKV) - <u>DTC P079C</u>
P07A3	Automatic Transmission - 5ET50 (MKV) - <u>DTC P07A3</u>
P07A5	Automatic Transmission - 5ET50 (MKV) - <u>DTC P07A5</u>
P07A7	Automatic Transmission - 5ET50 (MKV) - <u>DTC P07A7</u>
P0800	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P0856	Antilock Brake System - <u>DTC P0856</u>
P0960	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0960, P0962, or P0963</u>
P0962	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0960, P0962, or P0963</u>
P0963	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0960, P0962, or P0963</u>
P0964	Automatic Transmission - 5ET50 (MKV) - <u>DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730</u>

DTC	Diagnostic Procedure
P0966	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P0967	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P0968	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P0970	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P0971	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P0A0C	Hybrid/EV Energy Storage - DTC P0A0C or P0A0D
P0A0D	Hybrid/EV Energy Storage - DTC P0A0C or P0A0D
P0A1B	Hybrid/EV Controls - DTC P0A1B or P0A1C
P0A1C	Hybrid/EV Controls - DTC P0A1B or P0A1C
P0A1F	Data Communications - DTC P0A1F, P1A01, P1A05, or P1A06
P0A3F	Hybrid/EV Controls - DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03
P0A40	Hybrid/EV Controls - DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03
P0A45	Hybrid/EV Controls - DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04
P0A46	Hybrid/EV Controls - DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04
P0A5E	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A61	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A64	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A67	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A6A	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A6D	Hybrid/EV Controls - DTC P0A5E, P0A61, P0A64, P0A67, P0A6A, or P0A6D
P0A78	Hybrid/EV Controls - DTC P0A78 or P0A79
P0A79	Hybrid/EV Controls - DTC P0A78 or P0A79
P0A7E	Hybrid/EV System Heating and Cooling - DTC P0A7E
P0A7F	Hybrid/EV Energy Storage - DTC P0A7F
P0A8D	12 V Starting and Charging - DTC P0A8D
P0A9C	Hybrid/EV System Heating and Cooling - DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36
P0A9D	Hybrid/EV System Heating and Cooling - DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36
P0A9E	Hybrid/EV System Heating and Cooling - DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36
P0AA1	Hybrid/EV Energy Storage - DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3
P0AA4	Hybrid/EV Energy Storage - DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3
P0AA6	Hybrid/EV Energy Storage - DTC P0AA6 or P1AE6
P0AB9	Hybrid/EV Controls - DTC P0AB9

DTC	Diagnostic Procedure
P0ABB	Hybrid/EV Energy Storage - <u>DTC P0ABB, P0ABC, or P0ABD</u>
P0ABC	Hybrid/EV Energy Storage - <u>DTC P0ABB, P0ABC, or P0ABD</u>
P0ABD	Hybrid/EV Energy Storage - <u>DTC P0ABB, P0ABC, or P0ABD</u>
P0AC1	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P0AC2	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P0AC4	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P0AC6	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AC7	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AC8	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0ACB	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0ACC	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0ACD	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AD9	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0ADD	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0AE3	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0AE4	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0AE9	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AEA	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AEB	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0AEE	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0AEF	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0AF0	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0AF3	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>

DTC	Diagnostic Procedure
P0AF4	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0AF5	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0AF8	Hybrid/EV Energy Storage - <u>DTC P0AF8</u>
P0AFA	Hybrid/EV Energy Storage - <u>DTC P0AFA or P0AFB</u>
P0AFB	Hybrid/EV Energy Storage - <u>DTC P0AFA or P0AFB</u>
P0B01	Hybrid/EV Controls - <u>DTC P0B01, P0B04, or P0B07</u>
P0B04	Hybrid/EV Controls - <u>DTC P0B01, P0B04, or P0B07</u>
P0B07	Hybrid/EV Controls - <u>DTC P0B01, P0B04, or P0B07</u>
P0B10	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P0B11	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P0B13	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P0B3B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B3C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B3D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B3E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B40	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B41	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B42	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B43	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B45	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B46	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B47	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B48	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B4A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P0B4B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B4C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B4D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B4F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B50	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B51	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B52	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B54	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B55	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B56	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B57	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B59	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B5A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B5B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B5C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B5E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B5F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B60	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B61	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B63	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B64	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P0B65	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B66	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B68	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B69	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B6A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B6B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B6D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B6E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B6F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B70	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B72	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B73	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B74	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B75	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B77	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B78	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B79	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B7A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B7C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B7D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B7E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P0B7F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B81	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B82	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B83	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B84	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B86	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B87	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B88	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B89	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B8B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B8C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B8D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B8E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B90	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B91	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B92	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B93	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B95	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B96	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B97	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B98	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P0B9A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B9B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B9C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B9D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0B9F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BA9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BAA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BAB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BAC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BAE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BAF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P0BB4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BB9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BBA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BBB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P0BC3	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0BC4	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0BC5	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0BD2	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BD3	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BD4	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BD7	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BD8	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BD9	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BDC	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BDD	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BDE	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BE1	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BE2	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>

DTC	Diagnostic Procedure
P0BE3	Hybrid/EV Controls - <u>DTC P0AEE, P0AEF, P0AF0, P0AF3-P0AF5, P0BD2-P0BD4, P0BD7-P0BD9, P0BDC-P0BDE, or P0BE1-P0BE3</u>
P0BE6	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BE7	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BE8	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BEA	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BEB	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BEC	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BEE	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BEF	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF0	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF2	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF3	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF4	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF6	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF7	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BF8	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BFA	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BFB	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BFC	Hybrid/EV Controls - <u>DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, P0BF0, P0BF2-P0BF4, P0BF6-P0BF8, or P0BFA-P0BFC</u>
P0BFD	Hybrid/EV Controls - <u>DTC P0BFD or P0BFE</u>
P0BFE	Hybrid/EV Controls - <u>DTC P0BFD or P0BFE</u>
P0C01	Hybrid/EV Controls - <u>DTC P0C01 or P0C04</u>
P0C04	Hybrid/EV Controls - <u>DTC P0C01 or P0C04</u>
P0C0B	Hybrid/EV Controls - <u>DTC P0C0B or P0C0E</u>

DTC	Diagnostic Procedure
P0C0E	Hybrid/EV Controls - <u>DTC P0C0B or P0C0E</u>
P0C11	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C12	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C13	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C14	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C15	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C16	Hybrid/EV Controls - <u>DTC P0C11-P0C16</u>
P0C17	Hybrid/EV Controls - <u>DTC P0C17, P0C18, P1B0F, or P1B10</u>
P0C18	Hybrid/EV Controls - <u>DTC P0C17, P0C18, P1B0F, or P1B10</u>
P0C19	Hybrid/EV Controls - <u>DTC P0C19</u>
P0C1A	Hybrid/EV Controls - <u>DTC P0C1A</u>
P0C28	Hybrid/EV Controls - <u>DTC P0C28</u>
P0C34	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0C35	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0C36	Hybrid/EV System Heating and Cooling - <u>DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36</u>
P0C43	Hybrid/EV System Heating and Cooling - <u>DTC P0C43-P0C46</u>
P0C44	Hybrid/EV System Heating and Cooling - <u>DTC P0C43-P0C46</u>
P0C45	Hybrid/EV System Heating and Cooling - <u>DTC P0C43-P0C46</u>
P0C46	Hybrid/EV System Heating and Cooling - <u>DTC P0C43-P0C46</u>
P0C47	Hybrid/EV System Heating and Cooling - <u>DTC P0C47, P1E8C, or P1E8D</u>
P0C4E	Hybrid/EV Controls - <u>DTC P0C4E</u>
P0C4F	Hybrid/EV Controls - <u>DTC P0C4F</u>
P0C52	Hybrid/EV Controls - <u>DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>
P0C53	Hybrid/EV Controls - <u>DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>
P0C57	Hybrid/EV Controls - <u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>
P0C58	Hybrid/EV Controls - <u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>
P0C5C	Hybrid/EV Controls - <u>DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>
P0C5D	Hybrid/EV Controls - <u>DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>
P0C61	Hybrid/EV Controls - <u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>
P0C62	Hybrid/EV Controls - <u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>
P0C76	Hybrid/EV Controls - <u>DTC P0C76</u>
P0C78	Hybrid/EV Energy Storage - <u>DTC P0C78 or P3061</u>
P0CCC	Vehicle Access - <u>DTC P0CCC, P0CCE, or P0CCF</u>
P0CCE	Vehicle Access - <u>DTC P0CCC, P0CCE, or P0CCF</u>
P0CCF	Vehicle Access - <u>DTC P0CCC, P0CCE, or P0CCF</u>
P0CE9	Hybrid/EV System Heating and Cooling - <u>DTC P0CE9, P1F44, or P1F45</u>
P0CEF	Hybrid/EV System Heating and Cooling - <u>DTC P0CEF-P0CF2</u>
P0CF0	Hybrid/EV System Heating and Cooling - <u>DTC P0CEF-P0CF2</u>

DTC	Diagnostic Procedure
P0CF1	Hybrid/EV System Heating and Cooling - <u>DTC P0CEF-P0CF2</u>
P0CF2	Hybrid/EV System Heating and Cooling - <u>DTC P0CEF-P0CF2</u>
P0CF4	Plug-In Charging - <u>DTC P0CF4-P0CF6</u>
P0CF5	Plug-In Charging - <u>DTC P0CF4-P0CF6</u>
P0CF6	Plug-In Charging - <u>DTC P0CF4-P0CF6</u>
P0CF9	Plug-In Charging - <u>DTC P0CF9 or P0D01</u>
P0D01	Plug-In Charging - <u>DTC P0CF9 or P0D01</u>
P0D09	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0D0A	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P0D1F	Plug-In Charging - <u>DTC P0D1F</u>
P0D26	Plug-In Charging - <u>DTC P0D26</u>
P0D2B	Plug-In Charging - <u>DTC P0D2B or P0D2C</u>
P0D2C	Plug-In Charging - <u>DTC P0D2B or P0D2C</u>
P0D3E	Plug-In Charging - <u>DTC P0D3E-P0D40</u>
P0D3F	Plug-In Charging - <u>DTC P0D3E-P0D40</u>
P0D40	Plug-In Charging - <u>DTC P0D3E-P0D40</u>
P0D4D	Plug-In Charging - <u>DTC P0D4D-P0D4F</u>
P0D4E	Plug-In Charging - <u>DTC P0D4D-P0D4F</u>
P0D4F	Plug-In Charging - <u>DTC P0D4D-P0D4F</u>
P0D58	Plug-In Charging - <u>DTC P0D58 or P0D59</u>
P0D59	Plug-In Charging - <u>DTC P0D58 or P0D59</u>
P0D5A	Plug-In Charging - <u>DTC P0D5A</u>
P0D5C	Plug-In Charging - <u>DTC P0D5C</u>
P0D5E	Plug-In Charging - <u>DTC P0D5E</u>
P0D69	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D6A	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D6B	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D71	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D72	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D73	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D76	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D77	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0D78	HVAC - Automatic - <u>DTC P0D69-P0D7F</u>
P0E61	Plug-In Charging - <u>DTC P0E61 or P0E65</u>
P0E65	Plug-In Charging - <u>DTC P0E61 or P0E65</u>
P1101	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1101</u>
P111E	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P111E</u>
P111F	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F</u>

DTC	Diagnostic Procedure
P112F	Engine Heating and Cooling - DTC P112F
P1248	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1249	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124A	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P124B	Engine Controls and Fuel - 1.5L (L3A) - DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157
P1255	Engine Controls and Fuel - 1.5L (L3A) - DTC P1255
P126E	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P126F	Engine Controls and Fuel - 1.5L (L3A) - DTC P0182, P0183, P0187, P0188, P111F, P126E, or P126F
P127C	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128A	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128B	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128C	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128D	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P128F	Engine Controls and Fuel - 1.5L (L3A) - DTC P127C, P128A-P128D, P128F, P16E4, or P16E5
P129B	Engine Controls and Fuel - 1.5L (L3A) - DTC P129B or P129C
P129C	Engine Controls and Fuel - 1.5L (L3A) - DTC P129B or P129C
P129D	Engine Controls and Fuel - 1.5L (L3A) - DTC P129D
P129E	Engine Controls and Fuel - 1.5L (L3A) - DTC P129E or P12A8
P12A6	Engine Controls and Fuel - 1.5L (L3A) - DTC P12A6
P12A8	Engine Controls and Fuel - 1.5L (L3A) - DTC P129E or P12A8
P135A	Engine Controls and Fuel - 1.5L (L3A) - DTC P135A
P1400	Engine Controls and Fuel - 1.5L (L3A) - DTC P1400
P1426	Engine Controls and Fuel - 1.5L (L3A) - DTC P1426
P1427	Engine Controls and Fuel - 1.5L (L3A) - DTC P1427-P142A or P1437
P1428	Engine Controls and Fuel - 1.5L (L3A) - DTC P1427-P142A or P1437
P1429	Engine Controls and Fuel - 1.5L (L3A) - DTC P1427-P142A or P1437
P142A	Engine Controls and Fuel - 1.5L (L3A) - DTC P1427-P142A or P1437

DTC	Diagnostic Procedure
P1437	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1427-P142A or P1437</u>
P145C	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P145C or P145D</u>
P145D	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P145C or P145D</u>
P145E	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P145E</u>
P145F	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P043E, P043F, or P145F</u>
P1461	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1461</u>
P1462	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1462</u>
P1485	Engine Heating and Cooling - <u>DTC P1485-P1487</u>
P1486	Engine Heating and Cooling - <u>DTC P1485-P1487</u>
P1487	Engine Heating and Cooling - <u>DTC P1485-P1487</u>
P148A	Hybrid/EV System Heating and Cooling - <u>DTC P148A-P148C</u>
P148B	Hybrid/EV System Heating and Cooling - <u>DTC P148A-P148C</u>
P148C	Hybrid/EV System Heating and Cooling - <u>DTC P148A-P148C</u>
P150D	Hybrid/EV Controls - <u>DTC P150D or P150E</u>
P150E	Hybrid/EV Controls - <u>DTC P150D or P150E</u>
P1516	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1516, P2101, P2119, or P2176</u>
P151C	HVAC - Automatic - <u>DTC P151C or P2516-P2518</u>
P151E	Bumpers and Fascias - <u>DTC P059F or P151E</u>
P152A	Automatic Transmission - 5ET50 (MKV) - <u>DTC P152A or P152D</u>
P152C	Automatic Transmission - 5ET50 (MKV) - <u>DTC P152C</u>
P152D	Automatic Transmission - 5ET50 (MKV) - <u>DTC P152A or P152D</u>
P154F	HVAC - Automatic - <u>DTC P154F</u>
P155A	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P155B	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P155C	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P156A	HVAC - Automatic - <u>DTC P156A-P156C</u>
P156B	HVAC - Automatic - <u>DTC P156A-P156C</u>
P156C	HVAC - Automatic - <u>DTC P156A-P156C</u>
P15B9	Wiring Systems and Power Management - <u>DTC P15B9 or P15BA</u>
P15BA	Wiring Systems and Power Management - <u>DTC P15B9 or P15BA</u>
P15C5	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P15C6	HVAC - Automatic - <u>DTC P15C6 or P15C8-P15CB</u>
P15C8	HVAC - Automatic - <u>DTC P15C6 or P15C8-P15CB</u>
P15C9	HVAC - Automatic - <u>DTC P15C6 or P15C8-P15CB</u>
P15CA	HVAC - Automatic - <u>DTC P15C6 or P15C8-P15CB</u>
P15CB	HVAC - Automatic - <u>DTC P15C6 or P15C8-P15CB</u>
P15F0	Hybrid/EV Controls - <u>DTC P15F0</u>

DTC	Diagnostic Procedure
P15F1	Hybrid/EV Controls - <u>DTC P15F1</u>
P15F2	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P15F2</u>
P15F2	Hybrid/EV Controls - <u>DTC P15F2</u>
P15F6	Object Detection and Pedestrian Protection - <u>DTC P15F6</u>
P15F8	Antilock Brake System - <u>DTC P15F8</u>
P15FB	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P15FB</u>
P15FC	Hybrid/EV Controls - <u>DTC P15FC</u>
P162B	Immobilizer - <u>DTC P162B</u>
P162C	Cruise Control - <u>Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C</u>
P162D	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P162D</u>
P1631	Immobilizer - <u>DTC P1631</u>
P163A	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P163A</u>
P1649	Immobilizer - <u>DTC P1649</u>
P1682	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P169D	Vehicle Access - <u>DTC P169D</u>
P16A0	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P16A1	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P16A2	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P16A7	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P16AF	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P16B3	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0685-P0690, P1682, P16A7, P16AF, or P16B3</u>
P16B7	Data Communications - <u>DTC P16B7</u>
P16B8	Data Communications - <u>DTC P16B8-P16BA</u>
B16B9	Data Communications - <u>DTC P16B8-P16BA</u>
P16BA	Data Communications - <u>DTC P16B8-P16BA</u>
P16E0	Hybrid/EV Controls - <u>DTC P16E0</u>
P16E4	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P127C, P128A-P128D, P128F, P16E4, or P16E5</u>
P16E5	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P127C, P128A-P128D, P128F, P16E4, or P16E5</u>
P16E9	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P16F0	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>

DTC	Diagnostic Procedure
P16F3	Hybrid/EV Controls - DTC P16F3 (Hybrid/EV Powertrain Control Module 1)
P16F3	Engine Controls and Fuel - 1.5L (L3A) - DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B
P16F4	Hybrid/EV Controls - DTC P16F4 (Hybrid/EV Powertrain Control Module 1)
P16F6	Hybrid/EV Controls - DTC P16F6 (Hybrid/EV Powertrain Control Module 1)
P16F7	Automatic Transmission - 5ET50 (MKV) - DTC P16F7
P179A	Hybrid/EV Controls - DTC P179A
P179C	Automatic Transmission - 5ET50 (MKV) - DTC P179C
P179D	Automatic Transmission - 5ET50 (MKV) - DTC P179D
P1824	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182A	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182B	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182C	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182D	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182E	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P182F	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P1838	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P1839	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P1840	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P1841	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18B5	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18B6	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18B7	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18B8	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18B9	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3
P18BA	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BE, P18C0, P18C2, or P18C3

DTC	Diagnostic Procedure
P18BC	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3
P18BF	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3
P18C0	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3
P18C2	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3
P18C3	Automatic Transmission - 5ET50 (MKV) - DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3
P190A	Hybrid/EV Controls - DTC P190A-P190F
P190B	Hybrid/EV Controls - DTC P190A-P190F
P190C	Hybrid/EV Controls - DTC P190A-P190F
P190D	Hybrid/EV Controls - DTC P190A-P190F
P190E	Hybrid/EV Controls - DTC P190A-P190F
P190F	Hybrid/EV Controls - DTC P190A-P190F
P19FA	Hybrid/EV System Heating and Cooling - DTC P19FA-P19FC
P19FB	Hybrid/EV System Heating and Cooling - DTC P19FA-P19FC
P19FC	Hybrid/EV System Heating and Cooling - DTC P19FA-P19FC
P19FD	Hybrid/EV System Heating and Cooling - DTC P19FD-P19FF
P19FE	Hybrid/EV System Heating and Cooling - DTC P19FD-P19FF
P19FF	Hybrid/EV System Heating and Cooling - DTC P19FD-P19FF
P1A01	Data Communications - DTC P0A1F, P1A01, P1A05, or P1A06
P1A05	Data Communications - DTC P0A1F, P1A01, P1A05, or P1A06
P1A06	Data Communications - DTC P0A1F, P1A01, P1A05, or P1A06
P1A07	Hybrid/EV Energy Storage - DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040
P1A0C	12 V Starting and Charging - DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC
P1A0D	12 V Starting and Charging - DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC
P1A4F	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A50	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A51	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A52	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A53	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A54	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1A5E	Wiring Systems and Power Management - DTC P1A5E or P1A5F
P1A5F	Wiring Systems and Power Management - DTC P1A5E or P1A5F
P1A60	Wiring Systems and Power Management - DTC P1A60
P1ADC	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD
P1ADD	Hybrid/EV Controls - DTC P1A4F, P1A50-P1A54, P1ADC, or P1ADD

DTC	Diagnostic Procedure
P1ADE	Hybrid/EV Controls - <u>DTC P1ADE, P1ADF, P1AE0, or P1AE1</u>
P1ADF	Hybrid/EV Controls - <u>DTC P1ADE, P1ADF, P1AE0, or P1AE1</u>
P1AE0	Hybrid/EV Controls - <u>DTC P1ADE, P1ADF, P1AE0, or P1AE1</u>
P1AE1	Hybrid/EV Controls - <u>DTC P1ADE, P1ADF, P1AE0, or P1AE1</u>
P1AE6	Hybrid/EV Energy Storage - <u>DTC P0AA6 or P1AE6</u>
P1AEE	Hybrid/EV Controls - <u>DTC P1AEE or P1AEF</u>
P1AEF	Hybrid/EV Controls - <u>DTC P1AEE or P1AEF</u>
P1AF0	Hybrid/EV Controls - <u>DTC P1AF0 or P1AF2</u>
P1AF2	Hybrid/EV Controls - <u>DTC P1AF0 or P1AF2</u>
P1AF4	Hybrid/EV Controls - <u>DTC P1AF4-P1AF7</u>
P1AF5	Hybrid/EV Controls - <u>DTC P1AF4-P1AF7</u>
P1AF6	Hybrid/EV Controls - <u>DTC P1AF4-P1AF7</u>
P1AF7	Hybrid/EV Controls - <u>DTC P1AF4-P1AF7</u>
P1B03	Hybrid/EV Controls - <u>DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03</u>
P1B04	Hybrid/EV Controls - <u>DTC P0A45, P0A46, P0C57, P0C58, P0C61, P0C62, or P1B04</u>
P1B0B	Hybrid/EV Controls - <u>DTC P1B0B or P1B0C</u>
P1B0C	Hybrid/EV Controls - <u>DTC P1B0B or P1B0C</u>
P1B0D	Hybrid/EV Controls - <u>DTC P1B0D or P1B0E</u>
P1B0E	Hybrid/EV Controls - <u>DTC P1B0D or P1B0E</u>
P1B0F	Hybrid/EV Controls - <u>DTC P0C17, P0C18, P1B0F, or P1B10</u>
P1B10	Hybrid/EV Controls - <u>DTC P0C17, P0C18, P1B0F, or P1B10</u>
P1B12	Antilock Brake System - <u>DTC P1B12</u>
P1B15	Hybrid/EV Controls - <u>DTC P1B15</u>
P1B16	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B17	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B18	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B19	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B1A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B1B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B1C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B1D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B1E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B1F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B20	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B21	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B22	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B23	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B24	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B25	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B26	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B27	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B28	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B29	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B2A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B2B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B2C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B2D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B41	Hybrid/EV Controls - <u>DTC P1B41 or P1B42</u>
P1B42	Hybrid/EV Controls - <u>DTC P1B41 or P1B42</u>
P1B43	Hybrid/EV Controls - <u>DTC P1B43 or P1B44</u>
P1B44	Hybrid/EV Controls - <u>DTC P1B43 or P1B44</u>
P1B45	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B46	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B47	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B48	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B49	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B4F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B50	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B51	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B52	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B53	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B54	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B55	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B56	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B57	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B58	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B59	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B5A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B5B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B5C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B5D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B5E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B5F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B60	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B61	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B62	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B63	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B64	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B65	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B66	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B67	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B68	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B69	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B6F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B70	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B71	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B72	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B73	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B74	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B75	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B76	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B77	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B78	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B79	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B7F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B80	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B81	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B82	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B83	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B84	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B85	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B86	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B87	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B88	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B89	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B8F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B90	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B91	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B92	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B93	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B94	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B95	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B96	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B97	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B98	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B99	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B9A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B9B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B9C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1B9D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B9E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1B9F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BA9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAD	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BAF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1BB2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BB9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBD	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BBF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1BC7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BC9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCD	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BCF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BD9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BDA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BDB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1BDC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BDD	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BDE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BDF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BE9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BEA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BEB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BEC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BED	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BEE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BEF	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF0	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1BF1	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF2	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF3	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF4	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF5	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF6	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF7	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF8	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BF9	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BFA	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BFB	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BFC	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BFD	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1BFE	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E00	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P1E01	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E02	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E03	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E04	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E05	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E06	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E0A	Hybrid/EV Controls - <u>DTC P1E0A or P1E0B</u>

DTC	Diagnostic Procedure
P1E0B	Hybrid/EV Controls - <u>DTC P1E0A or P1E0B</u>
P1E1B	Hybrid/EV Controls - <u>DTC P1E1B-P1E1F</u>
P1E1C	Hybrid/EV Controls - <u>DTC P1E1B-P1E1F</u>
P1E1D	Hybrid/EV Controls - <u>DTC P1E1B-P1E1F</u>
P1E1E	Hybrid/EV Controls - <u>DTC P1E1B-P1E1F</u>
P1E1F	Hybrid/EV Controls - <u>DTC P1E1B-P1E1F</u>
P1E22	Hybrid/EV Controls - <u>DTC P1E22</u>
P1E29	Hybrid/EV Controls - <u>DTC P1E29</u>
P1E2A	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E2B	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E2C	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E2D	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E2E	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E2F	Hybrid/EV Controls - <u>DTC P1E2A-P1E2F</u>
P1E34	Hybrid/EV Controls - <u>DTC P1E34-P1E36</u>
P1E35	Hybrid/EV Controls - <u>DTC P1E34-P1E36</u>
P1E36	Hybrid/EV Controls - <u>DTC P1E34-P1E36</u>
P1E37	Hybrid/EV Controls - <u>DTC P1E37</u>
P1E38	Hybrid/EV Controls - <u>DTC P1E38</u>
P1E39	Hybrid/EV Controls - <u>DTC P1E39</u>
P1E3A	Hybrid/EV Controls - <u>DTC P1E3A</u>
P1E4A	Hybrid/EV Controls - <u>DTC P1E4A or P1E4B</u>
P1E4B	Hybrid/EV Controls - <u>DTC P1E4A or P1E4B</u>
P1E4C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4G	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4H	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4I	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4J	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4K	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1E4L	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4M	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4N	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4O	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4P	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4Q	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4R	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4S	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4T	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4U	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4V	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4W	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4X	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4Y	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E4Z	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E50	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E51	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E52	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E53	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E54	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E55	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1E56	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E57	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E58	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E59	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E5F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E60	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E61	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E62	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E63	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E64	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E65	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E66	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E67	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E68	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E69	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E6A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1E6B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E6C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E6D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E6E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E6F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E70	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E71	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E72	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E73	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E74	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E75	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E76	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E77	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E78	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E79	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7C	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7D	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7E	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E7F	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>

DTC	Diagnostic Procedure
P1E80	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E81	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E82	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E83	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E84	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E85	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E86	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E87	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E88	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E89	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E8A	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E8B	Hybrid/EV Energy Storage - <u>DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B</u>
P1E8C	Hybrid/EV System Heating and Cooling - <u>DTC P0C47, P1E8C, or P1E8D</u>
P1E8D	Hybrid/EV System Heating and Cooling - <u>DTC P0C47, P1E8C, or P1E8D</u>
P1E8E	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E8F	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E90	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E91	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E92	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1E93	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>

DTC	Diagnostic Procedure
P1E94	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E95	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E96	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E97	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E98	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1E99	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1E9A	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E9B	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E9C	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E9D	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1E9E	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1E9F	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1EA0	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1EA1	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1EA2	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1EA2	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>

DTC	Diagnostic Procedure
P1EA3	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1EA3	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1EA4	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1EA5	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1EAB	Hybrid/EV Energy Storage - <u>DTC P1EAB or P1EAC</u>
P1EAC	Hybrid/EV Energy Storage - <u>DTC P1EAB or P1EAC</u>
P1EB1	Data Communications - <u>DTC P1EB1</u>
P1EB2	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1EB3	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1EB4	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1EB5	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1EB6	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P1EB7	Hybrid/EV Controls - <u>DTC P0601-P0604, P0606, P062F, P1EB6, or P1EB7 (Hybrid/EV Powertrain Control Module 1)</u>
P1EB9	Data Communications - <u>DTC P1EB9</u>
P1EBA	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P1EBB	Hybrid/EV Energy Storage - <u>DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB</u>
P1EBD	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P1EC0	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P1EC1	Data Communications - <u>DTC P1EC1 or P1EC2</u>
P1EC2	Data Communications - <u>DTC P1EC1 or P1EC2</u>
P1EC3	Hybrid/EV Energy Storage - <u>DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE3, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3</u>
P1EC6	Hybrid/EV System Heating and Cooling - <u>DTC P1EC6</u>
P1EE6	Plug-In Charging - <u>DTC P1EE6</u>
P1EFC	12 V Starting and Charging - <u>DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC</u>
P1F00	Hybrid/EV Controls - <u>DTC P1F00</u>
P1F06	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>

DTC	Diagnostic Procedure
P1F07	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1F08	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1F09	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1F0A	HVAC - Automatic - <u>DTC P1F0A-P1F0D</u>
P1F0B	HVAC - Automatic - <u>DTC P1F0A-P1F0D</u>
P1F0C	HVAC - Automatic - <u>DTC P1F0A-P1F0D</u>
P1F0D	HVAC - Automatic - <u>DTC P1F0A-P1F0D</u>
P1F17	Hybrid/EV Energy Storage - <u>DTC P1F17</u>
P1F44	Hybrid/EV System Heating and Cooling - <u>DTC P0CE9, P1F44, or P1F45</u>
P1F45	Hybrid/EV System Heating and Cooling - <u>DTC P0CE9, P1F44, or P1F45</u>
P1F59	12 V Starting and Charging - <u>DTC P1F59, P1F5A, or P1F5B</u>
P1F5A	12 V Starting and Charging - <u>DTC P1F59, P1F5A, or P1F5B</u>
P1F5B	12 V Starting and Charging - <u>DTC P1F59, P1F5A, or P1F5B</u>
P1F5D	12 V Starting and Charging - <u>DTC P1F5D or P1F5E</u>
P1F5E	12 V Starting and Charging - <u>DTC P1F5D or P1F5E</u>
P1F63	Hybrid/EV Controls - <u>DTC P1F63-P1F65</u>
P1F64	Hybrid/EV Controls - <u>DTC P1F63-P1F65</u>
P1F65	Hybrid/EV Controls - <u>DTC P1F63-P1F65</u>
P1FA6	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FA7	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FA8	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FA9	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FAA	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FAB	Data Communications - <u>DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B</u>
P1FAC	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FAD	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FAE	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FAF	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>

DTC	Diagnostic Procedure
	<u>P303C-P303F, or P3042</u>
P1FBF	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FC0	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FC1	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FC2	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FC3	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC4	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC5	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC6	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC7	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC8	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P1FC9	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCA	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCB	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCC	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCD	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCE	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P1FCF	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P1FD0	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>

DTC	Diagnostic Procedure
P1FD1	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD2	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD3	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD4	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD5	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD6	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD7	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD8	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD9	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE0	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE1	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE2	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE3	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE4	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE5	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE6	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE7	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE8	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE9	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF0	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF1	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF2	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF3	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FFB	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFC	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFD	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFE	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFF	Hybrid/EV System Heating and Cooling - DTC P1FFF
P2088	Engine Controls and Fuel - 1.5L (L3A) - DTC P0010, P0013, or P2088-P2091
P2089	Engine Controls and Fuel - 1.5L (L3A) - DTC P0010, P0013, or P2088-P2091
P2090	Engine Controls and Fuel - 1.5L (L3A) - DTC P0010, P0013, or P2088-P2091
P2091	Engine Controls and Fuel - 1.5L (L3A) - DTC P0010, P0013, or P2088-P2091

DTC	Diagnostic Procedure
P2096	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2096 or P2097</u>
P2097	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2096 or P2097</u>
P2101	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1516, P2101, P2119, or P2176</u>
P2119	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1516, P2101, P2119, or P2176</u>
P2122	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2122, P2123, P2127, P2128, or P2138</u>
P2123	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2122, P2123, P2127, P2128, or P2138</u>
P2127	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2122, P2123, P2127, P2128, or P2138</u>
P2128	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2122, P2123, P2127, P2128, or P2138</u>
P2135	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0121-P0123, P0222, P0223, P16A0-P16A2, or P2135</u>
P2138	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2122, P2123, P2127, P2128, or P2138</u>
P2147	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2148	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2150	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2151	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2153	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2154	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2156	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P2157	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0201-P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, or P2157</u>
P215A	Antilock Brake System - <u>DTC P215A</u>
P215B	Automatic Transmission - 5ET50 (MKV) - <u>DTC P215B</u>
P215C	Automatic Transmission - 5ET50 (MKV) - <u>DTC P215C</u>
P2176	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P1516, P2101, P2119, or P2176</u>
P2181	Engine Heating and Cooling - <u>DTC P2181</u>
P2199	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2199</u>
P219A	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P219A</u>
P2227	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2227-P2230</u>

DTC	Diagnostic Procedure
P2228	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2227-P2230</u>
P2229	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2227-P2230</u>
P2230	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2227-P2230</u>
P2270	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P2271	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</u>
P228C	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0089, P00C6, P228C, or P228D</u>
P228D	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0089, P00C6, P228C, or P228D</u>
P2299	Antilock Brake System - <u>DTC P2299</u>
P2300	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2301	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2303	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2304	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2306	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2307	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2309	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2310	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, or P2310</u>
P2400	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2400-P2402</u>
P2401	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2400-P2402</u>
P2402	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2400-P2402</u>
P2418	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2418-P2420</u>
P2419	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2418-P2420</u>
P2420	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2418-P2420</u>
P2422	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2422</u>
P2450	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2450</u>
P2457	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2457</u>
P24B9	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P24B9-P24BB</u>
P24BA	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P24B9-P24BB</u>
P24BB	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P24B9-P24BB</u>
P2516	HVAC - Automatic - <u>DTC P151C or P2516-P2518</u>
P2517	HVAC - Automatic - <u>DTC P151C or P2516-P2518</u>
P2518	HVAC - Automatic - <u>DTC P151C or P2516-P2518</u>
P2534	Wiring Systems and Power Management - <u>DTC P2534 or P2535</u>

DTC	Diagnostic Procedure
P2535	Wiring Systems and Power Management - <u>DTC P2534 or P2535</u>
P2537	Wiring Systems and Power Management - <u>DTC P2537</u>
P2561	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P257D	Bolted Exterior Body Panels and Closures - <u>DTC P257D-P257F</u>
P257E	Bolted Exterior Body Panels and Closures - <u>DTC P257D-P257F</u>
P257F	Bolted Exterior Body Panels and Closures - <u>DTC P257D-P257F</u>
P25A2	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P25AF	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P25C6	Hydraulic Brakes - <u>DTC P25C6 or P25C7</u>
P25C7	Hydraulic Brakes - <u>DTC P25C6 or P25C7</u>
P25C9	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>
P2618	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2618</u>
P262B	Data Communications - <u>DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B</u>
P262B	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, or P262B</u>
P2635	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P2635</u>
P2670	Automatic Transmission - 5ET50 (MKV) - <u>DTC P2670 or P2671</u>
P2671	Automatic Transmission - 5ET50 (MKV) - <u>DTC P2670 or P2671</u>
P263A	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0650, P263A, or P263B</u>
P263B	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P0650, P263A, or P263B</u>
P2682	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P2683	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26A5	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26A6	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26A7	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26A9	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26AD	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26AE	HVAC - Automatic - <u>DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, or P26AE</u>
P26C8	Engine Controls and Fuel - 1.5L (L3A) - <u>DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9</u>

DTC	Diagnostic Procedure
P26C9	Engine Controls and Fuel - 1.5L (L3A) - DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, or P26C9
P2718	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2720	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2721	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2727	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2729	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2730	Automatic Transmission - 5ET50 (MKV) - DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, or P2730
P2797	Hybrid/EV Controls - DTC P2797
P27A7	Automatic Transmission - 5ET50 (MKV) - DTC P27A7
P3030	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P3031	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3032	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3033	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3034	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3035	Hybrid/EV Energy Storage - DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040
P3036	Hybrid/EV Energy Storage - DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041
P3037	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3038	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P3039	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P303A	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P303B	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P303C	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042

DTC	Diagnostic Procedure
P303D	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P303E	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P303F	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P3040	Hybrid/EV Energy Storage - <u>DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040</u>
P3041	Hybrid/EV Energy Storage - <u>DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041</u>
P3042	Data Communications - <u>DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042</u>
P3043	Hybrid/EV Energy Storage - <u>DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045</u>
P3044	Hybrid/EV Energy Storage - <u>DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045</u>
P3045	Hybrid/EV Energy Storage - <u>DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045</u>
P3061	Hybrid/EV Energy Storage - <u>DTC P0C78 or P3061</u>
P3260	Hybrid/EV Controls - <u>DTC P3260</u>
U0020	Data Communications - <u>DTC U0020</u>
U0028	Data Communications - <u>DTC U0028</u>
U0029	Data Communications - <u>DTC U0029</u>
U0073	Data Communications - <u>DTC U0073 or U2100</u>
U0074	Data Communications - <u>DTC U0074</u>
U0075	Data Communications - <u>DTC U0075</u>
U0077	Data Communications - <u>DTC U0077</u>
U0078	Data Communications - <u>DTC U0078</u>
U007A	Data Communications - <u>DTC U007A</u>
U0100-U02FF	Data Communications - <u>DTC U0100-U02FF</u>
U0300-U0336	Data Communications - <u>DTC U0300-U0336</u>
U0400-U05FF	Data Communications - <u>DTC U0400-U05FF</u>
U1340-U135F	Data Communications - <u>DTC U1340-U135F</u>
U1500-U15FF	Data Communications - <u>DTC U1500-U15FF</u>
U179A	Data Communications - <u>DTC U179A</u>
U179D	Data Communications - <u>DTC U179D</u>
U1803	Data Communications - <u>DTC U1803</u>

DTC	Diagnostic Procedure
U1806	Data Communications - <u>DTC U1806</u>
U180B	Data Communications - <u>DTC U180B</u>
U1814	Data Communications - <u>DTC U1814</u>
U1817	Data Communications - <u>DTC U1817</u>
U1818	Data Communications - <u>DTC U1818</u>
U182D	Data Communications - <u>DTC U182D</u>
U182E	Data Communications - <u>DTC U182E or U182F</u>
U182F	Data Communications - <u>DTC U182E or U182F</u>
U1833	Data Communications - <u>DTC U1833</u>
U183E	Data Communications - <u>DTC U183E</u>
U1845	Data Communications - <u>DTC U1845 or U1846</u>
U1846	Data Communications - <u>DTC U1845 or U1846</u>
U184A	Data Communications - <u>DTC U184A</u>
U184B	Data Communications - <u>DTC U184B</u>
U184C	Data Communications - <u>DTC U184C</u>
U184D	Data Communications - <u>DTC U184D</u>
U184E	Data Communications - <u>DTC U184E</u>
U185A	Data Communications - <u>DTC U185A</u>
U185B	Data Communications - <u>DTC U185B</u>
U1860	Data Communications - <u>DTC U1860</u>
U1876	Data Communications - <u>DTC U1876</u>
U1879	Data Communications - <u>DTC U1879</u>
U1885	Data Communications - <u>DTC U1885</u>
U18A2	Data Communications - <u>DTC U18A2</u>
U18B5	Data Communications - <u>DTC U18B5</u>
U18B9- U18BF	Data Communications - <u>DTC U18B9-U18BF</u>
U2098	Data Communications - <u>DTC U2098</u>
U2099	Data Communications - <u>DTC U2099</u>
U2100	Data Communications - <u>DTC U0073 or U2100</u>
U2160- U2231	Data Communications - <u>DTC U2160-U2231</u>
U2401	Data Communications - <u>DTC U2401</u>
U2602	Data Communications - <u>DTC U2602</u>
U2603- U2606	Data Communications - <u>DTC U2603-U2606 or U2617-U2624</u>
U2616	Data Communications - <u>DTC U2616</u>
U2617- U2624	Data Communications - <u>DTC U2603-U2606 or U2617-U2624</u>
U3000	Data Communications - <u>DTC U3000</u>

DTC	Diagnostic Procedure
U3001	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3003	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3006-U3009	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3012	Data Communications - <u>DTC U3012</u>
U3013	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3014	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3018	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3019	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>
U3500-U350B	12 V Starting and Charging - <u>DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B</u>

SYMPTOM BYTE LIST

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(00 - 0F) General Electrical Failures		
This category includes standard wiring failure modes (for example, shorts and opens), direct current (DC) quantities related by Ohm's Law and quantities related to amplitude, frequency or rate of change, and wave shape.		
00	-	This sub type is used for failures that cannot be assigned to a specific sub type. No additional information is available.
01	Short to Battery	This sub type is used for failures where the Electronic Control Unit measures vehicle system (battery positive) potential for greater than a specified time period or when some other value is expected.
02	Short to Ground	This sub type is used for failures where the Electronic Control Unit measures ground (battery negative) potential for greater than a specified time period or when some other value is expected.
03	Low Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage below a specified range but not necessarily a short to ground.
04	Open	This sub type is used for failures where the Electronic Control Unit determines an open

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
		circuit via lack of bias voltage, low current flow, no change in state of an input in response to an output, etc.
05	High Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
06	Low Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
07	High Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage above a specified range but not necessarily a short to battery.
08	Performance - Signal Invalid	This sub type is used for failures where the value of the signal is not plausible given the operating conditions.
09	Too Fast Transitions	This sub type is used for failures where the signal transitions more quickly than is reasonably allowed.
0A	Too Slow Transitions	This sub type is used for failures where the signal transitions more slowly than is reasonably allowed.
0B	High Current	This sub type is used for failures where the Electronic Control Unit measures current flow above a specified range.
0C	Low Current	This sub type is used for failures where the Electronic Control Unit measures current flow below a specified range.
0D	High Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance above a specified range.
0E	Low Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance below a specified range.
0F	Signal Erratic	This sub type is used for failures where the signal is momentarily implausible (not long enough for Signal Invalid) or discontinuous.
(10 - 1F) Additional General Electrical Failures		
This category includes the overflow from category 0.		
10	-	Currently not used.
11	High Input	This sub type is used for failures where some circuit quantity is above a specified range.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
12	Low Input	This sub type is used for failures where some circuit quantity is below a specified range.
13	Low Voltage/High Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage below a specified range.
14	High Voltage/Low Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage above a specified range.
15	Performance - Signal Rising Time Failure	This sub type is used for failures where the signal rise time is outside a specified range.
16	Performance - Signal Falling Time Failure	This sub type is used for failures where the signal fall time is outside a specified range.
17	Performance - Signal Shape/Waveform Failure	This sub type is used for failures where the shape of the signal (plot of the amplitude with respect to time) is not correct (for example, improper circuit impedance.)
18	Low Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage below a specified range but not necessarily a short to ground (for example, gain too low).
19	High Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage above a specified range but not necessarily a short to battery (for example, gain too high).
1A	Performance - Bias Level Out of Range	This sub type is used for failures where the Electronic Control Unit applies a bias voltage to a circuit upon which is superimposed a signal voltage (for example, Oxygen Sensor Circuit.)
1B	Signal Cross Coupled	This sub type is used for failures where the Electronic Control Unit detects a circuit shorted to another circuit when both circuits are controlled by the Electronic Control Unit.
1C	-	Currently not used.
1D	-	Currently not used.
1E	-	Currently not used.
1F	Erratic	This sub type is used for failures where the Electronic Control Unit momentarily detects one of the conditions defined above but not long enough to set a specific sub type.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(20 - 2F) FM/PWM Failures		
This category includes faults related to Frequency Modulated (FM) and Pulse Width Modulated (PWM) inputs and outputs of the Electronic Control Unit and faults where position is determined by counts.		
20	-	Currently not used.
21	Incorrect Period	This sub type is used for failures where the Electronic Control Unit measures an incorrect duration for one cycle of the output.
22	Too Short Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too narrow with respect to time.
23	Too Long Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too wide with respect to time.
24	Too Short High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too narrow with respect to time.
25	Too Long High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too wide with respect to time.
26	Low Frequency	This sub type is used for failures where the Electronic Control Unit detects too few cycles in a given time period.
27	High Frequency	This sub type is used for failures where the Electronic Control Unit detects too many cycles in a given time period.
28	Incorrect Frequency	This sub type is used for failures where the Electronic Control Unit measures an incorrect number of cycles in a given time period.
29	Too Few Pulses	This sub type is used for failures where the Electronic Control Unit measures too few pulses (for example, position is calibrated in counts from one extreme to the other).
2A	Too Many Pulses	This sub type is used for failures where the Electronic Control Unit measures too many pulses (for example, position is calibrated in counts from one extreme to the other).
2B	Missing Reference	This sub type is used for failures where the Electronic Control Unit does not detect a reference for a signal circuit or a group of signal circuits.
2C	-	Currently not used.
2D	-	Currently not used.
2E	-	Currently not used.
2F	-	Currently not used.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(30 - 3F) Electronic Control Unit Internal Failures		
This category includes faults related to memory, software, and internal electrical circuitry; requiring component replacement.		
30	-	Currently not used.
31	Internal Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
32	General Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where memory type is not specified.
33	Special Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where the specific memory type is not defined in this category.
34	RAM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) failure.
35	ROM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Read Only Memory (ROM) failure.
36	EEPROM Performance/Malfunction	This sub type is used by the Electronic Control Unit to indicate an Electrically Erasable Programmable Read Only Memory (EEPROM) failure.
37	Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a failure in the execution of operational software
38	Supervision Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a loop time error in the execution of the operational software.
39	Internal Malfunction	This sub type is used by the Electronic Control Unit to indicate the detection of an internal circuit failure.
3A	Incorrect Component Installed	This sub type is used by the Electronic Control Unit to indicate a mismatch between the hardware connected to the Electronic Control Unit and the hardware expected by the Electronic Control Unit.
3B	Self-Test Malfunction	This sub type is used by the Electronic Control Unit to indicate a sensor self-test failure launched by an Electronic Control Unit command.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
3C	Internal Communication Malfunction	This sub type is used by the Electronic Control Unit to indicate loss of an internal communication line, for example, between microprocessors in a dual microprocessor configuration.
3D	-	Currently not used.
3E	-	Currently not used.
3F	-	Currently not used.
(40 - 4F) Electronic Control Unit Programming Failures		
This category includes faults related to operational software, calibrations, and options; remedied by programming the Electronic Control Unit.		
40	-	Currently not used.
41	Not Programmed	This sub type is used to indicate that only boot software is present in the Electronic Control Unit.
42	Calibration Not Programmed	This sub type is used to indicate that operational software is present but calibration data is not.
43	EEPROM Incorrect Programming	This sub type is used to indicate an EEPROM error that may be remedied by reprogramming the module.
44	Security Access Not Activated	This sub type is used to indicate that programming was attempted without unlocking the Electronic Control Unit.
45	Variant Not Programmed	This sub type is used to indicate the need to enter (program) the sub system option content.
46	Configuration Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle option content.
47	VIN Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle identification number (VIN).
48	Security Code Not Programmed	This sub type is used to indicate the need to enter (program) the theft/security code.
49	RAM Incorrect Programming	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) error remedied by reprogramming.
4A	Programming Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
4B	Calibration Not Learned	This sub type is used by the Electronic Control Unit to indicate that a password, operational range, etc. for a sensor or actuator must be learned by the Electronic Control Unit.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
4C	DTC Memory Full	This sub type is used by the Electronic Control Unit to indicate that more DTCs have been detected than can be accommodated by the memory allocated for DTC storage.
4D	Stack Overflow	This subtype is used by the Electronic Control Unit to indicate that more memory has been used in a stack than is allocated to a program.
4E	-	Currently not used.
4F	-	Currently not used.
(50 - 5F) Algorithm Based Failures		
This category includes faults based on comparing two or more input parameters for plausibility or comparing a single parameter to itself with respect to time.		
50	-	Currently not used.
51	-	Currently not used.
52	-	Currently not used.
53	Low Temperature	This sub type is used for failures where the Electronic Control Unit calculates a low temperature condition based upon the duration of certain operating parameters.
54	High Temperature	This sub type is used for failures where the Electronic Control Unit calculates a high temperature condition based upon the duration of certain operating parameters.
55	Too Few Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects fewer than the expected number of transitions.
56	Too Many Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects more than the expected number of transitions.
57	-	Currently not used.
58	Performance	This sub type is used for failures where the Electronic Control Unit does not see the expected change to a parameter or group of parameters in response to a particular event.
59	Protection Time-Out	This sub type is used for failures where the Electronic Control Unit detects a function is active for greater than a specified time period.
5A	Not Plausible	This sub type is used for failures where the Electronic Control Unit compares two or more input parameters for plausibility.
5B	-	Currently not used.
5C	-	Currently not used.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
5D	-	Currently not used.
5E	-	Currently not used.
5F	-	Currently not used.
(60 - 6F) Mechanical Failures		
This category includes faults detected by inappropriate motion in response to an Electronic Control Unit controlled output.		
60	-	Currently not used.
61	Stuck	This sub type is used for failures where the Electronic Control Unit does not detect any motion in response to energizing a motor, solenoid, relay, etc.
62	Stuck Open	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to close some piece of equipment.
63	Stuck Closed	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to open some piece of equipment.
64	Slip Detected	This sub type is used for failures where the Electronic Control Unit detects excessive duration to command a motor, solenoid, relay, etc., to move a piece of equipment to a desired position.
65	Emergency Position Not Achievable	This sub type is used for failures where the Electronic Control Unit is unable to command a motor, solenoid, relay, etc., to move a piece of equipment to the emergency position.
66	Incorrect Mounting	This sub type is used for failures where the server detects incorrectly mounted components, for example, acceleration sensor showing a position error of 90°.
67	Incorrect Assembly	This sub type is used for failures where the control module has detected that the component has been incorrectly installed (for example, hydraulic pipes crossed over, circuits cross wired) or polarity errors.
68	-	Currently not used.
69	-	Currently not used.
6A	-	Currently not used.
6B	-	Currently not used.
6C	-	Currently not used.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
6D	-	Currently not used.
6E	-	Currently not used.
6F	-	Currently not used.
(70 - 7F) Bus Signal/Message Failures		
This category includes faults related to bus hardware and signal integrity. This category is also used when the physical input for a signal is located in one Electronic Control Unit and another Electronic Control Unit diagnoses the circuit.		
70	-	Currently not used.
71	Invalid Data	This sub type is used by the Electronic Control Unit to indicate a signal was received with the corresponding validity bit equal to Invalid or post processing of the signal determines it is invalid.
72	Message Counter Incorrect	This sub type is used by the Electronic Control Unit to indicate a signal was received without the corresponding rolling count value being properly updated.
73	Parity Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect parity calculation.
74	Bus Signal Checksum Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect protection (checksum) calculation.
75	Serial Data Link High Input	This sub type is used for failures where some circuit quantity, reported via serial data, is above a specified range.
76	Serial Data Link Low Input	This sub type is used for failures where some circuit quantity, reported via serial data, is below a specified range.
77	-	Currently not used.
78	-	Currently not used.
79	-	Currently not used.
7A	-	Currently not used.
7B	-	Currently not used.
7C	-	Currently not used.
7D	-	Currently not used.
7E	-	Currently not used.
7F	Bus Signal Erratic	This sub type is used for failures where the signal, reported via serial data, is momentarily implausible or discontinuous.
(80 - FF) Reserved		
Unique System Specific - See specific diagnostic procedures for symptom byte information if these symptom bytes are used.		

SYMPTOMS - VEHICLE

Body Repair

- [Symptoms - Bolted Exterior Body Panels and Closures](#)
- [Symptoms - Active Grille Air Shutter](#)

Body Systems

- [Symptoms - Fixed and Moveable Windows](#)
- [Symptoms - Horns](#)
- [Symptoms - Lighting](#)
- [Symptoms - Mirrors](#)
- [Symptoms - Vehicle Access](#)
- [Symptoms - Wiper/Washer Systems](#)

Brakes

- [Symptoms - Antilock Brake System](#)
- [Symptoms - Hydraulic Brakes](#)
- [Symptoms - Park Brake](#)

Driveline/Axle

[Symptoms - Wheel Drive Shafts](#)

Driver Information and Entertainment

- [Symptoms - Cellular Communication](#)
- [Symptoms - Entertainment](#)
- [Symptoms - Displays and Gauges](#)
- [Symptoms - Secondary and Configurable Customer Controls](#)

Engine

- [Symptoms - Engine Electrical](#)
- [Symptoms - Cruise Control](#)
- [Symptoms - Engine Controls](#)
- [Symptoms - Engine Cooling](#)
- [Symptoms - Engine Mechanical](#)
- [Symptoms - Engine Exhaust](#)
- [Symptoms - Hybrid Controls](#)

General Information

[Symptoms - Vibration Diagnosis and Correction](#)

HVAC

Symptoms - HVAC Systems - Automatic

Power and Signal Distribution

- Symptoms - Data Communications
- Symptoms - Mobile Device Wireless Charger
- Symptoms - Power Outlets
- Symptoms - Wiring Systems

Safety and Security

- Symptoms - Immobilizer
- Symptoms - Object Detection
- Symptoms - Remote Functions
- Symptoms - Seat Belts
- Symptoms - SIR
- Symptoms - Theft Deterrent

Seats

Symptoms - Seat Heating and Cooling

Steering

- Symptoms - Power Steering System
- Symptoms - Steering Wheel and Column

Suspension

- Symptoms - Suspension General Diagnosis
- Symptoms - Tire Pressure Monitoring

Transmission

- Symptoms - Automatic Transmission
- Symptoms - Automatic Transmission Shift Lock Control

ENGINE CRANKS BUT DOES NOT RUN

Refer to the appropriate diagnostic procedure below for the vehicle being serviced.

Engine Cranks But Does Not Run - 1.5L (L3A L3G LFV) engine

INSPECTION/MAINTENANCE SYSTEM CHECK

Refer to the appropriate diagnostic procedure below for the vehicle being serviced.

Inspection/Maintenance System Check - 1.5L (L3A L3G LFV) engine

DIAGNOSTIC REPAIR VERIFICATION

NOTE: After a repair has been made, some DTCs require the ignition to be turned OFF then back ON before the scan tool function will clear the DTC.

1. Vehicle OFF.
2. Install any components or connectors that have been removed or replaced during diagnosis.
3. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
4. Vehicle in Service Mode.
5. Clear the DTCs.
6. Vehicle OFF for 60 seconds.
7. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and perform the appropriate diagnostic procedure.

Or

If the repair was symptom related, duplicate the conditions under which the customer concern occurred to verify the repair. If the customer concern reoccurs or another symptom is present, return to [Symptoms - Vehicle](#) and perform the appropriate symptom diagnostic.

Article GUID: A00884635

GENERAL INFORMATION

Vehicle Diagnostic Information - Specifications - Volt

SPECIFICATIONS

K20 ENGINE CONTROL MODULE: SCAN TOOL INFORMATION

The engine control module scan tool data list contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the engine scan tool data list only after the following is determined:

- The [Diagnostic System Check - Vehicle](#) is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The engine scan tool data list represents values that may be seen on a normally running engine.

NOTE: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to [Symptoms - Engine Controls](#) for engine diagnosis.

Engine Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories Off/Brake Pedal Released			
5 V Reference 1, 2, 3, or 4	Vehicle ON	5 V	This parameter displays the voltage sensed on the 5 V reference circuits at the control module. The scan tool will display a higher value at higher voltage. The scan tool will display a lower value at lower voltage.
5 V Reference 1, 2, 3, or 4 Circuit Status	Vehicle ON	OK	This parameter displays OK if there is no 5 V reference circuit condition. If the circuit is shorted to ground or shorted to B+, Malfunction is displayed.
Accelerator Pedal Position	Accelerator pedal not actuated	0 %	This parameter displays the angle of the APP as calculated by the control module using the signals from the APP

Parameter	System State	Expected Value	Description
	Accelerator pedal fully actuated	100 %	sensors.
Accelerator Pedal Position	-	%	This parameter displays the angle of the accelerator pedal position (APP) as calculated by the control module using the signals from the APP sensors.
Accelerator Pedal Position When Engine Overspeed Detected	-	%	This parameter displays the accelerator pedal position (APP) observed upon initial detection of an overspeed condition. This value will be updated upon each overspeed condition.
A/C Compressor Clutch Relay Command	A/C ON	ON	This parameter displays the state of the air conditioning (A/C) clutch relay control circuit as commanded by the control module.
A/C Compressor Clutch Relay Control Circuit High Voltage Test Status	A/C ON or OFF	OK/Not Run	This parameter displays the state of the air conditioning (A/C) clutch relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
A/C Compressor Clutch Relay Control Circuit Low Voltage Test Status	A/C ON or OFF	OK/Not Run	This parameter displays the state of the air conditioning (A/C) clutch relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
A/C Compressor Clutch Relay Control Circuit Open Test Status	A/C ON or OFF	OK/Not Run	This parameter displays the state of the air conditioning (A/C) clutch relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
A/C Disable - A/C Pressure Out of Range	A/C ON	No	This parameter displays whether the A/C pressure is out of range for normal operation as determined by the control module.
A/C Disengage 1 - 8 History	A/C ON	Reason for A/C Disengagement	The parameter displays the reason the air conditioning (A/C) compressor was disengaged. The scan tool displays None, A/C Pressure, Engine Speed, Battery Voltage, Anti Stall, RPM Unstable, wide open throttle (WOT), Launch Performance, Coolant Hot,

Parameter	System State	Expected Value	Description
			Accelerator Pedal Position (APP), Air Bag Deploy, or A/C Relay DTC.
A/C High Side Pressure Sensor	A/C OFF	0.75 - 1.5 V*	This parameter displays the voltage from the A/C high side pressure sensor signal circuit to the control module. *Varies with temperature and relative humidity.
	A/C ON	1.3 - 2.5 V*	
A/C High Side Pressure Sensor	A/C OFF	450 - 650 kPa* (65 - 95 (PSI))*	This parameter displays the pressure from the A/C high side pressure sensor signal circuit to the control module. *Varies with temperature and relative humidity.
	Engine Speed at 2 000 RPM	900 - 2 350 kPa* (162 - 341 PSI)*	
A/C OFF for WOT	A/C ON	No	This parameter displays whether the control module is commanding the A/C compressor clutch relay OFF for WOT.
A/C Request Signal	A/C ON	Yes	This parameter displays the state of the A/C request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls.
A/C System Refrigerant Monitor Enabled This Ignition Cycle	-	Yes	The scan tool displays Yes when the A/C System Refrigerant Monitor is Enabled. If the scan tool displays No this could indicate a malfunction in the A/C System Refrigerant Monitor circuit. The A/C system must be turned ON for the diagnostic to run.
Air/Fuel Equivalence Ratio Command	-	Varies	This parameter displays the ratio of air to fuel as calculated by the control module based on various sensor inputs. The scan tool will display a lower air fuel ratio when a richer air to fuel mixture is commanded. The scan tool will display a higher air fuel ratio when a leaner air to fuel mixture is commanded. In closed loop operation the air fuel ratio should normally be approximately 14.7:1.
Ambient Air Temperature	-	Â°C (Â°F) Varies	This parameter displays the surrounding air temperature, at any given altitude.
APP Sensor 1	Accelerator pedal not actuated	0.88 - 1.08 V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 1 signal circuit

Parameter	System State	Expected Value	Description
	Accelerator pedal fully actuated	4.17 - 4.37 V	as measured by the control module.
APP Sensor 1 and 2	-	Agree	This parameter displays the results of a control module test that compares the signals from the APP sensors 1 and 2. The scan tool will display Agree or Disagree. Agree indicates that APP sensor 1 and APP sensor 2 voltages correspond to the same accelerator pedal position. Disagree indicates that APP sensor 1 and APP sensor 2 voltages correspond to different accelerator pedal positions.
APP Sensor 1 Circuit Status	Vehicle ON	OK	APP Sensor 1 Out of Range indicates that the sensed accelerator pedal position 1 sensor value is currently out of range or that a Malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 1 Position	Accelerator pedal not actuated	0 %	This parameter displays the angle of the APP sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
	Accelerator pedal fully actuated	100 %	
APP Sensor 2	Accelerator pedal not actuated	0.39 - 0.59 V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 2 signal circuit as measured by the control module.
	Accelerator pedal fully actuated	2.02 - 2.22 V	
APP Sensor 2 Circuit Status	Vehicle ON	OK	APP Sensor 2 Out of Range indicates that the sensed accelerator pedal position 2 sensor value is currently out of range or that a Malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 2 Position	Accelerator pedal not	0 %	This parameter displays the angle of the APP sensor 2 as calculated by the

Parameter	System State	Expected Value	Description
	actuated		control module using the signal from the APP sensor 2. APP sensor 2 is a
	Accelerator pedal fully actuated	100 %	range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
APP Sensors	-	0 %	This parameter displays the average of the APP sensors as calculated by the throttle actuator control (TAC) module. The APP average is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
Autostart Inhibit Reason Autostart/Autostop Malfunction	-	No	This parameter displays that a immediate stop was commanded due to a Autostart/Autostop malfunction.
Autostart Inhibit Reason	-	No	The scan tool displays Yes if one of the following Autostart Inhibit Reason is detected. Control Function Active, Crank Abort, ECM Malfunction, ECM Request, Hood Ajar, Hybrid/EV Battery Pack Contactor Open, Hybrid/EV Battery Pack Power Low, Hybrid/EV Battery Pack State of Charge Low, Hybrid/EV Battery Pack Voltage Low, Hybrid/EV Propulsion System Inactive, Not Commanded, Run/Crank Not Active, Transmission Range.
Autostart Reason	-	No	This parameter displays Yes if one of the following Autostart Reason is detected. A/C Request, Acceleration Request, Accelerator Pedal Pressed, Auxiliary Transmission Fluid Pump Not Available, Brake Booster Weak Vacuum, Brake Pedal Released, Control Function Active, Drive Motor Inverter Temperature High, Drive Motor Temperature High, ECM Request, Engine Coolant Temperature Out of Range, Hood Ajar, Hybrid/EV Battery Module Voltage Low, Hybrid/EV Battery Pack Power Low, Hybrid/EV Battery Pack State of

Parameter	System State	Expected Value	Description
			Charge Low, Hybrid/EV Battery Pack Temperature, Hybrid/EV Battery Pack Voltage Low, Hybrid/EV Propulsion System Inactive, Ignition Switch Start, Inclination, Invalid Data Received, Low Voltage Battery Discharge Current High, Low Voltage Battery State of Function Low, Low Voltage Battery State of Health Low, Low Voltage Battery Voltage Low, Maximum Autostop Time Exceeded, Minimum Engine Run Time Not met, Reduced Engine Power Active, Remote Vehicle Start Request, System Optimization, System Voltage Low, TCM Demand, Tow/Haul Mode Switch ON, Transmission Fluid Temperature Out of Range, Transmission In Reverse, Transmission Range, Vehicle Speed Too High.
Autostop Disable Reason	-	No	The scan tool displays Yes if one of the following Autostop Disable Reason is detected. 12 V Start Counter Exceeded, A/C Request, Acceleration Request, Accelerator Pedal Pressed, Auxiliary Transmission Fluid Pump Not Available, Brake Booster Weak Vacuum, Brake Pedal Released, Control Function Active, Drive Motor Inverter Temperature High, Drive Motor Temperature High, ECM Request, Engine Coolant Temperature Out of range, Engine Speed High, Generator Load High, Hood Ajar, Hybrid/EV Battery Module Voltage Low, Hybrid/EV Battery Pack Power Low, Hybrid/EV Battery Pack State of Charge Low, Hybrid/EV Battery Pack Temperature, Hybrid/EV Battery Pack Voltage Low, Hybrid/EV Propulsion System Inactive, Idle Boost Mode Active, Ignition Switch Start, Intake Manifold Weak Vacuum, Invalid Data Received, Low Voltage Battery Discharge Current High, Low Voltage Battery State of Charge Low, Low

Parameter	System State	Expected Value	Description
			Voltage Battery State of Function Low, Low Voltage Battery State of Health Low, Low Voltage Battery Temperature Out of Range, Low Voltage Battery Voltage Low, Maximum Vehicle Stop Time Exceeded, Minimum Engine Run Time Not Met, Reduced Engine Power Active, Remote Vehicle Start Request, Run/Crank Not Active, Stop/Start Select Switch, System Optimization, System Voltage Low, TCM Request, Tow/Haul Mode Switch ON, Transmission Fluid Temperature Out of Range, Transmission in Reverse, Transmission Range, Vehicle Inclination, Vehicle Speed Threshold Not Reached, Vehicle Speed Too High, Wheel Slip Detected.
Average Fuel Age	-	Days	This parameter displays the average age of the fuel in the vehicle's fuel tank.
Axle Torque Command	-	Y	This parameter displays the torque request for the slow response air path (control of the throttle). Based on current conditions the hybrid controller determines the optimum engine torque, which it sends as a request to the Engine Control Module.
BARO	-	65 - 104 kPa (8 - 16 PSI) - Varies with altitude	This parameter displays the barometric pressure (BARO). The control module uses the barometric pressure sensor input for fuel control to compensate for altitude differences.
Brake Pedal Position Signal	-	Released	This parameter displays the serial data message of the brake position sensor signal from the electronic brake and traction control module.
Calculated Air Flow	-	g/s Varies	This parameter displays the air flow of the engine as calculated by the control module.
Calculated Catalyst Temperature	-	Â°C (Â°F) Varies	This parameter displays the catalyst converter temperature as calculated by the engine control module.
Calculated Engine Oil Temperature	-	Â°C (Â°F) Varies	This parameter displays the temperature of the engine oil as

Parameter	System State	Expected Value	Description
			calculated by the control module using various sensor inputs. The engine oil temperature calculated has a range of values indicating a low value when the oil temperature is low to a high value when the oil temperature is high.
Calculated Time Until Next Engine Maintenance Mode	-	Days	This parameter displays the estimated time remaining until the next engine maintenance mode is required.
Calculated Time Until Next Engine Maintenance Mode	-	0 to 255 Days	Estimated time remaining until next engine maintenance mode.
Calculated Time Until Next Fuel Maintenance Mode	-	Days	This parameter displays the estimated time remaining until the next fuel maintenance mode is required.
Calculated Time Until Next Fuel Maintenance Mode	-	0 to 255 Days	Estimated time remaining until next fuel maintenance mode.
Camshaft Position	-	Varies	This parameter displays the position of the intake camshaft in terms of degrees of camshaft rotation (advance) from the park position (a value of zero represents the park position).
Camshaft Position Active Counter	-	0 - 255 Counts	This parameter displays an incrementing counter when the control module receives a signal from the camshaft position sensors.
Camshaft Position Command	-	%	This parameter displays the commanded duty cycle for the intake cam phase output.
Camshaft Position Sensor	-	Engine Speed	This parameter displays the speed of the engine as calculated by the signal from the camshaft position sensor, shown in RPM.
Catalyst Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the monitor completion status during the current driving/monitoring cycle.
Catalyst Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the monitor enable status during the current driving/monitoring cycle.
Catalyst Monitor Not At Idle Test Conditions Met	-	Yes/No	This parameter displays the status of the catalyst monitor diagnostic. Off Idle Conditions Met indicates if the off idle conditions for the catalyst monitor diagnostic have been met. Once the Off Idle Conditions are met the vehicle can return to idle and allow the catalyst

Parameter	System State	Expected Value	Description
			monitor diagnostic test to run.
Catalyst Monitor Test Counter	-	0 Counts	This parameter displays the number of iterations of the catalyst monitor diagnostic test that have been performed since a code clear (used to determine if a sufficient number of tests have run to report a passing condition).
Catalyst Monitor Test Result	-	Varies	This parameter displays the status of the catalyst monitor diagnostic.
Catalyst Monitor Test State	-	Varies	This parameter displays when the catalyst monitor diagnostic is actively running a test. This condition will only be true when the vehicle is at idle.
Charging Mode	-	Depleting or Continuous	This parameter displays the currently active charging mode for an extended range electric vehicle.
Cold Start Up	-	Varies	This parameter displays whether the engine meets the conditions for a cold startup during the present ignition cycle. The scan tool displays Yes when the conditions for a cold startup are met during this ignition cycle. The scan tool displays No when the conditions for a cold startup are not met during the present ignition cycle. Conditions for a cold startup require the coolant temperature and the intake air temperature to be below a predetermined temperature and within a certain range of each other. These conditions must occur after the engine was warmed up to a specific temperature during the previous ignition cycle.
Component Monitor Complete	-	No	This parameter displays Yes when the Component Monitor is Complete. The engine control module looks at many input and output components to make this determination. If a malfunction is detected, the scan tool will display No.
Component Monitor Enabled	-	No	This parameter displays Yes when Component Monitor is Enabled, and No when it is not Enabled.

Parameter	System State	Expected Value	Description
Cooling Fan Control Circuit High Voltage Test Status	-	Not Run	This parameter displays the diagnostic state of the output driver for the cooling fan relay control circuit. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
Cooling Fan Control Circuit Low Voltage Test Status	-	Not Run	This parameter displays the diagnostic state of the output driver for the cooling fan relay control circuit. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
Cooling Fan Control Circuit Open Test Status	-	Not Run	This parameter displays the diagnostic state of the output driver for the cooling fan relay control circuit. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
Cooling Fan Motor Command	-	%	This parameter displays the amount of cooling commanded by the ECM in a percentage.
CPP Learned Apply Position	-	Volts	This parameter displays the position learned for the clutch pedal position sensor when the clutch pedal is fully applied during the associated learn procedure.
CPP Learned Release Position	-	Volts	This parameter displays the position learned for the clutch pedal position sensor when the clutch pedal is released.
CPP Sensor	-	Volts	This parameter displays the clutch pedal position sensor analog input as a percentage of its reference voltage.
		%	This parameter displays the displacement of the clutch pedal, where 0% corresponds to the clutch pedal being released and 100% corresponds to the clutch pedal being fully applied.
Crank Request Signal	-	No	This parameter displays Yes or No when a Crank Request Input Request is received.
Crankshaft Position Active Counter	-	0 - 255 Counts	This parameter displays an incrementing counter when the control module receives a signal from the crankshaft position sensor.

Parameter	System State	Expected Value	Description
Crankshaft Position Resynchronization Counter	-	0 Counts	This parameter displays the number of counts the control module resynchronizes with the crankshaft position sensor.
Crankshaft Position Sensor	-	Engine Speed	This parameter displays the engine speed as calculated by the control module using the signal from the crankshaft position sensor.
Cruise Control	Cruise Control ON	Enabled/Disabled	This parameter displays the status of the cruise control system as determined by the control module.
Cruise Control Accelerate Switch	Cruise Control ON	Active/ Inactive/ Invalid	The scan tool displays ON, when the cruise ON/OFF switch is ON and the accelerate switch is pressed, the ECM detects a predetermined voltage value for this switch.
Cruise Control Cancel Switch	Cruise Control ON	Active/ Inactive/ Invalid	This parameter displays the status of the cruise control cancel switch.
Cruise Control Coast Switch	Cruise Control ON	Active/ Inactive/ Invalid	The scan tool displays ON, when the cruise ON/OFF switch is ON and the ECM detects a predetermined voltage value for the coast switch.
Cruise Control Disengage History 1 - 8	Cruise Control ON	Reason for Cruise Disengagement	The parameter displays the last 8 cruise control disengages in order from 1 - 8, with 8 being the most recent. There are approximately 40 possible causes for the cruise control to disengage.
Cruise Control Inhibit Reason	Cruise Control ON	Varies	The parameter displays the reason why the cruise control system is inhibited. There are approximately 40 possible causes for the cruise control to be inhibited.
Cruise Control ON/OFF Switch	Cruise Control ON	ON/OFF	The engine control module (ECM) monitors the signal circuit of the cruise control switch. A closed switch is displayed as ON.
Cruise Control Resume Switch	Cruise Control ON	Active/ Inactive/ Invalid	The scan tool displays ON, when the cruise ON/OFF switch is ON and the resume switch is pressed, the ECM detects a predetermined voltage value for the resume switch.
Cruise Control Set Switch	Cruise Control ON	Active/ Inactive/ Invalid	The scan tool displays ON, when the cruise ON/OFF switch is ON and the ECM detects a predetermined voltage value for the set switch.

Parameter	System State	Expected Value	Description
Current Gear	-	1	This parameter displays the current forward gear of the transmission
Current Gear When Engine Overspeed Detected	-	Varies	This parameter displays the transmission actual gear observed upon initial detection of an overspeed condition.
Cylinder 1 - 4 Current Misfire Counter	-	0 Counts	The scan tool displays 0 - 255 Counts. This parameter displays the number of misfires that have been detected during the last 200 cylinder firing events. The counters may normally display some activity, but the activity should be nearly equal for all of the cylinders, and in low numbers.
Cylinder 1 - 4 History Misfire Counter	-	0 Counts	The scan tool displays 0 - 255 Counts. The misfire history counters display the total level of misfire that has been detected on each cylinder. The misfire history counters will not update or show any activity until a misfire DTC P0300 has become active. The misfire history counters will update every 200 cylinder firing events.
Cylinder 1 - 4 Injector Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the injector control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
Cylinder 1 - 4 Injector Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the injector control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
Cylinder 1 - 4 Injector Control Circuit Open Test Status	-	OK	This parameter displays the state of the injector control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
Cylinder 1 - 4 Injector Disabled - Misfire Detected	-	No	This parameter displays the status of the fuel injector driver by the control module. The scan tool will display Yes if the fuel injector is being disabled due to a misfire detection. The scan tool will display No if the fuel injector is not being disabled by the control

Parameter	System State	Expected Value	Description
			module due to a misfire.
Cylinder 1 - 4 Knock Detected	-	No	This parameter displays the status of each cylinder for knock detection by the control module. The scan tool will display Yes if a knock condition has been detected related to that cylinder combustion event. The scan tool will display No if there is no knock condition detected related to that cylinder combustion event.
Deceleration Fuel Cut-Off	-	Inactive	This parameter displays the status of the operating mode used to turn off the fuel injectors during certain deceleration conditions. When the scan tool displays Active, the control module has turned off the fuel injectors. When the scan tool displays Inactive, the fuel system is operating normally.
Desired ECT	-	Â°C (Â°F) Varies	This parameter displays the desired engine coolant temperature (ECT) in Â°C (Â°F).
Desired Exhaust Camshaft Position	-	Varies	This parameter displays the desired exhaust camshaft angle as commanded by the engine control module.
Desired Intake Camshaft Position	-	Varies	This parameter displays the desired intake camshaft angle as commanded by the engine control module.
Desired Intake Manifold Runner Control Valve Position	-	Opened or Closed	This parameter displays the commanded state of the Intake Manifold Runner Control output as Opened or Closed.
Desired Throttle Position	-	2 - 6 %	This parameter displays the desired throttle position angle commanded by the control module.
Distance Since DTC Cleared	-	Varies	This parameter displays the distance accumulated since an emission diagnostic trouble code was cleared. The scan tool will display increasing distance as the vehicle is driven.
Distance Since First Malfunction	Vehicle ON	0 km/h (0 MPH)	This parameter displays in kilometers or miles the distance traveled since a Malfunction occurred.

Parameter	System State	Expected Value	Description
Distance Since Last Malfunction	-	Varies	This parameter displays the distance accumulated when the emission diagnostic trouble code last failed.
Distance Since Last Oil Pressure Warning	Vehicle ON	0 km/h (0 MPH)	This parameter displays in kilometers or miles the distance traveled since the last oil pressure warning Malfunction occurred.
Drive Motor No Crank At Restart	-	No	Starting System indicates that a condition in the starting system has been detected that would prevent a restart of the vehicle, and thus Autostops have been disabled.
Driver Requested Axle Torque	-	Varies	This parameter displays the drivers requested axle torque as determined by the ECM. The ECM monitors accelerator pedal position and determines how much axle torque is required in order to meet the drivers request. The parameter display range is -8192 to +8191.75 N.m.
Driver Selected Autostart/Autostop Disable Mode Active	-	No	This parameter displays if the Driver Selected Autostart/Autostop Disable Mode is active.
Driver Selected Autostart/Autostop Disable Mode Available	-	Yes	This parameter displays if the Driver Selected Autostart/Autostop Disable Mode is available.
Driver Selected Economy Mode Active	-	No	This parameter displays if the Driver Selected Economy Mode is active.
Driver Selected Economy Mode Available	-	Yes	This parameter displays if the Driver Selected Economy Mode is available.
Driver Selected Hold Mode Active	-	No	This parameter displays if the Driver Selected Hold Mode is active.
Driver Selected Hold Mode Available	-	Yes	This parameter displays if the Driver Selected Hold Mode is available.
Driver Selected Mountain Mode Active	-	No	This parameter displays if the Driver Selected Mountain Mode is active.
Driver Selected Mountain Mode Available	-	Yes	This parameter displays if the Driver Selected Mountain Mode is available.
Driver Selected Sport Mode Active	-	No	This parameter displays if the Driver Selected Sport Mode is active.
Driver Selected Sport Mode Available	-	No	This parameter displays if the Driver Selected Sport Mode is available.
DTC Present	-	No	This parameter displays that a Diagnostic Trouble Code (DTC) has

Parameter	System State	Expected Value	Description
			been set that prevents Autostops.
ECM Authentication Status	Vehicle ON	Unknown/ Incorrect/ Negative Response/ Valid	ECM Authentication Status indicates the result of the comparison between the last received immobilizer response and the expected response calculated into the ECM.
ECM Challenge Status	-	Valid	This parameter displays the immobilizer system status of the ECM challenge. This indicates whether the currently calculated ECM challenge is valid.
ECM Response Source	Vehicle ON	Ignition Switch Start/Remote Vehicle Start/Exterior Power Take Off (PTO) Vehicle Start	ECM Response Source indicates the source used to calculate the ECM response.
ECT Sensor	-	-39 to +140Â°C (-38 to +284Â°F) Varies	This parameter displays the temperature of the engine coolant based on input to the control module from the engine coolant temperature (ECT) sensor.
ECT vs. IAT Sensor Temperature at Last ECT vs. RCT Malfunction Detection	-	Agree	The ECT/RCT rationality diagnostic will compare the two values during a cold start to determine if one of the sensors is reading incorrectly. If the two coolant sensor values disagree, the sensor values will then be compared to the Intake Air Temperature (IAT) sensor value.
EGR/Camshaft Position Monitor Complete	-	Yes/No	This parameter displays the status of the EGR/Camshaft Position Monitor. The parameter will display Yes when the EGR/Camshaft Position Monitor is complete.
EGR/Camshaft Position Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the status of the EGR/Camshaft Position Monitor for this Ignition Cycle. The parameter will display Yes when the EGR/Camshaft Position Monitor is complete this Ignition Cycle.
EGR/Camshaft Position Monitor Enabled	-	Yes/No	This parameter displays the status of the EGR/Camshaft Position Monitor. The parameter will display Yes when the EGR/Camshaft Position Monitor is Enabled.

Parameter	System State	Expected Value	Description
EGR/Camshaft Position Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the status of the EGR/Camshaft Position Monitor for this Ignition Cycle. The parameter will display Yes when the EGR/Camshaft Position Monitor is Enabled this Ignition Cycle.
Engine Controls Ignition Relay Command	-	ON	This parameter displays the commanded state of the engine control ignition relay control circuit. The scan tool will display ON or OFF. ON indicates the engine control ignition relay control circuit is being grounded by the control module, allowing voltage to other control module circuits and systems. OFF indicates the engine control ignition relay is not being commanded ON by the control module.
Engine Controls Ignition Relay Control Circuit High Voltage Test Status	-	Not Run	This parameter displays the state of the engine control ignition relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
Engine Controls Ignition Relay Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the engine control ignition relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
Engine Controls Ignition Relay Control Circuit Open Test Status	-	Not Run	This parameter displays the state of the engine control ignition relay control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
Engine Controls Ignition Relay Feedback Signal	-	B+	This parameter displays the voltage available at the engine control ignition relay circuit of the control module.
Engine Coolant Thermostat Heater Command	-	%	This parameter displays the commanded duty cycle for the engine coolant thermostat.
Engine Coolant Thermostat Heater Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the Engine Coolant Thermostat Heater control circuit. The parameter displays Malfunction if the Engine Coolant

Parameter	System State	Expected Value	Description
			Thermostat Heater control circuit is shorted to voltage.
Engine Coolant Thermostat Heater Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the Engine Coolant Thermostat Heater control circuit. The parameter displays Malfunction if the Engine Coolant Thermostat Heater control circuit is shorted to ground.
Engine Coolant Thermostat Heater Control Circuit Open Test Status	-	OK	This parameter displays the state of the Engine Coolant Thermostat Heater control circuit. The parameter displays Malfunction if the Engine Coolant Thermostat Heater control circuit is open.
Engine Load	Engine Idling	11 - 30 % Varies	This parameter displays the calculated engine load in percent based on inputs to the control module from various engine sensors.
	Engine speed at 2 500 RPM	25 - 40 %	
Engine Maintenance Mode	-	Active/Inactive	This parameter displays that an Engine Maintenance Mode is currently active or inactive.
Engine Maintenance Mode Completed This Ignition Cycle	-	True/False	This parameter displays that an Engine Maintenance Mode has run to completion during the current ignition cycle.
Engine Maintenance Mode Completion Status	-	%	This parameter displays a percent complete of a currently running engine maintenance mode. Once 100 % is reached, the Engine Maintenance Mode has completed this Ignition Cycle.
Engine Maintenance Mode Counter	-	Varies	This parameter displays the accumulated number of engine maintenance mode events over the life of the engine control module.
Engine OFF Time	Ignition Switch in the OFF Position	Varies	This parameter displays the amount of time that has elapsed since the engine was last cycled OFF. The scan tool displays the time in hours, minutes, and seconds. The engine OFF time will reset to zero when the engine starts.
Engine Oil Pressure Switch	-	OK	This parameter displays the state of the engine oil pressure as determined by the control module. The control module monitors the engine oil pressure switch to determine if the engine oil pressure

Parameter	System State	Expected Value	Description
			is sufficient. The scan tool displays Low when the engine oil pressure is below a predetermined value.
Engine Oil Temperature When Engine Overspeed Detected	-	Varies	This parameter displays the engine oil temperature observed upon initial detection of an overspeed condition. This value will be updated after each overspeed condition.
Engine Run Time	Engine Operating	Varies	This parameter displays the time elapsed since the engine was started. The scan tool will display the time in hours, minutes and seconds. The engine run time will reset to zero when the engine stops running.
Engine Speed	Engine Cranking	Greater than 60 RPM	This parameter displays the speed of the engine crankshaft rotation from information received from the crankshaft position sensor.
	Engine Idling	Approximately 650 - 950 RPM	
Engine Speed When Engine Overspeed Detected	-	RPM	This parameter displays the engine speed observed upon initial detection of an overspeed condition. This value will be updated after each overspeed condition.
EVAP Leak Check Pump Output Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the EVAP leak check pump output circuit. The parameter displays Malfunction if the EVAP leak check pump output circuit is shorted to ground.
EVAP Leak Detection Pump Command	-	OFF	This parameter displays the commanded state of the EVAP Leak Check Pump vacuum pump output
EVAP Leak Detection Pump Output Circuit High Voltage Test Status	-	OK	This parameter displays the state of the EVAP leak detection pump control circuit. The parameter displays Malfunction if the EVAP leak detection pump control circuit is shorted to voltage.
EVAP Leak Detection Pump Output Circuit Open Test Status	-	OK	This parameter displays the state of the EVAP Leak Detection Pump Output circuit. The parameter displays Malfunction if the EVAP Leak Detection Pump Output circuit is opened.

Parameter	System State	Expected Value	Description
EVAP Leak Detection Pump Pressure	-	kPa	This parameter displays EVAP Leak Detection Pump absolute pressure measured by a sensor.
EVAP Leak Detection Pump Pressure	-	Volts	This parameter displays the EVAP Leak Check Pump (ELCP) pressure value input to the control module as a voltage.
EVAP Leak Detection Pump Service Bay Test Abort Reason	-	Varies	This parameter displays the EVAP Leak Detection Pump Service Bay Test Abort Reason.
EVAP Leak Detection Pump Service Bay Test Denial Reason	-	Varies	This parameter displays the reason the EVAP service bay test was denied.
EVAP Leak Detection Pump Service Bay Test Result	-	Varies	This parameter displays the result of the EVAP service bay test.
EVAP Leak Detection Pump Switching Valve Command	-	Off	This parameter displays the commanded state of the EVAP leak detection pump output.
EVAP Leak Detection Pump Switching Valve Command	-	Not Venting/ Venting	This parameter displays the commanded state of the EVAP Leak Check Pump switching valve output.
EVAP Leak Detection Pump Switching Valve Output Circuit High Voltage Test Status	-	OK	This parameter displays the state of the EVAP Leak Detection Pump Switching Valve Output circuit. The parameter displays Malfunction if the EVAP Leak Detection Pump Switching Valve Output circuit is shorted to voltage.
EVAP Leak Detection Pump Switching Valve Output Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the EVAP leak detection pump control circuit. The parameter displays Malfunction if the EVAP leak detection pump control circuit is shorted to ground.
EVAP Leak Detection Pump Switching Valve Output Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the EVAP Leak Detection Pump Switching Valve Output circuit. The parameter displays Malfunction if the EVAP Leak Detection Pump Switching Valve Output circuit is shorted to ground.
EVAP Leak Detection Pump Switching Valve Output Circuit Open Test Status	-	OK	This parameter displays the state of the EVAP leak detection pump control circuit. The parameter displays Malfunction if the EVAP leak detection pump control circuit is open.

Parameter	System State	Expected Value	Description
EVAP Leak Detection Pump Switching Valve Output Circuit Open Test Status	-	OK	This parameter displays the state of the EVAP Leak Detection Pump Switching Valve Output circuit. The parameter displays Malfunction if the EVAP Leak Detection Pump Switching Valve Output circuit is opened.
EVAP Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor completion status during the current driving/monitoring cycle.
EVAP Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor enable status during the current driving/monitoring cycle.
EVAP Purge Solenoid Valve Command	-	10 - 20 %	This parameter displays the on-time or duty cycle of the EVAP canister purge solenoid commanded by the control module. Zero percent indicates no purge. One hundred percent indicates full purge.
EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the status of the evaporative emission (EVAP) purge solenoid control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the status of the evaporative emission (EVAP) purge solenoid control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
EVAP Purge Solenoid Valve Control Circuit Open Test Status	-	OK	This parameter displays the status of the evaporative emission (EVAP) purge solenoid control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
EVAP Test	-	Varies	This parameter displays the state of the EVAP Test.
EVAP Vent Solenoid Valve Command	-	OFF	This parameter displays the state of the EVAP canister vent solenoid commanded by the control module. The scan tool displays ON Venting or OFF Not Venting.

Parameter	System State	Expected Value	Description
EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the diagnostic state of the output driver for the evaporative emission vent solenoid control circuit as determined by the engine control module. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
EVAP Vent Solenoid Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the diagnostic state of the output driver for the evaporative emission vent solenoid control circuit as determined by the engine control module. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
EVAP Vent Solenoid Valve Control Circuit Open Test Status	-	OK	This parameter displays the diagnostic state of the output driver for the evaporative emission vent solenoid control circuit as determined by the engine control module. The scan tool will display OK, Malfunction or Not Run. The scan tool will display OK if the circuit is operating correctly.
Exhaust Camshaft Position	-	Engine Idling: 5 Degrees Engine Speed at 2,000 RPM: 19 Degrees	This parameter displays the actual exhaust camshaft position in degrees.
Exhaust Camshaft Position Active Counter	-	0 - 255 Counts	This parameter displays an incrementing counter when the control module receives a signal from the exhaust camshaft position sensor.
Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the exhaust camshaft actuator solenoid control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is shorted to voltage.
Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the exhaust camshaft actuator solenoid control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is shorted to ground.

Parameter	System State	Expected Value	Description
Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status	-	OK	This parameter displays the state of the exhaust camshaft actuator solenoid control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is open.
Exhaust Camshaft Position Command	-	45 - 51 %	This parameter displays the on-time or duty cycle of the exhaust camshaft position actuator solenoid valve as commanded by the engine control module.
Exhaust Camshaft Position Variance	-	0.0 - 0.2 Degrees	This parameter displays in degrees, the difference between the desired exhaust camshaft position and the actual exhaust camshaft position.
Freeze Frame DTC	-	#	This parameter displays the diagnostic trouble code (DTC) that caused the freeze frame to be stored.
Fuel Alcohol Content	-	%	This parameter displays the percentage of alcohol in the fuel. The value is calculated by the ECM using the fuel composition sensor input.
Fuel Control Loop Status	-	Closed Loop	This parameter displays the state of the fuel control system as commanded by the control module. Closed loop operation indicates that the control module is controlling the fuel delivery based off the oxygen sensors input signal. In open loop operation the control module ignores the oxygen sensor input signal and bases the amount of fuel to be delivered on other sensor inputs.
Fuel Economy	Engine Idling	Liters per Hour	This Parameter displays the instant fuel consumption rate of the engine in liters per hour.
Fuel Enrichment - Hot Catalyst	-	No	This parameter displays Yes if the engine control module is commanding catalyst converter protection.
Fuel Enrichment - Hot Coolant	-	Inactive	This parameter displays the status of the fuel delivery system. The scan tool will display Active if the fuel system is running in open loop due to a temperature condition. The scan tool will display Inactive if the fuel system is operating normally.

Parameter	System State	Expected Value	Description
Fuel Level Sensor	-	Varies	This parameter displays the approximate fuel level in the fuel tank as a voltage. The control module calculates this level using the signal from the sensor used to monitor the fuel in the tank.
Fuel Maintenance Mode	-	Inactive	This parameter displays if the Fuel Maintenance Mode is active or inactive.
Fuel Maintenance Mode Counter	-	0 - 255	This parameter displays the number of fuel maintenance mode events over the life of the Engine Control Module (ECM).
Fuel Pump Enable Circuit High Voltage Test Status	-	OK/Not Run	This parameter displays the state of the fuel pump relay control circuit. The parameter displays Malfunction if the fuel pump control circuit is shorted to voltage.
Fuel Pump Enable Circuit Low Voltage Test Status	-	OK/Not Run	This parameter displays the state of the fuel pump control circuit. The parameter displays Malfunction if the fuel pump relay control circuit is shorted to ground.
Fuel Pump Enable Circuit Open Test Status	-	OK/Not Run	This parameter displays the state of the fuel pump control circuit. The parameter displays Malfunction if the fuel pump control circuit is opened.
Fuel Pump Enable Command	-	ON	This parameter displays the control modules commanded state of the fuel pump control circuit.
Fuel System Monitor Complete	-	No	This parameter displays Yes when the Fuel System Monitor is complete.
Fuel System Monitor Complete This Ignition Cycle	-	No	This parameter displays Yes when the Fuel System Monitor is Complete This Ignition Cycle.
Fuel System Monitor Enabled	-	No	This parameter displays Yes when the Fuel System Monitor is enabled.
Fuel System Monitor Enabled This Ignition Cycle	-	No	This parameter displays Yes when the Fuel System Monitor is Enabled This Ignition Cycle.
Fuel Tank Pressure Sensor	-	1.3 - 1.7 V	This parameter displays the voltage signal received by the control module from the fuel tank pressure sensor.

Parameter	System State	Expected Value	Description
Fuel Tank Pressure Sensor	-	Varies	This parameter displays the pressure/vacuum inside the fuel tank. A negative value indicates a vacuum, while a positive value indicates a pressure.
Fuel Tank Rated Capacity	-	70 L (18.4 Gal)	This parameter displays the rated maximum quantity of fuel the fuel tank will hold. This is calibrated in the control module to match the vehicle.
Fuel Trim Memory Cell	-	Varies	This parameter displays the fuel trim cell number as calculated by the control module based on engine speed and load inputs. The scan tool will display a lower number as conditions are closer to idle, and a higher number as conditions approach maximum engine speed and maximum load.
Fuel Trim System Test State	-	Monitoring	This parameter indicates the status of the Fuel Trim System Test. The scan tool will display Disabled, Enabled, Monitoring, or Run Purge Test.
HO2S 1 or HO2S 2	Vehicle ON, Engine OFF	50 - 900 mV	This parameter indicates the heated oxygen sensor (HO2S) sensor 1 or 2, output voltage as measured by the control module. The scan tool will display a higher value during a rich condition, and a lower value during a lean condition.
	Engine Operating	Varies	
HO2S 1 or HO2S 2 Heater	-	0.42 - 0.62 A	This parameter displays the amperage of the HO2S heater commanded by the engine control module.
HO2S 1 or HO2S 2 Heater Command	-	0 - 99 %	This parameter displays the commanded state of the HO2S 1 or HO2S 2 heater by the control module. The scan tool will display a higher value as the heater command is increased, and a lower value if the heater is not commanded ON.
HO2S 1 or HO2S 2 Heater Command	-	ON	This parameter displays the commanded state of the HO2S 1 or HO2S 2 heater circuit by the control module. The scan tool will display ON when the heater is commanded ON. The scan tool will display OFF when the heater is commanded OFF.

Parameter	System State	Expected Value	Description
HO2S 1 or HO2S 2 Heater Control Circuit High Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the HO2S 1 or HO2S 2. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
HO2S 1 or HO2S 2 Heater Control Circuit Low Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the HO2S 1 or HO2S 2. The scan tool displays OK, Malfunction or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
HO2S 1 or HO2S 2 Heater Control Circuit Open Test Status	-	OK	This parameter displays the status of the control circuit for the HO2S 1 or HO2S 2. The scan tool displays OK, Malfunction or Not Run. OK indicates that no circuit Malfunctions are detected during the current test.
HO2S Heater Monitor Complete	Engine Idling	Yes/No	This parameter displays the diagnostic monitor completion status during the current driving/monitoring cycle.
HO2S Heater Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor completion status during the current driving/monitoring cycle.
HO2S Heater Monitor Enabled	Engine Idling	Yes/No	This parameter displays the diagnostic monitor enable status during the current driving/monitoring cycle.
HO2S Heater Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor enable status during the current driving/monitoring cycle.
Hood Ajar Switch 1	-	Ajar	This parameter displays the Hood Ajar 1 switch as either Closed or Ajar.
Hood Ajar Switch 2	-	Ajar	This parameter displays the Hood Ajar 2 switch as either Closed or Ajar.
Hood Position	-	Open	This parameter displays the Hood Position as Closed, Ajar, Open or Invalid. Hood Open indicates that the state of the hood switch prevented an Autostop. Autostops are not allowed with the hood open.
Hybrid/EV Battery Pack Charge Remaining	-	Varies	This parameter displays the amount of charge left in the Hybrid/EV Battery Pack.

Parameter	System State	Expected Value	Description
Hybrid Transmission Mode Command	-	Park/Neutral	This parameter displays the current Hybrid Transmission Mode. • Park/Neutral • EV1 • EV2 • Gear 1 • Gear 2 • Gear 3 • Gear 4 • Invalid
IAT Sensor	-	-39 to +140Â°C (-38 to +284Â°F)	This parameter displays the temperature of the air entering the air induction system based on input to the control module from the intake air temperature (IAT) sensor.
ICE Status	-	Running	This parameter displays the status of the ICE.
Ignition 1 Signal	-	B+	This parameter displays B+ when the control module detects a voltage at the ignition 1 input terminal.
Ignition Accessory Signal	-	ON	This parameter displays the state of the ignition accessory position input to the control module from the ignition switch.
Ignition Coil 1, 2, 3 and 4 Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the Ignition control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
Ignition Coil 1, 2, 3 and 4 Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the Ignition control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit Malfunction are detected during the current test.
Ignition Coil 1, 2, 3 and 4 Control Circuit Open Test Status	-	OK	This parameter displays the state of the Ignition control circuit. The scan tool displays OK, Malfunction or Not Run. OK indicates that no circuit Malfunction are detected during the current test.

Parameter	System State	Expected Value	Description
Ignition Coil 2 and 3 Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the Ignition control circuit. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit faults are detected during the current test.
Ignition Cycles Since Last Completed Fuel Maintenance Mode	-	Days	This parameter displays the elapsed time in days since the most recent completion of Fuel Maintenance Mode.
Ignition Cycles with Malfunction Since 1st Malfunction	Vehicle ON	Counts	This Parameter displays the number of ignition cycles with a malfunction reported since the first ignition cycle with a malfunction reported.
Ignition Cycles without Completed Test Since 1st Malfunction	-	Counts	This Parameter displays the number of ignition cycles without a malfunction reported since the first ignition cycle.
Ignition Cycles without Malfunction Since Last Malfunction	Vehicle ON	Counts	This Parameter displays the number of ignition cycles with a pass reported and no malfunctions reported since the first ignition cycle with a malfunction reported.
Ignition Timing	-	-4 to +15 Degrees	This parameter displays the amount of spark advance the control module is commanding. The engine control module determines the desired advance.
Ignition Timing	-	Degrees	This parameter displays the final spark advance in terms of a crankshaft angle
Immobilizer Password Learn	-	Yes	This parameter displays Yes when a valid theft password has been learned.
Immobilizer Security Information Programmed	-	Yes	This parameter displays if the immobilizer system security code has been programmed.
Immobilizer System Status	-	Varies	This parameter displays the current state of the immobilizer System Status. The states include the following: Standby, Disabled at Startup, Disabled Due to No Response, Disabled Due to Negative Response, Disabled Due to Incorrect Response, Post Release, Pre-Release, Released.
Injector Duty Cycle	-	1.5 - 3 ms	This parameter displays the average pulse width of the fuel injectors as determined by the control module.

Parameter	System State	Expected Value	Description
Intake Camshaft Position Active Counter	-	0 - 255 Counts	This parameter displays an incrementing counter when the control module receives a signal from the intake camshaft position sensor.
Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the intake camshaft position actuator solenoid valve control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is shorted to voltage.
Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the intake camshaft position actuator solenoid valve control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is shorted to ground.
Intake Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status	-	OK	This parameter displays the state of the intake camshaft position actuator solenoid valve control circuit. The parameter displays Malfunction if the camshaft actuator solenoid control circuit is open.
Intake Camshaft Position Variance	-	Degrees	This parameter displays in degrees, the difference between the desired intake camshaft position and the actual intake camshaft position.
Intake Manifold Pressure	-	32 - 53 kPa (4.6 - 7.6 PSI)	This parameter displays the pressure difference between the Manifold Absolute Pressure (MAP) and the barometric pressure (BARO) as calculated by the control module.
Intake Manifold Runner Control Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the intake manifold runner control valve control circuit. The parameter displays Malfunction if the intake manifold runner control valve control circuit is shorted to voltage.
Intake Manifold Runner Control Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the intake manifold runner control valve control circuit. The parameter displays Malfunction if the intake manifold runner control valve control circuit is shorted to ground.
Intake Manifold Runner Control Valve Control	-	OK	This parameter displays the state of the intake manifold runner control valve

Parameter	System State	Expected Value	Description
Circuit Open Test Status			control circuit. The parameter displays Malfunction if the intake manifold runner control valve control circuit is open.
Knock Retard	-	0°	This parameter displays the amount of spark advance the control module removes from the ignition control spark advance in response to the signal from the knock sensors.
Last Engine Maintenance Mode	-	Incomplete	This parameter displays the status of the Last Engine Maintenance Mode.
Long Term Fuel Trim	-	-10 to +10 %	The scan tool range is -99 to +99 %. This parameter indicates the Long Term fuel trim correction as commanded by the ECM. A change made to the fuel delivery will be indicated by the Long and Short Term values. The Short Term values change rapidly in response to the HO2S signal voltages. These changes fine tune the engine fueling. The Long Term values change in response to the changes in the Short Term. The Long Term makes coarse adjustments to the fueling in order to re-center and restore control to the Short Term. The Short Term and the Long Term can be monitored with a scan tool. A positive fuel trim value indicates that the ECM is adding fuel in order to compensate for a lean condition. A negative fuel trim value indicates that the ECM is reducing the amount of fuel in order to compensate for a rich condition.
Long Term Fuel Trim Test Average	-	0.98 % Varies	This parameter is the average long term fuel trim for this bank as calculated by the control module. The scan tool will display a value more than 0 % indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0, indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 %

Parameter	System State	Expected Value	Description
			indicates no compensation is required to operate the engine at the desired air/fuel ratio.
Long Term Fuel Trim Test Average without Purge	-	1.02 % Varies	This parameter is calculated by the control module based on the Short Term Fuel Trim value. The Long Term Fuel Trim is used for the long term correction of the fuel delivery. The scan tool will display a high value for a large amount of long term fuel correction, and 0 % for no long term fuel trim correction. The scan tool will display a negative value when fuel system is running too rich and fuel is being removed from the combustion event. The scan tool will display a positive value if the fuel system is running lean and fuel is being added to the combustion event.
Low Voltage Battery Discharge Current	-	No	This parameter displays the state of the 12 V Low Voltage Battery Discharge.
MAF Performance Test	-	OK	This parameter displays the status of the mass air flow (MAF) performance test by the control module. The scan tool will display OK if no condition is detected. The scan tool will display Malfunction if the control module detects a condition during the test.
MAF Sensor	Engine Idling	1.7 - 3.7 g/s	This parameter indicates the quantity calculated by the control module based on a signal from the MAF sensor. The scan tool will display a high value at high engine speeds, and a low value at low engine speeds.
	Engine speed at 2 500 RPM	5.5 - 7.5 g/s	
MAF Sensor	-	1 700 - 2 100 Hz	This parameter indicates the frequency signal received from the MAF sensor by the control module. The scan tool will display a high value at high engine speeds, and a low value at low engine speeds.
MAF Sensor Supply Voltage Command	-	ON	This parameter displays the commanded state of the MAF sensor supply voltage output.
MAF Sensor Supply Voltage Control Circuit	-	OK or Not Run	This parameter displays the status of the Supply Voltage Control circuit for

Parameter	System State	Expected Value	Description
High Voltage Test Status			the MAF Sensor. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status	-	OK or Not Run	This parameter displays the status of the Supply Voltage Control circuit for the MAF Sensor. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MAF Sensor Supply Voltage Control Circuit Open Test Status	-	OK or Not Run	This parameter displays the status of the Supply Voltage Control circuit for the MAF Sensor. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MAF When Engine Overspeed Detected	-	g/s	This parameter displays the intake mass airflow observed upon initial detection of an overspeed condition. This value will be updated upon each subsequent overspeed condition.
Maintenance Mode Disabled Low Fuel Level	-	No	This parameter displays Maintenance Mode Disabled Due to Low Fuel Level. The scan tool displays Yes or No.
Maintenance Mode Status	-	Varies	This parameter displays the current status of the Maintenance Mode.
MAP Performance Test 1	-	OK	This parameter displays the status of the MAP performance test 1 by the engine control module. The scan tool will display OK if no malfunction is found. The scan tool will display malfunction if the engine control module detects a malfunction during the test.
MAP Performance Test 2	-	OK	This parameter displays the status of the MAP performance test 2 by the engine control module. The scan tool will display OK if no malfunction is found. The scan tool will display malfunction if the engine control module detects a malfunction during

Parameter	System State	Expected Value	Description
			the test.
MAP Sensor	-	26 - 52 kPa (3.7 - 7.6 PSI)	This parameter displays the pressure from the MAP sensor to the engine control module.
MAP Sensor	-	0.98 - 1.42 V	This parameter displays the signal voltage from the MAP sensor to the engine control module.
Maximum Engine Speed When Engine Overspeed Detected	-	RPM	This parameter displays the maximum engine speed observed during all overspeed condition and stores this information in the engine control module.
MIL Command	Vehicle ON	ON/OFF	This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit by the engine control module (ECM).
MIL Control Circuit High Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp control (MIL). The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Low Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp control (MIL). The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Open Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp control (MIL). The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Requested	Vehicle ON	Yes/No	This parameter displays the reason the engine control module illuminated the MIL. The scan tool will display Yes when the MIL is requested as a result of an A or B type DTC. The scan tool will display No if the MIL is illuminated for another reason, such as transmission DTCs.

Parameter	System State	Expected Value	Description
MIL Requested by DTC	-	No	This parameter indicates the reason the control module illuminated the MIL. The scan tool will display Yes when the MIL is requested as a result of an A or B type DTC. The scan tool will display No if the MIL is illuminated for another reason, such as transmission DTCs.
Misfire Monitor Complete	-	No	This parameter displays the status of the Misfire Monitor. The parameter will display Yes when the Misfire Monitor is Complete.
Misfire Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor completion status during the current driving/monitoring cycle.
Misfire Monitor Enabled	-	Yes/No	This parameter displays the status of the Misfire Monitor. The parameter will display Yes when the Misfire Monitor is Enabled.
Misfire Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor enable status during the current driving/monitoring cycle.
Not in Run Mode	-	No	This parameter displays Yes or No if the Run/Crank mode is not active.
Number of DTC(s)	-	0	This parameter indicates the number of diagnostic trouble codes (DTCs).
O2S/HO2S Monitor Complete	Engine Idling	Yes/No	This Parameter displays the enable and completion status during the current driving/monitoring cycle of each continuous legislated emission related monitor and non continuous legislated emission related monitor.
O2S/HO2S Monitor Complete This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor completion status during the current driving/monitoring cycle.
O2S/HO2S Monitor Enabled	Engine Idling	Yes/No	This Parameter displays the enable and completion status during the current driving/monitoring cycle of each continuous legislated emission related monitor and non continuous legislated emission related monitor.
O2S/HO2S Monitor Enabled This Ignition Cycle	-	Yes/No	This parameter displays the diagnostic monitor enable status during the current driving/monitoring cycle.

Parameter	System State	Expected Value	Description
Odometer When Engine Overspeed Detected	-	km/miles	This parameter displays the vehicle odometer reading in km/miles upon initial detection of an overspeed condition by the engine control module.
Output Shaft Speed Sensor	Vehicle needs to be moving	RPM	This Parameter displays the transmission output speed (the speed at the output of the gear box) determined from the speed measured by the transmission output speed sensor.
Power Enrichment	-	Inactive	This parameter indicates if the control module has detected conditions appropriate to operate in Power Enrichment mode. The scan tool will display Active if the mode is in operation, and Inactive if the mode is not in operation. The control module enters Open Loop operation and increases injector pulse width when in power enrichment mode.
Power Mode	Vehicle ON	OFF/ Accessory/ Run/ Crank Request	This Parameter displays the state of the System Power Mode. This signal is based upon the state of the system power mode received over serial communication from the vehicle electronics. If the serial data signal not received, the Parameter will display OFF.
Radiator Coolant Temperature Sensor	-	88 - 105Â°C (190 - 221Â°F)	The temperature of the engine coolant based on a voltage input from the radiator coolant temperature (RCT) sensor to the engine control module.
RCT vs. IAT Sensor Temperature at Last ECT vs. RCT Malfunction Detection	-	Agree, Disagree, Disabled	RCT/IAT Sensors Disagree indicates that the temperature values of the RCT and IAT sensors did not agree at the time of the most recent failure of the ECT/RCT rationality diagnostic (DTC P00B6).
Reduced Engine Power	-	Inactive	This parameter displays the status of the operating mode of the control module used to reduce engine power to prevent catalyst converter or engine damage or due to a Throttle Actuator Control (TAC) system condition.

Parameter	System State	Expected Value	Description
Reduced Engine Power History	-	OK	This parameter displays the last reason that ECM has Commanded Reduced Engine Power. The scan tool displays one of the following when Reduced Engine Power is commanded: • TAC DTC • Fan Control DTC • ECT Overtemperature • Engine Oil Overtemperature
Remaining Fuel in Tank	-	0 - 100 % Varies	This parameter displays the amount of fuel remaining in the fuel tank as measured in percentage. The control module determines the amount of fuel remaining in the tank by using information from the fuel level sensors. The scan tool will display a higher value with a full fuel tank, and a lower value with an empty fuel tank.
Remaining Fuel in Tank	-	Liters (Gallons) Varies	This parameter displays the amount of fuel remaining in the fuel tank as measured in liters (gallons). The control module determines the amount of fuel remaining in the tank by using information from the fuel level sensor. The scan tool will display a higher value with a full fuel tank, and a lower value with an empty fuel tank.
Secondary Air Injection Monitor Complete	-	No	This parameter displays the state of the secondary air injection monitor system.
Secondary Air Injection Monitor Complete This Ignition Cycle	-	No	This parameter displays the status of the secondary air injection monitor system.
Secondary Air Injection Monitor Enabled	-	Yes	This parameter displays if the secondary air injection monitor system is enabled.
Secondary Air Injection Monitor Enabled This Ignition Cycle	-	No	This parameter displays if the secondary air injection monitor system is enabled this ignition cycle.
Secondary Air Injection Pressure	-	kPa	This parameter displays the normalized secondary air injection system pressure for bank 1.

Parameter	System State	Expected Value	Description
Secondary Air Injection Pressure Sensor	-	kPa	This parameter displays the unfiltered secondary air injection system pressure for bank 1.
Secondary Air Injection Pressure Sensor	-	Volts	This parameter displays the secondary air injection system pressure analog input for bank 1 as a percentage of its reference voltage.
Secondary Air Injection Pressure Sensor Variance	-	kPa	This parameter displays the weighted average pressure error (difference between the predicted and actual secondary air injection system pressure) for bank 1 during the secondary air injection on test (phase 1).
Secondary Air Injection Pump Relay Command	-	Off	This parameter displays the commanded state of the secondary air injection pump output.
Secondary Air Injection Pump Relay Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the secondary air injection pump relay control circuit. The parameter displays Malfunction if the secondary air injection pump relay control circuit is shorted to voltage.
Secondary Air Injection Pump Relay Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the secondary air injection pump relay control circuit. The parameter displays Malfunction if the secondary air injection pump relay control circuit is shorted to ground.
Secondary Air Injection Pump Relay Control Circuit Open Test Status	-	OK	This parameter displays the state of the secondary air injection pump relay control circuit. The parameter displays Malfunction if the secondary air injection pump relay control circuit is open.
Secondary Air Injection Solenoid Valve Command	-	Off	This parameter displays the commanded state of the secondary air injection valve output.
Secondary Air Injection Solenoid Valve Control Circuit High Voltage Test Status	-	OK	This parameter displays the state of the secondary air injection solenoid valve control circuit. The parameter displays Malfunction if the secondary air injection solenoid valve control circuit is shorted to voltage.

Parameter	System State	Expected Value	Description
Secondary Air Injection Solenoid Valve Control Circuit Low Voltage Test Status	-	OK	This parameter displays the state of the secondary air injection solenoid valve control circuit. The parameter displays Malfunction if the secondary air injection solenoid valve control circuit is shorted to ground.
Secondary Air Injection Solenoid Valve Control Circuit Open Test Status	-	OK	This parameter displays the state of the secondary air injection solenoid valve control circuit. The parameter displays Malfunction if the secondary air injection solenoid valve control circuit is open
Short Term Fuel Trim	-	-10 to +10 %	The Short Term values change rapidly in response to the HO2S signal voltages. These changes fine tune the engine fueling. The Long Term values change in response to the changes in the Short Term. The Long Term makes coarse adjustments to the fueling in order to re-center and restore control to the Short Term. The Short Term and the Long Term can be monitored with a scan tool. A positive fuel trim value indicates that the ECM is adding fuel in order to compensate for a lean condition. A negative fuel trim value indicates that the ECM is reducing the amount of fuel in order to compensate for a rich condition.
Short Term Fuel Trim Test Average	-	-3 to +99 % Varies	This parameter displays the short term closed loop fuel correction. This value is compared to predetermined thresholds to determine if the fuel trim diagnostic is passing or failing.
Starter Relay Command	-	OFF	The scan tool displays ON or OFF. The scan tool displays OFF until the ignition is placed into the CRANK position.
Starter Relay Control Circuit High Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the starter relay. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.

Parameter	System State	Expected Value	Description
Starter Relay Control Circuit Low Voltage Test Status	-	Not Run	This parameter displays the status of the control circuit for the starter relay. The scan tool displays OK, Malfunctions, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
Starter Relay Control Circuit Open Test Status	-	OK	This parameter displays the status of the control circuit for the starter relay. The scan tool displays OK, malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
Start Up ECT	-	-39 to +140Â°C (-38 to +284Â°F)	This parameter displays the temperature of the engine coolant on start up based on input to the control module from the ECT sensor 1.
Start Up IAT	-	-39 to +140Â°C (-38 to +284Â°F)	This parameter displays the temperature of the intake air at start in the air induction system based on input to the control module from the IAT sensor.
SVS Indicator Command	-	OFF	This parameter displays that the Service Vehicle Soon lamp is being commanded on due to the malfunction of a non emission related diagnostic test.
TAC Forced Engine Shutdown	-	No	This parameter displays the status of TAC control by the control module. The scan tool will display Yes if the engine has been shut down due to a throttle control malfunction. The scan tool will display No if the engine has not been shut down by a throttle control malfunction.
TAC Motor	-	Disabled	This parameter displays the status of the TAC motor driver by the control module. The scan tool will display Enabled if TAC motor operation is allowed. The scan tool will display disabled if the TAC motor is disabled.
TAC Motor Command	-	0 - 100 % Varies	This parameter displays the percentage of the commanded state of the TAC motor by the control module.
Throttle Body Idle Air Flow Compensation	-	0 - 100 % Varies	This parameter displays the amount of airflow compensation in response to

Parameter	System State	Expected Value	Description
			engine intake air flow restrictions.
Throttle Position	-	2 - 9 %	This parameter displays the actual throttle position angle indicated by the control module using information from the two Throttle Body sensors.
Throttle Position Performance Test	-	OK	This parameter displays the status of the throttle position performance test by the control module. The scan tool will display OK if no malfunction is found. The scan tool will display Malfunction if the control module detects a malfunction during the test.
Throttle Position Sensor 1	Accelerator pedal not actuated	4.14 - 4.34 V	This parameter displays the voltage signal sent to the control module from throttle position sensor 1 of the throttle assembly. The throttle position sensor 1 is a range of values indicating a high voltage when the throttle is closed to a low voltage when the throttle plate is fully open.
	Accelerator pedal fully actuated	3.50 - 3.37 V	
Throttle Position Sensor 1 Learned Minimum	-	0.5 - 0.71 V	This parameter displays the learned minimum voltage for throttle position sensor 1 as determined by the control module this ignition cycle.
Throttle Position Sensor 1 Position	-	2 - 6 %	This parameter displays the angle of the throttle position sensor 1 as calculated by the control module using the signal from the throttle position sensor 1. The throttle position sensor 1 is a range of values indicating a low percentage when the throttle is closed to a high percentage when the throttle is fully open.
Throttle Position Sensor 2	Accelerator pedal not actuated	0.68 - 0.88 V	This parameter displays the voltage signal sent to the control module from throttle position sensor 2 of the throttle assembly. The throttle position sensor 2 is a range of values indicating a low voltage when the throttle is closed to a high voltage when the throttle plate is fully open.
	Accelerator pedal fully actuated	1.35 - 1.55 V	
Throttle Position Sensor 2 Learned Minimum	-	0.55 - 0.75 V	This parameter displays the learned minimum voltage for throttle position sensor 2 as determined by the control module this ignition cycle.

Parameter	System State	Expected Value	Description
Throttle Position Sensor 2 Position	-	2 - 6 %	This parameter displays the angle of the throttle position sensor 2 as calculated by the control module using the signal from the throttle position sensor 2. The throttle position sensor 2 is a range of values indicating a low percentage when the throttle is closed to a high percentage when the throttle is fully open.
Throttle Position Sensors 1 and 2	-	Agree	This parameter displays the results of a control module test that compares the signals from the Throttle Body sensors 1 and 2. The scan tool will display Agree or Disagree. Agree indicates that throttle position sensor 1 and throttle position sensor 2 voltages correspond to the same throttle position. Disagree indicates that throttle position sensor 1 and throttle position sensor 2 voltages correspond to different throttle positions.
Time Since Last Refuel Event	-	Days	This parameter displays the amount of time in the form of days since the most recent refueling event.
Torque Management Ignition Timing Retard	-	15 - 25 Degrees	This parameter displays how much the ignition spark timing is being retarded to control torque by the control module. The scan tool will display a higher value under extreme torque control conditions such as spinning wheels. The scan tool will display a lower value under low torque control conditions such as light driving.
Torque Request Inhibit - Fuel	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Torque Request Inhibit - Ignition Timing	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Torque Request Inhibit - Ignition Timing Advance	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.

Parameter	System State	Expected Value	Description
Torque Request Inhibit - Minimum Idle	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Torque Request Inhibit - Minimum Torque	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Torque Request Inhibit - TAC	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Torque Request Inhibit - TAC Limit	Engine Idling	Yes/No	This Parameter displays the existing condition in the ECM causing the transmission torque request to be limited.
Total Knock Retard	-	0°	This parameter displays how much ignition spark timing is being retarded due to all control systems monitored by the control module. The scan tool will display a high value during extreme conditions such as high temperatures and antilock braking. The scan tool will display a lower value during lighter driving conditions.
Vehicle Speed Sensor	-	0 km/h (0 MPH)	This parameter displays the speed of the vehicle as calculated by the transmission control module (TCM) from information received from the vehicle speed sensor.
Vehicle Speed When Engine Overspeed Detected	-	km/MPH	This parameter displays the vehicle speed observed upon initial detection of an overspeed condition by the engine control module.
Warm-Ups Since DTC Cleared	-	Varies	This parameter displays the number of warm-ups since the DTC was cleared in counts.
Warm-Ups without Emission Malfunctions	-	Varies	This parameter displays the number of warm-up cycles that have occurred without an emission malfunction present. The scan tool will display a 0 if a malfunction has occurred. The scan tool will display a higher count if a number of warm-up cycles have occurred without an emission

Parameter	System State	Expected Value	Description
			malfunction.
Warm-Ups without Non-Emission Malfunctions	-	Varies	This parameter displays the number of warm-up cycles that have occurred without a non-emission malfunction present. The scan tool will display a 0 if a malfunction has occurred. The scan tool will display a higher count if a number of warm-up cycles have occurred without a non-emission malfunction.
Wide Open Throttle	-	No	This parameter displays the throttle status commanded by the control module. The scan tool will display Yes if the vehicle throttle is commanded to wide open. The scan tool will display No if the vehicle throttle is commanded to an amount less than 100 %.

Engine Control Module (ECM) Scan Tool Output Controls

Output Control	Description
A/C Compressor Clutch Relay	This device control is used to activate the Air Conditioning Compressor Clutch.
Autostart/Autostop	This device control is used to force an Autostop or Autostart procedure.
Average Fuel Reset	This device control allows manual input of the average fuel range.
Camshaft Position Actuator Solenoid Valve	This device control is used to override the state of the camshaft position actuator solenoid output.
Compression Test	This device control is used to set up the internal combustion engine for a compression test.
Continuous Charge Mode Command	This device control enables the vehicle to enter a continuous charge mode.
Cooling Fan	This device control is used to override the state of the cooling fan control output.
Crankshaft Position Variation Learn	This device control is used to activate the crankshaft position variation learn software which calculates the reference pulse correction factors for the misfire diagnostic.
Cylinder Power Balance	This function disables the selected fuel injector. The normal commanded state is None. The scan tool initiates the test when the following conditions are met: • The engine is operating and the engine idle is stable. • The vehicle speed is 0 km/h (0 MPH). • There are no vehicle speed sensor DTCs set.

Output Control	Description
	If the fuel injector is disabled after 30 s, fuel injector control is not allowed again on the same fuel injector for 60 s.
Engine Controls Ignition Relay	This device control is used to override the state of the Powertrain Relay.
Engine Coolant Thermostat Heater	This device control is used to override the state of the Engine Coolant Thermostat Heater.
Engine Oil Life Reset	This device control may be used to reset the engine oil remaining life to 100% after an oil change or to any other value when replacing a control module.
Engine Speed	This function controls the idle speed override in 25 RPM, 100 RPM, and 500 RPM increments, from the base idle speed to 1 950 RPM. The scan tool initiates the test when the following conditions are met: • The vehicle speed is 0 km/h (0 MPH). • There are no VSS sensor DTCs set.
EVAP Leak Detection Pump Command	This function turns the EVAP Leak Detection Pump ON and OFF.
EVAP Leak Detection Pump Switching Valve Command	This device control is used to change the state of the canister vent control valve output from Not Venting or Venting.
EVAP Purge Solenoid Valve	This function controls the EVAP purge solenoid valve. The normal commanded state is None. The system will increase or decrease the amount of purge by changing the duty cycle of the purge valve in 10 % increments within a range of 0 - 100 %. The scan tool initiates the test when the following conditions are met: • The vacuum level in the EVAP purge system is within range. • There are no EVAP DTCs set. • The EVAP system test is not in progress. • In the correct Power Mode.
EVAP Test	This device control commands EVAP pump "ON" and opens DCV valve to allow the system to be subjected to vacuum.
EVAP Vent Solenoid Valve Command	This function controls the EVAP vent solenoid. The normal commanded state is none. When commanded ON, the vent valve switches to not venting. When commanded OFF, the vent valve switches to venting. The scan tool indicates the test when the following conditions are met: • The vacuum level in the EVAP purge system is within range. • There are no EVAP DTCs set. • The EVAP system test in not in process. • In the correct power mode.
Exhaust Camshaft Position Actuator	This device control is used to override the state of the exhaust cam phase output.

Output Control	Description
Exhaust Camshaft Position Actuator Solenoid Valve	This device control is used to override the state of the exhaust cam phase solenoid output.
Fuel Control Loop Status	This device control is used to enable or disable closed loop fuel control.
Fuel Filter Life Reset	This device control is used to reset the Fuel Life in the ECM after replacement.
Fuel Injector Balance	This function enables the fuel injector in order to verify proper fuel injector flow. The ECM will pulse the selected injector when the following conditions are met: • All instruction on the scan tool completed. • Fuel injector selected. • Key ON, engine OFF. The selected fuel injector can only be flowed or pulsed once per ignition cycle.
Fuel Pump Enable	This function controls the fuel pump. The normal commanded state is NONE. The scan tool initiates the test when the following conditions are met: • There are no vehicle speed sensor DTCs set. • The vehicle speed is 0 km/h (0 mph). When commanded ON/OFF, the engine control module (ECM) turns the fuel pump module ON/OFF. If the engine is running and the fuel pump is commanded OFF, the engine will stall. The system remains in the commanded state for about 2 seconds or until cancelled by the scan tool or the ECM detects a vehicle speed.
Fuel Trim Enable	This function enables or disables the ECM fuel trim learning. The normal commanded state is None.
Fuel Trim Reset	This function is used to reset the learned fuel trim values to their initial values.
HO2S Heater Learn	This function is used to trigger the reset of the learned resistances for the oxygen sensor heaters following a replacement. The learned resistances are reset to a calibration used to prevent overheating of the sensors until more accurate resistances may be learned following an extended engine OFF time.
HO2S Heater Sensor 1 or 2	This function controls the selected HO2S heater. The normal commanded state is None, ON, and OFF. Commanding the HO2S heater ON turns on the heater driver. The scan tool initiates the test when the following conditions are met: • The engine is operating. • The exhaust temperature is within range.

Output Control	Description
	• In the correct power mode. • The HO2S heaters are not over temperature. • The ignition voltage is not out of range while commanding the heaters ON.
HO2S Test	This device control is used to trigger a service bay procedure to execute the oxygen sensor response test following a sensor replacement in service. This procedure is required to set the oxygen sensor inspection and maintenance ready flag.
Idle Ignition Timing	Disables and enables idle spark advance with the engine running.
Idle Learn	This device control is used to reset the learned airflow adaptive values to their initial values.
Ignition Timing Retard	This function is used to control the amount of spark retard. The normal commanded state is None. The system will increase or decrease the amount of spark retard by 1° increments within a range of 0 - 10° maximum retard. The system remains in the commanded state until cancelled by the tool.
Intake Camshaft Position Actuator	This device control is used to override the state of the intake cam phase output.
Intake Camshaft Position Actuator Solenoid Valve	This device control is used to override the state of the intake cam phase solenoid output.
MAF Sensor Supply Voltage Low Side Driver Command	This device control is used to override the state of the mass air flow sensor supply voltage output. Engine must be running.
Malfunction Indicator Lamp (MIL)	This function controls the malfunction indicator lamp (MIL). The normal commanded state is None. When commanded ON or OFF, the ECM turns the malfunction indicator lamp (MIL) ON or OFF. This output can also be monitored on the scan tool data parameter MIL Command. The system remains in the commanded state until cancelled by the scan tool.
Misfire Graphic	This function is used to graph the accumulated misfires occurring in each cylinder. The scan tool allows for a reset of the misfire graph.
Programming History	This function displays the history buffer entries for the primary calibration part in the engine controller.
Secondary Air Injection Pump Relay	This device control is used to turn the AIR Pump on or off.
Secondary Air Injection Solenoid Valve	This device control is used to turn the AIR Valve on or off.
Secondary Air Injection System	This device control is used to activate the secondary air injection system.
Secondary Air Injection Test	This device control is used to trigger the secondary air injection (SAI) diagnostic service bay test.
Throttle Position	This function controls the throttle valve in 10 % increments. The scan tool initiates the test when the following conditions are met:

Output Control	Description
	- The engine speed is 0 RPM. - The vehicle speed is 0 km/h (0 MPH). The system remains in the commanded state until cancelled by the scan tool.
Throttle Sweep	This function moves the Throttle plate slowly from a closed position to wide open position, aiding diagnosis of TAC motor.

ACTIVE SAFETY CONTROL MODULE SCAN TOOL INFORMATION

Active Safety Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run power mode, engine off.			
Battery Voltage	-	B+	Voltage of vehicle battery.
System Power Mode	-	Run	Vehicle Power Mode
Frontview Camera Mode	-	Inactive	Current state of the Frontview Camera Module
Long Range Radar Mode	-	Inactive	Current state of the Long Range Radar Module
Lane Departure Warning Status Indicator	-	Active	Lane Departure Warning Status
Lane Departure Warning Switch Status	-	Inactive	Current state of Lane Departure Warning Switch
Left Front Short Range Radar Mode	-	Inactive	Current state of the Left Front Short Range Radar Module
Right Front Short Range Radar Mode	-	Inactive	Current state of the Right Front Short Range Radar Module
Rear Short Range Radar Mode	-	Inactive	Current state of the Rear Short Range Radar Module

Adaptive Cruise Control Inhibit History

Parameter	System State	Expected Value	Description
ABS Active	-	No	ABS activation has occurred while braking on a slippery road surface.
Automatic Braking Not Available	-	No	Automatic braking is not available. Verify no communication DTCs are set against the EBCM or Active Safety Control Module. Also verify no DTCs are set in the EBCM.
Automatic Braking Time Exceeded	-	No	The EBCM has detected a problem with the electronic parking brake. Verify no DTCs are set in the EBCM

Parameter	System State	Expected Value	Description
Automatic Transmission in Reverse or Neutral	-	No	The transmission is in R or N. Transmission must remain in D to activate cruise.
Brake Pedal Applied	-	No	Verify the brakes are not applied while attempting to activate the cruise control.
Chime Not Available	-	No	The infotainment system is not able to produce chime. Verify no DTCs are set in any of the infotainment control modules and verify no communication DTCs are set against any infotainment control modules
Clutch Pedal Applied	-	No	Verify the clutch is not pressed while attempting to activate the cruise control.
Cruise Control Switch Invalid	-	No	Cruise control switch malfunction. Check for DTCs. An intermittent open, short to ground, short to voltage, or an incorrect switch will also cause this concern.
Electric Park Brake Not Available	-	No	Electric park brake malfunction. Verify no DTCs are set in the EBCM or parking brake control module.
Frontview Camera Not Available	-	No	The frontview camera module is temporarily unavailable due to environmental conditions. Check for camera blockage such as water splash, temperature, voltage, or fogging between inner glass and camera.
Instrument Cluster Not Available	-	No	Verify no DTCs are set in the instrument cluster.
Long Range Radar Not Available	-	No	The long range radar module is temporarily unavailable due to environmental conditions. Check for radar blockage such as water splash, temperature, voltage, or RF disturbance.
Manual Transmission in Reverse or Neutral	-	No	The transmission is in R or N. Ensure the vehicle is moving in a forward gear before attempting to set adaptive cruise control.
Torque Command Denied	-	No	An active safety control module torque command has been denied. Refer to disable reasons in the ECM for cause.
Traction Control Active	-	No	The traction control system has been activated due to poor driving conditions or aggressive driving.
Vehicle Speed Too High	-	No	The vehicle speed is too fast to activate cruise control. Refer to the vehicle owner's manual.

Parameter	System State	Expected Value	Description
Vehicle Speed Too Low	-	No	The vehicle speed is too slow to activate cruise control. Refer to the vehicle owner's manual.
Vehicle Stability System Active	-	No	The electronic stability control has been activated due to poor driving conditions or aggressive driving.
Odometer	-	-	Odometer reading in km when inhibit condition was set.

Adaptive Cruise Control Disengage History

Parameter	System State	Normal Value	Description
ABS Active	-	No	ABS activation has occurred while braking on a slippery road surface.
Accelerator Pedal Position Signal Invalid	-	No	The accelerator pedal position signal is intermittent, has a short to ground, short to voltage, or open, or an incorrect sensor is installed. Check for DTCs.
Advanced Parking Assist Active	-	No	Advanced parking assist guidance mode was activated. Once a parking spot is found and vehicle is stopped, vehicle goes into guidance mode to complete the parking maneuver.
Air Bag Deployed	-	No	Cruise control will not function if the active safety control module has detected that an air bag has been deployed.
Automatic Braking Limited Functionality	-	No	The EBCM will not provide auto braking. Check for DTCs in the EBCM and verify the EBCM software is correct.
Automatic Braking Malfunction	-	No	The EBCM will not provide auto braking. If a stability control system exists, diagnose this malfunction first. If the stability control system is functioning normally, check for DTCs in active safety control module. Check for a possible communication concern between active safety control module and EBCM.
Automatic Braking Not Available	-	No	Automatic braking is not available. If this is accompanied by an inoperative stability control system, make sure to diagnose the stability control system first. Verify no communication DTCs are set against the EBCM or active safety control module. Also verify no DTCs are set in the EBCM or active safety control module. Verify there are no software calibration mismatch.

Parameter	System State	Normal Value	Description
Automatic Braking Time Exceeded	-	No	The EBCM has detected an issue with the electronic parking brake. Verify no DTCs are set in the EBCM or electronic parking brake control module.
Brake Pedal Position Signal Invalid	-	No	The brake pedal position signal not valid. Check for DTCs in the BCM, ECM, and active safety control module. Check for an intermittent signal, a short to ground, short to voltage, or open, or an incorrect sensor. Verify the software and calibrations for all involved control modules is correct and verify the brake pedal position has been successfully learned.
Brake Pedal Pressure Signal Invalid	-	No	Check the EBCM and active safety control module for DTCs. Check for a communication malfunction between EBCM and active safety control module.
Brake Request Denied	-	No	Check for DTCs in the EBCM and verify the EBCM software is correct.
Cancel Switch Pressed While Vehicle Stopped	-	No	Cruise control turned off. Ensure cruise control switch remains switched on while using adaptive cruise control.
Cancel Switch Pressed While Vehicle Was Stopped with Automatic Brake	-	No	Cruise control turned off. Ensure cruise control switch remains switched on while using adaptive cruise control.
Cruise Control Switched Off	-	No	Cruise control was turned off. Ensure the cruise control switch remains switched on while using adaptive cruise control.
Desired Speed Cannot Be Maintained - Too Fast	-	No	Verify the vehicle was not operated in hilly terrain. The vehicle speed too fast to allow cruise control operation. Make sure vehicle speed is less than 177 km/h (110 mph).
Desired Speed Cannot Be Maintained - Too Slow	-	No	Verify the vehicle was not operated in hilly terrain. The vehicle speed too slow to allow cruise control operation. Make sure vehicle speed is greater than 40 km/h (25 mph) when attempting to activate cruise control.
Distance Sensing Cruise Control Not Available	-	No	Check for DTCs and software and hardware part numbers.
Door Ajar	-	No	While at an auto stop, the driver door was opened and the seatbelt was unbuckled. The system will respond by applying the electric parking brake and disengaging the cruise control.

Parameter	System State	Normal Value	Description
Electric Park Brake Not Available	-	No	Verify proper operation of electric park brake. Verify communications between the electric park brake control module and active safety control module.
Engine Stopped Running	-	No	Ensure the engine remains running while using adaptive cruise control.
Excessive Latitudinal Acceleration Detected	-	No	Poor driving conditions or aggressive driving. Check sensor multi-axis sensor installation, configuration, software and hardware part numbers.
Excessive Longitudinal Acceleration Detected	-	No	Poor driving conditions or aggressive driving. Check sensor multi-axis sensor installation, configuration, software and hardware part numbers.
Excessive Yaw Detected	-	No	Poor driving conditions or aggressive driving. Check sensor multi-axis sensor installation, configuration, software and hardware part numbers.
Frontview Camera Not Available	-	No	Verify properly alignment of the frontview camera module, that there are no DTCs set, and that the software and hardware part numbers are correct. Frontview camera module temporarily unavailable due to environmental condition. Check for camera blockage such as water splash, temperature, voltage, or fogging between inner glass and camera.
Left Non-Driven Wheel Speed Sensor Signal Invalid	-	No	Invalid signal from the wheel speed sensor. Check for DTCs, an intermittent signal caused by a short to ground, short to voltage, or an open, or an incorrect sensor.
Long Range Radar Not Available	-	No	Verify properly alignment of the long range radar, that there are no DTCs set, and that the software and hardware part numbers are correct. Long range radar temporarily unavailable due to environmental conditions. Check for radar blockage such as water splash, temperature, voltage, or an RF disturbance.
Manual Transmission in Reverse or Neutral	-	No	The transmission is in R or N. Ensure the vehicle is moving in a forward gear before attempting to set adaptive cruise control.
Park Brake Active	-	No	Ensure the parking brake is not applied while using adaptive cruise control.

Parameter	System State	Normal Value	Description
Park Brake Signal Invalid	-	No	The electric park brake malfunction. Check for DTCs, intermittent open, short to ground, short to voltage.
Parking Lot Driving Detected	-	No	The active safety control module has determined that the vehicle is in a parking lot. Refrain from driving in a parking lot with adaptive cruise control engaged.
Power Mode Set to Accessory	-	No	Verify the power mode is not changed while cruise control is engaged.
Power Mode Set to Crank	-	No	Verify the power mode is not changed while cruise control is engaged.
Power Mode Set to Off	-	No	Verify the power mode is not changed while cruise control is engaged.
Right Non-Driven Wheel Speed Sensor Signal Invalid	-	No	Invalid signal from the wheel speed sensor. Check for DTCs, an intermittent signal caused by a short to ground, short to voltage, or an open, or an incorrect sensor.
Set/Resume Pressed Simultaneously	-	No	Verify set and resume switches were not pressed at the same time.
Steering Wheel Angle Sensor Signal Invalid	-	No	The steering wheel angle sensor is not calibrated or is otherwise unavailable. Check for DTCs in the EBCM and steering wheel angle sensor. Verify there is not an intermittent open, short to ground, or short to voltage on the steering wheel angle sensor power, ground, or signal circuits. Verify the sensor is the correct part and is properly installed. Check sensor configuration, calibration, software, and hardware part numbers.
Traction Control Active	-	No	The traction control system has been activated due to poor driving conditions or aggressive driving.
Traction Control Set to Off	-	No	Cruise control will not function if traction control is turned off.
Traction Control Set to Off-Road	-	No	Cruise control will not function if traction control is in off-road mode.
Traction Control System Malfunction	-	No	Verify there are no DTCs set in the EBCM.
Transfer Case in 4WD	-	No	Ensure the transfer case is not shifted into 4WD high or 4WD low.
Transfer Case Range Invalid	-	No	The transfer case range could not be determined. Verify communication with the transfer case shift control module and

Parameter	System State	Normal Value	Description
			that there are no DTCs set in the transfer case shift control module, ECM, transmission control module, and active safety control module.
Vehicle Direction Sensors Data Not Plausible	-	No	Check for DTCs, software and hardware part numbers.
Vehicle Speed Too High	-	No	The vehicle speed too fast to allow cruise control operation. Make sure vehicle speed is less than 177 km/h (110 mph).
Vehicle Speed Too Low	-	No	The vehicle speed too slow to allow cruise control operation. Make sure vehicle speed is greater than 40 km/h (25 mph) when attempting to activate cruise control.
Vehicle Stability System Active	-	No	The electronic stability control has been activated due to poor driving conditions or aggressive driving.
Vehicle Stability System Malfunction	-	No	Verify there are no DTCs set in the EBCM.
Wheel Speed Sensor Signal Invalid	-	No	Invalid signal from the wheel speed sensor. Check for DTCs, an intermittent signal caused by a short to ground, short to voltage, or an open, or an incorrect sensor.
Odometer	-	-	Odometer reading in km when disengage condition was set.

Active Safety Control Module Output Controls

Output Control	Description
Lane Departure Warning Switch Indicator	The active safety control module illuminates the LED in the lane departure warning switch.
Parking Assist Switch LED	The active safety control module illuminates the LED in the parking assist switch.

BODY CONTROL MODULE SCAN TOOL INFORMATION

Body Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON, Vehicle in Park, All Doors Closed			
5 V Ignition Switch	-	Accessory / Key Out	The scan tool displays Off, Accessory, Run, or Crank. This parameter displays the ignition switch mode.
Accent Lighting 1 Command	-	Varies	This parameter displays the interior lighting ambient 1 command as a percentage.

Parameter	System State	Expected Value	Definition
Accent Lighting 2 Command	-	Varies	This parameter displays the interior lighting ambient 2 command as a percentage.
Accessory	-	Active	The scan tool displays Active or Inactive.
Accessory Power Mode Indicator Command	-	Varies	This parameter displays ignition switch accessory LED PWM command as a percentage.
Accessory Relay Command	-	Active	The scan tool displays Active or Inactive.
Accessory/Retained Accessory Power Relay Command	-	Active	The scan tool displays Active or Inactive. This parameter displays the retained accessory power relay status.
All Doors Lock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the door lock status.
Ambient Light Sensor	-	Varies	The scan tool displays volts. This parameter displays the ambient light sensor signal voltage.
Ambient Light Status	-	Night	The scan tool displays Unknown, Night, or Day. This parameter displays the ambient light level status.
Automatic Headlamps Disable Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp disable switch status.
Automatic Transmission Manual Shift Switch	-	Off	The scan tool displays Off or On. This parameter displays the transmission tap up tap down switch status.
Backup Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the backup lamps relay status.
Battery Current Sensor	-	Varies	The scan tool displays the battery current in amperes.
Battery Low at Start	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the battery level is low when the vehicle starts.
Battery Reconnect Detected	-	No	The scan tool displays No or Yes when a battery disconnect/reconnect event has been detected.
Battery Voltage	-	Varies	The scan tool displays the current battery voltage.
BCM-Controlled Charging Voltage	-	Active	The scan tool displays Active or Inactive.

Parameter	System State	Expected Value	Definition
BCM-Requested Charging Voltage Reduction	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the BCM has detected a low battery voltage condition.
Boot Software Part Number	-	Varies	The scan tool displays the boot software part number.
Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the brake lamp command status.
Brake Pedal Applied	-	Inactive	The scan tool displays Active or Inactive.
Brake Pedal Initial Travel Position Achieved	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor	-	Varies	This displays Counts. This numeric value is the current brake pedal position.
Brake Pedal Position Sensor High Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Learn	-	No	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned.
Brake Pedal Position Sensor Learned Home Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the home position.
Brake Pedal Position Sensor Learned Released Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the released position.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays volts.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays percentage.
Brake Pedal Position Sensor Low Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Move During Learn	-	No	The scan tool displays No or Yes. This parameter displays the brake pedal sensor learn status.
Brake Pedal Position Sensor Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Reference	-	Varies	The scan tool displays the brake pedal position as voltage value. This parameter displays the current brake pedal position sensor reference.

Parameter	System State	Expected Value	Definition
Brake Pedal Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Pulled Up from Released Position	-	No	The scan tool displays No or Yes.
Brake Transmission Shift Interlock Solenoid Actuator	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history.
Brake Transmission Shift Interlock Solenoid Actuator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the last remote start diagnostic status history.
Calculated Brake Pedal Position	-	Varies	The scan tool displays volts.
Calculated Brake Pedal Position	-	Varies	The scan tool displays percentage.
Calibration Part Number 1-20	-	Varies	The scan tool displays the software module calibration part number.
Center Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center brake lamp status.
Center Stop Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center stop lamp status.
Central Door Lock Switch on Center Console/Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door lock switch status.
Child Security Lock Indicator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the child security lock indicator command status.
Child Security Lock Motors Command	-	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Content Theft Deterrent Alarm Status	-	Disarmed	The scan tool displays Off, Armed, or Disarmed. This parameter displays the content theft alarm status.
Content Theft Deterrent Disarmed Until Vehicle Closed	-	No	The scan tool displays No or Yes. This parameter displays the content theft deterrent system status.

Parameter	System State	Expected Value	Definition
Content Theft Deterrent Mode	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Content Theft Deterrent Trigger History 1-3	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, or Glass Breakage. This parameter displays the content theft deterrent trigger history status.
Courtesy Lamps Duty Cycle Command	-	Varies	This parameter displays the interior lights dimming command as a percentage.
Crank Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Cruise Charging Set Level	-	Varies	This parameter displays cruise charging set level.
Cruise Control Switch Status	-	OFF	The scan tool displays CANCEL, OFF, ON, RESUME, SET or ERROR. This parameter displays the cruise control switch status.
Current Content Theft Deterrent Trigger	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, Glass Breakage. This parameter displays the content theft deterrent current alarm trigger.
Current Driver	-	1-8	This parameter displays the current driver in vehicle.
Disable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Dome Lamp Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the dome lamp switch status.
Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.

Parameter	System State	Expected Value	Definition
Driver Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door Ajar switch status.
Driver Door Key Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door unlock command status.
Driver Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Seat Heating/Venting /Cooling Mode	-	Off	The scan tool displays On or Off.
Driver Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Window Learned	-	Yes	The scan tool displays No or Yes.
Driver Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window main control down switch input status.
Driver Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch express input status.
Driver Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch UP input status.
Driver Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express Down, Express, Up, Error, Inhibit, or Local Switch Overridden. This parameter displays the driver window motor mode status.
Driver Window Motor Reversing Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Sensing System Fault Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Undervoltage Status	-	No	The scan tool displays No or Yes.
Enable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.
End Model Part Number	-	Varies	This parameter displays the end model part number.

Parameter	System State	Expected Value	Definition
Engine Stalled	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Environment Identification	-	Unknown	The parameter displays the vehicle environment identification successful status.
Front Fog Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp relay status.
Front Fog Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp switch status.
Front Passenger Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front passenger window down switch status.
Front Passenger Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch express input status.
Front Passenger Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch UP input status.
Front Tire Pressure on Placard	-	Varies	The scan tool displays kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Fuel Economy Mode Inhibited - Low Charging Voltage	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the fuel economy mode status.
Generator Regulator Setpoint	-	Varies	The scan tool displays percentage.
Glove Box Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the instrument panel compartment release switch status.
Hazard Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the hazard lamps switch status.
Hazard Lamps Switch Backlight Command	-	Varies	The scan tool displays percentage. This parameter displays hazard switch backlight level PWM command status.
Headlamps On Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp on switch status.
Headlamps Flash Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamps

Parameter	System State	Expected Value	Definition
			flash to pass switch status.
Headlamp Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive.
High Beam Select Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam switch status.
High Beam Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam command status.
Hood Ajar Switch	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Ajar Switch Signal 1	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Position	-	CLOSED	The scan tool displays CLOSED, AJAR, or OPENED. This parameter displays the hood position.
Horn Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Horn Switch	-	Inactive	The scan tool displays Active or Inactive.
Idle Boost Level 2-3 Counter	-	Varies	This parameter displays the state of the idle boost level as counts.
Idle Charging Set Level	-	Varies	This parameter displays idle charging set level.
Ignition Mode Switch Dimming Command	-	Varies	The scan tool displays percentage.
Ignition Switch Reference	-	Varies	This parameter displays the ignition switch voltage reference.
Ignition Switch Signal Voltage	-	Varies	This parameter displays the ignition switch signal voltage.
Ignition Switch Status	-	Inactive	This parameter displays the ignition switch status.
Immobilizer Allows Engine To Start	-	Unknown	The scan tool displays Unknown, Incorrect, Not Allowed, or Valid. This parameter displays the immobilizer status.
Immobilizer Automatic Learn Timer	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the automatic learn timer status.
Immobilizer Environment Device 1-4	-	Unknown	The scan tool displays Incorrect, Correct, Not Received, Not Programmed or Unknown. This parameter displays the immobilizer source status.

Parameter	System State	Expected Value	Definition
Immobilizer Password Learn	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the password learn status.
Immobilizer Password Learn Scan Tool Delay	-	Varies	This parameter displays the auto learn timer status.
Immobilizer Security Code Accepted	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Lockout	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Programmed	-	Yes	The scan tool displays No or Yes.
In Park Switch Status	-	On	The scan tool displays On or Off. This parameter displays the park switch status.
Inadvertent Load Command	-	Active	The scan tool displays Active or Inactive.
Indicator Dimming Duty Cycle Command	-	Varies	The scan tool displays percentage. This parameter displays indicator lighting PWM command status.
Interior/Courtesy Lighting Master Switch	-	Door	The scan tool displays Door or other lighting switch status.
Interior Trunk Lid/Liftgate Window Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Key Capture Solenoid Actuator	-	Active	The scan tool display Active or Inactive. This parameter displays column lock input status.
Key Fob 1-4 Battery Status	-	OK	The scan tool displays OK or other key fob battery status. This parameter displays the key fob battery status.
Key Fob 1-4 Function	-	Undefined	The scan tool displays Inactive, Lock, Unlock Driver Door, All Door Unlock, Release Rear Closure, Actuate Left Sliding Door, Actuate Right Sliding door, Panic Alarm, Release Fuel door, Actuate Power Windows, Actuate Folding Top, Start Engine, Stop Engine, Programmed, Locator Alarm, Close Liftgate, Open Liftgate, Stop Liftgate While Closing, Stop Liftgate While opening, Deadlock All Doors, Stop Liftgate Motion, Start Liftgate Motion, Stop Left Sliding Door Motion, Stop Right Sliding Door Motion, Comfort open, or Comfort close. This parameter displays the key fob function status.

Parameter	System State	Expected Value	Definition
Key Fob in Vehicle	-	Inactive	This parameter displays the current key fob in the vehicle.
Key In Cylinder Switch	-	Active	The scan tool displays Active or Inactive.
Key In Cylinder Switch/Key Fob in Vehicle	-	Yes	The scan tool displays No or Yes.
Key in Ignition Status	-	Inactive	The scan tool displays Key Out or Key In. This parameter displays the key in ignition status.
Key Part Number	-	Varies	This parameter displays the key part number.
Key Type	-	Master Key	The scan tool displays Unknown, Master Key, Valet Key, Fleet Key, or Unconfigured. This parameter displays the key type.
Last Door Lock Function	-	All Doors Lock	The scan tool displays NO Action, PC UNDB Lock, PC Unlock, Unlock, Unlock Driver, Unlock Passenger, Unlock Left Rear, Unlock Right Rear, Unlock Cargo Liftgate, Unlock Driver Side, Unlock Passenger Side, Unlock Non Driver, Unlock All, Lock All, DBL Lock, or UNDBL Lock.
LED Backlight Dimming Command	-	Varies	The scan tool displays as a percentage. This parameter displays LED backlight dimming PWM command status.
Left Brake Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left brake lamp command status.
Left Dedicated Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left dedicated daytime running lamp command status.
Left Front Tire Pressure	-	Varies	This parameter displays left front tire pressure in PSI.
Left Front Tire Pressure Sensor Identification	-	Varies	This parameter displays left front tire pressure sensor ID.
Left Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter display tire pressure monitor system learned status.
Left Front Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool parameter displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or

Parameter	System State	Expected Value	Definition
			High.
Left Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Left Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Left Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left low beam/daytime running lamp status.
Left Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Left Rear Child Security Lock Switch	-	Inactive	This parameter displays Active or Inactive.
Left Rear Door Ajar Switch	-	Inactive	This parameter displays Active or Inactive. This parameter displays the left rear door ajar switch status.
Left Rear Tire Pressure	-	Varies	This parameter displays left rear tire pressure in PSI.
Left Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays left rear tire pressure sensor ID.
Left Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter displays tire pressure monitor system learned status.
Left Rear Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive. The parameter displays turn lamp outage status.
Left Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Left Rear Window Learned	-	Yes	The scan tool displays No or Yes.
Left Rear Window Main Control Down Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Express Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.

Parameter	System State	Expected Value	Definition
Left Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Left Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Left Stop Lamp Command	-	Varies	The scan tool display percentage.
Left Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the left turn signal switch status.
License Plate Lamps Command	-	Inactive	The scan tool displays Active or Inactive.
Load Reduction Level 2-3 Counter	-	Varies	The scan tool display as counts.
Low Beam Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp low beam relay status.
Manufacturers Enable Counter	-	Varies	This parameter tool displays various counter values.
Master Keys Learned	-	Varies	This parameter displays the total number of master keys learned.
Module Diagnostic Address	-	Varies	This parameter displays module diagnostic address.
Number of Key Fobs In Vehicle	-	1	This parameter displays the number of fobs located in the vehicle.
Odometer	-	Varies	This parameter displays the vehicle mileage.
Outside Rear View Mirror Courtesy Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Brake Switch	-	Active	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the parklamp switch is activated.
Passenger Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door ajar switch status.
Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door lock switch status.

Parameter	System State	Expected Value	Definition
Passenger Door Unlock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock switch status.
Passenger Door(s) Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Passenger Door(s) Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock status.
Passenger Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Seat Heating/Venting/Cooling Mode	-	Off	The scan tool displays On or Off.
Passenger Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Window Learned	-	Yes	The scan tool displays No or Yes. This parameter displays the passenger window learned status.
Passenger Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Passenger Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch status.
Pickup Bed Cargo Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays pickup bed cargo lamp command status.
Previous Key Type	-	Unknown	This parameter displays previous driver identification device type.
Primary Key Status	-	Yes	The scan tool displays No or Yes.
Push Button Ignition Switch	-	Inactive	The scan tool displays Active or Inactive.
Push Button Ignition Switch Voltage	-	Varies	This parameter displays the push button ignition switch voltage.
Rain Sensor	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Ajar Switch	-	Active	The scan tool displays Active or Inactive.
Rear Closure Cylinder Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Cylinder Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Tire Pressure on Placard	-	Varies	This parameter displays the rear tire pressure in kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.

Parameter	System State	Expected Value	Definition
Regulated Voltage Control Mode	-	Voltage	The scan tool displays voltage.
Remote Vehicle Start Attempts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining start attempts.
Remote Vehicle Start Crank Time	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Disabled by Driver	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Source	-	Ignition Switch Start	The scan tool displays Ignition Switch Start or Remote Vehicle Start.
Remote Vehicle Starts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining remote starts.
Right Brake Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right brake lamp PWM command status.
Right Dedicated Daytime Running Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right dedicated DRL PWM command status.
Right Front Tire Pressure	-	Varies	This parameter displays right front tire pressure in PSI.
Right Front Tire Pressure Sensor Identification	-	Varies	This parameter displays right front tire pressure sensor ID.
Right Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Front Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode or Learn Mode Pressure Triggered.
Right Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Right Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays right low

Parameter	System State	Expected Value	Definition
			beam/daytime running lamp status.
Right Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Right Rear Child Security Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Tire Pressure	-	Varies	This parameter displays right rear tire pressure in PSI.
Right Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays right rear tire pressure sensor ID.
Right Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Rear Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered. This parameter displays the pressure sensor mode status.
Right Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal or High. This parameter displays the right rear tire pressure status.
Right Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Right Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Right Stop Lamp Command	-	Varies	The scan tool displays percentage.
Right Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the right turn signal switch status.

Parameter	System State	Expected Value	Definition
Run Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Run Relay Command	-	Active	The scan tool displays Active or Inactive.
Run/Crank	-	Inactive	The scan tool displays Active or Inactive.
Run/Crank Relay Command	-	Active	The scan tool displays Active or Inactive.
Run/Crank Power Mode Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays ignition switch run LED PWM command status.
Secondary Key Status	-	No	The scan tool displays No or Yes.
Security Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays security LED PWM command status.
Selected Front Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the front tire type.
Selected Rear Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the rear tire type.
Start-Up State of Charge	-	Varies	The scan tool displays percentage. This parameter displays startup state of charge status.
State of Charge	-	Varies	The scan tool displays percentage. This parameter displays state of charge status.
Sunroof Enabled	-	Active	The scan tool displays Active or Inactive.
Sunroof Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Position	-	Closed	The scan tool displays Closed, Open, Venting, Comfort Open, Closing, Opening. This parameter displays the current sunroof position.
Sunroof Remote Command	-	Inactive	The scan tool displays Sunroof Secure Close, Venting, Close, or Open. This parameter displays the last sunroof remote command.
Sunroof Slide Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof slide

Parameter	System State	Expected Value	Definition
			switch status.
Sunroof Tilt Switch	-	Inactive	The scan tool displays Inactive, Open, Close, Short to Ground, Short to Battery or Stuck. This parameter displays the sunroof tilt switch status. When the switch experiences a malfunction Short to Ground, Short to Battery or Stuck will be displayed.
Sunroof/Sunshade Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.
Sunroof/Sunshade Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof or sunshade switch status.
Sunshade Enabled	-	Active	The scan tool displays Active or Inactive.
Sunshade Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunshade Position	-	Closed	The scan tool displays Ajar, Closed, Opened, Closing, or Opening. This parameter displays the sunshade position status.
Sunshade Remote Command	-	Inactive	The scan tool displays Close or Open. This parameter displays the last sunshade remote command.
Tamper Status	-	No	The scan tool displays No or Yes.
Telematics Enhanced Service Override Active	-	No	The scan tool displays No or Yes. This parameter displays vehicle theft deterrent system status.
Total Keys Learned	-	Varies	This parameter displays the number of keys learned.
Traction Control Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the traction control switch is active.
Transponder Authentication	-	Initializing	The scan tool displays Inactive, Initializing, ID Received, Password Received, Data Reception Complete, or Data Transmission Complete. This parameter displays the transponder key communication status.
Transponder Key Status	-	OK	The scan tool displays OK, LIN Bus Initialization Malfunction, Antenna Initialization Malfunction, Password Error, No Valid Key Detected, LIN Bus Communication Malfunction, or Antenna

Parameter	System State	Expected Value	Definition
			Malfunction. This parameter displays the transponder key communication error status.
Trunk Lamp Command	-	Varies	The scan tool displays as percentage.
Trunk Lid/Liftgate Window Exterior Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Trunk Lid/Liftgate Window Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Valet Keys Learned	-	Varies	This parameter displays the number of valet keys learned.
Valet Mode Status	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Valet switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the valet switch is on.
Vehicle Identification Number (VIN)	-	Varies	This parameter displays the vehicle identification number.
Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer relay status.
Windshield Washer Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer switch status.
Windshield Wiper Park Switch	-	Active	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Switch	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Motor Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper relay status.
Windshield Wiper Stalled During Sweep	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Stalled in Park Position	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper stalled status.
Windshield Wiper Switch	-	Off	The scan tool displays Off, Delay 1, Delay 2, Delay 3, Delay 4, Delay 5, or Low. This parameter displays the

Parameter	System State	Expected Value	Definition
			windshield wiper switch status.

Body Control Module Scan Tool Output Controls

Scan Tool Output Control	Description
Accent Lighting 1	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accent Lighting 2	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accessory Power Mode Indicator	The BCM activates the accessory indicator when you select On. The value should be 100%. The yellow LED accessory indicator on start button should illuminate until commanded Off.
Accessory Power Relay	The BCM actuates the accessory power relay when you select On. The accessory power relay should turn on allowing specific vehicle functions to operate.
Accessory/Retained Accessory Power Relay	The BCM actuates the retained accessory power relay when you select On. The retained accessory power relay should turn on allowing specific vehicle functions to operate.
All Doors Lock	The BCM activates all doors lock when you select Lock. All doors should lock.
All Doors Lock/Unlock	The BCM activates all doors lock/unlock when you select Lock/Unlock.
Auxiliary Ignition Run Relay	The BCM controls the Ignition Run Coil Control circuit to turn it On and Off.
Backup Lamps	The BCM actuates the backup lamps relay when you select On. The backup lamps should illuminate until commanded Off. Engine must be running.
Battery Saver Relay	The BCM activates the battery saver relay when you select Enable. This command sets the low power mode relay in the state in which it does not supply power to the non-essential parts of the vehicle. This is used to prevent the battery from being depleted when the vehicle is not used for a long period of time.
Brake Pedal Position Sensor Learn	The BCM activates the brake pedal position sensor learn when you select Learn. The brake pedal position sensor learn procedure should start.
Brake Transmission Shift Interlock Solenoid Actuator	The BCM activates the transmission shift interlock solenoid actuator when you select On.
Brake Transmission Shift Interlock Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Center Brake Lamp	The BCM activates the center brake lamp when you select On. The center brake lamp should illuminate until commanded Off.
Center Stop Lamp	The BCM activates the center stop lamp when you select On. The center stop lamp should illuminate until commanded Off.
Child Security Lock Indicator	The BCM activates the child security lock indicator when you select On. The child security lock indicator should illuminate until commanded Off.
Child Security Lock Motors	The BCM actuates the child security door motor when you select Lock. The child security doors should lock.

Scan Tool Output Control	Description
Child Security Lock/Window Lockout Switch Indicator	The BCM activates the child security lock/window lockout switch indicator when you select On. The child security lock/window lockout switch indicator should illuminate until commanded Off.
Clear Driver Window Learned Values	When you select Clear the clear driver window learn procedure should start.
Clear Passenger Window Learned Values	When you select Clear the clear left rear window learn procedure should start.
Courtesy Lamps	The BCM activates the courtesy lamps when you select On. The value should be 100%. The courtesy lamps should illuminate until commanded Off.
Driver Door Unlatch	The BCM activates the output circuit to unlatch the driver door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Driver Door Unlock	The BCM pulses the driver door unlock motor when you select Unlock. The driver door should unlock.
Driver Window Motor	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Driver Window Motor Mode	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Front Fog Lamps	The BCM actuates the front fog lamps relay when you select On. The front fog lamps relay should turn on.
Generator Regulator Setpoint	The BCM changes the output of the generator.
Hazard Lamps Switch Backlight	The BCM activates the hazard lamps switch when you select On. The value should be 100%. The hazard lamps switch backlight should illuminate until commanded Off.
High Beams	The BCM activates the high beam command when you select On. The high beam lights should illuminate. The headlamps have to be on.
Horn Relay	The BCM activates the horn when you select On. The horn should sound.
Inadvertent Load	The BCM activates the inadvertent load command when you select On. (It is an electronic request to shut down an electrical or electronic device that is drawing power from the battery at a time when there should be no activity, usually after the key has been removed from the ignition for a period of time.)
Incandescent Dimming	The BCM activates the incandescent light dimming when you select On. The values should be 100%. The incandescent light dimming should illuminate until commanded Off.
Indicator Dimming	The BCM activates the indicator dimming when you select On. The values should be 100%. The indicator should illuminate until commanded Off.

Scan Tool Output Control	Description
LED Backlight Dimming	The BCM activates the LED backlight dimming when you select On. The values should be 100%. The LED backlight dimming for control switches should illuminate until commanded Off.
Left Brake Lamp	The BCM activates the left brake lamp when you select On. The values should be 100%. The left brake lamp should illuminate until commanded Off.
Left Dedicated Daytime Running Lamp	The BCM activates the left dedicated daytime running lamp when you select ON. The value changes to 100%. The left daytime running lamp should illuminate.
Left Front Park Lamp	The BCM activates the left front park lamp when you select ON with a value of 100%. The left front park lamp should illuminate.
Left Front Park Lamp/Daytime Running Lamp	The BCM activates the left front park lamp/daytime running lamp when you select ON with a value of 100%. The left front park lamp/daytime running lamp should illuminate.
Left Front Turn Signal Lamp	The BCM activates the left front turn signal lamp when you select On. The left front turn signal lamp should illuminate until commanded Off.
Left Headlamp Lamp Low Beam	The BCM activates the left headlamp low beam when you select On. The values should be 100%. The left headlamp low beam should illuminate until commanded Off.
Left Park Lamps	The BCM activates the left park lamps when you select ON with a value of 100%. The left park lamps should illuminate.
Left Rear Park Lamp	The BCM activates the left rear park lamp when you select ON with a value of 100%. The left rear park lamp should illuminate.
Left Rear Stop/Park Lamp	The BCM activates the left rear stop/park lamp when you select ON with a value of 100%. The left rear stop/park lamp should illuminate.
Left Rear Turn Signal Lamp	The BCM activates the left rear turn signal lamp when you select On. The left rear turn signal lamp should illuminate until commanded Off.
Left Rear Turn Signal/Stop Lamp	The BCM activates the left rear turn signal/stop lamp when you select On. The left rear turn signal/stop lamp should illuminate until commanded Off.
Left Rear Window Motor	The BCM activates the left rear window motor when you select Up/Down/Stop/Express Down. The left rear window should follow the appropriate command.
Left Stop Lamp	The BCM activates the left stop lamp when you select ON with a value of 100%. The left stop lamp should illuminate.
Left Trailer Turn Signal Lamp	The BCM activates the left trailer turn signal lamp when you select ON with a value of 100%. The left trailer turn signal lamp should illuminate.
License Plate Lamps	The BCM activates the license plate lamps when you select On. The license plate lights should turn on until commanded Off.
Liftgate Unlatch	The BCM actuates the rear compartment lid release actuator when you select Unlatch. The trunk or liftgate should open.
LIN Bus Device Identification Data	When you select Update the LIN Bus Device part number and calibration part number should be updated.
Low Beam Lamps	The BCM activates the low beam lamps when you select On. The low beam lamps should turn on.

Scan Tool Output Control	Description
Low Beam Relay	The BCM activates the low beams when you select On. The low beam lights should turn on.
Outside Rear View Mirror Courtesy Lamp	The BCM activates the outside rear view mirror courtesy lamp when you select On. The outside rear view mirror courtesy lamp (at the bottom) should illuminate.
Passenger Door(s) Unlatch	The BCM activates the output circuit to unlatch the passenger door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Passenger Door(s) Unlock	The BCM pulses the passenger door unlock motor when you select Unlock. The passenger door should unlock.
Passenger Window Motor	The BCM activates the passenger window motor when you select Up/Down /Stop/Express Up/Express Down. The passenger window should follow the appropriate command.
Pickup Bed Cargo Lamp	The BCM activates the pickup bed cargo lamp when you select On. The values should be 100%. The pickup bed cargo lamp should illuminate until commanded Off.
Rear Fog Lamp(s) Relay	The BCM activates the rear fog lamps when you select On. The rear fog lamps should turn on.
Right Brake Lamp	The BCM activates the right brake lamp when you select On. The value should be 100%. The right brake lamp should illuminate until commanded Off.
Right Dedicated Daytime Running Lamp	The BCM activates the right dedicated daytime running lamp when you select On. The value should be 100%. The right daytime running lamp should illuminate.
Right Front Park Lamp	The BCM activates the right front park lamp when you select ON with a value of 100%. The right front park lamp should illuminate.
Right Front Park Lamp/Daytime Running Lamp	The BCM activates the right front park lamp/daytime running lamp when you select ON with a value of 100%. The right front park lamp/daytime running lamp should illuminate.
Right Front Turn Signal Lamp	The BCM activates the right front turn signal lamp when you select On. The right front turn signal/hazard lamp should illuminate.
Right Headlamp Low Beam	The BCM activates the right headlamp low beam when you select On. The right headlamp low beam should illuminate.
Right Park Lamps	The BCM activates the right park lamps when you select ON with a value of 100%. The right park lamps should illuminate.
Right Rear Park Lamp	The BCM activates the right rear park lamp when you select ON with a value of 100%. The right rear park lamp should illuminate.
Right Rear Stop/Park Lamp	The BCM activates the right rear stop/park lamp when you select ON with a value of 100%. The right rear stop/park lamp should illuminate.
Right Rear Turn Signal Lamp	The BCM activates the right rear turn signal/hazard lamp when you select On. The right rear turn signal lamp should illuminate until commanded Off.
Right Rear Turn Signal/Stop Lamp	The BCM activates the right rear turn signal/stop lamp when you select On. The right rear turn signal/stop lamp should illuminate until commanded Off.

Scan Tool Output Control	Description
Right Rear Window Motor	The BCM activates the right rear window motor when you select Up/Down/Stop/Express Down. The right rear window should follow the appropriate command.
Right Stop Lamp	The BCM activates the right stop lamp when you select ON with a value of 100%. The right stop lamp should illuminate.
Right Trailer Turn Signal Lamp	The BCM activates the right trailer turn signal lamp when you select ON with a value of 100%. The right trailer turn signal lamp should illuminate.
Run Relay	The BCM actuates the run relay when you select On. The run relay should turn on.
Run/Crank Relay	The BCM actuates the run/crank relay when you select On. The run/crank relay should turn on.
Run/Start Power Mode Indicator	The BCM activates the run/start lamp when you select On. The value should be 100%. The green LED on engine start/stop button should illuminate until commanded Off.
Security Indicator	The BCM activates the security indicator command when you select On. The security indicator at center of dash (or at DRL sensor) should illuminate until commanded Off.
Stop Lamps	The BCM activates the stop lamps when you select ON with a value of 100%. The stop lamps should illuminate.
Tire Pressure Sensors Learn	The BCM activates the tire pressure sensor learn procedure when you select Learn.
Tire Type/Pressure Selection	When you select OK, you can change tire type and load range.
Trailer Backup Lamps	The BCM activates the trailer backup lamps when you select ON with a value of 100%. The trailer backup lamps should illuminate.
Trailer Park Lamps	The BCM activates the trailer park lamps when you select ON with a value of 100%. The trailer park lamps should illuminate.
Transmission Range Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Trunk Lamp	The BCM activates the trunk lamp when you select On. The value should be 100%. The trunk lamp should illuminate until commanded Off.
Trunk Lid Unlatch	The BCM activates the trunk lid unlatch when you select On. The trunk lid should unlatch.
Window Lockout Switch Indicator	The BCM activates the window lockout switch indicator when you select On. The window lockout switch indicator should illuminate until commanded Off.
Windshield Washer Relay	The BCM actuates the windshield washer relay when you select On. The windshield washer relay should turn on.
Windshield Wiper High Speed Relay	The BCM actuates the windshield wiper high speed relay when you select On. The windshield wiper high speed relay should turn on.
Windshield Wiper Motor Relay	The BCM actuates the windshield wiper motor relay when you select On. The windshield wiper motor relay should turn on.

BRAKE BOOSTER CONTROL MODULE SCAN TOOL INFORMATION

The electronic brake booster control module (EBBCM) scan tool data parameters list contains all EBBCM related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Booster Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Vehicle in Service Mode			
Battery Voltage	-	Varies	This parameter will display the control module voltage.
Brake Booster Pump Motor Torque	-	Varies	This parameter displays the amount of torque currently being produced by the electric motor.
Brake Pedal Position Calculated from Input Rod Position Sensor 1	-	Varies	The travel of the brake booster input rod is used to calculate the travel of the brake pedal, which actuates the rod.
Brake Pedal Position Calculated from Input Rod Position Sensor 2	-	Varies	This displays ml/s. The scan tool displays the brake system target flow rate request.
Input Rod Position	-	Varies	This parameter indicates the location of the push rod which is connected to the brake pedal.
Input Rod Position Sensors 1 and 2 Supply Voltage	-	Varies	This parameter refers to the voltage used to power the internal position sensors (brake booster input rod position).
Motor Driver Temperature 1	-	Varies	Temperature of the electric motor.
Motor Driver Temperature 2	-	Varies	Temperature of the electric motor.
Output Rod Position	-	Varies	This parameter indicates the location of the push rod which is connected to the brake master cylinder.
Target Flow Rate Request by Electronic Brake Control Module	-	Varies	This parameter displays the brake system target flow rate
Target Pressure Request by Electronic Brake Control Module	-	Varies	This parameter displays the brake system target pressure

ELECTRONIC BRAKE CONTROL MODULE SCAN TOOL INFORMATION

The electronic brake control module (EBCM) scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Service Mode			
ABS Pump Motor Voltage	-	Varies	The scan tool displays the pump motor voltage.
Antilock Braking System	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the antilock braking system is in traction control event.
Antilock Braking System Status	-	No	The scan tool displays No or Yes. If there is an ABS malfunction the scan tool will display Yes.
Brake Booster Electric Vacuum Pump	-	Varies	This displays voltage of the Electric Vacuum Pump
Brake Controls Brake Pedal Position Sensor without Offset	-	Varies	This displays mm. This is the value used to compare the position of the primary piston sensors.
Brake Controls Brake Pedal Position Sen. 5 Volt Supply Voltage	-	Varies	This displays volts. This is the voltage supply to the brake controls brake pedal position sensor.
Brake Controls Brake Pedal Position	-	Varies	The scan tool displays the brake pedal counts. Learned or Not Learned. This is the brake controls brake pedal position sensor zeroed or learned value.
Brake Boost Power Status	-	Enabled	The scan tool displays Enabled or Disabled.
Brake Master Cylinder Pressure Sensor	-	Varies	This displays psi/kpa. This is the current brake applied pressure.
Brake Fluid Level Sensor	-	Varies	This displays volts. This is the voltage supply to the brake fluid level sensor signal.
Brake Pedal Position Sensor Signal	Brake pedal released	Released	The scan tool displays Applied or Release depending on the state of the brake pedal.
	Brake pedal applied	Applied	
Brake Pressure Sensor	Brake pedal released	0 - 1.55 V	The scan tool displays 0 - 5 V depending on the applied hydraulic brake pressure.
	Brake pedal applied	1.55 - 5 V	
Dynamic Rear Proportioning Status	-	No	The scan tool displays No or Yes. If the EBCM disables the dynamic rear proportioning due to a fault the scan tool will display Yes.
Engine Drag Control Status	-	No	The scan tool displays No or Yes. If the EBCM detects an ABS event, it sends a signal to the ECM to reduce engine

Parameter	System State	Expected Value	Description
			power and Yes is displayed on the scan tool.
High Pressure Accumulator Sensor	-	Varies	This displays the pressure of the accumulator.
Ignition Voltage	-	Varies	This displays volts. This is the voltage status of the electronic brake control module (EBCM).
Lateral Acceleration	-	Varies	The scan tool displays the current lateral acceleration in m/s ²
Left Front Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left front inlet solenoid valve is commanded ON.
Left Front Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left front outlet solenoid valve is commanded ON.
Left Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left front wheel speed sensor.
Left Rear Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left rear inlet solenoid valve is commanded ON.
Left Rear Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left rear outlet solenoid valve is commanded ON.
Left Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor.
Longitudinal Acceleration	-	Varies	The scan tool displays the current longitudinal acceleration in m/s ²
Panic Brake Assist Status	-	No	The scan tool displays No or Yes. If the EBCM disables the panic brake assist due to a fault the scan tool will display Yes.
Regenerative Braking Status	-	Active	The scan tool displays Active or Inactive.
Right Front Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right front inlet solenoid valve is commanded ON.
Right Front Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right front outlet solenoid valve is commanded ON.
Right Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right front wheel speed sensor.

Parameter	System State	Expected Value	Description
Right Rear Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right rear inlet solenoid valve is commanded ON.
Right Rear Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right rear outlet solenoid valve is commanded ON.
Right Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.
Steering Wheel Angle Sensor Signal	Steering wheel in straight position	-5 to +5°	The scan tool displays °. This is the current position of the steering angle sensor.
	Steering wheel turned left until stop	450 - 550°	
	Steering wheel turned right until stop	-550 to -450°	
System Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.
Traction Control System	-	No	The scan tool displays No or Yes. If there is a traction control malfunction the scan tool displays Yes.
Vehicle Stability System Status	-	No	The scan tool displays No or Yes. If there is a stability control malfunction the scan tool displays Yes.
Yaw Rate	-	Varies	The scan tool displays the current yaw rate in °/s.

Electronic Brake Control Module Scan Tool Output Controls

Output Control	Description
Automated Brake Bleed	This is used in order to bleed ABS hydraulics.
ABS Pump Motor	This is used in order to command the ABS pump motor On or Off.
ABS Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Right Front Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Right Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.

Output Control	Description
Traction Control Right Front Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Right Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Rear Brake Caliper Piston Extend	Commands the rear brake caliper piston to Extend Travel
Rear Brake Caliper Piston Retract	Commands the rear brake caliper piston to Retract Travel
Left Park Brake Actuator	Commands the park brake actuator ON or OFF.
Right Park Brake Actuator	Commands the park brake actuator ON or OFF.

Electronic Brake Control Module Configuration/Reset Functions

Functions	Description
Yaw Rate Sensor Learn	This learn is used to calibrate the multi-axis acceleration sensor.
Steering Angle Sensor Learn	This learn is used to calibrate the steering angle sensor.
Park Brake Calibration	This learn is used to calibrate the rear electronic parking brakes.

FUEL PUMP POWER CONTROL MODULE SCAN TOOL INFORMATION

Refer to [K20 Engine Control Module: Scan Tool Information](#).

BATTERY ENERGY CONTROL MODULE SCAN TOOL INFORMATION

Battery Energy Control Module Data

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Control Module Voltage Signal	Volts	Displays the voltage that is currently available for the control module to function. A typical values will be whatever the current available battery/charging voltage is (12 - 15.5 V).
5V Reference 1	Volts	The reference voltage is a fixed voltage that is provided by the control module to various sensors (3 V). This voltage is then used by the various sensors to produce a feedback signal to the electronic control module.
Hybrid/EV Battery Pack Low Resolution Current Sensor	Amps	A sensor that measures Hybrid/EV Battery pack current. There are 2 current sensors that measure total battery pack current. One is a low resolution and one is a high resolution.
Hybrid/EV Battery Pack High Resolution Current Sensor	Amps	A sensor that measures Hybrid/EV Battery pack current. There are 2 current sensors that measure total battery pack current. One is a low resolution and one is a high resolution.

Parameter	Expected Value	Definition
Hybrid/EV Battery Pack Terminal 1 Voltage	Volts	Hybrid/EV Battery DC Voltage Sensor 1 represents the Hybrid/EV Battery pack voltage as measured at the Battery side of the high voltage contactors.
Power Mode	OFF/ Accessory/ Crank Request	Display the status of the ignition switch on/off. The ignition switch allows the driver to control the power to the accessories. This switch also connects the starter to the battery.

Temperature Data

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Degrees C	Hybrid/EV Battery Temperature Sensor 1 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Degrees C	Hybrid/EV Battery Temperature Sensor 2 represents the temperature within Battery Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Degrees C	Hybrid/EV Battery Temperature Sensor 3 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 4	Degrees C	Hybrid/EV Battery Temperature Sensor 4 represents the temperature within Battery Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 5	Degrees C	Hybrid/EV Battery Temperature Sensor 5 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Degrees C	Hybrid/EV Battery Temperature Sensor 6 represents the temperature within Battery Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	Degrees C	The Hybrid/EV Battery pack coolant temperature measured at the coolant loop inlet of the Hybrid/EV Battery pack.

Voltage Data 1

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 1 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 2 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 3 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 4	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 4 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 5	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 5 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 6 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 7	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 7 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 8	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 8 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 9	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 9 within Section 3 of the Hybrid Battery Pack, as

Parameter	Expected Value	Definition
		measured by the battery energy control module.
Hybrid/EV Battery 10	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 10 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 11	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 11 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 12	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 12 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 13	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 13 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 14	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 14 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 15	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 15 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 16	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 16 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 17	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 17 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 18	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 18 within Section 3 of the Hybrid Battery Pack, as

Parameter	Expected Value	Definition
		measured by the battery energy control module.
Hybrid/EV Battery 19	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 19 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 20	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 20 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 21	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 21 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 22	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 22 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 23	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 23 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 24	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 24 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 25	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 25 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 26	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 26 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 27	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 27 within Section 3 of the Hybrid Battery Pack, as

Parameter	Expected Value	Definition
		measured by the battery energy control module.
Hybrid/EV Battery 28	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 28 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 29	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 29 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 30	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 30 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 31	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 31 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 32	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 32 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 2

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 33	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 33 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 34	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 34 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 35	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 35 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control

Parameter	Expected Value	Definition
		module.
Hybrid/EV Battery 36	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 36 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 37	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 37 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 38	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 38 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 39	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 39 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 40	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 40 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 41	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 41 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 42	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 42 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 43	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 43 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 44	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 44 within Section 3 of the Hybrid Battery Pack, as measured by the battery energy control

Parameter	Expected Value	Definition
		module.
Hybrid/EV Battery 45	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 45 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 46	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 46 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 47	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 47 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 48	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 48 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 49	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 49 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 50	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 50 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 51	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 51 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 52	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 52 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 53	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 53 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control

Parameter	Expected Value	Definition
		module.
Hybrid/EV Battery 54	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 54 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 55	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 55 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 56	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 56 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 57	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 57 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 58	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 58 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 59	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 59 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 60	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 60 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 61	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 61 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 62	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 62 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control

Parameter	Expected Value	Definition
		module.
Hybrid/EV Battery 63	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 63 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 64	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 64 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 3

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 65	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 65 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 66	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 66 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 67	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 67 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 68	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 68 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 69	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 69 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 70	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 70 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 71	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 71 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 72	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 72 within Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 73	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 73 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 74	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 74 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 75	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 75 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 76	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 76 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 77	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 77 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 78	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 78 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 79	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 79 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 80	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 80 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 81	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 81 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 82	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 82 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 83	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 83 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 84	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 84 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 85	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 85 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 86	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 86 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 87	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 87 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 88	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 88 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 89	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 89 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 90	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 90 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 91	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 91 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 92	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 92 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 93	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 93 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 94	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 94 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 95	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 95 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 96	Volts	Hybrid/EV Battery Voltage Sensor represents the voltage of Battery Cell Group 96 within Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

HEATING, VENTILATION AND AIR CONDITIONING CONTROL MODULE SCAN TOOL INFORMATION

Heating Ventilation and Air Conditioning Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/ Vehicle in Service Mode			
A/C Button/Switch	A/C Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C switch.
	A/C Button pressed	Active	
A/C Compressor Refrigerant Solenoid Valve Command	-	0 - 100%	The scan tool displays % depending on the command for compressor displacement. The value increases stepwise from 0 - 100% depending on the command/request.
A/C Indicator	A/C Off	Off	The scan tool displays On or Off depending on the state of the A/C mode.
	A/C On	On	
A/C Evaporator Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the A/C evaporator temperature sensor.
A/C Request Signal	A/C Off	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C mode.
	A/C On	Active	
Air Inlet Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Air Inlet Door Actuator Direction	-	Stop	The scan toll displays Stop, Outside Air, Increase, Recirculation, Decrease or Not Used depending on the state of the recirculation door. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Air Inlet Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Air Inlet Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Air Quality Sensor / Odor (AQS) Button/Switch	Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C switch.
	Button pressed	Active	
Air Quality / Odor (AQS) Sensor	-	Varies	The scan tool displays counts. The value increases with the increasing of the pollution of the ambient air.
Air Quality Sensor / Odor (AQS) Indicator	AQS Off	Off	The scan tool displays On or Off depending on the state of the AQS indicator command
	AQS On	On	
Air Recirculation Button/Switch	Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the air recirculation mode switch.
	Button pressed	Active	

Parameter	System State	Expected Value	Description
Air Recirculation Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Air Recirculation Door Actuator Direction	-	Stop	The scan toll displays Stop, Outside Air, Increase, Recirculation, Decrease or Not Used depending on the state of the recirculation door. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Air Recirculation Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Air Recirculation Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Air Recirculation Indicator	Recirculation Off	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Recirculation On	On	
Air Recirculation LED	Recirculation Off	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Recirculation On	On	
Air Recirculation Mode Switch	Air recirculation switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the air recirculation mode switch.
	Air recirculation switch pressed	Active	
Auto HVAC Button/ Switch	Auto HVAC button released	Inactive	The scan tool displays On or Off depending on the state of the Auto HVAC button.
	Auto HVAC button pressed	Active	
Auto HVAC Indicator	Auto mode is deactivated	Off	The scan tool displays On or Off depending on the state of the Auto mode command.
	Auto mode is activated	On	
Auto HVAC Switch	Auto HVAC switch released	Inactive	The scan tool displays On or Off depending on the state of the Auto HVAC switch.
	Auto HVAC switch pressed	Active	
Auto Recirculation Button/ Switch	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the switch.
Auto Recirculation Indicator	Auto Recirculation is deactivated	Off	The scan tool displays On or Off depending on the state of the Auto Recirculation indicator command.

Parameter	System State	Expected Value	Description
	Auto Recirculation is activated	On	
Auxiliary Blower Motor Button/Switch	-	Varies	The scan tool displays AUTO, OFF, 1, 2, 3, 4, or 5 depending on the position of the auxiliary blower motor switch.
Auxiliary Blower Motor Speed	-	0 - 100%	The scan tool displays % depending on the feedback. The value increases stepwise from 0 - 100% depending on the feedback.
Auxiliary Blower Motor Speed Command	-	0 - 100%	The scan tool displays % depending on the command. The value increases stepwise from 0 - 100% depending on the command/request.
Auxiliary Blower Motor Speed Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Auxiliary Blower Motor Switch - Rotary	-	Varies	The scan tool displays AUTO, OFF, 1, 2, 3, 4, or 5 depending on the position of the auxiliary blower motor switch.
Auxiliary Coolant Pump	-	Varies	The scan tool displays Active or Inactive depending on the requested state of the coolant pump.
Auxiliary Coolant Pump Relay Command	-	Varies	The scan tool displays Active or Inactive depending on the requested state of the relay.
Auxiliary Coolant Pump Speed Command Duty Cycle	-	0 - 100%	The scan tool displays % depending on the command. The value increases stepwise from 0 - 100% depending on the command/request.
Auxiliary Coolant Pump Speed Feedback Duty Cycle	-	0 - 100%	The scan tool displays % depending on the feedback. The value increases stepwise from 0 - 100% depending on the feedback.
Auxiliary Heater Coolant Pump Fault Status	-	Normal	The scan tool displays Normal, High/Low Current, Flow Restricted, Overvoltage, Over temperature, or Circuit Open/ Shorted indicating the status of the coolant pump.
Auxiliary Heater Output Status	-	OK	The scan tool displays OK, or Malfunction indicating the status of the auxiliary heater.

Parameter	System State	Expected Value	Description
Auxiliary Mode Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the rear mode actuator.
Auxiliary Mode Door Actuator Direction	-	Stop	The scan toll displays Stop, Increase, or Decrease depending on the state of therear mode actuator. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Auxiliary Mode Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Auxiliary Mode Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the rear mode actuator.
Auxiliary Mode Switch Indicator	Auxiliary Mode Switch inactive	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Auxiliary Mode Switch active	On	
Auxiliary Mode Switch Position - Knob	-	Varies	The scan tool displays Auto, Floor, Bi-level or Panel depending on the position of the switch.
Auxiliary Mode Switch Position - Toggle	-	Varies	The scan tool displays Auto, Floor, Bi-level or Panel depending on the position of the switch.
Base Model Part Number	-	Varies	Displays the currently installed part number of module.
Battery Voltage	-	Varies	The scan tool displays V. This is the current battery voltage.
Bi-Level Button/ Switch	Bi-Level Switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Bi-Level Switch pressed	Active	
Bi-Level Indicator	Bi-Level mode selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Bi-Level mode deselected	On	
Blower Motor Speed	-	0 - 100%	The scan tool displays % depending on the state of the selected blower motor speed. The value increases stepwise from 0 - 100% depending on the selected speed.
Blower Motor Speed 1 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator

Parameter	System State	Expected Value	Description
			command.
Blower Motor Speed 2 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 3 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 4 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 5 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 6 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed Command	-	0 - 100%	The scan tool displays % depending on the state of the selected blower motor speed. The value increases stepwise from 0 - 100% depending on the selected speed.
Blower Motor Switch-Toggle	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the blower motor switch.
Date Programmed	-	Varies	The scan tool displays the date the module was last programmed.
Desired Left Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Desired Rear Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Desired Right Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Diagnostic Data Identifier	-	Varies	The scan tool displays the 4 character alphanumeric device ID.
End Model Part Number	-	Varies	The scan tool displays the end software module part number.
Enhanced Defrost Button/Switch	Enhanced defrost switch released	Inactive	The scan tool displays On or Off depending on the state of the switch.
	Enhanced defrost switch pressed	Active	

Parameter	System State	Expected Value	Description
Enhanced Defrost Indicator	Enhanced defrost mode is deactivated	Off	The scan tool displays On or Off depending on the state of the enhanced defrost mode.
	Enhanced defrost mode is activated	On	
Floor Mode Button/ Switch	Floor mode switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Floor mode switch pressed	Active	
Floor Mode Indicator	Floor mode Not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Floor mode selected	On	
Fresh Air Button/Switch	Fresh air switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Fresh air switch pressed	Active	
Fresh Air Indicator	Fresh air not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Fresh air selected	On	
Front Defog Button/Switch	Front defog switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Front defog switch pressed	Active	
Front Defog Indicator	Front defog not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Front defog selected	On	
Front Defrost Button/ Switch	Defrost switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Defrost switch pressed	Active	
Front Defrost Indicator	Front defrost not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Front defrost selected	On	
Front HVAC System Status	-	Varies	The scan tool displays Comfort, ECO, or Fan Only depending on the selected operating mode of the HVAC system.
Front HVAC System Status Indicator	-	Varies	The scan tool displays: Link Active, AQS Active, Front Off Active, Fan Blower Minus Active, Fan Blower Plus Active, Knob Fan Active, Knob Temp

Parameter	System State	Expected Value	Description
			Active, FR Fahrenheit Active, FR Celsius Active, FL Fahrenheit Active, FL Celsius Active, Front Fan 6 Active, Front Fan 5 Active, Front Fan 4 Active, Front Fan 3 Active, Front Fan 2 Active, Front Fan 1 Active, FL Active, Rear Enable Active, Extended Defrost Active, Heat Mode Active, Bi-level Active, Floor Active, Vent Active, Defog Active, Rear Defrost Active, Automatic Active, Fresh Active, Recirculation Active, or A/C Active depending on the current operating mode of the HVAC system.
Heat Mode Button/Switch	Heat switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Heat switch pressed	Active	
Heat Mode Indicator	Heat not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Heat selected	On	
Heater Core Coolant Temperature Sensor	-	-40 to +215Â°C (-40 to +419Â°F)	The scan tool displays Â°C (Â°F). This is the temperature of the coolant at the inlet of the coolant heater
Heating Element 1 Duty Cycle Command	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
High Voltage Heater Pump Status	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.
HVAC Indicator Commanded Status	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
HVAC Actuators Supply Voltage	-	Active	The scan tool displays Active or Inactive. Inactive is displayed if there is a malfunction at the actuators supply voltage circuit.
HVAC Control Switch Activations - Extended	-	Inactive	The scan tool displays Active or Inactive. Active is displayed when a switch is pressed.
HVAC Heater Coolant Pump Speed Command Duty Cycle	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
HVAC Heater Coolant Pump Speed Feedback Duty Cycle	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.

Parameter	System State	Expected Value	Description
HVAC Mode Status	-	Varies	The scan tool displays: Peak Performance Mode, Normal, Economy Mode, Blower Only Mode, or Heater Economy Mode indicating the currently selected mode.
Hybrid/EV Battery Pack Coolant Pump Command	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
Hybrid/EV Battery Pack Coolant Pump Speed	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.
Hydrocarbon Air Quality Sensor	-	Varies	The scan tool displays counts. The value increases with the increasing of the pollution of the ambient air.
Ignition Voltage	-	11 - 14 V	The scan tool displays the current Ignition voltage.
Instrument Panel Vents Button/Switch	Instrument Panel Vent switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Instrument Panel Vent switch pressed	Active	
Instrument Panel Vents Indicator	Panel Vents not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Panel Vents selected	On	
Left / Single Solar Sensor	-	Varies	The scan tool displays W/m^2 . This is the current sun heat intensity.
Left Temperature Button/Switch	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the temperature switch.
Left Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Left Temperature Door Actuator Direction	-	Varies	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Left Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Left Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Left Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the left temperature knob is rotated.

Parameter	System State	Expected Value	Description
Lower Left Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.
Lower Rear Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.
Lower Right Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.
Manufacturing Enable Counter	-	0	The scan toll displays 0 - 255 counts. This counter typically decrements 1 count per ignition cycle. 0 indicates a locked ECU.
Manufacturing Traceability Data	-	Varies	This parameter displays the diagnostic module traceability number, which may be up to 16 digits long. This information may be used in certain situations to identify the manufacturer of the component.
Mode Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Mode Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Mode Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Mode Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Mode Switch - Toggle	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the mode switch.
Mode Switch Knob Position	-	Varies	The scan tool displays: Rear, Sync, Floor/Vent/Defrost (Tri-Level), Vent/Defrost, Front Defrost, Foot/Defrost 3 (Blend+), Foot/Defrost 2 (Blend), Foot/Defrost 1 (Floor +), Foot (Floor), Bi-level 3 (Bi-level +), Bi-level 2 (Bi-level), Bi-level 1 (Panel +), Face (Panel), or AUTO depending on the position of the switch.
MULTI-ZONE Button/Switch	MULTI-ZONE switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.

Parameter	System State	Expected Value	Description
	MULTI-ZONE switch pressed	Active	
MULTI-ZONE Indicator	MULTI-ZONE not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	MULTI-ZONE selected	On	
Outside Air Temperature Sensor Voltage	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the outside air temperature sensor.
Passenger Compartment Air Temperature (Filtered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the stored temperature of the passenger compartment air temperature sensor.
Passenger Compartment Air Temperature (Unfiltered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the passenger compartment air temperature sensor.
Passenger Compartment Humidity	-	3 - 100%	The scan tool displays %. This is the current relative humidity level at the windshield temperature and inside moisture sensor.
Passenger Compartment Humidity Sensor Temperature	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the humidity sensing element temperature sensor.
Rear Defogger Button/ Switch	Rear Defogger switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Rear Defogger switch pressed	Active	
Rear Defogger Deactivation Reason	-	Varies	The scan tool displays: Auto Start Active, Rear Defrost Inhibited, Load Shed Active, Convertible Top Down, or Battery State of Charge Low. This is the reason the defogger has been disabled.
Rear Defogger Indicator	Rear defogger is deactivated	Off	The scan tool displays On or Off depending on the state of the rear defogger.
	Rear defogger is activated	On	
Rear Defogger Status	Rear defogger is deactivated	Off	The scan tool displays On or Off depending on the state of the rear defogger command.
	Vehicle ON/ Rear defogger is activated	On	
Rear In Vehicle Temperature Sensor	-	-40 to +80Â°C (-40 to	The scan tool displays Â°C (Â°F). This is the stored temperature of the rear

Parameter	System State	Expected Value	Description
(Filtered)		+176Â°F)	passenger compartment air temperature sensor.
Rear In Vehicle Temperature Sensor (Unfiltered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the rear passenger compartment air temperature sensor.
Rear Temperature Button/Switch	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the temperature switch.
Rear Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the mode actuator.
Rear Temperature Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Rear Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Rear Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Rear Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the rear temperature knob is rotated.
Repair Shop Code or Tester Serial Number	-	Varies	This number may be used in certain situations to identify the supplier, control module and diagnostic capability of the component.
Right Solar Load	-	Varies	The scan tool displays W/m ² . This is the current sun heat intensity.
Right Solar Sensor	-	Varies	The scan tool displays W/m ² . This is the current sun heat intensity.
Right Temperature Button/Switch	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the temperature switch.
Right Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the mode actuator.
Right Temperature Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Right Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Right Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.

Parameter	System State	Expected Value	Description
Right Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the right temperature knob is rotated.
Security Code Accepted	-	Yes	The scan tool displays Yes or No depending on the current security code status.
Security Code Lockout	-	Security Code Accepted	The scan tool displays Tool Learn Delay Active, Vehicle Assembly Mode Flag, Security Code Lockout Active, Security Code Programmed, Security Code Accepted depending on the current security code status.
Security Code Lockout Active	-	Inactive	When active, the scan tool displays a timer which prohibits programming the security code when a certain number of attempts have been exceeded. The security code is a method of verifying that the module has not been swapped with a module from another vehicle
Security Code Programmed	-	Yes	The scan tool displays Yes or No depending on the current security code status.
Security Code Programming Counter	-	Varies	This parameter indicates the number of times the security code has been programmed. The security code is a method of verifying that the module has not been swapped with a module from another vehicle.
Security Code Reset Counter	-	Varies	This parameter indicates the number of times the security code has been reset. The security code is a method of verifying that the module has not been swapped with a module from another vehicle.
Software Module 1 Identifier	-	Varies	The scan tool displays the software calibration part number 1.
Software Module 2 Identifier	-	Varies	The scan tool displays the software calibration part number 2.
Software Module 3 Identifier	-	Varies	The scan tool displays the software calibration part number 3.
Sun Azimuth	-	0 - 90°	The scan tool displays degrees. This is the current angle in the horizontal plane between the sun and the vehicle driving direction.

Parameter	System State	Expected Value	Description
Sun Elevation	-	0 - 360°	The scan tool displays degrees. This is the current angle in the vertical sun height.
Sunload / Sun Intensity	-	0 - 1200 W/m ²	The scan tool displays W/m ² . This is the current sun heat intensity.
Upper Left Duct Air Temperature Sensor	-	-40 to +80°C (-40 to +176°F)	The scan tool displays °C (°F). This is the current temperature at the upper left duct temperature sensor.
Upper Rear Duct Air Temperature Sensor	-	-40 to +80°C (-40 to +176°F)	The scan tool displays °C (°F). This is the current temperature at the rear upper duct temperature sensor.
Upper Right Duct Air Temperature Sensor	-	-40 to +80°C (-40 to +176°F)	The scan tool displays °C (°F). This is the current temperature at the upper right duct temperature sensor.
Vehicle Identification Number (VIN)	-	Varies	The scan tool displays the learned vehicle identification number.
Windshield Temperature	-	-40 to +80°C (-40 to +176°F)	The scan tool displays °C (°F). This is the current temperature at the windshield temperature sensor.

Heating Ventilation and Air Conditioning Control Module Scan Tool Output Controls

Output Control	Description
A/C Compressor Clutch Enable	This control function enables or disables the A/C Compressor Clutch. The scan tool displays Engaged or Disengaged depending on the state of the A/C compressor clutch.
A/C Compressor Valve Control	This control function increases or decreases the command to the A/C Compressor Solenoid in %. The scan tool displays amperage in % depending on the state of the command for increased/decreased compressor displacement.
Aero Shutter Enable	This control function commands the state of the Aero Shutter between Active and Not Active.
Air Inlet Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Air Recirculation Door Actuator Direction	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Auxiliary Blower Motor Speed	This control function commands the auxiliary blower motor speed from 0 to 100% and back again.
Auxiliary Coolant Pump Speed	The HVAC control module enables or disables the coolant pump, and varies the pump speed when commanded from the scan tool.

Output Control	Description
Auxiliary Heater Output Enable	This control function increases or decreases the command to the Auxiliary Heater in %. The scan tool displays amperage in % depending on the state of the command.
Auxiliary Mode Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Blower Motor Speed/Command	This control function commands the blower motor speed from 0 to 100% and back again.
Heater Core Pump Relay Control Circuit	This control function commands the heater core pump relay On and Off.
Illuminate All Indicators	The HVAC control module illuminates all the indicators when commanded from the scan tool.
Left Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Mode Door Position Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Rear Defogger	This control function enables or disables the Rear Defogger. The scan tool displays Active or Not Active depending on the state of the rear defogger command.
Rear Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Right Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Single Zone Temperature Actuator Direction	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.

Heating Ventilation and Air Conditioning Control Module Configuration/Reset Functions

Output Control	Description
HVAC Afterblow Configuration	This control function enables or disables the afterblow configuration. When enabled, the Afterblow mode operates the blower motor after the engine has been turned off and the air conditioning has been used. This operation of the blower motor aids in drying the evaporator core

Output Control	Description
HVAC Actuators Learn	The HVAC control module executes the Motor Learn Routine when commanded. The actuators are commanded to their extreme travel available at both ends. These values are then used for future reference when determining door position.
Reset Source ID	Resets the communication IDs between modules

HEATING, VENTILATION, AND AIR CONDITIONING CONTROLS SCAN TOOL INFORMATION

HVAC Controls Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/ Vehicle in Service Mode			
Backlight Dimming	-	Varies	The scan tool displays % from 0 - 100 depending on the backlight dimming level.
Base Model Part Number	-	Varies	Base Model Part Number is the part number for the hardware without software and calibrations.
Battery Voltage	-	Varies	The scan tool displays V. This is the current battery voltage.
Boot Software Number	-	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	-	Varies	The scan tool displays the software calibration part number 1.
Calibration Part Number 2	-	Varies	The scan tool displays the software calibration part number 2.
Calibration Part Number 3	-	Varies	The scan tool displays the software calibration part number 3.
Diagnostic Data Identifier	-	Varies	The scan tool displays the 4 character alphanumeric device ID.
Driver HVAC Temperature Display	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Driver Seat Heating/Venting /Cooling Level	Driver Seat Heating/ Venting/ Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the drivers seat heating/ venting/ cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Driver Seat Heating/Venting /Cooling Mode	Driver Seat Heating/ Venting/ Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the drivers seat heating/ venting/ cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3

Parameter	System State	Expected Value	Description
			LEDs Activated depending on the selected level.
End Model Part Number	-	Varies	End Model Part Number is the part number for the hardware of the control module with software and calibrations.
HVAC Controls	No HVAC buttons active	No Button Pressed	The scan tool displays No Button Pressed or Button Pressed. Button Pressed is displayed when any HVAC button is activated.
	Any HVAC button active	Button Pressed	
HVAC Controls Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the backlight dimming level.
HVAC Display Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the display dimming level.
HVAC Indicator Dimming Level	-	Varies	The scan tool displays % from 0 - 100 depending on the indicator dimming level.
Left Temperature Knob Position	-	Varies	The scan tool displays counts from 0 - 255, indicating the current temperature knob setting.
Passenger HVAC Temperature Display	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Passenger Seat Heating/Venting/Cooling Level	Passenger Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the passenger seat heating/ venting/ cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Passenger Seat Heating/Venting/Cooling Mode	Passenger Seat Heating/Venting/Cooling OFF	No LEDs activated.	The scan tool displays No LED Activated when the passenger seat heating/ venting/ cooling is OFF. When the seat is activated, the scan tool displays 1 LED Activated, 2 LEDs Activated, or 3 LEDs Activated depending on the selected level.
Programming Date	-	Varies	The scan tool displays the date the module was last programmed.
Right Temperature Knob Position	-	Varies	The scan tool displays counts from 0 - 255, indicating the current temperature knob setting.

Parameter	System State	Expected Value	Description
System Power Mode	-	Run	The scan tool displays: Off, Accessory, Run, or Crank indicating the current vehicle power mode.

HUMAN MACHINE INTERFACE CONTROL MODULE SCAN TOOL INFORMATION

Human Machine Interface Control Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Battery Voltage	Varies	The scan tool displays volts. This is the voltage at the input to the human machine interface control module.
System Power Mode	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the vehicle power mode status as received by the human machine interface control module via high speed GMLAN.
Date From GPS	Varies	The scan tool displays the current date (Month, Day, and Year) acquired from the GPS satellites.
Time From GPS	Varies	The scan tool displays the current time acquired from the GPS satellites in 24 hour format HHMMSS
Human Machine Interface Control Module Microphone 1	Not Present	The scan tool displays Present or Not Present. Calibration indication that a primary microphone is present and connected to the human machine interface control module. The microphone input is ported to the MOST buss to the amplifier (for volume compensation, when required) instead of directly wired microphone to the amplifier.
Human Machine Interface Control Module Microphone 2	Not Present	The scan tool displays Present or Not Present. Calibration indication that a secondary microphone is present and connected to the human machine interface control module. The microphone input is ported to the MOST buss to the amplifier (for volume compensation, when required) instead of directly wired microphone to the amplifier.
Human Machine Interface Control Module Powers GPS	Not Present	The scan tool displays Present or Not Present. Calibration Indication that a GPS antenna input is primary to the human machine interface control module and powered by the human machine interface control module instead of shared with another vehicle location module.
Rearview Camera	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that the system is calibrated for rear view camera operation.
Rearview Camera Display	Inactive	The scan tool displays Active or Inactive. Indication that rear camera views are actively being displayed.

Parameter	Expected Value	Definition
Front Touch Screen	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that the system is calibrated for front touch screen operation.
USB Receptacle 1	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that a USB receptacle is connected to the human machine interface control module USB port 1. Does not indicate if a device is connected to the USB receptacle.
USB Receptacle 2	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that a USB receptacle is connected to the human machine interface control module USB port 2. Does not indicate if a device is connected to the USB receptacle.
Memory Card Receptacle	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that a SD Card receptacle input is present. Does not indicate the receptacle is occupied with digital media.
USB Hub 1	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that a hub device is connected to the human machine interface control module USB port 1.
USB Hub 2	Varies based on vehicle equipment	The scan tool displays Present or Not Present. Calibration indication that a hub device is connected to the human machine interface control module USB port 2.
USB Hub 1 Number of Ports	Varies based on vehicle equipment	The scan tool displays the number of receptacles (USB and/or memory card receptacles) present in the hub device connected to the human machine interface control module USB port 1.
USB Hub 2 Number of Ports	Varies based on vehicle equipment	The scan tool displays the number of receptacles (USB and/or memory card receptacles) present in the hub device connected to the human machine interface control module USB port 1.
Valet Mode	Inactive	The scan tool displays Active or Inactive. Actual indication that Valet Parking Mode which limits vehicle features (speed limiting, no disc eject, trunk lock, etc.), is active or inactive.
Human Machine Interface Control Module Theft Protection Armed	VIN Learned	The scan tool displays VIN Learned or No VIN Learned. Actual indication if the human machine interface control module has learned a VIN.
Human Machine Interface Control Module Theft Protection Locked	Inactive	The scan tool displays Active or Inactive. Actual indication the human machine interface control module is in theft protection (limited functionality) mode.

Parameter	Expected Value	Definition
Cooling Fan Speed	Varies	The scan tool displays OFF, or displays the current cooling fan speed expressed in stages from 1 to 6. Higher stages indicate increased speed of the cooling fan..
Control Module Temperature Sensor 1	Varies	The scan tool displays the actual value of the human machine interface control module circuit board temperature sensor 1.
Control Module Temperature Sensor 2	Varies	The scan tool displays the actual value of the human machine interface control module circuit board temperature sensor 2.
End Model Part Number	Varies	The scan tool displays the end software module part number.
Boot Software Part Number	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	Varies	The scan tool displays the software calibration part number 1.
Calibration Part Number 2	Varies	The scan tool displays the software calibration part number 2.
Calibration Part Number 3	Varies	The scan tool displays the software calibration part number 3.
Calibration Part Number 4	Varies	The scan tool displays the software calibration part number 4.
Calibration Part Number 5	Varies	The scan tool displays the software calibration part number 5.
Calibration Part Number 6	Varies	The scan tool displays the software calibration part number 6.
Calibration Part Number 7	Varies	The scan tool displays the software calibration part number 7.
Calibration Part Number 8	Varies	The scan tool displays the software calibration part number 8.
Calibration Part Number 9	Varies	The scan tool displays the software calibration part number 9.
Calibration Part Number 10	Varies	The scan tool displays the software calibration part number 10.
Calibration Part Number 11	Varies	The scan tool displays the software calibration part number 11.
Software Module 11 Identifier Alpha Code	Varies	The scan tool displays a two character software identifier.
Calibration Part Number 12	Varies	The scan tool displays the software calibration part number 12.
Software Module 12 Identifier Alpha Code	Varies	The scan tool displays a two character software identifier.
Calibration Part Number 13	Varies	The scan tool displays the software calibration part number 13.

Parameter	Expected Value	Definition
Calibration Part Number 14	Varies	The scan tool displays the software calibration part number 14.
Software Module 14 Identifier Alpha Code	Varies	The scan tool displays a two character software identifier.
Calibration Part Number 15	Varies	The scan tool displays the software calibration part number 15.
Calibration Part Number 16	Varies	The scan tool displays the software calibration part number 16.
Calibration Part Number 17	Varies	The scan tool displays the software calibration part number 17.
Calibration Part Number 18	Varies	The scan tool displays the software calibration part number 18.
Calibration Part Number 19	Varies	The scan tool displays the software calibration part number 19.
Software Freeze Date	Varies	The scan tool displays the software date in DD.MM.YYYY format.
Hardware Production Date	Varies	The scan tool displays the ECU hardware production date in DD.MM.YYYY format.
Manufacturer Enable Counter	0	The scan tool displays the counter value. This counter is used for manufacturing purposes only.
VIN Digits 2-17	Varies	The scan tool displays the learned VIN digits 2-17.
Diagnostic Data Identifier	Varies	The scan tool displays the 4 character alphanumeric device ID.

Wireless Access Data Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Number of Paired Bluetooth Devices Present	Varies	Number of paired (authenticated) devices detected and present but may or may not be connected.
Bluetooth Device Connection Status	Varies	The scan tool displays Connected or Not Connected. The parameter indicates if a Bluetooth device is currently connected to the system.
Bluetooth Device Hands Free Call Status	Varies	The scan tool displays Call Active or Inactive. Indicates if the currently connected Bluetooth device is actively in a hands free phone call.
Bluetooth Device Audio Streaming Status	Varies	The scan tool displays Active or Inactive. Indicates if the currently connected Bluetooth device is actively streaming audio.
Bluetooth Device Internet Connection Status	Varies	The scan tool displays Active or Inactive. Indicates if the currently connected Bluetooth device is actively connected to the Internet via the device's internet connection.

Parameter	Expected Value	Definition
Bluetooth Device Supports Hands Free	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Hands Free profile.
Bluetooth Device Supports Phone Book Access	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Phone Book Access profile.
Bluetooth Device Supports Text Message Access	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Text Message Access profile.
Bluetooth Device Supports Serial Port	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Serial Port profile.
Bluetooth Device Supports Navigation	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Portable Navigation profile.
Bluetooth Device Supports Audio Streaming using Audio Video Remote Control Profile 1.0	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Audio Streaming AVRCP (Audio/Video Remote Control Profile) 1.0. The Audio/Video Remote Control Profile is a Bluetooth profile that allows Bluetooth devices to control media playback on remote devices. It is typically used with A2DP devices for next/previous track selection and pause/play functions.
Bluetooth Device Supports Audio Streaming using Audio Video Remote Control Profile 1.3	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports the Bluetooth Audio Streaming AVRCP (Audio/Video Remote Control Profile) 1.3. The Audio/Video Remote Control Profile is a Bluetooth profile that allows Bluetooth devices to control media playback on remote devices. It is typically used with A2DP devices for next/previous track selection and pause/play functions.
Bluetooth Device Supports Internet Access - Dial-Up Network	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports internet access only through the device's dial-up network.
Bluetooth Device Supports Internet Access - Personal Area Network	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports internet access only through the device's personal area network.
Bluetooth Device Supports Internet Access - Dial-Up/Personal Area Network	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device supports internet access through the device's dial-up or personal area network.
Bluetooth Device Class - Phone	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device class is identified as a phone.

Parameter	Expected Value	Definition
Bluetooth Device Class - Audio/Video	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device class is identified as an audio and/or video device.
Bluetooth Device Class - Computer	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device class is identified as a computing device.
Bluetooth Device Class - LAN or Network Access Point	Varies	The scan tool displays Yes or No. Indicates if the currently connected Bluetooth device class is identified as a Local Area Network (LAN) or Network Access Point (NAP) device.
WLAN Link Quality	Counts	The scan tool displays the connection quality in counts, with higher numbers indicating a better connection.
App 1 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 1
App 1 Version	Varies	The scan tool displays the version number for the installed internet application number 1
App 2 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 2
App 2 Version	Varies	The scan tool displays the version number for the installed internet application number 2
App 3 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 3
App 3 Version	Varies	The scan tool displays the version number for the installed internet application number 3
App 4 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 4
App 4 Version	Varies	The scan tool displays the version number for the installed internet application number 4
App 5 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 5
App 5 Version	Varies	The scan tool displays the version number for the installed internet application number 5
App 6 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 6
App 6 Version	Varies	The scan tool displays the version number for the installed internet application number 6
App 7 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 7
App 7 Version	Varies	The scan tool displays the version number for the installed internet application number 7
App 8 Identifier	Varies	The scan tool displays the numeric identifier for the installed internet application number 8
App 8 Version	Varies	The scan tool displays the version number for the installed internet application number 8

Human Machine Interface Scan Tool Output Controls

Scan Tool Output Control	Description
Info Display Test	This output control will command the test of the Info Display.
Speech Recognition	This output control will command the various Speech Recognition prompts.
Cooling Fan	This output control will command the speed of the Cooling Fan.
Control Module Reset	This output control will command the reset of the Control Module.

HYBRID POWERTRAIN CONTROL MODULE SCAN TOOL INFORMATION

The hybrid powertrain control module is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Hybrid Powertrain Control Module Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Hybrid Powertrain Control Module Scan Tool Data Parameters list only after the following is determined:

- The [Diagnostic System Check - Vehicle](#) is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Hybrid Powertrain Control Module Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

NOTE: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to [Symptoms - Hybrid Controls](#) for diagnosis.

Hybrid Powertrain Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
14V High Voltage Circuit Current	-	Varies	This parameter displays the high voltage circuit current as determined by the accessory dc power control module. The parameter display range is -1638.4 to +1638.35 Amps.
14V Power Module Power Loss	-	Varies	The accessory DC power module converts high voltage (300V) direct current (DC) to low voltage

Parameter	System State	Expected Value	Description
			(12V) DC for accessory electrical operation and to charge the 12 volt battery. This parameter indicates the difference in power (power loss) between the input power and the output power of the Accessory Power Module. The power loss is determined based upon High Voltage current and voltage, Low Voltage current and voltage, and Intermediate Voltage current and voltage measurements from the accessory power module internal sensors.
14V Power Module Setpoint	-	Varies	This is the target voltage the accessory power module will try to maintain while operating the system. The accessory power module converts high voltage to intermediate or low voltage in order to support the various electrical system loads.
14V Power Module Setpoint	-	Varies	This is the target, expressed in percent, the accessory power module will try to maintain while operating the system. The accessory power module converts high voltage to intermediate or low voltage in order to support the various electrical system loads.
14V Power Module Status	-	Normal	The accessory power module converts high voltage (300V DC) to low voltage (12V DC) for accessory electrical operation and to charge the 12 volt battery. This parameter contains the control status of the accessory DC power module.
14V Power Module Temperature Sensor 1	-	Varies	This parameter displays the value received from temperature sensor 1 in the 14V Power Module.
14V Power Module Temperature Sensor 2	-	Varies	This parameter displays the value received from temperature sensor 2 in the 14V Power Module.

Parameter	System State	Expected Value	Description
A/C Auto Air Recirculation	-	Varies	Air Conditioning Recirculation State - On or Off
A/C Compressor Clutch Relay Command	-	Varies	Air Conditioning Compressor State - On or Off
A/C Compressor Power Consumption	-	Varies	This parameter contains the Air Conditioning Compressor Electric Power which represents the actual A/C compressor electric power as reported by the accessory DC power control module to the hybrid powertrain control module and the ECM.
A/C Compressor Power Limit	-	Varies	This parameter contains the Air Conditioning Compressor Power Limit which represents the amount of power the hybrid powertrain control module allows the accessory DC power control module to use to run the compressor.
A/C Compressor Power Limit Rate of Change	-	Varies	This parameter contains the Air Conditioning Compressor Power Gradient which represents the power gradient the hybrid powertrain control module allows the accessory DC power control module to use to run the compressor.
A/C Disabled - A/C Pressure Out of Range	-	Varies	Air Conditioning Compressor Pressure Disable - Yes or No
A/C Disengage History 1	-	None	The air conditioning (A/C) compressor may be disengaged by the ECM (Engine Control Module) for many reasons. These reasons are recorded by the A/C Disengage History parameters 1-8.
A/C Disengage History 2	-	None	
A/C Disengage History 3	-	None	
A/C Disengage History 4	-	None	
A/C Disengage History 5	-	None	
A/C Disengage History 6	-	None	
A/C Disengage History 7	-	None	
A/C Disengage History 8	-	None	
A/C Mode Request Signal	-	No	This parameter displays Yes if the AC System indicates that an autostop was prevented, or an autostart was commanded, due to a request from the air conditioning system. The

Parameter	System State	Expected Value	Description
			parameter display range is Yes, No. Note that repeated engine cycling is prevented when the air conditioning system is the only condition requesting engine on/off.
A/C Off for WOT	-	No	Air Conditioning Compressor Wide Open Throttle Disable.
A/C Request Signal	-	Varies	Air Conditioning Request On
Accelerator Pedal Position	-	No	This parameter indicates that an autostop was prevented or an autostart was commanded due to the accelerator pedal being pressed. The parameter display range is Yes, No.
Autostart/Autostop Fault	-	No	This parameter displays the status of an Autostart Inhibit due to a diagnostic trouble code (DTC) condition. Autostart is inhibited if the engine fails to start when cranked. The parameter display range is Yes, No.
Autostart/Autostop Override	-	No	This parameter displays the status of an Autostart Entry or Autostart or Autostop Inhibit due to a scan tool Autostart or Autostop device control request. The parameter display range is Yes, No.
Auxiliary Transmission Fluid Pump	-	Varies	This parameter displays auxiliary transmission fluid pump speed in percent. The parameter display range is 0 - 100%.
Auxiliary Transmission Fluid Pump	-	Varies	This parameter displays the actual speed of the auxiliary transmission fluid pump in revolutions per minute.
Auxiliary Transmission Fluid Pump	-	No	Auxiliary Transmission Pump indicates that an autostop was prevented or an autostart was commanded due to unavailability of the auxiliary transmission pump.

Parameter	System State	Expected Value	Description
Auxiliary Transmission Fluid Pump	-	Varies	This parameter displays the actual speed of the auxiliary transmission fluid pump as a percentage of maximum speed.
Auxiliary Transmission Fluid Pump	-	Varies	This parameter contains the torque value, in Y, for the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Control Module Positive Supply Isolation Voltage	-	Varies	This parameter indicates the high voltage positive to chassis voltage as measured for the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Command	-	Varies	This parameter displays the commanded rotations per minute of the auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Command	-	Varies	This parameter displays the commanded torque value for the auxiliary transmission fluid pump.
Auxiliary Transmission Fluid Pump Control Module Output Driver Temperature	-	Varies	This parameter contains the auxiliary transmission fluid pump motor IGBT module temperature 1 as measured by a sensor.
Auxiliary Transmission Fluid Pump Control Module Positive Supply Isolation Voltage	-	Varies	This parameter indicates the high voltage Positive to chassis voltage as measured for the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Current	-	Varies	This parameter indicates the DC current consumed by the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Inverter DC Voltage	-	Varies	This indicates the voltage on the DC bus at the auxiliary transmission fluid pump inverter.
Auxiliary Transmission Fluid Pump Inverter Status	-	Varies	This indicates the actual state of the auxiliary transmission fluid pump inverter.
Auxiliary Transmission Fluid Pump Motor Phase U Current	-	Varies	This indicates the auxiliary transmission fluid pump motor, phase U, RMS current.
Auxiliary Transmission Fluid Pump Motor Phase V Current	-	Varies	This indicates the auxiliary transmission fluid pump motor, phase V, RMS current.
Auxiliary Transmission Fluid Pump Motor Phase W Current	-	Varies	This indicates the auxiliary transmission fluid pump motor, phase W, RMS current.

Parameter	System State	Expected Value	Description
Auxiliary Transmission Fluid Pump Motor Torque	-	Varies	This indicates the actual torque value for the auxiliary transmission fluid pump motor.
Auxiliary Transmission Fluid Pump Temperature	-	Varies	This indicates the temperature of the auxiliary transmission fluid pump motor measured by a sensor.
Axle Torque	-	Varies	This parameter displays actual axle torque. The parameter display range is -8192 to +8191.75 N.m.
Axle Torque Command	-	Varies	This parameter displays commanded axle torque. The parameter display range is -8192 to +8191.75 N.m.
Axle Torque Immediate	-	Varies	This parameter displays the immediate axle torque required when accelerating. The parameter display range is -8192 to +8191.75 N.m.
Brake Booster Weak Vacuum	-	No	This parameter indicates that an Austostart Entry or Autostop Inhibit occurred due to brake vacuum pressure low. The parameter display range is Yes, No.
Brake Pedal Position Circuit Signal	-	No	Brake Pedal Apply Active indicates that the brake pedal apply input to the controller indicates that the brake is applied.
Brake Pedal Position Sensor Learned Home Position	-	Yes	Brake Pedal Fully Released Position Learn Complete indicates that the brake pedal fully released position has been successfully learned.
Brake Pedal Position Sensor Signal	-	No	Indicates that an autostop was disabled, or an autostart was initiated, due to a released brake pedal. The parameter display range is Yes, No.
Calculated Line Pressure	-	Varies	This indicates the expected actual line pressure after accounting for pump loss factors.

Parameter	System State	Expected Value	Description
Calculated Throttle Position	Pedal Released	0%	This parameter displays the position of the accelerator pedal as determined by the ECM. This parameter is not active when the transmission is in Park or Neutral. 100% is displayed when the pedal is fully depressed. The parameter display range is 0 - 100%.
	Pedal Fully Depressed	100%	
Calculated Clutch 1 Torque	-	Varies	This parameter contains the estimated clutch torque capacity based on the clutch pressure model and clutch properties. This quantity is used to prevent clutch torque load from exceeding clutch capacity.
Calculated Clutch 2 Torque	-	Varies	
Calculated Clutch 3 Torque	-	Varies	
Clutch 1 Fill Time	-	Varies	This indicates the estimated clutch fill time, in seconds, based on the clutch flow model and adapted stroke volume.
Clutch 2 Fill Time	-	Varies	
Clutch 3 Fill Time	-	Varies	
Clutch 1 Maximum Energy	-	Varies	This indicates the calculated clutch remaining energy capability for clutch assisted shifts. This value is used to prevent clutch overheating during shift to protect clutch hardware.
Clutch 2 Maximum Energy	-	Varies	
Clutch 3 Maximum Energy	-	Varies	
Crank Request	-	Varies	This indicates that the ECM has commanded an engine crank request to be aborted.
Crank Abort	-	Varies	This parameter displays the status of the internal combustion engine crank request of the ECM. The hybrid control module monitors the ECM for this data in order to determine whether to enable or disable ICE cranking.
Crankshaft Position Resync Counter	-	Varies	This parameter contains a rolling count of the number of times that crankshaft synchronization has been lost, at normal engine speeds.
Distance Since DTC Cleared	-	Varies	This parameter displays the distance in miles or kilometers since engine control module diagnostic trouble codes (DTCs) have been cleared using a service

Parameter	System State	Expected Value	Description
			tool.
Distance Since First Malfunction	-	Varies	This parameter displays the distance in miles or kilometers since the first DTC was detected.
Distance Since Last Malfunction	-	Varies	This parameter displays the distance in miles or kilometers since the most recent DTC was detected.
Distance with MIL On	-	Varies	This parameter displays the distance in miles or kilometers driven with the MIL on.
Drive Motor No Crank at Restart	-	No	Indicates that autostops have been disabled due to a condition detected in the starting system that would prevent a re-start of the vehicle.
Driver Axle Torque Request	-	No	Indicates that the last autostart was triggered based on overall system conditions, engine speed and torque optimization.
Driver Requested Axle Torque	-	No	This parameter displays the status of an Autostart Entry due to the drivers request for axle torque. Autostart is requested when the drivers axle torque requirements cannot be maintained without the internal combustion engine. The parameter display range is Yes, No.
DTC Present	-	Varies	This parameter displays the status of an Autostart or Autostop Inhibit or an Autostart Entry due to an ECM diagnostic trouble code (DTC) condition. Autostart and Autostop are inhibited when certain ECM DTCs are set. An Autostart may be commanded when certain ECM DTCs are set. The parameter display range is Yes, No.
ECM Challenge Status	-	Varies	Indicates if the engine control module has sent out a request to the immobilizer module to reply with a password.

Parameter	System State	Expected Value	Description
ECM Malfunction	-	No	This parameter indicates an immediate stop was commanded due to an ECM failure.
ECM Request	-	No	This parameter displays the status of an Autostop Inhibit or Autostart Entry request by the ECM. The ECM requests an Autostop Inhibit or Autostart Entry when certain ECM DTCs are currently testing or have failed. The parameter display range is Yes, No.
ECT Sensor	-	Near thermostat set-point	This parameter displays the temperature of the internal combustion engine (ICE) coolant as determined by the ECM. This display defaults to a set temperature whenever the ECM detects an ECT sensor circuit fault. The parameter display range is -40Â°C to +215Â°C (-40Â°F to +419Â°F).
Engine Coolant Temperature	-	No	This parameter displays the status of an Autostop Inhibit or Autostart Entry due to engine coolant temperature (ECT). Autostop is inhibited when ECT is not within a calibrated value range. The parameter display range is Yes, No.
Engine Speed	-	Varies	This parameter displays the revolutions per minute of the internal combustion engine (ICE) crankshaft position sensor as determined by the hybrid powertrain control module. The crankshaft position sensor signal is shared by the hybrid powertrain control module and the ECM. The parameter display range is 0 - 16, 383.75 RPM.
Engine Speed Command	-	Varies	This parameter displays the commanded engine cranking speed, in revolutions per minute, requested of the internal

Parameter	System State	Expected Value	Description
			combustion engine (ICE) by the ECM.
Engine Speed High	-	No	Engine Speed indicates that an autostop was prevented due to high engine speed.
Engine Torque	-	Varies	This parameter displays actual engine torque as determined by the ECM. This display is only active when the engine is running. The parameter display range is -8192 to +8191.75 N.m.
Engine Torque Command	-	Varies	This parameter displays commanded engine torque as determined by the ECM. This display is only active when the engine is running. The parameter display range is -8192 to +8191.75 N.m.
Extended Travel Brake Pedal Position Signal	-	Varies	Indicates the brake pedal travel beyond a moderate / extended travel threshold by the platform brake sensing module and is received over serial data.
Extended Travel Brake Pedal Switch	-	Varies	Indicates the state of the extended travel brake switch input to the ECM.
Free Start Active	-	Varies	Indicates that the free start function is active.
Gear Ratio	-	Varies	Transmission Gear Ratio
High Voltage Circuit Enable Command	-	Varies	Indicates if high voltage circuit charging is enabled.
Hood Position	-	No	This parameter displays the status of the hood latch switch as determined by the ECM. Yes is displayed when the hood switch indicates the hood is open or a switch circuit fault is observed. An autostart will be initiated if the hood switch indicates the hood is open.
HVAC System	-	Varies	The A/C System indicates that the last autostart was triggered when air conditioning system requested it. Note that repeated engine cycling is prevented when the air

Parameter	System State	Expected Value	Description
			conditioning system is the only condition requesting engine on/off.
Hybrid/EV Battery Pack Charge Remaining	-	Varies	Indicates the percent remaining charge for the hybrid battery pack.
Hybrid/EV Battery Pack Contactor System Status	-	Varies	Indicates an immediate stop was commanded due to open battery contactors.
Hybrid/EV Battery Pack Current	-	Varies	This parameter displays the actual current flow of the high voltage (300V) electrical system as determined by the Hybrid Powertrain Control Module 2. The parameter display range is -1638.4 to +1638.35 Amps. A negative current value indicates a battery charge while a positive current value indicates a battery discharge.
Hybrid/EV Battery Pack Power	-	No	This parameter displays the status of an Autostart Entry or Autostop Inhibit due to hybrid battery power. Autostart may be commanded or Autostop function may be disabled when hybrid battery power is less than a calibrated value. Hybrid battery power is dependent upon battery temperature. In cold or hot temperatures, battery power may be limited. Observe the Hybrid Battery Max Cell Temperature and Hybrid Battery Pack Minimum Cell Temperature parameters to determine if temperature is limiting battery power. The parameter display range is Yes, No.
Hybrid/EV Battery Pack State Of Charge	-	Varies	This parameter displays the state of charge of the battery pack as determined by the Hybrid Powertrain Control Module 2. The parameter display range is 0 - 100%.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack State Of Charge	-	No	This parameter displays the status of an Autostart Entry, Inhibit, or Autostop Entry due to hybrid battery state of charge. Autostart or Autostop function may be disabled when hybrid battery state of charge is less than a calibrated value. The parameter display range is Yes, No.
Hybrid/EV Battery Pack State of Charge Out of Range	-	No	Indicates that an Autostart Entry was prevented or forced due to a low battery state of charge.
Hybrid/EV Battery Pack State of Charge Out of Range	-	Varies	Indicates that the last autostart was triggered due to a low battery state of charge.
Hybrid/EV Battery Pack Temperature	-	Varies	This parameter indicates that an Autostart Entry or Inhibit was initiated due high battery pack temperature. The parameter display range is Yes, No.
Hybrid/EV Battery Pack Voltage	-	No	This parameter displays the status of an Autostart Entry, Inhibit, or Autostop Inhibit due to hybrid battery available voltage. Autostart may be commanded, or Autostop may be disabled when hybrid battery module voltage is not within a calibrated value range. The parameter display range is Yes, No.
Hybrid/EV Powertrain Control Module Authentication Status	-	Varies	This indicates the result of the comparison between the last received immobilizer system response and the expected response calculated by the hybrid powertrain control module.
Hybrid/EV Powertrain Control Module High Voltage Circuit	-	Varies	This displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0 - 655.35 V.
Hybrid/EV Powertrain Control Module Response Source	-	Varies	This will match the ECM parameter and indicates the source used to calculate the hybrid powertrain control module

Parameter	System State	Expected Value	Description
			response. The sources include Normal Start, Remote Vehicle Start, PTO Remote Start.
Hybrid/EV System	-	No	This parameter displays the status of an Autostart Entry or Inhibit due to a diagnostic trouble code (DTC) condition. Autostart may be initiated or inhibited when certain DTCs are set. The parameter display range is Yes, No.
Hybrid/EV System Shutdown Commanded	-	Varies	Indicates that an immediate stop was commanded due to the motor system not being ready or open battery contactors.
Hybrid/EV Transmission Mode Command	-	Varies	Indicates the currently commanded transmission gear or mode.
IAT Sensor	-	Varies	This parameter displays the temperature of the internal combustion engine (ICE) intake air as determined by the ECM. The parameter display range is -40Â°C to +215Â°C (-40Â°F to +419Â°F).
ICE Autostop Timer	-	Varies	Indicates that an autostop was prevented due to the expiration of the timer. Note that the AC system is not included within this timer.
ICE Run Time	-	No	This indicates an autostop was inhibited due to a minimum engine run time. The internal combustion engine must stay running for a minimum amount of time to prevent engine on/off cycling.
ICE Status	-	Varies	This parameter displays the status of the internal combustion engine (ICE) as determined by the ECM. The hybrid powertrain control module monitors the ECM for this data in order to determine ICE status. The parameter display range is Off, Invalid, Start,

Parameter	System State	Expected Value	Description
			Running, Stop and Stalled.
Idle Increase Command	-	Varies	Indicates that an autostop was prevented due to a need to boost the engine idle speed.
Ignition 1 Signal	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.
Ignition Input Accessory	-	Varies	This parameter displays the voltage of the accessory feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535V.
Ignition Input Off/On /Start	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535V.
Ignition Voltage	-	Varies	Run/Crank Voltage
Immobilizer Auto Learn Counter	-	Varies	This indicates the number of autolearn cycles that have been successfully completed within the immobilizer system.
Immobilizer Automatic Learn Timer	-	Varies	This indicates the time elapsed within the current autolearn cycle within the immobilizer system.
Immobilizer ECM Identifier	-	Varies	Powertrain Device Unknown indicates that the ICM has not received the powertrain identifier or has received the wrong powertrain identifier.
Immobilizer Environment Device 1	-	Varies	Environment Device 1 Unknown
Immobilizer Environment Device 2	-	Varies	Environment Device 2 Unknown
Immobilizer Environment Device 3	-	Varies	Environment Device 3 Unknown
Immobilizer Environment Device 4	-	Varies	Environment Device 4 Unknown
Immobilizer Module Environment Identification	-	Varies	This indicates that the vehicle environment identification process is active within the ICM. This indicator is the signal for the identification devices to identify

Parameter	System State	Expected Value	Description
			themselves to the immobilizer. If this indicator is set, the immobilizer response has not yet been released and is, therefore, invalid. This indicator will be cleared if the environment identification has completed successfully or has failed.
Immobilizer Module Fuel Disable	-	Varies	Vehicle Immobilized by ICM indicates that the ICM has decided to immobilize the vehicle. In this case, the immobilizer response will not be released from the ICM.
Immobilizer Module Identification	-	Varies	ICM Identification Completed indicates that the vehicle environment identification process within the ICM has completed successfully and the immobilizer response is valid.
Immobilizer Module Security Code Programmed	-	Varies	Security Code Programmed in ICM indicates that the ICM security code has been programmed, the immobilizer device is locked.
Immobilizer Password Learn	-	Varies	The vehicle theft deterrent (VTD) module must be put in a learn mode to learn the correct password when the module is replaced.
Immobilizer Password Learn Scan Tool Delay	-	Varies	Tool Learn Delay Active indicates that the security code has been accepted but the tool learn delay is active and will not allow learning enabled, programming security code, or resetting security code.
Immobilizer Security Code Accepted	-	Varies	Security Code Accepted indicates that the received security code is correct.
Immobilizer Security Code Lockout	-	Varies	Security Code Lockout Active indicates that the security code has not passed and lockout is active.

Parameter	System State	Expected Value	Description
Immobilizer Security Code Lockout Active Timer	-	Varies	This indicates the time elapsed since the receipt of the correct security code within the immobilizer system.
Immobilizer Security Code Programmed	-	Varies	Indicates that the security code has been programmed.
Immobilizer Security Code Programming Counter	-	Varies	Indicates the number of times a new immobilizer security code has been programmed through secure access. This counter can only be incremented.
Immobilizer Security Code Reset Counter	-	Varies	Indicates the number of times the immobilizer security code has been reset to the default value through secure access. This counter can only be incremented.
Immobilizer Security Information Programmed	-	Varies	This indicates that the immobilizer key has been programmed.
Immobilizer System Status	-	Varies	Indicates the current state of the immobilizer algorithm.
Immobilizer Transponder Identification	-	Varies	Indicates that the transponder identification process is active within the ICM. This indicator will be cleared if the identification has completed successfully or has failed.
Immobilizer Transponder Key Identification	-	Varies	Indicates that the transponder is unknown or has not yet been evaluated.
Immobilizer Valid Response Received Time	-	Varies	Indicates the actual time needed for the immobilizer to respond with a correct password.
Intake Manifold Pressure	-	No	Intake Manifold Pressure indicates that an autostop was prevented due to high intake air manifold pressure. The manifold pressure must drop below a calibratable idle threshold before an autostop is allowed.
Internal Mode Switch Range	-	Park or Neutral	This parameter displays the vehicle direction selected as determined by the manual shift shaft position switch, also referred to as the internal mode switch.

Parameter	System State	Expected Value	Description
			The internal mode switch contains two discrete shift lever-actuated switch patterns. The internal mode switch range switch pattern is monitored by the TCM and is utilized to determine gear range as selected by the shift lever. The internal mode switch direction switch pattern is monitored by the hybrid powertrain control module and is utilized to determine vehicle direction and the Park/Neutral start safety condition as selected by the shift lever. The parameter display range is Park, Reverse, Neutral, Drive, Transition, Invalid and Illegal Setting.
Internal Mode Switch Range	Park/Neutral/ Drive	No	This parameter displays the status of an Austostart Entry or Autostop Inhibit due to internal mode switch range selection. The parameter display range is Yes, No.
	Manual/ Reverse	Yes	
Internal Mode Switch 2	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - D1	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - D2	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - R1	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - R2	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Internal Mode Switch 2 - S	-	High/ Low	Indicates the status of the transmission Internal Mode Switch direction contacts.
Invalid Data	-	Varies	Indicates Internal Mode Switch Data is not valid. Depending on the fault there may be forced

Parameter	System State	Expected Value	Description
			austostart entry or autostop may be inhibited.
Invalid Signal Received	-	Varies	Indicates that the last autostart was forced due to an internal mode switch fault.
ISS/OSS Supply Voltage	-	Varies	Indicates the TISS/TOSS supply voltage is outside of the normal operating range as reported by the TCM.
Low-Voltage Battery Discharge Current	-	Varies	Indicates that the last autostart was triggered when the 12V battery discharge current was high.
Low-Voltage Battery Discharge Current	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded, due to a too high 12V battery discharge current.
Low-Voltage Battery State of Charge	-	Varies	Indicates that the last autostart was triggered when the 12V battery state of charge was low.
Low-Voltage Battery State Of Function Voltage	-	Varies	Indicates that the last autostart was triggered when the 12V battery state of function voltage was low.
Low-Voltage Battery State Of Function Voltage	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded due to a low 12V battery state of function voltage. The State-of-Function informs the vehicle-level energy management to which degree the battery could perform any intended function such as; cold or warm cranking, supporting specific loads, delivering propulsion power, or accepting charge.
Low-Voltage Battery State of Health	-	Varies	Indicates that the last autostart was triggered when the 12V battery state of health was low.
Low-Voltage Battery State of Health	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded due to a low 12V battery state of health.

Parameter	System State	Expected Value	Description
Low-Voltage Battery Temperature	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded, because the 12V battery temperature was out of a specified range, high or low.
Low-Voltage Battery Voltage	-	Varies	Indicates that the last autostart was triggered when the battery voltage was low.
Low-Voltage Battery Voltage Too Low	-	No	This parameter displays the status of a forced Autostart or an Autostop Inhibit due to the voltage of the hybrid battery assembly. The parameter display range is Yes, No.
Low-Voltage Circuit Enable Conditions Met	-	Varies	Indicates the status of the low voltage (14v) circuit on a hybrid vehicle accessory DC power control module.
Low-Voltage Circuit Voltage	-	Varies	Displays the value low voltage (12 V) circuit as detected by the accessory DC power control module.
Low-Voltage Enable Command	-	Varies	Indicates if the low voltage circuit is enabled.
Malfunction Counter	-	Varies	Indicates the number of ignition cycles with a failure reported since the first ignition cycle with a reported failure.
Maximum Hybrid/EV Battery Module Temperature	-	Varies	Indicates the temperature of the hybrid battery module with the highest temperature.
MIL Command	-	Varies	Indicates the commanded state of the malfunction indicator lamp (MIL) output.
MIL Requested by DTC	-	Varies	Indicates that the malfunction indicator lamp is being commanded on due to the failure of a diagnostic test.
Minimum Hybrid/EV Battery Module Temperature	-	Varies	Indicates the temperature of the hybrid battery module with the lowest temperature.
Minimum Hybrid/EV Battery Module Voltage	-	Varies	Indicates that the last autostart was triggered due to a low battery module voltage.

Parameter	System State	Expected Value	Description
Minimum Hybrid/EV Battery Module Voltage	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded, due to a low battery module voltage.
Minimum Hybrid/EV Battery Module Voltage	-	Varies	Indicates that an autostart was prevented due to a low battery module voltage.
Motor 1 Torque	-	Varies	Indicates the electric motor actual torque value for motor 1.
Motor 1 Torque Command	-	Varies	Indicates the electric motor commanded torque value for motor 1.
Motor 2 Torque	-	Varies	Indicates the electric motor actual torque value for motor 2.
Motor 2 Torque Command	-	Varies	Indicates the electric motor commanded torque value for motor 2.
Motor Temperature	-	Varies	Indicates that an autostop was prevented, or an autostart was commanded, due to high motor temperature.
Not in Run Mode	-	Varies	Indicates the vehicle is not in run.
Not Requested	-	Varies	Indicates that none of the Start Entry conditions have occurred.
Not Run Counter	-	Varies	Indicates the number of ignition cycles without a pass or a failure reported since the first ignition cycle with a failure reported.
Operating Conditions Determined by Driver	-	Varies	Indicates the last autostart was triggered based on torque conditions requested from the driver, generally a tip-in on the throttle.
Operating Conditions Determined by Driver	-	Varies	Indicates an autostart was commanded based on torque conditions requested from the driver (generally a tip-in on the throttle). When this condition is detected, autostops are disallowed.
Output Shaft Direction	-	Varies	Indicates the direction of a transmission output shaft rotation.
Output Shaft Speed Sensor	-	Varies	Indicates the directionally signed, filtered transmission output speed.

Parameter	System State	Expected Value	Description
Pass Counter	-	Varies	Indicates the number of ignition cycles with a pass reported and no failures reported since the first ignition cycle with a failure reported.
Power Mode	-	Varies	Displays system power mode status as determined by ignition switch inputs to the power mode master. System power mode status should match the ignition switch position.
Propulsion Not Active	-	Varies	Indicates an immediate stop was commanded due to Propulsion System Not Active and Key Off, Start Not Ready, or Not in Park/Neutral.
Reduced Engine Power	-	Varies	Indicates that the last autostart was triggered, and autostop disabled, when a situation was detected that caused the vehicle to operate with reduced power.
Regenerative Braking Axle Torque Request	-	Varies	Indicates the Regenerative Braking Axle Torque Request value sent from the anti lock brake module to the hybrid powertrain control module.
Regenerative Braking Torque Predicted	-	Varies	Indicates the Regenerative Braking Axle Torque Request value sent from the anti lock brake module to the hybrid powertrain control module.
Remote Vehicle Start Request	-	Varies	Indicates that the last autostart was triggered when the remote start command was activated.
Remote Vehicle Start Request	-	Varies	Internal combustion engine has been requested to run due to a remote start command.
Requested Engine Torque	-	Varies	Indicates the commanded engine torque value. This is the fast response torque request for spark control, retardation. Based on current conditions, the hybrid controller determines the optimum engine torque, which it sends as a request to the engine

Parameter	System State	Expected Value	Description
			controller's engine torque arbitration. During normal operating conditions, no spark retardation, this value is identical to the Engine Torque Command value. While spark retardation is active, this value will be lower than Engine Torque Command.
Reverse	-	Varies	Indicates that the last autostart was triggered when in Reverse and torque was requested from the driver.
Reverse Inhibit Command	-	Varies	Indicates an AutoStart while in Reverse and torque was requested from the driver. When this condition is detected, AutoStops are inhibited.
Run/Crank Mode	-	Varies	Indicates a driver forced AutoStart request
Security Code Lockout Active Timer	-	Varies	Indicates the time elapsed since the immobilizer security code lockout has been activated either due to a battery disconnect or an incorrect immobilizer security code being entered.
Starter/Generator Control Module DC/AC Inverter Temperature	-	Varies	Electric Motor Inverter Temperature indicates that the last autostart was triggered due to high motor inverter temperature.
System Voltage	-	Varies	Indicates that the last autostart was triggered due to vehicle accessories drawing more power than was available. Autostart and autostop are inhibited in this condition.
Torque Delivered Signal	-	Varies	Indicates engine steady state torque
Total Brake Torque	-	Varies	Indicates the actual state of blended regenerative braking as determined by the hybrid control module.
Traction Control	-	Varies	Indicates that an autostop was prevented due to wheel slip detected during the vehicle stop.

Parameter	System State	Expected Value	Description
Transmission Fluid Temperature	-	Varies	Indicates that the last autostart was triggered due to transmission temperature out of range.
Transmission Fluid Temperature Sensor	-	Varies	Transmission Oil Temperature.
Transmission Input Speed	-	Varies	The RPM at the transmission input shaft.
Transmission OSS	-	Varies	Transmission Output Speed.
Transmission Range Command	-	Varies	This PID contains the actual transmission range determined by arbitrating any delta between the range as determined by the HCP and that determined by the TCM. This will be the command to all the control algorithms.
Transmission Torque Command	-	Varies	Indicates the commanded transmission output torque.
Vehicle on Incline	-	Varies	Indicates that the last autostart was triggered when the grade level of the vehicle was too large. Autostop was inhibited at this time.
Vehicle Speed	-	Varies	Indicates vehicle speed calculated from the transmission output speed.
VIN Programming Counter	-	Varies	Indicates the number of times the VIN has been programmed. This counter can only be incremented.
Warm-Ups Since DTC Cleared	-	Varies	Indicates the number of OBD defined warm-up cycles since the last time codes were cleared with a scan tool or, when applicable, with a battery disconnect. Once this counter reaches its maximum value, it will stop counting and will remain at its maximum value until codes are cleared.
Warm-Ups without Emission Malfunctions	-	Varies	The scan tool displays a range of 0 - 255. This parameter counts the number of warm-up cycles without an emission fault present. The counter increments to 255 and rolls back to 0 unless a fault occurs. If a fault occurs, the counter reverts back to 0 until the

Parameter	System State	Expected Value	Description
			fault is corrected. Clearing the information with a scan tool or a loss of power to the PCM also resets the counter to 0. The scan tool displays counts. This display indicates the number of warm-up cycles without a emission failure. A warm-up means that the engine started from a cold start condition, which is some calibrated value usually around 70 or 80 degrees F, and warms to operating temperature in a single key cycle.
Warm-Ups without Non-Emission Malfunctions	-	Varies	The scan tool displays a range of 0 - 255. This parameter counts the number of warm-up cycles without a non-emission fault present. The counter increments to 255 and rolls back to 0 unless a fault occurs. If a fault occurs, the counter reverts back to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM also resets the counter to 0. A warm-up means that the engine started from a cold start condition, which is some calibrated value usually around 70 or 80 degrees F, and warms to operating temperature in a single key cycle.

Hybrid Powertrain Control Module Scan Tool Output Controls

Output Control	Description
Auto Start/Stop Command	NOTE: • The hood must remain closed while commanding either Autostart or Autostop with the scan tool. Opening the

Output Control	Description
	hood while commanding Autostop or Autostart will cause an engine stall, start/stall, vehicle disable condition. The disable condition will remain active until the hood is closed. • The Autostart command will not function when the gear selector is in Reverse, Drive, or Manual. Shift the gear selector to Park or Neutral in order to command an Autostart. • The hybrid powertrain control module controls the Autostop and Autostart hybrid operation modes. • When operating in the Autostop mode, the following control limits apply: • Vehicle ON. • The internal combustion engine (ICE) must be running. • The drive motor battery state of charge must be greater than 25%. • The engine coolant temperature (ECT) must be between

Output Control	Description
	68Â°C (154Â°F) and 109Â°C (228Â°F). When operating in the Autostart mode, the following control limits apply: Vehicle ON
Aux. Trans. Pump Speed	- The hybrid powertrain control module commands the auxiliary transmission fluid pump control module to turn the auxiliary pump ON and OFF. Additionally, the hybrid powertrain control module commands the auxiliary pump to operate at a certain speed (RPM). - When operating the Auxiliary Transmission Oil Pump Speed control, the following control limits apply: - The internal combustion engine (ICE) must be OFF. - Electric motor speed must be 0 RPM.
Clear Secured High Voltage DTCs	- This output control is used to clear a latched high voltage (HV) lockout state. - The hybrid powertrain control modules 1 and 2 monitor for high voltage safety conditions such as airbag deploy events and certain HV system faults. - If these conditions are present either module may set a DTC and prevent HV enabling until after this Output Control is exercised. NOTE: Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout. - Always refer to Clear Secured High Voltage DTCs procedure in Hybrid/EV Energy Storage service information for the proper sequence of procedures required to reset a HV lockout state.
Continuous Charge Mode	The hybrid powertrain control module allows selection of the battery charging mode as either "charge depleting" or "charge sustaining."
Regenerative Braking	The hybrid powertrain control module will enable or disable blended regenerative braking.

Output Control	Description
	When the vehicle is ON there are no limits to this control.

HYBRID POWERTRAIN CONTROL MODULE 2 SCAN TOOL INFORMATION

Charge History Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: The Charge History parameters capture the conditions present during the last five charge events. A charge event is recorded whenever the charge coupler is fully mated to the charge receptacle. History 1 is the most recent charge event. The Charge History parameters are cleared only during an HPCM2 replacement and/or programming event.		
Charge History (1 thru 5) - 110V AC Input	Varies	This parameter displays if the 110V charge cord was active during this charge event.
Charge History (1 thru 5) - 240V AC Input	Varies	This parameter displays if the 240V charge cord was active during this charge event.
Charge History (1 thru 5) - Autostart Inhibit	Varies	This parameter displays if the charge event was interrupted because of an engine start. An engine start could be commanded via remote start, key crank, cold battery, etc.
Charge History (1 thru 5) - Battery Charger Temperature Too High	No	This parameter displays if the charge event was interrupted because the Battery Charger internal temperature exceeded a set value.
Charge History (1 thru 5) - Charging Cord Error	No	This parameter displays if the vehicle battery charger is requesting utility power but AC input voltage is not present. Refer to DTC P1EE6.
Charge History (1 thru 5) - Contactor Open	No	This parameter displays if the charging related contactor(s) were commanded open, interrupting the charge event.
Charge History (1 thru 5) - Full Charge	Varies	This parameter displays if the high voltage battery was completely charged during this charge event.
Charge History (1 thru 5) - High Severity Fault	No	This parameter displays if high voltage battery DTCs such as cell overvoltage had set, inhibiting the charge event.
Charge History (1 thru 5) - Hybrid/EV Battery Pack Protection	No	This parameter displays if high voltage battery DTCs had set, inhibiting the charge event.
Charge History (1 thru 5) - Hybrid/EV Battery Pack Temperature Too Low	No	This parameter displays if the charge event was interrupted because the high voltage battery temperature was too low to allow charging.
Charge History (1 thru 5) - Low Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) - Low Voltage - Battery Voltage Low Before Charge	No	This parameter displays if the 12 V accessory battery voltage was too low prior to the charging event being enabled.

Parameter	Expected Value	Definition
Charge History (1 thru 5) - Low Voltage - Battery Voltage Low During Charge	No	This parameter displays if the 12V accessory battery voltage was too low during the charge event.
Charge History (1 thru 5) - Maximum Cell Voltage	No	This parameter displays if the maximum voltage for one of the high voltage battery cells was exceeded, interrupting the charge event.
Charge History (1 thru 5) - Maximum Charge Time Exceeded	No	This parameter displays if the maximum charge time was exceeded during this charge event. Maximum charge time varies by vehicle model with 40 hours being the shortest maximum allowed charge time.
Charge History (1 thru 5) - Medium Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) - Multiple Plug - In Events Within 30 Seconds	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 30 second time frame.
Charge History (1 thru 5) - Multiple Plug - In Events Within 5 Minutes	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 5 minute time frame.
Charge History (1 thru 5) - Time of Day Inhibit	Varies	This parameter displays if programmable charging (time of day/rate based) had delayed charging at some point during this event.
Charge History (1 thru 5) - Unplugged at Vehicle	Varies	This parameter displays if the charge event was interrupted because the charge cord was disconnected at the vehicle charge receptacle.
Charge History (1 thru 5) - Unplugged at Wall	Varies	This parameter displays if the charge event was interrupted when AC voltage was lost to the charge cord. Most likely this occurred by either the charge cord plug being removed from the household receptacle or a household utility circuit breaker tripping open.
Charge History (1 thru 5) - Utility Company Inhibit	Varies	This parameter displays if smart charging had delayed charging at some point during this charge event due to a utility company commanded transmitted via Onstar.
Charge History (1 thru 5) - Vehicle Conditions Not Correct	Yes	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run			
14V Power Module Power Available From	-	Varies	This parameter displays the amount of electrical power in

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack			kW the Hybrid/EV battery pack can supply to the 14V Power Module.
A/C Compressor Power Limit	-	No	This parameter displays if the electric power available to the Electric A/C compressor motor is at its limit.
A/C Compressor Speed	-	Varies	This parameter displays the actual speed of the electric A/C compressor motor shaft. This parameter is active only when the cabin controls are set to condition the vehicle.
A/C High Side Pressure Sensor	Compressor OFF	Equal to low side	This parameter displays the pressure of the A/C system high side pressure sensor.
	Compressor ON	Higher than low side	
A/C Low Side Pressure Sensor	Compressor OFF	Equal to high side	This parameter displays the pressure of the A/C system low side pressure sensor.
	Compressor ON	Lower than high side	
A/C Low Side Pressure Sensor	-	Varies	This parameter displays the voltage of the A/C system low side pressure sensor.
Airbag Deployed	-	No	This parameter displays if the contactors are commanded open because an air bag has deployed.
Ambient Air Temperature	-	Varies	This parameter displays the temperature of the air surrounding the vehicle.
Average Hybrid/EV Battery Pack Temperature	-	Varies	This parameter displays the average temperature for all of the Hybrid/EV battery pack module sensors.
Battery Charger High Output	-	Varies	This parameter displays the current in amps supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Output	-	Varies	This parameter displays the voltage supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Voltage Energy Output During Last Charge	-	Varies	This parameter displays the energy (kWh) the battery charger has delivered into the high voltage Hybrid/EV battery pack during the last charge event.

Parameter	System State	Expected Value	Description
Battery Charger High Voltage Power Output Available	-	Varies	This parameter displays the maximum battery charger power output in kW available for Hybrid/EV battery pack charging.
Battery Charger Input	-	Varies	This parameter displays the current in amps monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input	-	Varies	This parameter displays the voltage monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input 120V AC	-	Varies	This parameter displays the battery charging system is connected to 120V AC.
Battery Charger Input 240V AC	-	Varies	This parameter displays the battery charging system is connected to 240V AC.
Battery Charger Power Input Available	-	Varies	This parameter displays the maximum power in kW available at the battery charger plug receptacle coming from the wall outlet/utility supply.
Battery Charging System	-	OK	This parameter displays if the components that make up the charge system are allowing charging.
Battery Charging System Indicator Status	-	Varies	This parameter displays the status of the charging system indicator (LEDs/Bulbs/Icons) visible to the operator of the vehicle.
Battery Charging System Operating Conditions	-	OK	This parameter displays if the battery charging system operating conditions are allowing charging.
Battery Charging System Positive Contactor Command	Propulsion Active or Charge Mode	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on (+) side of the battery charging/14V power module system.
	Not in Charge Mode or Propulsion Active	Open	

Parameter	System State	Expected Value	Description
Charge Port Door	-	Varies	This parameter displays the state of the switch at the door where the charge cord plugs in.
Cooling Fan Motor Command	-	Varies	This parameter displays the commanded air flow in percent of the radiator coolant fan.
Crash Event Detected	-	No	This parameter displays if the contactors are commanded open due to a vehicle crash event being detected.
Discharging	-	No	This parameter displays if the system is inhibiting contactor closure because the high voltage system is currently in the process of discharging the capacitors on the high voltage bus. Discharging usually occurs immediately following opening of the high voltage contactors.
Distance Since DTC Cleared	-	Varies	This parameter displays the distance in miles or kilometers since OBD diagnostic trouble codes (DTCs) have been cleared using the service tool.
Distance with MIL On	-	Varies	This parameter displays the accumulated distance in miles or kilometers driven with the malfunction indicator lamp (MIL) on.
Fuel Door Indicator	Fuel Door Closed	Off	This parameter displays the Status of the Fuel Door indicator (LED, bulb, icon) visible to the operator of the vehicle.
	Fuel Door Open	On	
Fuel Door Lock	Fuel system vent not complete	Locked	This parameter displays the state of the lock mechanism of the fuel door.
	Fuel system vented	Unlocked	
Fuel Door Position	-	Varies	This parameter displays the state of the fuel door position switch.
Fuel Tank Pressure	-	Varies	This parameter displays the pressure/vacuum inside the fuel tank. A negative value indicates a vacuum, while a positive value indicates a pressure.

Parameter	System State	Expected Value	Description
High Voltage Interlock Circuit	-	No	This parameter displays if the contactors are commanded open because the high voltage interlock circuit is detected open or faulted.
High Voltage System Interlock Circuit	HV Enabled	Energized	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays if the high voltage interlock circuit is currently monitoring for high voltage system integrity.
	HV Not Enabled	De-Energized	
High Voltage System Interlock Circuit Status	HV Enabled	Pass	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays the results of the control modules diagnostic test of the high voltage interlock circuit.
	HV Not Enabled	Unknown	
High Voltage System Isolation Test Status	HV Enabled	Not Running	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the status of the Hybrid/EV battery pack isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will clear whenever DTCs are cleared.
	HV Not Enabled	Running/Complete	
Hood Position	-	Varies	This parameter displays the position of the hood as determined by the hood latch switch.
Hybrid/EV Battery Pack Capacity	-	Varies	This parameter displays the capacity of the hybrid/EV battery pack expressed in engineering data form.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Charging Limit	-	Varies	This parameter displays the maximum charge power limit in watts of the Hybrid/EV battery pack based on current conditions such as temperature and state of charge.
Hybrid/EV Battery Pack Coolant Level Switch	-	Varies	This parameter displays the voltage signal from the coolant level switch contained in the Hybrid/EV battery pack coolant surge tank.
Hybrid/EV Battery Pack Coolant Pump Command	-	Varies	This parameter displays the commanded percentage coolant flow for the Hybrid/EV battery pack coolant pump.
Hybrid/EV Battery Pack Coolant Pump Feedback	-	45 - 55%	This parameter displays the internal diagnostic status of the Hybrid/EV battery pack coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Battery Pack Coolant Pump Speed	-	Varies	This parameter displays the actual speed of the Hybrid/EV battery pack coolant pump motor shaft.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	-	Varies	A sensor monitors the temperature of coolant circulating through the Hybrid/EV battery pack. This parameter displays Sensor 1 which monitors temperature of the coolant entering the battery pack.
Hybrid/EV Battery Pack Current	-	Varies	This parameter displays the amount of current in amps flowing in or out of the Hybrid/EV battery pack.
Hybrid/EV Battery Pack Heater Power Command	-	Varies	This parameter displays the electric power in percent commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Heater Power Command	-	Varies	This parameter displays the electric power in kW commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Heater Power Limited	-	No	This parameter displays if the electric power available to the Hybrid/EV battery pack coolant heater is at its limit.
Hybrid/EV Battery Pack Heater Power Request	-	Varies	This parameter displays the electric power in kW requested by the hybrid powertrain control module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Isolation Test Status	-	Passed	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the results obtained when the Hybrid/EV battery pack last performed its internal isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will be cleared whenever DTCs are cleared.
Hybrid/EV Battery Pack Maximum Voltage	-	Varies	This parameter displays the total Hybrid/EV battery pack maximum voltage measured during the current ignition cycle.
Hybrid/EV Battery Pack Minimum State of Charge Limit	-	Varies	This parameter displays the minimum permissible Hybrid/EV battery pack state of charge in percent. The Hybrid/EV system will not discharge the battery pack below this limit.
Hybrid/EV Battery Pack Minimum Voltage	-	Varies	This parameter displays the total Hybrid/EV battery pack minimum voltage measured

Parameter	System State	Expected Value	Description
			during the current ignition cycle.
Hybrid/EV Battery Pack Negative Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (-) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery Pack Positive Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (+) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery Pack Precharge Contactor Command	HV Enable Initiated	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the operation of the Hybrid/EV Battery pack precharge contactor relay. Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled.
	HV Fully Enabled or HV Not Enabled	Open	
Hybrid/EV Battery Pack Resistance	-	Varies	This parameter displays the Hybrid/EV battery pack resistance value in ohms.
Hybrid/EV Battery Pack State Of Charge	-	Varies	This parameter displays the percentage available capacity remaining in a Hybrid/EV battery pack.
Hybrid/EV Battery Pack State of Charge Gauge	-	Varies	This parameter displays the percentage Hybrid/EV battery pack state of charge as indicated to the operator of the vehicle.
Hybrid/EV Battery Pack Voltage	-	Varies	This parameter displays the electrical potential of the Hybrid/EV battery pack as currently monitored.
Hybrid/EV Battery System Precharge Current Too High	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through

Parameter	System State	Expected Value	Description
			a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. This parameter displays if the contactors are commanded open because of excessive Precharge current.
Hybrid/EV Battery System Precharge Time Too Long	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too slow.
Hybrid/EV Battery System Precharge Time Too Short	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too fast.
Hybrid/EV Battery Temperature Sensor with Maximum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting the maximum temperature value.
Hybrid/EV Battery Temperature Sensor with Minimum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting

Parameter	System State	Expected Value	Description
			the minimum temperature value.
Hybrid/EV Battery Voltage Sensor with Maximum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the highest voltage.
Hybrid/EV Battery Voltage Sensor with Minimum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the lowest voltage.
Hybrid/EV Battery Voltage Sensors Average	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the average voltage measured at all of the cells/modules.
Hybrid/EV Electronics Coolant Pump Command	-	Varies	This parameter displays the percent commanded coolant flow for the Hybrid/EV electronics coolant pump.
Hybrid/EV Electronics Coolant Pump Feedback	-	45 - 55%	This parameter displays the internal diagnostic status for the Hybrid/EV electronics coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Electronics Coolant Pump Speed	-	Varies	This parameter displays the actual speed of the Hybrid/EV electronics coolant pump motor shaft.
Hybrid/EV Electronics Coolant Temperature	-	Varies	This parameter displays the temperature of the coolant within the hybrid electronics cooling system.
Hybrid/EV Powertrain Control Module Request	-	No	This parameter displays if the hybrid/EV powertrain control module (1) is requesting the contactors to be open.

Parameter	System State	Expected Value	Description
Ignition 1 Signal	-	Varies	This parameter displays the voltage monitored at the control module terminal connected to the Ignition 1 circuit.
Isolation Test Resistance	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the amount of isolation observed when the Hybrid/EV battery pack last performed its isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The value will be set to zero whenever DTCs are cleared.
Maximum Hybrid/EV Battery Module Temperature	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the highest temperature.
Maximum Hybrid/EV Battery Module Voltage	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the maximum voltage measured at any of the cells/modules.
Minimum Hybrid/EV Battery Module Temperature	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the lowest temperature.
Minimum Hybrid/EV Battery Module Voltage	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the minimum voltage measured at any of the cells/modules.
Overtemperature	-	No	This parameter displays if the system is commanding contactors open to protect them

Parameter	System State	Expected Value	Description
			from overheating. The contactors will overheat if cycled too many times within a short amount of time.
Passenger Compartment Heater Coolant Control Solenoid Valve Command	-	Varies	This parameter displays the commanded position for the solenoid valve that controls the coolant flow through the passenger compartment cooling system. This position determines if coolant is allowed to flow from the engine cooling system.
Passenger Compartment Heater Coolant Control Solenoid Valve Feedback	-	Varies	This parameter displays the actual position for the solenoid valve that controls the coolant flow through the passenger compartment cooling system. This position determines if coolant is allowed to flow from the engine cooling system.
Passenger Compartment Heater Coolant Control Solenoid Valve Learn Status	-	Learned	This parameter displays the status of the learn test for the solenoid valve that controls the coolant flow through the passenger compartment heater core.
Passenger Compartment Heater Power Limited	-	No	This parameter displays if the electric power available to the passenger compartment heater power is at its limit.
Power Delivered to Electric A/C Compressor from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to the A/C compressor in order for it to provide Hybrid/EV battery pack and/or passenger compartment cooling. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Delivered to Electric Passenger Compartment Heater from Hybrid/EV	-	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to

Parameter	System State	Expected Value	Description
Battery Pack			the passenger compartment heater in order for it to provide heat. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide Hybrid/EV battery pack and/or passenger compartment cooling. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide passenger compartment heating. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Mode	-	Run	This parameter displays the status of the ignition switch.
Proximity Detection Circuit	-	Varies	The proximity detection circuit detects the presence of the drive motor battery charge cord. This parameter displays the voltage monitored on the detection circuit.
Refuel Request	-	Varies	This parameter displays if the module has initiated a refuel request.
Refuel Request Switch	-	Varies	This parameter displays the state of the fuel door open request switch.
Refuel System Status	-	Varies	This parameter displays the current state of the refuel system.
Refuel System Vent Requested	-	Varies	This parameter displays if the module has requested the refuel system to vent the fuel tank.
Refuel System Vented	-	Varies	This parameter displays if the refuel system has completed the fuel tank vent process.

Parameter	System State	Expected Value	Description
Service Refuel System Indicator	-	Off	This parameter displays status of the Refuel system malfunction indicator (LED, bulb, icon) visible to the operator of the vehicle.
Shutdown Mode	-	No	Shutdown Mode is the semi-operational state while a control module is turning off. Shutdown mode allows time for house-keeping tasks such as writing data to stored memory. This parameter displays if the module is in the process of shutting down.
Stuck Open	-	No	This parameter displays the contactors are commanded open because the module has detected one or more of the high voltage contactors will not close.
Warm-Ups Since DTC Cleared	-	Varies	This parameter displays the number of OBD defined warm-up cycles since the last time codes were cleared with a scan tool or, when applicable, with a 12V battery disconnect. A warm-up cycle occurs after the propulsion system has been active for 1000 consecutive seconds with run/crank ignition active.

Hybrid Powertrain Control Module 2 Configuration/Reset Functions

Functions	Description
Fuel Economy Reset	This reset function is used to reset the learned Lifetime fuel economy displayed to the operator of the vehicle. The Lifetime fuel economy display will reset to the maximum limit.
Hybrid/EV Battery Pack Capacity Learn	This reset function is used to learn the hybrid/EV battery pack capacity whenever the HPCM2, the Hybrid/EV Battery pack or individual hybrid/EV battery sections are replaced. Refer to the Hybrid/EV Battery Pack Capacity Learn procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Pack Charging Adaptive Learn Reset	This reset function is used to reset the learned adaptive charging limits.
Hybrid/EV Battery Contactor Open Reasons Reset	The hybrid/EV powertrain control module 2, Hybrid/EV Battery Contactor Open Reasons scan tool parameter list identifies all past events

Functions	Description
	that commanded contactors open. This reset function is used to set all history reasons for contactor open events to NO. Refer to Clear Secured High Voltage DTCs procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Pack Data Reset	This reset function is used to reset certain engineering data parameters.
Passenger Compartment Heater Coolant Control Solenoid Valve Learn	This reset function is used to learn the end-stop positions of the coolant valve.

Hybrid Powertrain Control Module 2 Scan Tool Output Controls

Output Control	Description
Check High Voltage System Related DTCs	- The hybrid powertrain control module 2 monitors for high voltage safety conditions. If these conditions are present the module will set DTCs and prevent high voltage enabling. - This output control identifies if the related DTCs have passed.
Clear Secured High Voltage DTCs	- This output control is used to clear a latched high voltage (HV) lockout state. - The hybrid powertrain control modules 1 and 2 monitor for high voltage safety conditions such as airbag deploy events and certain HV system faults. - If these conditions are present either module may set a DTC and prevent HV enabling until after this Output Control is exercised. NOTE: Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout. - Always refer to Clear Secured High Voltage DTCs procedure in Hybrid/Energy Storage service information for the proper sequence of procedures required to reset a HV lockout state.
Cooling Fan Motor	This output control is used to vary the coolant radiator cooling fan motor between 10% and 90%.
Fuel Fill Door Lock	This output control is used to energize the M97 Fuel Fill Door Lock Actuator which in turn Locks and Unlocks the fuel fill door.

Output Control	Description
High Voltage Disabling	This output control initiates the on-vehicle control module software to attempt to disable and discharge high voltage outside of the Hybrid/EV battery pack. Always refer to the High Voltage Disabling procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Contactors	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Battery Pack Active Cooling	This output control is used to enable Active Cooling of the Hybrid/EV Battery Pack. The electric A/C compressor will be turned ON and the air conditioning refrigerant will cool the hybrid/EV battery coolant.
Hybrid/EV Battery Pack Active Isolation Test	• Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. • This output control commands the hybrid powertrain control module 2 to measure the isolation of the hybrid/EV battery pack • The following control limits apply: • All high voltage contactors are open • The vehicle power mode is OFF Depress and hold the brake pedal while the vehicle power mode is OFF to wake up the modules prior to enabling this output control.
Hybrid/EV Battery Pack Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 80%.
Hybrid/EV Battery Pack Heater Passive Isolation Test	This output control is used to energize the Battery Pack Heater while monitoring for high voltage loss of isolation condition.
Hybrid/EV Battery Pack Heater Power	This output control is used to energize the Battery Pack Heater to confirm heating function.
Hybrid/EV Electronics Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 80%.
Passenger Compartment Heater Coolant Control Solenoid Valve	This output control is used to energize the Q66 Passenger Compartment Heater Coolant Control Valve. The passenger compartment heater coolant control valve has two positions. When commanded in bypass mode, as when the engine is OFF, the passenger compartment heater coolant control valve separates the engine and the cabin heater control module coolant loops to prevent heat generated by the cabin heater control module for passenger compartment heating from dissipating into the engine coolant loop. After the engine starts up and is warmed up, excess engine heat is allowed to assist the cabin heater control module in heating the passenger compartment, the passenger compartment heater coolant control valve is commanded to link mode and the two coolant loops are connected.
Vent Refuel System	• This vehicles sealed fuel system features a normally sealed fuel tank and canister to reduce canister loading during daily cycles. Unlike the EVAP diagnostic hardware from conventional EVAP systems, this vent solenoid valve is normally closed. This keeps the fuel

Output Control	Description
	vapor sealed in the fuel tank and canister. The vent solenoid valve is only open for canister purge, refueling, fuel tank pressure (FTP) sensor correlation or leak check with the EVAP leak detection pump. This output control overrides the EVAP system control of the vent solenoid.

INFLATABLE RESTRAINT PASSENGER PRESENCE SYSTEM SCAN TOOL INFORMATION

Sensing and Diagnostic Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module which is stored in non volatile memory.
Battery Voltage	Volts	The scan tool will display battery voltage.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the PPS module.
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module in production.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the PPS module.
Passenger Classification	Empty Seat	The scan tool displays Unknown, Calibration Mode, Empty Seat, Small Occupant Type 1, Small Occupant Type 2, Small Occupant Type 3, Small Occupant Type 4, Large Occupant Type 1, Large Occupant Type 2, Large Occupant Type 3, Large Occupant Type 4, Module Setup, Not Available, Child Seat Facing Rearward, Child Seat Facing Forward, Child Seat Facing Unknown Direction. This is the state of what occupies the passenger seat, as monitored by the passenger presence system.
Passenger Presence Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Passenger Presence System Reporting DTC(s)	Yes/No	The PPS module will report if there are DTCs set in the passenger presence module.
Passenger Seat Occupancy Status	Empty Seat	The scan tool displays Undefined, Empty Seat, Occupied, or Invalid. This is the state of the passenger seat if it is occupied or empty and monitored by the passenger presence system.

Parameter	Expected Value	Definition
Power Mode	Off / Accessory / Run / Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the PPS module.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the PPS module received primary key data.
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the PPS module.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE SCAN TOOL INFORMATION

Sensing and Diagnostic Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
2nd Row Left Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the left rear seat belt reminder sensor pad is enabled to the SDM.
2nd Row Left Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the left rear seat belt reminder sensor pad has been learned by the SDM.
2nd Row Left Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the left rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear middle seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear middle seat belt reminder sensor pad has been learned by the SDM.
2nd Row Middle Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the middle rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear right seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear right seat belt reminder sensor pad has been learned by the SDM.

Parameter	Expected Value	Definition
2nd Row Right Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the right rear seat belt switch when the seat belt is buckled or unbuckled.
Air Bag Malfunction Indicator	On/Off/Flashes	The scan tool will display On or Flashes if there is a problem with the SIR system. Any problems within the SIR system will illuminate the air bag indicator. The indicator will either flash or stay on.
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM which is stored in non volatile memory.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the SDM.
Deployment Loop 1-18 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled. This is the status of the air bag or pretensioner.
Deployment Loop 1-18 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has defined the number loop programmed from an air bag or pretensioner.
Deployment Loop 1-18 Resistance	1.44 - 4.25 Ohms	The scan tool displays the resistance of the learned loop of the air bag or pretensioner when connected to the SDM.
Deployment Loop 1-18 Type	Varies	The scan tool displays the name of the air bag or pretensioner associated with the loop type 1 - 18.
Driver Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.
Driver Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat belt sensor in the seat belt buckle is enabled to the SDM.
Driver Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat belt sensor has been learned by the SDM.
Driver Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the driver seat belt switch when the seat belt is buckled or unbuckled.
Driver Seat Position Sensor	Rearward/Forward	The scan tool will display if the driver seat is forward or rearward of the sensor set position.
Driver Seat Position Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Driver Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat position sensor has been learned by the SDM.

Parameter	Expected Value	Definition
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM in production.
Impact Sensor 1-8 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled. This is the status of the impact sensor.
Impact Sensor 1-8 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has learned and has assigned a number to that impact sensor.
Impact Sensor 1-8 Type	Equipped/Not Equipped	The scan tool displays the name of the impact sensor associated with the type 1 - 8.
Inflatable Restraint Sensing and Diagnostic Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the SDM.
Module Setup	Incomplete/Complete	The scan tool indicates if the SDM is set up.
Passenger Air Bag Disabled Switch	On/Off	The scan tool displays Off when the customer manually turns the passenger airbag off with this switch.
Passenger Air Bag Off Indicator	On/Off	The scan tool displays Off when the passenger indicator is not illuminated. This indicator is off when the disable switch is in the off position or no one is sitting in the passenger seat.
Passenger Air Bag On Indicator	On/Off	The scan tool displays On when the passenger indicator is illuminated. This indicator is on when the disable switch is in the on position and someone is sitting in the passenger seat.
Passenger Air Bag Status	Enabled/Disabled	The scan tool displays if the passenger air bag is enabled to the SDM.
Passenger Air Bag Disable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable indicator is enabled to the SDM.
Passenger Air Bag Disable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable indicator.
Passenger Air Bag Disable Switch Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable switch is enabled to the SDM.
Passenger Air Bag Disable Switch Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable switch.
Passenger Air Bag Enable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag enable indicator is enabled to the SDM.

Parameter	Expected Value	Definition
Passenger Air Bag Enable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag enable indicator.
Passenger Classification	00 - 07	The scan tool will display what type of individual is sitting in the passenger seat.
Passenger Presence Detection System Enable Status	Enabled/Disabled	The scan tool displays if the passenger presence system is enabled to the SDM.
Passenger Presence Detection System Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the passenger presence system.
Passenger Presence Detection System Reporting DTC(s)	Yes/No	The SDM will report if there are DTCs set in the passenger presence module.
Passenger Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.
Passenger Seat Belt Reminder Indicator Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder indicator is enabled to the SDM.
Passenger Seat Belt Reminder Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder indicator has been learned by the SDM.
Passenger Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder sensor pad is enabled to the SDM.
Passenger Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder sensor pad has been learned by the SDM.
Passenger Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Passenger Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt sensor has been learned by the SDM.
Passenger Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the passenger seat belt switch when the seat belt is buckled or unbuckled.
Passenger Seat Occupancy Status	Empty Seat/Occupied	The scan tool displays Occupied if someone is sitting in the passenger seat.

Parameter	Expected Value	Definition
Passenger Seat Position Sensor	Rearward/Forward	The scan tool will display if the passenger seat is forward or rearward of the sensor set position.
Passenger Seat Position Sensor Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat position sensor pad is enabled to the SDM.
Passenger Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat position sensor has been learned by the SDM.
Power Mode	Off/Accessory/Run/Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the SDM.
Primary Key Status Last Ignition Cycle	Invalid/Valid	The SDM checks to see if the primary key data received is valid.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the SDM received primary key data.
Rollover Sensor Enable Status	Disabled/Enabled	The scan tool displays if the rollover sensor is enabled to the SDM.
Rollover Sensor Learn Status	Learn/Unlearn	The scan tool displays Learned or Not Learned. Learned is displayed if the rollover sensor has been learned by the SDM.
Security Code Accepted	Yes/No	The SDM either accepts the security code or it does not. The scan tool displays Yes if the security code has been accepted by the SDM.
Security Code Lockout	Yes/No	The scan tool displays Yes if the SDM has been locked out because of the security code not being accepted.
Security Code Lockout Active Timer	Random Value	The SDM uses a timer before the security code is locked in the SDM.
Security Code Programmed	Yes/No	The scan tool displays Yes if the SDM has been programmed with the security code.
Security Code Programming Counter	Random Value	The SDM uses a counter for the value of the security code programming.
Security Code Reset Counter	Random Value	The SDM uses a counter to reset the value of the security code.
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the SDM.
Vehicle Identification Number	Varies, 17 Digit Number	The VIN number of the vehicle programmed into the SDM.
VIN Programmed	Yes/No	The scan tool displays Yes if the VIN has been programmed into the SDM.

Parameter	Expected Value	Definition
VIN Programming Counter	Random Value	The SDM uses this counter while programming the VIN.

INSTRUMENT CLUSTER SCAN TOOL INFORMATION

Instrument Cluster Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Vehicle in Service Mode		
Ambient Air Temperature	15 Â°C	The scan tool displays outside temperature in Â°C.
Battery Voltage	12 - 14 V	The scan tool displays Volts. This is the current battery voltage signal.
Coolant Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Driver Information Center Switch	Active/Inactive	The scan tool displays Active or Inactive. This is the state of the driver information center reset switch.
Driver Information Center Switch	Varies	The scan tool displays Volts. This is the current driver information center switch input voltage.
	Inactive	The scan tool displays either Inactive, Up, Down, or Menu. This is the state of the driver information center switch.
Engine Speed	Varies	The scan tool displays the engine RPM.
Odometer Lock Status	Active/Inactive	The scan tool displays Active or Inactive. Active means the odometer is locked.
Washer Fluid Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Vehicle Speed	Varies	The scan tool displays the vehicle speed.

Instrument Cluster Scan Tool Output Controls

Output Control	Description
All Indicators	This function is used to command all the indicators ON or OFF.
CAN Bus Configuration Learn	This function is used to Reset the source ID for low speed CAN Bus communications.
Driver Information Center Dimming	This function is used to command the dimming of the driver information display to Increase or Decrease by 10%.
Driver Information Center Options	This function is used to command the driver information center buttons using the scan tool.
Driver Information Center Segments	This function is used to command the driver information center segments ON and OFF.
Instrument Cluster Gauge Sweep	Since there are no gauges, the instrument cluster will go through a screen test sequence instead of sweeping the gauges.

MOTOR CONTROL MODULE 1 SCAN TOOL INFORMATION

Motor control module 1 is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Motor Control Module 1 Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order.

Use the Motor Control Module 1 Scan Tool Data Parameters list only after the following is determined:

- The [Diagnostic System Check - Vehicle](#) is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Motor Control Module 1 Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

NOTE: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to [Symptoms - Hybrid Controls](#) for diagnosis.

Motor Control Module 1 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
Drive Motor 1 Current	-	Varies	This indicates the DC current consumed by hybrid electric motor 1.
Drive Motor 1 Inverter Status	-	Varies	This indicates the state of the Motor 1 Inverter.
Drive Motor 1 Inverter Supply Voltage Circuit	-	Varies	This indicates the voltage on the DC bus at the inverter for motor 1. This should be equal to the voltage measured at the inverter for motor 2.
Drive Motor 1 Control Module Negative Supply Isolation Voltage	-	Varies	This indicates the high voltage negative to chassis voltage as measured for motor 1.
Drive Motor 1 Control Module Positive Supply Isolation Voltage	-	Varies	This indicates the high voltage positive to chassis voltage as measured for motor 1.
Drive Motor 1 Phase U Current	-	Varies	This indicates the current flow to phase U of electric motor 1.
Drive Motor 1 Phase V Current	-	Varies	This indicates the current flow to phase V of electric motor 1.
Drive Motor 1 Phase W Current	-	Varies	This indicates the current flow to phase W of electric motor 1.

Parameter	System State	Expected Value	Description
Drive Motor 1 Position Sensor Offset Learn Status	-	Varies	This indicates the status of the resolver offset learn for electric motor 1. This will update based on any resolver learn, whether performed automatically as part of normal vehicle operation or as the result of a device control.
Drive Motor 1 Speed	-	Varies	This indicates the speed, in revolutions per minute, of hybrid electric motor 1 as determined from the resolver.
Drive Motor 1 Temperature	-	Varies	This indicates the temperature for motor 1.
Drive Motor 1 Torque	-	Varies	This indicates the torque value for motor 1.
Hybrid/EV Powertrain Control Module High Voltage Circuit	-	Varies	This displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0 - 655.35 V.
Ignition 1 Signal	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.

MOTOR CONTROL MODULE 2 SCAN TOOL INFORMATION

Motor control module 2 is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Motor Control Module 2 Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order.

Use the Motor Control Module 2 Scan Tool Data Parameters list only after the following is determined:

- The [Diagnostic System Check - Vehicle](#) is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Motor Control Module 2 Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

NOTE: A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to [Symptoms - Hybrid Controls](#) for diagnosis.

Motor Control Module 2 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle ON/Closed Throttle/Park or Neutral/Accessories OFF, unless otherwise noted			
Drive Motor 2 Current	-	Varies	This indicates the DC current consumed by hybrid electric motor 2.
Drive Motor 2 Inverter Status	-	Varies	This indicates the state of the Motor 2 Inverter.
Drive Motor 2 Inverter Supply Voltage Circuit	-	Varies	This indicates the voltage on the DC bus at the inverter for motor 2. This should be equal to the voltage measured at the inverter for motor 1.
Drive Motor 2 Control Module Negative Supply Isolation Voltage	-	Varies	This indicates the high voltage negative to chassis voltage as measured for motor 2.
Drive Motor 2 Control Module Positive Supply Isolation Voltage	-	Varies	This indicates the high voltage positive to chassis voltage as measured for motor 2.
Drive Motor 2 Phase U Current	-	Varies	This indicates the current flow to phase U of electric motor 2.
Drive Motor 2 Phase V Current	-	Varies	This indicates the current flow to phase V of electric motor 2.
Drive Motor 2 Phase W Current	-	Varies	This indicates the current flow to phase W of electric motor 2.
Drive Motor 2 Position Sensor Offset Learn Status	-	Varies	This indicates the status of the resolver offset learn for electric motor 2. This will update based on any resolver learn, whether performed automatically as part of normal vehicle operation or as the result of a device control.
Drive Motor 2 Speed	-	Varies	This indicates the speed, in revolutions per minute, of hybrid electric motor 2 as determined from the resolver.
Drive Motor 2 Temperature	-	Varies	This indicates the temperature for motor 2.
Drive Motor 2 Torque	-	Varies	This indicates the torque value for motor 2.
Hybrid/EV Powertrain Control Module High Voltage Circuit	-	Varies	This displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0 -

Parameter	System State	Expected Value	Description
			655.35 V.
Ignition 1 Signal	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.

PARKING ASSIST CONTROL MODULE SCAN TOOL INFORMATION

NOTE: Due to software and hardware variations, not all information may be applicable.

Parking Assist Control Module Scan Tool Data Parameters - Identification Information

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Vehicle Identification Number (VIN)	-	Varies	The scan tool displays the Vehicle Identification Number
Diagnostic Data Identifier	-	Varies	The scan tool displays the Diagnostic Data Identifier
XML Configuration Compatibility Identifier	-	Varies	The scan tool displays the XML Configuration Compatibility Identifier
XML Data File Part Number	-	Varies	The scan tool displays the XML Data File Part Number
XML Data File Alpha Code	-	Varies	The scan tool displays the XML Data File Alpha Code
Module Diagnostic Address	-	Varies	The scan tool displays the Module Diagnostic Address
Manufacturer's Traceability Number	-	Varies	The scan tool displays the Manufacturer's Traceability Number
Software Part Number	-	Varies	The scan tool displays the Software Part Number
Calibration Part Number 2	-	Varies	The scan tool displays the Calibration Part Number 2
End Model Part Number	-	Varies	The scan tool displays the End Model Part Number
Base Model Part Number	-	Varies	The scan tool displays the Base Model Part Number
Software Module 1 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 1 Identifier Alpha Code
End Model Part Number Alpha Code	-	Varies	The scan tool displays the End Model Part Number Alpha Code
Base Model Part Number Alpha Code	-	Varies	The scan tool displays the Base Model Part Number Alpha Code
GMLAN Identification Data - Bus 1 Type	-	Varies	The scan tool displays the GMLAN Identification Data - Bus 1 Type

Parameter	System State	Expected Value	Description
GMLAN Identification Data - Data Dictionary 1 Version	-	Varies	The scan tool displays the GMLAN Identification Data - Data Dictionary 1 Version
GMLAN Identification Data - GMLAN Kernel 1 Version	-	Varies	The scan tool displays the GMLAN Identification Data - GMLAN Kernel 1 Version
Date Programmed	-	Varies	The scan tool displays the date the module was programmed

Parking Assist Control Module Scan Tool Data Parameters - Park Assist System Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Power Mode	-	Run	The scan tool displays Off, Accessory, Run or Crank. This is the state of the ignition switch.
Battery Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.
Parking Assist System Status	-	Enable	The scan tool displays Disable, Enable, Inhibited or Failed. This is the state of the parking assist system.
Parking Assist Chime	-	Varies	The scan tool displays On or Off. On is displayed if there is an object within the measuring range of the object sensors.
Parking Assist Sensors	-	ON	The scan tool displays On or Off.
Calculated Transmission Range	Transmission in reverse	Park	The scan tool displays Park, Reverse, Neutral, Drive or Unknown depending on the state of the commanded gear.
Parking Assist Switch	-	Active/Inactive	The scan tool displays Active or Inactive depending on the state of the parking assist switch.
Advanced Parking Assist Switch	-	Active/Inactive	The scan tool displays Active or Inactive depending on the state of the advanced parking assist switch.
Parking Assist Sensors Reference Voltage	-	7.3 - 12.1 V	The scan tool displays V. This is the amount of voltage being sent to the object sensors.
Parking Assist Switch LED	-	Varies	The scan tool displays On or Off depending on the state of the parking assist switch LED.
Right Side Object Detection Indicator	-	Varies	The scan tool displays a blank, On or Off depending on the state of the right side object detection indicator

Parameter	System State	Expected Value	Description
			command status.
Left Side Object Detection Indicator	-	Varies	The scan tool displays a blank, On or Off depending on the state of the left side object detection indicator command status.
Advanced Parking Assist Status	-	Standby	The scan tool displays Standby, Active, or Inactive depending on the state of the advanced parking assist.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Sensor Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Parking Assist Sensors	-	ON	The scan tool displays On or Off.
Parking Assist Sensors Reference Voltage	-	7.3 - 12.1 V	The scan tool displays V. This is the voltage being sent to the object sensors.
Left Front Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Front Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Front Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Front Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Front Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Front Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Rear Advanced Parking Assist Side Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor

Parameter	System State	Expected Value	Description
Sensor			and the nearest object.
Right Rear Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Rear Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Disable History 1 - 4 Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Parking Assist Disable History 1	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 2	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 3	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 4	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Disable History 5 - 7 Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			

Parameter	System State	Expected Value	Description
Parking Assist Disable History 5	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 6	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 7	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.

Parking Assist Control Module Scan Tool Output Controls

Output Control	Description
Park Assist Switch LED	The parking assist control module illuminates the advanced park assist LED of the when commanded from the scan tool.
Clear Disable History Data	The parking assist control module clears the Parking Assist Disable History data when commanded from the scan tool.
Clear Side Object Detection Disable History	The parking assist control module clears the Side Object Detection Disable History data when commanded from the scan tool.
CAN Bus Configuration Learn	The parking assist control module learns the CAN Bus configuration when commanded from the scan tool.
Parking Assist Sensor Learn	The parking assist control module learns the Parking Assist Sensor configuration when commanded from the scan tool.

PEDESTRIAN ALERT SOUND CONTROL MODULE SCAN TOOL INFORMATION

Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Vehicle in Service Mode		
System Power Mode	On	The scan tool displays the present state of the System Power Mode. This can be Off, On, or Service Mode.
High Speed CAN Bus Communication Enable Status	Enabled	The scan tool will display either Enabled or Disabled.

Parameter	Expected Value	Description
Pedestrian Alert Sound System	Active	The scan tool will display Disabled, Active, or Malfunction.
Pedestrian Alert Sound	Active	The scan tool will display Active or Inactive.
Pedestrian Alert Sound When Driving Forward	Sound 1	The scan tool will display None, Sound 1, Sound 2, or Sound 3.
Pedestrian Alert Sound When Driving Backwards	Sound 1	The scan tool will display None, Sound 1, Sound 2, or Sound 3.
Service Pedestrian Alert Sound System Message	Inactive	The scan tool will display Active or Inactive.

POWER STEERING CONTROL MODULE SCAN TOOL INFORMATION

The power steering control module scan tool data parameters list contains all power steering related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Power Steering Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
Battery Voltage	-	9 - 16 V	Current battery voltage.
System Power Mode	-	-	Current system power mode.
Engine is running	-	No/Yes	Displays the running status of the engine.
Vehicle Speed	-	Varies	Displays the current vehicle speed in mph (km/h).
Engine Speed	-	Varies	Displays the current engine speed in RPM.
Steering System Mode	-	Normal/Sport	This is the current operating mode of the steering system.
Power Steering Control Module Temperature	-	-40 - 215Â° C	This is the current temperature of the power steering control module in Â° C.
Calculated System Temperature	-	-256 - 255.992 Â° C	This displays the current calculated system temperature in Â° C
Steering Wheel Angle	-	-2048Â° - 2048Â°	This displays the current steering wheel angle in degrees.
Steering Wheel Input Torque	-	Varies	This displays. This displays the current steering input torque in.
Electric Power Steering Motor Current Feedback	-	-200A - 200A	This displays the Electric Power Steering Motor Feedback in amps (A).

Power Steering Control Module Scan Tool Output Controls

Output Control	Description
Turn OFF all Control Functions	Cancels all active device controls.

Output Control	Description
Power Steering Motor	Changes the power assist mode.
Steering Wheel Angle Sensor Centering	Begins the Steering Wheel Angle Sensor calibration.
Power Steering Softstops Reset	Reset soft endstop range and offset.
Disable All System Outputs	Function to turn all of the module output drivers off.

RADAR SENSOR MODULE - LONG RANGE SCAN TOOL INFORMATION

Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run power mode, engine off.			
Alignment Status	-	OK	The scan tool displays OK or Not OK. This is current alignment state of the module.
Long Range Radar Sensor Module Blocked	-	No	The scan tool displays Yes or No. Yes is displayed when the module has determined that it cannot effectively transmit and receive radar signals.
Long Range Radar Sensor Module Learn Status	-	Learned	The scan tool displays Not Learned, Learn In Progress, Learned or Error. This is the current learn state of the module.
Long Range Radar Sensor Module Misaligned - Angled Down	-	No	The scan tool displays Yes, or No. Yes is and indicator that the module is misaligned too low.
Long Range Radar Sensor Module Misaligned - Angled Left	-	No	The scan tool displays Yes, or No. Yes is and indicator that the module is misaligned too much to the left.
Long Range Radar Sensor Module Misaligned - Angled Right	-	No	The scan tool displays Yes, or No. Yes is and indicator that the module is misaligned too much to the right.
Long Range Radar Sensor Module Misaligned - Angled Up	-	No	The scan tool displays Yes, or No. Yes is and indicator that the module is misaligned too high.
System Power Mode	-	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the current vehicle power mode
System Voltage	-	11 - 14 V	Current Vehicle Battery Voltage

Scan Tool Output Controls

Output Control	Description
Long Range Radar Sensor Module Learn	Initializes the module learn procedure.

RADIO SCAN TOOL INFORMATION

Radio Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Antenna Module	Enabled	The scan tool displays Enabled or Disabled. This indicates if the system uses an antenna module and the output status between the radio and the antenna module.
Auxiliary Audio Input	Present	The scan tool displays Present or Not Present. This parameter displays active when an auxiliary input is connected.
Battery Voltage	Varies	The scan tool displays volts. This is the voltage at the input to the radio.
Digital Radio Receiver	Present	The scan tool displays Present or Not Present. This is the state of the Digital Audio Broadcast.
Phone Signal	Present	The scan tool displays Present or Not Present. This parameter will display whether this system uses discrete a phone arbitration or not.
Power Mode	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the power mode radio.
Rear Seat Audio	Not Present	The scan tool displays Present or Not Present. This parameter displays Present if the system detects a rear seat audio module.
Radio Signal Strength	Varies	This displays the signal strength in dB. This is the signal strength of the radio signal.
Theft Lock Armed	Learned VIN	The scan tool displays Learned VIN or No VIN. This is the state of the VIN programming in the radio.
Radio Theft Lock Status	Inactive	The scan tool displays Active or Inactive. This is the state of the theft lock system.
Valet Mode Status	Inactive	The scan tool displays Active or Inactive. This is the state of the valet mode.
Video Display 1	Inactive	The scan tool displays Active or Inactive. When the rear video display 1 is ON, the scan tool will display Active.
Video Display 2	Inactive	The scan tool displays Active or Inactive. When the rear video display 2 is ON, the scan tool will display Active.
End Model Part Number	Varies	The scan tool displays the end model part number.
Boot Software Part Number	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	Varies	The scan tool displays the software module ID 1.
Calibration Part Number 2	Varies	The scan tool displays the software module ID 2.
Calibration Part Number 3	Varies	The scan tool displays the software module ID 3.
Calibration Part Number 4	Varies	The scan tool displays the software module ID 4.
Calibration Part Number 5	Varies	The scan tool displays the software module ID 5.

Parameter	Expected Value	Definition
Calibration Part Number 6	Varies	The scan tool displays the software module ID 6.
Calibration Part Number 7	Varies	The scan tool displays the software module ID 7.
Calibration Part Number 8	Varies	The scan tool displays the software module ID 8.
Calibration Part Number 9	Varies	The scan tool displays the software module ID 9.
Calibration Part Number 10	Varies	The scan tool displays the software module ID 10.
Calibration Part Number 11	Varies	The scan tool displays the software module ID 11.
Calibration Part Number 12	Varies	The scan tool displays the software module ID 12.
Calibration Part Number 13	Varies	The scan tool displays the software module ID 13.
Calibration Part Number 14	Varies	The scan tool displays the software module ID 14.
Calibration Part Number 15	Varies	The scan tool displays the software module ID 15.
Calibration Part Number 16	Varies	The scan tool displays the software module ID 16.
Vin Digits 2-17	Varies	The scan tool displays the vin digits 2-17.
Digital Radio Receiver ID	Varies	The scan tool displays the Digital Audio Broadcast receiver ID.
DVD Region Code	Varies	The scan tool displays the DVD region code.
DVD Region Code Changes Remaining	Varies	The scan tool displays the number DVD region code changes remaining.

Radio Scan Tool Output Controls

Scan Tool Output Control	Description
Left Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Left Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Center Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.

Scan Tool Output Control	Description
Subwoofer Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Eject	This output is a reset command to eject the disc.
Info Display/Infotainment Faceplate Reset	This output is a reset command to reset the radio display.
Info Display/Infotainment Faceplate Wakeup	This output commands a wakeup at the display and the faceplate controls.

SIDE OBJECT SENSOR MODULE SCAN TOOL INFORMATION

Scan Tool Output Controls

Output Control	Description
Object Detection Alert Indicators	When commanded by the scan tool, the module will provide power to illuminate the side blind zone indicators in appropriate outside rear view mirror. The outside rear view mirror indicator will illuminate.
Rear Cross Traffic Audible Alert	When commanded by the scan tool, the module will send a signal to the audio system to turn on the rear cross traffic audible alert signal. The audio system will beep.
Rear Cross Traffic Haptic Alert	When commanded by the scan tool, the module will send a signal to the memory seat module to turn on the rear cross traffic haptic alert. The driver's seat will vibrate.
Rear Cross Traffic Visual Alert	When commanded by the scan tool, the module will turn on the rear cross traffic alert indicators on infotainment display. The infotainment display will illuminate with the appropriate rear cross traffic alert.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE SCAN TOOL INFORMATION

Telematics Communication Interface Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
GPS Data			
• Dead Reckoning Calibration Status	-	Calibrated or Not Calibrated	Indicates the dead reckoning calibration status.
• Position Calibration Method	-	Varies	Indicates the method used to determine current location. (0) GPS, (1) Wheel Speed Dead Reckoning only, (2) Combined Wheel Speed and GPS, (3) Gyro only, (4) Combined Gyro and GPS, (5) No Fix

Parameter	System State	Expected Value	Description
• Month	-	MM	This displays the current month.
• Day	-	DD	This displays the current day of the month.
• Year	-	YY	This displays the current year.
• Hour	-	HH	This displays the GPS current hour (24 hour format - GMT).
• Minute	-	MM	This displays the GPS current minute.
• Second	-	SS	This displays the GPS current second.
• Number of Satellites Tracked	-	Varies	The scan tool displays the number of satellites being tracked by the telematics communication interface control module.
Signal Strength Data			
• GSM Signal Strength	-	Varies	The scan tool displays 0 - 127. This is the telematics communication interface control module signal strength.
• Current Public Land Mobile Network	-	Varies	Identifies the cellular communications network currently in use by the telematics communication interface control module. Each network has a unique decimal number assigned to it for identification.
Bluetooth Data			
• Bluetooth	-	Enabled	Indicates if the Bluetooth system is enabled or disabled.
• Bluetooth Link Status	-	Varies	Indicates the current link status. (0) Unconnected, (1) Connected / Idle, (2) Call active, (3) 3-way calling active
• Bluetooth Link Quality	-	Varies	The scan tool displays a decimal value between 0 and 255.
• Bluetooth Phone to Telematics Communication Interface Control Module Authentication Status	-	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module authentication status.
• Bluetooth Phone to Telematics	-	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module status.

Parameter	System State	Expected Value	Description
Communication Interface Control Module Communication Status			
Bluetooth Phone Voice Recognition Status	-	Active or Inactive	Displays the bluetooth phone to voice recognition status.
WLAN Device Data			
Off-Board Navigation	-	Enabled or Disabled	Indicates if Off-Board Navigation is enabled or disabled
Wireless LAN	-	Enabled or Disabled	Indicates the capability of the wireless communication of the Telematics Communication Interface Control Module
Number of WLAN Devices	-	Varies	Indicates the number of Wireless devices present
Active WLAN 2.4GHz Chennel	-	Varies	Indicates the active Wireless channel being used on the 2.4 GHz frequency
WLAN Link Status	-	Radio System - Never, Remembered but Not Associated or Associated	Indicates the link status of the Telematics Communication Interface Control Module and Infotainment system
GSM Signal Strength	-	Varies	State for Received Signal Strength Indicator
Mobile Communication Standard	-	2G, 3G, 4G or 4G LTE	State for Cellular Data Connection. Indicates the currently used data rate speed
WLAN Password	-	Varies	Indicates the Telematics Communication Interface Control Module Wireless Password
WLAN SSID (Service Set Identifier)	-	Varies	Indicates the Telematics Communication Interface Control Module Wireless Service Name
WLAN Encryption - WPA (Wi - Fi Protected Access)	-	Active or Inactive	Indicates if the WLAN Encryption - WPA (Wi - Fi Protected Access) is Active or Inactive
WLAN Encryption - WPA2 (Wi - Fi Protected Access II)	-	Active or Inactive	Indicates if the WLAN Encryption - WPA2 (Wi - Fi Protected Access II) is Active or Inactive
WLAN Encryption - AES (Advanced Encryption Standard)	-	Active or Inactive	Indicates if the WLAN Encryption - AES (Advanced Encryption Standard) is Active or Inactive

Parameter	System State	Expected Value	Description
WLAN Encryption - TKIP (Temporal Key Integrity Protocol)	-	Active or Inactive	Indicates if the WLAN Encryption - TKIP (Temporal Key Integrity Protocol) is Active or Inactive

Telematics Communication Interface Control Module Scan Tool Output Controls

Output Control	Description
B1000 Information	This shows the data recorded when DTC B1000 was set in the telematics communication interface control module.
Green Indicator	The telematics communication interface control module illuminates the green LED when ON is selected.
Phone Call Test	When ON is selected, telematics communication interface control module commands OnStar to connect to the OnStar Center.
Red Indicator	The telematics communication interface control module illuminates the red LED when ON is selected.
Preferred Roaming List Update	The telematics communication interface control module performs a preferred roaming list (PRL) update when this is selected.
Remote Vehicle Speed Limiting Reset	This function resets the speed limiting feature.

Article GUID: A00884730

GENERAL INFORMATION
Vibration Diagnosis and Correction - Volt

SPECIFICATIONS

TIRE AND WHEEL RUNOUT SPECIFICATIONS

Application	Specification	
	Metric	English
Tire and Wheel Assembly - Lateral and Radial		
• Off-Vehicle	1.27 mm	0.050 in
• On-Vehicle	1.52 mm	0.060 in
Wheel, Aluminum		
• Lateral	0.762 mm	0.030 in
• Radial	0.762 mm	0.030 in
Wheel, Steel		
• Lateral	1.143 mm	0.045 in
• Radial	1.015 mm	0.040 in
Wheel Hub/Axle Flange - Guideline	0.132 mm	0.0052 in
Wheel Stud - Guideline	0.25 mm	0.010 in

DIAGNOSTIC INFORMATION AND PROCEDURES

VIBRATION DIAGNOSIS, STARTING POINT, AND CORRECTION

The information contained in this Vibration Diagnosis and Correction section is designed to cover various vehicle designs and configurations. Not all content will apply to all vehicles.

NOTE: The following steps must be completed before using the analysis tables or the symptom tables.

1. Perform the **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)** **Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)** table before using the other Vibration Analysis tables or the Symptom tables in order to effectively diagnose the customer's concern.

The use of Vibration Analysis - Road Testing will first provide duplication of virtually any vibration concern and then identify the correct procedure for diagnosing the area of concern which has been duplicated.

2. Review the following Vibration Diagnostic Process.
3. Review the general descriptions to familiarize yourself with vibration theory and terminology, the **CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH)**, or the **EL-38792 - A Electronic Vibration Analyzer (EVA) 2**, and

the **EL-38792 - VS Vibrate Software**. Reviewing this information will help you determine whether the condition described by the customer is a potential operating characteristic or not.

Refer to the following:

- [**Vibration Theory and Terminology**](#)
- [**Oscilloscope Diagnostic Kit Description and Operation**](#)
- [**Electronic Vibration Analyzer \(EVA\) Description and Operation**](#)
- [**Vibrate Software Description and Operation**](#)
- [**Reed Tachometer Description**](#)

Vibration Diagnostic Process

NOTE: Using the following steps of the vibration diagnostic process will help you to effectively narrow-down and pin-point the search for the specific source of a vibration concern and to arrive at an accurate repair.

1. Gather specific information on the customer's vibration concern.
2. Perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to duplicate the customer's concern and evaluate the symptoms of the concern under changing conditions. Observe what the vibration feels like and what it sounds like. Observe when the symptoms first appear, when they change, and when they cease.
3. Determine if the customer's vibration concern is truly an abnormal condition or something that is potentially an operating characteristic of the vehicle.
4. Systematically eliminate or "rule-out" possible vehicle systems.
5. Focus diagnostic efforts on the remaining vehicle system and systematically eliminate or "rule-out" possible components of that system.
6. Make a repair on the remaining component, or components, which have not been eliminated systematically, and must therefore be the cause of the vibration.
7. Verify that the customer's concern has been eliminated or at least brought to an acceptable level.
8. Again perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to verify that the vehicle did not have more than one vibration occurring.

Preliminary Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the vehicle rotating component systems.
- Inspect the easily accessible or visible components of the vehicle rotating component systems for obvious damage or conditions which could cause the symptom.
- Inspect the tire inflation pressures for the proper pressure.

Diagnostic Aids

Improper component routing or isolation, or components which are worn or faulty may be the cause of intermittent conditions that are difficult to duplicate. If the vibration concern could not be duplicated by following the steps of the Vibration Diagnostic Process, refer to [**Vibration Diagnostic Aids**](#).

VIBRATION ANALYSIS - ROAD TESTING (EL-38792-A ELECTRONIC VIBRATION ANALYZER)

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to [Special Tools and Equipment](#).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5

Obtaining rotational speed for the components rotating at tire/wheel speed is critical to systematically eliminating specific vehicle component groups. These component rotational speeds can be generated by using an electronic vibration analyzer, or through calculating them manually.

10

NOTE: Be certain to **OBSERVE** for disturbances that match the customer's description **FIRST**, then look at the vibration analyzer frequency which corresponds with that disturbance.

Proper location of the vibration analyzer sensor onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

11

Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL and for the engine to decrease in RPM to idle speed, before coasting down through the disturbance range.

12

This test will either eliminate or confirm the engine as a contributing cause of the customer concern.

Step	Action	Yes	No
WARNING: Refer to Road Test Warning .			
1	Did you review the Diagnostic Starting Point - Vibration Diagnosis?	Go to Step 2	Go to Diagnostic Starting Point - Vehicle
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to Step 6	Go to Step 3
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to Step 5	Go to Step 4

Step	Action	Yes	No
4	NOTE: Do NOT operate the vehicle until the faults are corrected. Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding. Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to Step 5	Go to Step 3
5	1. Obtain the drive axle final drive ratio. 2. If the vibration analyzer has suitable software, obtain the transmission gear ratios. 3. If the a vibration analyzer is not available, take note of the tire size on each axle, then calculate the tire rotational speed for each size tire used. Refer to Component Rotational Speed Calculation. Did you obtain the powertrain ratios for use with the vibration analyzer, or calculate the component rotational speeds, if a vibration analyzer is NOT available?	Go to Step 6	-
6	1. Install a scan tool. 2. With the scan tool, bring up the Powertrain Control Module data list and select Engine Speed. Is the scan tool operating properly?	Go to Step 7	Go to Diagnostic Starting Point - Vehicle
7	Using a vibration analyzer is the preferred method for gathering necessary vibration frequency data. If a vibration analyzer is not available, the necessary vibration frequency data will have to be obtained based on symptoms observed during testing. Review Symptoms - Vibration Diagnosis and Correction to become familiar with the possible frequency ranges. Review Symptoms - Vibration Diagnosis and Correction, as necessary throughout the remainder of diagnostics. Is a vibration analyzer available for use?	Go to Step 8	Go to Step 9
8	Install the EL-38792-A Electronic Vibration Analyzer 2 (EVA 2). Is the vibration analyzer operating properly?	Go to Step 9	Go to Electronic Vibration Analyzer (EVA) Description and Operation
9	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to Vibration Analysis - Engine	Go to Step 10
10	1. Install the vibration analyzer sensor, if available, to the component identified by the customer as most respondent to the vibration. If no component was	Go to Step 11	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	identified, install the vibration analyzer sensor, if available, to the steering column. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected by the vibration analyzer • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the steering column, then move the vibration analyzer sensor, if available, onto that component and repeat steps 2 and 3. Were you able to duplicate the customer's concern?		
11	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. NOTE: If the vehicle is equipped with an automatic transmission, let the vehicle coast to a stop before shifting back into gear. 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting-down in NEUTRAL?	Go to Step 13	Go to Step 12
12	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs.	Go to <u>Vibration Analysis - Hub and/or Axle Input</u>	Go to <u>Vibration Analysis - Engine</u>

Step	Action	Yes	No
	2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?		
13	If the vibration analyzer is not available, refer to Symptoms - Vibration Diagnosis and Correction . Did the vibration analyzer detect a dominant frequency?	Go to Step 14	Go to Symptoms - Vibration Diagnosis and Correction
14	1. If the vibration analyzer HAS the features, use the drive axle final drive ratio, the specific transmission gear ratio, and the engine RPM to make a comparison to the dominant frequency reading recorded. 2. If the vibration analyzer does NOT have the features, compare the dominant frequency reading recorded to the component rotational data which you calculated previously. Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to Vibration Analysis - Tire and Wheel	Go to Symptoms - Vibration Diagnosis and Correction

VIBRATION ANALYSIS - ROAD TESTING (CH-51450-NVH OSCILLOSCOPE)

Special Tools

- CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH)
- EL-47955 Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to [Special Tools and Equipment](#).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

NOTE: Be certain to **OBSERVE** for disturbances that match the customers description **FIRST**, then look at the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) frequency which corresponds with that disturbance.

10

Proper location of the **CH-51450-NVH** oscilloscope accelerometer onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

11

Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL and for the engine to decrease in RPM to idle speed before coasting down through the disturbance

range.

12

This test will either eliminate or confirm the engine as a contributing cause of the customer concern.

Step	Action	Yes	No
1	Did you review the Diagnostic Starting Point - Vibration Diagnosis?	Go to Step 2	Go to Diagnostic Starting Point - Vehicle
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to Step 6	Go to Step 3
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to Step 5	Go to Step 4
4	NOTE: Do NOT operate the vehicle until the faults are corrected. Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding. Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to Step 5	Go to Step 3
5	Obtain the drive axle final drive ratio. Did you obtain the drive axle final drive ratio?	Go to Step 6	-
6	Install the CH-51450-NVH Oscilloscope and the EL-47955 MDI. Is the CH-51450-NVH Oscilloscope operating properly?	Go to Step 7	Oscilloscope Diagnostic Kit Description and Operation
7	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to Vibration Analysis - Engine	Go to Step 8
8	Did the customer concern indicate that the vibration occurs ONLY during heavy acceleration at launch?	Go to Step 9	Go to Step 10
9	1. Install the CH-51450-NVH-TA183 accelerometer to the pinion area of the drive axle. Route the accelerometer cable clear of rotating parts and loosely secure the wire clear of moving parts. If it is not possible to install the CH-51450-NVH-TA183 accelerometer to the drive axle, install the accelerometer to an exposed portion of the floor panel or seat track in the area that the customer noted is most respondent to the vibration. 2. Select a smooth, level road.	Go to Vibration Analysis - Hub and/or Axle Input	Go to Step 10

Step	Action	Yes	No
	3. With the vehicle at a stand-still, apply the brake pedal and place the transmission in the lowest forward gear. NOTE: Do not accelerate to the point of causing the drive wheels to squeal, slip, or hop. This would obscure the results of the test. 4. Release the brake pedal and accelerate aggressively to 32 km/h (20 mph). 5. Observe the vehicle for disturbances that match the customers description and note the following conditions: • The vibration frequency reading, if detected, by the CH-51450-NVH Oscilloscope • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the CH-51450-NVH Oscilloscope, move the CH-51450-NVH-TA183 accelerometer to another part that is respondent to the vibration and repeat Steps 3-5. Were you able to duplicate the customer concern?		
10	1. Install the CH-51450-NVH-TA183 accelerometer to the component identified by the customer as most respondent to the vibration. If no component was identified, install the CH-51450-NVH-TA183 accelerometer to the drivers side right seat rail. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customers description and note the following conditions or take a snapshot using the CH-51450-NVH software: • The vehicle speed • The engine RPM	Go to Step 11	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	• The transmission gear range and the specific gear • The vibration frequency reading, if detected, by the CH-51450-NVH Oscilloscope • The feel and/or the sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the rear rail, move the CH-51450-NVH-TA183 accelerometer onto that component and repeat Steps 2 and 3. Were you able to duplicate the customer concern?		
11	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. NOTE: If the vehicle is equipped with a continuously variable type automatic transmission, let the vehicle coast to a stop before shifting back into gear. 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting down in NEUTRAL?	Go to Step 13	Go to Step 12
12	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to <u>Vibration Analysis - Hub and/or Axle Input</u>	Go to <u>Vibration Analysis - Engine</u>
13	If the CH-51450-NVH Oscilloscope is not available, refer to <u>Symptoms - Vibration Diagnosis and Correction.</u>	Go to Step 14	Go to <u>Symptoms - Vibration Diagnosis and Correction</u>

Step	Action	Yes	No
	Did the CH-51450-NVH Oscilloscope detect a dominant frequency?		
14	Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to <u>Vibration Analysis - Tire and Wheel</u>	Go to <u>Symptoms - Vibration Diagnosis and Correction</u>

COMPONENT ROTATIONAL SPEED CALCULATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-47955** Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to **Special Tools and Equipment**.

NOTE: If using the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH), the component rotation is integrated into the tool. The diameter of the pulley will need to be measured and manually entered into the NVH software.

Tire Rotational Speed

Determining Tire Revolutions Per Second at 8 km/h (5 mph) - Using EVA

Tire and wheel assembly rotational speed can be obtained through using the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. Perform the following steps using the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 to obtain the rotational speed at 8 km/h (5 mph). Use the Enter key to advance and the Exit key to backup.

1. On the Main Menu screen, select Auto Mode.
2. On the Suspected Source screen, select Vehicle Speed.
3. On the Tire Info Source screen, select Manual Entry.
4. On the Tire Width screen, enter the specific width of the tires.

For example: For a P245/45/R18 tire, enter 245.

5. On the Aspect Ratio screen, enter the specific aspect ratio of the tires.

For example: For a P245/45/R18 tire, enter 0.45.

6. On the Rim Diameter screen, enter the specific rim diameter size.

For example: For a P245/45/R18 tire, enter 18.0.

7. On the Driveshaft Configuration screen, enter FWD, even if the vehicle is a rear wheel drive.
8. The next screen will display the tire size just entered for confirmation.

For example: 245 0.45 18.0 - Front Wheel Drive. If the tire size displayed is correct, press Enter.

9. On the Vehicle Speed Units screen, press Enter, disregard mph or km/h.
10. Press the Exit key several times slowly while watching the backwards progression of the screens. Stop at the

Tire Info Source screen.

11. On the Tire Info Source screen, select RPS at 5 mph.

12. The next screen will display the revolutions per second (RPS) at 8 km/h (5 mph) for that specific tire size.

For example: The P245/45/R18 will display 1.08 RPS.

Calculating Tire Revolutions Per Second at 8 km/h (5 mph) - Without Oscilloscope or EVA

If the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 is not available, the tire and wheel assembly rotational speed can be calculated approximately by performing the following steps.

1. Convert the rim diameter size from inches to centimeters.

For example: For a P245/45/R18 tire, the rim diameter of 18 in X 2.54 converts to 45.72 cm.

2. Calculate the radius of the rim by dividing the rim diameter by 2.

For example: For a P245/45/R18 tire, the rim diameter of 18 is converted to 45.72 cm divided by 2 = rim radius 22.86 cm.

3. Calculate the approximate tire sidewall height by multiplying the specific tire tread width by the aspect ratio, then reduce 7 percent from the amount by multiplying by 93 percent to approximate load on the tire reducing the sidewall height.

For example: For a P245/45/R18 tire, tread width 245 mm X aspect ratio as a decimal 0.45 = 110 mm X 0.93 = approximate sidewall height 102.30 mm.

4. Convert the calculated approximate tire sidewall height from millimeters to centimeters.

For example: For a P245/45/R18 tire, approximate sidewall height 102.30 mm converts to 10.23 cm.

5. Calculate the approximate tire and wheel assembly radius by adding the rim radius and approximate sidewall height, both in cm.

For example: For a P245/45/R18 tire, rim radius 22.86 cm + 10.23 cm = approximate tire and wheel assembly radius 33.09 cm.

6. Calculate the approximate circumference of the tire and wheel assembly by multiplying 2 X pi, or 6.283185 X the approximate tire and wheel assembly radius.

For example: For a P245/45/R18 tire, 6.283185 X approximate tire and wheel assembly radius 33.09 cm = approximate tire and wheel assembly circumference 207.911 cm.

7. Calculate the approximate revolutions per kilometer by dividing the number of cm in 1 km, 100, 000 cm by the approximate tire and wheel assembly circumference.

For example: For a P245/45/R18 tire, 100, 000 cm divided by approximate tire and wheel assembly circumference 207.911 cm = approximate revolutions per kilometer 480.975.

8. Calculate the approximate revolutions per second (RPS), or Hz, by dividing the approximate revolutions per kilometer by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds.

For example: For a P245/45/R18 tire, approximate revolutions per kilometer 480.975 divided by the number of

seconds to travel 1 km at a speed of 8 km per hour, 450 seconds = approximate RPS, or Hz 1.069 rounded to 1.07.

Calculating Tire Revolutions Per Second, or Hz at Concern Speed

A size P235/75R15 tire rotates ONE complete revolution per second (RPS), or 1 Hz, at a vehicle speed of 8 km/h (5 mph). This means that at 16 km/h (10 mph), the same tire will make TWO complete revolutions in one second, 2 Hz, and so on.

1. Determine the rotational speed of the tires in revolutions per second (RPS), or Hertz (Hz), at 8 km/h (5 mph), based on the size of the tires. Refer to the preceding Tire Rotational Speed information.

For example: According to the Tire Rotational Speed information, a P245/45R18 tire makes 1.08 revolutions per second (Hz) at a vehicle speed of 8 km/h (5 mph). This means that for every increment of 8 km/h (5 mph) in vehicle speed, the tire's rotation increases by 1.08 revolutions per second, or Hz.

2. Determine the number of increments of 8 km/h (5 mph) that are present, based on the vehicle speed in km/h (mph) at which the disturbance occurs.

For example: Assume that a disturbance occurs at a vehicle speed of 96 km/h (60 mph). A speed of 96 km/h (60 mph) has 12 INCREMENTS of 8 km/h (5 mph):

96 km/h (60 mph) divided by 8 km/h (5 mph) = 12 increments

3. Determine the rotational speed of the tires in revolutions per second, or Hz, at the specific vehicle speed in km/h (mph) at which the disturbance occurs.

For example: To determine the tire rotational speed at 96 km/h (60 mph), multiply the number of increments of 8 km/h (5 mph) by the revolutions per second, or Hz, for one increment:

12 increments X 1.08 Hz = 12.96 Hz, rounded to 13 Hz

NOTE: If the EL-38792-A Electronic Vibration Analyzer (EVA) 2 is not available, compare the calculated rotational speed to the frequency range associated with the symptoms of the vibration concern. Refer to [Symptoms - Vibration Diagnosis and Correction](#).

4. Compare the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, to the dominant frequency recorded on the EL-38792-A Electronic Vibration Analyzer (EVA) 2 during testing. If the frequencies match, then a first-order disturbance related to the rotation of the tire/wheel assemblies is present.

If the frequencies do not match, then the disturbance may be related to a higher order of tire/wheel assembly rotation.

5. To compute higher order tire/wheel assembly rotation related disturbances, multiply the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, by the order number:

13 Hz X 2, for second order = 26 Hz second-order tire/wheel assembly rotation related

13 Hz X 3, for third order = 39 Hz third-order tire/wheel assembly rotation related

If any of these computations match the frequency of the disturbance, a disturbance of that particular order, relating to the rotation of the tire/wheel assemblies and/or driveline components, also rotating at the same

speed, is present.

Component Rotational Speed Worksheet

Utilize the following worksheet as an aid in calculating the first, second and third order of tire/wheel assembly rotational speed related disturbances that may be present in the vehicle.

If after completing the Tire/Wheel Rotation Worksheet, the frequencies calculated do NOT match the dominant frequency of the disturbance recorded during testing, either recheck the data, or attempt to rematch the figures allowing for 1 1/2 - 8 km/h (1 - 5 mph) of speedometer error.

If the possible tire/wheel assembly rotational speed related frequencies still do not match the dominant frequency of the disturbance, the disturbance is most likely torque/load sensitive.

If after completing the Tire/Wheel Rotation Worksheet, one of the frequencies calculated DOES match the dominant frequency of the disturbance, the disturbance is related to the rotation of that component group - tire/wheel assembly related.

TIRE/WHEEL ROTATION WORKSHEET

Vehicle Information

Complaint Speed: _____ mph Year: _____ Model: _____
Symptom: _____ VIN: _____
Frequency: _____ Engine: _____ Trans: _____
Engine Speed: _____ rpm Tire Size: _____ Axle Ratio: _____ : _____
Gear: _____ TPC Spec: _____

Tire/Wheel Speed

Vibration Occurs at:		mph ÷ 8 (km/h) 5 (mph)	=		increments of 8 km/h / 5 mph
8 km/h / 5 mph increments		x		tire RPS * at 8 km/h / 5 mph (from table)	=
1st order		x 2	=		2nd order
1st order		x 3	=		3rd order

*RPS: revolutions per second; equals to cycles per second (Hz).

Fig. 1: Tire/Wheel Rotation Worksheet

Courtesy of GENERAL MOTORS COMPANY

VIBRATION ANALYSIS - TIRE AND WHEEL

Test Description

The numbers below refer to the step numbers in the diagnostic table:

4

A build-up of foreign material on a tire and wheel assembly and/or a damaged, abnormally or excessively worn tire and wheel assembly could cause a vibration disturbance.

6

Tire and wheel assemblies that exhibit excessive runout when measured while mounted on the vehicle, may or may not be contributing to, or causing a vibration disturbance. On-vehicle runout, if present, could contribute to, or cause a vibration disturbance, but the cause of the on-vehicle runout may not be the tire and wheel assemblies.

7

Tire and wheel assemblies that exhibit excessive runout when measured off of the vehicle could cause a vibration disturbance.

9

Tire and wheel assemblies that exhibit marginal runout - within acceptable limits, but close to the maximum - when measured off of the vehicle could still be contributing to a vibration disturbance, if its mating hub/axle flange also exhibits marginal runout. When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance.

14

Brake rotors and/or brake drums, if equipped, that exhibit excessive imbalance could contribute to, or possibly cause a vibration disturbance.

15

A hub/axle flange and/or wheel studs that exhibit excessive runout could cause a vibration disturbance.

16

When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance. Match-mounting or vectoring the tire and wheel assembly to the hub/axle flange will modify the amount of combined runout.

18

Force variation may be present in a tire and wheel assembly that exhibited acceptable balance and runout. Force variation, if present, could contribute to, or cause a vibration disturbance.

20

Vibration disturbances could be affected by, or possibly caused by, components that are susceptible to steering input and/or torque-load input.

22

On-vehicle balancing, or finish-balancing can be used to reduce small amounts of imbalance which may be present as a result of the combined stack-up of the tire and wheel assembly with other components which may exhibit marginal balance.

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to Step 2	Go to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)
2	Based on the Vibration Analysis - Road Testing table, is the concern first-order tire and wheel assembly related?	Go to Step 4	Go to Step 3
3	Based on the Vibration Analysis - Road Testing table, is the concern second-order, or higher-order tire and wheel assembly related?	Go to Step 18	Go to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)
4	Visually inspect the tire and wheel assemblies for the following: • Debris build-up, such as packed mud, undercoating, ice/snow buildup, road tar, etc. • Damage, abnormal or excessive wear Refer to Tire and Wheel Inspection. Do any of the tire and wheel assemblies exhibit any of the conditions listed?	Go to Step 5	Go to Step 6
5	1. Remove the debris from the tire and wheel assemblies. 2. Replace the damaged, abnormally or excessively worn wheels or tires as necessary. Did you complete the repair or replacement?	Go to Step 23	-
6	Measure the on-vehicle runout of the tire and wheel assemblies. Refer to Tire and Wheel Assembly Runout Measurement - On-Vehicle. Does the runout measurement indicate a runout concern?	Go to Step 7	Go to Step 12
7	Measure the off-vehicle runout of the tire and wheel assemblies. Refer to Tire and Wheel Assembly Runout Measurement - Off Vehicle. Does the runout measurement indicate a runout concern?	Go to Step 19	Go to Step 8
8	Is the vehicle equipped with run-flat tires?	Go to Step 12	Go to Step 9

Step	Action	Yes	No
9	Are any of the tire and wheel assembly runout measurements marginal; within acceptable limits, but close to the maximum?	Go to Step 10	Go to Step 15
10	NOTE: Ensure that each tire and wheel assembly that is match-mounted is properly balanced before reinstalling to the vehicle. 1. Match-mount the tire-to-wheel for each tire and wheel assembly with marginal runout. Refer to Tire-to-Wheel Match-Mounting (Vectoring). 2. Measure the runout of each match-mounted tire and wheel assembly. Refer to Tire and Wheel Assembly Runout Measurement - Off Vehicle. Were you able to significantly reduce the amount of tire and wheel assembly runout?	Go to Step 11	Go to Step 19
11	Re-measure the on-vehicle runout of the tire and wheel assemblies. Refer to Tire and Wheel Assembly Runout Measurement - On-Vehicle. Does the measurement indicate a runout concern?	Go to Step 15	Go to Step 23
12	Inspect the balance of the tire and wheel assemblies. Refer to Tire and Wheel Assembly Balancing - Off Vehicle. Are any or the tire and wheel assemblies out of balance?	Go to Step 13	Go to Step 14
13	Balance the tire and wheel assemblies as necessary. Refer to Tire and Wheel Assembly Balancing - Off Vehicle. Were you able to achieve balance?	Go to Step 23	Go to Vibration Diagnostic Aids
14	1. Inspect the brake rotors and brake drums, if equipped, for damage. 2. Inspect the balance of the brake rotors and brake drums, if equipped. Refer to Brake Rotor/Drum Balance Inspection. 3. Replace brake rotors and/or brake drums, if equipped, that are damaged and/or out of balance. Did you find and correct a condition?	Go to Step 23	Go to Step 17

Step	Action	Yes	No
15	1. Measure the runout of the hub/axle flanges and the wheel studs, if equipped. 2. Inspect the wheel bolts, if equipped, for straightness and damage. 3. Refer to Hub/Axle Flange and Wheel Stud Runout Inspection. 4. If the inspection procedure indicates a runout concern, replace the appropriate components: • Wheel studs, if equipped • Wheel bolts, if equipped • Wheel bearing/hub assembly Did you find and correct a condition?	Go to Step 23	Go to Step 16
16	1. Match-mount the tire and wheel assemblies-to-hub/axle flanges. Refer to Tire and Wheel Assembly-to-Hub/Axle Flange Match-Mounting. 2. Re-measure the on-vehicle runout of tire and wheel assemblies. Refer to Tire and Wheel Assembly Runout Measurement - On-Vehicle. Were you able to significantly reduce the amount of on-vehicle tire and wheel assembly runout?	Go to Step 23	Go to Step 2
17	Inspect for radial and lateral force variation. Refer to Tire and Wheel Assembly Isolation Test. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to Step 19	Go to Step 20
18	Inspect for radial and lateral force variation. Refer to Tire and Wheel Assembly Isolation Test. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to Step 19	Go to Step 21
19	Replace any tires and/or wheels that were isolated as the cause of the disturbance, as necessary. Did you complete the replacement?	Go to Step 23	-
20	Perform the Vibration Analysis - Hub/Axle Input table. Refer to Vibration Analysis - Hub and/or Axle Input. Did you find and correct a condition?	Go to Step 23	Go to Step 22
21	Perform the Vibration Analysis - Hub/Axle Input table. Refer to Vibration Analysis - Hub and/or Axle Input. Did you find and correct a condition?	Go to Step 23	Go to Vibration Diagnostic Aids
22	Finish-balance the tire and wheel assemblies on-vehicle. Refer to Tire and Wheel Assembly Balancing - On-Vehicle. Did you complete the on-vehicle finish balancing?	Go to Step 23	-

Step	Action	Yes	No
23	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) . Is the vibration still present?	Go to Step 2	System OK

VIBRATION ANALYSIS - HUB AND/OR AXLE INPUT

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2

This test will determine the effect of turning input on the vibration.

6

This test will determine the effect of an initial heavy torque load on the vibration.

7

Damaged or worn wheel drive shafts may cause a noise or vibration that may be transferred into the passenger compartment.

8

Damaged or worn wheel bearings may cause a noise or vibration that may be transferred into the passenger compartment.

9

Damaged or worn suspension components may cause a noise or vibration that may be transferred into the passenger compartment.

10

Damaged or worn powertrain mounts and/or exhaust mounts may cause a noise or vibration that may be transferred into the passenger compartment.

11

Incorrect trim height may cause binding and/or interference between components that may produce a vibration.

Step	Action	Yes	No
WARNING:			

Step	Action	Yes	No
Refer to Road Test Warning .			
1	Has the Vibration Analysis - Road Testing table been completed?	Go to Step 2	Go to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)
2	1. Operate the vehicle at the speed of the vibration concern. 2. While maintaining the concern speed, drive the vehicle through slow, sweeping turns - first in one direction, then in the other direction. 3. Observe the vehicle for changes in the vibration disturbance. 4. Select a smooth, level surface, such as an empty parking lot or a remote road. 5. While maintaining the vehicle at the concern speed if possible, drive the vehicle through sharp turns; 360 degrees - first in one direction, then in the other direction. 6. Observe the vehicle for changes in the vibration disturbance. Did the characteristics of the vibration change significantly - become worse or go away - during these steps?	Go to Step 3	Go to Step 6
3	Did you hear a clicking noise and/or feel a shudder during these steps?	Go to Step 7	Go to Step 4
4	Did you hear a growling noise during these steps?	Go to Step 8	Go to Step 5
5	Did you hear a popping noise during these steps?	Go to Step 9	Go to Step 12
6	1. With the vehicle at a stand-still, apply the regular brake and place the transmission in the lowest forward gear. NOTE: Do not accelerate to the point of causing the drive wheels to squeal, slip or hop -	Go to Step 7	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	this would obscure the results of the test. 2. Release the regular brakes and accelerate aggressively to 32 km/h (20 mph). 3. Observe the vehicle for changes in the vibration disturbance. Did you feel a shudder or shaking during these steps?		
7	1. Inspect the wheel drive shafts, if equipped, for damage, abnormal and/or excessive wear. 2. If the inspection indicated that a wheel drive shaft is damaged, abnormally and/or excessively worn, replace the shaft. Did you find and correct a condition?	Go to Step 12	Go to Step 9
8	1. Inspect the wheel bearings for wear and/or damage. 2. Replace any of the wheel bearings found to be worn and/or damaged. Did you find and correct a condition?	Go to Step 12	Go to <u>Vibration Diagnostic Aids</u>
9	1. Inspect the following suspension components for wear, damage, looseness and/or possible contact with other vehicle components: • Struts/shock absorbers • Springs • Bushings • Insulators 2. Replace any of the suspension components found to be worn, damaged, loose and/or contacting other vehicle components. Did you find and correct a condition?	Go to Step 12	Go to Step 10
10	1. Inspect the powertrain mounts - engine, transmission, transfer case, and direct-mount differential, if equipped - and any powertrain braces for the following conditions: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators	Go to Step 12	Go to Step 11

Step	Action	Yes	No
	• Bent, twisted, and/or deformed brackets 2. Replace powertrain mounts as necessary. 3. Inspect the exhaust system components for the following: • Loose and/or missing fasteners • Heat Shields • Joints and/or couplings: Nuts, bolts, studs, clamps, straps • Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets 4. Repair, replace, and/or realign exhaust system components as necessary. Did you find and correct a condition?		
11	Inspect the vehicle trim height and adjust as necessary. Refer to Trim Height Inspection . Did you find and correct a condition?	Go to Step 12	Go to Vibration Diagnostic Aids
12	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope). Is the vibration still present?	Go to Step 2	System OK

VIBRATION ANALYSIS - ENGINE

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH), or
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to [Special Tools and Equipment](#).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2

If powertrain related DTCs are present, there may be a powertrain performance condition present which could be a contributing cause to the customer's concern.

5

Making comparisons of the customer's vehicle with an equally equipped, same model year and type, KNOWN GOOD vehicle will help determine if certain disturbances may be characteristic of a vehicle design.

Step	Action	Yes	No
WARNING: Refer to Work Stall Test Warning .			
1	Has the Vibration Analysis - Road Testing table been completed?	Go to Step 2	Go to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)
2	Using a scan tool, determine if any DTCs are set. Were any DTCs set?	Go to Diagnostic Starting Point - Vehicle	Go to Step 3
3	1. Block the front wheels. 2. Apply BOTH the service brakes and the park brake. 3. With the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) and the EL-47955 Multi Diagnostic Interface (MDI), or the scan tool and the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available, still installed, start the engine. 4. Place the transmission in NEUTRAL or PARK. 5. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 6. Record the engine RPM obtained on the	Go to Step 4	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 7. Place the transmission in DRIVE. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 10. If no frequency data was obtained, or if the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, is not available, place the transmission into REVERSE, then repeat steps 8 and 9. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Were you able to duplicate the customer's concern?		
4	Did the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2 detect a dominant frequency, or was a significant vibration present?	Go to Vibration Analysis - Engine/Accessory Isolation	Go to Step 5
5	Compare the test results of the customer's vehicle to the results of the same tests run, at the same engine RPM, on an equally-equipped, same model year and type, KNOWN GOOD vehicle. Refer to Vehicle-to-Vehicle Diagnostic Comparison. 1. Install a scan tool into the known good vehicle. 2. Install the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available, into the known good vehicle; place the sensor in exactly the same location as it was placed in the customer's vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine.	Go to Vibration Diagnostic Aids	Go to Vibration Analysis - Engine/Accessory Isolation

Step	Action	Yes	No
	6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at which the disturbance was most noticeable in the customer's vehicle. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 12. If no frequency data was obtained, or if the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, is not available, place the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Did both of the vehicles exhibit the same characteristics?		

ENGINE ORDER CLASSIFICATION

Engine First Order Classification

- Convert the engine speed in revolutions per minute (RPM), recorded during duplication of the disturbance into Hertz, revolutions per second (RPS), by dividing the RPM by 60 seconds. Refer to the following example:
1, 200 RPM divided by 60 = 20 Hz (or RPS)
- Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine speed just converted into Hz, to determine if they are related.
- If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, ARE related, then an engine FIRST ORDER related disturbance is present. Engine first

order disturbances are usually related to an imbalanced component. Refer to the Engine Order Related Disturbances table.

4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine speed, converted into Hz, are NOT related, then determine if the disturbance is related to the engine's firing frequency. Proceed to Engine Firing Frequency Classification.

Engine Firing Frequency Classification

Engine firing frequency is a term used to describe the number of firing pulses (one firing pulse = one cylinder firing) that occur during ONE complete revolution of the crankshaft, multiplied by the number of crankshaft revolutions per second, Hz.

1. Calculate the engine firing frequency.
 - To determine the firing frequency of a 4-stroke engine during ONE complete revolution of the crankshaft, multiply the engine speed, converted into Hz, by HALF of the total number of cylinders in the engine.
 - For example: The engine speed, converted into Hz, was 20 Hz; if the vehicle was equipped with a V8 engine, 4 of the 8 cylinders would actually fire during ONE complete revolution of the crankshaft.
 - Multiply the converted engine speed (20 Hz) by 4 cylinders firing.

$$20 \text{ Hz} \times 4 = 80 \text{ Hz}$$

- The engine firing frequency for a V8 engine at the original engine speed of 1, 200 RPM, recorded during duplication of the disturbance, would be 80 Hz.
- In like manner, a 6-cylinder engine would have a firing frequency of 60 Hz at the same engine speed of 1, 200 RPM.

$$20 \text{ Hz} \times 3 = 60 \text{ Hz}$$

2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the engine firing frequency in Hz, just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated ARE related, then an engine FIRING FREQUENCY related disturbance is present. Engine firing frequency disturbances are usually related to improper isolation of a component. Refer to the Engine Order Related Disturbances table.
4. If the dominant frequency in Hz, recorded during duplication of the disturbance and the engine firing frequency in Hz, just calculated are NOT related, then determine if the disturbance is related to another engine order classification. Proceed to Other Engine Order Classification.

Other Engine Order Classification

1. Multiply the engine speed, converted into Hz, recorded during duplication of the disturbance by different possible order-numbers, other than 1 (first order) or the number used to determine the firing frequency of the engine.
2. Compare the dominant frequency in Hz, recorded during duplication of the disturbance with the other possible engine orders just calculated, to determine if they are related.
3. If the dominant frequency in Hz, recorded during duplication of the disturbance and one of the other engine order frequencies in Hz, just calculated ARE related, then an engine related disturbance of that order is present. If an engine related disturbance is present that is NOT related to first order or firing frequency, then it could be related to an engine driven accessory system. Proceed to Engine Driven Accessories Related to Engine Order.

Engine Driven Accessories Related to Engine Order

Engine driven accessory systems can be related to specific engine orders depending upon the relationship of the accessory pulley diameter to the crankshaft pulley diameter. For example:

- If the crankshaft pulley measured 20 cm (8 in) in diameter and one of the engine driven accessory pulleys measured 10 cm (4 in) in diameter, then that accessory pulley would rotate 2 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 2nd order engine related disturbance.
- In like manner, if an engine driven accessory pulley measured 5 cm (2 in) in diameter, then that accessory pulley would rotate 4 times for every one rotation of the crankshaft pulley. If that accessory system was not isolated properly, or was not operating properly, it would be identifiable as a 4th order engine related disturbance.

Engine driven accessories that contribute to, are excited by, or are the sole cause of a disturbance are usually doing so because of improper isolation that causes a transfer path into the passenger compartment or to another major component of the vehicle body.

Using the **EL-38792-VS** Vibrate Software, accurately measuring the diameters of the accessory pulleys and the crankshaft pulley, and performing the appropriate diagnostic procedures completely will lead to the specific accessory system which is either contributing to, or causing the customer's concern.

Engine Order Related Disturbances

Engine Order	Engine Arrangement						
	L4 W/O Balance Shaft	L4 With Balance Shaft	L5	L6	60 Degree V6	90 Degree V6 With Balance Shaft	90 Degree V8
1/2 Order Torque Sensitive	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnormal - Likely Single Cylinder Misfire and/or EGR/Fuel Variance	Abnormal - Likely Single Cylinder Misfire
1st Order	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance	Abnormal - Likely Component Imbalance
1 1/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance	Abnormal - Likely Bank to Bank EGR/Fuel Variance	Possible Engine Driven Accessory Related
					Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	
2nd Order Non Torque	Characteristic of Engine Arrangement - Possible	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic of Engine Arrangement - Possible	Characteristic of Engine Arrangement - Possible	Possible Engine Driven Accessory Related

Engine Order	Engine Arrangement						
	L4 W/O Balance Shaft	L4 With Balance Shaft	L5	L6	60 Degree V6	90 Degree V6 With Balance Shaft	90 Degree V8
Sensitive	Powertrain Isolation Related				Powertrain Isolation Related	Powertrain Isolation Related	
2nd Order Torque Sensitive	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Abnormal - Likely Bank to Bank EGR/Fuel Variance
	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related					Possible Engine Driven Accessory Related
2 1/2 Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related
			Possible Engine Driven Accessory Related				
3rd Order Torque Sensitive	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain Isolation Related	Possible Engine Driven Accessory Related
				Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	
4th Order Torque Sensitive	Characteristic - Minimal Amount - of Engine Arrangement - Possible	Characteristic - Minimal Amount - of Engine Arrangement - Possible	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related	Characteristic - ENGINE FIRING FREQUENCY - Possible Powertrain

Engine Order	Engine Arrangement						
	L4 W/O Balance Shaft	L4 With Balance Shaft	L5	L6	60 Degree V6	90 Degree V6 With Balance Shaft	90 Degree V8
	Powertrain Isolation Related	Powertrain Isolation Related					Isolation Related
	Possible Engine Driven Accessory Related	Possible Engine Driven Accessory Related					Possible Engine Driven Accessory Related

VIBRATION ANALYSIS - ENGINE/ACCESSORY ISOLATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-38792-25** Inductive Pickup Timing Light
- **EL-47955** Multi Diagnostic Interface MDI

For equivalent regional tools, refer to [Special Tools and Equipment](#).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5

A loose, damaged, misaligned, or defective powertrain insulator and/or bracket may create a transfer path into the passenger compartment.

6

A loose, damaged, misaligned, or defective exhaust system insulator and/or bracket may create a transfer path into the passenger compartment.

7

Incorrectly seated and/or aligned powertrain components and/or exhaust system components may create a transfer path into the passenger compartment.

When loosening powertrain mounts in order to re-bed the powertrain observe the following:

Do not loosen the mount bracket-to-engine bolts/nuts, do not loosen the mount bracket-to-vehicle frame bolts/nuts if mount brackets are used.

Loosen the mount-to-mount bracket bolts/nuts if mount brackets are used, or loosen the mount-to-slotted holes in vehicle frame bolts/nuts if a direct-mount design is used.

8

Non-rotating engine driven accessory component systems can no longer produce a unique disturbance.

Non-rotating engine driven accessory components can no longer produce a unique disturbance. If a disturbance is still present, but the characteristics have been altered, it is possible that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.

If a disturbance is still present, but the characteristics have NOT been altered, it is NOT likely that these component systems are acting as a transfer path for engine firing frequency or a first order engine disturbance.

12

If the mark placed on the face of an engine driven accessory pulley seems to stand still while running this test, then that accessory system is either responding to an existing frequency, such as engine firing pulses, or creating a disturbance.

13

A loose, damaged, misaligned, or defective engine driven accessory system insulator and/or bracket may create a transfer path into the passenger compartment.

15

Removing the engine driven accessory and bracket, or brackets from the engine allows a thorough inspection to determine if any conditions are present that may create a transfer path into the passenger compartment.

Step	Action	Yes	No
WARNING: Refer to Work Stall Test Warning .			
1	Were you sent here from the Vibration Analysis - Engine table?	Go to Step 2	Go to Vibration Analysis - Engine
2	Is the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, available?	Go to Step 3	Go to Step 5
3	1. Using the engine RPM and frequency data recorded for the customer's vehicle, determine the order of engine rotation to which the disturbance is related. 2. Determine the possible causes of the disturbance as it relates to a specific order of engine rotation. Refer to Engine Order Classification . Does the Engine Order Classification table indicate that the disturbance is of the same order as the engine firing frequency?	Go to Step 5	Go to Step 4
4	Does the Engine Order Classification table indicate that the disturbance is likely related to engine driven accessories?	Go to Step 8	Go to Step 5
5	Inspect the powertrain mounts - engine, transmission, transfer case, and direct-mount drive axle, if equipped -	Go to Step 15	Go to Step 6

Step	Action	Yes	No
	and any powertrain braces for the following conditions: • Loose and/or missing fasteners • Improper alignment • Cracked, dry-rotted, and/or oil-soaked insulators • Twisted, broken, torn, and/or collapsed insulators • Bent, twisted, and/or deformed brackets Realign or replace powertrain mounts as indicated by the inspection. Did you find and correct a condition?		
6	Inspect the exhaust system components for the following: • Loose and/or missing fasteners • Heat Shields • Joints and/or couplings: Nuts, bolts, studs, clamps, straps • Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears • Improper alignment • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked insulators • Stretched, twisted, broken, torn, and/or collapsed insulators • Bent, twisted, cracked, and/or deformed brackets Repair, replace, and/or realign exhaust system components as indicated by the inspection. Did you find and correct a condition?	Go to Step 15	Go to Step 7
7	Perform the Powertrain Mount Balance Procedure if available or perform the following procedure to re-bed the powertrain: 1. Loosen, but do not remove, all powertrain mounts and exhaust system hangers. 2. Ensure that the exhaust flexible coupling, if equipped, moves freely.	Go to Step 15	-

Step	Action	Yes	No
	3. Start the engine. 4. Settle the powertrain by shifting the transmission from DRIVE to REVERSE. 5. Place the transmission into NEUTRAL. 6. Turn OFF the ignition. 7. Tighten all of the loosened fasteners with the powertrain in a relaxed position. Did you complete the operation?		
8	CAUTION: Do not run the engine for longer than 60 seconds with the accessory drive belt, or belts removed, or overheating and/or damage may result. 1. Remove the engine accessory drive belt, or belts. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the scan tool still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Increase the engine RPM to the level recorded during duplication of the disturbance. 7. Allow the engine to idle, then place the transmission in DRIVE. 8. Increase the engine RPM to the level recorded during duplication of the disturbance. 9. Turn OFF the ignition. 10. Install the engine accessory drive belt, or belts. Was the disturbance significantly reduced or eliminated?	Go to Step 10	Go to Step 9
9	Were the characteristics of the disturbance altered but still present?	Go to Step 13	Go to Step 17
10	Is the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) being used for diagnosis?	Go to Step 11	Go to Step 12

Step	Action	Yes	No
11	1. Measure the diameter of the suspected accessory pulleys, including any related idler pulleys, and enter this information into the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH). 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) and the EL-47955 Multi Diagnostic Interface MDI still installed, start the engine. 5. Have an assistant place the transmission in NEUTRAL or PARK. 6. Slowly increase the engine RPM to the level recorded during the duplication of the disturbance, then maintain that speed. The frequency of the suspected pulleys will show up on the Record and Analyze tab within the software. 7. Turn OFF the engine. Did you identify an engine driven accessory system as being related to the disturbance?	Go to Step 13	Go to Vibration Diagnostic Aids
12	1. Mark the face of the suspected accessory pulleys, including any related idler pulleys, near the outer edge with a paint mark. 2. Install the EN-38792-25 Inductive Pickup Timing Light, to the EL-38792-A Electronic Vibration Analyzer (EVA) 2. For information on the use of the EVA features, refer to Electronic Vibration Analyzer (EVA) Description and Operation. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. With the scan tool and the EL-38792-A Electronic Vibration Analyzer (EVA) 2, still installed, start the engine. 6. Select the Smart Strobe feature on the EL-38792-A Electronic Vibration Analyzer (EVA) 2. 7. Enter the recorded frequency of the disturbance as the initial frequency for strobe operation. 8. Have an assistant place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed.	Go to Step 13	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	10. Using the EL-38792-A Inductive Pickup Timing Light, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 11. Allow the engine to idle, then place the transmission in DRIVE. 12. Slowly increase the engine RPM to the level recorded during duplication of the disturbance, then maintain that speed closely. 13. Using the EL-38792-25 Inductive Pickup Timing Light, check each of the suspected accessory pulleys to determine if any of them is related to the frequency of the disturbance. Check each of the accessory systems, both engaged and under maximum load and disengaged or under minimum load. 14. Turn OFF the ignition. Did you identify an engine driven accessory system as being related to the frequency of the disturbance?		
13	Inspect the components of the engine driven accessory system for the following: • Loose and/or missing fasteners • Heat Shields, if equipped • Joints and/or couplings: Nuts, bolts, studs, clamps, straps • Bracket and/or insulator mounting • Inadequate clearance to body and/or chassis components Inspect with the accessory system both under a LOAD and NOT loaded • Improper alignment • Bent or damaged pulleys • Disconnected and/or missing insulators • Cracked, dry-rotted, and/or oil-soaked component insulators	Go to Step 15	Go to Step 14

Step	Action	Yes	No
	• Stretched, twisted, broken, torn, and/or collapsed component insulators • Bent, twisted, cracked and/or deformed component brackets Repair, replace, and/or realign the engine driven accessory system components as indicated by the inspection. Did you find and correct a condition?		
14	1. Remove the engine driven accessory and bracket, or brackets from the engine. 2. Thoroughly inspect the accessory bracket, or brackets, bolts/nuts/studs, and the accessory itself for signs of the following: Bent, twisted, cracked and/or deformed conditions 3. Replace any of the components found to exhibit any of these conditions. 4. Reinstall the components to the engine. Did you find and correct a condition?	Go to Step 15	Go to Step 19
15	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install a scan tool into the customer's vehicle. 2. Install the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available, into the customer's vehicle; place the sensor in exactly the same location as it was originally placed in the vehicle. 3. Block the front wheels. 4. Apply BOTH the service brakes and the park brake. 5. Start the engine. 6. Place the transmission in NEUTRAL or PARK. 7. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 8. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 9. Place the transmission in DRIVE. 10. Slowly increase the engine RPM to the level at	Go to Step 20	Go to Step 16

Step	Action	Yes	No
	which the disturbance was most noticeable. 11. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 12. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 10 and 11. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?		
16	Have you investigated powertrain isolation as a possible cause of the disturbance?	Go to Step 17	Go to Step 5
17	Have you investigated engine driven accessories as a possible cause of the disturbance?	Go to Vibration Analysis - Engine Balance	Go to Step 18
18	Is the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2 available?	Go to Step 8	Go to Vibration Diagnostic Aids
19	Replace the engine driven accessory component causing the disturbance. Did you complete the replacement?	Go to Step 20	-
20	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope). Is the disturbance still present?	Go to Step 2	System OK

VIBRATION ANALYSIS - ENGINE BALANCE

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-47955** Multi Diagnostic Interface MDI

For equivalent regional tools, refer to [Special Tools and Equipment](#).

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4

If sufficient clearance exists to separate the transmission torque converter from the engine flywheel/flexplate, then further tests can be used to isolate the transmission from the engine.

5

An engine flywheel/flexplate that has excessive lateral runout, when combined with the mass of the transmission torque converter, can produce a disturbance.

6

An engine flywheel/flexplate that is loose at the engine crankshaft or that is cracked or damaged, when combined with the mass of the transmission torque converter, can produce a disturbance.

7

This step is designed to isolate the transmission from the engine to determine if the disturbance is related to the engine ONLY.

9

Re-indexing the transmission torque converter to the engine flywheel/flexplate alters the balance relationship between the torque converter and the rear of the engine.

11

Placing the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan along the FRONT and the REAR edge allows for a determination to be made, which will help to narrow down the cause of the disturbance.

13

An engine flywheel that has excessive lateral runout, when combined with the extra mass of the clutch pressure plate and clutch driven plate, can produce a disturbance.

14

The clutch pressure plate and the engine flywheel are marked for proper indexing of the heavy-spot of one to the light-spot of the other. Improper indexing of the pressure plate to the flywheel can produce a disturbance.

15

An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

16

An engine flywheel that is loose at the engine crankshaft or that is cracked, damaged and/or missing balance weights; and/or a clutch pressure plate and clutch driven plate that has loose springs, cracks, warpage, damage and/or missing balance weights - can produce a disturbance when their mass is combined.

17

Re-indexing the pressure plate to the engine flywheel alters the balance relationship between the pressure plate/flywheel assembly and the rear of the engine.

18

An engine flywheel/flexplate that is damaged, misaligned, and/or imbalanced, can produce a disturbance.

19

An engine crankshaft balancer that is damaged, misaligned, and/or imbalanced, can produce a disturbance.

Step	Action	Yes	No
WARNING: Refer to Work Stall Test Warning .			
1	Were you sent here from the Vibration Analysis - Engine/Accessory Isolation table?	Go to Step 2	Go to Vibration Analysis - Engine/Accessory Isolation
2	Is the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, available?	Go to Step 3	Go to Vibration Diagnostic Aids
3	Is the vehicle equipped with a manual transmission?	Go to Step 11	Go to Step 4
4	WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.	Go to Step 5	Go to Step 11

Step	Action	Yes	No
	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the flywheel/flexplate-to-torque converter bolts access cover, if equipped. 3. Determine if sufficient clearance exists to separate the transmission torque converter away from the engine flywheel/flexplate and safely secure the torque converter from accidentally engaging with the flywheel/flexplate. Is there sufficient clearance to separate and safely secure the transmission torque converter away from the engine flywheel/flexplate?		
5	1. With the flywheel/flexplate-to-torque converter access cover still removed, and with the vehicle still raised, mark the position of the transmission torque converter in relation to the engine flywheel/flexplate. 2. Disconnect the torque converter and move it away from the flywheel/flexplate. 3. Secure the transmission torque converter away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate. 4. Lower the vehicle, start the engine and allow the engine to idle. 5. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 6. Visually inspect the flywheel/flexplate for excessive lateral runout. 7. Lower the vehicle. 8. Turn OFF the ignition. Did the flywheel/flexplate exhibit excessive lateral runout?	Go to Step 8	Go to Step 6
6	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Inspect the flywheel/flexplate for the following: • Looseness at the engine crankshaft • Cracks and/or damage • Missing balance weights Did the flywheel/flexplate exhibit any of the conditions listed?	Go to Step 8	Go to Step 7

Step	Action	Yes	No
7	1. With the transmission torque converter still secured away from the engine flywheel/flexplate to avoid accidental engagement with the flywheel/flexplate, lower the vehicle. 2. Block the front wheels. 3. Apply BOTH the service brakes and the park brake. 4. With the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) and the EL-47955 Multi Diagnostic Interface MDI or the scan tool and the EL-38792-A Electronic Vibration Analyzer (EVA) 2 still installed, start the engine. 5. Place the transmission in NEUTRAL or PARK. 6. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 7. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the EL-38792-A Electronic Vibration Analyzer (EVA) 2. 8. Turn OFF the ignition. Has the disturbance been significantly reduced or eliminated?	Go to Step 9	Go to Step 11
8	1. If the flywheel/flexplate is loose at the engine crankshaft, tighten the flywheel/flexplate mounting bolts in sequence and to specification. 2. If the flywheel/flexplate is cracked, damaged, and/or has missing balance weights, replace the damaged flywheel/flexplate. Did you complete the tightening or replacement?	Go to Step 20	-
9	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Re-index the transmission torque converter to the engine flywheel/flexplate, 120 degrees from its original position. 3. Reconnect the transmission torque converter to the engine flywheel/flexplate. 4. Lower the vehicle. 5. Block the front wheels. 6. Apply BOTH the service brakes and the park brake. 7. With the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) and the EL-47955 Multi Diagnostic Interface MDI or the scan tool	Go to Step 20	Go to Step 10

Step	Action	Yes	No
	and the EL-38792-A Electronic Vibration Analyzer (EVA) 2 still installed, start the engine. 8. Place the transmission in NEUTRAL or PARK. 9. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 10. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2. 11. If the disturbance is still noticeable, re-index the torque converter again to obtain the least amount of disturbance. Has the disturbance been significantly reduced or eliminated?		
10	Replace the out-of-balance transmission torque converter. Did you complete the replacement?	Go to Step 20	-
11	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Position the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) accelerometer or the EL-38792-A Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan, along the FRONT edge. 3. Lower the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. With the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) and the EL-47955 Multi Diagnostic Interface MDI or the scan tool and the EL-38792-A Electronic Vibration Analyzer (EVA) 2, still installed, start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance is most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2 from the underside of the engine oil pan. 10. Repeat steps 1 through 9, placing the CH-51450-	Go to Step 19	Go to Step 12

Step	Action	Yes	No
	NVH Oscilloscope Diagnostic Kit (w/NVH) accelerometer or the EL-38792-A Electronic Vibration Analyzer (EVA) 2 sensor onto the underside of the engine oil pan, along the REAR edge. Is the disturbance greater along the FRONT of the engine?		
12	Is the vehicle equipped with an automatic transmission?	Go to Step 18	Go to Step 13
13	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle. 2. Remove the flywheel inspection cover. 3. Start the engine. Allow the engine to idle. 4. Visually inspect the engine flywheel clutch surface for excessive lateral runout. Does the engine flywheel clutch surface exhibit excessive lateral runout?	Go to Step 18	Go to Step 14
14	Inspect the clutch pressure plate to engine flywheel mounting for proper factory indexing. Is the clutch pressure plate properly indexed to the engine flywheel?	Go to Step 16	Go to Step 15
15	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: • Looseness at the engine crankshaft • Cracks, warpage and/or damage • Missing balance weights 3. Inspect the clutch pressure plate and clutch driven plate for the following: • Loose and/or damaged clutch driven plate damper springs • Loose and/or damaged clutch pressure plate diaphragm springs • Cracks, warpage and/or damage • Missing balance weights Do any of the above conditions exist?	Go to Step 18	Go to Step 17
16	1. Remove the clutch pressure plate and clutch driven plate from the engine flywheel. 2. Inspect the engine flywheel for the following: • Looseness at the engine crankshaft • Cracks, warpage and/or damage	Go to Step 18	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	• Missing balance weights 3. Inspect the clutch pressure plate and clutch driven plate for the following: • Loose and/or damaged clutch driven plate damper springs • Loose and/or damaged clutch pressure plate diaphragm springs • Cracks, warpage and/or damage • Missing balance weights Do any of the above conditions exist?		
17	Re-index the pressure plate to the engine flywheel. Did you complete the re-indexing?	Go to Step 20	-
18	Replace the engine flywheel/flexplate. Did you complete the replacement?	Go to Step 20	-
19	Replace the engine crankshaft balancer. Did you complete the replacement?	Go to Step 20	-
20	Check the vehicle to determine if the disturbance is now significantly reduced or eliminated. Perform the following steps: 1. Install or connect any components that were removed or disconnected during diagnosis. 2. Install a scan tool into the customer's vehicle. 3. Install the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available, into the customer's vehicle; place the sensor in exactly the same location as it was originally placed in the vehicle. 4. Block the front wheels. 5. Apply BOTH the service brakes and the park brake. 6. Start the engine. 7. Place the transmission in NEUTRAL or PARK. 8. Slowly increase the engine RPM to the level at which the disturbance was most noticeable. 9. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 10. Place the transmission in DRIVE. 11. Slowly increase the engine RPM to the level at	Go to Step 21	Go to Vibration Diagnostic Aids

Step	Action	Yes	No
	which the disturbance was most noticeable. 12. Record the engine RPM obtained on the scan tool and the most dominant frequency reading if obtained on the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) or the EL-38792-A Electronic Vibration Analyzer (EVA) 2, if available. 13. If the disturbance has been significantly reduced or eliminated, confirm the results by placing the transmission into REVERSE, then repeat steps 11 and 12. Reverse-loading of the powertrain may increase or change the characteristics of the vibration. Has the disturbance been significantly reduced or eliminated?		
21	Perform the Vibration Analysis - Road Testing table. Refer to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer) Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope). Is the disturbance still present?	Go to Vibration Diagnostic Aids	System OK

VIBRATION DIAGNOSTIC AIDS

NOTE: If you have not reviewed the Diagnostic Starting Point - Vehicle and completed the Vibration Analysis tables as indicated, refer to [Diagnostic Starting Point - Vehicle](#) BEFORE proceeding.

The diagnostic information contained in this Diagnostic Aids section will help you determine the correct course of action to take for the following 4 main conditions. Refer to the appropriate condition from this list:

- [Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated](#)
- [Vibration Diagnostic Aids - Vibration Duplicated, Component Not Identified](#)
- [Vibration Diagnostic Aids - Vibration Duplicated, Difficult to Isolate/Balance Component](#)
- [Vibration Diagnostic Aids - Vibration Duplicated, Appears to Be Potential Operating Characteristic](#)

VIBRATION DIAGNOSTIC AIDS - VIBRATION INTERMITTENT OR NOT DUPLICATED

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to [Vibration Diagnostic Aids](#) BEFORE proceeding.

If you have not been able to duplicate the vibration concern or have only been able to duplicate the concern intermittently, review the following information.

Most vibration concerns that cannot be duplicated are due to either specific conditions that are not present during the duplicating attempts, or due to not following the procedures designed to duplicate concerns properly and in the sequence indicated.

Specific Conditions Can Affect the Condition

Consider the following conditions which may not have been present while attempts were made to duplicate the vibration concern. Attempt to obtain more specific information from the customer as to the EXACT conditions that are present when they experience the vibration which they are concerned about. Attempt to duplicate the vibration concern again while recreating the EXACT conditions necessary, except those which pose a safety concern or are outside the boundaries of normal operating conditions, such as loading the vehicle beyond its designed weight ratings, etc.

Most attempts to duplicate a vibration concern are made after the vehicle has been driven to the repair facility and perhaps even sat inside the building for a time; the vehicle may be too warm to detect the concern during duplication efforts. The opposite could also occur; perhaps the vehicle has sat out in the cold for a time and fails to reach full operating temperatures during attempts to duplicate the concern.

Temperature, Ground-Out, Accessory Load

Flat Spots on Tires

Tires which have sat and been cool for a time can develop flat spots.

Irregular Wear on Tire Treads

Tires which have sat and been cool for a time will be stiffer and any irregular wear conditions will be more noticeable than they will be once the tires have warmed and softened.

Exhaust System Growth

Exhaust systems may exhibit a ground-out condition when cool which goes away once the system is hot. The opposite may be true that the exhaust system is fine when cool but a ground-out condition occurs once the system reaches operating temperatures. Exhaust systems can grow by 2 1/2 - 5 cm (1 - 2 in) when hot.

Engine-Driven Accessory Noises

NOTE: When a stethoscope equipped with a probe is used to assist in identifying possible vibrating components, the results must be compared to the sound quality of the same accessory, in a equally-equipped, same model year and type, KNOWN GOOD vehicle, and under the same conditions. Refer to [Vehicle-to-Vehicle Diagnostic Comparison](#).

A stethoscope equipped with a probe can be used as an additional means to assist in identifying accessories which may be causing or contributing to a vibration concern.

- Belt Whipping

An engine accessory drive belt, or belts could exhibit a whipping condition if a belt is deteriorating and deposits are building up on the underside of the belt.

- Loose Mounting Brackets or Component Ground-Out

Engine-driven accessories such as a generator, a power steering pump, or an air conditioning compressor could exhibit noise conditions due to either loose mounting brackets or due to related components of the system in a ground-out condition during certain operation of that accessory system.

- Cold or Hot

Accessories could exhibit noise conditions when cool which go away once they are fully warmed-up, or the opposite may be true.

- Load on an Accessory Component

Accessories could exhibit a noise condition while under a heavy load - perhaps when combined with a cool or fully warmed-up condition.

- Bent or Misaligned Pulleys

Bent or mis-aligned pulleys in one or more engine-driven accessory systems could contribute to a noise or vibration condition.

- Fluid Level in Accessory Systems

Accessories could exhibit a noise condition due to an abnormal amount of fluid contained in the system of which the accessory is a part. For example:

- An improper power steering fluid level could produce noises in the power steering system.
- An improper air conditioning refrigerant level or an excessive amount of refrigerant oil could produce noises or possibly vibrations in the air conditioning system.

- Incorrect Fluid Type in Accessory Systems

Accessories could exhibit a noise condition due to the incorrect type of fluid contained in the system of which the accessory is a part.

Vehicle Payload

The vibration concern may only occur when the vehicle is carrying heavy payloads or towing a trailer; the vehicle may have been empty during duplication efforts.

Heavy Payload

The vehicle may have been empty during attempts to duplicate the vibration concern, but the customer may actually experience the vibration concern while the vehicle is carrying a large payload.

Trailer Towing

The customer may experience the vibration concern only while towing a trailer.

Roadway Selection

The selection of roadways used to perform the vibration duplication procedures is likely to be in the near vicinity of the repair facility and may not provide a road surface that is similar enough to the surface on which the customer usually drives the vehicle.

The customer may only experience the vibration on a particular roadway. Perhaps the roadway is overly crowned or is very bumpy or rough.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, COMPONENT NOT IDENTIFIED

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.

Aftermarket Add-On Accessories

Aftermarket accessories which have been added to the vehicle can actually transmit and magnify INHERENT component rotational frequencies, if the accessories were not installed correctly.

An accessory should be installed in such a way that it is isolated from becoming a possible transfer path into the rest of the vehicle. For example, if a set of running boards has been installed improperly and they are sensitive to a particular frequency of a rotating component, the running boards could begin to respond to the frequency and actually create a disturbance once the amplitude of the frequency reaches a high enough point, probably at a higher vehicle speed.

If the same set of running boards were installed properly - isolated properly - the transfer path would be removed and the disturbance would no longer be present.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, DIFFICULT TO ISOLATE/BALANCE COMPONENT

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to [Vibration Diagnostic Aids](#) BEFORE proceeding.

If you have duplicated the vibration concern but have had difficulty in balancing a component or isolating a component, refer to the following information.

Most vibration concerns are corrected or eliminated through correcting excessive runout of a component, correcting balance of a component or isolating a component which has come into abnormal contact with another object/component.

Components which can generate a lot of energy and are experiencing excessive runout, imbalance or ground-out can produce a vibration with a strong enough amplitude that the vibration can transmit to components which are closely related. This type of a condition is usually related to and sensitive to torque-load. The most likely system that could exhibit this type of a condition is the driveline.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, APPEARS TO BE POTENTIAL OPERATING CHARACTERISTIC

NOTE: If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to [Vibration Diagnostic Aids](#) BEFORE proceeding.

Check Service Bulletins

If BOTH of the following statements are TRUE, then check service bulletins for the condition identified. If the condition has already been identified and investigated prior to this vehicle, and has been determined to be something that is not truly an operating characteristic or that perhaps is not design-intent, there will likely be adjustments or corrections identified which will address the condition.

- You CAREFULLY followed the steps indicated through reviewing the Diagnostic Starting Point - Vibration Diagnosis and completing the Vibration Analysis tables identified and you have duplicated the vibration concern.
- You have come to the conclusion through comparison with a very equally-equipped, same model year and type, KNOWN GOOD vehicle that the customer's concern is a condition that appears to be a potential operating characteristic of the vehicle.

SYMPTOMS - VIBRATION DIAGNOSIS AND CORRECTION

NOTE: Perform the following steps in sequence BEFORE using these symptom tables.

1. Begin the diagnosis of a vibration concern by reviewing [Diagnostic Starting Point - Vehicle](#) to become familiar with the diagnostic process used to properly diagnose vibration concerns.
2. Perform the [Vibration Analysis - Road Testing \(EL-38792-A Electronic Vibration Analyzer\)](#) [Vibration Analysis - Road Testing \(CH-51450-NVH Oscilloscope\)](#) table before using these symptom tables in order to duplicate and effectively diagnose the customer's concern.

Symptom Tables

Refer to a Vibration Analysis table as indicated in the following symptom tables, based on the most dominant characteristic of the customer's vibration concern, felt or heard, that is evident during the appropriate condition of the occurrence.

Vibration Symptoms that are Felt

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Shake	Can sometimes be seen or felt in the steering wheel, seat or console. Related terminology: shimmy, wobble, waddle, shudder, hop	5 - 20 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to Vibration Analysis - Tire and Wheel
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine
Roughness	Similar to the feeling of holding a jigsaw.	20 - 50 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to Vibration Analysis - Tire and Wheel
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine
Buzz	Similar to the feeling of holding an electric razor. May be felt in the hands through the steering wheel, in the feet through the floor, or in the seat of the pants.	50 - 100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine
Tingling	May produce a "pins and needles" sensation or may put hands or feet "to sleep". Highest vibration frequency range that can still be felt.	Greater than 100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine

Vibration Symptoms that are Heard

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Boom	Usually heard as an interior noise similar to the noise of a bowling ball rolling down an alley, deep thunder, or a bass drum. • Related terminology - droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration or roughness	20 - 60 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to Vibration Analysis - Tire and Wheel
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
Moan or Drone	Similar to the sound of a bumblebee or blowing air across the top of a bottle. • Related terminology - humming, buzzing, resonance • May be accompanied by a perceptible vibration such as a buzz	60 - 120 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine
Howl	Similar to the sound of the wind howling.	120 - 300 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to Vibration Analysis - Hub and/or Axle Input
			Engine Speed Sensitive	Go to Vibration Analysis - Engine
Whine	Similar to the sound of mosquitoes, turbine engines, or vacuum cleaners.	300 - 500 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to transmission diagnostic information

VEHICLE-TO-VEHICLE DIAGNOSTIC COMPARISON

Comparing the customer's vehicle to a KNOWN GOOD vehicle that is essentially identical will help determine if the customer's concern may be characteristic of a vehicle design. To arrive at a valid conclusion, the comparison must be performed under the same conditions, using the same criteria, on a vehicle that has the same option content as the customer's vehicle.

The comparison vehicle must match the customer's vehicle in the following areas:

- Model Year
- Make
- Model

- Body style
- Powertrain configuration
- Driveline configuration
- Final drive ratio
- Tire/wheel size and type
- Suspension package
- Trailering package
- GVW rating
- Performance options
- Luxury options

TIRE AND WHEEL INSPECTION

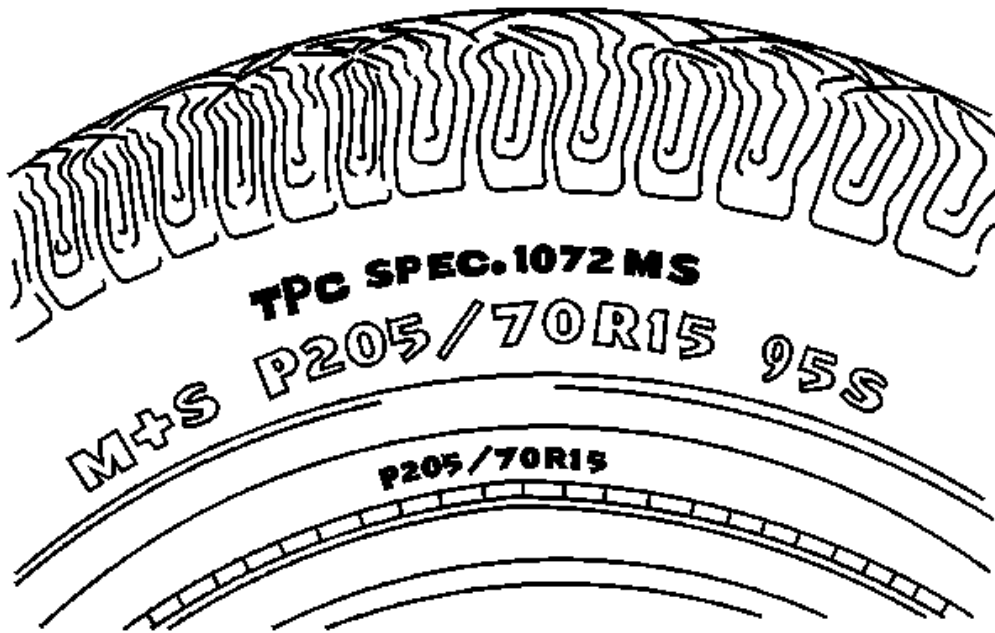


Fig. 2: Identifying Tire Performance Criteria (TPC) Rating Markings

Courtesy of GENERAL MOTORS COMPANY

The tires on all new production models have a tire performance criteria (TPC) rating number molded on the sidewall. The TPC rating will appear as a 4-digit number preceded by the letters TPC SPEC on the tire wall near the tire size. A replacement tire should have the same TPC rating.

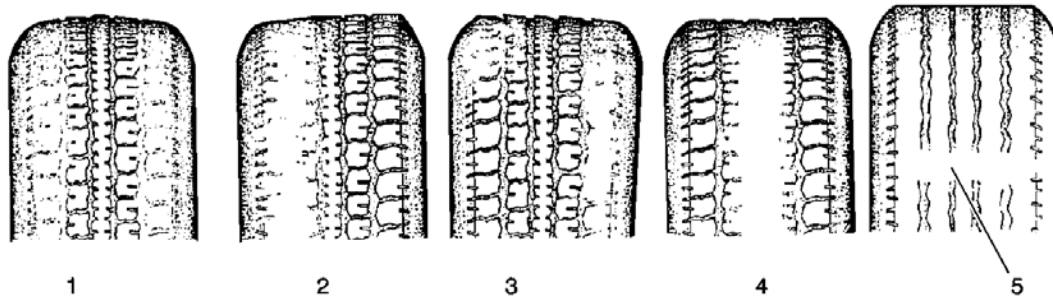


Fig. 3: Identifying Types Of Tire Wear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hard Cornering/Underinflation
2	Incorrect Alignment/Lack of Rotation
3	Incorrect Alignment/Non-uniform Tire
4	Heavy Acceleration/Over inflation
5	Wear Indicator

Inspect the tire and wheel assemblies for the following conditions:

- Unusual wear such as cupping, flat spots, and/or heel-and-toe wear

These conditions can cause tire growl, tire howl, slapping noises, and/or vibrations throughout the vehicle.

- Proper inflation to specifications for the vehicle
- Bulges in the sidewalls

Do not confuse bulges, which are an abnormal condition, with normal ply splices which are commonly seen as indentations in the sidewall.

- Bent rim flanges

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - ON-VEHICLE

1. Raise and support the vehicle.
2. Closely inspect each tire for proper and even bead seating.
3. If any of the tire beads were not properly or evenly seated, reseal the tire bead, then proceed to step 4. Refer to [Tire and Wheel Removal and Installation](#).
4. Following the tire inflation placard on the drivers door, inspect and if necessary adjust the tire inflation pressures.

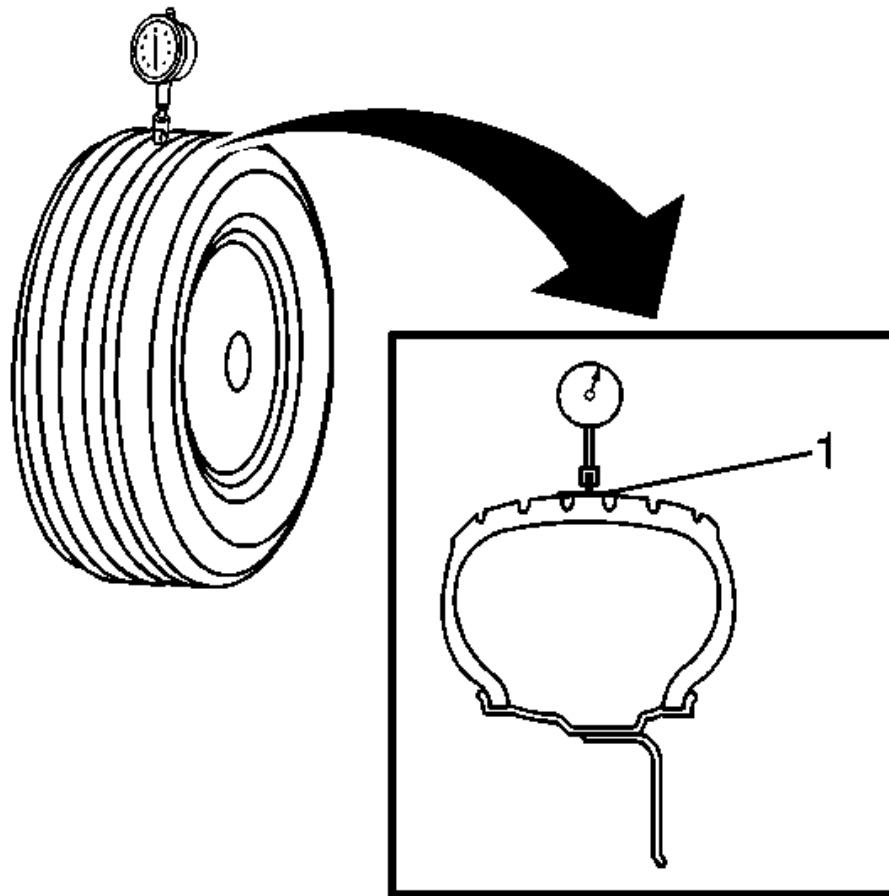


Fig. 4: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS COMPANY

5. Wrap the circumference of each tire with tape (1) in the center tread area.

Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

6. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
7. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
8. Set the dial indicator to zero at the low spot.
9. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

Specification

Maximum tire and wheel assembly radial runout - measured on-vehicle: 1.52 mm (0.060 in)

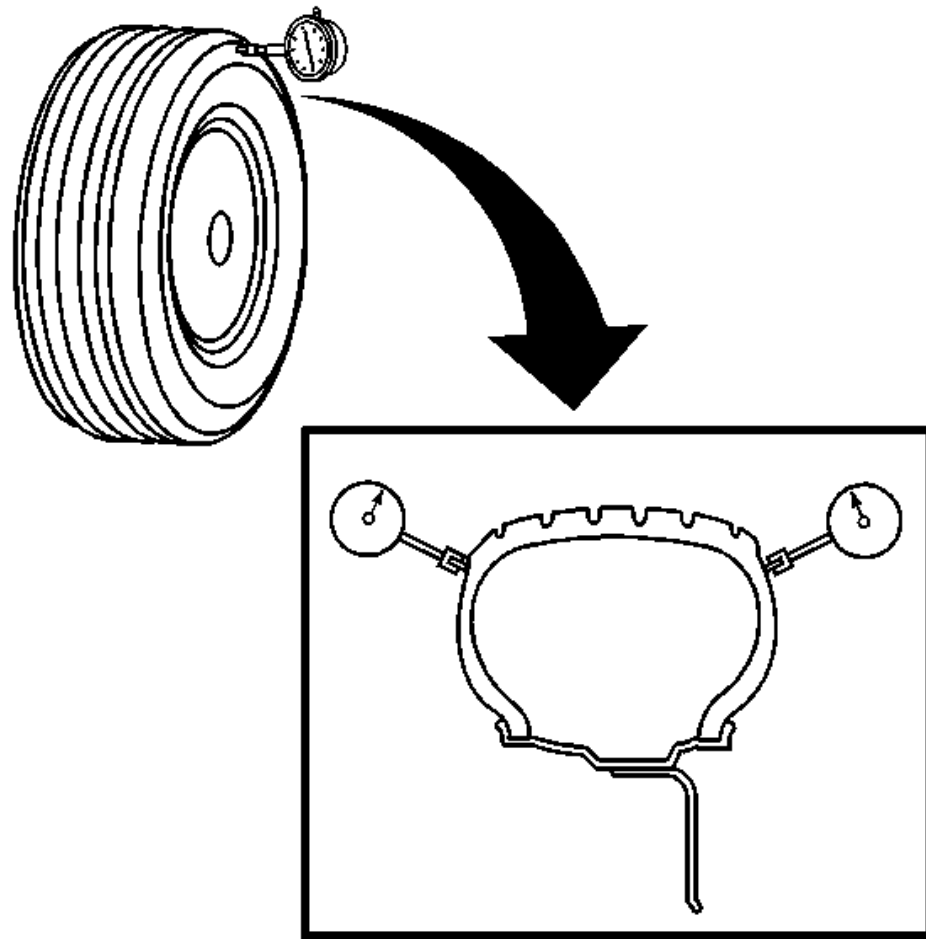


Fig. 5: Measuring Tire & Wheel Assembly Lateral Runout

Courtesy of GENERAL MOTORS COMPANY

10. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
11. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
12. Set the dial indicator to zero at the low spot.
13. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

Specification

Maximum tire and wheel assembly lateral runout - measured on-vehicle: 1.52 mm (0.060 in)

14. Repeat steps 4 through 12 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
15. Lower the vehicle.

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - OFF VEHICLE

1. Raise and support the vehicle.

2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle.
4. Closely inspect each tire for proper and even bead seating.
5. If any of the tire beads were not properly or evenly seated, reseal the tire bead, then proceed to step 6. Refer to [Tire and Wheel Removal and Installation](#).
6. Mount a tire and wheel assembly on a spin-type wheel balancer.

Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.

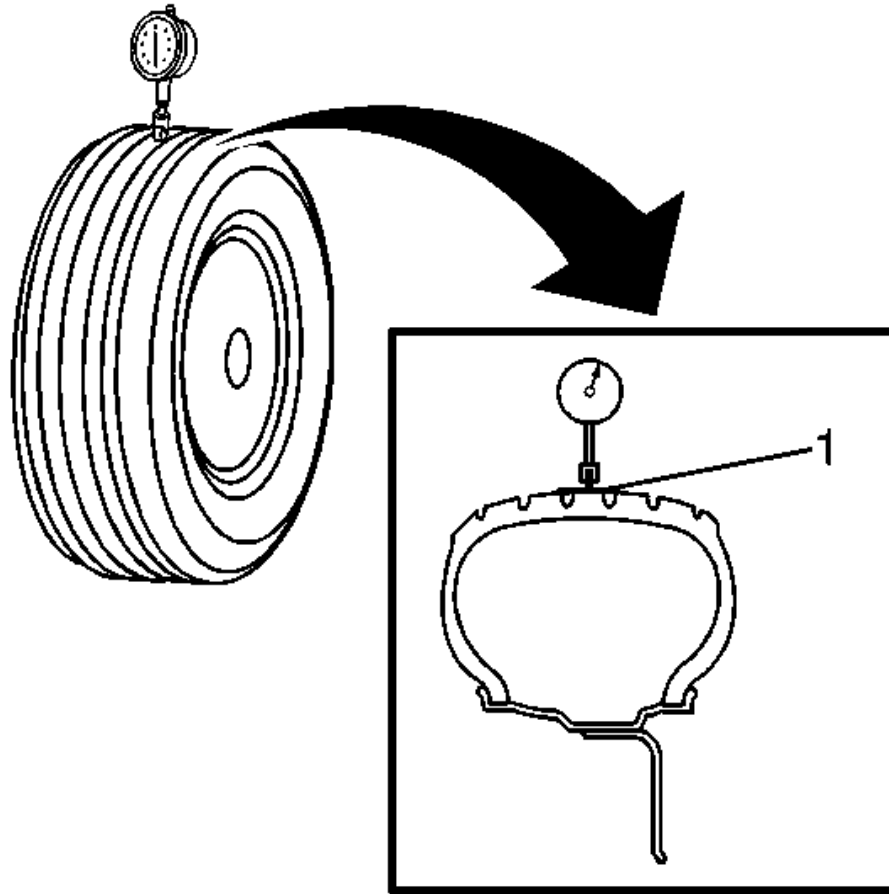


Fig. 6: Measuring Tire & Wheel Assembly Radial Runout

Courtesy of GENERAL MOTORS COMPANY

7. Wrap the outer circumference of each tire with tape (1) in the center tread area.

Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

8. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
9. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
10. Set the dial indicator to zero at the low spot.

11. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

Specification

Maximum tire and wheel assembly radial runout - measured off-vehicle: 1.27 mm (0.050 in)

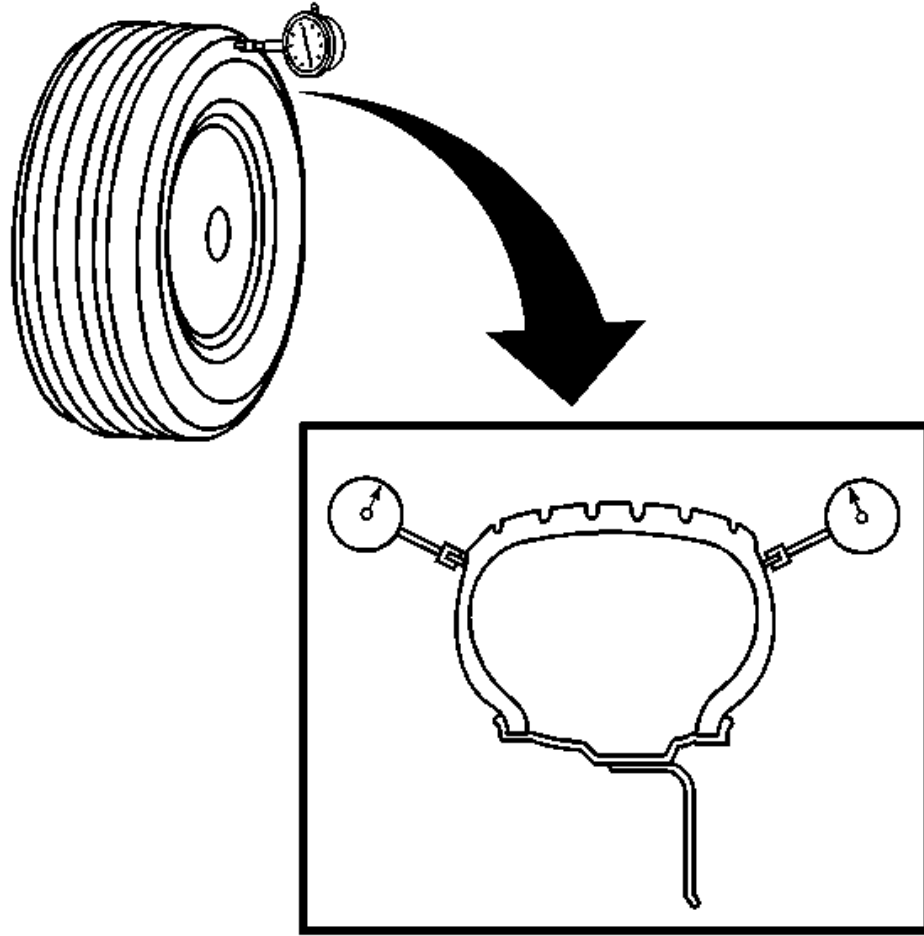


Fig. 7: Measuring Tire & Wheel Assembly Lateral Runout

Courtesy of GENERAL MOTORS COMPANY

12. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
13. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
14. Set the dial indicator to zero at the low spot.
15. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

Specification

Maximum tire and wheel assembly lateral runout - measured off-vehicle: 1.27 mm (0.050 in)

16. Repeat steps 6 through 15 until all of the tire and wheel assembly radial and lateral runout measurements have

been taken.

17. If ANY of the tire and wheel assembly runout measurements were NOT within specifications, proceed to step 19.
18. If ALL of the tire and wheel assembly runout measurements WERE within specifications, then the off-vehicle tire and wheel assembly runout is considered acceptable.

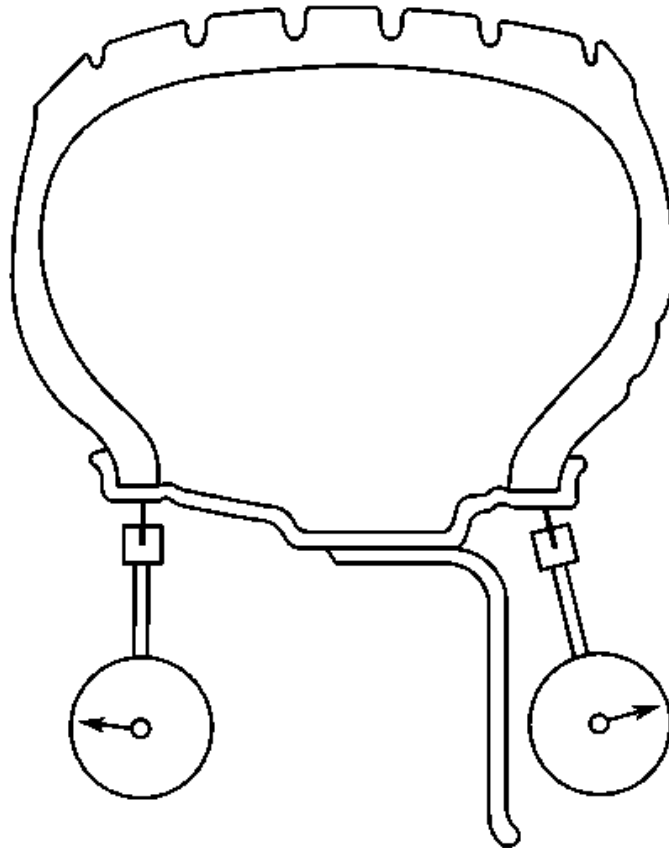


Fig. 8: Measuring Wheel Radial Runout (Off-Vehicle, Tire Mounted)

Courtesy of GENERAL MOTORS COMPANY

19. Position the dial indicator on the horizontal outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

20. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
21. Set the dial indicator to zero at the low spot.
22. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel radial runout.

Specification

- Maximum aluminum wheel radial runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
- Maximum steel wheel radial runout - measured off-vehicle, tire mounted: 1.015 mm (0.040 in)

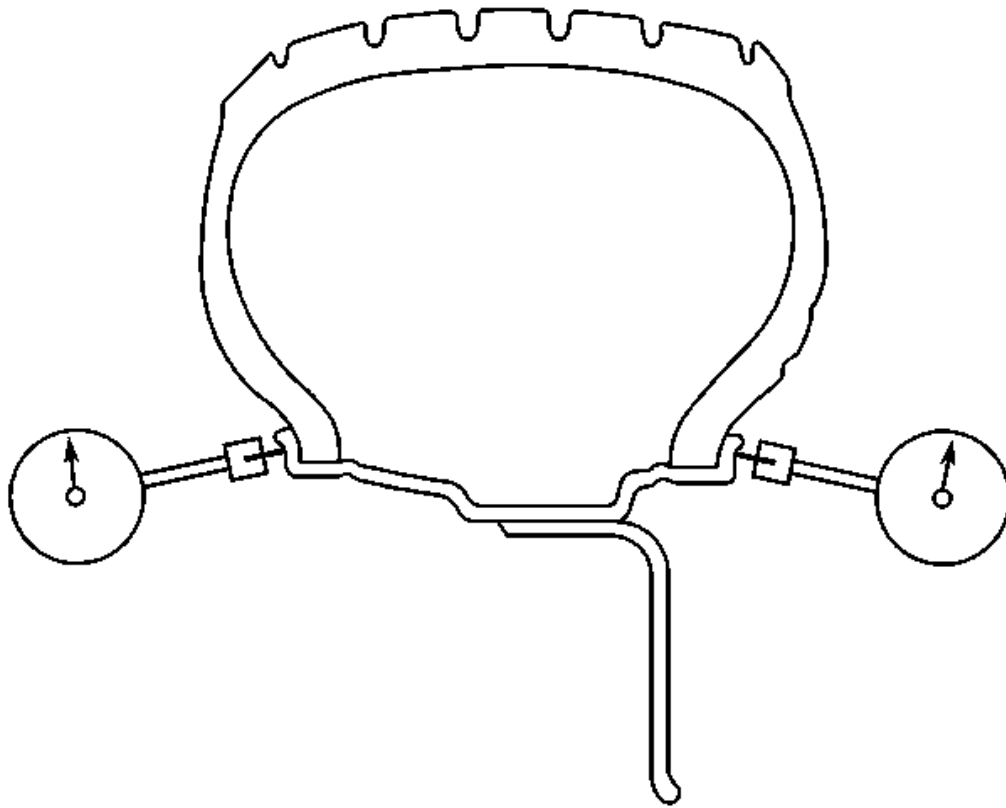


Fig. 9: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS COMPANY

23. Position the dial indicator on the vertical outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

24. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
25. Set the dial indicator to zero at the low spot.
26. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel lateral runout.

Specification

- Maximum aluminum wheel lateral runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
- Maximum steel wheel lateral runout - measured off-vehicle, tire mounted: 1.143 mm (0.045 in)

27. Repeat steps 19 through 26 until all of the wheel radial and lateral runout measurements have been taken on each of the - tire and wheel - assemblies with assembly runout measurements which were NOT within specifications.
28. If any of the wheel runout measurements were NOT within specifications, proceed to Measuring Wheel Runout - Tire Dismounted.
29. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to [Tire and Wheel Assembly Balancing - Off Vehicle](#).
30. After replacement of any tires, always re-measure the runout of the affected tire and wheel assembly, or assemblies.
31. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
32. Lower the vehicle.

Wheel Runout Measurement - Tire Dismounted

1. On the tire and wheel assembly, or assemblies with wheel runout measurements - tire mounted - which were NOT within specifications, mark each tire and wheel in relation to each other.
2. Dismount the tire from the wheel.
3. Mount the wheel on a spin-type wheel balancer.
4. Locate the wheel on the balancer with a cone through the back side of the center pilot hole.

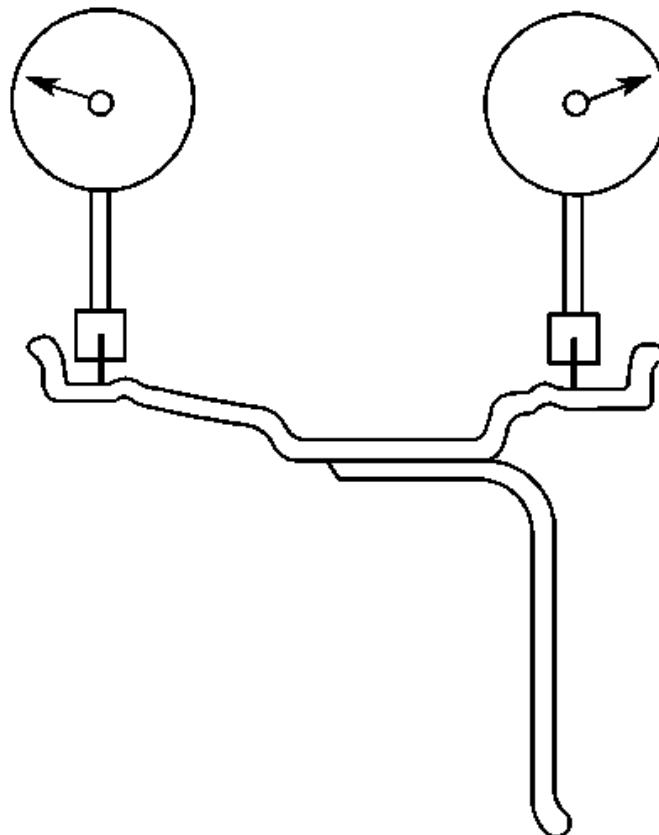


Fig. 10: Measuring Wheel Radial Runout (Off-Vehicle, Tire Dismounted)

Courtesy of GENERAL MOTORS COMPANY

5. Position the dial indicator on the horizontal inner surface of the wheel rim flange - with the tire dismounted - such that the dial indicator is perpendicular to the rim flange surface.

Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

6. Slowly rotate the wheel one complete revolution in order to find the low spot.
7. Set the dial indicator to zero at the low spot.
8. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel radial runout.

Specification

- Maximum aluminum wheel radial runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
- Maximum steel wheel radial runout - measured off-vehicle, tire dismounted: 1.015 mm (0.040 in)

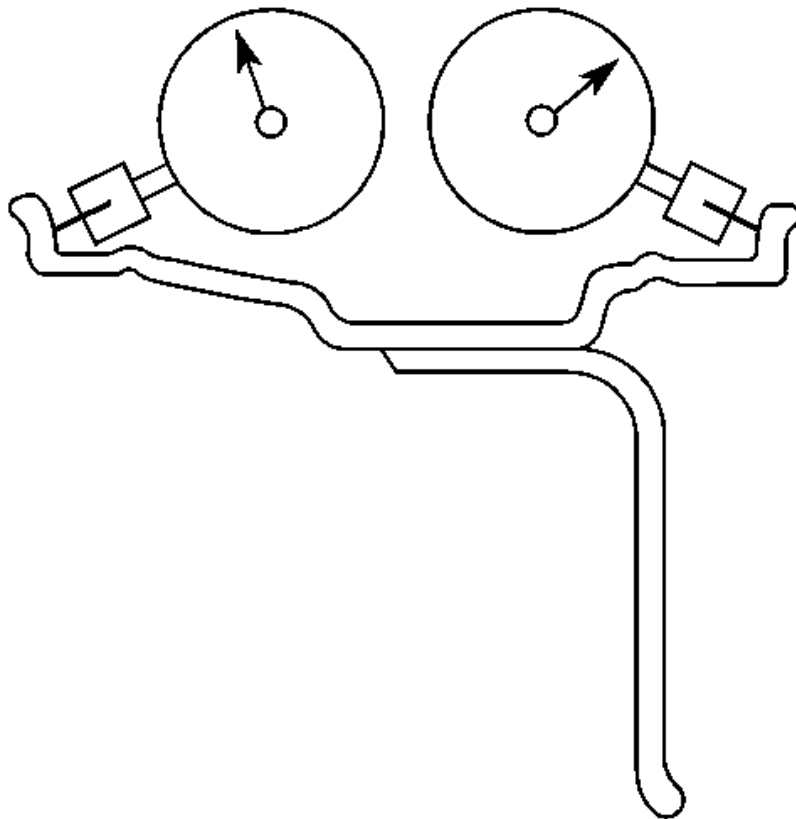


Fig. 11: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Dismounted)

Courtesy of GENERAL MOTORS COMPANY

9. Position the dial indicator on the vertical inner surface of the wheel rim flange - with the tire dismounted - such

that the dial indicator is perpendicular to the rim flange surface.

Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

10. Slowly rotate the wheel one complete revolution in order to find the low spot.
11. Set the dial indicator to zero at the low spot.
12. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel lateral runout.

Specification

- Maximum aluminum wheel lateral runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
 - Maximum steel wheel lateral runout - measured off-vehicle, tire dismounted: 1.143 mm (0.045 in)
13. Repeat steps 2 through 12 until all of the wheel radial and lateral runout measurements - tire dismounted - have been taken on each wheel with runout measurements - tire mounted - which were NOT within specifications.
 14. If any of the wheel runout measurements - tire dismounted - were NOT within specifications, replace the wheel.

Always measure the runout of any replacement wheels.

15. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to [Tire and Wheel Assembly Balancing - Off Vehicle.](#)
16. Using the matchmarks made prior to dismounting the tire, or tires, mount the tire, or tires to the wheel, or wheels, then balance the assembly, or assemblies. Refer to [Tire and Wheel Assembly Balancing - Off Vehicle.](#)

Always measure the runout of any of the tire and wheel assemblies which have had the tires dismounted and mounted.

17. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
18. Lower the vehicle.

BRAKE ROTOR/DRUM BALANCE INSPECTION

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Support the vehicle drive axle on a suitable hoist. Refer to [Lifting and Jacking the Vehicle](#) .
2. Remove the tire and wheel assemblies from the drive axle. Refer to [Tire and Wheel Removal and Installation](#) .

WARNING: Refer to [Work Stall Test Warning](#) .

3. Reinstall the wheel nuts in order to retain the brake rotors.
4. Run the vehicle at the concern speed while inspecting for the presence of the vibration.

CAUTION: Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.

5. If the vibration is still present, remove the rotors from the drive axle, then run the vehicle back to the concern speed.
6. If the vibration is eliminated when the brake rotors are removed from the drive axle, repeat the test with one rotor installed at a time. Replace the rotor that is causing or contributing to the vibration concern.

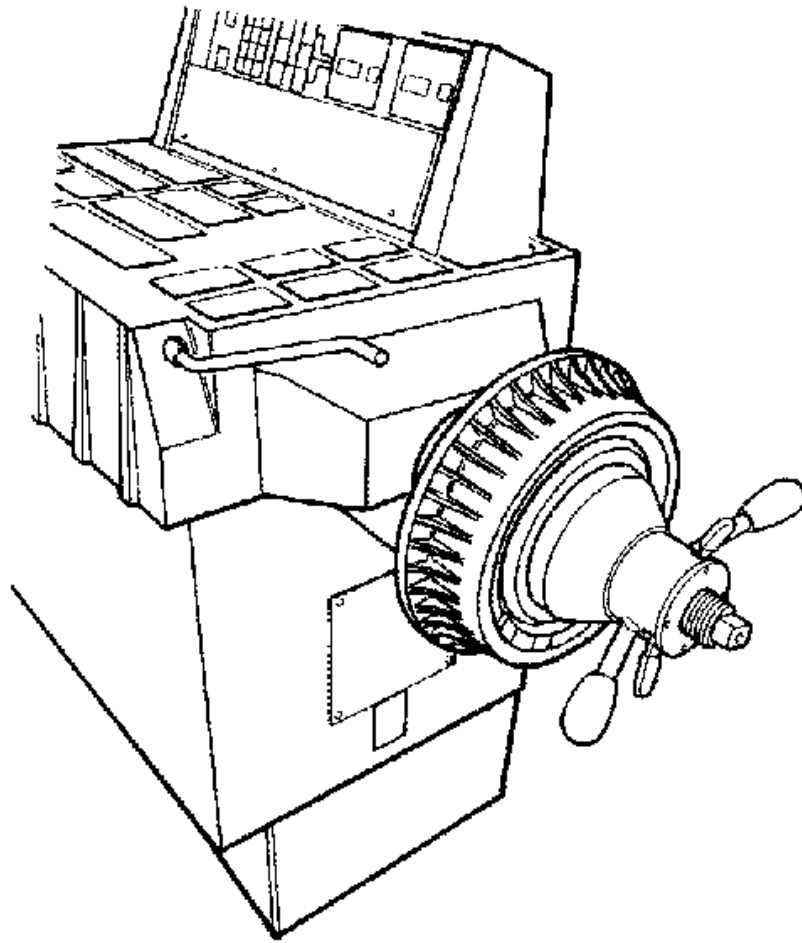


Fig. 12: Balancing Brake Drum

Courtesy of GENERAL MOTORS COMPANY

7. If a brake rotor was replaced as a result of following the previous steps, or if necessary to confirm the results obtained during the previous steps, and/or to check the non-drive axle components, perform the following:
 1. Mount the brake rotor/drum on a balancer in the same manner as a tire and wheel assembly.

NOTE: Check brake rotors/drums for static imbalance only; ignore the dynamic imbalance readings.

2. Inspect the rotor/drum for static imbalance.

There is not a set tolerance for brake rotor/drum static imbalance. However, any brake rotor/drum measured in this same manner which is over 21 g (3/4 oz) may have the potential to cause or contribute to a vibration. Rotors/drums suspected of causing or contributing to a vibration should be replaced. Any rotor/drum that is replaced should be checked for imbalance in the same manner.

HUB/AXLE FLANGE AND WHEEL STUD RUNOUT INSPECTION

Special Tools

GE-8001 Dial Indicator Set, or equivalent

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle. Refer to [Tire and Wheel Removal and Installation](#) .
4. Remove the brake rotors and/or brake drums from the vehicle. Clean the mounting surfaces of the brake rotors, the brake drums, if equipped, and the hub/axle flanges of any loose debris, rust, and corrosion.

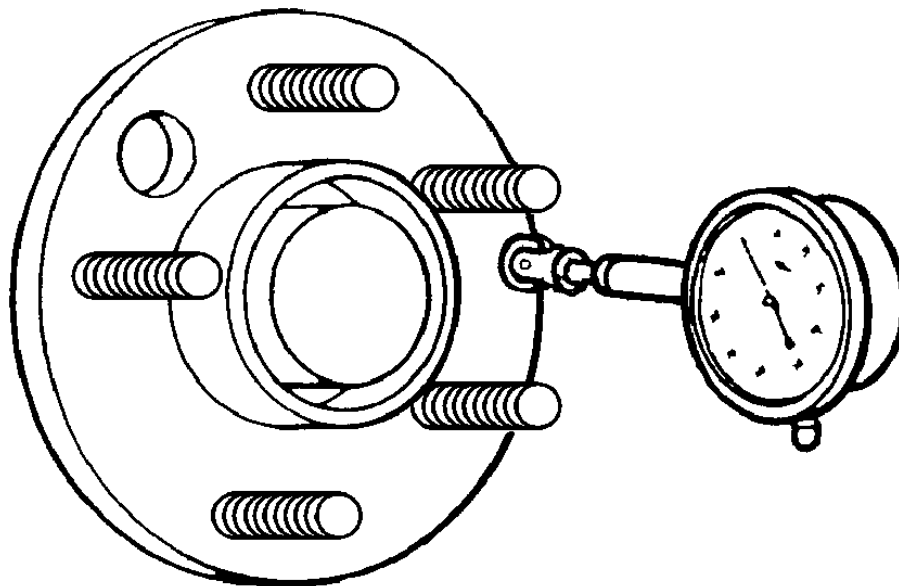


Fig. 13: Measuring Wheel Hub/Axle Flange Runout
Courtesy of GENERAL MOTORS COMPANY

5. Position the **GE-8001** Dial Indicator Set, or equivalent, on the machined surface of the wheel hub/axle flange

outside of the wheel studs.

6. Rotate the hub one complete revolution in order to find the low spot.
7. Set the **GE-8001** Dial Indicator Set, or equivalent, to zero at the low spot.
8. Rotate the hub one more complete revolution and measure the total amount of wheel hub/axle flange runout.

Specification - Guideline

Wheel hub/axle flange runout tolerance guideline: 0.132 mm (0.005 in)

9. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel studs, proceed to step 13.
10. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel bolts, proceed to step 19.
11. If the runout of the wheel hub/axle flange is marginal, the wheel hub may or may not be the source of the disturbance.
12. If the runout of the wheel hub/axle flange is excessive, replace the wheel hub/axle flange. Measure the runout of the new wheel hub/axle flange.

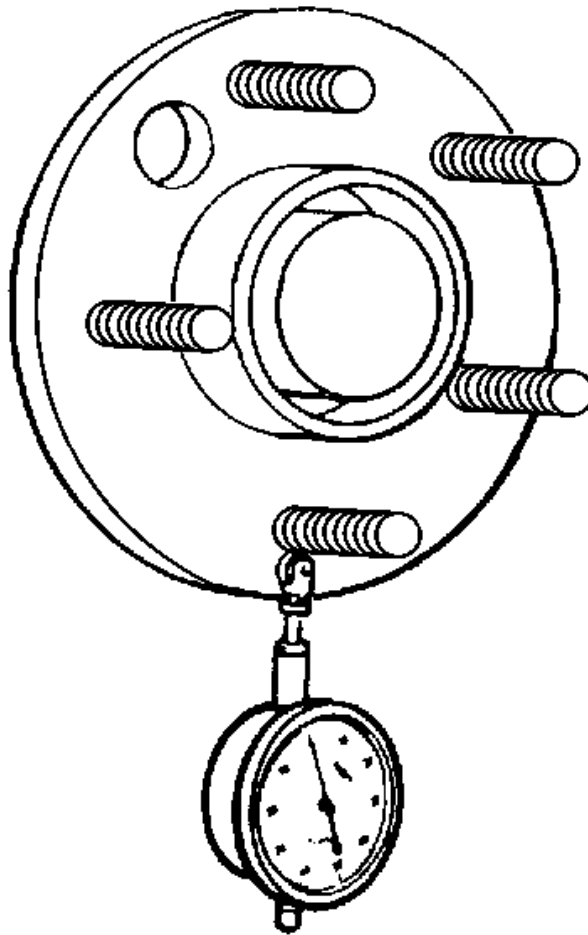


Fig. 14: Measuring Wheel Stud Runout

Courtesy of GENERAL MOTORS COMPANY

13. Position the **GE-8001** Dial Indicator Set, or equivalent, in order to contact the wheel mounting studs.

Measure the stud runout as close to the flange as possible.

14. Turn the hub one complete revolution to register on each of the wheel studs.

15. Zero the **GE-8001** Dial Indicator Set, or equivalent, on the lowest stud.

16. Rotate the hub one more complete revolution and measure the total amount of wheel stud - stud circle - runout.

Specification - Guideline

Wheel stud runout tolerance guideline: 0.254 mm (0.010 in)

17. If the runout of the wheel studs - stud circle - is marginal, the wheel studs may or may not be contributing to the disturbance.

18. If the runout of the wheel studs - stud circle - is excessive, replace the wheel studs as necessary. Measure the runout of the new wheel studs.

19. Inspect the threads and the tapered seat portion on each of the wheel bolts for damage.

20. Wheel bolts exhibiting damaged threads and/or damaged tapered seats require replacement.

21. Place the threaded portion of each wheel bolt along a straight edge to inspect for straightness.

22. Wheel bolts that are not straight require replacement.

TIRE AND WHEEL ASSEMBLY ISOLATION TEST

Force Variation

Force variation refers to a radial or lateral movement of the tire and wheel assembly which acts much like runout, however, force variation has to do with variations in the construction of the tire. These variations in tire construction may actually cause vibration in a vehicle, even though the tire and wheel assembly runout and balance may be within specifications.

Radial Force Variation

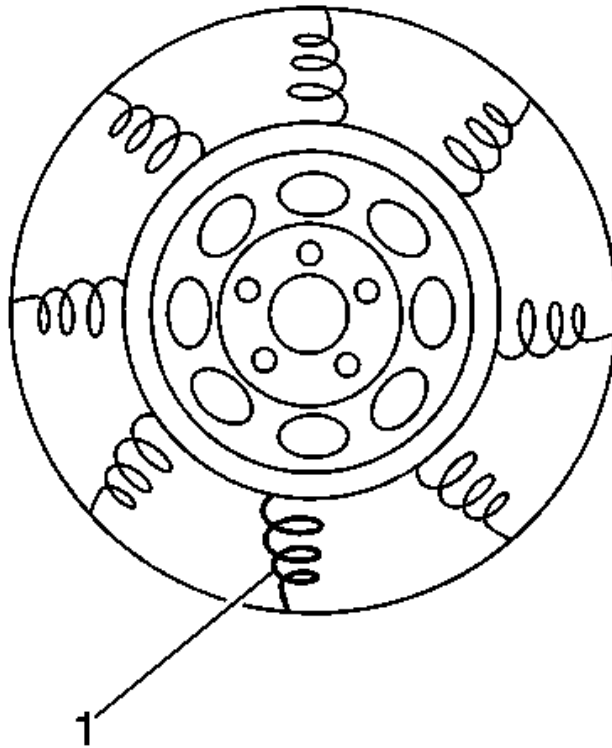


Fig. 15: Identifying Radial Force Variation

Courtesy of GENERAL MOTORS COMPANY

Radial force variation refers to the difference in the stiffness of a tire sidewall as the tire rotates and contacts the road. Tire sidewalls have some stiffness due to splices in the different plies of the tire, but these stiffness differences do not cause a problem unless the force variation is excessive. Stiff spots (1) in a tire sidewall can deflect a tire and wheel assembly upward as the assembly contacts the road.

Lateral Force Variation

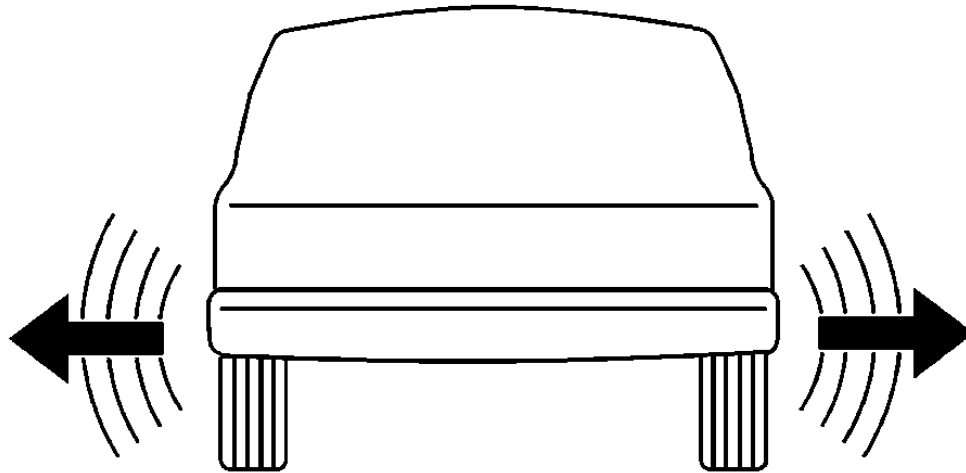


Fig. 16: Identifying Tire Wobble/Waddle

Courtesy of GENERAL MOTORS COMPANY

Lateral force variation refers to the difference in the stiffness or conformity of the belts within a tire as the tire rotates and contacts the road. Tire belts may have some stiffness or conformity differences, but these differences do not cause a problem unless the force variation is excessive. These variations in the belts of the tire can deflect the vehicle sideways or laterally. A shifted belt inside a tire may cause lateral force variation.

In most cases where excessive lateral force variation exists, the vehicle will display a wobble or waddle at low speeds, 8 - 40 km/h (5 - 25 mph), on a smooth road surface.

Isolation Test Procedure

Perform the following test in order to determine if force variation is present in the vehicle.

1. Substitute a set of KNOWN GOOD, pre-tested tire and wheel assemblies of the same size and type for the suspected original assemblies. Refer to [**Tire and Wheel Removal and Installation**](#) .
2. Road test the vehicle to determine if the vibration is still present. Refer to [**Vibration Analysis - Road Testing \(EL-38792-A Electronic Vibration Analyzer\)**](#)[**Vibration Analysis - Road Testing \(CH-51450-NVH Oscilloscope\)**](#).
3. If the vibration is still present while using the known good set of tire and wheel assemblies, then force variation is not the cause of the vibration.

4. If the vibration is eliminated when using the known good set of tire and wheel assemblies, install one of the original tire and wheel assemblies using the matchmarks made prior to removal. Refer to [**Tire and Wheel Removal and Installation**](#) . Road test the vehicle to determine if the vibration has returned. Refer to [**Vibration Analysis - Road Testing \(EL-38792-A Electronic Vibration Analyzer\)Vibration Analysis - Road Testing \(CH-51450-NVH Oscilloscope\)**](#).
5. Continue the process of installing the original tire and wheel assemblies one at a time, then road testing the vehicle, until the tire and wheel assembly, or assemblies which is causing the vibration has been identified.
6. Replace the tire, or tires on the vibration-causing tire and wheel assembly, or assemblies, then balance the assembly, or assemblies. Refer to [**Tire and Wheel Assembly Balancing - Off Vehicle**](#).

REPAIR INSTRUCTIONS

TIRE AND WHEEL ASSEMBLY BALANCING - OFF VEHICLE

WARNING: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

- Clean away any dirt or deposits from the inside of the wheels.
- Remove any stones from the tread.
- Wear eye protection.
- Use coated weights on aluminum wheels.

Tire and Wheel Assembly Balancer Calibration

Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

NOTE: If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's recommendations, or perform the following test.

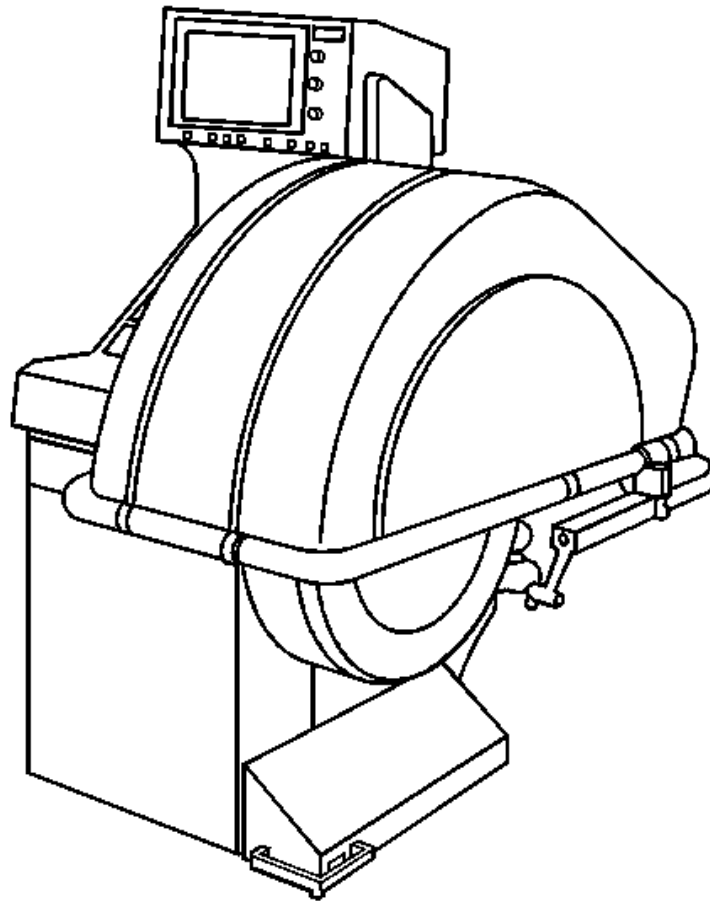


Fig. 17: View Of Tire & Wheel Assembly Balancer
Courtesy of GENERAL MOTORS COMPANY

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

Specification

Zero within 7 g (1/4 oz)

3. If the balancer is within the specification range, balance a tire and wheel assembly - that is within radial and lateral runout tolerances - to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
 - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
 - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.
6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.
7. Inspect the balancer readings:

Specification

Maximum variation: 7 g (1/4 oz)

8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.
9. Cycle the balancer with the assembly at the new location.
10. Inspect the balancer readings:

Specification

Maximum variation: 7 g (1/4 oz)

11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

NOTE: Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.

It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to [**Tire and Wheel Assembly Runout Measurement - Off Vehicle**](#) before proceeding.

There are 2 types of tire and wheel balance:

Static Balance

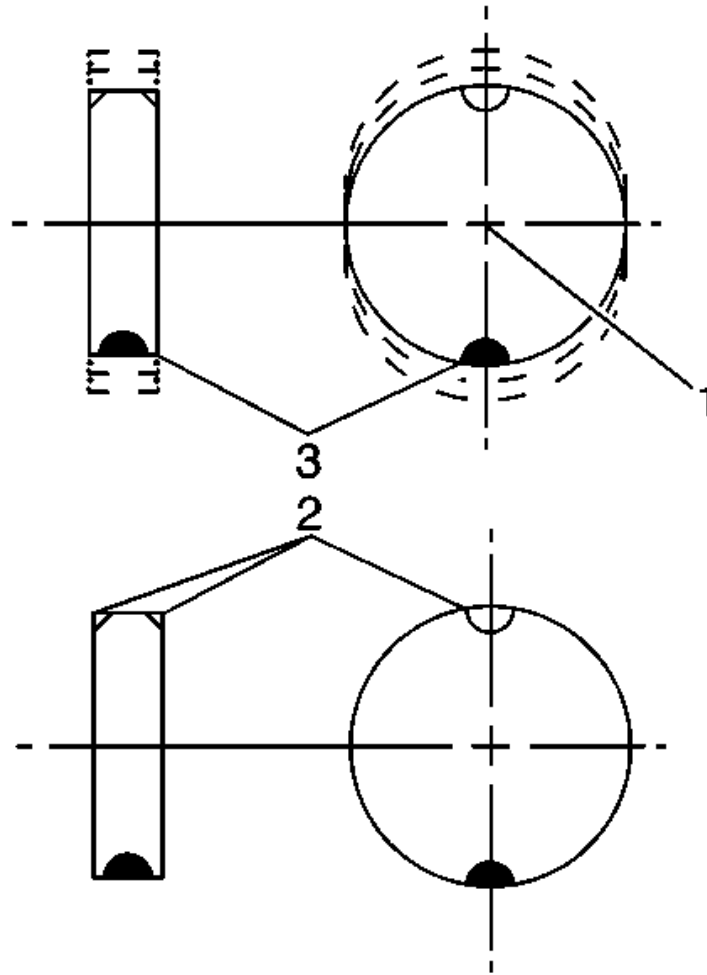


Fig. 18: View Of Static Balance

Courtesy of GENERAL MOTORS COMPANY

Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

Dynamic Balance

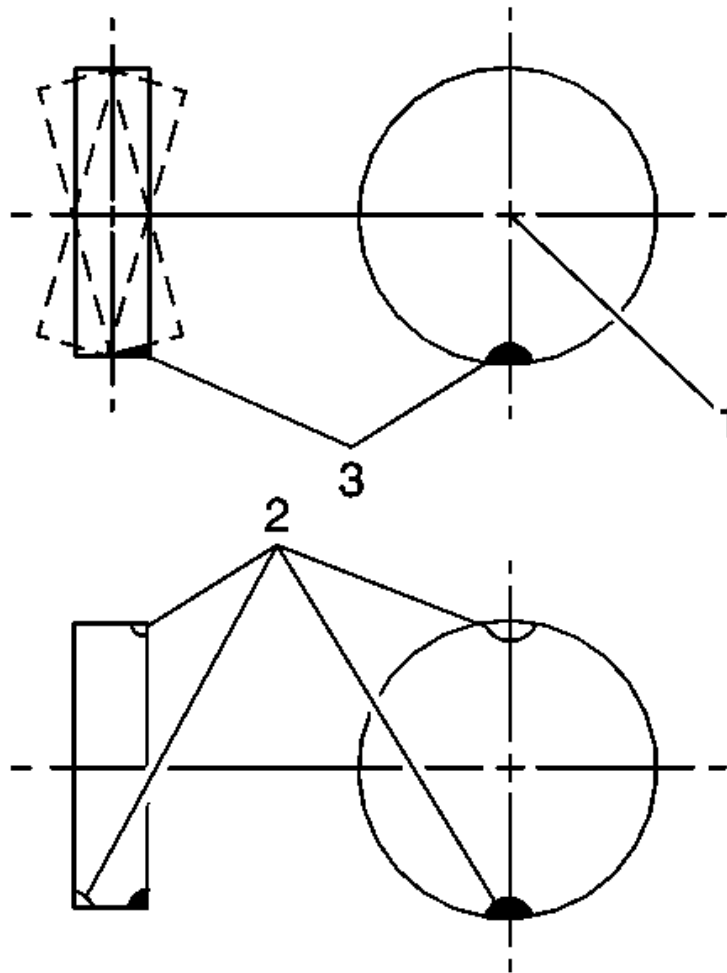


Fig. 19: View Of Dynamic Balance

Courtesy of GENERAL MOTORS COMPANY

Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14 - 21 g (1/2 - 3/4 oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

NOTE: When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to [Tire and Wheel Removal and Installation](#) .
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.

Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight Usage.
6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. Refer to [Tire and Wheel Removal and Installation](#) .
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

Clip-on Weights

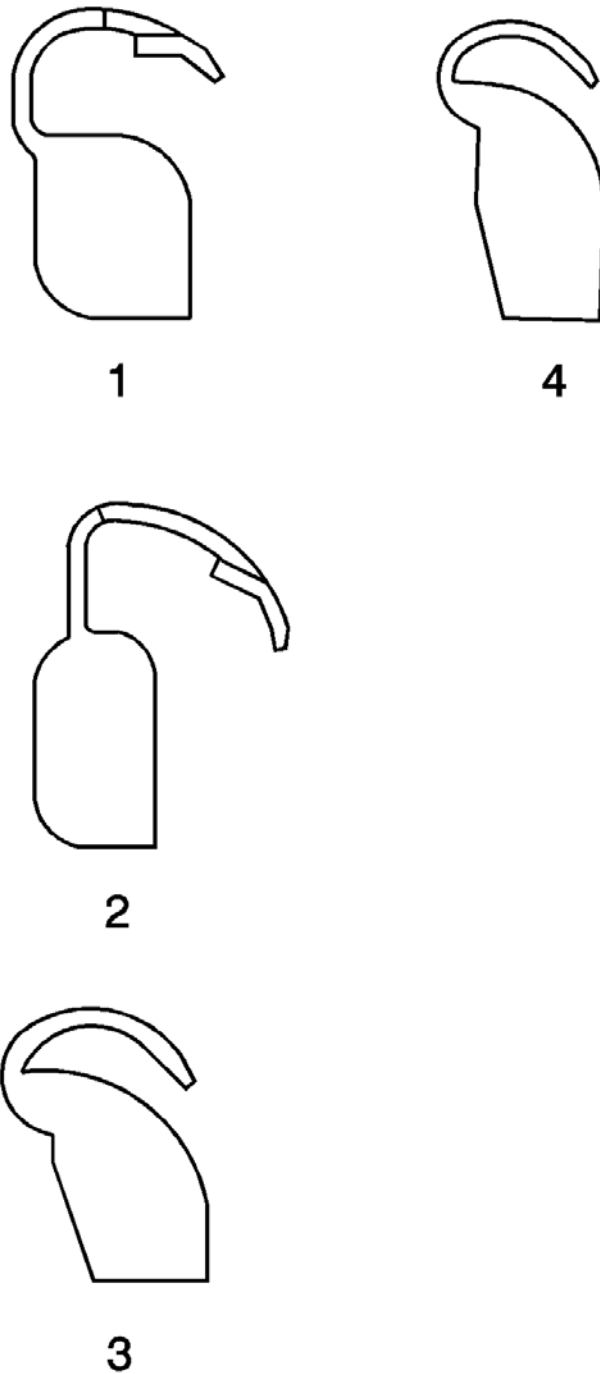


Fig. 20: Identifying Clip-On Wheel Weight Types

Courtesy of GENERAL MOTORS COMPANY

NOTE: When balancing factory aluminum wheels with clip-on wheel balance weights, be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.

- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.

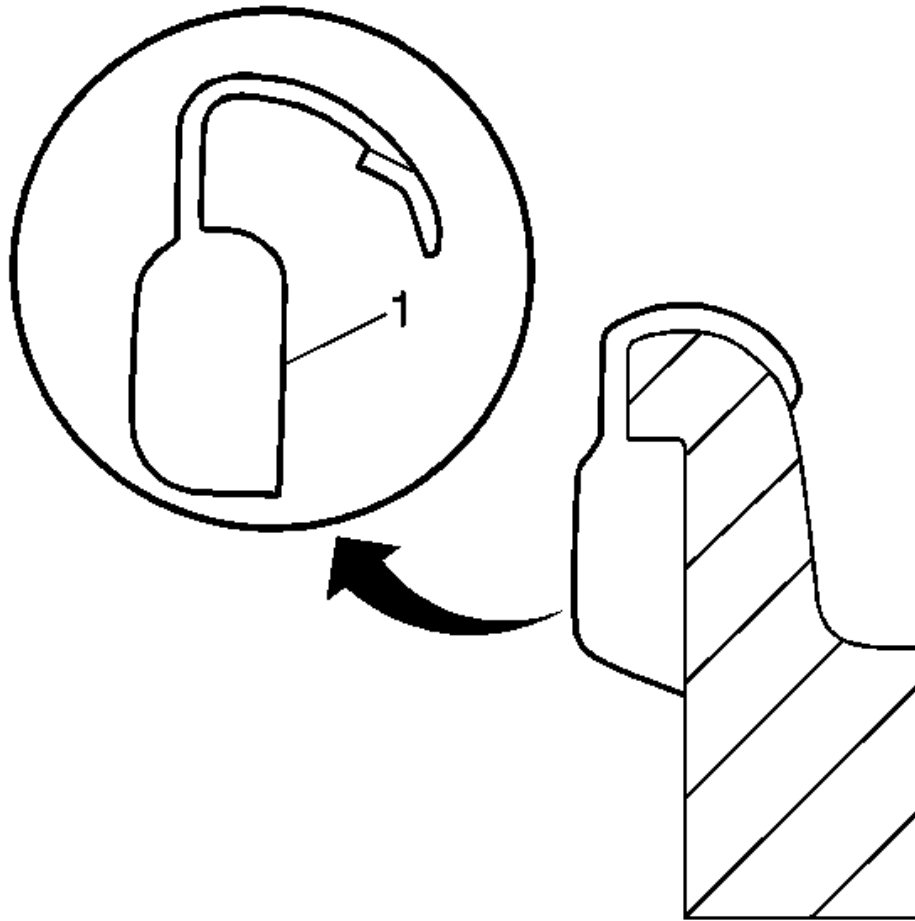


Fig. 21: Attaching Clip-On Wheel Weight

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement - Clip-on Weights

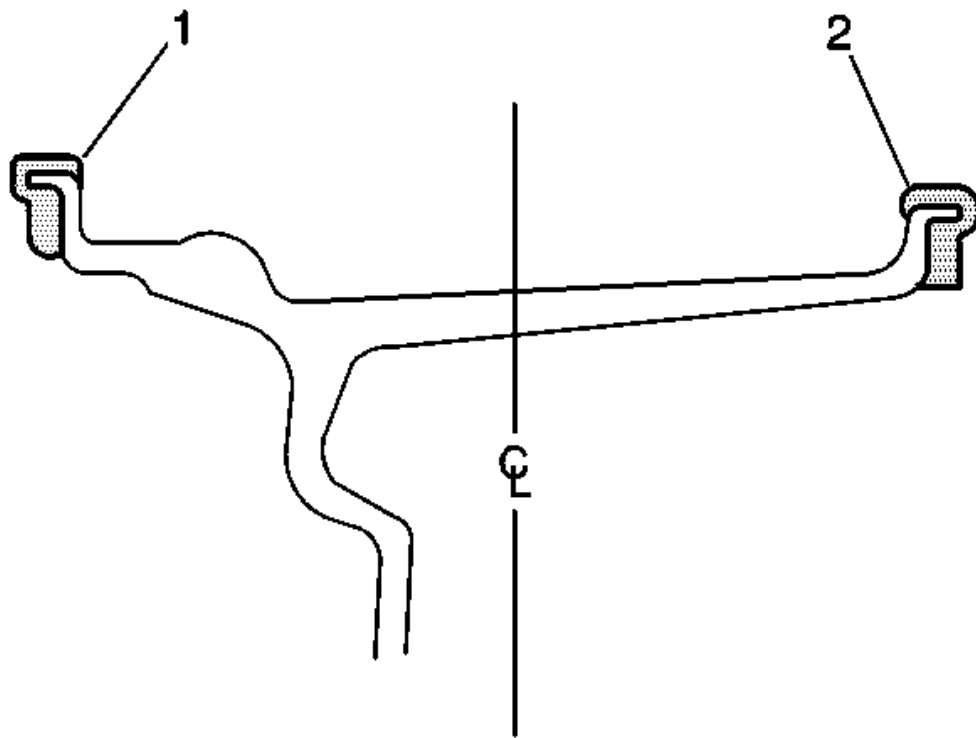


Fig. 22: Clip-On Weight Placement

Courtesy of GENERAL MOTORS COMPANY

When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights

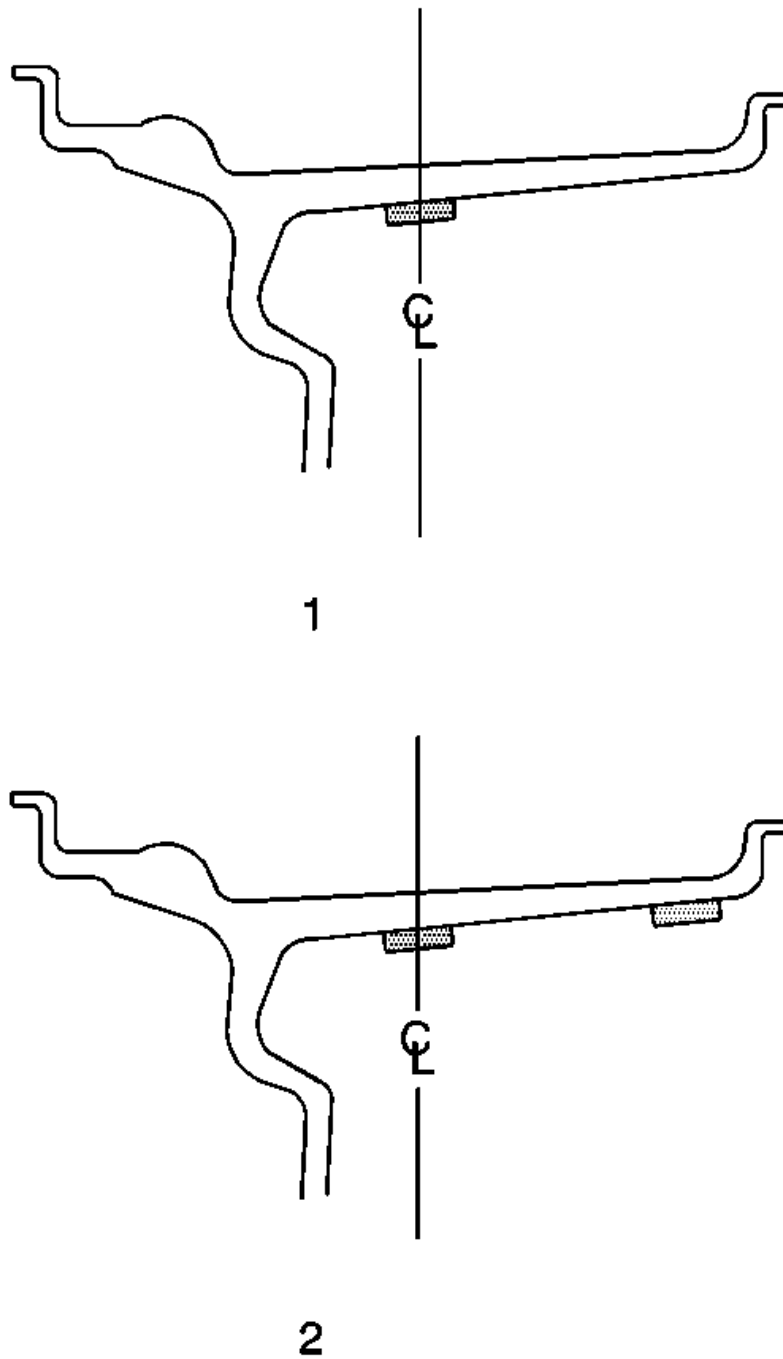


Fig. 23: Identifying Adhesive Weight Wheel Placement

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing adhesive balance weights on flangeless wheels, do NOT install the weight on the outboard surface of the rim.

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.

- When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
 - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel balancer.
2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

NOTE: Do not use abrasives to clean any surface of the wheel.

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

TIRE AND WHEEL ASSEMBLY BALANCING - ON-VEHICLE

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

If after following the tire and wheel vibration diagnostic process, some amount of tire and wheel vibration is still evident, an on-vehicle high-speed spin balancer may be used to perform an on-vehicle balance in an attempt to finish balance the tire and wheel assemblies, wheel hubs, brake rotors, brake drums, if equipped, and wheel trim, if equipped, simultaneously. On-vehicle balancing can also compensate for minor amounts of residual runout encountered as a result of mounting the tire and wheel assembly on the vehicle, as opposed to the balance which was achieved on the off-vehicle balancer.

In order to perform an on-vehicle balancing procedure, carefully follow the on-vehicle balancer manufacturer's specific operating instructions and carefully consider the following information before proceeding:

- Vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance.
- When performing an on-vehicle balance, great care must be taken when placing the wheel balance weights on the wheels. If the wheel balance weights are not placed accurately, they can actually induce dynamic imbalance and thus increase the severity of the vibration.
- Inspect the vehicle wheel bearings to ensure that they are in good condition.
- Thoroughly inspect all on-vehicle balancing equipment and ensure that it is fully within the manufacturer's recommended specifications.
- Do not remove the off-vehicle balance weights. The purpose of on-vehicle balance is to fine tune the assembly balance already achieved off-vehicle, not to start over.
- Leave all wheel trim installed whenever possible.

- If the on-vehicle balancer calls for more than 56 g (2 oz) of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly achieved in the off-vehicle balance. For wheel balance weight information, refer to [Tire and Wheel Assembly Balancing - Off Vehicle](#).
- If available, tape-off an area on top of the fenders and the quarter panels, then place the vibration sensor of the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 on the fender or quarter panel above the specific tire and wheel assembly while it is being on-vehicle balanced.

The **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 will provide a visual indication of the amplitude of the vibration, and the effect that the on-vehicle balance has on it.

TIRE-TO-WHEEL MATCH-MOUNTING (VECTORING)

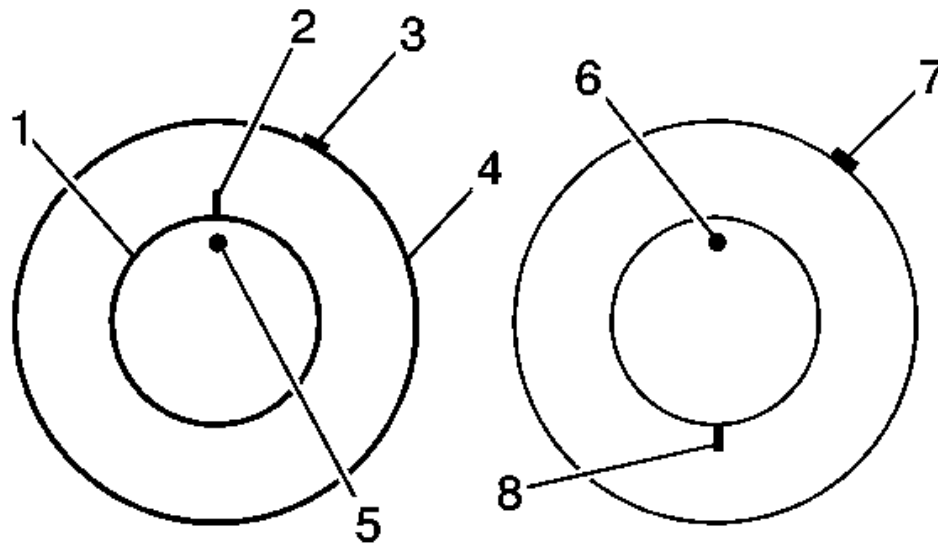


Fig. 24: View Of Tire-to-Wheel Match-Mounting

Courtesy of GENERAL MOTORS COMPANY

NOTE: After remounting a tire to a wheel or after replacing a tire and/or a wheel, remeasure the tire and wheel assembly runout in order to verify that the amount of runout has been reduced and brought to within tolerances. Ensure that the tire and wheel assembly is properly balanced before reinstalling to the vehicle.

1. Mark the location of the high spot (3) on the tire as determined during the off-vehicle tire and wheel assembly

runout measurement.

2. Place a reference mark (2) on the tire sidewall at the location of the valve stem (5).
 - Always refer to the valve stem as the 12 o'clock position.
 - Refer to the location of the high spot (3) by its clock position on the wheel, relative to the valve stem.
3. Mount the tire and wheel assembly on a tire machine and break down the bead. Do not dismount the tire from the wheel at this time.
4. Rotate the tire 180 degrees on the rim so that the valve stem reference mark (8) is now at the 6 o'clock position in relation to the valve stem (6). You may need to lubricate the bead in order to easily rotate the tire on the wheel.
5. Reinflate the tire and seat the bead properly.
6. Mount the assembly on the tire balancer and remeasure the runout. Mark the new location of the assembly runout high spot on the tire.
7. If the assembly runout has been reduced and is within tolerance, no further steps are necessary. Balance the tire and wheel assembly, then install the assembly to the vehicle. Refer to the following:
 - [Tire and Wheel Assembly Balancing - Off Vehicle](#)
 - [Tire and Wheel Removal and Installation](#)
8. If the clock location of the high spot remained at or near the original clock location of the high spot (7) and the assembly runout has NOT been reduced, the wheel is the major contributor to the assembly runout concern.

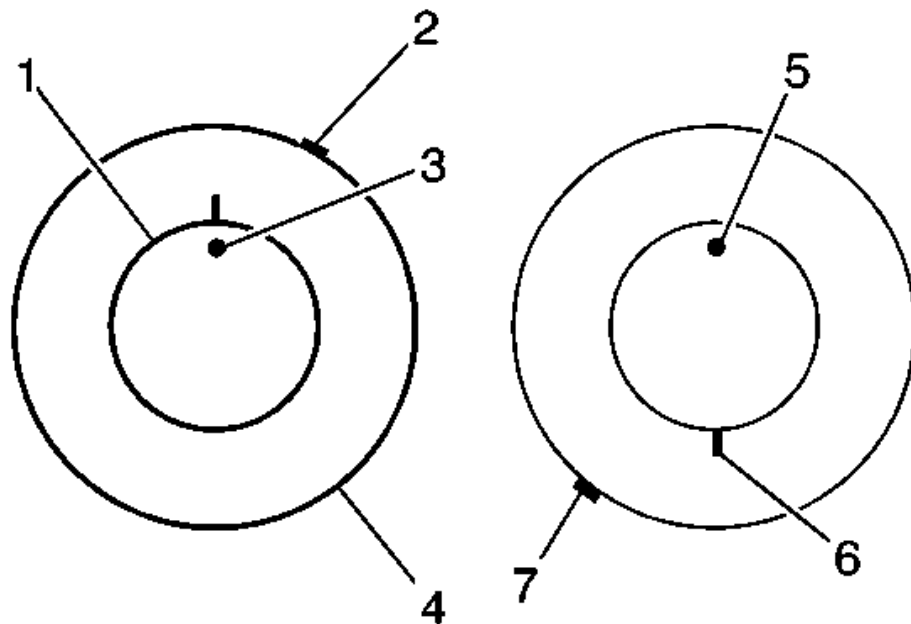


Fig. 25: View Of Match-Mounting Tire-To-Wheel

Courtesy of GENERAL MOTORS COMPANY

9. If the clock location of the high spot has moved, however the assembly runout has NOT been reduced, perform the following steps:
 1. If the clock location of the high spot (7) is now at or near a position 180 degrees from the original clock location of the high spot, the tire is the major contributor to the assembly runout concern.
 2. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and the wheel are both contributing to the assembly runout concern. Rotate the tire an additional 90 degrees in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly runout.

TIRE AND WHEEL ASSEMBLY-TO-HUB/AXLE FLANGE MATCH-MOUNTING

NOTE: After remounting a tire and wheel assembly to a hub/axle flange, remeasure the tire and wheel assembly on-vehicle runout in order to verify that the amount of runout has been reduced and brought to within tolerances.

1. Mark the location of the high spot on the tire and wheel assembly as determined during the on-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark on the wheel stud that is located closest to the wheel valve stem.
 - Always refer to the reference mark on the wheel stud as the 12 o'clock position.
 - Refer to the location of the high spot by its clock position on the tire and wheel assembly, relative to the marked wheel stud.
3. Remove the tire and wheel assembly from the hub/axle flange. Refer to [Tire and Wheel Removal and Installation](#).
4. Rotate the tire and wheel assembly as close to 180 degrees as possible on the hub/axle flange, so that the wheel valve stem is now approximately at the 6 o'clock position in relation to the marked wheel stud.
5. Reinstall the wheel lug nuts to secure the tire and wheel assembly in the new position. Refer to [Tire and Wheel Removal and Installation](#).
6. Remeasure the tire and wheel assembly on-vehicle runout. Mark the new location of the assembly on-vehicle runout high spot on the tire. Refer to [Tire and Wheel Assembly Runout Measurement - On-Vehicle](#).
7. If the assembly on-vehicle runout has been reduced and is within tolerance, no further steps are necessary.
8. If the assembly runout has NOT been reduced, perform the following steps:
 1. If the clock location of the high spot remained at or near the original clock location of the high spot, the hub/axle flange and/or the brake rotor/drum mounting flange is the major contributor to the assembly on-vehicle runout concern.
 2. If the clock location of the high spot is now at or near a position 180 degrees from the original clock location of the high spot, the tire and wheel assembly is the major contributor to the assembly on-vehicle runout concern.
 3. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and wheel assembly and the hub/axle flange are contributing to the assembly on-vehicle runout concern. Rotate the tire and wheel assembly as close to an additional 90 degrees as possible in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly on-vehicle runout.

DESCRIPTION AND OPERATION

VIBRATION THEORY AND TERMINOLOGY

Vibration Theory

The designs and engineering requirements of vehicles have undergone drastic changes over the last several years.

Vehicles are stiffer and provide more isolation from road input than they did previously. The structures of today's stiffer vehicles are less susceptible to many of the vibrations which could be present in vehicles of earlier designs, however, vibrations can still be detected in a more modern vehicle if a transfer path is created between a rotating component and the body of the vehicle.

There are not as many points of isolation from the road in many vehicles today. If a component produces a strong enough vibration, it may overcome the existing isolation and the component needs to be repaired or replaced.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall quality of the vehicle.

Vibration is the repetitive motion of an object, back and forth, or up and down. The following components cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

Rotating components will cause vibrations when excessive imbalance or runout is present. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a TOLERANCE and not a SPECIFICATION. In other words, the less imbalance or runout the better.

Rotating components will cause a vibration concern when they are not properly isolated from the passenger compartment: Engine firing pulses can be detected as a vibration if a motor mount is collapsed.

A vibrating component operates at a consistent rate (km/h, mph, or RPM). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates does not mean the source of vibration is in the seat.

Vibrations consist of the following three elements:

- The source - the cause of the vibration
- The transfer path - the path the vibration travels through the vehicle
- The responder - the component where the vibration is felt

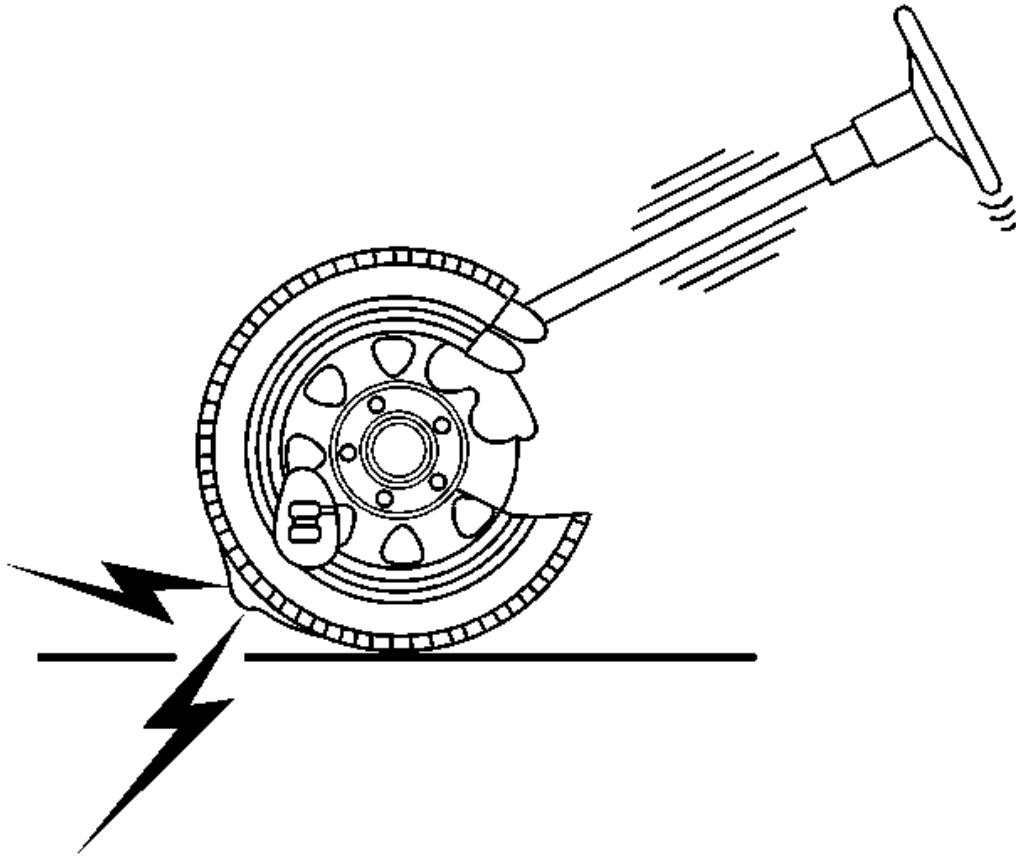


Fig. 26: Identifying Unbalanced Tire Vibration

Courtesy of GENERAL MOTORS COMPANY

In the preceding picture, the source is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.

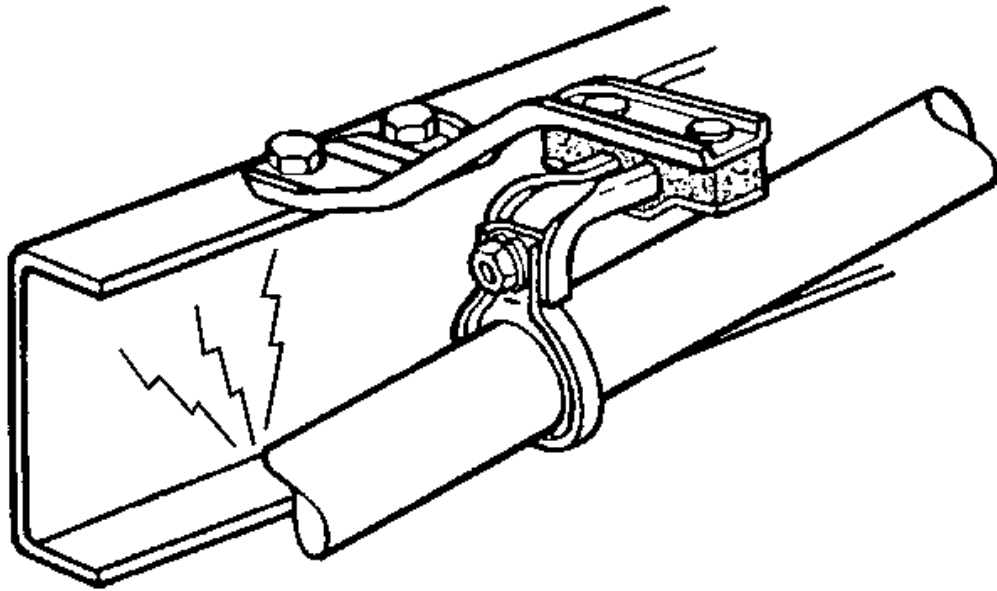


Fig. 27: Identifying Exhaust Pipe Noise

Courtesy of GENERAL MOTORS COMPANY

Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe grounded to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Basic Vibration Terminology

The following are the 2 primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame

- The IP

Vibration diagnosis involves the following simple outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of the rotational speed of a component that is operating at the same rate or speed.
3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:

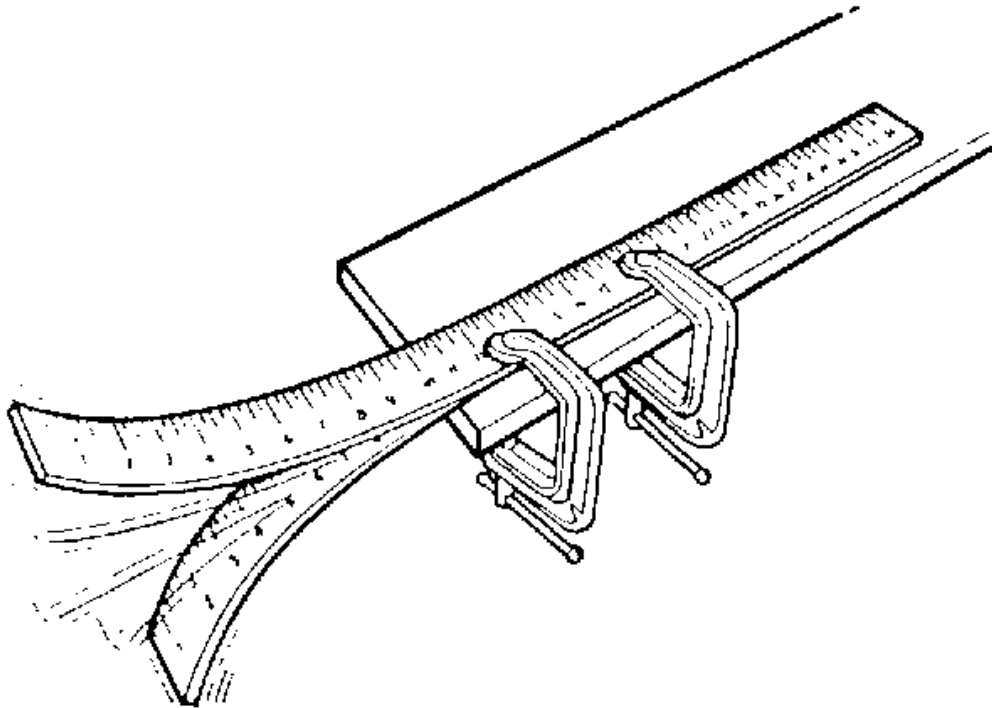


Fig. 28: Demonstrating Vibration Theory

Courtesy of GENERAL MOTORS COMPANY

1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one second. If we

measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. Redo the experiment as follows:

- 1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
- 2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1, 800 cycles per minute).

Cycle

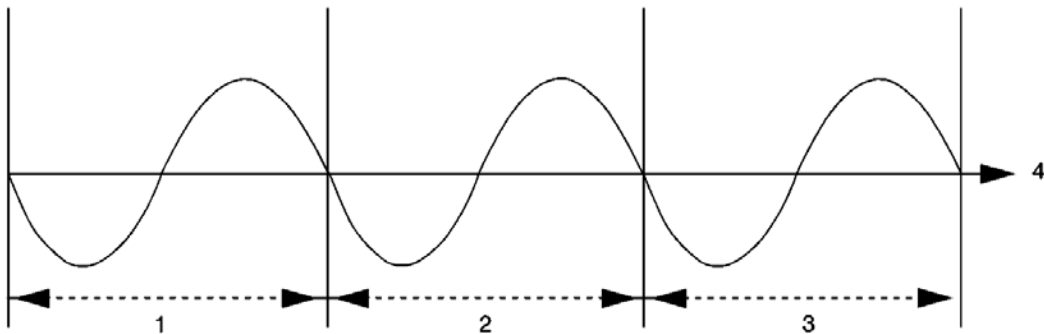


Fig. 29: Identifying Powertrain Vibration Cycles
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1st Cycle
2	2nd Cycle
3	3rd Cycle
4	Time

Vibration Cycles in Powertrain Components

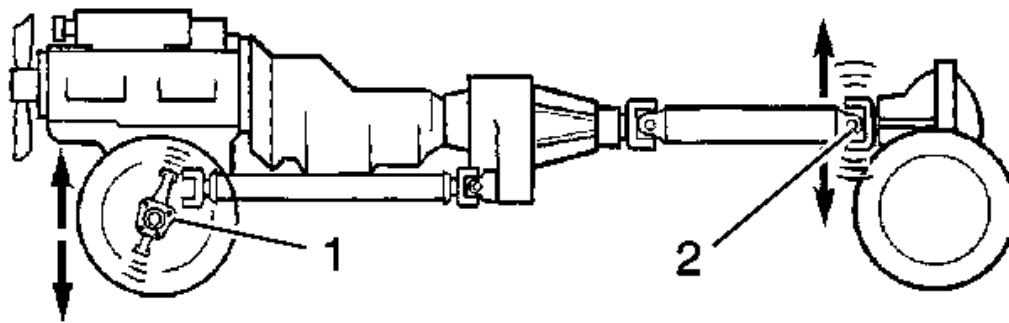


Fig. 30: Identifying Vibration Cycles In Powertrain Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Spindle
2	Pinion Nose

The word cycle comes from the same root as the word circle. A circle begins and ends at the same point, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency

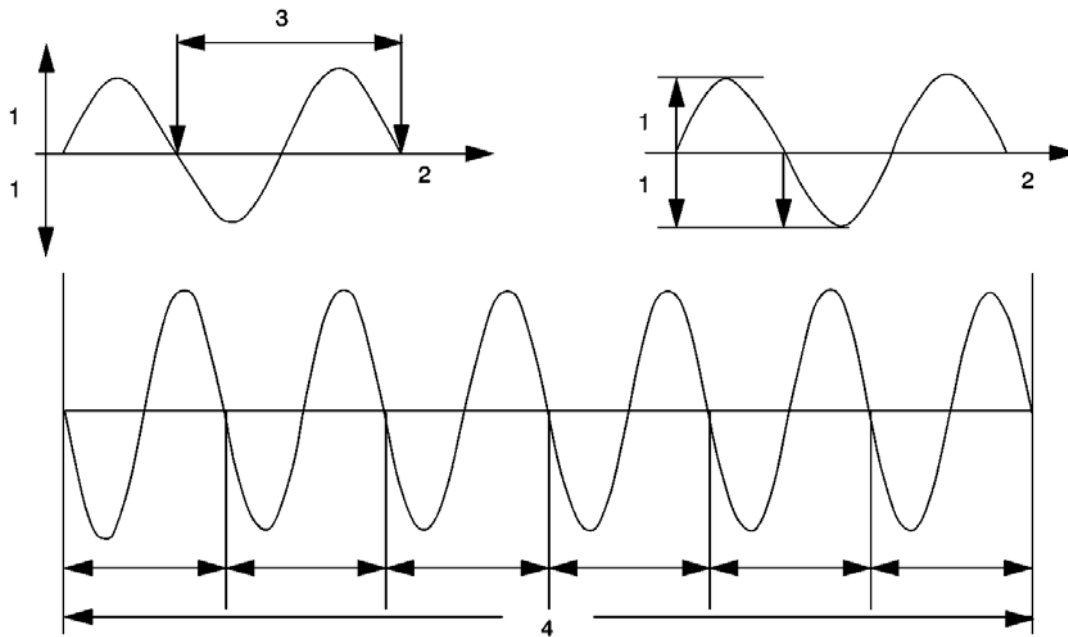


Fig. 31: Identifying Vibration Frequency

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Amplitude
2	Reference
3	Time in Seconds
4	1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is 1 second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude

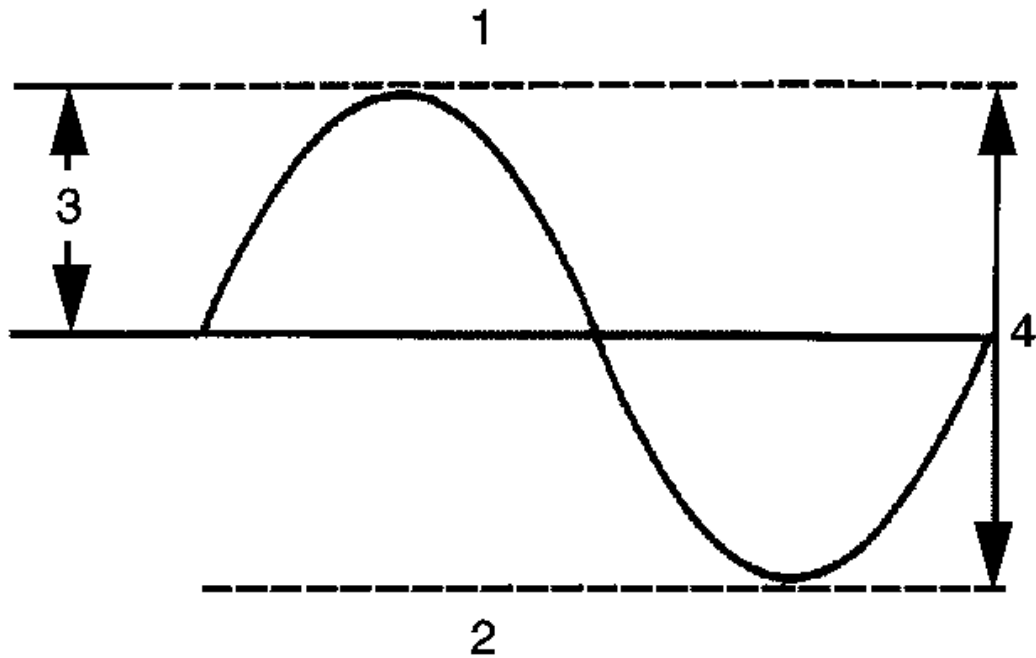


Fig. 32: Identifying Vibration Amplitude

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Maximum
2	Minimum
3	Zero-to-Peak Amplitude
4	Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, we are referring it to the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance

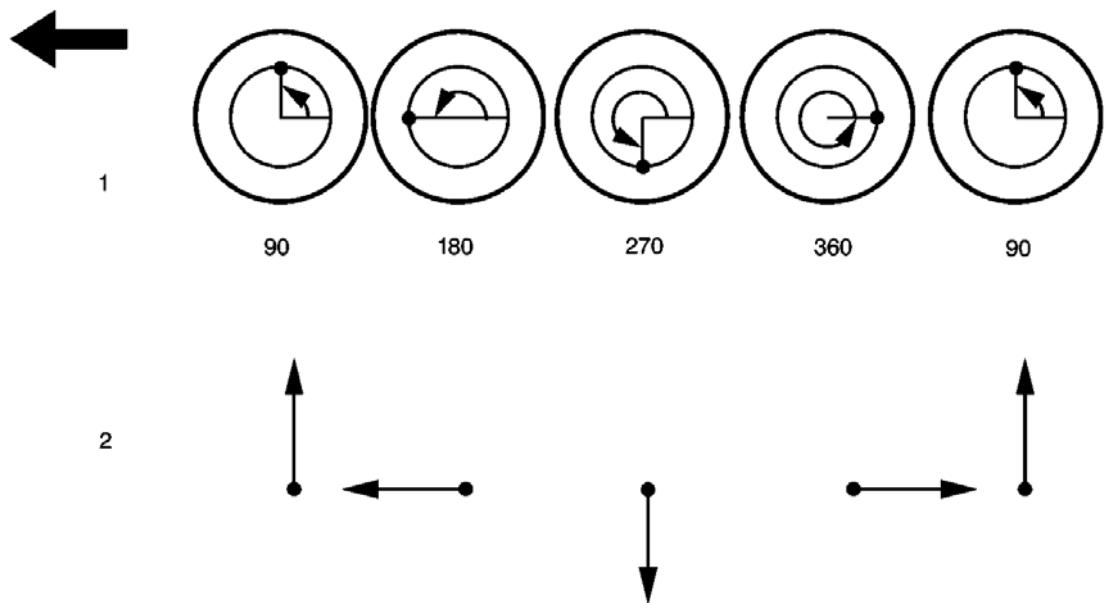


Fig. 33: Identifying Centrifugal Force Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Location of Imbalance (Degrees)
2	Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will spin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency

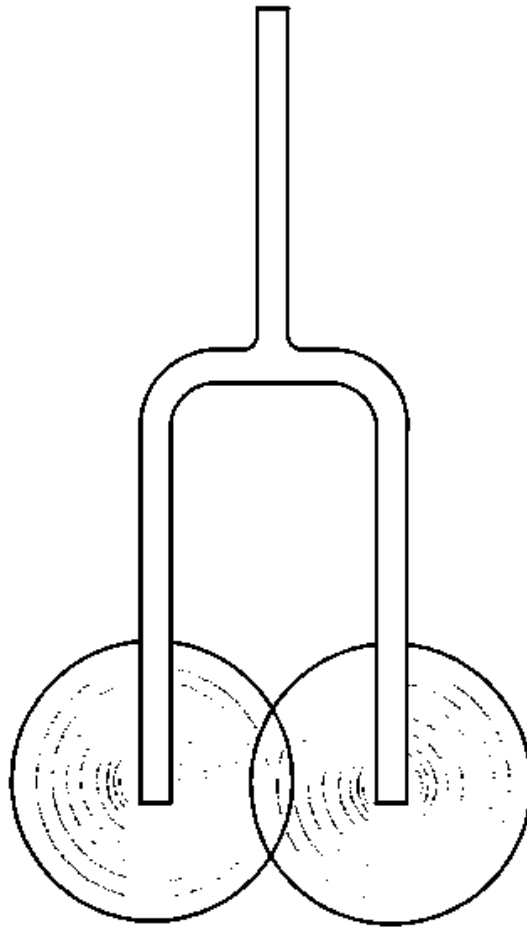


Fig. 34: View Of Natural Frequency

Courtesy of GENERAL MOTORS COMPANY

The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within the mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine RPM.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower the natural frequency. Conversely, the greater the mass, the lower the natural frequency.

Resonance

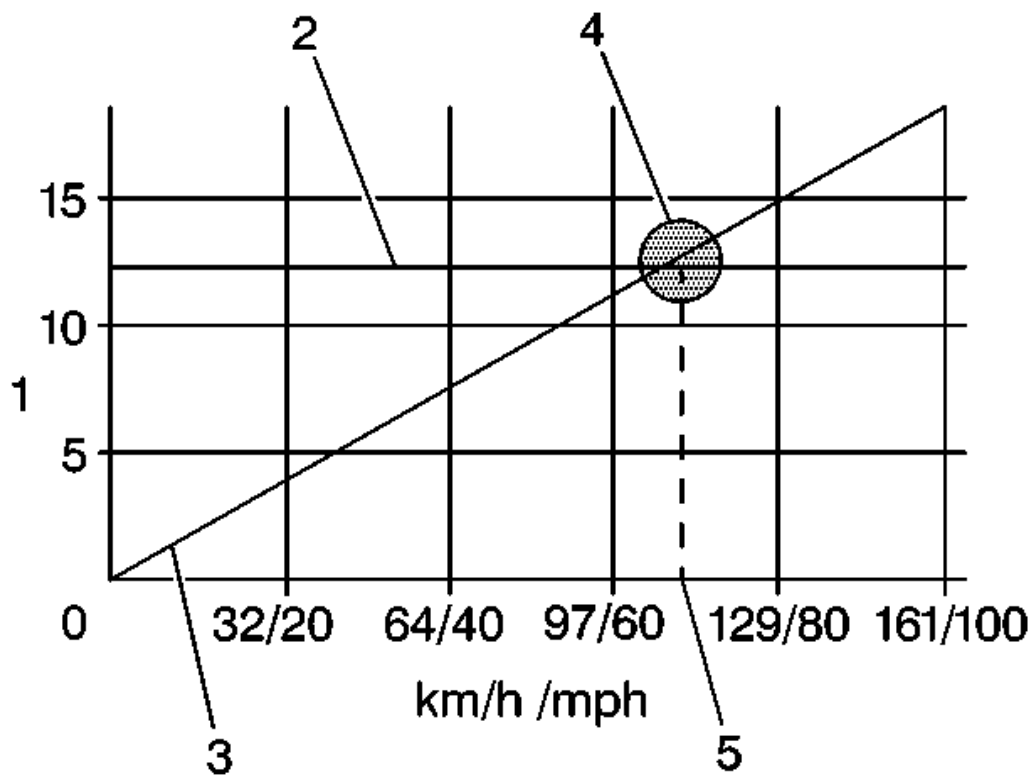


Fig. 35: Natural Frequency Of A Typical Automotive Front Suspension

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Frequency - cps
2	Suspension Frequency
3	Unbalanced Excitation
4	Point of Resonance
5	Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10 - 15 Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude of a vibration will be greatest at the point of resonance. While the vibration may be felt above and below the problem speed, the vibration may be felt the most at the point of resonance.

Damping

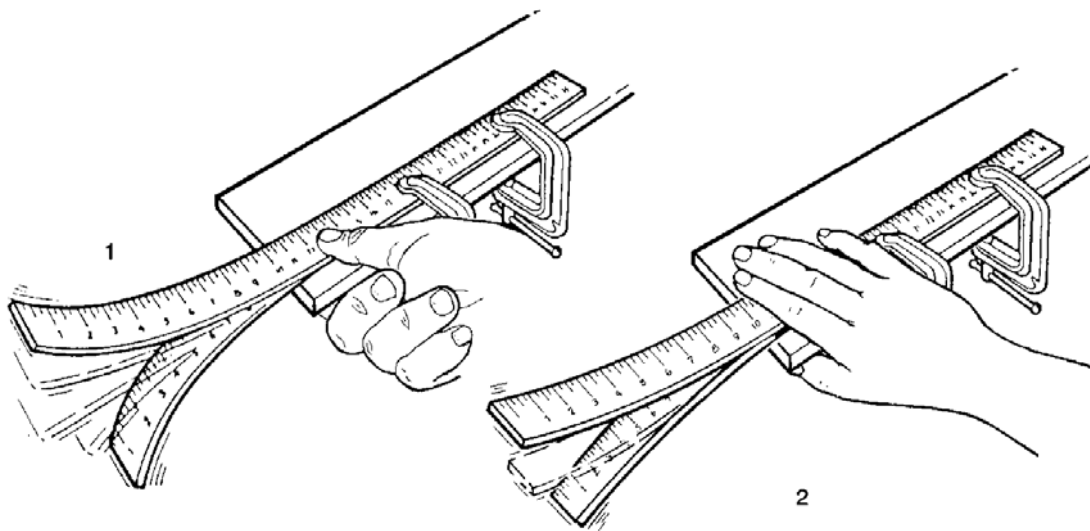


Fig. 36: Identifying Low & High Damping
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Low Damping
2	High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)

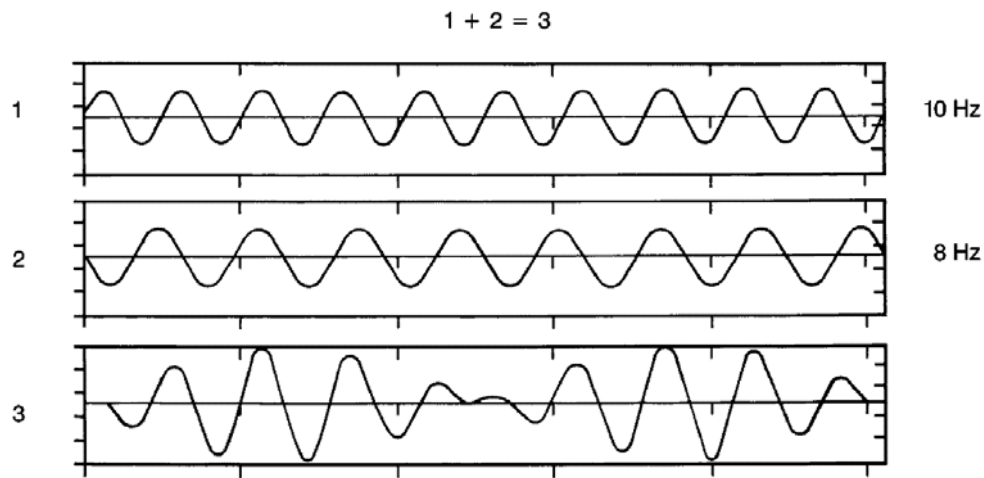


Fig. 37: Identifying Beating Or Phasing

Courtesy of GENERAL MOTORS COMPANY

Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when 2 vibrating forces are adding to each other's amplitude. However, 2 vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

Order

Order refers to how many times an event occurs during 1 revolution of a rotating component.

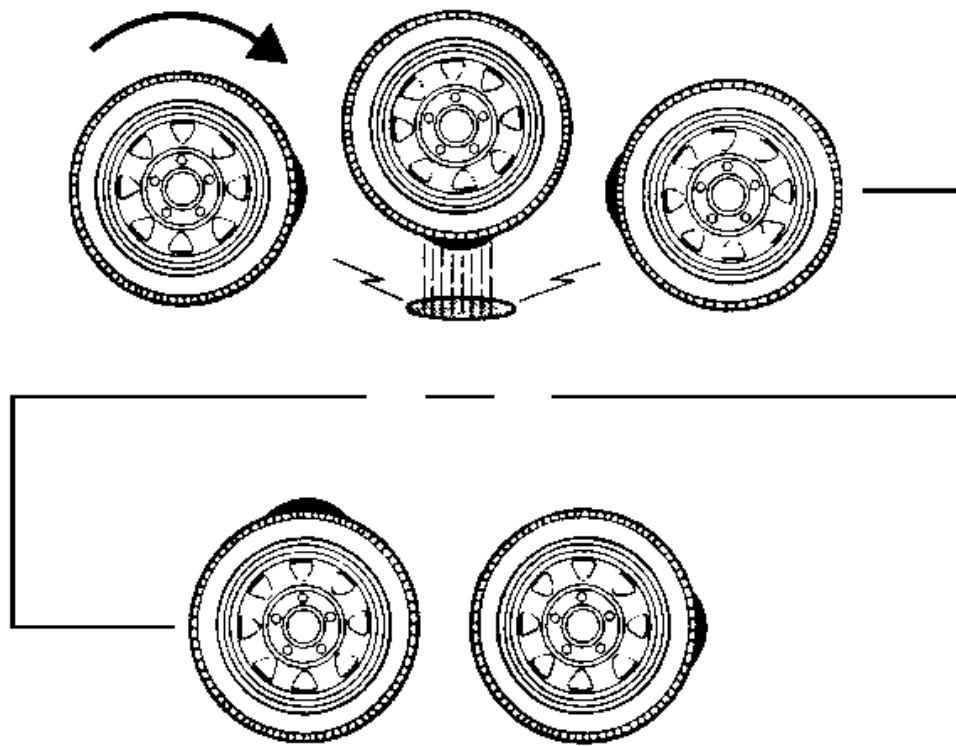


Fig. 38: Identifying First-Order Vibration
Courtesy of GENERAL MOTORS COMPANY

For example, a tire with 1 high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.

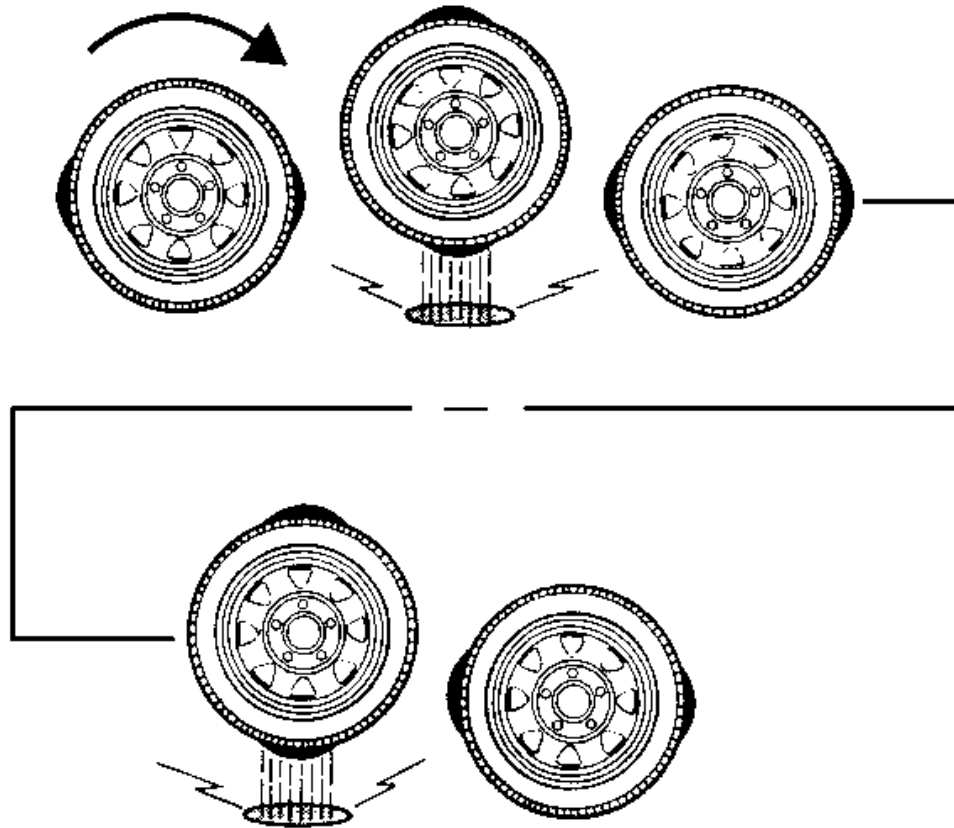


Fig. 39: Identifying Second-Order Vibration

Courtesy of GENERAL MOTORS COMPANY

An oval-shaped tire with 2 high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

ELECTRONIC VIBRATION ANALYZER (EVA) DESCRIPTION AND OPERATION

Special Tools

- **EL-38792-25** Inductive Pickup Timing Light
- **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2)

For equivalent regional tools, refer to [**Special Tools and Equipment**](#).

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2), is a 12 - volt powered hand-held device, similar to a scan tool, which receives input from an attached vibration sensor or accelerometer and displays the most dominate input frequency(ies) (up to three) on its liquid crystal display. The vibration concern frequency(ies) are obtained through the use of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) while following the Vibration Analysis Diagnostic Tables. The frequency(ies) obtained, when applied to the Vibration Analysis Diagnostic Tables, are used as a primary

input to help determine the source of the vibration concern.

EVA Vibration Sensor

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor incorporates a 6.1 m (20 ft) cord, that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt.

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) contains 2 sensor input ports which can be activated individually to allow for 2 individual vibration sensor inputs. The vibration sensors can then be placed in 2 different locations in the vehicle and their individual inputs can be read without having to stop a test, move the sensor and resume the test. The use of 2 vibration sensors can help in more quickly finding and recording an accurate frequency of the vibration concern, and in more quickly making comparisons between 2 different areas of a single component, or a vehicle system, during the diagnostic process.

EVA Vibration Sensor Placement

Proper placement of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor (accelerometer) is critical to ensure that proper vibration readings are obtained by the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). The vibration sensor should be placed on the specific vehicle component identified as being the most respondent to the vibration. If no component has been identified, install the sensor to the steering column as a starting point.

EVA Vibration Sensor-to-Component Attachment

NOTE: **The EL-38792-A Electronic Vibration Analyzer 2 (EVA 2) vibration sensor must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.**

The vibration sensor of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is designed to pickup disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor is therefore directional sensitive and must be attached to vehicle components such that the side of the sensor marked UP is always facing upright and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated or comparisons are made to other vehicles.

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using a magnet supplied with the sensor.

EVA Software Cartridge

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) uses a software cartridge, the GE-38792-60, which provides various information to the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). The GE-38792-60 provides the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) with an additional feature which can be selected and utilized to assist in diagnosing vibration concerns.

NOTE: **The Auto-Mode function of the EL-38792-A Electronic Vibration Analyzer 2 (EVA 2) cartridge, GE-38792-60, is designed to be used in SUPPORT of the Vibration Analysis Diagnostic Tables ONLY.**

This support-feature is available through the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) Auto-Mode function. When selected, the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) will prompt the user to select

which one of 2 vehicle systems (vehicle speed or engine speed), is the SUSPECTED source of the vibration concern. Using the inputted vehicle data parameters along with the most dominate vibration frequency obtained, it will identify a SUSPECTED source of the vibration concern, such as first-order tire and wheel. This can be a useful feature when used in conjunction with the Vibration Analysis Diagnostic Tables, to confirm results obtained through the diagnostic process.

EVA Smart Strobe Function

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify some rotating components/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **EL-38792-25** Inductive Pickup Timing Light, or equivalent included with the GE-38792-25 - KIT, or available separately. Using the Smart Strobe function enables the user to input the vibration frequency to which the strobe will flash. By marking the suspected rotating component, such as a pulley, adjusting the strobe frequency to match the dominant vibration frequency at the engine RPM noted during diagnosis, and then operating the engine at that specific RPM, the mark on the object will appear to be stationary if that object is imbalanced.

EVA Strobe Balancing Function

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify the light spot on a propeller shaft IF the propeller shaft rotational speed is the dominant frequency of the vibration concern. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **GE-38792-25** Inductive Pickup Timing Light, or equivalent included with the J-38792-25 - KIT, or available separately, and in conjunction with the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor to identify the light spot on a propeller shaft and to help in making a determination as to when propeller shaft balance is obtained.

Averaging/Non-Averaging Modes

The EVA provides 2 modes of displaying the most dominate frequencies which the EVA vibration sensor (accelerometer) detects; averaging and non-averaging (instantaneous).

The averaging mode uses multiple vibration samples taken over a period of time and then displays the most dominant frequencies which have been averaged-out. Using the averaging mode minimizes the distractions caused by a sudden vibration frequency being displayed that is not related to the concern vibration, such as from pot holes or from uneven road surfaces.

The non-averaging (instantaneous) mode is more sensitive to vibration disturbances than the averaging mode. Using the non-averaging mode will generate instantaneous frequency displays which are not averaged across multiple samples over a period of time; the specific vibration frequencies that occur at a specific moment during diagnostic testing will be displayed at that moment. The non-averaging (instantaneous) mode is useful when measuring a vibration disturbance that exists for only a short period of time or during acceleration/deceleration testing.

When operating the EVA in the averaging mode along with the Auto Mode, "A" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the averaging mode and the Manual Mode, "AVG" will be displayed along the top center of the screen.

When operating the EVA in the non-averaging (instantaneous) mode along with the Auto Mode, "I" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the non-averaging (instantaneous) mode and the Manual Mode, the top center of the screen will be blank.

EVA Display

R	P	M	A	A	V	G								G	'	S	
1	8	0	0											1	.	3	2
3	6	0												0	.	2	5
1	2	0	0											0	.	0	9

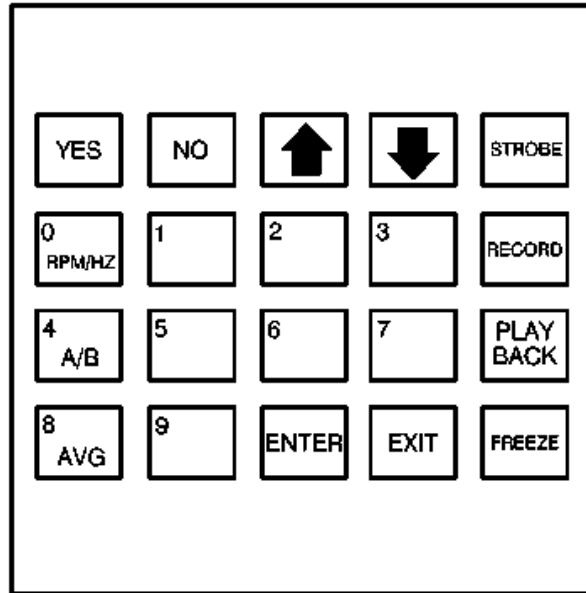


Fig. 40: View Of EVA Display

Courtesy of GENERAL MOTORS COMPANY

The most dominant input frequencies, up to three, received from the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor, are displayed in descending order of amplitude strength.

The frequency readings are displayed along the left side of the screen, followed to the right by either a bar graph or the suspected source of the vibration - depending upon the mode selected, then the amplitude reading for each frequency along the right side of the screen. The top row of the screen indicates the units of measure being displayed for the frequencies along the left side and for the amplitudes along the right side. The top row also indicates the vibration sensor input port which was selected on the keypad (A or B) and which mode was selected: averaging or non-averaging (instantaneous).

The frequency(ies) can be displayed in either revolutions per minute (RPM) or revolutions per second; Hertz (Hz). The selected display type (RPM or Hz) will be indicated at the left side of the screen, above the frequency readings.

When the AUTO MODE function is not in use, a bar graph is displayed next to each frequency to provide a quick visual indication of the relative amplitude strength.

When the AUTO MODE function is being used, the suspected source of the vibration is displayed next to each frequency to provide support to the diagnostic process.

The actual amplitude strength of each frequency is displayed at the right side of the screen and shown in G's-of-acceleration force.

OSCILLOSCOPE DIAGNOSTIC KIT DESCRIPTION AND OPERATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-47966** Multi Diagnostic Interface MDI

For equivalent regional tools, refer to [Special Tools and Equipment](#).

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) is an automotive oscilloscope which receives input from an attached accelerometer and displays all input frequencies on a laptop or tablet computer. The vibration concern frequency(ies) are obtained through the use of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) hardware, while vehicle component speed data is gathered through the **EL-47966** Multi Diagnostic Interface MDI. The MDI data is integrated into the Oscilloscope software so that vibration(s) can be tied to specific vehicle components based on their speed to determine the source of the vibration concern.

Oscilloscope Inputs

The **CH-51450-TA183** accelerometer incorporates a 3 m (9.8 ft) cord that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt. The accelerometer uses a self-powered NVH interface module. The NVH interface module uses a replaceable battery. Input B is the default port for a single accelerometer. The cord used to connect the NVH interface module to the **CH-51450-NVH** Oscilloscope is 5 m (16.4 ft) long.

Input D is used for the **CH-51450-TA186** optical tachometer sensor which is used during driveline balancing. It incorporates a 2.5 m (8.2 ft) cord and a 5 m (16.4 ft) cord.

There is also an optional microphone that can be used with the **CH-51450-NVH** Oscilloscope.

Oscilloscope Accelerometer Placement

Proper placement of the **CH-51450-TA183** accelerometer is critical to ensure that proper vibration readings are obtained by the **CH-51450-NVH** Oscilloscope. The accelerometer should be placed on the drivers side inboard seat track. Once a baseline reading has been taken, the accelerometer can be placed on the point of the customer concern to verify what the customer is hearing or feeling.

Oscilloscope Accelerometer-to-Component Attachment

NOTE: The **CH-51450-TA183** accelerometer must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.

The accelerometer of the **CH-51450-NVH** Oscilloscope is designed to pick up disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **CH-51450-TA183** accelerometer is therefore directionally sensitive, and must be attached to vehicle components such that the cord end is always facing upright, and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated, or comparisons are made to other vehicles.

The **CH-51450-TA183** accelerometer can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using the **CH-51450-TA096** magnet supplied with the sensor. For

hard aluminum surfaces, a ferrous washer can be glued on using a cyanoacrylate (super glue) and then the magnet can be used.

NVH Software Set-up

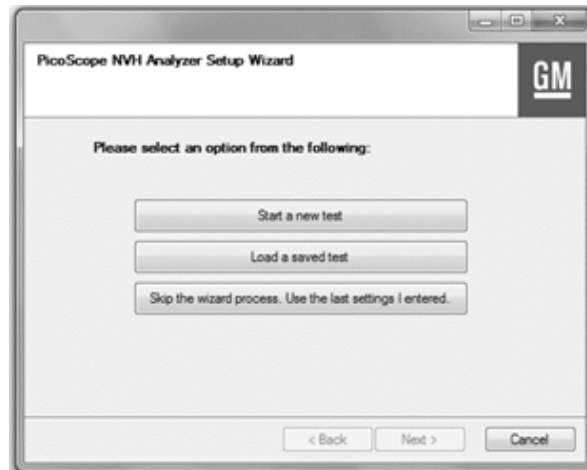


Fig. 41: Identifying NVH Software Set-Up Display Screen

Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the NVH tab is selected, there is a set-up wizard within the **CH-51450-NVH** NVH software which has a step-by-step guide to ensure the **CH-51450-NVH** Oscilloscope and MDI are connected correctly, and to input the vehicle information.

Oscilloscope NVH Display

The **CH-51450-NVH** Oscilloscope display consists of three tabs:

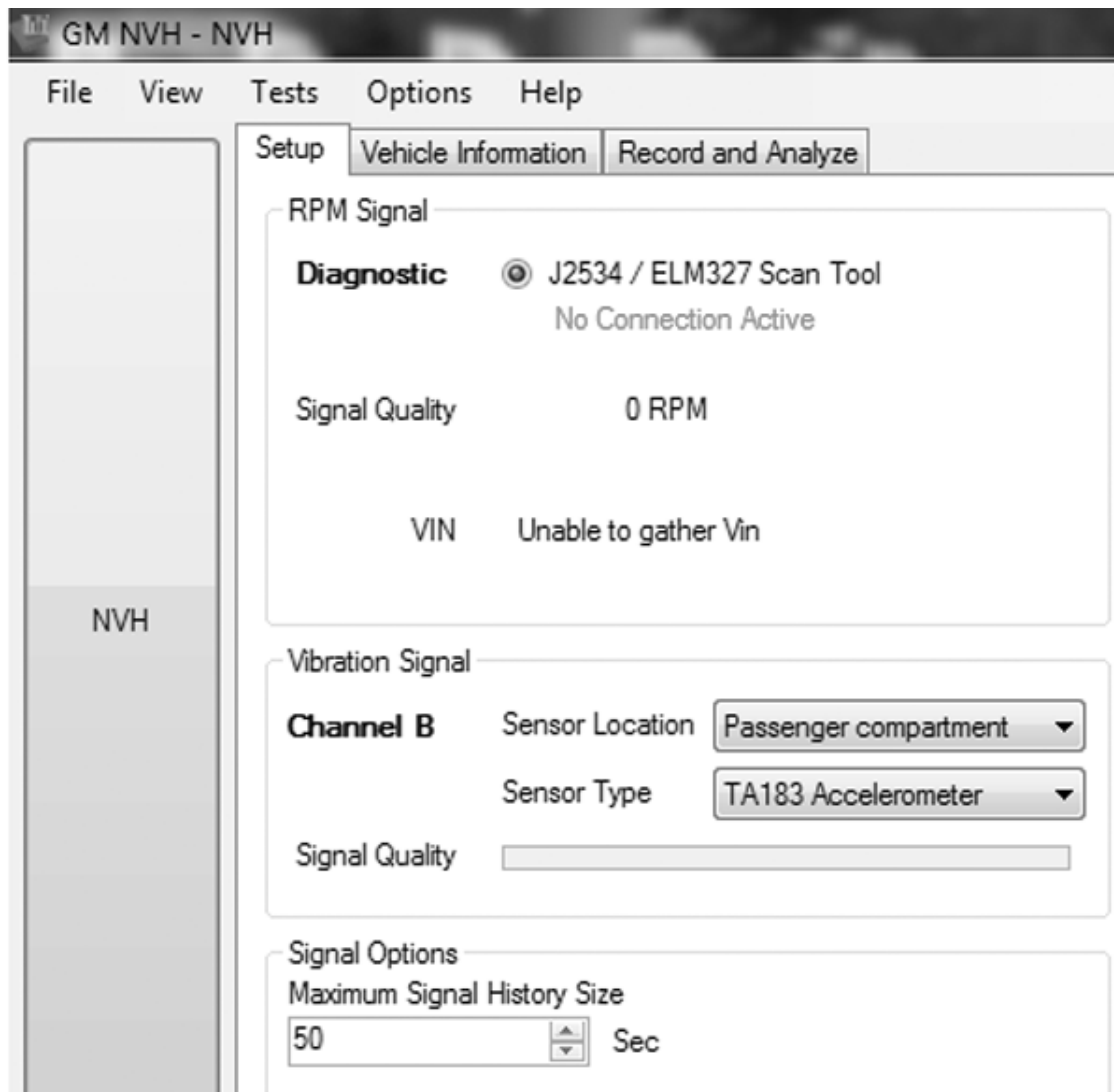


Fig. 42: Identifying Oscilloscope NVH Set-Up Display Screen

Courtesy of GENERAL MOTORS COMPANY

The first tab is set-up. The set-up information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary. A laptop or desktop computer, **EL-47966** Multi Diagnostic Interface MDI, **CH-51450-NVH** Oscilloscope, **CH-51450-TA148** NVH interface, and **CH-51450-TA183** accelerometer are needed to do a vibration analysis.

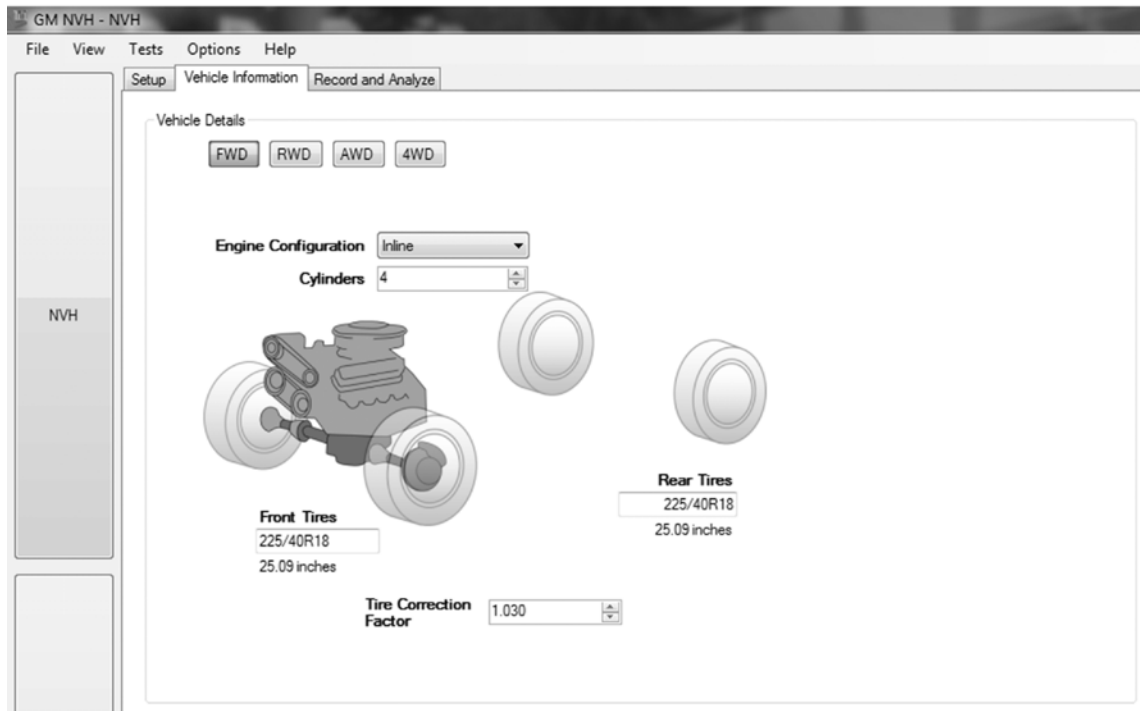


Fig. 43: Identifying Oscilloscope NVH Vehicle Information Display Screen
 Courtesy of GENERAL MOTORS COMPANY

The second tab is vehicle information. The vehicle information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary.

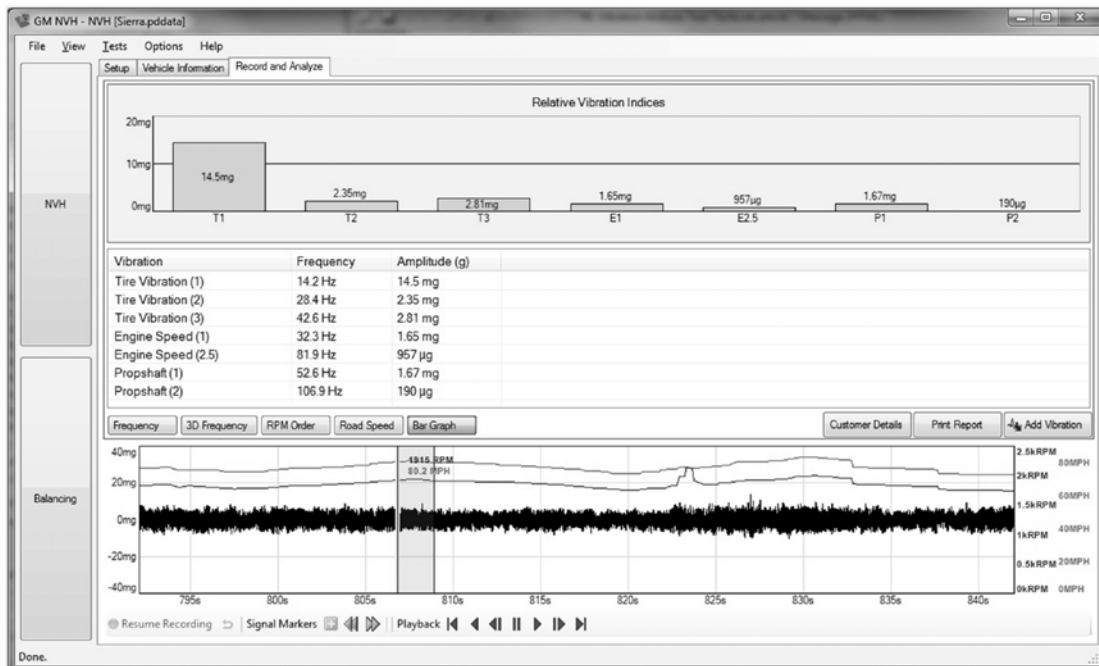


Fig. 44: Identifying Oscilloscope NVH Record And Analyze Display Screen
 Courtesy of GENERAL MOTORS COMPANY

The third tab is the record and analyze tab. The standard display will show the known input frequencies received from the **CH-51450-TA183** accelerometer as a bar graph at the top of the screen. At the middle of the screen, the input frequencies are listed as text. The frequency(ies) are displayed in Hertz (Hz). If desired, the frequency(ies) can be displayed in RPM by clicking Options, then Advanced Options. The actual amplitude strength of each frequency is displayed and shown in g's of acceleration (expressed to the thousandth of a force of gravity, or "milli-g"). At the bottom of the screen, it also shows a plot of all frequency inputs along with engine speed in blue, and vehicle speed in red. The data can be saved in 50 second increments. The data can then be saved by clicking File, then Save. Files that are saved can then be loaded into the software by clicking File, then Load.

Oscilloscope Balancing

The **CH-51450-NVH** Oscilloscope with balancing software can be used to identify some rotating component/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **CH-51450-NVH** Oscilloscope is used with the **CH-51450-TA186** optical tachometer sensor. The optical tachometer sensor directly measures component rotational speed so a known weight can be added for a baseline reading. Then the oscilloscope will determine where to add a specific amount of weight to the component.

For example, the **CH-51450-NVH** Oscilloscope can be used to balance the driveline on rear wheel drive and all wheel drive vehicles. The methods that can be employed are a tuned weight approach for drivelines that use couplers and a dual hose clamp approach for drivelines that use CV or two-axis universal joints. The balancing process consists of the **CH-51450-TA186** optical tachometer sensor to directly read the driveline speed and software that directs where the weights should be placed depending on the type of driveline/propeller shaft being balanced.

Oscilloscope Balancing Software Set-up

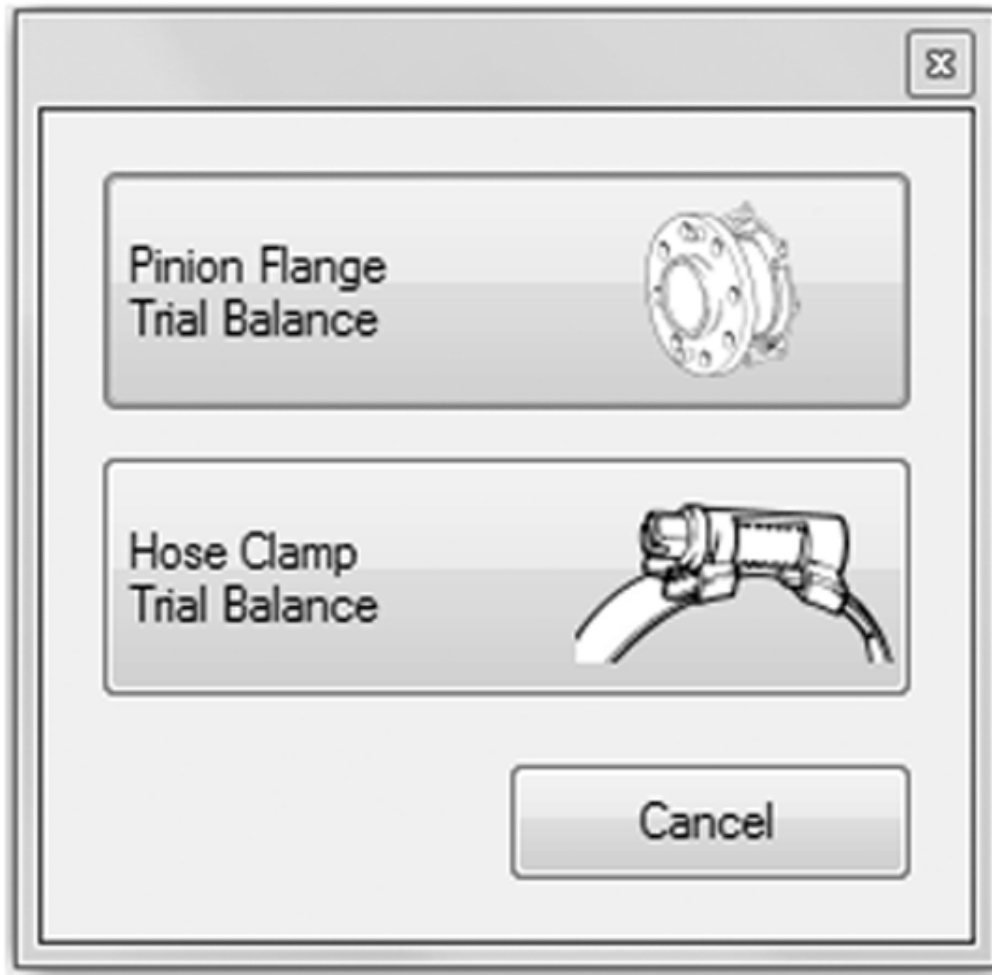


Fig. 45: Identifying Oscilloscope Balancing Software Set-Up Display Screen

Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the Balancing tab is selected, a pop-up box within the **CH-51450-NVH** balancing software will ask which type of balancing method is to be used. The two methods are pinion flange or hose clamp. Then either the wizard (which will walk through the connections and input data) or advanced configuration can be chosen to input the initial information and start the balancing procedure.

Oscilloscope Balancing Display

The propeller shaft balancing will consist of an initial run, three calibration runs, and a verification run. The software will walk through what is required for each run.

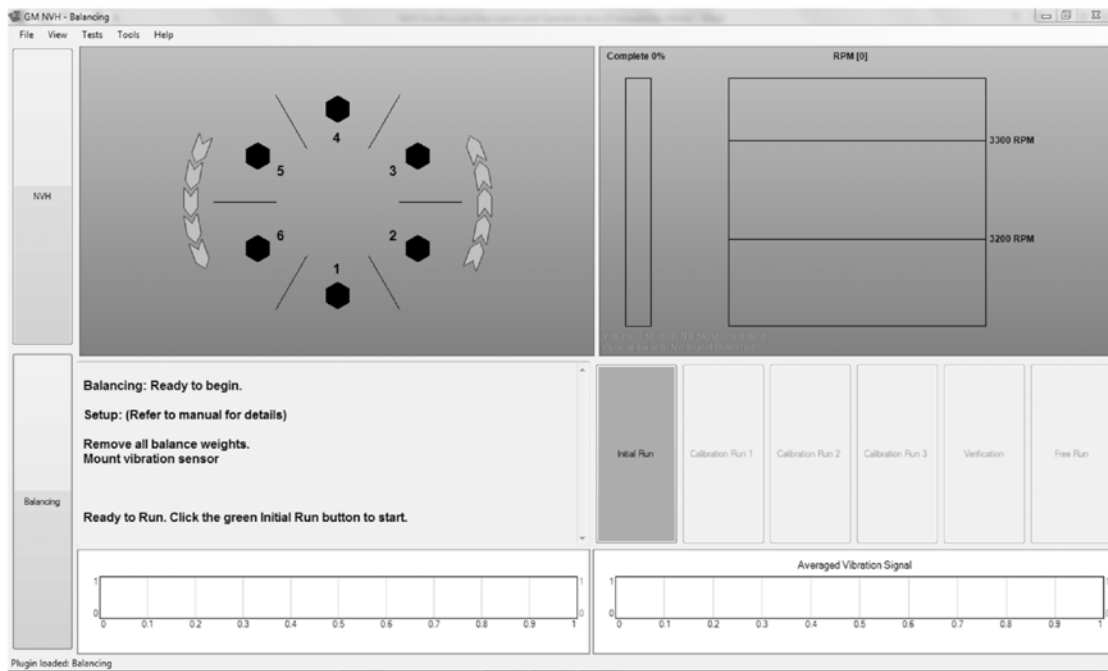


Fig. 46: Identifying Pinion Flange Balancing Screen
 Courtesy of GENERAL MOTORS COMPANY

An example of the pinion flange balancing screen is shown above.

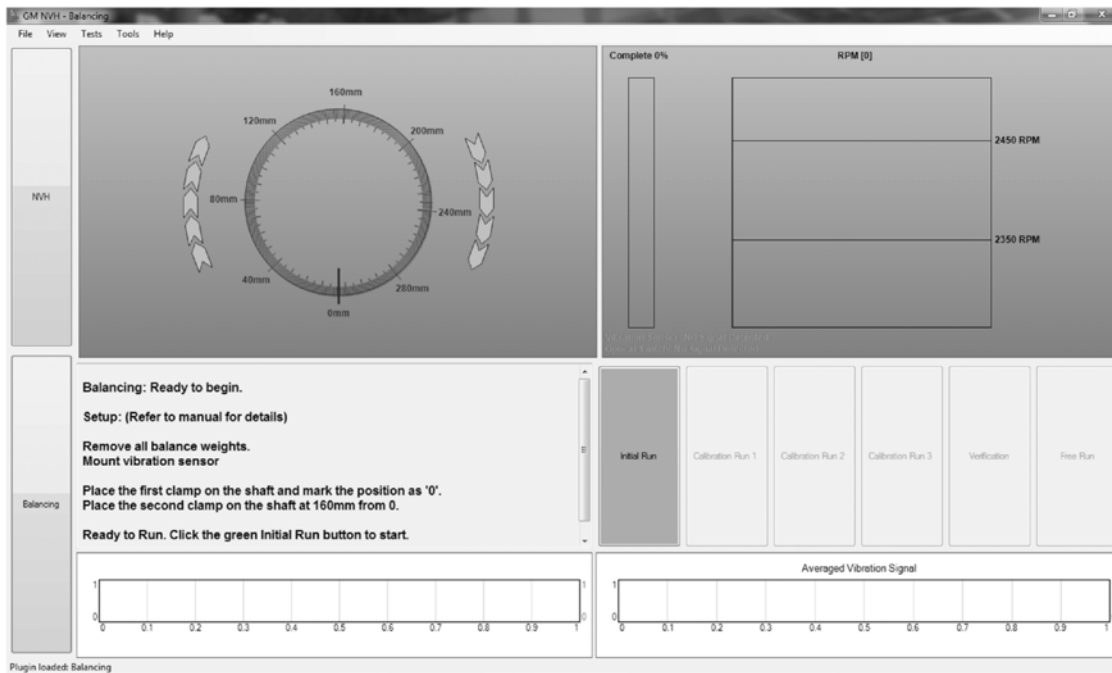


Fig. 47: Identifying Hose Clamp Balancing Screen
 Courtesy of GENERAL MOTORS COMPANY

An example of the hose clamp balancing screen is shown above.

VIBRATE SOFTWARE DESCRIPTION AND OPERATION

The **EL-38792-VS** Vibrate Software, is a computer software program which is designed to be used in support of the Vibration Analysis diagnostic tables, along with the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, and a scan tool, to help in determining the source of a vibration concern. The **EL-38792-VS** Vibrate Software is designed to provide quick calculations and produce a chart of the rotational speeds and frequency ranges for specific vehicle systems and components, based upon vehicle data parameters inputted by the user.

The **EL-38792-VS** Vibrate Software uses the vehicle data parameters, such as axle ratio, number of engine cylinders, etc. to create the base chart, depicting the relationships of the various vehicle systems and/or components. The chart view can be modified to show data related to vehicle speed only, engine speed only, or both vehicle speed and engine speed. The user can then plot the dominant frequency reading obtained on the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 which correlates with the vibration concern, and the engine RPM obtained on a scan tool which correlates with the concern. Once these pieces of data are correctly plotted, the chart will point to the source of the vibration concern, which should confirm the results obtained through the Vibration Analysis diagnostic tables.

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) includes a version of the vibrate software within its help file.

REED TACHOMETER DESCRIPTION

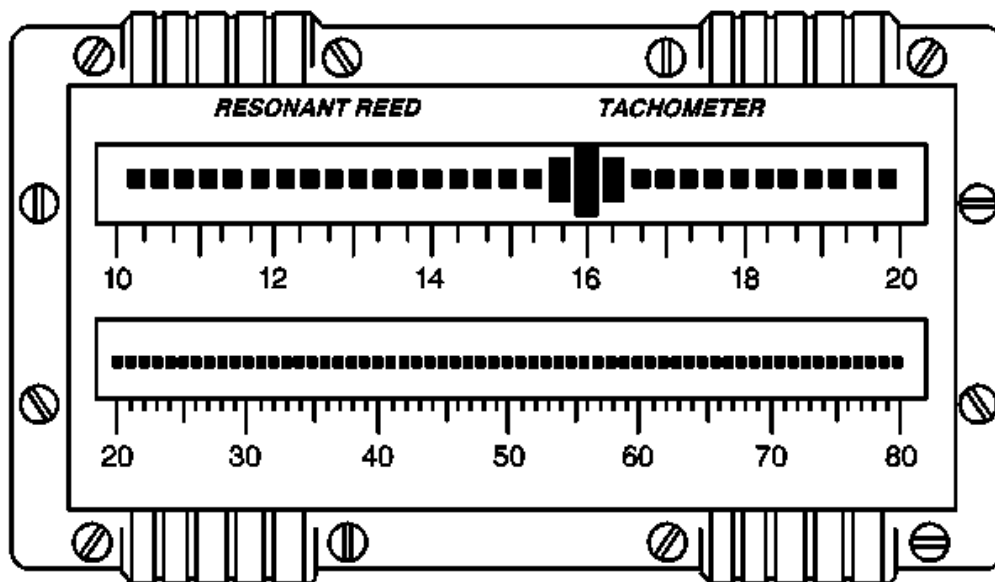


Fig. 48: Identifying Reed Tachometer
Courtesy of GENERAL MOTORS COMPANY

The reed tachometer consists of 2 rows of reeds arranged side-by-side. Each reed is tuned to vibrate or resonate when it is excited by a specific frequency. The reeds are arranged by their specific resonant frequency, increasing from left to right, ranging from 10 - 80 Hz. This arrangement allows for a visual display of the most dominate frequencies which fall within this range.

The reed tachometer can be a helpful diagnostic tool, however it is extremely sensitive to external inputs that are not related to the vibration concern, such as rough road surfaces, etc., and it is difficult to master its use. Due to these conditions, the reed tachometer has limited diagnostic capability.

Due to the limited diagnostic capability, limited availability and increasing costs of the reed tachometer, it is NOT recommended as the primary tool to use in diagnosing a vibration concern.

When diagnosing a vibration concern, use the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 have been designed to overcome the shortcomings to the reed tachometer. Refer to [Oscilloscope Diagnostic Kit Description and Operation](#), or [Electronic Vibration Analyzer \(EVA\) Description and Operation](#).

SPECIAL TOOLS AND EQUIPMENT

Illustration	Tool Number/Description
--------------	----------------------------

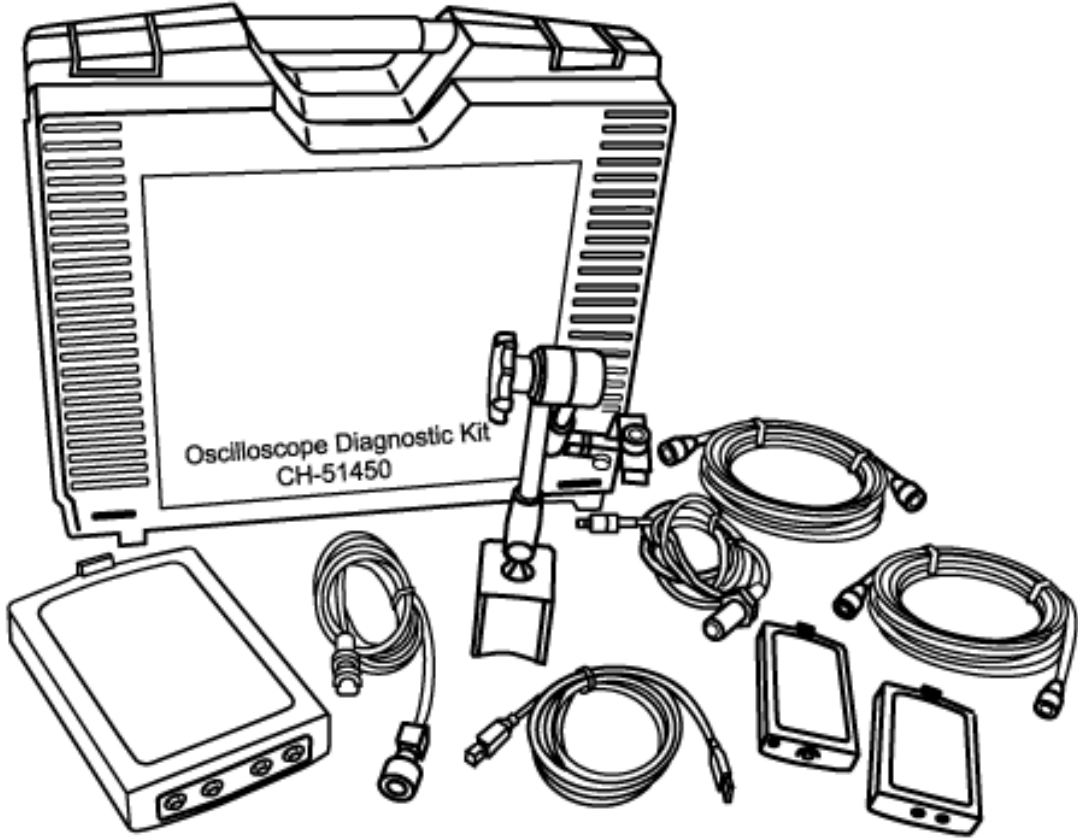
Illustration	Tool Number/Description
	CH 51450-NVH Oscilloscope Diagnostic Kit (w/NVH)

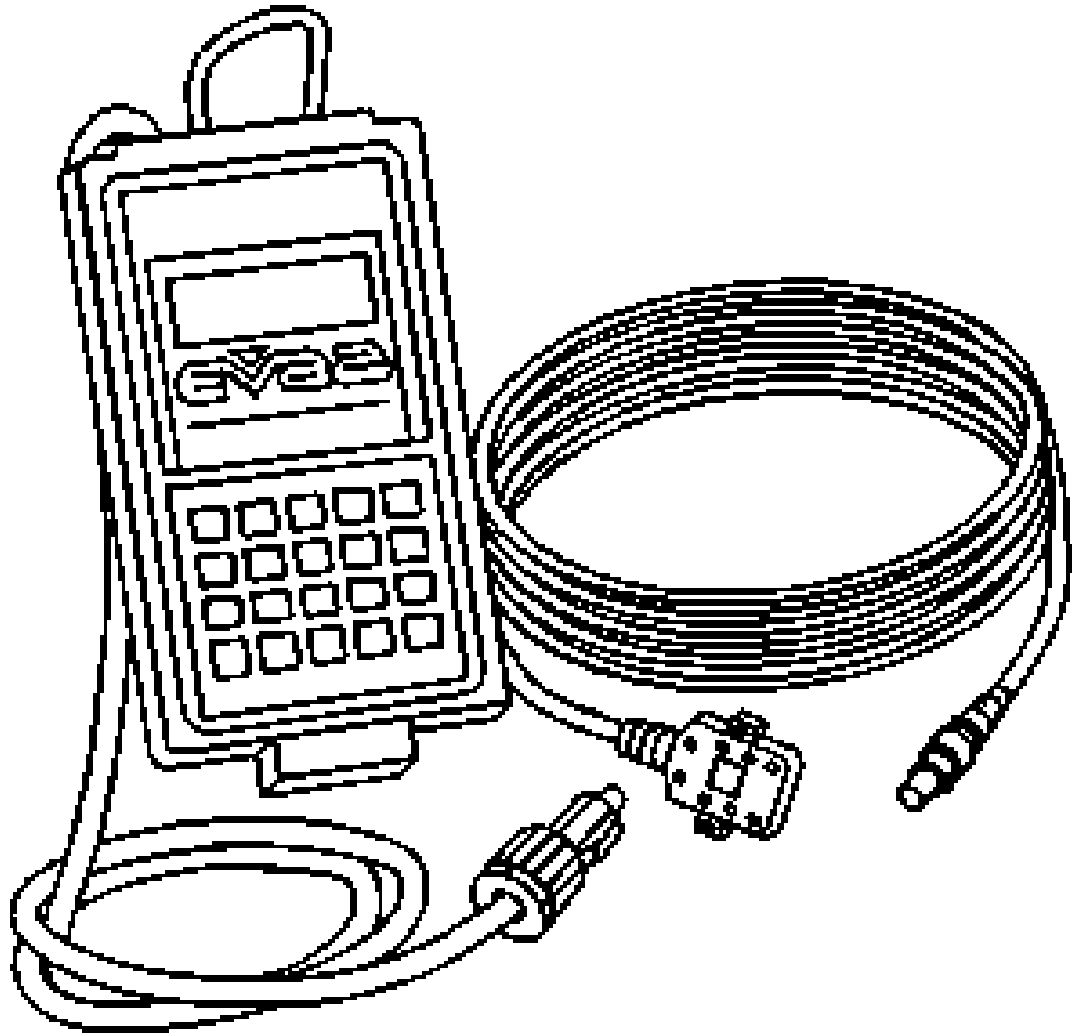
Illustration	Tool Number/Description
	EL 38792-A J 38792-A Electronic Vibration Analyzer (EVA) 2

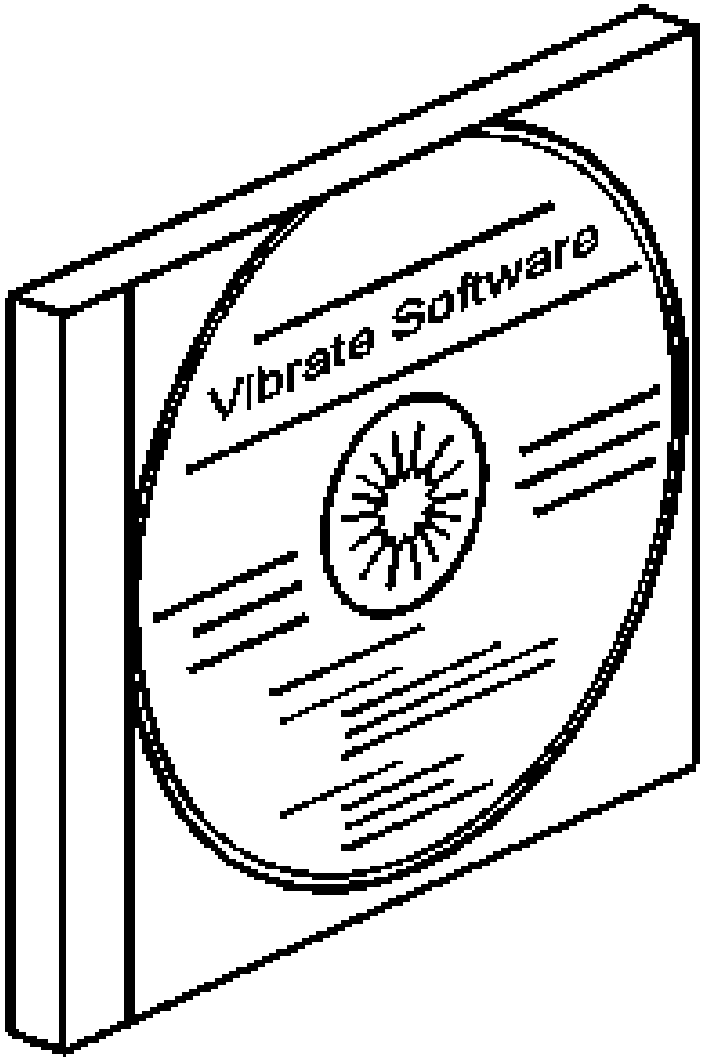
Illustration	Tool Number/Description
	EL 38792-VS J 38792-VS Vibration Software

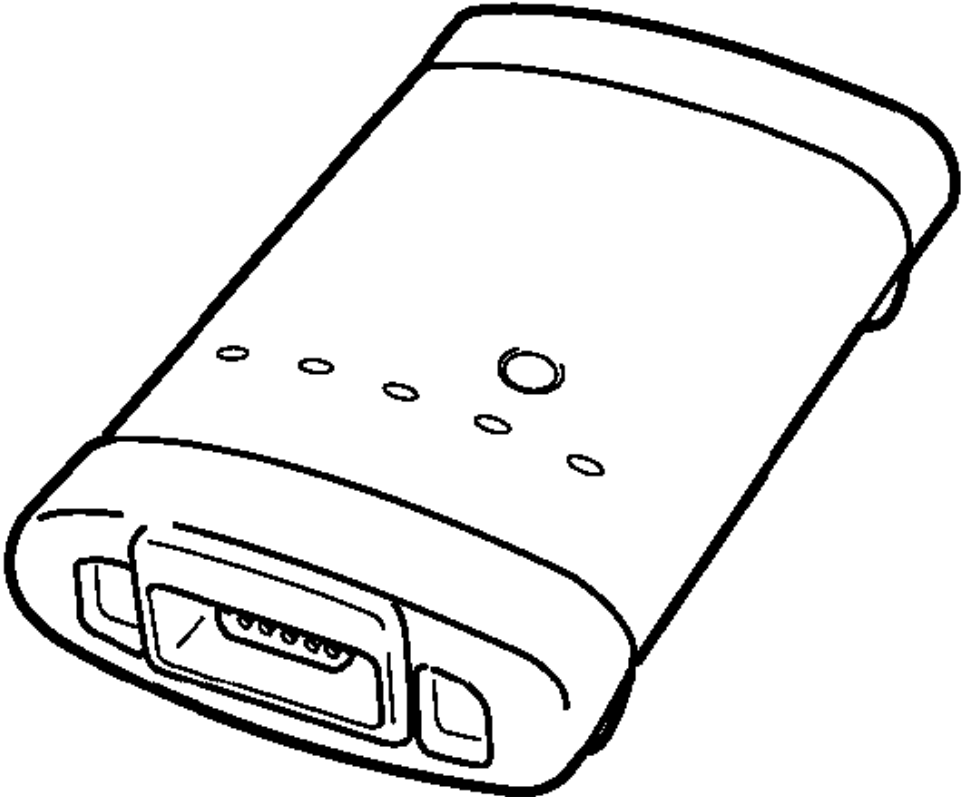
Illustration	Tool Number/Description
	EL 47955 J 2534 Multi Diagnostic Interface MDI

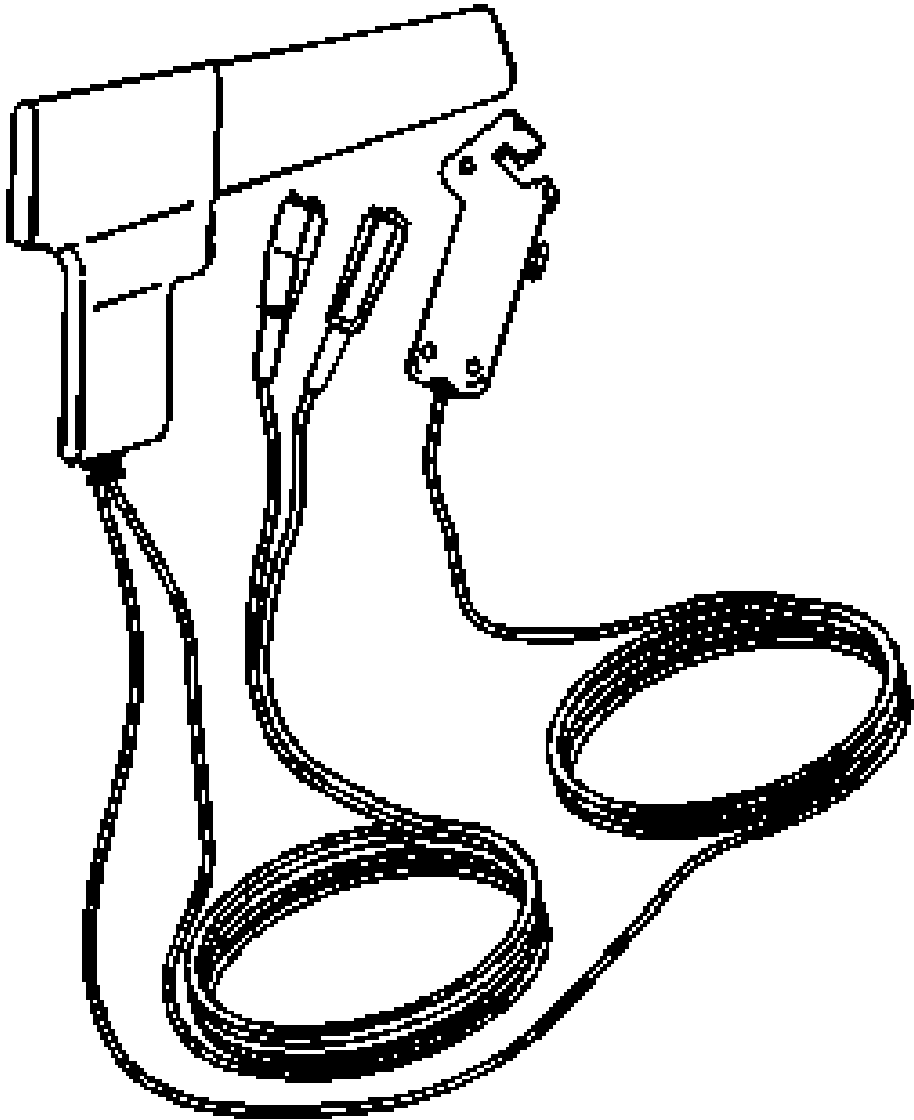
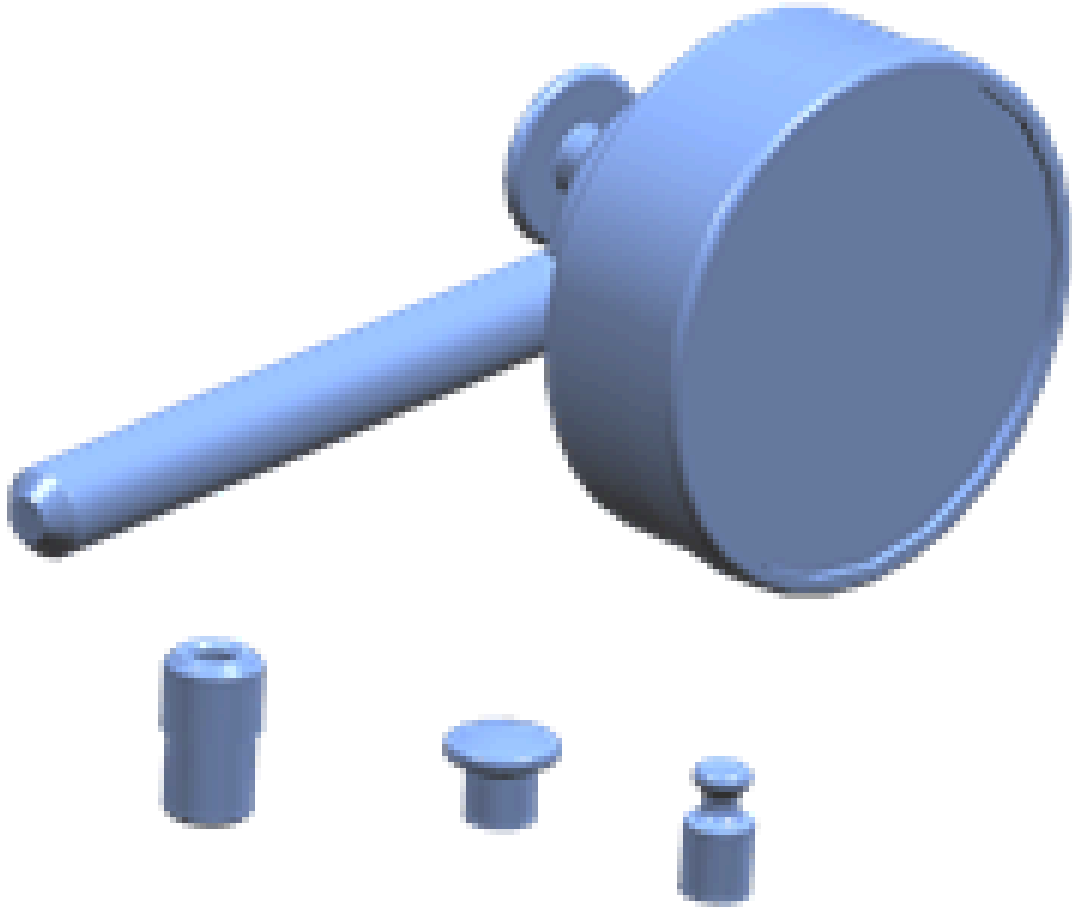
Illustration	Tool Number/Description
	EN 38792-25 J 38792-25 Inductive Pickup Timing Light

Illustration	Tool Number/Description
	GE 8001 J 8001 Dial Indicator Set

Article GUID: A00884690

GENERAL INFORMATION

Waveforms - Injector Pattern Tutorial

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

PURPOSE OF THIS ARTICLE

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

- How a DVOM and noid light fall short of a lab scope.
- The two types of injector driver circuits, voltage controlled & current controlled.
- The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
- The two different pattern types you can use to diagnose with, voltage & current.
- All the valuable details injector patterns can reveal.

SCOPE OF THIS ARTICLE

This is NOT a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

IS A LAB SCOPE NECESSARY?

INTRODUCTION

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

OVERVIEW OF NOID LIGHT

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

- If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
- If an injector driver is weak or a minor voltage drop is present.

Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

- A dimly flashing light when it should be normal.
- A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

- Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
- Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/ampere circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to

fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understanding the types of injector circuits that your noid lights are designed for. There are three. They are:

- Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
- Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
- Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) and an external injector resistor.

NOTE: **Some noid lights can meet both the second and third categories simultaneously.**

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

OVERVIEW OF DVOM

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

Checking Injector Resistance

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase a tool that checks injector coil windings under full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around \$240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

Checking Available Voltage At the Injector

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

- They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
- A few unusual conditions can cause inaccurate readings.
- Varying engine speeds can result in inaccurate readings.

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.

While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See [RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE](#).

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15° dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages everything together it does not miss anything (though this is also a severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

- Injector mS on-time specification.
- Engine RPM when specification is valid.
- How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360° of crankshaft rotation, a bank-fire that injects every 720°, or an SFI that injects every 720°. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1. Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.
2. Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360° bank-fired, meaning an injector fires each and every crankshaft revolution.
3. Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use. Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second. Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.
4. Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period. One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4° dwell.

Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O2 gets pushed into the exhaust and passes the O2 sensor. The O2 sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM 3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS

Dwell Meter ⁽²⁾	Duty Cycle Meter
1°	1%
15°	25%
30°	50%
45°	75%
60°	100%
(1) These are just some examples for your understanding. It is okay to fill in the gaps.	
(2) Dwell meter on the six-cylinder scale.	

THE TWO TYPES OF INJECTOR DRIVERS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. [Fig. 1](#).

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening times by increasing injector pulse width accordingly.

NOTE: **Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

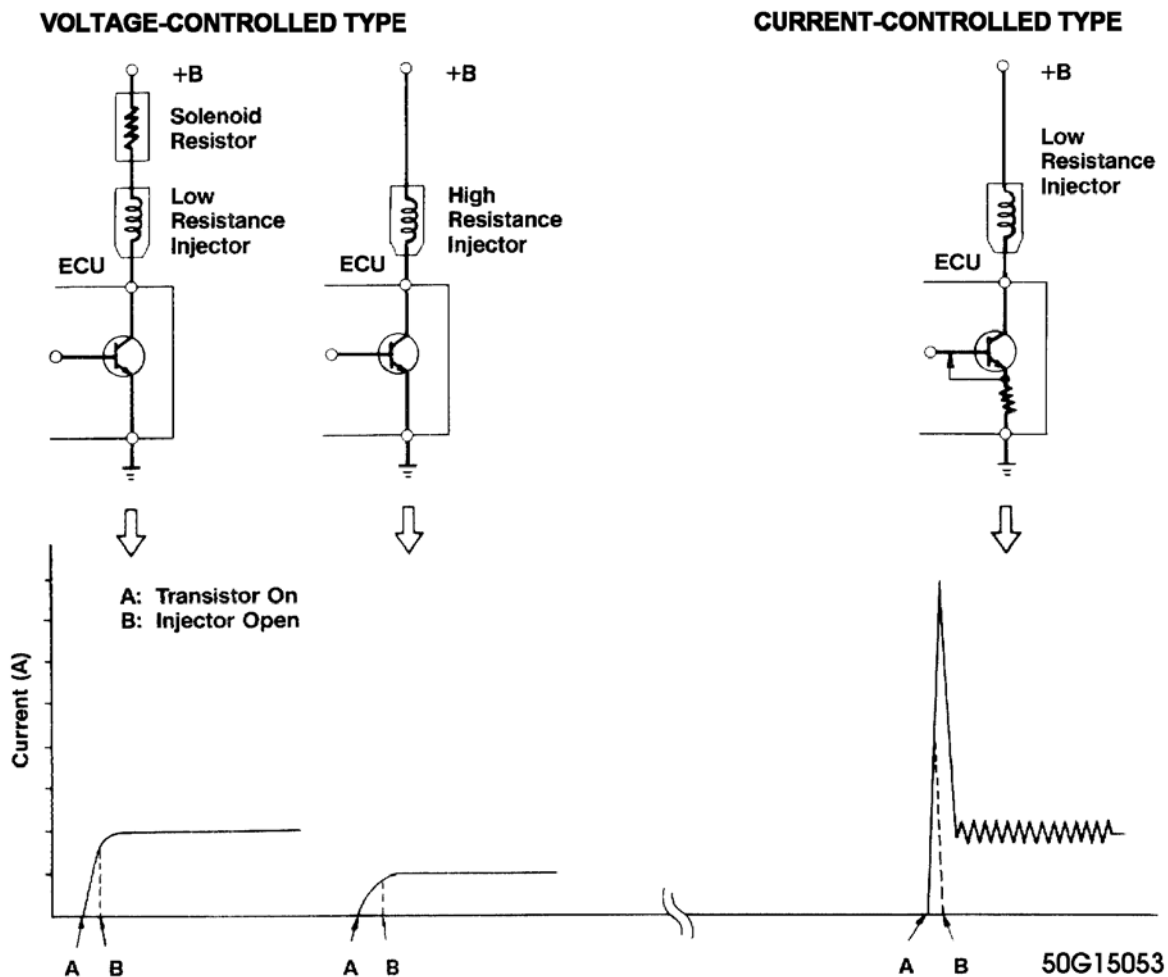


Fig. 1: Injector Driver Types - Current and Voltage

CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of [Fig. 1](#) for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

NOTE: Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.

THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the latter are the 1970's Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

INTERPRETING INJECTOR WAVEFORMS

NOTE: This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

INTERPRETING A VOLTAGE CONTROLLED PATTERN

NOTE: Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.

NOTE: This example is based on a constant power/switched ground circuit.

- See [Fig. 2](#) for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

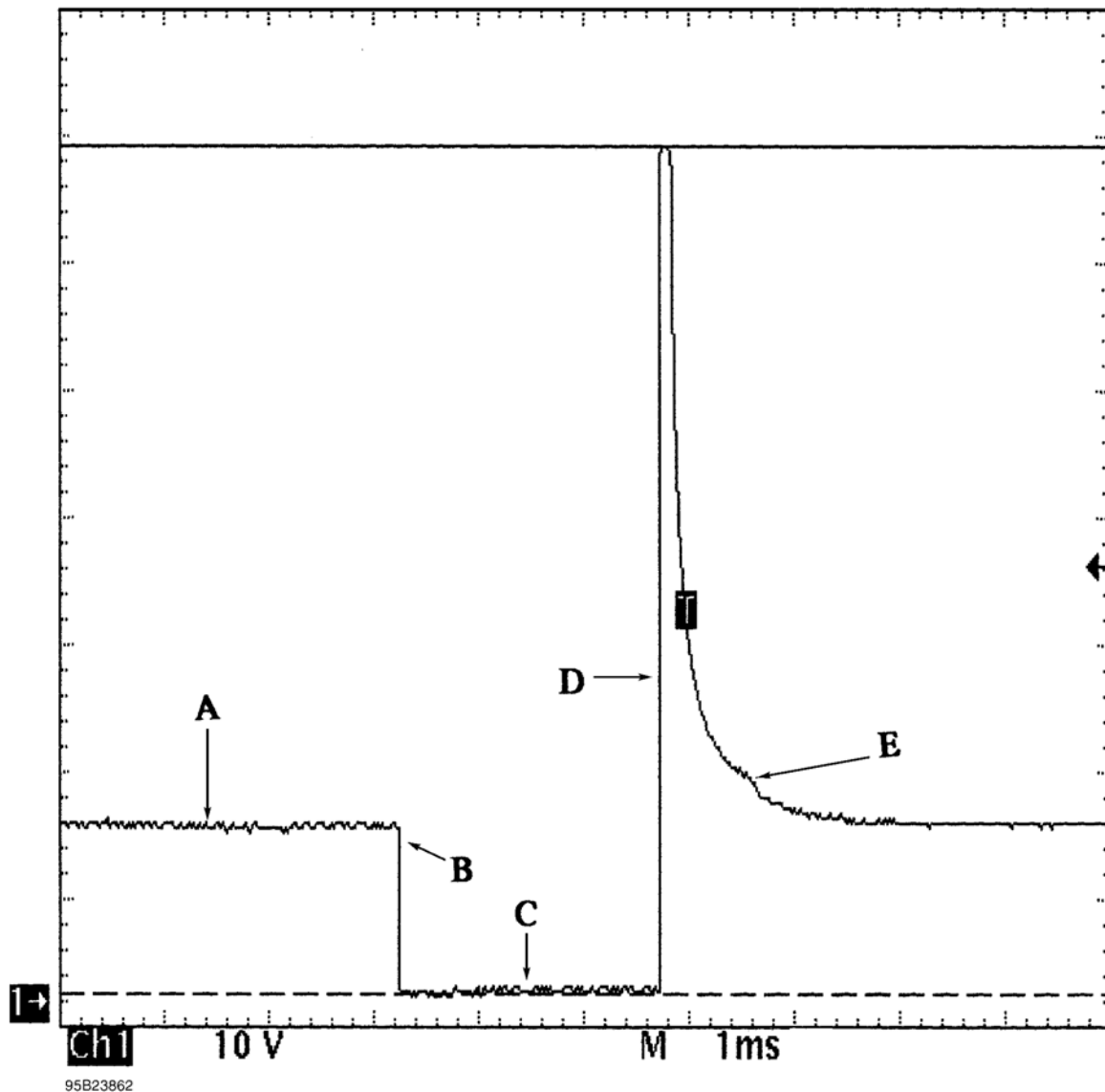


Fig. 2: Identifying Voltage Controlled Type Injector Pattern

INTERPRETING A CURRENT CONTROLLED PATTERN

NOTE: Current controlled drivers are also known as "Peak and Hold" drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.

NOTE: This example is based on a constant power/switched ground circuit.

- See [Fig. 3](#) for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will

cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

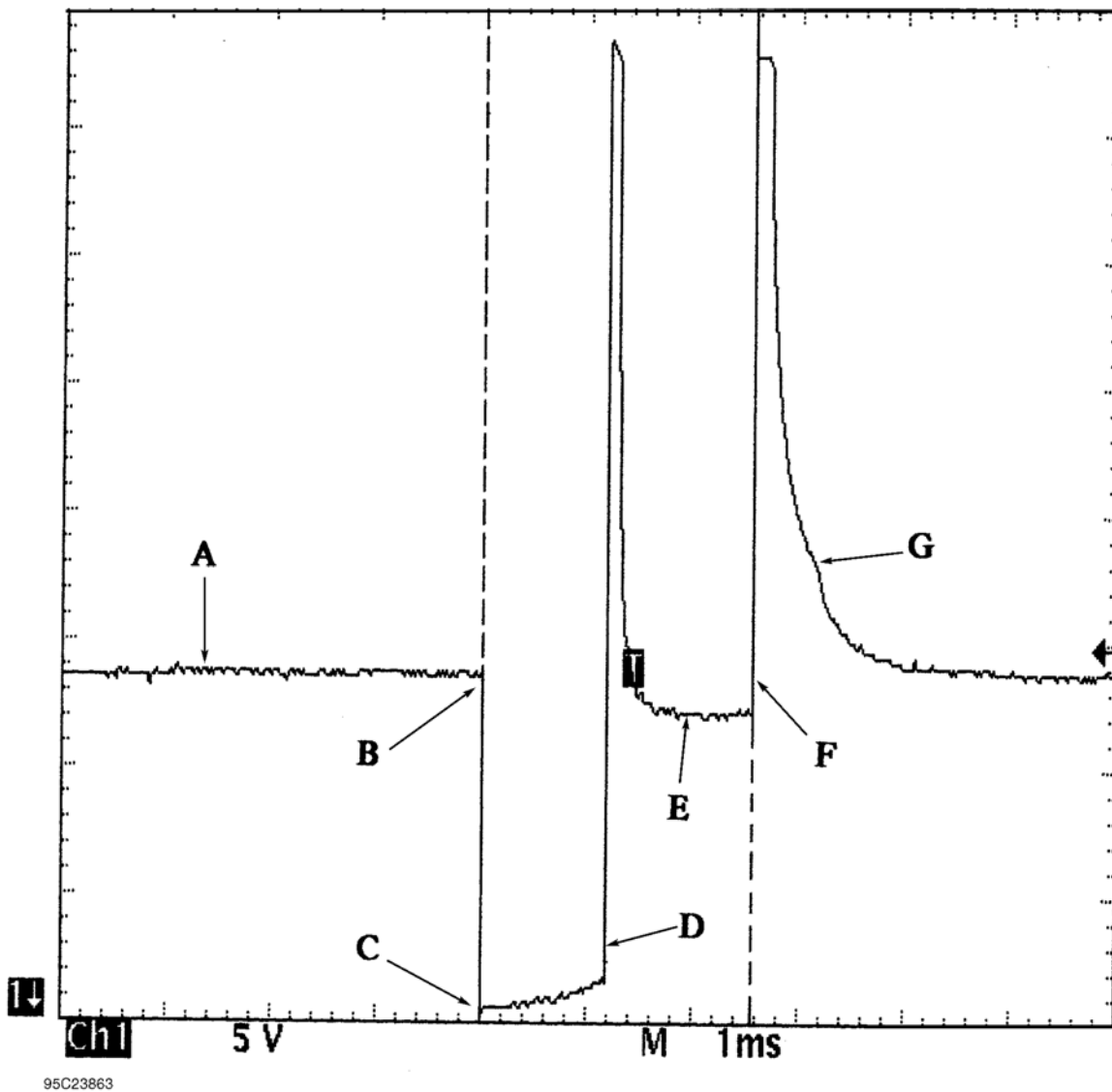


Fig. 3: Identifying Current Controlled Type Injector Pattern

CURRENT WAVEFORM SAMPLES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. [Fig. 4](#) indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created

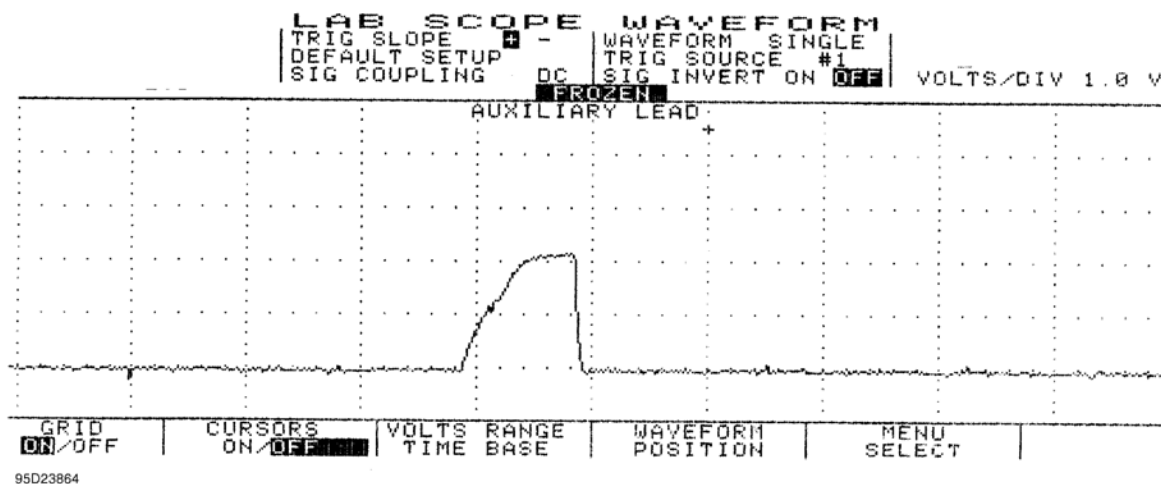
which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See [Fig. 4](#).

Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in [Fig. 5](#) indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in [Fig. 6](#). Notice that it limits current flow to 750 milliamps.

The waveform shown in [Fig. 7](#) illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.



[Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern](#)

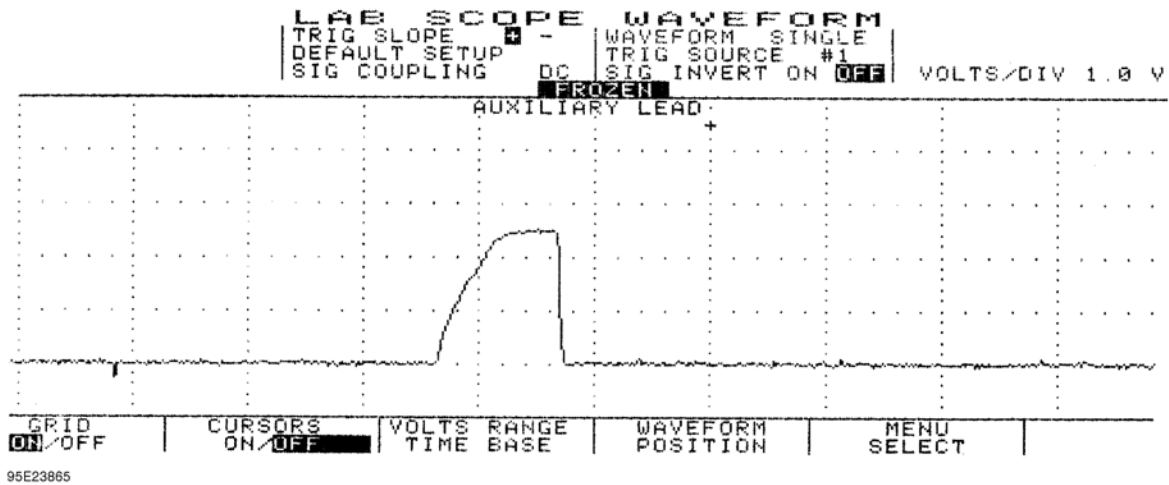


Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern

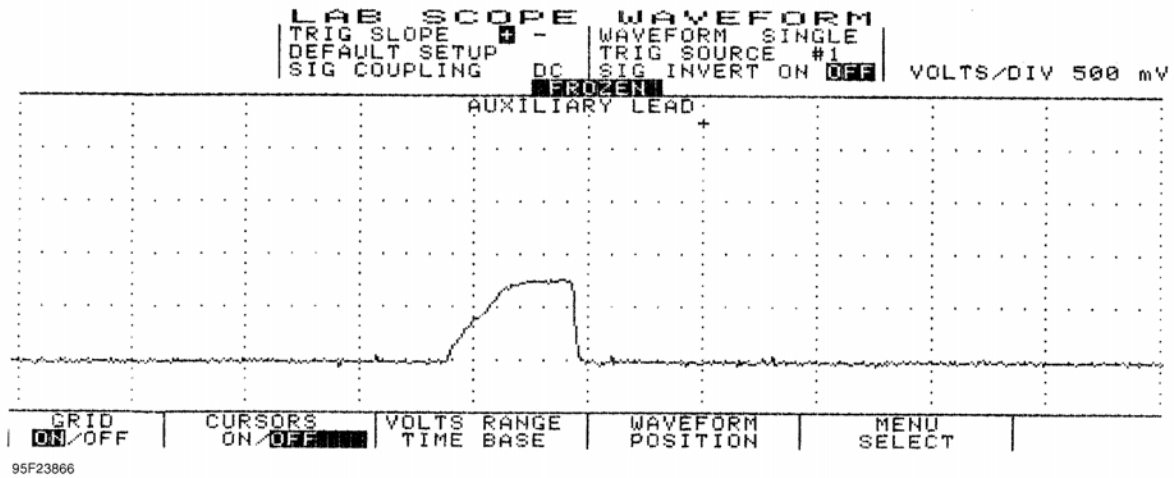


Fig. 6: Single Injector w/Normal Current Flow - Current Pattern

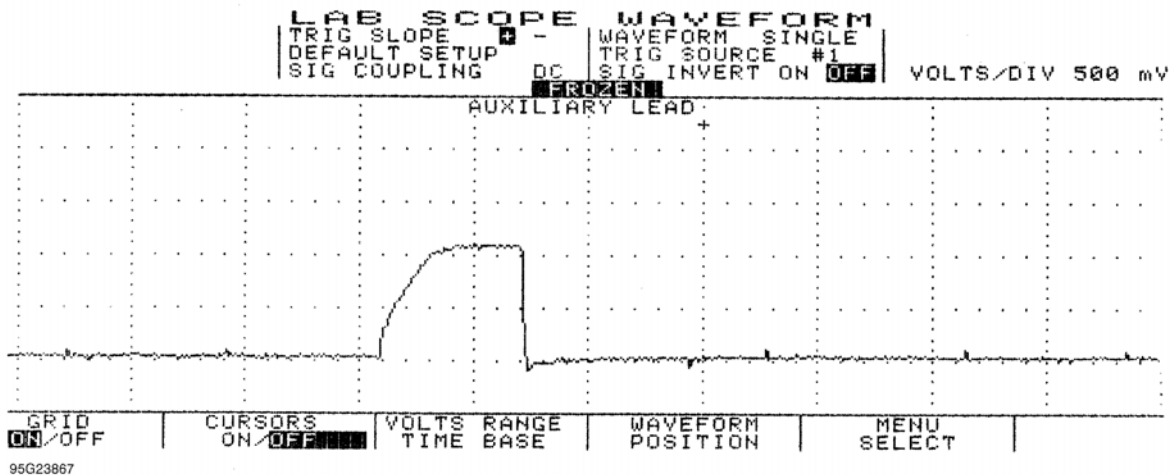


Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

This time we will look at a GM 3.1L V6 VIN [T]. Fig. [Fig. 8](#) shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in [EXAMPLE #1](#) above, other factors knock this value down to roughly the 2.6 amp neighborhood.

Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See [Fig. 9](#). Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. [Fig. 8](#)). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.

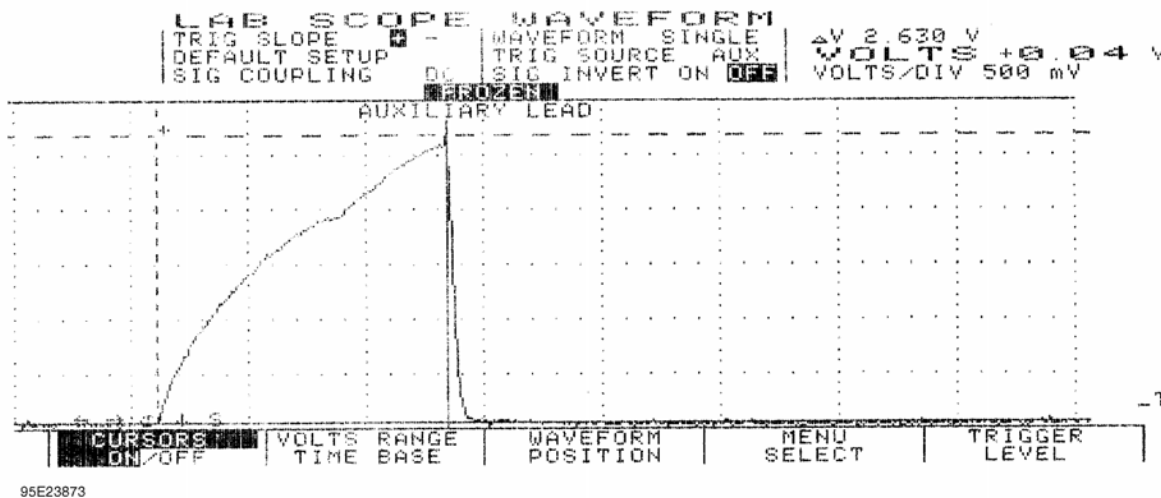


Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern

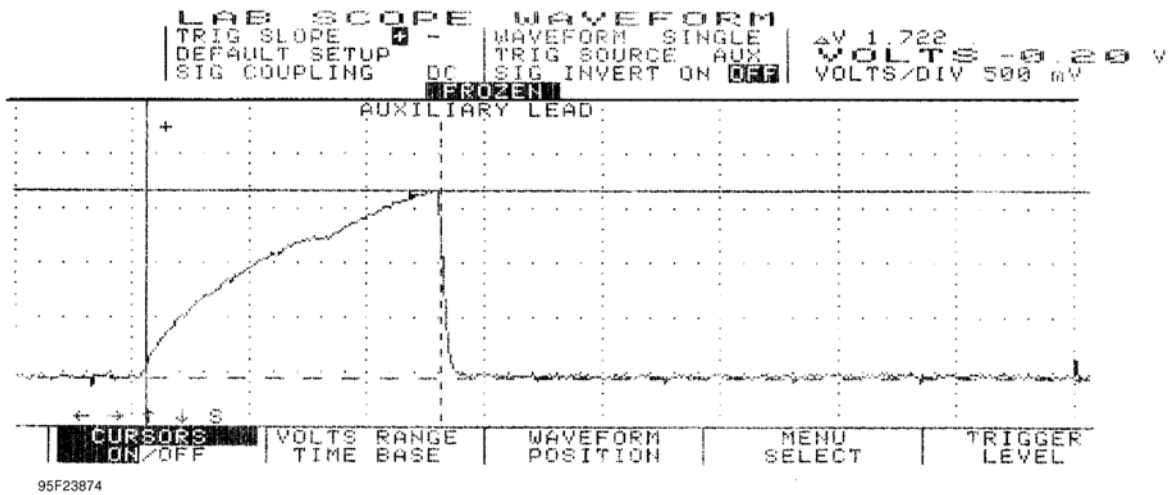


Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

Example #3 is of a Ford 5.0L V8 SEFI. Fig. [Fig. 10](#) shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

The next waveform pattern in Fig. [Fig. 11](#) shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.

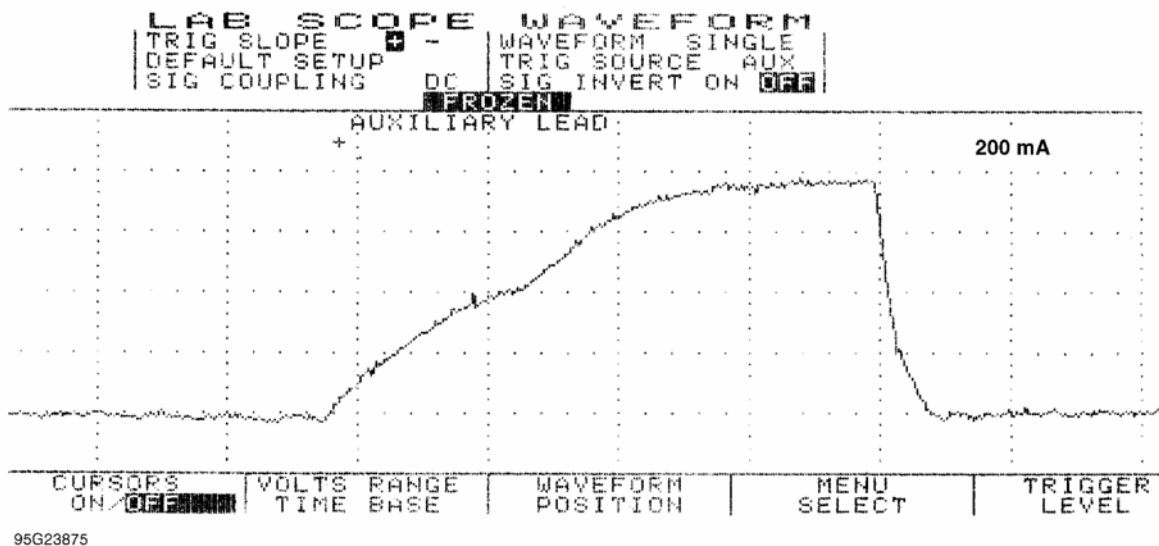


Fig. 10: Single Injector w/Normal Current Flow - Current Pattern

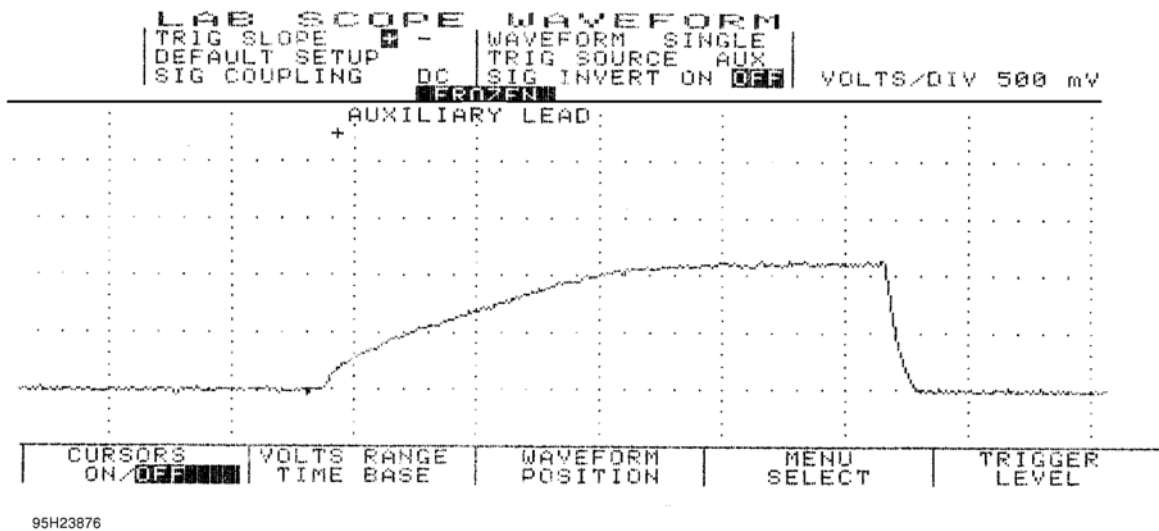


Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

Example #4 is of a Ford 4.6L SEFI VIN [W]. See [Fig. 12](#) for the known-good waveform pattern. This Ford system is different from the one above in [EXAMPLE #3](#) as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.

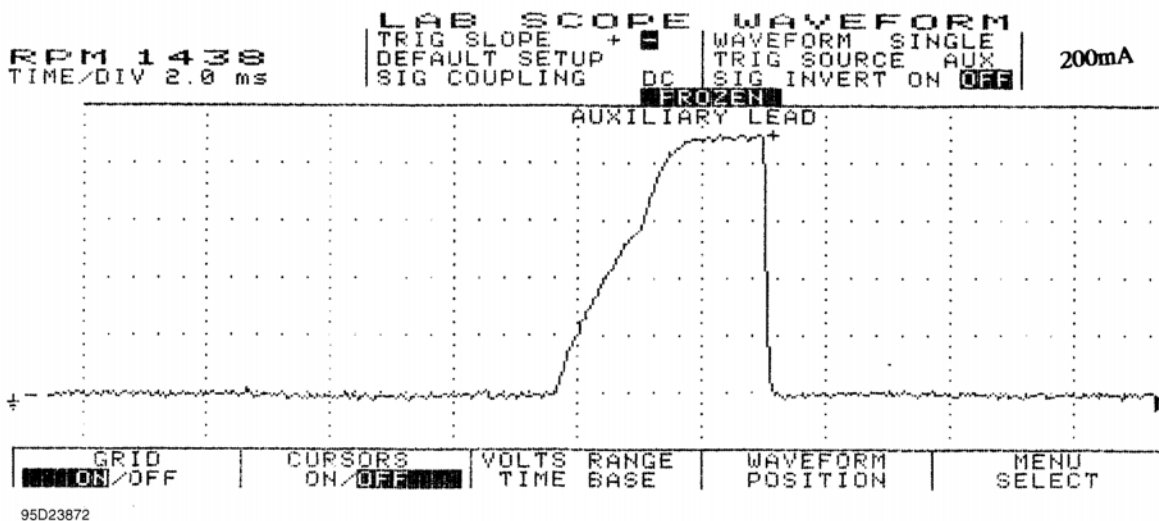


Fig. 12: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

The known-good waveform in [Fig. 13](#) is from a Chrysler 3.0L V6 PFI VIN [3]. It is a perfect example of

the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.

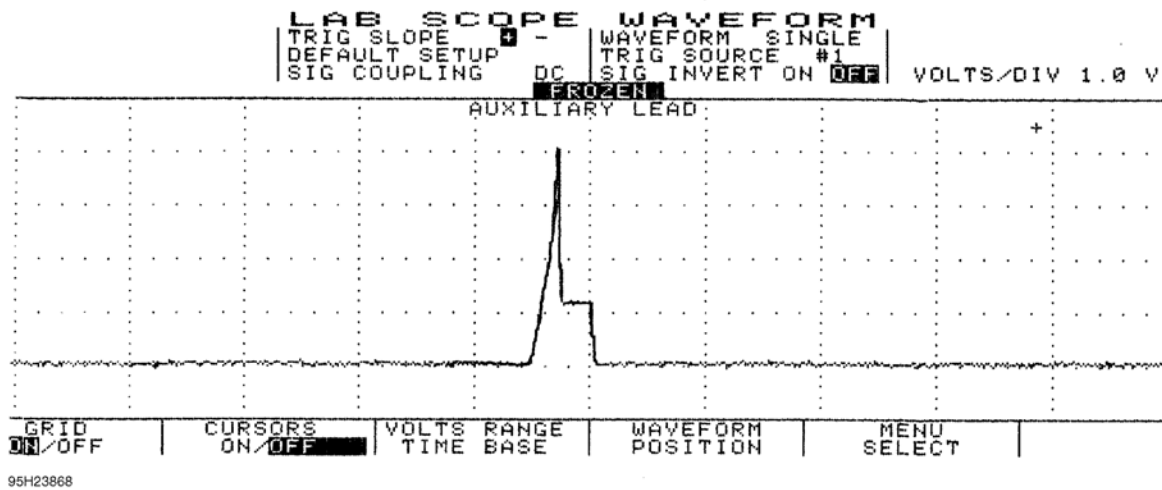


Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See [Fig. 14](#). The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.

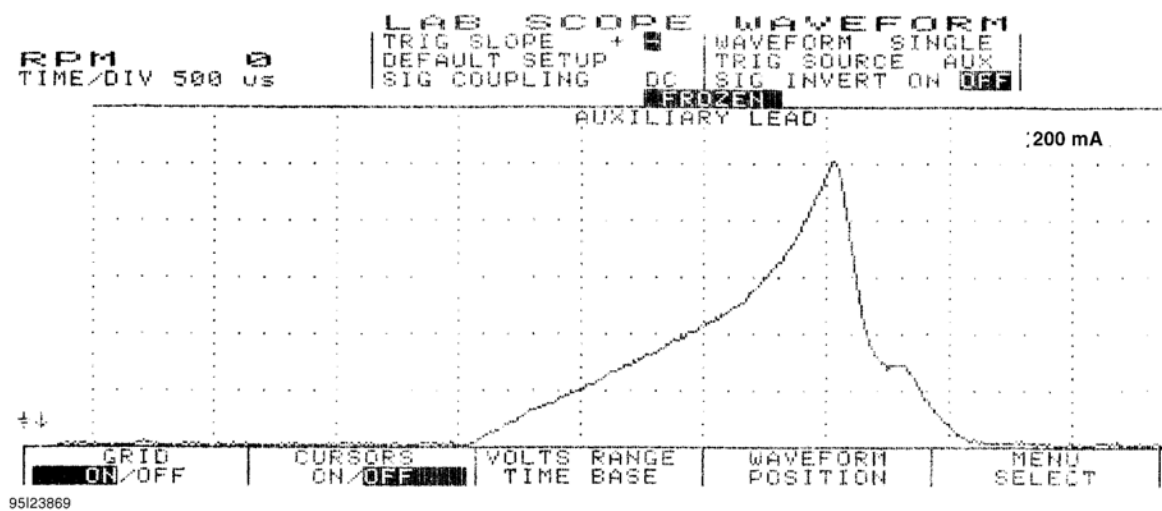


Fig. 14: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

The known-good current controlled type waveform in [Fig. 15](#) is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

The next waveform is from the same type of engine, except that it shows a faulty injector. See [Fig. 16](#). Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of

current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.

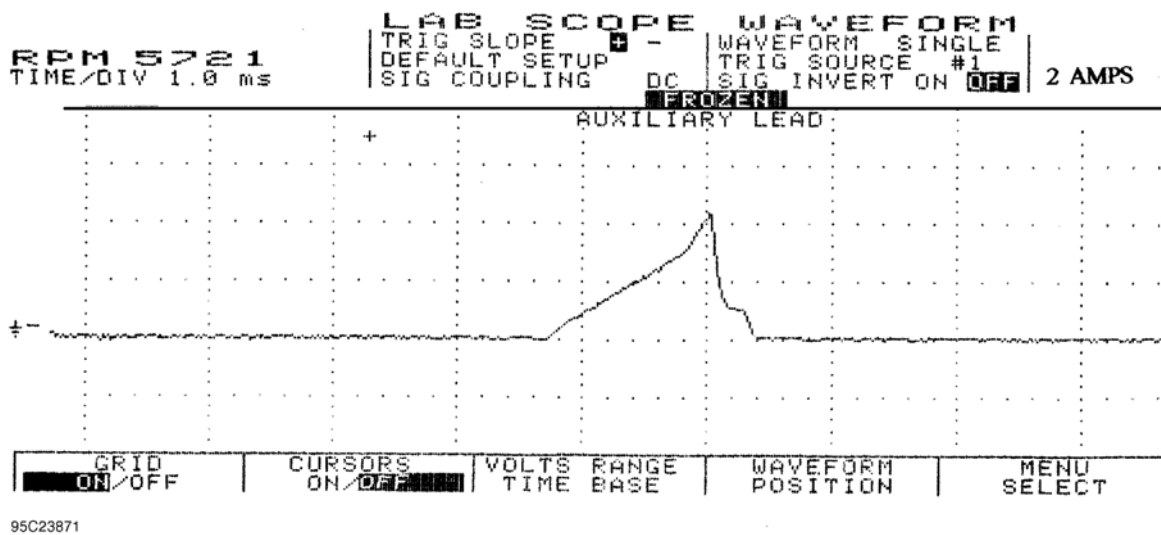


Fig. 15: Single Injector w/Normal Current Flow - Current Pattern

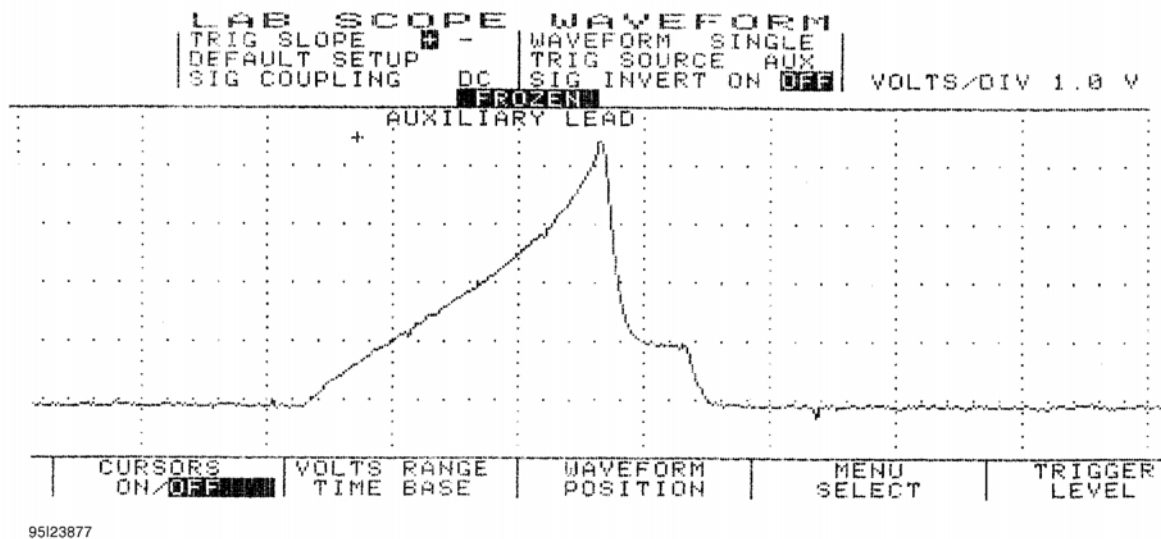


Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See [Fig. 17](#) for waveform.

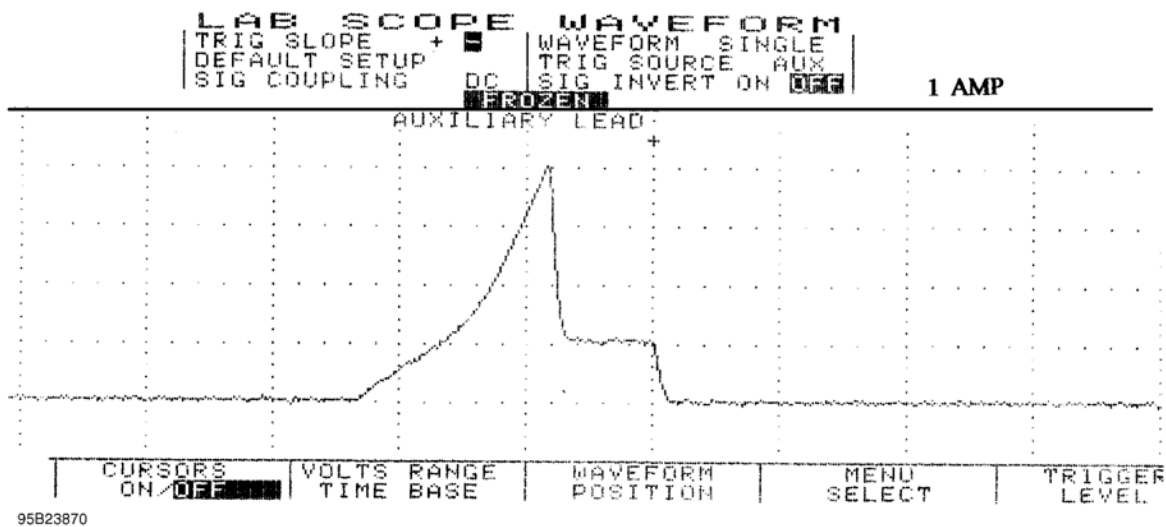


Fig. 17: Single Injector w/Normal Current Flow - Current Pattern

VOLTAGE WAVEFORM SAMPLES

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. [Fig. 18](#) illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. [Fig. 19](#), was taken during hot idle, closed loop, and no load.

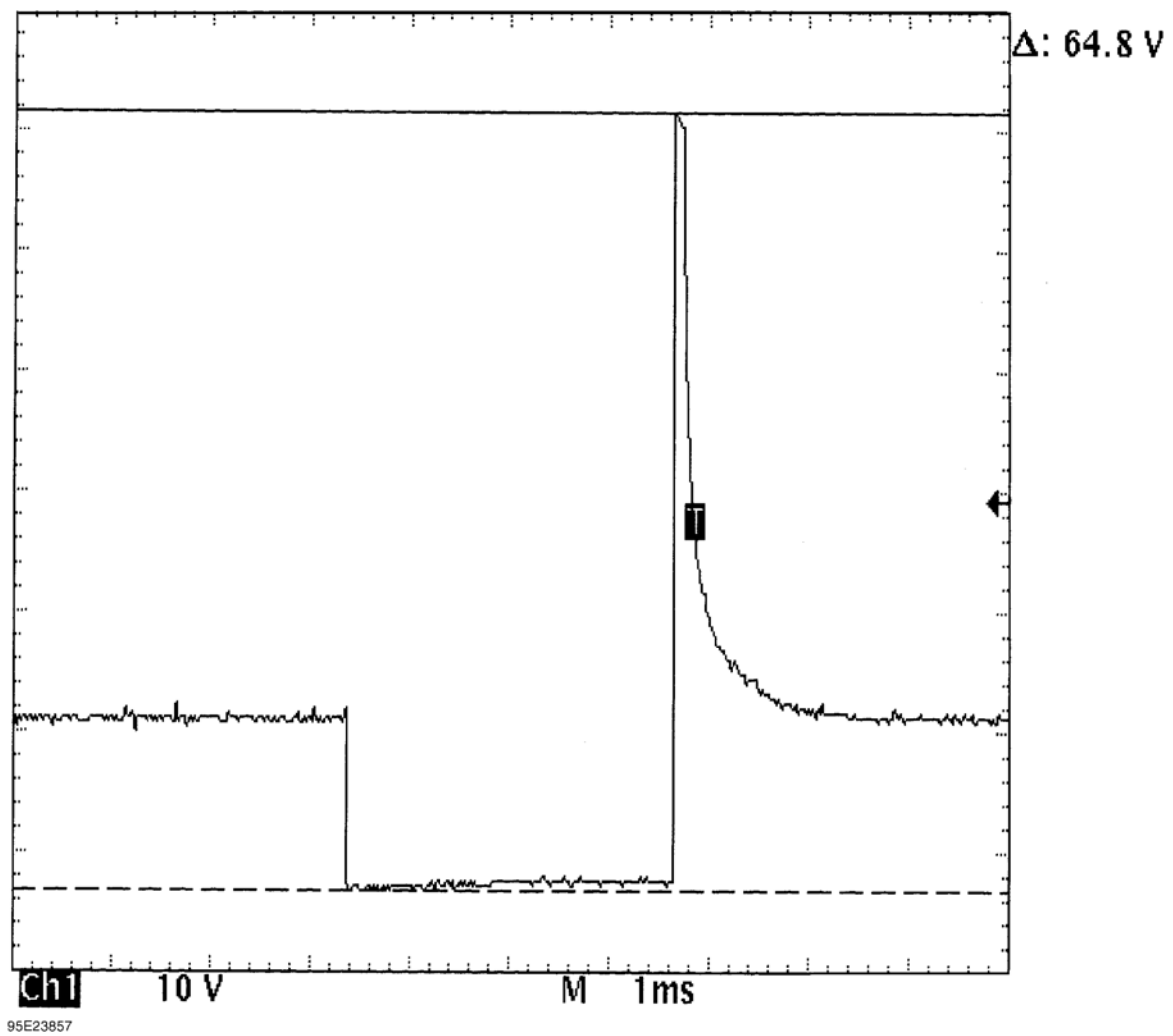


Fig. 18: Injector Bank - Known Good - Voltage Pattern

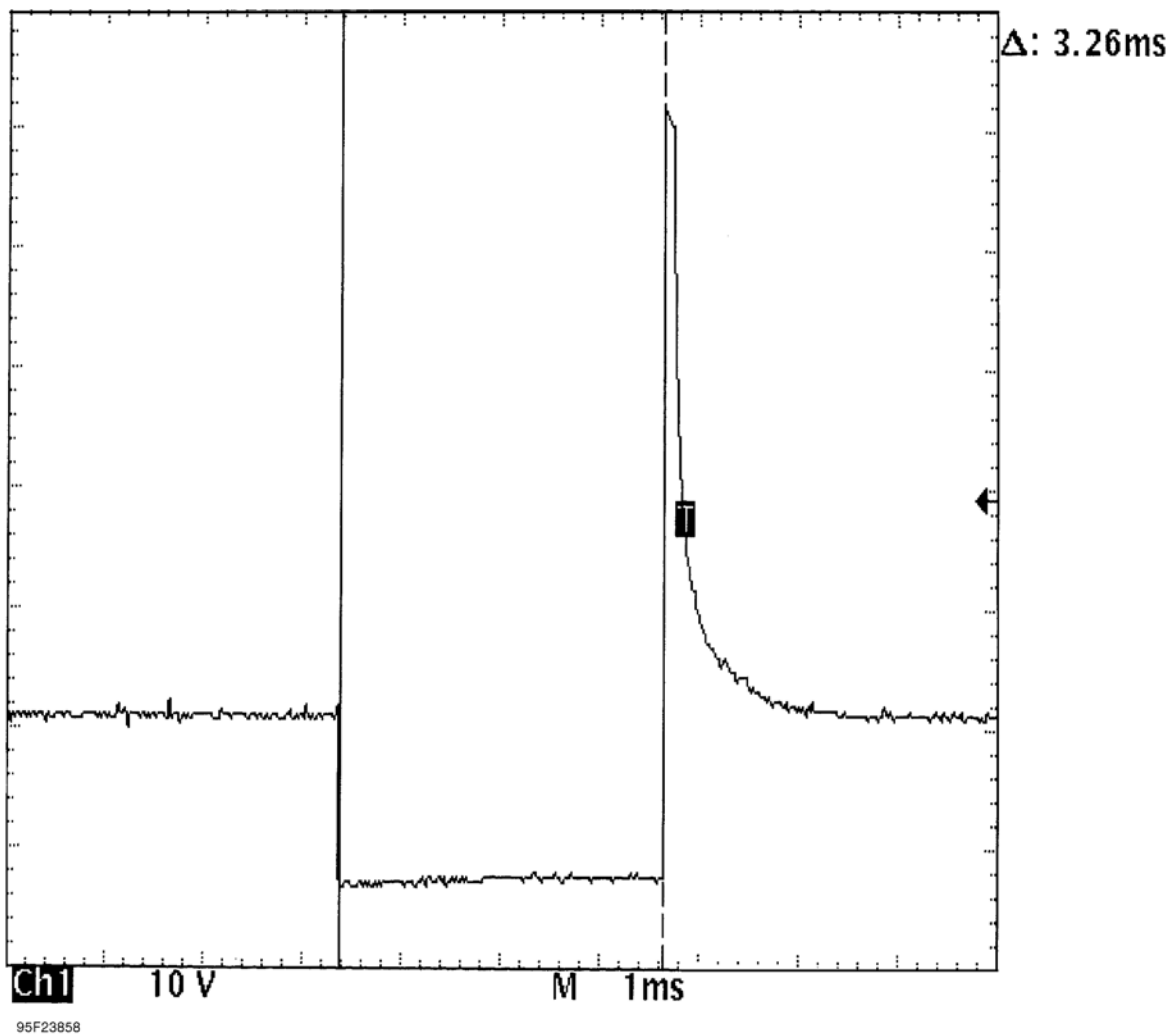


Fig. 19: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

The known-good waveform pattern in Fig. [Fig. 20](#) is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.

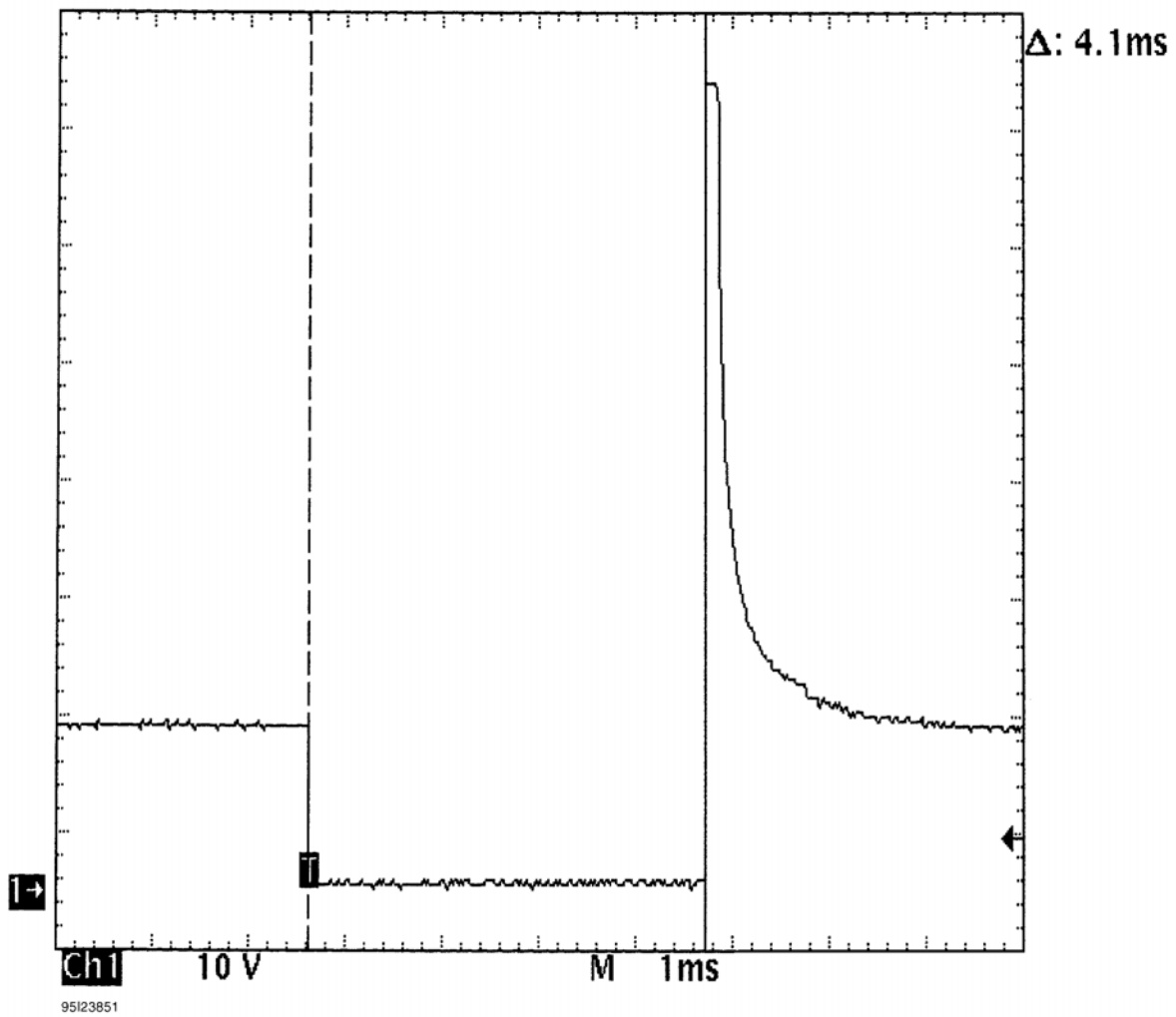


Fig. 20: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

This known-good waveform pattern, Fig. [Fig. 21](#), is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.

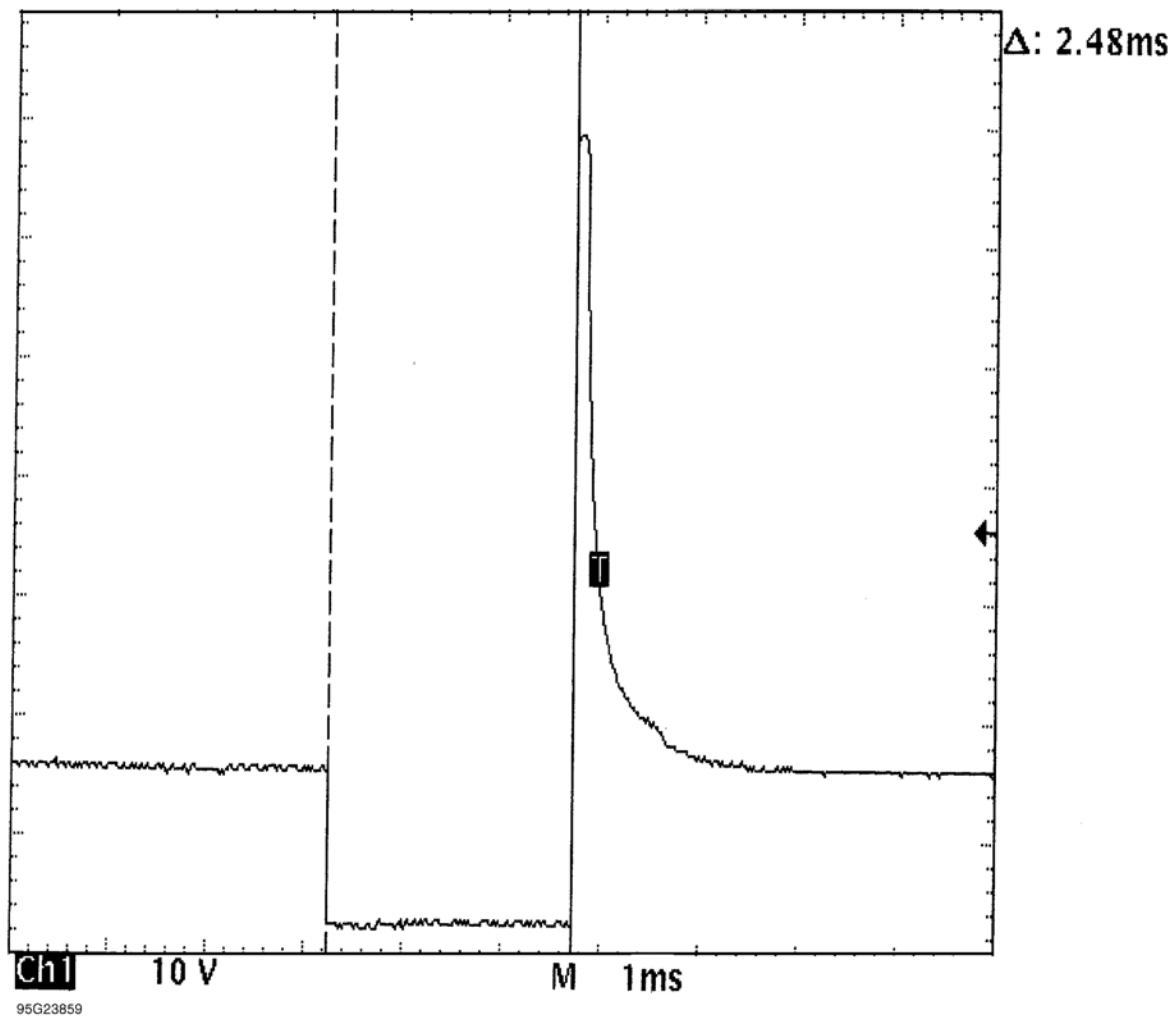


Fig. 21: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See [Fig. 22](#) for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.

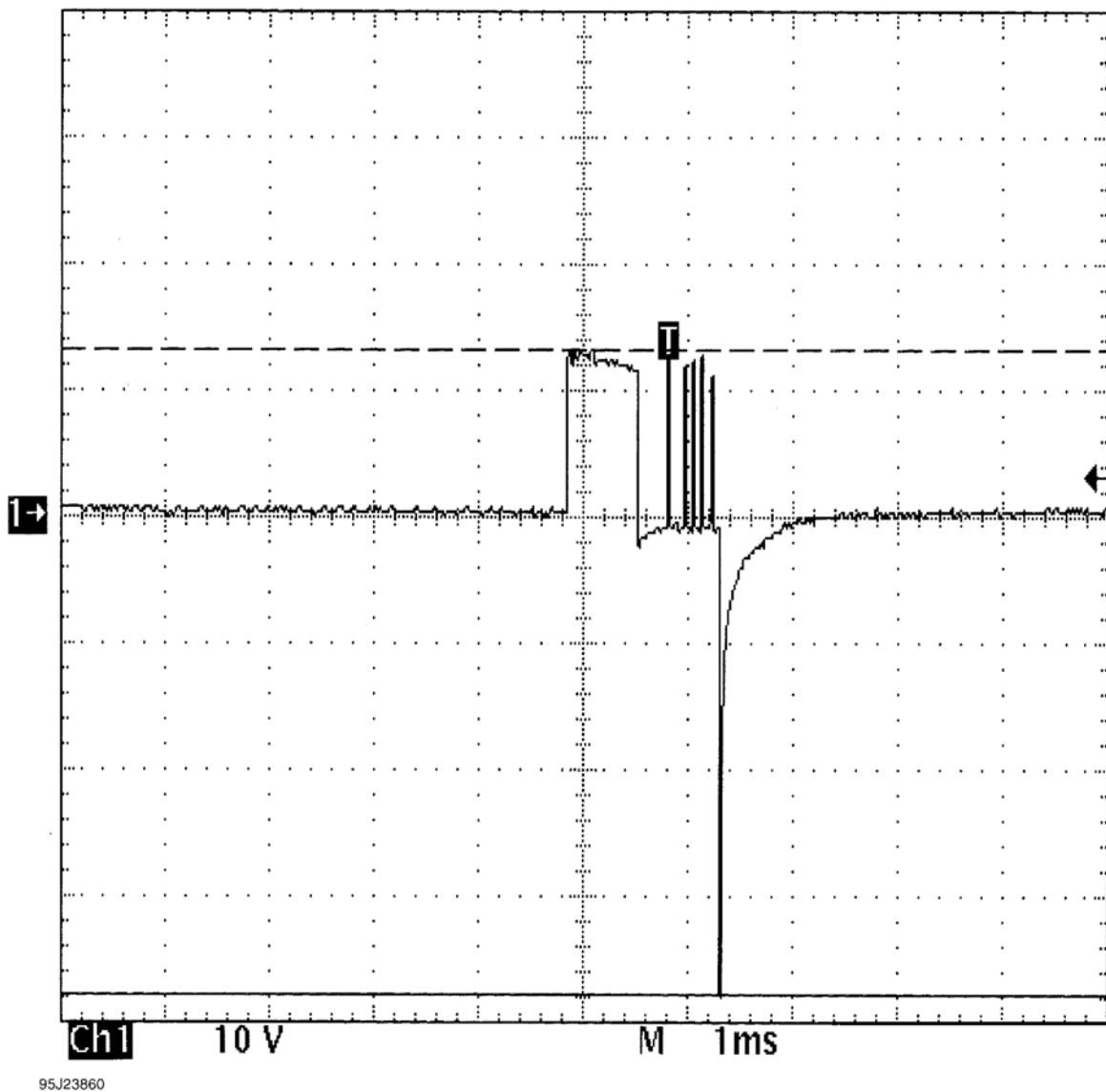


Fig. 22: Single Injector - Known Good - Voltage Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a Chrysler 3.0L V6 VIN [3]. The first waveform, Fig. [Fig. 23](#), is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. [Fig. 24](#), was taken during hot idle, closed loop, and no load.

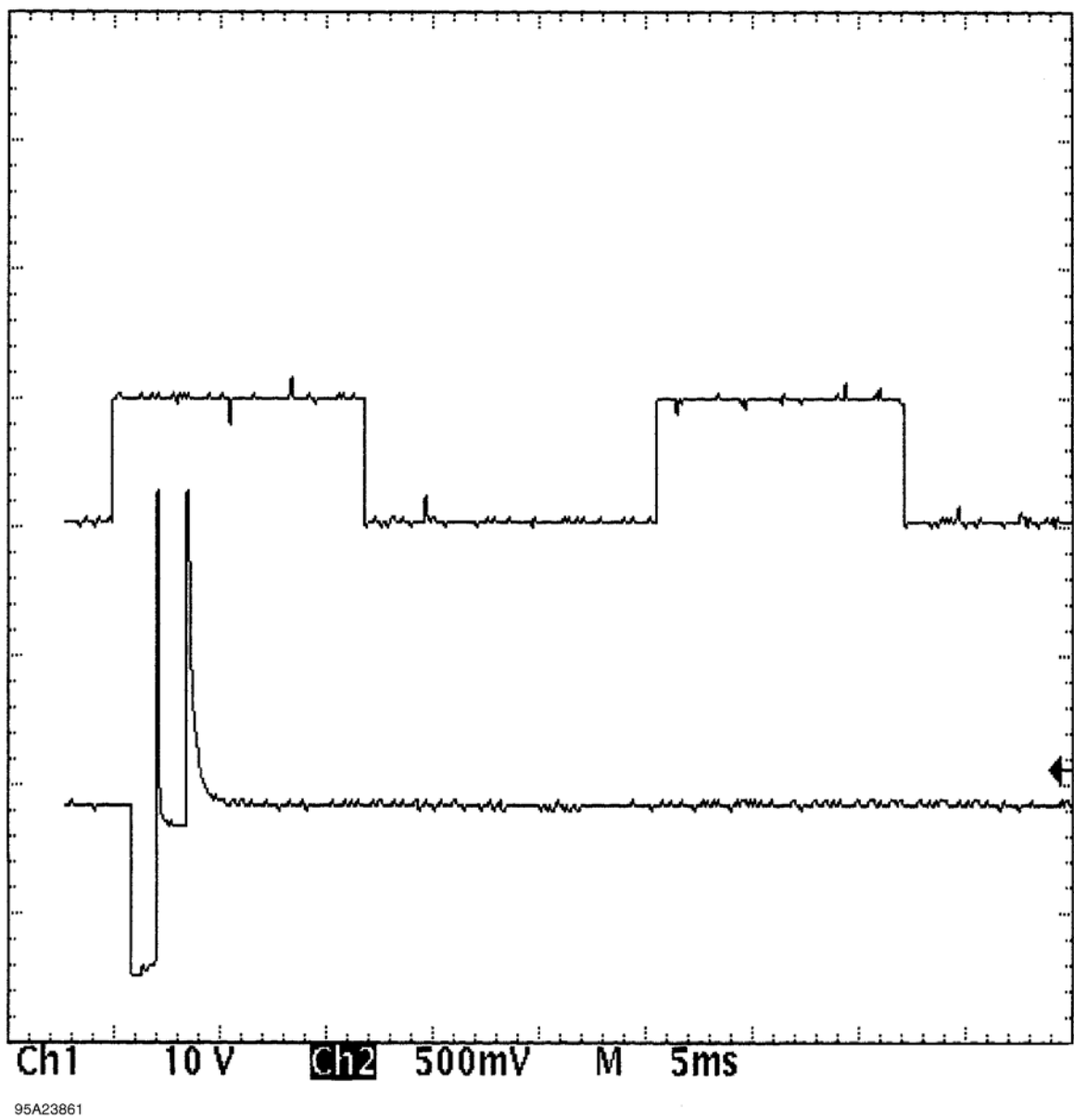


Fig. 23: Injector Bank - Known Good - Voltage Pattern

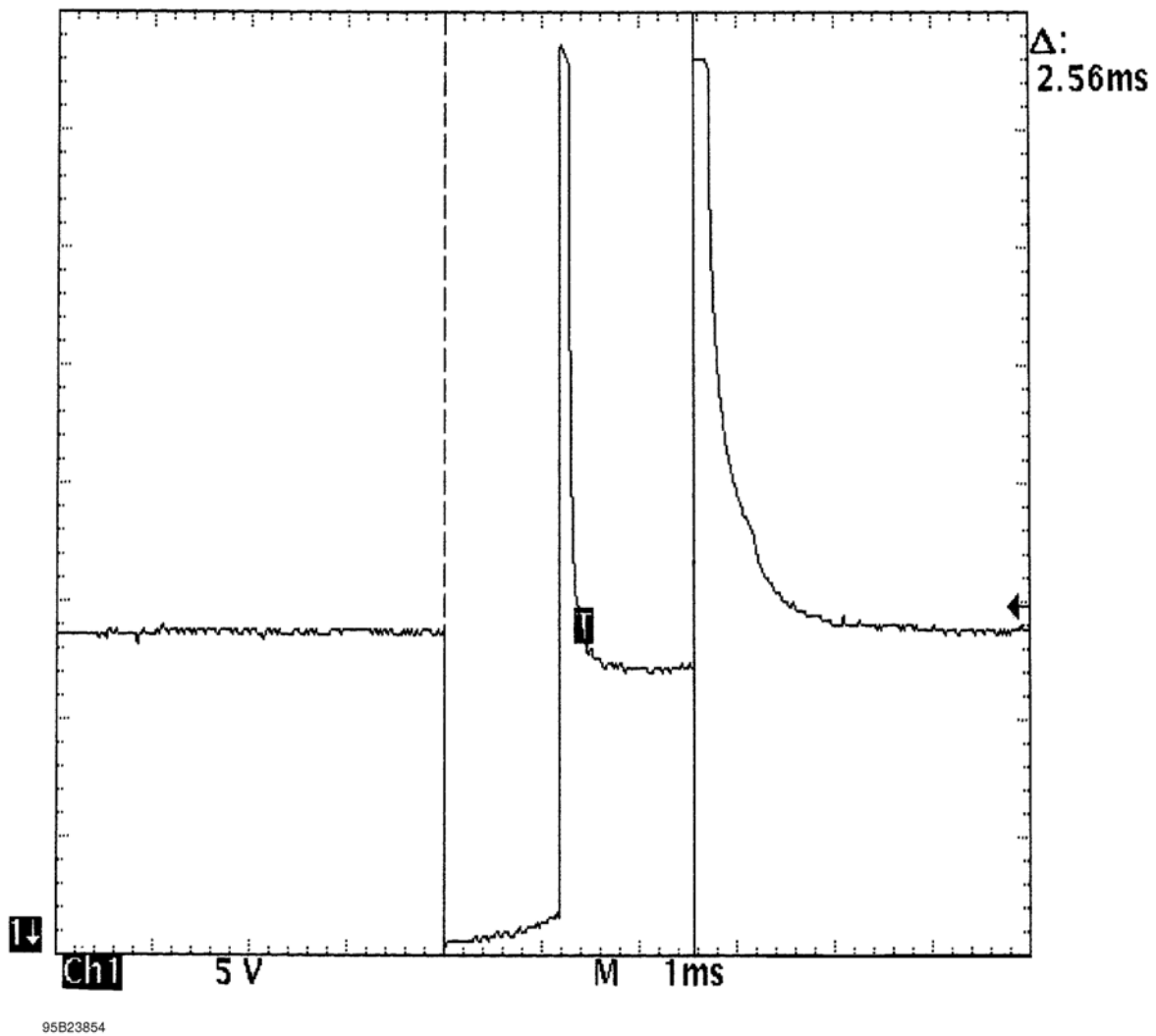


Fig. 24: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See [Fig. 25](#).

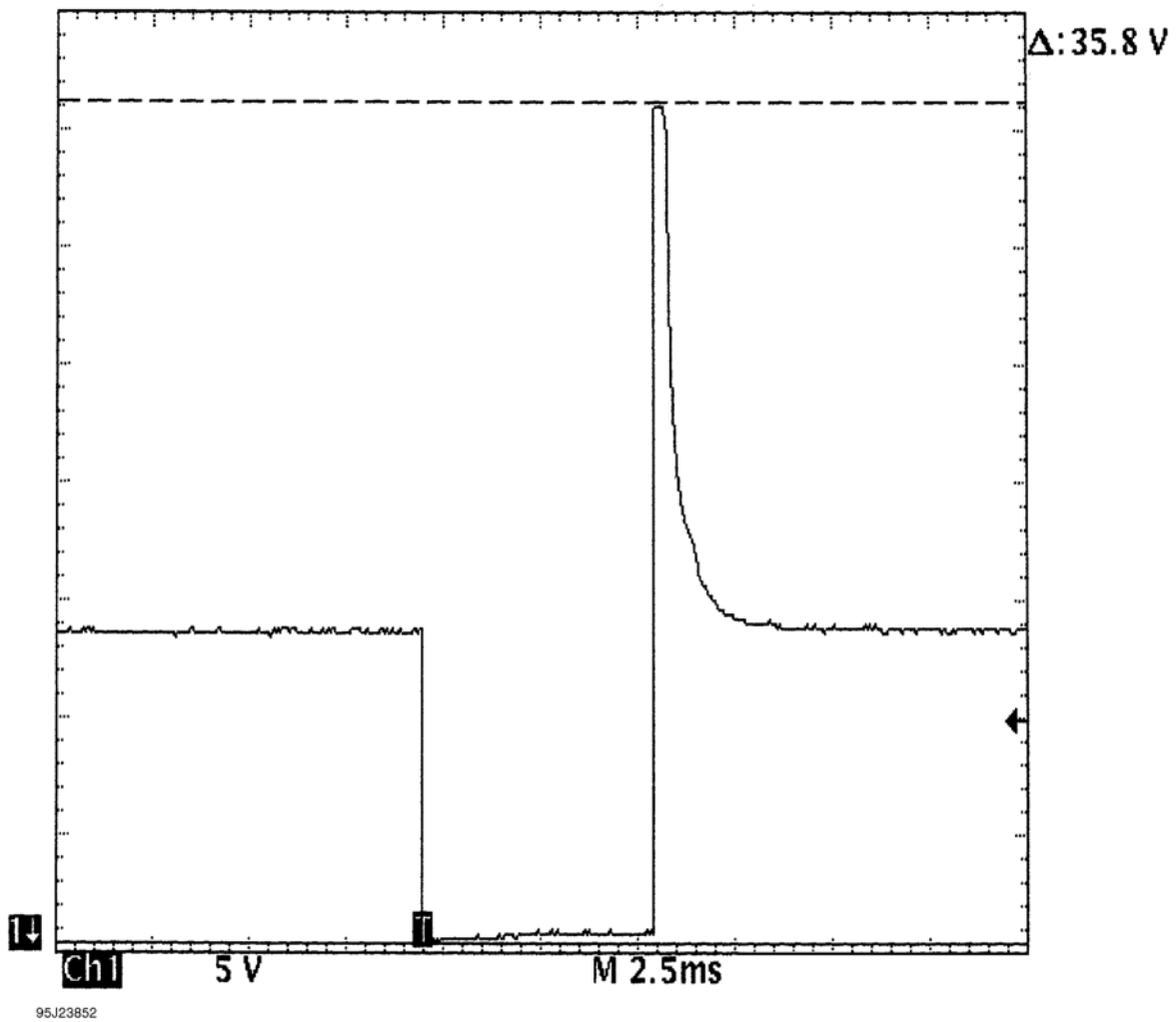


Fig. 25: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See [Fig. 26](#).

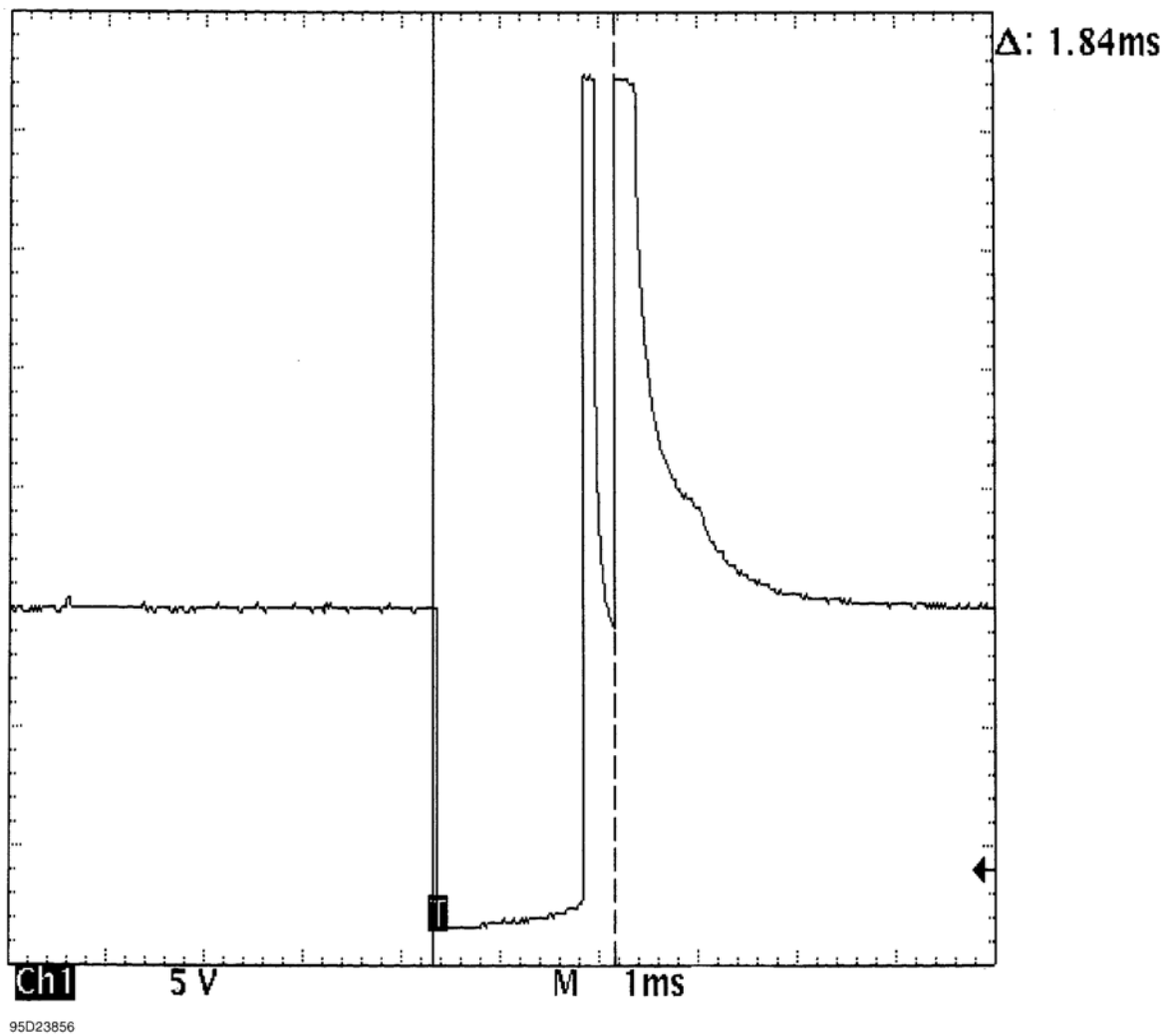


Fig. 26: Single Injector - Known Good - Voltage Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. [Fig. 27](#) illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. [Fig. 28](#), was taken during hot idle, closed loop, and no load.

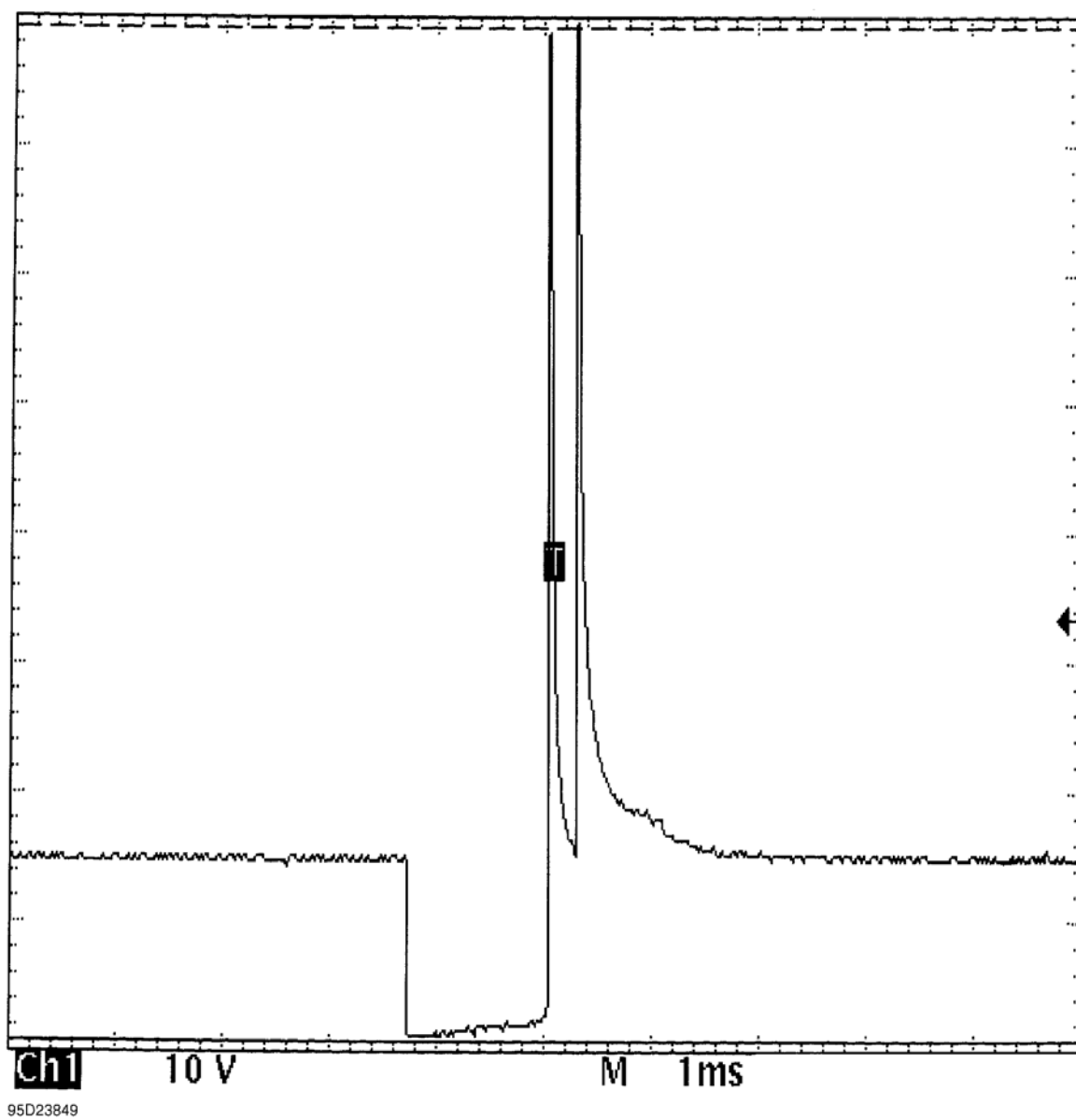


Fig. 27: Single Injector - Known Good - Voltage Pattern

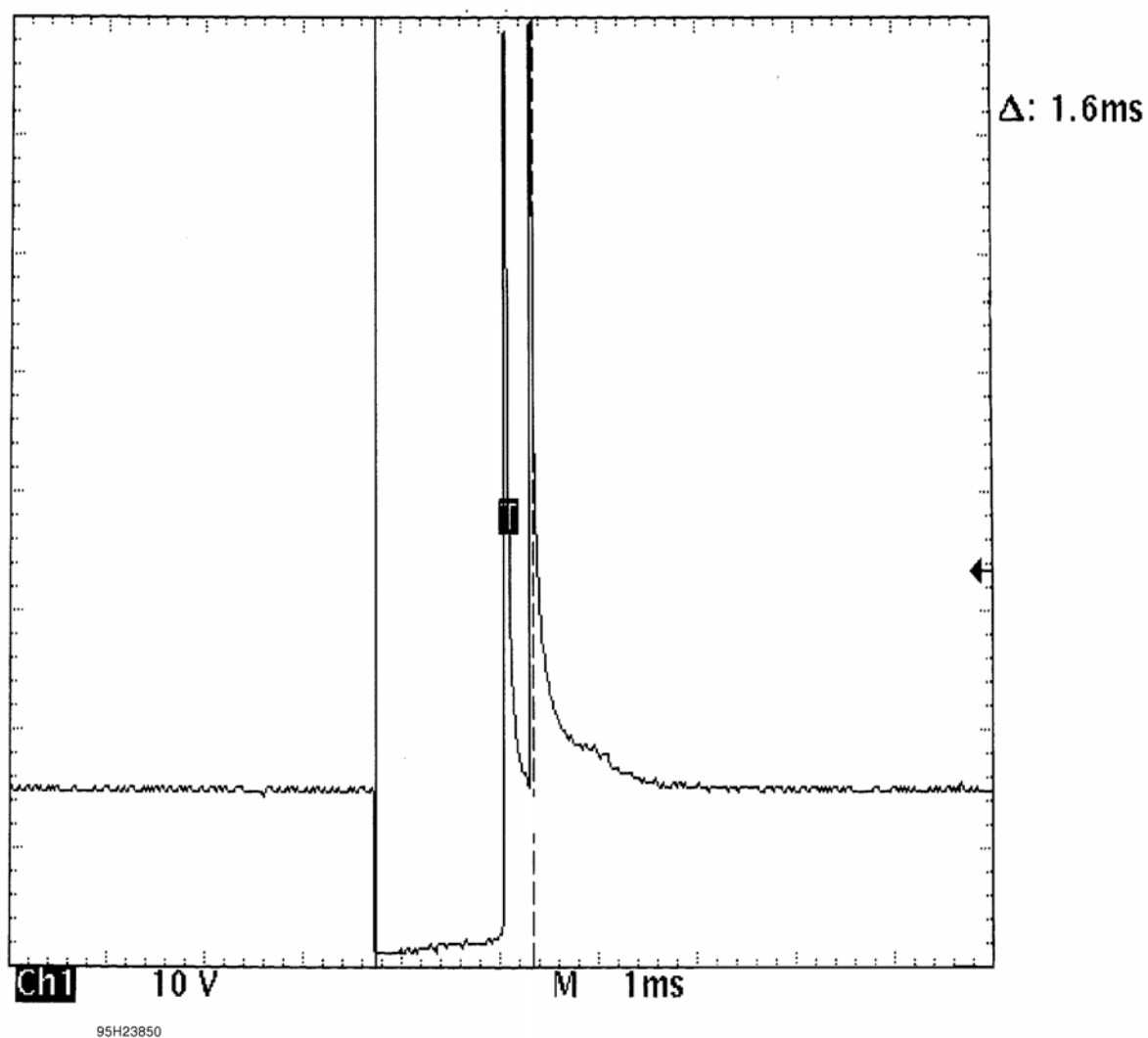


Fig. 28: Single Injector - Known Good - Voltage Pattern

Article GUID: A00010328

GENERAL INFORMATION

Wheel Alignment Theory & Operation

*** PLEASE READ THIS FIRST ***

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

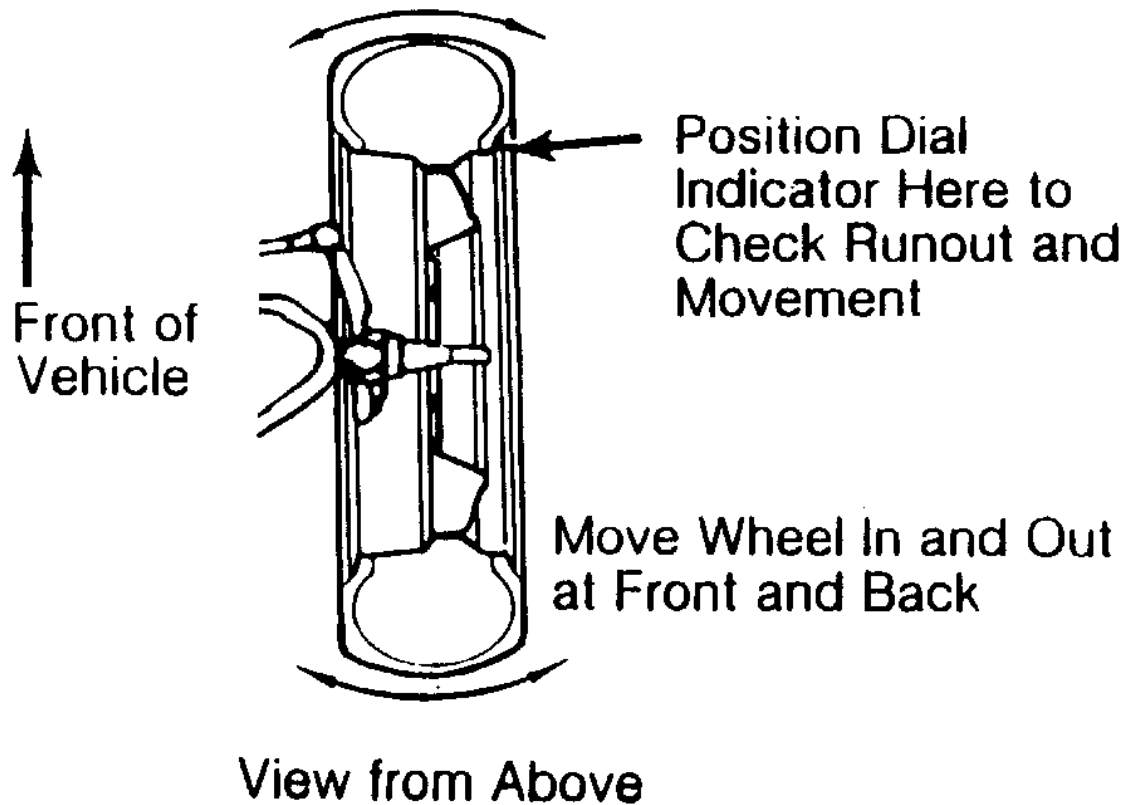
PRE-ALIGNMENT INSTRUCTIONS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

- Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
- Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See [Fig. 1](#).



26694

Fig. 1: Checking Steering Linkage

- Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm vehicle is at normal riding height.
- Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See [Fig. 2](#).
- Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

CAUTION: DO NOT attempt to correct alignment by straightening parts. Damaged parts MUST be replaced.

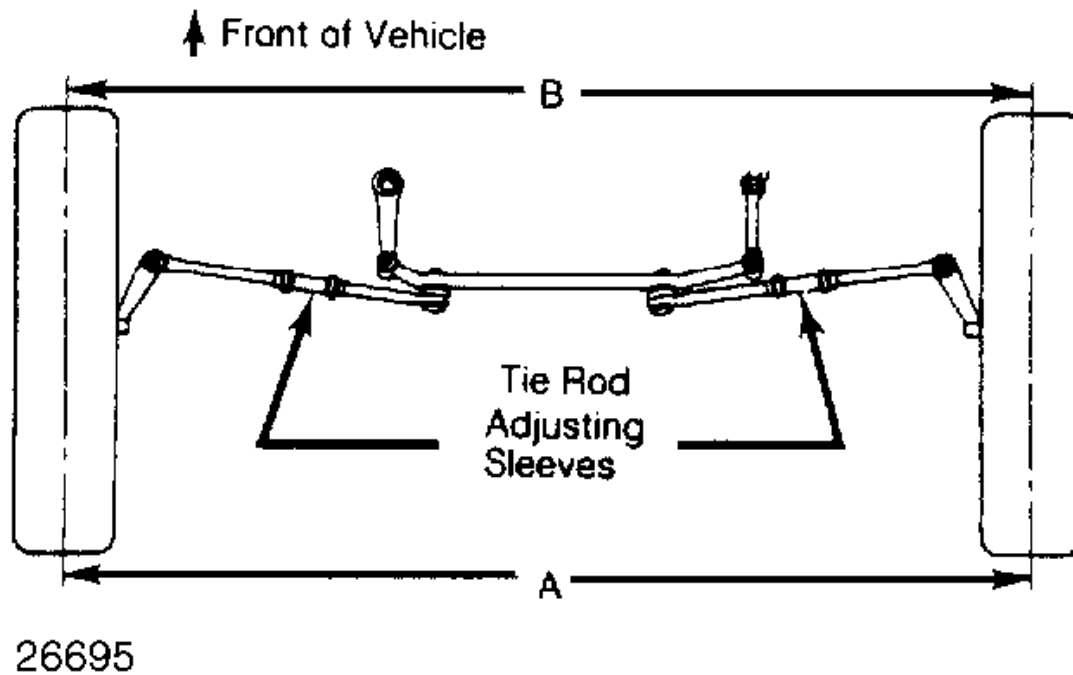


Fig. 2: Adjusting Tie Rod Sleeves (Top View)

ADJUSTMENTS

NOTE: This is **GENERAL** information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

CAMBER

1. Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See [Fig. 3](#).
2. When wheels tilt outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.

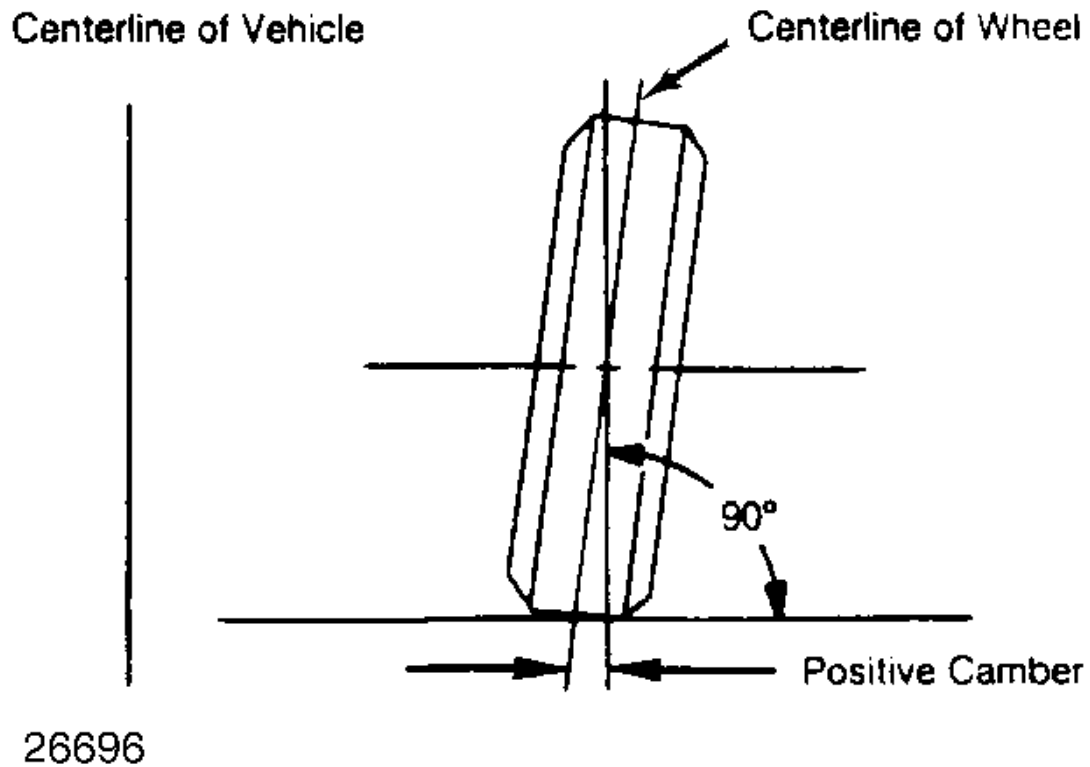


Fig. 3: Determining Camber Angle

CASTER

1. Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See [Fig. 4](#).
2. When axis is tilted backward from vertical, caster is positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.

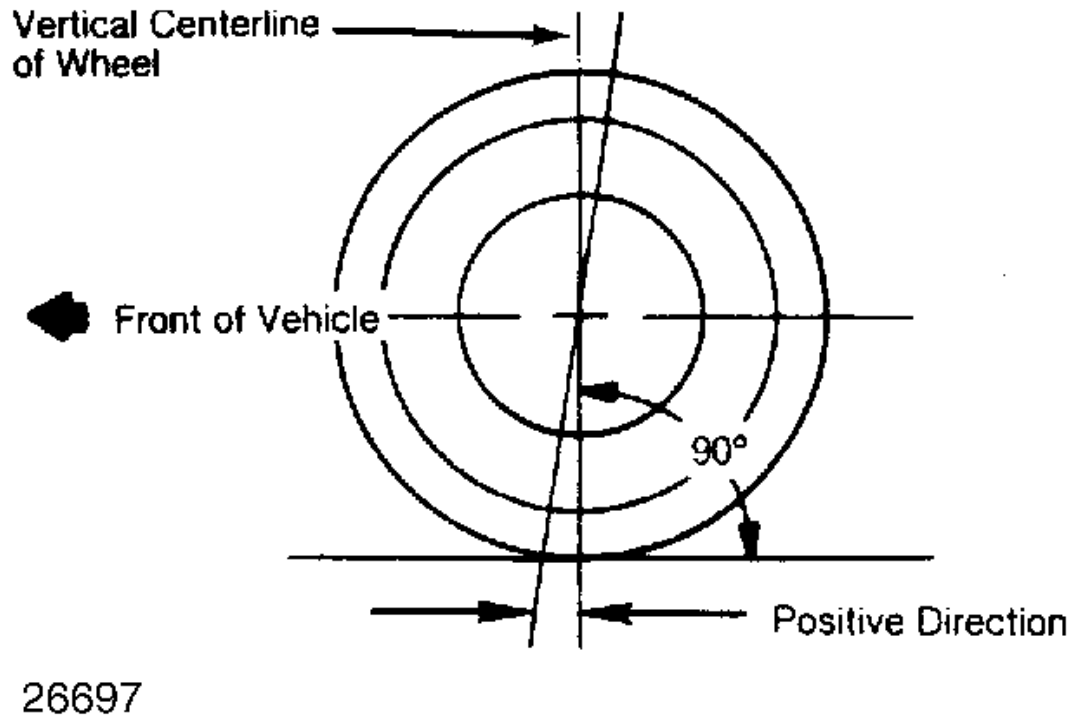


Fig. 4: Determining Caster Angle

TOE-IN ADJUSTMENT

Toe-in is the width measured at the rear of the tires subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

- 1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See [Fig. 2](#) and [Fig. 5](#).
- 2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.
- 3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.

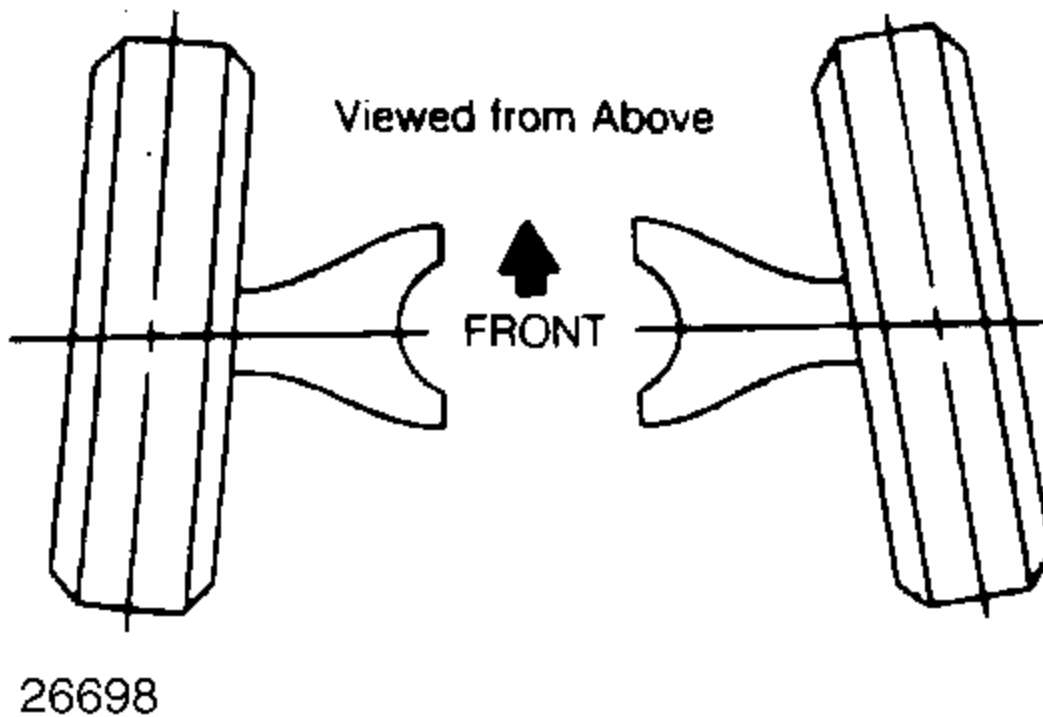


Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)

TOE-OUT ON TURNS

1. Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and toe-in properly adjusted, check toe-out with weight of vehicle on wheels.
2. Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

STEERING AXIS INCLINATION

1. Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See [Fig. 6](#).
2. If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.

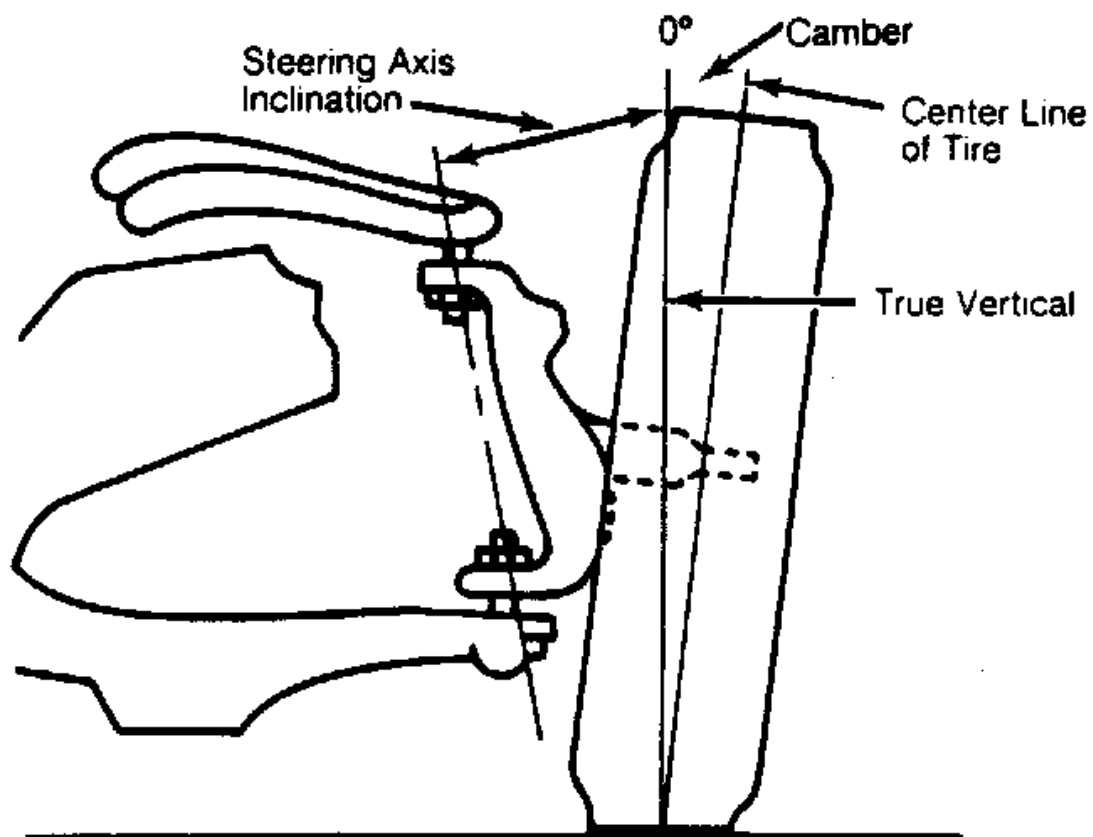


Fig. 6: Checking Steering Axis Inclination

Article GUID: A00060716

HVAC

Heating, Ventilation, and Air Conditioning - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Air Conditioning System Sealing Washer
Air Conditioning O-Ring Seal

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Air Conditioning and Drive Motor Battery Cooling Compressor Bolt	22 N.m (16 lb ft)
Air Conditioning and Drive Motor Battery Cooling Compressor Nut	22 N.m (16 lb ft)
Air Conditioning Compressor and Condenser Hose Bolt	22 N.m (16 lb ft)
Air Conditioning Compressor High Pressure Cut Off Switch	9 N.m (80 lb in)
Air Conditioning Compressor Hose Bolt	22 N.m (16 lb ft)
Air Conditioning Compressor Hose Nut	22 N.m (16 lb ft)
Air Conditioning Compressor Bracket Lower Stud	22 N.m (16 lb ft)
Air Conditioning Compressor Pressure Relief Valve	7 N.m (62 lb in)
Air Conditioning Cycling Switch	9 N.m (80 lb in)
Air Conditioning Evaporator Hose Nut	22 N.m (16 lb ft)
Air Conditioning Evaporator Thermal Expansion Valve Bolt	7 N.m (62 lb in)
Air Conditioning Evaporator Tube Bracket Nut	22 N.m (16 lb ft)
Air Conditioning Evaporator Upper Case Bolt	2.5 N.m (22 lb in)
Air Conditioning Receiver and Dehydrator Plug	9 N.m (80 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Air Conditioning Refrigerant High Pressure Service Valve	0.8 N.m (7 lb in)
Air Conditioning Refrigerant Low Pressure Service Valve	0.8 N.m (7 lb in)
Air Inlet Duct Nut	5 N.m (44 lb in)
Air Inlet Housing Bolt	2.5 N.m (22 lb in)
Blower Motor Bolt	2.5 N.m (22 lb in)
Condenser Tube Nut	9 N.m (80 lb in)
Floor Front Air Outlet Duct Bolt	2.5 N.m (22 lb in)
Heater Coolant Heater Bracket Bolt	9 N.m (80 lb in)
Heater Coolant Pump Bolt	22 N.m (16 lb ft)
Heater Core Cover Screw	2.5 N.m (22 lb in)
Heater Water Shutoff Valve Bracket Bolt	9 N.m (80 lb in)
Instrument Panel Bolt	2.5 N.m (22 lb in)
Instrument Panel Center Air Outlet Bracket Bolt	0.5 N.m (4 lb in)
Wiring Harness Bolt	9 N.m (80 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
Abrupt Refrigerant Loss Oil	60 ml	2.03 oz
Compressor Oil	100 ml	3.4 oz
Condenser Oil	20 ml	0.7 oz
Desiccant Cartridge Oil	10 ml	0.3 oz
Drive Motor Battery Cooler Oil	10 ml	0.3 oz
Evaporator Oil	10 ml	0.3 oz
Refrigerant Charge (R-134a)	0.95 kg	2.1 lb
Total System POE Oil Capacity	180 ml	6.1 oz

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Air Conditioning System	Refrigerant	12356150	10953485
POE Oil	Lubricant	88862657	88862658

DIAGNOSTIC INFORMATION AND PROCEDURES**HANDLING OF REFRIGERANT LINES AND FITTINGS**

CAUTION: To avoid system damage use only R-134a dedicated tools when servicing the A/C system.

- Keep all metal tubing lines free of dents or kinks. Any line restrictions will cause the loss of system capacity.
- Never bend a flexible hose line to a radius of less than four times the diameter of the hose.
- Never allow a flexible hose line to come within 65 mm (2 - 1/2 in) of the exhaust manifold.
- Inspect flexible hose lines regularly for leaks or brittleness.
- Replace flexible hose lines with new lines if you find signs of deterioration or leaking.
- Discharge the refrigeration system of all refrigerant before disconnecting any fitting in the refrigeration system.
- Proceed very cautiously regardless of the gauge readings.

WARNING: For personal protection, goggles and lint-free gloves should be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If refrigerant comes in contact with any part of the body severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

- Open the fittings very slowly.
- If you notice pressure when you loosen a fitting, allow the pressure to bleed off as described Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System.
- Cap or tape any refrigerant line immediately after it is opened. This will prevent the entrance of moisture and dirt, which can cause internal compressor wear or plugged lines in the condenser, the evaporator core, the expansion valve, or the compressor inlet screens.

NOTE: Use two proper wrenches to connect the fittings.

- Back up the opposing fitting to prevent distortion of the connecting lines or the components.
- Keep the sealing surfaces in perfect condition. A burr or a piece of dirt may cause a refrigerant leak.
- When seal washers are used, always install the seal washer without lubrication.

CAUTION: Use only the lubricant specified for this vehicles refrigerant system. Do not mix refrigerant oils which may result in system contamination and unknown reaction by-products which may cause HVAC System failure.

- When O-rings are used, always lightly coat the new O-ring seal with the proper refrigerant oil prior to installation.

LEAK TESTING

Special Tools

- **GE-50078** Infrared Refrigerant Leak Detector
- **GE-42220** Universal 12V Leak Detection Lamp
- **GE-43872** Fluorescent Dye Cleaner

For equivalent regional tools, refer to [Special Tools](#).

Refrigerant Leak Testing

NOTE: All A/C system repairs must be verified using electronic leak detection. Dye detection may take up 2 or 3 days to be reliable.

NOTE: General Motors vehicles are now manufactured with fluorescent dye installed directly into the air conditioning (A/C) system.

The fluorescent dye mixes and flows with the refrigerant oil throughout the refrigerant system.

Verifying some passive leaks may require using the **GE-50078** detector, even though the A/C system contains fluorescent dye.

Visual Inspection

Visually trace the entire refrigerant system and look for signs of lubricant leakage, damage, and corrosion on all lines hoses and components (Oil can be an indication of a leak). Each questionable area should be checked for leaks using an electronic leak detector.

Fluorescent Leak Detector

NOTE: Always use UV protective eyewear when working with UV light.

Fluorescent dye will assist in locating any leaks in the A/C system.

NOTE: POE oil is water soluble.

- Condensation on the evaporator core or the refrigerant lines may wash the POE oil and fluorescent dye away from the actual leak. Condensation may also carry dye through the HVAC module drain.
- Leaks in the A/C system will be indicated in a light green or yellow color when using the leak detection lamp.

Use the leak detection lamp in the following areas:

- All fittings or connections that use seal washers or O-rings
- All of the A/C components
- The A/C hoses and pressure switches
- The HVAC module drain tube, if the evaporator core is suspected of leaking
- The service port sealing caps

The sealing cap is the primary seal for the service ports.

- Follow the instructions supplied with the **GE-42220** lamp.
- To prevent false diagnosis in the future, thoroughly clean the residual dye from any area where leaks were found. Use a rag and the approved **GE-43872** cleaner.

Replacing System Dye After Flushing

NOTE: Do not add dye to the refrigerant system equipped with high voltage electric compressors. The only means of replenishing dye after flushing is by replacing component containing the dye. Currently a compatible dye wafer is contained in the O.E. desiccant package. Adding dye that is not compatible with the high voltage

electric compressor may cause compressor damage and high voltage isolation faults.

To prevent false diagnosis, thoroughly clean any residual dye from the service port with a rag and the approved fluorescent dye cleaner **GE-43872** cleaner.

Electronic Leak Detection

Infrared detectors operate differently than heated sensor type detectors. They detect changes in concentration of refrigerant rather than absolute concentration. If the tip is held at a detected leak for more than 5 seconds the detector will saturate and zero to that concentration and will no longer detect leaks at that concentration or less. Move tip away from the leak saturation area for 30 seconds to reset the sensitivity of the detector.

Adequate system pressure is required for effective leak detection.

- If system is empty install 10% of system charge.
- Temperature must be above 60 F.

Do not use:

- Soap solutions (not effective for leak detection)
- Shop air (will introduce contamination to the refrigerant system)
- High pressure gasses i.e nitrogen (May cause system damage)

Air movement from the engine cooling fan can affect the detectors ability to detect leaks. Always leak test with engine off and if possible after engine has reached normal operating temperature.

- All fittings and components should be checked.
- Take care not to contaminate the probe tip if the part being tested is contaminated.
- No cleaners containing solvents should be used prior to using electronic leak detector.
- Always follow the refrigerant system around in a continuous path so that no areas of potential leaks are missed. Move the tip along the refrigerant system at a rate of no more than 75 mm per second and a distance of 10 mm from the surface being tested. If a leak is found, always continue to test the remainder of the system.

Follow the instructions supplied with the **GE-50078** detector.

AIR CONDITIONING (A/C) SYSTEM PERFORMANCE TEST

This test measures the operating efficiency of the A/C system under the following conditions:

- The current ambient air temperature
- The current relative humidity
- The high side pressure of the A/C system
- The low side pressure of the A/C system
- The temperature of the air being discharged into the passenger compartment

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1

This step determines if the A/C system has at least the minimum refrigerant charge required to operate the system without damage.

2

This step measures the performance of the A/C system.

3

This step is to allow for vehicle variations as well as high ambient temperatures.

Step	Action	Values	Yes	No
NOTE: • The ambient air temperature must be at least 16°C (60°F). • Do not induce additional air flow across the front of the vehicle during the test. • If you were sent here from a DTC diagnostic table, clear the DTC upon completion of this test.				
1	1. Park the vehicle inside or in the shade. 2. Open the windows in order to ventilate the interior of the vehicle. 3. If the A/C system was operating, allow the A/C system to equalize for about 2 minutes. 4. Turn OFF the ignition. 5. Install the J-43600 ACR 2000 Air Conditioning Service Center or GE-48800 CoolTech A/C Recharge Machine.	More than 16°C (60°F) - 345 kPa (50 psi) More than 24°C (75°F) - 483 kPa (70 psi) More than 33°C	Go to Step 2	Go to Leak Testing

Step	Action	Values	Yes	No
	6. Record the ambient air temperature and humidity. 7. Record the low and high side STATIC pressure readings. Are both the low side and high side pressures within the specified value?	(90°F) - 690 kPa (100 psi)		
2	NOTE: Record the relative humidity and the ambient air temperature at the time of the test. 1. Close the vehicle doors and windows. 2. Open the drivers door window 12.7 - 15.2 cm (5 - 6 in). 3. Select the following HVAC control settings: • The A/C is ON. • The coldest temperature setting • The maximum blower speed • Recirculation mode • The instrument panel (I/P) outlet mode • All I/P outlets are OPEN. 4. Install thermometers in the left and right center panel air outlets. 5. Apply the parking brake. 6. Place the transaxle/transmission in one of the following positions: • PARK (Automatic) • NEUTRAL (Manual) 7. Start the engine and warm to operating temperature. 8. Operate the A/C system for 5 minutes. 9. Inspect A/C components for the following conditions: • Abnormal frost areas • Unusual noises 10. Record the following information:	-	Go to Step 5	Go to Step 3

Step	Action	Values	Yes	No
	- The panel outlet air temperatures - The low-side pressure - The high-side pressure 11. Compare the low and high side pressures and the panel output temperatures to the A/C Performance Table below. Does all the data recorded fall within the specified ranges of the A/C Performance Table below?			
3	If the pressures and temperatures recorded do not fall within the specified ranges: - Continue to operate the A/C system for an additional 5 minutes. - Record the pressures and temperatures again. - Compare the low and high side pressures and the panel output temperature to the A/C Performance Table below. Does all the data recorded fall within the specified ranges of the A/C Performance Table below?	-	Go to Step 5	Go to Step 4
4	Perform the necessary repairs. Refer to A/C Diagnostics Chart. Is the action complete?	-	Go to Step 5	-
5	Operate the system in order to verify the test results. Did you find the same results?	-	System OK	Go to Symptoms - HVAC Systems - Automatic

A/C Performance Table

Ambient Temperature	Relative Humidity	Low Side Service Port Pressure	High Side Service Port Pressure	Maximum Left Center Discharge Air Temperature
13 - 18Â°C (55 - 65Â°F)	0 - 100%	186 - 268 kPa (27 - 39 psi)	819 - 1322 kPa (119 - 192 psi)	12Â°C (52Â°F)
19 - 24Â°C (66 - 75Â°F)	Below 40%	186 - 275 kPa (27 - 40 psi)	930 - 1440 kPa (135 - 209 psi)	12Â°C (52Â°F)
	Above 40%	206 - 303 kPa (30 - 44 psi)	1061 - 1577 kPa (154 - 299 psi)	13Â°C (55Â°F)
25 - 29Â°C (76 - 85Â°F)	Below 35%	213 - 289 kPa (31 - 42 psi)	1267 - 1667 kPa (184 - 242 psi)	13Â°C (55Â°F)
	35 - 50%	227 - 303 kPa (33 - 44 psi)	1336 - 1708 kPa (194 - 248 psi)	14Â°C (57Â°F)
	Above 50%	241 - 323 kPa (35 - 47 psi)	1391 - 1791 kPa (202 - 260 psi)	17Â°C (61Â°F)

Ambient Temperature	Relative Humidity	Low Side Service Port Pressure	High Side Service Port Pressure	Maximum Left Center Discharge Air Temperature
30 - 35°C (86 - 95°F)	Below 30%	241 - 316 kPa (35 - 46 psi)	1529 - 1956 kPa (222 - 284 psi)	15°C (59°F)
	30 - 50%	248 - 330 kPa (36 - 48 psi)	1570 - 1991 kPa (228 - 289 psi)	18°C (63°F)
	Above 50%	261 - 351 kPa (38 - 51 psi)	1632-2039 kPa (237 - 296 psi)	19°C (66°F)
36 - 41°C (96 - 105°F)	Below 20%	261 - 337 kPa (38 - 49 psi)	1839 - 2253 kPa (267 - 327 psi)	18°C (63°F)
	20 - 40%	268 - 351 kPa (39 - 51 psi)	1860 - 2266 kPa (270 - 329 psi)	19°C (66°F)
	Above 40%	282 - 365 kPa (41 - 53 psi)	1887 - 2280 kPa (274 - 331 psi)	20°C (68°F)
42 - 46°C (106 - 115°F)	Below 20%	289 - 358 kPa (42 - 52 psi)	2156 - 2507 kPa (313 - 364 psi)	20°C (68°F)
	Above 20%	296 - 372 kPa (43 - 54 psi)	2170 - 2507 kPa (315 - 364 psi)	22°C (70°F)
47 - 49°C (116 - 120°F)	Below 30%	316 - 385 kPa (46 - 56 psi)	2432 - 2762 kPa (353 - 401 psi)	23°C (73°F)

A/C DIAGNOSTICS CHART

A/C System Concern		Potential Causes
Compressor Inoperative		Electrical Wiring Issue
		No or Low Refrigerant Charge
		Compressor Internal Malfunction
		Compressor Clutch Malfunction
		A/C Pressure Sensor Malfunction
		Evaporator Air Temperature (EAT) Malfunction
		HVAC Controls Malfunction
Low Side Gauge Reading	High Side Gauge Reading	Potential Causes
Same as High Side	Same as Low Side	No or Low Refrigerant Charge
		Compressor Malfunction
		A/C Pressure Sensor Malfunction
		EAT Malfunction
		HVAC Controls Malfunction
Normal	Normal	Temperature Actuator Malfunction
		Temperature Door Malfunction
Low	Low	Low Refrigerant Charge
		Restriction between the Compressor Outlet and Low Side Port
	Low/Normal	Evaporator Freezing/EAT Malfunction

A/C System Concern		Potential Causes
	High	Compressor Stuck at Maximum Displacement/EAT Malfunction
Normal/High	Normal/High	PAG or POE Oil Overcharge
High	Low	Restriction between the Low Side Port and Compressor Inlet
		Expansion Device Stuck Open
		Compressor has Low Displacement or Internal Malfunction
	High	Malfunctioning Cooling Fans
		Refrigerant Overcharge
		Restricted Condenser Air Flow
		Air in A/C System

NOTE:

Restrictions can occur in any part of an A/C system and may result in various gauge pressure values, depending on the system design and service port locations. The use of a non-contact, infrared thermometer can help diagnose a restricted A/C system with the ability to quickly observe significant, unexpected temperature changes in components and plumbing due to debris, contamination, pinched/damaged hoses, etc.

HEATING PERFORMANCE DIAGNOSTIC

Step	Action	Yes	No
DEFINITION: Heating system performance.			

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - HVAC Systems - Automatic
2	WARNING: Moving Parts and Hot Surfaces Warning . 1. Turn ignition to on. 2. Select vent mode. 3. Select the warmest temperature setting. 4. Select Maximum blower speed. 5. Feel the temperature of the heater core inlet hose. Does the heater core inlet hose feel warm to hot?	Go to Step 3	Go to Step 9
3	1. Select the minimum blower speed. 2. Feel the temperature of the heater core inlet and outlet hoses. Does the heater core inlet hose feel warmer than the heater core outlet hose?	Go to Step 7	Go to Step 4
4	1. Install a thermometer into the center I/P panel air outlet. 2. Secure a thermometer to the heater core outlet hose. 3. Select the maximum blower speed. 4. Record the temperature at the following locations: • The center I/P panel air outlet • The heater core outlet hose 5. Compare the recorded temperatures. Are the two temperature readings about equal?	Go to Step 5	Go to Step 6
5	1. Inspect and repair the following areas of the vehicle for cold air leaks: • The cowl • The recirculation door • The HVAC module case 2. Perform the necessary repairs. Are the repairs complete?	Go to Step 10	-

Step	Action	Yes	No
6	1. Inspect the temperature door operation. Refer to Heating and Air Conditioning System Description and Operation . 2. Perform any necessary repairs. Are the repairs complete?	Go to Step 10	-
7	1. Turn the ignition to off. 2. Backflush the heater core. 3. Turn the ignition to on. 4. Select the vent mode. 5. Select the minimum blower speed. 6. Select the warmest temperature setting. 7. Feel the temperature of the heater core inlet and outlet hoses. Does the heater core inlet hose feel warmer than the heater core outlet hose?	Go to Step 8	Go to Step 10
8	Replace the heater core. Refer to Heater Core Replacement . Is the repair complete?	Go to Step 10	-
9	Inspect and repair the following areas: • Inspect and adjust surge tank coolant level. • Verify coolant pump and coolant flow control valve DTCs do not exist. Resolve any pump faults before proceeding with this diagnostic procedure. • Verify coolant flow control valve operation by activating with the GDS tool • Verify coolant heater control module operation by activating with the GDS tool. • Pinched hose • Heater valve inlet filter Did you find and correct the condition?	Go to Step 10	Go to Engine Fails To Reach Normal Operating Temperature
10	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Engine Fails To Reach Normal Operating Temperature

DEFROSTING INSUFFICIENT

Step	Action	Yes	No
DEFINITION: Time required to defrost the windshield is longer than normal.			

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - HVAC Systems - Automatic
2	1. Turn ignition to ON. 2. Select the DEFROST mode. 3. Select the maximum blower speed. Does sufficient air flow from the defroster outlets?	Go to Step 3	Go to Step 6
3	WARNING: Refer to Moving Parts and Hot Surfaces Warning . 1. Select the minimum blower speed. 2. Select the maximum temperature setting. 3. Feel the temperature of the inlet and outlet hoses at the heater core. Does the inlet hose feel warmer than the outlet hose?	Go to Step 7	Go to Step 4
4	Perform the A/C system performance test. Refer to Air Conditioning (A/C) System Performance Test Is the A/C system operating within the specifications?	Go to Step 5	Go to Step 8
5	Inspect for correct operation of the air inlet door. Is the air inlet door operating correctly?	Go to Step 10	Go to Step 9
6	Repair the air delivery concern. Refer to Diagnostic Starting Point - Vehicle Is the repair complete?	Go to Step 10	-
7	Repair the heating concern. Refer to Heating Performance Diagnostic Is the repair complete?	Go to Step 10	-
8	Repair the A/C performance concern. Refer to Air Conditioning (A/C) System Performance Test Is the repair complete?	Go to Step 10	-
9	Repair the air inlet door concern. Refer to Air Inlet Housing Replacement Is the repair complete?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you find and correct the problem?	System OK	Go to Step 2

NOISE DIAGNOSIS - BLOWER MOTOR

Step	Action	Yes	No
DEFINITION: Noise originating from the blower motor.			

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - HVAC Systems - Automatic
2	Inspect the air inlet grille for debris. Is debris present?	Go to Step 8	Go to Step 3
3	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn the ignition to the accessory position. 4. Cycle the blower motor through all of the speeds and modes in order to determine where and when the noise occurs. Is a noise evident during the blower operation?	Go to Step 4	Go to Step 11
4	Inspect for excessive vibration at each blower motor speed by feeling the blower case. Is excess vibration present?	Go to Step 6	Go to Step 5
5	Listen to the blower motor at each speed. Is the blower motor making a squeaking or chirping noise?	Go to Step 9	Go to Step 11
6	1. Remove the blower motor. Refer to Blower Motor Replacement . 2. Inspect the blower motor impeller for deposits of foreign material. 3. Inspect the blower motor for deposits of foreign material. Did you find any foreign material on the blower motor or blower motor impeller?	Go to Step 8	Go to Step 7
7	Inspect the blower motor for the following conditions: • Cracked blades • A loose impeller retainer • Improper impeller alignment Did you find any of these conditions?	Go to Step 9	Go to Step 10
8	Remove the foreign material. Is the action complete?	Go to Step 10	-
9	Replace the blower motor. Refer to Blower Motor Replacement . Is the repair complete?	Go to Step 11	-
10	Install the blower motor. Refer to Blower Motor Replacement . Is the action complete?	Go to Step 11	-

Step	Action	Yes	No
11	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

ODOR DIAGNOSIS

Step	Action	Yes	No
DEFINITION: Odor originating or noticed through the HVAC system.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to Step 2	Go to Symptoms - HVAC Systems - Automatic
2	- Sit inside the vehicle. - Close all of the doors and windows. - Start Turn ignition to on. - Select the maximum blower speed. - Select the PANEL air outlet mode. - Select the coldest temperature setting. - Cycle through all of the blower speeds, modes and temperatures to define what type of odor is present. - Musty smell - Coolant smell - Oil smell Does the odor have a musty smell?	Go to Step 3	Go to Step 8
3	Inspect the HVAC filter and the air inlet grille for debris. Is debris present?	Go to Step 4	Go to Step 5
4	Remove any debris. Is the action complete?	Go to Step 15	-
5	Inspect for wet carpeting. Is the carpet wet?	Go to Step 6	Go to Step 8
6	Inspect for the following conditions: - Water leaks around the windshield - Blockage of the HVAC module drain - Leaks around the door seals Is a leak present?	Go to Step 7	Go to Step 15
7	Repair the leak as necessary. Is the repair complete?	Go to Step 15	-
8	Does the odor have a coolant smell?	Go to Step 9	Go to Step 12
9	Inspect the cooling system for leaks. Refer to Loss of Coolant . Is a leak present?	Go to Step 10	Go to Step 12

Step	Action	Yes	No
10	Inspect for coolant leaking inside the vehicle or for a film build-up on the windshield. Is the condition present?	Go to Step 11	Go to Step 15
11	Replace the heater core. Refer to Heater Core Replacement . Is the repair complete?	Go to Step 15	-
12	Does the odor have an oily smell?	Go to Step 13	Go to Step 15
13	1. Inspect the engine compartment for any leaks. Refer to the following procedures: - Oil Leak Diagnosis - Fluid Leak Diagnosis 2. Repair any oil leaks. Is the repair complete?	Go to Step 15	-
14	A musty odor can be caused by mold or mildew build-up on the evaporator or the heater core or inside of the HVAC module. Refer to Odor Correction . Is the action complete?	Go to Step 15	-
15	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to Step 2

REPAIR INSTRUCTIONS

ODOR CORRECTION

Eliminating Air Conditioning (A/C) Odor

Odors may be emitted from the air conditioning system primarily at start up in hot, humid climates. The following conditions may cause the odor:

- Debris is present in the HVAC module
- Microbial growth on the evaporator core

When the blower motor fan is turned on, the microbial growth may release an unpleasant musty odor into the passenger compartment. To remove odors of this type, the microbial growth must be eliminated. Perform the following procedure:

Deodorize the evaporator core using Deodorizing Aerosol Kit.

Perform the following steps in order to deodorize the A/C system:

1. Ensure that the plenum which draws outside air into the HVAC module is clear of debris.
2. Disable the air conditioning (A/C) compressor clutch operation by disconnecting the clutch coil electrical connector.
3. Dry the evaporator core by performing the following steps:
 1. Start the engine.
 2. Select the warmest temperature setting.

3. Select the recirculation mode.
4. Run the blower motor on high for 10 minutes.
4. Locate an area in the air conditioning duct between the blower motor and the evaporator core downstream of the blower motor.
5. Drill a 3.175 mm (0.125 in) hole where the hole will not interfere with or damage the following components:
 - The blower motor
 - The evaporator core
 - Any other operating part the of system
6. Wear safety goggles and latex gloves in order to perform the following actions:
 1. Select the maximum blower speed.
 2. Insert the deodorizer extension tube into the hole to the mark on the extension tube.
 3. Use short spray bursts and vary the direction of spray for a 2 - 3 minute period of time.
7. Shut the engine OFF. Allow the vehicle to sit for 3 - 5 minutes.
8. Seal the 3.175 mm (0.125 in) hole with body sealer or RTV gasket compound.
9. Start the engine.
10. Operate the blower motor on high for 15 - 20 minutes to dry.
11. Reconnect the A/C compressor clutch coil electrical connector.
12. Verify proper A/C clutch operation.

REFRIGERANT RECOVERY AND RECHARGING

Special Tools

- **GE 48997** Hybrid A/C Oil Injector Adapter Hose
- **GE 43600** Hybrid A/C Oil Injector Adapter Hose
- **GE-48800** CoolTech A/C Recharge Machine
- **GE-45037-A** A/C Oil Injector

For equivalent regional tools, refer to [Special Tools](#).

WARNING: To prevent personal injury, avoid breathing A/C Refrigerant and lubricant vapor or mist. Work in a well ventilated area. To remove refrigerant from the A/C System, use service equipment designed for recovery that is certified to meet the requirements of the appropriate SAE Standards. If an accidental system discharge occurs, ventilate the work area before continuing service. Additional health and safety information may be obtained from the refrigerant, refrigerant recovery, and lubricant manufacturers.

WARNING: For personal protection, goggles with side protection and lint-free gloves (insulated against heat loss and impermeable to refrigerant) must be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If refrigerant comes in contact with any part of the body severe frostbite and personal injury may result. The exposed area should be flushed immediately with cold water and prompt medical attention should be obtained.

- CAUTION:** This A/C refrigerant system is equipped with a High Voltage electric A/C compressor and you must replace the desiccant if the A/C refrigerant system has been open to atmosphere for more than thirty minutes, or if the A/C refrigerant oil has been contaminated. Failure to replace the desiccant will result in damage to the A/C refrigerant system.
- CAUTION:** R-134a is the only approved refrigerant for use in this vehicle. The use of any other refrigerant may result in poor system performance or component failure and potentially void the vehicle warranty for the refrigerant system.
- CAUTION:** This A/C system's high voltage A/C Compressor uses Polyolester (POE) refrigerant oil instead of Polyalkylene Glycol (PAG) refrigerant oil. Use only approved GM POE oil no more than two hours after removal from its sealed moisture proof packaging (reference GM POE label for proper usage) in refrigerant systems equipped with a High Voltage A/C compressor. GM POE oil is intended to be used with the GE-45037-A A/C oil injector and the GE-48997 A/C POE oil injector hose. Use of any refrigerant oil other than the approved GM POE, handled and installed per GM's requirements may result in compressor failure and/or loss of HV isolation with associated DTC's set.
- CAUTION:** Do not lubricate A/C line seal washers as mineral oil will damage the seal and cause leaks. Use only 525 viscosity mineral oil to lubricate o-rings as well as fitting threads for the prevention of fitting seizure.
- CAUTION:** Failure to flush the refrigerant recovery recharge equipment hoses before adding refrigerant to a hybrid vehicle with an electric compressor may result in an unacceptable amount of Polyalkylene Glycol (PAG) oil entering the refrigerant system. This could result in reduced electrical resistance of the Polyolester (POE) oil and reduce its ability to provide the required level of high voltage isolation.

Both the **GE 43600** Hybrid A/C Oil Injector Adapter Hose and **GE-48800** CoolTech A/C Recharge Machine are a complete air conditioning service center for R-134a. The ACR 2000 recovers, recycles, evacuates and recharges A/C refrigerant quickly, accurately and automatically. The unit has a display screen that contains the function controls and displays prompts that will lead the technician through the recover, recycle, evacuate and recharge operations. R-134a is recovered into and charged out of an internal storage vessel. Both units automatically replenishes this vessel from an external source tank in order to maintain a constant 5.45 - 6.82 kg (12 - 15 lbs) of A/C refrigerant.

The ACR 2000 has a built in A/C refrigerant identifier that will test for contamination, prior to recovery and will notify the technician if there are foreign gases present in the A/C system. If foreign gases are present, the ACR 2000 will not recover the refrigerant from the A/C system.

The ACR 2000 also features automatic air purge, single pass recycling and an automatic oil drain.

GE-48800 CoolTech A/C Recharge Machine is released as a required replacement for the previously essential **GE 43600** Hybrid A/C Oil Injector Adapter Hose. The **GE-48800** CoolTech A/C Recharge Machine is SAE J2788 compliant and meets GM requirements for A/C Refrigerant System Repairs on all General Motors vehicles, including Hybrid systems with Polyolester (POE) refrigerant oil.

Refer to the **GE 43600** Hybrid A/C Oil Injector Adapter Hose and **GE-48800** CoolTech A/C Recharge Machine ACR 2000 manual for operation and setup instruction. Always recharge the A/C System with the proper amount of R-134a. Refer to [Approximate Fluid Capacities](#) for the correct amount.

A/C Refrigerant System Oil Charge Replenishing

If oil was removed from the A/C system during the recovery process or due to component replacement, the oil must be replenished. If no oil was removed from the A/C system during recovery, do not charge any POE oil into the A/C system. POE refrigerant oil can be injected into a charged A/C system using **GE-45037-A** injector along with **GE 48997** adapter. For the proper quantities of oil to add to the A/C refrigerant system, refer to [Approximate Fluid Capacities](#).

FLUSHING

Special Tools

- **GE-42220** Universal 12V Leak Detection Lamp
- **GE-43600-50** Flush Loop Hose
- **GE-45268** Flush Adapter Kit
- **GE-48800** CoolTech A/C Recharge Machine

For equivalent regional tools. Refer to [Special Tools](#).

ACR2000 (GE-48800) Hose Flush Procedure

NOTE:

- The following hose flushing procedure must be performed every time the ACR2000 (GE-48800) is used on the hybrid vehicles. It must be completed before the ACR2000 (GE-48800) is connected to the vehicle to begin a diagnostic or service procedure.
- The high voltage (HV) electric air conditioning (A/C) compressor uses a polyolester (POE) refrigerant oil instead of a polyalkylene glycol (PAG) synthetic refrigerant oil. This is due to the better electrical resistance of the POE oil and its ability to provide HV isolation.
- The following hose flush procedure is required to prevent oil cross-contamination. Laboratory testing has shown that flushing the ACR2000 (GE-48800) using the following procedure will minimize oil cross-contamination to a negligible amount (<500 ppm).
- Failure to flush the ACR2000 (GE-48800) hoses before adding refrigerant to a hybrid vehicle with an electric A/C compressor may result in an unacceptable amount of PAG oil entering the refrigerant system. It may also cause a battery energy control module hybrid battery voltage system isolation lost diagnostic trouble code (DTC P1AE7) to be set. Additionally the A/C system warranty will be voided.
- The ACR2000 (GE-48800) will need to be retrofitted with a GE-43600-50 (Hose-ACR2000 Oil Flush Loop) to be able to perform the following procedure. All hybrid dealers will receive a GE-43600-50, with installation instructions, which is a component of the hybrid essential tool package. Dealers not included in the hybrid marketing plan and needing to service a hybrid vehicle can obtain the GE-43600-50 from SPX Kent Moore, 1-800-GM-TOOLS (1-800-468-6657).
 - The GE-43600-50 Retrofit Kit replaces the existing hose mount fittings on the ACR2000. Installation instructions are included to properly update the ACR2000 for hybrid vehicle A/C service.
 - New hybrid compliant A/C refrigerant recharging equipment (GE-48800) will replace current ACR2000 equipment. GE-48800 meets new SAE

refrigerant recovery standard J-2788 and is specially designed for GM hybrid vehicle A/C service.

Before Beginning the Hose Flushing Procedure

1. Always allow the ACR2000 to complete the hose flush cycle to assure that all oil and refrigerant is removed from the hoses and the ACR2000 flow control circuit.
2. Assure the ACR2000 has at least 4.08 kg (9 lb) of chargeable refrigerant before proceeding.
3. A Low Filter Flow message displayed during the hose flushing process indicates that the hose couplers are not connected or open.

Hose Flushing Procedure

1. Connect the ACR2000 service hose couplers to the GE-43600-50 hose flush adapter fittings and open the service hose coupler valves.
2. Power on the ACR2000.
3. If there is positive pressure in the ACR2000 service hoses, press START to recover the service hoses. If there is 88 - 98 kPa (26 - 29 Hg) of vacuum showing on the display screen, skip to step 7.
4. Press Vacuum.
5. Press Start. Allow the vacuum program to run until the display screen shows between 88 - 98 kPa (26 - 29 Hg).
6. Press Pause.
7. Press Main Menu.
8. Press Scroll Menu.
9. Press Oil Flush.
10. Press Next.
11. Enter 03:00 (for a three minute flush) and press Start.
12. The ACR2000 will now flush the service hoses for three minutes and then recover the refrigerant
13. Close the ACR2000 service hose couplers and remove the GE-43600-50 hose flush adapter.
14. The ACR2000 can now be connected to the hybrid vehicle to perform the A/C system diagnostic or service procedures.

ACR2000 (GE-48800) A/C System Procedure

NOTE: Flushing with the ACR 2000 is not intended to remove metal from the A/C system.

Flushing is intended to remove the following contaminants:

- Contaminated polyolester (POE) oil
- Desiccant, following a desiccant bag failure
- Overcharge of POE oil
- Refrigerant contamination

NOTE: Warmer engine or ambient temperature decreases the refrigerant recovery time during the A/C flush procedure.

1. Recover the refrigerant. Refer to [**Refrigerant Recovery and Recharging.**](#)
2. Remove the air conditioning refrigerant desiccant. Refer to [**Air Conditioning Refrigerant Desiccant Replacement.**](#)
3. Remove the air conditioning refrigerant desiccant plug from the desiccant cartridge.
4. Install the air conditioning refrigerant desiccant plug without the desiccant cartridge.
5. Remove the evaporator thermal expansion valve. Refer to [**Air Conditioning Evaporator Thermal Expansion Valve Replacement**](#)
6. Install GE-45268-115 to the evaporator.
7. Remove the drive motor battery cooler thermal expansion valve. Refer to [**Air Conditioning Evaporator Thermal Expansion Valve Replacement**](#)
8. Install another GE-45268-115 to the drive motor battery cooler.
9. Install A/C evaporator tube to both GE-45268-115.
10. Install A/C evaporator TXV tube to both GE-45268-115 using an oversized seal washer.
11. Remove the A/C and drive motor battery cooling compressor. Refer to [**Air Conditioning and Drive Motor Battery Cooling Compressor Replacement**](#)
12. Inspect the end of the suction hose for a suction screen.
13. Remove the suction screen, if installed.
14. Install GE-45268-4 to the A/C compressor suction hose.
15. Install GE-452688-5 to the A/C compressor discharge hose.

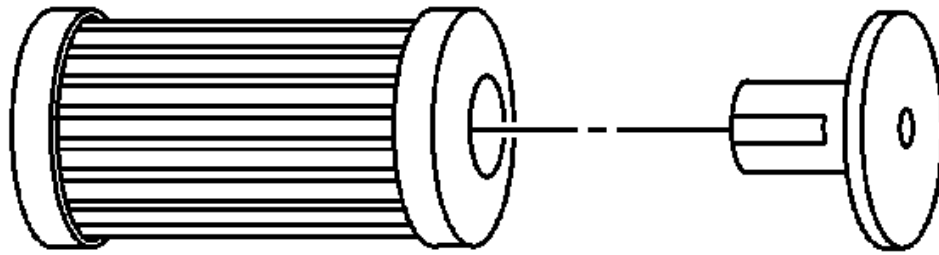


Fig. 1: A/C Filter And Check Valve

Courtesy of GENERAL MOTORS COMPANY

16. Forward flow refrigerant flushing is recommended for contaminated refrigerant or POE oil.

17. Perform the following procedure:

NOTE: **The filter inside the GE-45268-1 is serviceable. Remove and discard the check valve from the filter.**

1. Service the filter with ACDelco P/N GF 470, before each flush.

Connect the GE-45268-1 flush filter to the suction port of the GE-45268-4 flush adapter.

2. Connect the blue hose from the **GE-48800** ACR 2000 Air Conditioning Service Center to the J 45268-1 flush filter adapter.
3. Connect the red hose from the **GE-48800** ACR 2000 Air Conditioning Service Center to the GE-45268-5 flush adapter.

18. Reverse flow refrigerant flushing is recommended for desiccant cartridge failure.

NOTE: **The filter inside the J 45268-1 is serviceable. Remove and discard the check valve from the filter.**

1. Service the filter with AC P/N GF 470, before each flush. Connect the J 45268-1 flush filter to the discharge port of the GE-45268-5 flush adapter.
2. Connect the blue hose from the **GE-48800** ACR 2000 Air Conditioning Service Center to the J 45268-1 flush filter adapter.
3. Connect the red hose from the **GE-48800** ACR 2000 Air Conditioning Service Center to the suction port of the GE-45268-4 flush adapter.

NOTE: Close the valve on the external refrigerant tank, before starting the flush process.

19. Flush the front A/C system. Follow the instructions supplied with the **GE-48800** ACR 2000 Air Conditioning Service Center.

NOTE: Close the valve on the external refrigerant tank, before starting the flush process.

20. Flush the A/C system. Follow the instructions supplied with the **GE-48800** ACR 2000 Air Conditioning Service Center
21. Remove the GE-45268-4 from the A/C compressor suction hose.
22. Remove the GE-45268-5 from the A/C compressor discharge hose.

NOTE: Flushing will remove all the POE oil from the A/C system.

The A/C system must be replenished with the correct amount of POE oil.

23. If the removed A/C compressor is being reinstalled, perform the following procedure:
 - Drain the POE oil from the A/C compressor.
 - Add the total system capacity of POE oil to the A/C compressor. Refer to [Approximate Fluid Capacities](#).
24. If you will replace the A/C compressor after flushing the system, perform the following procedure:
 1. Refer to the [Approximate Fluid Capacities](#).
 2. DO NOT drain the new POE oil from the compressor.
 3. Deduct the amount of POE oil shipped with the service compressor from the amount of POE oil listed in the capacities table. Refer to [Approximate Fluid Capacities](#).
 4. Add the calculated amount to the compressor, as needed.
25. Install the air conditioning and drive motor battery cooling compressor. Refer to [Air Conditioning and Drive Motor Battery Cooling Compressor Replacement](#)

NOTE: Flushing will remove the fluorescent leak detection dye from the A/C system.

NOTE: The air conditioning refrigerant desiccant is manufactured with POE fluorescent leak detection dye wafer inside.

26. Replace the air conditioning refrigerant desiccant. Refer to [Air Conditioning Refrigerant Desiccant Replacement](#).
27. Remove A/C evaporator TXV tube from both GE-45268-115.
28. Remove A/C evaporator tube from both GE-45268-115.

- 29. Remove both GE-45268-115.
- 30. Install the drive motor battery cooler thermal expansion valve. Refer to [Air Conditioning Evaporator Thermal Expansion Valve Replacement](#)
- 31. Install the evaporator thermal expansion valve. Refer to [Air Conditioning Evaporator Thermal Expansion Valve Replacement](#)
- 32. Evacuate and recharge the A/C system. Refer to [Refrigerant Recovery and Recharging](#)
- 33. Leak test the fittings using **GE-42220** Universal 12V Leak Detection Lamp

AIR CONDITIONING AND DRIVE MOTOR BATTERY COOLING COMPRESSOR REPLACEMENT

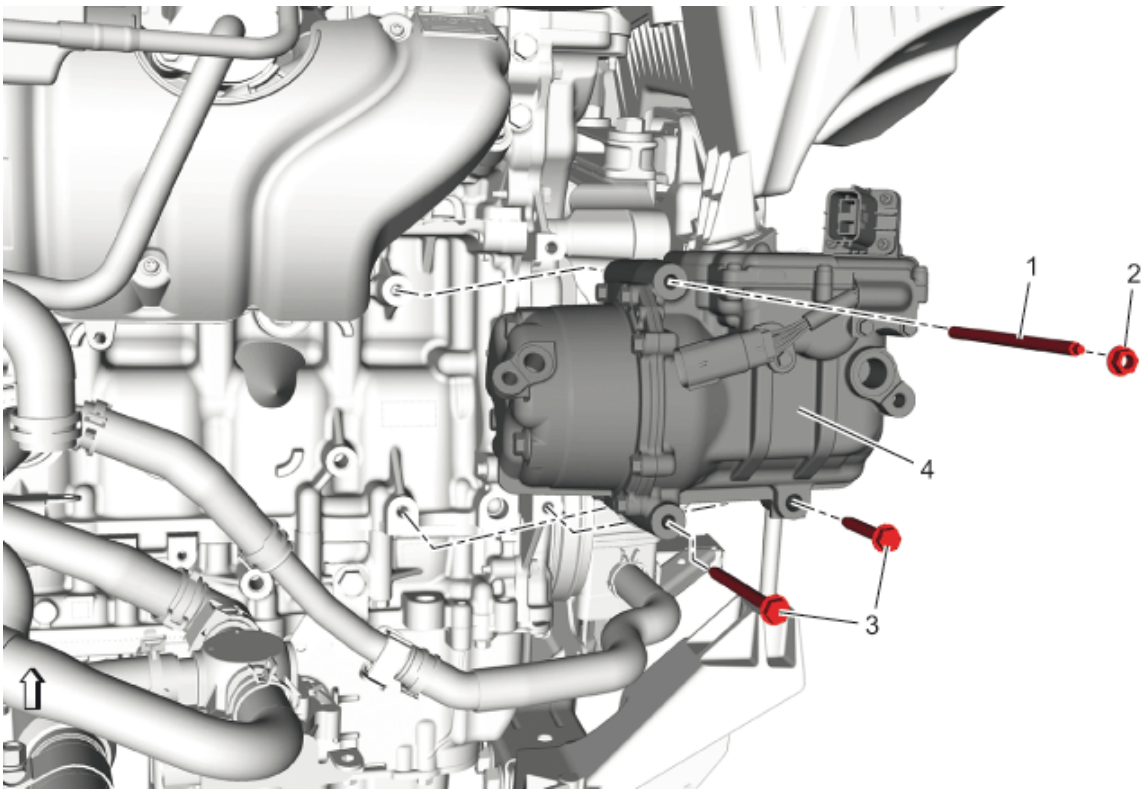


Fig. 2: Air Conditioning and Drive Motor Battery Cooling Compressor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper	

Callout	Component Name
procedures must be followed. The High Voltage Disabling procedure will perform the following tasks: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Failure to follow the procedures exactly as written may result in serious injury or death. WARNING: Do not use a service jack	

Callout	Component Name
in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death. CAUTION: This A/C system's high voltage A/C Compressor uses Polyolester (POE) refrigerant oil instead of Polyalkylene Glycol (PAG) refrigerant oil. Use only approved GM POE oil no more than two hours after removal from its sealed moisture proof packaging (reference GM POE label for proper	

Callout	Component Name
usage) in refrigerant systems equipped with a High Voltage A/C compressor. GM POE oil is intended to be used with the GE-45037-A A/C oil injector and the GE-48997 A/C POE oil injector hose. Use of any refrigerant oil other than the approved GM POE, handled and installed per GM's requirements may result in compressor failure and/or loss of HV isolation with associated DTC's set.	Preliminary Procedures 1. Disable high voltage system. Refer to High Voltage Disabling 2. Remove Air Conditioning Compressor Hose. Refer to Air Conditioning Compressor Hose Replacement 3. Remove Front Wheel Drive Shaft - Right Side. Refer to Front Wheel Drive Shaft Replacement 4. Position aside Heater Water Shutoff Valve. Refer to Heater Water Shutoff Valve Replacement
1	Air Conditioning Compressor Mounting Bracket Lower Stud Tighten 22 N.m (16 lb ft)

Callout	Component Name
2	Air Conditioning and Drive Motor Cooling Compressor Nut CAUTION: Refer to Fastener Caution Tighten 22 N.m (16 lb ft)
3	Air Conditioning and Drive Motor Cooling Compressor Bolt (Qty: 2) Tighten 22 N.m (16 lb ft)
4	Air Conditioning and Drive Motor Cooling Compressor Procedure 1. Disconnect the 2 electrical connectors. 2. A/C compressor oil balancing is not required. The service A/C compressor contains enough oil; however, add any oil that was removed during the A/C system recovery process. Refer to Refrigerant Recovery and Recharging. 3. Enable high voltage system. Refer to High Voltage Enabling

COMPRESSOR PRESSURE RELIEF VALVE REPLACEMENT

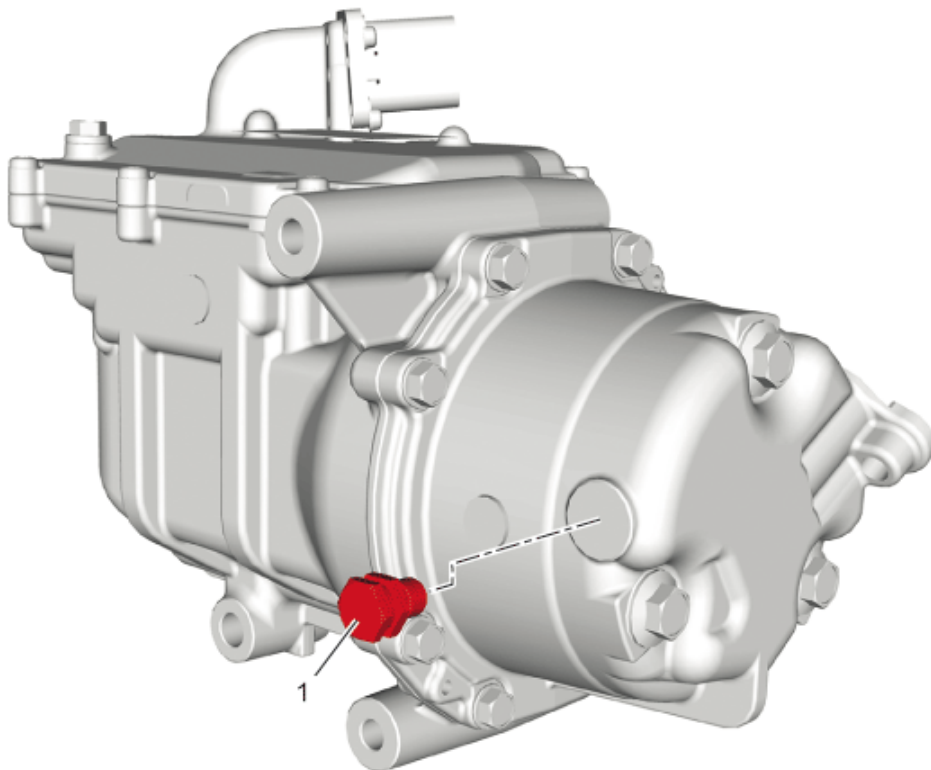


Fig. 3: Compressor Pressure Relief Valve

Callout	Component Name
Preliminary Procedure	
Remove Air Conditioning and Drive Motor Battery Cooling Compressor. Refer to Air Conditioning and Drive Motor Battery Cooling Compressor Replacement	
1	Air Conditioning Compressor Pressure Relief Valve CAUTION: Refer to Component Fastener Tightening Caution Tighten 7 N.m (62 lb in)

AIR CONDITIONING COMPRESSOR HOSE REPLACEMENT

Removal Procedure

- 1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
- 2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
- 3. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
- 4. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

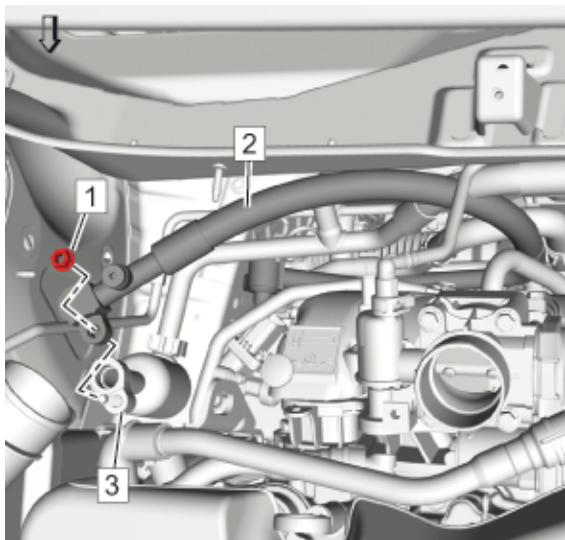


Fig. 4: Air Conditioning Compressor Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

- 5. Remove the air conditioning compressor hose nut (1) from the air conditioning evaporator hose (3).
- 6. Raise the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

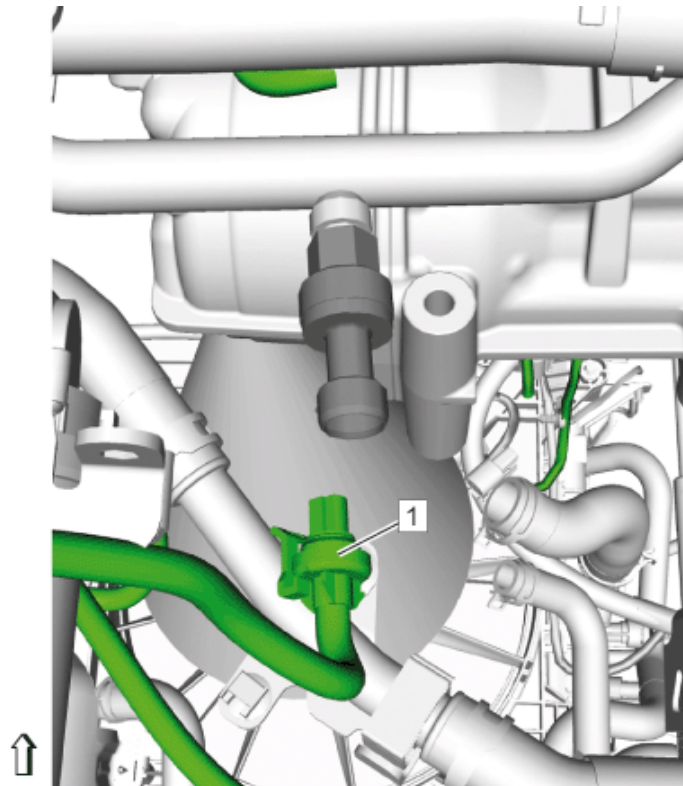


Fig. 5: A/C Cycling Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the A/C cycling switch electrical connector (1).

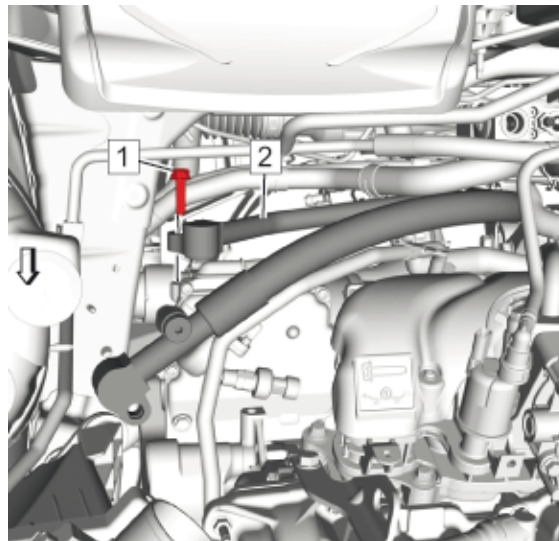


Fig. 6: Air Conditioning Compressor Hose Bolt And Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

8. Remove the air conditioning compressor hose bolt (1) from the air conditioning evaporator hose (2).
9. Remove Air Conditioning Compressor Hose

Installation Procedure

1. Replace Air Conditioning Refrigerant Pressure Sensor O-Ring Seal. Refer to **[Air Conditioning Refrigerant Pressure Sensor O-Ring Seal Replacement](#)**

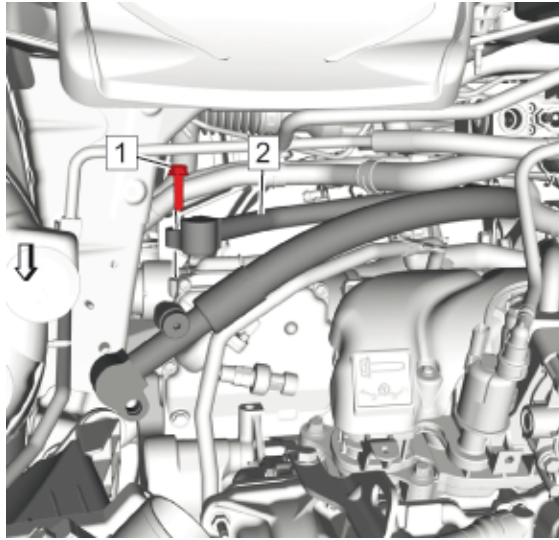


Fig. 7: Air Conditioning Compressor Hose Bolt And Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution**

2. Install the air conditioning evaporator hose (2) and the air conditioning compressor hose bolt (1) to the air conditioning compressor and tighten to 22 N.m (16 lb ft)

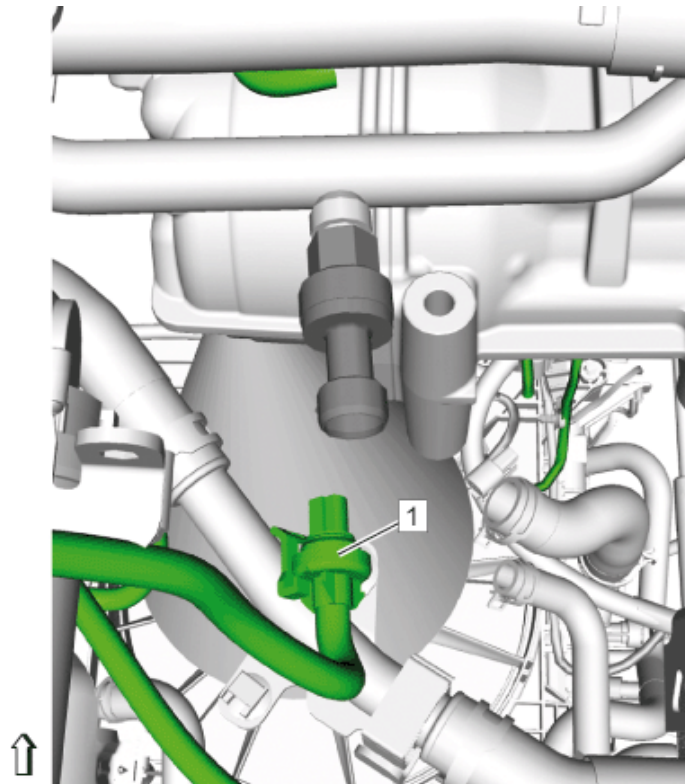


Fig. 8: A/C Cycling Switch Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect the A/C cycling switch electrical connector (1).
4. Lower the vehicle.

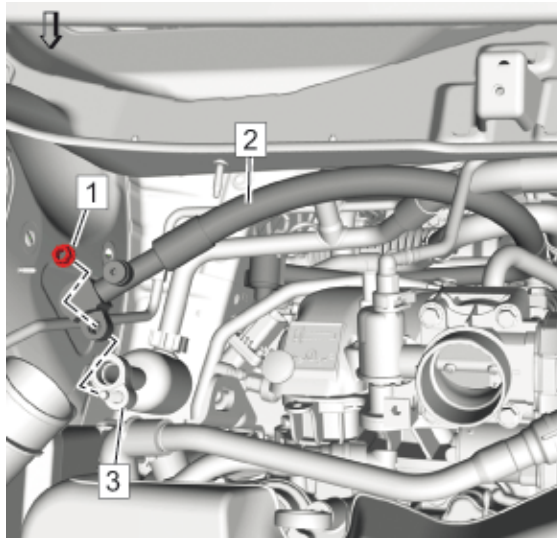


Fig. 9: Air Conditioning Compressor Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

5. Install the air conditioning compressor hose (2) and the air conditioning compressor hose nut (1) to the air conditioning evaporator hose (3) and tighten to 22 N.m (16 lb ft)
6. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
7. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
8. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
9. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
3. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
4. Remove Front Bumper Fascia. Refer to [Front Bumper Fascia Removal and Installation](#)
5. Remove Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
6. Remove Air Conditioning Compressor Hose. Refer to [Air Conditioning Compressor Hose Replacement](#)
7. Remove Radiator Outlet Hose. Refer to [Radiator Outlet Hose Replacement](#)

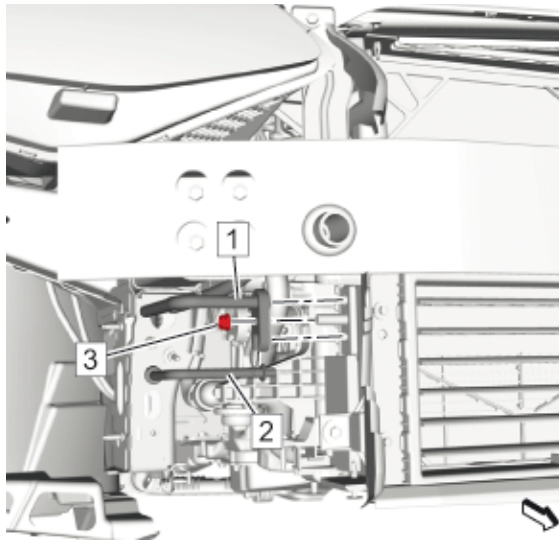


Fig. 10: Air Conditioning Evaporator Tube, Condenser Tube And Nut
Courtesy of GENERAL MOTORS COMPANY

8. Remove the air conditioning evaporator tube nut (3).
9. Remove the air conditioning evaporator tube (1) along with the condenser tube (2) from the condenser.

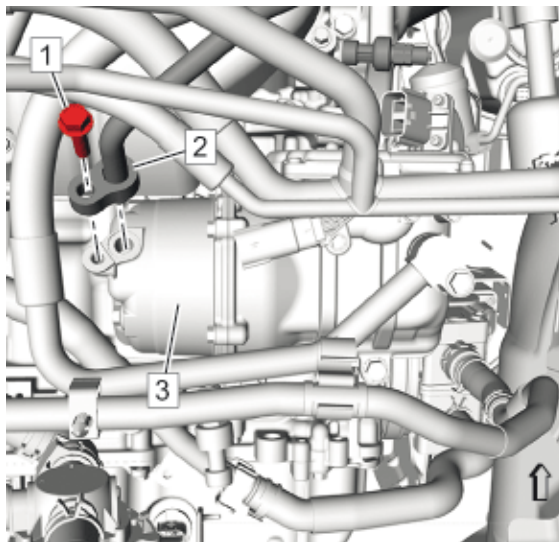


Fig. 11: Air Conditioning Compressor, Condenser Hose And Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove the air conditioning compressor and condenser hose bolt (1).
11. Remove the air conditioning compressor and condenser hose (2) from the air conditioning compressor (3).

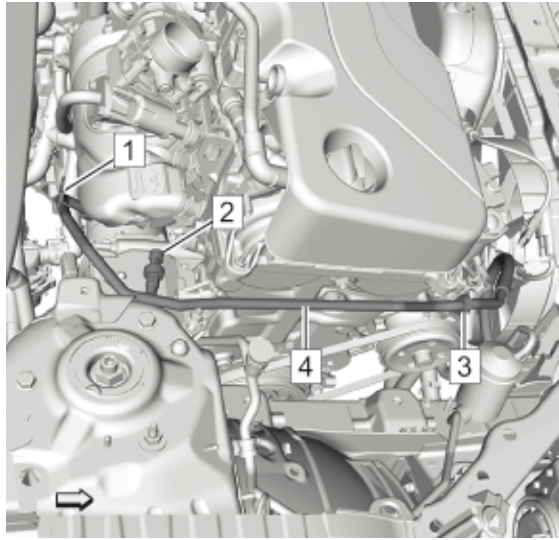


Fig. 12: A/C Compressor And Condenser Hose Tube, Retainer, Wiring Harness And Cycling Switch Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

12. Remove the air conditioning compressor and condenser hose tube (4).
13. Unclip the retainer (1) holding the air conditioning compressor and condenser hose tube to the engine bracket.
14. Unclip the wiring harness (2) from the air conditioning compressor and condenser hose tube.
15. Disconnect the air conditioning cycling switch electrical connector (3).
16. Remove Air Conditioning Compressor High Pressure Cut Off Switch. Refer to [Air Conditioning Compressor High Pressure Cut Off Switch Replacement](#)

Installation Procedure

1. Change the air conditioning O-ring seal. Refer to [Air Conditioning Refrigerant Pressure Sensor O-Ring Seal Replacement](#).
2. Install Air Conditioning Compressor High Pressure Cut Off Switch. Refer to [Air Conditioning Compressor High Pressure Cut Off Switch Replacement](#)

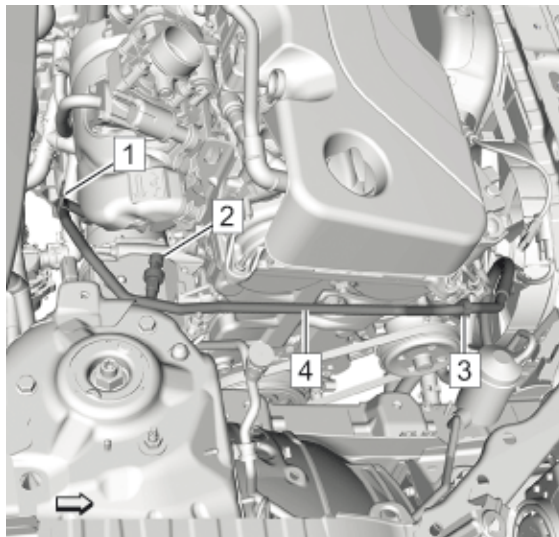


Fig. 13: A/C Compressor And Condenser Hose Tube, Retainer, Wiring Harness And Cycling Switch Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Install the air conditioning compressor and condenser hose tube (1).

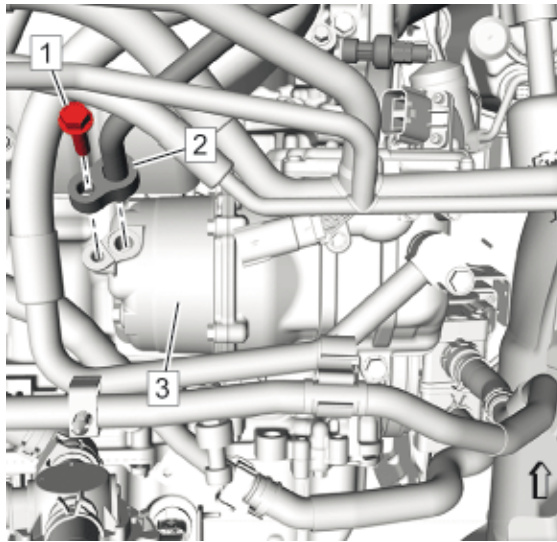


Fig. 14: Air Conditioning Compressor, Condenser Hose And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning compressor and condenser hose (2) to the air conditioning compressor (3).

CAUTION: Refer to [Fastener Caution](#)

5. Install the air conditioning compressor and condenser hose bolt (1) to the compressor and tighten to 22 N.m (16 lb ft).

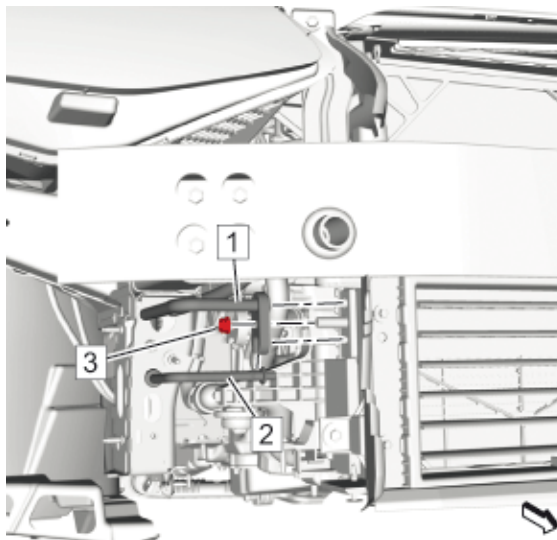


Fig. 15: Air Conditioning Evaporator Tube, Condenser Tube And Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install the air conditioning evaporator tube (1) along with the condenser tube (2) to the condenser
7. Install the air conditioning evaporator tube nut (3) and tighten to 22 N.m (16 lb ft).
8. Install Radiator Outlet Hose. Refer to [Radiator Outlet Hose Replacement](#)

9. Install Air Conditioning Compressor Hose. Refer to [**Air Conditioning Compressor Hose Replacement**](#)
10. Install Air Cleaner Assembly. Refer to [**Air Cleaner Assembly Replacement**](#)
11. Install Front Bumper Fascia. Refer to [**Front Bumper Fascia Removal and Installation**](#)
12. Install Dash Upper Extension Panel Opening Cover. Refer to [**Dash Upper Extension Panel Opening Cover Replacement**](#)
13. Evacuate and charge the refrigerant system. Refer to [**Refrigerant Recovery and Recharging**](#)
14. Connect Battery Negative Cable. Refer to [**Battery Negative Cable Disconnection and Connection**](#)

CONDENSER TUBE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [**Battery Negative Cable Disconnection and Connection**](#)
2. Recover the refrigerant. Refer to [**Refrigerant Recovery and Recharging**](#)
3. Remove Front Bumper Fascia. Refer to [**Front Bumper Fascia Removal and Installation**](#)
4. Remove Dash Upper Extension Panel Opening Cover. Refer to [**Dash Upper Extension Panel Opening Cover Replacement**](#)
5. Remove Air Conditioning Evaporator Hose Assembly. Refer to [**Air Conditioning Evaporator Hose Assembly Replacement**](#)
6. Remove Air Cleaner Assembly. Refer to [**Air Cleaner Assembly Replacement**](#)

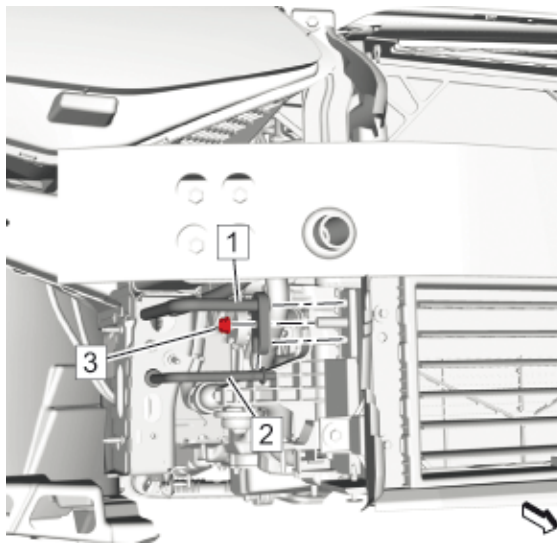


Fig. 16: Air Conditioning Evaporator Tube, Condenser Tube And Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the condenser tube nut (3) and remove the air conditioning evaporator tube (1) together with the condenser tube (2) from condenser.

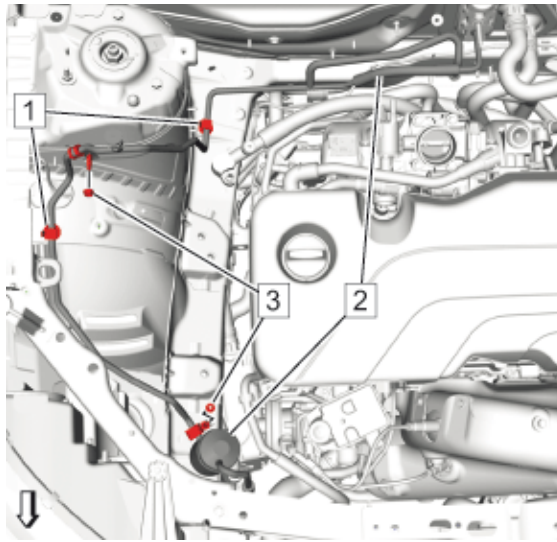


Fig. 17: Condenser Tube, Retainers And Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 condenser tube nuts (3).
9. Remove the 2 condenser tube retainers (1) and remove the condenser tube (2).

Installation Procedure

1. Replace Air Conditioning Refrigerant Pressure Sensor O-Ring Seal. Refer to [Air Conditioning Refrigerant Pressure Sensor O-Ring Seal Replacement](#)

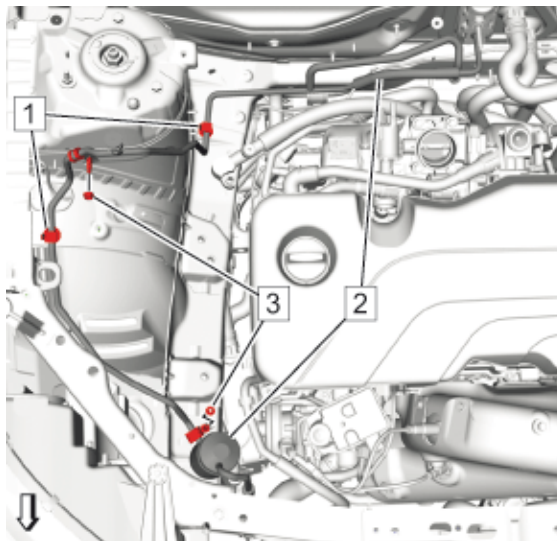


Fig. 18: Condenser Tube, Retainers And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

2. Install the condenser tube (2) the 2 condenser tube nuts (3).
3. Install the 2 condenser tube retainer (1) and the 2 condenser tube nuts (3) and tighten to 9 N.m (80 lb in).

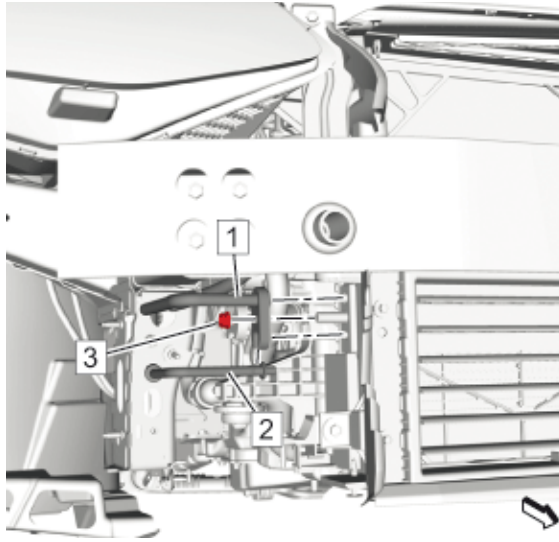


Fig. 19: Air Conditioning Evaporator Tube, Condenser Tube And Nut

Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning evaporator tube (1) together with the condenser tube (2) to the condenser and tighten to 22 N.m (16 lb ft)
5. Install Air Cleaner Assembly. Refer to [Air Cleaner Assembly Replacement](#)
6. Install Air Conditioning Evaporator Hose Assembly. Refer to [Air Conditioning Evaporator Hose Assembly Replacement](#)
7. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
8. Install Front Bumper Fascia. Refer to [Front Bumper Fascia Removal and Installation](#)
9. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
10. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AIR CONDITIONING EVAPORATOR HOSE ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#) -
3. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
4. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

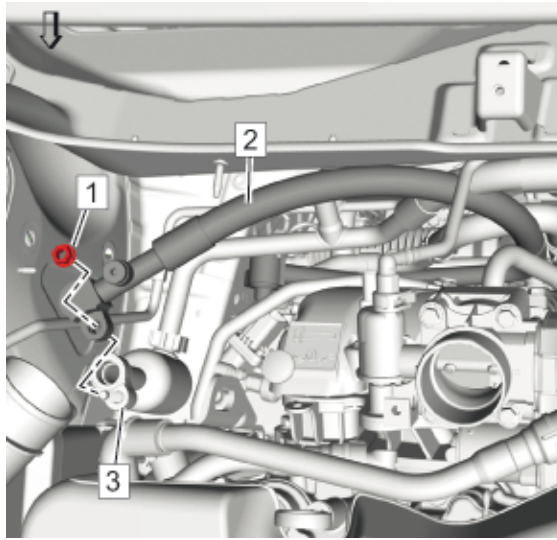


Fig. 20: Air Conditioning Compressor Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

5. Remove the air conditioning compressor hose nut (1) from the air conditioning evaporator hose (3).

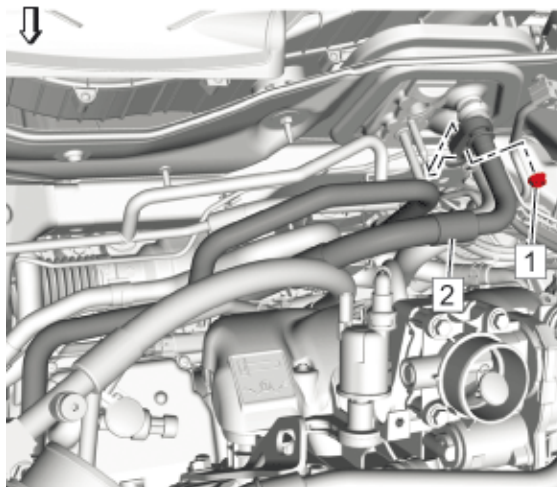


Fig. 21: Air Conditioning Evaporator Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

6. Remove the air conditioning evaporator hose nut (1) and remove the air conditioning evaporator hose (2) from TXV stud.
7. Disconnect the evaporative emission pipe at the canister purge solenoid valve, unclip and reposition the pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#) .

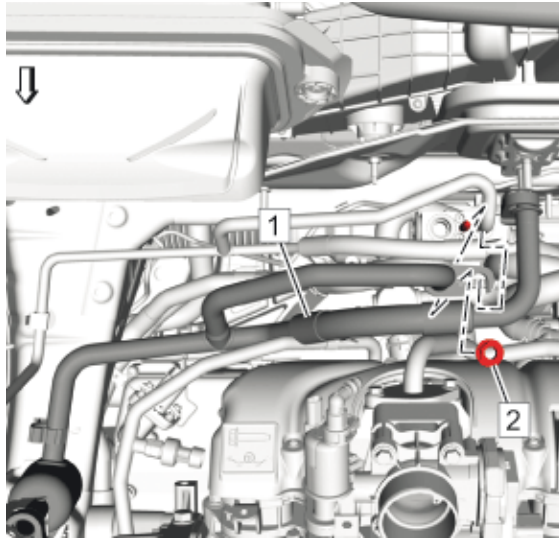


Fig. 22: Air Conditioning Evaporator Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

8. Remove the air conditioning evaporator hose nut (2) and remove the air conditioning evaporator hose (1) from TXV stud.
9. Unclip and remove the evaporator hose assembly from the vehicle.

Installation Procedure

1. Replace Air Conditioning Refrigerant Pressure Sensor O-Ring Seal. Refer to [Air Conditioning Refrigerant Pressure Sensor O-Ring Seal Replacement](#)
2. Position the evaporator hose assembly to the vehicle.

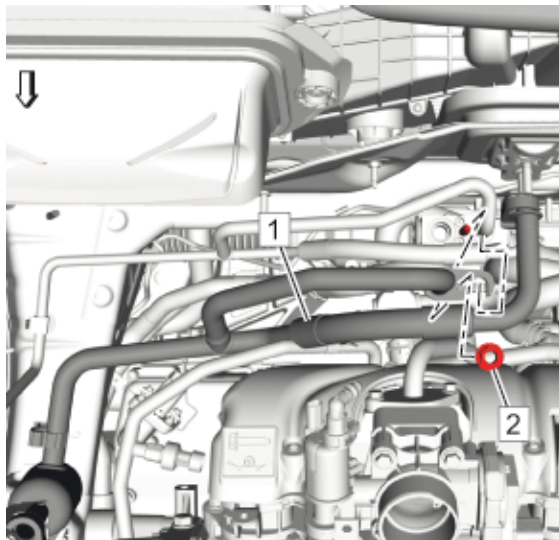


Fig. 23: Air Conditioning Evaporator Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

3. Install the air conditioning evaporator hose (1) and the air conditioning evaporator hose nut (2) and tighten to 22 N.m (16 lb ft).

4. Connect the evaporative emission pipe to the canister purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .

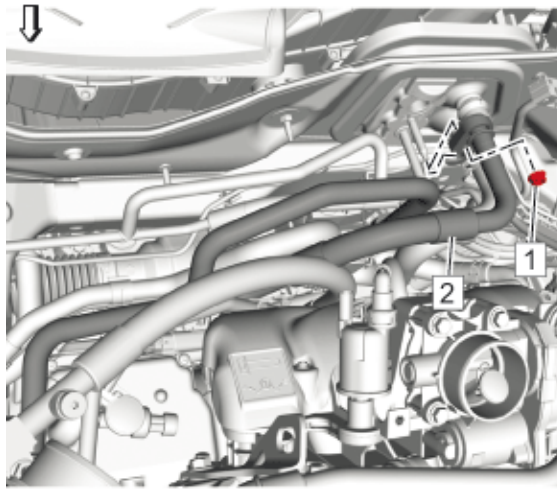


Fig. 24: Air Conditioning Evaporator Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

5. Install the air conditioning evaporator hose (2) and the air conditioning evaporator hose nut (1) and tighten to 22 N.m (16 lb ft).

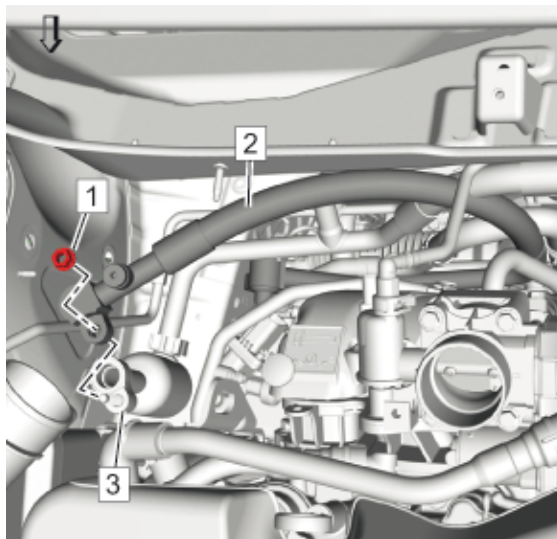


Fig. 25: Air Conditioning Compressor Hose And Nut

Courtesy of GENERAL MOTORS COMPANY

6. Install the air conditioning compressor hose (2) and the air conditioning compressor hose nut (1) to the air conditioning evaporator hose (3) and tighten to 22 N.m (16 lb ft)
7. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
8. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
9. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
10. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AIR CONDITIONING COMPRESSOR HIGH PRESSURE CUT OFF SWITCH REPLACEMENT

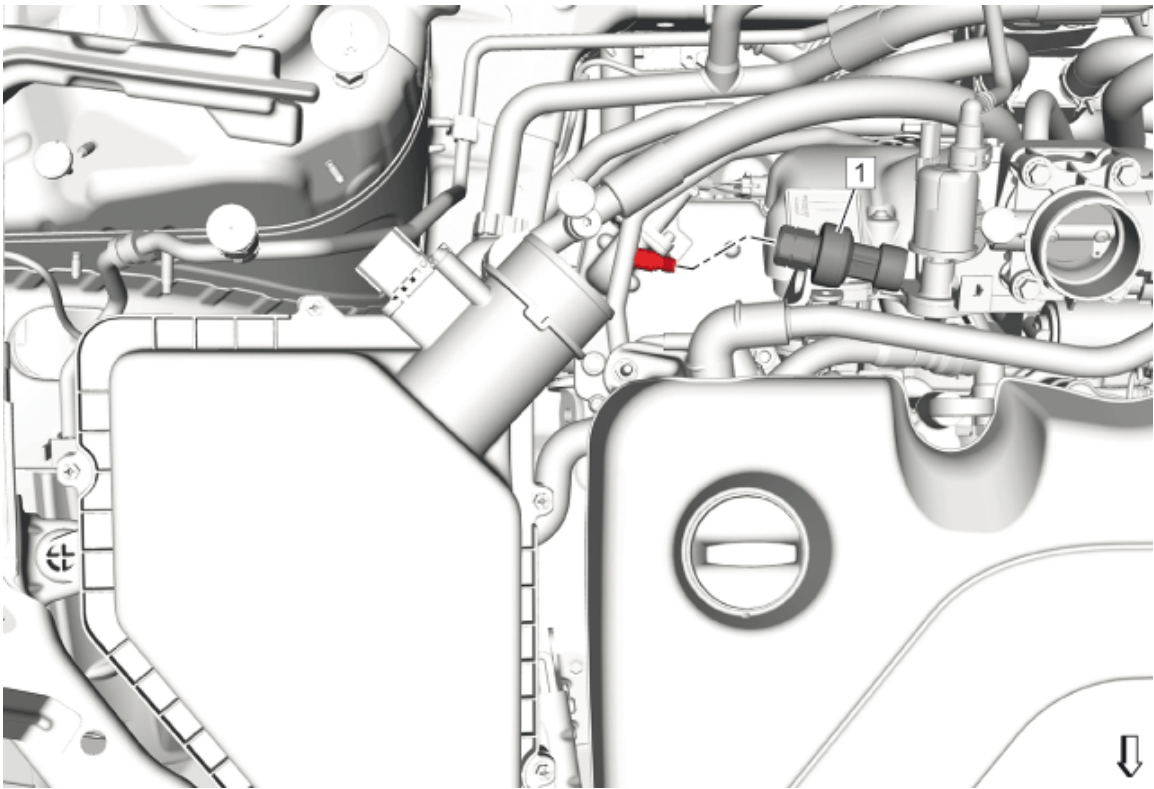


Fig. 26: Air Conditioning Compressor High Pressure Cut Off Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Dash Upper Extension Panel Opening Cover. Refer to Dash Upper Extension Panel Opening Cover Replacement 3. Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement	
1	Air Conditioning Compressor High Pressure Cut Off Switch CAUTION: Refer to Fastener Caution Procedure Disconnect the electrical connector. Tighten 9 N.m (80 lb in)

AIR CONDITIONING REFRIGERANT DESICCANT REPLACEMENT

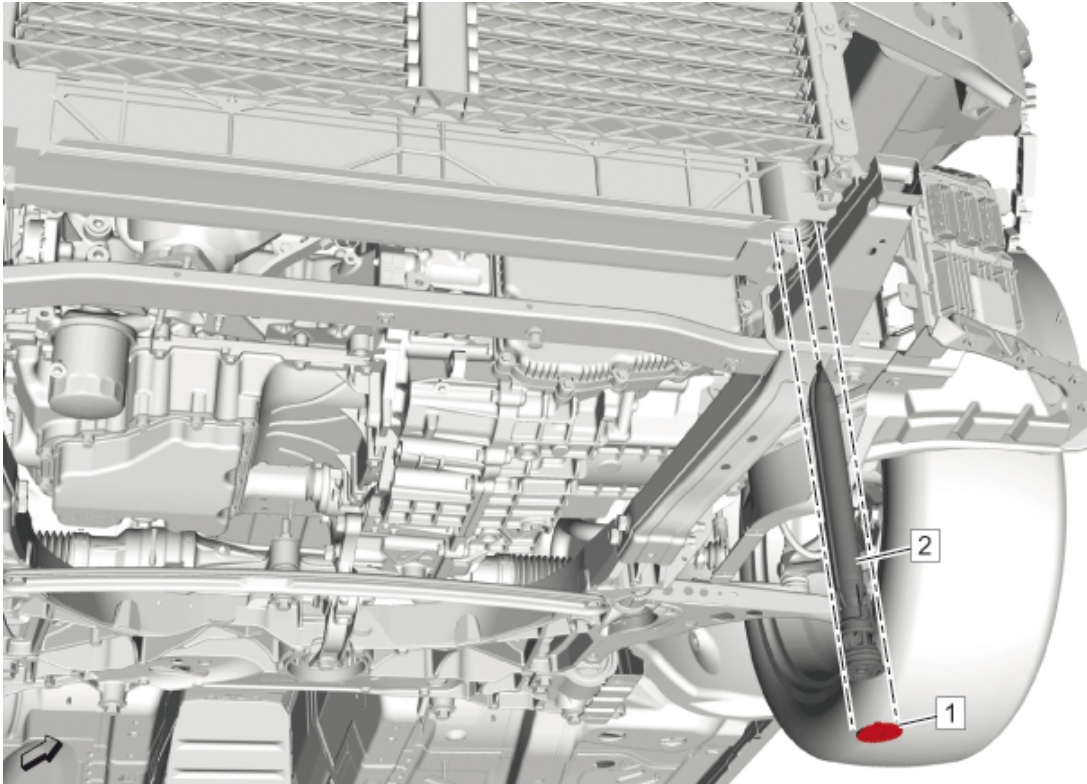


Fig. 27: Air Conditioning Refrigerant Desiccant
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging 3. Remove Front Bumper Fascia. Refer to Front Bumper Fascia Removal and Installation 4. Remove Radiator Air Lower Baffle and Deflector. Refer to Radiator Air Lower Baffle and Deflector Replacement	
1	Air Conditioning Receiver and Dehydrator Plug CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Air Conditioning Refrigerant Desiccant

AIR CONDITIONING EVAPORATOR THERMAL EXPANSION VALVE REPLACEMENT

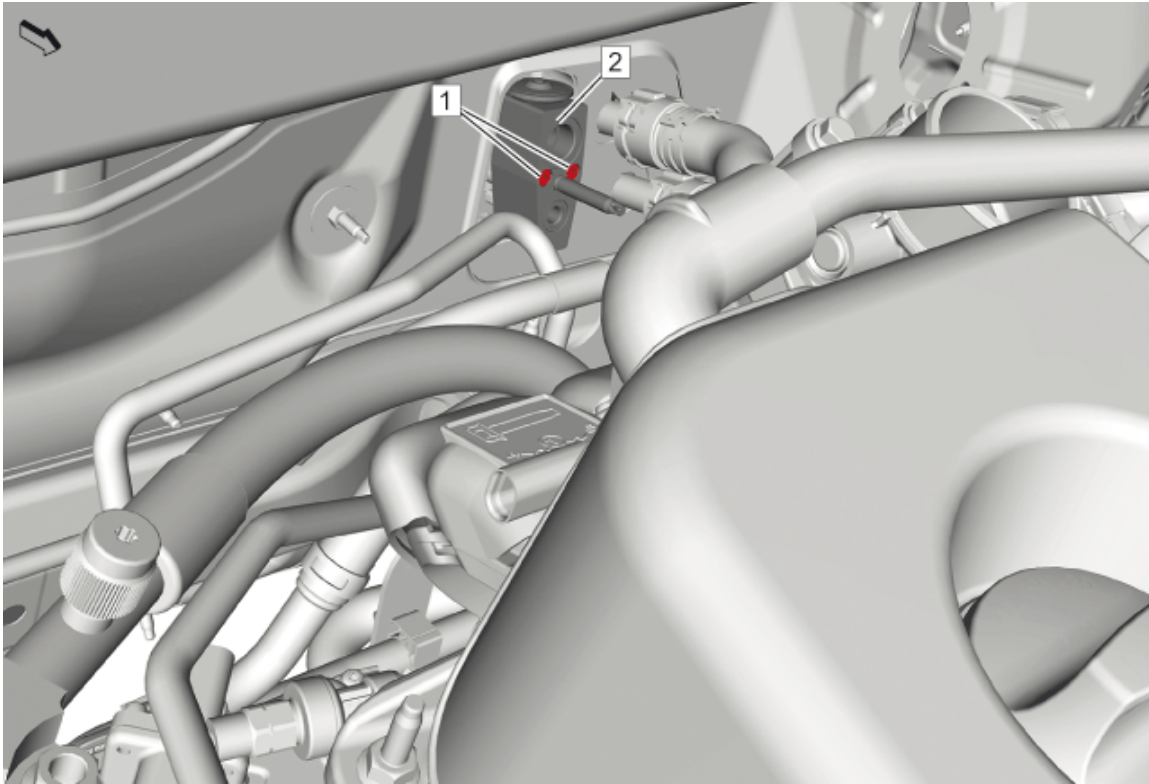


Fig. 28: Air Conditioning Evaporator Thermal Expansion Valve
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Dash Upper Extension Panel Opening Cover. Refer to Dash Upper Extension Panel Opening Cover Replacement 2. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging 3. Remove Air Conditioning Evaporator Hose @ Air Conditioning Evaporator Thermal Expansion Valve. Refer to Air Conditioning Evaporator Hose Assembly Replacement	
1	Air Conditioning Evaporator Thermal Expansion Valve Bolt CAUTION: Refer to Fastener Caution Tighten 7 N.m (62 lb in)
2	Air Conditioning Evaporator Thermal Expansion Valve Procedure Remove and discard the old sealing washers. Replace with NEW sealing washers.

AIR CONDITIONING REFRIGERANT PRESSURE SENSOR O-RING SEAL REPLACEMENT
Removal Procedure

1. Disassemble the A/C refrigerant components. Refer to the appropriate repair procedure
2. Remove the O-ring seal from the A/C refrigerant component.
3. Inspect the O-ring seal for signs of damage to help determine the root cause of the failure.
4. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.

NOTE: Cap or tape the open A/C refrigerant components immediately to prevent system contamination.

5. Cap or tape the A/C refrigerant components.

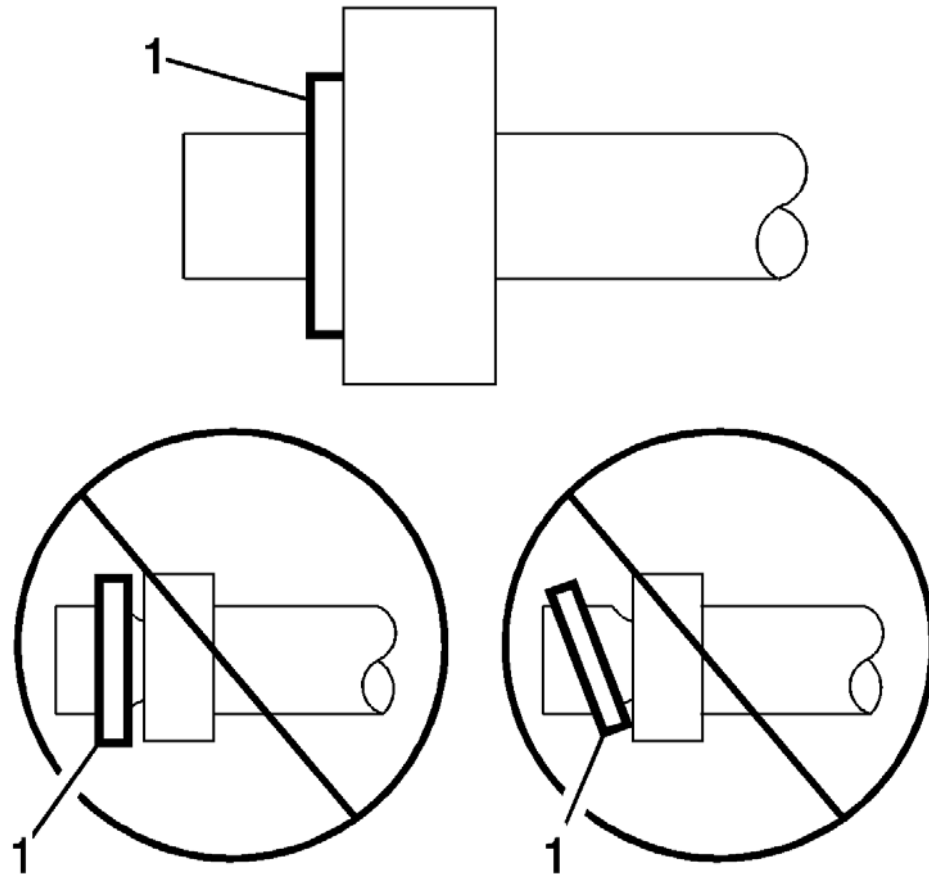


Fig. 29: Proper Seating Of A/C Refrigerant O-Ring
Courtesy of GENERAL MOTORS COMPANY

6. Discard the O-ring seal.

Installation Procedure

1. Inspect the new O-ring seal for any sign or cracks, cuts, or damage. Replace if necessary.
2. Remove the cap or tape from the A/C refrigerant components.
3. Using a lint-free clean, dry cloth, carefully clean the sealing surfaces of the A/C refrigerant components.

CAUTION: Use only the lubricant specified for this vehicles refrigerant system. Do not

mix refrigerant oils which may result in system contamination and unknown reaction by-products which may cause HVAC System failure.

4. Lightly coat the new O-ring seal with the proper refrigerant oil prior to installation.

NOTE: DO NOT reuse O-ring seals.

5. Carefully slide the new O-ring seal onto the A/C refrigerant component.

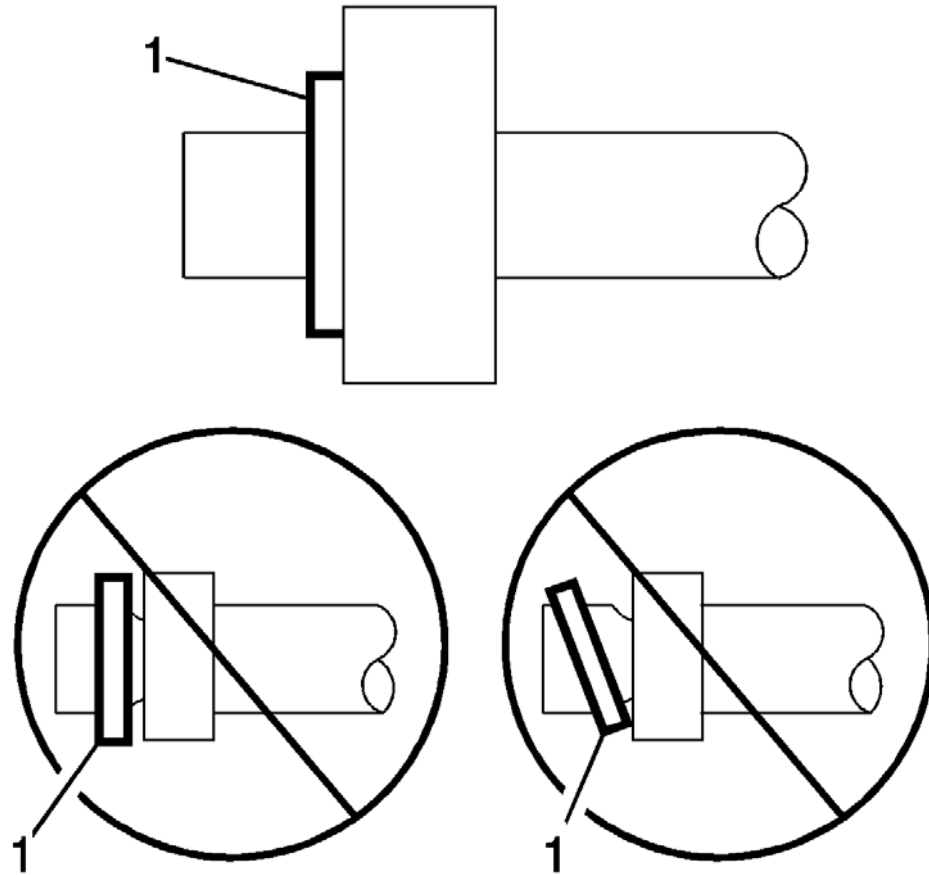


Fig. 30: Proper Seating Of A/C Refrigerant O-Ring
Courtesy of GENERAL MOTORS COMPANY

6. The O-ring seal must be fully seated.

7. Assemble the A/C components.

Refer to the appropriate repair procedure.

AIR CONDITIONING REFRIGERANT LOW PRESSURE SERVICE VALVE REPLACEMENT

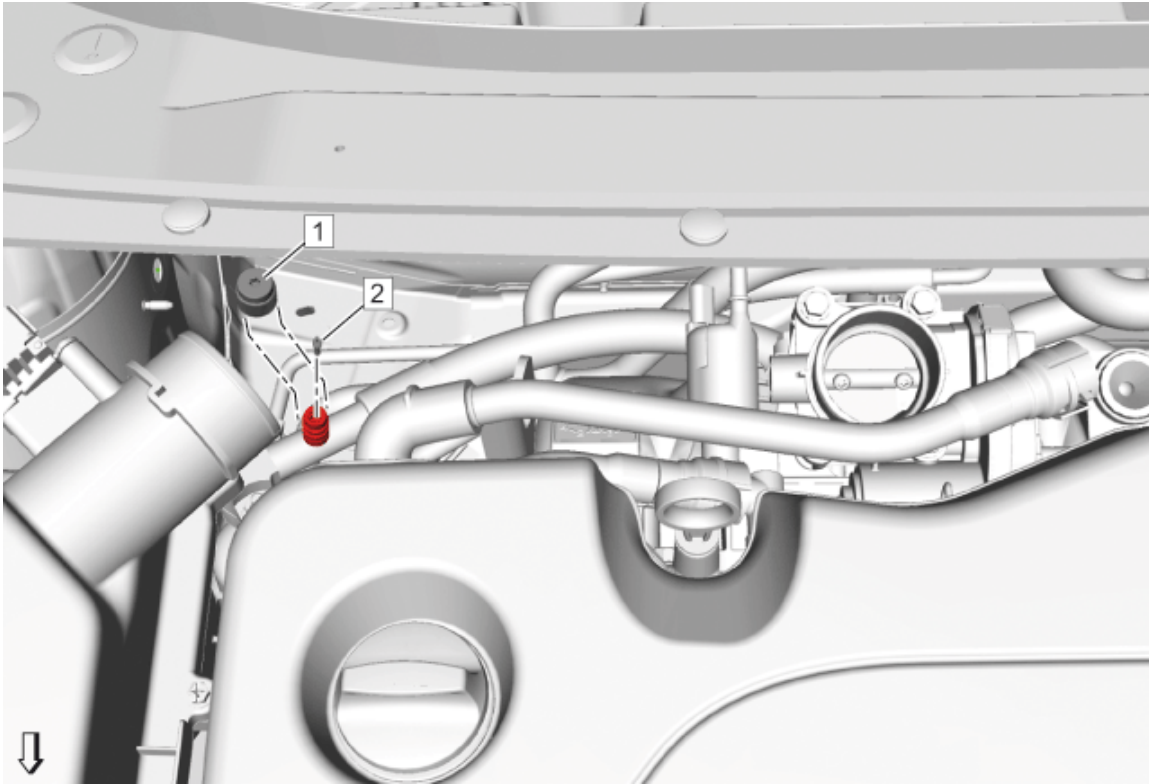


Fig. 31: Air Conditioning Refrigerant Low Pressure Service Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Recover the refrigerant. Refer to Refrigerant Recovery and Recharging 3. Remove Dash Upper Extension Panel Opening Cover. Refer to Dash Upper Extension Panel Opening Cover Replacement 4. Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement	
1	Air Conditioning Refrigerant Low Pressure Service Valve Cap
2	Air Conditioning Refrigerant Low Pressure Service Valve CAUTION: Refer to Fastener Caution Tighten 0.8 N.m (7 lb in) Special Tools GE-46246 Valve Core Removal Tool

AIR CONDITIONING REFRIGERANT HIGH PRESSURE SERVICE VALVE REPLACEMENT

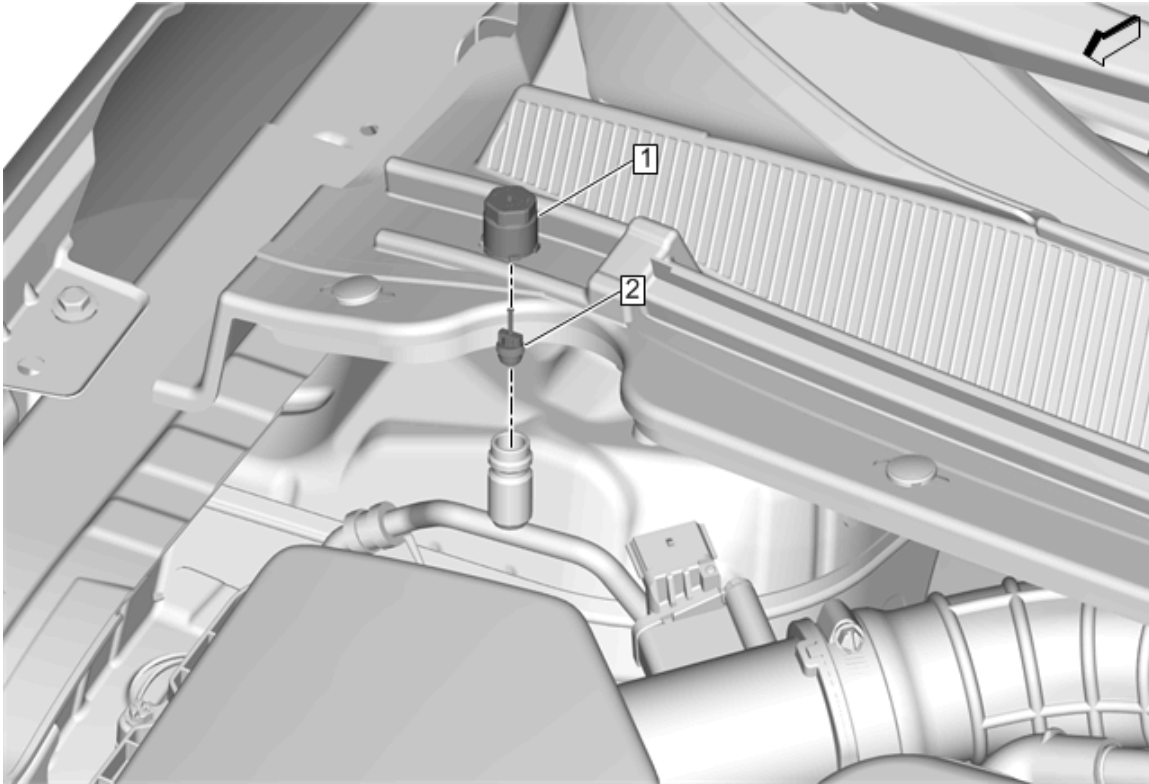


Fig. 32: Air Conditioning Refrigerant High Pressure Service Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Air Conditioning Refrigerant High Pressure Service Valve Cap
2	Air Conditioning Refrigerant High Pressure Service Valve CAUTION: Refer to Component Fastener Tightening Caution Tighten 0.8 N.m (7 lb in) Special Tools GE-46246 Valve Core Removal Tool

AIR CONDITIONING CYCLING SWITCH REPLACEMENT

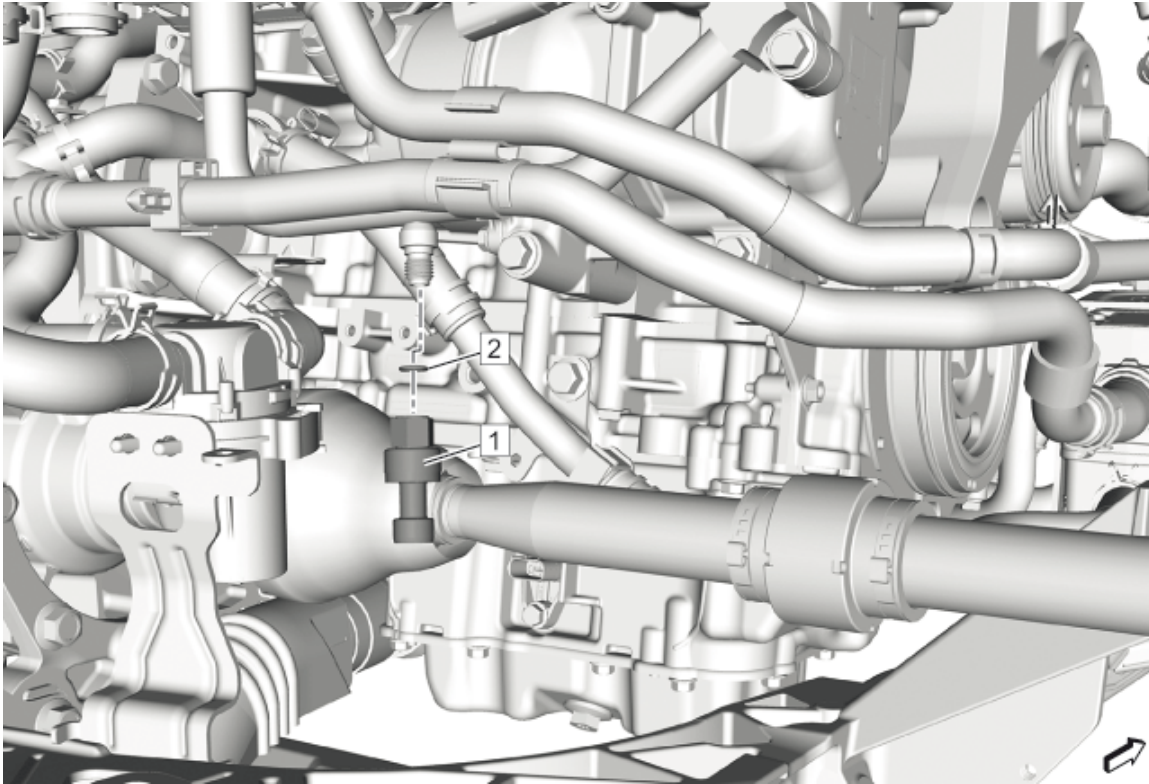


Fig. 33: Air Conditioning Cycling Switch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Air Conditioning Cycling Switch CAUTION: Refer to Component Fastener Tightening Caution Procedure Disconnect the electrical connector. Tighten 9 N.m (80 lb in)
2	Air Conditioning Refrigerant High Pressure Service Valve Sealing Ring

AIR CONDITIONING CONDENSER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
3. Remove Radiator Air Lower Baffle and Deflector. Refer to [Radiator Air Lower Baffle and Deflector Replacement](#)
4. Remove Radiator Air Upper Baffle and Deflector. Refer to [Radiator Air Upper Baffle and Deflector Replacement](#)
5. Remove the drive motor control module radiator inlet hose from air conditioning condenser. Refer to [Drive Motor Control Module Radiator Inlet Hose Replacement](#) .
6. Remove the drive motor generator control module cooling outlet hose from air conditioning condenser. Refer to [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\)](#) [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)
7. Remove the condenser tube from air conditioning condenser. Refer to [Condenser Tube Replacement](#).

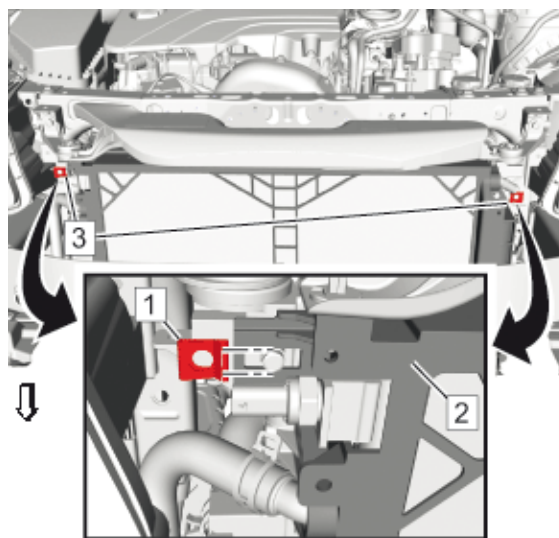


Fig. 34: Air Conditioning Condenser Bracket Spring And Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove the 2 air conditioning condenser bracket spring (3) from radiator assembly (2).

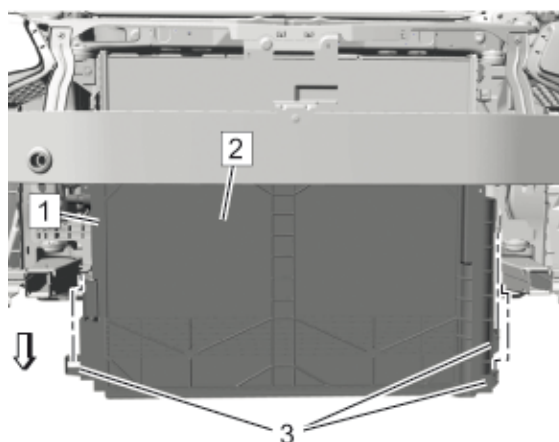


Fig. 35: Air Conditioning Condenser, Bracket And Retaining Tabs

Courtesy of GENERAL MOTORS COMPANY

9. Remove the air conditioning condenser (2) with air conditioning condenser bracket (1).
10. Unlock the 3 retaining tabs (3).

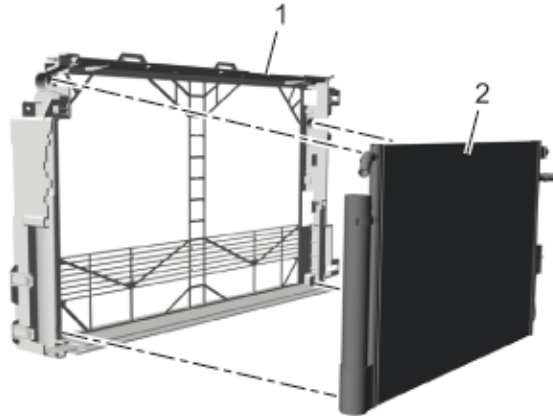


Fig. 36: Air Conditioning Condenser And Bracket

Courtesy of GENERAL MOTORS COMPANY

11. Remove the air conditioning condenser (2) from air conditioning condenser bracket (1).
12. Remove the air conditioning refrigerant desiccant from the air conditioning condenser. Refer to [Air Conditioning Refrigerant Desiccant Replacement](#).
13. Remove the engine coolant temperature sensor from the air conditioning condenser. Refer to [Engine Coolant Temperature Sensor Replacement - Radiator](#) .

Installation Procedure

1. Install the engine coolant temperature sensor to the air conditioning condenser. Refer to [Engine Coolant Temperature Sensor Replacement - Radiator](#) .
2. Install the air conditioning refrigerant desiccant to the air conditioning condenser. Refer to [Air Conditioning Refrigerant Desiccant Replacement](#).

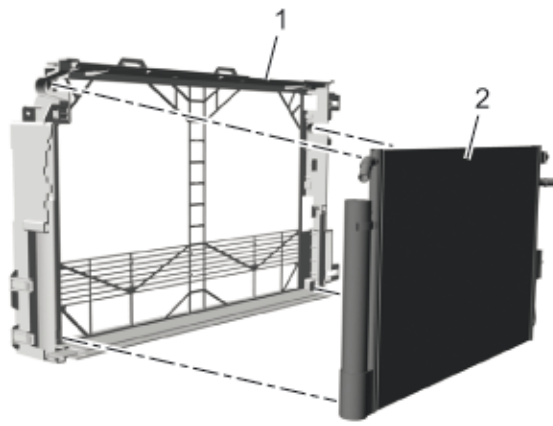


Fig. 37: Air Conditioning Condenser And Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Install the air conditioning condenser (2) to air conditioning condenser bracket (1).

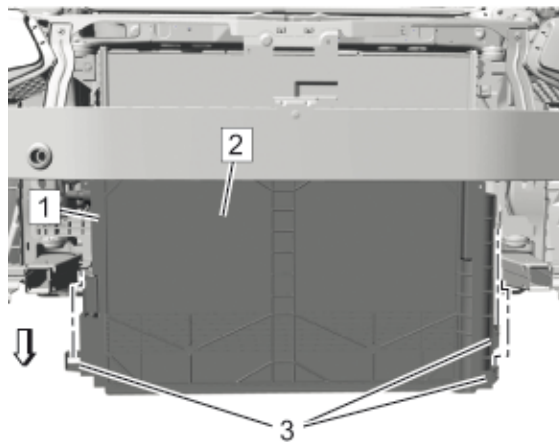


Fig. 38: Air Conditioning Condenser, Bracket And Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning condenser (2) with air conditioning condenser bracket (1).
5. Lock the 3 retaining tabs (3).

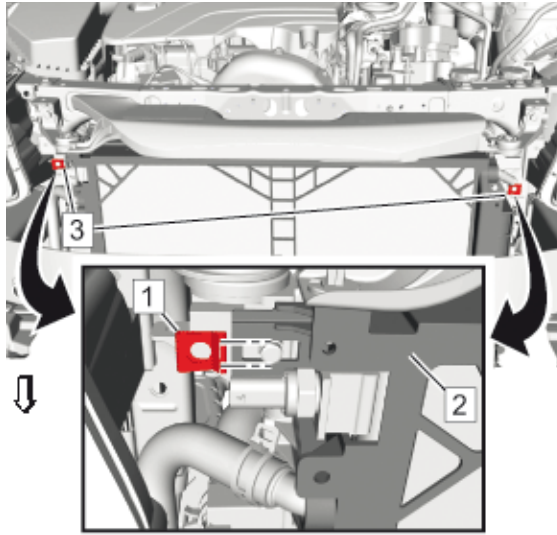


Fig. 39: Air Conditioning Condenser Bracket Spring And Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

6. Install the 2 air conditioning condenser bracket spring (3) to radiator assembly (2).
7. Install the condenser tube to the air conditioning condenser. Refer to [Condenser Tube Replacement](#).
8. Install the drive motor generator control module cooling outlet hose to air conditioning condenser. Refer to [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\) Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)
9. Install the drive motor control module radiator inlet hose from air conditioning condenser. Refer to [Drive Motor Control Module Radiator Inlet Hose Replacement](#) .
10. Install Radiator Air Upper Baffle and Deflector. Refer to [Radiator Air Upper Baffle and Deflector Replacement](#)
11. Install Radiator Air Lower Baffle and Deflector. Refer to [Radiator Air Lower Baffle and Deflector Replacement](#)
12. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
13. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AIR CONDITIONING EVAPORATOR LOWER CASE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
3. Remove Air Conditioning Evaporator Upper Case. Refer to [Air Conditioning Evaporator Upper Case Replacement](#)
4. Remove Blower Motor. Refer to [Blower Motor Replacement](#)
5. Remove Air Conditioning Evaporator. Refer to [Air Conditioning Evaporator Replacement](#)
6. Remove the evaporator seals.

Installation Procedure

1. Install the evaporator seals.
2. Install Air Conditioning Evaporator. Refer to [Air Conditioning Evaporator Replacement](#)
3. Install Blower Motor. Refer to [Blower Motor Replacement](#)
4. Install Air Conditioning Evaporator Upper Case. Refer to [Air Conditioning Evaporator Upper Case Replacement](#)
5. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
6. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AIR CONDITIONING EVAPORATOR UPPER CASE REPLACEMENT

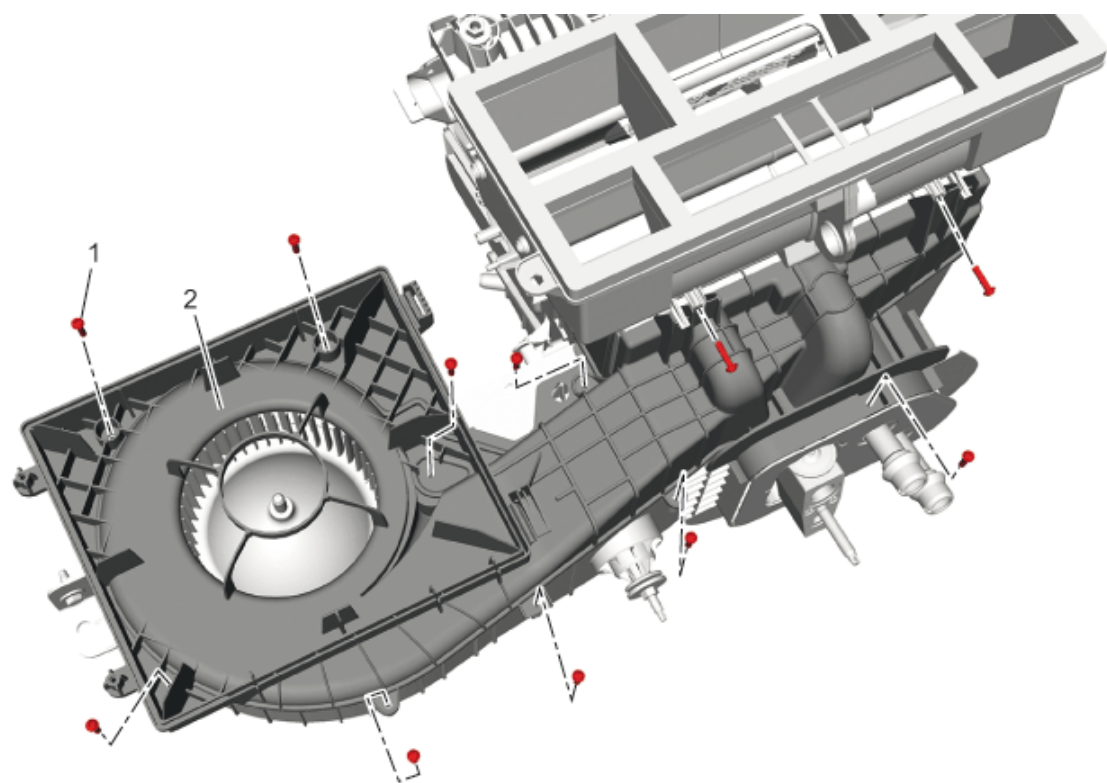


Fig. 40: Air Conditioning Evaporator Upper Case
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Air Inlet Housing. Refer to Air Inlet Housing Replacement 3. Remove Air Conditioning Evaporator and Blower Case. Refer to Air Conditioning Evaporator and Blower Case Replacement	

Callout	Component Name
1	Air Conditioning Evaporator Upper Case Bolt (Qty: 11) CAUTION: Refer to Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Air Conditioning Evaporator Upper Case Assembly

AIR CONDITIONING AND HEATER MODULE ASSEMBLY REMOVAL AND INSTALLATION

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
3. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)
4. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)

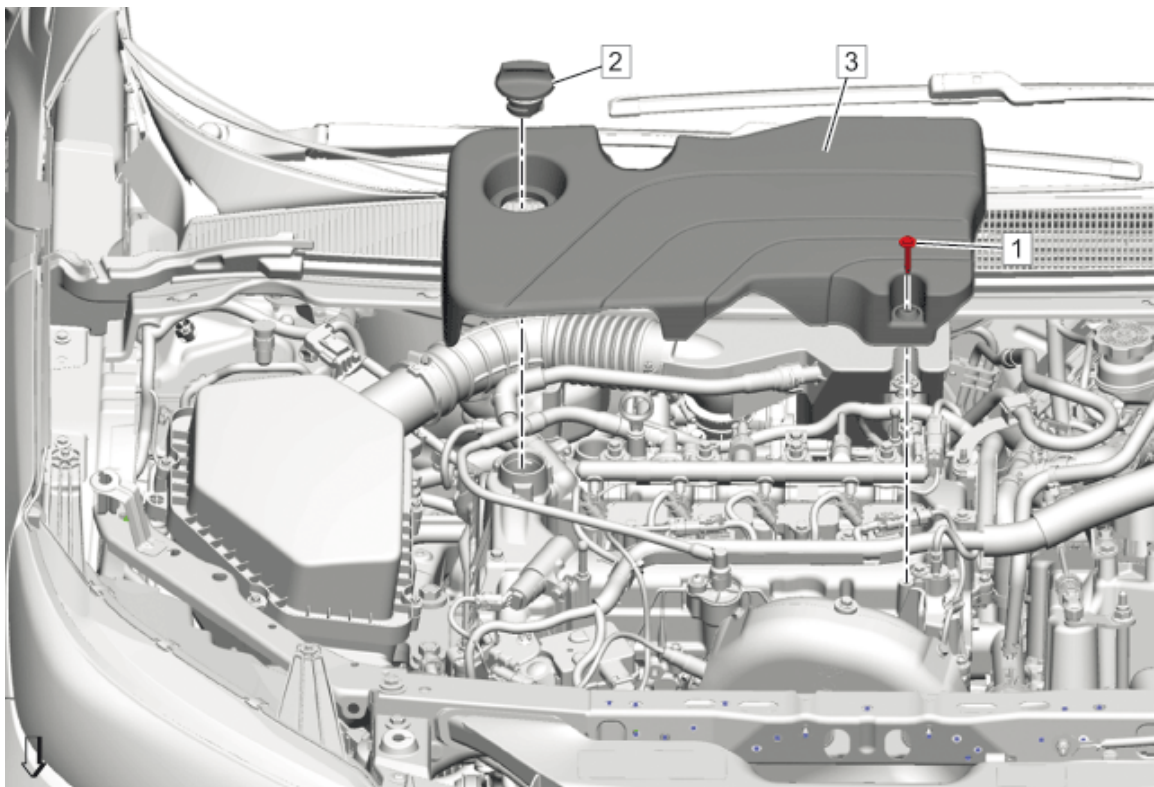


Fig. 41: Intake Manifold Cover

Courtesy of GENERAL MOTORS COMPANY

5. Remove Intake Manifold Cover (3). Refer to [Intake Manifold Cover Replacement](#)

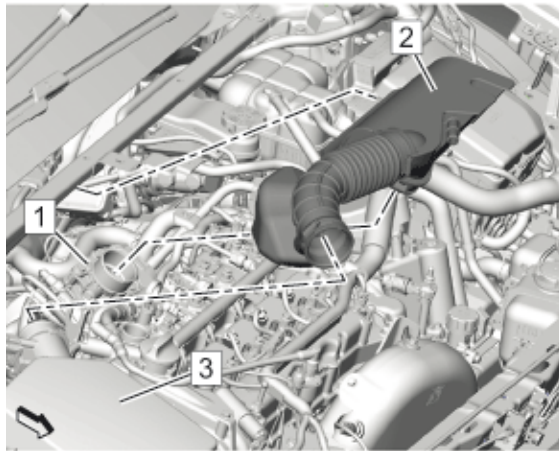


Fig. 42: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body
Courtesy of GENERAL MOTORS COMPANY

6. Remove Air Cleaner Outlet Duct (2). Refer to [Air Cleaner Outlet Duct Replacement](#)

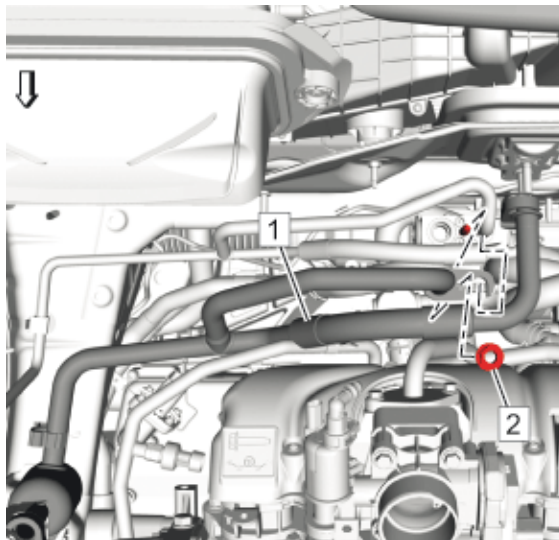


Fig. 43: Air Conditioning Evaporator Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove Air Conditioning Evaporator Hose Assembly (1) @ Air Conditioning Evaporator Thermal Expansion Valve. Refer to [Air Conditioning Evaporator Hose Assembly Replacement](#)

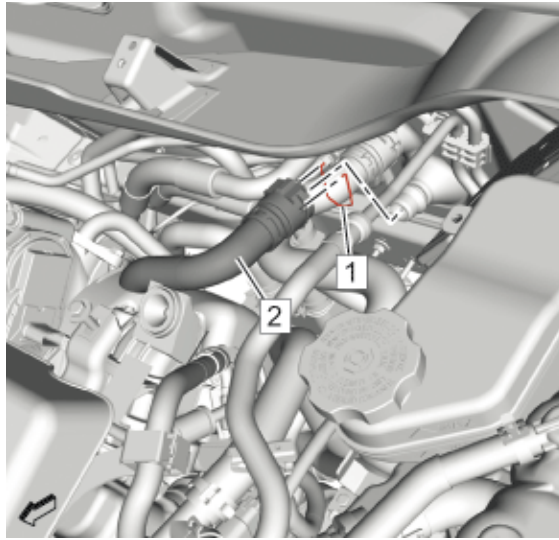


Fig. 44: Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

8. Remove Heater Inlet Hose (2) @ Heater Core Inlet Tube. Refer to [Heater Inlet Hose Replacement](#)

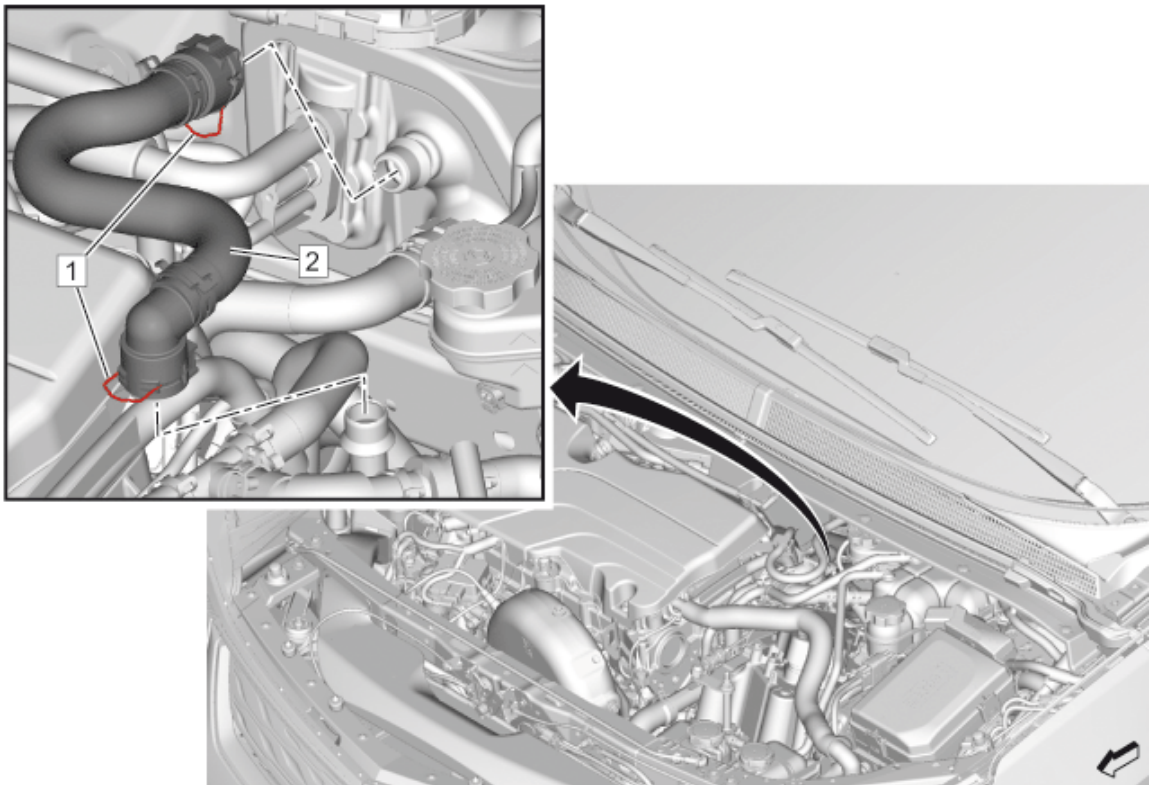


Fig. 45: Heater Water Shutoff Valve Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

9. Remove Heater Water Shutoff Valve Inlet Hose (2) @ Heater Core Outlet Tube. Refer to [Heater Water Shutoff Valve Inlet Hose Replacement](#)

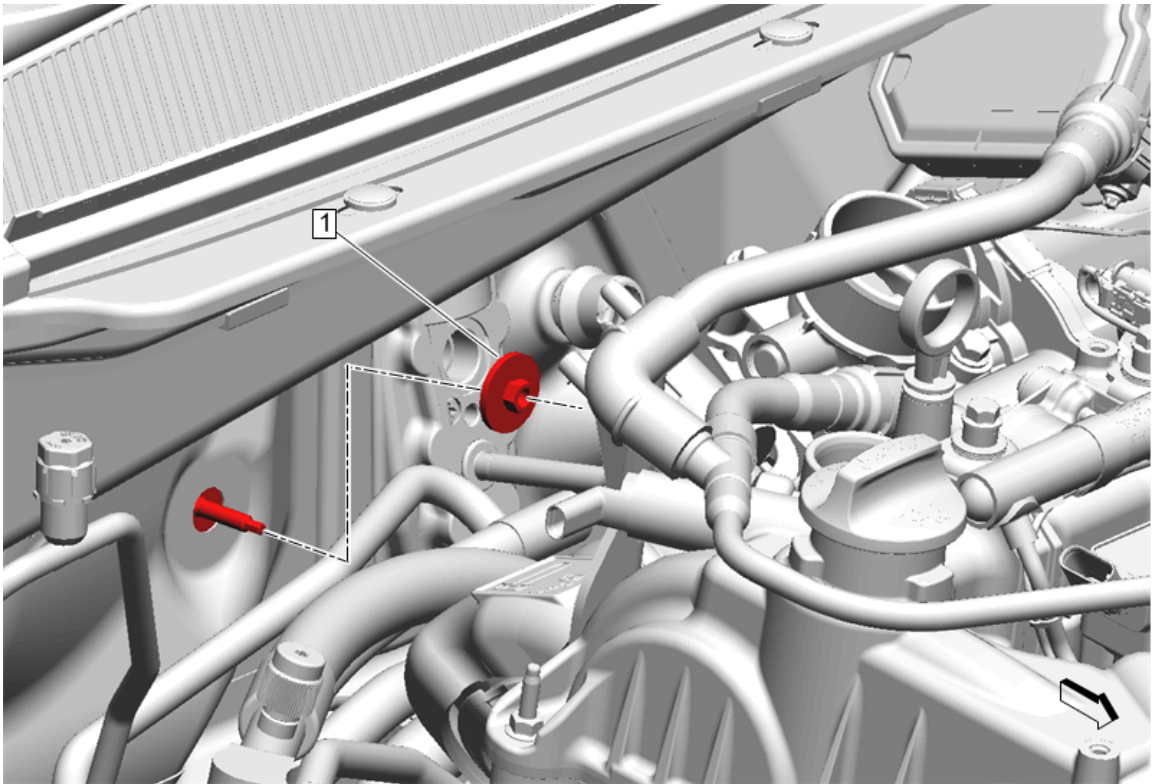


Fig. 46: Heater And Air Conditioning Evaporator And Blower Module Nut
 Courtesy of GENERAL MOTORS COMPANY

10. Remove Heater and Air Conditioning Evaporator and Blower Module Nut (1) @ Cowl Panel.

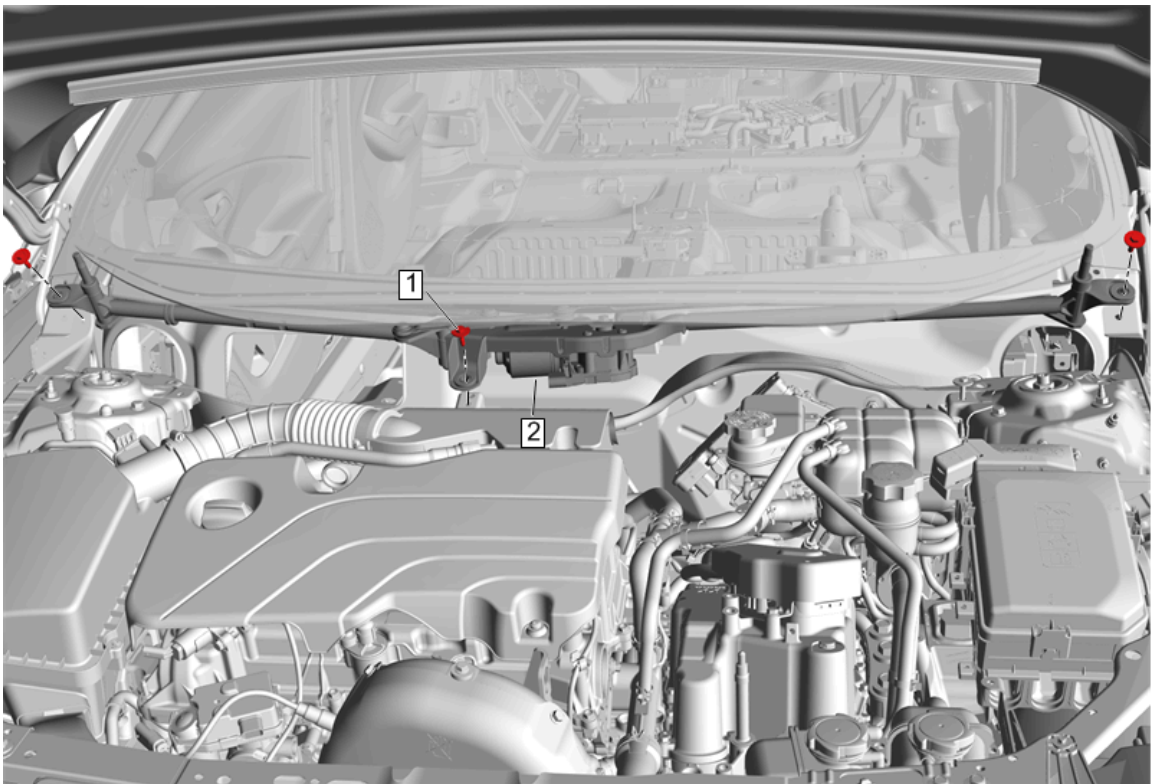


Fig. 47: Windshield Wiper System Module
 Courtesy of GENERAL MOTORS COMPANY

11. Remove Windshield Wiper System Module (2). Refer to [Windshield Wiper System Module Replacement](#)
12. Remove the left and right front side door (4). Refer to [Front Side Door Replacement](#)
13. Remove Drivers Seat and Passengers Seat. Refer to [Driver or Passenger Seat Removal and Installation](#)
14. Remove Front Floor Console. Refer to [Front Floor Console Replacement](#)

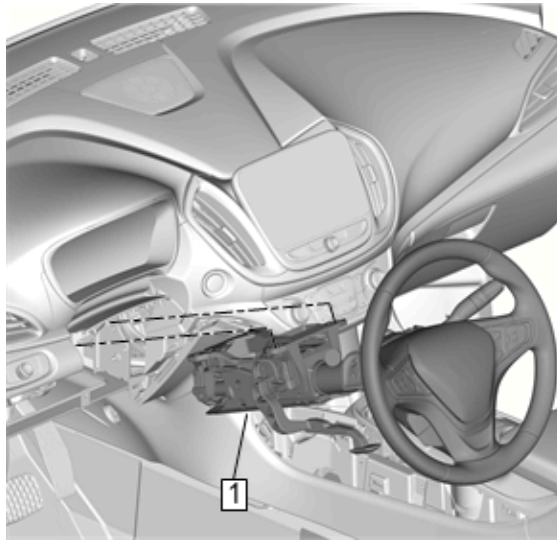


Fig. 48: Steering Column

Courtesy of GENERAL MOTORS COMPANY

15. Remove Steering Column (1). Refer to [Steering Column Replacement](#)

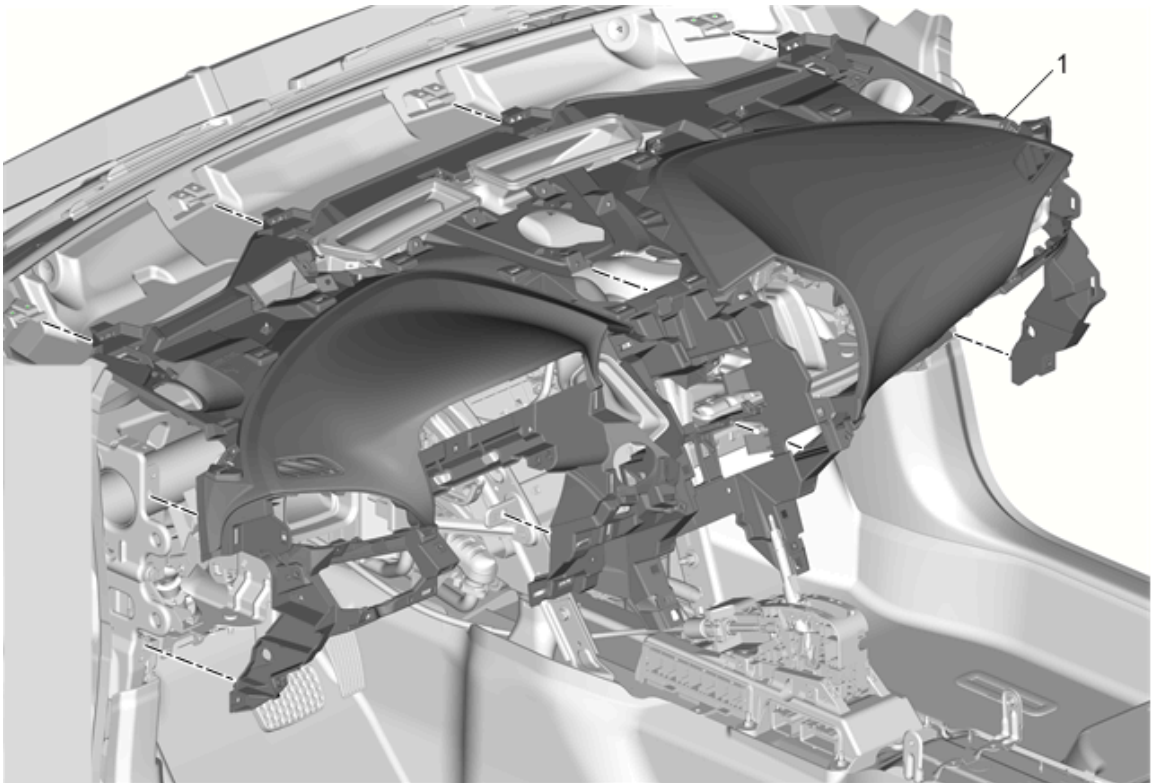


Fig. 49: Instrument Panel Carrier Assembly

Courtesy of GENERAL MOTORS COMPANY

16. Remove Instrument Panel (1). Refer to [Instrument Panel Assembly Replacement](#)

17. Disconnect the instrument panel wiring connectors.

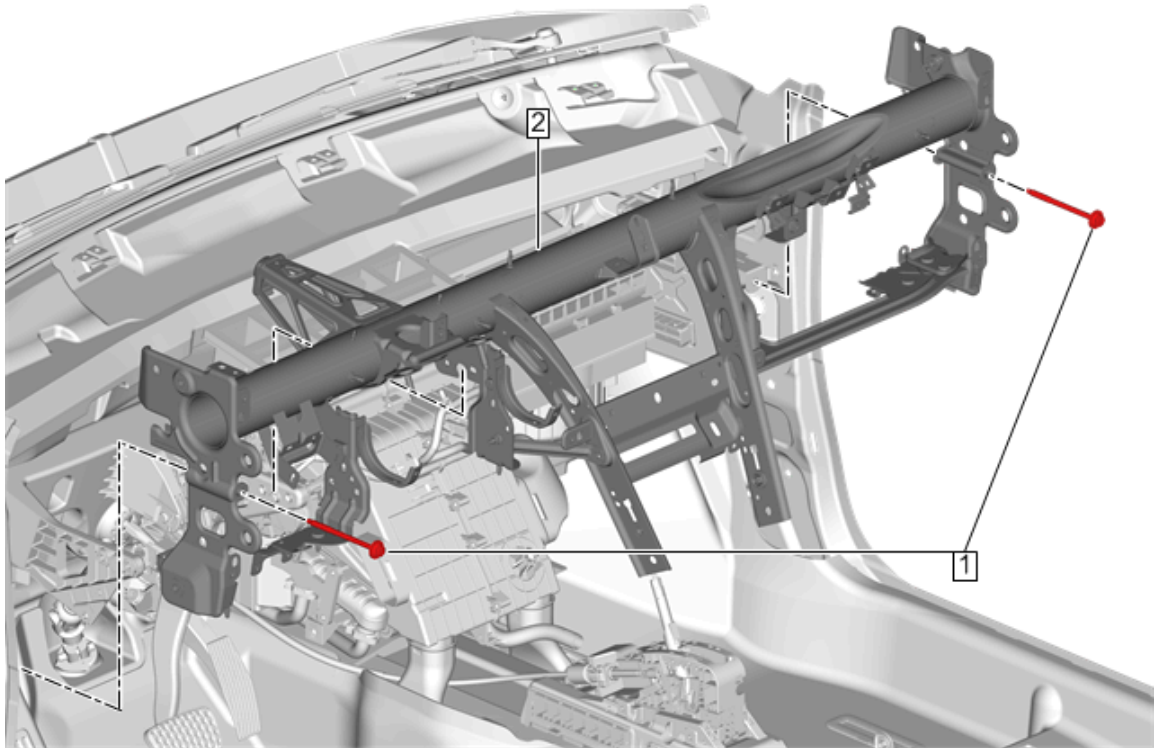


Fig. 50: Instrument Panel Tie Bar And Reinforcement Bolts

Courtesy of GENERAL MOTORS COMPANY

18. Remove Instrument Panel Tie Bar (2). Refer to [Instrument Panel Tie Bar Replacement](#)

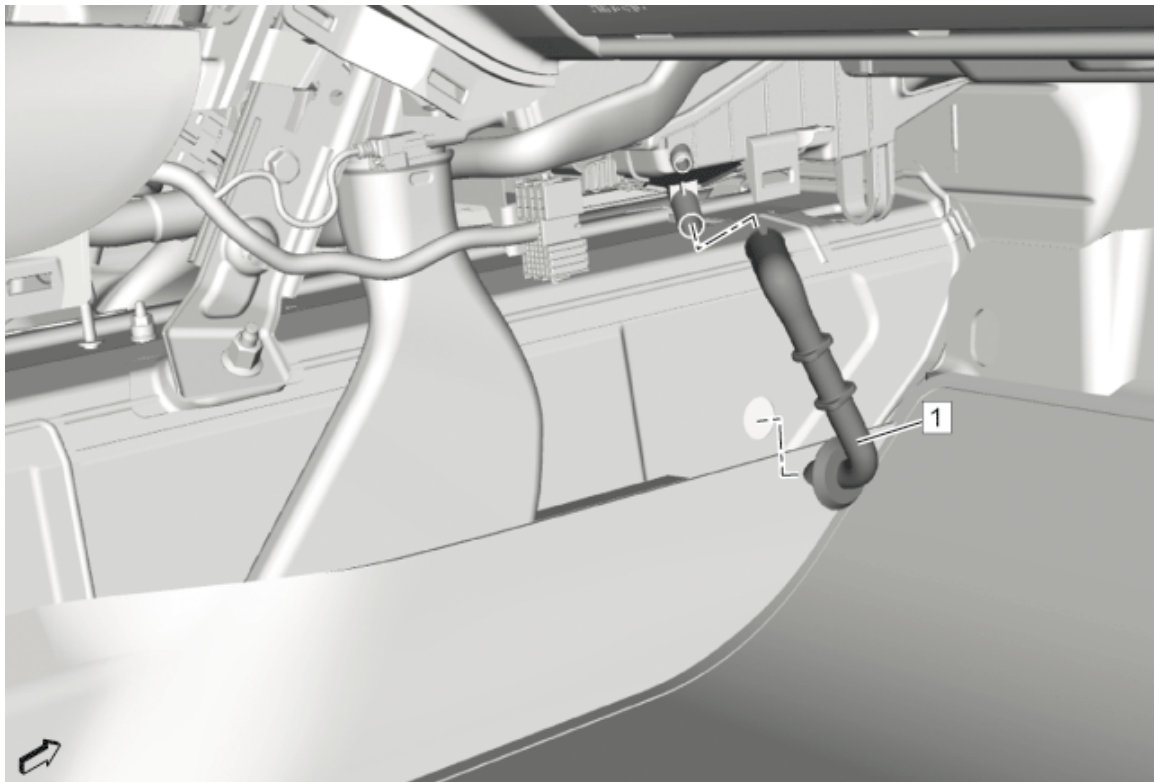


Fig. 51: Air Conditioning Evaporator And Blower Module Drain Hose

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [HVAC Module Drain Tube Caution](#) .

19. Prior to removing the air conditioning evaporator and blower module drain tube/hose, use clean and absorbent shop clothes/towels to cover the electrical components protecting the electrical components from water damage.
20. Remove Air Conditioning Evaporator and Blower Module Drain Hose (1) @ Heater and Air Conditioning Evaporator and Blower Module.
21. Support the heater and air conditioning evaporator and blower (HVAC) module assembly.

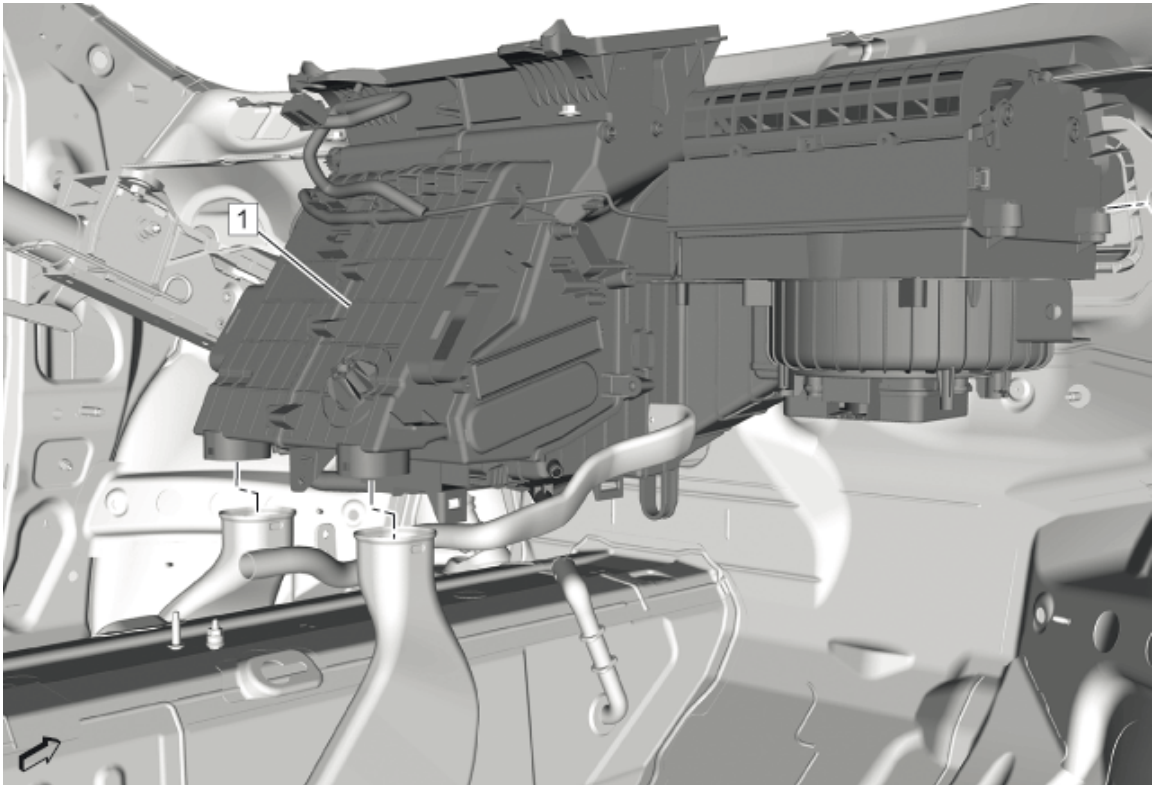


Fig. 52: Heater And Air Conditioning Evaporator And Blower Module

Courtesy of GENERAL MOTORS COMPANY

22. Remove Heater and Air Conditioning Evaporator and Blower Module (1) from the vehicle.
23. Transfer all necessary components.

Installation Procedure

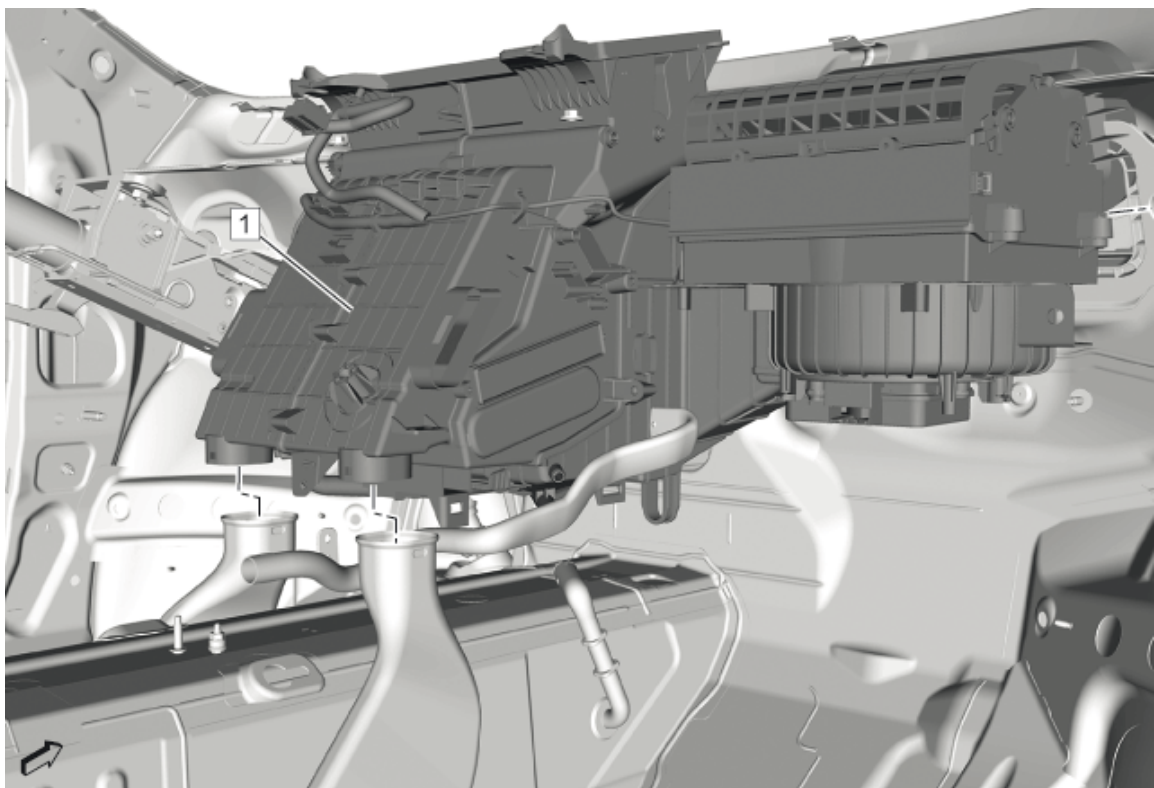


Fig. 53: Heater And Air Conditioning Evaporator And Blower Module
 Courtesy of GENERAL MOTORS COMPANY

1. Install Heater and Air Conditioning Evaporator and Blower Module (1) onto the vehicle.
2. Temporarily support HVAC module assembly.

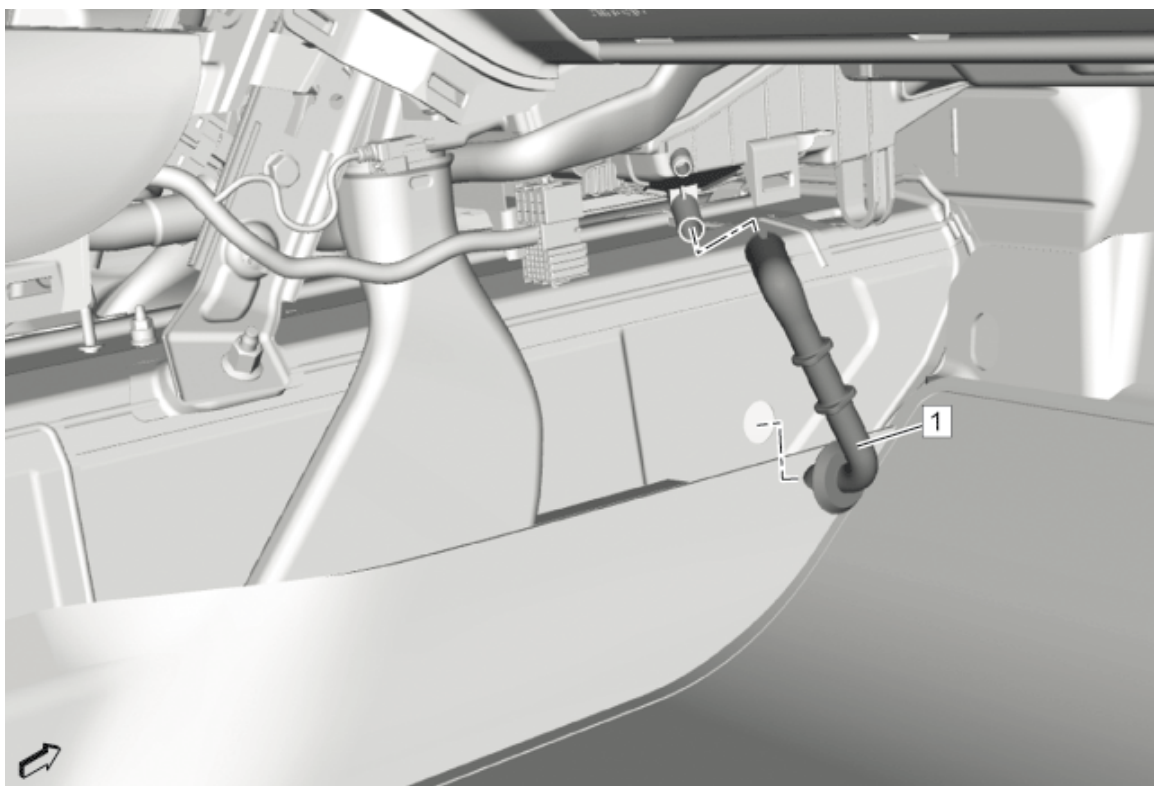


Fig. 54: Air Conditioning Evaporator And Blower Module Drain Hose

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [HVAC Module Drain Tube Caution](#) .

3. Install Air Conditioning Evaporator and Blower Module Drain Hose (1) @ Heater and Air Conditioning Evaporator and Blower Module.
4. Remove the absorbent shop clothes/towels covering the electrical components.

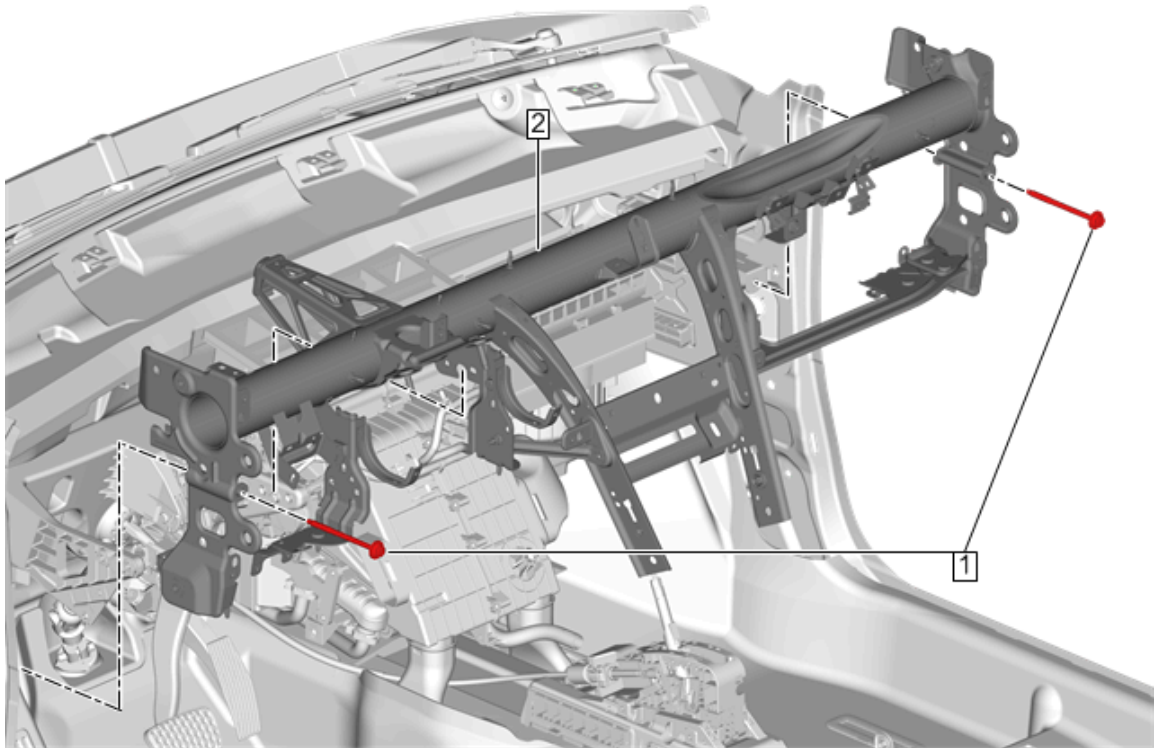


Fig. 55: Instrument Panel Tie Bar And Reinforcement Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install Instrument Panel Tie Bar (2). Refer to [Instrument Panel Tie Bar Replacement](#)
6. Connect the instrument panel wiring connectors.

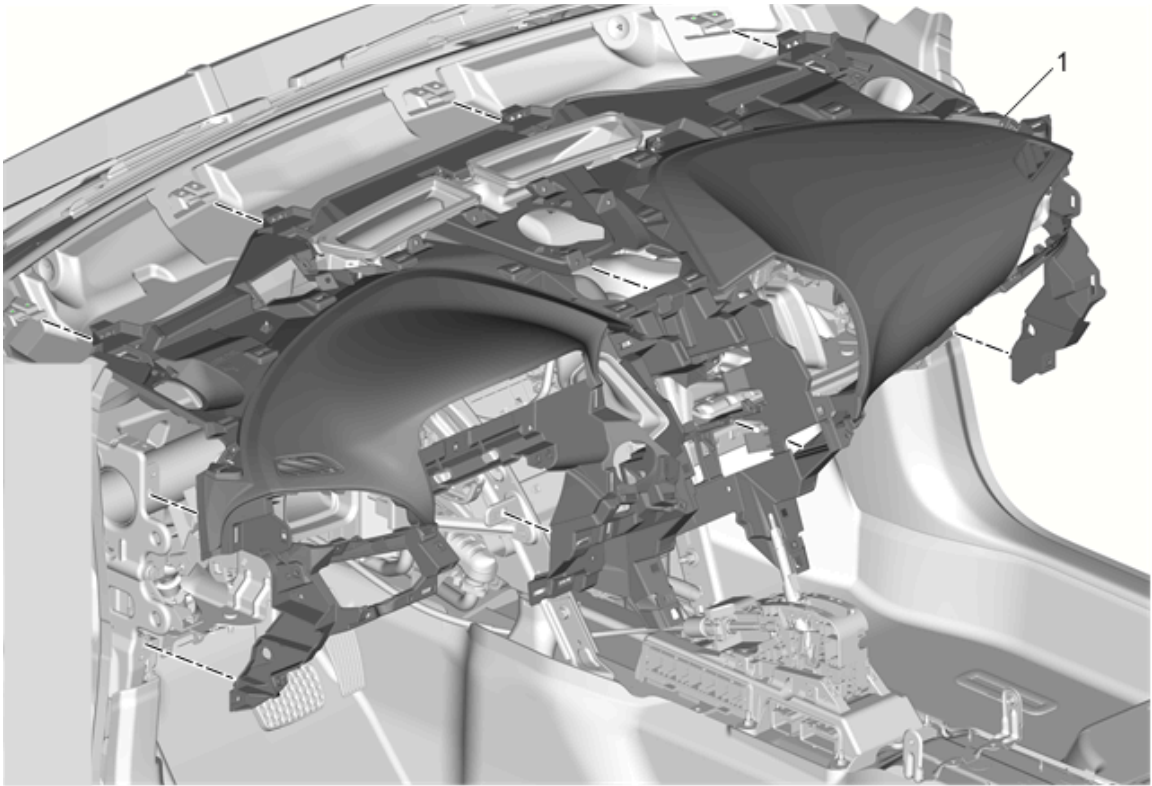


Fig. 56: Instrument Panel Carrier Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install Instrument Panel (1). Refer to [Instrument Panel Assembly Replacement](#)

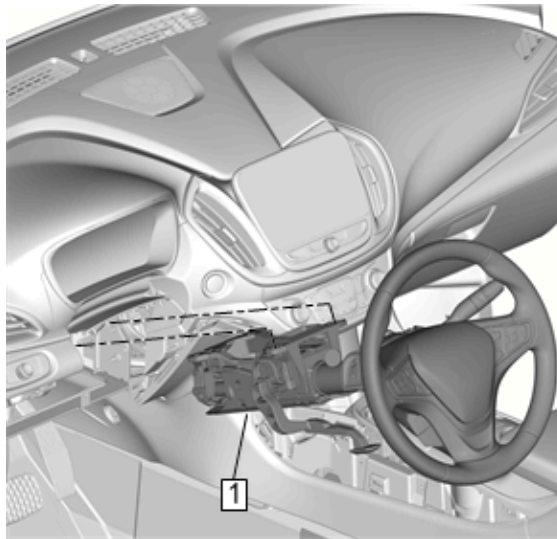


Fig. 57: Steering Column
Courtesy of GENERAL MOTORS COMPANY

8. Install Steering Column (1). Refer to [Steering Column Replacement](#)
9. Install Front Floor Console. Refer to [Front Floor Console Replacement](#)
10. Install Drivers Seat and Passengers Seat. Refer to [Driver or Passenger Seat Removal and Installation](#)
11. Install the left and right front side doors (4). Refer to [Front Side Door Replacement](#)

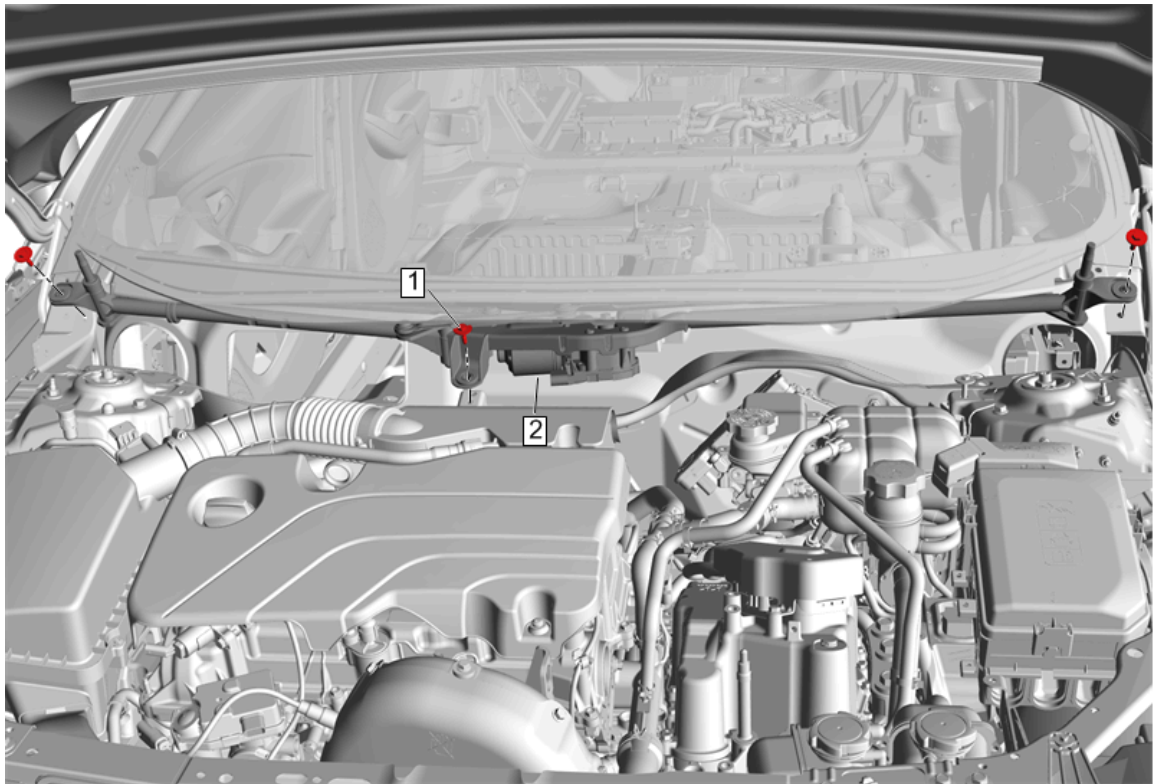


Fig. 58: Windshield Wiper System Module
 Courtesy of GENERAL MOTORS COMPANY

12. Install Windshield Wiper System Module (2). Refer to [Windshield Wiper System Module Replacement](#)

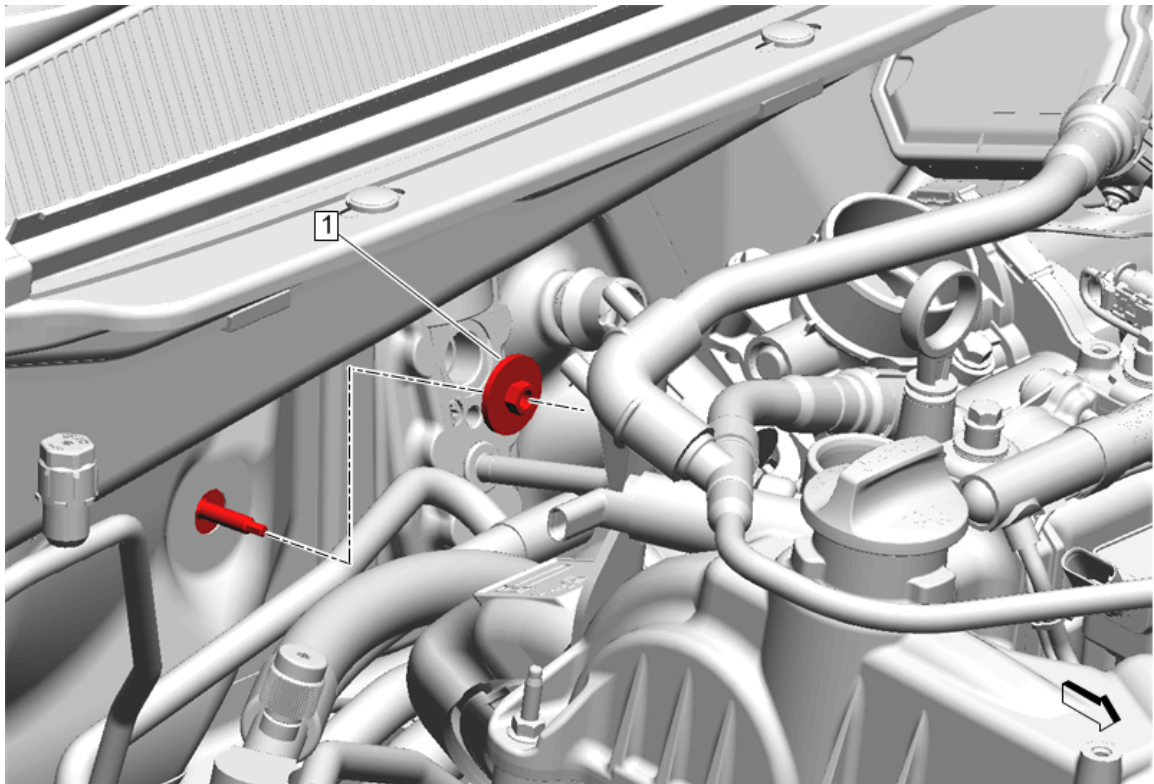


Fig. 59: Heater And Air Conditioning Evaporator And Blower Module Nut
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

13. Install and tighten Heater and Air Conditioning Evaporator and Blower Module Nut (1) @ Cowl Panel to 9.0 N.m (80 lb in)

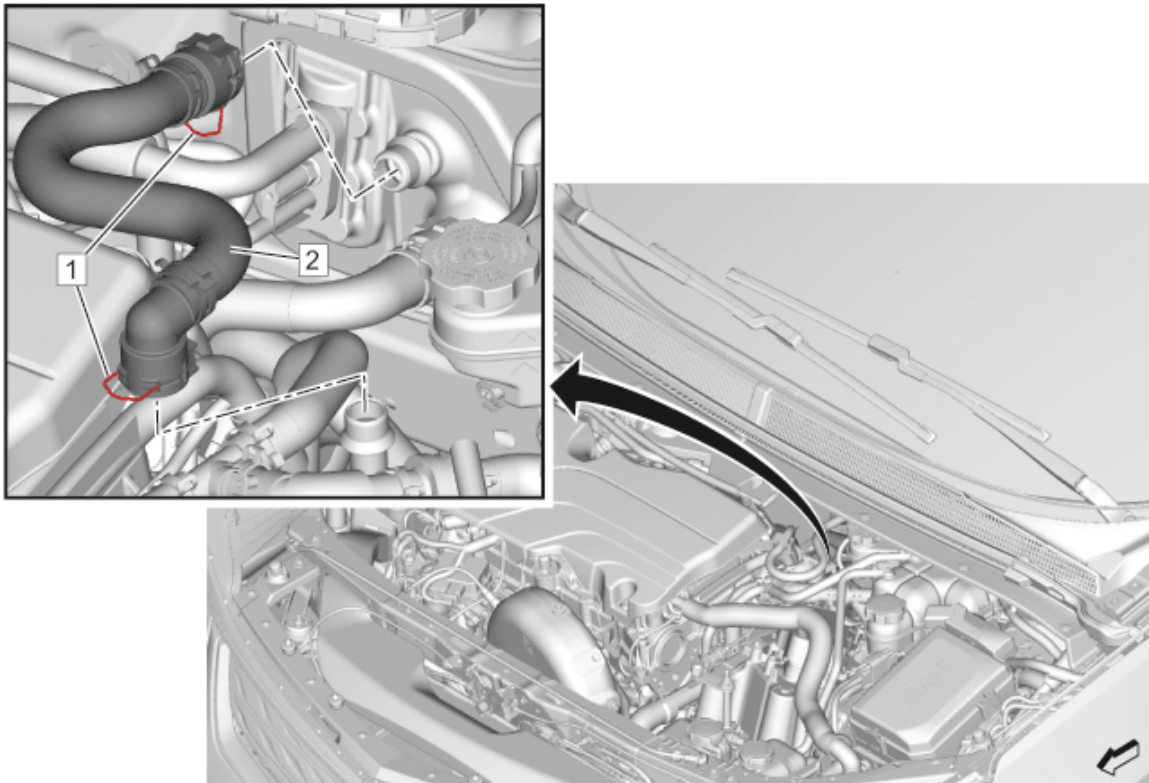


Fig. 60: Heater Water Shutoff Valve Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

14. Install Heater Water Shutoff Valve Inlet Hose (2) @ Heater Core Outlet Tube. Refer to [Heater Water Shutoff Valve Inlet Hose Replacement](#)

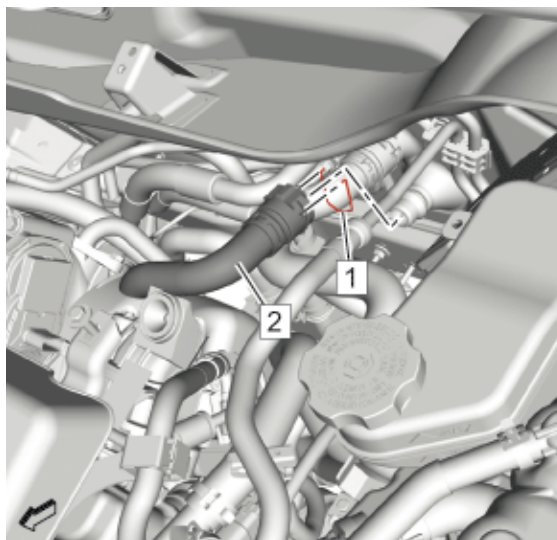


Fig. 61: Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

15. Install Heater Inlet Hose (2) @ Heater Core Inlet Tube. Refer to [Heater Inlet Hose Replacement](#)

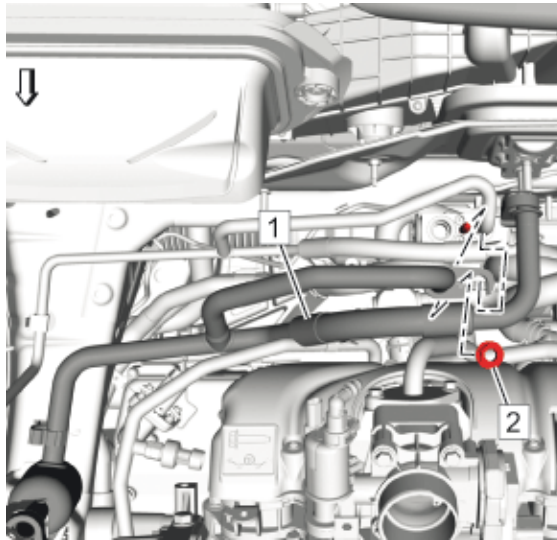


Fig. 62: Air Conditioning Evaporator Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

16. Install Air Conditioning Evaporator Hose Assembly (1) @ Air Conditioning Evaporator Thermal Expansion Valve. Refer to [Air Conditioning Evaporator Hose Assembly Replacement](#)

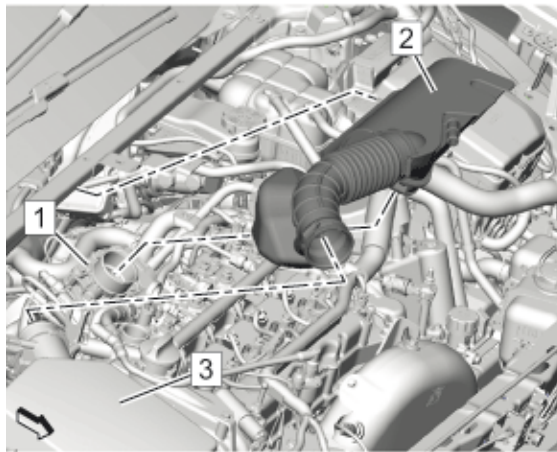


Fig. 63: Air Cleaner Outlet Duct, Air Cleaner Assembly And Throttle Body
Courtesy of GENERAL MOTORS COMPANY

17. Install Air Cleaner Outlet Duct (2). Refer to [Air Cleaner Outlet Duct Replacement](#)

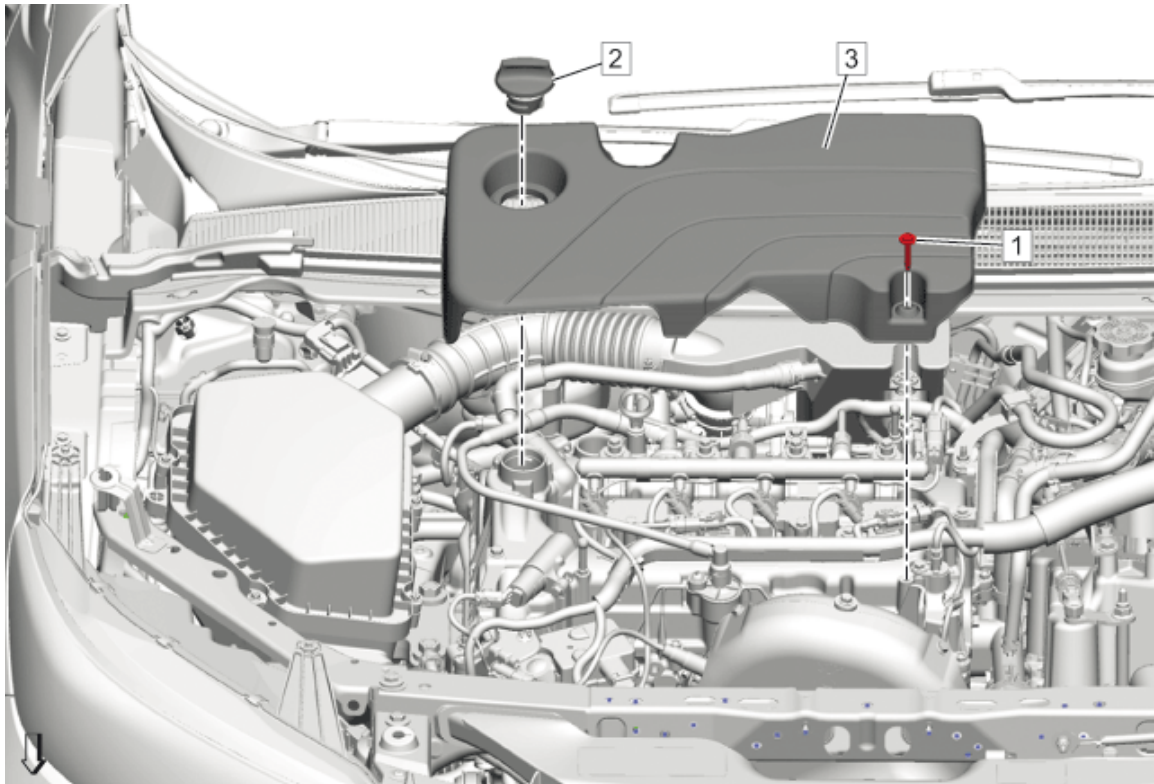


Fig. 64: Intake Manifold Cover

Courtesy of GENERAL MOTORS COMPANY

18. Install Intake Manifold Cover (3). Refer to [Intake Manifold Cover Replacement](#)
19. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
20. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling](#) .
21. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
22. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
23. Inspect for coolant leaks.
24. Visually inspect for air conditioning system refrigerant leaks.

AIR CONDITIONING EVAPORATOR REPLACEMENT

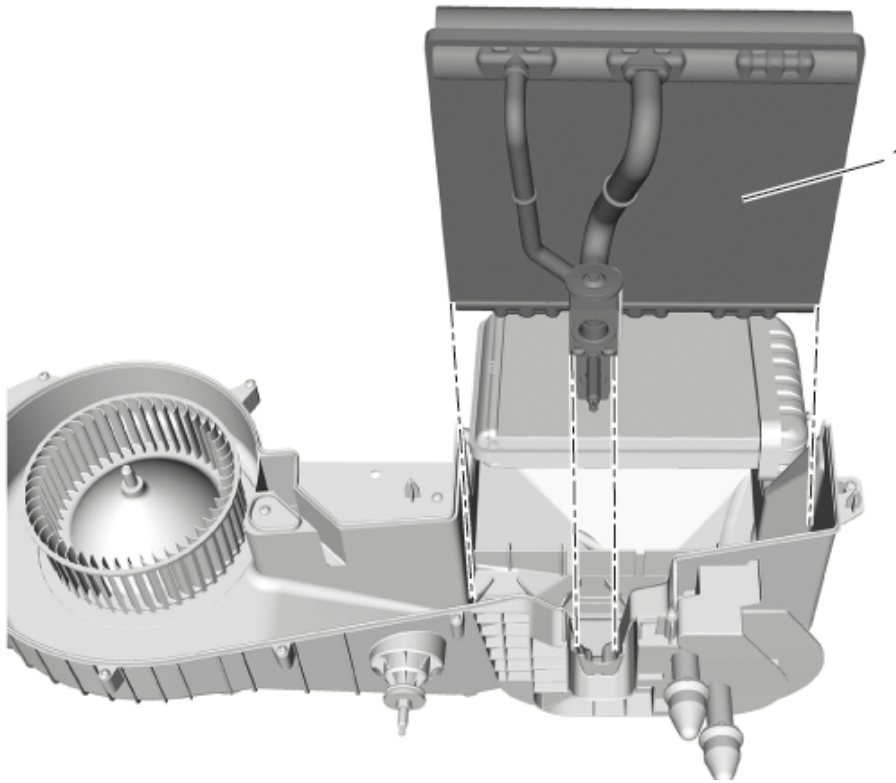


Fig. 65: Air Conditioning Evaporator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Air Conditioning Evaporator Lower Case. Refer to Air Conditioning Evaporator Lower Case Replacement	
1	Air Conditioning Evaporator Procedure Transfer components as necessary.

AIR CONDITIONING EVAPORATOR AND BLOWER CASE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Recover the refrigerant. Refer to [Refrigerant Recovery and Recharging](#)
3. Remove Air Conditioning and Heater Module Assembly. Refer to [Air Conditioning and Heater Module Assembly Removal and Installation](#)
4. Remove Heater Core. Refer to [Heater Core Replacement](#)

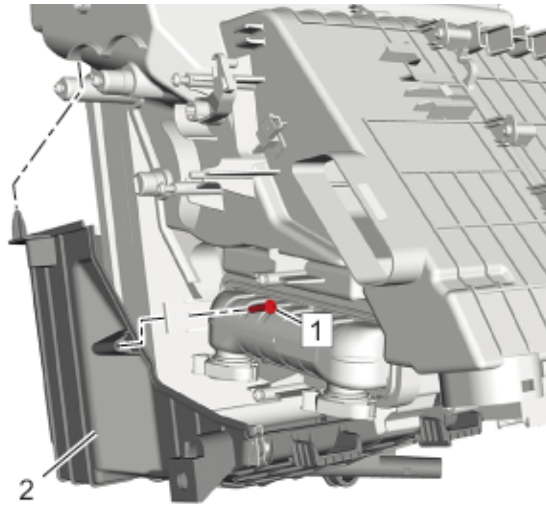


Fig. 66: Air Conditioning Lower Case Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the air conditioning lower case bolt (1).

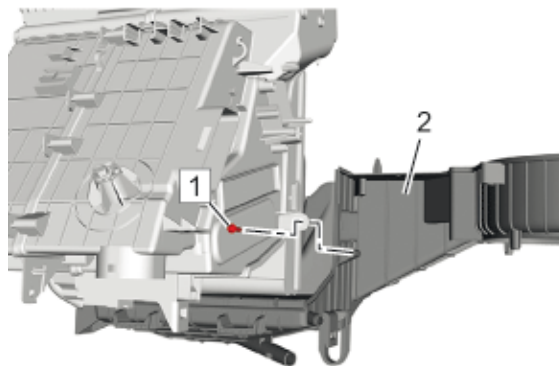


Fig. 67: Air Conditioning Evaporator Lower Case And Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the air conditioning evaporator lower case bolt (1).
7. Remove the air conditioning evaporator lower case (2).
8. Remove the air conditioning evaporator and blower case from the air conditioning evaporator upper and lower case bolts.
9. Remove Mode Valve Gear. Refer to [Mode Valve Gear Replacement](#)
10. Remove Vent Valve Lever. Refer to [Vent Valve Lever Replacement](#)
11. Remove Air Conditioning Evaporator. Refer to [Air Conditioning Evaporator Replacement](#)

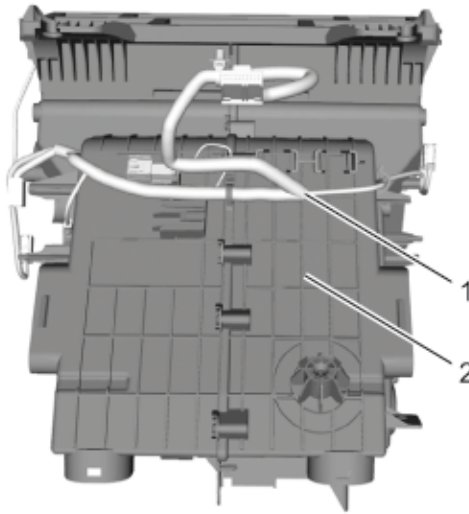


Fig. 68: Air Conditioning Evaporator/Blower Case And Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Remove the air conditioning evaporator and blower case wiring harness (1).
13. Remove the air conditioning evaporator and blower case (2).

Installation Procedure

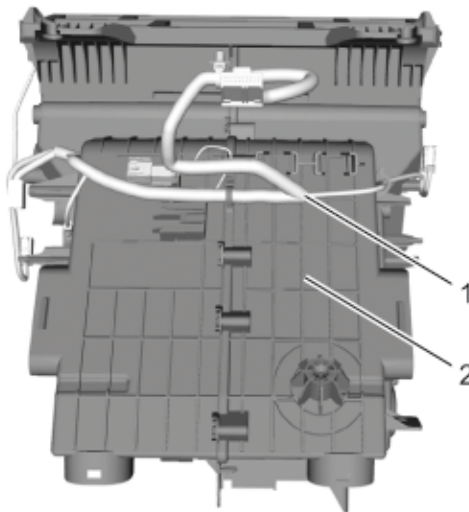


Fig. 69: Air Conditioning Evaporator/Blower Case And Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the air conditioning evaporator and blower case wiring harness (1) to the air conditioning evaporator and blower case (2).
2. Install Air Conditioning Evaporator. Refer to [**Air Conditioning Evaporator Replacement**](#)
3. Install Vent Valve Lever. Refer to [**Vent Valve Lever Replacement**](#)
4. Install Mode Valve Gear. Refer to [**Mode Valve Gear Replacement**](#)

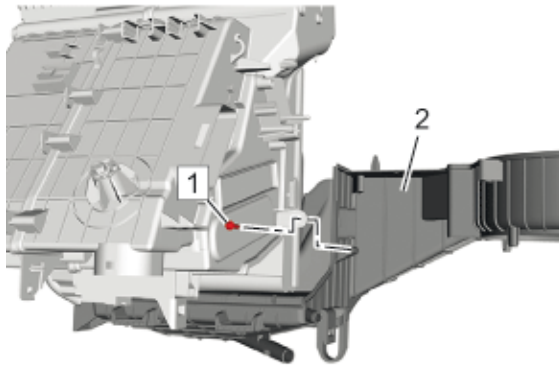


Fig. 70: Air Conditioning Evaporator Lower Case And Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

5. Install the air conditioning evaporator lower case (2).
6. Install the air conditioning evaporator lower case bolt (1) and tighten to 2.5 N.m (22 lb in).

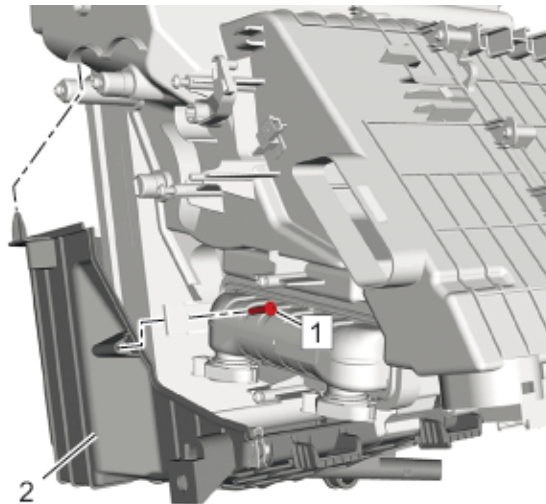


Fig. 71: Air Conditioning Lower Case Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install the air conditioning evaporator lower case bolt (1) and tighten to 2.5 N.m (22 lb in).
8. Install Heater Core. Refer to [Heater Core Replacement](#)
9. Install Air Conditioning and Heater Module Assembly. Refer to [Air Conditioning and Heater Module Assembly Removal and Installation](#)
10. Evacuate and charge the refrigerant system. Refer to [Refrigerant Recovery and Recharging](#)
11. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

HEATER INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)
2. Remove Front Wheelhouse Liner (Left Side). Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#) .
3. Remove Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
4. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

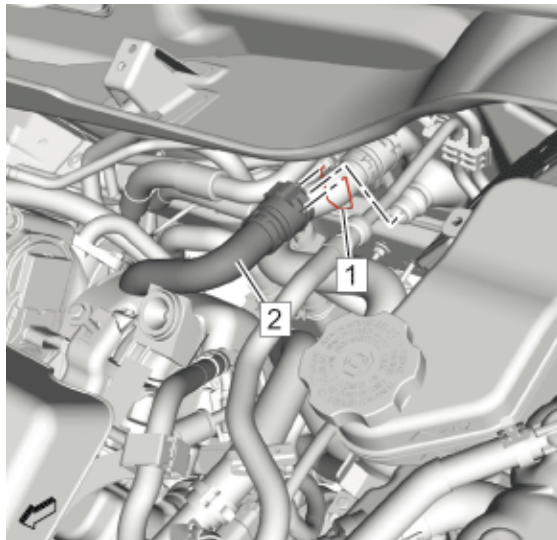


Fig. 72: Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Heater Inlet Hose Quick Connect (1) @ Heater Inlet Hose (2)
6. Remove Heater Inlet Hose (2) @ Heater Core Inlet Tube

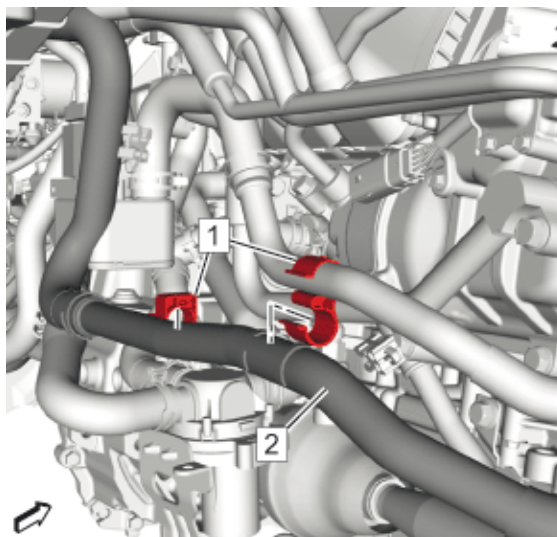


Fig. 73: Heater Inlet Hose And Retainers

Courtesy of GENERAL MOTORS COMPANY

7. Remove Heater Inlet Hose (2) @ Heater Inlet Hose Retainers (1) (Qty: 2)

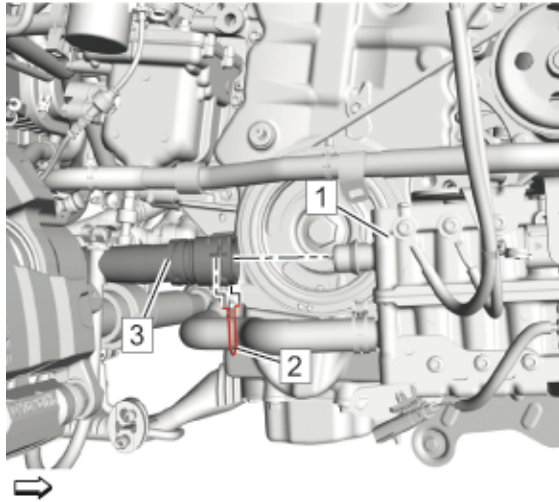


Fig. 74: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)
9. Disconnect Heater Inlet Hose (3) @ Heater Coolant Heater (1)
10. Remove Heater Inlet Hose (3)

Installation Procedure

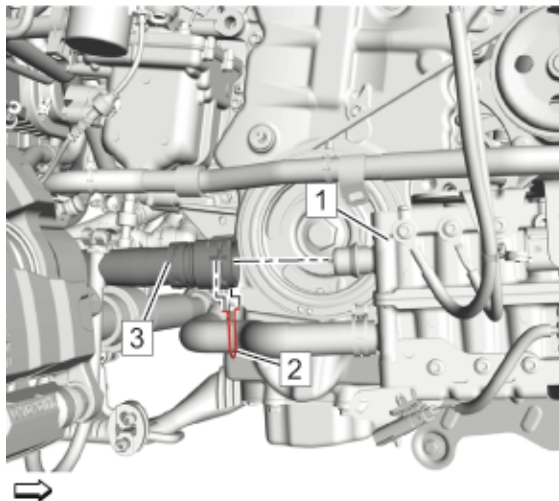


Fig. 75: Heater Coolant Heater, Heater Inlet Hose And Quick Connect
Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Inlet Hose (3) @ Heater Coolant Heater (1)

CAUTION: Refer to **Fastener Caution**

2. Connect Heater Inlet Hose Quick Connect (2) @ Heater Inlet Hose (3)

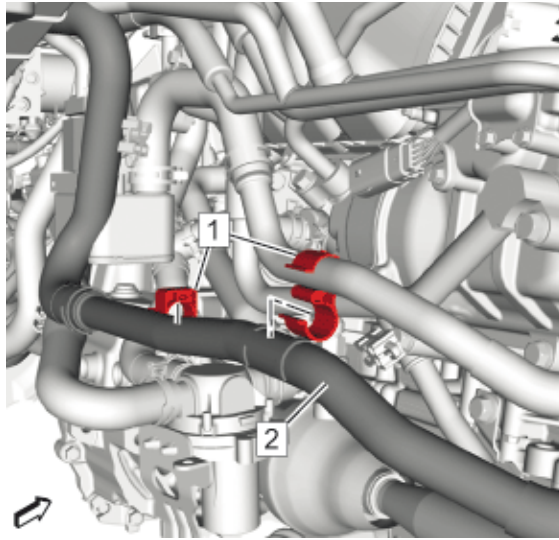


Fig. 76: Heater Inlet Hose And Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Install Heater Inlet Hose (2) @ Heater Inlet Hose Retainers (1) (Qty: 2)

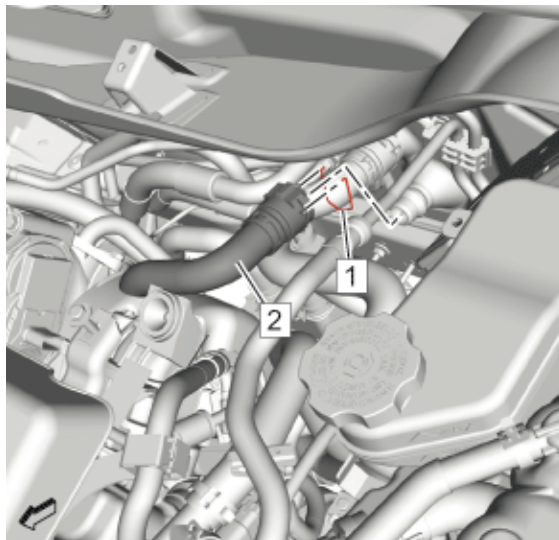


Fig. 77: Heater Inlet Hose And Quick Connect

Courtesy of GENERAL MOTORS COMPANY

4. Install Heater Inlet Hose (2) @ Heater Core Inlet Tube
5. Connect Heater Inlet Hose Quick Connect (1) @ Heater Inlet Hose (2)
6. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
7. Install Dash Upper Extension Panel Opening Cover. Refer to [Dash Upper Extension Panel Opening Cover Replacement](#)
8. Install Front Wheelhouse Liner (Left Side). Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#)
9. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)

HEATER INLET AND OUTLET PIPE REPLACEMENT

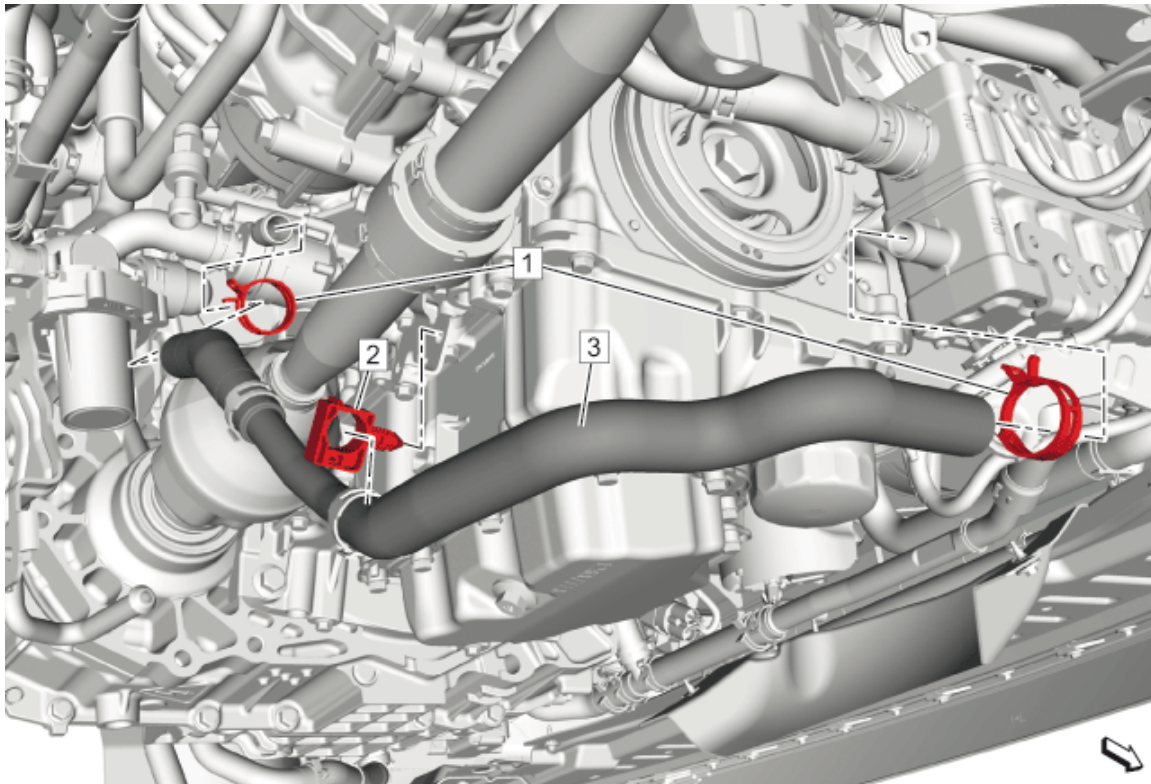


Fig. 78: Heater Inlet And Outlet Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Remove Heater Water Shutoff Valve. Refer to Heater Water Shutoff Valve Replacement 2. Remove Front Wheelhouse Liner (Right Side). Refer to Front Wheelhouse Liner Replacement (Right Side)	
1	Heater Inlet And Outlet Pipe Clamp (Qty: 2)
2	Heater Inlet And Outlet Pipe Retainer
3	Heater Inlet and Outlet Pipe

HEATER COOLANT PUMP REPLACEMENT

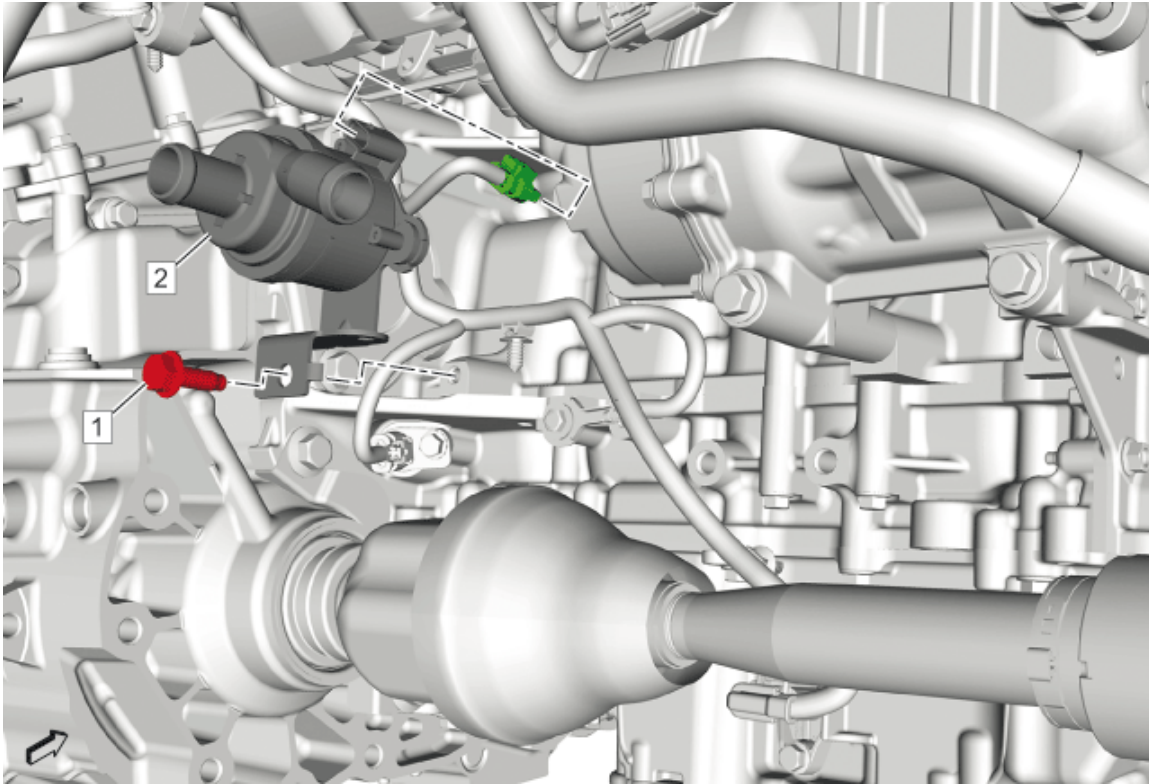


Fig. 79: Heater Coolant Pump
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the heater water auxiliary pump inlet hose from heater coolant pump. Refer to Heater Water Auxiliary Pump Inlet Hose Replacement. 2. Remove the heater inlet and outlet pipe from heater coolant pump. Refer to Heater Inlet And Outlet Pipe Replacement.	
1	Heater Coolant Pump Bolt CAUTION: Refer to Fastener Caution Tighten 22 N.m (16 lb ft)
2	Heater Coolant Pump Procedure Disconnect the electrical connector.

PASSENGER COMPARTMENT AIR FILTER REPLACEMENT

Removal Procedure

1. Remove Instrument Panel Compartment. Refer to [Instrument Panel Compartment Replacement](#)

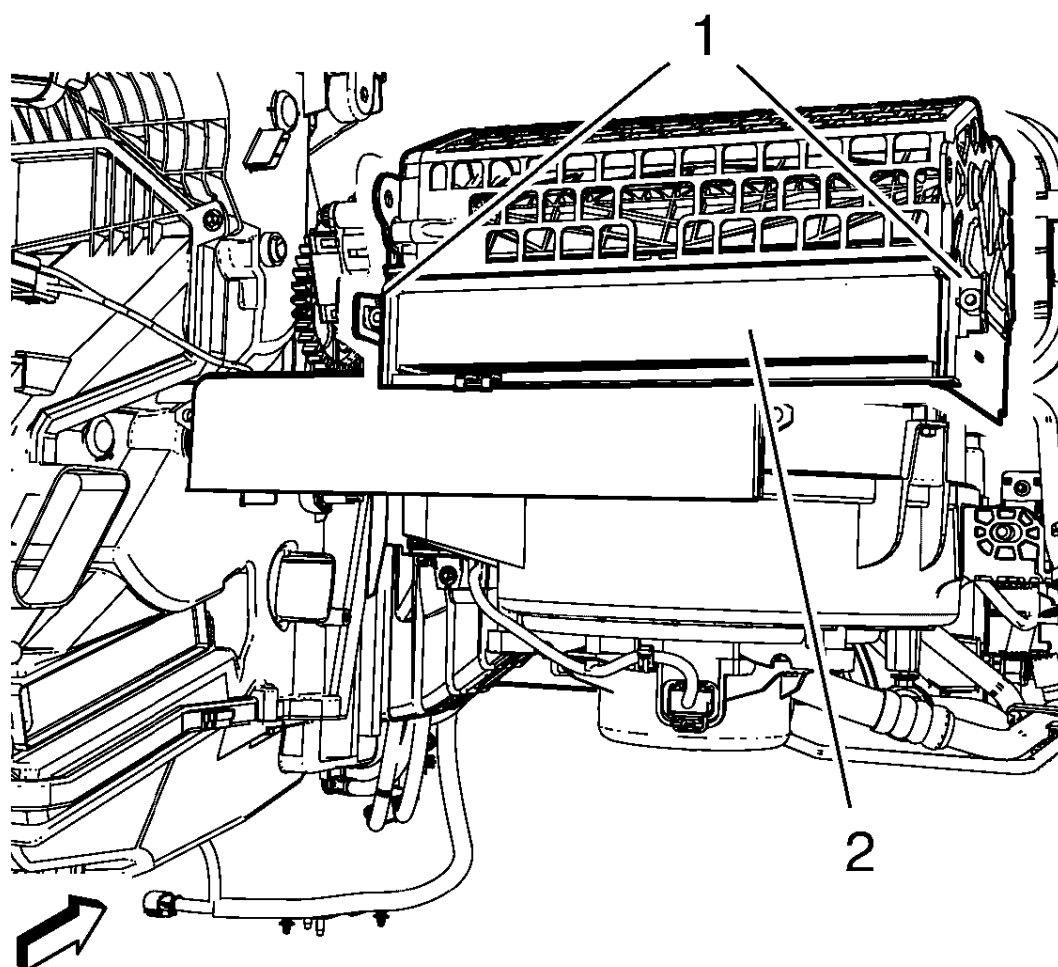


Fig. 80: Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS COMPANY

2. Unclip Passenger Compartment Air Filter (2)

Installation Procedure

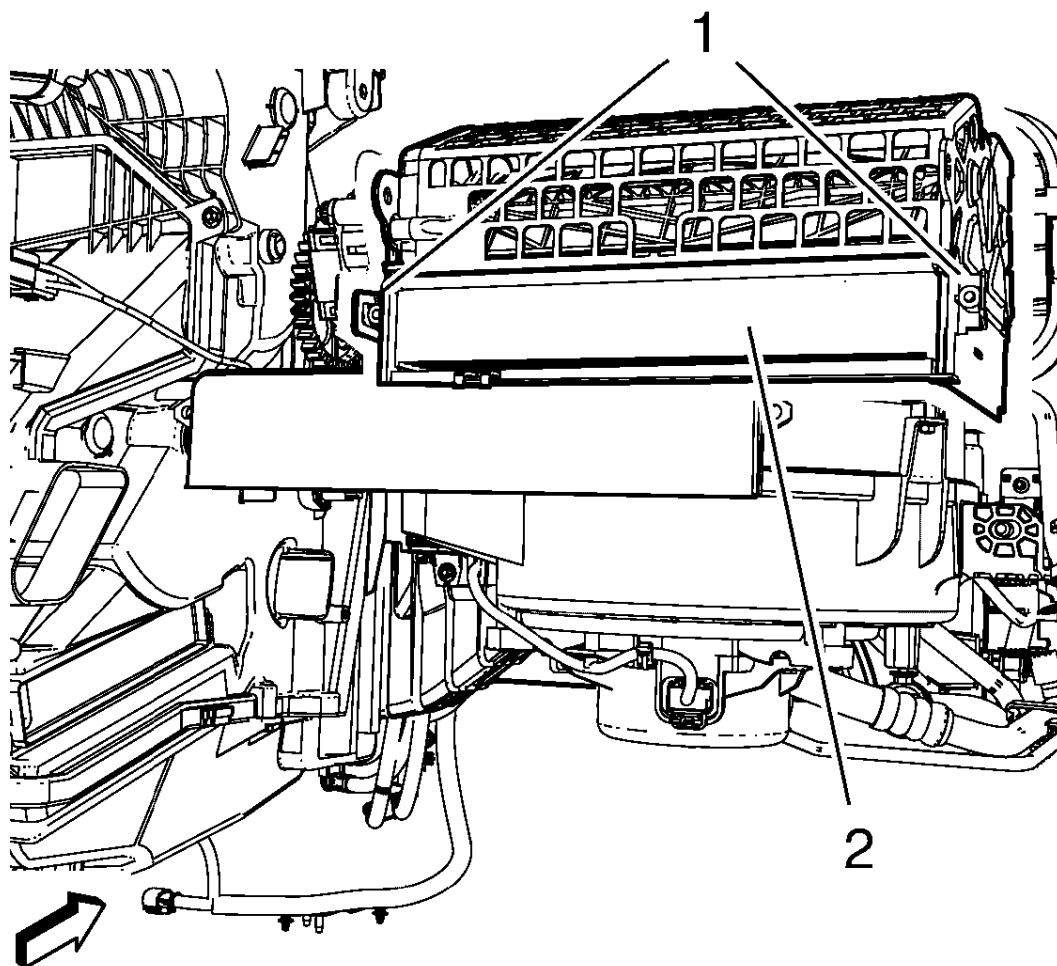


Fig. 81: Passenger Compartment Air Filter

Courtesy of GENERAL MOTORS COMPANY

1. Install Passenger Compartment Air Filter (2)
2. Install Instrument Panel Compartment. Refer to [Instrument Panel Compartment Replacement](#)

AIR INLET DUCT REPLACEMENT

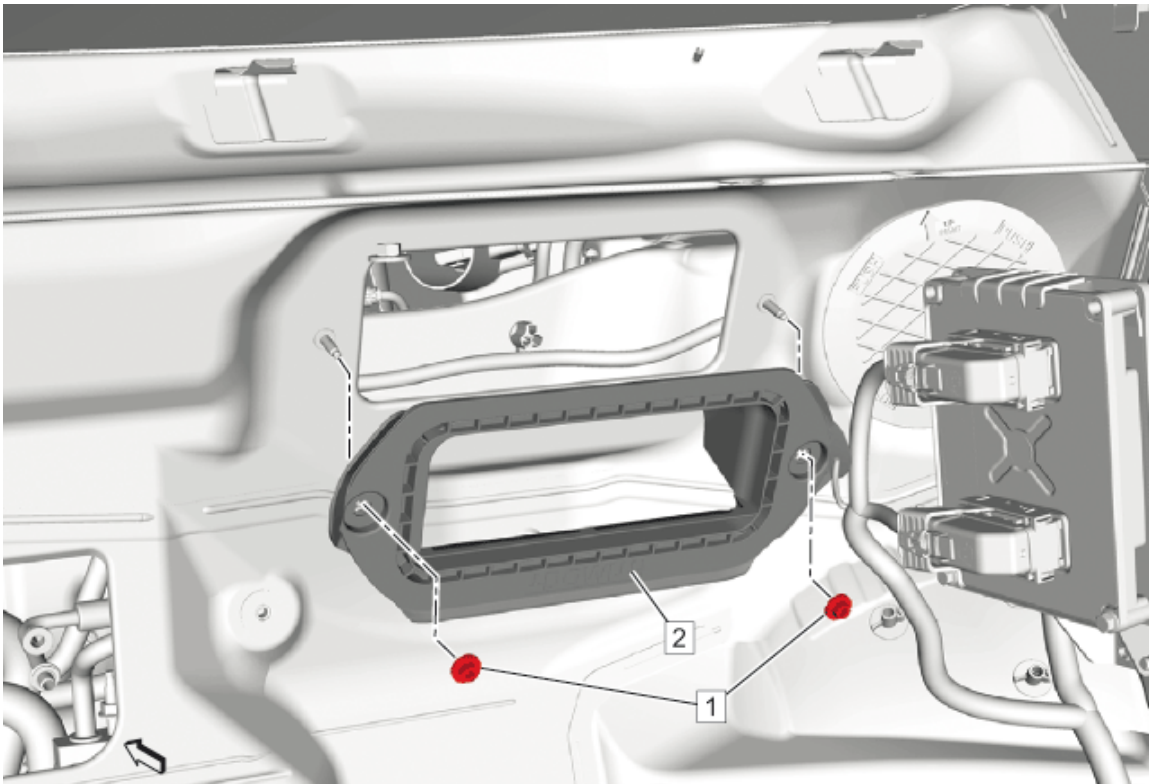


Fig. 82: Air Inlet Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Air Conditioning and Heater Module Assembly. Refer to Air Conditioning and Heater Module Assembly Removal and Installation	
1	Air Inlet Duct Nut (Qty: 2) CAUTION: Refer to Fastener Caution Tighten 5 N.m (44 lb in)
2	Air Inlet Duct

AIR INLET HOUSING REPLACEMENT

Removal Procedure

1. Remove Air Conditioning and Heater Module Assembly. Refer to [Air Conditioning and Heater Module Assembly Removal and Installation](#)

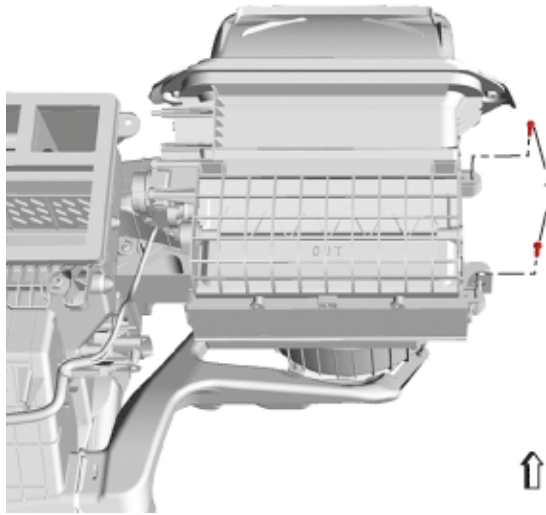


Fig. 83: Air Inlet Housing Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Remove Air Inlet Housing Bolts (1) (Qty: 2)

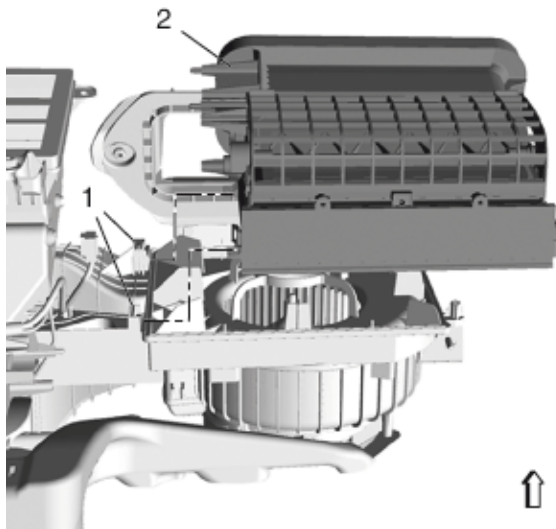


Fig. 84: Air Inlet Housing And Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Inlet Housing (2) @ Heater and Air Conditioning Evaporator Case
 1. Disconnect all electrical connectors.
 2. Disengage the air inlet housing (2) from the retainers (1).

Installation Procedure

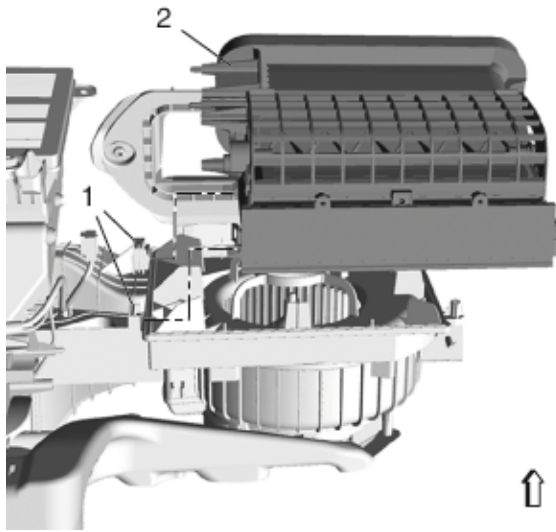


Fig. 85: Air Inlet Housing And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Install Air Inlet Housing (2) @ Heater and Air Conditioning Evaporator Case
 1. Guide the air inlet housing (2) into the retainers (1).
 2. Connect the electrical connectors.

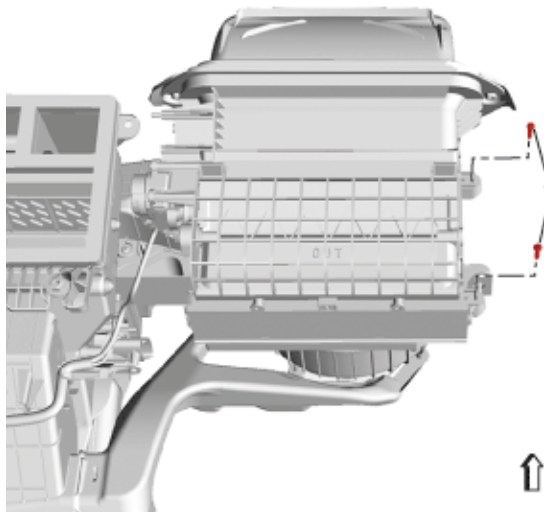


Fig. 86: Air Inlet Housing Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Remove Fastener Caution

2. Install and tighten Air Inlet Housing Bolts (1) (Qty: 2) to 2.5 N.m (22 lb in)
3. Install Air Conditioning and Heater Module Assembly. Refer to [Air Conditioning and Heater Module Assembly Removal and Installation](#)

HEATER AND AIR CONDITIONING CONTROL MODE LEVER REPLACEMENT

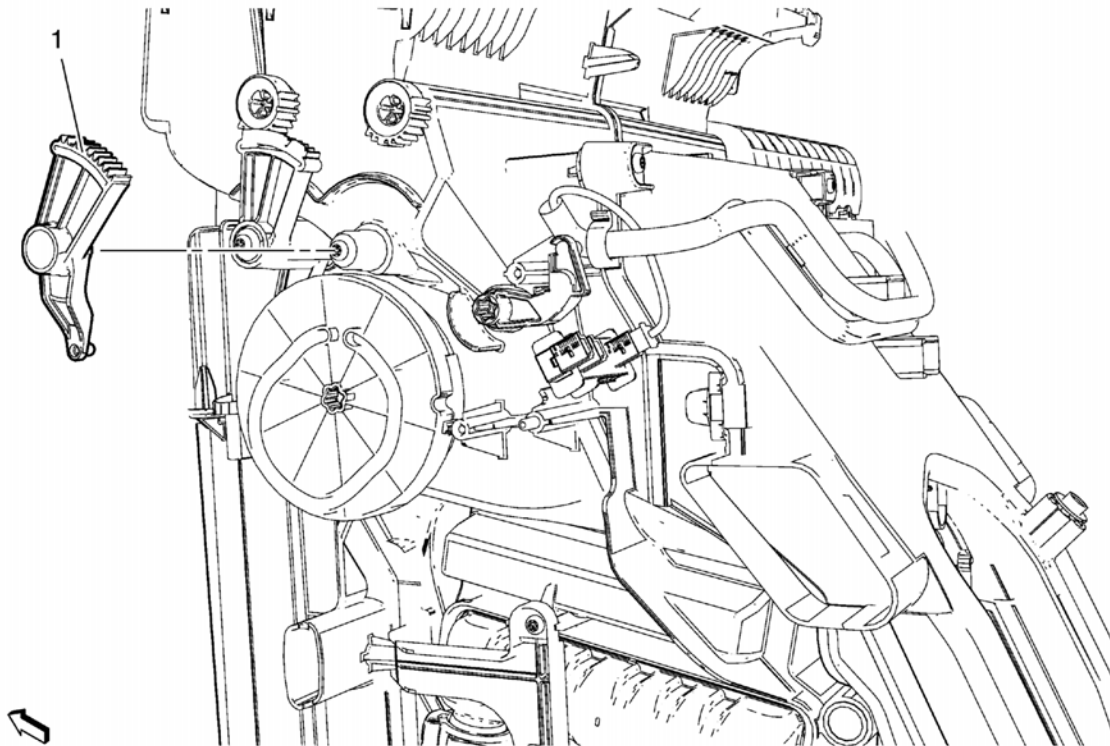


Fig. 87: Heater And Air Conditioning Control Mode Lever

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Mode Control Cam Actuator Mounting Plate. Refer to Mode Control Cam Actuator Mounting Plate Replacement	
1	Heater and Air Conditioning Control Mode Lever Procedure 1. Mark the location of the cam and levers prior to removal. 2. Lubricate the heater and air conditioning control mode lever in order to assure proper operation. Use Polylub GLY 801, or equivalent.

BLOWER MOTOR REPLACEMENT

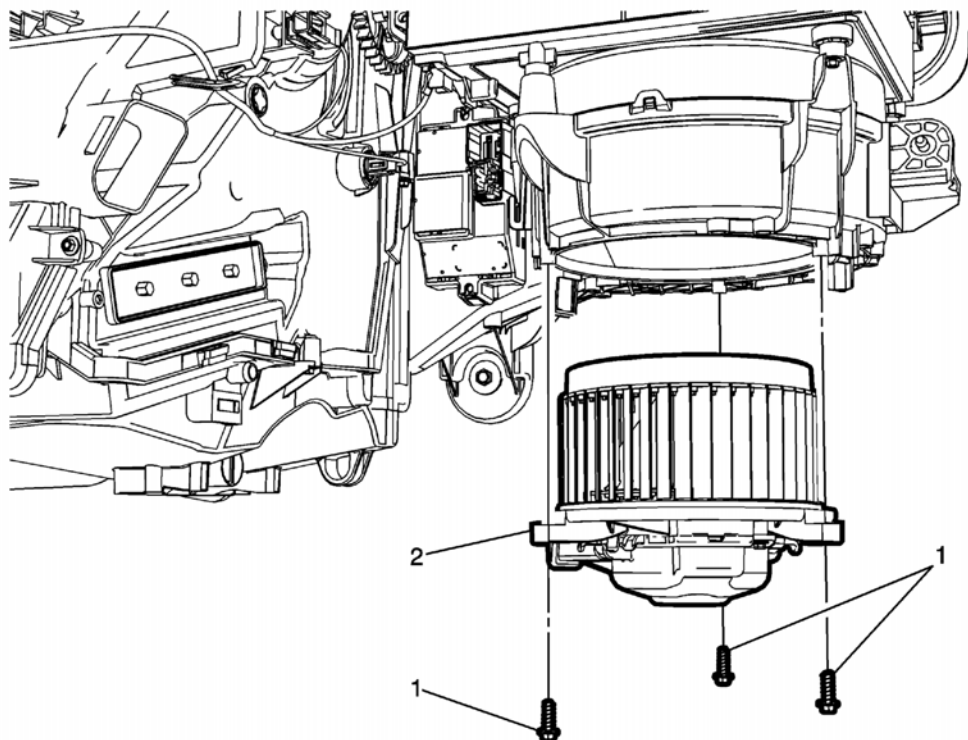


Fig. 88: Blower Motor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Instrument Panel Lower Trim Panel Insulator. Refer to Instrument Panel Lower Trim Panel Insulator Replacement 2. Disconnect the electrical connector.	
1	Blower Motor Bolt (Qty: 3) CAUTION: Refer to Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Blower Motor

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - LEFT SIDE

Removal Procedure

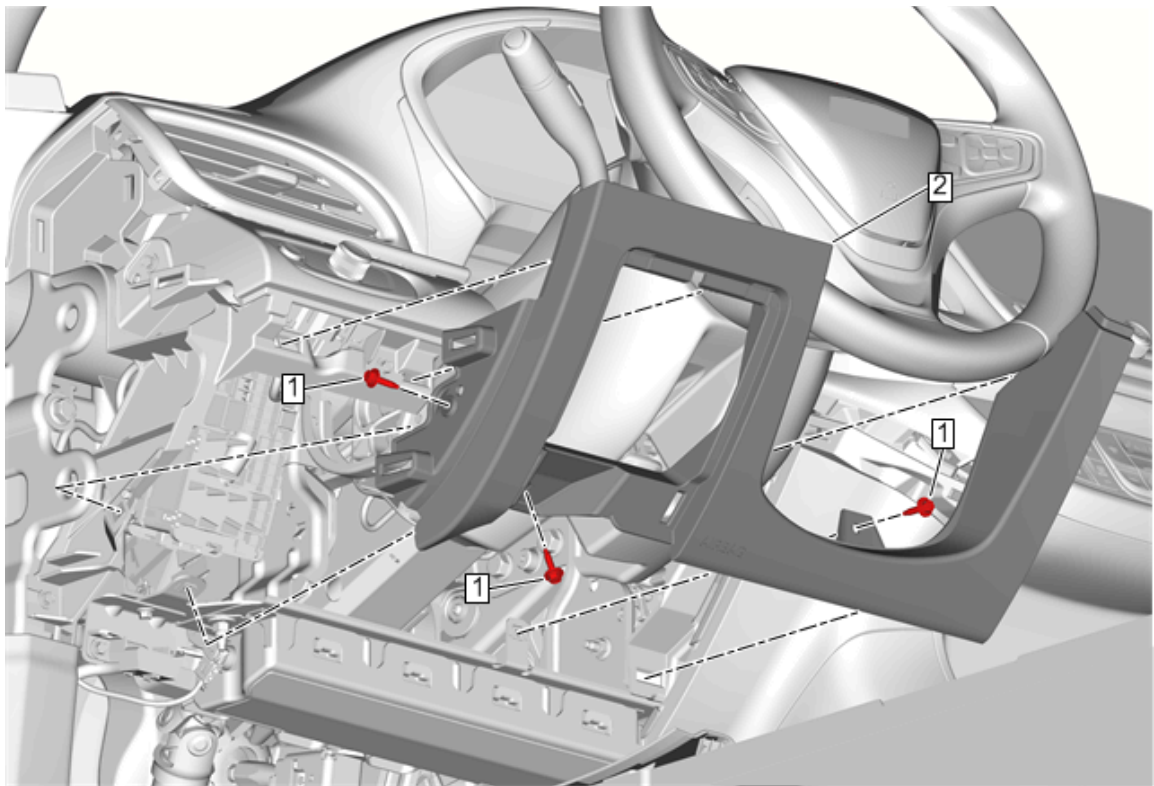


Fig. 89: Instrument Panel Knee Bolster

Courtesy of GENERAL MOTORS COMPANY

1. Remove Instrument Panel Knee Bolster (2). Refer to [Instrument Panel Knee Bolster Replacement](#)

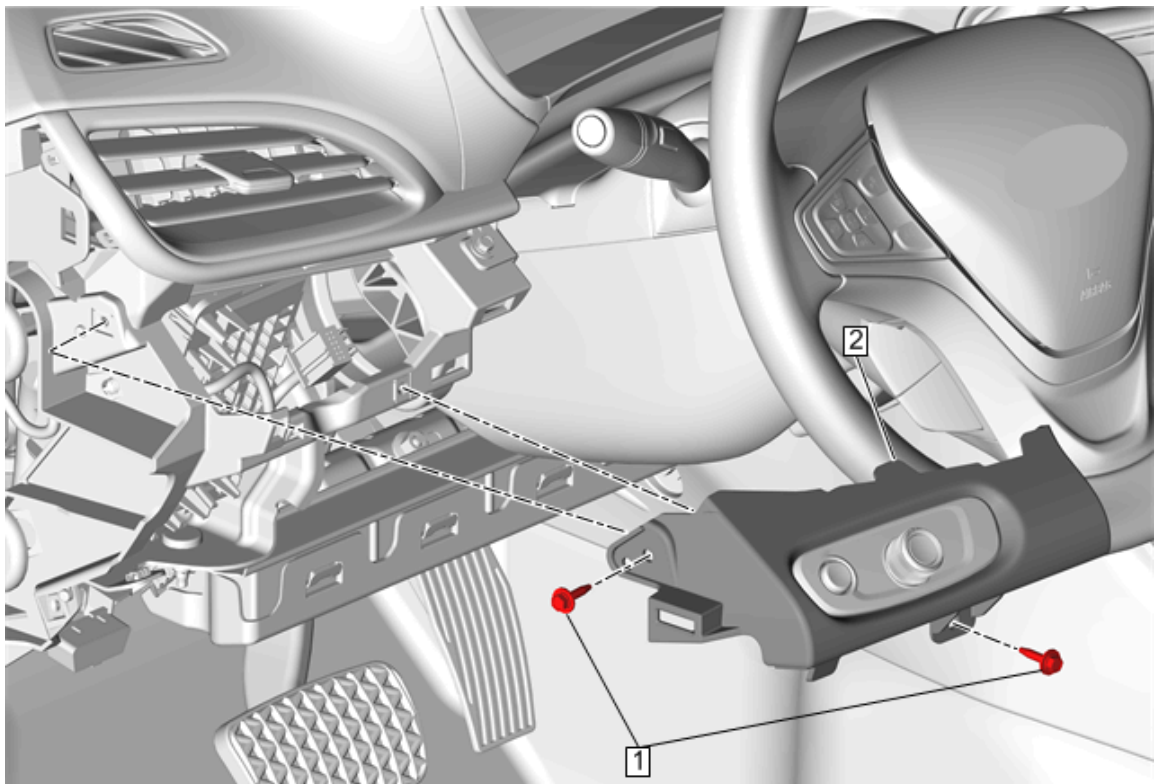


Fig. 90: Instrument Panel Switch Trim Plate

Courtesy of GENERAL MOTORS COMPANY

2. Remove Instrument Panel Switch Trim Plate (2). Refer to [Instrument Panel Switch Trim Plate Replacement](#)

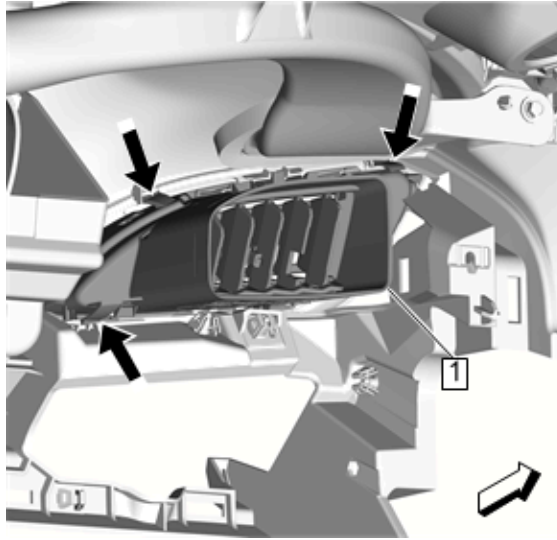


Fig. 91: Instrument Panel Outer Air Outlet
Courtesy of GENERAL MOTORS COMPANY

3. Depress the three tabs on the instrument panel outer air outlet (1) from behind the instrument panel to properly release the outlet.

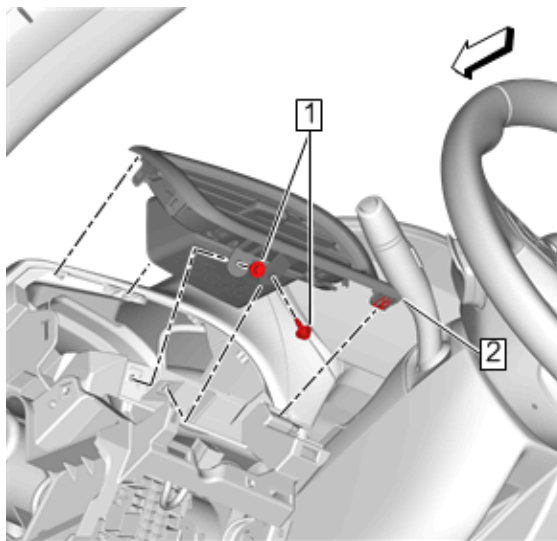


Fig. 92: Instrument Panel Outer Air Outlet - Left Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Instrument Panel Bolts (1) (Qty: 2)
5. Remove Instrument Panel Outer Air Outlet - Left Side (2)
6. Use a flat bladed plastic tool to remove.

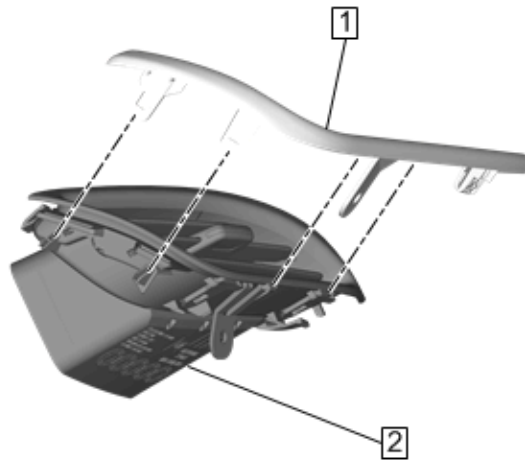


Fig. 93: Instrument Panel Outer Air Outlet And Trim Plate Applique
Courtesy of GENERAL MOTORS COMPANY

7. Release the plastic retaining tabs to separate the instrument panel trim plate applique (1) from the instrument panel outer air outlet (2).
8. Transfer components as necessary.

Installation Procedure

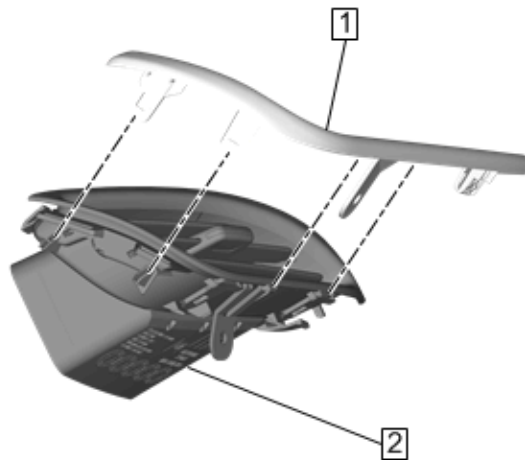


Fig. 94: Instrument Panel Outer Air Outlet And Trim Plate Applique
Courtesy of GENERAL MOTORS COMPANY

1. Install the instrument panel trim plate applique (1) to the instrument panel outer air outlet (2).

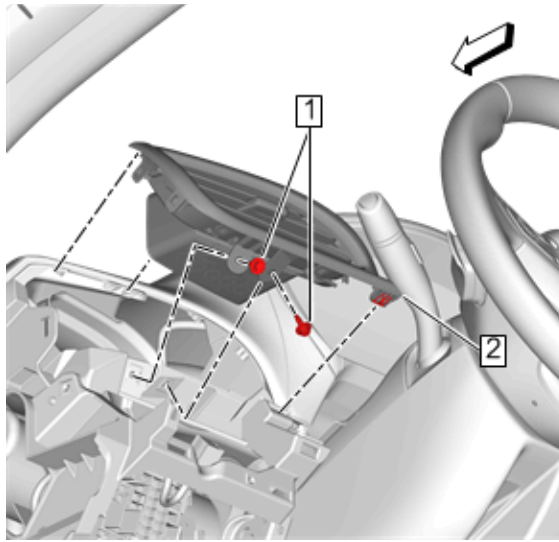


Fig. 95: Instrument Panel Outer Air Outlet - Left Side And Bolts
 Courtesy of GENERAL MOTORS COMPANY

2. Install Instrument Panel Outer Air Outlet - Left Side (2)

CAUTION: Refer to [Fastener Caution](#) .

3. Install and tighten Instrument Panel Bolts (1) (Qty: 2) to 2.5 N.m (22 lb in)

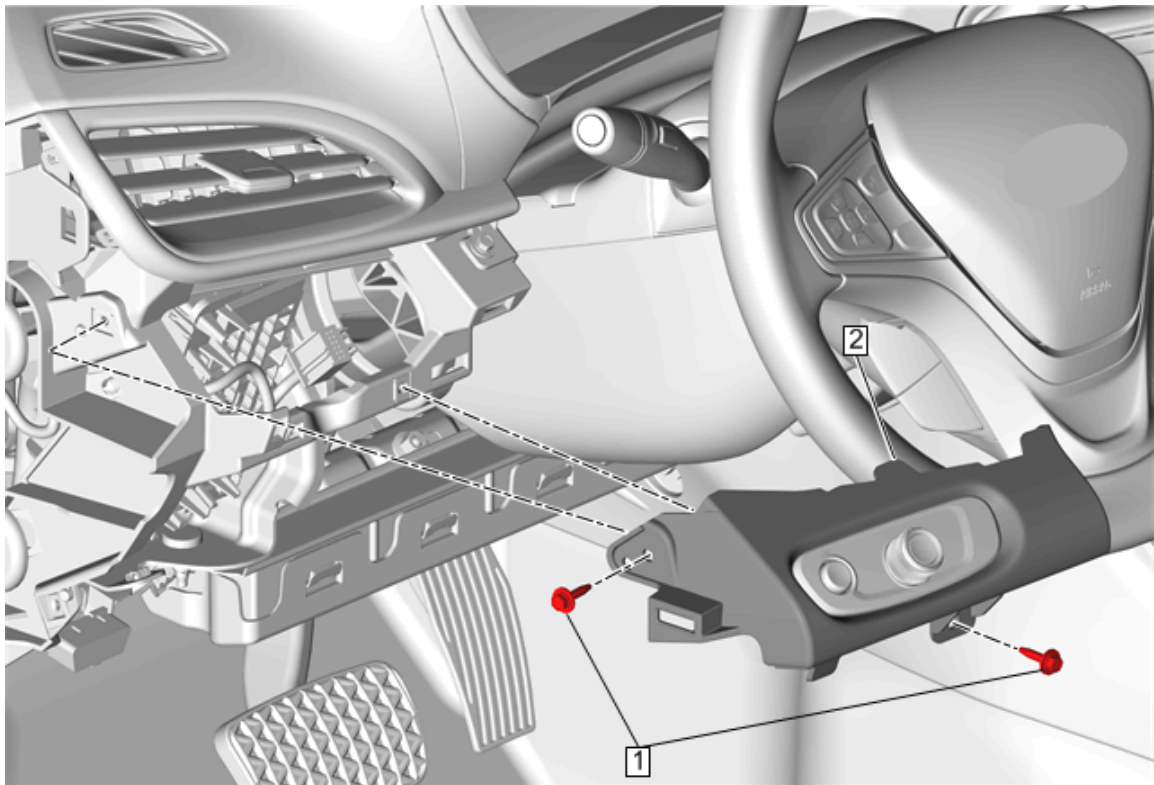


Fig. 96: Instrument Panel Switch Trim Plate
 Courtesy of GENERAL MOTORS COMPANY

4. Install Instrument Panel Switch Trim Plate (2). Refer to [Instrument Panel Switch Trim Plate Replacement](#)

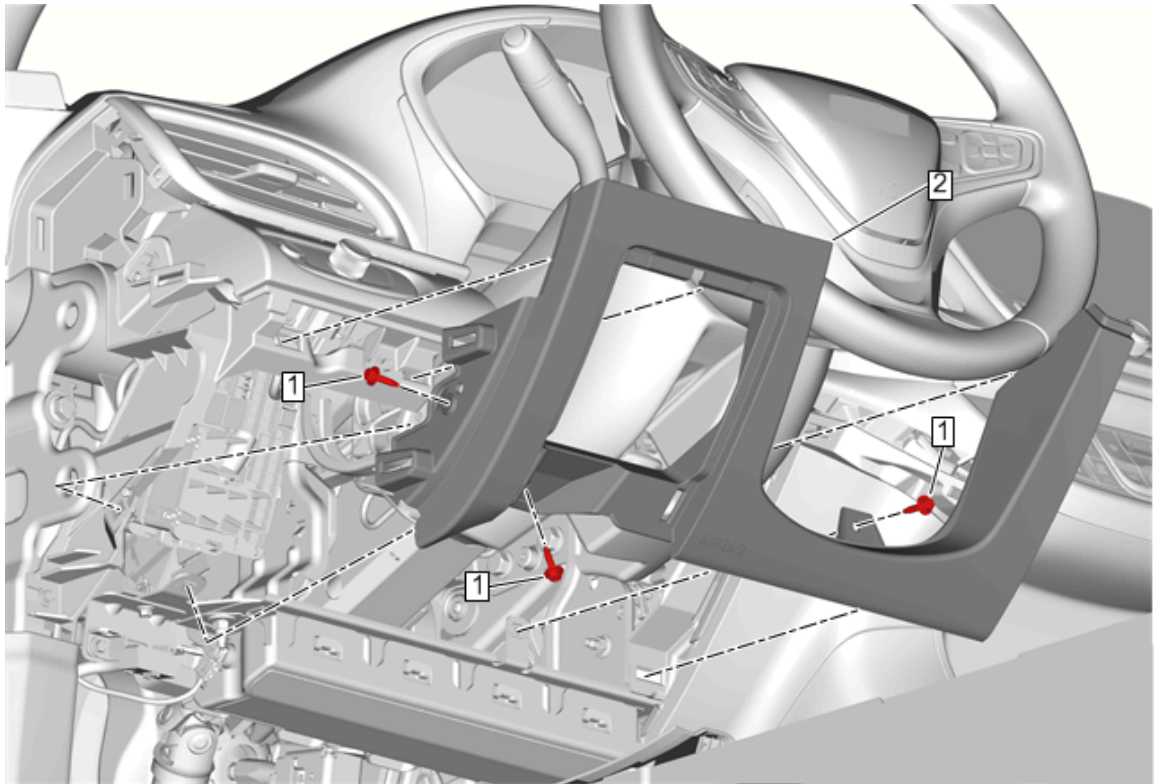


Fig. 97: Instrument Panel Knee Bolster

Courtesy of GENERAL MOTORS COMPANY

5. Install Instrument Panel Knee Bolster (2). Refer to [Instrument Panel Knee Bolster Replacement](#)

INSTRUMENT PANEL CENTER AIR OUTLET REPLACEMENT

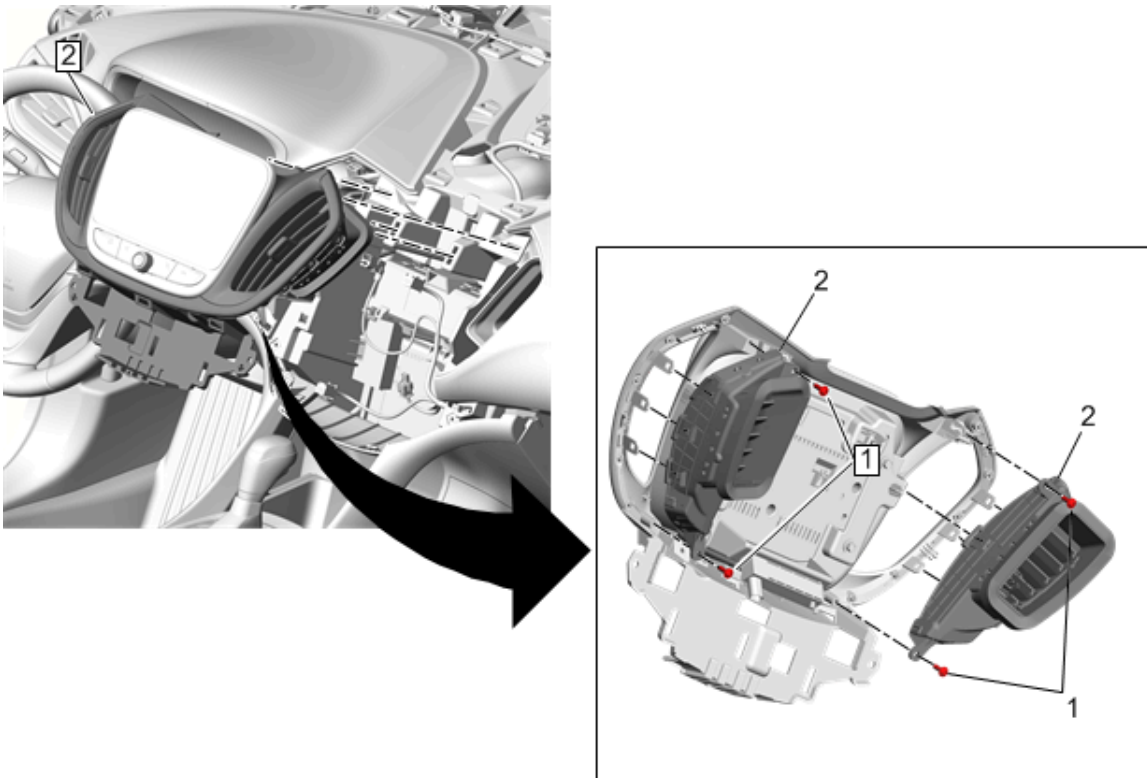


Fig. 98: Instrument Panel Center Air Outlet

Callout	Component Name
Preliminary Procedure 1. Remove Instrument Panel Extension. Refer to Instrument Panel Extension Replacement 2. Remove Heater and Air Conditioning User Interface Control. Refer to Heater and Air Conditioning User Interface Control Replacement 3. Remove Instrument Panel Lower Center Trim Panel (Upper). Refer to Instrument Panel Lower Center Trim Panel Replacement (Upper)	
1	Instrument Panel Center Air Outlet Bracket Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 0.5 N.m (4 lb in)
2	Instrument Panel Center Air Outlet Procedure 1. Use a flat bladed plastic trim tool. 2. Disconnect the electrical connectors. 3. Release the plastic retaining tabs. 4. Transfer components as necessary.

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - RIGHT SIDE

Removal Procedure

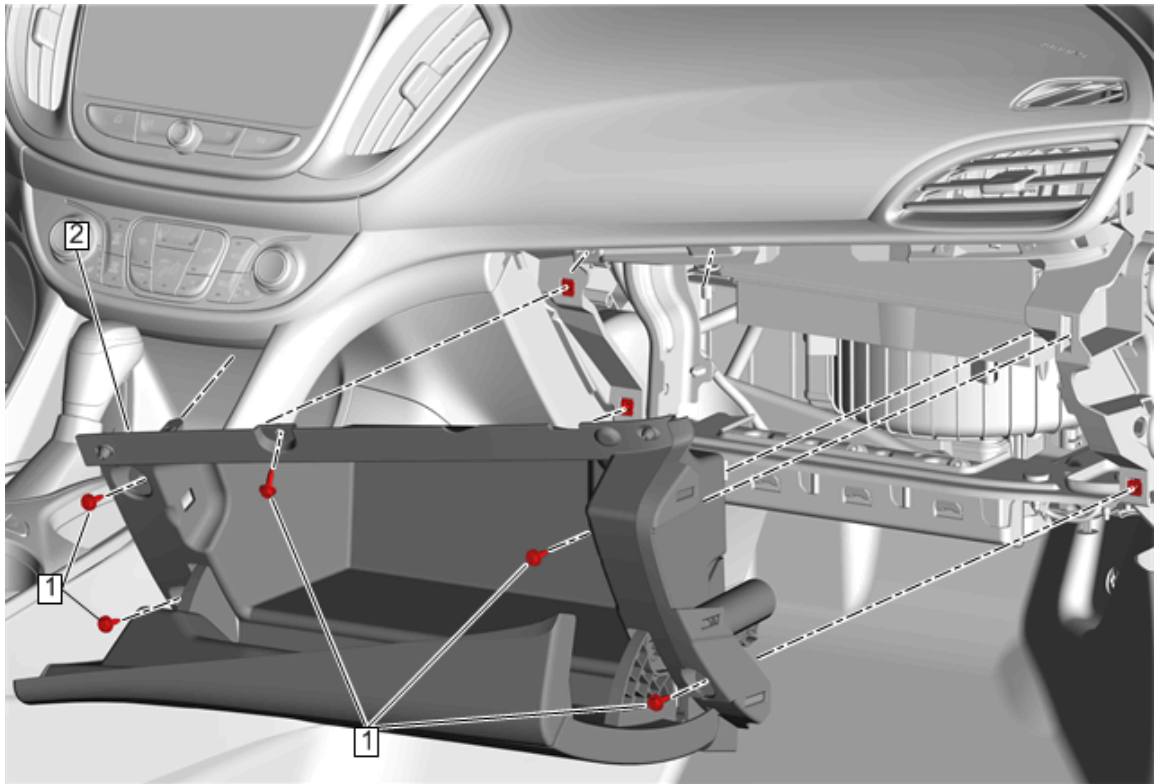


Fig. 99: Instrument Panel Compartment

Courtesy of GENERAL MOTORS COMPANY

1. Remove Instrument Panel Compartment (1). Refer to [Instrument Panel Compartment Replacement](#)

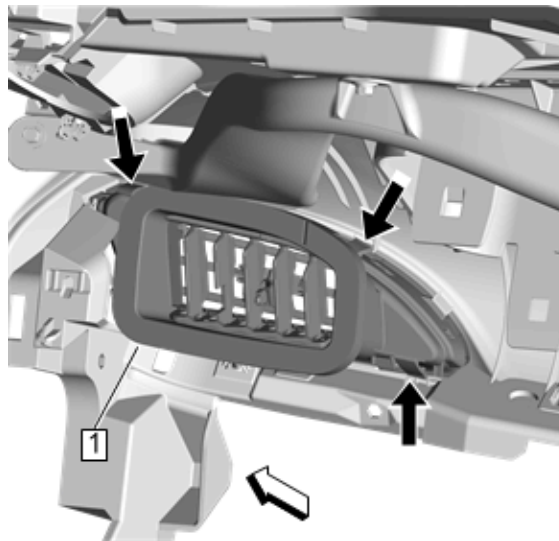


Fig. 100: Instrument Panel Outer Air Outlet

Courtesy of GENERAL MOTORS COMPANY

2. Depress the three tabs on the instrument panel outer air outlet (1) from behind the instrument panel to properly release the outlet.

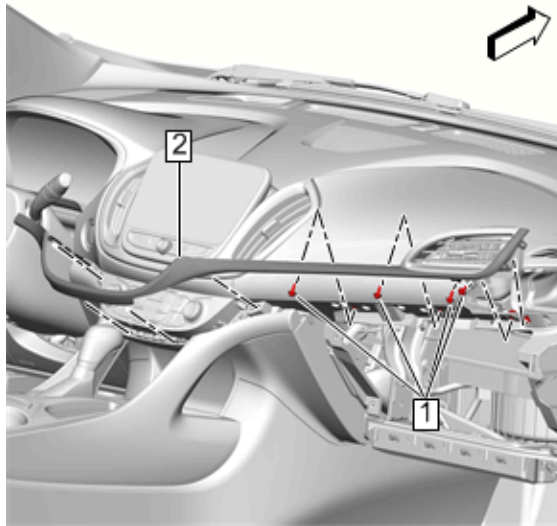


Fig. 101: Instrument Panel Trim Plate Applique - Right Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Instrument Panel Bolts (1) (Qty: 4)
4. Remove Instrument Panel Trim Plate Applique - Right Side (2)
5. Use a flat bladed plastic tool to remove.

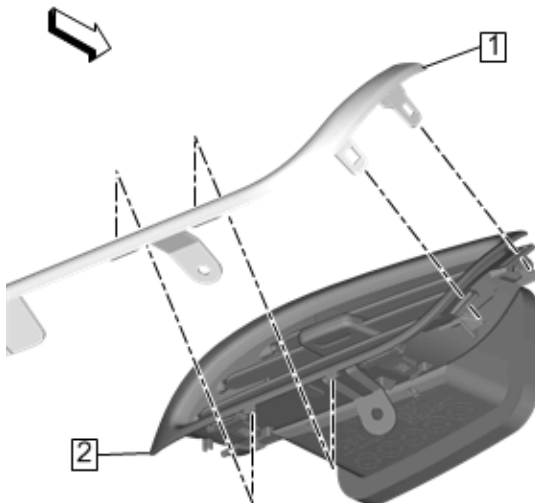


Fig. 102: Instrument Panel Outer Air Outlet And Trim Plate Applique
Courtesy of GENERAL MOTORS COMPANY

6. Release the plastic retaining tabs to separate the instrument panel trim plate applique (1) from the instrument panel outer air outlet (2).
7. Transfer components as necessary.

Installation Procedure

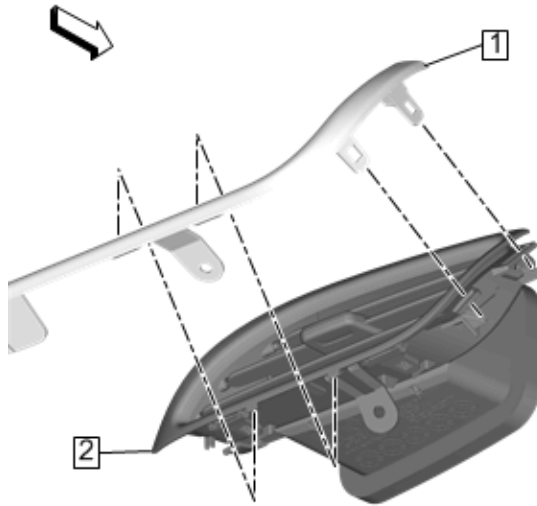


Fig. 103: Instrument Panel Outer Air Outlet And Trim Plate Applique
Courtesy of GENERAL MOTORS COMPANY

1. Install the instrument panel trim plate applique (1) to the instrument panel outer air outlet (2).

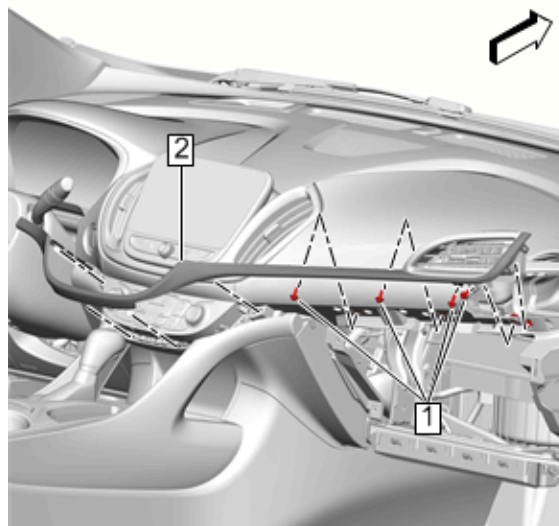


Fig. 104: Instrument Panel Trim Plate Applique - Right Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install Instrument Panel Trim Plate Applique - Right Side (2)

CAUTION: Refer to [Fastener Caution](#) .

3. Install and tighten Instrument Panel Bolts (1) (Qty: 4) to 2.5 N.m (22 lb in)

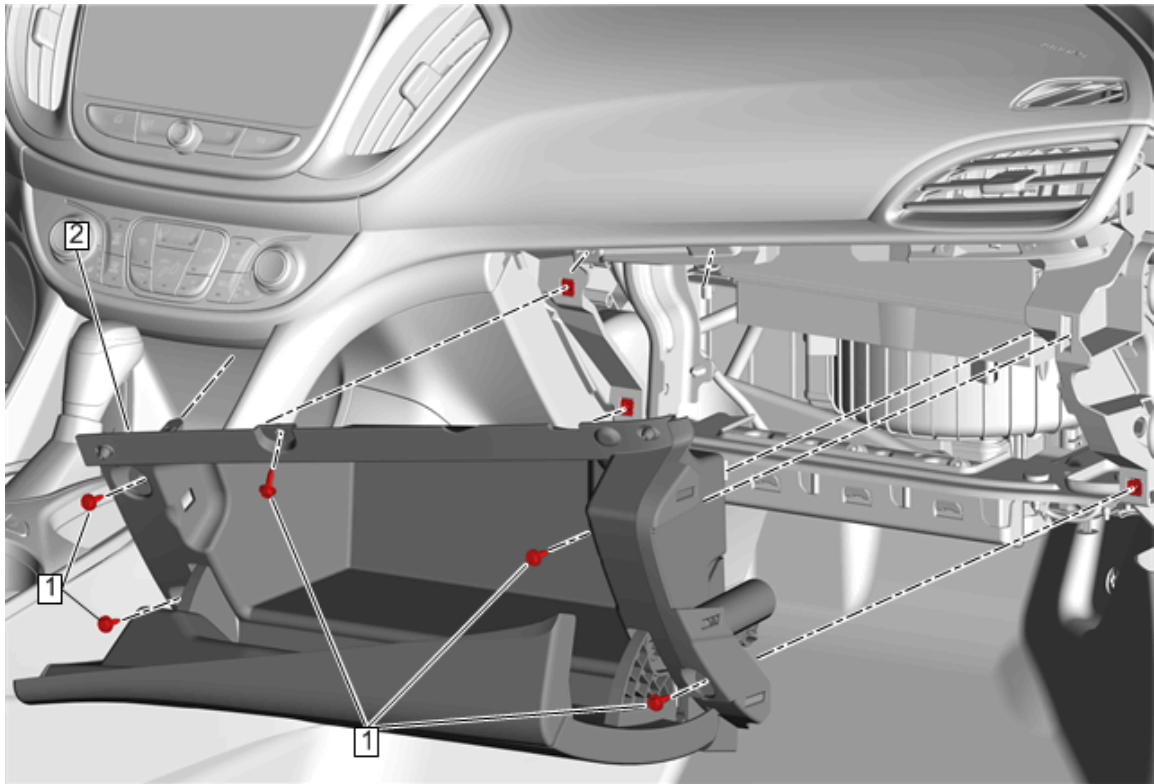


Fig. 105: Instrument Panel Compartment

Courtesy of GENERAL MOTORS COMPANY

4. Install Instrument Panel Compartment (2). Refer to [Instrument Panel Compartment Replacement](#)

FLOOR FRONT AIR OUTLET DUCT REPLACEMENT - RIGHT SIDE

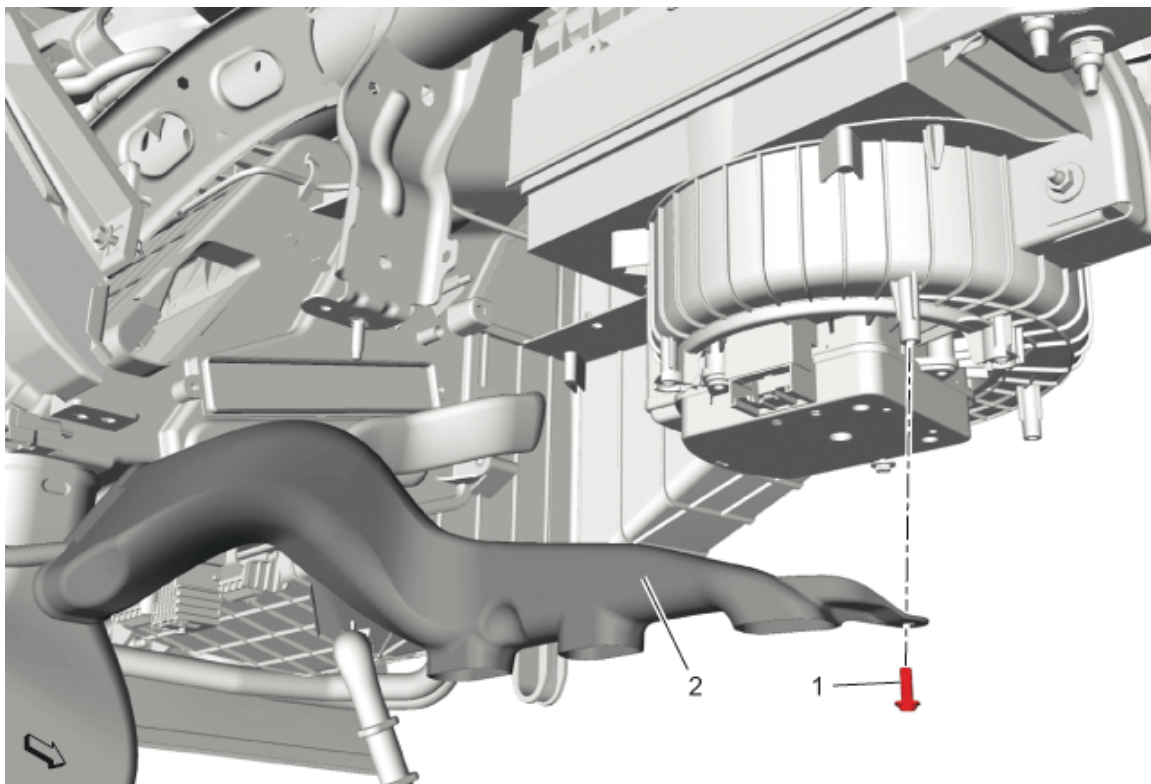


Fig. 106: Floor Front Air Outlet Duct - Right Side

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Lower Airbag - Passenger Side. Refer to Instrument Panel Lower Airbag Replacement - Passenger Side	
1	Floor Front Air Outlet Duct Bolt CAUTION: Refer to Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Floor Front Air Outlet Duct - Right Side

FLOOR FRONT AIR OUTLET DUCT REPLACEMENT - LEFT SIDE

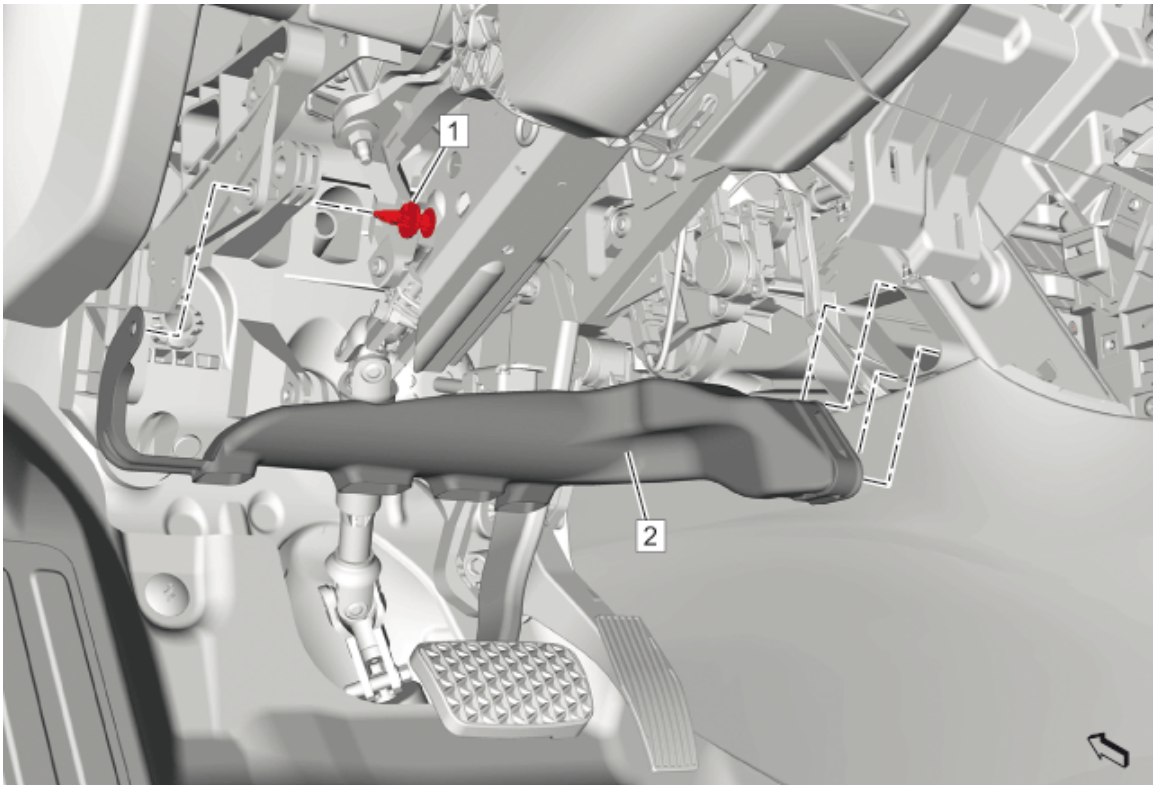


Fig. 107: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Lower Airbag - Driver Side. Refer to Instrument Panel Lower Airbag Replacement - Driver Side	
1	Floor Front Air Outlet Duct Retainer

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Lower Airbag - Driver Side. Refer to Instrument Panel Lower Airbag Replacement - Driver Side	
	CAUTION: Refer to Fastener Caution
2	Floor Front Air Outlet Duct - Left Side

FLOOR REAR AIR OUTLET DUCT REPLACEMENT

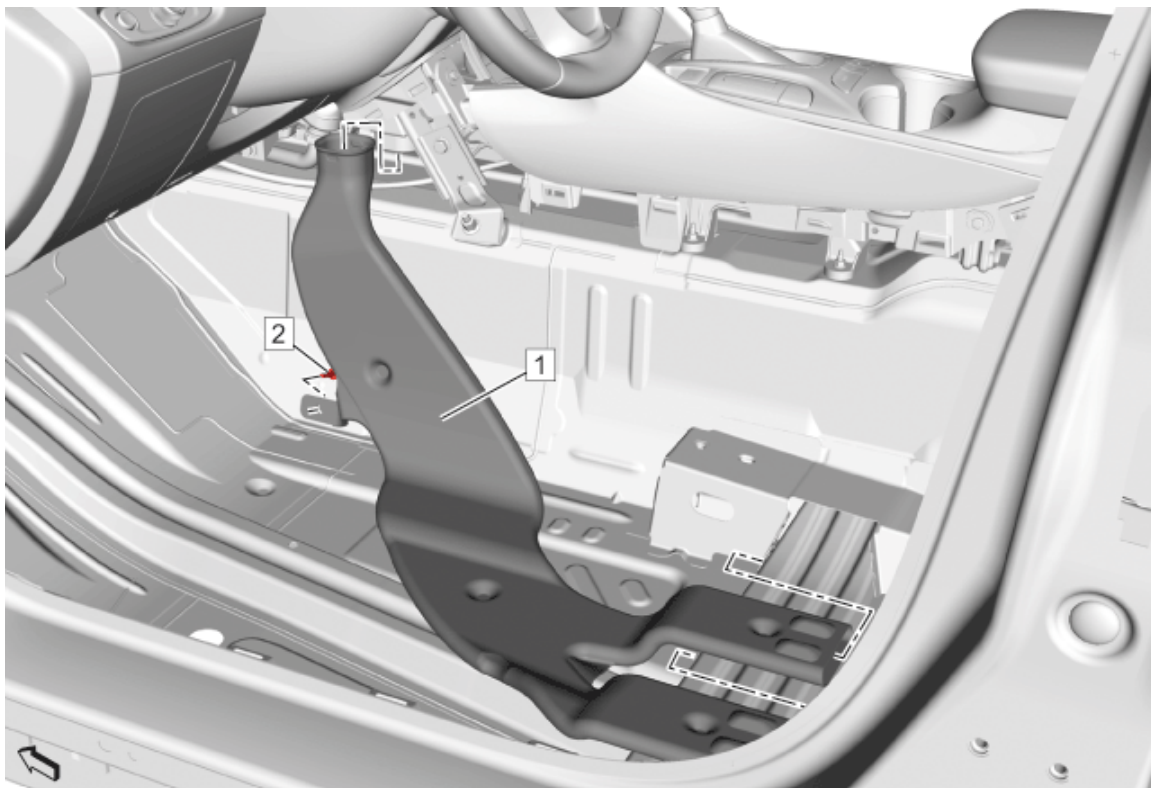


Fig. 108: Floor Rear Air Outlet Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Floor Panel Carpet (Left Side). Refer to Front Floor Panel Carpet Replacement (Left Side)	
1	Floor Rear Air Outlet Duct Stud Procedure Pull the floor rear air outlet duct to remove from the stud
2	Floor Rear Air Outlet Duct

HEATER AND AIR CONDITIONING CONTROL TEMPERATURE LEVER REPLACEMENT

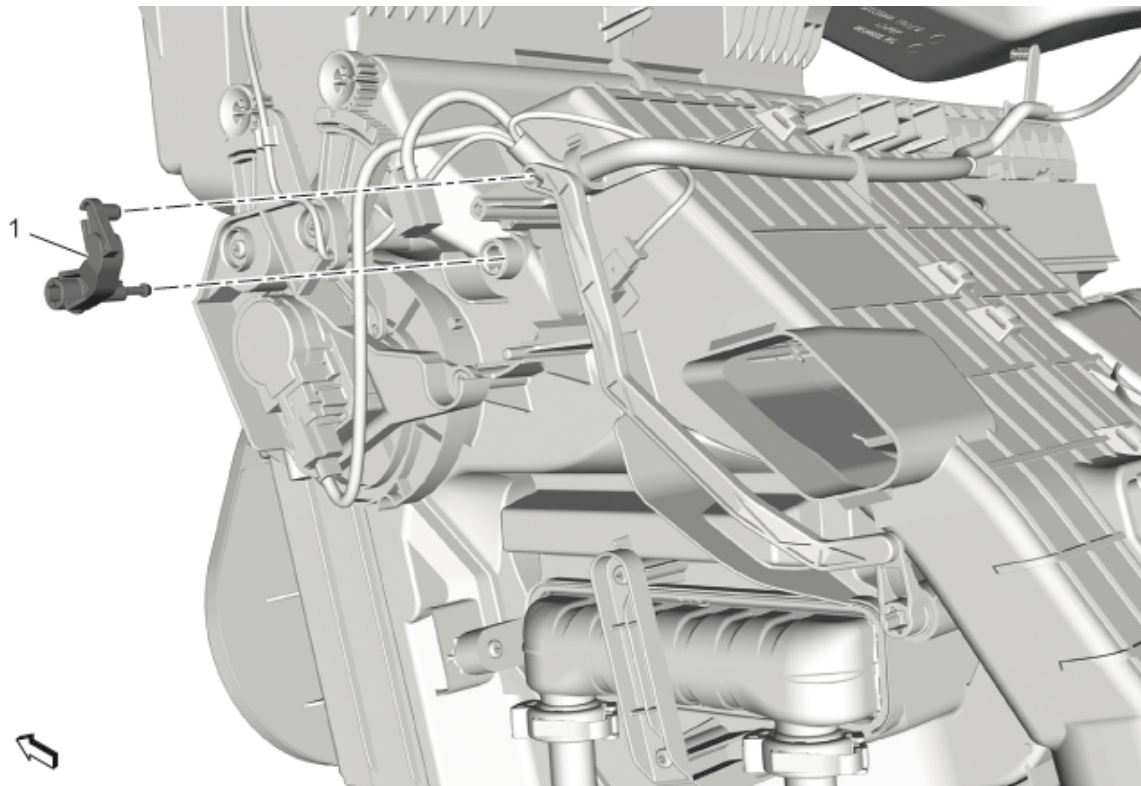


Fig. 109: Heater and Air Conditioning Control Temperature Lever
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Remove Floor Front Air Outlet Duct - Left Side. Refer to Floor Front Air Outlet Duct Replacement - Left Side 2. Remove Temperature Valve Actuator. Refer to Temperature Valve Actuator Replacement	
1	Heater and Air Conditioning Control Temperature Lever Procedure Lubricate the heater and air conditioning control temperature lever in order to assure proper operation. Use Polylub GLY 801, or equivalent

HEATER CORE REPLACEMENT

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)
2. Remove Front Floor Console Extension Panel - Left Side. Refer to [Front Floor Console Extension Panel Replacement - Left Side](#)
3. Place protective coverings and suitable drain pans below heater core to protect the carpeting.

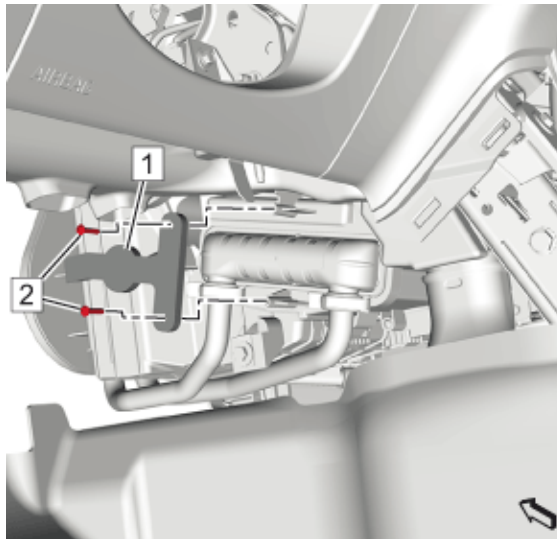


Fig. 110: Heater Core Cover And Screws

Courtesy of GENERAL MOTORS COMPANY

4. Remove Heater Core Cover Screws (2) (Qty: 2)
5. Remove Heater Core Cover (1)

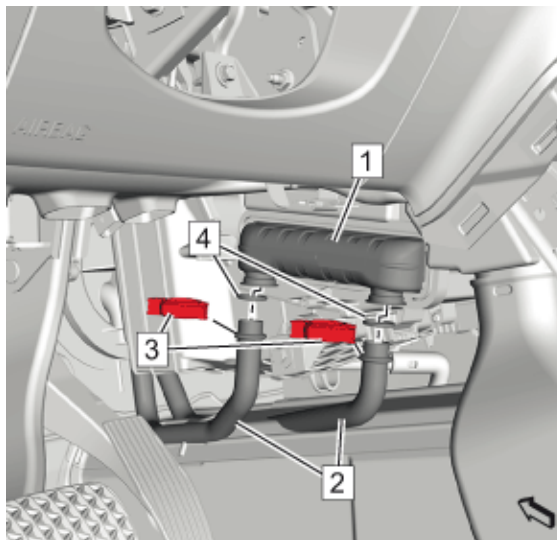


Fig. 111: Heater Core, Clamps, Tubes And Sealing Rings

Courtesy of GENERAL MOTORS COMPANY

6. Remove Heater Core Clamps (3) (Qty: 2)
7. Remove Heater Core Tubes (Qty: 2) @ Heater Core (1)
8. Remove Heater Core (1)
9. Remove and DISCARD Heater Core Tube Sealing Rings (4) (Qty: 2)

Installation Procedure

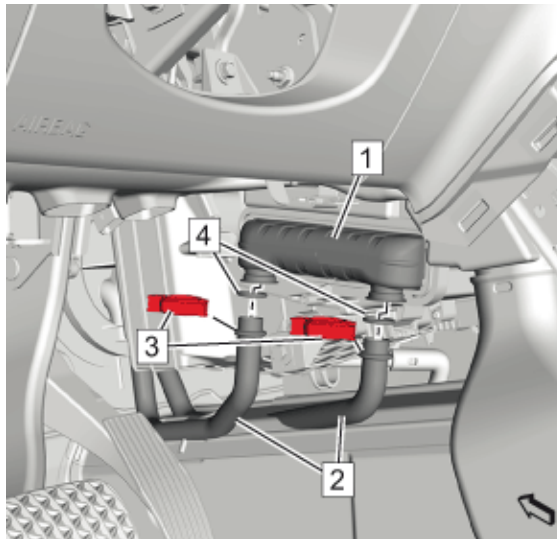


Fig. 112: Heater Core, Clamps, Tubes And Sealing Rings
Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Core (1)

NOTE: Install **NEW** seal rings.

2. Install NEW Heater Core Tube Sealing Rings (4) (Qty: 2)
3. Install Heater Core Tubes (Qty: 2) @ Heater Core (1)
4. Tighten Heater Core Clamps (3) (Qty: 2)

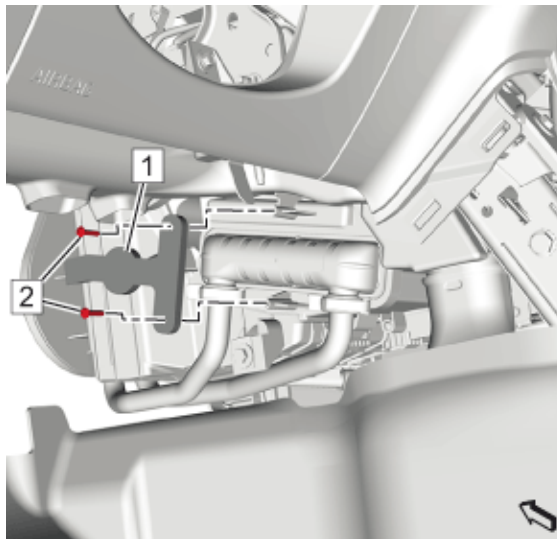


Fig. 113: Heater Core Cover And Screws
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution**

5. Install Heater Core Cover (1)
6. Install and tighten Heater Core Cover Screws (2) (Qty: 2) to 2.5 N.m (22 lb in)
7. Install Front Floor Console Extension Panel - Left Side. Refer to **Front Floor Console Extension Panel Replacement - Left Side**

8. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)

HEATER COOLANT HEATER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)
3. Remove Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
4. Disconnect Heater Inlet Hose @ Heater Coolant Heater. Refer to [Heater Inlet Hose Replacement](#)
5. Disconnect Heater Inlet and Outlet Pipe @ Heater Coolant Heater. Refer to [Heater Inlet And Outlet Pipe Replacement](#)

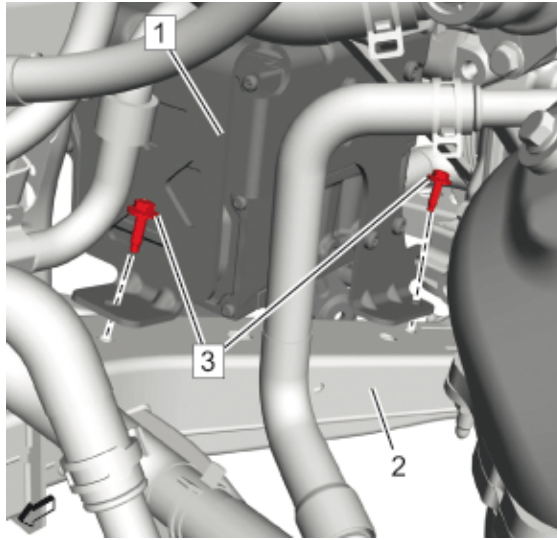


Fig. 114: Heater Coolant Heater Bracket Assembly And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Remove the 2 heater coolant heater bracket assembly bolts (3) with heater coolant heater bracket assembly (2) from the drive train (1).

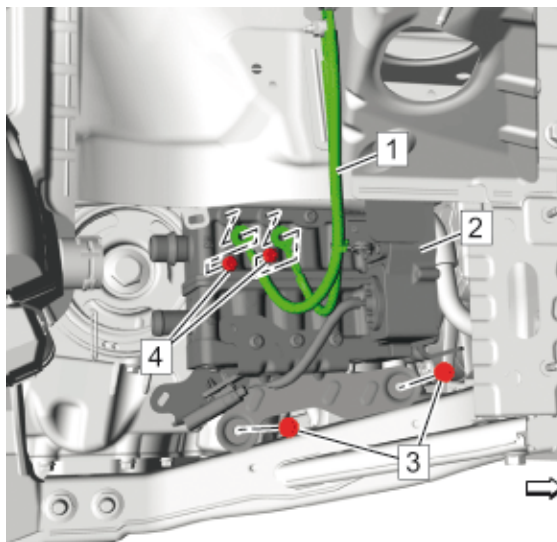


Fig. 115: Heater Coolant Heater Bracket Assembly, Bolts And Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

7. Remove the 2 wiring harness bolts (4) and the wiring harness (1) from the heater coolant heater assembly (2).
8. Unclip the wiring harness retainers and disconnect the electrical connectors.
9. Remove the 2 heater coolant heater bracket bolts (3) and remove the heater coolant heater bracket assembly (2).

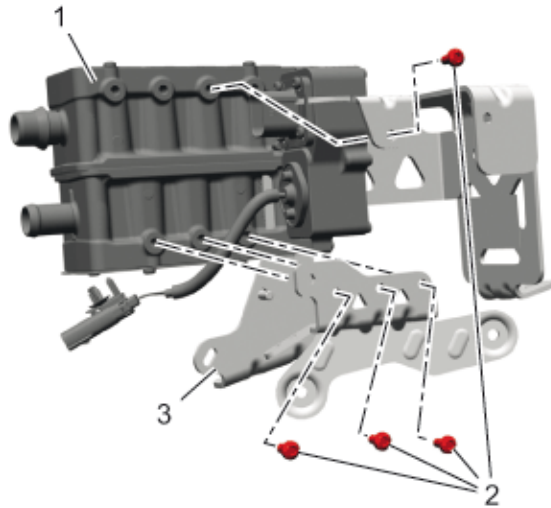


Fig. 116: Heater Coolant Heater, Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

10. Remove the 4 heater coolant heater bracket bolts (2) from the heater coolant heater bracket (3) and heater coolant heater (1).

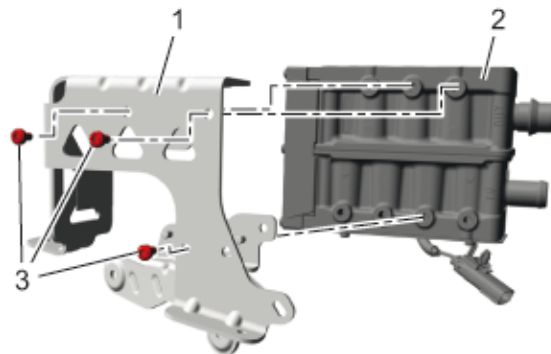


Fig. 117: Heater Coolant Heater, Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

11. Remove the 3 heater coolant heater bracket bolts (3) from the heater coolant heater bracket (1) and remove the heater coolant heater (2).

Installation Procedure

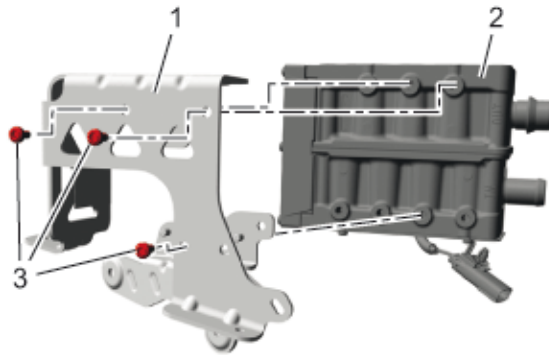


Fig. 118: Heater Coolant Heater, Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

1. Install the heater coolant heater (2) to the heater coolant heater bracket (1).
2. Install and tighten the 3 heater coolant heater bracket bolts (3) to the heater coolant heater bracket 9 N.m (80 lb in).

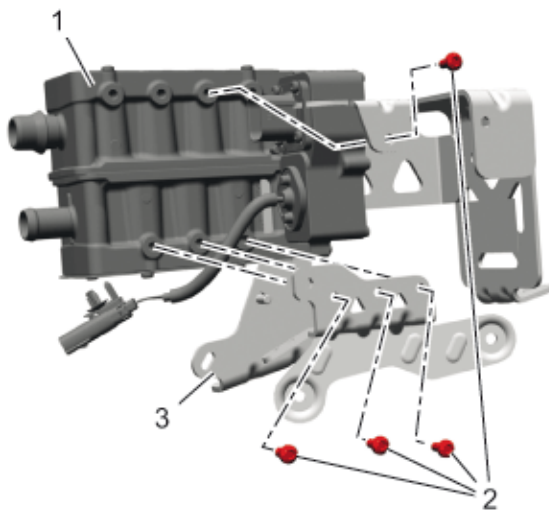


Fig. 119: Heater Coolant Heater, Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install and tighten the 4 heater coolant heater bracket bolts (2) to the heater coolant heater bracket (3) and the heater coolant heater (1) 9 N.m (80 lb in).
4. Clip in the wiring harness retainers and connect the electrical connectors.

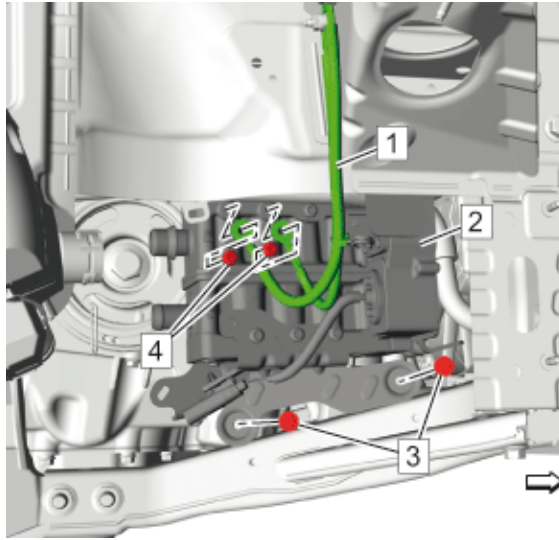


Fig. 120: Heater Coolant Heater Bracket Assembly, Bolts And Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Install the heater coolant heater bracket assembly (2) and the 2 heater coolant heater bracket bolts (3) and tighten to 9 N.m (80 lb in)
6. Install the 2 wiring harness bolts (4) along with the wiring harness (1) and tighten to 9 N.m (80 lb in).

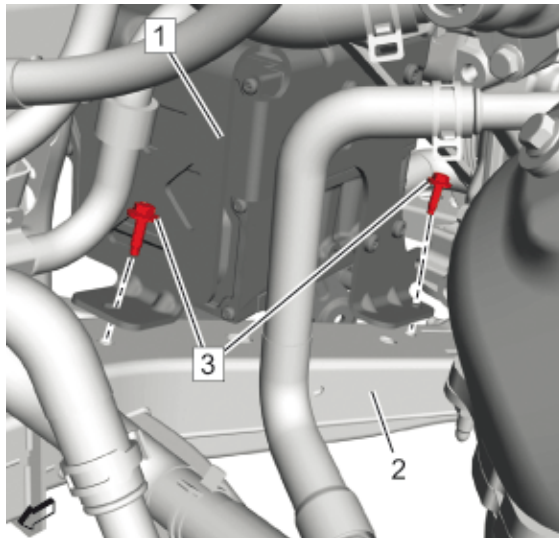


Fig. 121: Heater Coolant Heater Bracket Assembly And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install the 2 heater coolant heater bracket assembly bolts (3) along with the heater coolant heater bracket assembly (2) to the drive train (1) and tighten to 9 N.m (80 lb in).
8. Connect Heater Inlet and Outlet Pipe @ Heater Coolant Heater. Refer to [Heater Inlet And Outlet Pipe Replacement](#)
9. Connect Heater Inlet Hose @ Heater Coolant Heater. Refer to [Heater Inlet Hose Replacement](#)
10. Install Front Wheelhouse Liner (Right Side). Refer to [Front Wheelhouse Liner Replacement \(Right Side\)](#)
11. Fill the cooling system. Refer to [Cooling System Draining and Filling](#)
12. Enable the high voltage system. Refer to [High Voltage Enabling](#)

HEATER WATER SHUTOFF VALVE REPLACEMENT

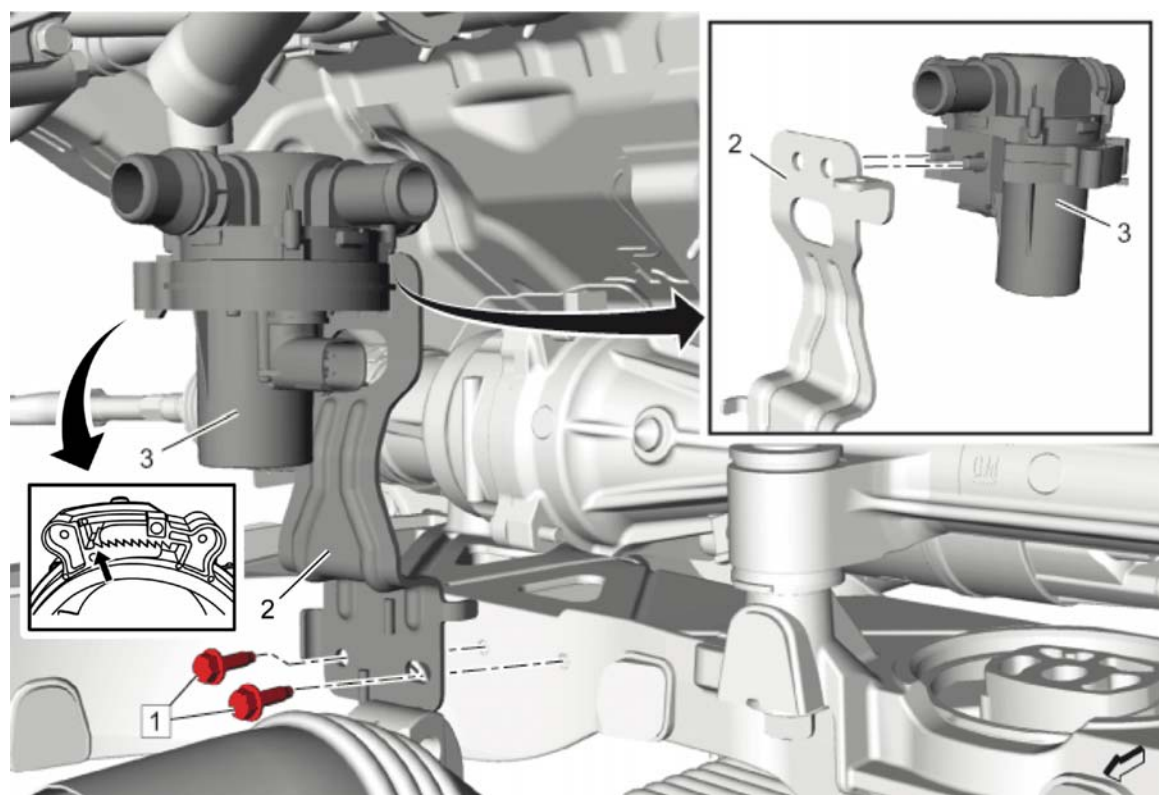


Fig. 122: Heater Water Shutoff Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling 2. Disconnect Heater Water Shutoff Valve Inlet Hose (Qty: 2) @ Heater Water Shutoff Valve. Refer to Heater Water Shutoff Valve Inlet Hose Replacement 3. Disconnect Heater Water Auxiliary Pump Inlet Hose @ Heater Water Shutoff Valve. Refer to Heater Water Auxiliary Pump Inlet Hose Replacement	
1	Heater Water Shutoff Valve Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Heater Water Shutoff Valve Bracket Procedure

Callout	Component Name
	1. Remove Exhaust Hanger Insulator @ Heater Water Shutoff Valve Bracket 2. Disconnect Engine Wiring Harness @ Heater Water Shutoff Valve Bracket
3	Heater Water Shutoff Valve Procedure 1. Remove Electrical Connector @ Heater Water Shutoff Valve Bracket 2. Separate Heater Water Shutoff Valve @ Heater Water Shutoff Valve Bracket NOTE: When removing or replacing the heater shutoff valve, the retainer band clamp must not be separated from the valve assembly. If the retainer band clamp is accidentally released, it must be reinstalled in the position shown by the arrow in the graphic, with two teeth remaining to ensure a proper clamp force.

HEATER WATER SHUTOFF VALVE INLET HOSE REPLACEMENT

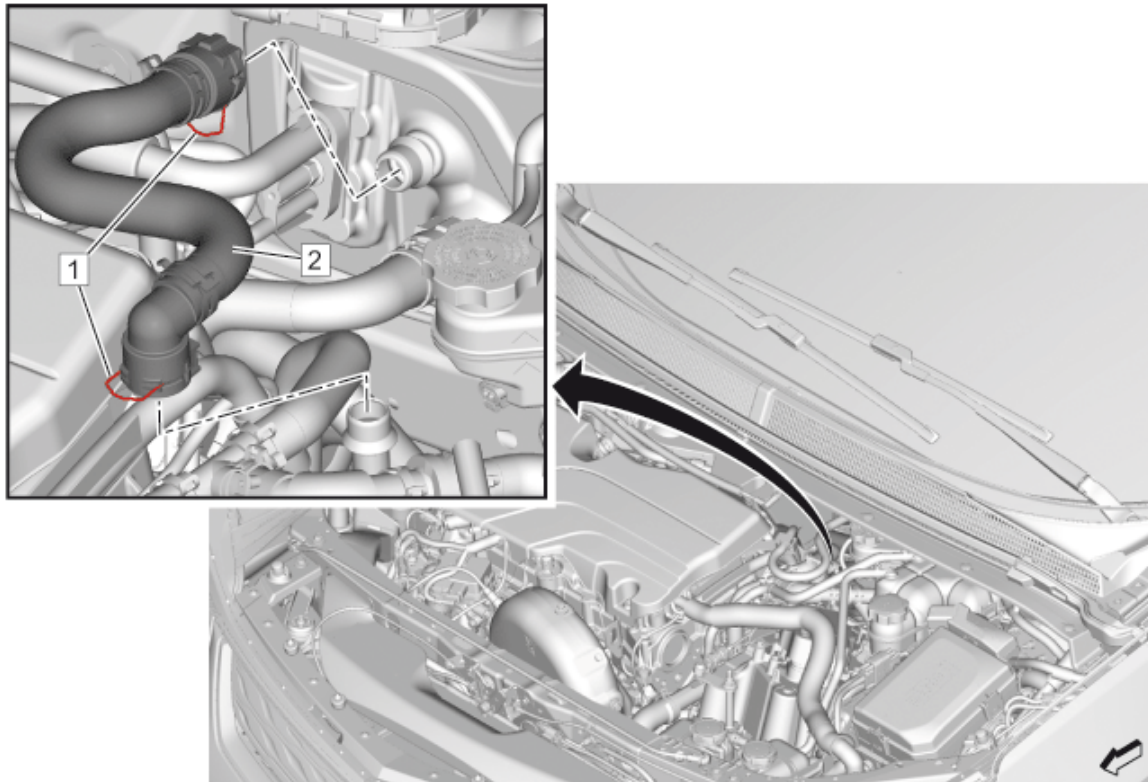


Fig. 123: Heater Water Shutoff Valve Inlet Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling	
1	Heater Water Shutoff Valve Inlet Hose Clamp (Qty: 2) Procedure Reposition Heater Water Shutoff Valve Inlet Hose Clamps (Qty: 2)
2	Heater Water Shutoff Valve Inlet Hose NOTE: Replace all corroded hose clamps and brackets.

HEATER WATER AUXILIARY PUMP INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain the cooling system. Refer to [Cooling System Draining and Filling](#)

2. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
3. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)

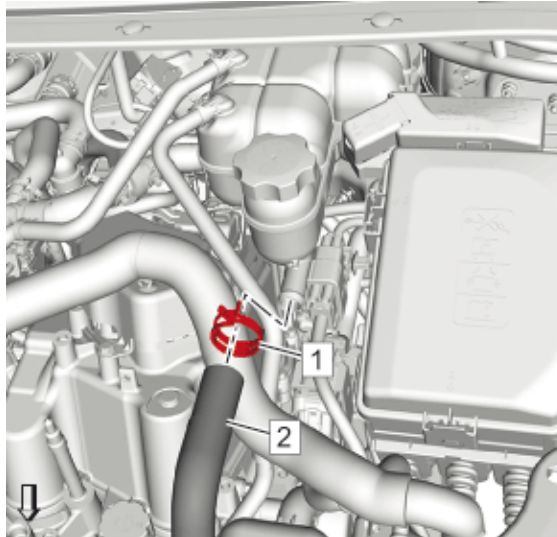


Fig. 124: Heater Water Auxiliary Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Loosen Heater Water Auxiliary Pump Inlet Hose Clamp (1)
5. Remove Heater Water Auxiliary Pump Inlet Hose (2) @ Surge Tank

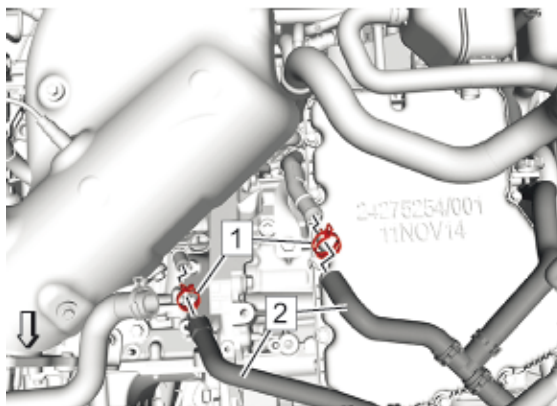


Fig. 125: Heater Water Auxiliary Pump Inlet Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

6. Loosen Heater Water Auxiliary Pump Inlet Hose Clamps (1) (Qty: 2)
7. Remove Heater Water Auxiliary Pump Inlet Hoses (2) (Qty: 2) @ Engine

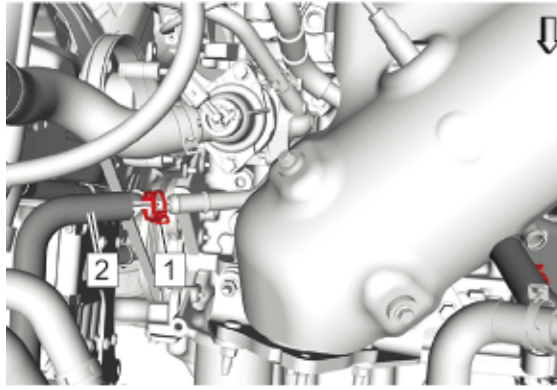


Fig. 126: Heater Water Auxiliary Pump Inlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Loosen Heater Water Auxiliary Pump Inlet Hose Clamp (1)
9. Remove Heater Water Auxiliary Pump Inlet Hose (2) @ Water Pump Inlet Adapter

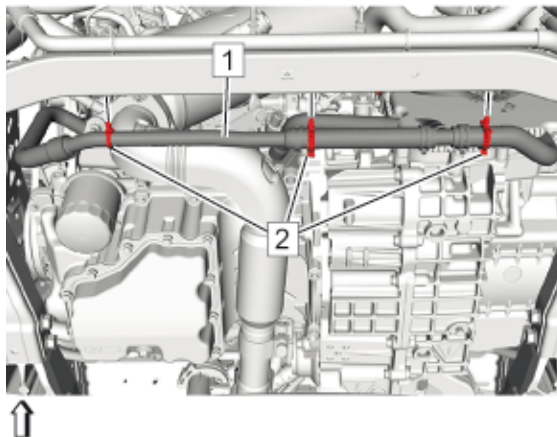


Fig. 127: Heater Water Auxiliary Pump Inlet Hose And Clamps

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Heater Water Auxiliary Pump Inlet Hose Clamps (2) (Qty: 3)
11. Remove Heater Water Auxiliary Pump Inlet Hose (1) @ Vehicle

Installation Procedure

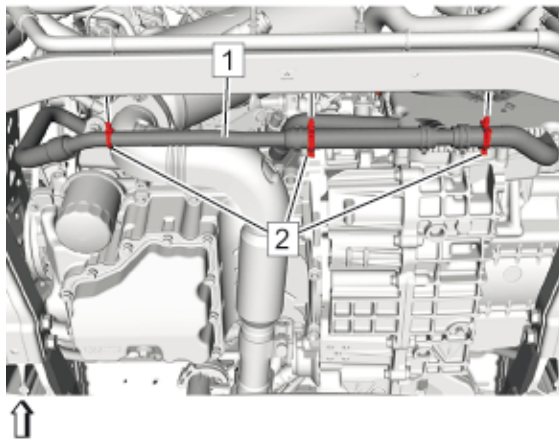


Fig. 128: Heater Water Auxiliary Pump Inlet Hose And Clamps
 Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Water Auxiliary Pump Inlet Hose (1) @ Vehicle
2. Install Heater Water Auxiliary Pump Inlet Hose Clamps (2) (Qty: 3)

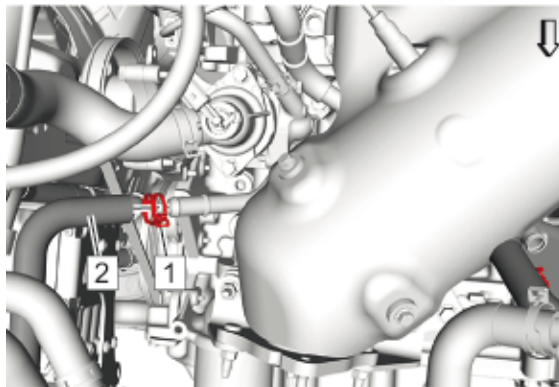


Fig. 129: Heater Water Auxiliary Pump Inlet Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

3. Install Heater Water Auxiliary Pump Inlet Hose (2) @ Water Pump Inlet Adapter
4. Tighten Heater Water Auxiliary Pump Inlet Hose Clamp (1)

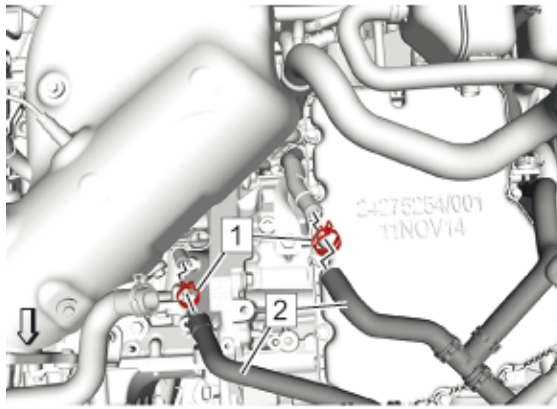


Fig. 130: Heater Water Auxiliary Pump Inlet Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

5. Install Heater Water Auxiliary Pump Inlet Hoses (2) (Qty: 2) @ Engine
6. Tighten Heater Water Auxiliary Pump Inlet Hose Clamps (1) (Qty: 2)

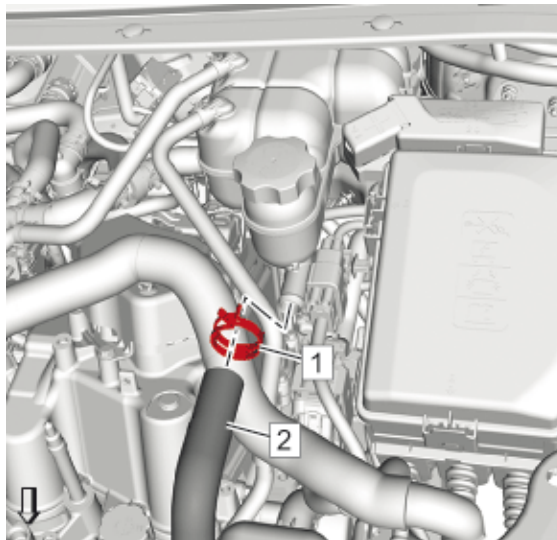


Fig. 131: Heater Water Auxiliary Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Install Heater Water Auxiliary Pump Inlet Hose (2) @ Surge Tank
8. Tighten Heater Water Auxiliary Pump Inlet Hose Clamp (1)
9. Install Front Compartment Splash Shield. Refer to [**Front Compartment Splash Shield Replacement**](#)
10. Connect Battery Negative Cable. Refer to [**Battery Negative Cable Disconnection and Connection**](#)
11. Fill the cooling system. Refer to [**Cooling System Draining and Filling**](#)

HEATER OUTLET HOSE VAPOR VENT HOSE REPLACEMENT

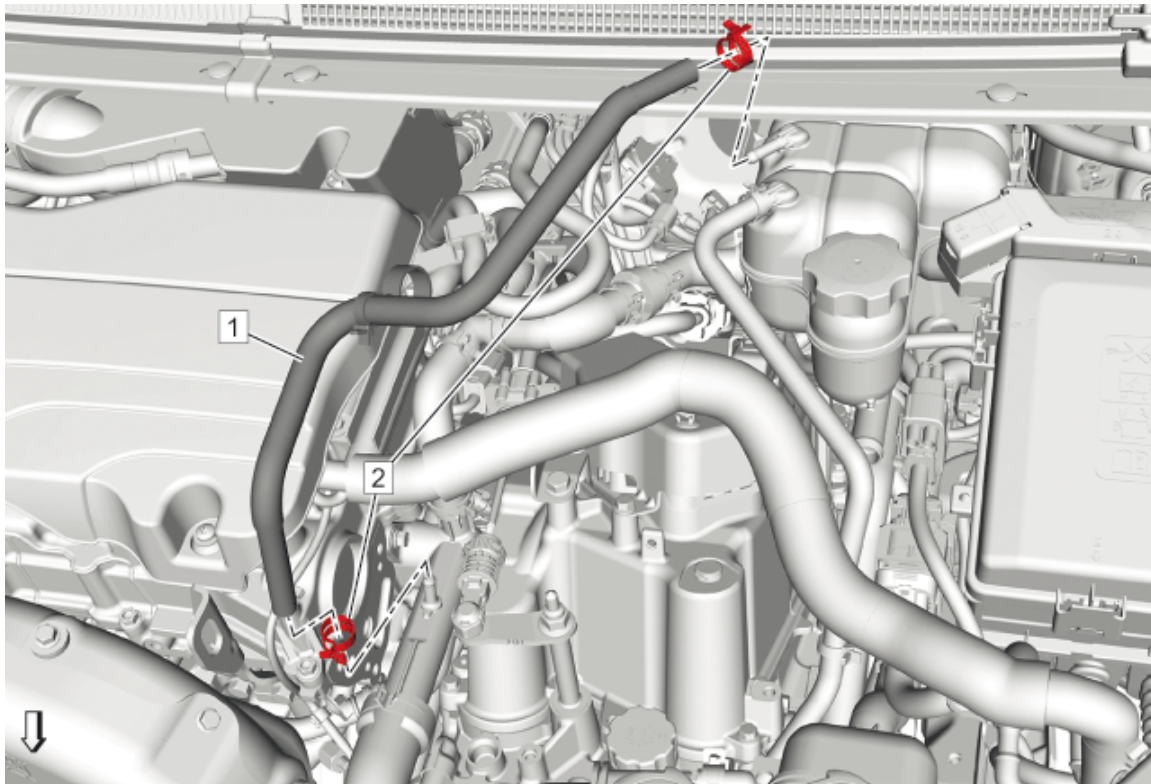


Fig. 132: Heater Outlet Hose Vapor Vent Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Refer to Cooling System Draining and Filling	
1	Heater Outlet Hose Vapor Vent Hose Clamp (Qty: 2)
	Procedure 1. Reposition Heater Outlet Hose Vapor Vent Hose Clamp 2. Replace corroded hose clamps and brackets.
2	Heater Outlet Hose Vapor Vent Hose

DESCRIPTION AND OPERATION

HEATING AND AIR CONDITIONING SYSTEM DESCRIPTION AND OPERATION

Heating

The heating system uses the engine and a high voltage heater to provide heat to the passenger compartment. The high voltage heater is used when the engine is not running and passenger compartment heat is requested. The high voltage heater provides different levels of heat depending on the amount of heat needed and outside temperature.

The HVAC Control Module turns on the coolant pump and monitors the temperature sensors in the passenger compartment, outside air, engine radiator, high voltage heater and the engine to determine the position of the coolant flow control valve and if the high voltage heater is needed. Passenger compartment heat is provided by air flowing through the heater core. The heater core is heated by coolant from either the engine or the high voltage heater.

The engine cooling system circulates a 50/50 mixture of Dex-cool and deionized water.

Air Conditioning

The A/C system uses the refrigerant R-134a which is a gas at very low temperatures and can transfer heat from the passenger compartment and high voltage battery to the outside air. The A/C system is mechanically protected with the use of a high pressure relief valve on the A/C compressor. If the refrigerant pressure sensor were to fail or if the A/C system becomes restricted and the refrigerant pressure continued to rise, the high pressure relief will open and release refrigerant from the system.

The high voltage electric A/C compressor is a self contained high voltage inverter, electric motor, and direct coupled compressor. The electric A/C compressor has the ability to run and provide cooling performance while the vehicle engine is not running. This feature enables the electric A/C compressor to run at a speed independent of the engine. The electronic climate control module and the Vehicle Integration Control Module (VICM) will command the electric A/C compressor to a speed necessary to maintain a desired cooling level rather than cycle the electric A/C compressor on and off.

The electric A/C compressor builds pressure and adds heat to the refrigerant gas. The refrigerant gas flows from the electric A/C compressor to the condenser where heat is transferred to the outside air when the refrigerant condenses from a gas to a liquid. The liquid refrigerant then flows to a thermal expansion valve (TXV) on the battery chiller. The TXV lowers the pressure of the liquid refrigerant which makes the refrigerant expand from a liquid to a vapor. The low pressure refrigerant vapor flows into the battery chiller and begins to boil and change into a gas as the refrigerant absorbs heat from the battery coolant also flowing inside the battery chiller. The battery coolant and refrigerant are separated by several plates inside the battery chiller. The liquid refrigerant also flows to a second TXV on the evaporator. The low pressure refrigerant vapor flows from the TXV into the evaporator and begins to boil and change into a gas as the refrigerant absorbs heat from the passenger compartment air that is flowing through the outside of the evaporator. The moisture in the passenger compartment air condenses on the outside of the evaporator and flows down to the bottom of the HVAC module where it drains outside the passenger compartment through a drain hose. The low pressure refrigerant gas then flows from the battery chiller and the evaporator back to the electric A/C compressor where the cycle is repeated.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

Illustration	Tool Number/Description
	J-38185 Hose Clamp Pliers

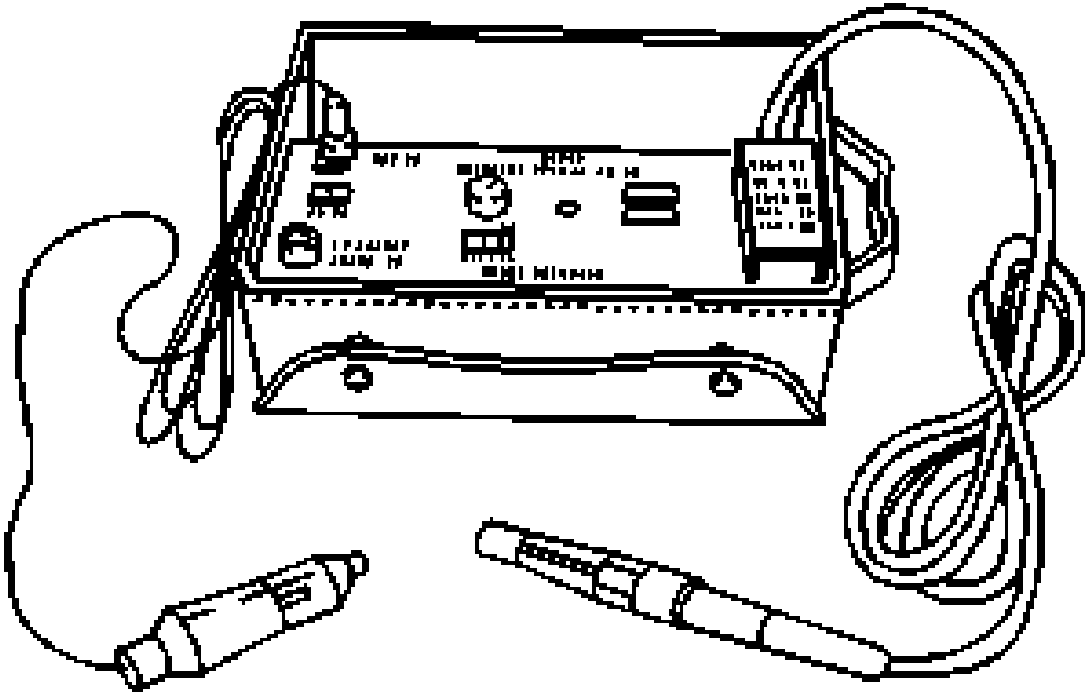
Illustration	Tool Number/Description
	GE 39400-A J 39400-A Halogen Leak Detector

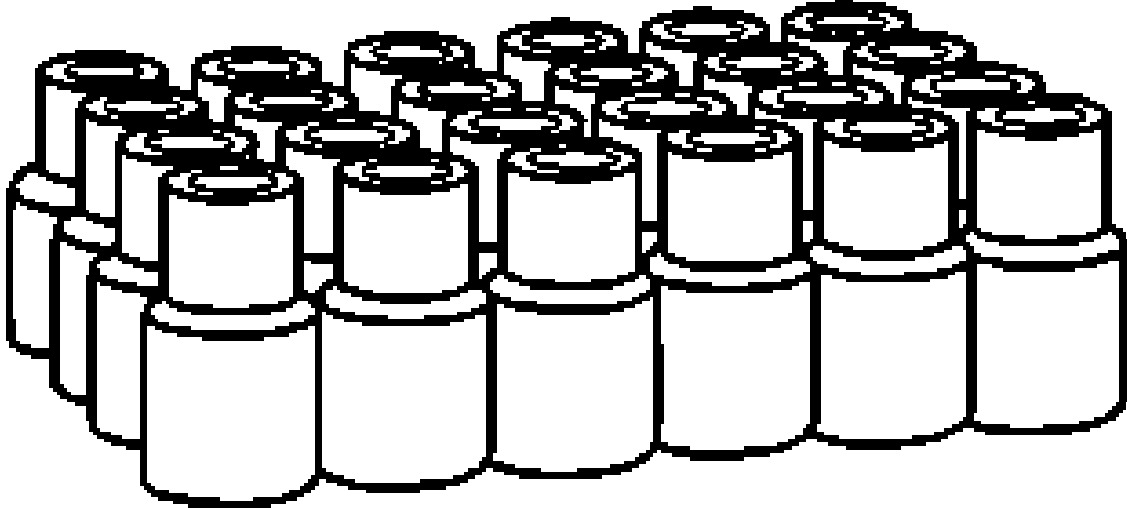
Illustration	Tool Number/Description
	J-41447 R-134A A/C Tracer Dye - Box of 24

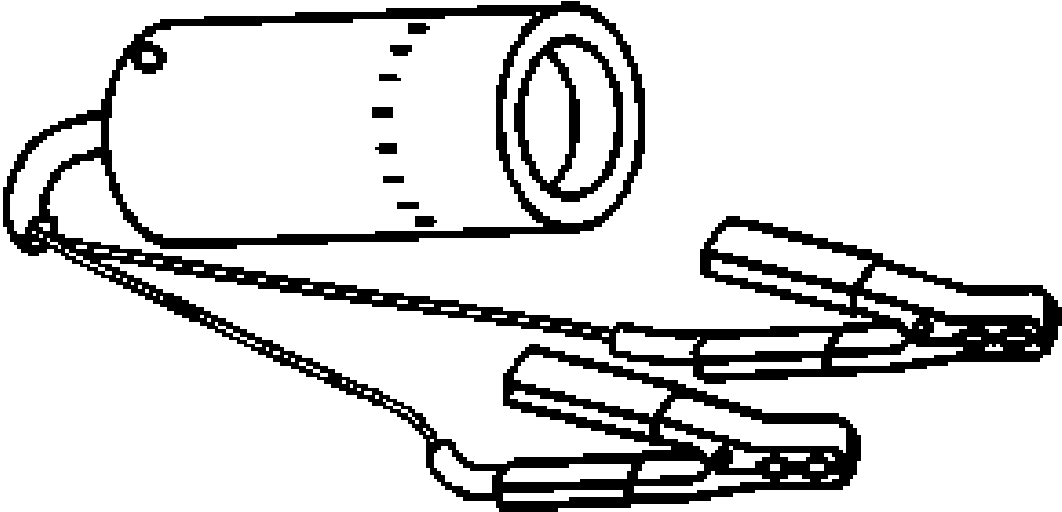
Illustration	Tool Number/Description
	GE 42220 J 42220 Universal 12V Leak Detection Lamp

Illustration	Tool Number/Description
	GE 43872 J 43872 Fluorescent Dye Cleaner

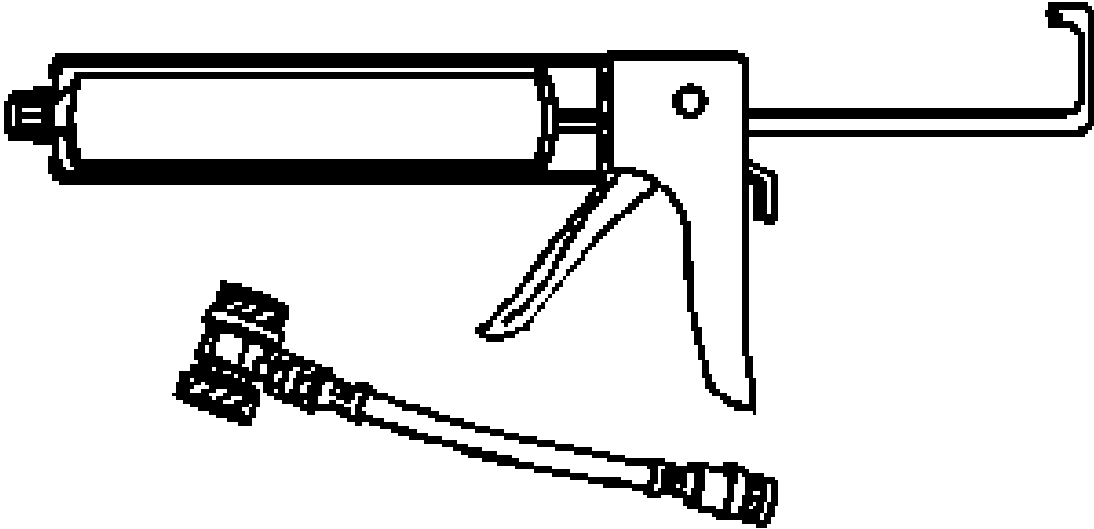
Illustration	Tool Number/Description
	GE 45037-A J 45037-A A/C PAG/POE Oil Injector

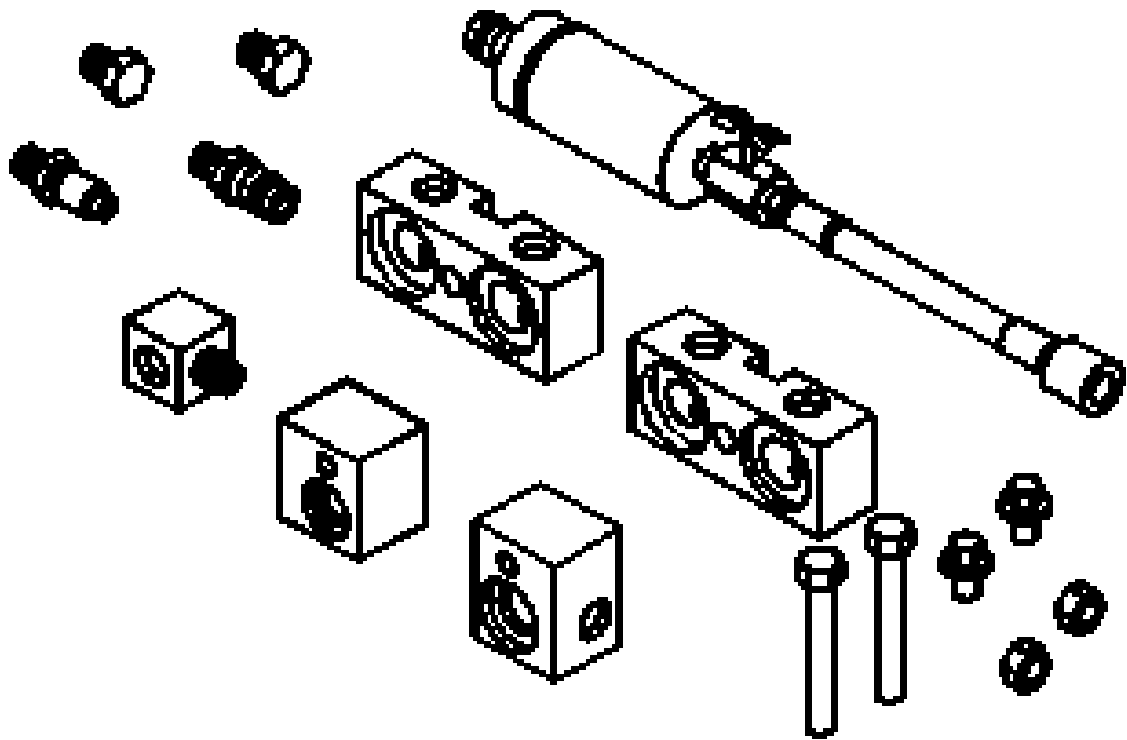
Illustration	Tool Number/Description
	GE 45268 J 45268 Flush Adapter Kit

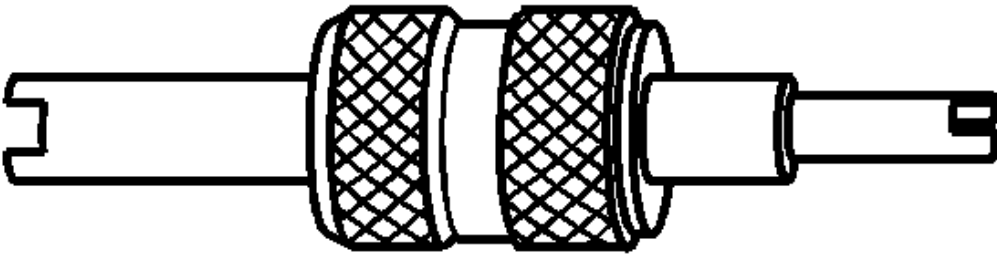
Illustration	Tool Number/Description
	GE 46246 J 46246 Valve Core Removal Tool

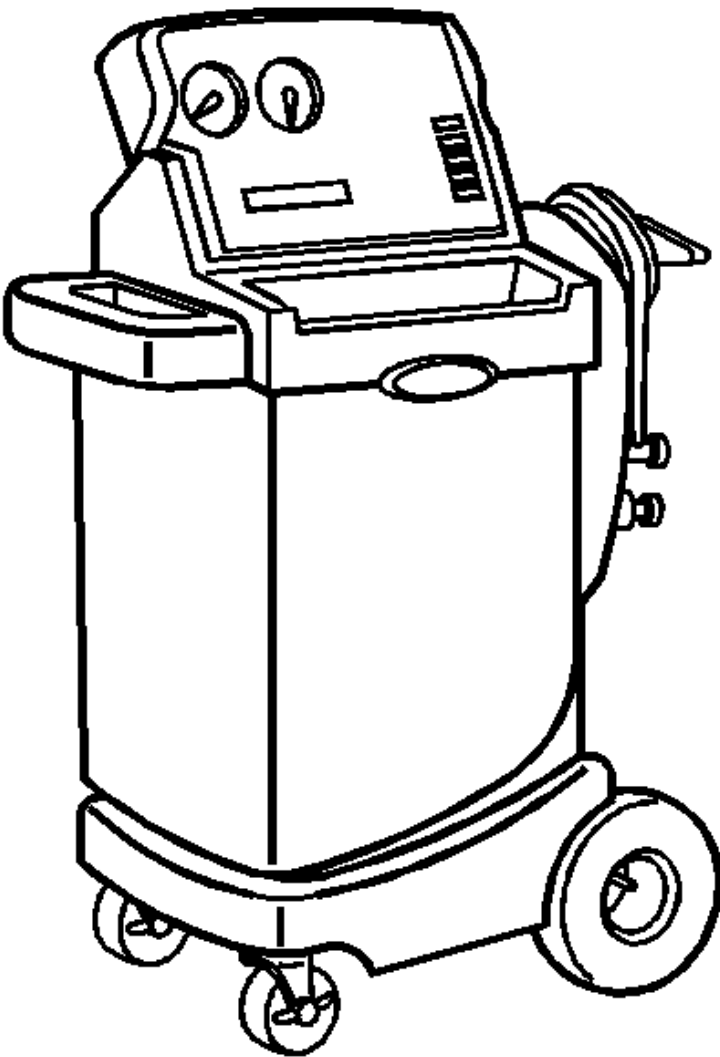
Illustration	Tool Number/Description
	GE 48800 CoolTech A/C Recharge Machine

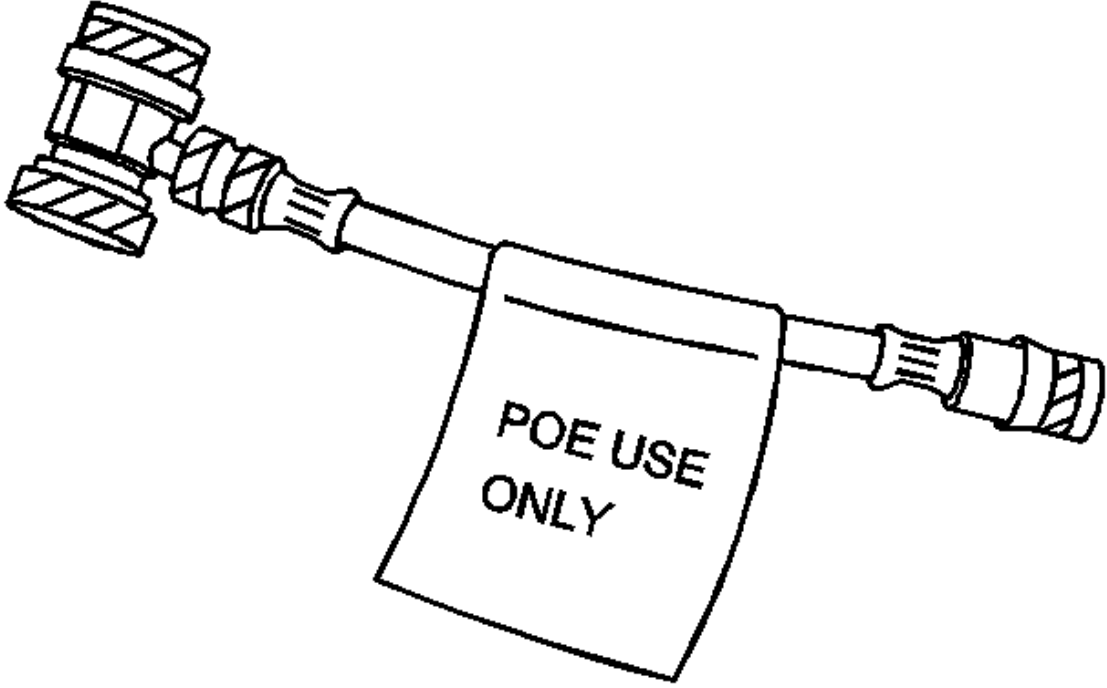
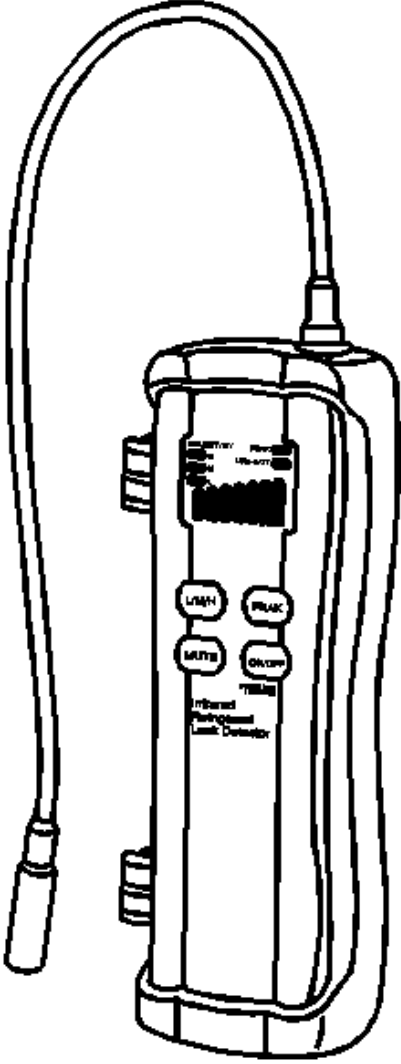
Illustration	Tool Number/Description
	GE 48997 Hybrid A/C Oil Injector Adapter Hose

Illustration	Tool Number/Description
	GE 50078 Electric Leak Detector

Article GUID: A00884662

HVAC
HVAC - Automatic - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Air Inlet Valve Actuator Fastener	2.5 N.m (22 lb in)
Heater and Air Conditioning User Interface Control Bolt	2.5 N.m ((22 lb in)
Mode Control Cam Actuator Bolt	2.5 N.m ((22 lb in)
Temperature Valve Actuator Fastener	2.5 N.m ((22 lb in)

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, Data Communication and Blower Controls

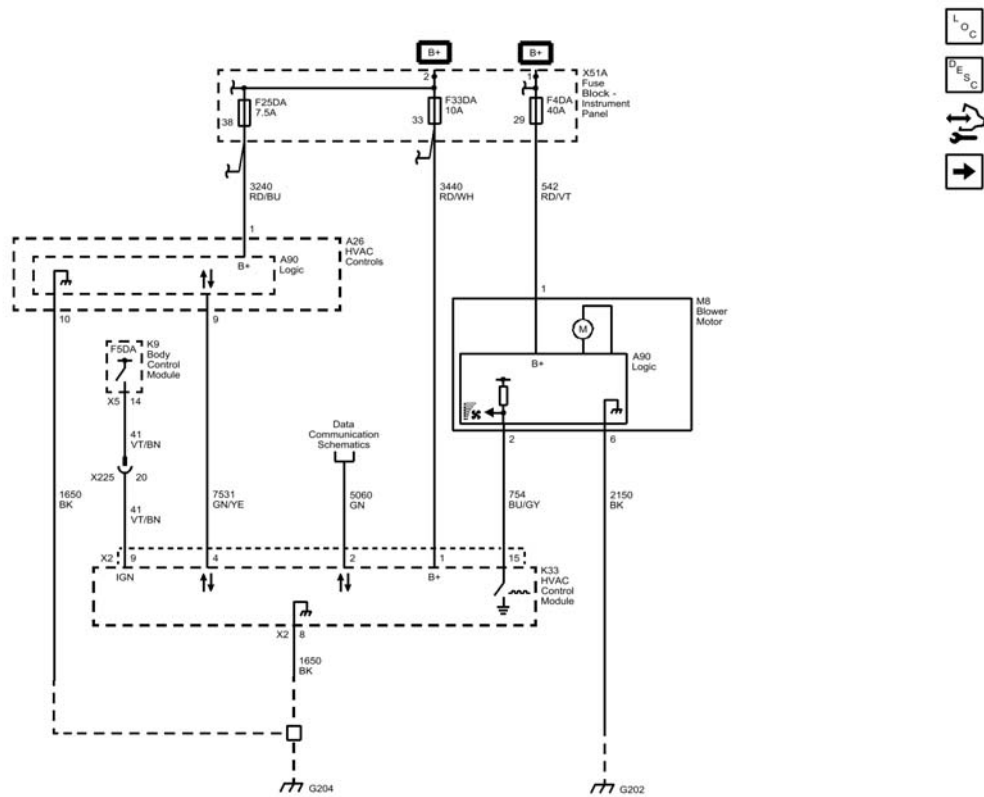


Fig. 1: Power, Ground, Data Communication and Blower Controls
Courtesy of GENERAL MOTORS COMPANY

Temperature Sensors

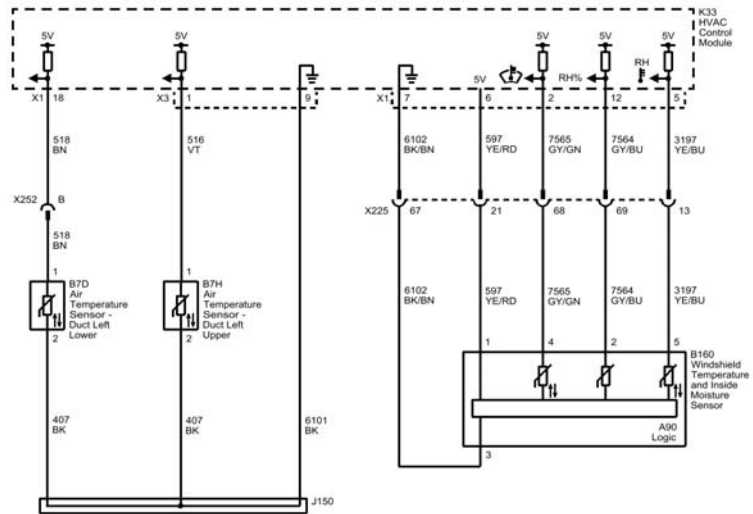


Fig. 2: Temperature Sensors
Courtesy of GENERAL MOTORS COMPANY

Compressor Controls

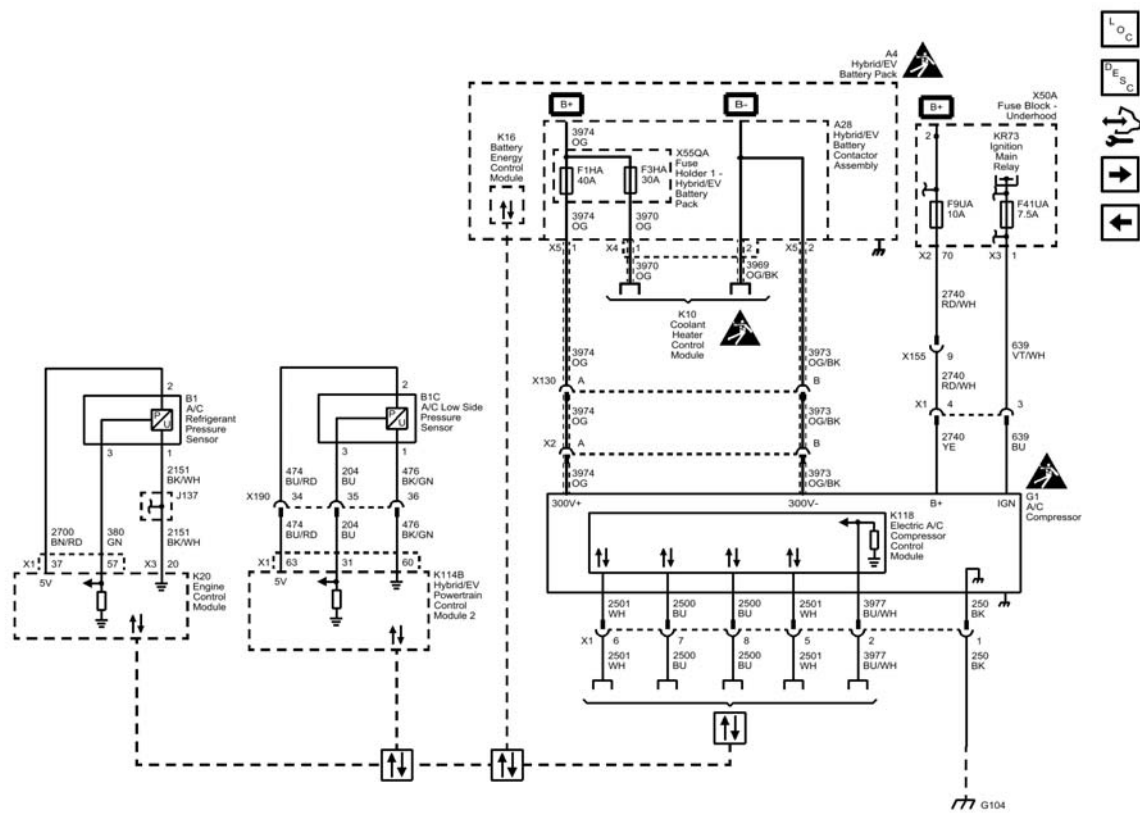


Fig. 3: Compressor Controls
 Courtesy of GENERAL MOTORS COMPANY

Cabin Heater

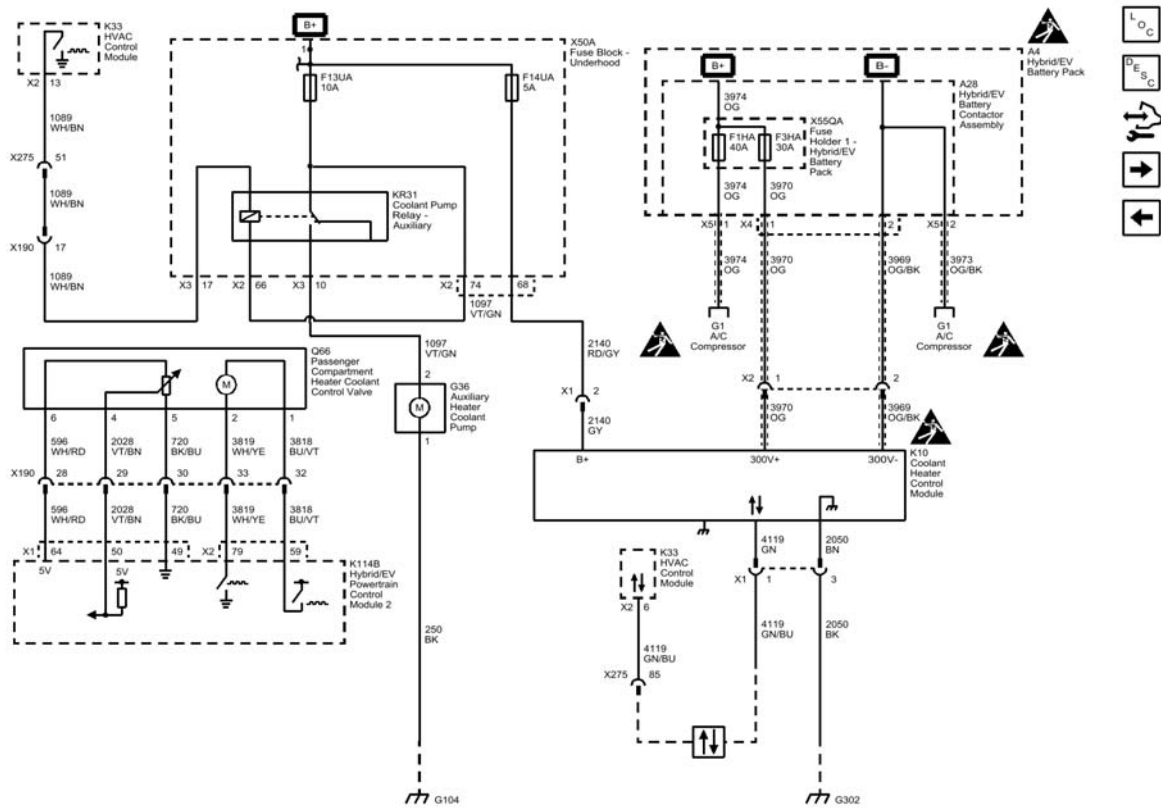


Fig. 4: Cabin Heater

Courtesy of GENERAL MOTORS COMPANY

Actuators

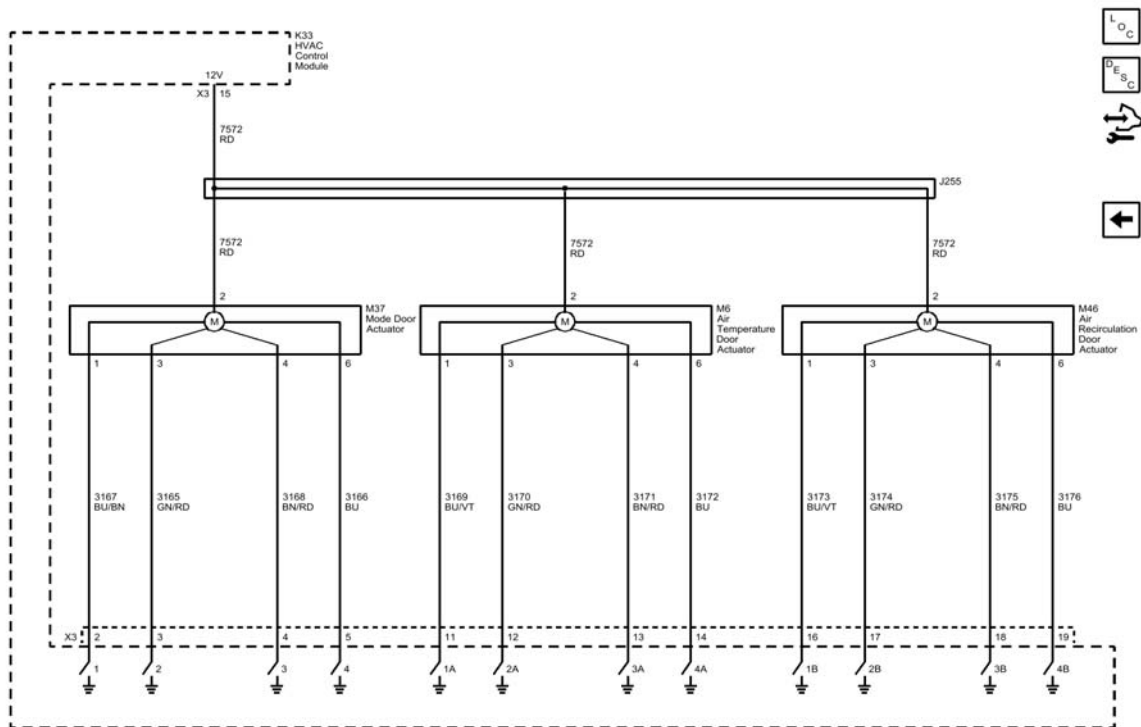


Fig. 5: Actuators

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
A26 HVAC Controls	Heater and Air Conditioning User Interface Control Replacement
B1 A/C Refrigerant Pressure Sensor	Air Conditioning Compressor High Pressure Cut Off Switch Replacement
B10B Ambient Light/Sunload Sensor	Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Replacement
B160 Windshield Temperature and Inside Moisture Sensor	Inside Air Moisture and Windshield Temperature Sensor Replacement
B1C A/C Low Side Pressure Sensor	Air Conditioning Cycling Switch Replacement
B7D Air Temperature Sensor - Duct Left Lower	Floor Air Temperature Sensor Replacement
B7H Air Temperature Sensor - Duct Left Upper	Inside Air Temperature Sensor Replacement - Left Side Upper
G1 A/C Compressor	Air Conditioning and Drive Motor Battery Cooling Compressor Replacement

Component	Repair Instruction
G36 Auxiliary Heater Coolant Pump	<u>Heater Coolant Pump Replacement</u>
K10 Coolant Heater Control Module	<u>Heater Coolant Heater Replacement</u>
K33 HVAC Control Module	<u>Heater and Air Conditioning Remote Control Replacement</u>
M8 Blower Motor	<u>Blower Motor Replacement</u>
M37 Mode Door Actuator	<u>Mode Control Cam Actuator Replacement</u>
M46 Air Recirculation Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>
M6 Air Temperature Actuator	<u>Temperature Valve Actuator Replacement</u>
Q66 Passenger Compartment Heater Coolant Control Valve	<u>Heater Water Shutoff Valve Replacement</u>

DTC B0163: PASSENGER COMPARTMENT TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0163 02

Passenger Compartment Temperature Sensor Circuit Short to Ground

DTC B0163 05

Passenger Compartment Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Inside Air Temperature Sensor Signal Terminal 3	B0163 02	B0163 05	B0163 05	-
Twilight Sentinel Delay Sensor Signal Terminal 4	B0183 02	B0183 05	B0183 05	-
Low Reference	-	B0163 05, B0183 05	-	-

Circuit/System Description

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity

- Passenger compartment temperature

The vehicle uses a sunload sensor that is integrated into one sensor assembly along with the passenger compartment temperature sensor. Low reference and signal circuits enable the sensor to operate. The sensor signal varies between 0 - 5 V.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0 - 5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B0163 02 or B0163 05

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 0 W/m².

Conditions for Clearing the DTC

B0163 02 or B0163 05

The sensor signal is within specified range between 0.1 - 4.9 V.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 60 Ω between the low reference circuit terminal 6 and ground.
 - **If 60 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.
 - **If less than 60 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Passenger Compartment Air Temperature (Unfiltered) parameter is less than -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$).
 - **If -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$) or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
 - **If less than -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the low reference circuit terminal 6.
6. Verify the scan tool Passenger Compartment Air Temperature (Unfiltered) parameter is greater than 110 $^{\circ}\text{C}$ (240 $^{\circ}\text{F}$).
 - **If 110 $^{\circ}\text{C}$ (240 $^{\circ}\text{F}$) or less**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF
 4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K33 HVAC control module.
- **If greater than 110 $^{\circ}$ C (240 $^{\circ}$ F)**

7. Test or replace the B10B Ambient Light/Sunload Sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- HVAC Component Replacement Reference
- Control Module References for HVAC control module replacement, programming and setup

DTC B0173 OR B0178: UPPER LEFT DUCT AIR TEMPERATURE SENSOR CIRCUIT/LOWER LEFT DUCT AIR TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B0173 02

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0173 05

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0178 02

Lower Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0178 05

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Upper Left Duct Air Temperature Sensor Signal	B0173 02	B0173 05	B0173 05	-
Lower Left Duct Air Temperature Sensor Signal	B0178 02	B0178 05	B0178 05	-
Low Reference	-	B0173 05, B0178 05	-	-

Circuit/System Description

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The vehicle uses the following air temperature sensors:

- Air temperature sensor left upper
- Air temperature sensor left lower

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +85Â°C (-40 to +185Â°F). The sensor signal varies between 0 - 5 V. The HVAC control module converts the signal to a range between 0 - 255 counts. As the air temperature increases the count value will decrease. If the HVAC control module detects a malfunctioning sensor, then the control module software will use a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

The vehicle is turned ON.

Conditions for Setting the DTC

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

A default value is used when the DTC is set.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects a failure.
- The history DTC will clear after 100 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B and ground.
 - **If 50 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool parameter is less than -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$).
 - Lower Left Duct Air Temperature Sensor
 - Upper Left Duct Temperature Sensor
 - **If greater than -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$)**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the signal circuit terminal A and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
 - **If -37 $^{\circ}\text{C}$ (-35 $^{\circ}\text{F}$) or less**
5. Install a 3 A fused jumper wire between the signal circuit and the low reference circuit terminal B.
6. Verify the scan tool parameter is greater than 110 $^{\circ}\text{C}$ (230 $^{\circ}\text{F}$).
 - Lower Left Duct Air Temperature Sensor
 - Upper Left Duct Temperature Sensor
 - **If 110 $^{\circ}\text{C}$ (230 $^{\circ}\text{F}$) or less**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF
4. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K33 HVAC control module.
- **If greater than 110 $^{\circ}$ C (230 $^{\circ}$ F)**

7. Test or replace the temperature sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- HVAC Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DTC B018A, B048C, B048F, OR B1395: WINDSHIELD TEMPERATURE SENSOR CIRCUIT/HUMIDITY SENSORCONTROL MODULE VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B018A 02

Windshield Temperature Sensor Circuit Short to Ground

DTC B018A 05

Windshield Temperature Sensor Circuit High Voltage/Open

DTC B048C 02

Humidity Sensor Humidity Circuit Short to Ground

DTC B048C 05

Humidity Sensor Humidity Circuit High Voltage/Open

DTC B048F 02

Humidity Sensor Temperature Circuit Short to Ground

DTC B048F 05

Humidity Sensor Temperature Circuit High Voltage/Open

DTC B1395 03

Control Module Voltage Reference Output Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1395 03	-	B1395 07	-
Signal Terminal 2	B048C 02	B048C 05	B048C 05	-
Signal Terminal 5	B048F 02	B048F 05	B048F 05	-
Signal Terminal 4	B018A 02	B018A 05	B018A 05	-
Ground	-	B018A 05, B048C 05, B048F 05	-	-

Circuit/System Description

The windshield temperature and inside moisture sensor integrates the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level on inside windshield
- Temperature of the inside windshield
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity on the compartment side of the windshield. It also detects the temperature of the windshield surface on the compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element. It is only needed if the thermal contact between the humidity sensing element and the inside windshield surface is not sufficient.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B018A 02, B048C 02, B048C 02 or B1395 03

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V for more than 50 ms.

B018A 05, B048C 05, B048C 05 or B1395 07

The HVAC control module detects the sensor signal out of range. The signal voltage is greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 60% for humidity.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B160 windshield temperature and inside moisture sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 60 Ω between the low reference circuit terminal 3 and ground.
 - **If 60 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If less than 60 Ω**

3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC control module.
5. Verify the scan tool parameters listed below are less than -37 $^{\circ}$ C (-35 $^{\circ}$ F).
 - Windshield Temperature
 - Passenger Compartment Humidity Sensor Temperature
 - **If -37 $^{\circ}$ C (-35 $^{\circ}$ F) or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the signal circuit terminals listed below and ground:
 - Windshield temperature sensor signal terminal 4
 - Passenger compartment humidity sensor temperature signal terminal 5
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
6. Verify the scan tool Passenger Compartment Humidity parameter is greater than 95%.
 - **If 95% or less**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
 - **If greater than 95%**
7. Install a 3 A fused jumper wire between each signal circuit terminal listed below and the low reference circuit terminal 3 one at a time.
 - Windshield temperature sensor signal terminal 4
 - Passenger compartment humidity sensor temperature signal terminal 5

8. Verify the appropriate scan tool parameter listed below is greater than 114Â°C (238Â°F).

- Windshield Temperature
- Passenger Compartment Humidity Sensor Temperature
- **If 114Â°C (238Â°F) or less**

1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.

2. Test for less than 1 V between the signal circuit terminals listed below and ground:

- Windshield temperature sensor signal terminal 4
- Passenger compartment humidity sensor temperature signal terminal 5
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K33 HVAC control module.

- **If greater than 114Â°C (238Â°F)**

9. Install a 3 A fused jumper wire between the passenger compartment humidity sensor signal circuit terminal 2 and the low reference circuit terminal 3.

10. Verify the scan tool Passenger Compartment Humidity parameter is less than 5%.

- **If 5% or greater**

1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.

2. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K33 HVAC control module.

- **If less than 5%**

11. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.

12. Test for less than 1 V between the signal circuit terminal 2 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

13. Test or replace the B160 windshield temperature and inside moisture sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for HVAC control module replacement, programming and setup

DTC B0183: SOLAR LOAD SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0183 02

Solar Load Sensor Circuit Short to Ground

DTC B0183 05

Solar Load Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor Signal Terminal 3	B0163 02	B0163 05	B0163 05	1
Sensor Signal Terminal 4	B0183 02	B0183 05	B0183 05	1
Low Reference	-	B0163 05, B0183 05	-	-
1. HVAC Malfunction				

Circuit/System Description

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The vehicle uses a sunload sensor that is integrated into one sensor assembly along with the passenger compartment temperature sensor. Low reference and signal circuits enable the sensor to operate. The sensor signal varies between 0 - 5 V.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0 - 5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B0163 02 or B0163 05

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

B0183 02

The 5 V identification pulse is not received.

B0183 05

The input signal is static and greater than 4.8 V.

Action Taken When the DTC Sets

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 0 W/m².

Conditions for Clearing the DTC

B0163 02 or B0163 05

The sensor signal is within specified range between 0.1 - 4.9 V.

B0183 02 or B0183 05

The sensor signal is within specified range between 0.1 - 4.9 V.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B10B Ambient Light/Sunload Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 60 Ω between the low reference circuit terminal 6 and ground.
 - **If 60 Ω or greater**
 1. Vehicle OFF, disconnect the X1 harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If less than 60 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the signal circuit terminal 4 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X1 harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X1 harness connector at the K33 HVAC control module, Vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC control module.
 - **If between 4.8 - 5.2 V**
5. Replace the B10B Ambient Light/Sunload Sensor.
6. Verify DTC B0183 does not set while operating the vehicle under the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K33 HVAC control module
 - **If the DTC does not set**
7. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for HVAC control module replacement, programming and setup

DTC B0193: FRONT BLOWER MOTOR SPEED CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B0193 06	B0193 06	-	-
Control	B0193 06	B0193 06	B0193 01	1
Ground	-	B0193 01	-	-

Circuit/System Description

The blower motor speed control signal from the HVAC control module, battery positive and ground circuits enable the blower motor to operate. The blower motor control circuitry is integrated within the blower motor assembly. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor to request a specific motor speed. The blower motor translates the PWM signal and drives the motor accordingly.

Conditions for Running the DTC

- Vehicle ON.
- The HVAC Control Module is ON.

Conditions for Setting the DTC

B0193 01

The voltage at the HVAC Control Module output to the blower motor control module is always high.

B0193 06

The voltage at the HVAC Control Module output to the blower motor control module is always low or

fluctuating.

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

The design of this motor does not allow for bench testing. The motor will not operate by simply applying power and ground.

Inspect the motor shaft for rust or other foreign material which may prohibit proper motor operation.

Check for Preliminary Information or Technical Service Bulletins.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M8 Blower Motor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the M8 Blower Motor.
 - **If the test lamp illuminates**
4. Remove the test lamp.
5. Vehicle in Service Mode. Test for less than 1 V between the control circuit terminal 2 and ground.
 - **If 1 V or greater**
 1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module. Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC Control Module
 - **If less than 1 V**
6. Vehicle OFF. It may take up to 10 min for all vehicle systems to power down.
7. Test for infinite resistance between the control circuit terminal 2 and ground.
 - **If less than infinite resistance**
 1. Disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module
 - **If infinite resistance**

NOTE: Verify the ignition is OFF before connecting the blower motor or incorrect test results may occur.

8. Vehicle OFF, connect the harness connector at the M8 Blower Motor. Vehicle in Service Mode.
9. While backprobing terminal 2 at the M8 Blower Motor, test for greater than 1 V between control circuit and ground.

- **If less than 1 V**

Replace the M8 Blower Motor.

- **If 1 V or greater**

10. Verify the voltage decreases and increases while using the controls to change the blower speed selection.

- **If the voltage does not decrease and increase as the blower speed selection is changed**

1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.

2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K33 HVAC Control Module.

- **If the voltage decreases and increases as the blower speed selection is changed**

11. Replace the M8 Blower Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC B0223, B0233, B023A, OR B0408: RECIRCULATE POSITION COMMAND 1 CIRCUIT/AIR FLOW CONTROL CIRCUIT/HVAC ACTUATORS SUPPLY VOLTAGE/MAIN TEMPERATURE CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0223

Recirculate Position Command 1 Circuit

DTC B0233

Air Flow Control Circuit

DTC B023A

HVAC Actuators Supply Voltage

DTC B0408

Main Temperature Control Circuit

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stepper Motors 12 V Reference	B023A 02	B0223 06, B0233 06, B0408 06, 1	-	-
Recirculation Actuator Control 1	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 2	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 3	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 4	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Air Temperature Actuator Control 1	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 2	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 3	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 4	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Mode Actuator Control 1	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 2	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 3	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 4	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
1. Actuator door malfunction				

Circuit/System Description

Stepper motors are used for temperature regulation, air distribution control and recirculation flap control.

With the appropriate switches at the HVAC control, the desired door positions can be selected. The selected values are passed to the HVAC control module via serial data. The HVAC control module supplies a 12 V reference voltage to the stepper motors and energizes the stepper motors with a pulsed ground signal. The stepper motors put the appropriate door into the calculated position in order to reach the desired temperature, mode, and recirculation position.

Conditions for Running the DTC

- Vehicle on, or in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B023A 02

The stepper motors supply output is shorted to ground.

B0223 01, B0233 01 or B0408 01

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to voltage when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

B0223 06, B0233 06 or B0408 06

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to ground or open when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

Action Taken When the DTC Sets

B023A 02

- The affected output will be switched off for hardware protection.
- All stepper motors are deactivated.

B0223, B0233 or B0408

- The affected output will be switched off for hardware protection.
- The affected stepper motor is deactivated.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

During diagnosis, it is important to verify that the air control door and any associated components (linkage, cams, gears, etc.) operate properly. Inspect for any conditions that may limit or prevent the air control door from moving smoothly or moving through its full range of travel. Any mechanical issues should be corrected first, before proceeding with electrical diagnosis.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Actuator Recalibration** procedure.
2. Verify the concern or DTC has been corrected.
 - **If the concern or DTC has not been corrected**
 1. Verify DTC B023A is not set.
 - If DTC B023A is set, refer to Circuit/System Testing - DTC B023A
 - If DTC B023A is not set, refer to Circuit/System Testing - DTC B0223, B0233 or B0408.
 - **If the concern or DTC has been corrected**
3. All OK.

Circuit/System Testing

DTC B023A

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the components listed below. It may take up to 2 min for all vehicle systems to power down.
 - M37 Mode Door Actuator
 - M46 Air Recirculation Door Actuator
 - M6 Air Temperature Door Actuator
2. Disconnect the X3 harness connector at the K33 HVAC Control Module.
3. Test for infinite resistance between the K33 HVAC Control Module circuit terminal 15 X3 and ground.
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
4. Vehicle OFF, connect the X3 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
5. Verify DTC B023A is not set.
 - **If the DTC is set.**

Replace the K33 HVAC Control Module.
 - **If the DTC is not set.**
6. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.
 - M37 Mode Door Actuator
 - M46 Air Recirculation Door Actuator

- M6 Air Temperature Door Actuator
- **If the DTC sets after connecting one of the components**

Replace the actuator that was connected immediately before the DTC set.

- **If the DTC does not set**

7. All OK.

DTC B0223, B0233 or B0408

1. Vehicle OFF, disconnect the harness connector at the appropriate door actuator, It may take up to 2 min for all vehicle systems to power down. Vehicle in Service Mode.

NOTE: **If more than one actuator is affected, test the B+ circuit at each actuator.**

2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.

- **If the test lamp illuminates**

3. Command the appropriate actuator with a scan tool.

4. Verify a test lamp is flashing on and off when connected between the B+ circuit terminal 2 and each control circuit terminal listed below:

- Control Circuit - terminal 1
- Control Circuit - terminal 3
- Control Circuit - terminal 4
- Control Circuit - terminal 6

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.

- **If the test lamp is flashing On and Off**

5. Test or replace the actuator.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC B048E: AUXILIARY HEATER SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B048E 00

Auxiliary Heater System Malfunction

DTC B048E 39

Auxiliary Heater System Internal Malfunction

DTC B048E 58

Auxiliary Heater System Incorrect Reaction After Event

DTC B048E 5A

Auxiliary Heater System Plausibility Failure

Circuit/System Description

The coolant heater control module is a high voltage electric heater. Fused high voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The HVAC control module requests heater operation if the coolant temperature is low and additional heat is required to meet the desired settings of the HVAC system.

The coolant heater control module monitors itself during operation, and if a fault is detected a message is sent to the HVAC control module. The HVAC control module then sets the DTC.

Conditions for Running the DTC

- 12 V battery system voltage is greater than 10.2 V.
- The HVAC control module is ON.
- The electrical auxiliary heater is commanded ON.

Conditions for Setting the DTC

B048E 00

- The coolant heater control module reports a recoverable fault for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 39

- The coolant heater control module reports an internal malfunction for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 58

- The coolant heater control module reports a limited operation status for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 5A

- The HVAC control module determines the coolant temperature reported by the coolant heater control module is not rational based on the vehicle operating conditions for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

Action Taken When the DTC Sets

- The DIC displays the Service Heater Soon message
- The coolant heater is inoperative, or operates in a limited state.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

- Verify the cooling system is full before performing diagnostics. A low or aerated coolant condition may cause this DTC to set.

- Insufficient or no coolant flow through the coolant heater due to a restriction, blockage, or coolant pump malfunction may cause this DTC to set.
- Insufficient or no voltage from the Hybrid/EV battery may cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Verify that no other DTCs are set.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

- **If no other DTCs are set**

2. Verify that DTC B048E 39 is not set.

- **If DTC B048E 39 is set**

Replace the K10 Coolant Heater Control Module

- **If DTC B048E 39 is not set**

3. Verify that DTC B048E 00 is not set.

- **If DTC B048E 00 is set**

Refer to Circuit/System Testing

- **If DTC B048E 00 is not set**

4. Verify the cooling system is filled to the proper level.

- **If the cooling system is not filled to the proper level**

1. Diagnose and correct the cause of the improper coolant level.
2. Fill the cooling system to the proper level. Refer to [Cooling System Draining and Filling](#).
3. Clear DTCs and re-evaluate the concern.

- **If the cooling system is filled to the proper level**

5. Verify the scan tool ECM Engine Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.

- **If the ECM Engine Coolant Temperature sensor parameter is NOT within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**

Allow the engine to cool until the ECM Engine Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.

- **If the ECM Engine Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**

6. Verify the G36 Auxiliary Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.

- **If the G36 Auxiliary Heater Coolant Pump does not operate**

Refer to [Auxiliary Heater Coolant Pump Malfunction](#).

- **If the G36 Auxiliary Heater Coolant Pump operates**

7. Vehicle ON, HVAC system set to hot, blower set to high. Command the Passenger Compartment Heater Coolant Control Solenoid Valve to bypass.

8. Verify the scan tool parameter Coolant Heater Control Module Status displays only Normal Running.

- **If the scan tool parameter Coolant Heater Control Module Status displays only Limited Operation**

1. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is greater than 15 A.

- If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is less than 15 A, replace the K10 Coolant Heater Control Module
- If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is greater than 15 A, refer to step 10.

- **If the scan tool parameter Coolant Heater Control Module Status switches between Limited Operation and Normal Running.**

Refer to step 12

- **If the scan tool parameter Coolant Heater Control Module Status displays only Normal Running**

9. Continue to operate the system for 10 min.
10. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is not within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.**

Replace the K10 Coolant Heater Control Module

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.**

11. Vehicle OFF. Inspect the cooling system for restrictions or blockages in coolant flow. Refer to [Heating Performance Diagnostic](#) .

- **If restrictions or blockages in coolant flow are found.**

1. Diagnose and correct the cause of the restrictions or blockage.
2. Verify the G36 Auxiliary Heater Coolant Pump operates.
3. Clear DTCs and re-evaluate the concern.

- **If no restrictions or blockages are found**

12. Vehicle ON, engine running, HVAC system set to hot, blower set to high. Command the Passenger Compartment Heater Coolant Control Solenoid Valve to link.

13. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is equal to Engine Coolant Temperature.

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is not equal to Engine Coolant Temperature**

1. Verify there are no ECM engine coolant temperature related DTCs

- If ECM engine coolant temperature DTCs are present, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , then clear DTCs and re-evaluate the concern.
- If no ECM engine coolant temperature DTCs are present, replace the K10 Coolant Heater Control Module.

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is equal to Engine Coolant Temperature.**

14. All OK.

[Circuit/System Testing](#)

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to [High Voltage Disabling](#).
2. Disconnect the X4 harness connector at the A4 Hybrid/EV Battery Pack and the X2 harness connector at the K10 Coolant Heater Control Module. Refer to [High Voltage Connectors](#).
3. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:
 - A4 Hybrid/EV Battery Pack harness connector terminal 1 X4 and K10 Coolant Heater Control Module harness connector terminal 1 X2.
 - A4 Hybrid/EV Battery Pack harness connector terminal 2 X4 and K10 Coolant Heater Control Module harness connector terminal 2 X2.
 - **If 2 Ω or greater**
Replace the 300-Volt Positive and Negative Cable.
 - **If less than 2 Ω**
4. Verify the F3HA K10 Coolant Heater fuse is not open. Refer to [High Voltage Battery Disconnect Relay Fuse Replacement \(Front - BDU\)](#) [High Voltage Battery Disconnect Relay Fuse Replacement \(Rear - BDU\)](#).
 - **If the F3HA K10 Coolant Heater fuse is open**
Replace the fuse and the K10 Coolant Heater Control Module.
 - **If the F3HA K10 Coolant Heater fuse is not open**
5. Replace the K10 Coolant Heater Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC B3844: ENGINE COOLANT CIRCULATION PUMP CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

DTC B3844 06

Engine Coolant Circulation Pump Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow when the engine is not operating, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G36 Auxiliary Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump Relay On and Off with a scan tool.
 - **If the G36 Auxiliary Heater Coolant Pump does not operate**

Refer to Circuit/System Testing
 - **If the G36 Auxiliary Heater Coolant Pump operates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X3 harness connector at the X50A Fuse Block- Underhood.
2. Connect a test lamp between the control circuit terminal 17 and B+, Vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump Relay On and Off with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
 - **If the test lamp turns ON and OFF**
4. Vehicle OFF and all vehicle systems OFF, connect the X3 harness connector at the X50A Fuse Block- Underhood. Disconnect the harness connector at the G36 Auxiliary Heater Coolant Pump. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

6. Connect a test lamp between the control circuit terminal 2 and ground.

7. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump Relay ON and OFF with a scan tool.

- **If the test lamp is always OFF and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp, disconnect the X3 harness connector at the X50A Fuse Block- Underhood.

2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the X50A Fuse Block- Underhood.

- **If the test lamp is always OFF and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, test or replace the G36 Auxiliary Heater Coolant Pump.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the disconnect the X3 harness connector at the X50A Fuse Block- Underhood, Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the X50A Fuse Block- Underhood.

- **If the test lamp turns ON and OFF**

8. Test or replace the G36 Auxiliary Heater Coolant Pump.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P0531, P0532, OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of the diagnostic category.

DTC Descriptors

DTC P0531

Air Conditioning (A/C) Refrigerant Pressure Sensor Performance

DTC P0532

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0532	P0532	P0533	-
Signal	P0532	P0532	P0533	P0531
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

Conditions for Running the DTC

P0531

Engage Test

Compressor speed is greater than 300 RPM.

OFF Test

The compressor has been OFF for more than 20 s.

ON Test

The compressor has been ON for more than 10 s.

P0532 and P0533

- Any of the conditions for setting the DTC are met for 15 s.
- 12 V battery system voltage is between 11 - 18 V.

Conditions for Setting the DTC

P0531

Engage Test

The A/C high side pressure sensor change over a predetermined period of time is outside of an acceptable expected amount. The expected amount of change is determined using ambient temperature, coolant temperature, vehicle speed, and fan speed.

OFF Test

The A/C high side pressure sensor value is above the acceptable threshold.

ON Test

The A/C high side pressure sensor value is below the acceptable threshold.

P0532

The engine control module detects that the A/C pressure is less than .25 V.

P0533

The engine control module detects that the A/C pressure is greater than 4.75 V.

Action Taken When the DTC Sets

This is a type B DTC.

Conditions for Clearing the DTC

This is a type B DTC.

Diagnostic Aids

A malfunction within the refrigerant system causing high pressure can cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

GE-48800 CoolTech A/C Recharge Machine

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Install the **GE-48800** CoolTech A/C Recharge Machine.
3. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.
 - **If the reading is not within 10%**
Refer to Circuit/System Testing.
 - **If the reading is within 10%**
4. Refer to [Air Conditioning \(A/C\) System Performance Test](#) .

[Circuit/System Testing](#)

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8 - 5.2 V**
 5. Verify the scan tool Engine Control Module A/C High Side Pressure Sensor parameter is less than .25 V.
 - **If .25 V or greater**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than .25 V**
 6. Connect a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
 7. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 4.75 V.
 - **If 4.75 V or less**
 1. Vehicle OFF, remove the jumper wire and disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.75 V**
 8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P0534: AIR CONDITIONING (A/C) REFRIGERANT CHARGE LOW

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0534

Air Conditioning (A/C) Refrigerant Charge Low

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down and dehumidify the cabin and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor may be activated when any of the following events occur:

- The customer selects ECO or MAX.
- The HVAC system is fan only but the customer selects defrost mode
- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 (HPCM2) uses values from the A/C refrigerant pressure transducers, ambient air temperature sensor, cabin climate control request, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the HPCM2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0534 Case 1

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor has been off for more than 60 min.
- The AC compressor is commanded on and operating above 500 RPM
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 2

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 15Â° C (59Â°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 3

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 5Â° C (41Â°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

Conditions for Setting the DTC

DTC P0534 Case 1

Low side pressure is less than 90 kPa (13.05 PSI) within 60 sec of the compressor turning on

DTC P0534 Case 2

Low side pressure is less than 150 kPa (21.75 PSI) for outside air temperature greater than 20Â° C (68Â°F).

DTC P0534 Case 3

Low side pressure is less than 100 kPa (14.50 PSI) for outside air temperature between 5 - 20Â° C (41 - 68Â°F).

Action Taken When the DTC Sets

Active cooling mode for the battery may be disabled.

Conditions for Clearing the DTC

P0534 is a type B DTC.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Install the appropriate air conditioning service center, vehicle in Service Mode.
2. Verify the low side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C Low Side Pressure Sensor parameter.
 - **If the reading is not within 3%**

Refer to **DTC P151C or P2516-P2518**.
 - **If the reading is within 3%**
3. Verify the high side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C High Side Pressure Sensor parameter.
 - **If the reading is not within 3%**

Refer to **DTC P0531, P0532, or P0533**.
 - **If the reading is within 3%**
4. Verify the A/C System is operating correctly, refer to **Air Conditioning (A/C) System Performance Test**.
5. Clear all codes in the K114B Hybrid Powertrain Control Module 2 using a scan tool.
6. Verify DTC P0534 does not set while operating the HVAC system under the Conditions for Running the DTC.
 - **If the DTC is set**

Replace the K114B Hybrid Powertrain Control Module 2.
 - **If the DTC is not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup.

DTC P0D69-P0D7F: A/C COMPRESSOR MOTOR VOLTAGE SENSOR AND ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0D69

A/C Compressor Motor Voltage Sensor Performance

DTC P0D6A

A/C Compressor Motor Voltage Sensor Circuit High Voltage

DTC P0D6B

A/C Compressor Motor Voltage Sensor Circuit Low Voltage

DTC P0D71

Electric A/C Compressor Control Module Internal Temperature Sensor Performance

DTC P0D72

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit High Voltage

DTC P0D73

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit Low Voltage

DTC P0D76

Electric A/C Compressor Control Module Output Driver Temperature Sensor Performance

DTC P0D77

Electric A/C Compressor Control Module Output Driver Temperature Sensor Circuit High Voltage

DTC P0D78

Electric A/C Compressor Control Module Output Driver Temperature Sensor Circuit Low Voltage

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button
- The HVAC control, in AUTO mode, requests the electric AC compressor on to help in cooling the cabin or removing moisture in the defrost mode

- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This speed request message is sent from the Hybrid/EV Powertrain Control Module 2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0D69

- 12 V battery system voltage is greater than 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A; P0D6B, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A must not be set.

DTC P0D6A

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P2534, P2535, P3061, or U016B must not be set.

DTC P0D6B

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, or U016B must not be set.

DTC P0D71 or P0D76

- 12 V battery system voltage is above 10.2 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor has been off for more than 2 hours
- Outside air temperature is greater than -7°C (19°F)
- DTCs P0071, P0072, P0073, P0074, P0D72, P0D73, P0D77, P0D78, P2534, P2535, or U016B must not be set

DTC P0D72, P0D73, P0D77, or P0D78

- 12 V battery system voltage is above 10.2 V.
- DTCs P2534, P2535, or U016B must not be set

Conditions for Setting the DTC

DTC P0D69

A/C compressor motor voltage is greater than 30 V.

DTC P0D6A

The A/C compressor high voltage input sensor value is greater than 527.25 V for 1 second.

DTC P0D6B

The A/C compressor high voltage input sensor value is less than 27.75 V for 1 second.

DTC P0D71

The A/C compressor processor temperature sensor value is greater than 22°C (72°F).

AND

The difference between the A/C compressor processor temperature sensor value and the outside air temperature value is greater than 22°C (72°F).

DTC P0D72

A/C compressor processor temperature sensor value is less than -40°C (-40°F) for 6 seconds.

DTC P0D73

A/C compressor processor temperature sensor value is greater than 150°C (302°F) for 6 seconds.

DTC P0D76

The A/C compressor temperature sensor value is greater than 22°C (72°F).

AND

The difference between the A/C compressor temperature sensor value and the outside air temperature value is greater than 22°C (72°F).

DTC P0D77

A/C compressor temperature sensor value is less than -40°C (-40°F) for 6 seconds.

DTC P0D78

A/C compressor temperature sensor value is greater than 150°C (302°F) for 6 seconds.

Action Taken When the DTC Sets

The A/C compressor is disabled.

Conditions for Clearing the DTC

These are all type B DTC's

Reference Information

Schematic Reference

[HVAC Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Automatic HVAC Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0071, P0072, P0073, P0074, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A are not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If none of the DTCs are set**

3. Verify that DTC P0D6B is not set.

- **If DTC P0D6B is set**

Refer to Circuit/System Testing

- **If DTC P0D6B is not set**

4. Verify that DTC P0D69, P0D6A, P0D71, P0D72, P0D73, or P0D74 are not set.

- **If any of the DTCs are set**

1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.
2. Verify the DTC's do not set

- If any of the DTC's set, replace the affected control module.
- If none of the DTC's are set

3. All OK.

- **If none of the DTCs are set**

5. All OK.

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the G1 A/C Compressor. Refer to [High Voltage Disabling](#) .
2. Disconnect the X5 harness connector at the A4 Hybrid/EV Battery Pack and the X2 harness connector at the G1 A/C Compressor. Refer to [High Voltage Connectors](#) .
3. Verify the inline harness connector X130 is properly connected.
4. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:

- A4 Hybrid/EV Battery Pack harness connector terminal 1 X5 and G1 A/C Compressor harness connector terminal A X2.
- A4 Hybrid/EV Battery Pack harness connector terminal 2 X5 and G1 A/C Compressor harness connector terminal B X2.
- **If 2 Ω or greater**

Replace the 300-Volt Positive and Negative Cable.

- **If less than 2 Ω**

5. Verify the F1HA G1 A/C Compressor fuse is not open. Refer to [High Voltage Battery Disconnect Relay Fuse Replacement \(Front - BDU\)](#) [High Voltage Battery Disconnect Relay Fuse Replacement \(Rear - BDU\)](#) .

- **If the F1HA G1 A/C Compressor fuse is open**

Replace the fuse and the G1 A/C Compressor.

- **If the F1HA G1 A/C Compressor fuse is not open**

6. Replace the G1 A/C Compressor.

7. Operate the vehicle within the conditions for running the DTC. Verify the DTC does not set.

- **If the DTC sets**

Replace the A28 Hybrid/EV Battery Contactor Assembly.

- **If the DTC does not set**

8. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P151C OR P2516-P2518: AIR CONDITIONING (A/C) REFRIGERANT LOW SIDE PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P151C

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Not Plausible

DTC P2516

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Performance

DTC P2517

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit Low Voltage

DTC P2518

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0CE5 00, P0CE6 00,	P2516 00 P2517 00	P0CE7 00, P0606 00,	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	P0606 00, P2517 00, P26A6 00, P2681 00		P2518 00, P26A7 00	
A/C Low Pressure Sensor Signal	P2516 00 P2517 00	P2517 00	P0CE5 00, P0CE7 00, P0606 00, P2518 00, P26A5 00, P26A9 00	P2516 00
Low Reference	-	P2517 00	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor. The Hybrid/EV Powertrain Control Module 2 supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the Hybrid/EV Powertrain Control Module 2 to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low.

Conditions for Running the DTC

P151C

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0531, P0532, P0533, P0606.
- Outside Air Temperature raw and corrected values must have had a chance to settle out. Once this occurs these variables are assigned a status of valid. The vehicle may need to have some time driving in EV mode.
- Coolant temperature must be within 15 degrees of outside air temperature.
- Outside Air Temperature between 0Â°C (32Â°F) and 25Â°C (77Â°F).
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- High side refrigerant pressure reading must be between 0 kPa and 675 kPa.

P2516

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0606.

- Coolant temperature must be within 15 degrees of outside air temperature.
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- AC compressor must be turned on for one minute. (This may require the service technician to select an HVAC mode that causes the AC compressor to run).

P2517 or P2518

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.

Conditions for Setting the DTC

DTC P151C

- The A/C low side Refrigerant Pressure reading and the A/C high side Refrigerant Pressure reading differ by more than 200 kPa (29 psi).
- Loss of HVAC Control Module communication

DTC P2516

The difference between the A/C low side pressure Sensor before compressor on and after compressor on changes less than 50 kPa (7 psi) over a 15 second period.

DTC P2517

The Hybrid/EV Powertrain Control Module 2 detects a short to ground or open at the A/C low side pressure sensor signal circuit.

DTC P2518

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage at the A/C low side pressure sensor signal circuit.

Action Taken When the DTC Sets

These are type B DTCs.

Conditions for Clearing the DTC

These are type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs U0140 and U184B are not set.

- **If any of the DTCs are set**

Refer to **DTC U0100-U02FF** , or **DTC U184B** .

- **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, all vehicle systems OFF, scan tool disconnected, and key removed from vehicle, disconnect the harness connector at the B1C A/C Low Side Pressure Sensor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the terminals listed below and ground.
 - Terminal 63
 - Terminal 64
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit terminal 63 end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If greater than 5.2 V**
1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
2. Test for less than 1 V between the terminals listed below and ground.
 - Signal circuit terminal 25
 - Signal circuit terminal 31
 - Signal circuit terminal 50
 - 5 V reference circuit terminal 63
 - 5 V reference circuit terminal 64
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If between 4.8 - 5.2 V**
5. Verify the scan tool Hybrid/EV Powertrain Control Module 2 A/C Low Side Pressure Sensor parameter is less than 0.1 V.
 - **If 0.1 V or greater**
 - 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 - 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 0.1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C Low Side Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 - 1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 - 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If greater than 4.8 V**
8. Test or replace the B1C A/C Low Side Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P154F: ELECTRIC A/C COMPRESSOR MOTOR INPUT CURRENT- POSITIVE CONTACTOR STATE NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P154F

Electric A/C Compressor motor Input Current- Positive Contactor State Not Plausible

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the electrical current reported by the compressor is not logical based on the currently commanded state, the hybrid powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A.
- The time since the high voltage contactors have been commanded opened or closed is greater than 1 s.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 250 ms when the above conditions are met.

Conditions for Setting the DTC

DTC P154F is a Type B DTC.

Condition 1

- The high voltage battery contactors are commanded open.
- Electrical current is reported via serial data from the A/C compressor.

Condition 2

- The high voltage battery contactors are commanded closed.
- The A/C compressor is commanded OFF (0 RPM).
- Electrical current is reported via serial data from the A/C compressor.

OR

- The RPM reported via serial data from the A/C compressor is greater than 60 RPM.

Condition 3

- The high voltage battery contactors are commanded closed.
- The high voltage battery is between 300 - 410 V.
- The A/C compressor is commanded ON.
- The RPM reported via serial data from the A/C compressor is between 1000 - 8600 RPM.
- The A/C refrigerant high side pressure reported via serial data from the ECM is between 200 - 2300 kPa (29 - 334 PSI).
- Electrical current reported via serial data from the A/C compressor is less than 0.2 A or greater than 27 A.

Action Taken When the DTC Sets

DTC P154F is a Type B DTC.

Conditions for Clearing the DTC

DTC P154F is a Type B DTC.

Diagnostic Aids

These DTCs may be set during a stall.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

[Circuit/System Verification](#)

1. Verify DTCs P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A. are not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
2. Replace the G1 A/C Compressor.
3. Verify DTC P154F does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTCs sets**

Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the DTCs does not set**
4. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[HVAC Component Replacement Reference](#)

[Control Module References](#) for control module replacement, programming and setup.

DTC P156A-P156C: AIR CONDITIONING (A/C) PRESSURE

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of the diagnostic category.

[DTC Descriptors](#)

DTC P156A

Air Conditioning (A/C) Pressure Too High when A/C Off

DTC P156B

Air Conditioning (A/C) Pressure Too Low when A/C On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P0532, P0641	P0532	P0453, P0533, P0641	-
Signal	P0532	P0532	P0533	P0531, P156A, P156B
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

If the engine control module detects the refrigerant pressure sensor signal is not logical based on the current operating conditions, the engine control module sets the DTC.

Conditions for Running the DTC

P156A

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been OFF for more than 20 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

P156B

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been ON for more than 10 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

Conditions for Running the DTC

P156A

- P156A is a type B DTC
- The ECM detects the A/C high side pressure is too high based on the current operating conditions.

P156B

- P156B is a type B DTC

- The ECM detects the A/C high side pressure is too low based on the current operating conditions.

Action Taken When the DTC Sets

P156A and P156B are type B DTCs

Conditions for Clearing the DTC

P156A and P156B are type B DTCs

Diagnostic Aids

A malfunction within the refrigerant system causing can cause these DTCs to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

GE-48800 CoolTech A/C Recharge Machine

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If no other DTCs are set**

3. Install the appropriate Air Conditioning Service Center.
4. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.

- **If the reading is not within 10%**

Refer to [DTC P0531, P0532, or P0533](#).

- **If the reading is within 10%**

5. Refer to [Air Conditioning \(A/C\) System Performance Test](#) .

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

DTC P15C6 OR P15C8-P15CB: ELECTRIC A/C COMPRESSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for a overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P15C6

Electric A/C Compressor Speed Request Signal Message Counter Incorrect

DTC P15C8

Electric A/C Compressor Data Message Counter Incorrect

DTC P15C9

Electric A/C Compressor Status Message Counter Incorrect

DTC P15CA

Electric A/C Compressor Sensors Signal Message Counter Incorrect

DTC P15CB

Electric A/C Compressor Sensors Status Message Counter Incorrect

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the message counter from the A/C compressor is not incrementing based on the currently commanded state, the hybrid

powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P2534, P2535, or U016B
- The A/C compressor is active.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 100 ms when the above conditions are met.

Conditions for Setting the DTC

The hybrid powertrain control module 2 detects the message counter from the A/C compressor is not being updated.

Action Taken When the DTC Sets

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Conditions for Clearing the DTC

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **[Automatic HVAC Description and Operation](#)**
- **[Hybrid/EV Cooling System Description and Operation](#)**

Electrical Information Reference

- **[Circuit Testing](#)**
- **[Connector Repairs](#)**
- **[Testing for Intermittent Conditions and Poor Connections](#)**
- **[Wiring Repairs](#)**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify DTCs P2534, P2535, or U016B are not set.

- **If DTC P2534, P2535, or U016B are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If DTC P2534, P2535, or U016B are not set**

2. Replace the G1 A/C Compressor.

3. Verify DTCs P15C6, P15C8, P15C9, P15CA, or P15CB do not set while operating the vehicle within the Conditions for Running the DTC.

- **If any of the DTCs are set**

Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[HVAC Component Replacement Reference](#)

[Control Module References](#) for control module replacement, programming and setup.

DTC P1F0A-P1F0D: A/C COMPRESSOR MOTOR AND ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1F0A

A/C Compressor Motor Speed Performance

DTC P1F0B

A/C Compressor Motor Start-Up Current Performance

DTC P1F0C

DTC P1F0D

Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit High Voltage

Circuit/System Description

The A/C compressor function is to provide refrigerant flow in the A/C refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High voltage battery and inverts it to alternating current for the motor. The A/C compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button
- The HVAC control, in AUTO mode, requests the electric A/C compressor on to help in cooling the cabin or removing moisture in the defrost mode
- The High Voltage Battery Thermal System requests the A/C compressor on to help maintain the battery temperature

The Hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the Hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

A/C Compressor has a motor start up procedure that can take a variable length of time to run to bring the motor up to requested speed. Length of time is dependent on external conditions such as underhood temperature and high side pressure. In hotter conditions, the motor start up time will be longer. The A/C compressor control module monitors an internal parameter known as the DC link current which is based off DC input current. It is not possible to measure this parameter externally.

Conditions for Running the DTC

DTC P1F0A

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0B

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0C

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0D

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

Conditions for Setting the DTC

DTC P1F0A

- A/C compressor control module temperature is greater than 85°C (185°F) and compressor motor speed does not reach to 1800 RPM within 20 s after the start of spinning
- A/C compressor control module temperature is less than or equal to 85°C and A/C compressor motor speed does not reach to 1800 RPM.

DTC P1F0B

Any A/C compressor control module phase current (U/V/W) greater than or equal to -1 A during initial motor startup process

DTC P1F0C

A/C compressor control module DC link Current is less than 2.5 A for 6 s

DTC P1F0D

A/C compressor control module DC link Current is greater than 36.7 A for 6 s

Action Taken When the DTC Sets

The A/C compressor control module is disabled but will retry once the compressor speed request goes to 0 RPM and a new speed request greater than 0 RPM is sent.

Conditions for Clearing the DTC

These are type B DTC's

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs P1F0A-P1F0D are not set.
 - **If any of the DTCs are set**
 1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.
 2. Verify the DTCs do not set
 - If any of the DTCs set, replace the affected control module.
 - If none of the DTCs are set
 - 3. All OK.
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- HVAC Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DTC P15C5, P2682, P2683, P26A5-P26A7, P26A9, P26AD, OR P26AE: ENGINE COOLANT BYPASS VALVE POSITION SENSOR/ENGINE COOLANT BYPASS VALVE CONTROL CIRCUITS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P15C5 00

Engine Coolant Bypass Valve Position Sensor Range/ Performance - Unexpected Position Change Detected

DTC P2682 00

Engine Coolant Bypass Valve Control Circuit 1 Low Voltage

DTC P2683 00

Engine Coolant Bypass Valve Control Circuit 1 High Voltage

DTC P26A5 00

Engine Coolant Bypass Valve Position Sensor Range/ Performance

DTC P26A6 00

Engine Coolant Bypass Valve Position Sensor Circuit Low Voltage

DTC P26A7 00

Engine Coolant Bypass Valve Position Sensor Circuit High Voltage

DTC P26A9 00

Engine Coolant Bypass Valve Position Sensor Stop/ Minimum Stop Performance

DTC P26AD 00

Engine Coolant Bypass Valve Control Circuit 2 Low Voltage

DTC P26AE 00

Engine Coolant Bypass Valve Control Circuit 2 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Valve Control Circuit 1	P2682 00	P2683 00, P26A9 00	P2683 00	-
Valve Control Circuit 2	P26AD 00	P26AE 00, P26A9 00	P26AE 00	-
Coolant Valve Position Sensor 5 V Reference	P26A6 00	P26A6 00	P26A7 00	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Valve Position Sensor Signal	P26A5 00, P26A6 00	P26A5 00, P26A7 00	P26A5 00, P26A7 00	P15C5 00, P26A5 00, P26A9 00
Coolant Valve Position Sensor Low Reference	-	P26A7 00	-	-

Circuit/System Description

The passenger compartment heater coolant control valve regulates the engine coolant flow into the cabin heater loop depending on engine coolant temperature and ambient temperature conditions. The passenger compartment heater coolant control valve has two positions: ByPass or Link. In the ByPass position, the coolant in the engine loop and heater loop are separated and in the link position the coolant circulates through both loops. The valve movement is controlled by a bidirectional motor. A 50% duty cycle is a normal duty cycle. A 75% duty cycle represents a valve commanded to the link position. A 25% duty cycle represents a valve commanded to the ByPass position. The passenger compartment heater coolant control valve uses an internal position sensor that sends a signal to the hybrid powertrain control module 2 to determine the valve position.

When the engine coolant temperature heats up, a valve learn procedure takes place. The hybrid powertrain control module 2 commands the valve to the link position and records the voltage coming back from the position sensor. Then the hybrid powertrain control module 2 commands the valve back to the bypass position and records the voltage coming back from the position sensor. The voltage values in both the link and bypass positions must fall within calibrated ranges.

Conditions for Running the DTC

P15C5

- 12 V battery system voltage is greater than or equal to 10.2 V.
- The propulsion system is active.
- None of the following DTCs are set: P2682, P2683, P26A5, P26A6, P26A7, P26A9, P26AD, or P26AE.
- The valve control command is stop.

P2682

- 12 V battery system voltage is greater than 10.2 V.
- The valve control 1 command is low.

P2683

- 12 V battery system voltage is greater than 10.2 V.
- The valve control 1 command is high or stop.

P26A5

- 12 V battery system voltage is greater than or equal to 10.2 V.
- The propulsion system is active.
- None of the following DTCs are set: P2682, P2683, P26A6, P26A7, P26AD, or P26AE.

- The valve control command is stop.

P26A6 and P26A7

12 V battery system voltage is greater than 10.2 V.

P26A9

- 12 V battery system voltage is greater than 10.2 V.
- The propulsion system is active.
- None of the following DTCs are set; P0116, P0117, P0118, P0119, P2682, P2683, P26A6, P26A7, P26AD, P26AE.
- The coolant temperature is above 58°C(136°F).

P26AD

- 12 V battery system voltage is greater than 10.2 V.
- The valve control 2 command is low.

P26AE

- 12 V battery system voltage is greater than 10.2 V.
- The valve control 2 command is high or stop.

Conditions for Setting the DTC

P15C5

The hybrid powertrain control module 2 has detected the valve feedback has drifted out of the commanded position when the valve command is stop.

P2682

The hybrid powertrain control module 2 has detected a short to ground on the valve drive 1 circuit.

P2683

The hybrid powertrain control module 2 has detected a short to voltage or an open on the valve drive 1 circuit.

P26A5

The hybrid powertrain control module 2 has detected the valve feedback has exceeded the valid range.

P26A6

The hybrid powertrain control module 2 has detected a short to ground on feedback circuit. The feedback signal is less than 5% (0.25 V).

P26A7

The hybrid powertrain control module 2 has detected a short to voltage on feedback circuit. The feedback signal

is greater than 95% (4.25 V).

P26A9

- The valve has not reached the commanded position, valve position relearn was attempted and the valve still does not reach the commanded position.

OR

- An open circuit condition exists on either of the valve control circuits.

P26AD

The hybrid powertrain control module 2 has detected a short to ground on the valve drive 2 circuit.

P26AE

The hybrid powertrain control module 2 has detected a short to voltage or an open on the valve drive 2 circuit.

Action Taken When the DTC Sets

DTCs P15C5, P2682, P2683, P26A5, P26A6, P26A7 P26A9, P26AD, and P26AD are type B DTCs.

Conditions for Clearing the DTC

DTCs P15C5, P2682, P2683, P26A5, P26A6, P26A7 P26A9, P26AD, and P26AD are type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0116, P0117, P0118, or P0119 is not set.

- **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Refer to Circuit/System testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the Q66 Passenger Compartment Heater Coolant Control Valve. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 5 and ground.

- **If 5 Ω or greater**

1. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If less than 5 Ω**

3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 6 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 5.2 V**

1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool Hybrid Powertrain Control Module 2, Passenger Compartment Heater Coolant Control Solenoid Valve Feedback parameter is greater than 95%.
 - **If less than 95%**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the signal circuit terminal 50 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 95%**
 6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 5.
 7. Verify the scan tool Passenger Compartment Heater Coolant Control Solenoid Valve Feedback parameter is less than 10%.
 - **If 10% or greater**
 1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 50 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Vehicle OFF.
 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 10%**
 8. Vehicle OFF, remove the jumper wire.
 9. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 10. Test for less than 1 V between each control circuit listed below and ground:
 - Q66 Passenger Compartment Heater Coolant Control Valve terminal 1
 - Q66 Passenger Compartment Heater Coolant Control Valve terminal 2
 - **If 1 V or greater**

Repair the short to voltage on the circuit.
 - **If less than 1 V**
 11. Vehicle OFF.
 12. Test for infinite resistance between each control circuit listed below and ground:
 - Q66 Passenger Compartment Heater Coolant Control Valve terminal 1

- Q66 Passenger Compartment Heater Coolant Control Valve terminal 2
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If infinite resistance**

13. Test for less than 2 Ω in each control circuit end to end.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

14. Replace the Q66 Passenger Compartment Heater Coolant Control Valve.

15. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.

- **If the DTC sets**

Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the DTC does not set**

16. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for the control module replacement, programming and setup.

SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Automatic HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.
- Verify that the customer is using the correct key to enable personalization and is not inadvertently

activating auxiliary HVAC controls.

- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
 - Wet carpet or mats
 - High humidity
 - Interior water leak
 - Blocked A/C evaporator drain tube
 - Maximum passenger capacity
 - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
 - Obstructed or dirty passenger compartment air filter, if equipped
 - Blocked or damaged air inlet or outlet vents

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

HVAC System Malfunction

HVAC SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Vehicle in Service Mode.
2. Verify every applicable scan tool switch parameter changes when pressing the appropriate switch on the A26 HVAC Controls.
 - **If any parameter does not change**
Replace the A26 HVAC Controls.
 - **If all parameters change**
3. Verify the blower motor operates properly with the blower motor switch in each speed position.
 - **If the blower motor does not operate properly in each speed position**
Refer to **DTC B0193**.
 - **If the blower motor operates properly in each speed position**
4. Verify every HVAC door moves correctly when pressing the appropriate switch.
 - **If any HVAC door does not move correctly**
Refer to **DTC B0223, B0233, B023A, or B0408**.
 - **If all HVAC doors move correctly**
5. Install the appropriate ACR Air Conditioning Service Center, Vehicle in Service Mode
6. Verify the high side pressure on the gauge is within 10% of the scan tool A/C High Side Pressure Sensor parameter.
 - **If the A/C High Side Pressure Sensor parameter is not within 10%**
Refer to **DTC P0531, P0532, or P0533**.
 - **If the A/C High Side Pressure Sensor parameter is within 10%**

7. Verify the A/C High Side Pressure Sensor parameter is between 269-2929 kPa (39-425 PSI).

- **If the reading is not between 269-2929 kPa (39-425 PSI)**

Refer to [Air Conditioning \(A/C\) System Performance Test](#)

- **If the reading is between 269-2929 kPa (39-425 PSI)**

8. Verify the low side pressure on the gauge is within 10% of the scan tool A/C Low Side Pressure Sensor parameter.

- **If the A/C Low Side Pressure Sensor parameter is not within 10%**

Refer to [DTC P151C or P2516-P2518.](#)

- **If the A/C Low Side Pressure Sensor parameter is within 10%**

9. Verify the scan tool parameters listed below are within 10% of ambient temperature.

- Lower Left Duct Air Temperature Sensor
- Upper Left Duct Air Temperature Sensor
- **If not within 10% of ambient temperature**

Refer to [DTC B0173 or B0178.](#)

- **If within 10% of ambient temperature**

10. Verify the scan tool Sunload parameter changes while covering the B10B Ambient Light/Sunload Sensor with a shop towel or other suitable item.

- **If the Sunload parameter does not change**

Refer to [DTC B0183.](#)

- **If the Sunload parameter changes**

11. Verify the actual inside air temperature, using a thermometer, is less than 3Â°C (5Â°F) difference from the scan tool Inside Passenger Compartment Air Temp. Sensor parameter.

- **If greater than a 3Â°C (5Â°F) difference**

Refer to [DTC B0163.](#)

- **If less than a 3Â°C (5Â°F) difference**

12. Verify the scan tool parameters listed below are within 10% of actual conditions.

- Passenger Compartment Humidity
- Passenger Compartment Humidity Sensor Temperature
- Passenger Compartment Windshield Temperature
- **If not within 10% of actual conditions**

Refer to [DTC B018A, B048C, B048F, or B1395.](#)

- **If within 10% of actual conditions**

13. Vehicle ON, A/C system ON.

14. Verify cool air flows from the ducts with the temperature control in the coldest position.

- **If the air is not cool**

Refer to [Air Conditioning \(A/C\) System Performance Test](#)

- **If the air is cool**

15. Engine OFF, Vehicle in Service Mode.

16. Verify the G36 Auxiliary Heater Coolant Pump turns On and Off when commanded with a scan tool.

- **If the G36 Auxiliary Heater Coolant Pump does not turn On and Off**

Refer to [DTC B3844](#).

- **If the G36 Auxiliary Heater Coolant Pump turns On and Off**

17. Vehicle ON, verify the K10 Coolant Heater Control Module is operating properly.

- **If the K10 Coolant Heater Control Module is not operating properly**

Refer to [DTC B048E](#)

- **If the K10 Coolant Heater Control Module is operating properly**

18. Verify warm air flows from the ducts with the temperature control in the warmest position.

- **If the air is not warm**

Refer to [Heating Performance Diagnostic](#) .

- **If the air is warm**

19. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

AUXILIARY HEATER COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

DTC B3844 06

Engine Coolant Circulation Pump Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow when the engine is not operating, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G36 Auxiliary Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump Relay On and Off with a scan tool.

- **If the G36 Auxiliary Heater Coolant Pump does not operate**

Refer to [DTC B3844](#).

- **If the G36 Auxiliary Heater Coolant Pump operates**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

AFTERBLOW ENABLING

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned off. This aids in reducing microbial growth that can create undesirable odors.

The vehicle does not come equipped with the afterblow feature turned on. If the afterblow feature is required due to an odor concern, it must be enabled by using the scan tool.

Use the following procedure to enable the afterblow feature:

1. Connect the Scan Tool.
2. Ignition ON/ Vehicle in Service Mode
3. Select Module Diagnostics.
4. Select HVAC Control Module.
5. Select Configuration/Reset Functions.
6. Select HVAC Afterblow Configuration.

When afterblow has been enabled, the following conditions must be met for the HVAC control module to operate afterblow:

- The vehicle must be turned OFF.
- The outside air temperature must be at least 11Â°C (52Â°F) when the compressor was last operating before the engine was turned OFF.
- The A/C compressor must have operated for more than 2 minutes before the engine was turned OFF.
- The system voltage must be above 12 V.

Once the above conditions have been met, the blower motor will operate at a low blower speed, following the sequence below up to 5 times:

1. The blower motor will be OFF for 7 - 11 minutes.
2. The blower motor will operate for 20 - 60 seconds.

ACTUATOR RECALIBRATION

NOTE: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

When replacing the HVAC control module it will be necessary to allow the HVAC control module to perform a calibration process. When installing the HVAC control module be sure to perform the following:

1. Place the ignition switch to the OFF position.
2. Disconnect the scan tool.
3. Install the HVAC control module.
4. Connect all previously disconnected components.
5. Vehicle in Service Mode.
6. Wait 40 seconds for the HVAC control module to self-calibrate.
7. Verify that no DTCs have set as current DTCs.

When replacing the HVAC actuator it will be necessary to allow the HVAC control module to perform a calibration process. When installing the HVAC actuator be sure to perform one of the following:

Preferred Method (with Scan Tool)

NOTE: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

1. Clear all DTCs.
2. Place the ignition switch in the OFF position.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Start the vehicle.
6. With the scan tool, initiate the HVAC Actuators re-calibration feature of the Remote Heater and Air Conditioning Control Module Special Functions menu.
7. Verify that no DTCs have set as current DTCs.

Alternate Method (without Scan Tool)

NOTE: Do not adjust any controls on the HVAC control module while the HVAC control module is self-calibrating. If interrupted, improper HVAC performance will result.

1. Clear all DTCs.
2. Place the ignition switch to the OFF position.
3. Install the HVAC actuator.
4. Connect all previously disconnected components.
5. Remove the HVAC control module fuse for a minimum of 10 seconds.
6. Install the HVAC control module fuse.
7. Vehicle in Service Mode.
8. Wait 40 seconds for the HVAC control module to self-calibrate.
9. Verify that no DTCs have set as current DTCs.

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - HVAC

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:

- Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
- Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
- Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.

2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
- Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
- Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
- Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
- If the wire is damaged, repeat this procedure after removing the damaged section.

4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.

5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

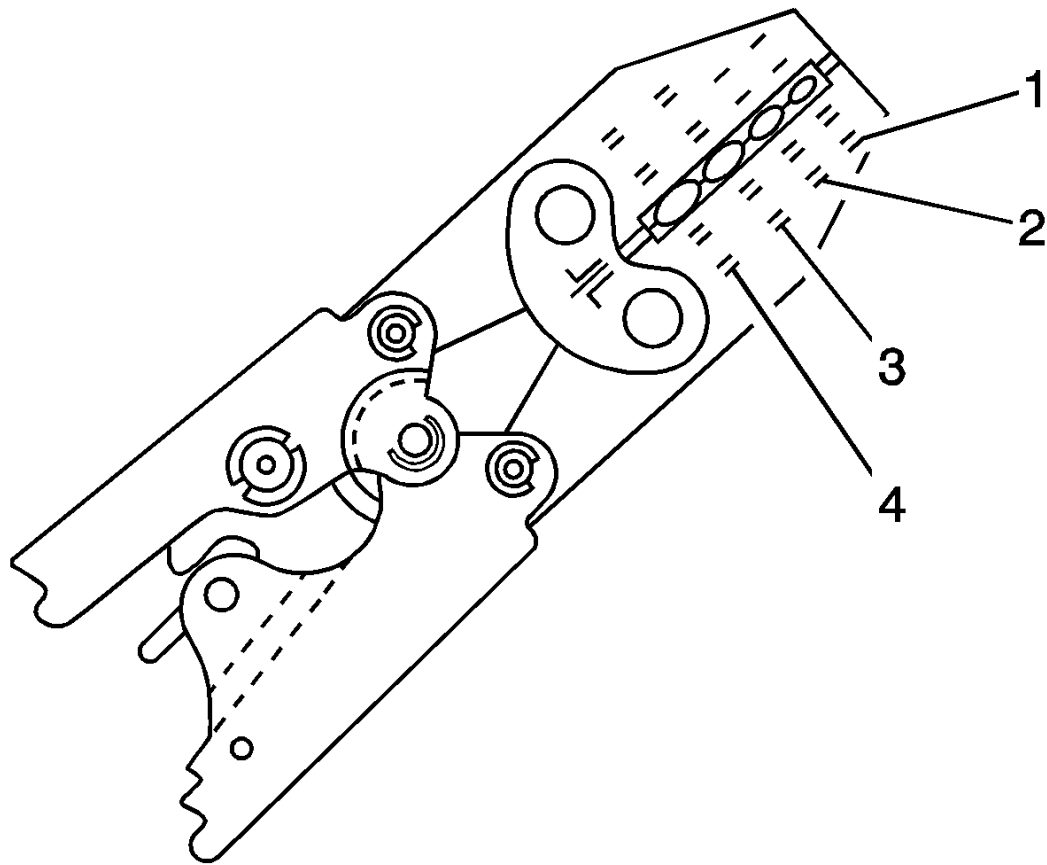


Fig. 6: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

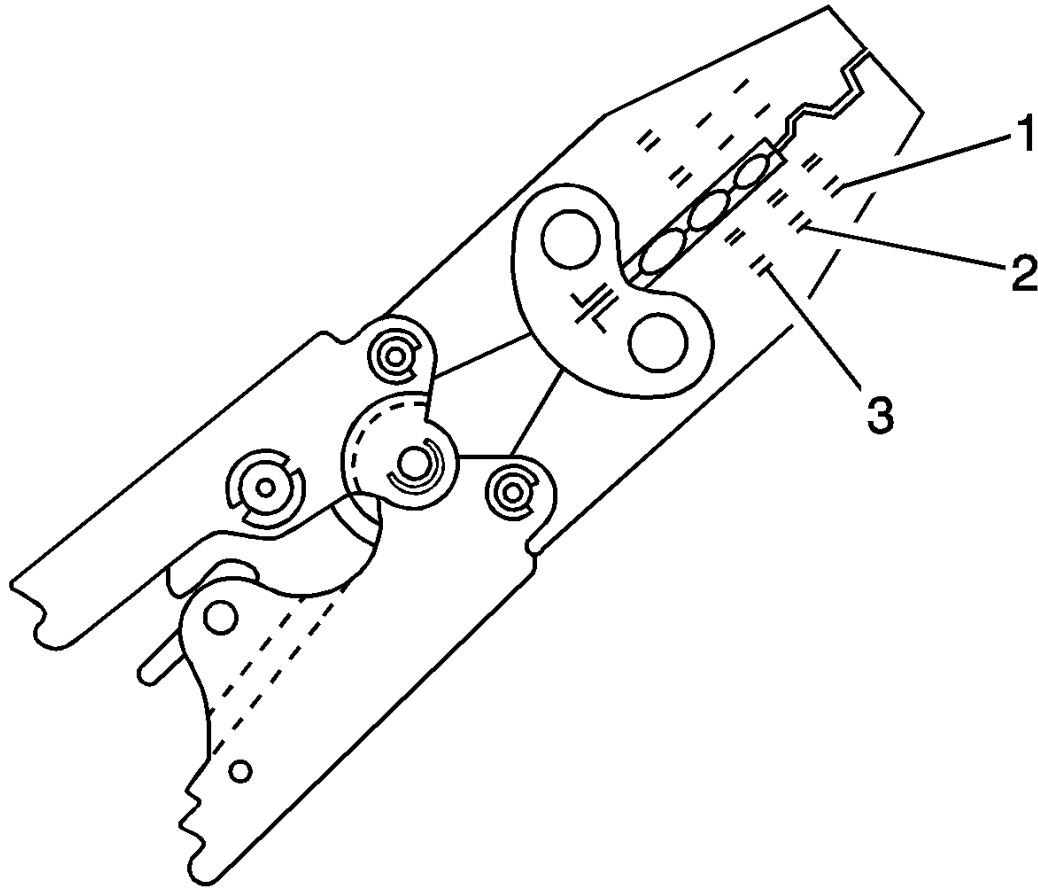


Fig. 7: Splice Sleeve Crimping Tool With 3 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

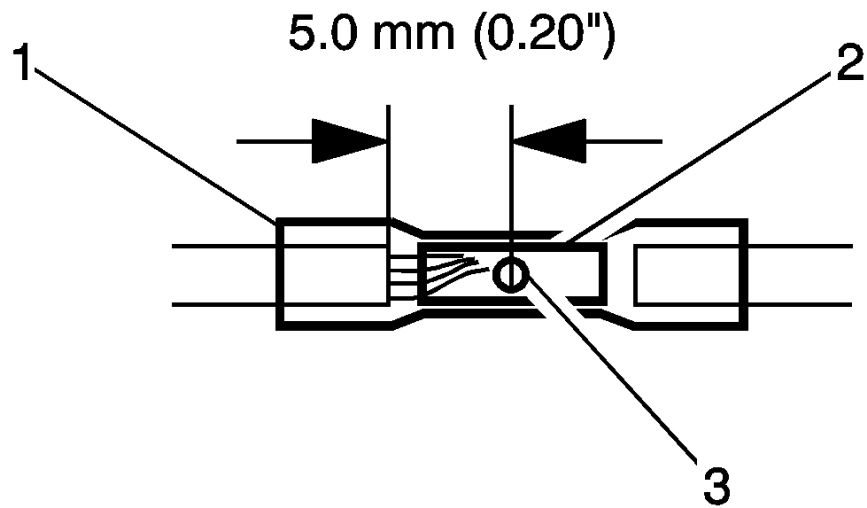


Fig. 8: Identifying Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 9: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 10: Crimped Duraseal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

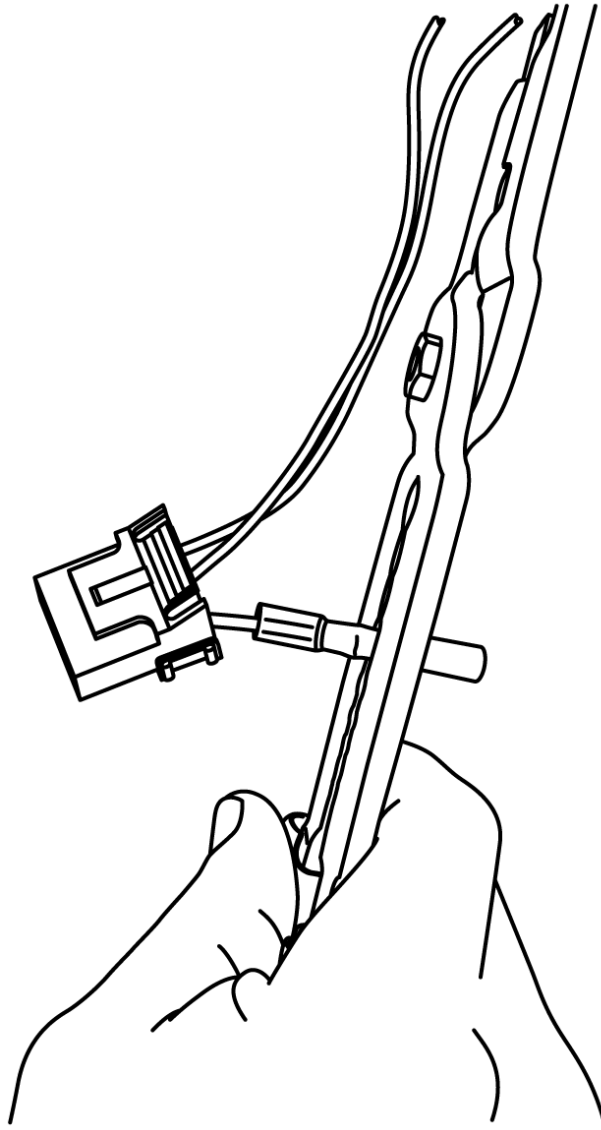


Fig. 11: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

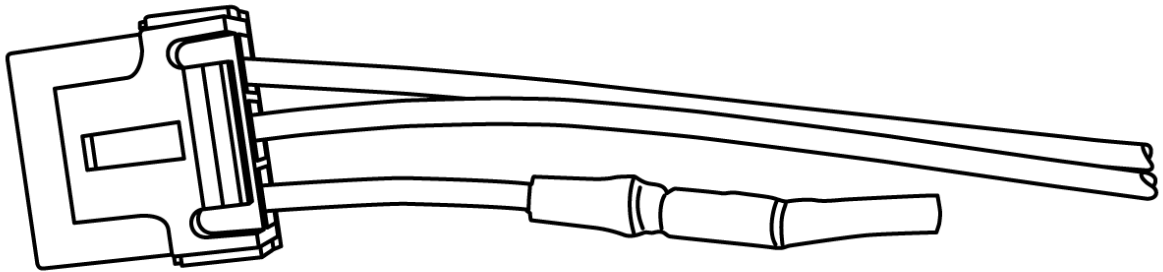


Fig. 12: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

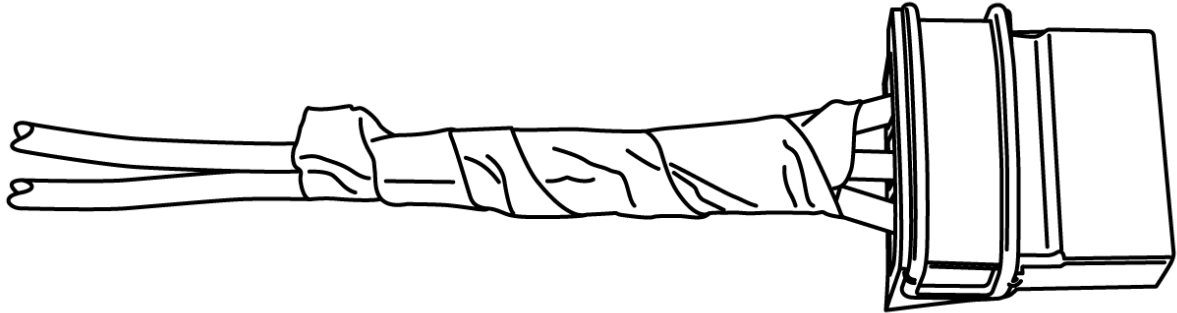


Fig. 13: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - HVAC

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

HEATER AND AIR CONDITIONING USER INTERFACE CONTROL REPLACEMENT

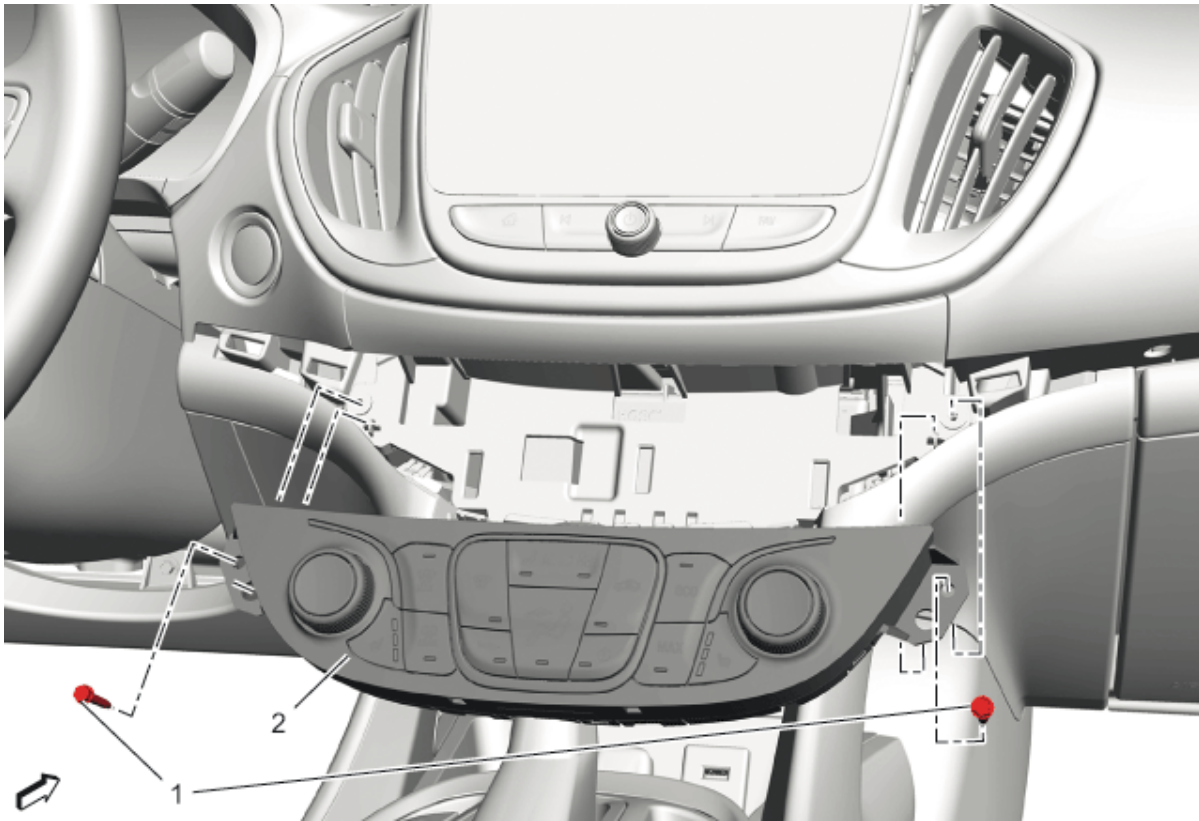


Fig. 14: Heater And Air Conditioning User Interface Control

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Instrument Panel Trim Plate Applique Replacement - Right Side</u> <u>Instrument Panel Lower Center Trim Panel Replacement (Upper)</u> <u>Instrument Panel Lower Center Trim Panel Replacement (Lower)</u>	
1	Heater and Air Conditioning User Interface Control Bolt (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Heater and Air Conditioning User Interface Control Procedure NOTE:

Callout	Component Name
	Considerable force will be required to release the retainers. 1. Release the three metal retainers securing the heater and air conditioning user interface control to the instrument panel center air outlet. 2. Disconnect the electrical connector.

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT

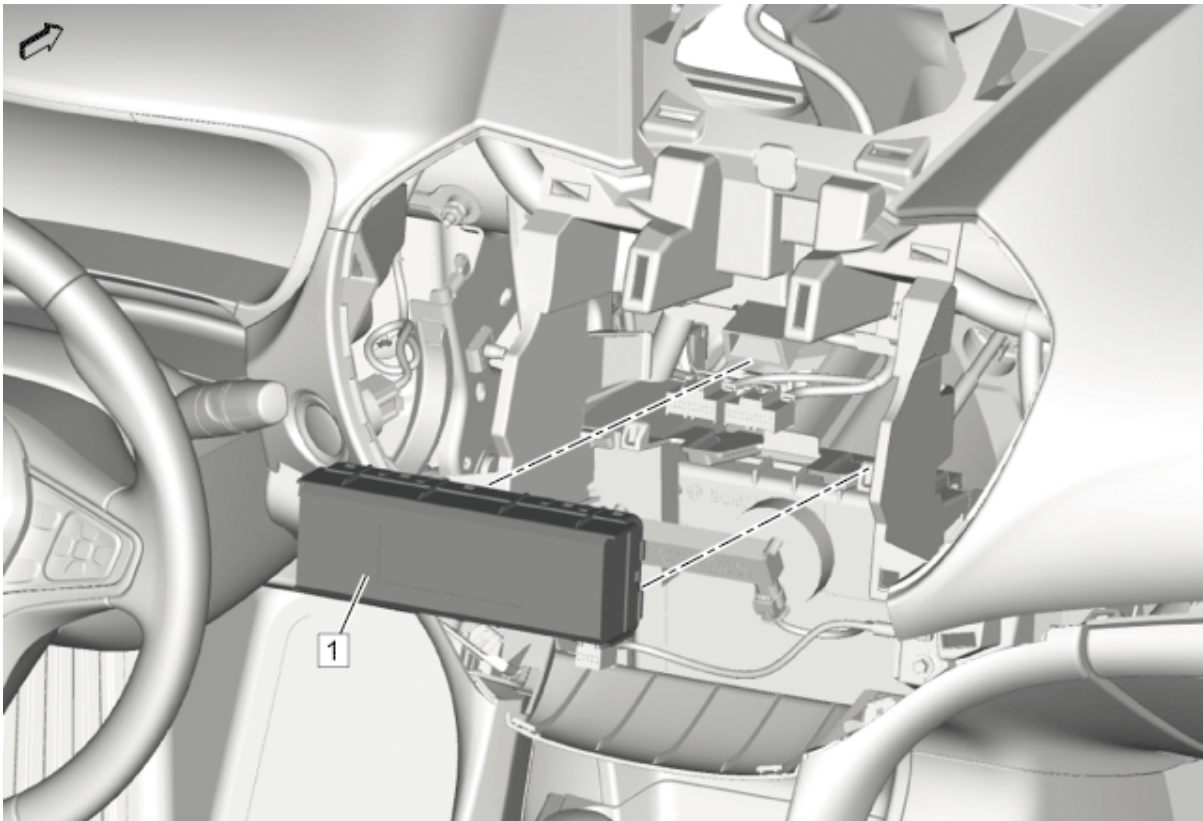


Fig. 15: Heater and Air Conditioning Remote Control
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Prepare the heater and air conditioning remote control for replacement. Refer to Control Module References . 2. Instrument Panel Center Air Outlet Replacement	
1	Heater and Air Conditioning Remote Control

Callout	Component Name
	Procedure 1. Disconnect the electrical connector. 2. Program the heater and air conditioning remote control. Refer to Control Module References .

AIR CONDITIONING MODULE WIRING HARNESS REPLACEMENT

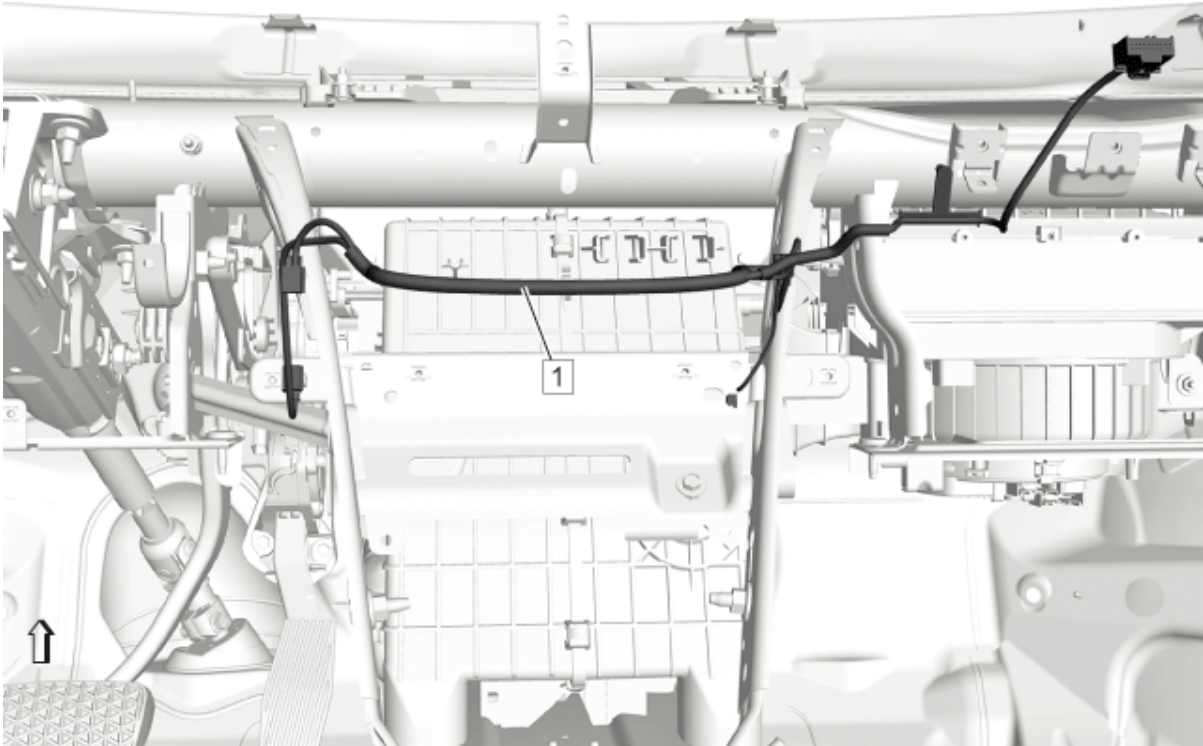


Fig. 16: Air Conditioning Module Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Assembly Replacement	
1	Air Conditioning Module Wiring Harness Procedure Disconnect the electrical connector.

MODE VALVE LEVER REPLACEMENT

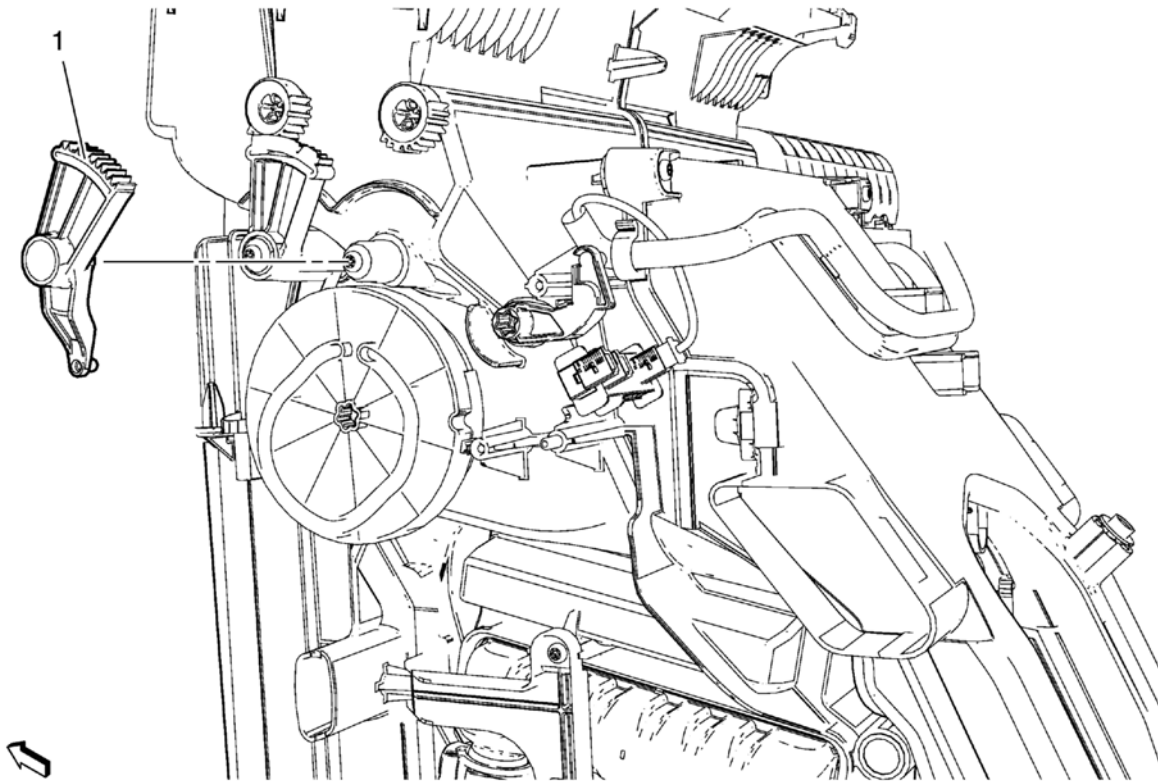


Fig. 17: Mode Valve Lever

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Mode Control Cam Actuator Mounting Plate Replacement</u>	
1	Mode Valve Lever Procedure Lubricate mode valve lever in order to assure proper operation. Use Polylub GLY 801, or equivalent.

VENT VALVE LEVER REPLACEMENT

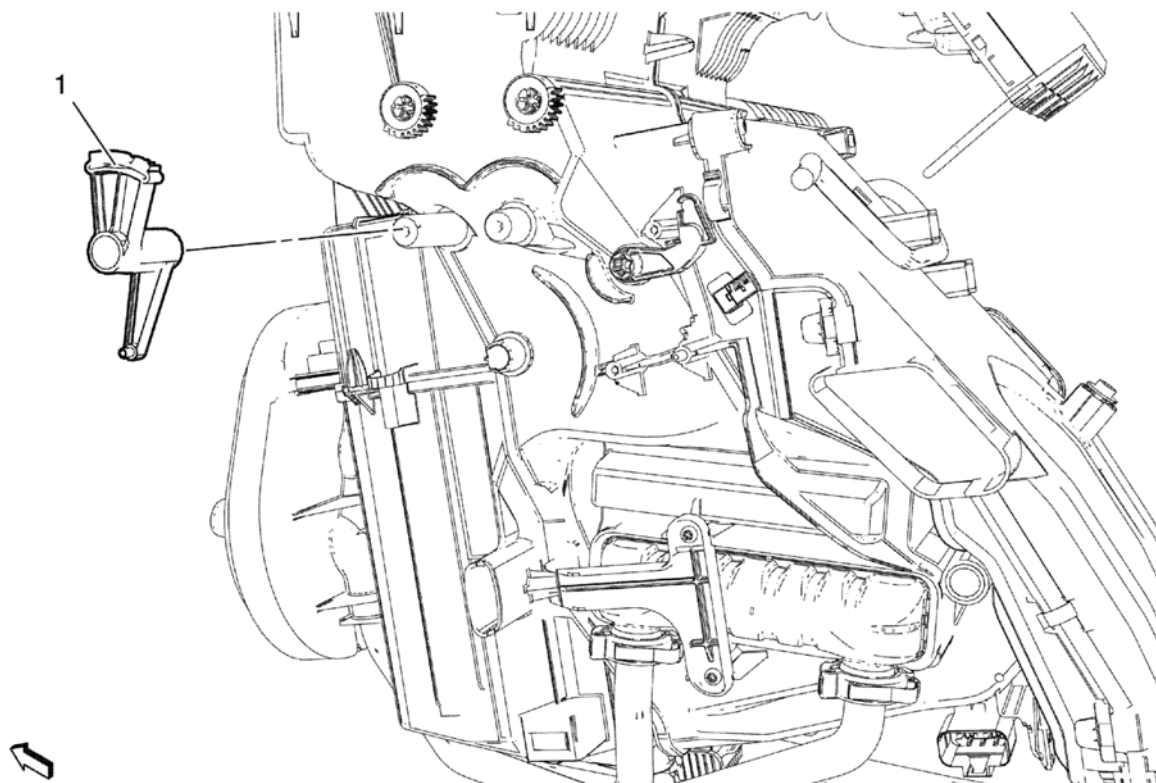


Fig. 18: Vent Valve Lever

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
<u>Mode Control Cam Replacement</u>	
1	Vent Valve Lever Procedure Lubricate vent valve lever in order to assure proper operation. Use Polylub GLY 801, or equivalent.

AIR INLET VALVE LEVER REPLACEMENT - FRONT

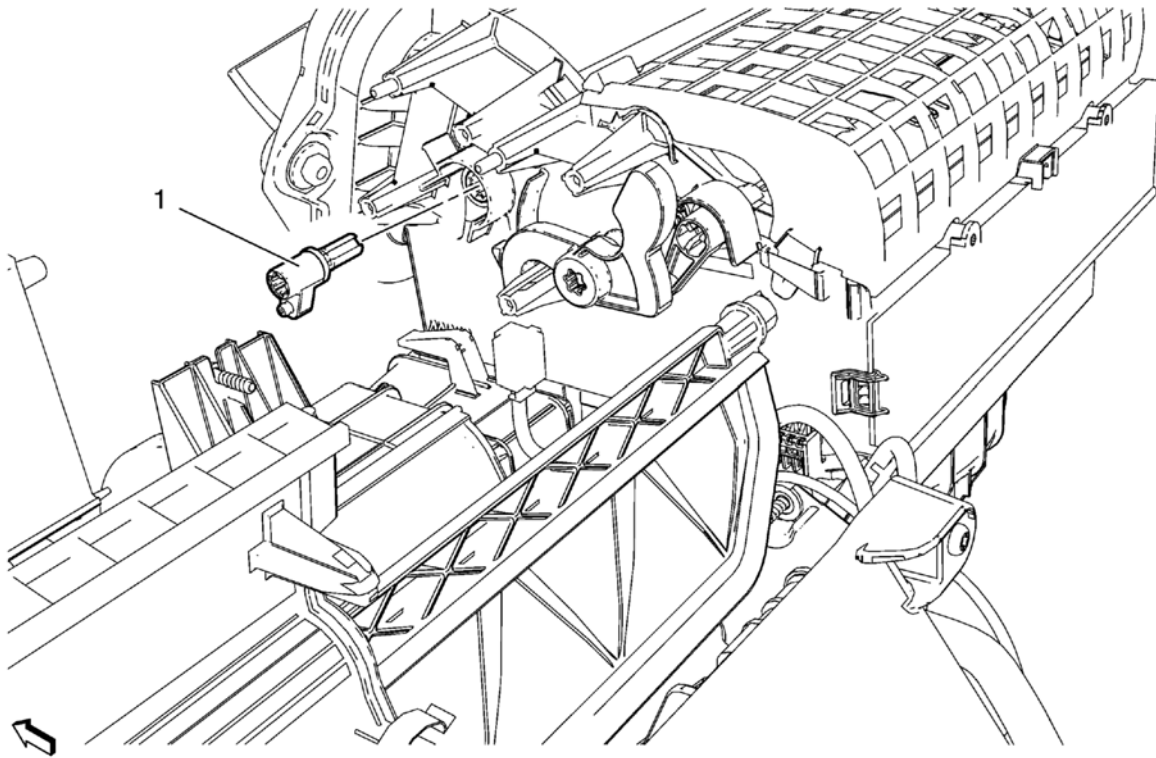


Fig. 19: Air Inlet Valve Lever - Front

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Air Inlet Valve Actuator Replacement</u>	
1	Air Inlet Valve Lever - Front Procedure Lubricate the air inlet valve lever to ensure proper operation. - Use Polylub GLY 801, or equivalent.

AIR INLET VALVE LEVER REPLACEMENT - MIDDLE

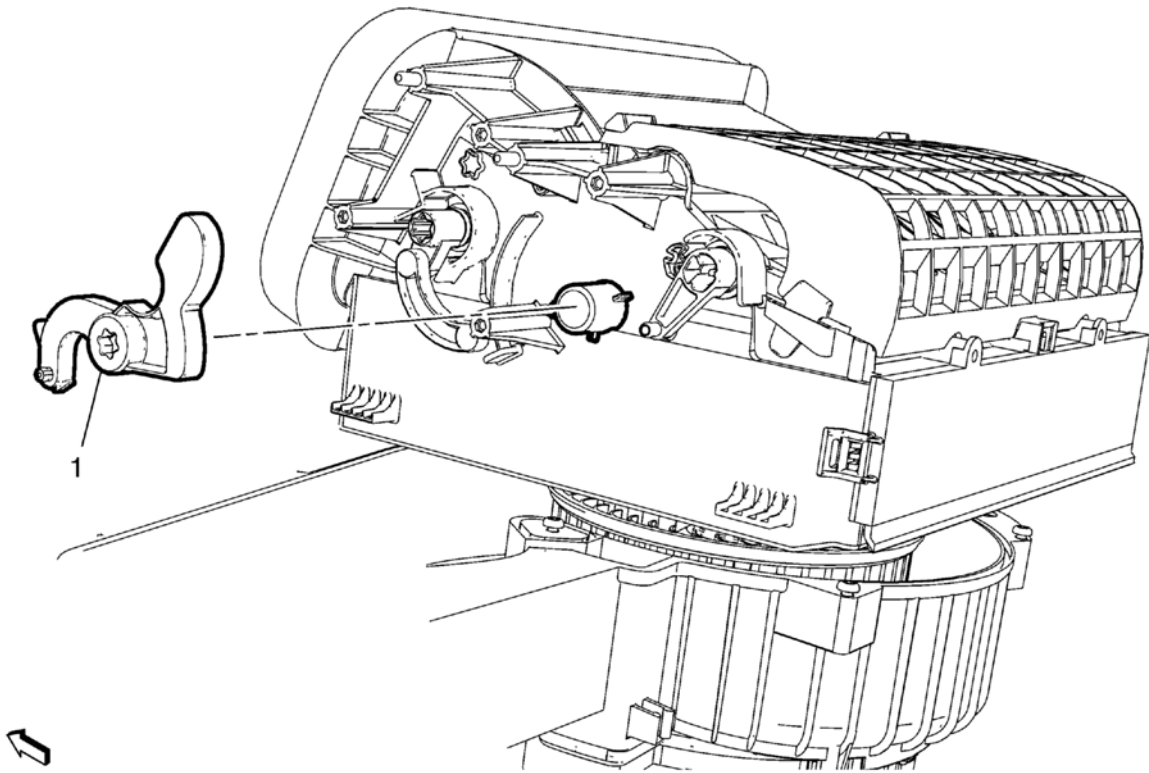


Fig. 20: Air Inlet Valve Lever - Middle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Air Inlet Valve Actuator Replacement</u>	
1	Air Inlet Valve Lever - Middle Procedure Lubricate the air inlet valve lever in order to assure proper operation. Use Polylub GLY 801, or equivalent.

AIR INLET VALVE LEVER REPLACEMENT - REAR

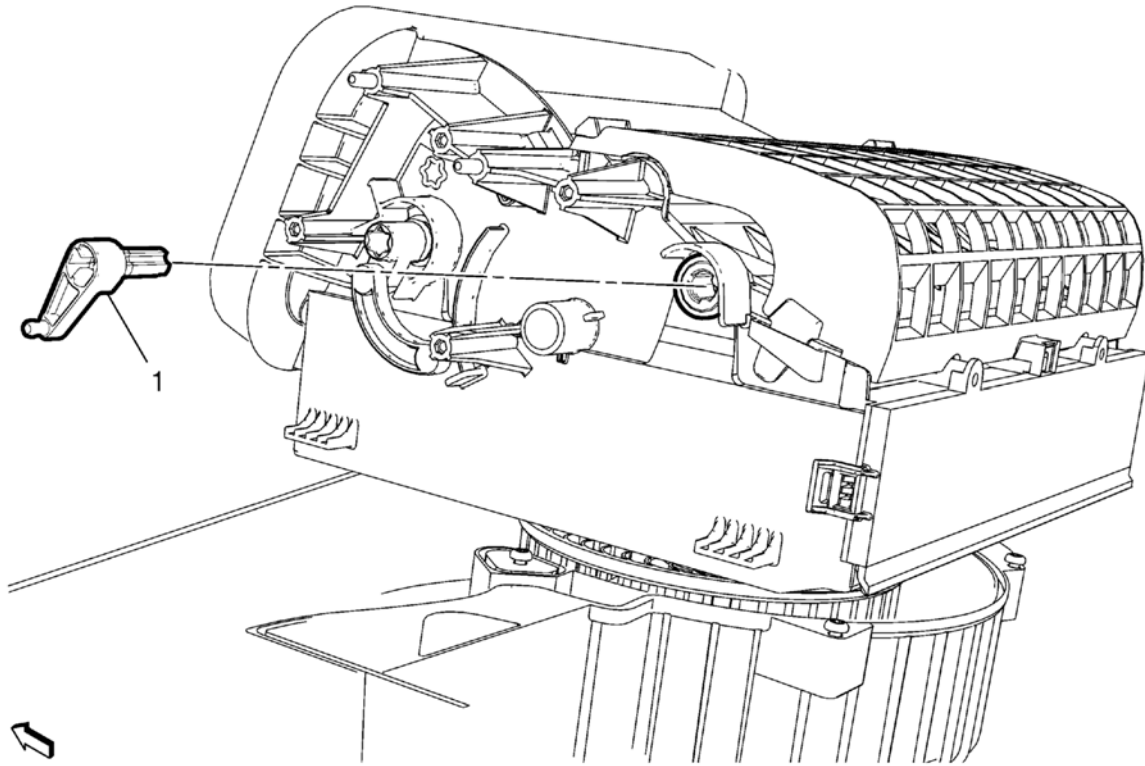


Fig. 21: Air Inlet Valve Lever - Rear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Air Inlet Valve Lever Replacement - Middle</u>	
1	Air Inlet Valve Lever - Rear Procedure Lubricate the air inlet valve lever in order to assure proper operation. Use Polylub GLY 801, or equivalent.

AIR INLET VALVE ACTUATOR REPLACEMENT

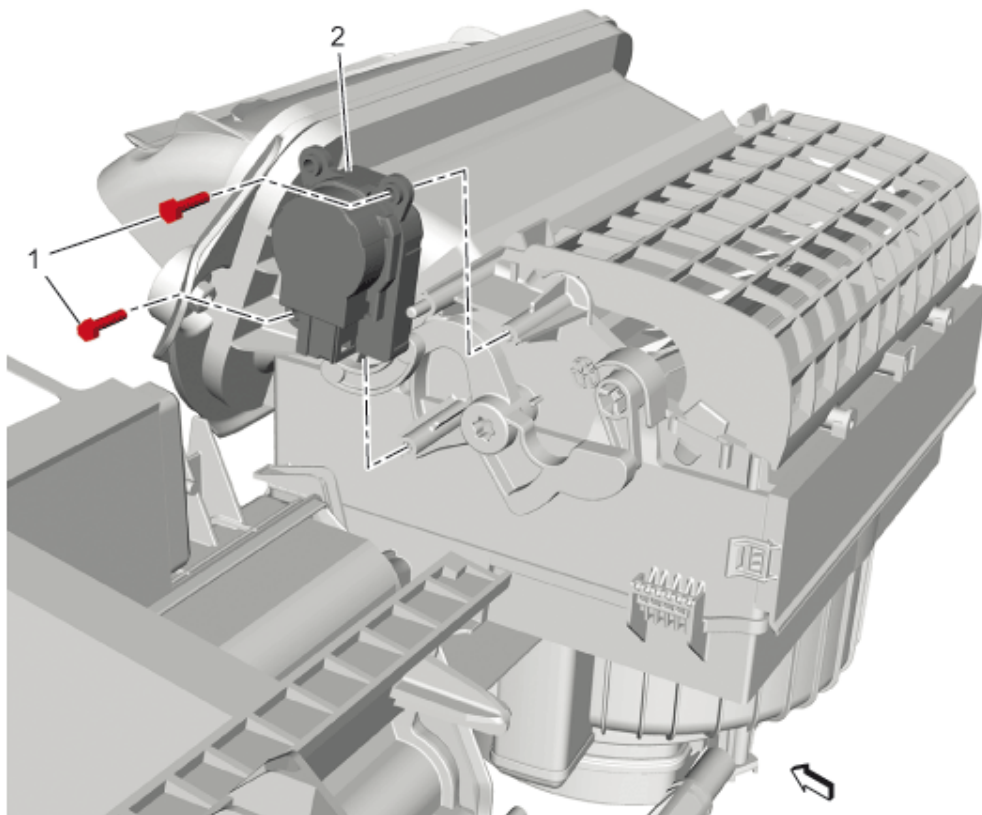


Fig. 22: Air Inlet Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Air Inlet Housing Replacement</u>	
1	Air Inlet Valve Actuator Fastener (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Air Inlet Valve Actuator Procedure 1. Disconnect the electrical connector. 2. <u>Actuator Recalibration</u> - Programming and Setup

AIR INLET VALVE LINK REPLACEMENT

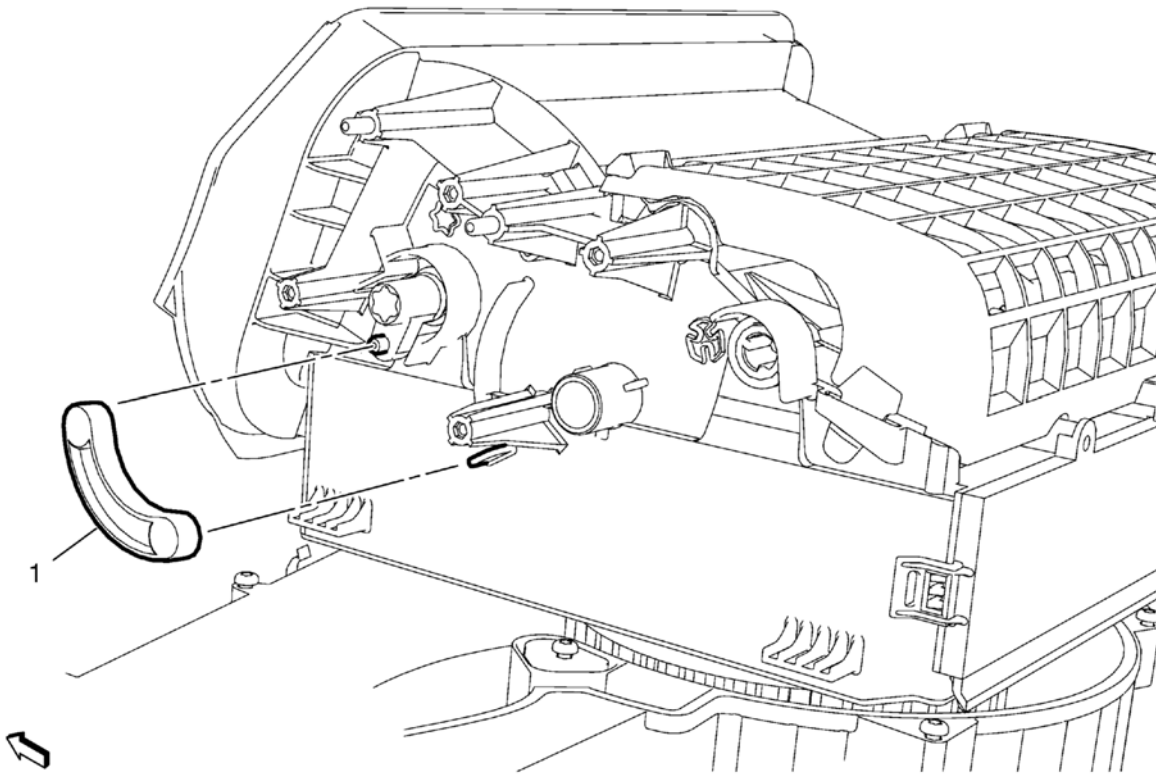


Fig. 23: Air Inlet Valve Link

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Air Inlet Valve Actuator Replacement</u>	
1	Air Inlet Valve Link Procedure Lubricate the air inlet valve link in order to assure proper operation. Use Polylub GLY 801, or equivalent.

MODE VALVE GEAR REPLACEMENT

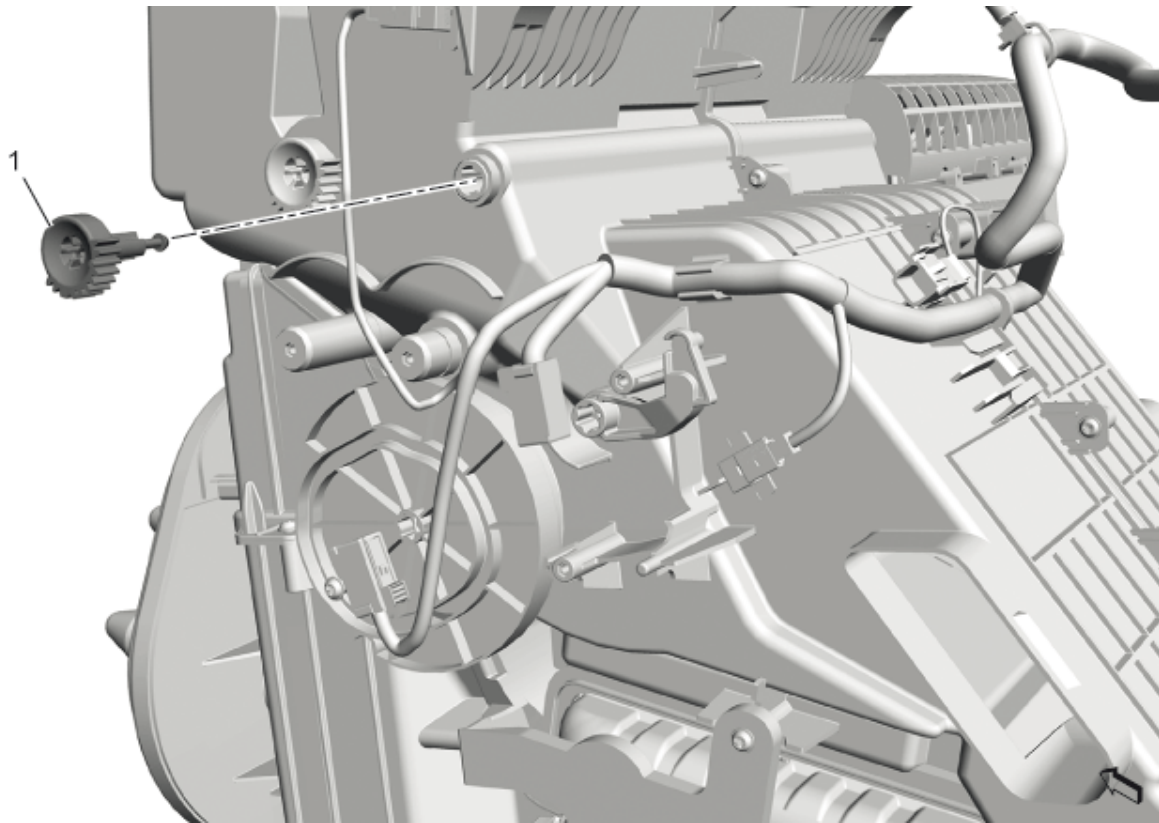


Fig. 24: Mode Valve Gear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Mode Valve Lever Replacement</u>	
1	Mode Valve Gear
	Procedure 1. Mark the location of the gears and levers for proper installation. 2. Lubricate vent valve lever in order to assure proper operation. Use Polylub GLY 801™, or equivalent.

MODE CONTROL CAM ACTUATOR REPLACEMENT

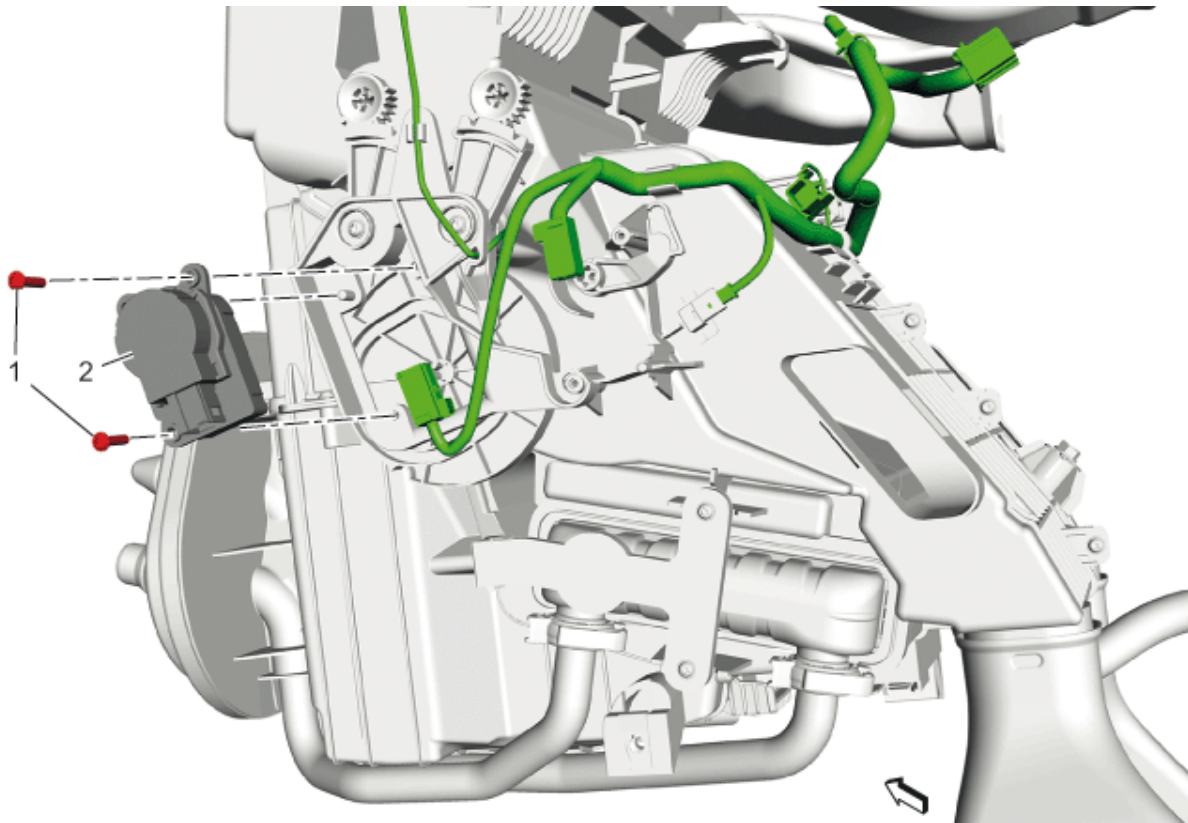


Fig. 25: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Air Conditioning and Heater Module Assembly Removal and Installation</u>	
1	Mode Control Cam Actuator Bolt (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Mode Control Cam Actuator Procedure 1. Mark cam and levers for proper installation. 2. Disconnect the electrical connector. 3. <u>Actuator Recalibration</u>

MODE CONTROL CAM REPLACEMENT

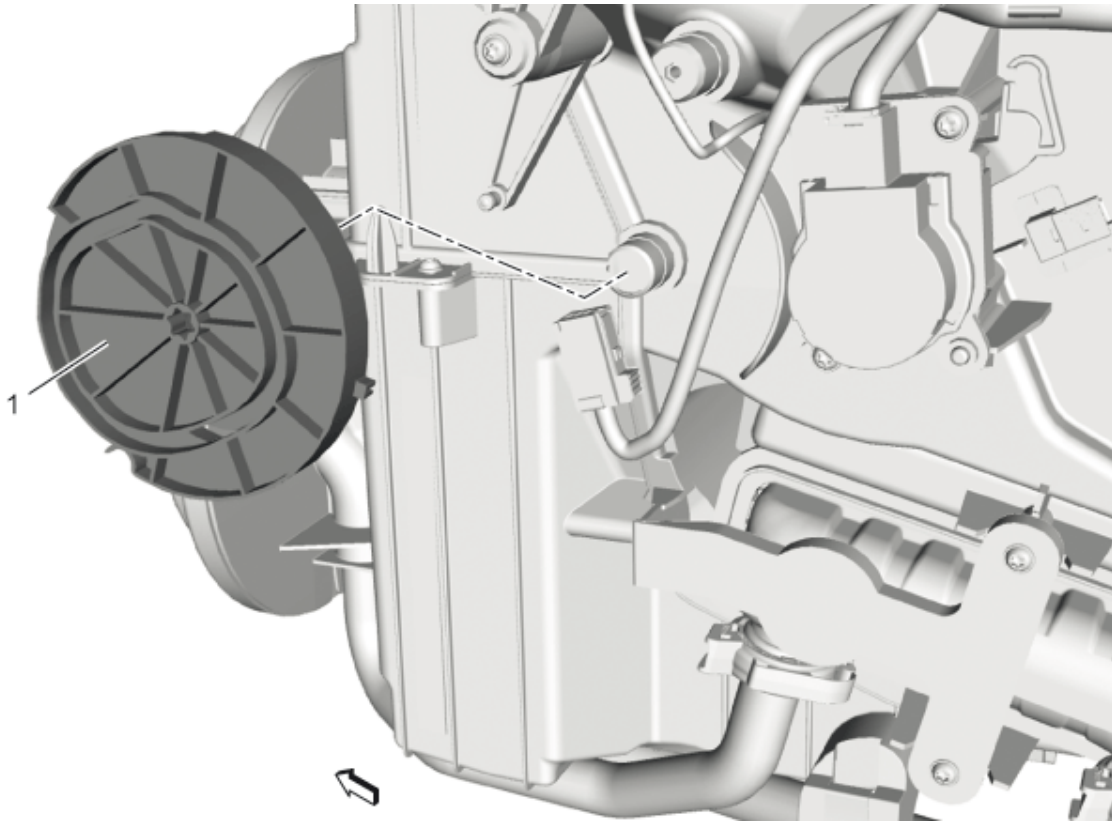


Fig. 26: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Mode Valve Lever Replacement</u>	
1	Mode Control Cam Procedure 1. Mark the cam and levers for proper installation. 2. Lubricate the mode control cam in order to assure proper operation. Use Polyub GLY 801™, or equivalent.

MODE CONTROL CAM ACTUATOR MOUNTING PLATE REPLACEMENT

Removal Procedure

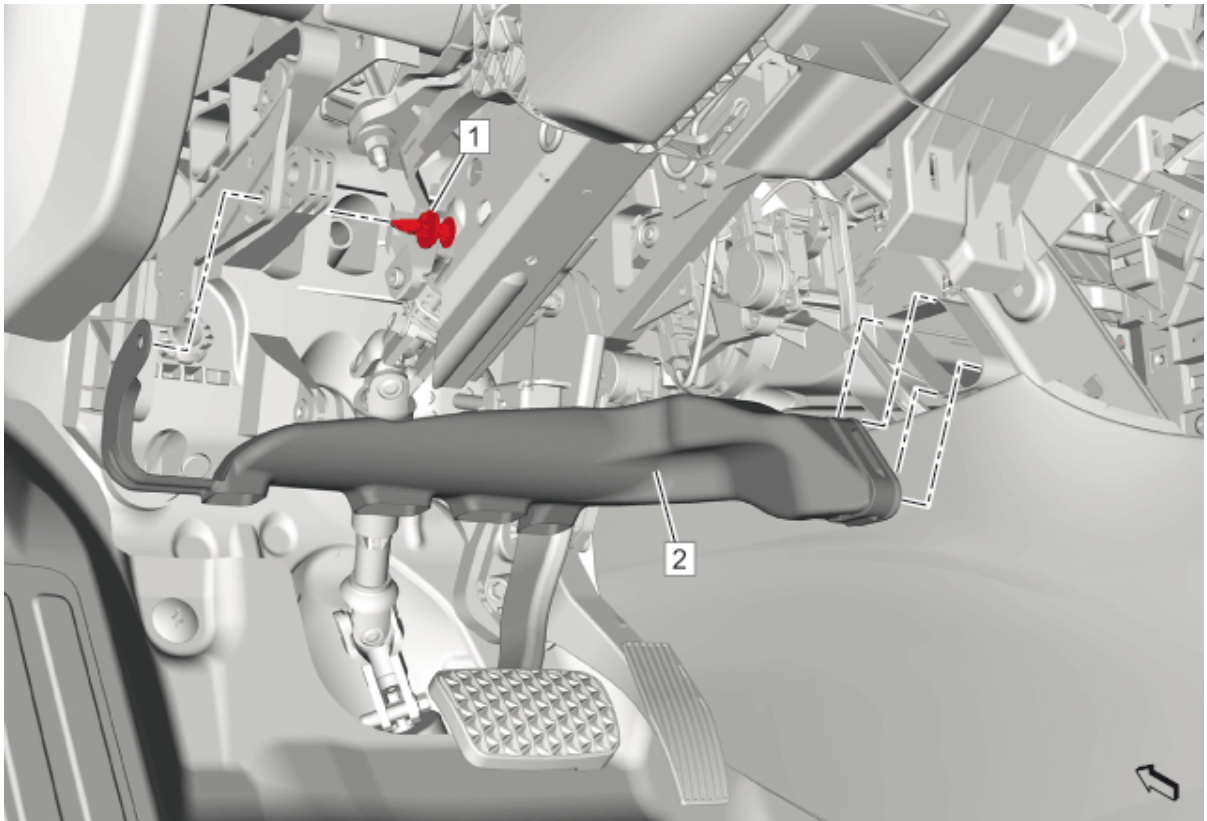


Fig. 27: Floor Front Air Outlet Duct - Left Side

Courtesy of GENERAL MOTORS COMPANY

1. Remove Floor Front Air Outlet Duct - Left Side (2) **Floor Front Air Outlet Duct Replacement - Left Side**

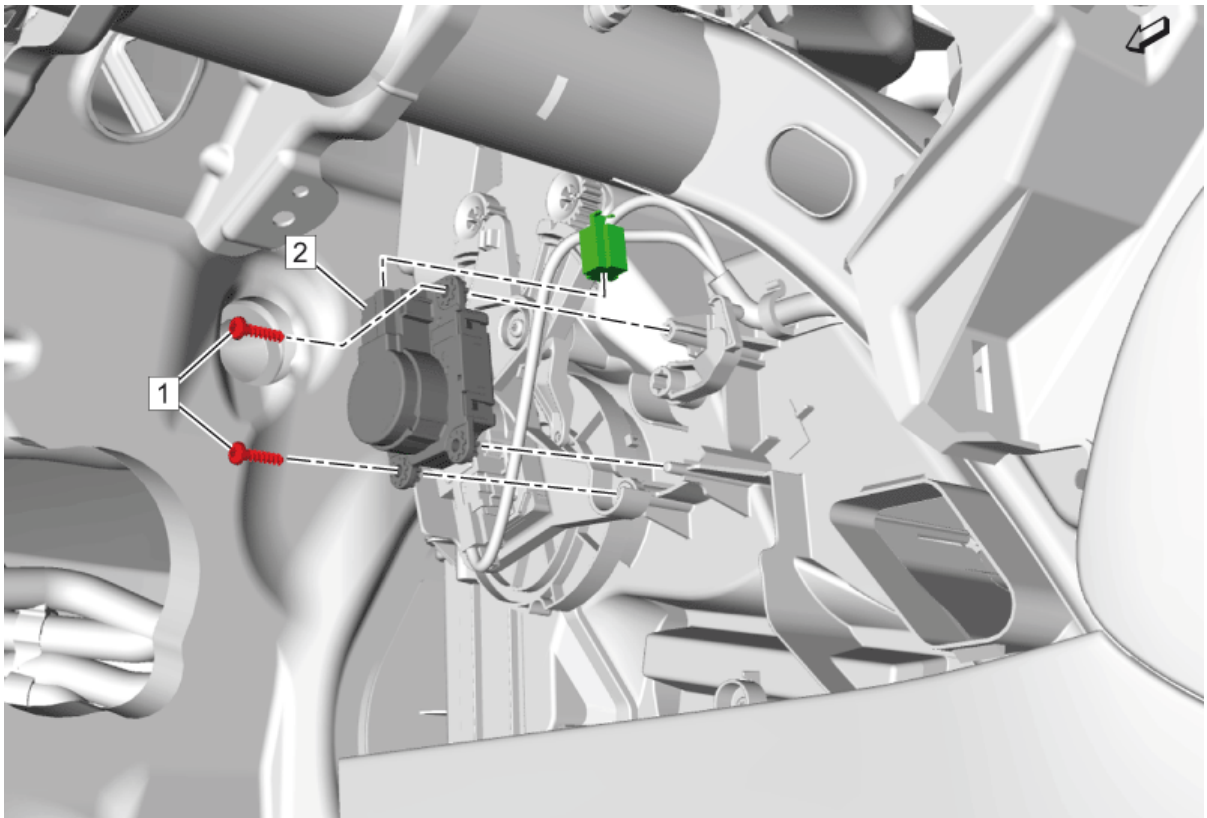


Fig. 28: Temperature Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

2. Remove Temperature Valve Actuator (2) [Temperature Valve Actuator Replacement](#)

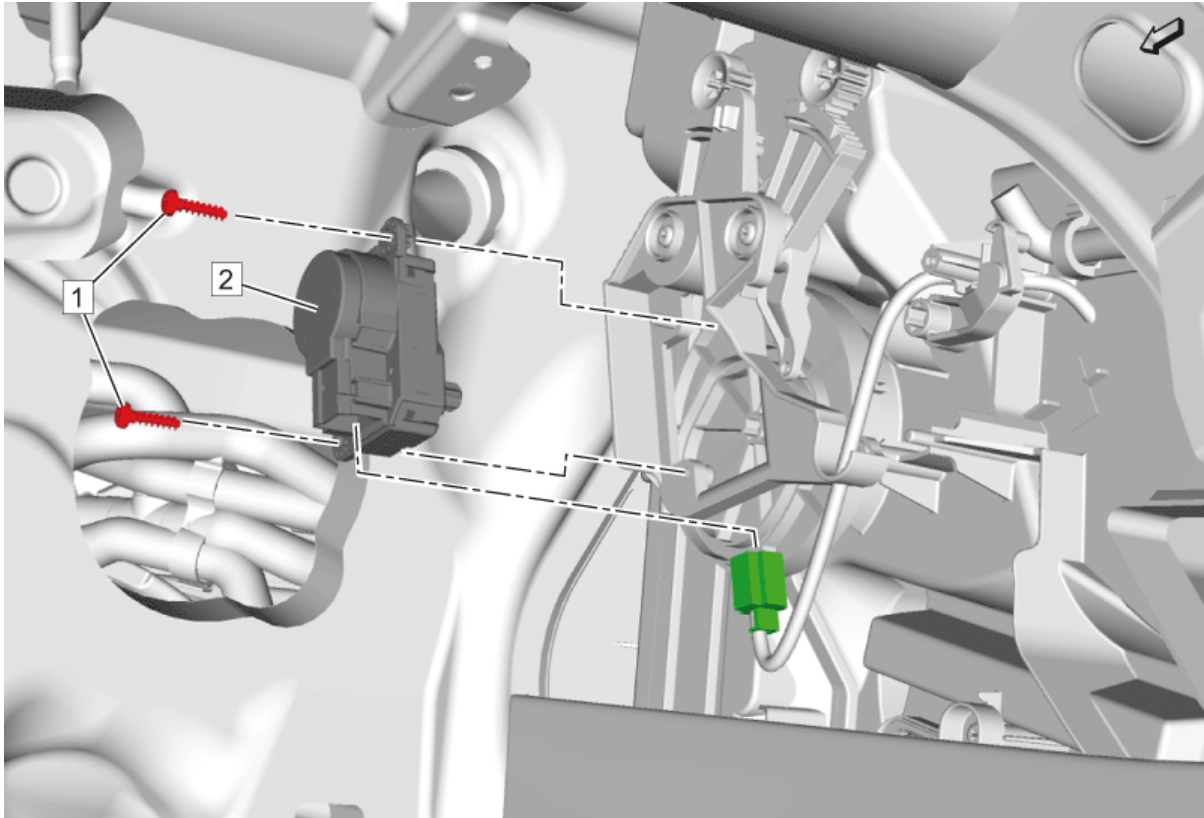


Fig. 29: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

3. Remove Mode Control Cam Actuator (2) [Mode Control Cam Actuator Replacement](#)

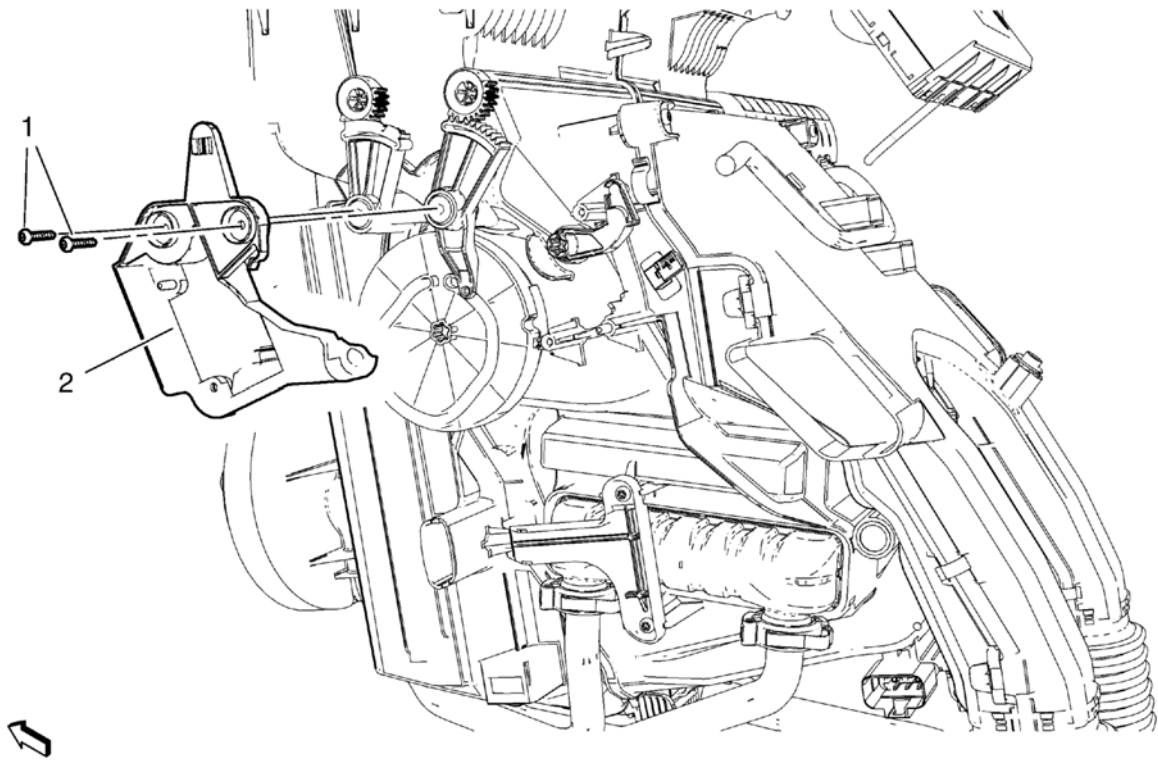


Fig. 30: Mode Control Cam Actuator Mounting Plate & Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Mode Control Cam Actuator Mounting Plate Bolt (1)
5. Remove Mode Control Cam Actuator Mounting Plate (2)

Installation Procedure

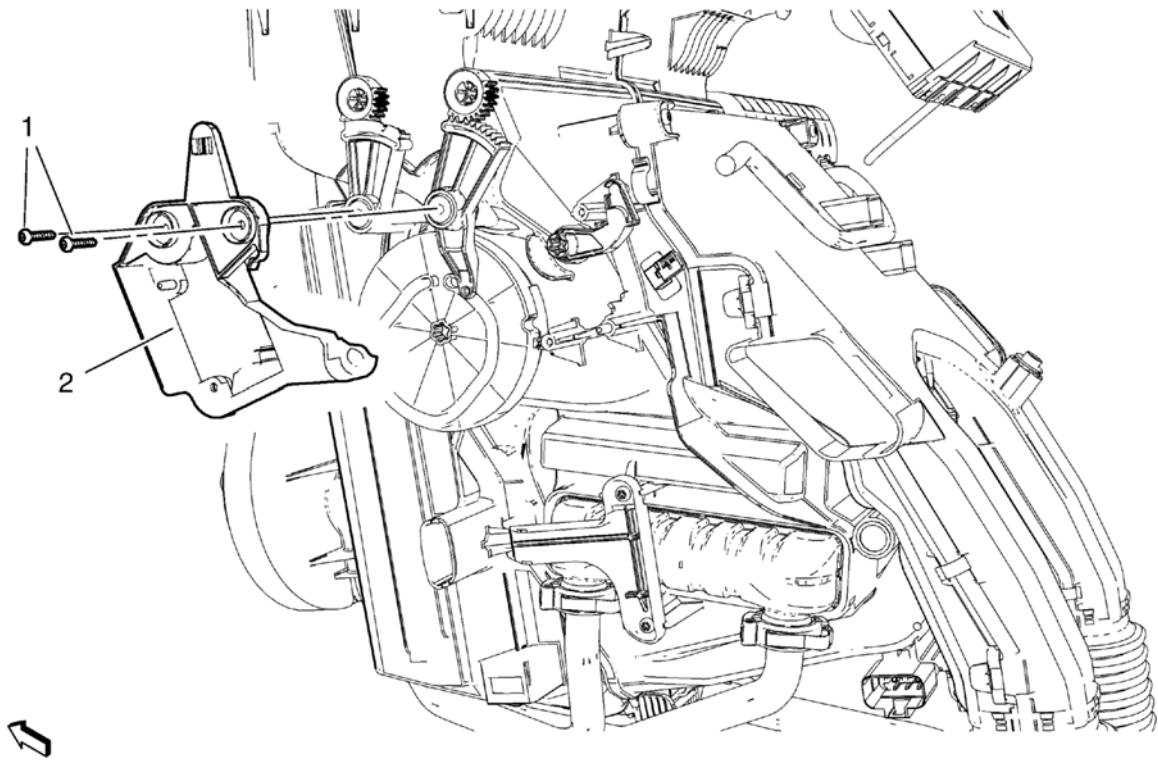


Fig. 31: Mode Control Cam Actuator Mounting Plate & Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Mode Control Cam Actuator Mounting Plate (2)

CAUTION: Refer to **Fastener Caution** .

2. Install Mode Control Cam Actuator Mounting Plate Bolt (1) and tighten 2.5 N.m (22 lb in)

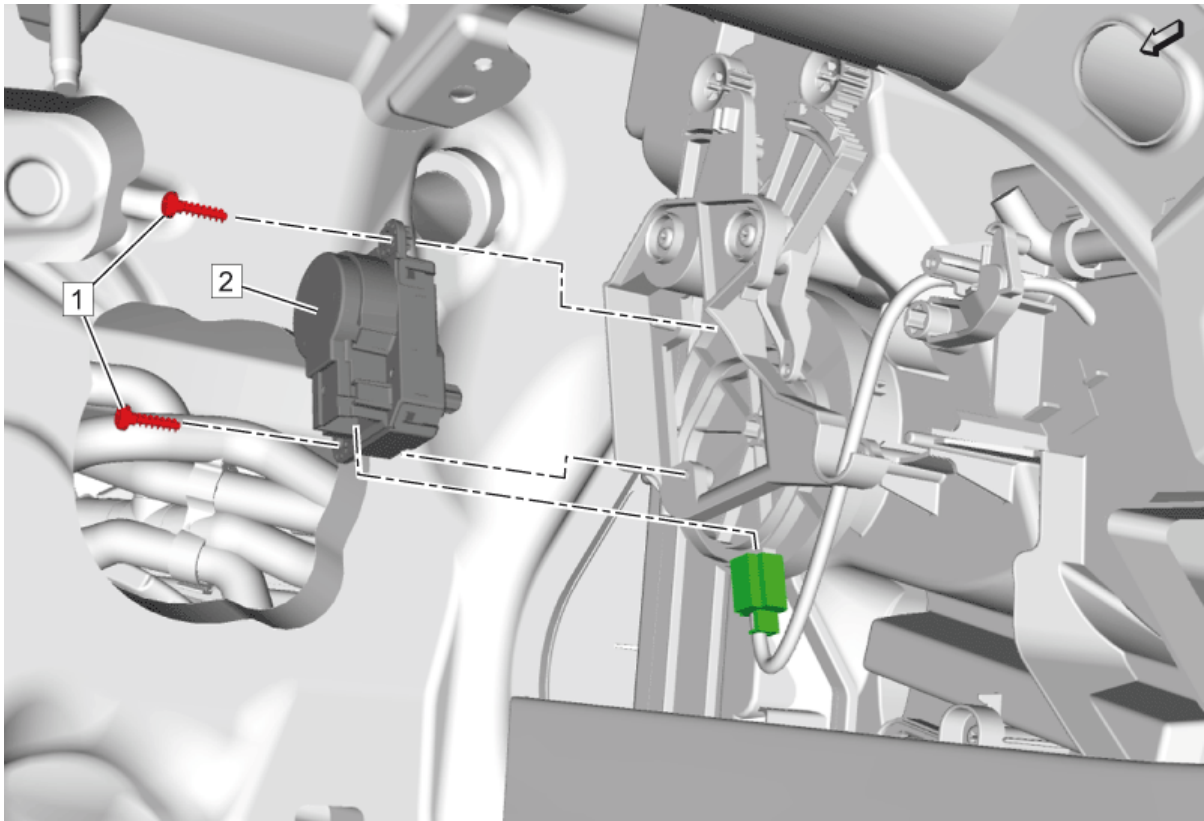


Fig. 32: Mode Control Cam Actuator

Courtesy of GENERAL MOTORS COMPANY

3. Install Mode Control Cam Actuator (2) [Mode Control Cam Actuator Replacement](#)

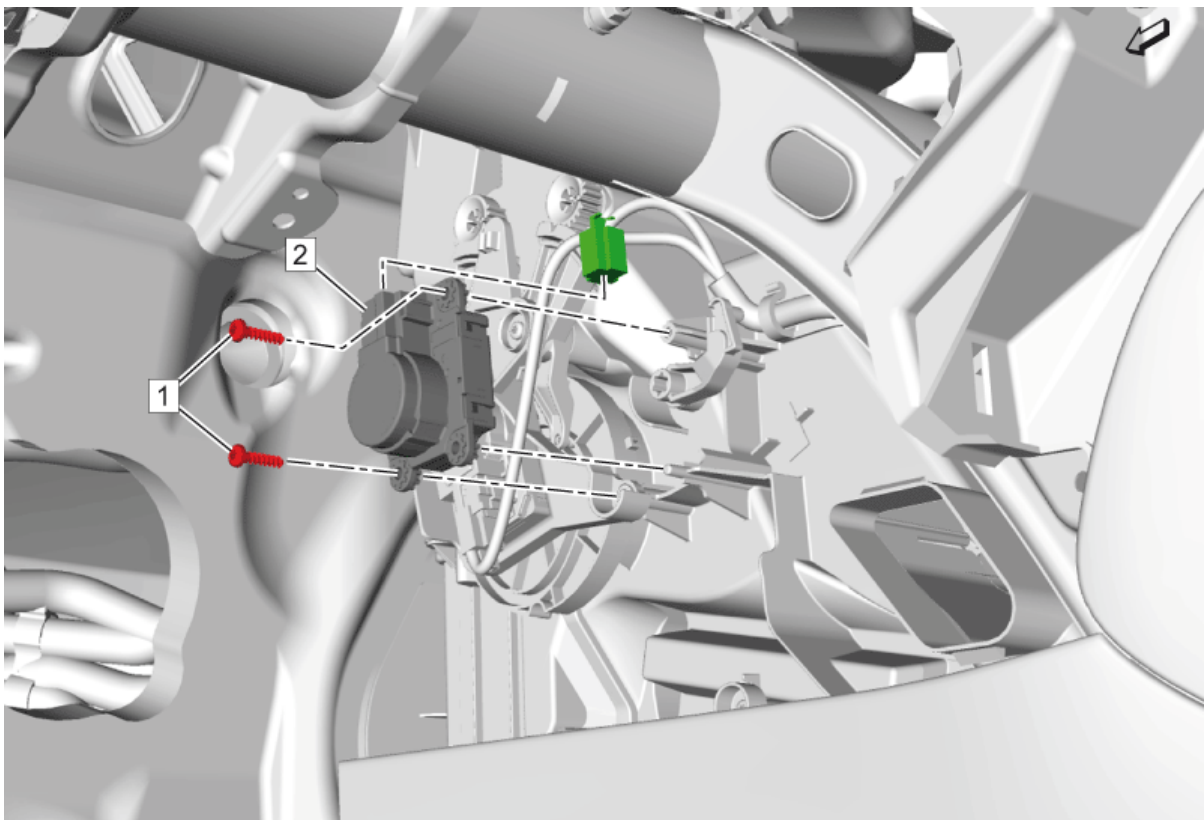


Fig. 33: Temperature Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

4. Install Temperature Valve Actuator (2) **Temperature Valve Actuator Replacement**

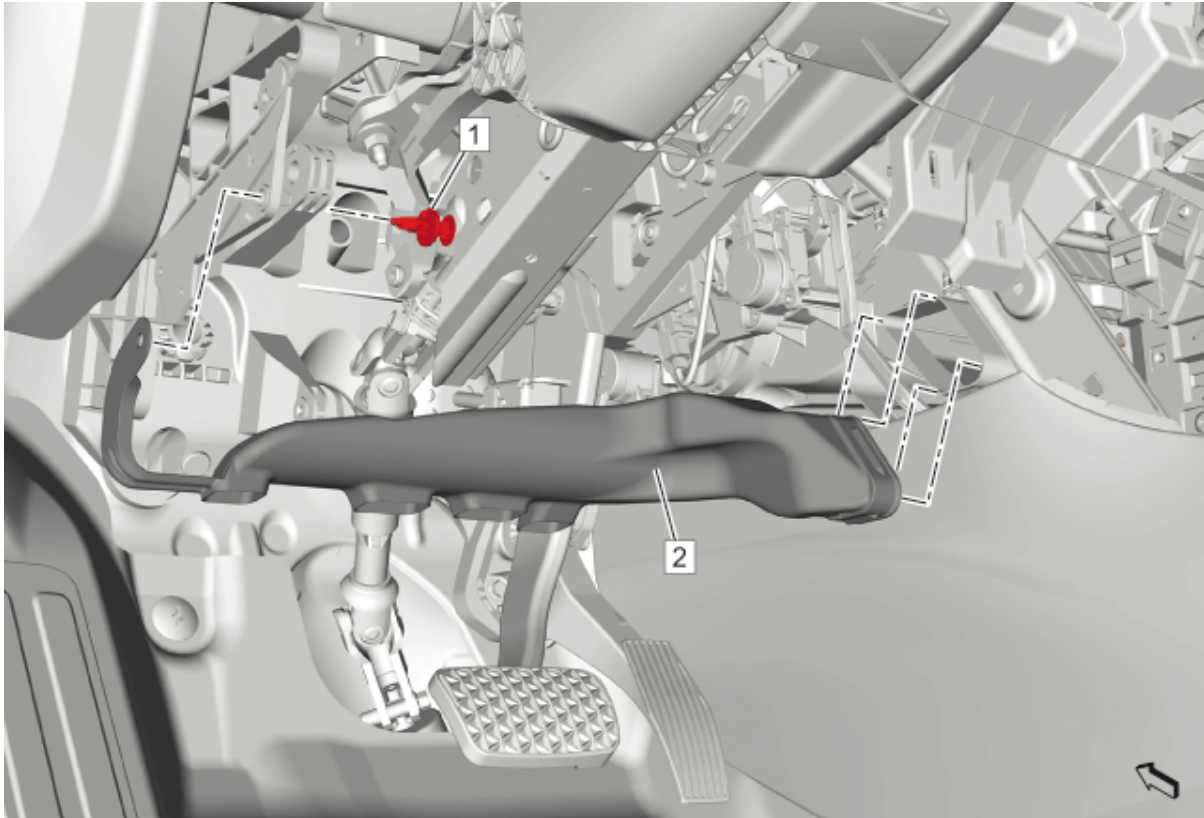


Fig. 34: Floor Front Air Outlet Duct - Left Side

Courtesy of GENERAL MOTORS COMPANY

5. Floor Front Air Outlet Duct - Left Side (2) **Floor Front Air Outlet Duct Replacement - Left Side**

TEMPERATURE VALVE ACTUATOR REPLACEMENT

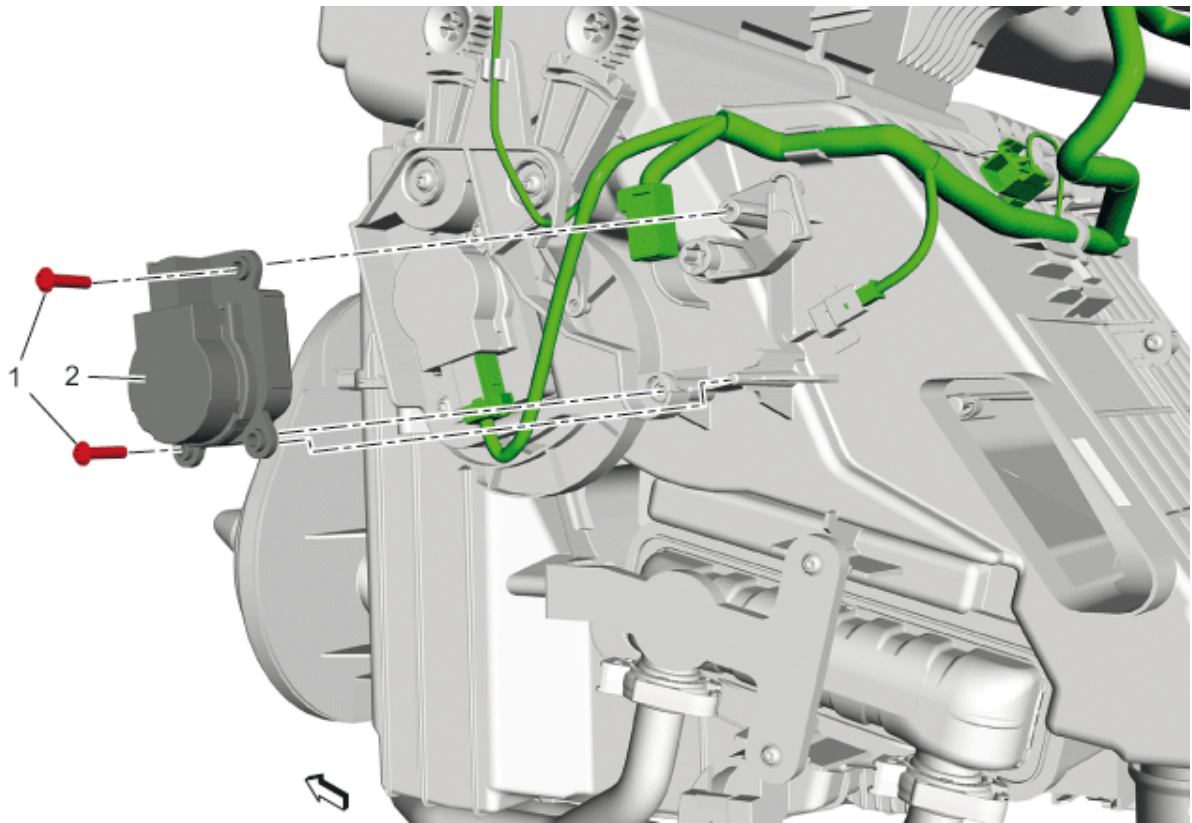


Fig. 35: Temperature Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Instrument Panel Assembly Replacement</u>	
1	Temperature Valve Actuator Fastener (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 2.5 N.m (22 lb in)
2	Temperature Valve Actuator Procedure 1. Disconnect the electrical connector. 2. <u>Actuator Recalibration</u>

FLOOR AIR TEMPERATURE SENSOR REPLACEMENT

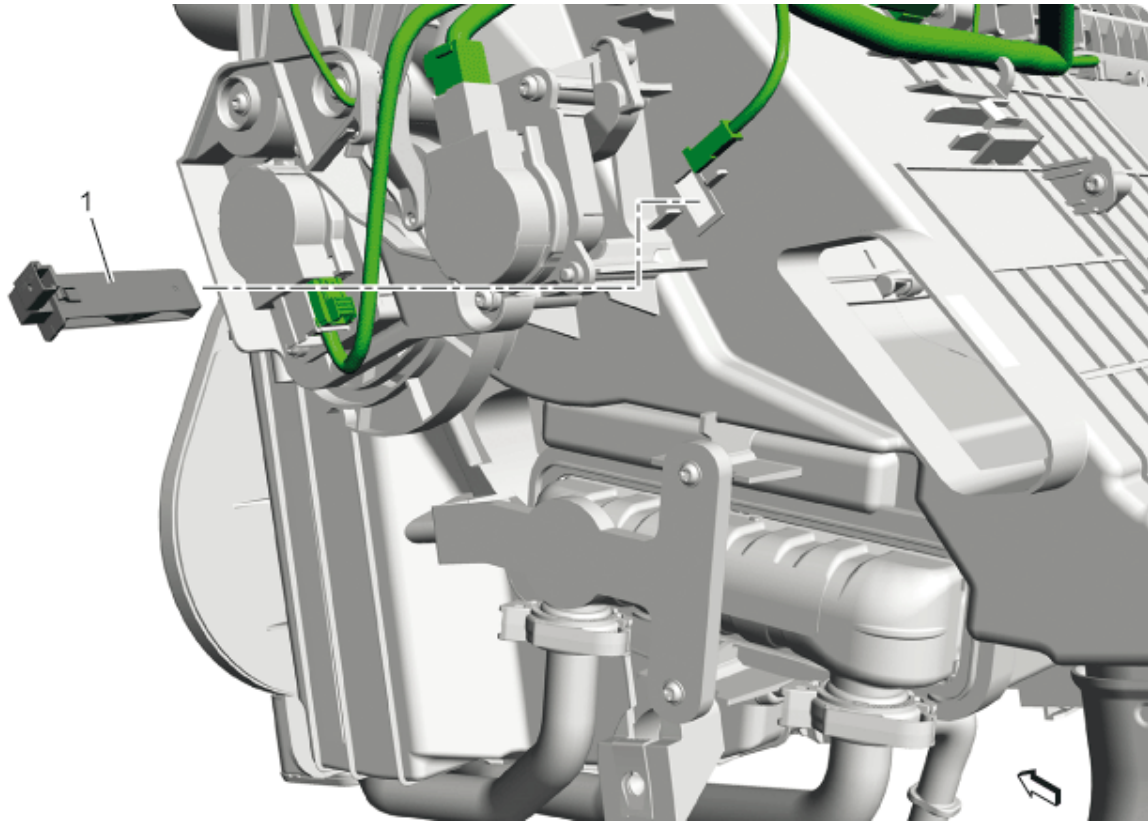


Fig. 36: Floor Air Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Floor Front Air Outlet Duct Replacement - Left Side</u>	
1	Floor Air Temperature Sensor Procedure 1. Disconnect the electrical connector. 2. Use a flat bladed plastic tool to remove.

INSIDE AIR TEMPERATURE SENSOR REPLACEMENT - LEFT SIDE UPPER

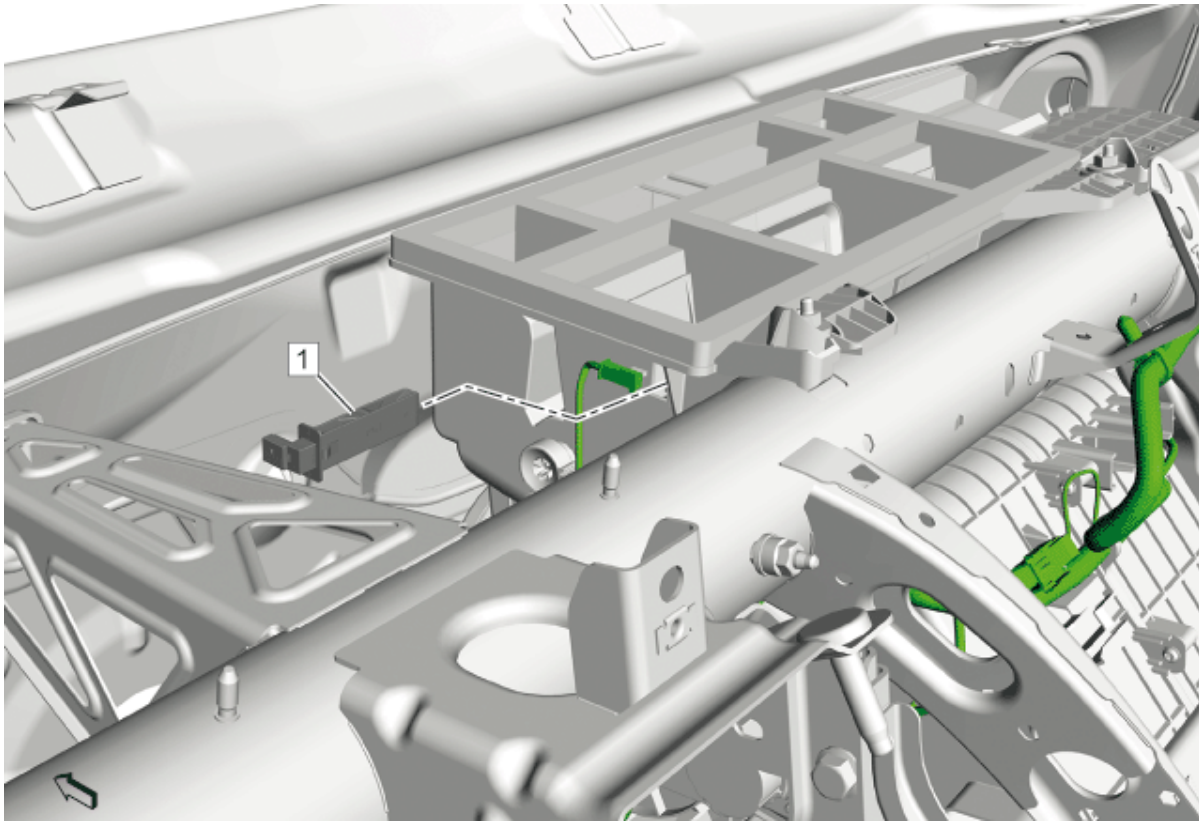


Fig. 37: Inside Air Temperature Sensor - Left Side Upper

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Assembly Replacement</u>	
1	Inside Air Temperature Sensor - Left Side Upper Procedure 1. Disconnect the electrical connector. 2. Use a flat bladed plastic tool to remove.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT

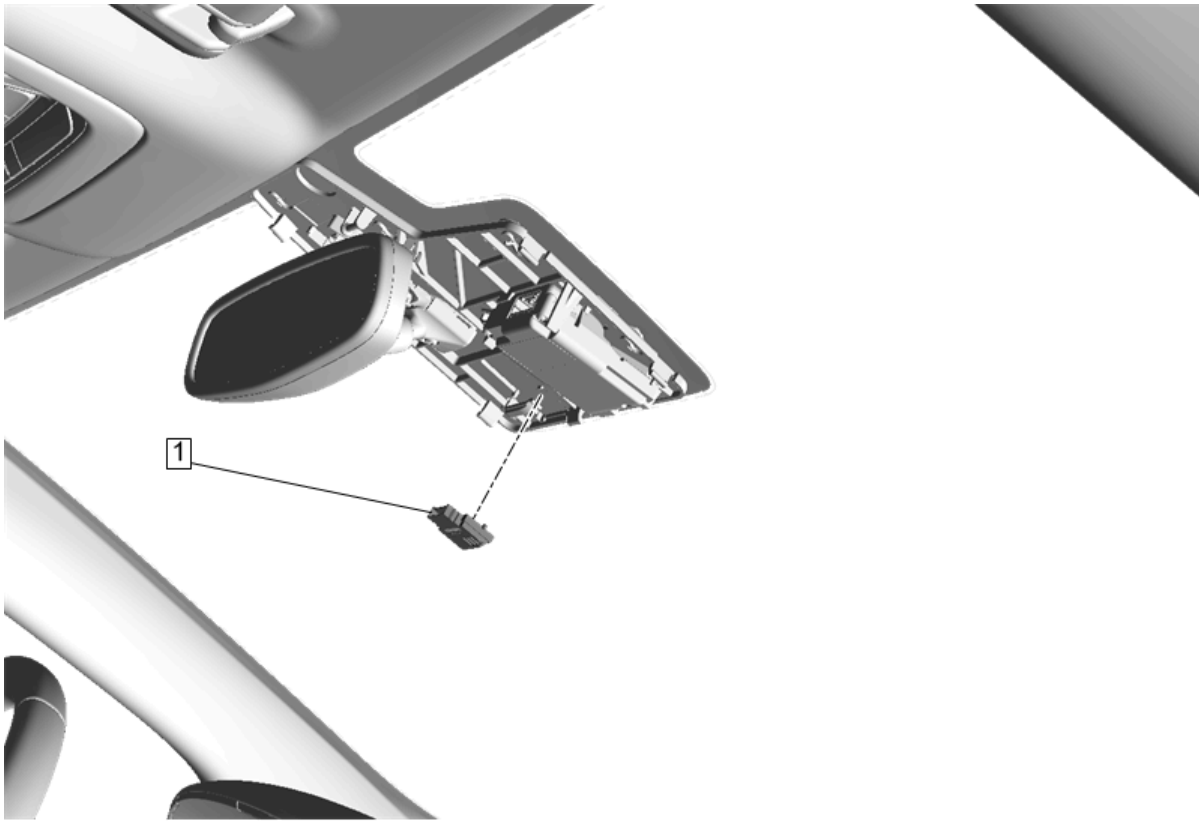


Fig. 38: Inside Air Moisture And Windshield Temperature Sensor

Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure	
<u>Windshield Multifunction Sensor Mount Bracket Lower Cover Replacement</u>	
	Inside Air Moisture and Windshield Temperature Sensor
1	Procedure 1. Un-clip the inside air moisture and windshield temperature sensor from the inside rear view mirror support bracket 2. Disconnect the electrical connector.

SUN LOAD TEMPERATURE AND HEADLAMP AUTOMATIC CONTROL AMBIENT LIGHT SENSOR REPLACEMENT

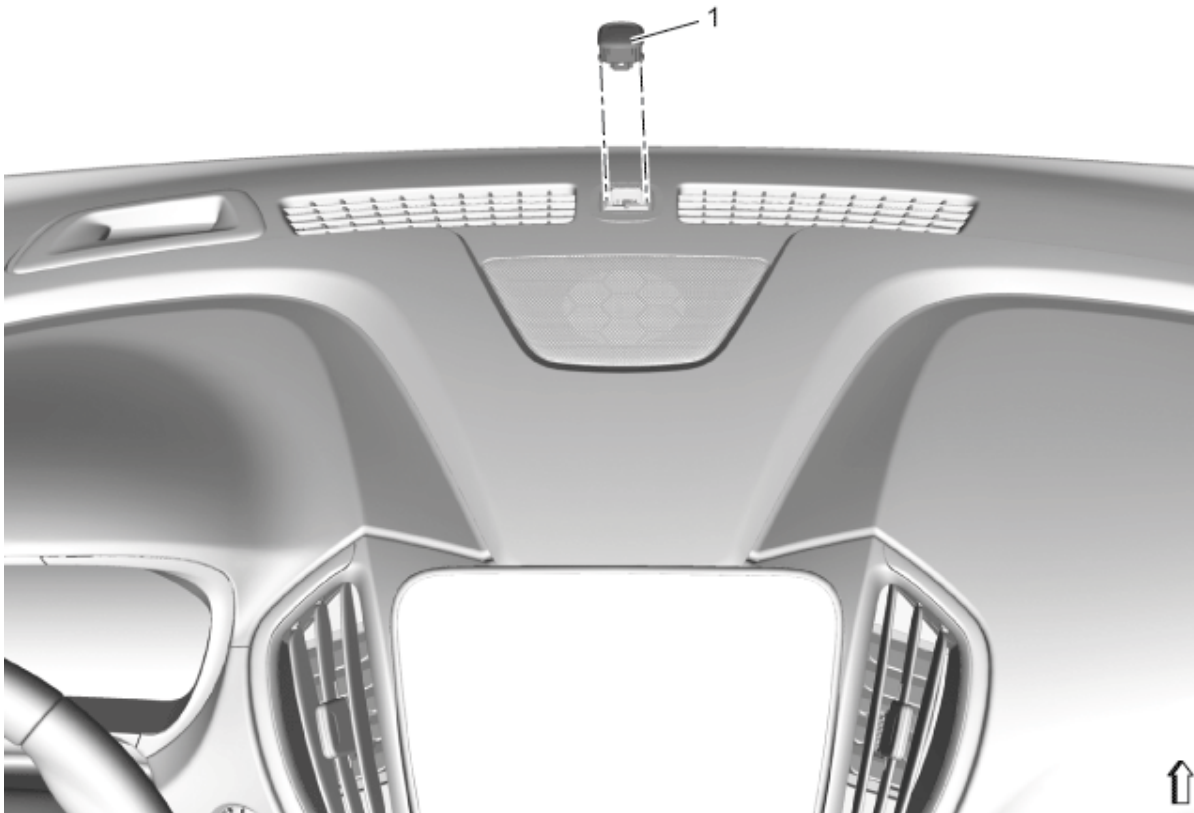


Fig. 39: Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Extension Replacement</u>	
1	Sun Load Temperature and Headlamp Automatic Control Ambient Light Sensor Procedure 1. Use a suitable tool. 2. Unlock the retaining tabs. 3. Disconnect the electrical connector.

DESCRIPTION AND OPERATION

AUTOMATIC HVAC DESCRIPTION AND OPERATION

The air temperature and the air delivery description and operation are divided into the following areas:

- HVAC Control Components
- Air Speed
- Air Delivery
- Heating and A/C Operation
- Recirculation Operation

- Automatic Operation
- Coolant Heater Control Module
- Engine Coolant and A/C System Refrigerant

HVAC Control Components

HVAC Control

The HVAC control contains all switches, which are required to control the functions of HVAC and serve as interface between the operator and the HVAC control module. The selected values are passed to the HVAC control module via serial data.

HVAC Control Module

The HVAC control module is a serial data device that interfaces between the operator and the HVAC system to maintain and control desired air temperature and air distribution settings. The battery positive voltage circuit provides power that the HVAC control module uses for keep alive memory. If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from keep alive memory. The body control module (BCM), which is the vehicle power mode master, provides a device ON-Signal. The HVAC control module provides blower, air delivery mode and air temperature settings.

The HVAC control module supports the following features:

Feature	Availability
Afterblow	Available if reprogrammed by the technician
Purge	Yes
Personalization	Yes
Actuator Calibration	Yes

Actuators

Doors in the HVAC case assembly are used to control air flow. The HVAC control module operates the doors through the use of actuators, with one actuator being used for each door. The system has the following air control doors and associated actuators: mode, temperature, and recirculation.

Each actuator used in the system is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor moves the associated air control door into the calculated position in order to reach the selected position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the air control door.

Blower Motor

The blower motor speed control signal from the HVAC control module, battery positive and ground circuits enable the blower motor to operate. The blower motor control circuitry is integrated within the blower motor assembly. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor to request a specific motor speed. The blower motor translates the PWM signal and drives the motor accordingly.

Duct Temperature Sensors

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The sensors operate within a temperature range of -40 to +85°C (-40 to +185°F). The sensors are installed in the air distribution ducts and measure the temperature of the air that streams from the ducts. The HVAC control module uses these values to calculate the mixed air flap position.

A/C Refrigerant High Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The engine control module (ECM) converts the voltage signal to a pressure value. When pressure is too high or too low, the ECM will not allow the A/C compressor to engage.

A/C Refrigerant Low Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor.

A/C Compressor

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes high voltage direct current from the vehicle's high voltage battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button or
- The HVAC control, in ECO climate or Comfort Climate Settings, requests the electric AC compressor on to help in cooling the cabin or removing moisture in conditions where the windows may fog or
- The hybrid/EV powertrain control module 2 requests the AC compressor on to help maintain the battery temperature

The hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure sensor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors, and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

Ambient Light/Sunload Sensor

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The solar sensor is connected to ground and to a 5 V stabilized voltage supply through the HVAC control module. As the sunload increases, the sensor signal voltage also increases and vice versa. The signal varies between 1.4 - 4.5 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0 - 5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

Windshield Temperature and Inside Moisture Sensor

The windshield temperature and inside moisture sensor includes the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level at windshield (compartment side)
- Temperature of the windshield inside (compartment side)
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity of the compartment side of the windshield. It also detects the temperature of the windshield surface on the passenger compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element.

HVAC Coolant Pump

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow when the engine is not operating, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Air Speed

The blower control switch is part of the HVAC faceplate control. The selected value of the blower switch position is sent to the HVAC control module via serial data.

The blower motor control circuitry is integrated within the blower motor assembly. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor to request a specific motor speed. The blower motor translates the PWM signal and drives the motor accordingly.

Air Delivery

The HVAC control module controls the distribution of air within the passenger compartment by the use of the mode actuator. The modes that may be selected are:

- Defrost
- Defog
- Panel
- Floor
- BiLevel

In auto mode, the air delivery mode is controlled automatically based on cooling/warming needs of the compartment. The desired air distribution mode can be selected with the air distribution buttons at the HVAC faceplate control. The HVAC control delivers the values to the HVAC control module via serial data. The HVAC control module controls the mode actuator so that it drives the flap to the calculated position. Depending on the position of the flap, air is distributed through various ducts leading to the outlets in the dash. Turning the mode flap to the defrost position, the HVAC control module will move the recirculation actuator to outside air, reducing window fogging. When defrost is selected, the blower motor will be activated. The HVAC control module enables a high volume of air delivered to the front defrost vents. A/C is available in all modes.

The rear window defogger does not affect the HVAC system.

Recirculation Operation

The recirculation switch is integrated into the HVAC control. The selected recirculation switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake using the recirculation actuator. In recirculation mode the recirculation door opens in order to circulate the air within the vehicle. In fresh air mode the recirculation door is closed in order to route outside air into the vehicle.

Inside air recirculation is prevented if the defrost mode is active. When the defrost mode is active, the recirculation actuator opens the recirculation door and outside air is circulated to the windshield to reduce fogging.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on passenger compartment side of the windshield compartment side. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

- Ambient air temperature
- Difference between inside and desired temperature
- Blower motor speed setting
- Mode setting
- Air conditioning control module operation

- Hybrid/EV powertrain control module 2 operation
- Coolant heater control module

Pressing the climate mode buttons (MAX Mode or ECO Mode) enables the HVAC control module to determine whether to request A/C compressor and coolant heater activation, based on the thermal conditions of the vehicle and the temperature selected. The HVAC control module sends a serial data message to the hybrid/EV powertrain control module 2 to request A/C compressor operation or sends the heating request to the coolant heater control module to produce heat.

The mode selected modifies the effect of operating the HVAC system with the vehicle's operating range. ECO mode provides a balance between comfort and economy, while MAX mode is biased for best cabin comfort.

If neither ECO or MAX is selected, the system operates in Fan Only mode. Air conditioning and heating are disabled unless overridden by dehumidification requirements or if MAX DEFROST is selected. This mode has the least effect on the vehicle's range.

Automatic Operation

The user can select to operate the Blower, Recirculation and Air Delivery operations in auto per auto operation mode.

When the auto button is pressed, the system responds by putting the blower, air delivery and recirculation into auto mode. If any of these functions are adjusted then the auto button indication shall go off and that function will leave auto operation and follow the user requested setting. In this setting the blower request is adjusted to quickly heat the cabin initially. After comfort is reached, the blower speed is minimized to reduce noise and temperature drifts.

Under cold ambient temperatures, the automatic HVAC system provides heat in the most efficient manner. The operator can select an extreme temperature setting but the system will not warm the vehicle any faster. Under warm ambient temperatures, the automatic HVAC system also provides air conditioning in the most efficient manner. Selecting an extreme cool temperature will not cool the vehicle any faster.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on the passenger compartment side of the windshield and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The A/C compressor and the defrost mode may be activated to prevent or remove fog on the passenger compartment side of the windshield. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield.

Coolant Heater Control Module

The coolant heater control module is a high voltage electric heater. High voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The coolant heater control module is an essential element of the hybrid heating system. The hybrid/EV powertrain control module 2 controls the passenger compartment heater coolant control valve, and the HVAC commands the coolant heater control module activation via serial data. Heated coolant either from the engine or the coolant heater control module will meet HVAC temperature demands. The coolant heater control module

will be commanded "off" if the coolant temperature exceeds the desired temperature.

Coolant heat generated by the engine is also an element of the heating system. Once the engine coolant is warm enough to supply the required heat, the passenger compartment heater coolant control valve will move to the 'link' position, which allows sharing of coolant between the engine, the coolant heater control module and passenger compartment heater core. The coolant heater control module power level will be reduced and/or cycled on/off as the engine turns on/off during charge-sustaining mode, maintaining cabin comfort. When the engine is utilized for charge sustaining mode the thermostat will control the normal engine operating coolant temperature. The thermostat also creates a restriction for the cooling system that promotes a positive coolant flow and helps prevent cavitation.

Heater coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module, absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature flap controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculates back to the system as controlled by the coolant passenger compartment heater coolant control valve.

Engine Coolant and A/C System Refrigerant

For information on engine coolant, coolant flow, A/C refrigerant, and the A/C refrigerant cycle, refer to [Heating and Air Conditioning System Description and Operation](#) .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	--------------------------------

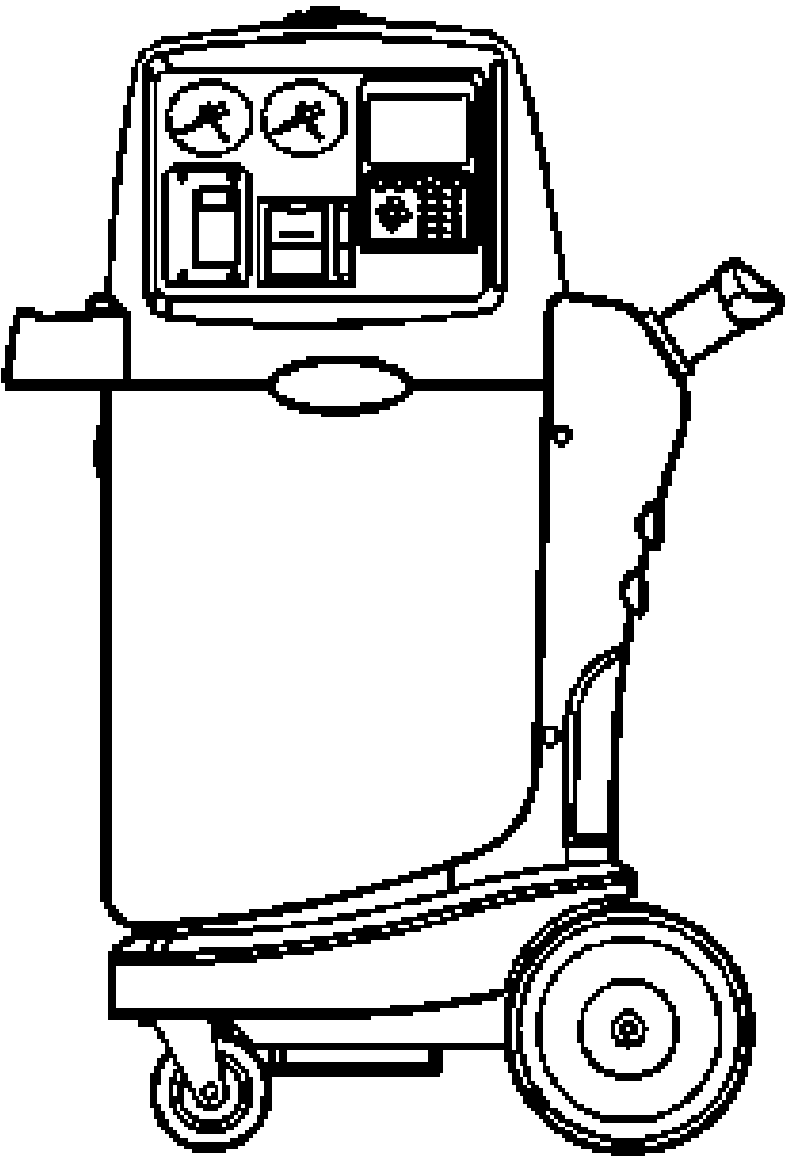
Illustration	Tool Number/ Description
	J 43600 A/C Filling Device

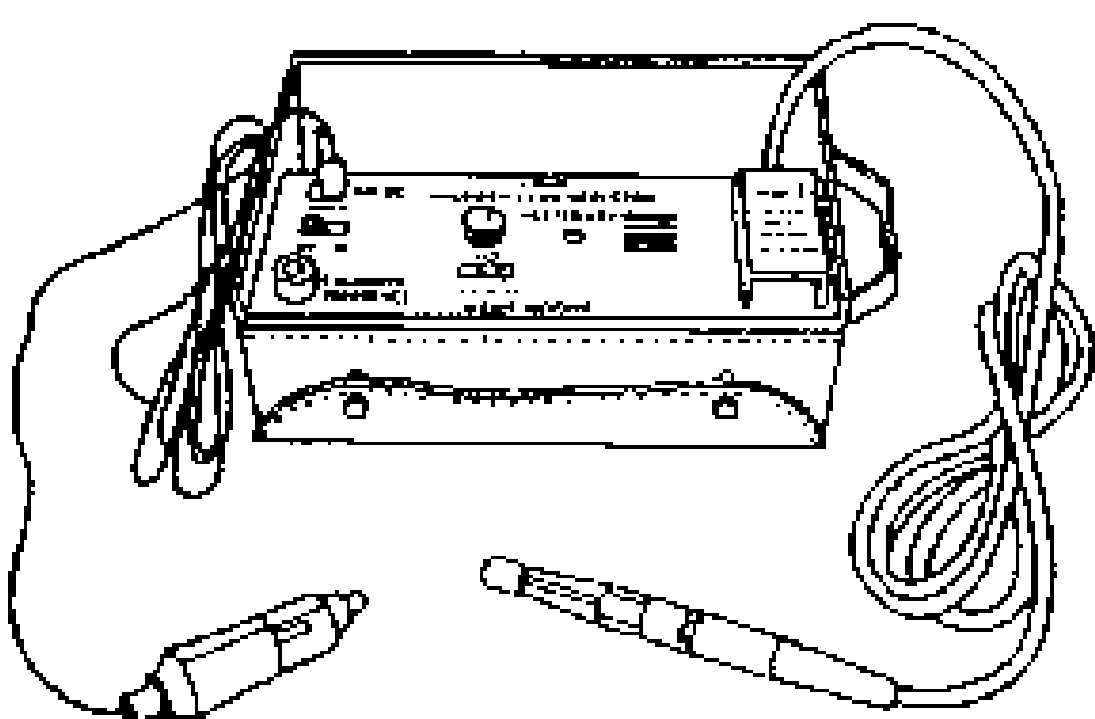
Illustration	Tool Number/ Description
	GE-39400 J-39400 Electric Halogen Leak Detector

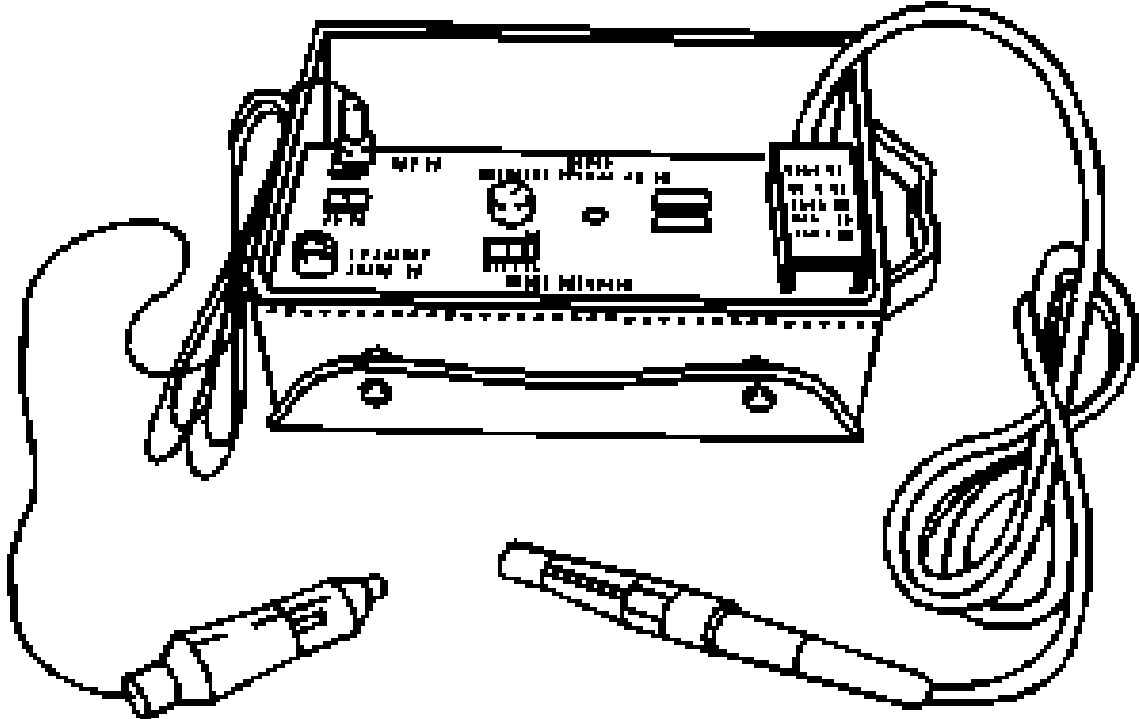
Illustration	Tool Number/ Description
	GE-50078 Halogen Leak Detector

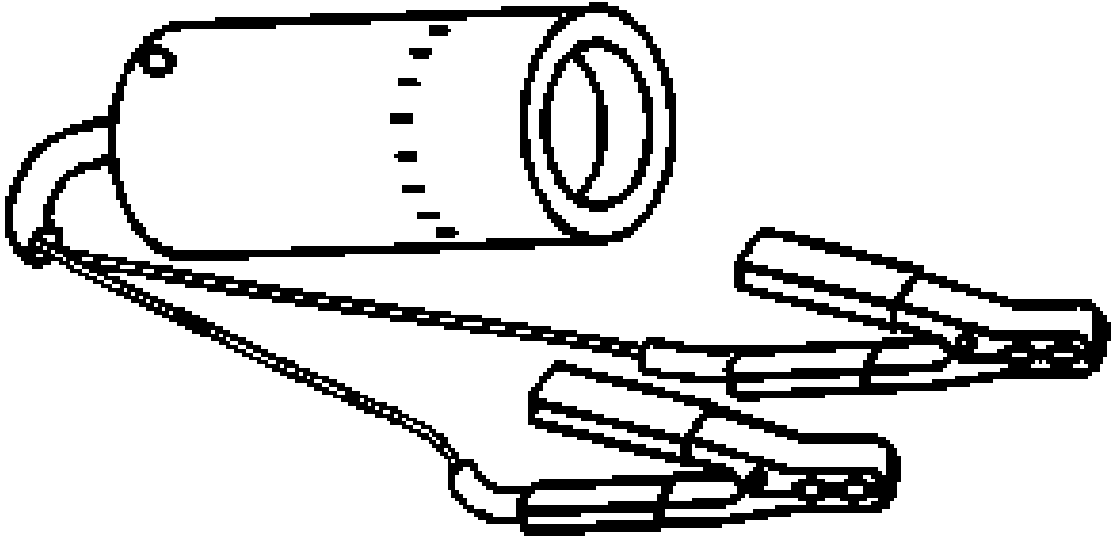
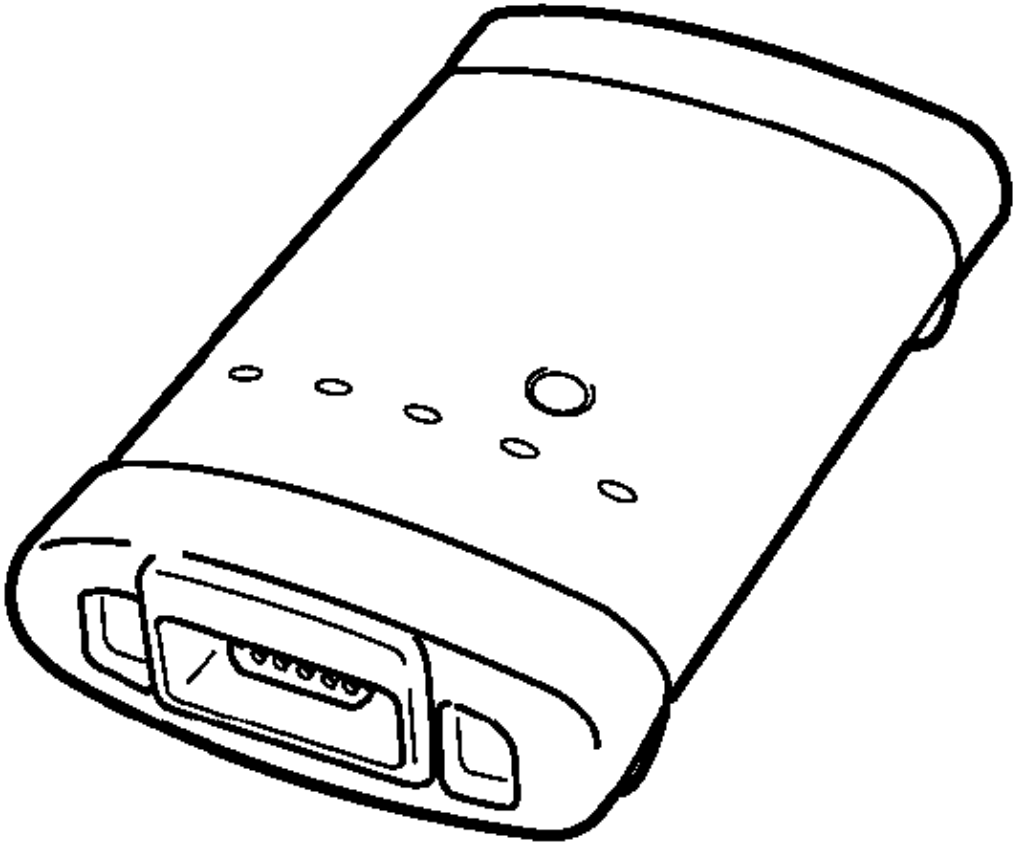
Illustration	Tool Number/ Description
 A line drawing of a cylindrical leak detection lamp. The lamp is oriented horizontally. A coiled cable extends from the left side of the lamp. At the end of the cable, there are two alligator clips. The clips are positioned to connect to a component on the right side of the lamp, which appears to be a probe or a sensor. The drawing is a simple black and white line art.	BO-42220 J-42220 GE-42220 Universal 12V Leak Detection Lamp

Illustration	Tool Number/ Description
	EL-47955 J-2534 Multi Diagnostic Interface MDI

Article GUID: A00884661

ACCESSORIES & EQUIPMENT

Lighting - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Brake Pedal Position Sensor Bolt	3 N.m (27 lb in)
Daytime Running Lamp Screw	2.5 N.m (22 lb in)
Headlamp Bolt	2.5 N.m (22 lb in)
High Mount Stop Lamp Nut	4.7 (42 lb in)
Liftgate Bumper Pad Screw	2.5 N.m (22 lb in)
Rear Body Structure Stop Lamp Screw	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

HEADLIGHTS/DAYTIME RUNNING LIGHTS (DRL) WIRING SCHEMATICS

Daytime Running Lamps and Low Beams

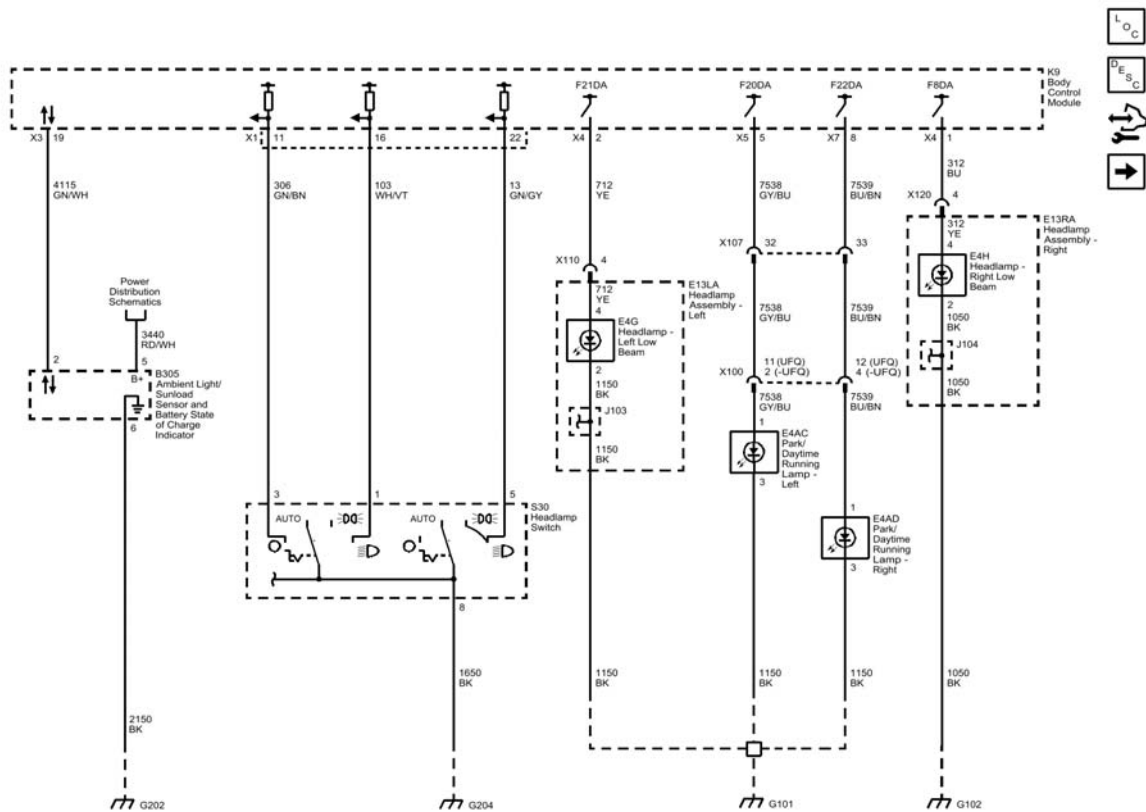


Fig. 1: Daytime Running Lamps and Low Beams
 Courtesy of GENERAL MOTORS COMPANY

High Beams

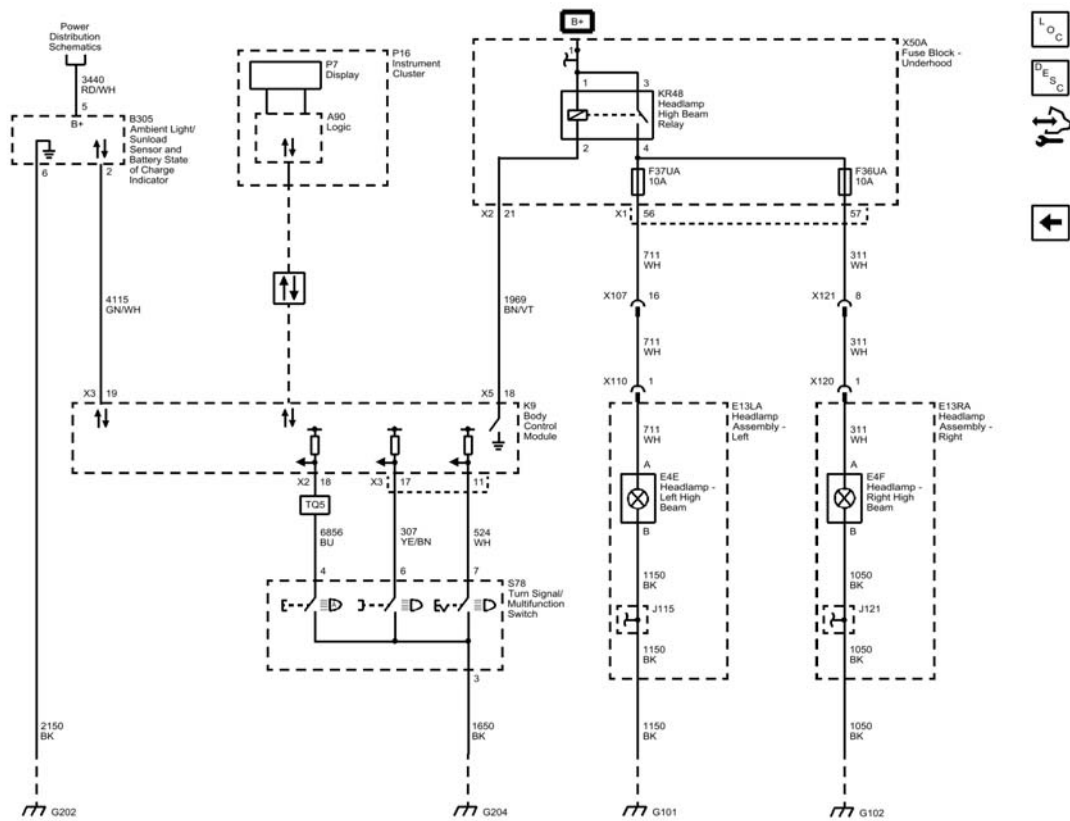


Fig. 2: High Beams

Courtesy of GENERAL MOTORS COMPANY

EXTERIOR LIGHTS WIRING SCHEMATICS

Front Turn Signals and Controls

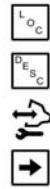
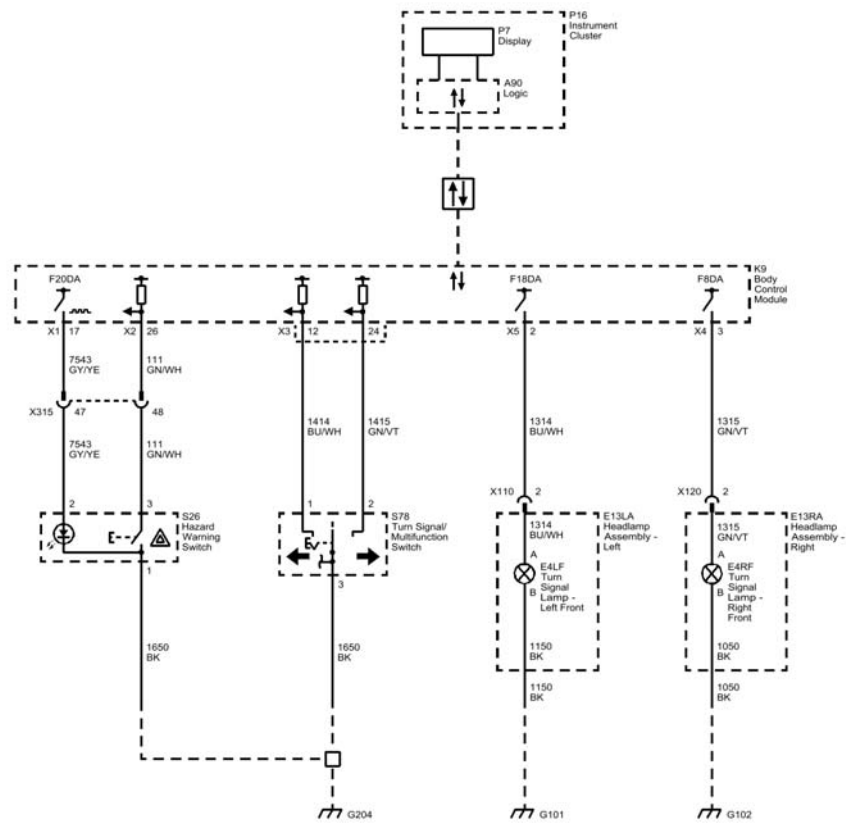


Fig. 3: Front Turn Signals and Controls
 Courtesy of GENERAL MOTORS COMPANY

Park, Tail and License Lamps

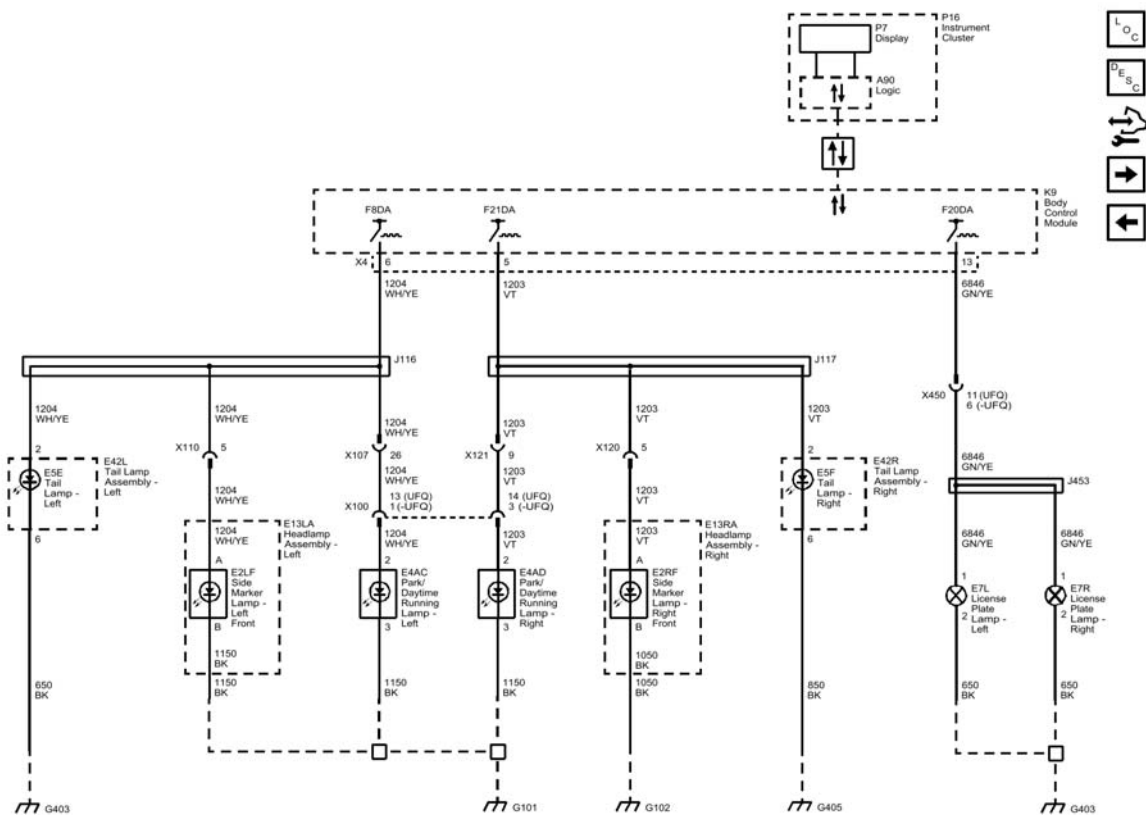


Fig. 4: Park, Tail and License Lamps
 Courtesy of GENERAL MOTORS COMPANY

Rear Turn Signals, Stop Lamps, and Backup Lamp

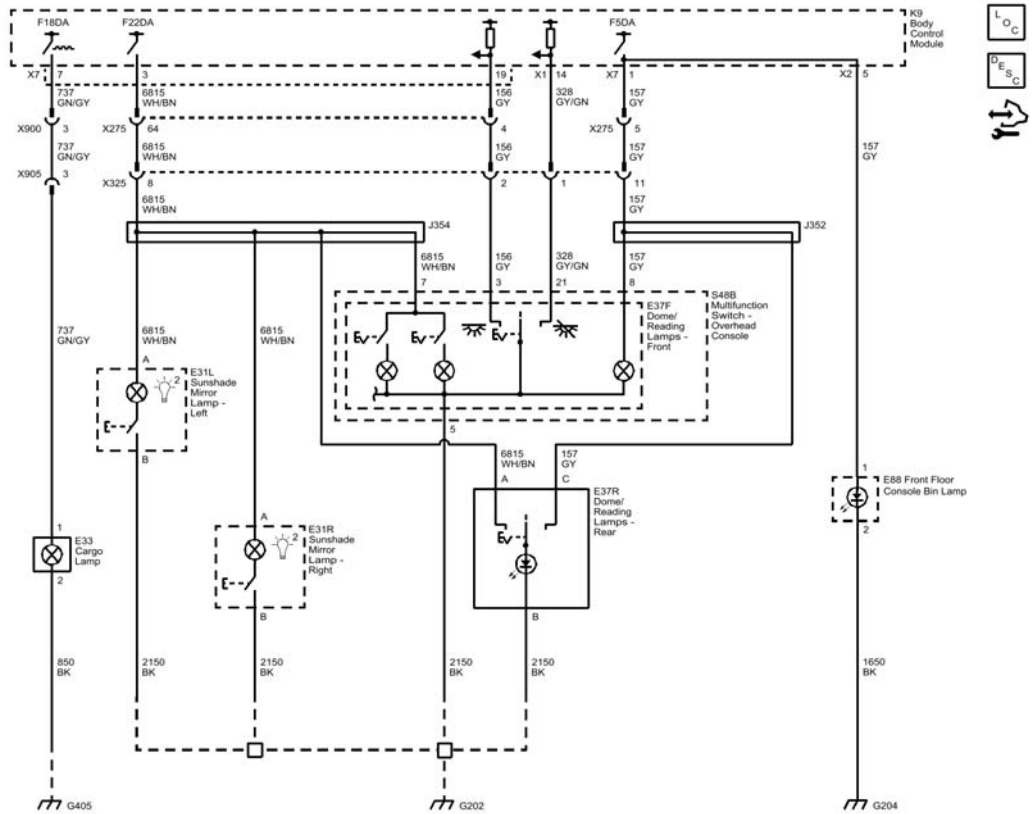


Fig. 6: Interior Lights

Courtesy of GENERAL MOTORS COMPANY

INTERIOR LIGHTS DIMMING WIRING SCHEMATICS

Display Dimming

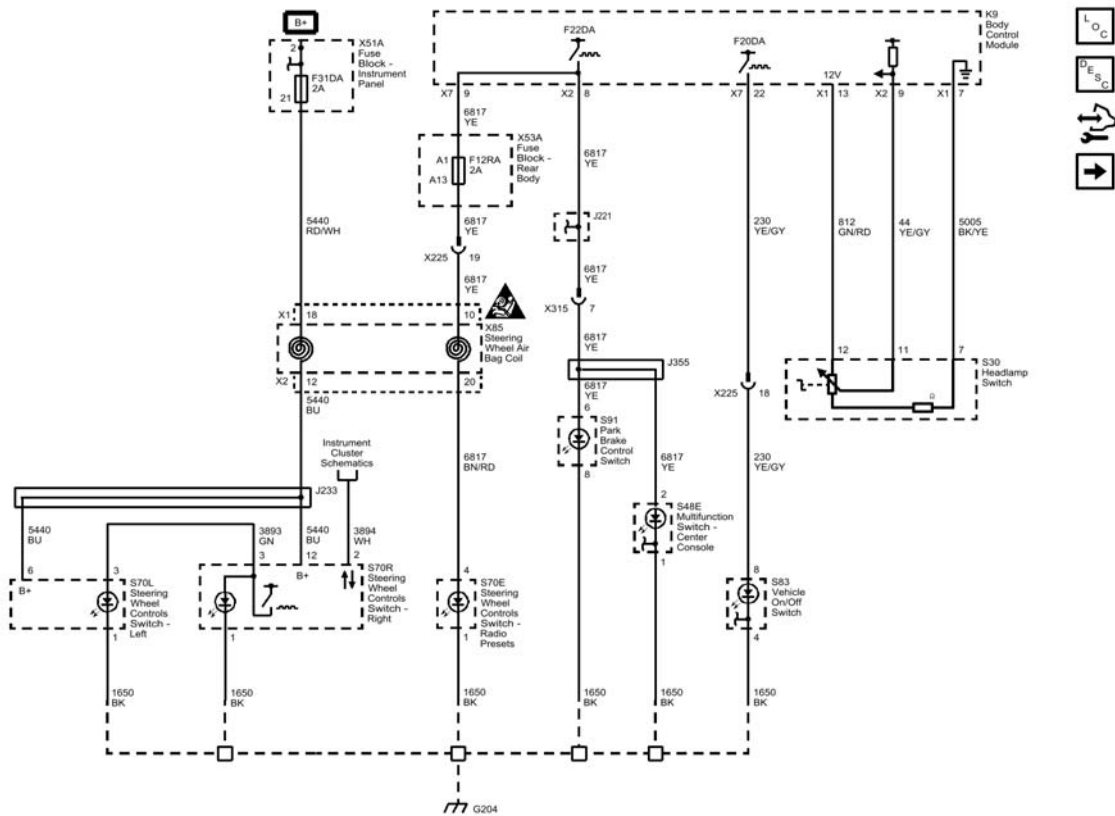


Fig. 7: Display Dimming

Courtesy of GENERAL MOTORS COMPANY

Controls Dimming (1 of 2)

	Ground	Resistance	Voltage	Performance
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B1395 03

- The BCM detects a short to ground in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground in the instrument panel dimmer switch signal circuit.

DTC B1395 07

- The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

All interior backlighting defaults to FULL bright.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.
 - **If less than B+**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
3. Test for B+ between the B+ circuit terminal 12 and the low reference circuit terminal 7.
 - **If less than B+**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the low reference circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.
 - **If the test lamp illuminates**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
 5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.
 - **If less than B+**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 11 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
 6. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

DTC B1480: BATTERY RUNDOWN PROTECTION CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1480 02

Battery Rundown Protection Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Courtesy Lamps Control - Terminal 3 X7	B1480 02	1	1	-
Dome/Reading Lamps - Front Ground	-	1, 2	-	-
Dome/Reading Lamps - Rear Ground	-	1, 2	-	-
Sunshade Mirror Lamp - Left Ground	-	1	-	-
Sunshade Mirror Lamp - Right Ground	-	1	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the front reading lamps and left and right sunshade lamps via the courtesy lamp control circuit. When a sunshade mirror is opened, the switch contact close allowing battery voltage to flow illuminating the respective lamps. The front reading lamps are controlled by individual switches that are activated by the operator when additional cabin lighting is required. In the event that any of these courtesy lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the courtesy lamp control circuit.

Actions Taken When the DTC Sets

The BCM will disable the circuit and the sunshade lamps and front reading lamps will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Schematics

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connectors at the components listed below.
 - S48B Multifunction Switch - Overhead Console
 - E37R Dome/Reading Lamps - Rear
 - E31L Sunshade Mirror Lamp - Left
 - E31R Sunshade Mirror Lamp - Right
2. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - S48B Multifunction Switch - Overhead Console terminal 7
 - E37R Dome/Reading Lamps - Rear terminal A
 - E31L Sunshade Mirror Lamp - Left terminal A
 - E31R Sunshade Mirror Lamp - Right terminal A
3. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in

Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**
4. Test or replace the appropriate courtesy lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Sunshade Illuminated Mirror Lamp Bulb Replacement](#)
- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2545: BACKUP LAMPS CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2545 01

Backup Lamps Circuit Short to Battery

DTC B2545 02

Backup Lamps Circuit Short to Ground

DTC B2545 04

Backup Lamps Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Lamp Control	B2545 02	1	1	-
Backup Lamp Ground	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the

reverse position. The BCM applies battery voltage to the backup lamp control circuit illuminating the backup lamp. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamp control circuit. The vehicle must be ON for the backup lamps to operate.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Vehicle ON.
- Transmission placed in REVERSE gear.

Conditions for Setting the DTC

DTC B2545 01 and B2545 04

The BCM detects an open/high resistance in the backup lamp control circuit.

DTC B2545 02

The BCM detects a short to ground in the backup lamp control circuit.

Actions Taken When the DTC Sets

The backup lamp will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E5 Backup Lamp, vehicle in Service Mode.
2. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E5 Backup Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Backup Lamp Bulb Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B255D: PASSENGER COMPARTMENT LAMP CONTROL 2 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B255D 01

Passenger Compartment Lamp Control 2 Circuit Short to Battery

DTC B255D 02

Passenger Compartment Lamp Control 2 Circuit Short to Ground

DTC B255D 04

Passenger Compartment Lamp Control 2 Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accent Lamp Control - Terminal 23 X1	B255D 02	1	1	-
Accent Lamp - Driver Door Ground	-	1	-	-
Accent Lamp - Instrument Panel Ground	-	1	-	-
Accent Lamp - Passenger Door Ground	-	1	-	-
Flood Lamp - Driver Door Handle Ground	-	1	-	-
Flood Lamp - Passenger Door Handle Ground	-	1	-	-
Flood Lamp - Left Rear Door Handle Ground	-	1	-	-
Flood Lamp - Right Rear Door Handle Ground	-	1	-	-
Multifunction Switch - Overhead Console Ground	-	1	-	-
1. Interior Accent Lighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting

components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, signal, and low reference circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B255D 01

The BCM detects a short to voltage in the courtesy lamps control circuit terminal 23 X1.

DTC B255D 02

The BCM detects a short to ground in the courtesy lamps control circuit terminal 23 X1.

DTC B255D 04

The BCM detects an open/high resistance in the courtesy lamps control circuit terminal 23 X1.

Actions Taken When the DTC Sets

The BCM will disable the courtesy lamps control circuit terminal 23 X1.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- Turn the ignition OFF and wait 30 s.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Ignition OFF, exterior lamps OFF, disconnect the harness connector at the inoperative courtesy lamp.
2. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - E1D Accent Lamp - Driver Door terminal 2
 - E1P Accent Lamp - Passenger Door terminal 2
 - E63D Flood Lamp - Driver Door Handle terminal 1
 - E63LR Flood Lamp - Left Rear Door Handle terminal 1
 - E63RR Flood Lamp - Right Rear Door Handle terminal 1
 - E63P Flood Lamp - Passenger Door Handle terminal 1
 - E1W Accent Lamp - Instrument Panel terminal 3
 - S48B Multifunction Switch - Overhead Console terminal 2
3. Verify the test lamp turns ON and OFF when commanding the Accent Lighting ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
4. Test or replace the appropriate courtesy lamp.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Inside Handle Illumination Lamp Replacement](#)
- Refer to [Rear Side Door Inside Handle Illumination Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2570: TRUNK LAMP CONTROL CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2570 02

Trunk Lamp Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cargo Lamp Control	B2570 02	1	1	-
Cargo Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the cargo lamp through the cargo lamp control circuit. When the BCM receives a rear liftgate open input from the rear compartment lid latch, the BCM applies battery voltage to the cargo lamp control circuit illuminating the cargo lamp. In the event that the cargo lamp were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position, the BCM will deactivate the cargo lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Liftgate OPEN.

Conditions for Setting the DTC

The BCM detects a short to ground in the cargo lamp control circuit.

Actions Taken When the DTC Sets

The cargo lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- [Interior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Interior Lighting Systems Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E33 Cargo Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the E33 Cargo Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cargo Center Courtesy Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2575 OR B2699: LEFT HEADLAMP CONTROL CIRCUIT/RIGHT HEADLAMP CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2575 01

Headlamps Control Circuit Short to Battery

DTC B2575 02

Headlamps Control Circuit Short to Ground

DTC B2575 04

Headlamps Control Circuit Open

DTC B2699 01

Right Headlamp Control Circuit Short to Battery

DTC B2699 02

Right Headlamp Control Circuit Short to Ground

DTC B2699 04

Right Headlamp Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Beam Headlamp - Left Control	B2575 02	1	1	-
Low Beam Headlamp - Right Control	B2699 02	1	1	-
Headlamp - Left Ground	-	1	-	-
Headlamp - Right Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

With the headlamp switch in the ON position, the headlamp switch headlamp ON signal circuit is grounded through the headlamp switch. The body control module (BCM) responds by applying battery positive voltage to the left and right low beam headlamp control circuits illuminating the low beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Low beam headlamps ON.

Conditions for Setting the DTC

DTC B2575 01 and B2575 04

The BCM detects an open/high resistance in the left low beam headlamp control circuit.

DTC B2575 02

The BCM detects a short to ground in the left low beam headlamp control circuit.

DTC B2699 01 and B2699 04

The BCM detects an open/high resistance in the right low beam headlamp control circuit.

DTC B2699 02

The BCM detects a short to ground in the right low beam headlamp control circuit.

Actions Taken When the DTC Sets

- When DTC B2575 sets, the left low beam headlamp will be inoperative.
- When DTC B2699 sets, the right low beam headlamp will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B2575

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E4G Headlamp - Left Low Beam.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 4 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Left Headlamp Low Beam ON and OFF

with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the E4G Headlamp - Left Low Beam.

DTC B2699

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E4H Headlamp - Right Low Beam.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 4 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Right Headlamp Low Beam ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the E4H Headlamp - Right Low Beam.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Bulb Replacement \(Left Side\)](#)[Headlamp Bulb Replacement \(Right Side\)](#)
- Refer to [Headlamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

DTC B257A: HEADLAMP SWITCH INPUT SIGNALS CORRELATION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B257A 00

Headlamp Switch Input Signals Correlation Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Headlamp Switch Headlamps OFF Signal	B257A 00	1	1	-
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	-
Headlamp Switch Ground	-	1	-	-
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors three signal circuits from the headlamp

switch. When the headlamp switch is in the AUTO position, the three signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects an open/high resistance in the headlamp switch park lamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps OFF signal circuit.

Actions Taken When the DTC Sets

- When DTC B257A 00 is present on the headlamp switch headlamps OFF signal circuit, the low beam and high beam headlamps are inoperative.
- When DTC B257A 00 is present on the headlamp switch headlamps ON signal circuit, the low beam headlamps are always ON in the PARK position and the park lamps are always ON in all positions.
- When DTC B257A 00 is present on the headlamp switch park lamps ON signal circuit, the high beam and low beam headlamps are inoperative in the PARK and HEAD positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- [Headlights/Daytime Running Lights \(DRL\) Schematics](#)
- [Exterior Lights Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Exterior Lighting Systems Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Automatic Headlamps Disable Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 8.
6. Verify the scan tool Automatic Headlamps Disable Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
7. Verify the scan tool Park Lamps Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 8.
9. Verify the scan tool Park Lamps Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 5 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

10. Verify the scan tool Headlamps On Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

11. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 8.
12. Verify the scan tool Headlamps On Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

13. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2580: HEADLAMP HIGH BEAM CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2580 01

Headlamp High Beam Control Circuit Short to Battery

DTC B2580 02

Headlamp High Beam Control Circuit Short to Ground

DTC B2580 04

Headlamp High Beam Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp High Beam Relay Control	1	1	B2580 01	-
High Beam Headlamp - Left Control	1	1	1	-
High Beam Headlamp - Right Control	1	1	1	-
Headlamp - Left Ground	-	1	-	-
Headlamp - Right Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the

high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- High beam headlamps ON.

Conditions for Setting the DTC

DTC B2580 01

The BCM detects a short to voltage in the headlamp high beam relay control circuit.

DTC B2580 02 and B2580 04

The BCM detects a short to ground or an open/high resistance in the headlamp high beam relay control circuit.

Actions Taken When the DTC Sets

- For an open/high resistance fault, the high beam headlamps and flash to pass function are inoperative. The high beam indicator on the instrument cluster operates normally.
- For a short to ground fault, the high beam headlamps and high beam indicator on the instrument cluster are always ON with the headlamp switch in the AUTO or HEAD positions.
- For a short to voltage fault, the high beam headlamps and flash to pass function are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the control circuit terminal 18 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
 2. Test for infinite resistance between the control circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the X50A Fuse Block - Underhood.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect a 3 A fused jumper between the control circuit terminal 18 and ground, vehicle in Service Mode, low beams ON.
4. Verify the high beam headlamps illuminate.
 - **If the high beam headlamps do not illuminate**
 1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal 18 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block - Underhood.
 - **If the high beam headlamps illuminate**
5. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Fuse Block Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2585 OR B3867: LEFT PARK LAMPS CONTROL CIRCUIT/RIGHT PARK LAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2585 01

Left Park Lamps Control Circuit Short to Battery

DTC B2585 02

Left Park Lamps Control Circuit Short to Ground

DTC B2585 04

Left Park Lamps Control Circuit Open

DTC B3867 01

Right Park Lamp Control Circuit Short to Battery

DTC B3867 02

Right Park Lamp Control Circuit Short to Ground

DTC B3867 04

Right Park Lamp Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Park Lamps ON Signal	1	B257A 00	1	-
License Plate Lamp Control	B3883 02	1	1	-
Park Lamps Control - Left	B2585 02	1	1	-
Park Lamps Control - Right	B3867 02	1	1	-
License Plate Lamp Ground - Right	-	1	-	-
License Plate Lamp Ground - Left	-	1	-	-
Park/Daytime Running Lamp Ground - Left	-	B2585 01, B2585 04	-	-
Park/Daytime Running Lamp Ground - Right	-	B3867 01, B3867 04	-	-
Side Marker Lamp Ground - Left Front	-	1	-	-
Side Marker Lamp Ground - Right Front	-	1	-	-
Tail Lamp Ground - Left	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Tail Lamp Ground - Right	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamps ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, and license lamps control circuits illuminating the park, tail, and license lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2585 01 and B2585 04

- The BCM detects a short to voltage or an open/high resistance in the left front park lamp control circuit.
- The BCM detects an open/high resistance in the left front park lamp ground circuit.

DTC B2585 02

The BCM detects a short to ground in the left front park lamp control circuit.

DTC B3867 01 and B3867 04

- The BCM detects a short to voltage or an open/high resistance in the right front park lamp control circuit.
- The BCM detects an open/high resistance in the right front park lamp ground circuit.

DTC B3867 02

The BCM detects a short to ground in the right front park lamp control circuit.

Actions Taken When the DTC Sets

DTC B2585 01

The left front park lamp is always ON.

DTC B2585 02 and B2585 04

The left front park lamp is inoperative.

DTC B3867 01

The right front park lamp is always ON.

DTC B3867 02 and B3867 04

The right front park lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Exterior Lighting Systems Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

DTC B2585

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp listed below.
 - E4AC Park/Daytime Running Lamp - Left
 - E2LF Side Marker Lamp - Left Front
 - E42L Tail Lamp Assembly - Left
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
 - E4AC Park/Daytime Running Lamp - Left terminal 3
 - E2LF Side Marker Lamp - Left Front terminal B

- E42L Tail Lamp Assembly - Left terminal 6
 - **If 10 Ω or greater**
1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - E4AC Park/Daytime Running Lamp - Left terminal 2
 - E2LF Side Marker Lamp - Left Front terminal A
 - E42L Tail Lamp Assembly - Left terminal 2
 4. Verify the test lamp turns ON and OFF when commanding the Left Front Park Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 5. Test or replace the left park lamp.

DTC B3867

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp listed below.
 - E4AD Park/Daytime Running Lamp - Right
 - E2RF Side Marker Lamp - Right Front
 - E42R Tail Lamp Assembly - Right
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
 - E4AD Park/Daytime Running Lamp - Right terminal 3

- E2RF Side Marker Lamp - Right Front terminal B
- E42R Tail Lamp Assembly - Right terminal 6
- **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
- 3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - E4AD Park/Daytime Running Lamp - Right terminal 2
 - E2RF Side Marker Lamp - Right Front terminal A
 - E42R Tail Lamp Assembly - Right terminal 2
- 4. Verify the test lamp turns ON and OFF when commanding the Right Front Park Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
- 5. Test or replace the right park lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Turn Signal Lamp Bulb Replacement](#)
- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Daytime Running Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2600 OR B2605: LEFT DAYTIME RUNNING LAMPS CONTROL CIRCUIT SHORT TO GROUND/RIGHT DAYTIME RUNNING LAMPS CONTROL CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2600 02

Left Daytime Running Lamps Control Circuit Short to Ground

DTC B2605 02

Right Daytime Running Lamps Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Daytime Running Lamp Control - Left	B2600 02	1	1	-
Daytime Running Lamp Control - Right	B2605 02	1	1	-
Daytime Running Lamp Ground - Left	-	1	-	-
Daytime Running Lamp Ground - Right	-	1	-	-
1. Daytime Running Lamps Malfunction				

Circuit/System Description

The ambient light/sunload sensor is used to monitor outside lighting conditions. The ambient light/sunload sensor provides a serial data message to the body control module (BCM) based on outside lighting conditions to determine if outside lighting conditions are correct for either daytime running lamps or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lamps ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lamps operation.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B2600 02

The BCM detects a short to ground in the left daytime running lamp control circuit.

DTC B2605 02

The BCM detects a short to ground in the right daytime running lamp control circuit.

Actions Taken When the DTC Sets

DTC B2600 02

The left daytime running lamp is inoperative.

DTC B2605 02

The right daytime running lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

The daytime running lamps will only operate in daylight conditions with the vehicle ON and in any transmission gear except PARK.

Reference Information

Schematic Reference

- [Headlights/Daytime Running Lights \(DRL\) Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the inoperative E4A Park/Daytime Running Lamp.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle ON.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Dedicated Daytime Running Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X5 - left daytime running lamp
 - X7 - right daytime running lamp
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle ON.
 - X5 - left daytime running lamp
 - X7 - right daytime running lamp
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
5. Test or replace the appropriate E4A Park/Daytime Running Lamp.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to [Daytime Running Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2610: PASSENGER COMPARTMENT DIMMING 1 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2610 01

Passenger Compartment Dimming 1 Circuit Short to Battery

DTC B2610 02

Passenger Compartment Dimming 1 Circuit Short to Ground

DTC B2610 04

Passenger Compartment Dimming 1 Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Backlight Dimming Control Terminal 8 X2	B2610 02	1	1	-
LED Backlight Dimming Control Terminal 9 X7	B2610 02	1	1	-
Dome/Reading Lamps - Rear Ground	-	1	-	-
Door Lock Switch - Driver Ground	-	1	-	-
Door Lock Switch - Passenger Ground	-	1	-	-
Headlamp Switch Ground	-	1	-	-
Multifunction Switch - Center Console Ground	-	1	-	-
Multifunction Switch - Overhead Console Ground	-	1	-	-
Park Brake Control Switch Ground	-	1	-	-
Refuel Request Switch Ground	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Seat Heating Switch - Left Rear Ground	-	1	-	-
Seat Heating Switch - Right Rear Ground	-	1	-	-
Steering Wheel Controls Switch - Left Ground	-	1	-	-
Steering Wheel Controls Switch - Radio Presets Ground	-	1	-	-
Steering Wheel Controls Switch - Right Ground	-	1	-	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The headlamp switch is used to increase and decrease the brightness of the interior backlighting components. The headlamp switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a B+, low reference, and signal circuits to the headlamp switch. When the headlamp switch is placed in the desired position, the dimmed voltage setting is applied from the headlamp switch through the headlamp switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2610 01

The BCM detects a short to battery in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

DTC B2610 02

The BCM detects a short to ground in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

DTC B2610 04

The BCM detects an open/high resistance in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

Actions Taken When the DTC Sets

The BCM will disable the LED backlight dimming control circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the appropriate ground circuit terminal and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Connect a test lamp between the appropriate control circuit terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X2 terminal 8
 - X7 terminal 9
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode
 - X2 terminal 8
 - X7 terminal 9
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the component with inoperative backlighting.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Parking Brake Actuator Switch Replacement](#)
- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Headlamp Switch Replacement](#)
- Refer to [Door Lock Switch Replacement - Driver Side](#)
- Refer to [Door Lock Switch Replacement - Passenger Front](#)
- Refer to [Interior Lamp and Multifunction Switch Replacement](#)
- Refer to [Fuel Tank Filler Door Lock Release Switch Replacement](#)
- Refer to [Steering Wheel Spoke Cover Replacement](#)

- Refer to [Radio Control Switch Replacement - Steering Wheel \(Left Side Rear\)](#) [Radio Control Switch Replacement - Steering Wheel \(Right Side Rear\)](#) [Radio Control Switch Replacement - Steering Wheel \(Right Side Front\)](#) [Radio Control Switch Replacement - Steering Wheel \(Left Side Lower\)](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2615: PASSENGER COMPARTMENT DIMMING 2 CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2615 02

Passenger Compartment Dimming 2 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 2) Fuse B+	B270A 01, B2615 02	B270A 01, B2615 02	-	-
Accent Lamp Control - Terminal 5 X2	B270A 01, B2615 02	1	1	-
Dome Lamps Control - Terminal 1 X7	B270A 01, B2615 02	1	1	-
Accent Lamp Ground - Instrument Panel	-	1	-	-
Dome/Reading Lamps - Front Ground	-	1	-	-
Dome/Reading Lamps - Rear Ground	-	1	-	-
1. Dome Lamps Malfunction				

Circuit/System Description

The dome lamp switch has 3 positions: DOOR, OFF, and ON. The ON position provides a ground for continuous operation and the dome lamps will remain illuminated until the switch is placed in either the DOOR or OFF position. When in the DOOR position, the dome lamps operation is controlled by the body control module (BCM). When any door is opened, the door ajar switch contacts close and the BCM receives a door-open input. The BCM illuminates the dome lamps when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamps will remain illuminated approximately 3 seconds after the last door closes. When the driver places the dome lamp switch in the OFF position, the dome lamps will be disabled. In the event that the dome lamps were to remain illuminated for more

than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the dome lamps control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

- The BCM detects a short to ground in the dome lamps control circuit.
- The BCM detects a short to ground or an open/high resistance in the F5DA (BCM 2) fuse B+ circuit.

Actions Taken When the DTC Sets

The front and middle dome lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

When the F5DA (BCM 2) fuse is open, both dome lamps, sunshade lamps, reading lamps, and backup lamps will be inoperative. DTC B2545 will also set for the backup lamps when the vehicle is placed in the reverse gear.

Reference Information

Schematic Reference

- [Interior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the inoperative component listed below. It may take up to 2 min for all vehicle systems to power down.
 - S48B Multifunction Switch - Overhead Console
 - E37R Dome/Reading Lamps - Rear
 - E1W Accent Lamp - Instrument Panel
5. Test for less than 5 Ω between the ground circuit terminals listed below and ground.
 - S48B Multifunction Switch - Overhead Console terminal 5
 - E37R Dome/Reading Lamps - Rear terminal B
 - E1W Accent Lamp - Instrument Panel terminal 2
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuits end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
6. Connect a test lamp between the control circuit terminals listed below and ground.
 - S48B Multifunction Switch - Overhead Console terminal 8
 - E37R Dome/Reading Lamps - Rear terminal C
 - E1W Accent Lamp - Instrument Panel terminal 1
7. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan

tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.

- X7 - S48B Multifunction Switch - Overhead Console and E37R Dome/Reading Lamps - Rear
- X2 - E1W Accent Lamp - Instrument Panel

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.

- X7 - S48B Multifunction Switch - Overhead Console and E37R Dome/Reading Lamps - Rear
- X2 - E1W Accent Lamp - Instrument Panel

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the inoperative dome/reading lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Front Floor Console Bin Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B2625: DISPLAY DIMMING PULSE WIDTH MODULATION OUTPUT CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2625 02

Display Dimming Pulse Width Modulation Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Switch Indicator LED Backlight Control Terminal 5 X1	B0968 06, B2625 02	1	1	-
Multifunction Switch - Center Console Control	1	1	1	-
Multifunction Switch - Overhead Console Control	1	1	1	-
Seat Heating Switch - Left Rear Control	1	1	1	-
Seat Heating Switch - Right Rear Control	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the amber switch indicators through the amber LED indicator control circuit. When the appropriate switch has been activated, the BCM applies a pulse width modulated voltage through the amber LED indicator control circuit illuminating the rear seat heating switches, overhead console multifunction switch, and center console multifunction switch amber LEDs.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

The BCM detects a short to ground in the switch indicator LED backlight dimming control circuit terminal 5 X1.

Actions Taken When the DTC Sets

The switch indicator LED backlight dimming control circuit terminal 5 X1 driver is shut down.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connectors at the components listed below.

- S32LR Seat Heating Switch - Left Rear
- S32RR Seat Heating Switch - Right Rear
- S48B Multifunction Switch - Overhead Console
- S48E Multifunction Switch - Center Console

NOTE: **The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.**

2. Vehicle in Service Mode, verify a test lamp illuminates between each control circuit terminal listed below and ground.

- S32LR Seat Heating Switch - Left Rear terminal 6
- S32RR Seat Heating Switch - Right Rear terminal 6
- S48B Multifunction Switch - Overhead Console terminal 18
- S48E Multifunction Switch - Center Console terminal 3
- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Verify a test lamp does not illuminate at FULL intensity between each control circuit terminal listed below and ground.

- S32LR Seat Heating Switch - Left Rear terminal 6
- S32RR Seat Heating Switch - Right Rear terminal 6
- S48B Multifunction Switch - Overhead Console terminal 18
- S48E Multifunction Switch - Center Console terminal 3

- **If the test lamp illuminates at FULL intensity**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp does not illuminate at FULL intensity**

4. Test or replace the component with the inoperative switch indicator.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Interior Lamp and Multifunction Switch Replacement](#)
- Refer to [Headlamp Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3596: HAZARD LAMPS REQUEST CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3596 00

Hazard Lamps Request Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	B3596 00	1	1	-
Hazard Warning Switch Ground	-	1	-	-
1. Hazard Lamps Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Hazard lamps ON.

Conditions for Setting the DTC

The hazard warning switch input is Active for longer than 60 s.

Actions Taken When the DTC Sets

The hazard lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
7. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Hazard Warning Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3600: PASSENGER COMPARTMENT DIMMING REQUEST SIGNAL CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3600 03

Passenger Compartment Dimming Request Signal Circuit Low Voltage

DTC B3600 07

Passenger Compartment Dimming Request Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B3600 03

- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch B+ reference circuit.

- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch signal circuit.

DTC B3600 07

- The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

All interior backlighting defaults to FULL bright.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.
 - **If less than B+**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in

Service Mode.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If B+**

3. Test for B+ between the B+ circuit terminal 12 and the low reference circuit terminal 7.

• **If less than B+**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the low reference circuit terminal 7 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If B+**

4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.

• **If the test lamp illuminates**

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

• **If the test lamp does not illuminate**

5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.

• **If less than B+**

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit terminal 11 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

• **If B+**

6. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

DTC B3650: HIGH BEAM REQUEST SIGNAL CIRCUIT PERFORMANCE - SIGNAL INVALID

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3650 08

High Beam Request Signal Circuit Performance - Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors three signal circuits from the turn signal/multifunction switch. When the turn signal/multifunction switch is in the AUTO position, the three signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the turn signal/multifunction switch is placed in the OFF position, the turn signal/multifunction switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the turn signal/multifunction switch in the PARK LAMPS position, the turn signal/multifunction switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the turn signal/multifunction switch is in the HEADLAMP position, both the turn signal/multifunction switch park lamps ON signal circuit and the turn signal/multifunction switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch high beam signal circuit.

Actions Taken When the DTC Sets

The high beam headlamps will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
 4. Verify the scan tool High Beam Select Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 7 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
 5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 3.
 6. Verify the scan tool High Beam Select Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
 7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Turn Signal Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3806: HIGH BEAM AND HEADLAMP FLASH SELECT CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3806 00

High Beam and Headlamp Flash Select Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the body control module (BCM) through the flash to pass signal circuit. The BCM responds to the flash to pass request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps. The high beam headlamps will only illuminate for as long as the flash to pass switch is activated.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch flash to pass signal circuit.

Actions Taken When the DTC Sets

The high beam lamps and the high beam indicator on the instrument panel cluster are always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Headlamps Flash Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 3.
6. Verify the scan tool Headlamps Flash Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 6 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Turn Signal Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3881 OR B3882: LEFT TAIL LAMP CIRCUIT/RIGHT TAIL LAMP CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3881 01

Left Tail Lamp Circuit Short to Battery

DTC B3881 02

Left Tail Lamp Circuit Short to Ground

DTC B3881 04

Left Tail Lamp Circuit Open

DTC B3882 01

Right Tail Lamp Circuit Short to Battery

DTC B3882 02

Right Tail Lamp Circuit Short to Ground

DTC B3882 04

Right Tail Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Control - Left Rear	B3881 02	1	1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Control - Right Rear	B3882 02	1	1	-
Headlamp Switch Ground	-	1	-	-
Stop Lamp Ground - Left	-	1	-	-
Stop Lamp Ground - Right	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits illuminating the left and right stop lamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Stop lamps ON.

Conditions for Setting the DTC

DTC B3881 01 and B3881 04

The BCM detects a short to voltage or an open/high resistance in the left rear stop lamp control circuit.

DTC B3881 02

The BCM detects a short to ground in the left rear stop lamp control circuit.

DTC B3882 01 and B3882 04

The BCM detects a short to voltage or an open/high resistance in the right rear stop lamp control circuit.

DTC B3882 02

The BCM detects a short to ground in the right rear stop lamp control circuit.

Actions Taken When the DTC Sets

DTC B3881 01

The left rear stop lamp is always ON.

DTC B3881 02 and B3881 04

The left rear stop lamp is inoperative.

DTC B3882 01

The right rear stop lamp is always ON.

DTC B3882 02 and B3882 04

The right rear stop lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, trunk latch latched, disconnect the harness connector at the appropriate E5 Stop Lamp.
2. Test for less than 5 Ω between the ground circuit terminal B and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**

3. Connect a test lamp between the control circuit terminal A and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Rear Park Lamp ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X4 - left stop lamp
 - X5 - right stop lamp
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.
 - X4 - left stop lamp
 - X5 - right stop lamp
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E5 Stop Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3883: LICENSE PLATE LAMP CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3883 01

License Plate Lamp Circuit Short to Battery

DTC B3883 02

License Plate Lamp Circuit Short to Ground

DTC B3883 04

License Plate Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01	-
License Plate Lamp - Right Ground	-	1	-	-
License Plate Lamp - Left Ground	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps and license lamps control circuits illuminating the park and license lamps.

Conditions for Running the DTC

DTC B3883 01

Turn signal/multifunction switch in OFF position.

DTC B3883 02 and B3883 04

Turn signal/multifunction switch in AUTO, PARK or ON positions.

Conditions for Setting the DTC

DTC B3883 01

The BCM detects a short to voltage in the license plate lamp control circuit.

DTC B3883 02

The BCM detects a short to ground in the license plate lamp control circuit.

DTC B3883 04

The BCM detects an open/high resistance in the license plate lamp control circuit.

Actions Taken When the DTC Sets

DTC B3883 01

License plate lamps always ON.

DTC B3883 02 and B3883 04

License plate lamps inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, remove both E7 License Plate Lamp bulbs.
2. Test for less than 5 Ω between each ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Connect a test lamp between the E7L License Plate Lamp - Left control circuit terminal 1 and ground, vehicle in Service Mode.
 4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 5. Vehicle OFF.
 6. Connect a test lamp between the E7R License Plate Lamp - Right control circuit terminal 1 and ground, vehicle in Service Mode.
 7. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - **If the test lamp turns ON and OFF**
 8. Test or replace the E7 License Plate Lamp bulb.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Rear License Plate Lamp Replacement](#)

- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3884: CENTER HIGH MOUNTED STOP LAMP CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3884 01

Center High Mounted Stop Lamp Circuit Short to Battery

DTC B3884 02

Center High Mounted Stop Lamp Circuit Short to Ground

DTC B3884 04

Center High Mounted Stop Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Center High Mounted Stop Lamp Control	B3884 02	B3884 04	B3884 01	-
Center High Mounted Stop Lamp Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp control circuit illuminating the left and right stop lamps and the center high mounted stop lamp.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC B3884 01

The BCM detects a short to voltage in the center high mounted stop lamp control circuit.

DTC B3884 02

The BCM detects a short to ground in the center high mounted stop lamp control circuit.

DTC B3884 04

The BCM detects an open/high resistance in the center high mounted stop lamp control circuit.

Actions Taken When the DTC Sets

DTC B3884 01

Center high mounted stop lamp always ON.

DTC B3884 02 and B3884 04

Center high mounted stop lamp inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lights Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Mount Stop Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC B3948 OR B3949: LEFT FRONT TURN SIGNAL CIRCUIT/RIGHT FRONT TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3948 01

Left Front Turn Signal Circuit Short to Battery

DTC B3948 02

Left Front Turn Signal Circuit Short to Ground

DTC B3948 04

Left Front Turn Signal Circuit Open

DTC B3949 01

Right Front Turn Signal Circuit Short to Battery

DTC B3949 02

Right Front Turn Signal Circuit Short to Ground

DTC B3949 04

Right Front Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 3) Fuse B+	B3949 01	B3949 01	-	-
F18DA (BCM 7) Fuse B+	B3948 01, B3951 01	B3948 01, B3951 01	-	-
Turn Signal Control - Left Front	B3948 02	B3948 01	B3948 01	-
Turn Signal Control - Right Front	B3949 02	B3949 01	B3949 01	-
Turn Signal Lamp - Left Front Ground	-	1	-	-
Turn Signal Lamp - Right Front Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be

activated with the vehicle ON/OFF switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument panel requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B3948 01 and B3948 04

- The BCM detects a short to ground or an open/high resistance in the F18DA (BCM 7) fuse B+ circuit.
- The BCM detects an open/high resistance in the left front turn signal control circuit.
- The BCM detects an open/high resistance in the left front turn signal ground circuit.

DTC B3948 02

The BCM detects a short to ground in the left front turn signal control circuit.

DTC B3949 01 and B3949 04

- The BCM detects a short to ground or an open/high resistance in the F8DA (BCM 3) fuse B+ circuit.
- The BCM detects an open/high resistance in the right front turn signal control circuit.
- The BCM detects an open/high resistance in the right front turn signal ground circuit.

DTC B3949 02

The BCM detects a short to ground in the right front turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3948

- The left front turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Left Front Turn Indicator Failure".

DTC B3949

- The right front turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Right Front Turn Indicator Failure".

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.

- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3948

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Exterior lamps OFF, disconnect the harness connectors at the E4LF Turn Signal Lamp - Left Front.
5. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the E4LF Turn Signal Lamp - Left Front.

DTC B3949

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Exterior lamps OFF, disconnect the harness connector at the component E4RF Turn Signal Lamp - Right Front.
5. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the E4RF Turn Signal Lamp - Right Front.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Front Turn Signal Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

DTC B3950 OR B3951: LEFT REAR TURN SIGNAL CIRCUIT/RIGHT REAR TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3950 01

Left Rear Turn Signal Circuit Short to Battery

DTC B3950 02

Left Rear Turn Signal Circuit Short to Ground

DTC B3950 04

Left Rear Turn Signal Circuit Open

DTC B3951 01

Right Rear Turn Signal Circuit Short to Battery

DTC B3951 02

Right Rear Turn Signal Circuit Short to Ground

DTC B3951 04

Right Rear Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F18DA (BCM 7) Fuse B+	B3948 01, B3951 01	B3948 01, B3951 01	-	-
F21DA (BCM 4) Fuse B+	B3950 01	B3950 01	-	-
Turn Signal - Left Front Control	B3948 02	B3948 01	B3948 01	-
Turn Signal - Right Front Control	B3949 02	B3949 01	B3949 01	-
Turn Signal - Left Rear Control	B3950 02	B3950 01	B3950 01	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal - Right Rear Control	B3951 02	B3951 01	B3951 01	-
Turn Signal Lamp - Left Rear Ground	-	1	-	-
Turn Signal Lamp - Right Rear Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument panel requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B3950 01 and B3950 04

- The BCM detects a short to ground or an open/high resistance in the F21DA (BCM 4) fuse B+ circuit.
- The BCM detects an open/high resistance in the left rear turn signal control circuit.
- The BCM detects an open/high resistance in the left rear turn signal ground circuit.

DTC B3950 02

The BCM detects a short to ground in the left rear turn signal control circuit.

DTC B3951 01 and B3951 04

- The BCM detects a short to ground or an open/high resistance in the F18DA (BCM 7) fuse B+ circuit.
- The BCM detects an open/high resistance in the right rear turn signal control circuit.
- The BCM detects an open/high resistance in the right rear turn signal ground circuit.

DTC B3951 02

The BCM detects a short to ground in the right rear turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3950

- The left rear turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Left Rear Turn Indicator Failure".

DTC B3951

- The right rear turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Right Rear Turn Indicator Failure".

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3950

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.
2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Exterior lamps OFF, disconnect the harness connector at the E4LR Turn Signal Lamp - Left Rear.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Left Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the E4LR Turn Signal Lamp - Left Rear.

DTC B3951

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF.

2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.

2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.

4. Exterior lamps OFF, disconnect the harness connector at the E4RR Turn Signal Lamp - Right Rear.

5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.

7. Verify the test lamp turns ON and OFF when commanding the Right Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**
8. Test or replace the E4RR Turn Signal Lamp - Right Rear.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

DTC C0277 OR C0890: BRAKE PEDAL POSITION SENSOR CIRCUIT/CONTROL MODULE VOLTAGE REFERENCE OUTPUT 3 CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0277 06

Brake Pedal Position Sensor Circuit Low Voltage/Open

DTC C0277 07

Brake Pedal Position Sensor Circuit High Voltage

DTC C0277 09

Brake Pedal Position Sensor Circuit Too Fast Transitions

DTC C0277 4B

Brake Pedal Position Sensor Circuit Calibration Not Learned

DTC C0890 03

Control Module Voltage Reference Output 3 Circuit Low Voltage

DTC C0890 07

Control Module Voltage Reference Output 3 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, U0422 71	C0277 06, U0422 71, C0890 03	C0277 07, C0890 07, U0422 71	-
Brake Pedal Position Sensor Signal	C0277 06, U0422 71	C0277 06, U0422 71	C0277 07, C0890 07, U0422 71	C0277 09
Brake Pedal Position Sensor Low Reference	-	1	1	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC C0277 06

- The BCM detects a short to ground or an open/high resistance in the BPP sensor 5 V reference circuit.
- The BCM detects a short to ground or an open/high resistance in the BPP sensor signal circuit.

DTC C0277 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

DTC C0277 09

The BCM detects the BPP sensor signal is changing faster than possible under normal operating conditions.

DTC C0277 4B

The DTC will set when the BPP sensor home position is not learned.

DTC C0890 03

- The BCM detects a short to ground or an open/high resistance in the BPP sensor 5 V reference circuit.

DTC C0890 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

Actions Taken When the DTC Sets

DTC C0277 06 and C0890 03

- The vehicle will not start with a short to ground or an open/high resistance on the BPPS 5 V reference circuit or the BPPS signal circuit.

DTC C0277 07 and C0890 07

The vehicle will not start with a short to voltage on the BPPS 5 V reference circuit or the BPPS signal circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- For DTC C0277 4B a successful brake pedal position sensor calibration has been performed.
- A history DTC will clear once 50 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.
- A DTC will not clear the current status until the next ignition cycle.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

DTC C0277 06, C0277 07, C0890 03, and C0890 07

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If between 4.8 - 5.2 V**
3. Verify the scan tool Brake Pedal Applied parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If Inactive**
4. Install a 3 A fused jumper wire between the 5-volt reference circuit terminal 1 and the signal circuit terminal 3.
5. Verify the scan tool Brake Pedal Applied parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

6. Test or replace the B22 Brake Pedal Position Sensor.

DTC C0277 4B

1. Verify DTC C0277 4B is not set.

- **If DTC C0277 4B is set**

1. Vehicle in Service Mode.

2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to [Brake Pedal Position Sensor Calibration](#).

3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.

- If the DTC resets, replace the B22 Brake Pedal Position Sensor.
- If the DTC does not reset

4. All OK.

- **If DTC C0277 4B is not set**

2. All OK.

DTC C0277 09

1. Verify DTC C0277 09 is not set.

- **If DTC C0277 09 is set**

1. Replace the B22 Brake Pedal Position Sensor.

2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to [Brake Pedal Position Sensor Calibration](#).

3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.

- If the DTC resets, replace the K9 Body Control Module.
- If the DTC does not reset

4. All OK.

- **If DTC C0277 09 is not set**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Pedal Position Sensor Calibration](#)
- Refer to [Brake Pedal Position Sensor Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DTC C0297: BRAKE APPLIED OUTPUT CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0297 02

Brake Applied Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Applied Signal	C0297 02	1	1	-
1. Cruise Control Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground or an open/high resistance on the brake applied signal circuit.

Actions Taken When the DTC Sets

The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a test lamp between the signal circuit terminal 50 and ground, vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**

4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Brake Pedal Position Sensor Calibration](#)
- Refer to [Control Module References](#) for BCM or ECM replacement, programming, and setup

SYMPTOMS - LIGHTING

NOTE: The following steps must be completed before using a symptom table.

- Perform the [Diagnostic System Check - Vehicle](#) before using a symptom table in order to verify that all of the following conditions are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to the following:
 - [Exterior Lighting Systems Description and Operation](#)
 - [Interior Lighting Systems Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the lighting system. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Thoroughly inspect the wiring and connectors. An incomplete inspection of the wiring and connectors may result in misdiagnosis causing part replacement with the reappearance of the malfunction. If an intermittent malfunction exists, refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Backup Lamps Malfunction](#)
- [Courtesy Lamps Malfunction](#)
- [Daytime Running Lamps Malfunction](#)
- [Dome Lamps Malfunction](#)
- [Hazard Lamps Malfunction](#)
- [Headlamps Malfunction](#)
- [Interior Accent Lighting Malfunction](#)
- [Interior Backlighting Malfunction](#)

- [Park, License, and/or Tail Lamps Malfunction](#)
- [Rear Compartment Lamp Malfunction](#)
- [Stop Lamps Malfunction](#)
- [Turn Signal Lamps and/or Indicators Malfunction](#)

BACKUP LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F22DA (BCM 6) Fuse B+	1	1	-	-
Backup Lamp Control	B2545 02	1	1	-
Backup Lamp Ground	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamp control circuit illuminating the backup lamp. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamp control circuit. The vehicle must be ON for the backup lamps to operate.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Testing](#)

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E5 Backup Lamp.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
- **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the E5 Backup Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Backup Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

COURTESY LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F22DA (BCM 6) Fuse B+	1	1	-	-
Courtesy Lamps Control - Terminal 3 X7	B1480 02	1	1	-
Dome/Reading Lamps - Front Ground	-	1, 2	-	-
Dome/Reading Lamps - Rear Ground	-	1, 2	-	-
Sunshade Mirror Lamp - Left Ground	-	1	-	-
Sunshade Mirror Lamp - Right Ground	-	1	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the front reading lamps and left and right sunshade lamps via the courtesy lamp control circuit. When a sunshade mirror is opened, the switch contact close allowing battery voltage to flow illuminating the respective lamps. The front reading lamps are controlled by individual switches that are activated by the operator when additional cabin lighting is required. In the event that any of these courtesy lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Diagnostic Aids

When the F22DA (BCM 6) fuse is open, both dome lamps, sunshade lamps, reading lamps, and backup lamps will be inoperative.

Reference Information

Schematic Reference

- [Interior Lights Dimming Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Interior Lighting Systems Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
 4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connectors at the components listed below. It may take up to 2 min for all vehicle systems to power down.
 - S48B Multifunction Switch - Overhead Console
 - E37R Dome/Reading Lamps - Rear
 - E31L Sunshade Mirror Lamp - Left
 - E31R Sunshade Mirror Lamp - Right
 5. Test for less than 15 Ω between the appropriate ground circuit terminal listed below and ground.
 - S48B Multifunction Switch - Overhead Console terminal 5
 - E37R Dome/Reading Lamps - Rear terminal B
 - E31L Sunshade Mirror Lamp - Left terminal B
 - E31R Sunshade Mirror Lamp - Right terminal B
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
 6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - S48B Multifunction Switch - Overhead Console terminal 7
 - E37R Dome/Reading Lamps - Rear terminal A
 - E31L Sunshade Mirror Lamp - Left terminal A
 - E31R Sunshade Mirror Lamp - Right terminal A
 7. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.
- **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**
 8. Test or replace the appropriate courtesy lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Sunshade Illuminated Mirror Lamp Bulb Replacement](#)
- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

DAYTIME RUNNING LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F20DA Fuse (BCM 1) Fuse B+	B0968 06, B1517 07	B0968 06, B1517 07	-	-
F22DA Fuse (BCM 6) Fuse B+	1	1	-	-
Ambient Light/Sunload Sensor B+	U135B 00	U135B 00	U135B 00	-
Daytime Running Lamp Control - Left	B2600 02	1	1	-
Daytime Running Lamp Control - Right	B2605 02	1	1	-
Daytime Running Lamp Ground - Left	-	1	-	-
Daytime Running Lamp Ground - Right	-	1	-	-
1. Daytime Running Lamps Malfunction				

Circuit/System Description

The ambient light/sunload sensor is used to monitor outside lighting conditions. The ambient light/sunload sensor provides a serial data message to the body control module (BCM) based on outside lighting conditions to determine if outside lighting conditions are correct for either daytime running lamps or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lamps ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lamps operation.

Diagnostic Aids

The daytime running lamps will only operate in daylight conditions with the vehicle ON and in any transmission gear except PARK.

Reference Information

Schematic Reference

- [Headlights/Daytime Running Lights \(DRL\) Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lights Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the left daytime running lamp turns ON and OFF when commanding the Left Dedicated Daytime Running Lamp ON and OFF with a scan tool.

- **If the left daytime running lamp does not turn ON and OFF**

Refer to Daytime Running Lamp Malfunction.

- **If the left daytime running lamp turns ON and OFF**

3. Verify the right daytime running lamp turns ON and OFF when commanding the Right Dedicated

Daytime Running Lamp ON and OFF with a scan tool.

- **If the right daytime running lamp does not turn ON and OFF**

Refer to Daytime Running Lamp Malfunction.

- **If the right daytime running lamp turns ON and OFF**

4. Refer to [DTC U1340-U135F](#) .

Circuit/System Testing

Daytime Running Lamp Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
5. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
6. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
7. Exterior lamps OFF, disconnect the harness connector at the inoperative E4 Daytime Running Lamp.
8. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
- **If less than 10 Ω**
9. Connect a test lamp between the control circuit terminal 1 and ground, vehicle ON.
10. Verify the test lamp turns ON and OFF when commanding the appropriate Dedicated Daytime Running Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X5 - left daytime running lamp
 - X7 - right daytime running lamp
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle ON.
 - X5 - left daytime running lamp
 - X7 - right daytime running lamp
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
11. Test or replace the appropriate E4 Daytime Running Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Daytime Running Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM or HVAC control module replacement, programming, and setup

DOME LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F5DA (BCM 2) Fuse B+	B270A 01, B2615 02	B270A 01, B2615 02	-	-
Dome Lamps Control - Terminal 1 X7	B270A 01, B2615 02	1	1	-
Accent Lamp Control - Terminal 5 X2	B270A 01, B2615 02	1	1	-
Dome Lamp Switch Cancel Signal	2	2	2	-
Dome Lamp Switch ON Signal	2	2	2	-
Accent Lamp Ground - Instrument Panel	-	1	-	-
Dome Lamp Ground - Front	-	1, 2	-	-
Dome Lamp Ground - Rear	-	1	-	-
1. Dome Lamps Malfunction 2. Dome Lamp Switch Malfunction				

Circuit/System Description

The dome lamp switch has 3 positions: DOOR, OFF, and ON. The ON position provides a ground for continuous operation and the dome lamps will remain illuminated until the switch is placed in either the DOOR or OFF position. When in the DOOR position, the dome lamps operation is controlled by the body control module (BCM). When any door is opened, the door ajar switch contacts close and the BCM receives a door-open input. The BCM illuminates the dome lamps when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamps will remain illuminated approximately 3 seconds after the last door closes. When the driver places the dome lamp switch in the OFF position, the dome lamps will be disabled. In the event that the dome lamps were to remain illuminated for more than 10 minutes with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the dome lamps control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- [Interior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Ajar Sw. parameter changes between Active and Inactive while opening and closing each vehicle door.
 - **If the parameter does not change**

Refer to [Door Ajar Indicator Malfunction](#) .
 - **If the parameter changes**
3. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter changes between Door, On, and Cancel while placing the dome lamp switch in the Door, On, and Cancel positions.
 - **If the parameter does not change**

Refer to Dome Lamp Switch Malfunction.
 - **If the parameter changes**
4. Verify the dome lamps turn ON and OFF while commanding the Courtesy Lamps ON and OFF with a scan tool.
 - **If the dome lamps do not turn ON and OFF**

Refer to Dome Lamp Malfunction.
 - **If the dome lamps turn ON and OFF**
5. All OK.

Circuit/System Testing

Dome Lamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 5 and ground.
 - **If 5 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
- **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is Door.
 - **If Cancel**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 21 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If On**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Door**
5. Install a 3 A fused jumper wire between the signal circuit terminal 21 and the ground circuit terminal 6.
6. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is Cancel.
 - **If not Cancel**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 21 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Cancel**
7. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 6.
8. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is On.
 - **If not On**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If On**

9. Test or replace the E37F Dome/Reading Lamps - Front.

Dome Lamps Malfunction

- Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the inoperative component listed below. It may take up to 2 min for all vehicle systems to power down.
 - S48B Multifunction Switch - Overhead Console
 - E37R Dome/Reading Lamps - Rear
 - E1W Accent Lamp - Instrument Panel
- Test for less than 5 Ω between the ground circuit terminals listed below and ground.
 - S48B Multifunction Switch - Overhead Console terminal 5
 - E37R Dome/Reading Lamps - Rear terminal B
 - E1W Accent Lamp - Instrument Panel terminal 2
 - **If 5 Ω or greater**
 - Vehicle OFF.
 - Test for less than 2 Ω in the ground circuits end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
- Connect a test lamp between the control circuit terminals listed below and ground, vehicle in Service Mode.
 - S48B Multifunction Switch - Overhead Console terminal 8
 - E37R Dome/Reading Lamps - Rear terminal C
 - E1W Accent Lamp - Instrument Panel terminal 1
- Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 - Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X7 - S48B Multifunction Switch - Overhead Console and E37R Dome/Reading Lamps - Rear
 - X2 - E1W Accent Lamp - Instrument Panel
 - Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.

- X7 - S48B Multifunction Switch - Overhead Console and E37R Dome/Reading Lamps - Rear
- X2 - E1W Accent Lamp - Instrument Panel

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the inoperative dome lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Front Floor Console Bin Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

HAZARD LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F20DA (BCM 1) Fuse B+	B0968 06, B1517 07	B0968 06, B1517 07	-	-
Hazard Warning Switch Signal	B3596 00	1	1	-
Hazard Warning Switch LED Backlighting Control	2	2	2	-
Hazard Warning Switch Ground	-	1	-	-
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is

momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hazard Lamps Switch parameter changes between Active and Inactive while commanding the hazard lamps ON and OFF with the hazard warning switch.
 - **If the parameter does not change**

Refer to Hazard Warning Switch Malfunction.
 - **If the parameter changes**
3. Verify all left and right turn signal lamps turn ON and OFF while commanding the hazard lamps ON and OFF with the hazard warning switch.
 - **If all turn signal lamps do not turn ON and OFF**

Refer to [Turn Signal Lamps and/or Indicators Malfunction](#)
 - **If all turn signal lamps turn ON and OFF**
4. Verify the scan tool Hazard Lamps Switch backlighting turns ON and OFF while commanding the Hazard

Lamps Switch Backlight ON and OFF with a scan tool.

- **If the hazard warning switch backlighting does not turn ON and OFF**

Refer to Hazard Warning Switch Backlighting Malfunction.

- **If the hazard warning switch backlighting turns ON and OFF**

5. All OK.

Circuit/System Testing

Hazard Warning Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground terminal 1.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**

7. Test or replace the S26 Hazard Warning Switch.

Hazard Warning Switch Backlighting Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S26 Hazard Warning Switch. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
6. Vehicle in Service Mode, test for B+ between the control circuit terminal 2 and ground.
 - **If less than B+**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
7. Verify a test lamp does not illuminate between control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in

Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp does not illuminate**

8. Test or replace the S26 Hazard Warning Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Hazard Warning Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

HEADLAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 3) Fuse B+	B3949 01	B3949 01	-	-
F21DA (BCM 4) Fuse B+	B3950 01	B3950 01	-	-
Headlamp High Beam Relay Control	2	2	B2580 01	-
Low Beam Headlamp Control - Left	B2575 02	1	1	-
Low Beam Headlamp Control - Right	B2699 02	1	1	-
High Beam Headlamp Control - Left	2	2	2	-
High Beam Headlamp Control - Right	2	2	2	-
Headlamp Switch Headlamps OFF Signal	B257A 00	4	4	-
Headlamp Switch Headlamps ON Signal	B257A 00	4	4	-
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	3	3	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	3	3	-
Turn Signal/Multifunction Switch Auto High Beam Select Signal (TQ5)	5	5	5	-
Headlamp Ground - Left	-	1, 2	-	-
Headlamp Ground - Right	-	1, 2	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Ground	-	4	-	-
Turn Signal/Multifunction Switch Ground	-	3	-	-
1. Headlamps Malfunction - Low Beam 2. Headlamps Malfunction - High Beam 3. Turn Signal/Multifunction Switch Malfunction 4. Headlamp Switch Malfunction 5. Automatic High Beam Select Switch Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors 3 signal circuits from the headlamp switch. When the headlamp switch is in the AUTO position, the 3 signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with 2 signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps.

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the BCM through the flash to pass signal circuit. The BCM responds by applying ground to the high beam relay control circuit which energizes the high beam relay illuminating the high beams for a brief moment or until the flash to pass switch is released.

Reference Information

Schematic Reference

- [Headlights/Daytime Running Lights \(DRL\) Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Headlamps On Switch parameter changes between Active and Inactive while commanding the headlamps ON and OFF with the Headlamp Switch.
 - **If the parameter does not change**

Refer to Headlamp Switch Malfunction.
 - **If the parameter changes**
3. Verify the scan tool Automatic Headlamps Disable Switch parameter changes between Active and Inactive while commanding the automatic lamp control ON and OFF with the Headlamp Switch.
 - **If the parameter does not change**

Refer to Headlamp Switch Malfunction.
 - **If the parameter changes**
4. Verify the scan tool Headlamps Flash Switch parameter changes between Active and Inactive while commanding the flash to pass ON and OFF with the turn signal/multifunction switch.
 - **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.
 - **If the parameter changes**
5. Verify the scan tool High Beam Select Switch parameter changes between Active and Inactive while commanding the high beams ON and OFF with the turn signal/multifunction switch.
 - **If the parameter does not change**

Refer to Turn Signal/Multifunction Switch Malfunction.
 - **If the parameter changes**
6. Verify the left low beam headlamp lamp turns ON and OFF when commanding the Left Headlamp Low Beam ON and OFF with a scan tool.
 - **If the left low beam headlamp does not turn ON and OFF**

Refer to Headlamps Malfunction - Low Beam.

- **If the left low beam headlamp turns ON and OFF**

7. Verify the right low headlamp turns ON and OFF when commanding the Right Headlamp Low Beam ON and OFF with a scan tool.

- **If the right low beam headlamp does not turn ON and OFF**

Refer to Headlamps Malfunction - Low Beam.

- **If the right low beam headlamp turns ON and OFF**

8. Low beam headlamps ON, verify the high beams turn ON and OFF when commanding the High Beams ON and OFF with a scan tool.

- **If the high beams do not turn ON and OFF**

Refer to Headlamps Malfunction - High Beam.

- **If the high beams turn ON and OFF**

9. Verify the high beam indicator on the instrument cluster turns ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.

- **If the high beam indicator does not turn ON and OFF**

Refer to High Beam Indicator Malfunction.

- **If the high beam indicator turns ON and OFF**

10. (TQ5 only) Verify the scan tool Auto High Beam Select Switch parameter changes between Active and Inactive while commanding the auto high beams ON and OFF with the turn signal/multifunction switch.

- **If the parameter does not change**

Refer to Automatic High Beam Select Switch Malfunction.

- **If the parameter changes**

11. All OK.

Circuit/System Testing

Headlamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool Automatic Headlamps Disable Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 3 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.

6. Verify the scan tool Automatic Headlamps Disable Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit terminal 3 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Verify the scan tool Park Lamps Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 5 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 5 and ground.

9. Verify the scan tool Park Lamps Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit terminal 5 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

10. Verify the scan tool Headlamps On Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

11. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.

12. Verify the scan tool Headlamps On Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the signal circuit terminal 1 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

13. Test or replace the S30 Headlamp Switch.

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Vehicle in Service Mode.

4. Verify the scan tool High Beam Select Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit terminal 7 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
6. Verify the scan tool High Beam Select Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

7. Verify the scan tool Headlamps Flash Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
9. Verify the scan tool Headlamps Flash Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 6 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Automatic High Beam Select Switch Malfunction

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Ignition ON.
4. Verify the scan tool Auto High Beam Select Switch parameter is Inactive.
 - **If not Inactive**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground.
6. Verify the scan tool Auto High Beam Select Switch parameter is Active.
 - **If not Active**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
7. Test or replace the S78 Turn Signal/Multifunction Switch.

Headlamps Malfunction - Low Beam

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
 4. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
 5. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E4 Headlamp - Low Beam.
 6. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 7. Connect a test lamp between the control circuit terminal 4 and ground, vehicle in Service Mode.
 8. Verify the test lamp turns ON and OFF when commanding the appropriate Headlamp Low Beam ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

9. Test or replace the E4 Headlamp - Low Beam.

Headlamps Malfunction - High Beam

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the control circuit terminal 18 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.

2. Test for infinite resistance between the control circuit terminal and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the X50A Fuse Block - Underhood.

- **If the test lamp illuminates**

3. Vehicle OFF, connect a 3 A fused jumper between the control circuit terminal 18 and ground.

4. Remove the left high beam fuse (F37UA) at the X50A Fuse Block - Underhood, vehicle in Service Mode.

5. Verify a test lamp illuminates between the left high beam fuse (F37UA) B+ switch control terminal and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.

2. Test for less than 1 V between the control circuit terminal 18 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the X50A Fuse Block - Underhood.

- **If the test lamp illuminates**

6. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.

7. Install the left high beam fuse (F37UA) at the X50A Fuse Block - Underhood.

8. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E4 Headlamp - High Beam.

9. Test for less than 10 Ω between the ground circuit terminal B and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

10. Connect a test lamp between the control circuit terminal A and ground, vehicle in Service Mode.

11. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the X50A Fuse Block - Underhood.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the X50A Fuse Block - Underhood.

- **If the test lamp turns ON and OFF**

12. Test or replace the E4 Headlamp - High Beam.

High Beam Indicator Malfunction

1. Vehicle in Service Mode.

2. Verify the high beam indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.

- **If the high beam indicator is always OFF or remains ON**

Replace the P16 Instrument Cluster.

- **If the high beam indicator turns ON and OFF**

3. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Replacement](#)
- Refer to [Headlamp Bulb Replacement \(Left Side\)](#)[Headlamp Bulb Replacement \(Right Side\)](#)
- Refer to [Headlamp Switch Replacement](#)
- Refer to [Turn Signal Switch Replacement](#)
- Refer to [Fuse Block Replacement](#)
- Refer to [Control Module References](#) for BCM and Instrument Cluster replacement, programming, and setup

INTERIOR ACCENT LIGHTING MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accent Lamp Control - Terminal 23 X1	B255D 02	1	1	-
Accent Lamp - Driver Door Ground	-	1	-	-
Accent Lamp - Instrument Panel Ground	-	1	-	-
Accent Lamp - Passenger Door Ground	-	1	-	-
Flood Lamp - Driver Door Handle Ground	-	1	-	-
Flood Lamp - Passenger Door Handle Ground	-	1	-	-
Flood Lamp - Left Rear Door Handle Ground	-	1	-	-
Flood Lamp - Right Rear Door Handle Ground	-	1	-	-
Multifunction Switch - Overhead Console Ground	-	1	-	-
1. Interior Accent Lighting Malfunction				

Circuit/System Description

The headlamp switch is used to increase and decrease the brightness of the interior backlighting components. The headlamp switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, signal, and low reference circuits to the headlamp switch. When the headlamp switch is placed in the desired position, the dimmed voltage setting is applied from the headlamp switch through the headlamp switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Reference Information

Schematic Reference

[Interior Lights Dimming Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: Each accent lamp may need to be disconnected to isolate the short to ground. Use the schematic to identify the following:

- All accent lamps equipped with the vehicle
- Component locations on the accent light control circuit
- Each component's control circuit terminals

1. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the appropriate courtesy lamp. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the appropriate ground circuit terminal below and ground.

- E63D Flood Lamp - Driver Door Handle terminal 2
- E63LR Flood Lamp - Left Rear Door Handle terminal 2
- E63RR Flood Lamp - Right Rear Door Handle terminal 2
- E63P Flood Lamp - Passenger Door Handle terminal 2
- E1D Accent Lamp - Driver Door terminal 1
- E1P Accent Lamp - Passenger Door terminal 1
- E1W Accent Lamp - Instrument Panel terminal 2
- S48B Multifunction Switch - Overhead Console terminal 5
- **If 5 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - E63D Flood Lamp - Driver Door Handle terminal 1
 - E63LR Flood Lamp - Left Rear Door Handle terminal 1
 - E63RR Flood Lamp - Right Rear Door Handle terminal 1
 - E63P Flood Lamp - Passenger Door Handle terminal 1
 - E1D Accent Lamp - Driver Door terminal 2
 - E1P Accent Lamp - Passenger Door terminal 2
 - E1W Accent Lamp - Instrument Panel terminal 3
 - S48B Multifunction Switch - Overhead Console terminal 2
4. Verify the test lamp turns ON and OFF when commanding the appropriate Accent Lighting Command ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate accent lamp

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Side Door Inside Handle Illumination Lamp Replacement](#)
- Refer to [Rear Side Door Inside Handle Illumination Lamp Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

INTERIOR BACKLIGHTING MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F20DA (BCM 1) Fuse B+	B0968 06, B1517 07	B0968 06, B1517 07	-	-
F22DA (BCM 6) Fuse B+	2	2	-	-
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	1	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	1	-
LED Backlight Dimming Control Terminal 8 X2	B2610 02	2	2	-
LED Backlight Dimming Control Terminal 9 X7	B2610 02	2	2	-
Switch Indicator Amber LED Backlight Dimming Control Terminal 5 X1	B0968 06, B2625 02	1	1	-
Vehicle ON/OFF Switch Dimming Control	3	3	3	-
Headlamp Switch Low Reference	1	1	1	-
Dome/Reading Lamps - Rear Ground	-	2	-	-
Door Lock Switch - Driver Ground	-	2	-	-
Door Lock Switch - Passenger Ground	-	2	-	-
Headlamp Switch Ground	-	2	-	-
Multifunction Switch - Center Console Ground	-	2	-	-
Multifunction Switch - Overhead Console Ground	-	2	-	-
Park Brake Control Switch Ground	-	2	-	-
Refuel Request Switch Ground	-	2	-	-
Seat Heating Switch - Left Rear Ground	-	2	-	-
Seat Heating Switch - Right Rear Ground	-	2	-	-
Steering Wheel Controls Switch - Left Ground	-	2	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Steering Wheel Controls Switch - Radio Presets Ground	-	2	-	-
Steering Wheel Controls Switch - Right Ground	-	2	-	-
Vehicle ON/OFF Switch Ground	-	3	-	-
1. Dimmer Switch Malfunction 2. Interior Backlighting Malfunction 3. Vehicle On/Off Switch Malfunction				

Circuit/System Description

The headlamp switch is used to increase and decrease the brightness of the interior backlighting components. The headlamp switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal, circuits to the headlamp switch. When the headlamp switch is placed in the desired position, the dimmed voltage setting is applied from the headlamp switch through the headlamp switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Reference Information

Schematic Reference

- [Interior Lights Dimming Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, park lamps ON.
2. Verify the scan tool LED Backlight Dimming Command parameter changes between a high percentage to a low percentage while operating the dimmer switch from high to low.

- **If the parameter does not change**

Refer to Dimmer Switch Malfunction.

- **If the parameter changes**

3. Verify the backlighting components turn ON and OFF while commanding the LED Backlight Dimming ON and OFF with a scan tool.

- **If the backlighting components do not turn ON and OFF**

Refer to Interior Backlighting Malfunction.

- **If the backlighting components turn ON and OFF**

4. Verify the switch indicator amber LED's for the components listed below illuminate when the appropriate switch is commanded ON and OFF.

- S48B Multifunction Switch - Overhead Console
- S48E Multifunction Switch - Center Console
- S32LR Seat Heating Switch - Left Rear
- S32RR Seat Heating Switch - Right Rear

- **If the switch indicator amber LED's do not illuminate**

Refer to Switch Indicator Amber LED Backlighting Malfunction.

- **If the switch indicator amber LED's illuminate**

5. Verify the vehicle on/off switch backlighting switch illuminates during entry backlighting mode.

- **If the switch does not illuminate**

Refer to Vehicle On/Off Switch Malfunction.

- **If the switch illuminates**

6. All OK.

Circuit/System Testing

Dimmer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.

- **If less than B+**

1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
3. Verify a test lamp illuminates between the B+ circuit terminal 12 and the low reference circuit terminal 7.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the low reference circuit terminal 7 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp illuminates**
 4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp does not illuminate**
 5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.
 - **If less than B+**
 1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 11 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If B+**
 6. Test or replace the S30 Headlamp Switch.

Interior Backlighting Malfunction

NOTE: Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:

- Backlighting components the vehicle is equipped with
- Each component's control and ground circuit terminals
- Component locations on the backlighting control circuit

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

• **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.

4. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.

5. Test for less than 5 Ω between the appropriate ground circuit terminal and ground.

• **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

• **If less than 5 Ω**

6. Connect a test lamp between the appropriate control circuit terminal and ground, vehicle in Service Mode.

7. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.

• **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.

- X2 terminal 8
- X7 terminal 9

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode
 - X2 terminal 8
 - X7 terminal 9
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the component with inoperative backlighting.

Switch Indicator Amber LED Backlighting Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Disconnect the harness connectors at the components listed below.
 - S32LR Seat Heating Switch - Left Rear
 - S32RR Seat Heating Switch - Right Rear
 - S48B Multifunction Switch - Overhead Console
 - S48E Multifunction Switch - Center Console

NOTE: The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.

5. Vehicle in Service Mode, verify a test lamp illuminates between each control circuit terminal listed below

and ground.

- S32LR Seat Heating Switch - Left Rear terminal 6
- S32RR Seat Heating Switch - Right Rear terminal 6
- S48B Multifunction Switch - Overhead Console terminal 18
- S48E Multifunction Switch - Center Console terminal 3
- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp illuminates**

6. Verify a test lamp does not illuminate at FULL intensity between each control circuit terminal listed below and ground.

- S32LR Seat Heating Switch - Left Rear terminal 6
- S32RR Seat Heating Switch - Right Rear terminal 6
- S48B Multifunction Switch - Overhead Console terminal 18
- S48E Multifunction Switch - Center Console terminal 3
- **If the test lamp illuminates at FULL intensity**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp does not illuminate at FULL intensity**

7. Test or replace the component with the inoperative switch indicator.

Vehicle On/Off Switch Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Ignition OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminal 4 and ground.

- **If 5 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

6. Connect a test lamp between the control circuit terminal 8 and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the appropriate Accent Lighting Command ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the S83 Vehicle On/Off Switch

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Parking Brake Actuator Switch Replacement](#)
- Refer to [Center Reading Lamp Replacement](#)
- Refer to [Headlamp Switch Replacement](#)

- Refer to [Door Lock Switch Replacement - Driver Side](#)
- Refer to [Door Lock Switch Replacement - Passenger Front](#)
- Refer to [Interior Lamp and Multifunction Switch Replacement](#)
- Refer to [Fuel Tank Filler Door Lock Release Switch Replacement](#)
- Refer to [Steering Wheel Spoke Cover Replacement](#)
- Refer to [Radio Control Switch Replacement - Steering Wheel \(Left Side Rear\)](#) [Radio Control Switch Replacement - Steering Wheel \(Right Side Rear\)](#) [Radio Control Switch Replacement - Steering Wheel \(Right Side Front\)](#) [Radio Control Switch Replacement - Steering Wheel \(Left Side Lower\)](#)
- Refer to [Ignition and Start Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming and setup

PARK, LICENSE, AND/OR TAIL LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 3) Fuse B+	B3949 01	B3949 01	-	-
F20DA (BCM 1) Fuse B+	B0968 06, B1517 07	B0968 06, B1517 07	-	-
F21DA (BCM 4) Fuse B+	B3950 01	B3950 01	-	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
License Plate Lamp Control	B3883 02	3	3	-
Park Lamps Control - Left	B2585 02	1	1	-
Park Lamps Control - Right	B3867 02	1	1	-
Headlamp Switch Ground	-	2	-	-
License Plate Lamp Ground - Left	-	3	-	-
License Plate Lamp Ground - Right	-	3	-	-
Park Lamp Ground - Left	-	B2585 01, B2585 04	-	-
Park Lamp Ground - Right	-	B3867 01, B3867 04	-	-
Side Marker Lamp Ground - Left Front	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Side Marker Lamp Ground - Right Front	-	1	-	-
Tail Lamp Ground - Left	-	1	-	-
Tail Lamp Ground - Right	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction 3. License Plate Lamps Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamps ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps, tail lamps, license plate lamps, and side marker lamps control circuits illuminating the park, tail, license, and side marker lamps.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Park Lamp Switch parameter changes between Active and Inactive while commanding the park lamps ON and OFF with the Headlamp Switch.
 - **If the parameter does not change**

Refer to Park Lamp Switch Malfunction.

- **If the parameter changes**

3. Verify the left front park lamp turns ON and OFF when commanding the Left Front Park Lamp ON and OFF with a scan tool.

- **If the left front park lamp does not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the left front park lamp turns ON and OFF**

4. Verify the left rear park lamp turns ON and OFF when commanding the Left Rear Park Lamp ON and OFF with a scan tool.

- **If the left rear park lamp does not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the left rear park lamp turns ON and OFF**

5. Verify the right front park lamp turns ON and OFF when commanding the Right Front Park ON and OFF with a scan tool.

- **If the right front park lamp does not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the right front park lamp turns ON and OFF**

6. Verify the right rear park lamp turns ON and OFF when commanding the Right Rear Park ON and OFF with a scan tool.

- **If the right rear park lamp does not turn ON and OFF**

Refer to Park Lamps Malfunction.

- **If the right rear park lamp turns ON and OFF**

7. Verify the license plate lamps turn ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

- **If the license plate lamps do not turn ON and OFF**

Refer to License Plate Lamps Malfunction.

- **If the license plate lamps turn ON and OFF**

8. All OK.

Circuit/System Testing

Park Lamp Switch Malfunction

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.

- **If 5 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 8.
6. Verify the scan tool Park Lamps Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 5 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
7. Test or replace the S30 Headlamp Switch.

Park Lamps Malfunction

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
 - **If the test lamp illuminates**
 4. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
 5. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the inoperative park lamp.
 6. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
 - E4AC Park/Daytime Running Lamp - Left terminal 3
 - E4AD Park/Daytime Running Lamp - Right terminal 3
 - E2LF Side Marker Lamp - Left Front terminal B
 - E2RF Side Marker Lamp - Right Front terminal B
 - E42L Tail Lamp Assembly - Left terminal 6
 - E42R Tail Lamp Assembly - Right terminal 6
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
 7. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
 - E4AC Park/Daytime Running Lamp - Left terminal 2
 - E4AD Park/Daytime Running Lamp - Right terminal 2
 - E2LF Side Marker Lamp - Left Front terminal A
 - E2RF Side Marker Lamp - Right Front terminal A
 - E42L Tail Lamp Assembly - Left terminal 2
 - E42R Tail Lamp Assembly - Right terminal 2
 8. Verify the test lamp turns ON and OFF when commanding the appropriate Park Lamps ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

• **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

• **If the test lamp turns ON and OFF**

9. Test or replace the appropriate park lamp.

License Plate Lamps Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module

• **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove the appropriate E7 License Plate Lamp bulbs.
5. Test for less than 5 Ω between each ground circuit terminal 2 and ground.

• **If 5 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

• **If less than 5 Ω**

6. Connect a test lamp between the appropriate E7 License Plate Lamp control circuit terminal 1 and ground, vehicle in Service Mode.

7. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground at the appropriate E7 License Plate Lamp.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end at the appropriate E7 License Plate Lamp.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal and ground at the appropriate E7 License Plate Lamp.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

8. Test or replace the appropriate E7 License Plate Lamp bulb.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Headlamp Replacement](#)
- Refer to [Headlamp Bulb Replacement \(Left Side\)](#)[Headlamp Bulb Replacement \(Right Side\)](#)
- Refer to [Daytime Running Lamp Replacement](#)
- Refer to [Rear License Plate Lamp Replacement](#)
- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Headlamp Switch Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

REAR COMPARTMENT LAMP MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to	Open/High	Short to	Signal
---------	----------	-----------	----------	--------

	Ground	Resistance	Voltage	Performance
F18DA (BCM 7) Fuse B+	B3948 01, B3951 01	B3948 01, B3951 01	-	-
Cargo Lamp Control	B2570 02	1	1	-
Cargo Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the cargo lamp through the cargo lamp control circuit. When the BCM receives a rear liftgate open input from the rear compartment lid latch, the BCM applies battery voltage to the cargo lamp control circuit illuminating the cargo lamp. In the event that the cargo lamp were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position, the BCM will deactivate the cargo lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- [Interior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module
- **If the test lamp illuminates**
 3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
 4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E33 Cargo Lamp. It may take up to 2 min for all vehicle systems to power down.
 5. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
 6. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
 7. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 8. Test or replace the E33 Cargo Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cargo Center Courtesy Lamp Bulb Replacement](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

STOP LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 3) Fuse B+	B3949 01	B3949 01	-	-
F20DA (BCM 1) Fuse B+	B0968 06, B1517 07	B0968 06, B1517 07	-	-
F21DA (BCM 4) Fuse B+	B3950 01	B3950 01	-	-
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, U0422 71	C0277 06, U0422 71, C0890 03	C0277 07, C0890 07, U0422 71	-
Brake Pedal Position Sensor Signal	C0277 06, U0422 71	C0277 06, U0422 71	C0277 07, C0890 07, U0422 71	C0277 09
Center High Mounted Stop Lamp Control	B3884 02	2	2	-
Stop Lamp Control - Left	B3881 02	1	1	-
Stop Lamp Control - Right	B3882 02	1	1	-
Brake Pedal Position Sensor Low Reference	-	3	3	-
Center High Mounted Stop Lamp Ground	-	2	-	-
Stop Lamp Ground - Left	-	1	-	-
Stop Lamp Ground - Right	-	1	-	-
1. Stop Lamps Malfunction 2. Center High Mounted Stop Lamp Malfunction 3. Brake Pedal Position Sensor Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Exterior Lighting Systems Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Pedal Applied parameter changes between Active and Inactive while pressing and releasing the brake pedal.
 - **If the parameter does not change**

Refer to Brake Pedal Position Sensor Malfunction.
 - **If the parameter changes**
3. Verify the left brake lamp turns ON and OFF when commanding the Left Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.
 - **If the left brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.
 - **If the left brake lamp turns ON and OFF**
4. Verify the right brake lamp turns ON and OFF when commanding the Right Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.
 - **If the right brake lamp does not turn ON and OFF**

Refer to Stop Lamps Malfunction.

- **If the right brake lamp turns ON and OFF**

5. Verify the center high mounted stop lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.

- **If the center high mounted stop does not turn ON and OFF**

Refer to Center High Mount Stop Lamp Malfunction.

- **If the center high mounted stop turns ON and OFF**

6. All OK.

Circuit/System Testing

Brake Pedal Position Sensor Malfunction

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.

2. Test for B+ between the low reference circuit terminal 2 and B+.

- **If less than B+**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K9 Body Control Module.

- **If B+**

3. Test for less than 1 V between the low reference circuit terminal 2 and ground.

- **If 1 V or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Test for less than 1 V between the low reference circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the K9 Body Control Module.

- **If less than 1 V**

4. Test or replace the B22 Brake Pedal Position Sensor.

Stop Lamps Malfunction

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If the test lamp illuminates**
4. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
5. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E5 Stop Lamp.
6. Test for less than 5 Ω between the ground circuit terminal B and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
7. Connect a test lamp between the control circuit terminal A and ground, vehicle in Service Mode.
8. Verify the test lamp turns ON and OFF when commanding the appropriate Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X4 - left stop lamp
 - X5 - right stop lamp
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control

Module, vehicle in Service Mode.

- X4 - left stop lamp
- X5 - right stop lamp

2. Test for less than 1 V between the control circuit terminal and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

• **If the test lamp turns ON and OFF**

9. Test or replace the appropriate E5 Stop Lamp.

Center High Mount Stop Lamp Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

• **If the test lamp does not illuminate and the circuit fuse is good**

1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

• **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 Body Control Module.

• **If the test lamp illuminates**

3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.

4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp.

5. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

• **If 5 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

• **If less than 5 Ω**

6. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.

7. Verify the test lamp turns ON and OFF when commanding the Center Brake Lamp ON and OFF with a scan tool.

• **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
8. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [High Mount Stop Lamp Replacement](#)
- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Brake Pedal Position Sensor Replacement](#)
- Refer to [Brake Pedal Position Sensor Calibration](#)
- Refer to [Control Module References](#) for BCM replacement, programming, and setup

TURN SIGNAL LAMPS AND/OR INDICATORS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 3) Fuse B+	B3949 01	B3949 01	-	-
F18DA (BCM 7) Fuse B+	B3948 01, B3951 01	B3948 01, B3951 01	-	-
F21DA (BCM 4) Fuse B+	B3950 01	B3950 01	-	-
Turn Signal Switch Signal - Left	2	2	2	-
Turn Signal Switch Signal - Right	2	2	2	-
Turn Signal Control - Left Front	B3948 02	B3948 01	B3948 01	-
Turn Signal Control - Right Front	B3949 02	B3949 01	B3949 01	-
Turn Signal Control - Left Rear	B3950 02	B3950 01	B3950 01	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal Control - Right Rear	B3951 02	B3951 01	B3951 01	-
Turn Signal Lamp Ground - Left Front	-	1	-	-
Turn Signal Lamp Ground - Right Front	-	1	-	-
Turn Signal Lamp Ground - Left Rear	-	1	-	-
Turn Signal Lamp Ground - Right Rear	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	2	-	-
1. Turn Signal Lamps and/or Indicators Malfunction 2. Turn Signal/Multifunction Switch Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the vehicle mode switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Diagnostic Aids

The tail lamp outage detection circuits are low current B+ circuits that will not illuminate a test lamp.

Reference Information

Schematic Reference

- [Exterior Lights Schematics](#)
- [Body Control System Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle in Service Mode.
2. Verify the scan tool Right Turn Signal Switch and Left Turn Signal Switch parameters change between Active and Inactive while cycling the turn signal switch between the right and left positions.
 - **If the parameters do not change**
Refer to Turn Signal/Multifunction Switch Malfunction.
 - **If the parameters change**
3. Verify the left front turn signal lamp turns ON and OFF while commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.
 - **If the left front turn signal lamp does not turn ON and OFF**
Refer to Turn Signal Lamps Malfunction.
 - **If the left front turn signal lamp turns ON and OFF**
4. Verify the right front turn signal lamp turns ON and OFF while commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.
 - **If the right front turn signal lamp does not turn ON and OFF**
Refer to Turn Signal Lamps Malfunction.
 - **If the right front turn signal lamp turns ON and OFF**
5. Verify the left rear turn signal lamp turns ON and OFF while commanding the Left Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.
 - **If the left rear turn signal lamp does not turn ON and OFF**
Refer to Turn Signal Lamps Malfunction.
 - **If the left rear turn signal lamp turns ON and OFF**
6. Verify the right rear turn signal lamp turns ON and OFF while commanding the Right Rear Turn Signal/Brake Lamp ON and OFF with a scan tool.
 - **If the right rear turn signal lamp does not turn ON and OFF**
Refer to Turn Signal Lamps Malfunction.
 - **If the right rear turn signal lamp turns ON and OFF**
7. Verify the left and right turn signal indicators turn ON and OFF while commanding the Instrument Cluster Gauge Sweep Test ON and OFF with a scan tool.

- **If the left or right turn signal indicators do not turn ON and OFF**

Refer to Turn Signal Indicators Malfunction.

- **If the left and right turn signal indicators turn ON and OFF**

8. All OK.

Circuit/System Testing

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 3 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Left Turn Signal Switch parameter is Inactive.
 - **If not Inactive**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.
 - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.
6. Verify the scan tool Left Turn Signal Switch parameter is Active.
 - **If not Active**
 1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If Active**
7. Verify the scan tool Right Turn Signal Switch parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K9 Body Control Module.

- **If Inactive**

8. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
9. Verify the scan tool Right Turn Signal Switch parameter is Active.

- **If not Active**

1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate E4 Turn Signal Lamp.
2. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Connect a test lamp between the control circuit at the socket terminal and ground.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Turn Signal Lamp ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
 - X5 left turn signals
 - X4 right turn signals
2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.
 - X5 left turn signals
 - X4 right turn signals
 2. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.
 - **If the test lamp turns ON and OFF**
 5. Test or replace the appropriate E4 Turn Signal Lamp.

Turn Signal Indicators Malfunction

1. Vehicle in Service Mode.
2. Verify the left and right turn signal indicators turn ON and OFF while commanding the Instrument Cluster Gauge Sweep Test ON and OFF with a scan tool.
 - **If the left or right turn signal indicators are always OFF or remain ON**

Replace the P16 Instrument Cluster.
 - **If the left and right turn signal indicators turn ON and OFF**
3. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Front Turn Signal Lamp Bulb Replacement](#)
- Refer to [Turn Signal Bulb Replacement](#)
- Refer to [Stop and Tail Lamp Bulb Replacement](#)
- Refer to [Turn Signal Switch Replacement](#)
- Refer to [Control Module References](#) for BCM or Instrument Cluster replacement, programming and setup

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - LIGHTING

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#).

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² /(AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:

- Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
- Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
- Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.

2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
- Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
- Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
- Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
- If the wire is damaged, repeat this procedure after removing the damaged section.

4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.

5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

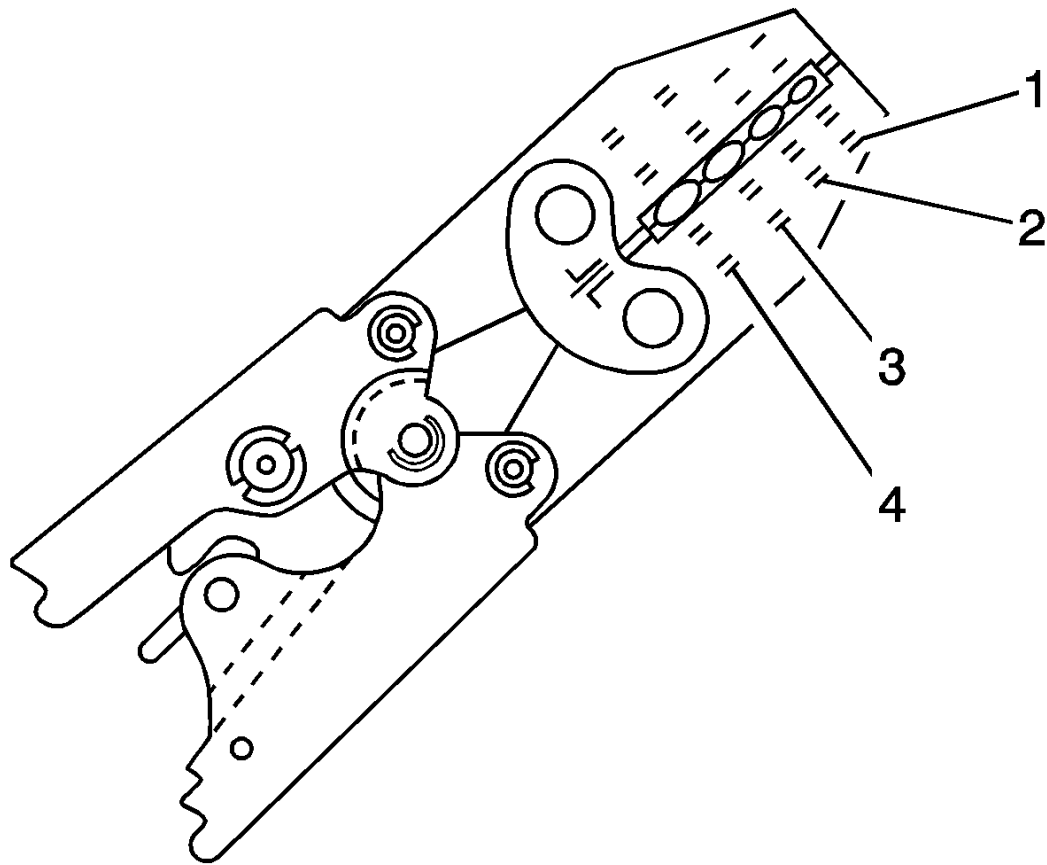


Fig. 10: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

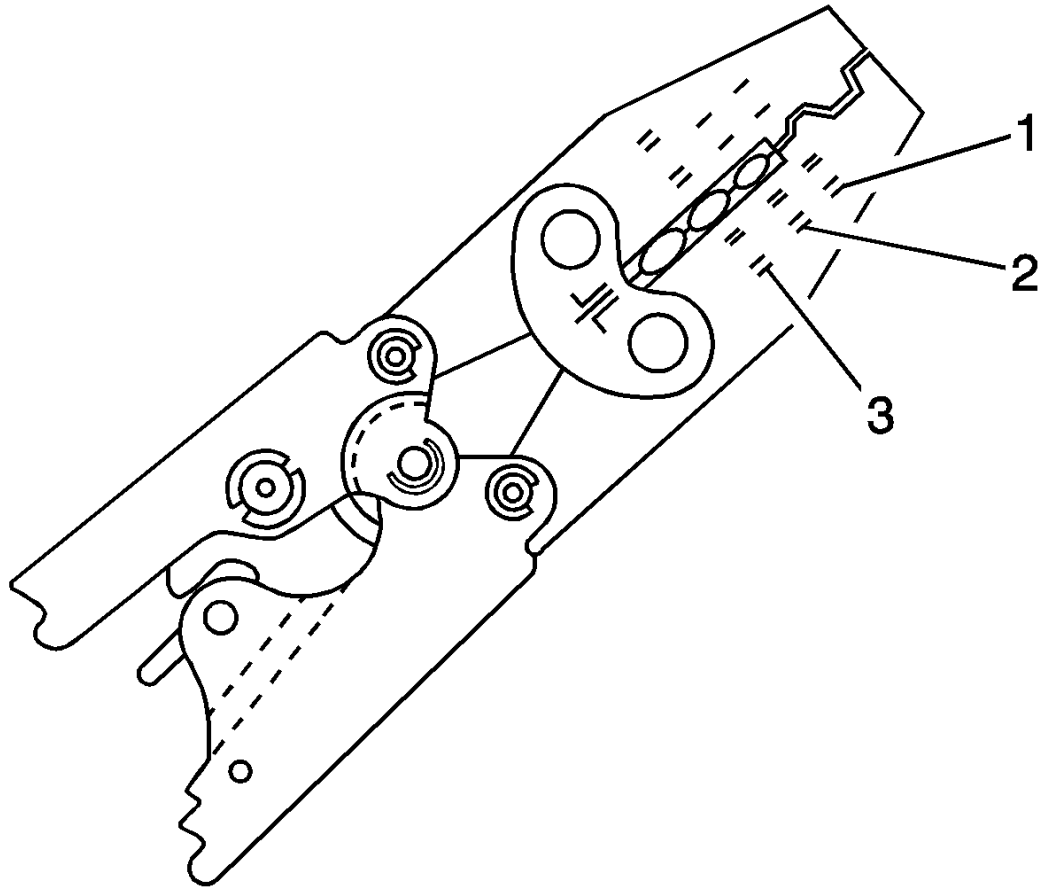


Fig. 11: Splice Sleeve Crimping Tool With 3 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

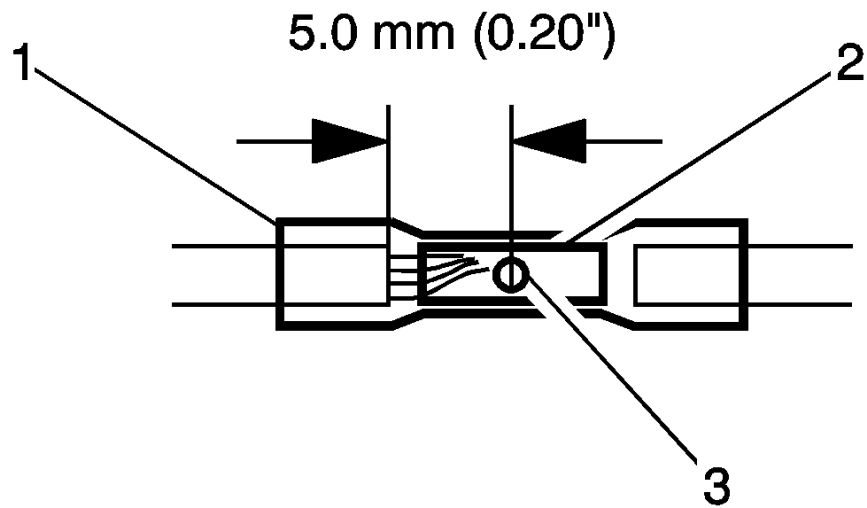


Fig. 12: Identifying DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 13: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 14: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

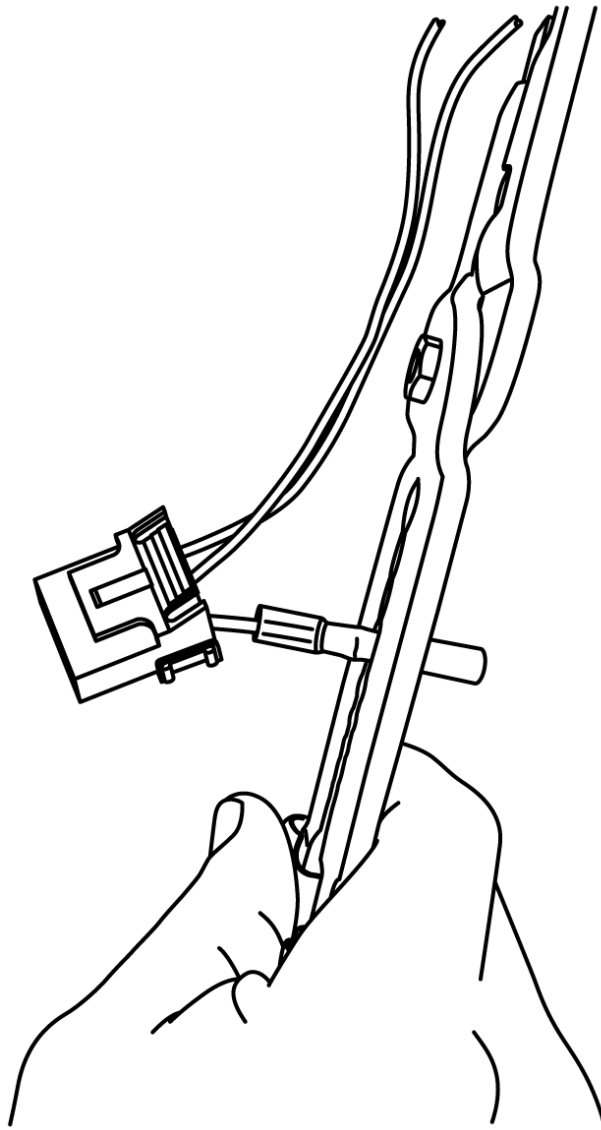


Fig. 15: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

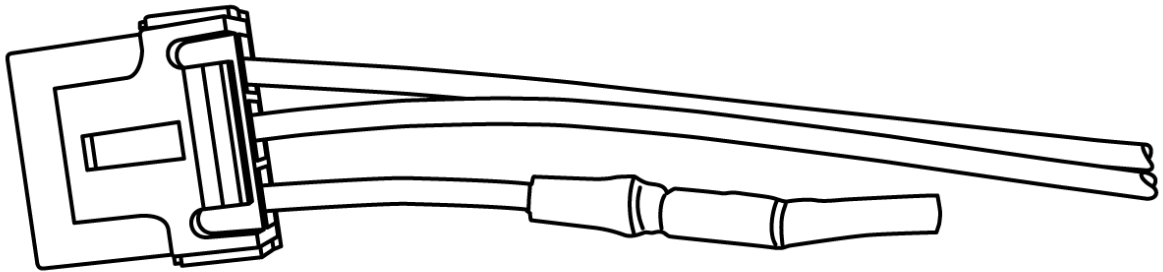


Fig. 16: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

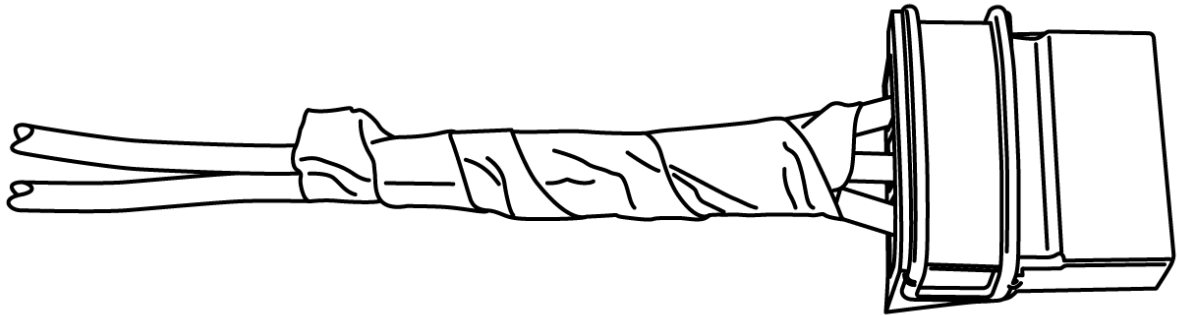


Fig. 17: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - LIGHTING

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

BRAKE PEDAL POSITION SENSOR CALIBRATION

Calibration Criteria

NOTE: **Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.**

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), engine control module (ECM), or hybrid powertrain control module have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM/HPCM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Vehicle in Service Mode, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.

- 3. Install a scan tool.
- 4. Clear all DTCs before proceeding.
- 5. Navigate to the Configuration/Reset Functions menu of the BCM.
- 6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

BRAKE PEDAL POSITION SENSOR REPLACEMENT

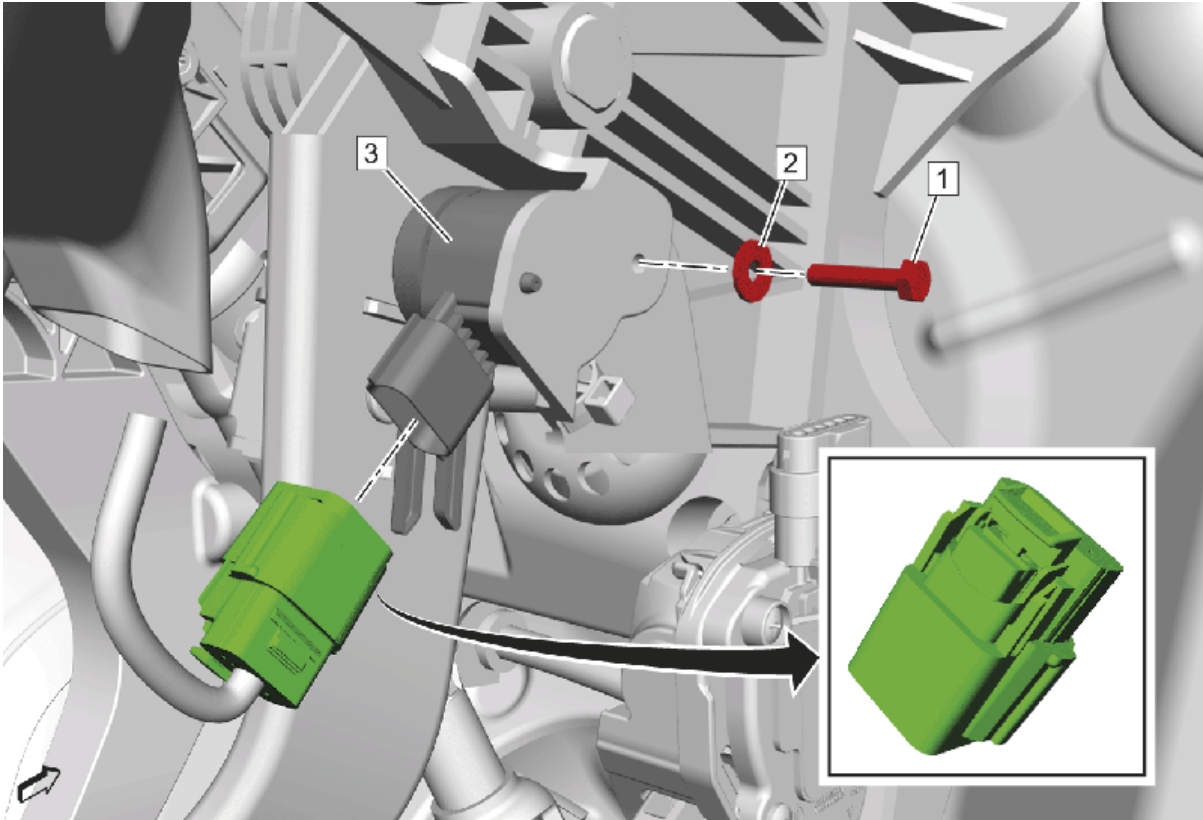


Fig. 18: Brake Pedal Position Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Floor Front Air Outlet Duct - Left Side. Refer to Floor Front Air Outlet Duct Replacement - Left Side	
1	Brake Pedal Position Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 3 N.m (27 lb in)
2	Brake Pedal Position Sensor Washer

Callout	Component Name
3	Brake Pedal Position Sensor Procedure 1. Disconnect the electrical connector. 2. After the installation is complete, calibrate the brake pedal position sensor. Refer to Brake Pedal Position Sensor Calibration

HEADLAMP SWITCH REPLACEMENT

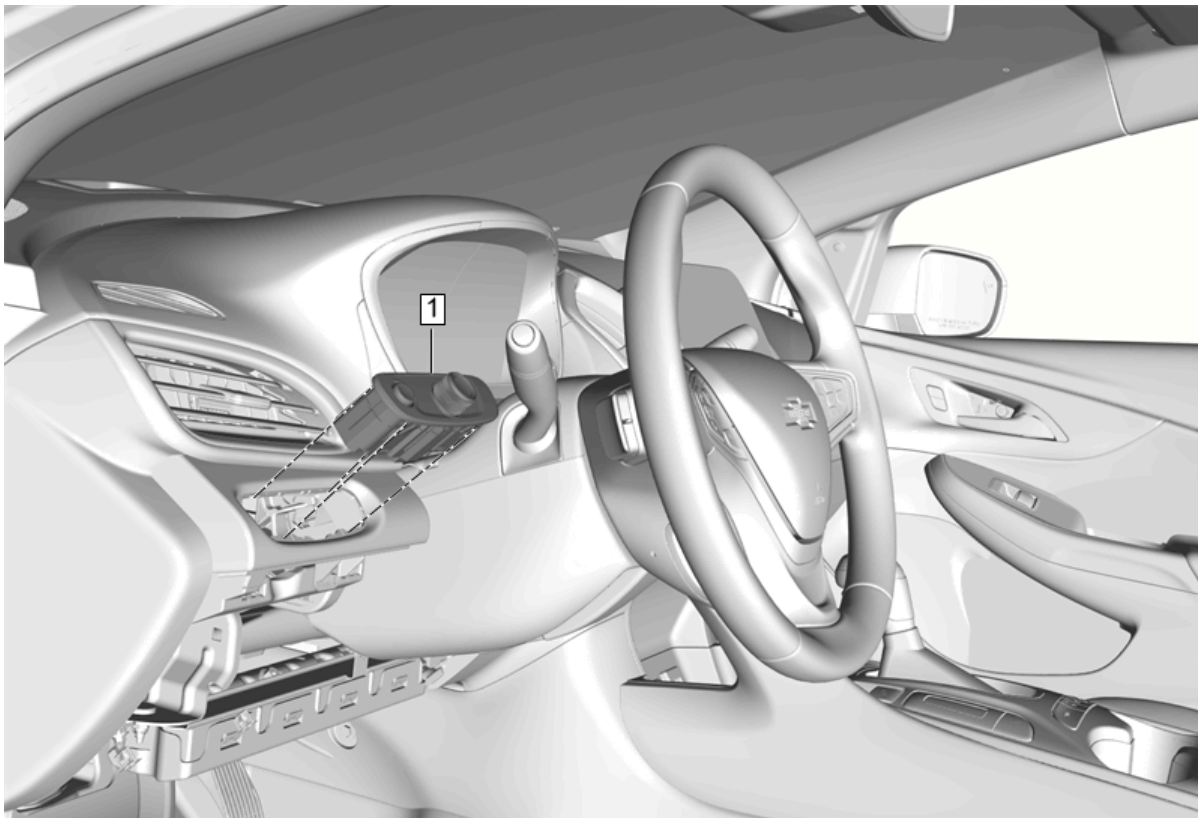


Fig. 19: Headlamp Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Switch Trim Plate. Refer to Instrument Panel Switch Trim Plate Replacement	
1	Headlamp Switch Procedure 1. Disconnect the electrical connector. 2. Depress tabs on switch and remove from the instrument switch trim plate.

INTERIOR LAMP AND MULTIFUNCTION SWITCH REPLACEMENT

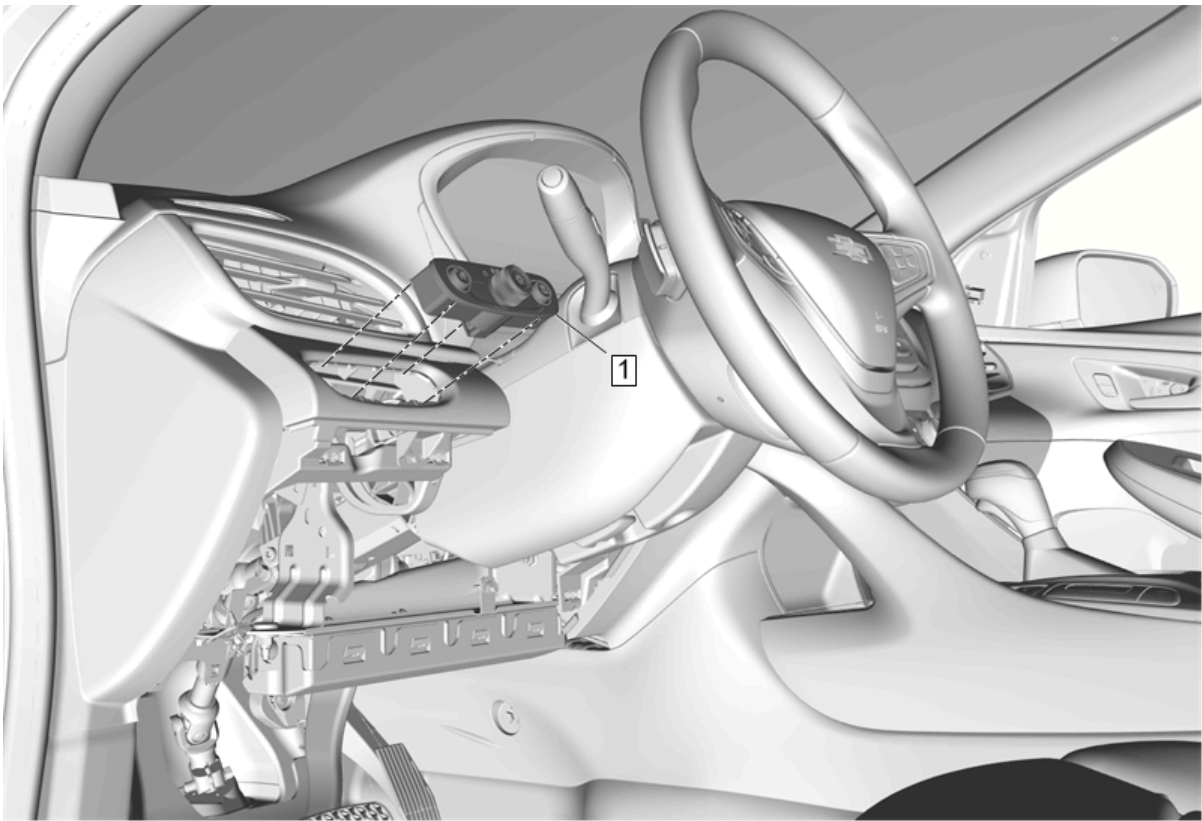


Fig. 20: Interior Lamp And Multifunction Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Switch Trim Plate. Refer to Instrument Panel Switch Trim Plate Replacement	
1	Interior Lamp and Multifunction Switch Procedure 1. Disconnect the electrical connector. 2. Depress tabs on switch and remove from the instrument switch trim plate.

HAZARD WARNING SWITCH REPLACEMENT

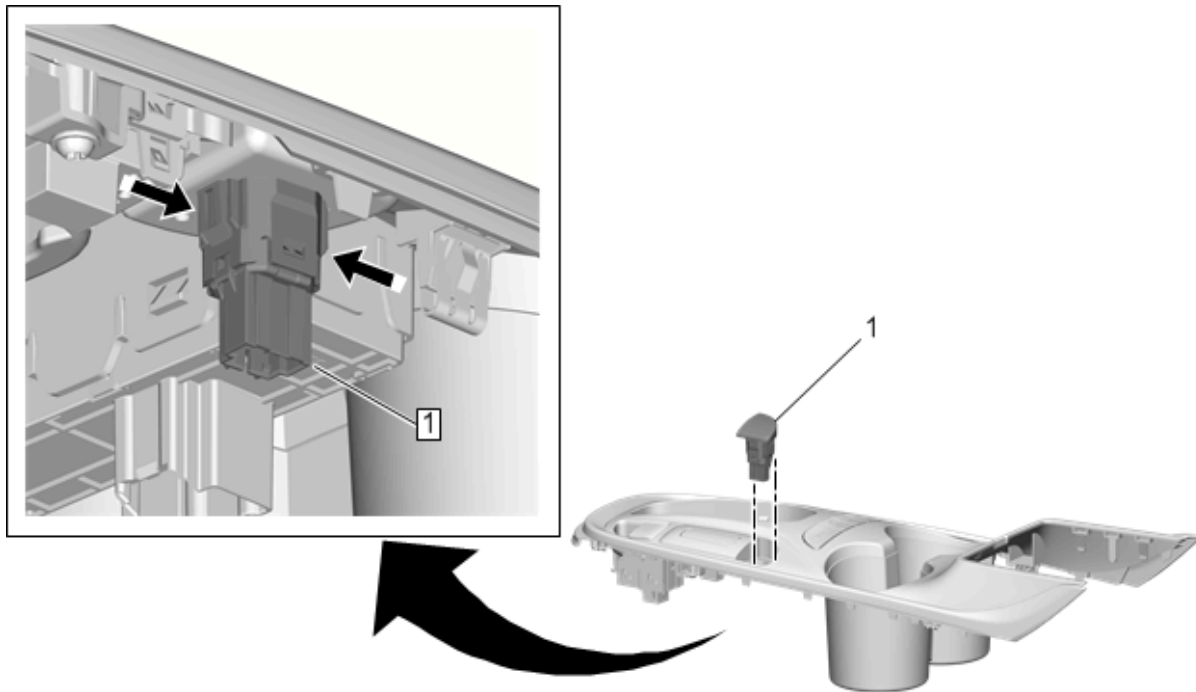


Fig. 21: Hazard Warning Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure It is only necessary to lift up the front floor console accessory trim plate. Only do those steps in the front floor console accessory trim plate replacement that will lift up the front floor console accessory trim plate enough to gain access to the part. Refer to Front Floor Console Accessory Trim Plate Replacement	
1	Hazard Warning Switch Procedure Release the tabs and remove the switch.

CENTER READING LAMP REPLACEMENT

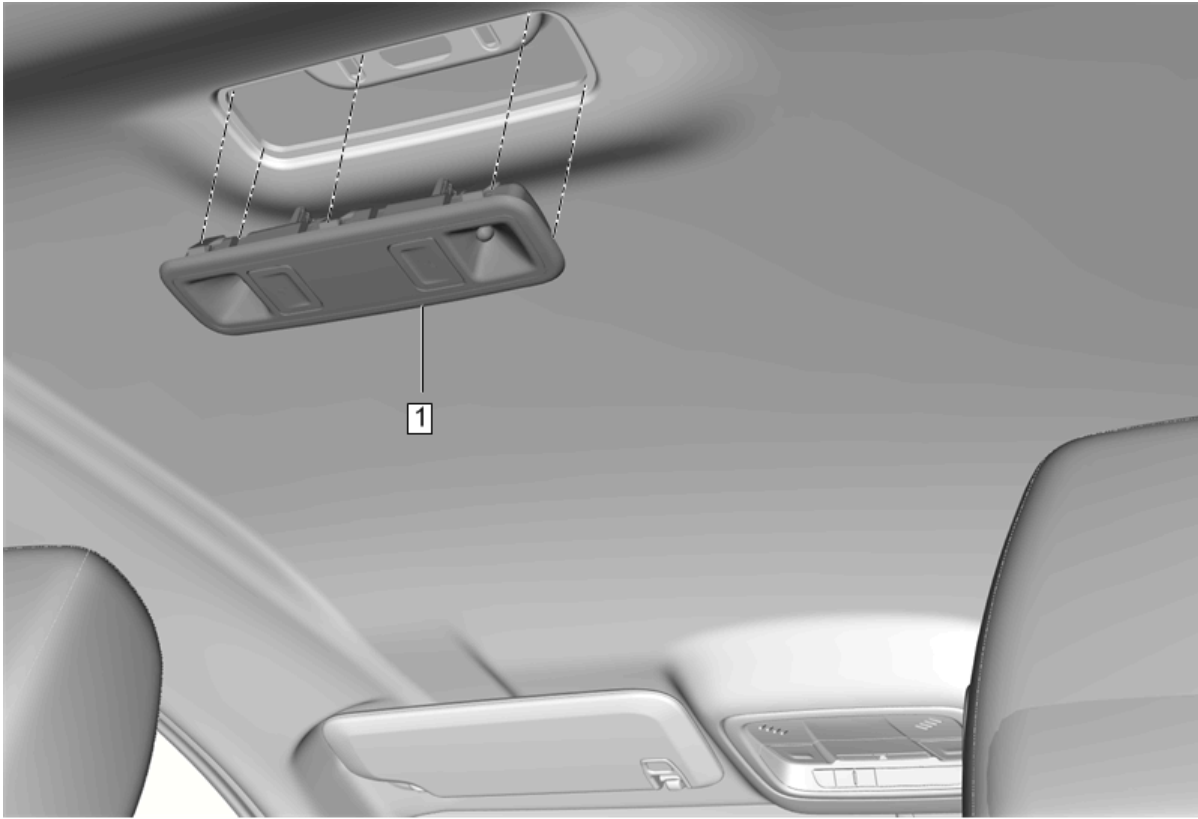


Fig. 22: Center Reading Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Reading Lamp Procedure 1. Depress the rear integral tabs using the appropriate tool to remove the reading lamp from the headlining trim panel. 2. Disconnect the electrical connector.

FRONT FLOOR CONSOLE BIN LAMP REPLACEMENT



Fig. 23: Front Floor Console Bin Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Bin lamp Procedure 1. Release the plastic retaining tabs. 2. Disconnect the electrical connector.

FRONT SIDE DOOR INSIDE HANDLE ILLUMINATION LAMP REPLACEMENT

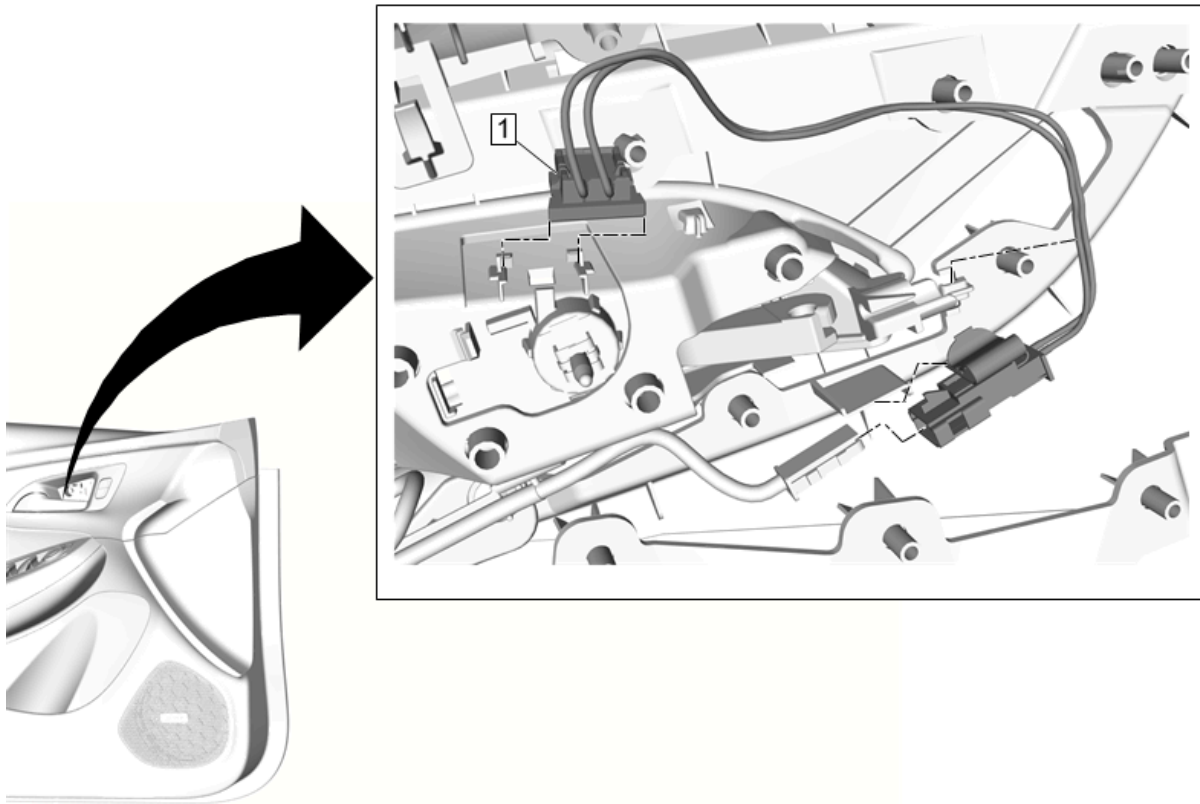


Fig. 24: Front Side Door Inside Handle Illumination Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	
1	Front Side Door Inside Handle Illumination Lamp Procedure 1. Disconnect the electrical connector. 2. Unsnap lamp from the trim panel tabs.

REAR SIDE DOOR INSIDE HANDLE ILLUMINATION LAMP REPLACEMENT

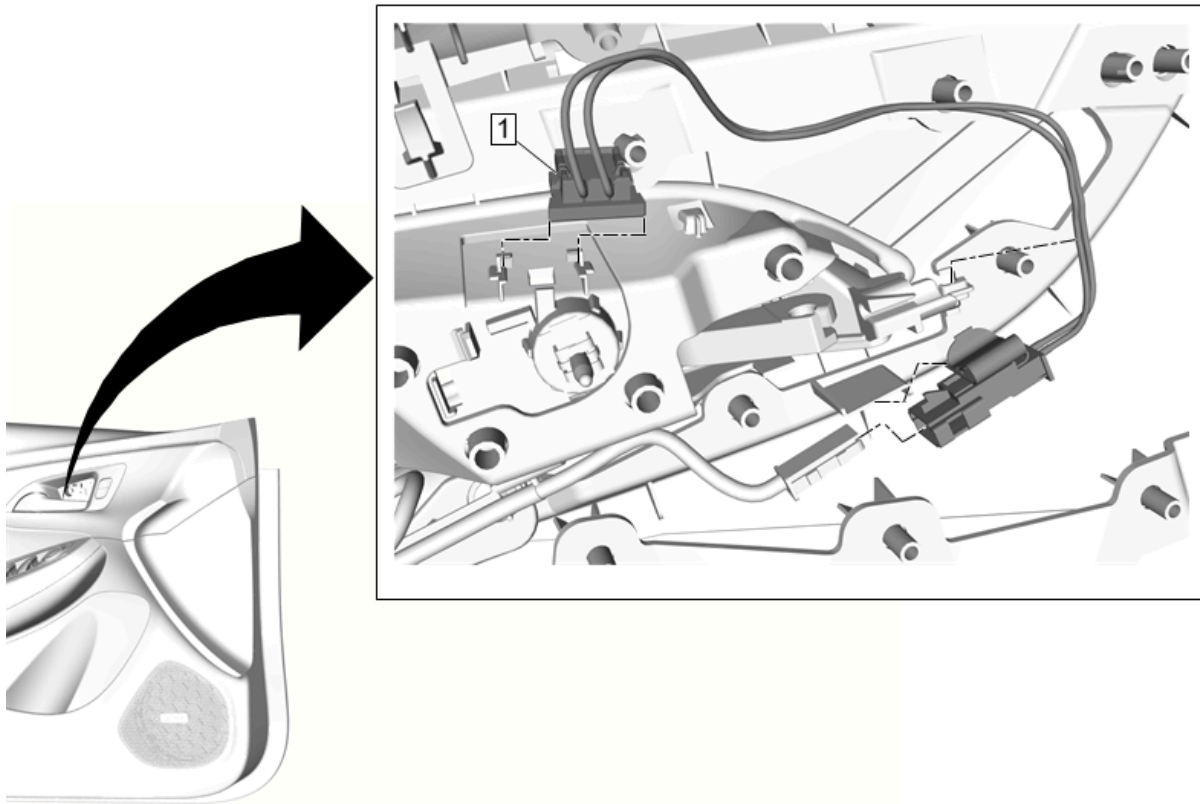


Fig. 25: Rear Side Door Inside Handle Illumination Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Side Door Trim. Refer to Rear Side Door Trim Replacement	
1	Rear Side Door Inside Handle Illumination Lamp Procedure 1. Disconnect the electrical connector. 2. Unsnap lamp from the trim panel tabs.

SUNSHADE ILLUMINATED MIRROR LAMP BULB REPLACEMENT

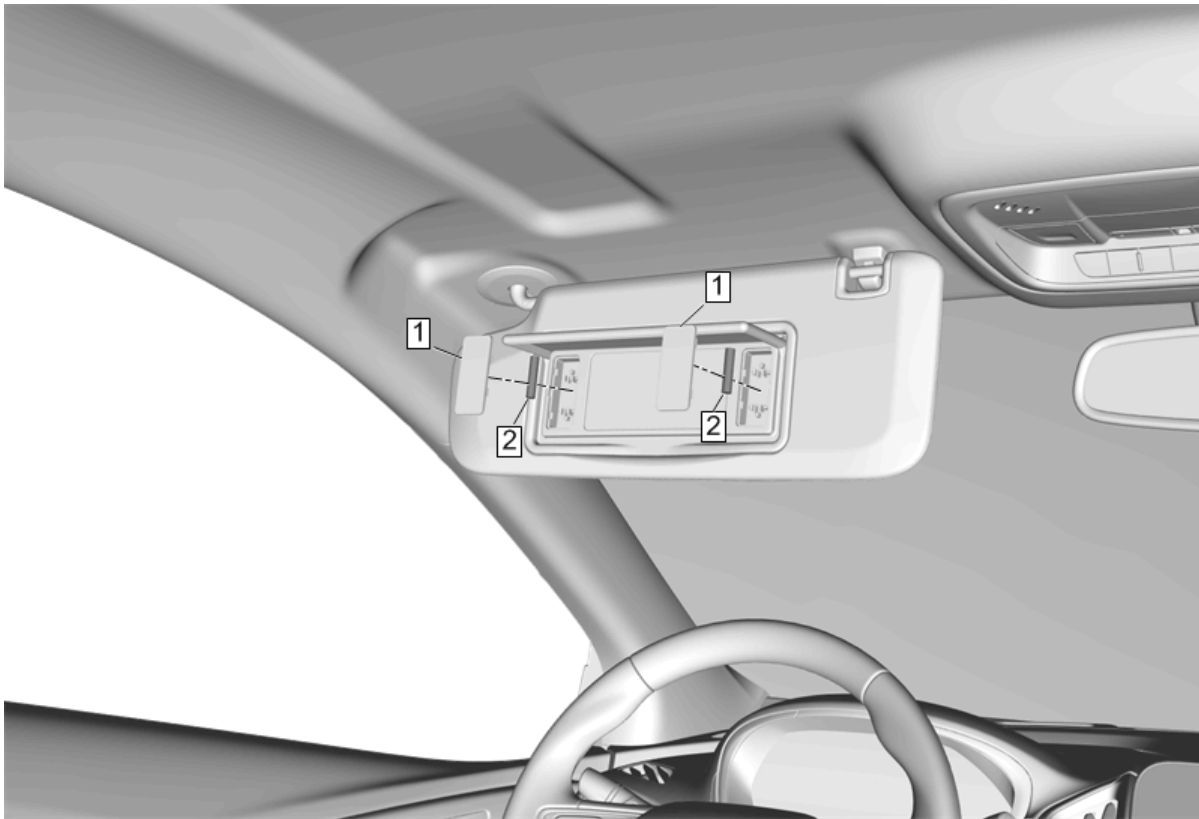


Fig. 26: Sunshade Illuminated Mirror Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sunshade Illuminated Mirror Lamp Lens (Qty: 2) Procedure Carefully use a flat bladed tool and release the tabs retaining the lamp lens to the sunshade.
2	Sunshade Illuminated Mirror Lamp Bulb (Qty: 2)

HEADLAMP REPLACEMENT

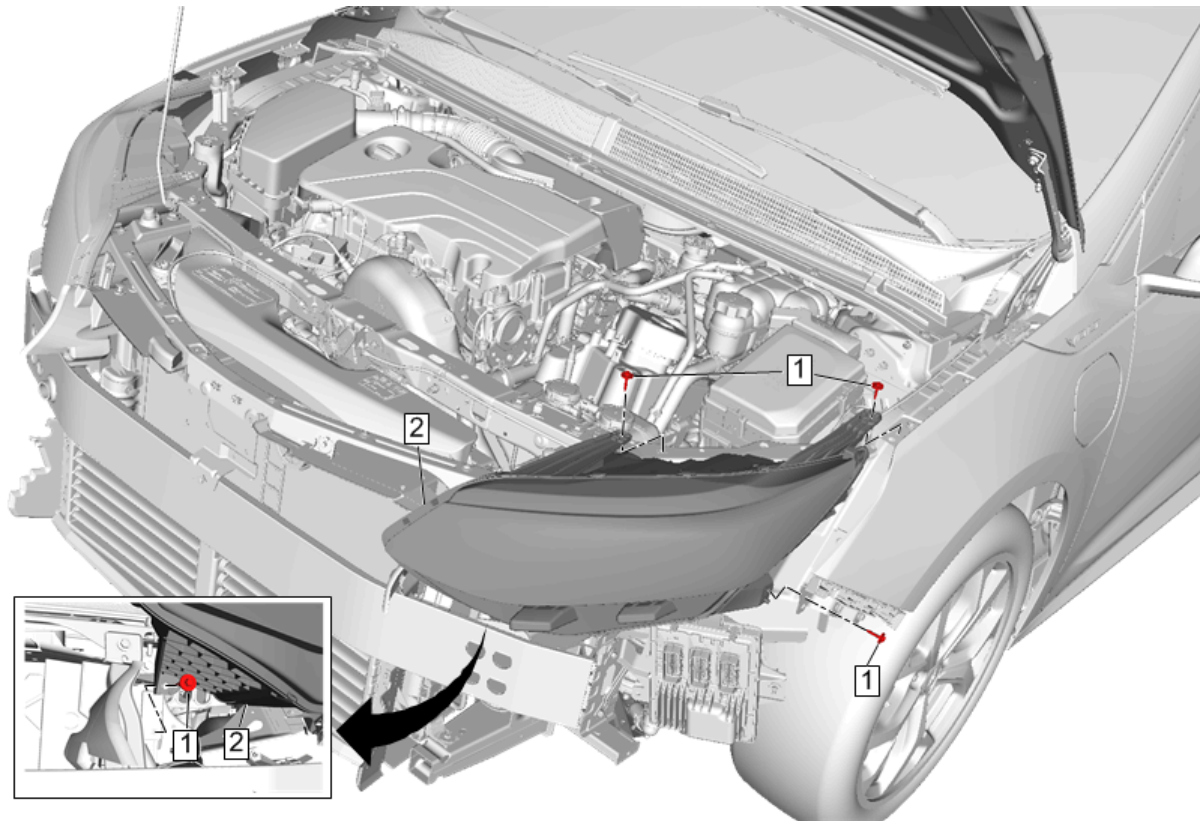


Fig. 27: Headlamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following steps: • Identify how to disable high voltage. • Identify how to	

Callout	Component Name
	test for the presence of high voltage. - Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: - Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. - Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. - Visually and functionally inspect the gloves before use. - Wear the Insulation gloves with

Callout	Component Name
	leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Open the hood. 2. Remove Front Bumper Fascia. Refer to Front Bumper Fascia Removal and Installation 3. Disconnect all electrical connectors.
1	Headlamp Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Headlamp WARNING: Refer to Halogen Bulb Warning . Procedure

Callout	Component Name
	1. Transfer components as necessary. 2. Adjust headlamp. Refer to Headlamp Aiming

HEADLAMP BULB REPLACEMENT (LEFT SIDE)

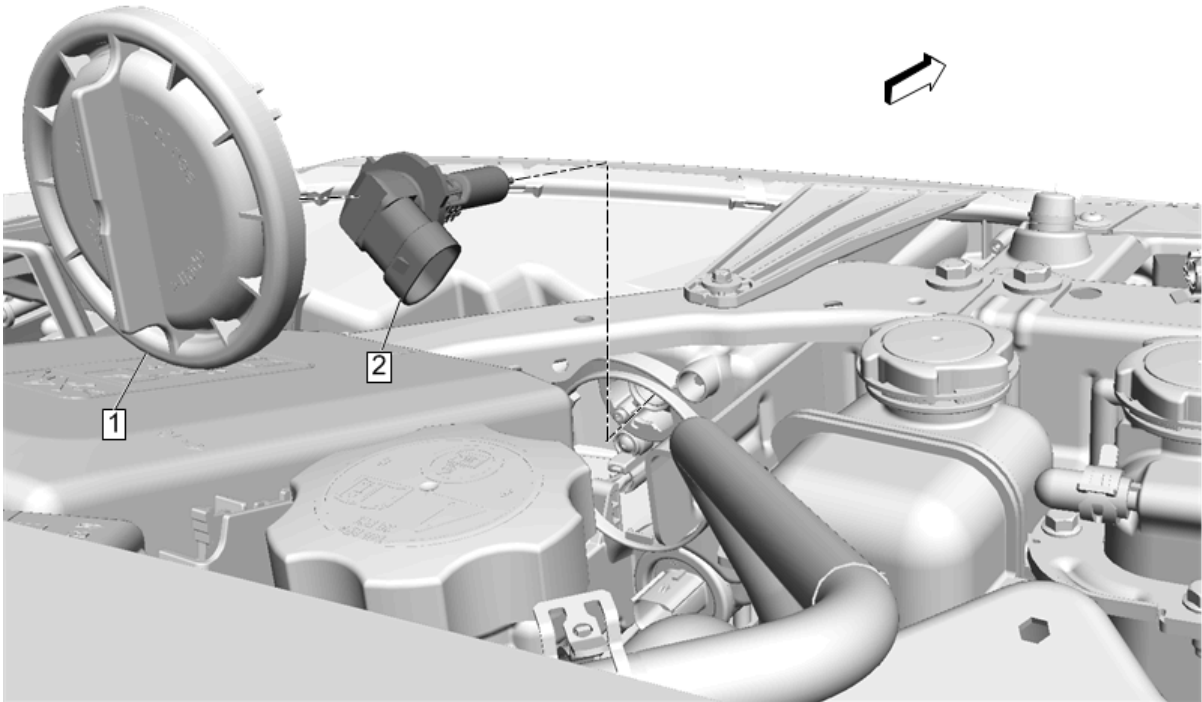


Fig. 28: Headlamp Bulb (Left Side)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Halogen Bulb Warning .	
Preliminary Procedures 1. Open the hood. 2. Unclip and reposition the engine wiring harness and retainers as necessary to gain access to the part.	
1	Headlamp Bulb Access Cover Procedure Rotate the access cover a quarter turn counterclockwise and remove.

Callout	Component Name
2	Headlamp Bulb Procedure 1. Disconnect the electrical connector. 2. Rotate the bulb a quarter turn counterclockwise and remove.

HEADLAMP BULB REPLACEMENT (RIGHT SIDE)

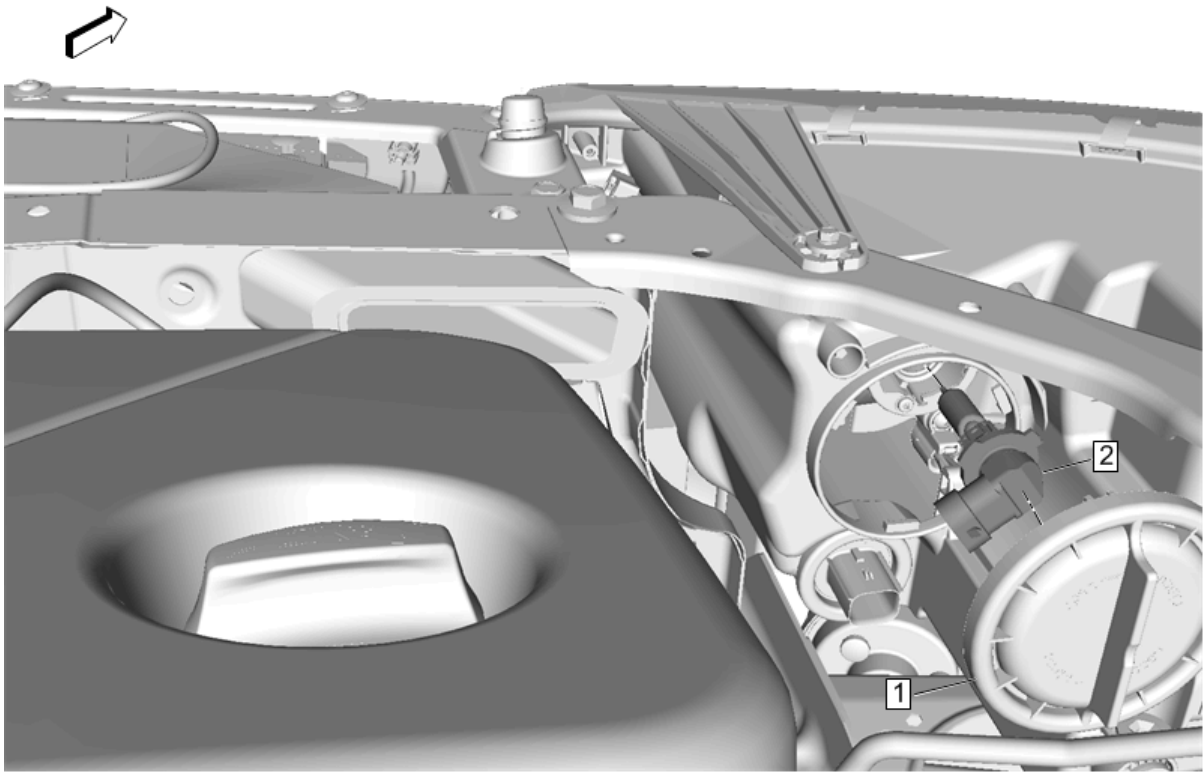


Fig. 29: Headlamp Bulb (Right Side)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Halogen Bulb Warning . Preliminary Procedures 1. Open the hood. 2. Remove Windshield Washer Solvent Container Filler Tube. Refer to Windshield Washer Solvent Container Filler Tube Replacement	

HEADLAMP AIMING

Visual Aiming Preparation Procedure

NOTE: Some state and local laws specify requirements for headlamp aim. Comply with all of these laws when performing any headlamp aiming operations.

Headlamp aim should be checked:

- When a new headlamp capsule is installed.
- If service or repairs to the front end area have, or may have, disturbed the headlamps or their mounting.

The aiming screen should meet the following criteria:

- The area will consist of a level surface large enough to allow for a vehicle and an additional 7.62 m (25 ft) measured from face of lamps to the front of the aiming screen.
- The screen will be 1.52 m (5 ft) high x 3.66 m (12 ft) wide with a matte white surface well shaded from extraneous light, and properly adjusted to the floor on which the vehicle stands. Provisions should be made to align the aiming screen parallel with the vehicle.
- The screen shall be provided with a fixed vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.
- If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately 1.83 m (6 ft) high and 3.66 m (12 ft) wide. The surface should be finished with a washable non-gloss white paint.

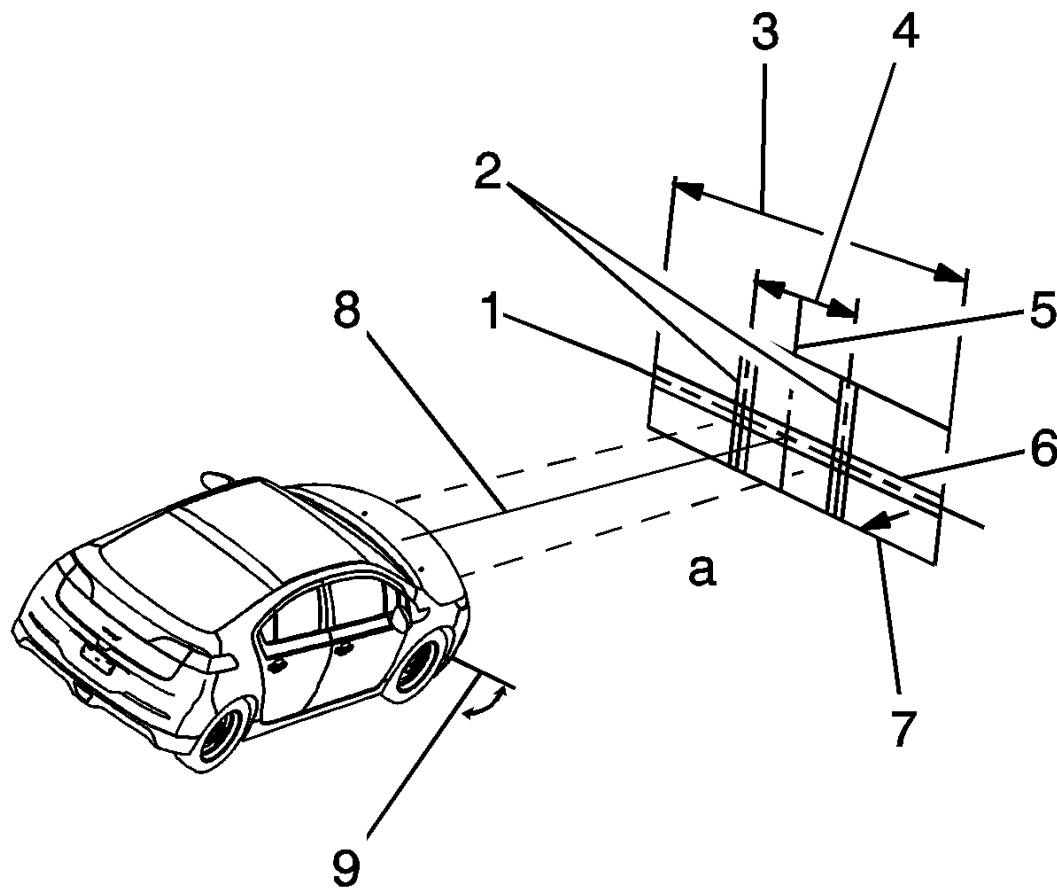


Fig. 30: Headlamp Aiming Screen Layout

Courtesy of GENERAL MOTORS COMPANY

- After the aiming screen has been set up in a permanent location, paint a reference line on the floor directly under the lens of the lamps to indicate the proper location of the headlamps when they are being aimed:
 - Distance between headlamps (1)
 - Center line of screen (2)
 - Adjustable vertical pointer (3)
 - Adjustable horizontal tape (4)
 - Diagram of light screen (5)
 - Vertical center line ahead of right headlamp pointer position (6)
 - 7.62 m (25 ft) (7)
 - Car axis (8)
 - Adjustable vertical pointer
 - Horizontal center line of lamps
 - Vertical center line ahead of left headlamp

Prior to aiming the headlamps, the following steps must be taken:

1. Engage the PARK brake.
2. Remove any snow, ice or mud from the vehicle.
3. The vehicle must have a full tank of gas.
4. Stop all other work on the vehicle.
5. If any service has been performed on the vehicle, make sure that all of the components are back in their original place.
6. The vehicle must be on a level surface.

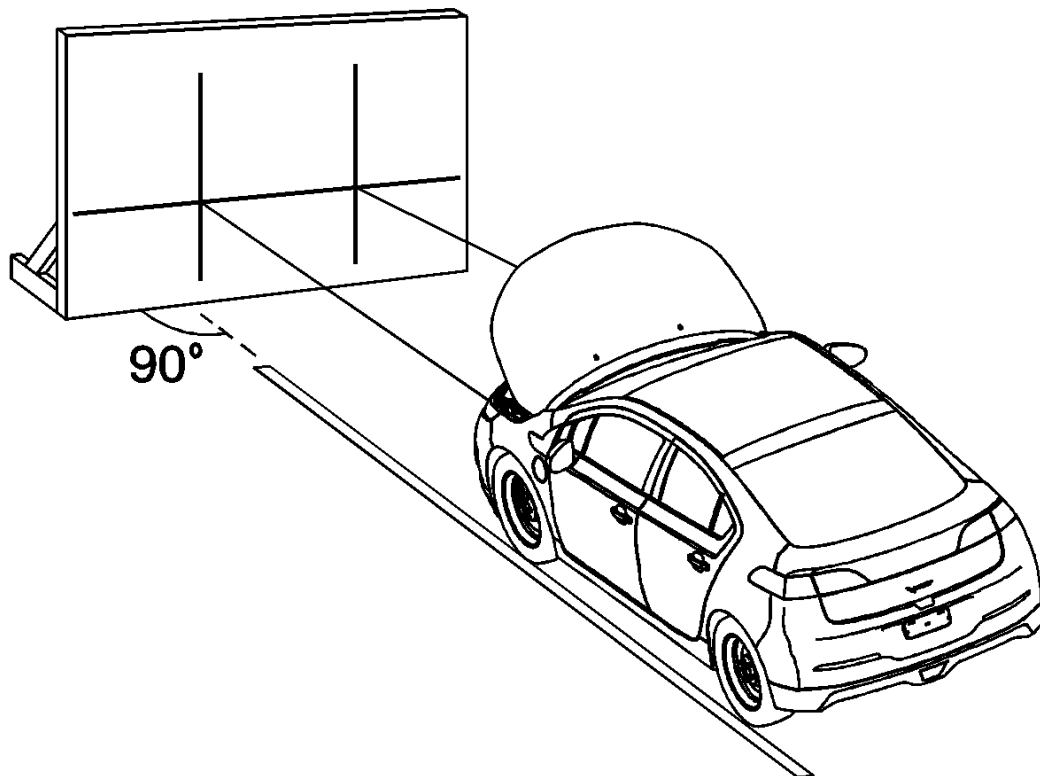


Fig. 31: Headlamp Aiming Alignment

Courtesy of GENERAL MOTORS COMPANY

7. The vehicle left tires must be aligned with the reference line extending from the screen with the headlamps aligned with the reference line.
8. Do not load any cargo in the vehicle.
9. The vehicle must contain approximately 75 kg (165 lb) on the driver seat.
10. Inflate the tires to the proper pressure.

11. Simulate the vehicle loads if the intended use of the vehicle is for hauling heavy loads or towing a trailer.
12. Rock the vehicle in order to stabilize the suspension.
13. Turn on the headlamps to low beam and observe the left and the top edges of the high intensity zone on the screen. The edges of the high intensity zone should fall within the specifications.

Headlamp Aiming Procedure

1. Open the hood.

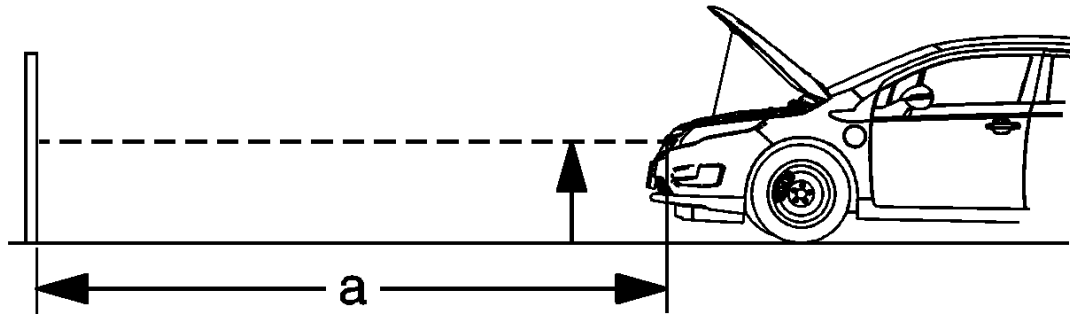


Fig. 32: Headlamp Bulb Aiming Distance

Courtesy of GENERAL MOTORS COMPANY

2. Measure from the floor to the center of the headlamp bulb. Some headlamps have an aim dot marked on the headlamp lens.
3. At the screen, measure from the floor and place the horizontal tape at the measured distance.
4. Measure from the reference line on the floor to the left headlamp bulb centerline.
5. At the screen, measure from the reference line and place the vertical tape at the measured distance.
6. Measure from the reference line on the floor to the right headlamp bulb centerline.
7. At the screen, measure from the reference line and place the vertical tape at the measured distance.

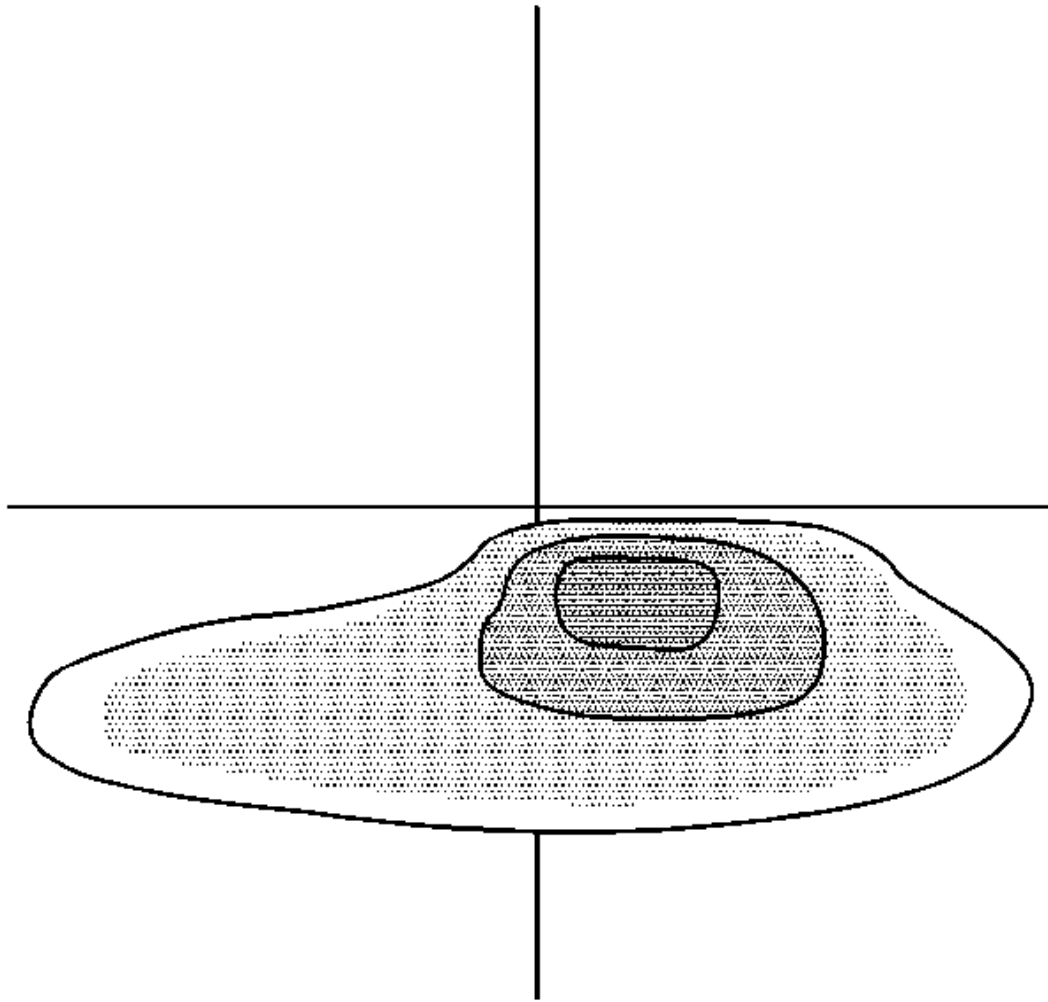


Fig. 33: Headlamp Projection On Screen

Courtesy of GENERAL MOTORS COMPANY

NOTE: **DO NOT cover the headlamp. This may cause excessive heat build up.**

8. Turn ON the low beam headlamps. Block the light from projecting onto the screen from the passenger side headlamp.

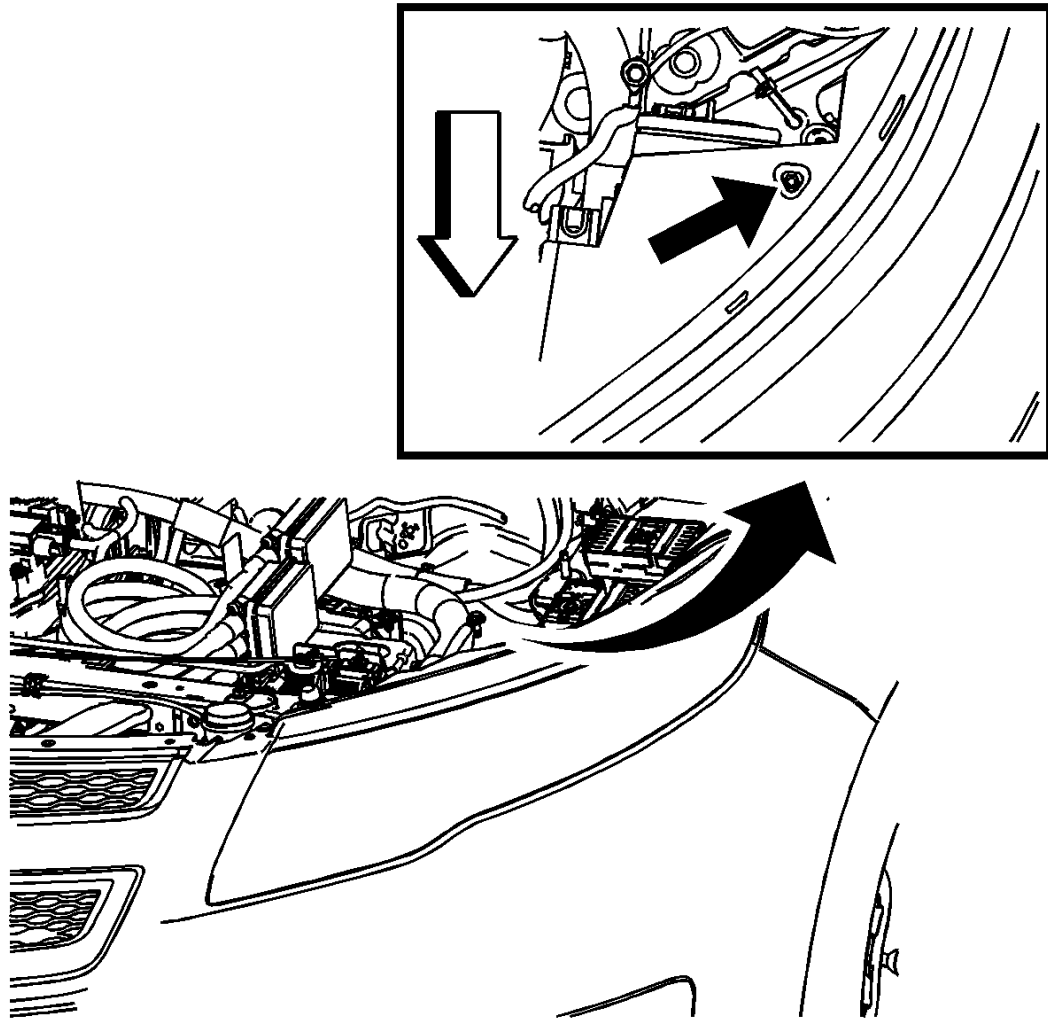


Fig. 34: Headlamp Adjustment Components
Courtesy of GENERAL MOTORS COMPANY

NOTE: The headlamps can not be adjusted horizontally.

9. Adjust the vertical aim screw of the headlamps to the specifications required by the state and the local authorities, or as shown in step number 8.
10. Repeat the aiming procedure for the passenger side headlamp while blocking the light from projecting onto the screen from the driver side headlamp.
11. Turn the headlamps OFF.
12. Close the hood.

DAYTIME RUNNING LAMP REPLACEMENT

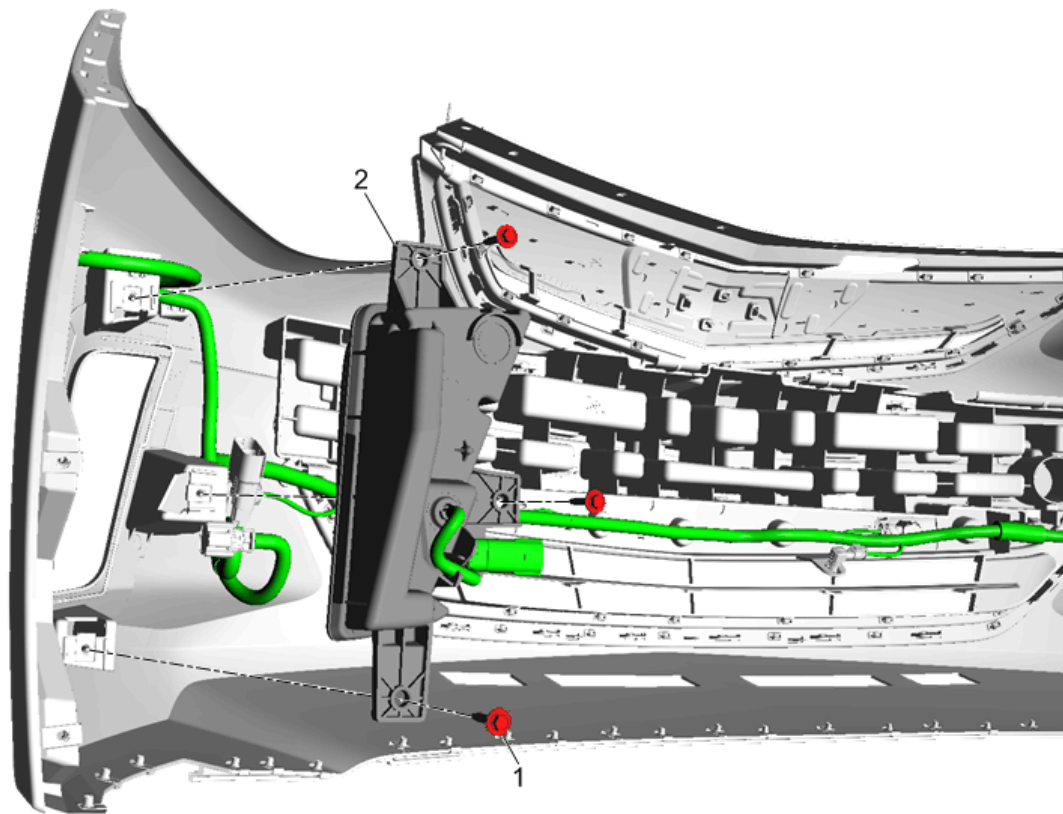


Fig. 35: Daytime Running Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Halogen Bulb Warning . WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure includes the following	

Callout	Component Name
steps: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Before working on any high voltage system, be sure to wear the following Personal Protection Equipment: • Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors. • Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors. • Visually and functionally	

Callout	Component Name
	inspect the gloves before use. • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not. Failure to follow the procedures may result in serious injury or death. Preliminary Procedures 1. Remove Front Bumper Fascia. Refer to Front Bumper Fascia Removal and Installation 2. Disconnect the electrical connector.
1	Daytime Running Lamp Screw (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Daytime Running Lamp

FRONT TURN SIGNAL LAMP BULB REPLACEMENT

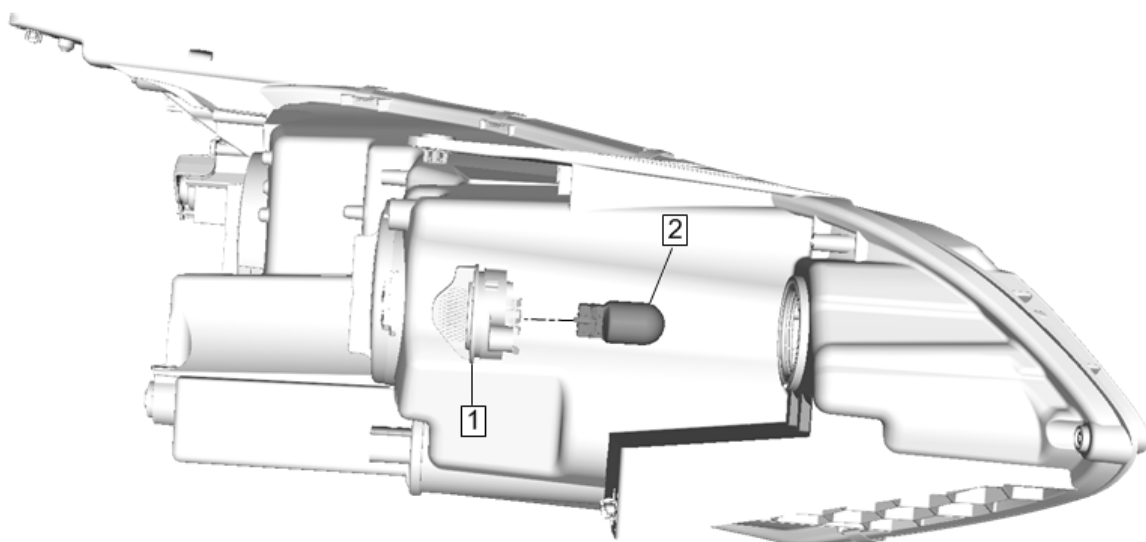


Fig. 36: Front Turn Signal Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Headlamp. Refer to Headlamp Replacement	
1	Front Turn Signal Lamp Bulb Access Cover Procedure 1. Rotate the cover a quarter turn counter-clockwise and remove the headlamp. 2. Disconnect the electrical connector. NOTE: The access cover and the lamp socket are a one piece assembly and removed together as an assembly.
2	Front Turn Signal Lamp Bulb Procedure Pull the bulb straight from the lamp socket.

TURN SIGNAL BULB REPLACEMENT

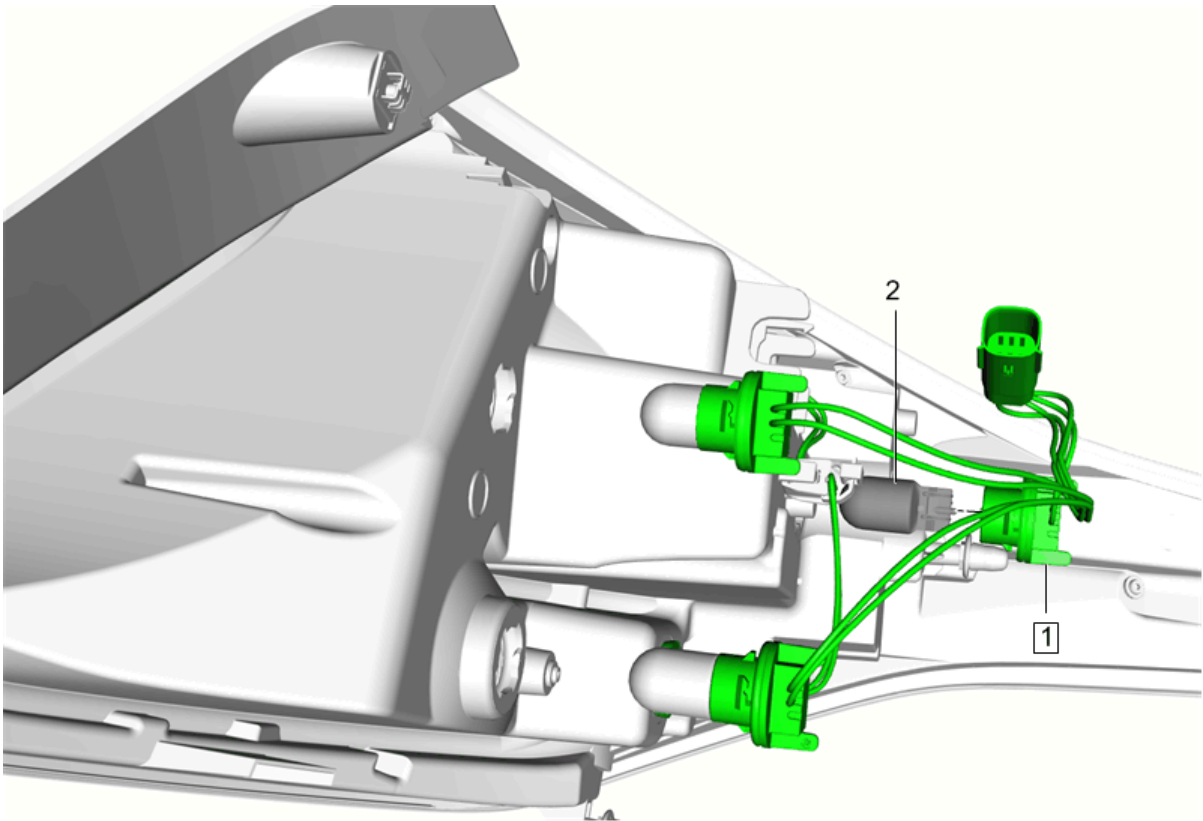


Fig. 37: Turn Signal Bulb
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Body Structure Stop Lamp. Refer to Rear Body Structure Stop Lamp Replacement	
1	Turn Signal Bulb Socket Procedure Rotate the bulb socket a quarter turn counterclockwise and remove.
2	Turn Signal Bulb Procedure Pull the bulb from the bulb socket.

HIGH MOUNT STOP LAMP REPLACEMENT

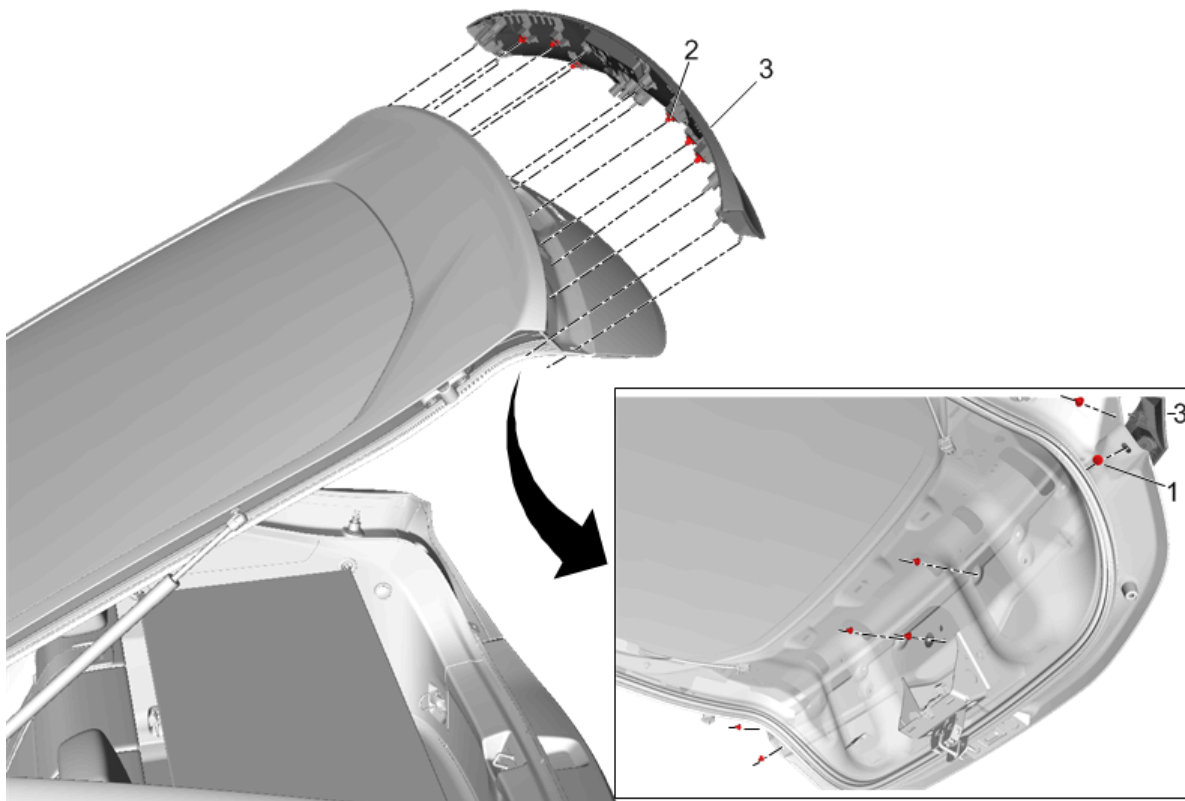


Fig. 38: High Mount Stop Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Open the liftgate. 2. Remove Liftgate Lower Trim Finish Panel. Refer to Liftgate Lower Trim Finish Panel Replacement 3. Disconnect the electrical connector.	
1	High Mount Stop Lamp Nut (Qty: 7) CAUTION: Refer to Fastener Caution . Tighten 4.7 N.m (42 lb in)
2	High Mount Stop Lamp Retainer (Qty: 6) Procedure Depress the retainers from the liftgate while pulling outward on the lamp.
3	High Mount Stop Lamp

REAR BODY STRUCTURE STOP LAMP REPLACEMENT



Fig. 39: Rear Body Structure Stop Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the liftgate.	
1	Liftgate Bumper Pad Screw CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Rear Body Structure Stop Lamp Screw (Qty: 2) Tighten 2.5 N.m (22 lb in)
3	Rear Body Structure Stop Lamp Procedure 1. Grasp the stop lamp and give a quick pull rearward in order to disengage the 2 outer

Callout	Component Name
	stop lamp locator pins and retainer from the stop lamp pocket. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

CARGO CENTER COURTESY LAMP BULB REPLACEMENT

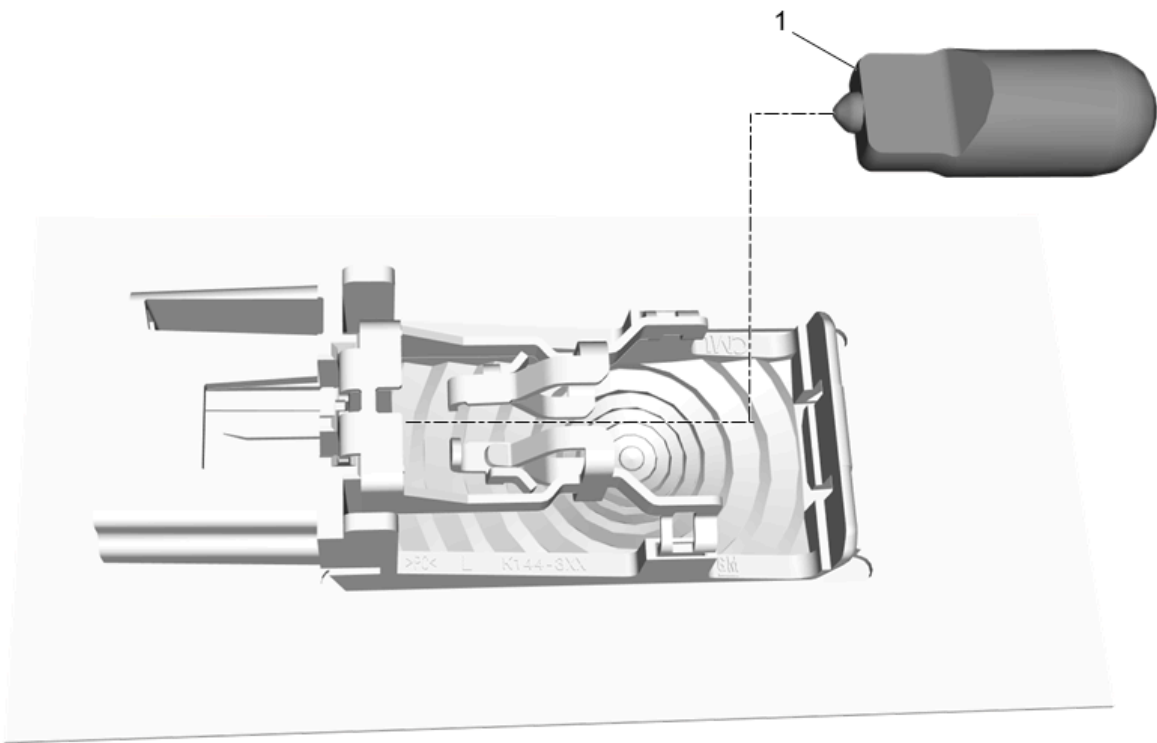


Fig. 40: Cargo Center Courtesy Lamp Bulb
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Liftgate Courtesy Lamp. Refer to Liftgate Courtesy Lamp Replacement	
1	Cargo Center Courtesy Lamp Bulb Procedure Pull the bulb from the bulb socket.

BACKUP LAMP BULB REPLACEMENT

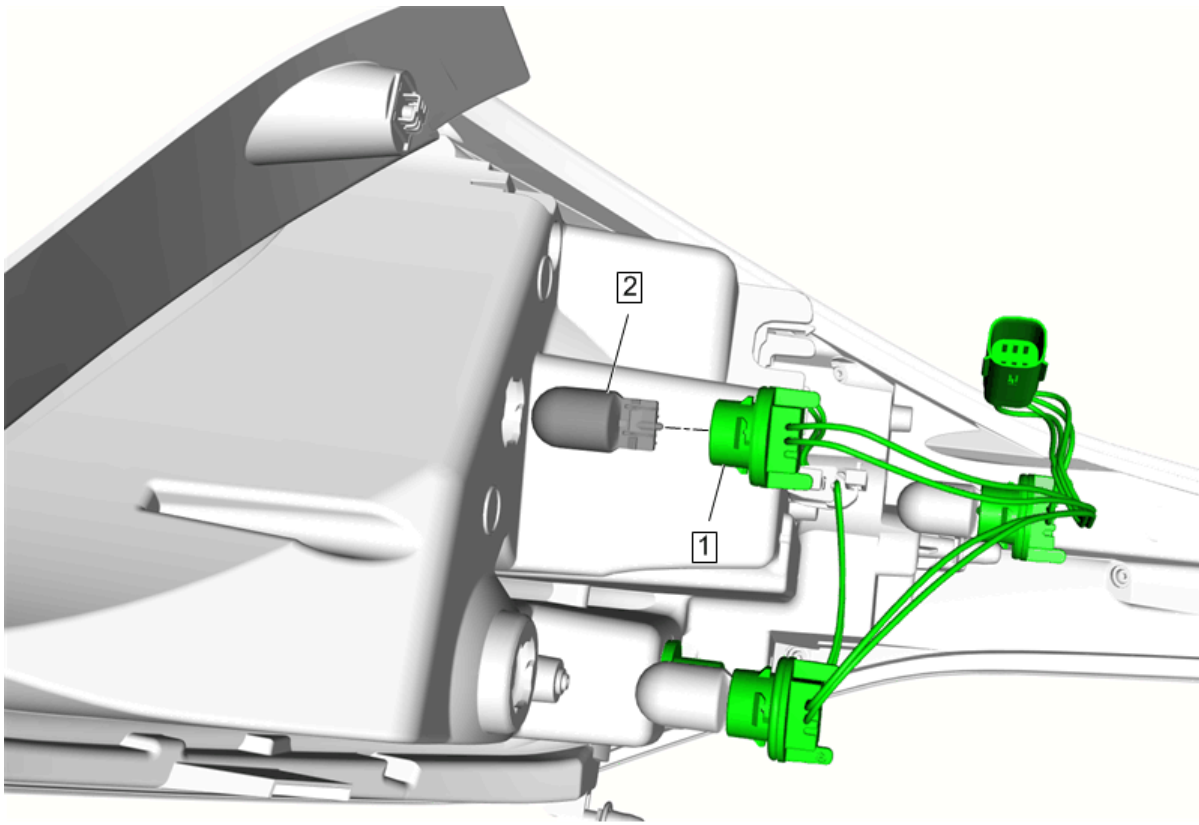


Fig. 41: Backup Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Body Structure Stop Lamp. Refer to Rear Body Structure Stop Lamp Replacement	
1	Backup Lamp Bulb Socket Procedure Rotate the bulb socket a quarter turn counterclockwise and remove.
2	Backup Lamp Bulb Procedure Pull the bulb from the bulb socket.

REAR LICENSE PLATE LAMP REPLACEMENT

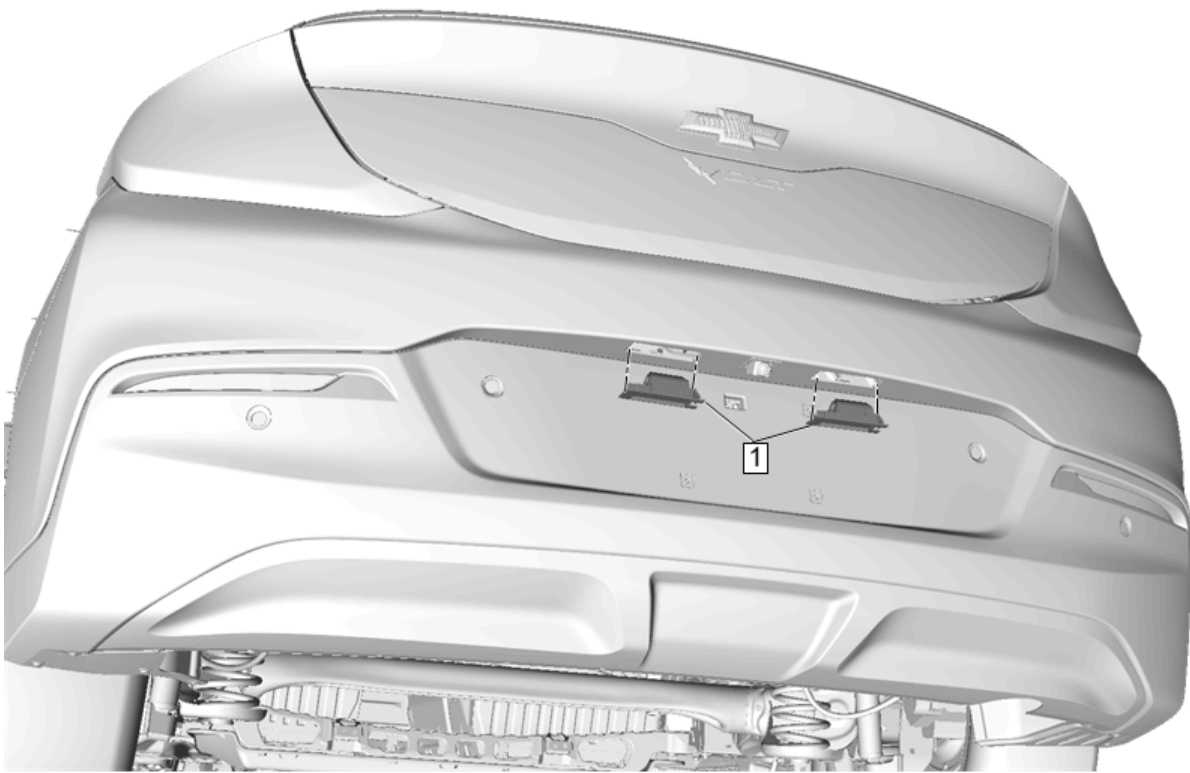


Fig. 42: Rear License Plate Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear License Plate Lamp Procedure 1. Using a flat-bladed tool, insert the tool on the passenger side of the lamp and push inward and rotate downward to disengage the lamp from the rear bumper fascia opening. 2. Rotate the bulb socket a quarter turn counterclockwise and remove.

REAR LICENSE PLATE LAMP BULB REPLACEMENT

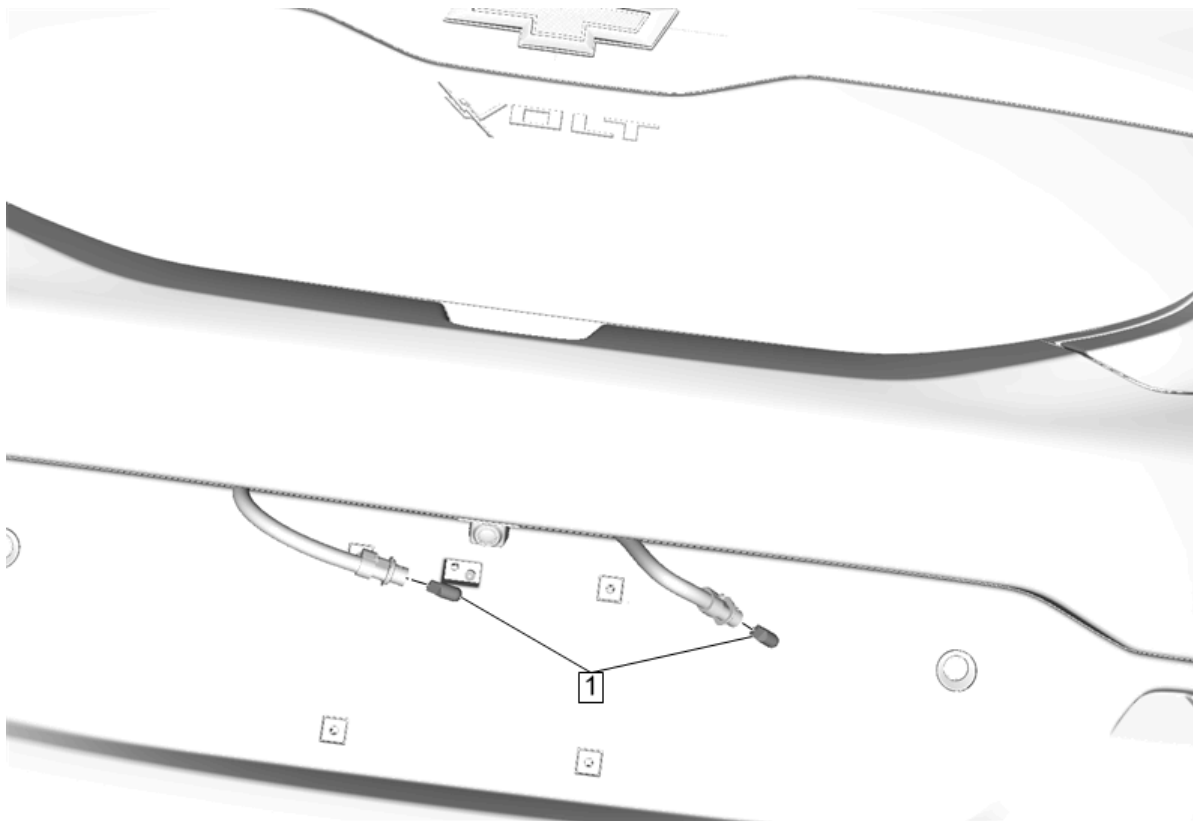


Fig. 43: Rear License Plate Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear License Plate Lamp. Refer to <u>Rear License Plate Lamp Replacement</u>	
1	License Plate Lamp Bulb Procedure Pull the bulb straight from the lamp socket.

STOP AND TAIL LAMP BULB REPLACEMENT

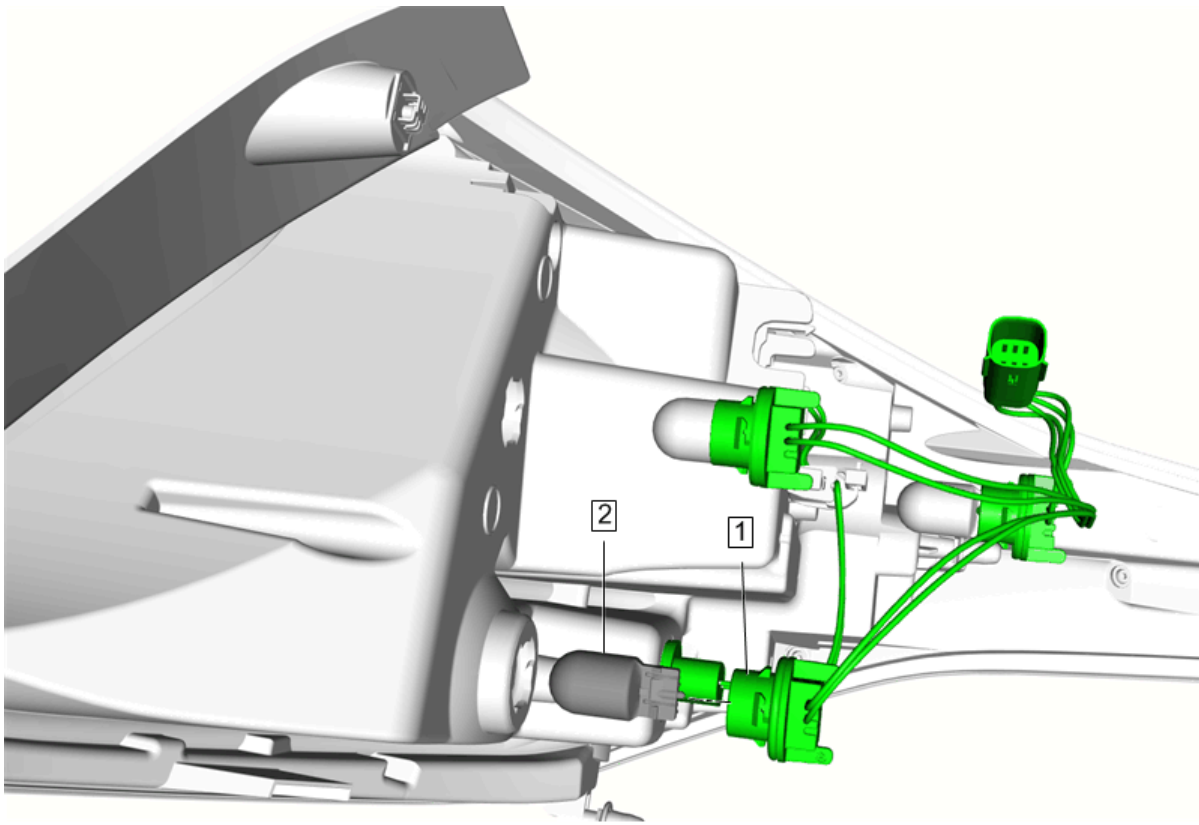


Fig. 44: Stop And Tail Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Rear Body Structure Stop Lamp. Refer to Rear Body Structure Stop Lamp Replacement	
1	Stop and Tail Lamp Bulb Socket Procedure Rotate the bulb socket a quarter turn counterclockwise and remove.
2	Stop and Tail Lamp Bulb Procedure Pull the bulb from the bulb socket.

REAR FASCIA LOWER SIGNAL LAMP REPLACEMENT

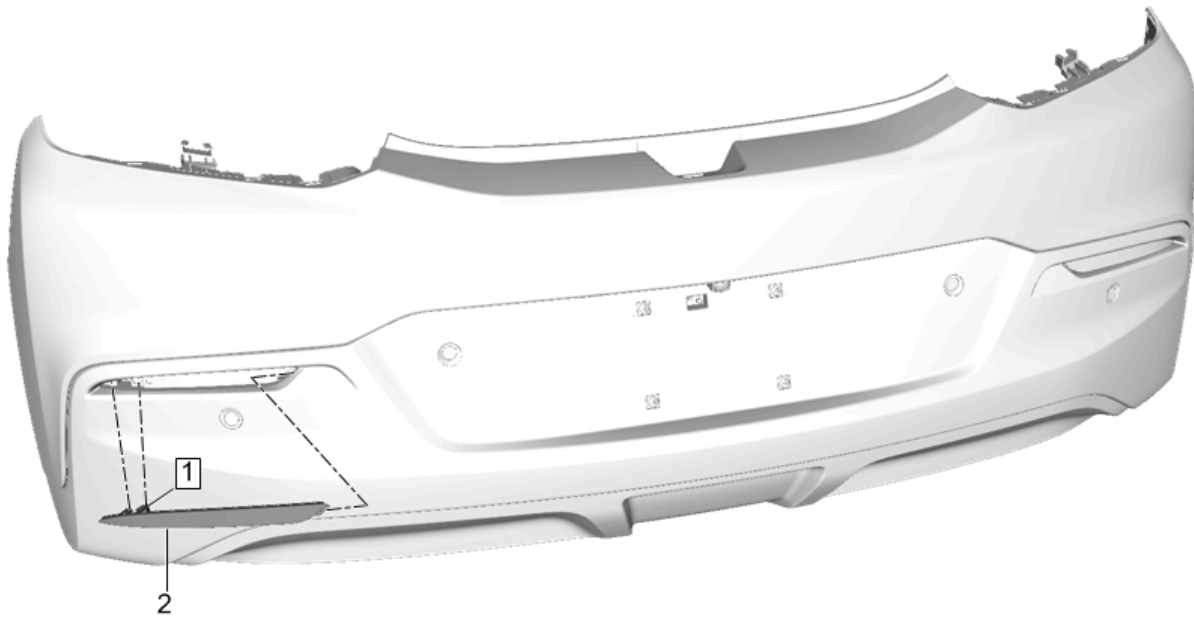


Fig. 45: Rear Fascia Lower Signal Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Fascia. Refer to Rear Bumper Fascia Removal and Installation	
1	Rear Reflector Retainer Procedure Depress the retainer tabs and pull out from the fascia.
2	Rear Fascia Lower Signal Lamp

LIFTGATE COURTESY LAMP REPLACEMENT



Fig. 46: Liftgate Courtesy Lamp

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Liftgate Courtesy Lamp Procedure 1. Open the liftgate. 2. Using the appropriate trim tool, release the lamp from the rear quarter trim panel. 3. Disconnect the electrical connector.

DESCRIPTION AND OPERATION

EXTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Exterior Lamps

The exterior lighting system consist of the following lamps if equipped:

- Automatic high beam assist
- Backup lamps
- Daytime running lamps
- Hazard warning lamps
- Headlamps

- Park, tail, license, and side marker lamps
- Stop lamps
- Turn signal lamps

Low Beam Headlamps

The headlamps may be turned ON in 3 different ways:

- When the headlamp switch is placed in the ON position, for normal operation
- When the headlamp switch is placed in the AUTO position, for automatic lamp control
- When the headlamp switch is placed in the AUTO position, with the windshield wipers ON in daylight conditions, after a 6 second delay

The BCM will also command the low beam headlamps ON during daylight conditions when the following conditions are met:

- Headlamp switch in the AUTO position
- Windshield wipers ON
- Vehicle in any gear but PARK

The body control module (BCM) monitors three signal circuits from the headlamp switch. When the headlamp switch is in the AUTO position, all three signal circuits are open. When placed in the AUTO position, the BCM monitors inputs from the ambient light sensor to determine if headlamps are required or if daytime running lamps will be activated based on outside lighting conditions. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM applies B+ to both low beam headlamp control circuits illuminating the low beam headlamps.

When the BCM commands the low beam headlamps ON, the operator will notice the interior backlighting for the instrument cluster and the various other switches dim to the level of brightness selected by the instrument panel dimmer switch.

High Beam Headlamps

When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits and on to the left and right high beam headlamps illuminating the high beam headlamps.

Automatic High Beam Assist

The automatic high beam assist system operates the high beam headlamps ON and OFF automatically when the system is activated and certain conditions are met. The automatic high beam assist system consists of a front

camera module that detects light and is able to identify approaching vehicles on an even, straight road at a distance of greater than 0.4 km (0.25 mi). The front camera module analyzes light color, intensity, and movement. The automatic high beam assist system will turn OFF the high beam headlamps when approaching vehicle headlamps or preceding vehicle taillights are detected by the front camera module. Automatic high beam assist can be deactivated when the headlamp dimmer switch is moved from the neutral position to the high beam or flash to pass positions. Automatic high beam assist can be reactivated by operating the high beam select switch from the neutral position to the high beam position twice within 2 s.

Automatic High Beam Assist System Activation

- Vehicle ON
- Turn signal/multifunction switch placed in the AUTO position
- Turn signal/multifunction switch high beam dimmer switch must be in the neutral position
- Press the Auto High Beam ON/OFF switch located on the turn signal/multifunction switch
- Outside lighting conditions must be dark
- Vehicle speed greater than 25 MPH (40 km/h)

Automatic High Beam Assist System Operation

The following are conditions that the automatic high beam assist system will turn the high beam headlamps off during operation:

- The system detects approaching traffic headlamps
- The system detects preceding traffic tail lamps
- Ambient light level too high due to towns or twilight situations
- The vehicle's speed drops below 13 MPH (22 km/h)
- Delay

NOTE: **Automatic high beam assist may not operate properly if any of the following conditions exist:**

- Approaching and preceding vehicles lamps are undetectable due to dirt, snow, road spray, smoke, fog, or any other airborne conditions.
- The front camera module is covered with ice, dirt, snow, haze, or is obstructed.
- The vehicle is being driven on winding or hilly road conditions which would make any on coming vehicle headlamps undetectable by the automatic high beam assist system.

Automatic High Beam Assist System Deactivation

- Manually operating the turn signal/multifunction switch high beam dimmer switch from neutral to high beam position
- Press the Auto High Beam ON/OFF switch located on the turn signal/multifunction switch

Automatic High Beam Assist System Indicator

The status of the automatic high beam assist system is shown by a green indicator located on the instrument

panel cluster. When automatic high beam assist is active, the indicator will be illuminated continuously. If the operator deactivates the automatic high beam assist system, the indicator will turn off.

Daytime Running Lamps

The daytime running lamps will illuminate continuously when the following conditions are met:

- The vehicle mode switch is in the RUN or CRANK position
- The shift lever is out of the PARK position for vehicles equipped with automatic transmissions or the parking brake is released for vehicles with manual transmissions
- The low and high beam headlamps are OFF

The ambient light sensor is used to monitor outside lighting conditions. The BCM monitors the ambient light sensor via serial data to determine if outside lighting conditions are correct for either daytime running lights or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lights ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lights operation.

Flash to Pass

When the low beam headlamps are on and the turn signal/multi-function switch is momentarily placed in the flash to pass position, ground is applied to the turn signal/multi-function switch. The turn signal/multifunction switch applies ground to the BCM through the flash to pass switch signal circuit. The BCM then applies ground to the high beam relay control circuit. This energizes the high beam relay, closing the switch side contacts of the high beam relay, applying battery voltage to the left and right high beam fuses. Battery voltage is applied from the high beam fuses through the high beam voltage supply circuit to the high beam headlamp assemblies. This causes the high beam headlamps to illuminate at full brightness momentarily or until the flash to pass switch is released.

Hazard Lamps

The hazard flashers may be activated in any power mode. The hazard switch signal circuit is momentarily grounded when the hazard switch is pressed. The body control module (BCM) responds to the hazard switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard switch is activated, the BCM sends a serial data message to the instrument panel cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a signal from the instrument panel dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch light emitting diode (LED) backlighting control circuit illuminating the LED to the desired level of brightness.

Park, Tail, License, and Side Marker Lamps

The park lamps, tail lamps, license plate lamps, and side marker lamps are turned ON when the headlamp switch is placed in the PARK LIGHT or LOW BEAM position or anytime the headlights are requested. When the BCM receives a request from the headlamp switch to turn ON the park lamps the BCM sends out a PWM signal, which illuminates the park lamps, tail lamps, license plate lamps, and side marker lamps.

Stop Lamps

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp control circuit illuminating the left and right stop lamps and the center high mounted stop lamp. Regen on Demand allows increased deceleration by pressing and holding the steering wheel paddle. It works in D (Drive) and L (Low). The accelerator pedal must be fully released for it to work, cruise control will turn off, and the brake lights may come on, when this feature is activated.

Turn Signal Lamps

Ground is applied at all times to the turn signal/multi-function switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the Service Mode or ON position. When the turn signal/multi-function switch is placed in either the TURN RIGHT or TURN LEFT position, ground is applied to the BCM through either the right turn or left turn signal switch signal circuit. The BCM then applies a pulsating voltage to the front and rear turn signal lamps through their respective voltage supply circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Backup Lamps

With the engine ON and the transmission in the REVERSE position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the REVERSE position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the REVERSE position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The vehicle must be ON for the backup lamps to operate.

Battery Run Down Protection/Inadvertent Power

To provide battery run down protection, the exterior lamps will be deactivated automatically under certain conditions. The BCM monitors the state of the headlamp switch. If the park or headlamp switch is ON when the vehicle mode switch is placed in either the CRANK or RUN position and then placed in the OFF position, the BCM initiates a 10 min timer. At the end of the 10 min, the BCM will turn off the control power output to the park lamp controls as well as the headlamp relay coils, deactivating the exterior lamps. This feature will be cancelled if any power mode other than OFF becomes active. The BCM will disable battery run down protection if any of the following conditions exist. The park or headlamp switch is placed in the ON to OFF position, and back to the ON position during battery run down protection. The BCM determined that the park or headlamp switch was not active when the vehicle mode switch was turned OFF.

INTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Interior Lamps

The interior lamps consist of 2 groups, those which can dim from the instrument panel cluster lamps dimmer switch and those that can not dim.

Courtesy/Illuminated Entry Lamps

The following lamps may be manually turned ON by placing the interior lamp switch in the ON position, or by opening a door while the switch is in the AUTOMATIC LIGHT position.

- The dome lamp
- The liftgate lamps
- Courtesy lamps

The courtesy lamp supply voltage circuit of the body control module (BCM) supplies battery positive voltage to the dome lamp, the liftgate lamps and courtesy lamps. When any door is opened, the door jamb switch contacts close providing a door open input to the BCM. The BCM then provides a B+ to the interior lamps with the switch in the AUTO position. The interior lamps receive a ground when the switch is in the ON position.

NOTE: If the liftgate is opened after all the modules go to sleep, the dome light will not come on. The liftgate ajar switch input to the BCM will not wake up the BCM once it has gone to sleep, so the dome light will not come on. Once the BCM gets an input to wake it up, from remote keyless entry or a door handle, the dome light will turn on when the liftgate is opened.

If the driver inadvertently leaves any interior lamp ON, the BCM will turn it OFF after a 20 min time-out.

The courtesy lamps will turn OFF immediately if the vehicle ON/OFF switch is turned to the ON position or approximately 20 s after all doors are closed.

Keyless Entry Interior Illumination

When the BCM receives a door unlock command from the remote keyless entry transmitter, the BCM will flash the park lamps several times, illuminate the courtesy and park lamps, and illuminate the low beam headlamps at low intensity. The lamps will remain on until the vehicle ON/OFF switch is turned from the OFF position, a keyless entry transmitter door lock command is received, or after an approximate 20 s delay.

Interior Lamps Dimming

This group includes lamps which may dim. This group may use a combination of vacuum fluorescent illumination, LEDs and incandescent lamps.

- HVAC control module, head assembly
- Rear HVAC control module, head assembly
- Radio
- Rear seat audio
- The instrument panel cluster
- The PRNDL lamp, with the exception of the current gear select position
- Power window switches
- Various switches

When the vehicle ON/OFF switch is turned to the ON position, the vacuum fluorescent display, radio, turns ON at maximum brightness. When the park lamps are ON, all incandescent back lighting turn ON at the dimming level indicated by the instrument panel dimmer switch. At the same time all fluorescent display displays dim to match the indicated dimming level. When the headlamp switch is placed in the PARK position, the park lamp

supply voltage circuit provides an input to the BCM. The BCM then supplies voltage to the instrument panel dimmer switch through the dimming control circuit. The setting of the instrument panel dimmer switch determines the amount of voltage that the instrument panel dimmer switch supplies to the BCM through the instrument panel dimming lamps low reference circuit. The BCM then sends a PWM voltage to all the interior lamps. All the fluorescent display and incandescent back lighting lamps are provided a specific voltage and are then grounded. When the headlight switch is turned to the park lamp or headlamp position, all incandescent back lighting turn ON at the dimming level indicated by the instrument panel dimmer switch. When the instrument panel dimmer switch is moved from MIN to MAX, all fluorescent display displays, as well as all incandescent back lighting respond from minimum intensity to maximum brightness in response to the instrument panel dimmer switch.

Inadvertent Power

The BCM used in this vehicle controls the lighting system through circuits that enable the interior lamps. The BCM opens these enabling circuits shortly after the vehicle ON/OFF switch is turned OFF with no lamp switch activity. If the vehicle ON/OFF switch is turned to any position other than OFF, or if a lamp switch is activated during this period, the timer will reset itself.

Article GUID: A00884643

GENERAL INFORMATION

Maintenance and Lubrication - Volt

SPECIFICATIONS

APPROXIMATE FLUID CAPACITIES

Maintenance Procedure	Link
Hydraulic Brake System Capacities	Approximate Fluid Capacities
Engine Heating and Cooling Capacities	Approximate Fluid Capacities
HVAC Capacities	Approximate Fluid Capacities
Hybrid/EV System Heating and Cooling	Approximate Fluid Capacities
Engine Controls and Fuel Capacities - 1.5L (L3A)	Approximate Fluid Capacities
Engine Mechanical - 1.5L (L3A)	Approximate Fluid Capacities
Automatic Transmission Fluid Capacities - 5ET50 (MKV)	Approximate Fluid Capacities

FLUID AND LUBRICANT RECOMMENDATIONS

Usage	Fluid/Lubricant
Engine Oil	Use only engine oil licensed to the dexos1 specification, or equivalent, of the proper SAE viscosity grade. ACDelco dexos1 Synthetic Blend is recommended. Use SAE 5W-20 viscosity grade engine oil. Cold Temperature Operation: In an area of extreme cold, where the temperature falls below -29 Â°C (-20 Â°F), an SAE 0W-30 oil may be used. An oil of this viscosity grade will provide easier cold starting for the engine at extremely low temperatures. When selecting an oil of the appropriate viscosity grade, always select an oil of the correct specification. Refer to Owner's Manual for more information.
Engine Coolant	DEX-COOLÂ® (Premix 50/50 with deionized water)
High Voltage Battery Cooling System	Premix DEX-COOL
Power Electronics Cooling System	Premix DEX-COOL
Hydraulic Brake System	DOT 3 Hydraulic Brake Fluid
Windshield Washer	Automotive windshield washer fluid that meets regional freeze protection requirements.
Electric Drive Unit	DEXRONÂ®-VI Automatic Transmission Fluid
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube
Hood, Hatch, and Rear Folding Seat Hinges	Multi-Purpose Lubricant, Superlube
Weatherstrip Conditioning	Weatherstrip Lubricant or Dielectric Silicone Grease

MAINTENANCE ITEMS

Maintenance Procedure	Link
Approximate Fluid Capacities	Approximate Fluid Capacities
Fluid and Lubricant Recommendations	Fluid and Lubricant Recommendations
Maintenance Replacement Parts	Maintenance Replacement Parts
GM Oil Life System Resetting	GM Oil Life System ResettingGM Oil Life System Resetting (With Scan Tool)
Tire Pressure Indicator Sensor Learn	Tire Pressure Indicator Sensor Learn
Passenger Compartment Air Filter Replacement	Passenger Compartment Air Filter Replacement
Brake Pad Inspection	Brake Pad Inspection
Cooling System Draining and Filling	Cooling System Draining and Filling
Air Cleaner Element Replacement - 1.5L (L3A)	Air Cleaner Element Replacement - 1.5L (L3A)
Spark Plug Replacement - 1.5L (L3A)	Spark Plug Replacement - 1.5L (L3A)
Automatic Transmission Fluid Drain and Fill - 5ET50 (MKV)	Transmission Fluid Drain and Fill

MAINTENANCE REPLACEMENT PARTS

Replacement parts identified below by name, part number, or specification can be obtained from your dealer.

Part	GM Part Number	ACDelco Part Number
Engine Air Cleaner/Filter	20871244	A3148C
Cabin Air Filter	13508023	CF185
Engine Oil Filter	12670058	UPF64R
Spark Plugs	12637197	41-124
Wiper Blades		
• Left - 65 cm (25.6 in)	23251330	-
• Right - 65 cm (25.6 in)	23251332	-

MAINTENANCE

MAINTENANCE SCHEDULE

The Maintenance Schedule information will only be found in the Owner's Manual.

Refer to the Maintenance Schedule subsection of the Owner's Manual, or you may be able to use the Search information function using the words Scheduled Maintenance.

GM OIL LIFE SYSTEM RESETTNG

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which includes engine revolutions and engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed.

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message comes on. Change the oil as soon as possible within the next 1 000 km (600 miles). It is possible that, if driving under the best conditions, the oil life system might indicate that an oil change is not necessary for up to two years. The engine oil and filter must be changed at least once every two years and, at this time, the system must be reset. Your dealer has trained service people who will perform this work using genuine parts and reset the system. It is also important to check the oil regularly over the course of an oil drain interval and keep it at the proper level.

If the system is ever reset accidentally, the oil must be changed at 5 000 km (3, 000 miles) since the last oil change. Remember to reset the oil life system whenever the oil is changed.

How to Reset the Engine Oil Life System

Reset the system whenever the engine oil change is changed so that the system can calculate the next engine oil change. To reset the system:

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

If the Change Engine Oil Soon message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

GM OIL LIFE SYSTEM RESETTING (WITH SCAN TOOL)

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A ENGINE OIL light message will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

(If applicable)With Scan Tool

1. Ignition - On / Vehicle - In Service Mode
 2. Select:Module Diagnostics
 3. Select:K20 Engine Control Module
 4. Select:Configuration/Reset Functions
 5. Select:Reset Functions
 6. Select:Engine Oil Life Reset
 7. Enter the desired value
 8. Select:Continue
-

REMINDER INDICATOR (RESET PROCEDURES)

GM: Buick / Cadillac / Chevrolet / GMC / Olds / Pontiac - 1980-18

ENGINE OIL REPLACEMENT REMINDER

NOTE: Most 1981-88 General Motors vehicles do not use a Service Reminder Indicator (SRI).

NOTE: To determine the appropriate reset procedure, refer to [ENGINE OIL REPLACEMENT REMINDER RESET INDEX](#). Only vehicles listed in this index have an oil change reminder reset.

ENGINE OIL REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
Alero	
1999-03	Engine Oil Replacement Reminder Reset - Procedure 01
2004	Engine Oil Replacement Reminder Reset - Procedure 03
Acadia	
2007-10	Engine Oil Replacement Reminder Reset - Procedure 16
2011-18	Engine Oil Replacement Reminder Reset - Procedure 06
Allante	
1989-93	Engine Oil Replacement Reminder Reset - Procedure 23
ATS	
2013-18	Engine Oil Replacement Reminder Reset - Procedure 33
Aurora	
1995-99	Engine Oil Replacement Reminder Reset - Procedure 27
2001-03	Engine Oil Replacement Reminder Reset - Procedure 06
Avalanche	
2002-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-13	Engine Oil Replacement Reminder Reset - Procedure 06
Aveo / Wave	
2009-11	Engine Oil Replacement Reminder Reset - Procedure 03
Aztek	
2001-05	Engine Oil Replacement Reminder Reset - Procedure 03
Bravada	
2002-04	Engine Oil Replacement Reminder Reset - Procedure 11
Bonneville	
2003-05	Engine Oil Replacement Reminder Reset - Procedure 06
Brougham	
1992	Engine Oil Replacement Reminder Reset - Procedure 03
Cascada	
2016-18	Engine Oil Replacement Reminder Reset - Procedure 18

Model & Year	Reset Procedure
Camaro	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 01</u>
2010-15	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Canyon	
2004-12	<u>Engine Oil Replacement Reminder Reset - Procedure 10</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Caprice	
1994	<u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2011-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Captiva Sport	
2012-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Century	
1997-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
City Express	
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Classic	
2005	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Cobalt & G5 Pursuit (Canadian)	
2005-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Colorado	
2004-12	<u>Engine Oil Replacement Reminder Reset - Procedure 10</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Corvette	
1990-96	<u>Engine Oil Replacement Reminder Reset - Procedure 05</u>
1997-13	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Cruze	
2011-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Cruze Limited	
2016	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
CT6	
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
CTS	
2003-04	<u>Engine Oil Replacement Reminder Reset - Procedure 20</u>
2005-08	<u>Engine Oil Replacement Reminder Reset - Procedure 22</u>
2009	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2010-11	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
	OR <u>Engine Oil Replacement Reminder Reset - Procedure 19</u>

Model & Year	Reset Procedure
2012-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Cutlass Calais, Cutlass Supreme, Cutlass Ciera, Cutlass Cruiser	
1990-91	<u>Engine Oil Replacement Reminder Reset - Procedure 28</u>
DeVille	
1991-93	<u>Engine Oil Replacement Reminder Reset - Procedure 25</u>
1994-99	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
DeVille Concours	
1994-96	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1997-99	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
DTS	
2006-11	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Eighty Eight & Ninety Eight	
1990-91	<u>Engine Oil Replacement Reminder Reset - Procedure 28</u>
1992-94	<u>Engine Oil Replacement Reminder Reset - Procedure 29</u>
1995-97	<u>Engine Oil Replacement Reminder Reset - Procedure 30</u>
Eldorado	
1989-91	<u>Engine Oil Replacement Reminder Reset - Procedure 24</u>
1992-93	<u>Engine Oil Replacement Reminder Reset - Procedure 26</u>
1994-97	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1997-02	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
ELR	
2014-16	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Enclave	
2008-18	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
Encore	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Envision	
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Envoy Series	
2002-06	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2007-09	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Equinox	
2005-09	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2010-14	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 34</u>
Escalade Series	
2002-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-14	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2015-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>

Model & Year	Reset Procedure
Express/ Chevy Express/ Cutaway/ RV	
2003-17	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2018	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Firebird	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Fleetwood	
1991-92	<u>Engine Oil Replacement Reminder Reset - Procedure 25</u>
1993-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Grand Am	
1999-02	<u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
2003-05	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Grand Prix	
1998-03	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2004-08	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
GTO	
2004-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
G5	
2007-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
G6	
2005-10	<u>Engine Oil Replacement Reminder Reset - Procedure 32</u>
G8	
2008-09	<u>Engine Oil Replacement Reminder Reset - Procedure 09</u>
HHR	
2006-11	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Impala	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 08</u>
2007-13	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Impala Limited	
2014-16	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>
Intrigue	
1998-02	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
LaCrosse & Allure	
2005-13	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
LeSabre	
1994-99	<u>Engine Oil Replacement Reminder Reset - Procedure 12</u>
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 14</u>
Lucerne	
2006-10	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2011	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>

Model & Year	Reset Procedure
Lumina	
1997-01	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Malibu	
2004-07	<u>Engine Oil Replacement Reminder Reset - Procedure 13</u>
2008-12	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Malibu Limited	
2016	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Montana	
2000-05	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Monte Carlo	
1997-99	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 08</u>
2007	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Park Avenue	
1991-94	<u>Engine Oil Replacement Reminder Reset - Procedure 15</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 12</u>
1997-05	<u>Engine Oil Replacement Reminder Reset - Procedure 14</u>
Pickup/ C3500/ Cab & Chassis (C/K)	
1996-00	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Rainier	
2004-07	<u>Engine Oil Replacement Reminder Reset - Procedure 17</u>
Regal (All Versions)	
1997-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2011-13	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2014-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Rendezvous	
2002-07	<u>Engine Oil Replacement Reminder Reset - Procedure 17</u>
Roadmaster	
1994	<u>Engine Oil Replacement Reminder Reset - Procedure 15</u> or <u>Engine Oil Replacement Reminder Reset - Procedure 02</u>
1995-96	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Savana Series/ Cutaway/ RV	
2003-17	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2018	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Seville	
1989-91	<u>Engine Oil Replacement Reminder Reset - Procedure 24</u>
1992-93	<u>Engine Oil Replacement Reminder Reset - Procedure 26</u>
1994-97	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
1998-04	<u>Engine Oil Replacement Reminder Reset - Procedure 16</u>

Model & Year	Reset Procedure
Sierra Series	
1999-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Silhouette	
2000-01	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2002-04	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Silverado Series	
2001-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-15	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Solstice	
2006-10	<u>Engine Oil Replacement Reminder Reset - Procedure 04</u>
Sonic	
2012-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Spark	
2013-16	<u>Engine Oil Replacement Reminder Reset - Procedure 35</u>
2017-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
SRX	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 20</u>
2005-06	<u>Engine Oil Replacement Reminder Reset - Procedure 22</u>
2007-09	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2010-12	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
2013-16	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
SS	
2014-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
SSR	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2005-06	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
STS	
2005-11	<u>Engine Oil Replacement Reminder Reset - Procedure 07</u>
Suburban	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Tahoe	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Terrain	
2011-18	<u>Engine Oil Replacement Reminder Reset - Procedure 34</u>
Toronado	
1989-92	<u>Engine Oil Replacement Reminder Reset - Procedure 31</u>
Torrent	

Model & Year	Reset Procedure
2006-09	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
Trailblazer	
2002-09	<u>Engine Oil Replacement Reminder Reset - Procedure 11</u>
Traverse	
2009-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Trax	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Uplander, Montana SV6 (Canadian)	
2005-08	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Venture	
2000-04	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2005	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
Verano	
2012-17	<u>Engine Oil Replacement Reminder Reset - Procedure 18</u>
Volt	
2011-15	<u>Engine Oil Replacement Reminder Reset - Procedure 21</u>
2016-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
XLR	
2004	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>
2005-09	<u>Engine Oil Replacement Reminder Reset - Procedure 19</u>
XT5	
2017-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
XTS	
2013-18	<u>Engine Oil Replacement Reminder Reset - Procedure 33</u>
Yukon Series	
2000-06	<u>Engine Oil Replacement Reminder Reset - Procedure 03</u>
2007-18	<u>Engine Oil Replacement Reminder Reset - Procedure 06</u>

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 01

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset (on some models a chime will also sound). Reset is complete when OIL CHANGE light goes out.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 02

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. To reset CHANGE OIL light:

1. Remove IP fuse block cover (cover can be seen when driver's door is open).
2. Turn ignition ON, engine OFF.
3. Press OIL RESET button and hold for 5 seconds.
4. If Oil Life light does not reset, repeat procedure with ignition OFF.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 03

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.

1. To reset oil life monitor and turn off CHANGE OIL light (or message), turn ignition to ON position with engine off.
2. Depress accelerator pedal to wide open throttle 3 times within 5 seconds.
3. Turn ignition to LOCK/OFF
4. If light (or message) does not turn off, turn ignition OFF and repeat procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 04

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1, 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

Reset Procedure

1. Turn the ignition key to RUN with the engine OFF.
2. Press the INFO and RESET buttons on the Driver Information Center (DIC) at the same time to enter the personalization menu.
3. Press the INFO button to scroll through the available personalization menu modes until the DIC display shows OIL-LIFE RESET.
4. Press the INFO and RESET buttons at the same time for one second and release.
5. Press and hold the reset button until the DIC display shows ACKNOWLEDGED. This will tell you the system has been reset.
6. Turn the key to LOCK/OFF.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 05

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the oil is nearly worn out. A CHANGE OIL light on left side of instrument cluster is illuminated when it is time to change oil. To reset oil life monitor:

1. Turn ignition on.
2. Depress ENG MET button on trip monitor and release.
3. Within 5 seconds, depress and release ENG MET button again.
4. Within 5 seconds, depress and hold the ENG MET or GAUGES button again. The CHANGE OIL light should flash.
5. Depress and hold the RANGE or GAUGES button until the CHANGE OIL light stops flashing and goes out. When the light goes out, the engine oil life monitor is reset. This should take about 10 seconds.

NOTE: If the light does not reset, turn ignition off and repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 06

The Driver Information Center (DIC) will display a CHANGE OIL message when an oil change is due. The instrument cluster may also have a CHANGE OIL light. To reset the oil life monitor:

Reset Procedure

1. Turn ignition switch to RUN position, with engine off.
2. Press the TRIP (on some models SELECT or SET/RESET) button, located on the DIC, until the OIL LIFE display appears. Message will display percentage of oil life remaining.

NOTE: On models without DIC buttons, use the TRIP/ODOMETER reset stem.

3. Press and hold SET/RESET button (on some models, the check-symbol button) on DIC for at least 5 seconds. The message will change to indicate that the Oil Life has been reset. On some models, 3 chimes will also sound.
4. Turn ignition off.
5. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

NOTE: On some models, if oil life system does not reset, try turning ignition OFF after displaying oil life message. Then press and hold reset button.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 07

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message in the DIC comes on. Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. To reset the system:

1. Press the up or down arrow to scroll the DIC to show OIL LIFE.
2. Once the XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the RESET button until the percentage shows 100%

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 08

The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

1. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 4. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the DISP (on some models, TUNE DISP) button (or knob) on the radio for at least 5 seconds until SETTINGS is displayed.
2. Press the SEEK (on some models, SEEK PTYPE or SEEK PSCAN) up or down arrow to scroll through the main menu. Scroll until OIL LIFE appears on the display. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the DISP/TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the DISP/TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 09

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. Press and hold the TRIP button on the steering wheel while turning on the ignition. Do not start the engine.
2. The instrument panel cluster will prompt to clear the service code.
3. Release the button.
4. Press and hold ENTER Switch on the left side of the steering wheel for approximately one second.
5. Turn off the ignition.

If the CHANGE ENGINE OIL SOON message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 10

1. Turn ignition ON, with engine off.
2. Press and release reset stem on instrument panel while OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold stem in until several beeps will sound. This confirms that oil life system has been reset. Turn ignition off or full LOCK position. If CHANGE OIL messages comes back after starting engine, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 11

Reset Procedure

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

Alternate Method

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 12

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 13

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 14

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 15

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, locate reset button hole under the dash near passenger door. Use a pencil or similar object to push and hold button (inside hole) for 5 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 16

Vehicles WITHOUT Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN, with the engine off. The vehicle must be in P (Park) to access this display. Press the trip odometer reset stem until OIL LIFE REMAINING displays.
2. Press and hold the trip odometer reset stem until OIL LIFE REMAINING shows "100%." Three chimes sound and the CHANGE ENGINE OIL SOON message goes off.
3. Turn the key to LOCK/OFF. If the CHANGE ENGINE OIL SOON message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Vehicles WITH Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN position, with the engine off.
2. Press the VEHICLE INFORMATION BUTTON (i) until OIL LIFE REMAINING displays.
3. Press and hold the SET/RESET button (check-mark symbol) until "100%" is displayed. Three chimes sound (on some models) and the CHANGE ENGINE OIL SOON message goes off.
4. Turn ignition to LOCK/OFF position. If the CHANGE ENGINE OIL SOON message comes back on when engine is started, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 17

Reset Procedure

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the Driver Information Center (DIC) reads OIL LIFE LEFT/HOLD SET TO RESET.
3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.
4. If the CHANGE ENGINE OIL message comes back on when engine is started, the engine oil life system has not reset. Repeat the procedure.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 18

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL message or light will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

Vehicles with DIC (& Steering Wheel Controls)

1. Using the DIC controls on the right side of the steering wheel (see [Fig. 1](#)), display REMAINING OIL LIFE on the driver information center (DIC).
2. Press SEL or SET/CLR (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

NOTE: If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

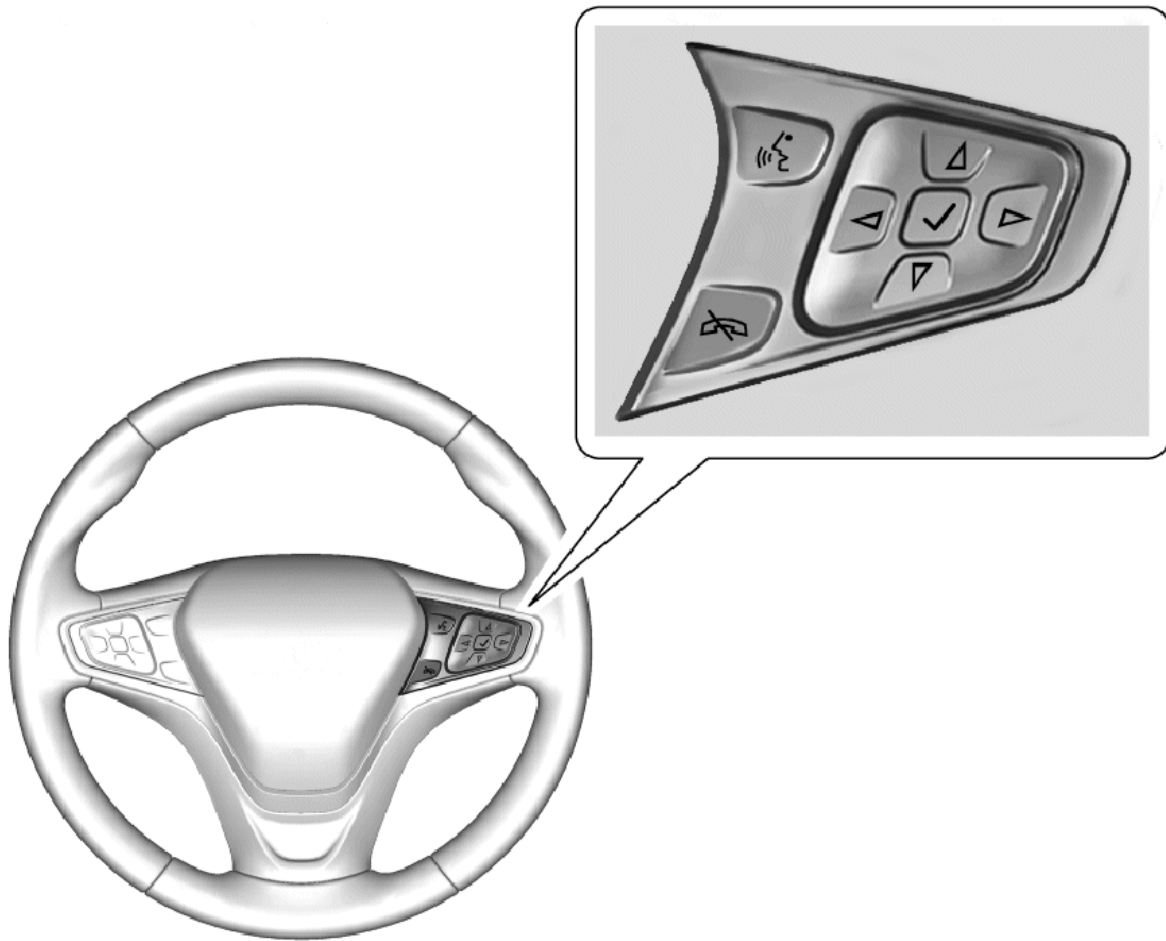


Fig. 1: Identifying DIC Controls (Steering Wheel - Typical)

Courtesy of GENERAL MOTORS COMPANY

Vehicles with DIC (& Turn Signal Lever Controls)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button on the turn signal lever to enter the Vehicle Information Menu. Use the thumbwheel to scroll through the menu items until you reach REMAINING OIL LIFE. See [Fig. 2](#).

NOTE: On vehicles with an Uplevel DIC, the controls are at the right-hand side of the steering wheel.

3. Press the SET/CLR button (on some models, the check-symbol button) while the oil life display is active. After a few seconds, there will be a single chime (on some models) and the oil life will be reset to 100%.
4. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE OIL message is off and the REMAINING OIL LIFE 100% message is displayed.

NOTE: If the CHANGE OIL message comes back on or Code 82 DIC message comes on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

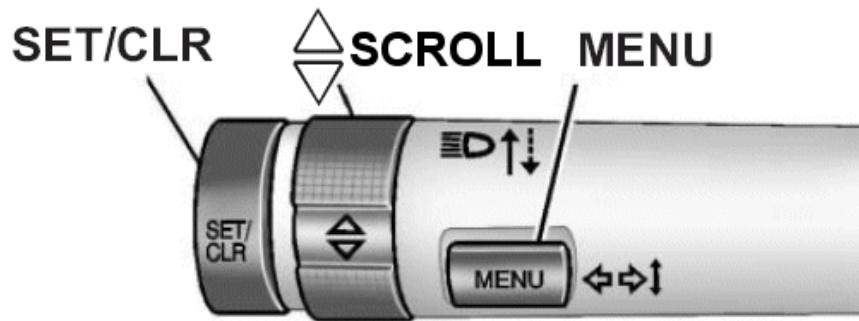


Fig. 2: Identifying DIC Controls (Turn Signal Lever)

Courtesy of GENERAL MOTORS COMPANY

Vehicles without DIC (Some Models)

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

Reset Using Diagnostic Scan Tool (Some Models)

1. Turn on ignition.
2. Connect scan tool.
3. Select Module Diagnosis.
4. Select Engine Control Module.
5. Select Configuration/Reset function.
6. Select Engine Oil System Reset.
7. Push Enter button to run function.
8. Confirm Executed successfully.
9. Turn ignition off and confirm.
10. Turn ignition on and confirm.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 19

1. The Driver Information Center (DIC) will display remaining oil life as a percentage estimate of the useful life of oil.
2. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When oil life expires, display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press INFORMATION (or INFORMATION SKIP) button to display OIL LIFE LEFT. Press and hold RESET (or RESET NO) button until 100 OIL LIFE LEFT (0.0 OIL LIFE LEFT on some early models) is displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 20

With Base Audio System

Press up or down arrow on the INFO button located to right of Driver Information Center (DIC) display to

access DIC menu. Once 100 percent ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. Percentage will return to 100 and oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

With Navigation System

Turn the system on by pressing PWR/VOL knob once. PWR/VOL knob is located to lower left of DIC display. Press INFO button located to left of the display to access Vehicle Information menu. Turn TUNE/SEL knob located to lower right of the display until ENGINE OIL LIFE is highlighted. Press TUNE/SEL knob once to select it. When 100 percent Engine Oil Life is displayed, press multifunction button next to reset prompt in upper right corner of the display. Percentage will return to 100 and the oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 21

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 22

With Base Audio System

1. Press the CLR button located to the right of the driver information center (DIC) display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Press the up or down arrow on the INFO button located to the right of the Driver Information Center (DIC) display to access the DIC menu.
3. Once 100% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
4. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

Without DIC

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

With Navigation System

1. Press the multifunction button, next to the OK prompt in the upper right of the display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Turn the system on by pressing the PWR/VOL knob once. The PWR/VOL knob is located to the lower left of the driver information center (DIC) display.

3. Press the INFO button located to the left of the display to access the Vehicle Information menu.
4. Turn the TUNE/SEL knob located to the lower right of the display until Engine Oil Life is highlighted. Press the knob once to select it.
5. Once the 100% Engine Oil Life is displayed, press the multifunction button next to the Reset prompt in the upper right corner of the display. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
6. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 23

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset service reminder on 1989 models, press RANGE button until OIL LIFE INDEX appears on display. Depress and hold in AVG ECON and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.
4. On 1990-93 models, press RANGE button until OIL LIFE INDEX appears on DIC display. Depress and hold in AVG SPEED and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 24

1. An OIL LIFE INDEX is one of 4 displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. Display will show 100 percent when the system is reset. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When the oil life expires, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press ENG DATA button until OIL LIFE INDEX appears on DIC display. Depress and hold in ENG DATA and RANGE buttons until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 25

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a estimated percentage of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After performing necessary services, reset service reminder.
3. To reset service reminder, turn ignition to on position. Do not start engine. Depress and hold RANGE and FUEL USED buttons until OIL LIFE INDEX appears on DIC display. Depress and hold RANGE and RESET buttons for 5-60 seconds.
4. When CHANGE OIL SOON light flashes 4 times, remaining oil life index is reset to 100 percent. If CHANGE OIL SOON comes on and stays on for 5 seconds, display did not reset. Repeat step [3](#).

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 26

1. Oil change reminder display on the Driver Information Center (DIC) is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset, press INFORMATION button to display OIL LIFE INDEX. Press and hold STORE/RECALL button until 100 is displayed. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 27

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 28

1. An oil change reminder displays estimated percentage of the remaining useful life of the oil. When engine is started, a tone will sound and approximate distance to next oil change will be displayed.
2. When remaining oil life is 10 percent or less, the system will calculate distance to next oil change. When the oil life is 0 percent, the display will show CHANGE OIL NOW. After changing oil, reset oil life display.
3. To reset the display, press and hold in OIL button to select the oil life display. Then, press and hold in RESET and OIL buttons for at least 5 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 29

1. To reset the display, press and release the TEST button.
2. Press and release the OIL button.
3. Press and hold the RESET button for at least 7 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 30

1. To reset the display, press and release RESET button on Driver Information Center (DIC).
2. Press SEL button (with down arrow) to select OIL.
3. Press SEL button (with left and right arrows) to display oil life.
4. Press and hold RESET button for about 5 seconds.
5. A reset message will display, then oil life will display 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 31

With Information Center Display

OIL LIFE INDEX is one of 4 engine data displays used on models with Information Center display. It will display remaining oil life as estimated percentage of the useful life of oil. It will show 100 percent when the system is reset. After changing oil, reset oil life display.

1. To reset the display, press ENG DATA button (1989-90) or OPTIONS button (1991-92) until oil life index is displayed.
2. Then, press and hold in ENG DATA and GAGE buttons (1989) or RESET/ENTER button (1990-92) for at least 5 seconds. This will reset remaining oil life to 100 percent.

With Visual Information Center

OIL LIFE is one of the displays used on models with a Visual Information Center (VIC). It will display data regarding previous oil change. A bar graph display shows full when oil is changed. Bar graph will go down as vehicle is driven and oil ages. When bar graph reaches CHANGE OIL mark, oil should be changed. After changing oil, reset oil life display.

1. To reset the display, press INFO hard key and then OIL LIFE soft key to display oil life index.
2. Press RESET soft key.
3. A reset confirmation page will appear and ask if oil has been changed. Press YES soft key to reset bar graph, and update last oil change date and mileage information.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 32

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. With the CHANGE OIL SOON message displayed, press any of the three driver information center (DIC) buttons to clear the CHANGE OIL SOON message.
2. Display OIL LIFE RESET on the DIC.
3. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has reset.
4. Turn the ignition to OFF.

If the CHANGE ENGINE OIL message comes back on when you start the vehicle the Engine Oil Life System has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 33

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which include engine revolutions, engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed. To reset the system:

Reset Procedure

1. Using the DIC controls on the right side of the steering wheel, display REMAINING OIL LIFE on the driver information center (DIC).

2. Press SEL (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 34

Vehicles with Driver Information Center (DIC)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button, on the center console or right-hand steering wheel controls, to enter the Vehicle Information Menu.
3. Press either the up or down arrows to view REMAINING OIL LIFE.
4. Press the SET/CLR button until 100% is displayed.
5. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE ENGINE OIL SOON message goes off.

NOTE: If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Alternate Method

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, than start the vehicle.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 35

Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. Always reset the engine oil life to 100% after every oil change. It will not reset itself. Use the DIC controls at the right side of the instrument cluster to reset the system.

1. Display remaining oil life (oil can w/ %) on the DIC
2. Press and hold SET/CLR on the DIC for more than five seconds. The oil life will change to 100%.

If the OIL CHANGE DIC message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

EMISSIONS MAINTENANCE REMINDER (REMINDER FLAG)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET](#). Only vehicles listed in this index have an Oxygen Sensor Reminder Flag reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Some Models	
1980	Emissions Maintenance Reminder Reset Procedure

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

- 1. Every 30, 000 miles, a reminder flag appears in speedometer face, indicating service of oxygen sensor is necessary. See [Fig. 3](#). Inspect and service oxygen sensor as necessary and reset flag.
- 2. To reset flag, remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when flag is fully reset.

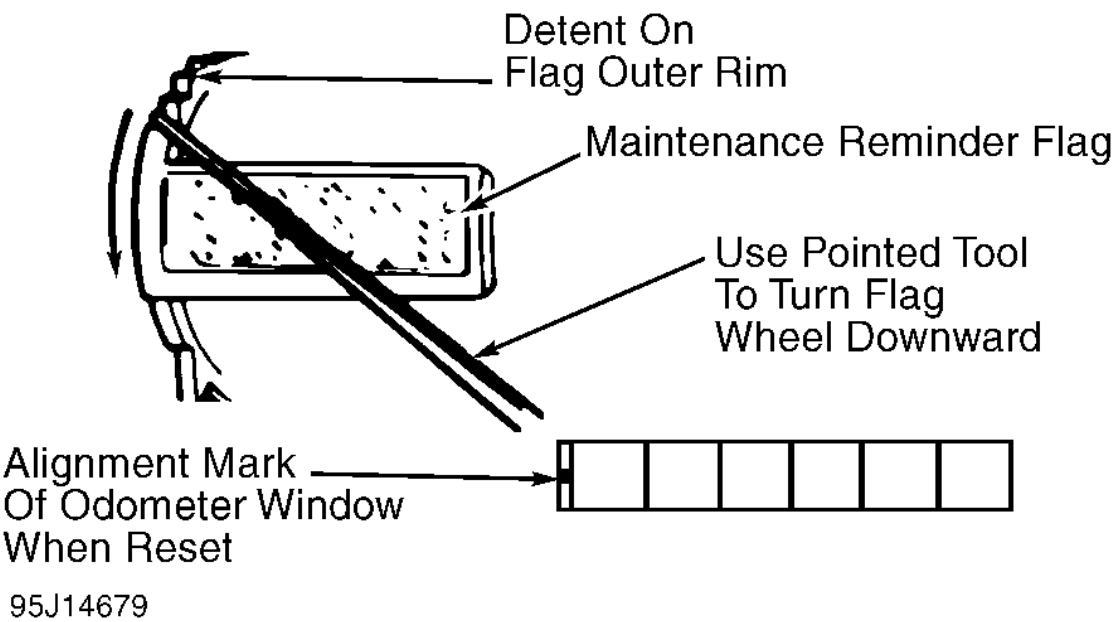


Fig. 3: Resetting Reminder Flag
Courtesy of GENERAL MOTORS CORP.

EMISSIONS MAINTENANCE REMINDER (WARNING LIGHT)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET INDEX](#). Only vehicles listed in this index have an oxygen sensor warning light reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Sprint	
1985-86	<u>Emissions Maintenance Reminder Reset Procedure</u>

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

At 30, 000 mile intervals, a SENSOR light in dash will start flashing, indicating oxygen sensor needs replacement. To reset mileage counter (after sensor replacement), locate SENSOR light cancel switch on right side of fuse box. Return cancel switch to OFF position. Start engine to ensure light remains off.

EMISSIONS MAINTENANCE REMINDER (CHECK ENGINE LIGHT)

NOTE: To determine the appropriate reset procedure, refer to [EMISSIONS MAINTENANCE REMINDER RESET INDEX](#). Only vehicles listed in this index have a check engine light reset.

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Geo Tracker	
1989-94	<u>Emissions Maintenance Reminder Reset Procedure</u>

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

Federal Emissions

1. CHECK ENGINE light functions as a service reminder indicator and emission system service. CHECK ENGINE light will come on each 50, 000 miles (PCV and EGR), each 80, 000 miles (oxygen sensor) and each 100, 000 miles (charcoal canister) to indicate needed emission system service.
2. After servicing and/or replacing components, reset CHECK ENGINE light by sliding cancel switch to its opposite position. See [CHECK ENGINE LIGHT RESET SWITCH LOCATION \(GEO TRACKER\)](#) for switch location.

CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)

Application	Location
1989-91	Behind Access Panel, Directly Below Steering Column
1992-94	⁽¹⁾ Behind Instrument Panel, Next To Left Speaker
(1) See <u>Fig. 4</u> .	

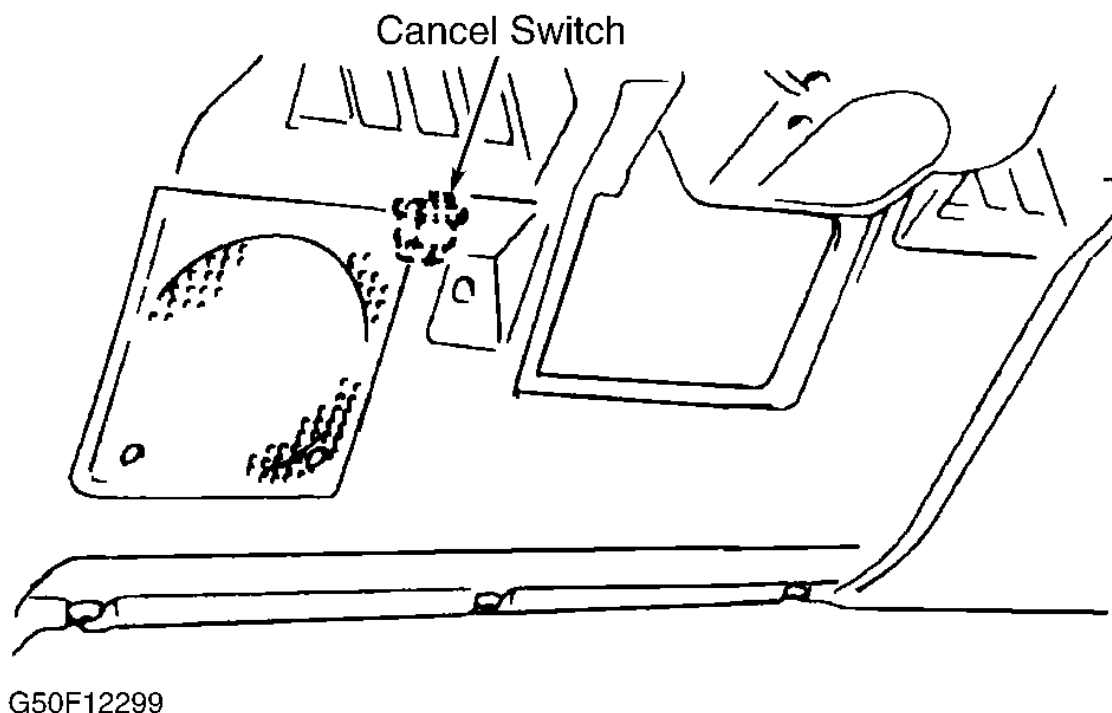


Fig. 4: Check Engine Light Reset Switch Location (1992-94 Geo Tracker - Federal Emissions)

Courtesy of GENERAL MOTORS CORP.

California Emissions

CHECK ENGINE light indicates when it is necessary to have emission system serviced, regardless of mileage. CHECK ENGINE light comes on briefly when starting as a bulb check. If light does not come on or stays on constantly, repair as necessary.

FUEL FILTER REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [Fuel Filter Life Reset Index](#). Only vehicles listed in this index have a fuel filter life reset.

FUEL FILTER REPLACEMENT REMINDER RESET INDEX

Application	Reset Procedure
Some Diesel Models	Fuel Filter Replacement Reminder Reset Procedure

FUEL FILTER REPLACEMENT REMINDER RESET PROCEDURE

NOTE: This procedure applies to some diesel models. Manufacturer does not specify which vehicles are equipped with a Fuel Filter Replacement Reminder.

NOTE: ALWAYS reset the FUEL FILTER LIFE system (if equipped) after a fuel filter change.

"FUEL FILTER LIFE" message will appear when a reset is performed either by using the steering wheel controls or performing manual reset procedure.

1. On vehicles with steering wheel controls, press and hold the select button for 5 seconds while the FUEL FILTER LIFE message is displayed. This message will appear on the Driver Information Center (DIC) for 10 seconds.
2. On vehicles without steering wheel controls, go to next step.
3. Without pressing the pedals, turn the ignition key to the ON position, engine off. Wait 5 seconds.
4. Completely depress the brake and accelerator pedals simultaneously and hold for 10 seconds. The system is now reset. Turn ignition key OFF.
5. On all vehicles, the next time engine is started, the message will no longer be displayed.

MAINTENANCE SERVICE REMINDER

NOTE: To determine the appropriate reset procedure, refer to [MAINTENANCE SERVICE REMINDER RESET INDEX](#). Only vehicles listed in this index have a Service Reminder reset.

MAINTENANCE SERVICE REMINDER RESET INDEX

Model & Year	Reset Procedure
6000 STE	
1987-89	<u>Maintenance Service Reminder Reset - Procedure 01</u>
Bonneville	
1988-91	<u>Maintenance Service Reminder Reset - Procedure 01</u>
Caprice	
2011	<u>Maintenance Service Reminder Reset - Procedure 02</u>

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 01

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

1. To reset service reminder, push DIC button until desired service item is displayed.
2. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles.
3. Release button when desired distance is displayed on the DIC.

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 02

The displayed service reminder is reset using a scan tool or by the following procedure:

1. Turn the ignition to the OFF position.
2. Press and hold the TRIP button.
3. Turn the ignition to the ON position.
4. Release the TRIP button.

5. Once in the Service Reset screen, press and hold the ENTER switch for 3-5 seconds. A confirmation beep will sound upon reset.
6. Turn the ignition to the OFF position.

NOTE: If the service reminder comes back on when you start the vehicle, the Service Reminder Display has not reset. Repeat the procedure.

TIMING BELT REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [TIMING BELT REPLACEMENT REMINDER INDEX](#). Only the vehicles listed in this index have a Timing Belt Replacement Reminder Reset.

CHANGE TIMING BELT MESSAGE INDEX

Model & Year	Reset Procedure
Chevrolet Cruze - 1.8L LUW and LWE Engines (2011-16)	Timing Belt Replacement Reminder Reset Procedure
Chevrolet Sonic - 1.8L LUW and LWE Engines (2012-16)	Timing Belt Replacement Reminder Reset Procedure

TIMING BELT REPLACEMENT REMINDER RESET PROCEDURE

NOTE: Applies to 1.8L LUW and LWE engines.

Description

On LUW and LWE engines, the Instrument Cluster monitors the odometer mileage to determine when a timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100, 000 miles (160, 000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message.

Message Reset

After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster, for two minutes.

- **2011-16 Cruze :** Fuse #21 (F21DA) Underhood ([Fig. 5](#))
- **2012-16 Sonic :** Fuse #F26 (F26DA) Under Dash (lower-left of dash - [Fig. 6](#))

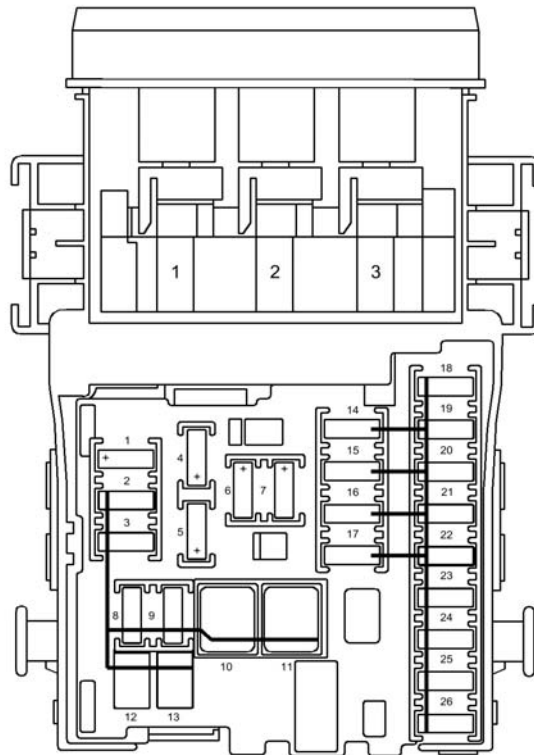


Fig. 5: Underhood Fuses (Cruze)

Courtesy of GENERAL MOTORS CORP.

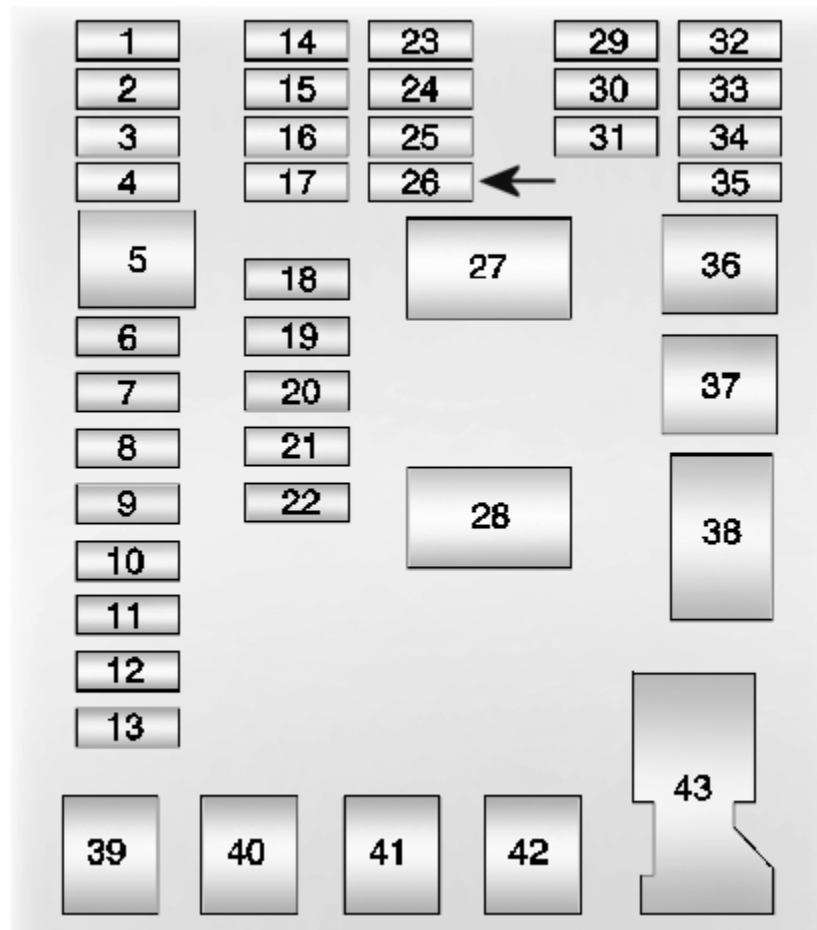


Fig. 6: Instrument Panel Fuses (Sonic)

Courtesy of GENERAL MOTORS CORP.

TRANSMISSION FLUID REPLACEMENT REMINDER

NOTE: To determine the appropriate reset procedure, refer to [TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX](#). Only the vehicles listed in this index have a CHANGE TRANS FLUID MESSAGE reset.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
Aurora	
1995-99	Transmission Fluid Replacement Reminder Reset - Procedure 04
Concours	
1994-98	Transmission Fluid Replacement Reminder Reset - Procedure 01
1999	Transmission Fluid Replacement Reminder Reset - Procedure 02
CTS	
2003	Transmission Fluid Replacement Reminder Reset - Procedure 03
2004	Transmission Fluid Replacement Reminder Reset - Procedure 02
DeVille	
1992-97	Transmission Fluid Replacement Reminder Reset - Procedure 01
1998-04	Transmission Fluid Replacement Reminder Reset - Procedure 02
Eldorado	
1992-98	Transmission Fluid Replacement Reminder Reset - Procedure 01
1999-00	Transmission Fluid Replacement Reminder Reset - Procedure 02
2001-02	Transmission Fluid Replacement Reminder Reset - Procedure 01
Seville	
1992-97	Transmission Fluid Replacement Reminder Reset - Procedure 01
1998-04	Transmission Fluid Replacement Reminder Reset - Procedure 02
SRX	
2004	Transmission Fluid Replacement Reminder Reset - Procedure 02

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 01

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Change fluid in both the oil pan and side cover.

1. To reset display, turn ignition ON with engine OFF.
2. On the climate control panel, press and hold OFF and REAR DEFOG buttons until TRANS FLUID RESET message appears in DIC (about 5-20 seconds).

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 02

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Percentage of transaxle fluid life remaining may be checked at any time by pressing INFO button

several times until TRANS FLUID LIFE message appears.

- 1. To reset display, turn ignition key ON with engine OFF.
- 2. Press the INFO button until TRANS FLUID LIFE message appears.
- 3. Press and hold INFO RESET button until display shows 100 percent TRANS FLUID LIFE. Transaxle fluid life index is now reset.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 03

NOTE: The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due.

Resetting With Base Audio System

Press CLR button located to the right of the DIC display to acknowledge the CHANGE TRANS FLUID message. This will clear the message from the display and reset it. To reset transmission fluid life indicator, press up or down arrow on INFO button located to the right of the DIC display to access the DIC menu. Once percentage TRANS FLUID LIFE menu item is highlighted, press and hold CLR button. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

Resetting With Navigation System

Press multifunction button located to the right of the DIC display, next to the OK prompt to acknowledge the CHANGE TRANS FLUID message. This will clear the message from the display and reset it. To reset transmission fluid life indicator, turn system on by pressing PWR/VOL knob once. PWR/VOL knob is located to the lower left of the DIC display. Press INFO button located to the left of the DIC display to access the VEHICLE INFO menu. Turn TUNE/SEL knob located to the lower right of the DIC display until TRANS FLUID LIFE is highlighted. Press knob once to select it. Once percentage TRANS FLUID LIFE is displayed, press multifunction button next to the RESET prompt in the upper right corner of the display. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 04

- 1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of transaxle fluid. When remaining fluid life is 0 percent, the display will show CHANGE TRNS FLUID NOW. After changing transaxle fluid, reset oil life display.
- 2. To reset the display, turn ignition on with engine off. Press ENG button to select the TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
- 3. The word RESET will appear. Then, TRNS FLUID 100 will be displayed.

TIRE PRESSURE MONITOR SYSTEM REMINDER

NOTE: To determine the appropriate reset procedure, refer to **TPMS REMINDER RESET INDEX**. Only vehicles listed in this index have a TPMS Reminder Reset.

TPMS REMINDER RESET INDEX

Model	Application	Procedure
Buick		

Model	Application	Procedure
Allure	2006-09	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Cascada	2016-18	<u>TPMS Reminder Reset - Procedure 25</u>
Century	1999-05	<u>(1) TPMS Reminder Reset - Procedure 21</u>
Enclave	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 09</u>
Encore	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Envision	2016-18	<u>TPMS Reminder Reset - Procedure 26</u>
LaCrosse	2006-09	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2010-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 26</u>
LaSabre	2002-05	<u>(1) TPMS Reminder Reset - Procedure 20</u>
Lucerne	2006	<u>(1) TPMS Reminder Reset - Procedure 22</u>
Â	2007-11	<u>TPMS Reminder Reset - Procedure 02</u>
Park Avenue	1998-05	<u>(1) TPMS Reminder Reset - Procedure 20</u>
Rainier	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Regal	1999-04	<u>(1) TPMS Reminder Reset - Procedure 21</u>
Â	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 26</u>
Regal TourX	2018	<u>TPMS Reminder Reset - Procedure 26</u>
Rendezvous	2003-07	<u>(1) TPMS Reminder Reset - Procedure 24</u>
Verano	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-17	<u>TPMS Reminder Reset - Procedure 25</u>
Cadillac		
ATS	2013-18	<u>TPMS Reminder Reset - Procedure 11</u>
CT6	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
CTS	2004-12	With RPO UH3: <u>TPMS Reminder Reset - Procedure 09</u>
		W/O RPO UH3: <u>TPMS Reminder Reset - Procedure 10</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 11</u>
Deville	2001-05	<u>TPMS Reminder Reset - Procedure 04</u>
DTS	2006-11	<u>TPMS Reminder Reset - Procedure 02</u>
ELR	2014-16	<u>TPMS Reminder Reset - Procedure 11</u>
Escalade Series	2004-06	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 11</u>
Seville	2001-04	<u>TPMS Reminder Reset - Procedure 04</u>

Model	Application	Procedure
SRX	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012-16	<u>TPMS Reminder Reset - Procedure 11</u>
STS	2005-11	<u>TPMS Reminder Reset - Procedure 03</u>
XLR	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
XT5	2017-18	<u>TPMS Reminder Reset - Procedure 11</u>
XTS	2013-18	<u>TPMS Reminder Reset - Procedure 11</u>
Chevrolet		
Avalanche	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Aveo / Wave	2008-11	⁽²⁾ <u>TPMS Reminder Reset - Procedure 07</u>
Bolt EV	2017-18	<u>TPMS Reminder Reset - Procedure 28</u>
Camaro	2010-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-15	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
Caprice	2011-13	<u>TPMS Reminder Reset - Procedure 31</u>
Â	2014-17	<u>TPMS Reminder Reset - Procedure 25</u>
Captiva Sport	2012-15	<u>TPMS Reminder Reset - Procedure 02</u>
City Express	2015-18	<u>TPMS Reminder Reset - Procedure 32</u>
Cobalt	2008-10	<u>TPMS Reminder Reset - Procedure 03</u>
Colorado	2006-12	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2015-18	Base DIC <u>TPMS Reminder Reset - Procedure 25</u> Uplevel DIC <u>TPMS Reminder Reset - Procedure 11</u>
Corvette	1987-96	⁽¹⁾ <u>TPMS Reminder Reset - Procedure 20</u>
Â	1997-04	<u>TPMS Reminder Reset - Procedure 06</u>
Â	2005-06	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2007-13	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 08</u>
Cruze	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	Base DIC <u>TPMS Reminder Reset - Procedure 25</u> Uplevel DIC <u>TPMS Reminder Reset - Procedure 11</u>
Cruze Limited	2016	<u>TPMS Reminder Reset - Procedure 25</u>
Equinox	2007	<u>TPMS Reminder Reset - Procedure 05</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 11</u>

Model	Application	Procedure
Â	2013-14	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 33</u>
Express Van	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 27</u>
HHR	2008-11	<u>TPMS Reminder Reset - Procedure 03</u>
Impala	2000-02	<u>(1) TPMS Reminder Reset - Procedure 13</u>
Â	2003-05	<u>(1) TPMS Reminder Reset - Procedure 14</u>
Â	2006-07	<u>TPMS Reminder Reset - Procedure 05</u>
Â	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 28</u>
Impala Limited	2014-16	<u>TPMS Reminder Reset - Procedure 09</u>
Malibu / Classic	2008-11	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 25</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 28</u>
Malibu Limited	2016	<u>TPMS Reminder Reset - Procedure 25</u>
Monte Carlo	2000-02	<u>(1) TPMS Reminder Reset - Procedure 13</u>
Â	2003-05	<u>(1) TPMS Reminder Reset - Procedure 14</u>
Â	2006-07	<u>TPMS Reminder Reset - Procedure 05</u>
Orlando (Canada)	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Silverado Series	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 27</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 26</u>
Sonic	2012	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Spark	2013-15	<u>TPMS Reminder Reset - Procedure 29</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 25</u>
Spark EV	2014-16	<u>TPMS Reminder Reset - Procedure 30</u>
SS	2014-17	<u>TPMS Reminder Reset - Procedure 25</u>
Suburban	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
Tahoe	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>

Model	Application	Procedure
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
TrailBlazer	2006-09	<u>TPMS Reminder Reset - Procedure 01</u>
Traverse	2009-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 09</u>
Trax	2013-18	<u>TPMS Reminder Reset - Procedure 25</u>
Uplander	2008	<u>TPMS Reminder Reset - Procedure 03</u>
Volt	2011-12	<u>TPMS Reminder Reset - Procedure 11</u>
Â	2013-15	<u>TPMS Reminder Reset - Procedure 30</u>
Â	2016-18	<u>TPMS Reminder Reset - Procedure 11</u>
GMC		
Acadia	2007-11	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-16	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2017-18	<u>TPMS Reminder Reset - Procedure 11</u>
Acadia Limited	2017	<u>TPMS Reminder Reset - Procedure 09</u>
Canyon	2006-12	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 34</u>
Envoy	2006-09	<u>TPMS Reminder Reset - Procedure 01</u>
Savana Series	2008-12	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2013-18	<u>TPMS Reminder Reset - Procedure 27</u>
Sierra Series	2006-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2014-18	<u>TPMS Reminder Reset - Procedure 26</u>
Terrain	2010-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012-18	<u>TPMS Reminder Reset - Procedure 12</u>
Yukon Series	2004-07	<u>TPMS Reminder Reset - Procedure 01</u>
Â	2008-11	<u>TPMS Reminder Reset - Procedure 02</u>
Â	2012	<u>TPMS Reminder Reset - Procedure 03</u>
Â	2013-14	<u>TPMS Reminder Reset - Procedure 09</u>
Â	2015-18	<u>TPMS Reminder Reset - Procedure 26</u>
Oldsmobile		
Alero	1999-00	<u>(1) TPMS Reminder Reset - Procedure 16</u>
Aurora	2001-03	<u>(1) TPMS Reminder Reset - Procedure 17</u>
Pontiac		
Aztek	2003-05	<u>(1) TPMS Reminder Reset - Procedure 23</u>
Bonneville	2000-05	<u>(1) TPMS Reminder Reset - Procedure 15</u>
G3	2009	<u>TPMS Reminder Reset - Procedure 02</u>

Model	Application	Procedure
G5	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
G6	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
G8	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Grand Am	1999-05	<u>(1) TPMS Reminder Reset - Procedure 18</u>
Grand Prix	2008	<u>TPMS Reminder Reset - Procedure 02</u>
Solstice	2008-10	<u>TPMS Reminder Reset - Procedure 02</u>
Torrent	2008-09	<u>TPMS Reminder Reset - Procedure 02</u>
Wave	2008	<u>TPMS Reminder Reset - Procedure 02</u>
Vibe	2005-10	<u>(1) TPMS Reminder Reset - Procedure 19</u>
(1) This is an Indirect TPM System. A tire sensor activation tool is not required for this procedure.		
(2) A tire sensor activation tool cannot be used for this procedure.		

TPMS REMINDER RESET - PROCEDURE 01

- NOTE:** When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensors.
- NOTE:** The DIC will display the "SERVICE TIRE MONITOR" message if one or more of the tire pressure sensors has malfunctioned or if all of the sensors have not been programmed successfully. If, after the relearn procedure, the warning indicators are still on, there is a problem in the TPM system.
- NOTE:** If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, see appropriate manufacturer service information.
- NOTE:** The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor.
- NOTE:** Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF. Apply parking brake.

NOTE: If Learn Mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.

3. To enable Learn Mode, turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.
7. Test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

TPMS REMINDER RESET - PROCEDURE 02

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the TPM system may not function properly:

- If one or more of the tire pressure sensors are missing or inoperable.
- A compact spare tire is used.

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.

NOTE: The relearn procedure must be completed within 15 minutes from when the vehicle is stationary after being driven at 20 mph (32 km/h), or greater, for 10 seconds.

NOTE: The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the RCDLR memory.
- If equipped, the DIC will display dashes instead of tire pressures.

- **DTC C0775 will be set.**

These conditions will now require the learn procedure to be repeated for the system to function properly.

Ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray

IMPORTANT: sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Turn ignition switch to ACC position. Apply parking brake.
2. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
3. To enable Learn Mode:
 - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. On vehicles with DIC, a TIRE LEARN message may be displayed. The left front turn signal will also be illuminated.
 - On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the TIRE LEARN message appears on the DIC display. Press and hold the SET/RESET button until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
4. Ignition ON.
5. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
6. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 03

NOTE: If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: In vehicles without the "UH3" option, each turn signal will illuminate one at a time indicating which location is to be learn.

NOTE: The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ACC position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.

NOTE: The left front turn signal will also illuminate to indicate the learn mode has been enabled.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 04

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are

erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.

NOTE: If the TPM Learn Mode cannot be enabled, ensure the TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.

NOTE: If a horn chirp does not sound after 15 seconds, remove, then re-apply TPM sensor relearn magnet.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 05

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

NOTE: Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 06

NOTE: If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.

NOTE: When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.

NOTE: The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Press RESET button on DIC in order to clear any warning messages.
4. Press and release OPTIONS button until display is blank.
5. Press and hold RESET button for 3 seconds.

NOTE: If the DIC does not display "TIRE TRAINING" message, ensure TPM option is enabled in the RCDLR. See appropriate manufacturer service information.

6. Press and release OPTIONS button until "TIRE TRAINING" is displayed.
7. Press and release RESET button. The DIC should display "LEARN L FRONT TIRE", verifying Learn Mode has been enabled.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.

9. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
10. Turn the ignition switch to OFF position to exit the learn mode.

TPMS REMINDER RESET - PROCEDURE 07

- NOTE:** An OEM scan tool or Pressure Increase/Decrease Method is used to perform this procedure.
- NOTE:** Before proceeding with this process, ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a scan tool, initiate the TPM Learn Mode.
3. Perform the procedure by following the menu selections. A double horn chirp will sound and the IPC tire pressure monitor indicator warning lamp icon will flash indicating Learn Mode is enabled.
4. Starting with the left front tire, active the sensors by one of the following methods:
 - Hold the antenna of the scan tool, aimed upward, against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned.
 - Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached. Once the horn chirp has sounded, the sensor information has been learned.
5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the left rear sensor is learned, a double horn chirp will sound indicating all sensor IDs have been learned and the tire pressure module will exit the Learn mode turning OFF the IPC tire pressure monitor warning indicator lamp icon.
7. Ignition OFF, adjust all tires to the recommended pressures. Refer to the tire placard label.

TPMS REMINDER RESET - PROCEDURE 08

Automatic Sensor Learn Process

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. When a tire is installed, the vehicle must be stationary for about 20 minutes before the system recalculates. The following

relearn process takes up to 10 minutes, driving at a minimum speed of 12 mph (19 km/h). A dash (-) or pressure value will display in the DIC. A warning message displays in the DIC if a problem occurs during the relearn process.

TPMS REMINDER RESET - PROCEDURE 09

- NOTE:** For Cadillac CTS with RPO UH3, use this procedure. For CTS without RPO UH3, see Procedure 10.
- NOTE:** If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.
- NOTE:** When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.
- NOTE:** The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.
- NOTE:** Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to RUN position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled. On some models, a TIRE LEARNING ACTIVE message may also be displayed on the DIC screen.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 10

- NOTE:** For Cadillac CTS without RPO UH3, use this procedure. For CTS with RPO UH3, see Procedure 9.

- NOTE:** If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.
- NOTE:** When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.
- NOTE:** The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the ignition switch is turned to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.
- NOTE:** Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Depending on ignition type:
 - With standard ignition switch, place the switch in the RUN position.
 - With electronic keyless ignition, place the switch in the ACC position.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 11

NOTE: This procedure is for vehicles with an Uplevel DIC.

When a low tire pressure condition is detected, the TPMS illuminates the low tire pressure warning light on the instrument cluster. A message to check the pressure in a specific tire displays in the Driver Information Center (DIC). The low tire pressure warning light and the DIC warning message come on at each ignition cycle until the tires are inflated to the correct inflation pressure. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go

off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Place the vehicle power mode in ON/RUN/START.
4. Make sure the Tire Pressure info display option is turned on. The info displays on the DIC can be turned on and off through the Settings menu.
5. Use the five-way DIC control on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SEL button located in the center of the five-way DIC control. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Press STOP to turn the ignition off.

TPMS REMINDER RESET - PROCEDURE 12

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Use the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC). Use the arrow keys to scroll to the Tire Pressure screen
5. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
6. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.

8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition to LOCK/OFF.

TPMS REMINDER RESET - PROCEDURE 13

LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or when vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. There are 2 ways to reset the tire inflation monitor. To reset the tire inflation monitor using the exterior or interior lamp controls, go to step 4. To reset tire inflation monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine OFF. Press and hold the TUNE DISP button on the radio for at least 5 seconds until settings is displayed.
2. To scroll through the main menu:
 - On Impala, press the SEEK PTYPE up or down arrow.
 - On Monte Carlo, press the SEEK PSCAN up or down arrow.On all models, scroll until TIRE MON appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. Reset the tire inflation monitor:
 - On Impala, using the interior lighting controls, turn the switch from OFF to ON position 3 times with ignition switch in ON position.
 - On Monte Carlo, using the exterior lighting controls, turn the switch from OFF to parking lamps 3 times with ignition switch in ON position.

TPMS REMINDER RESET - PROCEDURE 14

NOTE: There are 3 different ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.

Using Exterior Lamp Switch

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Cycle the exterior lamp switch from OFF to parking lamps 3 times within 5 seconds.
4. Use the scan tool in order to clear the TPM DTC.

Using RDS Radio, If Equipped

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn the ignition to ACC or ON, with the engine OFF.
3. Turn the radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed.
5. Press the SEEK up or down arrows until TIRE MON is displayed.
6. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
7. Press the DISP button, A chime will sound and DONE will be displayed.
8. Scroll until EXIT is displayed.
9. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit.
10. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.
3. Turn ignition ON with engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. Use the scan tool in order to clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 15

CHECK TIRE PRESSURE or TIRE PRESS message will come on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

NOTE: If vehicle is equipped with Systems Monitor, go to step 2.

1. To recalibrate vehicle equipped with Driver Information Center (DIC), turn ignition ON with engine OFF. Using the MODE and SELECT button on DIC, change display until TIRE PRESSURE appears. Press and hold RESET button for 5 seconds. TIRE PRESSURE RESET should now appear on display. If TIRE PRESSURE RESET does not appear on display after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.
2. To recalibrate vehicle equipped with Systems Monitor, turn ignition ON with engine OFF. Press and hold TIRE PRESS RESET button for 5 seconds. TIRE PRESS light on the Systems Monitor should begin to flash. Release the TIRE PRESS RESET button. TIRE PRESS light should go out and system is now reset. If TIRE PRESS light does not begin to flash after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

TPMS REMINDER RESET - PROCEDURE 16

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting

system.

1. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 17

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

NOTE: When the low tire pressure warning messages appear, immediately check air pressure of all tires and adjust to the specified pressure. If warning messages are still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.
- Only one tire is replaced with a new tire during service.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.
- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press SELECT right arrow button until "GAGE" is displayed.
5. Press SELECT down arrow button until "TIRE PRESSURE" is displayed.
6. Press and hold RESET button until "TIRE PRESSURE RESET" is displayed.
7. Release RESET button. DIC should display "TIRE PRESSURE NORMAL".
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select "SPECIAL FUNCTIONS".
5. Select "TIRE PRESSURE RESET".
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 18

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 mph, 40-70 mph and 70-90 mph.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 19

NOTE: After resetting, the tire pressure monitoring (TPM) system requires 60 minutes or more of driving at a speed of 30 km/h (19 mph) or above to complete the calibration process to have full capability for detecting a tire pressure condition.

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Press and hold the tire pressure warning reset switch until the tire pressure warning indicator blinks 3 times at one second intervals.
4. If the tire pressure warning indicator does not blink, repeat the procedure starting at step 2.
5. Drive the vehicle for 60 minutes or more at a speed of 30 km/h (19 mph).
6. Verify the system has initialized. Turn ignition ON with engine OFF and observe the tire pressure warning indicator.
 - System Initialized: light on for 3 seconds.
 - System not initialized: light on for 4 seconds.

TPMS REMINDER RESET - PROCEDURE 20

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure

has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

NOTE: When the tire pressure warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning message is still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.

NOTE: Under the following conditions, the system may not function properly:

- More than one tire is low.
- Vehicle is moving faster than 65 mph (105 km/h).
- The system is not yet calibrated.
- Tire treadwear is uneven.
- Compact spare tire is installed.
- Tire chains are being used.
- Vehicle is being driven on a rough or frozen road.
- If ABS warning light is on.

NOTE: There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:

- *Using DIC Reset Button* (if no scan tool is available)
- *Using Scan Tool* (if an OBD-II compatible scan tool is available).

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold appropriate button (located on left side of steering column) until "TIRE PRESSURE" message appears on display:
 - 1997-99 models: Press and hold GAGES button
 - 2000-05 models: Press and hold GAGES INFO button
5. Press and hold RESET button for 5 seconds. After 5 seconds, "TIRE PRESSURE RESET" message should appear on display.
6. Release RESET button. A "TIRE PRESSURE NORMAL" message should appear on display.
7. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).

- 40-70 mph (64-113 km/h).
- 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select SPECIAL FUNCTIONS.
5. Select TIM RESET.
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
 - 15-40 mph (24-64 km/h).
 - 40-70 mph (64-113 km/h).
 - 70-90 mph (113-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 21

Using Reset Button (1999-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
3. The LOW TIRE indicator will flash 3 times, then turn off.
4. Use scan tool to clear the TPM DTC.

Using Scan Tool (2003-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Install scan tool. Turn ignition ON with engine OFF.
3. With scan tool, select Special Functions.
4. Select TIM Reset.
5. Press Reset soft key.
6. LOW TIRE indicator will flash 3 times, then turn OFF.
7. Clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 22

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button chime sounds and "TIRE PRESSURE RESET" is displayed and a chime sounds 3 times.
6. Release SET button and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure. If it does not work after two tries, refer to appropriate service information.

7. After resetting, the TPM system requires up to 5 miles of driving in each of the following speed ranges to complete the calibration process:
 - 25-40 mph (40-64 km/h).
 - 40-60 mph (65-96 km/h).
 - 60-85 mph (96-136 km/h).

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 23

1. Check and adjust air pressure in all 4 tires before resetting system. Refer to tire placard located on the

inside edge of the driver's door. Turn ignition ON, with engine OFF.

2. Press the MODE button on the Driver Information System until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
3. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.
4. Release the SET button and TIRE PRESSURE NORMAL will be displayed.

TPMS REMINDER RESET - PROCEDURE 24

NOTE: When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.

CAUTION: DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button until a chime sounds and "TIRE PRESSURE RESET" is displayed.
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

NOTE: If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure.

7. After resetting, the TPM system requires up to 5 miles (8 km) of flat, smooth road, straight line driving in each of the 4 speed ranges (about 10-20 minutes in each range) to complete the calibration process:
 - 19-40 mph (31-65 km/h).
 - 40-59 mph (65-95 km/h).
 - 59-74.5 mph (95-120 km/h).
 - 74.5-90 mph (120-145 km/h).

NOTE: The EBCM learns tire pressure calibration for each speed range independently. In Calibration Mode, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Detection Mode, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.

NOTE: Learning process does not need to be completed during a single trip.

TPMS REMINDER RESET - PROCEDURE 25

NOTE: **This procedure is for vehicles with a Base DIC.**

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions using a TPMS relearn tool. There are two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See [Fig. 7](#).
4. Use the MENU button to select the VEHICLE INFORMATION MENU in the Driver Information Center (DIC). See [Fig. 8](#).
5. Use the thumbwheel (or up and down arrows) to scroll to the TIRE PRESSURE MENU item screen.
6. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

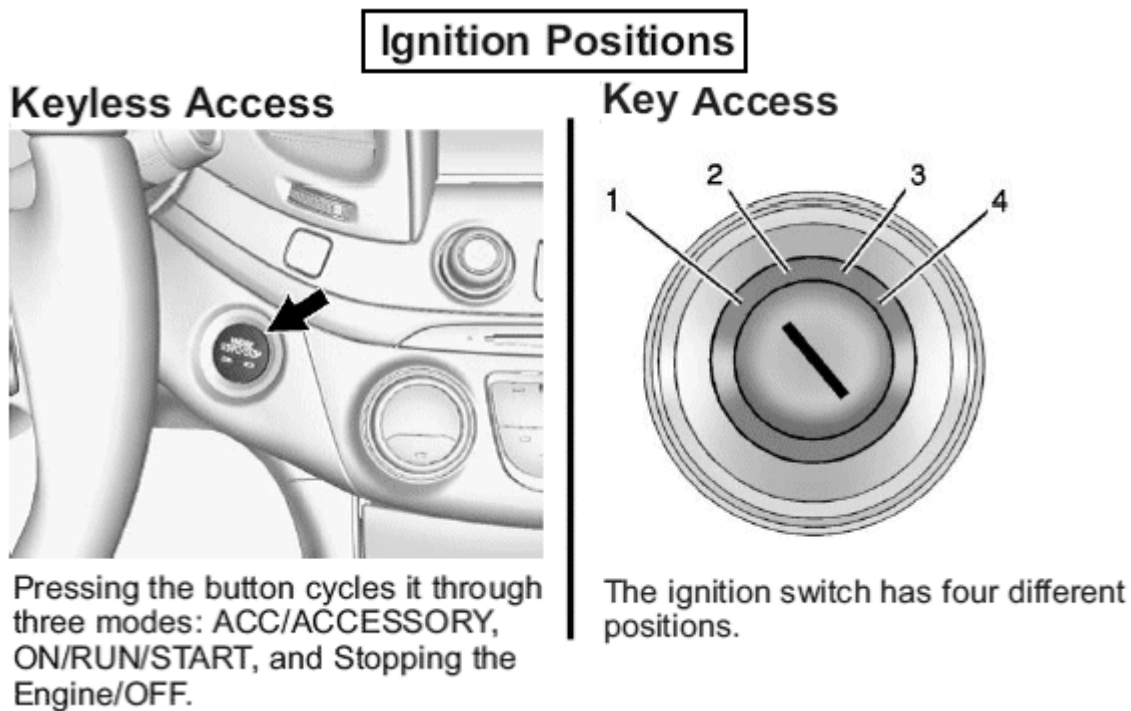


Fig. 7: Ignition Positions (Key & Keyless)
 Courtesy of GENERAL MOTORS CORP.

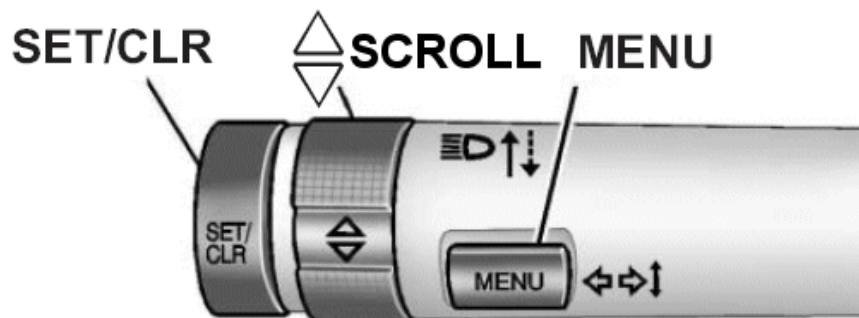


Fig. 8: Identifying DIC Controls (Turn Signal Lever)
 Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 26

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.

4. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
5.
 - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
 - **Base-Level DIC** : Use the TRIP ODOMETER RESET stem to scroll to the TIRE PRESSURE screen.
6.
 - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
 - **Base-Level DIC** : Press and hold the TRIP ODOMETER RESET stem for about five seconds. A message asking if the process should begin should appear. Select YES and press the TRIP ODOMETER RESET stem to confirm the selection.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 27

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ON/RUN position, with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled. The TIRE LEARNING ACTIVE message displays on the DIC screen.

NOTE: If the vehicle does not have RKE, press the Driver Information Center (DIC) vehicle information button until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen. If the vehicle does not have RKE or DIC buttons, press the trip odometer reset stem on the instrument cluster until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS

message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 28

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See [Fig. 7](#).
4. Make sure the Tire Pressure info page option is turned on. The info pages on the Driver Information Center (DIC) can be turned on and off through the Settings menu.
5. Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SET/RESET button (check mark symbol) located in the center of the DIC controls.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 29

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (right-hand side of instrument cluster) once on the Driver Information Center (DIC).
5. Press the up or down arrow button until the Tire Learn screen is displayed.
6. Press and hold the SET/CLR button to begin the sensor matching process.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 30

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Put the vehicle in ON/ RUN and place the vehicle in P (Park).
4. If the Driver Information Center (DIC) display is minimized, press the SELECT knob to maximize it. See [Fig. 9](#).
5. Use the SELECT knob to scroll to the Tire Pressure display screen.
6. Press and hold the SELECT knob for five seconds to begin the sensor matching process. A message displays confirming to begin the process.
7. Use the SELECT knob to select YES with the highlighted selection, and press the SELECT knob again to confirm the selection.

8. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
9. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
10. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
11. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

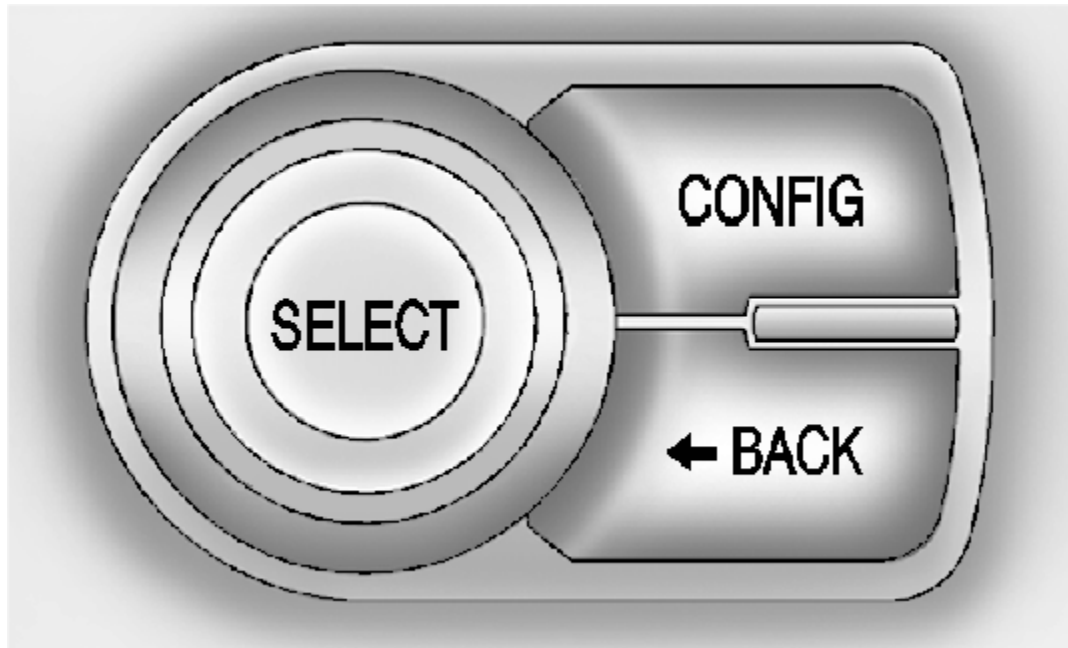


Fig. 9: Identifying DIC Controls (Spark EV)

Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 31

NOTE: You have two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Enter the learn sequence from the TPM Learn screen, located under the Customization Menu in the instrument panel cluster. Press SRCE button until you see Customize Options and then press ENTER (left pointing arrow). Move the thumbwheel up or down to scroll through the available options. Press ENTER to select an item. To exit the current menu, or go back, use the thumbwheel to select BACK (left arrow) at the top of the screen and then press ENTER.
5. Start with the driver side front tire. The driver side front indicator lamp also comes on to indicate that corner's sensor is ready to be learned. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor

identification code has been matched to this tire and wheel position

6. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After the driver side rear TPMS sensor has been learned the horn chirps two times. The driver side rear indicator lamp turns off and the TPMS sensor matching process is done. Turn the ignition switch to LOCK/OFF.

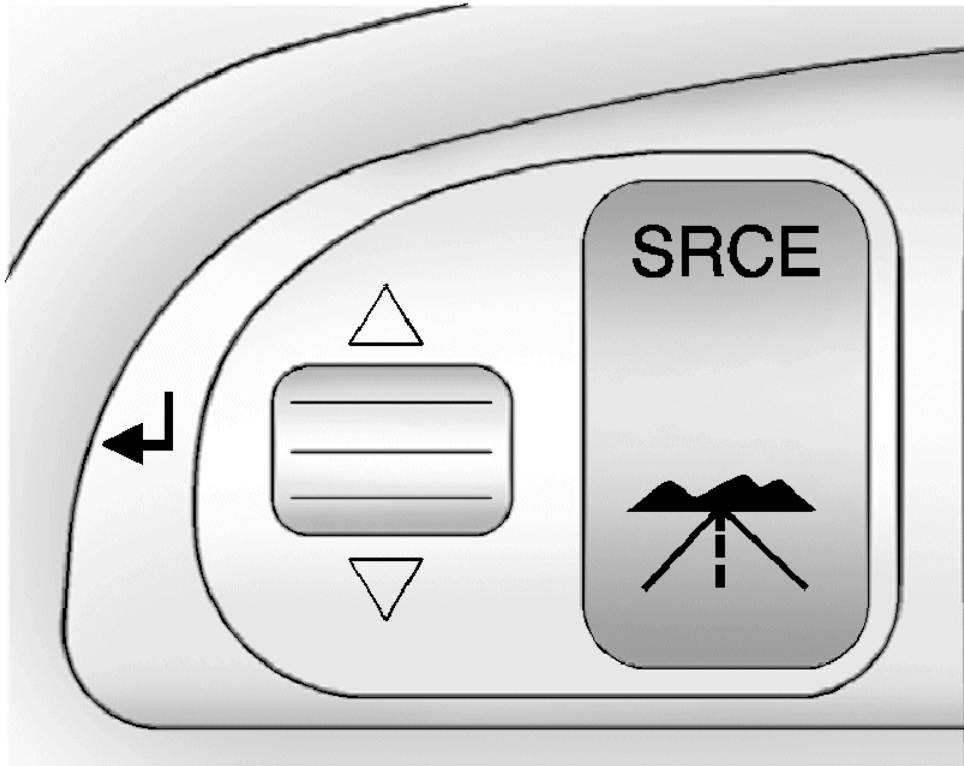


Fig. 10: Identifying DIC Controls

Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 32

NOTE: An OEM or generic TPMS sensor activation tool is used to perform this procedure.

NOTE: The sensor learn procedure must be performed after every tire rotation, tire pressure indicator module replacement, or sensor replacement. Make sure the TPM sensor activation tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. The low tire pressure warning light will start to flash to indicate the learn mode has been enabled. The front and back turn signals will flash twice when a sensor has been learned.

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a sensor activation tool, initiate the TPM Learn Mode.

3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure sensor activation tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for the front and back turn signals to flash twice. If the front and back turn signals do not flash, repeat the sensor activation sequence with the tool. Once the front and back turn signals have flashed twice, the sensor information is learned.

NOTE: Follow the sensor order listed here since there is no visual indicator on the vehicle for the sensor learn order.

4. After the front and back turn signals have flashed twice, repeat step 2 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
5. When the left rear sensor has been learned, the front and back turn signals will flash twice, the learn process is complete and the tire pressure indicator module exits the Learn mode.

TPMS REMINDER RESET - PROCEDURE 33

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC).
5. Use the arrow keys to scroll to the Tire Pressure screen.
6. Press the SET/CLR button to begin the sensor matching process. A message should display requesting acceptance of the process.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 34

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS

receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn the ignition to ON/RUN with the engine OFF. Set the parking brake.
3. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
4.
 - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
 - **Base-Level DIC** : Use the MENU button to select the Vehicle Information menu in the DIC. Use the thumbwheel to scroll to the Tire Pressure Menu item screen. See [Fig. 8](#).
5.
 - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
 - **Base-Level DIC** : Press the SET/CLR button to begin the sensor matching process. A message asking if the process should begin should appear. Press the SET/CLR button again to confirm the selection.
6. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
8. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition switch to LOCK/OFF.
11. Set all four tires to the recommended air pressure level as indicated on the Tire and Loading Information label.

Article GUID: A00161620

RESTRAINTS

Seat Belts - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Front Seat Belt Buckle Fastener	45 N.m (33 lb ft)
Rear Center Seat Belt Retractor Fastener	45 N.m (33 lb ft)
Rear Seat Belt Anchor Bolt	45 N.m (33 lb ft)
Rear Seat Belt Buckle Nut	45 N.m (33 lb ft)
Rear Seat Belt Retractor Bolt	45 N.m (33 lb ft)

SCHEMATIC WIRING DIAGRAMS

SEAT BELT WIRING SCHEMATICS

Seat Belts

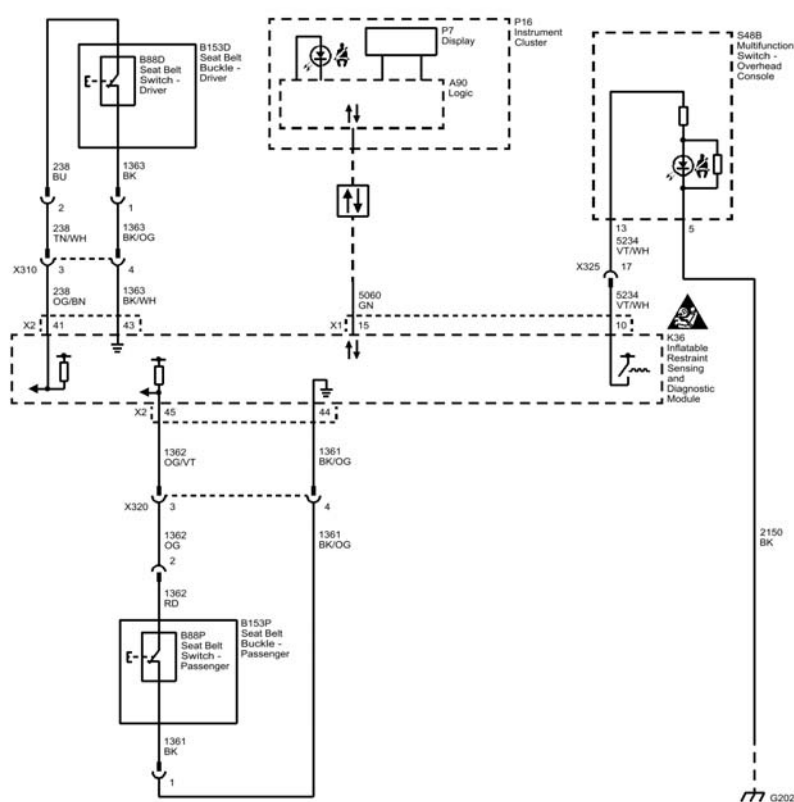


Fig. 1: Seat Belts

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SEAT BELT SYSTEM OPERATIONAL AND FUNCTIONAL CHECKS

NOTE: If the vehicle has been in a collision, refer to [Repairs and Inspections Required After a Collision](#) for additional information.

Perform the following inspection from the driver seat:

1. Turn the ignition switch to the ON position. Verify proper operation of the seat belt reminder lamp with the belt buckled and with the belt unbuckled.
2. Inspect the shoulder belt guide in order to ensure that the following conditions are met:
 - The shoulder belt guide swivels freely.
 - The seat belt webbing is seated flat in the guide slot.
 - The seat belt webbing does not bind.
3. Verify that the seat belt buckle faces inboard and is accessible.
4. Verify that the seat belt retractor units are securely attached.
5. Verify that the seat belt anchor bolts are secure.
6. Fully extend the seat belt webbing. Verify that the seat belt webbing does not have any twists or tears.

7. Allow the seat belt webbing to retract. Verify that the seat belt webbing returns freely and completely back into the retractor. If the seat belt webbing will not retract, refer to [Seat Belt Does Not Retract](#).
8. Snap the seat belt latch plate into the buckle.
9. Sharply tug on the seat belt latch plate and the buckle. Verify that the seat belt latch plate and the buckle remain locked when tugged.
10. Push the button on the buckle:
 - Verify that the seat belt latch plate releases easily from the buckle.
 - Verify that the button returns to its original position.

Perform the following inspection procedure from the passenger seat.

1. Verify the automatic locking retractor (ALR) feature operates properly by performing the following checks:
 1. Pull the seat belt all the way out of the retractor until it stops.
 2. Slowly allow the belt to retract partially, while listening for a ratcheting sound.
 3. Sharply tug on the belt ensuring that the retractor lock sets and does not allow the belt to be pulled from the retractor.
 4. After performing steps 1.1 through 1.3 ensure the belt fully retracts.
2. Repeat the inspection procedure steps 2 through 10 from the passengers seat.

Perform the following steps in order to inspect the left and right rear seat belts:

1. Inspect the shoulder belt guide in order to ensure that the following conditions are met:
 - The seat belt webbing is seated flat in the guide slot.
 - The seat belt webbing does not bind.
2. Verify that the seat belt buckle is accessible.
3. Verify that the seat belt retractor units are securely attached.
4. Verify that the seat belt anchor bolts are secure.
5. Fully extend the seat belt webbing. Verify that the seat belt webbing does not have any twists or tears.
6. Allow the seat belt webbing to retract. Verify that the seat belt webbing returns freely and completely back into the retractor.
7. Snap the seat belt latch plate into the buckle.
8. Sharply tug on the seat belt latch plate and the buckle. Verify that the seat belt latch plate and the buckle remain locked when tugged.
9. Push the button on the buckle:
 - Verify that the seat belt latch plate releases easily from the buckle.
 - Verify that the button returns to its original position.

Emergency Locking Retractors

WARNING: Perform this test in an area clear of other vehicles or obstructions. Do not conduct this test on the open road. A large, empty parking lot is suitable. Failure to observe this precaution may result in damage to the vehicle and

possible personal injury.

1. Fasten the seat belts, an assistant is needed when the retractor under test is not part of the driver seat belt.
2. Accelerate the vehicle slowly to 16 km/h (10 mph) and apply the brakes firmly.
3. Verify that the seat belt locks when braking firmly.

NOTE: When performing this check, note the position that the retractors are mounted. Some retractors are not mounted at a zero degree inclination.

4. If the belt does not lock, proceed with the following steps:
 1. Remove the seat belt retractor assembly.
 2. Tilt the seat belt retractor slowly.

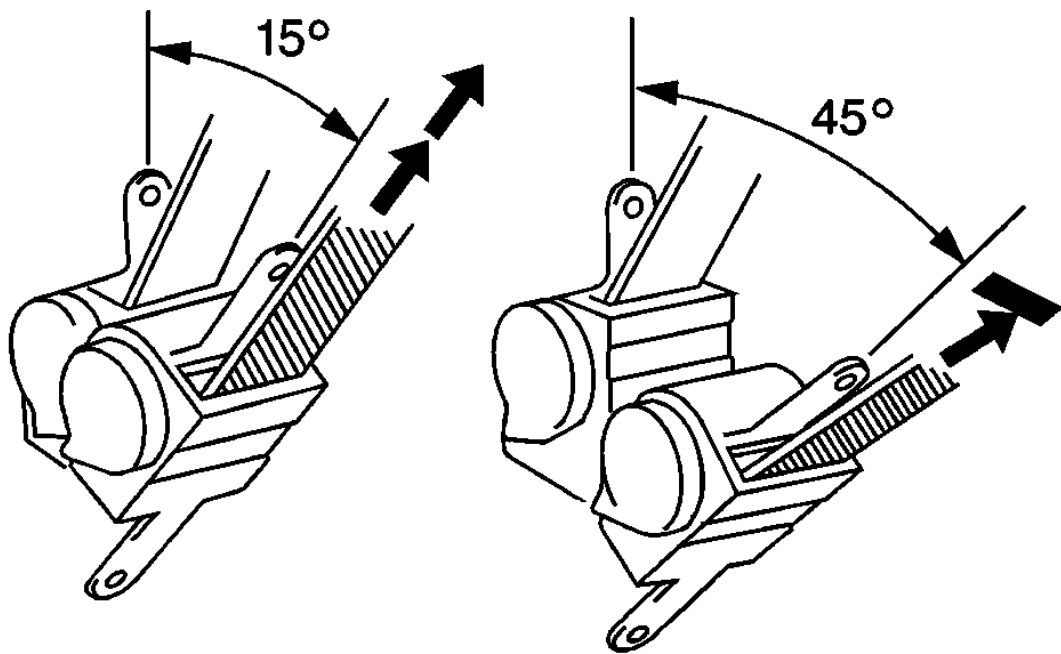


Fig. 2: Checking Seat Belt Retractor Inclination
Courtesy of GENERAL MOTORS COMPANY

3. Ensure that the seat belt webbing can be pulled from the retractor at an inclination of 15 degrees forward or less, from the retractors mounted position.

4. Ensure the retractor cannot be pulled from the retractor at an inclination of 45 degrees forward or more.
5. If a seat belt retractor does not operate as described, replace the retractor assembly.

DTC B0072 OR B0073: DRIVER/PASSENGER SEAT BELT SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category

DTC Descriptors

DTC B0072

Driver Seat Belt Switch

DTC B0073

Passenger Seat Belt Switch

For symptom byte information refer to [Symptom Byte List](#) .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Sensor Control	B0072 02, B0072 0B	B0072 04, B0072 06, B0072 0C	B0072 04, B0072 06	B0072 01, B0072 05	B0072 08
Passenger Seat Belt Sensor Control	B0073 02, B0073 0B	B0073 04, B0073 06, B0073 0C	B0073 04, B0073 06	B0073 01, B0073 05	B0073 08

Circuit/System Description

The inflatable restraint seat belt buckle switch is within the seat belt buckle and provides an input to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The Inflatable Restraint Sensing and Diagnostic Module supplies a low reference circuit and a seat belt switch signal circuit to determine a buckled or unbuckled condition. The Inflatable Restraint Sensing and Diagnostic Module monitors the seat belt switch circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0072 01 or B0073 01

The seat belt switch circuit is shorted to voltage.

B0072 02 or B0073 02

The seat belt switch circuit is shorted to ground.

B0072 04 or B0073 03

The seat belt switch circuit is open.

B0072 05 or B0073 05

The seat belt switch circuit is shorted to voltage or open.

B0072 06 or B0073 06

The seat belt switch circuit is shorted to ground or open.

B0072 08 or B0073 08

The seat belt switch signal is invalid.

B0072 0B or B0073 0B

The seat belt switch signal is above threshold.

B0072 0C or B0073 0C

The seat belt switch signal is below threshold.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module will store a DTC and illuminate the Air Bag indicator in the instrument cluster.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the appropriate scan tool Seat Belt Status parameter changes between Buckled and Unbuckled when the seat belt is buckled and unbuckled.
 - **If the parameter does not change**

Refer to Circuit/System Testing.
 - **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153D Seat Belt Buckle-Driver**
- **B153P Seat Belt Buckle-Passenger**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Vehicle OFF, disconnect the harness connector at the appropriate B153 Seat Belt Buckle.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 Ω**
3. Vehicle ON.
4. Verify the appropriate scan tool Seat Belt Status parameter is Buckled.
 - **If not Buckled**

1. Vehicle OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
6. Verify the appropriate scan tool Seat Belt Status parameter is Unbuckled.
 - **If not Unbuckled**
 1. Vehicle OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, Vehicle ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If Unbuckled**
7. Test or replace the B153 Seat Belt Buckle.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B153 Seat Belt Buckle.
2. Test for infinite resistance between the signal terminal 2 and the low reference terminal 1.
 - **If less than infinite resistance**

Replace the B153 Seat Belt Buckle.
 - **If infinite resistance**
3. Insert the seat belt into the buckle.
4. Test for less than 5 Ω between the signal terminal 2 and the low reference terminal 1.
 - **If 5 Ω or greater**

Replace the B153 Seat Belt Buckle.
 - **If less than 5 Ω**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Front Seat Belt Buckle Replacement**

- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for Inflatable Restraint Sensing and Diagnostic Module replacement, setup, and programming

DTC B059A: PASSENGER SEAT BELT INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category

DTC Descriptors

DTC B059A 01

Passenger Seat Belt Indicator Circuit Short to Battery

DTC B059A 02

Passenger Seat Belt Indicator Circuit Short to Ground

DTC B059A 04

Passenger Seat Belt Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Indicator Control	B059A 02	B059A 04	B059A 01	-

Circuit/System Description

The Inflatable Restraint Sensing and Diagnostic Module (SDM) monitors the passenger seat status and the passenger seat belt buckle switch and provides an output to the passenger seat belt indicator. When the Inflatable Restraint Sensing and Diagnostic Module detects the passenger seat is occupied and the seat belt is not fastened, the Inflatable Restraint Sensing and Diagnostic Module supplies a pulse width modulated signal to control the passenger seat belt indicator circuit. The Inflatable Restraint Sensing and Diagnostic Module monitors the passenger seat belt indicator circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B059A 01

The passenger seat belt indicator circuit is shorted to voltage.

B059A 02

The passenger seat belt indicator circuit is shorted to ground.

B059A 04

The passenger seat belt indicator circuit is open.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module will store the DTC.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **S48B Multifunction Switch - Overhead Console.**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Ignition OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console.

2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 13 and ground, ignition ON.
4. Verify the test lamp turns OFF and ON when the passenger seat belt is buckled and unbuckled with occupant in seat.
 - **If the test lamp is always on**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1V or greater, repair the short to voltage on the circuit.
 - If less than 1V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the test lamp is always off**
 1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the seat belt switch signal circuit terminal 45 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If test lamp turns on and off while changing between the commanded states**
5. Test or replace the S48B Multifunction Switch - Overhead Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Roof Console Replacement](#) for S48B Multifunction Switch - Overhead Console Replacement
- [Control Module References](#) for Inflatable Restraint Sensing and Diagnostic Module replacement, programming, and setup

SYMPTOMS - SEAT BELTS

NOTE: Review the seat belt system description and operation in order to familiarize yourself with the system and how it functions. Refer to [Seat Belt System Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the seat belt system. Refer to [Checking Aftermarket Accessories](#) .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to the following symptom diagnostic procedure in order to diagnose the symptom:

- [Seat Belt Indicator Malfunction - Driver](#)
- [Seat Belt Indicator Malfunction - Passenger](#)
- [Seat Belt Indicator Malfunction - Rear](#)

SEAT BELT DOES NOT RETRACT

1. Grab the seat belt webbing and slowly and firmly extract 15 - 25 mm (5/8 - 1 in) of webbing from the seat belt.
2. Release the seat belt and allow the webbing to slowly retract back into the retractor.
3. Check to see if the seat belt is released. If the seat belt is not released, repeat steps 1 and 2, two times more.
4. If the retractor does not release after repeating the steps, replace with a new retractor.

SEAT BELT INDICATOR MALFUNCTION - DRIVER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Switch Signal	1	2	2	2	-
Driver Seat Belt Switch Low Reference	-	2	2	2	-
1. Indicator will remain ON with seat belt buckled. 2. Indicator will illuminate only for the bulb check.					

Circuit/System Description

The driver seat belt switch is a 2-wire switch wired to the Inflatable Restraint Sensing and Diagnostic Module (SDM) using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed,

and when the seat belt is buckled the switch is open. The SDM sends the status of the driver seat belt via serial data to the instrument panel cluster. After receiving the message, the instrument panel cluster controls the illumination of the driver seat belt indicator.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Command the instrument cluster all indicators ON and OFF with a scan tool. The driver seat belt indicator should turn ON and OFF as commanded.
 - **If the driver seat belt indicator does not turn ON and OFF as commanded**

Replace the P16 Instrument Cluster.
 - **If the driver seat belt indicator does turn ON and OFF as commanded**
2. Monitor the scan tool Driver Seat Belt Switch parameter while buckling and unbuckling the seat belt. The parameter should display Buckled and Unbuckled when changing seat belt states.
 - **If the scan tool Driver Seat Belt Switch parameter does not display Buckled and Unbuckled when changing seat belt states**

Refer to Circuit/System Testing.
 - **If the scan tool Driver Seat Belt Switch parameter does display Buckled and Unbuckled when changing seat belt states**
3. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153D Seat Belt Buckle - Driver**
- **Seat belt switch harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

1. Vehicle OFF.
2. Disconnect the harness connector at the B153D Seat Belt Buckle - Driver.
3. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 Ω**
4. Vehicle in Service Mode.
5. Verify the scan tool Driver Seat Belt Status parameter displays Buckled.
 - **If the scan tool Driver Seat Belt Status parameter does not display Buckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the seat belt switch signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the scan tool Driver Seat Belt Status parameter does display Buckled**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
7. Verify the scan tool Driver Seat Belt Status parameter displays Unbuckled.
 - **If the scan tool Driver Seat Belt Status parameter does not display Unbuckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Vehicle in Service Mode.
 3. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 4. Test for less than 2 Ω in each circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the scan tool Driver Seat Belt Status parameter does display Unbuckled**

8. Replace the B153D Seat Belt Buckle - Driver.

Component Testing

1. Vehicle OFF.
2. Disconnect the harness connector at the B153D Seat Belt Buckle - Driver, buckle the driver seat belt.
3. Test for infinite resistance between the signal circuit terminal 1 and the ground terminal 2 at the B153D Seat Belt Buckle - Driver.

- **If there is not infinite resistance**

Replace the B153D Seat Belt Buckle - Driver.

- **If there is infinite resistance**

4. Unbuckle the driver seat belt.
5. Test for less than 1 Ω between the signal circuit terminal 1 and the ground terminal 2 at the B153D Seat Belt Buckle - Driver.

- **If 1 Ω or greater**

Replace the B153D Seat Belt Buckle - Driver.

- **If less than 1 Ω**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Front Seat Belt Buckle Replacement
- Control Module References for Inflatable Restraint Sensing and Diagnostic Module and Instrument Cluster replacement, programming and setup

SEAT BELT INDICATOR MALFUNCTION - PASSENGER

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category

DTC Descriptors

DTC B059A 01

Passenger Seat Belt Indicator Circuit Short to Battery

DTC B059A 02

Passenger Seat Belt Indicator Circuit Short to Ground

DTC B059A 04

Passenger Seat Belt Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Indicator Control	B059A 02	B059A 04	B059A 01	-

Circuit/System Description

The Inflatable Restraint Sensing and Diagnostic Module (SDM) monitors the passenger seat status and the passenger seat belt buckle switch and provides an output to the passenger seat belt indicator. When the Inflatable Restraint Sensing and Diagnostic Module detects the passenger seat is occupied and the seat belt is not fastened, the Inflatable Restraint Sensing and Diagnostic Module supplies a pulse width modulated signal to control the passenger seat belt indicator circuit. The Inflatable Restraint Sensing and Diagnostic Module monitors the passenger seat belt indicator circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B059A 01

The passenger seat belt indicator circuit is shorted to voltage.

B059A 02

The passenger seat belt indicator circuit is shorted to ground.

B059A 04

The passenger seat belt indicator circuit is open.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module will store the DTC.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **S48B Multifunction Switch - Overhead Console.**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Ignition OFF, disconnect the harness connector at the S48B Multifunction Switch - Overhead Console.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.
2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 13 and ground, ignition ON.
4. Verify the test lamp turns OFF and ON when the passenger seat belt is buckled and unbuckled with occupant in seat.

- **If the test lamp is always on**

1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If the test lamp is always off**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
2. Test for infinite resistance between the seat belt switch signal circuit terminal 45 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If test lamp turns on and off while changing between the commanded states**
5. Test or replace the S48B Multifunction Switch - Overhead Console.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Roof Console Replacement](#) for S48B Multifunction Switch - Overhead Console Replacement
- [Control Module References](#) for Inflatable Restraint Sensing and Diagnostic Module replacement, programming, and setup

SEAT BELT INDICATOR MALFUNCTION - REAR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Rear Seat Belt Switch Signal	1	2	2	2	-
Rear Seat Belt Switch Low Reference	-	2	2	2	-
1. Green indicator will illuminate only for the bulb check. The red indicator will remain ON with seat belt buckled.					
2. Green indicator will illuminate only for the bulb check. The red indicator will never illuminate.					

Circuit/System Description

The two rear seat belt switches are 2-wire switch wired to the Inflatable Restraint Sensing and Diagnostic Module using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed, and when the seat belt is buckled the switch is open. The Inflatable Restraint Sensing and Diagnostic Module sends the status of the rear seat belt via serial data to the driver information center (DIC). After receiving the message, the driver information center controls the illumination of the rear seat belt indicators.

Second row seating positions monitored for safety belt use are represented by a colored symbol on the

instrument cluster indicating safety belt status.

When the vehicle is started, two safety belt symbols come on and stay on for several seconds to alert the driver that passengers may need to fasten their safety belts. After the passenger safety belt is buckled, the corresponding safety belt symbol in the instrument cluster turns green. If a safety belt is not initially buckled, the instrument cluster displays a gray safety belt symbol.

While the vehicle is moving, if a second row passenger who was previously buckled becomes unbuckled, the corresponding safety belt symbol will change to flashing red for several seconds and a chime may sound.

Diagnostic Aids

- The mechanical stop in the buckle may prevent latching but the switch in the buckle may momentarily open and the Inflatable Restraint Sensing and Diagnostic Module would interpret this as an occupant in the rear seat position and that the buckle was attempting to latch.
- If a rear occupant attempts to latch the seat belt into the wrong buckle, the indicator may illuminate and the system assumes there is an occupant not buckled in that seat position.
- An unseated connector can appear as a buckled seat belt connection.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all connectors are fully seated.
2. With a scan tool, monitor the appropriate 2nd Row Seat Belt Status parameter and P16 Instrument Cluster rear seat belt indicator while buckling and unbuckling the seat belt. The parameter should display Buckled when the rear seat belt is buckled and Unbuckled when the rear seat belt is unbuckled.

- If the scan tool does not display the parameters as specified, refer to Circuit System Testing.
- If the scan tool displays the parameters as specified but the P16 Instrument Cluster does not display the correct corresponding rear seat belt indicator, replace the P16 Instrument Cluster.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **B153 Seat Belt Buckle**
- **B153 Seat Belt Buckle harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

1. Vehicle OFF.
2. Disconnect the harness connector at the appropriate B153 Seat Belt Buckle.
3. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for less than 2 Ω in each control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 5 Ω**
4. Vehicle in Service Mode.
5. Verify the scan tool 2nd Row Seat Belt Status parameter displays Buckled.
 - **If the scan tool 2nd Row Seat Belt Status parameter does not display Buckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the seat belt switch signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If the scan tool 2nd Row Seat Belt Status parameter does display Buckled**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
7. Verify the scan tool 2nd Row Seat Belt Status parameter displays Unbuckled.
 - **If the scan tool 2nd Row Seat Belt Status parameter does not display Unbuckled**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Vehicle in Service Mode.
 3. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.

4. Test for less than 2 Ω in each circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

• **If the scan tool 2nd Row Seat Belt Status parameter does display Unbuckled**

8. Replace the B153 Seat Belt Buckle.

Component Testing

1. Vehicle OFF.

2. Disconnect the harness connector at the appropriate B153 Seat Belt Buckle.

3. Buckle the B153 Seat Belt Buckle.

4. Test for infinite resistance between the signal circuit terminal 1 and the low reference terminal 2 at the B153 Seat Belt Buckle.

- **If there is not infinite resistance**

Replace the B153 Seat Belt Buckle.

- **If there is infinite resistance**

5. Unbuckle the B153 Seat Belt Buckle.

6. Test for less than 1 Ω between the signal circuit terminal 1 and the low reference terminal 2 at the B153 Seat Belt Buckle.

- **If 1 Ω or greater**

Replace the B153 Seat Belt Buckle.

- **If less than 1 Ω**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Rear Seat Belt Buckle Replacement**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module and instrument cluster replacement, programming and setup

SEAT BELT SERVICE PRECAUTIONS

IMPORTANT: If the vehicle has been in a collision, refer to **Repairs and Inspections Required After a Collision** for additional information.

- Do not bleach or dye the seat belt webbing. Use only the following items in order to clean the seat belt webbing:
 - A mild soap and water solution
 - A soft brush or cloth
- Keep sharp edges and damaging objects away from the seat belts. Avoid bending or damaging any part of

the seat belt buckle or the latch plate. Replace any seat belts which are cut or damaged in any way.

- Use only the correct seat belt anchor bolts/screws and tighten the anchor bolts/screws to the correct torque value. Refer to [Fastener Specifications](#). When installing seat belt anchor bolts, start the bolt by hand to ensure that the bolt is threaded straight.
- Some seat belts and retractors require service as a set, with service replacement parts only. Do not attempt to repair to individual components that require service as a set.
- Verify that the replacement part number is correct for the vehicle at that seating position. Do not substitute a seat belt from a different seating position.

REPAIR INSTRUCTIONS

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

WARNING: Restraint systems can be damaged in a collision. To help avoid injury and ensure that all parts in need of replacement are replaced:

- Replace any seat belt system that was in use during the collision serious enough to deploy any automatic restraint device such as air bags and seat belt pretensioners. This not only includes seat belt systems in use by people of adult size, but seat belt systems used to secure child restraints, infant carriers and booster seats, including LATCH system and top tether anchorages.
- Replace any seat belt system that has torn, worn, or damaged components. This not only includes adult seat belt systems, but built-in child restraints and LATCH system components, if any.
- Replace any seat belt system if you observe the words "REPLACE" or "CAUTION", or if a yellow tag is visible. Do not replace a seat belt if only the child seat caution label is visible.
- Replace any seat belt system if you are doubtful about its condition. This not only includes adult seat belt systems, but built-in child restraints, LATCH system components, and any restraint system used to secure infant carriers, child restraints, and booster seats.

Do NOT replace single seat belt system components in vehicles that have been in a collision as described above. Always replace the entire seat belt system with the buckle, guide and retractor assembly, which includes the latch and webbing material.

After a minor collision where no automatic restraint device was deployed, seat belt system replacement may not be necessary, unless some of the parts are torn, worn, or damaged.

SEAT BELT LATCH STOP INSTALLATION

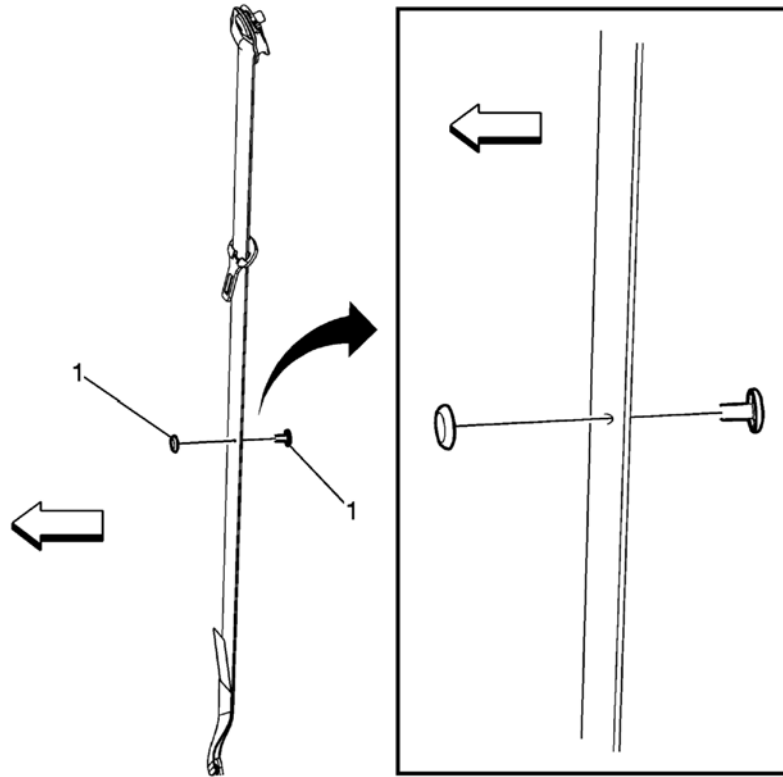


Fig. 3: View Of Seat Belt Latch Stop Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
1. Locate the hole in the seat belt webbing where the original seat belt stop button was located. 2. If the original hole in the seat belt webbing is not visible, perform the following: • If either the right or left stop button is missing use the opposing seat belt as a reference. • With the opposing seat belt fully stowed, measure the distance between the seat belt lower anchor and the stop button. • Using the measurement obtained above, measure and mark the location of the missing stop button on the center of the seat belt webbing. 3. Ensure the seat belt latch plate is located above the mark or original hole.	

Callout	Component Name
1	Seat Belt Stop Button Procedure 1. Work the male half of the stop button through the hole in the webbing or at the marked location. 2. Align the female half of the stop button with the male half of the stop button. 3. Snap the two halves together. 4. Trim off any excess of the male half of the stop button flush with the female half of the stop button. TIP: Ensure the male half of the stop button is facing forward in the vehicle in order to ensure the stop button will not snag customers clothing.

FRONT SEAT BELT BUCKLE REPLACEMENT

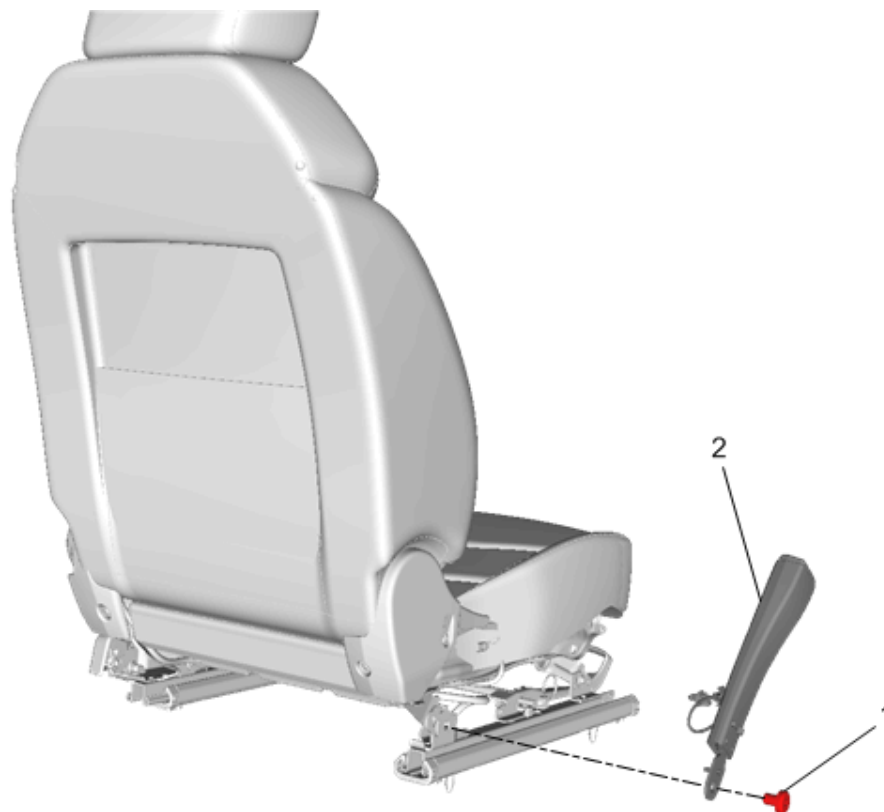


Fig. 4: Front Seat Belt Buckle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Driver or Passenger Seat Removal and Installation</u>	

Callout	Component Name
1	Front Seat Belt Buckle Fastener CAUTION: Refer to Fastener Caution . Tighten 45 N.m (33 lb ft)
2	Front Seat Belt Buckle Procedure Disconnect the electrical connector.

REAR SEAT BELT BUCKLE REPLACEMENT

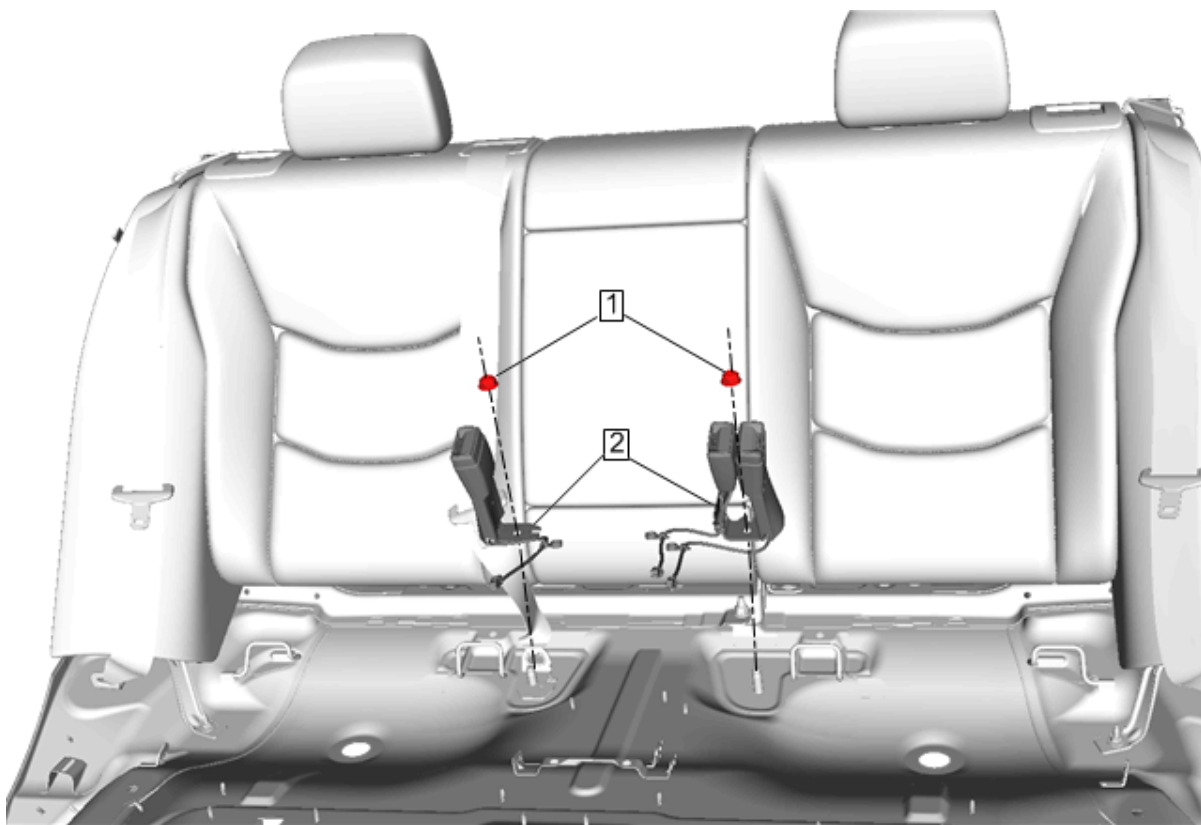


Fig. 5: Rear Seat Belt Buckle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Belt Buckle Nut CAUTION:

Callout	Component Name
	Refer to Fastener Caution . Tighten 45 N.m (33 lb ft)
2	Rear Seat Belt Buckle Procedure Disconnect the electrical connector.

REAR CENTER SEAT BELT RETRACTOR REPLACEMENT

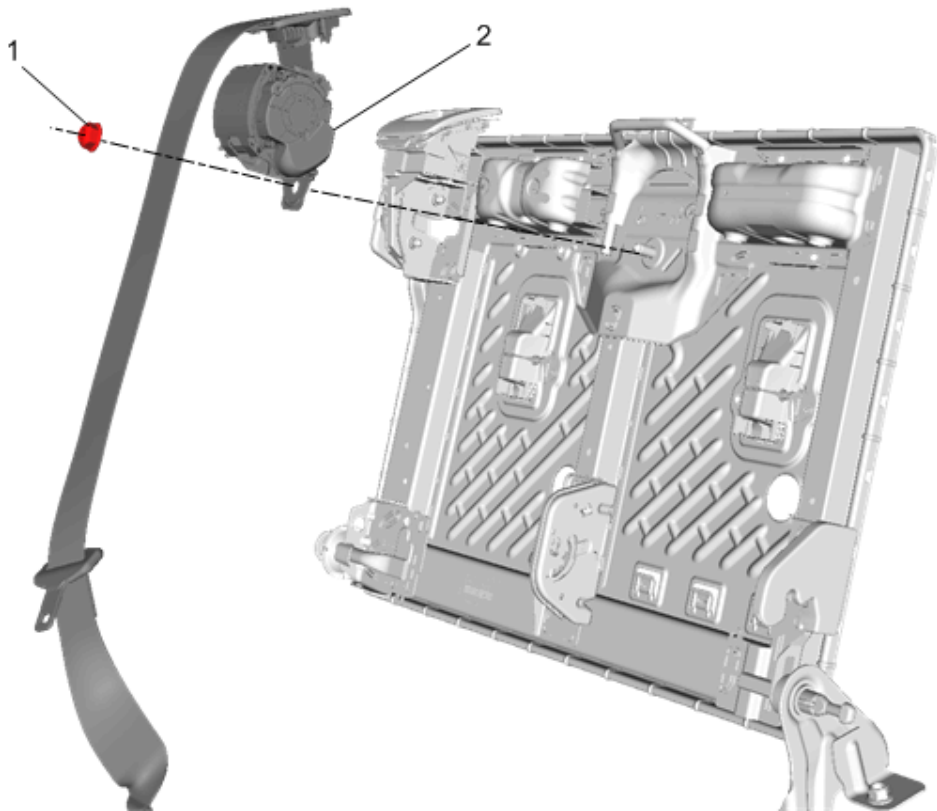


Fig. 6: Rear Center Seat Belt Retractor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Back Cushion Cover and Pad Replacement (40%) Rear Seat Back Cushion Cover and Pad Replacement (60%)	
1	Rear Center Seat Belt Retractor Fastener CAUTION:

Callout	Component Name
	Refer to <u>Fastener Caution</u> . Tighten 45 N.m (33 lb ft)
2	Rear Center Seat Belt Retractor

REAR SEAT SHOULDER BELT GUIDE REPLACEMENT

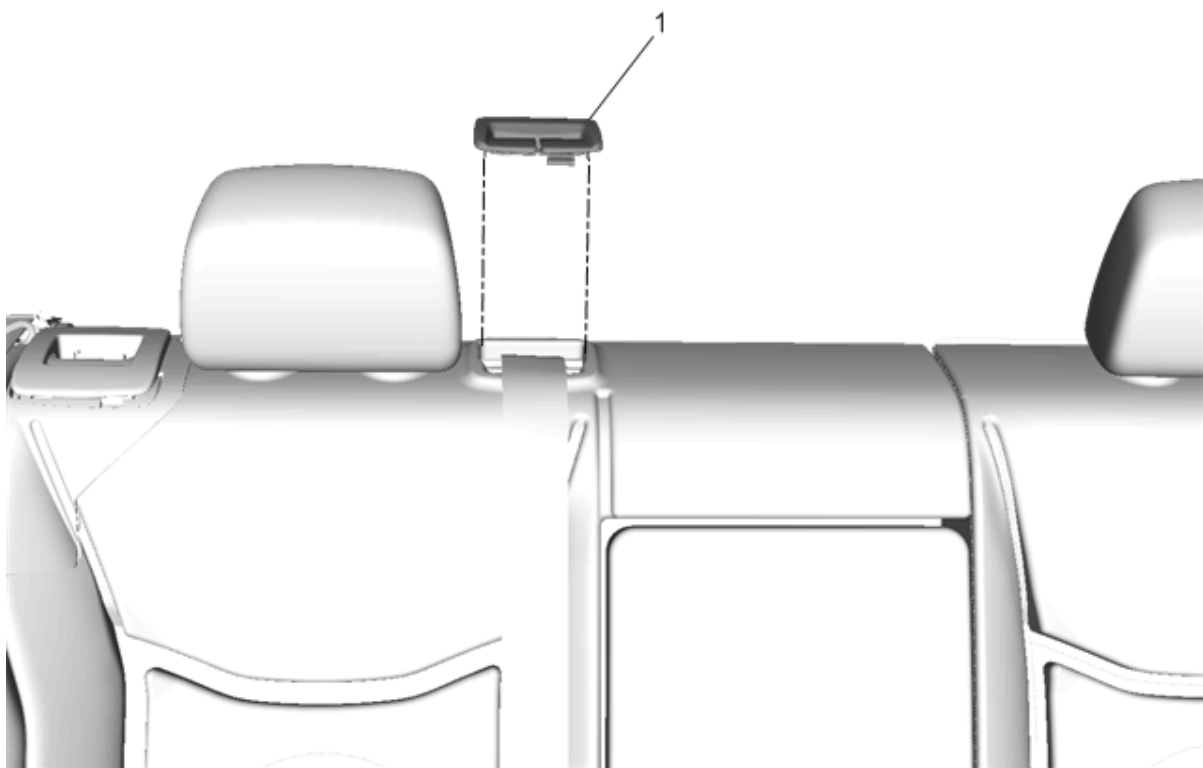


Fig. 7: Rear Seat Shoulder Belt Guide

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Shoulder Belt Guide Procedure Position the belt through the slot in the guide.

REAR SEAT BELT RETRACTOR REPLACEMENT

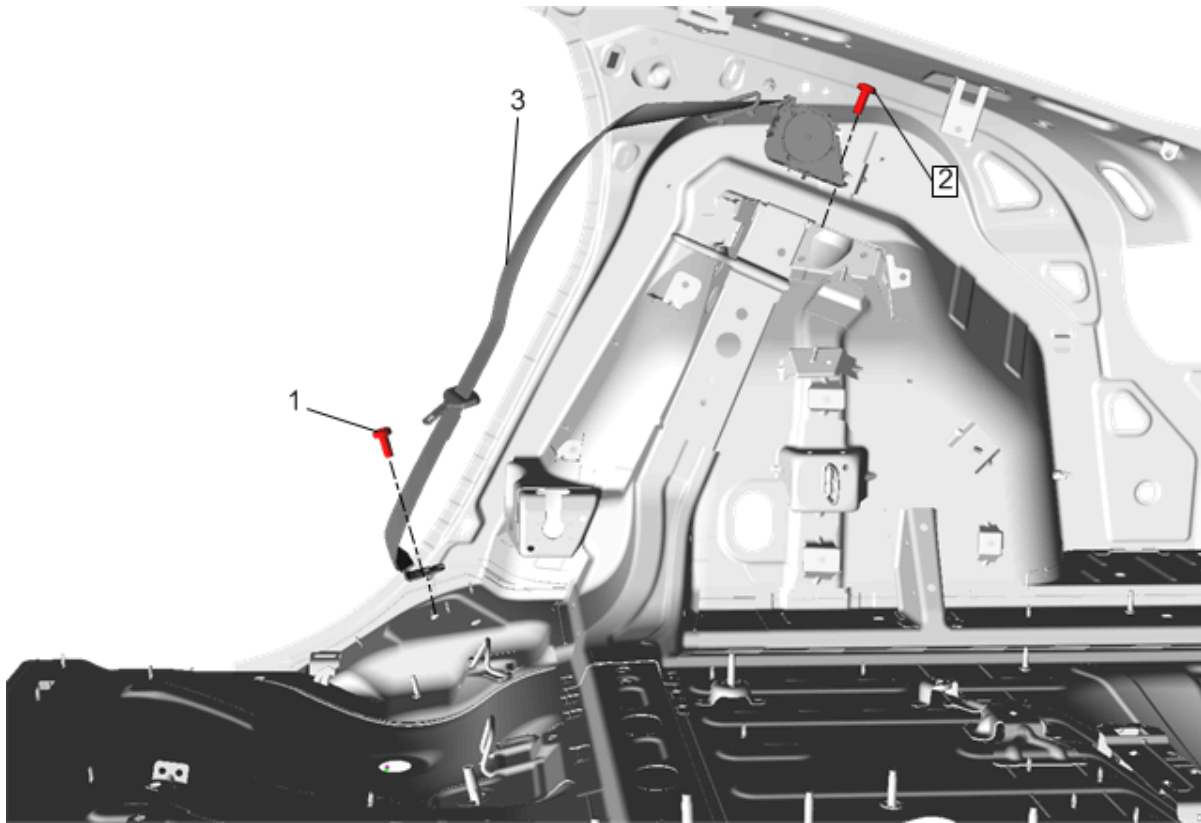


Fig. 8: Rear Seat Belt Retractor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Quarter Lower Rear Trim Panel Replacement (Left Side) Quarter Lower Rear Trim Panel Replacement (Right Side)</u>	
1	Rear Seat Belt Anchor Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 45 N.m (33 lb ft)
2	Rear Seat Belt Retractor Bolt Tighten 45 N.m (33 lb ft)
3	Rear Seat Belt Retractor

DESCRIPTION AND OPERATION

SEAT BELT SYSTEM DESCRIPTION AND OPERATION

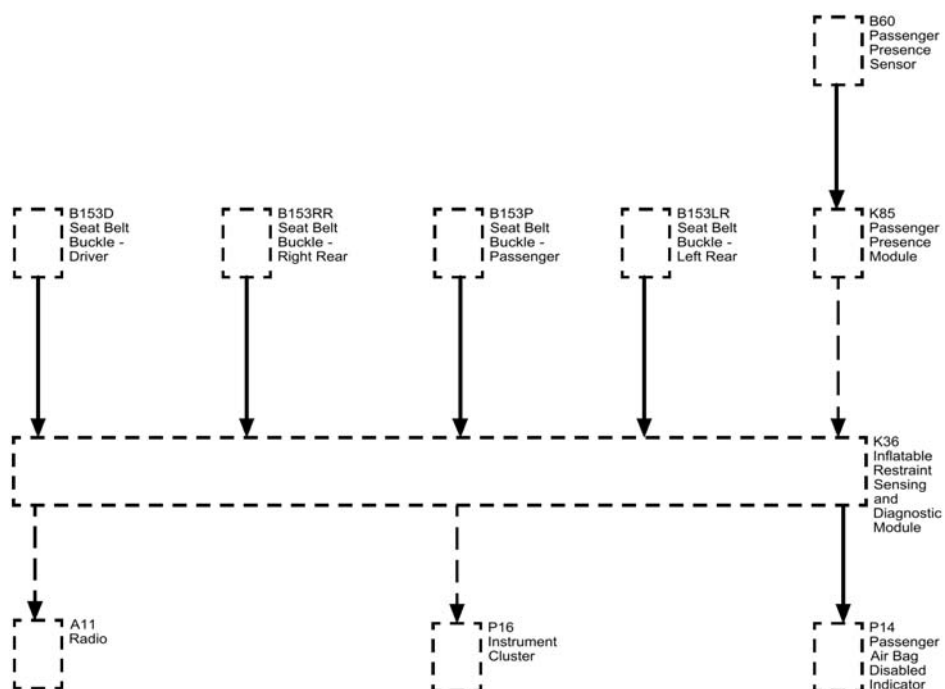


Fig. 9: Seat Belt With P14 B60 And K85 Two Rear Belts Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B153D	B153D Seat Belt Buckle - Driver
B153RR	B153RR Seat Belt Buckle - Right Rear
B153P	B153P Seat Belt Buckle - Passenger
B153LR	B153LR Seat Belt Buckle - Left Rear
K85	Passenger Presence Module
B60	B60 Passenger Presence Sensor
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
A11	A11 Radio
P16	P16 Instrument Cluster
P14	P14 Passenger Air Bag Disabled Indicator

Restraint System

NOTE: If the vehicle has been in a collision, refer to [Repairs and Inspections Required](#)

After a Collision for additional information.

The vehicle has front and rear seat belts that are the primary means of occupant restraint. Seat belts help to keep the occupants inside the passenger compartment and to gradually reduce the impact forces during the following events:

- Frontal impact type crashes
- Rear impact type crashes
- Side impact type crashes
- Roll-over type crashes

All seat belt retractors have emergency locks. The retractors remain unlocked during normal operation and under normal driving conditions. The retractors remain unlocked during normal conditions in order to allow free movement of the upper body of each occupant. A pendulum locks the seat belt webbing into position. The pendulum causes a locking bar to engage a cog on the spool of the retractor mechanism when the following conditions occur:

- A rapid extraction of the seat belt webbing from the retractor
- An abrupt change in vehicle speed
- An abrupt change in vehicle direction
- Operation of the vehicle on a steep upgrade
- Operation of the vehicle on a downgrade

The seat belts have an automatic locking (cinch) feature. The cinch feature is activated when the seat belt webbing is completely extended from the retractor. The cinch feature prevents the webbing from extending beyond the position from which it is allowed to retract. Use of the cinch feature is recommended for securing a child seat. The cinch feature may be cancelled by allowing the webbing to wind back completely into the retractor. After the cinch feature is cancelled, the webbing is unlocked. After the cinch feature is cancelled, the webbing will extend from the retractor. This vehicle is also equipped with a supplemental inflatable restraint (SIR) system. Refer to **Supplemental Inflatable Restraint System Description and Operation** .

Front Seat Belt System

The front seat belt system includes a driver and passenger seat belt pretensioner retractor and anchor. Both front seat belt pretensioners includes a seat belt switch in the seat buckle which controls a reminder lamp and a tone alarm.

NOTE: **The front passenger seat is equipped with a passenger presence detection sensor, which detects an occupant. If the passenger presence detection sensor detects an empty front passenger seat, then the passenger fasten safety belt indicator will be disabled.**

- When the driver seat belt is buckled and the vehicle mode switch is in Vehicle ON mode, the following events will occur:
 - The tone alarm will not operate.
 - The reminder lamp will not operate.
- When the passenger seat belt is buckled with an occupant sitting in the passenger front seat, Vehicle ON,

the following events will occur:

- The tone alarm will not operate.
- The reminder lamp, which is located within the Passenger Air Bag Disable Indicator, will not be turned ON.
- When the driver seat belt is not buckled and Vehicle ON, the following events will occur:
 - The tone alarm will operate for 4 - 8 seconds and then go OFF.
 - The fasten safety belt indicator will turn ON for 20 seconds, until the driver seat belt is buckled.
- When the passenger seat belt is not buckled with an occupant sitting in the passenger front seat, then the Vehicle ON, the following events will occur:
 - The tone alarm will operate for 4 - 8 seconds and then go OFF.
 - The reminder lamp, which is located within the Passenger Air Bag Disable Indicator, will be turned ON.

Rear Seat Belt System

The Rear Seat Belt System includes the following components:

- The rear seat belt retractor is located at the wheelhouse panel and attached to the floor panel by the rear seat shoulder belt retractor bracket.
- The rear seat belt buckles are attached to each seat.
- Each of the rear seat belts include a seat belt switch in the seat buckle which controls a reminder lamp and a tone alarm.
- If both rear seat belts are unbuckled when the vehicle is started the rear seat belt indicators show as red indicators in the Driver Information Center.
- If any rear seat belts are buckled when the vehicle is started, the corresponding indicators will be green for that seat.
- When in Vehicle ON mode, a rear seat belt is buckled, the rear doors are closed and the speed exceeds 10 kph (6.5 mph) for a continuous 35 seconds the following events will occur:
 - The tone alarm will not operate.
 - The green rear seat belt indicators in the Driver Information Center will illuminate for 35 seconds.
- When in Vehicle ON mode, a rear seat belt is not buckled for the duration of the ignition cycle, the rear doors are closed and the speed exceeds 10 kph (6.5 mph) for a continuous 35 seconds the following events will occur:
 - The tone alarm will not operate.
 - The red rear seat belt indicator in the Driver Information Center will remain illuminated.
- When in Vehicle ON mode, a rear seat belt is buckled and during that ignition cycle is unbuckled with the rear doors closed at all times and the speed exceeding 10 kph (6.5 mph) for a continuous 35 seconds the following events will occur:
 - The tone alarm will operate for 3 seconds.
 - The red rear seat belt indicator in the Driver Information Center will illuminate and remain on for a continuous 35 seconds until the seat belt is buckled again or the ignition cycle ends.

Child Seat Restraint System

WARNING: A child in a rear-facing child restraint can be seriously injured if the right-front

A child in a rear-facing child restraint can be seriously injured if the right-front passengers air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. NEVER use a rear-facing child restraint in this vehicle. If a forward-facing child restraint is suitable for your child, ALWAYS move the front passenger seat as far back as it will go and then install the child restraint. Be sure the child restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instruction that came with the child restraint.

The child seat may only be used in a forward facing seating location. The child seat should be installed and secured according to the manufacturer's directions. If the child seat has a top strap, the seat will need to be anchored. Passengers should not be allowed to sit at locations where the seat belts are being used to secure the child seat.

All vehicles are equipped with a dual-mode type retractor with emergency and automatic locking features. The automatic locking feature is for restraint of a child seat. The child seat can be secured by pulling the seat belt all the way out to lock it. Then tighten the seat belt around the child seat.

If a child seat is to be used in the second seat position, a special dealer-installed anchor must be used in order to anchor the child seat top strap. This only applies to the seats designed with the top strap provision and for the vehicles sold in Canada. In order to ensure the correct top strap angle, the child seat is only to be used at the seating position for which the top strap anchor is installed.

Fasten Safety Belt Indicators

There are three fasten safety belt indicators for this vehicle. The driver fasten safety belt reminder is displayed in the Instrument Cluster, the passenger fasten safety belt reminder is displayed in the passenger air bag disable indicator, and the rear fasten safety belt reminder is displayed in the driver information center. The fasten safety belt indicator may only be ON during RUN. The fasten safety belt indicator illuminates under the following conditions:

- During the bulb check
 - The Inflatable Restraint Sensing and Diagnostic Module (SDM) sends the status of the driver seat belt to the instrument cluster via serial data. The passenger seat belt status is sent to the passenger air bag disable indicator via serial data. The rear seat belt status is sent to the driver information center via serial data. If any of the seat belts are unfastened, the instrument cluster will send a message requesting a chime sound to be turned ON after a bulb check.
-

RESTRAINTS

Supplemental Restraints - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Airbag Front End Discriminating Sensor Fastener	7.5 N.m (66 lb in)
Airbag Sensing and Diagnostic Module Nut	9 N.m (80 lb in)
Airbag Side Impact Rear Sensor Fastener	7.5 N.m (66 lb in)
Airbag Side Impact Sensor Fastener	7.5 N.m (66 lb in)
Front and Rear Row Seat Roof Rail Airbag Fastener	9 N.m (80 lb in)
Front Seat Belt Anchor Plate Tensioner Bolt	45 N.m (33 lb ft)
Front Seat Belt Anchor Plate Tensioner Cover Bolt	6 N.m (53 lb in)
Front Seat Belt Retractor Bolt - Lower	45 N.m (33 lb ft)
Front Seat Belt Retractor Bolt - Upper	9 N.m (80 lb in)
Front Seat Belt Retractor D Ring Bolt	45 N.m (33 lb ft)
Front Seat Outboard Seat Back Airbag Nut	3.5 N.m (31 lb in)
Instrument Panel Lower Airbag Nut	9 N.m (80 lb in)
Rear Seat Bolster Airbag Nut	3. 25 N.m (29 lb in)

SCHEMATIC WIRING DIAGRAMS

SIR WIRING SCHEMATICS

Power, Ground, Data Communication and Passenger Presence Detection

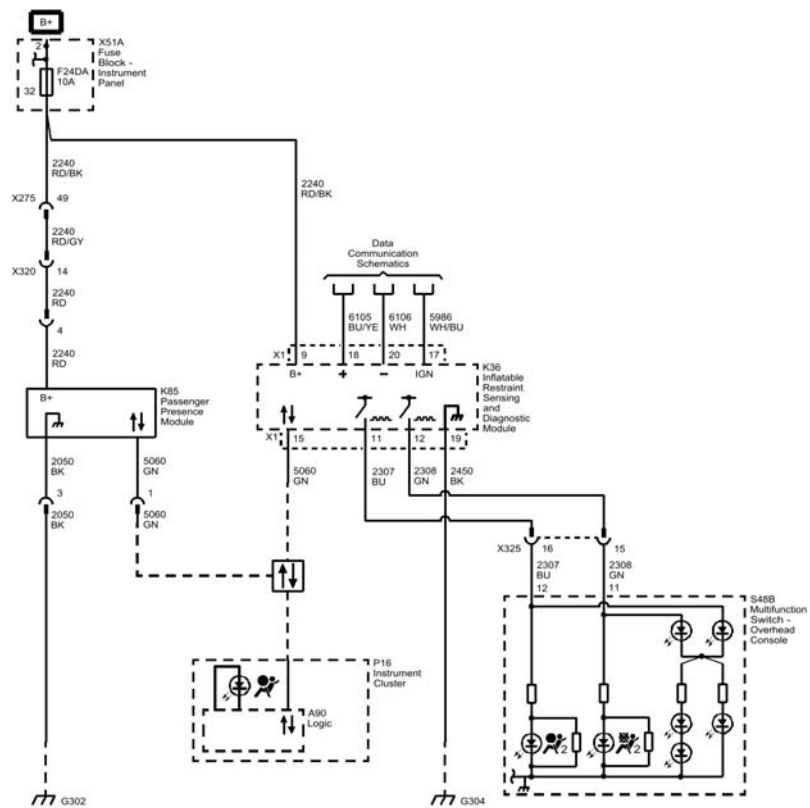


Fig. 1: Power, Ground, Data Communication and Passenger Presence Detection
 Courtesy of GENERAL MOTORS COMPANY

Impact Sensors

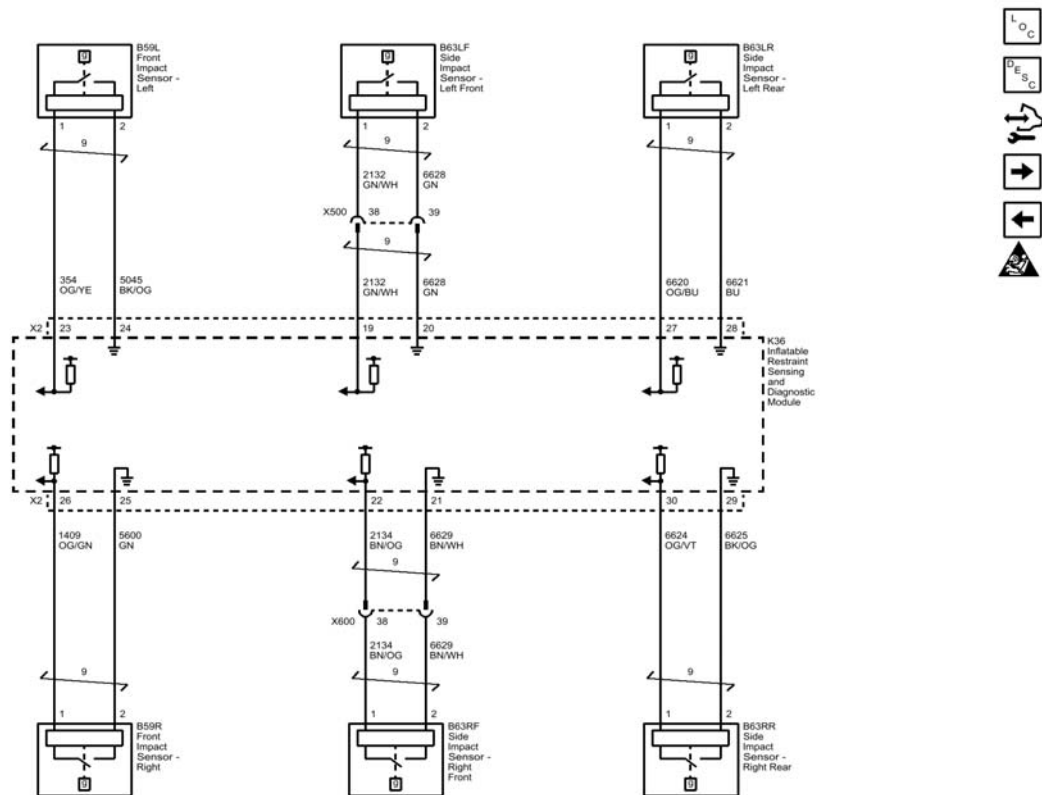


Fig. 2: Impact Sensors

Courtesy of GENERAL MOTORS COMPANY

Air Bags

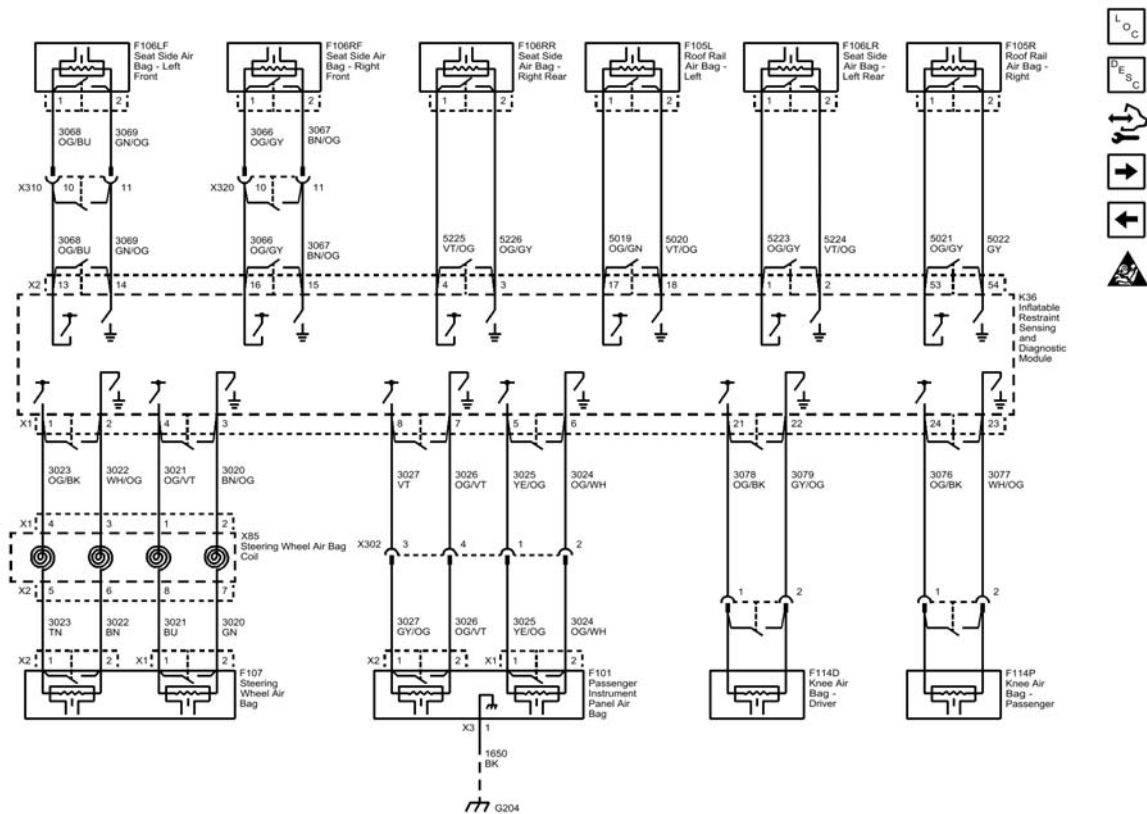


Fig. 3: Air Bags
 Courtesy of GENERAL MOTORS COMPANY

Pretensioners

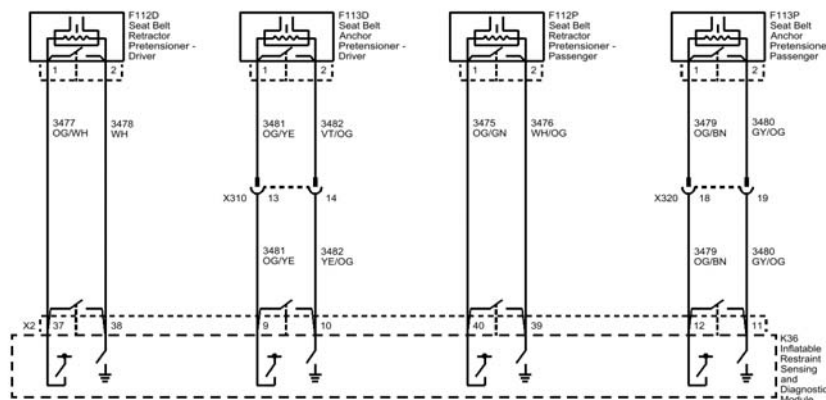
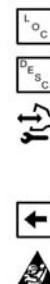


Fig. 4: Pretensioners

Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

SIR IDENTIFICATION VIEWS

The SIR Identification Views shown below illustrate the approximate location of all SIR components available for the vehicle. This will assist in determining the appropriate SIR Disabling and Enabling for a given service procedure. Refer to [SIR Disabling and Enabling](#).

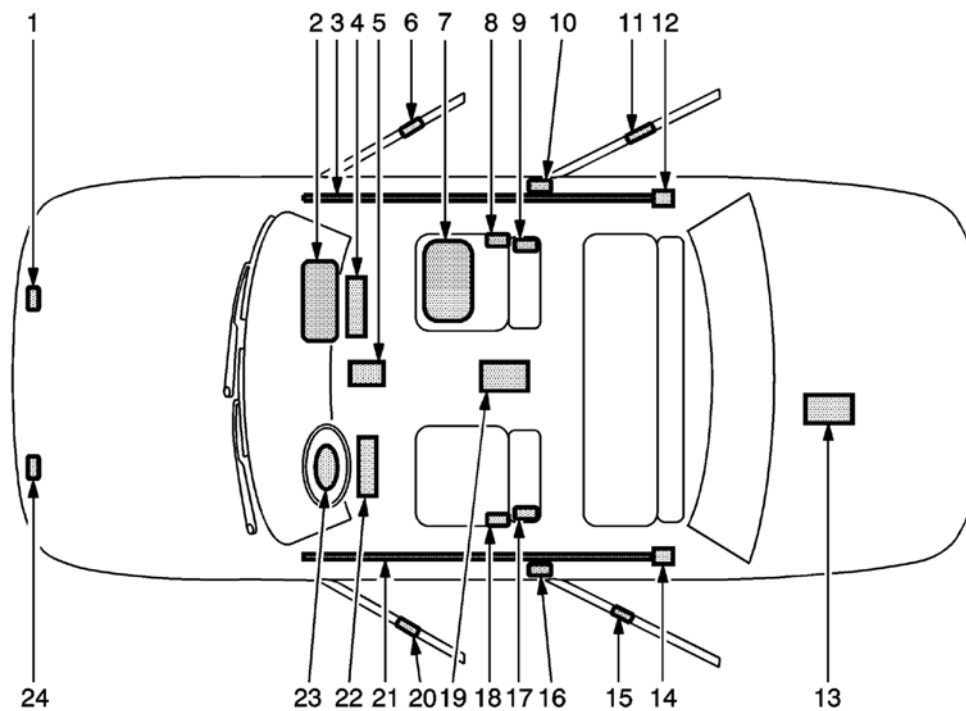


Fig. 5: SIR Identification Views

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Right Front Impact Sensor - Located under the hood at the front right side of the vehicle
2	Passenger Instrument Panel Air Bag - Located at the top right under the instrument panel
3	Right Roof Rail Air Bag - Located under the headliner, extending from the passenger front windshield pillar to the passenger rear windshield pillar
4	Passenger Knee Air Bag - Located in the instrument panel behind the glove box.
5	Inflatable Restraint Sensing and Diagnostic Module (SDM) - Located underneath the center console
6	Right Front Side Impact Sensor - Located in the right front door
7	Passenger Presence System - Located on the passenger front seat underneath the seat bottom trim
8	Passenger Seat Belt Anchor Pretensioner - Located on the outboard side of the passenger seat
9	Passenger Seat Side Air Bag - Located on the seat back of the passenger seat
10	Passenger Seat Belt Retractor Pretensioner - Located under the trim near the bottom of the center pillar on the passenger side of vehicle
11	Right Rear Side Impact Sensor - Located in the right rear door
12	Inflator Module for Right Roof Rail Air Bag - Located behind the headliner above the C-pillar
13	12 V Battery - Located in the trunk

Callout	Component Name
14	Inflator Module for Left Roof Rail Air Bag - Located behind the headliner above the C-pillar
15	Left Rear Side Impact Sensor - Located in the left rear door
16	Driver Seat Belt Retractor Pretensioner - Located under the trim near the bottom of the center pillar on the driver side of vehicle
17	Driver Seat Side Air Bag - Located on the seat back of the driver seat
18	Driver Seat Belt Anchor Pretensioner - Located on the outboard side of the driver seat
19	300 V Battery - Located in between the driver and passenger seats, underneath the center console
20	Left Front Side Impact Sensor - Located in the left front door
21	Leftt Roof Rail Air Bag - Located under the headliner, extending from the driver front windshield pillar to the driver rear windshield pillar
22	Driver Knee Air Bag - Located in the instrument panel below the steering wheel
23	Driver Steering Wheel Air Bag - Located on the steering wheel
24	Left Front Impact Sensor - Located under the hood at the front left side of the vehicle

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0012 OR B0013: DRIVER STEERING WHEEL AIR BAG DEPLOYMENT LOOP STAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category

DTC Descriptors

DTC B0012 01

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Short to Battery

DTC B0012 02

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Short to Ground

DTC B0012 04

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Open

DTC B0012 0D

Driver Steering Wheel Air Bag Deployment Loop Stage 1 High Resistance

DTC B0012 0E

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Low Resistance

DTC B0013 01

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Short to Battery

DTC B0013 02

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Short to Ground

DTC B0013 04

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Open

DTC B0013 0D

Driver Steering Wheel Air Bag Deployment Loop Stage 2 High Resistance

DTC B0013 0E

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Steering Wheel Air Bag Stage 1 High Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Driver Steering Wheel Air Bag Stage 1 Low Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Driver Steering Wheel Air Bag Stage 2 High Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-
Driver Steering Wheel Air Bag Stage 2 Low Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-

Circuit/System Description

During a frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the steering wheel air bag. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. There are two shorting bars used within the steering wheel air bag coil connector which will short together both steering wheel air bag stage 1 high control circuit and steering wheel air bag stage 1 low control circuit and both steering wheel air bag stage 2 high control circuit and steering wheel air bag stage 2 low control circuit when the connector is disconnected. This will help to prevent unwanted deployment of the steering wheel air bag during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0012 01 stage 1 or B0013 01 stage 2

The steering wheel air bag deployment loop is shorted to voltage for 2 s

B0012 02 stage 1 or B0013 02 stage 2

The steering wheel air bag deployment loop is shorted to ground for 2 s

B0012 04 stage 1 or B0013 04 stage 2

The steering wheel air bag deployment loop is open for 2 s

B0012 0D stage 1 or B0013 0D stage 2

The steering wheel air bag deployment loop resistance is greater than 4.4 Ω for 2 s

B0012 0E stage 1 or B0013 0E stage 2

The steering wheel air bag deployment loop resistance is less than 1.7 Ω for 2 s

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployment.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

A worn steering wheel air bag coil can cause a repeated history DTC to set. To verify this condition, turn the steering wheel 360 degrees in one direction then back 360 degrees in the other direction, multiple times, while viewing the scan tool Deployment Loop Resistance parameters.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Steering wheel air bag assembly
- Steering wheel air bag coil assembly
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to SIR Service Precautions.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Driver steering wheel air bag
 - Driver steering wheel air bag coil
 - Inflatable restraint sensing and diagnostic module
 - Air bag wiring harness connector
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace

any CPA that is damaged or missing.

- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.

- **If less than 2.1 Ω or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts**

Replace the X85 Steering Wheel Air Bag Coil.

- **If between 2.1 - 4.0 Ω without any spikes or dropouts**

2. Verify DTC B0012 or B0013 is only set as a history DTC.

- **If the DTC is set as current**

Refer to Circuit/System Testing.

- **If the DTC is set as history**

3. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any drop outs or spikes while moving the harness near each connector listed below.

- X85 Steering Wheel Air Bag Coil
- F107 Steering Wheel Air Bag
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If the reading is erratic while moving the harness, perform the following**
- Inspect each connector terminal for damage or corrosion and repair as necessary
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
- Ensure each connector and CPA is correctly seated
- **If between 2.1 - 4.0 Ω without any spikes or dropouts**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool and disconnect the appropriate harness connector listed below at the F107 Driver Steering Wheel Air Bag.

- DTC B0012 connector X1
- DTC B0013 connector X2

2. Test for greater than 25 Ω between the control circuit terminal 1 and the control circuit terminal 2.

- **If 25 Ω or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.

- If less than infinite resistance, repair the short between the two circuits.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

3. Ignition ON.

4. Test for less than 11 V between each control circuit terminal listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. Ignition OFF.

6. Test for greater than 25 Ω between each control circuit terminal listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 25 Ω or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow

accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

• If greater than 25 Ω

7. Install a 3 A fused jumper wire between the control circuit terminal 1 and the control circuit terminal 2, ignition ON.

8. Verify the appropriate scan tool Deployment Loop Resistance parameter is consistently less than 2 Ω while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.

• If the reading is erratic while turning the steering wheel

Replace the X85 Steering Wheel Air Bag Coil.

• If 2 Ω or greater

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 Ω in the K85 Steering Wheel Airbag Coil and each control circuit end to end.

- If 2 Ω or greater, replace the X85 Steering Wheel Air Bag Coil or repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

• If less than 2 Ω

9. Ignition OFF, connect the harness connector at the F107 Steering Wheel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.

10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

11. Verify DTC B0012 or B0013 is not set.

• If DTC B0012 or B0013 is set

Test or replace the F107 Steering Wheel Air Bag.

• If DTC B0012 or B0013 is not set

12. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Steering Wheel Airbag Coil Replacement](#)
- [Steering Wheel Airbag Replacement](#)
- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0014, B0021, B0031, OR B0038: SEAT SIDE AIR BAG DEPLOYMENT LOOPS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0014 01

Driver Seat Side Air Bag Deployment Loop Short to Battery

DTC B0014 02

Driver Seat Side Air Bag Deployment Loop Short to Ground

DTC B0014 04

Driver Seat Side Air Bag Deployment Loop Open

DTC B0014 0D

Driver Seat Side Air Bag Deployment Loop High Resistance

DTC B0014 0E

Driver Seat Side Air Bag Deployment Loop Low Resistance

DTC B0021 01

Passenger Seat Side Air Bag Deployment Loop Short to Battery

DTC B0021 02

Passenger Seat Side Air Bag Deployment Loop Short to Ground

DTC B0021 04

Passenger Seat Side Air Bag Deployment Loop Open

DTC B0021 0D

Passenger Seat Side Air Bag Deployment Loop High Resistance

DTC B0021 0E

Passenger Seat Side Air Bag Deployment Loop Low Resistance

DTC B0031 01

Left Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0031 02

Left Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0031 04

Left Rear Seat Side Air Bag Deployment Loop Open

DTC B0031 0D

Left Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0031 0E

Left Rear Seat Side Air Bag Deployment Loop Low Resistance

DTC B0038 01

Right Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0038 02

Right Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0038 04

Right Rear Seat Side Air Bag Deployment Loop Open

DTC B0038 0D

Right Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0038 0E

Right Rear Seat Side Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Front Seat Side Air Bag High Control	B0014 02, B0014 0E	B0014 0D	B0014 04, B0014 0D	B0014 01	-
Left Front Seat Side Air Bag Low Control	B0014 02, B0014 0E	B0014 0D	B0014 04, B0014 0D	B0014 01	-
Right Front Seat Side Air Bag High Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-
Right Front Seat Side Air Bag Low Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Rear Seat Side Air Bag High Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Left Rear Seat Side Air Bag Low Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Right Rear Seat Side Air Bag High Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-
Right Rear Seat Side Air Bag Low Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-

Circuit/System Description

During a side or frontal crash of sufficient force, the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are 2 shorting bars used within the connector that will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0014 01, B0021 01, B0031 01, B0038 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0014 02, B0021 02, B0031 02, B0038 02

The air bag control circuit is shorted to ground for 2 seconds.

B0014 04, B0021 04, B0031 04, B0038 04

The air bag control circuit is open for 2 seconds.

B0014 0D, B0021 0D, B0031 0D, B0038 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0014 0E, B0021 0E, B0031 0E, B0038 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Front and rear seat side air bags
- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to [SIR Service Precautions](#).
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Seat side air bag
 - Inflatable restraint sensing and diagnostic module
 - All wiring harness connectors
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while moving the harness near each connector.

- F106 Seat Side Air Bag
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 Ω or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following:**
 - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
 - Apply dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
 - Ensure each connector and CPA is correctly seated.
 - **If between 2.1 - 4.0 Ω without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the harness connector at the appropriate F106 Seat Side Air Bag.

2. Test for greater than 25 Ω between the control circuit terminals 1 and 2.

- **If 25 Ω or less**

1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the 2 control circuits.

- If less than infinite resistance, repair the short between the 2 circuits.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

3. Ignition ON.

4. Test for less than 11 V between each control circuit terminal listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 11 V or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. Ignition OFF.

6. Test for greater than 25 Ω between each control circuit terminal listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 25 Ω or less**

1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2, ignition ON.

8. Verify the appropriate scan tool Deployment Loop Resistance parameter is less than 2 Ω .

- **If 2 Ω or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 Ω**

9. Ignition OFF, connect the harness connector at the F106 Seat Side Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.

10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

11. Verify DTC B0014, B0021, B0031, or B0038 is not set.

- **If DTC B0014, B0021, B0031, or B0038 is set**

Test or replace the F106 Seat Side Air Bag.

- **If DTC B0014, B0021, B0031, or B0038 is not set**

12. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Front Seat Outboard Seat Back Airbag Replacement](#)
- [Rear Seat Bolster Airbag Replacement](#)
- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming, and setup

DTC B0015, B001A, B001B, OR B0022: SEAT BELT RETRACTOR PRETENSIONER DEPLOYMENT LOOPS/SEAT BELT ANCHOR PRETENSIONER DEPLOYMENT LOOPS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0015 01

Driver Seat Belt Retractor Pretensioner Deployment Loop Short to Battery

DTC B0015 02

Driver Seat Belt Retractor Pretensioner Deployment Loop Short to Ground

DTC B0015 04

Driver Seat Belt Retractor Pretensioner Deployment Loop Open

DTC B0015 0D

Driver Seat Belt Retractor Pretensioner Deployment Loop High Resistance

DTC B0015 0E

Driver Seat Belt Retractor Pretensioner Deployment Loop Low Resistance

DTC B001A 01

Driver Seat Belt Anchor Pretensioner Deployment Loop Short to Battery

DTC B001A 02

Driver Seat Belt Anchor Pretensioner Deployment Loop Short to Ground

DTC B001A 04

Driver Seat Belt Anchor Pretensioner Deployment Loop Open

DTC B001A 0D

Driver Seat Belt Anchor Pretensioner Deployment Loop High Resistance

DTC B001A 0E

Driver Seat Belt Anchor Pretensioner Deployment Loop Low Resistance

DTC B001B 01

Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Battery

DTC B001B 02

Passenger Seat Belt Anchor Pretensioner Deployment Loop Short to Ground

DTC B001B 04

Passenger Seat Belt Anchor Pretensioner Deployment Loop Open

DTC B001B 0D

Passenger Seat Belt Anchor Pretensioner Deployment Loop High Resistance

DTC B001B 0E

Passenger Seat Belt Anchor Pretensioner Deployment Loop Low Resistance

DTC B0022 01

Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Battery

DTC B0022 02

Passenger Seat Belt Retractor Pretensioner Deployment Loop Short to Ground

DTC B0022 04

Passenger Seat Belt Retractor Pretensioner Deployment Loop Open Circuit

DTC B0022 0D

Passenger Seat Belt Retractor Pretensioner Deployment Loop High Resistance

DTC B0022 0E

Passenger Seat Belt Retractor Pretensioner Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Retractor Pretensioner High Control	B0015 02, B0015 0E	B0015 0D	B0015 04, B0015 0D	B0015 01	-
Driver Seat Belt Retractor Pretensioner Low Control	B0015 02, B0015 0E	B0015 0D	B0015 04, B0015 0D	B0015 01	-
Driver Seat Belt Anchor Pretensioner Low Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Driver Seat Belt Anchor Pretensioner High Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Passenger Seat Belt Anchor Pretensioner Low Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-
Passenger Seat Belt Anchor Pretensioner High Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-
Passenger Seat Belt Retractor Pretensioner High Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-
Passenger Seat Belt Retractor Pretensioner Low Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the Inflatable Restraint Sensing and Diagnostic Module will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0015 01, B001A 01, B001B 01, B0022 01

The pretensioner control circuit is shorted to voltage for 2 seconds.

B0015 02, B001A 02, B001B 02, B0022 02

The pretensioner control circuit is shorted to ground for 2 seconds.

B0015 04, B001A 04, B001B 04, B0022 04

The pretensioner control circuit is open for 2 seconds.

B0015 0D, B001A 0D, B001B 0D, B0022 0D

The pretensioner deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0015 0E, B001A 0E, B001B 0E, B0022 0E

The pretensioner deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the Instrument Cluster to illuminate the AIR BAG indicator.
- The Inflatable Restraint Sensing and Diagnostic Module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed CPA or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger anchor or retractor pretensioners
- Inline connectors - on the side of the harness connector
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extend of travel while using the scan tool to observe deployment type loop

parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Seat belt retractor pretensioner
 - Seat belt retractor pretensioner wiring harness connector
 - Seat belt anchor pretensioner
 - Seat belt anchor pretensioner wiring harness connector
 - Inflatable Restraint Sensing and Diagnostic Module
 - Inflatable Restraint Sensing and Diagnostic Module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.

- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:

- F112 Seat Belt Retractor Pretensioner
- F113 Seat Belt Anchor Pretensioner
- Any inline harness
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
- Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
- Ensure each connector and CPA is correctly seated.
- **If within 2.1 and 4.0 Ω without any spikes or dropouts**

2. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the scan tool. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the appropriate harness connector listed below:

- F112 Seat Belt Retractor Pretensioner
- F113 Seat Belt Anchor Pretensioner

2. Test for greater than 25 Ω between the appropriate control circuit terminals listed below:

- F112 Seat Belt Retractor Pretensioner terminals 1 and 2
- F113 Seat Belt Anchor Pretensioner terminals 1 and 2
- **If 25 Ω or less**

1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE:

Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the 2 control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 Ω**
3. Vehicle in Service Mode.
4. Test for less than 11 V between the control circuit terminals listed below and ground:
 - F112 Seat Belt Retractor Pretensioner terminal 1
 - F112 Seat Belt Retractor Pretensioner terminal 2
 - F113 Seat Belt Anchor Pretensioner terminal 1
 - F113 Seat Belt Anchor Pretensioner terminal 2
 - **If 11 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, vehicle in Service Mode.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
5. Vehicle OFF. It may take up to 2 minutes for all vehicle systems to power down.
6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:
 - F112 Seat Belt Retractor Pretensioner terminal 1
 - F112 Seat Belt Retractor Pretensioner terminal 2
 - F113 Seat Belt Anchor Pretensioner terminal 1
 - F113 Seat Belt Anchor Pretensioner terminal 2
 - **If 25 Ω or less**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between each control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the appropriate control circuit terminals listed below:
 - F112 Seat Belt Retractor Pretensioner terminals 1 and 2
 - F113 Seat Belt Anchor Pretensioner terminals 1 and 2
8. Vehicle in Service Mode.
9. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω .
 - **If 2 Ω or greater**
 1. Vehicle OFF.
 2. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 Ω**

10. Vehicle OFF, connect the harness connector at the F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner, press in the CPA (if equipped) until an audible and/or tactile click is heard.
11. Vehicle in Service Mode, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B0015, B001A, B001B, or B0022 is not set.

- **If B0015, B001A, B001B, or B0022 is set**

Replace the appropriate F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner.

- **If DTC B0015, B001A, B001B, or B0022 is not set**

13. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Front Seat Belt Anchor Plate Tensioner Replacement](#)
- [Front Seat Belt Retractor Replacement](#)
- [Control Module References](#) for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B0016, B0018, B0023, OR B0025: LEFT/RIGHT ROOF RAIL AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0016 01

Left Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0016 02

Left Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0016 04

Left Roof Rail Air Bag Deployment Loop Open

DTC B0016 0D

Left Roof Rail Air Bag Deployment Loop High Resistance

DTC B0016 0E

Left Roof Rail Air Bag Deployment Loop Low Resistance

DTC B0023 01

Right Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0023 02

Right Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0023 04

Right Roof Rail Air Bag Deployment Loop Open

DTC B0023 0D

Right Roof Rail Air Bag Deployment Loop High Resistance

DTC B0023 0E

Right Roof Rail Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Roof Rail Air Bag High Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Left Roof Rail Air Bag Low Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Right Roof Rail Air Bag High Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-
Right Roof Rail Air Bag Low Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0016 01, B0023 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0016 02, B0023 02

The air bag control circuit is shorted to ground for 2 seconds.

B0016 04, B0023 04

The air bag control circuit is open for 2 seconds.

B0016 0D, B0023 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0016 0E, B0023 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat DTC can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

[SIR Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Supplemental Inflatable Restraint System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

[Circuit/System Verification](#)

NOTE:

- Refer to [SIR Service Precautions](#).
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Roof rail air bag
 - Roof rail air bag wiring harness connector
 - Inflatable restraint sensing and diagnostic module
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the appropriate scan tool Deployment Loop Resistance parameter stays consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:

- F105L Roof Rail Air Bag - Left
- F105R Roof Rail Air Bag - Right
- Any inline harness connector
- K36 inflatable restraint sensing and diagnostic module
- **If less than 2.1 or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
- Inspect each connector terminal and harness for damage or corrosion and repair as necessary
- Ensure each connector and CPA is correctly seated.
- **If within 2.1 and 4.0 Ω without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF. Scan tool disconnected. Disconnect the harness connector at the appropriate F105 Roof Rail Air Bag. It may take up to 2 min for all vehicle systems to power down.

2. Test for greater than 25 Ω between the control circuit terminals 1 and 2.

- **If 25 Ω or less**

1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.

- If less than infinite resistance, repair the short between the two circuits.
- If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.

- **If greater than 25 Ω**

3. Ignition ON.

4. Test for less than 11 V between the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2
- **If 11 V or greater**

1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and

diagnostic module. Ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 inflatable restraint sensing and diagnostic module.

- **If less than 11 V**

5. Ignition OFF.

6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 25 Ω or less**

1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.

- **If greater than 25 Ω**

7. Ignition OFF. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2. Ignition ON.

8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω .

- **If 2 Ω or greater**

1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 inflatable restraint sensing and diagnostic module.

- **If less than 2 Ω**

9. Ignition OFF, connect the harness connector at the F105 Roof Rail Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.

10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

11. Verify DTC B0016 or B0023 is not set.

- **If DTC B0016 or B0023 is set**

Test or replace the F105 Roof Rail Air Bag.

- **If DTC B0016 or B0023 is not set**

12. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Front and Rear Row Seat Roof Rail Airbag Replacement](#)
- [SIR/SRS Wiring Repairs](#)

- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0017 OR B0024: DRIVER/PASSENGER KNEE AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0017 01

Driver Knee Air Bag Deployment Loop Short to Battery

DTC B0017 02

Driver Knee Air Bag Deployment Loop Short to Ground

DTC B0017 04

Driver Knee Air Bag Deployment Loop Open

DTC B0017 0D

Driver Knee Air Bag Deployment Loop High Resistance

DTC B0017 0E

Driver Knee Air Bag Deployment Loop Low Resistance

DTC B0024 01

Passenger Knee Air Bag Deployment Loop Short to Battery

DTC B0024 02

Passenger Knee Air Bag Deployment Loop Short to Battery

DTC B0024 04

Passenger Knee Air Bag Deployment Loop Open

DTC B0024 0D

Passenger Knee Air Bag Deployment Loop High Resistance

DTC B0024 0E

Passenger Knee Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Knee Air Bag High Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Driver Knee Air Bag Low Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Passenger Knee Air Bag High Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-
Passenger Knee Air Bag Low Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are 2 shorting bars used within the connector that will short together the control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0017 01, B0024 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0017 02, B0024 02

The air bag control circuit is shorted to ground for 2 seconds.

B0017 04, B0024 04

The air bag control circuit is open for 2 seconds.

B0017 0D, B0024 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0017 0E, B0024 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument cluster to illuminate the AIR BAG indicator.
- The Inflatable Restraint Sensing and Diagnostic Module will store a DTC, however if an event occurs the

system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed CPA or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger Knee Air Bags
- Inline connectors - on the side of the harness connector
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extend of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to [SIR Service Precautions](#).
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Knee Air Bag
 - Inflatable Restraint Sensing and Diagnostic Module
 - Knee Air Bag wiring harness connector
 - Inflatable Restraint Sensing and Diagnostic Module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:

- F114D Knee Air Bag - Driver
- F114P Knee Air Bag - Passenger
- Any inline harness
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
- Inspect each connector terminal and harness for damage or corrosion and repair as necessary
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
- Insure each connector and CPA is correctly seated.
- **If within 2.1 and 4.0 Ω without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Vehicle OFF, disconnect the scan tool, disconnect the appropriate F114 Knee Air Bag harness connector, and then wait for 120 seconds.
2. Test for greater than 25 Ω between the appropriate control circuit terminals 1 and 2.

- **If 25 Ω or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

3. Vehicle in Service Mode.

4. Test for less than 11 V between the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 11 V or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, Vehicle in Service Mode.

2. Test for less than 1 V between each control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. Vehicle OFF.

6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:

- Control circuit terminal 1
- Control circuit terminal 2

- **If 25 Ω or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between each control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

7. Vehicle OFF, install a 3 A fused jumper wire between the control circuit terminals 1 and 2.

8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω .

- **If 2 Ω or greater**

1. Vehicle OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 Ω**

9. Vehicle OFF, connect the harness connector at the F114 knee air bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.

10. Vehicle in Service Mode, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

11. Verify DTC B0017 or B0024 is not set.

- **If DTC B0017 or B0024 is set**

Replace the appropriate F114 Knee Air Bag.

- **If DTC B0017 or B0024 is not set**

12. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Instrument Panel Lower Airbag Replacement - Driver Side](#)
- [Instrument Panel Lower Airbag Replacement - Passenger Side](#)
- [Control Module References](#) for inflatable restraint sensing and diagnostic module control module replacement, programming and setup

DTC B0019 OR B0020: PASSENGER INSTRUMENT PANEL AIR BAG DEPLOYMENT LOOP STAGE 1 AND 2

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0019

Passenger Instrument Panel Air Bag Deployment Loop Stage 1

DTC B0020

Passenger Instrument Panel Air Bag Deployment Loop Stage 2

For symptom byte information refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Passenger Instrument Panel Air Bag Stage 1 High Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 1 Low Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 2 High Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-
Passenger Instrument Panel Air Bag Stage 2 Low Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0019 01, B0020 01

The air bag control circuit is shorted to voltage for 2 s.

B0019 02, B0020 02

The air bag control circuit is shorted to ground for 2 s.

B0019 04, B0020 04

The air bag control circuit is open for 2 s.

B0019 0D, B0020 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 s.

B0019 0E, B0020 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 s.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Passenger instrument panel air bag
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions.**
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Passenger instrument panel air bag
 - inflatable restraint sensing and diagnostic module
 - Passenger instrument panel air bag wiring harness connector
 - inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:

- F101 Passenger Instrument Panel Air Bag
- Any inline harness connector
- K36 Inflatable Restraint Sensing and Diagnostic Module
- **If less than 2.1 Ω or greater than 4.0 Ω**

Refer to Circuit/System Testing.

- **If there are spikes or dropouts, perform the following**
- Inspect each connector terminal and harness for damage or corrosion and repair as necessary
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
- Insure each connector and CPA is correctly seated.
- **If between 2.1 - 4.0 Ω without any spikes or dropouts**

2. All OK.

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the X302 inline harness connector for the F101 Passenger Instrument Panel Air Bag. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 25 Ω between the appropriate control circuit terminals listed below on the K36 Inflatable Restraint Sensing and Diagnostic Module side of the connector:
 - F101 Passenger Instrument Panel Air Bag stage 1 X302 terminal 1 and 2
 - F101 Passenger Instrument Panel Air Bag stage 2 X302 terminal 3 and 4
 - **If 25 Ω or less**
 1. Disconnect the X1 harness connector at the K36 inflatable restraint sensing and diagnostic module.

NOTE: Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

2. Test for infinite resistance between the two control circuits.
 - If less than infinite resistance, repair the short between the two circuits.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between each control circuit terminal listed below on the instrument panel harness side of the connector and ground:
 - X302 control circuit terminal 1
 - X302 control circuit terminal 2
 - X302 control circuit terminal 3
 - X302 control circuit terminal 4
 - **If 11 V or greater**
 1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between each control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between each control circuit terminal listed below on the instrument panel harness side of the connector and ground:
 - X302 control circuit terminal 1

- X302 control circuit terminal 2
- X302 control circuit terminal 3
- X302 control circuit terminal 4
- **If 25 Ω or less**

1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 25 Ω**

7. Install a 3 A fused jumper wire between the control circuit terminals listed below on the instrument panel harness side of the connector:

- F101 Passenger Instrument Panel Air Bag stage 1 X302 terminal 1 and 2
- F101 Passenger Instrument Panel Air Bag stage 2 X302 terminal 3 and 4

8. Ignition ON.

9. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω .

- **If 2 Ω or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 Ω**

10. Ignition OFF, connect the X302 inline harness connector and disconnect the appropriate X1 (DTC B0019) or X2 (DTC B0020) harness connector at the F101 Passenger instrument panel air bag, ignition ON.

11. Test for less than 11 V between each control circuit terminals listed below and ground:

- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
- **If 11 V or greater**

Repair the short to voltage on the circuit.

- **If less than 11 V**

12. Ignition OFF.

13. Test for greater than 25 Ω between each control circuit terminals listed below and ground:

- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
- F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2

- F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
- **If 25 Ω or less**

Repair the short to ground on the circuit.

- **If greater than 25 Ω**

14. Install a 3 A fused jumper wire between the control circuit terminals listed below:

- F101 Passenger Instrument Panel Air Bag stage 1 control circuit terminal 1 X1 and 2 X1
- F101 Passenger Instrument Panel Air Bag stage 2 control circuit terminal 1 X2 and 2 X2

15. Ignition ON.

16. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω .

- **If 2 Ω or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit between the F101 Passenger Instrument Panel Air Bag connector and the X302 inline harness connector.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 2 Ω**

17. Ignition OFF, connect the harness connector at the F101 Passenger Instrument Panel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.

18. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

19. Verify DTC B0019 or B0020 is not set.

- **If DTC B0019 or B0020 is set**

Test or replace the F101 Passenger Instrument Panel Air Bag.

- **If DTC B0019 or B0020 is not set**

20. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Airbag Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module control module replacement, programming and setup

DTC B0052: DEPLOYMENT COMMANDED CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using the diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0052 00

Deployment Commanded

DTC B0052 56

Deployment Commanded Too Many Transitions

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) senses vehicle impacts and provides deployment signals to the air bags and anchor and/or retractor pretensioners when warranted. The inflatable restraint sensing and diagnostic module sets DTC B0052 after each command for deployment. DTC B0052 will latch and not clear after 3 commanded deployments by the inflatable restraint sensing and diagnostic module. Therefore the inflatable restraint sensing and diagnostic module has to be replaced.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

- The inflatable restraint sensing and diagnostic module detects a frontal impact of sufficient force to warrant deployment of the frontal air bags.
- The inflatable restraint sensing and diagnostic module detects a side impact or rollover (if equipped) of sufficient force to warrant deployment of a seat air bag and/or roof rail air bag.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- DTC B0052 00 is a DTC that may be cleared with a scan tool without replacing the inflatable restraint sensing and diagnostic module. This DTC will not clear if deployment has been commanded more than two times, and the inflatable restraint sensing and diagnostic module would have to be replaced.
- DTC B0052 56 is a latched DTC. The DTC cannot be cleared with the scan tool. Replacement of the inflatable restraint sensing and diagnostic module is required.

Reference Information

Schematic Reference

[SIR Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B0052 00 is not set.

- **If DTC B0052 00 is set**

Clear the DTC. If the DTC will not clear, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0052 00 is not set**

2. Verify that DTC B0052 56 is not set.

- **If DTC B0052 56 is set**

Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0052 56 is not set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0074: PASSENGER PRESENCE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0074 00

Passenger Presence Sensor Circuit Malfunction

DTC B0074 0D

Passenger Presence Sensor Resistance Above Threshold

DTC B0074 0E

Passenger Presence Sensor Resistance Below Threshold

DTC B0074 0F

Passenger Presence Sensor Erratic (Wet Seat)

Circuit/System Description

The passenger presence module monitors the sensor status continually. Whenever the sensor mat has an internal malfunction, the passenger presence module will set DTC B0074.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0074 00

The passenger presence module has detected a disconnection from the sensor mat.

B0074 0D

The passenger presence module has detected a resistance above threshold.

B0074 0E

The passenger presence module has detected a resistance below threshold.

B0074 0F

The passenger presence module has detected a wet seat fault.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the inflatable restraint sensing and diagnostic module or passenger presence module were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (computers, MP3 players, cell phones, diagnostic scan tool, power inverter, etc.) was placed on the passenger seat the passenger presence module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: This system is serviced as a kit (seat foam, module and/or sensing mat). Perform a Passenger Presence System Preload whenever a component is replaced, refer to Passenger Presence System Programming and Setup . Inspect component connectors for damage or corrosion. Repair or replace the affected component/connector:

- Passenger presence module

- Passenger presence module harness connector
- Seat wiring harness to vehicle harness connector

The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click.

1. Verify the DTC remains current while moving the passenger seat forward and backward through it's full range of motion.

- **If the DTC changes to History**

If the status changes this could be indication of a seat to vehicle harness connection issue, refer to Circuit/System Testing.

- **If the DTC remains Current**

2. Verify with the scan tool, the fault does not change status while moving the harness near each connector listed below.

- K85 Passenger Presence Module
- B60 Passenger Presence Sensor
- Any seat harness inline

- **If the status changes**

If the reading is erratic while moving the harness, perform the following:

- Inspect each connector terminal for damage or corrosion and repair as necessary.
- Ensure each connector and CPA is correctly seated.

- **If the status does not change**

3. All OK.

Circuit/System Testing

NOTE: This system is serviced as a kit (seat foam, module and/or sensing mat). Perform a Passenger Presence System Preload whenever a component is replaced, refer to [Passenger Presence System Programming and Setup](#) . Inspect component connectors for damage or corrosion. Repair or replace the affected component/connector:

1. Confirm that all passenger presence system connectors are fully seated.

2. Verify that DTC B0074 0F is not set.

- **DTC B0074 0F is set.**

NOTE: Verify there are no electronic devices on the passenger seat. If not, then verify the seat is dry by removing the trim from the seat bottom frame. If the seat is wet, allow 24-48 hours dry time with trim completely off. If the DTC is history, do not replace B60 Passenger Presence Sensor. Clear passenger presence module DTCs.

1. Verify there are no electronic devices on the passenger seat.
 - Completely empty the passenger seat of any objects
 - If the seat is empty
2. Verify the seat is dry by removing the trim from the seat bottom frame.
 - If the seat is wet, allow 24-48 hours dry time with trim completely off.
 - If the seat is dry
3. If the DTC is history, do not replace B60 Passenger Presence Sensor, and clear passenger presence module DTCs.
 - **DTC B0074 0F does not set.**
3. Verify DTC B0074 00, B0074 0D or B0074 0E is not set.
 - **DTC B0074 00, B0074 0D or B0074 0E is set.**

Replace the K85 Passenger Presence Module.

 - **DTC B0074 00, B0074 0D or B0074 0E do not set.**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for passenger presence module replacement, programming and setup

DTC B0081: PASSENGER PRESENCE MODULE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using the diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0081 00

Passenger Presence Module Erratic (sets in the Inflatable Restraint Sensing and Diagnostic Module)

DTC B0081 3A

Passenger Presence Module Incorrect Component Installed (sets in the Inflatable Restraint Sensing and Diagnostic Module)

DTC B0081 71

Passenger Presence Module Invalid Serial Data Received (sets in Inflatable Restraint Sensing and Diagnostic Module)

DTC B0081 11

Passenger Presence Module High Input (sets in the Passenger Presence Module)

DTC B0081 4B

Passenger Presence Module Calibration Not Learned (sets in the Passenger Presence Module)

DTC B0081 5A

Passenger Presence Module Plausibility Failure (sets in Passenger Presence Module)

Circuit/System Description

When the ignition is turned ON, the Passenger Presence Module and the Inflatable Restraint Sensing and Diagnostic Module performs tests to diagnose critical malfunctions. When the Inflatable Restraint Sensing and Diagnostic Module has completed the power-up mode, the Inflatable Restraint Sensing and Diagnostic Module will establish communication with the Passenger Presence Module. The Inflatable Restraint Sensing and Diagnostic Module will also request the instrument panel cluster (IPC) to illuminate both of the PASSENGER AIR BAG ON/OFF indicators ON for 5 seconds. If the Inflatable Restraint Sensing and Diagnostic Module determines the correct Passenger Presence Module is installed and functioning normally, the Inflatable Restraint Sensing and Diagnostic Module will illuminate the passenger air bags ON or OFF indicator based on messages from the Passenger Presence Module. The Inflatable Restraint Sensing and Diagnostic Module sends a message to the IPC to illuminate the appropriate PASSENGER AIR BAG ON/OFF indicator.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

All of the following conditions must exist for 5 seconds:

B0081 00

The Inflatable Restraint Sensing and Diagnostic Module sets this DTC if there is a fault present in the Passenger Presence Module.

B0081 3A

The Inflatable Restraint Sensing and Diagnostic Module sets this DTC when the Inflatable Restraint Sensing and Diagnostic Module has received a message from the Passenger Presence Module which indicates a mismatch between the Inflatable Restraint Sensing and Diagnostic Module and Passenger Presence Module. There is either an incorrect Inflatable Restraint Sensing and Diagnostic Module or Passenger Presence Module installed on this vehicle.

B0081 71

The Inflatable Restraint Sensing and Diagnostic Module sets this DTC when the Inflatable Restraint Sensing and Diagnostic Module has received invalid serial data from the Passenger Presence Module.

B0081 11

The Passenger Presence Module sets this DTC when there is a high input to the Passenger Presence Module.

B0081 4B

The Passenger Presence Module sets this DTC when the Passenger Presence Module has not learned the calibrations.

B0081 5A

The Passenger Presence Module sets this code when the Passenger Presence Module has lost communications with the Inflatable Restraint Sensing and Diagnostic Module.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module disables the passenger instrument panel air bag.
- The Passenger Presence Module will illuminate the Passenger Airbag On/Off indicator status as OFF.
- When the Passenger Presence Module sets this DTC, the Passenger Presence Module communicates with the Inflatable Restraint Sensing and Diagnostic Module to turn the AIRBAG indicator on.
- When the Inflatable Restraint Sensing and Diagnostic Module sets this DTC, the Inflatable Restraint Sensing and Diagnostic Module will turn the AIRBAG indicator on.
- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster (IPC) to illuminate the AIRBAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists and there is no activity on the low speed serial data circuits.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the Inflatable Restraint Sensing and Diagnostic Module or Passenger Presence Module were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (Computers, MP3 Players, Cell Phones, Diagnostic Scan Tool, Power Inverter, etc.) was placed on the passenger seat the Passenger Presence Module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Schematic Reference

SIR Schematics

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **When removing connectors inspect for damage, corrosion or poor connection. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
- **Passenger Presence Module**
- **Inflatable Restraint Sensing and Diagnostic Module**
- **Passenger Presence Module harness connector**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

1. Vehicle in Service Mode.

Verify that DTC B0081 is the only DTC set in the K36 Inflatable Restraint Sensing and Diagnostic Module or K85 Passenger Presence Module.

- **If any other DTC is set**

Diagnose the other DTCs first, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If B0081 is the only DTC set**

NOTE:

The K36 Inflatable Restraint Sensing and Diagnostic Module sets a redundant B0081 00 DTC when the K85 Passenger Presence Module sets a DTC B0081 11, B0081 4B, or B0081 71.

2. Verify DTC B0081 11 or DTC B0081 4B is not set in the K85 Passenger Presence Module.

- **If DTC B0081 11 or DTC B0081 4B is set in the K85 Passenger Presence Module**

The correct calibration was not learned by the K85 Passenger Presence Module. Perform the Passenger Presence System Preload Test procedure. Refer to [Passenger Presence System Programming and Setup](#) .

- **If neither of these DTCs are set in the K85 Passenger Presence Module**

3. Verify DTC B0081 5A is not set in the K85 Passenger Presence Module.

- **If DTC B0081 5A is set in the K85 Passenger Presence Module**

1. Check the connections at the K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module.

2. Clear the DTC's and check if DTC B0081 5A sets again in the K85 Passenger Presence Module.

- If DTC B0081 5A sets again replace the B60 Passenger Presence Sensor.
- If DTC B0081 5A does not set

3. All OK.

- **If none of these DTCs set in the K85 Passenger Presence Module**

4. Verify DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0081 3A is set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Either an incorrect replacement K85 Passenger Presence Module or K36 Inflatable Restraint Sensing and Diagnostic Module was placed in this vehicle. Check and make sure the part numbers are correct for each module.

- If either part number is incorrect replace it with the correct part number.
- If both part numbers are correct

2. Clear the DTC's and check if DTC B0081 3A sets again in the K36 Inflatable Restraint Sensing and Diagnostic Module.

- If DTC B0081 3A sets again replace the B60 passenger presence sensor. If the DTC sets again replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- If DTC B0081 3A does not set

3. All OK.

- **If DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

5. Verify DTC B0081 71 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B0081 71 is set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Check the connections at the K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module.

2. Clear the DTC's and check if DTC B0081 71 sets again in the K36 Inflatable Restraint Sensing and Diagnostic Module.

- If DTC B0081 71 sets again replace the B60 passenger presence sensor.
- If DTC B0081 71 does not set

3. All OK.

- **If DTC B0081 71 does not set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for passenger presence system or Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B0083 OR B0084: LEFT FRONT IMPACT SENSOR/RIGHT FRONT IMPACT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0083

Left Front Impact Sensor

DTC B0084

Right Front Impact Sensor

For symptom byte information refer to [Symptom Byte List](#)

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Impact Sensor High Signal	B0083 02	B0083 01, B0083 04,	B0083 05	B0083 3A
Left Front Impact Sensor Low Reference	B0083 02	B0083 01, B0083 04,	B0083 05	B0083 3A
Right Front Impact Sensor High Signal	B0084 02	B0083 01, B0083 04,	B0083 05	B0084 3A
Right Front Impact Sensor Low Reference	B0084 02	B0083 01, B0083 04,	B0083 05	B0084 3A

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the Supplemental Inflatable Restraint (SIR) System performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the inflatable restraint sensing and diagnostic module. The impact sensors can assist in determining the severity of some frontal and side collisions. The inflatable restraint sensing and diagnostic module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the inflatable restraint sensing and diagnostic module determines a deployment is warranted, the inflatable restraint sensing and diagnostic module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0083 01, B0084 01

- The sensor circuit is open.
- The sensor circuit has high resistance.

B0083 02, B0084 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0083 04, B0084 04,

- The sensor circuit is open.
- The inflatable restraint sensing and diagnostic module has not received a message from the sensor for greater than 375 milliseconds.

B0083 05, B0084 05

- The sensor has been shorted to voltage.
- The sensor has High Voltage/Open.

B0083 39, B0084 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0083 3A, B0084 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the sensor, which does not match the identification stored in the inflatable restraint sensing and diagnostic module memory.
- The inflatable restraint sensing and diagnostic module has reset the impact sensor twice without detecting the correct identification message.

B0083 71, B0084 71

The inflatable restraint sensing and diagnostic module has received invalid serial data from the sensor.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

Terminal fretting, damaged terminals, damaged connectors, or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 05 is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to SIR Service Precautions.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Impact sensor
 - Impact sensor wiring harness connector
 - Inflatable restraint sensing and diagnostic module
 - Inflatable restraint sensing and diagnostic module wiring harness

connector

- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0083 or B0084 symptom byte 39 or 71 is not set as current.

- **If DTC B0083 or B0084 symptom byte 39 or 71 is set as current**

Replace the appropriate B59 Impact Sensor.

- **If DTC B0083 or B0084 symptom byte 39 or 71 is not set as current**

2. Verify that the inflatable restraint sensing and diagnostic module calibrations match the VIN, software part number, and calibration part number.

- **If the inflatable restraint sensing and diagnostic module calibrations do not match the VIN data**

Program the inflatable restraint sensing and diagnostic module.

- **If the inflatable restraint sensing and diagnostic module calibrations match the VIN data**

3. Verify the B59 Front Impact Sensors have the correct part numbers, matching the label part numbers with the parts catalog.

- **If the inflatable restraint sensing and diagnostic module part numbers do not match**

Replace the incorrect B59 Front Impact Sensor

- **If the inflatable restraint sensing and diagnostic module part numbers do match**

4. Verify that DTC B0083 or B0084 symptom byte 01, 02, 04, or 05 is not set as current.

- **If DTC B0083 or B0084 symptom byte 01, 02, 04, or 05 is set as current**

Refer to Circuit/System Testing.

- **If DTC B0083 or B0084 symptom byte 01, 02, 04, 05 is not set as current**

5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B59 front impact sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Ignition OFF, disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 inflatable restraint sensing and diagnostic module.
- **If less than 10 Ω**
3. Test for greater than 50k Ω between the signal circuit terminal 1 and ground.
 - **If 50k Ω or less**
 1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 50k Ω**
4. Ignition ON, wait 1 min, test for less than 1 V between the signal circuit terminal 1 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If less than 1 V**

NOTE: When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

5. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V. Ignition ON.
6. Verify the MAX voltage captured by the DMM is between 4 - 9V.
 - **If less than 4 V**
 1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the Inflatable Restraint Sensing and Diagnostic Module.
 - **If greater than 9V**

1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
 - **If between 4 - 9V**
7. Ignition OFF, reconnect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
8. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
9. Operate the vehicle under the conditions for setting the DTC. The DTC should not set.
 - **If the DTC sets**

Replace the B59 Impact Sensor.
 - **If the DTC does not set**
10. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Airbag Front End Discriminating Sensor Replacement - Right Side](#)
- [Airbag Front End Discriminating Sensor Replacement - Left Side](#)
- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0085 OR B0088: LEFT FRONT SIDE IMPACT SENSOR/RIGHT REAR SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0085 02

Left Front Side Impact Sensor Short to Ground

DTC B0085 05

Left Front Side Impact Sensor High Voltage/Open

DTC B0085 39

Left Front Side Impact Sensor Internal Malfunction

DTC B0085 3A

Left Front Side Impact Sensor Incorrect Component Installed

DTC B0085 71

Left Front Side Impact Sensor Invalid Data

DTC B0088 02

Right Rear Side Impact Sensor Short to Ground

DTC B0088 05

Right Rear Side Impact Sensor High Voltage/Open

DTC B0088 39

Right Rear Side Impact Sensor Internal Malfunction

DTC B0088 3A

Right Rear Side Impact Sensor Incorrect Component Installed

DTC B0088 71

Right Rear Side Impact Sensor Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Side Impact Sensor High Signal	B0085 02, B0088 02	B0085 05	B0085 05, B0088 05	B0085 39
Left Front Side Impact Sensor Low Reference	B0085 02, B0088 02	B0085 05	B0085 05, B0088 05	B0085 39
Right Rear Side Impact Sensor High Signal	B0085 02, B0088 02	B0088 05	B0085 05, B0088 05	B0088 39
Right Rear Side Impact Sensor Low Reference	B0085 02, B0088 02	B0088 05	B0085 05, B0088 05	B0088 39

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the supplemental inflatable restraint (SIR) system performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the sensing and diagnostic module (SDM). The impact sensors can assist in determining the severity of some frontal and side collisions. The SDM uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the SDM determines a deployment is warranted, the SDM will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0085 02, B0088 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0085 05, B0088 05

- The sensor circuit is open.
- The inflatable restraint sensing and diagnostic module has not received a message from the sensor for greater than 375 milliseconds.

B0085 39, B0088 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0085 3A, B0088 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the sensor, which does not match the identification stored in the inflatable restraint sensing and diagnostic module memory.
- The inflatable restraint sensing and diagnostic module has reset the impact sensor twice without detecting the correct identification message.

B0085 71, B0088 71

The inflatable restraint sensing and diagnostic module has received invalid serial data from the sensor.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Side impact sensor
 - Inflatable restraint sensing and diagnostic module
 - Front impact sensor wiring harness connector
 - Side impact sensor wiring harness connector
 - Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify that DTC B0085 or B0088 symptom byte 3A, 39 or 71 is not set as current.

- **If DTC B0085 or B0088 symptom byte 3A, 39 or 71 is set as current**

Replace the appropriate B63 side impact sensor

- **If DTC B0085 or B0088 symptom byte 3A, 39 or 71 is not set as current**
2. Verify that DTC B0085 or B0088 symptom byte 02 or 05 is set as current.
 - **If only DTC B0085 symptom byte 02 or 05 is set as current**
 Refer to Circuit/System Testing - Only DTC B0085 or B0088 is set.
 - **If only DTC B0088 symptom byte 02 or 05 is set as current**
 Refer to Circuit/System Testing - Only DTC B0085 or B0088 is set.
 - **If both DTC B0085 or B0088 symptom byte 02 or 05 is set as current**
 Refer to Circuit/System Testing - Both DTC B0085 and B0088 are set.
 - **If DTC B0085 or B0088 symptom byte 02 or 05 is not set as current**
 3. All OK.

Circuit/System Testing

NOTE: The signal circuit is shared at the K36 inflatable restraint sensing and diagnostic module between the B63LF side impact sensor left front and the B63RR side impact sensor right rear (DTC B0085 and DTC B0088). Therefore a short to ground or short to voltage in either of these signal circuits can set a DTC for both circuits, and an open in either circuit should only set its corresponding DTC.

Only DTC B0085 or B0088 is set

1. Vehicle OFF, disconnect the harness connector at the appropriate B63 side impact sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 inflatable restraint sensing and diagnostic module.
 - **If less than 10 Ω**
3. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
4. Test for less than 2 Ω between the signal circuit terminal 1 at the B63 side impact sensor and the K36 inflatable restraint sensing and diagnostic module terminal listed below:
 - Left front signal terminal 19 X2
 - Right rear signal terminal 30 X2
 - **If 2 Ω or greater**
 Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Vehicle OFF, reconnect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
6. Vehicle in Service Mode, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify DTC B0085 or B0088 is not set.

- **If DTC B0085 or B0088 is set**

Replace the appropriate B63 side impact sensor.

- **If DTC B0085 or B0088 is not set**

8. All OK.

Both DTC B0085 and B0088 are set

1. Vehicle OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 1 V between the signal circuit terminals listed below and ground:
 - Left front signal circuit - terminal 19 X2
 - Right rear signal circuit - terminal 30 X2
 - **If 1 V or greater**
 1. Disconnect the harness connector at the B63 side impact sensor that failed the test.
 2. Test for less than 1 V between signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the B63 side impact sensor.
 - **If less than 1 V**
3. Test for greater than 50k Ω between each signal circuit listed below and ground:
 - Left front signal circuit - terminal 19 X2
 - Right rear signal circuit - terminal 30 X2
 - **If 50k Ω or less**
 1. Disconnect the harness connector at the B63 side impact sensor that failed the test.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B63 side impact sensor.
 - **If greater than 50k Ω**
4. Replace the K36 inflatable restraint sensing and diagnostic module.

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

- [**Airbag Side Impact Sensor Replacement**](#)
- [**Control Module References**](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0086 OR B0087: RIGHT FRONT/ LEFT REAR SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0086 02

Right Front Side Impact Sensor Short to Ground

DTC B0086 05

Right Front Side Impact Sensor High Voltage/Open

DTC B0086 39

Right Front Side Impact Sensor Internal Malfunction

DTC B0086 3A

Right Front Side Impact Sensor Incorrect Component Installed

DTC B0086 71

Right Front Side Impact Sensor Invalid Data

DTC B0087 02

Left Rear Side Impact Sensor Short to Ground

DTC B0087 05

Left Rear Side Impact Sensor High Voltage/Open

DTC B0087 39

Left Rear Side Impact Sensor Internal Malfunction

DTC B0087 3A

Left Rear Side Impact Sensor Incorrect Component Installed

DTC B0087 71

Left Rear Side Impact Sensor Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Front Side Impact Sensor High Signal	B0086 02, B0087 02	B0086 05	B0086 05, B0087 05	B0086 39
Right Front Side Impact Sensor Low Reference	B0086 02, B0087 02	B0086 05	B0086 05, B0087 05	B0086 39
Left Rear Side Impact Sensor High Signal	B0086 02, B0087 02	B0087 05	B0086 05, B0087 05	B0087 39
Left Rear Side Impact Sensor Low Reference	B0086 02, B0087 02	B0087 05	B0086 05, B0087 05	B0087 39

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the supplemental inflatable restraint (SIR) system performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the sensing and diagnostic module (SDM). The impact sensors can assist in determining the severity of some frontal and side collisions. The SDM uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the SDM determines a deployment is warranted, the SDM will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0086 02, B0087 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0086 05, B0087 05

- The sensor circuit is open.
- The inflatable restraint sensing and diagnostic module has not received a message from the sensor for greater than 375 milliseconds.

B0086 39, B0087 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0086 3A, B0087 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the sensor, which does not match the identification stored in the inflatable restraint sensing and diagnostic module memory.

- The inflatable restraint sensing and diagnostic module has reset the impact sensor twice without detecting the correct identification message.

B0086 71, B0087 71

The inflatable restraint sensing and diagnostic module has received invalid serial data from the sensor.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Refer to **SIR Service Precautions**.
- Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.
 - Side impact sensor

- Inflatable restraint sensing and diagnostic module
- Front impact sensor wiring harness connector
- Side impact sensor wiring harness connector
- Inflatable restraint sensing and diagnostic module wiring harness connector
- The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.
- If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify that DTC B0086 or B0087 symptom byte 3A, 39 or 71 is not set as current.

- **If DTC B0086 or B0087 symptom byte 3A, 39 or 71 is set as current**

Replace the appropriate B63 side impact sensor

- **If DTC B0086 or B0087 symptom byte 3A, 39 or 71 is not set as current**

2. Verify that DTC B0086 or B0087 symptom byte 02 or 05 is set as current.

- **If only DTC B0086 symptom byte 02 or 05 is set as current**

Refer to Circuit/System Testing - Only DTC B0086 or B0087 is set.

- **If only DTC B0087 symptom byte 02 or 05 is set as current**

Refer to Circuit/System Testing - Only DTC B0086 or B0087 is set.

- **If both DTC B0086 or B0087 symptom byte 02 or 05 is set as current**

Refer to Circuit/System Testing - Both DTC B0086 and B0087 are set.

- **If DTC B0086 or B0087 symptom byte 02 or 05 is not set as current**

3. All OK.

Circuit/System Testing

NOTE: The signal circuit is shared at the K36 inflatable restraint sensing and diagnostic module between the B63RF side impact sensor right front and the B63LR side impact sensor left rear (DTC B0086 and DTC B0087). Therefore a short to ground or short to voltage in either of these signal circuits can set a DTC for both circuits, and an open in either circuit should only set its corresponding DTC.

Only DTC B0086 or B0087 is set

1. Vehicle OFF, disconnect the harness connector at the appropriate B63 side impact sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K36 inflatable restraint sensing and diagnostic module.
 - **If less than 10 Ω**
3. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
4. Test for less than 2 Ω between the signal circuit terminal 1 at the B63 side impact sensor and the K36 inflatable restraint sensing and diagnostic module terminal listed below:
 - Right front signal terminal 22 X2
 - Left rear signal terminal 27 X2
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
5. Vehicle OFF, reconnect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
6. Vehicle in Service Mode, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify DTC B0086 or B0087 is not set.
 - **If DTC B0086 or B0087 is set**

Replace the appropriate B63 side impact sensor.
 - **If DTC B0086 or B0087 is not set**
8. All OK.

Both DTC B0086 and B0087 are set

1. Vehicle OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 50k Ω between each signal circuit listed below and ground:
 - Right front signal circuit - terminal 22 X2
 - Left rear signal circuit - terminal 27 X2
 - **If 50k Ω or less**
 1. Disconnect the harness connector at the B63 side impact sensor that failed the test.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the B63 side impact sensor.

- **If greater than 50k Ω**

3. Test for less than 1 V between the signal circuit terminals listed below and ground:

- Right front signal circuit - terminal 22 X2
- Left rear signal circuit - terminal 27 X2

- **If 1 V or greater**

1. Disconnect the harness connector at the B63 side impact sensor that failed the test.

2. Test for less than 1 V between signal circuit and ground.

- If 1 V or greater, repair the short to voltage in the circuit.
- If less than 1 V, replace the B63 side impact sensor.

- **If less than 1 V**

4. Replace the K36 inflatable restraint sensing and diagnostic module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Side Impact Sensor Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B067F OR B0680: PASSENGER AIR BAG ON INDICATOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B067F 01

Passenger Air Bag On Indicator Circuit Short to Battery

DTC B067F 02

Passenger Air Bag On Indicator Circuit Short to Ground

DTC B067F 04

Passenger Air Bag On Indicator Circuit Open

DTC B0680 01

Passenger Air Bag Off Indicator Circuit Short to Battery

DTC B0680 02

Passenger Air Bag Off Indicator Circuit Short to Ground

DTC B0680 04

Passenger Air Bag Off Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag OFF Indicator Control	B0680 02	B0680 04	B0680 01	-
Passenger Air Bag ON Indicator Control	B067F 02	B067F 04	B067F 01	-
Passenger Air Bag Disable Indicator Ground	-	B067F 04, B0680 04	-	-

Circuit/System Description

The passenger air bag ON/OFF indicators are used to notify the driver when the passenger presence system has enabled or disabled the passenger instrument panel air bag. When the ignition is turned ON, the ignition voltage is supplied to the passenger presence module. When the inflatable restraint sensing and diagnostic module (SDM) receives the appropriate serial data message from the passenger presence module the SDM will then provide voltage to the appropriate indicator.

Conditions for Running the DTC

Ignition Voltage is between 9 - 16 V

Conditions for Setting the DTC

The SDM detects improper voltage on the control circuit of the passenger air bag ON or OFF indicator

Actions Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- Passenger air bag ON and OFF indicators are disabled.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: The passenger air bag ON and OFF indicators may not operate as expected if there are supplemental inflatable restraint (SIR) DTCs. Repair all SIR DTCs before proceeding with this diagnostic.

1. Ignition ON.
2. With a scan tool command the passenger air bag ON indicator and passenger air bag OFF indicator ON and OFF. The respective indicators should turn ON and OFF as commanded.
3. Verify the passenger air bag ON indicator and passenger air bag OFF indicators turn ON and OFF when commanded ON and OFF with a scan tool.

- **If the passenger air bag indicators do not change**

Refer to Circuit/System Testing

- **If the passenger air bag indicators change**

4. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.

- **Passenger air bag disable on/off indicator.**
- **Passenger air bag disable on/off indicator wiring harness.**

1. Ignition OFF, disconnect the harness connector at the S48B Multifunction Switch - Instrument Panel.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

3. Ignition ON, with a scan tool, command the passenger air bag OFF indicator OFF.

4. Test for less than 11 V between the control circuit terminal 11 and ground.

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. With a scan tool, command the passenger air bag OFF indicator ON.

6. Test for greater than 4 V between the control circuit terminal 11 and ground.

- **If 4 V or less**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 4 V**

7. With a scan tool, command the passenger air bag ON indicator OFF.

8. Test for less than 11 V between the control circuit terminal 12 and ground.

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

9. With a scan tool, command the passenger air bag ON indicator ON.

10. Test for greater than 4 V between the control circuit terminal 12 and ground.

- **If 4 V or less**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If greater than 4 V**

11. Replace the S48B Multifunction Switch - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Roof Console Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B1001: OPTION CONFIGURATION (INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptor

DTC B1001 00

Option Configuration

Circuit/System Description

The inflatable restraint sensing and diagnostic module stores a primary data key, which is a 4-digit number. When the ignition is turned ON, the inflatable restraint sensing and diagnostic module compares this information to the information stored in the body control module (BCM) via serial data. If there is a mismatch between the information stored in the inflatable restraint sensing and diagnostic module and body control module, DTC B1001 will set.

Conditions for Running the DTC

System voltage is between 9 - 16 V.

Conditions for Setting the DTC

The 4-digit Primary Data Key stored in the inflatable restraint sensing and diagnostic module does not match the 4 digits stored in the body control module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module disables all deployments.

Conditions for Clearing the DTC

The last 4-digit Primary Data Key in the inflatable restraint sensing and diagnostic module matches the last 4 digits stored in the Body Control Module.

Diagnostic Aids

- This DTC is an indication that an incorrect inflatable restraint sensing and diagnostic module is installed in the vehicle, or that the inflatable restraint sensing and diagnostic module and/or the body control module was replaced without reprogramming the body control module with the new information.
- If the inflatable restraint sensing and diagnostic module was previously programmed and DTC B1001 is now set, the setup portion of program was not completed. Proceed to the inflatable restraint sensing and diagnostic module setup portion of the [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#)

Reference Information

Schematic Reference

[SIR Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Supplemental Inflatable Restraint System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify the scan tool K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Valid.

- **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Invalid**

Perform the K36 Inflatable Restraint Sensing and Diagnostic Module setup. Refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#) .

- **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Valid**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B1001: OPTION CONFIGURATION ERROR (PASSENGER PRESENCE SYSTEM)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001 00

Option Configuration Error

Circuit/System Description

The Inflatable Restraint Sensing and Diagnostic Module (SDM) stores a 4-digit primary key for the Passenger Presence Module. The Inflatable Restraint Sensing and Diagnostic Module sends the Passenger Presence Module the primary key. If the Passenger Presence Module determines that it is the wrong primary key, the Passenger Presence Module will set DTC B1001 and send the Inflatable Restraint Sensing and Diagnostic Module a vehicle mismatch message. The Inflatable Restraint Sensing and Diagnostic Module then will set DTC B0081 and illuminate the SIR warning indicator. The Passenger Presence Module does not use a secondary key.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 volts.

Conditions for Setting the DTC

The 4-digit primary key stored in the Inflatable Restraint Sensing and Diagnostic Module does not match the 4-digit key stored in the Passenger Presence Module.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment is disabled.

Conditions for Clearing the DTC

The 4-digit Primary Key in the Inflatable Restraint Sensing and Diagnostic Module and in the Passenger

Presence Module match.

Diagnostic Aids

This DTC is an indication that the passenger presence system module was not set-up correctly, is not the correct part number or that the Passenger Presence Module is defective.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **SIR/SRS Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.

- **Passenger Presence Module**
- **Passenger Presence Module wiring harness**

1. Verify the correct K85 Passenger Presence Module part number has been installed

- **If the K85 Passenger Presence Module installed has an incorrect part number**

Replace the K85 Passenger Presence Module.

- **If the K85 Passenger Presence Module installed has a correct part number**

2. Verify that DTC B1001 is not set as current in the K85 Passenger Presence Module.

- **If DTC is set as current. If Inflatable Restraint Sensing and Diagnostic Module part number**

is correct

1. Verify the Inflatable Restraint Sensing and Diagnostic Module part number is correct.
 - If the K36 Inflatable Restraint Sensing and Diagnostic Module part number is incorrect, replace the K36 Inflatable Restraint Sensing and Diagnostic Module
 - If the K36 Inflatable Restraint Sensing and Diagnostic Module part number is correct
2. Replace the K85 Passenger Presence Module
 - **If the DTC is no set as current**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for K85 Passenger Presence Module and K36 Inflatable Restraint Sensing and Diagnostic Module replacement, setup, and programming

DTC B1019: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B1019 00

System Configuration Error

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) monitors the number of safety components installed on the vehicle. When the Vehicle is turned ON, the Inflatable Restraint Sensing and Diagnostic Module evaluates the number of safety components installed and compares it to the number of components the Inflatable Restraint Sensing and Diagnostic Module expects to see on the vehicle with its current calibration. If there is a mismatch between detected components and the components programmed with the Inflatable Restraint Sensing and Diagnostic Module calibration, DTC B1019 will set. The components (if equipped) that the Inflatable Restraint Sensing and Diagnostic Module will detect include inflatable restraint deployment loops, impact sensors, passenger presence system components, seat position sensors, disable switches, and seat belt switches.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

The setup for the Inflatable Restraint Sensing and Diagnostic Module has not been completed and the Inflatable Restraint Sensing and Diagnostic Module does not detect the correct number of sensors or deployment loops

than is expected with this calibration.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the Instrument Cluster to illuminate the AIR BAG warning indicator.
- The DTC must be cleared before running the setup Inflatable Restraint Sensing and Diagnostic Module.
- Air bag indicator will continue to flash until Inflatable Restraint Sensing and Diagnostic Module setup procedure is complete.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

The Inflatable Restraint Sensing and Diagnostic Module scan tool deployment loop and impact sensor data will match what the Inflatable Restraint Sensing and Diagnostic Module has been programmed to expect to see on the vehicle. B1019 DTC will set if a deployment loop or impact sensor is added or removed from the system.

DTC B1019 will set when an open/high resistance DTC sets for a deployment loop or impact sensor. This causes mismatch between the learned and actual components connected to the Inflatable Restraint Sensing and Diagnostic Module.

DTC B1019 can set with no other DTCs if an unused deployment loop or impact sensor circuit is shorted to ground. This causes a mismatch between the learned and actual components connected to the Inflatable Restraint Sensing and Diagnostic Module.

Reference Information

Schematic Reference

- [Seat Belt Schematics](#)
- [SIR Schematics](#)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Seat Belt System Description and Operation](#)
- [Supplemental Inflatable Restraint System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Connector Repairs](#)

- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

NOTE: DTC B1019 can set after the inflatable restraint sensing and diagnostic module has been replaced and/or reprogrammed before the setup procedure is completed. The setup procedure cannot be completed if DTC B1019 is set as current or history. If a short or open is detected in a deployment circuit prior to the setup procedure being performed, the inflatable restraint sensing and diagnostic module will set DTC B1019.

1. Vehicle in Service Mode.
2. Verify no other Inflatable Restraint Sensing and Diagnostic Module DTCs are set.
 - **If other inflatable restraint sensing and diagnostic module DTCs are set**

Diagnose those DTCs first. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **If no other inflatable restraint sensing and diagnostic module DTCs are set**
3. Verify the impact sensors called out in the scan tool data list match the number of actual impact sensors installed on the vehicle.
 - **If the number of impact sensors do not match**
 1. Verify the correct Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the inflatable restraint sensing and diagnostic module.
 - If the inflatable restraint sensing and diagnostic module calibration file is correct and the vehicle contains an incorrect number of sensors, identify which sensors are missing to make the vehicle match the inflatable restraint sensing and diagnostic module impact sensor calibration scan tool data list.
 - If the calibration file is incorrect
 2. Reprogram the Inflatable Restraint Sensing and Diagnostic Module. Refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#)
 - **If the number of impact sensors match**
4. Verify the enabled deployment loops called out in the scan tool data list match the deployment loops installed on the vehicle.
 - **If the number of enabled deployment loops do not match**
 1. Verify the correct Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the inflatable restraint sensing and diagnostic module.
 - If the inflatable restraint sensing and diagnostic module calibration file is correct and the vehicle contains an incorrect number of loops, identify which deployment loops are missing to make the vehicle match the inflatable restraint sensing and diagnostic module impact sensor calibration scan tool data list.
 - If the calibration file is incorrect

2. Reprogram the Inflatable Restraint Sensing and Diagnostic Module. Refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#)

- **If the number of enabled deployment loops match**

5. Verify a passenger presence system is equipped on the vehicle.

- **If a passenger presence system is not equipped on the vehicle**

Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If a passenger presence system is equipped on the vehicle**

6. Verify the passenger presence enable status called out in the scan tool data list is enabled.

- **If the passenger presence enable status is not enabled**

Refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#)

- **If the passenger presence is enabled**

7. Verify the passenger presence learn status called out in the scan tool data list is learned.

- **If the passenger presence learn status is not learned**

1. Verify the scan tool can communicate with the passenger presence system.

- If the scan tool will not communicate with the passenger presence system, refer to [Scan Tool Does Not Communicate with Low Speed GMLAN Device](#)
- If the scan tool communicates

2. Vehicle OFF, disconnect the scan tool, wait two minutes.

3. Vehicle in Service Mode, verify DTC B1019 is not set as current.

- If the DTC is set as current, refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#)
- If the DTC is not set as current

4. All OK.

- **If the passenger presence learn status is learned**

8. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

PASSENGER PRESENCE SYSTEM REZEROING

Introduction

The inflatable restraints passenger presence system is a calibrated system that requires re-zeroing or a zero check anytime the seat cushion trim attachments have been removed or the passenger presence system has been replaced. The procedures below are designed to assist in the re-zeroing of the passenger presence system.

Before you start, read these procedures carefully and completely. For further information regarding the passenger presence system refer to [Supplemental Inflatable Restraint System Description and Operation](#).

NOTE: The following procedures must be followed:

1. Read this procedure carefully and completely.
2. The passenger presence system will not function properly if the passenger presence system re-zeroing procedure is not performed.
3. Perform the [Diagnostic Repair Verification](#) after successfully completing the re-zeroing procedure to ensure the system is functioning properly.

Passenger Presence System Re-zeroing Procedure

NOTE:

- Before the passenger presence system can be re-zeroed the front passenger seat must be completely empty of all items. The presence of any items on the front passenger seat will affect the calibration and operation of the passenger presence system.
- DTC B0081 will set if the re-zero system test is performed with:
 - An aftermarket seat heater located too close to the sensor mat
 - A scan tool, laptop, or other electronic device is in the seat
 - The seat is damp or wet
 - An object or person is in the seat

1. Make sure that temperature is between 32Â°F to 100Â°F before running a Re-zero procedure.
2. Empty the front outboard passenger seat.
3. Verify that all SIR and passenger presence system components, connectors, and connector position assurances are properly connected and mounted.
4. Install a scan tool.

NOTE: The presence of current DTCs, except DTC B0081 4A or B0081 4B, will prevent the passenger presence system from re-zeroing and may set additional DTCs.

5. Vehicle ON, with a scan tool, perform the Passenger Presence Sensor Learn procedure.
6. If the test fails, confirm that the seat is empty. Perform the Passenger Presence Sensor Learn test again. If the test fails again, verify DTC B0081 is not set as current. If the DTC is set refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) . If the test successfully completed, Vehicle OFF.
7. After the passenger presence system has been successfully re-zeroed, perform the [Diagnostic Repair Verification](#) .

SYMPTOMS - SIR

IMPORTANT: Complete the following steps before using the symptom tables:

1. Perform [Diagnostic System Check - Vehicle](#) before using the symptom tables in order to verify that all

of the following are true:

- There are no DTCs set.
- The inflatable restraint sensing and diagnostic module (SDM) can communicate via the serial data link.

2. Review the SIR system description and operation in order to familiarize yourself with the system functions. Refer to [Supplemental Inflatable Restraint System Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the SIR system. Refer to [Checking Aftermarket Accessories](#).
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

[Airbag Indicator Malfunction \(Driver\)](#)[Airbag Indicator Malfunction \(Passenger\)](#) in order to diagnose the symptom.

AIRBAG INDICATOR MALFUNCTION (DRIVER)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Circuit/System Description

With the Vehicle in Service Mode, during the bulb check, the driver air bag indicator will flash, and then turn OFF after the bulb check. The Inflatable Restraint Sensing and Diagnostic Module (SDM) performs diagnostic tests on the SIR system during the bulb check. If any malfunction exists the Inflatable Restraint Sensing and Diagnostic Module will request the instrument cluster to illuminate the air bag indicator steady, via serial data. If a preexisting malfunction exists, the air bag indicator will illuminate steady immediately after the ignition is turned ON. If the ignition 1 voltage is outside of the normal operating voltage range of 9 - 16 V, the Inflatable Restraint Sensing and Diagnostic Module will command the instrument cluster to illuminate the air bag indicator ON, even with no DTCs present, and then disable all deployment loops.

Diagnostic Aids

- A DTC B1370 may set if the ignition 1 circuit is outside the 9 - 16 V range.
- A flashing driver air bag indicator is displayed if the inflatable restraint sensing and diagnostic module was programmed but did not fully complete the programming. For a flashing driver airbag indicator, refer

to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#) .

Reference Information

Schematic Reference

[SIR Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Supplemental Inflatable Restraint System Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Connector Repairs](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

If the driver air bag indicator is flashing, refer to [Inflatable Restraint Sensing and Diagnostic Module Programming and Setup](#) .

Circuit/System Testing

1. Vehicle in Service Mode. With a scan tool, verify Inflatable Restraint Sensing and Diagnostic Module DTCs are not set.

- **If Inflatable Restraint Sensing and Diagnostic Module DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **If Inflatable Restraint Sensing and Diagnostic Module DTCs are not set**

2. With a scan tool command the Instrument Cluster to turn all instrument cluster indicators ON and OFF. The air bag indicator should turn ON and OFF as commanded.

- **If air bag indicator does not turn on or off**

If the air bag indicator does not turn ON and OFF as expected, replace the P16 Instrument Cluster.

- **If air bag indicator does turn on or off**

3. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- [SIR/SRS Wiring Repairs](#)
- [Control Module References](#) for Instrument Cluster or Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

AIRBAG INDICATOR MALFUNCTION (PASSENGER)

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B067F 01

Passenger Air Bag On Indicator Circuit Short to Battery

DTC B067F 02

Passenger Air Bag On Indicator Circuit Short to Ground

DTC B067F 04

Passenger Air Bag On Indicator Circuit Open

DTC B0680 01

Passenger Air Bag Off Indicator Circuit Short to Battery

DTC B0680 02

Passenger Air Bag Off Indicator Circuit Short to Ground

DTC B0680 04

Passenger Air Bag Off Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag OFF Indicator Control	B0680 02	B0680 04	B0680 01	-
Passenger Air Bag ON Indicator Control	B067F 02	B067F 04	B067F 01	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag Disable Indicator Ground	-	B067F 04, B0680 04	-	-

Circuit/System Description

The passenger air bag ON/OFF indicators are used to notify the driver when the passenger presence system has enabled or disabled the passenger instrument panel air bag. When the ignition is turned ON, the ignition voltage is supplied to the passenger presence module. When the inflatable restraint sensing and diagnostic module (SDM) receives the appropriate serial data message from the passenger presence module the SDM will then provide voltage to the appropriate indicator.

Conditions for Running the DTC

Ignition Voltage is between 9 - 16 V

Conditions for Setting the DTC

The SDM detects improper voltage on the control circuit of the passenger air bag ON or OFF indicator

Actions Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- Passenger air bag ON and OFF indicators are disabled.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Control Module References for scan tool information

Circuit/System Verification

NOTE: The passenger air bag ON and OFF indicators may not operate as expected if there are supplemental inflatable restraint (SIR) DTCs. Repair all SIR DTCs before proceeding with this diagnostic.

1. Ignition ON.
2. With a scan tool command the passenger air bag ON indicator and passenger air bag OFF indicator ON and OFF. The respective indicators should turn ON and OFF as commanded.
3. Verify the passenger air bag ON indicator and passenger air bag OFF indicators turn ON and OFF when commanded ON and OFF with a scan tool.

- **If the passenger air bag indicators do not change**

Refer to Circuit/System Testing

- **If the passenger air bag indicators change**

4. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.

- **Passenger air bag disable on/off indicator.**
- **Passenger air bag disable on/off indicator wiring harness.**

1. Ignition OFF, disconnect the harness connector at the S48B Multifunction Switch - Instrument Panel.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.

- **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

3. Ignition ON, with a scan tool, command the passenger air bag OFF indicator OFF.
4. Test for less than 11 V between the control circuit terminal 11 and ground.

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

5. With a scan tool, command the passenger air bag OFF indicator ON.

6. Test for greater than 4 V between the control circuit terminal 11 and ground.

- **If 4 V or less**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 4 V**

7. With a scan tool, command the passenger air bag ON indicator OFF.

8. Test for less than 11 V between the control circuit terminal 12 and ground.

- **If 11 V or greater**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If less than 11 V**

9. With a scan tool, command the passenger air bag ON indicator ON.

10. Test for greater than 4 V between the control circuit terminal 12 and ground.

- **If 4 V or less**

1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

3. Test for less than 2 Ω in each control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 4 V**

11. Replace the S48B Multifunction Switch - Instrument Panel.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Roof Console Replacement](#)

- [Control Module References](#) for inflatable restraint sensing and diagnostic module replacement, programming and setup

SIR DISABLING AND ENABLING

SIR component location affects how a vehicle should be serviced. There are parts of the SIR system installed in various locations around a vehicle. To find the location of the SIR components refer to [Master Electrical Component List](#).

There are several reasons for disabling the SIR system, such as repairs to the SIR system or servicing a component near or attached to an SIR component. There are several ways to disable the SIR system depending on what type of service is being performed. The following information covers the proper procedures for disabling/enabling the SIR system.

Condition	Action
If the vehicle was involved in an accident with an air bag deployment.	Disconnect the negative battery cable(s)
When performing SIR diagnostics.	Follow the appropriate SIR service manual diagnostic procedure(s) *
When moving, removing or replacing an SIR component or a component attached to an SIR component. (Anytime you remove fasteners.)	Disconnect the negative battery cable(s) *
If the vehicle is suspected of having shorted electrical wires.	Disconnect the negative battery cable(s) *
When performing electrical diagnosis on components other than the SIR system.	Remove the SIR/Airbag fuse(s) when indicated by the diagnostic procedure to disable the SIR system
* DTCs will be lost when the negative battery cable is disconnected.	

SIR Service Precautions

WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Failure to observe the correct procedure could cause deployment of the SIR components. Serious injury can occur. Failure to observe the correct procedure could also result in unnecessary SIR system repairs.

The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the air bags if the Inflatable Restraint Sensing and Diagnostic Module loses battery power during a collision. Deployment power is available for as much as 2 minutes after disconnecting the vehicle power. Waiting 2 minutes before working on the system after disabling the SIR system prevents deployment of the air bags from the reserved energy supply.

General Service Instructions

The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose air bags to temperatures above 65°C (149°F).
- Verify the correct replacement part number. Do not substitute a component from a different vehicle.
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system.

Discard any of the following components if it has been dropped from a height of 92 cm (3 feet) or greater:

- Inflatable Restraint Sensing and Diagnostic Module (SDM)
- Any air bag
- Driver steering wheel air bag coil
- Any impact sensor
- Seat belt anchor and/or retractor pretensioners
- Passenger presence module and/or occupant sensor

Disabling Procedure - Air Bag Fuse

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Vehicle OFF.

WARNING: The SDM may have more than one fused power input. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove all fuses supplying power to the SDM. With all SDM fuses removed and the ignition switch in the ON position, the AIR BAG warning indicator illuminates. This is normal operation, and does not indicate a SIR system malfunction.

3. Locate and remove the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to [SIR Schematics](#), or [Electrical Center Identification Views](#) .
4. Wait 2 minutes before working on the system.

Enabling Procedure - Air Bag Fuse

1. Vehicle OFF.
2. Install the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to [SIR Schematics](#), or [Electrical Center Identification Views](#) .
3. Vehicle in Service Mode. The AIR BAG indicator will flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to [Diagnostic System Check - Vehicle](#) .

Disabling Procedure - Negative Battery Cable

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Vehicle OFF.
3. Disconnect the negative battery cable from the battery. Refer to [Battery Negative Cable Disconnection and Connection](#) .
4. Wait 2 minutes before working on system.

Enabling Procedure - Negative Battery Cable

1. Vehicle OFF.
2. Connect the negative battery cable to the battery. Refer to [Battery Negative Cable Disconnection and](#)

Connection .

3. Vehicle in Service Mode. The AIR BAG indicator will flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to Diagnostic System Check - Vehicle .

REPAIR INSTRUCTIONS

SIR SERVICE PRECAUTIONS

General Service Instructions

WARNING: If a service procedure indicates that a module is to be replaced, a new production unit **MUST** be ordered from the GM Parts Catalog or certified supplier. Using a module that has been reset by a 3rd party company is strictly prohibited. Not using a new production unit may result in improper performance of the safety system in the event of an accident, which may result in bodily injury.

WARNING: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.

WARNING: Do not strike or jolt the inflatable restraint sensing and diagnostic module (SDM). Before applying power to the SDM, make sure that it is securely fastened with the arrow facing toward the front of the vehicle. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

NOTE: The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the SIR air bags. Deployment power may be available for up to 2 minutes after disconnecting the vehicle power. Disabling the SIR system prevents deployment of the SIR air bags from the reserved energy supply.

NOTE: The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose air bags to temperatures above 85 °C (185 °F)
- Verify the correct replacement part number. Do not substitute a component from a different vehicle
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system

NOTE: Discard any of the following components if it has been dropped from a height of 80 cm (31.49 in) or greater:

- Inflatable Restraint Sensing and Diagnostic Module

- Passenger instrument panel air bag
- Driver steering wheel air bag
- Driver steering wheel air bag coil
- Roof rail air bags
- Front and /or side impact sensors
- Seat belt anchor and/or retractor pretensioners
- Front seat side air bag
- Knee air bag

AIRBAG FRONT END DISCRIMINATING SENSOR REPLACEMENT - RIGHT SIDE

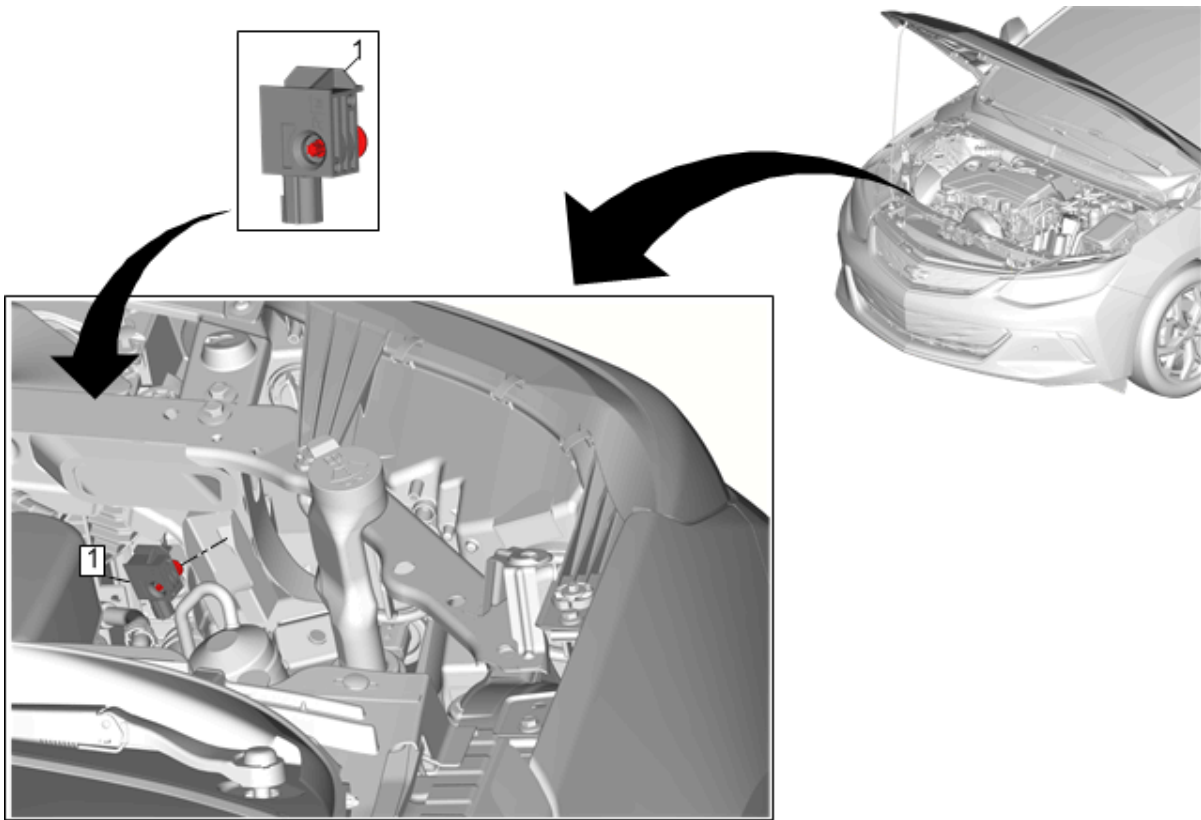


Fig. 6: Airbag Front End Discriminating Sensor - Right Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling	

Callout	Component Name
<u>and Storage Warning</u> . WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedure 1. <u>SIR Disabling and Enabling</u> 2. <u>Air Cleaner Assembly Replacement</u>	
1	Airbag Front End Discriminating Sensor CAUTION: Refer to <u>Fastener Caution</u> .

Callout	Component Name
	Procedure 1. Disconnect the electrical connector. 2. Loosen the fastener and slide the sensor out of the keyhole slot. Tighten 7.5 N.m (66 lb in) NOTE: The fastener is integral to the sensor assembly, DO NOT remove separately.

AIRBAG FRONT END DISCRIMINATING SENSOR REPLACEMENT - LEFT SIDE

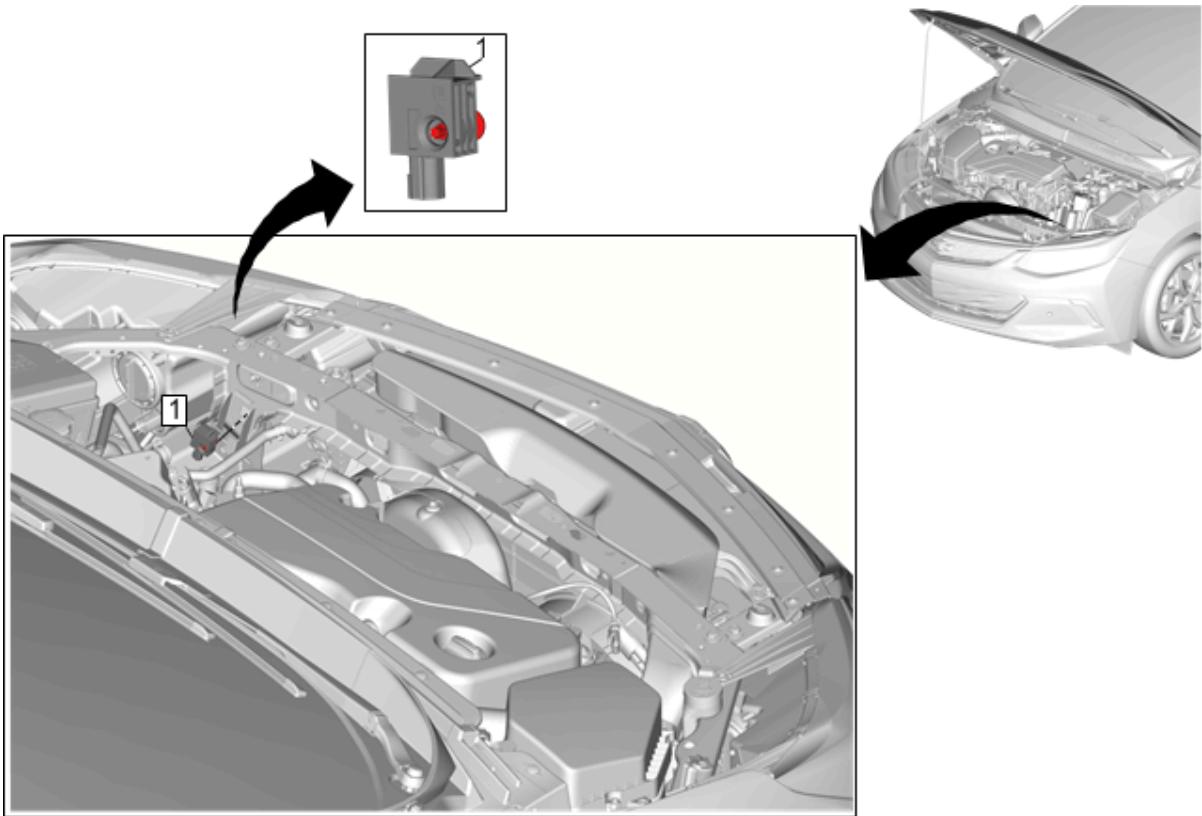


Fig. 7: Airbag Front End Discriminating Sensor - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING:	

Callout	Component Name
Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedure 1. Disable the SIR system. SIR Disabling and Enabling	

Callout	Component Name
	2. It is only necessary to reposition the radiator surge tank. Only do those steps in radiator surge tank replacement that will reposition the surge tank enough to gain access to the sensor. Radiator Surge Tank Replacement (Drive Motor Battery Radiator Surge Tank) Radiator Surge Tank Replacement (Drive Motor Generator Power Inverter Module Surge Tank)
1	Airbag Front End Discriminating Sensor CAUTION: Refer to Fastener Caution . Procedure 1. Disconnect the electrical connector. 2. Loosen the fastener and slide the sensor out of the keyhole slot. 3. The fastener is integral to the sensor assembly, DO NOT remove separately. 4. Enable the SIR System. SIR Disabling and Enabling Tighten 7.5 N.m (66 lb in) NOTE: Integral sensor assembly bolt uses Left Hand threads. Use counterclockwise rotation to loosen fastener at TORX® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.

AIRBAG SIDE IMPACT SENSOR REPLACEMENT

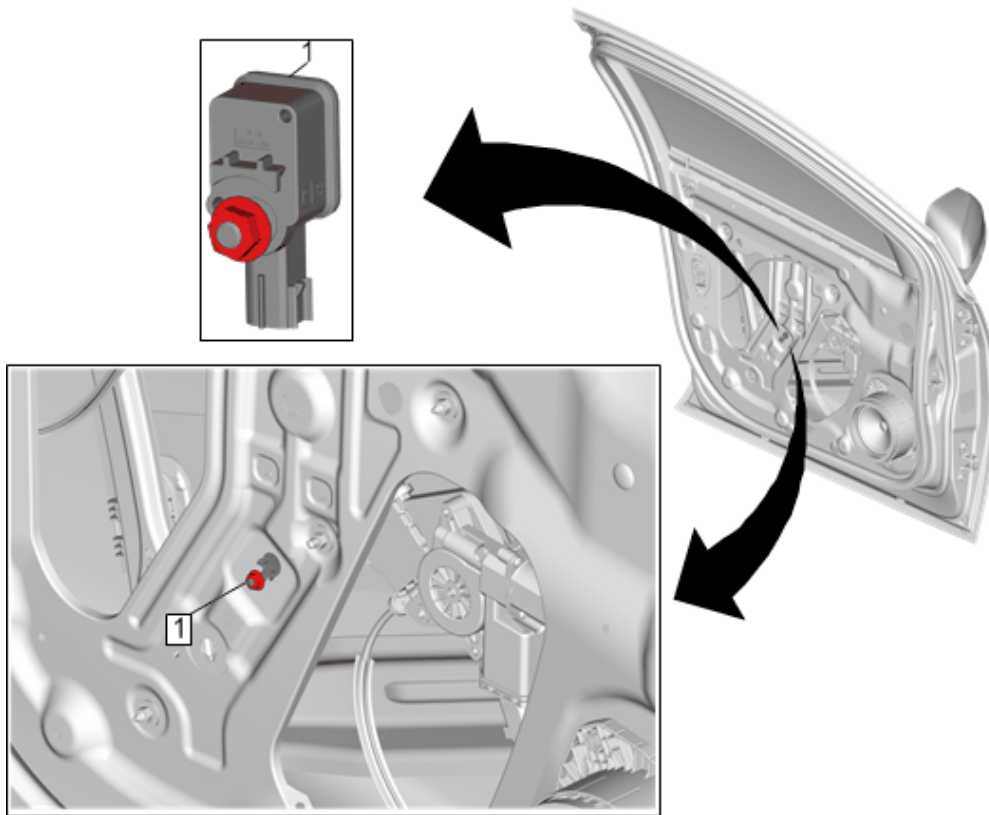


Fig. 8: Airbag Side Impact Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these	

Callout	Component Name
parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedures 1. SIR Disabling and Enabling 2. Front Side Door Trim Replacement 3. Front Side Door Armrest Bracket Replacement 4. Remove the front side door water deflector.	
1	Airbag Side Impact Sensor CAUTION: Refer to Fastener Caution . Procedure 1. Disconnect the electrical connector. 2. Loosen the fastener and slide the sensor out of the keyhole slot. 3. The fastener is integral to the sensor assembly, DO NOT remove separately. Tighten 7.5 N.m (66 lb in)

Callout	Component Name
	NOTE:

The sensor
AIRBAG SENSING AND DIAGNOSTIC MODULE REPLACEMENT
 is located on
 the inside of

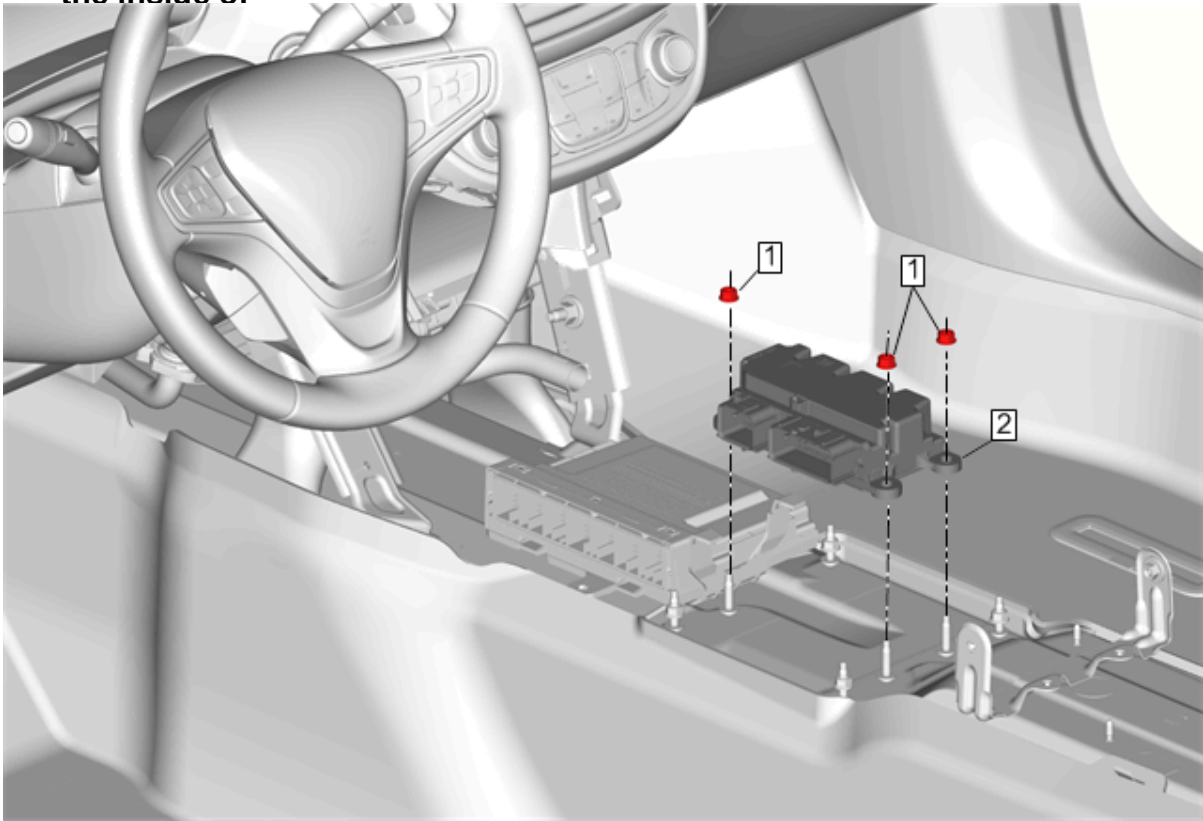


Fig. 9: Airbag Sensing And Diagnostic Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Do not strike or jolt the inflatable restraint Sensing and Diagnostic Module (SDM). Before applying power to the SDM, make sure that it is securely fastened. Failure to	

Callout	Component Name
	observe the correct installation procedure could cause Supplemental Inflatable Restraint (SIR) deployment, personal injury, or unnecessary SIR system repairs. WARNING: Refer to SIR Warning . Preliminary Procedures 1. Disable the SIR system. SIR Disabling and Enabling 2. Transmission Control Replacement (With Base) Transmission Control Replacement (Without Base)
1	Airbag Sensing and Diagnostic Module Nut (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Airbag Sensing and Diagnostic Module Procedure 1. Disconnect the electrical connectors. 2. Perform the necessary programming and setup procedure: Control Module References 3. Enable the SIR System. SIR Disabling and Enabling

STEERING WHEEL AIRBAG REPLACEMENT

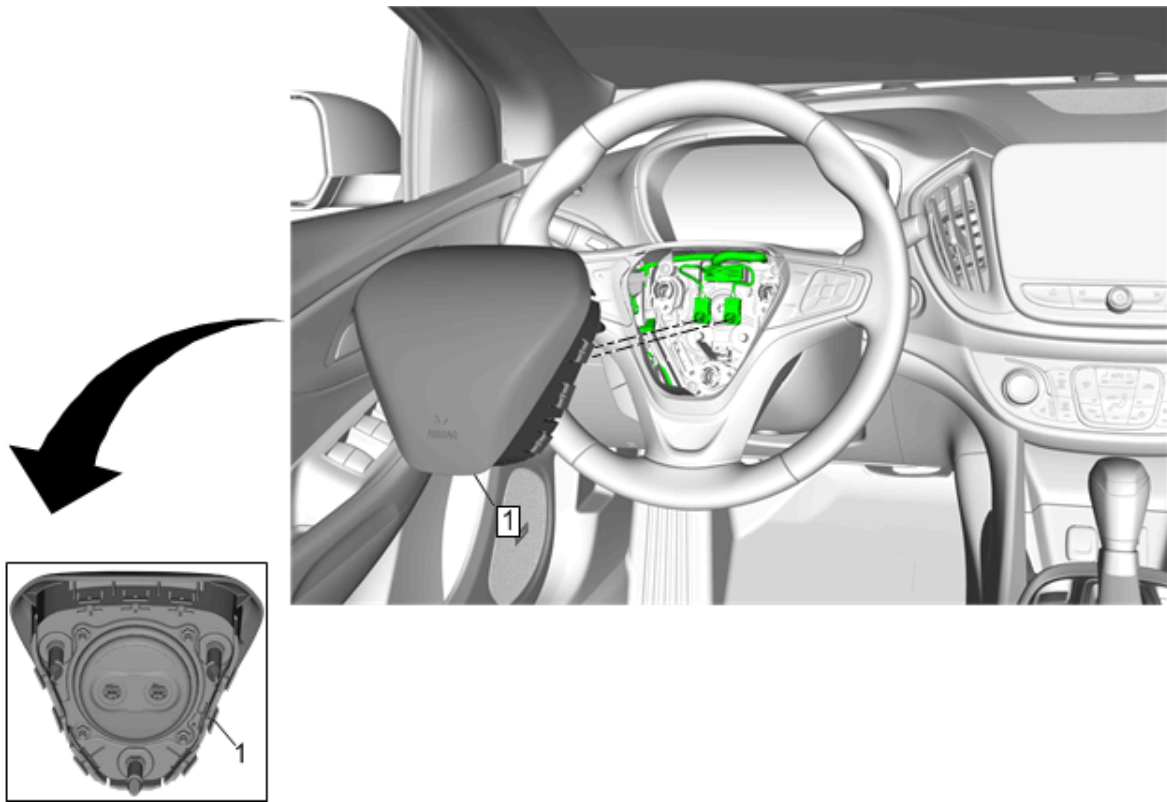


Fig. 10: Steering Wheel Airbag

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . Preliminary Procedures SIR Disabling and Enabling	
1	Steering Wheel Airbag WARNING: After installation of the steering wheel airbag module to

Callout	Component Name
	the steering wheel, slightly pull the module outward. If there is no give on the airbag module then it is secured correctly. If the airbag module is not fully attached personal injury could result. Procedure 1. Fully Insert a long 3 mm allen wrench or equivalent tool into access holes on the rear left and right side of the steering wheel. 2. Apply and keep constant pressure on handle towards front of vehicle to push the spring fastener inward to release the steering wheel airbag from the steering wheel. 3. Release the connector position assurance (CPA) retainer. 4. Disconnect the electrical connectors. 5. <u>Inflatable Restraint Module Handling and Scrapping</u>

STEERING WHEEL AIRBAG COIL REPLACEMENT

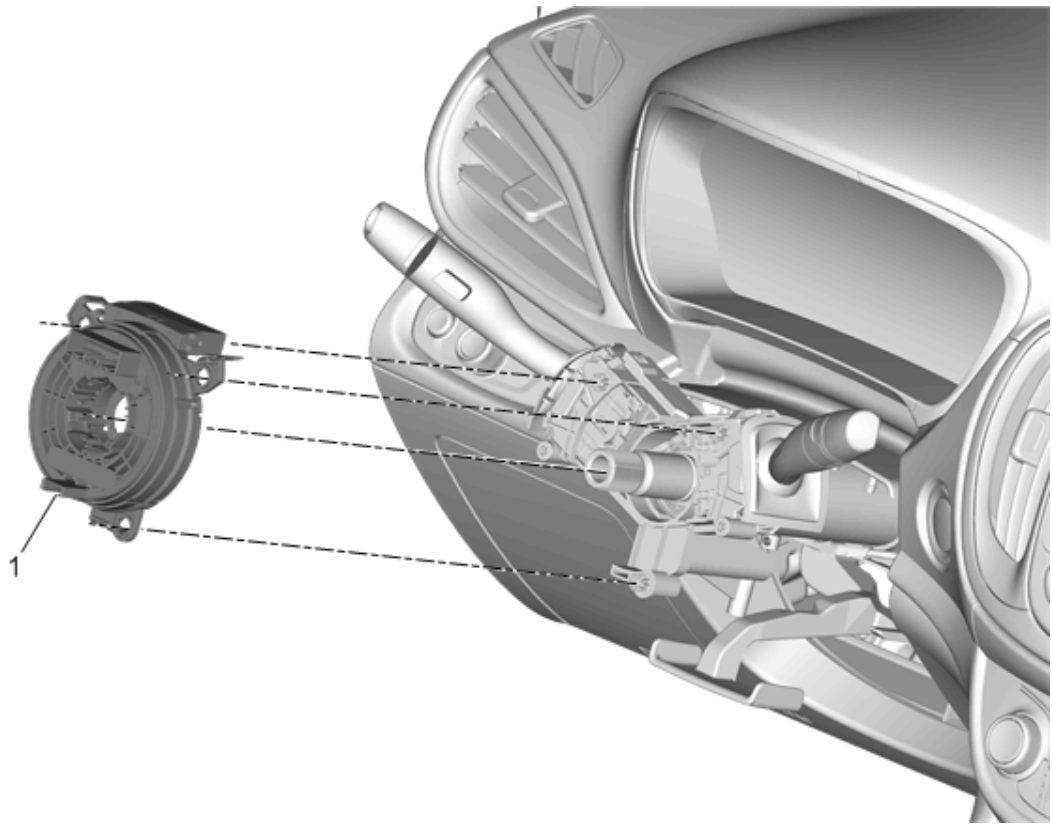


Fig. 11: Steering Wheel Airbag Coil
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Steering Wheel Replacement</u> <u>Steering Column Lower Trim Cover Replacement</u> - Reposition the steering column upper trim cover as necessary.	
1	Steering Wheel Airbag Coil Procedure - Disconnect the electrical connectors. - Release the retaining tabs and remove the steering wheel airbag coil from the steering column. - Ensure the steering wheel airbag coil is CENTERED during installation. <u>Airbag Steering Wheel Module Coil Centering</u>

AIRBAG STEERING WHEEL MODULE COIL CENTERING



Fig. 12: Steering Wheel Airbag Coil

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The new SIR coil assembly will be centered. Improper alignment of the SIR coil assembly may damage the unit, causing an inflatable restraint malfunction.

1. Inspect the steering wheel airbag coil. If the yellow lock pin (1) is present, the uplead post (2) is at the 12 o'clock position and the loop (u-turn) appears in the centering window (3) then the coil is already in the centered position and no further action is required.

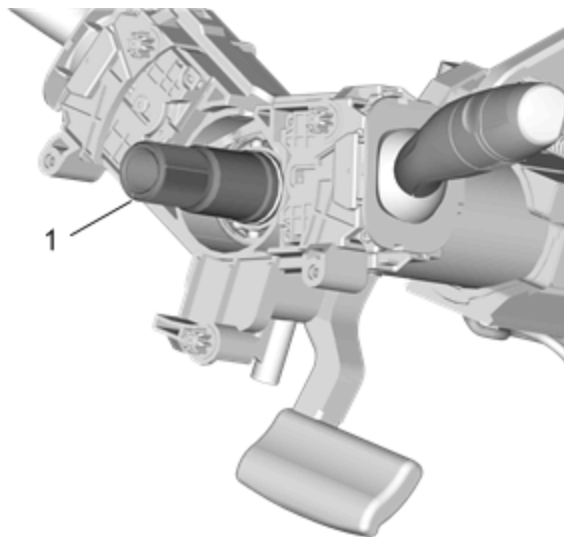


Fig. 13: Block Tooth

Courtesy of GENERAL MOTORS COMPANY

2. If the steering wheel airbag coil needs to be centered, perform the following preliminary steps:
 1. Ensure the wheels on the vehicle are straight ahead.
 2. Ensure the block tooth (1) on the steering shaft is in the 6 o'clock position.

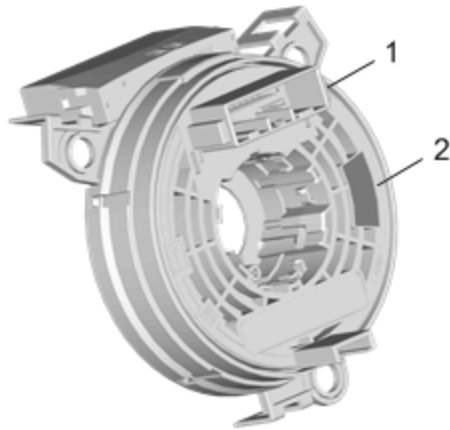


Fig. 14: Centering Steering Wheel Airbag Coil
Courtesy of GENERAL MOTORS COMPANY

3. To center the steering wheel airbag coil, perform the following steps:
 1. Hold the coil with the face up.
 2. Slowly rotate the coil hub clockwise until the coil ribbon stops.
 3. Slowly rotate the coil hub counterclockwise approximately 2.5 turns until the uplead post (1) is at the 12 o'clock position.
 4. View the centering window (2) and ensure the loop (u-turn) is visible. If the loop is visible then the coil is in the center position.
 5. While holding the coil hub in the center position, align the coil with the steering column components and slide the coil onto the steering shaft.

INSTRUMENT PANEL AIRBAG REPLACEMENT

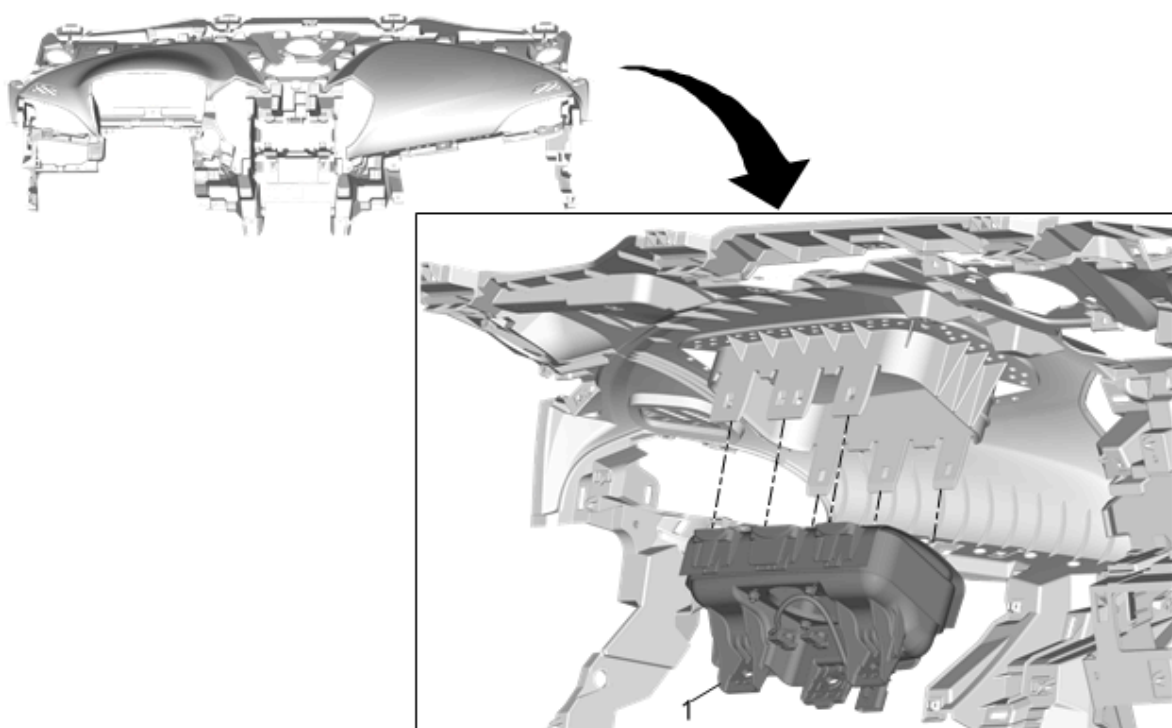


Fig. 15: Instrument Panel Airbag

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: Refer to SIR Warning . Preliminary Procedures 1. Disable the SIR system. SIR Disabling and Enabling 2. Instrument Panel Assembly Replacement	
1	Instrument Panel Airbag Procedure 1. Inflatable Restraint Module Handling and Scrapping

Callout	Component Name
	2. Insert a wood straight edge, one per side behind all locking tabs, to simultaneously release the instrument panel airbag housing from the instrument panel chute without overextending the airbag locking tabs. Use a wood straight edge that is approximately 50.8 cm (20 in) long and 5 mm (0.20 in) thick with a rounded edge. 3. Enable the SIR System. SIR Disabling and Enabling

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - DRIVER SIDE

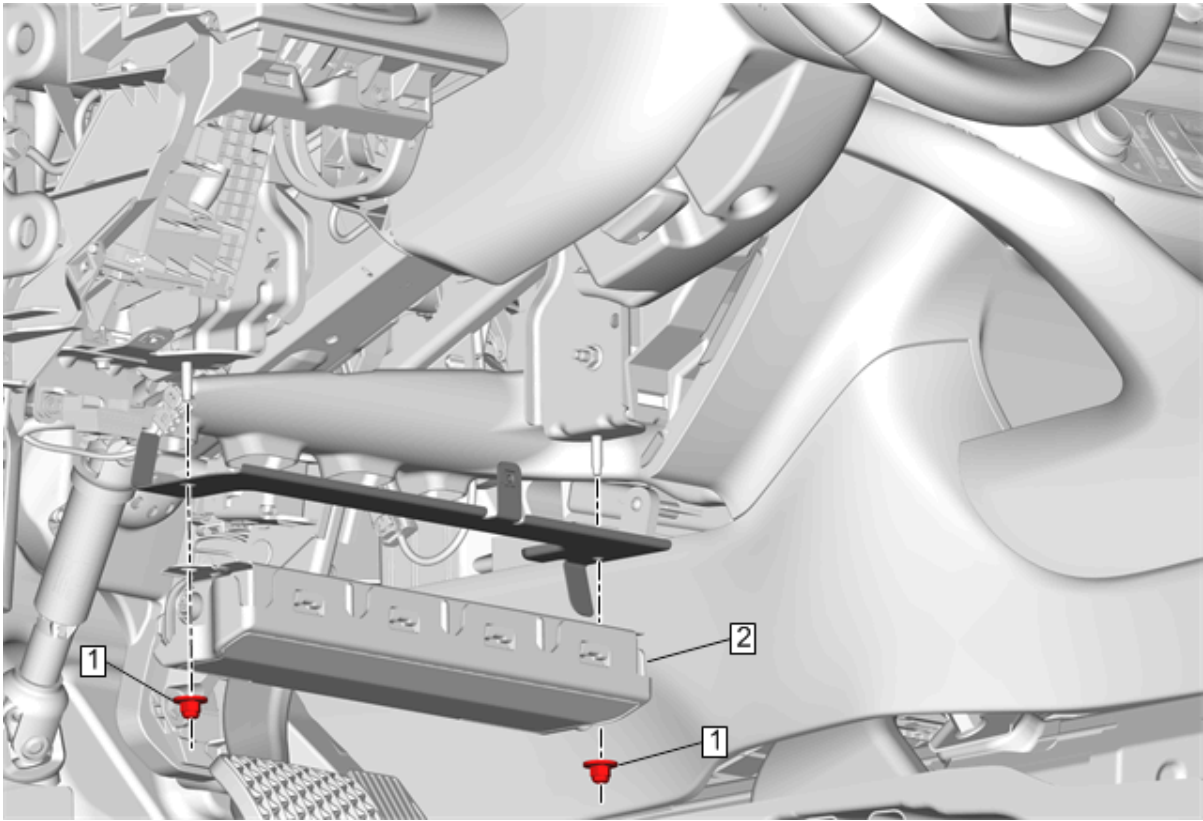


Fig. 16: Instrument Panel Lower Airbag - Driver Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: Refer to SIR Warning .	

Callout	Component Name
Preliminary Procedure 1. Disable the SIR system. SIR Disabling and Enabling 2. Instrument Panel Knee Bolster Replacement	
1	Instrument Panel Lower Airbag Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Instrument Panel Lower Airbag - Driver Side Procedure 1. Disconnect the electrical connector. 2. Inflatable Restraint Module Handling and Scrapping 3. Enable the SIR System. SIR Disabling and Enabling NOTE: Instrument panel airbag lower bracket shares the same fasteners and will need to be reinstalled in the correct direction.

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - PASSENGER SIDE

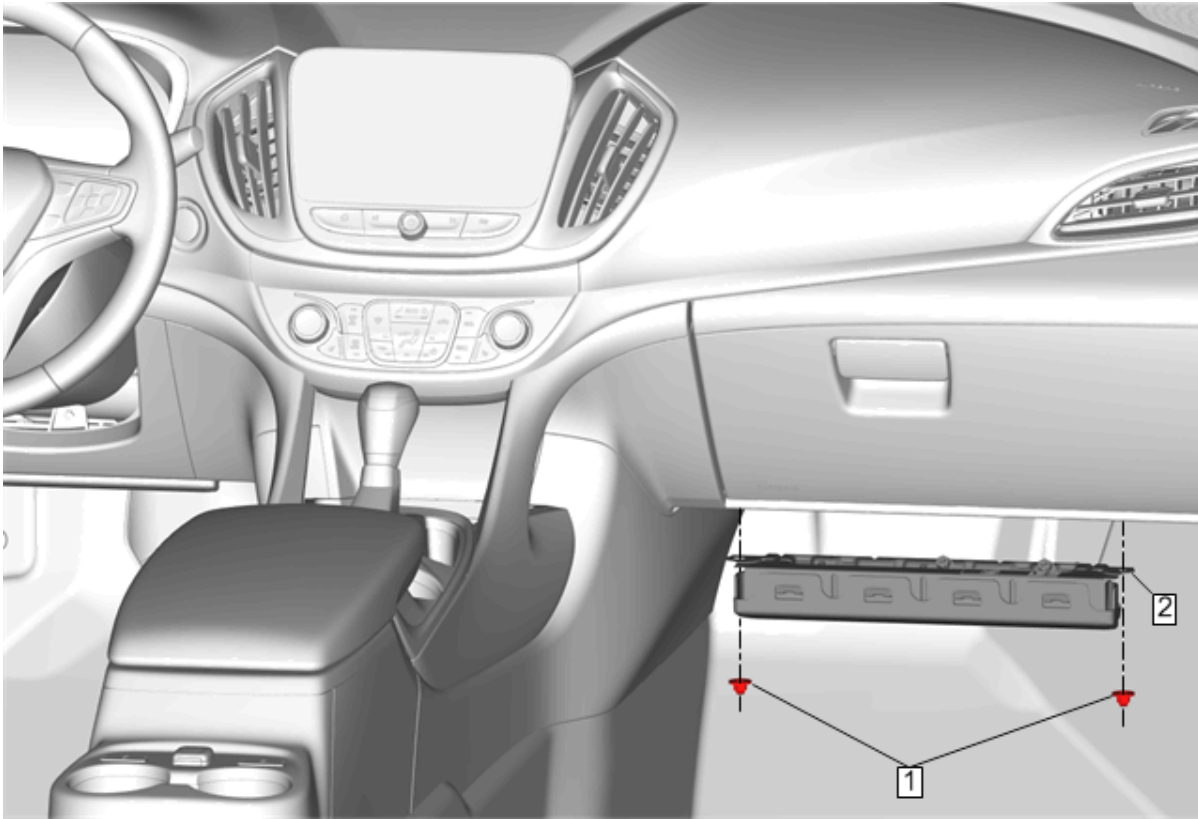


Fig. 17: Instrument Panel Lower Airbag - Passenger Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: Refer to SIR Warning . Preliminary Procedure SIR Disabling and Enabling	
1	Instrument Panel Lower Airbag Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten

Callout	Component Name
	9 N.m (80 lb in)
2	Instrument Panel Lower Airbag - Passenger Side Procedure 1. Disconnect the electrical connector. 2. <u>Inflatable Restraint Module Handling and Scrapping</u> 3. <u>SIR Disabling and Enabling</u>

AIRBAG FRONT PASSENGER PRESENCE MODULE REPLACEMENT

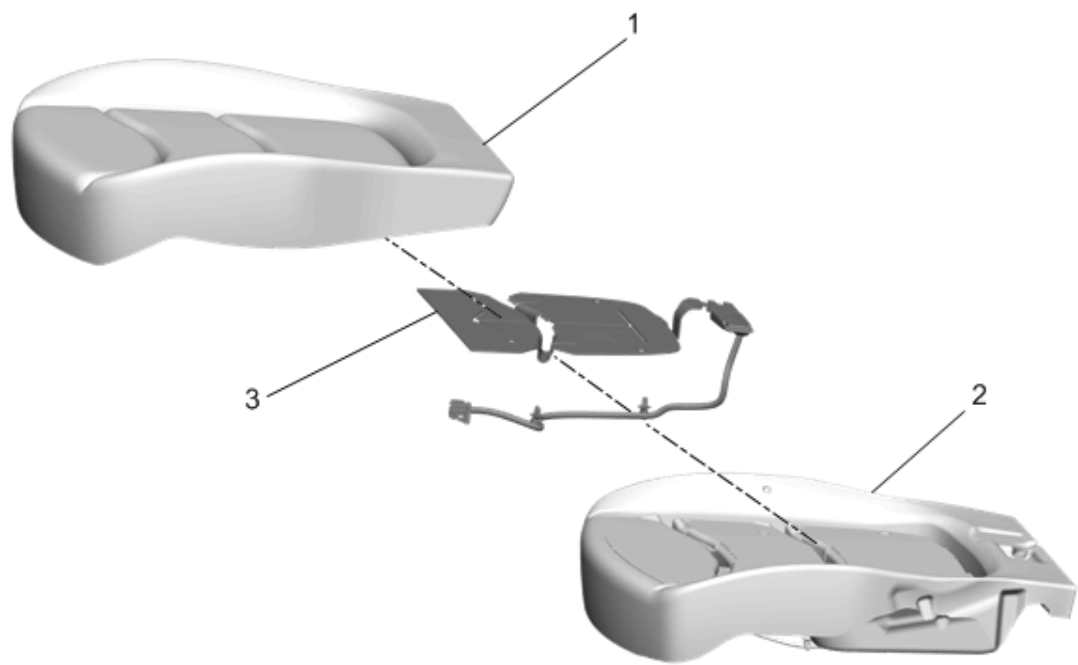


Fig. 18: Airbag Front Passenger Presence Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING: To avoid personal injuries, re-zero the	

Callout	Component Name
passenger presence system whenever you remove or replace the seat cushion or trim. Failure to do so may cause the system to malfunction.	
Preliminary Procedure Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Cushion Cover
2	Front Seat Cushion Pad
3	Airbag Front Passenger Presence Module Assembly Procedure 1. Remove the hog rings that attach the passenger presence system to the foam cushion pad. 2. Remove the passenger presence system from the foam cushion pad and heater assembly, if equipped. 3. Note the routing of the wiring harness and connector location for installation. 4. Control Module References for programming or setup information, if required.

FRONT AND REAR ROW SEAT ROOF RAIL AIRBAG REPLACEMENT

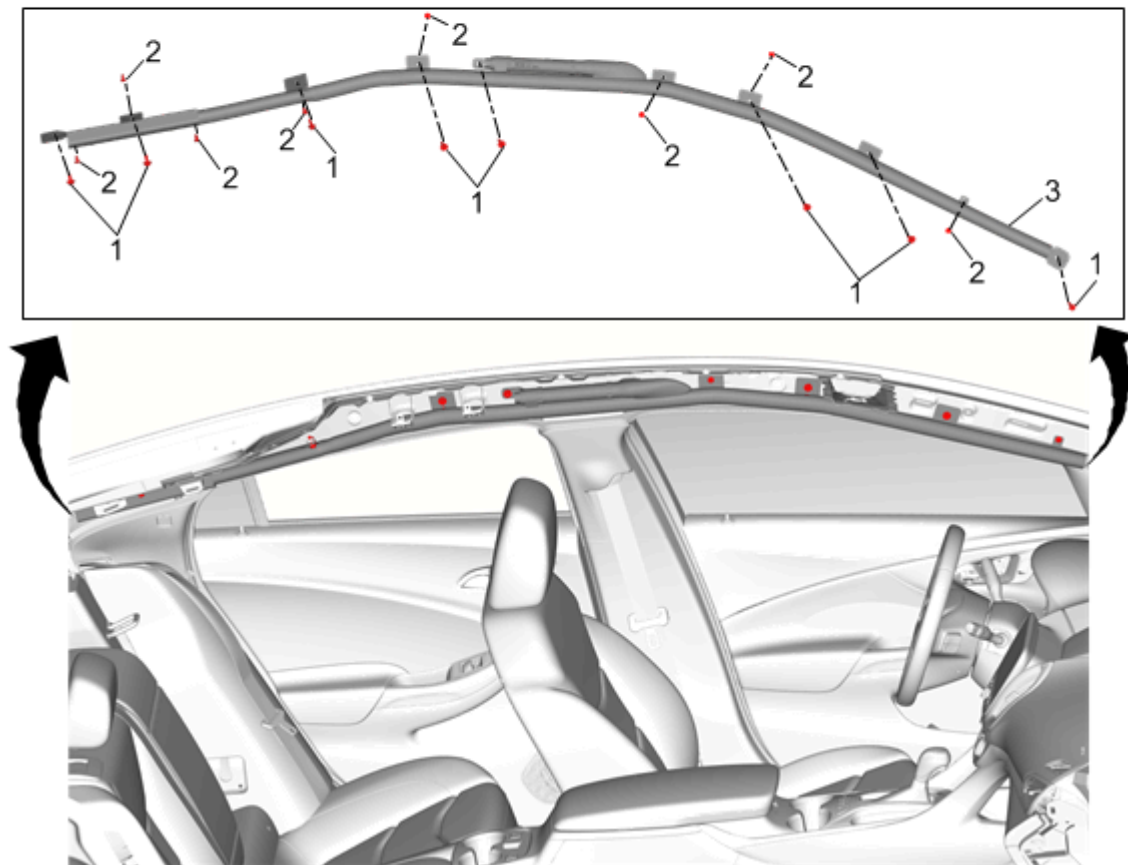


Fig. 19: Front And Rear Row Seat Roof Rail Airbag

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . Preliminary Procedures 1. SIR Disabling and Enabling	

Callout	Component Name
2. It is only necessary to lower the headliner. Only do those steps in headliner replacement that will lower the headliner enough to gain access to the part. Headlining Trim Panel Replacement	
1	Front and Rear Row Seat Roof Rail Airbag Fastener (Qty: 8) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Front and Rear Row Seat Roof Rail Airbag Retainer (Qty: 8)
3	Front and Rear Row Seat Roof Rail Airbag Procedure 1. Disconnect the electrical connector. 2. Remove the roof side rail inflatable restraint module from the vehicle. 3. Inflatable Restraint Module Handling and Scrapping

FRONT SEAT OUTBOARD SEAT BACK AIRBAG REPLACEMENT

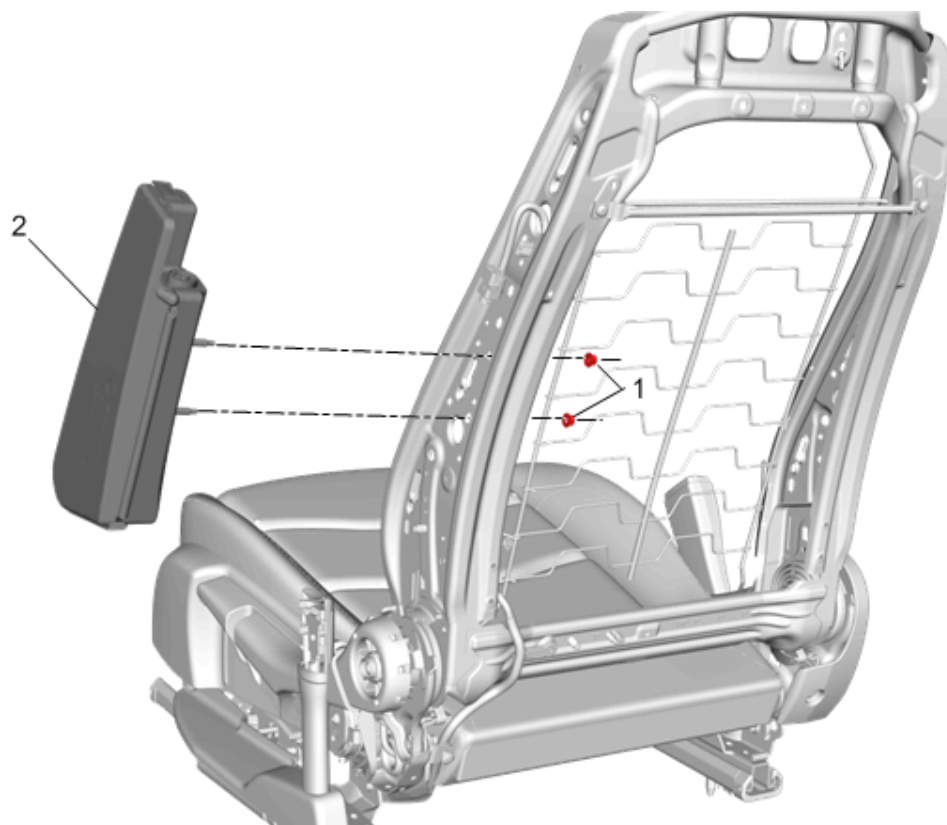


Fig. 20: Front Seat Outboard Seat Back Airbag

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedure <u>Driver or Passenger Seat Back Cover and Pad Replacement</u>	
1	Front Seat Outboard Seat Back Airbag Nut (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Procedure 1. Reposition the wiring harness.

Callout	Component Name
	2. Remove the protective caps from the nuts. Tighten 3.5 N.m (31 lb in)
2	Front Seat Outboard Seat Back Airbag Procedure 1. Remove the connector position assurance (CPA) from the module electrical connector. 2. Disconnect the electrical connector. 3. <u>Inflatable Restraint Module Handling and Scrapping</u>

REAR SEAT BOLSTER AIRBAG REPLACEMENT

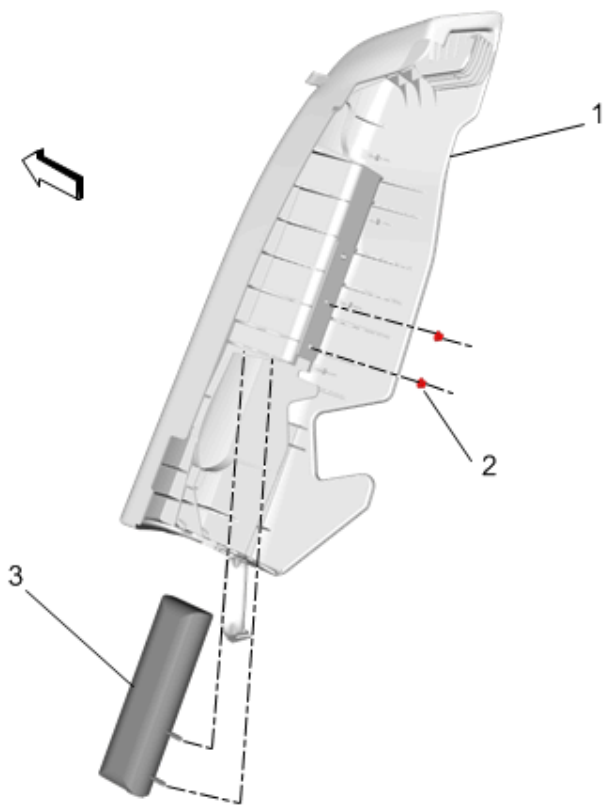


Fig. 21: Rear Seat Bolster Airbag
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING:	

Callout	Component Name
Following the deployment of a rear seat side air bag, inspect the following parts for damage. Replace these parts if necessary: • The rear seat side bolster, attachments, brackets and wiring • The rear seat back frame, cushion and cover • The rear seat cushion frame, cushion and cover Failure to do so may cause future personal injury. Preliminary Procedure Rear Seat Back Bolster Replacement	
1	Rear Seat Back Bolster
2	Rear Seat Bolster Airbag Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 3.25 N.m (29 lb in)
3	Rear Seat Bolster Airbag Procedure

Callout	Component Name
	1. Disconnect the electrical connector. 2. <u>Inflatable Restraint Module Handling and Scrapping.</u>

AIRBAG SIDE IMPACT REAR SENSOR REPLACEMENT

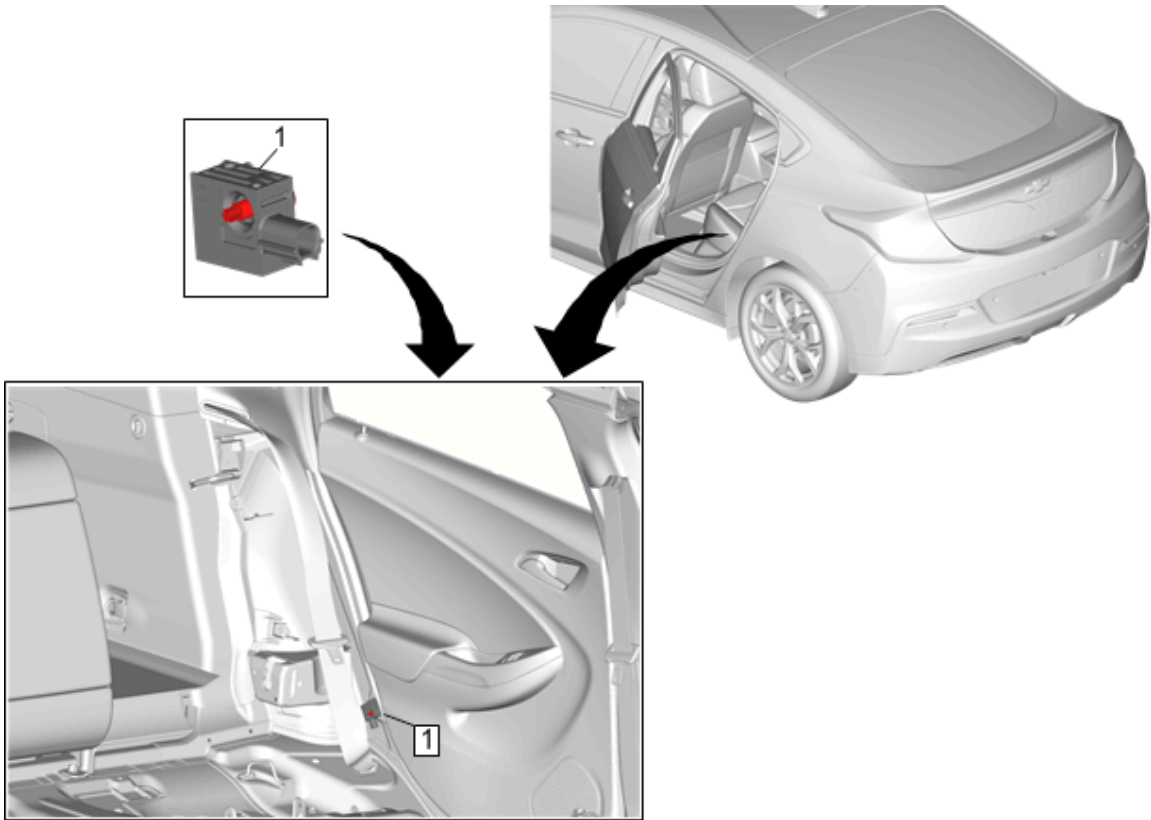


Fig. 22: Airbag Side Impact Rear Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING:	
Refer to <u>SIR Warning</u> .	
WARNING:	
Refer to <u>SIR Inflator Module Handling and Storage Warning</u> .	
WARNING:	

Callout	Component Name
Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary: • The seat cushion frame • The seat recliner, if equipped • The seat adjuster • The seat back frame Failure to do so may cause future personal injury. Preliminary Procedures 1. SIR Disabling and Enabling 2. Rear Seat Back Bolster Replacement	
1	Airbag Side Impact Rear Sensor CAUTION: Refer to Fastener Caution . Procedure 1. Disconnect the electrical connector. 2. Loosen the fastener and slide the sensor out of the keyhole slot.

Callout	Component Name
	NOTE: Integral sensor assembly bolt uses Left Hand threads. Use counterclockwise rotation to loosen fastener at TORX® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt. Tighten 7.5 N.m (66 lb in)

FRONT SEAT BELT RETRACTOR REPLACEMENT

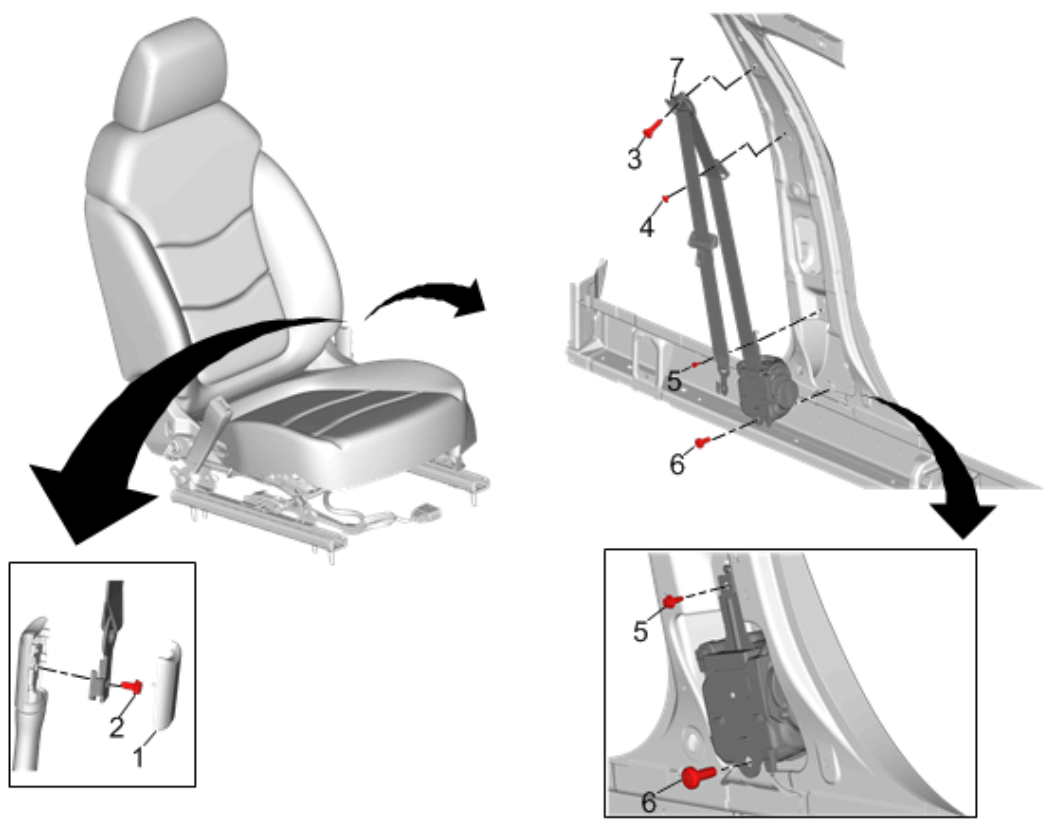


Fig. 23: Front Seat Belt Retractor Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . WARNING: In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflatable restraint seat belt pretensioner as normal shop waste. Undeployed seat belt pretensioners contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely	

Callout	Component Name
dispose of an undeployed seat belt pretensioner. Failure to observe the following disposal methods may be a violation of appropriate country, regional or local laws. Preliminary Procedures 1. SIR Disabling and Enabling 2. Center Pillar Upper Trim Panel Replacement 3. Move the front seat to a full forward and full up position.	
1	Front Seat Belt Anchor Plate Tensioner Cover
2	Front Seat Belt Anchor Plate Tensioner Cover Bolt CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
3	Front Seat Belt Retractor D Ring Bolt Tighten 45 N.m (33 lb ft)
4	Front Seat Belt Intermediate Guide Retainer
5	Front Seat Belt Retractor Bolt - Upper Tighten 9 N.m (80 lb in)
6	Front Seat Belt Retractor Bolt - Lower Tighten 45 N.m (33 lb ft)
7	Front Seat Belt Retractor 1. Disconnect the electrical connector.

Callout	Component Name
	2. <u>Pretensioner Handling and Scrapping</u>

FRONT SEAT BELT ANCHOR PLATE TENSIONER REPLACEMENT



Fig. 24: Front Seat Belt Anchor Plate Tensioner
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to <u>SIR Warning</u> . WARNING: Refer to <u>SIR Inflator Module Handling and Storage Warning</u> . Preliminary Procedures <u>SIR Disabling and Enabling</u> <u>Driver or Passenger Seat Removal and Installation</u>	

Callout	Component Name
3. <u>Front Seat Belt Anchor Plate Tensioner Cover Replacement</u>	
1	Front Seat Belt Anchor Plate Tensioner Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 45 N.m (33 lb ft)
2	Front Seat Belt Anchor Plate Tensioner Procedure Disconnect the electrical connector.

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

Accident With or Without Air Bag Deployment - Component Inspections

WARNING: Proper operation of the Supplemental Inflatable Restraint (SIR) sensing system requires that any repairs to the vehicle structure return the vehicle structure to the original production configuration. Not properly repairing the vehicle structure could cause non-deployment of the air bag(s) in a frontal collision or deployment of the air bag(s) for conditions less severe than intended.

After any collision, inspect the following components as indicated. If you detect any damage, replace the component. If you detect any damage to the mounting points or mounting hardware, repair the component or replace the hardware as needed.

- The high voltage system - Inspect the high voltage system. Refer to High Voltage System Inspection .
- The steering column - Inspect the steering column for bending, twisting, buckling or any type of damage.
- The instrument panel knee bolsters and mounting points - Inspect the knee bolsters for bending, twisting, buckling, or any other type of damage.
- The instrument panel brackets, braces, etc. - Inspect for bending, twisting, buckling, or any other type of damage.
- The seat belts - Perform the seat belt operational and functional checks. Refer to Repairs and Inspections Required After a Collision .
- The instrument panel cross car beam - Inspect for bending, twisting, buckling, or any other type of damage.
- The instrument panel mounting points and brackets - Inspect for bending, twisting, buckling, or any other type of damage.
- The seats and seat mounting points - Inspect for bending, twisting, buckling, or any other type of damage.
- The roof and headliner mounting points.
- The brake pedal --Inspect the brake pedal for bending, twisting, buckling or any type of damage.

Accident With Frontal Air Bag Deployment - Component Replacement and Inspections

After a collision involving air bag deployment, replace the following components.

- Driver steering wheel air bag
- Passenger instrument panel air bag, if deployed
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and Diagnostic Module has set DTC B0052 and will not clear
- Front and/or side impact sensors
- Driver/Passenger seat side air bag, if deployed
- Seat back cover if side seat air bag is deployed
- Driver/Passenger seat belt anchor and/or retractor pretensioners

Perform additional inspections on the following components.

- Steering wheel air bag coil and the coil wiring pigtail - Inspect for melting, scorching, or other damage due to excessive heat.
- Mounting points or mounting hardware for the passenger instrument panel air bag, steering wheel air bag, SDM, seat side air bag (if deployed) and seat belt anchor and/or retractor pretensioners - Inspect for any damage and repair or replace each component as needed.

Accident With Side Seat Air Bag Deployment - Component Replacement and Inspections

After a collision involving driver/passenger side seat air bag deployment, replace the following components.

- Left/right side impact sensors on the side of the impact.
- Left/right roof rail air bag on the side of the impact.
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and Diagnostic Module has set DTC B0052 and will not clear
- Inflatable restraint seat belt anchor and/or retractor pretensioner.
- Driver or passenger seat back cushion cover replacement.

WARNING: Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury.

Perform additional inspections on the following components.

- Mounting points or mounting hardware for the side impact sensors, and driver/passenger side seat air bags on the side of impact - Inspect for any damage and repair or replace each component as needed.
- Mounting points, mounting hardware, headliner and trim pieces for the left/right roof rail air bag on the side of impact - Inspect for any damage and repair or replace each component as needed.
- Mounting points or mounting hardware for the SDM and seat belt anchor and/or retractor pretensioners - Inspect for any damage and repair or replace each component as needed.
- The seat cushion frame

- The seat recliner and cover, if equipped
- The seat adjuster
- The seat back frame
- Door trim assembly
- Impacted seat cushion side covers and switches

Impact Sensor Replacement Guidelines

The impact sensor replacement policy requires replacing sensors in the area of the accident damage. The area of accident damage is defined as the portion of the vehicle which is crushed, bent, or damaged due to a collision. An example of this would be a moderate collision where the front of the vehicle impacts a object. If the vehicle has an impact sensor mounted forward of the radiator, it must be replaced.

- Replace the impact sensor whether or not the air bags have deployed.
- Replace the impact sensor even if it appears to be undamaged.

Impact sensor damage which is not visible, such as slight bending of the mounting bracket or cuts in the wire insulation, can cause improper operation of the SIR system. Do not try to determine whether the impact sensor is undamaged, replace the impact sensor. Also, if you follow a diagnostic trouble code (DTC) procedure and a malfunctioning impact sensor is indicated, replace the impact sensor.

INFLATABLE RESTRAINT MODULE HANDLING AND SCRAPPING

Special Tools

- **EL-38826** SIR Deployment Harness
- **EL-39401-B** SIR Deployment Fixture

For equivalent regional tools, refer to [Special Tools](#).

Live and Undeployed Air Bag

WARNING: Refer to [SIR Inflator Module Handling and Storage Warning](#) .

Take special care when handling or storing an undeployed air bag. An air bag deployment produces a rapid generation of gas. This may cause the air bag, or an object in front of the air bag, to project through the air in the event of an unlikely deployment.

Dual Stage Air Bags

Dual stage air bags have two deployment stages. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. Therefore, a deployed dual stage air bag must be treated as an active air bag. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.

Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will require the disposal of a live and undeployed air bag. Do NOT dispose a live and undeployed air bag through normal disposal channels until the air bag has been deployed.

Do not deploy the air bag in the following situations:

- After replacement of an air bag under warranty - the air bag may need to be returned undeployed to the manufacturer.
- If the vehicle is the subject of a product liability claim, related to the SIR system and is subject to a preliminary investigation - do NOT alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the air bags - follow the instructions in the campaign service bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.

You can deploy the air bag either inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation:

Deployment Outside Vehicle - Steering Wheel Air Bag, Instrument Panel Air Bag, and Roof Rail Air Bag

Deploy the air bag outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the air bag is malfunctioning.
- The air bag is cosmetically damaged, scratched, or ripped.
- The air bag pigtail is damaged.
- The air bag connector is damaged.
- The air bag connector terminals are damaged.

Deployment and disposal of a malfunctioning air bag is subject to any required retention period.

WARNING: Refer to [SIR Inflator Module Disposal Warning](#) .

1. Vehicle OFF.

WARNING: Refer to [SIR Inflator Module Handling and Storage Warning](#) .

2. Remove the air bag.

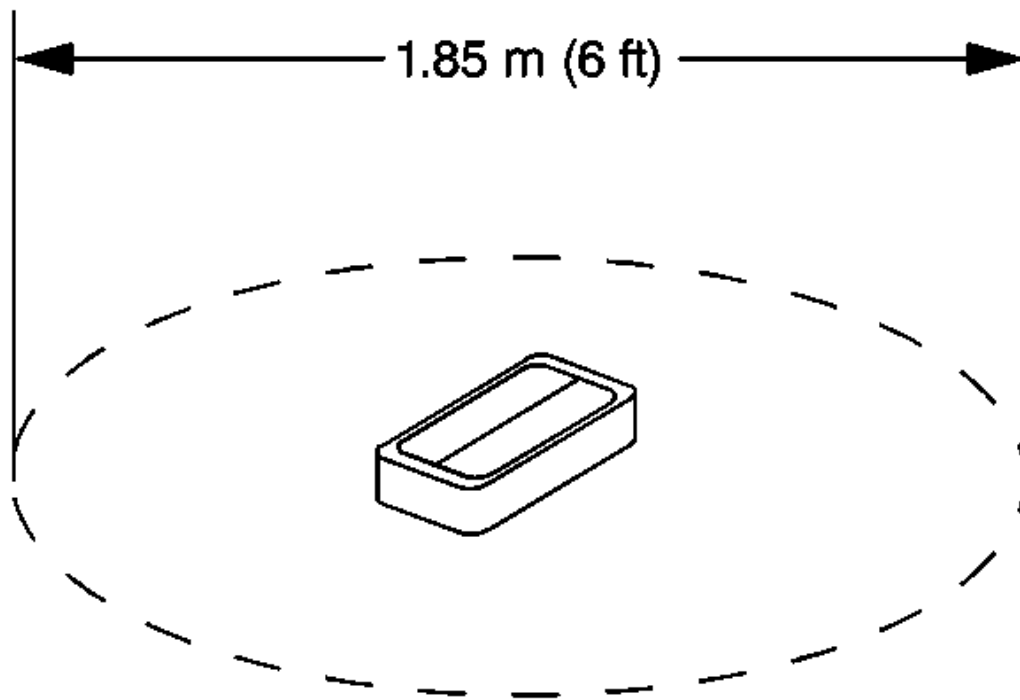


Fig. 25: Identifying Clearance For Deployment Of Inflator Module

Courtesy of GENERAL MOTORS COMPANY

3. Clear a space on the ground about 1.85 m (6 ft) in diameter for deployment of the air bag or deployment fixture. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Ensure you have sufficient ventilation.
4. Clear the area of loose or flammable objects.

NOTE:

Dual stage deployments are only used in steering wheel and instrument panel air bags. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.

5. If you are deploying a steering wheel air bag, place the air bag in the center of the space with the vinyl trim cover facing up and away from the surface.

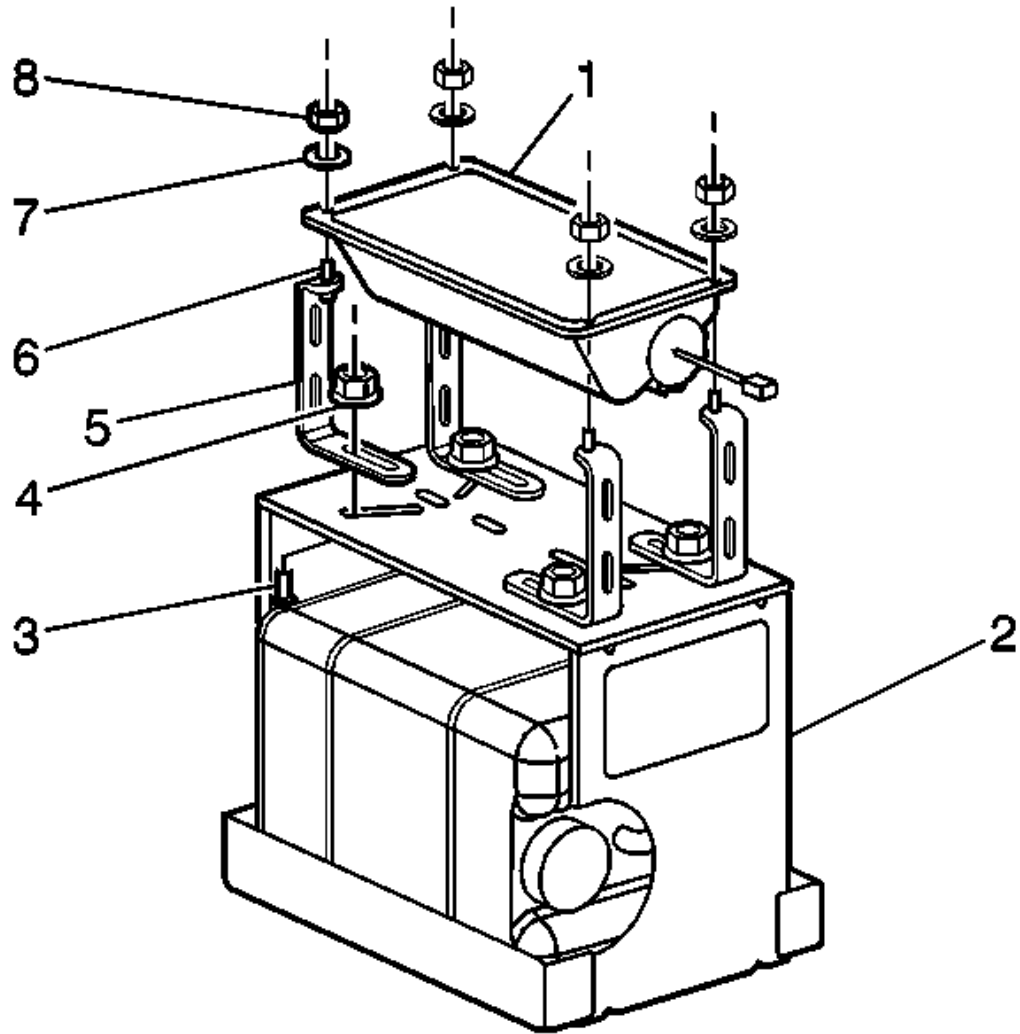


Fig. 26: Identifying I/P Module Components
Courtesy of GENERAL MOTORS COMPANY

6. When deploying an instrument panel air bag, perform the following instructions:
 1. Place the **EL-39401-B** fixture in the center of the cleared area.
 2. Fill the deployment fixture with water or sand.
 3. Using the proper nuts and bolts, mount the instrument panel air bag (1) to the deployment fixture (2), with the vinyl trim facing up.
 4. Securely tighten all fasteners that hold the instrument panel air bag (1) to the deployment fixture (2).

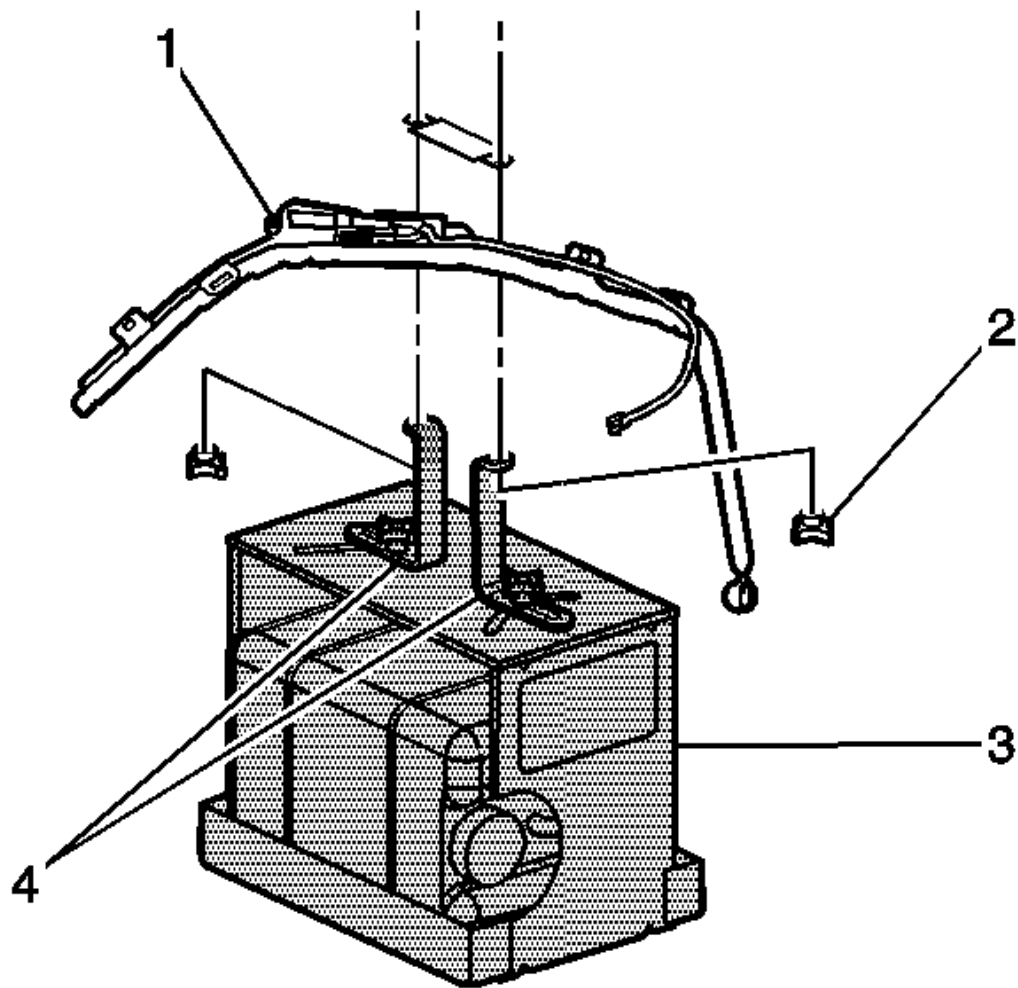


Fig. 27: Identifying Fasteners Holding Side Impact Module To Deployment Fixture
Courtesy of GENERAL MOTORS COMPANY

7. When deploying a roof rail air bag, perform the following instructions:
 1. Place the **EL-39401-B** fixture (3) in the center of the cleared area.
 2. Fill the deployment fixture with water or sand to provide sufficient stabilization of fixture during deployment.
 3. Adjust and secure the fixture arms (4) to the deployment fixture (3), using the proper nuts and bolts.
 4. Attach the roof rail air bag in the deployment fixture and securely tighten all fasteners.

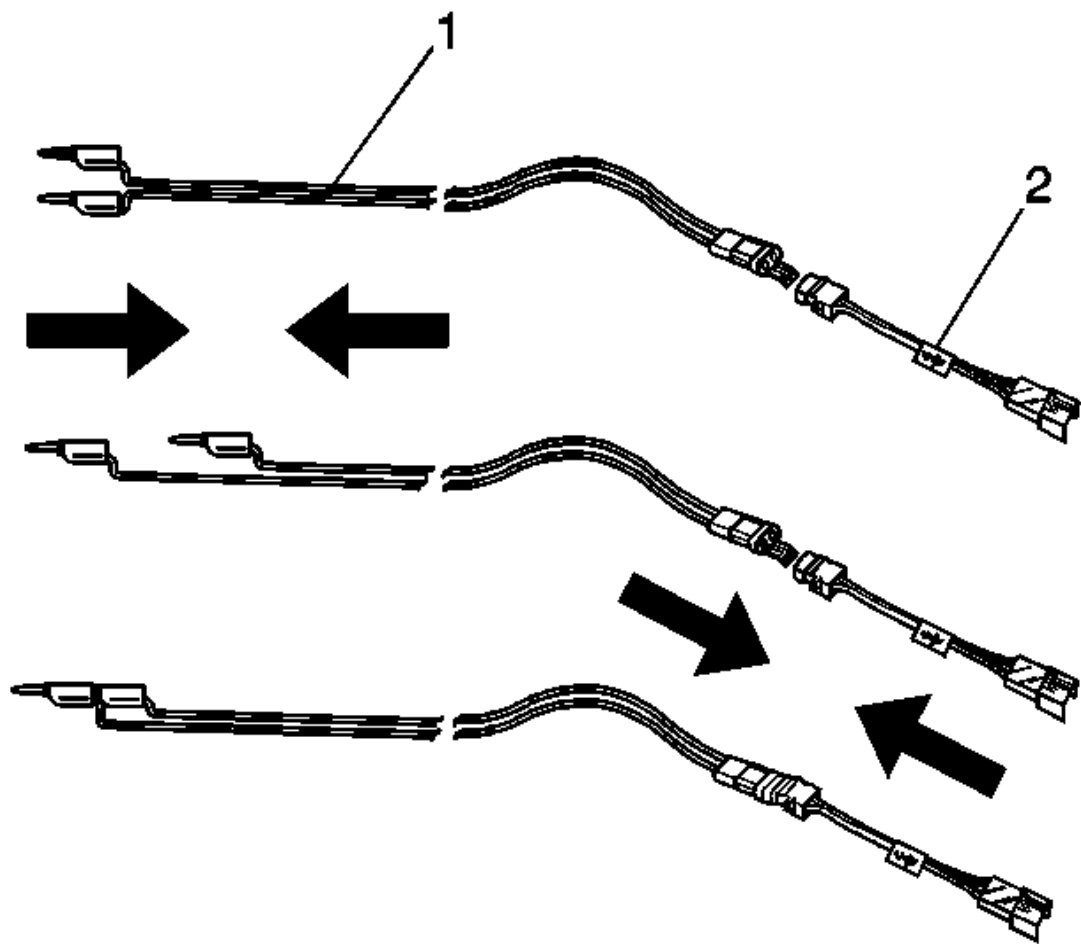


Fig. 28: Identifying SIR Deployment Harness & Adapter

Courtesy of GENERAL MOTORS COMPANY

8. Inspect the **EL-38826** harness and the appropriate pigtail adapter (2) for damage. Replace as needed.
9. Short the 2 SIR deployment harness leads (1) together using one banana plug seated into the other.
10. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

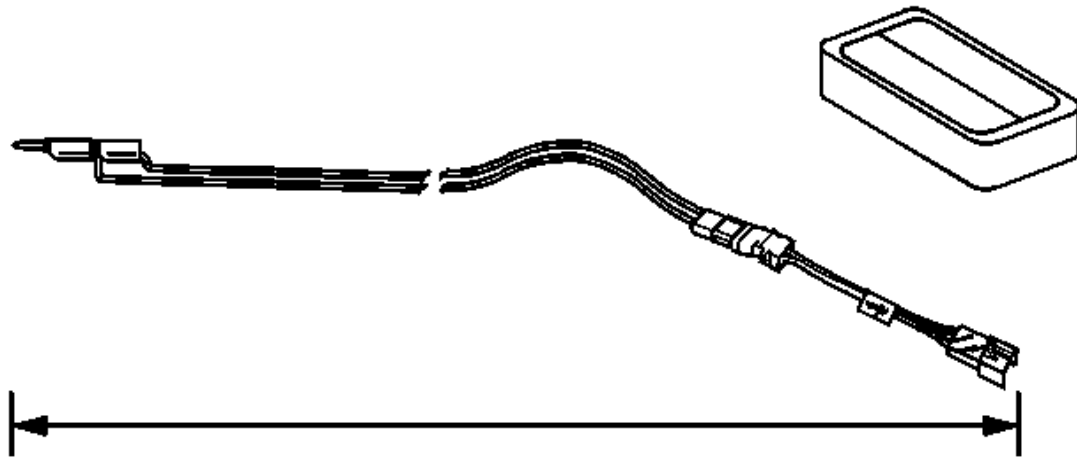


Fig. 29: Extending SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Extend the SIR deployment harness and adapter to the full length from the deployment fixture or area.

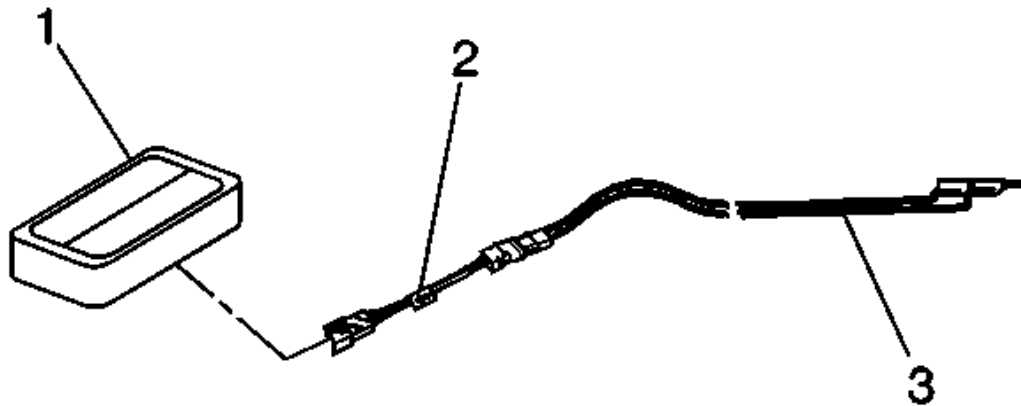


Fig. 30: Identifying Inflator Module, SIR Deployment Harness & Adapter

Courtesy of GENERAL MOTORS COMPANY

NOTE: On a dual stage air bag, both connectors must be attached to the deployment harness adapter. This will ensure that both stage 1 and stage 2 of the deployment loops are energized, regardless of the deployment state.

12. Connect the air bag (1) to the adapter (2) on the SIR deployment harness (3).

NOTE:

- The rapid expansion of gas involved with deploying an air bag is very loud. Notify all the people in the immediate area that you intend to deploy the air bag.
- When the air bag deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the air bag due to the force of the rapid expansion of gas inside the air bag.
- If you are deploying a dual stage air bag with stage 1 already deployed, the fixture may not move and the noise may have been

reduced.

13. Clear the area of people.

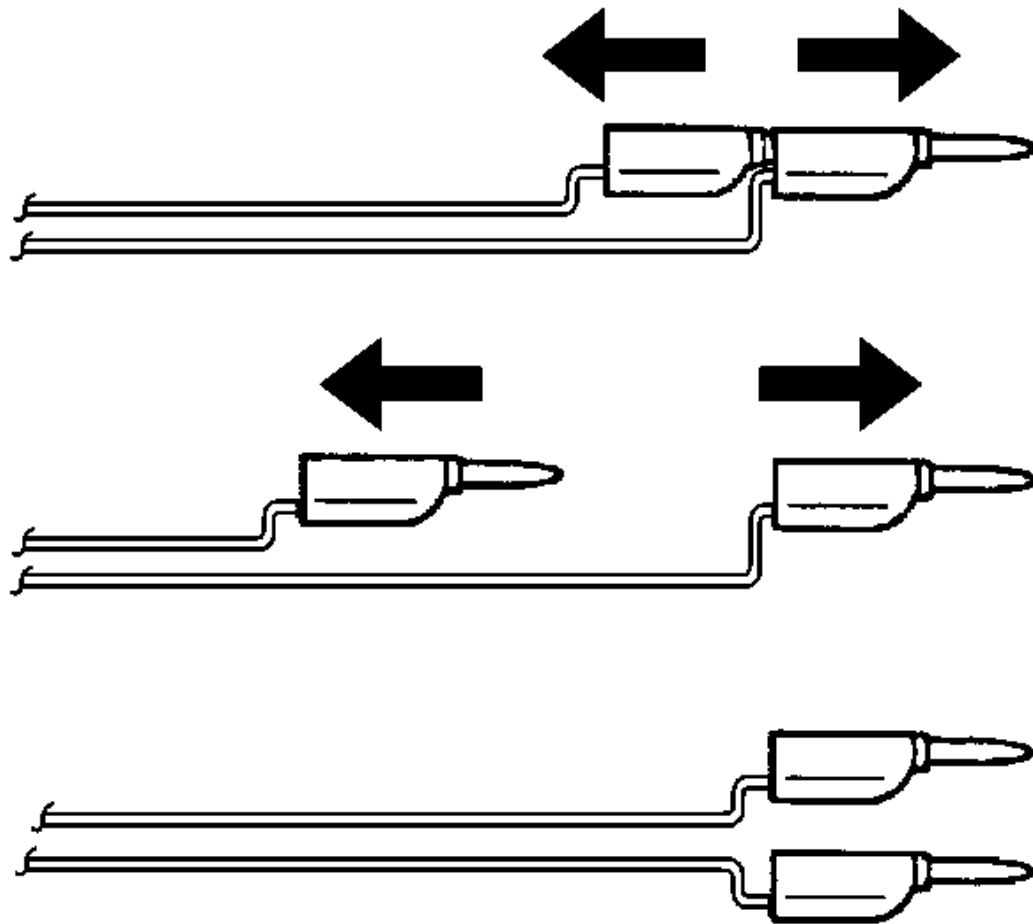


Fig. 31: Separating Banana Plugs

Courtesy of GENERAL MOTORS COMPANY

14. Separate the 2 banana plugs on the SIR deployment harness that were shorted together earlier in the procedure.

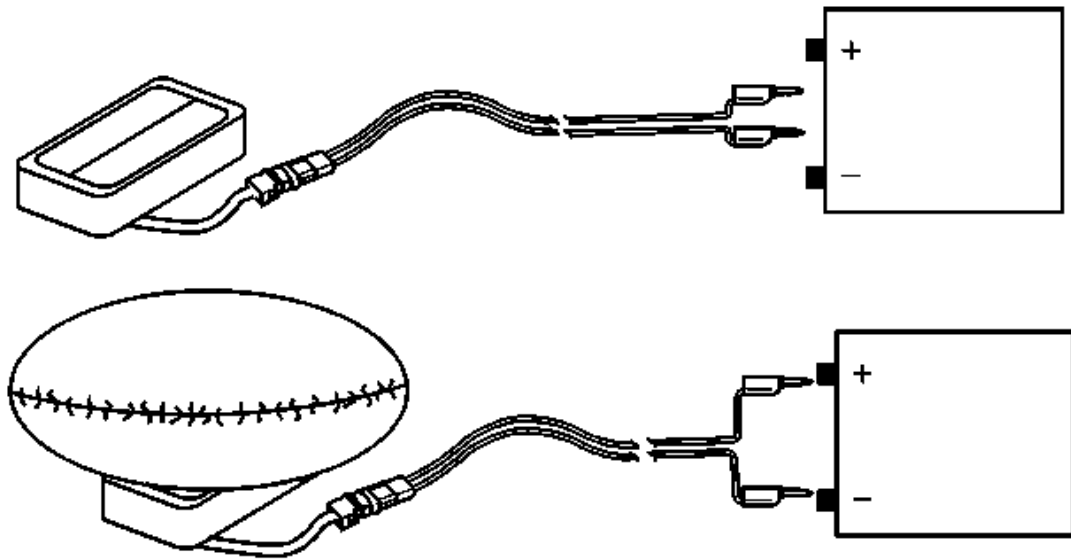


Fig. 32: Identifying SIR Deployment Harness Wires To Power Source

Courtesy of GENERAL MOTORS COMPANY

15. Place a 12 V minimum/2A minimum power source, such as a vehicle battery, near the shorted end of the harness.
16. Connect the SIR deployment harness wires to the power source. Deployment of the air bag will occur when contact is made.

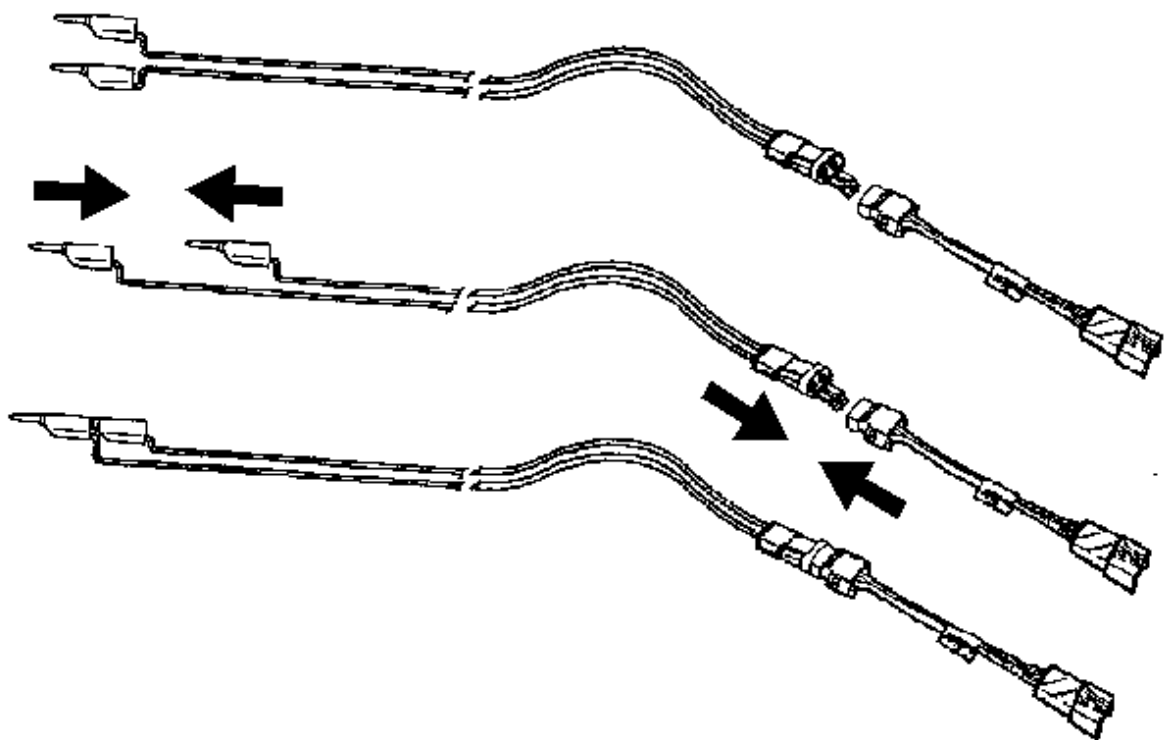


Fig. 33: View Of Deployment Harness Leads

Courtesy of GENERAL MOTORS COMPANY

17. Disconnect the SIR deployment harness from the power source after the air bag deploys.
18. If the air bag did not deploy, disconnect the adapter and discontinue the procedure and contact the Technical Assistance Group.

If deployment was successful, proceed to the following steps.

WARNING: Refer to [SIR Deployed Inflator Modules Are Hot Warning](#) .

19. Seat one banana plug into the other in order to short the deployment harness leads.
20. Put on a pair of shop gloves.
21. Disconnect the pigtail adapter from the air bag as soon as possible.
22. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
23. Dispose of the deployed air bag through normal refuse channels.

24. Wash your hands with a mild soap.

Deployment Inside Vehicle - Vehicle Scrapping Procedure

Deploy the air bags inside of the vehicle when destroying the vehicle or when salvaging the vehicle for parts. This includes, but is not limited to, the following situations:

- The vehicle has completed all useful life.
- Irreparable damage occurred to the vehicle in a non-deployment type accident.
- Irreparable damage occurred to the vehicle during a theft.
- The vehicle is being salvaged for parts to be used on a vehicle with a different VIN, as opposed to rebuilding as the same VIN.

WARNING: Refer to [SIR Inflatable Module Deployment Outside Vehicle Warning](#) .

1. Lower the driver and passenger windows.
2. Vehicle OFF, and remove the key(s) from vehicle.
3. Check that all air bags which will be deployed are mounted securely.
4. Remove all loose objects from the front seats.

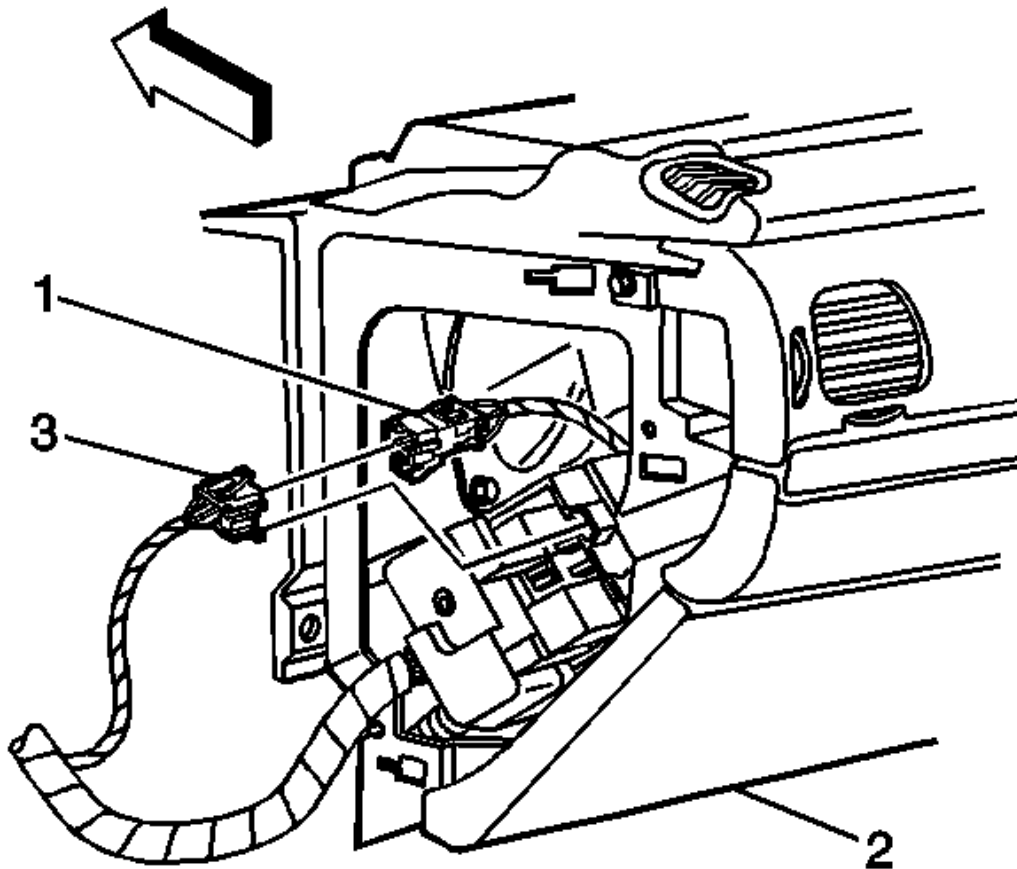


Fig. 34: Identifying I/P Module Connector To Vehicle Harness Connector (LH Side I/P)

Courtesy of GENERAL MOTORS COMPANY

WARNING: A deployed dual stage inflator module will look the same whether one or both stages were used. Always assume a deployed dual stage inflator module has an active stage 2. Improper handling or servicing can activate the inflator module and cause personal injury.

5. Disconnect the steering wheel air bag yellow connector (1) from vehicle harness yellow connector (3).

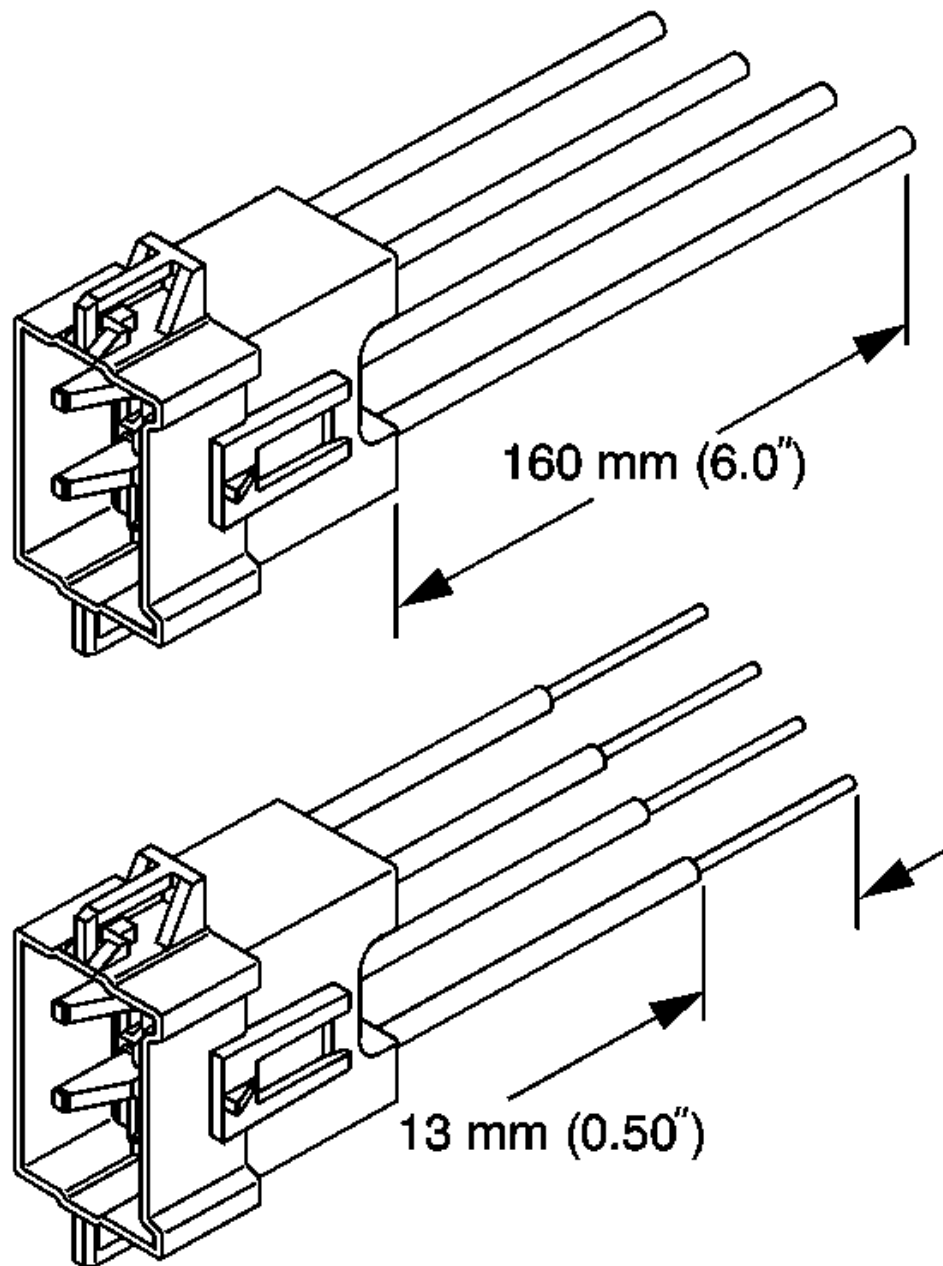


Fig. 35: Stripping SIR Wires

Courtesy of GENERAL MOTORS COMPANY

NOTE:

If the vehicle is equipped with dual stage air bags the steering wheel air bag and instrument panel air bag will each have 4 wires. Refer to [COMPONENT CONNECTOR END VIEWS - INDEX](#) for determining high and low circuits.

6. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
7. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

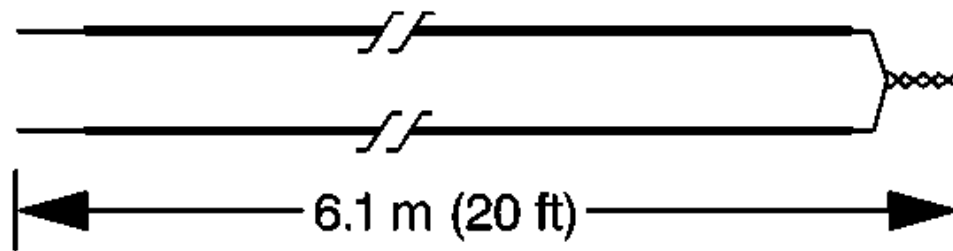


Fig. 36: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS COMPANY

8. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. Use these wires to fabricate the driver deployment harness.
9. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
10. Twist together one end from each of the wires in order to short the wires. Deployment wires shall remain shorted, and not connected to a power source until you are ready to deploy the air bag.

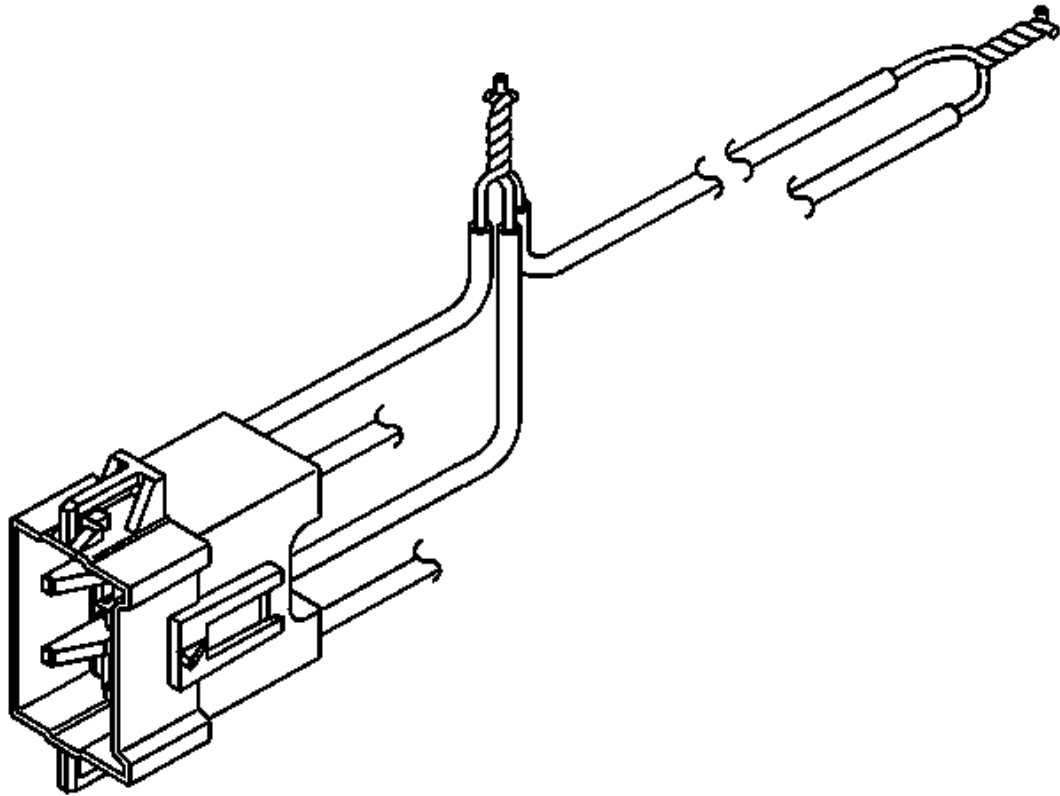


Fig. 37: Twisting Connector Wire Leads (High Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

11. Twist together the 2 connector wire leads from the high circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** in order to determine the correct circuits.
12. Inspect that the 3-wire connection is secure.
13. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.

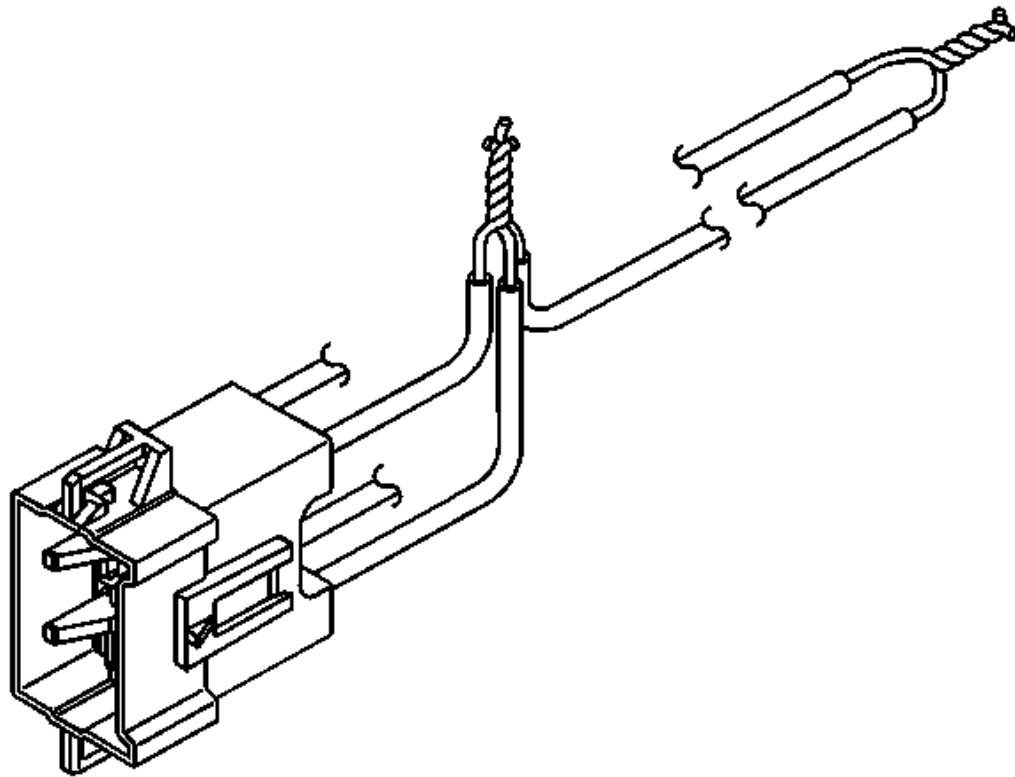


Fig. 38: Twisting Connector Wire Leads (Low Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

14. Twist together the 2 connector wire leads from the low circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** in order to determine the correct circuits.
15. Inspect that the 3-wire connection is secure.
16. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
17. Connect the deployment harness to the connector on the steering wheel air bag.
18. Route the deployment harness out of the driver side of the vehicle.
19. Disconnect the yellow left roof rail harness connector from the vehicle harness connector.
20. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
21. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
22. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
23. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
24. Twist together one end from each of the wires in order to short the wires.

25. Twist together one connector wire lead to one deployment wire.
26. Secure and insulate the connection using electrical tape.
27. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
28. Connect the deployment harness to the yellow connector of the roof rail air bag.
29. Route the deployment harness out of the driver side of the vehicle.

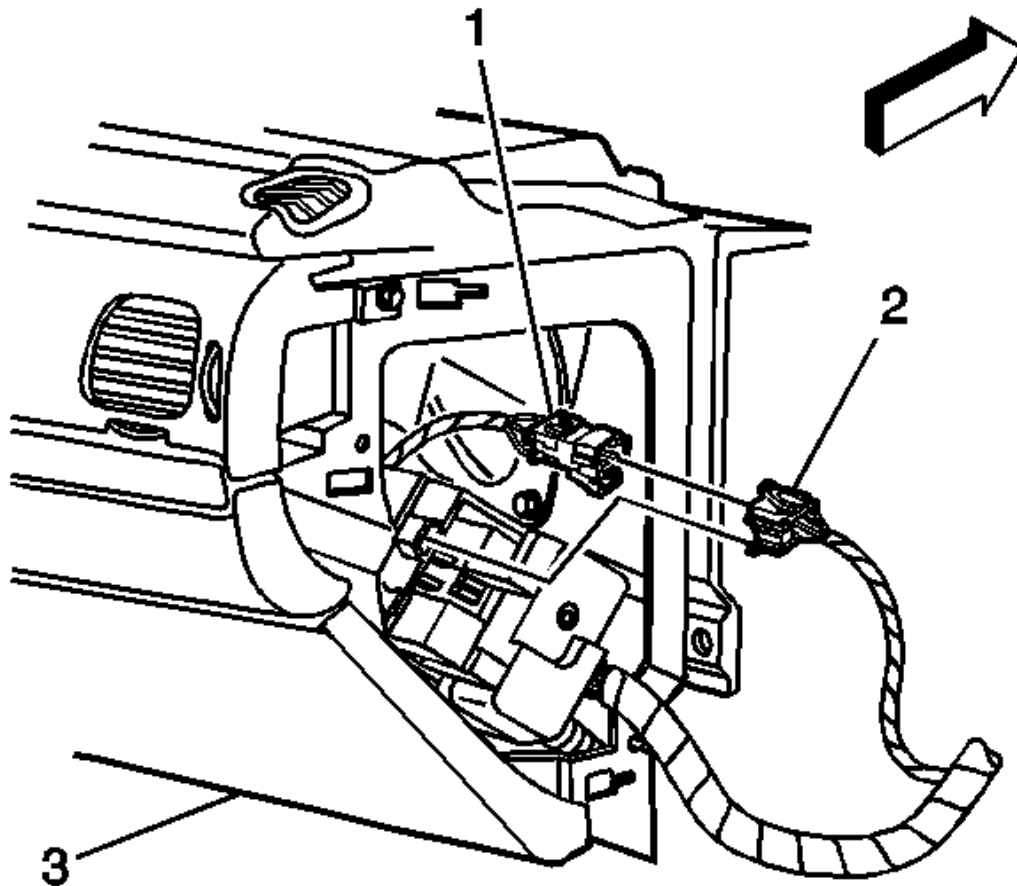


Fig. 39: Identifying I/P Module Connector To Vehicle Harness Connector

Courtesy of GENERAL MOTORS COMPANY

30. Disconnect the instrument panel air bag yellow harness connector (1) from the vehicle harness connector (2).

NOTE: If the vehicle is equipped with dual stage air bags the steering wheel air bag and instrument panel air bag will each have 4 wires. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** for determining high and low circuits.

31. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
32. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

33. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the passenger deployment harness.
34. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
35. Twist together one end from each of the wires in order to short the wires.
36. Twist together the 2 connector wire leads from the high circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to [COMPONENT CONNECTOR END VIEWS - INDEX](#) in order to determine the correct circuits.
37. Inspect that the 3-wire connection is secure.
38. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
39. Twist together the 2 connector wire leads from the low circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to [COMPONENT CONNECTOR END VIEWS - INDEX](#) in order to determine the correct circuits.
40. Inspect that the 3-wire connection is secure.
41. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
42. Connect the deployment harness to the instrument panel air bag in-line connector.
43. Route the deployment harness out of the passenger side of the vehicle.
44. Disconnect the yellow harness connector to the right roof rail air bag from the vehicle harness connector.
45. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
46. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
47. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
48. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
49. Twist together one end from each of the wires in order to short the wires.
50. Twist together one connector wire lead to one deployment wire.
51. Secure and insulate the connection using electrical tape.
52. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
53. Connect the deployment harness to the roof rail air bag yellow connector.
54. Route the deployment harness out of the passenger side of the vehicle.
55. Completely cover the windshield and the front door window openings with a drop cloth.
56. Stretch to the full length all of the deployment harness wires on the right side of the vehicle.
57. Deploy each deployment loop one at a time.
58. Place a power source, 12 V minimum/2A minimum, such as a vehicle battery, near the shorted end of the harnesses.
59. Separate one set of wires and touch the wire ends to the power source in order to deploy the selected air bag.
60. Disconnect the deployment harness from the power source and twist the wire ends together.
61. Continue the same process with the remaining deployment harnesses.
62. Disconnect all harnesses from the vehicle.
63. Discard the harnesses.
64. Scrap the vehicle in the same manner as a non-SIR equipped vehicle.

65. If one or all of the air bags did not deploy, remove the undeployed air bags from the vehicle.

PRETENSIONER HANDLING AND SCRAPPING

Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) pretensioner. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner. Deploy the pretensioner before disposal. Do not dispose of a live (undeployed) pretensioner through normal disposal channels until the pretensioner has been deployed. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner.

- After replacement of a pretensioner under warranty. The pretensioner may need to be returned undeployed to the original manufacturer of pretensioner.
- If the vehicle is the subject of a Product Liability report related to the SIR system and is subject to a Preliminary Investigation (GM-1241). Do not alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the pretensioners. Follow the instructions in the Campaign Service Bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.

The pretensioner can be deployed inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation.

Deployment Inside the Vehicle

Refer to **Inflatable Restraint Module Handling and Scrapping** for deploying the pretensioner inside vehicle under Vehicle Scrapping Procedure.

Deployment Outside Vehicle for Seat Belt Pretensioners

Deploy the seat belt pretensioners outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the seat belt pretensioner is malfunctioning.
- The pretensioner pigtail (if equipped) is damaged.
- The pretensioner connector is damaged.
- The pretensioner connector terminal is damaged.

Deployment and disposal of a malfunctioning seat belt pretensioner is subject to any required retention period.

WARNING: In order to prevent accidental deployment of the pretensioner which could cause personal injury, do not dispose of an undeployed pretensioner as normal shop waste. The undeployed pretensioner contains substances that could

cause severe illness or personal injury if the sealed container is damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed pretensioner. Failure to dispose of a pretensioner as instructed may be a violation of federal, state, or local laws.

WARNING: When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

Special Tools

- **EL-39401-B** SIR Deployment Fixture
- **EL-38826** SIR Deployment Harness

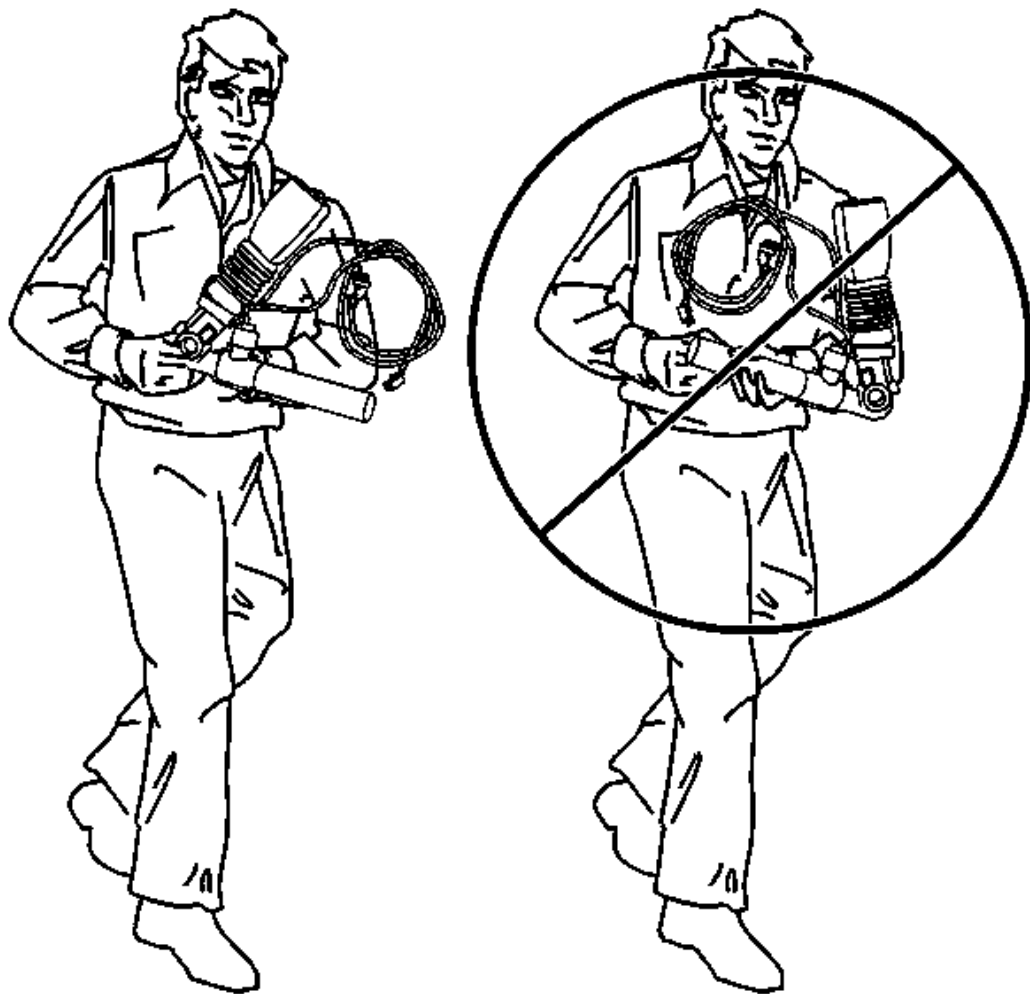


Fig. 40: Proper Pretensioner Carrying

Courtesy of GENERAL MOTORS COMPANY

1. Turn the ignition switch to the OFF position.
2. Remove the ignition key.

3. Put on safety glasses.
4. Remove the seat belt pretensioner from the vehicle.
5. When carrying a pretensioner to the deployment area keep the open end of pretensioner pointed away from the body.

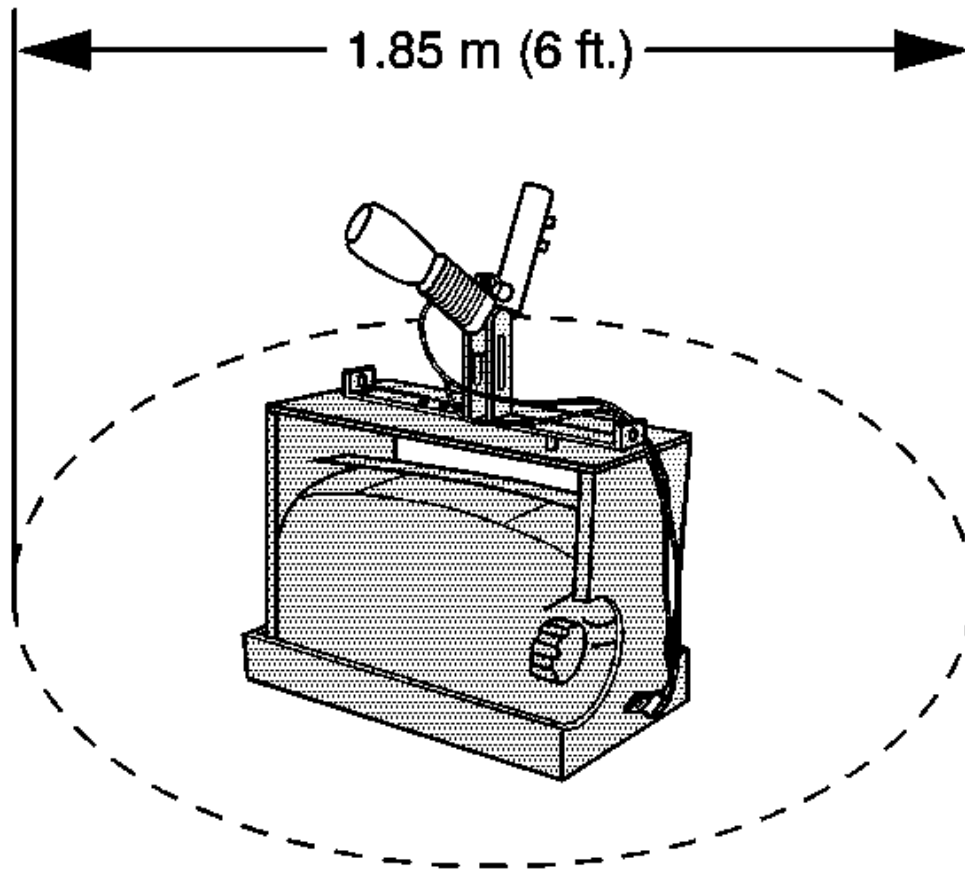


Fig. 41: Pretensioner Deployment Area

Courtesy of GENERAL MOTORS COMPANY

6. Clear a space on the ground about 1.85 M (6 ft) in diameter for deployment of the pretensioner. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Make sure you have sufficient ventilation.
7. Make sure no loose or flammable objects are in the area.
8. Place the **EL-39401-B** SIR deployment fixture in the center of the cleared area.
9. Fill the fixture plastic reservoir with water or sand.

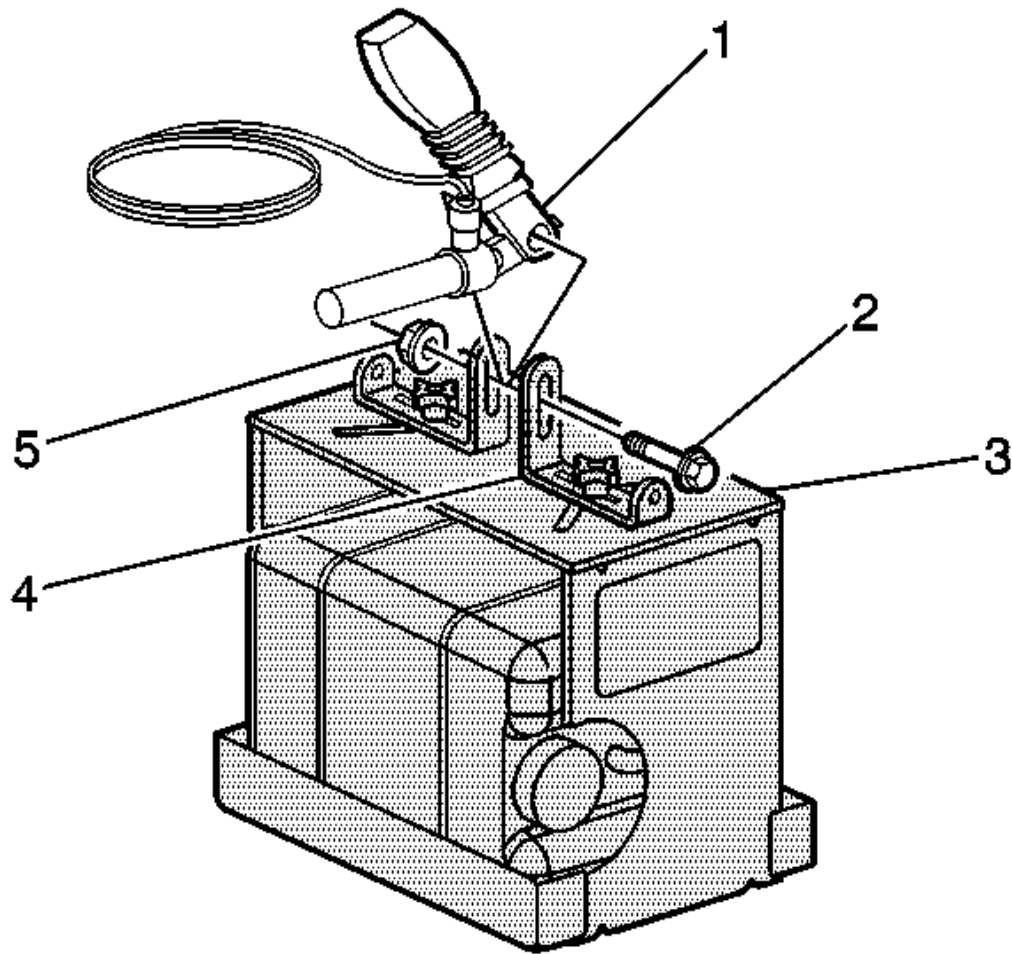


Fig. 42: Mounting Pretensioner In SIR Deployment Fixture

Courtesy of GENERAL MOTORS COMPANY

10. Mount the pretensioner (1) in the SIR deployment fixture (3) with the open end facing up using the following mounting method.
 1. Adjust and secure the EL-39401-B arms (4) to the deployment fixture (3).
 2. To mount, use the proper size bolt (2) and nut (5) with washers in order to secure the pretensioner (1) to the deployment fixture brackets (4).
 3. Securely tighten all fasteners prior to deployment.

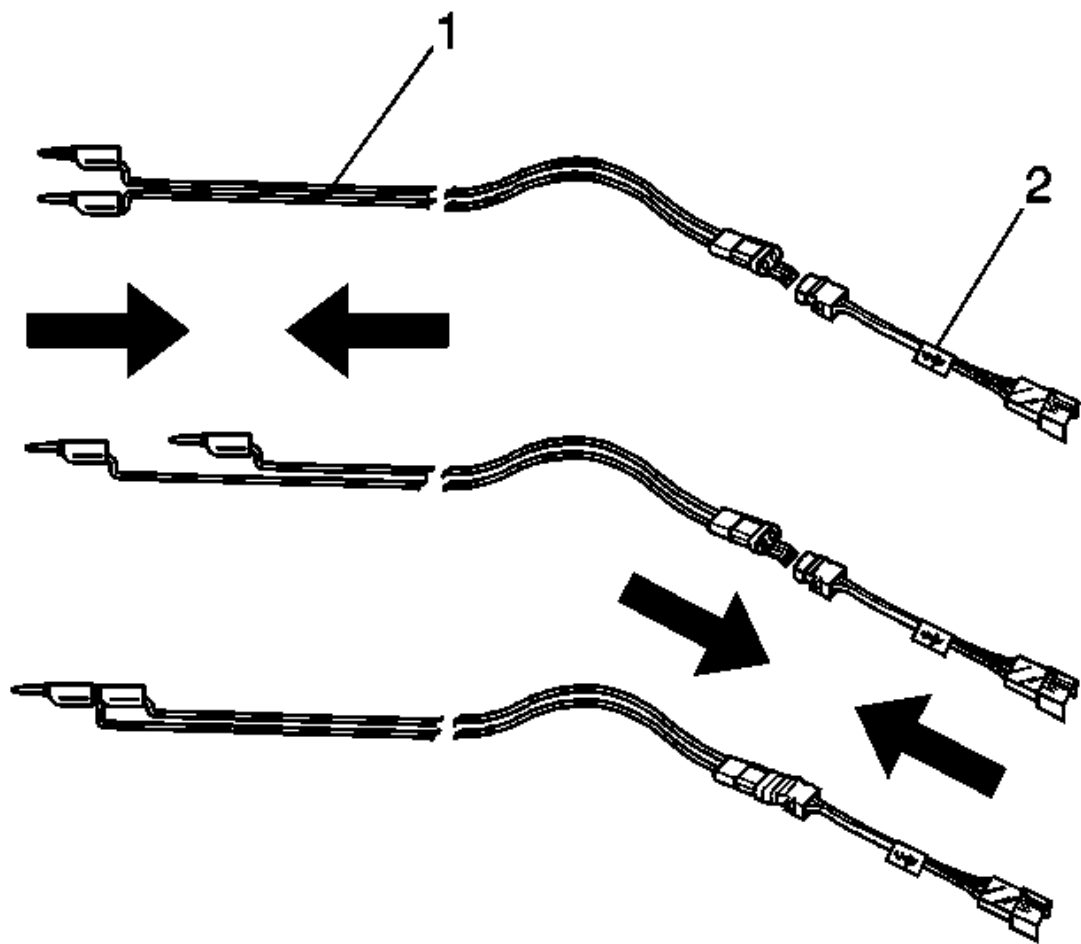


Fig. 43: Identifying SIR Deployment Harness & Adapter

Courtesy of GENERAL MOTORS COMPANY

11. Inspect the **EL-38826** SIR deployment harness and the appropriate pigtail adapter for damage. Replace as needed.
12. Short the 2 SIR deployment harness (1) leads together using one banana plug seated into the other.
13. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

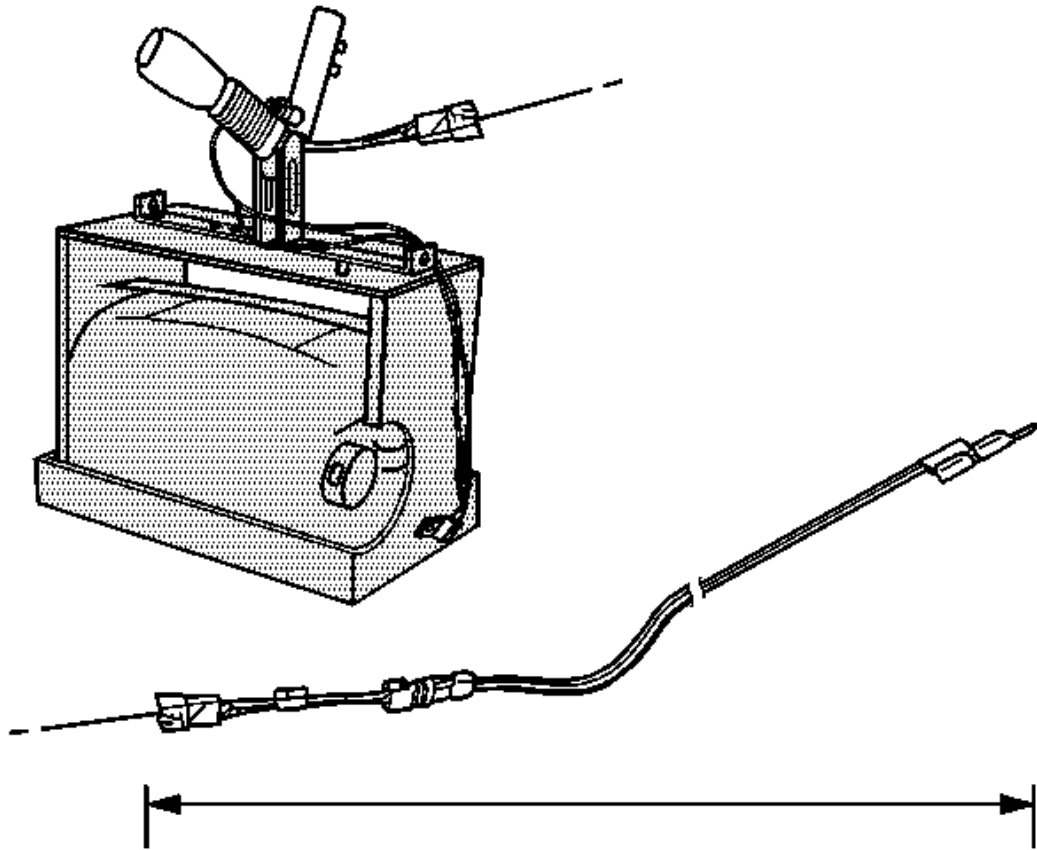


Fig. 44: Extending SIR Deployment Harness & Adapter

Courtesy of GENERAL MOTORS COMPANY

14. Extend the SIR deployment harness and adapter to full length from the deployment fixture.

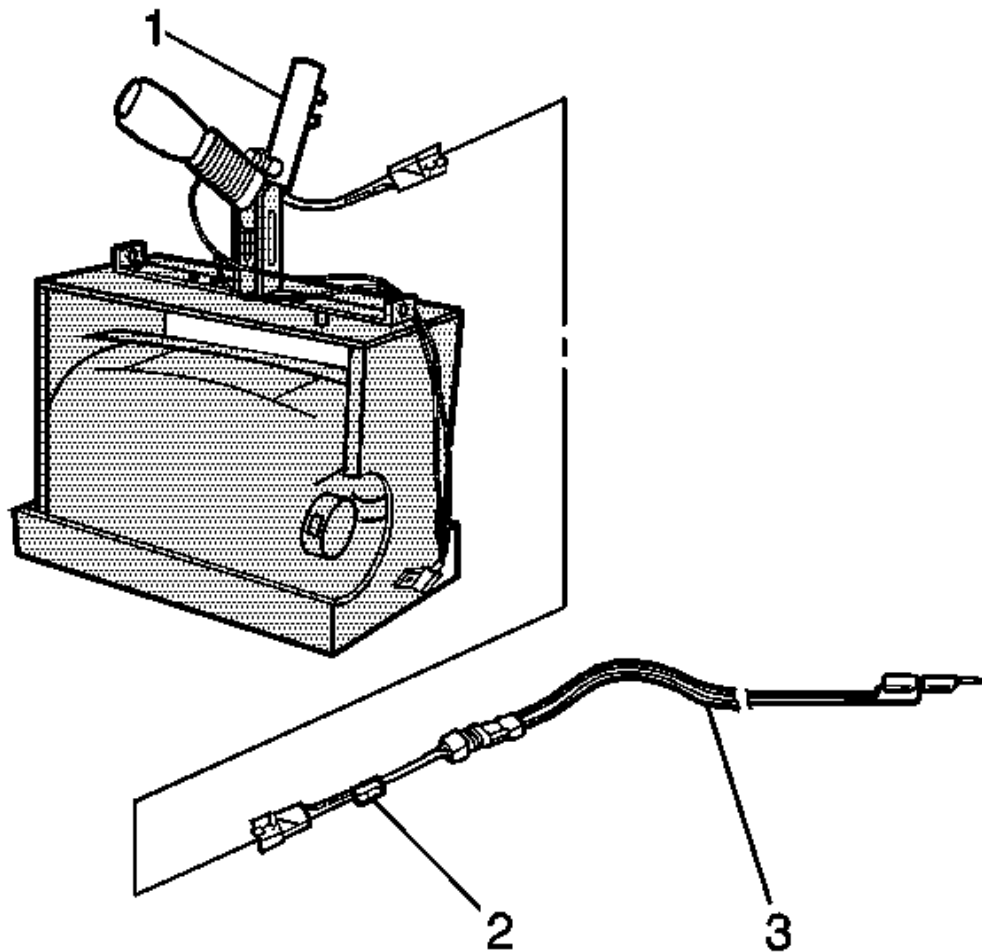


Fig. 45: Connecting Pretensioner To Adapter
Courtesy of GENERAL MOTORS COMPANY

15. Connect the pretensioner (1) to the adapter (2) on the deployment harness (3).

NOTE: The rapid gas expansion involved with deploying a pretensioner is very loud. Notify all the people in the immediate area that you intend to deploy the seat belt pretensioner.

16. Clear the area of people.

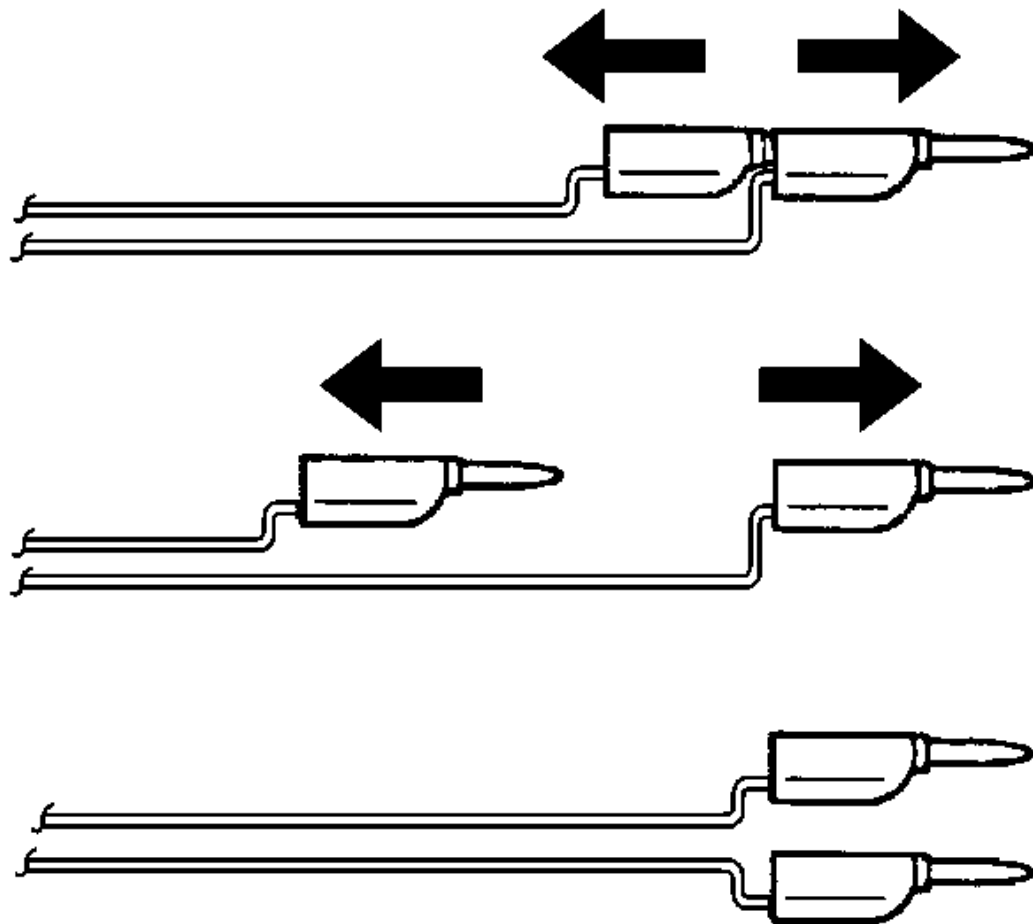


Fig. 46: Separating Banana Plugs

Courtesy of GENERAL MOTORS COMPANY

WARNING: When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.

17. Separate the 2 banana plugs on the SIR deployment harness.

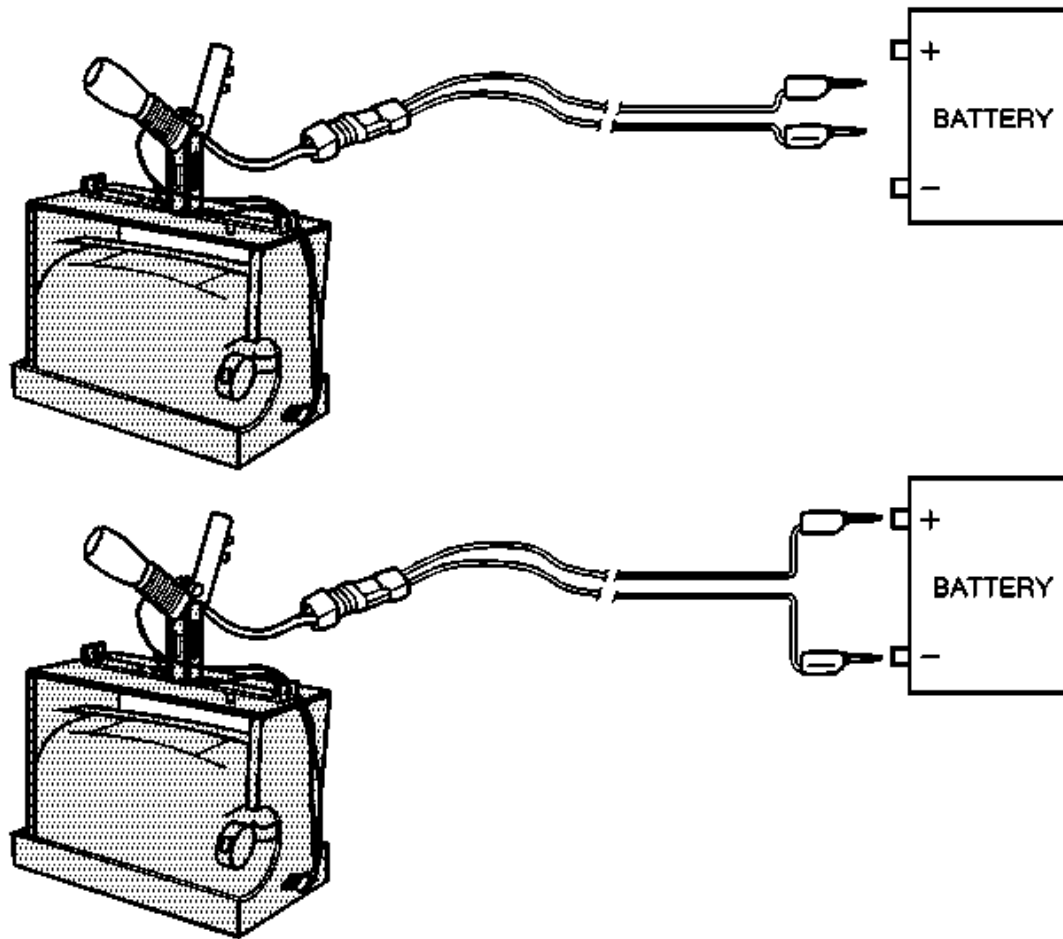


Fig. 47: Deploying Pretensioner

Courtesy of GENERAL MOTORS COMPANY

NOTE: When the seat belt pretensioner deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the seat belt pretensioner due to the force of the rapid expansion of gas inside the pretensioner.

18. Place a 12 V minimum/2 A minimum power source (i.e., vehicle battery) near the shorted end of the harness.
19. Connect the SIR deployment harness wires to the power source. Pretensioner deployment will occur when contact is made.
20. Disconnect the SIR deployment harness from the power source after the pretensioner deploys.

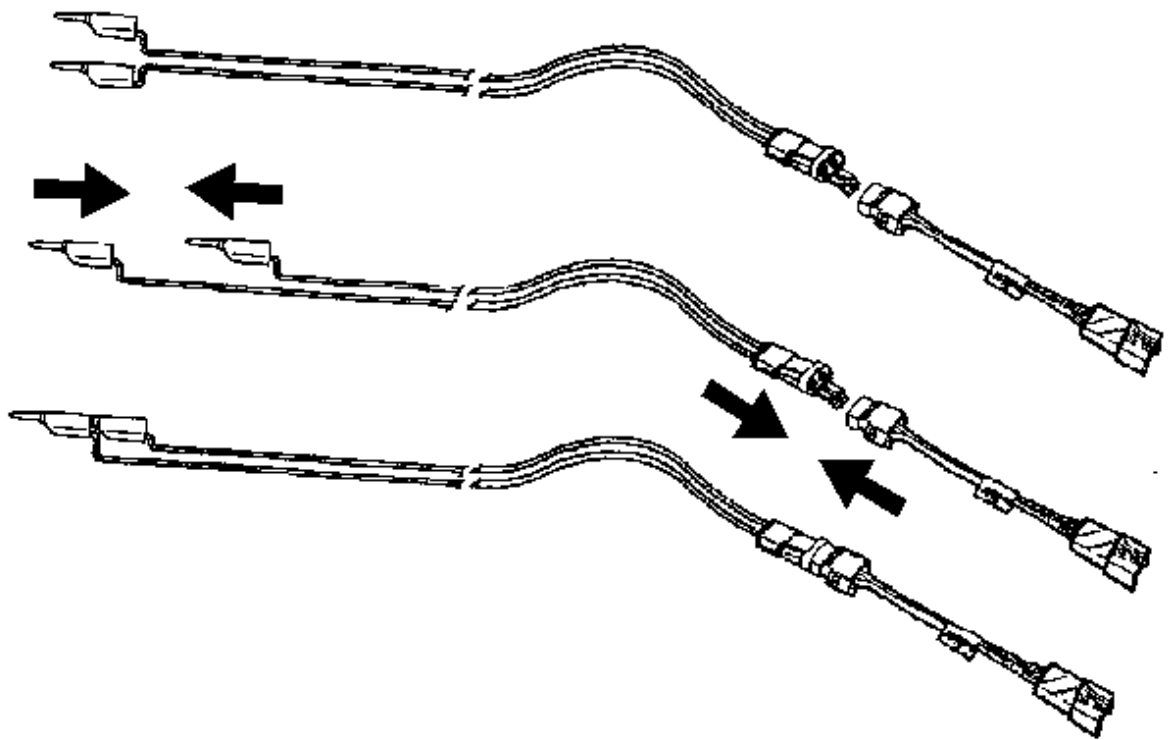


Fig. 48: View Of Deployment Harness Leads

Courtesy of GENERAL MOTORS COMPANY

21. Seat one banana plug into the other in order to short the deployment harness leads.
22. If the pretensioner did not deploy, disconnect the adapter and discontinue the procedure. Contact the Technical Assistance Group. Otherwise, proceed to the following steps.
23. Put on a pair of shop gloves.
24. Disconnect the pigtail adapter from the pretensioner as soon as possible.
25. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
26. Dispose of the deployed pretensioner through normal refuse channels.
27. Wash hands with a mild soap.

DESCRIPTION AND OPERATION

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM DESCRIPTION AND OPERATION

SIR System Overview

The supplemental inflatable restraint (SIR) system supplements the protection offered by the seat belts. The SIR system contains an inflatable restraint sensing and diagnostic module (SDM), air bags, seat belt pretensioners (anchor and retractor), and impact sensors. The SDM determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. When the SDM detects a collision, the SDM will process the information provided by the impact sensors to further support air bag or pretensioner deployment. The SDM will deploy the air bags and pretensioners if it detects a collision of sufficient force. If the force of the impact is not sufficient to warrant air bag deployment, the SDM may still deploy the seat belt pretensioners. The SDM contains a sensing device that converts vehicle velocity changes to an electrical signal. The SDM compares these signals to values stored in memory. If the signals exceed a stored value, the SDM will determine the severity of the impact and either cause current to flow through the frontal deployment loops deploying the frontal air bags and pretensioners, or it will deploy the pretensioners only. The SDM continuously monitors the deployment loops for malfunctions and illuminates the AIR BAG indicator if a fault is detected. The SDM performs continuous diagnostic monitoring of the SIR system electrical components. Upon detection of a circuit malfunction, the SDM will set a DTC and inform the driver by illuminating the AIR BAG indicator. The steering column and knee bolsters are designed to absorb energy and compress during frontal collisions in order to limit leg movement and decrease the chance of injury to the driver and passenger.

AIR BAG Indicator (Driver)

The AIR BAG indicator, located in the instrument cluster, is used to notify the driver of SIR system malfunctions and to verify that the inflatable restraint sensing and diagnostic module (SDM) is communicating with the instrument cluster. When the ignition is turned ON, the SDM is supplied with ignition positive voltage. The instrument cluster will momentarily turn on the AIR BAG indicator. While the indicator is on, the SDM conducts tests on all SIR system components and circuits. If no malfunctions are detected the SDM will communicate with the instrument cluster through the serial data circuit and command the AIR BAG indicator OFF. The SDM provides continuous monitoring of the air bag circuits by conducting a sequence of checks. If a malfunction is detected the SDM will store a diagnostic trouble code (DTC) and command the instrument cluster to illuminate the AIR BAG indicator via serial data. The presence of a SIR system malfunction could result in non-deployment of the air bags or deployment in conditions less severe than intended. The AIR BAG indicator will remain ON until the malfunction has been repaired.

Inflatable Restraint Sensing and Diagnostic Module (SDM)

The inflatable restraint sensing and diagnostic module (SDM) is a microprocessor and the control center for the supplemental inflatable restraint (SIR) system. The SDM contains internal sensors along with external impact sensors, mounted at strategic locations on the vehicle. In the event of a collision, the SDM compares the signals from the internal and external impact sensors to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the appropriate deployment loops to deploy the air bags. The SDM records the SIR system status when a deployment occurs and illuminates the AIR BAG indicator located in the instrument cluster. The SDM performs continuous diagnostic monitoring of the SIR system electrical components and circuitry when the ignition is turned ON. If the SDM detects a malfunction, a DTC will be stored and the SDM will request the instrument cluster to illuminate the AIR BAG indicator, notifying the driver that a malfunction exists. In the event that ignition positive voltage is lost during a collision, the SDM maintains a 23-volt loop reserve for deployment of the air bags. It is important when disabling the SIR system for servicing or rescue operations to allow the 23-volt loop reserve to dissipate, which could take up to 1 minute.

Air Bags

This vehicle may contain up to 10 air bags. The 10 air bags are located in the steering wheel (dual air bags), instrument panel (passenger side) (dual air bags), driver seat side (B-pillar), passenger seat side (B-pillar), left rear seat side, right rear seat side, left roof rail, right roof rail, driver knee (instrument panel), passenger knee (instrument panel). To view the locations of the air bags refer to [Master Electrical Component List](#). Air bags contain a housing, inflatable air bag, two initiating devices (if dual air bag), canister of gas generating material and, in some cases, stored compressed gas. The deployment loops supply current through the air bags to deploy the air bags. The steering wheel and passenger instrument panel air bags have two stages of deployment, which varies the amount of restraint to the occupant according to the collision severity. For moderate frontal collisions the air bags deploy at less than full deployment which consists of stage 1 of the air bag. For more severe frontal collisions a full deployment is initiated which consists of stage 1 and stage 2 of the air bag. The current passing through the air bags ignites the material in the canister producing a rapid generation of gas and in some cases, the release of compressed gas. The gas produced from this reaction rapidly inflates the air bag. Once the air bag is inflated it quickly deflates through the air bag vent holes and/or the bag fabric. Each air bag is equipped with a shorting bar located in the connectors of the air bag. The shorting bar shorts the air bag deployment loop circuitry to prevent unwanted deployment of the air bag when it is disconnected.

Seat Belt Pretensioners (Anchor and Retractor)

The seat belt pretensioners (driver and passenger) consist of a housing, seat belt retractor (located in the B-pillar), seat belt anchor (located on the floor), seat belt webbing, an initiator, and a canister of gas generating materials. To view the locations of the seat belt pretensioners refer to [Master Electrical Component List](#). The initiator is part of the seat belt pretensioner deployment loop. When the vehicle is involved in a collision of sufficient force, the SDM causes current to flow through the seat belt deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas. The gas produced from this reaction deploys the seat belt pretensioners which removes all of the slack in the seat belts. Depending on the severity of the collision, the seat belt pretensioners may deploy without the frontal air bags deploying, or they will deploy immediately before the frontal air bags deploy. Each seat belt pretensioner is equipped with a shorting bar that is located in the connector of the seat belt pretensioner. The shorting bar shorts the seat belt pretensioner circuitry to prevent unwanted deployment of the seat belt pretensioner when the connector is disconnected.

Impact Sensors

There are multiple impact sensors which may be located in the front of the vehicle, in the front doors or on the B-pillar, and on the C-pillar depending on the vehicle configuration. To view the locations of the impact sensors refer to [Master Electrical Component List](#). The front of vehicle, B-pillar, and C-pillar impact sensors contain a sensing device which monitors vehicle acceleration to detect collisions that are severe enough to warrant air bag deployment. The front door impact sensors contain a sensing device which monitors the door cavity air pressure change to detect side collisions that are severe enough to warrant air bag deployment. It is important when working on components in the door to make sure any items which have a sealing impact on the door (water deflector, exterior door handle, speaker, door harness grommet, or sealing strip) are securely fastened when reinstalled. The impact sensors are not part of the deployment loop, but instead provide input to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The Inflatable Restraint Sensing and Diagnostic Module contains a microprocessor that performs calculations using the measured inputs from acceleration and pressure sensors. When the generated calculations exceed the stored value, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the appropriate air bags.

Passenger Presence Detection System and Air Bag Indicator (Passenger)

NOTE: The passenger presence system (PPS) is a calibrated unit. When replacing the assembly all parts in the service kit must remain together. Do not mix any of the old parts with the new parts. After repairing or replacing the PPS, the preload test must be performed in order to function properly.

The passenger presence detection system (PPS) is used to monitor the type of occupant that is sitting in the front passenger seat and communicate the status to the inflatable restraint sensing and diagnostic module (SDM). The SDM then uses this information to determine whether to enable or suppress the deployment of the passenger instrument panel air bag. The PPS consists of an electronic control module, a sensor mat in the seat, a harness, and PASSENGER AIR BAG ON/OFF indicators. The PPS transmits and receives a low-level electric field. The measured capacitance value of this field is used to determine the type of occupant sitting in the front passenger seat. If the measured capacitance is less than a calibrated value, then the passenger presence module will send a serial data signal to the SDM to disable the passenger instrument panel air bag. If the measured capacitance is greater than a calibrated value, then the passenger presence module will send a serial data signal to the SDM to enable the passenger instrument panel air bag. The SDM will notify the customer of the enable/disable status by illuminating one of the PASSENGER AIR BAG ON/OFF indicator. PPS monitors itself for faults and will displays diagnostic trouble codes (DTCs) onthe scan tool. When a fault is detected, the passenger presence module sends out a message to the SDM. The SDM responds by sending a command message to the IPC to illuminate the AIR BAG indicator.

Seat Belt Indicators

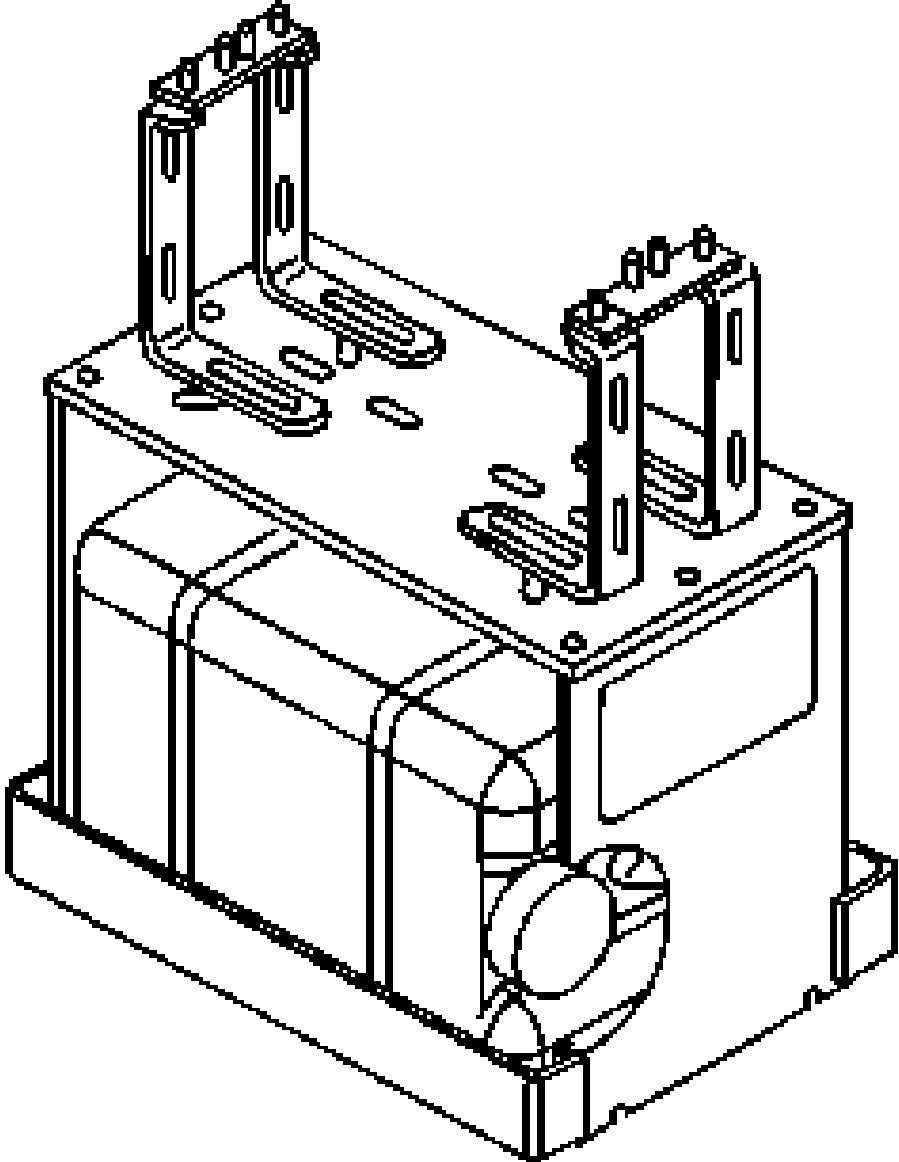
The seat belt indicators are controlled through the inflatable restraint sensing and diagnostic module (SDM). For further information on seat belt indicators refer to [Seat Belt System Description and Operation](#) .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration		Tool Number/ Description
--------------	--	--------------------------------

Illustration	Tool Number/ Description
	EL 38826 J 38826 KM 799-3 SIR Deployment Harness

Illustration	Tool Number/ Description
	EL 39401-B J 39401-B SIR Deployment Fixture

Article GUID: A00884675

STEERING
Power Steering - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Steering Gear Boot Inner Clamp	
Steering Gear Shaft Dampener Ring	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Steering Gear Bolt	
• First Pass:	55 N.m (41 lb ft)
• Final Pass:	150 - 165 Degrees

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Steering Linkage Inner Tie Rod	83 N.m (61 lb ft)
Steering Linkage Outer Tie Rod Nut	
• First Pass:	35 N.m (26 lb ft)
• Final Pass:	30 - 45 Degrees

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Power Steering

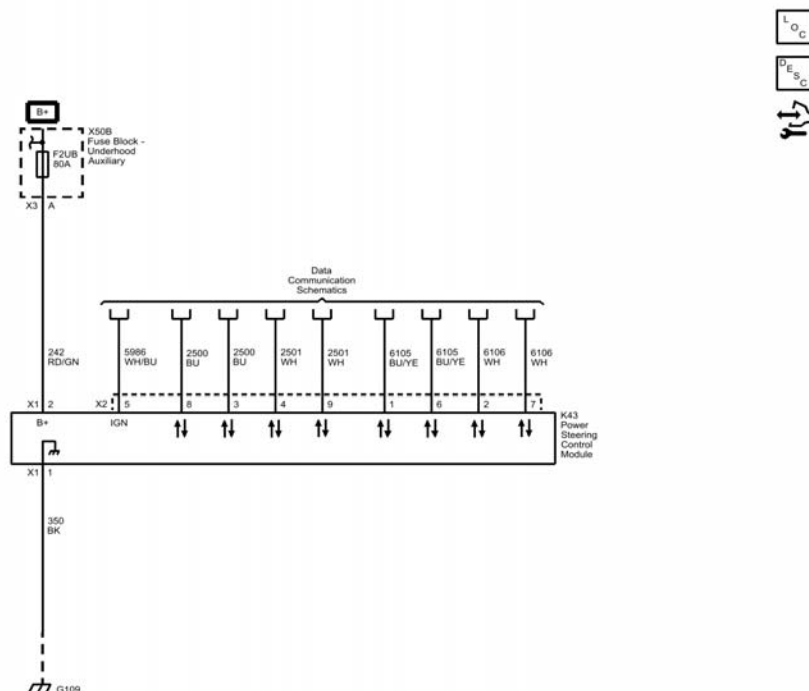


Fig. 1: Power Steering

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR HIGH TEMPERATURE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0176 54

Control Module Temperature Sensor High Temperature

Circuit/System Description

The power steering control module monitors the temperature of the Power Steering System. The power steering control module uses voltage, current levels and input from an internal temperature sensor to calculate an estimated system temperature. If the power steering control module detects a high system temperature event is occurring, the amount of assist is decreased to reduce system temperature, in effort to prevent thermal damage to the power steering components.

Conditions for Running the DTC

- Ignition ON, engine Running.
- Power steering system voltage is 9 - 16 V.
- Repetitive steering input applied.

Conditions for Setting the DTC

The power steering control module detects a high system temperature.

Action Taken When the DTC Sets

- DTC C0176 54 is stored in memory.
- Steering assist is reduced.

Conditions for Clearing the DTC

A current DTC will clear on the next malfunction-free ignition cycle.

Diagnostic Aids

- DTC C0176 54 does not indicate that a malfunction has occurred. Rather that the power steering control module had to limit current to the power steering motor to avoid thermal damage to the power steering system components. Discuss with the customer about driving conditions when the steering assist was reduced.
- Ensure that no steering components down stream of the power steering column assembly, such as ball joints, tie rod ends, universal joints, or the steering gear assembly, are mechanically binding.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify that the DTC sets outside of the conditions for running and setting. Since most occurrences of this DTC are caused by excessive driver inputs, review with the customer the conditions under which the DTC set.
 - **If the DTC did not set outside of the conditions for running and setting**
 1. Ignition ON.
 2. Operate the vehicle within the conditions that the customer experienced, avoiding excessive inputs, and verify the DTC does not reset.
 - If the DTC is set
 1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to Increase in Effort While Turning Steering Wheel
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering gear.
 - If the DTC is not set- 3. All OK.
 - **If the DTC set outside of the conditions for running and setting**
- 2. All OK. The power steering is operating as designed.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement
- Refer to Control Module References for power steering control module replacement, programming and setup.

DTC C0460: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0460 00

Steering Wheel Angle Sensor Malfunction

DTC C0460 4B

Steering Wheel Angle Sensor Calibration Not Learned

DTC C0460 5A

Steering Wheel Angle Sensor Signal Not Plausible

Circuit/System Description

The Electric Belt Drive Rack and Pinion Steering Gear contains the steering wheel angle sensor. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation to calculate the driver intended driving direction. The power steering control module uses the signal to determine the proper amount of steering assist to provide.

Conditions for Running the DTC

The condition for running the DTC will not occur until the initialization phase has been completed. The initialization of the electronic brake control module occurs when the following conditions have been met:

- Ignition voltage is greater than 8 V.
- The initialization happens once each ignition cycle when the vehicle speed is greater than 20 km/h (12 MPH) and the vehicle is driven in a straight line without the brake pedal being applied.

Conditions for Setting the DTC

DTC C0460 00, C0460 5A

- Steering angle signal is not valid.
- Steering angle signal line is open.
- Angle signal cycle time is out of range.
- Angle signal duty is out of range.

DTC C0460 4B

Steering sensor zero position is not set.

Action Taken When the DTC Sets

- DTC C0460 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A current DTC will clear on the next malfunction-free ignition cycle.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the DTC is not set.
 - **If the DTC is set**
 1. Calibrate the K43 Power Steering Control Module. Refer to **Power Steering Control Module Calibration**
 2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC
 - If the DTC sets, replace the Electric Belt Drive Rack and Pinion Steering Gear.
 1. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC is not set
 2. All OK.
 - If the DTC is not set
 - 3. All OK.
 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC C0475: POWER STEERING MOTOR CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0475 00

Power Steering Motor Circuit Malfunction

Circuit/System Description

The power steering control module continuously monitors the voltage and current levels being commanded to the 3-phase steering assist motor. The power steering control module compares the desired and actual current levels to detect malfunctions in the internal power steering assist motor circuits.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The power steering control module detects a short to ground, short to voltage, or an open/high resistance on any of the internal power steering assist motor circuits.

Action Taken When the DTC Sets

- The DTC is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 50 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C0475 is not set.
 - **If the DTC C0475 is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 - 3. All OK.
 - **If the DTC C0475 is not set**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module programming and setup.

DTC C0545: STEERING WHEEL TORQUE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0545 00

Steering Wheel Torque Sensor

Circuit/System Description

The power steering control module continuously monitors the digital torque sensors torque and index current signals. As the steering wheel is turned and torsional twist is applied to the steering shaft, the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque. The steering wheel torque sensor needs to be calibrated to be fully functional.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The power steering control module detects a short to ground, short to voltage, or an open/high resistance on any of the torque sensor circuits.

Action Taken When the DTC Sets

- DTC C0545 is stored in memory.
- The driver information center displays the SERVICE POWER STEERING warning message.
- No Steering assist.

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify that DTC C0545 is not set.
 - If the DTC is set

NOTE: Check the torque sensor terminal connections for signs of corrosion or damage.

Replace the steering gear.

- **If the DTC is not set**

2. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC C055C: STEERING GEAR PERFORMANCE MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C055C 00

Steering Gear Performance Malfunction

Circuit/System Description

The power steering control module continuously verifies the mechanical friction of the steering gear. If the friction is too high the clutch between motor and rack slips and the internal angle is not longer valid.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The DTC is set when the mechanical friction of the steering gear is too high.

Action Taken When the DTC Sets

- DTC C055C is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 40 consecutive malfunction free ignition cycles.

Diagnostic Aids

Ensure that no steering components down stream of the power steering column assembly, such as ball joints, tie rod ends, universal joints, or the steering gear assembly, are mechanically binding.

Reference Information

Schematic Reference

[Power Steering Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Power Steering System Description and Operation \(Belt Drive Electronic Power Steering\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

[Circuit/System Verification](#)

1. Ignition ON.
2. Verify that DTC C055C is not set.
 - **If the DTC is set**
 1. Verify that no steering components down stream of the power steering column assembly are mechanically binding. Refer to [Increase in Effort While Turning Steering Wheel](#)
 - If steering components are mechanically binding, replace the mechanically binding steering components.
 - If no steering components are mechanically binding, replace the steering gear.
 - **If the DTC is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- Refer to [Control Module References](#) for power steering control module replacement, programming and setup.

[DTC C0569: INTERNAL CHECK SUM ERROR/CALIBRATION NOT PROGRAMMED/CONFIGURATION NOT PROGRAMMED](#)

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0569 31

Internal Check Sum Error

DTC C0569 42

Calibration Not Programmed

DTC C0569 46

Configuration Not Programmed

Circuit/System Description

The power steering control module continuously monitors the parameters of the steering gear. The power steering control module performs a self-test diagnostic during power-up. The configuration is not complete from supplier.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

Electronic power steering control module configuration is not complete.

Action Taken When the DTC Sets

- DTC C0569 is stored in memory.
- No steering assist.

Conditions for Clearing the DTC

A history DTC will clear after 40 consecutive malfunction free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

[Circuit/System Verification](#)

1. Ignition ON.
2. Verify that DTC C0569 is not set.
 - **If the DTC C0569 is set**
 Replace the steering gear.
 - **If the DTC C0569 is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- Refer to [Control Module References](#) for power steering control module replacement, programming and setup.

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE (POWER STEERING CONTROL MODULE)

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

[DTC Descriptor](#)

DTC C056D

Electronic Control Unit Hardware

For symptom byte information, refer to [Symptom Byte List](#) .

[Circuit/System Description](#)

The internal fault detection is handled inside the power steering control module. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

[Conditions for Running the DTC](#)

The power steering control module runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The power steering control module has detected an internal malfunction.

Action Taken When the DTC Sets

The power steering control module refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C056D is not set.
 - **If DTC C056D is set with symptom byte 19, 38, 3B, 3C, 49, or 5A**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.

- If the DTC sets, replace the K43 Power Steering Control Module.
- If the DTC does not set

3. All OK.

- **If DTC C056D is set with symptom byte 37 or 39**

Replace the K43 Power Steering Control Module

- **If DTC C056D is not set**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for control module replacement, programming and setup.

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C056E

Electronic Control Unit Software

For symptom byte information, refer to [Symptom Byte List](#) .

Circuit/System Description

After replacement of the power steering control module, the power steering control module must be configured with the proper tuning profile using the service programming system (SPS).

After replacement of the power steering control module, power steering motor, or steering gear, the steering position/torque sensor calibration procedure must be performed.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The device has detected an internal fault.

Actions Taken When DTC Sets

- DTC is stored in memory.
- Reduced or no steering assist.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation (Belt Drive Electronic Power Steering)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C056E is not set.
 - **If the DTC C056E is set**
 1. Program the K43 Power Steering Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K43 Power Steering Control Module.
 - If the DTC does not set
 3. All OK.
 - **If the DTC C056E is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for Control Module replacement, programming and setup.

DTC C1436: STEERING WHEEL ANGLE SIGNAL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C1436

Steering Wheel Angle Signal

For symptom byte information refer to [Symptom Byte List](#)

Circuit/System Description

The steering wheel angle sensor is integrated into the steering gear assembly. The steering wheel angle sensor identifies the position and direction of the steering wheel rotation.

The electronic brake control module receives high speed serial data inputs from the steering angle sensor identifying the position and direction of the steering wheel rotation. The electronic brake control module utilizes this signal to calculate the driver intended driving direction.

Conditions for Running the DTC

The condition for running the DTC will not occur until the initialization phase has been completed. The initialization of the electronic brake control module occurs when the following conditions have been met:

- Ignition voltage is greater than 8 V
- The initialization happens once each ignition cycle when the vehicle speed is greater than 20 km/h (12 mph) and the vehicle is driven in a straight line without the brake pedal being applied.

Conditions for Setting the DTC

C1436 09

The steering wheel angle sensor signal gradient unplausible.

C1436 0A

The steering wheel angle sensor signal remains constant during turning maneuvers.

C1436 11

The steering wheel angle sensor signal is out of range.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- A Service StabiliTrak message may displayed on the driver information center.
- A Service Brake Assist message may displayed on the driver information center.
- A Service Power Steering Drive with Care message may displayed on the driver information center.
- The electronic brake control module disables the traction control and the electronic stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Check and adjust all tires to the stated cold air pressure as identified on the tire placard.
- The car should not pull in either direction causing the steering wheel to be off center while driving in a straight line on a level surface.
- Confirm that all tires are of the proper size and matching brands. If a mis-sized or non-matching brand tire is present, inform the customer that in order for the vehicle stability enhanced system to function normally, tires need to be a uniform size and rolling diameter.
- Inspect the serial data circuits and connections at the power steering control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. With a scan tool check the Power Steering Control Module for any DTCs.

- **If any DTCs are present in the Power Steering Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) in Power Steering Diagnostic Information and Procedures.

- **If there are no DTCs present in the Power Steering Control Module**

1. With a scan tool check to see if DTCs U0126, U0130, or U0131 are set.

- **If DTCs U0126, U0130, or U0131 are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If DTCs U0126, U0130, and U0130 are not set**

2. With a scan tool check to see if DTCs C0035 - C0050 are set in the Electronic Brake Control Module

- **If DTCs C0035 - C0050 are set in the Electronic Brake Control Module**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **If DTCs C0035 - C0050 are not set in the Electronic Brake Control Module**

3. Perform the [Steering Wheel Angle Sensor Centering](#) procedure.

- **If the Steering Angle Sensor Centering procedure corrected the DTC**

Proceed to step 6

- **If the Steering Angle Sensor Centering procedure did not correct the DTC**

4. Replace the Steering Gear Assembly.

- **If steering gear assembly replacement corrected the DTC**

Proceed to step 6

- **If steering gear assembly replacement did not correct the DTC**

5. Replace the Electronic Brake Control module.

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Electric Belt Drive Rack and Pinion Steering Gear Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

SYMPTOMS - POWER STEERING SYSTEM

NOTE: Review the system description and operation in order to familiarize yourself with the system functions. Refer to [Power Steering System Description and Operation \(Belt Drive Electronic Power Steering\)](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Rattle, Clunk, Pop or Shudder Noise from the Power Steering System](#)

- [Whine or Growl Noise from the Power Steering System](#)
- [Increase in Effort While Turning Steering Wheel](#)
- [Poor Return of Steering Wheel](#)
- [Steering Wheel Surges/Jerks While Turning](#)
- [Steering Wheel Kickback](#)
- [Steering Effort Hard or Too Easy in One or Both Directions](#)

RATTLE, CLUNK, POP OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Steering Wheel and Column</u>
2	Road test the vehicle in order to verify the complaint. It may be necessary to compare to a like vehicle. Is a rattle, clunk, popping, or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering gear bushings for wear or damage. Are the power steering gear bushings worn or damaged?	Go to Step 9	Go to Step 4
4	Inspect the power steering gear fasteners for looseness. Are the power steering gear fasteners loose?	Go to Step 10	Go to Step 5
5	Inspect the steering linkage inner and outer tie rods for looseness. Refer to: • <u>Steering Linkage Inner Tie Rod Inspection</u> • <u>Steering Linkage Outer Tie Rod Inspection</u> Did you find and correct the condition?	Go to Step 14	Go to Step 6
6	Inspect the front suspension components for damage or wear. Are the front suspension components damaged or worn?	Go to Step 11	Go to Step 7
7	Inspect the intermediate steering shaft for proper installation and loose or missing fasteners. Is the intermediate steering shaft installed incorrectly or are any fasteners loose or missing?	Go to Step 12	Go to Step 8
8	For a popping noise, inspect the steering gear shaft dampener rings by performing the following steps: 1. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Rotate the steering wheel until the power steering gear reaches its end of travel. Repeat in both directions. Was a popping noise present near the end of travel in one	Go to Step 13	Go to Step 2

Step	Action	Yes	No
	or both directions?		
9	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement . Did you complete the repair?	Go to Step 14	-
10	Install the power steering gear fasteners correctly. Refer to Fastener Specifications . Did you complete the repair?	Go to Step 14	-
11	Replace the damaged or worn front suspension components. Did you complete the repair?	Go to Step 14	-
12	Install the intermediate steering shaft and/or fasteners correctly. Refer to: • Intermediate Steering Shaft Replacement • Fastener Specifications Did you complete the repair?	Go to Step 14	-
13	Replace the steering gear shaft dampener ring(s). Refer to Steering Gear Shaft Dampener Ring Replacement .	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Special Tools

CH-39570 Chassis Ear

Equivalent regional tools: [Special Tools](#)

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to Step 3	System OK
3	Inspect the power steering gear fasteners for looseness and inspect the power steering gear mounting surface for damage. Are the steering gear fasteners loose and/or the mounting surface damaged?	Go to Step 6	Go to Step 4
4	Inspect the power steering assist motor for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the power steering assist motor?	Go to Step 7	Go to Step 5

Step	Action	Yes	No
5	Inspect the power steering gear for a whine or growl noise using the CH-39570 chassis ear. Is the noise present at the power steering gear?	Go to Step 7	Go to Step 3
6	If the mounting surface on the power steering gear is NOT damaged then replace the power steering gear fasteners. If the mounting surface on the power steering gear IS damaged then replace the power steering gear AND power steering gear fasteners. Refer to: • Fastener Specifications • Electric Belt Drive Rack and Pinion Steering Gear Replacement Did you complete the repair?	Go to Step 8	-
7	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement . Did you complete the repair?	Go to Step 8	-
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

INCREASE IN EFFORT WHILE TURNING STEERING WHEEL

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that there is an increase in effort while turning the steering wheel. Does the system operate normally?	System OK	Go to Step 3
3	Inspect for the following tire related conditions: • Incorrect tire inflation • Improper tire size Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label . Did you find and correct the condition?	Go to Step 10	Go to Step 4

Step	Action	Yes	No
4	Perform the following steps: 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Inspect the steering linkage outer tie rods for wear or a binding condition. Are the steering linkage outer tie rods worn or binding?	Go to Step 7	Go to Step 5
5	Inspect for a worn or binding intermediate steering shaft. Is the intermediate shaft worn or binding?	Go to Step 8	Go to Step 6
6	Inspect for a worn or binding power steering gear. Is the power steering gear worn or binding?	Go to Step 9	System OK
7	Replace the steering linkage outer tie rod(s). Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair?	Go to Step 10	-
8	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair?	Go to Step 10	-
9	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement . Did you complete the repair?	Go to Step 10	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

POOR RETURN OF STEERING WHEEL

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to Step 3
3	Perform the following steps: 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Lubricate the steering linkage outer tie rods and front suspension ball joints, if applicable. 3. Inspect the front suspension system for worn or damaged components. 4. Repair any worn or damaged front suspension	Go to Step 12	Go to Step 4

Step	Action	Yes	No
	components as necessary. Did you find and correct the condition?		
4	Perform the following steps: 1. Rotate the steering wheel ONE revolution in both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to Step 5	Go to Step 10
5	NOTE: • Once the intermediate steering shaft is disconnected, do NOT rotate the steering wheel more than one complete revolution from center. • Ensure the steering column is locked before connecting the intermediate steering shaft. Perform the following steps: 1. Position the front wheels straight ahead and lock the steering wheel to prevent rotation. 2. Disconnect the intermediate steering shaft from the steering column. 3. Note the position of the steering wheel and rotate the steering wheel ONE complete revolution in both directions. 4. Rotate the steering wheel back to the original	Go to Step 11	Go to Step 6

Step	Action	Yes	No
	position. Was the steering wheel abnormally difficult to rotate in either direction?		
6	Inspect the intermediate steering shaft for wear or a binding condition. Did you find and complete the repair?	Go to Step 12	Go to Step 7
7	Perform the following steps: 1. Remove the front tire and wheel assemblies. Refer to <u>Tire and Wheel Removal and Installation</u> . 2. Disconnect both steering linkage outer tie rods from the steering knuckles. 3. Use your hands in order to move the steering linkage outer tie rod studs. 4. If abnormally difficult to move, replace the steering linkage outer tie rod(s). Did you find and complete the repair?	Go to Step 12	Go to Step 8
8	Perform the following steps: 1. Turn each steering knuckle and strut assembly inboard and outboard to inspect for binding strut components, ball joints or drive axles. 2. Repair or replace any abnormally stiff or loose components. Did you find and complete the repair?	Go to Step 12	Go to Step 9
9	Perform the following steps: 1. Inspect for binding in the power steering gear. 2. If binding is present, repair or replace the power steering gear. Did you find and complete the repair?	Go to Step 12	Go to Step 10
10	Inspect the wheel alignment and adjust as necessary. Refer to <u>Wheel Alignment Measurement</u> . Did you find and complete the repair?	Go to Step 12	-
11	Perform the following steps: 1. Inspect the steering column for binding. 2. If binding is present, repair or replace the steering column as necessary. Go to Step 12	Go to Step 12	-

Step	Action	Yes	No
	Did you find and complete the repair?		
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING WHEEL SURGES/JERKS WHILE TURNING

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Power Steering System
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to Step 3
3	Inspect for worn or binding front suspension components. Did you find and correct the condition?	Go to Step 14	Go to Step 4
4	Perform the following steps: 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Inspect the steering linkage outer tie rods for wear or a binding condition. Are the steering linkage outer tie rods worn or binding?	Go to Step 10	Go to Step 5
5	Inspect for a worn or binding intermediate steering shaft. Is the intermediate shaft worn or binding?	Go to Step 11	Go to Step 6
6	Inspect for a worn or binding power steering gear. Is the power steering gear worn or binding?	Go to Step 12	Go to Step 7
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to Step 13	Go to Step 8
8	Check for excessive heat in the power steering assist motor. Does the power steering assist motor appear to be overheated?	Go to Step 9	Go to Step 12
9	NOTE: • Do NOT perform excessive parking lot maneuvers during testing. • Excessive parking lot maneuvers can cause the power	Go to Step 14	Go to Step 12

Step	Action	Yes	No
	steering assist motor to heat up. Allow the power steering assist motor to cool and retest the system. Did you correct the condition?		
10	Replace the steering linkage outer tie rod(s). Refer to Steering Linkage Outer Tie Rod Replacement. Did you complete the repair?	Go to Step 14	-
11	Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement. Did you complete the repair?	Go to Step 14	-
12	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement. Did you complete the repair?	Go to Step 14	-
13	Replace the steering column. Refer to Steering Column Replacement. Did you complete the repair?	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

STEERING WHEEL KICKBACK

Condition	Action
The steering column mounting fasteners are loose.	Tighten the steering column mounting fasteners to specification. Refer to Steering Column Replacement.
The power steering gear mounting fasteners are loose.	Tighten the power steering gear mounting fasteners to specification. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement.
The steering linkage inner and/or outer tie rods are loose or damaged.	Inspect the steering linkage inner and outer tie rods. Refer to: • Steering Linkage Inner Tie Rod Inspection • Steering Linkage Outer Tie Rod Inspection

STEERING EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Condition	Action
The battery power is low.	Ensure proper battery voltage.

Condition	Action
One or both of the steering column dash seals are binding.	Adjust or replace the steering column dash seal(s). Refer to: • Steering Column Dash Inner Seal Replacement • Steering Column Dash Outer Seal Replacement
The intermediate steering shaft joints and/or fasteners are loose, worn or binding.	Tighten or replace the intermediate steering shaft joints and/or fasteners. Refer to Intermediate Steering Shaft Replacement .
The power steering gear is binding.	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement .
The steering column shaft is bent.	Replace the steering column. Refer to Steering Column Replacement .
The connectors to the power steering assist motor are damaged or disconnected.	Perform the following steps: 1. Verify the connectors are properly connected. 2. Verify the connectors are not damaged. 3. If the connectors are damaged, replace the connectors.
The power steering gear sensor wire is damaged.	Replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement .
The power steering control module is malfunctioning.	Confirm the DTC and replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement .
The power steering assist motor shaft is binding.	Confirm the DTC and replace the power steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement .

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - STEERING

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or

component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

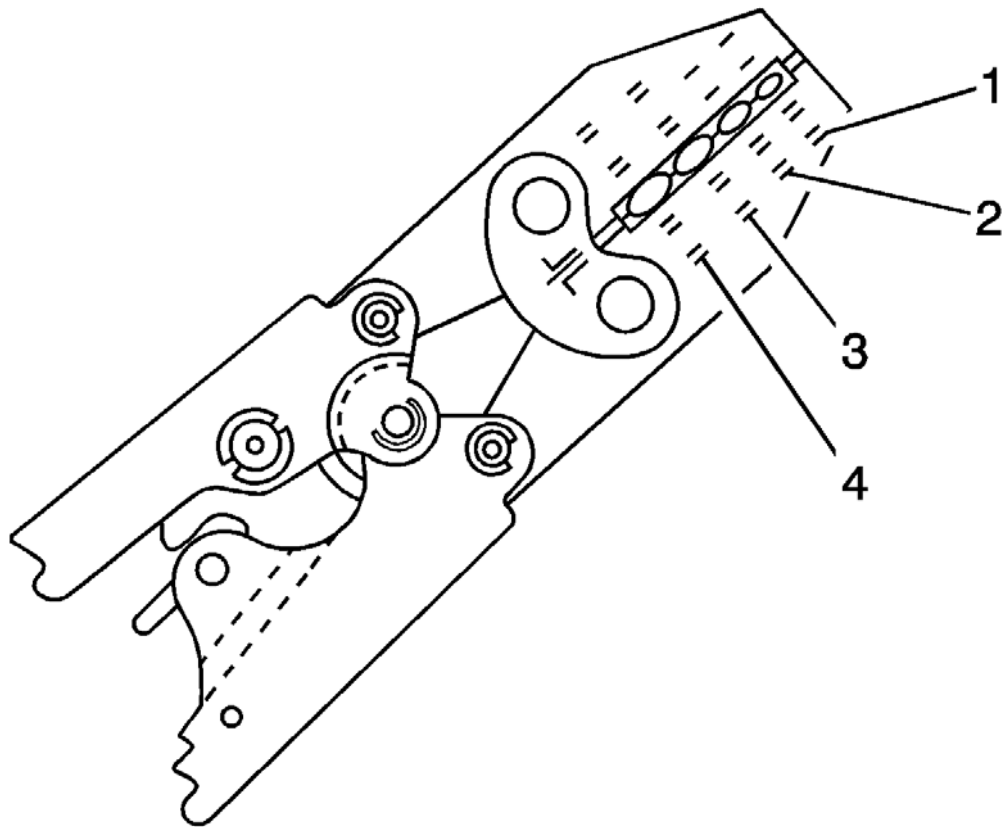


Fig. 2: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used

for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

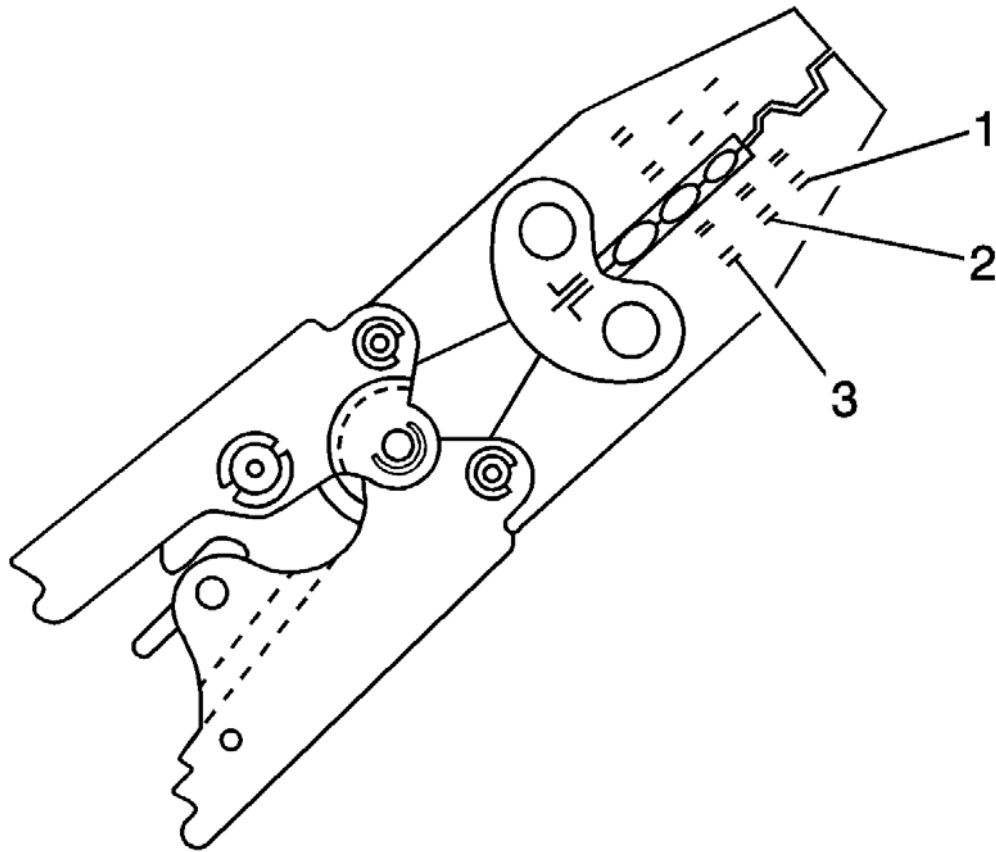


Fig. 3: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

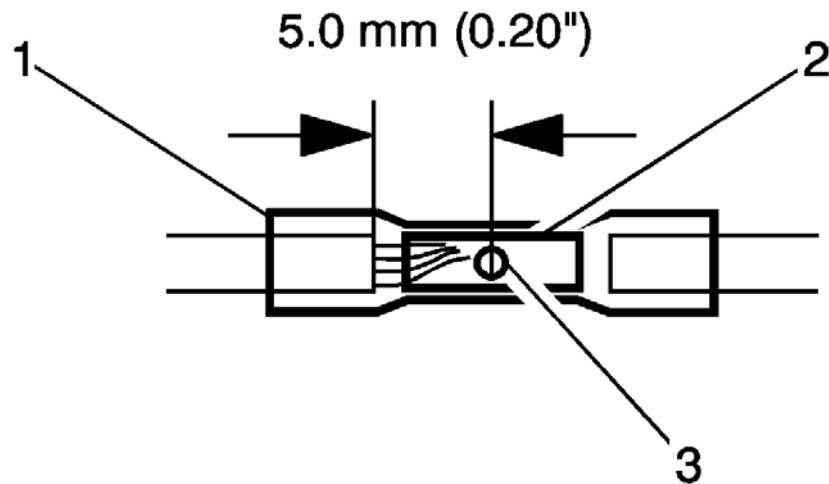


Fig. 4: Identifying DuraSeal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 5: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 6: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [**Folded-Over Wire Repair**](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different

gauges.

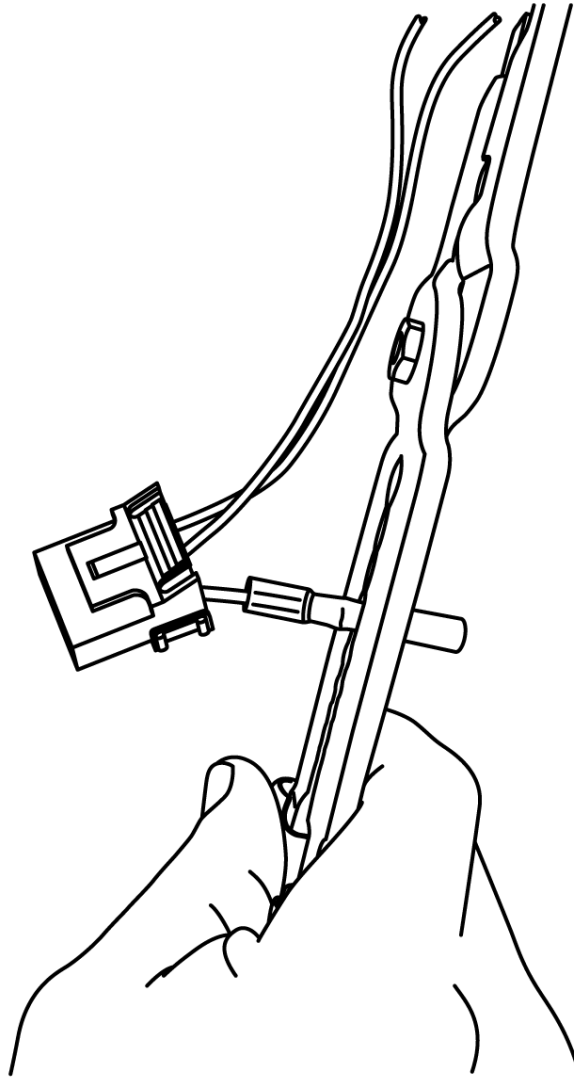


Fig. 7: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

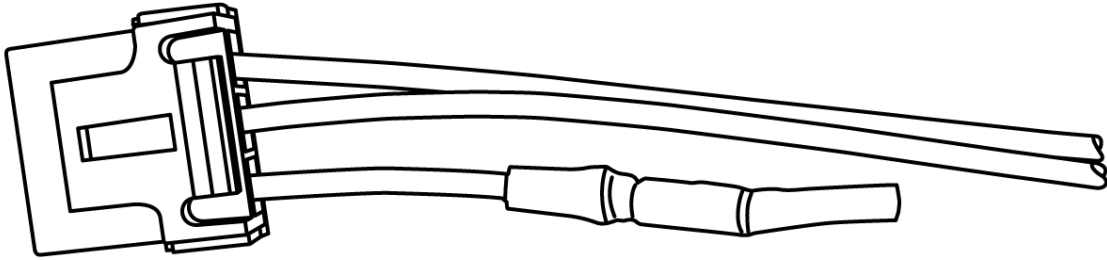


Fig. 8: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

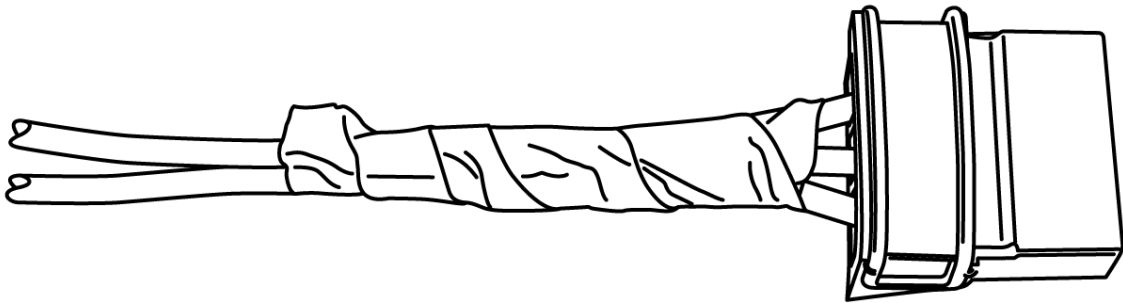


Fig. 9: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - STEERING

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect

component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is

present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .

- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a

clamping diode.

- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

STEERING LINKAGE INNER TIE ROD INSPECTION

Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to [Special Tools](#).

NOTE: **This inspection procedure does not supersede local government required inspections that have more stringent requirements.**

1. Turn the ignition key to the ON position with the engine OFF.

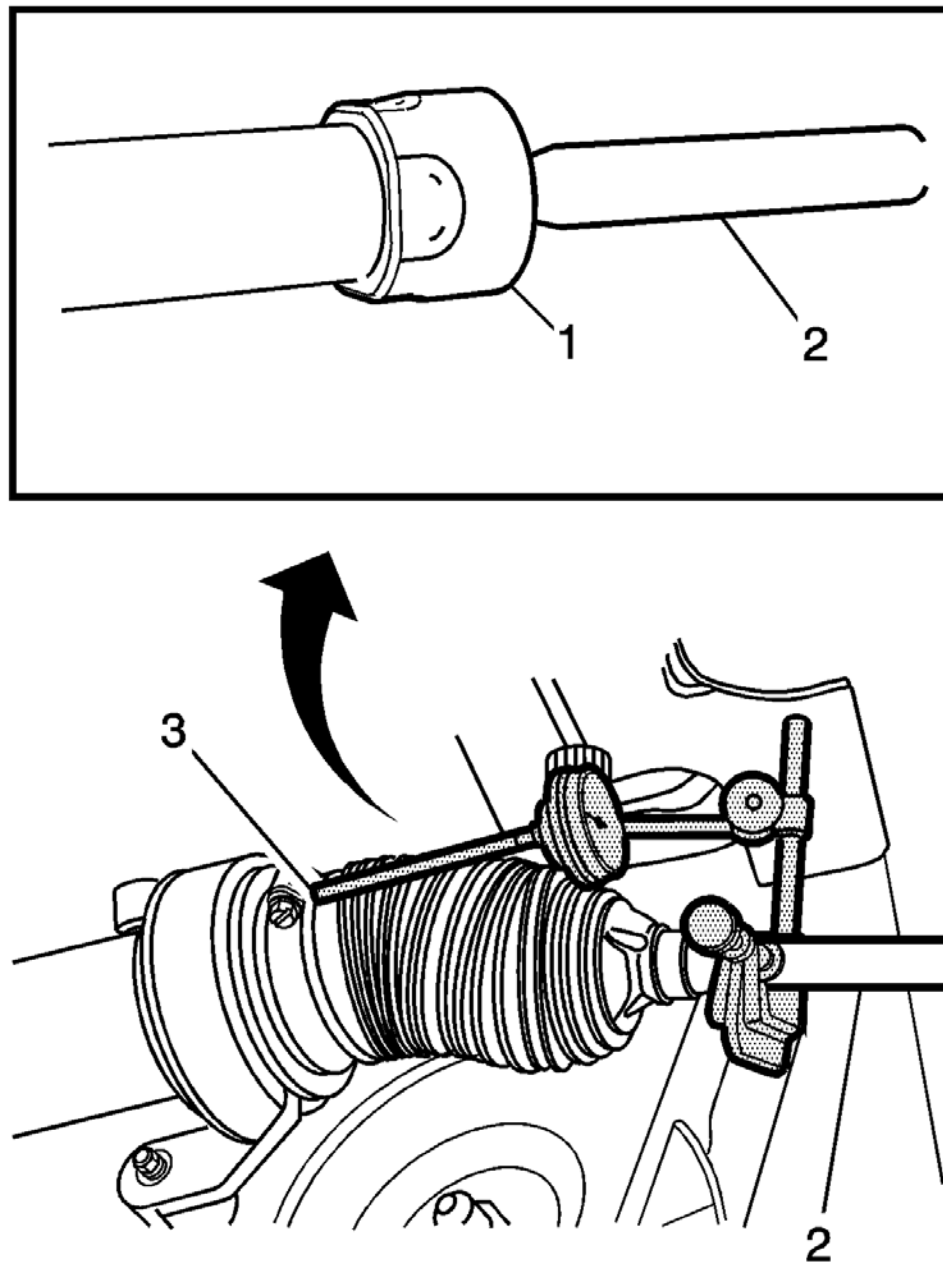


Fig. 10: Measuring Lash Between Inner Tie Rod And Steering Gear Housing
Courtesy of GENERAL MOTORS COMPANY

2. With the aid of an assistant, turn the steering wheel to the full stop position and hold the steering wheel in that position until the test is complete. Part of the steering linkage inner tie rod (2) being tested should be inside the steering gear housing. The inner tie rod housing (1) being tested should be inside the steering gear housing and seated against the steering stop.
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
4. If there is not a good location for the **GE-8001** dial indicator pointer at the steering gear housing, install a large

worm gear hose clamp (3) to the steering gear housing over the larger steering gear boot clamp and align the clamp so that the screw can be a location for the **GE-8001** dial indicator pointer.

5. Install the **GE-8001** dial indicator between the inner tie rod and the steering gear housing or the worm gear clamp in such a way as to measure the lash between the inner tie rod and the steering gear housing. The lash between the inner tie rod and the steering gear housing is equal to the lash between the inner tie rod and the inner tie rod housing because the inner tie rod housing is inside the steering gear housing during this procedure.

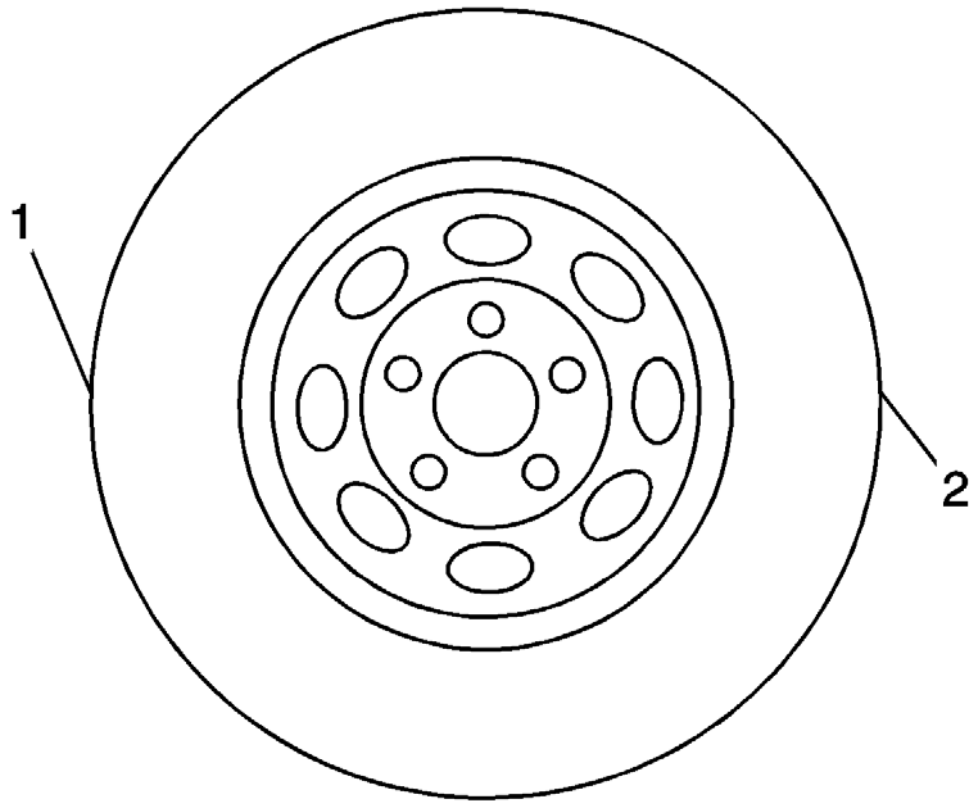


Fig. 11: Identifying Tire Grasping Positions

Courtesy of GENERAL MOTORS COMPANY

NOTE: Only move the tire enough to feel any lash between the inner tie rod and the inner tie rod housing without moving the steering gear rack.

6. Grasping the tire at the 3 o'clock (2) and 9 o'clock (1) positions, gently push in on one side of the tire in order to remove any lash.
7. Zero the **GE-8001** dial indicator.
8. On the same side of the tire previously pushed in, gently pull out and measure the lash.
9. Record the measurement shown on the **GE-8001** dial indicator.
10. If the measured value exceeds 0.5 mm (0.02 in), replace the inner tie rod. Refer to [Steering Linkage Inner Tie Rod Replacement](#).

11. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD INSPECTION

Special Tools

GE-8001 Dial Indicator Set

For equivalent regional tools, refer to [Special Tools](#).

NOTE: This inspection procedure does not supersede local government required inspections that have more stringent requirements.

1. Inspect the outer tie rod seal. If the outer tie rod seal is torn, replace the outer tie rod. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
2. Raise the side of the vehicle being inspected with a floor jack while maintaining contact between the opposite wheel and the shop floor. Support the lower control arm with a floor jack stand as far outboard as possible and remove the floor jack. Refer to [Lifting and Jacking the Vehicle](#).

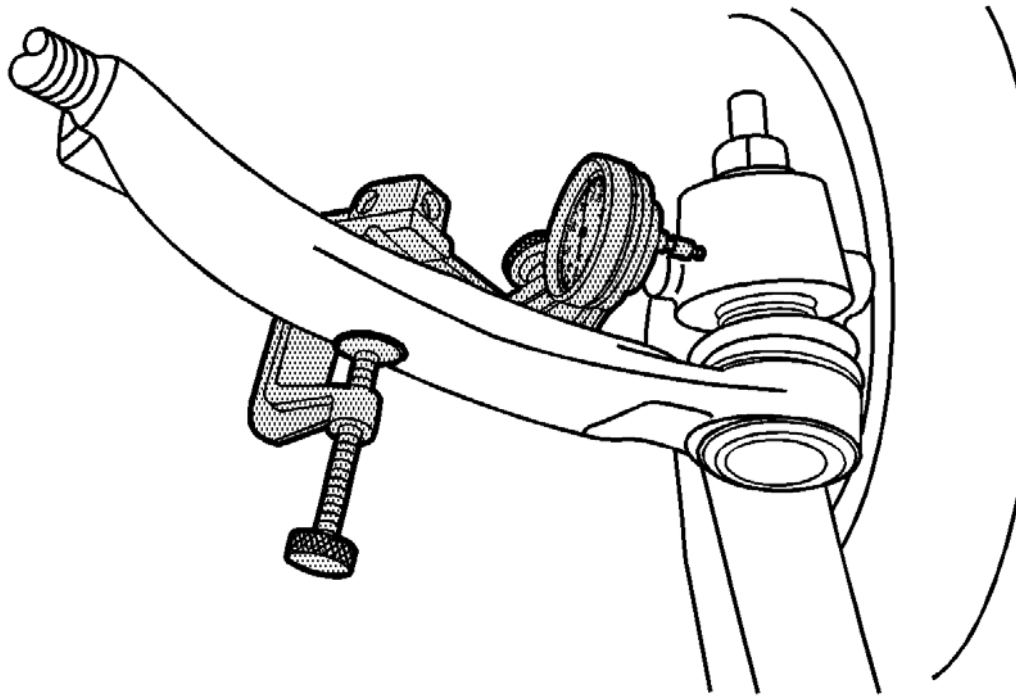


Fig. 12: Measuring Outer Tie Rod Lash
Courtesy of GENERAL MOTORS COMPANY

3. Install the **GE-8001** dial indicator between the outer tie rod and the steering knuckle as shown in the graphic.

Note that the tire and wheel assembly is shown removed only for clarification of the **GE-8001** dial indicator position.

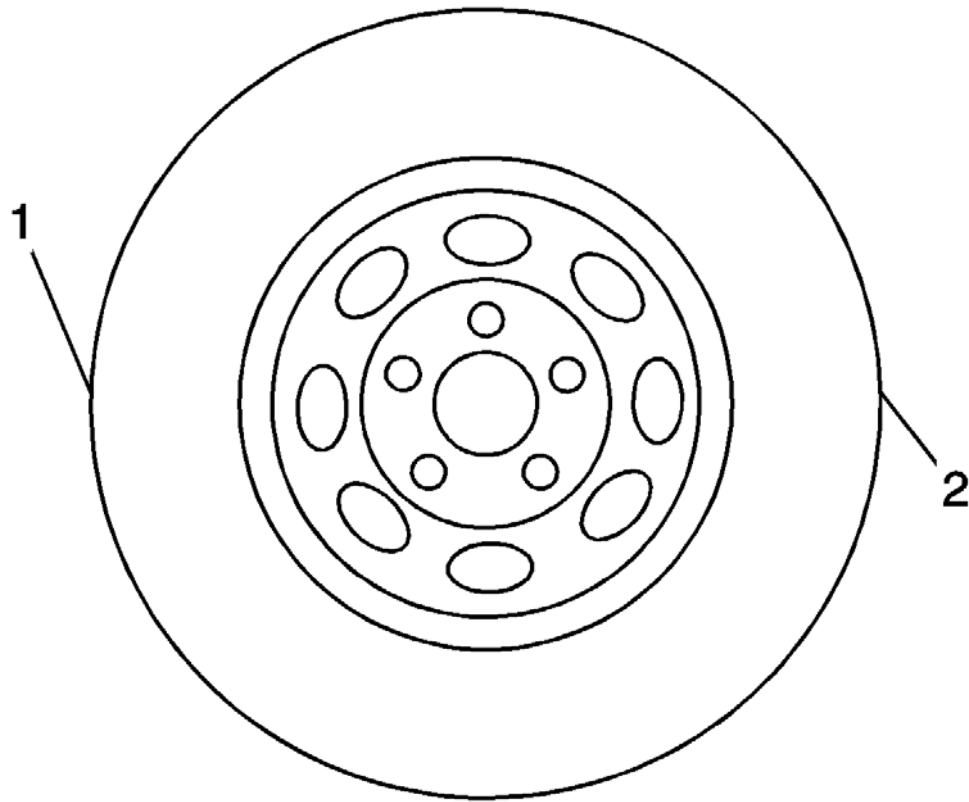


Fig. 13: Identifying Tire Grasping Positions
Courtesy of GENERAL MOTORS COMPANY

4. Grasping the tire at the 3 o'clock (2) and 9 o'clock (1) positions, gently push in on one side of the tire to remove any lash.
5. Zero the **GE-8001** dial indicator.
6. On the same side of the tire previously pushed inwards, gently pull outwards and measure the lash.
7. Record the measurement shown on the **GE-8001** dial indicator.
8. If the measured value exceeds 0.5 mm (0.02 in), replace the outer tie rod. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
9. Repeat the procedure for the other side.

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

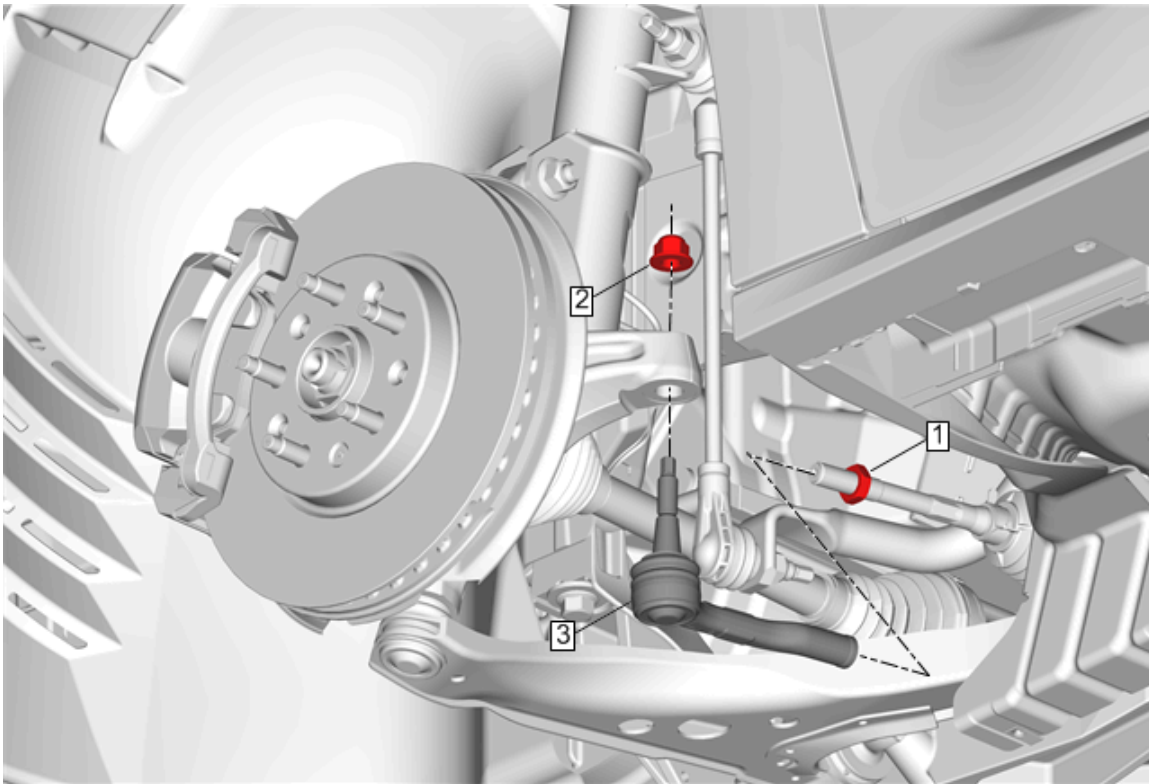


Fig. 14: Steering Linkage Outer Tie Rod
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation	
1	Steering Linkage Inner Tie Rod Nut Procedure Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod. NOTE: Do NOT tighten the steering linkage inner tie rod nut during installation. Tighten the nut after adjusting the front toe.

Callout	Component Name
2	Steering Linkage Outer Tie Rod Nut CAUTION: Refer to Fastener Caution . Procedure Use the EN-45059 meter to tighten the steering linkage outer tie rod nut. Tighten First Pass: 35 N.m (26 lb ft) Final Pass: (30 - 45 degrees) Special Tools EN-45059 Torque Angle Meter Equivalent regional tools: Special Tools
3	Steering Linkage Outer Tie Rod CAUTION: Do not free the ball stud by using a pickle fork or a wedge-type tool. Damage to the seal or bushing may result. Procedure 1. Use the CH-24319-B puller to separate the steering linkage outer tie rod from the steering knuckle. 2. Clean the tapered surface of the steering knuckle. 3. Inspect the steering linkage inner tie rod for bent or damaged threads. If necessary, replace the steering linkage inner tie rod. Refer to Steering Linkage Inner Tie Rod Replacement 4. Measure and adjust the front toe. Refer to Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment 5. Calibrate the power steering control module. Refer to Power Steering Control Module Calibration Special Tools CH-24319-B Universal Steering Linkage and Tie Rod Puller Equivalent regional tools: Special Tools

STEERING GEAR BOOT REPLACEMENT

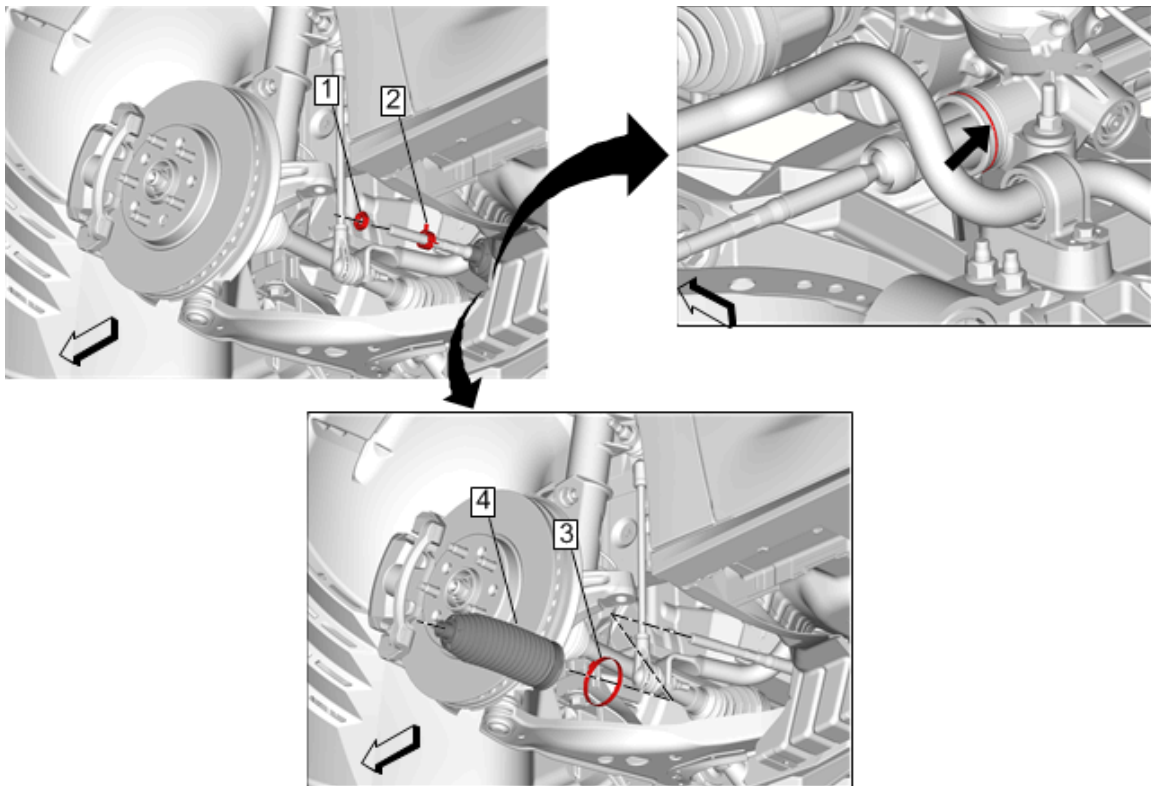


Fig. 15: Steering Gear Boot

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Linkage Outer Tie Rod. Refer to Steering Linkage Outer Tie Rod Replacement	
1	Steering Linkage Inner Tie Rod Nut Procedure Place match marks on the steering linkage inner tie rod nut and the steering linkage inner tie rod.
2	Steering Gear Boot Outer Clamp
3	Steering Gear Boot Inner Clamp Procedure 1. Cut the steering gear boot inner clamp. DISCARD the clamp. 2. Use the CH-22610 pliers to install the NEW steering gear boot inner clamp. NOTE: Position the NEW steering gear boot inner clamp on the steering gear boot

Callout	Component Name
	before installing the boot on the steering gear. Special Tools CH-22610 Keystone Clamp Pliers Equivalent regional tools: Special Tools
4	Steering Gear Boot Procedure 1. After removing the steering gear boot, inspect the steering linkage inner tie rod for evidence of corrosion or contamination. If corrosion or contamination is evident, replace the steering gear. Refer to Electric Belt Drive Rack and Pinion Steering Gear Replacement 2. Install the steering gear boot and ensure the boot is seated in the assembly groove of the steering gear before installing the steering gear boot clamps.

STEERING GEAR SHAFT DAMPENER RING REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the steering gear outer and inner boot clamps and slide the steering gear boot onto the steering linkage inner tie rod. Refer to [Steering Gear Boot Replacement](#)

DISCARD the steering gear boot inner clamp.

3. Separate Steering Linkage Inner Tie Rod @ Steering Gear. Refer to [Steering Linkage Inner Tie Rod Replacement](#)
4. Turn the front wheels all the way opposite of the side being serviced.

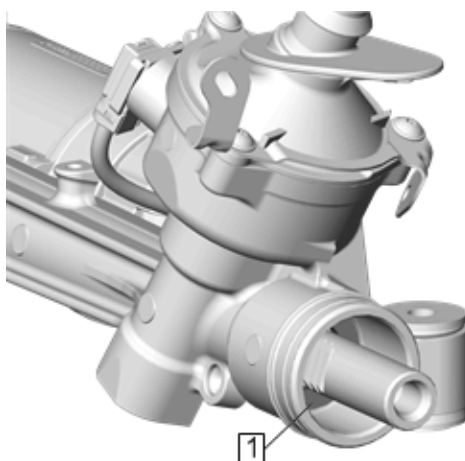


Fig. 16: Steering Gear Shaft Dampener Ring
Courtesy of GENERAL MOTORS COMPANY

5. Use a small pick tool to grasp the steering gear shaft dampener ring (1) inside the steering gear housing.

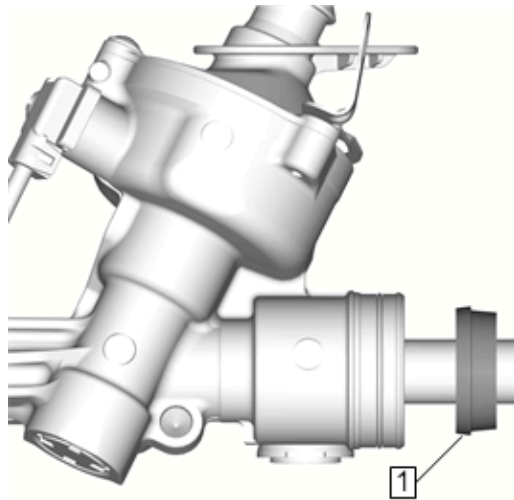


Fig. 17: Steering Gear Shaft Dampener Ring
Courtesy of GENERAL MOTORS COMPANY

6. Remove the steering gear shaft dampener ring (1) from the steering gear housing.

DISCARD the ring.

Installation Procedure

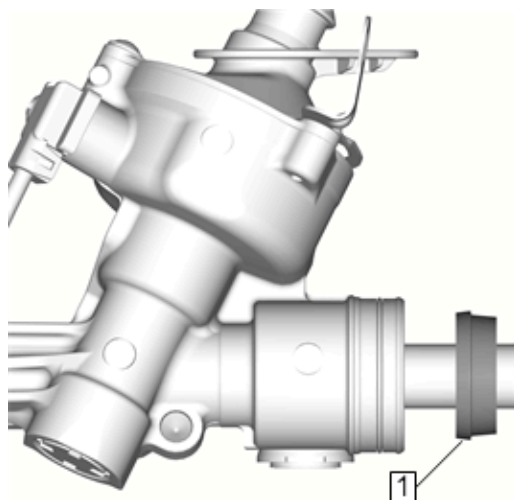


Fig. 18: Steering Gear Shaft Dampener Ring
Courtesy of GENERAL MOTORS COMPANY

NOTE: After the steering linkage inner tie rod and steering gear boot are installed, rotate the front tires all the way to the side being serviced to finish seating the steering gear shaft dampener ring.

1. Position the NEW steering gear shaft dampener ring (1) in the steering gear housing.

Push the seal in as far as it will go by hand.

NOTE: The NEW steering gear boot inner clamp **MUST** be positioned on the steering gear boot while the steering linkage inner tie rod is disconnected from the steering gear.

2. Install Steering Linkage Inner Tie Rod @ Steering Gear. Refer to [Steering Linkage Inner Tie Rod Replacement](#)
3. Slide the steering gear boot into place on the steering gear and install the steering gear boot inner and outer clamps. Refer to [Steering Gear Boot Replacement](#)

Use a NEW steering gear boot inner clamp.

4. Measure and adjust the front toe. Refer to [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)

ELECTRIC BELT DRIVE RACK AND PINION STEERING GEAR REPLACEMENT

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

CAUTION: Electrostatic discharge (ESD) can damage many solid-state electrical components. ESD susceptible components may or may not be labeled with the ESD symbol. Handle all electrical components carefully. Use the following precautions in order to avoid ESD damage:

- Touch a metal ground point in order to remove your body's static charge before servicing any electronic component; especially after sliding across the vehicle seat.
- Do not touch exposed terminals. Terminals may connect to circuits susceptible the ESD damage.
- Do not allow tools to contact exposed terminals when servicing connectors.
- Do not remove components from their protective packaging until required to do so.
- Avoid the following actions unless required by the diagnostic procedure:
 - Jumpering or grounding of the components or connectors.
 - Connecting test equipment probes to components or connectors. Connect the ground lead first when using test probes.
- Ground the protective packaging of any component before opening. Do not rest solid-state components on metal workbenches, or on top of TVs, radios, or other electrical devices.

CAUTION: During removal and installation, all EPS components including mechanical and/or electrical is extremely susceptible to damage. Dropping or prying on any EPS component may cause internal damage. If damage occurs or a part is dropped, the

EPS component must be replaced.

CAUTION: Care must be taken during removal and installation of the Electronic Power Steering (EPS) components to not hit or break the EPS motor/controller module or module harness connectors. If the EPS motor/controller module or module connectors are damaged, the complete component must be replaced.

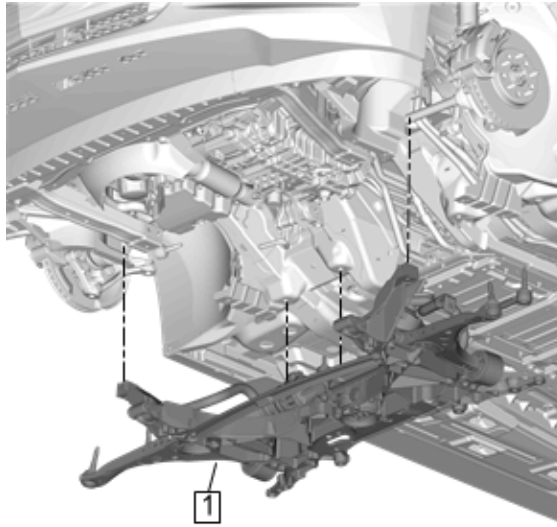


Fig. 19: Drivetrain And Front Suspension Cradle
Courtesy of GENERAL MOTORS COMPANY

1. Remove Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

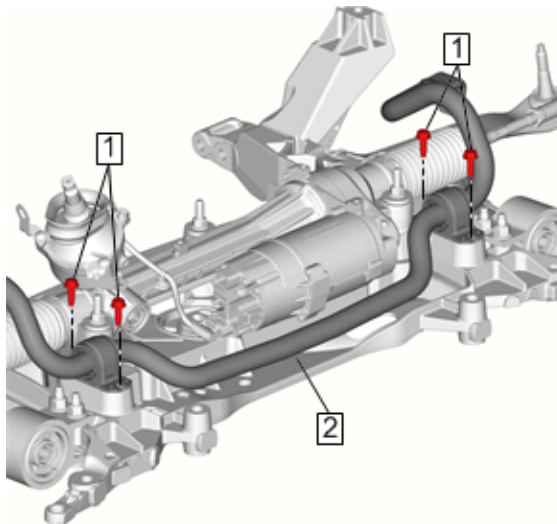


Fig. 20: Front Stabilizer Shaft And Insulator Clamp Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Stabilizer Shaft Insulator Clamp Bolts (1) (Qty: 4)

DISCARD the bolts.
3. Remove the front stabilizer shaft (2) from the drivetrain and front suspension cradle.

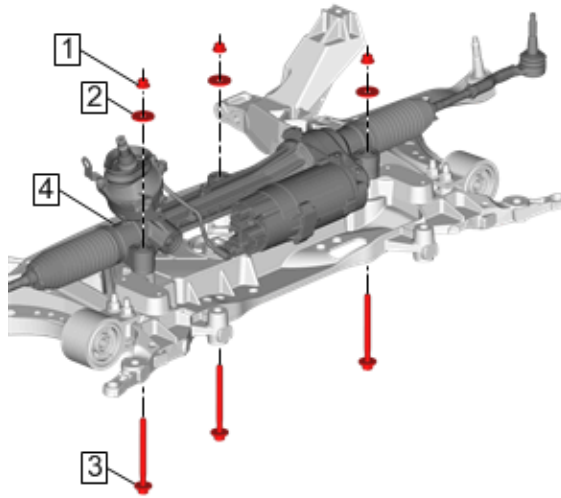


Fig. 21: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Steering Gear Nuts (1) (Qty: 3)
5. Remove Steering Gear Washers (2) (Qty: 3)
6. Remove Steering Gear Bolts (3) (Qty: 3)

DISCARD the bolts.

7. Remove the steering gear (4) from the drivetrain and front suspension cradle.
8. Transfer components as necessary.

Installation Procedure

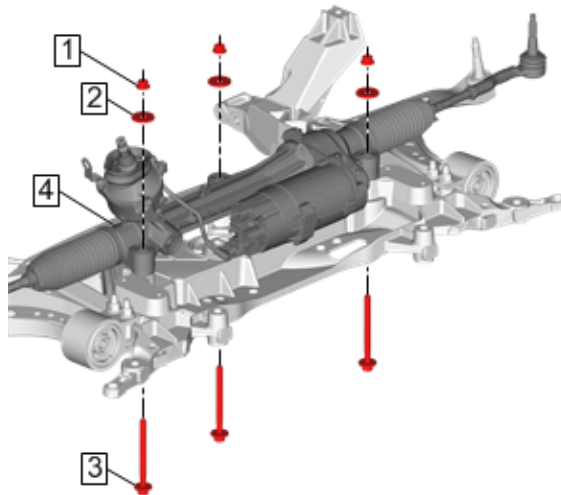


Fig. 22: Steering Gear, Nuts, Washers And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Position the steering gear (4) on the drivetrain and front suspension cradle.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component.

Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

2. Install NEW Steering Gear Bolts (3) (Qty: 3)

Install NEW bolts.

3. Install Steering Gear Washers (2) (Qty: 3)
4. Install Steering Gear Nuts (1) (Qty: 3)

CAUTION: Refer to [Fastener Caution](#) .

5. Use the **EN-45059** meter to tighten the steering gear bolts (3) to:

Tighten

1. First Pass: 55 N.m (41 lb ft)
2. Final Pass: (150 - 165 degrees)

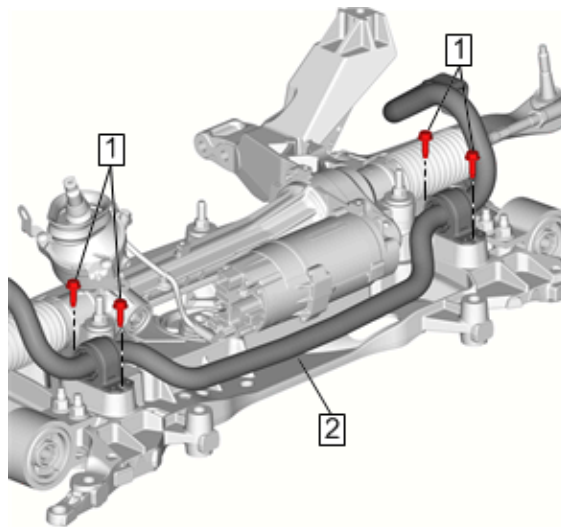


Fig. 23: Front Stabilizer Shaft And Insulator Clamp Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Position the front stabilizer shaft (2) on the drivetrain and front suspension cradle.
7. Install NEW Front Stabilizer Shaft Insulator Clamp Bolts (1) (Qty: 4). Refer to [Stabilizer Shaft Replacement](#)

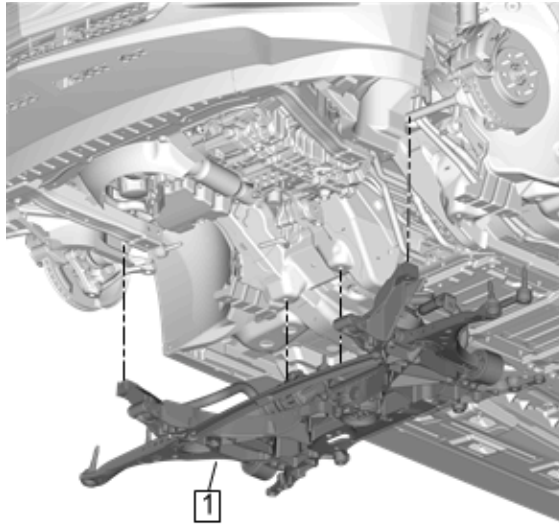


Fig. 24: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

8. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement](#)
9. Program the power steering control module. Refer to [Control Module References](#)
10. Measure and adjust the wheel alignment. Refer to [Wheel Alignment Measurement](#)
11. Calibrate the power steering control module. Refer to [Power Steering Control Module Calibration](#)

STEERING LINKAGE INNER TIE ROD REPLACEMENT

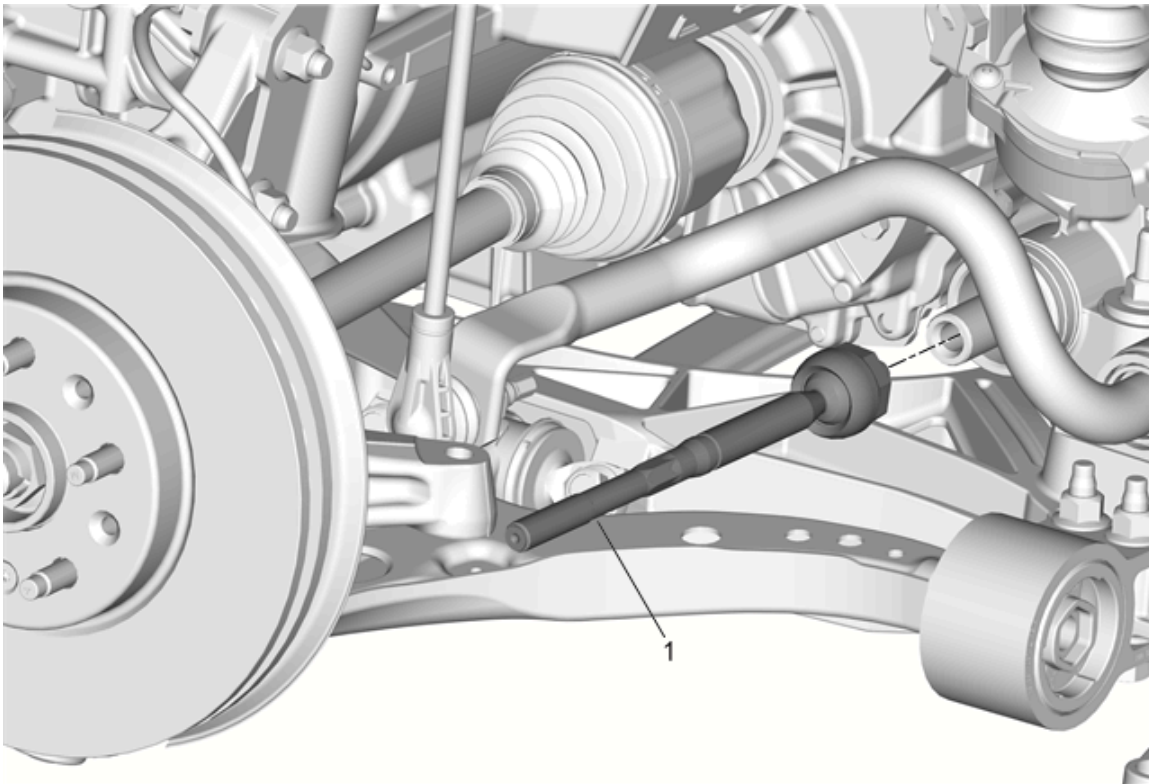


Fig. 25: Steering Linkage Inner Tie Rod

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Gear Boot. Refer to Steering Gear Boot Replacement	
1	Steering Linkage Inner Tie Rod CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear. Procedure 1. Place an appropriate size crow foot wrench or equivalent on the flats of the steering linkage inner tie rod housing. 2. Rotate the inner tie rod housing counterclockwise to remove the inner tie rod and clockwise to install the inner tie rod. 3. Measure and adjust the front toe. Refer to Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment 4. Calibrate the power steering control module. Refer to Power Steering Control Module Calibration

Callout	Component Name
	Tighten 83 N.m (61 lb ft)

POWER STEERING CONTROL MODULE CALIBRATION

Steering Angle Sensor Centering and Software Endstop Learning

WARNING: An inaccurate or not centered steering angle sensor could limit the operation of the electric power steering and may result in personal injury.

Centering of the steering angle sensor and software endstop learning might be required after certain service procedures are performed. Some of these procedures are as follows:

- Steering angle sensor replacement
- Steering gear replacement
- Power steering assist motor replacement
- Steering column replacement
- Steering linkage inner tie rod replacement
- Steering linkage outer tie rod replacement

Internal Steering Angle Sensor Centering

The centering procedure of the internal steering angle sensor can be completed with the following steps:

Conditions: Front axle measured and set, engine running, vehicle speed 0 km/h (0 MPH), internal steering angle sensor is activated.

1. Using the steering wheel, align the front wheels in the center forward position.
2. Using a scan tool, perform the Configuration/Reset Functions, Steering Wheel Angle Sensor Centering procedure.
3. Steer from the center position slowly 90° to the left.
4. Steer slowly back to the center position and then slowly 90° to the right.
5. Steer slowly back to the center position.
6. Perform the steering movements again.
7. Centering procedure is completed.

Software Endstop Learning

The software endstop learning procedure is completed during the Steering Wheel Angle Sensor Centering procedure above.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION (BELT DRIVE ELECTRONIC POWER STEERING)

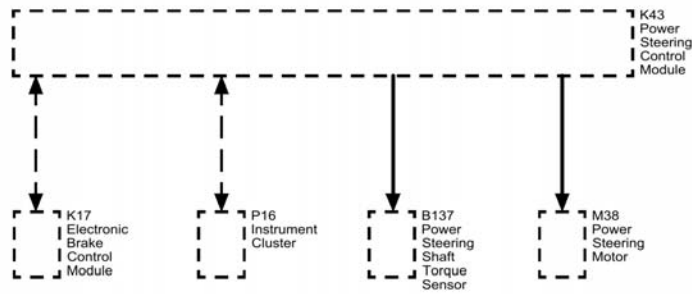


Fig. 26: Electric Power Steering System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K43	K43 Power Steering Control Module
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster
B137	B137 Power Steering Shaft Torque Sensor
M38	M38 Power Steering Motor

The belt driven electronic power steering system consists of the following components:

- The integrated electromechanical power steering unit, containing the power steering control module, its sensors, the power steering motor, a belt drive and a ball nut mechanism
- The Electric Belt Drive Rack and Pinion Steering Gear containing the steering angle sensor and power steering shaft torque sensor

The belt driven electric power steering system reduces the amount of effort needed to steer the vehicle utilizing the power steering control module to control the power steering motor to maneuver the steering gear. The power steering control module also uses a combination of the torque sensor, motor rotational sensor, battery voltage circuit and GMLAN serial data circuit to perform the system functions. The power steering control module monitors vehicle speed and engine speed from the engine control module via the GMLAN serial data circuit to determine the amount of steering assist needed to steer the vehicle. At low speeds more assist is provided for easy turning during parking maneuvers. At higher speeds less assist is provided for improved road feel and directional stability.

The power steering control module uses a combination of the torque sensor, motor rotational sensor, vehicle speed, and calculated system temperature inputs to determine the amount of assist needed. The power steering control module continuously monitors the digital torque sensor's torque and index current signals. As the steering wheel is

turned and torsional twist is applied to the steering shaft, the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque. The voltage signals of the motor position sensor and the digital torque sensor's index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.

The power steering control module responds to the change in the digital torque sensor signals as well as the motor rotational sensor's voltage signals by commanding current to the power steering motor. The power steering control module controls the motor drive circuit to drive the alternating current motor. The power steering control module & motor assembly is attached to the base of the steering gear housing and applies power assist directly to the rack with a belt drive and a ball nut mechanism to maneuver the rack laterally depending on the direction the steering wheel is turned.

The power steering control module has the ability to calculate an internal system temperature to protect the power steering system from damage caused by high temperature. To reduce a high system temperature, the power steering control module will reduce the amount of current commanded to the power steering motor, which reduces the amount of steering assist. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected that disables steering assist will cause the SERVICE POWER STEERING message to be displayed on the driver information center.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

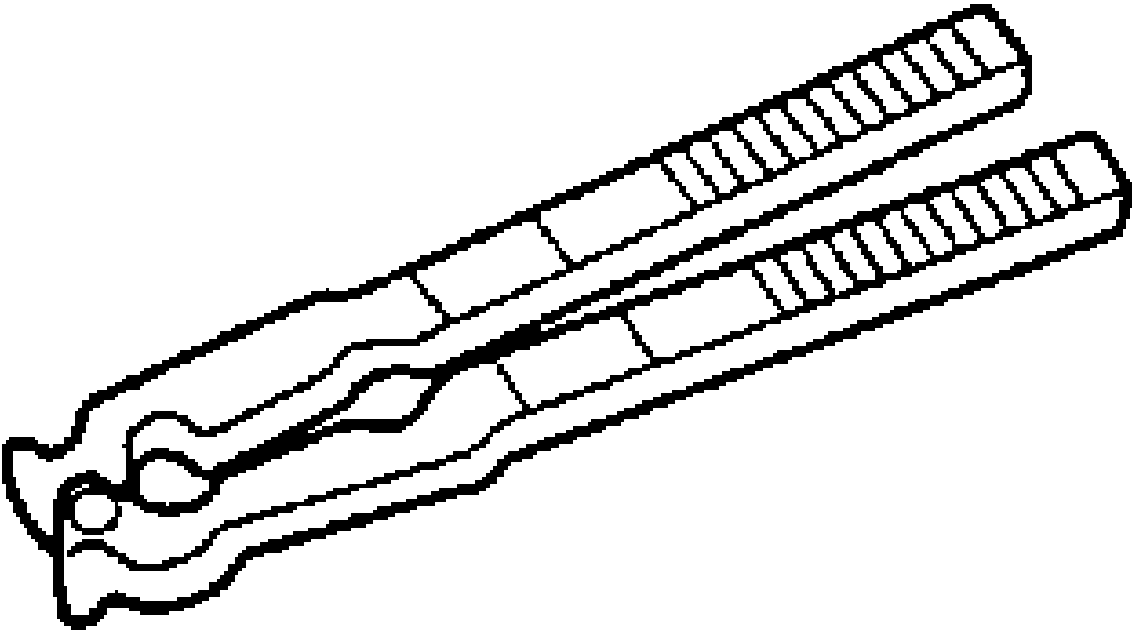
Illustration	Tool Number/Description
	CH-22610 J-22610 KM-J-22610 SA9164C Keystone Clamp Pliers

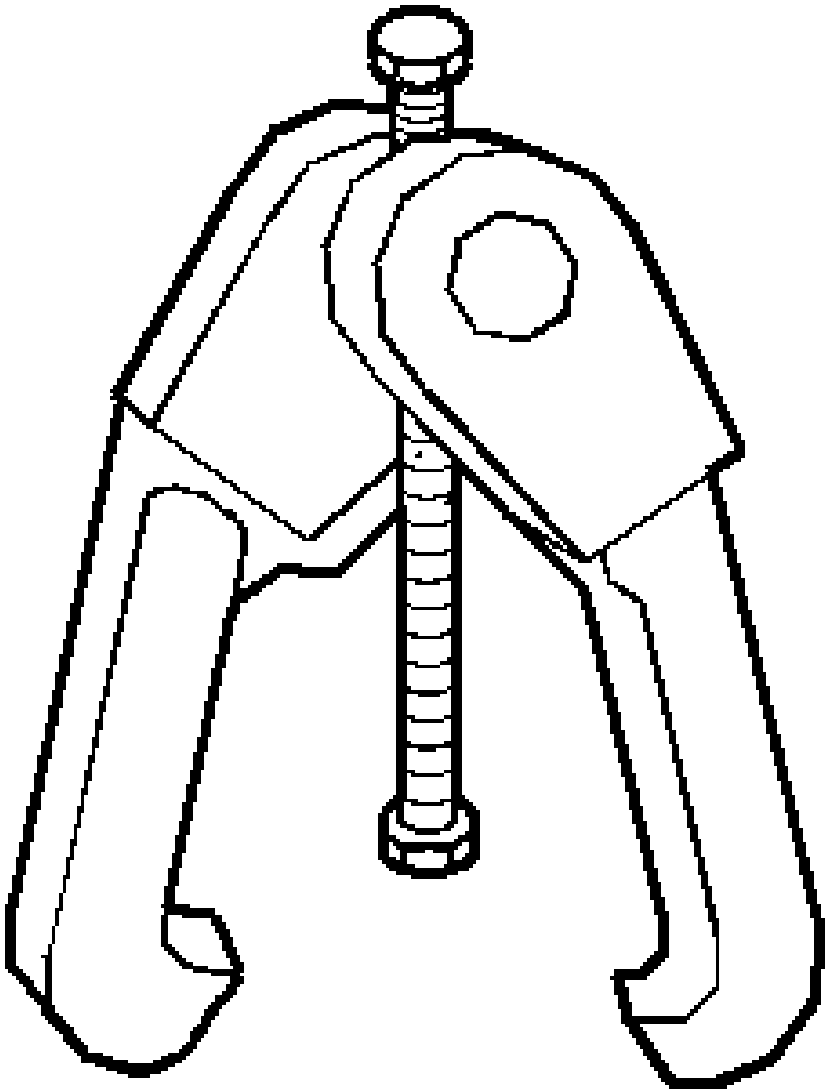
Illustration	Tool Number/Description
	CH-24319-B J-24319-B SA91100C 7503 Universal Steering Linkage and Tie Rod Puller

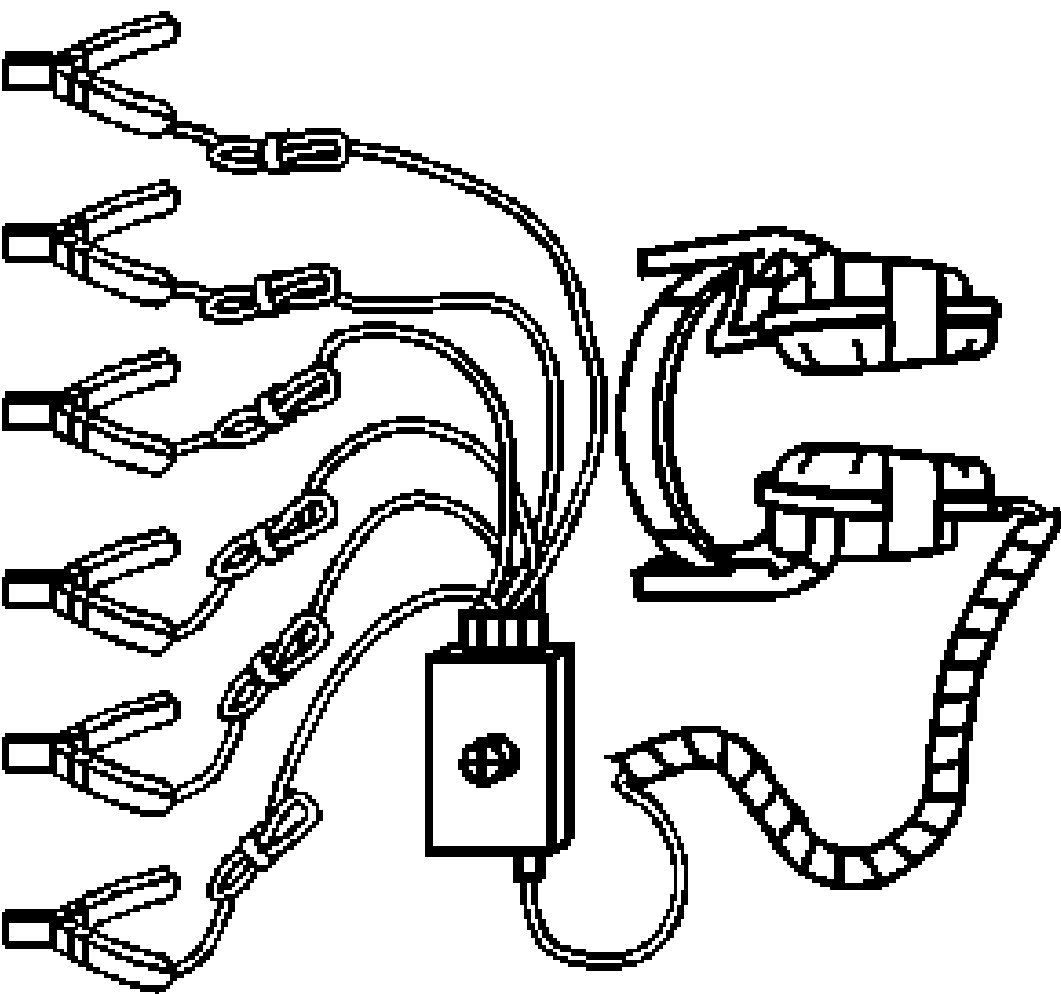
Illustration	Tool Number/Description
	CH-39570 J-39570 Chassis Ear

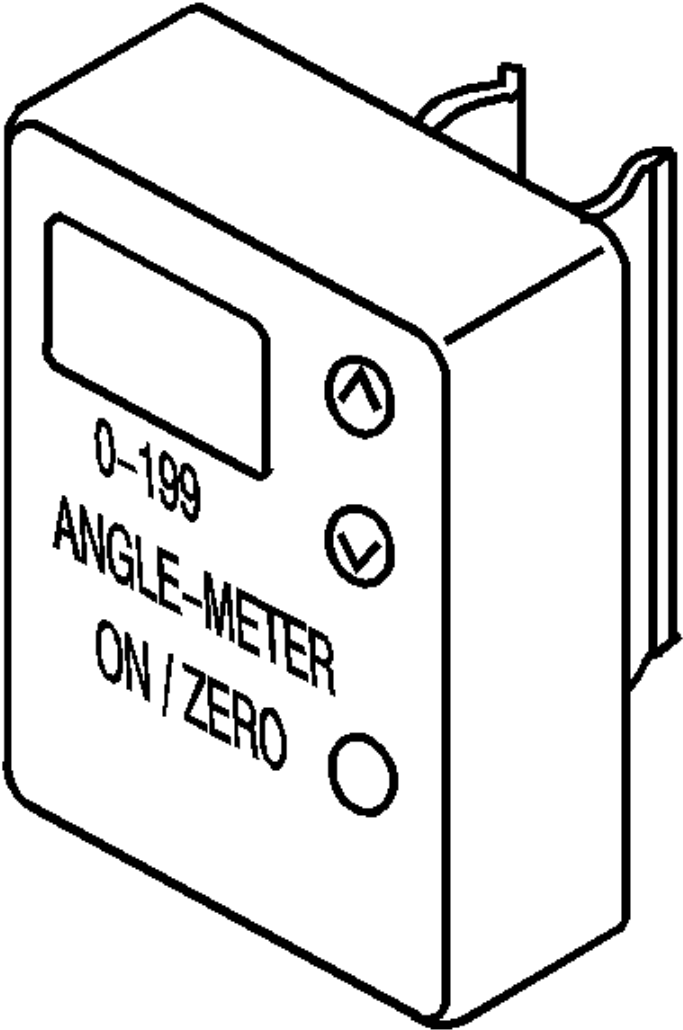
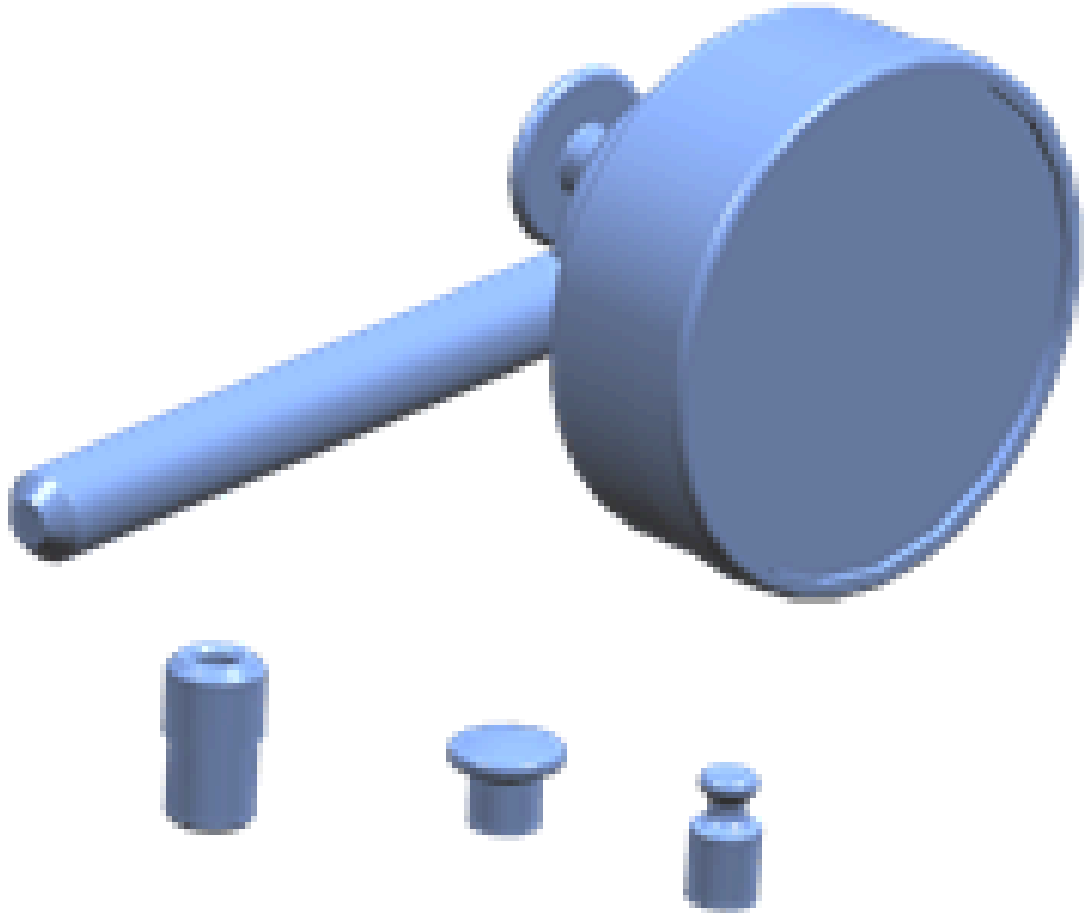
Illustration	Tool Number/Description
	EN-45059 J-45059 Torque Angle Meter

Illustration	Tool Number/Description
	GE-8001 J-8001 Dial Indicator Set

Article GUID: A00884722

STEERING

Steering Wheel and Column - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Intermediate Steering Shaft Upper Bolt	
• First Pass:	25 N.m (18 lb ft)
• Final Pass:	180 - 195 degrees

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Instrument Panel Cluster Trim Plate Bolt	2.5 N.m (22 lb in)
Instrument Panel Steering Column Lower Trim Cover Bolt	2.5 N.m (22 lb in)
Intermediate Steering Shaft Lower Bolt	58 N.m (43 lb ft)
Steering Column Nut	22 N.m (16 lb ft)
Steering Wheel Bolt	45 N.m (33 lb ft)
Steering Wheel Spoke Cover Fastener	1.5 N.m (13 lb in)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
-------------	------------------	----------------

		United States	Canada
Intermediate Steering Shaft Lower Bolt	Thread Locking Adhesive	12345382	10953489
Intermediate Steering Shaft Upper Bolt	Thread Locking Adhesive	12345382	10953489
Steering Wheel Bolt	Thread Locking Adhesive	12345382	10953489

SCHEMATIC WIRING DIAGRAMS

STEERING WHEEL WIRING SCHEMATICS

Heated Steering Wheel (UVD)

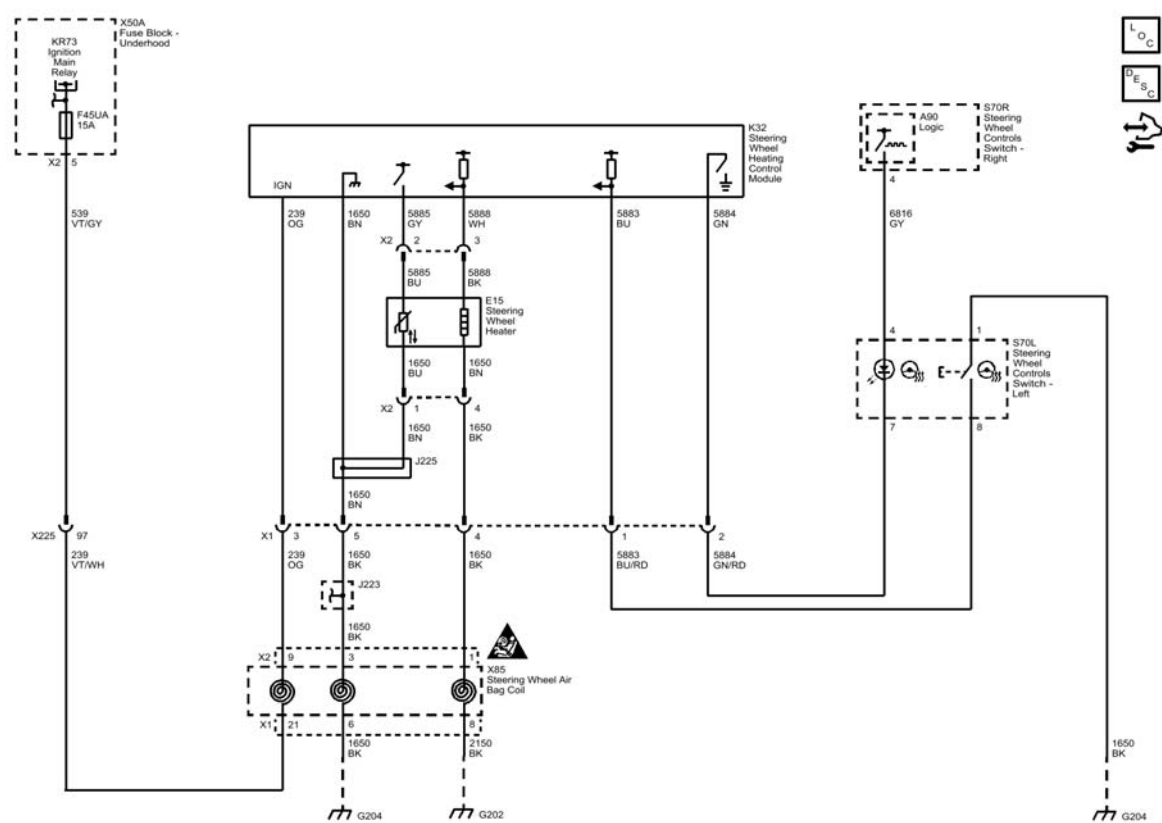


Fig. 1: Heated Steering Wheel (UVD)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - STEERING WHEEL AND COLUMN

Review the system description and operation in order to familiarize yourself with the system functions. Refer to [Steering Wheel and Column Description and Operation](#).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the steering wheel and column.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Steering Column Tilt Function Inoperative](#)
- [Noise in Steering Column](#)
- [Looseness in Steering Column](#)

HEATED STEERING WHEEL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Switch Signal	2	1	-	-
Indicator Dimming Control 2	3	3	-	-
Heated Steering Wheel Switch LED Control	4	3	3	-
Switch Ground	-	1	-	-
Module Ground	-	1	-	-
1. Heated Steering Wheel System Inoperative 2. Heated Steering Wheel Always ON 3. LED Inoperative 4. LED Always ON				

Circuit/System Description

The Steering Wheel Heating Control Module controls the heated steering wheel and the heated steering wheel ON indicator based on an input from the heated steering wheel switch. When the heated steering wheel switch is pressed, the switch signal circuit is pulled to ground. This indicates to the heating steering wheel control module that steering wheel heat is requested. When the request is seen, the heated steering module supplies voltage to the indicator lamp and supplies voltage to the heating elements, which are internal to the steering wheel.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel and Column Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

1. Ignition ON.
2. Verify the S70L Steering Wheel Controls Switch - Left is OFF. The steering wheel heater indicator should not be illuminated and the left and right sides of the steering wheel should not be warm.

- **The steering wheel is always warm**

Refer to [Heated Steering Wheel Malfunction](#)

- **The steering wheel does not become warm and the heater indicator is illuminated**

Refer to Circuit/System Testing

- **The steering wheel does not become warm and the heater indicator is not illuminated**

3. Press and release the S70L Steering Wheel Controls Switch - Left. The steering wheel heater indicator should illuminate and the left and right sides of the steering wheel should become warm.

- **The steering wheel does not become warm**

Refer to [Heated Steering Wheel Malfunction](#)

- **The steering wheel becomes warm and the heater indicator does not illuminate**

Refer to Circuit/System Testing

- **The steering wheel becomes warm and the heater indicator illuminates**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 in-line harness connector at the K32 Heated Steering Wheel Control Module.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.

- **If 10 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.

4. Verify a test lamp illuminates between the ignition voltage circuit terminal 9 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse. Refer to [Power Mode Mismatch](#).
- If 2 Ω or greater

3. Verify the in-line fuse is OK and there is voltage at the fuse.

- If the in-line fuse is blown, replace the K32 Steering Wheel Heating Control Module.
- If the in-line fuse is OK, repair the open/high resistance in the circuit.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Ignition OFF.

2. Test for infinite resistance between the ignition voltage circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K32 Steering Wheel Heating Control Module.

- **If the test lamp illuminates**

5. Ignition OFF, connect the X2 in-line harness connector. Disconnect the harness connector at the S70L Steering Wheel Control Switch - Left. Ignition ON.

6. Verify a test lamp illuminates between the signal voltage circuit terminal 4 and ground.

- **If the test lamp does not illuminate**

1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Control Switch - Right.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the S70R Steering Wheel Control Switch - Right.

- **If the test lamp illuminates**

7. Ignition ON.

8. Test for less than 1 V between the control circuit terminal 7 and ground.

- **If greater than 1 V**

1. Disconnect the K32 Steering Wheel Heating Control Module harness connector.

2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If greater than 1 V, repair the short to voltage on the circuit.
 - If less than 1 V
3. Replace the K32 Steering Wheel Heating Control Module.
 - **If infinite resistance**
9. Ignition OFF.
10. Test for infinite resistance between the control circuit terminal 7 and ground.
 - **If less than infinite resistance**
 1. Disconnect the K32 Steering Wheel Heating Control Module harness connector.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Replace the K32 Steering Wheel Heating Control Module.
 - **If infinite resistance**
11. Install a 3 A fused jumper wire between the ground circuit terminal 7 and ground. Ignition ON.
12. Verify the steering wheel heat indicator is illuminated.
 - **If the steering wheel heat indicator does not illuminate**
 1. Disconnect the K32 Steering Wheel Heating Control Module harness connector.
 2. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - Replace the S70L Steering Wheel Control Switch - Left
 - **If the steering wheel heat indicator illuminates**
13. Replace the K32 Steering Wheel Heating Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair

- Refer to [Cruise Control Switch Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

HEATED STEERING WHEEL MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Switch Signal	2	1	-	-
Switch and LED Ground	-	1	-	-
Temperature Sensor Signal	3	3	3	-
Temperature Sensor Ground	-	3	-	-
Heater Element Control	3	3	2	-
Heater Element Ground	-	3	-	-
Module Ground	-	1	-	-
1. Heated Steering Wheel System Inoperative 2. Heated Steering Wheel Always ON 3. Heated Steering Wheel Inoperative				

Circuit/System Description

The heated steering wheel control module controls the heated steering wheel and the heated steering wheel ON indicator based on an input from the heated steering wheel switch. When the heated steering wheel switch is pressed, the switch signal circuit is pulled to ground. This indicates to the heating steering wheel control module that steering wheel heat is requested. When the request is seen, the heated steering wheel control module supplies voltage to the indicator lamp and supplies voltage to the heating elements, which are internal to the steering wheel.

Diagnostic Aids

- Before replacing the steering wheel for complaints of not getting hot enough, a reliable infrared temperature gun should be used to measure the temperature at various points around the rim. The steering wheel's normal operating temperature is 32°C (89.6°F) and takes approximately 10 min to reach that temperature. It may take up to 20 min for the normal operating temperature to stabilize within the steering wheel rim. There may be spike in temperature during the first 3 - 4 min before it stabilizes at normal operating temperature. The steering wheel will take longer to heat up if the vehicle temperature is below -21°C (-5.8°F). The steering wheel heater will not operate when the steering wheel temperature is above 32°C (89.6°F).

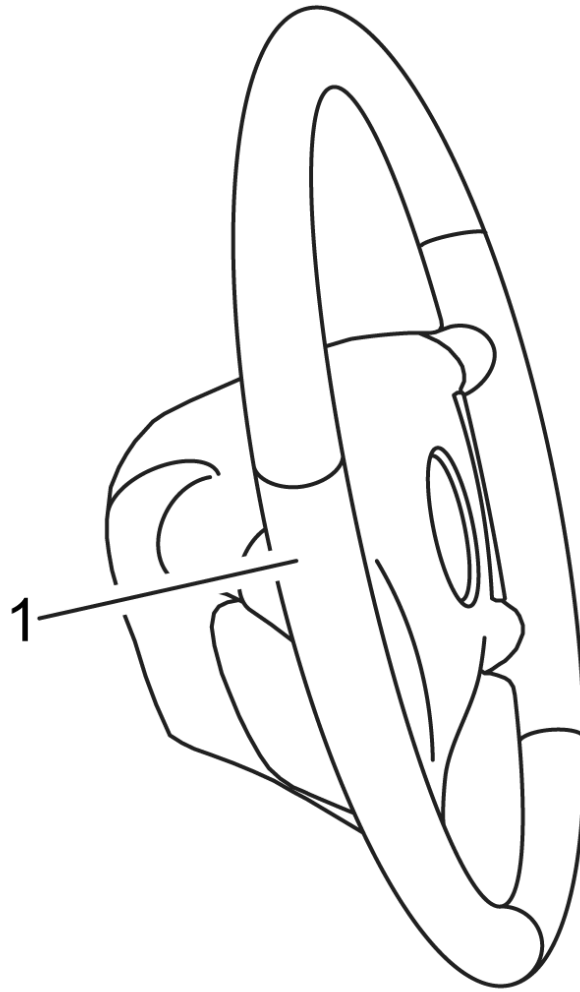


Fig. 2: Steering Wheel Rim Infrared Measurement Point
Courtesy of GENERAL MOTORS COMPANY

- The infrared measurements are made at the rim (1) at the 3 and 9 o'clock positions of the steering wheel.

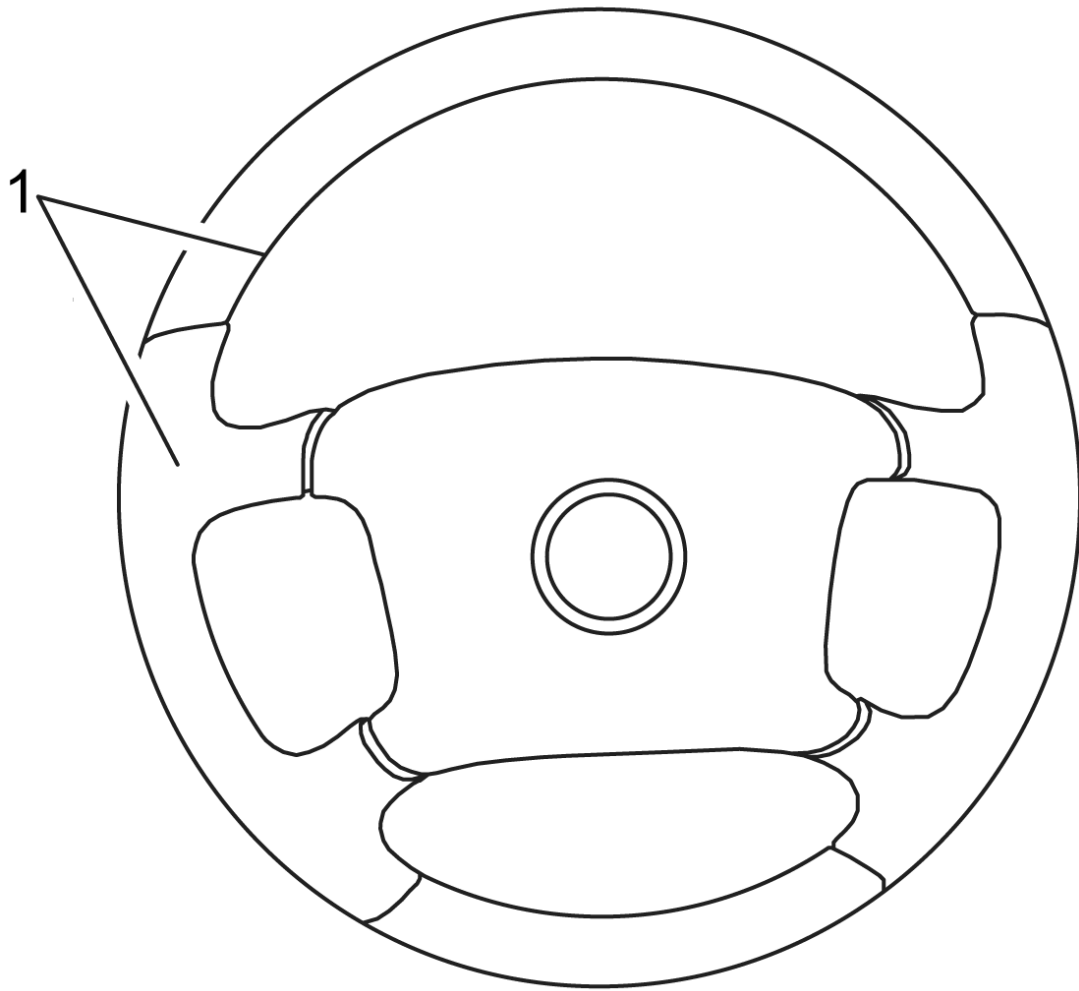


Fig. 3: Temperature Measurements Should Not Be Made On Face

Courtesy of GENERAL MOTORS COMPANY

- The wood sections and the stitching are not heated. Temperature measurements should not be made on the face (1) to insure accurate temperature readings.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel and Column Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Circuit/System Verification

Using an Infrared Temperature Gun

1. Engine running, all accessories OFF.
2. Verify the steering wheel heater switch is OFF and the steering wheel heater indicator should not be illuminated.
 - **If the heater indicator is illuminated**

Refer to [Heated Steering Wheel Indicator Malfunction](#)

- **If the heater indicator is not illuminated**

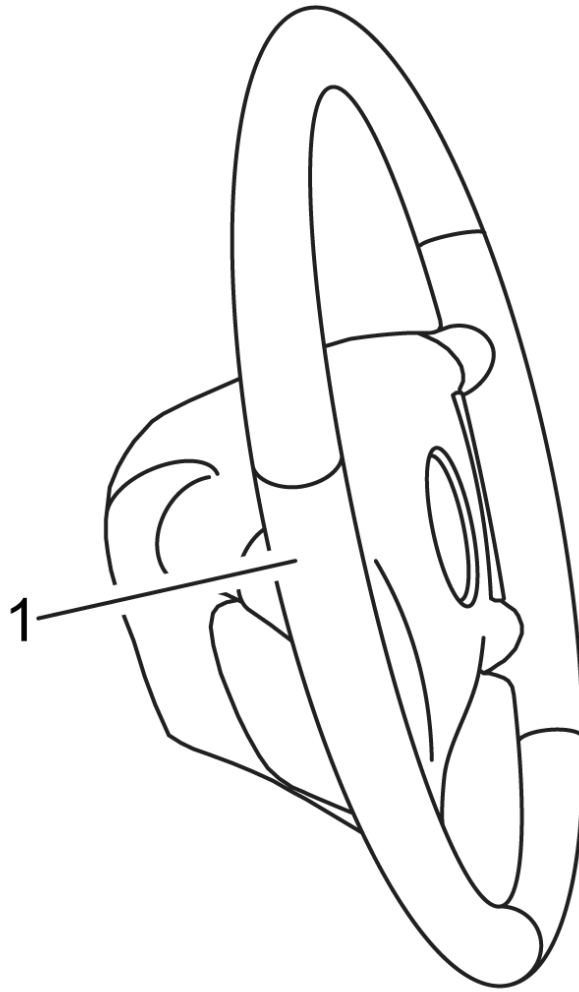


Fig. 4: Steering Wheel Rim Infrared Measurement Point

Courtesy of GENERAL MOTORS COMPANY

NOTE: The Infrared Temperature Gun should be within 50.8 mm (2 in) and parallel to the steering wheel rim when taking temperature readings.

3. Measure the temperature readings at the 3 and 9 o'clock positions on the steering wheel rim (1).
4. Verify that the steering wheel temperature is 25°C (77°F) or below.

- **If the steering wheel temperature is greater than 25°C (77°F)**

Allow the steering wheel to cool before proceeding to next step.

- **If the steering wheel temperature is 25°C (77°F) or below**

5. Press and release the steering wheel heater switch. The steering wheel heater indicator should illuminate. Allow the steering wheel to heat for a minimum of 10 min so that the temperature stabilizes.

- **If the heater indicator does not illuminate**

Refer to [Heated Steering Wheel Indicator Malfunction](#)

- If the heater indicator illuminates

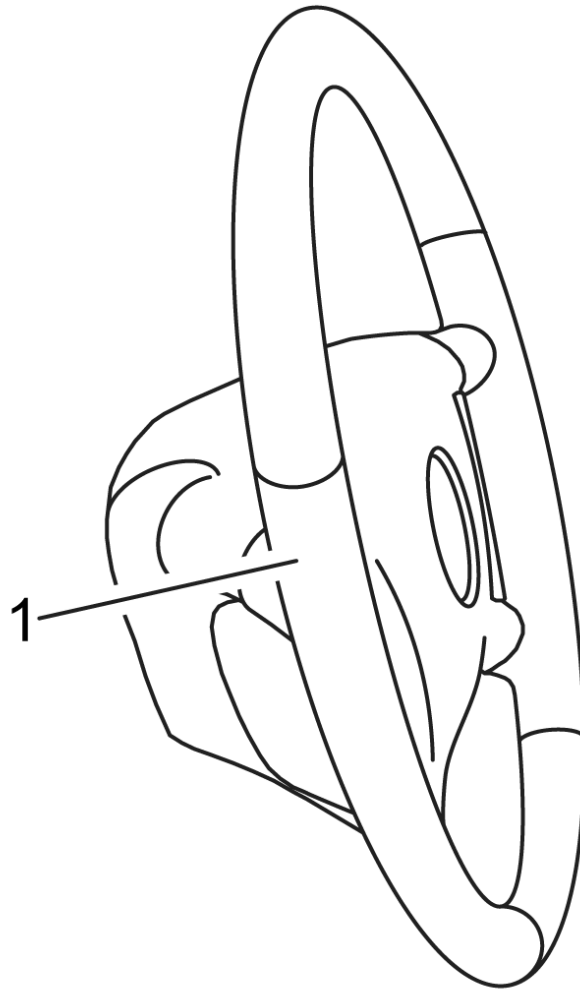


Fig. 5: Steering Wheel Rim Infrared Measurement Point

Courtesy of GENERAL MOTORS COMPANY

NOTE: The Infrared Temperature Gun should be within 50.8 mm (2 in) and parallel to the steering wheel rim when taking temperature readings.

6. Measure the temperature readings at the 3 and 9 o'clock positions on the steering wheel rim (1).
7. Verify that the steering wheel temperature is greater than 28°C (82.4°F) within 20 min.
 - If after 20 minutes the measured temperature is less than 28°C (82.4°F)

Refer to Circuit System Testing.

- If after 20 minutes the measured temperature is 28°C (82.4°F) or greater

8. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 in-line harness connector at the K32 Heated Steering Wheel Control Module.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition voltage circuit terminal 9 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse. Refer to [Power Mode Mismatch](#).
 - If 2 Ω or greater
 3. Verify the in-line fuse is OK and there is voltage at the fuse.
 - If the in-line fuse is blown, replace the K32 Steering Wheel Heating Control Module.
 - If the in-line fuse is OK, repair the open/high resistance in the circuit.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K32 Steering Wheel Heating Control Module.
 - **If the test lamp illuminates**
5. Ignition OFF, connect the in-line harness connector X2. Disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left.
6. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
7. Ignition ON.
8. Test for B+ between the signal circuit terminal 8 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the in-line harness connector at the S70L Steering Wheel Controls Switch

- Left.

2. Test for infinite resistance between the control circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K32 Steering Wheel Heating Control Module.

• **If B+**

9. Ignition OFF, disconnect the harness connector at the K32 Heated Steering Wheel Control Module.

10. Ignition ON.

11. Test for less than 1 V between the signal circuit terminal 1 and ground.

• **If greater than 1 V**

Repair the short to voltage on the circuit.

• **If less than 1 V**

12. Ignition OFF, connect the harness connector at the K32 Heated Steering Wheel Control Module.

13. Place the S70L Steering Wheel Controls Switch - Left in the OFF position.

14. Test for infinite resistance between terminal 8 and terminal 1 at the S70L Steering Wheel Controls Switch - Left.

• **If less than infinite resistance**

Replace the S70L Steering Wheel Controls Switch - Left.

• **If infinite resistance**

15. Place the S70L Steering Wheel Controls Switch - Left in the ON position.

16. Test for less than 40 Ω between terminal 8 and terminal 1.

• **If 40 Ω or greater**

Replace the S70L Steering Wheel Controls Switch - Left

• **If less than 40 Ω**

17. Disconnect the in-line harness connector at the E15 Steering Wheel Heater.

18. Test for less than 10 Ω between the ground circuit terminal 4 at the K32 Steering Wheel Heating Control Module and ground.

• **If 10 Ω or greater**

Repair the open/high resistance in the circuit.

• **If less than 10 Ω**

19. Test for 1.5 - 3.0 Ω between the signal terminal 3 and the ground terminal 4 at the E15 Steering Wheel Heater.

• **If not within the specified range**

Replace the E15 Steering Wheel Heater.

- **If within the specified range**

20. Test for 9 - 11k Ω between the control circuit terminal 2 and the ground terminal 1 on the E15 Steering Wheel Heater.

- **If not within the specified range**

Replace the E15 Steering Wheel Heater.

- **If within the specified range**

21. Replace the K32 Steering Wheel Heating Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Cruise Control Switch Replacement](#)
- Refer to [Steering Wheel Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

STEERING COLUMN TILT FUNCTION INOPERATIVE

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Steering Wheel and Column
2	Verify that the steering column tilt function is inoperative. Does the steering column tilt function operate normally?	System OK	Go to Step 3
3	If equipped, verify that the following components are not seized or corroded: • Tilt pivot pins • Tilt head lock shoes Are the components seized or corroded?	Go to Step 7	Go to Step 4
4	Inspect the tilt pivot pins for binding. Are the tilt pivot pins binding?	Go to Step 8	Go to Step 5
5	Inspect for a weak or broken steering column tilt spring. Is the steering column tilt spring weak or broken?	Go to Step 9	Go to Step 6
6	Inspect the steering column wiring harness routing for tightness. Was the steering column wiring harness routed correctly?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
7	Replace the steering column. Refer to Steering Column Replacement . Did you complete the repair?	Go to Step 11	-
8	If serviceable, replace the pivot pins. If not serviceable replace the steering column. Refer to Steering Column Replacement . Did you complete the repair?	Go to Step 11	-
9	If serviceable, replace the tilt spring. Did you complete the repair?	Go to Step 11	-
10	Route the steering column wiring harness to the correct location. Did you correctly route the wiring harness?	Go to Step 11	-
11	Operate the steering column tilt function in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

NOISE IN STEERING COLUMN

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Steering Wheel and Column
2	Verify that noise is present in the steering column during operation. Is noise present in the steering column during operation?	Go to Step 3	System OK
3	Inspect the steering column mounting features for the following conditions: • The steering column mounting fasteners are loose. • The steering column mounting features are sheared. Are the steering column mounting features loose or sheared?	Go to Step 10	Go to Step 4
4	Inspect the SIR/SRS coil for noise. Is the SIR/SRS coil noisy?	Go to Step 11	Go to Step 5
5	If equipped, inspect the lock plate retaining ring for correct installation. Is the lock plate retaining ring installed incorrectly?	Go to Step 12	Go to Step 6
6	Inspect the steering column upper and lower bearings for the following conditions:	Go to Step 13	Go to Step 7

Step	Action	Yes	No
	• Damage • Lubrication • Wear • Proper seating Are the bearings in need of repair or replacement?		
7	Does the steering column tilt joint need to be lubricated?	Go to Step 14	Go to Step 8
8	NOTE: Inspect the intermediate steering shaft for noise while driving the vehicle, turning the steering wheel, and applying the brakes. Inspect the intermediate steering shaft for noise. Is the intermediate steering shaft noisy?	Go to Step 15	Go to Step 9
9	NOTE: For vehicles equipped with a telescoping steering column, perform this step. If not equipped, go to next step. Inspect the steering column for noise while telescoping the column. Is the steering column noisy while telescoping?	Go to Step 16	Go to Step 17
10	NOTE: If the steering column mounting	Go to Step 17	-

Step	Action	Yes	No
	features are damaged or sheared, replace the steering column. Refer to Steering Column Replacement. Tighten the steering column mounting fasteners to specification. Refer to Fastener Specifications. Did you complete the repair?		
11	Replace the SIR/SRS coil. Refer to Steering Wheel Airbag Coil Replacement. Did you complete the repair?	Go to Step 17	-
12	Install the lock plate retaining ring correctly. Did you complete the repair?	Go to Step 17	-
13	NOTE: If the steering column upper and/or lower bearings are not serviceable, replace the steering column. Refer to Steering Column Replacement. Replace the steering column upper and/or lower bearings, if serviceable. Did you complete the replacement?	Go to Step 17	-
14	Lubricate the steering column tilt joint. Did you complete the repair?	Go to Step 17	-
15	Replace the appropriate intermediate steering shaft component. Did you complete the repair?	Go to Step 17	-

Step	Action	Yes	No
16	Redistribute or add lubricant to the steering column lower jacket with the column telescoped to its end of outward travel. Did you complete the repair?	Go to Step 17	-
17	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

LOOSENESS IN STEERING COLUMN

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Steering Wheel and Column
2	Verify that the steering column is loose. Is the steering column loose?	Go to Step 3	System OK
3	Inspect the steering column mounting features for the following conditions. - The steering column mounting fasteners are loose. - The steering column mounting features are sheared. Are the steering column mounting features loose or sheared?	Go to Step 5	Go to Step 4
4	Inspect the upper and/or lower bearings for looseness. Are any of the bearings worn or loose?	Go to Step 6	Go to Step 7
5	NOTE: If the steering column mounting features are damaged or sheared, replace the steering column. Refer to Steering Column Replacement. Tighten the steering column mounting fasteners to specification. Refer to Fastener Specifications. Did you	Go to Step 7	-

Step	Action	Yes	No
	complete the repair?		
6	NOTE: If the steering column upper and/or lower bearings are not serviceable, replace the steering column. Refer to Steering Column Replacement. Replace the upper and/or lower bearings, if serviceable. Did you complete the repair?	Go to Step 7	-
7	Operate the steering column in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

REPAIR INSTRUCTIONS

WIRE TO WIRE REPAIR - STEERING

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to [Special Tools](#) .

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring

harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.

- Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
 5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

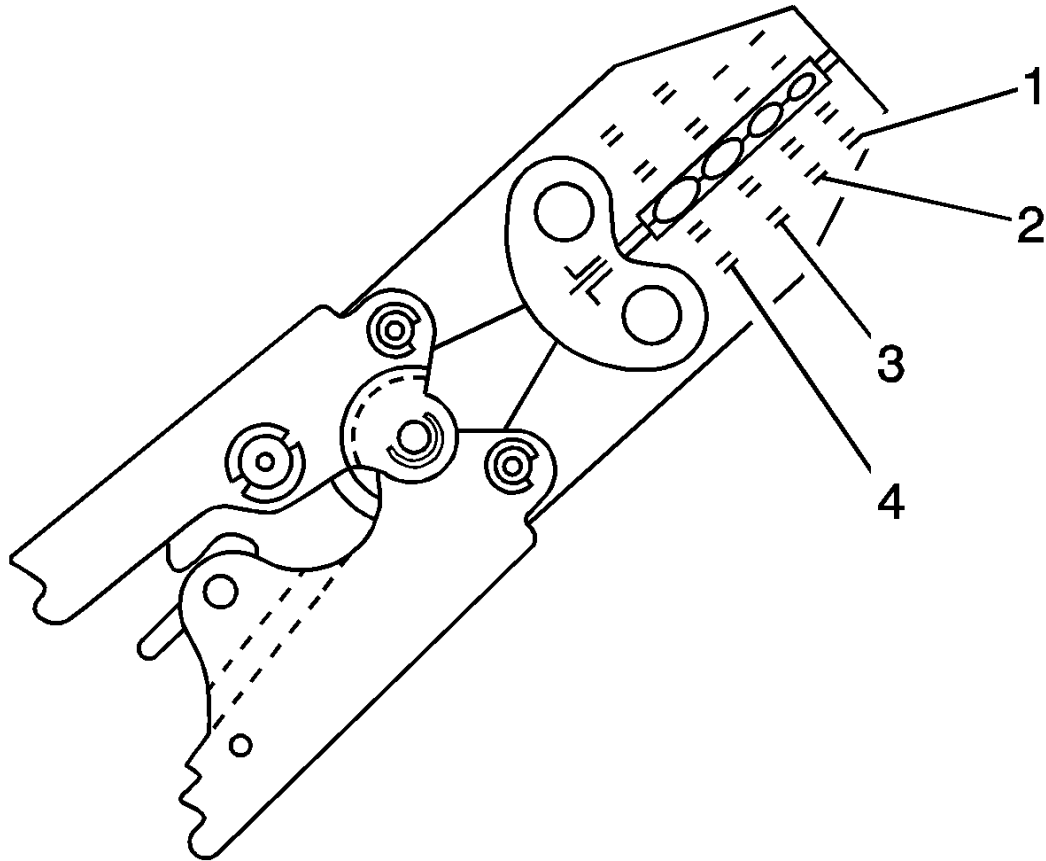


Fig. 6: Splice Sleeve Crimping Tool With 4 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge

wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

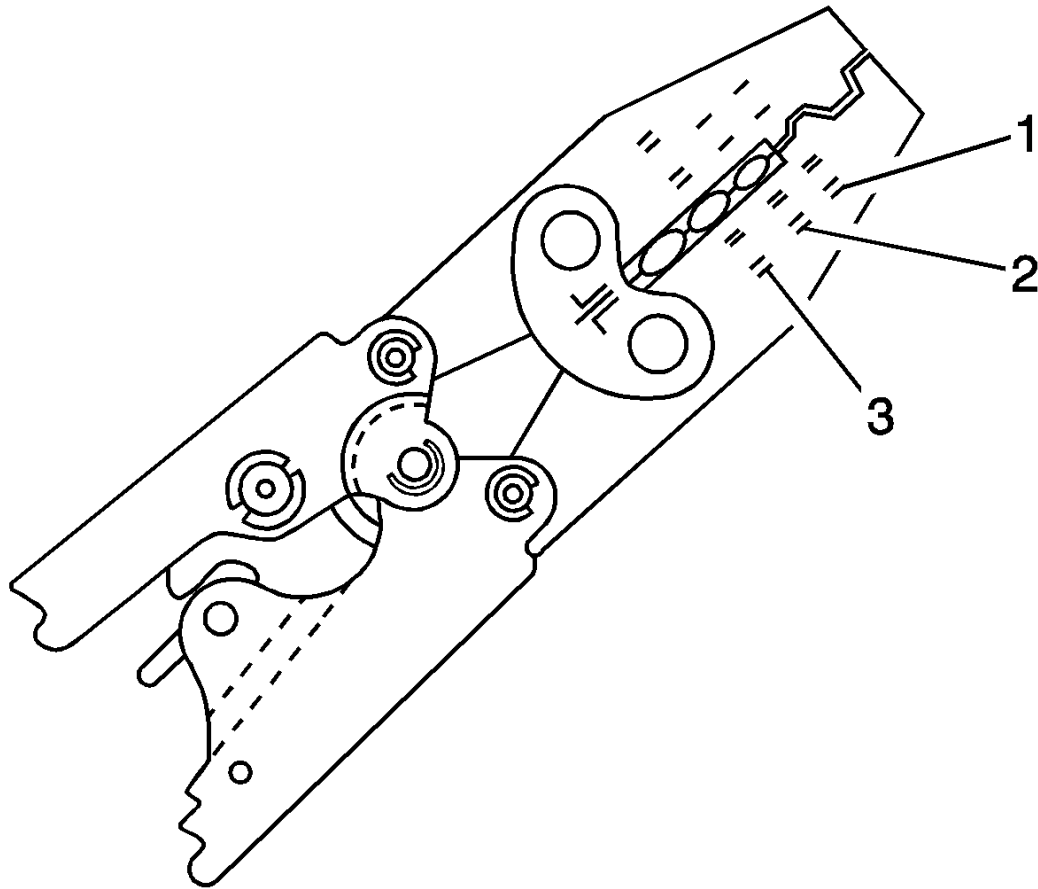


Fig. 7: Splice Sleeve Crimping Tool With 3 Crimp Nests

Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

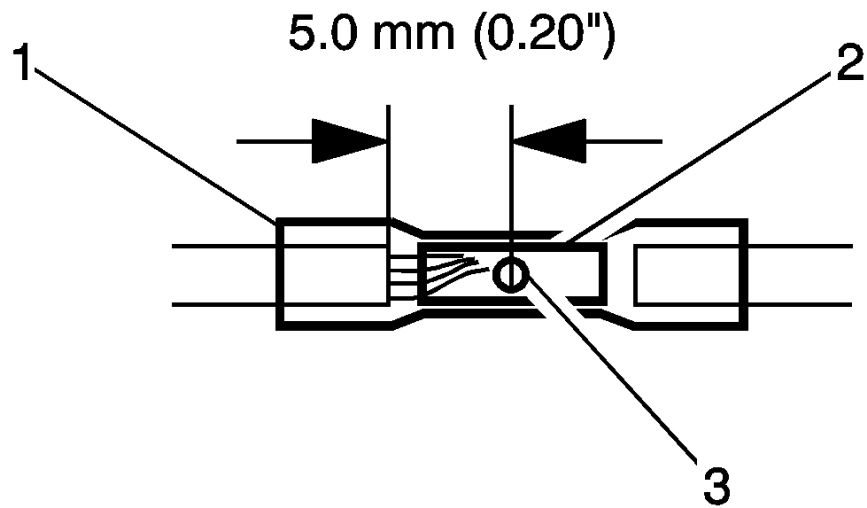


Fig. 8: Identifying DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 9: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 10: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to [Folded-Over Wire Repair](#) for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

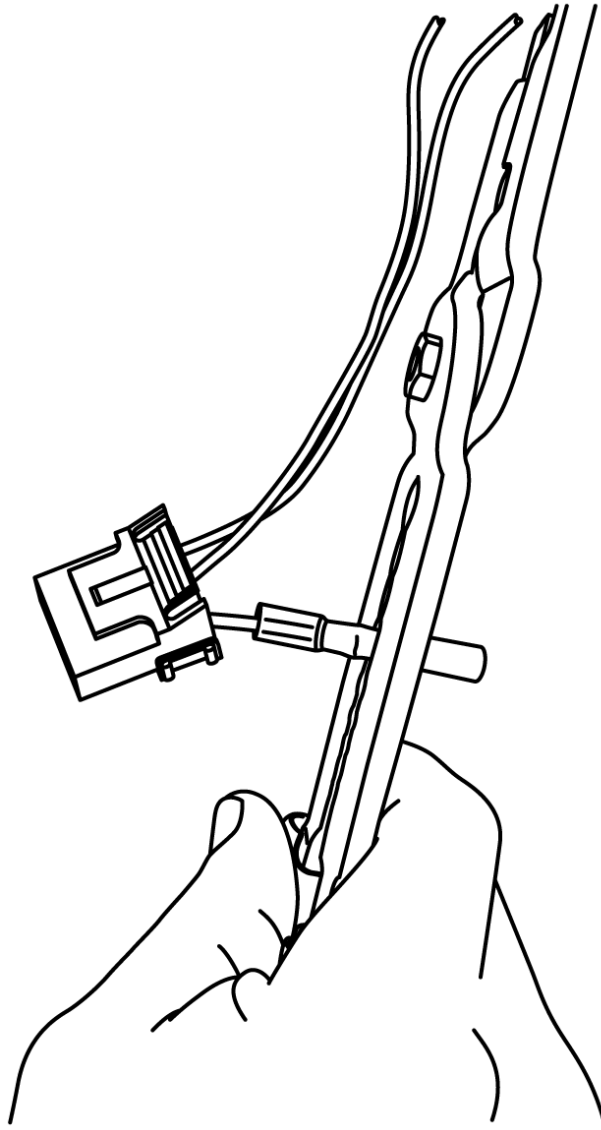


Fig. 11: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

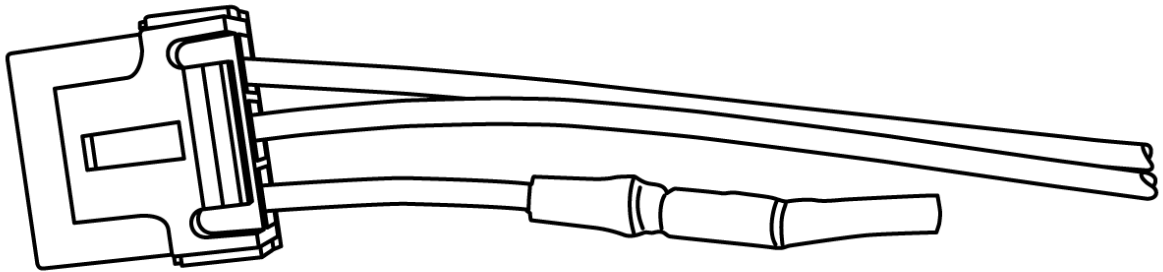


Fig. 12: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

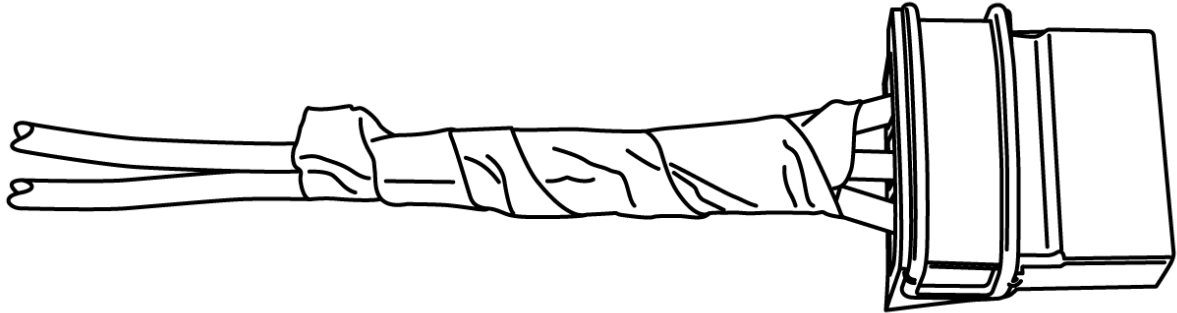


Fig. 13: Taping Extra Terminated Leads Back Into Harness

Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - STEERING

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded, or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel

760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Power Distribution Schematics](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics](#) .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition

components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#) .
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup, and programming.

INTERMEDIATE STEERING SHAFT REPLACEMENT

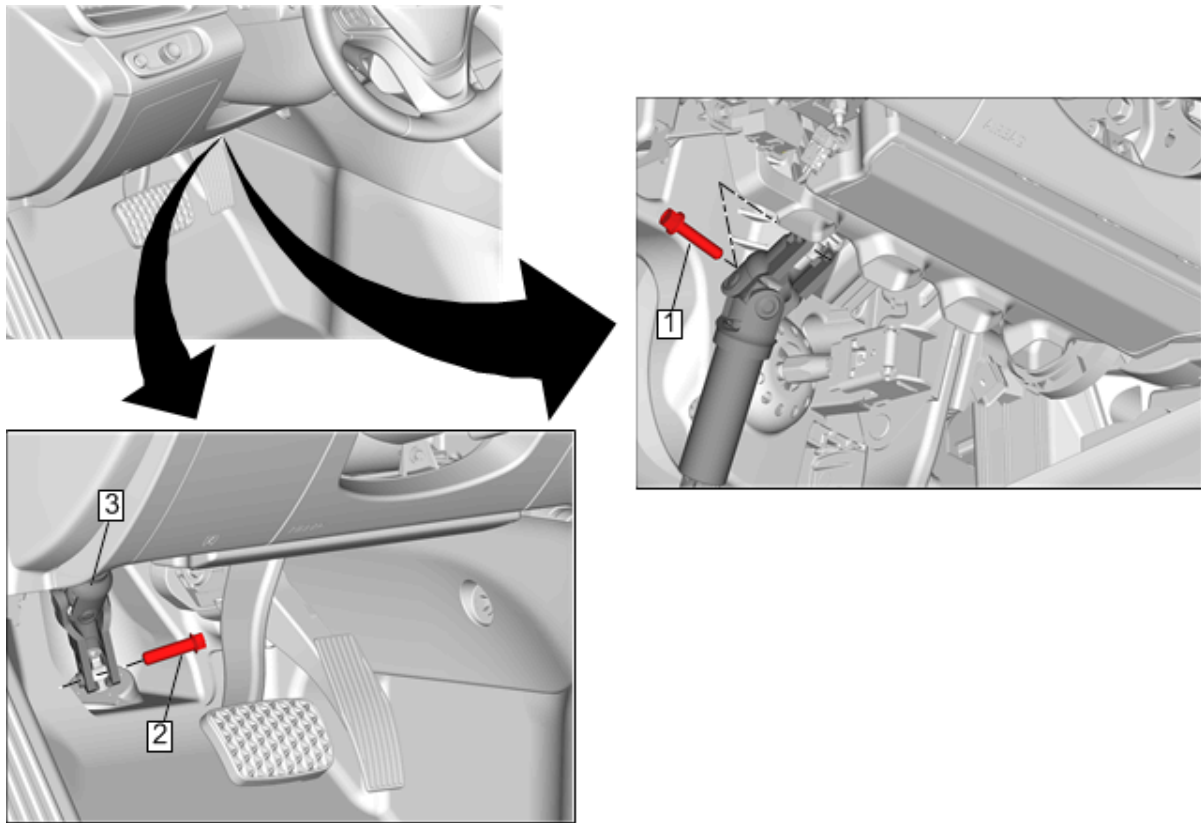


Fig. 14: Intermediate Steering Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in	

Callout	Component Name
position before disconnecting the following components: • The steering column • The intermediate shaft(s) • The steering gear After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil. Preliminary Procedures 1. With the front wheels in the straight ahead position, pull the driver's seat belt between the spokes on the steering wheel and buckle the seat belt to secure the steering wheel. 2. Place match marks on the steering gear shaft and the intermediate steering shaft to aid in installation. 3. Place match marks on the steering column shaft and the intermediate steering shaft to aid in installation.	

STEERING COLUMN UPPER TRIM COVER REPLACEMENT

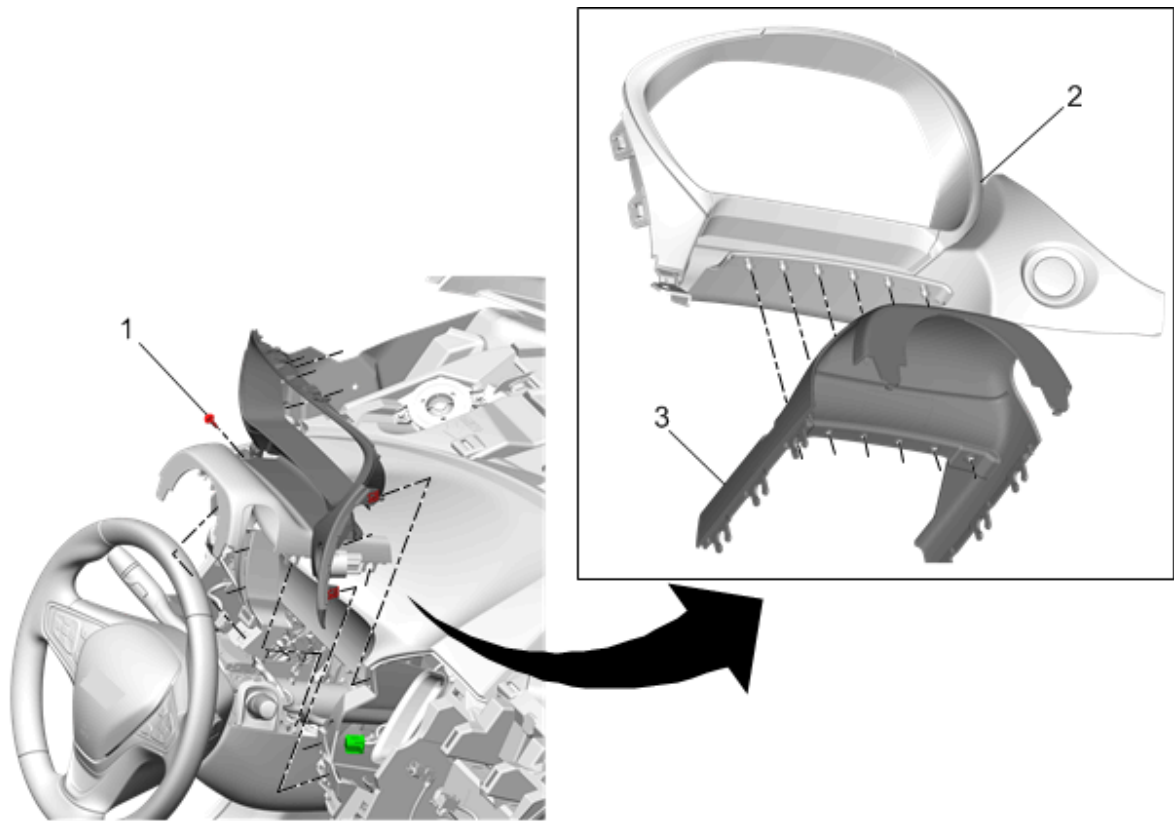


Fig. 15: Steering Column Upper Trim Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
NOTE: The instrument panel cluster trim plate and the steering column upper trim cover must be removed as an assembly, do not attempt to separate. Preliminary Procedure 1. Disable SIR system. Refer to SIR Disabling and Enabling 2. Remove Instrument Panel Trim Plate Applique - Left Side. Refer to Instrument Panel Trim Plate	

Callout	Component Name
<u>Applique Replacement - Left Side</u> 3. Remove Instrument Panel Center Air Outlet. Refer to <u>Instrument Panel Center Air Outlet Replacement</u>	
1	Instrument Panel Cluster Trim Plate Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 N.m (22 lb in)
2	Instrument Panel Cluster Trim Plate Procedure 1. Use a flat bladed plastic trim tool. 2. Grasp the instrument panel cluster trim plate and steering column upper trim cover assembly and pull rearward releasing the clips securing the assembly to the instrument panel. 3. Disconnect the electrical connector.
3	Steering Column Upper Trim Cover Procedure 1. Turn the steering wheel to the left in order to release the left tab securing the upper trim cover to the lower trim cover. 2. Release the retainers along the left side of the upper trim cover securing it to the lower trim cover. 3. While holding the left side of the trim cover up, turn the steering wheel enough to release the right retainer tab securing the right side of the upper trim cover to the lower trim cover. 4. Release the retainers along the right side of the upper trim cover securing it to the lower trim cover. 5. Transfer components as necessary. 6. When replacing either the instrument panel cluster trim plate or the steering column upper trim cover snap the two pieces together prior to installing them into the vehicle.

STEERING COLUMN LOWER TRIM COVER REPLACEMENT

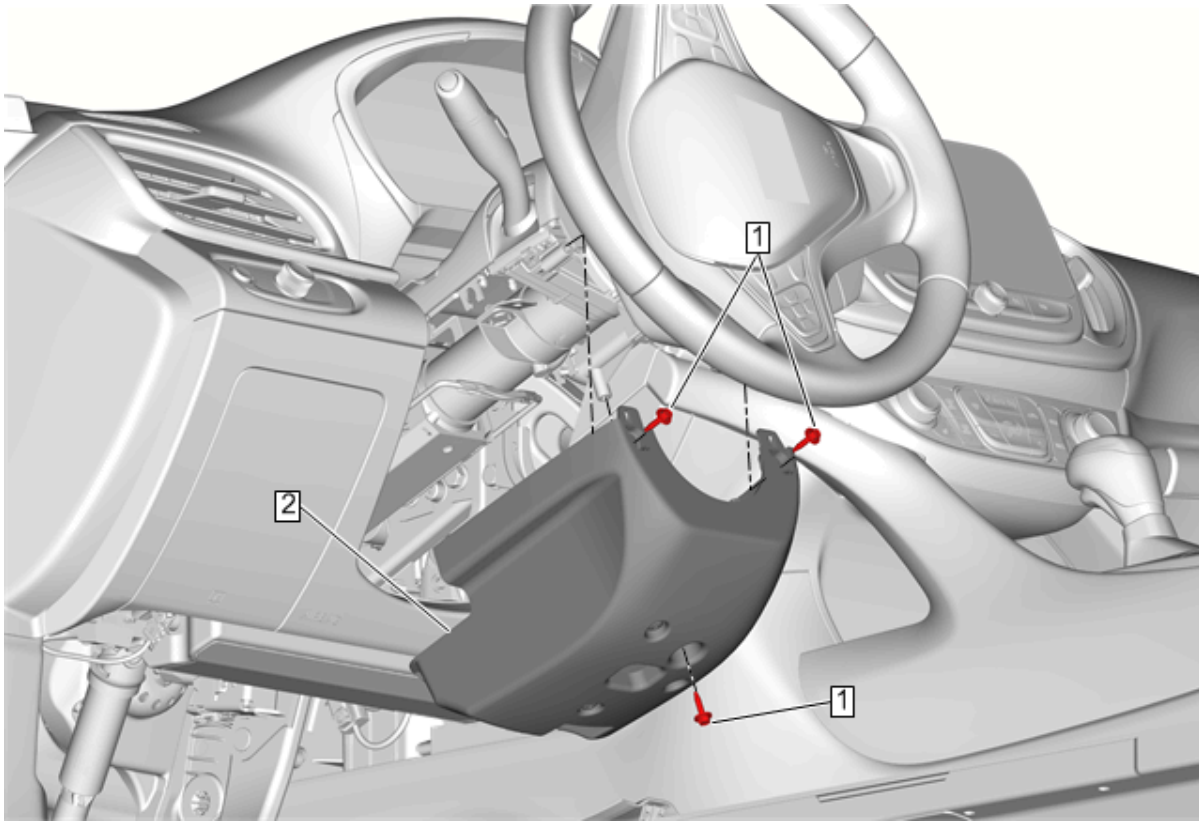


Fig. 16: Steering Column Lower Trim Cover
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Loosen Steering Column Upper Trim Cover. Refer to Steering Column Upper Trim Cover Replacement	
1	Instrument Panel Steering Column Lower Trim Cover Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Procedure Rotate the steering wheel left and right to access the fasteners securing the lower trim cover to the turn signal switch bracket. Tighten 2.5 N.m (22 lb in)
2	Steering Column Lower Trim Cover Procedure Extend the steering column to the fully telescoped position.

TURN SIGNAL SWITCH REPLACEMENT

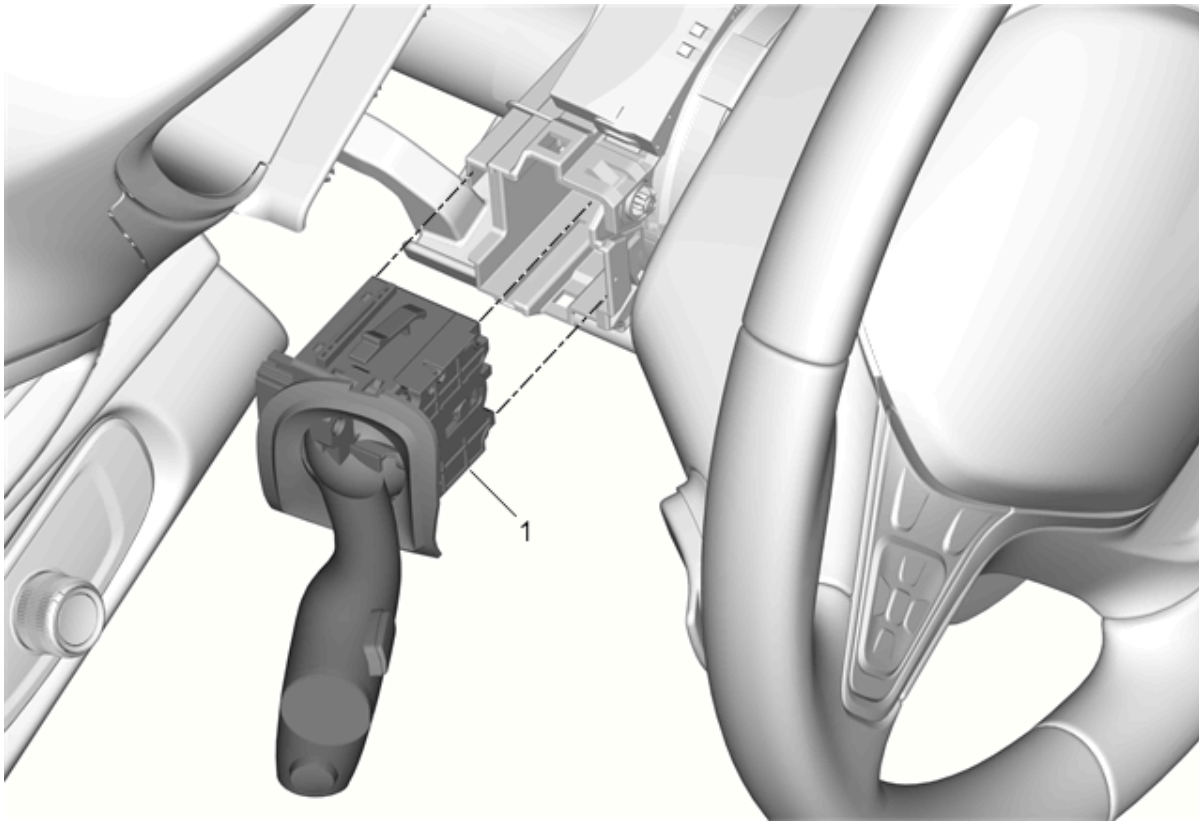


Fig. 17: Turn Signal Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Steering Column Lower Trim Cover. Refer to Steering Column Lower Trim Cover Replacement 2. Reposition the steering column upper trim cover as necessary.	
1	Turn Signal Switch Procedure 1. Disconnect the electrical connector. 2. Release the retaining tabs and remove the turn signal switch from the turn signal switch bracket.

TURN SIGNAL SWITCH BRACKET REPLACEMENT

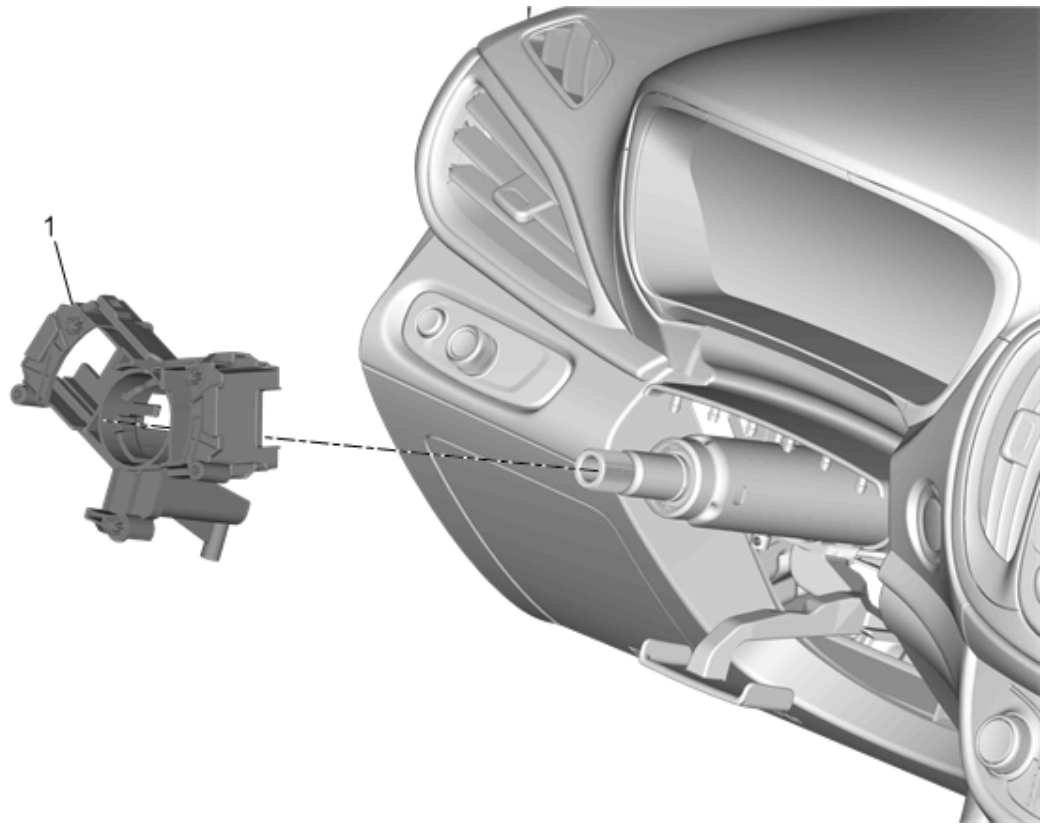


Fig. 18: Turn Signal Switch Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Steering Wheel Airbag Coil. Refer to Steering Wheel Airbag Coil Replacement 2. Remove Turn Signal Switch. Refer to Turn Signal Switch Replacement 3. Remove Windshield Wiper and Washer Switch. Refer to Windshield Wiper and Washer Switch Replacement	
1	Turn Signal Switch Bracket Procedure Release the retaining tabs and remove the turn signal switch bracket from the steering column.

STEERING WHEEL PAD ACCESSORY WIRING HARNESS REPLACEMENT

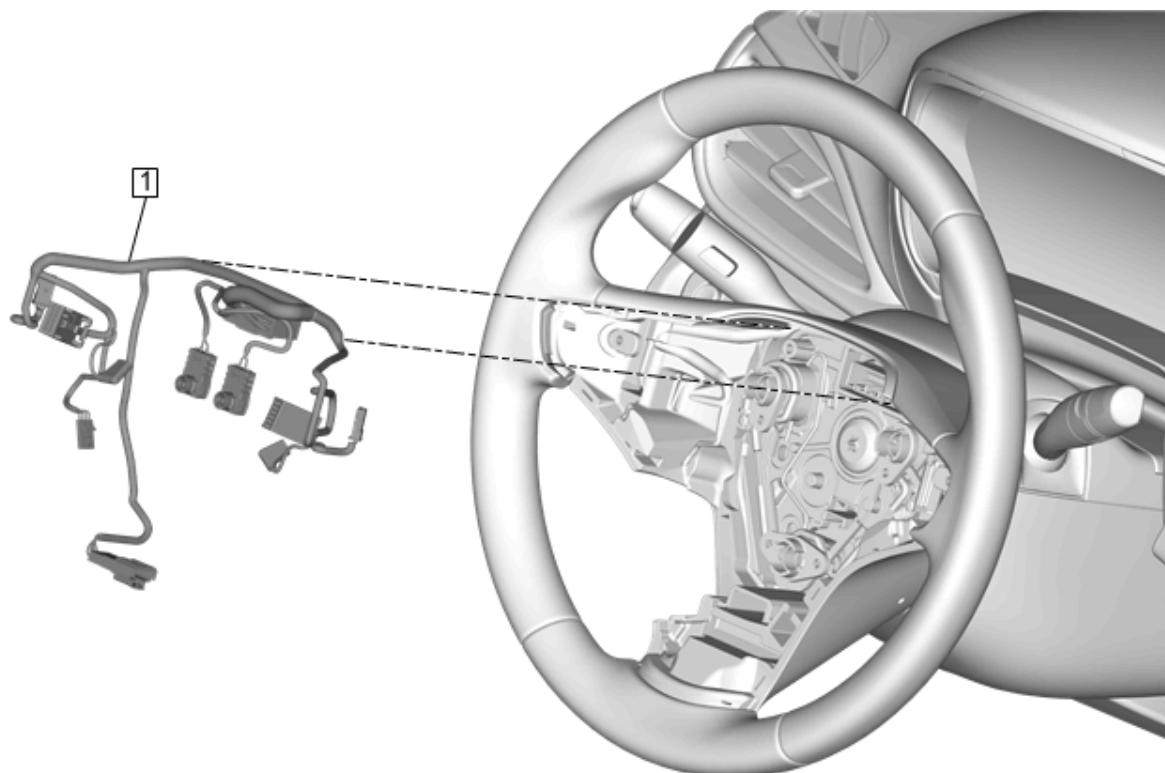


Fig. 19: Steering Wheel Pad Accessory Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove the left side lower steering wheel radio control switch. Refer to Radio Control Switch Replacement - Steering Wheel (Left Side Lower) 2. Remove the left side rear steering wheel radio control switch. Refer to Radio Control Switch Replacement - Steering Wheel (Left Side Rear) 3. Remove the right side rear steering wheel radio control switch. Refer to Radio Control Switch Replacement - Steering Wheel (Right Side Rear)	
1	Steering Wheel Pad Accessory Wiring Harness Procedure 1. Disconnect the electrical connectors. 2. Remove the steering wheel pad accessory wiring harness from the steering wheel.

STEERING WHEEL REPLACEMENT

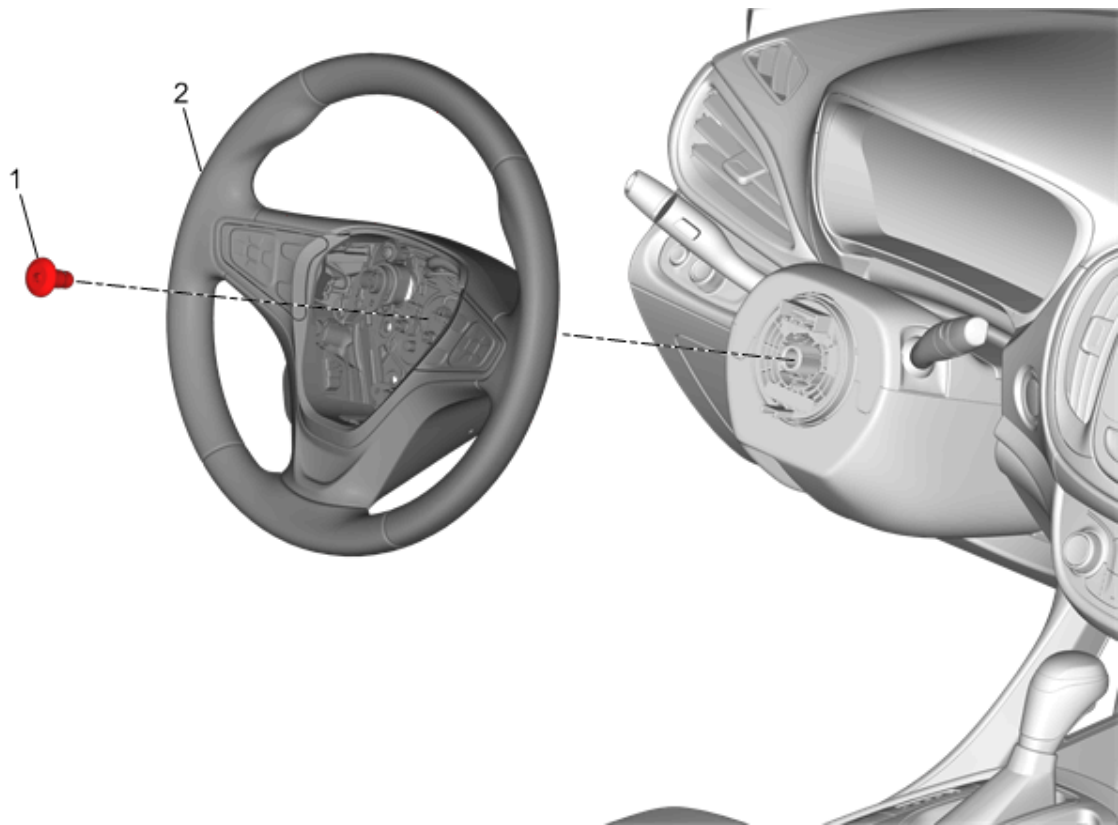


Fig. 20: Steering Wheel
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to SIR Warning . WARNING: Refer to SIR Inflator Module Handling and Storage Warning . Preliminary Procedures 1. Disable SIR system. Refer to SIR Disabling and Enabling 2. Remove Steering Wheel Airbag. Refer to Steering Wheel Airbag Replacement	
1	Steering Wheel Bolt CAUTION:

Callout	Component Name
	Refer to <u>Fastener</u> <u>Caution</u> . Procedure 1. Clean the threads of the bolt with denatured alcohol or equivalent and allow to dry. 2. Apply thread locking adhesive to the bolt. Refer to <u>Adhesives, Fluids, Lubricants, and Sealers</u> Tighten 45 N.m (33 lb ft)
2	Steering Wheel Procedure 1. Disconnect the electrical connectors. 2. Install the steering wheel bolt until 2 to 3 threads are engaged. 3. Wiggle the steering wheel until the wheel disengages completely. 4. Remove Steering Wheel Bolt 5. Remove Steering Wheel 6. Transfer components as necessary.

STEERING WHEEL SPOKE COVER REPLACEMENT

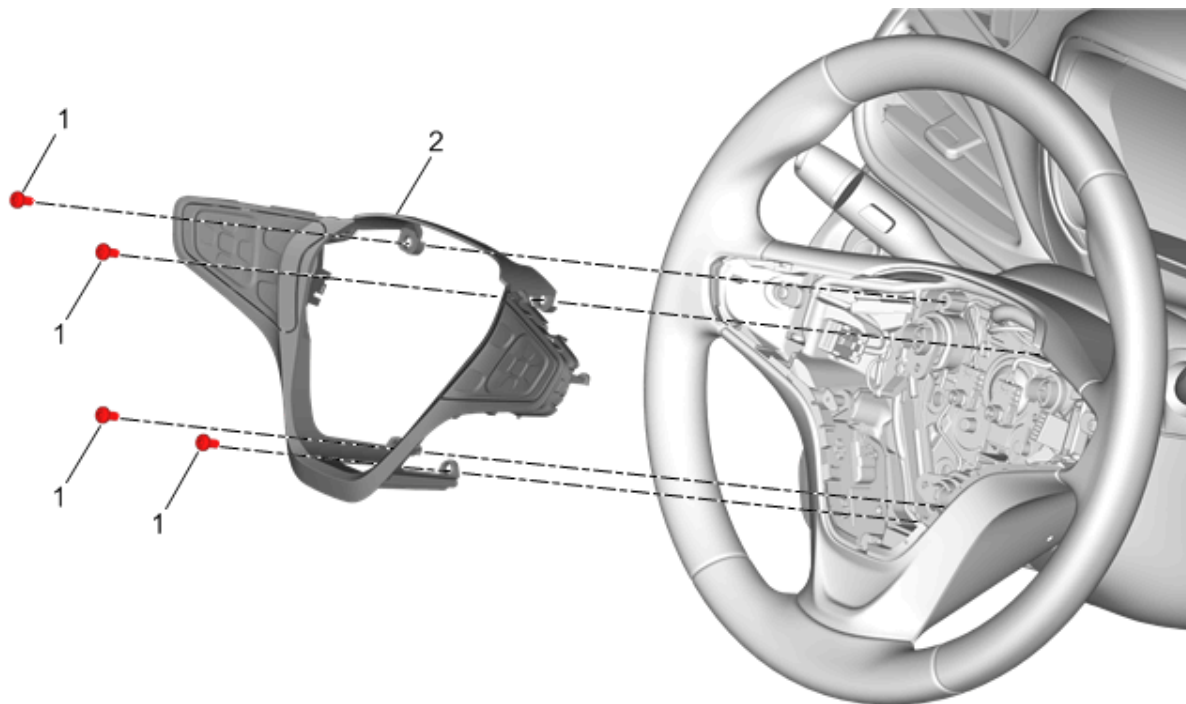


Fig. 21: Steering Wheel Spoke Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Airbag. Refer to Steering Wheel Airbag Replacement	
1	Steering Wheel Spoke Cover Fastener (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 1.5 N.m (13 lb in)
2	Steering Wheel Spoke Cover Procedure 1. Use the appropriate trim tool to release the steering wheel switches from the steering wheel. 2. Disconnect the electrical connectors. 3. Transfer components as necessary.

STEERING COLUMN REPLACEMENT

Removal Procedure

WARNING: Refer to [SIR Warning](#) .

WARNING: Refer to [SIR Inflator Module Handling and Storage Warning](#) .

1. Disable the SIR system. Refer to [SIR Disabling and Enabling](#)
2. With the vehicle in accessory mode, remove fuse to unlock the steering column lock control module. Refer to [Steering Wheel Schematics](#)

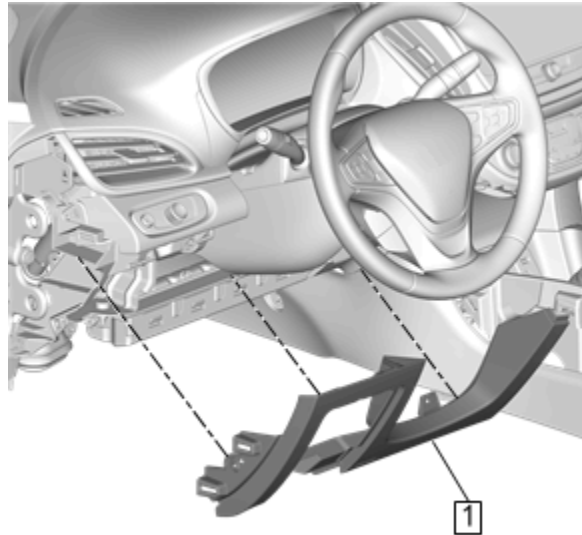


Fig. 22: Instrument Panel Knee Bolster

Courtesy of GENERAL MOTORS COMPANY

3. Remove Instrument Panel Knee Bolster (1). Refer to [Instrument Panel Knee Bolster Replacement](#)

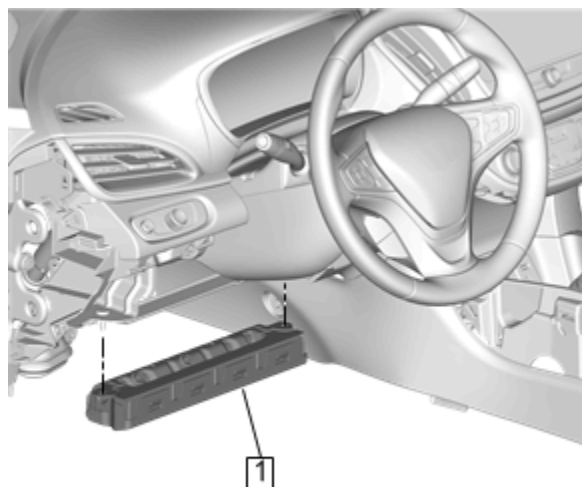


Fig. 23: Instrument Panel Lower Airbag - Driver Side

Courtesy of GENERAL MOTORS COMPANY

4. Remove Instrument Panel Lower Airbag - Driver Side (1). Refer to [Instrument Panel Lower Airbag Replacement - Driver Side](#)

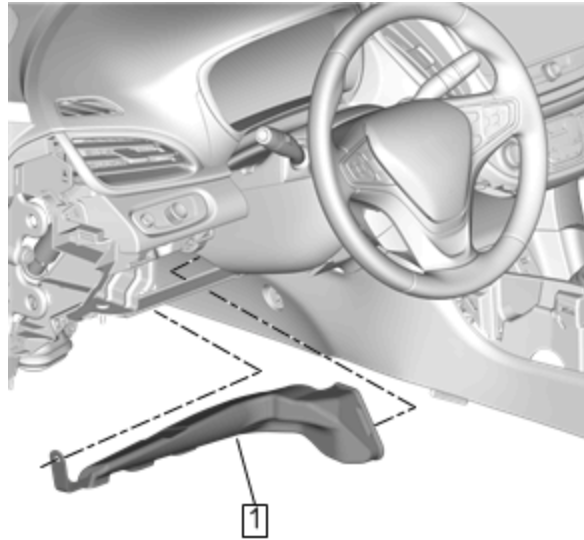


Fig. 24: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

5. Remove Floor Front Air Outlet Duct - Left Side (1). Refer to [Floor Front Air Outlet Duct Replacement - Left Side](#)

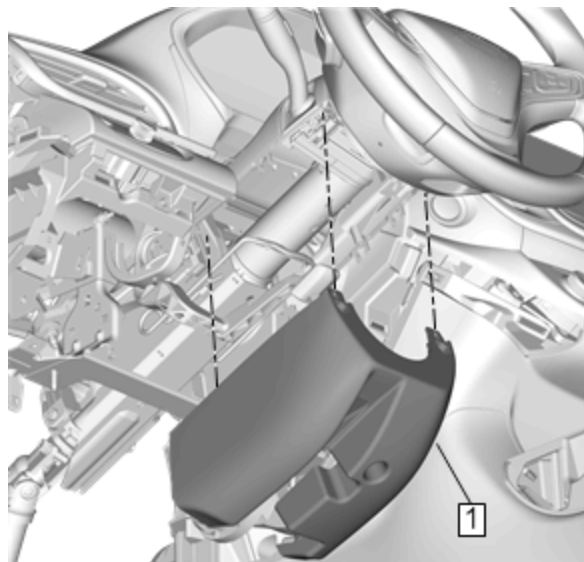


Fig. 25: Steering Column Lower Trim Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: Reposition the steering column upper trim cover as necessary.

6. Remove Steering Column Lower Trim Cover (1). Refer to [Steering Column Lower Trim Cover Replacement](#)

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap

to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

7. With the steering wheel in the straight ahead position, LOCK the steering column.

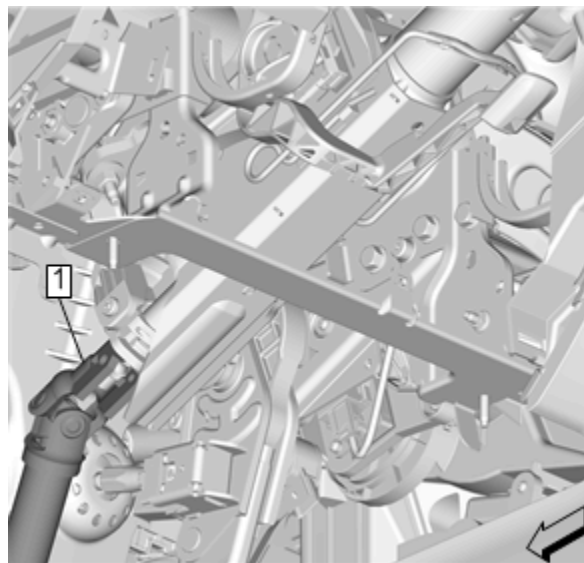


Fig. 26: Intermediate Steering Shaft

Courtesy of GENERAL MOTORS COMPANY

NOTE: Place match marks on the steering column shaft and the intermediate steering shaft to aid in installation.

8. Separate Intermediate Steering Shaft (1) @ Steering Column. Refer to [Intermediate Steering Shaft Replacement](#)
9. Disconnect the steering column electrical connectors as necessary.

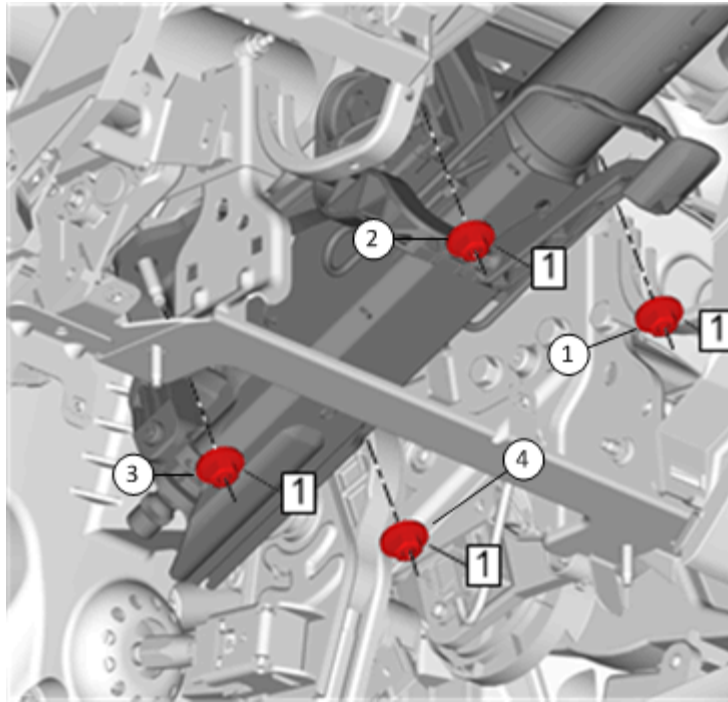


Fig. 27: Steering Column Nuts

Courtesy of GENERAL MOTORS COMPANY

10. Remove Steering Column Nuts (1) (Qty: 4)

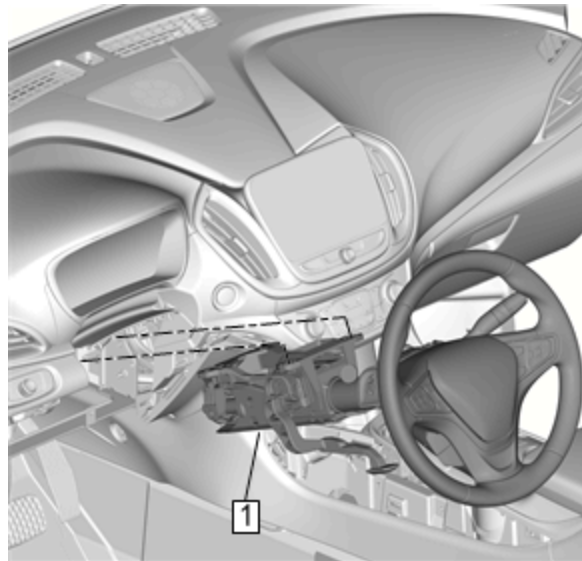


Fig. 28: Steering Column

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on the end could collapse the steering shaft or loosen the plastic injections, which maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. Do NOT hammer on the end of the shaft, because hammering could loosen the plastic injections, which maintain

column rigidity. If you need to remove the steering wheel, refer to the Steering Wheel Replacement procedure in this section.

11. Remove the steering column (1) from the vehicle.
12. If replacing the steering column, transfer components as necessary.
13. If replacing the steering column, copy the match marks from the OLD steering column to the NEW steering column.

Installation Procedure

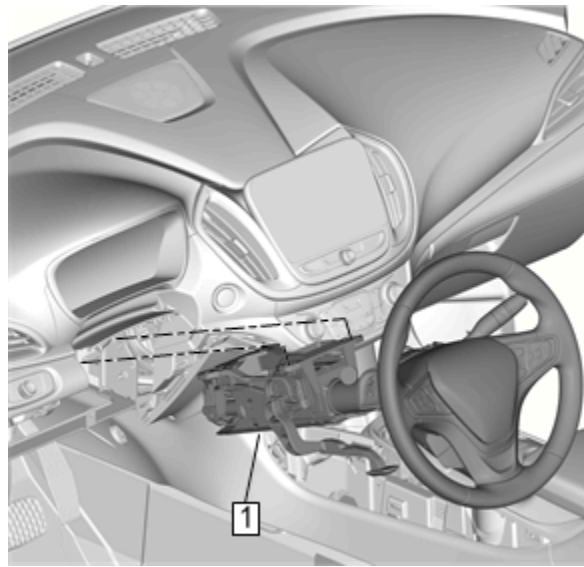


Fig. 29: Steering Column

Courtesy of GENERAL MOTORS COMPANY

1. Position the steering column (1) on the vehicle.

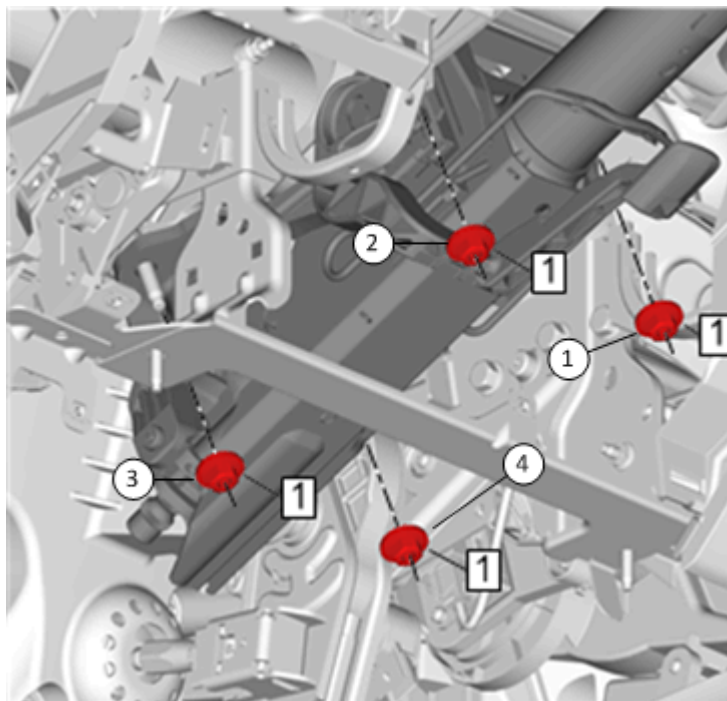


Fig. 30: Steering Column Nuts With Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

2. Install and tighten Steering Column Nuts (1) (Qty: 4) in sequence to 22 N.m (16 lb ft)
3. Connect the steering column electrical connectors.

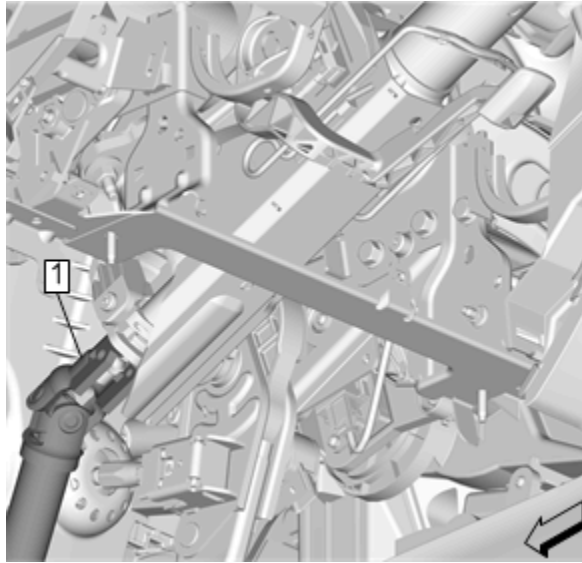


Fig. 31: Intermediate Steering Shaft

Courtesy of GENERAL MOTORS COMPANY

4. Install Intermediate Steering Shaft (1) @ Steering Column. Refer to [Intermediate Steering Shaft Replacement](#)

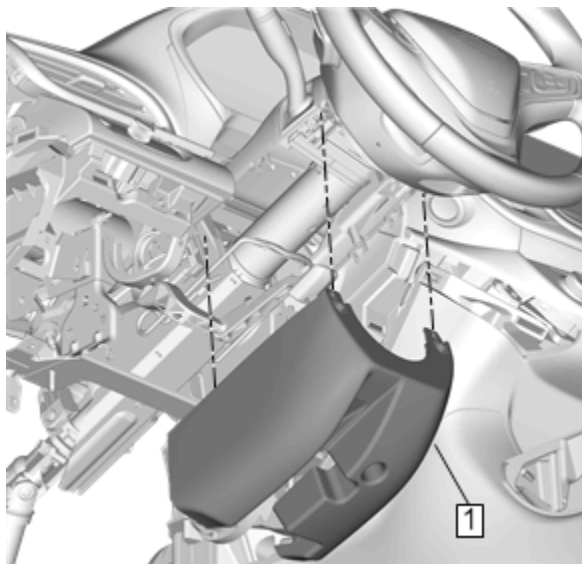


Fig. 32: Steering Column Lower Trim Cover

Courtesy of GENERAL MOTORS COMPANY

5. Install Steering Column Lower Trim Cover (1). Refer to [Steering Column Lower Trim Cover Replacement](#)

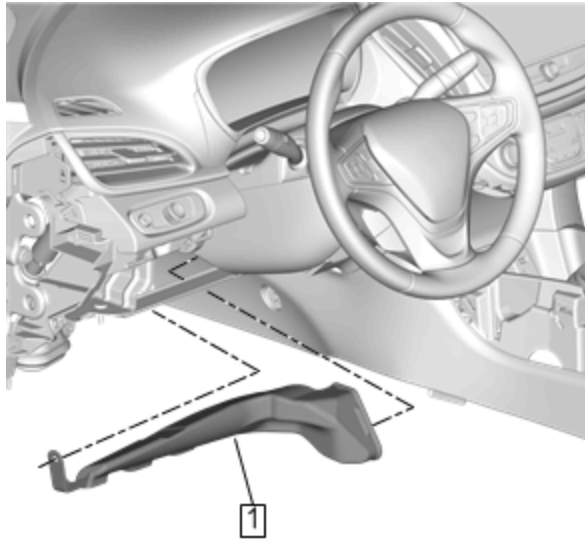


Fig. 33: Floor Front Air Outlet Duct - Left Side

Courtesy of GENERAL MOTORS COMPANY

6. Install Floor Front Air Outlet Duct - Left Side (1). Refer to [Floor Front Air Outlet Duct Replacement - Left Side](#)

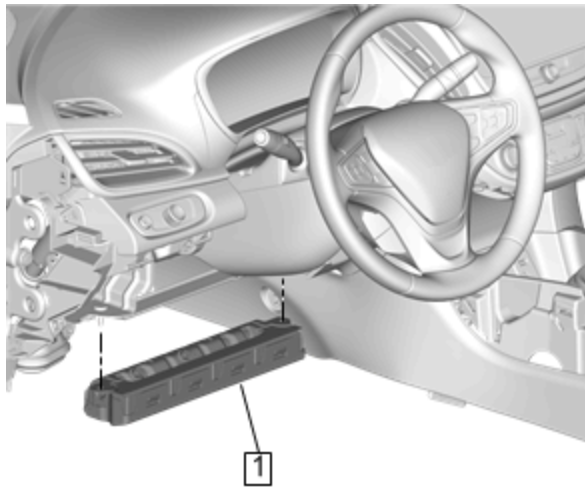


Fig. 34: Instrument Panel Lower Airbag - Driver Side

Courtesy of GENERAL MOTORS COMPANY

7. Install Instrument Panel Lower Airbag - Driver Side (1). Refer to [Instrument Panel Lower Airbag Replacement - Driver Side](#)

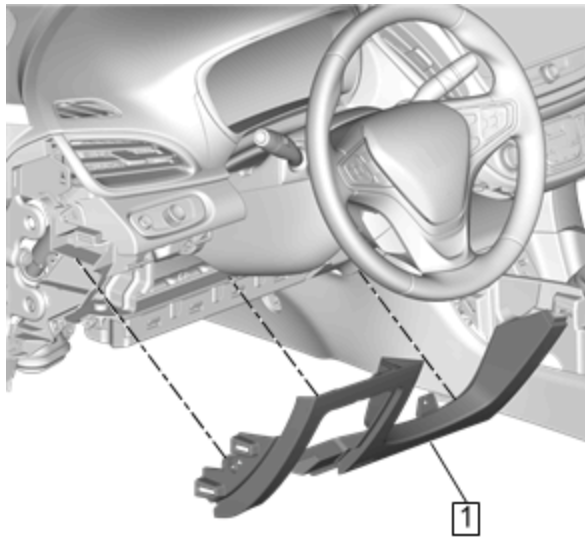


Fig. 35: Instrument Panel Knee Bolster

Courtesy of GENERAL MOTORS COMPANY

8. Install Instrument Panel Knee Bolster (1). Refer to [Instrument Panel Knee Bolster Replacement](#)
9. Install the steering column lock control module fuse.
10. Program the steering column lock control module. Refer to [Control Module References](#)
11. Center the steering angle sensor. Refer to [Steering Wheel Angle Sensor Centering](#)

STEERING COLUMN DASH INNER SEAL REPLACEMENT

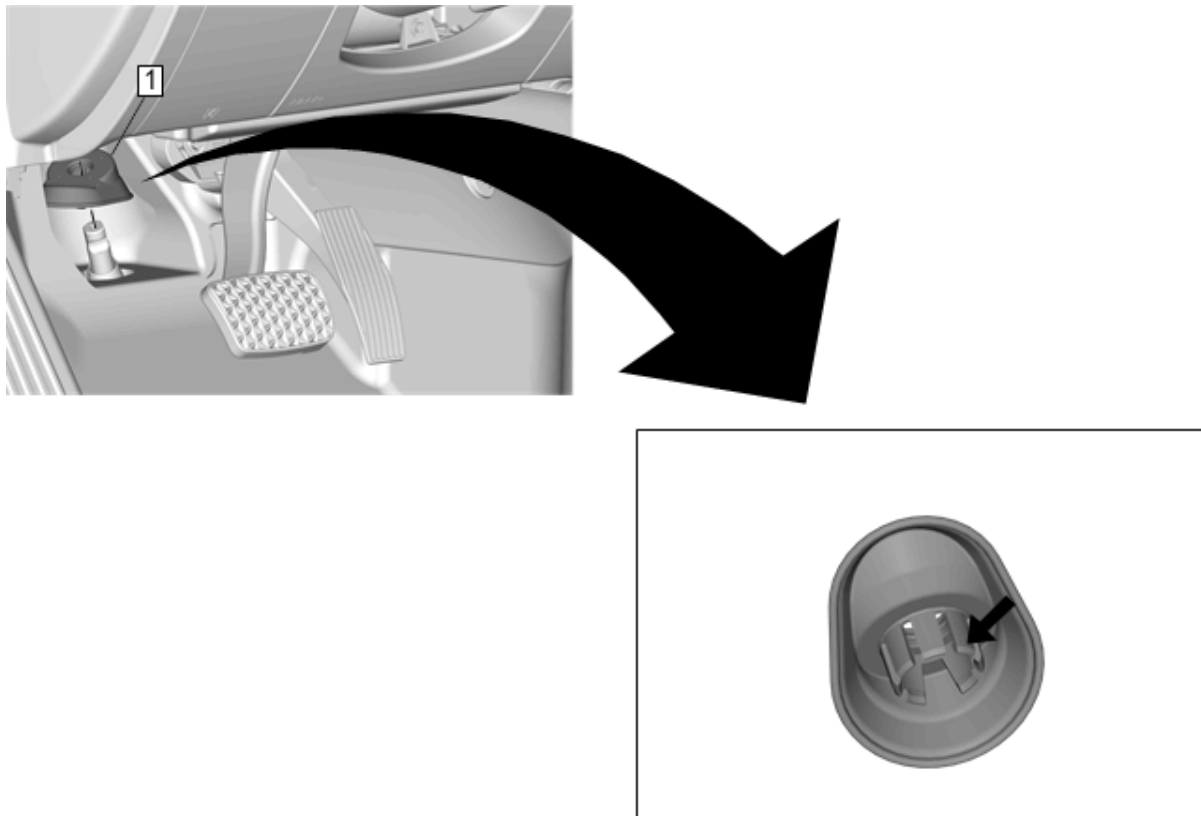


Fig. 36: Steering Column Dash Inner Seal

Callout	Component Name
Preliminary Procedure Separate Intermediate Steering Shaft @ Steering Gear. Refer to Intermediate Steering Shaft Replacement	
1	Steering Column Dash Inner Seal Procedure 1. To remove the steering column dash inner seal, lift the edge of the seal and release the plastic retaining tabs from the steering gear input shaft. 2. To install the steering column dash inner seal, push the seal until the plastic retaining tabs engage the steering gear input shaft.

STEERING COLUMN DASH OUTER SEAL REPLACEMENT

Removal Procedure

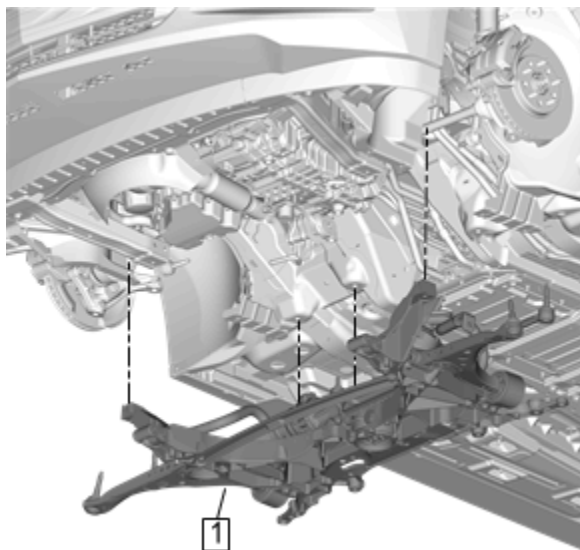


Fig. 37: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

1. Remove Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

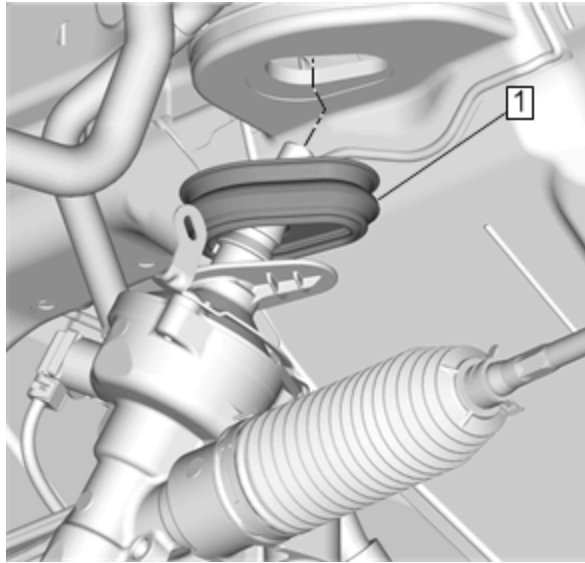


Fig. 38: Steering Column Dash Outer Seal

Courtesy of GENERAL MOTORS COMPANY

2. Remove the steering column dash outer seal (1) from the steering gear.

Installation Procedure

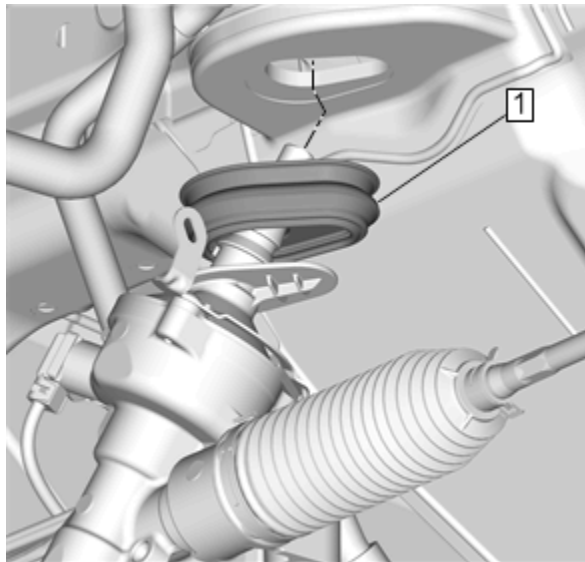


Fig. 39: Steering Column Dash Outer Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE: Align the slot in the steering column dash outer seal with the raised section on the steering gear.

1. Install the steering column dash outer seal (1) on the steering gear.

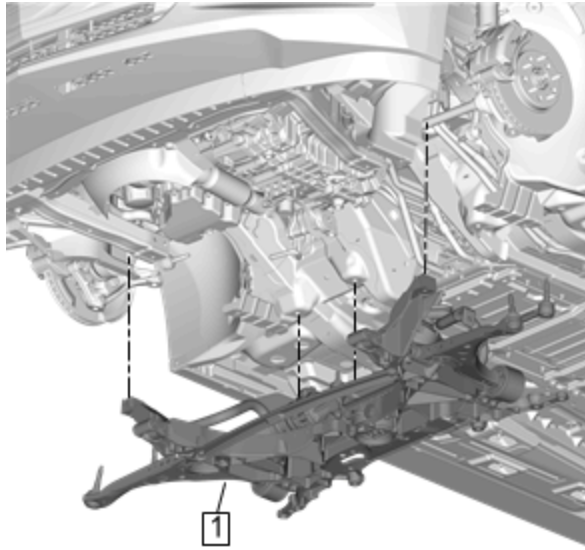


Fig. 40: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

2. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

DESCRIPTION AND OPERATION

STEERING WHEEL AND COLUMN DESCRIPTION AND OPERATION

The steering wheel and column has 4 primary functions:

- Vehicle steering
- Vehicle security
- Driver convenience
- Driver safety

Vehicle Steering

The steering wheel is the first link between the driver and the vehicle. The steering wheel is fastened to a steering shaft within the column. At the lower end of the column, the intermediate shaft connects the column to the steering gear.

The steering column can be adjusted vertically and longitudinally

Vehicle Security

Theft deterrent components are mounted and designed into the steering column. The following components allow the column to be locked in order to minimize theft:

- The ignition switch
- The steering column lock
- The ignition cylinder

- The theft deterrent immobilizer module, if equipped

Driver Convenience

The steering wheel and column may also have driver controls attached for convenience and comfort. The following controls may be mounted on the steering wheel or column.

- The turn signal switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad
- The redundant radio/entertainment system controls
- The tilt functions
- The telephone system controls
- The DIC controls
- The cruise control functions
- The automatic transmission manual setting function

Driver Safety

The steering wheel and column has safety features to protect the driver. The following components may be mounted on or near the steering column:

Energy-Absorbing Steering Column: The energy-absorbing steering column compresses in the event of a front-end collision, which reduces the chance of injury to the driver. The energy-absorbing feature, collapsible steering shaft, and break away mounting features help reduce the injury in the event of an accident.

Article GUID: A00884704

SUSPENSION

Front Suspension - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Front Lower Control Arm Front Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees
Front Lower Control Arm Rear Bolt	
Front Stabilizer Shaft Insulator Clamp Bolt	
• First Pass:	22 N.m (16 lb ft)
• Final Pass:	30 - 45 Degrees
Front Suspension Strut Mount Bolt	
• First Pass:	22 N.m (16 lb ft)
• Final Pass:	30 - 45 Degrees
Front Suspension Strut Mount Nut	
Steering Knuckle Bolt@Strut Assembly	
Wheel Stud	

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be</i>
--

**reused after
removal.**

Application	Specification
	Metric (English)
Front Lower Control Arm Rear Nut	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	30 - 45 Degrees
Front Stabilizer Shaft Link Nut	65 N.m (48 lb ft)
Front Suspension Strut Lower Mounting Nut	70 N.m (52 lb ft)
Front Wheel Bearing and Hub Assembly Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	15 - 30 Degrees
Steering Knuckle Nut@Front Lower Control Arm	
• First Pass:	35 N.m (26 lb ft)
• Final Pass:	30 - 45 Degrees
Steering Knuckle Nut@Strut Assembly	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Steering Knuckle Bearing Pilot Bore	Grease	12345996	10953501

REPAIR INSTRUCTIONS

STABILIZER SHAFT REPLACEMENT

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools:[Special Tools](#)

Removal Procedure

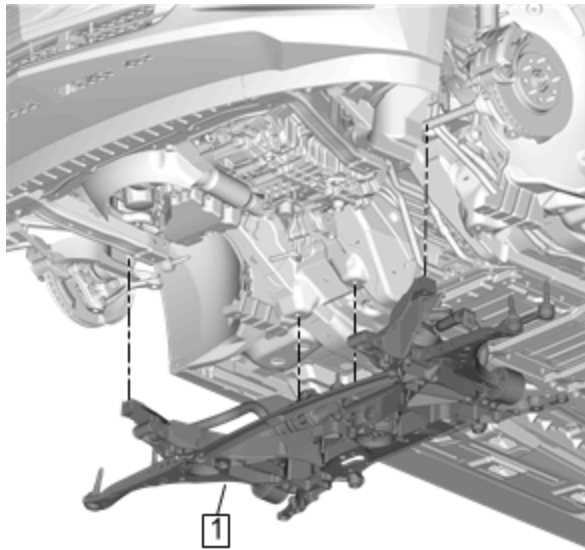


Fig. 1: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

1. Remove Drivetrain and Front Suspension Cradle (1) **Drivetrain and Front Suspension Cradle Replacement**

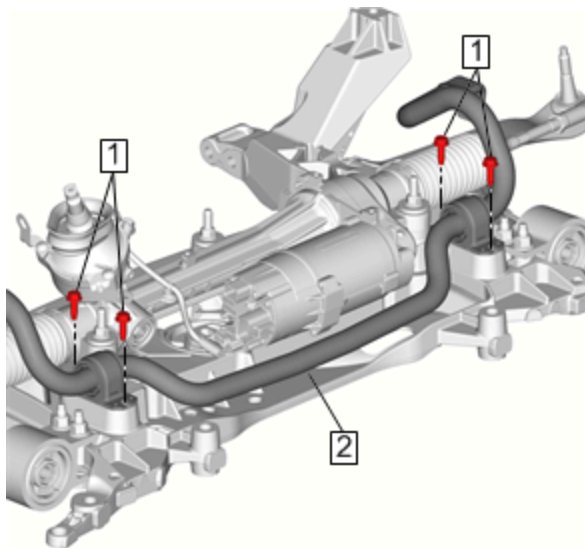


Fig. 2: Front Stabilizer Shaft And Insulator Clamp Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Stabilizer Shaft Insulator Clamp Bolt (1)

DISCARD the bolts.

3. Remove the front stabilizer shaft (2) from the drivetrain and front suspension cradle.

Installation Procedure

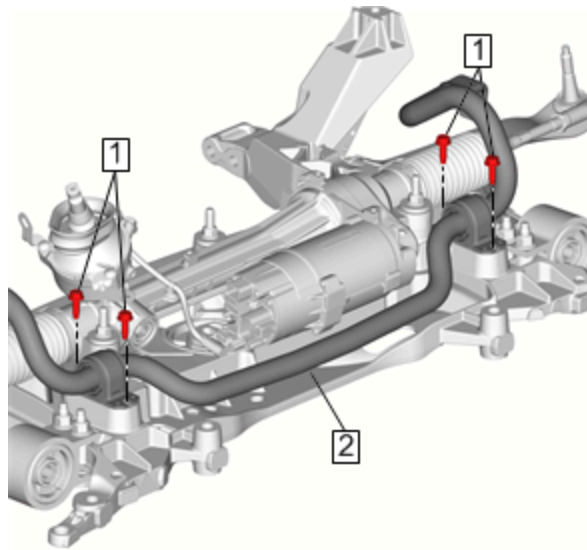


Fig. 3: Front Stabilizer Shaft And Insulator Clamp Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Position the front stabilizer shaft (2) on the drivetrain and front suspension cradle.

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

2. Install Front Stabilizer Shaft Insulator Clamp Bolt (1)

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Use the **EN-45059** meter to tighten the front stabilizer shaft insulator clamp bolts (1).

Tighten

1. First Pass: 22 N.m (16 lb ft)
2. Final Pass: (30 - 45 degrees)

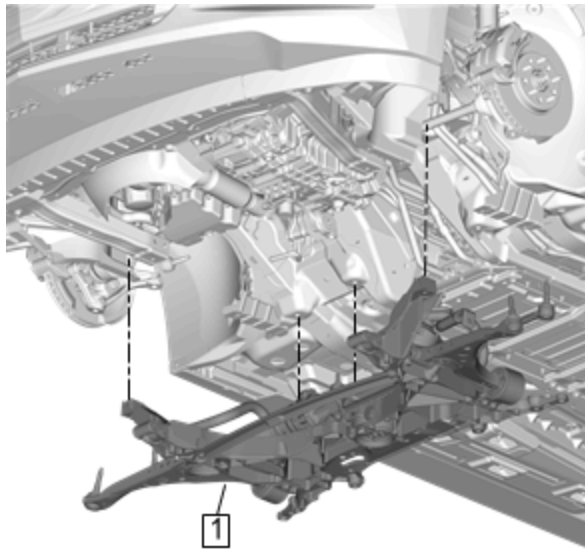


Fig. 4: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

4. Install Drivetrain and Front Suspension Cradle (1) [Drivetrain and Front Suspension Cradle Replacement](#)
5. Measure and adjust the wheel alignment. [Wheel Alignment Measurement](#)

STABILIZER SHAFT LINK REPLACEMENT

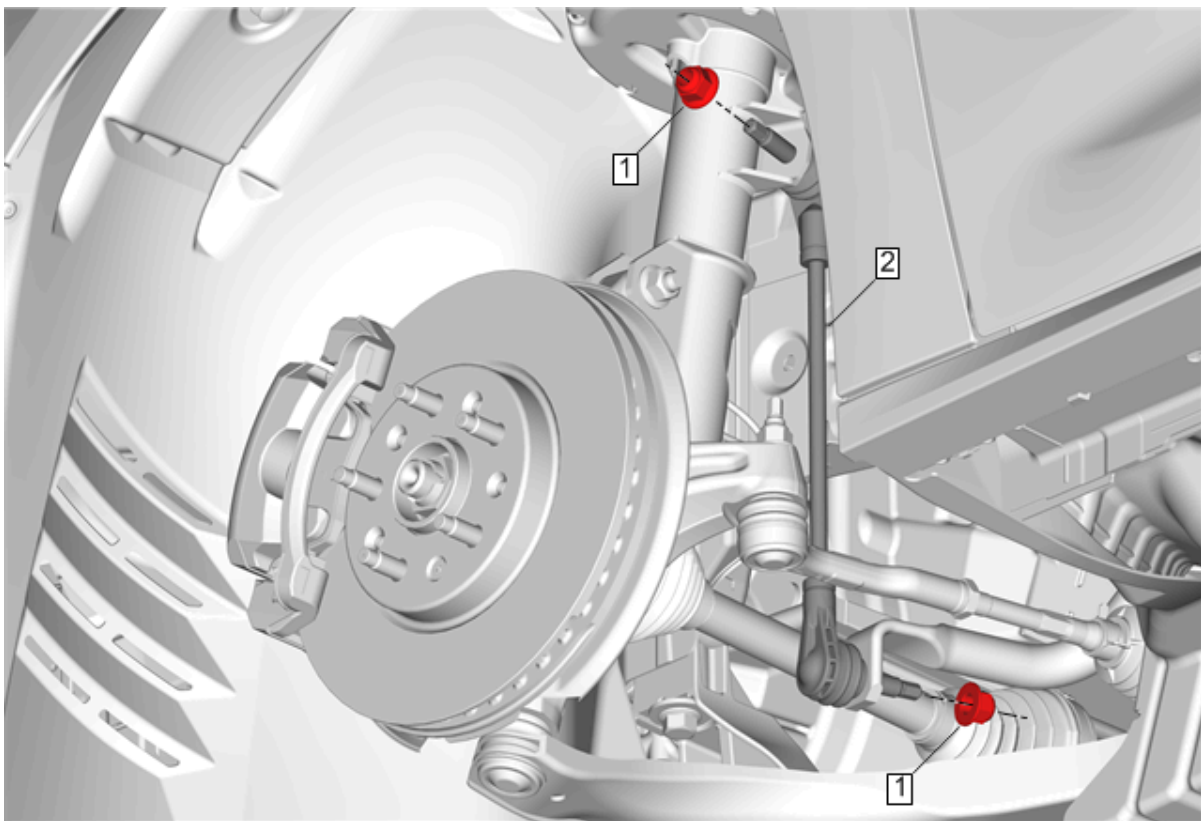


Fig. 5: Stabilizer Shaft Link

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front tire and wheel assembly. Tire and Wheel Removal and Installation	
1	Front Stabilizer Shaft Link Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 65 N.m (48 lb ft)
2	Front Stabilizer Shaft Link

FRONT WHEEL BEARING AND HUB REPLACEMENT

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

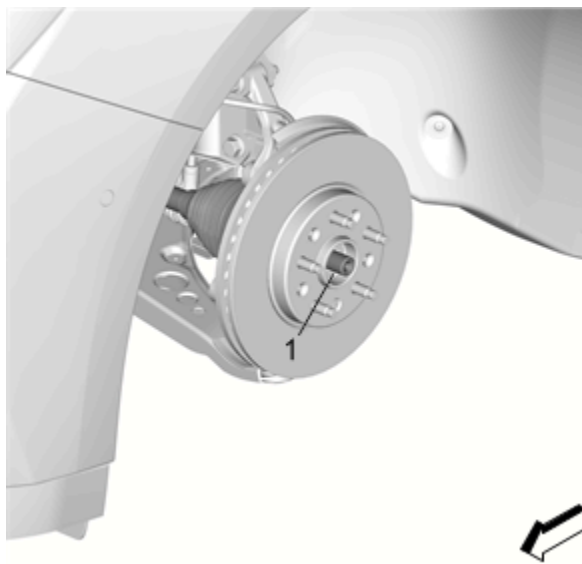


Fig. 6: Front Wheel Drive Shaft

Courtesy of GENERAL MOTORS COMPANY

2. Separate Front Wheel Drive Shaft (1) @Front Wheel Bearing and Hub Assembly [Front Wheel Drive Shaft Replacement](#)

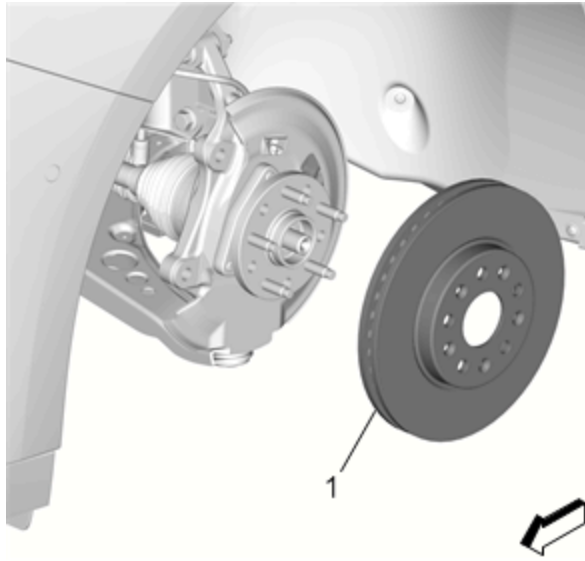


Fig. 7: Front Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Brake Rotor (1) [Front Brake Rotor Replacement](#)

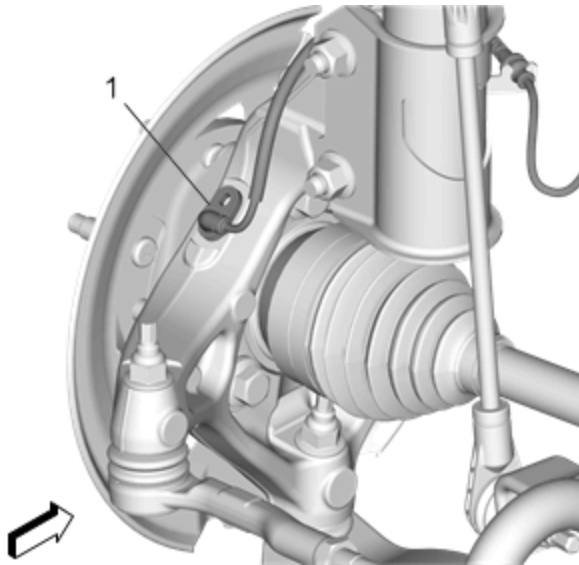


Fig. 8: Front Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Wheel Speed Sensor (1) @Steering Knuckle [Front Wheel Speed Sensor Replacement](#)

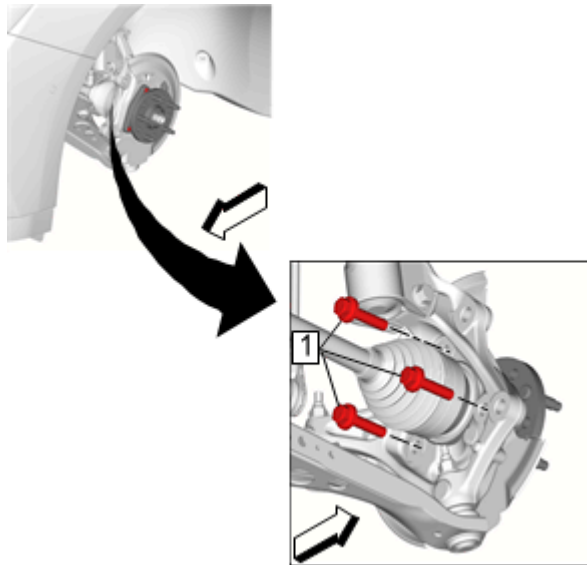


Fig. 9: Front Wheel Bearing and Hub Assembly Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Wheel Bearing and Hub Assembly Bolt (1)

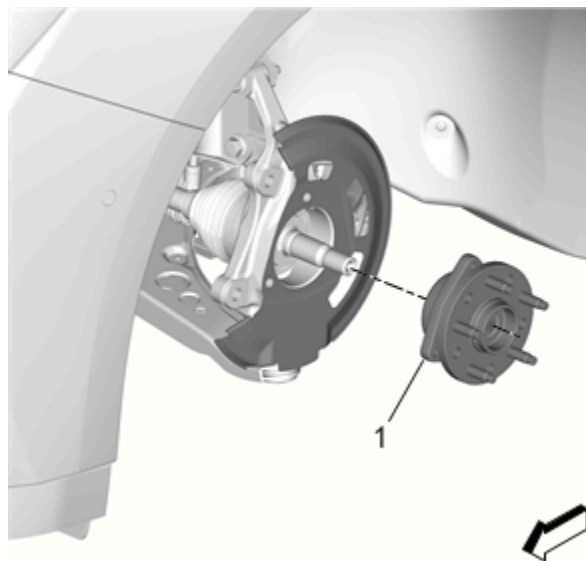


Fig. 10: Front Wheel Bearing And Hub Assembly

Courtesy of GENERAL MOTORS COMPANY

6. Remove the front wheel bearing and hub assembly (1) from the vehicle.

Installation Procedure

NOTE: Avoid applying grease to any other machined surfaces, holes, or threads. Ensure the drain channel at the bottom of the bore is not blocked with grease or debris.

1. Apply grease evenly and ensure complete coverage to the steering knuckle bearing pilot bore only.

Adhesives, Fluids, Lubricants, and Sealers

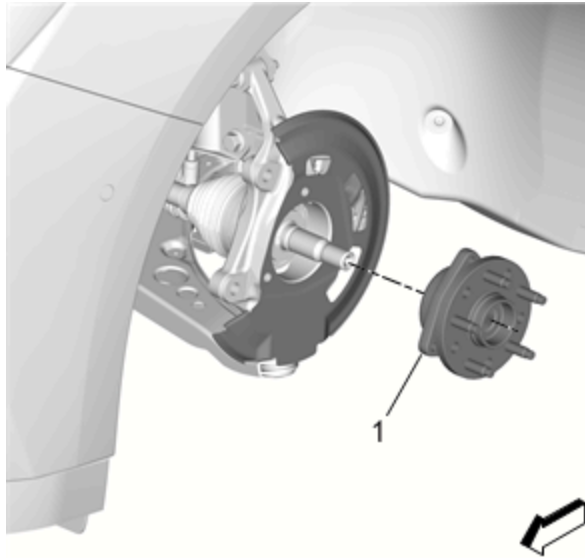


Fig. 11: Front Wheel Bearing And Hub Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Position the front wheel bearing and hub assembly (1) on the vehicle.

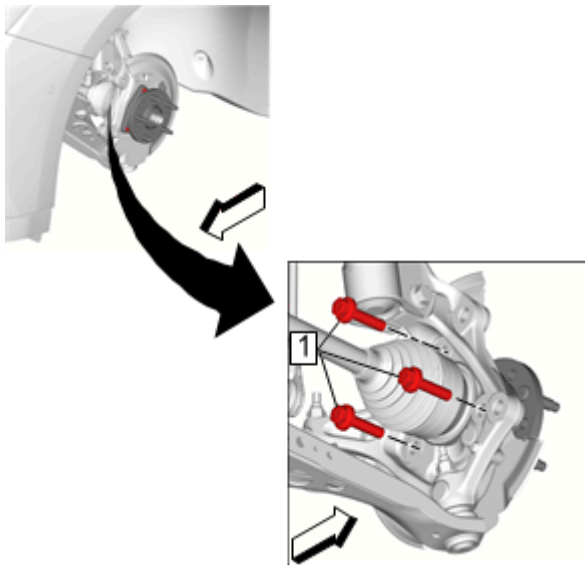


Fig. 12: Front Wheel Bearing and Hub Assembly Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install Front Wheel Bearing and Hub Assembly Bolt (1)
4. Use the **EN-45059** meter to tighten the front wheel bearing and hub assembly bolts (1).

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (15 - 30 degrees)

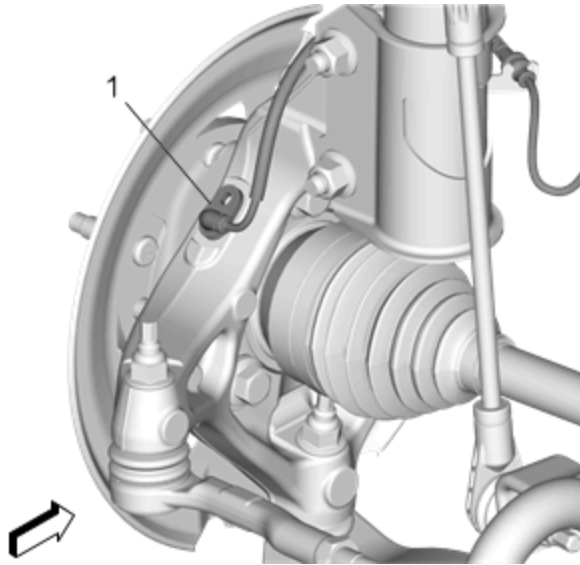


Fig. 13: Front Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

5. Install Front Wheel Speed Sensor (1) @Steering Knuckle [Front Wheel Speed Sensor Replacement](#)

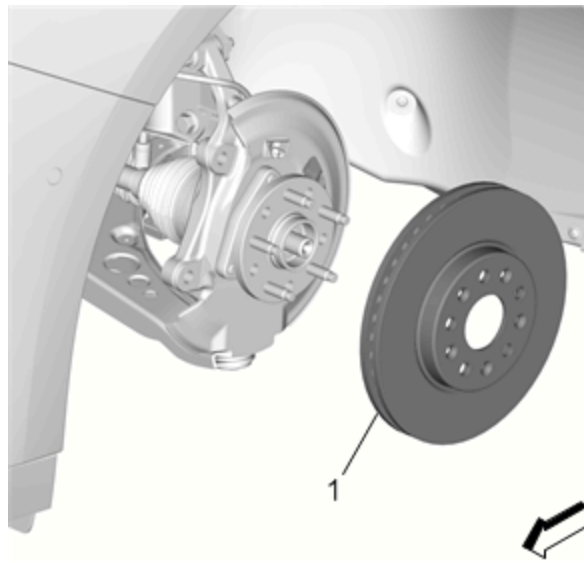


Fig. 14: Front Brake Rotor

Courtesy of GENERAL MOTORS COMPANY

6. Install Front Brake Rotor (1) [Front Brake Rotor Replacement](#)

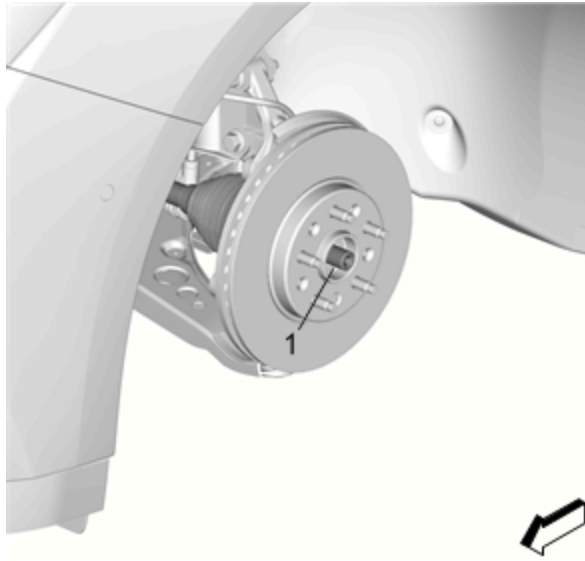


Fig. 15: Front Wheel Drive Shaft

Courtesy of GENERAL MOTORS COMPANY

7. Install Front Wheel Drive Shaft (1) @Front Wheel Bearing and Hub Assembly [Front Wheel Drive Shaft Replacement](#)
8. Install the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

STEERING KNUCKLE REPLACEMENT

Removal Procedure

1. Remove the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

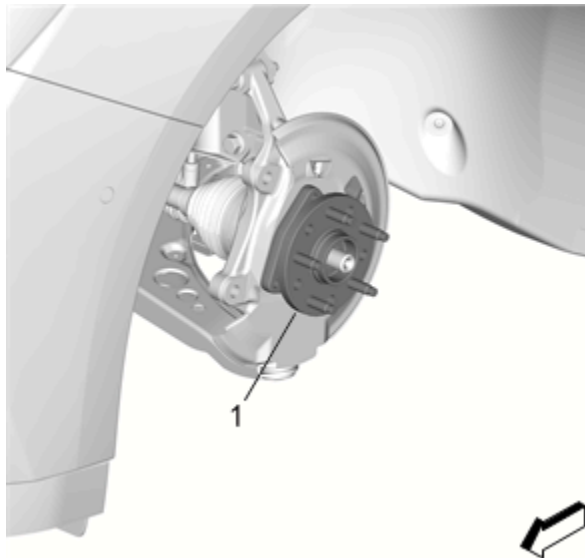


Fig. 16: Front Wheel Bearing and Hub

Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Wheel Bearing and Hub Assembly (1) [Front Wheel Bearing and Hub Replacement](#)

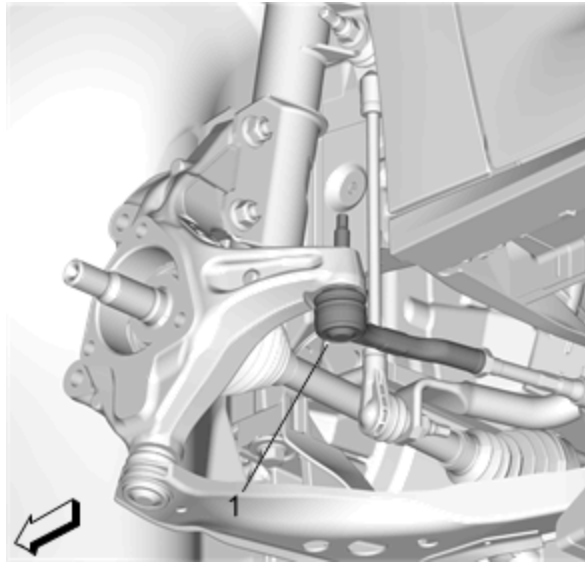


Fig. 17: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

3. Separate Steering Linkage Outer Tie Rod (1) @Steering Knuckle [Steering Linkage Outer Tie Rod Replacement](#)

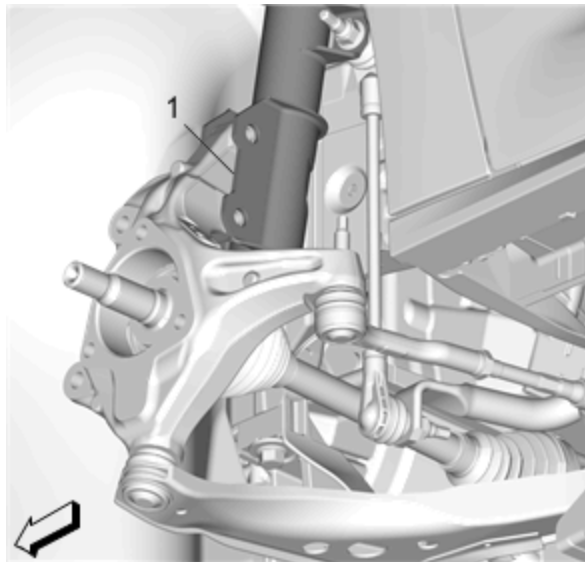


Fig. 18: Strut Assembly

Courtesy of GENERAL MOTORS COMPANY

4. Separate Strut Assembly (1) @Steering Knuckle [Strut Assembly Removal and Installation](#)

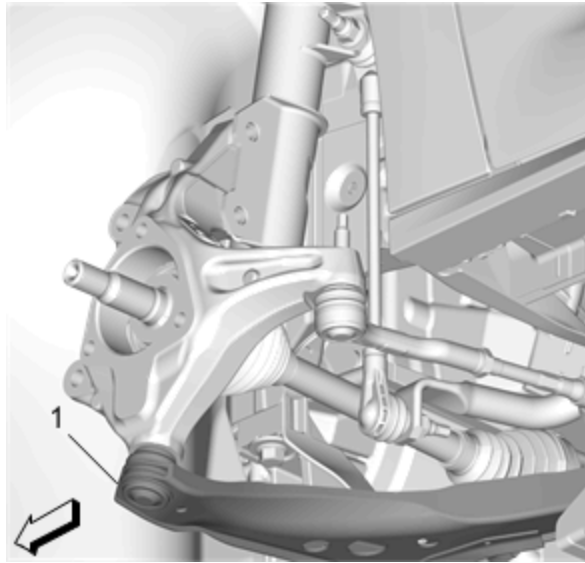


Fig. 19: Front Lower Control Arm

Courtesy of GENERAL MOTORS COMPANY

5. Separate Front Lower Control Arm (1) @Steering Knuckle **Lower Control Arm Replacement**

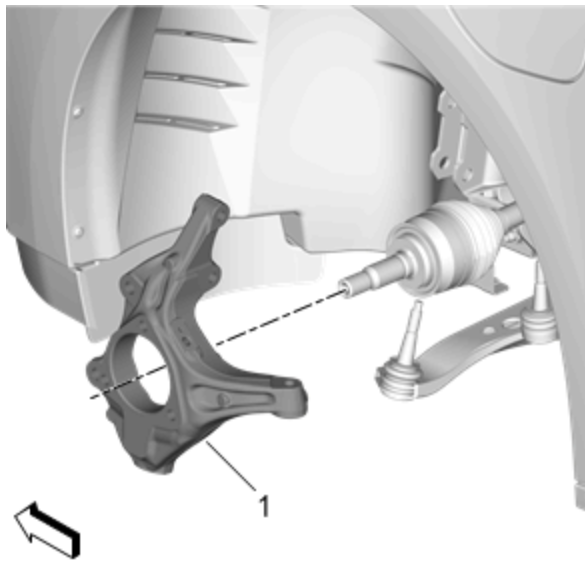


Fig. 20: Steering Knuckle

Courtesy of GENERAL MOTORS COMPANY

6. Remove the steering knuckle (1) from the vehicle.

Installation Procedure

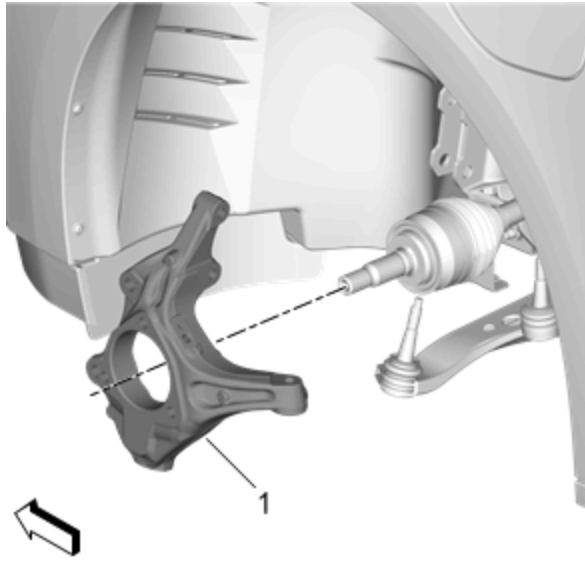


Fig. 21: Steering Knuckle

Courtesy of GENERAL MOTORS COMPANY

1. Position the steering knuckle (1) on the vehicle.

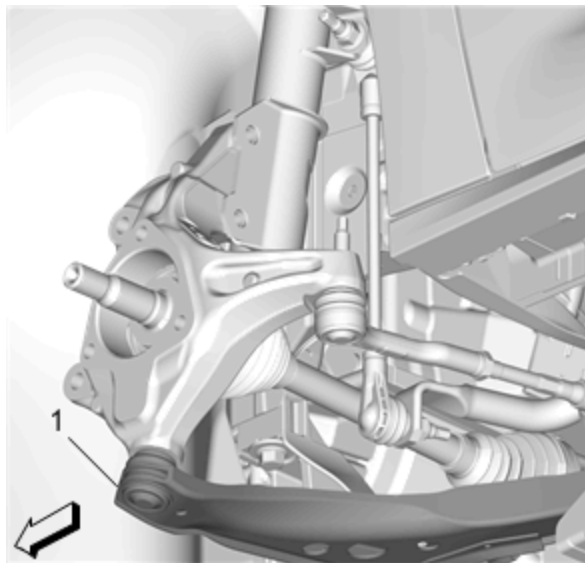


Fig. 22: Front Lower Control Arm

Courtesy of GENERAL MOTORS COMPANY

2. Install Front Lower Control Arm (1) @Steering Knuckle [Lower Control Arm Replacement](#)

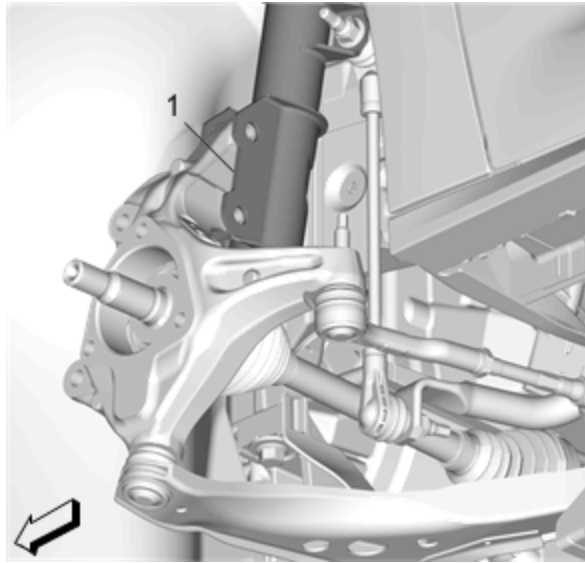


Fig. 23: Strut Assembly

Courtesy of GENERAL MOTORS COMPANY

3. Install Strut Assembly (1) @Steering Knuckle [Strut Assembly Removal and Installation](#)

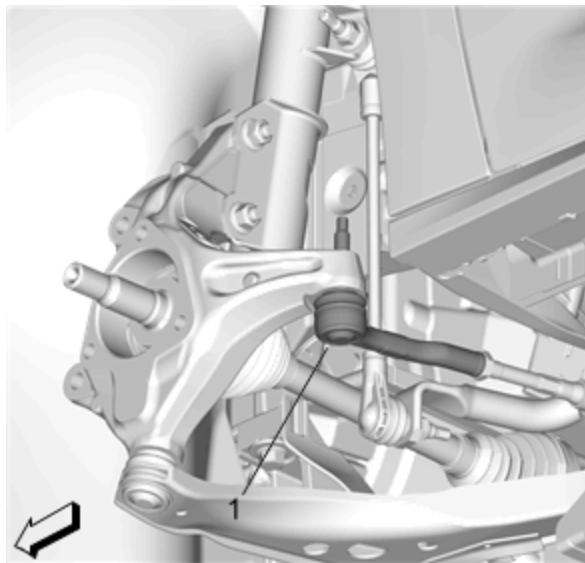


Fig. 24: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

4. Install Steering Linkage Outer Tie Rod (1) @Steering Knuckle [Steering Linkage Outer Tie Rod Replacement](#)

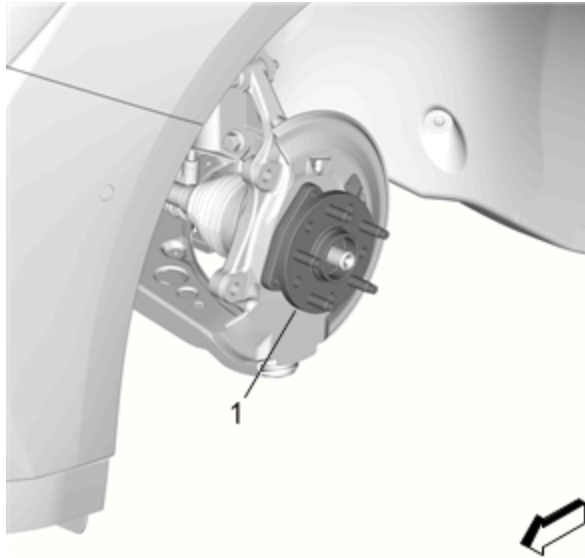


Fig. 25: Front Wheel Bearing and Hub

Courtesy of GENERAL MOTORS COMPANY

5. Install Front Wheel Bearing and Hub Assembly (1) [Front Wheel Bearing and Hub Replacement](#)
6. Install the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

LOWER CONTROL ARM REPLACEMENT

Special Tools

- **CH-42188-B** Ball Joint Separator
- **EN-45059** Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)

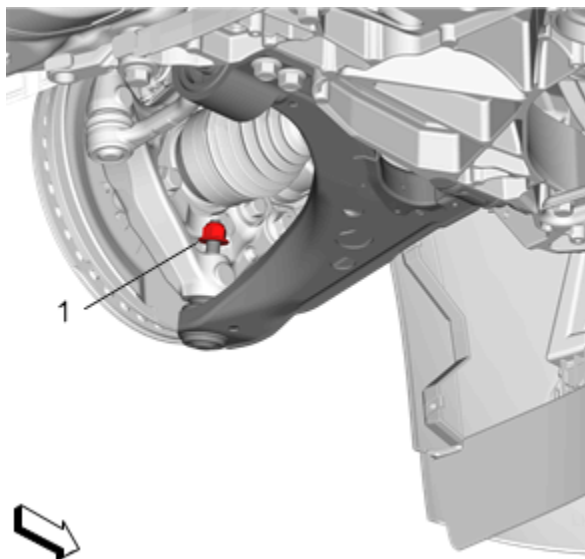


Fig. 26: Steering Knuckle Nut

Courtesy of GENERAL MOTORS COMPANY

2. Loosen Steering Knuckle Nut (1)

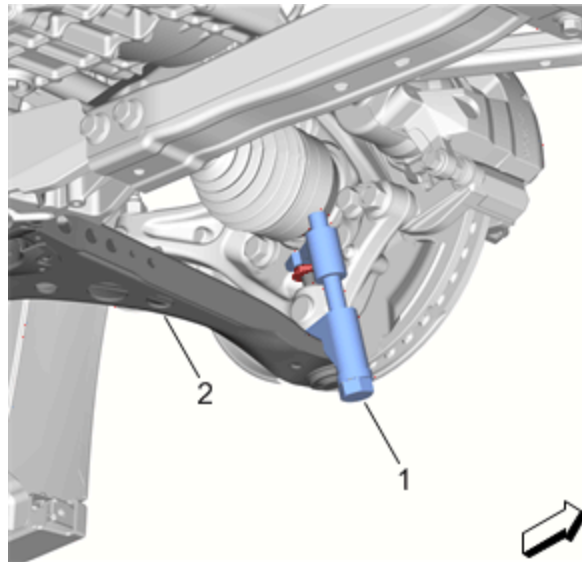


Fig. 27: Special Tool And Front Lower Control Arm

Courtesy of GENERAL MOTORS COMPANY

3. Use the **CH-42188-B** separator (1) to separate the front lower control arm (2) from the steering knuckle.

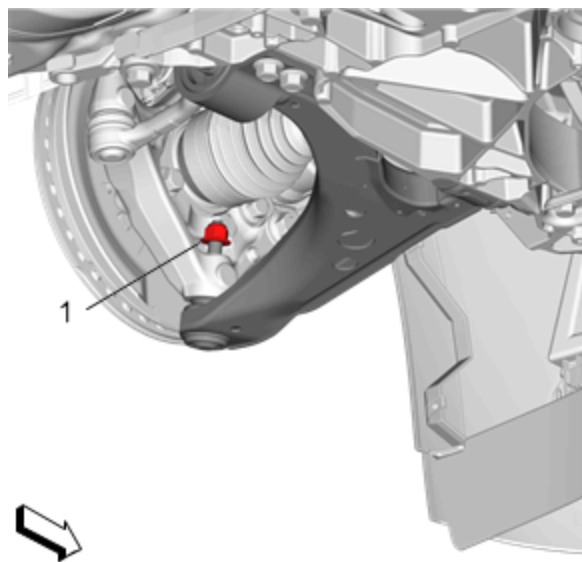


Fig. 28: Steering Knuckle Nut

Courtesy of GENERAL MOTORS COMPANY

4. Remove Steering Knuckle Nut (1)

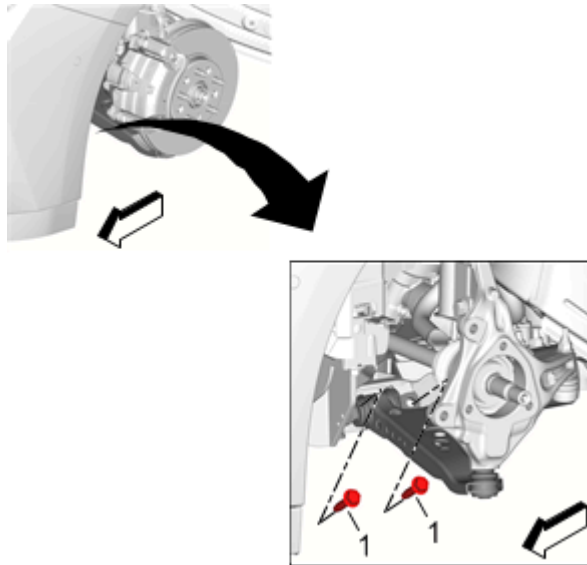


Fig. 29: Front Lower Control Arm Front Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Some front brake and front suspension components are NOT shown for clarity only. It is NOT necessary to remove these components to service the front lower control arm.

5. Remove Front Lower Control Arm Front Bolt (1)

DISCARD the bolts.

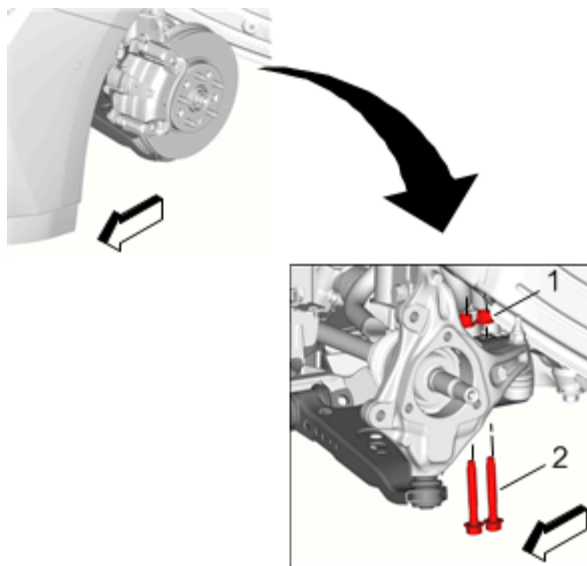


Fig. 30: Front Lower Control Arm Rear Nuts And Bolts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Some front brake and front suspension components are NOT shown for clarity only. It is NOT necessary to remove these components to service the front lower control arm.

6. Remove Front Lower Control Arm Rear Nut (1)

7. Remove Front Lower Control Arm Rear Bolt (2)

DISCARD the bolts.

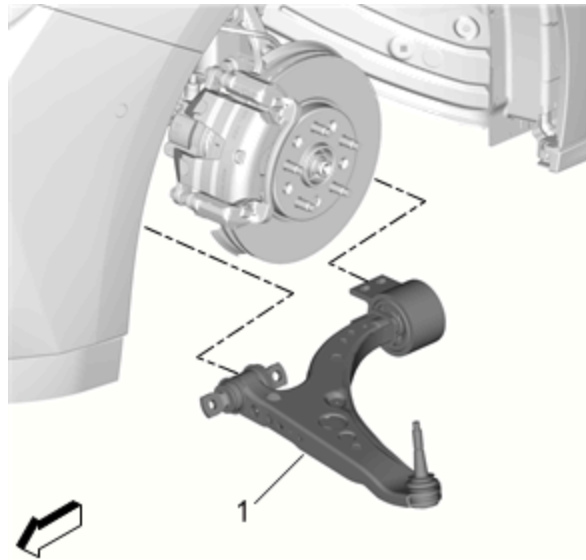


Fig. 31: Front Lower Control Arm
Courtesy of GENERAL MOTORS COMPANY

8. Remove the front lower control arm (1) from the vehicle.

9. Transfer components as necessary.

Installation Procedure

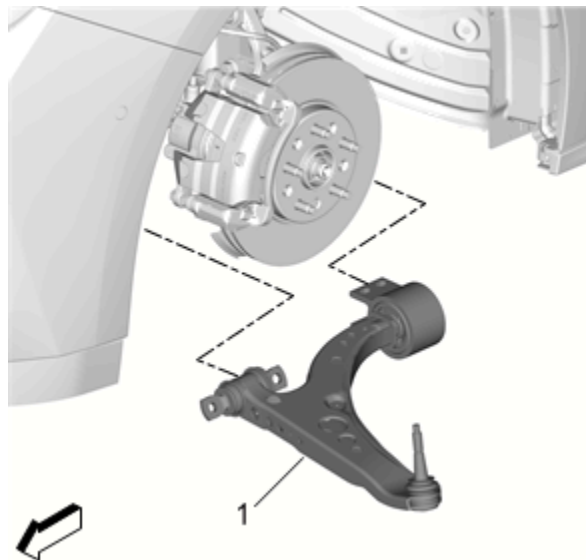


Fig. 32: Front Lower Control Arm
Courtesy of GENERAL MOTORS COMPANY

1. Position the front lower control arm (1) on the vehicle.

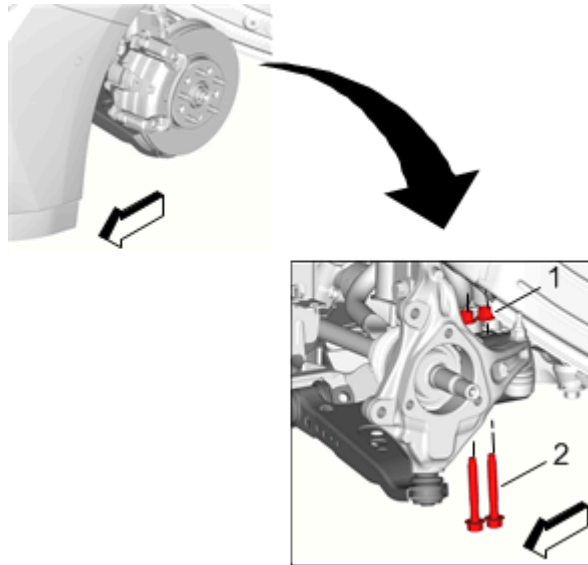


Fig. 33: Front Lower Control Arm Rear Nuts And Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

2. Install Front Lower Control Arm Rear Bolt (2)

Install NEW bolts.

3. Install Front Lower Control Arm Rear Nut (1), but do NOT tighten

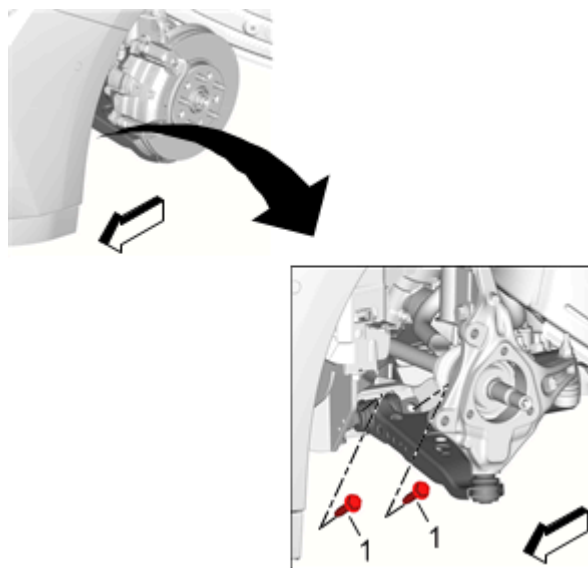


Fig. 34: Front Lower Control Arm Front Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Install Front Lower Control Arm Front Bolt (1)but do NOT tighten

Install NEW bolts.

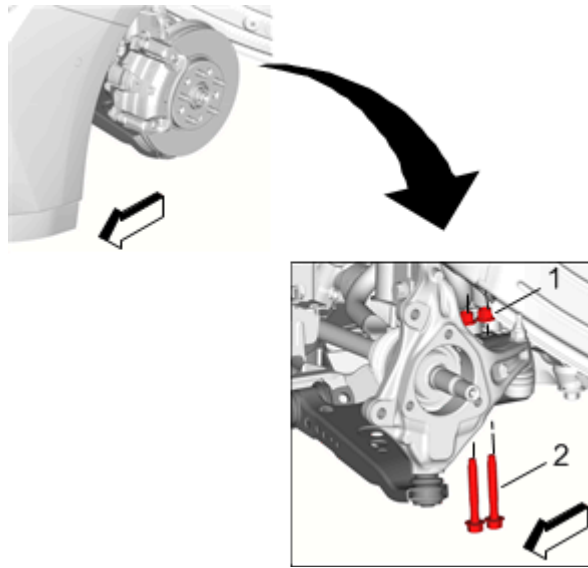


Fig. 35: Front Lower Control Arm Rear Nuts And Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

5. Use the **EN-45059** meter to tighten the front lower control arm rear nuts. (1)

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (30 - 45 degrees)

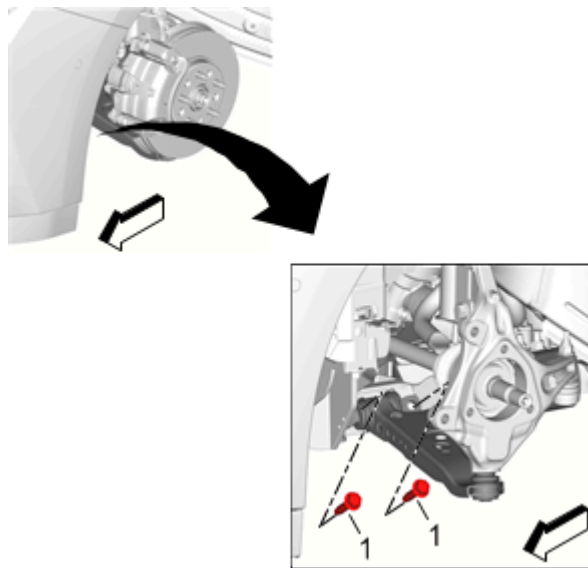


Fig. 36: Front Lower Control Arm Front Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Use the **EN-45059** meter to tighten the front lower control arm front bolts.(1)

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (45 - 60 degrees)

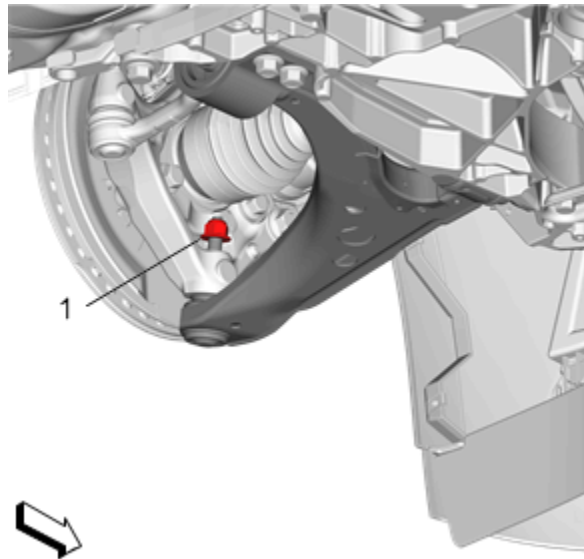


Fig. 37: Steering Knuckle Nut

Courtesy of GENERAL MOTORS COMPANY

7. Install Steering Knuckle Nut (1)
8. Use the **EN-45059** meter to tighten the steering knuckle nut.(1)

Tighten

1. First Pass: 35 N.m (26 lb ft)
 2. Final Pass: (30 - 45 degrees)
9. Install the front tire and wheel assembly. [Tire and Wheel Removal and Installation](#)
 10. Measure and adjust the wheel alignment. [Wheel Alignment Measurement](#)

FRONT LOWER CONTROL ARM REAR BUSHING REPLACEMENT

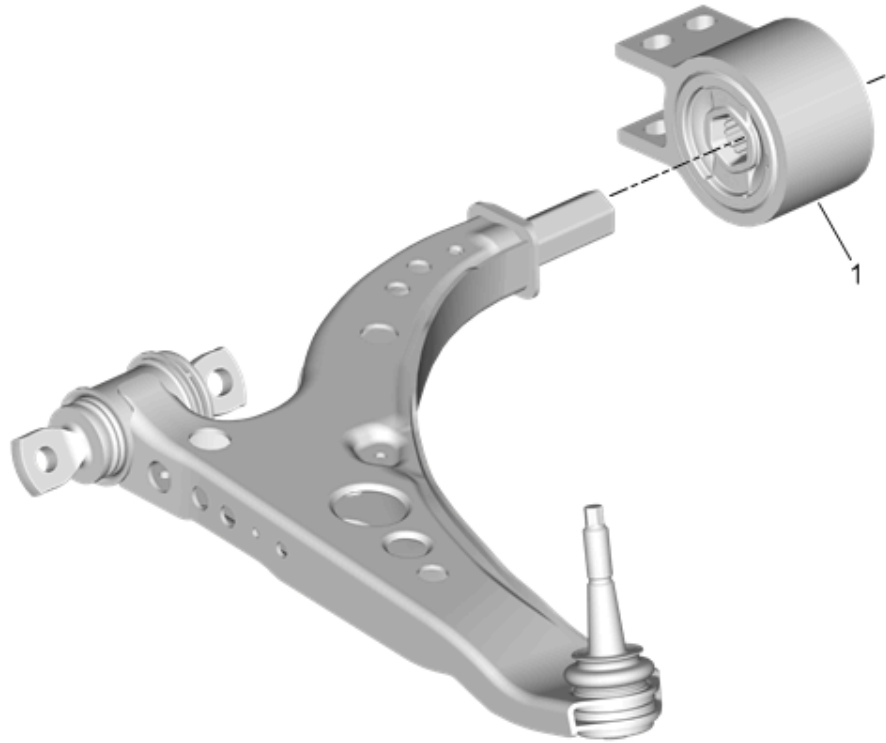


Fig. 38: Front Lower Control Arm Rear Bushing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Lower Control Arm Replacement</u>	
1	Front Lower Control Arm Rear Bushing

WHEEL STUD REPLACEMENT

Special Tools

CH-43631 Ball Joint Separator

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Remove Front Wheel Bearing and Hub Assembly **Front Wheel Bearing and Hub Replacement**

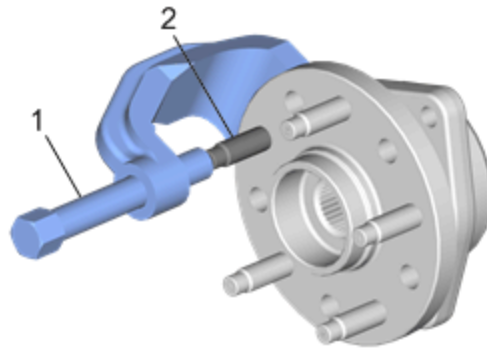


Fig. 39: Separator And Wheel Stud

Courtesy of GENERAL MOTORS COMPANY

2. Use the **CH-43631** separator (1) to remove the wheel stud (2) from the flange on the hub assembly.
- DISCARD the stud.

Installation Procedure

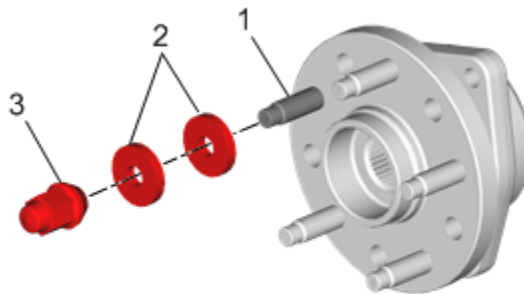


Fig. 40: Wheel Stud, Flat Washers And Wheel Nut

Courtesy of GENERAL MOTORS COMPANY

1. Position the NEW wheel stud (1) in the flange on the hub assembly.
2. Install flat washers (2) and an OLD wheel nut (3) on the wheel stud.
3. Use a suitable tool to prevent the flange on the hub assembly from rotating.
4. Tighten the wheel nut until the wheel stud is firmly seated.
5. Remove the wheel nut and flat washers.
6. Install Front Wheel Bearing and Hub Assembly [Front Wheel Bearing and Hub Replacement](#)

STRUT AND SHOCK ABSORBER INSPECTION

NOTE: The strut assembly **DOES NOT** have to be removed from the vehicle to perform the following inspection procedure.

NOTE: A light film of oil on the top portion of the strut is normal. **DO NOT** replace the strut for this condition.

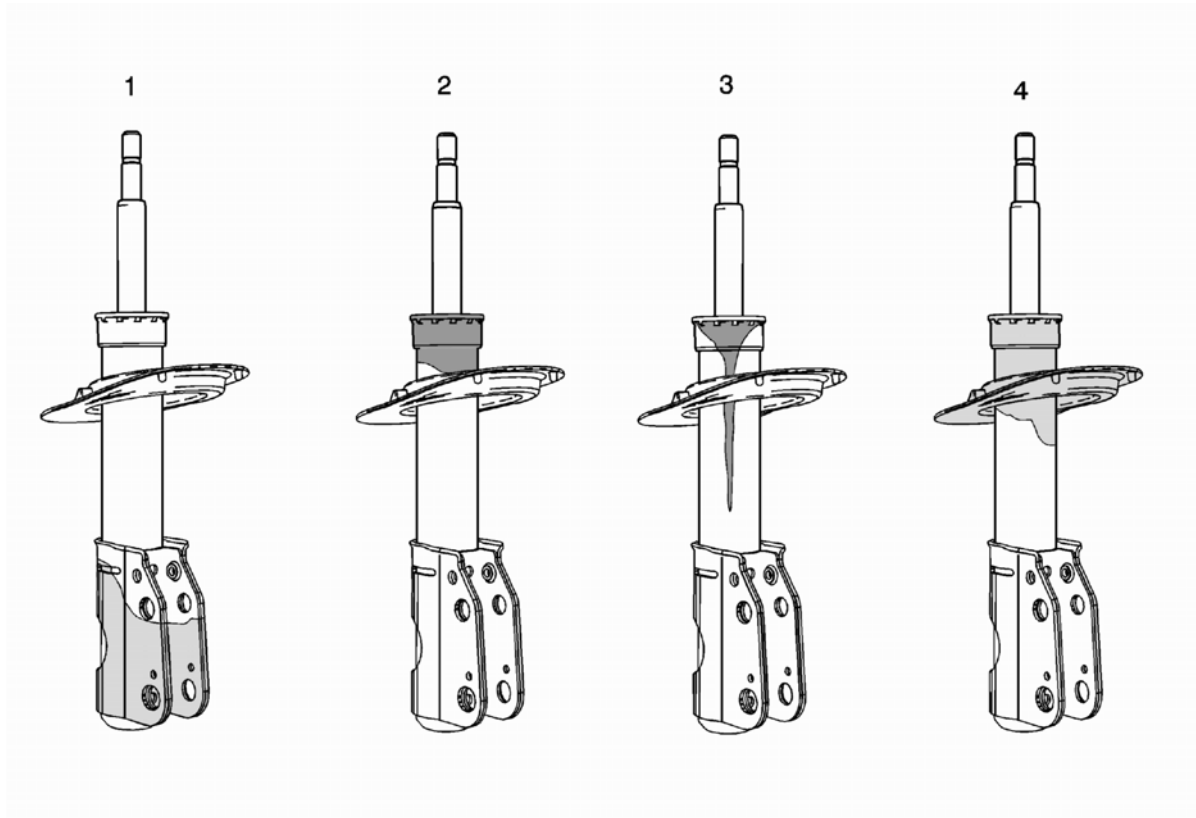


Fig. 41: Strut and Shock Absorber Inspection
Courtesy of GENERAL MOTORS COMPANY

Condition 1

Oil or fluid residue only on the bottom of the strut tube or on other strut components and not originating from the shaft seal, is not a strut related problem. **DO NOT** replace the strut, look for other external leaks.

Condition 2

Light film/residue on the strut tube, but not on the spring seat and originating from the shaft seal, is a **NORMAL** condition. **DO NOT** replace the strut.

Condition 3

Oil drip or trail down the strut tube and originating from the shaft seal, is an **ABNORMAL** condition. Replace the strut.

Condition 4

Extreme wet film of oil covering the strut tube and pooling in the spring seat and originating from the shaft seal, is an ABNORMAL condition. Replace the strut.

Inspection

1. Verify the customer's concern is present. If the concern is present, continue to the next step. If the concern is not present, then the vehicle is operating normally.

NOTE: **The strut assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
3. Visually inspect each of the shock absorbers or struts for external fluid leaks. Refer to the following conditions 1, 2, 3, and 4 for visual inspection.
 - If conditions 1 or 2 are found, continue to step 4.
 - If conditions 3 or 4 are found, replace strut. Refer to Strut Replacement.
4. If equipped with electronic suspension control system, ensure that the system is working properly. Refer to Diagnostic Starting Point-Electronic Suspension Control.
5. Use your hands in order to lift up and push down on each corner of the vehicle 3 times. Remove your hands from the vehicle. If the corner motion exceeds 2 cycles, replace the strut. If the strut does not exceed 2 cycles, NO repair is necessary.

STRUT ASSEMBLY REMOVAL AND INSTALLATION

Special Tools

EN-45059 Torque Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Air Inlet Grille Panel [Air Inlet Grille Panel Replacement](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)

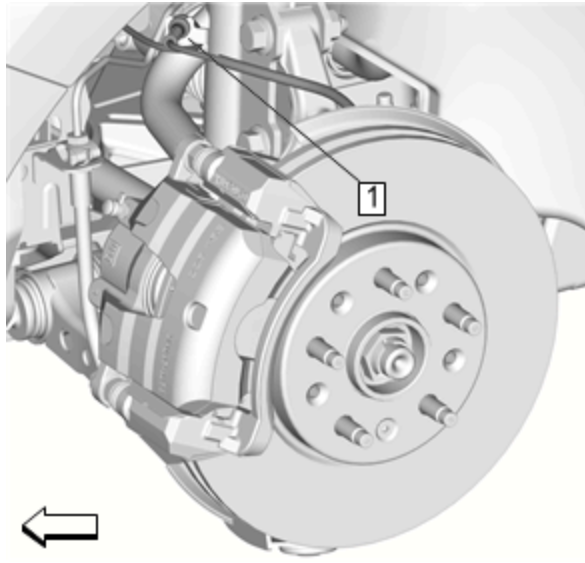


Fig. 42: Front Wheel Speed Sensor Grommet
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheel Speed Sensor Grommet (1) @Strut Assembly [Front Wheel Speed Sensor Replacement](#)

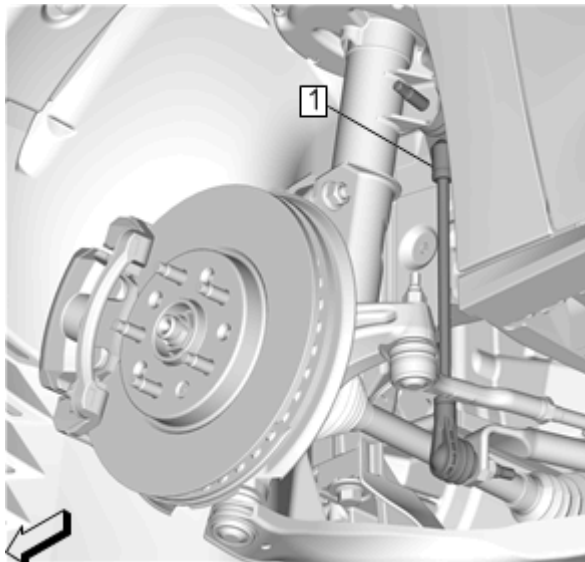


Fig. 43: Front Stabilizer Shaft Link
 Courtesy of GENERAL MOTORS COMPANY

4. Separate Front Stabilizer Shaft Link (1) @Strut Assembly [Stabilizer Shaft Link Replacement](#)

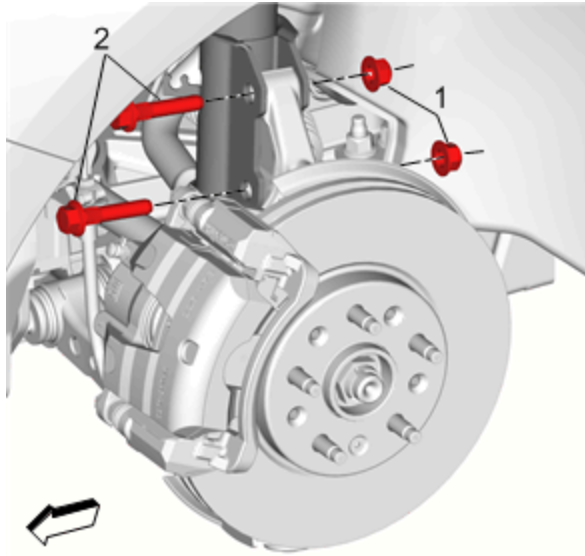


Fig. 44: Steering Knuckle Nuts And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove Steering Knuckle Nut (1)
6. Remove Steering Knuckle Bolt (2)

DISCARD the bolts.

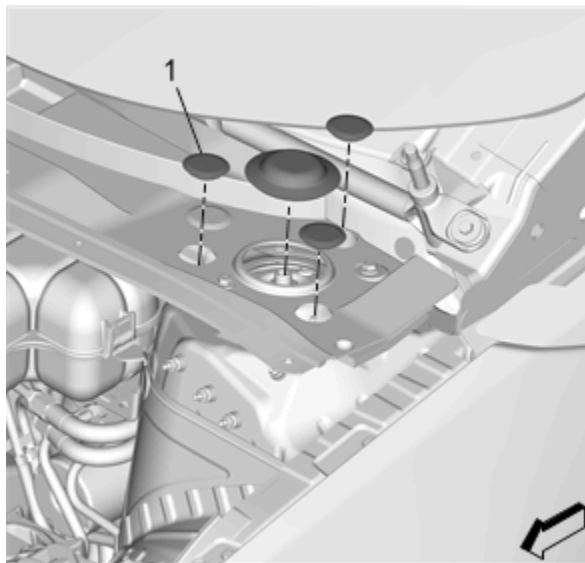


Fig. 45: Front Suspension Strut Mount Fasteners

Courtesy of GENERAL MOTORS COMPANY

7. Remove the plugs that cover the front suspension strut mount fasteners. (1)

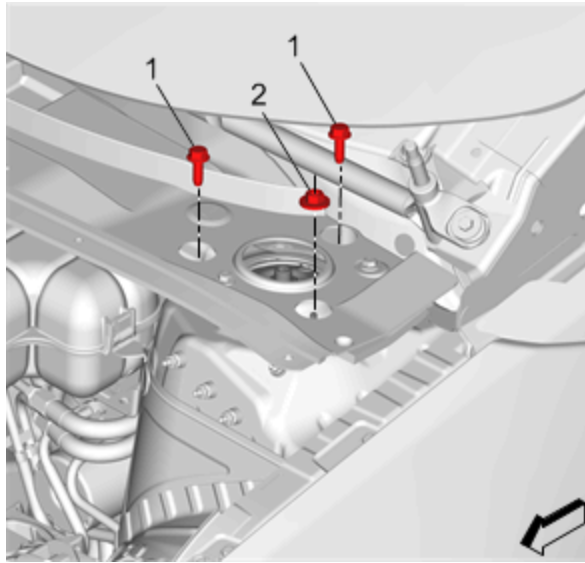


Fig. 46: Front Suspension Strut Mount Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Suspension Strut Mount Bolt (1)

DISCARD the bolts.

NOTE:

- If the front strut assembly has been replaced previously, a third front suspension strut mount bolt may be present instead of a front suspension strut mount nut.
- If a third front suspension strut mount bolt is present, DISCARD the bolt along with the other two front suspension strut mount bolts as in the previous removal step.

9. Remove Front Suspension Strut Mount Nut (2)

DISCARD the nut.

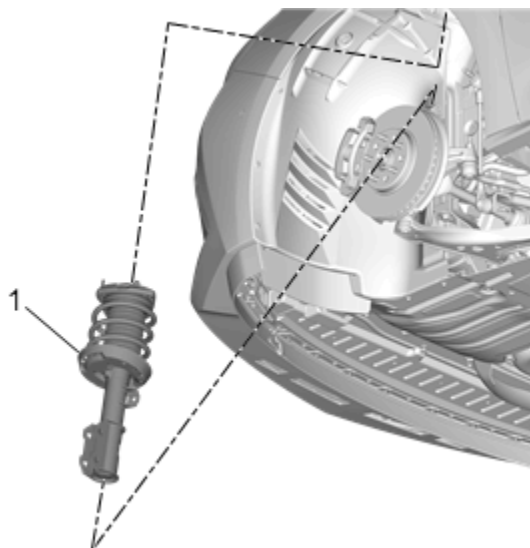


Fig. 47: Front Suspension Strut Assembly
Courtesy of GENERAL MOTORS COMPANY

10. Remove the front suspension strut assembly (1) from the vehicle.

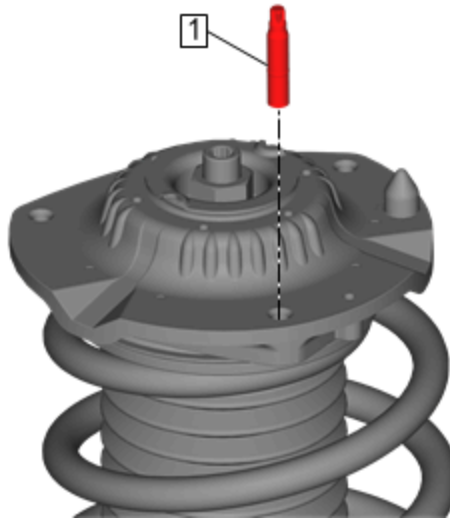


Fig. 48: Front Suspension Strut Mount Stud
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- The front suspension strut assembly comes from the factory with a stud in one of the front suspension strut mount holes that is used in the factory to align the assembly. The stud is torque-to-yield and should NOT be reused.
- When reinstalling the front suspension strut assembly, engineering recommends removing the stud from the front suspension strut mount and replacing it with a third bolt. The bolt is the same part number as the other two mount bolts.

11. Remove Front Suspension Strut Mount Stud

DISCARD the stud.

Installation Procedure

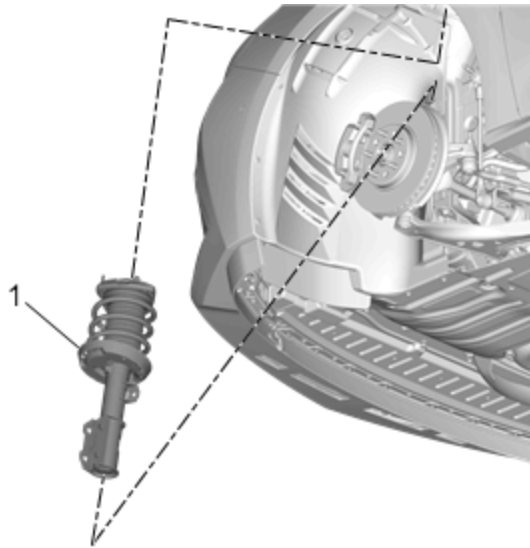


Fig. 49: Front Suspension Strut Assembly

Courtesy of GENERAL MOTORS COMPANY

1. Position the front suspension strut assembly (1) on the vehicle.

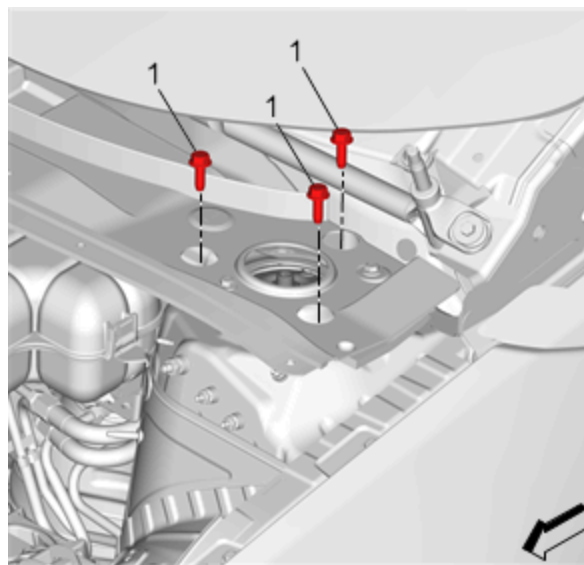


Fig. 50: Front Suspension Strut Mount Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

2. Install Front Suspension Strut Mount Bolt (1)

Install NEW bolts.

CAUTION: Refer to [Fastener Caution](#) .

3. Use the **EN-45059** meter to tighten the front suspension strut mount bolts.(1)

Tighten

1. First Pass: 22 N.m (16 lb ft)
2. Final Pass: (30 - 45 degrees)

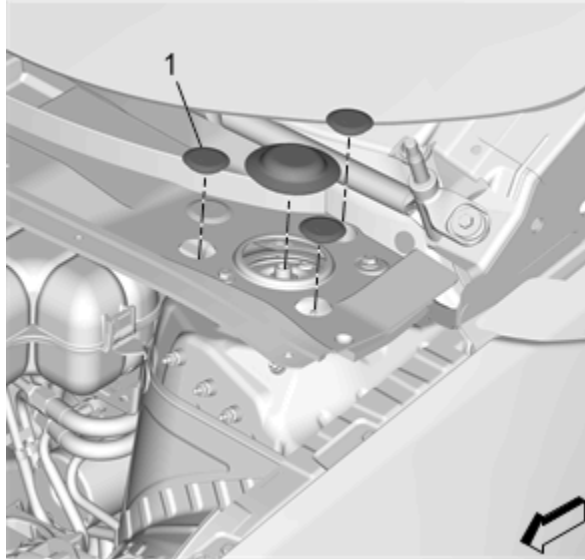


Fig. 51: Front Suspension Strut Mount Fasteners

Courtesy of GENERAL MOTORS COMPANY

4. Install the plugs that cover the front suspension strut mount fasteners.(1)

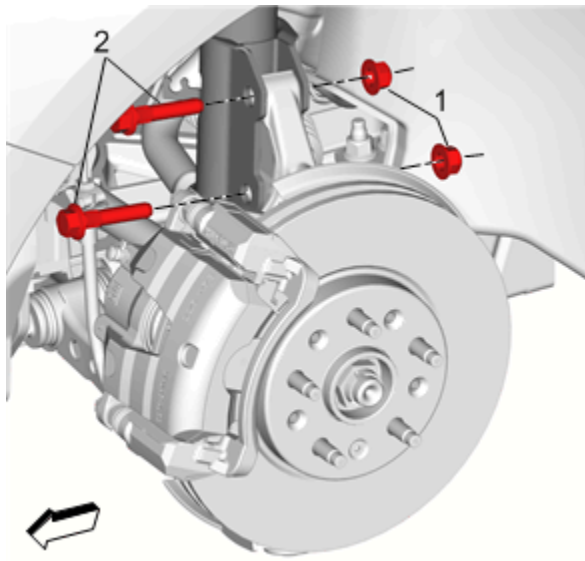


Fig. 52: Steering Knuckle Nuts And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install Steering Knuckle Bolt (2)

Install NEW bolts.

6. Install Steering Knuckle Nut (1)
7. Use the **EN-45059** meter to tighten the steering knuckle nuts.(1)

Tighten

1. First Pass: 100 N.m (74 lb ft)
2. Final Pass: (45 - 60 degrees)

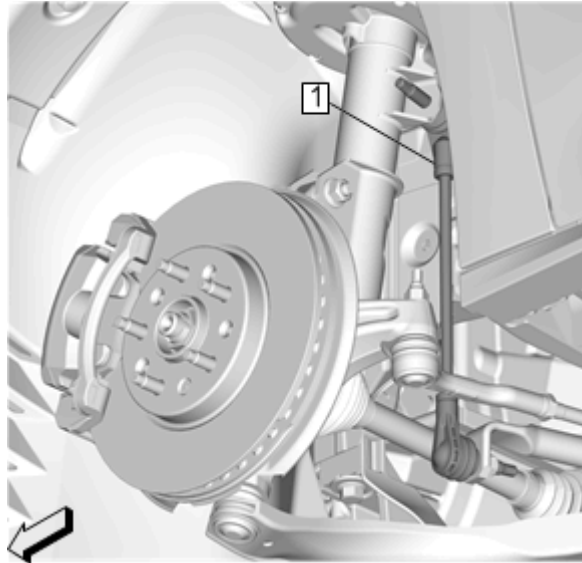


Fig. 53: Front Stabilizer Shaft Link

Courtesy of GENERAL MOTORS COMPANY

8. Install Front Stabilizer Shaft Link (1) @Strut Assembly [Stabilizer Shaft Link Replacement](#)

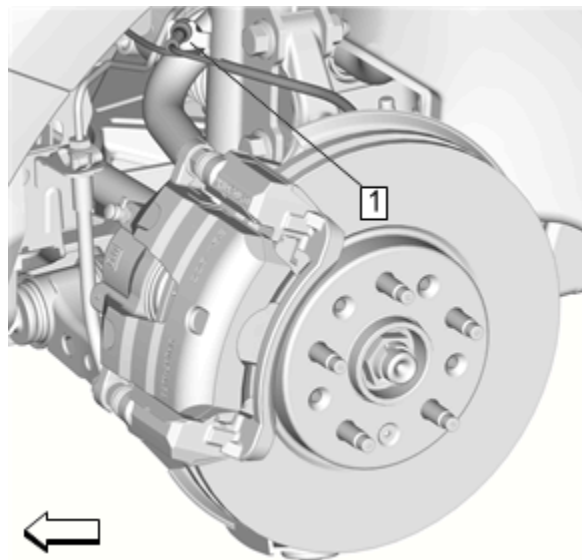


Fig. 54: Front Wheel Speed Sensor Grommet

Courtesy of GENERAL MOTORS COMPANY

9. Install Front Wheel Speed Sensor Grommet (1) @Strut Assembly [Front Wheel Speed Sensor Replacement](#)

10. Install Air Inlet Grille Panel [Air Inlet Grille Panel Replacement](#)
11. Measure and adjust the wheel alignment. [Wheel Alignment Measurement](#)

SUSPENSION STRUT DISPOSAL

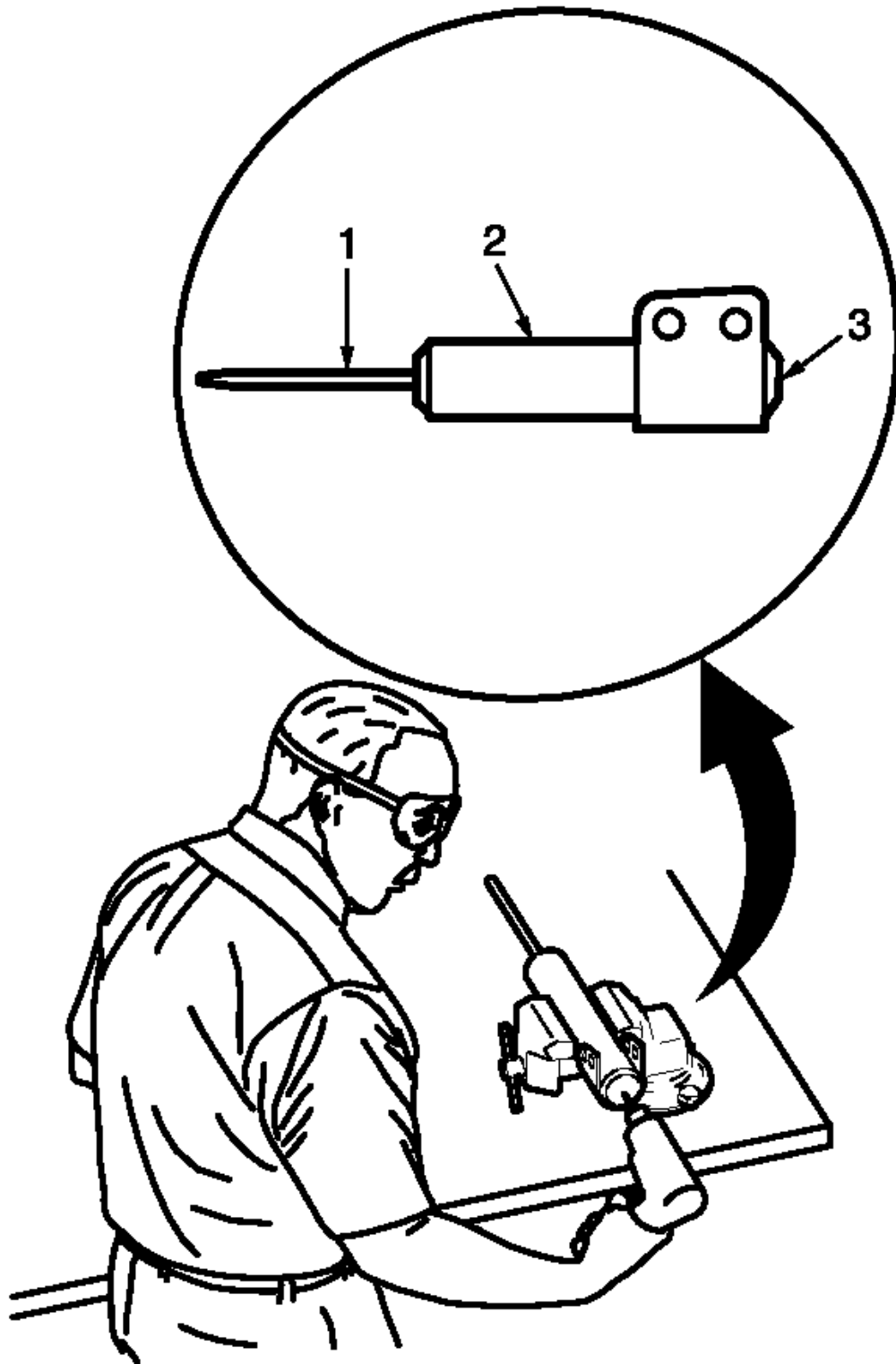


Fig. 55: Drilling Hole In Strut At Center Of End Cap
Courtesy of GENERAL MOTORS COMPANY

WARNING: Use the proper eye protection when drilling to prevent metal chips from causing physical injury.

- 1. Clamp the strut in a vise horizontally with the rod (1) completely extended.
- 2. Drill a hole in the strut at the center of the end cap (3) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the strut. Use shop towels in order to contain the escaping oil.
- 3. Remove the strut from the vise.
- 4. Hold the strut over a drain pan vertically with the hole down.
- 5. Move the rod (1) in and out of the tube (2) to completely drain the oil from the strut.

STRUT, STRUT COMPONENT, OR SPRING REPLACEMENT

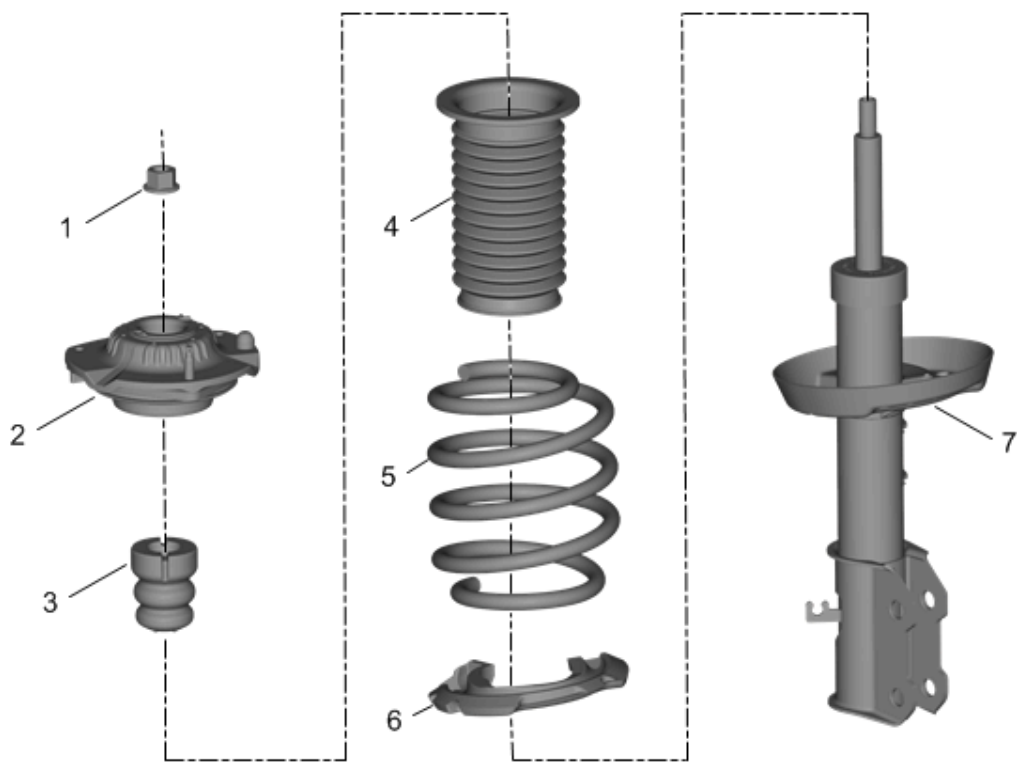


Fig. 56: Strut, Strut Component or Spring
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: To prevent personal injury and/or component damage, use the proper tools to	

Callout	Component Name
	support and compress the coil spring prior to removal of the strut shaft nut when removing the coil spring. The coil spring is under extreme pressure and can become a projectile should the spring separate from the strut before all of the tension is relieved. Preliminary Procedure Strut Assembly Removal and Installation
1	Front Suspension Strut Lower Mounting Nut CAUTION: Refer to Fastener Caution . Procedure 1. Use the CH-6066 holder and the CH-6068 tensioner to compress the front coil spring. 2. Use the CH-49375 wrench to remove and install the front suspension strut lower mounting nut. Tighten 70 N.m (52 lb ft) Special Tools

Callout	Component Name
	• CH-6066 Holder • CH-6068 Spring Tensioner • CH-49375 Strut Wrench Equivalent regional tools:Special Tools
2	Front Suspension Strut Mount
3	Front Suspension Strut Bumper
4	Front Strut Boot
5	Front Coil Spring
6	Front Coil Spring Lower Insulator
7	Front Suspension Strut

DESCRIPTION AND OPERATION

FRONT SUSPENSION DESCRIPTION AND OPERATION

The front suspension has 2 primary purposes:

- Isolate the driver from irregularities in the road surface.
- Define the ride and handling characteristics of the vehicle.

The front suspension absorbs the impact of the tires travelling over irregular road surfaces and dissipates this energy throughout the suspension system. This process isolates the vehicle occupants from the road surface. The rate at which the suspension dissipates the energy and the amount of energy that is absorbed is how the suspension defines the vehicles ride characteristics. Ride characteristics are designed into the suspension system and are not adjustable. The ride characteristics are mentioned in this description in order to aid in the understanding of the functions of the suspension system. The suspension system must allow for the vertical movement of the tire and wheel assembly as the vehicle travels over irregular road surfaces while maintaining the tire's horizontal relationship to the road.

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder. The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The

lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting the independent movement defines the vehicles handling characteristics on turns.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

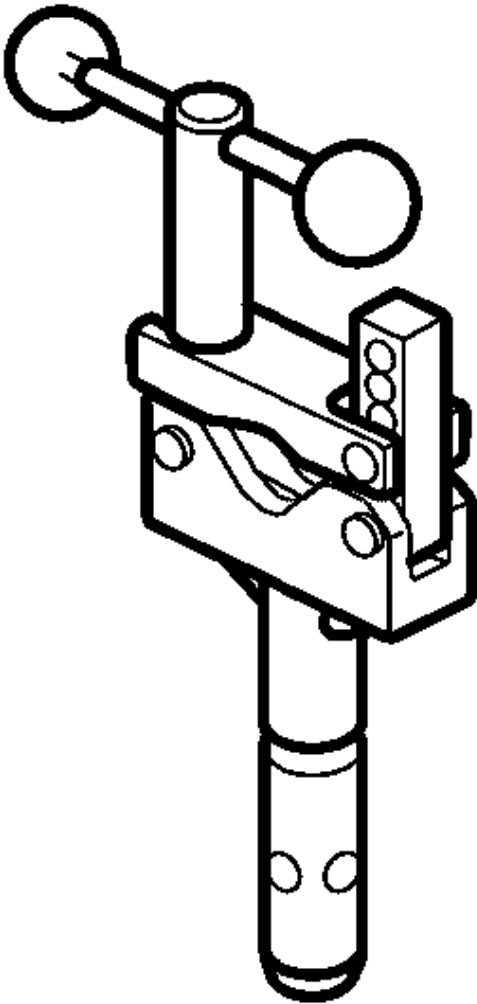
Illustration	Tool Number/ Description
	CH-6066 KM-6066 Holder

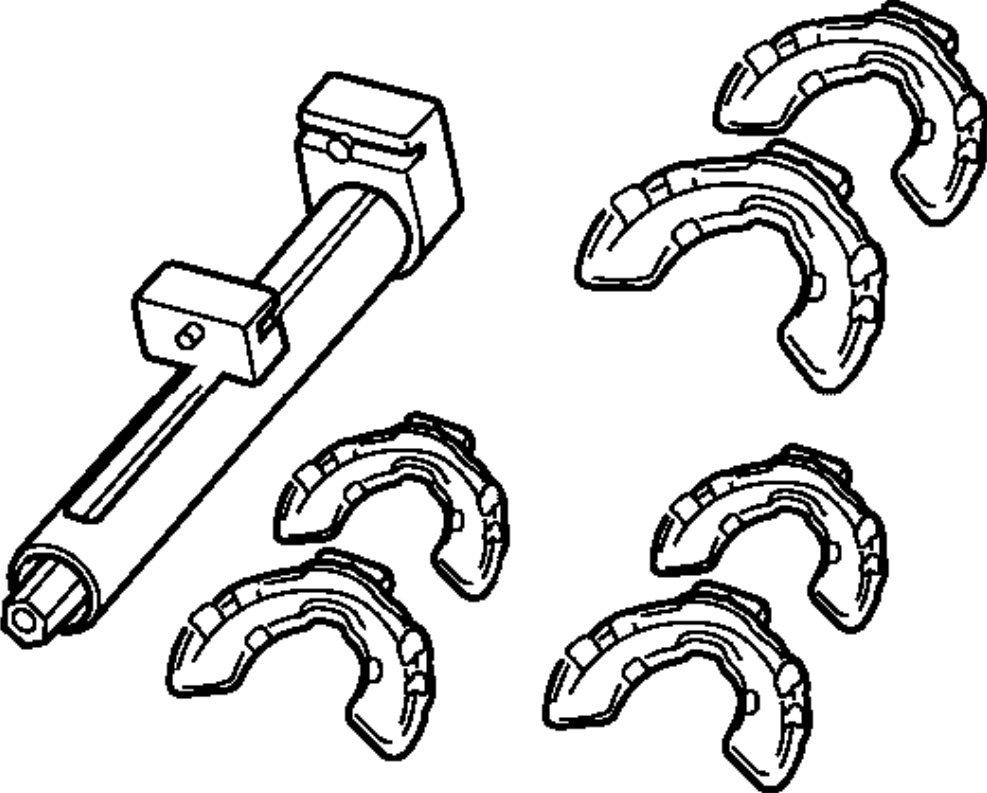
Illustration	Tool Number/ Description
 The illustration shows a mechanical spring tensioner tool on the left, consisting of a long handle with a threaded end and a sliding block. To the right of the tool are six dental arches, three upper and three lower, arranged in two columns of three. Each arch has a series of small rectangular tabs or notches along its inner curve, which are designed to engage with the spring tensioner tool for adjustment.	CH-6068 MKM-6068 Spring Tensioner

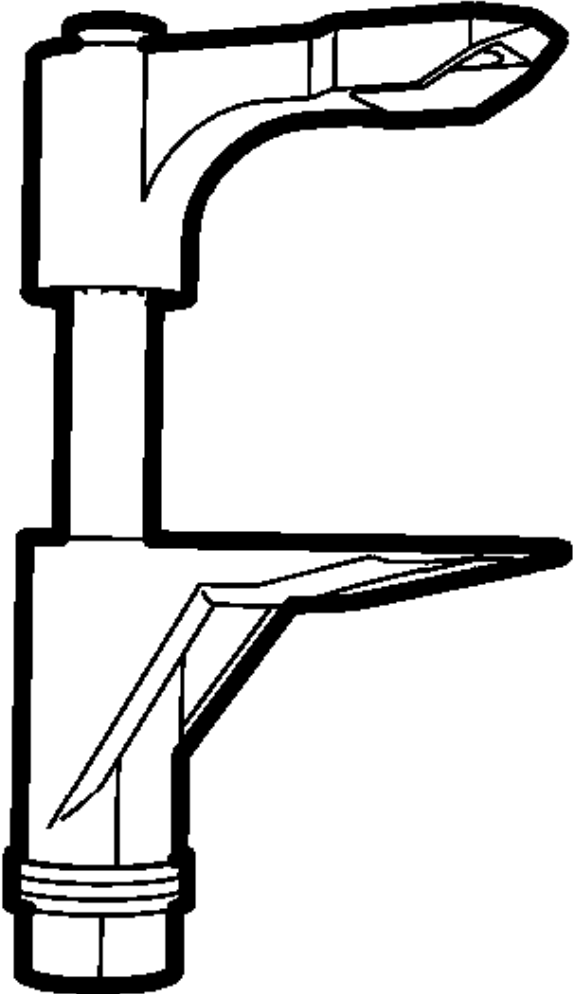
Illustration	Tool Number/ Description
	CH-42188-B J-42188-B Ball Joint Separator

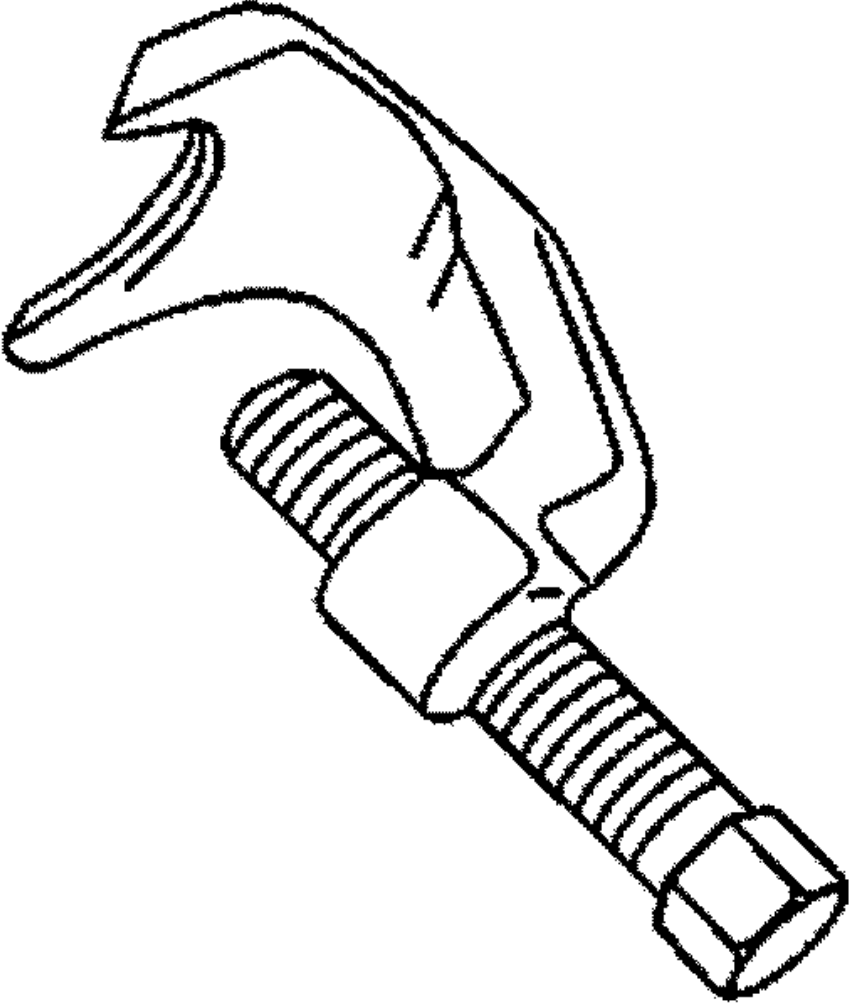
Illustration	Tool Number/ Description
	CH-43631 KM-507-C J-43631 Ball Joint Separator

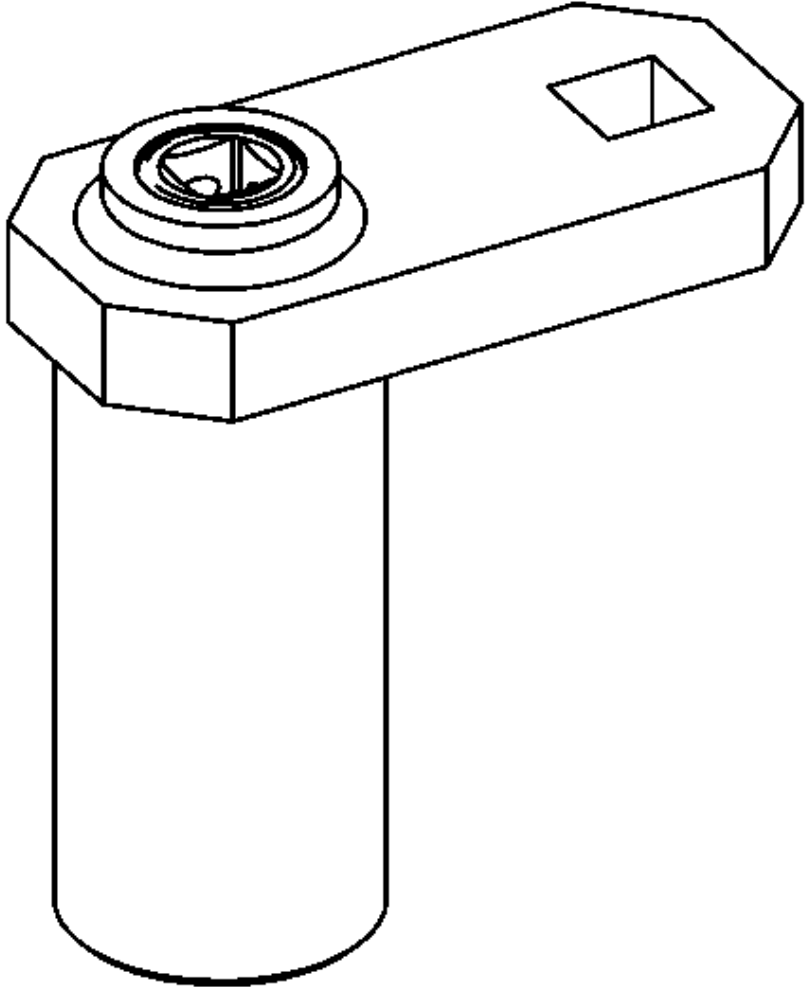
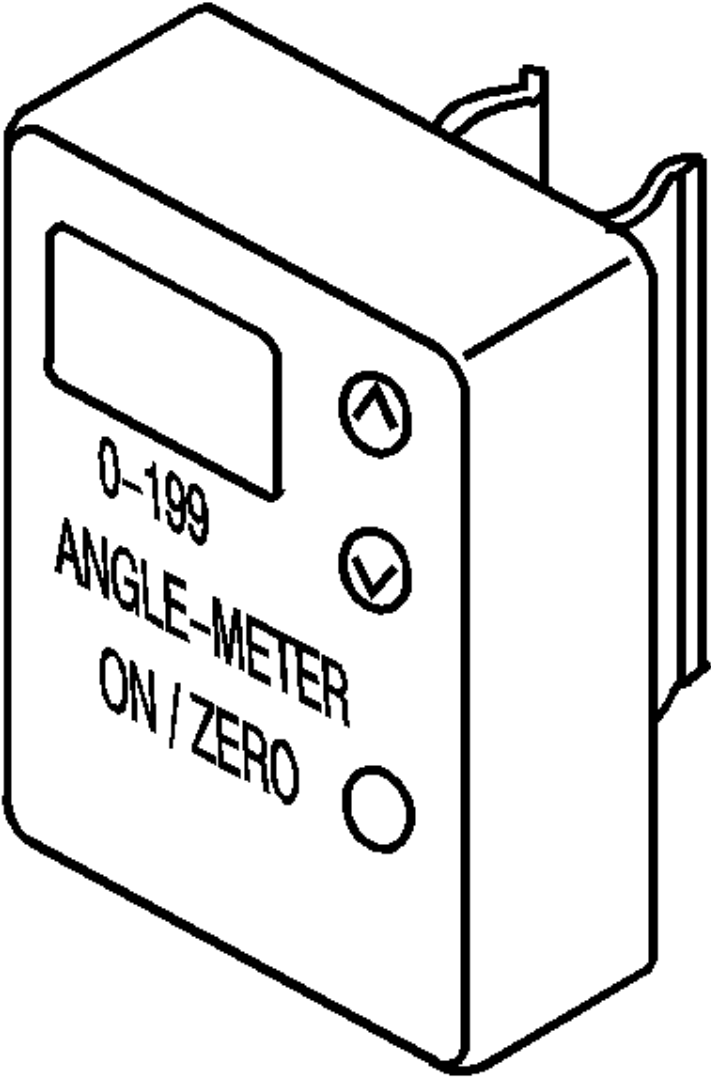
Illustration	Tool Number/ Description
	CH-49375 Strut Wrench

Illustration	Tool Number/ Description
	EN-45059 J-45059 Torque Angle Meter

Article GUID: A00884728

SUSPENSION

Rear Suspension - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Rear Axle Bracket Bolt - to Chasis	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	30-45 degrees
Rear Axle Bracket Bolt - to Rear Axle	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	30-45 degrees

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Rear Shock Absorber Bolt - Lower	100 N.m (74 lb ft)
Rear Shock Absorber Bolt - Upper	22 N.m (16 lb ft)
Rear Shock Absorber Nut	25 N.m (18 lb ft)
Rear Wheel Bearing and Hub Bolt	

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
• First Pass:	50 N.m (37 lb ft)
• Final Pass:	30-45 degrees

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
Rear Wheel Bearing Hub Bolts	Threadlock	Refer to the Electronic Parts Catalog
Rear Brake Caliper Mounting Bracket Pilot Bore	Grease	Refer to the Electronic Parts Catalog

REPAIR INSTRUCTIONS**REAR WHEEL BEARING AND HUB REPLACEMENT****Removal Procedure**

1. Remove the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
2. Remove [Rear Brake Rotor Replacement](#)
3. Remove [Rear Wheel Speed Sensor Replacement](#)

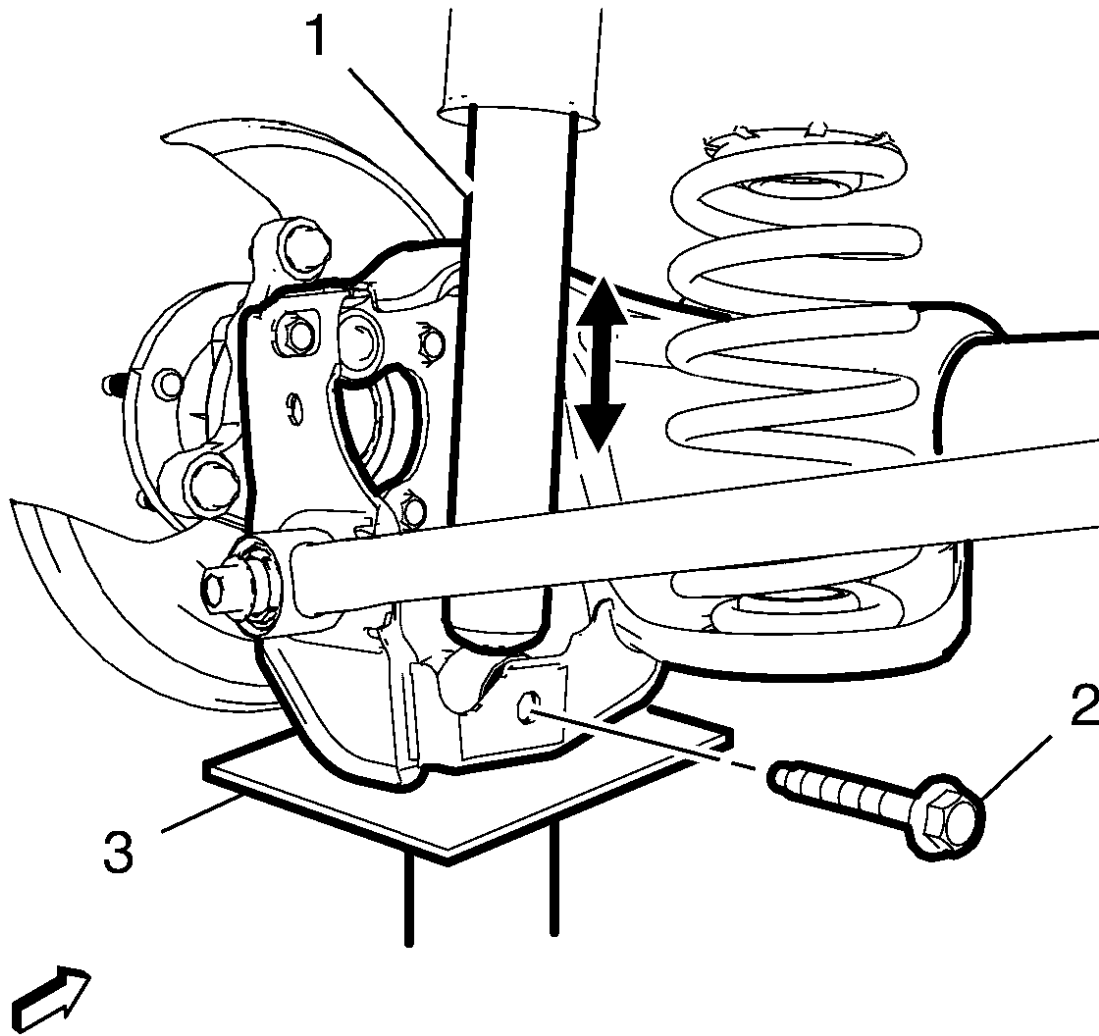


Fig. 1: Rear Shock Absorber, Bolt And Hydraulic Lift

Courtesy of GENERAL MOTORS COMPANY

4. Support the rear axle with a tall jack stand (3) near the shock absorber.
5. Remove Rear Shock Absorber Bolt (2)
6. Reposition the shock absorber (1) to gain access to the rear wheel bearing and hub bolts.

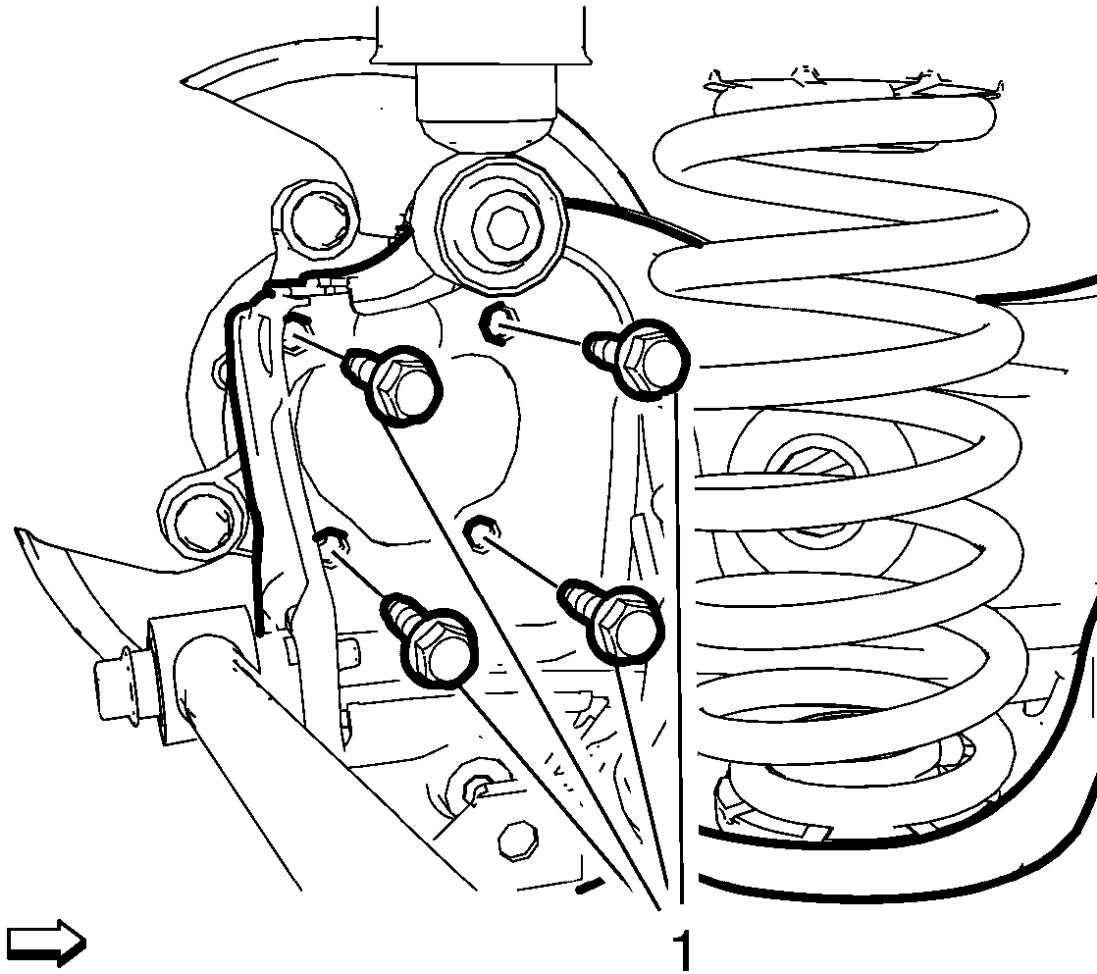


Fig. 2: Rear Wheel Bearing And Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Bolt (1)

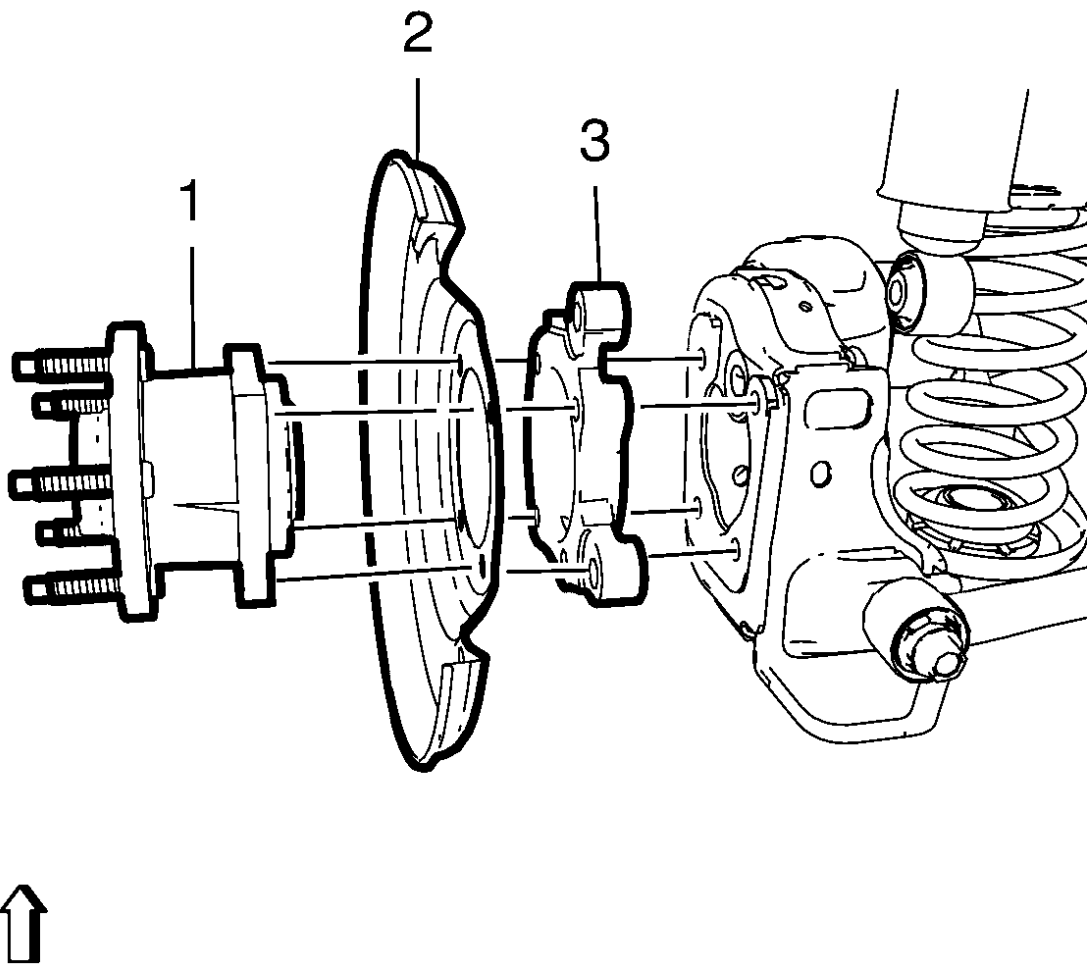


Fig. 3: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly

Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Wheel Bearing and Hub Assembly (1)
9. Remove Rear Brake Shield (2)
10. Remove Rear Brake Caliper Mount Plate (3)

Installation Procedure

1. Prepare the wheel bearing and hub threaded holes and bolts for assembly.
 1. Thoroughly clean the residue from the bolt threads with denatured alcohol or equivalent and allow to dry.
 2. Thoroughly clean the residue from the threaded holes with denatured alcohol or equivalent and allow to dry.
 3. Apply thread locking adhesive to the bolts. **Adhesives, Fluids, Lubricants, and Sealers**

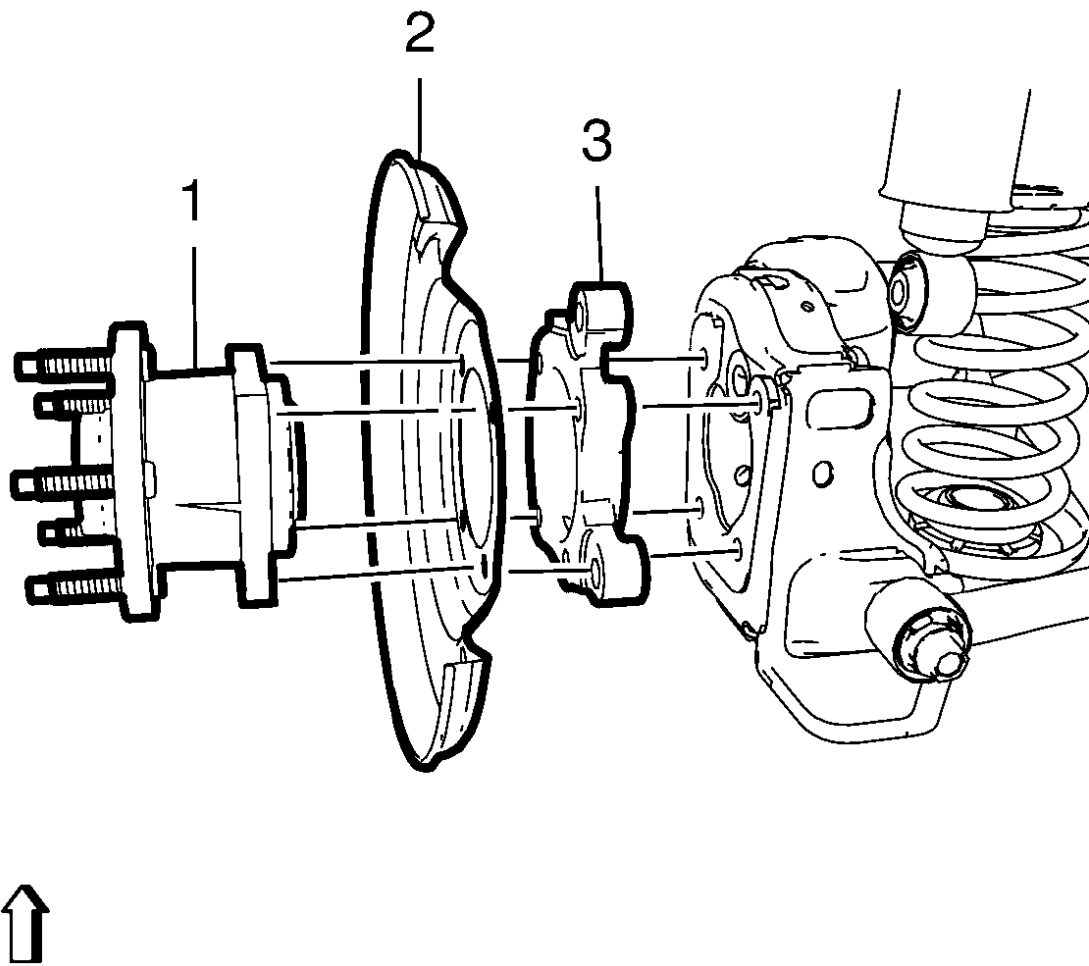


Fig. 4: Rear Brake Caliper Mount Plate, Rear Brake Shield, Rear Wheel Bearing and Hub Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Install Rear Brake Caliper Mount Plate (3)
3. Install Rear Brake Shield (2)
4. Install Rear Wheel Bearing and Hub Assembly (1)

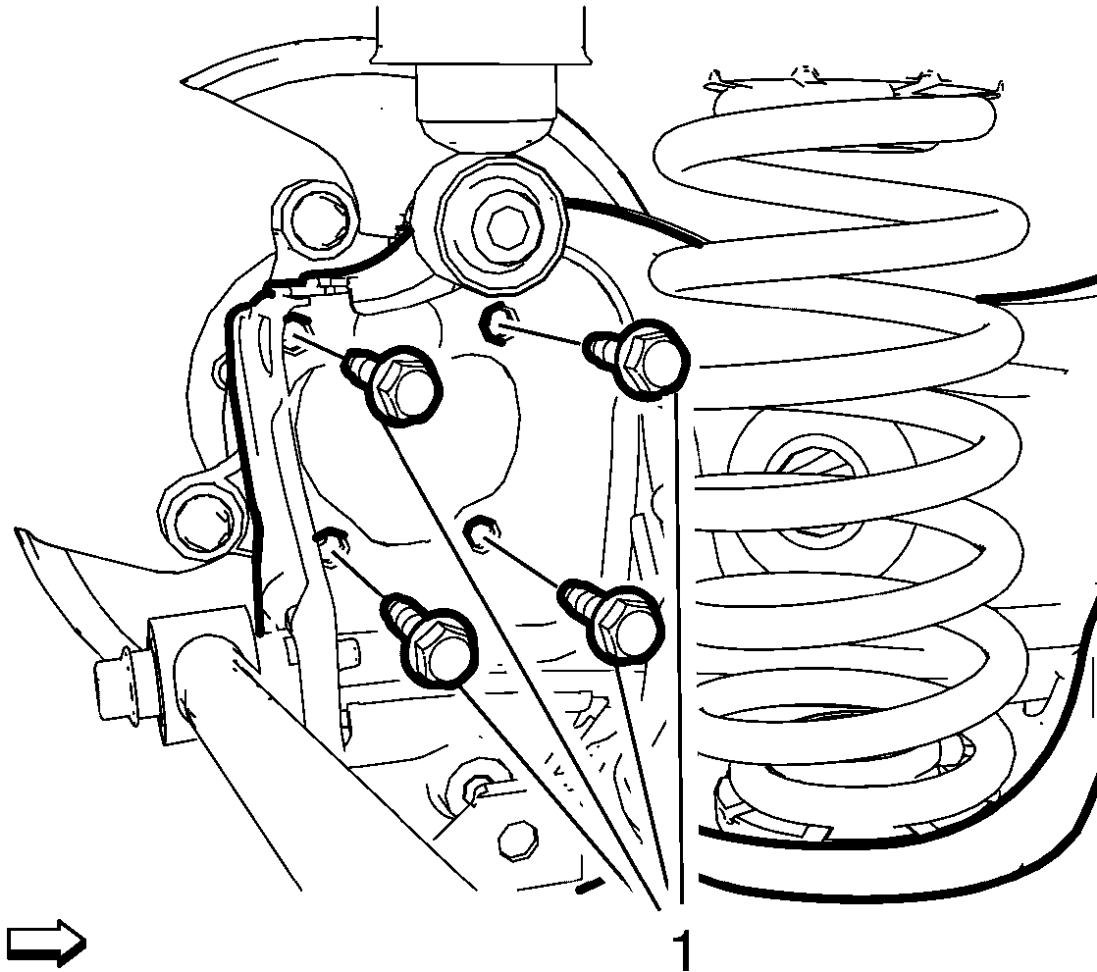


Fig. 5: Rear Wheel Bearing And Hub Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

5. Install Bolt (1) and tighten
 1. First Pass:50 N.m (37 lb ft)
 2. Final Pass:30 - 45 degrees
6. Prepare the rear shock absorber threaded hole and bolt for assembly.
 1. Thoroughly clean the residue from the bolt threads with denatured alcohol or equivalent and allow to dry.
 2. Thoroughly clean the residue from the threaded holes with denatured alcohol or equivalent and allow to dry.
 3. Apply thread locking adhesive to the bolts. [Adhesives, Fluids, Lubricants, and Sealers](#)

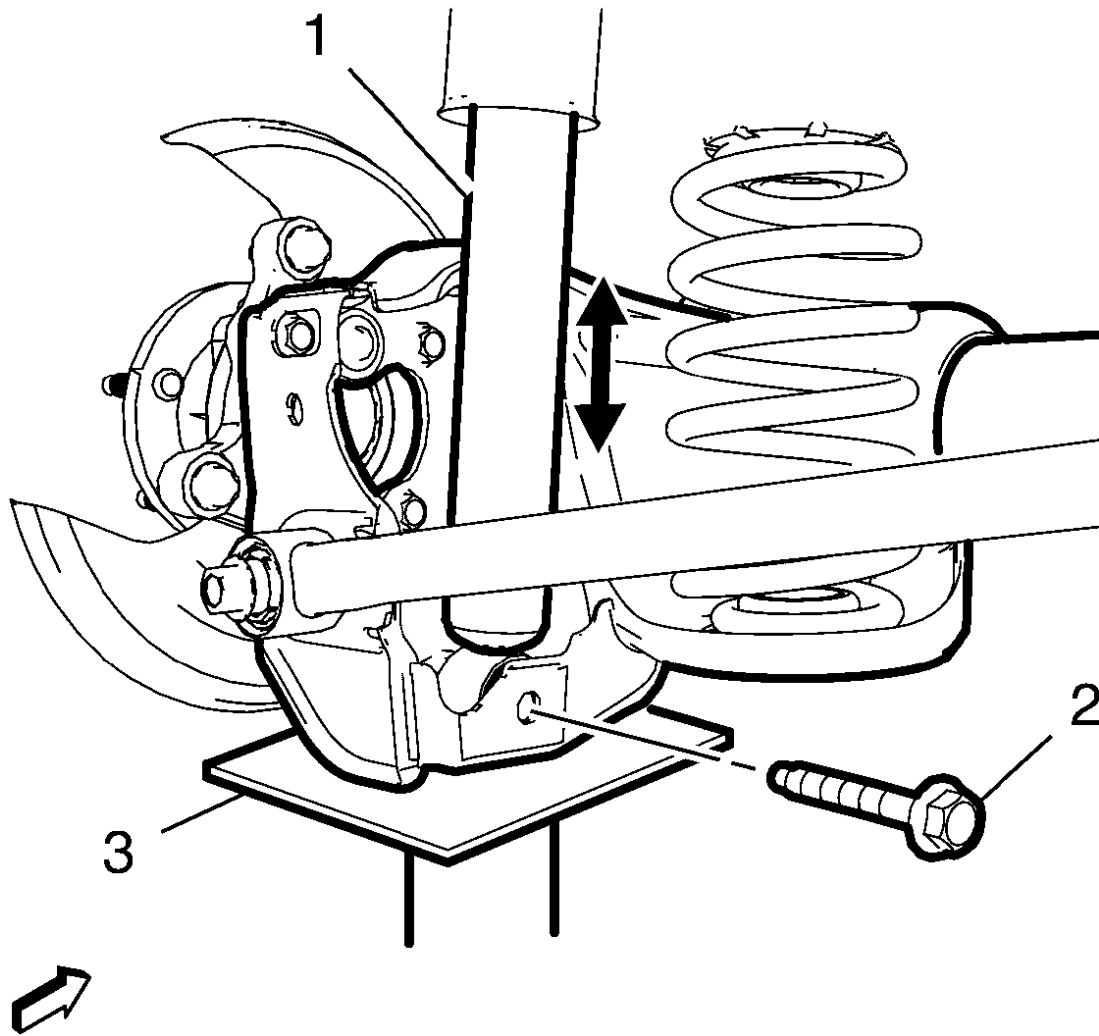


Fig. 6: Rear Shock Absorber, Bolt And Hydraulic Lift
Courtesy of GENERAL MOTORS COMPANY

7. Install Rear Shock Absorber Bolt (2), but do NOT tighten
8. Remove the tall jack stand (3) supporting the rear axle near the shock absorber.
9. Install [Rear Wheel Speed Sensor Replacement](#)
10. Install [Rear Brake Rotor Replacement](#)
11. Install [Tire and Wheel Removal and Installation](#)
12. Lower the vehicle.

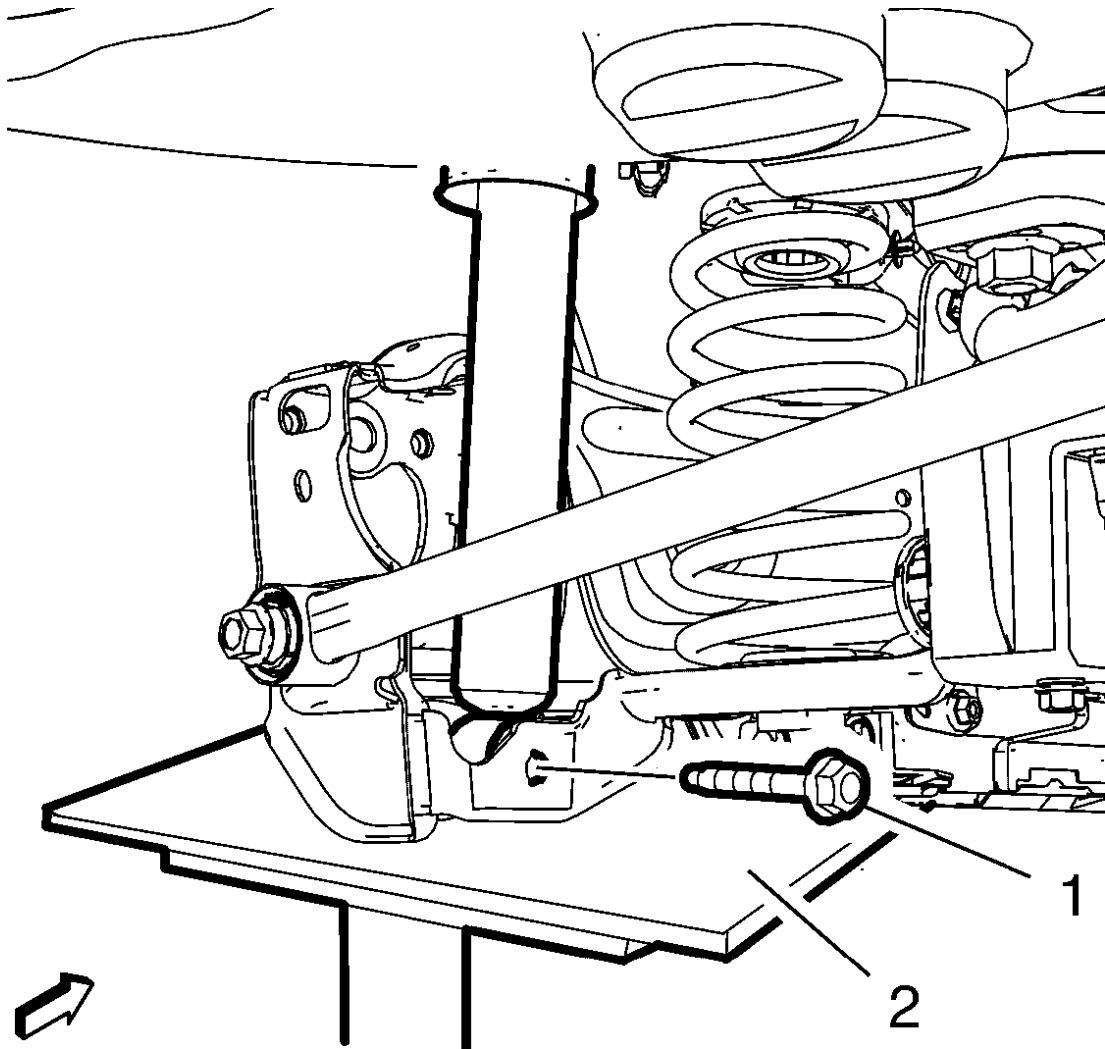


Fig. 7: Rear Shock Absorber Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the rear shock absorber bolt with the vehicle at curb height.

13. Tighten Rear Shock Absorber Bolt (1) [Shock Absorber Replacement](#)

REAR AXLE BRACKET REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)

3. Remove Exhaust Muffler [Exhaust Muffler Replacement](#)
4. Remove Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

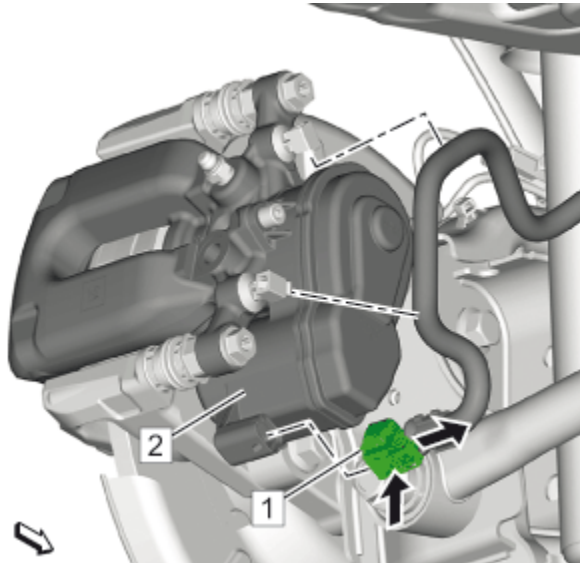


Fig. 8: Brake Caliper Assembly And Lectrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @Rear Parking Brake Actuator (2)

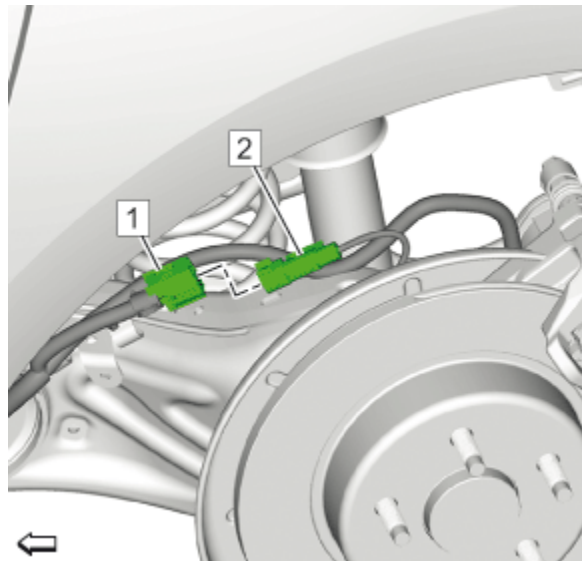


Fig. 9: Wiring Harness Rear Wheel Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

6. Remove Wiring Harness (1) @Rear Wheel Speed Sensor (2)
7. Remove Wiring Harness@Rear Axle

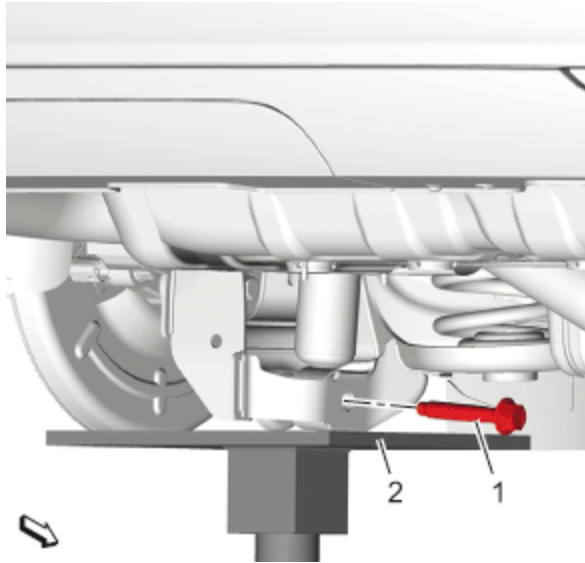


Fig. 10: Rear Shock Absorber Bolt And Hydraulic Jack
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Use two hydraulic jacks, one for each side.

8. Lift the rear axle with a hydraulic jack (2).
9. Remove Rear Shock Absorber Bolt (1)

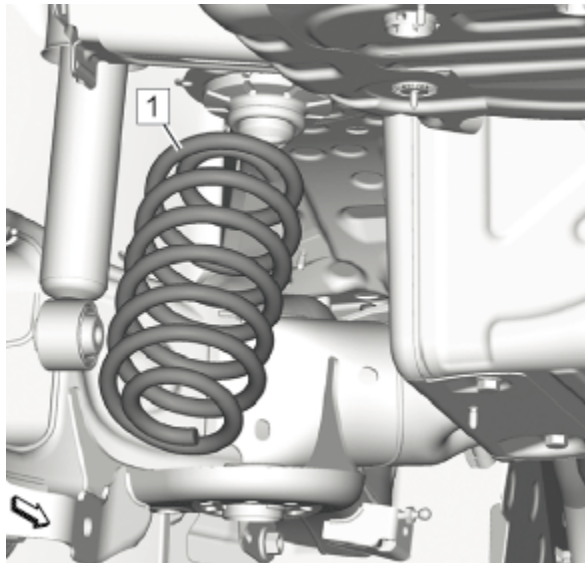


Fig. 11: Rear Spring
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Using a grease pencil, mark the orientation of the rear coil springs for proper installation.

10. Remove Rear Spring (1)
11. Remove Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)

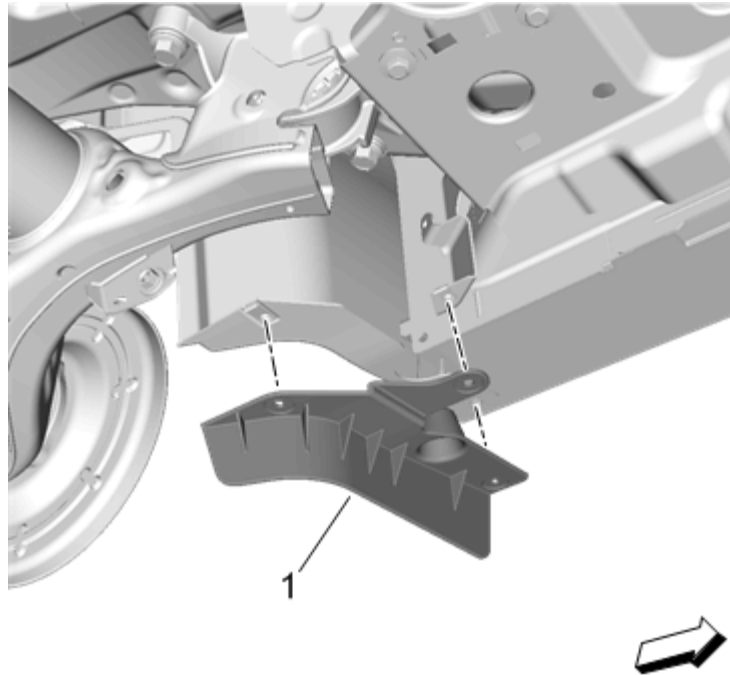


Fig. 12: Rear Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

12. Reposition Rear Tire Front Air Deflector (1) **Rear Tire Front Air Deflector Replacement**

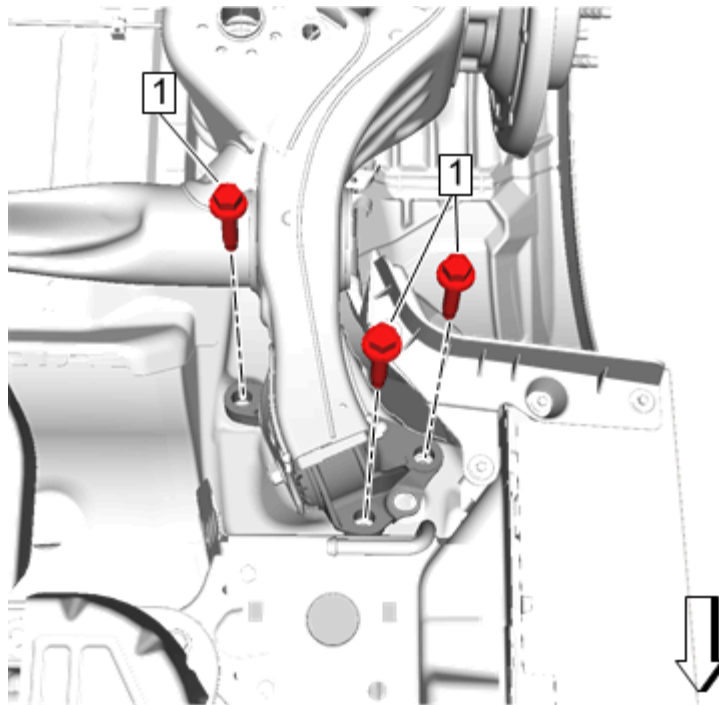


Fig. 13: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

13. Remove Rear Axle Bracket Bolt (1) @Body and DISCARD

CAUTION: Do not suspend the rear axle by the brake hoses. Damage to the brake hoses may result.

14. Carefully lower the rear axle as necessary without applying stress to the rear brake hoses.

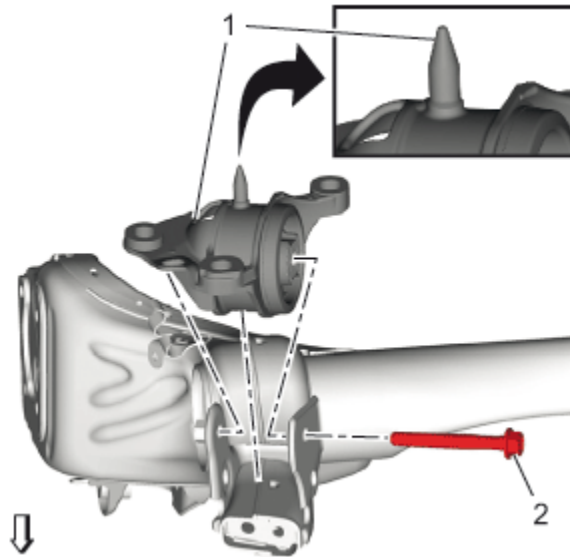


Fig. 14: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

15. Remove Rear Axle Bracket Bolt (2) and DISCARD

16. Remove Rear Axle Bracket (1)

Installation Procedure

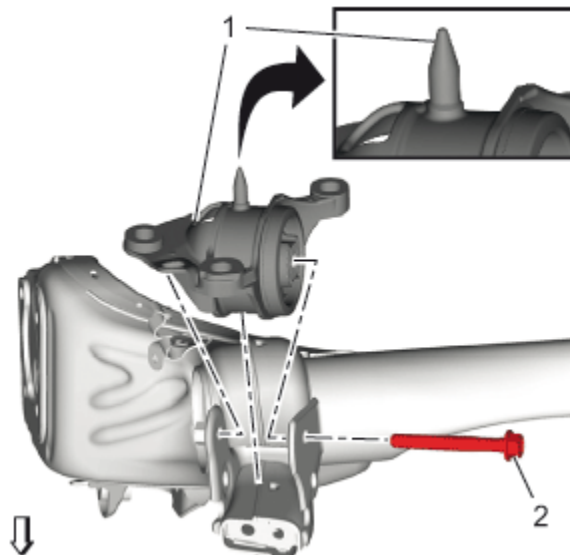


Fig. 15: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The Rear Axle Bracket (1) is equipped with a pin to arrange the rear axle on the vehicle. The pin has to be insert into the vehicle.

1. Install Rear Axle Bracket (1)

NOTE: Install, but do NOT tighten

2. Install New Rear Axle Bracket Bolt (2)

NOTE: A second technician is required.

3. Position the rear axle to the vehicle.

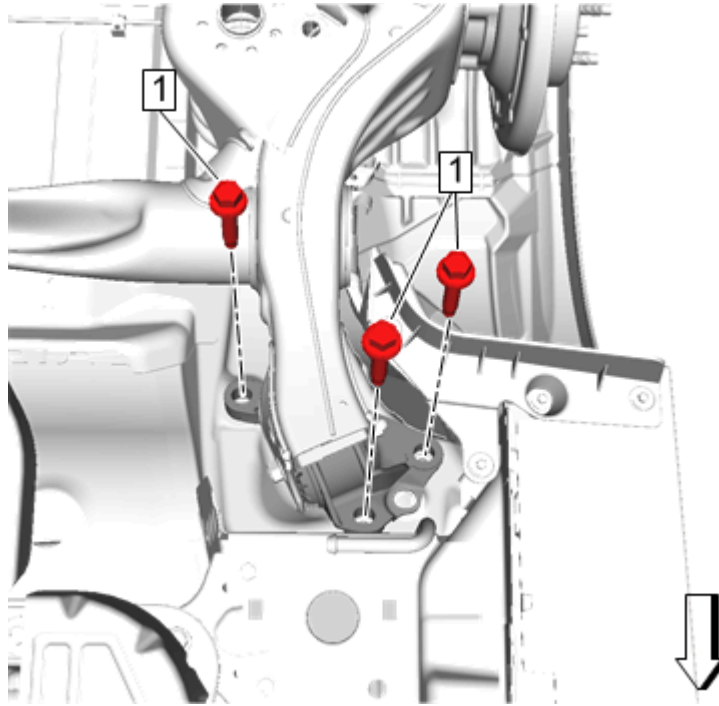


Fig. 16: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

CAUTION: Fastener Caution

4. Install Rear Axle Bracket Bolt (1) @Body and tighten the NEW bolt.

1. First Pass: 100 N.m (74 lb ft)

2. Final Pass: 30 - 45 degrees

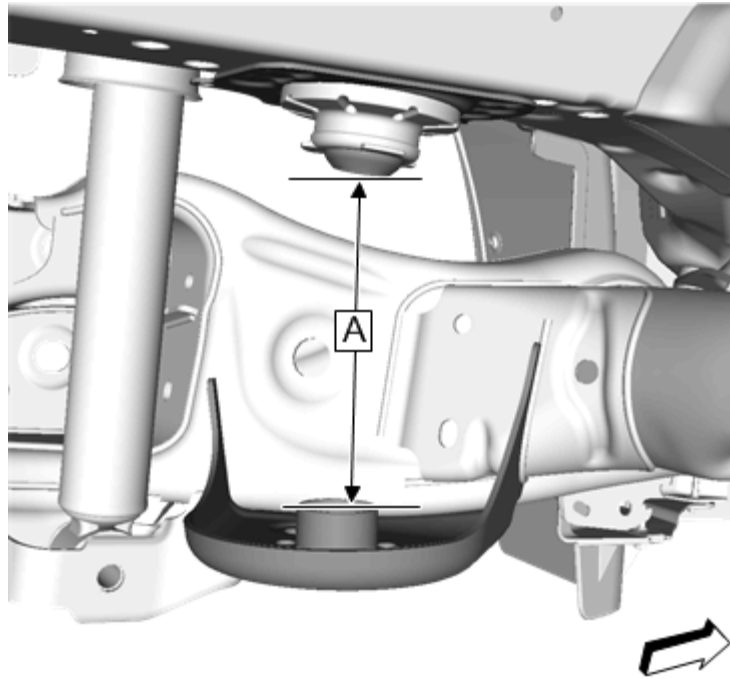


Fig. 17: Measuring Vertical Distance

Courtesy of GENERAL MOTORS COMPANY

5. Raise the rear axle to the proper trim height specification by measuring the vertical distance (A) between the upper and lower insulator seat.
 - Adjust (A) to: **152 mm (5.98 in)**

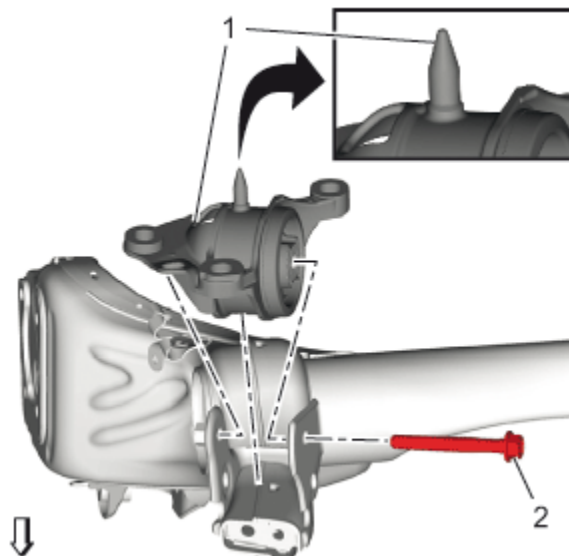


Fig. 18: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: **Torque-to-Yield Fastener Warning**

6. Tighten the bolts.(2)
 1. First Pass: 100 N.m (74 lb ft)

2. Final Pass:30 - 45 degrees

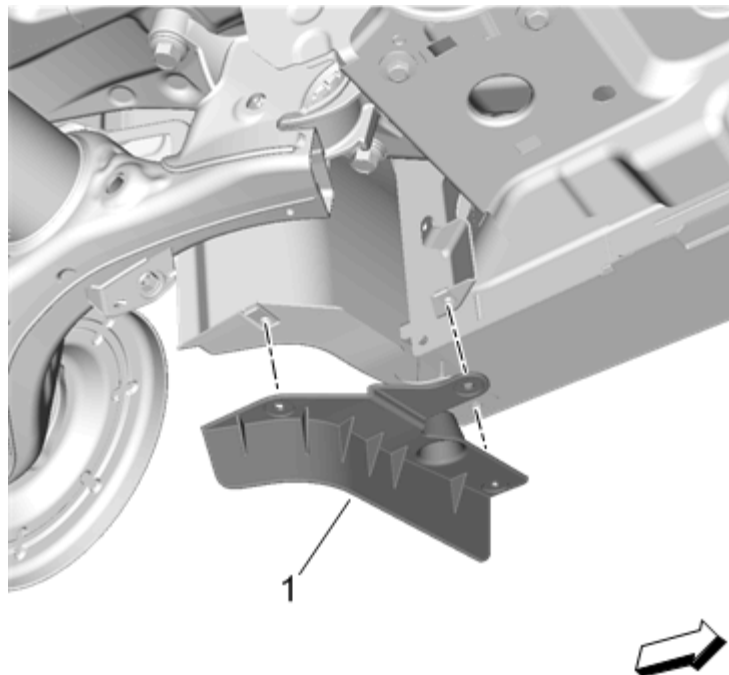


Fig. 19: Rear Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

7. Install Rear Tire Front Air Deflector (1)[Rear Tire Front Air Deflector Replacement](#)
8. Install Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)

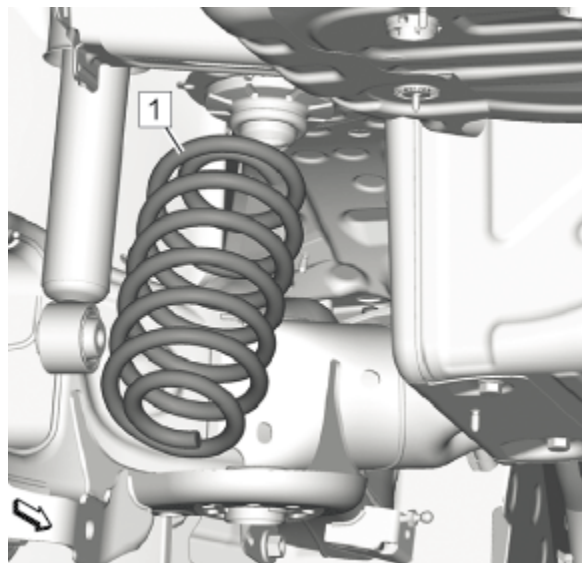


Fig. 20: Rear Spring

Courtesy of GENERAL MOTORS COMPANY

NOTE: For proper rear spring installation, align the reference marks made during removal.

9. Install Rear Coil Spring (1)

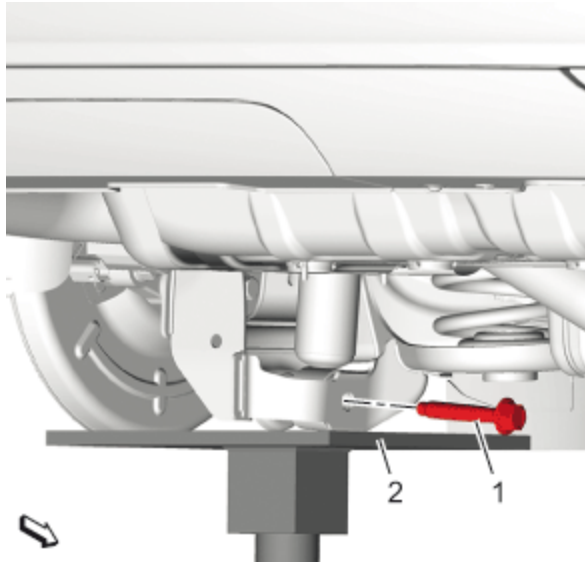


Fig. 21: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

10. Support the rear axle with a hydraulic jack (2) near the shock absorber.

NOTE: Install, but do NOT tighten

NOTE: Service may offer bolts without microencapsulated thread locking adhesive. If this is the case, apply thread locking adhesive to the bolt.

11. Loosely install Rear Shock Absorber Bolt (1)

12. Install Exhaust Muffler [Exhaust Muffler Replacement](#)

13. Install Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

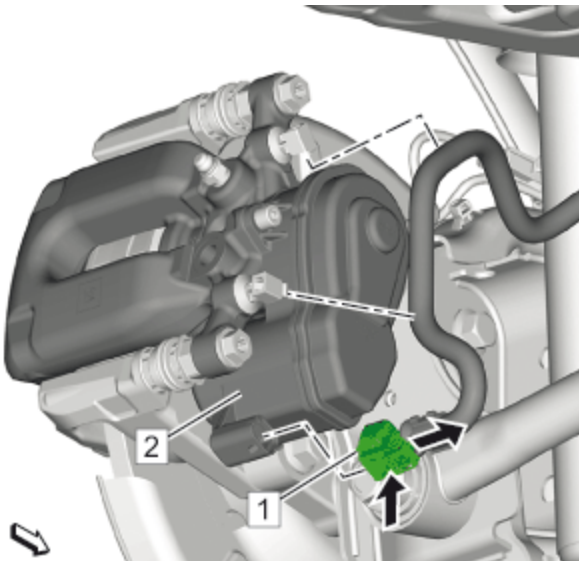


Fig. 22: Brake Caliper Assembly And Lectrical Connector

Courtesy of GENERAL MOTORS COMPANY

14. Connect Electrical Connector (1) @Rear Parking Brake Actuator (2)

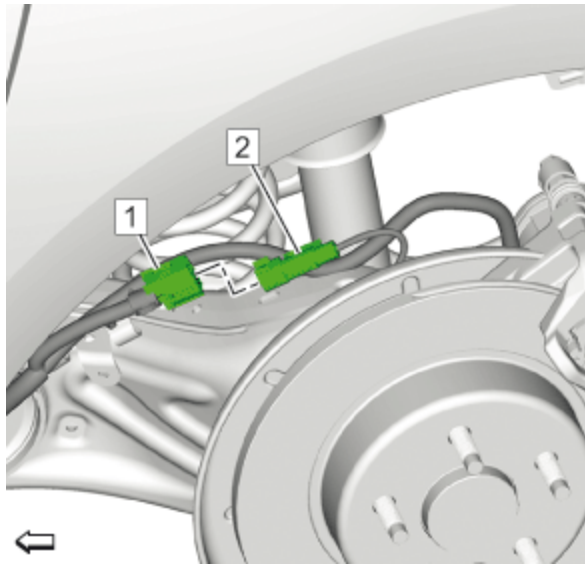


Fig. 23: Wiring Harness Rear Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

15. Connect Electrical Connector (1) @Rear Wheel Speed Sensor (2)
16. Install Wiring Harness@Rear Axle
17. Install the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
18. Remove the support and lower the vehicle.

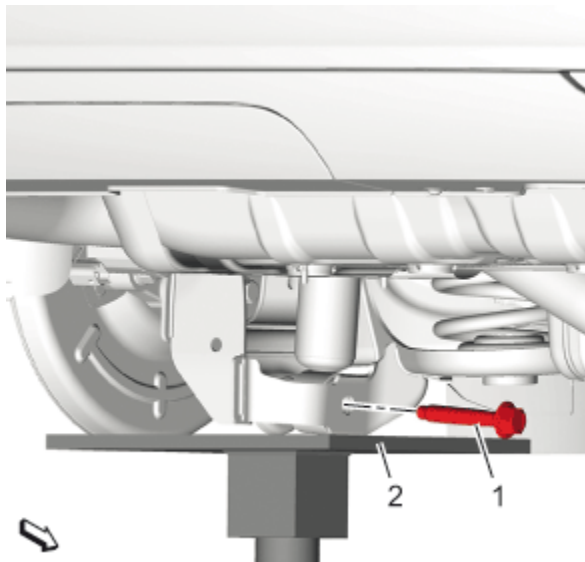


Fig. 24: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the bolts with vehicle standing on the ground.

19. Rear Shock Absorber Bolt (1) - Tighten [Shock Absorber Replacement](#)

STRUT AND SHOCK ABSORBER INSPECTION

NOTE: The shock absorber assembly DOES NOT have to be removed from the vehicle

to perform the following inspection procedure.

NOTE: A light film of oil on the top portion of the lower shock absorber tube is normal. DO NOT replace the shock absorber for this condition.

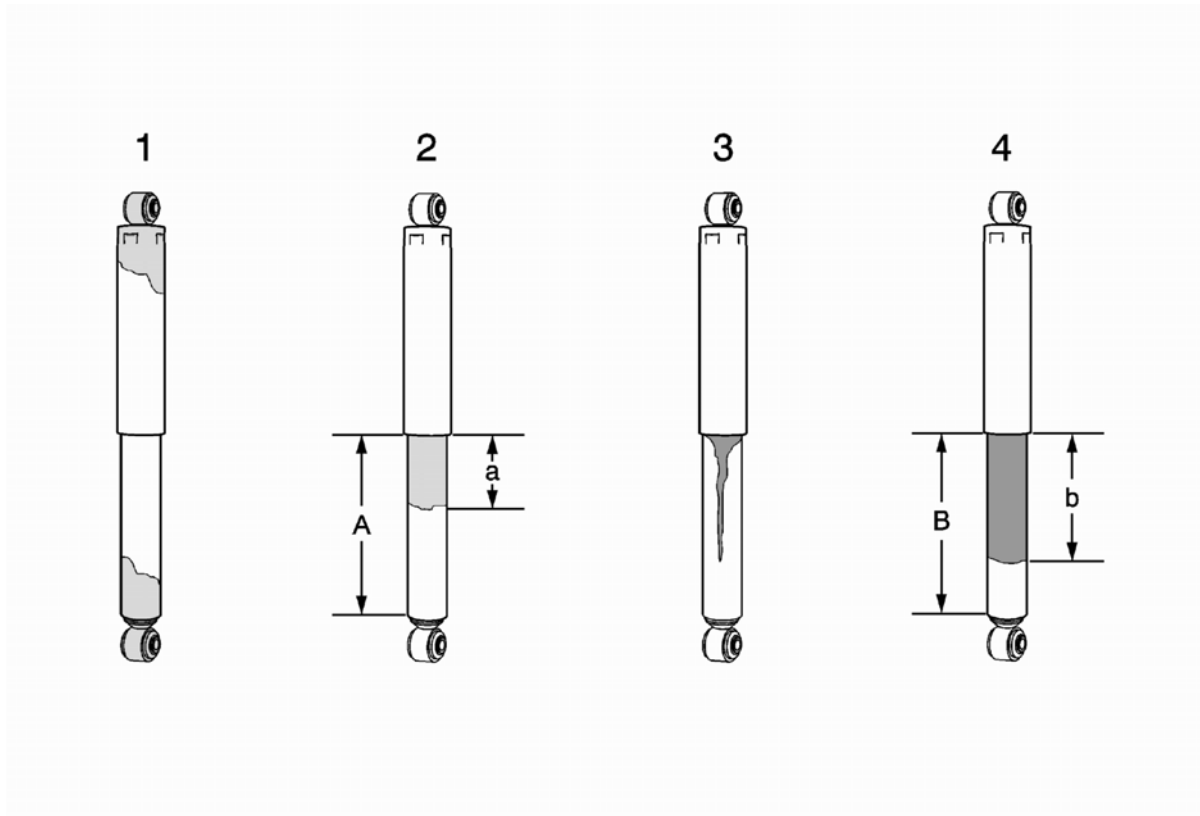


Fig. 25: Identifying Shock Absorber Conditions

Courtesy of GENERAL MOTORS COMPANY

Condition 1

Oil or fluid residue only on the bottom or top of the shock absorber and not originating from the shaft seal, is not a shock absorber related problem. DO NOT replace the shock absorber, look for other external leaks.

Condition 2

Light film/residue on approximately 1/3 (a) or less of the lower shock tube (A) and originating from the shaft seal, is a NORMAL condition. DO NOT replace the shock absorber.

Condition 3

Oil drip or trail down the lower shock tube and originating from the shaft seal, is an ABNORMAL condition. Replace the shock absorber. Refer to [Shock Absorber Replacement](#).

Condition 4

An extreme wet film of oil covering more than 1/3 (b) of the lower shock tube (B) and originating from the shaft seal, is an ABNORMAL condition. Replace the shock absorber. Refer to [Shock Absorber Replacement](#).

Inspection

- 1. Verify the customer's concern is present. If the concern is present, continue to the next step. If the concern is not present, then the vehicle is operating normally.

NOTE: **The shock absorber assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

- 2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
- 3. Visually inspect each of the shock absorbers for external fluid leaks. Refer to the following conditions 1, 2, 3 and 4 for visual inspection.
 - If conditions 1 or 2 are found, continue to step 4.
 - If conditions 3 or 4 are found, replace shock absorber. Refer to [Shock Absorber Replacement](#).
- 4. Use your hands in order to lift up and push down on each corner of the vehicle 3 times. Remove your hands from the vehicle. If the corner motion exceeds 2 cycles, replace the shock absorber. If the shock absorber does not exceed 2 cycles, NO repair is necessary.

REAR SHOCK ABSORBER BUMPER REPLACEMENT

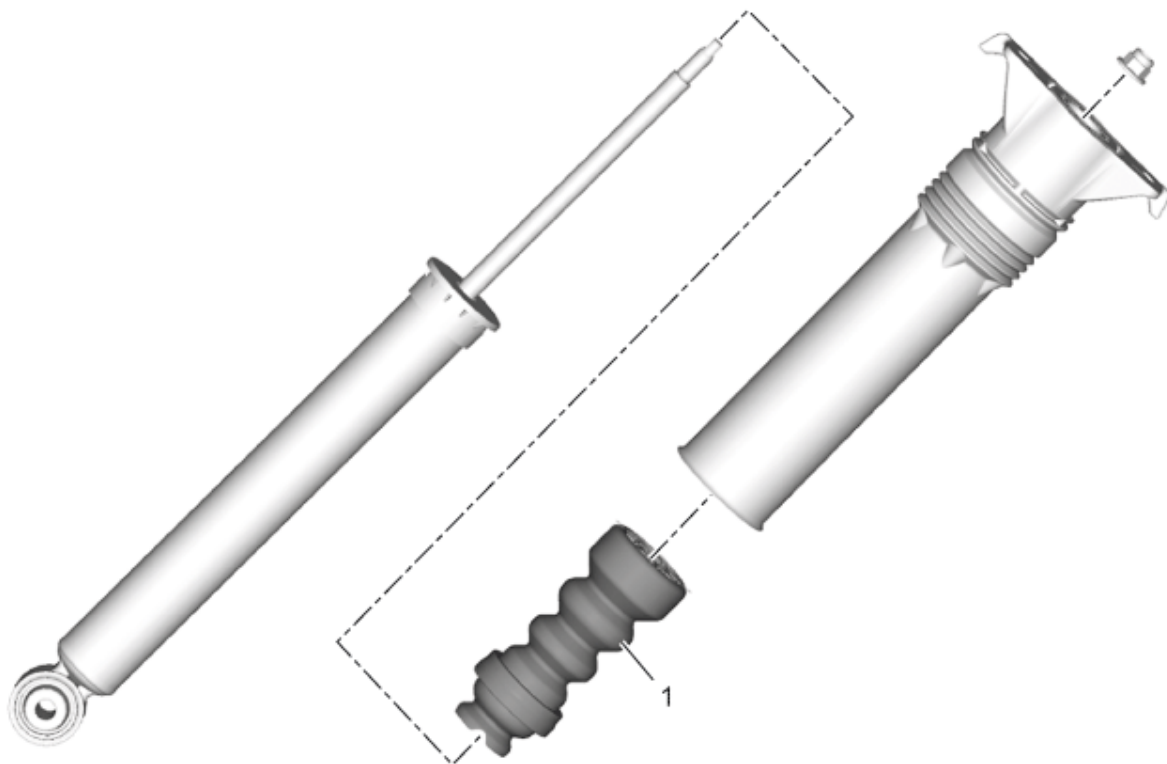


Fig. 26: Rear Shock Absorber Bumper
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1.	Tire and Wheel Removal and Installation

Callout	Component Name
2. Shock Absorber Replacement	
3. Rear Shock Absorber Mount Replacement	
1	Rear Shock Absorber Bumper

REAR SHOCK ABSORBER MOUNT REPLACEMENT

Special Tools

CH-51095 Wrench

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove [Tire and Wheel Removal and Installation](#)
2. Remove [Shock Absorber Replacement](#)

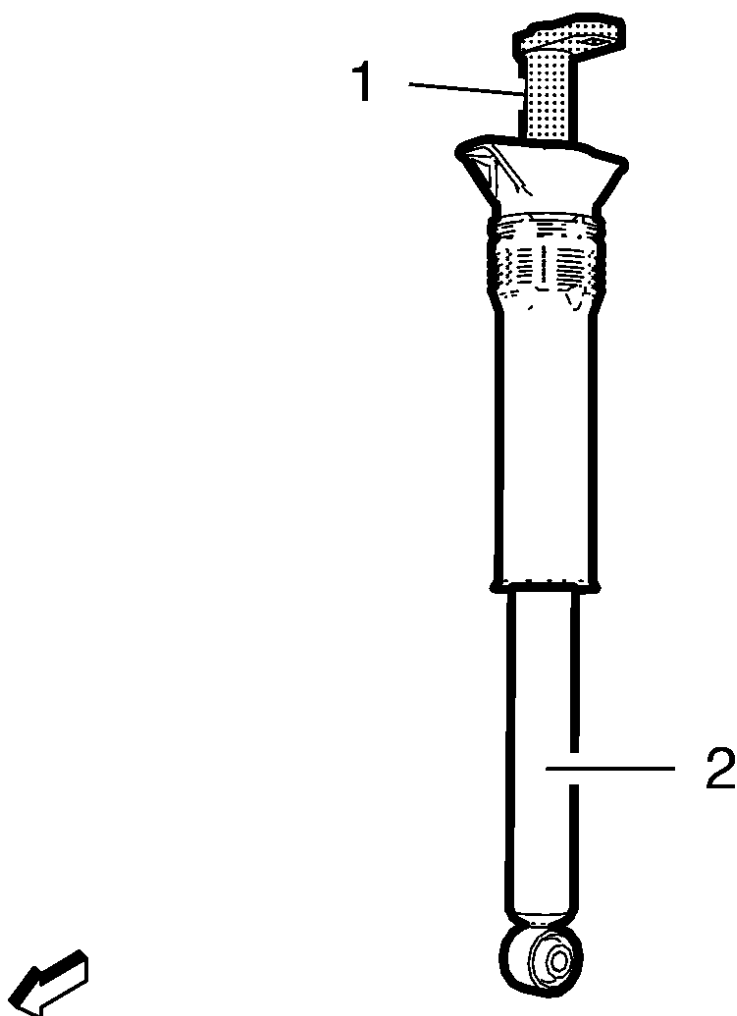


Fig. 27: Rear Shock Absorber And Wrench
Courtesy of GENERAL MOTORS COMPANY

3. Install **CH-51095** wrench (1) @Rear Shock Absorber (2)

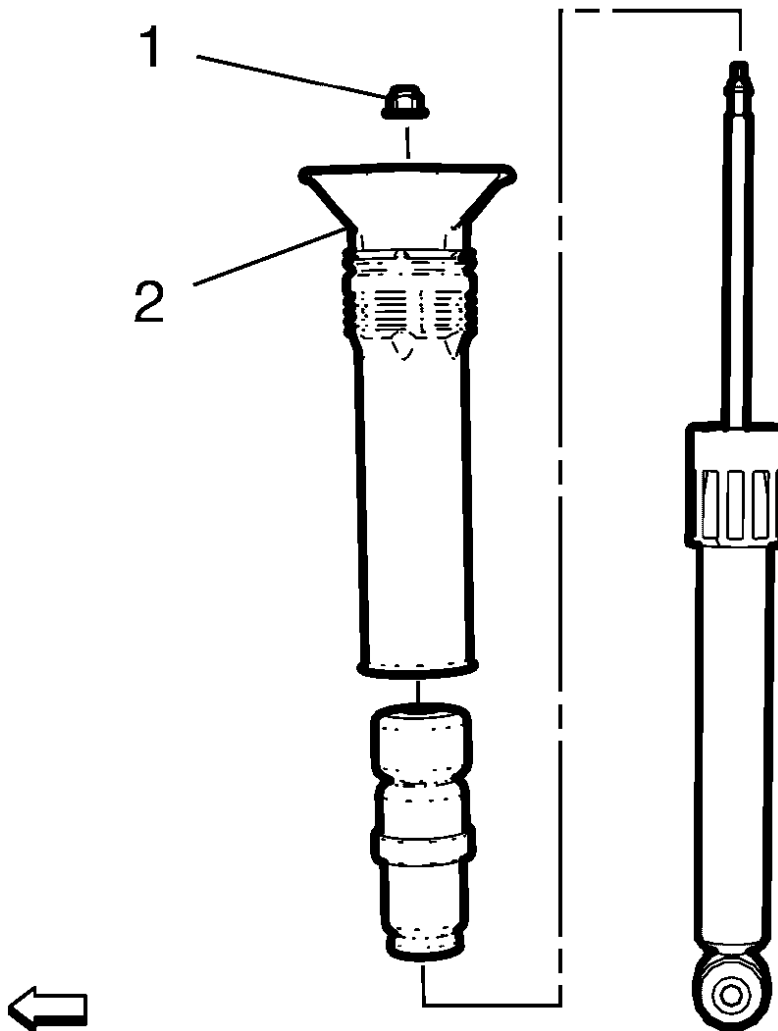


Fig. 28: Rear Shock Absorber Nut And Upper Mount
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Shock Absorber Nut (1) and DISCARD
5. Remove Rear Shock Absorber Upper Mount (2)

Installation Procedure

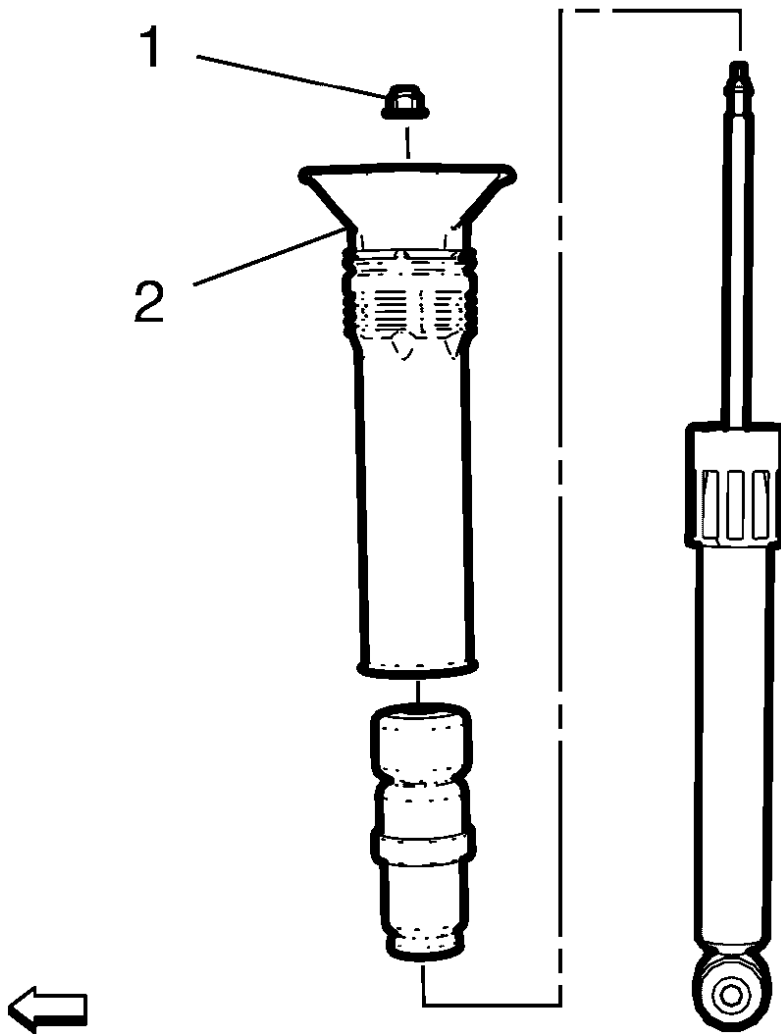


Fig. 29: Rear Shock Absorber Nut And Upper Mount
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Shock Absorber Upper Mount (2)
2. Install Rear Shock Absorber Nut (1) but do NOT tighten

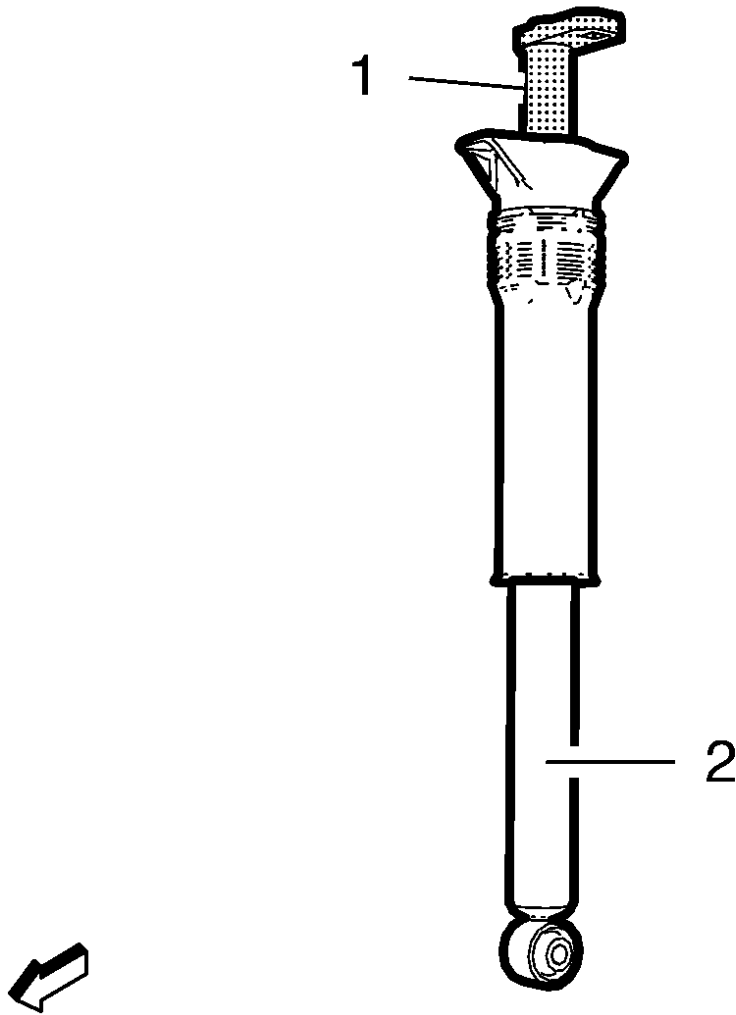


Fig. 30: Rear Shock Absorber And Wrench

Courtesy of GENERAL MOTORS COMPANY

3. Install **CH-51095** wrench (1) @Rear Shock Absorber (2)

CAUTION: Refer to **Fastener Caution** .

4. Rear Shock Absorber Nut - Tighten 25 N.m (18 lb ft)
5. Install **Shock Absorber Replacement**
6. Install **Tire and Wheel Removal and Installation**

SHOCK ABSORBER REPLACEMENT

Removal Procedure

1. Remove **Tire and Wheel Removal and Installation**

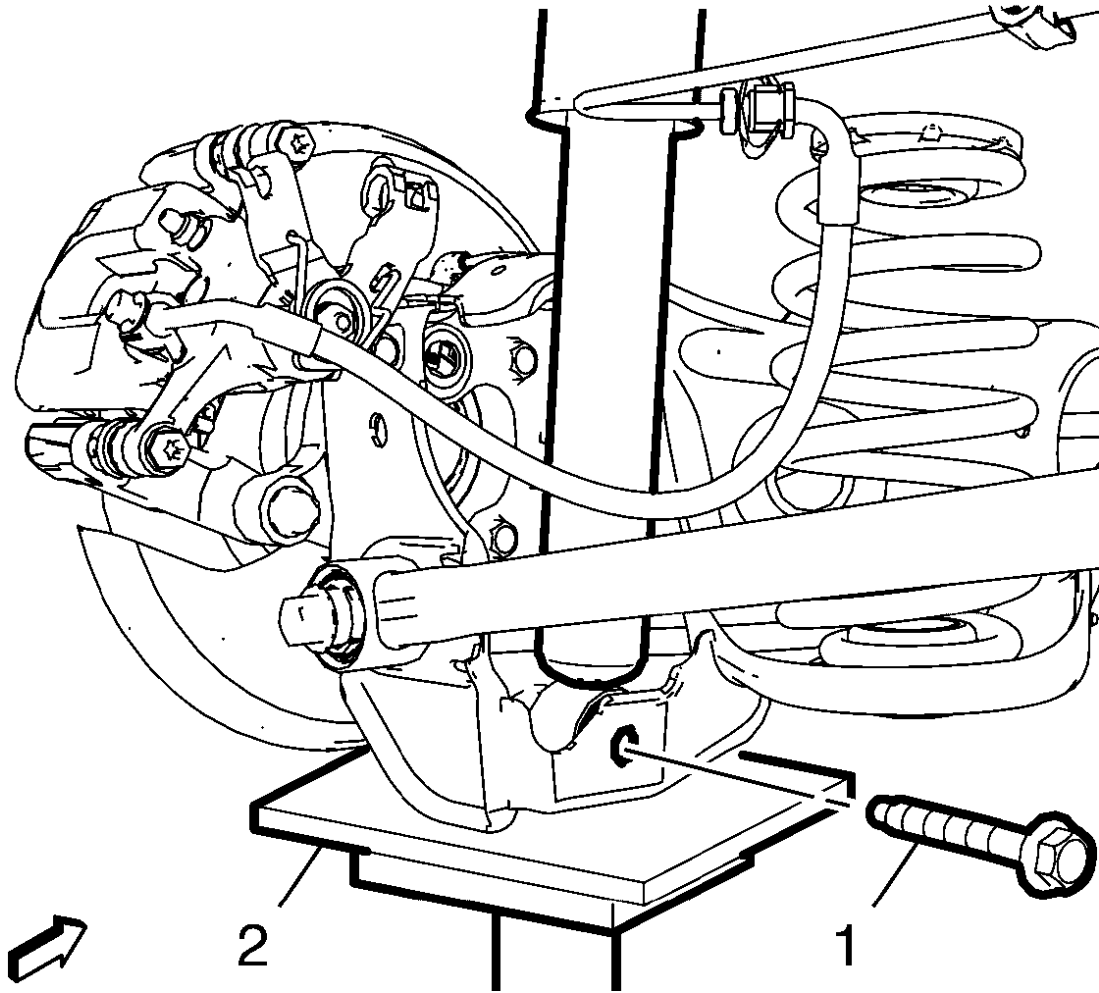


Fig. 31: Rear Shock Absorber Bolt

Courtesy of GENERAL MOTORS COMPANY

2. Support the rear axle with a tall jack stand near the shock absorber.
3. Remove Rear Shock Absorber Bolt (1)

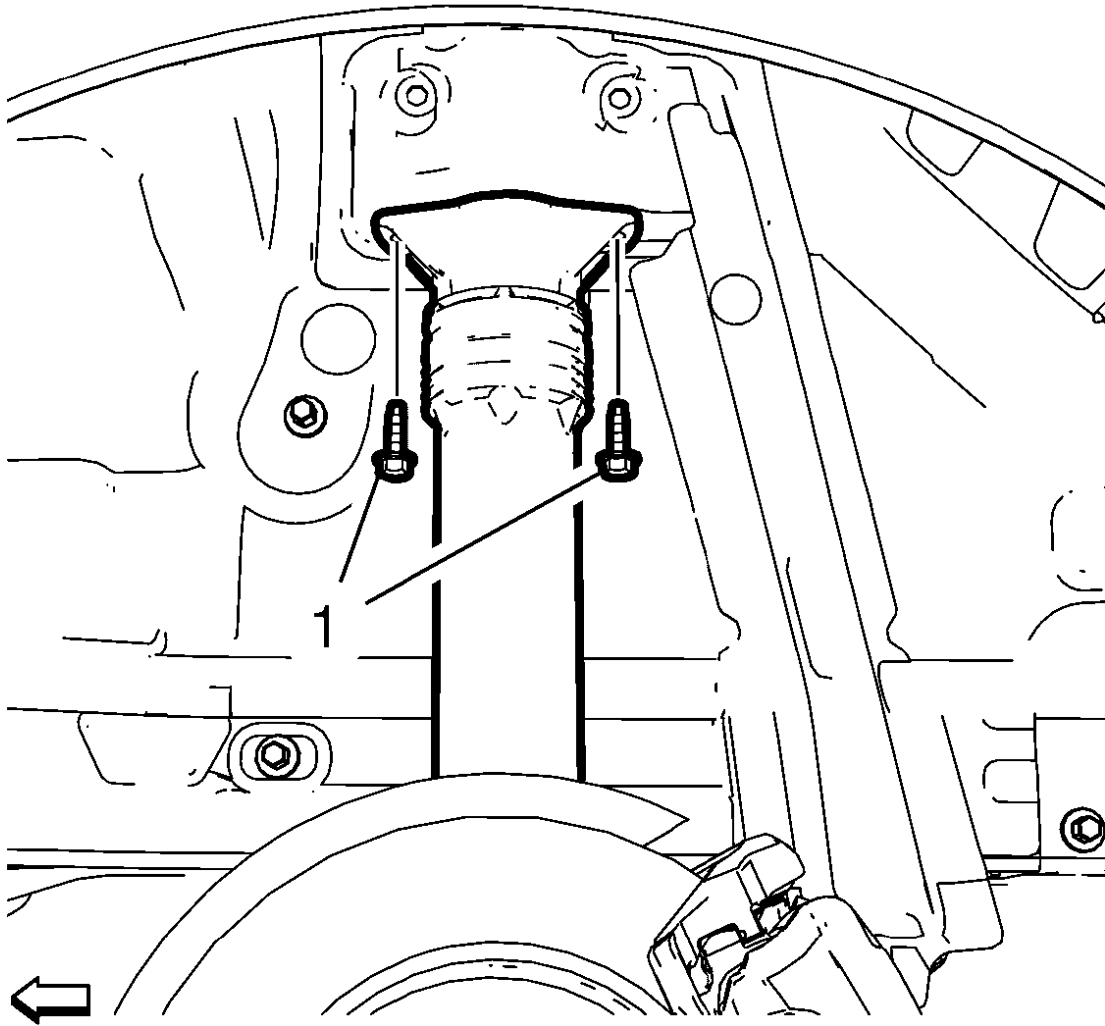


Fig. 32: Rear Shock Absorber Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Shock Absorber Bolt (1)

Installation Procedure

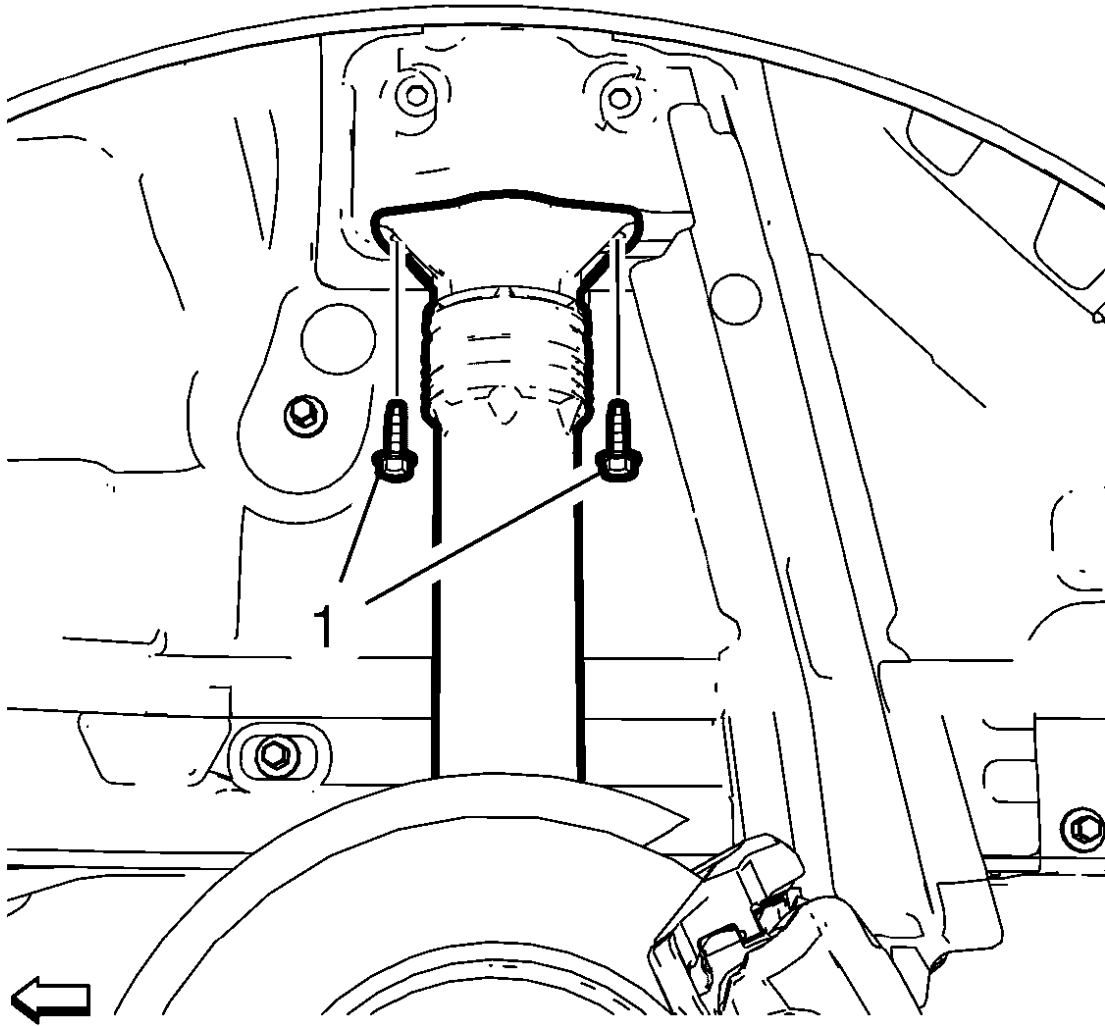


Fig. 33: Rear Shock Absorber Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Shock Absorber Bolt (1)

CAUTION: Refer to [Fastener Caution](#) .

2. Rear Shock Absorber Bolt (1) - Tighten 22 N.m (16 lb ft)

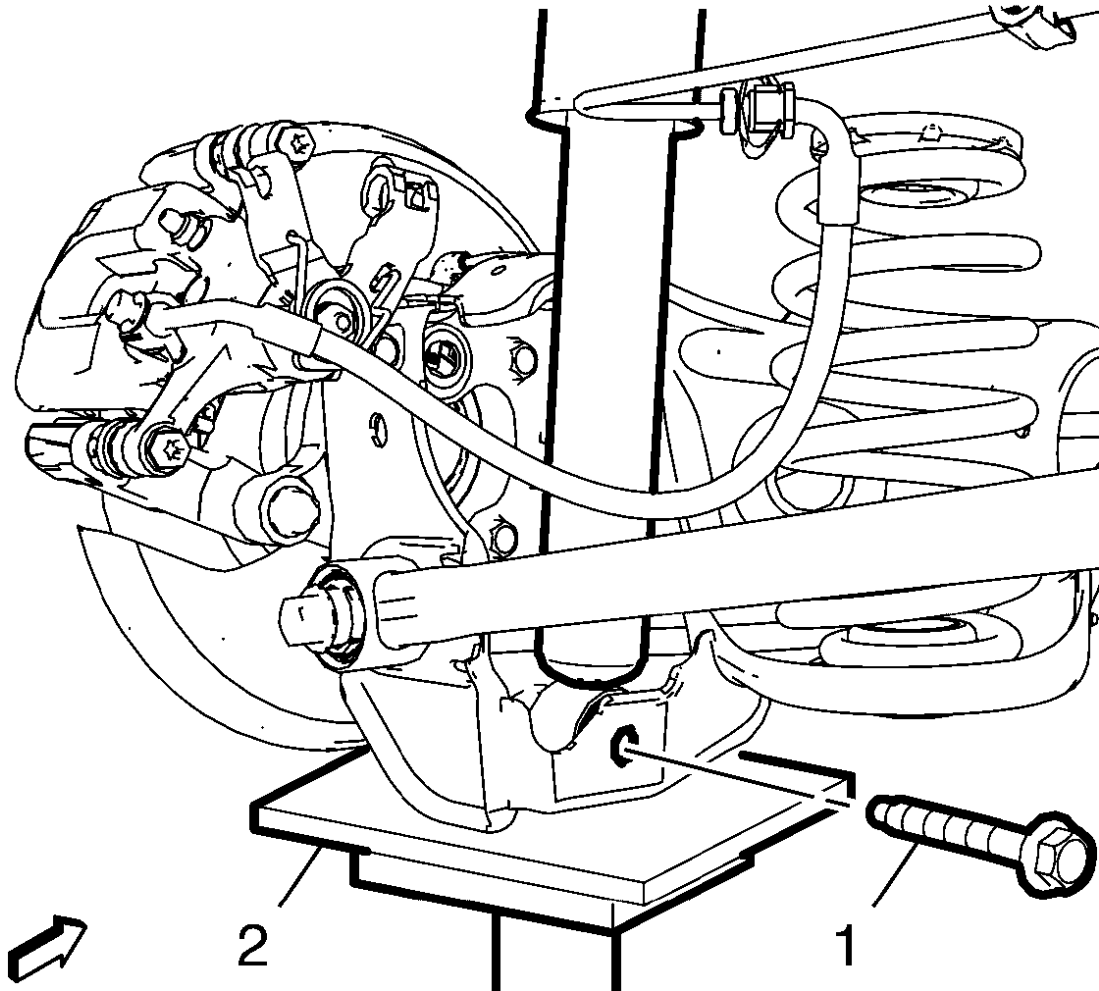


Fig. 34: Rear Shock Absorber Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install Rear Shock Absorber Bolt (1), but do NOT tighten
4. Install [Tire and Wheel Removal and Installation](#)
5. Lower the vehicle.

NOTE: Tighten the bolt with vehicle standing on the ground.

6. Rear Shock Absorber Bolt (1), Tighten 100 N.m (74 lb ft)

SHOCK ABSORBER DISPOSAL

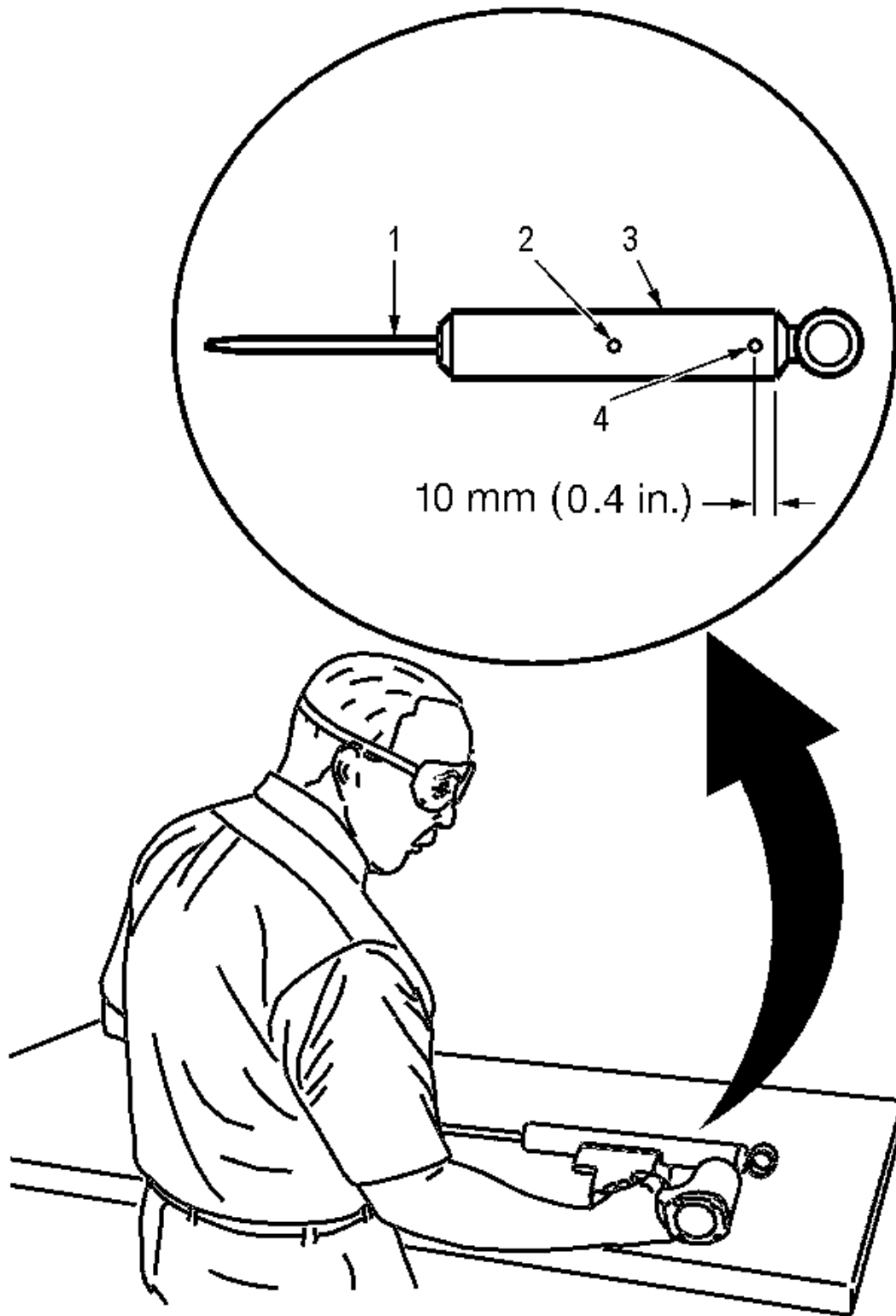


Fig. 35: Drilling Hole In Shock Absorber At Centerpunched Locations

Courtesy of GENERAL MOTORS COMPANY

WARNING: Gas charged shock absorbers contain high pressure gas. Do not remove the snap ring from inside the top of the tube. If the snap ring is removed, the contents of the shock absorber will come out with extreme force which may result in personal injury.

WARNING: To prevent personal injury, wear safety glasses when centerpunching and drilling the shock absorber. Use care not to puncture the shock absorber tube with the centerpunch.

1. Make an indentation 10 mm (0.4 in) from the bottom (4) of the tube (3) using a centerpunch.
2. Clamp the shock absorber in a vise horizontally with the shock absorber rod (1) completely extended.
3. Drill a hole in the shock absorber at the centerpunch (4) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the shock absorber. Use shop towels in order to contain the escaping oil.
4. Make an indentation in the middle (2) of the tube (3) with a centerpunch.
5. Drill a second hole in the shock absorber at the centerpunch (2) using a 5 mm (3/16 in) drill bit. Oil will exhaust when the drill bit penetrates the shock absorber. Use shop towels in order to contain the escaping oil.
6. Remove the shock absorber from the vise. Hold the shock absorber over a drain pan horizontally with the holes down. Move the rod (1) in and out of the tube (3) to completely drain the oil from the shock absorber.

REAR COIL SPRING REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
2. Remove Exhaust Muffler [Exhaust Muffler Replacement](#)
3. Remove Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

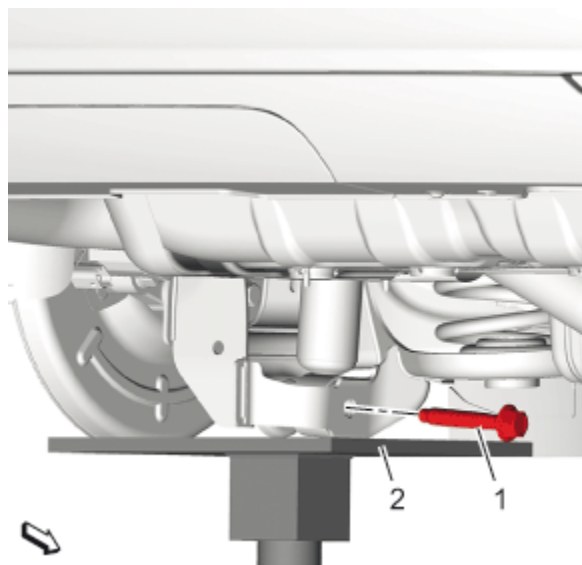


Fig. 36: Rear Shock Absorber Bolt And Hydraulic Jack
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use two hydraulic jacks, one for each side.

4. Lift the rear axle with a hydraulic jack (2).
5. Remove Rear Shock Absorber Bolt (1)

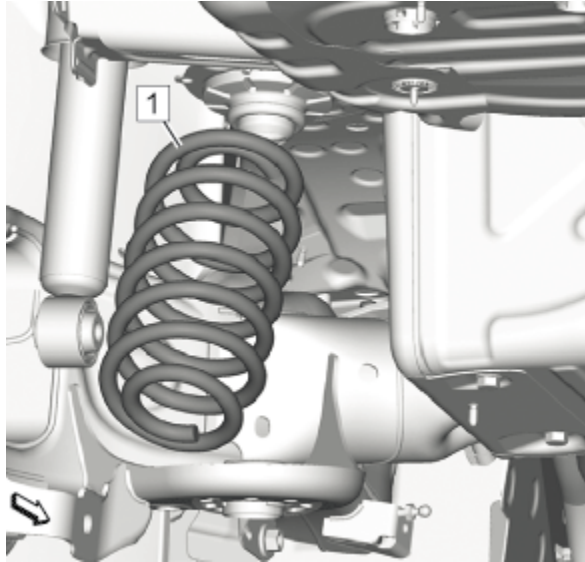


Fig. 37: Rear Spring

Courtesy of GENERAL MOTORS COMPANY

NOTE: Note the orientation of the rear springs for proper installation.

6. Remove Rear Spring (1)
7. Remove Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)
8. Remove Rear Coil Spring Insulator [Rear Coil Spring Insulator Replacement](#)

Installation Procedure

1. Install Rear Coil Spring Insulator [Rear Coil Spring Insulator Replacement](#)
2. Install Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)

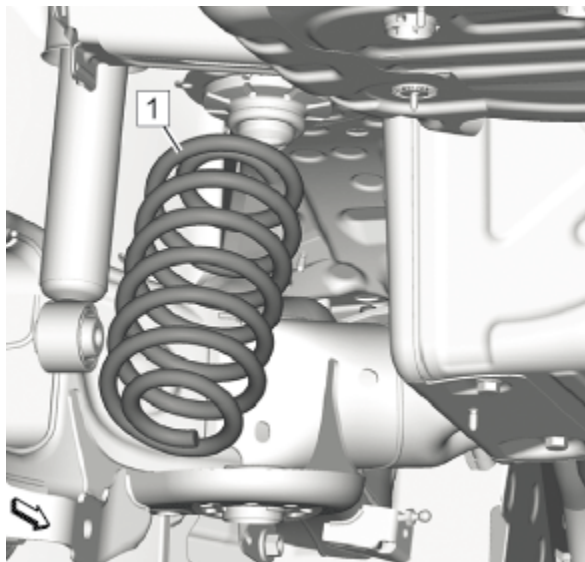


Fig. 38: Rear Spring

Courtesy of GENERAL MOTORS COMPANY

NOTE: For proper rear spring orientation ensure that the end of the rear spring, with the label closest to it, is installed in the upright position.

3. Install Rear Spring (1)

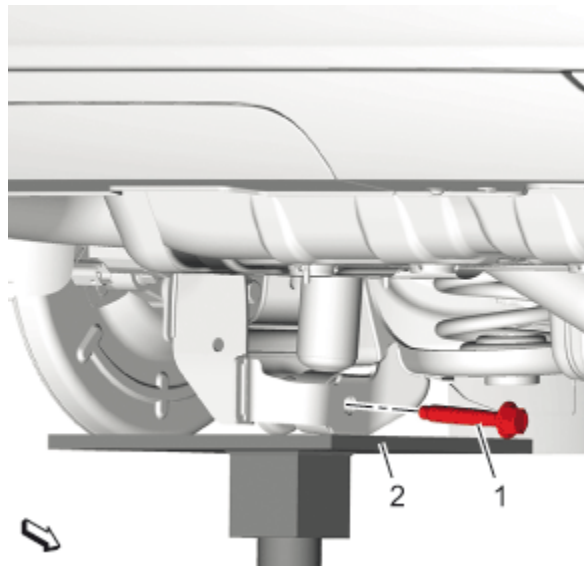


Fig. 39: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

4. Support the rear axle with a hydraulic jack (2) near the shock absorber.

NOTE: Install, but do NOT tighten

5. Loosely install Rear Shock Absorber Bolt (2)

6. Install Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

7. Install Exhaust Muffler [Exhaust Muffler Replacement](#)

8. Install [Tire and Wheel Removal and Installation](#)

9. Lower the vehicle.

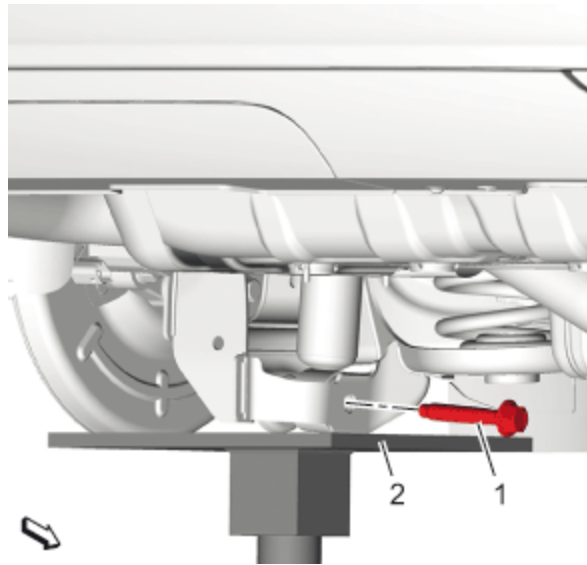


Fig. 40: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the bolts with vehicle standing on the ground.

10. Rear Shock Absorber Bolt (1) - Tighten [Shock Absorber Replacement](#)

REAR COIL SPRING INSULATOR REPLACEMENT

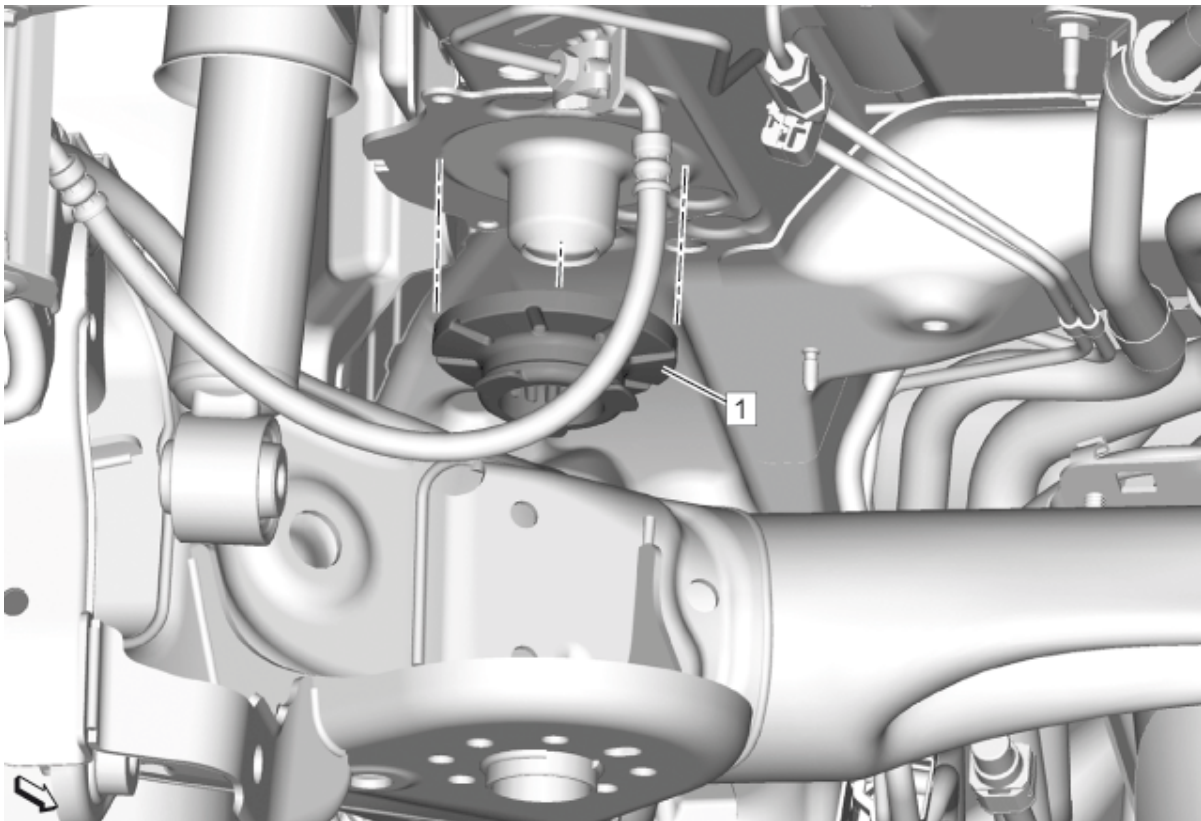


Fig. 41: Rear Coil Spring Insulator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Tire and Wheel Removal and Installation 2. Underbody Rear Air Deflector Replacement 3. Separate Rear Shock Absorber@Rear Axle Shock Absorber Replacement 4. Rear Coil Spring Replacement	
1	Rear Spring Insulator Upper Procedure Check for proper fit and alignment to the vehicle.

REAR COIL SPRING LOWER INSULATOR REPLACEMENT

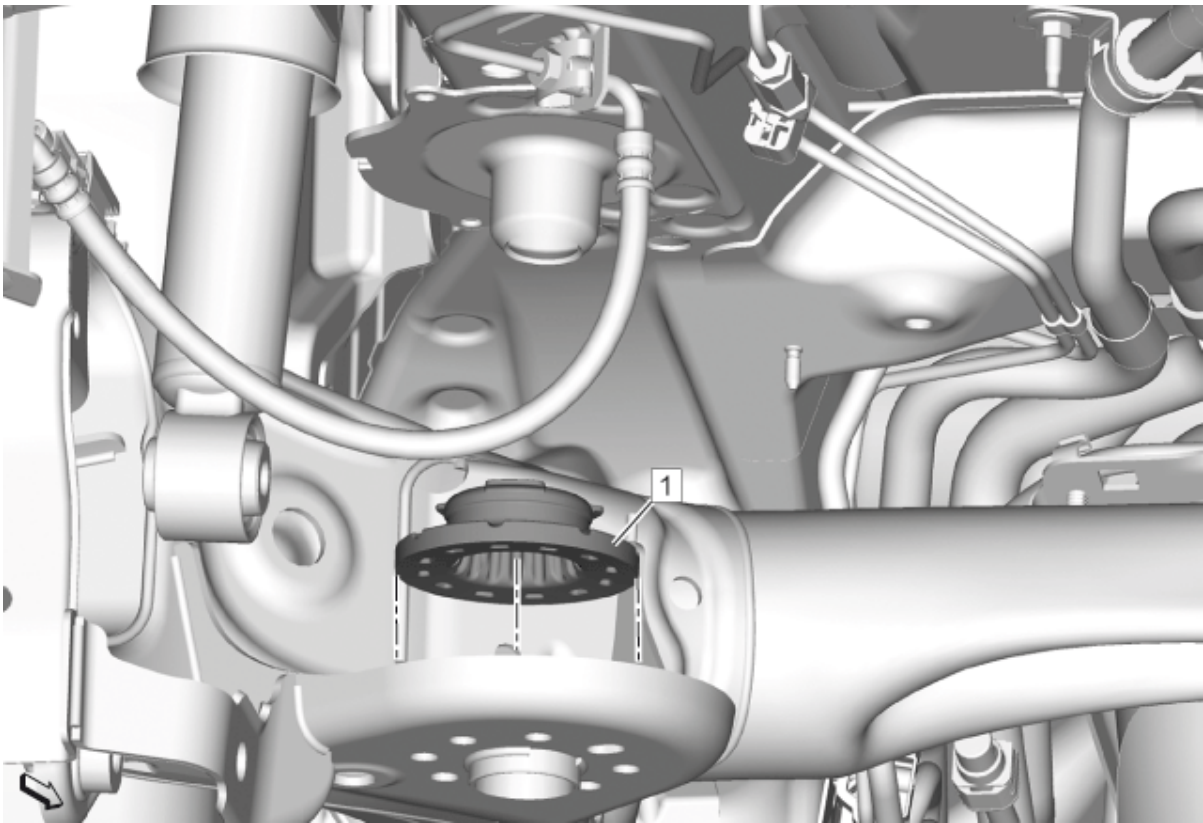


Fig. 42: Rear Coil Spring Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Tire and Wheel Removal and Installation 2. Underbody Rear Air Deflector Replacement 3. Separate Rear Shock Absorber@Rear Axle Shock Absorber Replacement 4. Rear Coil Spring Replacement	

Callout	Component Name
1	Rear Coil Spring Lower Insulator Procedure Check for proper fit and alignment to the vehicle.

REAR AXLE REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools:[Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
3. Remove Exhaust Muffler [Exhaust Muffler Replacement](#)
4. Remove Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

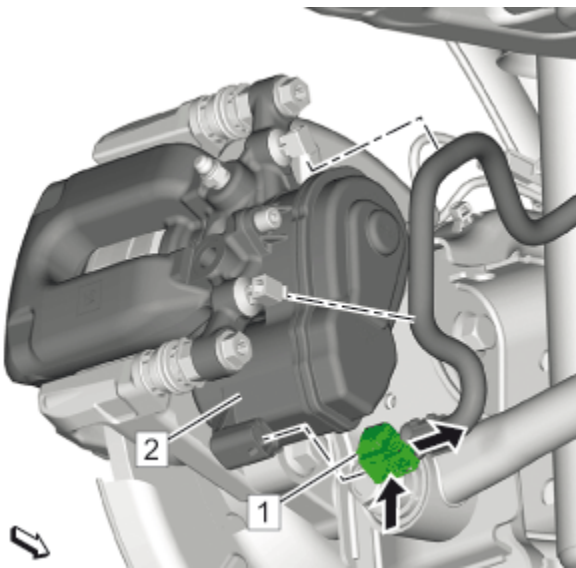


Fig. 43: Brake Caliper Assembly And Lectrical Connector

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @Rear Parking Brake Actuator (2)

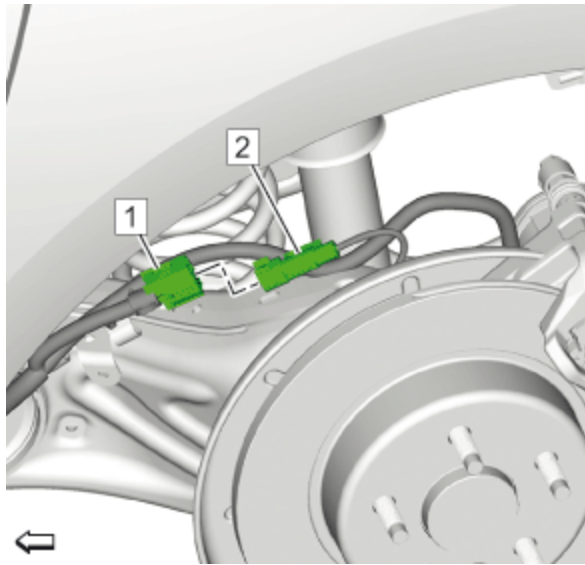


Fig. 44: Wiring Harness Rear Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Electrical Connector (1) @Rear Wheel Speed Sensor (2)
7. Remove Wiring Harness@Rear Axle

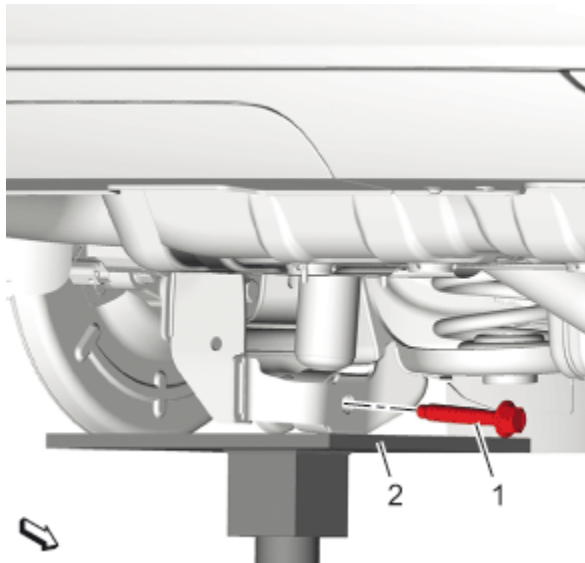


Fig. 45: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use two hydraulic jacks, one for each side.

8. Lift the rear axle with a hydraulic jack (2).
9. Remove Rear Shock Absorber Bolt (1)

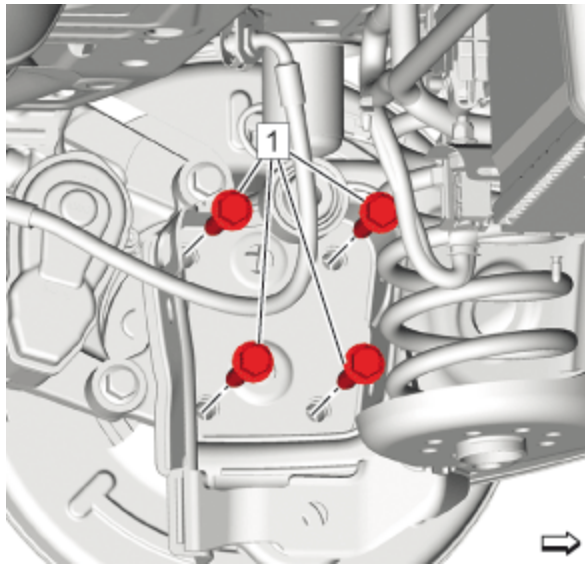


Fig. 46: Locating Bolts

Courtesy of GENERAL MOTORS COMPANY

10. Remove Rear Wheel Bearing Bolt (1) @Rear Axle

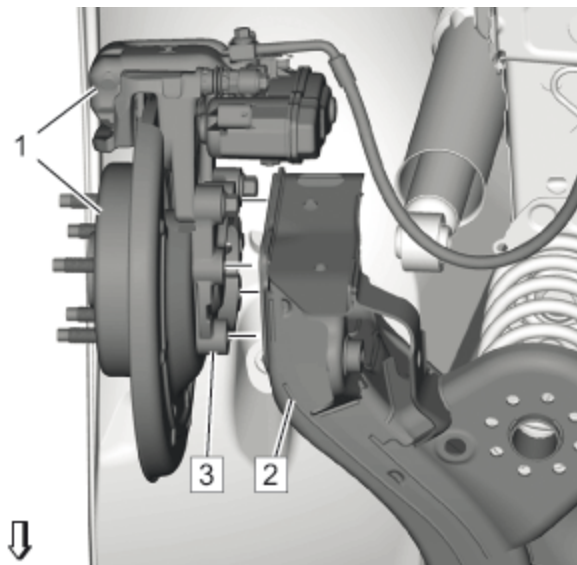


Fig. 47: Rear Brake Assemblies, Rear Axle And Rear Wheel Bearing Hubs

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

11. Remove the 2 rear wheel bearing hubs (3) and the 2 rear brake assemblies (1) from the rear axle (2) and support the assemblies with heavy mechanics wire suitably attached to the body.

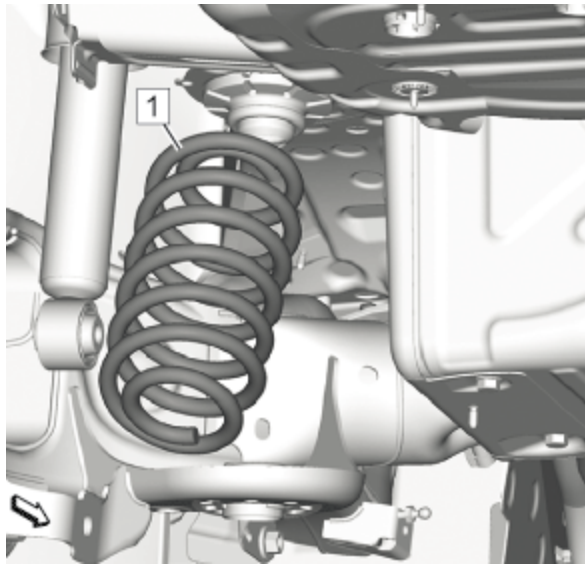


Fig. 48: Rear Spring

Courtesy of GENERAL MOTORS COMPANY

NOTE: Using a grease pencil, mark the orientation of the rear coil springs for proper installation.

12. Remove Rear Coil Spring (1)
13. Remove Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)

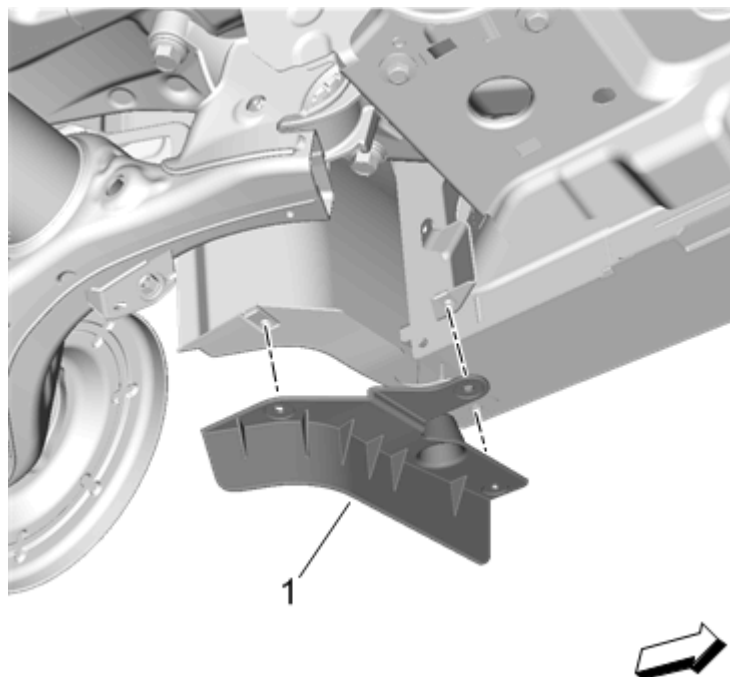


Fig. 49: Rear Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

14. Reposition Rear Tire Front Air Deflector (1) [Rear Tire Front Air Deflector Replacement](#)

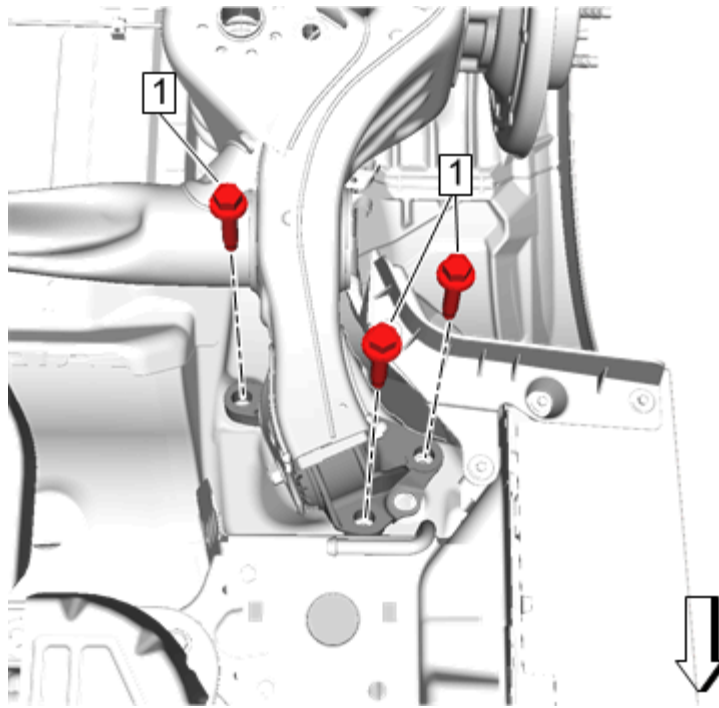


Fig. 50: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: A second technician is required.

15. Remove Rear Axle Bracket Bolt (1) @Body and DISCARD
16. Lower the rear axle.

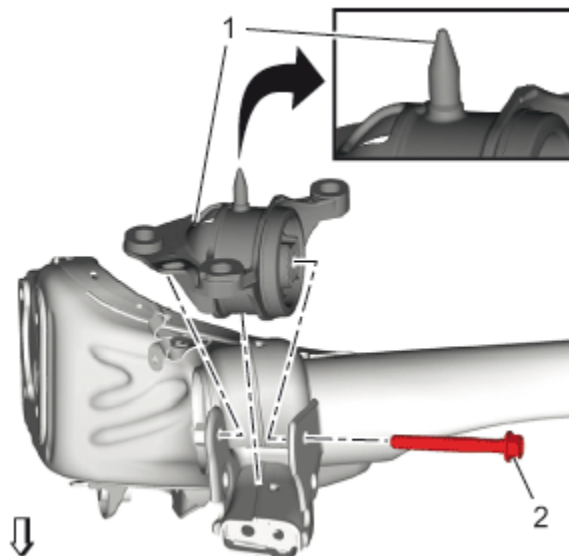


Fig. 51: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

17. Remove Rear Axle Bracket Bolt (2) @Rear Axle and DISCARD
18. Remove Rear Axle Bracket (1)
19. Transfer components as necessary.

Installation Procedure

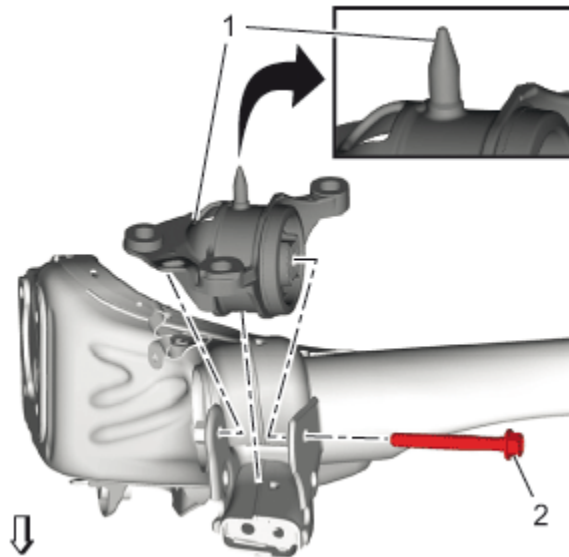


Fig. 52: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: The Rear Axle Bracket (1) is equipped with a pin to arrange the rear axle on the vehicle. The pin has to be insert into the vehicle.

1. Install Rear Axle Bracket (1)

NOTE: Install, but do NOT tighten

2. Install New Rear Axle Bracket Bolt (2) @Rear Axle - NEW bolts.

NOTE: A second technician is required.

3. Position the rear axle to the vehicle.

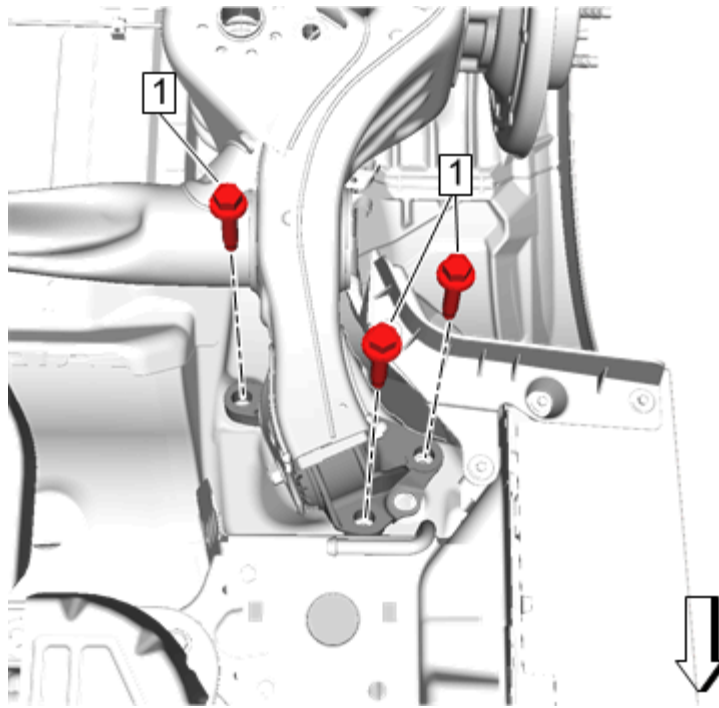


Fig. 53: Right Side Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

CAUTION: Fastener Caution

4. Install Rear Axle Bracket Bolt (1) @Body and tighten the NEW bolt.

1. First Pass: 100 N.m (74 lb ft)

2. Final Pass: 30 - 45 degrees

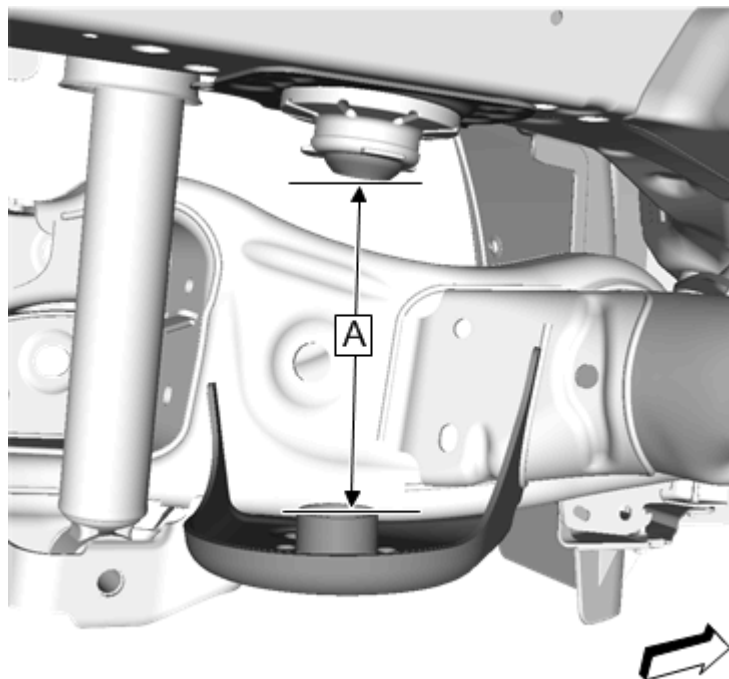


Fig. 54: Measuring Vertical Distance

Courtesy of GENERAL MOTORS COMPANY

5. Raise the rear axle to the proper trim height specification by measuring the vertical distance (A) between the upper and lower insulator seat.
 - Adjust (A) to: **152 mm (5.98 in)**

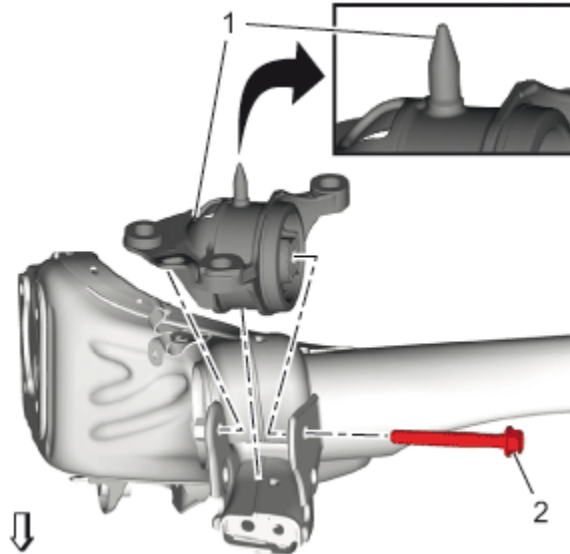


Fig. 55: Rear Axle Bracket Bolts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Torque-to-Yield Fastener Warning

6. Rear Axle Bracket Bolt (2) @Rear Axle - Tighten
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 30 - 45 degrees

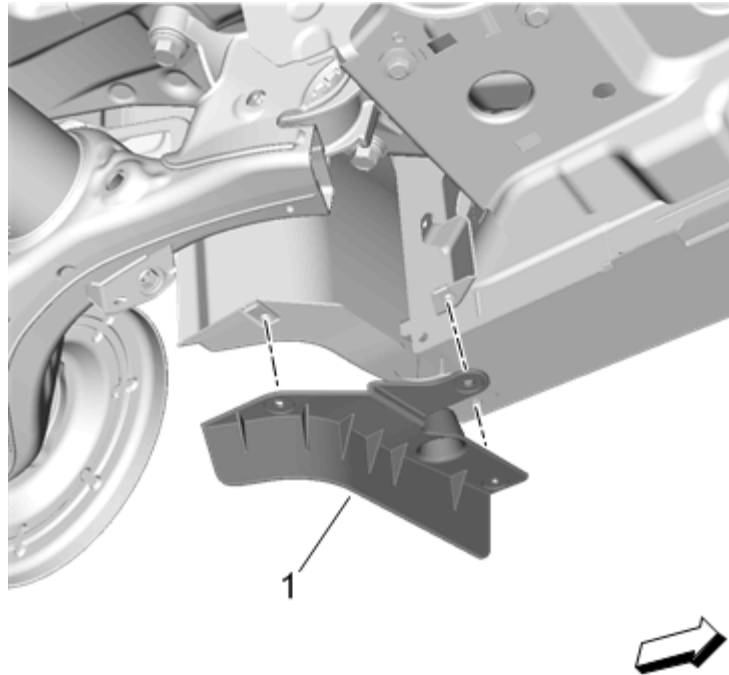


Fig. 56: Rear Tire Front Air Deflector

Courtesy of GENERAL MOTORS COMPANY

7. Install Rear Tire Front Air Deflector (1) [Rear Tire Front Air Deflector Replacement](#)

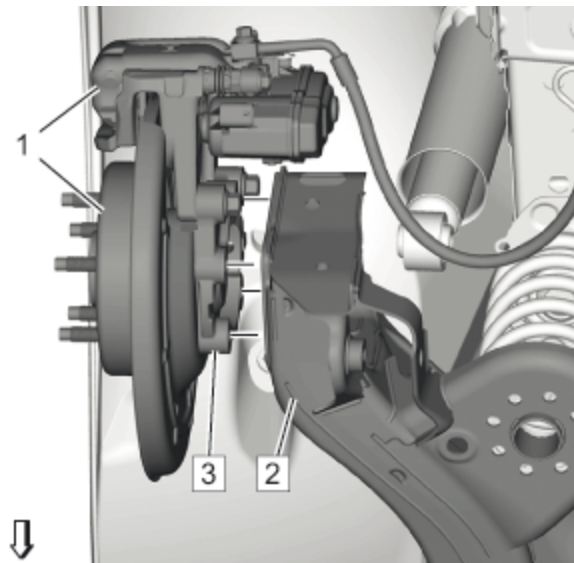


Fig. 57: Rear Brake Assemblies, Rear Axle And Rear Wheel Bearing Hubs

Courtesy of GENERAL MOTORS COMPANY

8. Remove the heavy mechanics wire support and install the rear wheel bearing hub (3) and the rear brake assembly (1) to the rear axle (2).

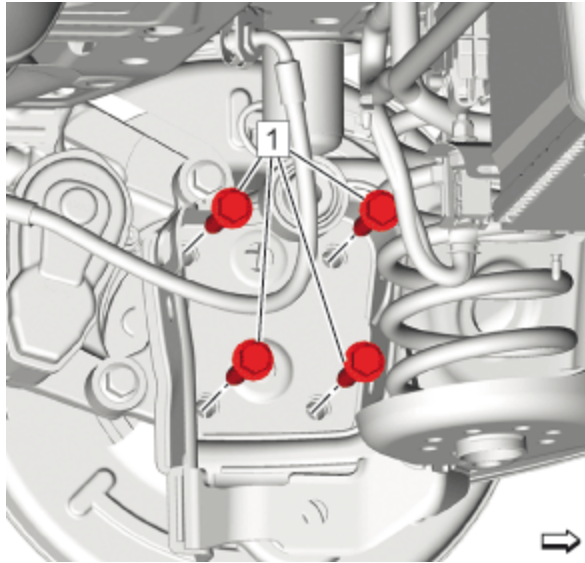


Fig. 58: Locating Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Service may offer bolts without microencapsulated thread locking adhesive. If this is the case, apply thread locking adhesive to the bolt.

9. Install Rear Wheel Bearing Bolt @Rear Axle and tighten (1)[Rear Wheel Bearing and Hub Replacement](#)
10. Install Rear Coil Spring Lower Insulator [Rear Coil Spring Lower Insulator Replacement](#)

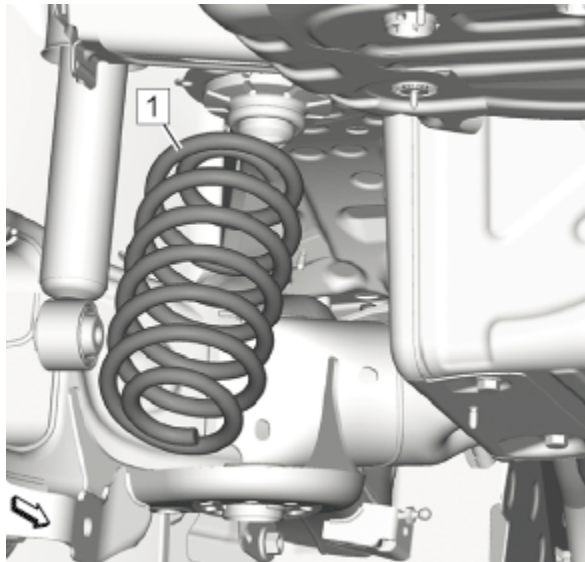


Fig. 59: Rear Spring

Courtesy of GENERAL MOTORS COMPANY

NOTE: For proper rear spring installation, align the reference marks made during removal.

11. Install Rear Coil Spring (1)

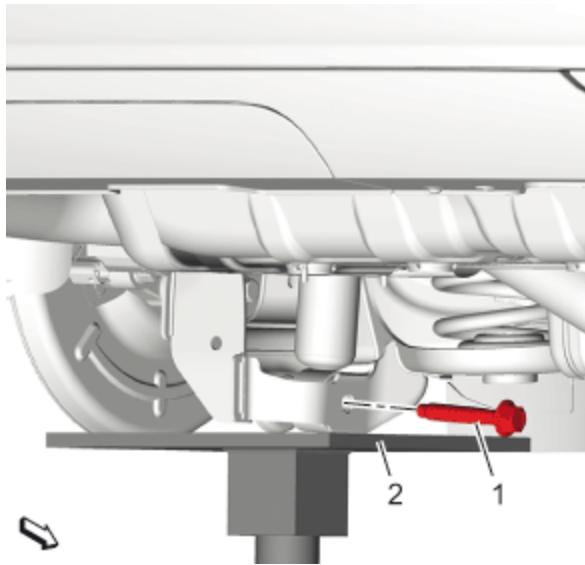


Fig. 60: Rear Shock Absorber Bolt And Hydraulic Jack
 Courtesy of GENERAL MOTORS COMPANY

12. Support the rear axle with a hydraulic jack (2) near the shock absorber.

NOTE: Install, but do NOT tighten

NOTE: Service may offer bolts without microencapsulated thread locking adhesive. If this is the case, apply thread locking adhesive to the bolt.

13. Loosely Install Rear Shock Absorber Bolt (1)

14. Install Exhaust Muffler [Exhaust Muffler Replacement](#)

15. Install Underbody Rear Air Deflector [Underbody Rear Air Deflector Replacement](#)

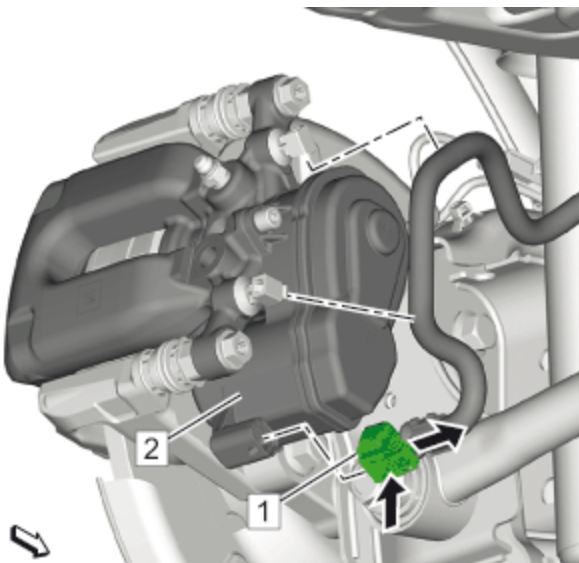


Fig. 61: Brake Caliper Assembly And Lectrical Connector
 Courtesy of GENERAL MOTORS COMPANY

16. Electrical Connector (1) @Rear Parking Brake Actuator (2)

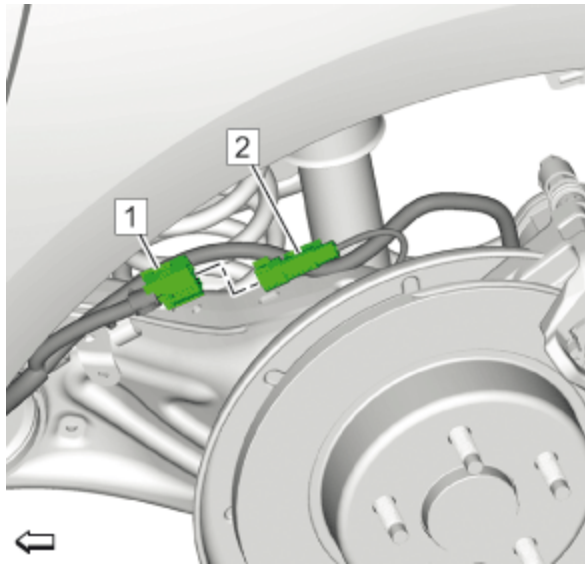


Fig. 62: Wiring Harness Rear Wheel Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

17. Connect Electrical Connector (1) @Rear Wheel Speed Sensor (2)
18. Install Wiring Harness@Rear Axle
19. Install the rear tire and wheel assemblies. [Tire and Wheel Removal and Installation](#)
20. Remove the support and lower the vehicle.

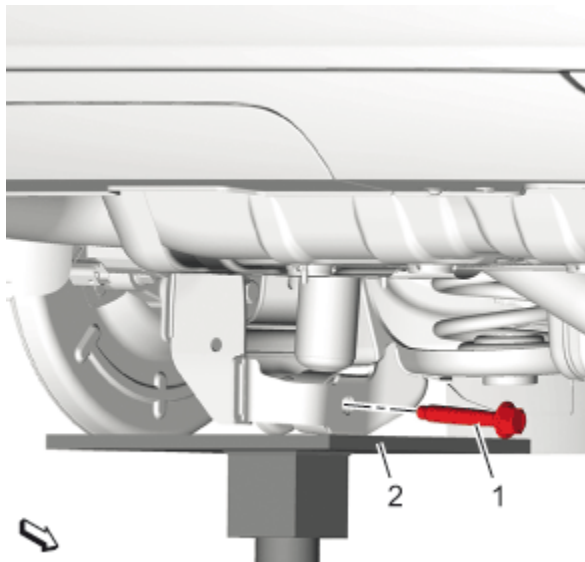


Fig. 63: Rear Shock Absorber Bolt And Hydraulic Jack

Courtesy of GENERAL MOTORS COMPANY

NOTE: Tighten the bolts with vehicle standing on the ground.

21. Rear Shock Absorber Bolt (1) - Tighten [Shock Absorber Replacement](#)

WHEEL STUD REPLACEMENT

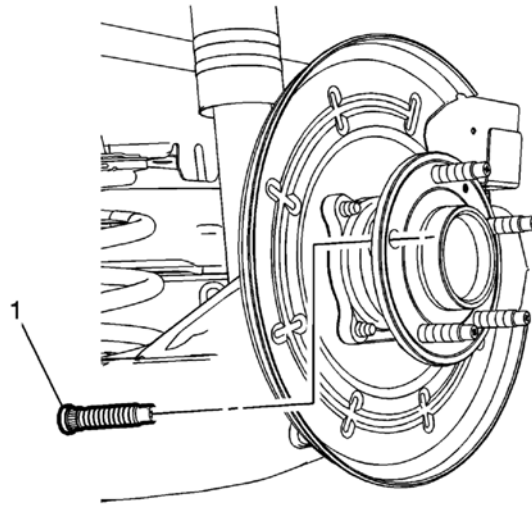


Fig. 64: Wheel Stud

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the tire and wheel assembly. Refer to Tire and Wheel Removal and Installation . 3. Remove the rear brake rotor. Refer to Rear Brake Rotor Replacement	
1	Wheel Stud (Qty: 5) Procedure 1. Rotate the wheel hub to gain enough worker area to remove the wheel stud. 2. Using the CH 43631 remover, remove and discard the wheel stud from the wheel hub. Replace with new only. 3. When installing the wheel stud, use the proper amount of washers to allow the wheel stud to be fully seated against the wheel hub flange. 4. Use a wheel nut with the flat side of the wheel nut facing the washers to fully seat the wheel stud. Special Tools CH 43631 Ball Joint Remover For equivalent regional tools, refer to Special Tools.

DESCRIPTION AND OPERATION

REAR SUSPENSION DESCRIPTION AND OPERATION

This vehicle has a semi-independent twist-beam rear suspension system consisting of the following components:

- An axle with integral trailing arms
- A "V" shaped twisting cross beam
- Two coil springs
- Two shock absorbers

Axle Assembly

The axle assembly attaches to the underbody through a rubber bushing and bracket located at the front of each integral trailing arm. The brackets are bolted to the underbody side rails. The axle structure itself maintains the geometrical relationship of the wheels relative to the centerline of the body.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
--------------	--------------------------------

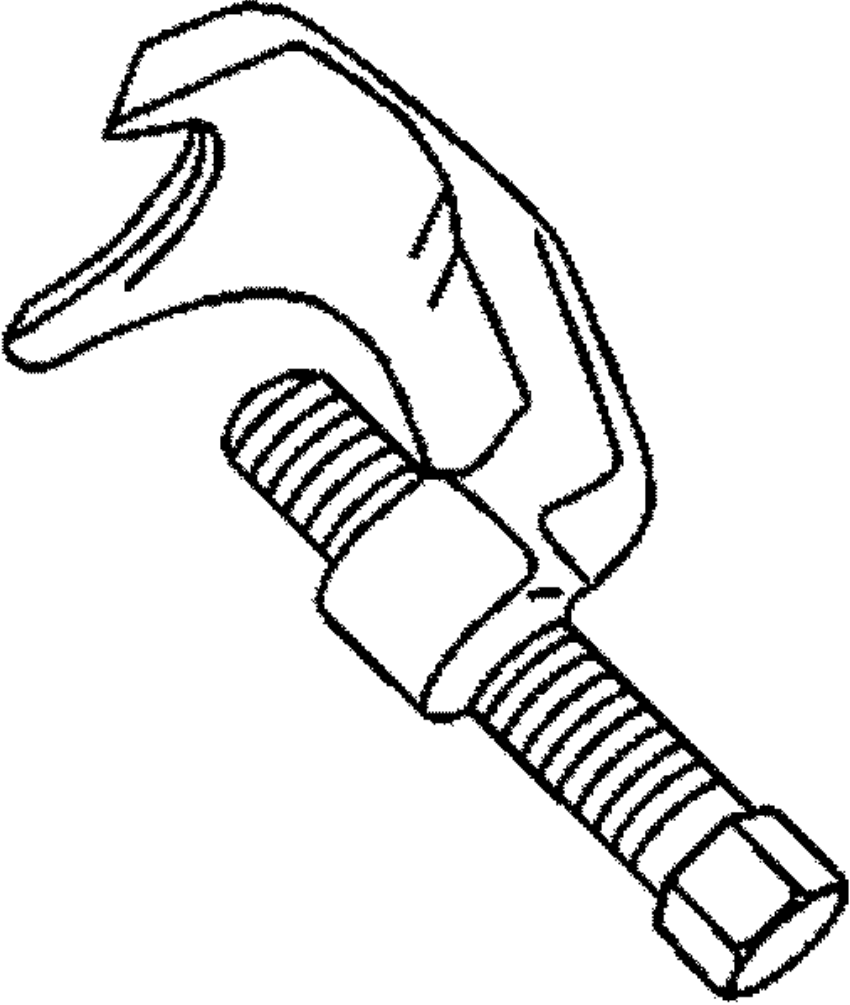
Illustration	Tool Number/ Description
	CH-43631 KM-507-C J-43631 Ball Joint Separator

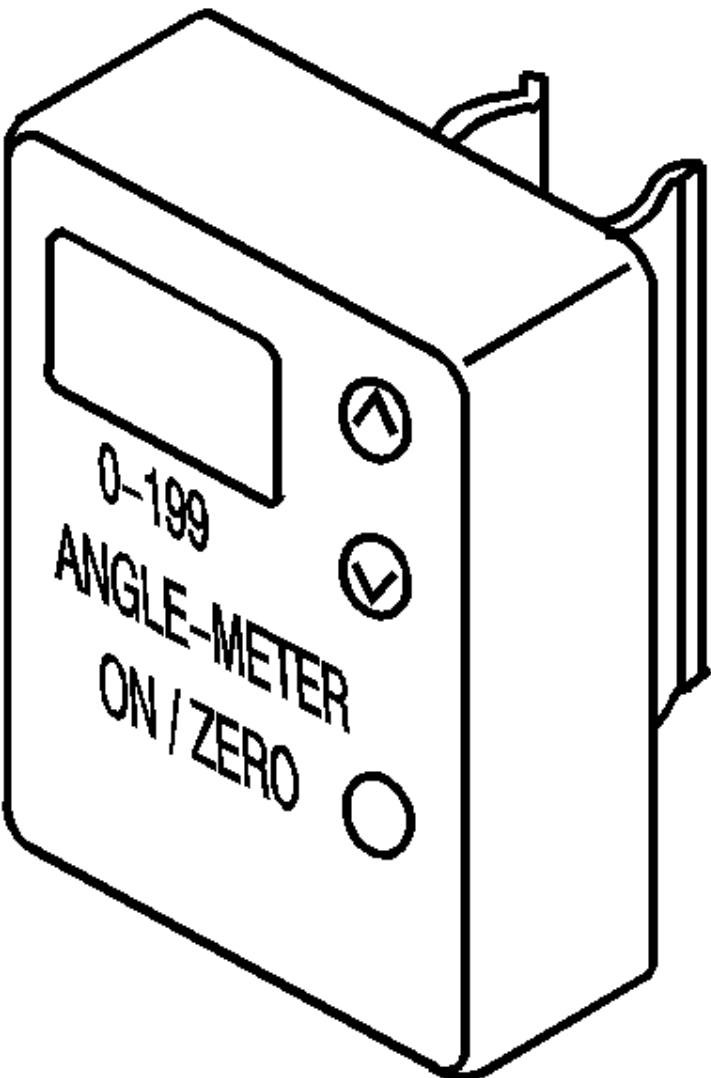
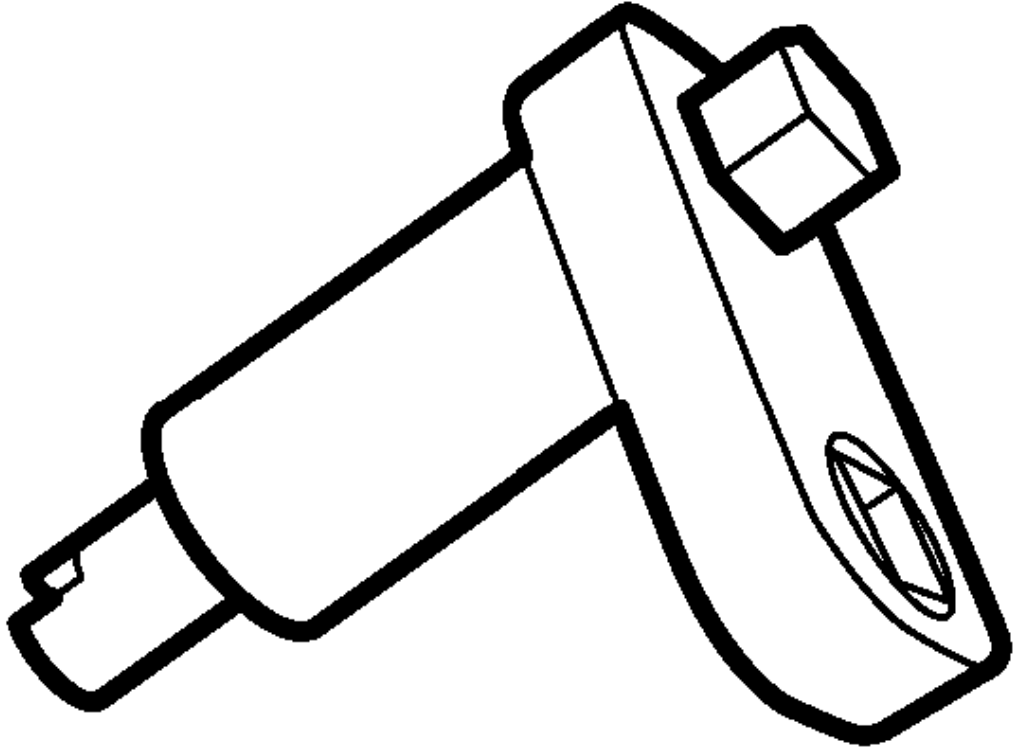
Illustration	Tool Number/ Description
	EN-45059 J-45059 Angle Meter

Illustration	Tool Number/ Description
	CH-51095 Wrench

Article GUID: A00884648

SUSPENSION

Suspension General Diagnosis - Volt

SPECIFICATIONS

TRIM HEIGHT SPECIFICATIONS

Model	Tire Size	P	R	Z	D
	Front	Â± 12 mm (0.5 in)	Â± 12 mm (0.5 in)	Â± 10 mm (0.4 in)	Â± 10 mm (0.4 in)
All	P215/50R17	687 mm (27.05 in)	700 mm (27.56 in)	21 mm (0.83 in)	255 mm (10.04 in)

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - SUSPENSION GENERAL DIAGNOSIS

IMPORTANT: The following step must be completed before using the symptom tables.

Review the system description and operation in order to familiarize yourself with the system functions. Refer to the appropriate description and operation:

- [Front Suspension Description and Operation](#) for the front suspension
- [Rear Suspension Description and Operation](#) for the rear suspension
- [General Description](#) for tires and wheels

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of any of the suspension subsystems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for proper tire size and inflation pressure. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- [Ride Diagnosis](#)
- [Vehicle Leads/Pulls](#)
- [Suspension Bottoms](#)
- [Torque Steer](#)
- [Memory Steer](#)

RIDE DIAGNOSIS

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	NOTE: Verify the vehicle suspension package RPO. Verify that the ride is too soft or too hard. Does the vehicle ride normally?	System OK	Go to Step 3
3	Check the tire inflation and adjust to specifications. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label . Did you adjust the tire pressure?	Go to Step 6	Go to Step 4
4	Inspect the vehicle trim height. Refer to Trim Height Inspection. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Inspect the following suspension components for wear or damage: - Shock Absorbers - Refer to Strut and Shock Absorber Inspection , for front and Strut and Shock Absorber Inspection for rear. - Springs Did you find and correct the condition?	Go to Step 6	-
6	Drive the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

VEHICLE LEADS/PULLS

Step	Action	Yes	No
DEFINITION: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path.			
1	Did you review the General Description and perform the visual/physical inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	Road test the vehicle in order to verify the complaint. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect the tire/wheel assemblies for the following conditions:	Go to Step 9	Go to Step 4

Step	Action	Yes	No
	• Correct tire pressure - Refer to the tire placard. • Correct tire size - Refer to the tire placard. • Abnormal tire wear or damage Did you find and correct the condition?		
4	Perform the Radial Tire Lead/Pull Correction . Did you find and correct the condition?	Go to Step 9	Go to Step 5
5	Inspect and correct/adjust the suspension and steering systems for the following conditions: • Vehicle trim height - Refer to Trim Height Specifications. • Excessively worn, loose, or damaged components Did you find and correct the condition?	Go to Step 9	Go to Step 6
6	Inspect the brake system for brake drag. With the vehicle suspended on a hoist, brake drag can be identified by rotating each wheel several times and observing whether more force is need to rotate the left wheel or the right wheel. Refer to Brake Rotor Thickness Variation Measurement . Did you find and correct the condition?	Go to Step 9	Go to Step 7
7	Inspect the wheel alignment and adjust as necessary. Refer to Wheel Alignment Measurement . Did you correct the condition?	Go to Step 9	Go to Step 8
8	Inspect the steering gear for unequal effort. The vehicle must be suspended on a hoist, the engine running, and the transmission in PARK or NEUTRAL. Grasp the tire assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed to turn to the left or to the right. If this condition exists replace the steering gear. Did you correct the condition?	System OK	Go to Step 3
9	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

BODY LEANS OR SWAYS IN CORNERS

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General

Step	Action	Yes	No
			Diagnosis
2	Verify the vehicle leans or sways in corners. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect the following components for wear or damage: • Rear Coil Springs • Front Coil Springs Are the components worn or damaged?	Go to Step 5	Go to Step 4
4	1. Inspect the stabilizer shaft link for wear or damage. 2. Repair as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 2
5	Replace the springs as necessary. Did you complete the repair?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

SUSPENSION BOTTOMS

Step	Action	Yes	No
DEFINITION: A loud bang or thump that can usually be felt and/or heard when the vehicle is driven over bumps. This condition is commonly noticed when the vehicle trim height is too low.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	Verify that the suspension bottoms. Does the vehicle operate normally?	System OK	Go to Step 3
3	Inspect for vehicle overloading and correct the overloading condition as necessary. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label for specifications. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Inspect the following components: • Inspect the shock absorbers. Refer to Strut and Shock Absorber Inspection , for front and Strut and Shock Absorber Inspection for rear. • Inspect for damaged coil springs, torsion bar or leaf springs and replace as necessary.	Go to Step 6	Go to Step 5

Step	Action	Yes	No
	Did you find and correct the condition?		
5	Inspect the vehicle trim height. Refer to Trim Height Inspection . Did you complete the trim height inspection procedure?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

TORQUE STEER

Step	Action	Yes	No
DEFINITION: On a dry, smooth, flat road, the vehicle has a left or right steering force only during acceleration.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	1. Drive the vehicle on a straight, smooth, flat road. 2. Press the accelerator and determine if any additional steering input is required to maintain a straight ahead direction. 3. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal. Does the vehicle exhibit torque steer when the accelerator is pressed?	Go to Step 3	System OK
3	1. Drive the vehicle on a straight, smooth, flat road at 64 - 97 km/h (40 - 60 mph). 2. Remove your foot from the accelerator. 3. Shift the transmission into NEUTRAL in order to allow the vehicle to coast. 4. Is any additional steering input required to maintain a straight ahead direction. 5. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal. Does the vehicle direction change when the steering	Go to Vehicle Leads/Pulls	Go to Step 4

Step	Action	Yes	No
	wheel is momentarily released?		
4	Inspect the front suspension and powertrain mounts for worn or damaged components and repair as necessary. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Inspect the vehicle trim height. Refer to Trim Height Inspection . Did you find and correct the condition?	Go to Step 6	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

MEMORY STEER

Step	Action	Yes	No
DEFINITION: A lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.			
1	Did you review the General Description and perform the necessary inspections?	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	Verify that memory steer is present. Does the system operate normally?	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Lubricate the tie rod ends and the ball joints if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to Step 7	Go to Step 4
4	Inspect for binding strut bearings. 1. Disconnect the strut from the steering knuckle. 2. If the strut is abnormally difficult to rotate, repair or replace the upper bearing mount. Did you find and complete the repair?	Go to Step 7	Go to Step 5
5	Inspect for binding in the lower ball joints. If joint is binding, replace the joint. Did you find and complete the repair?	Go to Step 7	Go to Step 6
6	Inspect the wheel alignment and adjust as necessary. Refer to Wheel Alignment Measurement . Did you complete the wheel alignment?	Go to Step 7	-

Step	Action	Yes	No
7	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

WHEEL BEARINGS DIAGNOSIS

Step	Action	Values	Yes	No
1	Did you review the General Description and perform the necessary inspections?	-	Go to Step 2	Go to Symptoms - Suspension General Diagnosis
2	Road test the vehicle in order to verify the customer's complaint. Does the vehicle operate normally?	-	System OK	Go to Step 3
3	1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Inspect for tire or wheel damage. Refer to Tire and Wheel Assembly Runout Measurement - On-Vehicle . Did you find and correct the condition?	-	Go to Step 7	Go to Step 4
4	1. Install the J 39570 chassis ear. 2. Road test the vehicle to verify the location of the wheel bearing noise. Did you locate the source of the wheel bearing noise?	-	Go to Step 6	Go to Step 5
5	IMPORTANT: Support the vehicle by the lower control arms or the rear axle to prevent movement during wheel bearing/hub inspection. 1. Mount and secure the J 8001 dial indicator set. 2. Ensure that the dial indicator contacts the vertical surface of the wheel as close as possible to the top wheel stud. 3. Push and pull on the top of the tire in order to inspect the total travel indicated by the dial indicator. Is the measurement greater then the specified value?	0.127 mm (0.005 in)	Go to Step 6	System OK

Step	Action	Values	Yes	No
6	Replace the wheel bearing. Refer to Front Wheel Bearing and Hub Replacement , or Rear Wheel Bearing and Hub Replacement . Did you complete the repair?	-	Go to Step 7	-
7	Road test the vehicle to verify the repair. Does the vehicle operate normally?	-	System OK	Go to Step 3

TRIM HEIGHT INSPECTION

Trim Height Measurement

Trim height is a predetermined measurement relating to vehicle ride height. Incorrect trim heights can cause the vehicle to bottom out over bumps, damage to the suspension components and symptoms similar to wheel alignment problems. Check the trim heights when diagnosing suspension concerns and before checking the wheel alignment.

Perform the following before measuring the trim heights:

- Set the tire pressure to the specifications shown on the certification label. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#)

NOTE: One U.S. gallon of gasoline weights approximately 6.5 lbs. One liter of gasoline weights approximately 0.7 kg.

- Check the fuel level. Add additional weight if necessary to simulate a full tank.
- Make sure the passenger and rear compartments are empty, except for the spare tire.
- Make sure the vehicle is on a flat and level surface, such as an alignment rack.
- Check that all the vehicle doors are securely closed.
- Check that the vehicle hood and rear deck lids are securely closed.
- Check for installed after market accessories or modifications that could affect trim height measurement:
 - Larger or Smaller than production wheels and tires.
 - Lifting or Lowering Kits
 - Wheel Opening Flares or Ground Affects

Measuring the P and R Dimension

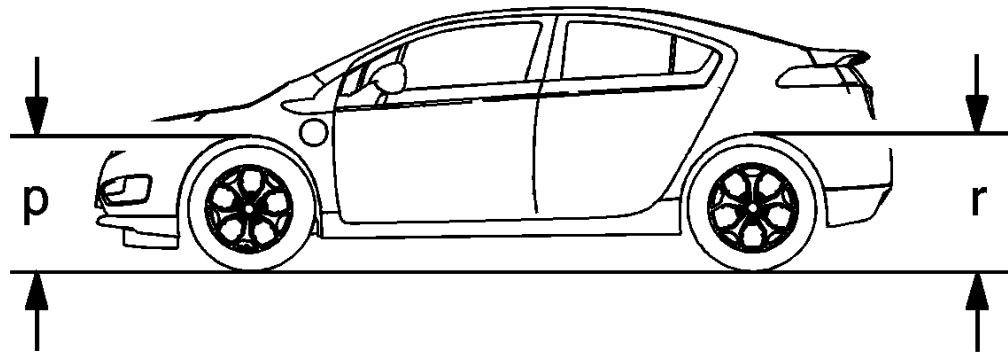


Fig. 1: Identifying P And R Dimension

Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

P Height: The vertical distance from the ground to the top of the wheel opening through the centerline of the front wheel.

R Height: The vertical distance from the ground to the top of the wheel opening through the centerline of the rear wheel.

Use the following procedures to measure the P and R dimensions:

NOTE:

- Measure from the center of the wheel well opening to the ground.
- The left and right P and R height differences should be no more than 10 mm (0.39 in).

1. Push the front bumper down a minimum of 25 mm (1 in) and release. Perform this step three times.
2. Measure and record the trim height per the "Measurement Definitions" above.

3. Lift the bumper up a minimum of 25 mm (1 in) and release. Perform this step three times.
4. Measure and record the trim height per the "Measurement Definitions" above.
5. The true P height measurement is the average of the measurements taken in step 2 and 4. Refer to [Trim Height Specifications](#)
6. Repeat the above steps at the rear of the vehicle for the R heights.
7. If the P and R heights are outside of the specifications, measure the Z & D heights.

Measuring the Z Dimension

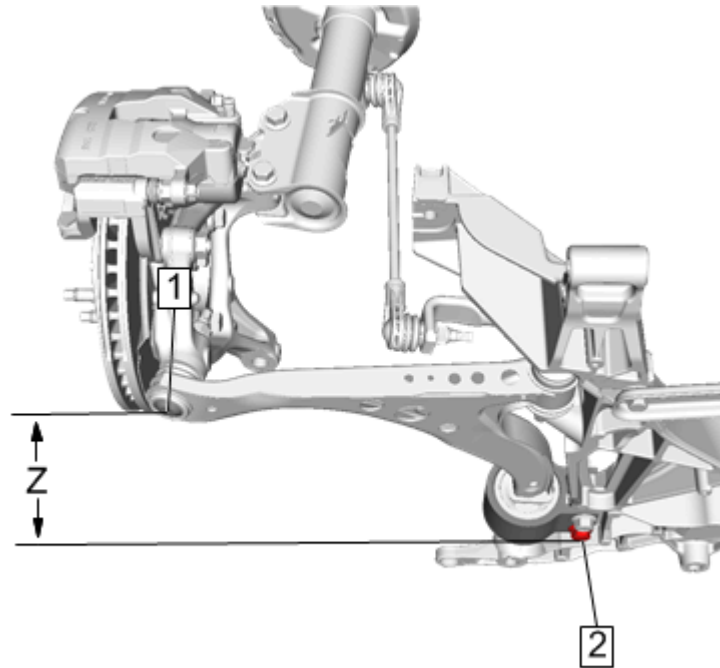


Fig. 2: Identifying Z Height Dimension

Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

The Z Height: The vertical distance from the front lower control arm rear bushing rear attach bolt head surface (2) to the center of the ball joint cup (1).

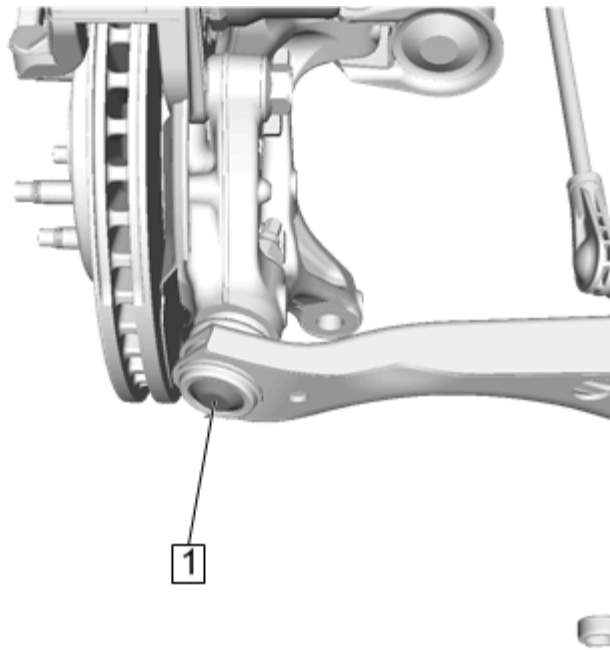


Fig. 3: Center Of Ball Joint Cup

Courtesy of GENERAL MOTORS COMPANY

Call out (1) is the center of the ball joint cup.

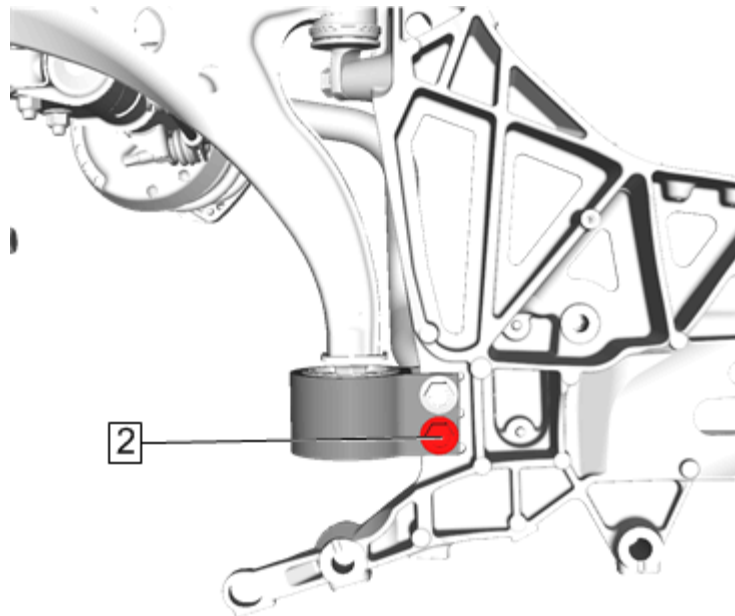


Fig. 4: Front Lower Control Arm Rear Bushing Rear Attach Bolt Head Surface

Courtesy of GENERAL MOTORS COMPANY

Call out (2) is the front lower control arm rear bushing rear attach bolt head surface.

Use the following procedures to measure the Z dimensions:

NOTE: The left and right Z height differences should be no more than 10 mm (0.39 in).

1. Push the front bumper down a minimum of 25 mm (1 in) and release. Perform this step three times.
2. Measure and record the trim height per the "Measurement Definitions" above.
3. Lift the front bumper a minimum of 25 mm (1 in) and release. Perform this step three times.
4. Measure and record the trim height per the "Measurement Definitions" above.
5. The true Z height dimension is the average of the measurements taken in steps 2 and 4. Refer to [Trim Height Specifications](#)
6. If these measurements are out of specifications, inspect for the following conditions:
 - Worn or damaged suspension components
 - Collision damage

D Height Measurement

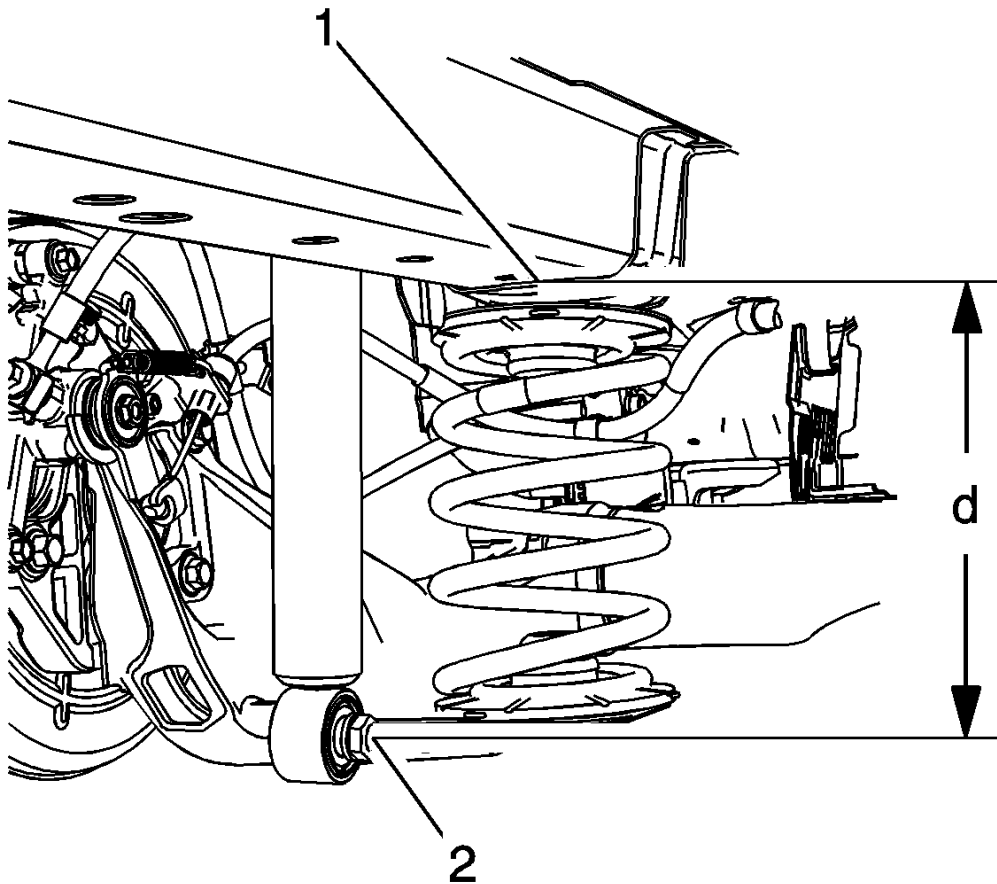


Fig. 5: Identifying D Height

Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

The D Height: The vertical distance from the bottom surface of the body side rail (1) to the center of the lower shock attaching bolt head (2).

Use the following procedure to check the D dimension:

NOTE: **The left and right D height difference should be no more than 10 mm (0.39 in).**

1. Push the rear bumper down a minimum of 25 mm (1 in) and release. Perform this step three times.
 2. Measure and record the trim height per the "Measurement Definitions" above.
 3. Lift the rear bumper up a minimum of 25 mm (1 in) and release. Perform this step three times.
 4. Measure and record the trim height per the "Measurement Definitions" above.
 5. The true D height is the average of the measurements taken in steps 2 and 4. Refer to [Trim Height Specifications](#)
 6. If these measurements are out of specifications, inspect for the following conditions:
 - Worn or damaged suspension components
 - Collision damage
-

Article GUID: A00884691

ACCESSORIES & EQUIPMENT

Tire Pressure Monitoring - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Tire Pressure Indicator Sensor Fastener	1.4 N.m (12.4 lb in)

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0569: SYSTEM CONFIGURATION MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0569 00

System Configuration Malfunction

Circuit/System Description

If the tire type and pressure information is not entered during the body control module (BCM) setup, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the ignition is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0569 will be set and the tire type and pressure information will need to be entered for the system to function correctly.

Conditions for Running the DTC

Ignition On/Vehicle in Service Mode.

Conditions for Setting the DTC

The tire type and pressure information is not entered into the BCM during programming and setup.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has undergone the tire type and pressure selection setup procedure and one ignition cycle has occurred.

Diagnostic Aids

A newly replaced BCM will set DTC C0569 after programming on it's initial ignition ON cycle if the module setup information has not been entered.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation (UJM)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Enter the tire type and pressure information into the K9 Body Control Module with a scan tool. Refer to Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label.
3. Ignition OFF, then Ignition On/Vehicle in Service Mode.
4. Verify DTC C0569 is not set.
 - **If the DTC is set**

Replace the K9 Body Control Module.
 - **If the DTC is not set.**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming, and setup.

DTC C0750, C0755, C0760, OR C0765: TIRE PRESSURE SENSORS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0750 03

Left Front Tire Pressure Sensor Low Voltage

DTC C0750 29

Left Front Tire Pressure Sensor Too Few Pulses

DTC C0750 39

Left Front Tire Pressure Sensor Internal Malfunction

DTC C0755 03

Right Front Tire Pressure Sensor Low Voltage

DTC C0755 29

Right Front Tire Pressure Sensor Too Few Pulses

DTC C0755 39

Right Front Tire Pressure Sensor Internal Malfunction

DTC C0760 03

Left Rear Tire Pressure Sensor Low Voltage

DTC C0760 29

Left Rear Tire Pressure Sensor Too Few Pulses

DTC C0760 39

Left Rear Tire Pressure Sensor Internal Malfunction

DTC C0765 03

Right Rear Tire Pressure Sensor Low Voltage

DTC C0765 29

Right Rear Tire Pressure Sensor Too Few Pulses

DTC C0765 39

Right Rear Tire Pressure Sensor Internal Malfunction

Circuit/System Description

The tire pressure monitor system has a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR) which in turn translates the received sensor data into sensor presence, sensor mode, and tire pressure before passing it onto the body control module (BCM). Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the first sensor to go into Drive mode, then checks if all sensors have gone into Drive mode. If one or more sensors does not go into these modes, or does not transmit at all, the BCM will set DTC C0750, C0755, C0760, or C0765 respectively.

Conditions for Running the DTC

Vehicle speed is greater than 40 km/h (25 MPH).

Conditions for Setting the DTC

- A sensor does not transmit or transmits invalid data to the BCM.
- A sensor low battery condition.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the malfunction is no longer present and one ignition cycle occurs.

Diagnostic Aids

- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool is placed along the tire sidewall and no further than 15 cm (6 in) from the sensor and the antenna is aiming upward.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#).
- Occasionally sensor transmissions are not received by the BCM due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal being blocked by another component.
- Occasionally sensors can become mislocated due to previous tire rotations where the sensor learn procedure was not performed. Always learn the sensors to ensure the DTC set is for that actual physical corner of the vehicle. Refer to [Tire Pressure Indicator Sensor Learn](#).
- A sensor low battery condition will set a sensor DTC but will not illuminate the low tire pressure indicator or display a message on the driver information center, if equipped. The sensor battery condition can be verified in the scan tool BCM data list. If a sensor low battery condition is indicated on the scan tool, the sensor will need

to be replaced. Refer to [Tire Pressure Indicator Sensor Replacement](#).

- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference.

Reference Information

Description and Operation

[Tire Pressure Monitor Description and Operation \(UJM\)](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Verify there are no communication DTCs set along with DTC C0750, C0755, C0760, and C0765.
 - **If a communication DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If a communication DTC is not set**
2. Verify the scan tool Tire Pressure Sensor Rolling Count parameter of all 4 tire pressure sensors is above 50%.
 - **If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires**

NOTE: When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.

1. Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to [Tire and Wheel Removal and Installation](#) .
 - If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the [Tire Pressure Indicator Sensor Learn](#).
 - If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal.
 - **If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires**
3. Verify if all 4 tire monitor pressure sensor DTCs are not set.
 - If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#)
4. Perform the [Tire Pressure Indicator Sensor Learn](#).
5. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
 - **If a Tire Pressure Sensor Mode parameter does not change to Drive**
 1. Replace the appropriate B2 Tire Pressure Sensor.
 2. Perform the [Tire Pressure Indicator Sensor Learn](#).

- If the Tire Pressure Sensor Mode parameter changes to Drive

6. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Tire Pressure Indicator Sensor Replacement](#)
- Refer to [Tire Pressure Indicator Sensor Learn](#)

DTC C0775: TIRE PRESSURE MONITORING SYSTEM SENSORS MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0775 00

Tire Pressure Monitoring System Sensors Malfunction

Circuit/System Description

If the body control module (BCM) has been reprogrammed or replaced and the tire pressure sensor learn procedure has not been performed, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0775 will be set in the BCM and the tire pressure sensor learn procedure will need to be performed for the system to function correctly.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The body control module (BCM) has not learned tire pressure sensor ID and location information from the tire pressure sensors.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type warning message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has received tire pressure sensor ID and location after tire pressure sensor indicator learn procedure has been performed.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation (UJM)

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Tire Pressure Indicator Sensor Learn.
2. Verify DTC C0775 is not set.
 - **If the DTC is set**
 1. Test the keyless entry antenna for proper operation. Refer to Keyless Entry System Malfunction (Active) Keyless Entry System Malfunction (Passive) .
 2. Clear DTC.
 3. Verify DTC does not set.
 - If the DTC sets, replace the K9 Body Control Module.
 - If the DTC does not set.

All OK.

 - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming, and setup.

SYMPTOMS - TIRE PRESSURE MONITORING

1. Perform the Diagnostic System Check - Vehicle , before using the Symptom Tables in order to verify that all of the following are true:
 - The control modules can communicate via the serial data link.
 - If one of the current or previous sensor learn is not successful.
 - If there are dashes displayed in the driver information center. Refer to Tire Pressure Rolling Count Procedure
2. Review the system operation in order to familiarize yourself with the system functions. Refer to Tire Pressure Monitor Description and Operation (UJM).

Visual/Physical Inspection

- Inspect if tires are inflated per placard values.
- Inspect for aftermarket devices which could affect the operation of the Tire Pressure Monitoring (TPM) System. Refer to Checking Aftermarket Accessories .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to [Low Tire Pressure Indicator Malfunction](#) in order to diagnose the symptom.

LOW TIRE PRESSURE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Circuit/System Description

The tire pressure monitor system has a radio frequency transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR), using radio frequency (RF) transmissions. The RCDLR then decodes the RF data and passes it to the body control module (BCM). In turn, the BCM translates the data contained in the tire pressure sensor radio frequency transmissions into sensor presence, sensor mode, and tire pressure. Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the sensors to go into Drive mode.

Each sensor has its own unique identification (ID) code, which it transmits as part of each RF message, that must be learned into the BCM memory. Once all 4 IDs have been learned and vehicle speed is greater than 40 km/h (25 mph), the BCM continuously compares IDs and pressure data in the received transmissions to the learned IDs and vehicle placard pressures to determine if all 4 sensors are present and if one or more tires are low. If the BCM detects a low tire pressure condition or a malfunction in the system, it will send a serial data message to the instrument cluster requesting the appropriate tire pressure monitor indicator illumination and also to display the appropriate data message on the driver information center, if equipped.

Diagnostic Aids

- If unsure about the condition, cycle the ignition and observe the tire pressure monitor indicator icon. If the tire pressure monitor indicator icon is continuously illuminated after the instrument cluster bulb check is completed, a low tire pressure condition is present. Check the tires for damage or leaks and inflate to the tire placard specifications. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) . If the tire pressure monitor indicator icon flashes for 1 min after the instrument cluster bulb check is completed and then remains illuminated, a tire pressure monitor system DTC is set. Perform the [Diagnostic System Check - Vehicle](#) to proceed with the proper diagnosis.
- Temperature can greatly effect tire pressures. Low tire pressure on a cold morning may cause the tire pressure monitor indicator icon to turn ON. The air pressure in the tire increases as the ambient temperature rises or as the tire warms up while the vehicle is driven. The pressure may increase enough to exceed the predetermined low pressure threshold which will turn OFF the tire pressure monitor indicator icon.
- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool antenna is no further than 15 cm (6 in) from the sensor and is aiming upward.
- Aftermarket wheel value stem locations can cause a sensor to not function correctly.

- A sensor may have been damaged due to a previous wheel/tire service or flat tire event. This is a courtesy item as it is not covered by warranty.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#).
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor's information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal is being blocked by another component.
- Occasionally sensor transmissions are not received by the BCM due to vehicle level RF interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference. Refer to [Tire Pressure Rolling Count Procedure](#).

Reference Information

Description and Operation

[Tire Pressure Monitor Description and Operation \(UJM\)](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Low tire pressure in one or more tires is indicated by a continuously illuminated tire pressure monitor indicator icon after the instrument cluster bulb check is completed. If equipped with a driver information center, a check tire pressure type message will also be displayed.

When a tire pressure monitor DTC is set, the tire pressure monitor indicator icon will flash for 1 min after the instrument cluster bulb check is completed and then remains illuminated. If equipped with a driver information center, a service tire monitor type message will also be displayed.

1. Adjust all tire pressures to the correct pressure. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#).
2. Drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
3. Verify the low tire pressure indicator is OFF.
 - **If the low tire pressure indicator is ON**
 1. Perform the [Tire Pressure Indicator Sensor Learn](#).
 2. Record all 4 Tire Pressure Parameters values from the scan tool.
 3. Check and record the tire pressures with a known accurate hand held tire pressure gauge.
 4. Verify that the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi) from the actual tire pressure readings.
 - If the scan tool Tire Pressure parameters differ more than 27.6 kPa (4 psi), replace the appropriate

B2 Tire Pressure Sensor then perform the [Tire Pressure Indicator Sensor Learn](#).

- If the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi)

5. Verify the BCM Tire Type and Pressure selections are setup correctly with a scan tool. Refer to the [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) .

- If the BCM Tire Type and Pressure selections are incorrect, input the proper placard values for the vehicle with the scan tool then drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
- If the BCM Tire Type and Pressure selections are correct

6. Ignition On/Vehicle in Service Mode.

7. Verify the low tire pressure monitor indicator icon turns ON and OFF when commanding All Indicators ON and OFF with a scan tool.

- If the low tire pressure monitor icon does not turn ON and OFF, replace the P16 Instrument Cluster.
- If the low tire pressure monitor icon turns ON and OFF

8. All OK

- **If the tire pressure indicator is OFF**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Tire Pressure Indicator Sensor Replacement](#)
- Refer to [Tire Pressure Indicator Sensor Learn](#)
- Refer to [Control Module References](#) for control module replacement, programming, and setup.

TIRE PRESSURE ROLLING COUNT PROCEDURE

Introduction

The Tire Pressure Rolling Count parameter for each sensor can be used to help confirm if the sensor transmissions are being received. As the vehicle is being driven, the Tire Pressure Rolling Count increments with every received TPM sensor transmission. If a suspected Sensor is not incrementing, incrementing very slowly compared to others or not at all, that could be a result of interference from aftermarket devices. The sensor transmission success rate (the rate at which each sensors transmission is being received by the RCDLR) can be verified in the scan tool.

NOTE: Scan tool procedure will be used if Tire Pressure Sensor exhibits "no Signal or poor intermittent signal reception" Before proceeding, check for the following:

Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- A sensor does not transmit or transmits invalid data to the RCDLR.
- A sensor might exhibit low battery condition.
- If equipped, the driver information center displays " dashes" for the suspected sensor.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the

sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#)

- Occasionally sensor transmissions are not received by the RCDLR due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting

How to determine if Sensor Signal is poor or has no signal

Use Scan Tool and follow on screen instructions:

1. Select Module Diagnosis
2. Select Body Control Module
3. Select Configuration/Reset Functions
4. Select Tire Pressure Sensor Signal Reset
5. The Tire Pressure Sensor Rolling Count parameters will be displayed

If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires

NOTE: When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.

- Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to [Tire and Wheel Removal and Installation](#) .
- If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the [Tire Pressure Indicator Sensor Learn](#).
- If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal. Unplug the device and re-run test.

If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires (Follow normal TPM troubleshooting in Service information)

1. Verify if all 4 tire monitor pressure sensor DTCs are not set.
2. If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to [Keyless Entry System Malfunction \(Active\)](#) [Keyless Entry System Malfunction \(Passive\)](#) .
3. Perform the [Tire Pressure Indicator Sensor Learn](#).
4. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
5. If a Tire Pressure Sensor Mode parameter does not change to Drive.
6. Replace the appropriate B2 Tire Pressure Sensor.
7. Perform the [Tire Pressure Indicator Sensor Learn](#).
8. If the Tire Pressure Sensor Mode parameter changes to Drive.
9. All OK.

REPAIR INSTRUCTIONS

TIRE PRESSURE INDICATOR SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
3. Dismount the tire from the rim. Refer to [Tire Dismounting and Mounting](#)



Fig. 1: Tire Pressure Indicator Sensor Components

Courtesy of GENERAL MOTORS COMPANY

NOTE: Never fit the tire pressure indicator sensor on unapproved wheel rims.

NOTE: Whenever the tire will be removed from the rim, install a new valve stem and a new bolt. Do not reuse the old parts.

4. Remove and DISCARD the bolt (1) from the tire pressure transmitter (2) and pull it straight off the tire pressure valve stem (3).

CAUTION: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

5. Remove and DISCARD the tire pressure valve stem by pulling it through the rim.

Installation Procedure

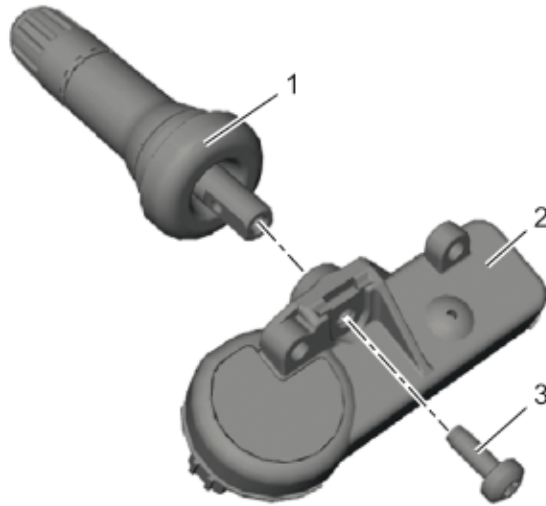


Fig. 2: Tire Pressure Indicator Sensor Components

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Ensure the flat of the valve lines up with the flats of the snap in the enclosure.
- Valve stems and bolts are single use items.

1. Assemble the tire pressure transmitter (2) to the NEW valve stem (1) and install the NEW bolt (3).

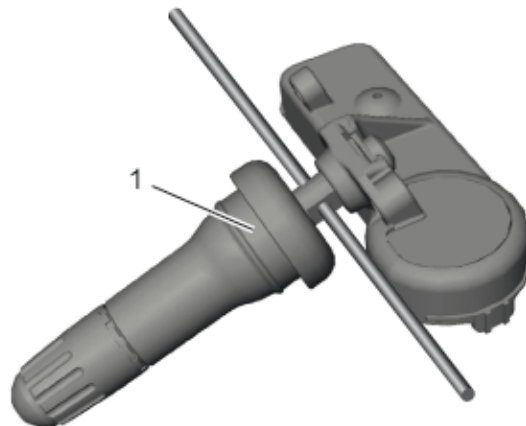


Fig. 3: Anti Rotation Pin

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Insert an anti rotation pin (1) through the cross-drilled hole in the valve stem and tighten the bolt to 1.4 N.m (12.4 lb in).

NOTE: When mounting the tires, use an approved tire mounting lubricant.

3. Apply tire soap to the rubber portion of the valve stem (2).

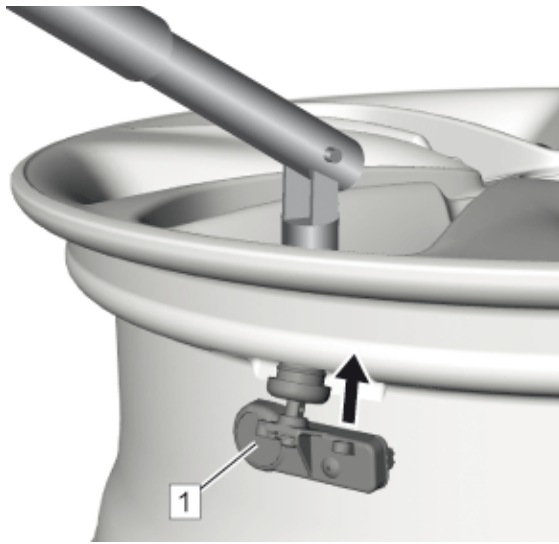


Fig. 4: Pull Valve Stem Through Rim Using Special Tool

Courtesy of GENERAL MOTORS COMPANY

4. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim.

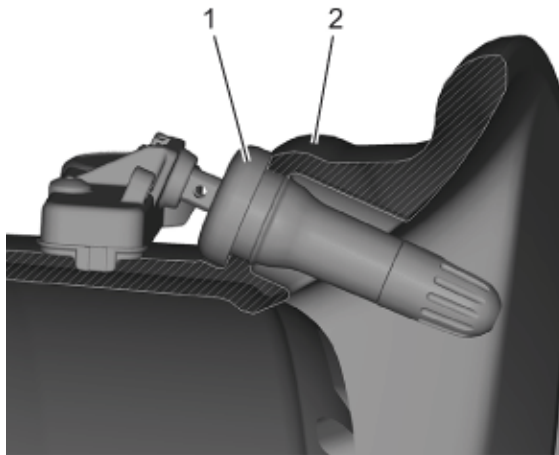


Fig. 5: Proper Valve Stem Seating

Courtesy of GENERAL MOTORS COMPANY

5. Check the valve stem (1) for correct seat on the rim (2).
 - The rim hole edge has to be completely in the notch of the valve stem.
 - The valve and the rim hole have to be concentric.

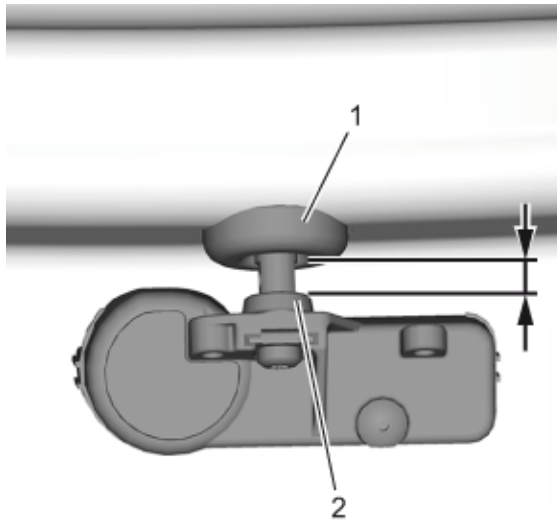


Fig. 6: Tire Pressure Transmitter To Valve Stem Gap

Courtesy of GENERAL MOTORS COMPANY

6. Make sure that there is a gap between the valve stem (1) and the tire pressure transmitter (2).

NOTE: The tire should not have contact with the tire pressure indicator sensor during installation to prevent a damage of the tire pressure indicator sensor.

7. Mount the tire to the rim. Refer to [Tire Dismounting and Mounting](#)
8. Inflate the tire to the specified pressure as stated on the tire placard.
9. Install the NEW dust cap.
10. Balance the tire and wheel assembly.
11. Install the tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)
12. Learn the tire pressure indicator sensor. Refer to [Tire Pressure Indicator Sensor Learn](#).
13. Lower the vehicle.

TIRE PRESSURE INDICATOR SENSOR LEARN

Special Tools

- **EL-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools \(UJM\)](#).

Learn Mode Description

The tire pressure monitor system uses the instrument cluster, body control module (BCM), 4 radio frequency transmitting pressure sensors, remote control door lock receiver (RCDLR) and the serial data circuit to perform the tire pressure monitor learn mode functions. The sensor learn procedure must be performed after every tire rotation, BCM replacement, or sensor replacement. Once the Learn mode has been enabled, each of the sensors unique identification codes can be learned into the BCM memory. When a sensor ID has been learned, the BCM sounds a horn chirp indicating the sensor has transmitted its ID and the BCM has received and learned it. The BCM must learn the sensor IDs in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will

individually illuminate indicating which location is to be learned in the proper sequence.

Sensor Functions Using EL-46079, EL-50448, or Equivalent

Each sensor has an internal low frequency coil. When the tire pressure monitor special tool is used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in Learn Mode-Remotely Triggered. When the BCM receives a learn mode transmission while in Learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

Learn Mode Cancellation

The Learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor or 5 min overall has elapsed to match all four sensors. If the relearn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the relearn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the BCM memory.
- If equipped, the driver information center will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the Learn procedure to be repeated for the system to function properly.

Tire Pressure Monitor Learn Procedure

NOTE: In the event a particular sensor is activated and the horn does not chirp, it may be necessary to rotate the wheel so that the valve stem is in a different position due to the sensor signal is being blocked by another component. Make sure the TPM tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning.

1. Apply park brake (manual transmission only).
2. Ignition On/Vehicle in Service Mode, using a scan tool or driver information center buttons (refer to owners manual), initiate the Tire Pressure Sensors Learn mode. A double horn chirp will sound indicating the Learn mode has been enabled. The left front turn signal will also be illuminated.
3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure monitor special tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for a horn chirp. If the horn does not chirp, repeat the sensor activation sequence with the tool. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
4. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 3 for the remaining 3 sensors in the following order:
 1. Right front
 2. Right rear
 3. Left rear
5. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the BCM exits the Learn mode.

DESCRIPTION AND OPERATION

TIRE PRESSURE MONITOR DESCRIPTION AND OPERATION (UJM)

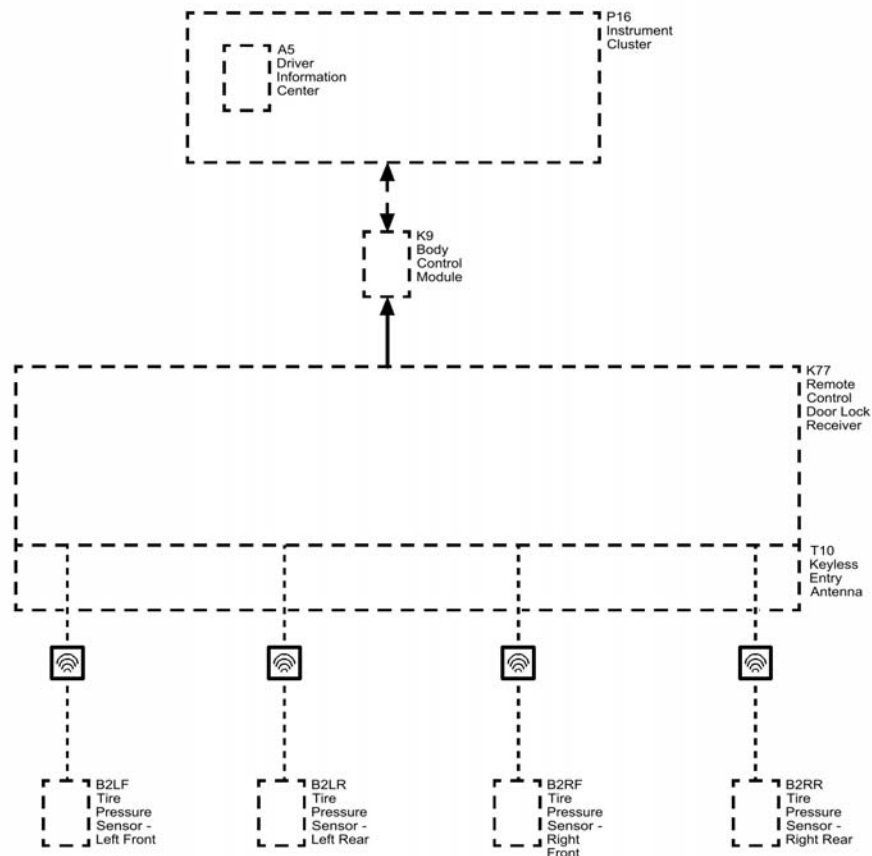


Fig. 7: Tire Pressure Monitoring System Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
K9	K9 Body Control Module
K77	K77 Remote Control Door Lock Receiver
T10	T10 Keyless Entry Antenna
B2LF	B2LF Tire Pressure Sensor - Left Front
B2LR	B2LR Tire Pressure Sensor - Left Rear
B2RF	B2RF Tire Pressure Sensor - Right Front
B2RR	B2RR Tire Pressure Sensor - Right Rear

Special Tools

- **EL-46079/J-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to [Special Tools \(UJM\)](#).

The tire pressure monitor system warns the driver when a significant loss of tire pressure occurs in any of the 4 tires and allows the driver to display the individual tire pressures and their locations on the driver information center.

The system uses the body control module (BCM), driver information center, instrument cluster, remote control door lock receiver (RCDLR), and a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly, and the serial data circuit to perform the system functions. Each sensor has an internal power supply with an approximate 10 year service life.

When the vehicle is stationary, the sensor's internal accelerometer is inactive, which puts the sensors into a Stationary state. In this state the sensors sample tire pressure once every 30 seconds and do not transmit at all if the tire pressure does not change. As vehicle speed increases, centrifugal force activates the sensors internal accelerometer causing the sensors to go into Wake and then Drive mode. In Drive mode, the sensors sample tire pressure once every 30 seconds and transmit in Drive mode once every 60 seconds. The RCDLR receives and translates the data contained in each sensors RF transmission into sensor presence, sensor mode, and tire pressure and passes it to the BCM. In turn, the BCM sends the tire pressure and tire location data to the driver information center via the serial data circuit where they are displayed.

The sensors continuously compare their last pressure sample to their current pressure sample and will transmit in Learn Mode-Pressure Triggered if a 8.3 kPa (1.2 psi) change in tire pressure has been detected in either a Stationary or Drive state. When the tire pressure monitor system detects a significant loss of tire pressure, the tire pressure monitor indicator icon is illuminated on the instrument cluster and if equipped, a tire pressure low, add air to tire type message is displayed on the driver information center. Both the indicator icon and driver information center message can be cleared by adjusting the tire pressures to the recommended pressures and driving the vehicle above 40 km/h (25 mph) for at least 2 minutes.

If power is disconnected from the BCM or if the vehicle battery is disconnected, each tire pressure monitor sensor ID is retained but all of the tire pressure information is lost. Under these circumstances the BCM cannot assume that the tire pressures were maintained over an unknown period of time. If equipped, the driver information center will display all dashes and the scan tool will indicate a default tire pressure value of 1020 kPa (148 psi) for each tire. Driving the vehicle above 40 km/h (25 mph) for at least 2 minutes will activate the sensors causing the driver information center to display the current tire pressures. The **EL-46079/J-46079** tire pressure monitor diagnostic tool, **EL-50448** tire pressure monitor sensor activation tool, or equivalent may also be used to activate the sensors as well.

The BCM has the ability to detect malfunctions within the tire pressure monitor system. In the event a DTC is set, the tire pressure monitor indicator icon on the instrument cluster, if equipped will flash for 1 minute and then remain illuminated after the ignition is turned ON and the instrument cluster bulb check has been completed. Any malfunction detected will cause the driver information center to display a service tire monitor system type message. For more information on other functions of the BCM, refer to [Keyless Entry System Description and Operation](#) .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS (UJM)

Illustration	Tool Number/Description
--------------	----------------------------

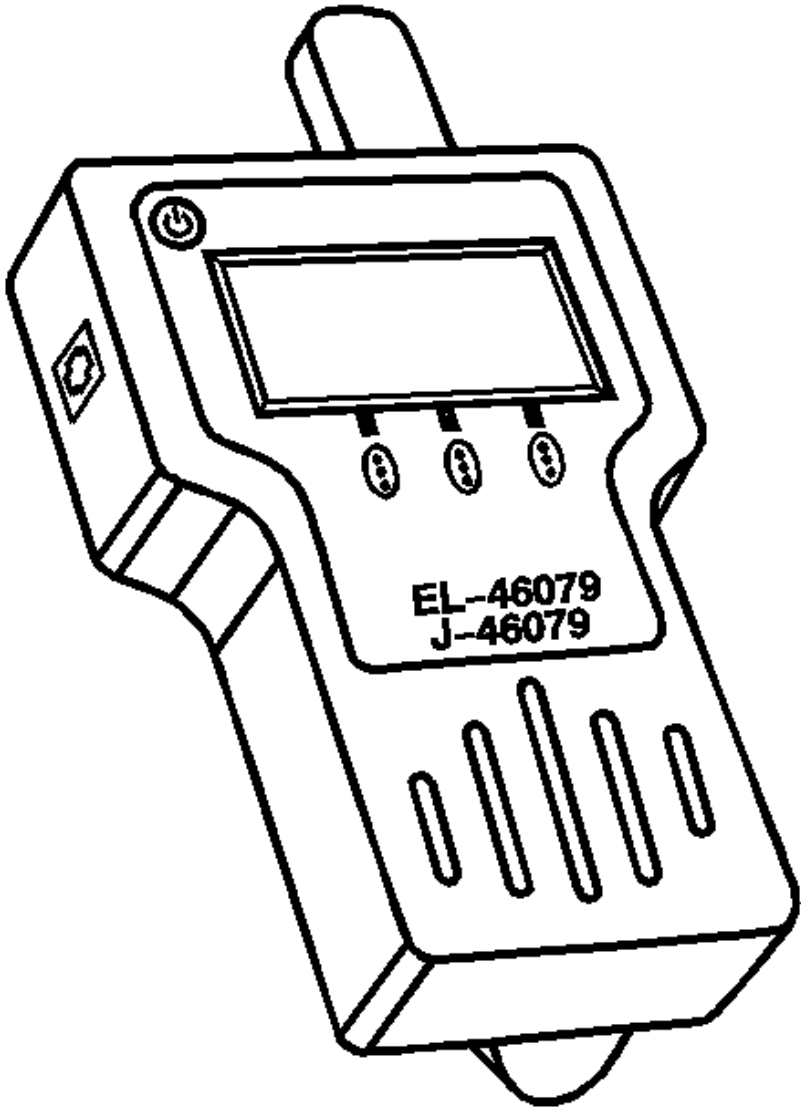
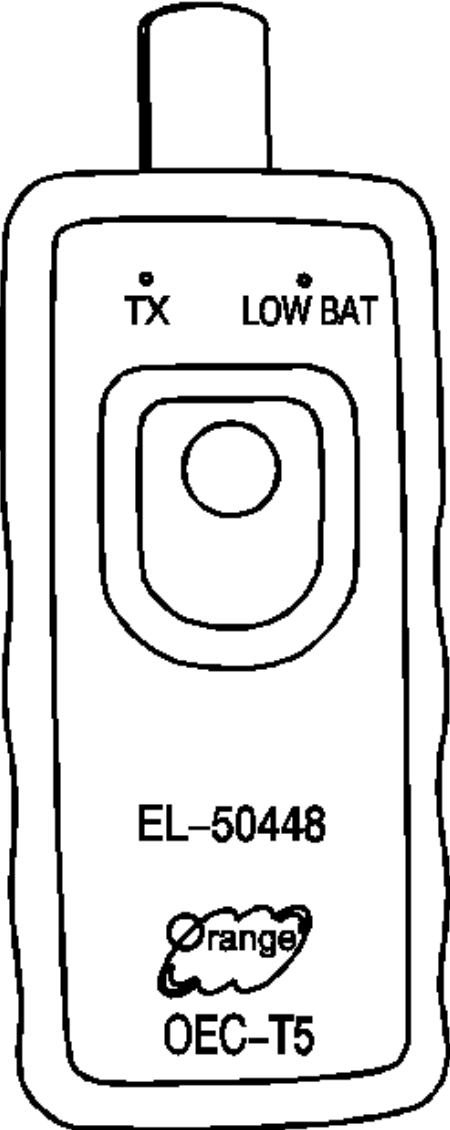
Illustration	Tool Number/Description
	EL 46079 Tire Pressure Monitor Diagnostic Tool

Illustration	Tool Number/Description
	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Article GUID: A00884699

SUSPENSION

Tires and Wheels - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Wheel Nut	140 N.m (103 lb ft)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	Canadian Part Number
Aluminum Wheel	Adhesive/Sealant	12378478	88900041
Aluminum Wheel	3M [®] General Purpose Cleaner	08984	-
Wheel	Mounting Lubricant	12345884	88863415
Wheel to Hub	Lubricant	1051344	993037

DIAGNOSTIC INFORMATION AND PROCEDURES

TIRE DIAGNOSIS - IRREGULAR OR PREMATURE WEAR

Tire Wear

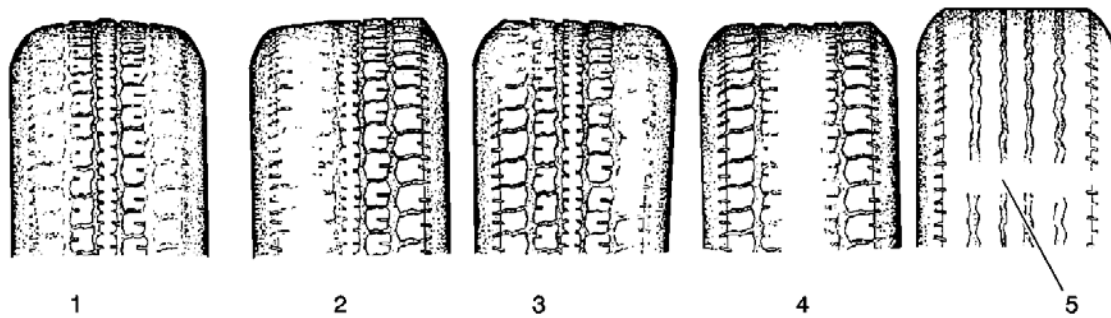


Fig. 1: Identifying Types Of Tire Wear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Under-Inflation, Hard Cornering, Lack of Regular Rotation
2	Incorrect Wheel Alignment, Hard Cornering, Lack of Regular Rotation
3	Incorrect Wheel Alignment
4	Over-Inflation, Heavy Acceleration, Lack of Regular Rotation
5	Normal Wear to the Wear Indicator

Inspection Procedure

1. Inspect the front tire wear.
2. Inspect the rear tire wear.
3. Rotate the tires if any of the following conditions exist:
 - The amount of time or mileage since the last tire rotation matches the maintenance schedule.
 - The outer tread blocks are worn more than the middle tread blocks (1).
 - The outer tread blocks are worn more than the inner tread blocks (2).
 - The middle tread blocks are worn more than the outer tread blocks (4).
4. Measure the wheel alignment if any of the following conditions exist:
 - The tread blocks have feathered edges (3).
 - The outer tread blocks are worn more than the inner tread blocks (2).
 - The inner tread blocks are worn more than the outer tread blocks (2).
5. Inspect the struts or the shock absorbers if the tire tread exhibits a cupped appearance (3).

TIRE DIAGNOSIS - WADDLE COMPLAINT

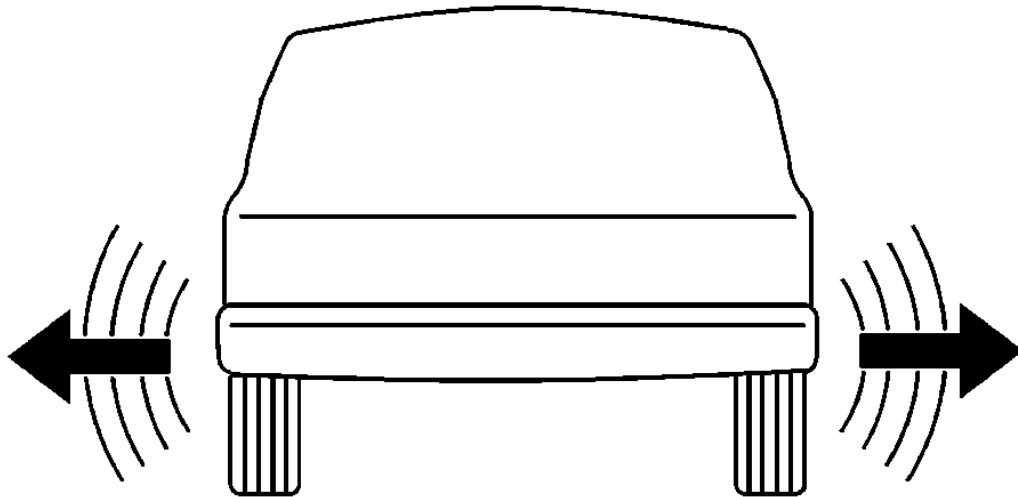


Fig. 2: Identifying Tire Wobble/Waddle

Courtesy of GENERAL MOTORS COMPANY

Tire waddle is a side to side movement at the front of the vehicle and/or the rear of the vehicle. Tire waddle can be caused by the following conditions:

- A steel belt not being straight within the tire
- Excessive lateral runout of the tire
- Excessive lateral runout of the wheel

The tire waddle is most noticeable at a low speed of about 8 - 48 km/h (5 - 30 mph). Tire waddle may appear as ride roughness at 80 - 113 km/h (50 - 70 mph). Tire waddle may appear as a vibration at 80 - 113 km/h (50 - 70 mph).

Inspection Procedure

1. Raise and support the vehicle with safety stands. Refer to [**Lifting and Jacking the Vehicle**](#) .

CAUTION: **Wear gloves when inspecting the tires in order to prevent personal injury**

from steel belts sticking through the tire.

2. Perform the following preliminary inspection:
 1. Mark the tire with a crayon in order to note the start and the stop position.
 2. Rotate each tire and wheel by hand.
 3. Inspect the tire for bulges or bent wheels. Replace as necessary.
3. Use tire substitution in order to identify the faulty tire. Perform the following steps for a tire substitution check:
 1. Use a comparable tire in order to replace each tire, one at a time.
 2. Test drive the vehicle.
 3. If the problem is tire or wheel related, you will eliminate the problem when you remove the faulty tire from the vehicle.

WHEEL MOUNTING SURFACE CHECK

Replace any wheels that are bent or dented, or have excessive lateral or radial runout. Wheels with runout greater than specified may cause objectionable vibrations.

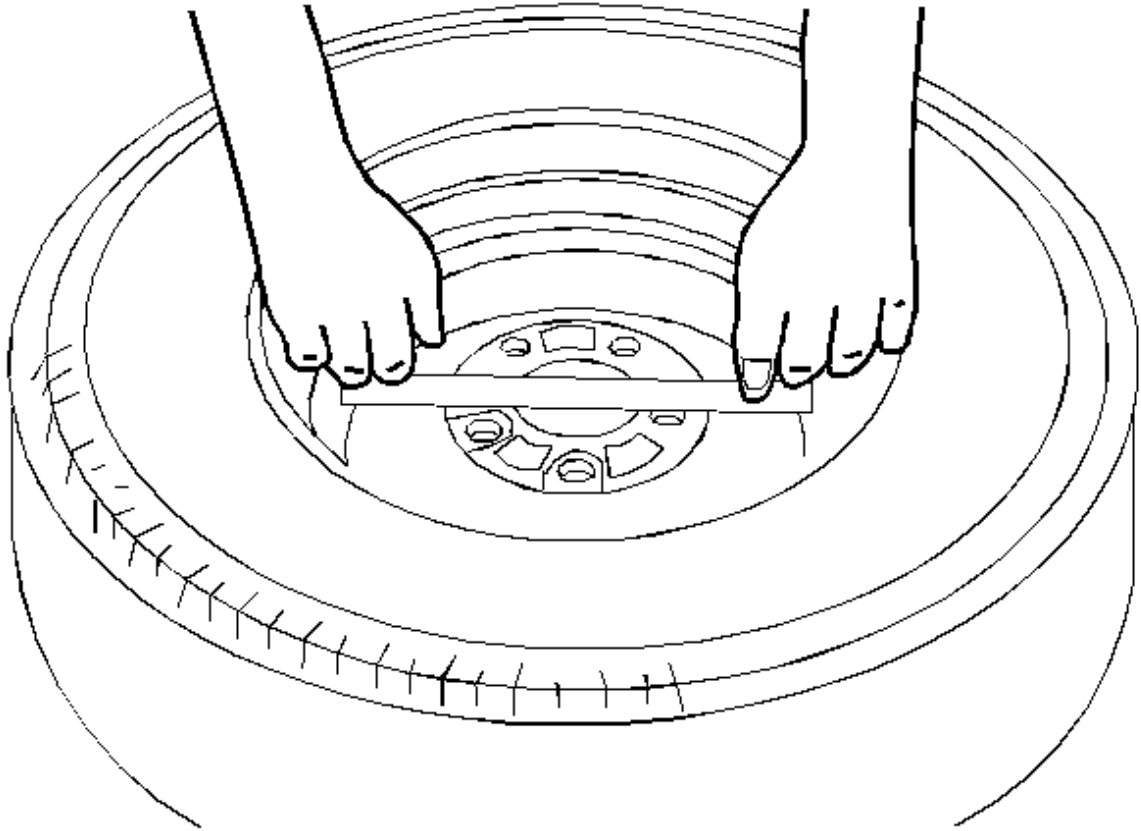


Fig. 3: Checking Wheel Mounting Surface

Courtesy of GENERAL MOTORS COMPANY

1. Thoroughly clean the wheel mounting surface with a clean shop towel and denatured alcohol, or equivalent.
2. Use a straight edge 203 - 229 mm (8 - 9 in) long. Place the straight edge on the wheel inboard mounting surface. Try to rock the straight edge up and down within the mounting surface.
3. For aluminum flat-mount wheels, repeat the procedure in step 2 on at least 3 - 4 different positions on the inboard mounting surface.

If you can rock the straight edge, the mounting surface is bent and you must replace the wheel.

4. Inspect the mounting wheel/nut holes for damage caused from over-torquing the wheel/nuts. Inspect for collapsed wheel/nut bosses. Inspect for cracked wheel bosses.

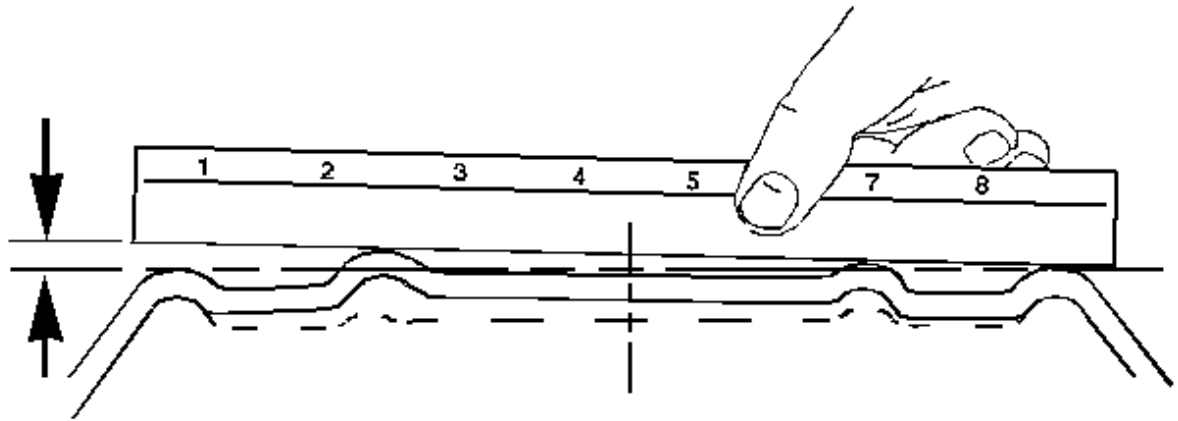


Fig. 4: Inspecting Wheel Inboard Mounting Surface

Courtesy of GENERAL MOTORS COMPANY

5. For steel wheels, repeat the procedure in step 2 on at least 3 - 4 different positions on the inboard mounting surface.
 - The outer mounting ring is designed to be raised slightly above the inner mounting ring.
 - If you can rock the straight edge, the mounting surface is bent and you must replace the wheel.

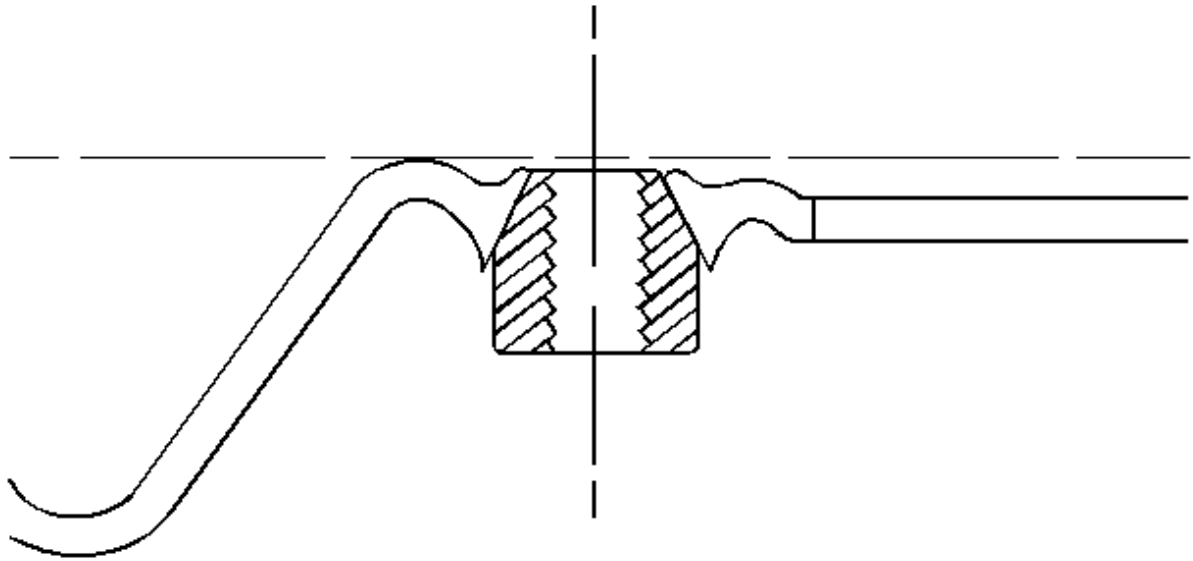


Fig. 5: Identifying Mounting Wheel/Nut Holes Damage

Courtesy of GENERAL MOTORS COMPANY

6. Inspect the mounting wheel/nut holes for damage caused from over-torquing the wheel/nuts. Inspect for collapsed wheel/nut bosses. Inspect for cracked wheel bosses.

CAUTION: The use of non-GM original equipment wheels may cause:

- Damage to the wheel bearing, the wheel fasteners and the wheel
- Tire damage caused by the modified clearance to the adjacent vehicle components
- Adverse vehicle steering stability caused by the modified scrub radius
- Damage to the vehicle caused by the modified ground clearance
- Speedometer and odometer inaccuracy

- Replacement wheels must be equivalent to the original equipment wheels in the following ways:
 - The load capacity
 - The wheel diameter
 - The rim width
 - The wheel offset
 - The mounting configuration
- A wheel of the incorrect size or type may affect the following conditions:
 - Wheel and hub-bearing life
 - Brake cooling
 - Speedometer/odometer calibration
 - Vehicle ground clearance
 - Tire clearance to the body and the chassis

IMPORTANT:

7. Replace the wheel if the wheel is bent.
8. Replace the wheel if the wheel/nut boss area is cracked.

Identify steel wheels with a 2 or 3 - letter code stamped into the rim near the valve stem. Aluminum wheels have the code, the part number, and the manufacturer identification cast into the back side of the wheel.

RADIAL TIRE LEAD/PULL CORRECTION

Step	Action	Yes	No
DEFINITION: Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel.			
1	Did you perform the Vehicle Leads/Pull diagnostic table?	Go to Step 2	Go to Vehicle Leads/Pulls
2	Road test the vehicle to verify the complaint. Select a smooth level surface to perform the test. Does the condition exist?	Go to Step 3	System OK
3	1. Cross-switch the front tire/wheel assemblies. Refer to Tire and Wheel Removal and Installation . 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?	Go to Step 4	System OK
4	Does the vehicle lead/pull in the opposite direction?	Go to Step 5	Go to Wheel Alignment Measurement
5	1. Cross-switch the left front tire/wheel assembly with the left rear tire/wheel assembly. Refer to Tire and Wheel	Go to Step 6	Go to Step 7

Step	Action	Yes	No
	<u>Removal and Installation.</u> 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?		
6	1. Cross-switch the right front tire/wheel assembly with the right rear tire/wheel assembly. Refer to <u>Tire and Wheel Removal and Installation.</u> 2. Road test the vehicle on a smooth level surface. Does the vehicle still lead/pull?	Go to <u>Wheel Alignment Measurement</u>	Go to Step 8
7	Replace the left rear tire. Refer to <u>Tire Dismounting and Mounting.</u> Is the repair complete?	Go to Step 9	-
8	Replace the right rear tire. Refer to <u>Tire Dismounting and Mounting.</u> Is the repair complete?	Go to Step 9	-
9	Verify proper vehicle operation. Does the original condition still exist?	Go to Step 1	System OK

REPAIR INSTRUCTIONS

TIRE AND WHEEL REMOVAL AND INSTALLATION

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools.**

Removal Procedure

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Remove the wheel cover, if equipped.

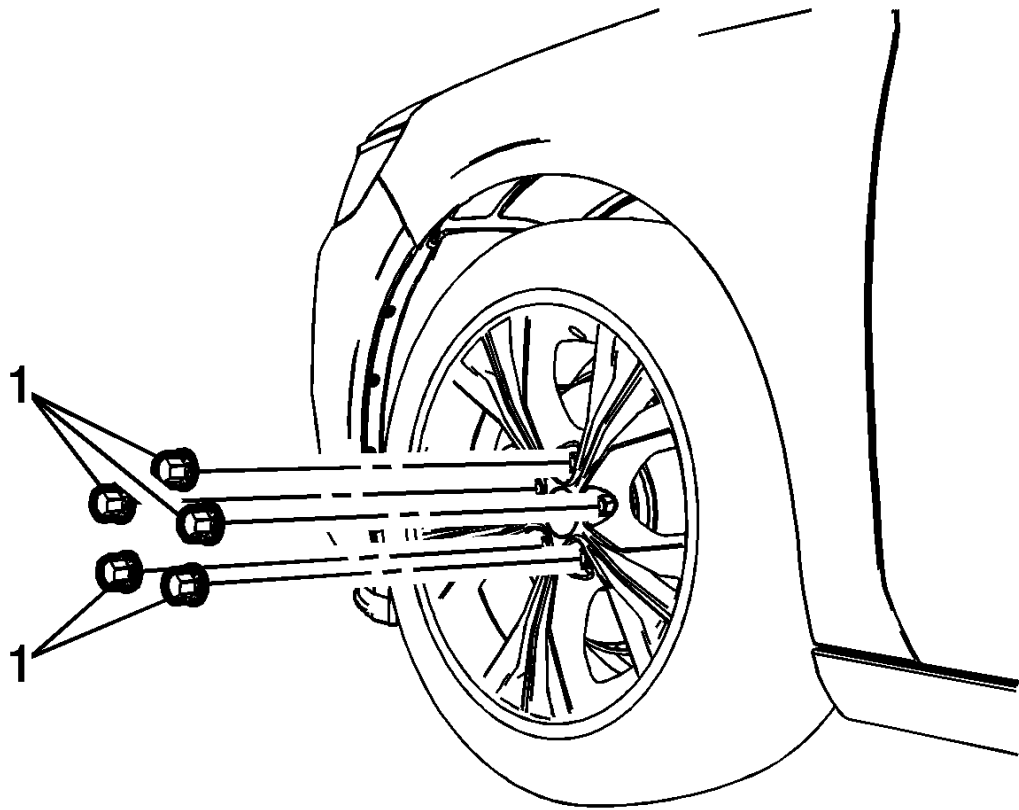


Fig. 6: Wheel Nut Caps

Courtesy of GENERAL MOTORS COMPANY

3. Remove the wheel nut caps (1), if equipped.

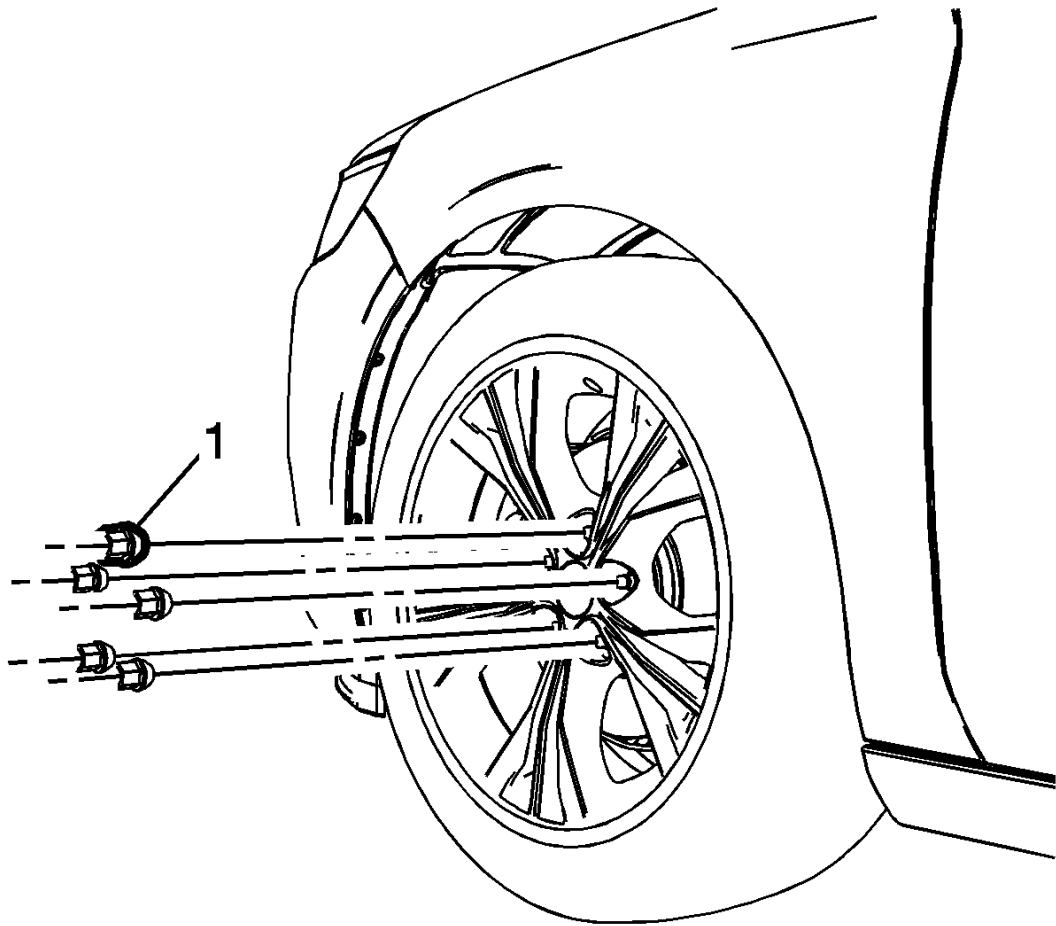


Fig. 7: Wheel Nuts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the wheel nuts (1).

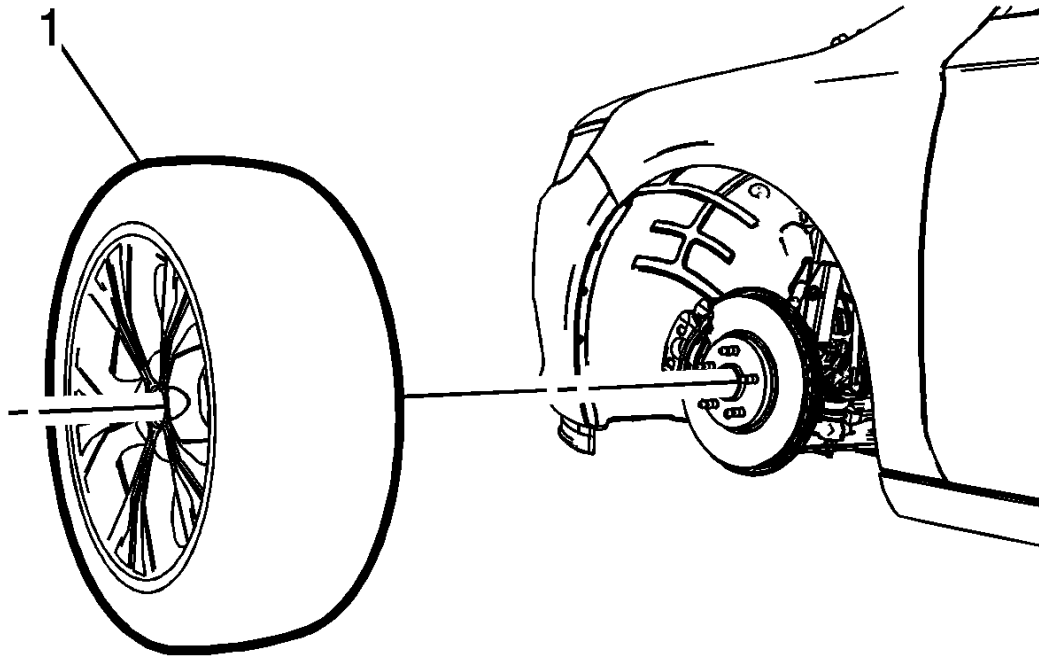


Fig. 8: Tire & Wheel Assembly

Courtesy of GENERAL MOTORS COMPANY

5. Remove the tire and wheel assembly (1).

WARNING: If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum it could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident.

CAUTION: Removing the wheel may be difficult because of foreign materials or a tight fit between the wheel and the hub/rotor. Slightly tap the tire side wall with a rubber mallet in order to remove the wheel. Failure to follow these instructions may result in damage to the wheel.

CAUTION: Never use heat to loosen a tight wheel bolt or nut. This can shorten the life of wheel and damage wheel bearings.

6. If the tire and wheel assembly is difficult to remove or cannot be removed, perform the following steps:

- Hand install the wheel nuts.
- Loosen the wheel nuts 2 complete turns.

- Lower the vehicle.
 - Rock the vehicle from side to side.
 - Repeat the procedure if necessary.
7. When the tire and wheel assembly loosens, raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
 8. Remove the wheel nuts.
 9. Remove the tire and wheel assembly.
 10. If necessary and equipped, remove the center cap.

Installation Procedure

WARNING: Before installing the wheels, remove any buildup of corrosion on the wheel mounting surface and brake drum or disc mounting surface. Installing wheels with poor metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen. This can cause a wheel to come off when the vehicle is moving, causing loss of control and possibly personal injury.

NOTE: Do not use power grinding tools to clean the brake rotor or drum to wheel mating surfaces.

1. Using a wire brush or wire wheel, clean the wheel to brake rotor or drum mating surface.
2. Using the **CH-41013** Rotor Resurfacing Kit, clean the rotor or drum to wheel contact area.
3. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, clean the surfaces around the wheel studs.
4. Clean the threads of the wheel studs.
5. If the threads of the wheel stud are damaged, replace the wheel stud. [Wheel Stud Replacement](#) , or [Wheel Stud Replacement](#)
6. After cleaning all of the wheel and brake rotor or drum contact areas, use brake cleaner or denatured alcohol to remove any dirt and debris from the wheel nuts and the brake rotor or drum.
7. Inspect and clean the contact areas of the wheel. [Wheel Mounting Surface Check](#)

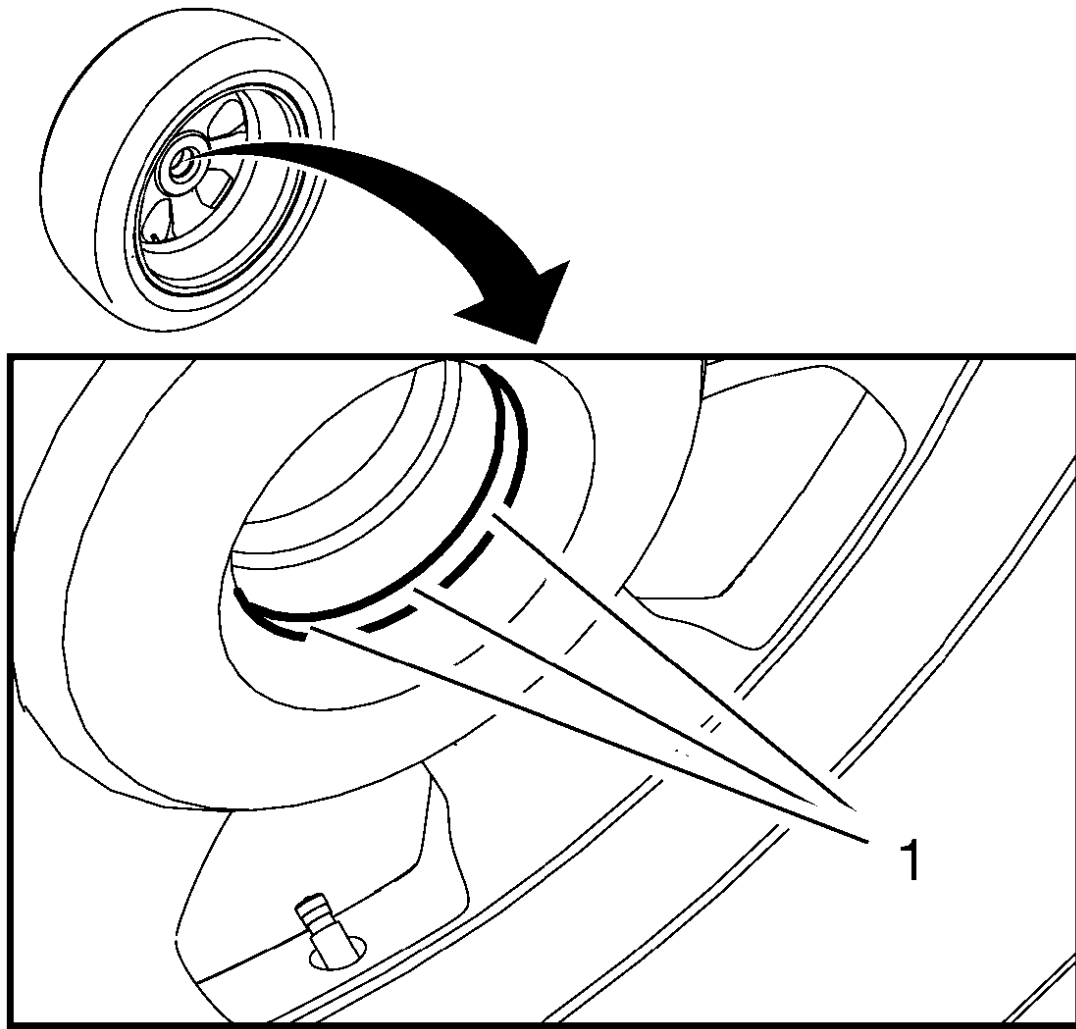


Fig. 9: Rim Inner Center Seat

Courtesy of GENERAL MOTORS COMPANY

8. Apply a small amount of lubricant to the inner diameter of the wheel hub pilot hole (1) where it contacts the wheel hub flange. **Adhesives, Fluids, Lubricants, and Sealers**

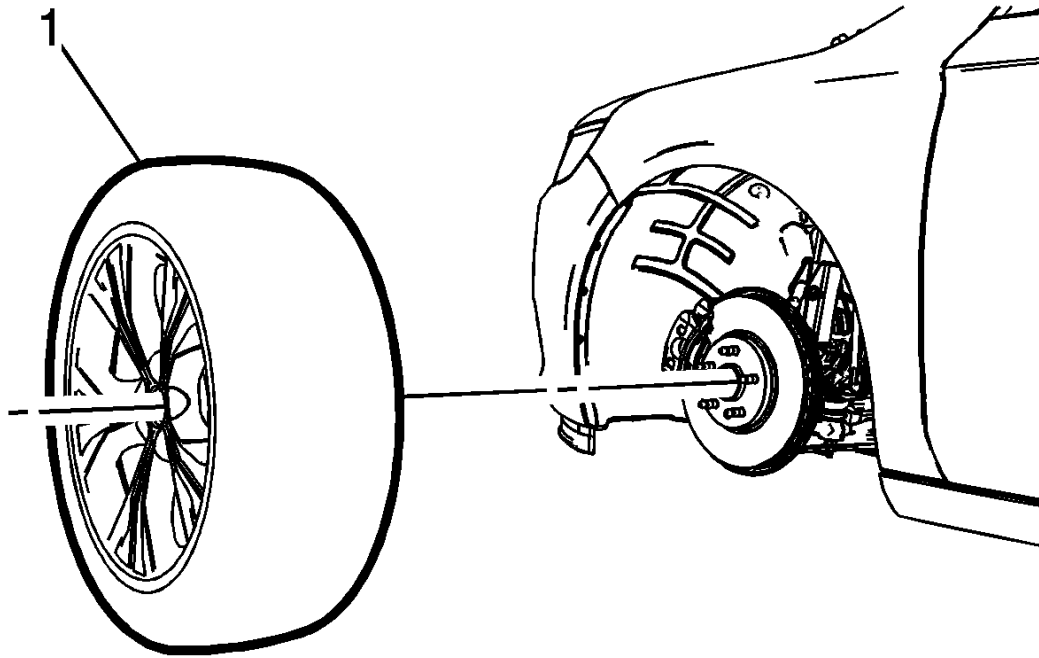


Fig. 10: Tire & Wheel Assembly

Courtesy of GENERAL MOTORS COMPANY

9. Install the tire and wheel assembly (1).

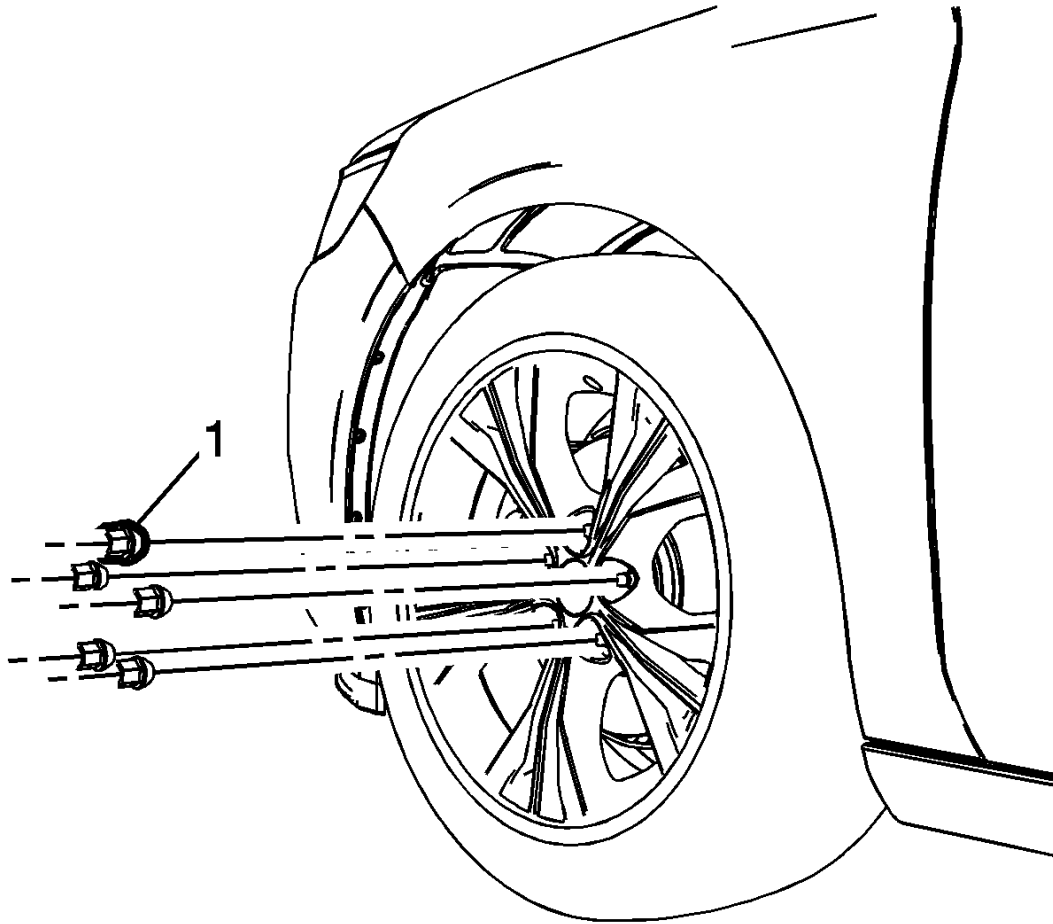


Fig. 11: Wheel Nuts

Courtesy of GENERAL MOTORS COMPANY

WARNING: Never grease or lubricate wheel nuts, studs and mounting surfaces. Wheel nuts, studs, and mounting surfaces must be clean and dry. Tightening the lubricated parts can cause damage to the wheel studs. This can cause a wheel to come off when the vehicle is moving, causing loss of control and possibly personal injury.

10. Hand install the wheel nuts (1).

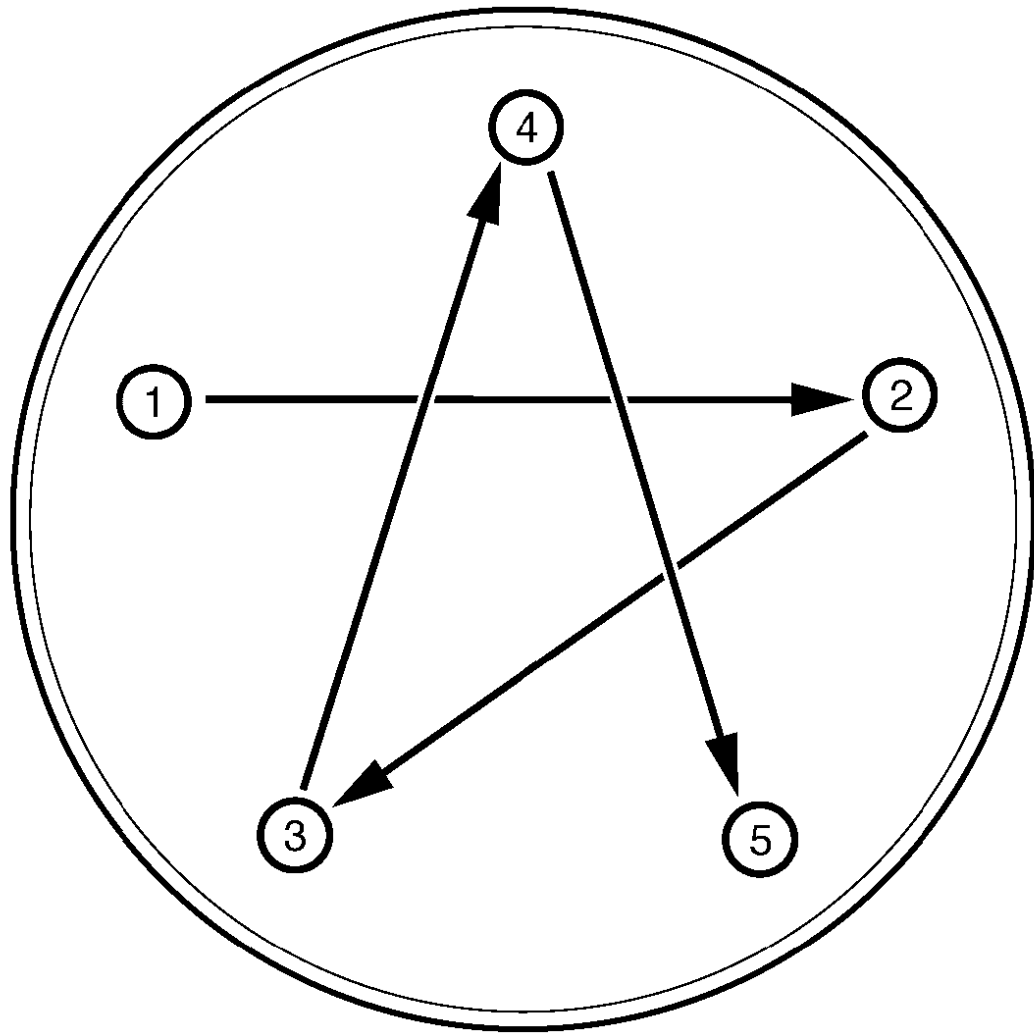


Fig. 12: Wheel Nut Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Improperly tightened wheel bolts or nuts can lead to brake pulsation and rotor damage. In order to avoid expensive brake repairs, evenly tighten the wheel bolts or nuts to the proper torque specification.

CAUTION: Refer to [Fastener Caution](#) .

11. Using a torque wrench and the appropriate socket, alternately and evenly tighten the wheel nuts to 140 N.m (103 lb ft) in the sequence illustrated.

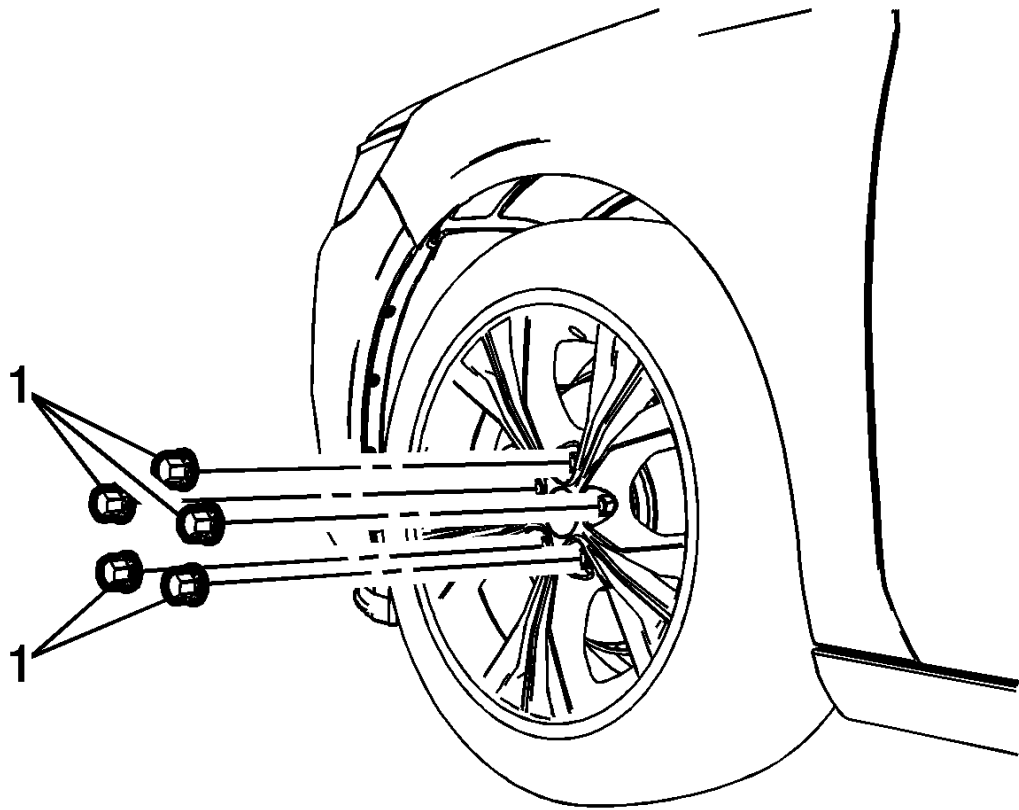


Fig. 13: Wheel Nut Caps

Courtesy of GENERAL MOTORS COMPANY

12. Install the wheel nut caps (1), if equipped.
13. Install the wheel center cap or wheel cover, if equipped.

TIRE REPAIR

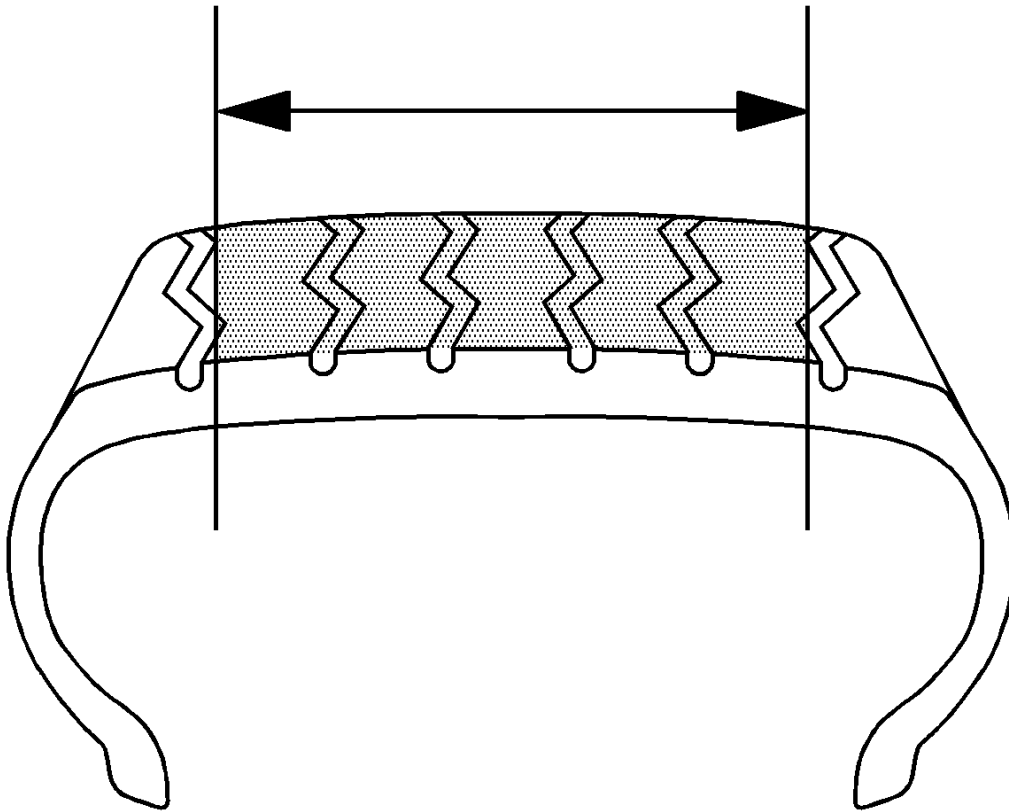


Fig. 14: Identifying Repairable Area On A Radial Tire

Courtesy of GENERAL MOTORS COMPANY

WARNING:

- Tire changing can be dangerous and should be done by trained professionals using proper tools and procedures. Always read and understand any manufacturer's warnings contained in their customers literature or molded into the tire sidewall.
- Serious eye and ear injury may result from not wearing adequate eye and ear protection while repairing tires.
- NEVER inflate beyond 275 kPa (40 pounds) pressure to seat beads.
- NEVER stand, lean or reach over the assembly during inflation.

NOTE:

Repairable area on a radial tire.

- NEVER repair tires worn to the tread indicators 1.59 mm (2/32 in) remaining depth.
- NEVER repair tires with a tread puncture larger than 6.35 mm (1/4 in).
- NEVER substitute an inner tube for a permissible or non-permissible

repair.

- **NEVER** perform an outside-in tire repair (plug only, on the wheel).
- Every tire must be removed from the wheel for proper inspection and repair.
- Regardless of the type of repair used, the repair must seal the inner liner and fill the injury.
- Consult with repair material supplier/manufacturer for repair unit application procedures and repair tools/repair material recommendations.

Three basic steps for tire puncture repair:

1. Remove the tire from the wheel for inspection and repair.
2. Fill the injury (puncture) to keep moisture out.
3. Seal the inner liner with a repair unit to prevent air loss.

External Inspection

1. Prior to demounting, inspect the tire surface, the valve and the wheel for the source of the leak by using a water and soap solution. Mark the injured area and totally deflate the tire by removing the valve core.
2. Demount the tire from the wheel and place the tire on a well-lighted spreader.

Internal Inspection

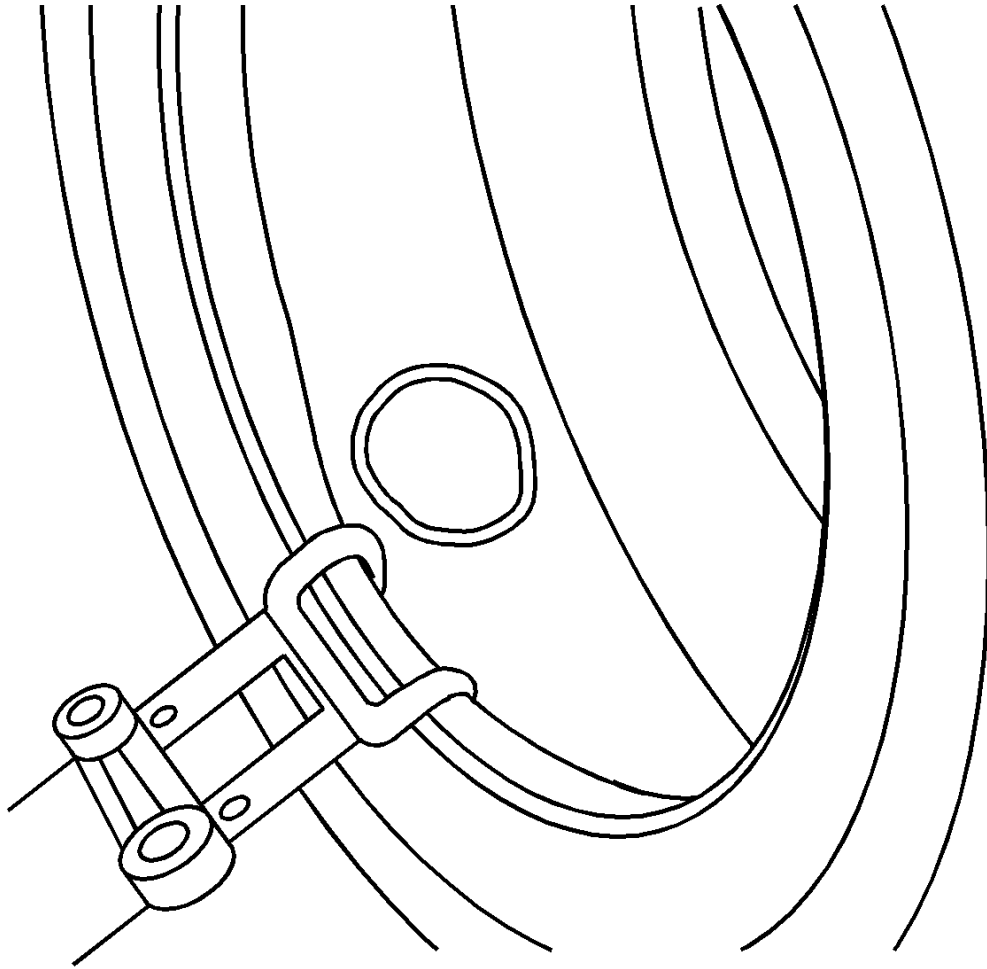


Fig. 15: Marking Tire Puncture Location

Courtesy of GENERAL MOTORS COMPANY

1. Spread the beads and mark the puncture with a tire crayon.
2. Inspect the inner tire for any signs of internal damage.
3. Remove the puncturing object, noting the direction of the penetration.
4. Probe the injury with a blunt awl in order to determine the extent and direction of the injury.
5. Remove any loose foreign material from the injury.
6. Punctures exceeding 6.35 mm (1/4 in) should not be repaired.

Cleaning

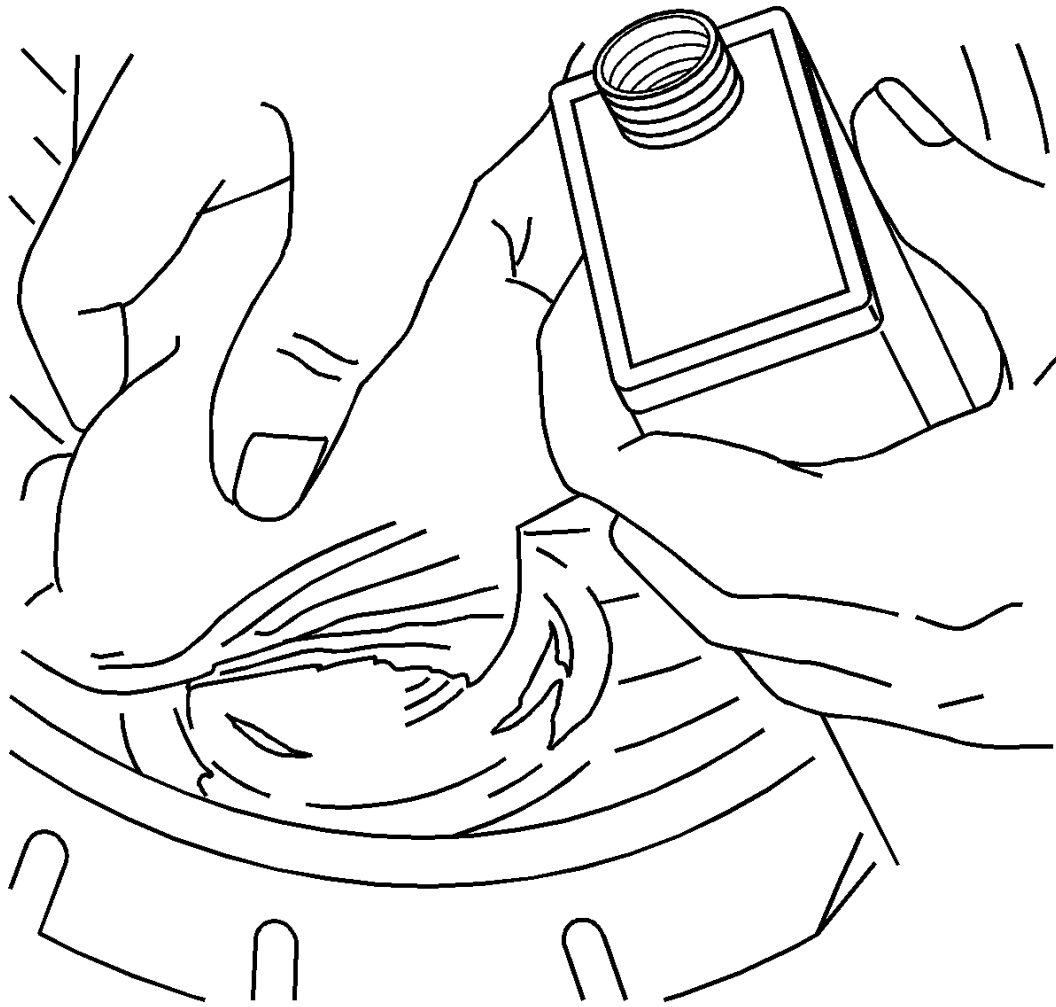


Fig. 16: Cleaning Repair Area

Courtesy of GENERAL MOTORS COMPANY

1. Clean the area around the puncture thoroughly with a proper liner cleaner, clean cloth and a scraper. This step serves to remove dirt and mold lubricants to insure proper adhesion and non-contamination of the buffing tool.
2. Refer to information on the product or manufacturer's Material Safety Data Sheet and follow guidelines for handling and disposal.

Clean the Injury Channel

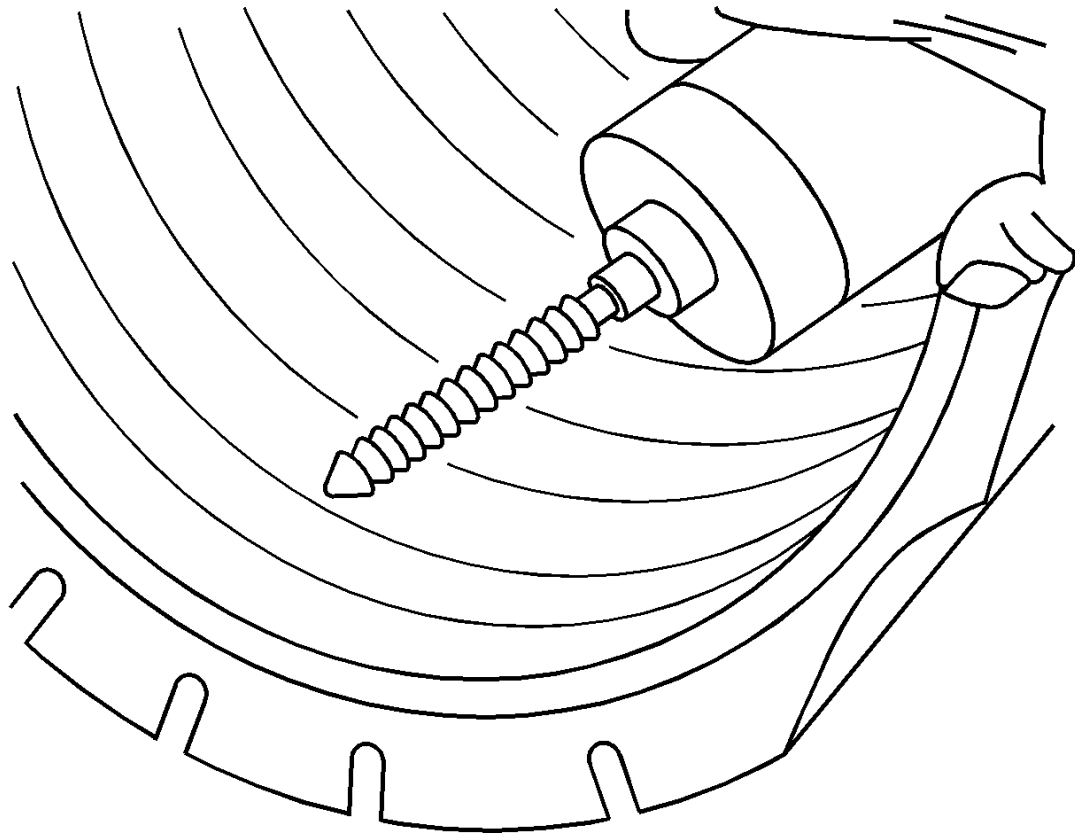


Fig. 17: Reaming Puncture Channel

Courtesy of GENERAL MOTORS COMPANY

1. Use a proper hand reamer, carbide cutter or drill bit to ream the puncture channel from the inside of the tire in order to clean the injury.
2. Remove steel wires protruding above the liner surface to prevent damage to the repair unit.
3. Consult your repair material supplier for recommended reaming tool(s).

Fill the Injury

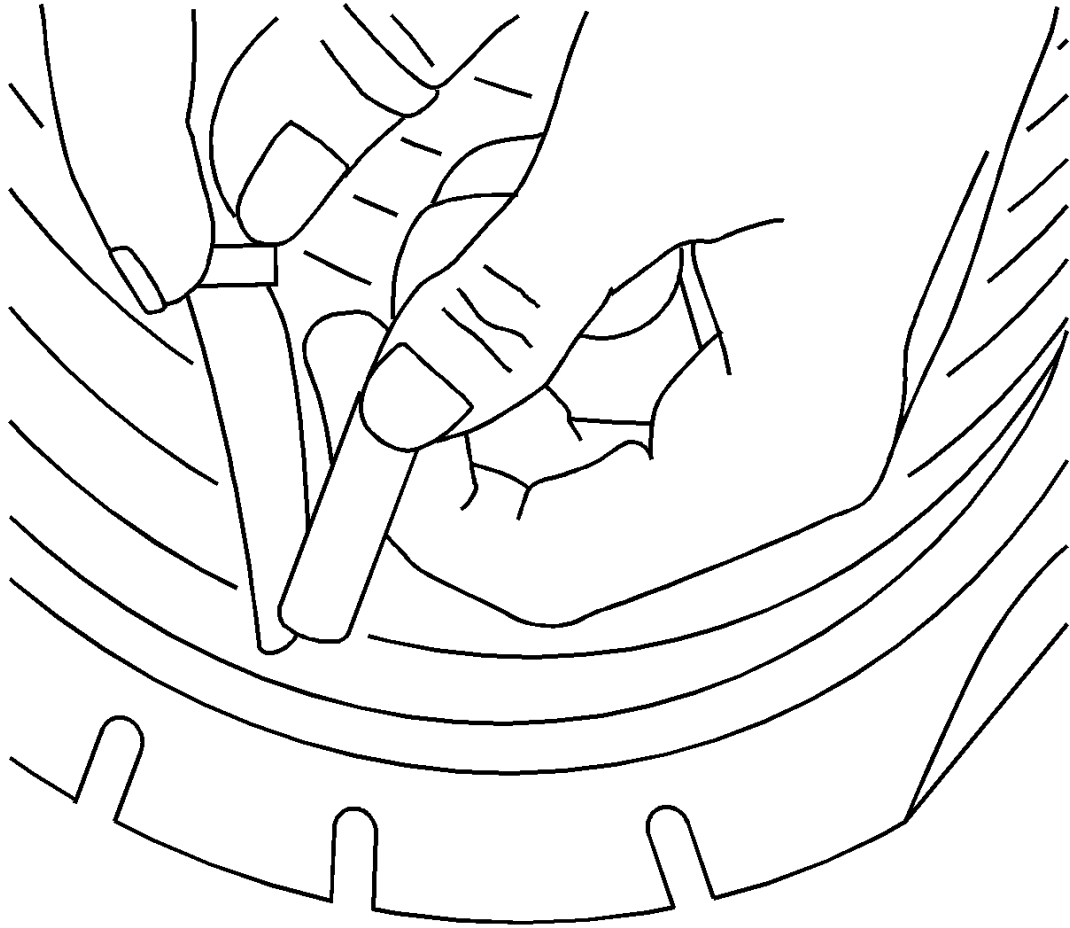


Fig. 18: Filling Injury Location

Courtesy of GENERAL MOTORS COMPANY

1. It is necessary to fill the injury channel to provide back up for the repair unit and to prevent moisture from entering the tire fabric and steel wires.
2. For combination repair/plug units skip this step. Cement the injured channel and fill the injury from the inside of the tire with the repair plug per repair material manufacturer's recommendations. Without stretching the plug, cut the plug off just above the inside tire surface.
3. Consult your repair material supplier for proper repair material selection.

Repair Unit Selection

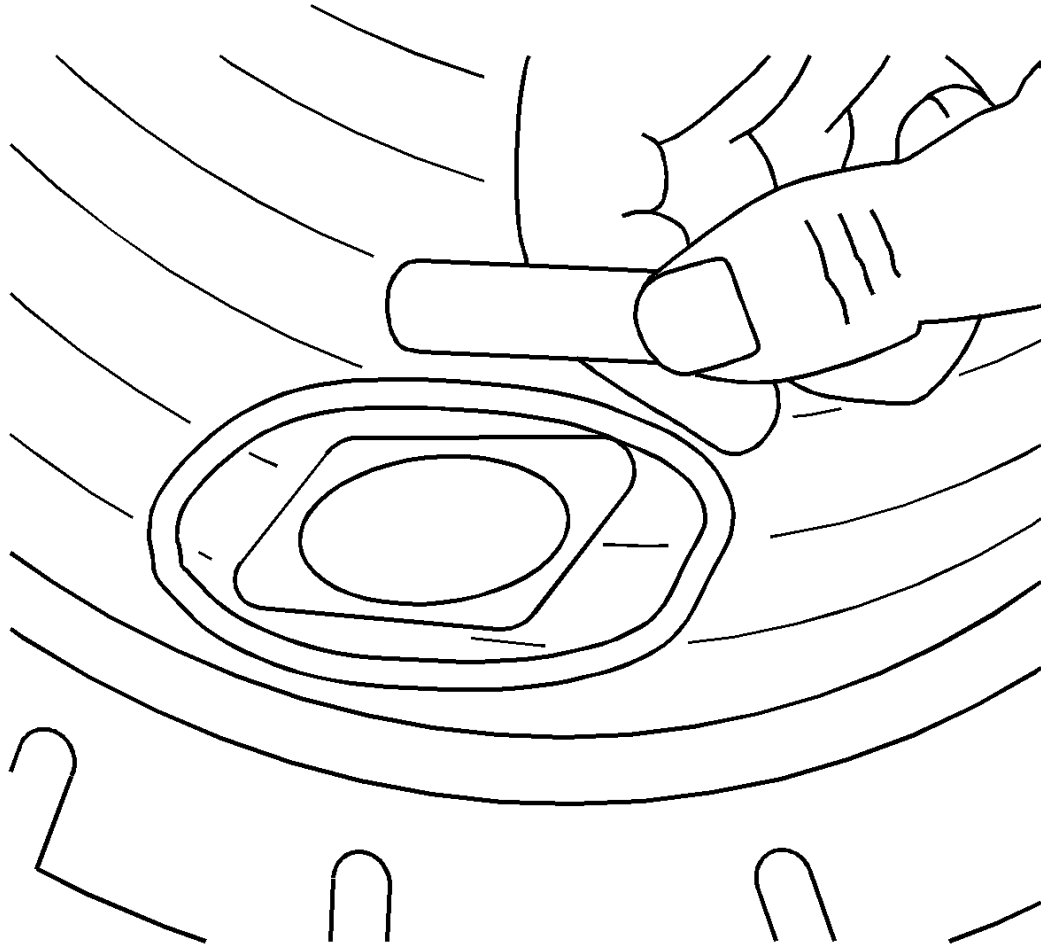


Fig. 19: Outlining Tire Injury Area

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not install the repair unit in this step.

1. Center the repair unit over the injury as a reference and outline an area larger than the unit so that buffing will not remove the crayon marks.
2. Remove the repair unit.
3. DO NOT overlap previous or multiple repair units.
4. Consult your repair material supplier for proper repair unit selection.

Buffing

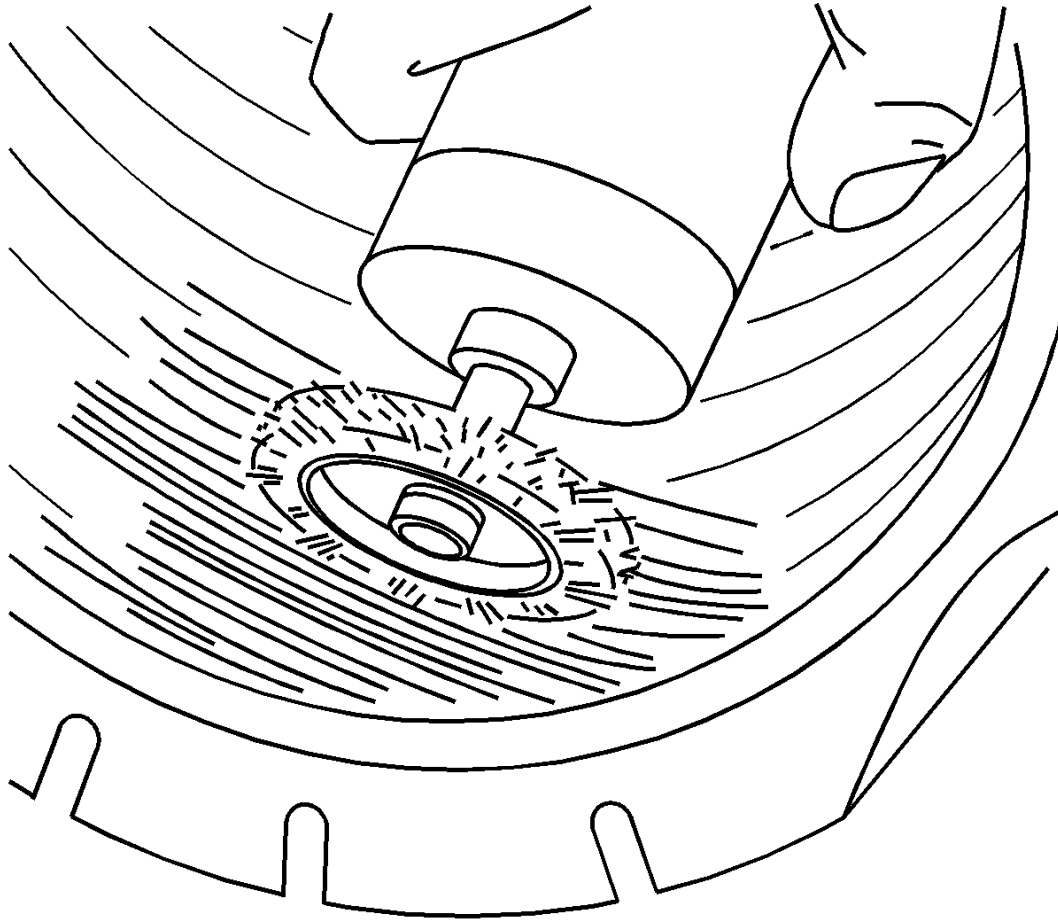


Fig. 20: Buffing Within Marked Area

Courtesy of GENERAL MOTORS COMPANY

1. To prevent contamination and preserve the outline, buff within the marked area thoroughly and evenly with a low speed buffing tool using a fine wire brush or gritted rasp.
2. Buff to a smooth velvet surface (RMA #1 or #2 buffed texture).
3. Use caution not to gouge the inner liner or expose casing fabric.
4. Remove any buffing dust with a vacuum cleaner.
5. Consult your repair material supplier for a proper buffing tool.

Cementing

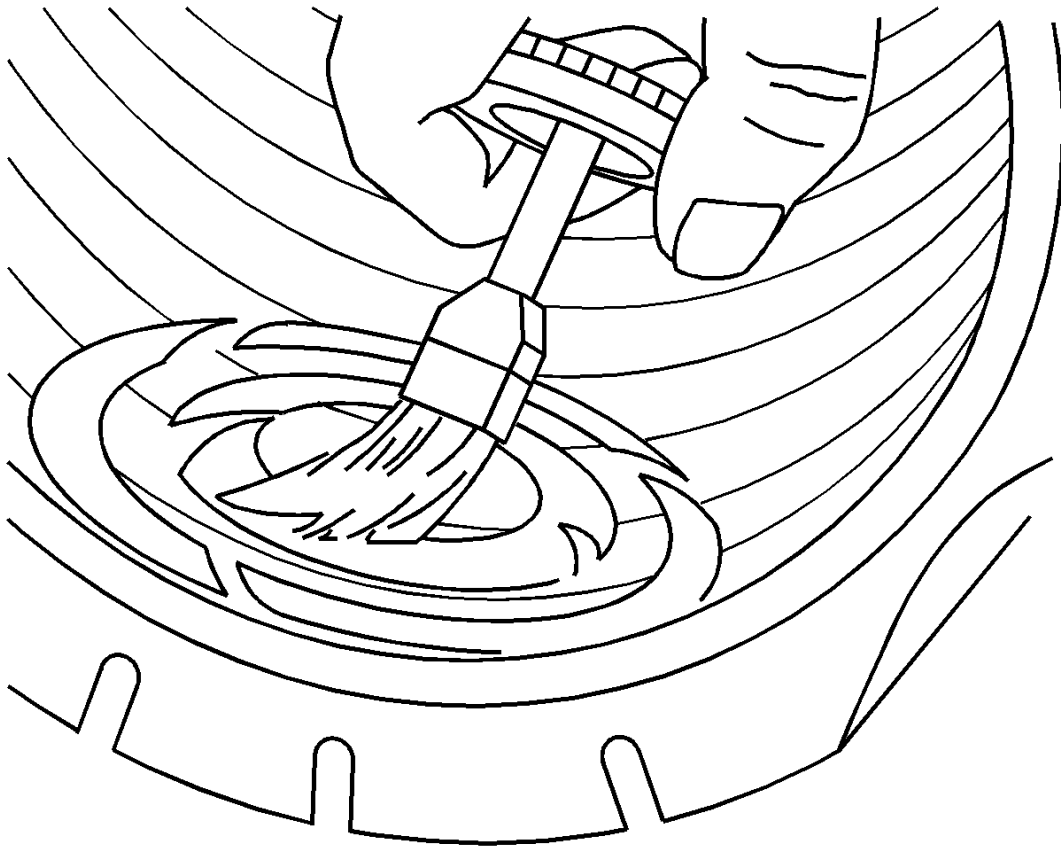


Fig. 21: Applying Chemical Cement

Courtesy of GENERAL MOTORS COMPANY

Apply chemical cement according to the repair material manufacturer's procedures.

Repair Unit Application

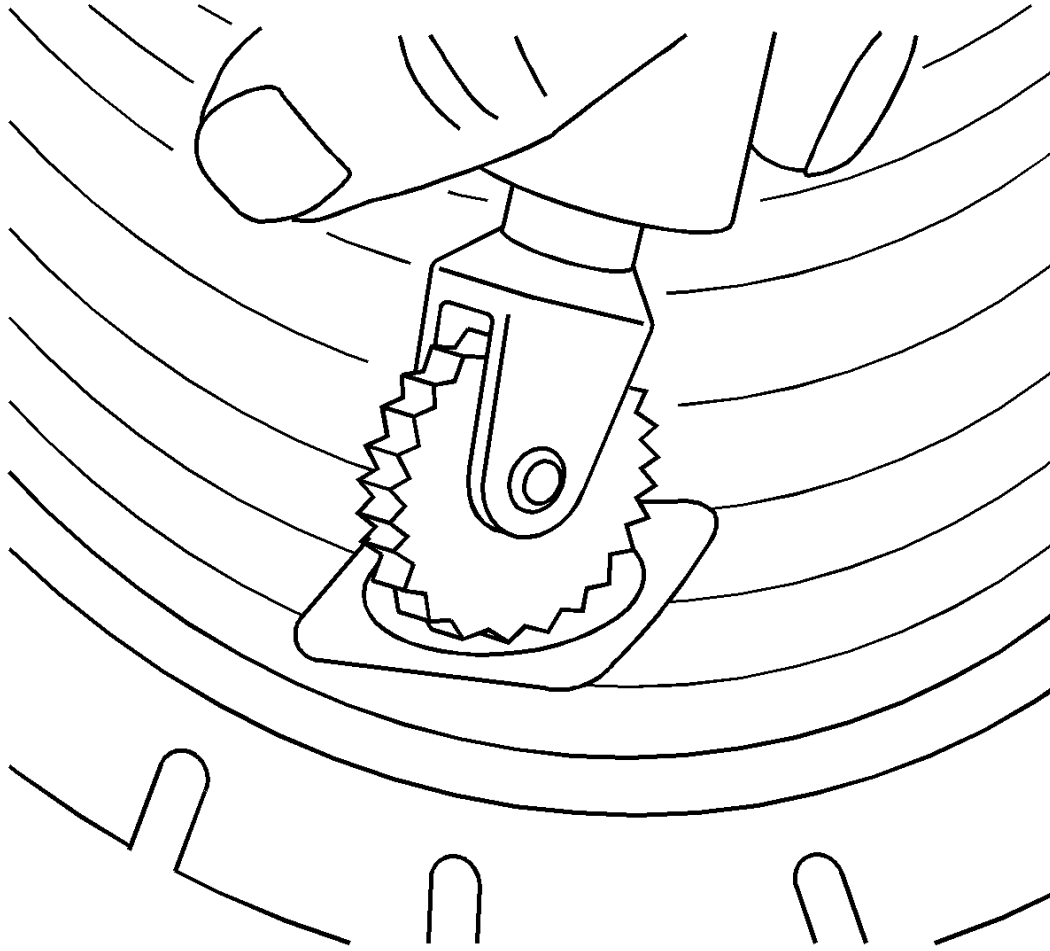


Fig. 22: Installing Repair Unit

Courtesy of GENERAL MOTORS COMPANY

The tire must be in the relaxed position when the repair unit is installed. Do not spread the beads excessively.

Two-Piece Plug and Repair Units

1. If applicable, install the repair unit so that the alignment is correct.
2. Center the repair unit over the injury and stitch down thoroughly with the stitching tool, working from the center out.

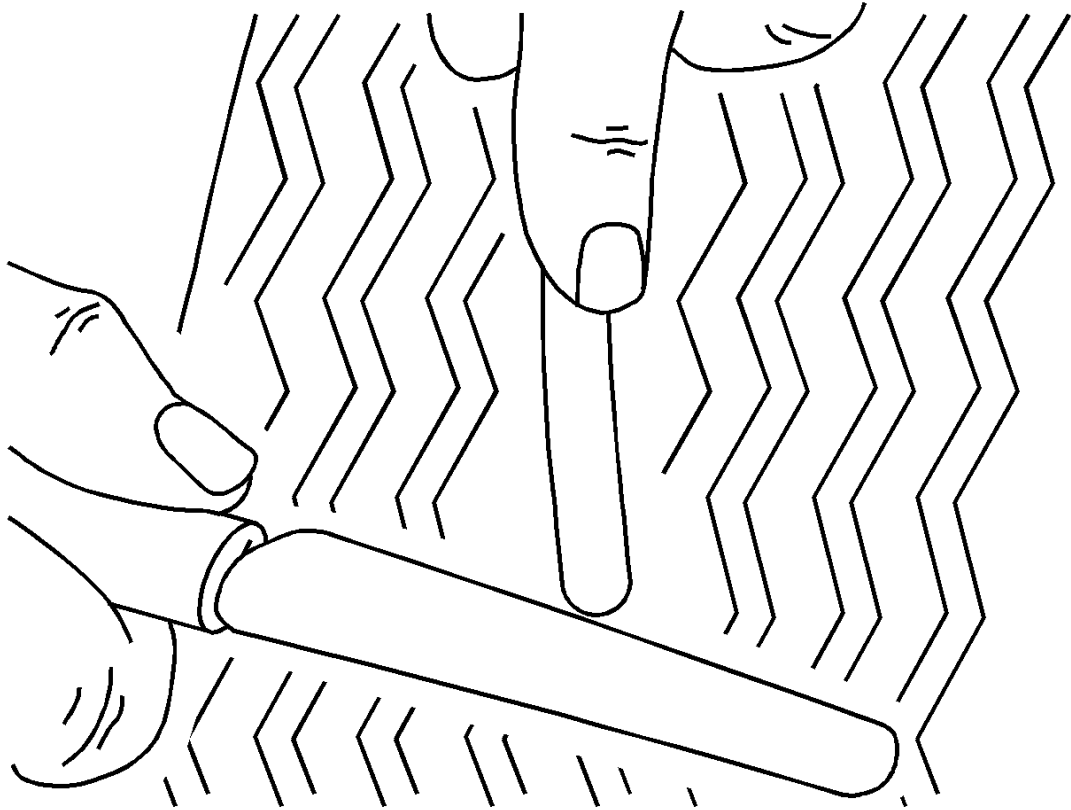


Fig. 23: Cutting Plug Material

Courtesy of GENERAL MOTORS COMPANY

3. Being careful not to stretch the plug material, cut the plug flush with the outer tread.

Combination Repair/Plug Units

1. Pull the plug through the injury until the repair just reaches the liner. Stitch down thoroughly.
2. Follow the repair material manufacturer's recommendations for further installation instructions.

Consult your repair material supplier for the proper stitching tool.

Safety Cage

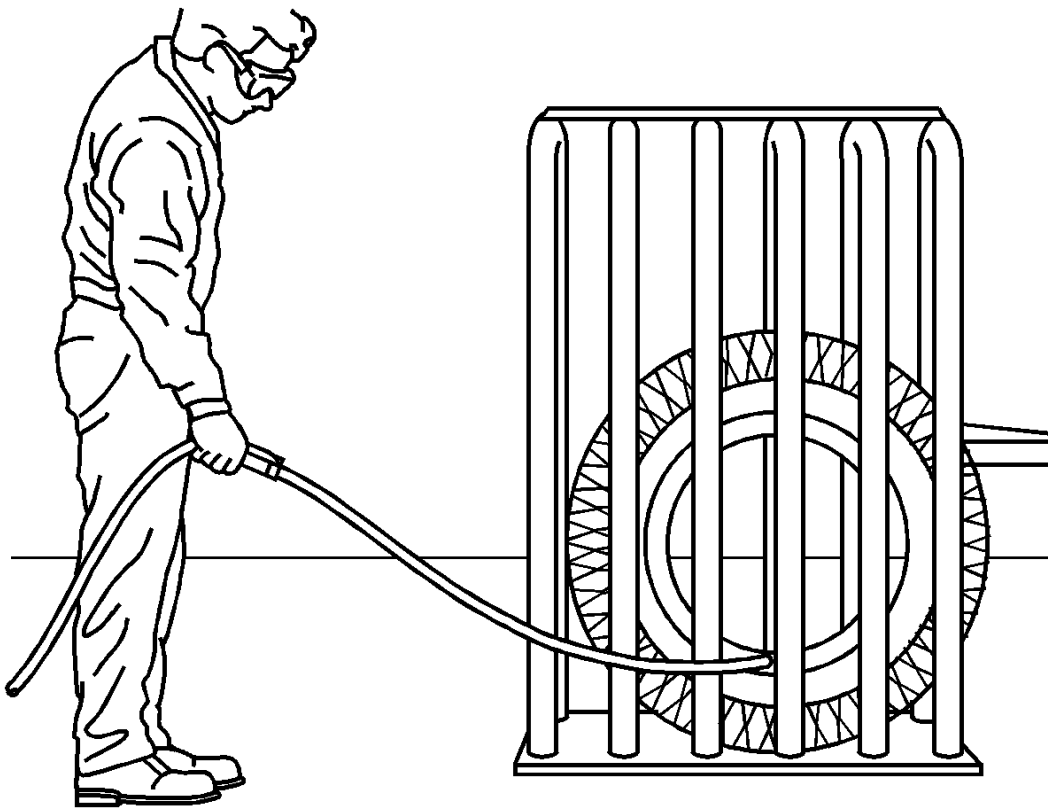


Fig. 24: Identifying Safety Cage

Courtesy of GENERAL MOTORS COMPANY

Some run flat tires and high performance tires may require more than 275 kPa (40 psi) to seat the bead. In such a case, a tire safety cage must be used. Consult the tire manufacturer for its individual repair policy.

Final Inspection

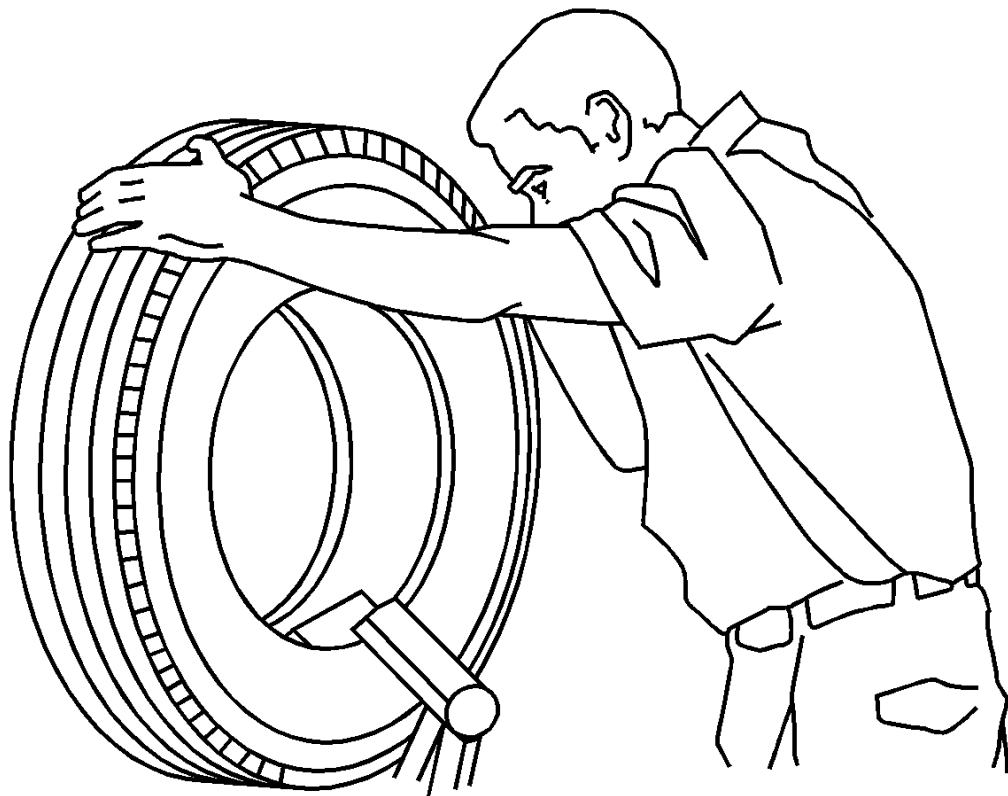


Fig. 25: Performing Final Inspection

Courtesy of GENERAL MOTORS COMPANY

1. After remounting and inflating the tire, check both beads, the repair and the valve with a water and soap solution in order to detect leaks.
2. If the tire continues to lose air, the tire must be demounted and reinspected.
3. Balance the tire and wheel assembly. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle** .

For additional tire puncture repair information, contact:

Rubber Manufacturers Association (RMA)

1400 K Street, N.W., Suite 900

Washington

DC

20005-2403

Telephone: 202-682-4800

E-mail: info@rma.org

Website: www.rma.org

TIRE DISMOUNTING AND MOUNTING

CAUTION: Use a tire changing machine in order to dismount tires. Do not use hand tools or tire irons alone in order to remove the tire from the wheel. Damage to the tire beads or the wheel rim could result.

CAUTION: Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.

CAUTION: Damage to either the tire bead or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting procedures. It takes up to 70 seconds for all of the air to completely exhaust from a large tire. Failure to follow the proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy, and under severe usage lead to wheel cracking.

1. Remove the valve core from the valve stem.
2. Deflate the tire completely.

NOTE: Rim-clamp European-type tire changers are recommended.

3. Use the tire changer in order to remove the tire from the wheel. Follow steps 4 - 7 to remove the tire from the wheel.

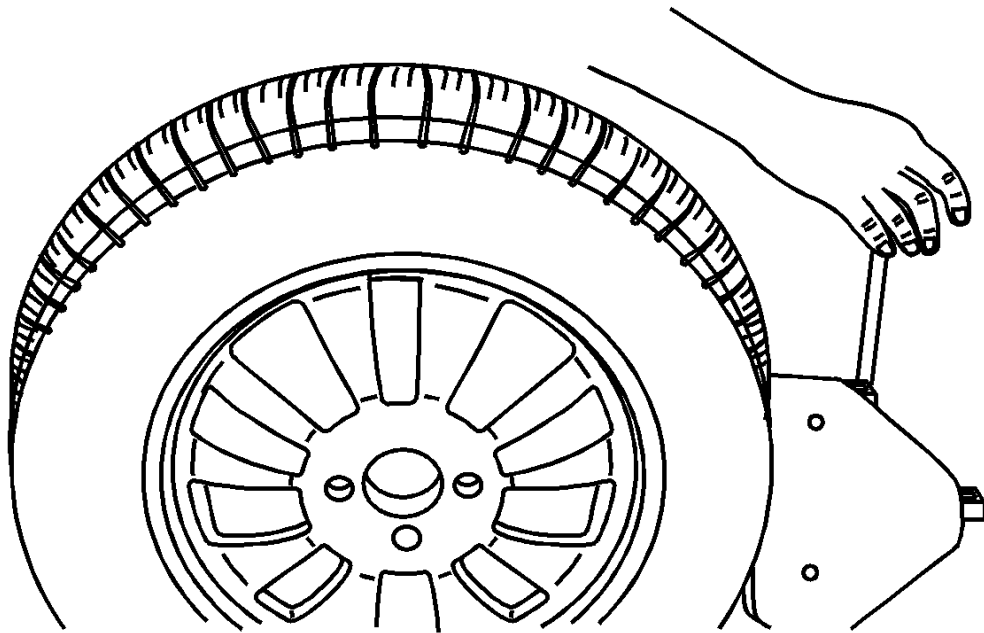


Fig. 26: Tire Changer

Courtesy of GENERAL MOTORS COMPANY

4. When separating the tire bead from the wheel, position the bead breaking fixture 90, 180 and 270 degrees from the valve stem.

CAUTION: Failure to position valve stem in proper position while dismounting and mounting the tire may result in the TPM sensor to become damaged.

5. Position the wheel and tire so the valve stem is at the 7 o'clock position relative to the head. Apply tire bead lubricant to the pry bar to prevent damage to the tire bead. The tire iron or pry bar can be inserted when prying the outer tire bead up and over the mounting/dismounting head.

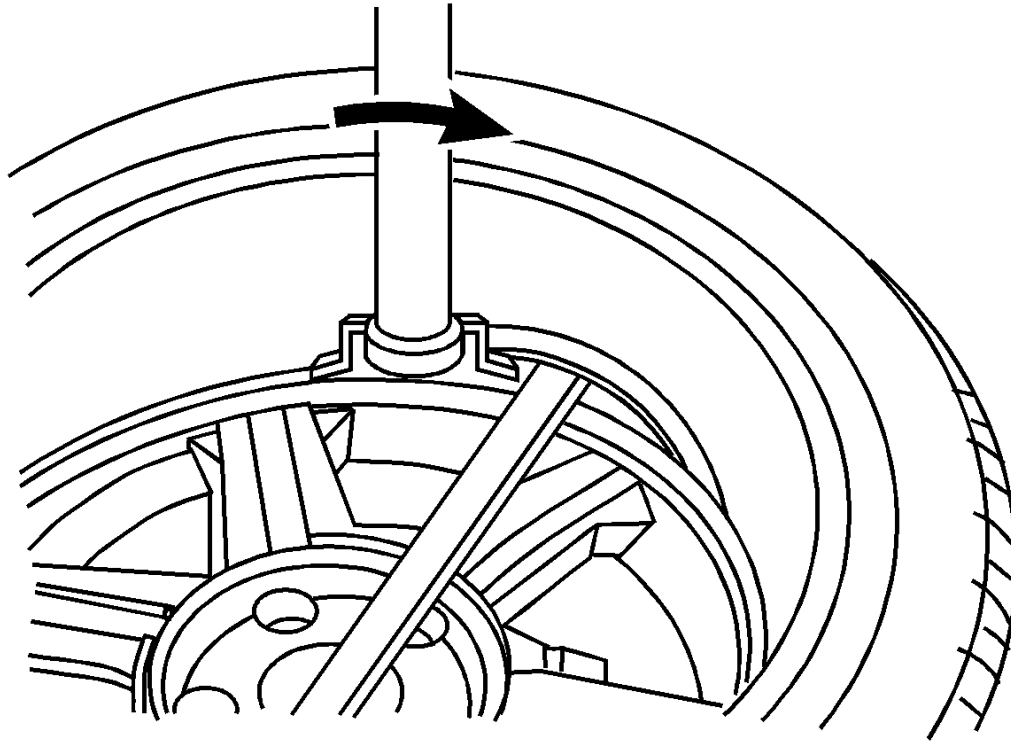


Fig. 27: Separating Tire Bead from Wheel

Courtesy of GENERAL MOTORS COMPANY

6. Position the wheel and tire so the valve stem is again at the 7 o'clock position relative to the head. The tire iron or pry bar can be inserted when prying the inner tire bead up and over the mounting/dismounting head.
7. Remove all residual liquid sealant from the inside of the tire and wheel surfaces. If any tire sealant is noted upon tire dismounting on vehicles equipped with TPM, replace the tire pressure sensor. Refer to [Tire Pressure Indicator Sensor Replacement](#).
8. Use medium coarseness steel wool in order to remove any rubber, light rust or corrosion from the wheel bead seats.

CAUTION: When mounting the tires, use an approved tire mounting lubricant. **DO NOT** use silicon or corrosive base compounds to lubricate the tire bead and the wheel rim. A silicon base compound can cause the tire to slip on the rim. A corrosive type compound can cause tire or rim deterioration.

9. Apply mounting lubricant to the tire bead and the wheel rim. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#).

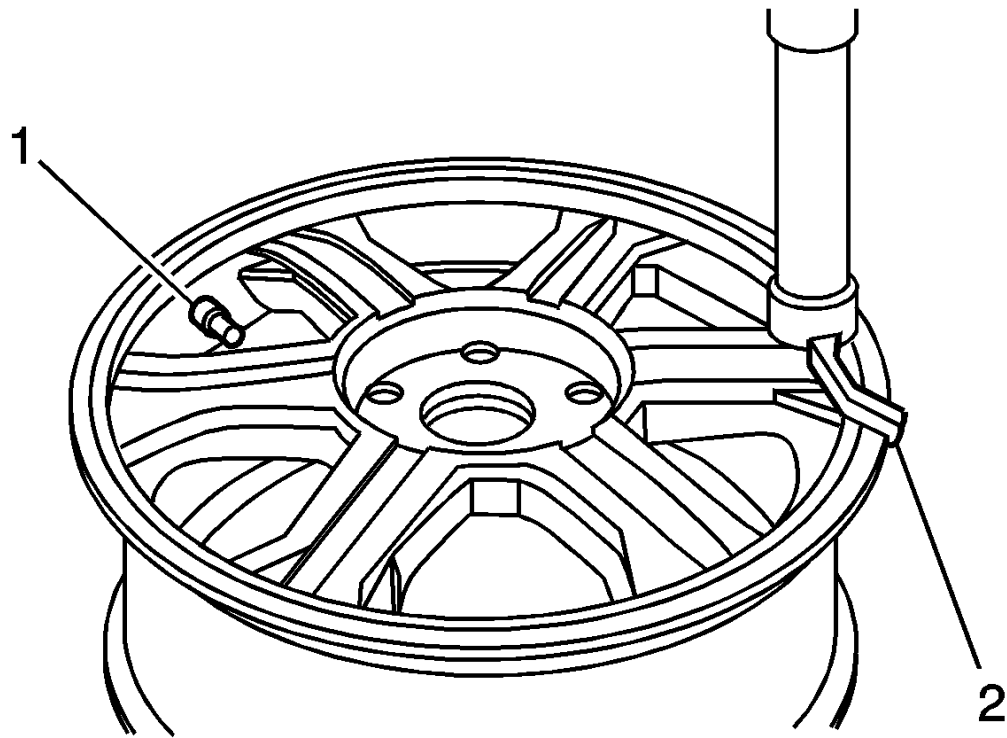


Fig. 28: Position Rim So Valve Stem Is At 7 O'clock Position Relative To Head

Courtesy of GENERAL MOTORS COMPANY

10. Position the rim so the valve stem (1) is at the 7 o'clock position relative to the head (2). This will protect the sensor when the bottom bead seats.

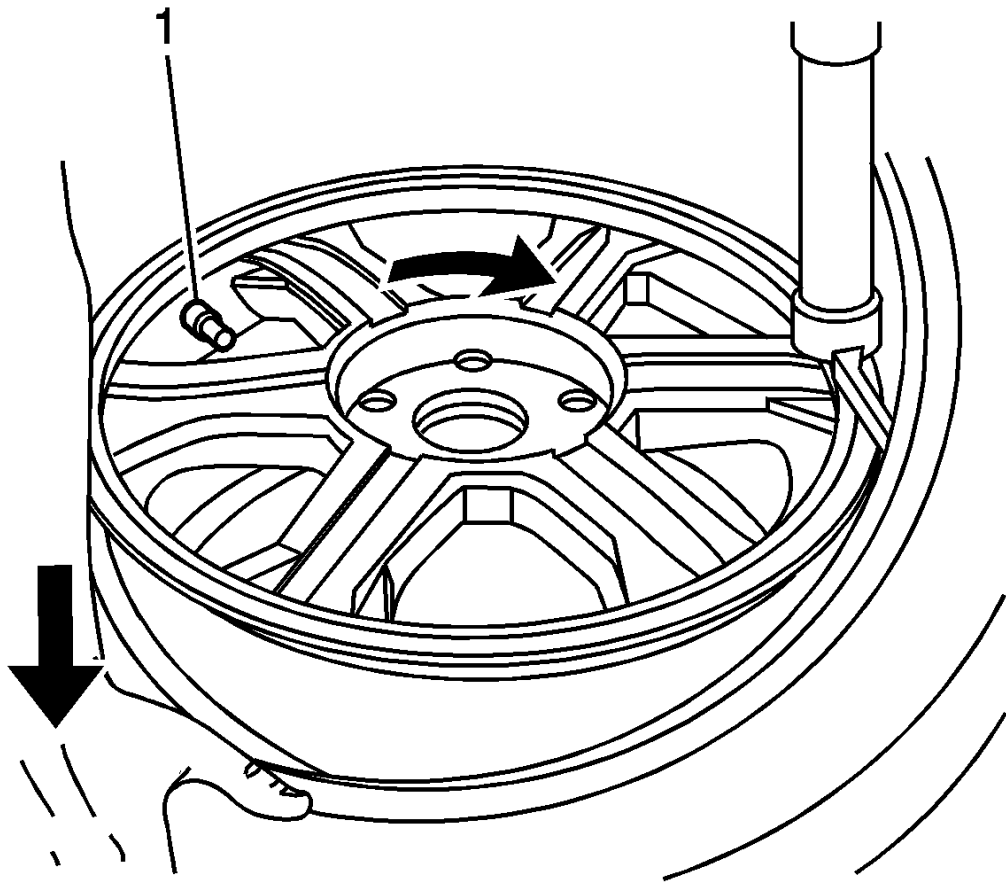


Fig. 29: Ensure Valve Stem Is At 7 O'clock Position

Courtesy of GENERAL MOTORS COMPANY

11. Using the tire machine, rotate the tire/wheel assembly clockwise when transferring the tire bead to the inside of the wheel rim. Ensure that the valve stem (1) is at the 7 o'clock position.

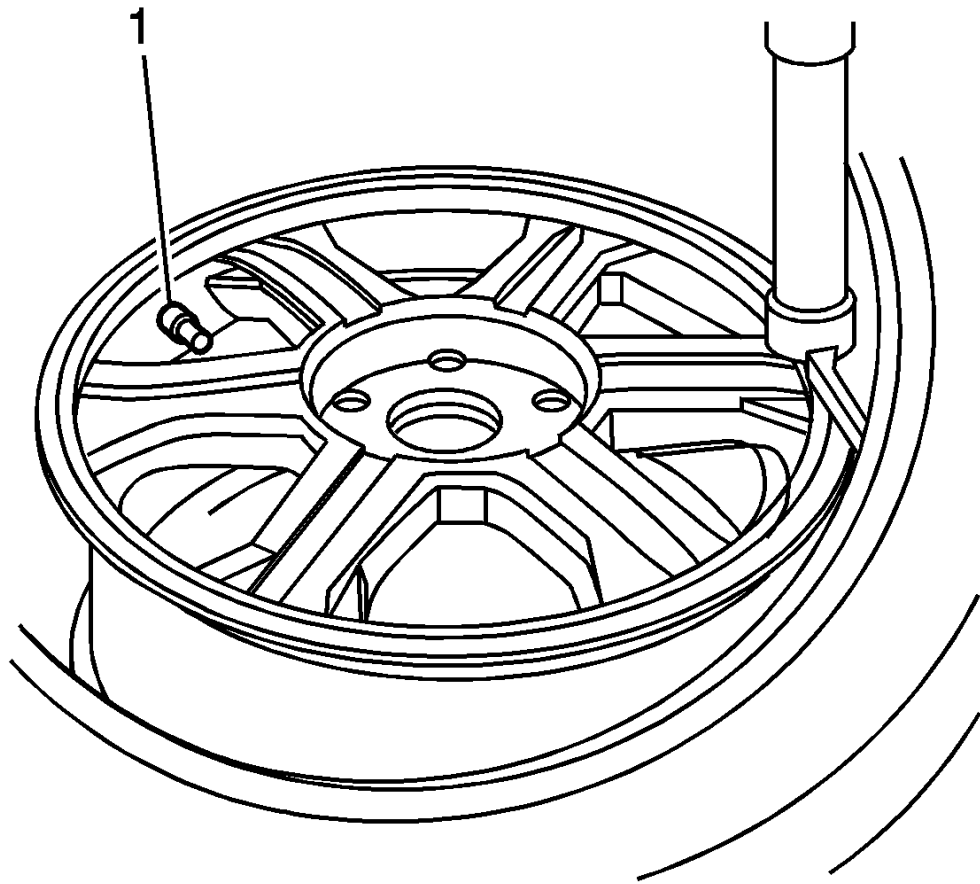


Fig. 30: Reposition Wheel And Tire So Valve Stem Is At 7 O'clock Position Relative To Head
Courtesy of GENERAL MOTORS COMPANY

12. After the bottom bead is on the wheel, reposition the wheel and tire so that the valve stem (1) is at the 7 o'clock position relative to the head. This will protect the sensor while mounting the tire bead to the outside of the wheel.

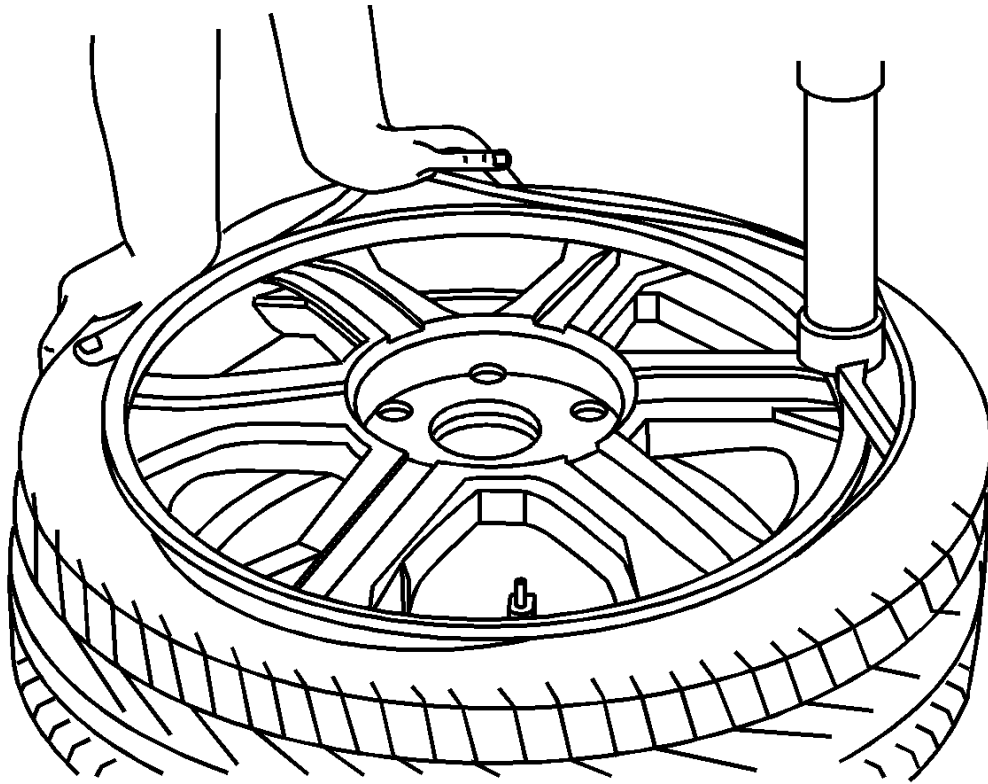


Fig. 31: Using Tire Changer

Courtesy of GENERAL MOTORS COMPANY

13. Use the tire changer in order to install the tire to the wheel.

WARNING: To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

14. Inflate the tire until it passes the bead humps. Be sure that the valve core is not installed at this time.

15. Install the valve core to the valve core stem.

16. Inflate the tire to the proper air pressure.

17. Ensure that the locating rings are visible on both sides of the tire in order to verify that the tire bead is fully seated on the wheel.

TIRE ROTATION

Rotate the tire and wheel assemblies at frequent intervals to equalize wear. Refer to [Maintenance Schedule](#) . In addition to scheduled rotation, rotate the tire and wheel assembly whenever uneven tire wear is noticed.

Radial tires tend to wear faster in the shoulder area, particularly in front positions. Radial tires in non-drive locations may develop an irregular wear pattern that may increase tire noise. This makes regular rotation especially necessary.

Refer to [Tire and Wheel Removal and Installation](#).

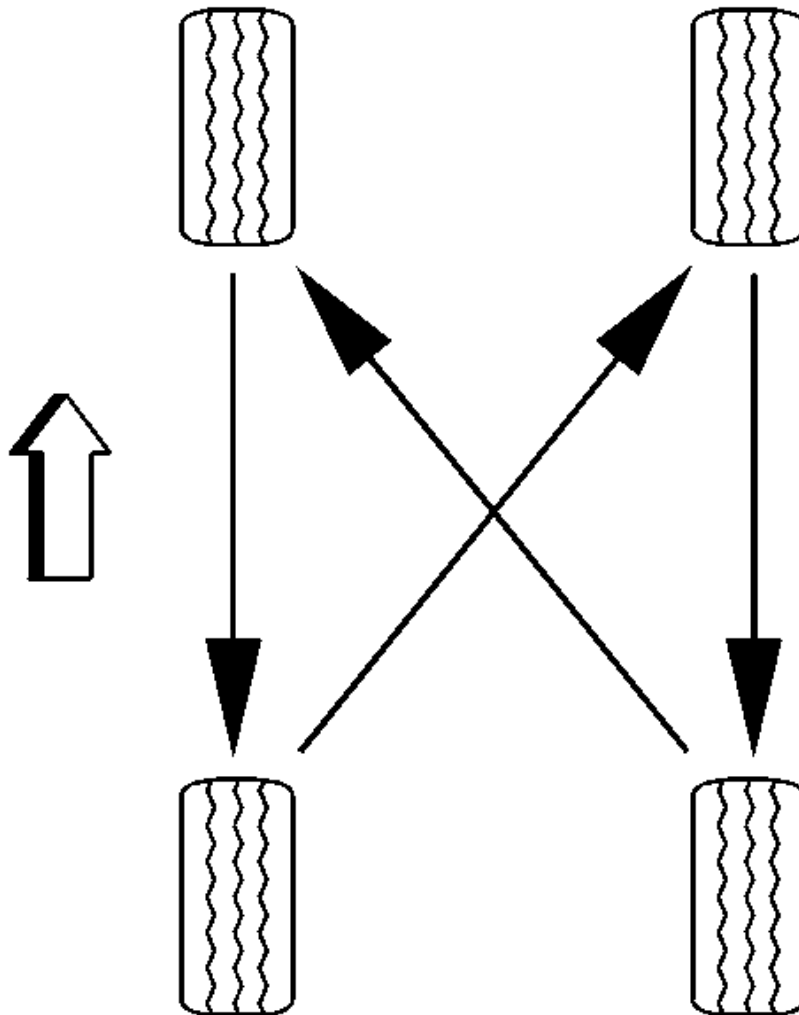


Fig. 32: Identifying Tire Rotation Pattern

Courtesy of GENERAL MOTORS COMPANY

Always use a 4-wheel rotation. After rotation, check the wheel nuts for specified torque. Then set the tire pressure.

TIRE AND WHEEL BALANCING

WARNING: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

- Clean away any dirt or deposits from the inside of the wheels.
- Remove any stones from the tread.
- Wear eye protection.
- Use coated weights on aluminum wheels.

Tire and Wheel Assembly Balancer Calibration

Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

NOTE: If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's recommendations, or perform the following test.

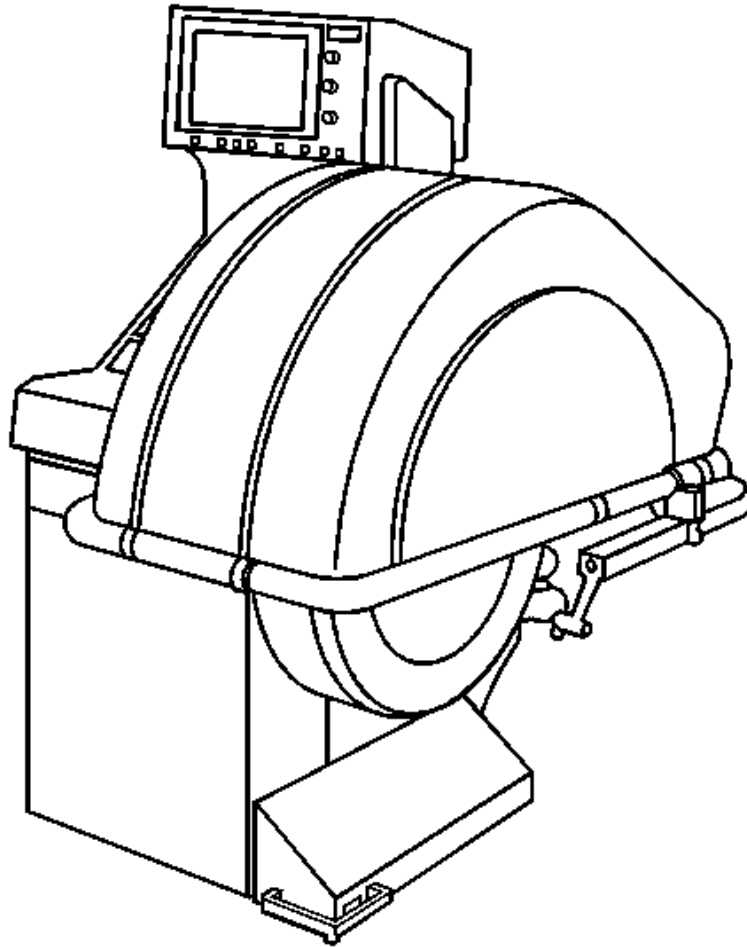


Fig. 33: View Of Tire & Wheel Assembly Balancer

Courtesy of GENERAL MOTORS COMPANY

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

Specification

Zero within 7 g (1/4 oz)

3. If the balancer is within the specification range, balance a tire and wheel assembly - that is within radial and lateral runout tolerances - to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
 - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
 - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.

6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.

7. Inspect the balancer readings:

Specification

Maximum variation: 7 g (1/4 oz)

8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.

9. Cycle the balancer with the assembly at the new location.

10. Inspect the balancer readings:

Specification

Maximum variation: 7 g (1/4 oz)

11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

NOTE: Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.

It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to [**Tire and Wheel Assembly Runout Measurement - Off Vehicle**](#) before proceeding.

There are 2 types of tire and wheel balance:

Static Balance

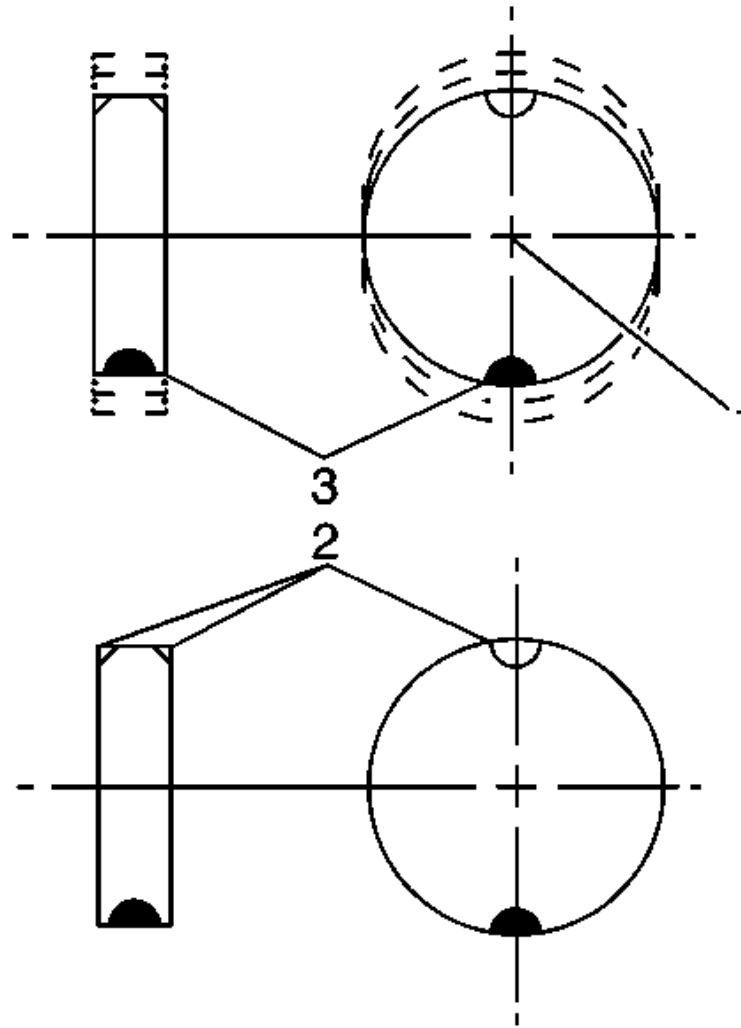


Fig. 34: View Of Static Balance

Courtesy of GENERAL MOTORS COMPANY

Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

Dynamic Balance

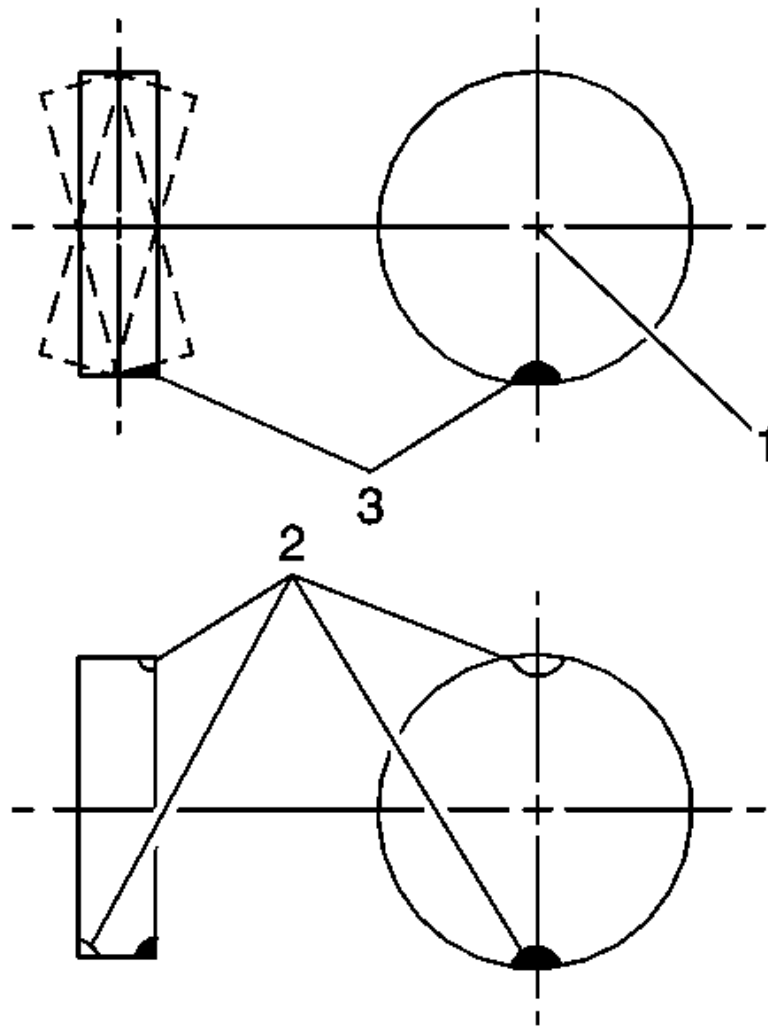


Fig. 35: View Of Dynamic Balance

Courtesy of GENERAL MOTORS COMPANY

Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14 - 21 g (1/2 - 3/4 oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

NOTE: When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.

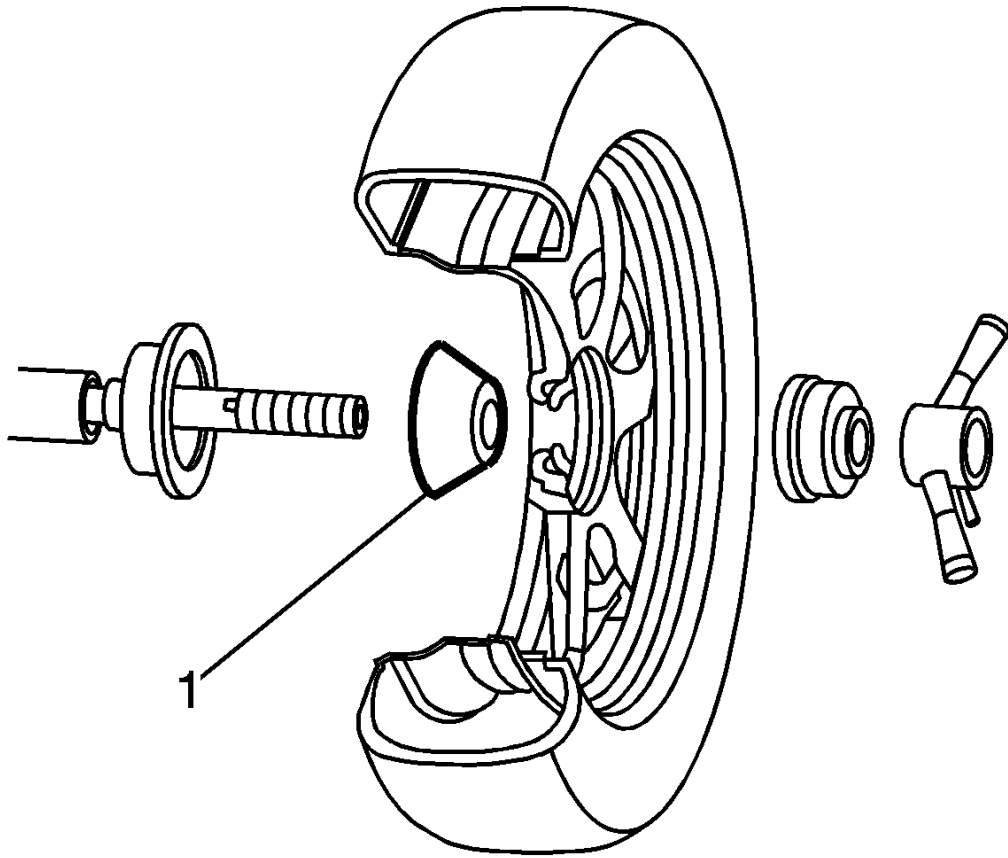


Fig. 36: Wheel Balancer Center Cone

Courtesy of GENERAL MOTORS COMPANY

NOTE: Carefully follow the wheel balancer manufacturers's instructions for proper mounting of the center cone (1).

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. [Tire and Wheel Removal and Installation](#)
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.

Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight

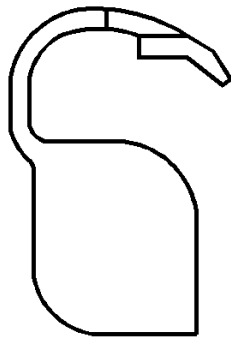
Usage.

6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. **Tire and Wheel Removal and Installation**
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

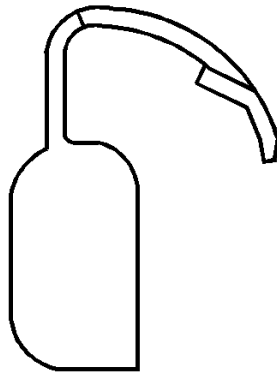
Clip-on Weights



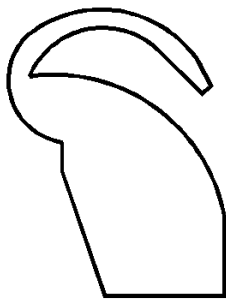
1



4



2



3

Fig. 37: Identifying Clip-On Wheel Weight Types

Courtesy of GENERAL MOTORS COMPANY

NOTE:

When balancing factory aluminum wheels with clip-on wheel balance weights, be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.
- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.

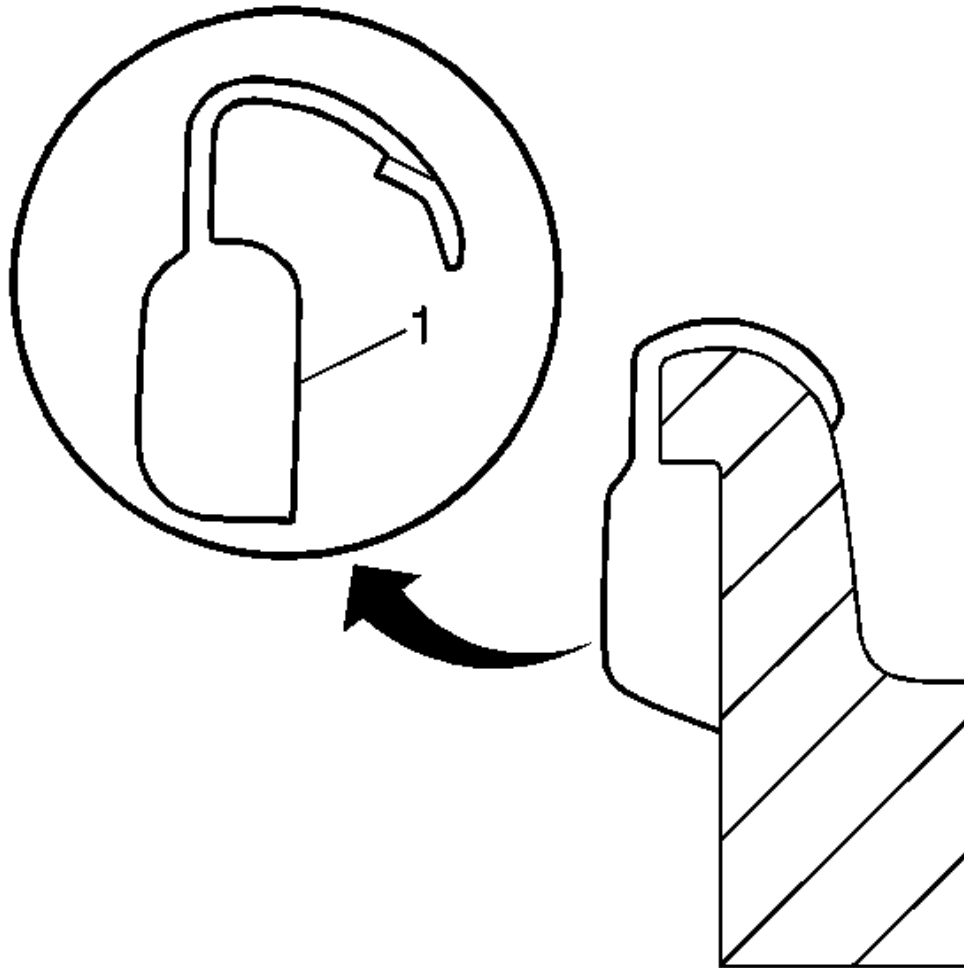


Fig. 38: Attaching Clip-On Wheel Weight

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement - Clip-on Weights

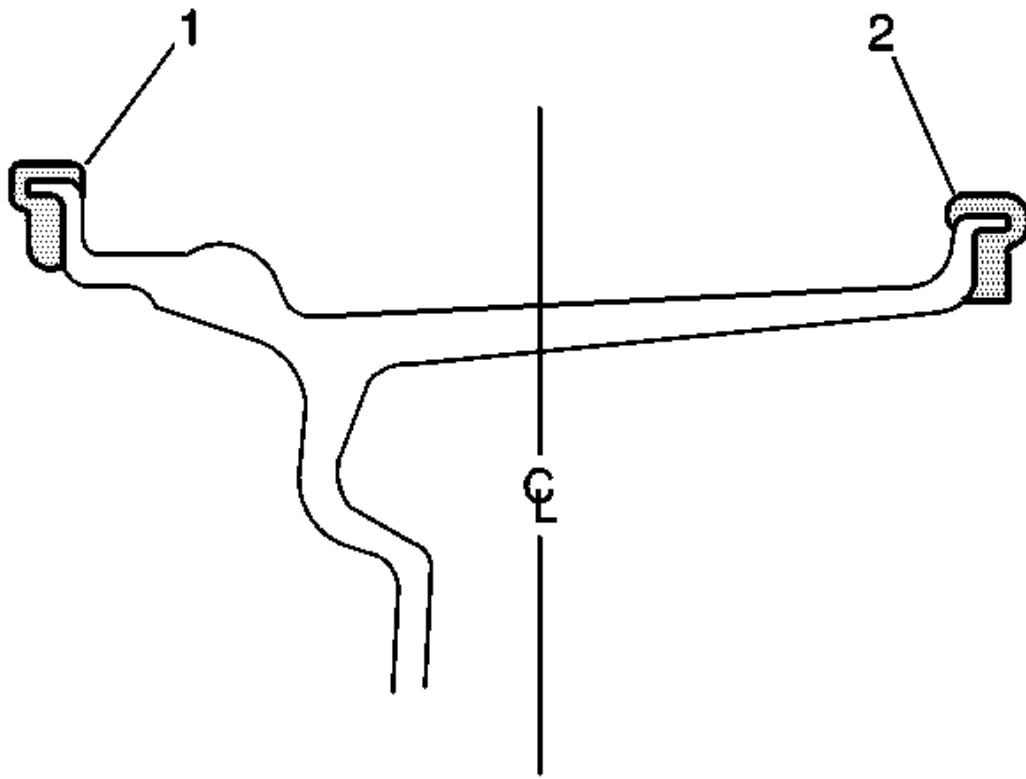


Fig. 39: Clip-On Weight Placement

Courtesy of GENERAL MOTORS COMPANY

When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights

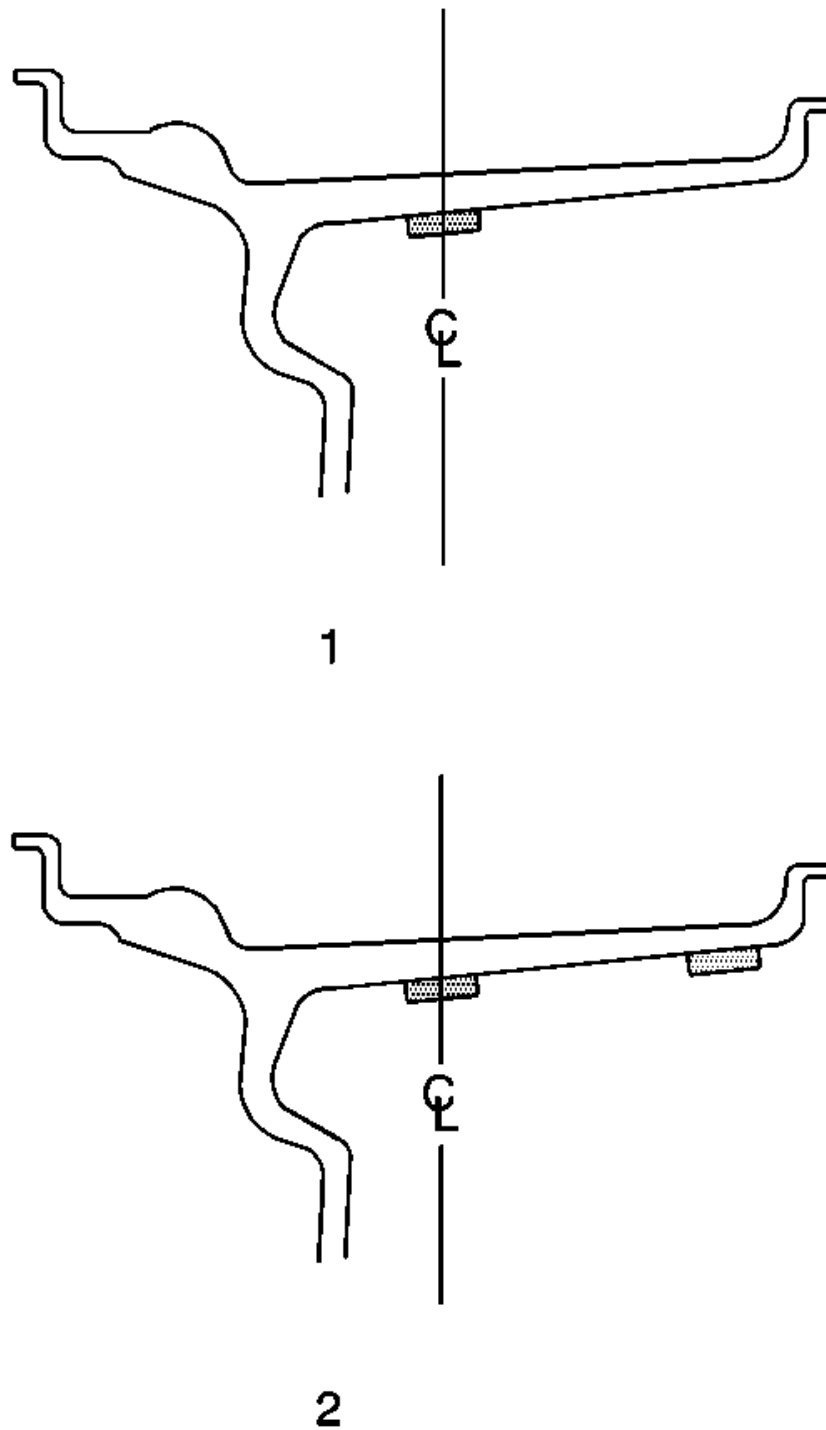


Fig. 40: Identifying Adhesive Weight Wheel Placement

Courtesy of GENERAL MOTORS COMPANY

NOTE: When installing adhesive balance weights on flangeless wheels, do NOT install the weight on the outboard surface of the rim.

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to

install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.
 - When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
 - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel balancer.
2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

NOTE: Do not use abrasives to clean any surface of the wheel.

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

DESCRIPTION AND OPERATION

ALL SEASONS TIRES DESCRIPTION

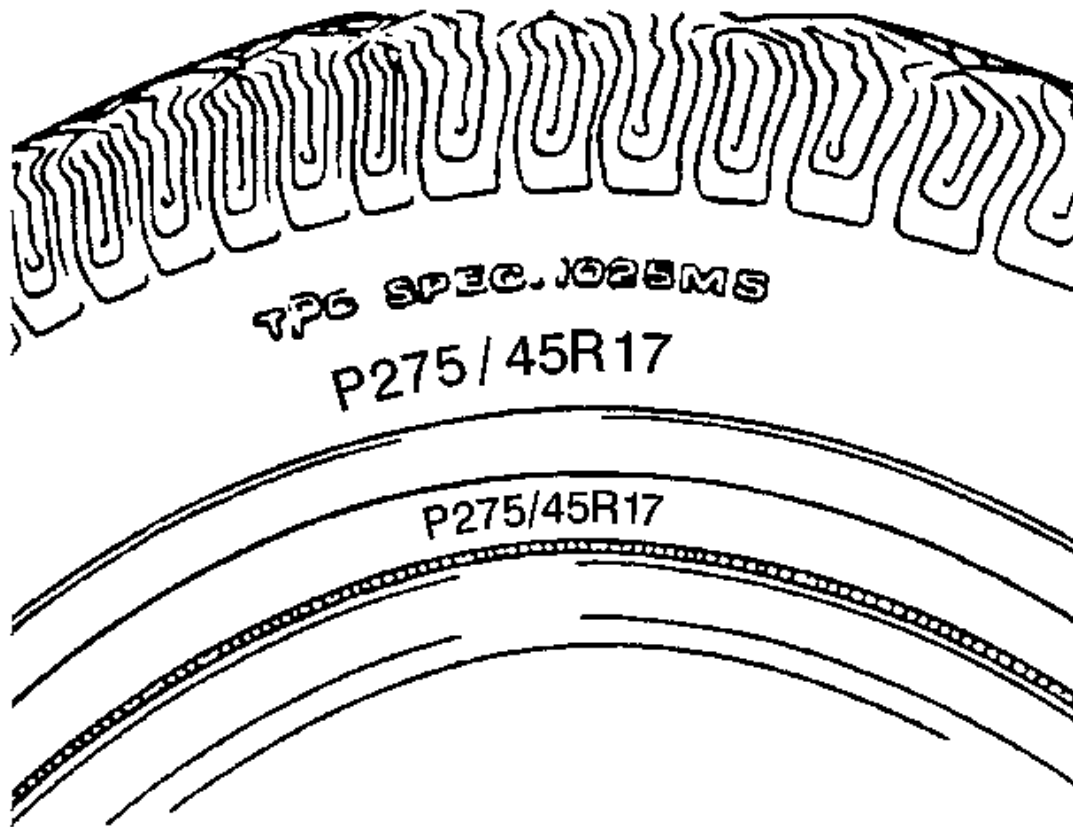


Fig. 41: Identifying All Seasons Tire Marking

Courtesy of GENERAL MOTORS COMPANY

Most GM vehicles are equipped with steel belted all-season radial tires as standard equipment. These tires qualify as snow tires, with a higher than average rating for snow traction than the non-all season radial tires previously used. Other performance areas, such as wet traction, rolling resistance, tread life, and air retention, are also improved. This is done by improvements in both tread design and tread compounds. These tires are identified by an M + S molded in the tire side wall after the tire size. The suffix MS is also molded in the tire side wall after the TPC specification number.

The optional handling tires used on some vehicles now also have the MS marking after the tire size and the TPC specification number.

GENERAL DESCRIPTION

The factory installed tires are designed to operate satisfactorily with loads up to and including the full rated load capacity when these tires are inflated to the recommended pressures.

The following factors have an important influence on tire life:

- Correct tire pressures
- Correct wheel alignment
- Proper driving techniques
- Tire rotation

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

METRIC WHEEL NUTS AND BOLTS DESCRIPTION

Metric wheel/nuts and bolts are identified in the following way:

- The wheel/nut has the word Metric stamped on the face.
- The letter M is stamped on the end of the wheel bolt.

The thread sizes of metric wheel/nuts and the bolts are indicated by the following example: M12 x 1.5.

- M = Metric
- 12 = Diameter in millimeters
- 1.5 = Millimeters gap per thread

P-METRIC SIZED TIRES DESCRIPTION

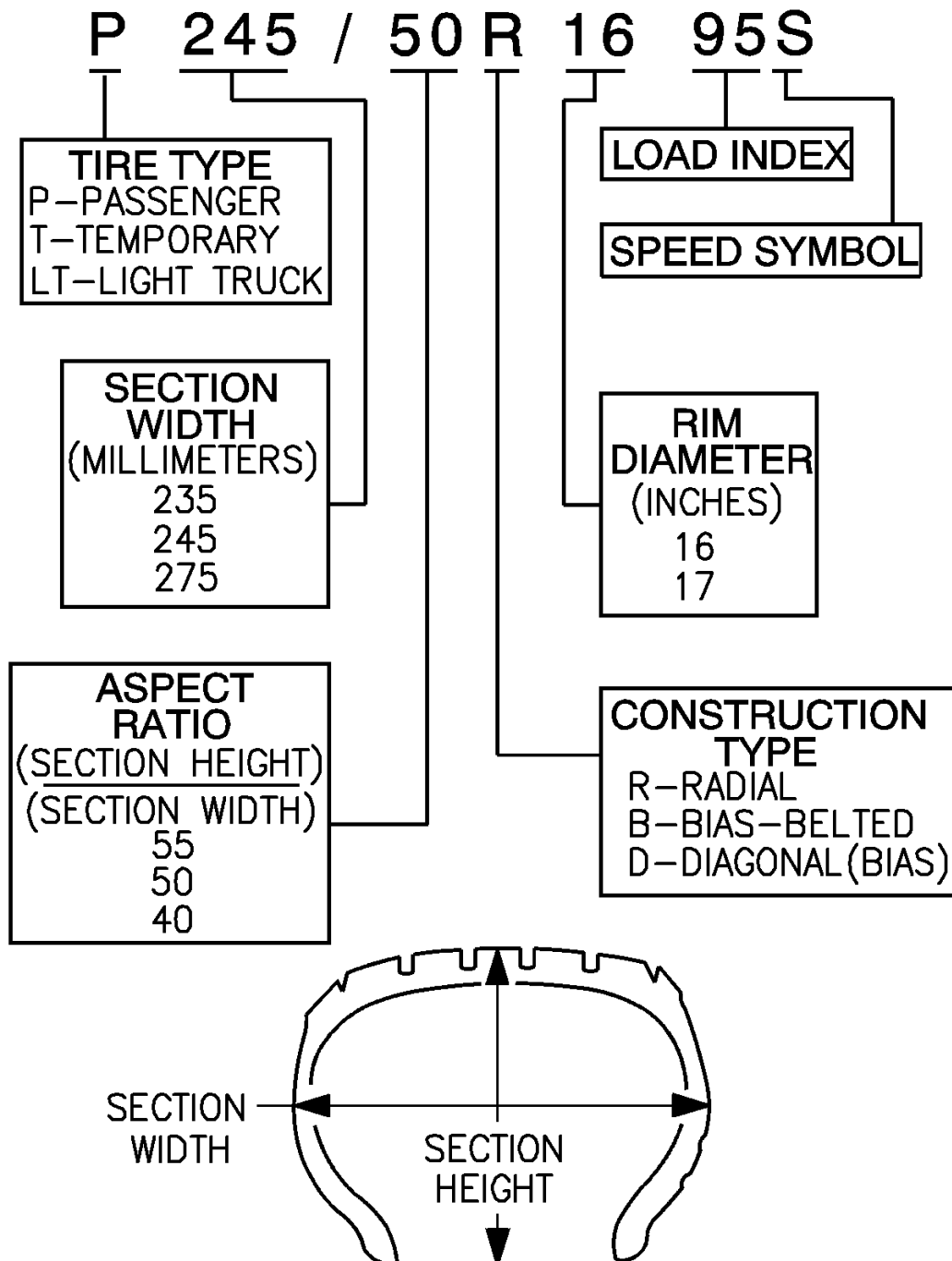


Fig. 42: Identifying P-Metric Sized Tire Marking
Courtesy of GENERAL MOTORS COMPANY

Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. Replacement tires should be of the same tire performance criteria TPC specification number including the same size, the same load range, and the same construction as those originally installed on the vehicle. Consult a tire dealer if you must replace the P-metric tire with other sizes. Tire companies can best recommend the closest match of alphanumeric to

P-metric sizes within their own tire lines. The above illustration may not correspond with your vehicle, but is meant as an example.

REPLACEMENT WHEELS DESCRIPTION

Replace the wheel if any of the following conditions exist:

- The wheel exhibits excessive runout.
- The wheel is bent.
- The wheel is cracked.
- The wheel is severely rusted.
- The wheel is severely corroded.

NOTE: Air leaks caused by porosity on aluminum wheels are repairable.

- The wheel leaks air.

WARNING: If you are replacing the wheel(s), the wheel stud(s), the wheel nut(s) or the wheel bolt(s), install only new GM original equipment parts. Installation of used parts or non-GM original equipment parts may cause the wheel to loosen, loss of tire air pressure, poor vehicle handling and loss of vehicle control resulting in personal injury.

CAUTION: The use of non-GM original equipment wheels may cause:

- Damage to the wheel bearing, the wheel fasteners and the wheel
- Tire damage caused by the modified clearance to the adjacent vehicle components
- Adverse vehicle steering stability caused by the modified scrub radius
- Damage to the vehicle caused by the modified ground clearance
- Speedometer and odometer inaccuracy

Replace the wheel, the wheel studs and the wheel/nuts, or the wheel bolts if applicable, if any of the following conditions exist:

- The wheel has elongated bolt holes.
- The wheel/nuts, or bolts if applicable, loosen repeatedly.

Steel wheel identification is stamped into the wheel near the valve stem.

Aluminum wheel identification is cast into the inboard side of the wheel.

TIRE INFLATION DESCRIPTION

This vehicle has been engineered to operate up to the stated load capacity with wheel and tire assemblies of the type, size, construction, and configuration as originally installed. Maintenance of the tire inflation pressures is critical to the continued satisfactory performance, handling, and operating economy of the vehicle. Operation

with incorrectly or improperly inflated tires can adversely affect vehicle performance and may contribute to the following:

- Reduced fuel economy
- Tire overloading
- Shortened tire life
- Excessive tire wear
- Uneven tire wear
- Vehicle handling concerns

Inspect the tire pressures when the vehicle has not been driven for at least 3 hours or not more than 1.6 km (1 mi) and when the tires are cool to the touch.

Tire inflation pressures should be inspected monthly and before an extended trip and adjusted to meet the specifications listed for the particular vehicle. Replace any missing or damaged tire valve stem extensions and/or caps to prevent the intrusion of water and contaminants.

One pound per square inch (psi) equals 6.9 kilopascals (kPa). The following table illustrates the conversion of kilopascals to pounds per square inch:

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

For the correct inflation pressures refer to the vehicle's Tire Placard.

Tires inflated to a higher than recommended pressure can contribute to the following conditions:

- A hard ride
- Tire bruising
- Rapid tread wear at the center of the tire

Tires inflated to a lower than recommended pressure can contribute to the following conditions:

- Tire squeal on turns

- Hard steering
- Rapid and/or uneven wear on the outer edges of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Sluggish vehicle handling
- Higher fuel consumption

Unequal pressure on the same axle can cause the following conditions:

- Uneven braking action
- Steering lead
- Imprecise vehicle handling

TREAD WEAR INDICATORS DESCRIPTION

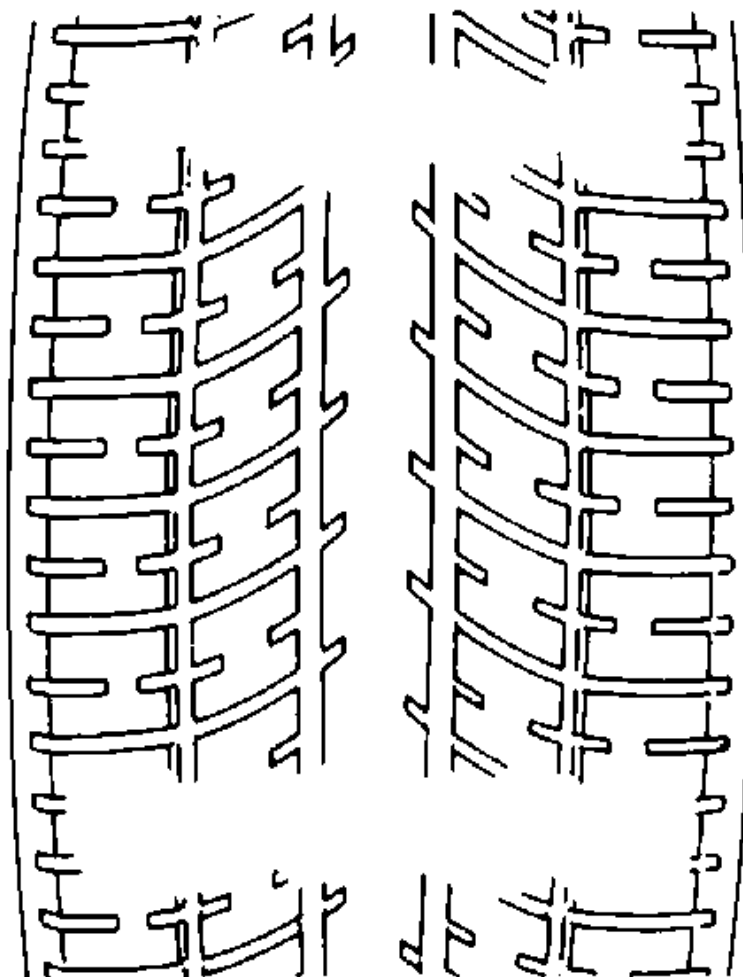


Fig. 43: View Of Tread Wear Indicators

Courtesy of GENERAL MOTORS COMPANY

The original equipment tires have tread wear indicators that show when you should replace the tires.

The location of these indicators are at 60 degree intervals around the outer diameter of the tire. The indicators appear as a 6 mm (0.25 in) wide band when the tire tread depth becomes 1.6 mm (2/32 in).

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

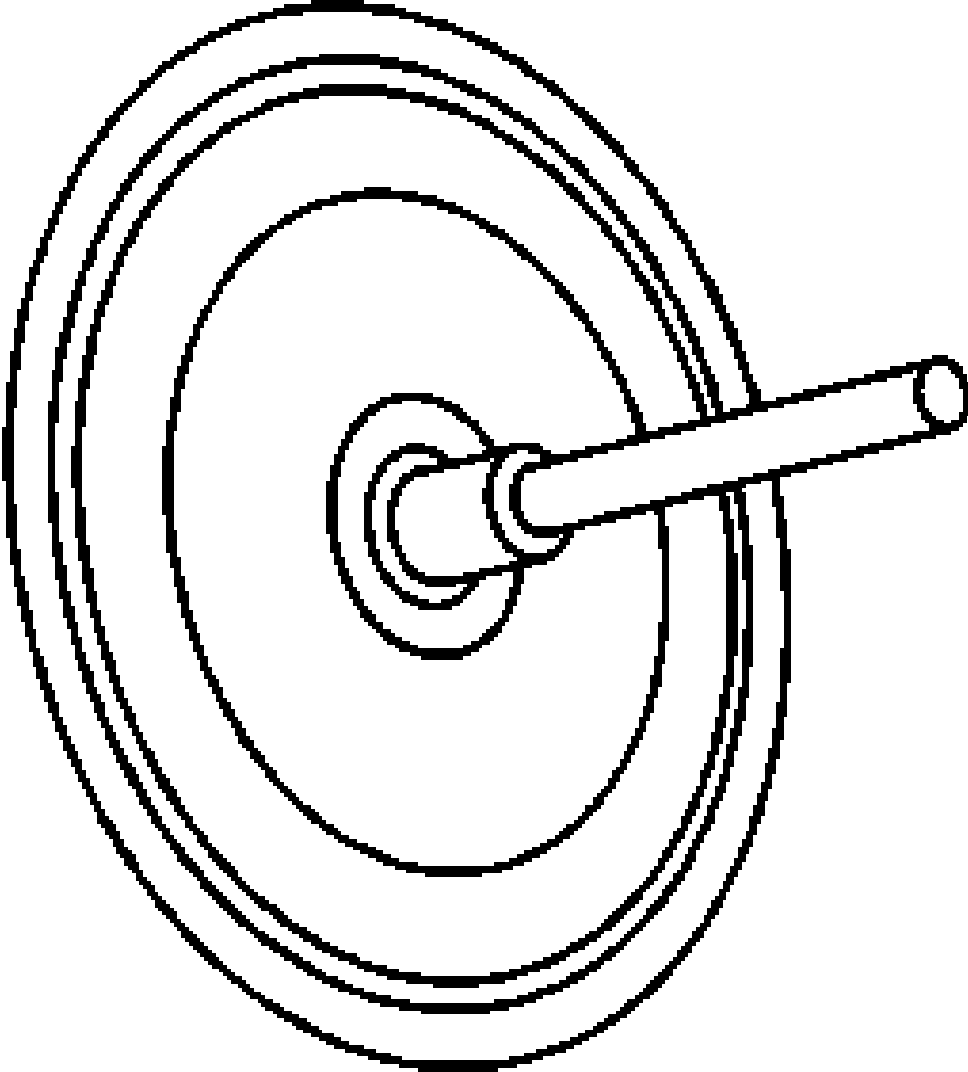
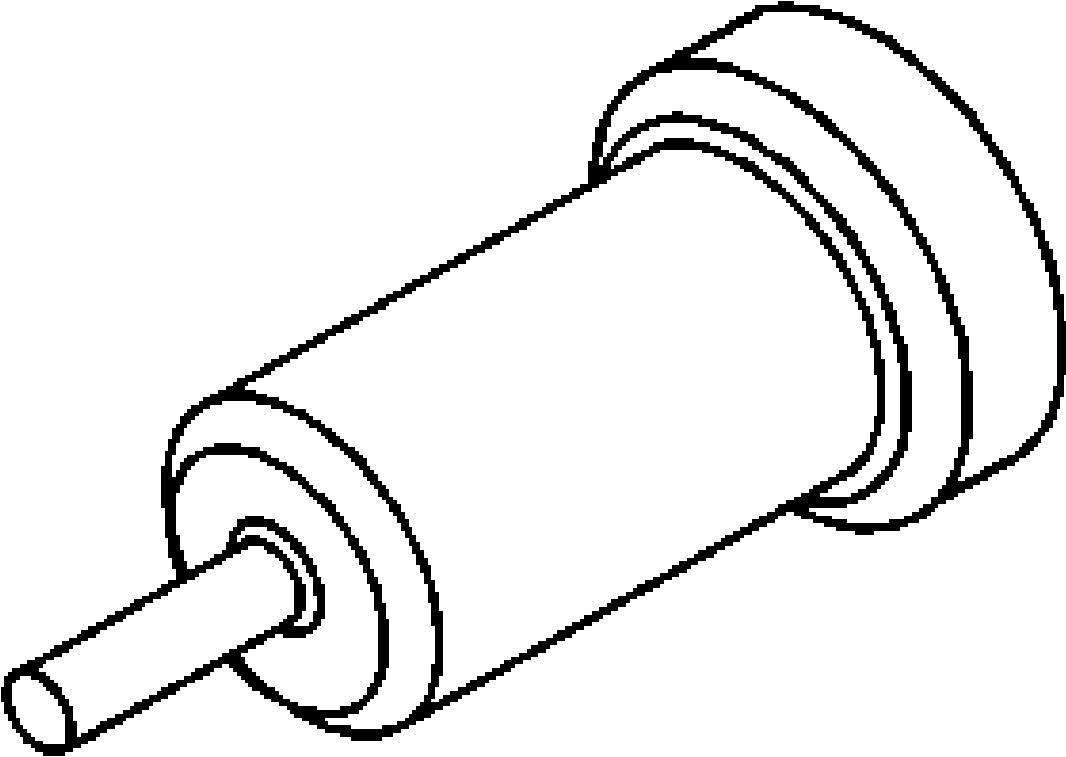
Illustration	Tool Number/ Description
	CH 41013 J 41013 Rotor Resurfacing kit

Illustration	Tool Number/ Description
	CH 42450 - A J 42450 - A Wheel Hub Resurfacing Kit

Article GUID: A00884649

SUSPENSION

Wheel Alignment - Volt

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

NOTE: All specifications are in degrees, convert to angular minutes, if necessary.

Conversion

- 1.00 degree = 60 angular minutes
- 0.75 degrees = 45 angular minutes
- 0.50 degrees = 30 angular minutes
- 0.25 degrees = 15 angular minutes
- 1.00 angular minute = 60 angular seconds

Example

0.14 degrees *	60 angular minutes / degree =	8.40 angular minutes
0.40 angular / minutes *	60 angular seconds / angular minute =	24.00 angular seconds
NOTE: Angular seconds up to 30 are rounded off, angular seconds beyond are rounded up to 60 angular seconds.		
24.00 angular seconds ->	0 angular seconds =	0.00 angular minute
0.14 degrees =	8.40 angular minutes =	8.00 angular minutes
Condition: Full tank, no passengers and placed on plane ground.		

Front and Rear Specifications

Suspension	Camber L / R (°)	Cross Camber (L - R) (°)	Caster L / R (°)	Cross Caster (L - R) (°)	Steering Wheel Angle (°)	Thrust Angle (L - R) / 2 (°)	Total Toe (°)	Toe-in variation with inner wheel deflection of 20° (°)
------------	------------------------	-----------------------------------	------------------------	-----------------------------------	-----------------------------------	--	---------------------	---

Suspension	Camber L / R (°)	Cross Camber (L - R) (°)	Caster L / R (°)	Cross Caster (L - R) (°)	Steering Wheel Angle (°)	Thrust Angle (L - R) / 2 (°)	Total Toe (°)	Toe-in variation with inner wheel deflection of 20° (°)
Front								
McPherson Strut (GNA)	-0.35 ± 0.80	0.00 ± 0.80	4.20 ± 0.80	0.00 ± 0.90	0.00 ± 3.50	-	0.20 ± 0.20	-
Rear								
Compound Crank	-1.40 ± 0.50	-	-	-	-	0.00 ± 0.40	0.20 ± 0.40	-

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Application	Specification
	Metric (English)
Steering Linkage Inner Tie Rod Nut	60 N.m (44 lb ft)

REPAIR INSTRUCTIONS

STEERING WHEEL ALIGNMENT

A steering wheel that is off center is not always the result of improper steering wheel alignment. One possible cause is tire lead due to worn or improperly manufactured tires. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. Refer to [Radial Tire Lead/Pull Correction](#) in order to determine if the vehicle has a tire lead problem. Before aligning the steering wheel the vehicle alignment must also be correct.

Before performing any adjustment affecting wheel alignment, perform the following inspections and adjustments in order to ensure correct alignment :

- Inspect the tires for the proper inflation and irregular tire wear. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) , and [Tire Diagnosis - Irregular or Premature Wear](#) .
- Inspect the steering gear for looseness at the frame. Refer to [Fastener Specifications](#) .
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.

Perform the following steps in order to perform steering wheel alignment adjustment:

1. Tires must be in the straight ahead position.
2. It maybe necessary to have an assistant hold the steering so it does not rotate freely once the steering shaft is disconnected on a vehicle equipped with an SIR system.
3. Disconnect the steering shaft from the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
4. Rotate the intermediate shaft until the steering wheel is visually straight. If the steering wheel is out over a half turn check for other damage on the vehicle.
5. Reconnect the steering shaft to the steering gear. Refer to [Intermediate Steering Shaft Replacement](#) .
6. Verify that the steering wheel is straight.

WHEEL ALIGNMENT MEASUREMENT

Steering and vibration complaints are not always the result of improper alignment. One possible cause is wheel and tire imbalance. Another possibility is tire lead due to worn or improperly manufactured tires. Lead/pull is defined as follows: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. Refer to [Radial Tire Lead/Pull Correction](#) in order to determine if the vehicle has a tire lead problem.

Before performing any adjustment affecting wheel alignment, perform the following inspections in order to ensure correct alignment readings:

- Inspect for visible damage to the suspension components and replace as necessary.
- Inspect the tires for the proper inflation and irregular tire wear. Refer to [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) , and [Tire Diagnosis - Irregular or Premature Wear](#) .
- Inspect the runout of the wheels and the tires. Refer to [Tire and Wheel Runout Specifications](#) .
- Inspect the wheel bearings for backlash and excessive play. Refer to [Wheel Bearings Diagnosis](#) .
- Inspect the ball joints for looseness or wear.
- Inspect the tie rod ends for looseness or wear.
- Inspect the control arms and stabilizer shaft for looseness or wear.
- Inspect the steering gear for looseness at the frame. Refer to [Fastener Specifications](#) .
- Inspect the struts/shock absorbers for wear, leaks, and any noticeable noises. Refer to [Strut and Shock Absorber Inspection](#) , for front and [Strut and Shock Absorber Inspection](#) for rear.
- Inspect the vehicle trim height. Refer to [Trim Height Inspection](#) .
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.
- Inspect the fuel level. The fuel tank should be full or the vehicle should have a compensating load added.

Give consideration to excess loads, such as tool boxes, sample cases, etc. If normally carried in the vehicle, these items should remain in the vehicle during alignment adjustments. Give consideration also to the condition of the equipment being used for the alignment. Follow the equipment manufacturer's instructions.

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, if the setting exceeds the service allowable specifications, correct the alignment to the service preferred specifications. Refer to [Wheel Alignment Specifications](#).

Perform the following steps in order to measure the front and rear alignment angles:

1. Install the alignment equipment according to the manufacturer's instructions.
2. Jounce the front and the rear bumpers 3 times prior to checking the wheel alignment.
3. Measure the alignment angles and record the readings.

NOTE:

- Record the "Before" and "After" alignment measurements.
- When performing adjustments to vehicles requiring a 4-wheel alignment, set the rear toe adjustment first in order to obtain proper front alignment angles.

4. Adjust alignment angles to vehicle specification, if necessary. Refer to [Wheel Alignment Specifications](#).

FRONT CAMBER ADJUSTMENT

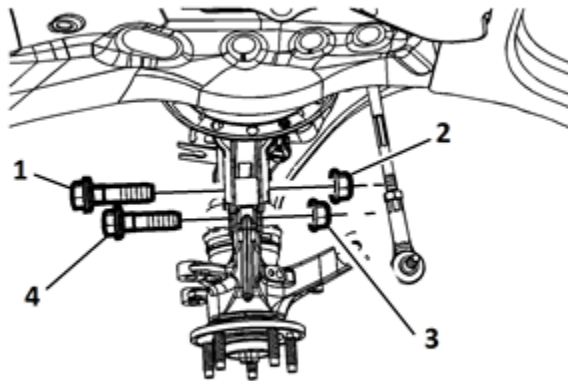


Fig. 1: Front Camber Adjustment Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE:

A Service Bolt is available for the lower strut to steering knuckle position. Do not attempt to file on the strut to make camber adjustment. The service bolt is approximately 2 mm smaller in diameter to allow adjustment. Refer to the electronic parts catalog for proper application.

1. If the front camber is out of specifications, perform the following:
 - Remove the top front strut to steering knuckle nut (2) and the bolt (1). DISCARD the bolt.
 - Replace the top front strut to steering knuckle bolt (1) with the service bolt. (No spines or knurls)
Do not fully tighten the nut.

- Loosen the nut (3) on the bottom bolt (4) enough to allow the strut to move.
 - Adjust the front camber to specifications. [Wheel Alignment Specifications](#)
2. Tighten the top front strut nut (2). [Strut Assembly Removal and Installation](#)
 3. Remove the bottom front strut to steering knuckle nut (3) and the bolt (4). DISCARD the bolt.
 4. Replace the bottom front strut to steering knuckle bolt. Install a NEW splined/knurled bolt.
 5. Tighten the bottom front strut nut. [Strut Assembly Removal and Installation](#)

WHEEL ALIGNMENT - STEERING WHEEL ANGLE AND/OR FRONT TOE ADJUSTMENT

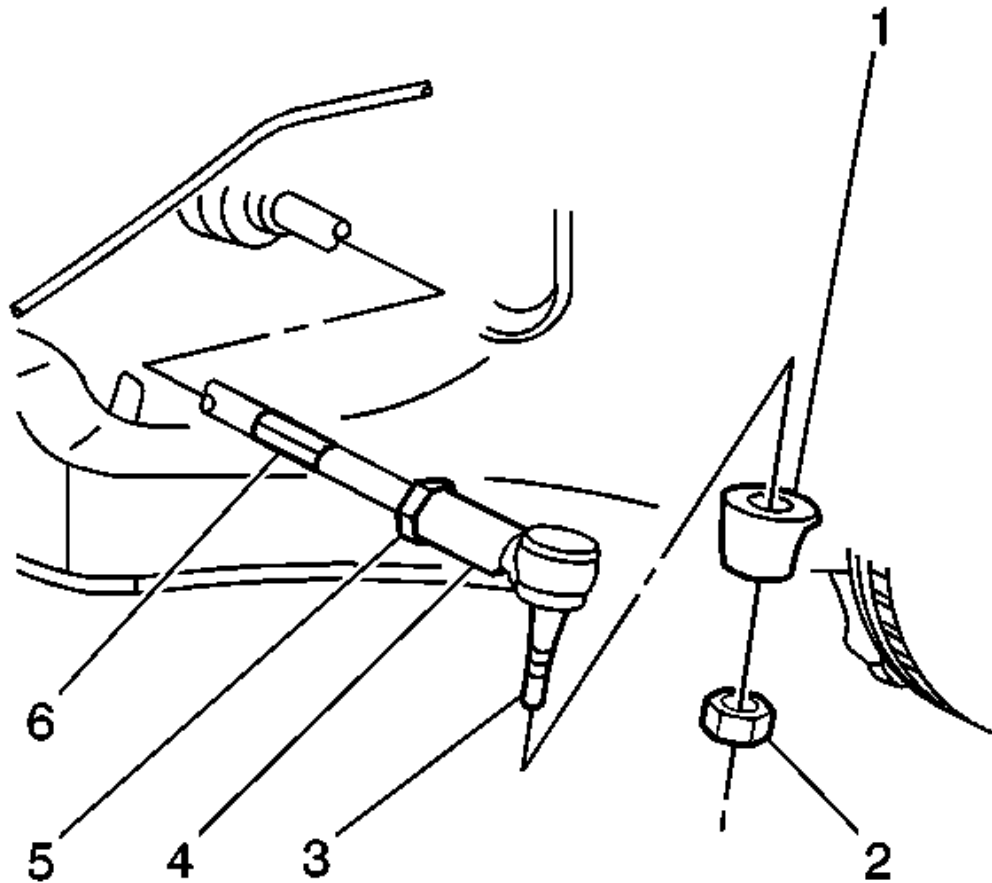


Fig. 2: View Of Tie Rod Jam Nut & Adjuster
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Before performing any adjustments affecting the wheel alignment, refer to [Wheel Alignment Measurement](#).

1. Ensure that the steering wheel is set in a straight ahead position and centered.
2. Loosen the tie rod nut (5).
3. Adjust the toe to specification. Refer to [Wheel Alignment Specifications](#)

CAUTION: Refer to [Fastener Caution](#) .

4. Tighten the tie rod nut (5).

Tighten

Tighten the tie rod nut (5) to 60 N.m (44 lb ft).

REAR CAMBER ADJUSTMENT

The rear camber is not adjustable. If the rear camber angle is not within specifications, inspect for suspension support misalignment or rear suspension damage. Replace any damaged suspension components as necessary.

REAR TOE ADJUSTMENT

The rear toe is not adjustable. If the rear toe angle is not within specifications, inspect for suspension support misalignment or rear suspension damage. Replace any damaged suspension components as necessary.

DESCRIPTION AND OPERATION

CAMBER DESCRIPTION

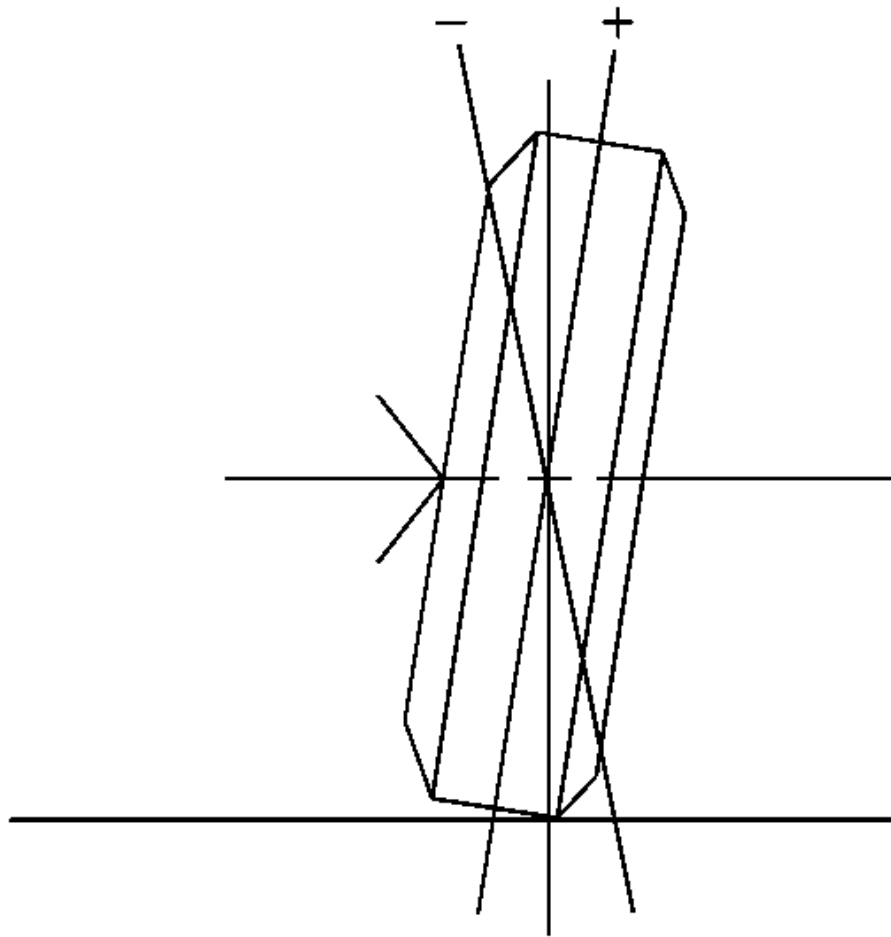


Fig. 3: Illustrating Camber Angle

Courtesy of GENERAL MOTORS COMPANY

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive (+). When the wheel tilts inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Camber settings influence the directional control and the tire wear.

Too much positive camber will result in premature wear on the outside of the tire and cause excessive wear on the suspension parts.

Too much negative camber will result in premature wear on the inside of the tire and cause excessive wear on the suspension parts.

Unequal side-to-side camber of 1 degree or more will cause the vehicle to pull or lead to the side with the most positive camber.

Cross Camber is the difference between the left camber value and the right camber value.

Cross Camber = L camber - R camber

CASTER DESCRIPTION

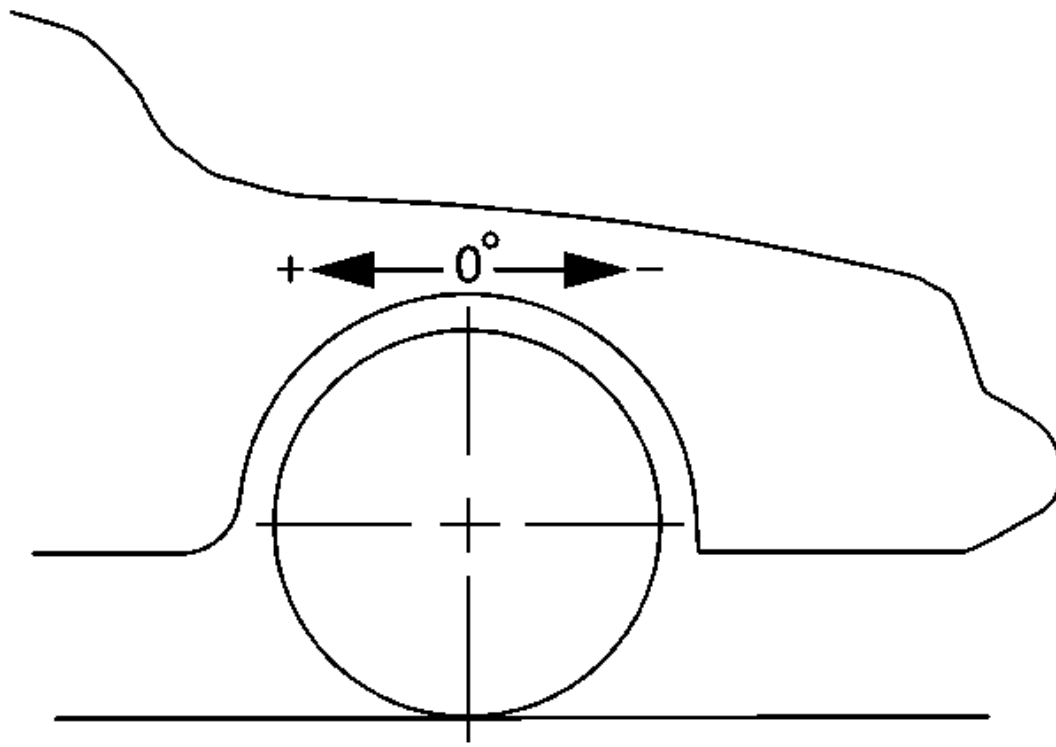


Fig. 4: Illustrating Caster Angle

Courtesy of **GENERAL MOTORS COMPANY**

Caster is the tilting of the uppermost point of the steering axis either forward or backward, when viewed from the side of the vehicle. A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences directional control of the steering but does not affect the tire wear. Caster is affected by the vehicle height, therefore it is important to keep the body at its designed height. Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster.

With too little positive caster, steering may be touchy at high speed and wheel returnability may be diminished when coming out of a turn. If one wheel has more positive caster than the other, that wheel will pull toward the center of the vehicle. This condition will cause the vehicle to pull or lead to the side with the least amount of positive caster.

Cross Caster is the difference between the left caster value and the right caster value.

Cross caster = L caster - R caster

LEAD/PULL DESCRIPTION

At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path.

IMPORTANT: Vehicles will tend to lead/pull in the direction of the road slope as part of normal operation.

Lead/pull is usually caused by the following factors:

- Road slope
- Variability in tire construction
- Wheel alignment (front cross caster and camber)
- Unbalanced steering gear
- Electronic Power Steering (EPS) steering position and torque sensors not calibrated correctly, if equipped.

MEMORY STEER DESCRIPTION

Memory steer is when the vehicle wants to lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.

SCRUB RADIUS DESCRIPTION

Ideally, the scrub radius is as small as possible. Normally, the SAI angle and the centerline of the tire and the wheel intersect below the road surface, causing a positive scrub radius. With struts, the SAI angle is much larger than the long arm/short arm type of suspension. This allows the SAI angle to intersect the camber angle above the road surface, forming a negative scrub radius. The smaller the scrub radius, the better the directional stability. Installing aftermarket wheels that have additional offset will dramatically increase the scrub radius. The newly installed wheels may cause the centerline of the tires to move further away from the spindle. This will increase the scrub radius.

A large amount of scrub radius can cause severe shimmy after hitting a bump. Four-wheel drive vehicles with large tires use a steering damper to compensate for an increased scrub radius. Scrub radius is not directly measurable by the conventional methods. Scrub radius is projected geometrically by engineers during the design phase of the suspension.

THRUST ANGLES DESCRIPTION

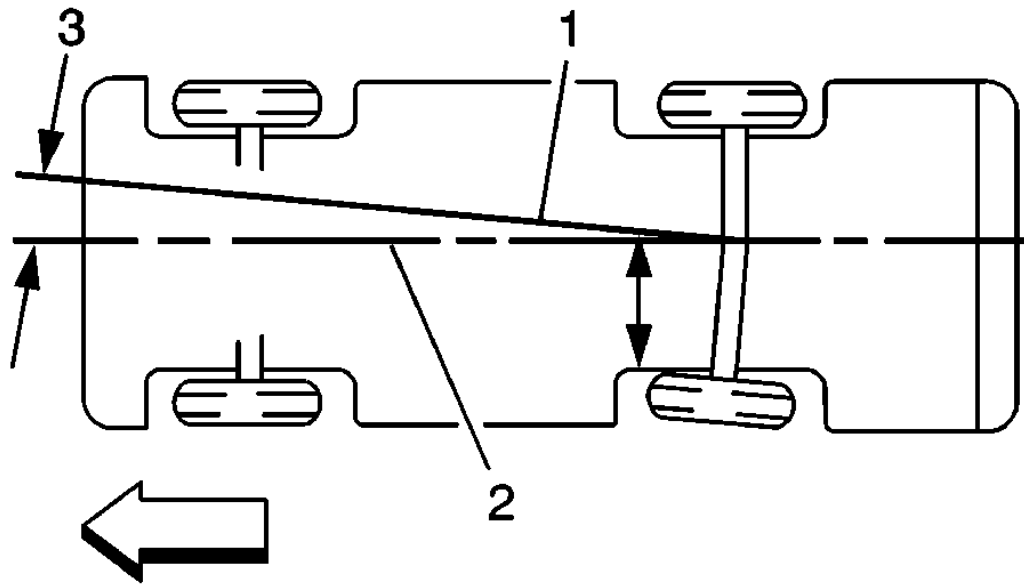


Fig. 5: Illustrating Thrust Angles

Courtesy of GENERAL MOTORS COMPANY

The front wheels aim or steer the vehicle. The rear wheels control tracking. This tracking action relates to the thrust angle (3). The thrust angle is the path that the rear wheels take. Ideally, the thrust angle is geometrically aligned with the body centerline (2).

In the illustration, toe-in is shown on the left rear wheel, moving the thrust line (1) off center. The resulting deviation from the centerline is the thrust angle.

If the thrust angle is not set properly the vehicle may "dog track", the steering wheel may not be centered or it could be perceived as a bent axle. Thrust angle can be checked during a wheel alignment.

Positive thrust angle means the thrust line is pointing to the right hand side (RHS) of the vehicle.

Negative thrust angle means the thrust line is pointing to the left hand side (LHS) of the vehicle.

If the thrust angle is out of specification, moving the axle to body relationship will change the thrust angle reading.

If the vehicle is out in the Positive (+) direction-moving the RHS forward and/or LHS rearward will move the thrust angle towards zero degrees.

If the vehicle is out in the Negative (-) direction-moving the RHS rearward and/or LHS forward will move the thrust angle towards zero degrees.

TOE DESCRIPTION

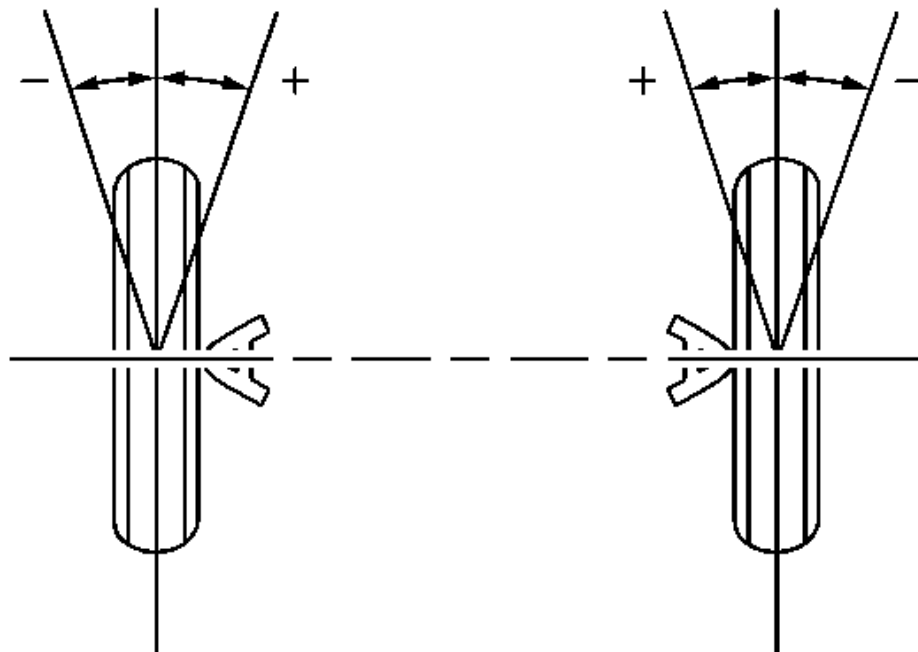


Fig. 6: Illustrating Toe Angle

Courtesy of GENERAL MOTORS COMPANY

Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel.

Toe also offsets the small deflections of the wheel support system that occur when the vehicle is rolling forward. In other words, with the vehicle standing still and the wheels set with toe-in, the wheels tend to roll parallel on the road when the vehicle is moving.

Improper toe adjustment will cause premature tire wear and cause steering instability.

TORQUE STEER DESCRIPTION

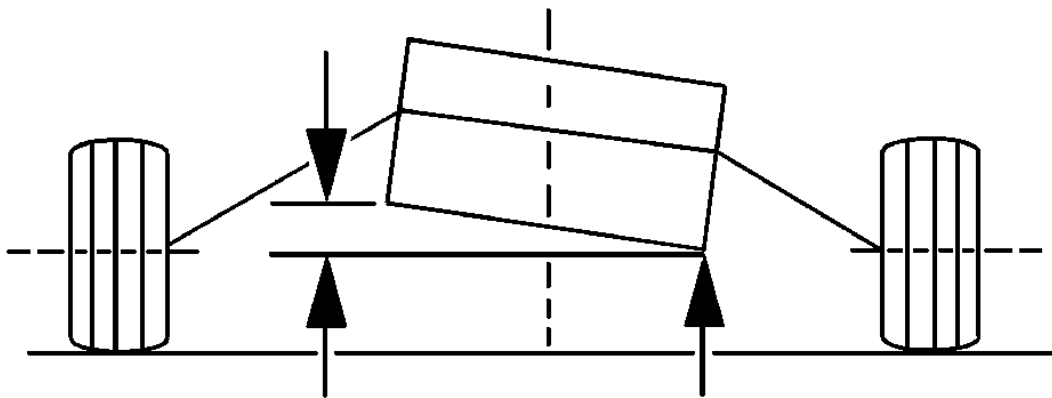


Fig. 7: Identifying Torque Steer

Courtesy of **GENERAL MOTORS COMPANY**

A vehicle pulls or leads in one direction during hard acceleration. A vehicle pulls or leads in the other direction during deceleration.

The following factors may cause torque steer to be more apparent on a particular vehicle:

- A slightly smaller diameter tire on the right front increases a right torque lead. Inspect the front tires for differences in the brand, the construction, or the size. If the tires appear to be similar, change the front tires from side-to-side and retest the vehicle. Tire and wheel assemblies have the most significant effect on torque steer correction.
- A large difference in the right and left front tire pressure
- Left-to-right differences in the front view axle angle may cause significant steering pull in a vehicle. The pull will be to the side with the most downward sloping axle from the differential to the wheels. Axles

typically slope downward from the differential. The slope of the transaxle pan to level ground may be used as an indication of bias axle angles. The side with the higher transaxle pan (shown on the left side of the illustration) has the most downward sloping axle angle.

WANDER DESCRIPTION

Wander is the undesired drifting or deviation of a vehicle to either side from a straight path with hand pressure on the steering wheel. Wander is a symptom of the vehicle's sensitivity to external disturbances, such as road crown and crosswind, and accentuated by poor on-center steering feel.

Article GUID: A00884729

TRANSMISSION

Automatic Transmission - 5ET50 (MKV) - Volt

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE (TRANSMISSION FLUID TEMPERATURE SENSOR)

Temperature	Temperature	Minimum Resistance	Nominal Resistance	Maximum Resistance
°C	°F	Ω	Ω	Ω
-50	-58	71455	77458	83641
-40	-40	40,221	43,321	46,422
-30	-22	23,515	25,155	26,794
-20	-4	14,228	15,126	16,023
-10	14	8,881	9,388	9,894
0	32	5,704	5,997	6,291
10	50	3,759	3,934	4,108
20	68	2,537	2,643	2,749
30	86	1,750	1,816	1,882
40	104	1,232	1,274	1,315
50	122	883	910	937
60	140	645	662	679
70	158	478	489	500
80	176	360	367	376
90	194	275	280	284
100	212	212	216	219
110	230	166	168	170
120	248	132	133	134
130	266	105	106	107
140	284	84	86	87
150	302	69	70	71

FASTENER SPECIFICATIONS (OFF-VEHICLE)

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application

Automatic Transmission Fluid Filter Seal

NOTE:

**All
fasteners/components
listed in this table
MUST BE
DISCARDED and
replaced with NEW
after removal.**

Application
Automatic Transmission Pump Fluid Outlet Seal
Automatic Transmission Torque Dampener and Differential Housing Gasket
Automatic Transmission Torque Dampener Bypass Clutch Piston Inner Seal
Automatic Transmission Torque Dampener Bypass Clutch Piston Outer Seal
Control Valve Lower Body Spacer Plate
Drive Motor Power Inverter Module Connector
Drive Motor Power Inverter Module Fluid Seal
Drive Motor Rotor Bearing Retaining Ring
Drive Motor Support
Manual Shift Shaft Pin
Transmission Fluid Level Hole Plug
Variable Low Clutch Backing Plate Retaining Ring
Variable Low Clutch Fluid Passage Seal
Variable High Clutch Fluid Seal Ring
Variable High Clutch Fluid Transfer Support Seal
Variable High Clutch Housing Seal
Variable High Clutch Piston Dam Inner Seal
Variable High Clutch Piston Dam Outer Seal
Variable High Clutch Piston Dam Retaining Ring
Variable High Clutch Piston Inner Seal
Variable High Clutch Piston Outer Seal

Single Use Threaded Fastener/Component Tightening Specifications**NOTE:**

**All
fasteners/components
listed in this table
MUST BE
DISCARDED and
replaced with NEW
after removal.**

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Case Extension Bolt	230	1	M8 x 38.5	38 N.m (28 lb ft)

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Case Extension Bolt	252	1	M8 x 55.8	38 N.m (28 lb ft)
Automatic Transmission Torque Damper Bolt				
• First Pass	305	6	M10 x 31.05	58 N.m (35 lb ft)
• Final Pass	305	6	M10 x 31.05	37.5 Degrees
Drive Motor Position Sensor Bolt	502	4	M6 x 15.5	5 N.m (44 lb in)
Drive Motor Position Sensor Bolt	522	4	M6 x 15.5	5 N.m (44 lb in)
Drive Motor Power Inverter Module Connector Bolt	231	2	M6 x 21	9 N.m (80 lb in)
Drive Motor Stator Bolt	509	4	M6 x 55	11 N.m (97 lb in)
Drive Motor Stator Bolt	529	4	M6 x 80.75	11 N.m (97 lb in)

Reusable Threaded Fastener Tightening Specifications**NOTE:**

All fasteners listed in this table can be reused after removal.

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Case Extension Bolt	238	2	M8 x 35.7	38 N.m (28 lb ft)
Automatic Transmission Case Extension Bolt	247	4	M8 x 60.8	26 N.m (19 lb ft)
Automatic Transmission Case Plug	68	1	1/8"-27 NPTF	11 N.m (97 lb in)
Automatic Transmission Fluid Filter Bolt	202	1	M6 x 20	9 N.m (80 lb in)
Automatic Transmission Fluid Level Hole Plug	66	1	1/8"-27 NPTF	11 N.m (97 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Fluid Pressure Test Hole Plug	57	1	1/8"-27 NPTF	11 N.m (97 lb in)
Automatic Transmission Fluid Pressure Test Hole Plug	59	1	1/8"-27 NPTF	11 N.m (97 lb in)
Automatic Transmission Fluid Pump Bolt	209	3	M8 x 35	22 N.m (16 lb ft)
Automatic Transmission Output Speed Sensor Bolt	240	1	M6 x 25	9 N.m (80 lb in)
Automatic Transmission Wiring Harness Connector Bracket Bolt	709	2	M6 x 20	9 N.m (80 lb in)
Drive Link Snubber Bolt	210	2	M6 x 30	9 N.m (80 lb in)
Drive Link Snubber Bolt	212	2	M6 x 25	9 N.m (80 lb in)
Drive Motor Battery Positive and Negative Cable Connector Bolt	28	4	M6 x 26	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Buss Bar Bolt	30	6	M6 x 25	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Bolt	504	3	M6 x 35	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Bolt	524	3	M6 x 35	9 N.m (80 lb in)
Drive Motor Power Inverter Module Bolt	22	7	M6 x 25	9 N.m (80 lb in)
Drive Motor Stator Cooling Tube Bolt	242	2	M6 x 25	9 N.m (80 lb in)
Fluid Transfer Pipe Bolt	9	1	M6 x 23	9 N.m (80 lb in)
Front Differential Carrier Baffle Bolt	204	2	M6 x 25	9 N.m (80 lb in)
Manual Shift Detent Lever Spring	706	1	M6 x 25.65	9 N.m (80 lb in)
Park Pawl Actuator Guide Bolt	700	1	M6 x 35	9 N.m (80 lb in)
Torque Converter and Differential Housing Bolt	60	16	M8 x 30	32 N.m (24 lb ft)
Transmission Fluid Drain Plug	67	1	1/8"-27 NPTF	11 N.m (97 lb in)
Valve Body Bolt	5	4	M6 x 72	9 N.m (80 lb in)
Valve Body Bolt	8	13	M6 x 45	9 N.m (80 lb in)
Valve Body Cover Bolt	1	16	M6 x 30	9 N.m (80 lb in)
Drive Motor Power Inverter Module Cover Bolt	25	17	M6 x 30	9 N.m (80 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Variable High Clutch Housing Bolt	637	8	M6 x 16	9 N.m (80 lb in)

FASTENER SPECIFICATIONS (ON-VEHICLE)**Single Use Non-Threaded Fasteners/Components****NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Front Wheel Drive Shaft Seal - Left
Front Wheel Drive Shaft Seal - Right
Main Shift Shaft Seal

Single Use Threaded Fastener/Component Tightening Specifications**NOTE:**

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Transmission Mount Bolt (1)	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	60-75 Degrees
Transmission Mount Bolt (2)	
• First Pass:	100 N.m (74 lb ft)

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
• Final Pass:	60-75 Degrees
Transmission Mount Strut Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	60-75 Degrees
Transmission Mount Strut Bracket Bolt	
• First Pass:	75 N.m (55 lb ft)
• Final Pass:	45-60 Degrees
Transmission Mount Transmission Side Bracket Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	60-75 Degrees

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Automatic Transmission Fluid Pressure Test Hole Plug	11 N.m (97 lb in)
Control Valve Body Bolt	9 N.m (80 lb in)
Control Valve Body Bolt @ Fluid Transfer Pipe Bolt	9 N.m (80 lb in)
Control Valve Body Cover Bolt	9 N.m (80 lb in)
Drive Motor Battery Positive and Negative Cable Connector Bolt	9 N.m (80 lb in)
Drive Motor Generator Control Module Cooling Outlet Hose Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Buss Bar Bolt	9 N.m (80 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Drive Motor Power Inverter Module Bolt	9 N.m (80 lb in)
Engine Wiring Harness Bracket Nut	9 N.m (80 lb in)
Engine Wiring Harness Fuse Block Bracket Bolt	22 N.m (17 lb ft)
Engine Wiring Harness Stud	9 N.m (80 lb in)
Ground Cable Bolt	9 N.m (80 lb in)
Heater Inlet Hose Bracket Bolt	9 N.m (80 lb in)
Heater Water Shutoff Valve Inlet Hose Bolt	22 N.m (17 lb ft)
Main Shaft Bolt, Nut	7 N.m (62 lb in)
Manual Shift Detent Lever Spring Bolt	12 N.m (106 lb in)
Torque Converter Bolt	60 N.m (44 lb ft)
Transmission Control Lever Housing Bracket Nut	9 N.m (80 lb in)
Transmission to Engine Bolts	58 N.m (43 lb ft)
Transmission Fluid Cooler Pipe Bolt	22 N.m (17 lb ft)
Transmission Fluid Drain Plug	11 N.m (97 lb in)
Transmission Mount Transmission Side Bolt	58 N.m (43 lb ft)
Transmission Range Selector Lever Cable Bracket Bolt	22 N.m (17 lb ft)
Transmission Range Selector Lever Nut	30 N.m (22 lb ft)
Wiring Harness Bracket Bolt	9 N.m (80 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
5ET50		
Fluid Change - Drain Plug - Approximate Capacity	3.2 liters	3.4 quarts
Overhaul - Approximate Capacity (Includes Cooling System)	6.75 liters	7.13 quarts

TRANSMISSION GENERAL SPECIFICATIONS

Name	5ET50
RPO Codes	MKV
Production Location	Warren, Michigan
Transmission Drive	Front Wheel Drive Transaxle
One-Motor EV Drive (CD)	Motor-Generator B provide or absorb vehicle torque for electric only
Two-Motor EV Drive (CD)	Motor-Generator B and Motor-Generator A combine to provide or absorb vehicle torque for electric only

Name	5ET50
	operation
Extended Range Low (Mode 1) (CS)	Online optimizer balances engine, Motor-Generator A, and Motor-Generator B, to achieve the most efficient vehicle operation at lower vehicle speeds
Extended Range High (Mode 2) (CS)	Online optimizer balances engine, Motor-Generator A, and Motor-Generator B, to achieve the most efficient vehicle operation at higher vehicle speeds
Fixed Ratio Extended Range (CS)	Motor/Generator B will be able to electrically boost or regenerate the vehicle torque in parallel with the engine torque. Motor/Generator A is locked to the case and not contribute to torque
Pressure Tap	Line Pressure
Transmission Fluid Type	DEXRON VI®
Transmission Type: Electric	Electrically Variable
Transmission Type: EV	MKV: 48 kW (Drive Motor A (1) and 87 kW (Drive Motor B (2) Internal Motor
Transmission Type: T	Transaxle Mount
Transmission Type: 50	Product Series
Position Quadrant	P, R, N, D, L
Case Material	Die Cast Aluminum
Transmission Net Weight (Wet)	119 kg (262 pounds)
Maximum Trailer Towing Capacity	MKV: N/A

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
Automatic Transmission Fluid	DEXRON®VI	Refer to Electronic Parts Catalog
Drive Motor Position Sensor Bolt	Threadlocker Red	Refer to Electronic Parts Catalog
Drive Motor Power Inverter Module Bolt	Threadlocker Blue	Refer to Electronic Parts Catalog

CLUTCH BACKING PLATE RETAINING RING SPECIFICATIONS

Variable High Clutch Backing Plate Retaining Ring

Clutch Pack Travel Specification - 0.98 - 1.54 mm (0.039 - 0.061 in)		
Retaining Ring Thickness		Ring Identification Color
Metric	English	
NOTE: After measuring clutch pack travel, determine if the		

Clutch Pack Travel Specification - 0.98 - 1.54 mm (0.039 - 0.061 in)		
Retaining Ring Thickness		Ring Identification Color
Metric	English	
measurement is within the specification. If the measurement is not within the specification, measure the thickness of the existing retaining ring, and then choose a thicker or thinner retaining ring that will bring the measurement within specification.		
1.40 - 1.50 mm	0.055 - 0.059 in	Dark Green
1.70 - 1.80 mm	0.067 - 0.071 in	Yellow
2.01 - 2.11 mm	0.079 - 0.083 in	No Color
2.31 - 2.41 mm	0.091 - 0.095 in	Light Blue
2.62 - 2.72 mm	0.103 - 0.107 in	Orange

Variable Low Clutch Backing Plate Retaining Ring

Clutch Pack Travel Specification - 0.90 - 1.46 mm (0.035 - 0.057 in)		
Retaining Ring Thickness		Ring Identification Color
Metric	English	
NOTE: After measuring clutch pack travel, determine if the measurement is within the specification. If the measurement is not within		

Clutch Pack Travel Specification - 0.90 - 1.46 mm (0.035 - 0.057 in)		
Retaining Ring Thickness		Ring Identification Color
Metric	English	
the specification, measure the thickness of the existing retaining ring, and then choose a thicker or thinner retaining ring that will bring the measurement within specification.		
2.55 - 2.85 mm	0.100 - 0.112 in	Dark Green
2.87 - 2.97 mm	0.113 - 0.117 in	Yellow
3.20 - 3.30 mm	0.126 - 0.130 in	Purple
3.52 - 3.62 mm	0.139 - 0.143 in	Light Blue
3.85 - 3.95 mm	0.152 - 0.156 in	Orange

AUTOMATIC TRANSMISSION TORQUE DAMPENER THRUST WASHER SPECIFICATIONS

Automatic Transmission Torque Dampener Thrust Washer Calculation Specification - Dimension B Min 47.870 - Max 49.620 mm - Dimension A Min 33.165 - Max 34.465 mm			
Automatic Transmission Torque Dampener Thrust Washer Thickness		Ring Identification Color	Dimension B - Dimension A Calculation Range
Metric	English		
NOTE: Measure the thickness of the torque dampener and differential housing gasket and subtract from measured dimension A to use as dimension A in			

Automatic Transmission Torque Dampener Thrust Washer Calculation Specification - Dimension B Min 47.870 - Max 49.620 mm - Dimension A Min 33.165 - Max 34.465 mm			
Automatic Transmission Torque Dampener Thrust Washer Thickness		Ring Identification Color	Dimension B - Dimension A Calculation Range
Metric	English		
calculation.			
1.892 - 1.992 mm	0.0745 - 0.0784 in	Red	13.712 - 14.033 mm
2.214 - 2.314 mm	0.0872 - 0.0911 in	Light Grey	14.034 - 14.355 mm
2.536 - 2.636 mm	0.0998 - 0.1038 in	Blue	14.356 - 14.677 mm
2.858 - 2.958 mm	0.1125 - 0.1165 in	Natural	14.678 - 14.999 mm
3.180 - 3.280 mm	0.1252 - 0.1291 in	Black	15.000 - 15.321 mm
3.502 - 3.602 mm	0.1379 - 0.1418 in	Pink	15.322 - 15.643 mm
3.824 - 3.924 mm	0.1506 - 0.1545 in	Brown	15.644 - 15.965 mm

RANGE REFERENCE

Mode Chart			VFS Line Pressure Reg Solenoid (PR)	ON/OFF High Range Clutch (C2)	ON/OFF Low Range Clutch (C1)	ON/OFF Lube Boost (Motor Cooling)	ON/OFF Damper Bypass Clutch (DBC)
Unpowered State (pressure)			Normally High	Normally Low	Normally Low	Normally Low	Normally Low
PCS Number			PCS1	PCS2	PCS3	PCS4	PCS5
Range State	Park	Engine On	Regulating	OFF	ON	On Demand**	OFF
		Engine Off		OFF	ON		ON
	Reverse EV Mode	Engine Off		OFF	ON		ON
	Neutral	Engine Off		OFF	OFF		ON
	Drive	-		-	-		-
	Single or Dual Motor EV	Engine Off		OFF	ON		ON
	Extended Range Low	Engine On		OFF	ON		OFF
	Extended Range Fixed Ratio	Engine On		ON	ON		OFF
	Extended Range High	Engine On		ON	OFF		OFF
	**Demand based on torque and temperature						

TRANSMISSION INTERNAL MODE SWITCH LOGIC

Internal Mode Switch

Internal Mode Switch	Selector Position
----------------------	-------------------

Circuits/Parameter	Park	Reverse	Neutral	Drive	Low
Switch Operating Conditions: Ignition ON, range selector in appropriate gear					
Internal Mode Switch A	High	Low	Low	High	High
Internal Mode Switch B	Low	High	High	Low	Low
Internal Mode Switch C	High	High	Low	Low	Low
Internal Mode Switch P	Low	Low	High	High	High
Internal Mode Switch S	Low	High	Low	High	Low
Always High status: Open/short to voltage condition					
Always Low status: Short to ground condition					

SCHEMATIC WIRING DIAGRAMS

AUTOMATIC TRANSMISSION CONTROLS WIRING SCHEMATICS

Drive Mode Select Function

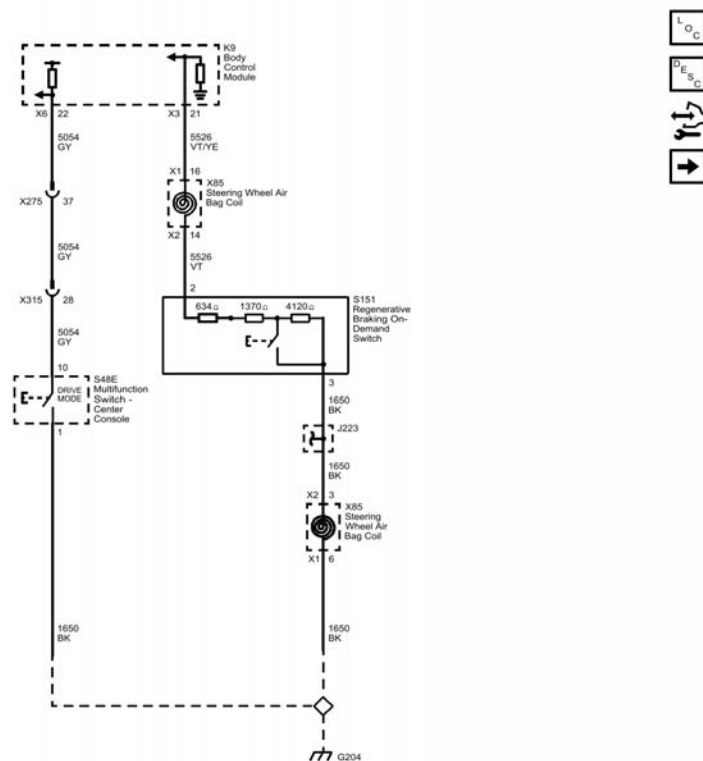


Fig. 1: Drive Mode Select Function

Courtesy of GENERAL MOTORS COMPANY

Pressure Controls, Shift Controls and Speed Sensor

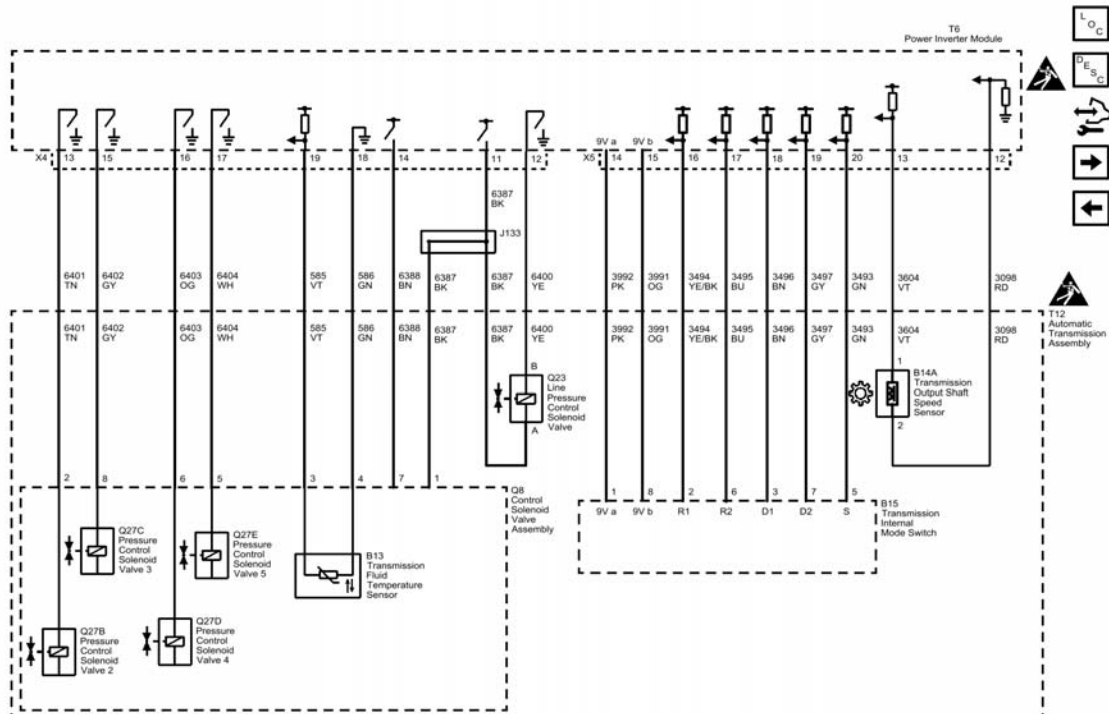


Fig. 2: Pressure Controls, Shift Controls and Speed Sensor
 Courtesy of GENERAL MOTORS COMPANY

Shift Lever Position Indicator

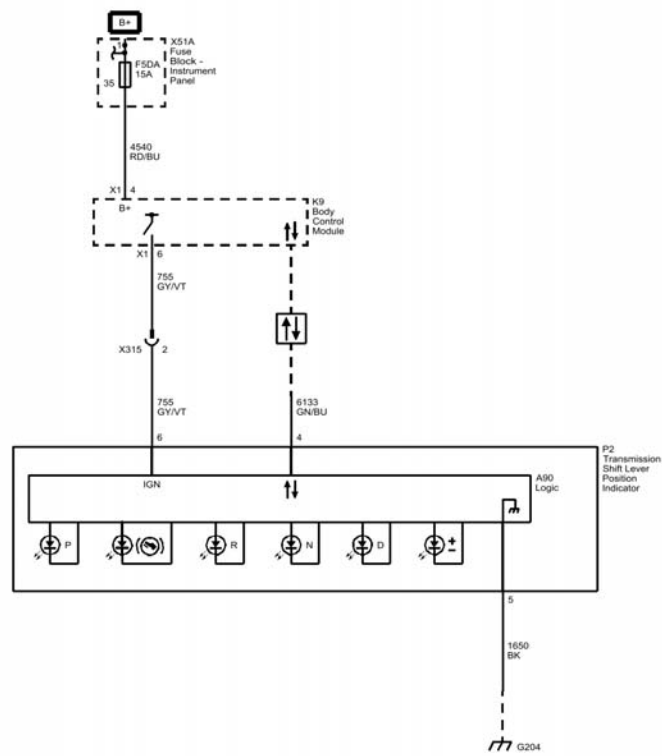


Fig. 3: Shift Lever Position Indicator

Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Case and Associated Parts (1 of 2)

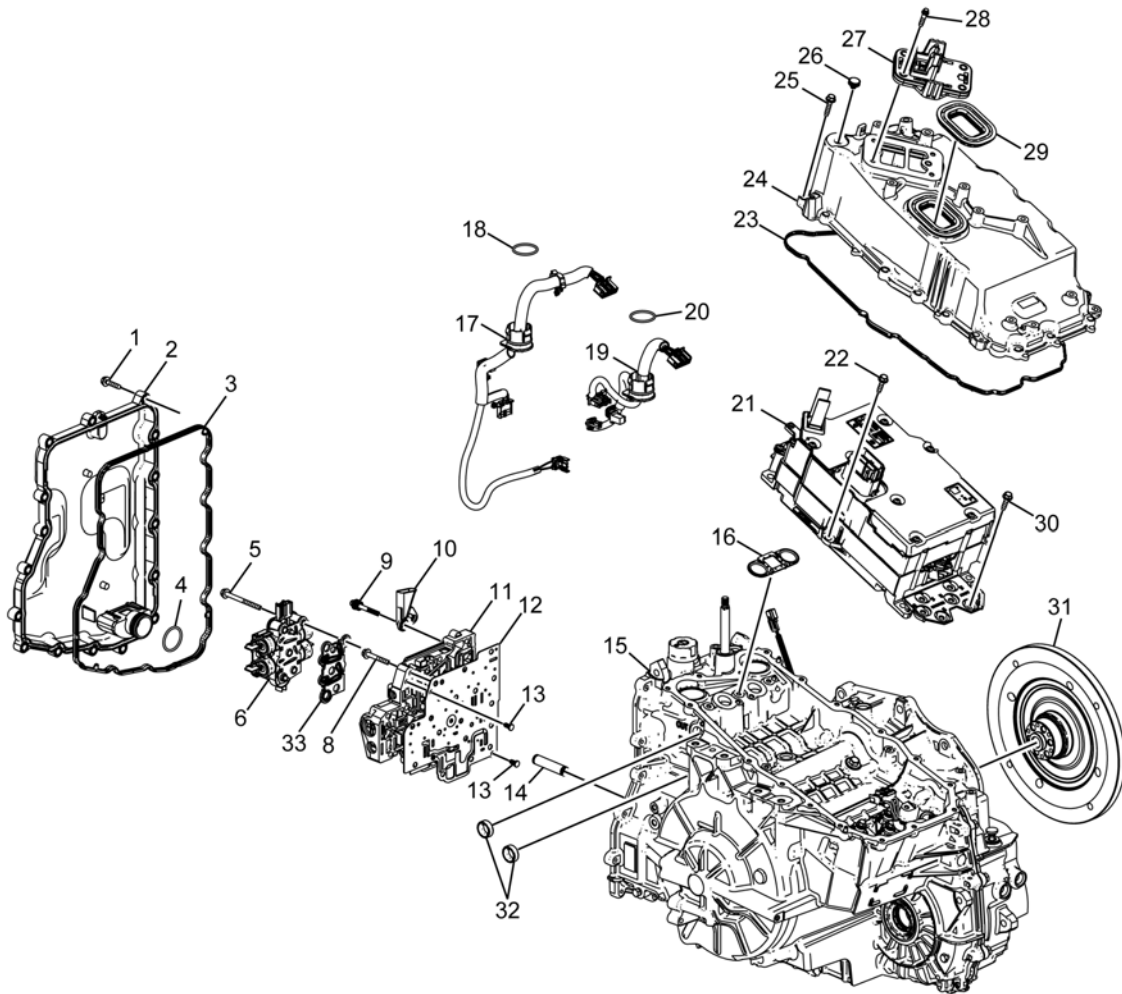


Fig. 4: Case and Associated Parts (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Valve Body Cover Bolt
2	Control Valve Body Cover
3	Automatic Transmission Fluid Level Control Valve Seal - Gasket
4	Automatic Transmission Fluid Level Control Valve Seal - O-Ring
5	Valve Body Bolt
6	Control Solenoid Valve
8	Valve Body Bolt
9	Fluid Transfer Pipe Bolt
10	Fluid Transfer Pipe
11	Control Valve
12	Control Valve Lower Body Spacer Plate
13	Control Valve Body Spacer Plate Retainer
14	Variable Low Clutch Fluid Passage Seal
15	Automatic Transmission Case
16	Drive Motor Power Inverter Module Fluid Seal

Callout	Component Name
17	Automatic Transmission Wiring Harness - Control Solenoid Valve
18	Automatic Transmission Wiring Connector Seal - O Ring
19	Automatic Transmission Wiring Harness - Shift Shaft Position Switch
20	Automatic Transmission Wiring Connector Seal - O Ring
21	Drive Motor Generator Power Inverter Module
22	Drive Motor Power Inverter Module Bolt
23	Drive Motor Power Inverter Module Cover Gasket
24	Drive Motor Power Inverter Module Cover
25	Drive Motor Power Inverter Module Cover Bolt
26	Drive Motor Power Inverter Module Cover Vent
27	Drive Motor Battery Positive and Negative Cable Connector
28	Drive Motor Battery Positive and Negative Cable Connector Bolt
29	Drive Motor Power Inverter Module Electrical Connector Seal
30	Drive Motor Power Inverter Module 3-Phase Buss Bar Bolt
31	Input Drive Flange
32	Transmission Fluid Cooler Pipe Fitting Seal
33	Control Solenoid Valve Filter Plate

Case and Associated Parts (2 of 2)

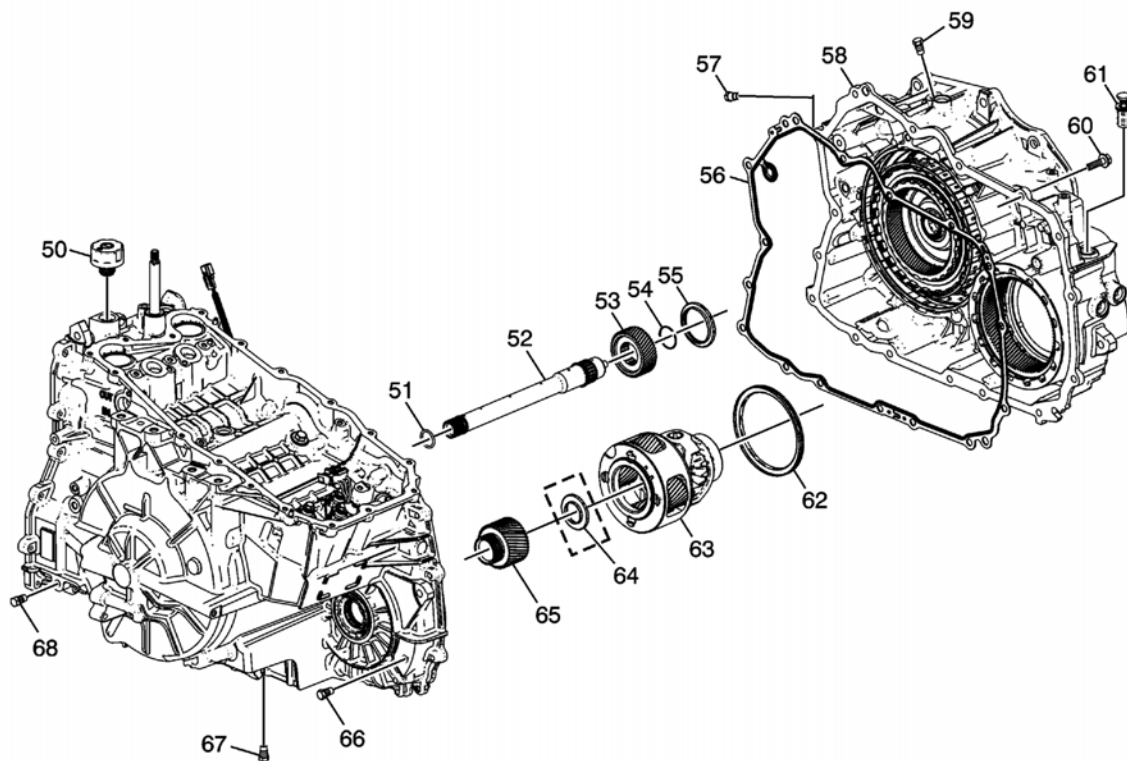


Fig. 5: Case and Associated Parts (2 of 2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
50	Transmission Fluid Filler Cap
51	Variable High Clutch Housing Seal - O Ring
52	Input Sun Gear Shaft
53	Input Sun Gear
54	Input Sun Gear Retaining Ring
55	Input Internal Gear Thrust Bearing
56	Automatic Transmission Torque Dampener and Differential Housing Gasket
57	Automatic Transmission Fluid Pressure Test Hole Plug
58	Automatic Transmission Torque Dampener and Differential Housing
59	Automatic Transmission Fluid Pressure Test Hole Plug
60	Torque Converter and Differential Housing Bolt
61	Transmission Fluid Filler Tube Plug
62	Front Differential Carrier Bearing
63	Front Differential Carrier
64	Differential Carrier Sun Gear Thrust Bearing
65	Front Differential Carrier Sun Gear
66	Automatic Transmission Fluid Level Hole Plug
67	Transmission Fluid Drain Plug
68	Automatic Transmission Case Plug

Transmission Case Assembly (1 of 2)

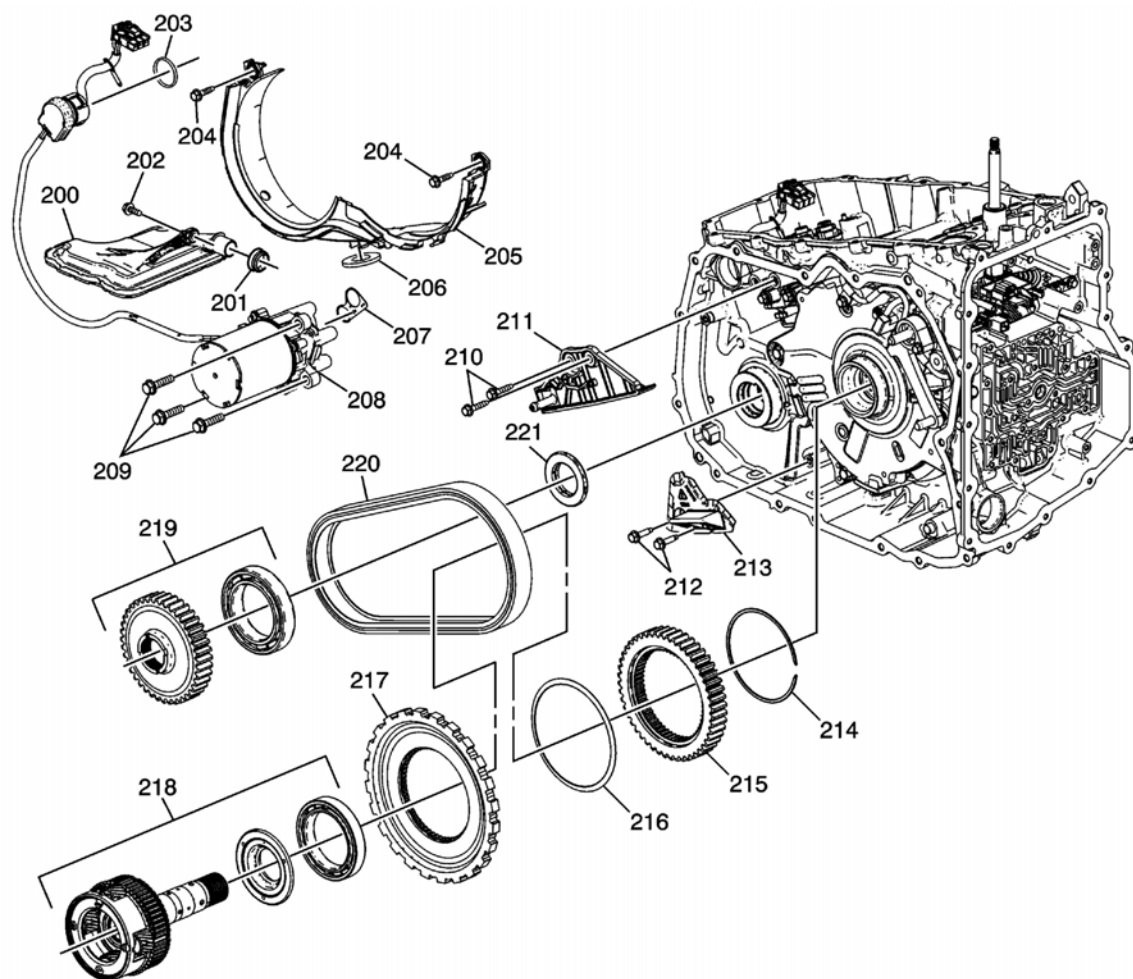


Fig. 6: Transmission Case Assembly (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
200	Automatic Transmission Fluid Filter
201	Automatic Transmission Fluid Filter Seal
202	Automatic Transmission Fluid Filter Bolt
203	Automatic Transmission Auxiliary Fluid Pump Motor 3-Phase Cable Seal
204	Front Differential Carrier Baffle Bolt
205	Front Differential Carrier Baffle
206	Automatic Transmission Fluid Chip Collector Magnet
207	Automatic Transmission Pump Fluid Outlet Seal
208	Automatic Transmission Fluid Pump Motor
209	Automatic Transmission Fluid Pump Bolt
210	Drive Link Snubber Bolt
211	Drive Link Snubber - (Drive Side)
212	Drive Link Snubber Bolt
213	Drive Link Snubber - (Coast Side)
214	Drive Sprocket Retaining Ring
215	Drive Sprocket

Callout	Component Name
216	Park Gear Spring
217	Park Gear
218	Input Carrier
219	Driven Sprocket
220	Drive Link
221	Driven Sprocket Bearing

Transmission Case Assembly (2 of 2)

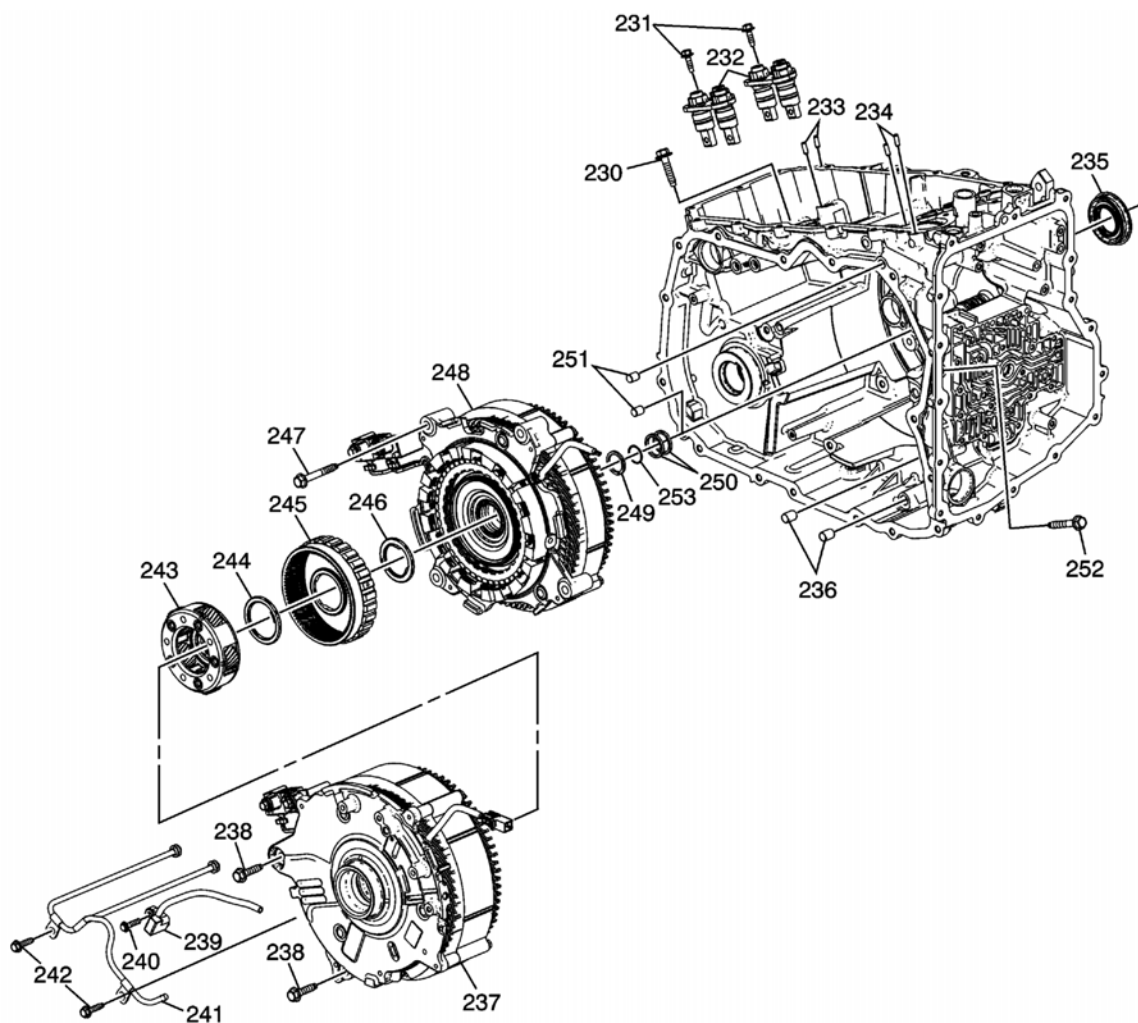


Fig. 7: Transmission Case Assembly (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
230	Automatic Transmission Case Extension Bolt
231	Drive Motor Power Inverter Module Connector Bolt
232	Drive Motor Power Inverter Module Connector
233	Drive Motor Power Inverter Module Pin
234	Drive Motor Power Inverter Module Cover Pin
235	Front Wheel Drive Shaft Oil Seal
236	Automatic Transmission Fluid Pump Locating Pin

Callout	Component Name
237	Drive Motor - (2nd Position)
238	Automatic Transmission Case Extension Bolt
239	Automatic Transmission Output Speed Sensor
240	Automatic Transmission Output Speed Sensor Bolt
241	Drive Motor Stator Cooling Tube
242	Drive Motor Stator Cooling Tube Bolt
243	Output Carrier
244	Output Carrier Thrust Bearing
245	Output Carrier Internal Gear
246	Output Carrier Internal Gear Hub Thrust Bearing
247	Automatic Transmission Case Extension Bolt
248	Drive Motor - (1st Position)
249	Variable High Clutch Fluid Transfer Support Seal
250	Variable High Clutch Fluid Transfer Support Seal
251	Transmission Case Locating Pin
252	Automatic Transmission Case Extension Bolt
253	Variable High Clutch Fluid Seal Ring

Torque Dampener and Differential Housing Assembly

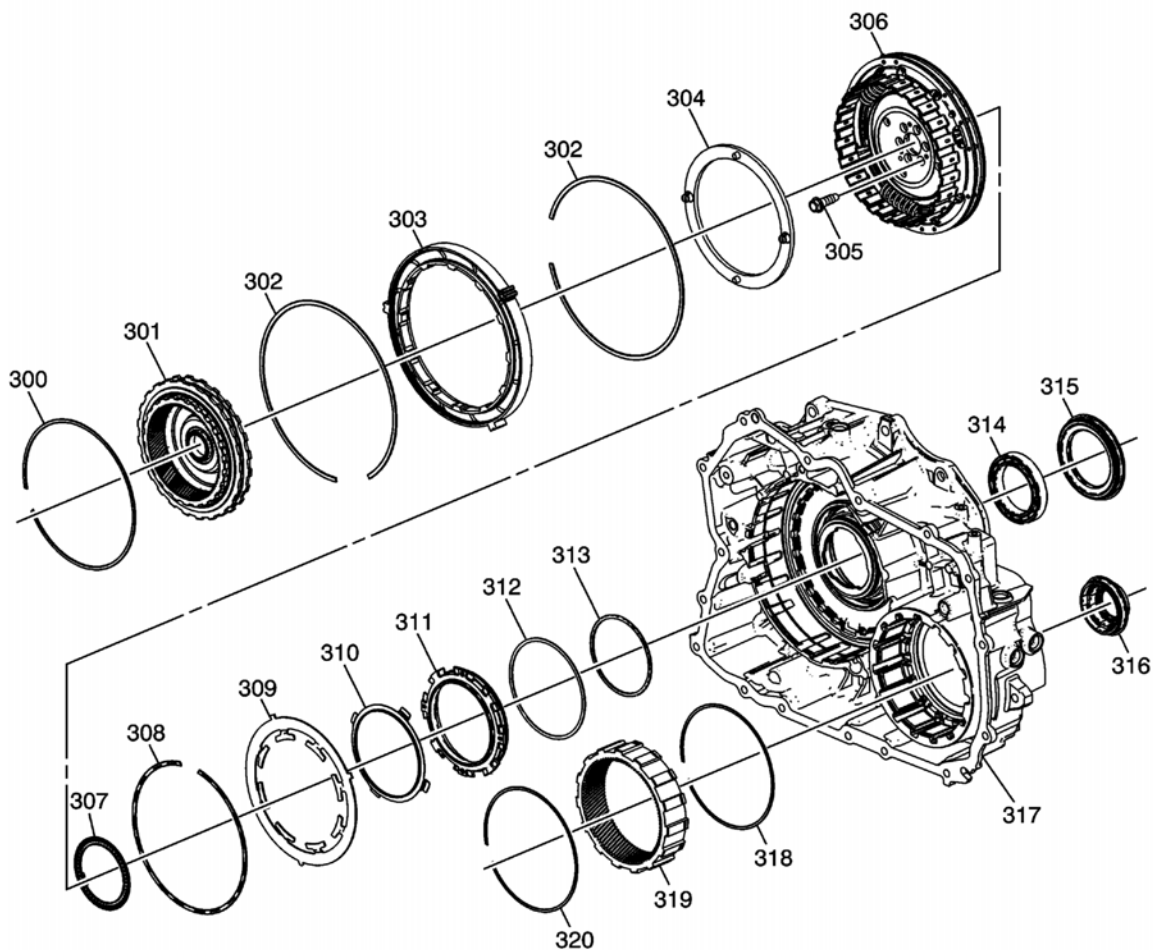


Fig. 8: Torque Dampener and Differential Housing Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
300	Input Internal Gear Retaining Ring
301	Input Internal Gear
302	Input Brake Clutch Retaining Ring
303	Input Brake Clutch
304	Automatic Transmission Torque Dampener Thrust Washer
305	Automatic Transmission Torque Dampener Bolt
306	Automatic Transmission Torque Dampener
307	Automatic Transmission Torque Dampener Thrust Bearing
308	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring Retaining Ring
309	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring
310	Automatic Transmission Torque Dampener Bypass Clutch Apply Bearing
311	Automatic Transmission Torque Dampener Bypass Clutch Piston
312	Automatic Transmission Torque Dampener Bypass Clutch Piston Outer Seal
313	Automatic Transmission Torque Dampener Bypass Clutch Piston Inner Seal
314	Input Shaft Bearing
315	Input Shaft Seal
316	Front Wheel Drive Shaft Oil Seal
317	Automatic Transmission Torque Dampener and Differential Housing
318	Front Differential Carrier Internal Gear Wear Ring
319	Front Differential Ring Gear
320	Front Differential Ring Gear Retainer

Control Valve Body Assembly

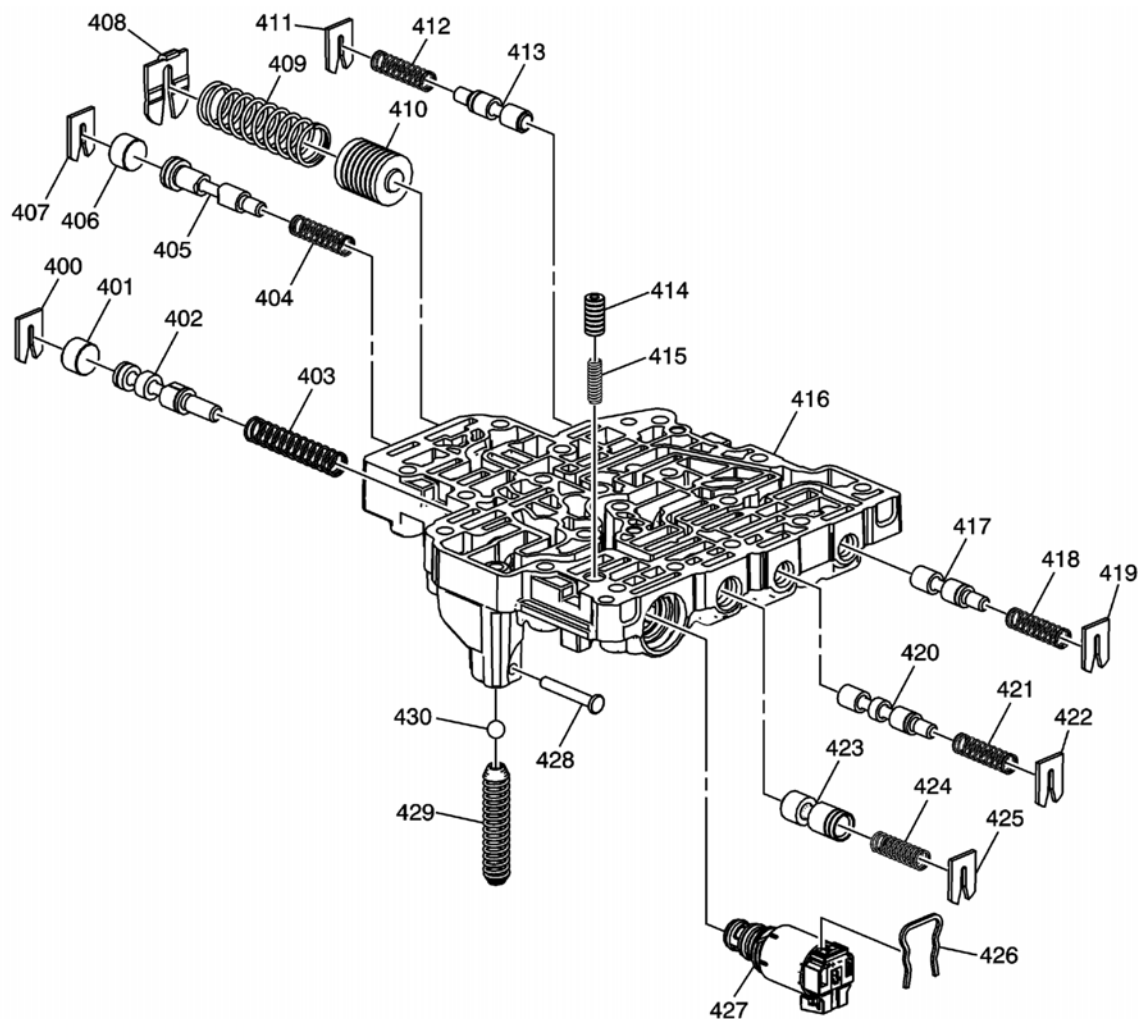


Fig. 9: Control Valve Body Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
400	Pressure Regulator Valve Bore Plug Retainer
401	Pressure Regulator Valve Bore Plug
402	Pressure Regulator Valve
403	Pressure Regulator Valve Spring
404	Lube Regulator Valve Spring
405	Lube Regulator Valve
406	Lube Regulator Valve Bore Plug
407	Lube Regulator Valve Bore Plug Retainer
408	Variable Low Clutch Accumulator Piston Spring Retainer
409	Variable Low Clutch Accumulator Piston Spring
410	Variable Low Clutch Accumulator Piston
411	Automatic Transmission Torque Dampener Bypass Clutch Valve Bore Plug Retainer
412	Automatic Transmission Torque Dampener Bypass Clutch Spring
413	Variable Low Clutch Valve
414	Line Pressure Control Solenoid Valve Accumulator Piston
415	Line Pressure Control Solenoid Valve Accumulator Piston Spring
416	Valve Body
417	Variable Low Clutch Valve Spring Retainer
418	Variable Low Clutch Valve Spring
419	Variable Low Clutch Valve
420	Variable Low Clutch Valve Spring Retainer
421	Variable Low Clutch Valve Spring
422	Variable Low Clutch Valve
423	Variable Low Clutch Valve Spring Retainer
424	Variable Low Clutch Valve Spring
425	Variable Low Clutch Valve
426	Variable Low Clutch Valve Spring Retainer
427	Variable Low Clutch Valve Spring
428	Variable Low Clutch Valve
429	Variable Low Clutch Valve Spring Retainer

Callout	Component Name
416	Control Valve Body
417	Automatic Transmission Torque Dampener Bypass Clutch Valve
418	Variable Low Clutch Regulator Valve Spring
419	Variable Low Clutch Regulator Valve Bore Plug Retainer
420	Variable High Clutch Valve
421	Variable Low Clutch Regulator Valve Spring
422	Variable Low Clutch Regulator Valve Bore Plug Retainer
423	Variable High Clutch Dam Feed Regulator Valve
424	Variable High Clutch Dam Feed Regulator Valve Spring
425	Variable High Clutch Dam Feed Regulator Valve Bore Plug Retainer
426	Line Pressure Control Solenoid Valve Retainer
427	Line Pressure Control Solenoid Valve
428	Pressure Relief Ball Valve Spring Pin
429	Pressure Relief Ball Valve Spring
430	Pressure Relief Ball Valve

Drive Motor Assembly (1st Position)

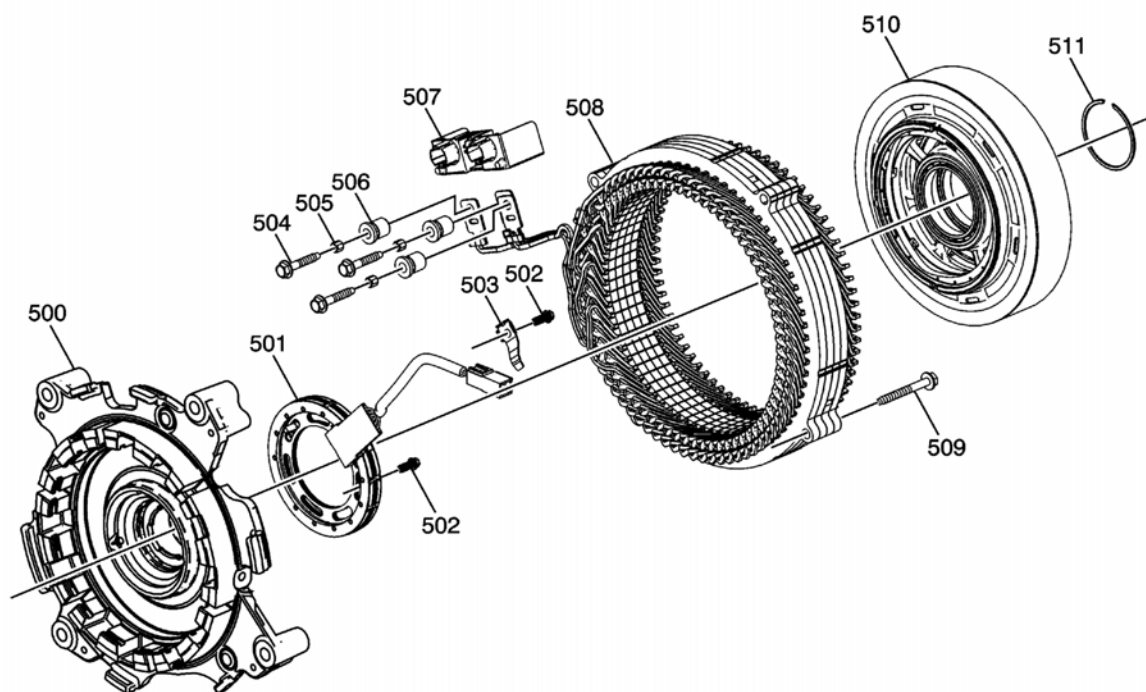


Fig. 10: Drive Motor Assembly (1st Position)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
500	Drive Motor Support
501	Drive Motor Position Sensor Stator
502	Drive Motor Position Sensor Bolt
503	Drive Motor Position Sensor Connector Clip
504	Drive Motor Power Inverter Module 3-Phase Cable Bolt
505	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer
506	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing
507	Drive Motor Power Inverter Module Cable Guide
508	Drive Motor Stator - (1st Position)
509	Drive Motor Stator Bolt
510	Drive Motor Rotor - (1st Position)
511	Drive Motor Rotor Bearing Retaining Ring

Drive Motor Assembly (2nd Position)

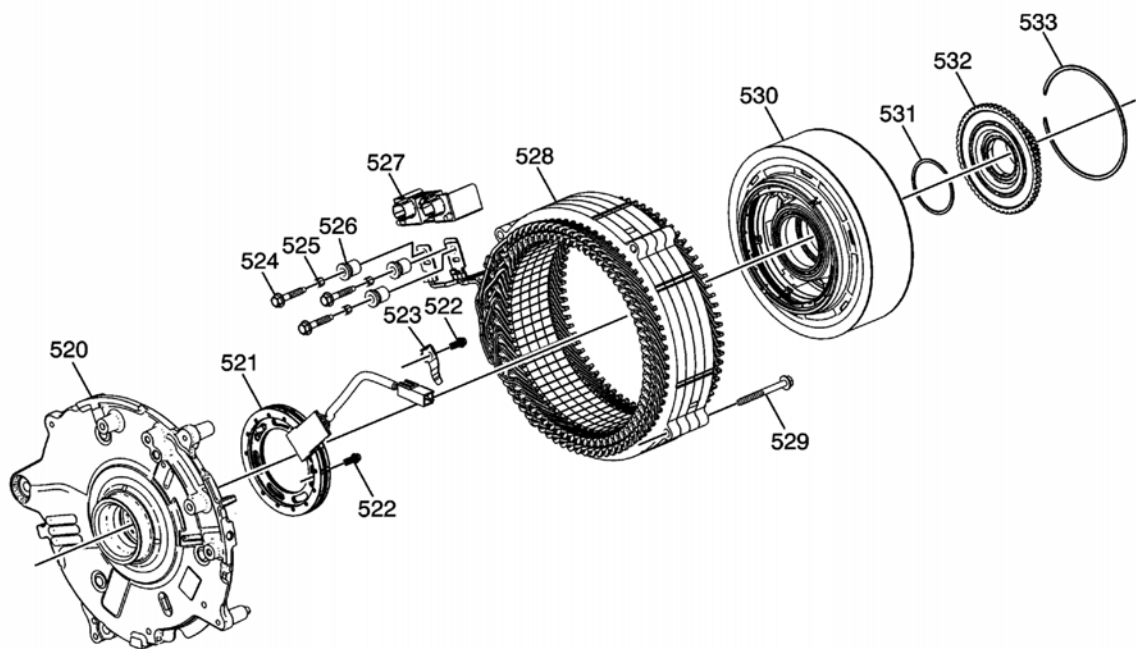


Fig. 11: Drive Motor Assembly (2nd Position)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
520	Drive Motor Support

Callout	Component Name
521	Drive Motor Position Sensor Stator
522	Drive Motor Position Sensor Bolt
523	Drive Motor Position Sensor Connector Clip
524	Drive Motor Power Inverter Module 3-Phase Cable Bolt
525	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer
526	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing
527	Drive Motor Power Inverter Module Cable Guide
528	Drive Motor Stator - (2nd Position)
529	Drive Motor Stator Bolt
530	Drive Motor Rotor - (2nd Position)
531	Drive Motor Rotor Bearing Retaining Ring
532	Output Sun Gear
533	Output Sun Gear Retaining Ring

Output Carrier Internal Gear Assembly

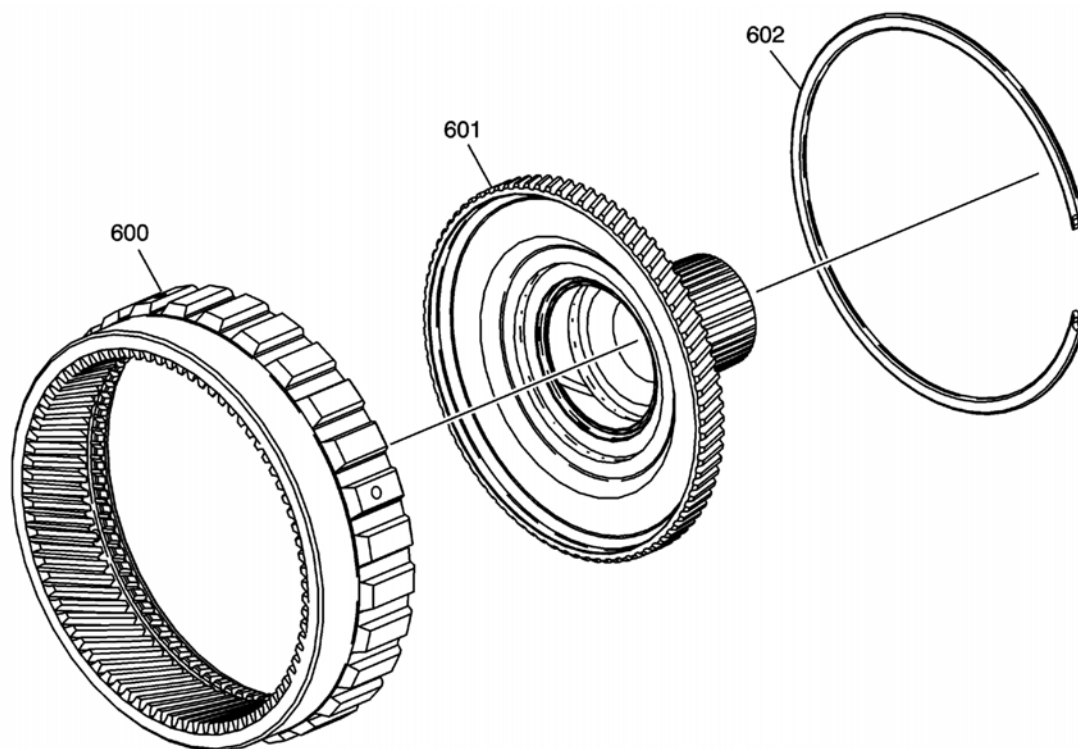


Fig. 12: Output Carrier Internal Gear Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
600	Output Carrier Internal Gear
601	Output Carrier Internal Gear Hub
602	Output Carrier Internal Gear Retaining Ring

Variable Low Clutch Assembly

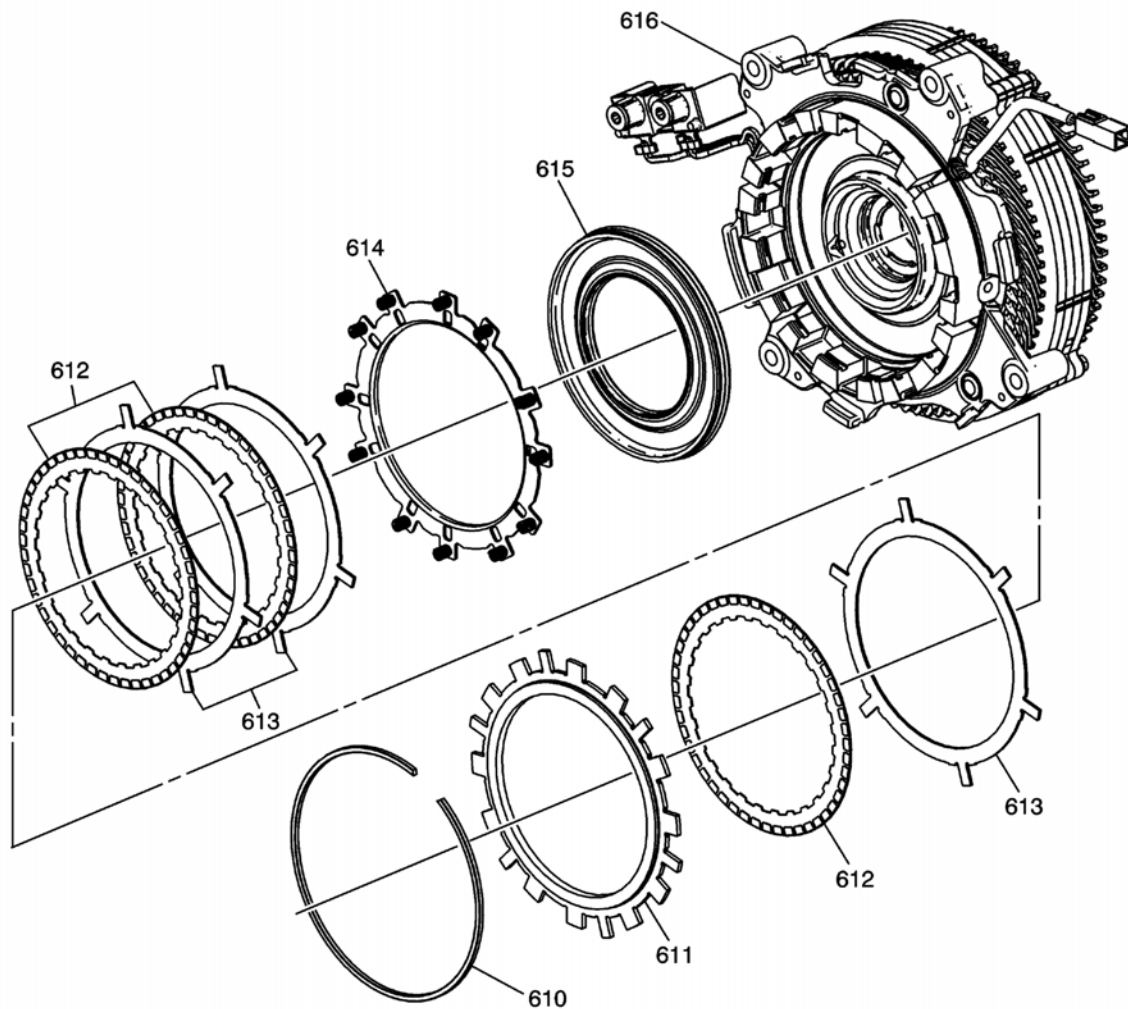


Fig. 13: Variable Low Clutch Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
610	Variable Low Clutch Backing Plate Retaining Ring - (Selective)
611	Variable Low Clutch Backing Plate
612	Variable Low Clutch Plate - Friction
613	Variable Low Clutch Plate
614	Variable Low Clutch Spring
615	Variable Low Clutch Piston
616	Drive Motor - (1st Position)

Variable High Clutch Assembly

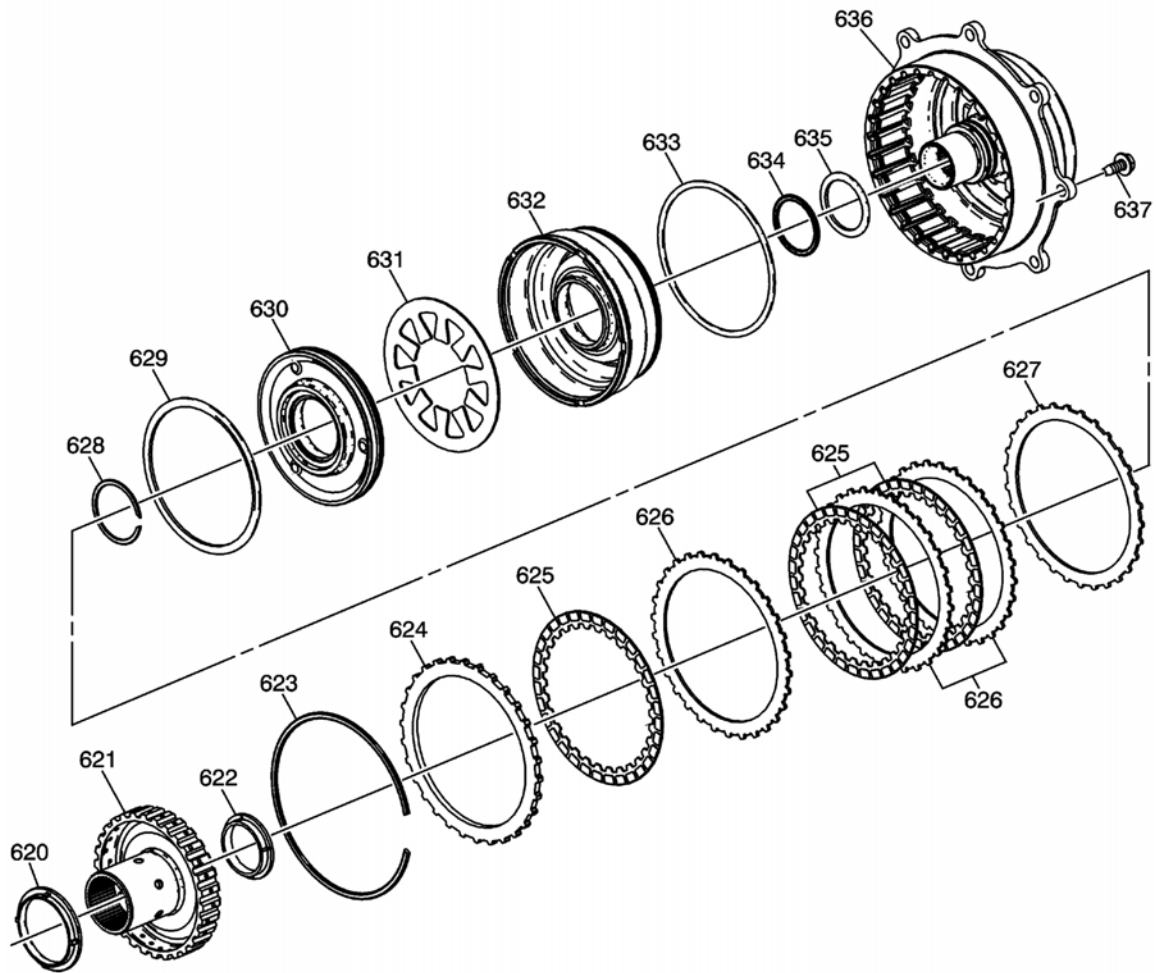


Fig. 14: Variable High Clutch Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
620	Variable High Clutch Hub Thrust Washer
621	Variable High Clutch Hub
622	Variable High Clutch Hub Thrust Washer
623	Variable High Clutch Backing Plate Retaining Ring - (Selective)
624	Variable High Clutch Backing Plate
625	Variable High Clutch Plate - Friction
626	Variable High Clutch Plate
627	Variable High Clutch Waved Plate
628	Variable High Clutch Piston Dam Retaining Ring
629	Variable High Clutch Piston Outer Seal
630	Variable High Clutch Piston Dam
631	Variable High Clutch Piston Spring
632	Variable High Clutch Piston
633	Variable High Clutch Piston Dam Outer Seal
634	Variable High Clutch Piston Dam Inner Seal
635	Variable High Clutch Piston Inner Seal

Callout	Component Name
636	Variable High Clutch Housing
637	Variable High Clutch Housing Bolt

Torque Limiting Clutch Assembly

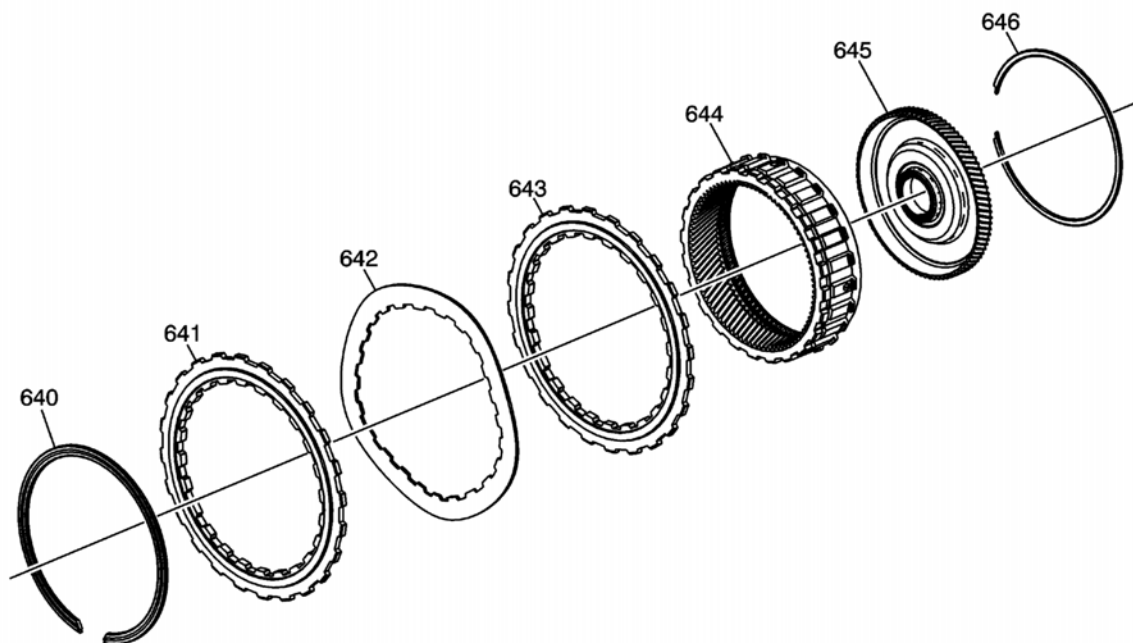


Fig. 15: Torque Limiting Clutch Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
640	Automatic Transmission Torque Limit Clutch Backing Plate Ring
641	Automatic Transmission Torque Limit Clutch Backing Plate
642	Automatic Transmission Torque Limit Clutch Spring
643	Automatic Transmission Torque Limit Clutch Backing Plate
644	Input Internal Gear
645	Input Internal Gear Hub
646	Input Internal Gear Retaining Ring

Park System Components

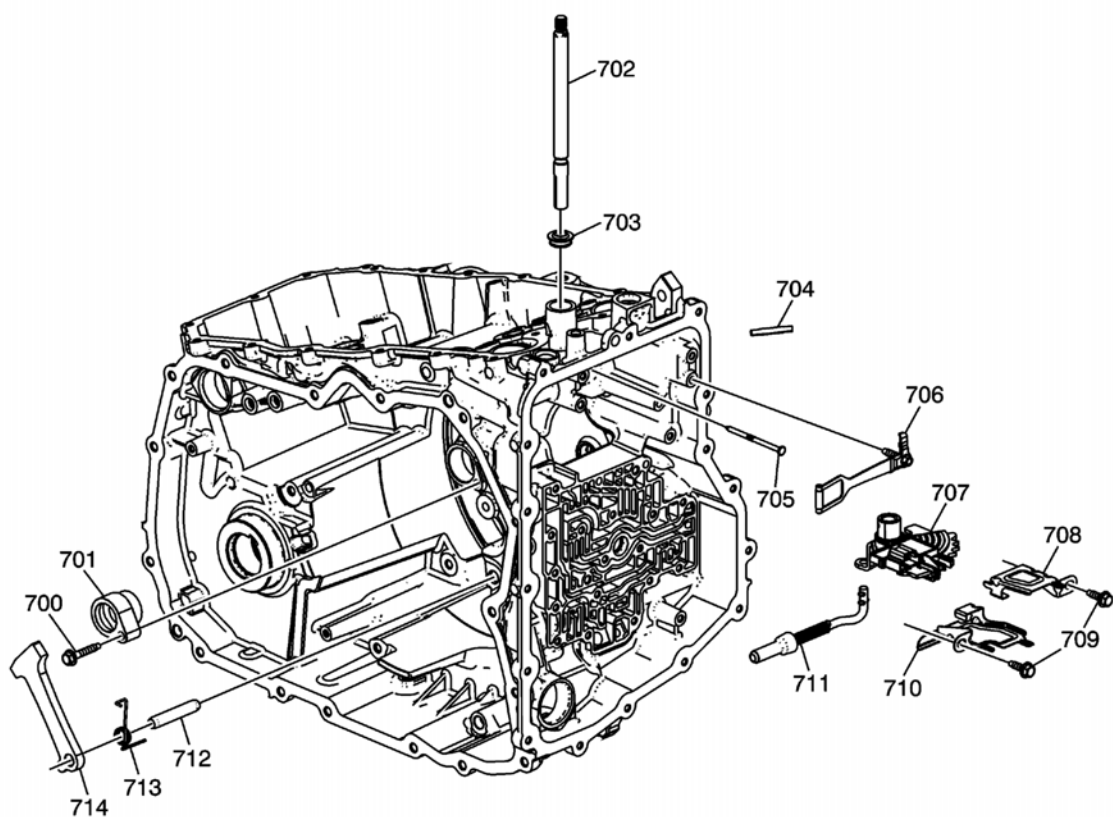


Fig. 16: Park System Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
700	Park Pawl Actuator Guide Bolt
701	Park Pawl Actuator Guide
702	Manual Shift Detent Lever Shaft
703	Manual Shift Shaft Seal
704	Manual Shift Detent Lever Pin
705	Manual Shift Shaft Pin
706	Manual Shift Detent Lever Spring
707	Manual Shift Detent Lever
708	Automatic Transmission Wiring Harness Bracket
709	Automatic Transmission Wiring Harness Connector Bracket Bolt
710	Automatic Transmission Wiring Harness Bracket
711	Park Pawl Actuator
712	Park Pawl Shaft
713	Park Pawl Spring
714	Park Pawl

COMPONENT LOCATION

Component Locations

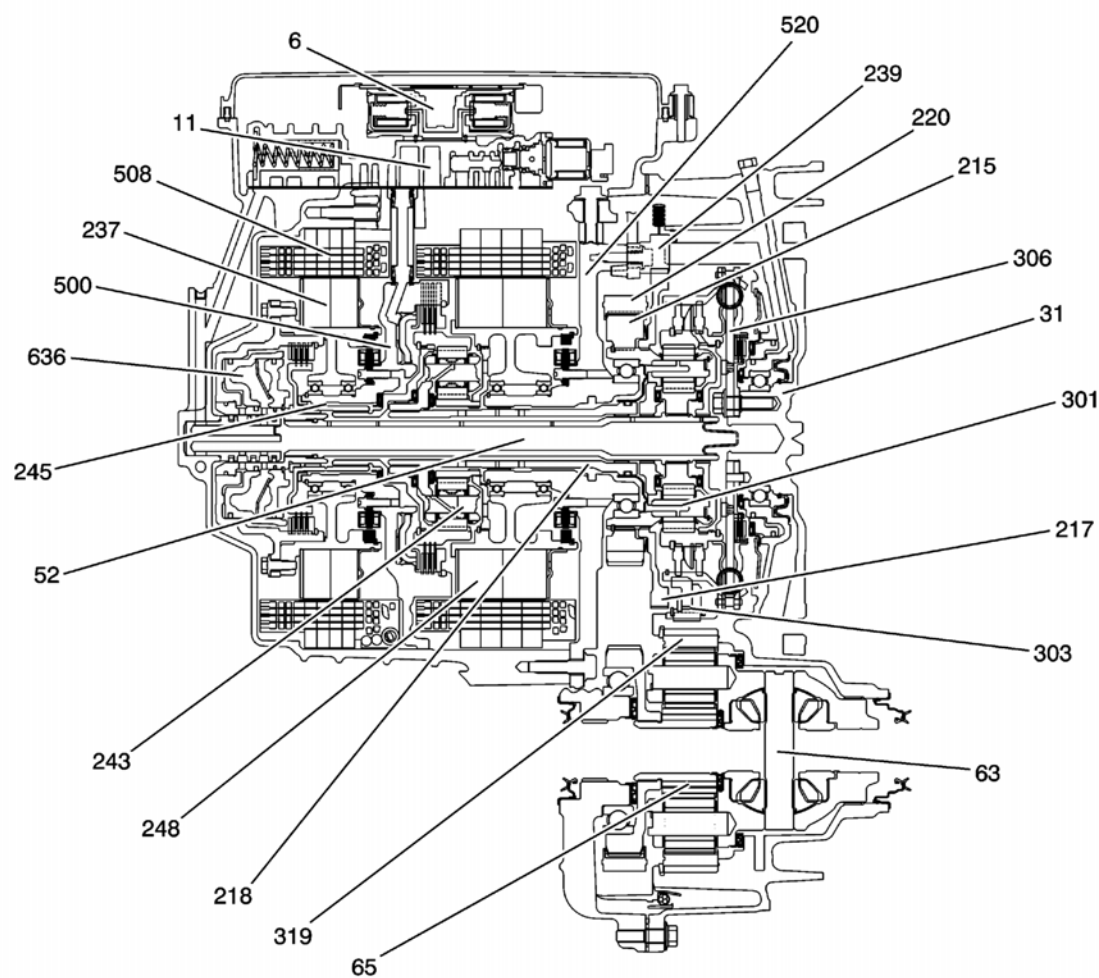


Fig. 17: Transaxle Internal Component Locations
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
6	Control Solenoid Valve
11	Control Valve
31	Input Drive Flange
52	Input Sun Gear Shaft
63	Front Differential Carrier Assembly
65	Front Differential Carrier Sun Gear
215	Drive Sprocket
217	Park Gear
218	Input Carrier
220	Drive Link
237	Drive Motor
239	Automatic Transmission Output Speed Sensor
243	Output Carrier Assembly

Callout	Component Name
245	Output Carrier Internal Gear
248	Drive Motor
301	Input Internal Gear
303	Input Brake Clutch
306	Automatic Transmission Torque Dampener
319	Front Differential Ring Gear
500	Drive Motor Support
508	Drive Motor Stator
520	Drive Motor Support
636	Variable High Clutch Housing

BUSHING, BEARING, AND WASHER LOCATIONS

Location Of The Bushings, Bearings, and Washers

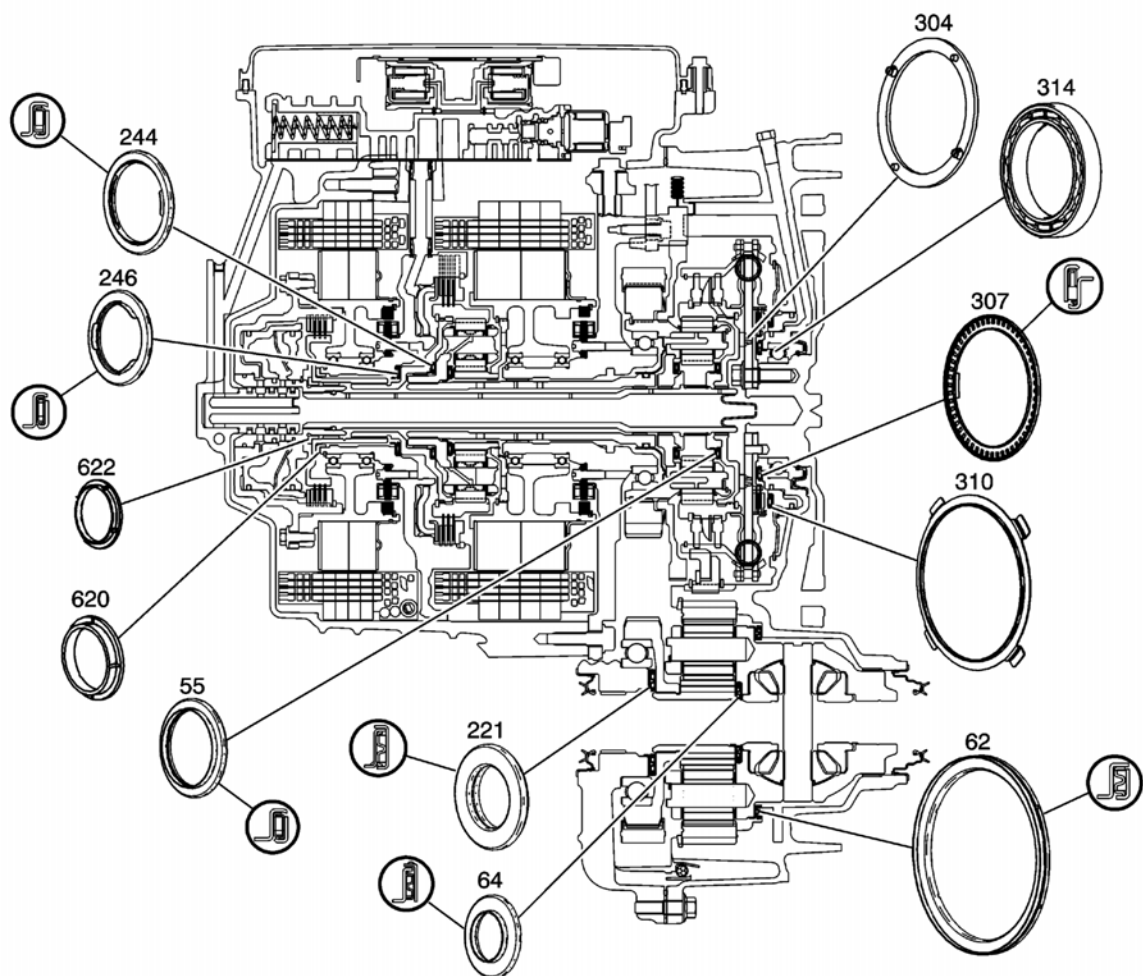


Fig. 18: Bushings, Bearings, And Washer Locations

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
55	Input Internal Gear Thrust Bearing

Callout	Component Name
62	Front Differential Carrier Bearing
64	Differential Carrier Sun Gear Thrust Bearing
221	Driven Sprocket Bearing
244	Output Carrier Thrust Bearing
246	Output Carrier Internal Gear Hub Thrust Bearing
304	Automatic Transmission Torque Dampener Thrust Washer
307	Automatic Transmission Torque Dampener Thrust Bearing
310	Automatic Transmission Torque Dampener Bypass Clutch Apply Bearing
314	Input Shaft Bearing
620	Variable High Clutch Hub Thrust Washer
622	Variable High Clutch Hub Thrust Washer

SEAL LOCATIONS

Seal Locations #1

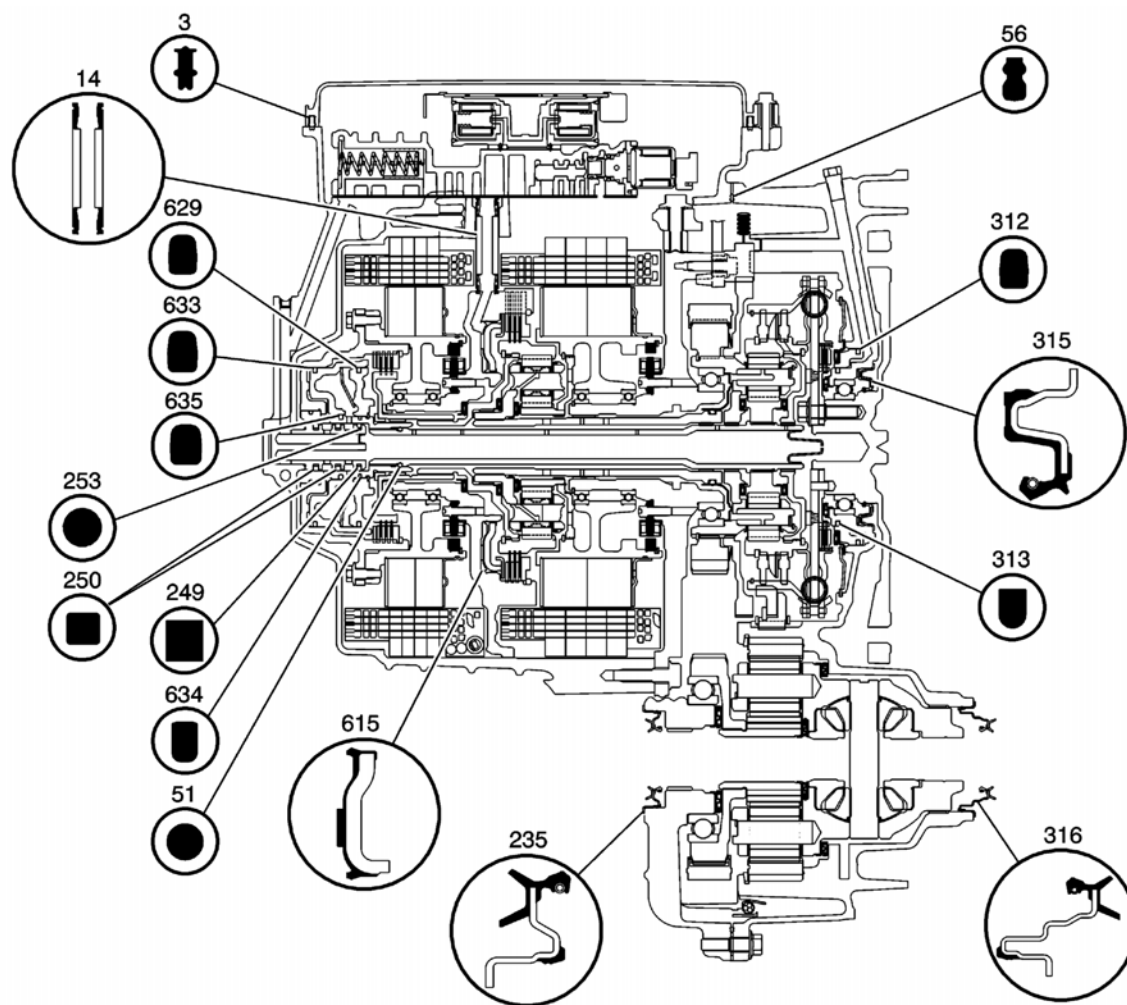


Fig. 19: Seal Locations #1

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
3	Automatic Transmission Fluid Level Control Valve Seal - (Gasket)
14	Variable Low Clutch Fluid Passage Seal
51	Variable High Clutch Housing Seal - (O-ring)
56	Automatic Transmission Torque Dampener and Differential Housing Gasket
235	Front Wheel Drive Shaft Oil Seal
249	Variable High Clutch Fluid Transfer Support Seal
250	Variable High Clutch Fluid Transfer Support Seal
253	Variable High Clutch Fluid Seal Ring
312	Automatic Transmission Torque Dampener Bypass Clutch Piston Outer Seal
313	Automatic Transmission Torque Dampener Bypass Clutch Piston Inner Seal
315	Input Shaft Seal
316	Front Wheel Drive Shaft Oil Seal
615	Variable Low Clutch Piston
629	Variable High Clutch Piston Outer Seal
633	Variable High Clutch Piston Dam Outer Seal
635	Variable High Clutch Piston Inner Seal

Seal Locations #2

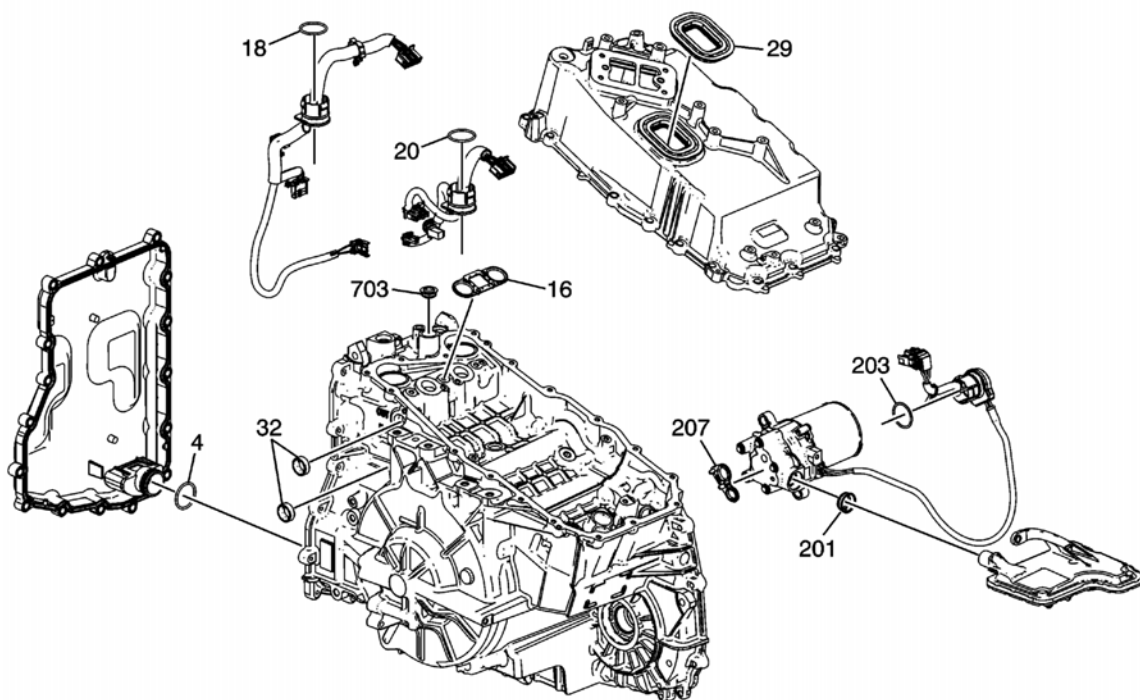


Fig. 20: Seal Locations #2

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4	Automatic Transmission Fluid Level Control Valve Seal - (O-ring)
16	Drive Motor Power Inverter Module Fluid Seal
18	Automatic Transmission Wiring Connector Seal - (O-ring)

Callout	Component Name
20	Automatic Transmission Wiring Connector Seal - (O-ring)
29	Drive Motor Power Inverter Module Electrical Connector Seal
32	Transmission Fluid Cooler Pipe Fitting Seal
201	Automatic Transmission Fluid Filter Seal
203	Automatic Transmission Auxiliary Fluid Pump Motor 3-Phase Cable Seal
207	Automatic Transmission Pump Fluid Outlet Seal
703	Manual Shift Shaft Seal

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0658 OR P0659: ACTUATOR HIGH CONTROL CIRCUIT GROUP 1 VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0658

Actuator High Control Circuit Group 1 Low Voltage

DTC P0659

Actuator High Control Circuit Group 1 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0658	P0659	P0659	-

Typical Scan Tool Data

High Side Drive 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On Parameter Normal Range: On			
High Side Driver 1	Off	On	Off

Circuit/System Description

The high side driver 1 is internal to the Hybrid/EV powertrain Control Module 1. With the ignition On, the high side driver 1 provides 12 V to the transmission control solenoid valve and line pressure control solenoid. If excessive current flow is detected in high side driver 1 circuit, the high side driver 1 will turn Off. When the circuit fault is corrected, the high side driver 1 will reset. The hybrid/EV powertrain control module 1 and both drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter

module, and not serviced separately.

Conditions for Running the DTC

High side driver 1 is On.

Conditions for Setting the DTC

P0658

Hybrid/EV powertrain Control Module 1 has detected a short to ground on the high side driver 1 circuit during Hybrid/EV powertrain Control Module 1 initialization.

P0659

Hybrid/EV powertrain Control Module 1 has detected a short to voltage on the high side driver 1 circuit during Hybrid/EV powertrain Control Module 1 initialization.

Actions Taken When the DTC Sets

DTCs P0658, and P0659 are Type A DTCs.

P0658

- The Hybrid/EV powertrain control module commands maximum line pressure.
- The Hybrid/EV powertrain control module inhibits clutch 1, also call the variable low clutch.

Conditions for Clearing the DTC

DTCs P0658, and P0659 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool High Side Driver 1 Command parameter displays On.
 - **If On is not displayed**

Refer to Circuit/System Testing.
 - **If On is displayed**
3. Verify the parameters listed below do not display Malfunction when commanding the high side driver 1, On and Off with a scan tool.
 - High Side Driver 1 Circuit Low Voltage Test Status
 - High Side Driver 1 Circuit Open Test Status
 - High Side Driver 1 Circuit High Voltage Test Status
 - **If Multifunction is displayed**

Refer to Circuit/System Testing.
 - **If Multifunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal

protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Remove the Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#).
3. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the Q8 Control Solenoid Valve.
4. Connect the 12 V battery.
5. Ignition ON, connect a test lamp between the high side driver circuit X1 terminal 1 and the ground.
6. Verify the test lamp turns ON.

• **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If less than 2 Ω , replace the T6 Power Inverter Module.

• **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the T6 Power Inverter Module.

• **If the test lamp turns ON and OFF**

7. Test or replace the Q8 Control Solenoid Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement, often referred to as the

Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Automatic Transmission Wiring Harness - Control Solenoid Valve replacement.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P0711-P0713: TRANSMISSION FLUID TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0711

Transmission Fluid Temperature Sensor Performance

DTC P0712

Transmission Fluid Temperature Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
TFT Sensor Signal	P0712	P0713	P0713	P0711
Low Reference	-	P0713	-	P0711

Typical Scan Tool Data

Transmission Fluid Temperature

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: -39 to +149Â°C (-38 to +300Â°F)			
TFT Signal	Greater than 149Â°C (300Â°F)	Less than -39Â°C (-38Â°F)	Less than -39Â°C (-38Â°F)*
Low Reference	-	Less than -39Â°C (-38Â°F)	Less than -39Â°C (-38Â°F)*
* Internal TFT sensor damage may result if shorted to B+			

Circuit/System Description

The primary source of heat in the transmission is the drive motor generators. The drive motor generators are cooled by the transmission fluid. Hot fluid exits the drive motor generators and flows to the transmission cooler supply line. The supply line connects to the transmission cooler, which is internal to the radiator. The transmission fluid cooler pipe assembly is equipped with an internal thermostat that opens at 80°C (176°F) for optimum transmission operation and fuel economy. The transmission cooler pipe thermostat is part of the transmission fluid cooler pipe assembly, located near the transmission and is not serviced separately. From the cooler, the fluid returns through the transmission fluid cooler pipe assembly and enters the lubrication circuits. After lubricating the internal components, the fluid returns to the oil pan. The transmission fluid temperature sensor is part of the control solenoid valve assembly and is not serviced separately.

Conditions for Running the DTC

- The ignition On is greater than 3 s.
- The system voltage is greater than 9 V.

P0711

- DTCs P0712, P0713, U179A, or U0293 are not active.
- Vehicle speed is detected for 5 s.
- Cold soak average and vehicle running transmission fluid temperature is between -40°C (-40°F) and 130°C (266°F).
- The difference between the transmission fluid temperature sensor and the cold soak average temperature is less than 15°C (27°F) at -40°C to -20°C (-40°F to -4°F) or less than 10°C (18°F) greater than -20°C (-40°F) ambient temperature.

Conditions for Setting the DTC

P0711

- The difference between the transmission fluid temperature sensor and the cold soak average temperature is greater than 15°C (27°F) at -40°C to -20°C (-40°F to -4°F) or greater than 10°C (18°F) greater than -20°C (-40°F) ambient temperature for greater than or equal to 300 s.

OR

- The transmission fluid temperature is stuck for greater than or equal to 300 s.

P0712

The Hybrid/EV Powertrain Control Module 1 detects a transmission fluid temperature sensor resistance of less than or equal to 68.6 Ω which corresponds to 149°C (300°F) for 2 s out of a 3 s window.

P0713

The Hybrid/EV Powertrain Control Module 1 detects a transmission fluid temperature sensor resistance of greater than or equal to 83,641 Ω which corresponds to -50°C (-58°F) for 2 s out of a 3 s window.

Actions Taken When the DTC Sets

- DTCs P0711, P0712 and P0713 are Type A DTCs.
- The Hybrid/EV powertrain control module switches to a calculated transmission fluid temperature.

Conditions for Clearing the DTC

DTCs P0711, P0712 and P0713 are Type A DTCs.

Diagnostic Aids

The Transmission Fluid Temperature parameter on the scan tool should rise steadily to a normal operating temperature, and then stabilize. Ask about the customer's driving habits, overloading, etc. Ensure the engine and transmission cooling system is functioning normally.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Special Tools

GE-24731 Tempil Stick

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Vehicle ON, observe the scan tool Transmission Fluid Temperature and the ECT temperature parameter after a 9 hour cold soak. The readings should be between -50 to 149Â°C (-58Â°F to 300Â°F) and vary less than 15Â°C (27Â°F) at -40Â°C to -20Â°C (-40Â°F to -4Â°F) or less than 10Â°C (18Â°F) greater than -20Â°C (-40Â°F) from ambient temperature after an 9.5 hour cold soak. The transmission fluid temperature parameter should rise steadily then stabilize when the vehicle is driven for greater than 300 s.

- **If greater than the specified range, or stuck at a fixed temperature**

Refer to Circuit/System Testing.

- **If within the specified range**

Test for a transmission overheat condition. Refer to [Transmission Overheats](#) .

- **If no automatic transmission overheating condition exists**

2. Refer to Circuit System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Remove the Control Valve Body Cover. Refer to [Control Valve Body Cover Removal](#).
3. Vehicle Off and all vehicle systems Off. Disconnect the X1 harness connector at the Q8 Control Solenoid Valve. It may take up to 2 min. for all vehicle systems to power down.
4. Test for less than 10 Ω between the low reference circuit terminal 4 on the X1 harness connector and ground.
 - **If 10 Ω or greater**
 1. Vehicle Off, disconnect the Automatic Transmission Wiring Harness (Control Solenoid Valve) harness connector at the T6 Power Inverter Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, replace the Automatic Transmission Wiring Harness (Control Solenoid Valve).
 - If less than 2 Ω , replace the T6 Power Inverter Module.
 - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.
 - **If not between 4.8 - 5.2 V**
 1. Ignition Off, disconnect the Automatic Transmission Wiring Harness (Control Solenoid Valve) harness connector at the T6 Power Inverter Module.

2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, replace the Automatic Transmission Wiring Harness (Control Solenoid Valve).
 - If infinite resistance
3. Test for less than 1 Ω in the signal circuit end to end.
 - If 1 Ω or greater, replace the Automatic Transmission Wiring Harness (Control Solenoid Valve).
 - If less than 1 Ω , replace the T6 Power Inverter Module.
 - **If between 4.8 - 5.2 V**
7. Replace the Q8 Control Solenoid Valve.

Component Testing

1. Perform each step listed below:
 - Perform the [Fluid Leak Diagnosis](#).
 - Perform the [Transmission Fluid Level and Condition Check](#) procedure.
 - Perform the [Line Pressure Check](#) procedure.
 - Perform the [Automatic Transmission Fluid Pump Pressure High or Low](#) procedure.
 - With a hand held infra-red thermometer, or **GE-24731** tempil stick test for the transmission cooler supply line thermostat for opening at 80 $\hat{\text{A}}$ °C (176 $\hat{\text{A}}$ °F). The transmission cooler supply line temperature should be higher on the transmission side of the thermostat than the cooler side until 80 $\hat{\text{A}}$ °C (176 $\hat{\text{A}}$ °F) is reached.
 - **If the thermostat tests stuck open or closed**

Replace the transmission cooler supply pipe assembly.
 - **If thermostat tests OK**
2. Perform the [Control Solenoid Valve Performance Test](#).
 - **If a concern is found**

Replace the Q8 Control Solenoid Valve.
 - **If a concern is not found**
3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Transmission Fluid Cooler Thermal Bypass Valve Replacement](#)
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.
- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.
- Refer to [Automatic Transmission Wiring Harness Replacement](#)
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P0721: OUTPUT SPEED SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0721

Output Speed Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P077C, P215C	P077D, P215C	P215C	P0721, P077B, P215C
Low Reference	P215C	P215C	P215C	P0721, P077B, P215C

Typical Scan Tool Data

Output Shaft Direction

Circuit	Normal Range	Open/High Resistance	Short to Voltage	Short to Ground
Operating Conditions: Vehicle moving, normal operating temperature				
Transmission OSS	Forward/Reverse	Invalid/Unknown	Invalid/Unknown	Invalid/Unknown
Output Shaft Speed Sensor	Greater than 0 RPM	0 RPM	0 RPM	0 RPM

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 2 internal hall-effect type sensors, and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the hybrid/EV powertrain control module 1 through the transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 5 V on the OSS supply voltage circuit from the hybrid/EV powertrain control module 1. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft. The two sensor elements in the output speed sensor assembly are spaced approximately 1/2 a tooth apart.

- When the vehicle is moving in a forward direction, sensor A detects a particular tooth before sensor B.
- When the vehicle is moving in a reverse direction, sensor B detects a particular tooth before sensor A.

The electronics in the sensor combine the two signals and send a signal with a different pulse width. This signal is interpreted by the hybrid/EV powertrain control module 1 for speed and direction and is transmitted through the serial data circuits to the engine control module (ECM). The ECM, hybrid/EV powertrain control module 1, compare the output speed sensor signal with the antilock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced.

separately.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects an invalid Automatic Transmission Output Shaft Speed Sensor direction for 2.5 s within a 3 s window.

Action Taken When the DTC Sets

The hybrid/EV powertrain control module 1 calculates vehicle speed based on the drive motor 2 speed.

Conditions for Clearing the DTC

DTC P0721 is a Type A DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Special Tools

EL 38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Operate the vehicle at 16 - 32 km/h (10 - 20 mph), observe the scan tool Transmission OSS parameter. The reading should be greater than 150 RPM and not drop out.

2. Observe the scan tool OSS Supply Voltage parameter. The reading should display OK.

Circuit/System Testing

1. Vehicle ON.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify DTC P7021 is not set.
 - **If DTC is set**

Perform the **Output Shaft Speed Input Test**.
 - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Solenoid Valve Characterization Reprogramming** when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P077B-P077D: OUTPUT SPEED SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P077B

Output Speed Sensor Circuit Direction Incorrect

DTC P077C

Output Speed Sensor Circuit Low Voltage

DTC P077D

Output Speed Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P077C, P215B	P0721, P215B, P077D	P0721, P215B, P077D	P077B, P0721, P215C

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Signal	P077C, P215B	P0721, P215B, P077D	P0721, P215B, P077D	P077B, P0721, P215C

Typical Scan Tool Data

Output Shaft Direction

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
Transmission OSS	Forward/Reverse	Out of Range	Out of Range
OSS Supply Voltage	OK	Out of Range	Out of Range

Circuit/System Description

The transmission output shaft speed sensor has 2 internal hall-effect type sensors, and is capable of sensing both speed and direction. The transmission output shaft speed sensor mounts to the A/Trans case assembly and is connected to the hybrid/EV powertrain control module 1 assembly through a wire harness and connector. The sensor faces the drive sprocket machined teeth surface. The sensor receives 5 V on the OSS supply voltage circuit from the hybrid/EV powertrain control module 1. As the drive sprocket rotates, the sensor produces a signal frequency based on the machined surface of the drive sprocket.

The two sensor elements in the transmission output shaft speed sensor are spaced approximately 1/2 a tooth apart.

- When the vehicle is moving in a forward direction, sensor A detects a particular tooth before sensor B.
- When the vehicle is moving in a reverse direction, sensor B detects a particular tooth before sensor A.

The electronics in the sensor combine the two signals and send a signal with a different pulse width. This signal is interpreted by the hybrid/EV powertrain control module 1 for speed and direction and is transmitted through the GMLAN circuits to the ECM. The ECM and hybrid/EV powertrain control module 1, compare the OSS signal with hybrid motor speed/direction and the ABS wheel speed sensor signal.

Conditions for Running the DTC

P077B

- DTC P0721, P077C, P077D, or P215C is not set.
- The drive motor estimated output speed is greater than 50 RPM.

P077C

- DTC P077D is not set.
- System voltage is at least 9 V and no more than 32 V.

P077D

- DTC P077B is not set.
- System voltage is at least 9 V and no more than 32 V.

Conditions for Setting the DTC

P077B

The hybrid/EV powertrain control module 1 detects an incorrect OSS direction.

P077C

The hybrid/EV powertrain control module 1 detects the output speed sensor signal voltage is less than 0.36 V for 0.25 s.

P077D

The hybrid/EV powertrain control module 1 detects the output speed sensor signal voltage is greater than 4.25 V for 0.25 s.

Action Taken When the DTC Sets

The hybrid/EV powertrain control module 1 uses drive motor 2 speed to calculate vehicle speed.

Conditions for Clearing the DTC

P077B, P077C, and P077D are Type A DTCs.

Diagnostic Aids

Inspect the output speed sensor, harness, connector and control solenoid valve assembly pins for metallic debris and output shaft machined face for damage or misalignment. Proper torque of the output speed sensor mounting bolt is critical to proper output speed sensor operation. Use a terminal test kit for any test that requires probing the control solenoid valve assembly harness connector or a component harness connector.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information.

Special Tools

EL 38522 Variable Signal Generator

For equivalent regional tools, refer to [Special Tools](#).

Circuit/System Verification

1. Verify that DTC P0721, P0970, P0971, P0973, P2720, P2721, P2729, or P2730 are not set.
 - If any of the DTCs are set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
2. Operate the vehicle at 16 - 32 km/h (10 - 20 mph) while observing the Transmission Data OSS Direction parameter on the scan tool. The OSS Direction parameter should match vehicle direction.
 - If the OSS parameter corresponds with the vehicle direction and the DTC is set, replace the T6 power inverter module.

Circuit/System Testing

1. Vehicle ON.
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify DTC P077B, P077C, or P077D is not set.
 - **If DTC is set**

Perform the [Output Shaft Speed Input Test](#).
 - **If the DTC is not set**
4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for Drive Motor Generator Power Inverter Module, also called the T6 power inverter module replacement, programming, and setup
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P079A: TRANSMISSION CLUTCH 1 SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P079A

Transmission Clutch 1 Slip Detected

Typical Scan Tool Data

Variable Low Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0 - 161 km/h (0 - 100 mph) Parameter Normal Range: 0 - 6,000 RPM			
Clutch 1 Slip Speed	0 RPM	0 - 6,000 RPM	0 - 6,000 RPM
Clutch 1 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 1 Slip Speed for each Hybrid Transmission Mode Commanded state. The hybrid/EV powertrain control module 1 monitors clutch slip when the variable low clutch is applied. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Clutch 1 is applied.
- No P1B0D, P1B0E, P1E4A or P1E4B DTCs.
- The commanded line pressure is at least 190 kPa (28 psi) for 1 s.
- The variable low clutch torque estimated is greater than 74 N.m (55 lb ft) for 1 s.
- Wheel slip speed is 0.
- Shutdown is not commanded.

Conditions for Setting the DTC

- The hybrid/EV powertrain control module 1 detects clutch 1 slip speed greater than 190 RPM for 1 s, 3 times within the same key cycle.
- Clutch 1 energy is greater than 8 joules 3 times within the same key cycle, the fault will set instantly.

Action Taken When the DTC Sets

- P079A is a Type A DTC.
- The hybrid/EV powertrain control module 1 commands the internal combustion engine On.
- The hybrid/EV powertrain control module 1 inhibits mode 1 and gear 1.

Conditions for Clearing the DTC

P079A is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0721, P077B-P077D or P215C is not set.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTC is not set**
3. Verify correct fluid level and condition by performing the [Transmission Fluid Level and Condition Check](#).
4. Verify correct oil pressure by performing the [Line Pressure Check](#).
5. Operate the vehicle within the Conditions for Running the DTC. The Clutch 1 Slip Speed parameter reading should be less than 190 RPM when the Clutch 1 Status parameter reading is Applied.
 - **If clutch slip speed is greater than 190 RPM**

Refer to Component Testing.
 - **If clutch slip speed is less than 190 RPM**
6. All OK.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#)
2. Verify control solenoid valve assembly condition by performing the [Control Solenoid Valve Inspection](#).
3. Verify control solenoid valve assembly function by performing the [Control Solenoid Valve Performance Test](#).

- **If a concern is found**

Replace the Q8 Control Solenoid Valve.

- **If no concern is found**

4. Inspect the a/trans fluid level control valve for stuck closed or damaged condition.

- **If you found a concern with the a/trans fluid level control valve**

Replace the a/trans fluid level control valve.

- **If no concern is found**

5. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve. Refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer (w/gasket) plate assembly
- Variable low clutch valve and variable low clutch accumulator.
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

6. Inspect the variable low clutch assembly snap ring, piston, clutch discs, and housing for a slipping or damaged condition.

- **If you found a variable low clutch assembly concern**

Repair or replace the variable low clutch assembly as necessary.

- **If no concern is found**

7. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Valve Body Replacement](#) for control valve body replacement.
- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.
- Refer to [Variable Low Clutch Plate Removal](#), and [Variable Low Clutch Plate Installation](#) for variable low clutch replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P079B: TRANSMISSION CLUTCH 2 SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P079B

Transmission Clutch 2 Slip Detected

Typical Scan Tool Data

Variable High Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0 - 80 km/h (0 - 50 mph) Parameter Normal Range: 0 - 6,000 RPM			
Clutch 2 Slip Speed	0 RPM	0 - 6,000 RPM	0 - 6,000 RPM
Clutch 2 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors Clutch 2 Slip Speed for each Hybrid Transmission Mode Commanded state. The hybrid/EV powertrain control module 1 monitors clutch slip when the variable high clutch is commanded ON. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Clutch 2 is applied.
- No P1B0D, P1B0E, P1E4A or P1E4B DTCs.
- The commanded line pressure is at least 190 kPa (28 psi) for 1 s.
- The variable high clutch torque estimated is greater than 15 N.m (11 lb ft) for 1 s.
- Wheel slip speed is 0.
- Shutdown is not commanded.

Conditions for Setting the DTC

- The hybrid/EV powertrain control module 1 detects clutch 2 slip speed greater than 100 RPM for 2.5 s within a 3 s window, 3 times within the same key cycle.
- Clutch 1 energy is greater than 5.8 joules 3 times within the same key cycle, the fault will set instantly.

Action Taken When the DTC Sets

- DTC P079B is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 2 and gear 1.

Conditions for Clearing the DTC

P079B is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0721, P077B-P077D or P215C is not set.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTC is not set**
3. Verify correct fluid level and condition by performing the [Transmission Fluid Level and Condition Check](#).
4. Verify correct oil pressure by performing the [Line Pressure Check](#).
5. Operate the vehicle within the Conditions for Running the DTC. The Clutch 2 Slip Speed parameter reading should be less than 100 RPM when the Clutch 2 Status parameter reading is Applied.
 - **If clutch slip speed is greater than 100 RPM**

Refer to Component Testing.
 - **If clutch slip speed is less than 100 RPM**
6. All OK.

Component Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following

Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Verify control solenoid valve assembly condition by performing the [Control Solenoid Valve Inspection](#).
3. Verify control solenoid valve assembly function by performing the [Control Solenoid Valve Performance Test](#).

- **If a concern is found**

Replace the Q8 Control Solenoid Valve.

- **If no concern is found**

4. Inspect the a/trans fluid level control valve is for a stuck, closed or damaged condition.

- **If you found a concern with the a/trans fluid level control valve**

Replace the a/trans fluid level control valve.

- **If no concern is found**

5. Inspect the variable high clutch valve is not sticking or damaged. Refer to [Control Valve Body Diagnostic Inspection](#).

- **If you found a concern with the variable high clutch valve**

Repair or replace the valve body.

- **If no concern is found**

6. Verify the variable high clutch assembly piston, snap ring, and clutch discs are not in a damaged condition.

- **If you found a variable high clutch concern**

Repair or replace the variable high clutch as necessary.

- **If no concern is found**

7. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Valve Body Replacement](#) for control valve body replacement
- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.

- Refer to [Variable High Clutch Removal](#), and [Variable High Clutch Installation](#) for variable high clutch replacement.
- Refer to [Control Valve Body Diagnostic Inspection](#)
- Refer to [Transmission Replacement](#) for Transmission removal.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P079C: TRANSMISSION CLUTCH 3 SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P079C

Transmission Clutch 3 Slip Detected

Typical Scan Tool Data

Input Brake Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0 - 161 km/h (0 - 100 mph) Parameter Normal Range: 0 - 6,000 RPM			
Clutch 3 Slip Speed	0 RPM	0 - 6,300 RPM	0 - 6,300 RPM
Clutch 3 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch Slip 3 Speed for each Hybrid Transmission Mode Commanded state. Clutch 3 in the vehicle software is tied to the input brake clutch in the transmission. This is a one way mechanical clutch. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Line pressure command is greater than 190 kPa (27.6 psi) for 1 s.
- No P1B0D, P1B0E, P1E4A, or P1E4B motor speed DTCs are set.
- Clutch 3 command is Locked.
- Wheel slip speed is 0.
- Shutdown is not commanded.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects the clutch 3 Slip Speed is greater than 100 RPM for 1 s.

Action Taken When the DTC Sets

- P079C is a Type A DTC.
- The hybrid/EV powertrain control module 1 commands the internal combustion engine On.

Conditions for Clearing the DTC

P079C is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Component Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and

personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#) .
2. Inspect the flexplate for a broken condition.
3. Inspect the input brake clutch for a broken condition.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Transmission Replacement](#) for Transmission removal
- Refer to [Automatic Transmission Flex Plate Removal](#)
- Refer to [Automatic Transmission Torque Dampener and Differential Housing Disassemble](#) for Input Brake Clutch removal procedure
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A3: TRANSMISSION CLUTCH 1 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07A3

Transmission Clutch 1 Stuck On

Typical Scan Tool Data

Variable Low Clutch Reference

Parameter	Commanded ON	Commanded OFF	Stuck/Welded When
-----------	--------------	---------------	-------------------

			Commanded OFF
Operating Conditions: Vehicle speed 0 - 50 MPH (80 km/h)			
Parameter Normal Range: 0 - 6,000 RPM			
Clutch 1 Slip Speed	0 RPM	0 - 9,500 RPM	0 RPM
Clutch 1 Status	Applied	Released	Released

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the variable low clutch slip speed for each Hybrid/EV Transmission Mode Command state. Low clutch slip speed when the clutch is commanded Off indicates a stuck or welded clutch condition. If the hybrid/EV powertrain control module 1 detects a stuck clutch condition, the hybrid/EV powertrain control module 1 will cycle the clutch 3 times within 30 seconds. The customer may feel 3 bumps before the DTC sets. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Variable low clutch (Clutch 1) is commanded OFF.
- No P179A, P1B0D, P1B0E, P1E4A, or P1E4B motor speed DTCs are set.
- Shutdown is not commanded.

Conditions for Setting the DTC

Clutch slip is less than 30 RPM 3 times within 1 s when clutch slip is expected.

Action Taken When the DTC Sets

- P07A3 is a Type A DTC.
- The hybrid/EV powertrain control module 1 commands clutch 1 and clutch 2 Off.

Conditions for Clearing the DTC

P07A3 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any transmission output speed sensor DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

[Circuit/System Verification](#)

1. Verify that P0721, P077B-P077D or P215C is not set.
 - If any of the DTCs are set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
2. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
 - If the transmission fluid is low or discolored, refer to [Transmission Fluid Drain and Fill](#).
3. Operate the vehicle within the Conditions for Running the DTC while monitoring the Clutch 1 Slip Speed parameter. The Clutch 1 Slip Speed parameter should display greater than 30 RPM when the Clutch 1 Status parameter displays Released.
 - If the DTC P07A3 resets, go to Component Testing.

[Component Testing](#)

1. Verify correct oil pressure by performing the [Line Pressure Check](#).
2. Perform the [Control Solenoid Valve Performance Test](#).
 - If a concern is found, replace the Q8 control solenoid valve.
3. Inspect the valve body assembly for sticking or damaged valves. Refer [Control Valve Body Diagnostic Inspection](#).
 - If you found a stuck or damaged valve, repair or replace the valve or valve body.
4. Inspect the variable low clutch for a stuck On or damaged condition.
 - If you found a variable low clutch concern, repair or replace the variable low clutch assembly as necessary.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Variable Low Clutch Plate Removal](#), and [Variable Low Clutch Plate Installation](#) for variable clutch repair or replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Q8 control solenoid valve or control valve body replacement.
- Refer to [Transmission Replacement](#) for transmission removal.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A5: TRANSMISSION CLUTCH 2 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07A5

Transmission Clutch 2 Stuck On

Typical Scan Tool Data

Variable High Clutch Reference

Parameter	Commanded ON	Commanded OFF	Stuck/Welded When Commanded OFF
Operating Conditions: Vehicle speed 0 - 50 MPH (80 km/h) Parameter Normal Range: 0 - 6,000 RPM			
Clutch 2 Slip Speed	0 RPM	0 - 6,000 RPM	0 RPM
Clutch 2 Status	Applied	Released	Released

Circuit/System Description

The hybrid/EV powertrain control module monitors the Clutch Slip parameters for each Hybrid/EV Transmission Mode Command state. Low clutch slip speed when the clutch is commanded Off indicates a stuck or welded clutch condition. If the hybrid/EV powertrain control module 1 detects a stuck clutch condition, the hybrid/EV powertrain control module 1 will cycle the clutch 3 times within 30 seconds. The customer may feel 3 bumps before the DTC sets. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- Variable high clutch (Clutch 2) is commanded Off.
- No P179B, P1B0D, P1B0E, P1E4A, or P1E4B motor speed DTCs are set.
- Shutdown is not commanded.

Conditions for Setting the DTC

Clutch slip is less than 30 RPM 3 times within 1 s when clutch slip is expected.

Action Taken When the DTC Sets

- P07A5 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 commands clutch 1 and clutch 2 Off.
- The hybrid/EV powertrain control module 1 commands the internal combustion engine On.

Conditions for Clearing the DTC

P07A5 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify that P0721, P077B-P077D or P215C is not set.
 - If any of the DTCs are set, refer to Diagnostic Trouble Code (DTC) List - Vehicle .
2. Perform the Transmission Fluid Level and Condition Check to verify correct fluid level and condition.
 - If the transmission fluid is low or discolored, refer to Transmission Fluid Drain and Fill.
3. Operate the vehicle within the Conditions for Running the DTC while observing the Clutch 2 Slip Speed parameter. The Clutch 2 Slip Speed parameter should display greater than 30 RPM when the Clutch 2 Status parameter displays Released.
 - If the DTC P07A5 is set, go to Component Testing.

Component Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Verify correct oil pressure by performing the [Line Pressure Check](#).
 - If you found a concern, repair the concern.
3. Perform the [Control Solenoid Valve Performance Test](#).
 - If a concern is found, replace the Q8 control solenoid valve assembly.
4. Inspect the valve body assembly for sticking or damaged valves. Refer [Control Valve Body Diagnostic Inspection](#).
 - If you found a concern, repair or replace the valve or valve body.
5. Inspect the variable high clutch for a stuck On or damaged condition.
 - If you found a variable high clutch concern, repair or replace the variable high clutch assembly as necessary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Variable High Clutch Removal](#), and [Variable High Clutch Installation](#) for variable high clutch replacement or overhaul.
- Refer to [Control Valve Body Replacement](#) for control valve body replacement.
- Perform the valve body inspection procedure, refer to [Control Solenoid Valve Inspection](#). If the inspection procedure indicates to replace the valve body, refer to [Control Valve Body Replacement](#).
- Refer to [Transmission Replacement](#) for transmission removal.
- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A7: TRANSMISSION CLUTCH 3 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07A7

Transmission Clutch 3 Stuck On

Typical Scan Tool Data

Input Brake Clutch Reference

Parameter	Commanded ON	Commanded OFF	Stuck when Commanded OFF
Operating Conditions: Vehicle speed 0 - 161 km/h (0 - 100 mph) Parameter Normal Range: 0 - 6,000 RPM			
Clutch 3 Slip Speed	0 RPM	0 - 6,300 RPM	0 - 6,300 RPM
Clutch 3 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch Slip 3 Speed for each Hybrid Transmission Mode Commanded state. Clutch 3 in the vehicle software is tied to the input brake clutch in the transmission. This is a one way mechanical clutch. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

Clutch 3 command is Off.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects the clutch 3 Slip Speed is greater than 0 RPM for 1 s when commanded Off.

Action Taken When the DTC Sets

- P07A7 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits gear 1.
- The hybrid/EV powertrain control module 1 commands the internal combustion engine Off.

Conditions for Clearing the DTC

P07A7 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in

duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the internal combustion engine (ICE) starts and stays running.

- **If the ICE does not start**

Refer to Engine Will Not Crank - Crankshaft Will Not Rotate

- **If the ICE starts and stays running**

2. All OK.

Component Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
 - **Visually and functionally inspect the gloves before use.**
 - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Inspect the input brake clutch for a broken or seized condition. The input break clutch should rotate freely in one direction and lock in the other direction.
3. If the input brake clutch tests OK, replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Seized Engine or Transmission Separation](#)
- Refer to [Transmission Replacement](#) for Transmission removal
- Refer to [Automatic Transmission Torque Dampener and Differential Housing Disassemble](#) for Input Brake Clutch removal procedure
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Refer to [Control Module References](#) for T6 Power Inverter Module, replacement, programming, and setup.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P0960, P0962, OR P0963: TRANSMISSION CONTROL SOLENOID VALVE 1 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0960

Transmission Control Solenoid Valve 1 Control Circuit Open

DTC P0962

Transmission Control Solenoid Valve 1 Control Circuit Low Voltage

DTC P0963

Transmission Control Solenoid Valve 1 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Line Pressure Control Solenoid Low Side Driver	P0962	P0963	P0963	P0960

Circuit/System Description

The line pressure control solenoid regulates the transmission fluid line pressure. The hybrid/EV powertrain control module 1 varies the current to the normally high line pressure control solenoid valve from 0.1 amp for maximum line pressure, to 1.1 amps for minimum line pressure. This is accomplished by varying the current in order to obtain the desired line pressure in kPa (psi). The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- The propulsion system is active.
- The system voltage is 11 - 18 volts.

Conditions for Setting the DTC

P0960

The transmission control module detects an internal electrical performance malfunction of the line pressure control solenoid control circuit for 5 s.

P0962

The transmission control module detects an internal low voltage electrical malfunction of the line pressure control solenoid control circuit for 400 milliseconds.

P0963

The transmission control module detects an internal high voltage electrical malfunction of the line pressure control solenoid control circuit for 400 milliseconds.

Action Taken When the DTC Sets

DTCs P0960, P0962 and P0963 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0960, P0962 and P0963 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Vehicle ON, verify the transmission fluid temperature is between 50 - 80°C (122 - 176°F).
2. Drive the vehicle, observe the scan tool Line Pressure Control Solenoid Valve Test Status parameters. The reading should display OK.
 - **If the reading is not within the specified value**

Refer to Circuit/System Testing.
 - **If the reading is within specification**
3. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Remove the Control Valve Body Cover, refer to [Control Valve Body Cover Replacement](#).
3. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the Q23 Line Pressure Control Solenoid Valve.
4. Connect the 12 V battery.
5. Ignition ON, connect a test lamp between the Q23 Line Pressure Control Solenoid Valve circuit terminal A and the ground circuit terminal B.
6. Verify the test lamp turns ON and OFF when commanding the Line Pressure Control Solenoid Valve Increase and Decrease with a scan tool.

• **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the control circuit and switched ground circuit to ground.
 - If less than infinite resistance, replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit and switched ground circuits end to end.
 - If 2 Ω or greater, replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.
 - If less than 2 Ω , replace the T6 Power Inverter Module.

• **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.
 - If less than 1 V, replace the T6 Power Inverter Module.

• **If the test lamp turns ON and OFF**

7. Replace the Q23 Line Pressure Control Solenoid Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement.
- Refer to [Line Pressure Control Solenoid Valve Replacement](#) for Q23 Line Pressure Control Solenoid Valve replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) to replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.

- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P0964, P0966-P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, OR P2730: TRANSMISSION CONTROL SOLENOID VALVE 2, 3, 4 OR 5 CONTROL CIRCUIT(S)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0964

Transmission Control Solenoid Valve 2 Control Circuit Open

DTC P0966

Transmission Control Solenoid Valve 2 Control Circuit Low Voltage

DTC P0967

Transmission Control Solenoid Valve 2 Control Circuit High Voltage

DTC P0968

Transmission Control Solenoid Valve 3 Control Circuit Open

DTC P0970

Transmission Control Solenoid Valve 3 Control Circuit Low Voltage

DTC P0971

Transmission Control Solenoid Valve 3 Control Circuit High Voltage

DTC P2718

Transmission Control Solenoid Valve 4 Control Circuit Open

DTC P2720

Transmission Control Solenoid Valve 4 Control Circuit Low Voltage

DTC P2721

Transmission Control Solenoid Valve 4 Control Circuit High Voltage

DTC P2727

Transmission Control Solenoid Valve 5 Control Circuit Open

DTC P2729

Transmission Control Solenoid Valve 5 Control Circuit Low Voltage

DTC P2730

Transmission Control Solenoid Valve 5 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Clutch Pressure Control Solenoid 2/3/4/5 Control	P0966, P0970, P2720, P2729	P0964, P0968, P2718, P2727	P0967, P0971, P2721, P2730

Circuit/System Description

The hybrid/EV powertrain control module 1 supplies 12 volts to the clutch pressure control solenoid valve. The hybrid/EV powertrain control module 1 controls the pressure control solenoids through the clutch pressure control solenoid valve control circuits. The normally closed pressure control solenoid valve flows fluid to the appropriate transmission hydraulic circuit when commanded ON. The clutch pressure control solenoids are part of the control solenoid valve and are not serviced separately.

Conditions for Running the DTC

- Propulsion system is active.
- The system voltage is 9 - 16 V.

Conditions for Setting the DTC

P0964, P0968, P2718, P2727

The hybrid/EV powertrain control module 1 detects an open solenoid control circuit for 1 s.

P0966, P0970, P2720, P2729

The hybrid/EV powertrain control module 1 detects a low voltage solenoid control circuit for 1 s.

P0967, P0971, P2721, P2730

The hybrid/EV powertrain control module 1 detects a high voltage solenoid control circuit for 1 s.

Actions Taken When the DTC Sets

DTCs P0964, P0966, P0967, P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, and P2730 are Type A DTCs.

P0964, P0967

- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 inhibits gear 1.
- The hybrid/EV powertrain control module 1 inhibits commands the internal combustion engine On.

P0966

- The hybrid/EV powertrain control module 1 inhibits mode 2.
- The hybrid/EV powertrain control module 1 commands clutch 1 and clutch 2 Off.

P2718

The hybrid/EV powertrain control module 1 inhibits mode 2 and gear 1.

P2720

- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 inhibits commands the internal combustion engine On.

P2721

- The hybrid/EV powertrain control module 1 inhibits mode 2.
- The hybrid/EV powertrain control module 1 inhibits gear 1.

Conditions for Clearing the DTC

DTCs P0964, P0966, P0967, P0968, P0970, P0971, P2718, P2720, P2721, P2727, P2729, and P2730 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Vehicle ON, verify the transmission fluid temperature is between 50 - 80°C (122 - 176°F).
2. Drive the vehicle in order to obtain single motor mode, observe the scan tool Pressure Control Solenoid Valve Performance Test Status parameters. The readings should display OK.

- **If the reading is not within the specified range**

Refer to Circuit/System Testing.

- **If the reading is within specified range**

3. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Remove the Control Valve Body Cover, refer to [Control Valve Body Cover Replacement](#).
3. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the Q8 Control Solenoid Valve Assembly.
4. Connect the 12 V battery.
5. Ignition ON, connect a test lamp between the control circuit terminal and the ground circuit terminals listed below:
 - Solenoid valve 2, high side driver circuit terminal 1 to control circuit terminal 2
 - Solenoid valve 3, high side driver circuit terminal 7 to control circuit terminal 8
 - Solenoid valve 4, high side driver circuit terminal 7 to control circuit terminal 6
 - Solenoid valve 5, high side driver circuit terminal 7 to control circuit terminal 5
6. Verify the test lamp turns ON and OFF when commanding the Pressure Control Solenoid Valve On and Off with a scan tool for each corresponding solenoid.
 - **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If less than 2 Ω , replace the T6 Power Inverter Module.
- **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the T6 Power Inverter Module.
- **If the test lamp turns ON and OFF**
7. Replace the Q8 Control Solenoid Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement.
- Refer to [Control Solenoid Valve Replacement](#) for Control Solenoid Valve replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Automatic Transmission Wiring Harness - Control Solenoid Valve replacement.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P152A OR P152D: REGENERATIVE BRAKING CONTROL SWITCH 1 CIRCUIT/REGENERATIVE BRAKING CONTROL SWITCH 1 AND 2 CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P152A

Regenerative Braking Control Switch 1 Circuit

DTC P152D

Regenerative Braking Control Switch 1 and 2 Circuit

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = Inactive/Active				
Tap Up/Tap Down Switch Signal 2 Circuit	P152D	Regenerative Braking On Demand Malfunction	Regenerative Braking On Demand Malfunction	P152A, P152C

Circuit/System Description

Regenerative Braking On Demand enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage Regenerative Braking On Demand, the driver releases the accelerator pedal and pulls back on the left steering-wheel paddle to begin regenerating electricity. When engaged, Regenerative Braking On Demand provides vehicle deceleration that is more than what a typical vehicle experiences while coasting or when the transmission shifter is in the L position, providing control and dynamic performance characteristics similar to downshifting in a manual-transmission vehicle. The feature does not bring the vehicle to a complete stop. Releasing the paddle cancels the Regeneration on Demand request, allowing the vehicle to coast normally. The driver can engage and disengage Regeneration on Demand as desired and as traffic conditions allow. When Regenerative Braking On Demand is requested, a signal is sent to the Body Control Module and then to the hybrid/EV powertrain control module 1 via serial data. The Regenerative Braking On Demand parameter is displayed as Inactive and Active on the scan tool. The Regenerative Braking On Demand parameter states are listed below:

- Inactive - when the S2L automatic transmission manual shift switch-left is not switch is pressed
- Active - when the S2L automatic transmission manual shift switch-left is pressed

Conditions for Running the DTC

Propulsion system is active.

Conditions for Setting the DTC

P152A

The hybrid/EV powertrain control module 1 detects the Regenerative Braking On Demand is active for greater than 600 s.

P152D

The hybrid/EV powertrain control module 1 detects an invalid voltage regenerative braking on demand switch - left circuit for 60 s.

Action Taken When the DTC Sets

- DTC P152A and P152D are Type C DTCs.
- The hybrid/EV powertrain control module 1 disables regenerative braking on demand.

Conditions for Clearing the DTC

DTC P152A and P152D are Type C DTCs.

Diagnostic Aids

DTC P152A can be customer induced by holding regenerative braking control switch in the regeneration on demand position while driving for greater than 600 s. Verify the customer is not pressing the switch for greater than 600 s.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle ON, verify with a scan tool the following hybrid/EV powertrain control module 1 parameter displays the correct values the S2L automatic transmission manual shift switch-left state:
 - Regenerative Braking On Demand displays Inactive when not pressed.
 - Regenerative Braking On Demand displays Active when pressed.
 - **If the hybrid/EV powertrain control module 1 parameter is incorrect**

Refer to Circuit/System Testing.
 - **If the hybrid/EV powertrain control module 1 Regenerative Braking On Demand parameter is correct**
2. After performing the above step, verify that the DTC does not reset by operating the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. If the vehicle passes the Circuit/System Verification procedure then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S2L automatic transmission

manual shift switch-left. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal X1 3 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Vehicle ON.

4. Verify the scan tool Regenerative Braking On Demand parameter is Inactive.

- **If not Inactive**

1. Vehicle OFF, disconnect the harness connector at the K9 BCM X3 connector.

2. Test for infinite resistance between the signal circuit terminal X3 21 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 BCM.

- **If Active**

5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.

6. Verify the scan tool Regenerative Braking On Demand parameter is Active.

- **If not Inactive**

1. Vehicle OFF, remove the jumper wire, disconnect the X3 harness connector at the K9 BCM, vehicle ON.

2. Test for less than 1 V between the signal circuit terminal 21 and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 BCM.

- **If Active**

7. Test or replace the S2L automatic transmission manual shift switch-left.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Steering Wheel Replacement](#) for S2L automatic transmission manual shift switch-left replacement.
- Refer to [Control Module References](#) for K9 BCM replacement, programming, and setup.

DTC P152C: REGENERATIVE BRAKING CONTROL SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P152C

Regenerative Braking Control Switch Signal Message Counter Incorrect

Circuit/System Description

Hybrid Low Mode enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage hybrid low mode the shift lever is placed in low (L), the driver shift request, also known as the tap shift function is activated. The driver shift request allows the vehicle operator to switch from L2 to L1 pressing the minus (-) button and back to L2 by pressing the plus (+) button. The body control module (BCM) supplies a signal circuit to the automatic transmission manual shift switch. The automatic transmission manual shift switch has switches connected to a resistor array. When the lever is in the L position, a voltage drop occurs across the resistor network. When the plus or minus button is pressed, a corresponding voltage drop occurs across the resistor network. This voltage drop is monitored by the BCM. The BCM will send the request to the hybrid/EV powertrain control module 1 to perform the transition from L2 to L1 or if already in L1 then back to L2. When the shifter is moved the L position, the instrument cluster will display L2, the hybrid/EV powertrain control module 1 will command a higher level of regenerative braking than what is commanded in the D position. When the minus (-) button is pressed, the L1 mode is commanded by the hybrid/EV powertrain control module 1. When the plus (+) button is pressed when in L1 mode the system will transition back to L2.

Conditions for Running the DTC

The propulsion system is active.

Conditions for Setting the DTC

The hybrid/EV powertrain control module has detected a drive mode signal rolling count error for 0.8 seconds.

Action Taken When the DTC Sets

DTC P152C is a Type C DTC.

Conditions for Clearing the DTC

DTC P152C is a Type C DTC.

Diagnostic Aids

When attempting to set hybrid/EV powertrain control module serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete hybrid/EV powertrain control module shutdown.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

[Circuit/System Verification](#)

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify DTC P152C is not set.
 - **If the DTC is set**
 1. Program the T6 Power Inverter Module.
 2. Verify the DTC does not set.
 - If the DTC is set, replace the T6 Power Inverter Module.
 - If the DTC does not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement, programming and setup.
- Refer to [Solenoid Valve Characterization Reprogramming](#) if the T6 Power Inverter Module is programmed or replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P16F7: CONTROL MODULE PRESSURE CONTROL SOLENOID COMMAND INCORRECT

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

[DTC Descriptor](#)

DTC P16F7

Control Module Pressure Control Solenoid Command Incorrect

[Circuit/System Description](#)

This is an internal fault detection of the hybrid/EV powertrain control module 1 or drive motor control modules. The hybrid/EV powertrain control module 1 and both drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and not serviced separately. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P16F7 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P16F7 is a Type A DTC.

Reference Information

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.

- **If the DTC is set**

Refer to [DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC](#) .

- **If the DTC is not set**

3. Verify DTC P16F7 is not set.

- **If the DTC is set**

1. Program the T6 Power Inverter Module.
2. Verify the DTC does not set.

- If the DTC sets, replace the T6 Power Inverter Module.
- If the DTC does not set.

3. All OK

- **If the DTC is not set**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P179C: TRANSMISSION CLUTCH 1 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P179C

Transmission Clutch 1 Minor Slip Detected

Typical Scan Tool Data

Variable Low Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0 - 161 km/h (0 - 100 mph)			
Parameter Normal Range: 0 - 6,000 RPM			
Clutch 1 Slip Speed	0 RPM	0 - 6,000 RPM	0 - 6,000 RPM
Clutch 1 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 1 Slip Speed for each Hybrid Transmission Mode Commanded state. The hybrid/EV powertrain control module 1 monitors clutch slip when the variable Low clutch is applied.

Conditions for Running the DTC

- The clutch pressure control solenoid valve 3 commanded pressure is at least 1800 kPa (261 psi) for 1 second.
- The variable clutch torque estimated is greater than 200 N.m (148 lb ft).
- The variable clutch fill detected.

- The commanded mode is:
 - Reverse
 - Dual Electric Motors
 - Dual Electric Motors and ICE

Conditions for Setting the DTC

- The transmission control module detects Hybrid low clutch slip greater than 200 RPM for 63 seconds, 3 times within the same key cycle, repeated 30 seconds apart.
- Motor 1 or 2 are approaching overspeed limits due to clutch slip, the fault will set instantly.

Action Taken When the DTC Sets

P179C is a Type B DTC.

Conditions for Clearing the DTC

P179C is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0721, P0796, P0966, P0967, P0969, P0970, P0971, P0973, P0974, P0976, P0977, P215C, P2720, P2721, P2728, P2729, or P2730 is not set.
 - **If the DTC is set**
 Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If the DTC is not set**
3. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
4. Perform the [Line Pressure Check](#) to verify correct oil pressure.
5. Operate the vehicle in Dual Electric Motors and Dual Electric Motors and ICE mode. The Clutch 1 Slip Speed parameter reading should be less than 200 RPM when the Clutch 1 Status parameter reading is Applied.

- If clutch slip speed is greater than 200 RPM

Refer to Component Testing.

- If clutch slip speed is less than 200 RPM

6. All OK

Component Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Verify control solenoid valve assembly condition by performing the [Control Solenoid Valve Inspection](#).
3. Verify control solenoid valve assembly function by performing the [Control Solenoid Valve Performance Test](#).

- If a concern is found

Replace the Q8 Control Solenoid Valve Assembly.

- If no concern is found

4. Inspect the a/trans fluid level control valve for stuck closed or damaged condition.

- If you found a concern with the a/trans fluid level control valve

Replace the a/trans fluid level control valve.

- If no concern is found

5. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to

Control Valve Body Diagnostic Inspection:

- Control valve body spacer (w/gasket) plate assembly
- Variable Low clutch and drive motor/generator stator cooling regulator valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

6. Inspect the Variable Low clutch assembly snap ring, piston, clutch discs, and housing for a slipping or damaged condition.

- **If you found a Variable Low clutch assembly concern**

Repair or replace the Variable Low clutch assembly as necessary.

- **If no concern is found**

7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Valve Body Replacement** for control valve body replacement
- Refer to **Variable Low Clutch Plate Removal**, and **Variable Low Clutch Plate Installation** for Variable Low Clutch Assembly replacement
- Refer to **Control Module References** for T6 Power Inverter Module replacement, programming, and setup.
- Refer to **Solenoid Valve Characterization Reprogramming** when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P179D: TRANSMISSION CLUTCH 2 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P179D

Transmission Clutch 2 Minor Slip Detected

Typical Scan Tool Data

Variable Hi Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0 - 80 km/h (0 - 50 mph)			

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Parameter Normal Range: 0 - 6,000 RPM			
Clutch 2 Slip Speed	0 RPM	0 - 6,000 RPM	0 - 6,000 RPM
Clutch 2 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors Clutch 2 Slip Speed for each Hybrid Transmission Mode Commanded state. The hybrid/EV powertrain control module 1 monitors clutch slip when the variable high clutch is commanded ON.

Conditions for Running the DTC

Variable high clutch is applied.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 detects the variable high clutch adapt is exceeded 10 times.

Action Taken When the DTC Sets

DTC P179D is a Type B DTC.

Conditions for Clearing the DTC

DTC P179D is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- [Electronic Component Description](#)
- [Transmission General Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0721, P0723, P0776, P0777, P0966, P0967, P0969, P0970, P0971, P0973, P0974, P0976, P0977, P215C, P2720, P2721, P2728, P2729, or P2730 is not set.
 - **If the DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If the DTC is not set**
3. Verify correct fluid level and condition by performing the **Transmission Fluid Level and Condition Check**.
4. Verify correct oil pressure by performing the **Line Pressure Check**.
5. Operate the vehicle in Dual Motors mode. The Clutch 2 Slip Speed parameter reading should be less than 200 RPM when the Clutch 2 Status parameter reading is Applied.
 - **If clutch slip speed is greater than 200 RPM**

Refer to Component Testing.
 - **If clutch slip speed is less than 200 RPM**
6. All OK

Component Testing

1. Perform the **Control Solenoid Valve Inspection** to verify Q8 Control Solenoid Valve Assembly condition.
2. Perform the **Control Solenoid Valve Performance Test** to verify Q8 Control Solenoid Valve Assembly function.
 - **If a concern is found**

Replace the Q8 Control Solenoid Valve Assembly.
 - **If no concern is found**
3. Verify the a/trans fluid level control valve is not stuck, closed or in a damaged condition.
 - **If you found a concern with the a/trans fluid level control valve**

Replace the a/trans fluid level control valve.
 - **If no concern is found**
4. Verify the variable hi clutch and drive motor/generator stator cooling regulator boost valve is not sticking or damaged. Refer to **Control Valve Body Diagnostic Inspection**.
 - **If you found a concern with the variable hi clutch and drive motor/generator stator cooling**

regulator boost valve

Repair or replace the valve or valve body.

- **If no concern is found**

5. Verify the variable hi clutch assembly piston, snap ring, and clutch discs are not in a damaged condition.

- **If you found a variable hi clutch concern**

Repair or replace the variable high clutch as necessary.

- **If no concern is found**

6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Variable High Clutch Removal**, and **Variable High Clutch Installation** for variable High Clutch replacement
- Refer to **Control Valve Body Replacement** for control valve body replacement
- Refer to **Control Valve Body Diagnostic Inspection**
- Refer to **Transmission Replacement** for Transmission removal
- Refer to **Control Module References** for Control Solenoid Valve Assembly replacement
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, OR P18C3: INTERNAL MODE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1824

Internal Mode Switch P Circuit High Voltage

DTC P182A

Internal Mode Switch A Circuit Low Voltage

DTC P182B

Internal Mode Switch B Circuit Low Voltage

DTC P182C

Internal Mode Switch B Circuit High Voltage

DTC P182D

Internal Mode Switch P Circuit Low Voltage

DTC P182E

Internal Mode Switch Indicates Invalid Range

DTC P182F

Internal Mode Switch C Circuit High Voltage

DTC P1838

Internal Mode Switch A Circuit High Voltage

DTC P1839

Internal Mode Switch C Circuit Low Voltage

DTC P1840

Internal Mode Switch S Circuit Low Voltage

DTC P1841

Internal Mode Switch S Circuit High Voltage

DTC P18B5

Internal Mode Switch A Circuit Shorted

DTC P18B6

Internal Mode Switch B Circuit Shorted

DTC P18B7

Internal Mode Switch C Circuit Shorted

DTC P18B8

Internal Mode Switch P Circuit Shorted

DTC P18B9

Internal Mode Switch S Circuit Shorted

DTC P18BA

Internal Mode Switch A Stuck Off

DTC P18BC

Internal Mode Switch C Stuck Off

DTC P18BF

Internal Mode Switch A Stuck On

DTC P18C0

Internal Mode Switch B Stuck On

DTC P18C2

Internal Mode Switch P Stuck On

DTC P18C3

Internal Mode Switch S Stuck On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Range Signal A	P182A	P1838	P1838	P182E, P18B5
Transmission Range Signal B	P182B	P182C	P182C, P18B6	P182E, P18C0
Transmission Range Signal C	P1839	P182F	P182F, P18BC	P182E
Transmission Range Signal P	P182D	P1824	P1824	P182E, P18C2
Transmission Range Signal S	P1840	P1841	P182E, P1841, P18B9	P18C3

Typical Scan Tool Data

Internal Mode Switch A/B/C/P

Circuit	Normal Range	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle ON, range selector in Park				
Internal Mode Switch A	1.62V - 2.49V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch B	0.66V - 1.02V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch C	1.62V - 2.49V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch P	0.66V - 1.02V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch S	0.66V - 1.02V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Valid High = Switch open = 1.62V - 2.49V				
Valid Low = Switch Closed = 0.66V - 1.02V				

Transmission Internal Mode Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P	Signal S
------------------------	----------	----------	----------	----------	----------

Gear Selector Position	Signal A	Signal B	Signal C	Signal P	Signal S
Park (P)	High	Low	High	Low	Low
Reverse (R)	Low	High	High	Low	High
Neutral (N)	Low	High	Low	High	Low
Drive (D)	High	Low	Low	High	High
Low (L)	High	Low	Low	High	Low

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, is a hall-effect switch attached to the transmission case within the transmission. The 5 outputs from the switch indicate which position is selected by the transmission manual shaft. Five outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P/S. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C, and signal P signal S. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- No Output Shaft Speed DTCs P0722 or P077B.
- The system voltage is 9 - 32 V.

Conditions for Setting the DTC

Any one or more of the following conditions:

- The Internal Mode Switch signal circuit A, B, P or S are Low in Park for greater than 8 s.
- The Internal Mode Switch signal circuit A is Low in D for 8 s.
- The Internal Mode Switch signal circuit C is High in D for 8 s.
- The hybrid/EV powertrain control module 1 detects an invalid range from the Internal Mode Switch for 3.25 s.
- The Internal Mode Switch signal circuit C is high in D for greater than 8 s.
- Park/Neutral Switch equals P/N and the Internal Mode Switch state is not Park or Neutral, or the Park/Neutral switch is not Park or Neutral and the Internal Mode Switch state equals Park or Neutral for 4 s.
- Or the transmission internal mode switch indicates a transitional state for 8 s.

Action Taken When the DTC Sets

- The PRNDL position indicator on the instrument cluster will be blank.
- The hybrid/EV powertrain control module 1 may command neutral if multiple circuit faults exist.

Conditions for Clearing the DTC

- DTC P182E is a Type A DTC.
- DTCs P1824, P182A-P182D, P182F, P1838-P1841, P18B5-18B9, P18BA, P18BC, P18BF, P18C0, P18C2, and P18C3 are Type B DTCs.

Diagnostic Aids

The transmission internal mode switch connects electrically to the control solenoid valve assembly. Inspect the transmission internal mode switch, harness, connector, and control solenoid assembly pins for metallic debris. Use a terminal test kit for any test that requires probing the control solenoid assembly harness connector or a component harness connector. The transmission internal mode switch can be damaged by currents exceeding 2 mA. Test the transmission internal mode switch for an open condition whenever a short to voltage condition is observed.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Vehicle ON, observe the scan tool Internal Mode Switch A/B/C/P parameter while moving the gear shift lever from Park, through all gear selector positions, and back to Park. The parameter should match each gear range that is selected. Refer to [Transmission Internal Mode Switch Logic](#).
2. Verify all the Internal Mode Switch Status parameters display Valid while moving the gear shift lever from Park, through all gear selector positions, and back to Park.
 - **If any of the parameters display Invalid**

Refer to Circuit/System Testing.
 - **If all the parameters display valid**
3. Verify all the Internal Mode Switch parameters display 1.62V - 2.49V when High and 0.66V - 1.02V when Low.
 - **If any of the parameters display outside of the specified range**

Refer to Circuit/System Testing.
 - **If all the parameters display within the specified range**

4. Perform the [Range Selector Lever Cable Adjustment](#) procedure to verify proper adjustment.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify [DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3](#) is not set.
 - **If any of the DTCs are set**

Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
7. All OK

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Vehicle OFF, remove the control valve body cover. Refer to [Control Valve Body Cover Replacement](#).
2. Disconnect the harness connector at the B15 Transmission Internal Mode Switch.
3. Vehicle in Service Mode.
4. Test for 8.3V to 9.4V between both 9 V reference circuits terminal 1, terminal 8 and ground.
 - **If not within the specified range**

Test the voltage circuits for an open/high resistance end to end.
 - If 2 Ω or greater, replace the A/Trans Wiring Extension Harness Assembly.
 - If 2 Ω or less, replace the T6 Power Inverter Module.
 - **If within the specified range**
5. Vehicle ON.
6. Install a 3 A fused jumper wire between each signal circuit listed below and the 9 V reference circuit:
 - Switch Signal A: terminal 2 and terminal 1
 - Switch Signal B: terminal 6 and terminal 8
 - Switch Signal C: terminal 3 and terminal 1
 - Switch Signal P: terminal 7 and terminal 8
 - Switch Signal S: terminal 5 and terminal 8
7. Verify each scan tool Internal Mode Switch A/B/C/P/S voltage parameter displays 4.88 - 5.12 V when jumped.
 - **If any parameter does not display 4.88 - 5.12 V when jumped**

Test the signal circuit for an open/short to voltage or short together.
 - If an open/short to voltage or short together is found, replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.
 - If an open/short to voltage or short together is not found, replace the T6 Power Inverter Module.
 - **If each signal circuit parameter displays 4.88 - 5.12 V when jumped**
8. Replace the B15 Transmission Internal Mode Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

NOTE: Perform the [Control Solenoid Valve Inspection](#) for the following components before replacing the components.

- Refer to [Manual Shift Shaft and Manual Shift Detent Lever Replacement](#) for B15 Transmission Internal Mode Switch, often referred to as the Automatic Transmission Manual Shift Detent Lever with Shaft Position Switch Assembly, replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Automatic Transmission Wiring Harness - Shift Shaft Position Switch replacement.
- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P215B: VEHICLE SPEED - OUTPUT SHAFT SPEED NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P215B

Vehicle Speed - Output Shaft Speed Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P0722, P0723	P0722, P0723	P0722, P0723	P0721, P215B
OSS Signal	P0722, P0723	P0722, P0723	P0722, P0723	P0721, P215B

Typical Scan Tool Data

Transmission Output Shaft Speed Sensor

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
Signal	0 - 7,000 RPM	0 RPM	0 RPM
Supply Voltage	-	0 RPM	0 RPM

OSS Supply Voltage

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Key ON, engine OFF or engine running, normal operating temperature			

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Signal	OK	OK	OK
Supply Voltage	OK	Out of range	Out of range
8.3 - 9.3 Volts = OK, Any other voltage = Out of range			

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 2 internal hall-effect type sensors, and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the hybrid/EV powertrain control module 1 through the control solenoid valve assembly and transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 5.0 volts on the OSS supply voltage circuit from the hybrid/EV powertrain control module 1. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

The two sensor elements in the output speed sensor assembly are spaced approximately 1/2 a tooth apart.

- When the vehicle is moving in a forward direction, sensor A detects a particular tooth before sensor B.
- When the vehicle is moving in a reverse direction, sensor B detects a particular tooth before sensor A.

The electronics in the sensor combine the two signals and send a signal with a different pulse width. This signal is interpreted by the hybrid/EV powertrain control module 1 for speed and direction and is transmitted through the serial data circuits to the engine control module (ECM). The ECM, hybrid/EV powertrain control module 1, compare the output speed sensor signal with the anti-lock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- The vehicle speed is greater than 20 km/h (12.42 mph).
- The vehicle is not in Park or Neutral.

Conditions for Setting the DTC

ECM

The ECM OSS signal and the ABS wheel speed sensor signals differ by greater than 10 km/h (6.2 mph) for more than 25 ms.

Hybrid/EV Powertrain Control Module 1

The ECM OSS signal and the ABS wheel speed sensor signals differ by greater than 19 km/h (12 mph) for more than 10 seconds.

Action Taken When the DTC Sets

ECM

- The ECM commands reduced vehicle power.
- PROPULSION POWER REDUCED message is displayed on the driver information center.

Hybrid/EV Powertrain Control Module 1

The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

ECM

P215B is a Type A DTC.

Hybrid/EV Powertrain Control Module 1

P215B is a Type A DTC.

Diagnostic Aids

The hybrid system is very sensitive to the OSS signal for overall operation.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Inspect for broken driveline components.
2. Operate the vehicle at 16-32 km/h (10-20 mph) while observing the Transmission OSS and ABS wheel parameters on the scan tool.
 - ECM - The OSS signal and AS wheel speed signal displays should not vary by greater than 10 km/h (6.2 mph).
 - Hybrid/EV Powertrain Control Module 1 - The OSS and ABS wheel speed signal displays should not vary by greater than 19 km/h (12 mph).

Circuit/System Testing

1. Verify DTC C0035-C0050, C1207-C1210, C1221-C1228, C1232-C1235, C005A, C0245, C122E, P0721, P0723, U0073, U0074, U0077, U0101, U0129, or U1833 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **If the DTCs are not set**

2. Program the control module which set the DTC with the latest software version and retest for DTCs.

- **If the DTC resets**

Replace the control module which set the DTC.

- **If the DTC does not reset**

3. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for K20 ECM or T6 Power Inverter Module, replacement, programming, and setup.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module is replaced.
- Refer to [Control Module References](#) for T6 Power Inverter Module, replacement, programming, and setup.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P215C: OUTPUT SHAFT SPEED - WHEEL SPEED NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P215C

Output Shaft Speed - Wheel Speed Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C
OSS Signal	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C

Typical Scan Tool Data

Transmission OSS

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
OSS Signal	0 - 7,000 RPM	0 RPM	0 RPM
OSS Supply Voltage	-	0 RPM	0 RPM

OSS Supply Voltage

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Key ON, Engine OFF or Engine running, normal operating temperature			
OSS Signal	OK	OK	OK
OSS Supply Voltage	OK	Out of Range	Out of Range
8.3 - 9.3 Volts = OK, Any other voltage = Out of range			

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 2 internal hall-effect type sensors, and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the hybrid/EV powertrain control module 1 through the control solenoid valve assembly and transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 5.0 volts on the OSS supply voltage circuit from the hybrid/EV powertrain control module 1. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

The two sensor elements in the output speed sensor assembly are spaced approximately 1/2 a tooth apart.

- When the vehicle is moving in a forward direction, sensor A detects a particular tooth before sensor B.
- When the vehicle is moving in a reverse direction, sensor B detects a particular tooth before sensor A.

The electronics in the sensor combine the two signals and send a signal with a different pulse width. This signal is interpreted by the hybrid/EV powertrain control module 1 for speed and direction and is transmitted through the serial data circuits to the engine control module (ECM). The ECM, hybrid/EV powertrain control module 1, compare the output speed sensor signal with the anti-lock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately.

Conditions for Running the DTC

- The vehicle is moving.
- The hybrid/EV powertrain control module 1 correlates the transmission output speed with the ABS wheel speed and motor speed to detect any failures in the transmission output speed sensor.

Conditions for Setting the DTC

- The difference between transmission output speed and the calculated average of output speed from the drive motors and ABS wheel speed sensors is greater than 50 RPM.
- The difference between the average of wheel speed sensors and drive motors and the output speed sensor is greater than 60 RPM.

Action Taken When the DTC Sets

- P215C is a Type B DTC.

- The hybrid/EV powertrain control module 1 calculates output speed based drive motor 2 speed if ABS wheel speed is not available.

Conditions for Clearing the DTC

P215C is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Special Tools

EL 38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

Operate the vehicle at 16 - 32 km/h (10 - 20 mph) while observing the Transmission OSS and ABS wheel parameters on the scan tool. The Transmission OSS and ABS wheel speed signal parameters should not vary by greater than 10 km/h (6 mph).

Circuit/System Testing

1. Verify DTC C0035-C0050, C1207-C1210, C1221-C1228, C1232-C1235, C005A, C0245, or C122E is not set in the electronic brake control module.
 - **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

2. Perform the [Output Shaft Speed Input Test](#).

- If the DTC does not set

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Perform the [Drive Motor Removal - 2nd Position](#), and [Drive Motor Installation - 2nd Position](#) for OSS replacement.
- Refer to [Control Module References](#) for Drive Motor Generator Power Inverter Module, also called the power inverter module replacement.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P2670 OR P2671: ACTUATOR HIGH CONTROL CIRCUIT GROUP 2 VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P2670

Actuator High Control Circuit Group 2 Low Voltage

DTC P2671

Actuator High Control Circuit Group 2 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2670	P2671	P2670, P2671	-

Typical Scan Tool Data

High Side Drive 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On Parameter Normal Range: On			
High Side Driver 2	Off	On	Off

Circuit/System Description

The high side driver 2 is internal to the Hybrid/EV powertrain Control Module 1. With the ignition On, the high side

driver 2 provides 12 V to the transmission control solenoid valve. If excessive current flow is detected in high side driver 2 circuit, the high side driver 1 will turn Off. When the circuit fault is corrected, the high side driver 1 will reset. The hybrid/EV powertrain control module 1 and both drive motor control modules are internal to the power inverter module, often referred to as the drive motor generator power inverter module, and not serviced separately.

Conditions for Running the DTC

High side driver 2 is On.

Conditions for Setting the DTC

P2670

Hybrid/EV powertrain Control Module 1 has detected a short to ground on the high side driver 2 circuit during Hybrid/EV powertrain Control Module 1 initialization.

P2671

Hybrid/EV powertrain Control Module 1 has detected a short to voltage on the high side driver 2 circuit during Hybrid/EV powertrain Control Module 1 initialization.

Actions Taken When the DTC Sets

P2670

- DTC P2670 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits clutch 2.

P2671

DTC P2671 is a Type B DTC.

Conditions for Clearing the DTC

- DTC P2670 is a Type A DTC.
- DTC P2671 is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information.

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool High Side Driver 1 Command parameter displays On.
 - **If On is not displayed**

Refer to Circuit/System Testing.
 - **If On is displayed**
3. Verify the parameters listed below do not display Malfunction when commanding the high side driver 2, On and Off with a scan tool.
 - High Side Driver 2 Circuit Low Voltage Test Status
 - High Side Driver 2 Circuit Open Test Status
 - High Side Driver 2 Circuit High Voltage Test Status
 - **If Multifunction is displayed**

Refer to Circuit/System Testing.
 - **If Multifunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).
2. Remove the Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#).
3. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the Q8 Control Solenoid Valve.
4. Connect the 12 V battery.
5. Ignition ON, connect a test lamp between the high side driver circuit X1 terminal 7 and the ground.
6. Verify the test lamp turns ON.

• **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, replace the Automatic Transmission Wiring Harness - Control Solenoid Valve.
 - If less than 2 Ω , replace the T6 Power Inverter Module.

• **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the T6 Power Inverter Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the T6 Power Inverter Module.

• **If the test lamp turns ON and OFF**

7. Test or replace the Q8 Control Solenoid Valve.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.
- Refer to [Control Solenoid Valve Replacement](#) for Q8 Control Solenoid Valve replacement.
- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Automatic Transmission Wiring Harness - Control Solenoid Valve replacement.
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module is replaced.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P27A7: TRANSMISSION CONTROL SOLENOID VALVE 1 CALIBRATION INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P27A7

Transmission Control Solenoid Valve 1 Calibration Incorrect

Circuit/System Description

The transmission control solenoids in this transmission require unique electrical current vs. oil pressure performance matching data values in order to function at maximum performance and efficiency. This data is programmed and stored in the Hybrid/EV Powertrain Control Module 1. When a transmission assembly, transmission line pressure control solenoid, or Hybrid/EV Powertrain Control Module 1 is replaced, the Hybrid/EV Powertrain Control Module 1 must be programmed with the new or existing solenoid performance data.

Conditions for Running the DTC

- Ignition On.
- T6 Hybrid/EV Powertrain Control Module 1 has completed initialization.

Conditions for Setting the DTC

Transmission control solenoid valve 1 matching performance data is not programmed into the Hybrid/EV Powertrain Control Module 1.

Action Taken When the DTC Sets

- P27A7 is a Type A DTC.
- The vehicle will not start.

Conditions for Clearing the DTC

P27A7 is a Type A DTC.

Diagnostic Aids

Obtain the replacement solenoid information code for the solenoid that was replaced, from the TIS Service Information web site.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: P27A7 is a informational DTC.

NOTE: Solenoid performance data is only available for the variable force solenoid, not the On/Off solenoids.

1. If the T12 Automatic Transmission Assembly or the line pressure control solenoid was replaced.
 - Obtain the solenoid performance data for the variable force solenoids from the TIS Service Information web site. Program the data into the existing T6 Hybrid/EV Powertrain Control Module 1. Perform the Transmission Service Fast Learn Procedure.
 - If the T12 Automatic Transmission was not replaced.
2. If the T6 Hybrid/EV Powertrain Control Module 1 was replaced.
 - Obtain the existing solenoid performance data for the variable force solenoids from the TIS Service Information web site. Program the data into the new T6 Hybrid/EV Powertrain Control Module 1. Perform the Transmission Service Fast Learn Procedure.
 - If the T6 Hybrid/EV Powertrain Control Module 1 was not replaced.

3. If the line pressure variable force solenoid was replaced.

- Obtain the solenoid performance data from the TIS Service Information web site for the new solenoids. Program the data into the existing T6 Hybrid/EV Powertrain Control Module 1.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Perform the [Solenoid Valve Characterization Reprogramming](#).
- Refer to [Control Module References](#) for T6 Hybrid/EV Powertrain Control Module 1 replacement, programming and setup.

SOLENOID VALVE CHARACTERIZATION REPROGRAMMING

The solenoids in this transmission require unique performance characteristic data in order to function at maximum efficiency. This data is programmed and stored in the vehicle's hybrid/EV powertrain control module 1. When a transmission assembly, hybrid/EV powertrain control module 1, valve body, or line pressure control solenoid are replaced during service, the performance characteristic data for the solenoids must be retrieved from a web server "cloud" repository and reprogrammed into the hybrid/EV powertrain control module 1.

Reprogramming also ensures that the characteristic data relationship is properly matched between the solenoids, valve body, and transmission.

Solenoid characterization reprogramming is performed using the TIS2Web Service Programming System (SPS).

Solenoid Reprogramming Procedure

Perform solenoid characterization reprogramming after one of the following service procedures:

NOTE: Select "Replace Transmission" at the MCVM Characterization selection screen.

- Replace transmission assembly

NOTE: Select "Replace Valve Body" at the MCVM Characterization selection screen.

- Replace valve body assembly

NOTE: Select "Replace Solenoid" at the MCVM Characterization selection screen.

- Replace solenoid - currently not an available Service Procedure

NOTE: Select "Refresh Characterization Data" at the MCVM Characterization selection screen.

- Replace T6 Power Inverter Module

NOTE: Select "Refresh Characterization Data" at the MCVM Characterization selection screen.

- Solenoid characterization may also be performed to "refresh" characterization data.

To perform solenoid characterization after a transmission component replacement:

1. Document the new Transmission Unique Number (TUN) or Part Unique Number (PUN) as required. Refer to [Transmission Identification Information](#).
2. Log into TIS2Web/SPS.
3. Type the vehicle identification number (VIN).
4. Select "T6 Power Inverter Module - MCVM Operations".
5. Select the applicable service procedure performed and provide the necessary TUN or PUN. At this point, the system will read the VIN from the engine control module (ECM) using the multiple diagnostic interface (MDI) and then retrieve the applicable genealogy data tree from the cloud. This data tree accesses the original characterization data so that it may be updated with the new component information. The system acquires characterization data for the given TUN/PUN via the cloud and updates the genealogy tree. The hybrid/EV powertrain control module 1 is updated with the correct solenoid characterization data, and the cloud is updated with the new genealogy relationship.

SYMPTOMS - AUTOMATIC TRANSMISSION

NOTE: Use the symptom tables only if the following conditions are met:

- Refer to [Diagnostic Starting Point - Vehicle](#) .
- There are no DTCs set.
- The control modules can communicate via the serial data link.
- Review the system operation in order to familiarize yourself with the system functions. Refer to [Transmission General Description](#), and [Transmission Component and System Description](#).

Visual/Physical Inspection

Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Fluid Diagnosis
 - [Transmission Fluid Level and Condition Check](#)
 - [Fluid Leak Diagnosis](#)
- Noise and Vibration Diagnosis
 - [Whine/Growl Noise That Changes with Vehicle Speed](#)
 - [Noise in Drive or Reverse Gear](#)
 - [Vibration](#)
 - [Noise and Vibration Analysis](#)
- Range Performance Diagnosis

- [No Park or Drive](#)
- [No Drive in All Ranges](#)
- [No Reverse Gear](#)
- [No Drive or Reverse Gear](#)
- Shift Quality Feel Diagnosis
 - [Harsh Garage Shift](#)
 - [Harsh, Soft, Delayed or Slipping Drive or Reverse Gear](#)
- Shift Pattern
 - [No Drive in All Ranges](#)
 - [No Drive or Reverse Gear](#)
 - [Stuck in Drive or Reverse Gear](#)
- Symptoms Not Found or No Symptom Detected
 - [Transmission Fluid Level and Condition Check](#)
 - [Line Pressure Check](#)
 - [Road Test](#)
 - [Clutch Plate Diagnosis](#)
 - [Engine Coolant/Water in Transmission](#)
 - [Case Porosity Repair](#)
 - [Bushing and Mating Shaft Inspection](#)

REGENERATIVE BRAKING ON DEMAND MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = Inactive/Active				
Regenerative Braking On Demand Switch Circuit	P152D	Regenerative Braking On Demand Malfunction	Regenerative Braking On Demand Malfunction	P152C

Circuit/System Description

Regenerative Braking On Demand enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage Regenerative Braking On Demand, the driver releases the accelerator pedal and pulls back on the left steering-wheel paddle to begin regenerating electricity. When engaged, Regenerative Braking On Demand provides vehicle deceleration that is greater than what a typical vehicle experiences while coasting or when the transmission shifter is in the L position, providing control and dynamic

performance characteristics similar to downshifting in a manual-transmission vehicle. The feature does not bring the vehicle to a complete stop. Releasing the paddle cancels the Regeneration on Demand request, allowing the vehicle to coast normally. The driver can engage and disengage Regeneration on Demand as desired and as traffic conditions allow. When Regenerative Braking On Demand is requested, a signal is sent to the Body Control Module and then to the hybrid/EV powertrain control module 1 via serial data. The Regenerative Braking On Demand parameter is displayed as Inactive and Active on the scan tool. The Regenerative Braking On Demand parameter states are listed below:

- Inactive - when no switch is pressed
- Active - when the S2L automatic transmission manual shift switch-left is activated.

Diagnostic Aids

The Regenerative Braking On Demand feature has a maximum of 60kW charging power. Performance may be reduced when the high voltage battery is cold and/or the high voltage battery is fully charged. The following conditions listed below will reduce or inhibit Regenerative Braking On Demand performance:

- The high voltage battery is warmer than 20Â°C (68Â°F), and battery state of charge is greater than 80%.
- The high voltage battery is warmer than 10Â°C (50Â°F), and battery state of charge is greater than 75%.
- The high voltage battery is warmer than 0Â°C (32F), and battery state of charge is greater than 60%.
- The high voltage battery is colder than -10Â°C (14Â°F).
- If the battery state of charge is greater than 90%, Regenerative Braking On Demand is inhibited.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify with a scan tool the following hybrid/EV powertrain control module 1 Regenerative Braking On Demand parameter displays the correct values for the S2L automatic transmission manual shift switch-left state:
 - Regenerative Braking On Demand parameter displays Inactive when not activated.
 - Regenerative Braking On Demand parameter displays Active when activated.
 - **If the hybrid/EV powertrain control module 1 parameter is incorrect**

Refer to Circuit/System Testing.
 - **If the Regenerative Braking On Demand parameter is correct**
2. If the vehicle passes the Circuit/System Verification procedure then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Circuit/System Testing

1. Vehicle OFF, disconnect the S2L automatic transmission manual shift switch-left wire harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the following harness side ground circuit and ground:

S2L automatic transmission manual shift switch-left X1 terminal 3.
 - **If 10 Ω or greater**

Test for less than 2 Ω in the ground circuit end to end.
 - If greater than 2 Ω , repair the Open/High resistance in the circuit.
 - If less than 2 Ω , repair the ground connection.
 - **If less than 10 Ω**
3. Vehicle ON, test for 11 - 13 volts between X1 terminal 2 harness connector and ground.
 - **If not within the specified value**

Test the voltage circuit end to end for a short to ground or an open/high resistance. If the circuit tests normal, replace the K9 BCM.
 - **If within the specified value**
4. Vehicle OFF, test for 0.8 - 1.2 k Ω between terminal 1 and terminal 2 on the S2L automatic transmission manual shift switch-left, with the switch closed.
 - **If not within the specified value**

Replace the S2L automatic transmission manual shift switch-left.
 - **If within the specified value**
5. Replace the K9 BCM.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Steering Wheel Replacement](#) for S2L automatic transmission manual shift switch-left replacement.

- Refer to [Control Module References](#) for K9 body control module replacement, programming, and setup.

CONTROL SOLENOID VALVE INSPECTION

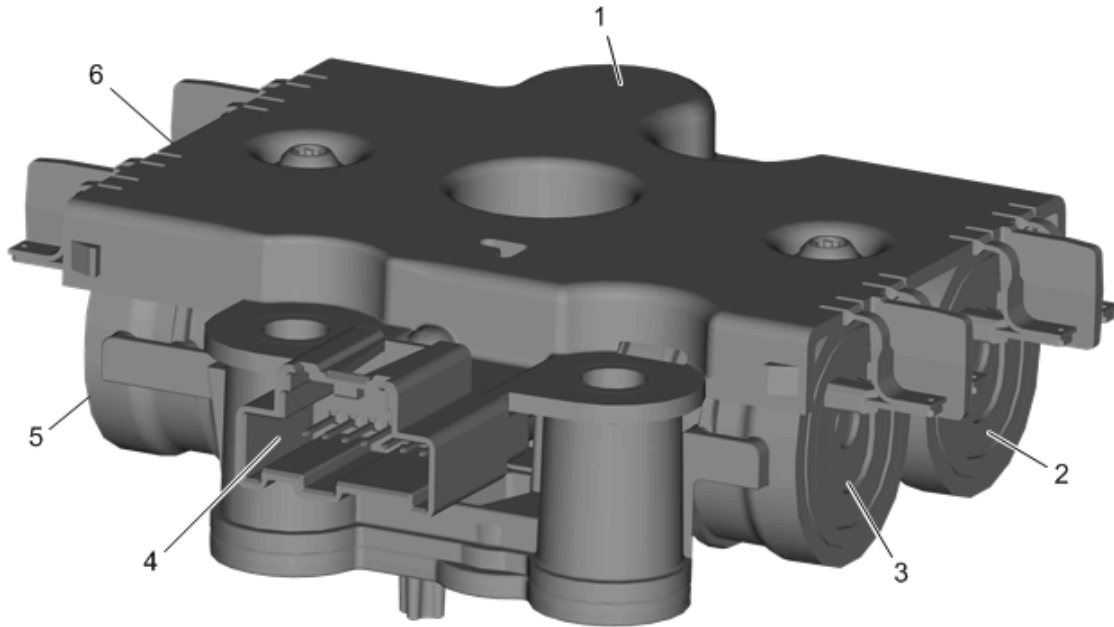


Fig. 21: Control Solenoid Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Fluid Temperature Sensor
2	Pressure Control Solenoid Valve 2
3	Pressure Control Solenoid Valve 5
4	Electrical Connector - 8 Pins
5	Pressure Control Solenoid Valve 3
6	Pressure Control Solenoid Valve 4

1. Inspect the control solenoid valve assembly connectors and the 8 electrical connector pins for the following conditions:
 - Damage
 - Bent pins
 - Debris
 - Broken retaining tab
 - Contamination
2. Ensure no metallic debris is inside the connectors near the terminal pins.
3. Inspect the control solenoid valve assembly solenoid leads for contamination or metallic debris.
4. Inspect the control solenoid valve assembly filter plate and retaining tabs for cracks and ensure proper tension when a new filter plate is attached.

OUTPUT SHAFT SPEED INPUT TEST

Special Tools

EL 38522 Variable Signal Generator

For equivalent regional tools, refer to [Special Tools](#).

The purpose of this test is to provide a simulated output speed sensor signal to the control solenoid valve assembly Transmission Output Shaft Speed Sensor input circuits in order to verify the control solenoid valve assembly is able to process the output speed sensor signal.

1. Vehicle OFF, remove the control valve body cover. Refer to [Control Valve Body Cover Removal](#).
2. Vehicle OFF, disconnect the Automatic Transmission Wiring Harness - Control Solenoid Valve from the OSS wiring harness.
3. Vehicle ON, test for 8.3 - 9.3 volts between terminals 1 and 2.

- **If not within the specified range**

Test the Automatic Transmission Wiring Harness - Control Solenoid Valve for an open, short to ground or short to voltage. If the harness tests OK, replace the T6 Power Inverter Module.

- **If within the specified range**

4. Vehicle OFF, using the **EL 35616** terminal test kit, connect the **EL 38522** variable signal generator red lead to the OSS signal circuit terminal 2 on the Automatic Transmission Wiring Harness - Control Solenoid Valve.
5. Connect the black lead from the **EL 38522** variable signal generator to ground.
6. Set the **EL 38522** variable signal generator to 8 volts, the frequency to 120 Hz, and the percent duty cycle to 50 or the normal position.
7. Vehicle ON, verify with a scan tool the Transmission OSS parameter is between 375 - 400 RPM.

- **If not within the specified range**

Replace the T6 Power Inverter Module.

- **If within the specified range**

8. Test the Automatic Transmission Wiring Harness - Control Solenoid Valve for an open, short to ground or short to voltage.

- **If Automatic Transmission Wiring Harness - Control Solenoid Valve is shorted or open**

Replace the Automatic Transmission Wiring Harness - Control Solenoid Valve harness.

- **If all circuits test normal**

9. Test or replace the B14A Transmission Output Shaft Speed Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#), and [Control Valve Assembly and Transmission Wiring Harness Installation](#).
- Refer to [Drive Motor Removal - 2nd Position](#), and the [Drive Motor Installation - 2nd Position](#) for OSS replacement.

- Refer to [Control Module References](#) for T6 Power Inverter Module replacement, programming, and setup.

CONTROL SOLENOID VALVE PERFORMANCE TEST

The purpose of this procedure is to test the functionality of the control solenoid valve solenoids for a stuck open or stuck closed condition, or a faulty transmission fluid temperature sensor.

Preliminary Procedures

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the control solenoid valve assembly from the transmission. Refer to [Control Solenoid Valve Replacement](#).
3. Perform the [Control Solenoid Valve Inspection](#) procedure.

Solenoid Testing Procedure

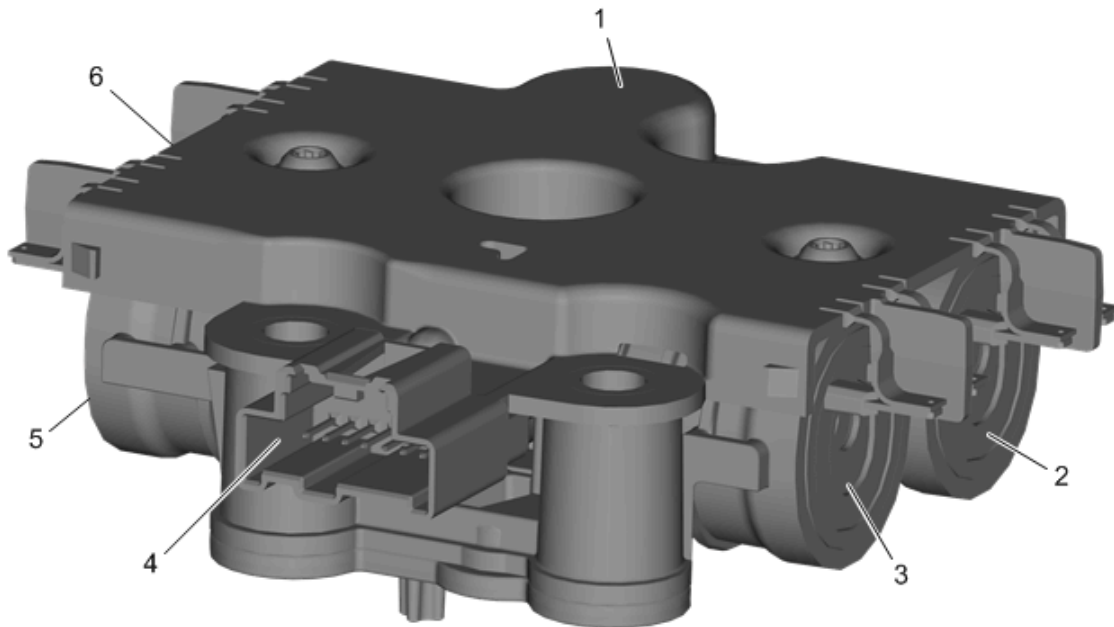


Fig. 22: Control Solenoid Valve Assembly
Courtesy of GENERAL MOTORS COMPANY

Control Solenoid Valve

Callout	Component Name	Normal Resistance	Terminal	DTC/Symptom
1	Transmission Fluid Temperature Sensor	Temperature Versus Resistance (Transmission Fluid Temperature Sensor)	X1 Terminal 3, X1 Terminal 4	P0711, P0712, or P0713
2	Pressure Control Solenoid Valve 2	23 - 24 Ω	X1 Terminal 2, X1 Terminal 7	P0964, P0966, or P0967
3	Pressure Control Solenoid Valve 5	23 - 24 Ω	X1 Terminal 5, X1 Terminal 7	P2727, P2729, or P2730

Callout	Component Name	Normal Resistance	Terminal	DTC/Symptom
4	Electrical Connector - 8 Pins	-	-	-
5	Pressure Control Solenoid Valve 3	23 - 24 Ω	X1 Terminal 8, X1 Terminal 7	P0968, P0970, or P0971
6	Pressure Control Solenoid Valve 4	23 - 24 Ω	X1 Terminal 6, X1 Terminal 7	P2718, P2720, or P2721

DTC P0711, P0712, or P0713

1. Measure the transmission fluid temperature sensor resistance between X1 Terminal 3 and X1 Terminal 4, refer to [Temperature Versus Resistance \(Transmission Fluid Temperature Sensor\)](#).

- **If the resistance is not within the specified range**

Replace the Q8 Control Solenoid Valve Assembly.

- **If the resistance is within the specified range**

2. Test the transmission internal harness for an open, short to ground, or short to voltage. If the transmission internal harness tests OK, replace the T6 Power Inverter Module.

DTC P079A, P079B, P079C, P07A3, P07A5, P179C, P179D

1. Measure each pressure control solenoid valve for 23 - 24 Ω .

- **If the resistance is not within the specified range**

Replace the Q8 Control Solenoid Valve Assembly.

- **If the resistance is within the specified range**

2. With a rubber tipped blow gun, pressurize the line pressure side of each solenoid fluid passage of the Q8 control solenoid valve assembly. When the solenoid is not energized, air should not leak out of the exhaust port.
3. One at a time, energize each solenoid with a 12 V source. With a rubber tipped blow gun, pressurize the line pressure side of each solenoid fluid passage of the Q8 control solenoid valve assembly. When the solenoid is energized, air should leak out of the exhaust port.

- **If the Q8 control solenoid valve assembly fails any of the above tests**

Replace the Q8 Control Solenoid Valve Assembly.

- **If the Q8 control solenoid valve assembly passes the above tests**

The concern is internal to the transmission.

4. Repair as necessary.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- Refer to [Control Valve Assembly and Transmission Wiring Harness Removal](#) for Q8 Control Solenoid Valve replacement.

- Refer to [Control Module References](#) for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

RESET TRANSMISSION ADAPTS

Reset Transmission Adapts is a procedure for automatic transmissions in which a series of tests are run to allow the hybrid/EV powertrain control module 1 to learn individual clutch characteristics. Once the clutch data is learned, Reset Transmission Adapts translates it into the adaptive data cells, which the hybrid/EV powertrain control module 1 uses for clutch control during shifts. The scan tool provides initiation of the Reset Transmission Adapts procedure. This procedure is to be used following transmission repair.

The Reset Transmission Adapts procedure must be performed when one of the following repairs have been made to the vehicle. Failure to perform the procedure after one of the following repairs may result in poor transmission performance, as well as transmission DTCs being set:

- Transmission internal service/overhaul
- Valve body repair or replacement
- Control solenoid valve assembly replacement
- Hybrid/EV powertrain control module 1 software/calibration update
- Any service in response to a shift quality concern

NOTE: Ensure the following conditions are met before performing the Reset Transmission Adapts procedure:

- Drive wheels are blocked
- Parking brake is applied
- Service brake is applied
- Zero percent throttle and no external engine RPM control
- Transmission fluid temperature is between 70 - 115°C (158 - 239°F)
- Transmission gear selector has been cycled from Park to Reverse 3 times in order to purge air from the clutches.

NOTE: If at any time during the procedure, required conditions are not met, Reset Transmission Adapts may abort and the process may need to be started again from the beginning. If this occurs, the transmission will be left in a neutral state until the controller is shut down, vehicle OFF and remove the scan tool and wait for more than 30 seconds prior to re-try procedure. If the procedure repeatedly fails, a limit that engineering set is being exceeded and there is possibly a transmission hardware issue.

1. Use the scan tool to perform the Reset Transmission Adapts procedure. As the procedure is being performed, the scan tool data display will provide operator instructions. Follow the scan tool instructions as required.
2. Once the procedure is complete, vehicle OFF and power down the hybrid/EV powertrain control module 1. You will lose communication to the scan tool.

Ensure you exit back to the main screen in the scan tool, shut the scan tool OFF, and unplug it from the DLC or the hybrid/EV powertrain control module 1 may not shut down leaving the vehicle in a neutral state.

NOTE: When the Reset Transmission Adapts procedure is completed, the transmission will remain in a neutral state until the controller shuts down. If after 1 - 2 minutes of sitting, with the vehicle OFF and scan tool removed, the vehicle remains in a neutral state, disconnect the battery and wait 5 - 10 minutes and then connect the battery. Reverse and drive should return.

3. Vehicle ON. This will complete the Reset Transmission Adapts procedure.
4. Perform the [Road Test](#).

Troubleshooting

If the Reset Transmission Adapts will not run and the above stated conditions have been met, ensure the following:

- Transmission Fluid Temperature parameter is between 40 - 60°C (104 - 140°F).
- Brakes and brake switch are functioning properly.
- No active DTCs.
- Park/Neutral position switch is properly adjusted and functioning.
- Line pressure control is able to provide 1000 kPa and is within specifications.
- Vehicle is not moving, or vibrating excessively.
- Clutches are properly assembled.

CONTROL VALVE BODY DIAGNOSTIC INSPECTION

The purpose of this inspection procedure is to determine if the control valve body assembly is the cause of a transmission DTC or symptom concern. The table will assist you in identifying which component within the control valve body is associated with a particular DTC or symptom. The components within the control valve body are not serviced separately.

Component Testing

WARNING: Valve springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

CAUTION: After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.

CAUTION: Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

1. Remove the control valve body assembly. Refer to [Control Valve Body Replacement](#).
2. Clean and inspect all control valve body assembly components for the following conditions listed below:
 - Stuck or scored control valve
 - Scored or damaged control valve body bore
 - Broken, weak, or damaged control valve return spring
 - Missing, damaged, or stuck check ball
 - Missing, restricted, or out of position modulated fluid pressure orifice
 - Missing or damaged control valve retainer

- Debris or sediment
 - If a condition is found, and cannot be repaired by cleaning
 Replace the control valve body assembly.
 - If a condition is not found

3. All OK

Control Valve Body Assembly

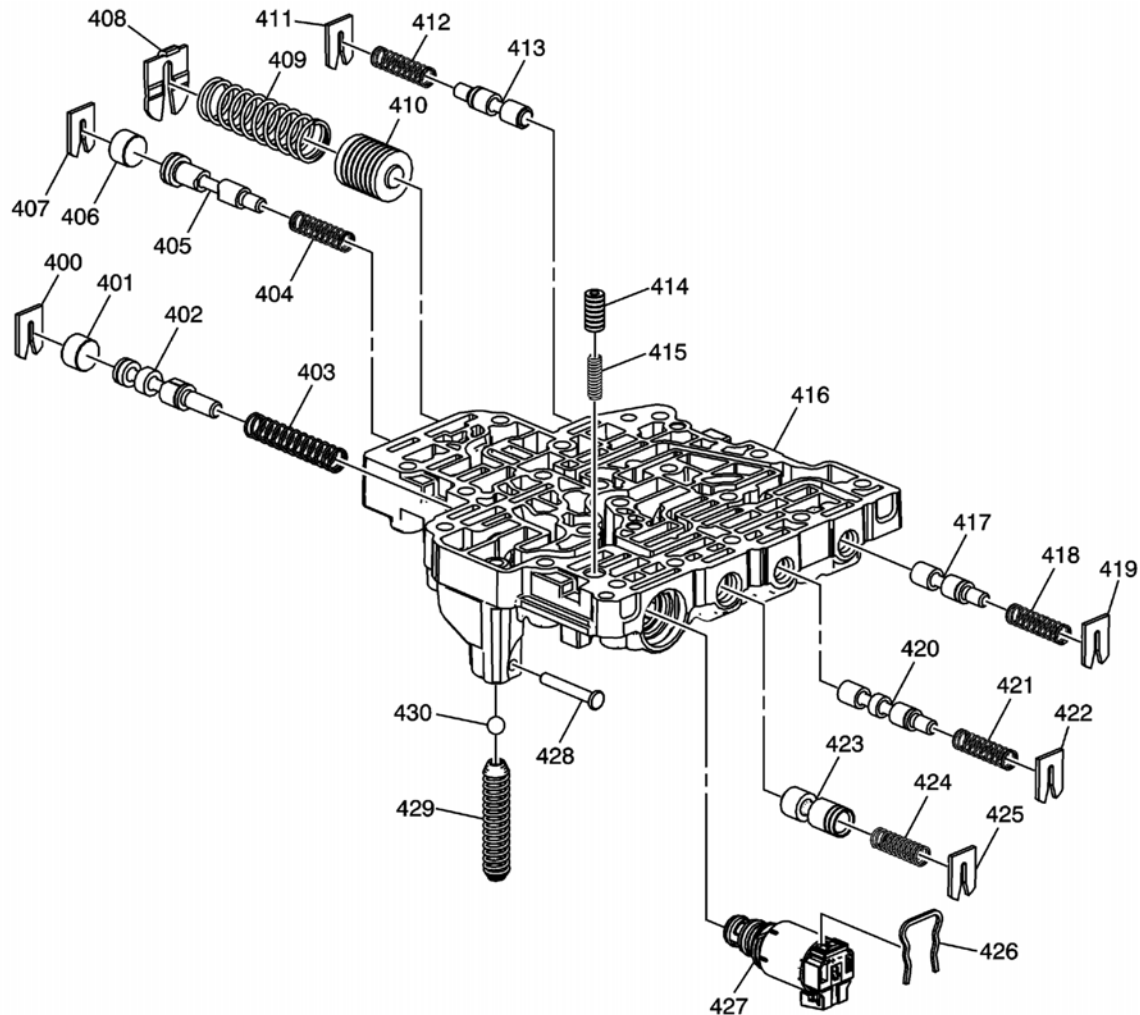


Fig. 23: Control Valve Body Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
400	Pressure Regulator Valve Bore Plug Retainer
401	Pressure Regulator Valve Bore Plug
402	Pressure Regulator Valve
403	Pressure Regulator Valve Spring
404	Lube Regulator Valve Spring
405	Lube Regulator Valve
406	Lube Regulator Valve Bore Plug
407	Lube Regulator Valve Bore Plug Retainer

Callout	Component Name
408	Variable Low Clutch Accumulator Piston Spring Retainer
409	Variable Low Clutch Accumulator Piston Spring
410	Variable Low Clutch Accumulator Piston
411	Automatic Transmission Torque Dampener Bypass Clutch Valve Bore Plug Retainer
412	Automatic Transmission Torque Dampener Bypass Clutch Spring
413	Variable Low Clutch Valve
414	Line Pressure Control Solenoid Valve Accumulator Piston
415	Line Pressure Control Solenoid Valve Accumulator Piston Spring
416	Control Valve Body
417	Automatic Transmission Torque Dampener Bypass Clutch Valve
418	Variable Low Clutch Regulator Valve Spring
419	Variable Low Clutch Regulator Valve Bore Plug Retainer
420	Variable High Clutch Valve
421	Variable Low Clutch Regulator Valve Spring
422	Variable Low Clutch Regulator Valve Bore Plug Retainer
423	Variable High Clutch Dam Feed Regulator Valve
424	Variable High Clutch Dam Feed Regulator Valve Spring
425	Variable High Clutch Dam Feed Regulator Valve Bore Plug Retainer
426	Line Pressure Control Solenoid Valve Retainer
427	Line Pressure Control Solenoid Valve
428	Pressure Relief Ball Valve Spring Pin
429	Pressure Relief Ball Valve Spring
430	Pressure Relief Ball Valve

Control Valve Body Diagnostic Inspection

Callout	Component Name	DTC/Symptom Associated with Component
402 - A Bore	Pressure Regulator Valve	P079A, P079B, P179C, P179D
405 - B Bore	Lube Regulator Valve	Transmission/Drive Motor Overheating
410 - C Bore	Variable Low Clutch Accumulator Piston	P079A, P179C
413 - D Bore	Variable Low Clutch Valve	P079A, P07A3, P179C
417 - E Bore	Automatic Transmission Torque Dampener Bypass Clutch Valve	Engine start/stop transitions
420 - F Bore	Variable High Clutch Valve	P079B, P07A5, P179D
423 - G Bore	Variable High Clutch Dam Feed Regulator Valve	P079B, P179D
427 - H Bore	Line Pressure Control Solenoid Valve	P079A, P079B, P179C, P179D
430 -	Pressure Relief Ball Valve	P079A, Low Line Pressure

Repair Instructions

- Refer to [Control Valve Body Replacement](#)
- Refer to [Solenoid Valve Characterization Reprogramming](#) when the T6 Power Inverter Module, Valve Body, or Q23 Line Pressure Control Solenoid is replaced.

TRANSMISSION FLUID LEVEL AND CONDITION CHECK

This procedure checks both the transmission fluid level, as well as the condition of the fluid itself.

CAUTION: The transmission fluid level must be checked when the transmission fluid temperature is at 45 - 55Â°C (113 - 131Â°F). If the transmission fluid temperature is not at this range, operate the vehicle or allow the fluid to cool as required. Setting the transmission fluid level with fluid temperature outside this range will result in either an under or over-filled transmission. Fluid temperature higher than 55Â°C will result in an under-filled condition. Fluid temperature lower than 45Â°C will result in an over-filled condition. An under-filled transmission will cause premature component damage. An over-filled transmission may cause fluid to discharge out the vent tube, fluid foaming, pump cavitation, or overheating. Transmission overheating may result in loss of vehicle propulsion without warning.

Initial Fluid Level Confirmation

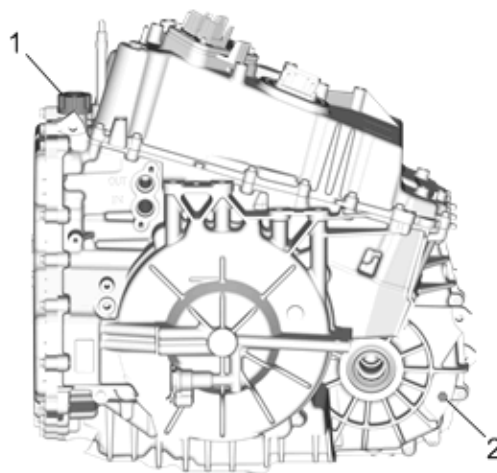


Fig. 24: Transmission Fluid Filler Cap And Fluid Level Hole Plug

Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the transmission has enough fluid in it to safely start the vehicle without damaging the transmission. With the vehicle off and the transmission fluid temperature at approximately 20 - 25Â°C (68 - 77Â°F), there must be at least enough fluid to drain out of the fluid level hole.

1. Verify if transmission service has been performed.
2. If no transmission repair has been performed and no leaks are evident, proceed directly to the Final Level Checking Procedure below.
3. Following any transmission service, remove the fluid filler cap (1) and the fluid level hole plug (2).
 - If the fluid is flowing as a steady stream, wait until the fluid begins to drip.

NOTE: Service replacement transmissions may come shipped with up to 3L (3.2 Q) of fluid.

- If no fluid comes out, add fluid until fluid drips out. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#), and [Wire to Wire Repair - Engine Controls and Fuel](#).
4. Install the fluid level hole plug. Refer to [Fastener Specifications \(Off-Vehicle\)](#)[Fastener Specifications \(On-](#)

Vehicle).

NOTE: You must confirm fluid level at the proper temperature range.

5. Perform the Final Level Checking Procedure below.

Final Level Checking Procedure

NOTE: You may have to open the hood to maintain engine operation.

1. Start the engine.
2. Allow the engine to idle in Park (P).

NOTE: If the transmission fluid temperature reading is not at the required temperature, allow the vehicle to cool, or operate the vehicle until the appropriate range is reached. If the fluid temperature is below the specified range, driving the vehicle will raise the fluid temperature to the specification quicker than engine idling.

3. Keep the engine running and observe the transmission fluid temperature using the scan tool.
4. When the transmission fluid temperature is in the 45 - 55°C (113 - 131°F) range, move the shift lever through Park (P), Neutral (N) and Drive (D) 2 times and back to Park (P).
5. Raise the vehicle on a hoist. The vehicle must be level, with the engine running and the shift lever in the PARK range.

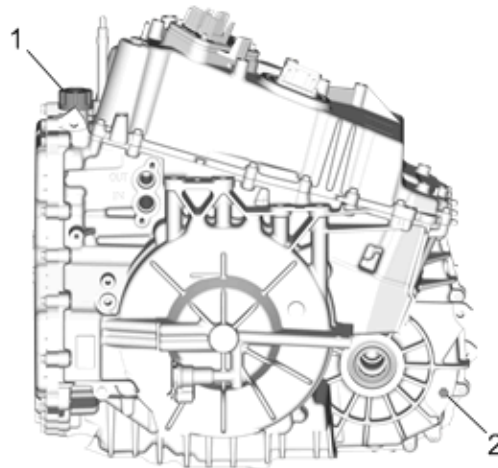


Fig. 25: Transmission Fluid Filler Cap And Fluid Level Hole Plug
Courtesy of GENERAL MOTORS COMPANY

6. While the vehicle is idling, remove the fluid level hole plug (2). Allow any fluid to drain.
 - If the fluid is flowing as a steady stream, wait until the fluid begins to drip.
 - If no fluid comes out, add fluid until fluid drips out.
 - Proper level is achieved when fluid slowly drips at a rate of 3 drips per second.
 - Reinstall the fluid level hole plug. Refer to **Fastener Specifications (Off-Vehicle)****Fastener Specifications (On-Vehicle).**

7. Inspect the fluid color. The fluid should be red or dark brown.
 - If the fluid color is very dark or black and has a burnt odor, inspect the fluid for excessive metal particles or other debris. Refer to [Road Test](#) to verify transmission operation. Change the transmission fluid if no other conditions are found.
 - Fluid that is cloudy or milky or appears to be contaminated with water indicates engine coolant or water contamination. Refer to [Engine Coolant/Water in Transmission](#).
8. Inspect for external leaks. Refer to [Fluid Leak Diagnosis](#)
9. If the fluid was changed, reset the transmission oil life monitor if applicable.

LINE PRESSURE CHECK

Special Tools

EN 21867-A Pressure Gauge

For equivalent regional tools refer to [Special Tools](#)

Main Line Pressure Check

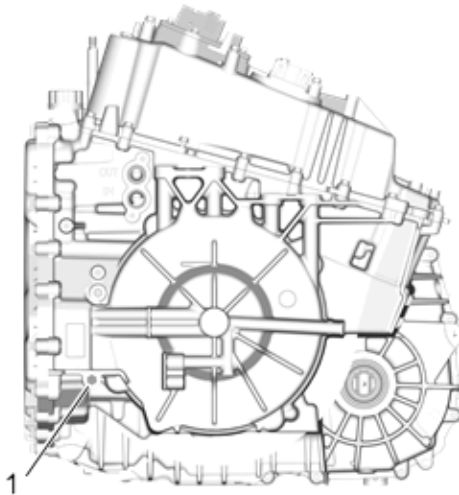


Fig. 26: Transmission Fluid Pressure Test Hole Plug

Courtesy of GENERAL MOTORS COMPANY

WARNING: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

1. Install a scan tool.

NOTE: Depending on the hybrid/EV battery state of charge the engine may not start. To start or keep the engine running open the hood.

2. Start the engine.
3. If the engine will not start, refer to [Engine Will Not Crank - Crankshaft Will Not Rotate](#).
4. Inspect the transmission for the proper fluid level. Refer to [Transmission Fluid Level and Condition Check](#).
5. Inspect the manual linkage at the transmission for proper function.
6. Turn the engine OFF.

NOTE: You may need to remove or disconnect components in order to gain access to the transmission line pressure test hole plug.

7. Remove the line pressure test hole plug.
8. Install the **EN 21867-A** pressure gauge.
9. Access the Scan Tool Transmission Output Controls for the Line Pressure Control Solenoid.
10. Start the engine.

NOTE: In order to achieve accurate line pressure readings, the following procedure must be performed at least 3 times in order to gather uniform pressure readings. Also if you do not have the hood open the engine may go in to AutoStop.

The scan tool is only able to control the line Pressure Control solenoid in **PARK** and **NEUTRAL** with engine speeds below 1500 RPM. This protects the clutches from extreme high or low line pressures.

11. Use the scan tool to increase and decrease the Line Pressure Control Solenoid in increments of approximately 100 KPa (15 psi). The scan tool commands the increment values automatically.
12. Allow the pressure to stabilize between increments.
13. Compare your pressure readings on the scan tool to those indicated on the **EN 21867 - A** pressure gauge.
14. If the pressure readings vary greatly, refer to [Automatic Transmission Fluid Pump Pressure High or Low](#)
15. Install the pressure test hole plug. Tighten the pressure plug to 11 N.m (97 lb in).

DRIVE MOTOR POWER INVERTER MODULE FLUID SEAL PRESSURE TEST

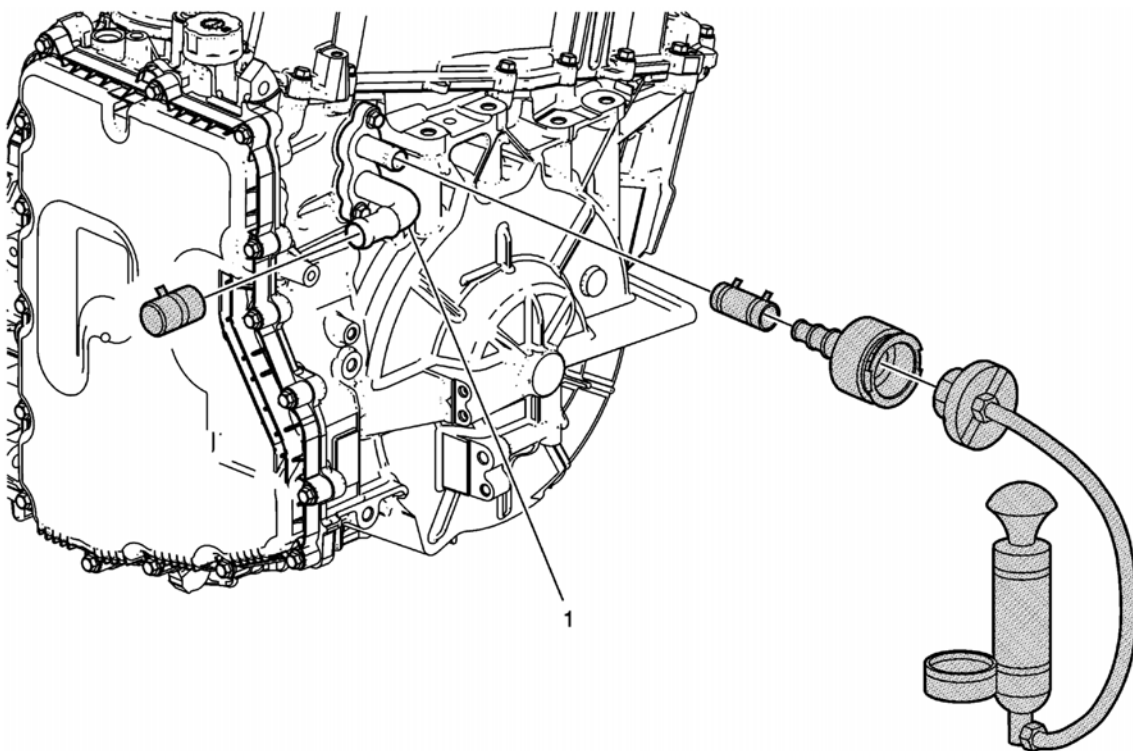


Fig. 27: Drive Motor Power Inverter Module Fluid Seal Pressure Test
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Install Drive Motor Power Inverter Module. Refer to: Drive Motor Power Inverter Module Installation .	
1	Drive Motor Power Inverter Module Coolant Pipe CAUTION: Refer to Fastener Caution . Procedure 1. Install the drive motor power inverter module coolant pipe and bolts. Tighten the bolts to 9 N.m (80 lb in). 2. Clamp GE-48494 adapter kit components to the coolant outlet pipe. 3. Plug the coolant inlet pipe with the GE-48494 adapter kit plug and clamp. 4. Apply 20 psi (138 kPa) pressure with J-24460-01 pressure tester. 5. Monitor the pressure tester gauge for 5 minutes and ensure that pressure remains at the specified value. • If the specified pressure cannot be maintained, check the coolant hose and connections for leaks. If the coolant hose and connections check good, remove the drive motor power inverter module and replace the fluid seal. • If pressure remains at the specified value, proceed to the next step. 6. Remove all GE-48494 adapter kit components. Special Tools • GE-48494 Power Electronics Pressure Test Adapter Kit • GE-48494-10 Pressure Tester Kit • J-24460-01 Cooling System Pressure Tester For equivalent regional tools, refer to Special Tools.

ROAD TEST

NOTE: The Road Test Procedure should be performed only as part of the Symptom Diagnosis. Refer to [Symptoms - Automatic Transmission](#).

The following test provides a method of evaluating the condition of the automatic transmission. The test is divided into the following parts:

- Low Voltage Electrical Function Check
- Hydraulic Control Function Check
- High Voltage Electric Machine Control Function Check

NOTE: Complete the test in the sequence given.

Before the road test, ensure the following:

- The engine is performing properly.
- Transmission fluid level is correct. Refer to [Transmission Fluid Level and Condition Check](#).
- Tire pressure is correct.
- The high voltage battery is above 30% state of charge.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- To view the scan tool data while conducting this test, take along qualified help in order to operate the vehicle safely, or review the data after the drive audit.
- Observe any unusual sounds or smells.

After the road test, check the following:

- Inspect for proper transmission fluid level. Refer to [Transmission Fluid Level and Condition Check](#).
- Inspect for any diagnostic trouble codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Monitor the scan tool data for any abnormal readings or data.
- Inspect for fluid leaks. Refer to [Fluid Leak Diagnosis](#).

Low Voltage Electrical Function Check

Perform this procedure first in order to ensure the electronic transmission components are functioning properly. If these components are not checked, a simple electrical condition could be misdiagnosed.

1. Connect the scan tool.
2. Ensure the gear selector is in PARK and set the parking brake.
3. Start the vehicle. To ensure the engine starts, open the hood.
4. With a scan tool, monitor the transmission data parameters and compare them to typical scan tool data definitions.

Refer to [Hybrid Powertrain Control Module Scan Tool Information](#) for typical data values. Data that is questionable may indicate a concern.

5. Monitor transmission range on the scan tool data list.
 1. Apply the brake pedal and ensure the parking brake is set.
 2. Move the gear selector through all ranges.
 3. Pause 2 to 3 seconds in each range.
 4. Return gear selector to PARK.
 5. Verify that all selector positions match the scan tool display.
6. Check accelerator position sensor input.
 1. Apply the brake pedal and ensure the parking brake is set while monitoring accelerator pedal data.
 2. Ensure the gear selector is in PARK.

3. Monitor the scan tool Accelerator Pedal Position while increasing and decreasing engine speed with the accelerator pedal. The scan tool Accelerator Pedal Position percentage should increase and decrease with engine speed.

If any of the above checks do not perform properly, record the result for reference after completion of the road test.

Hydraulic and Electric Machine Control Function Checks

NOTE: If in the above steps you opened the hood to start the engine make sure it is closed before driving the vehicle.

Charge vehicle to greater than 25% state of charge to enter EV only mode, if not already done. Perform the following steps while monitoring Hybrid/EV data list:

1. Drive vehicle at 35 mph at steady state.
2. Accelerate safely with 100% accelerator pedal to 55 mph, then drive at or above 55 mph.
 1. Monitor for any excessive variable low clutch slip speed during acceleration.
3. Slow vehicle by shifting to LOW or pressing the regenerative braking button.
4. Switch vehicle to Hold Mode to start the engine (if needed) by pressing the Drive Mode Button 4 times.
5. Drive vehicle below 35 mph with stop-and-go city driving.
 1. The engine will stop and start as needed.
 2. Ensure smooth operation free of excessive vibrations.
6. Accelerate safely with 100% accelerator pedal to 55 mph, then drive at or above 55 mph.
 1. Monitor for any excessive variable low clutch slip speed during acceleration.
 2. Ensure variable high clutch engages during 55 mph steady state driving and monitor for slip.
7. Slow vehicle by shifting to LOW or pressing the regenerative braking button.
 1. Ensure smooth deceleration as variable low clutch re-engages at lower vehicle speeds.

Reverse

Perform the following test safely:

1. With the vehicle stopped, move the gear selector to REVERSE.
2. Slowly accelerate the vehicle.
3. Verify that there is no noticeable slip, noise or vibration.
4. This test ensures the control system is properly applying torque in the reverse direction.

This procedure checks general functionality of the transmission. For diagnosing intermittent problems, try to duplicate the conditions of the original complaint. Refer to freeze frame records if a DTC set to determine the conditions.

CLUTCH PLATE DIAGNOSIS

Composition Plates

Dry the plates and inspect the plates for the following conditions:

- Pitting
- Flaking

- Delamination - splitting or separation of bonded clutch material
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

Steel Plates

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

Causes of Burned Clutch Plates

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch or apply plates
- Engine coolant or water in the transmission fluid
- A cracked clutch piston
- Damaged or missing seals
- Low line pressure
- Valve body conditions
 - The valve body face is not flat.
 - Porosity is between channels.
 - The valve bushing clips are improperly installed.
 - The checkballs are misplaced.
- The Teflon® seal rings are worn or damaged.

ENGINE COOLANT/WATER IN TRANSMISSION

CAUTION: The antifreeze or water will deteriorate the seals, gaskets and the glue that bonds the clutch material to the pressure plate. Both conditions may cause damage to the transmission.

If antifreeze or water has entered the transmission, perform the following:

1. Disassemble the transmission.
2. Replace all of the rubber type seals. The coolant will attack the seal material which will cause leakage.
3. Replace the composition-faced clutch plate assemblies. The facing material may separate from the steel center portion.
4. Replace all of the nylon parts - washers.
5. Replace the torque dampener.
6. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the vehicle.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.

WARNING: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.
3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for three hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures.

BUSHING AND MATING SHAFT INSPECTION

NOTE: Proper bushing and corresponding mating shaft inspection should be performed before replacing the bushing, shaft, and in some cases, the component which houses the bushing. Thoroughly clean and dry the bushing and shaft surfaces before inspecting for damage.

Any of the following bushing conditions require replacement of the bushing and/or housing:

- Discoloration due to heat distress
- Misalignment or displacement of bushing as a result of spinning in housing
- Medium to heavy scoring that can be easily detected with fingernail. Light scoring is a normal condition.
- Debris embedded into the bushing lining material
- Obvious damage, including excessive and uneven wear
- Excessive polishing. Minor polishing of the bushing is an indication of normal wear and does not require replacement.

Any of the following conditions require replacement of the bushing's mating shaft:

- Discoloration due to heat distress
- Rough surface finish that can be easily detected with finger
- Obvious shaft abnormalities, including warping or uneven surfaces
- Obvious damage or cracking

AUTOMATIC TRANSMISSION FLUID PUMP PRESSURE HIGH OR LOW

Checks	Causes
Automatic Transmission Fluid Pump Motor	• Faulty fluid pump motor assembly • Faulty fluid pump motor wiring • Low fluid level • Inspect for leaking or damaged fluid pump outlet seal and fluid filter seal

Checks	Causes
	• Inspect for improperly installed or damaged fluid filter
Control Solenoid Valve	• Inspect for leaking or damaged control solenoid valve seals • Inoperable control solenoid valve • Inspect for damaged control solenoid electrical connector or wiring • Inspect for damaged or worn control solenoid valve accumulator or accumulator bore
Control Valve Assembly	• Inspect for leaking or damaged control valve body spacer plate • Inspect for damaged or stuck open line pressure blow-off ball valve • Inspect for a sticky or stuck line pressure regulator valve • Inspect solenoid module assembly for damage to plastic body or seal plate • Inspect for other sticky or stuck valves within the control valve assembly • Inspect for other leak paths within the line pressure hydraulic circuit or control valve solenoid hydraulic circuitry

AUTOMATIC TRANSMISSION FLUID LEAKS

Checks	Causes
Torque Dampener	Inspect for damage.
Case Assembly	• Inspect for porosity or damage on the sealing surfaces • Inspect for loose oil cooler line bolts or damaged oil cooler line seals • Inspect for damaged manual shift shaft seal • Inspect for damaged or worn drive shaft oil seals on the axle shafts • Inspect for loose pressure test plug and fluid level hole plug
Torque Dampener and Differential Housing Assembly	• Inspect for damaged torque dampener and differential housing assembly • Inspect for porosity or damage on the sealing surfaces • Inspect for damaged torque dampener and differential housing gasket • Inspect for loose torque dampener and differential housing bolts • Inspect for damaged or worn drive shaft oil seals on the axle shafts

Checks	Causes
Control Valve Body Cover	• Inspect for damaged or warped control valve body cover • Inspect for damaged fluid level control valve seal - gasket • Inspect for loose control valve body cover bolts.

FLUID LEAK DIAGNOSIS

General Method

1. Verify that the leak is transmission fluid.

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

2. Thoroughly clean the suspected leak area using a rag.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

Powder Method

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

1. Thoroughly clean the suspected leak area using a rag.
2. Apply an aerosol type leak tracing powder to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

Dye and Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Operate the vehicle for 24 km (15 mi) or until normal operating temperatures are reached.
3. Detect the leak with the black light.
4. Make the necessary repairs.

Find the Cause of the Leak

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the

leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual shaft or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Control Valve Body Cover

- Incorrectly tightened bolts
- Improperly installed or damaged gasket/seal
- Damaged mounting face
- Incorrect gasket seal

Case Leak

- Damaged manual shift shaft seal
- Loose or damaged oil cooler lines/seals
- Worn or damaged drive shaft oil seal
- Loose line pressure plug or fluid level hole plug
- Porous casting
- Warped torque dampener and differential housing
- Damaged torque dampener and differential housing gasket

Torque Dampener and Differential Housing

- Damaged torque dampener and differential housing gasket.
- Worn or damaged drive shaft oil seal
- Porous casting of the torque dampener and differential housing

Leak at the Vent

- Overfilled system
- Water or coolant in the fluid; The fluid will appear milky
- Transmission case porous
- Incorrect fluid level indicator causing an overfilled system
- Plugged vent

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Checks	Causes
Input Internal Gear Thrust Bearing	Inspect the bearing for wear or damage.
Output Carrier Thrust Bearing	• Inspect the carrier assembly for damaged pinion gears, pins, and rollers. • Inspect for damaged thrust bearings. • Inspect for damaged sun gears. • Inspect for damaged or stripped splines on the output carrier assembly.
Output Carrier Internal Gear Hub Thrust Bearing	Inspect the bearing for wear or damage.
Front Differential Carrier	Inspect for damaged gears and bearings.
Front Differential Carrier Bearing	Inspect the bearing for wear or damage.
Drive Link Assembly	Inspect for damaged sprockets, bearings, and drive link.

NOISE IN DRIVE OR REVERSE GEAR

Checks	Causes
Variable Low Clutch Assembly	• Inspect for damaged or worn variable low clutch plates. • Inspect for damaged variable low clutch backing plate. • Inspect for damaged variable low clutch backing plate retaining ring. • Inspect for damaged variable low clutch piston assembly and spring.
Front Differential Carrier	Inspect for damaged gears and bearings.
Drive Link Assembly	Inspect for damaged sprockets, bearings, and drive link.

VIBRATION

Checks	Causes
Lug bolts for the Input Drive Flange	Inspect for loose bolts.
Input Internal Gear Thrust Bearing	Inspect for wear or damage.
Output Carrier Thrust Bearing	Inspect the bearing for wear or damage.
Output Carrier	• Inspect the carrier assembly for damaged pinion gears, thrust washers, pins, and rollers. • Inspect for a worn or damaged center support roller bearing assembly. • Inspect for damaged thrust bearings. • Inspect the carrier assembly for damaged output carrier rear sun gear thrust bearing (captured).
Front Differential Carrier	Inspect for damaged gears and bearings.

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

If noise or vibration is noticeable in PARK and NEUTRAL with the engine at idle, but is less noticeable as RPM increases, the cause may be from poor engine performance.

- Inspect the tires for the following conditions:
 - Uneven wear
 - Imbalance
 - Mixed sizes
 - Mixed radial and bias ply
- Inspect the suspension components for the following conditions:
 - Alignment wear or damage
 - Loose fasteners
 - Driveline damage or wear
- Inspect the engine and transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following conditions:
 - Missing bolts, nuts, and studs
 - Stripped threads
 - Cracks
- Inspect the flywheel for the following conditions:
 - Missing or loose bolts
 - Cracks
 - Imbalance
- Inspect the input drive flange for the following conditions:
 - Missing or loose bolts or lugs
 - Missing or loose balance weights
 - Imbalance caused by heat distortion or fluid contamination

NO PARK OR DRIVE

Checks	Causes
Front Differential Carrier	Inspect for damaged gears and bearings.
Drive Link Assembly	Inspect for damaged sprockets, bearings, and drive link.

NO DRIVE IN ALL RANGES

Checks	Causes
Output Carrier	• Inspect the carrier assembly for damaged pinion gears, thrust washers, pins, and rollers. • Inspect for damaged thrust bearings. • Inspect for damaged sun gears. • Inspect the carrier assembly for damaged output carrier rear sun gear thrust bearing (captured).
Drive Motor - 2nd Position	Motor Failure • Inspect connections at motor • Inspect motor end bearings
Thrust Bearing	Inspect the bearing for wear or damage.
Front Differential Carrier	Inspect for damaged gears and bearings.
Drive Link Assembly	Inspect for damaged sprockets, bearings, and drive link.
Front Differential Carrier Sun Gear	Inspect for spline wear or damage.
Automatic Transmission Fluid Filter	• Inspect for damaged or restricted fluid filter. • Inspect for damaged fluid filter seal or improper sealing interface, leaks, and fluid aeration.
Automatic Transmission Fluid Pump Outlet Seal	Inspect for worn or damaged seal.

NO REVERSE GEAR

Checks	Causes
Output Carrier	• Inspect the carrier assembly for damaged pinion gears, thrust washers, pins, and rollers. • Inspect for damaged thrust bearings. • Inspect for damaged sun gears. • Inspect the carrier assembly for damaged output carrier rear sun gear thrust bearing (captured).
Drive Motor - 2nd Position	Motor Failure • Inspect connections at motor • Inspect motor end bearings

Checks	Causes
Thrust Bearing	Inspect the bearing for wear or damage.
Front Differential Carrier	Inspect for damaged gears and bearings.
Drive Link Assembly	Inspect for damaged sprockets, bearings, and drive link.
Front Differential Carrier Sun Gear	Inspect for spline wear or damage.
Automatic Transmission Fluid Filter	- Inspect for damaged or restricted fluid filter. - Inspect for damaged fluid filter seal or improper sealing interface, leaks, and fluid aeration.
Automatic Transmission Fluid Pump Outlet Seal	Inspect for worn or damaged seal.

NO DRIVE OR REVERSE GEAR

Checks	Causes
Variable Low Clutch Assembly	- Inspect for damaged or distorted clutch housing. - Inspect for damaged or distorted clutch plates.
Variable High Clutch Assembly	- Inspect for damaged or distorted clutch housing. - Inspect for damaged or distorted clutch plates.

HARSH, SOFT, DELAYED OR SLIPPING DRIVE OR REVERSE GEAR

Checks	Causes
Variable Low Clutch Assembly	- Inspect for damaged or worn variable low clutch plates. - Inspect for damaged variable low clutch backing plate. - Inspect for damaged variable low clutch backing plate retaining ring. - Inspect for damaged variable low clutch piston assembly and spring.
Variable High Clutch Assembly	- Inspect for damaged or worn variable high clutch plates. - Inspect for damaged variable high clutch backing plate. - Inspect for damaged variable high clutch backing plate retaining ring. - Inspect for damaged variable high clutch piston assembly and spring.
Control Valve Assembly	- Inspect solenoid module assembly for damage to plastic body, electrical connections and wire harness, or seal plate. - Inspect low variable shift valve for stickiness or stuck condition. - Inspect for stuck or sticky compensator feed valve. - Inspect for leak paths within the variable high or compensator feed hydraulic circuits.

Checks	Causes
	• Inspect for leaking or damaged control valve body spacer plate. • Inspect for plugged control valve body spacer plate orifice(s).

STUCK IN DRIVE OR REVERSE GEAR

Checks	Causes
Variable Low Clutch Assembly	• Inspect for damaged or worn variable low clutch plates. • Inspect for damaged variable low clutch backing plate. • Inspect for damaged variable low clutch backing plate retaining ring. • Inspect for damaged variable low clutch piston assembly and spring.

HARSH GARAGE SHIFT

Checks	Causes
Variable Low Clutch Assembly	Inspect for damaged or worn variable low clutch plates.

SEIZED ENGINE OR TRANSMISSION SEPARATION

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

1. Ensure that the vehicle is properly supported and squarely positioned. Refer to [Lifting and Jacking the Vehicle](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

2. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
3. Disable the high voltage system and disconnect the A4 Hybrid/EV Battery Pack high voltage harness connector at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#).

4. Set the parking brake.
5. Remove the engine and transmission assembly from the vehicle. Refer to [Engine Replacement](#) , and [Transmission Replacement](#).
6. With the engine and transmission assembly on the cradle, support both the engine and transmission.

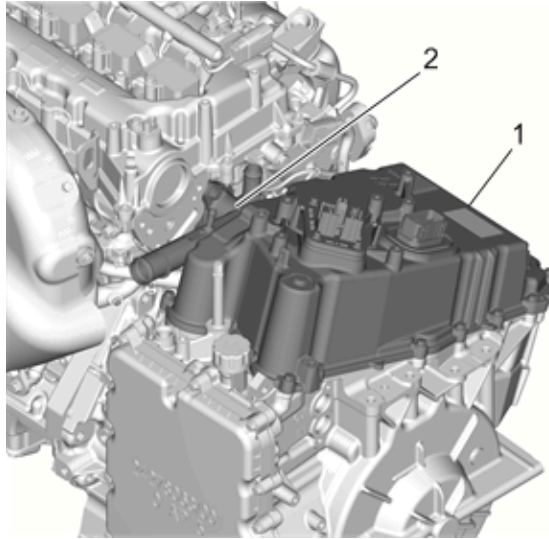


Fig. 28: Drive Motor Power Inverter Module Cover And Water Outlet
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module Cover (1). Refer to [Drive Motor Power Inverter Module Cover Removal](#)
8. Remove Water Outlet (2). Refer to [Water Outlet Replacement](#)
9. Install Drive Motor Power Inverter Module Cover (1). Refer to [Drive Motor Power Inverter Module Cover Installation](#)

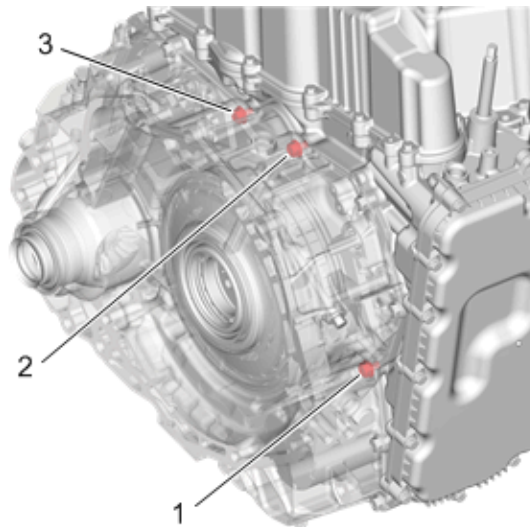


Fig. 29: Hidden Torque Dampener And Differential Housing Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Mark the location of the three hidden torque dampener and differential housing bolts 1 to 3.
11. With an air chisel, remove the torque dampener and differential housing material in order to gain access to the three hidden bolts.

12. With a 13 mm box end wrench, remove the torque dampener and differential housing bolts including the now exposed hidden bolts. (Qty: 16)

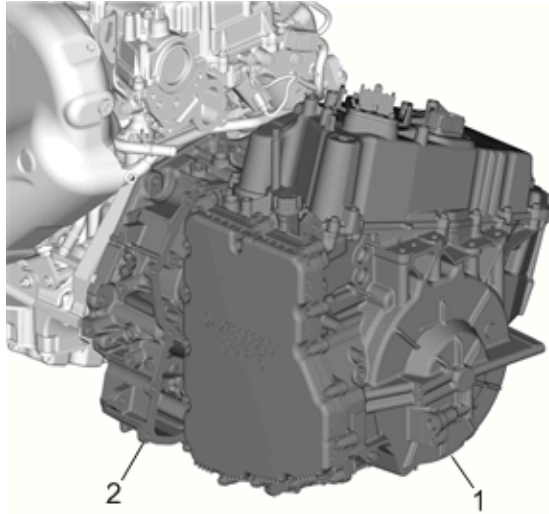


Fig. 30: Transmission Case And Torque Dampener And Differential Housing
Courtesy of GENERAL MOTORS COMPANY

13. With an appropriate hoist, separate the transmission case (1) from the torque dampener and differential housing (2).

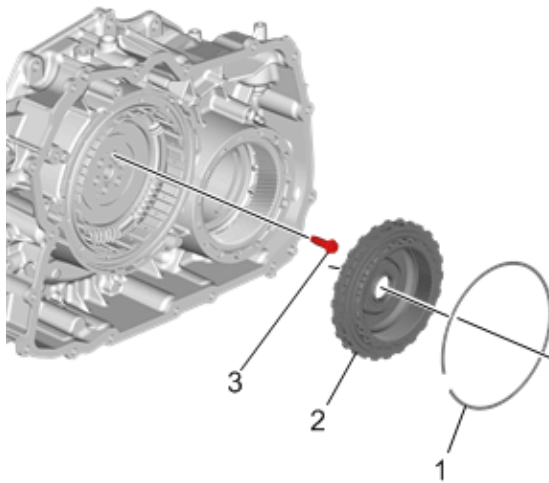


Fig. 31: Input Internal Gear, Retaining Ring And Transmission Torque Dampener Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Remove Input Internal Gear Retaining Ring (1)
15. Remove Input Internal Gear (2)
16. Remove Automatic Transmission Torque Dampener Bolts (3) (Qty: 6)
17. Remove the torque dampener and differential housing to engine bolts.
18. Remove the torque dampener and differential housing from the engine.
19. Remove the input drive flange from the automatic transmission flex plate.

Installation Procedure

1. Determine the correct torque dampener thrust washer. Refer to [Automatic Transmission Torque Dampener Thrust Washer Measurement](#).
2. Using a NEW torque dampener and differential housing assembly, install the torque dampener and differential housing to the transmission case. Refer to [Automatic Transmission Torque Dampener and Differential Housing Installation](#).

REPAIR INSTRUCTIONS - ON VEHICLE

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

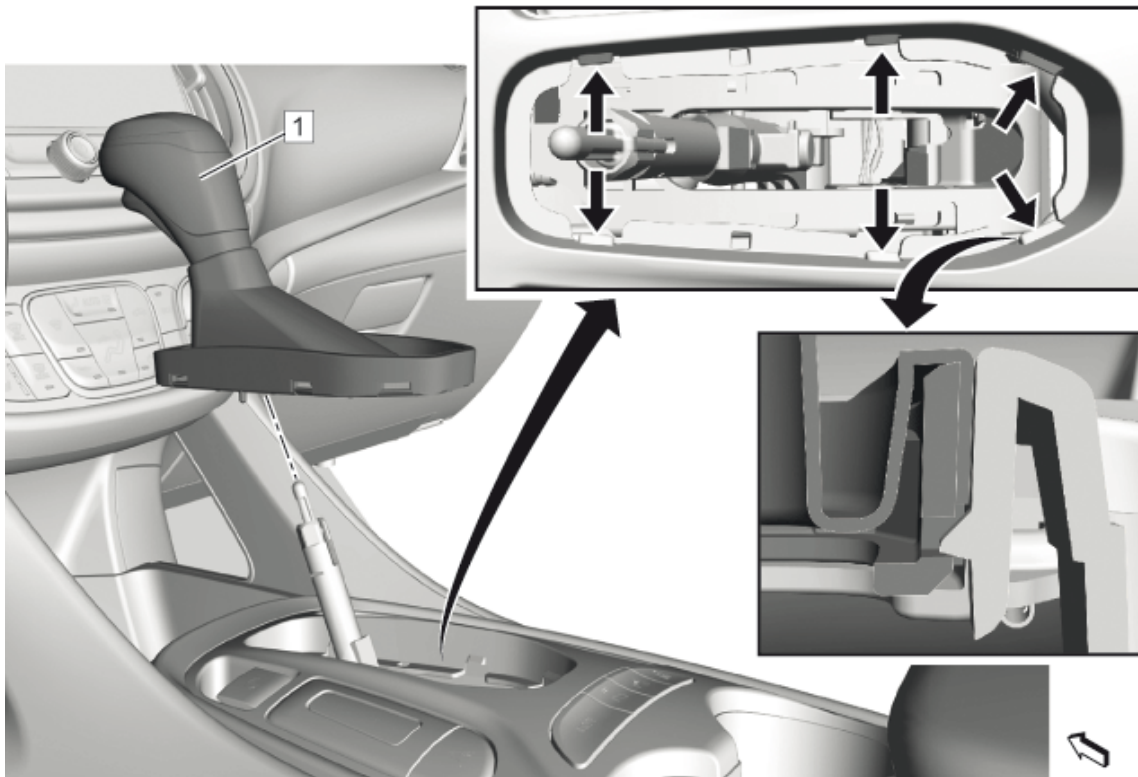


Fig. 32: Transmission Control Lever Knob

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Control Lever Knob Procedure 1. Release the lever boot from the 6 retainers (arrows). 2. Pull the knob with both hands upward with a twisting motion of max. 1 - 2 degrees to release from the transmission control lever. 3. Remove transmission control lever knob from the transmission control. NOTE: Considerable effort may be necessary to release the

Callout	Component Name
	knob from the control lever.

TRANSMISSION CONTROL REPLACEMENT (WITH BASE)

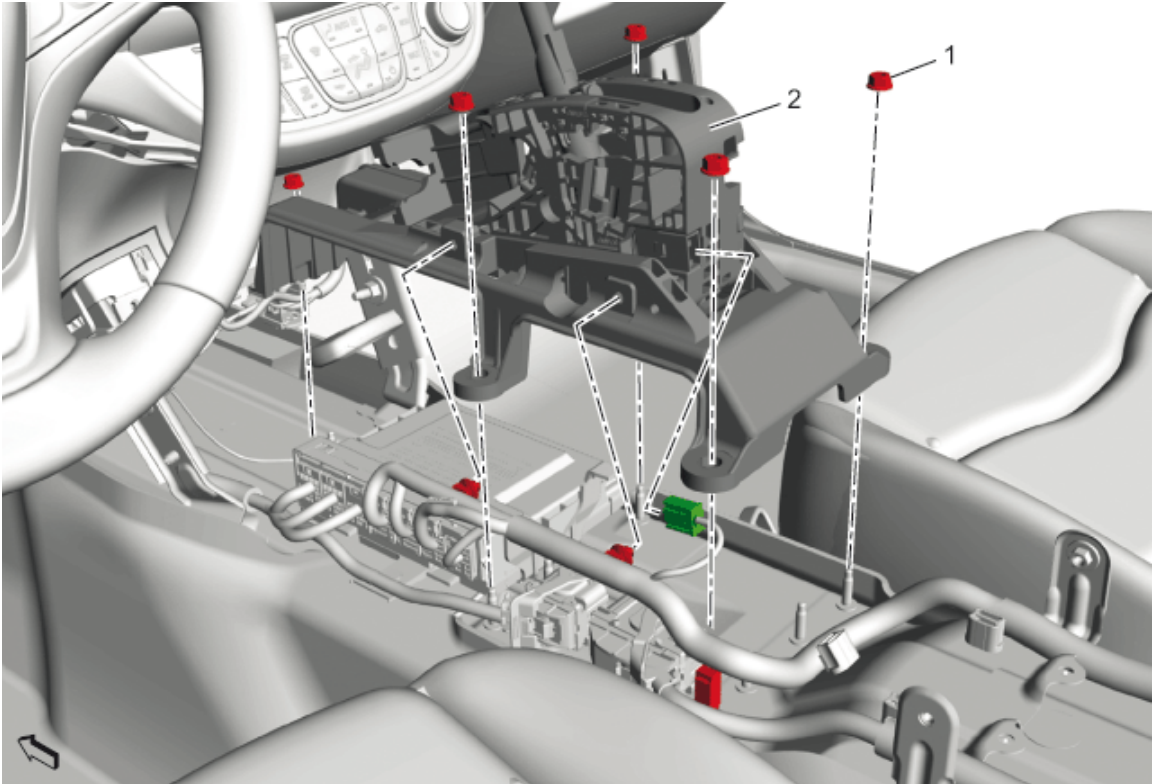


Fig. 33: Transmission Control (With Base)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Transmission Control Lever Knob. Refer to Transmission Control Lever Knob Replacement 2. Remove Front Floor Console. Refer to Front Floor Console Replacement WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that	

Callout	Component Name
	the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury. 3. Disconnect Range Selector Lever Cable @ Transmission Control. Refer to Range Selector Lever Cable Replacement 4. Disconnect the wiring harness connector and the wiring harness retainers.
1	Transmission Control Lever Housing Bracket Nut (Qty: 5) CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Transmission Control Procedure 1. Transfer parts as needed. 2. After the installation is complete perform a range selector lever cable adjustment. Refer to Range Selector Lever Cable Adjustment.

TRANSMISSION CONTROL REPLACEMENT (WITHOUT BASE)

Removal Procedure

1. Set the park brake.
2. Remove Front Floor Console. Refer to [Front Floor Console Replacement](#)

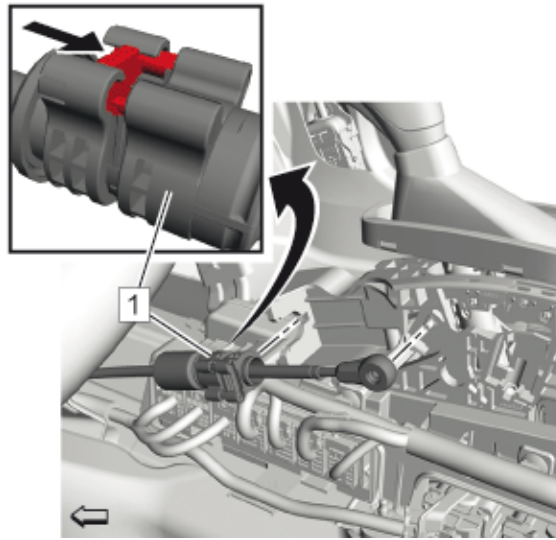


Fig. 34: Range Selector Lever Cable And Transmission Control

Courtesy of GENERAL MOTORS COMPANY

3. Remove the range selector lever cable (1) from the transmission control. Release the cable from the bracket by pushing the retainer (arrow).
4. Disconnect the transmission control electrical connector.

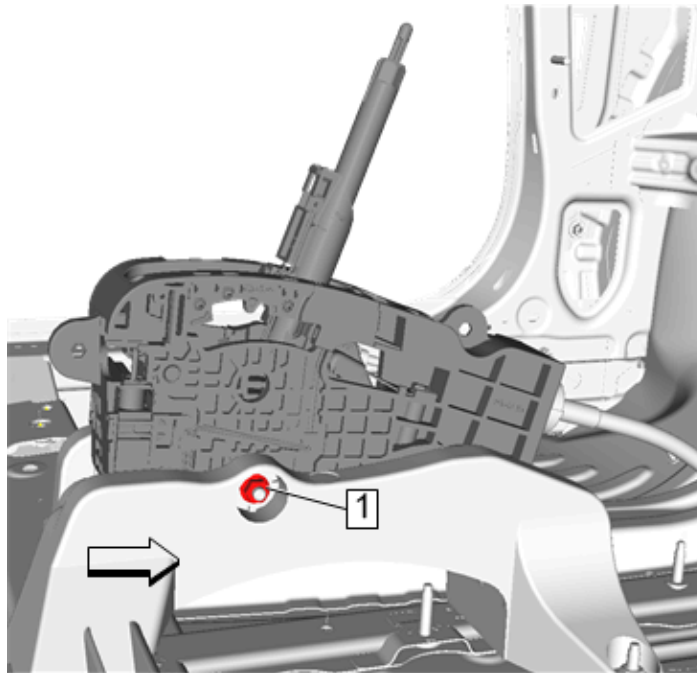


Fig. 35: Nut And Washer

Courtesy of GENERAL MOTORS COMPANY

5. Remove the nut and washer (1) from the control assembly.

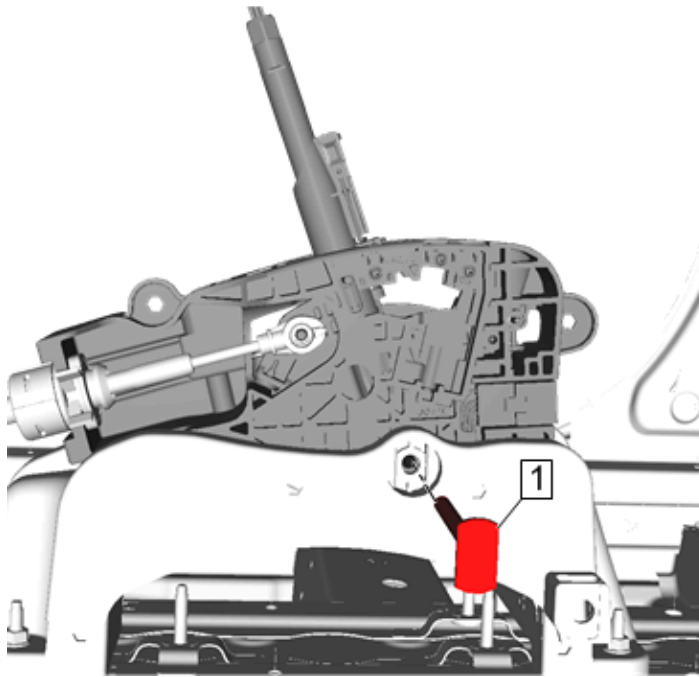


Fig. 36: Main Shaft Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Remove the main shaft bolt (1).

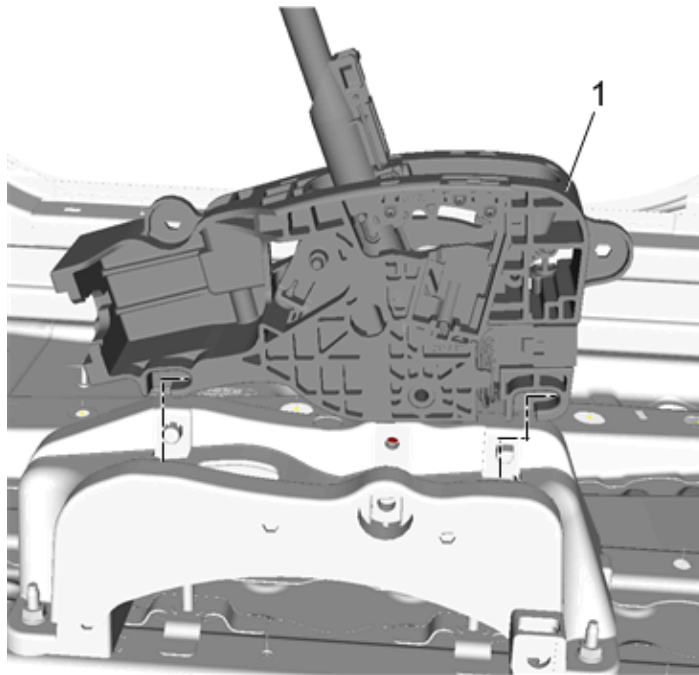


Fig. 37: Transmission Control Assembly

Courtesy of GENERAL MOTORS COMPANY

7. Pull the transmission control assembly (1) rearward and upward to unseat it from the transmission control base.
8. Remove the transmission control assembly from the vehicle.

Installation Procedure

1. Position the transmission control assembly to the transmission control base.

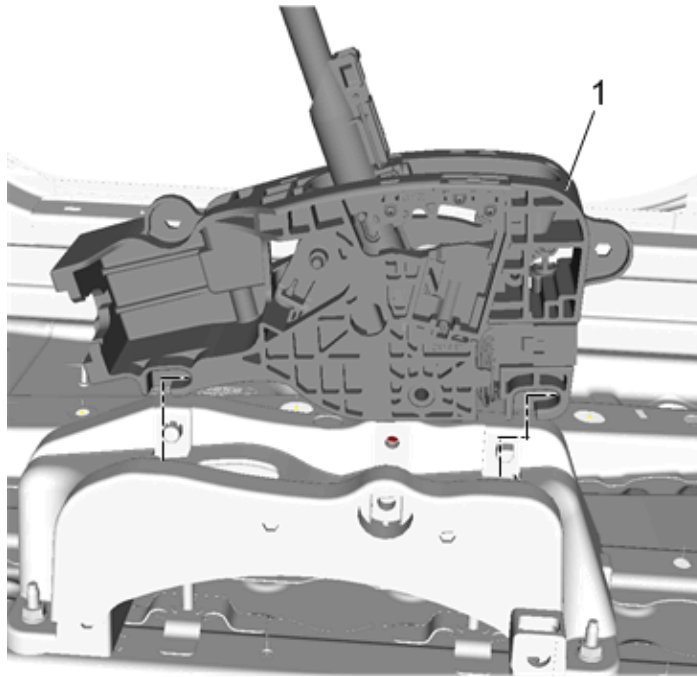


Fig. 38: Transmission Control Assembly

Courtesy of GENERAL MOTORS COMPANY

2. Push the transmission control assembly (1) downward and forward to seat it to the transmission control base.

NOTE: Ensure the flats of the bolt align with the transmission control assembly flat points inside the base before tightening the nut.

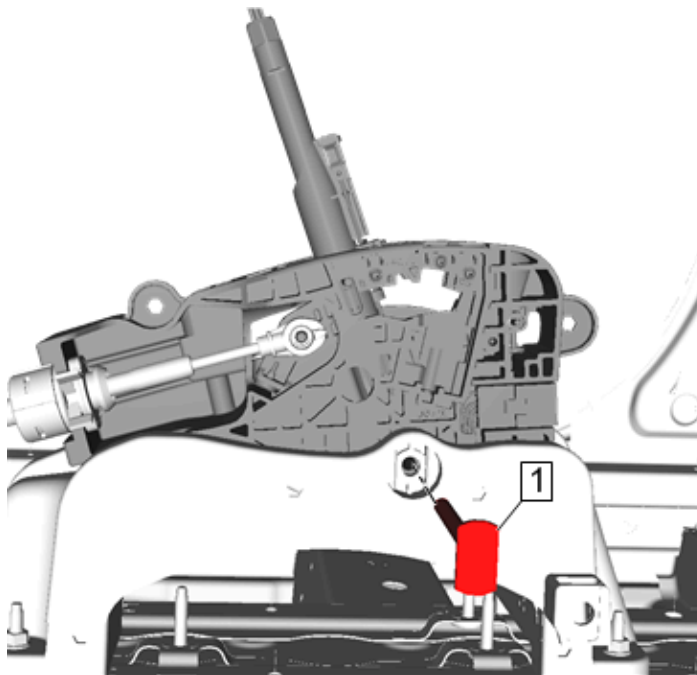


Fig. 39: Main Shaft Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install the main shaft bolt (1).

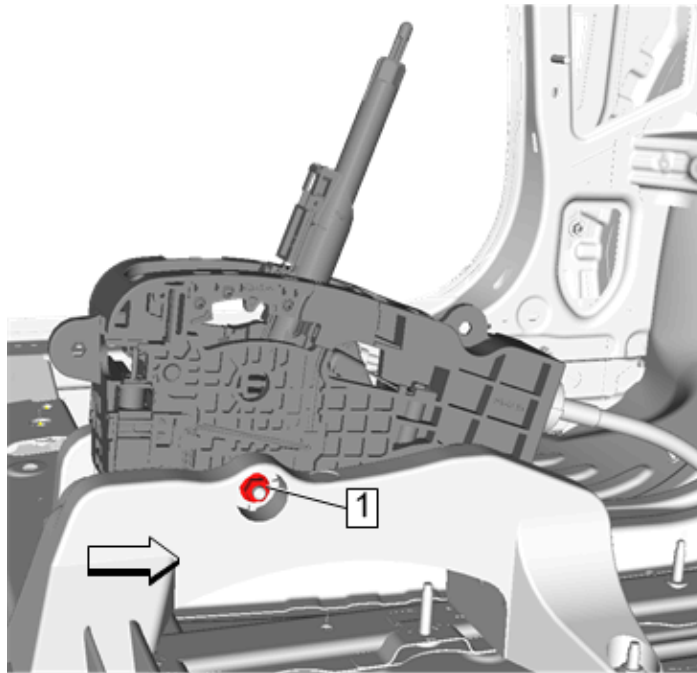


Fig. 40: Nut And Washer

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

NOTE: When installing the transmission control main shaft bolt, the face of the bolt must be held in the slot of the mounting bracket as the nut is torqued to ensure it remains seated and doesn't rotate out of the slot. Failure to perform this task can result in a loose shifter feel, squeaks & rattles, or excessive cross car lash resulting in a customer's poor perceived quality of the system.

4. Install the nut and washer (1) to the control assembly and tighten to 7 N.m (62 lb in).
5. Connect the transmission control electrical connector.

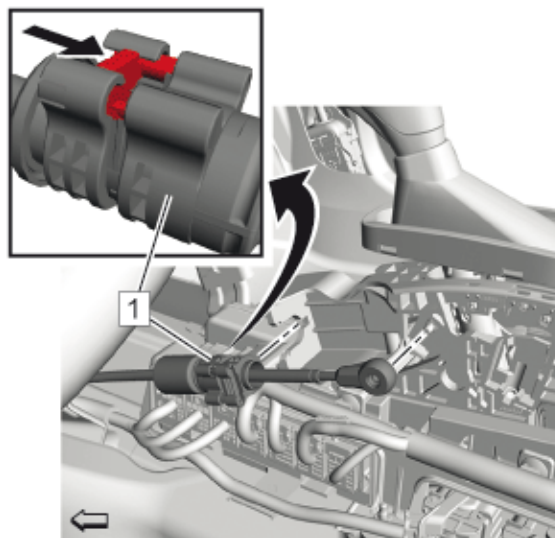


Fig. 41: Range Selector Lever Cable And Transmission Control

Courtesy of GENERAL MOTORS COMPANY

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

6. Install the range selector lever cable (1) to the transmission control.
7. Install Front Floor Console. Refer to [Front Floor Console Replacement](#)
8. Release the park brake.
9. Adjust the automatic transmission range selector lever cable. Refer to [Range Selector Lever Cable Adjustment](#)

DRIVE MOTOR GENERATOR POWER INVERTER MODULE REPLACEMENT

Removal Procedure

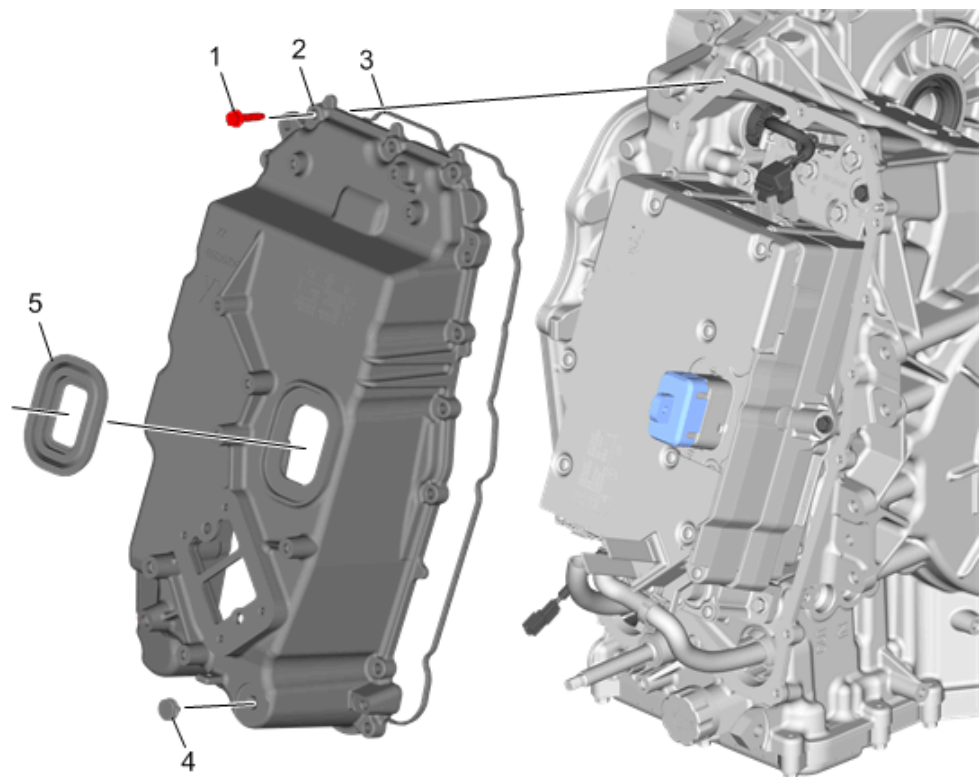


Fig. 42: Drive Motor Power Inverter Module Cover And Components

Courtesy of GENERAL MOTORS COMPANY

1. Remove Drive Motor Power Inverter Module Cover (2). Refer to [Drive Motor Power Inverter Module Cover Replacement](#)

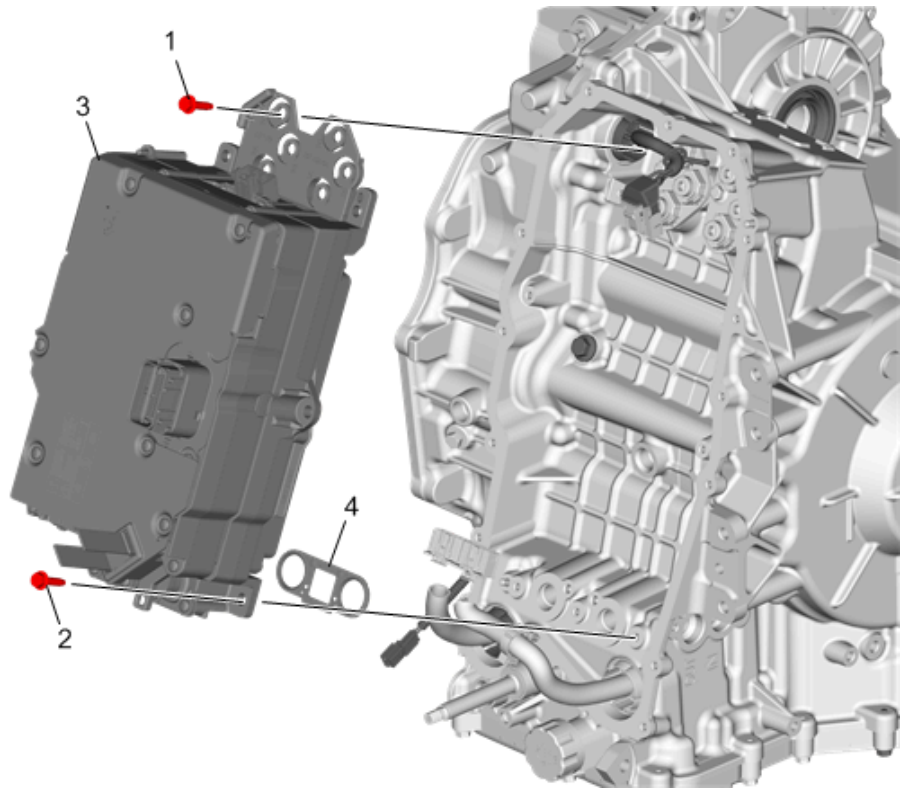


Fig. 43: Drive Motor Power Inverter Module And Components
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Drive Motor Power Inverter Module (3). Refer to [Drive Motor Power Inverter Module Removal](#)

Installation Procedure

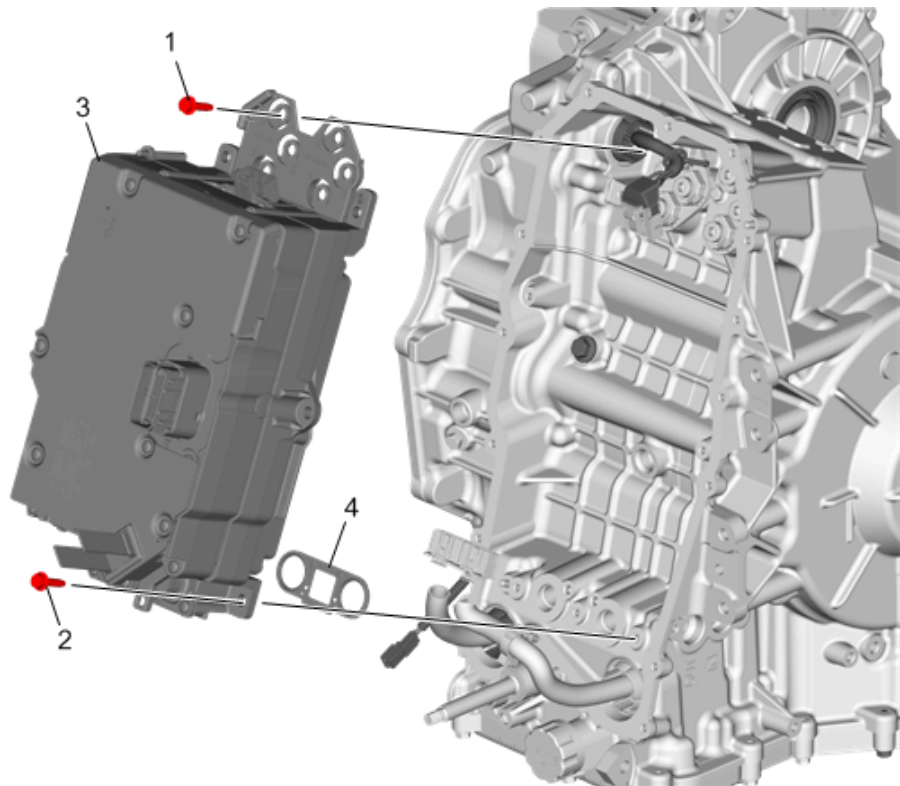


Fig. 44: Drive Motor Power Inverter Module And Components

Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module (3). Refer to [Drive Motor Power Inverter Module Installation](#)

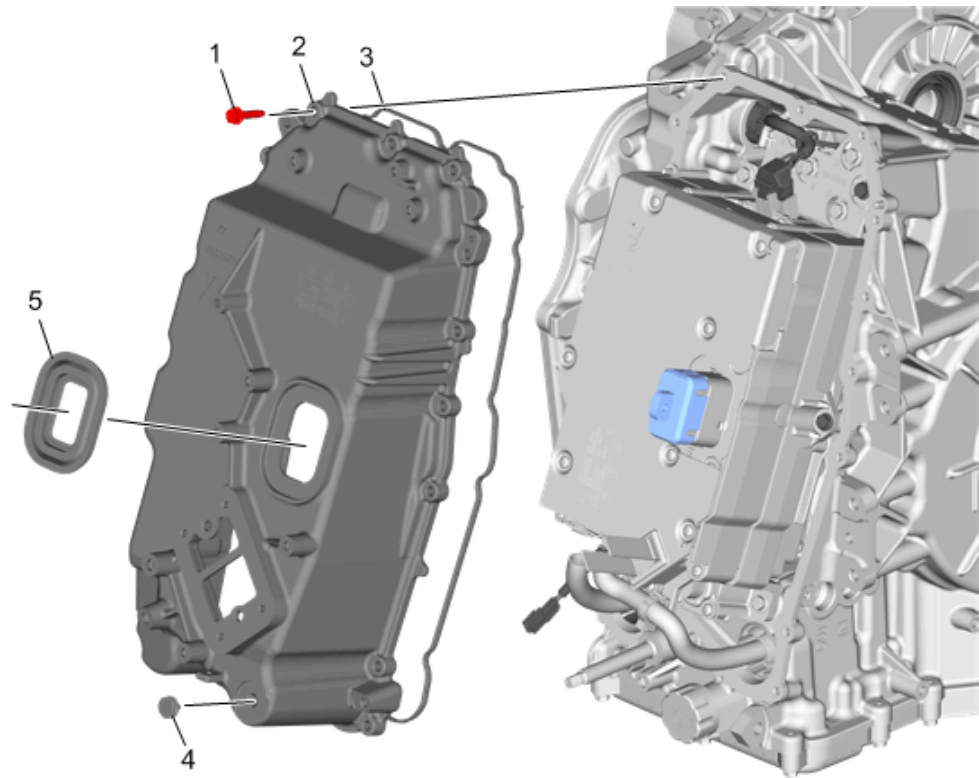


Fig. 45: Drive Motor Power Inverter Module Cover And Components

Courtesy of GENERAL MOTORS COMPANY

2. Install Drive Motor Power Inverter Module Cover (2). Refer to [Drive Motor Power Inverter Module Cover Replacement](#)
3. Program the power inverter module and the immobilizer control module. Refer to [Control Module References](#)

DRIVE MOTOR POWER INVERTER MODULE COVER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Set the parking brake.
2. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
3. Disable the high voltage system and disconnect the A4 Hybrid/EV Battery Pack high voltage harness connector at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#) .

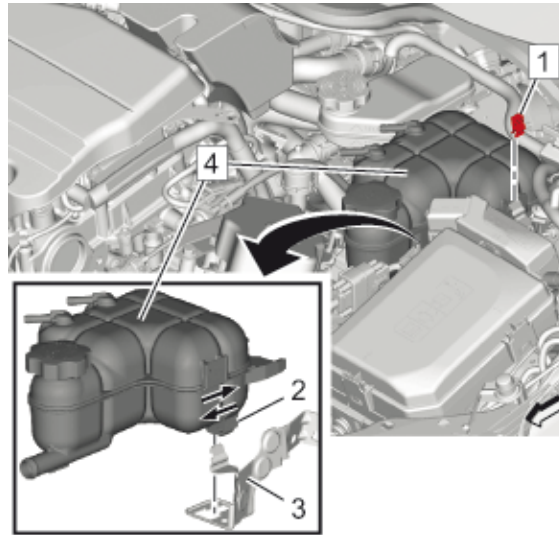


Fig. 46: Radiator Surge Tank, Bracket And Clips
Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Surge Tank Clip (1)

NOTE: To remove the radiator surge tank from the radiator surge tank bracket move it in driving direction.

5. Move the radiator surge tank (4) in arrow direction to release the radiator surge tank clip (2) from the radiator surge tank bracket (3).
6. Relocate the radiator surge tank out of the way of the Drive Motor Power Inverter Module Cover and secure with tie strap.

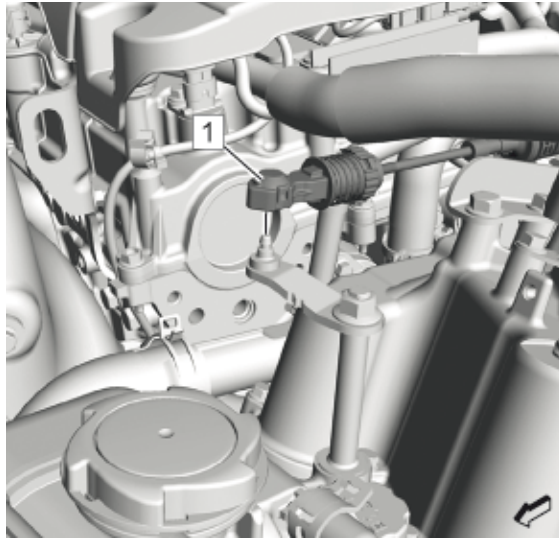


Fig. 47: Range Selector Lever Cable And Range Selector Lever Cable Lever
 Courtesy of GENERAL MOTORS COMPANY

7. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

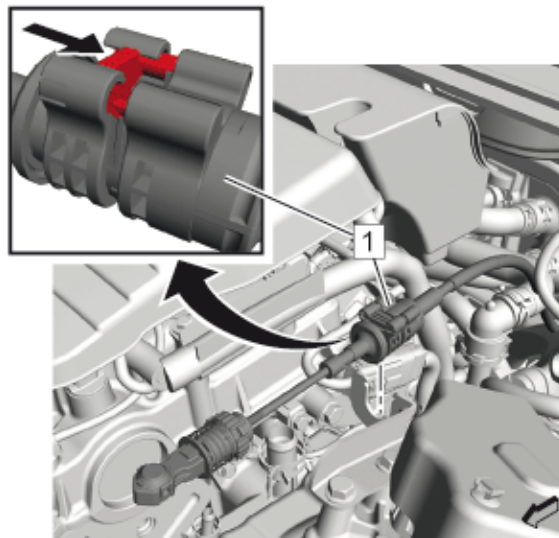


Fig. 48: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
 Courtesy of GENERAL MOTORS COMPANY

8. Remove the range selector lever cable (1) from the range selector lever cable bracket.

Release the cable from the bracket by pushing the retainer (arrow).

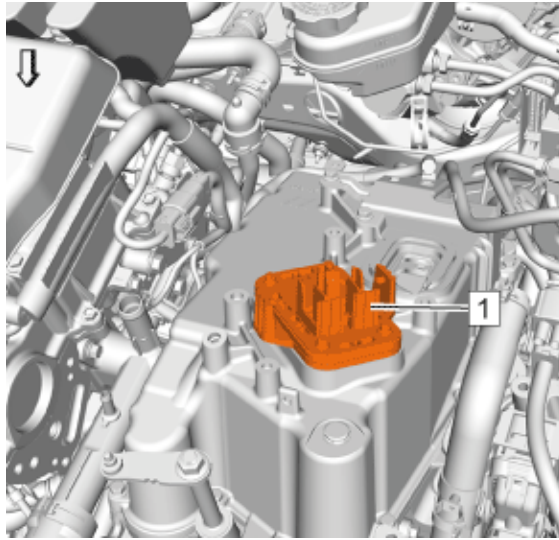


Fig. 49: Drive Motor Battery Positive And Negative Cable Connector

Courtesy of GENERAL MOTORS COMPANY

9. Place a shop towel over the drive motor battery positive and negative cable connector (1) to prevent coolant from entering the cover.
10. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
11. Remove Front Wheelhouse Liner. Refer to [Front Wheelhouse Liner Replacement \(Left Side\) Front Wheelhouse Liner Replacement \(Right Side\)](#)
12. Drain Drive Motor Generator Power Inverter Module Cooling System. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)

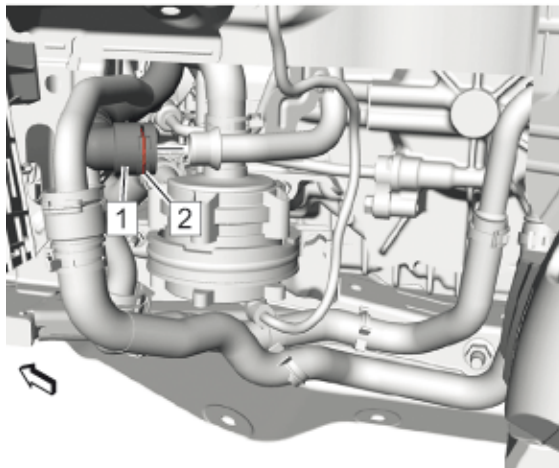


Fig. 50: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

NOTE: The following 2 steps are necessary to prevent contamination of other components while removing residual coolant with shop air.

13. Loosen Clamp (2)
14. Disconnect Drive Motor Generator Control Module Cooling Outlet Hose (1)

15. Lower the vehicle.

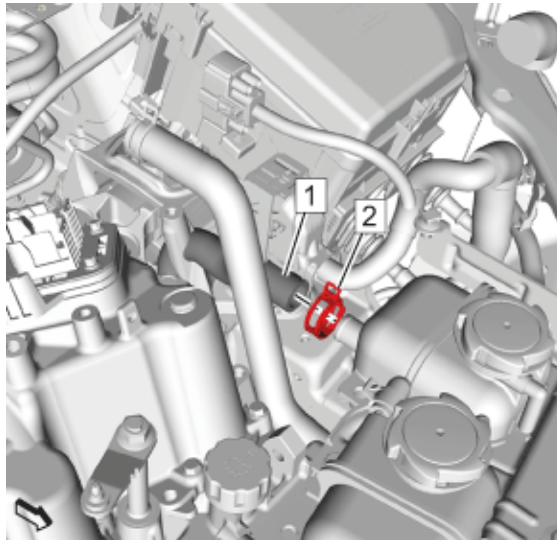


Fig. 51: Drive Motor Generator Power Inverter Module Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

16. Loosen the drive motor generator power inverter module outlet hose clamp (2), using the **BO-38185** pliers.
17. Remove the drive motor generator power inverter module outlet hose (1).
18. Using shop air, blow air through the drive motor power inverter module cooling outlet hose to remove residual coolant from the drive motor power inverter module.

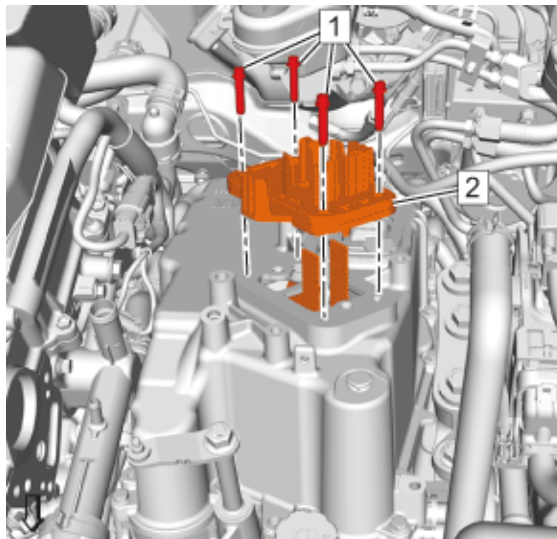


Fig. 52: Drive Motor Battery Positive And Negative Cable Connector And Bolts
Courtesy of GENERAL MOTORS COMPANY

19. Remove Drive Motor Battery Positive and Negative Cable Connector Bolts (1) (Qty: 4)
20. Remove Drive Motor Battery Positive and Negative Cable Connector (2)

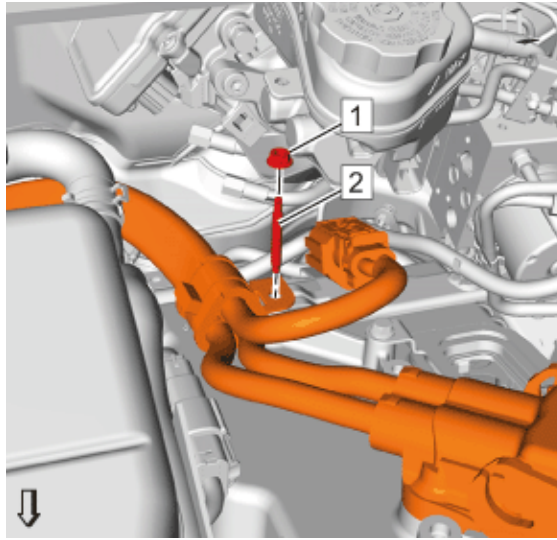


Fig. 53: Engine Wiring Harness Bracket Nut And Stud
 Courtesy of GENERAL MOTORS COMPANY

21. Remove Engine Wiring Harness Bracket Nut (1)
22. Remove the engine wiring harness stud (2).

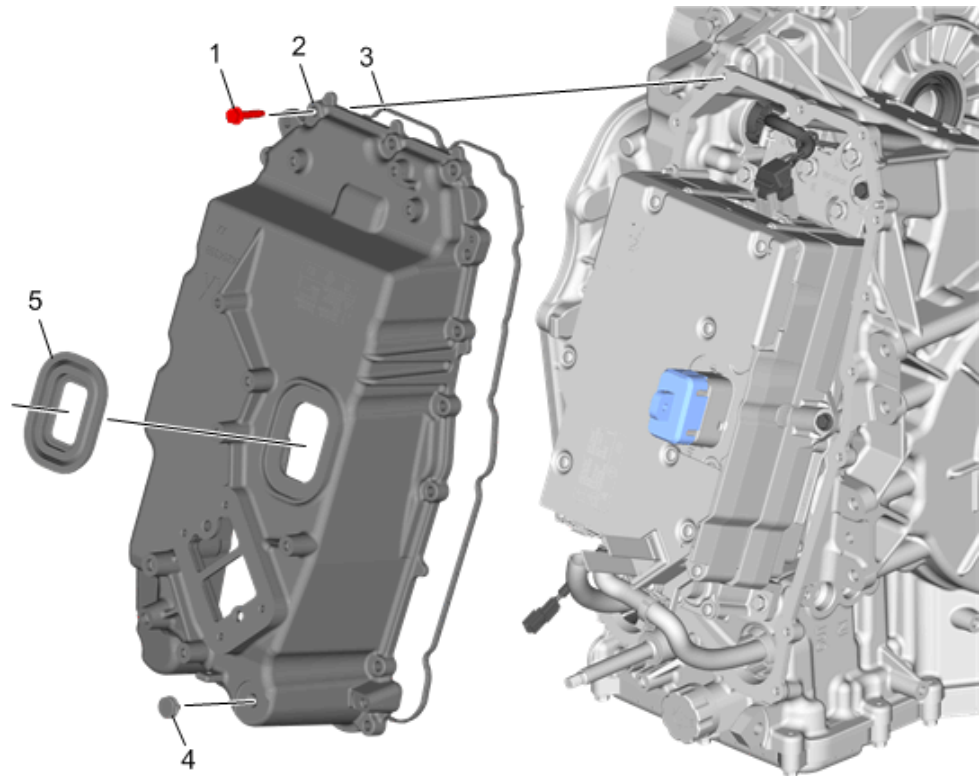


Fig. 54: Drive Motor Power Inverter Module Cover And Components
 Courtesy of GENERAL MOTORS COMPANY

23. Remove Drive Motor Power Inverter Module Cover (2). Refer to [Drive Motor Power Inverter Module Cover Removal](#)

Installation Procedure

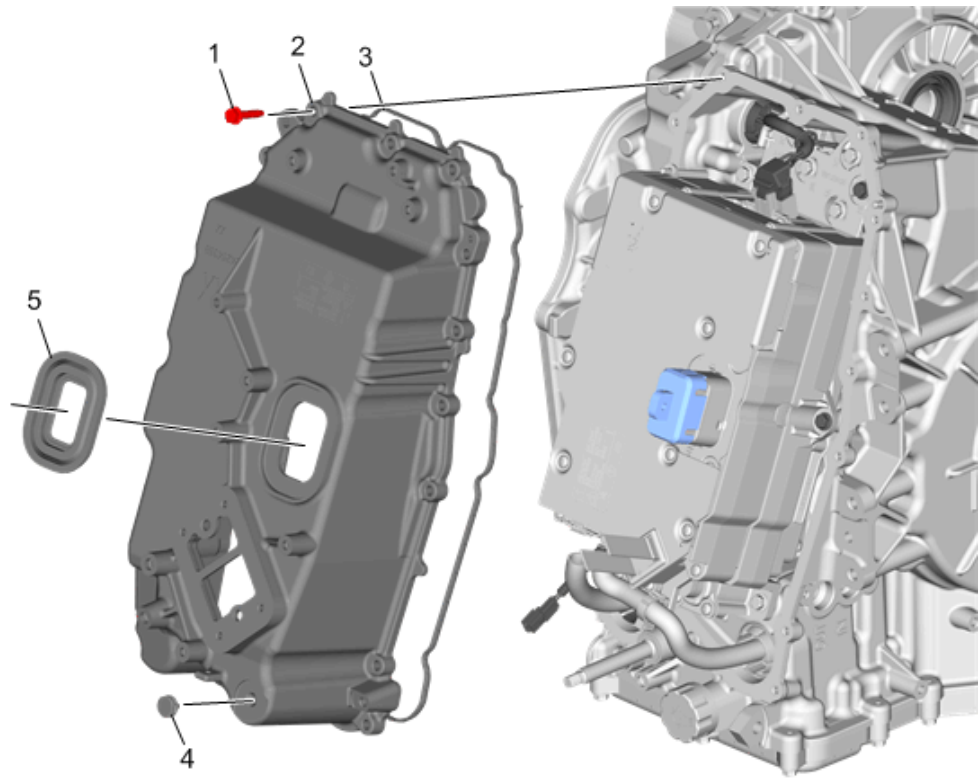


Fig. 55: Drive Motor Power Inverter Module Cover And Components
 Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module Cover (2). Refer to [Drive Motor Power Inverter Module Cover Installation](#)

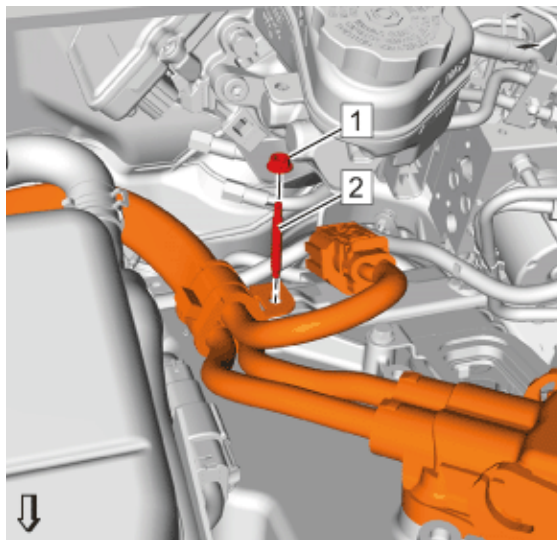


Fig. 56: Engine Wiring Harness Bracket Nut And Stud
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

2. Install the engine wiring harness stud (2) and tighten to 9 N.m (80 lb in).
3. Install and tighten Engine Wiring Harness Bracket Nut (1) to 9 N.m (80 lb in)

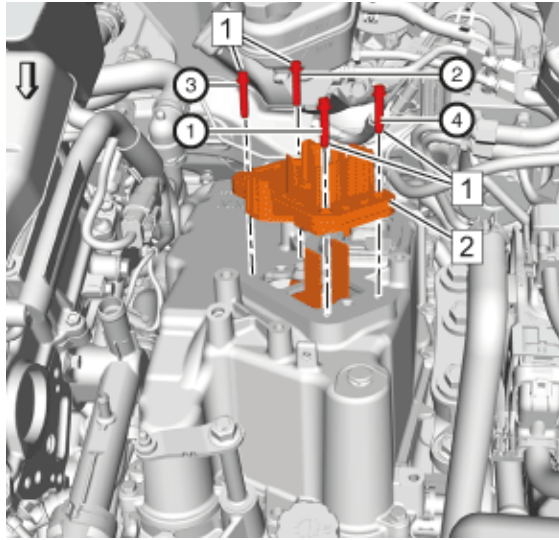


Fig. 57: Drive Motor Battery Positive And Negative Cable Connector And Bolts (With Bolt Tightening Sequence)

Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Positive and Negative Cable Connector (2)
5. Tighten Drive Motor Battery Positive and Negative Cable Connector Bolts (1) (Qty: 4) in sequence to 9 N.m (80 lb in)

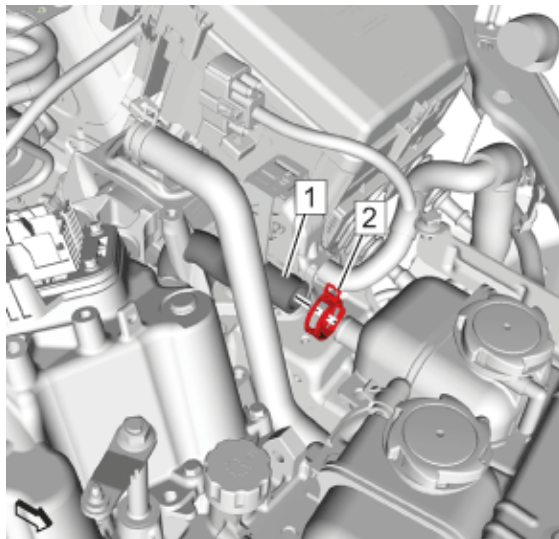


Fig. 58: Drive Motor Generator Power Inverter Module Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

6. Install the drive motor generator power inverter module outlet hose (1).
7. Install the drive motor generator power inverter module outlet hose clamp (2), using the **BO-38185** pliers.

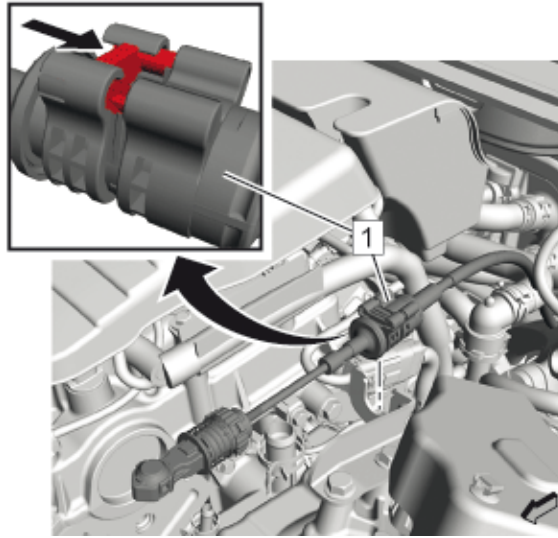


Fig. 59: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

8. Install the range selector lever cable (1) to the range selector lever cable bracket.

The retainer snaps automatically in.

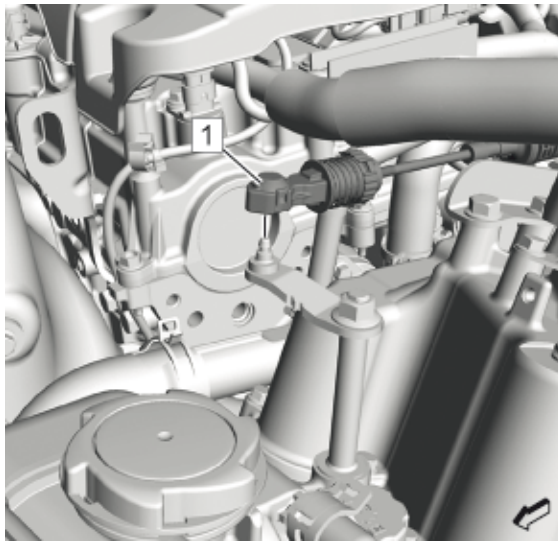


Fig. 60: Range Selector Lever Cable And Range Selector Lever Cable Lever
Courtesy of GENERAL MOTORS COMPANY

9. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever
10. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#)

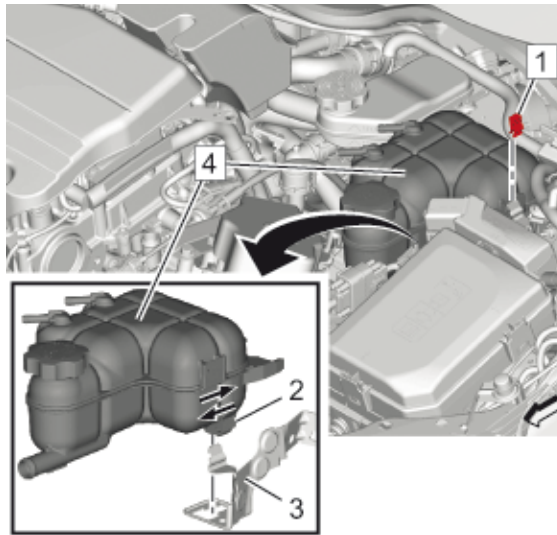


Fig. 61: Radiator Surge Tank, Bracket And Clips

Courtesy of GENERAL MOTORS COMPANY

11. Remove the tie strap holding the radiator surge tank.

NOTE: To install the radiator surge tank to the radiator surge tank bracket move it against driving direction.

12. Move the radiator surge tank (4) in arrow direction to clip in the radiator surge tank clip (2) into the radiator surge tank bracket (3).

13. Install Radiator Surge Tank Clip (1)

14. Raise the vehicle.

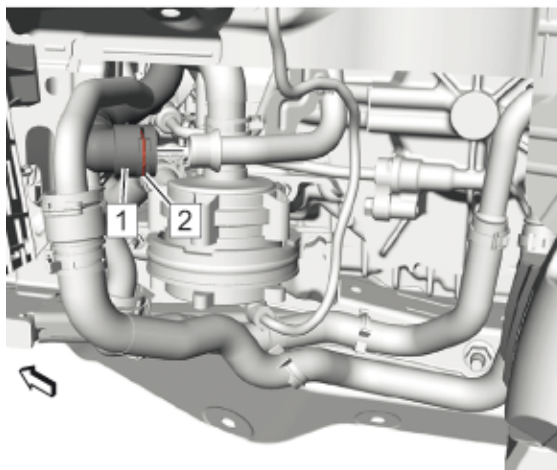


Fig. 62: Coolant Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

15. Connect Drive Motor Generator Control Module Cooling Outlet Hose (1)

16. Install Clamp (2)

17. Install Front Wheelhouse Liner. Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)

18. Fill Drive Motor Generator Power Inverter Module Cooling System. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
19. Lower the vehicle.
20. Enable the high voltage system and connect the A4 Hybrid/EV Battery Pack high voltage harness connector at the T6 Power Inverter Module. Refer to [High Voltage Enabling](#) .
21. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER REPLACEMENT

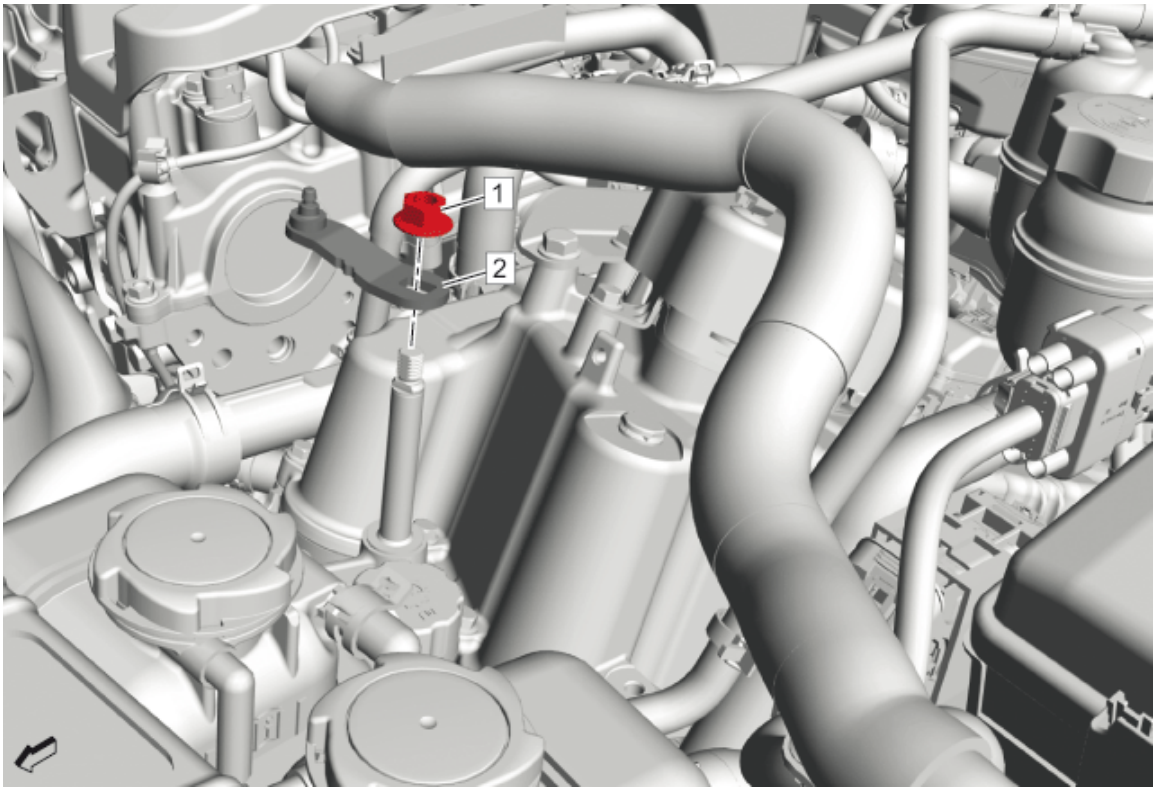


Fig. 63: Automatic Transmission Range Selector Lever
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Set the parking brake. WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections	

Callout	Component Name
	to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury. 2. Remove Range Selector Lever Cable @ Automatic Transmission Range Selector Lever. Refer to Range Selector Lever Cable Replacement
1	Transmission Range Selector Lever Nut WARNING: Hold the transmission range selector lever while removing or installing the lever retaining nut. Failure to hold the lever can cause damage to the transmission internal park system components which could allow the vehicle to

Callout	Component Name
	roll when placed in the park position. CAUTION: Refer to Fastener Caution Tighten 30 N.m (22 lb ft)
2	Automatic Transmission Range Selector Lever Procedure After the installation is complete perform a range selector lever cable adjustment. Refer to Range Selector Lever Cable Adjustment.

RANGE SELECTOR LEVER CABLE REPLACEMENT

Removal Procedure

1. Set the parking brake.

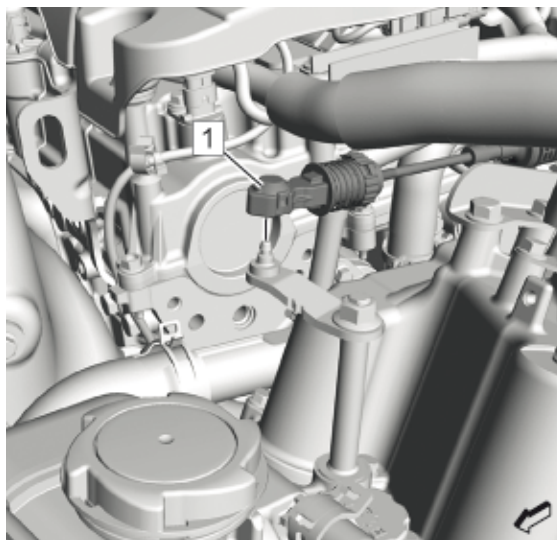


Fig. 64: Range Selector Lever Cable And Range Selector Lever Cable Lever
Courtesy of GENERAL MOTORS COMPANY

2. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

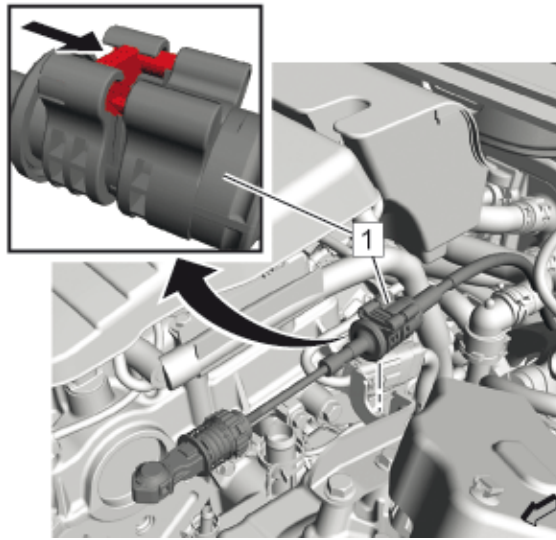


Fig. 65: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Remove the range selector lever cable (1) from the range selector lever cable bracket.

Release the cable from the bracket by pushing the retainer (arrow).

4. Remove Front Floor Console. Refer to [**Front Floor Console Replacement**](#)

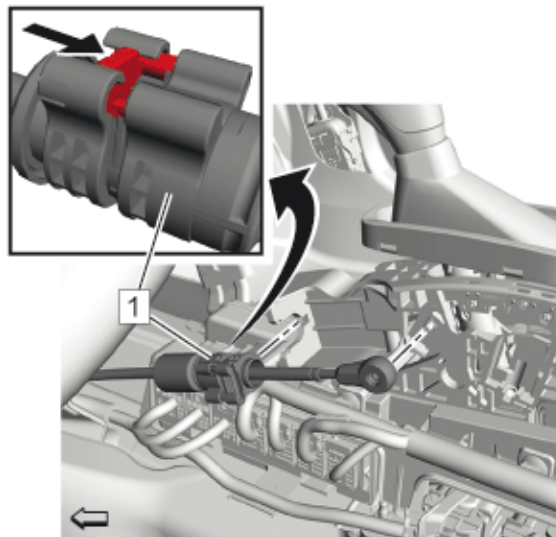


Fig. 66: Range Selector Lever Cable And Transmission Control
Courtesy of GENERAL MOTORS COMPANY

5. Remove the range selector lever cable (1) from the transmission control.

Release the cable from the bracket by pushing the retainer (arrow).

6. Note the routing of the range selector lever cable.

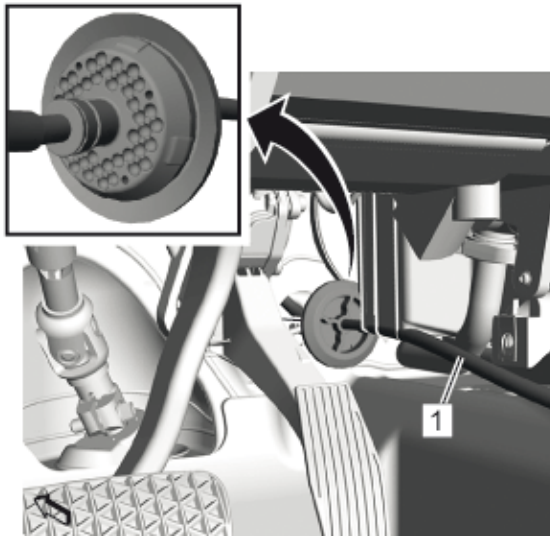


Fig. 67: Range Selector Lever Cable And Grommet
 Courtesy of GENERAL MOTORS COMPANY

7. Gently pry the grommet out, then remove the range selector lever cable (1) from the inside of the vehicle.

Installation Procedure

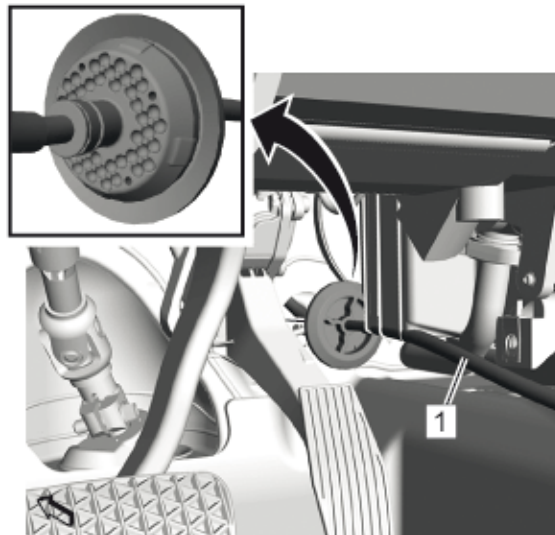


Fig. 68: Range Selector Lever Cable And Grommet
 Courtesy of GENERAL MOTORS COMPANY

1. Position the range selector lever cable in the vehicle.
2. Install the range selector lever cable grommet (1) into the panel.

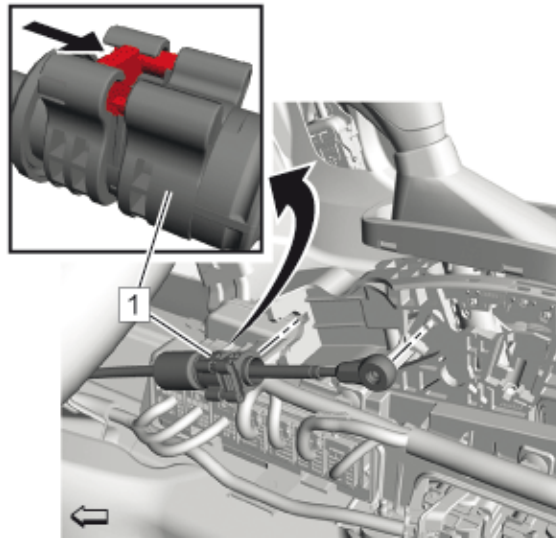


Fig. 69: Range Selector Lever Cable And Transmission Control
Courtesy of GENERAL MOTORS COMPANY

3. Install the range selector lever cable (1) to the transmission control.

The retainer snaps automatically in.

4. Install Front Floor Console. Refer to [Front Floor Console Replacement](#)

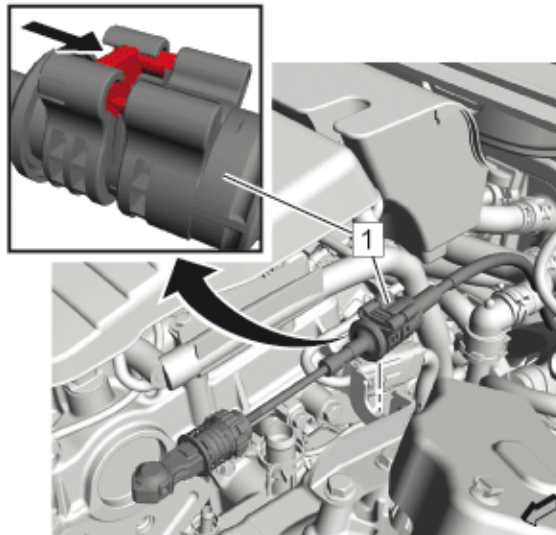


Fig. 70: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Install the range selector lever cable (1) to the range selector lever cable bracket.

The retainer snaps in automatically.

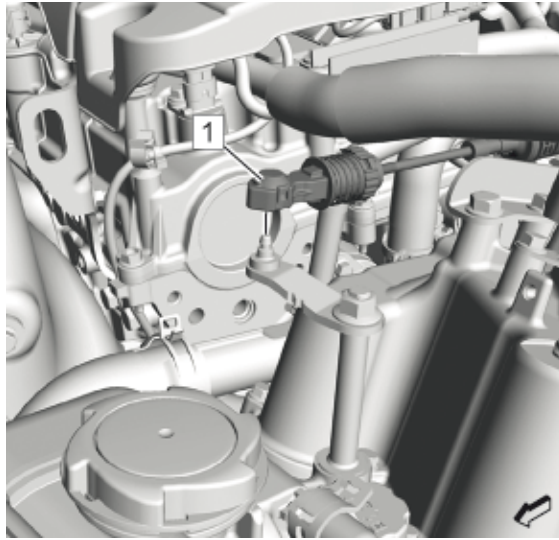


Fig. 71: Range Selector Lever Cable And Range Selector Lever Cable Lever
 Courtesy of GENERAL MOTORS COMPANY

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

6. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever
7. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#)

RANGE SELECTOR LEVER CABLE ADJUSTMENT

1. Set the parking brake.

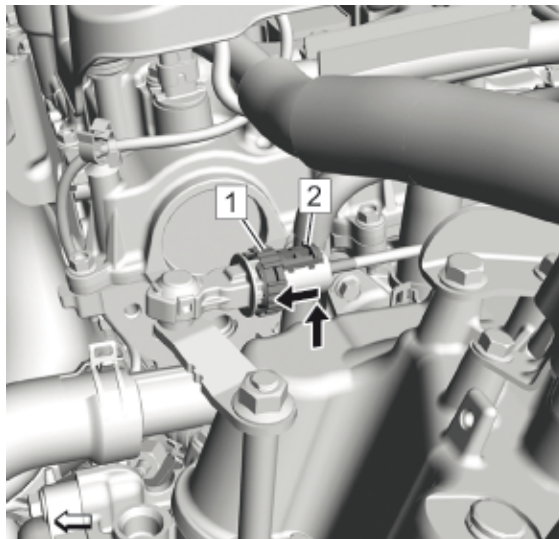


Fig. 72: Retaining Collar And Range Select Cable Adjuster Clip
 Courtesy of GENERAL MOTORS COMPANY

2. Pull the retaining collar (1) forward, then release the range select cable adjuster clip (2) by pushing out on the adjuster clip from the underneath.

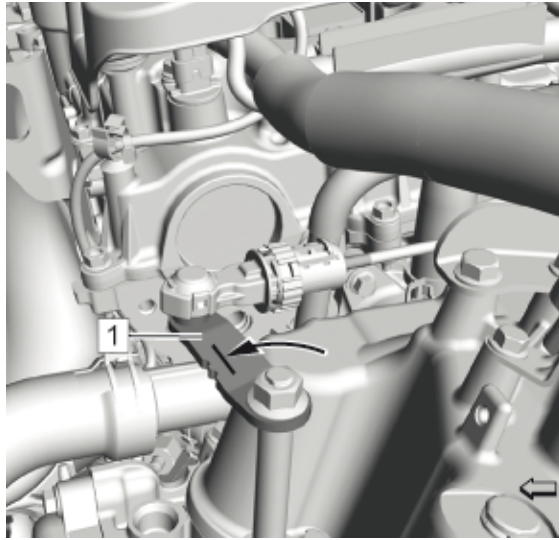


Fig. 73: Range Selector Lever

Courtesy of GENERAL MOTORS COMPANY

NOTE: Adjust the automatic transmission range selector lever cable while the transmission and the transmission control are in the Park position only. Failure to do so may cause false adjustment.

3. Verify the range selector lever (1) is in the park position.

Rotate the lever counterclockwise till the stop (arrow).



Fig. 74: Transmission Control Lever

Courtesy of GENERAL MOTORS COMPANY

NOTE: Adjust the automatic transmission range selector lever cable while the transmission and the transmission control are in the park position only. Failure to do so may cause false adjustment.

4. Verify the transmission control lever (1) is in the park position.

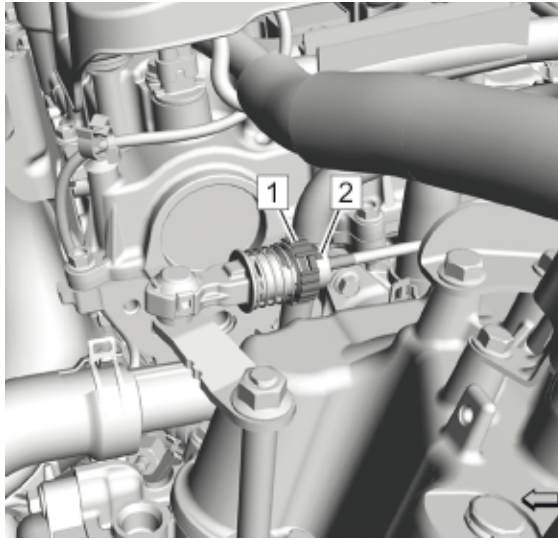


Fig. 75: Retaining Collar And Adjuster Clip

Courtesy of GENERAL MOTORS COMPANY

5. Depress the adjuster clip (2) locking the adjuster clip completely, then release the retaining collar (1).

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

6. Ensure that the cable adjuster is secured.
7. Check the transmission control lever in all gear selections for proper operation.

RANGE SELECTOR LEVER CABLE BRACKET REPLACEMENT

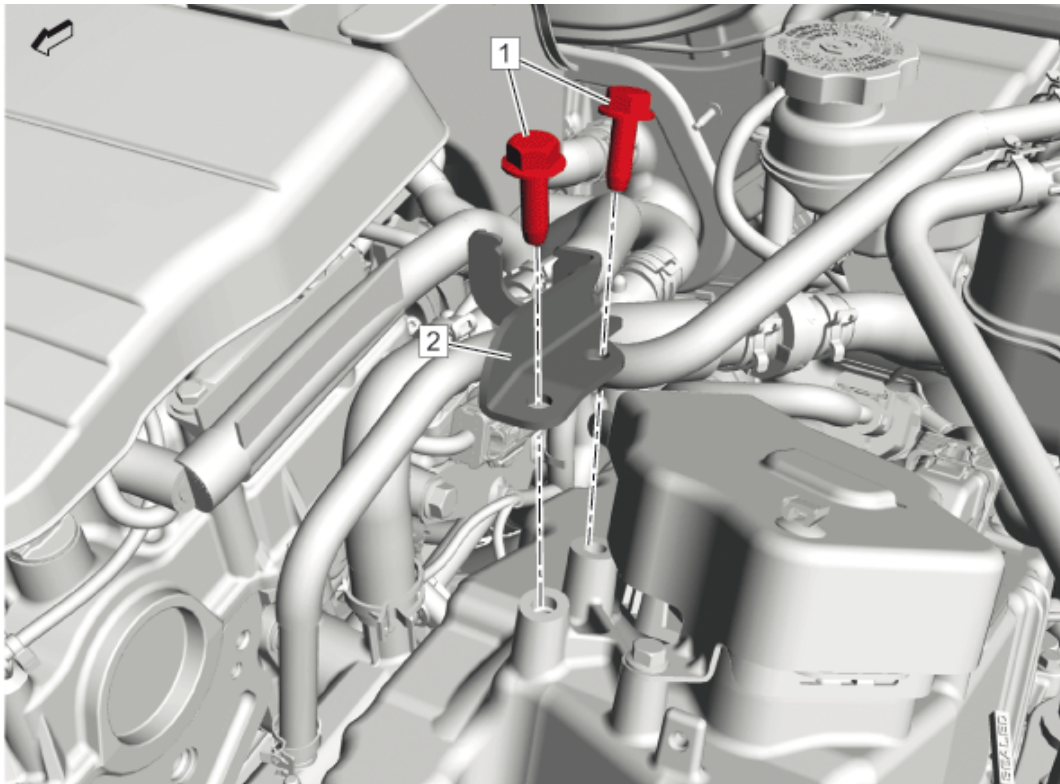


Fig. 76: Range Selector Lever Cable Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Transmission Range Selector Lever Cable @ Automatic Transmission Range Selector Lever & Transmission Range Selector Lever Cable Bracket. Refer to Range Selector Lever Cable Replacement	
1	Transmission Range Selector Lever Cable Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution Tighten 30 N.m (22 lb ft)
2	Transmission Range Selector Lever Cable Bracket Procedure After the installation is complete perform a range selector lever cable adjustment. Refer to Range Selector Lever Cable Adjustment .

TRANSMISSION FLUID DRAIN AND FILL

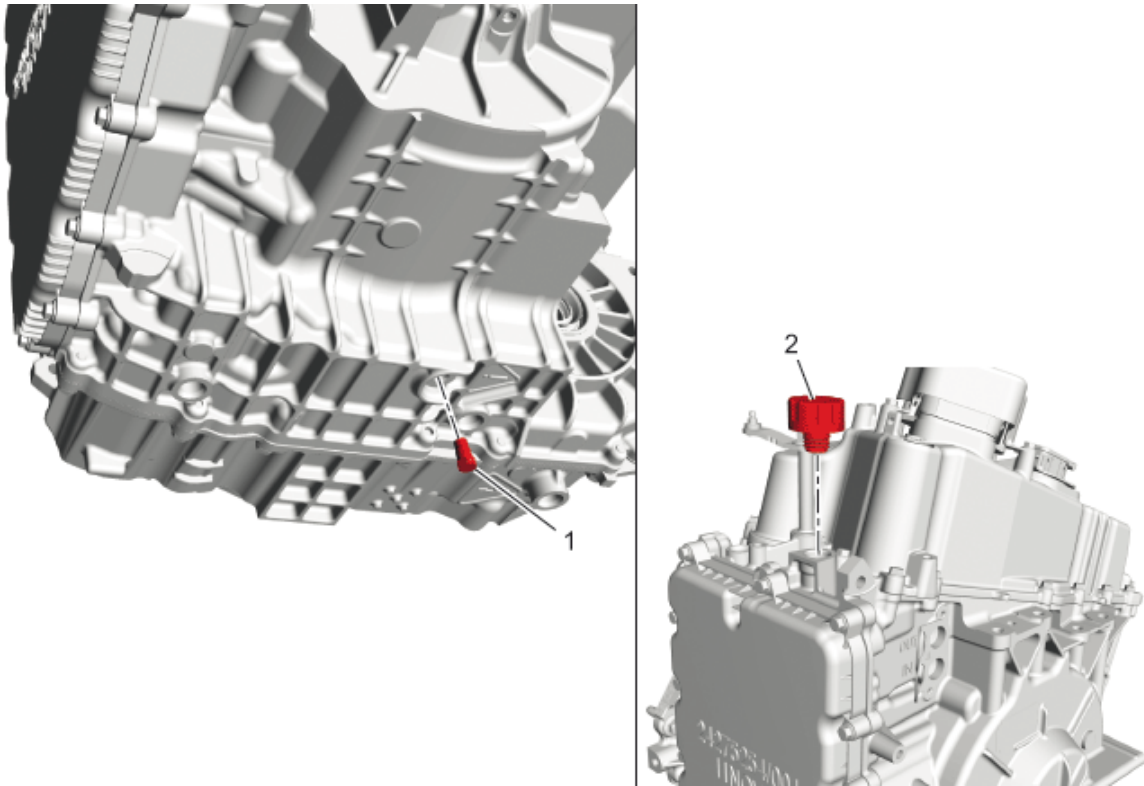


Fig. 77: Transmission Fluid Drain and Fill
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Compartment Splash Shield. Refer to Front Compartment Splash Shield Replacement	
1	Transmission Fluid Drain Plug CAUTION: Refer to Fastener Caution Tighten 11 N.m (97 lb in)
2	Transmission Fluid Filler Cap NOTE: • Transmission will require approximately 6.5 - 7 liters (7 - 7.4 quarts) of fluid. • Fill the transmission to the proper

Callout	Component Name
	level with NEW transmission fluid. Refer to: Transmission Fluid Level and Condition Check

AUTOMATIC TRANSMISSION FLUID PRESSURE TEST HOLE PLUG REPLACEMENT

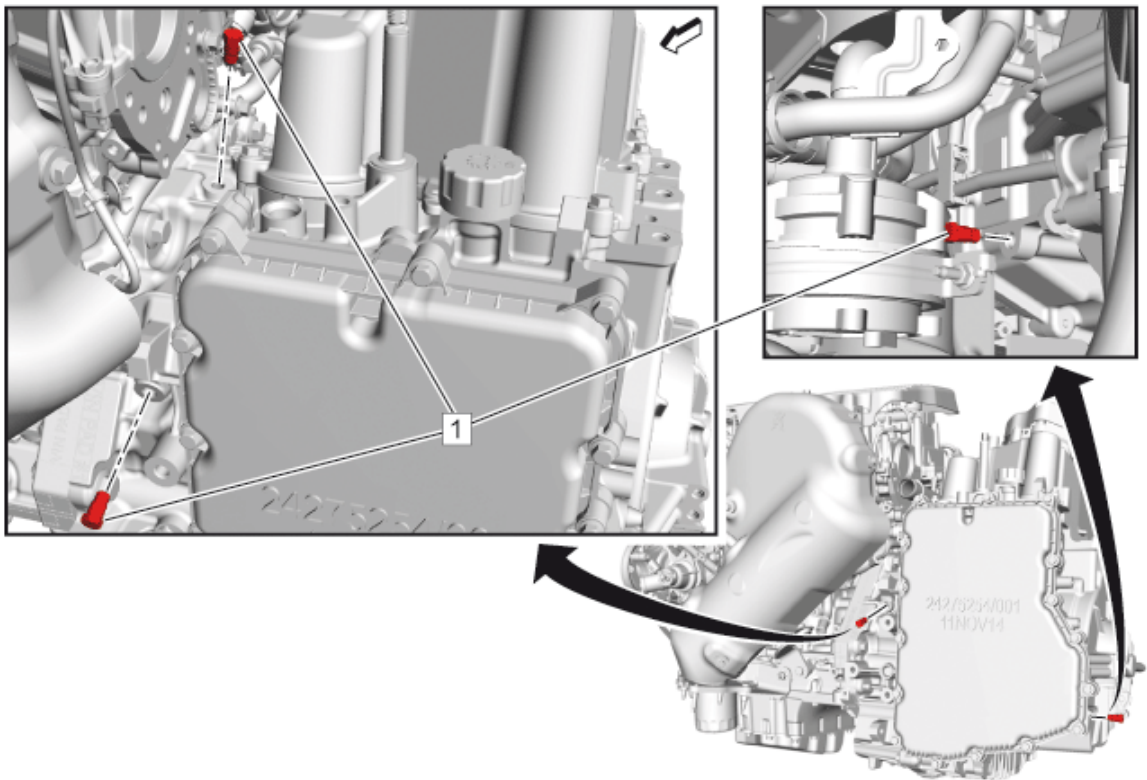


Fig. 78: Automatic Transmission Fluid Pressure Test Hole Plug
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Water Outlet. Refer to Water Outlet Replacement 2. Remove Front Underbody Air Deflector. Refer to Front Underbody Air Deflector Replacement 3. Remove Front Wheelhouse Liner (Left Side). Refer to Front Wheelhouse Liner Replacement (Left Side)	
1	Automatic Transmission Fluid Pressure Test Hole Plug (Qty: 3) CAUTION:

Callout	Component Name
	Refer to Fastener Caution Tighten 11 N.m (97 lb in)

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - LEFT SIDE

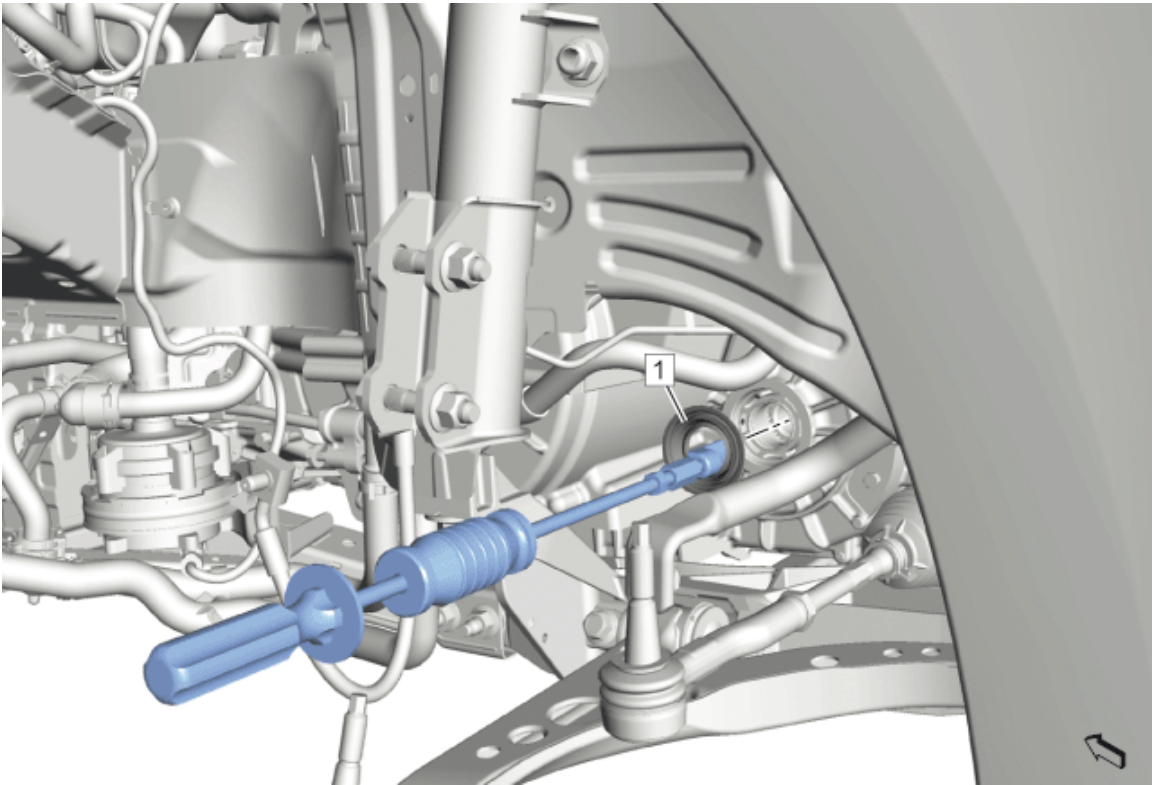


Fig. 79: Front Wheel Drive Shaft Seal - Left Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Wheel Drive Shaft - Left Side. Refer to Front Wheel Drive Shaft Replacement	
1	Front Wheel Drive Shaft Seal Procedure Push the steering knuckle aside. NOTE: • For pushing the steering knuckle aside a 2nd

Callout	Component Name
	technician is required. • For seal removal use GE-6125-1B Slide Hammer with Adapter. with GE-23129 Universal Seal Remover. • For seal installation use GE-8092 Driver Handle with DT-50301 Seal Installer. Special Tools • DT-50301 Seal Installer • GE-6125-1B Slide Hammer with Adapter • GE-8092 Driver Handle • GE-23129 Universal Seal Remover Equivalent regional tools: Special Tools

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - RIGHT SIDE

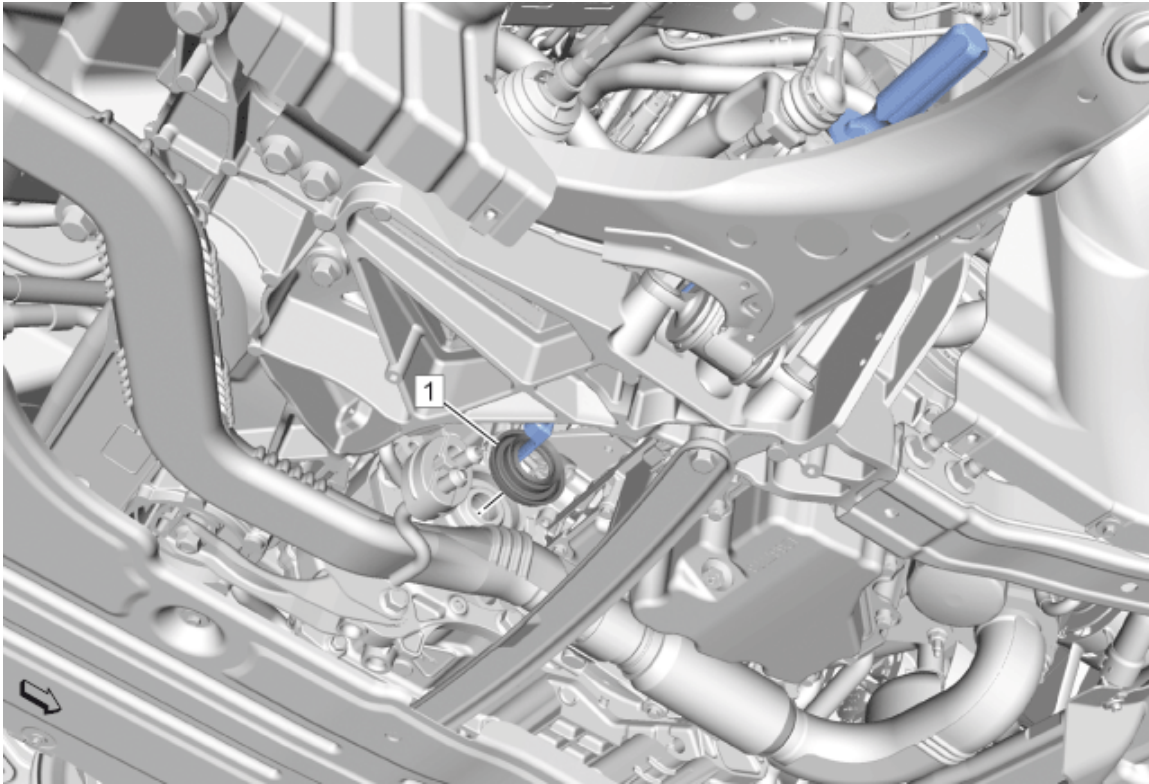


Fig. 80: Front Wheel Drive Shaft Seal - Right Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Front Compartment Air Deflector. Refer to Front Compartment Air Deflector Replacement 2. Remove Front Wheel Drive Shaft - Right Side. Refer to Front Wheel Drive Shaft Replacement	
1	Front Wheel Drive Shaft Seal NOTE: • For seal removal use GE-6125-1B Slide Hammer with Adapter. with GE-23129 Universal Seal Remover. • For seal installation use

Callout	Component Name
	GE-8092 Driver Handle with DT-50301 Seal Installer. Special Tools • DT-50301 Seal Installer • GE-6125-1B Slide Hammer with Adapter • GE-8092 Driver Handle • GE-23129 Universal Seal Remover Equivalent regional tools: Special Tools

MANUAL SHIFT SHAFT SEAL REPLACEMENT

Removal Procedure

1. Set the parking brake.
2. Remove Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)
3. Remove Manual Shift Shaft Seal

Installation Procedure

1. Install Manual Shift Shaft Seal
2. Install Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)

MANUAL SHIFT SHAFT AND SEAL REPLACEMENT

Special Tools

- **DT-45201** Seal Remover
- **DT-51672** Seal Installer

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Set the parking brake.
2. Remove Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)
3. Remove Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)

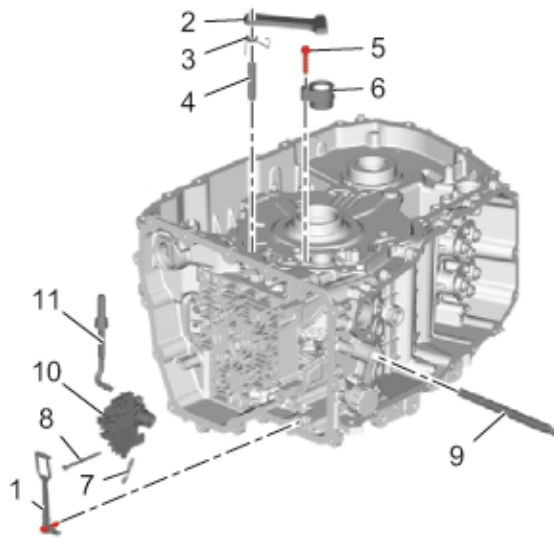


Fig. 81: Manual Shift Detent Lever Pin And Shaft

Courtesy of GENERAL MOTORS COMPANY

4. Remove Manual Shift Detent Lever Pin (7). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal](#)
5. Remove Manual Shift Detent Lever Shaft (9). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal](#)

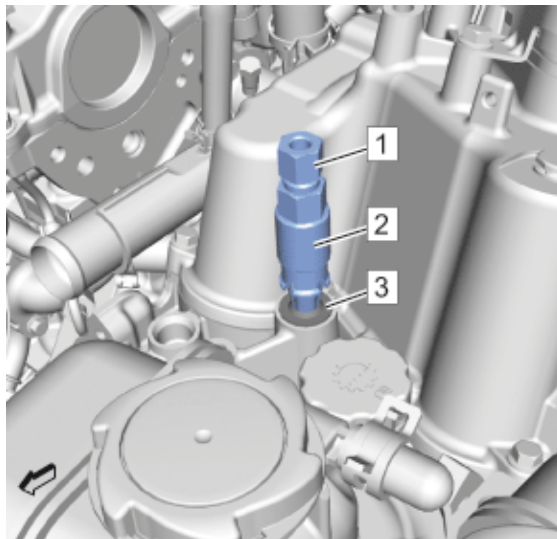


Fig. 82: Manual Shift Shaft Seal And Removal Tools

Courtesy of GENERAL MOTORS COMPANY

6. Install the **DT-45201** remover intermediate part (2) to the manual shift shaft seal (3)
7. Install the **DT-45201** remover inner part (1) to the intermediate part and tighten carefully.

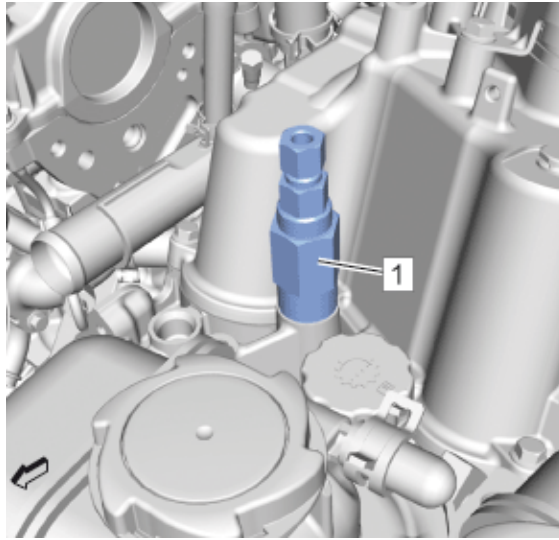


Fig. 83: Removal Tool Outer Part

Courtesy of GENERAL MOTORS COMPANY

8. Install the **DT-45201** remover outer part (1) to the **DT-45201** remover and tighten carefully in order to pull out the manual shift shaft seal.

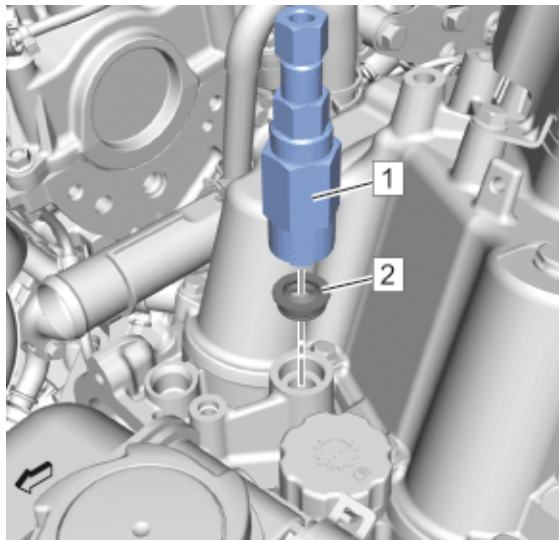


Fig. 84: Manual Shift Shaft Seal And Removal Tool Outer Part

Courtesy of GENERAL MOTORS COMPANY

9. Remove the **DT-45201** remover (1) along with the manual shift shaft seal (2).
10. Remove Manual Shift Shaft Seal @ **DT-45201** remover.

Installation Procedure

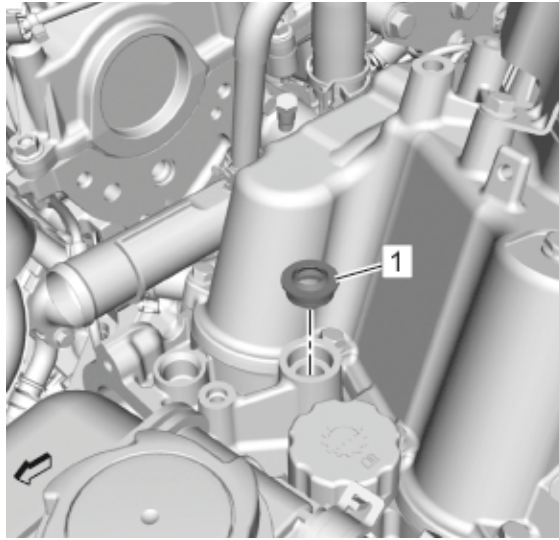


Fig. 85: Manual Shift Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

1. Install Manual Shift Shaft Seal (1) using **DT-51672** installer

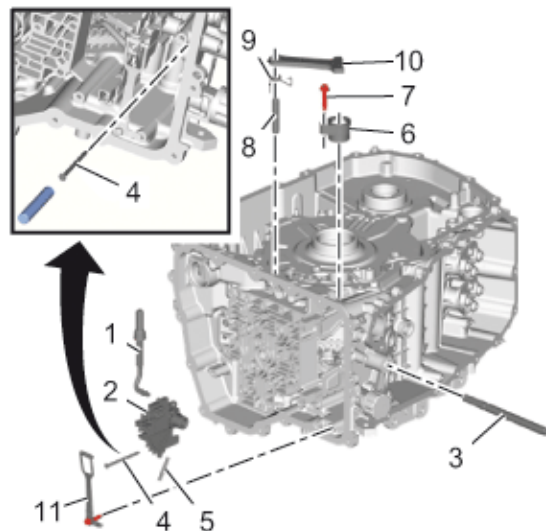


Fig. 86: Manual Shift Detent Lever Shaft And Pin

Courtesy of GENERAL MOTORS COMPANY

2. Install Manual Shift Detent Lever Shaft (3). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation](#)
3. Install Manual Shift Detent Lever Pin (5). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation](#)
4. Install Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)
5. Install Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)

MANUAL SHIFT DETENT LEVER SHAFT REPLACEMENT

Removal Procedure

1. Set the parking brake.

3. Install Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)
4. Install Range Selector Lever Cable @ Automatic Transmission Range Selector Lever. Refer to [Range Selector Lever Cable Replacement](#)
5. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#) - Adjust

MANUAL SHIFT SHAFT AND MANUAL SHIFT DETENT LEVER REPLACEMENT

Removal Procedure

1. Set the parking brake.
2. Remove Range Selector Lever Cable @ Automatic Transmission Range Selector Lever. Refer to [Range Selector Lever Cable Replacement](#)
3. Remove Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)
4. Remove Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)

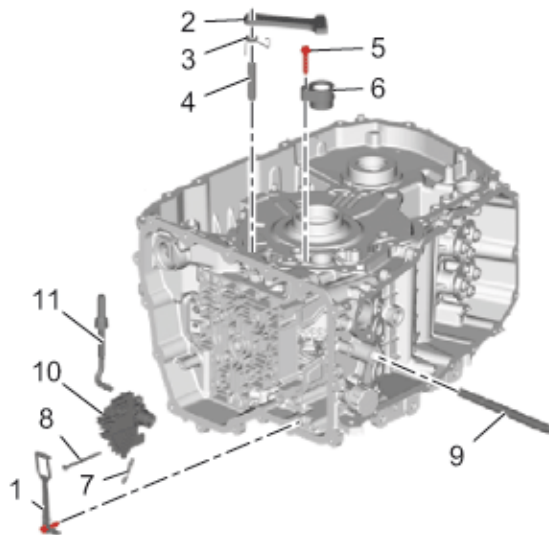


Fig. 89: Manual Shift Detent Lever Pin And Shaft

Courtesy of GENERAL MOTORS COMPANY

5. Remove the manual shift detent lever pin (7) and the manual shift detent lever shaft (9). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal](#).

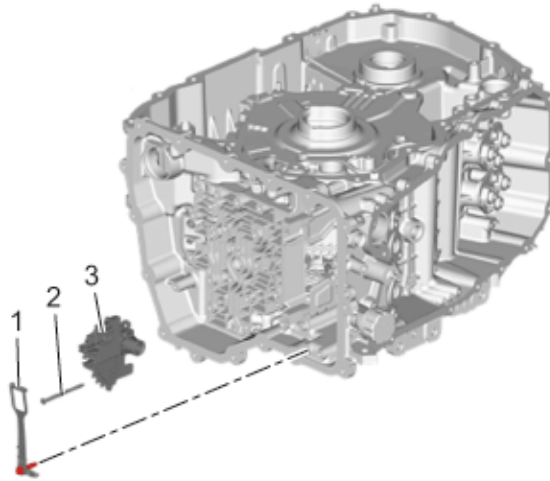


Fig. 90: Manual Shift Detent Lever, Spring And Manual Shift Shaft Pin
Courtesy of GENERAL MOTORS COMPANY

6. Remove Manual Shift Detent Lever Spring (1)
7. Remove Manual Shift Shaft Pin (2)
8. Remove Manual Shift Detent Lever (3)

Installation Procedure

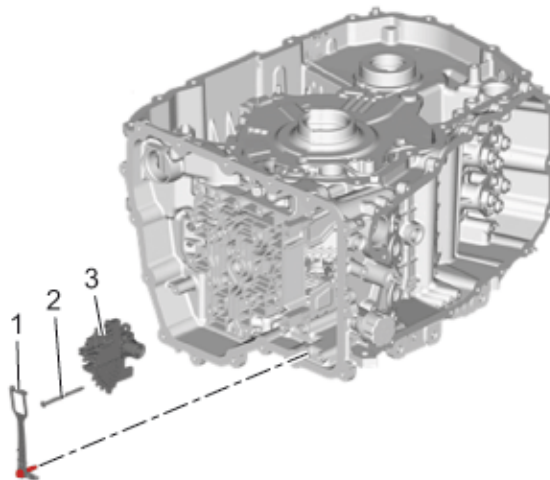


Fig. 91: Manual Shift Detent Lever, Spring And Manual Shift Shaft Pin
Courtesy of GENERAL MOTORS COMPANY

1. Install Manual Shift Detent Lever (3)
2. Install Manual Shift Shaft Pin (2)
3. Install and tighten Manual Shift Detent Lever Spring (1) to 12 N.m (106 lb in)

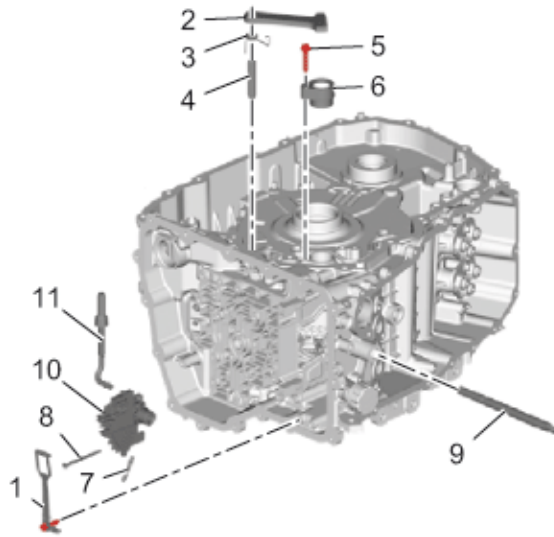


Fig. 92: Manual Shift Detent Lever Pin And Shaft

Courtesy of GENERAL MOTORS COMPANY

4. Install the manual shift detent lever pin (7) and the manual shift detent lever shaft (9). Refer to [Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation](#).
5. Install Manual Shift Detent Lever Pin
6. Install Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)
7. Install Automatic Transmission Range Selector Lever. Refer to [Automatic Transmission Range Selector Lever Replacement](#)
8. Install Range Selector Lever Cable @ Automatic Transmission Range Selector Lever. Refer to [Range Selector Lever Cable Replacement](#)
9. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#)

CONTROL VALVE BODY COVER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Drain Engine Cooling System. Refer to [Cooling System Draining and Filling](#)
2. Remove Radiator Inlet Hose. Refer to [Radiator Inlet Hose Replacement](#)
3. Remove Radiator Surge Tank (Drive Motor Battery Radiator Surge Tank). Refer to [Radiator Surge Tank Replacement \(Drive Motor Battery Radiator Surge Tank\)](#)
4. Remove Radiator Surge Tank (Drive Motor Generator Power Inverter Module Surge Tank). Refer to [Radiator Surge Tank Replacement \(Drive Motor Generator Power Inverter Module Surge Tank\)](#)

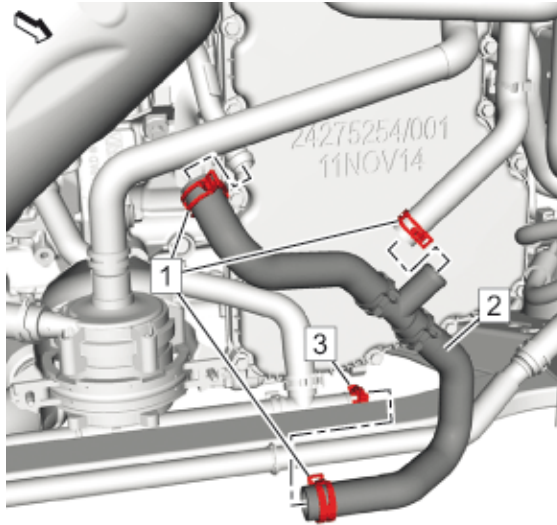


Fig. 93: Radiator Inlet Hose, Hose Clamps And Retainer
 Courtesy of GENERAL MOTORS COMPANY

5. Loosen Radiator Inlet Hose Clamps (1) (Qty: 3) using **BO-38185** pliers
6. Disconnect Retainer (3)
7. Remove Radiator Inlet Hose (2)

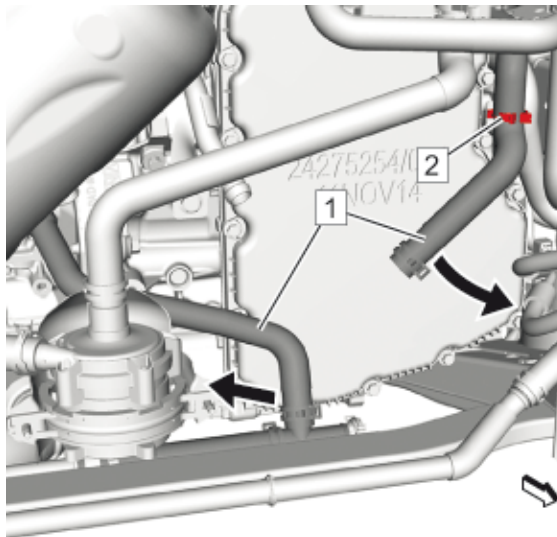


Fig. 94: Radiator Inlet Hoses And Retainer
 Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Retainer (2)
9. Position the 2 radiator inlet hoses (1) aside to gain access.

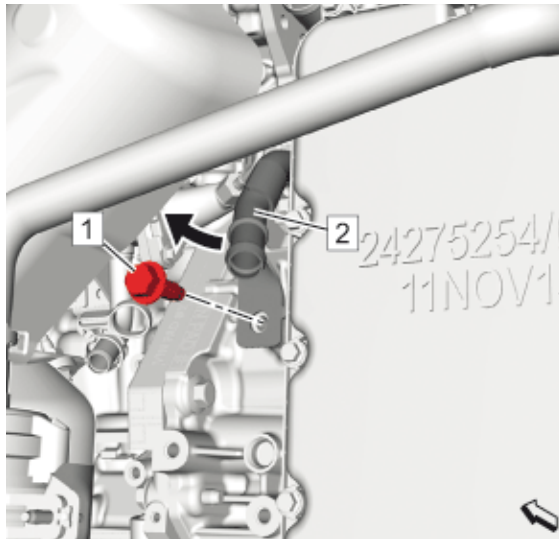


Fig. 95: Heater Water Shutoff Valve Inlet Hose And Bolt

Courtesy of GENERAL MOTORS COMPANY

10. Remove Heater Water Shutoff Valve Inlet Hose Bolt (1)
11. Position the heater water shutoff inlet hose (2) aside to gain access.
12. Drain the transmission fluid. Refer to [Transmission Fluid Drain and Fill](#)
13. Remove the front wheelhouse liner - left side. Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#)

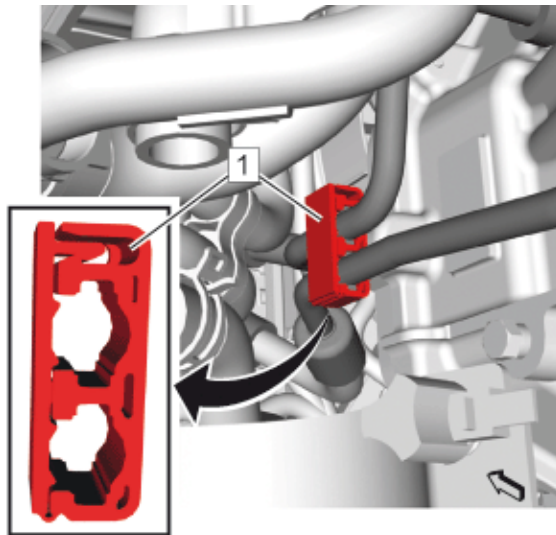


Fig. 96: Transmission Fluid Cooler Inlet And Outlet Pipe Clip

Courtesy of GENERAL MOTORS COMPANY

14. Remove Transmission Fluid Cooler Inlet and Outlet Pipe Clip (1)

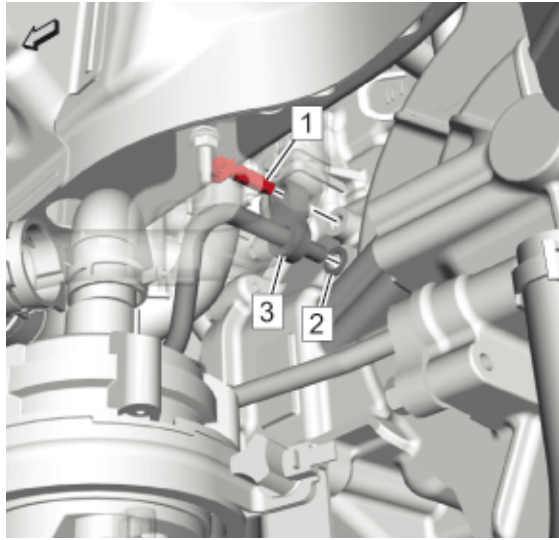


Fig. 97: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

15. Remove Transmission Fluid Cooler Pipe Bolt (1)
16. Disconnect Transmission Fluid Cooler Inlet Pipe (3)
17. Remove and DISCARD Sealing Washer (2)
18. Position the transmission fluid cooler inlet pipe aside to gain access to the control valve body cover bolts.

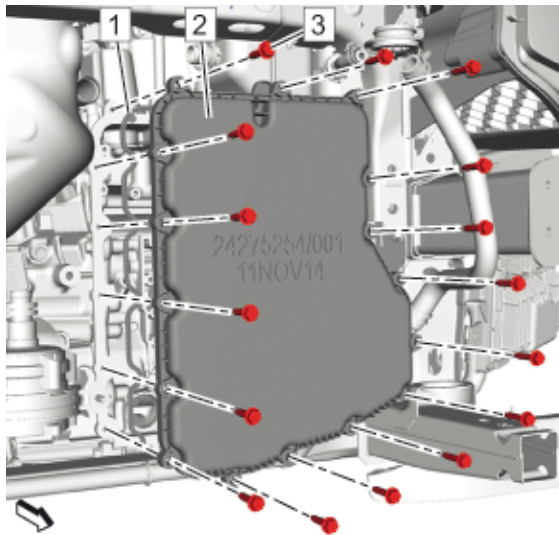


Fig. 98: Control Valve Body Cover, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

19. Place a container beneath the control valve body cover (2) to catch spilling transmission fluid.
20. Remove Control Valve Body Cover Bolts (3) (Qty: 16)
21. Remove Control Valve Body Cover (2)

NOTE: The gasket is reusable, inspect the gasket and replace if damaged.

22. Remove Control Valve Body Cover Gasket (1)

Installation Procedure

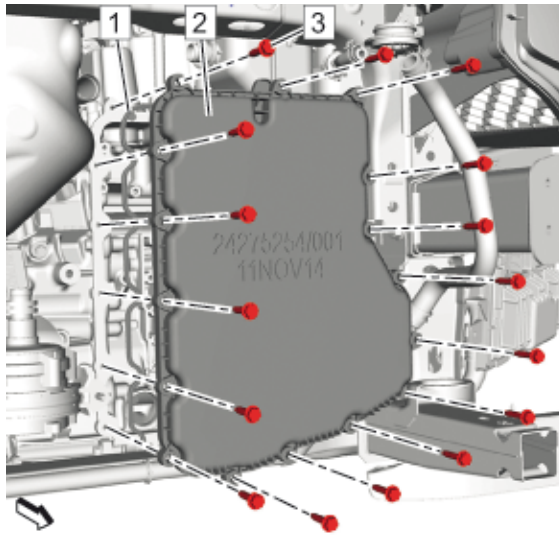


Fig. 99: Control Valve Body Cover, Bolts And Gasket

Courtesy of GENERAL MOTORS COMPANY

NOTE: The gasket is reusable, inspect the gasket and replace if damaged.

1. Install Control Valve Body Cover Gasket (1)
2. Install Control Valve Body Cover (2)

CAUTION: Refer to [Fastener Caution](#)

3. Install Control Valve Body Cover Bolts (3) (Qty: 16) and Hand tighten only.

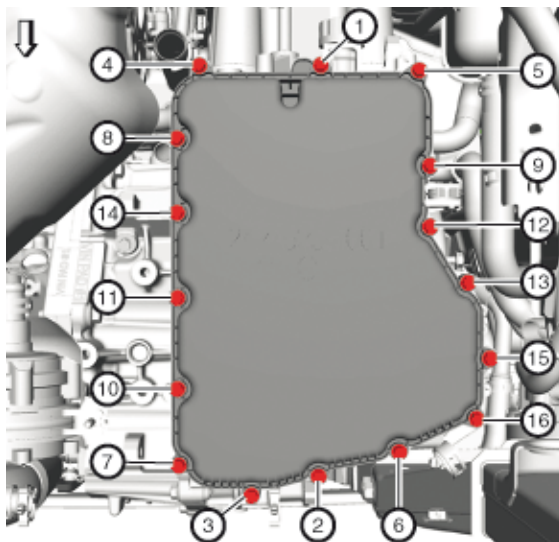


Fig. 100: Control Valve Body Cover Bolts Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

4. Tighten Control Valve Body Cover Bolts in sequence (Qty: 16) to 9 N.m (80 lb in)

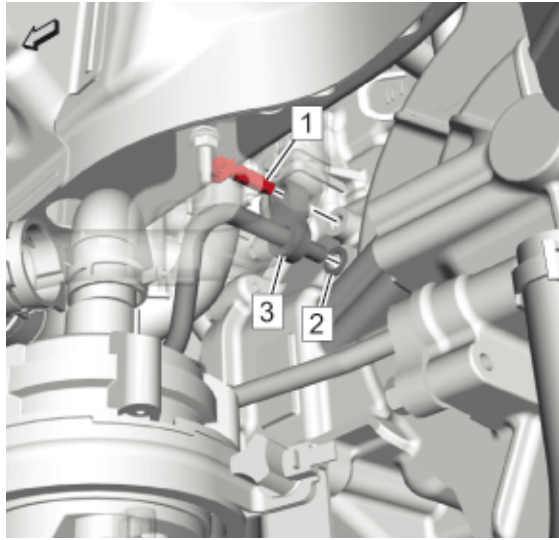


Fig. 101: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

5. Reposition Transmission Fluid Cooler Inlet Pipe (3)
6. Install a NEW sealing washer (2).
7. Connect Transmission Fluid Cooler Inlet Pipe (3)
8. Install and tighten Transmission Fluid Cooler Pipe Bolt (1) to 22 N.m (16 lb ft)

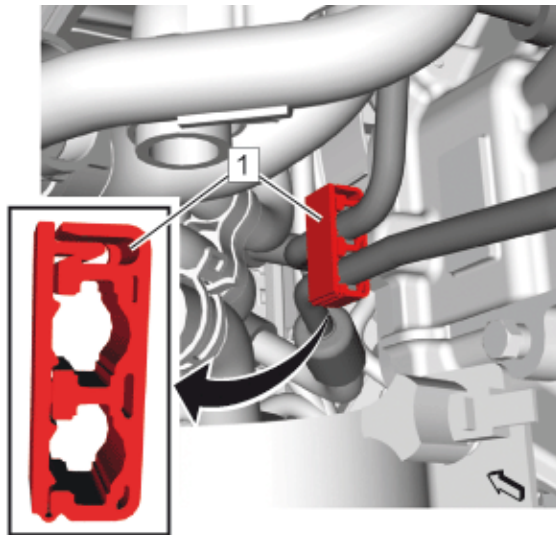


Fig. 102: Transmission Fluid Cooler Inlet And Outlet Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

9. Install Transmission Fluid Cooler Inlet and Outlet Pipe Clip (1)
10. Install the front wheelhouse liner - left side. Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#)

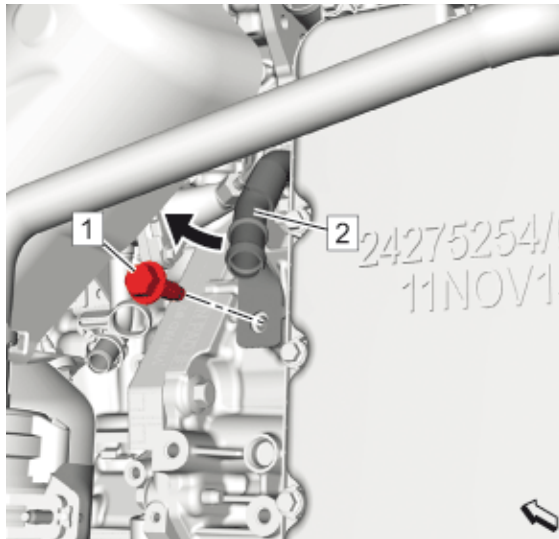


Fig. 103: Heater Water Shutoff Valve Inlet Hose And Bolt

Courtesy of GENERAL MOTORS COMPANY

11. Position the heater water shutoff inlet hose (2) into original position.
12. Install and tighten Heater Water Shutoff Valve Inlet Hose Bolt (1) to 22 N.m (16 lb ft)

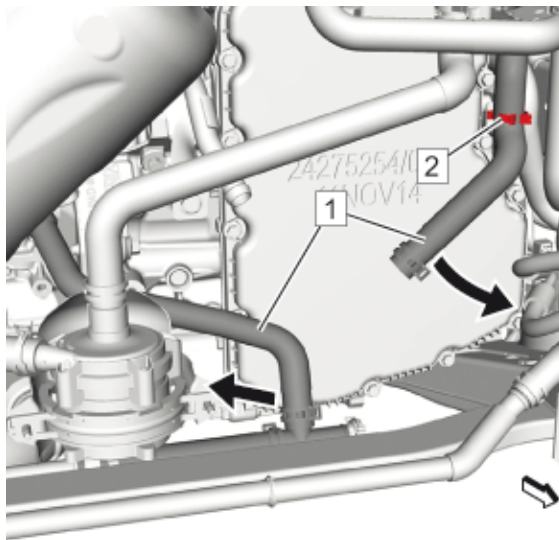


Fig. 104: Radiator Inlet Hoses And Retainer

Courtesy of GENERAL MOTORS COMPANY

13. Position the 2 radiator inlet hoses (1) into original position.
14. Connect Retainer (2)

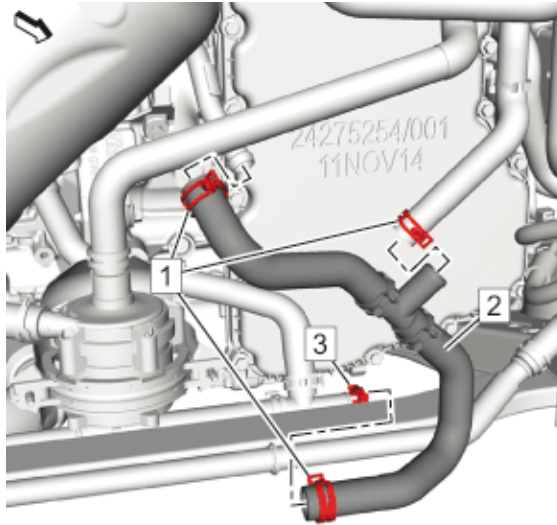


Fig. 105: Radiator Inlet Hose, Hose Clamps And Retainer
Courtesy of GENERAL MOTORS COMPANY

15. Install Radiator Inlet Hose (2)
16. Connect Retainer (3)
17. Tighten Radiator Inlet Hose Clamps (1) (Qty: 3) using **BO-38185** pliers
18. Install Radiator Surge Tank (Drive Motor Generator Power Inverter Module Surge Tank). Refer to [Radiator Surge Tank Replacement \(Drive Motor Generator Power Inverter Module Surge Tank\)](#)
19. Install Radiator Surge Tank (Drive Motor Battery Radiator Surge Tank). Refer to [Radiator Surge Tank Replacement \(Drive Motor Battery Radiator Surge Tank\)](#)
20. Install Radiator Inlet Hose. Refer to [Radiator Inlet Hose Replacement](#)
21. Fill Engine Cooling System. Refer to [Cooling System Draining and Filling](#)
22. Fill the transmission to the proper level with NEW transmission fluid. Refer to [Transmission Fluid Level and Condition Check](#)

CONTROL VALVE BODY REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)

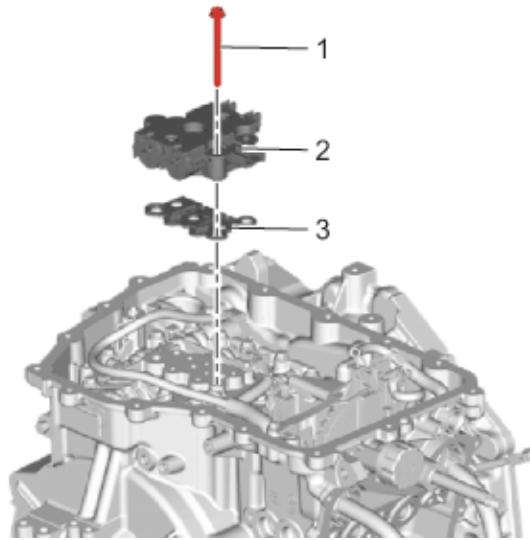


Fig. 106: Control Valve Body Bolts, Control Solenoid Valve And Filter Plate
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the control solenoid valve wiring harness.
3. Remove Control Valve Body Bolts (1) (Qty: 4)
4. Remove Control Solenoid Valve (2)
5. Remove Control Solenoid Valve Filter Plate (3)

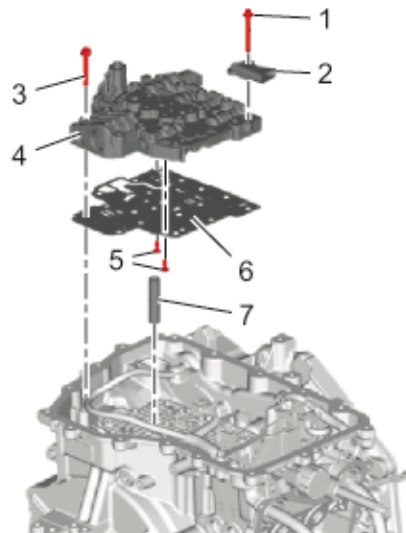


Fig. 107: Control Valve Body Components
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the control valve body wiring harness.
7. Remove Fluid Transfer Pipe Bolt (1)
8. Remove Fluid Transfer Pipe (2)
9. Remove Control Valve Body Bolts (3) (Qty: 13)
10. Remove Control Valve Body (4)
11. Remove Control Valve Body Spacer Plate Retainer (5) (Qty: 2)
12. Remove and DISCARD Control Valve Lower Body Spacer Plate (6)

13. Remove and DISCARD Variable Low Clutch Fluid Passage Seal (7)

Installation Procedure

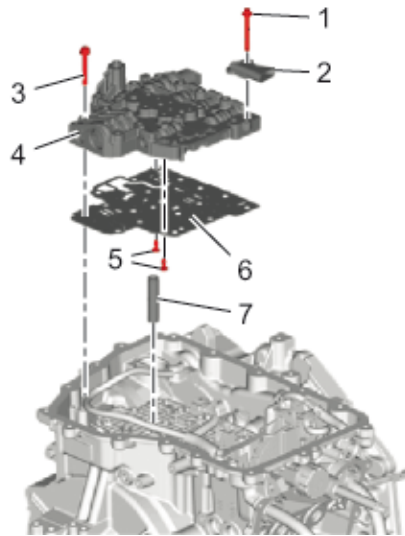


Fig. 108: Control Valve Body Components

Courtesy of GENERAL MOTORS COMPANY

NOTE: Install a **NEW** seal.

1. Install NEW Variable Low Clutch Fluid Passage Seal (7)

NOTE: Install a **NEW** spacer plate.

2. Install NEW Control Valve Lower Body Spacer Plate (6)
3. Install Control Valve Body Spacer Plate Retainer (5) (Qty: 2)
4. Install Control Valve Body (4)

CAUTION: Refer to **Fastener Caution**

5. Install and hand tighten Control Valve Body Bolts (3) (Qty: 13). Hand tighten only.
6. Install Fluid Transfer Pipe (2)
7. Install and hand tighten Fluid Transfer Pipe Bolt (1). Hand tighten only.
8. Connect the control valve body wiring harness.

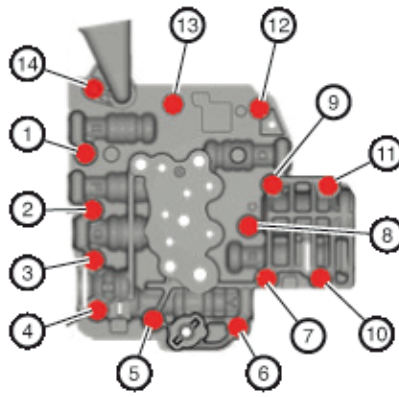


Fig. 109: Control Valve Body Bolt And Fluid Transfer Pipe Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

9. Tighten Control Valve Body Bolts @ Fluid Transfer Pipe Bolt in sequence to 9 N.m (80 lb in)

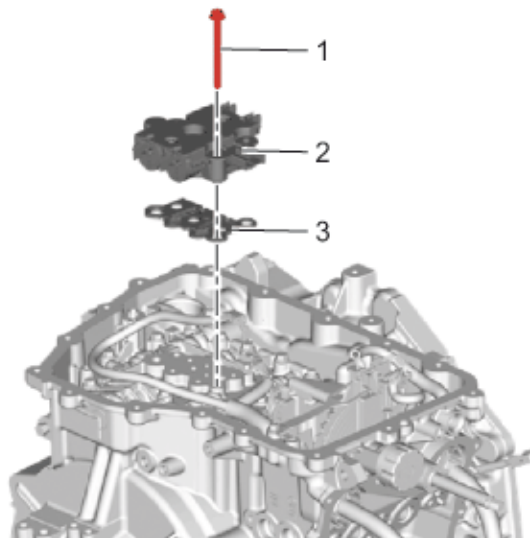


Fig. 110: Control Valve Body Bolts, Control Solenoid Valve And Filter Plate
Courtesy of GENERAL MOTORS COMPANY

10. Install Control Solenoid Valve Filter Plate (3)
11. Install Control Solenoid Valve (2)
12. Install and hand tighten Control Valve Body Bolts (1) (Qty: 4). Hand tighten only.
13. Connect the control solenoid valve wiring harness.

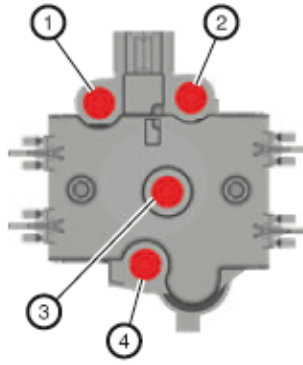


Fig. 111: Control Valve Body Bolts Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

14. Tighten Control Valve Body Bolts in sequence to 9 N.m (80 lb in)
15. Install Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)

LINE PRESSURE CONTROL SOLENOID VALVE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Control Valve Body. Refer to [Control Valve Body Replacement](#)

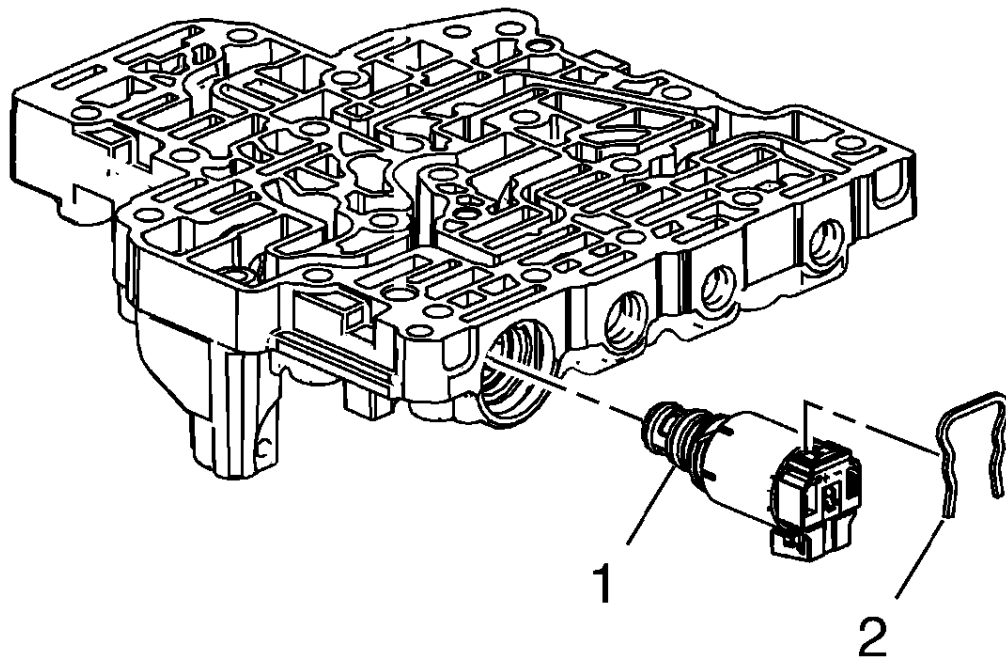


Fig. 112: Line Pressure Control Solenoid Valve And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Remove Line Pressure Control Solenoid Valve Retainer (2)
3. Remove Line Pressure Control Solenoid Valve (1)

Installation Procedure

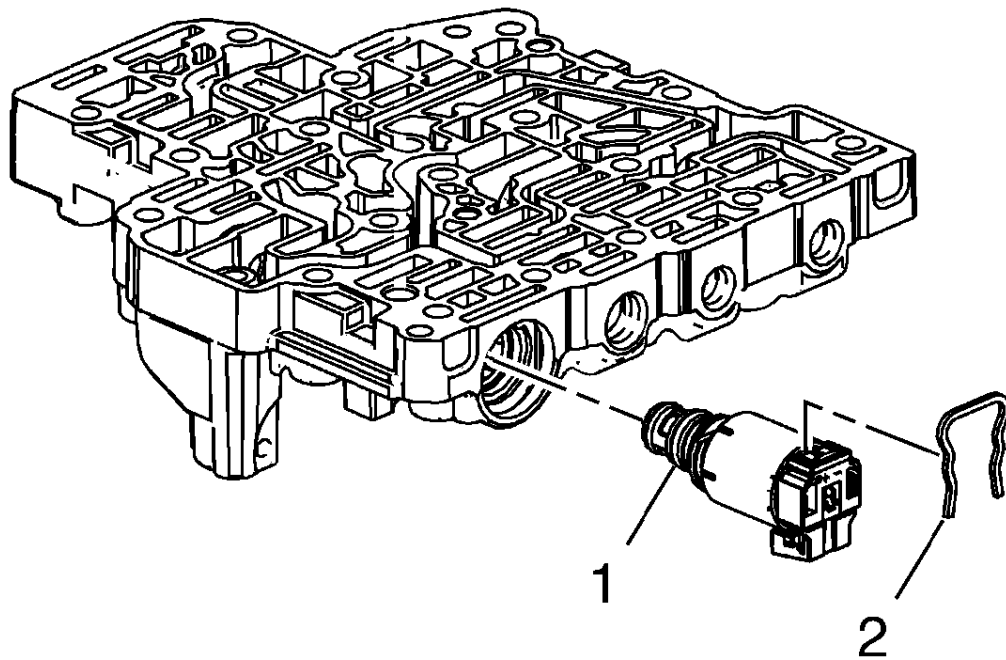


Fig. 113: Line Pressure Control Solenoid Valve And Retainer

Courtesy of **GENERAL MOTORS COMPANY**

1. Install Line Pressure Control Solenoid Valve (1)
2. Install Line Pressure Control Solenoid Valve Retainer (2)
3. Install Control Valve Body. Refer to [Control Valve Body Replacement](#)

CONTROL SOLENOID VALVE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Control Valve Body. Refer to [Control Valve Body Cover Replacement](#)

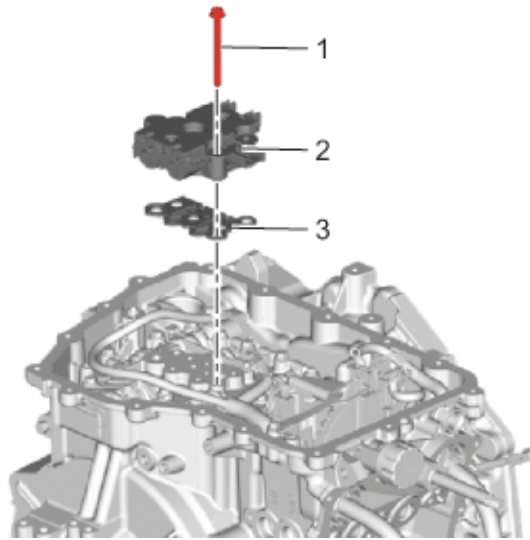


Fig. 114: Control Valve Body Bolts, Control Solenoid Valve And Filter Plate
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Control Solenoid Valve Wiring Harness
3. Remove Control Valve Body Bolts (1) (Qty: 4)
4. Remove Control Solenoid Valve (2)
5. Remove Control Solenoid Valve Filter Plate (3)

Installation Procedure

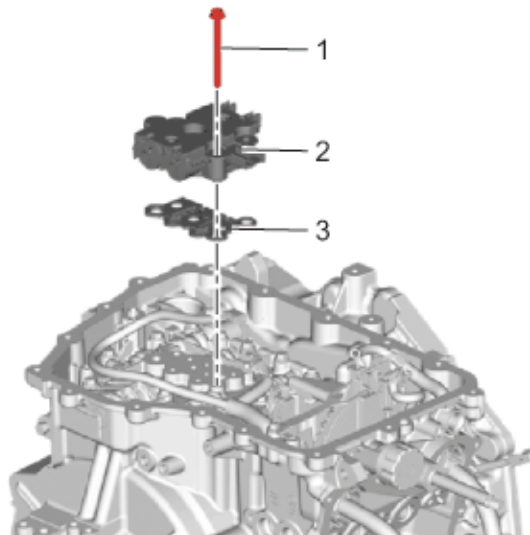


Fig. 115: Control Valve Body Bolts, Control Solenoid Valve And Filter Plate
Courtesy of GENERAL MOTORS COMPANY

1. Install Control Solenoid Valve Filter Plate (3)
2. Install Control Solenoid Valve (2)

CAUTION: Refer to **Fastener Caution**

3. Install and hand tighten Control Valve Body Bolts (1) (Qty: 4). Hand tighten only.
4. Connect Control Solenoid Valve Wiring Harness

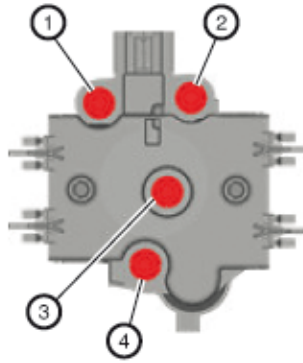


Fig. 116: Control Valve Body Bolts Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

5. Tighten Control Valve Body Bolts in sequence to 9 N.m (80 lb in)
6. Install Control Valve Body Cover. Refer to [Control Valve Body Cover Replacement](#)

AUTOMATIC TRANSMISSION WIRING HARNESS REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
2. Remove Control Valve Body. Refer to [Control Valve Body Replacement](#)

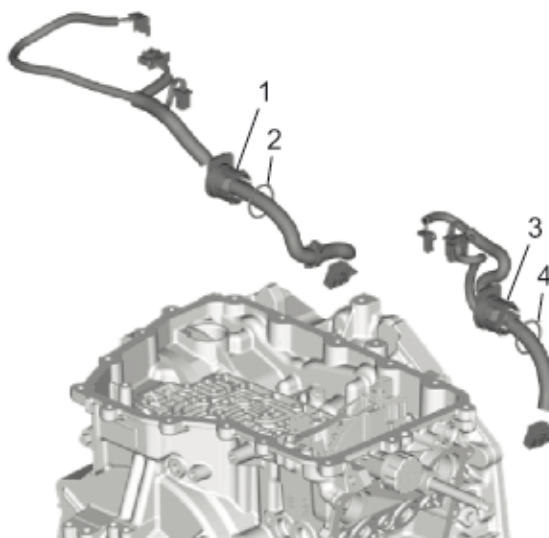


Fig. 117: Automatic Transmission Wiring Harness And Seals

Courtesy of GENERAL MOTORS COMPANY

NOTE: Remove the manual shift detent lever spring to aid in removal of the transmission wiring harness.

3. Remove Automatic Transmission Wiring Harness - Control Solenoid Valve (1)
4. Remove Automatic Transmission Wiring Connector Seal (2)
5. Remove Automatic Transmission Wiring Harness - Shift Shaft Position Switch (3)
6. Remove Automatic Transmission Wiring Connector Seal (4)

Installation Procedure

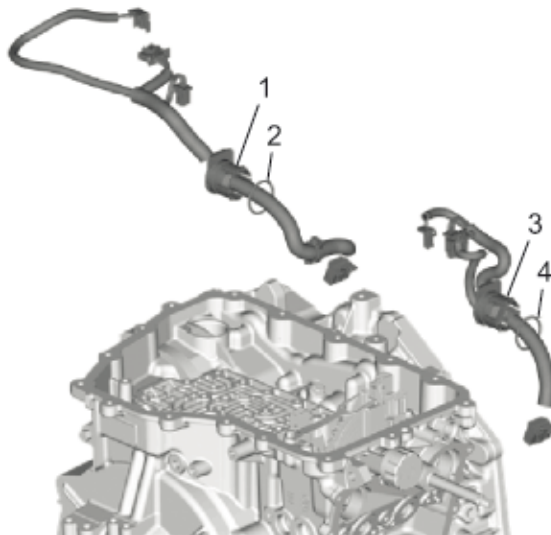


Fig. 118: Automatic Transmission Wiring Harness And Seals

Courtesy of GENERAL MOTORS COMPANY

1. Install Automatic Transmission Wiring Connector Seal (4)
2. Install Automatic Transmission Wiring Harness - Shift Shaft Position Switch (3)
3. Install Automatic Transmission Wiring Connector Seal (2)

NOTE: Install the manual shift detent lever spring previously removed to aid the removal of the transmission wiring harness.

4. Install Automatic Transmission Wiring Harness - Control Solenoid Valve (1)
5. Install Control Valve Body. Refer to [Control Valve Body Replacement](#)
6. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection](#)

TRANSMISSION MOUNT STRUT BRACKET REPLACEMENT

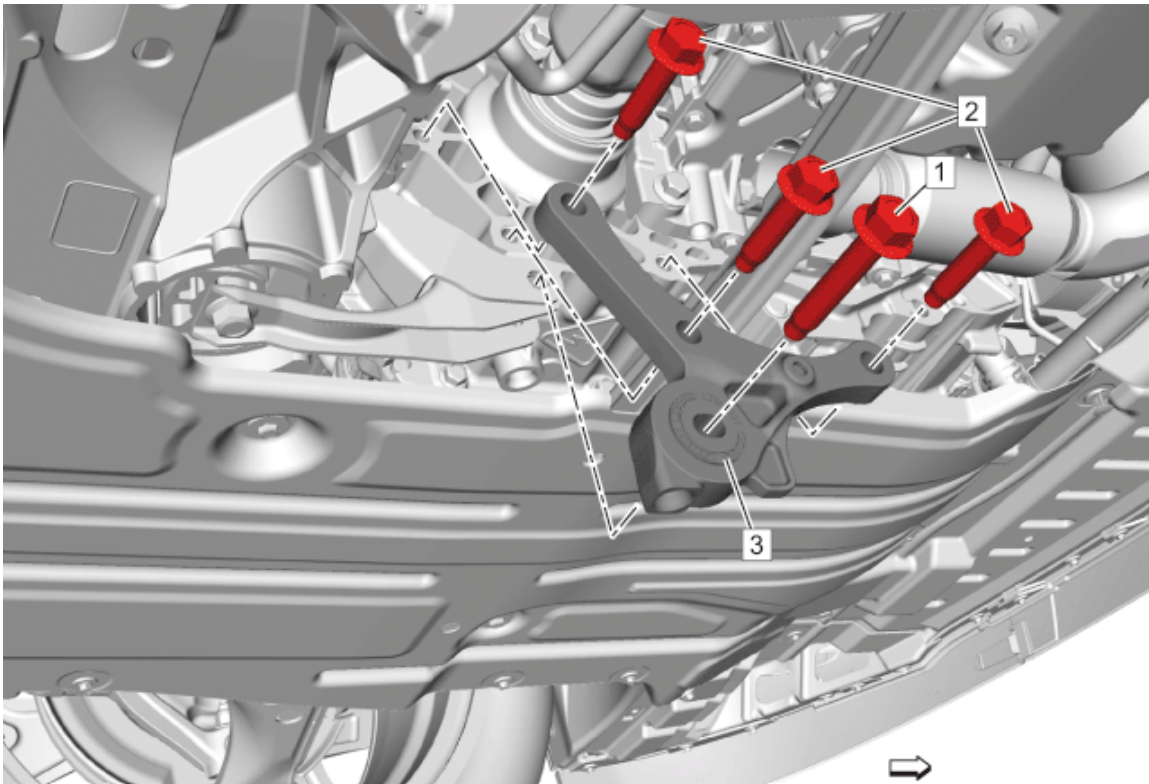


Fig. 119: Transmission Mount Strut Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Using a suitable jack stand, support the rear of the powertrain.	
1	Transmission Mount Strut Bolt CAUTION: Refer to Fastener Caution CAUTION: Refer to Torque-to-Yield Fastener Caution Procedure Always use NEW bolts. - Do NOT reuse old bolts. Tighten • First Pass: 100 N.m (74 lb ft) • Final Pass: 60 - 75 degrees

Callout	Component Name
	Special Tools EN-45059 Angle Meter Equivalent regional tools: Special Tools
2	Transmission Mount Strut Bracket Bolt (Qty: 3) CAUTION: Refer to Torque-to-Yield Fastener Caution Procedure Always use NEW bolts. - Do NOT reuse old bolts. Tighten • First Pass: 75 N.m (55 lb ft) • Final Pass: 45 - 60 degrees Special Tools EN-45059 Angle Meter Equivalent regional tools: Special Tools
3	Transmission Mount Strut Bracket

TRANSMISSION MOUNT TRANSMISSION-SIDE BRACKET REPLACEMENT

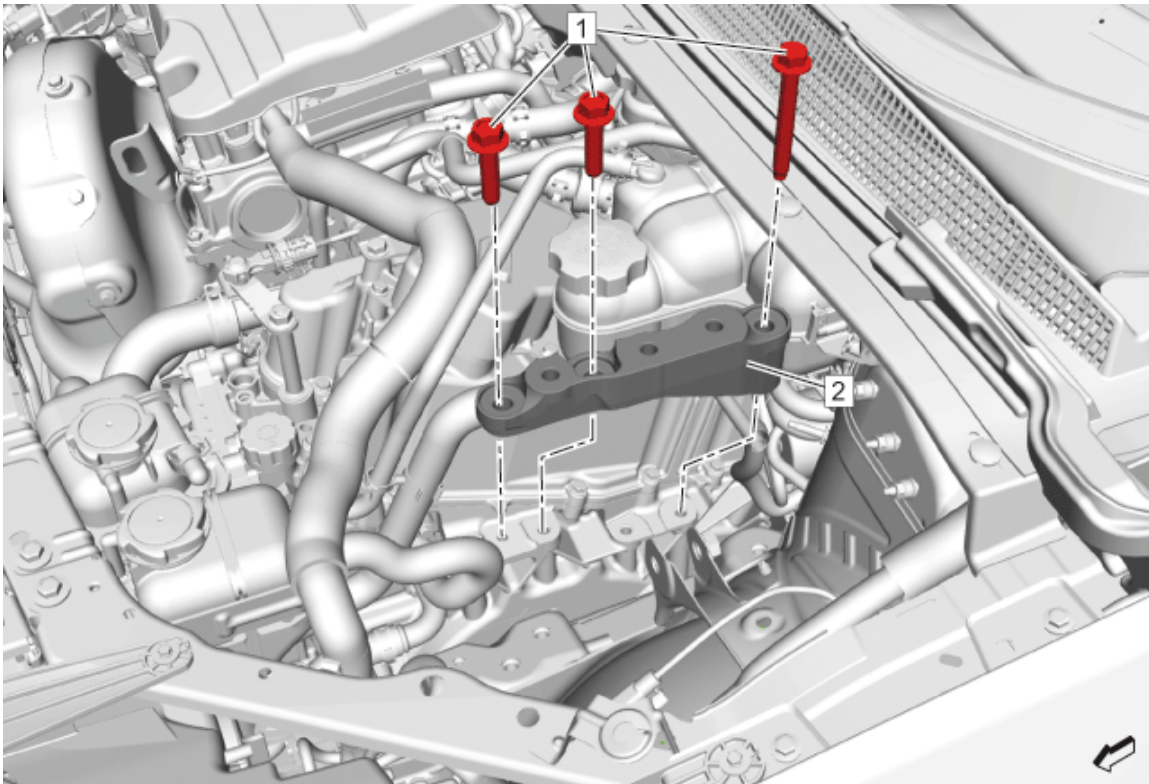


Fig. 120: Transmission Mount Transmission-Side Bracket

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Transmission Mount. Refer to Transmission Mount Replacement	
1	Transmission Mount Transmission Side Bracket Bolt (Qty: 3) CAUTION: Refer to Fastener Caution CAUTION: Refer to Torque-to-Yield Fastener Caution Procedure Always use NEW bolts. - Do NOT reuse old bolts. Tighten • First Pass: 58 N.m (43 lb ft) • Final Pass: 60 - 75 degrees

Callout	Component Name
	Special Tools EN-45059 Angle Meter Equivalent regional tools: Special Tools
2	Transmission Mount Transmission Side Bracket

TRANSMISSION MOUNT REPLACEMENT

Special Tools

EN-45059 Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove Engine Wiring Harness Junction Block. Refer to [Engine Wiring Harness Junction Block Replacement](#)

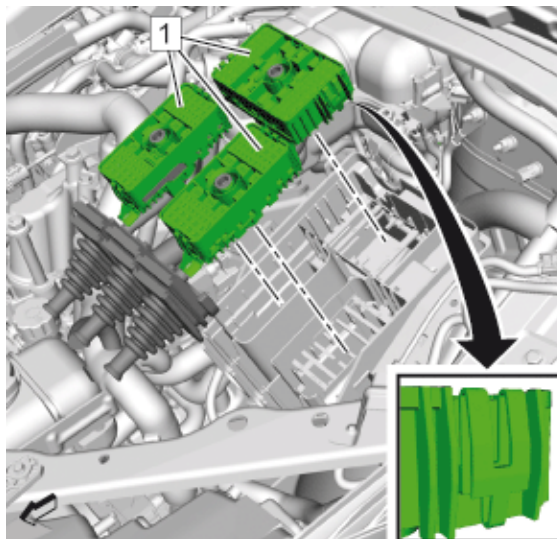


Fig. 121: Wiring Harness Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Remove Wiring Harness Connectors (1) (Qty: 3)

Unclip (Qty: 6)

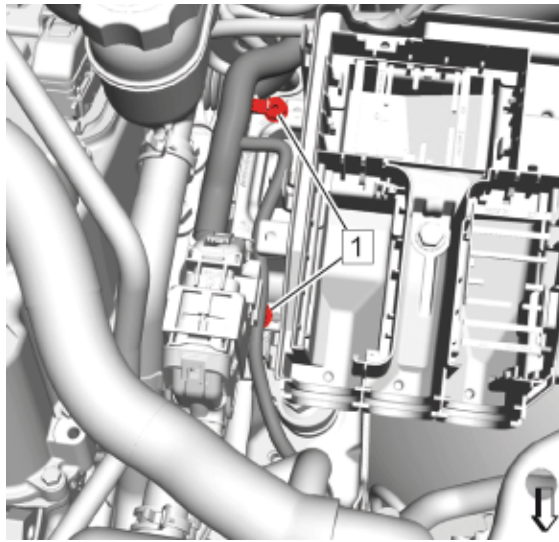


Fig. 122: Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

3. Remove Wiring Harness Retainers (1) (Qty: 2)

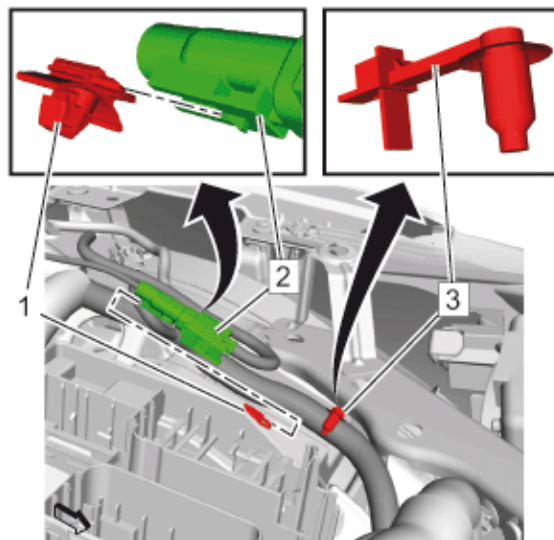


Fig. 123: Wiring Harness Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Remove Wiring Harness Connector (2) @ Retainers (1)
5. Unclip Wiring Harness Retainer (3)

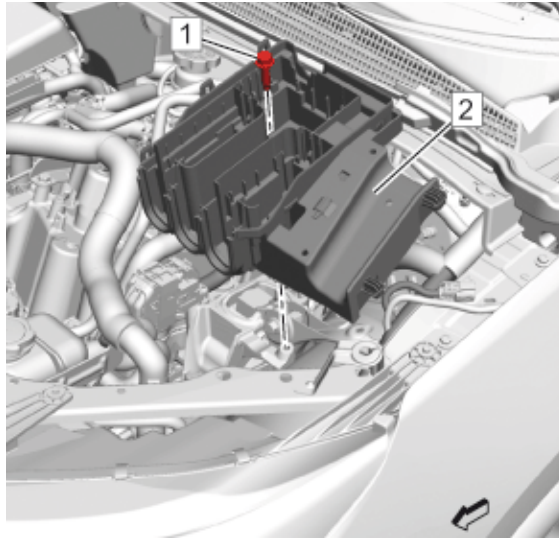


Fig. 124: Engine Wiring Harness Fuse Block Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove Engine Wiring Harness Fuse Block Bracket Bolt (1)
7. Remove Engine Wiring Harness Fuse Block Bracket (2)

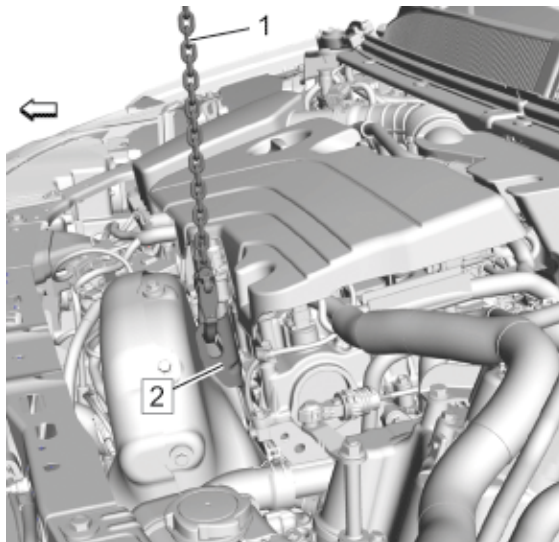


Fig. 125: Engine Lifting Chain And Engine Lift Rear Bracket
Courtesy of GENERAL MOTORS COMPANY

8. Install the engine lifter (1) to the engine lift rear bracket (2).
9. Apply tension to the chain.

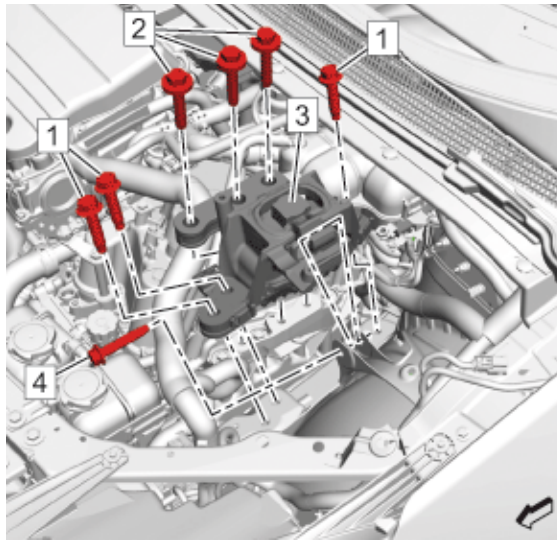


Fig. 126: Transmission Mount And Bolts

Courtesy of GENERAL MOTORS COMPANY

10. Prior to removing the mount, mark the mount location using paint pent or a marker for correct positioning during installation.
11. Remove and DISCARD Transmission Mount Bolts (2) (Qty: 3)
12. Remove Transmission Mount Transmission Side Bolt (4)
13. Remove and DISCARD Transmission Mount Bolt (1) (Qty: 3)
14. Remove Transmission Mount (3)

Installation Procedure

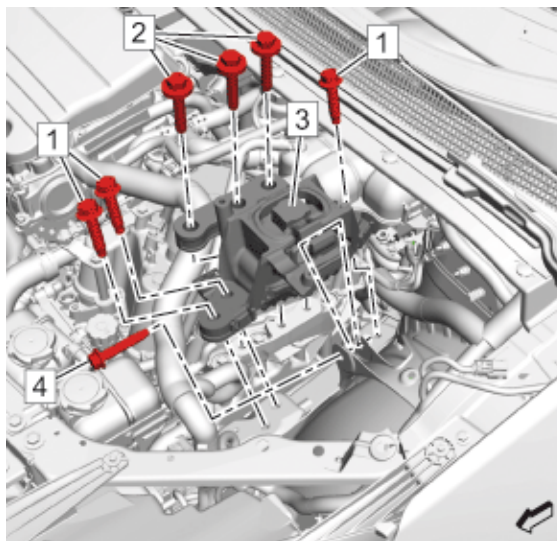


Fig. 127: Transmission Mount And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Transmission Mount (3)

CAUTION: Refer to [Fastener Caution](#)

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

NOTE: Install **NEW** bolts.

2. Install NEW Transmission Mount Bolts (1) (Qty: 3). Hand tighten only.

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

NOTE: Install **NEW** bolts.

3. Install NEW Transmission Mount Bolts (2) (Qty: 3). Hand tighten only.
4. Align the transmission mount and the powertrain unit to the previously made marks.
5. Tighten Transmission Mount Bolts (1) (Qty: 3)
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 60 - 75 degrees, use the **EN-45059** meter
6. Tighten Transmission Mount Bolts (2) (Qty: 3)
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 60 - 75 degrees, use the **EN-45059** meter
7. Install and tighten Transmission Mount Transmission Side Bolt (4) to 58 N.m (43 lb ft)

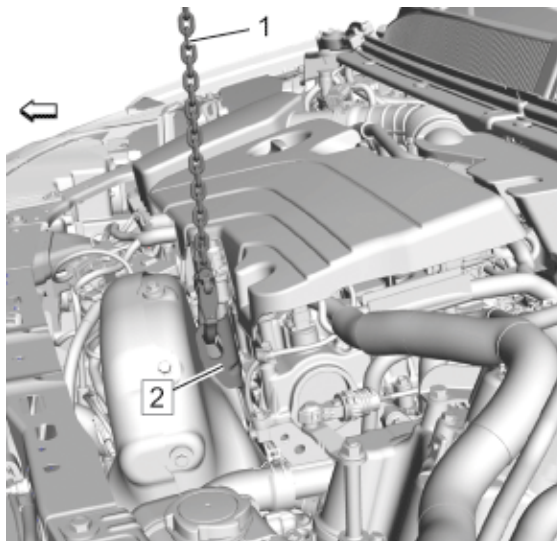


Fig. 128: Engine Lifting Chain And Engine Lift Rear Bracket
Courtesy of GENERAL MOTORS COMPANY

8. Remove the engine lifter (1) from the engine lift rear bracket (2).

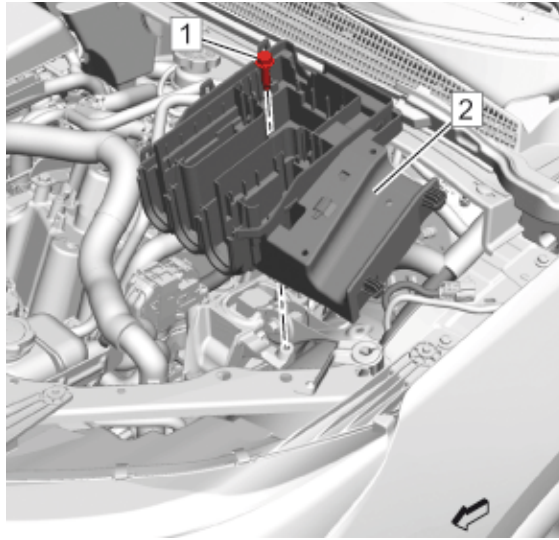


Fig. 129: Engine Wiring Harness Fuse Block Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Wiring Harness Fuse Block Bracket (2)
10. Install and tighten Engine Wiring Harness Fuse Block Bracket Bolt (1) to 22 N.m (16 lb ft).

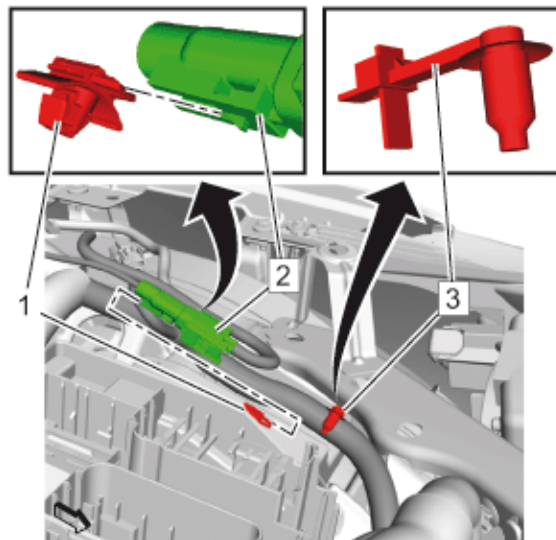


Fig. 130: Wiring Harness Connector And Retainers
Courtesy of GENERAL MOTORS COMPANY

11. Install Wiring Harness Retainer (3)
12. Install Wiring Harness Connector (2) @ Retainer (1)

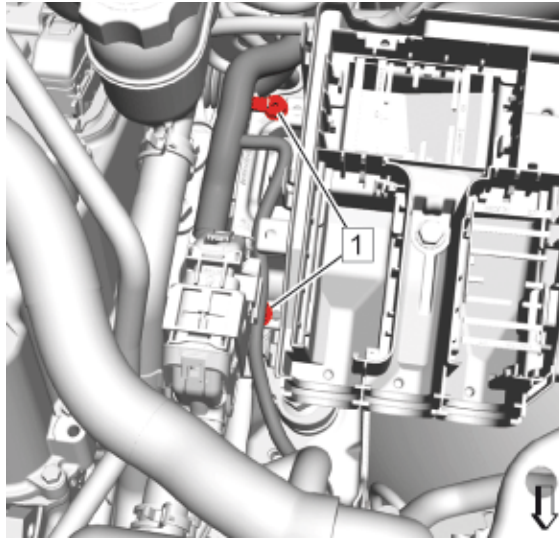


Fig. 131: Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

13. Install Wiring Harness Retainers (1) (Qty: 2)

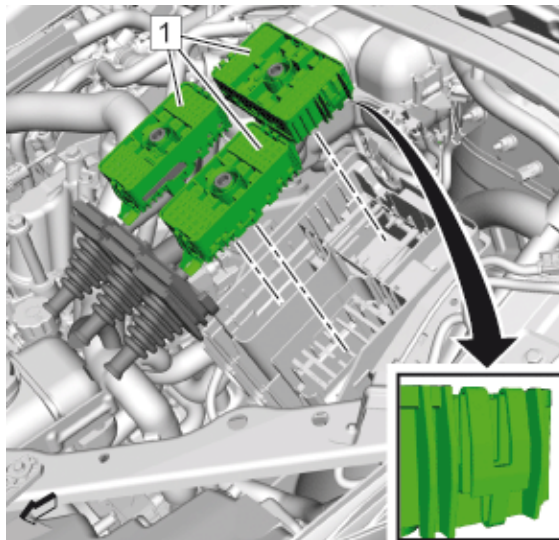


Fig. 132: Wiring Harness Connectors

Courtesy of GENERAL MOTORS COMPANY

14. Install Wiring Harness Connectors (1) (Qty: 3)

Install (Qty: 6)

15. Install Engine Wiring Harness Junction Block. Refer to [Engine Wiring Harness Junction Block Replacement](#)

TRANSMISSION REAR MOUNT REPLACEMENT

Special Tools

CH-51999 Volt Cradle Bushing Remover/Installer

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Remove the drivetrain and front suspension cradle from the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

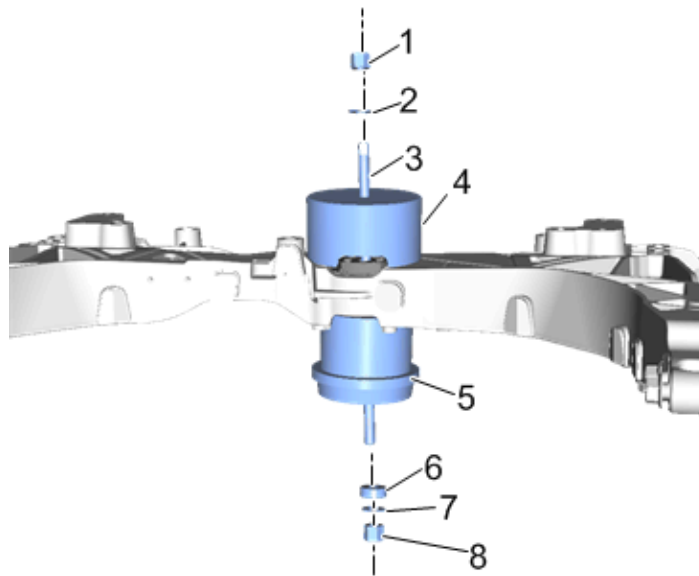


Fig. 133: Volt Cradle Bushing Remover/Installer Components

Courtesy of GENERAL MOTORS COMPANY

2. Assemble the **CH-51999** Volt Cradle Bushing Remover/Installer (1 through 8) onto the transmission rear mount and the drivetrain and front suspension cradle.
3. Turning the nut (8), release the transmission rear mount from the drivetrain and front suspension cradle.

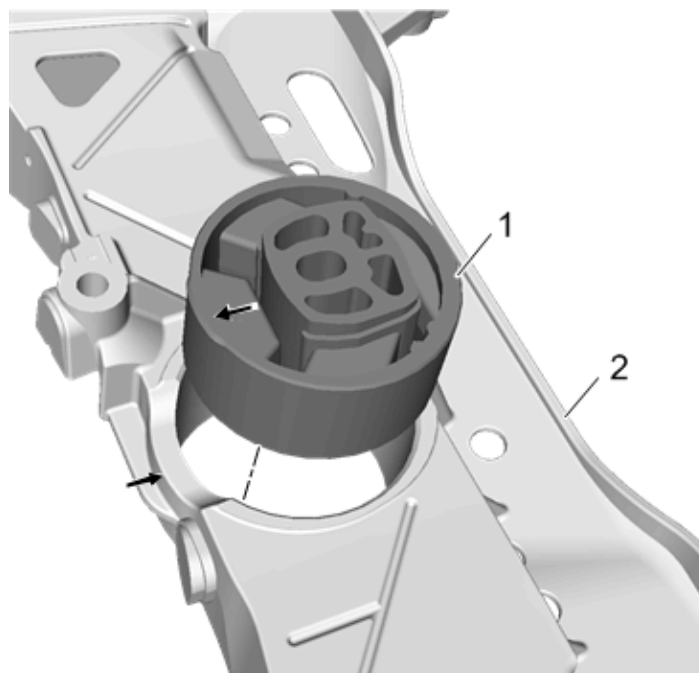


Fig. 134: Transmission Rear Mount, Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

4. Remove the transmission rear mount (1) from the drivetrain and front suspension cradle (2).

Installation Procedure

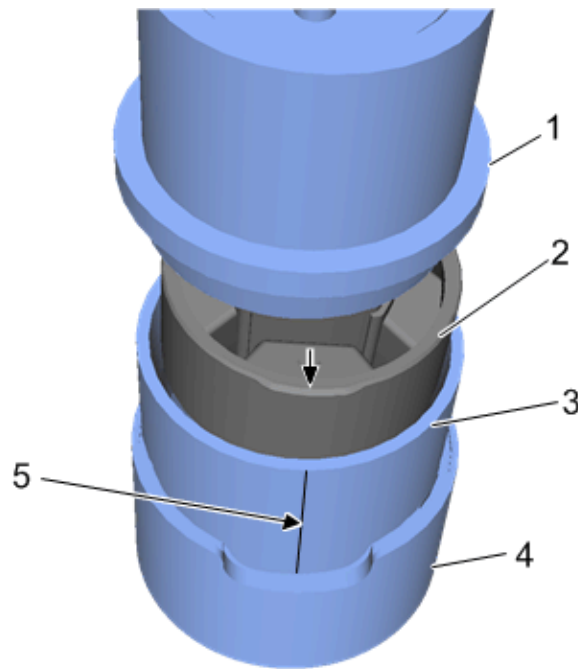


Fig. 135: Cradle Bushing Remover/Installer Receiver Cup, Transmission Mount And Alignment Mark
Courtesy of GENERAL MOTORS COMPANY

1. Clean the **CH-51999** Volt Cradle Bushing Remover/Installer receiver cup (3) free from oil and grease.
2. Position the transmission mount (2) into the receiver cup with the arrow on the transmission mount aligning with the alignment mark (5).

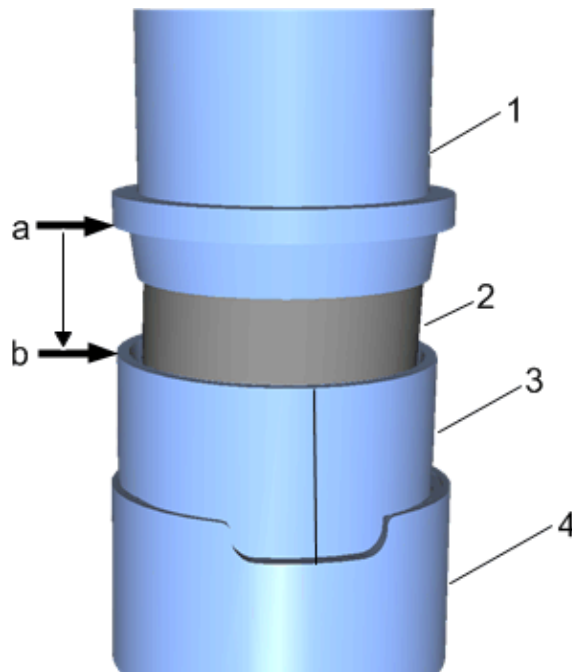


Fig. 136: Upper Tool Rim With Top Of Receiver Cup
Courtesy of GENERAL MOTORS COMPANY

NOTE: The transmission mount will be at the correct depth in the receiver cup, when the upper tool rim (a) is in the contact with the top of the receiver cup (b).

IMPORTANT: No lubricant is allowed.

3. Using a press or the threaded rod assembly, and the components (1, 4) shown from the **CH-51999** Volt Cradle Bushing Remover/Installer kit. Compress the transmission mount (2) into the receiver cup (3).
4. Clean the hole for the transmission rear mount in the drivetrain and front suspension frame cradle.

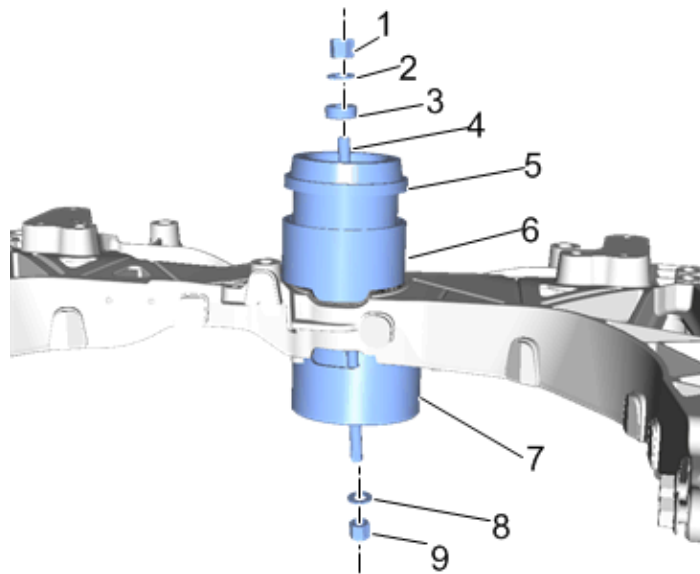


Fig. 137: Cradle Bushing Remover/Installer Components

Courtesy of GENERAL MOTORS COMPANY

NOTE: Insure the transmission mount inside the receiver cup (6) is in the correct orientation before proceeding.

5. Assemble the **CH-51999** Volt Cradle Bushing Remover/Installer (1 through 9) onto the drivetrain and front suspension cradle.

NOTE: When the rim on the tool (5) contacts the top edge of tool (6) completely, the transmission mount will be at it's correct depth in the drivetrain and front suspension cradle.

6. Turning the nut (1), install the transmission rear mount to the drivetrain and front suspension cradle.
7. Remove the **CH-51999** Volt Cradle Bushing Remover/Installer (1 through 9) from the drivetrain and front suspension cradle.
8. If the transmission rear mount is not positioned correctly, remove the transmission rear mount from the drivetrain and front suspension frame cradle and reinstall it.
9. Install the drivetrain and front suspension cradle to the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement](#)

TRANSMISSION MOUNT STRUT REPLACEMENT

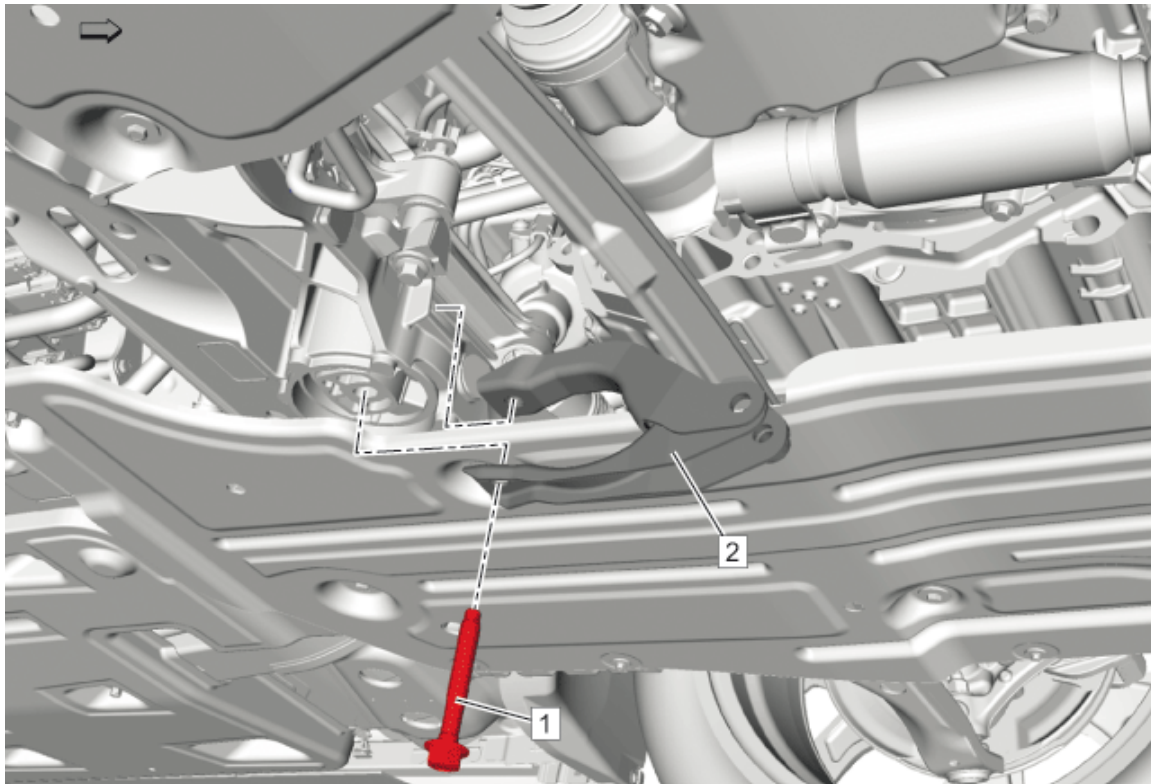


Fig. 138: Transmission Mount Strut

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Using a suitable jack stand, support the rear of the powertrain. 2. Remove Transmission Mount Strut Bracket. Refer to Transmission Mount Strut Bracket Replacement	
1	Transmission Mount Strut Bolt CAUTION: Refer to Fastener Caution CAUTION: Refer to Torque-to-Yield Fastener Caution Procedure Always use NEW bolts. - Do NOT reuse old bolts. Tighten

Callout	Component Name
	• First Pass: 100 N.m (74 lb ft) • Final Pass: 60 - 75 degrees Special Tools EN-45059 Angle Meter Equivalent regional tools: Special Tools
2	Transmission Mount Strut

TRANSMISSION REPLACEMENT

Special Tools

- **BO-38185** Hose Clamp Pliers
- **DT-51504** Seal Protector
- **EN-45059** Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

WARNING: Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Ensure that the vehicle is properly supported and squarely positioned. Refer to [Lifting and Jacking the Vehicle](#) .
2. Disable the high voltage system and disconnect the A4 Hybrid/EV Battery Pack high voltage harness connector at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#) .
3. Set the parking brake.

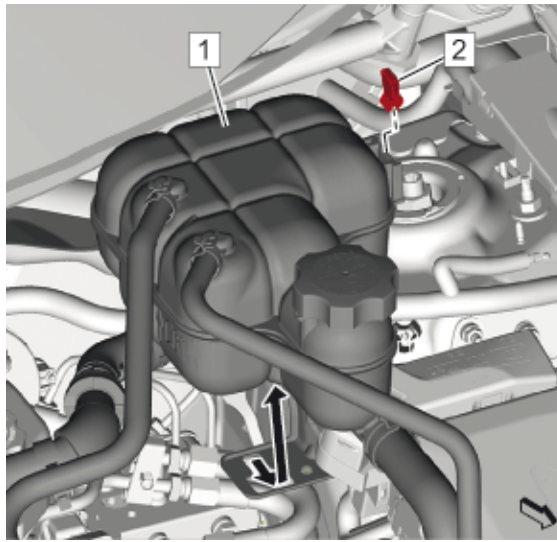


Fig. 139: Radiator Surge Tank And Bracket Clip

Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Surge Tank Bracket Clip (2)
5. Remove the radiator surge tank (1) from the vehicle. Refer to [Radiator Surge Tank Replacement](#)

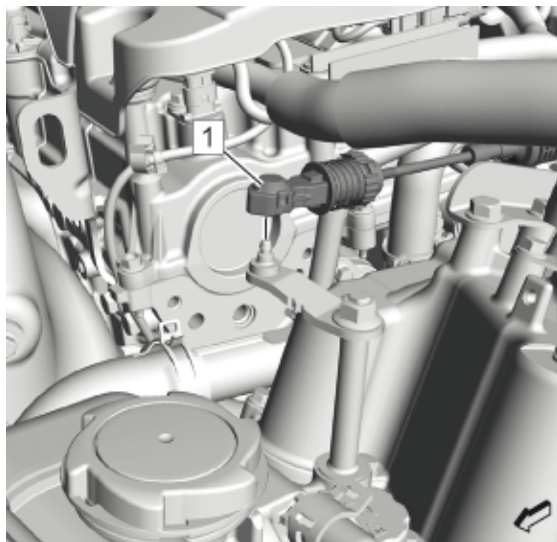


Fig. 140: Range Selector Lever Cable And Range Selector Lever Cable Lever

Courtesy of GENERAL MOTORS COMPANY

6. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

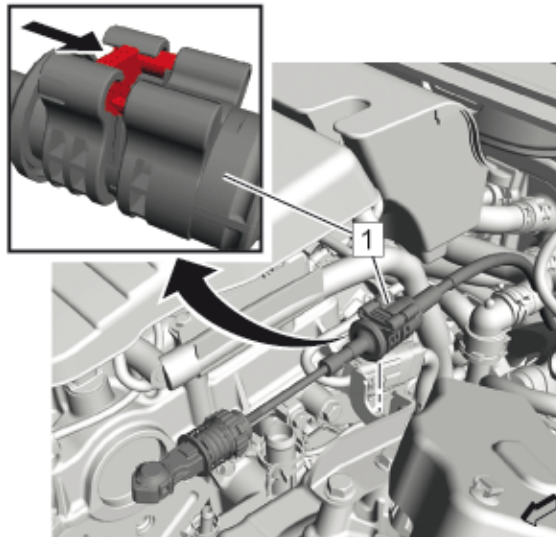


Fig. 141: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Remove the range selector lever cable (1) from the range selector lever cable bracket.

Release the cable from the bracket by pushing the retainer (arrow).

8. Remove Radiator Inlet Hose. Refer to [Radiator Inlet Hose Replacement](#)
9. Drain Drive Motor Generator Power Inverter Module Cooling System. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
10. Remove the drive motor generator control module cooling outlet hose. Refer to [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\)](#) [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)

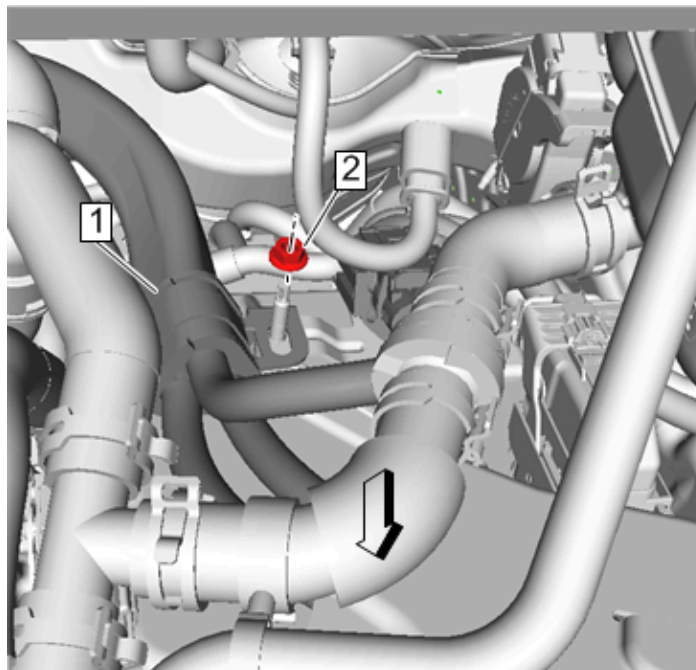


Fig. 142: Wiring Harness Bracket And Nut
Courtesy of GENERAL MOTORS COMPANY

11. Remove Nut (2)
12. Remove Wiring Harness Bracket (1)

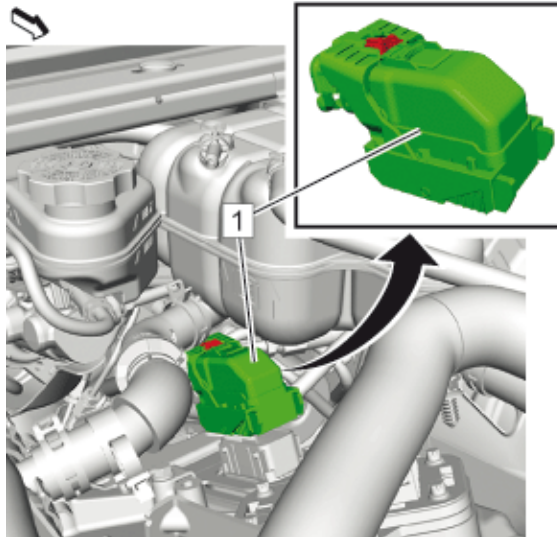


Fig. 143: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

13. Disconnect Electrical Connector (1)

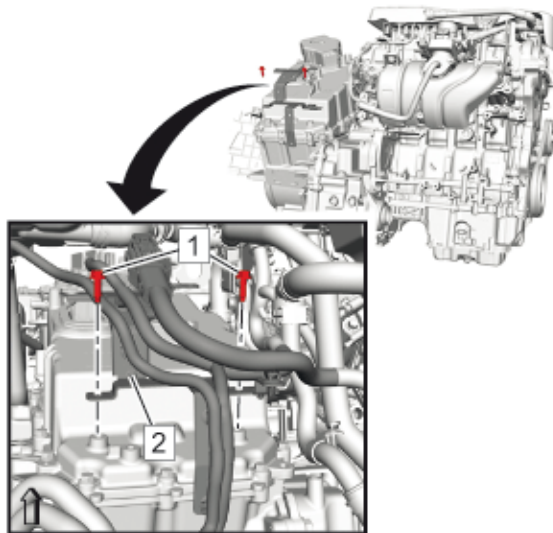


Fig. 144: Wiring Harness Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

14. Remove Bolts (1) (Qty: 2)
15. Remove Wiring Harness Bracket (2)

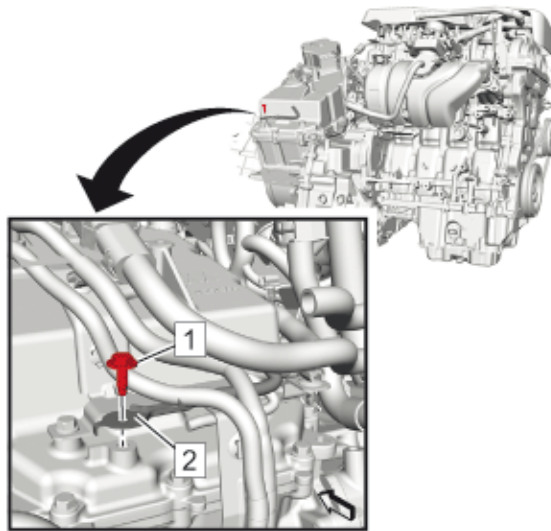


Fig. 145: Ground Cable And Bolt

Courtesy of GENERAL MOTORS COMPANY

16. Remove Ground Cable Bolt (1)
17. Remove Ground Cable (2)
18. Install Engine Support Fixture. Refer to [Engine Support Fixture](#)

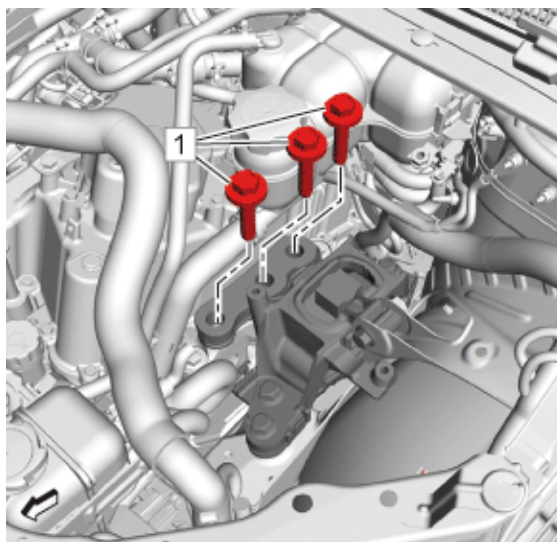


Fig. 146: Transmission Mount Bolts

Courtesy of GENERAL MOTORS COMPANY

19. Remove and DISCARD Transmission Mount Bolts (1) (Qty: 3)

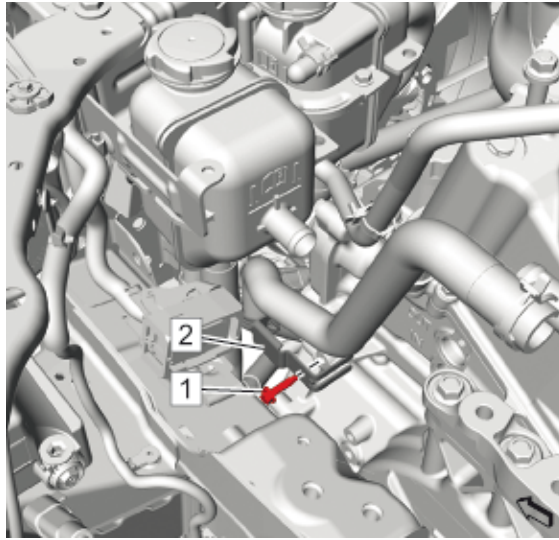


Fig. 147: Heater Inlet Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

20. Remove Bolt (1)
21. Remove Heater Inlet Hose Bracket (2)
22. Remove Drivetrain and Front Suspension Cradle. Refer to [Drivetrain and Front Suspension Cradle Replacement](#)
23. Drain Transmission Fluid. Refer to [Transmission Fluid Drain and Fill](#)
24. Remove the left and right wheel drive shafts. Refer to [Front Wheel Drive Shaft Replacement](#)

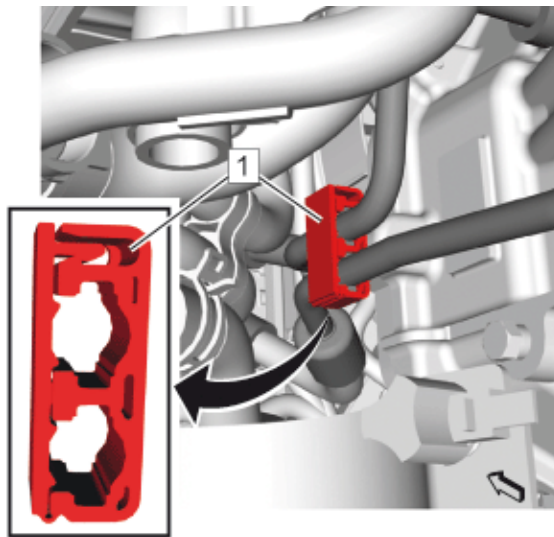


Fig. 148: Transmission Fluid Cooler Inlet And Outlet Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

25. Remove Clip (1)

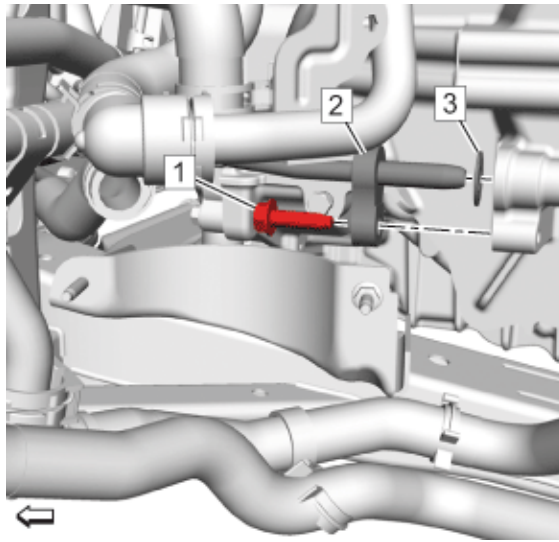


Fig. 149: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

26. Place a container beneath the transmission fluid cooler outlet pipe (2) to catch spilling transmission fluid.
27. Remove Transmission Fluid Cooler Pipe Bolt (1)
28. Disconnect Transmission Fluid Cooler Outlet Pipe (2)
29. Remove and DISCARD Sealing Washer (3)

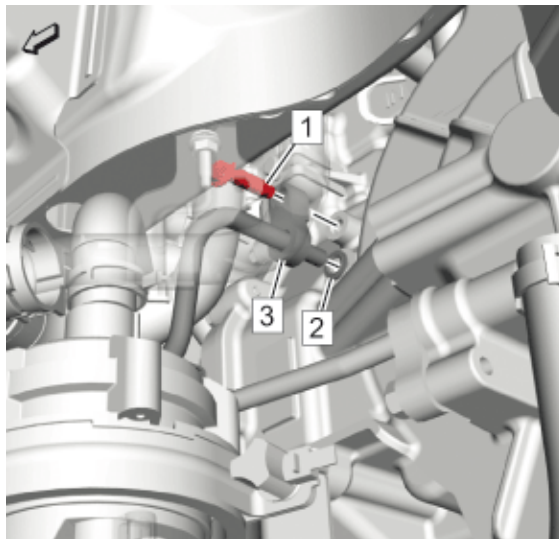


Fig. 150: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

30. Place a container beneath the transmission fluid cooler inlet pipe (3) to catch spilling transmission fluid.
31. Remove Transmission Fluid Cooler Pipe Bolt (1)
32. Disconnect Transmission Fluid Cooler Inlet Pipe (3)
33. Remove and DISCARD Sealing Washer (2)

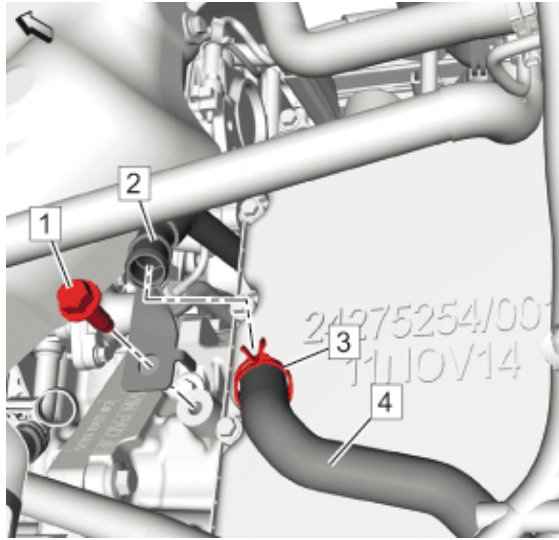


Fig. 151: Heater Water Auxiliary Pump Inlet Hose, Clamp, Heater Water Shutoff Valve Inlet Hose Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

34. Loosen Heater Water Auxiliary Pump Inlet Hose Clamp (3) using **BO-38185** pliers
35. Remove Heater Water Auxiliary Pump Inlet Hose (4)
36. Remove Heater Water Shutoff Valve Inlet Hose Bracket Bolt (1)
37. Remove the heater water shutoff valve inlet hose and bracket (2) from the front side of the vehicle.

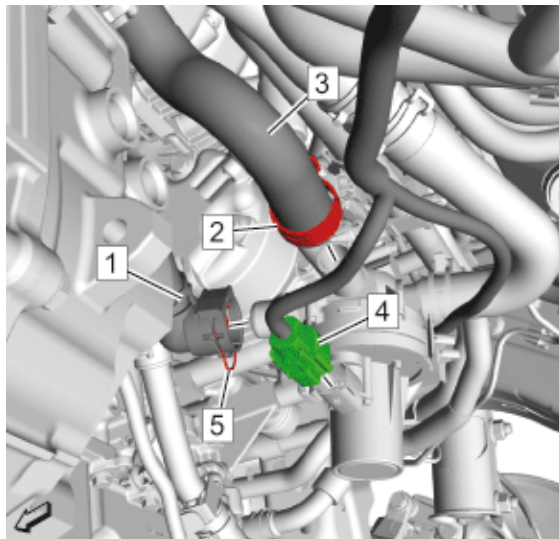


Fig. 152: Heater Water Shutoff Valve Electrical Connector, Inlet Hose, Retainer, Heater Water Shutoff Valve Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

38. Disconnect the heater water shutoff valve electrical connector (4).
39. Loosen Retainer (5)

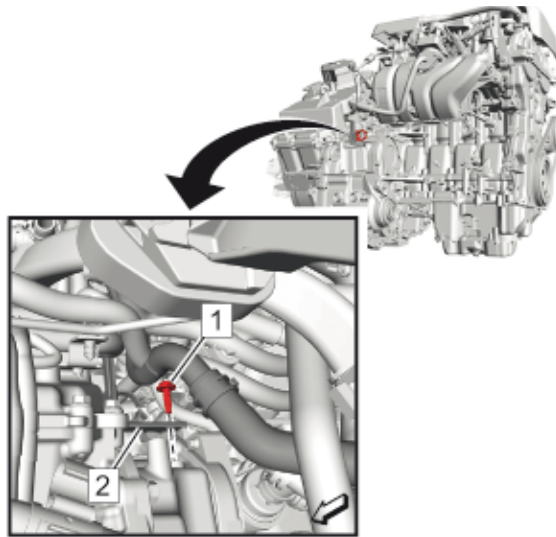


Fig. 153: Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

- 40. Remove Bolt (1)
- 41. Loosen the bracket (2).

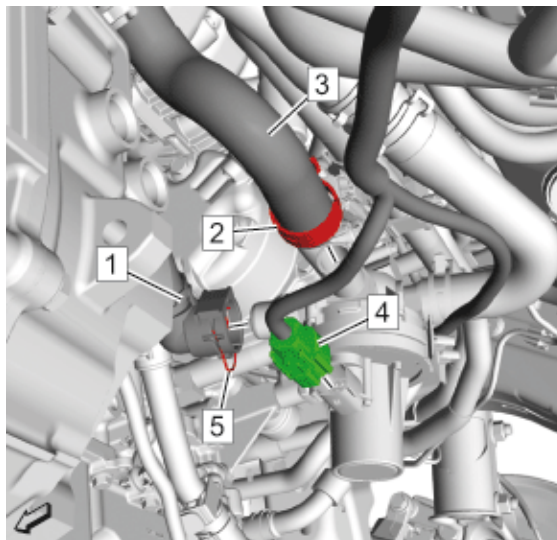


Fig. 154: Heater Water Shutoff Valve Electrical Connector, Inlet Hose, Retainer, Heater Water Shutoff Valve Outlet Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

- 42. Remove Heater Water Shutoff Valve Inlet Hose (1) @ Heater Water Shutoff Valve
- 43. Loosen the heater water shutoff valve outlet hose clamp (2), using the **BO-38185** pliers.
- 44. Remove the heater water shutoff valve outlet hose (3) with the heater water shutoff valve.

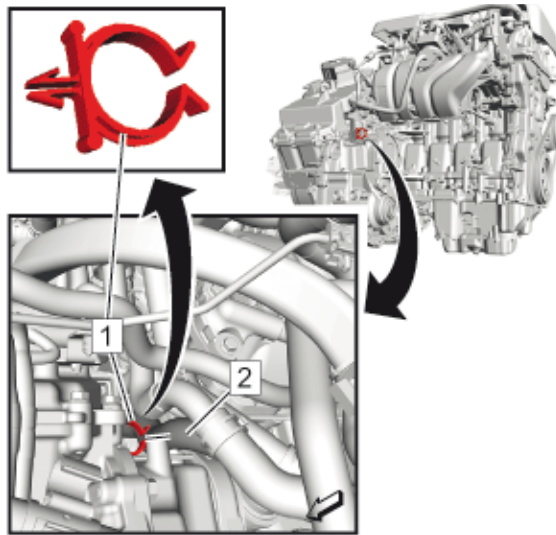


Fig. 155: Heater Water Shutoff Valve Inlet Hose And Clip

Courtesy of GENERAL MOTORS COMPANY

45. Remove Heater Water Shutoff Valve Inlet Hose (2) @ Clip (1)
46. Remove Heater Water Shutoff Valve @ Vehicle
47. Remove Heater Coolant Pump. Refer to [Heater Coolant Pump Replacement](#)

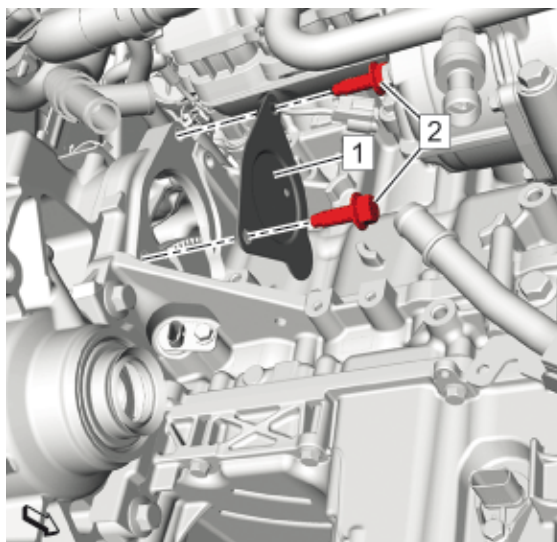


Fig. 156: Starter Opening Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

48. Remove Bolts (2) (Qty: 2)
49. Remove the starter opening cover (1).

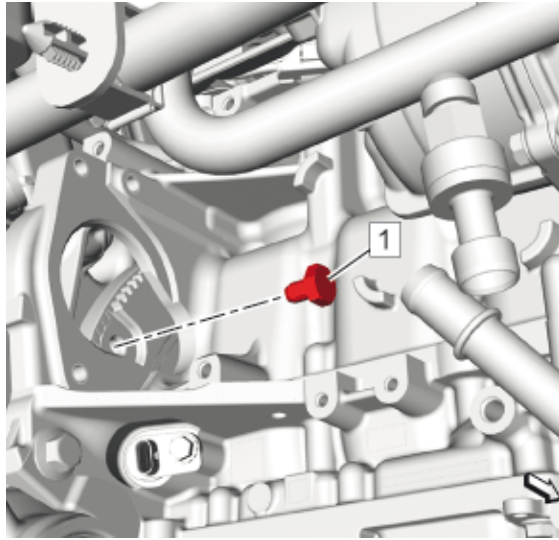


Fig. 157: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

50. Remove the torque converter bolts. (1) (Qty: 4)

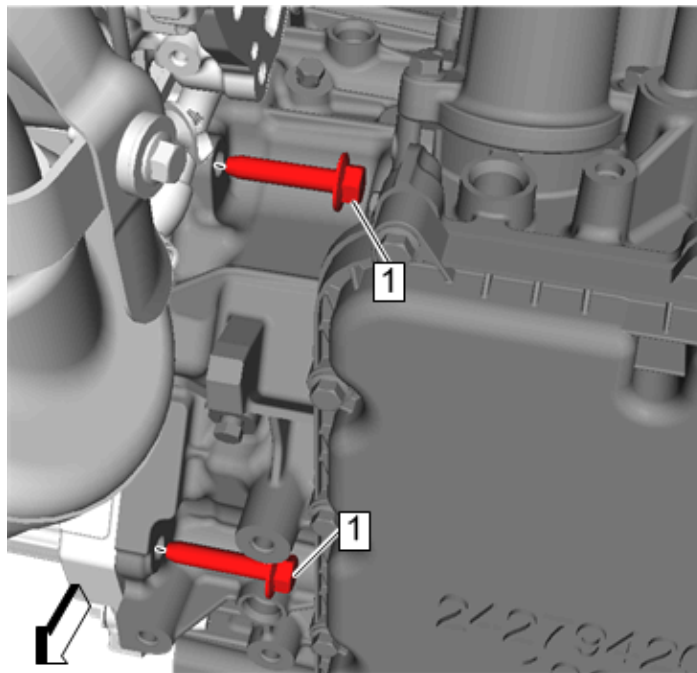


Fig. 158: Upper Front Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

51. Remove the upper front transmission bolts (1) (Qty: 2).

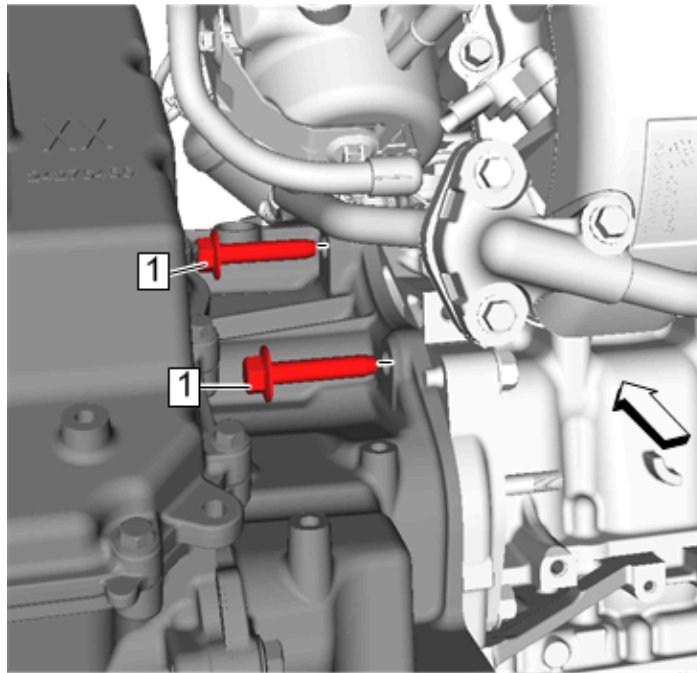


Fig. 159: Upper Rear Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

52. Remove the upper rear transmission bolts (1) (Qty: 2).
53. Support the transmission with a suitable jack.
54. Using a suitable straps or chains, secure the transmission to the transmission jack.

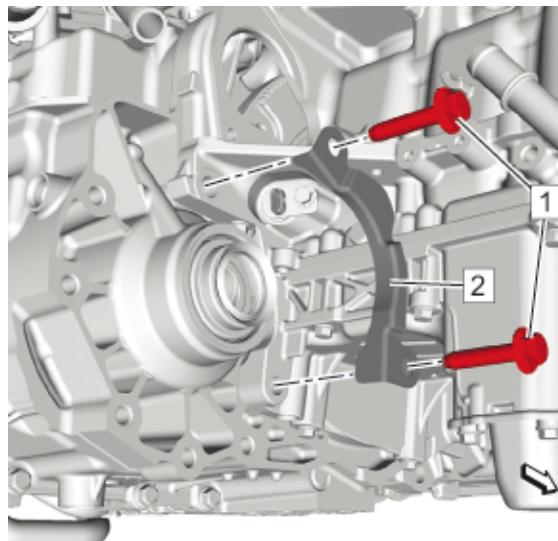


Fig. 160: Transmission Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

55. Remove the transmission bolts. (1) (Qty: 2)
56. Remove Transmission Cover (2)

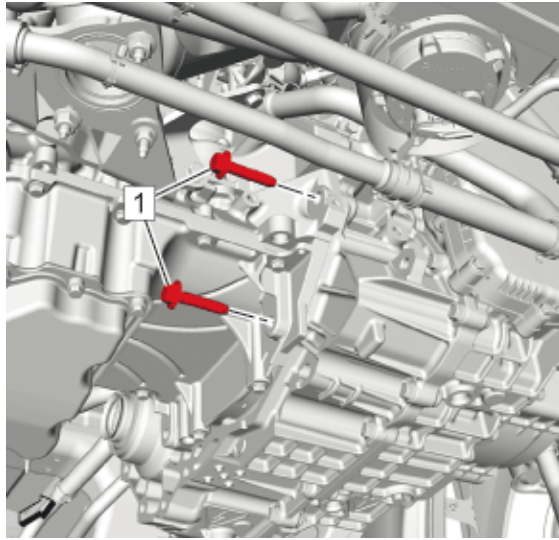


Fig. 161: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

57. Remove the transmission bolts. (1) (Qty: 2)
58. Carefully lower the transmission along with the jack, closely watching hoses and wiring harnesses to not disturb.

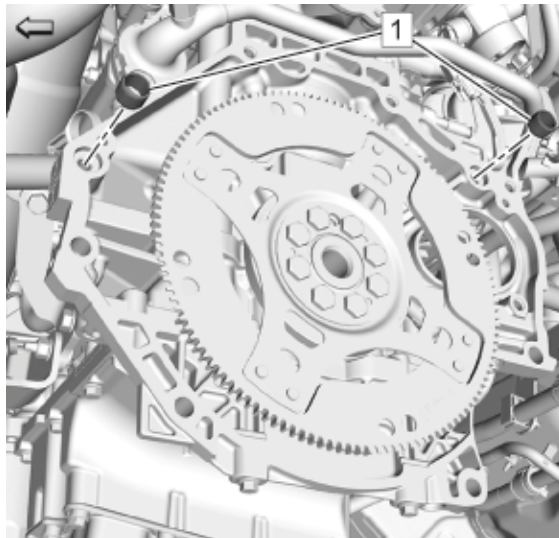


Fig. 162: Transmission Locating Pins

Courtesy of GENERAL MOTORS COMPANY

59. Ensure the transmission locating pins (1) are properly seated in the engine block and not damaged.
60. Transfer parts as needed.
61. Flush and flow test the fluid cooler and lines. Refer to [Transmission Fluid Cooler Flow Test and Flushing](#)

Installation Procedure

NOTE: The alignment hole is oblong and is slightly smaller than the other holes in the engine flex plate.

1. Set engine to any top dead center (TDC). This puts the alignment hole in the starter pocket.

Do not tighten bell housing bolts at this time. There must be a small 1 mm (0.039 in) to 2 mm (0.079 in) mm gap between the engine and transmission to allow rotation for input flange alignment.

2. Install 2 guide pins into the lower engine block holes where the locating pins are to guide the transmission into place.
3. Position the transmission in the vehicle on the locating pins leaving a small gap between the engine and transmission.

CAUTION: Refer to [Fastener Caution](#)

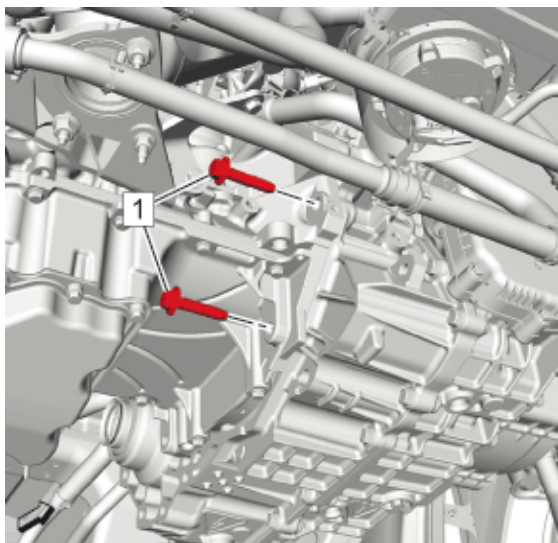


Fig. 163: Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Remove the guide pins, then Install the 2 transmission bolts (1) (Qty: 2) and hand tighten, allowing a small 1 mm (0.039 in) to 2 mm (0.079 in) mm gap between the engine and transmission.

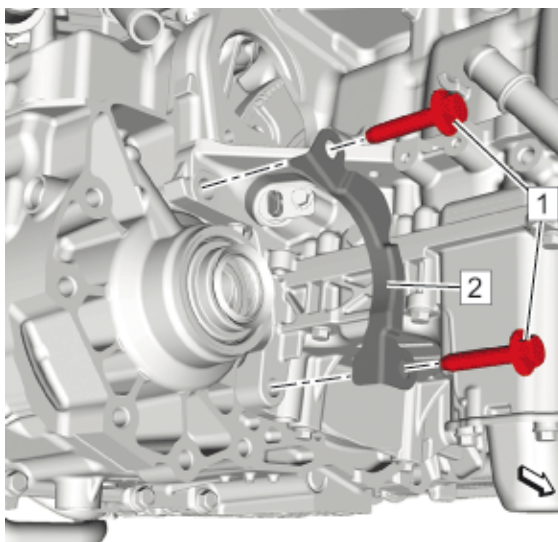


Fig. 164: Transmission Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install Transmission Cover (2)
6. Install the 2 transmission bolts (1) (Qty: 2) and hand tighten, allowing a small 1 mm (0.039 in) to 2 mm (0.079 in) mm gap between the engine and transmission.

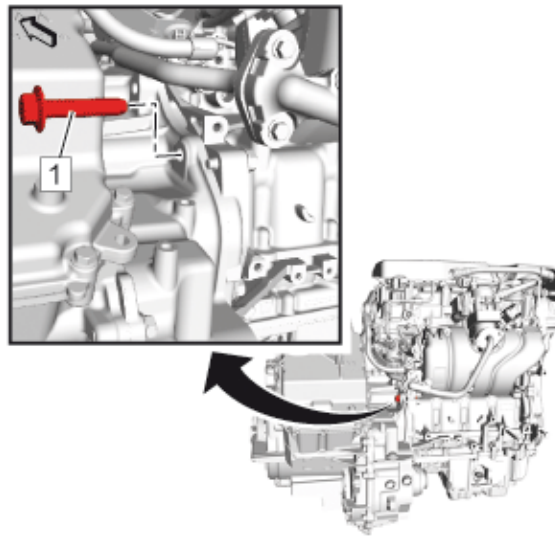


Fig. 165: Transmission Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Remove the guide pin, then install the transmission bolt (1) and hand tighten, allowing a small 1 mm (0.039 in) to 2 mm (0.079 in) mm gap between the engine and transmission.

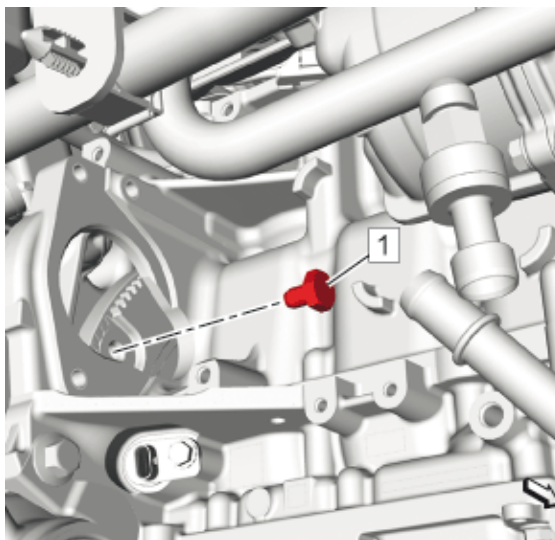


Fig. 166: Torque Converter Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Once the Loctite® has been applied to the bolts it will 'SET IN APPROXIMATELY IN 10 MINUTES' and will fully cure in 24 hours.

8. Apply blue Loctite® on the torque converter bolt (1). Hand start bolt a few threads in the oblong alignment hole.
9. Tighten all lower transmission bolts to 58 N.m (43 lb ft).
10. Install Heater Coolant Pump. Refer to [Heater Coolant Pump Replacement](#)

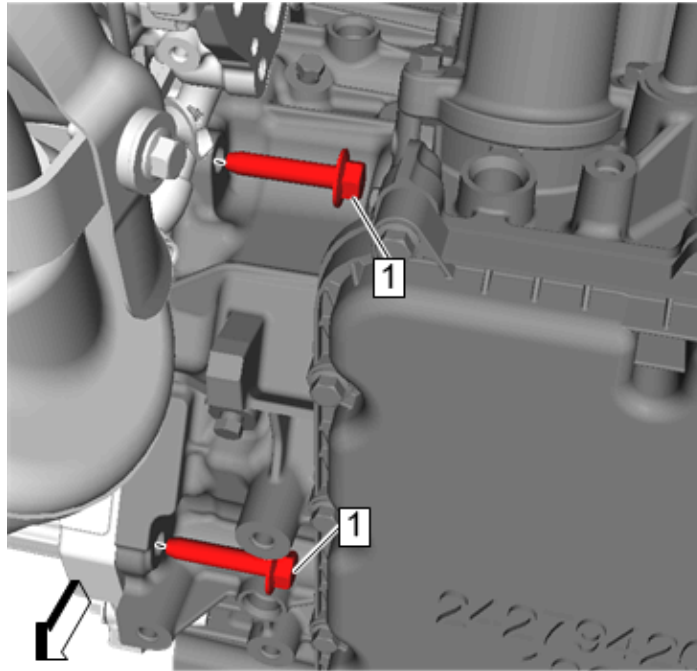


Fig. 167: Upper Front Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

11. Install the upper front transmission bolts (1) (Qty: 2) and tighten to 58 N.m (43 lb ft).

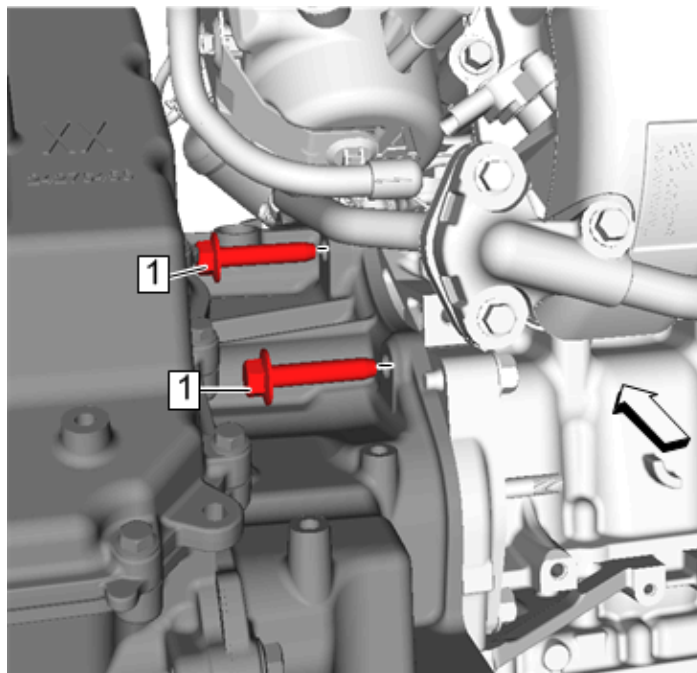


Fig. 168: Upper Rear Transmission Bolts

Courtesy of GENERAL MOTORS COMPANY

12. Install the upper rear transmission bolts (1) (Qty: 2) and tighten to 58 N.m (43 lb ft).
13. Tighten torque converter bolt to 60 N.m (44 lb ft). Rotate the engine to the next hole. Apply blue Loctite® on the three remaining torque converter bolts. Install and tighten the bolts to 60 N.m (44 lb ft).

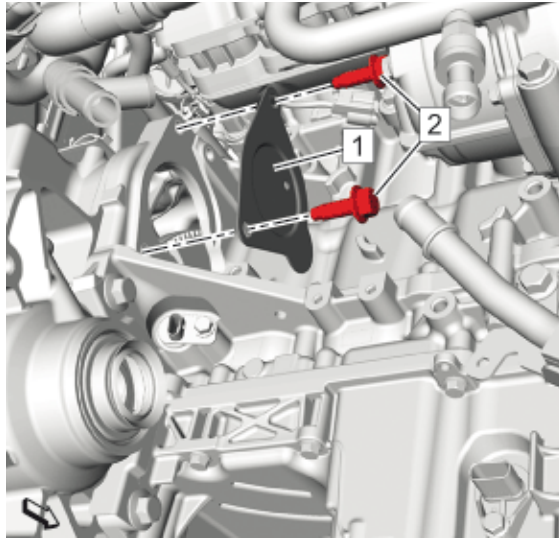


Fig. 169: Starter Opening Cover And Bolts

Courtesy of GENERAL MOTORS COMPANY

14. Install the starter opening cover (1) and the 2 bolts (2) (Qty: 2).

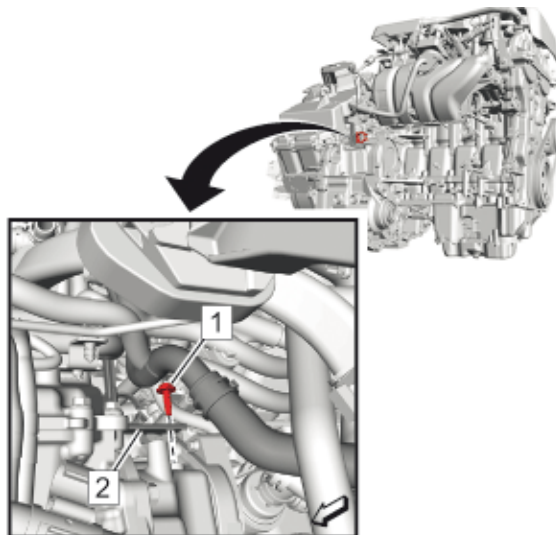


Fig. 170: Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

15. Install the bracket (2).
16. Install and tighten Bolt (1) to 9 N.m (80 lb in)

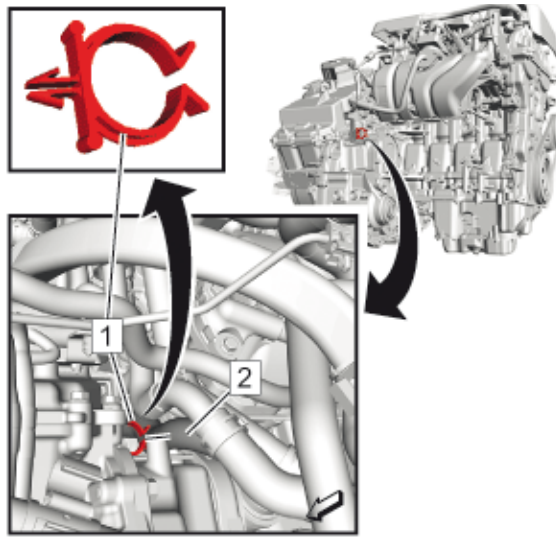


Fig. 171: Heater Water Shutoff Valve Inlet Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

17. Install Heater Water Shutoff Valve Inlet Hose (2) @ Vehicle
18. Install Heater Water Shutoff Valve Inlet Hose (2) @ Clip (1)

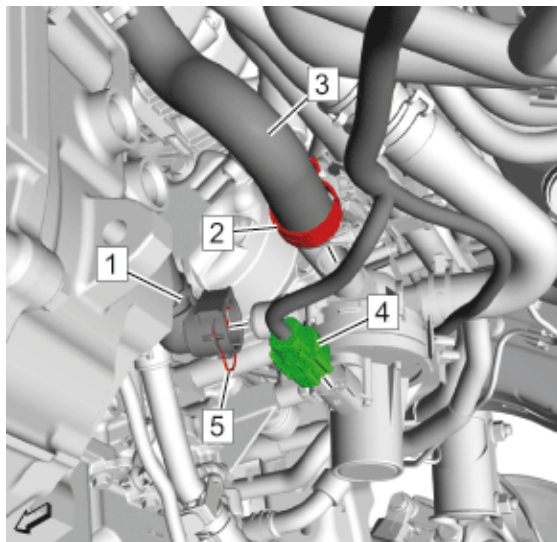


Fig. 172: Heater Water Shutoff Valve Electrical Connector, Inlet Hose, Retainer, Heater Water Shutoff Valve Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

19. Install the heater water shutoff valve outlet hose (3) with the heater water shutoff valve.
20. Install the heater water shutoff valve outlet hose clamp (2), using the **BO-38185** pliers.
21. Install Heater Water Shutoff Valve Inlet Hose (1) @ Heater Water Shutoff Valve
22. Install Retainer (5)
23. Connect the heater water shutoff valve electrical connector (4).

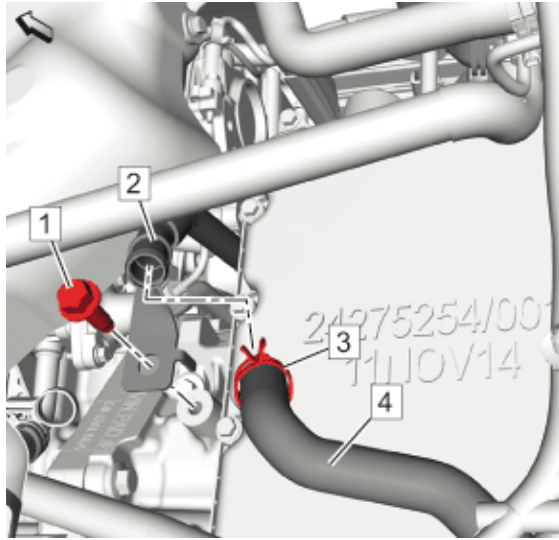


Fig. 173: Heater Water Auxiliary Pump Inlet Hose, Clamp, Heater Water Shutoff Valve Inlet Hose Bracket And Bolt

Courtesy of GENERAL MOTORS COMPANY

24. Install Heater Water Shutoff Valve Inlet Hose Bracket (2)
25. Install and tighten Heater Water Shutoff Valve Inlet Hose Bracket Bolt (1) to 22 N.m (16 lb ft)
26. Install Heater Water Auxiliary Pump Inlet Hose (4)
27. Install Heater Water Auxiliary Pump Inlet Hose Clamp (3) using **BO-38185** pliers

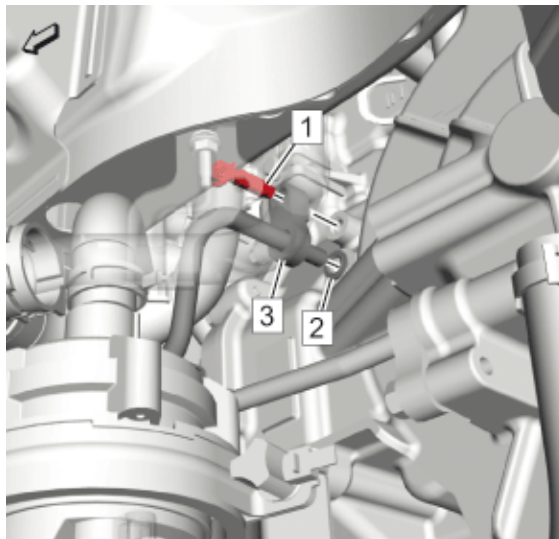


Fig. 174: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer

Courtesy of GENERAL MOTORS COMPANY

28. Install a NEW sealing washer. (2)
29. Connect Transmission Fluid Cooler Inlet Pipe (3) - Connect
30. Install and tighten Transmission Fluid Cooler Pipe Bolt (1) to 22 N.m (16 lb ft)

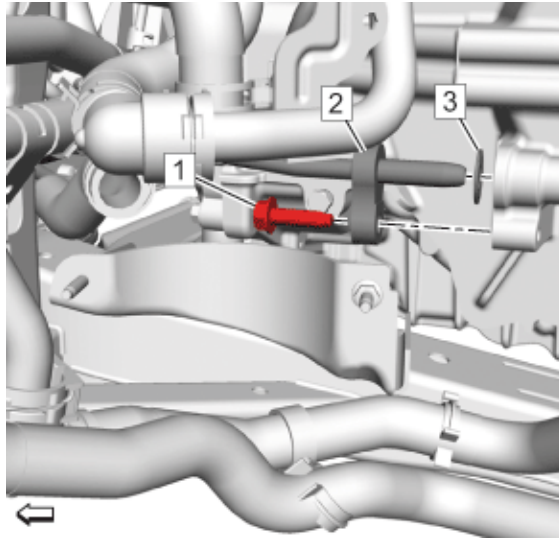


Fig. 175: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

31. Install a NEW sealing washer. (3)
32. Connect Transmission Fluid Cooler Outlet Pipe (2)
33. Install and tighten Transmission Fluid Cooler Pipe Bolt (1) to 22 N.m (16 lb ft)
34. Install the left and right wheel drive shafts. Refer to [Front Wheel Drive Shaft Replacement](#)

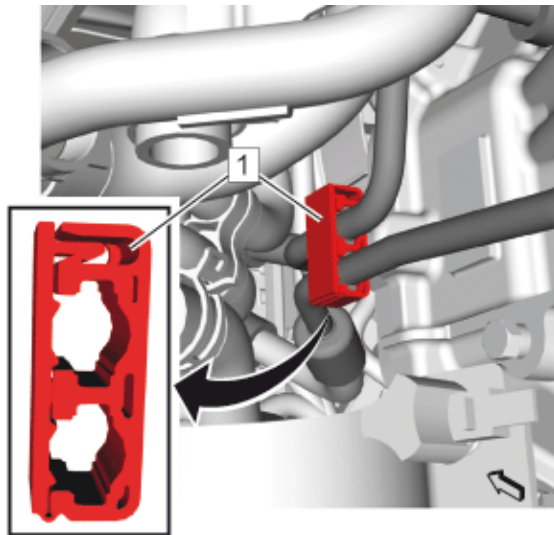


Fig. 176: Transmission Fluid Cooler Inlet And Outlet Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

35. Install Clip (1)
36. Install Drivetrain and Front Suspension Cradle. Refer to [Drivetrain and Front Suspension Cradle Replacement](#)
37. Install Radiator Inlet Hose. Refer to [Radiator Inlet Hose Replacement](#)

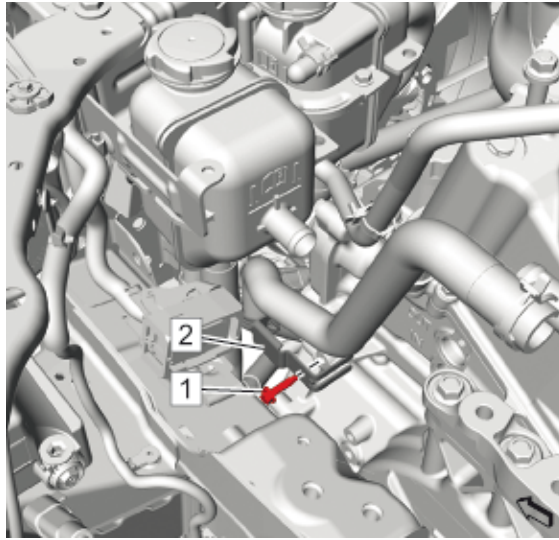


Fig. 177: Heater Inlet Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

38. Install Heater Inlet Hose Bracket (2)
39. Install and tighten Bolt (1) to 9 N.m (80 lb in)

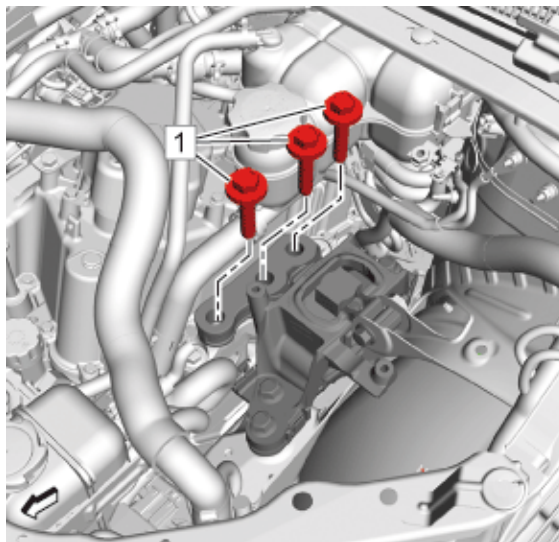


Fig. 178: Transmission Mount Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Torque-to-Yield Fastener Caution](#)

NOTE: Install NEW bolts.

40. Install NEW Transmission Mount Bolts (1) (Qty: 3). Hand tighten only.
41. Tighten Transmission Mount Bolts (1) (Qty: 3)
 1. First Pass: 100 N.m (74 lb ft)
 2. Final Pass: 60 - 75 degrees, use the **EN-45059** meter
42. Remove Engine Support Fixture. Refer to [Engine Support Fixture](#)

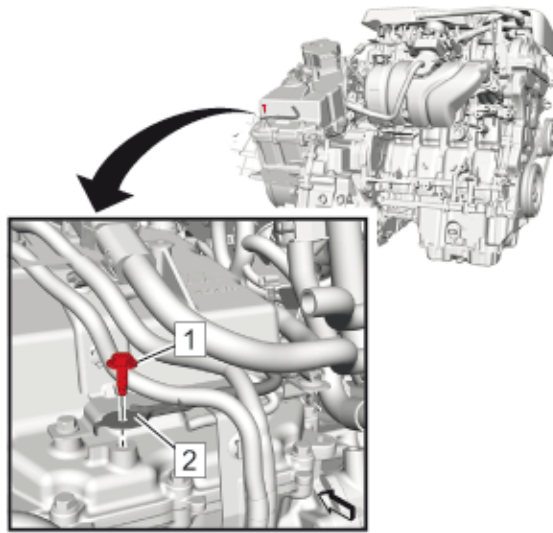


Fig. 179: Ground Cable And Bolt

Courtesy of GENERAL MOTORS COMPANY

- 43. Install Ground Cable (2)
- 44. Install and tighten Ground Cable Bolt (1) to 9 N.m (80 lb in)

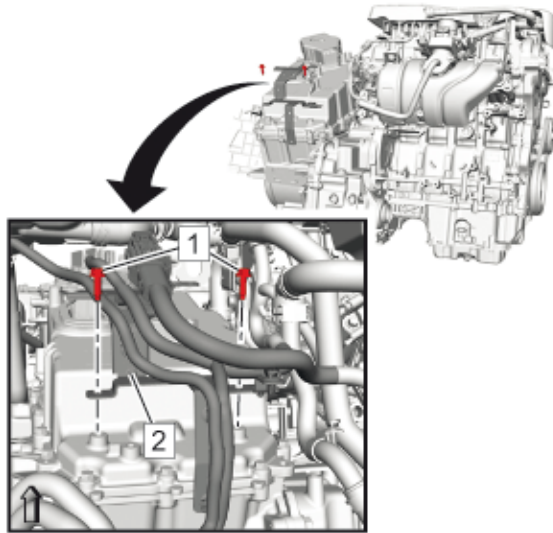


Fig. 180: Wiring Harness Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

- 45. Install Wiring Harness Bracket (2)
- 46. Install and tighten Bolts (1) (Qty: 2) to 9 N.m (80 lb in)
- 47. Lower the vehicle.

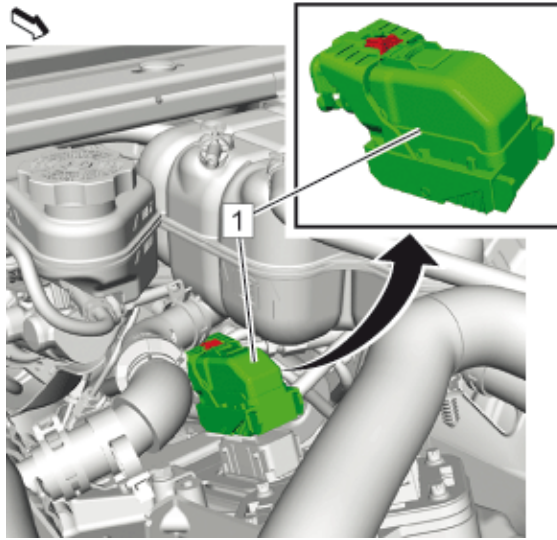


Fig. 181: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

48. Connect Electrical Connector (1)

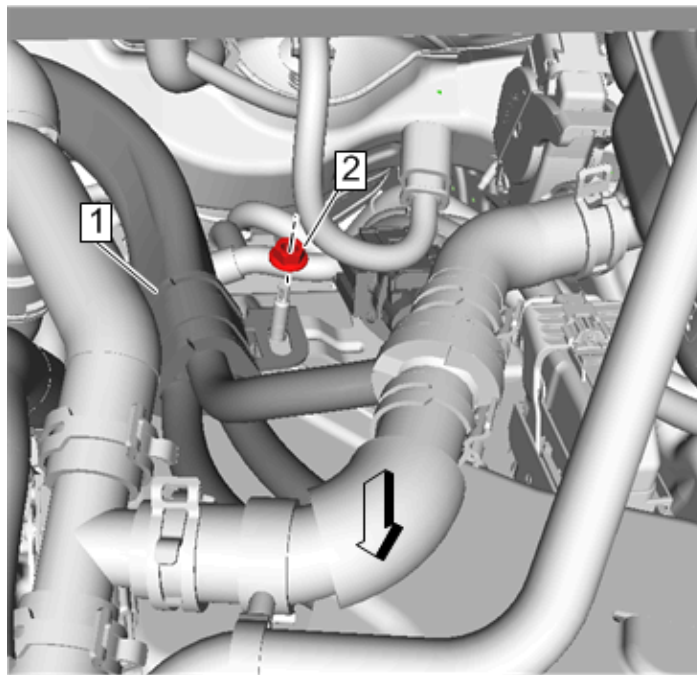


Fig. 182: Wiring Harness Bracket And Nut

Courtesy of GENERAL MOTORS COMPANY

49. Install Wiring Harness Bracket (1)

50. Install and tighten Nut (2) to 9 N.m (80 lb in)

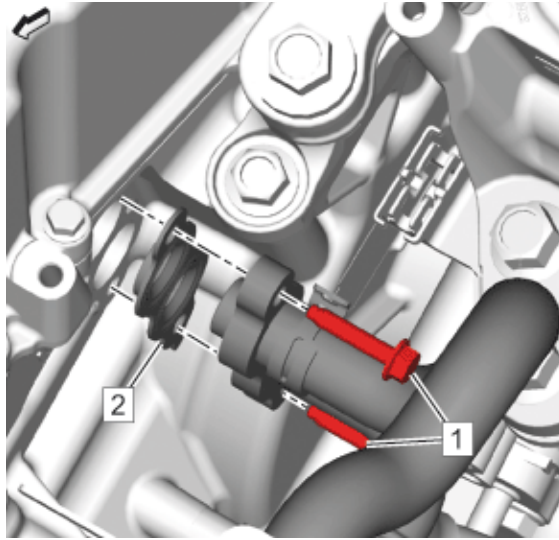


Fig. 183: Drive Motor Generator Control Module Cooling Outlet Hose And Bolts
Courtesy of GENERAL MOTORS COMPANY

51. Install the drive motor generator control module cooling outlet hose. Refer to [Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line\) Drive Motor Generator Control Module Cooling Outlet Hose Replacement \(Underbody Line to Traction Power Inverter Module Inlet\)](#)
52. Fill Drive Motor Generator Power Inverter Module Cooling System. Refer to [Drive Motor Generator Power Inverter Module Cooling System Draining and Filling](#)
53. Fill Transmission Fluid. Refer to [Transmission Fluid Drain and Fill](#)
54. Fill Cooling System. Refer to [Cooling System Draining and Filling](#)

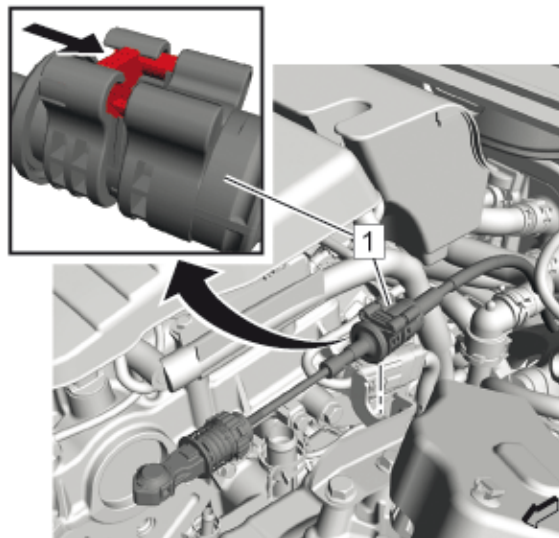


Fig. 184: Range Selector Lever Cable And Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

55. Install the range selector lever cable (1) to the range selector lever cable bracket.

The retainer snaps automatically in.

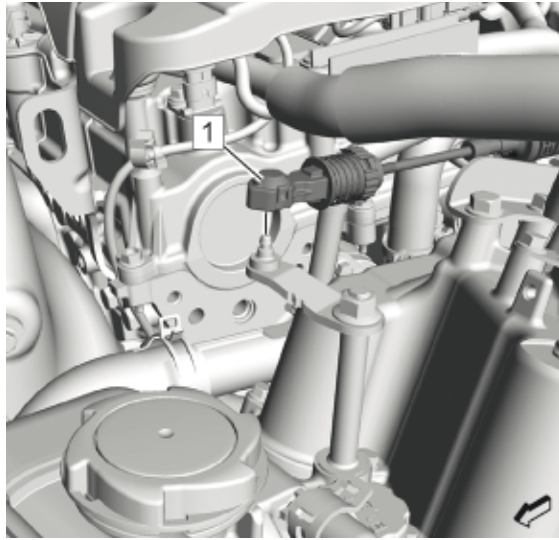


Fig. 185: Range Selector Lever Cable And Range Selector Lever Cable Lever
Courtesy of GENERAL MOTORS COMPANY

- 56. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever
- 57. Adjust Range Selector Lever Cable. Refer to [Range Selector Lever Cable Adjustment](#)

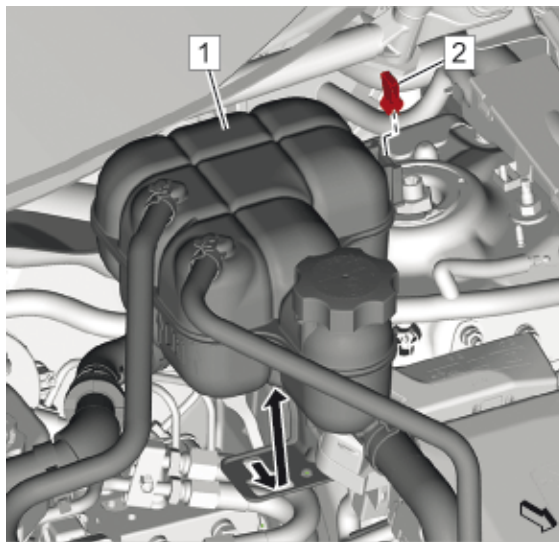


Fig. 186: Radiator Surge Tank And Bracket Clip
Courtesy of GENERAL MOTORS COMPANY

- 58. Install Radiator Surge Tank (1)
- 59. Install Radiator Surge Tank Bracket Clip (2)
- 60. Enable the high voltage system and connect the A4 Hybrid/EV Battery Pack high voltage harness connector at the T6 Power Inverter Module. Refer to [High Voltage Disabling](#)
- 61. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection](#)
- 62. Program the power inverter module and the immobilizer control module. Refer to [Control Module References](#)

REPAIR INSTRUCTIONS - OFF VEHICLE

HOLDING FIXTURE INSTALLATION

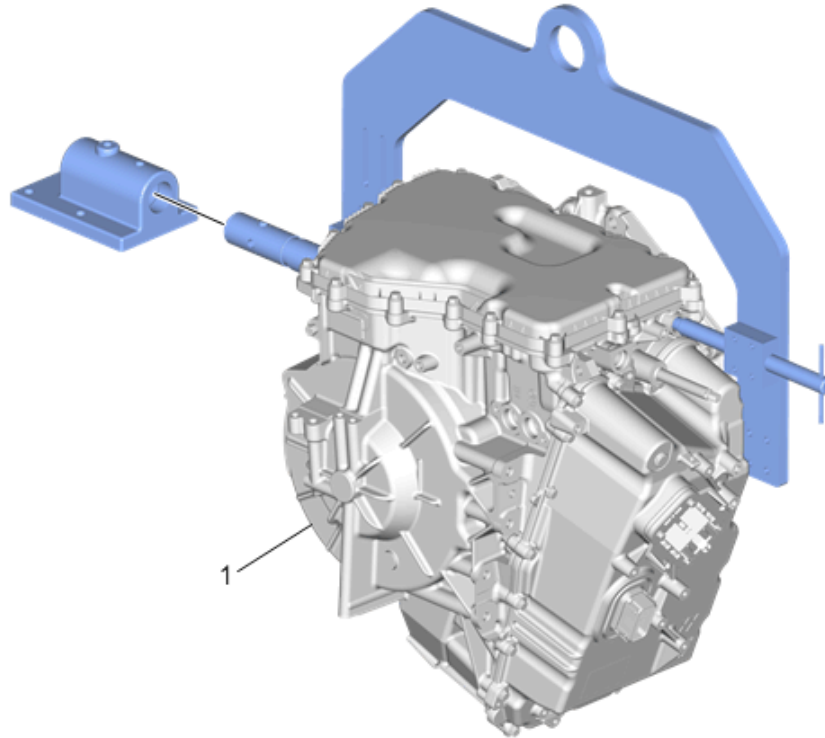


Fig. 187: Holding Fixture Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Â WARNING: Handle with care, the transmission assembly weighs over 183 Kg (403 lbs). Bodily injury could occur if not handled properly. CAUTION: Refer to Fastener Caution . Procedure 1. Use the supplied template to relocate holes on the fixture for mounting blocks. 2. Adjust mounting blocks on DT-46625 Holding Fixture to match bosses on case and

Callout	Component Name
	tighten to 13 N.m (115 lb in).
	Special Tools • DT-03289-20 Holding Fixture Base Assembly • DT-46625 Holding Fixture • DT-46625-20 Holding Fixture Adapters
	For equivalent regional tools, refer to Special Tools .

DRIVE MOTOR POWER INVERTER MODULE COVER REMOVAL

Drive Motor Battery Positive and Negative Cable Connector Removal

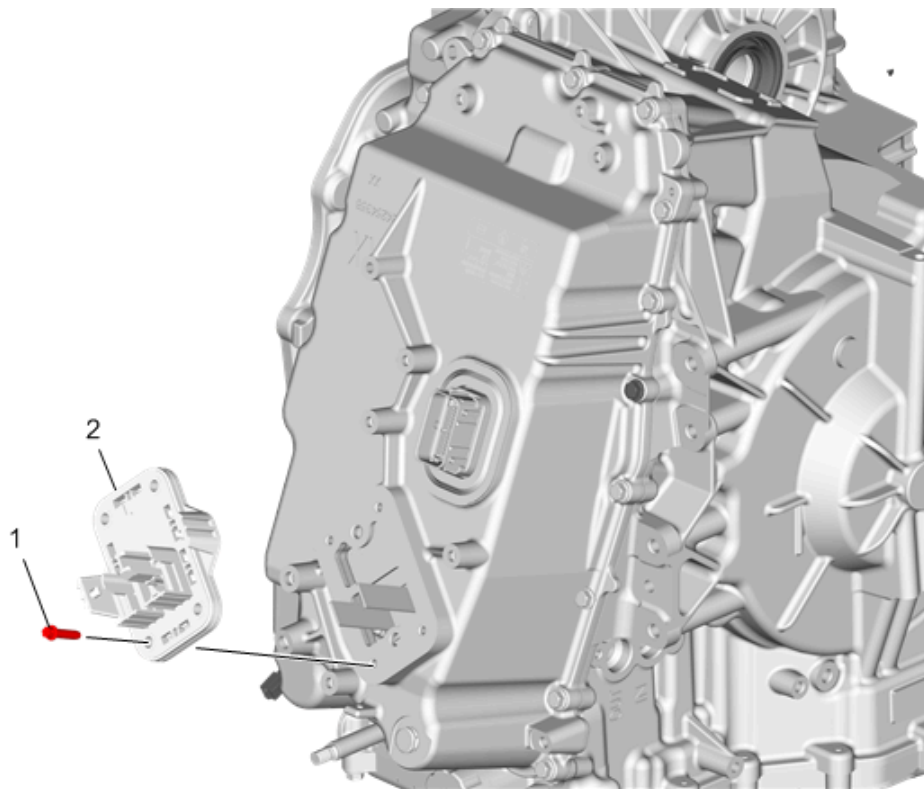


Fig. 188: Drive Motor Battery Positive And Negative Cable Connector

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Battery Positive and Negative Cable Connector Removal

Callout	Component Name
1	Drive Motor Battery Positive and Negative Cable Connector Bolt (Qty: 4)
2	Drive Motor Battery Positive and Negative Cable Connector

Drive Motor Power Inverter Module Cover Removal

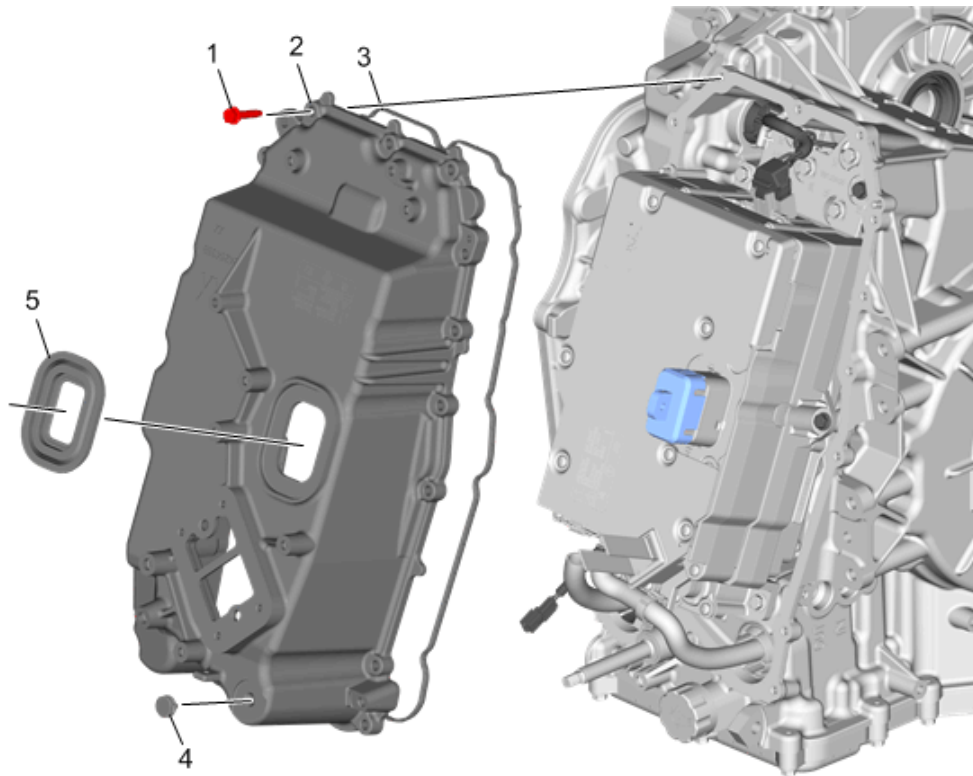


Fig. 189: Drive Motor Power Inverter Module Cover And Components

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cover Removal

Callout	Component Name
1	Drive Motor Power Inverter Module Cover Bolt (Qty: 17)
2	Drive Motor Power Inverter Module Cover Procedure Use the DT-51626 protector when removing the cover to avoid damaging the connector seal. Special Tools DT-51626 Seal Protector For equivalent regional tools, refer to Special Tools .
3	Drive Motor Power Inverter Module Cover Gasket NOTE: The gasket is reusable, inspect the gasket and replace if damaged.
4	Drive Motor Power Inverter Module Cover Vent
5	Drive Motor Power Inverter Module Electrical Connector Seal NOTE: The seal is reusable,

Callout	Component Name
	inspect the seal and replace if damaged.

DRIVE MOTOR POWER INVERTER MODULE REMOVAL

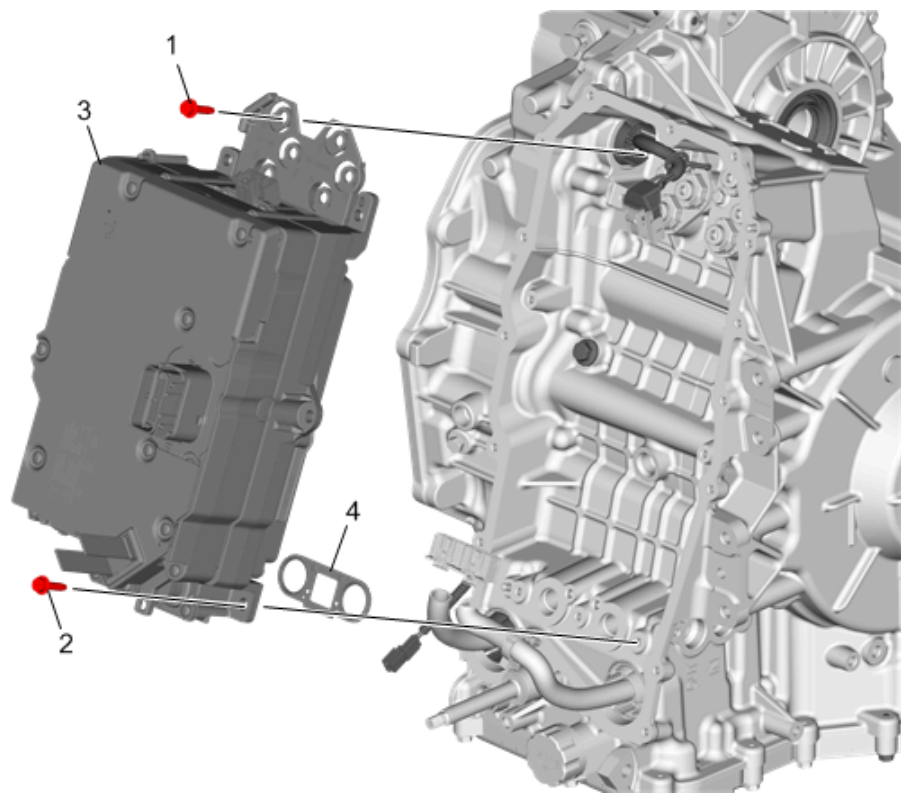


Fig. 190: Drive Motor Power Inverter Module And Components
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Disconnect the 3 drive motor power inverter module connectors. 2. Using shop air, blow air through the drive motor power inverter module cooling passage on the transmission to remove residual coolant.	
1	Drive Motor Power Inverter Module 3-Phase Buss Bar Bolt (Qty: 6)
2	Drive Motor Power Inverter Module Bolt (Qty: 7)
3	Drive Motor Power Inverter Module
4	Drive Motor Power Inverter Module Fluid Seal NOTE: DISCARD the seal.

CONTROL VALVE BODY COVER REMOVAL

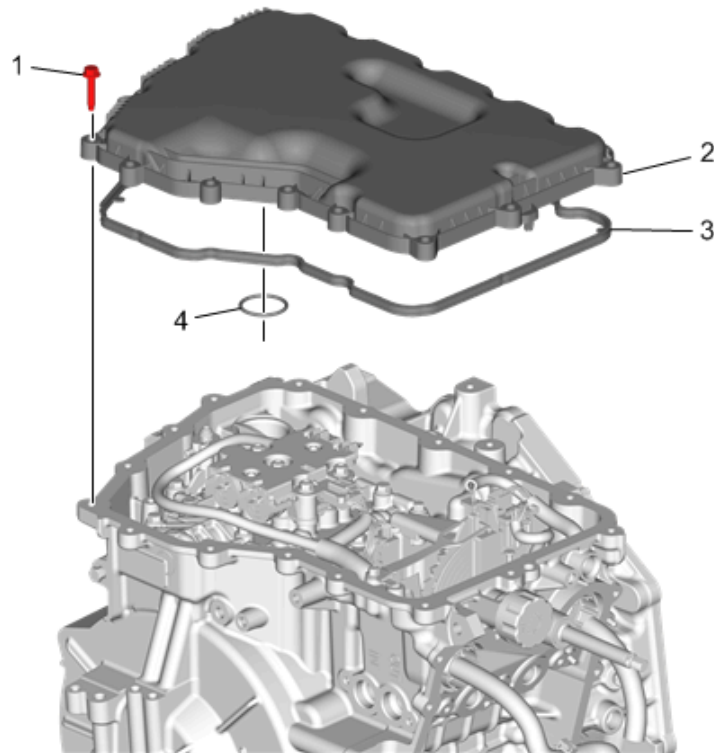


Fig. 191: Control Valve Body Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Valve Body Cover Bolt (Qty: 16)
2	Control Valve Body Cover
3	Automatic Transmission Fluid Level Control Valve Seal NOTE: The gasket is reusable, inspect the gasket and replace if damaged.
4	Automatic Transmission Fluid Level Control Valve Seal - O-ring NOTE: The seal is reusable, inspect the seal and replace if damaged.

CONTROL VALVE ASSEMBLY AND TRANSMISSION WIRING HARNESS REMOVAL

Control Solenoid Valve Removal

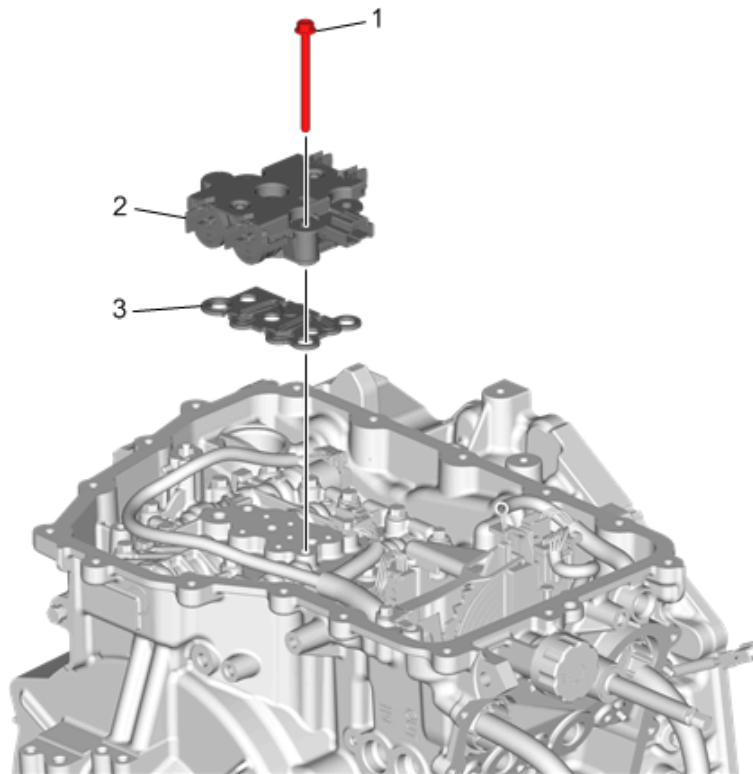


Fig. 192: Control Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

Control Solenoid Valve Removal

Callout	Component Name
Preliminary Procedure 1. Disconnect the control solenoid valve wiring harness. 2. Remove the connectors from the wiring harness brackets and shift detent lever.	
1	Control Valve Body Bolt (Qty: 4)
2	Control Solenoid Valve
3	Control Solenoid Valve Filter Plate NOTE: The filter plate is reusable, inspect the filter plate and replace if damaged.

Control Valve (with Body and Valve) Removal

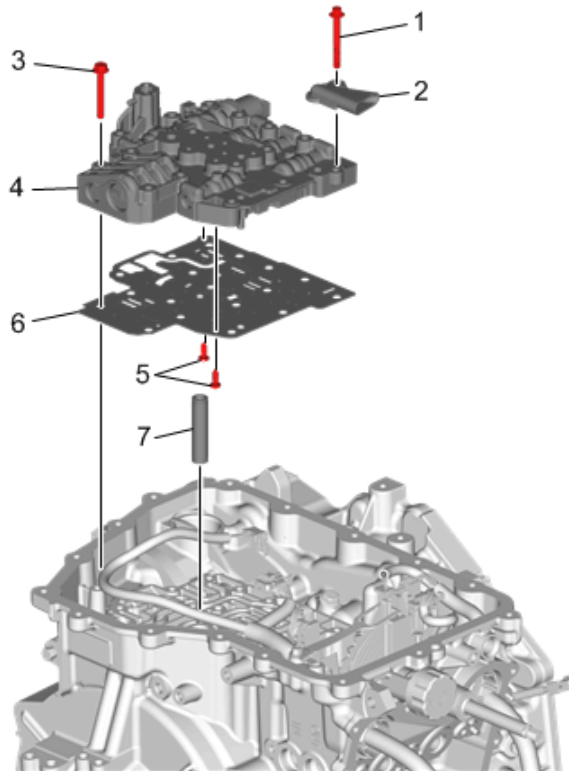


Fig. 193: Control Valve (With Body And Valve)

Courtesy of GENERAL MOTORS COMPANY

Control Valve (with Body and Valve) Removal

Callout	Component Name
Preliminary Procedure	
Disconnect the transmission wiring harness from the control valve body.	
1	Fluid Transfer Pipe Bolt
2	Fluid Transfer Pipe
3	Control Valve Body Bolt (Qty: 13)
4	Control Valve (with Body and Valve)
5	Control Valve Body Spacer Plate Retainer (Qty: 2)
6	Control Valve Lower Body Spacer Plate
7	Variable Low Clutch Fluid Passage Seal

Automatic Transmission Wiring Harness Removal

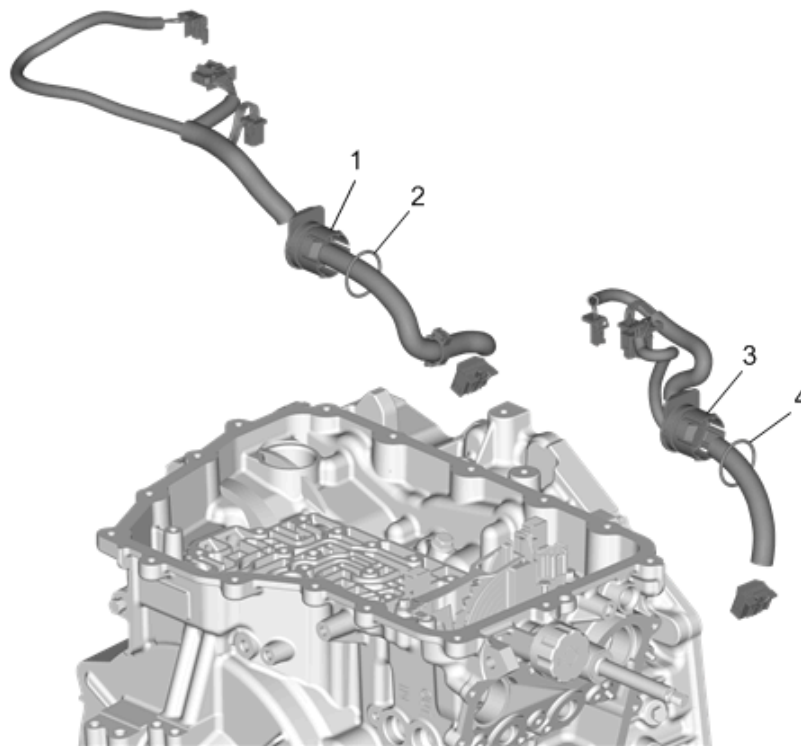


Fig. 194: Automatic Transmission Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Wiring Harness Removal

Callout	Component Name
Preliminary Procedure	
1. Disconnect the wiring harness connector from the manual shift detent lever and remove the connectors from the wiring harness brackets noting location for installation. 2. Remove the manual shift detent lever spring to aid in removal of the transmission wiring harness.	
1	Automatic Transmission Wiring Harness - Control Solenoid Valve
2	Automatic Transmission Wiring Connector Seal
3	Automatic Transmission Wiring Harness - Shift Shaft Position Switch
4	Automatic Transmission Wiring Connector Seal

AUTOMATIC TRANSMISSION TORQUE DAMPENER AND DIFFERENTIAL HOUSING REMOVAL

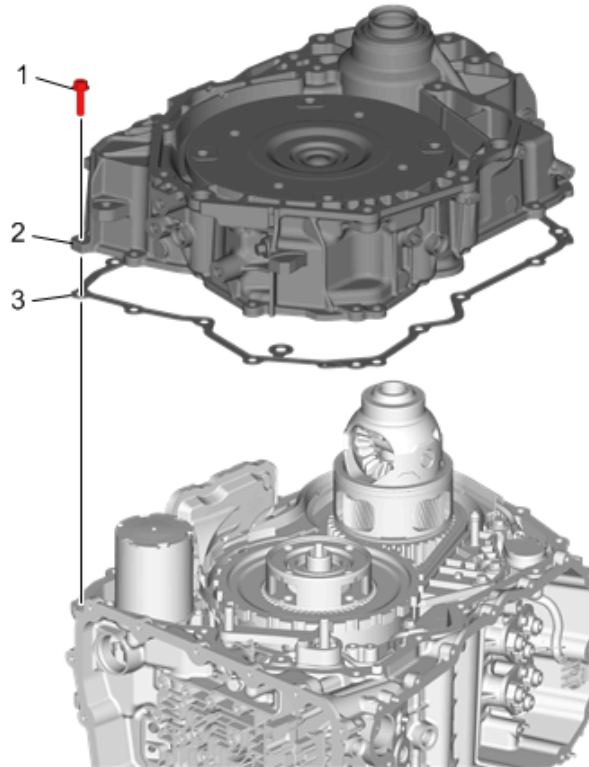


Fig. 195: Automatic Transmission Torque Dampener And Differential Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Torque Converter and Differential Housing Bolt (Qty: 16)
2	Automatic Transmission Torque Dampener and Differential Housing NOTE: The input internal gear assembly could stick to the torque dampener and differential housing.
3	Automatic Transmission Torque Dampener and Differential Housing Gasket NOTE: DISCARD the gasket.

FRONT DIFFERENTIAL CARRIER REMOVAL

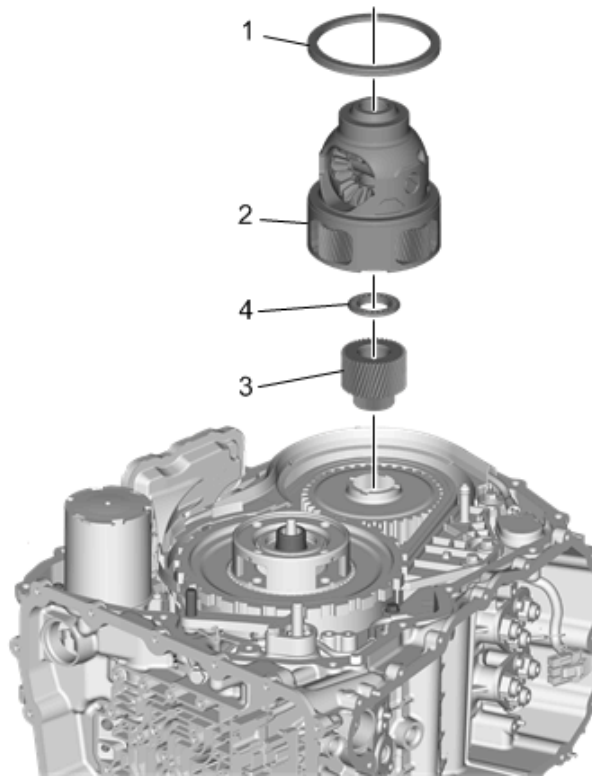


Fig. 196: Front Differential Carrier

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Differential Carrier Bearing
2	Front Differential Carrier
3	Front Differential Carrier Sun Gear
4	Differential Carrier Sun Gear Thrust Bearing

INPUT SUN GEAR SHAFT REMOVAL

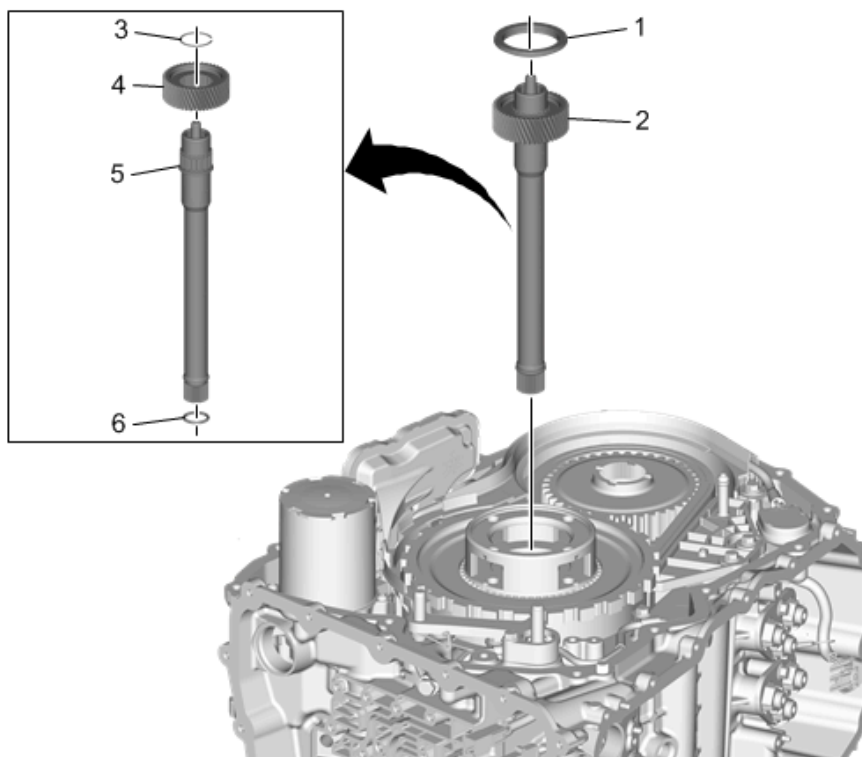


Fig. 197: Input Sun Gear Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Internal Gear Thrust Bearing
2	Input Sun Gear Shaft Assembly
3	Input Sun Gear Retaining Ring
4	Input Sun Gear
5	Input Sun Gear Shaft
6	Variable High Clutch Housing Seal
	NOTE: DISCARD the seal.

FRONT DIFFERENTIAL CARRIER BAFFLE REMOVAL

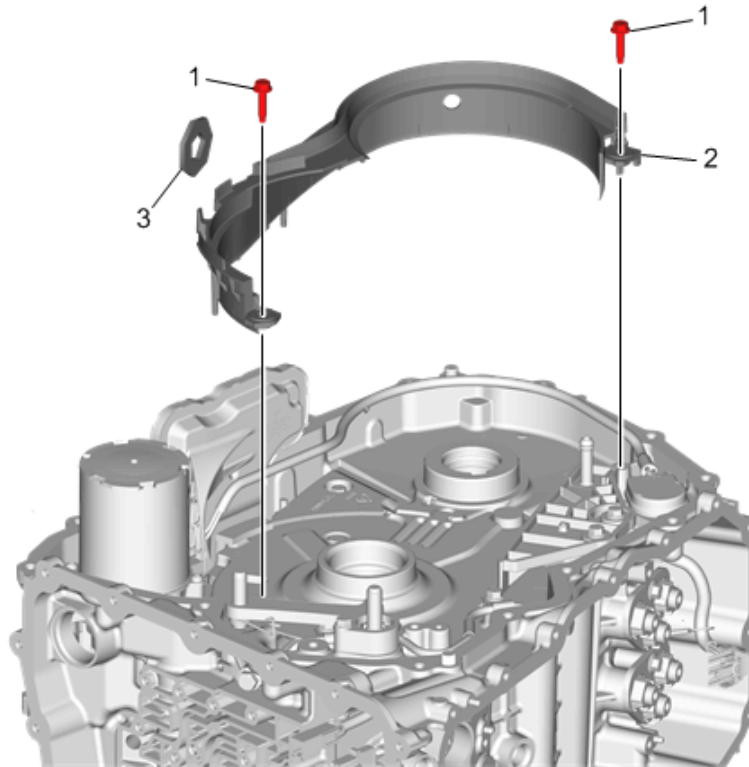


Fig. 198: Front Differential Carrier Baffle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Differential Carrier Baffle Bolt (Qty: 2)
2	Front Differential Carrier Baffle
3	Automatic Transmission Fluid Chip Collector Magnet

DRIVE SPROCKET, DRIVEN SPROCKET, AND DRIVE LINK REMOVAL

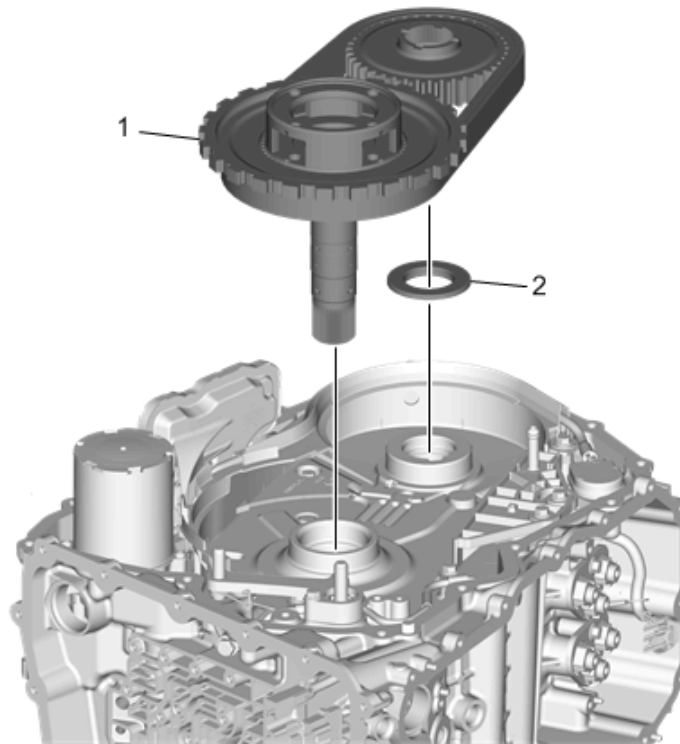


Fig. 199: Drive Sprocket, Driven Sprocket And Drive Link
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Sprocket, Driven Sprocket, and Drive Link NOTE: Inspect the bearing that is pressed into the driven sprocket. If the bearing is loose, replace the driven sprocket.
2	Driven Sprocket Bearing

DRIVE LINK SNUBBER REMOVAL

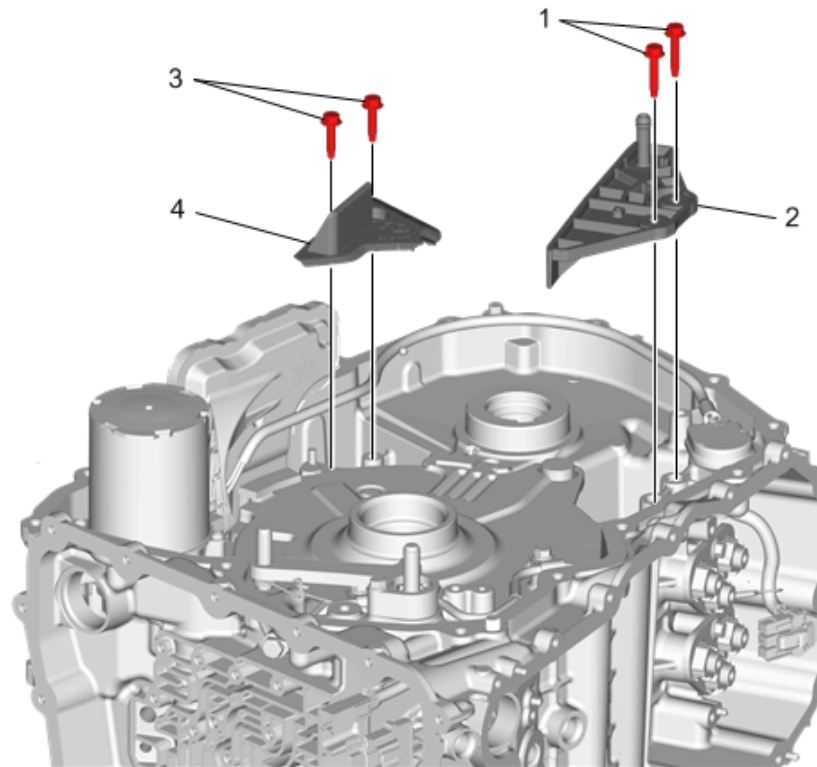


Fig. 200: Drive Link Snubber

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Link Snubber Bolt (Qty: 2)
2	Drive Link Snubber
3	NOTE: A plastic washer is used on the bolts during initial assembly. These washers may come loose after bolt removal. Ensure that the washers do not drop into the transmission case. Discard the washers. Drive Link Snubber Bolt (Coast Side) (Qty: 2)

Callout	Component Name
4	Drive Link Snubber (Coast Side)

AUTOMATIC TRANSMISSION FLUID PUMP AND FLUID FILTER REMOVAL

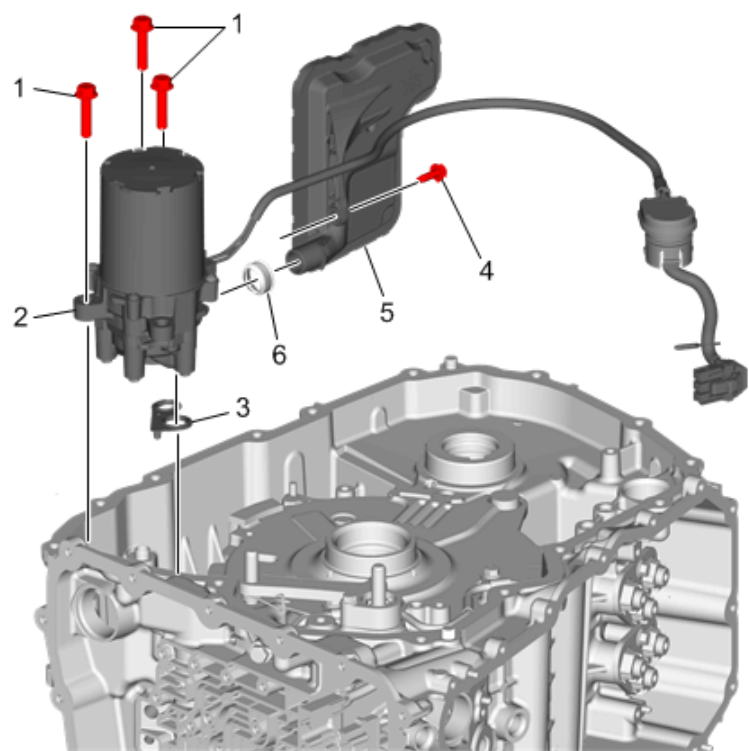


Fig. 201: Automatic Transmission Fluid Pump And Fluid Filter
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Disconnect the fluid pump pass thru connector from the case.	
1	Automatic Transmission Fluid Pump Bolt (Qty: 3)
2	NOTE: Guide the fluid pump wiring harness from the case. Automatic Transmission Fluid Pump
3	NOTE: DISCARD the seal. Automatic Transmission Pump Fluid Outlet Seal
4	Automatic Transmission Fluid Filter Bolt

Callout	Component Name
5	Automatic Transmission Fluid Filter
6	NOTE: DISCARD the seal. Automatic Transmission Fluid Filter Seal

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR REMOVAL

Automatic Transmission Wiring Harness Bracket Removal

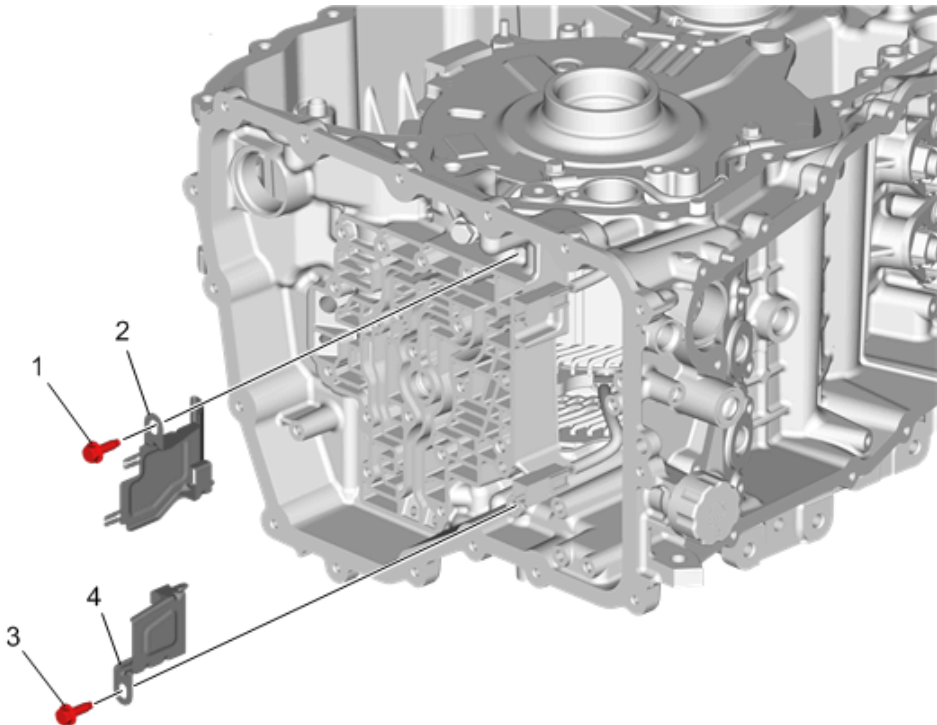


Fig. 202: Automatic Transmission Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Wiring Harness Bracket Removal

Callout	Component Name
Preliminary Procedure	
Remove the drive motor wiring harness connectors from the wiring harness connector brackets.	
1	Automatic Transmission Wiring Harness Connector Bracket Bolt (Qty: 1)
2	Automatic Transmission Wiring Harness Bracket
3	Automatic Transmission Wiring Harness Connector Bracket Bolt (Qty: 1)
4	Automatic Transmission Wiring Harness Bracket

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal

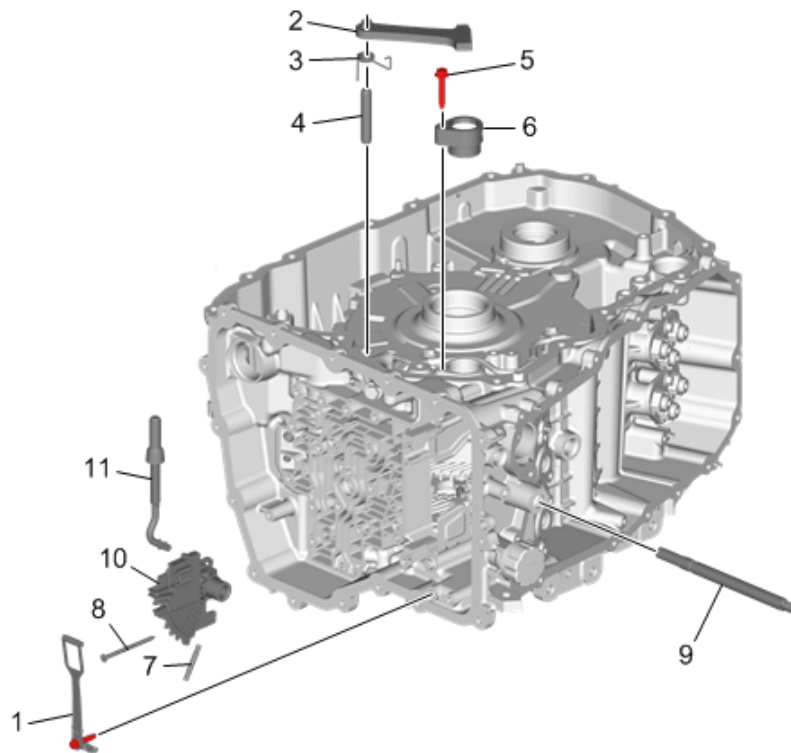


Fig. 203: Manual Shift Detent Lever With Shaft Position Switch Assembly And Park Pawl Actuator
 Courtesy of GENERAL MOTORS COMPANY

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Removal

Callout	Component Name
1	Manual Shift Detent Lever Spring
2	Park Pawl
3	Park Pawl Spring
4	Park Pawl Shaft
5	Park Pawl Actuator Guide Bolt
6	Park Pawl Actuator Guide
7	Manual Shift Detent Lever Pin
8	Manual Shift Shaft Pin NOTE: DISCARD the manual shift shaft pin.
9	Manual Shift Detent Lever Shaft
10	Manual Shift Detent Lever
11	Park Pawl Actuator

DRIVE MOTOR REMOVAL - 2ND POSITION

Drive Motor Stator Cooling Tube Removal

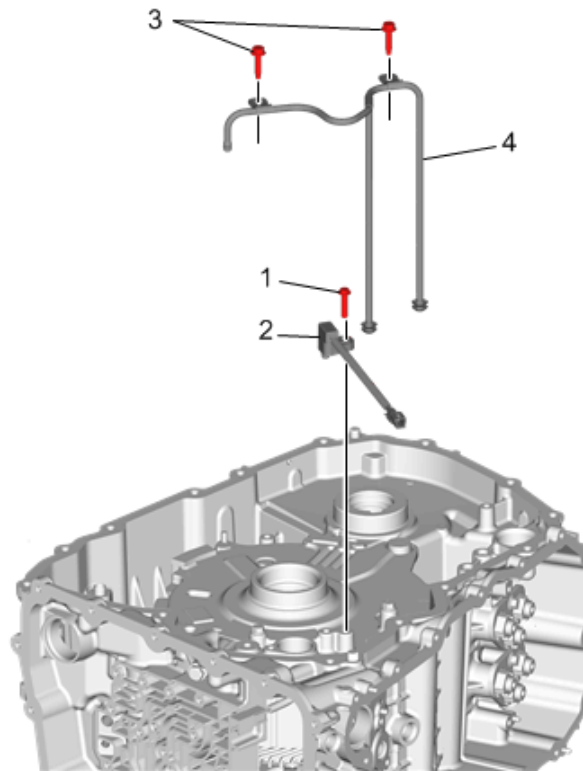


Fig. 204: Drive Motor Stator Cooling Tube

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator Cooling Tube Removal

Callout	Component Name
1	Automatic Transmission Output Speed Sensor Bolt
2	Automatic Transmission Output Speed Sensor
3	Drive Motor Stator Cooling Tube Bolt (Qty: 2) NOTE: A plastic washer is used on the bolts during initial assembly. These washers may come loose after bolt removal. Ensure that the washers do not drop into the transmission case. Discard the

Callout	Component Name
	washers.
4	Drive Motor Stator Cooling Tube

Drive Motor - 2nd Position Bolt Removal

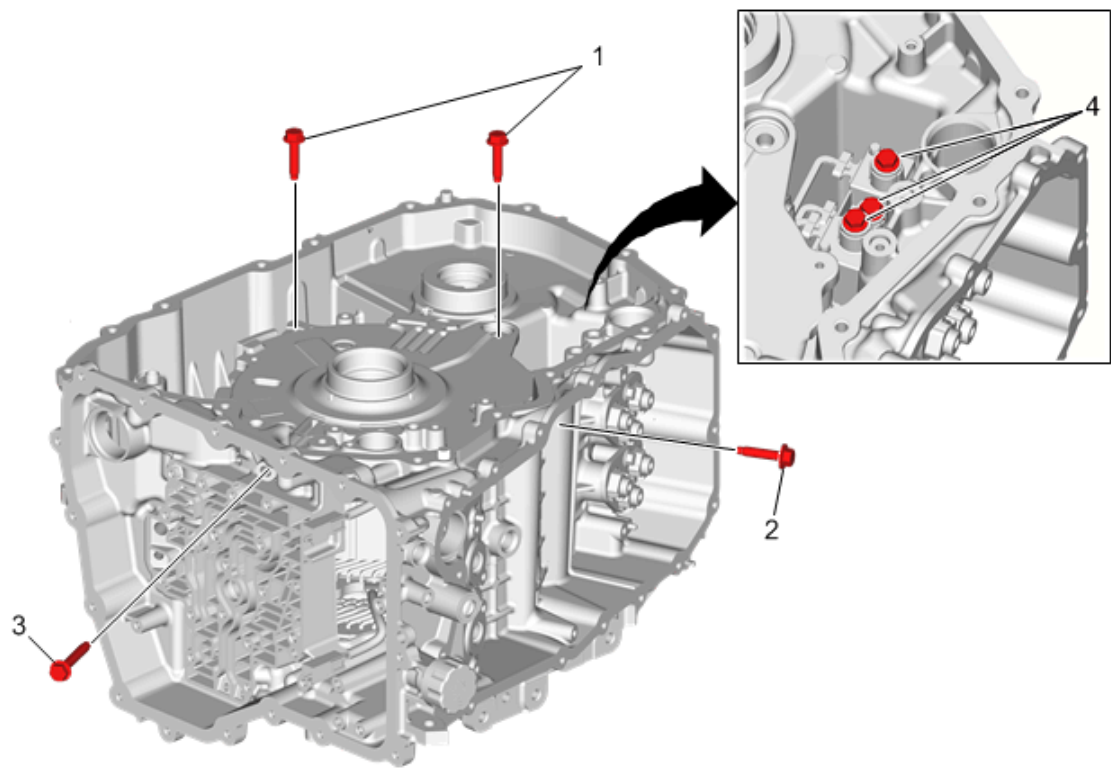


Fig. 205: Drive Motor - 2nd Position Bolts
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 2nd Position Bolt Removal

Callout	Component Name
1	Automatic Transmission Case Extension Bolt (Qty: 2)
2	Automatic Transmission Case Extension Bolt (Qty: 1) NOTE: DISCARD the bolt.
3	Automatic Transmission Case Extension Bolt (Qty: 1) NOTE: DISCARD the bolt.
4	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)

Drive Motor - 2nd Position Removal

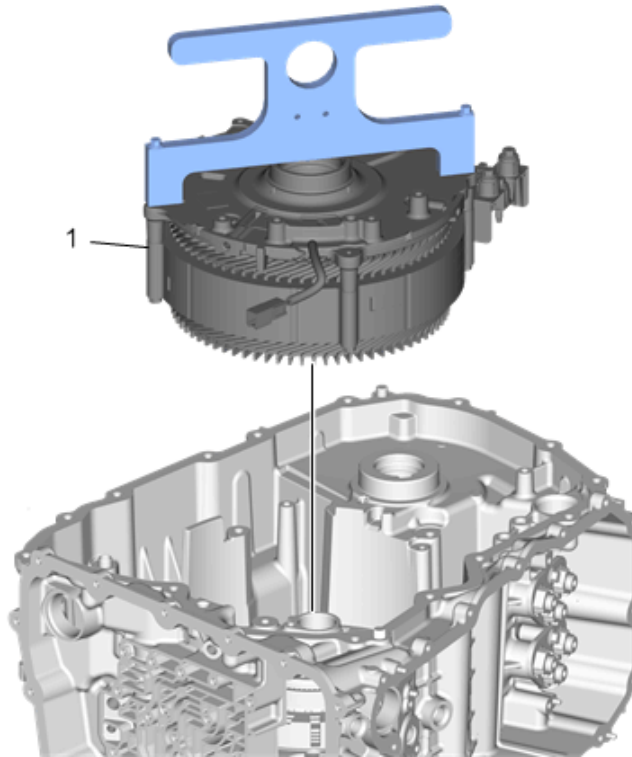


Fig. 206: Drive Motor - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 2nd Position Removal

Callout	Component Name
1	Drive Motor - 2nd Position WARNING: The generator motor weighs approximately 23 kg (50 lbs). Personal injury may result if you lift the generator motor improperly. CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils.

Callout	Component Name
	Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. Procedure 1. Install the DT-51623 motor lift bar. 2. Attach a lift assist hook through the DT-51623 motor lift bar. 3. Guide the drive motor resolver wire through the transmission case while lifting the drive motor using a lift assist. 4. Set the drive motor on its side on a clean lint free cloth. DO NOT rest the drive motor on the stator end coils. 5. Detach the lift assist hook and remove the DT-51623 motor lift bar. 6. Carefully tip over the drive motor flat onto the work surface resting on it cast aluminum support. Special Tools DT-51623 Motor Lift Bar For equivalent regional tools, refer to <u>Special Tools</u>.

Drive Motor Power Inverter Module Connector Removal

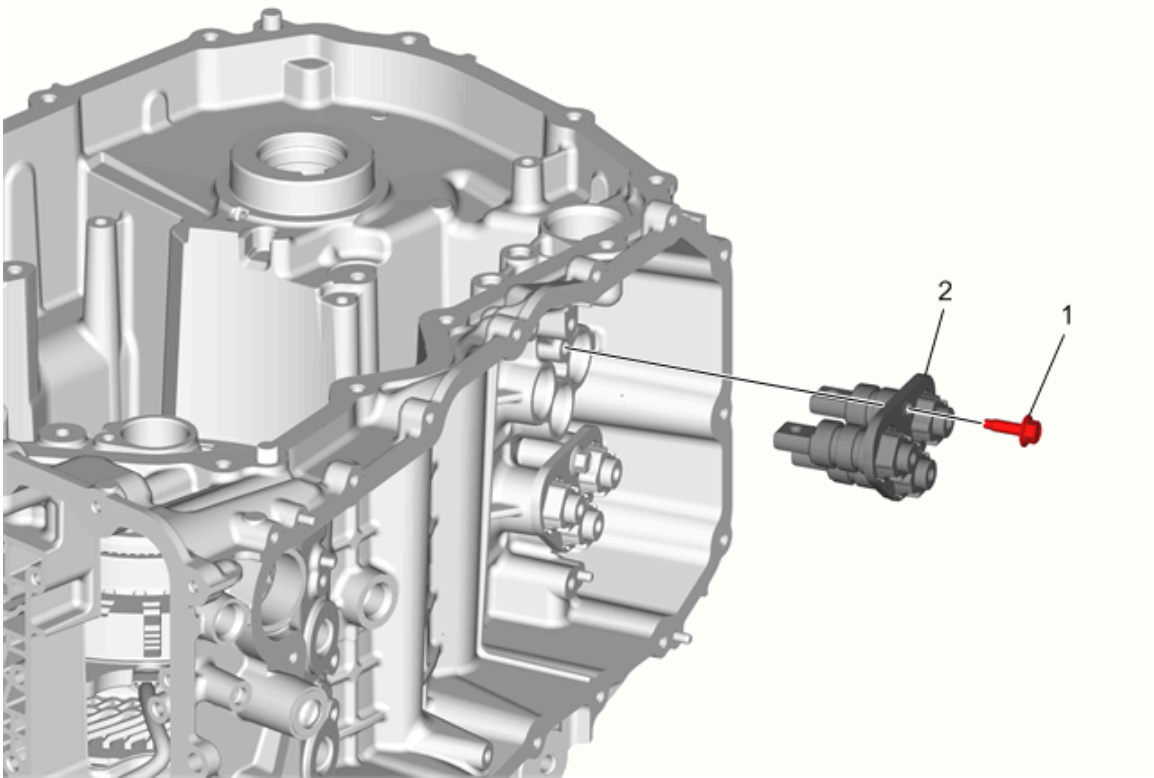


Fig. 207: Drive Motor Power Inverter Module Connector

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Connector Removal

Callout	Component Name
1	Drive Motor Power Inverter Module Connector Bolt NOTE: DISCARD the bolt.
2	Drive Motor Power Inverter Module Connector NOTE: DISCARD the connector.

OUTPUT CARRIER AND OUTPUT CARRIER INTERNAL GEAR REMOVAL

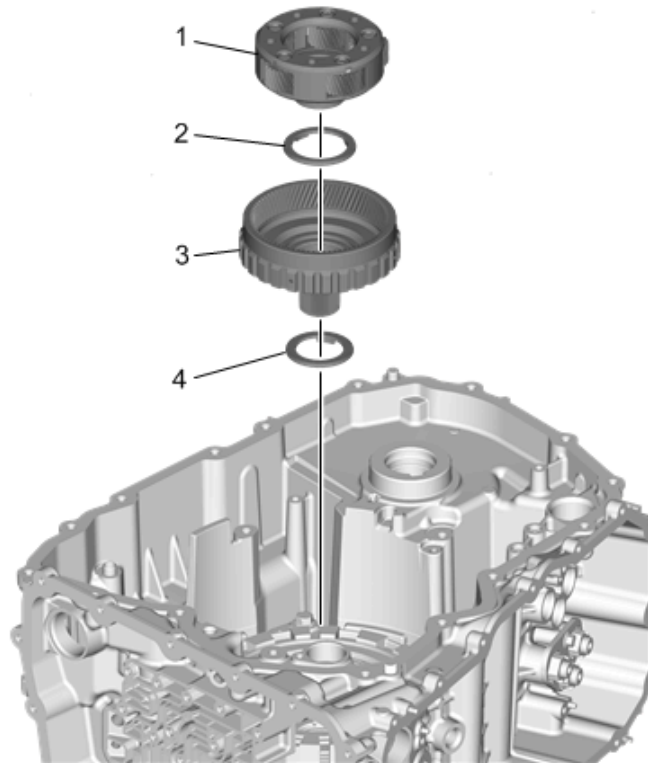


Fig. 208: Output Carrier And Output Carrier Internal Gear

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Carrier
2	Output Carrier Thrust Bearing
3	Output Carrier Internal Gear
4	Output Carrier Internal Gear Hub Thrust Bearing

DRIVE MOTOR REMOVAL - 1ST POSITION

Drive Motor - 1st Position Removal

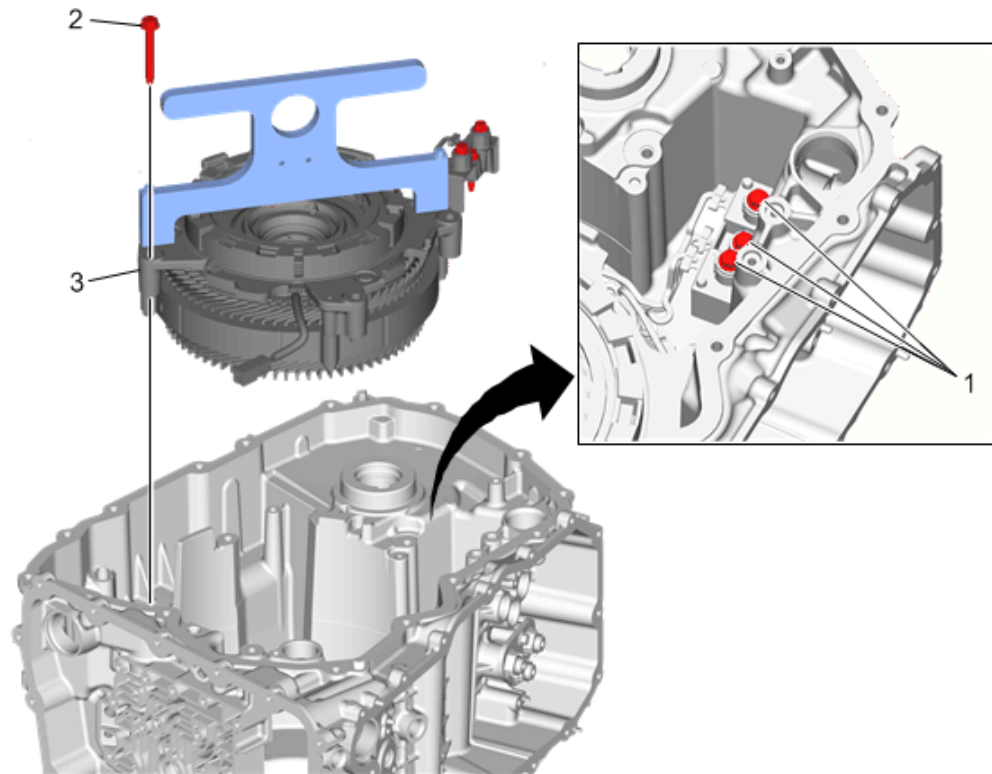


Fig. 209: Drive Motor - 1st Position

Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 1st Position Removal

Callout	Component Name
1	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)
2	Automatic Transmission Case Extension Bolt (Qty: 4)
3	Drive Motor - 1st Position WARNING: The generator motor weighs approximately 23 kg (50 lbs). Personal injury may result if you lift the generator motor improperly. CAUTION: DO NOT contact or rest the drive motor stator on the

Callout	Component Name
	copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. Procedure 1. Install the DT-51623 motor lift bar. 2. Attach a lift assist hook through the DT-51623 motor lift bar. 3. Guide the drive motor resolver wire through the transmission case while lifting the drive motor using a lift assist. 4. Set the drive motor on its side on a clean lint free cloth. DO NOT rest the drive motor on the stator end coils. 5. Detach the lift assist hook and remove the DT-51623 motor lift bar. 6. Carefully tip over the drive motor flat onto the work surface resting on it cast aluminum support. Special Tools DT-51623 Motor Lift Bar For equivalent regional tools, refer to Special Tools.

Drive Motor Power Inverter Module Connector Removal

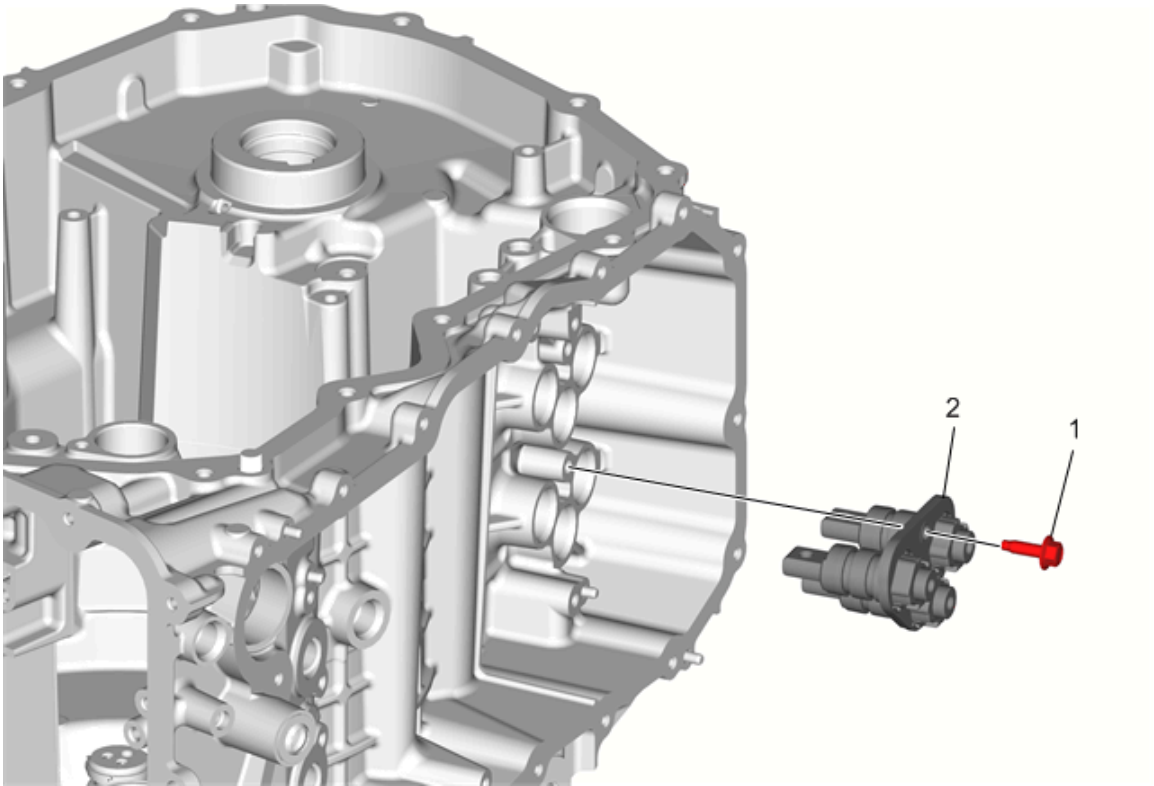


Fig. 210: Drive Motor Power Inverter Module Connector

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Connector Removal

Callout	Component Name
1	Drive Motor Power Inverter Module Connector Bolt NOTE: DISCARD the bolt.
2	Drive Motor Power Inverter Module Connector NOTE: DISCARD the connector.

VARIABLE HIGH CLUTCH FLUID TRANSFER SUPPORT SEAL OVERHAUL

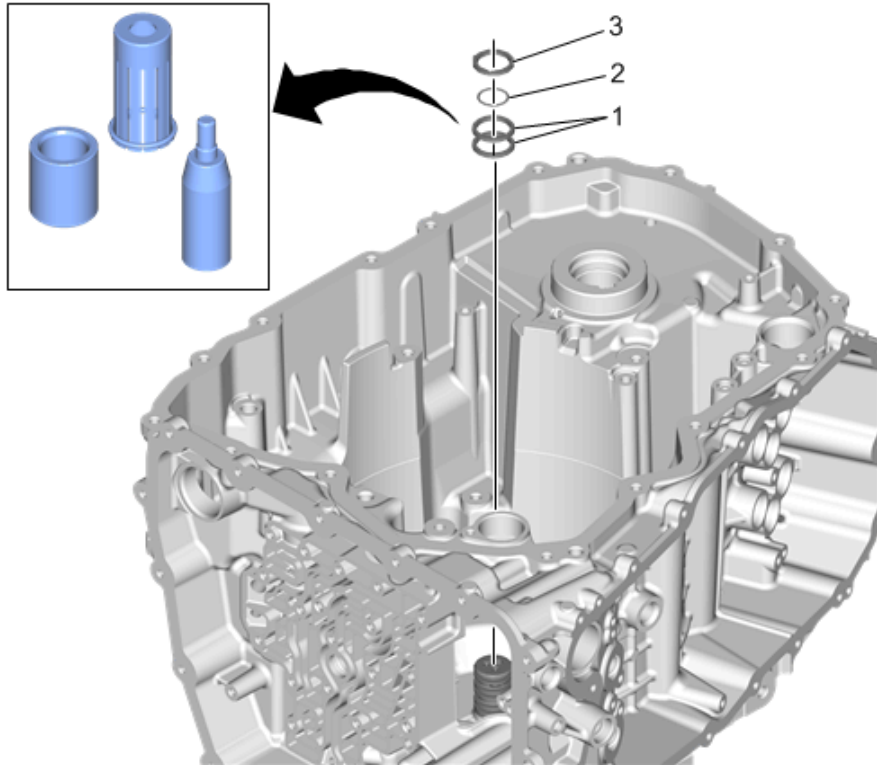


Fig. 211: Variable High Clutch Fluid Transfer Support Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: Refer to Seal Reuse Caution .	
1	Variable High Clutch Fluid Transfer Support Seal (Qty: 2) CAUTION: Size the fluid seal rings for at least 5 minutes after installation to obtain proper seal ring size. Failure to do so may cause internal transmission leaks and transmission damage.

Callout	Component Name
	Procedure 1. Use the DT-50911-2 pusher and adjustment screw from DT-50911-3 with DT-51700 installer to install the seals. 2. Adjust the turn screw on the protector and install the bottom seal ring first. 3. Use the large taper side of DT-51700 seal sizer for initial seal sizing, then flip the tool over for final sizing. 4. Leave DT-51700 seal sizer in place until the drive motor is ready to be installed. NOTE: Use NEW seals. Special Tools • DT-50911 Seal Installer • DT-51700 Seal Installer For equivalent regional tools, refer to Special Tools.
2	Variable High Clutch Fluid Transfer Support Seal - O-Ring NOTE: Use a NEW seal.
3	Variable High Clutch Fluid Seal Ring NOTE: Use a NEW seal.

FRONT WHEEL DRIVE SHAFT OIL SEAL REMOVAL - LEFT SIDE

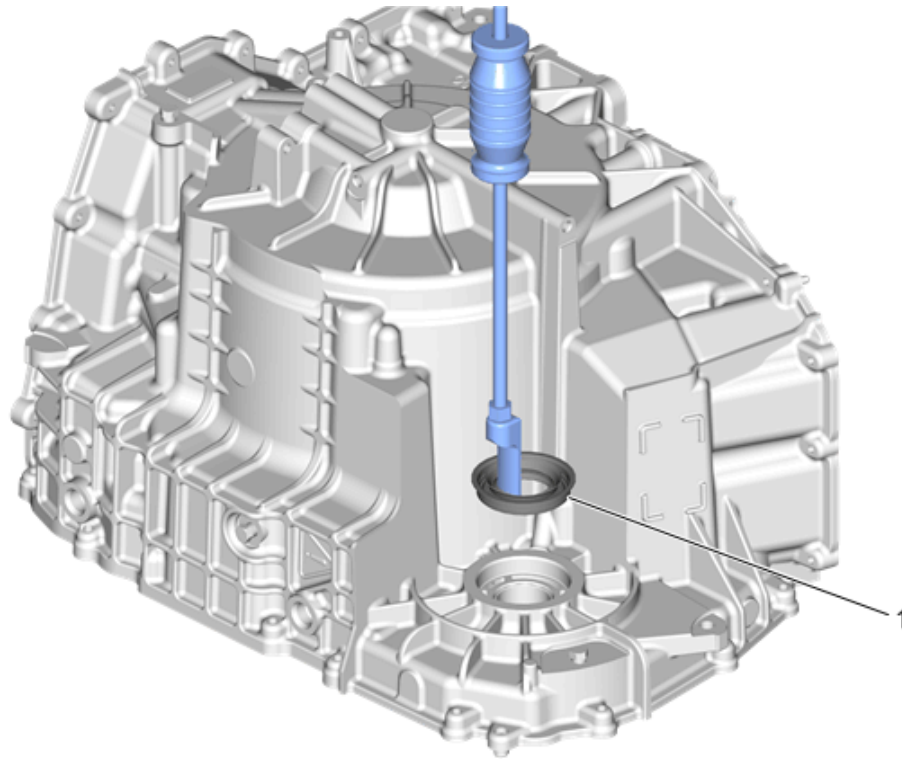


Fig. 212: Front Wheel Drive Shaft Oil Seal - Left Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Special Tools • DT-23129 Universal Seal Remover • GE-6125-1B Slide Hammer For equivalent regional tools, refer to Special Tools.

TRANSMISSION CASE CLEANING AND INSPECTION

Transmission Case Inspection (1 of 2)

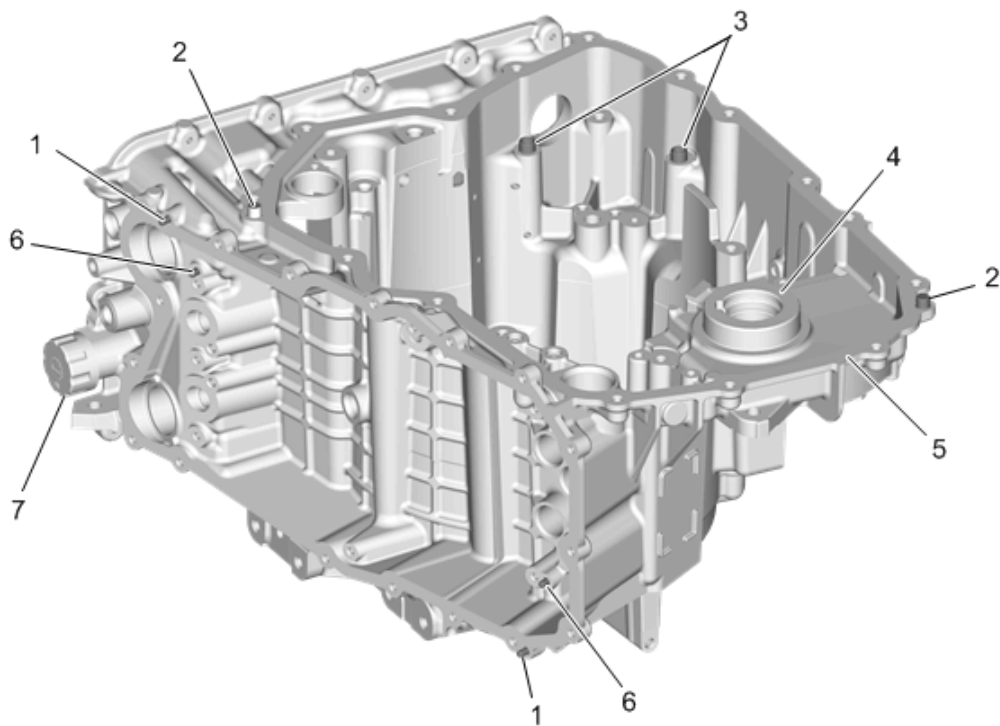


Fig. 213: Transmission Case Inspection (1 Of 2)
 Courtesy of GENERAL MOTORS COMPANY

Transmission Case Inspection (1 of 2)

Callout	Component Name
CAUTION: Do not use abrasive pads or bristle devices to clean the sealing surfaces. Abrasive pads produce a fine grit that can effect transmission function. Abrasive pads can also remove enough metal to create oil leaks.	

Callout	Component Name
CAUTION: After CAUTION: Do not use any cleaning agents, solvents, or dry-cleaning compounds. Do not use a cloth or paper towels in order to dry the transmission components. Lint from the towels can cause premature component failure. Thoroughly clean the transmission case assembly, including case threads, with clean solvent. 2. Clean gasket sealing surfaces. Remove all residual gasket material. 3. Inspect all threaded holes. If necessary, repair any thread damage.	
1	Drive Motor Power Inverter Module Cover Pin
2	Transmission Case Locating Pin
3	Automatic Transmission Fluid Pump Locating Pin
4	Driven Sprocket Bearing Mating Surface
5	Transmission Case to Torque Dampener and Differential Housing Sealing Surface
6	Drive Motor Power Inverter Module Pin
7	Transmission Fluid Filler Cap

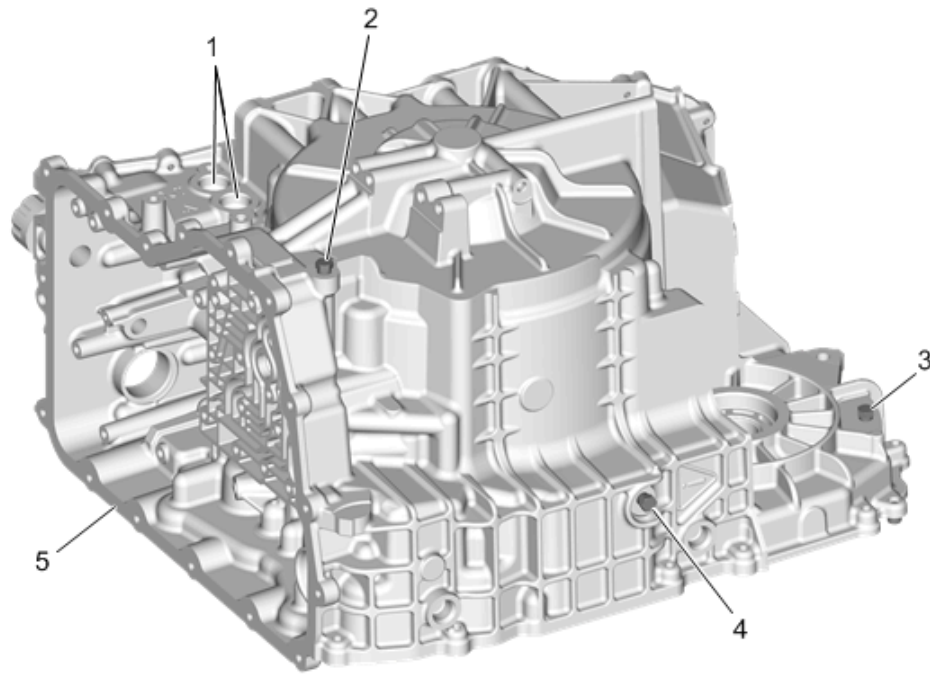


Fig. 214: Transmission Case Inspection (2 Of 2)
 Courtesy of GENERAL MOTORS COMPANY

Transmission Case Inspection (2 of 2)

Callout	Component Name
1	Transmission Fluid Cooler Pipe Sealing Surface (Qty: 2)
2	Automatic Transmission Case Plug
3	Automatic Transmission Fluid Level Hole Plug
4	Transmission Fluid Drain Plug
5	Transmission Case to Control Valve Body Cover Sealing Surface

FRONT WHEEL DRIVE SHAFT OIL SEAL INSTALLATION - LEFT SIDE

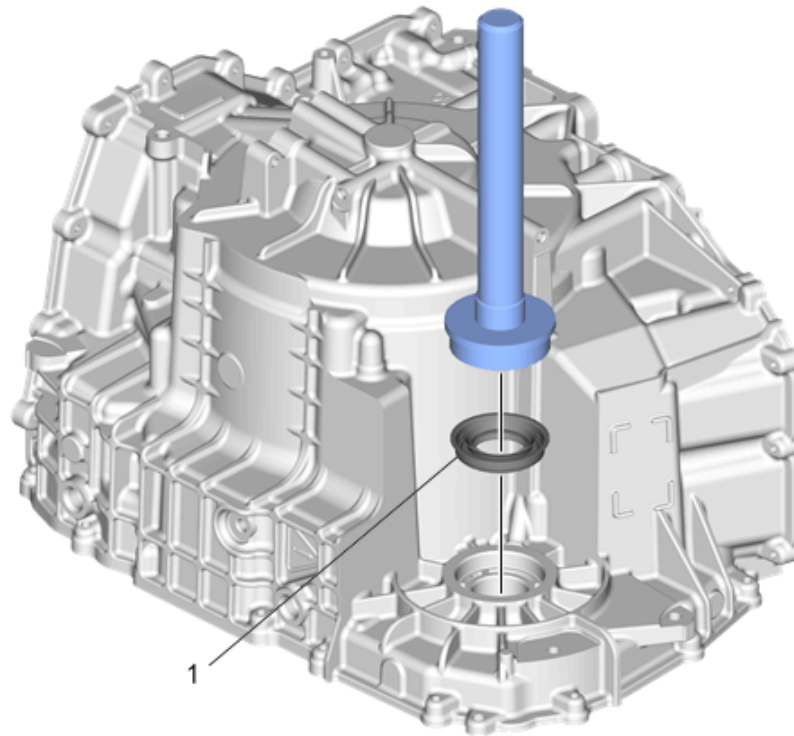


Fig. 215: Front Wheel Drive Shaft Oil Seal - Left Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Special Tools • DT-46629-A Axle Seal Installer • GE-8092 Driver Handle For equivalent regional tools, refer to Special Tools.

MANUAL SHIFT SHAFT SEAL REMOVAL

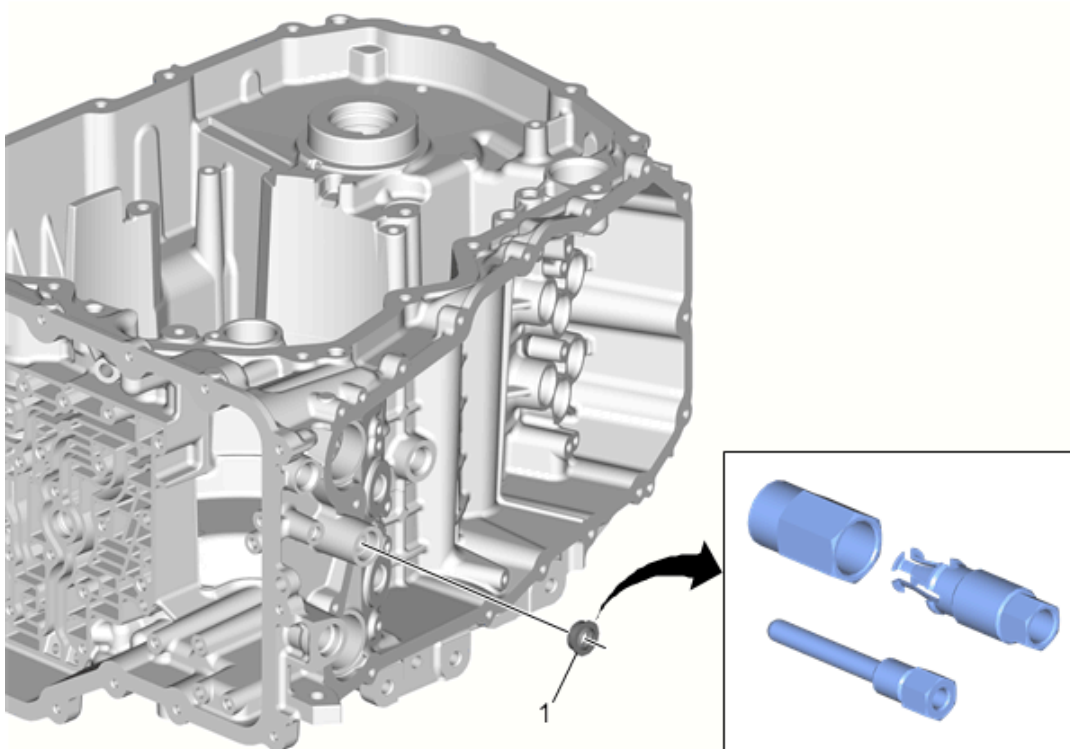


Fig. 216: Manual Shift Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Seal Special Tools DT-45201 Seal Remover For equivalent regional tools, refer to Special Tools .

VARIABLE LOW CLUTCH PLATE REMOVAL

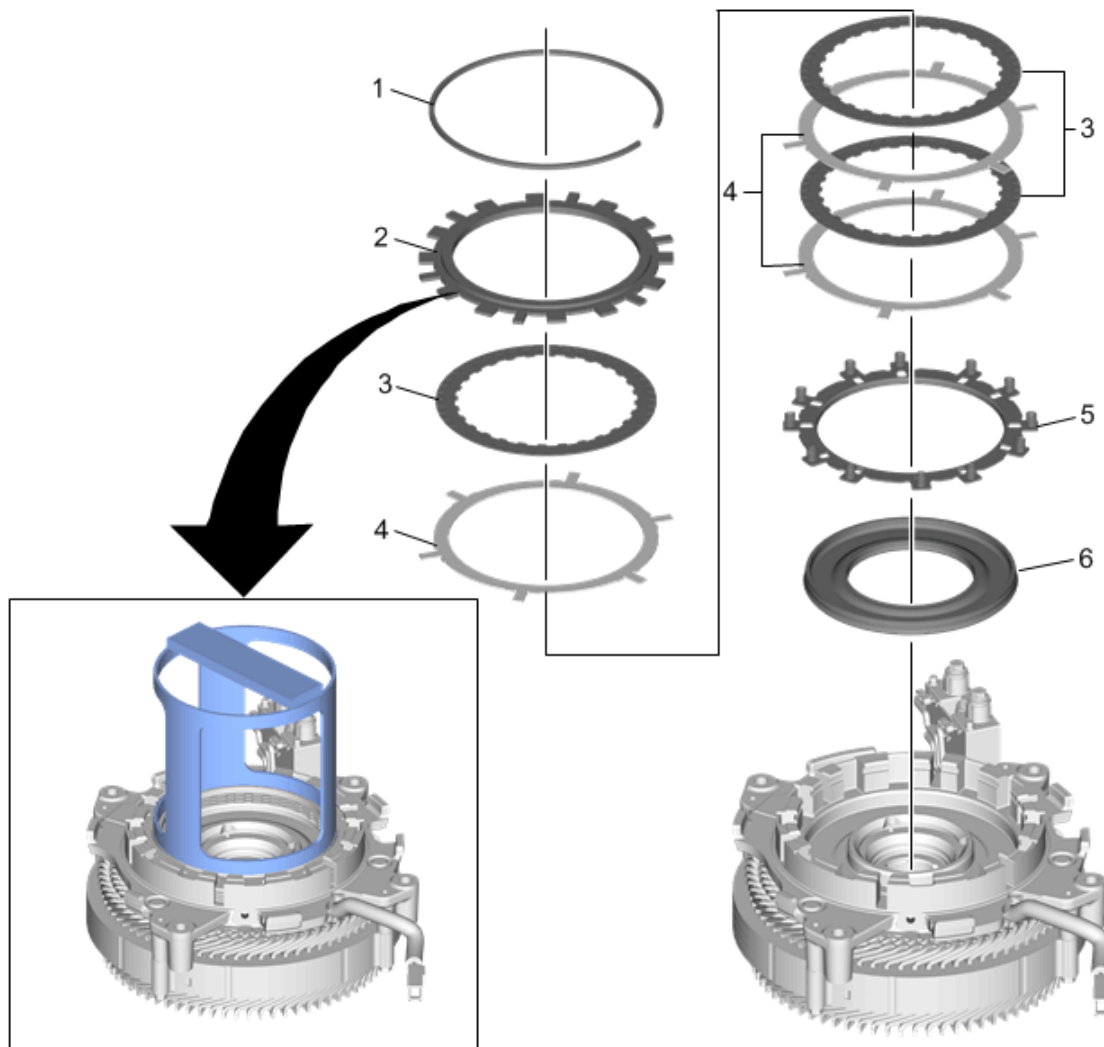


Fig. 217: Variable Low Clutch Plate

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle	

Callout	Component Name
operation, resulting in component damage.	
Service the variable low clutch with the variable high clutch installed onto the drive motor rotor. This will prevent contact of the drive motor stator copper end coils with the work surface.	
1	Variable Low Clutch Backing Plate Retaining Ring Procedure Use DT-47694 compressor and a suitable press to remove the retaining ring. NOTE: DISCARD the retaining ring. Special Tools DT-47694 Piston Spring Compressor For equivalent regional tools, refer to <u>Special Tools</u> .
2	Variable Low Clutch Backing Plate
3	Variable Low Clutch Plate - Friction (Qty: 3)
4	Variable Low Clutch Plate (Qty: 3)
5	Variable Low Clutch Spring
6	Variable Low Clutch Piston Procedure Use compressed air in the drive motor fluid feed passage to remove the piston.

VARIABLE HIGH CLUTCH REMOVAL

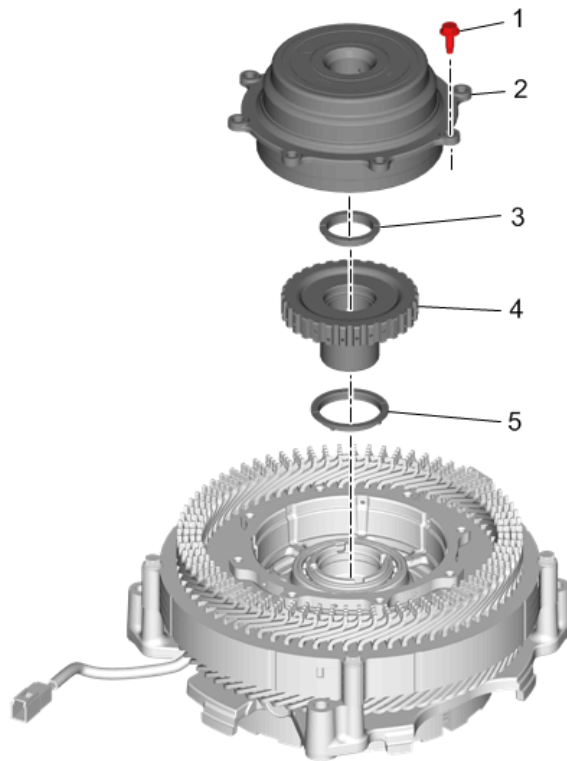


Fig. 218: Variable High Clutch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage.	
1	Variable High Clutch Housing Bolt (Qty: 8)
2	Variable High Clutch Housing
3	Variable High Clutch Hub Thrust Washer
4	Variable High Clutch Hub
5	Variable High Clutch Hub Thrust Washer

DRIVE MOTOR DISASSEMBLE - 1ST POSITION

Drive Motor Stator and Rotor Removal

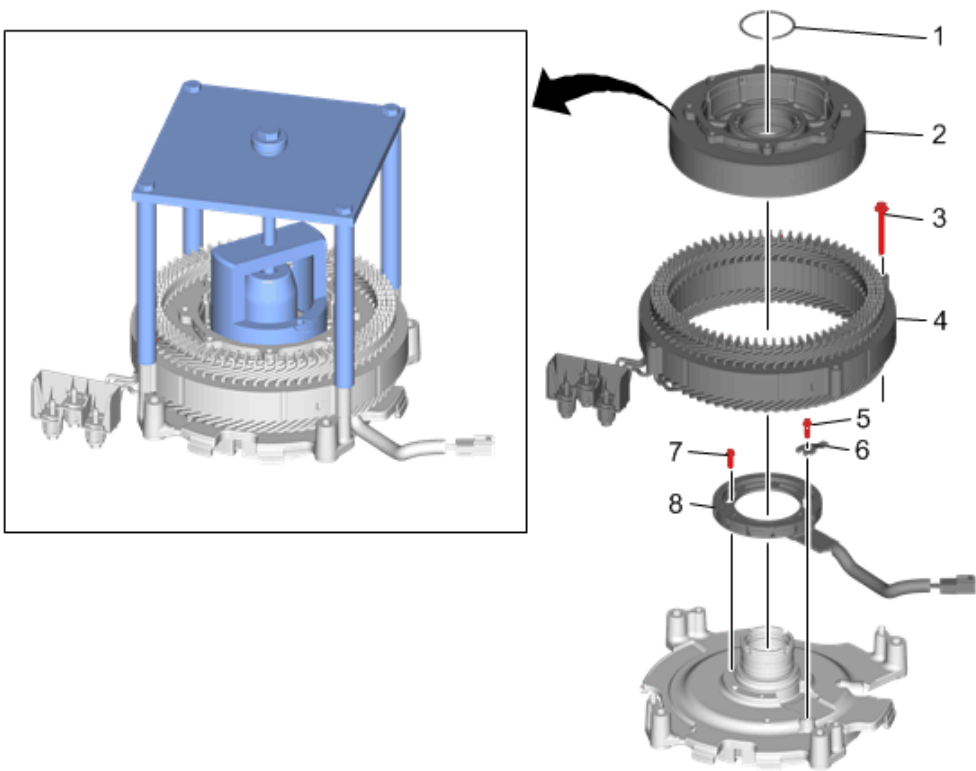


Fig. 219: Drive Motor Stator And Rotor
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator and Rotor Removal

Callout	Component Name
1	Drive Motor Rotor Bearing Retaining Ring NOTE: DISCARD the retaining ring.
2	Drive Motor Rotor NOTE: The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components.

Callout	Component Name
	NOTE: Place the drive motor stator on a lint free cloth to prevent metallic debris from adhering to the outer diameter. Special Tools DT-51621 Rotor Remove/Installer For equivalent regional tools, refer to Special Tools.
3	Drive Motor Stator Bolt (Qty: 4) NOTE: from discarding the bolts.
4	Drive Motor Stator CAUTION: DO NOT touch the contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. NOTE: Place the drive motor stator on a lint free cloth over a piece of cardboard.
5	Drive Motor Position Sensor Bolt (Qty: 1) NOTE: DISCARD the bolts.
6	Drive Motor Position Sensor Connector Clip

Callout	Component Name
7	Drive Motor Position Sensor Bolt (Qty: 3) NOTE: DISCARD the bolts.
8	Drive Motor Position Sensor Stator

Drive Motor Power Inverter Module Cable Guide Assembly Removal

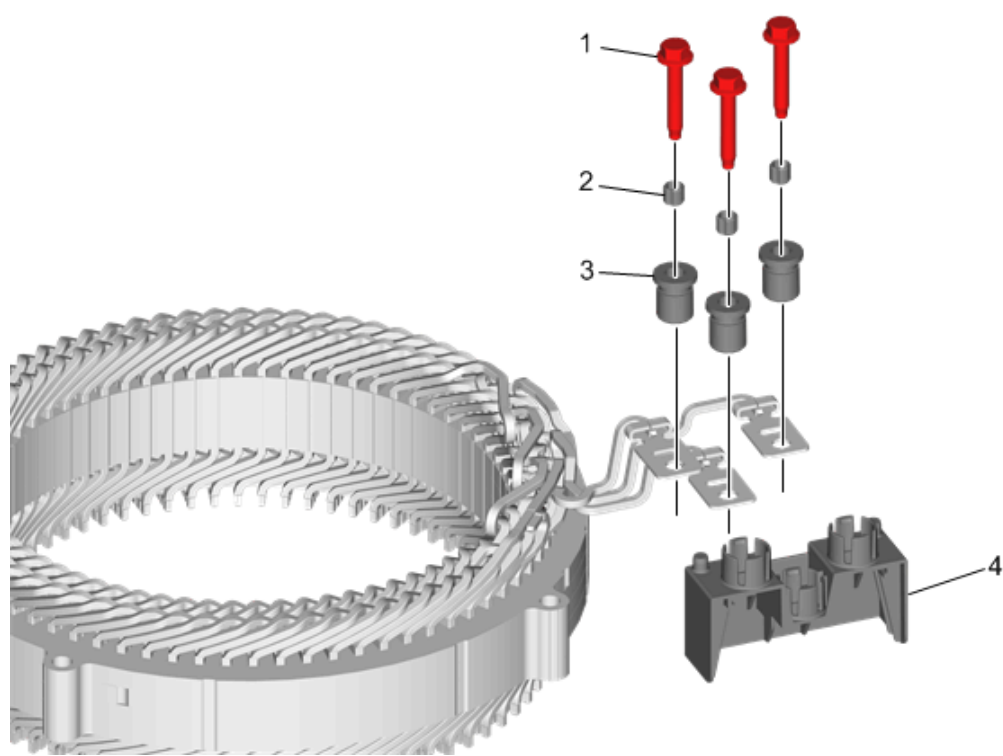


Fig. 220: Drive Motor Power Inverter Module Cable Guide Assembly
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cable Guide Assembly Removal

Callout	Component Name
1	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)
2	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer (Qty: 3)
3	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing (Qty: 3)
4	Drive Motor Power Inverter Module 3-Phase Cable Guide Assembly

DRIVE MOTOR ASSEMBLE - 1ST POSITION

Drive Motor Power Inverter Module Cable Guide Installation

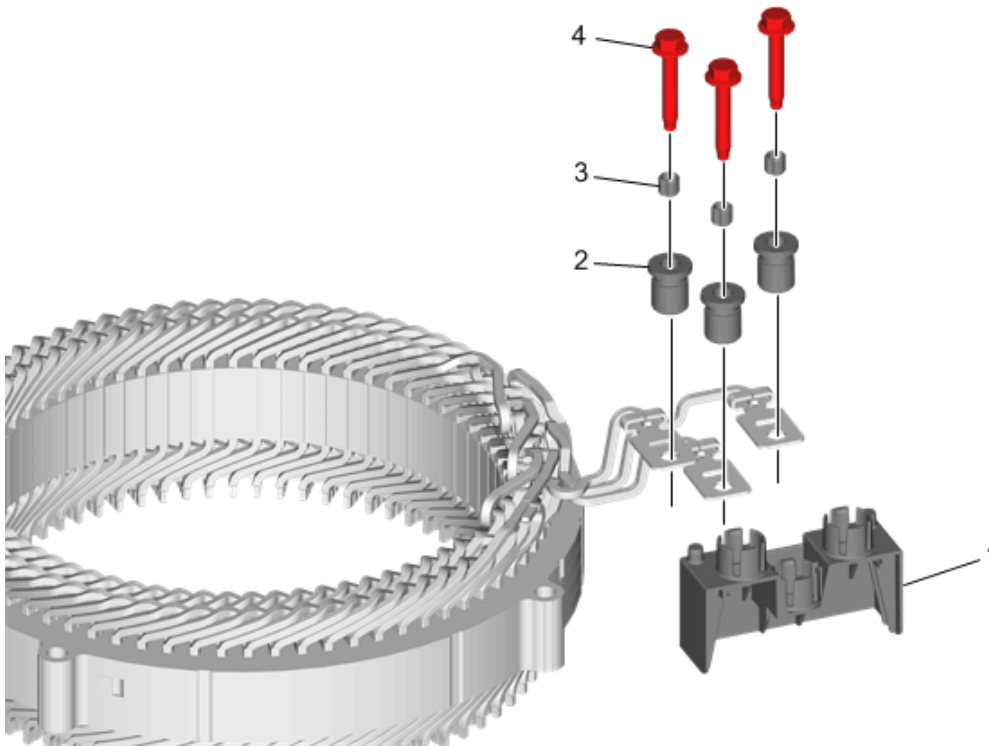


Fig. 221: Drive Motor Power Inverter Module Cable Guide

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cable Guide Installation

Callout	Component Name
1	Drive Motor Power Inverter Module Cable Guide
2	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing (Qty: 3)
3	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer (Qty: 3)
4	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)

Drive Motor Stator and Rotor Installation

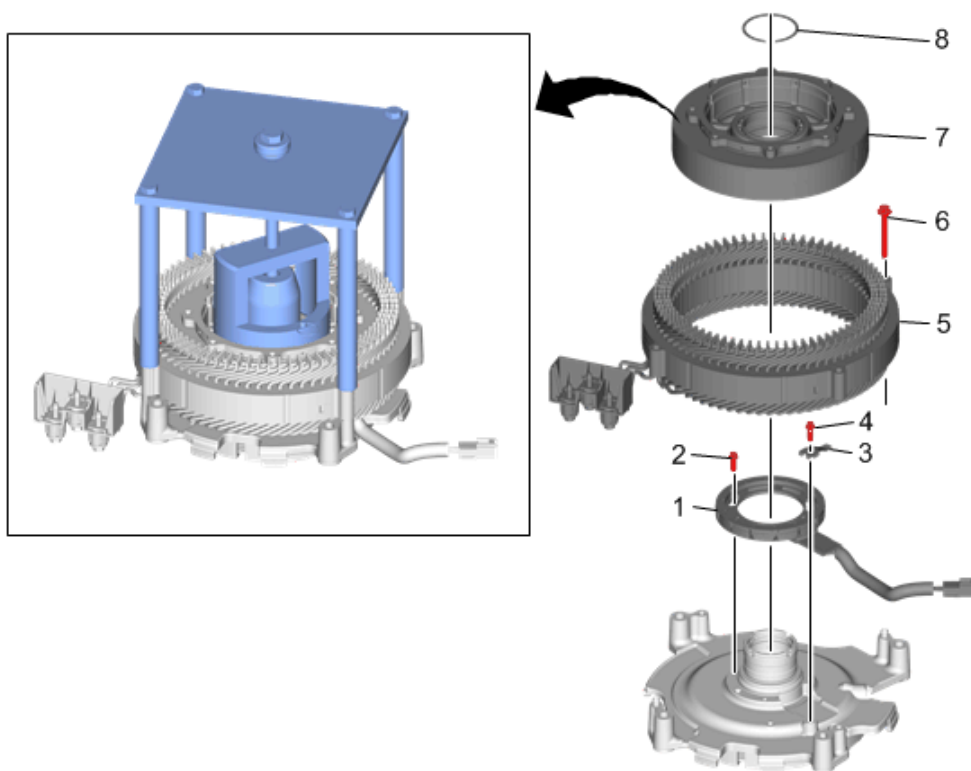


Fig. 222: Drive Motor Stator And Rotor
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator and Rotor Installation

Callout	Component Name
1	Drive Motor Position Sensor Stator

Callout	Component Name
2	Drive Motor Position Sensor Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Use Threadlocker Red on the bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. NOTE: Use NEW bolts. Tighten 5 N.m (44 lb in)
3	Drive Motor Position Sensor Connector Clip
4	Drive Motor Position Sensor Bolt (Qty: 1) CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Use Threadlocker Red on the bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. NOTE: Use NEW bolts. Tighten 5 N.m (44 lb in)

Callout	Component Name
5	Drive Motor Stator CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage.
6	Drive Motor Stator Bolt (Qty: 4) CAUTION: Refer to <u>Torque-to-Yield</u> <u>Fastener</u> <u>Caution</u> . NOTE: Use NEW bolts. Tighten 11 N.m (97 lb in)
7	Drive Motor Rotor NOTE: The drive motor rotor bearing retaining ring groove will be visible when the drive

Callout	Component Name
	motor rotor is completely installed. It may be necessary to jiggle the DT-51621 installer to allow the rotor to fully drop into position. NOTE: The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components. Metallic debris can be removed from the motor outer diameter by blotting with adhesive tape. Special Tools DT-51621 Rotor Remove/Installer For equivalent regional tools, refer to Special Tools.
8	Drive Motor Rotor Bearing Retaining Ring NOTE: Install a NEW retaining ring.

VARIABLE HIGH CLUTCH DISASSEMBLE

Variable High Clutch Plate Removal

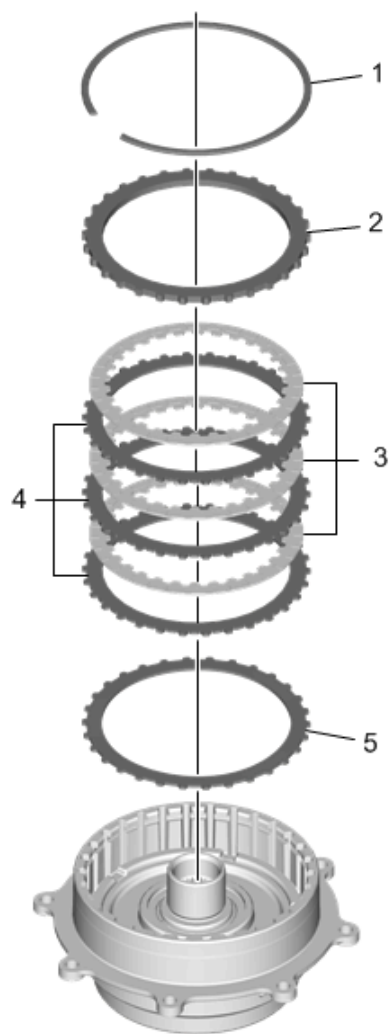


Fig. 223: Variable High Clutch Plate
Courtesy of GENERAL MOTORS COMPANY

Variable High Clutch Plate Removal

Callout	Component Name
1	Variable High Clutch Backing Plate Retaining Ring
2	Variable High Clutch Backing Plate
3	Variable High Clutch Plate (Qty: 3)
4	Variable High Clutch Plate (Qty: 3)
5	Variable High Clutch Waved Plate

Variable High Clutch Piston Removal

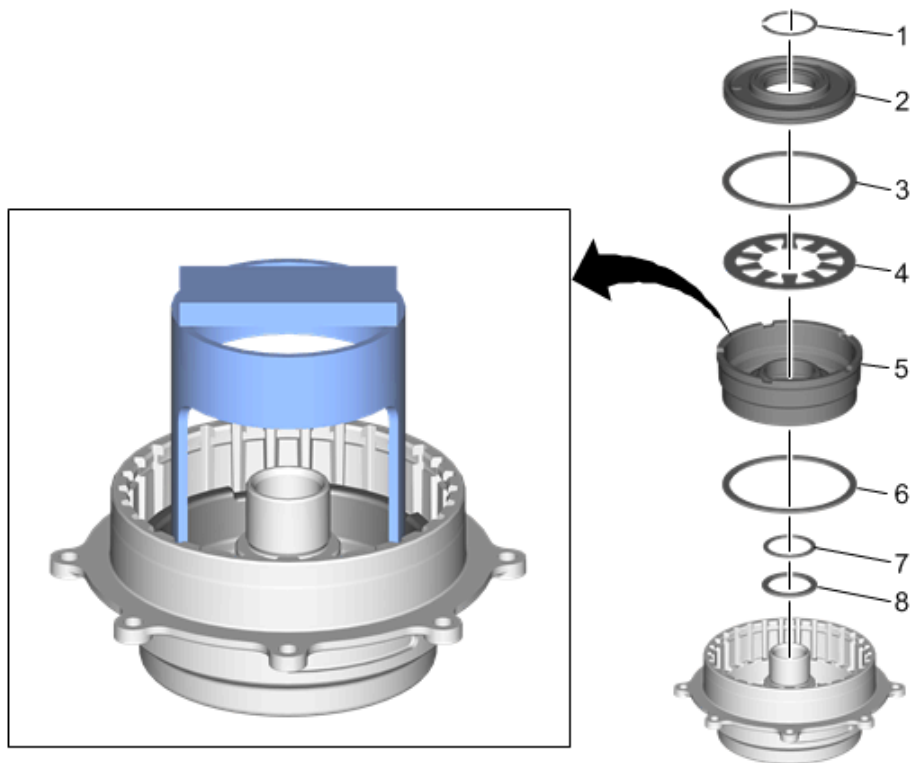


Fig. 224: Variable High Clutch Piston

Courtesy of GENERAL MOTORS COMPANY

Variable High Clutch Piston Removal

Callout	Component Name
1	Variable High Clutch Piston Dam Retaining Ring Procedure Use a press and DT-48903 compressor against the variable high clutch piston dam to remove the retaining ring. NOTE: • DO NOT exceed 5.0 mm (0.20 in) of travel below the snap ring groove when compressing the variable high clutch piston dam. • DISCARD the retaining ring.

Callout	Component Name
	Special Tools DT-48903 Spring Compressor For equivalent regional tools, refer to Special Tools .
2	Variable High Clutch Piston Dam
3	Variable High Clutch Piston Outer Seal
4	Variable High Clutch Piston Spring
5	Variable High Clutch Piston
6	Variable High Clutch Piston Dam Outer Seal
7	Variable High Clutch Piston Dam Inner Seal
8	Variable High Clutch Piston Inner Seal

VARIABLE HIGH CLUTCH ASSEMBLY

Variable High Clutch Piston Installation

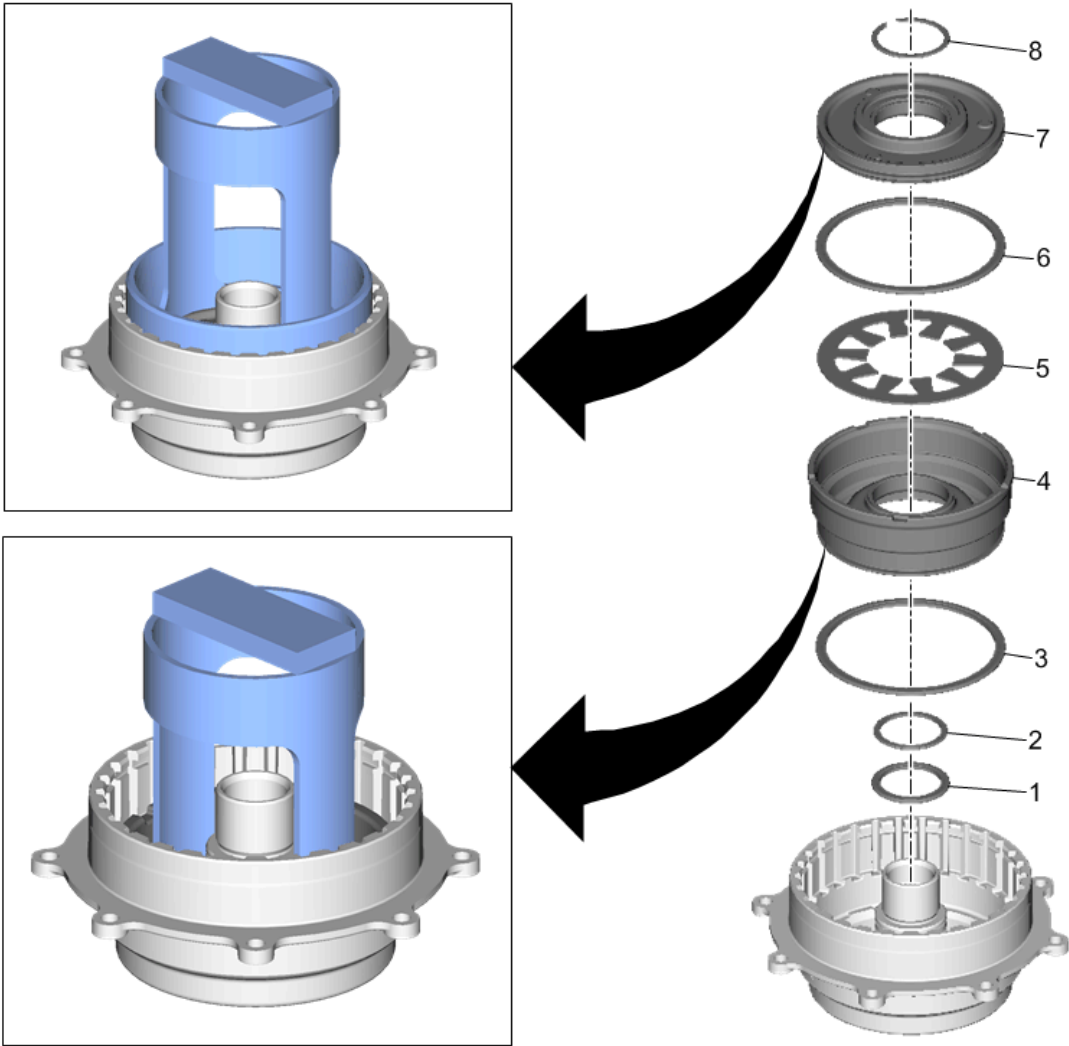


Fig. 225: Variable High Clutch Piston
 Courtesy of GENERAL MOTORS COMPANY

Variable High Clutch Piston Installation

Callout	Component Name
---------	----------------

Callout	Component Name
CAUTION: Refer to Seal Reuse Caution . Preliminary Procedure Lubricate all seals with automatic transmission fluid (ATF) prior to installation.	
1	Variable High Clutch Piston Inner Seal NOTE: Use a NEW seal.
2	Variable High Clutch Piston Dam Inner Seal NOTE: Use a NEW seal.
3	Variable High Clutch Piston Dam Outer Seal NOTE: Use a NEW seal.
4	Variable High Clutch Piston Special Tools DT-48903 Spring Compressor For equivalent regional tools, refer to Special Tools .
5	Variable High Clutch Piston Spring
6	Variable High Clutch Piston Outer Seal NOTE: Use a NEW seal.
7	Variable High Clutch Piston Dam Special Tools • DT-48903 Spring Compressor • DT-51669 Protector For equivalent regional tools, refer to Special Tools .
8	Variable High Clutch Piston Dam Retaining Ring CAUTION: Refer to Retaining Ring Reuse Caution . Procedure

Callout	Component Name
	Use a press and DT-48903 compressor against the variable high clutch piston dam to install the retaining ring. NOTE: DO NOT exceed 5.0 mm (0.20 in) of travel below the snap ring groove when compressing the variable high clutch piston dam. NOTE: Use a NEW retaining ring. Special Tools DT-48903 Spring Compressor For equivalent regional tools, refer to <u>Special Tools.</u>

Variable High Clutch Plate Installation

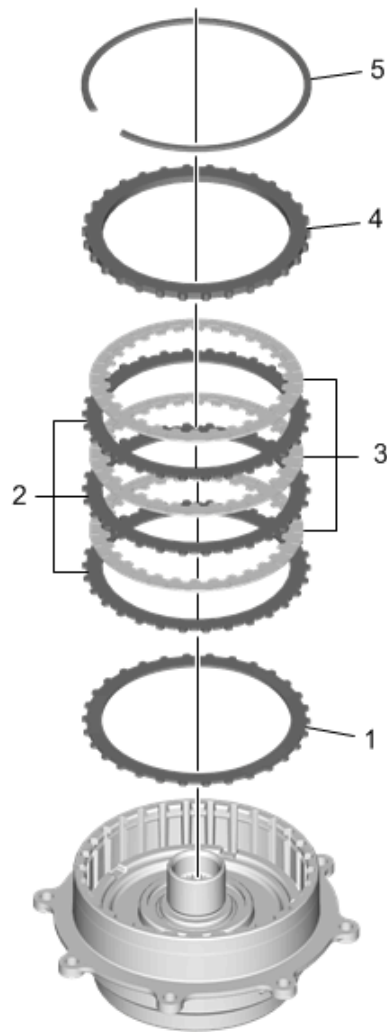


Fig. 226: Variable High Clutch Plate

Courtesy of GENERAL MOTORS COMPANY

Variable High Clutch Plate Installation

Callout	Component Name
1	Variable High Clutch Waved Plate
2	Variable High Clutch Plate (Qty: 3)
3	Variable High Clutch Plate - Friction (Qty: 3)
4	Variable High Clutch Backing Plate
5	Variable High Clutch Backing Plate Retaining Ring
	Procedure Select the correct retaining ring. Refer to Variable High Clutch Backing Plate Retaining Ring Measurement .

VARIABLE HIGH CLUTCH BACKING PLATE RETAINING RING MEASUREMENT

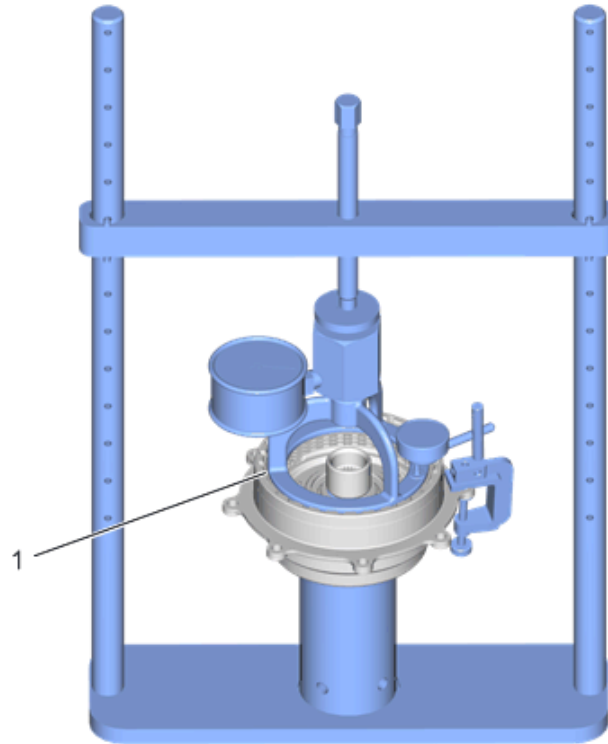


Fig. 227: Variable High Clutch Backing Plate Retaining Ring Measurement
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Assemble the variable high clutch. Refer to Variable High Clutch Assemble .	
1	Variable High Clutch Backing Plate Retaining Ring Procedure 1. Assemble the tools as shown and clamp the DT-50900 fixture to the bench. 2. Apply 20 pounds of pressure to the load gauge by turning the screw on the DT-50900 fixture clockwise. 3. Zero out the dial indicator. 4. Remove the pressure on the load gauge by turning the screw on the DT-50900 fixture one full turn counterclockwise. 5. Apply 50 PSI of compressed air and simultaneously adjust the screw on the DT-50900 fixture to apply 20 pounds of pressure to the load gauge. 6. Observe the dial indicator measurement. Refer to Clutch Backing Plate Retaining Ring Specifications to determine the correct variable high clutch backing plate retaining ring. Special Tools • DT-50900 Clutch Travel Support Fixture • DT-50903 Clutch Travel Load Gauge • DT-50905 Clutch Travel Air Adapter • DT-51627 Clutch Travel Air Adapter

Callout	Component Name
	• GE-8001 Dial Indicator Set • J-23327-1 Clutch Spring Compressor For equivalent regional tools, refer to Special Tools.

VARIABLE HIGH CLUTCH INSTALLATION

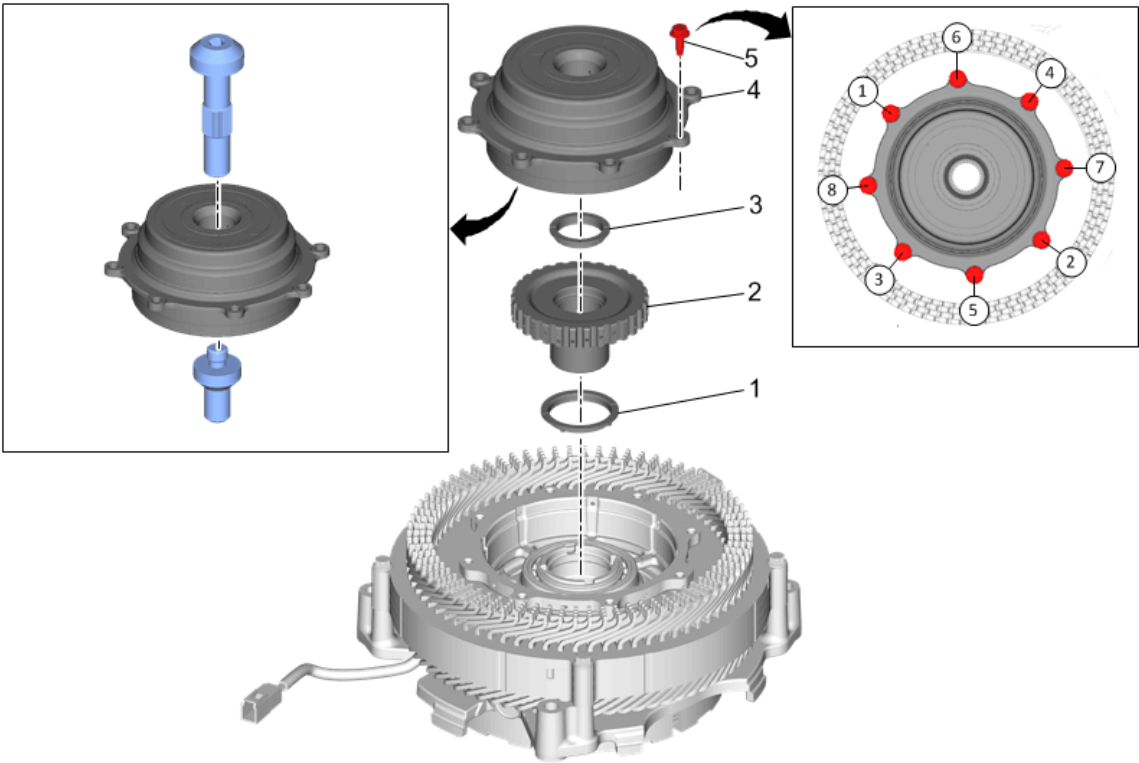


Fig. 228: Variable High Clutch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable High Clutch Hub Thrust Washer
2	Variable High Clutch Hub
3	Variable High Clutch Hub Thrust Washer
4	Variable High Clutch Housing Special Tools DT-51628 Clutch Holder For equivalent regional tools, refer to Special Tools .
5	Variable High Clutch Housing Bolt (Qty: 8) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 9 N.m (80 lb in)

VARIABLE LOW CLUTCH PLATE INSTALLATION

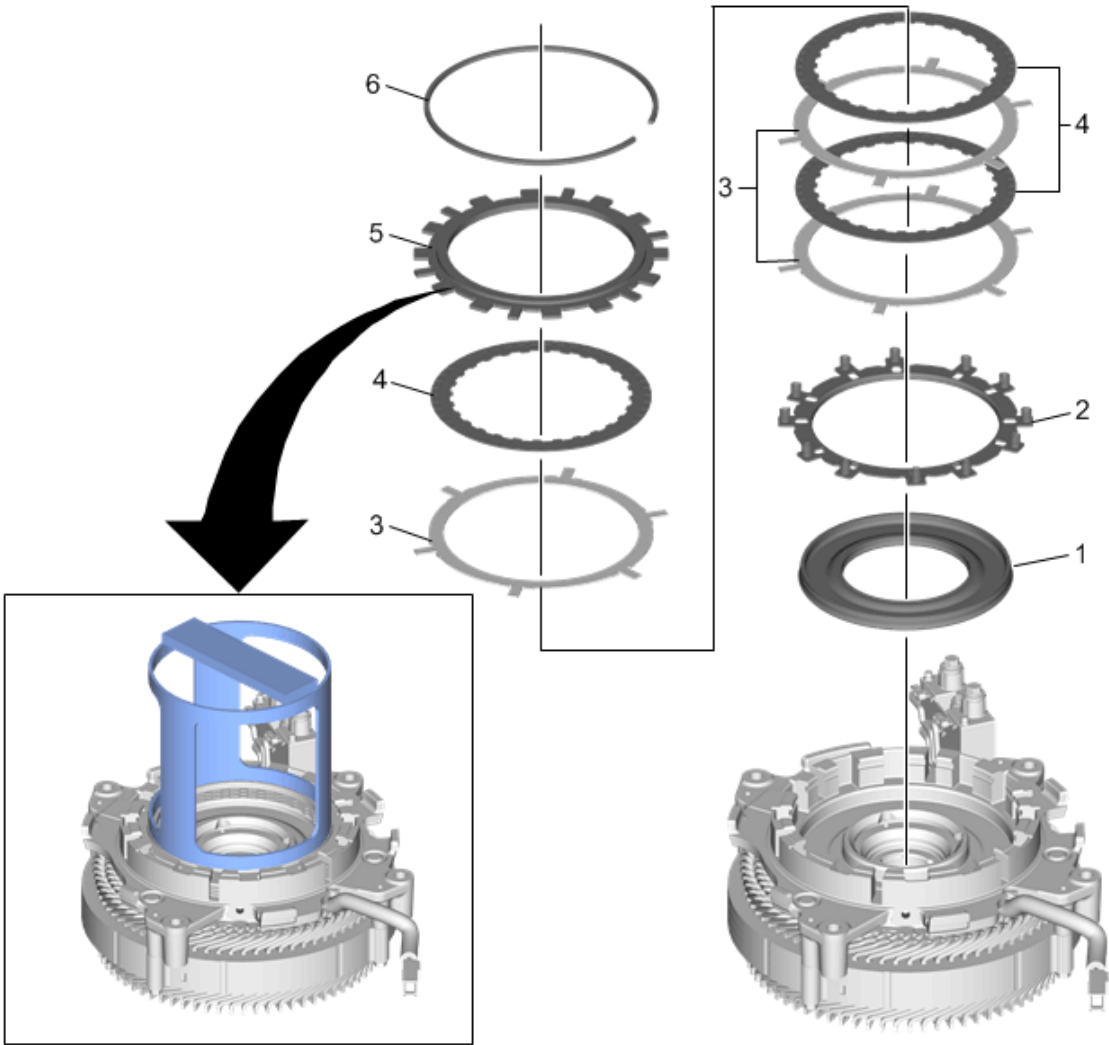


Fig. 229: Variable Low Clutch Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils	

Callout	Component Name
may cause a high voltage short during vehicle operation, resulting in component damage. Preliminary Procedure Service the variable low clutch with the variable high clutch installed onto the drive motor rotor. This will prevent contact of the drive motor stator copper end coils with the work surface.	
1	Variable Low Clutch Piston
2	Variable Low Clutch Spring
3	Variable Low Clutch Plate (Qty: 3)
4	Variable Low Clutch Plate - Friction (Qty: 3)
5	Variable Low Clutch Backing Plate
6	Variable Low Clutch Backing Plate Retaining Ring - Selective Procedure 1. Select the correct retaining ring. Refer to: Variable Low Clutch Backing Plate Retaining Ring Measurement. 2. Use DT-47694 compressor and a suitable press to install the retaining ring. Special Tools DT-47694 Piston Spring Compressor For equivalent regional tools, refer to Special Tools.

VARIABLE LOW CLUTCH BACKING PLATE RETAINING RING MEASUREMENT

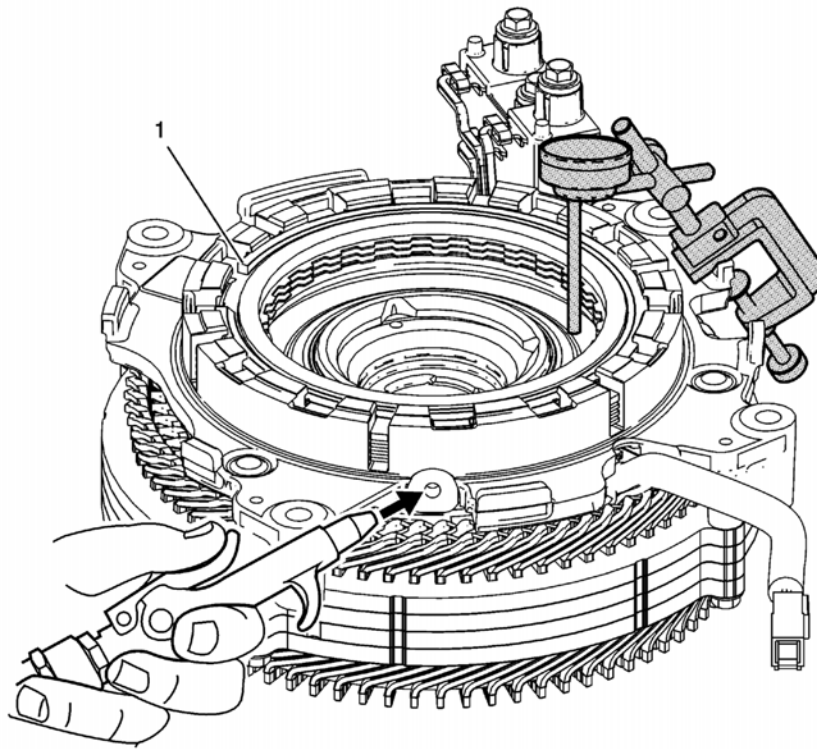


Fig. 230: Variable Low Clutch Backing Plate Retaining Ring Measurement

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure - Assemble the variable low clutch. Refer to Variable Low Clutch Plate Installation. CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. - Service the variable low clutch with the variable high clutch installed onto the drive motor rotor. This will prevent contact of the drive motor stator copper end coils with the work surface.	

DRIVE MOTOR INSTALLATION - 1ST POSITION

Drive Motor Power Inverter Module Connector Installation

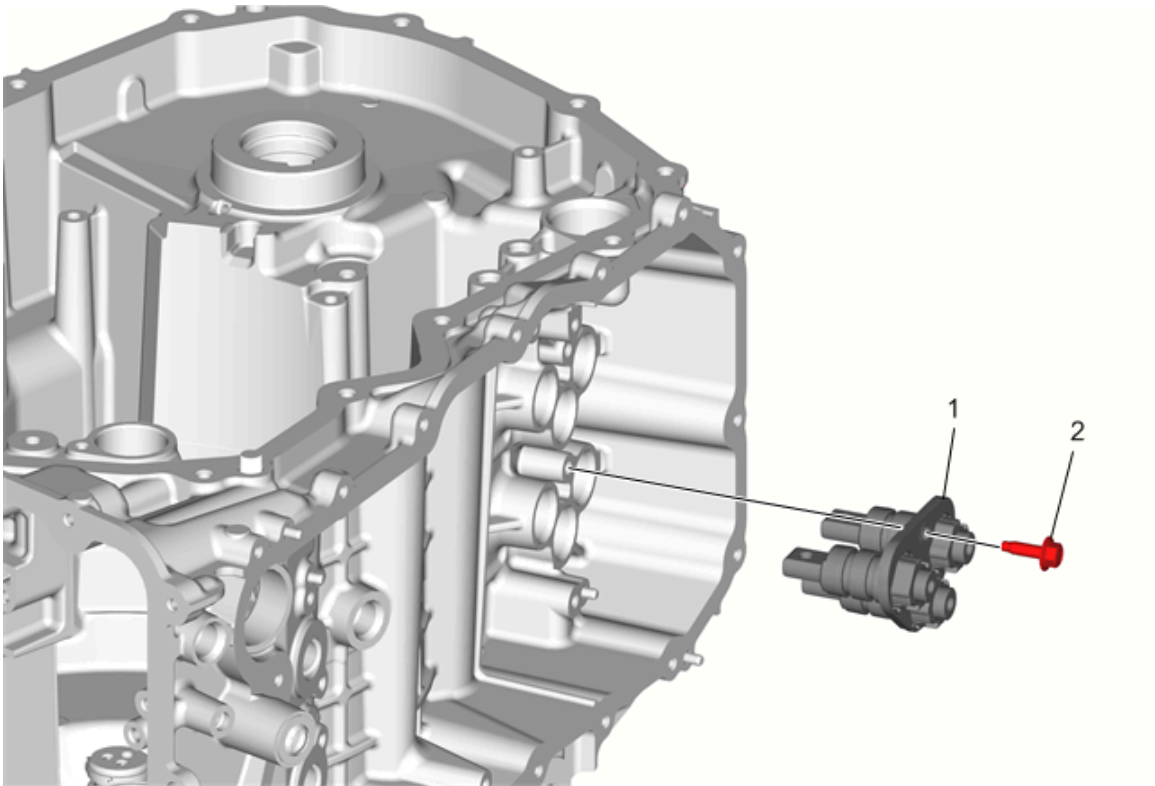


Fig. 231: Drive Motor Power Inverter Module Connector
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Connector Installation

Callout	Component Name
1	Drive Motor Power Inverter Module Connector NOTE: Use a NEW connector.
2	Drive Motor Power Inverter Module Connector Bolt Procedure Use Threadlocker Blue on the bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers . NOTE: Install a NEW bolt. Tighten 9 N.m (80 lb in)

Drive Motor - 1st Position Installation

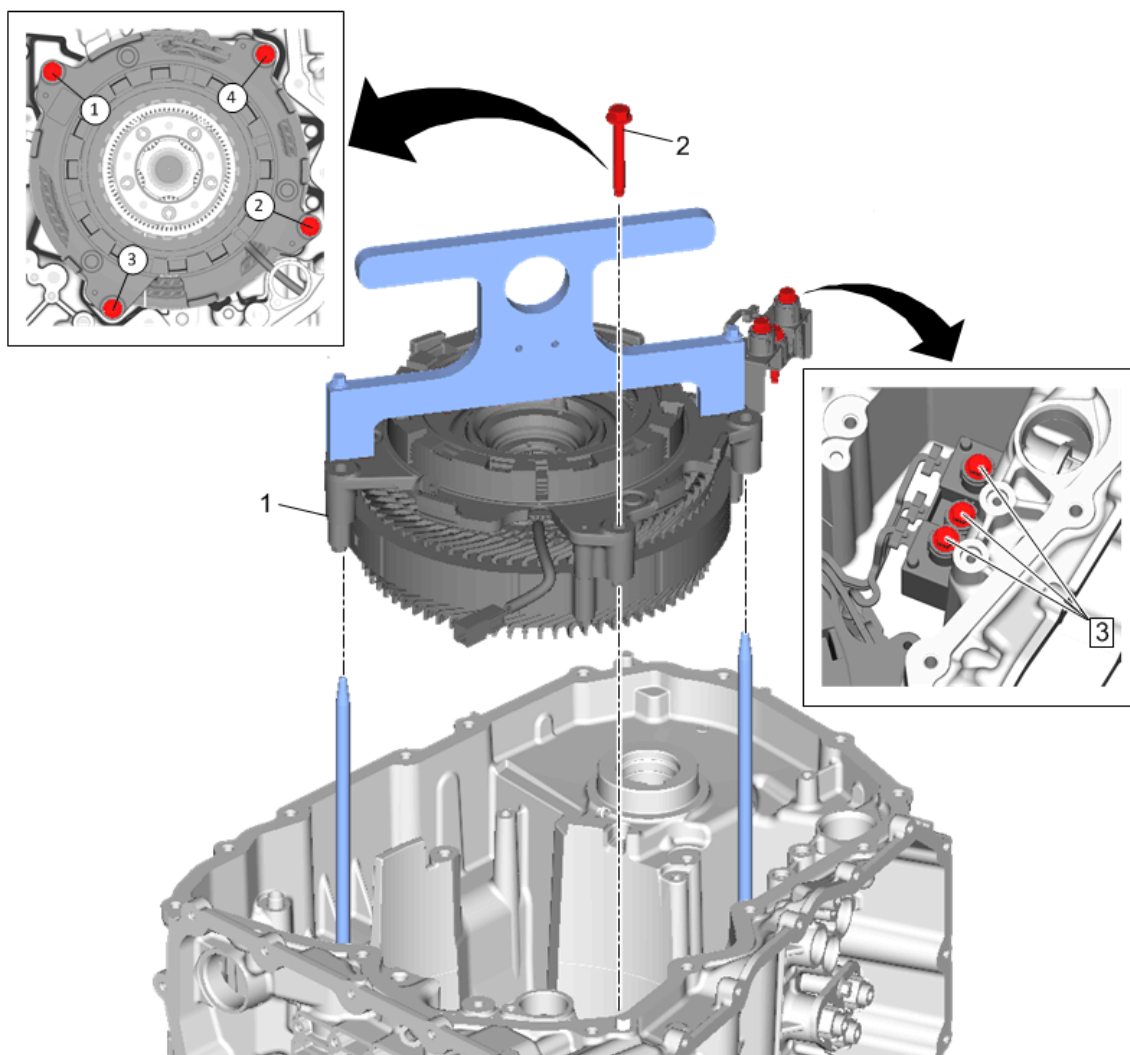


Fig. 232: Drive Motor - 1st Position

Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 1st Position Installation

Callout	Component Name
1	Drive Motor - 1st Position WARNING: The generator motor weighs approximately 23 kg (50 lbs). Personal injury may result if you lift the generator motor improperly. CAUTION:

Callout	Component Name
	DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. Procedure 1. Install the DT-51623 motor lift bar. 2. Install the DT-51624 alignment pins. 3. Carefully tip the drive motor onto its side, resting on the cast aluminum support. Never rest the drive motor on the stator copper end coils. 4. Attach a lift assist hook through the DT-51623 motor lift bar handle hole and carefully raise the drive motor while holding it to rotate into position for assembly. 5. Carefully lower the drive motor into the transmission case ensuring the copper end coils do not contact any metallic parts. NOTE: Ensure the seal sizer has been removed from the variable high clutch fluid transfer seals. 6. Use the DT-51624 alignment pins to guide the drive motor into position. 7. Guide the drive motor resolver wire through the transmission case while lowering the drive motor using a lift assist. 8. The drive motor should sit below the cast line in the transmission case when properly installed. Special Tools

Callout	Component Name
	• DT-51623 Motor Lift Bar • DT-51624 Alignment Pins For equivalent regional tools, refer to Special Tools.
2	Automatic Transmission Case Extension Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 26 N.m (19 lb ft)
3	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3) Tighten 9 N.m (80 lb in)

OUTPUT CARRIER INTERNAL GEAR OVERHAUL

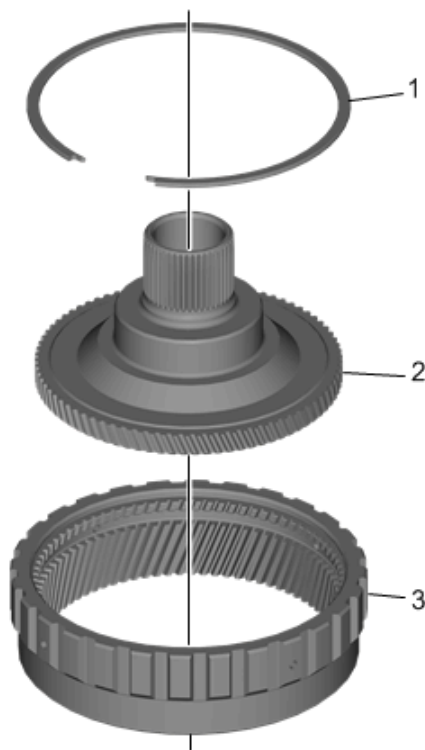


Fig. 233: Output Carrier Internal Gear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Carrier Internal Gear Retaining Ring
2	Output Carrier Internal Gear Hub

Callout	Component Name
3	Output Carrier Internal Gear

OUTPUT CARRIER AND OUTPUT CARRIER INTERNAL GEAR INSTALLATION

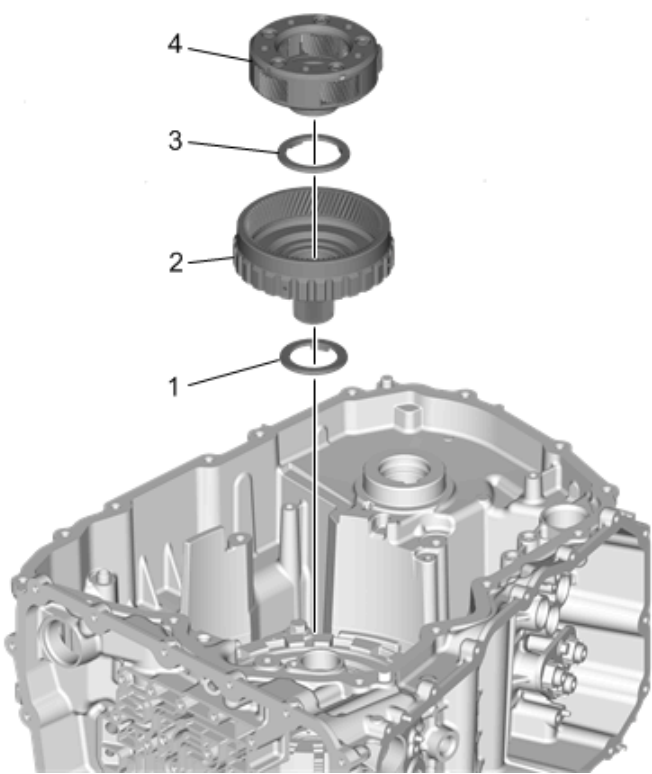


Fig. 234: Output Carrier And Output Carrier Internal Gear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Carrier Internal Gear Hub Thrust Bearing
2	Output Carrier Internal Gear
3	Output Carrier Thrust Bearing
4	Output Carrier

DRIVE MOTOR DISASSEMBLE - 2ND POSITION

Drive Motor Rotor Removal

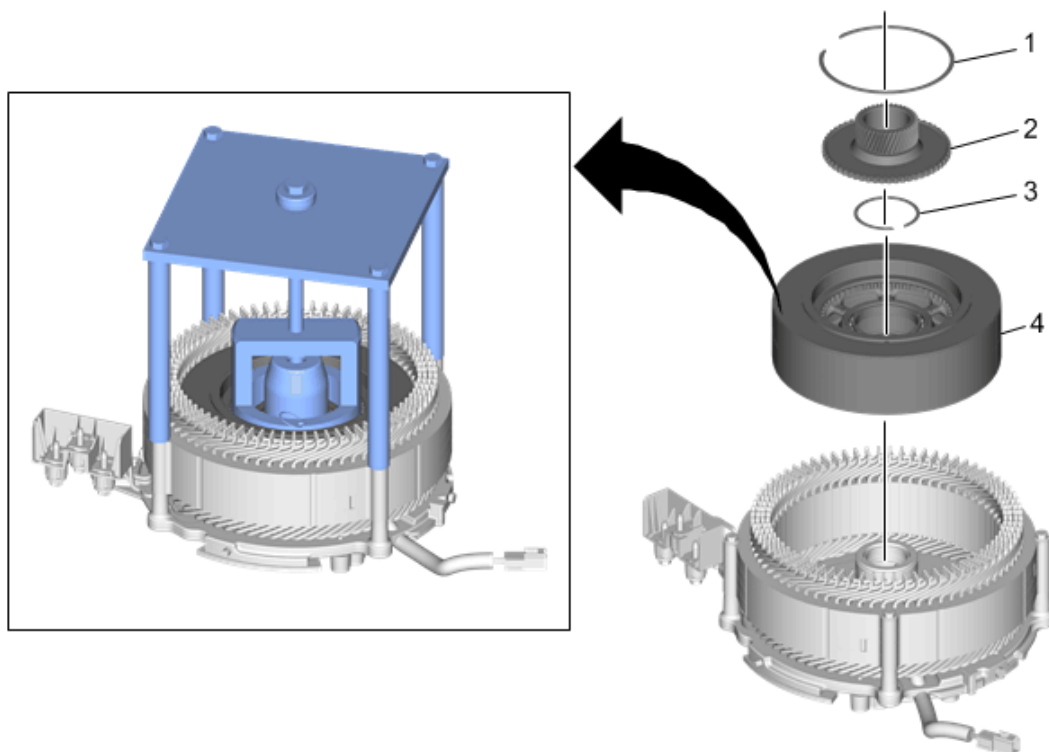


Fig. 235: Drive Motor Rotor

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Rotor Removal

Callout	Component Name
1	Output Sun Gear Retaining Ring
2	Output Sun Gear
3	Drive Motor Rotor Bearing Retaining Ring NOTE: DISCARD the retaining ring.
4	Drive Motor Rotor NOTE: The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components. NOTE:

Callout	Component Name
	Place the drive motor rotor on a lint free cloth to prevent metallic debris from adhering to the outer diameter. Metallic debris can be removed from the motor outer diameter by blotting with adhesive tape. Special Tools DT-51621 Rotor Remover/Installer For equivalent regional tools, refer to Special Tools.

Drive Motor Stator Removal

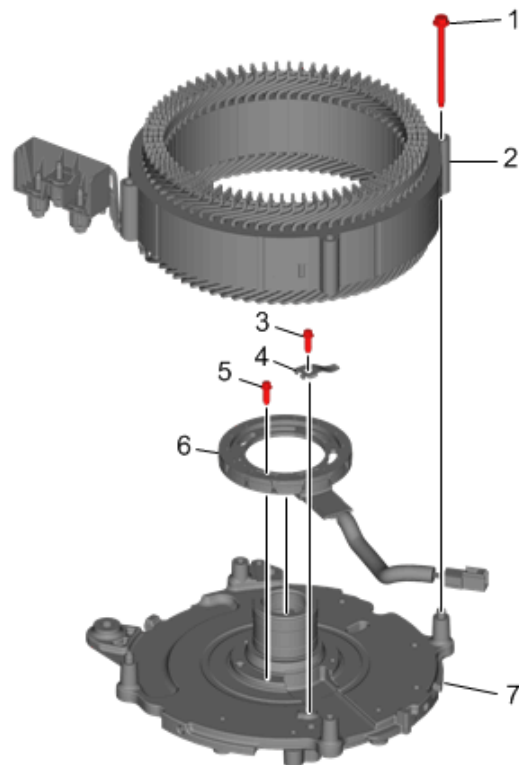


Fig. 236: Drive Motor Stator

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator Removal

Callout	Component Name
1	Drive Motor Stator Bolt (Qty: 4) NOTE: DISCARD the bolts.
2	Drive Motor Stator CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. NOTE: Place the drive motor stator on a lint free cloth over a piece of cardboard.
3	Drive Motor Position Sensor Bolt (Qty: 1) NOTE: DISCARD the bolts.
4	Drive Motor Position Sensor Connector Clip
5	Drive Motor Position Sensor Bolt (Qty: 3) NOTE:

Callout	Component Name
	DISCARD the bolts.
6	Drive Motor Position Sensor Stator
7	Drive Motor Support NOTE: The drive motor support is a mandatory replacement component. Discard the drive motor support.

Drive Motor Power Inverter Module Cable Guide Removal

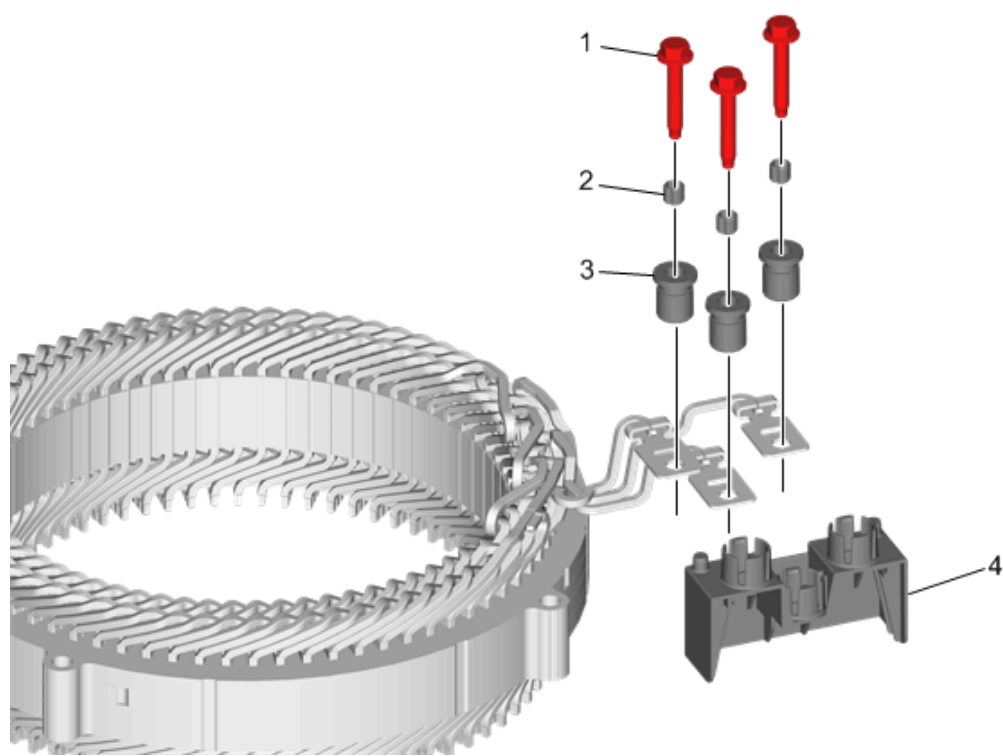


Fig. 237: Drive Motor Power Inverter Module Cable Guide Assembly
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cable Guide Removal

Callout	Component Name
1	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)
2	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer (Qty: 3)
3	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing (Qty: 3)
4	Drive Motor Power Inverter Module 3-Phase Cable Guide Assembly

DRIVE MOTOR ASSEMBLE - 2ND POSITION

Drive Motor Power Inverter Module Cable Guide Installation

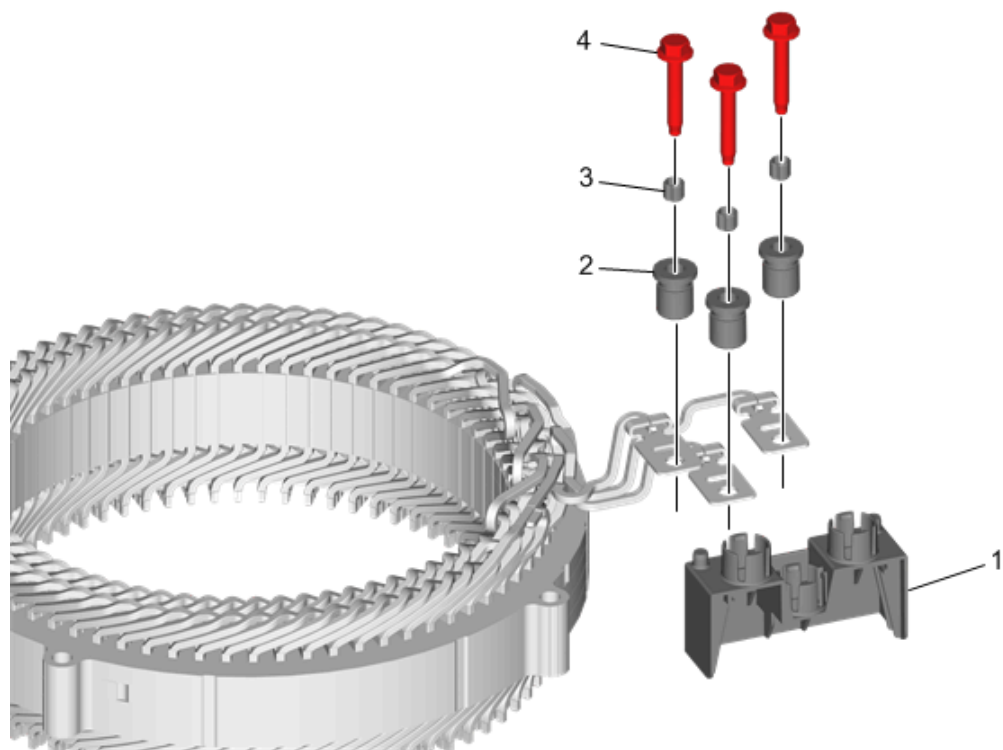


Fig. 238: Drive Motor Power Inverter Module Cable Guide

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cable Guide Installation

Callout	Component Name
1	Drive Motor Power Inverter Module Cable Guide
2	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing (Qty: 3)
3	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer (Qty: 3)
4	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3)

Drive Motor Stator Installation

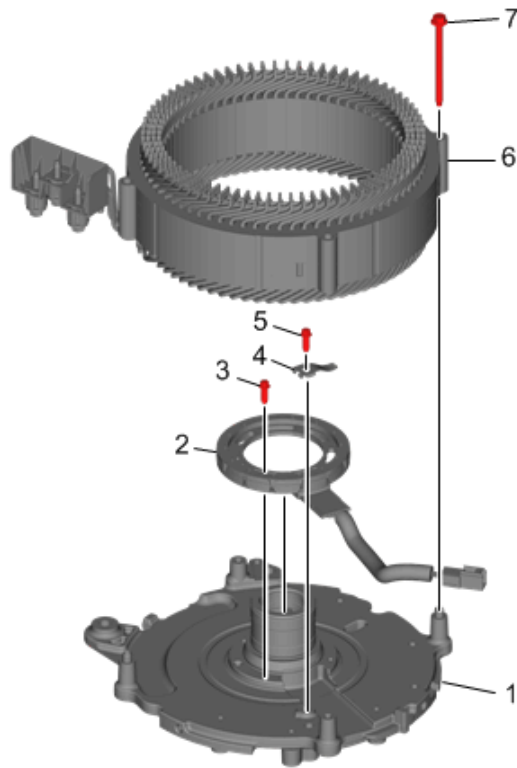


Fig. 239: Drive Motor Stator

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator Installation

Callout	Component Name
1	Drive Motor Support NOTE: The drive motor support is a mandatory replacement component. Install a NEW drive motor support.
2	Drive Motor Position Sensor Stator
3	Drive Motor Position Sensor Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . CAUTION:

Callout	Component Name
	Refer to <u>Torque-to-Yield</u> <u>Fastener</u> <u>Caution</u> . Procedure Use Threadlocker Red on the bolt threads. Refer to <u>Adhesives, Fluids, Lubricants, and Sealers</u>. NOTE: Use NEW bolts. Tighten 5 N.m (44 lb in)
4	Drive Motor Position Sensor Connector Clip
5	Drive Motor Position Sensor Bolt (Qty: 1) CAUTION: Refer to <u>Torque-to-Yield</u> <u>Fastener</u> <u>Caution</u> . NOTE: Use NEW bolts. Tighten 5 N.m (44 lb in)
6	Drive Motor Stator CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils

Callout	Component Name
	may cause a high voltage short during vehicle operation, resulting in component damage.
7	Drive Motor Stator Bolt (Qty: 4) CAUTION: Refer to Torque-to-Yield Fastener Caution . NOTE: Use NEW bolts. Tighten 11 N.m (97 lb in)

Drive Motor Rotor Installation

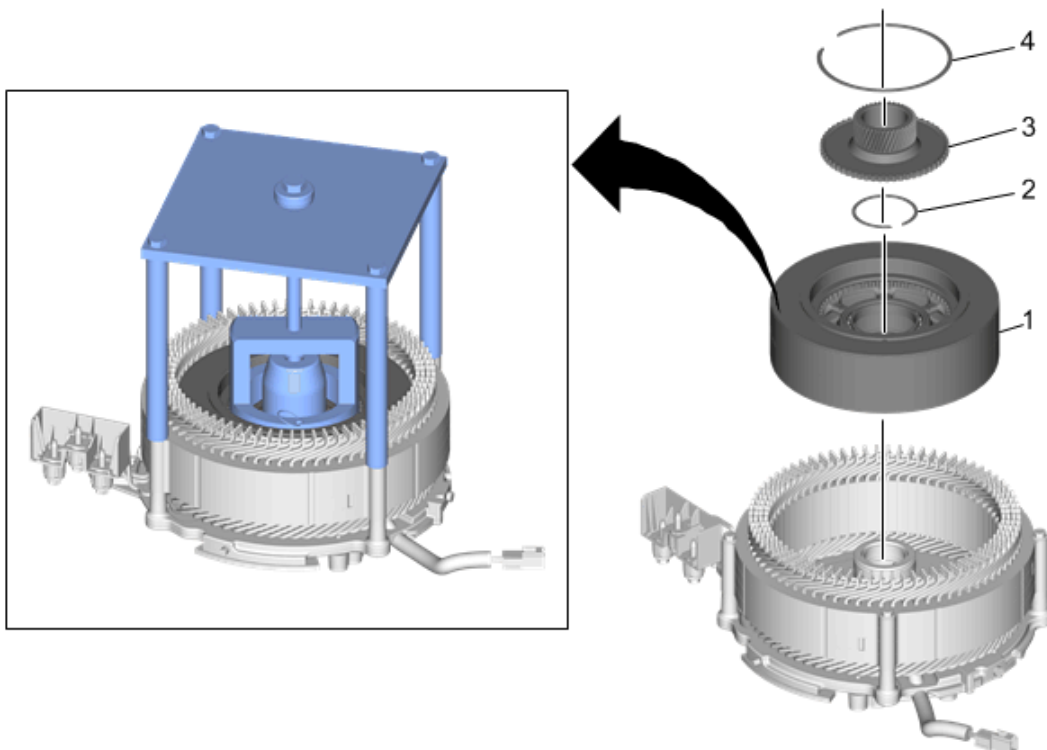


Fig. 240: Drive Motor Rotor
Courtesy of GENERAL MOTORS COMPANY

Drive Motor Rotor Installation

Callout	Component Name
---------	----------------

Callout	Component Name
1	Drive Motor Rotor NOTE: The drive motor rotor bearing retaining ring groove will be visible when the drive motor rotor is completely installed. It may be necessary to jiggle the DT-51621 installer to allow the rotor to fully drop into position. NOTE: The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components. Metallic debris can be removed from the motor outer diameter by blotting with adhesive tape. Special Tools DT-51621 Rotor Remover/Installer

Callout	Component Name
	For equivalent regional tools, refer to Special Tools .
2	Drive Motor Rotor Bearing Retaining Ring NOTE: Install a NEW retaining ring.
3	Output Sun Gear
4	Output Sun Gear Retaining Ring

DRIVE MOTOR INSTALLATION - 2ND POSITION

Drive Motor Power Inverter Module Connector Installation

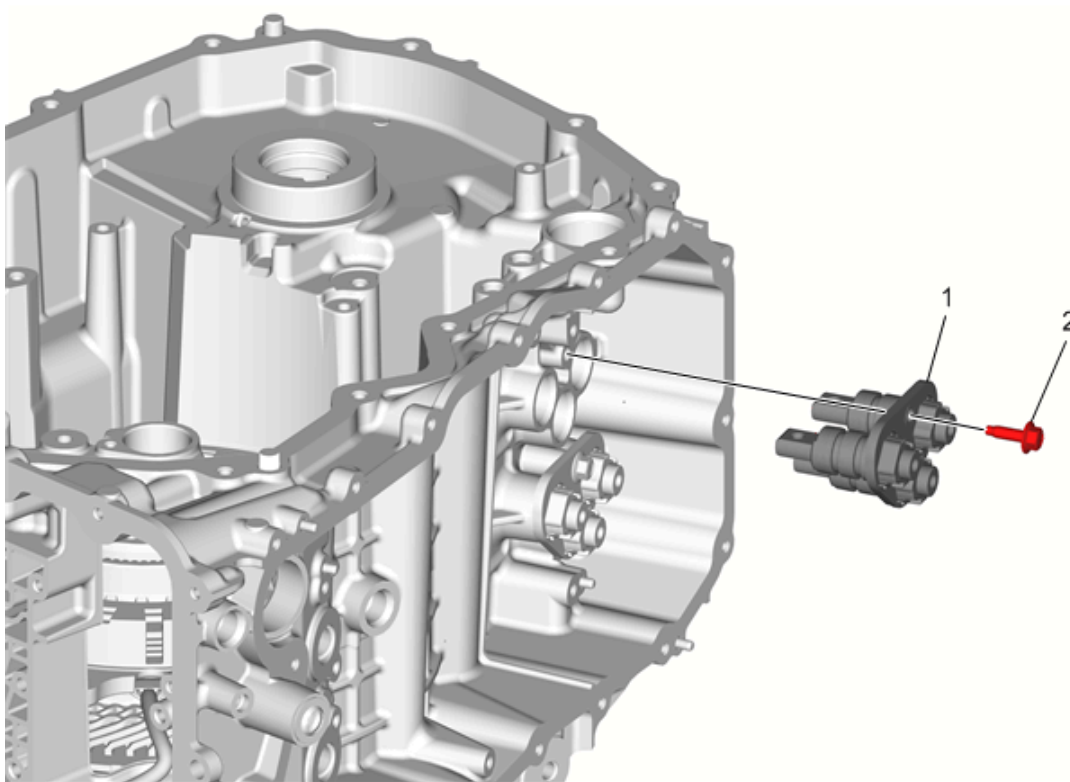


Fig. 241: Drive Motor Power Inverter Module Connector

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Connector Installation

Callout	Component Name
1	Drive Motor Power Inverter Module Connector NOTE: Use a NEW connector.

Callout	Component Name
2	Drive Motor Power Inverter Module Connector Bolt (Qty: 1) Procedure Use Threadlocker Blue on the bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. NOTE: Install a NEW bolt. Tighten 9 N.m (80 lb in)

Drive Motor - 2nd Position Installation

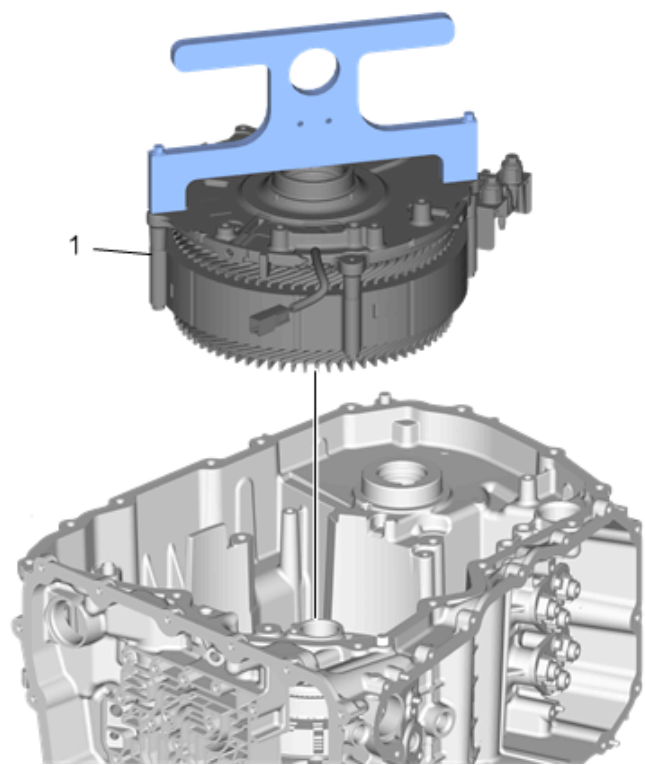


Fig. 242: Drive Motor - 2nd Position
Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 2nd Position Installation

Callout	Component Name
1	Drive Motor - 2nd Position WARNING: The generator motor weighs approximately 23 kg (50 lbs).

Callout	Component Name
	Personal injury may result if you lift the generator motor improperly. CAUTION: DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage. Procedure 1. Install the DT-51623 motor lift bar. 2. Carefully tip the drive motor onto its side, resting on the cast aluminum support. Never rest the drive motor on the stator copper end coils. 3. Attach a lift assist hook through the DT-51623 motor lift bar handle hole and carefully raise the drive motor while holding it to rotate into position for assembly. 4. Carefully lower the drive motor into the transmission case ensuring the copper end coils do not contact any metallic parts. 5. Guide the drive motor resolver wire through the transmission case while lowering the drive motor using a lift assist. 6. If the drive motor will not fully seat, raise the drive motor up with the lift assist so that the planetary gear set can be rotated slightly to engage the sun gear on the drive motor. 7. Repeat step 5 until the drive motor can be fully seated. DO NOT rock, shake, or hammer the drive motor to seat it. Special Tools DT-51623 Motor Lift Bar For equivalent regional tools, refer to <u>Special Tools</u>.

Drive Motor - 2nd Position Bolt Installation

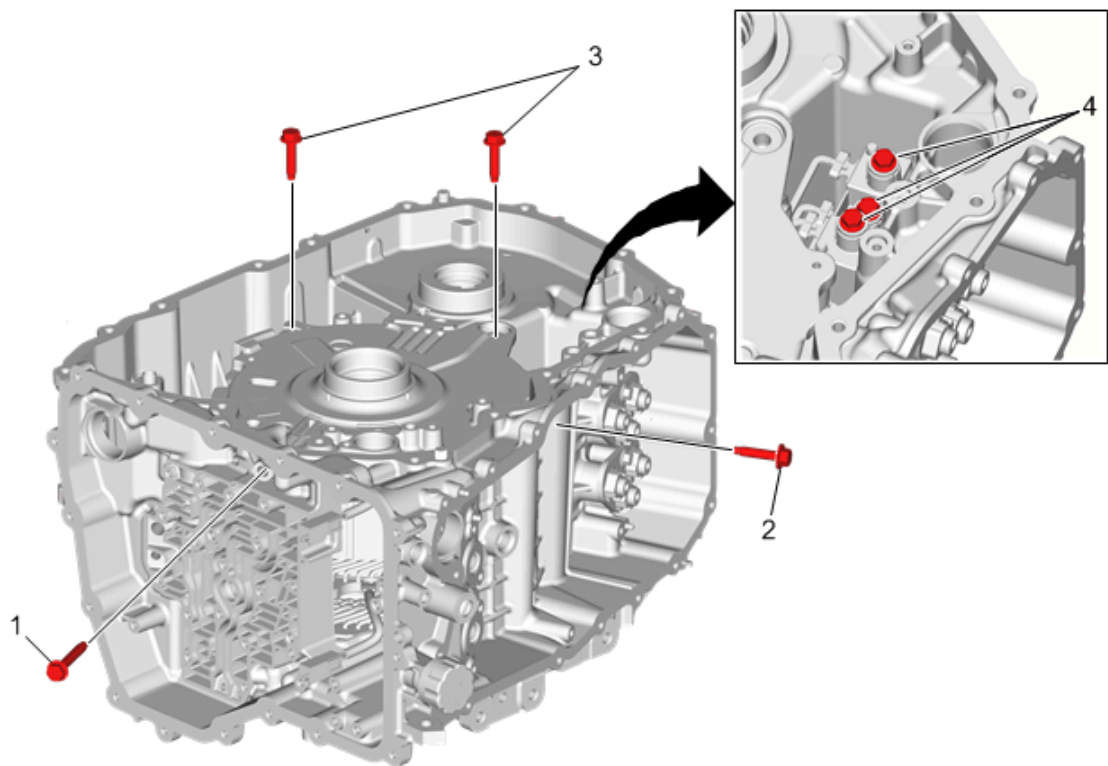


Fig. 243: Drive Motor - 2nd Position Bolts
Courtesy of GENERAL MOTORS COMPANY

Drive Motor - 2nd Position Bolt Installation

Callout	Component Name
1	Automatic Transmission Case Extension Bolt (Qty: 1) NOTE: Use NEW bolts. Tighten 38 N.m (28 lb ft)
2	Automatic Transmission Case Extension Bolt (Qty: 1) NOTE: Use NEW bolts. Tighten 38 N.m (28 lb ft)
3	Automatic Transmission Case Extension Bolt (Qty: 2) Tighten 38 N.m (28 lb ft)

Callout	Component Name
4	Drive Motor Power Inverter Module 3-Phase Cable Bolt (Qty: 3) Tighten 9 N.m (80 lb in)

Drive Motor Stator Cooling Tube Installation

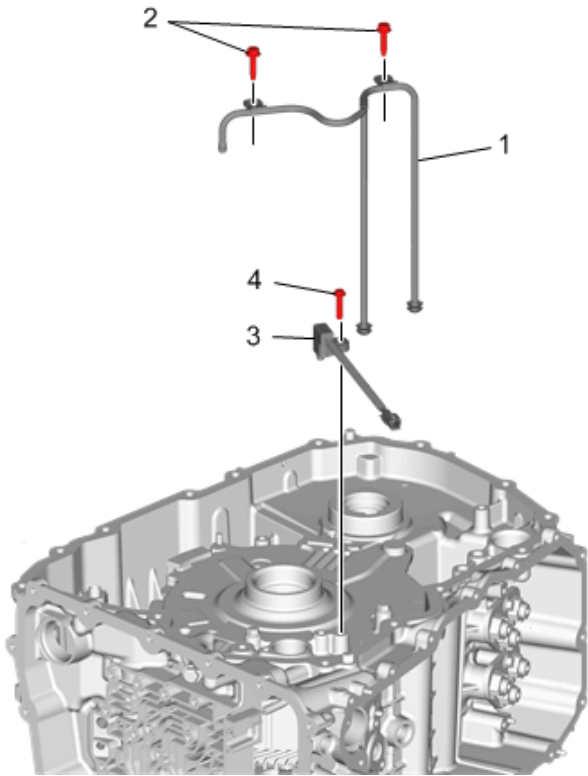


Fig. 244: Drive Motor Stator Cooling Tube
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor Stator Cooling Tube Installation

Callout	Component Name
1	Drive Motor Stator Cooling Tube
2	Drive Motor Stator Cooling Tube Bolt (Qty: 2) Tighten 9 N.m (80 lb in)
3	Automatic Transmission Output Speed Sensor
4	Automatic Transmission Output Speed Sensor Bolt Tighten 9 N.m (80 lb in)

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR INSTALLATION

Automatic Transmission Wiring Harness Bracket Installation

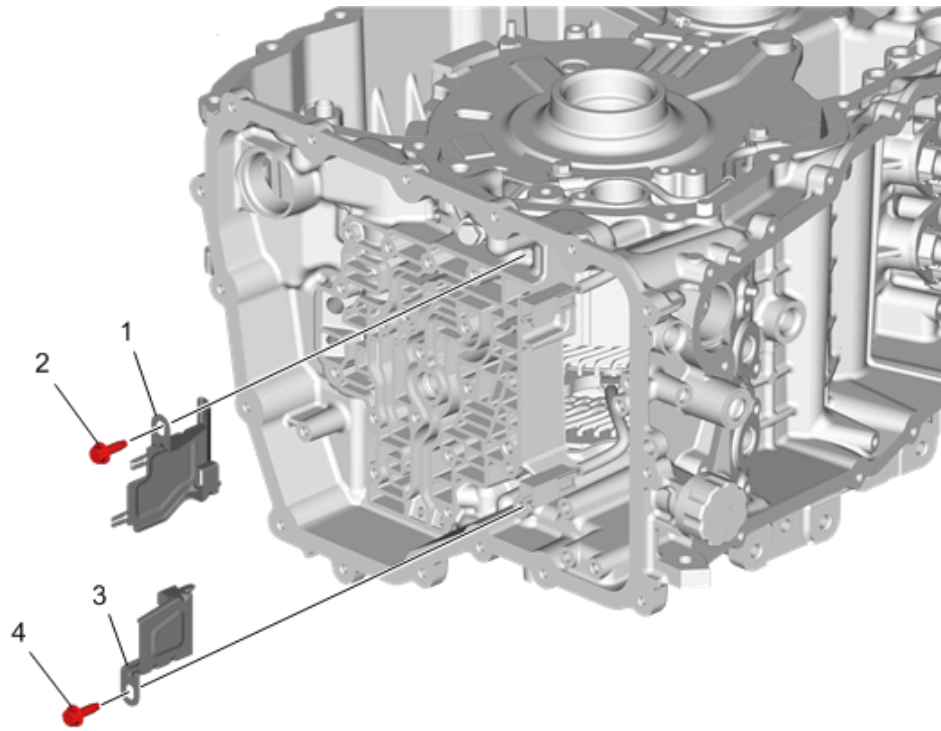


Fig. 245: Automatic Transmission Wiring Harness Bracket

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Wiring Harness Bracket Installation

Callout	Component Name
1	Automatic Transmission Wiring Harness Bracket
2	Automatic Transmission Wiring Harness Connector Bracket Bolt (Qty: 1) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 9 N.m (80 lb in)
3	Automatic Transmission Wiring Harness Bracket
4	Automatic Transmission Wiring Harness Connector Bracket Bolt (Qty: 1) Tighten 9 N.m (80 lb in)

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation

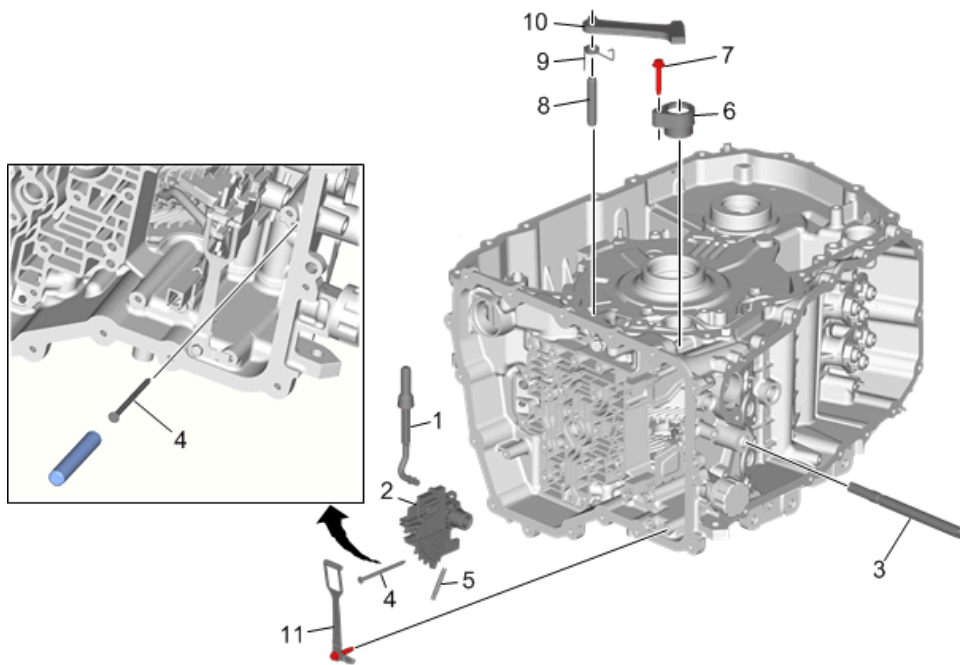


Fig. 246: Manual Shift Detent Lever With Shaft Position Switch Assembly And Park Pawl Actuator
 Courtesy of GENERAL MOTORS COMPANY

Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator Installation

Callout	Component Name
1	Park Pawl Actuator
2	Manual Shift Detent Lever
3	Manual Shift Detent Lever Shaft
4	Manual Shift Shaft Pin CAUTION: The manual shift shaft pin must be installed before the manual shift detent lever pin. Use the special tool, DT-51436, to install the manual shift shaft pin to the proper depth. Failure to follow these steps may result in damage to

Callout	Component Name
	the transmission. Procedure Install the manual shift shaft pin before installing the manual shift detent lever pin. Special Tools DT-51436 Manual Shaft Pin Installer For equivalent regional tools, refer to Special Tools.
5	Manual Shift Detent Lever Pin
6	Park Pawl Actuator Guide
7	Park Pawl Actuator Guide Bolt Tighten 14 N.m (124 lb in)
8	Park Pawl Shaft
9	Park Pawl Spring
10	Park Pawl
11	Manual Shift Detent Lever Spring Tighten 9 N.m (80 lb in)

MANUAL SHIFT SHAFT SEAL INSTALLATION

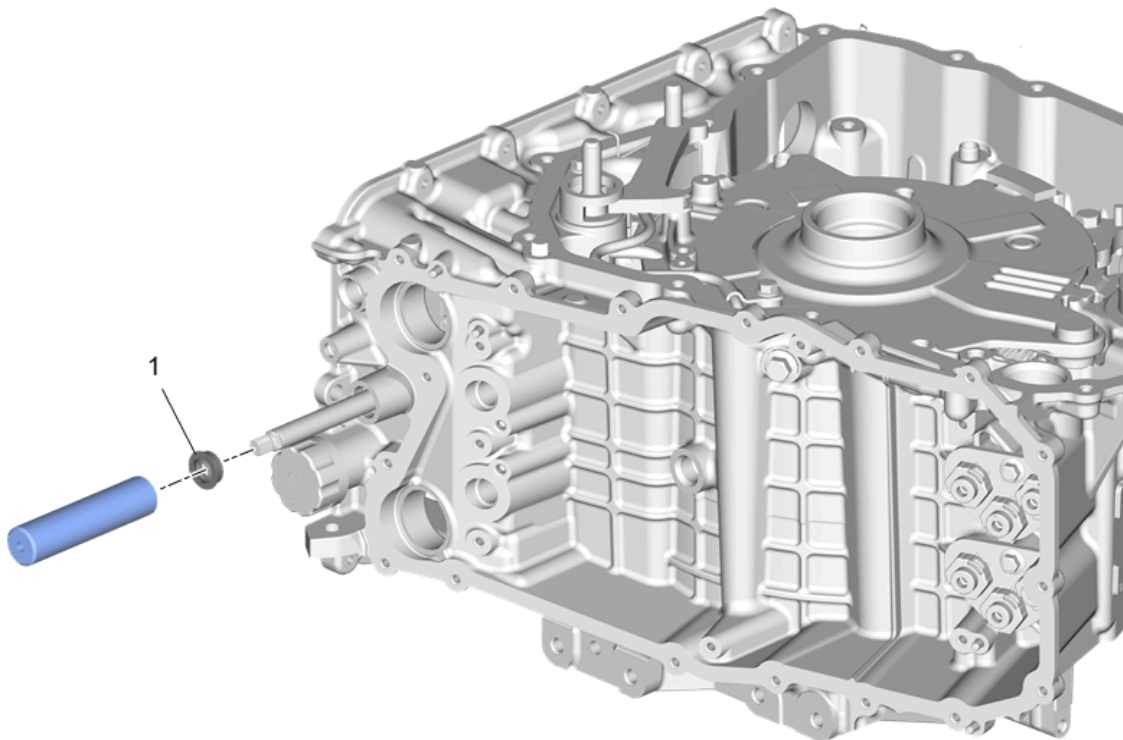


Fig. 247: Manual Shift Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Seal Special Tools DT-51672 Seal Installer For equivalent regional tools, refer to Special Tools .

AUTOMATIC TRANSMISSION FLUID PUMP AND FLUID FILTER INSTALLATION

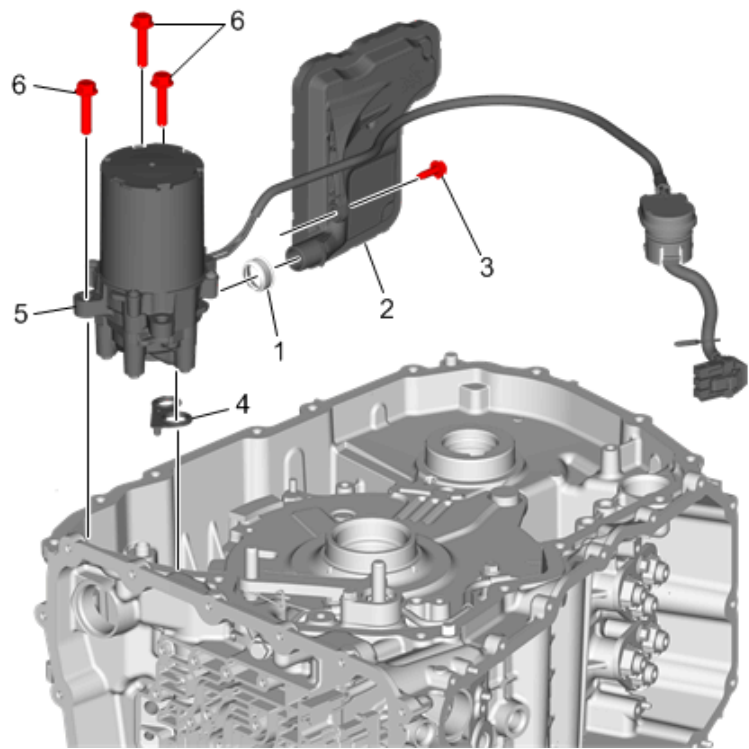


Fig. 248: Automatic Transmission Fluid Pump And Fluid Filter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Filter Seal
2	Automatic Transmission Fluid Filter
3	Automatic Transmission Fluid Filter Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
4	Automatic Transmission Pump Fluid Outlet Seal
5	Automatic Transmission Fluid Pump Procedure Connect the fluid pump pass thru connector to the case.

Callout	Component Name
6	Automatic Transmission Fluid Pump Bolt (Qty: 3) Tighten 22 N.m (16 lb ft)

DRIVE LINK SNUBBER INSTALLATION

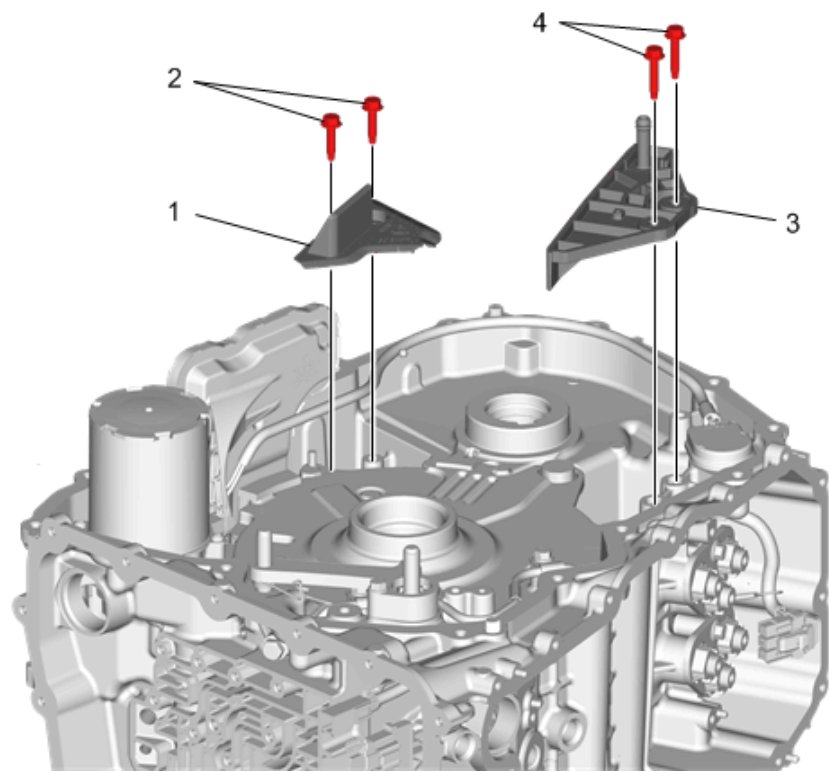


Fig. 249: Drive Link Snubber
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Link Snubber - Coast Side
2	Drive Link Snubber Bolt (Qty: 2) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 9 N.m (80 lb in)
3	Drive Link Snubber - Drive Side
4	Drive Link Snubber Bolt (Qty: 2) Tighten 9 N.m (80 lb in)

FRONT DIFFERENTIAL CARRIER BAFFLE INSTALLATION

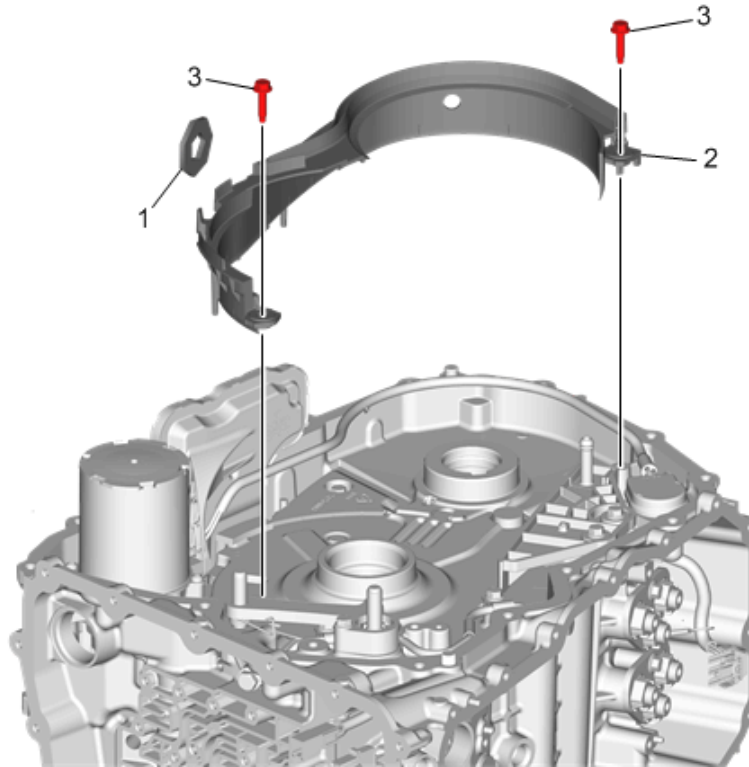


Fig. 250: Front Differential Carrier Baffle
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Chip Collector Magnet
2	Front Differential Carrier Baffle
3	Front Differential Carrier Baffle Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

DRIVE SPROCKET, DRIVEN SPROCKET, AND DRIVE LINK INSTALLATION

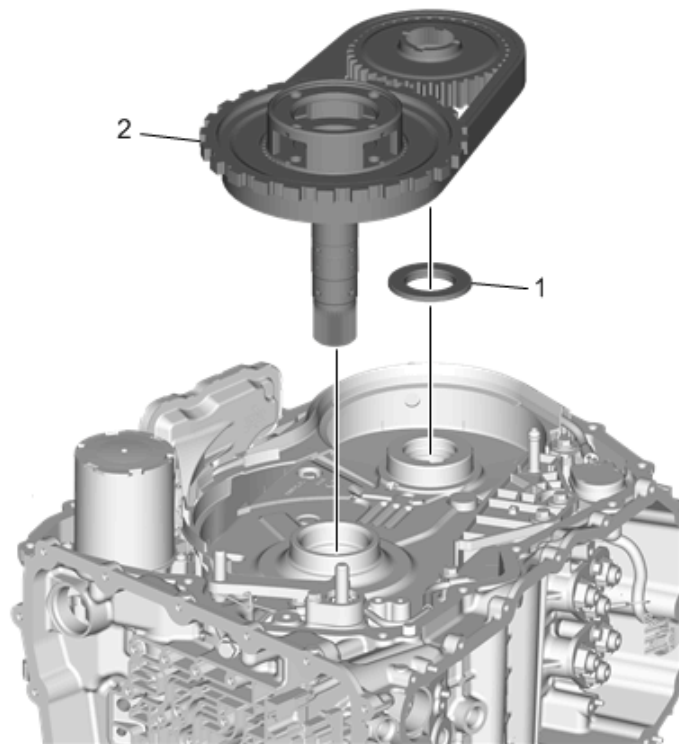


Fig. 251: Drive Sprocket, Driven Sprocket And Drive Link

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Driven Sprocket Bearing
2	Drive Sprocket, Driven Sprocket, and Drive Link

INPUT SUN GEAR SHAFT INSTALLATION

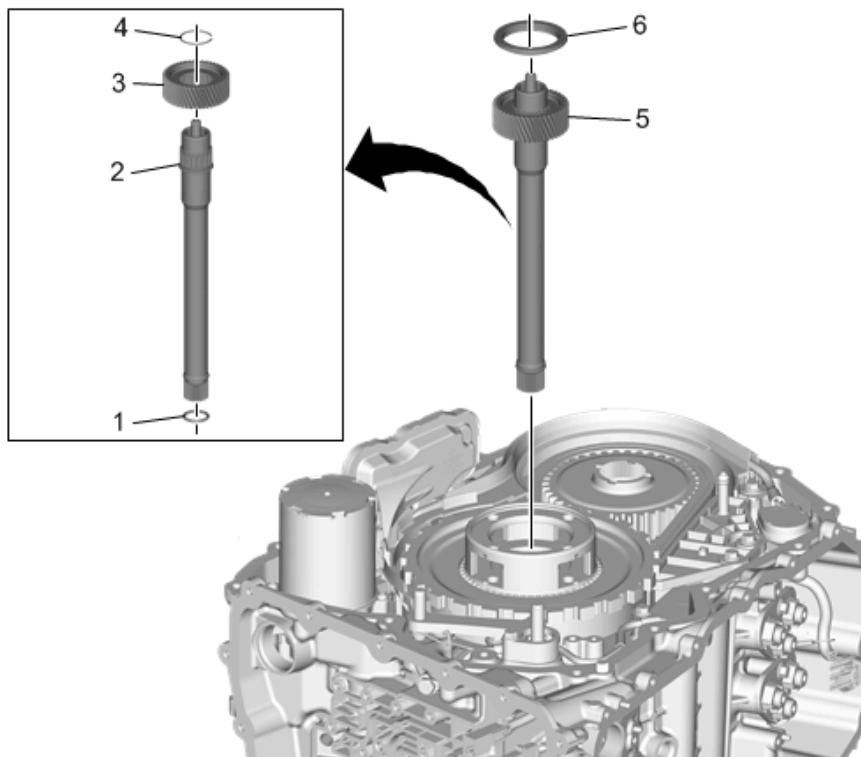


Fig. 252: Input Sun Gear Shaft
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable High Clutch Housing Seal
2	Input Sun Gear Shaft
3	Input Sun Gear
4	Input Sun Gear Retaining Ring
5	Input Sun Gear Shaft Assembly
6	Input Internal Gear Thrust Bearing

FRONT DIFFERENTIAL CARRIER INSTALLATION

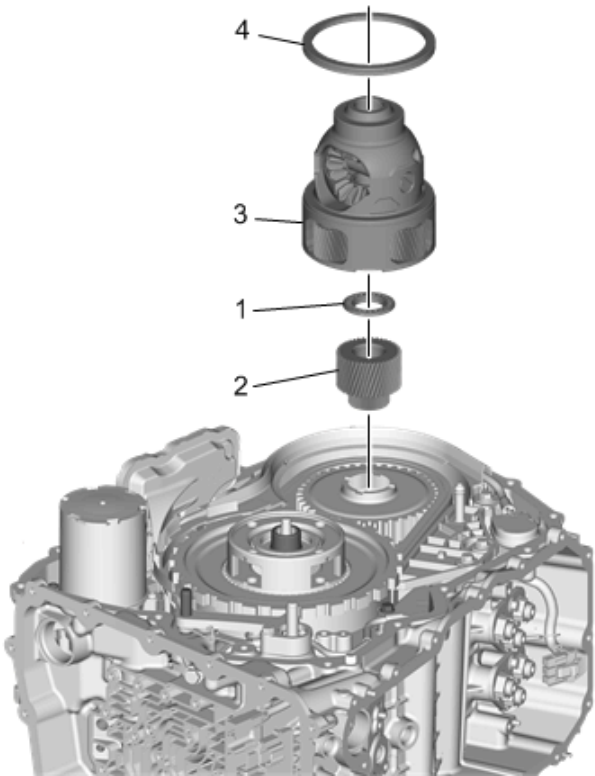


Fig. 253: Front Differential Carrier
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Differential Carrier Sun Gear Thrust Bearing
2	Front Differential Carrier Sun Gear
3	Front Differential Carrier
4	Front Differential Carrier Bearing

AUTOMATIC TRANSMISSION TORQUE DAMPENER AND DIFFERENTIAL HOUSING DISASSEMBLE

Front Differential Ring Gear Removal

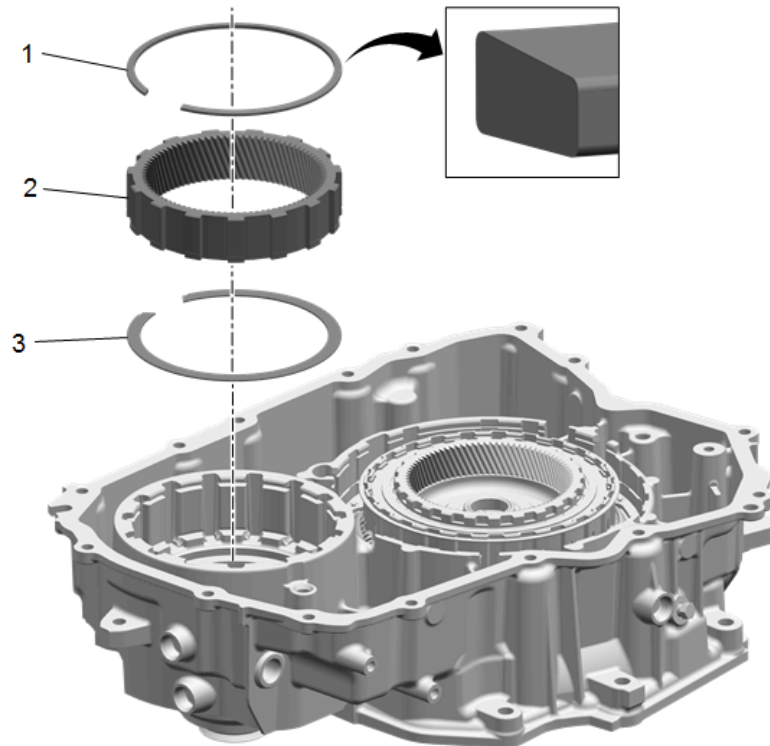


Fig. 254: Front Differential Ring Gear
 Courtesy of GENERAL MOTORS COMPANY

Front Differential Ring Gear Removal

Callout	Component Name
Preliminary Procedure	
Use wooden blocks or equivalent to elevate the torque dampener and differential housing on the bench to protect the front wheel drive shaft oil seal.	
1	Front Differential Ring Gear Retainer
2	Front Differential Ring Gear
3	Front Differential Carrier Internal Gear Wear Ring

Input Brake Clutch Removal

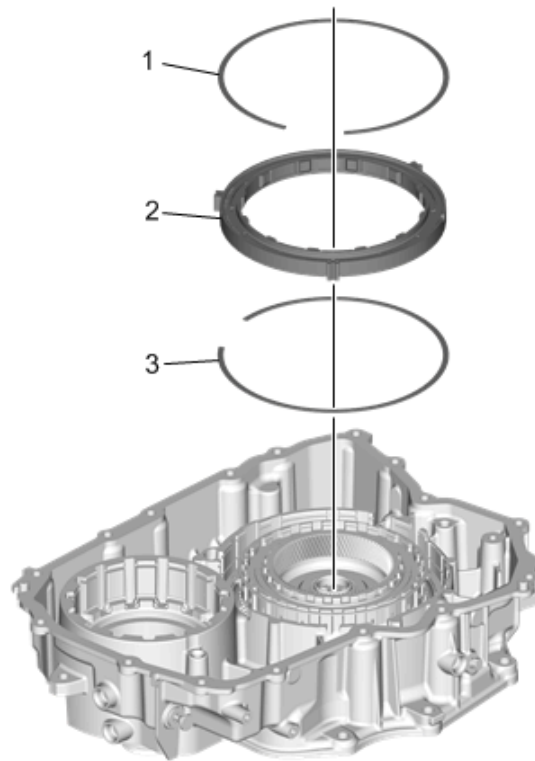


Fig. 255: Input Brake Clutch

Courtesy of GENERAL MOTORS COMPANY

Input Brake Clutch Removal

Callout	Component Name
1	Input Brake Clutch Retaining Ring
2	Input Brake Clutch
3	Input Brake Clutch Retaining Ring

Input Internal Gear Removal

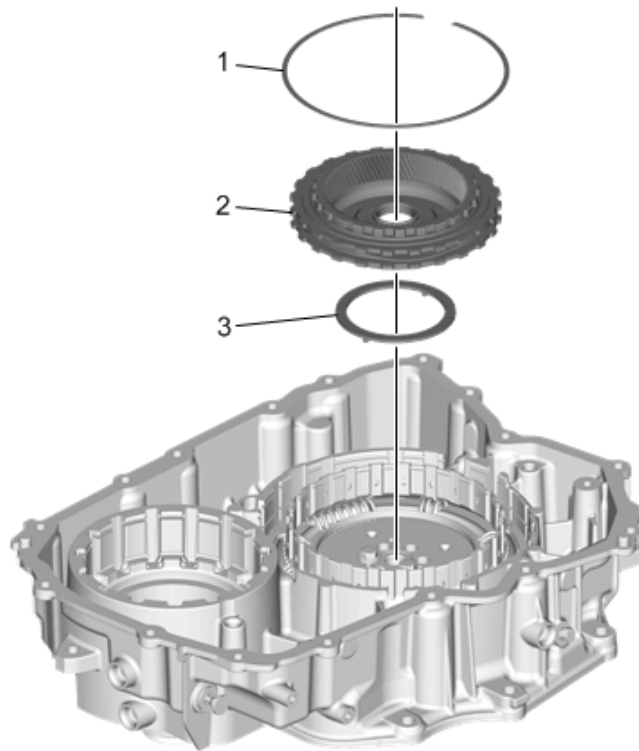


Fig. 256: Input Internal Gear

Courtesy of GENERAL MOTORS COMPANY

Input Internal Gear Removal

Callout	Component Name
1	Input Internal Gear Retaining Ring
2	Input Internal Gear
3	Automatic Transmission Torque Dampener Thrust Washer

Input Drive Flange Removal

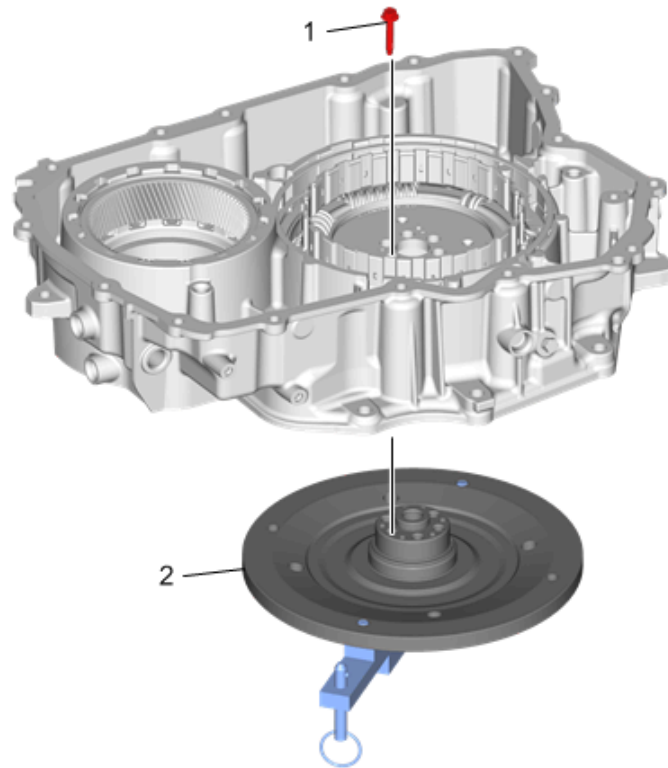


Fig. 257: Input Drive Flange

Courtesy of GENERAL MOTORS COMPANY

Input Drive Flange Removal

Callout	Component Name
1	Automatic Transmission Torque Dampener Bolt (Qty: 6) Procedure Use DT-51654 holder in a vise to hold the torque dampener while removing the bolts. NOTE: DISCARD the bolts. Special Tools DT-51654 Dampener Holder For equivalent regional tools, refer to Special Tools.
2	Input Drive Flange

Automatic Transmission Torque Dampener Removal

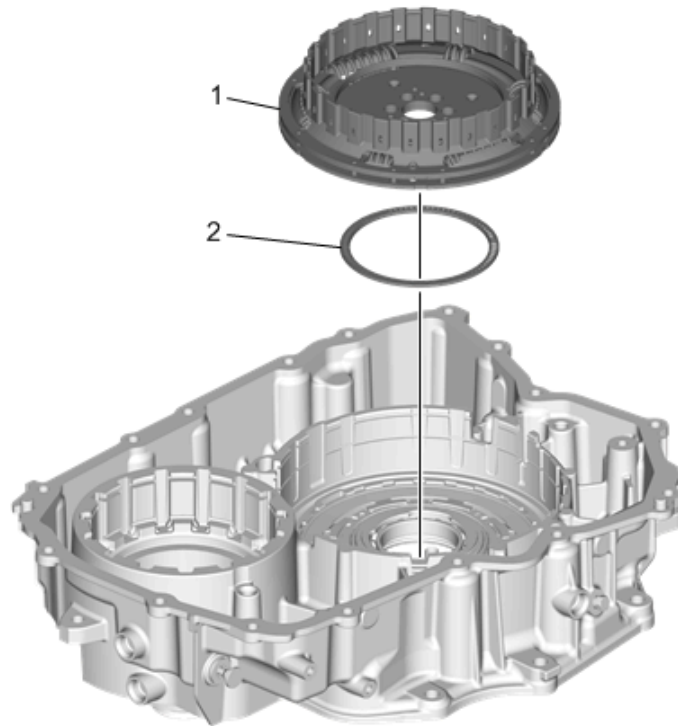


Fig. 258: Automatic Transmission Torque Dampener

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Removal

Callout	Component Name
1	Automatic Transmission Torque Dampener
2	Automatic Transmission Torque Dampener Thrust Bearing NOTE: The thrust bearing may be stuck to the torque dampener.

Automatic Transmission Torque Dampener Bypass Clutch Piston Removal

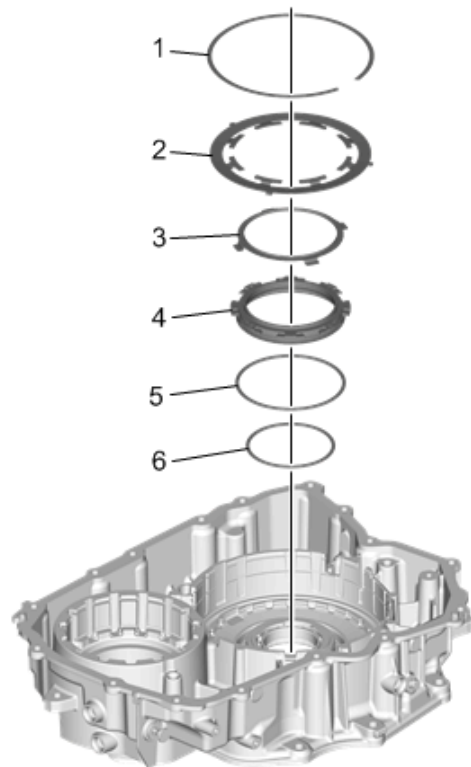


Fig. 259: Automatic Transmission Torque Dampener Bypass Clutch Piston

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Bypass Clutch Piston Removal

Callout	Component Name
CAUTION: Refer to Seal Reuse Caution .	
1	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring Retaining Ring
2	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring
3	Automatic Transmission Torque Dampener Bypass Clutch Apply Bearing
4	Automatic Transmission Torque Dampener Bypass Clutch Piston NOTE: It may be necessary to apply air to the apply passage to remove the piston.
5	Automatic Transmission Torque Dampener Bypass Clutch Piston Outer Seal NOTE: DISCARD the seal.

Callout	Component Name
6	Automatic Transmission Torque Dampener Bypass Clutch Piston Inner Seal NOTE: DISCARD the seal.

FRONT WHEEL DRIVE SHAFT OIL SEAL REMOVAL - RIGHT SIDE

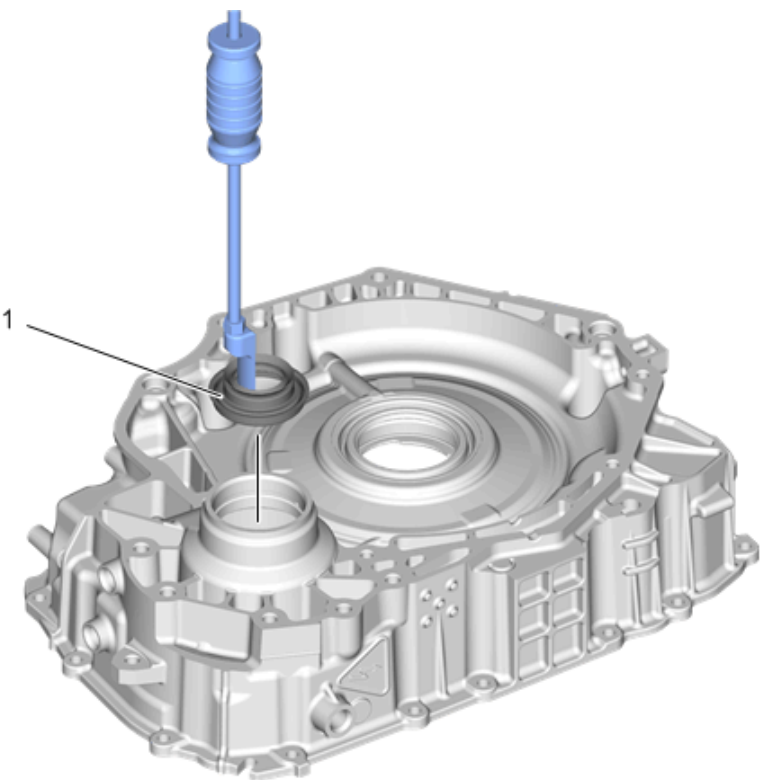


Fig. 260: Front Wheel Drive Shaft Oil Seal - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Special Tools • DT-23129 Universal Seal Remover • GE-6125-1B Slide Hammer For equivalent regional tools, refer to Special Tools .

INPUT SHAFT SEAL REMOVAL

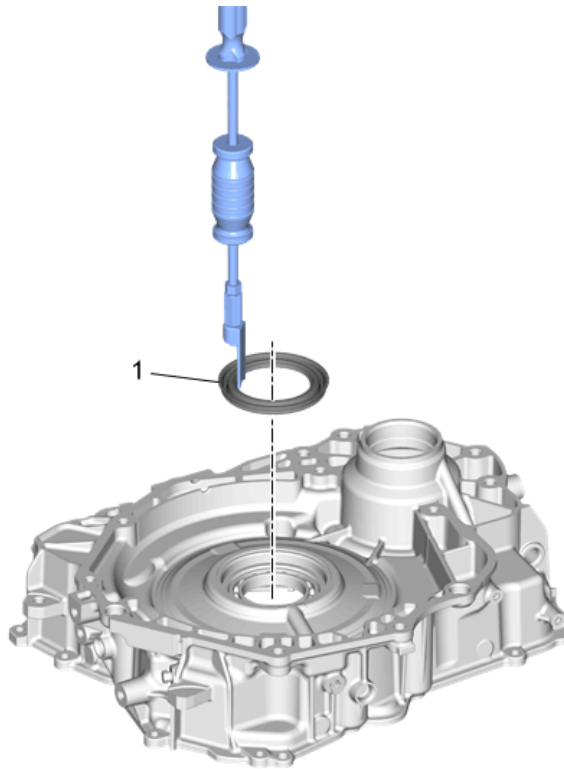


Fig. 261: Input Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Seal Special Tools • DT-23129 Universal Seal Remover • GE-6125-1B Slide Hammer For equivalent regional tools, refer to Special Tools.

INPUT SHAFT BEARING REMOVAL

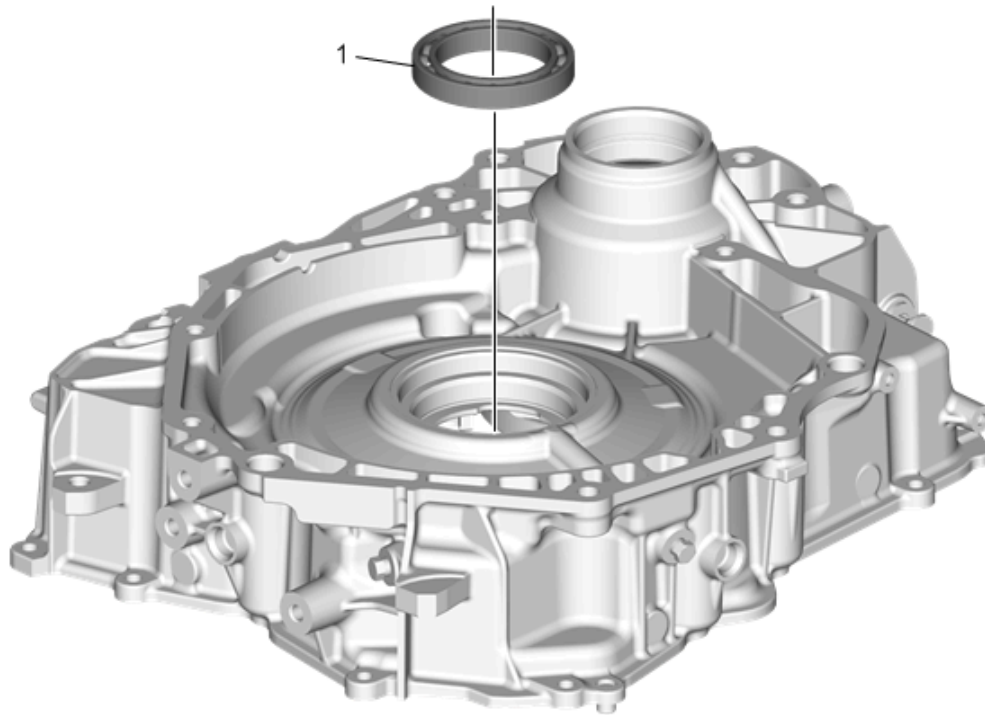


Fig. 262: Input Shaft Bearing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Bearing Procedure Use a punch and hammer to remove the bearing.

AUTOMATIC TRANSMISSION TORQUE DAMPENER AND DIFFERENTIAL HOUSING CLEANING AND INSPECTION

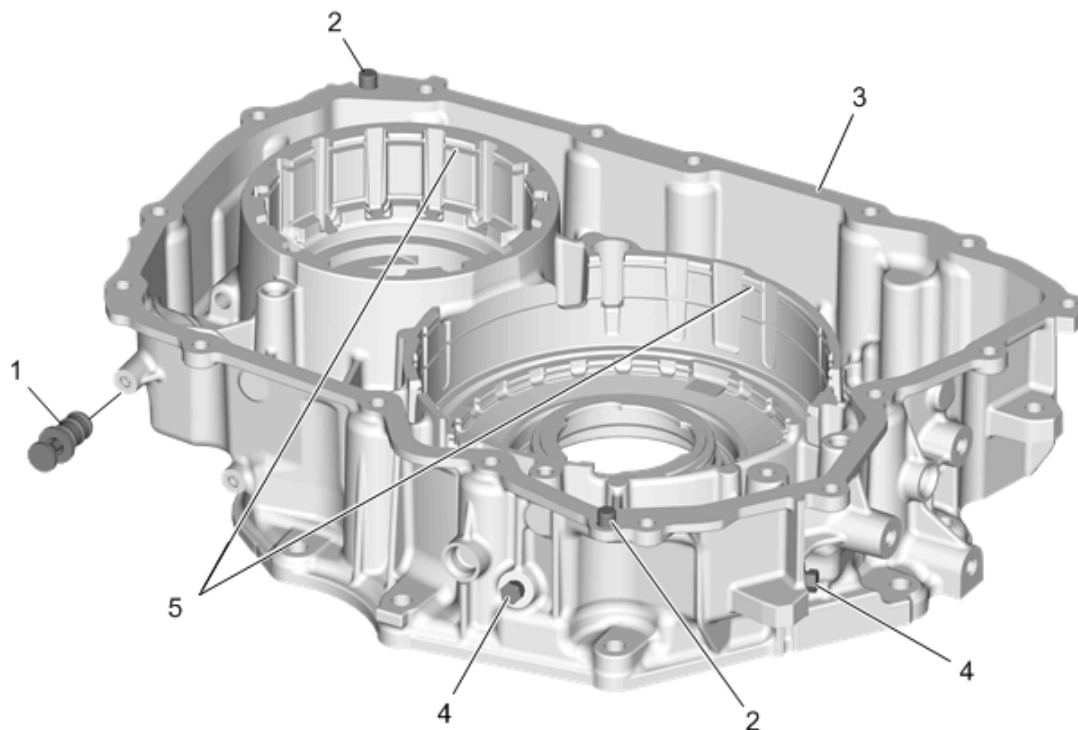


Fig. 263: Automatic Transmission Torque Dampener And Differential Housing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: Do not use abrasive pads or bristle devices to clean the sealing surfaces. Abrasive pads produce a fine grit that can effect transmission function. Abrasive pads can also remove enough metal to create oil leaks.	

Callout	Component Name
CAUTION: After cleaning components, allow to air dry. Do not use cloth or paper towels in order to sit down. Any transmission damage caused by lint from the towels can cause premature component failure. 1. Thoroughly clean the torque dampener and differential housing, including case threads, with clean solvent. 2. Clean gasket sealing surfaces. Remove all residual gasket material. 3. Inspect all threaded holes. If necessary, repair any thread damage.	
1	Transmission Fluid Filler Tube Plug
2	Transmission Fluid Filler Tube Plug
3	Transmission Case to Torque Dampener and Differential Housing Sealing Surface
4	Automatic Transmission Fluid Pressure Test Hole Plug (Qty: 2)
5	Retaining Ring Grooves

INPUT SHAFT BEARING INSTALLATION

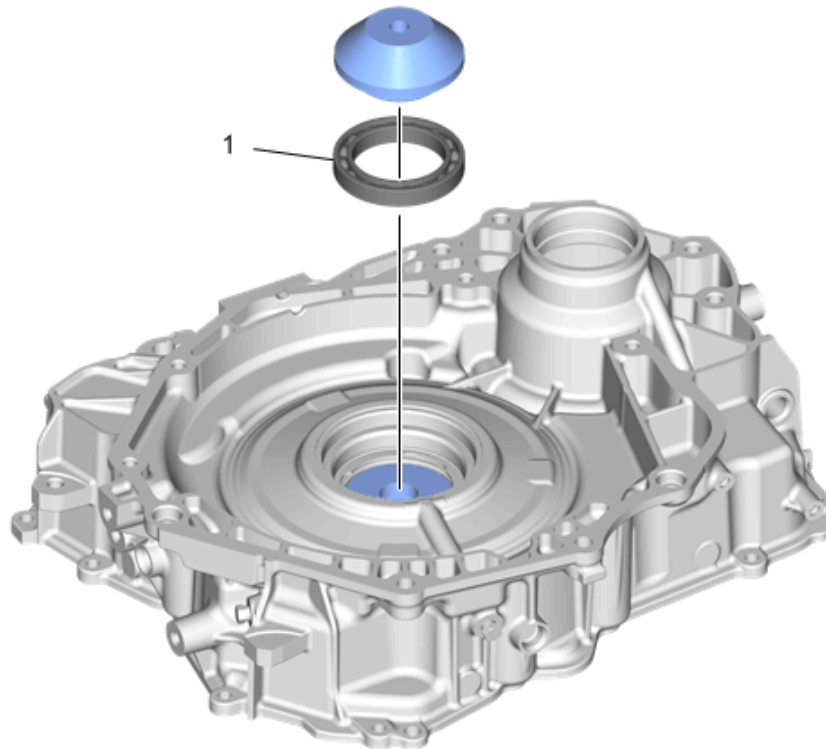


Fig. 264: Input Shaft Bearing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Bearing Procedure Use DT-48008 support with the small shoulder facing up to support the housing while using DT-51625-1 installer and a press to install the bearing. Special Tools • DT-48008 Press Support/Pinion Bearing Installer • DT-51625-1 Bearing Installer For equivalent regional tools, refer to Special Tools.

INPUT SHAFT SEAL INSTALLATION

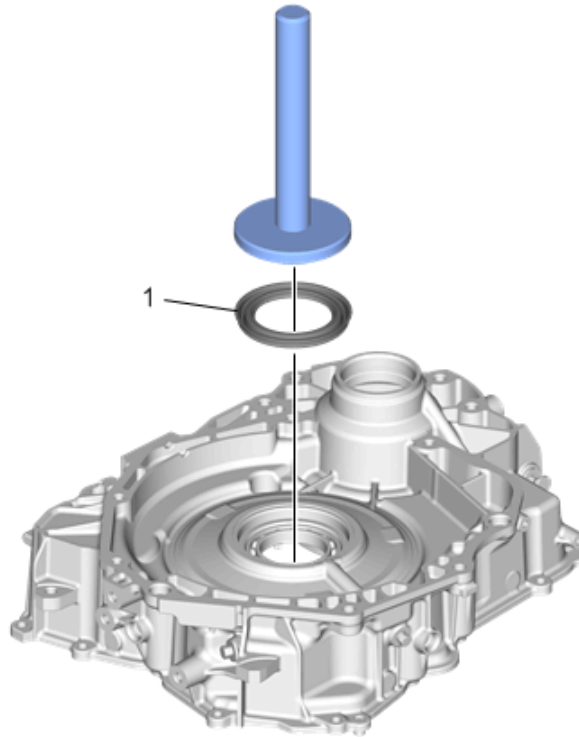


Fig. 265: Input Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Seal Special Tools • DT-8092 Drive Handle • DT-51622 Seal Installer For equivalent regional tools, refer to Special Tools.

FRONT WHEEL DRIVE SHAFT OIL SEAL INSTALLATION - RIGHT SIDE

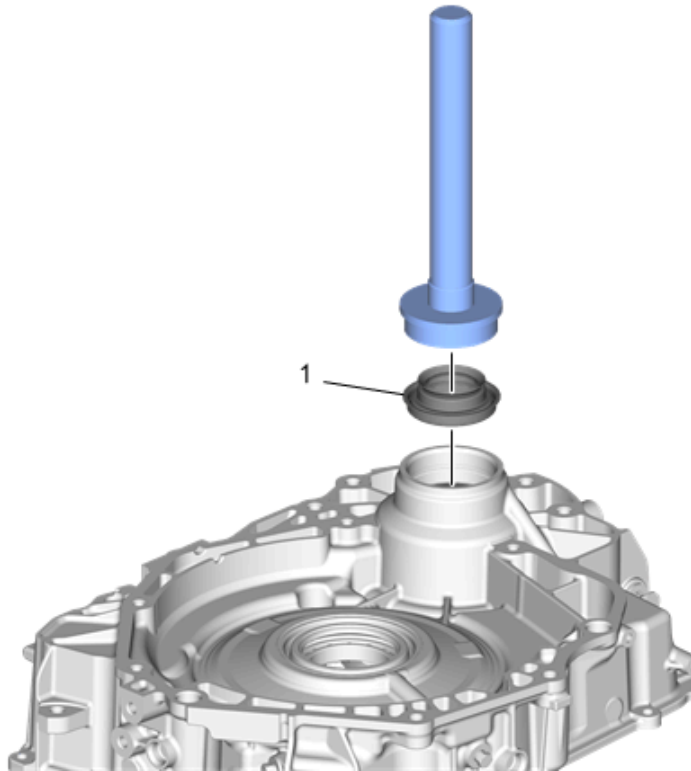


Fig. 266: Front Wheel Drive Shaft Oil Seal - Right Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Special Tools • DT-46629-A Axle Seal Installer • GE-8092 Driver Handle For equivalent regional tools, refer to Special Tools.

INPUT INTERNAL GEAR ASSEMBLY OVERHAUL

Automatic Transmission Torque Limit Clutch

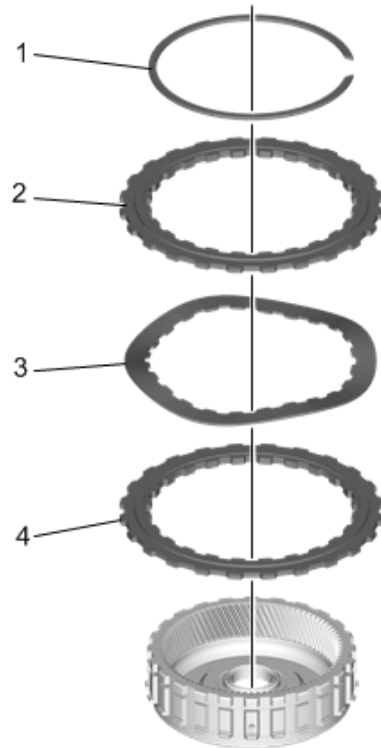


Fig. 267: Automatic Transmission Torque Limit Clutch

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Limit Clutch

Callout	Component Name
1	Automatic Transmission Torque Limit Clutch Backing Plate Ring
2	Automatic Transmission Torque Limit Clutch Backing Plate
3	Automatic Transmission Torque Limit Clutch Spring
4	Automatic Transmission Torque Limit Clutch Backing Plate

Input Internal Gear Hub

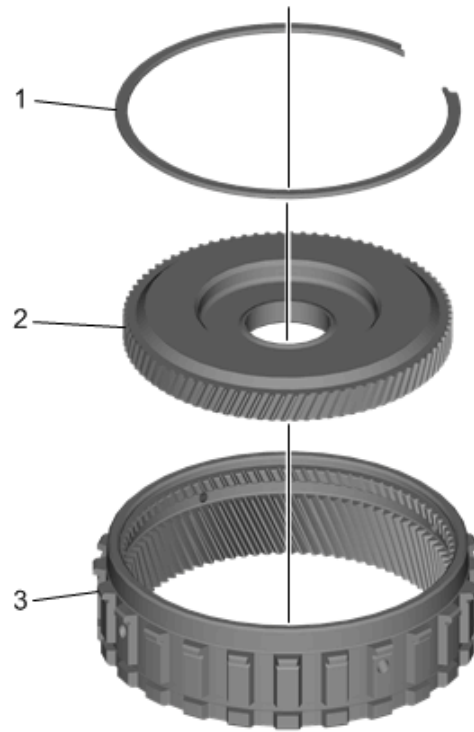


Fig. 268: Input Internal Gear Hub

Courtesy of GENERAL MOTORS COMPANY

Input Internal Gear Hub

Callout	Component Name
1	Input Internal Gear Retaining Ring
2	Input Internal Gear Hub
3	Input Internal Gear

AUTOMATIC TRANSMISSION TORQUE DAMPENER AND DIFFERENTIAL HOUSING ASSEMBLE

Automatic Transmission Torque Damper Bypass Clutch Piston Installation

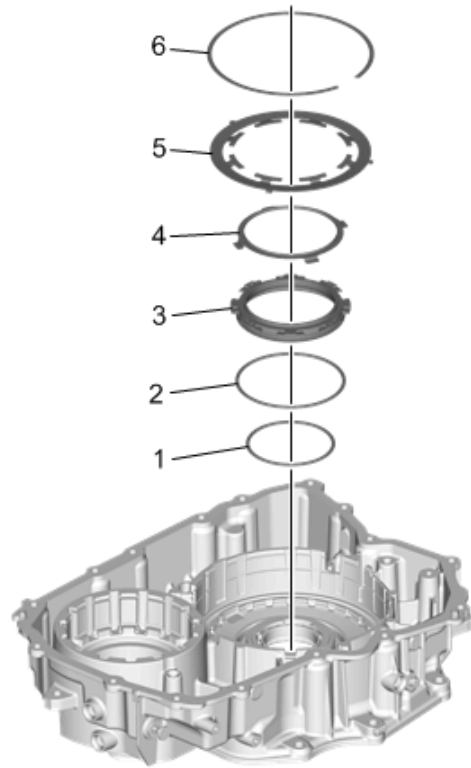


Fig. 269: Automatic Transmission Torque Dampener Bypass Clutch Piston
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Bypass Clutch Piston Installation

Callout	Component Name
CAUTION: Refer to Seal Reuse Caution .	
1	Automatic Transmission Torque Dampener Bypass Clutch Piston Inner Seal NOTE: Install a NEW seal.
2	Automatic Transmission Torque Dampener Bypass Clutch Piston Outer Seal NOTE: Install a NEW seal.
3	Automatic Transmission Torque Dampener Bypass Clutch Piston Procedure Align the dot on the piston to the 6 o'clock notch on the dampener and differential housing. NOTE: Lubricate the piston seals with

Callout	Component Name
	automatic transmission fluid (ATF) to aid in installation of the piston.
4	Automatic Transmission Torque Dampener Bypass Clutch Apply Bearing
5	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring
6	Automatic Transmission Torque Dampener Bypass Clutch Piston Return Spring Retaining Ring

Automatic Transmission Torque Dampener Installation

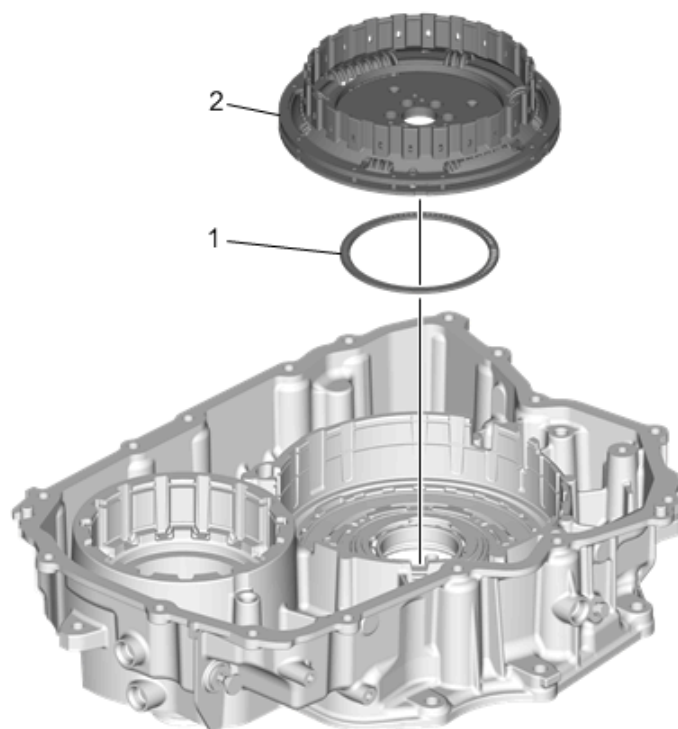


Fig. 270: Automatic Transmission Torque Dampener

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Installation

Callout	Component Name
1	Automatic Transmission Torque Dampener Thrust Bearing
2	Automatic Transmission Torque Dampener

Input Drive Flange Installation

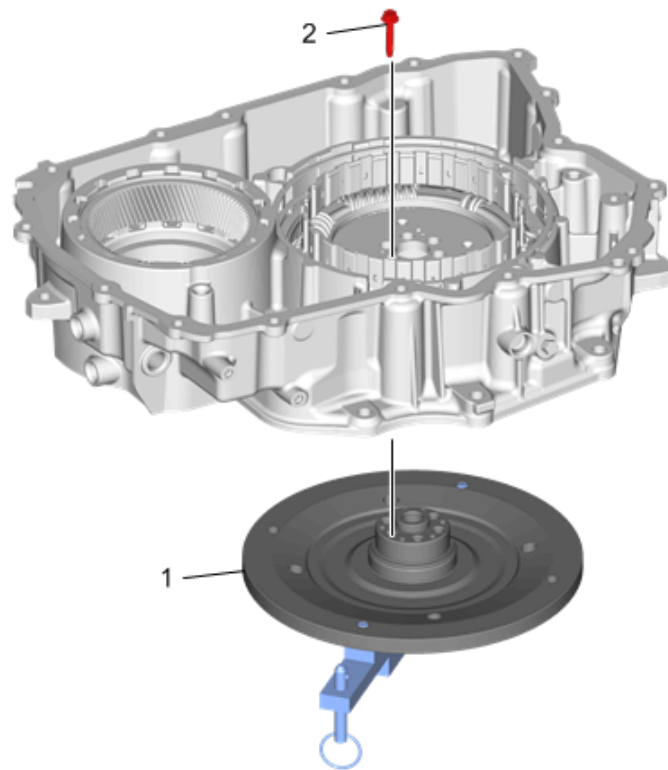


Fig. 271: Input Drive Flange

Courtesy of GENERAL MOTORS COMPANY

Input Drive Flange Installation

Callout	Component Name
1	Input Drive Flange
2	Automatic Transmission Torque Damper Bolt (Qty: 6) CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure NOTE: Install NEW bolts.

Callout	Component Name
	Use DT-51654 holder in a vise to hold the torque dampener while installing the bolts. Tighten 58 N.m (35 lb ft) +37.5 Degrees Special Tools • DT-51654 Dampener Holder • EN-45059 Angle Meter For equivalent regional tools, refer to Special Tools.

Input Internal Gear Installation

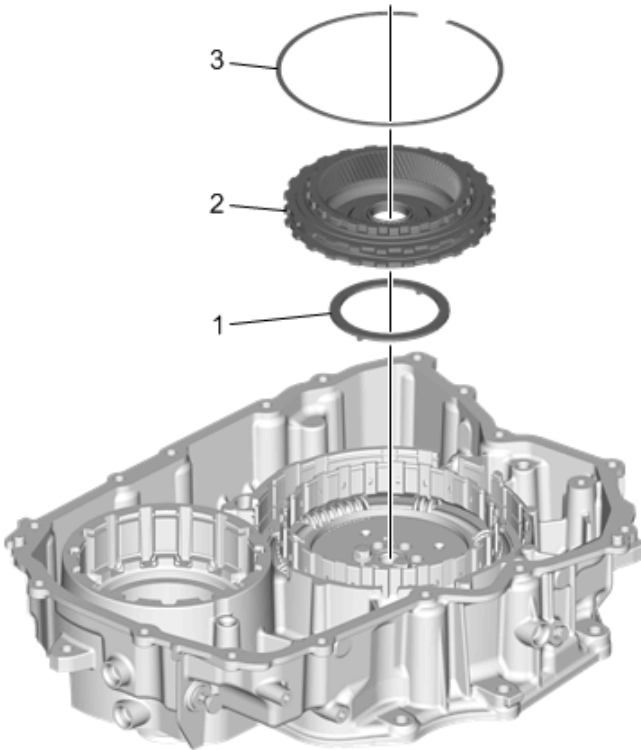


Fig. 272: Input Internal Gear
Courtesy of GENERAL MOTORS COMPANY

Input Internal Gear Installation

Callout	Component Name
1	Automatic Transmission Torque Dampener Thrust Washer - Selective Procedure Select the correct thrust washer. Refer to: Automatic Transmission Torque Dampener Thrust Washer Measurement .
2	Input Internal Gear
3	Input Internal Gear Retaining Ring

Input Brake Clutch Installation

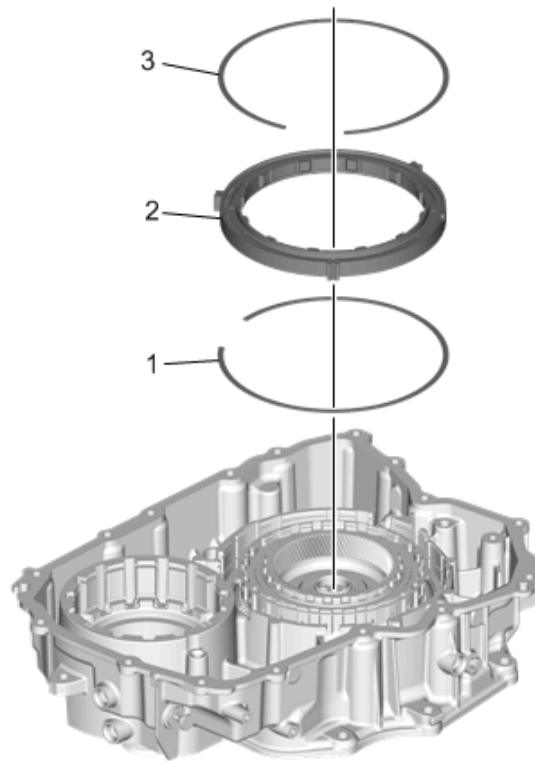


Fig. 273: Input Brake Clutch

Courtesy of GENERAL MOTORS COMPANY

Input Brake Clutch Installation

Callout	Component Name
1	Input Brake Clutch Retaining Ring
2	Input Brake Clutch NOTE: The input brake clutch should rotate freely in one direction and lock in the opposite direction. Rotate the clutch assembly and listen/feel for the ratchet of the clutch in it's designed rotational direction.

Callout	Component Name
3	Input Brake Clutch Retaining Ring

Front Differential Ring Gear Installation

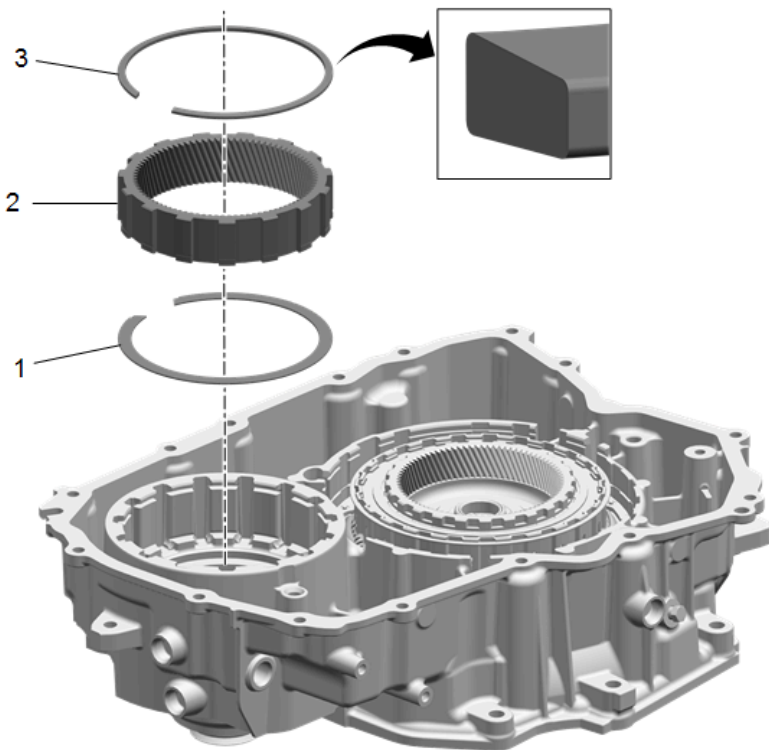


Fig. 274: Front Differential Ring Gear
 Courtesy of GENERAL MOTORS COMPANY

Front Differential Ring Gear Installation

Callout	Component Name
1	Front Differential Carrier Internal Gear Wear Ring NOTE: Inspect the dampener housing for wear before installing the wear ring. If excessive wear is found, replace the dampener housing.
2	Front Differential Ring Gear
3	Front Differential Ring Gear Retainer

Callout	Component Name
	NOTE:

Stake the retainer to ensure it is seated in the

AUTOMATIC TRANSMISSION TORQUE DAMPENER THRUST WASHER MEASUREMENT

Automatic Transmission Torque Dampener Thrust Washer Measurement (Step 1)

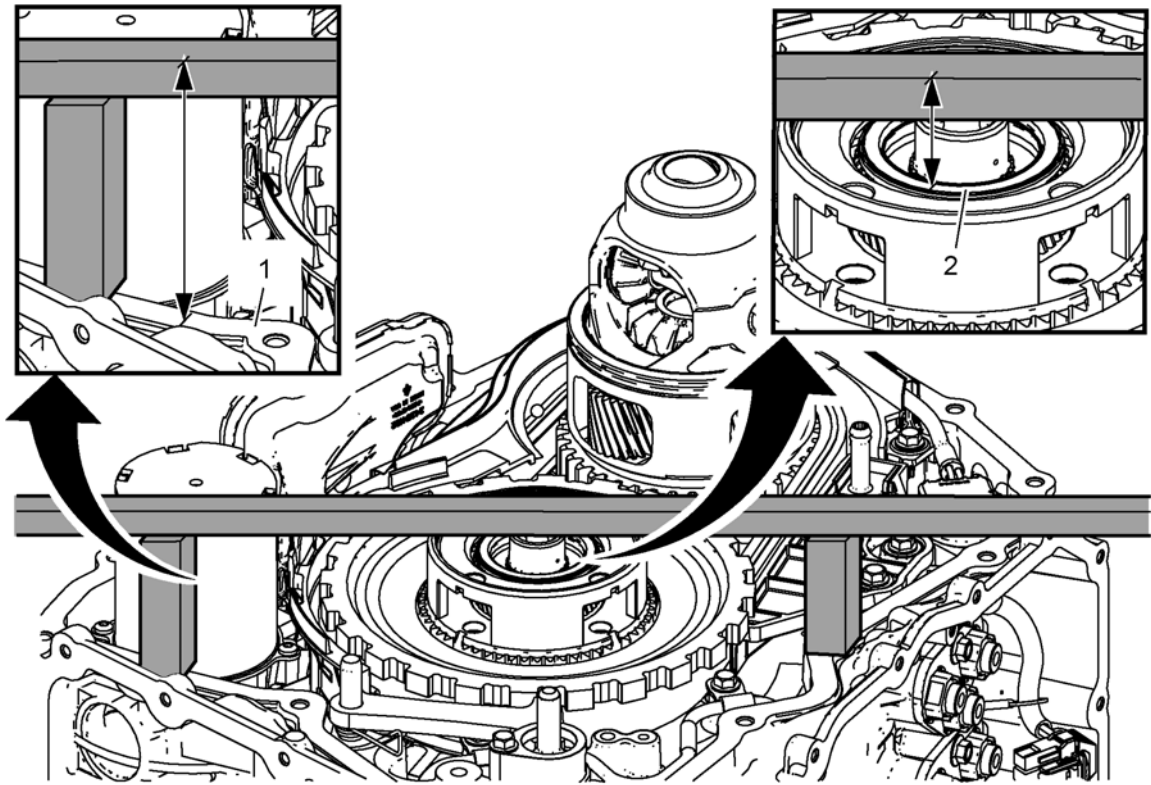


Fig. 275: Automatic Transmission Torque Dampener Thrust Washer Measurement (Step 1)
 Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Thrust Washer Measurement (Step 1)

Callout	Component Name
	Automatic Transmission Case Mating Surface
	Procedure - Using 2 inch gauge blocks and at least a 16 inch straight edge, set up the measurement as shown. - Measure from the case mating surface to the top of the straight edge and record the measurement. - Measure from the top of the input internal gear thrust bearing to the top of the straight edge and subtract this dimension from the measurement taken in step 2. Record the measurement - Measure the thickness of the torque dampener and differential housing gasket and subtract from the measurement recorded in step 3. Record this as dimension A.
1	
2	Input Internal Gear Thrust Bearing

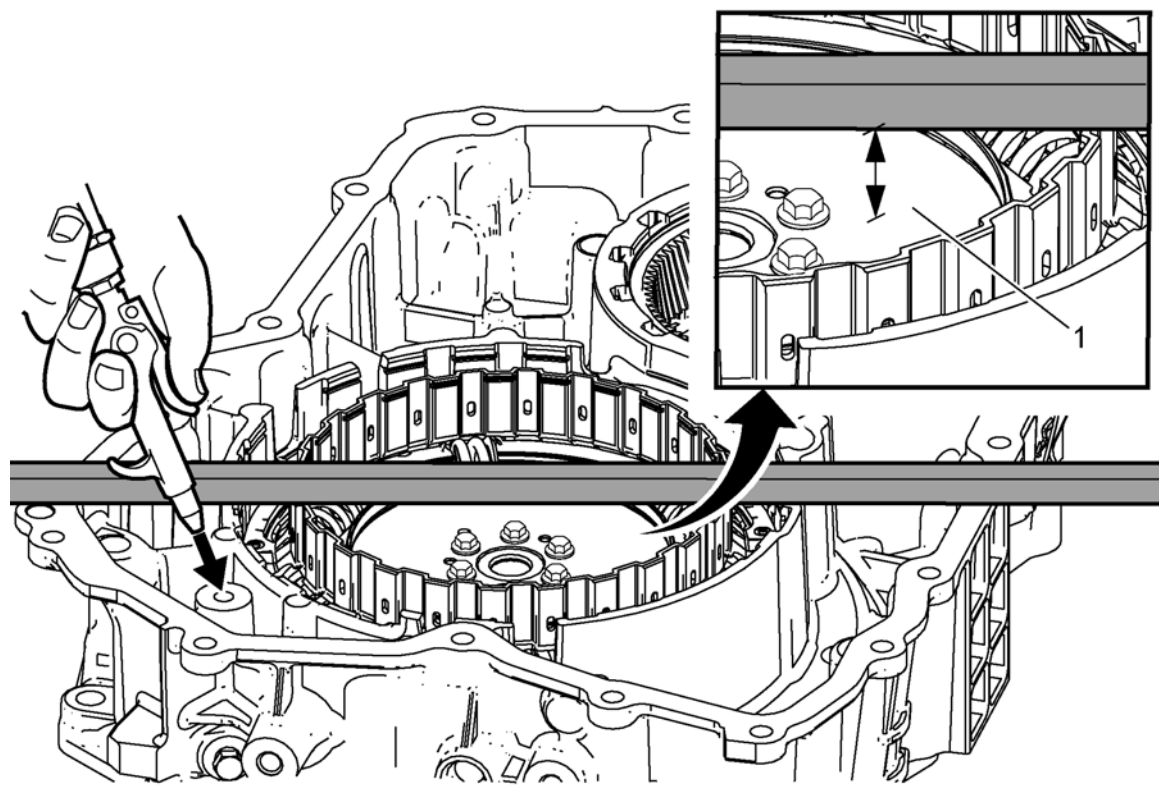


Fig. 276: Automatic Transmission Torque Dampener Thrust Washer Measurement (Step 2)
Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Torque Dampener Thrust Washer Measurement (Step 2)

Callout	Component Name
1	Automatic Transmission Torque Dampener Procedure 1. Apply 50 PSI of compressed air to the torque dampener bypass clutch and measure from the torque dampener and differential housing mating face to the torque dampener. Record this as dimension B. 2. Subtract dimension A from dimension B to determine the correct automatic transmission torque dampener thrust washer. Refer to Automatic Transmission Torque Dampener Thrust Washer Specifications.

**AUTOMATIC TRANSMISSION TORQUE DAMPENER AND DIFFERENTIAL HOUSING
INSTALLATION**

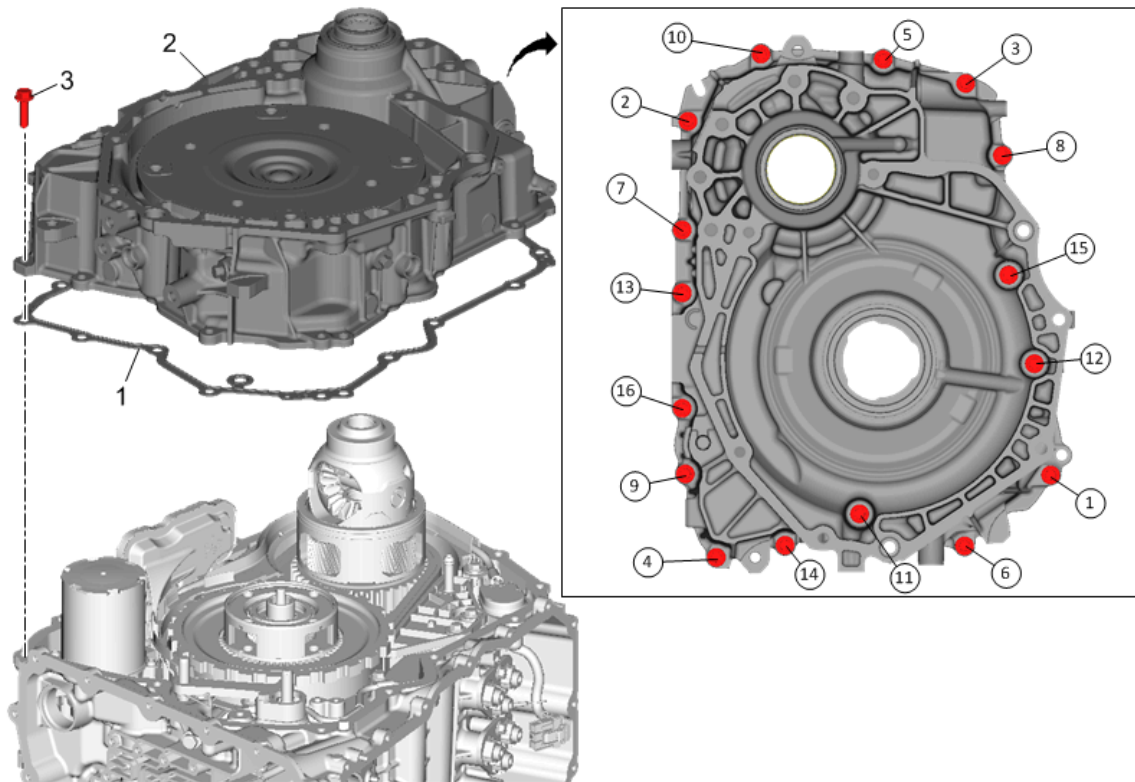


Fig. 277: Automatic Transmission Torque Dampener And Differential Housing With Bolt Tightening Sequences

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Torque Dampener and Differential Housing Gasket NOTE: Install a NEW gasket.
2	Automatic Transmission Torque Dampener and Differential Housing NOTE: Use care not to crush the front differential carrier baffle, this may prevent the torque dampener and differential housing from seating properly.

Callout	Component Name
3	Torque Converter and Differential Housing Bolt (Qty: 16) CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 32 N.m (24 lb ft)

CONTROL VALVE ASSEMBLY DISASSEMBLE

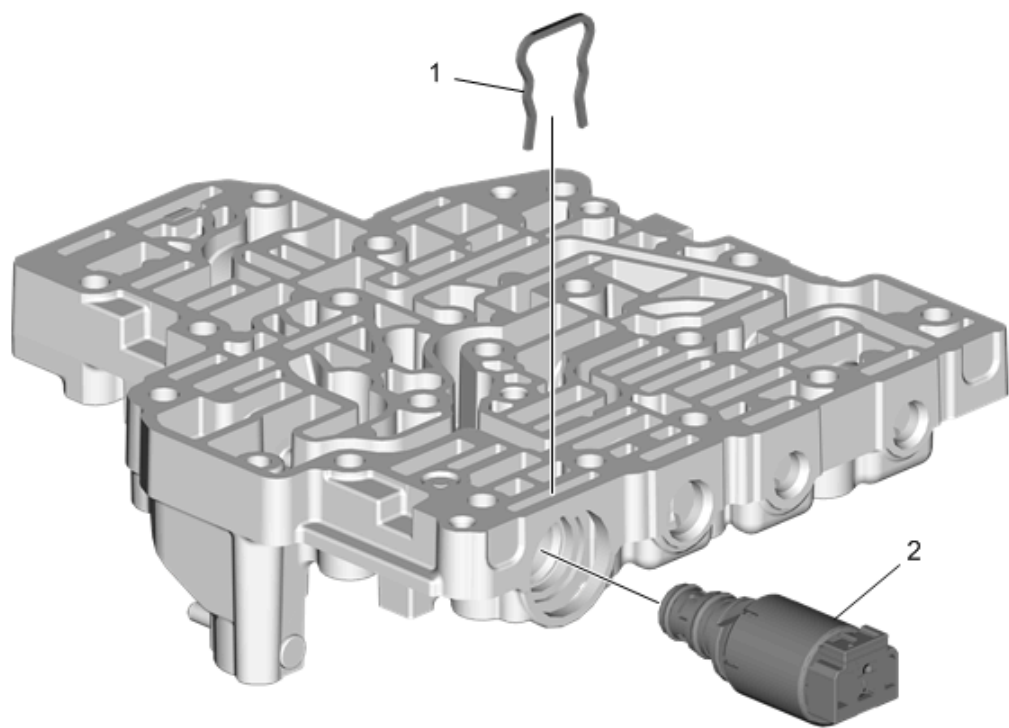


Fig. 278: Control Valve Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Line Pressure Control Solenoid Valve Retainer
2	Line Pressure Control Solenoid Valve

CONTROL VALVE ASSEMBLY ASSEMBLE

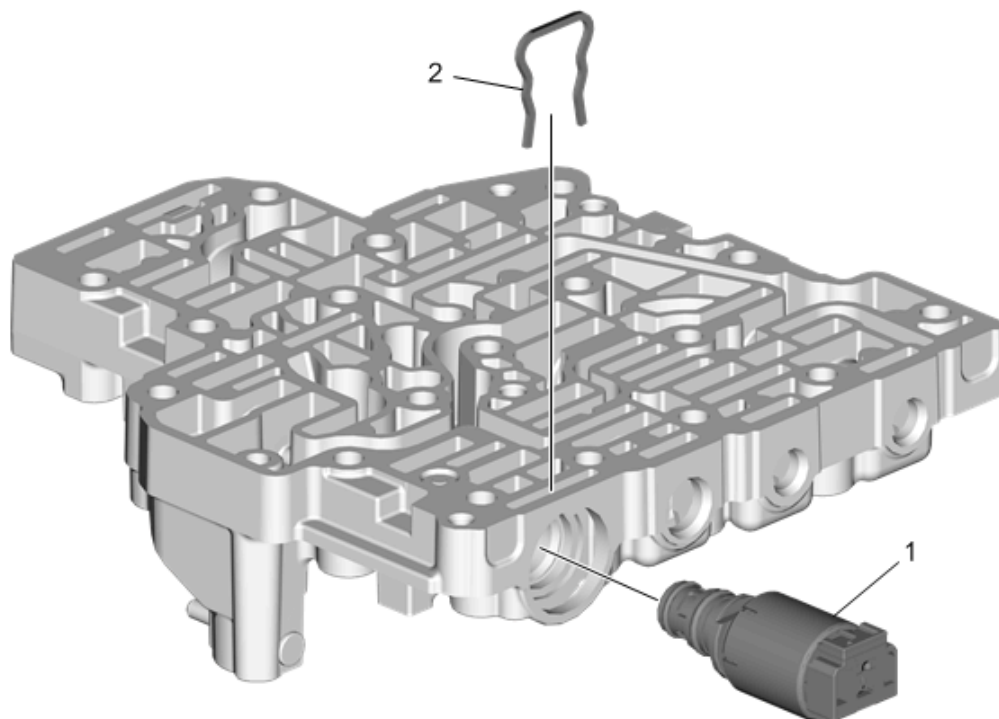


Fig. 279: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Line Pressure Control Solenoid Valve
2	Line Pressure Control Solenoid Valve Retainer

CONTROL VALVE ASSEMBLY AND TRANSMISSION WIRING HARNESS INSTALLATION

Automatic Transmission Wiring Harness Installation

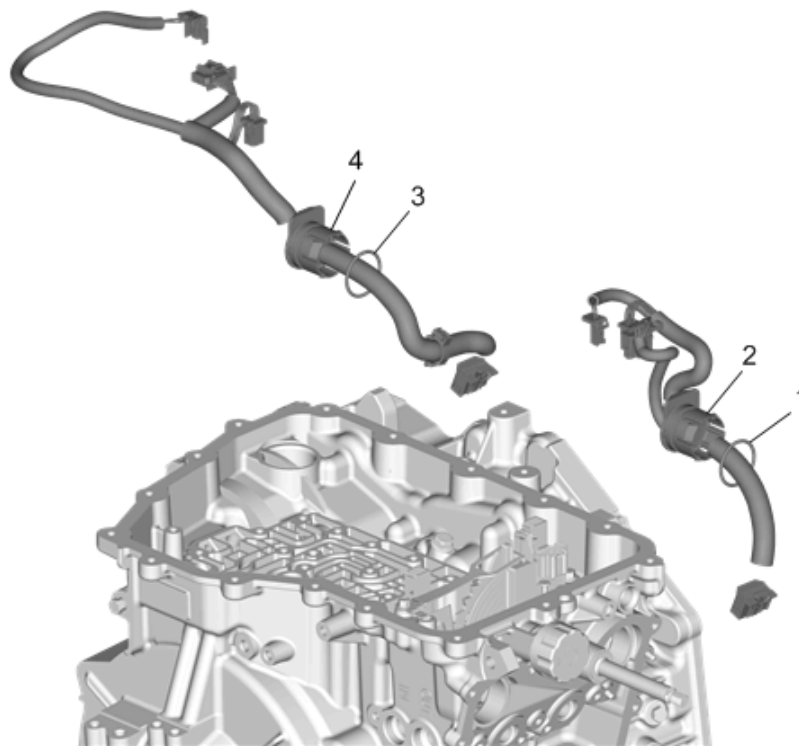


Fig. 280: Automatic Transmission Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Wiring Harness Installation

Callout	Component Name
1	Automatic Transmission Wiring Connector Seal
2	Automatic Transmission Wiring Harness - Shift Shaft Position Switch
3	Automatic Transmission Wiring Connector Seal
4	Automatic Transmission Wiring Harness - Control Solenoid Valve

Control Valve (with Body and Valve) Installation

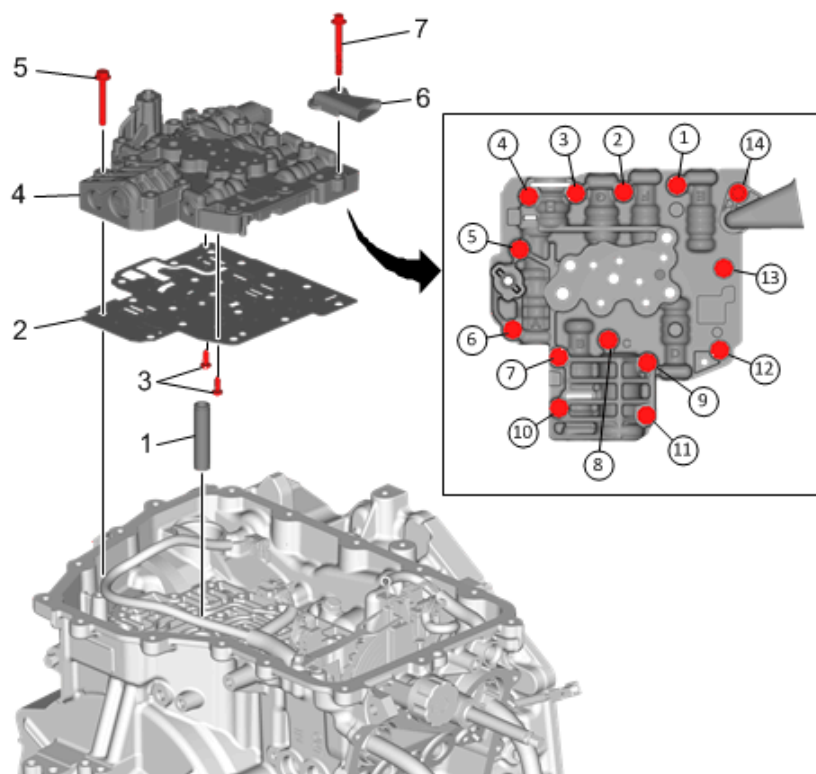


Fig. 281: Control Valve (With Body And Valve) With Bolt Tightening Sequence

Courtesy of GENERAL MOTORS COMPANY

Control Valve (with Body and Valve) Installation

Callout	Component Name
1	Variable Low Clutch Fluid Passage Seal NOTE: Install a NEW seal.
2	Control Valve Lower Body Spacer Plate NOTE: Install a NEW spacer plate.
3	Control Valve Body Spacer Plate Retainer (Qty: 2)
4	Control Valve (with Body and Valve) Procedure Connect the transmission wiring harness to the control valve body.
5	CAUTION: Refer to Fastener Caution .
	Control Valve Body Bolt (Qty: 13) Tighten 9 N.m (80 lb in)
6	Fluid Transfer Pipe

Callout	Component Name
7	Fluid Transfer Pipe Bolt Tighten 9 N.m (80 lb in)

Control Solenoid Valve Installation

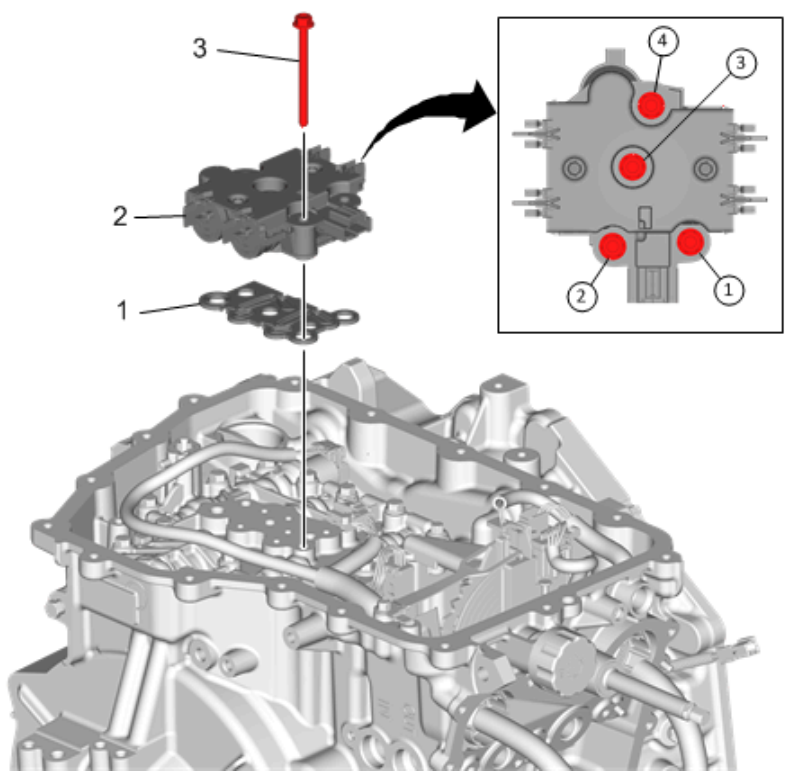


Fig. 282: Control Solenoid Valve (With Bolt Tightening Sequence)

Courtesy of GENERAL MOTORS COMPANY

Control Solenoid Valve Installation

Callout	Component Name
1	Control Solenoid Valve Filter Plate Procedure Align and engage the alignment tabs on the control solenoid valve filter plate to the control solenoid valve. NOTE: The filter plate is reusable, inspect the filter plate and replace if damaged.
2	Control Solenoid Valve Procedure Connect the control solenoid valve wiring harness.

Callout	Component Name
3	Control Valve Body Bolt (Qty: 4) Tighten 9 N.m (80 lb in)

CONTROL VALVE BODY COVER INSTALLATION

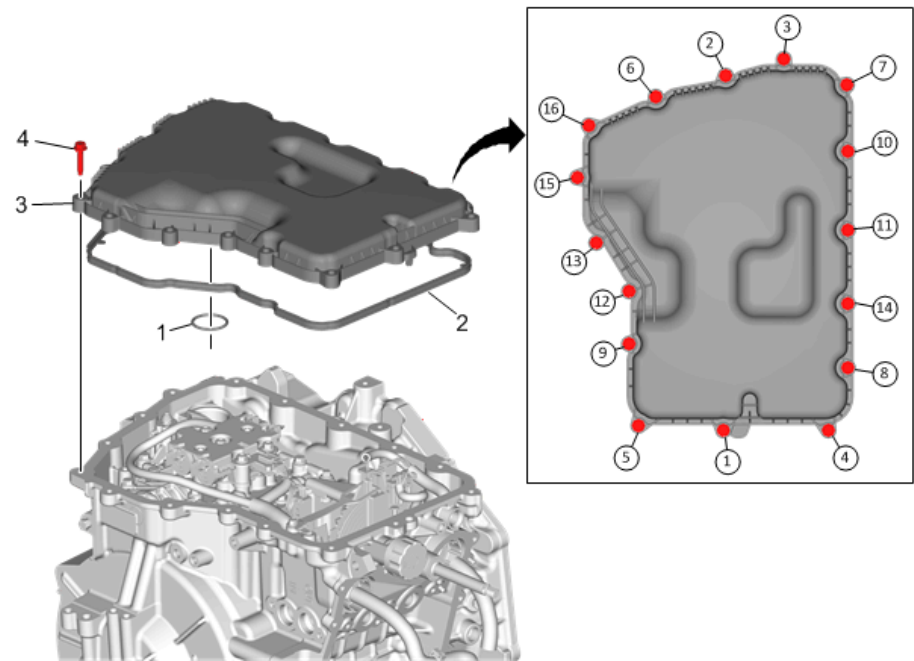


Fig. 283: Control Valve Body Cover (With Bolt Tightening Sequence)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Level Control Valve Seal - O-ring NOTE: The seal is reusable, inspect the seal and replace if damaged.
2	Automatic Transmission Fluid Level Control Valve Seal NOTE: The gasket is reusable, inspect the gasket and replace if damaged.
3	Control Valve Body Cover

Callout	Component Name
4	Control Valve Body Cover Bolt (Qty: 16) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

DRIVE MOTOR POWER INVERTER MODULE INSTALLATION

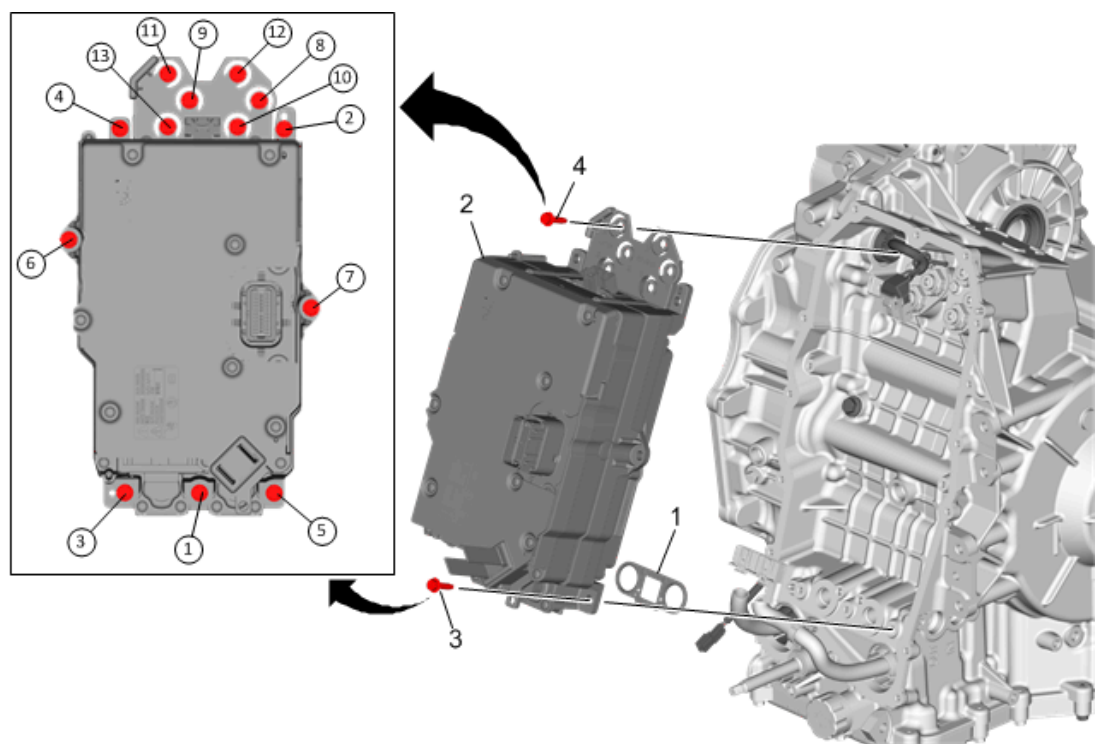


Fig. 284: Drive Motor Power Inverter Module (With Bolt Tightening Sequence)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Ensure the drive motor power inverter module cavity is free of debris and coolant before installation.	
1	Drive Motor Power Inverter Module Fluid Seal Procedure Ensure proper operation of the seal after installation of the drive motor power inverter module. Refer to Drive Motor Power Inverter Module Fluid Seal Pressure Test. NOTE: Install a NEW seal.
2	Drive Motor Power Inverter Module

Callout	Component Name
3	Drive Motor Power Inverter Module Bolt (Qty: 7) CAUTION: Refer to Fastener Caution . Procedure Use threadlocker blue on the bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers. Tighten 9 N.m (80 lb in)
4	Drive Motor Power Inverter Module 3-Phase Buss Bar Bolt (Qty: 6) Procedure 1. Connect the 3 drive motor power inverter module connectors after the drive motor power inverter module is installed. 2. Ensure the wiring harness is routed properly and the wires are in the plastic conduit to prevent cut or chaffed wires. Tighten 9 N.m (80 lb in)

DRIVE MOTOR POWER INVERTER MODULE COVER INSTALLATION

Drive Motor Power Inverter Module Cover Installation

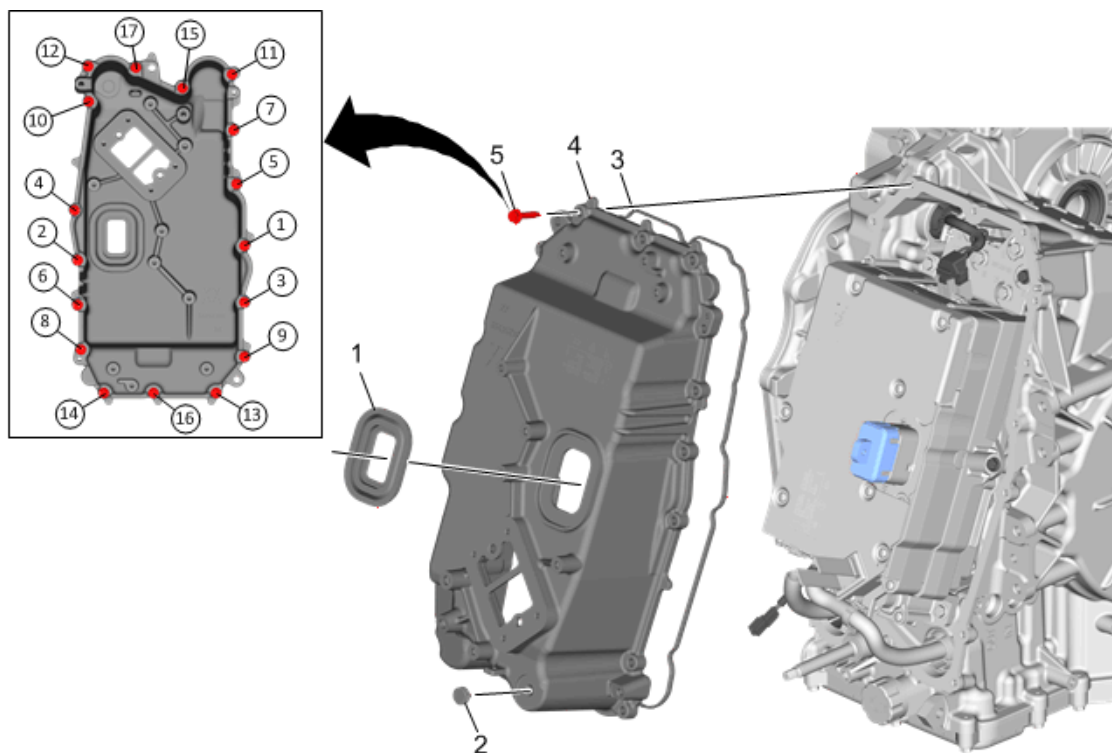


Fig. 285: Drive Motor Power Inverter Module Cover (With Bolt Tightening Sequence)

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Power Inverter Module Cover Installation

Callout	Component Name
1	Drive Motor Power Inverter Module Electrical Connector Seal NOTE: The seal is reusable, inspect the seal and replace if damaged.
2	Drive Motor Power Inverter Module Cover Vent
3	Drive Motor Power Inverter Module Cover Gasket
4	Drive Motor Power Inverter Module Cover Procedure Use the DT-51626 protector when installing the cover to avoid damaging the connector seal. NOTE: Ensure the drive motor power inverter module cover alignment pins are clean and free of debris to allow the cover to seat flush to the case sealing surface. Special Tools DT-51626 Seal Protector For equivalent regional tools, refer to Special Tools .
5	Drive Motor Power Inverter Module Cover Bolt (Qty: 17) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 9 N.m (80 lb in)

Drive Motor Battery Positive and Negative Cable Connector Installation

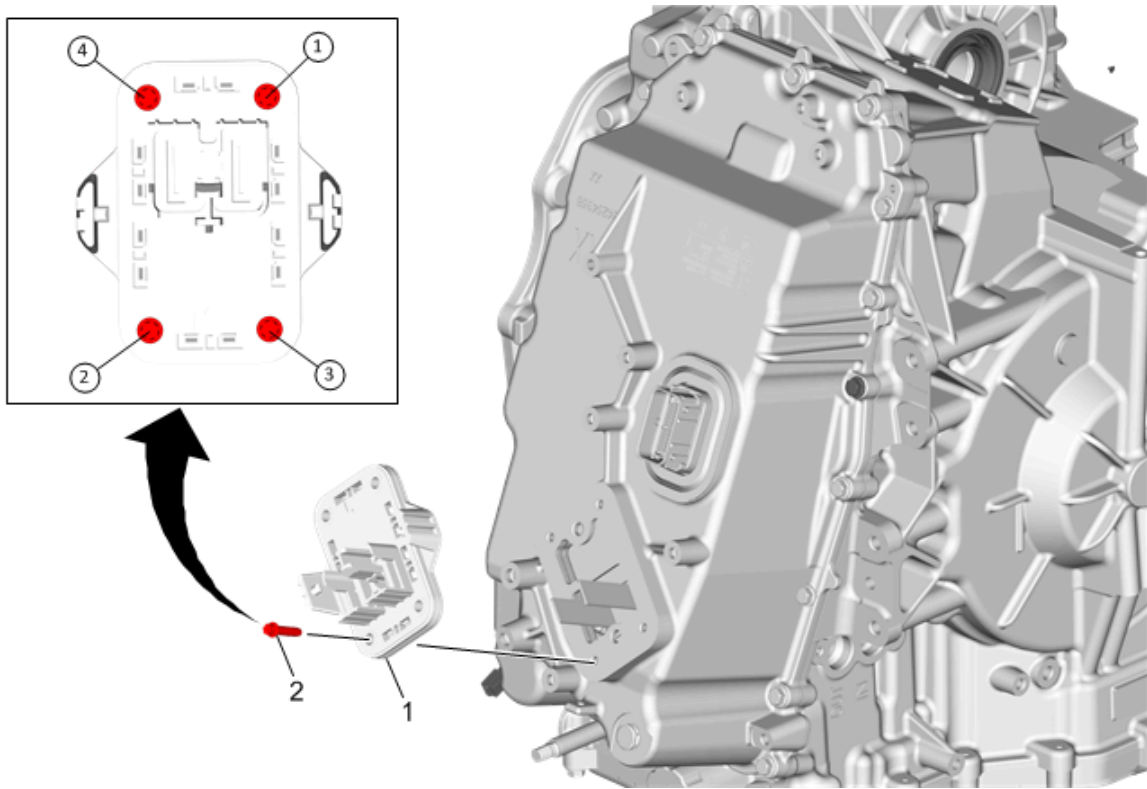


Fig. 286: Drive Motor Battery Positive And Negative Cable Connector (With Bolt Tightening Sequence)
 Courtesy of GENERAL MOTORS COMPANY

Drive Motor Battery Positive and Negative Cable Connector Installation

Callout	Component Name
1	Drive Motor Battery Positive and Negative Cable Connector
2	Drive Motor Battery Positive and Negative Cable Connector Bolt (Qty: 4) Tighten 9 N.m (80 lb in)

FRONT DIFFERENTIAL CARRIER FINAL ROTATIONAL TORQUE MEASUREMENT

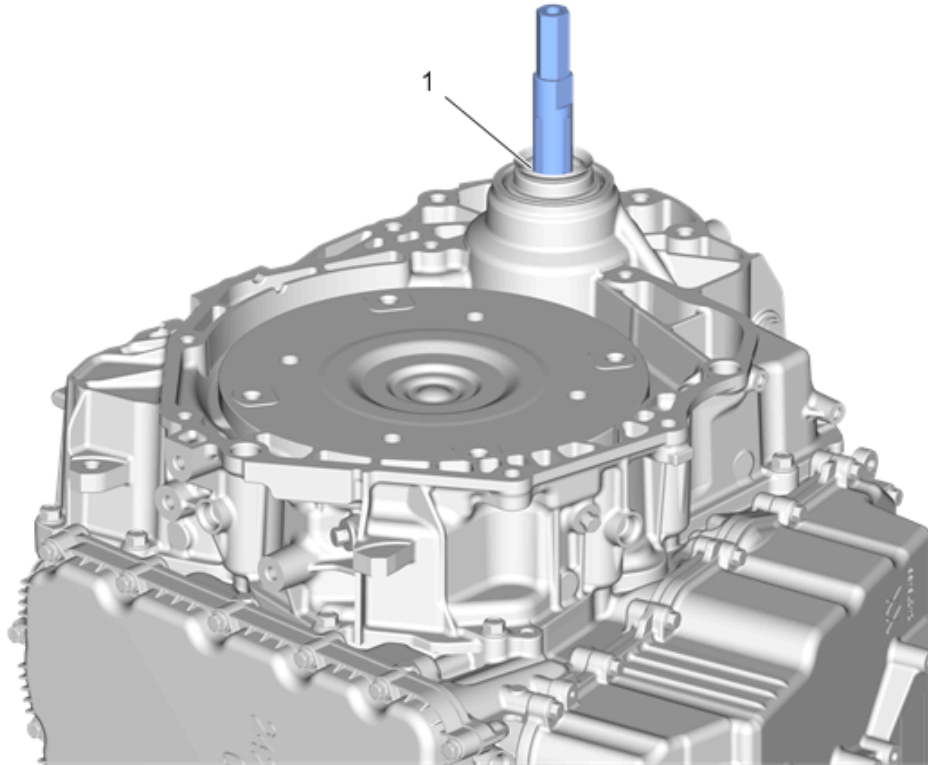


Fig. 287: Front Differential Carrier Final Rotational Torque Measurement

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Differential Carrier Procedure Use a dial or beam torque wrench with DT-49938 Differential Rotating Tool to measure turning torque. The rotational torque should be below 7.45 N.m (65.94 lb in) Special Tools DT-49938 Differential Rotating Tool For equivalent regional tools, refer to Special Tools.

HOLDING FIXTURE REMOVAL

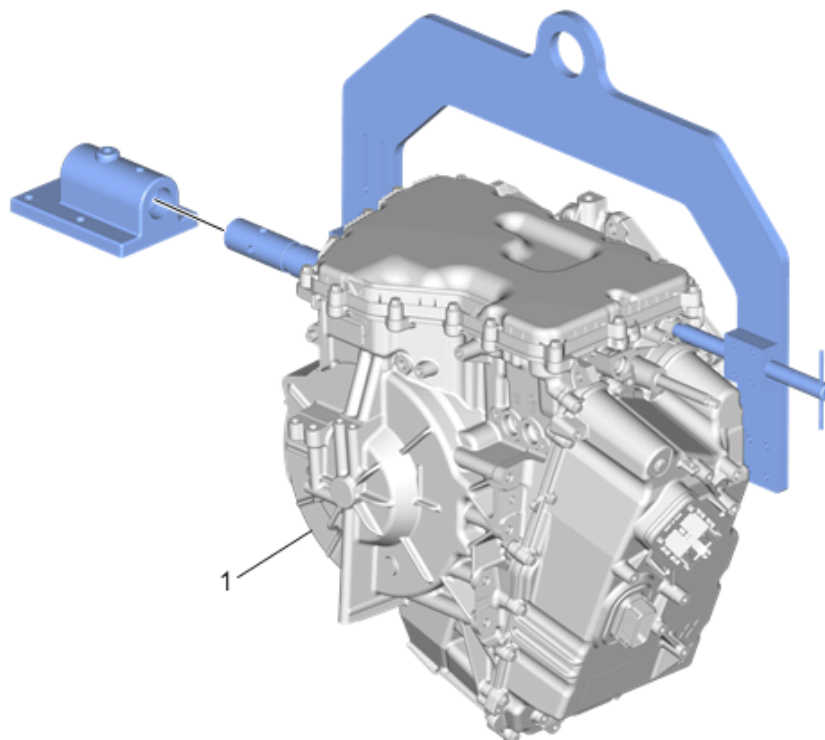


Fig. 288: Holding Fixture Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Â WARNING: Handle with care, the transmission assembly weighs over 183 Kg (403 lbs). Bodily injury could occur if not handled properly. Procedure 1. Install DT-46625 Holding Fixture. 2. Remove lock pin from DT-3289-20 Holding Fixture. 3. Raise the transmission with an overhead hoist in order to remove the holding DT-46625 Transmission Holding Fixture. 4. Lower the transmission assembly onto the transmission jack. Special Tools

Callout	Component Name
	• DT-03289-20 Holding Fixture Base Assembly • DT-46625 Holding Fixture • DT-46625-20 Holding Fixture Adapters For equivalent regional tools, refer to Special Tools.

DESCRIPTION AND OPERATION

DEFINITIONS AND ABBREVIATIONS

Throttle Positions

Engine Braking

A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Full Throttle Downshift

A quick apply of the accelerator pedal to its full travel, forcing a downshift.

Heavy Throttle

Approximately 3/4 of accelerator pedal travel, 75 percent throttle position.

Light Throttle

Approximately 1/4 of accelerator pedal travel, 25 percent throttle position.

Medium Throttle

Approximately 1/2 of accelerator pedal travel, 50 percent throttle position.

Minimum Throttle

The least amount of throttle opening required for an upshift.

Wide Open Throttle (WOT)

Full travel of the accelerator pedal, 100 percent throttle position.

Zero Throttle Coastdown

A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Shift Condition Definitions

Bump

A sudden and forceful apply of a clutch or a band.

Chuggle

A bucking or jerking. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed

A condition where a shift is expected but does not occur for a period of time. This could be described as a clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator, or during manual downshifting to a lower range. This term is also defined as LATE or EXTENDED.

Double Bump - Double Feel

Two sudden and forceful applies of a clutch or a band.

Early

A condition where the shift occurs before the car has reached proper speed. This condition tends to labor the engine after the upshift.

End Bump

A firmer feel at the end of a shift than at the start of the shift. This is also defined as END FEEL or SLIP BUMP.

Firm

A noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. This apply should not be confused with HARSH or ROUGH.

Flare

A quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. This condition is also defined as SLIPPING.

Harsh - Rough

A more noticeable apply of a clutch or band than FIRM. This condition is considered undesirable at any throttle position.

Hunting

A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM, such as a 4 - 3 - 4 shift pattern. This condition is also defined as BUSYNESS.

Initial Feel

A distinctly firmer feel at the start of a shift than at the finish of the shift.

Late

A shift that occurs when the engine RPM is higher than normal for a given amount of throttle.

Shudder

A repeating jerking condition similar to CHUGGLE but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Slipping

A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band apply.

Soft

A slow, almost unnoticeable clutch or band apply with very little shift feel.

Surge

A repeating engine related condition of acceleration and deceleration that is less intense than CHUGGLE.

Tie-Up

A condition where two opposing clutch and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

Drive Link Noise

A whine or growl that increases or fades with vehicle speed, and is most noticeable under a light throttle acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light throttle acceleration.

Planetary Gear Noise

A whine related to vehicle speed, which is most noticeable in FIRST gear, SECOND gear, FOURTH gear or REVERSE. The condition may become less noticeable, or go away, after an upshift.

Pump Noise

A high pitched whine that increases in intensity with engine RPM. This condition may also be noticeable in all operating ranges with the vehicle stationary or moving.

Driver Shift Control

Driver shift control (DSC) allows the driver to change gears similar to a manual transmission. Refer to the vehicle owner's manual for specific DSC operating instructions.

Transmission Abbreviations

A/C

Air Conditioning

AC

Alternating Current

AT

Automatic Transmission

CCDIC

Climate Control Driver Information Center

DC

Direct Current

DIC

Driver Information Center

DLC

Data Link Connector

DMM

Digital Multimeter

DSC

Driver Shift Control

DTC

Diagnostic Trouble Code

EBTCM

Electronic Brake/Traction Control Module

ECCC

Electronically-Controlled Capacity Clutch

ECT

Engine Coolant Temperature

EMI

Electromagnetic Interference

IAT

Intake Air Temperature

IGN

Ignition

IMS

Internal Mode Switch

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

OBD

On Board Diagnostic

OSS

Output Speed Sensor

PC

Pressure Control

PCM

Powertrain Control Module

PCS

Pressure Control Solenoid

PS

Pressure Switch

PWM

Pulse Width Modulation

RPM

Revolutions Per Minute

SS

Shift Solenoid

TAP

Transmission Adaptive Pressure

TFP

Transmission Fluid Pressure

TFT

Transmission Fluid Temperature

TP

Throttle Position

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

TRANSMISSION IDENTIFICATION INFORMATION

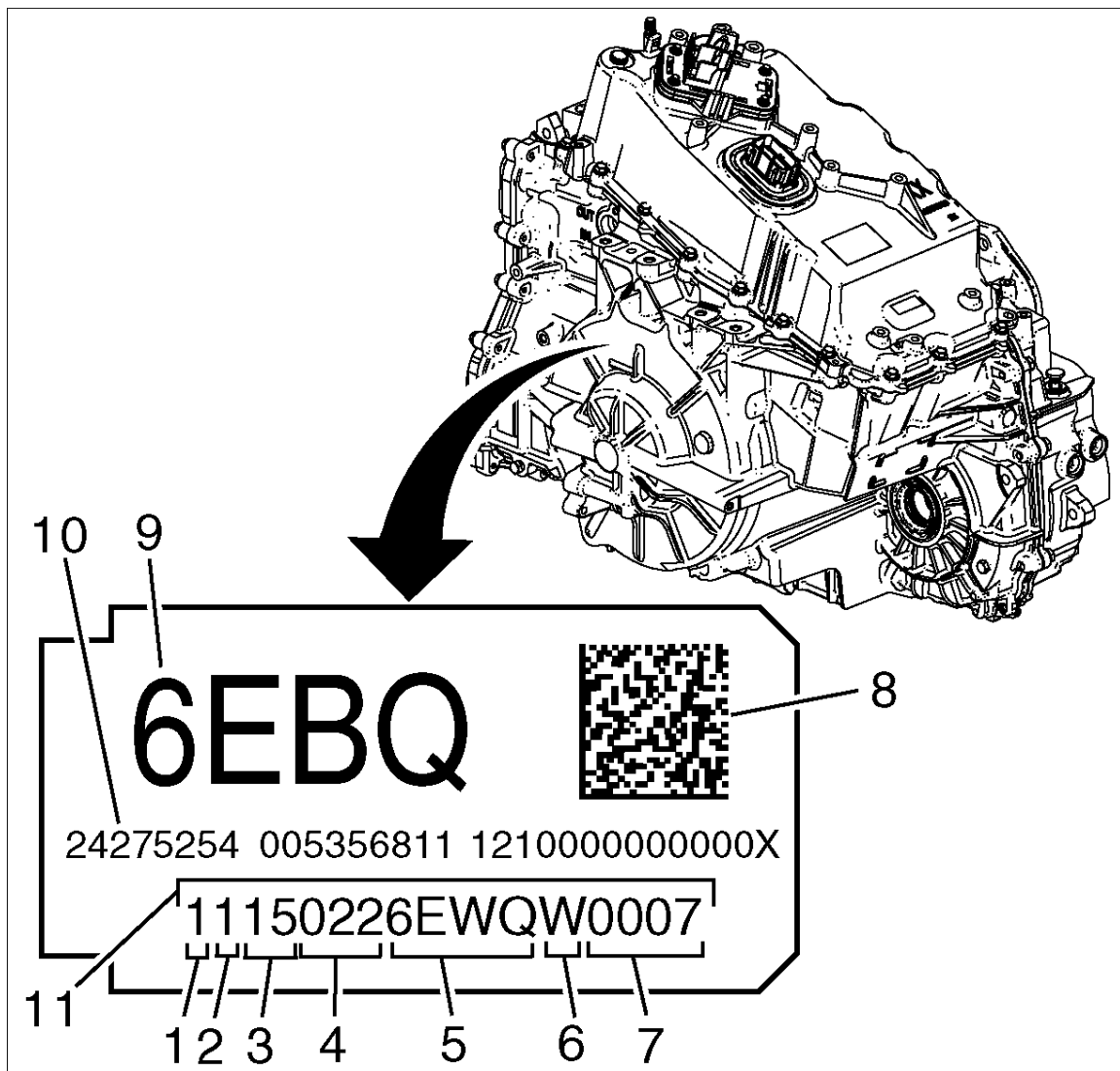


Fig. 289: Transmission Identification Information Plate

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Line ID
2	Shift ID
3	Build Year
4	Julian Date
5	Broadcast Code
6	Reserved Use
7	Sequence Number
8	Machine Readable Matrix
9	Broadcast Code
10	GM Part Number
11	Transmission Unique Number (TUN)

TRANSMISSION GENERAL DESCRIPTION

The 5ET50 is a fully automatic, front wheel drive transaxle containing an electronically-controlled continuously-

variable electric transmission. It includes an input flange, a torque dampener assembly with a rotating friction clutch, a stationary mechanical (one way) clutch, one stationary and one rotating friction clutch assemblies, a hydraulic pressurization and control system, a power inverter (and control) module, an electric fluid pump, two planetary gear sets, and two electric drive motor-generators. Drive motor-generator A (1) is 48 kW and drive motor-generator B (2) is 87 kW.

The torque damper is internal to the transmission, bolted to the input flange, and contains coil springs and a damper bypass clutch. The torque damper acts as a spring coupling to smoothly transmit shaft power from the engine to the input planetary gear set in the transmission and as a direct mechanical coupling from the transmission to the engine using the damper bypass clutch during engine starting and engine stopping.

The power inverter module is under the angled top cover and includes a control circuit board, solid-state switches, capacitors, and other electronic components. The power inverter module receives and monitors driver commands and various other electronic sensor inputs and uses this information to vary the torque and speed of each electric motor-generator and to command the engine controller and engine operation. The power inverter module is connected with each of the two drive motor-generators through three internal terminal posts for transmitting variable-frequency, high-voltage, three-phase alternating-current (AC) electricity. The power inverter module is also electrically connected with the battery pack through a high-voltage, high-power connector and cable assembly for transmitting direct-current (DC) electricity.

The hydraulic system includes a high pressure electric fluid pump driven by an electric motor supplied with high-voltage current from the power inverter module, shift solenoid valves, a variable line pressure control solenoid valve, and control wiring harness. All of the shift solenoids and the transmission fluid temperature sensor are packaged into a self-contained control solenoid valve assembly under the front cover. The electric pump maintains working pressure and control of the clutches when the engine is on and when the engine is off.

The two planetary gear sets, electric motor-generators, and other clutches together provide all-electric propulsion, continuously-variable hybrid transmission ratios, and a single fixed mechanical transmission ratio. When the vehicle is operating all-electrically, the stationary mechanical clutch reacts torque from motor-generator A to the output in the forward direction and the stationary friction clutch assembly can react torque from motor-generator B to the output. When the engine is in use, the stationary and rotating friction clutch assemblies are controlled by the power inverter module using hydraulic shift solenoids to select from a variable lower range of hybrid transmission ratios, a fixed mechanical transmission ratio, and a variable higher range of hybrid transmission ratios.

The transmission may be operated in any of the following gear ranges:

P (PARK)

This position locks the wheels and prevents the vehicle from rolling either forward or backward. PARK is the best position to use when starting the vehicle. Because the transmission utilizes a shift lock control system, it is necessary to fully depress the brake pedal before shifting out of PARK. For safety reasons, use the parking brake in addition to the PARK position.

R (REVERSE)

This position allows the vehicle to be operated in a rearward direction. There is no separate reverse clutch or gearing in the transmission. All of the torque for reverse comes from motor-generator B.

N (NEUTRAL)

In this position, the propulsion system does not provide power to the wheels.

D (DRIVE)

Drive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Drive position allows the transmission to operate all-electrically using one or both motor-generators when sufficient battery power and energy are available or using the engine when the battery is not sufficient.

L (Low)

This position is used for the "feel" of engine braking and can be used for the slowing of the vehicle once the throttle is lifted. While in the position the vehicle will slow quicker and use the drive motor generator B to more aggressively collect energy during a regenerative braking event.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the hybrid 5ET50 Transmission are as follows:

- Input Brake Clutch (MKV Only)
- Input Drive Flange
- Input Sun Gear Shaft
- Input Carrier
- Input Internal Gear
- Drive Motor (1) and (2)
- Driven and Drive Sprocket with Drive Link Assembly
- Output Carrier Internal Gear
- Variable Low Clutch Assembly
- Variable High Clutch Assembly
- Control Valve Body Assembly
- Automatic Transmission Torque Dampener
- Front Differential Carrier

The electrical components of the 5ET50 are as follows:

- Drive Motor (1)
- Drive Motor (2)
- Fluid Pump Motor
- Output Speed Sensor
- Manual Shift Detent Lever
- Drive Motor Generator Power Inverter Module
- Drive Motor Power Inverter Module Connector

For more information, refer to [Electronic Component Description](#).

HYBRID TRANSMISSION MODES OF OPERATION

Single Motor Electric Vehicle (EV)

Single motor EV operation is used when lower torque is required. This includes reverse gear. The Internal Combustion Engine (ICE) and drive motor A (1) are OFF. The high range clutch is open and the low range

clutch is closed. Drive motor B (2) provides torque through the planetary gear set to the wheels.

Dual Motor Electric Vehicle (EV)

Dual motor EV operation is used when high torque is required at any vehicle speed. The Internal Combustion Engine (ICE) is OFF. Drive motor A (1) and drive motor B (2) are ON. The high range clutch (C2) is open and the low range clutch (C1) is closed. Drive motors A (1) and B (2) both provide torque through the planetary gear sets to the wheels.

Extended Range Low

Extended range low is used when the rechargeable energy storage system (RESS) requires charging at lower vehicle speeds. The Internal Combustion Engine (ICE) is ON. Drive motor A (1) and drive motor B (2) are ON. The low range clutch (C1) is closed, and the high range clutch (C2) is open. Drive motor A (1) is generating to charge the RESS. Drive motor B (2) provides torque through the planetary gear set to the wheels.

Extended Range Fixed Ratio

Extended range fixed ratio is used when the rechargeable energy storage system (RESS) requires charging at mid-range vehicle speeds. The Internal Combustion Engine (ICE) is ON. The ICE provides power through the planetary gear set to the wheels. Drive motor A (1) and drive motor B (2) are ON. The low range clutch (C1) is closed, and the high range clutch (C2) is closed. Drive motor B (2) can perform regeneration to charge the RESS in low torque demands or provide torque through the planetary gear set to the wheels in high torque demands.

Extended Range High

Extended range high is used when the rechargeable energy storage system (RESS) requires charging at higher vehicle speeds. The Internal Combustion Engine (ICE) is ON. The ICE provides power through the planetary gear set to the wheels. Drive motor A (1) and drive motor B (2) are ON. The low range clutch (C1) is open and the high range clutch (C2) is closed. Both drive motor A (1) and drive motor B (2) can either operate in regeneration mode to charge the RESS or provide power to the wheels.

TRANSMISSION INDICATORS AND MESSAGES

No transmission-related indicators or messages are displayed on the instrument panel cluster (IPC). For a complete listing and description of all vehicle indicators and messages, refer to Indicator/Warning Message Description and Operation.

ELECTRONIC COMPONENT DESCRIPTION

Electronic Components

The 5ET50 transmission contains the electronic components listed below:

- Automatic Transmission Fluid Pump
- Control Solenoid Valve
- Drive Motor Assembly - 1st Position
- Drive Motor Assembly - 2nd Position
- Manual Shift Detent Lever A/Trans Output Speed Sensor Assembly

This transmission is a fully automatic front wheel drive transaxle, and is an electronically-controlled continuously-

variable electric transmission. High voltage three phase circuits connect the 2 motor/generators and the electric automatic transmission fluid pump drive motor assembly, to the drive motor control modules. The high voltage electric automatic transmission fluid pump provides transmission fluid pressure.

Drive Motor Assembly (1st Position)

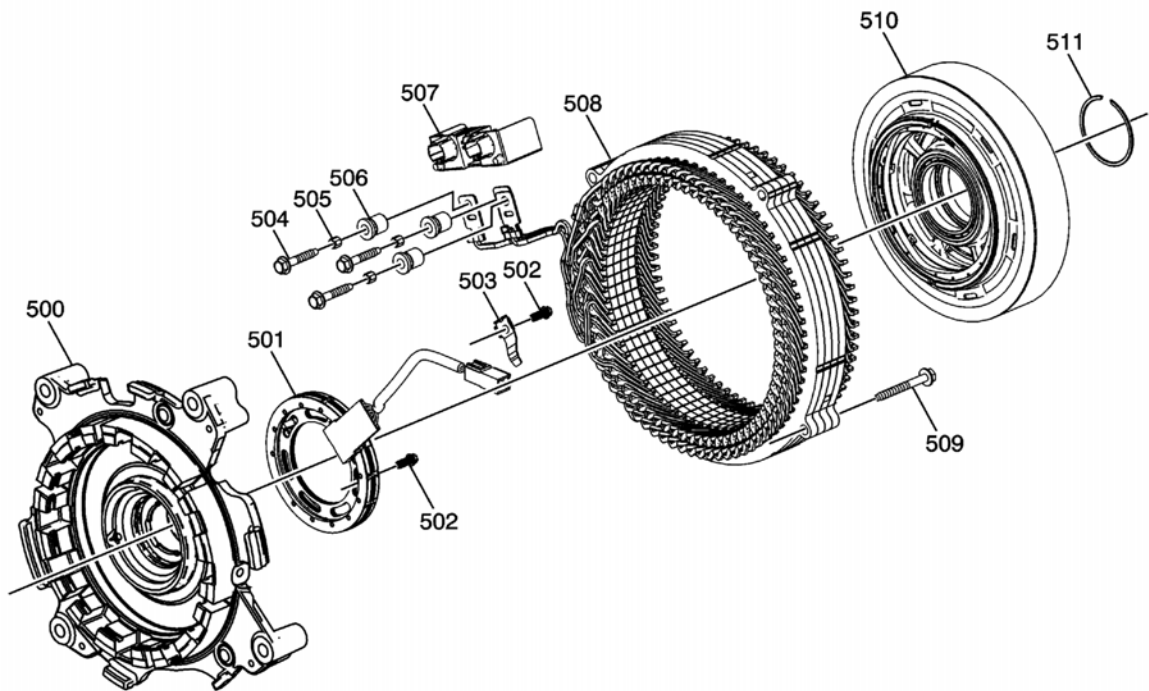


Fig. 290: Drive Motor Assembly (1st Position)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
500	Drive Motor Support
501	Drive Motor Position Sensor Stator
502	Drive Motor Position Sensor Bolt
503	Drive Motor Position Sensor Connector Clip
504	Drive Motor Power Inverter Module 3-Phase Cable Bolt
505	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer
506	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing
507	Drive Motor Power Inverter Module Cable Guide
508	Drive Motor Stator - (1st Position)
509	Drive Motor Stator Bolt
510	Drive Motor Rotor - (1st Position)

Callout	Component Name
511	Drive Motor Rotor Bearing Retaining Ring

The drive motor generator power inverter module controls the three permanent magnet 3-phase electric motors that are internal to the transmission, and perform the following functions:

- Torque for vehicle propulsion
- Engine cranking
- Battery charging
- Regenerative Braking
- Transmission fluid pressure

Drive Motor Assembly (2nd Position)

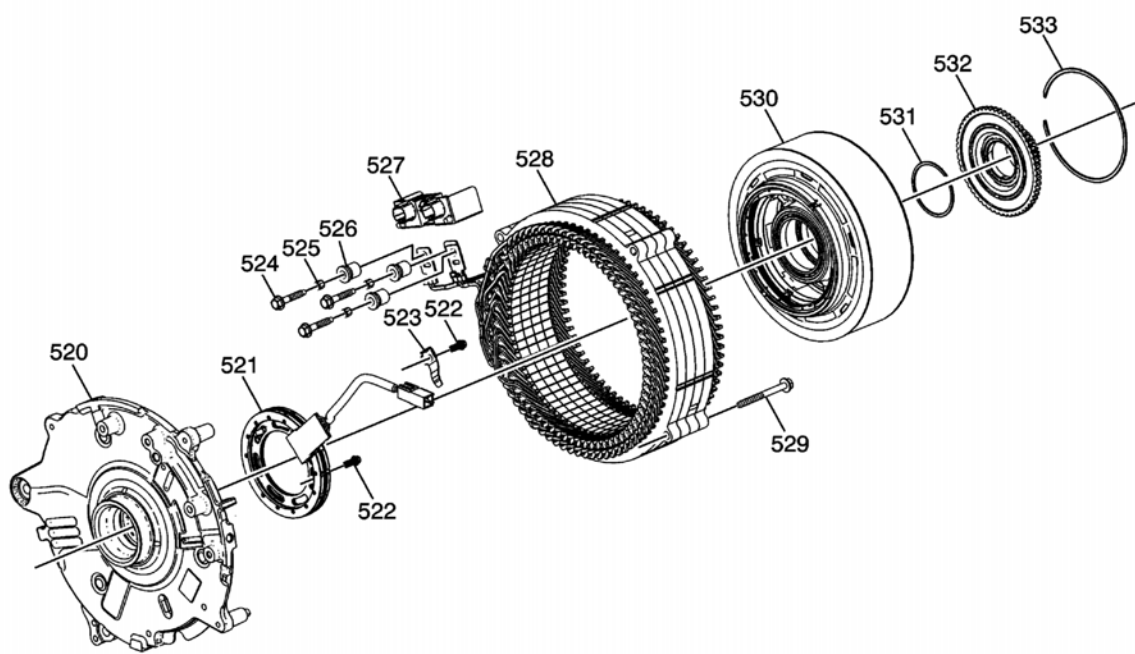


Fig. 291: Drive Motor Assembly (2nd Position)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
520	Drive Motor Support
521	Drive Motor Position Sensor Stator
522	Drive Motor Position Sensor Bolt

Callout	Component Name
523	Drive Motor Position Sensor Connector Clip
524	Drive Motor Power Inverter Module 3-Phase Cable Bolt
525	Drive Motor Power Inverter Module Cable Bolt Install Guide Retainer
526	Drive Motor Power Inverter Module Cable Bolt Install Guide Bushing
527	Drive Motor Power Inverter Module Cable Guide
528	Drive Motor Stator - (2nd Position)
529	Drive Motor Stator Bolt
530	Drive Motor Rotor - (2nd Position)
531	Drive Motor Rotor Bearing Retaining Ring
532	Output Sun Gear
533	Output Sun Gear Retaining Ring

The Drive Motor/Generator Description

Drive Motor Assembly (1st position) is a generator referred to as Drive Motor 1 on the scan tool and consists of a permanent magnet rotor with a distributed bar wound, NdFeB magnet stator capable of producing 55 kW of peak electrical energy and 138 N.m (102 lb ft).

Drive Motor Assembly (2nd position) is a traction motor referred to as Drive Motor 2 on the scan tool and consists of a permanent magnet rotor with a distributed bar wound, NdFeB magnet stator capable of producing 76 kW of peak electrical energy and 178 N.m (131 lb ft).

Both are actively cooled via transmission fluid. Drive Motor Assembly (1st position) is used to start the engine and maintain charge to the hybrid battery. Drive Motor Assembly (2nd position) propels the vehicle. Motor speeds are controlled and monitored by resolver-type position sensors. The drive motor position sensors are monitored by the motor control modules. The motor control modules monitor the angular position, speed and direction of the drive motor generator based upon the signals of these position sensors. The position sensor, or resolver, contains a drive coil, 2 driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At ignition ON, the motor control module outputs a low AC voltage, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the 2 driven coils and the irregular shaped rotor. The motor control module then monitors the 2 driven coil circuits for a return signal. The position of the irregular shaped metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the 2 driven coils signals allows the motor control module to determine the exact angle, speed and direction of the drive motor generator. For more information on the drive motor function and system interaction refer to [Drive Motor Power Inverter Module Description and Operation](#) .

Automatic Transmission Fluid Pump

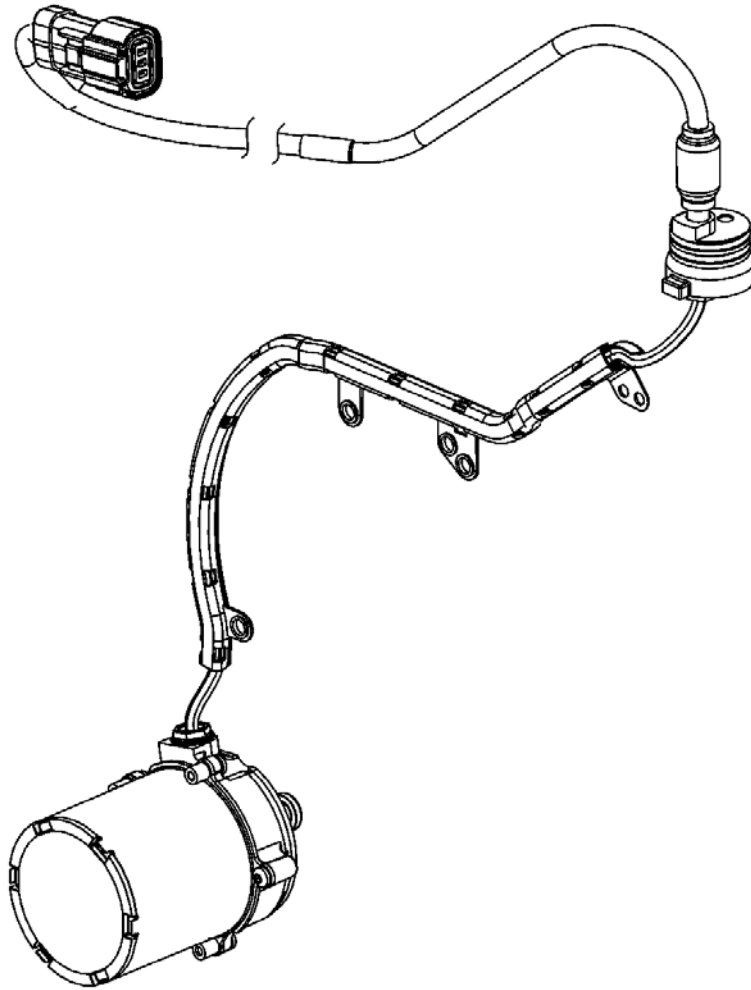


Fig. 292: Electric Auxiliary Pump Drive Motor Assembly Components

Courtesy of GENERAL MOTORS COMPANY

The electric automatic transmission fluid pump assembly is driven by high voltage AC which is controlled by the drive motor/generator power inverter module assembly. The purpose of the auxiliary fluid pump motor is to supply oil pressure to the transmission for lube, cooling and clutch application during vehicle propulsion. The automatic transmission fluid pump motor is commanded on when the propulsion system is active.

Control Solenoid Valve

The control solenoid valve assembly contains the following components:

Control Solenoid Valve Assembly

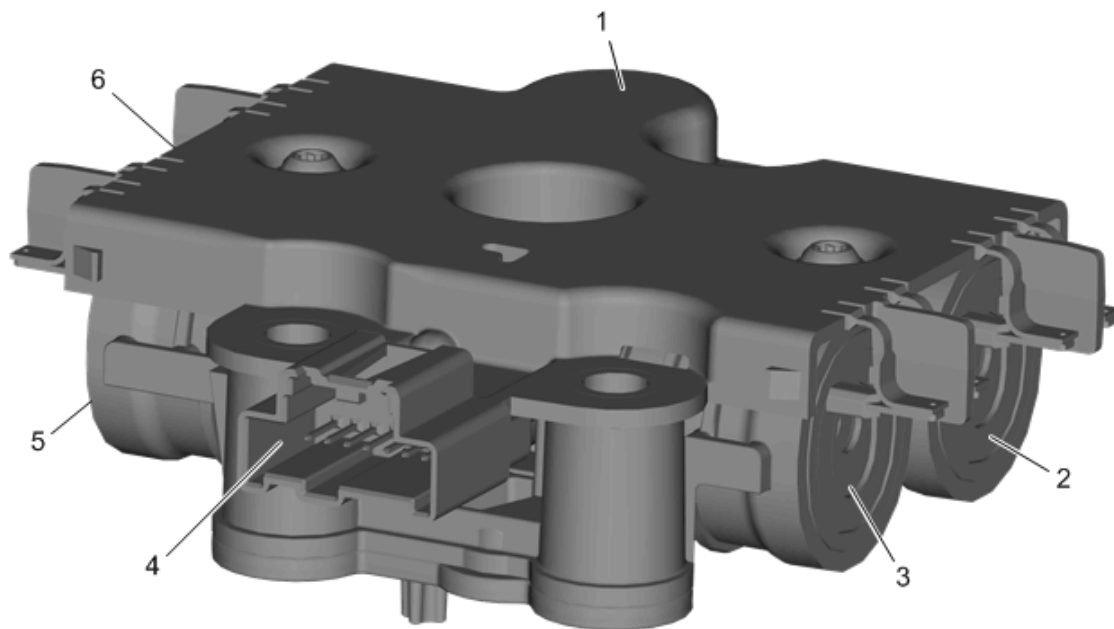


Fig. 293: Control Solenoid Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Fluid Temperature Sensor
2	Pressure Control Solenoid Valve 2
3	Pressure Control Solenoid Valve 5
4	Electrical Connector - 8 Pins
5	Pressure Control Solenoid Valve 3
6	Pressure Control Solenoid Valve 4

These components are not serviced separately. The control solenoid valve bolts directly to the valve body within the transmission. The control solenoid assembly X1 connector connects to the Automatic Transmission Wiring Harness - Control Solenoid Valve.

Line Pressure Control Solenoid Valve

The line pressure solenoid control valve is located in the H bore of the control valve body assembly. The A - H bores are stamped on the control valve body assembly in order to aid in the locating the control valve body components. The line pressure control solenoid valve is a variable force solenoid valve, this type of solenoid can increase or decrease the amount of pressurized fluid based on the amount of current applied to solenoid valve coil. The line pressure solenoid control valve is used to control transmission fluid pressure for clutch pressure, lube, and drive motor cooling.

Solenoid Characterization

The line pressure solenoid control valve is tested after assembly to determine the output fluid pressure at certain electrical current values, applied to coil windings. This information is referred to as solenoid current/pressure data points. The solenoid valves are tested two ways, with an increasing and decreasing electrical current applied to the

coil windings. The resultant current versus pressure data points are saved and assigned a file number. The file number is marked on the solenoid valve housing end. The performance data file is stored on the TIS web site. This data file is programmed and stored in the vehicle's hybrid/EV powertrain control module 1. Replacing any of the following components will require the hybrid/EV powertrain control module 1 to be programmed with the new or existing solenoid valve performance data.

- Hybrid/EV powertrain control module 1 - program the new hybrid/EV powertrain control module 1 with the existing solenoid data files stored on the TIS web site for the line pressure solenoid control valve.
- Line pressure solenoid control valve - program the hybrid/EV powertrain control module 1 with the new solenoid data file stored on the TIS web site for the line pressure solenoid control valve.
- Control valve body assembly - program the hybrid/EV powertrain control module 1 with the existing solenoid data files stored on the TIS web site for the line pressure solenoid control valve.
- Line pressure solenoid control valve and control valve body as a complete assembly - program the hybrid/EV powertrain control module 1 with the new solenoid data file stored on the TIS web site for the line pressure solenoid control valve.
- Transmission Assembly - A new transmission assembly will have the solenoid characterization data programmed into the hybrid/EV powertrain control module 1.

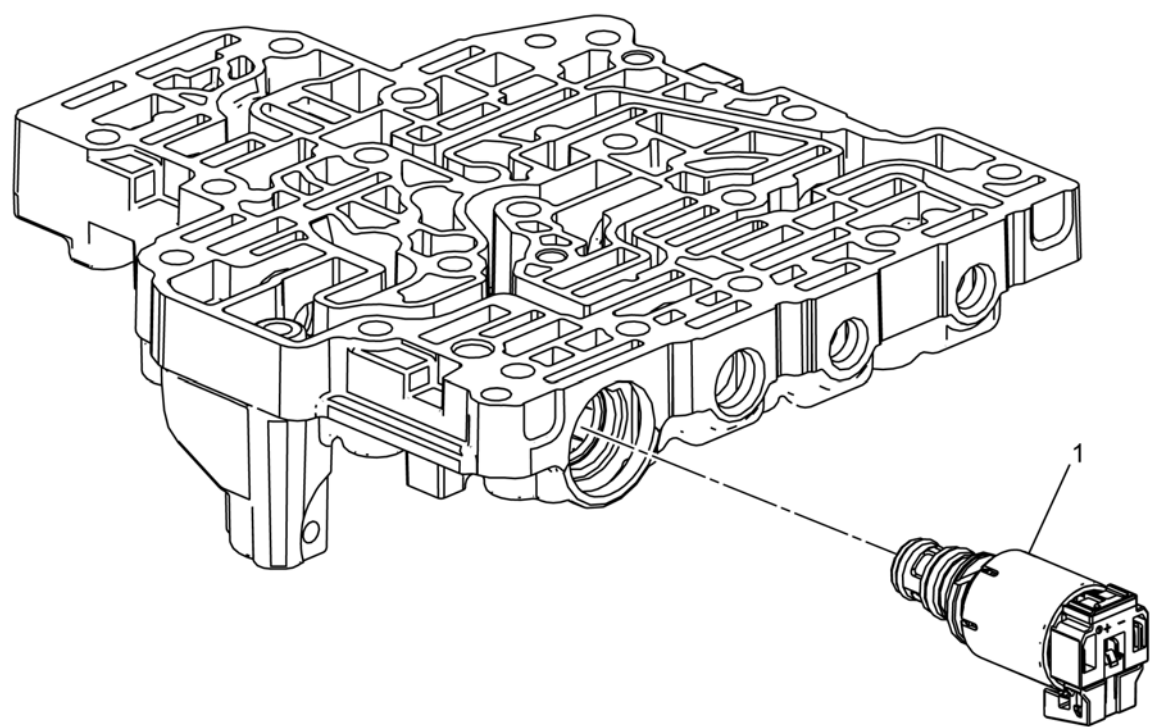


Fig. 294: Line Pressure Control Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Bore	Description
1	H Bore	Line Pressure Control Solenoid Valve

Manual Shift Detent Lever

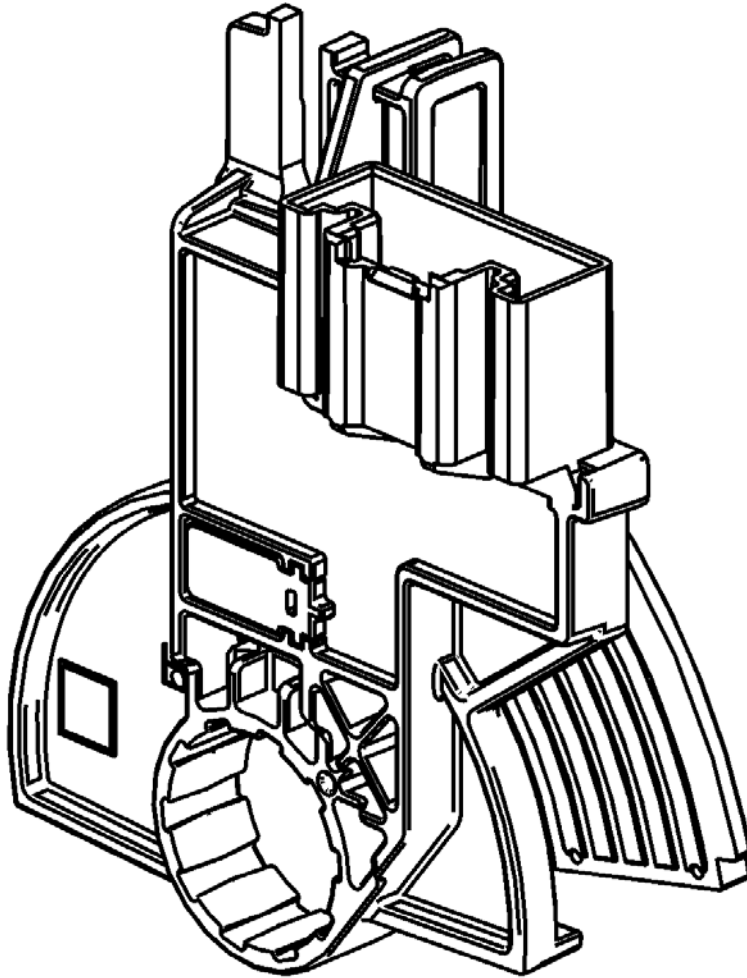


Fig. 295: Internal Mode Switch (IMS)

Courtesy of GENERAL MOTORS COMPANY

The 5 electronic switches are called the transmission range switches and are used to indicate the gear position the vehicle operator has selected. The 5 outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1, through the Automatic Transmission Wiring Harness - Shift Shaft Position Switch. The manual shift detent lever assembly is mounted on the interior front of the transmission case above the control valve body assembly. The internal mode switch indicates to the hybrid/EV powertrain control module 1 which gear position the vehicle operator has selected. The Internal Mode Switch consists of 5 separate hall effect switches. Each hall effect switch is supplied a 9 V reference circuit, and a signal circuit from the hybrid/EV powertrain control module 1. Each signal circuit for each gear selector position will have either a voltage reading of 0.70 - 0.96 V indicating ON or 1.68 - 2.38 V indicating OFF. The voltage values on each Internal Mode Switch circuit will change and are dependent on the position of the gear selector. The state of each Internal Mode Switch A/B/C/P/S circuit is displayed on the scan tool.

Output Speed Sensor (OSS)

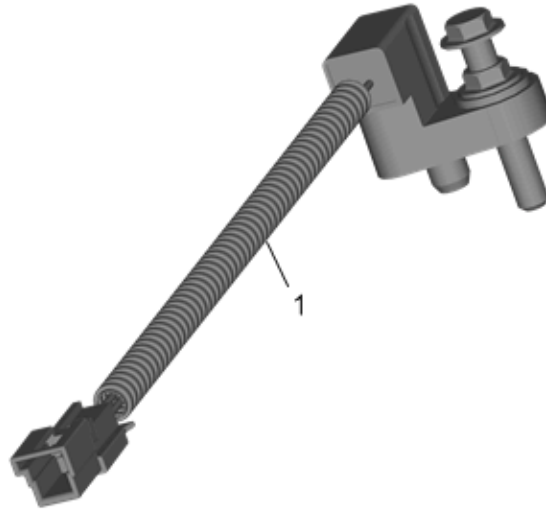


Fig. 296: Output Speed Sensor (OSS) Assembly
Courtesy of GENERAL MOTORS COMPANY

The output speed sensor assembly has 2 internal hall-effect type sensors, and is capable of sensing both speed and direction. The output speed sensor mounts to the A/Trans case assembly and is connected to the hybrid/EV powertrain control module 1 through Automatic Transmission Wiring Harness - Control Solenoid Valve. The sensor faces the front differential drive pinion (w/transfer gear) gear assembly machined teeth surface. The sensor receives 8.3 - 9.3 volts on the OSS supply voltage circuit from the hybrid/EV powertrain control module 1. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

The two sensor elements in the output speed sensor assembly are spaced approximately 1/2 a tooth apart.

- When the vehicle is moving in a forward direction, sensor A detects a particular tooth before sensor B.
- When the vehicle is moving in a reverse direction, sensor B detects a particular tooth before sensor A.

The electronics in the sensor combine the two signals and send a signal with a different pulse width. This signal is interpreted by the hybrid/EV powertrain control module 1 for speed and direction and is transmitted through the serial data circuits to the ECM. The ECM and hybrid/EV powertrain control module 1, compare the output speed sensor signal with the anti-lock brake system wheel speed sensor signal. The hybrid/EV powertrain control module 1 also compares the output shaft direction with the drive motor 1 and drive motor 2 direction.

PARK ENGINE OFF

When the gear selector lever is in the Park (P) position and the internal combustion engine is OFF, the fluid pump is commanded ON and line pressure is directed to the pressure regulator valve and other various components. The following steady-state conditions exist in the transmission's hydraulic and electrical systems.

Fluid Pressure Directed In Preparation For A Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid flow to various components such as the line pressure regulating valve, line pressure control solenoid, variable high clutch dam feed regulator valve, shift solenoid 2, shift solenoid 3, shift solenoid 4, shift solenoid 5, variable low clutch valve, variable high clutch valve and dampener bypass clutch valve. Line pressure is controlled by the HPCM by varying electrical current supplied to the line pressure control solenoid dependent on transmission operating conditions.

Variable Low Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing line fluid to enter the solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable low clutch valve.

Variable Low Clutch Valve

Solenoid 3 signal fluid, at the variable low clutch valve, opposes variable low clutch valve spring force to supply line fluid pressure into the variable low clutch fluid circuit.

Variable Low Clutch Assembly

Line fluid is routed through orifice #8 through the variable low clutch valve and into the variable low clutch circuit. Variable low clutch fluid passes through the variable low clutch housing and moves the variable low clutch piston against spring force to apply the variable low clutch.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid is also sent to the variable low clutch accumulator piston. Variable low clutch fluid moves the variable low clutch accumulator piston against accumulator spring force to cushion apply of the variable low clutch assembly.

Torque Dampener Clutch Applies

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing line fluid to enter the solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the dampener bypass clutch valve.

Dampener Bypass Clutch Valve

Solenoid 5 signal fluid, at the dampener bypass clutch valve, opposes dampener bypass clutch valve spring force to supply line pressure into the dampener bypass clutch circuit.

Torque Damper Assembly

Line fluid is routed through orifice #12 through the damper bypass clutch valve and into the damper bypass clutch circuit. Damper bypass clutch fluid passes through the automatic transmission case and automatic transmission torque damper and differential housing and moves the torque damper bypass clutch piston against spring force to apply the automatic transmission torque damper in preparation for an engine start.

Lube boost is available

Shift Solenoid 4

Shift solenoid 4 (Lube Boost) is commanded ON based on torque and temperature inputs to the HPCM. The shift solenoid 4 is energized ON, allowing line fluid to enter the solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed through orifice #4 to the lube regulator valve elevating lube and motor cooling pressure and flow.

Park Engine Off

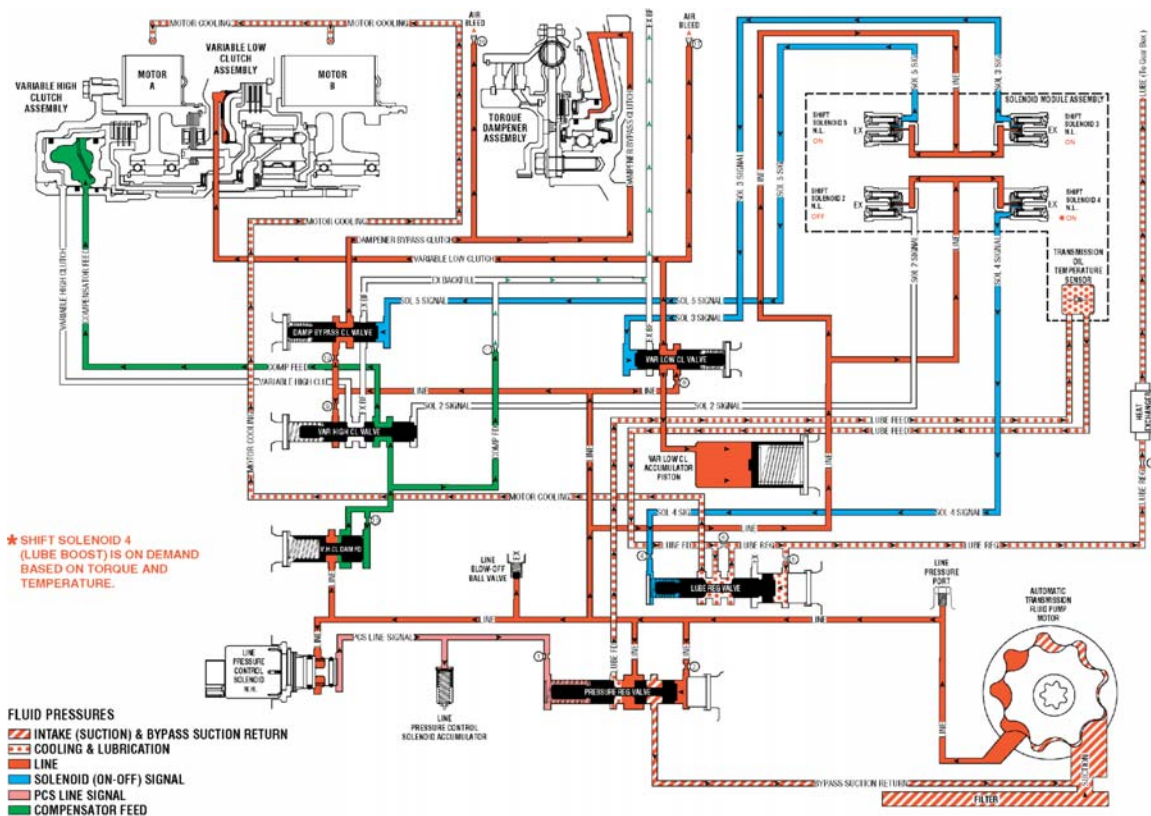


Fig. 297: Park Engine Off - Hydraulic Flow Diagram
 Courtesy of GENERAL MOTORS COMPANY

PARK ENGINE ON

If the HPCM determines that operating conditions (low state of battery charge, low temperature) are appropriate for the internal combustion engine (ICE) to be ON in Park, the fluid pump is commanded ON and line pressure is directed to the pressure regulator valve and other various components. The following steady-state conditions exist in the transmission's hydraulic electrical systems. Note that the torque damper assembly is commanded ON only during the start sequence and is OFF once the ICE is ON.

Fluid Pressure Directed in Preparation for a Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid flow to various components such as the line pressure regulating valve, line pressure control solenoid, variable high clutch dam feed regulator valve, shift solenoid 2, shift solenoid 3, shift solenoid 4, shift solenoid 5, variable low clutch valve, variable high clutch valve and dampener bypass clutch valve. Line pressure is controlled by the HPCM by varying electrical current supplied to the line pressure control solenoid dependent on transmission operating conditions.

Variable Low Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing line fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable low clutch valve.

Variable Low Clutch Valve

Solenoid 3 signal fluid, at the variable low clutch valve, opposes variable low clutch valve spring force to supply line fluid pressure into the variable low clutch fluid circuit.

Variable Low Clutch Assembly

Line fluid is routed through orifice #8 through the variable low clutch valve and into the variable low clutch circuit. Variable low clutch fluid passes through the variable low clutch housing and moves the variable low clutch piston against spring force to apply the variable low clutch.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid is also sent to the variable low clutch accumulator piston. Variable low clutch fluid moves the variable low clutch accumulator piston against accumulator spring force to cushion apply of the variable low clutch assembly.

Lube Boost Is Available

Shift Solenoid 4

Shift solenoid 4 (Lube Boost) is commanded ON based on torque and temperature inputs to the HPCM. The shift solenoid 4 is energized ON, allowing line fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed through orifice #4 to the lube regulator valve elevating lube and motor cooling pressure and flow.

Park Engine ON

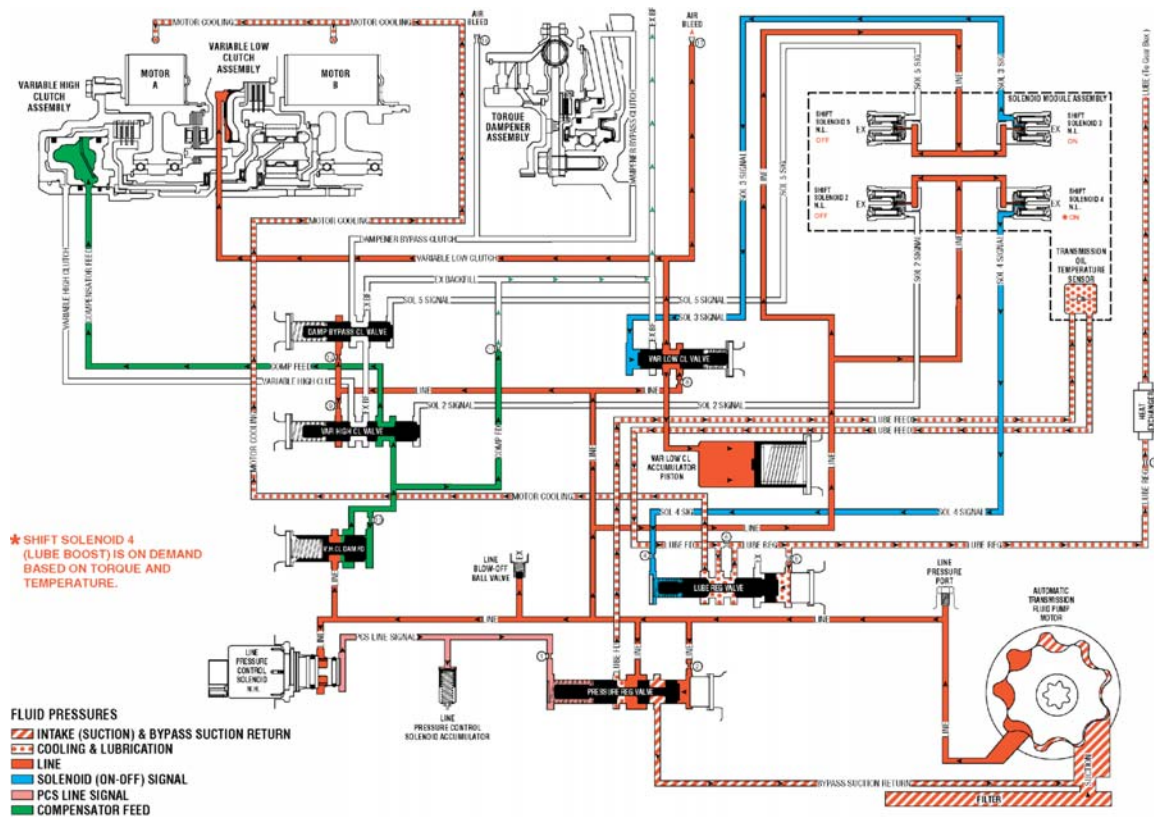


Fig. 298: Park Engine ON - Hydraulic Flow Diagram

Courtesy of GENERAL MOTORS COMPANY

NEUTRAL ENGINE OFF

When the gear selector lever is in the Neutral (N) position and the internal combustion engine is OFF, the fluid pump is commanded ON and line pressure is directed to the pressure regulator valve and other various components. If Neutral is selected after the vehicle was operating in Reverse EV Mode or Drive Single Motor EV Mode, the variable low clutch releases and the torque damper clutch stays applied.

Fluid Pressure Directed In Preparation For A Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid flow to various components such as the line pressure regulating valve, line pressure control solenoid, variable high clutch dam feed regulator valve, shift solenoid 2, shift solenoid 3, shift solenoid 4, shift solenoid 5, variable low clutch valve, variable high clutch valve and dampener bypass clutch valve. Line pressure is controlled by the HPCM by varying electrical current supplied to the line pressure control solenoid dependent on transmission operating conditions.

Variable Low Clutch Releases

Shift Solenoid 3

The shift solenoid 3 is commanded OFF, allowing Solenoid 3 signal fluid to exhaust from the variable low clutch valve.

Variable Low Clutch Valve

Variable low clutch valve spring force moves the variable low clutch valve to the released position, allowing variable low clutch accumulator fluid and variable low clutch pressure to exhaust.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid pressure is exhausted from the variable low clutch accumulator piston. Accumulator spring force moves the variable low clutch piston accumulator to the released position.

Variable Low Clutch Assembly

Variable low clutch fluid pressure is exhausted from the clutch assembly, allowing variable low clutch spring force to move the variable low clutch to the OFF position.

Torque Dampener Clutch Applies

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing line fluid to enter the solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the dampener bypass clutch valve.

Dampener Bypass Clutch Valve

Solenoid 5 signal fluid, at the damper bypass clutch valve, opposes damper bypass clutch valve spring force to supply line fluid pressure into the damper bypass clutch fluid circuit.

Torque Damper Assembly

Line fluid is routed through orifice #12 through the damper bypass clutch valve and into the damper bypass clutch circuit. Damper bypass clutch fluid passes through the automatic transmission case and automatic transmission torque damper and differential housing and moves the torque damper bypass clutch piston against spring force to

apply the automatic transmission torque damper in preparation for an engine start.

Lube Boost Is Available

Shift Solenoid 4

Shift solenoid 4 (Lube Boost) is commanded ON based on torque and temperature inputs to the HPCM. The shift solenoid 4 is energized ON, allowing line fluid to enter the solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed through orifice #4 to the lube regulator valve elevating lube and motor cooling pressure and flow.

Neutral Engine Off

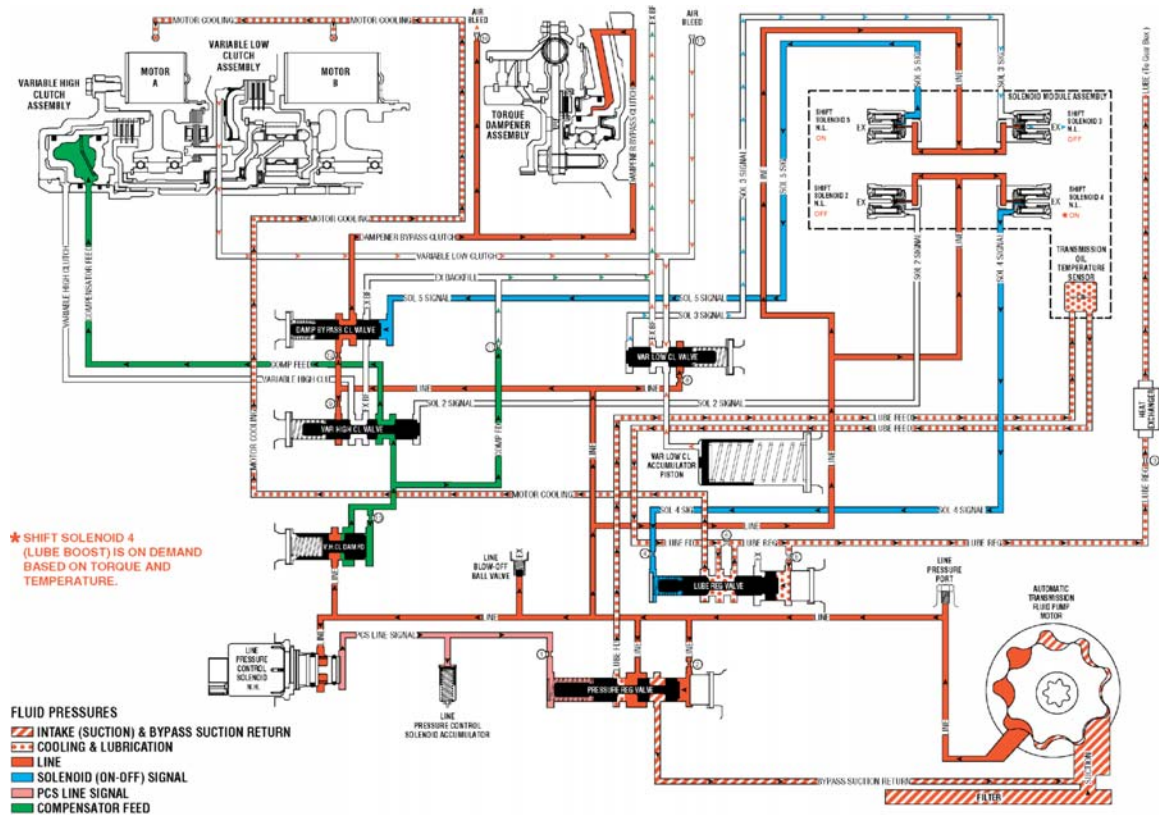


Fig. 299: Neutral Engine Off - Hydraulic Flow Diagram

Courtesy of GENERAL MOTORS COMPANY

REVERSE EV MODE ENGINE OFF

When the gear selector lever is moved to the Reverse (R) position (from the Park position), and the internal combustion engine (ICE) is OFF, the following steady-state conditions exist in the transmission's hydraulic and electrical systems.

Fluid Pressure Directed In Preparation For A Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid flow to various components such as the line pressure regulating valve, line pressure control solenoid, variable high clutch dam feed regulator valve, shift solenoid 2, shift solenoid 3, shift solenoid 4, shift solenoid 5, variable low clutch valve, variable high clutch valve and dampener bypass clutch valve. Line pressure is controlled by the HPCM by varying electrical current supplied to the line pressure control solenoid dependent on transmission operating conditions.

Variable Low Clutch Applied

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing line fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable low clutch valve.

Variable Low Clutch Valve

Solenoid 3 signal fluid, at the variable low clutch valve, opposes variable low clutch valve spring force to supply line fluid pressure into the variable low clutch fluid circuit.

Variable Low Clutch Assembly

Line fluid is routed through orifice #8 through the variable low clutch valve and into the variable low clutch circuit. Variable low clutch fluid passes through the variable low clutch housing and moves the variable low clutch piston against spring force to apply the variable low clutch.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid is also sent to the variable low clutch accumulator piston. Variable low clutch fluid moves the variable low clutch accumulator piston against accumulator spring force to cushion apply of the variable low clutch assembly.

Torque Dampener Clutch Applied

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing line fluid to enter the Solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the dampener bypass clutch valve.

Dampener Bypass Clutch Valve

Solenoid 5 signal fluid, at the dampener bypass clutch valve, opposes dampener bypass clutch valve spring force to supply line fluid pressure into the dampener bypass clutch fluid circuit.

Torque Damper Assembly

Line fluid is routed through orifice #12 through the damper bypass clutch valve and into the damper bypass clutch circuit. Damper bypass clutch fluid passes through the automatic transmission case and automatic transmission torque damper and differential housing and moves the torque damper bypass clutch piston against spring force to apply the automatic transmission torque damper in preparation for an engine start.

Lube Boost Is Available

Shift Solenoid 4

Shift solenoid 4 (Lube Boost) is commanded ON based on torque and temperature inputs to the HPCM. When required, shift solenoid 4 is energized ON, allowing line fluid to enter the solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed through orifice #4 to the lube regulator valve elevating lube and motor cooling pressure and flow.

Reverse EV Mode Engine Off

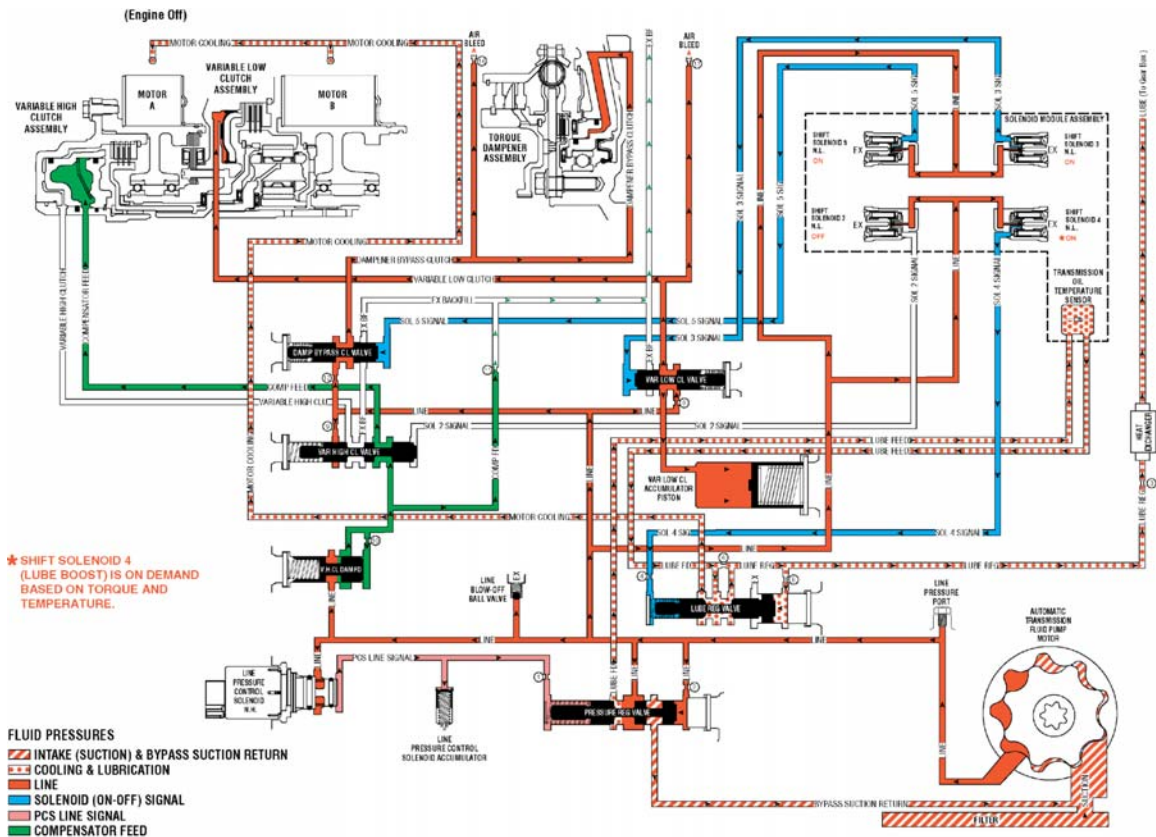


Fig. 300: Reverse EV Mode Engine Off - Hydraulic Flow Diagram
 Courtesy of GENERAL MOTORS COMPANY

DRIVE SINGLE OR DUAL MOTOR EV ENGINE OFF

When the gear selector lever is in the Drive (D) position and the internal combustion engine (ICE) is OFF, the fluid pump is commanded ON and line pressure is directed to the pressure regulator valve and other various components. The following steady-state conditions exist in the transmission's hydraulic and electrical systems. If Drive (D) was selected after the vehicle was operating in Reverse EV Mode or Park (Engine off), the variable low clutch and the torque damper clutch stay applied.

Fluid Pressure Directed In Preparation For A Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid flow to various components such as the line pressure regulating valve, line pressure control solenoid, variable high clutch dam feed regulator valve, shift solenoid 2, shift solenoid 3, shift solenoid 4, shift solenoid 5, variable low clutch valve, variable high clutch valve and dampener bypass clutch valve. Line pressure is controlled by the HPCM by varying electrical current supplied to the line pressure control solenoid dependent on transmission operating conditions.

Variable Low Clutch Applied

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing line fluid to enter the solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable low clutch valve.

Variable Low Clutch Valve

Solenoid 3 signal fluid, at the variable low clutch valve, opposes variable low clutch valve spring force to supply line fluid pressure into the variable low clutch fluid circuit.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid is also sent to the variable low clutch accumulator piston. Variable low clutch fluid moves the variable low clutch accumulator piston against accumulator spring force to cushion apply of the variable low clutch assembly.

Variable Low Clutch Assembly

Line fluid is routed through orifice #8 through the variable low clutch valve and into the variable low clutch circuit. Variable low clutch fluid passes through the variable low clutch housing and moves the variable low clutch piston against spring force to apply the variable low clutch.

Torque Dampener Clutch Applied

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing line fluid to enter the solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the dampener bypass clutch valve.

Dampener Bypass Clutch Valve

Solenoid 5 signal fluid, at the damper bypass clutch valve, opposes damper bypass clutch valve spring force to supply line fluid pressure into the damper bypass clutch fluid circuit.

Torque Damper Assembly

Line fluid is routed through orifice #12 through the damper bypass clutch valve and into the damper bypass clutch circuit. Damper bypass clutch fluid passes through the automatic transmission case and automatic transmission torque damper and differential housing and moves the torque damper bypass clutch piston against spring force to apply the automatic transmission torque damper in preparation for an engine start.

Lube Boost Is Available

Shift Solenoid 4

Shift solenoid 4 (Lube Boost) is commanded ON based on torque and temperature inputs to the HPCM. When required, shift solenoid 4 is energized ON, allowing line fluid to enter the solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed through orifice #4 to the lube regulator valve elevating lube and motor cooling pressure and flow.

Drive Single or Dual Motor EV Engine Off

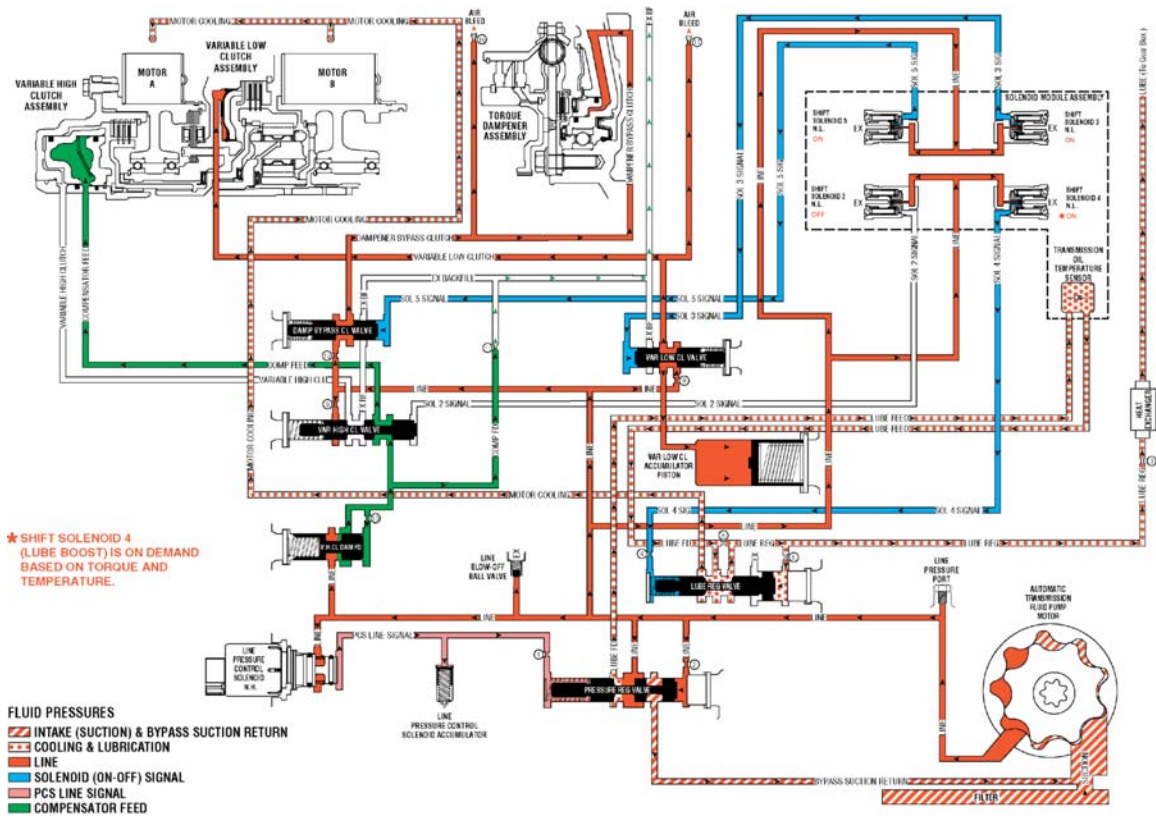


Fig. 301: Drive Single Or Dual Motor EV Engine Off - Hydraulic Flow Diagram

Courtesy of GENERAL MOTORS COMPANY

DRIVE EXTENDED RANGE LOW ENGINE ON

When the gear selector lever is in the Drive (D) position and the HPCM determines that operating conditions are appropriate, the internal combustion engine (ICE) is started, the main fluid pump provides hydraulic fluid pressure. If Drive (D) is selected after the vehicle was operating in Reverse EV Mode or Park (Engine off), the variable low clutch stays applied. After Engine Start, the following changes would occur to the transmission's hydraulic and electrical systems in order to start the vehicle moving from a stopped position.

Torque Dampener Clutch Releases

Shift Solenoid 5

The shift solenoid 5 is commanded OFF, allowing Solenoid 5 signal fluid to exhaust from the dampener bypass clutch valve.

Dampener Bypass Clutch Valve

Dampener bypass clutch valve spring force moves the dampener bypass clutch valve to the released position, allowing dampener bypass clutch fluid pressure to exhaust.

Torque Dampener Assembly

Dampener bypass clutch fluid exhausts from the torque dampener clutch assembly through the dampener bypass clutch valve allowing the torque dampener clutch to release.

Drive Extended Range Low Engine On

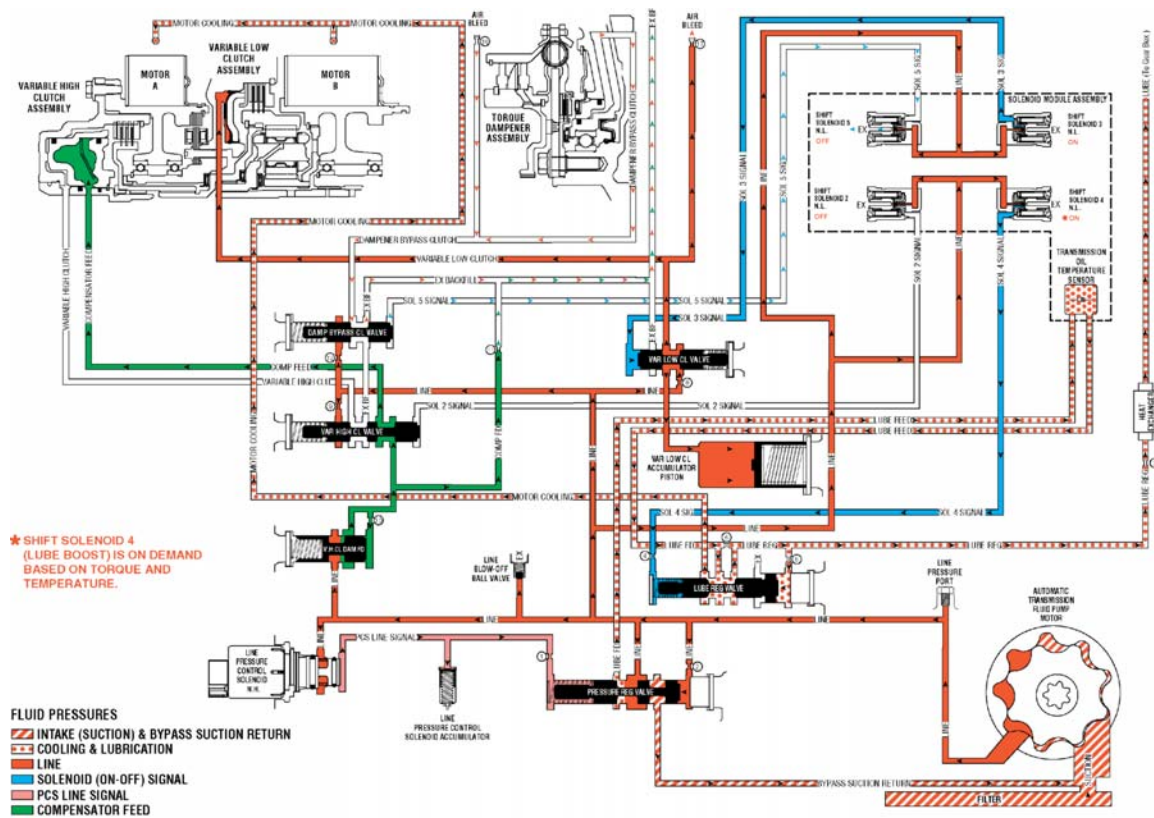


Fig. 302: Drive Extended Range Low Engine On - Hydraulic Flow Diagram

Courtesy of GENERAL MOTORS COMPANY

DRIVE EXTENDED RANGE HIGH ENGINE ON

When the gear selector lever is in the Drive (D) position and the HPCM determines that operating conditions are appropriate, the internal combustion engine (ICE) is started, the main fluid pump provides hydraulic fluid pressure. If the transmission is operating in extended range fixed gear ratio and the HPCM determines that operating conditions are appropriate for a shift to extended range high, the following changes would occur to the transmission's hydraulic and electrical systems.

Variable Low Clutch Releases

Shift Solenoid 3

The shift solenoid 3 is commanded OFF, allowing Solenoid 3 signal fluid to exhaust from the variable low clutch valve.

Variable Low Clutch Valve

Variable low clutch valve spring force moves the variable low clutch valve to the released position, allowing variable low clutch accumulator fluid pressure to exhaust.

Variable Low Clutch Accumulator Piston

Variable low clutch fluid pressure is exhausted from the variable low clutch accumulator piston. Accumulator spring force moves the variable low clutch piston accumulator to the released position.

Variable Low Clutch Assembly

Variable low clutch fluid pressure is exhausted from the clutch assembly, allowing variable low clutch spring force to move the variable low clutch to the OFF position.

Drive Extended Range High Engine On

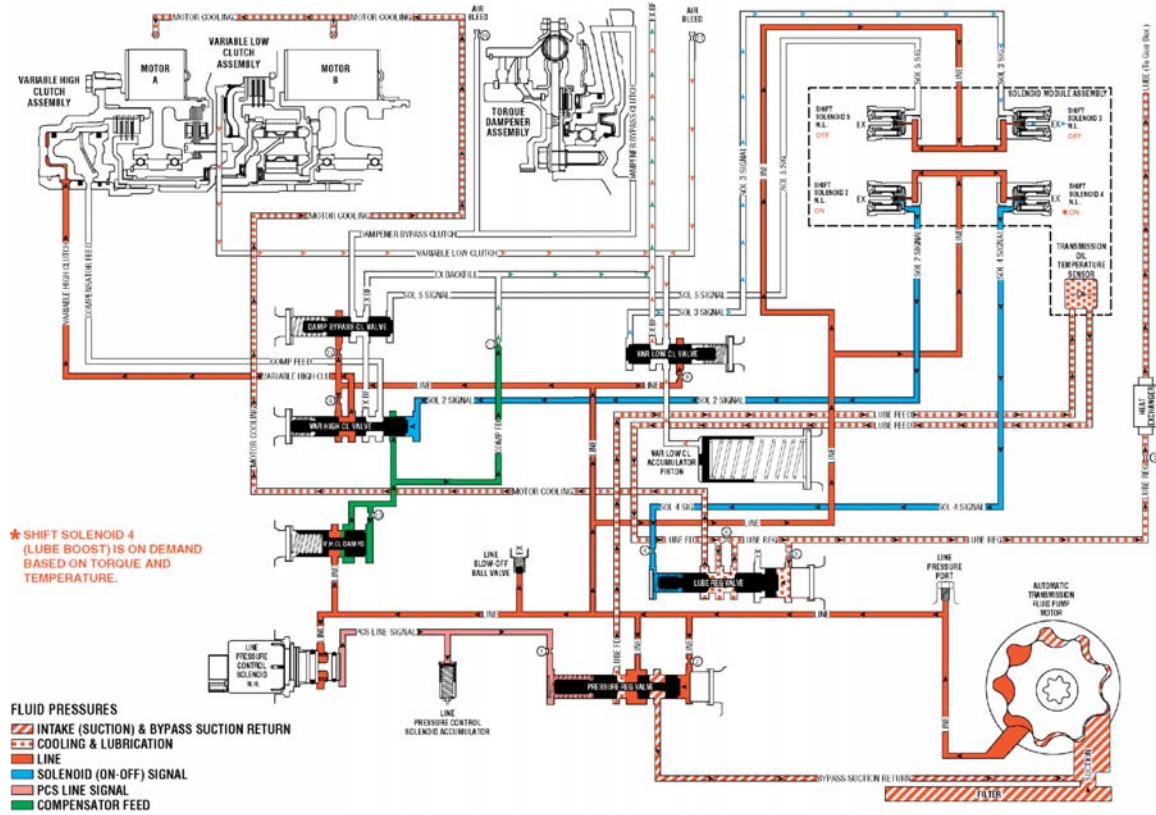


Fig. 303: Drive Extended Range High Engine On - Hydraulic Flow Diagram

Courtesy of GENERAL MOTORS COMPANY

DRIVE EXTENDED RANGE FIXED RATIO ENGINE ON

When the gear selector lever is in the Drive (D) position and the HPCM determines that operating conditions are appropriate, the internal combustion engine (ICE) is started, the main fluid pump provides hydraulic fluid pressure. If the transmission is operating in extended range low (mode 1) and the HPCM determines that operating conditions are appropriate for a shift to extended range fixed ratio, the following changes would occur to the transmission's hydraulic and electrical systems.

Variable High Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing line fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable high clutch valve.

Variable High Clutch Valve

Solenoid 2 signal fluid, at the variable high clutch valve, opposes variable high clutch valve spring force to supply line fluid pressure into the variable high clutch fluid circuit. This also allows compensator feed fluid to exhaust through the variable high clutch valve exhausting the variable high clutch dam.

Variable High Clutch Assembly

Line fluid is routed through orifice #9 through the variable high clutch valve and into the variable high clutch fluid circuit. Variable high clutch fluid passes through the transmission case and variable high clutch housing and moves the variable high clutch piston against spring force to apply the variable high clutch.

Drive Extended Range Fixed Ratio Engine On

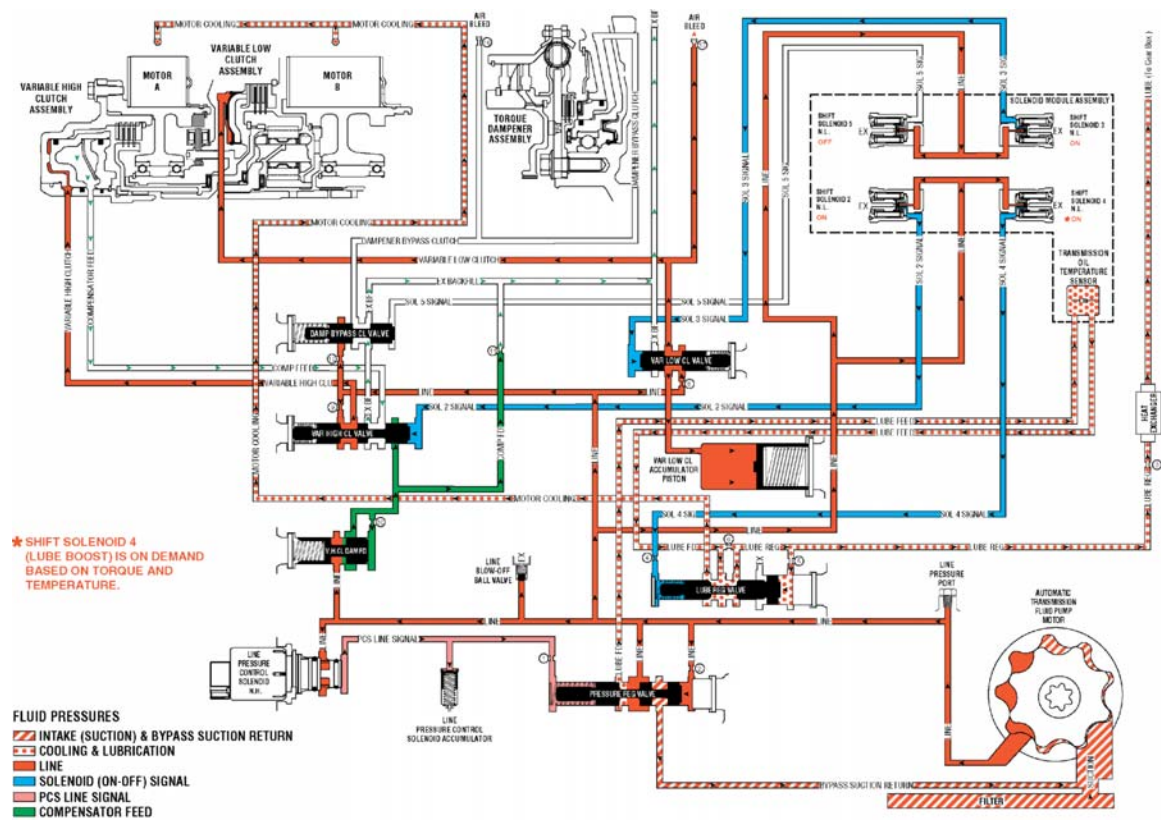


Fig. 304: Drive Extended Range Fixed Ratio Engine On - Hydraulic Flow Diagram
Courtesy of GENERAL MOTORS COMPANY

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

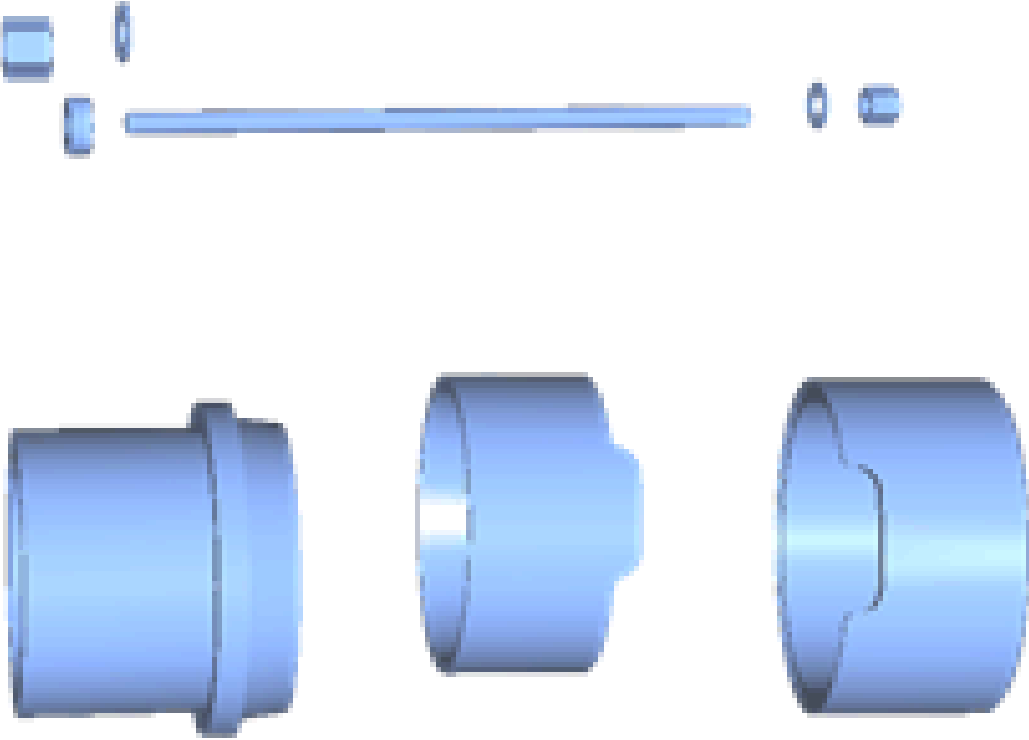
Illustration	Tool Number/Description
 The illustration shows an exploded view of a bolt and nut assembly at the top. The bolt is a long, thin rod with a hexagonal head on the left and a hexagonal nut on the right. There are three small, cylindrical bushings shown in the exploded view. Below the bolt and nut assembly, there are three views of a bushing: a side view, a front view, and a back view. The bushing is a cylindrical component with a flange on one end and a central hole.	CH-51999 Volt Cradle Bushing Remover/Installer

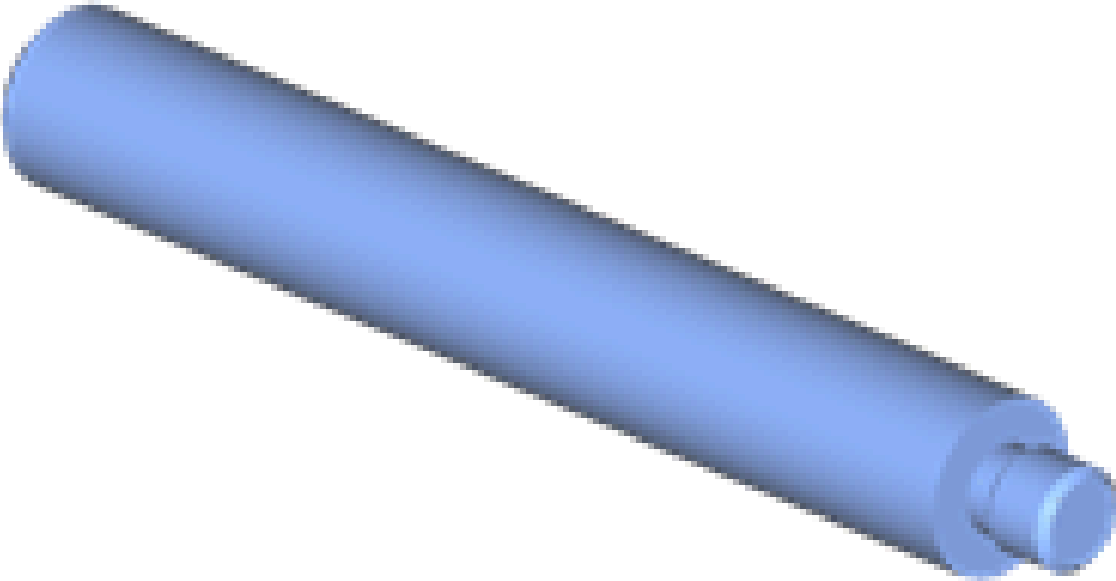
Illustration	Tool Number/Description
	DT-8092 GE-8092 Drive Handle

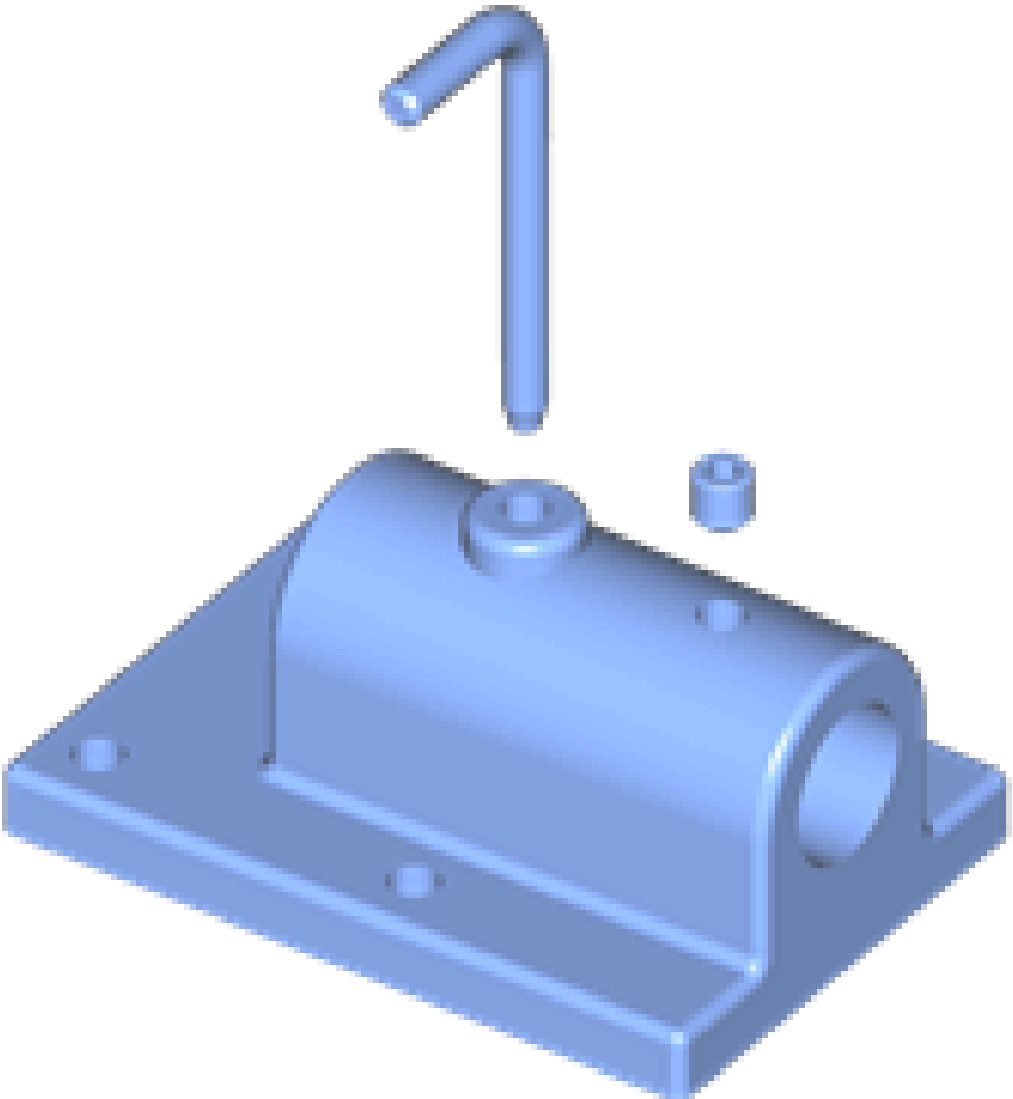
Illustration	Tool Number/Description
	DT-03289-20 Holding Fixture Base Assembly

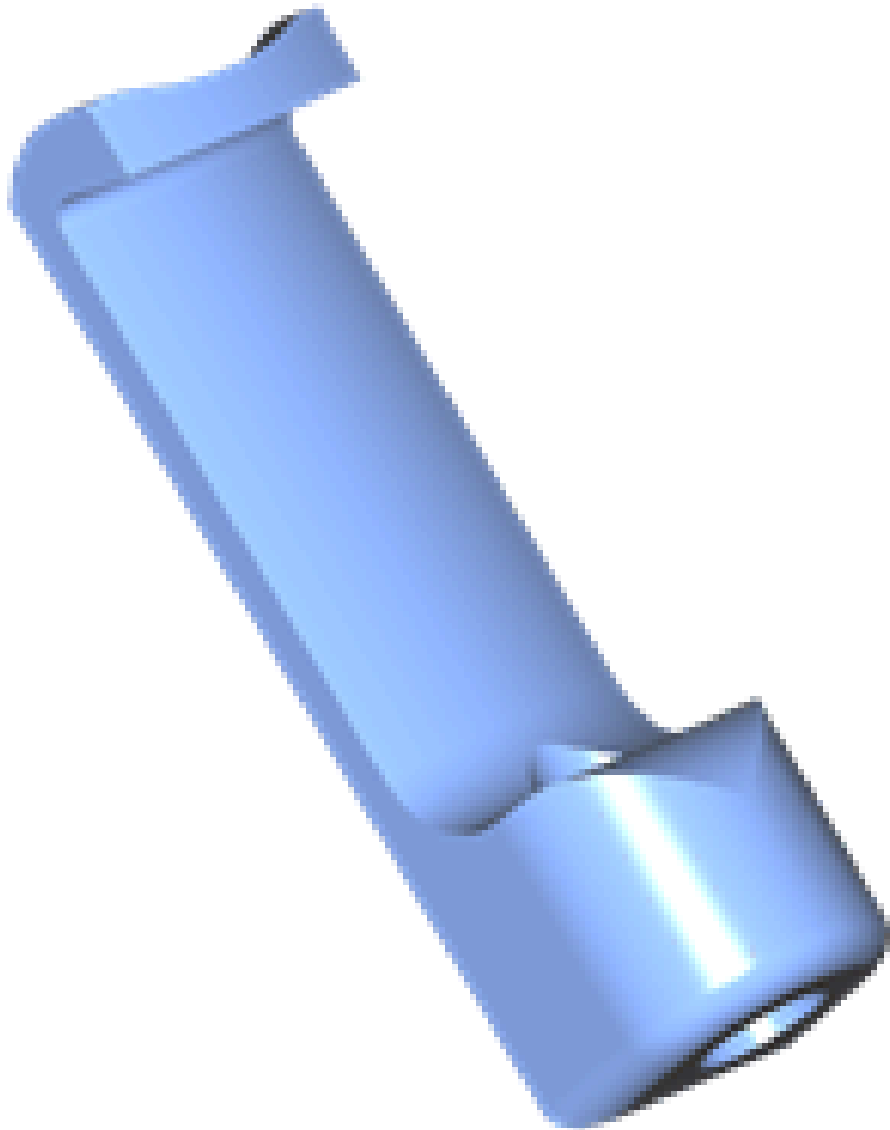
Illustration	Tool Number/Description
	DT-23129 Universal Seal Remover

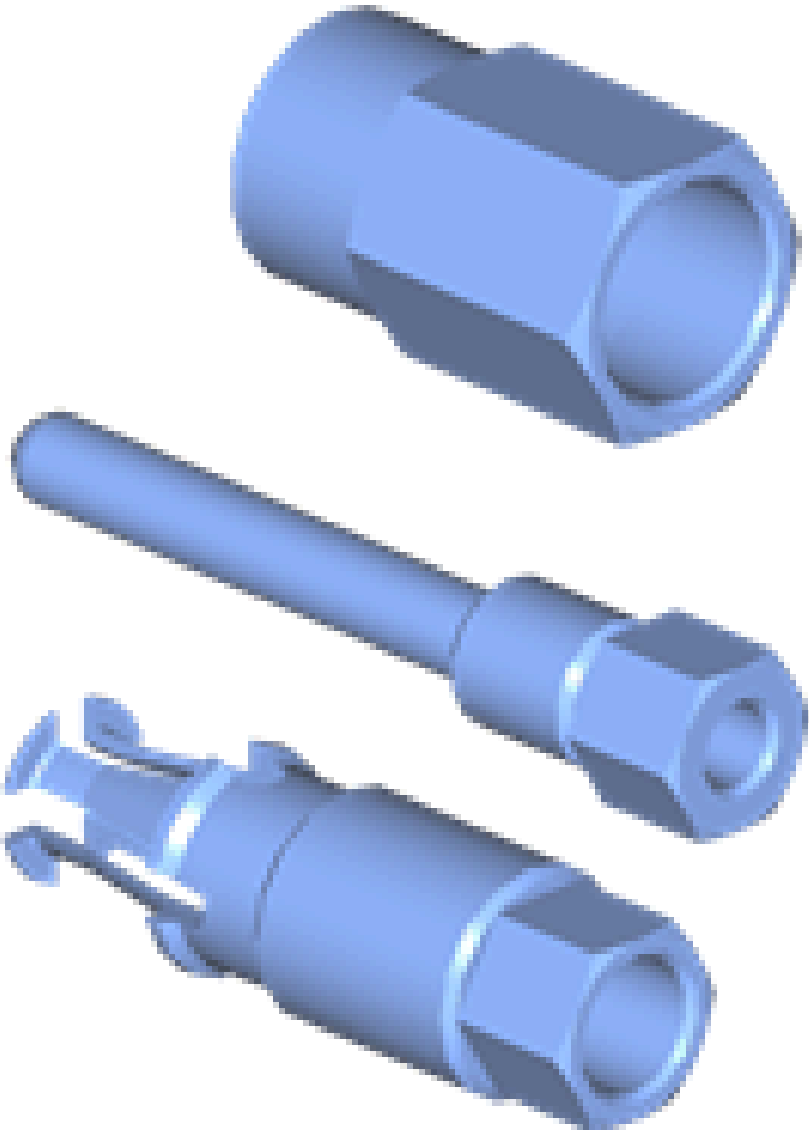
Illustration	Tool Number/Description
	DT-45201 Seal Remover

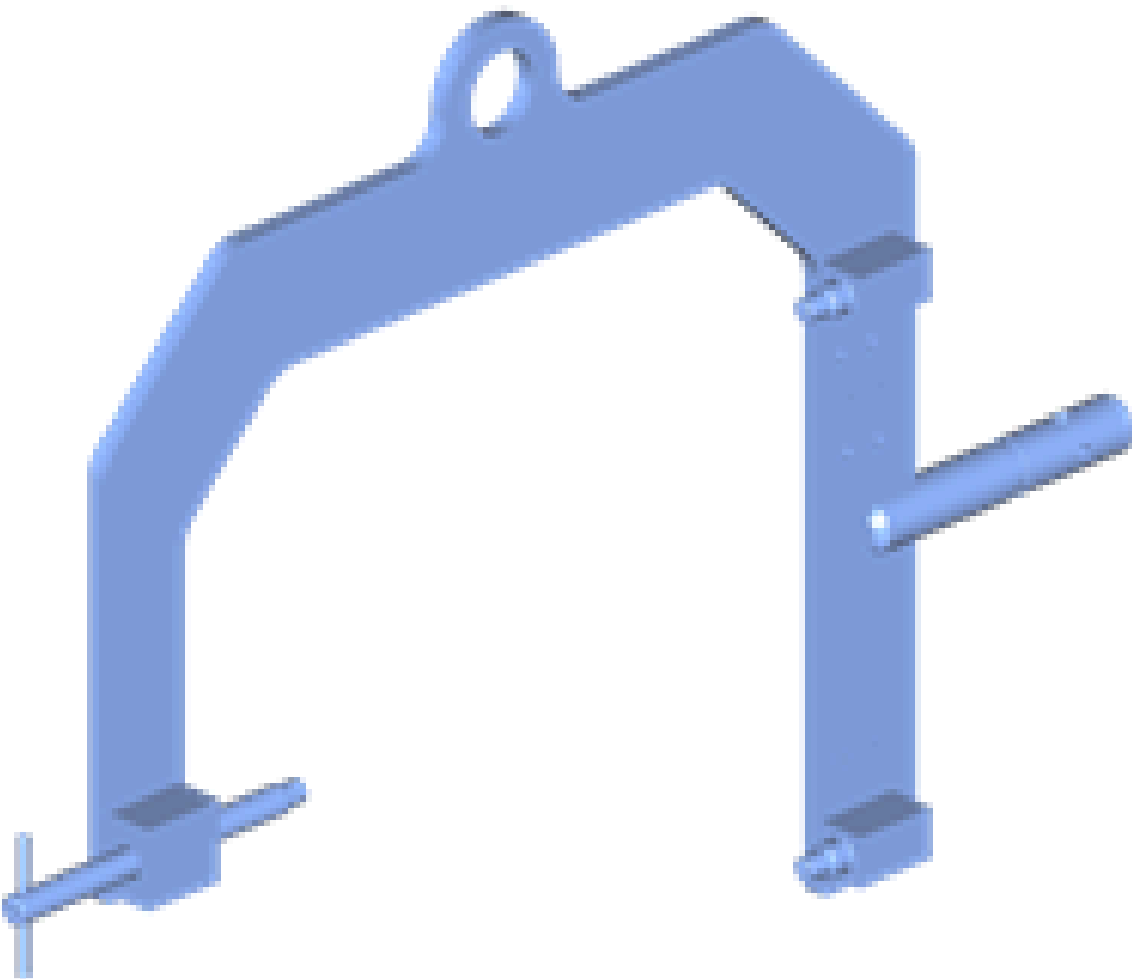
Illustration	Tool Number/Description
	DT-46625 Holding Fixture

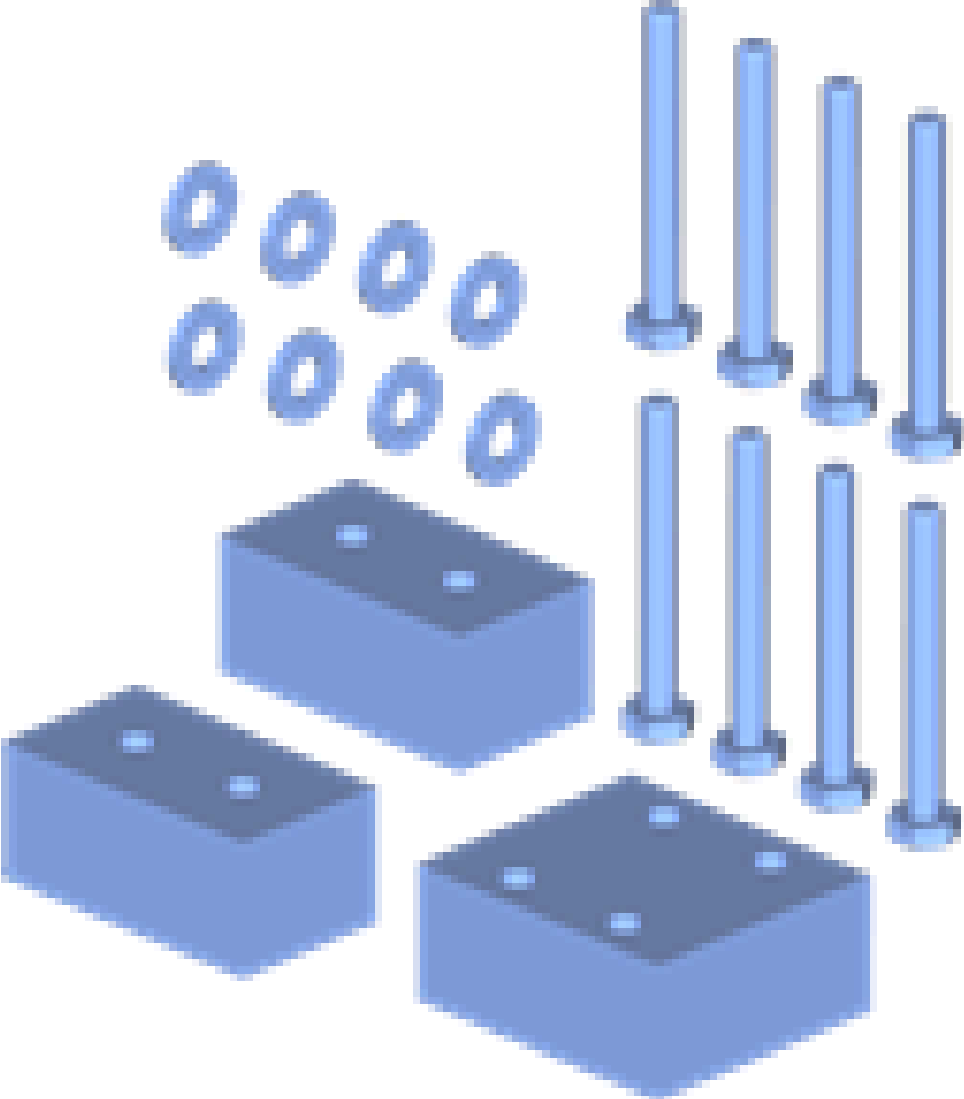
Illustration	Tool Number/Description
	DT-46625-20 Holding Fixture Adapters

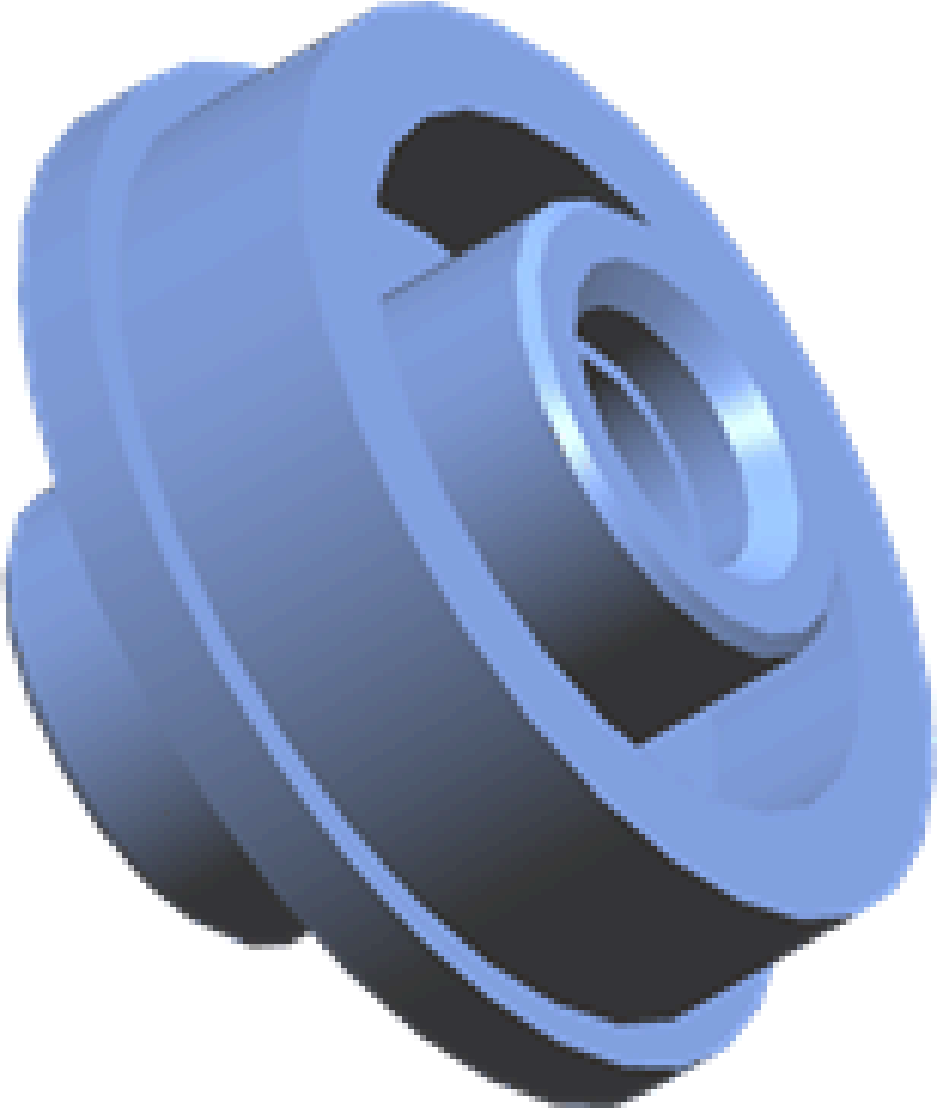
Illustration	Tool Number/Description
	DT-46629-A Axle Seal Installer

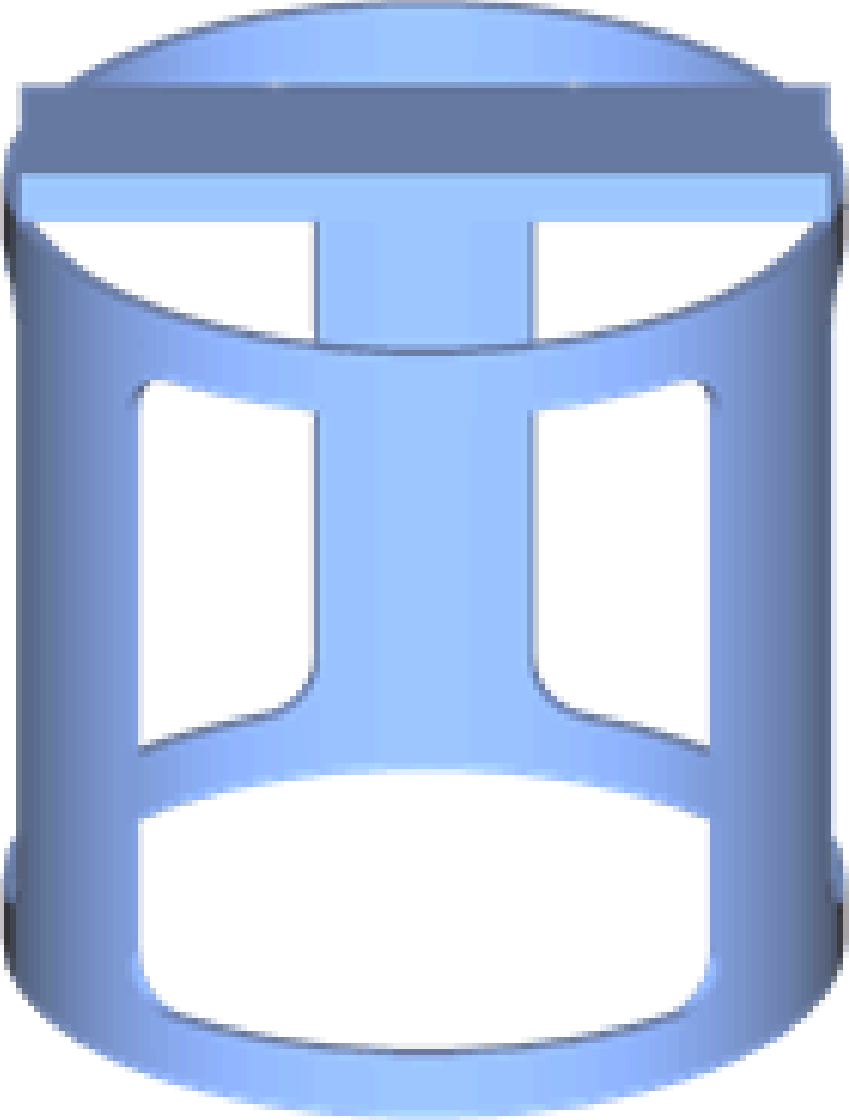
Illustration	Tool Number/Description
	DT-47694 Piston Spring Compressor

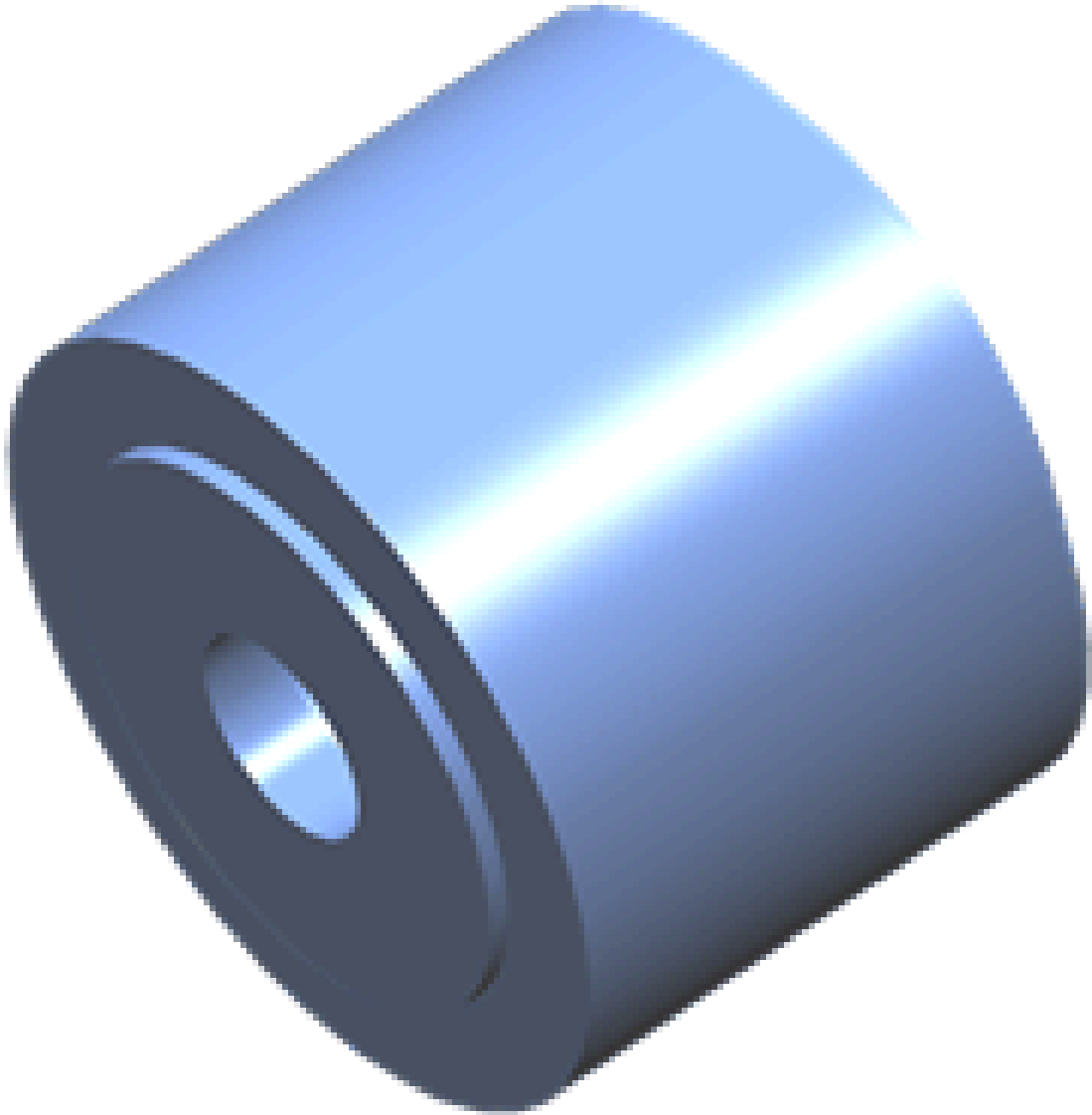
Illustration	Tool Number/Description
	DT-48008 Press Support/Pinion Bearing Installer

Illustration	Tool Number/Description
	DT-48903 Spring Compressor

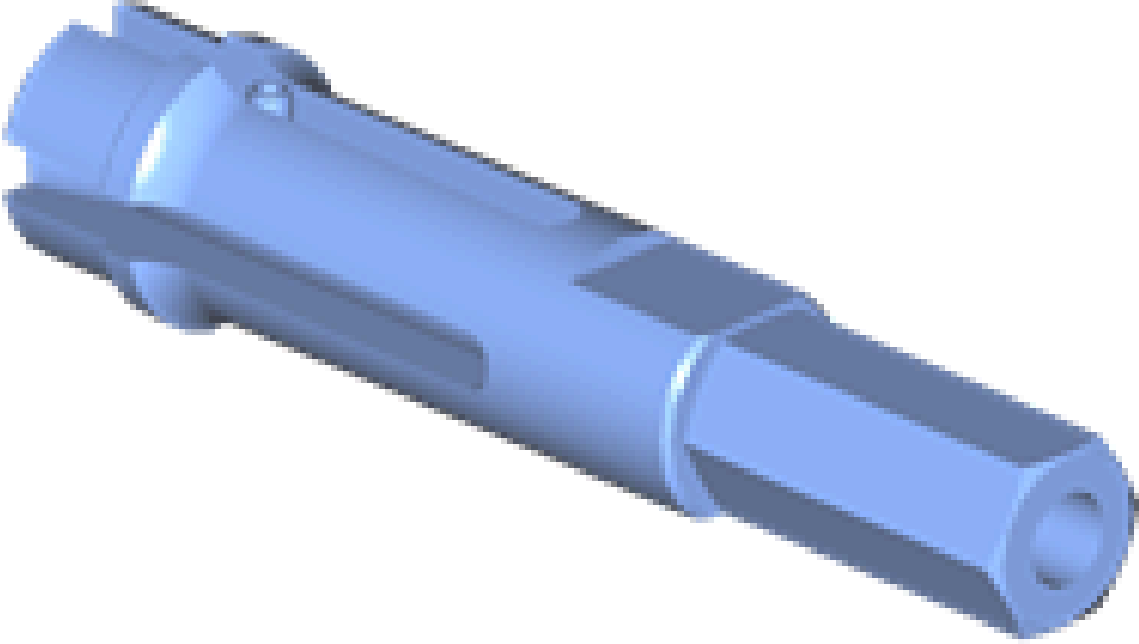
Illustration	Tool Number/Description
	DT-49938 Differential Rotating Tool

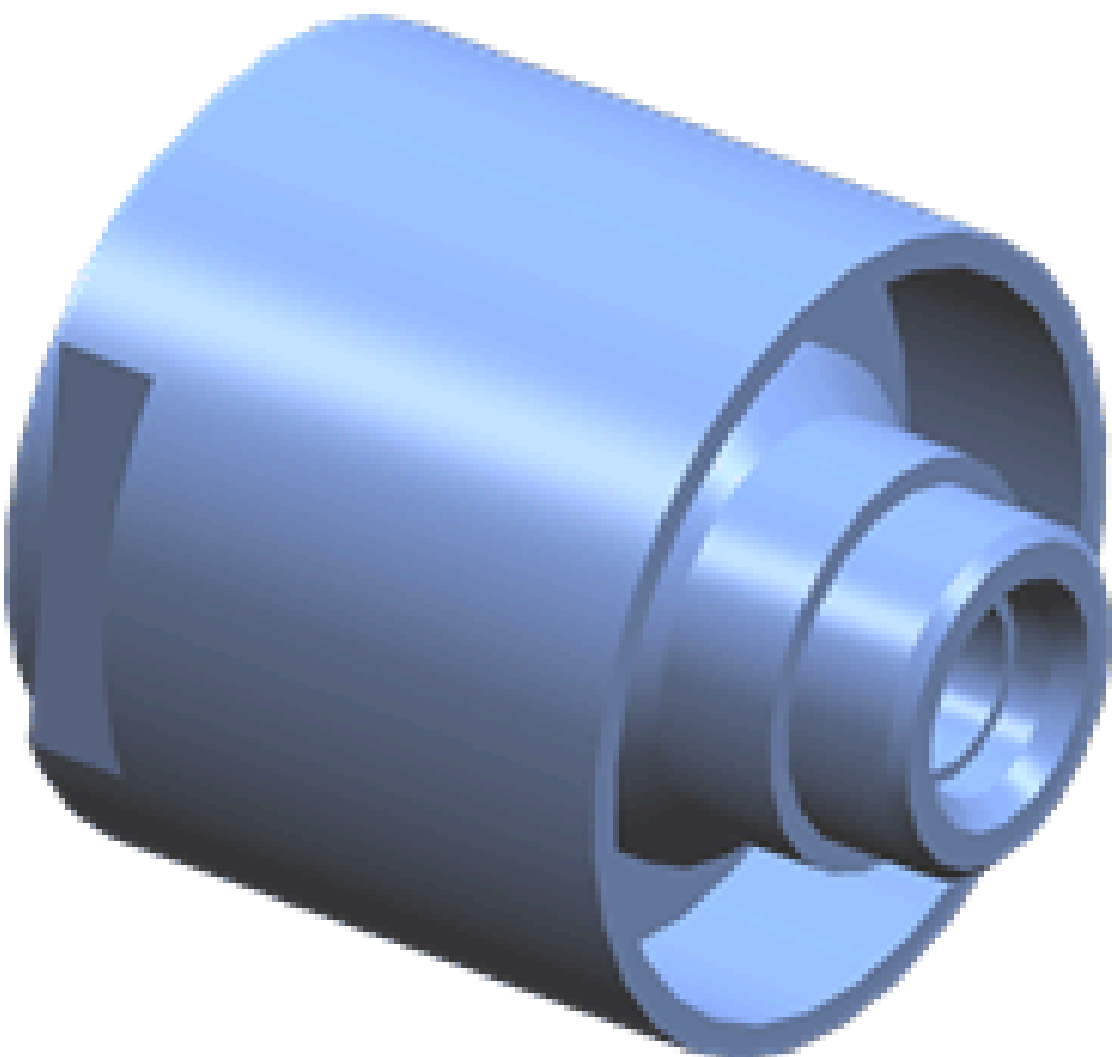
Illustration	Tool Number/Description
	DT-50301 Seal Installer

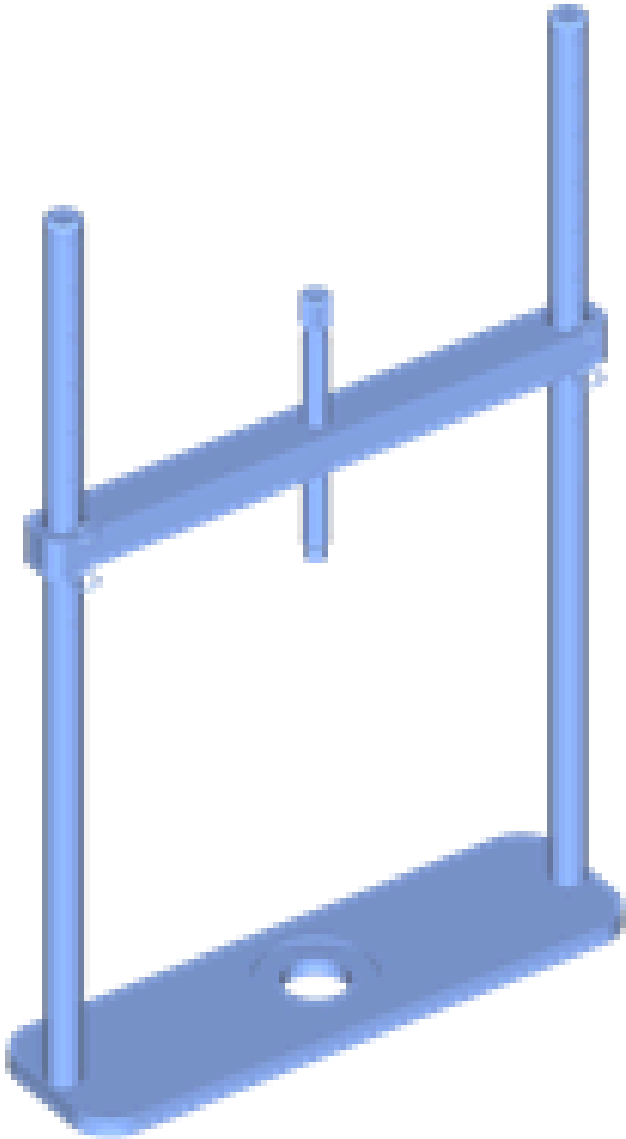
Illustration	Tool Number/Description
	DT-50900 Clutch Travel Support Fixture

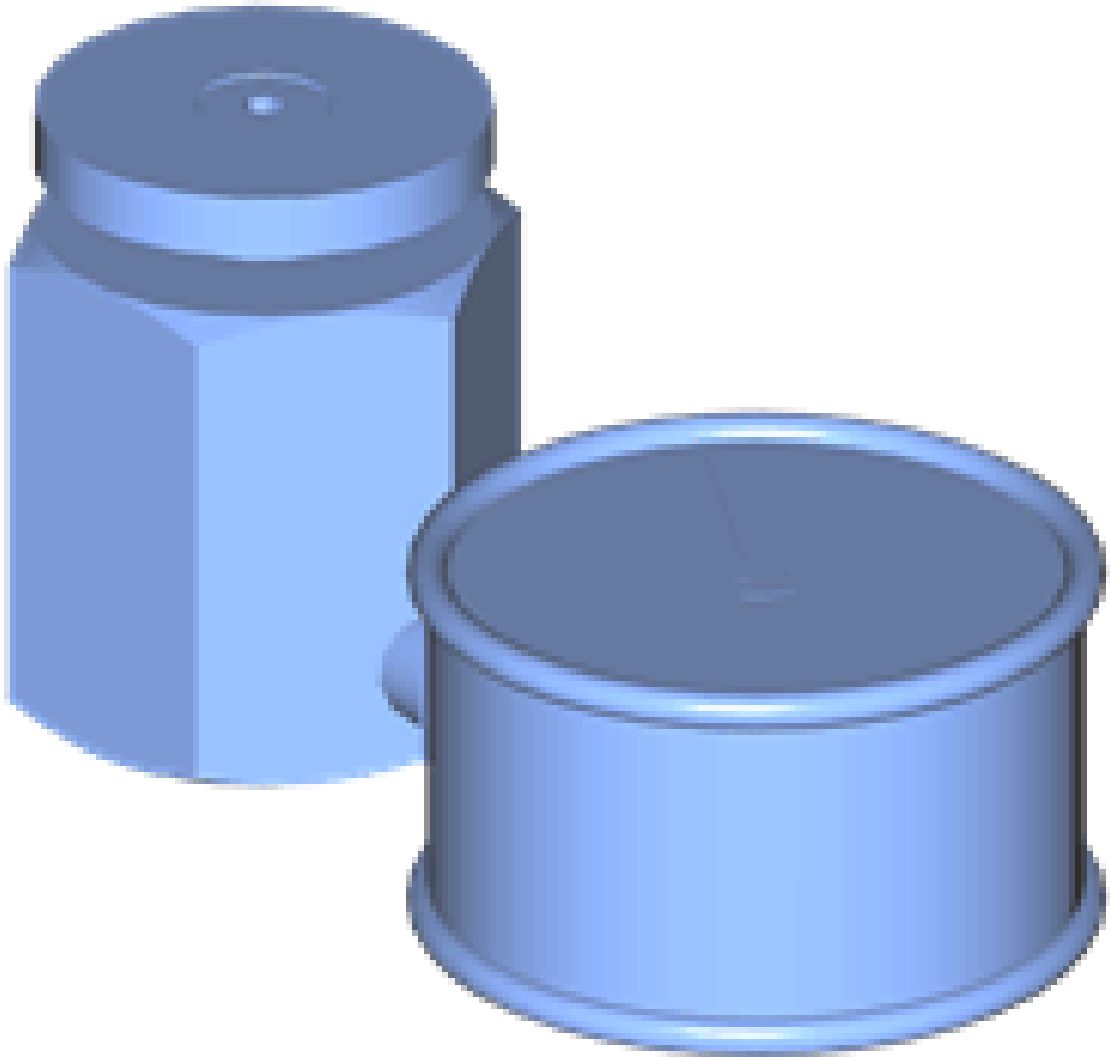
Illustration	Tool Number/Description
	DT-50903 Clutch Travel Load Gauge

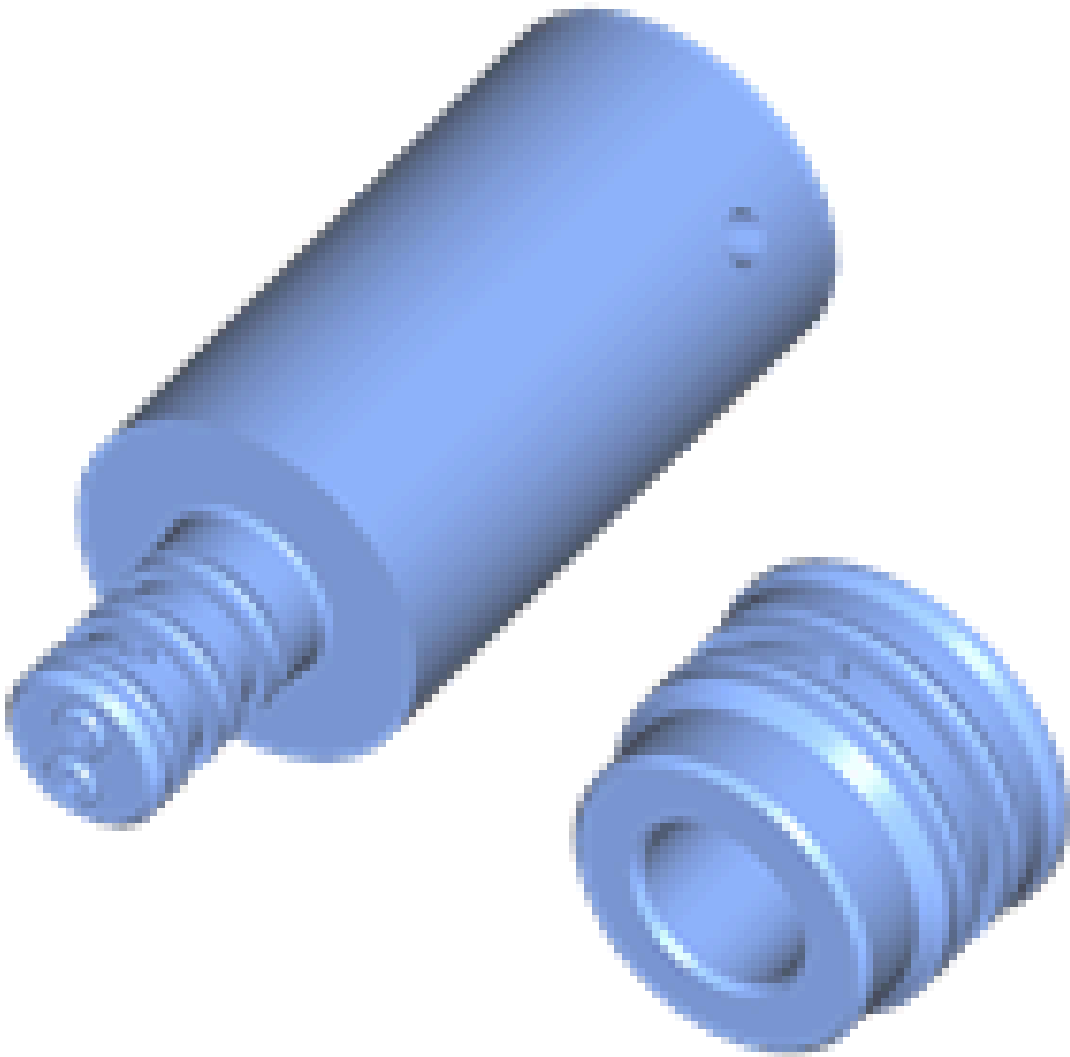
Illustration	Tool Number/Description
	DT-50905 Clutch Air Travel Adapter

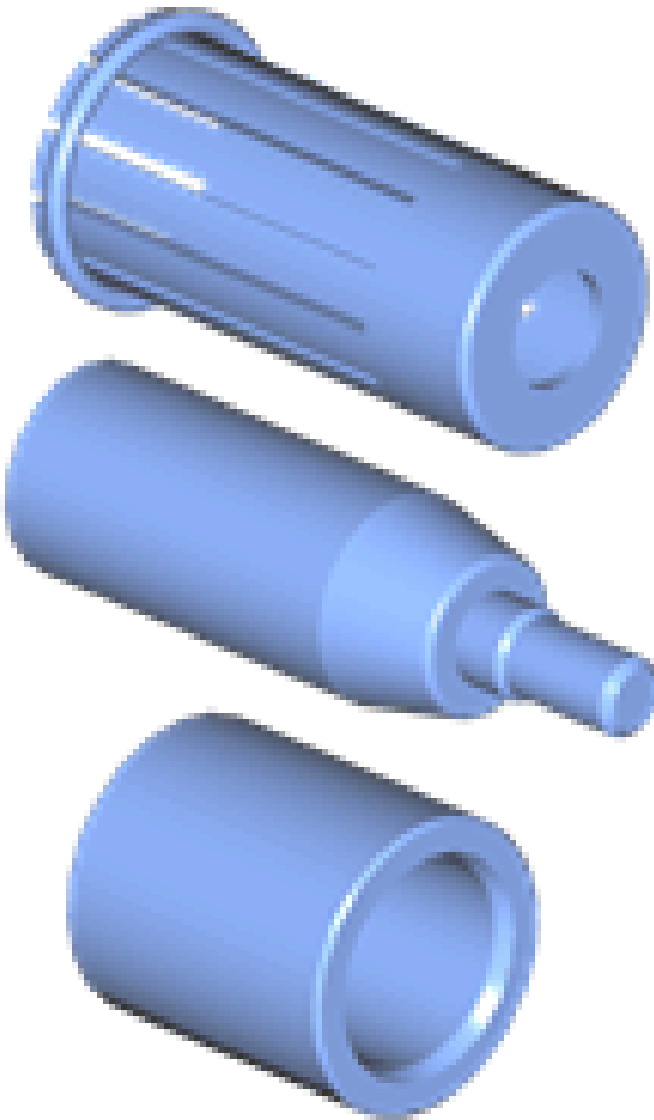
Illustration	Tool Number/Description
	DT-50911 Seal Installer

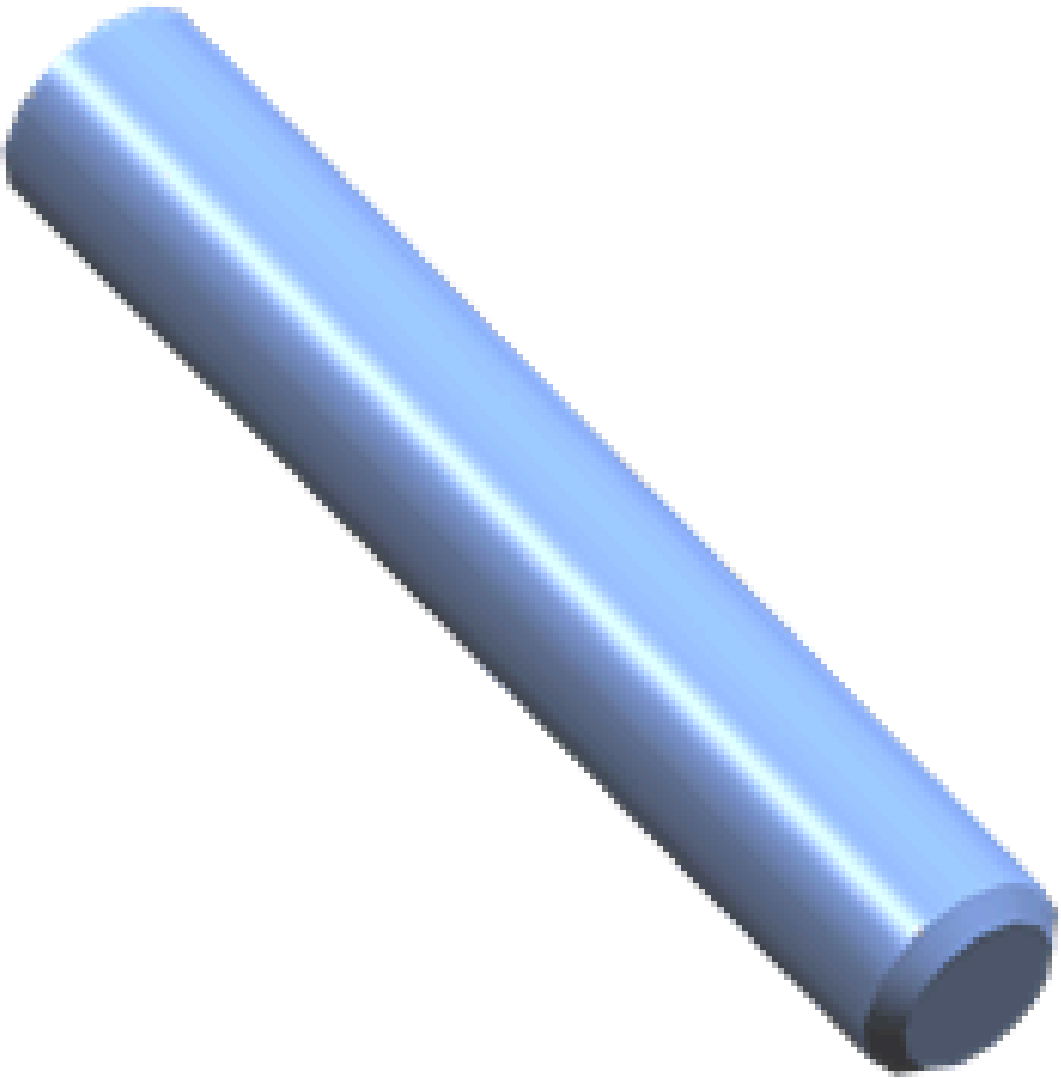
Illustration	Tool Number/Description
	DT-51436 Manual Shaft Pin Installer

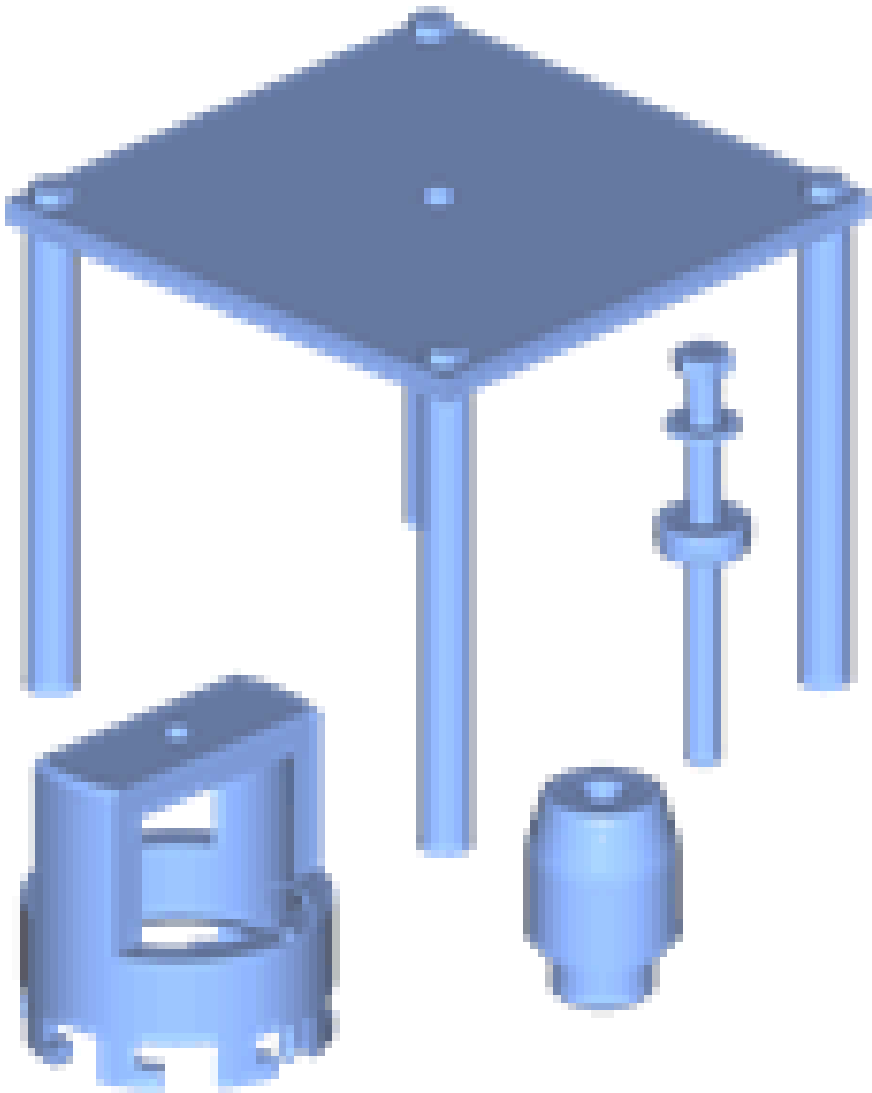
Illustration	Tool Number/Description
 An exploded view of the DT-51621 Rotor Remover/Installer tool assembly. The assembly consists of a square base plate with four vertical support legs. A central vertical rod passes through the base plate. To the right of the base plate is a long vertical rod with three circular flanges. In the foreground, there is a large, complex, blue-colored component with multiple mounting points and a central opening, and a smaller, cylindrical blue component.	DT-51621 Rotor Remover/Installer

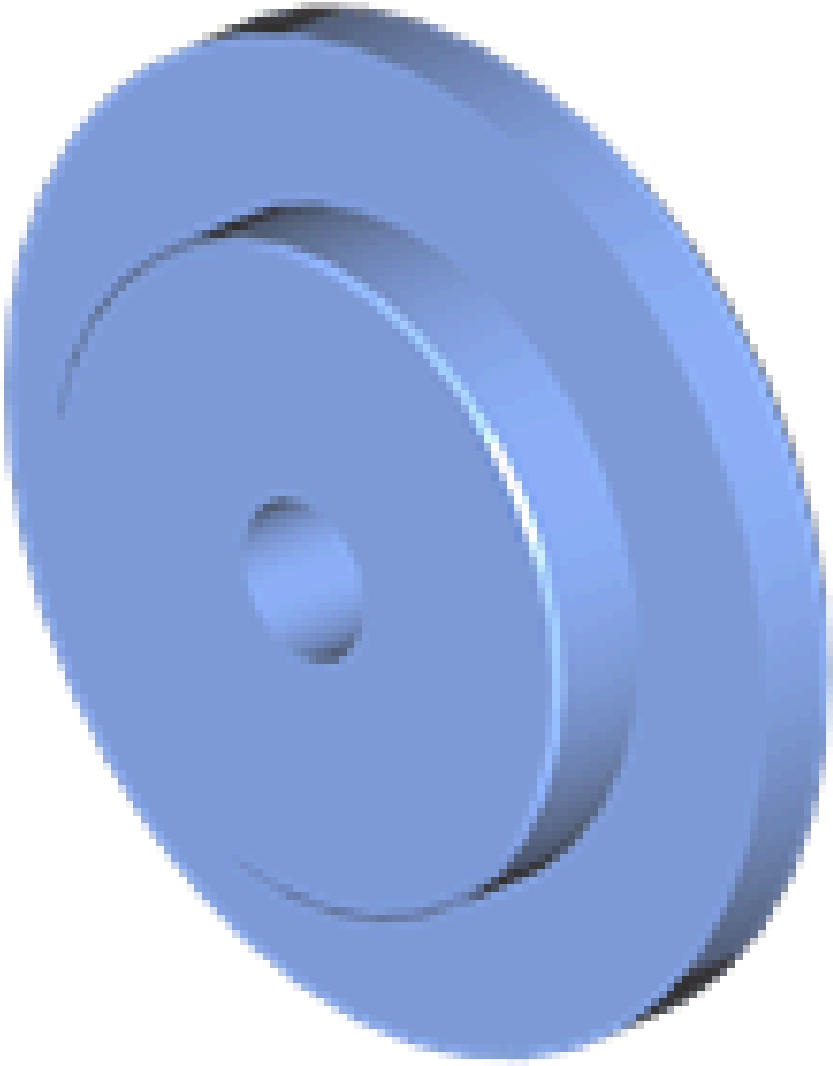
Illustration	Tool Number/Description
	DT-51622 Seal Installer

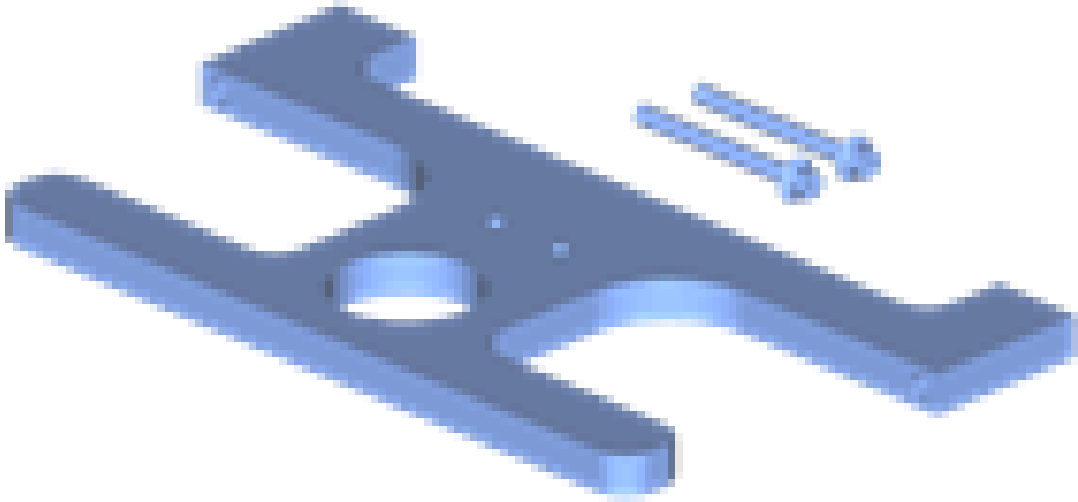
Illustration	Tool Number/Description
 A 3D perspective rendering of a blue metal motor lift bar. The bar has a central circular hole and two L-shaped mounting flanges at opposite ends. Two blue screws are shown floating above the bar, indicating they are used for assembly.	DT-51623 Motor Lift Bar

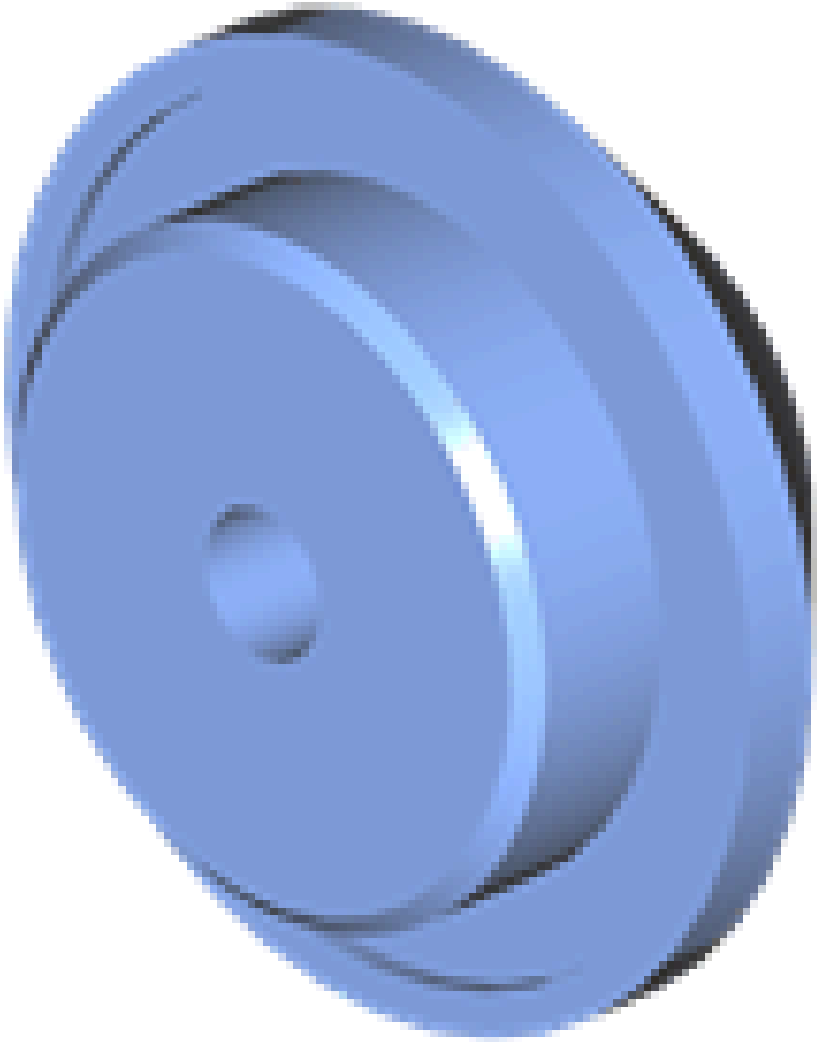
Illustration	Tool Number/Description
	DT-51625-1 Bearing Installer

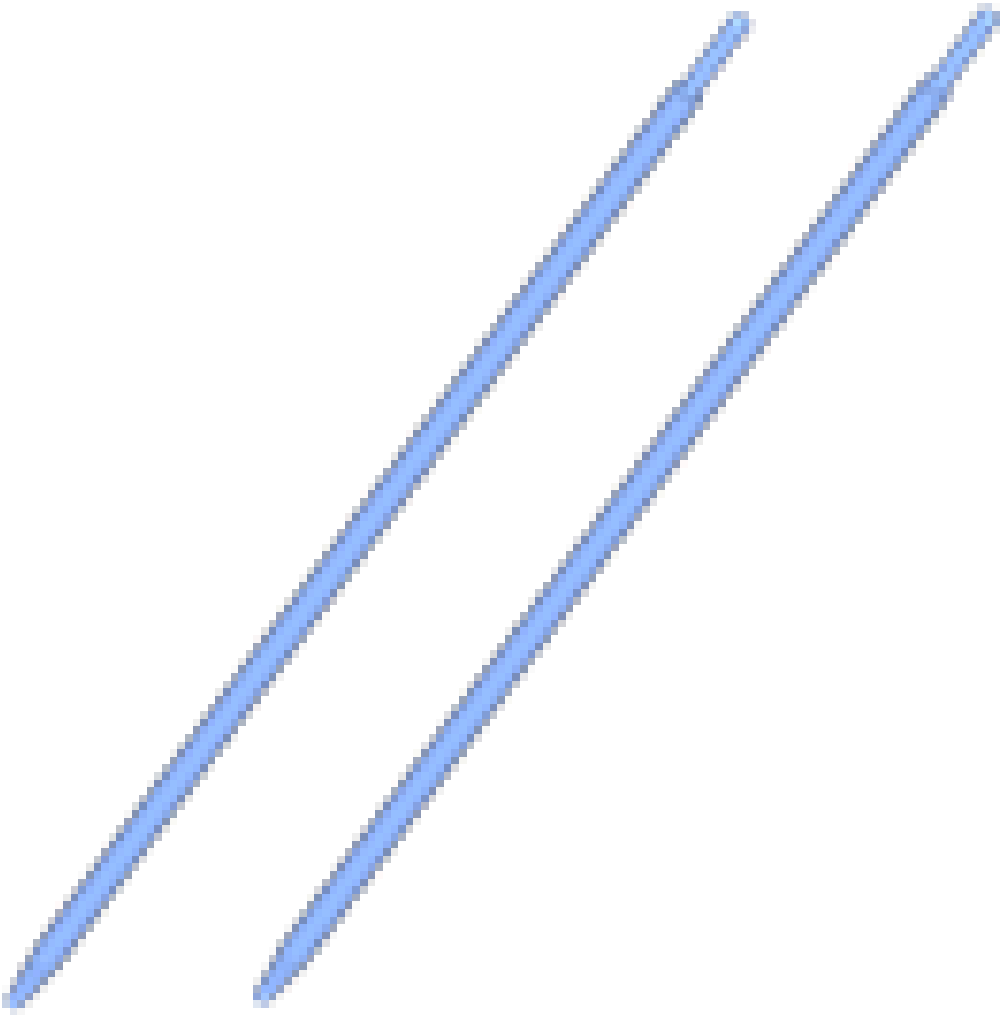
Illustration	Tool Number/Description
 The illustration shows two identical blue alignment pins. Each pin is a long, thin cylinder with a slightly wider, rounded tip at one end. They are positioned diagonally, with the tips pointing towards the upper right corner of the illustration area. The two pins are parallel to each other, with the second pin shifted slightly to the right and down from the first.	DT-51624 Alignment Pins

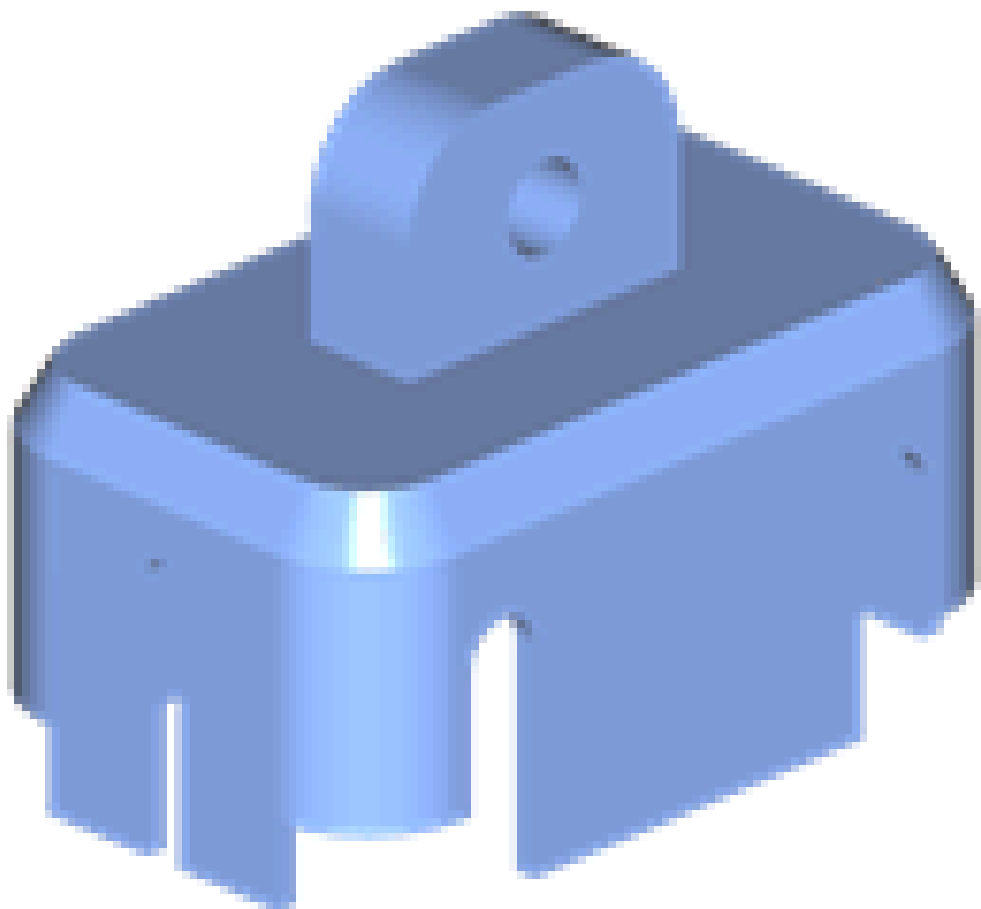
Illustration	Tool Number/Description
	DT-51626 Seal Protector

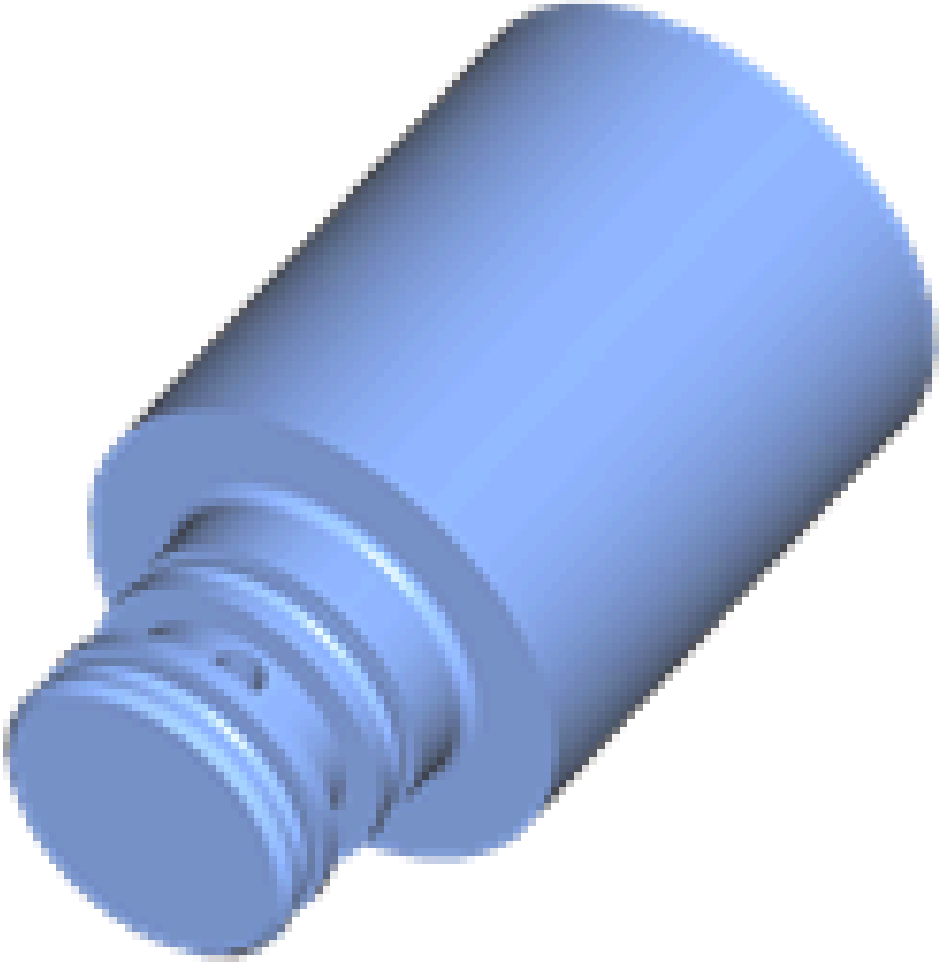
Illustration	Tool Number/Description
	DT-51627 Clutch Travel Air Adapter

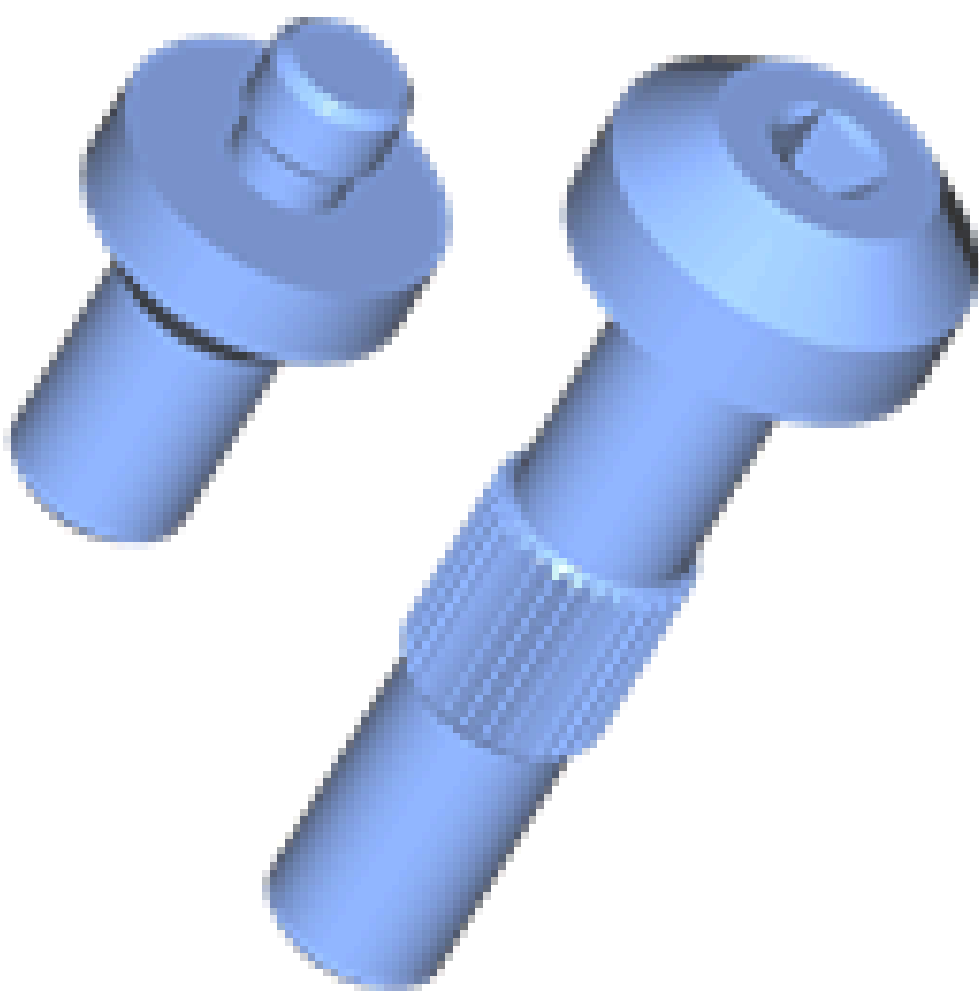
Illustration	Tool Number/Description
	DT-51628 Clutch Holder

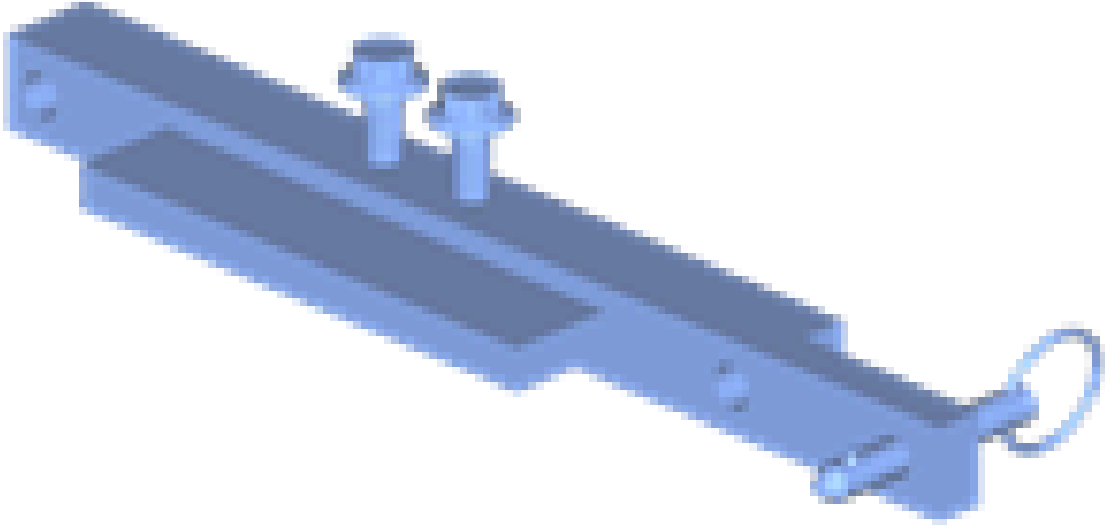
Illustration	Tool Number/Description
	DT-51654 Dampener Holder

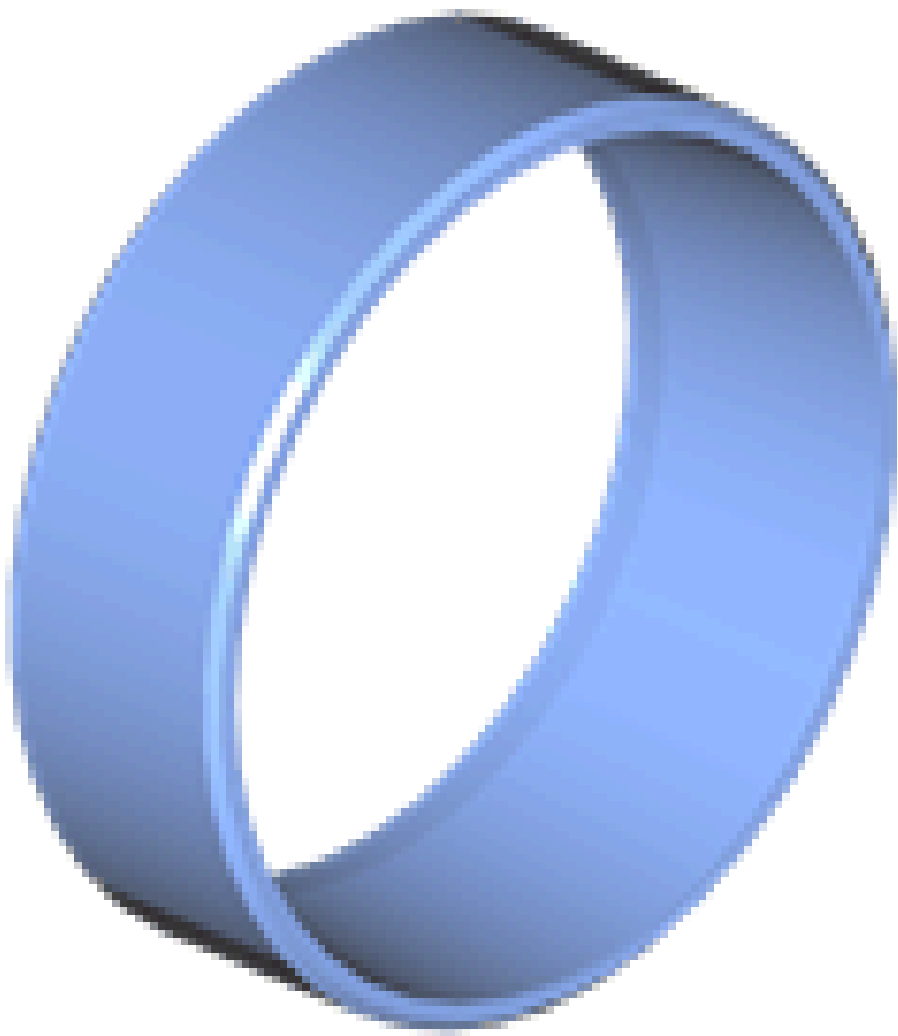
Illustration	Tool Number/Description
	DT-51669 Protector

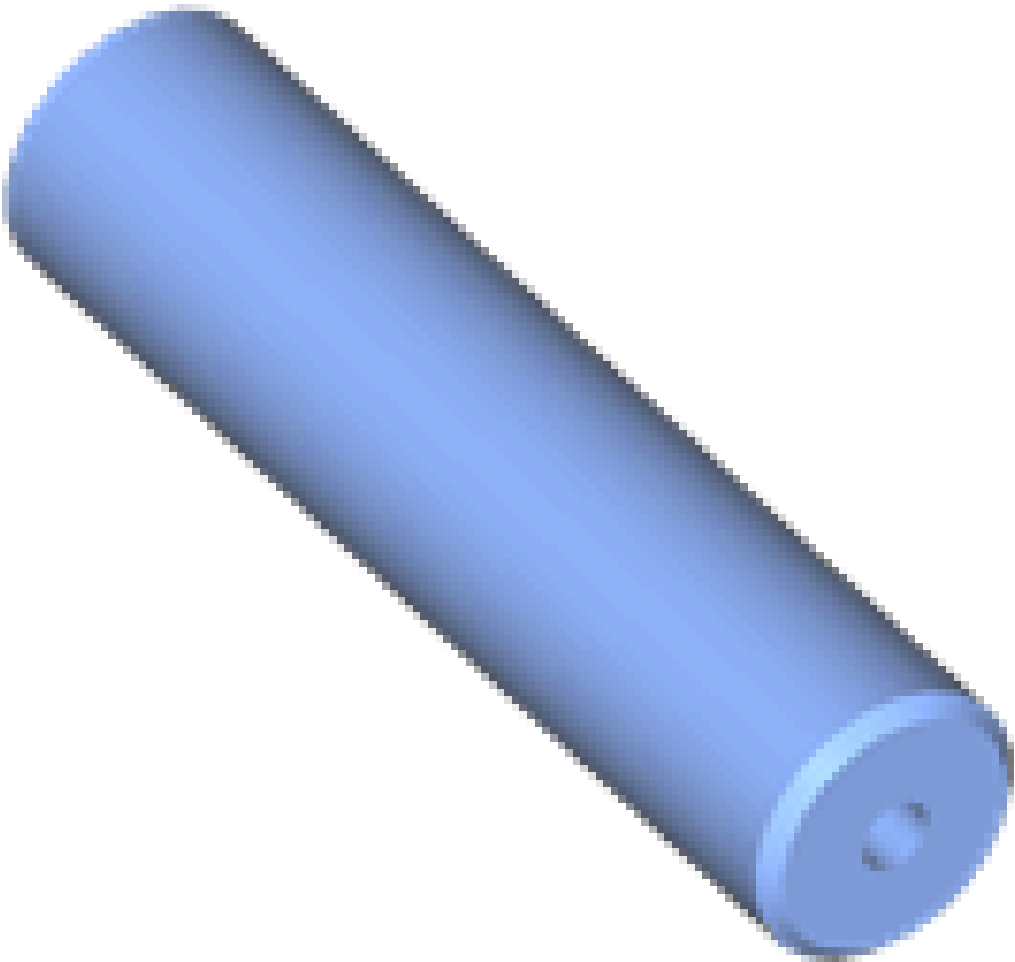
Illustration	Tool Number/Description
	DT-51672 Seal Installer

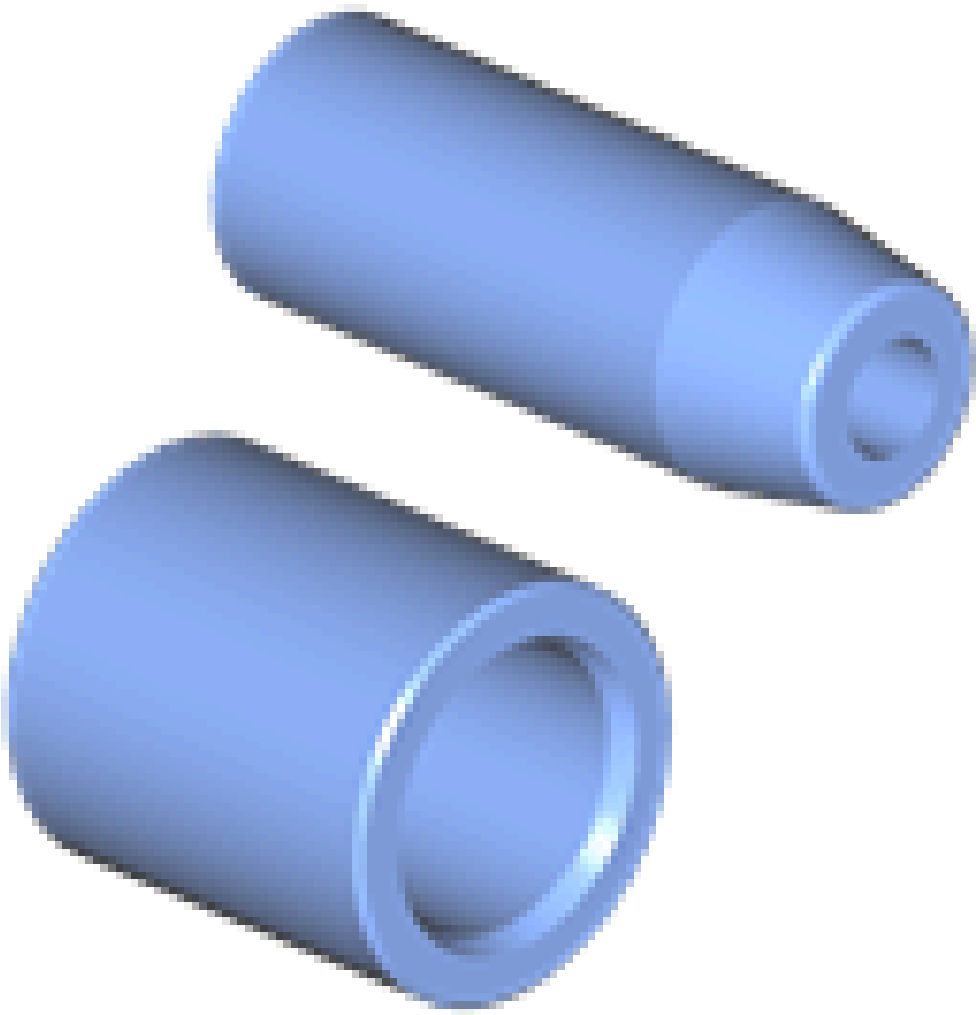
Illustration	Tool Number/Description
	DT-51700 Seal Installer

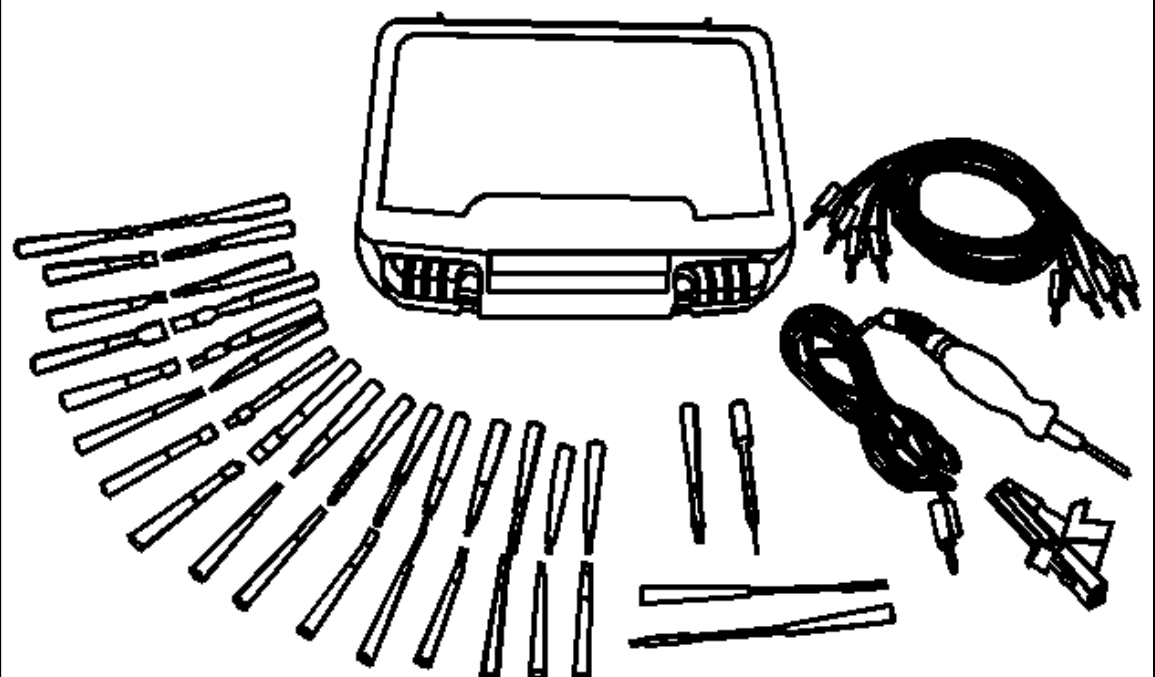
Illustration	Tool Number/Description
	EL-35616 Terminal Test Kit

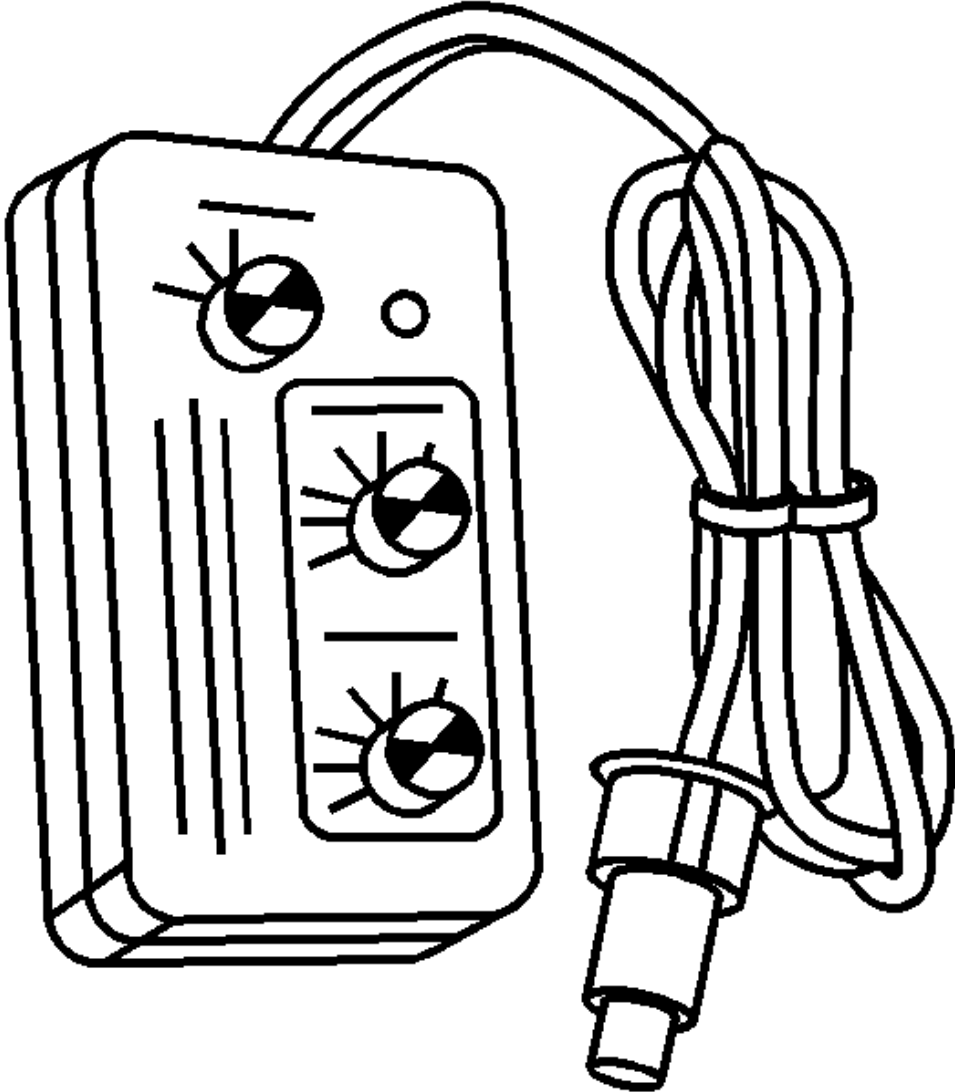
Illustration	Tool Number/Description
 A line drawing of a rectangular electronic device, likely a signal generator. It features three rotary knobs arranged vertically on the front panel. The top knob has a single tick mark above it. The middle knob has a horizontal line above it. The bottom knob has a horizontal line above it. To the left of the knobs are several vertical lines, possibly representing ventilation or a scale. A cable is connected to the top of the device, loops around, and ends in a probe tip with a cylindrical handle.	EL-38522 Variable Signal Generator

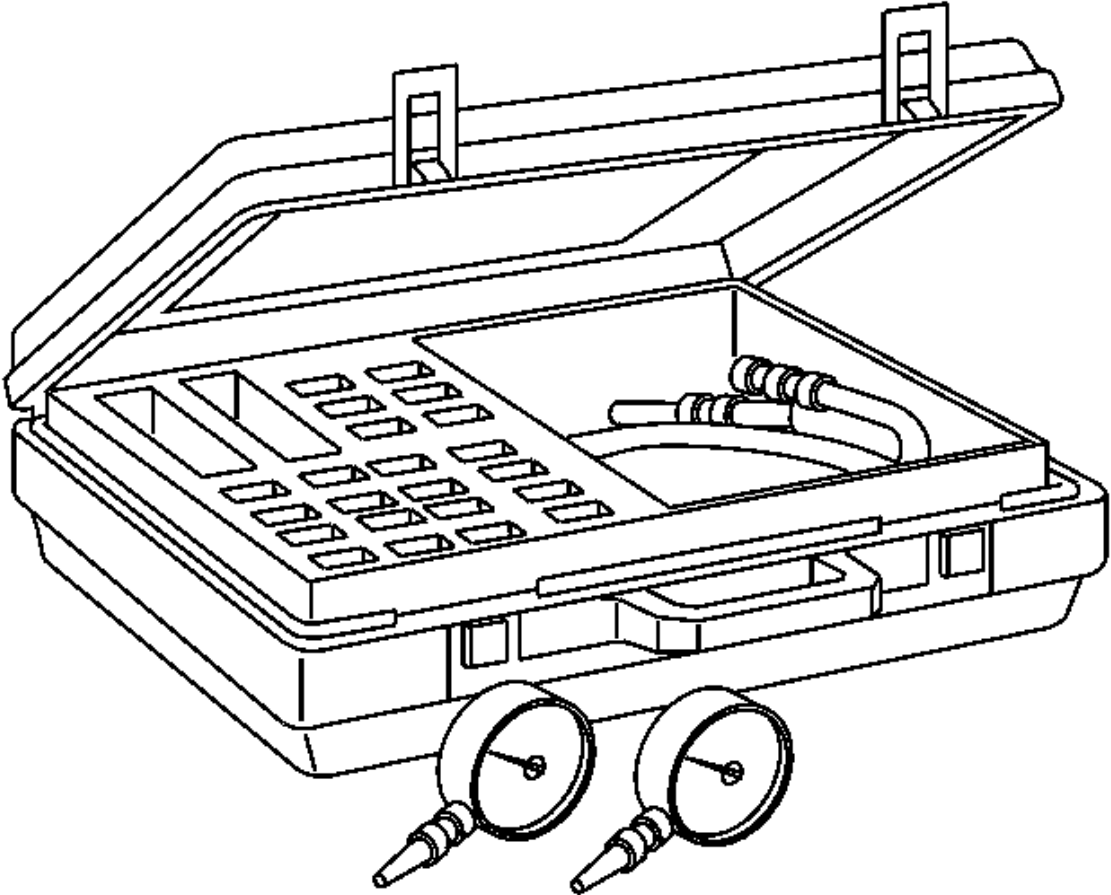
Illustration	Tool Number/Description
	EN-21867-A Pressure Gauge

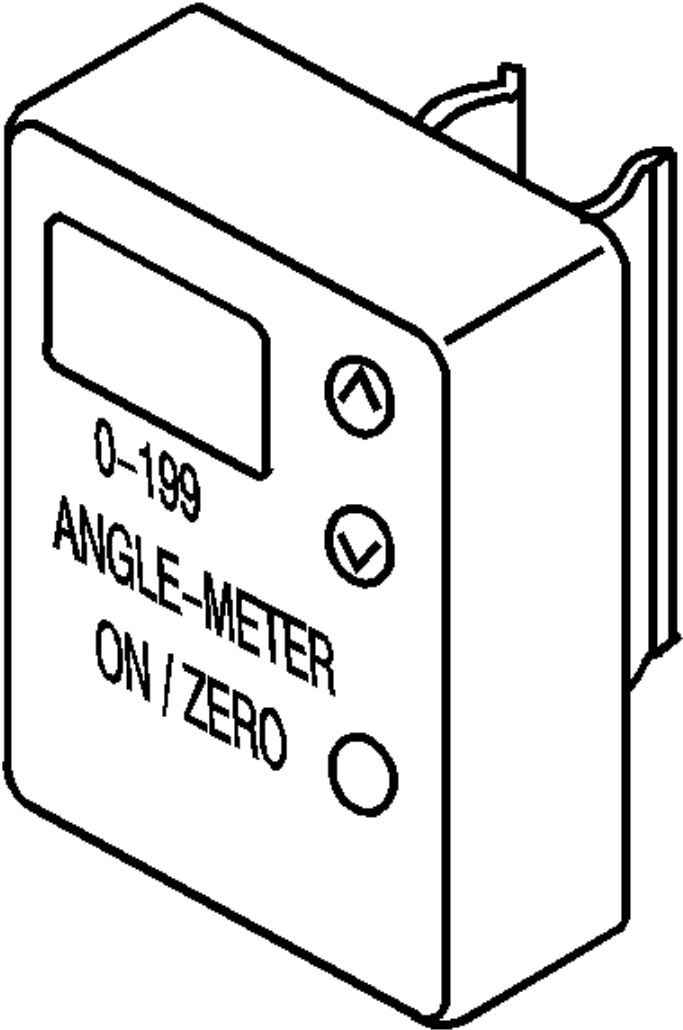
Illustration	Tool Number/Description
	EN-45059 J-45059 Angle Meter

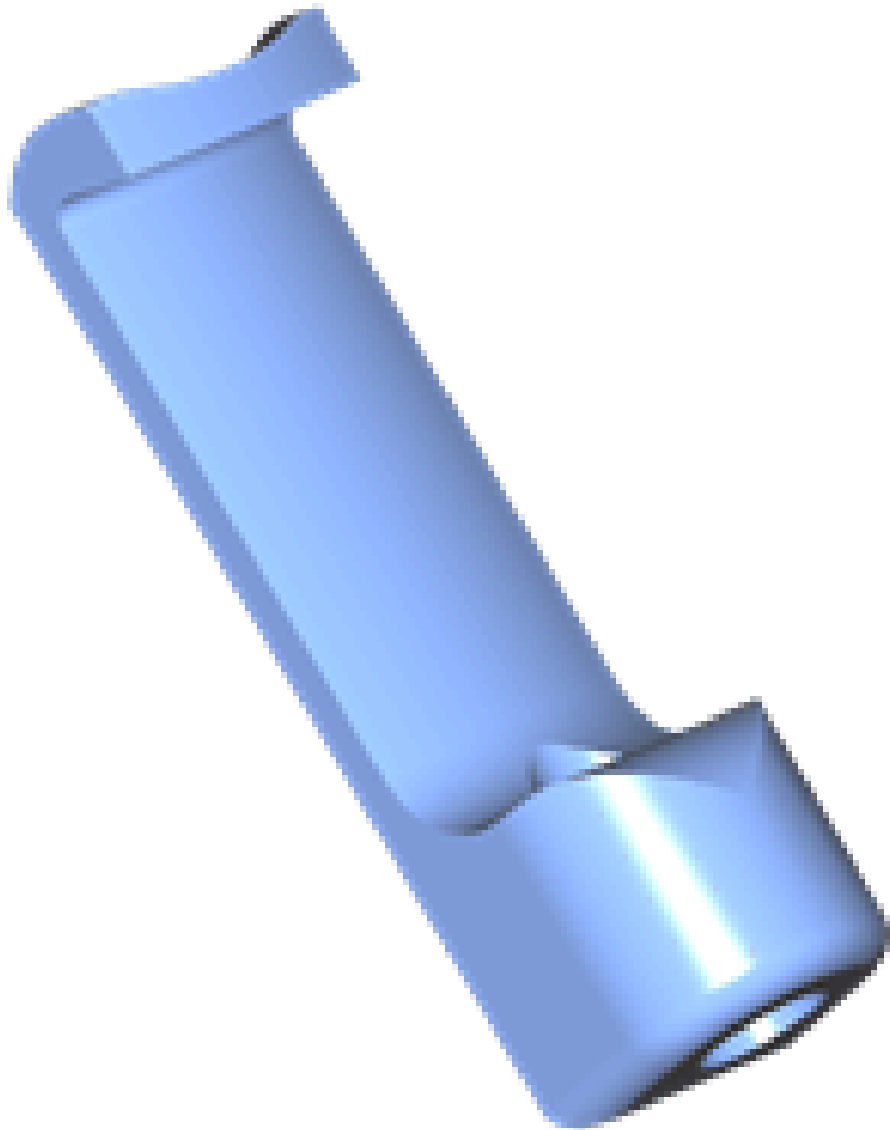
Illustration	Tool Number/Description
	GE-23129 Universal Seal Removal

Illustration	Tool Number/Description
	GE-6125-1B Slide Hammer with Adapter

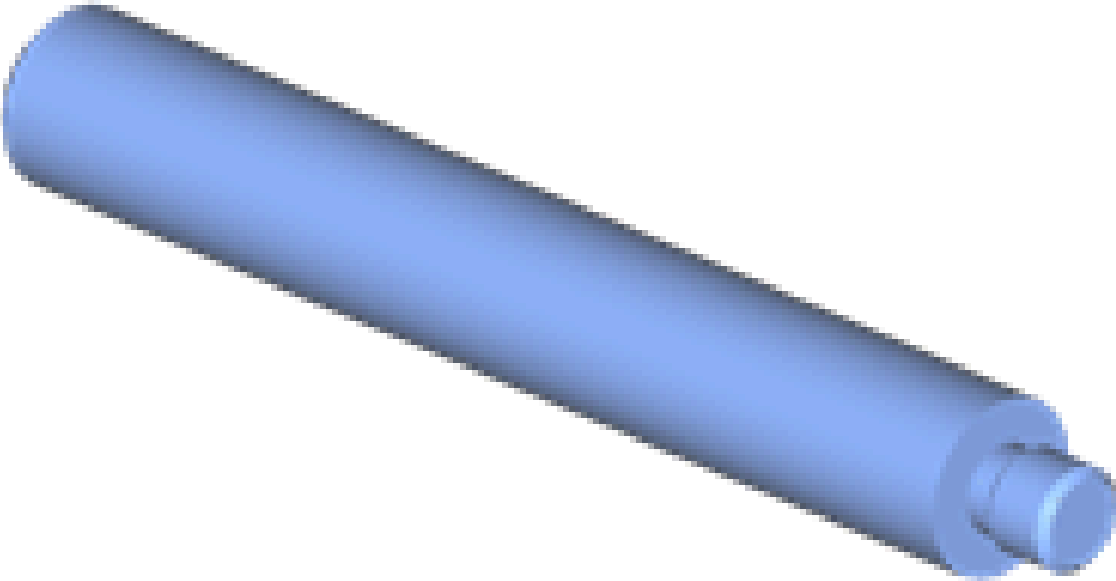
Illustration	Tool Number/Description
	GE-8092 Driver Handle

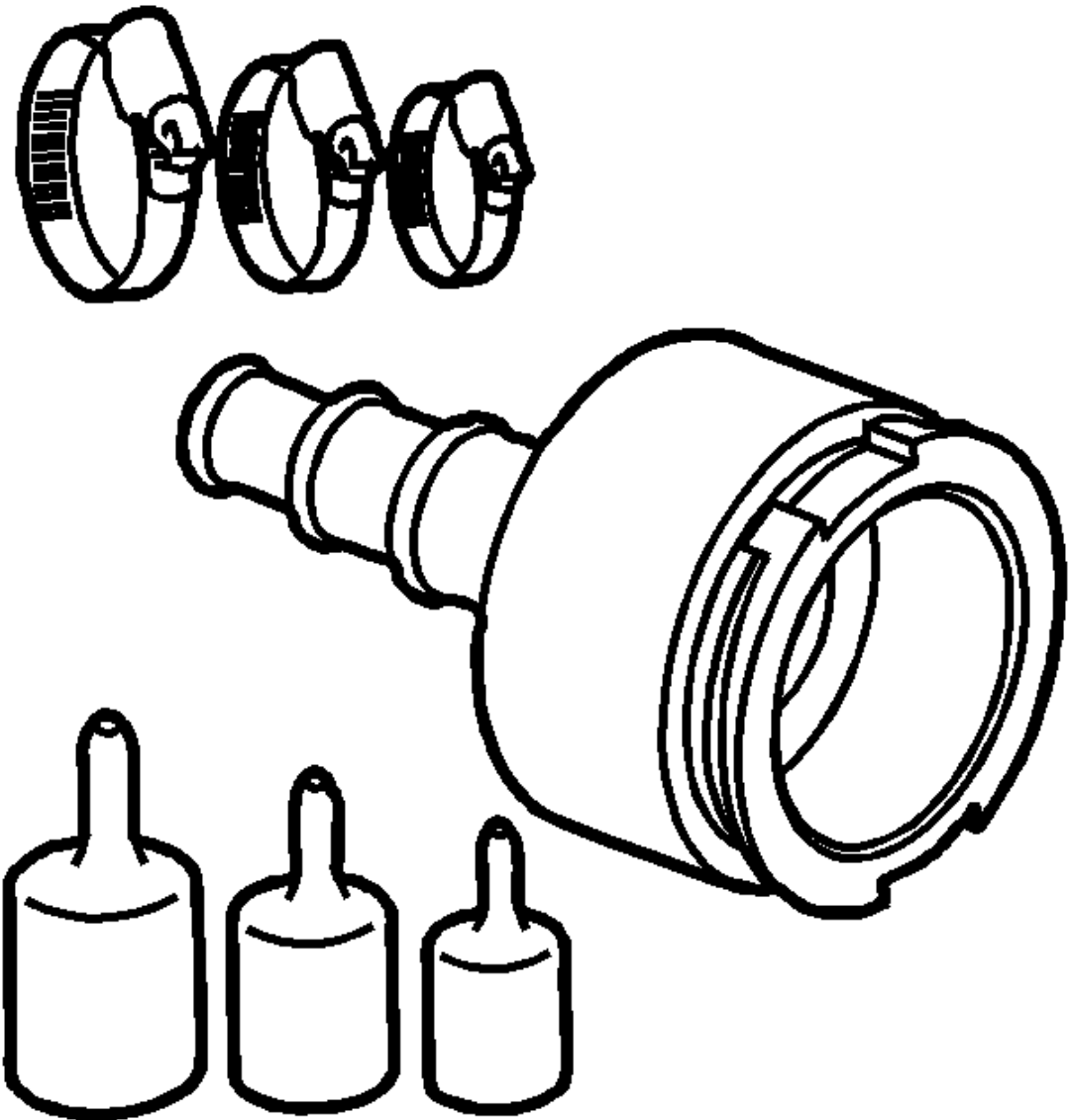
Illustration	Tool Number/Description
	GE-48494 J-48494 Power Electronics Pressure Test Adapter Kit

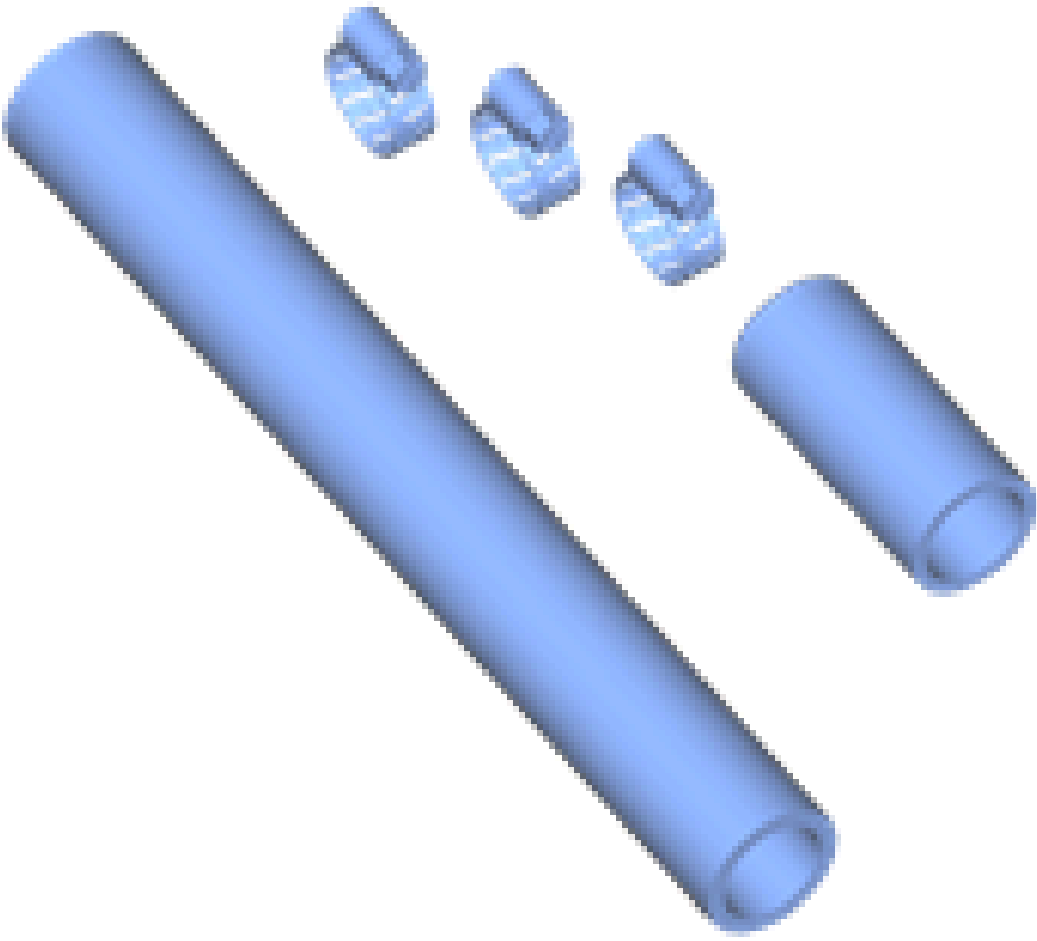
Illustration	Tool Number/Description
	GE-48494-10 Pressure Tester Kit

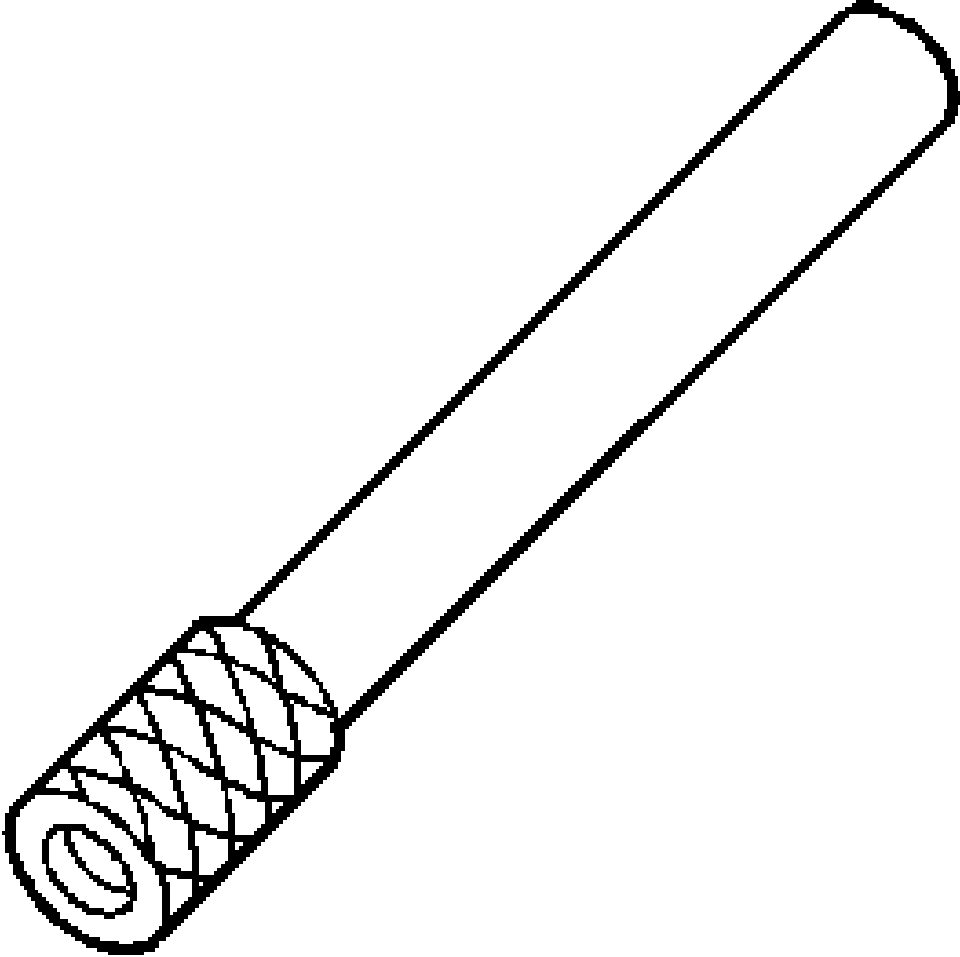
Illustration	Tool Number/Description
	GE-7057 J-7057 Dial Indicator Extension

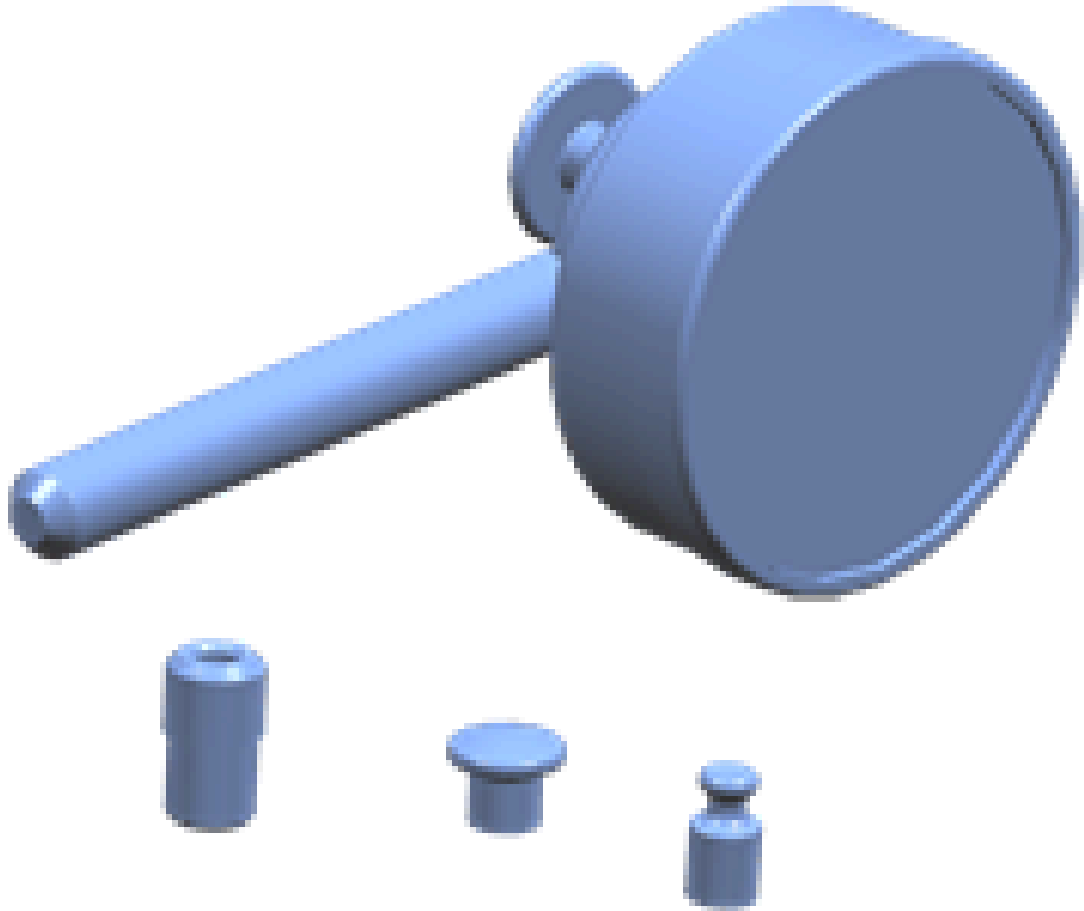
Illustration	Tool Number/Description
	GE-8001 J-8001 Dial Indicator Set

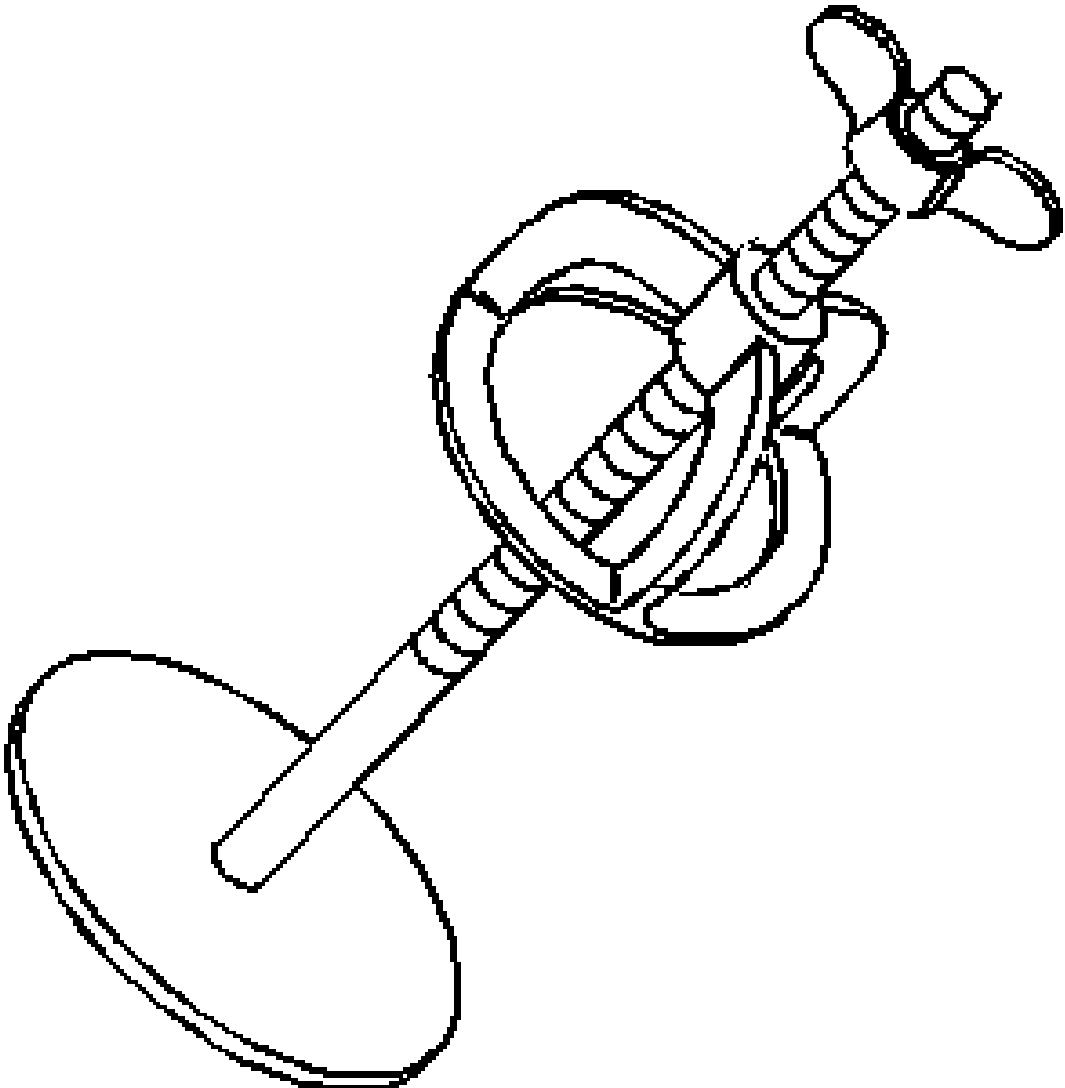
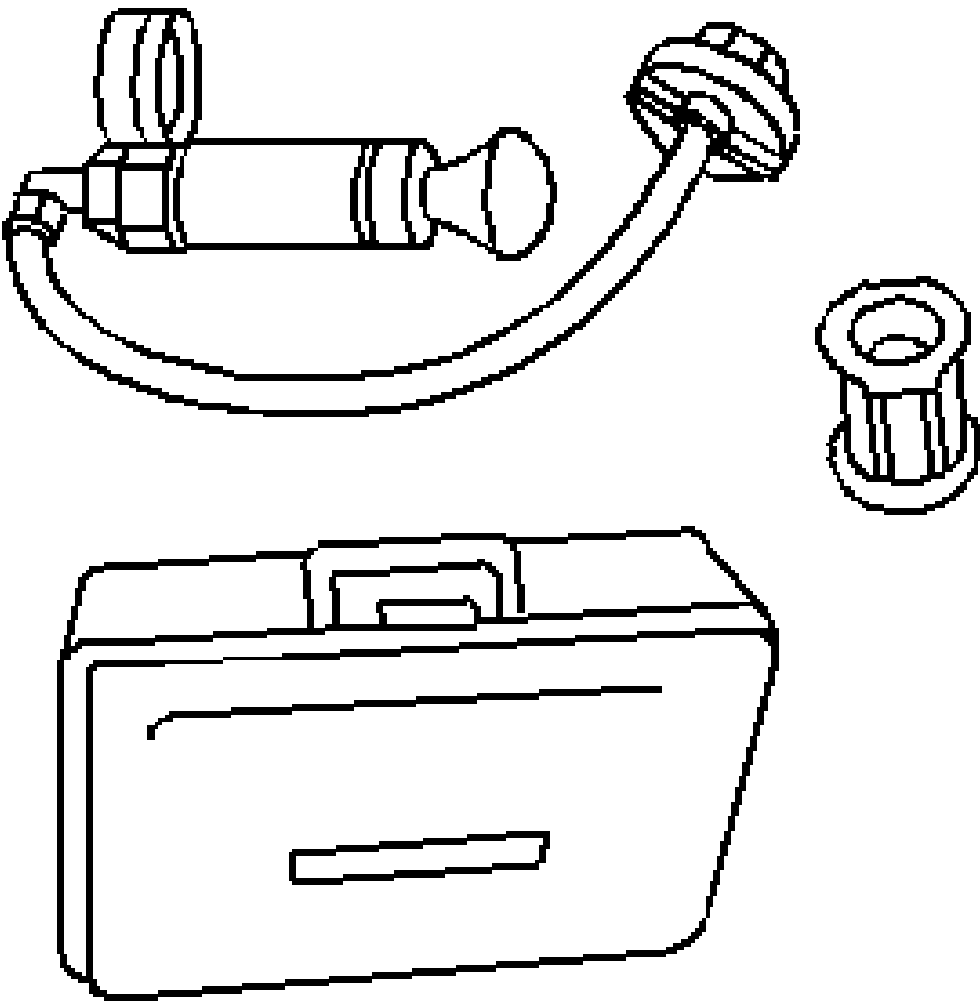
Illustration	Tool Number/Description
	J-23327-1 Clutch Spring Compressor (Bridge)

Illustration	Tool Number/Description
	J-24460-01 Cooling System Pressure Tester

Article GUID: A00884644

TRANSMISSION

Shift Lock Control - Volt

SCHEMATIC WIRING DIAGRAMS

SHIFT LOCK CONTROL WIRING SCHEMATICS

Shift Lock

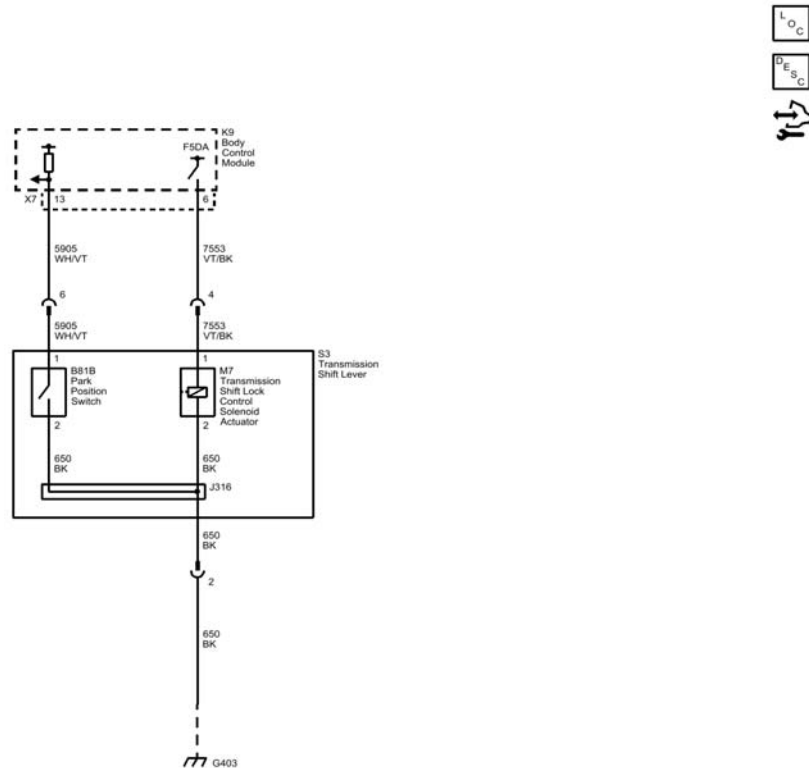


Fig. 1: Shift Lock

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B270A: PARK LOCK SOLENOID CONTROL CIRCUIT SHORT TO BATTERY/GROUND

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B270A 01

Park Lock Solenoid Control Circuit Short to Battery

DTC B270A 02

Park Lock Solenoid Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuse B+	B270A 01, 1	B270A 01, 1	-	-
Control	B270A 02, 1	1	B270A 01, 2	-
Ground	-	1	-	-
1. Transmission shift lever will not move from PARK with the brake pedal applied. 2. Transmission shift lever will move from PARK without the brake pedal applied.				

Circuit/System Description

The body control module (BCM) controls the transmission shift lock control solenoid actuator by providing a battery positive voltage to the solenoid when the brake pedal is applied. The BCM monitors the voltage and current flow of the control circuit.

Conditions for Running the DTC

- The ignition switch is in the ON position.
- The brake pedal is applied.
- The transmission is in the PARK position.
- The DTC runs continuously once the above conditions are met.

Conditions for Setting the DTC

B270A 01

The body control module detects a short to voltage in the transmission shift lock control solenoid actuator control circuit for 1 s.

B270A 02

The body control module detects a short to ground in the transmission shift lock control solenoid actuator control circuit for 1 s.

Action Taken When the DTC Sets

The body control module will not attempt to enable the voltage supply circuit of the automatic transmission park lock control solenoid until the next power switch cycle.

Conditions for Clearing the DTC

- A current DTC B270A will clear when the malfunction is no longer present and the power switch is cycled.
- A history DTC will clear after 100 ignition cycles with no current DTC active during the 100 power switch cycles.

Reference Information

Schematic Reference

- [Body Control System Schematics](#)
- [Shift Lock Control Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Automatic Transmission Shift Lock Control Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Transmission Shift Interlock Solenoid Actuator Command parameter changes from Inactive to Active when the brake pedal is applied.
 - **If the Brake Transmission Shift Interlock Solenoid Actuator Command does not change**
Refer to [Stop Lamps Malfunction](#)
 - **If the Brake Transmission Shift Interlock Solenoid Actuator Command changes**
3. Verify the S3 Transmission Shift Lever moves out of the PARK position when the brake pedal is applied.
 - **If the S3 Transmission Shift Lever does not move out of the PARK position**
Refer to Circuit/System Testing.
 - **If the S3 Transmission Shift Lever does move out of the PARK position**
All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Disconnect the harness connector at the S3 Transmission Shift Lever.
 4. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S3 Transmission Shift Lever.
 - **If the test lamp illuminates**
3. Vehicle OFF and all vehicle systems OFF, connect the X1 harness connector at the K9 Body Control Module. Disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
5. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 4 and the ground circuit terminal 2.
6. Verify the test lamp turns ON and OFF when commanding the Brake Transmission Shift Interlock Solenoid Actuator ON and OFF with a scan tool.
 - **If the test lamp is always OFF**
 1. Vehicle OFF, remove the test lamp, disconnect the X7 harness connector at the K9 Body Control Module.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit
 - If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the X7 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

7. Test or replace the S3 Transmission Shift Lever.

Component Testing

1. Install a 10 A fused jumper wire between the control terminal 4 and 12 V. Momentarily install a jumper wire between the ground terminal 2 and ground.
2. Verify the solenoid turns on & off/clicks, etc.

- **If the solenoid does not turn on & off/clicks, etc.**

Replace the S3 Transmission Shift Lever.

- **If the solenoid does turn on & off/clicks, etc.**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Transmission Control Replacement (With Base) Transmission Control Replacement (Without Base)**
- **Control Module References** for control module replacement, programming, and setup.

SYMPTOMS - AUTOMATIC TRANSMISSION SHIFT LOCK CONTROL

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Automatic Transmission Shift Lock Control Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the automatic transmission shift lock control. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#)

Symptom List

Refer to a symptom diagnostic procedure in order to diagnose the symptom:

[Transmission Control Lever Malfunction](#)

TRANSMISSION CONTROL LEVER MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuse B+	B270A 01, 1	B270A 01, 1	-	-
Control	B270A 02, 1	1	B270A 01, 2	-
Ground	-	1	-	-
1. Transmission shift lever will not move from PARK with the brake pedal applied. 2. Transmission shift lever will move from PARK without the brake pedal applied.				

Circuit/System Description

The body control module (BCM) controls the transmission shift lock control solenoid actuator by providing a battery positive voltage to the solenoid when the brake pedal is applied. The BCM monitors the voltage and current flow of the control circuit.

Reference Information

Schematic Reference

- [Body Control System Schematics](#)
- [Shift Lock Control Schematics](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Description and Operation

[Automatic Transmission Shift Lock Control Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Transmission Shift Interlock Solenoid Actuator Command parameter changes from Inactive to Active when the brake pedal is applied.
 - **If the Brake Transmission Shift Interlock Solenoid Actuator Command does not change**

Refer to [Stop Lamps Malfunction](#)

- **If the Brake Transmission Shift Interlock Solenoid Actuator Command changes**
3. Verify the S3 Transmission Shift Lever moves out of the PARK position when the brake pedal is applied.
 - **If the S3 Transmission Shift Lever does not move out of the PARK position**

Refer to Circuit/System Testing.

- **If the S3 Transmission Shift Lever does move out of the PARK position**

All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Disconnect the harness connector at the S3 Transmission Shift Lever.
 4. Test for infinite resistance between the control circuit terminal 4 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the S3 Transmission Shift Lever.

- **If the test lamp illuminates**

3. Vehicle OFF and all vehicle systems OFF, connect the X1 harness connector at the K9 Body Control Module. Disconnect the harness connector at the S3 Transmission Shift Lever. It may take up to 2 minutes for all vehicle systems to power down.

4. Test for less than 10 Ω between the ground circuit terminal 2 and ground.

- **If 10 Ω or greater**

1. Vehicle OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

5. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 4 and the ground circuit terminal 2.

6. Verify the test lamp turns ON and OFF when commanding the Brake Transmission Shift Interlock Solenoid Actuator ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the X7 harness connector at the K9 Body Control Module.

2. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit
- If less than 2 Ω , replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, remove the test lamp, disconnect the X7 harness connector at the K9 Body Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

7. Test or replace the S3 Transmission Shift Lever.

Component Testing

1. Install a 10 A fused jumper wire between the control terminal 4 and 12 V. Momentarily install a jumper wire between the ground terminal 2 and ground.

2. Verify the solenoid turns on & off/clicks, etc.

- **If the solenoid does not turn on & off/clicks, etc.**

Replace the S3 Transmission Shift Lever.

- **If the solenoid does turn on & off/clicks, etc.**

3. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Transmission Control Replacement \(With Base\)](#) [Transmission Control Replacement \(Without Base\)](#)
- [Control Module References](#) for control module replacement, programming, and setup.

DESCRIPTION AND OPERATION

AUTOMATIC TRANSMISSION SHIFT LOCK CONTROL DESCRIPTION AND OPERATION

The automatic transmission park lock control system is a safety device that prevents an inadvertent shift out of PARK. The driver must press the brake pedal before moving the park lever out of the PARK position. The system consists of the following components:

- The automatic transmission park lock solenoid (serviced as the automatic transmission shift lock actuator), is located within the floor shift control assembly.
- The body control module, which controls the voltage supply circuit of the park lock control solenoid.
- The engine control module.

The body control module controls the voltage to the park lock control solenoid through the park lock control solenoid controlled voltage circuit. The following conditions must be met before the body control module will supply voltage to the park lock solenoid:

- The ignition is in the ON position.
- The engine control module sends an input via GMLAN serial data to the body control module indicating the transmission is in the PARK position.
- The body control module determines the brake pedal is applied according the brake pedal position.

Since the park lock control solenoid is permanently grounded, the body control module supplies voltage to the automatic transmission park lock control solenoid, unlocking the park lever allowing the driver to move the park lever out of the PARK position as the solenoid energizes. When the brake pedal is not applied, the body control module turns the control voltage output of the park lock control solenoid OFF, de-energizing the park lock control solenoid. The de-energized solenoid mechanically locks the park lever in the PARK position.

Article GUID: A00884634

TRANSMISSION

Transmission Cooling - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Transmission Oil Cooler Pipe Fitting Retaining Clip
Sealing Washer

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Transmission Fluid Cooler Pipe Bolt	22 N.m (16 lb ft)
Transmission Fluid Cooler Pipe Fitting	11 N.m (97 lb in)
Transmission Fluid Cooler Thermal Bypass Valve Bolt	9 N.m (80 lb in)

DIAGNOSTIC INFORMATION AND PROCEDURES

TRANSMISSION OVERHEATS

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Cause	DTCs
Engine:	
• Engine coolant level low • Engine Overheating • Incorrect engine coolant • Old coolant or incorrect concentration level • Cooling system leak • Radiator hose kinked or pinched • Loose, missing, or damaged radiator air seals or deflector - restricted air flow • The radiator and air conditioning condenser has air flow obstructions to include large amount of bent fins • The cooling fans do not operate • Inspect the engine mechanical for worn, leaking, cracked cylinder heads, or engine block	-
Transmission:	
Vehicle Overload or Beyond Capacity Towing: • Vehicle is overloaded • Vehicle is towing beyond capacity. This vehicle is neither designed nor intended to tow a trailer or another vehicle. • Vehicle modifications	-
Heat Transfer: • Engine overheating • Cooler restrictions - transmission fluid auxiliary cooler restricted flow or blockage • Restricted air flow • Vehicle modifications • Aftermarket auxiliary cooler installed incorrectly, incorrect flow direction - reversed flow • Restricted, blocked, or pinched transmission cooler lines • Stuck closed transmission thermal bypass valve	-
Transmission Abuse: • Vehicle overloaded • Vehicle is towing beyond capacity. This vehicle is neither designed nor intended to tow a trailer or another vehicle. • Vehicle modifications	-

Cause	DTCs
Vehicle Damage: • Transmission oil cooler pipe kinked, pinched or restricted • Restricted air flow	-
Transmission Fluid: • Fluid leaks • Low fluid level • Contaminated or poor transmission fluid quality	P079A P079B
Low Fluid Pump Output: • Low fluid level • Blocked, damaged or loose filter • Pinched or restricted cooler lines • Restricted cooler - damage or debris • Inefficient pump - worn	-
Clutch Slippage: • Low fluid level • Low fluid pump output • Damaged or leaking clutch seals • Internal hydraulic leak • Worn clutch plate assembly	P079A P079B

Circuit/System Description

The primary source of heat in the 5ET50 transmission is the drive motors. The drive motors are cooled by the transmission fluid. Hot fluid exits the drive motors and flows to the transmission oil cooler through the transmission cooler supply line and thermal bypass valve. The thermal bypass valve assembly is located near the lower left side of the radiator. The cooled fluid returns to the transmission through the transmission fluid cooler pipe assembly and cools the control solenoid assembly. The transmission fluid temperature sensor is located in the control solenoid assembly and is not serviced separately. The Transmission Fluid Temperature parameter on the scan tool should rise steadily to a normal operating temperature, and then stabilize.

The thermal bypass valve is mechanically operated, based on the oil temperature of the transmission in order to maintain optimum transmission operating efficiency. The valve has an activating temperature of 82°C (176°F), with the range to move being 78 - 83°C (172 - 181°F). The full open temperature is 96°C (205°F). The thermal bypass valve assembly begins to open at 82°C (176°F) for optimum transmission operation and fuel economy. The valve has a typical oil flow rate of 9 - 10 lpm (2.4 - 2.6 gpm).

Cold Mode:

82Â°C (176Â°F) and below the thermal bypass valve bypasses the oil going to the cooler and sends the fluid back to the transmission.

Mixing Mode:

82 - 96Â°C (176 - 205Â°F) the thermal bypass valve is in mixing mode - some of the fluid flows back to the trans and some flows through the transmission oil cooler.

Hot Mode:

Above 96Â°C (205Â°F) The thermal bypass valve is fully open and transmission oil flows through the cooler then back to the transmission.

Reference Information

Schematic Reference

- [Automatic Transmission Controls Schematics](#)
- [Park Engine Off](#)
- [Park Engine On](#)

Description and Operation

- [Transmission General Description](#)
- [Transmission Indicators and Messages](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **DT-24731** Tempil Stick
- **DT-45096** Transmission Oil Cooler System Flush and Flow Test Tool

For equivalent regional tools, refer to [Special Tools](#) .

Component Testing

1. Perform the [Fluid Leak Diagnosis](#) .
2. Verify airflow through the radiator is not obstructed. Refer to [Radiator Cleaning](#) .
3. Perform the [Transmission Fluid Level and Condition Check](#) procedure.
4. Perform the [Line Pressure Check](#) procedure.
5. Perform the [Automatic Transmission Fluid Pump Pressure High or Low](#) procedure.
6. Perform the [Transmission Fluid Cooler Flow Test and Flushing](#).
7. With a hand held or infra red thermometer or **DT-24731** tempil stick, test for the transmission cooler supply line thermal bypass valve assembly opening at 96Â°C (205Â°F). The transmission cooler supply line temperature should be higher on the transmission side of the thermal bypass valve assembly than the cooler side until 96Â°C (205Â°F) is reached.

- **If the thermal bypass valve tests stuck closed**

Replace the thermal bypass valve assembly.

- **If the thermal bypass valve tests normal**

Inspect the transmission oil passages for a blockage.

- **If passages are blocked**

Repair as necessary.

- **If passages are not blocked**

8. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Transmission Fluid Auxiliary Cooler Replacement**
- **Transmission Fluid Cooler Thermal Bypass Valve Replacement**
- **Transmission Fluid Cooler Inlet Pipe Replacement**
- **Transmission Fluid Cooler Outlet Pipe Replacement**

TRANSMISSION FLUID COOLER FLOW TEST AND FLUSHING

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

NOTE: Use the DT-45096 transmission oil cooling system flush and flow test tool to flush and flow test the transmission oil cooler and the oil cooler pipes after the transmission is removed for repairs.

Only use the appropriate GM automatic transmission fluid when doing a repair on a GM transmission.

If the fluid in the **DT - 45096** transmission oil cooling system flush and flow test tool is different than what is used in the transmission, after performing the flush and flow test, use compressed air to blow the residual transmission fluid out of the oil cooler and lines.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

Cooler Flow Check and Flushing Steps

1. Machine Set-up
2. Determine Minimum Flow Rate

3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Special Tools

- **DT-45096** Transmission Oil Cooling System Flush and Flow Test Tool
- **DT-45096-50** Transmission Cooler Flush Adapter
- **DT-45096-55** Transmission Cooler Flush Adapter
- Shop air supply with water/oil filters, regulator and pressure gauge - minimum 90 psi
- Eye protection
- Rubber gloves

For equivalent regional tools, refer to [Special Tools](#).

Machine Set-up

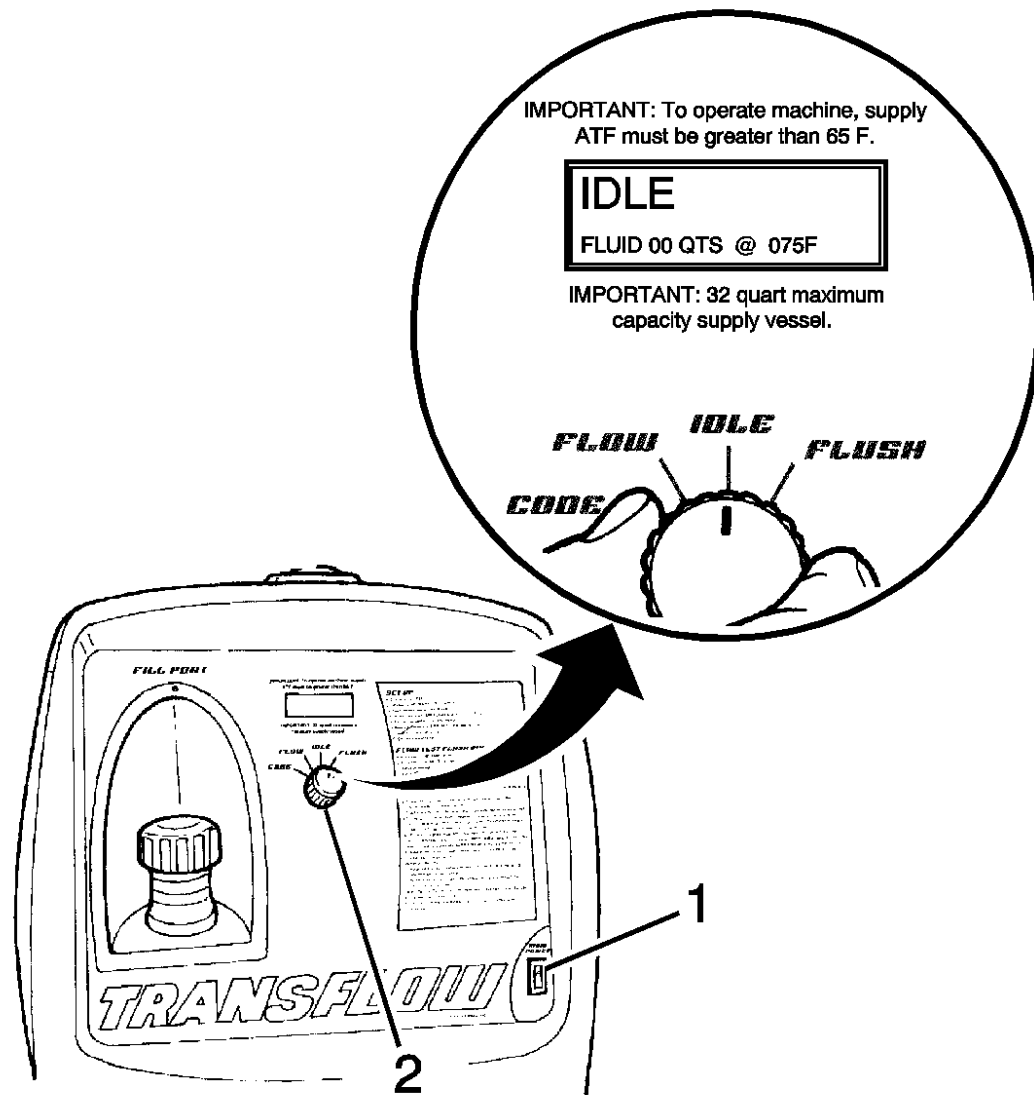


Fig. 1: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS COMPANY

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

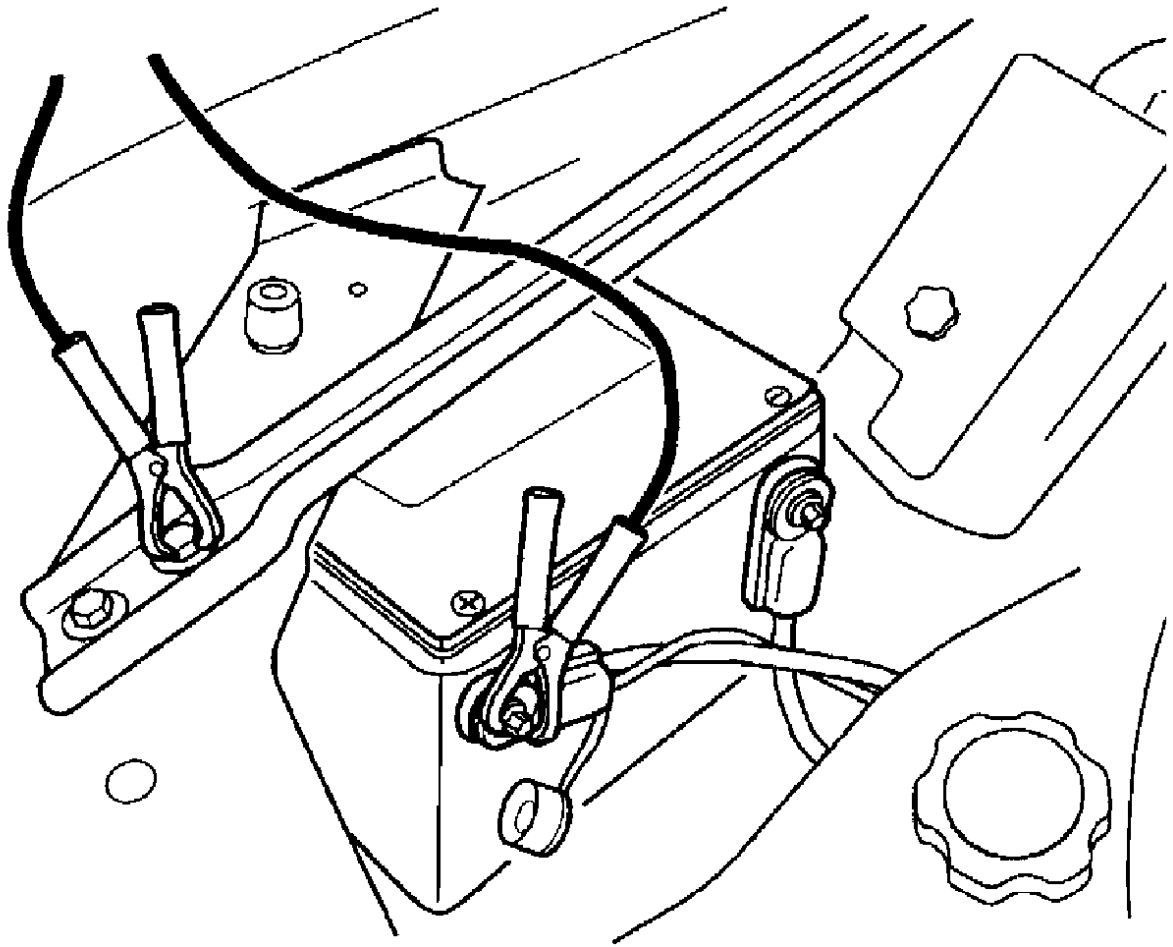


Fig. 2: Connecting To 12V DC Power Source

Courtesy of GENERAL MOTORS COMPANY

3. Connect **DT 45096** flush and flow test tool to the vehicle 12V DC power source by connecting the red battery clip to the positive, +, battery post on the vehicle and connect the negative lead to a known good chassis ground.
4. Turn the main power switch to the ON position.

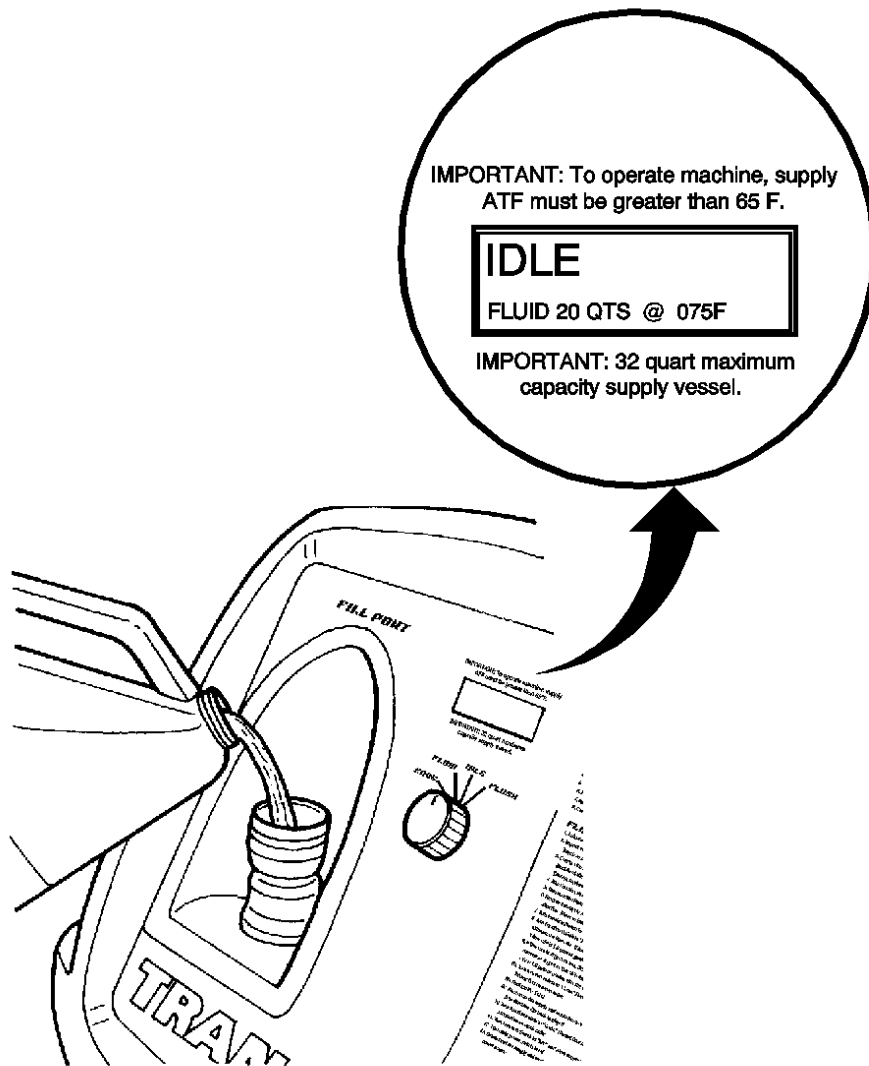


Fig. 3: Filling Supply Tank With Transmission Fluid

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).

5. Fill the supply tank with the appropriate GM automatic transmission fluid through the fill port.
6. Reinstall and tighten the fill cap.

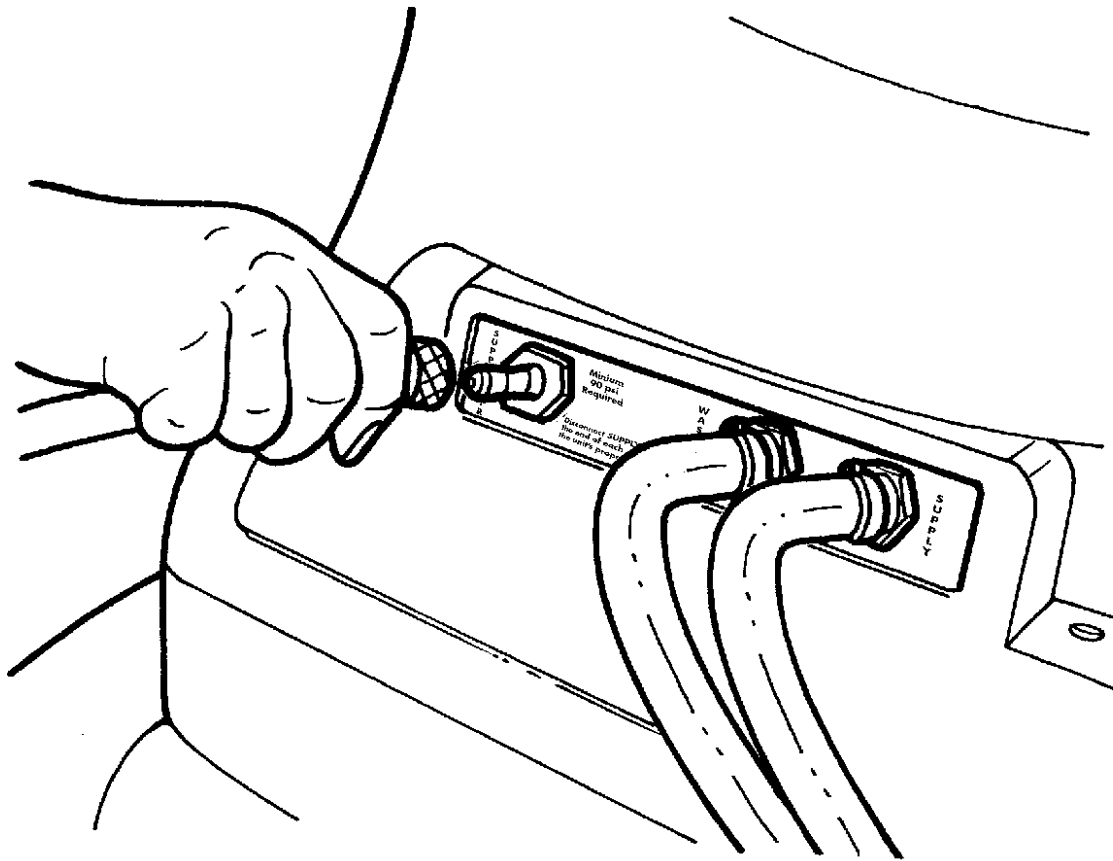


Fig. 4: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

Determine Minimum Flow Rate

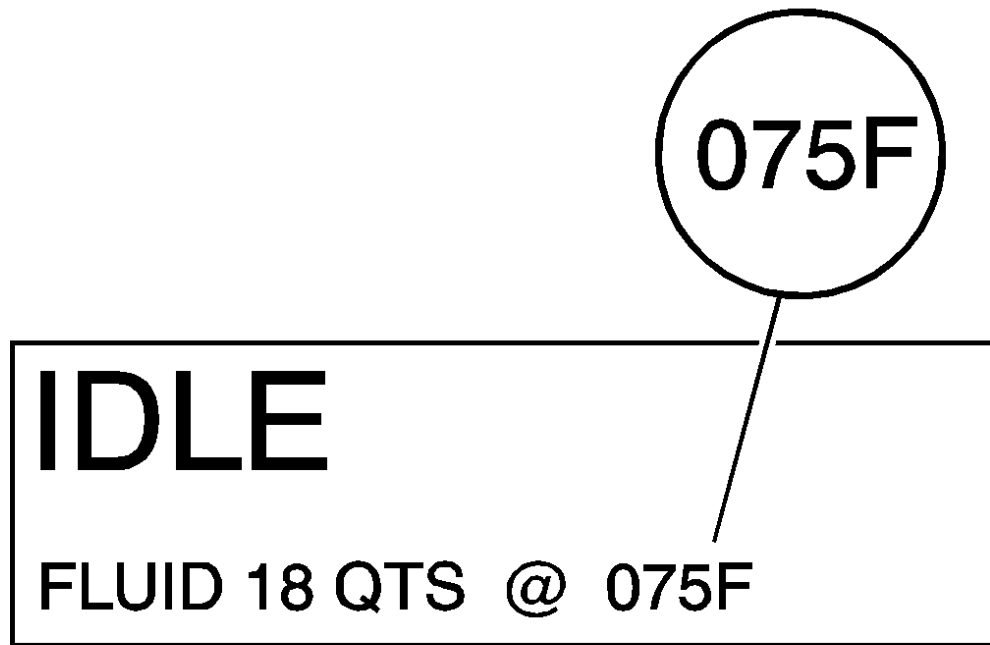


Fig. 5: Identifying Machine Display Of Automatic Transmission Fluid Temperature
Courtesy of GENERAL MOTORS COMPANY

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **DT 45096** flush and flow test tool.

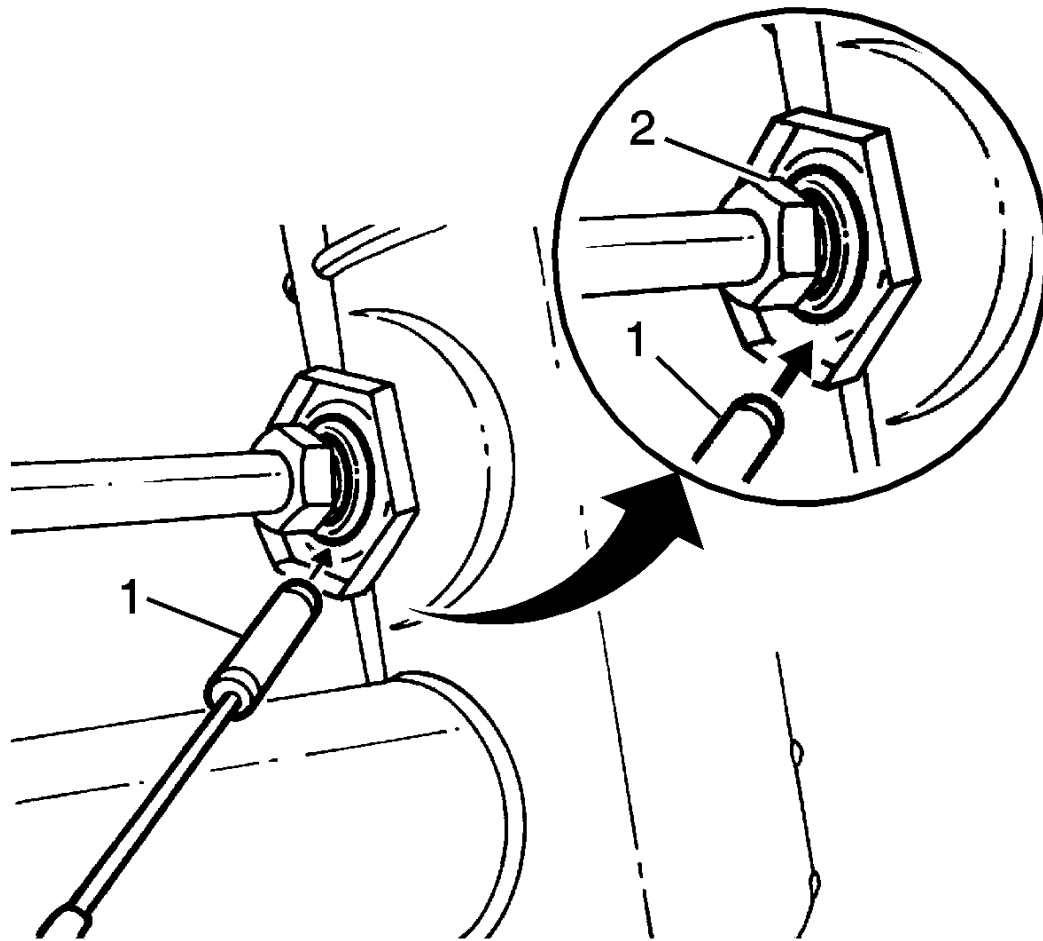


Fig. 6: Identifying Transmission Oil Cooler Metal Composition

Courtesy of GENERAL MOTORS COMPANY

2. Determine whether the transmission oil cooler is steel or aluminum by using a magnet (1) at the cooler flange (2) at the radiator.
3. Refer to the table below. Using the temperature from step 1, locate on either the Steel MINIMUM Flow Rate table or the Aluminum MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.

Example

- Fluid temperature: 75°F
- Cooler Type: Steel

The MINIMUM flow rate for this example would be 0.8 GPM.

4. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow. Repair as needed and refer to the appropriate GM service manual procedures.

Minimum Flow Rate in Gallons Per Minute (gpm)

Temperature Range	Steel	Aluminum
65 - 66°F	0.6 gpm	0.5 gpm
67 - 70°F	0.7 gpm	0.6 gpm
71 - 75°F	0.8 gpm	0.7 gpm
76 - 80°F	0.9 gpm	0.8 gpm
81 - 84°F	1.0 gpm	0.9 gpm
85 - 89°F	1.1 gpm	1.0 gpm
90 - 94°F	1.2 gpm	1.1 gpm
95 - 98°F	1.3 gpm	1.2 gpm
99 - 103°F	1.4 gpm	1.3 gpm
104 - 108°F	1.5 gpm	1.4 gpm
109 - 112°F	1.6 gpm	1.5 gpm
113 - 117°F	1.7 gpm	1.6 gpm
118 - 120°F	1.8 gpm	1.7 gpm

Bypass Valve Removal

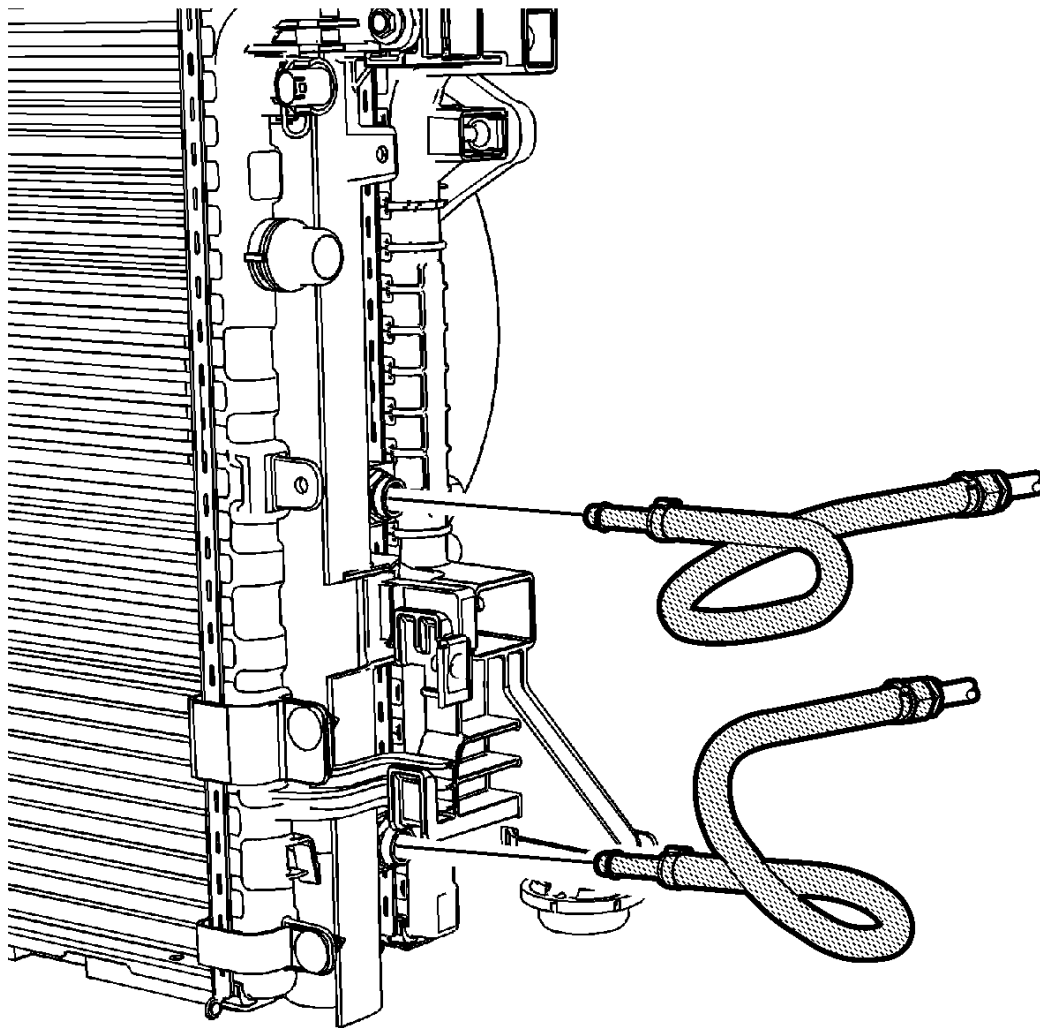


Fig. 7: Fluid Cooler Bypass Valve

Courtesy of GENERAL MOTORS COMPANY

1. Remove the fluid cooler bypass valve. Refer to [Transmission Fluid Cooler Thermal Bypass Valve Replacement](#).
2. Install the **DT 45096-55** cooler flush adapter.

Back Flush Procedure

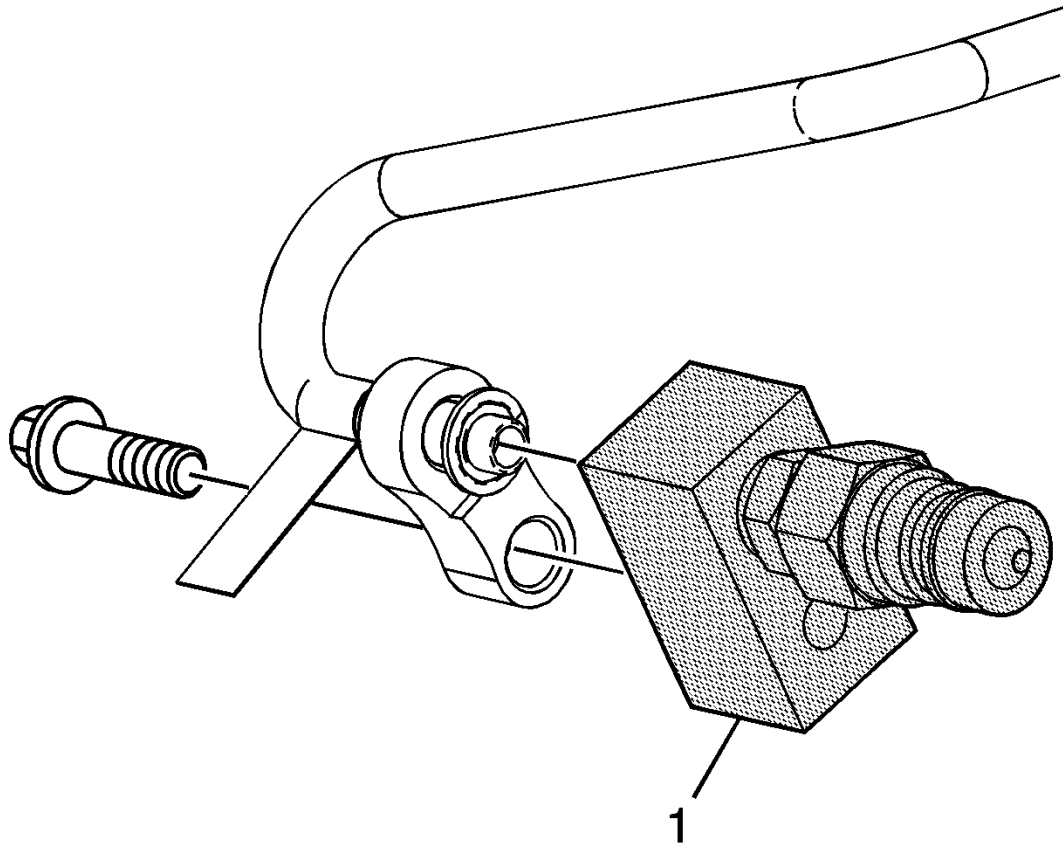


Fig. 8: Cooler Flush Adapter

Courtesy of GENERAL MOTORS COMPANY

1. Connect the **DT 45096-50** flush adapter (1) to the vehicle transmission oil cooler supply and return lines at the transmission.

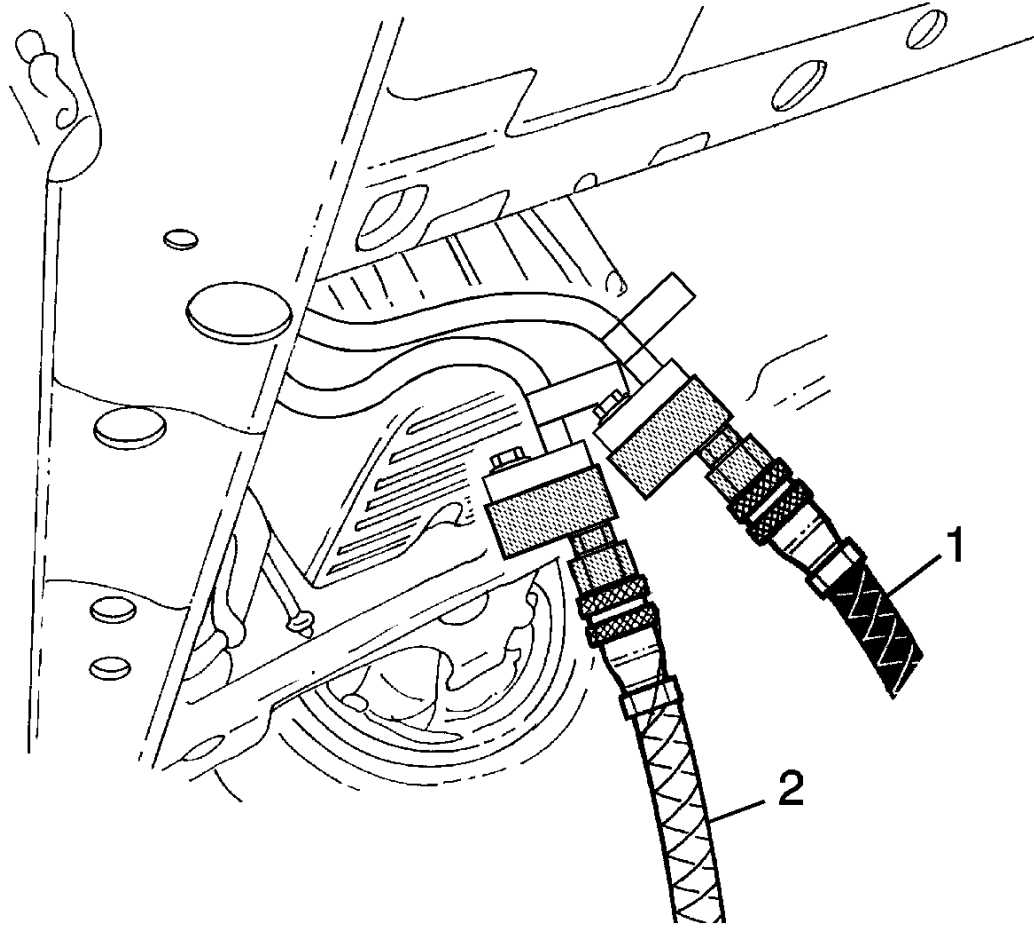


Fig. 9: View Of Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS COMPANY

2. Connect the black supply hose (1) to the return line, top connector of the transmission, and the clear waste hose (2) to the feed line, bottom connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

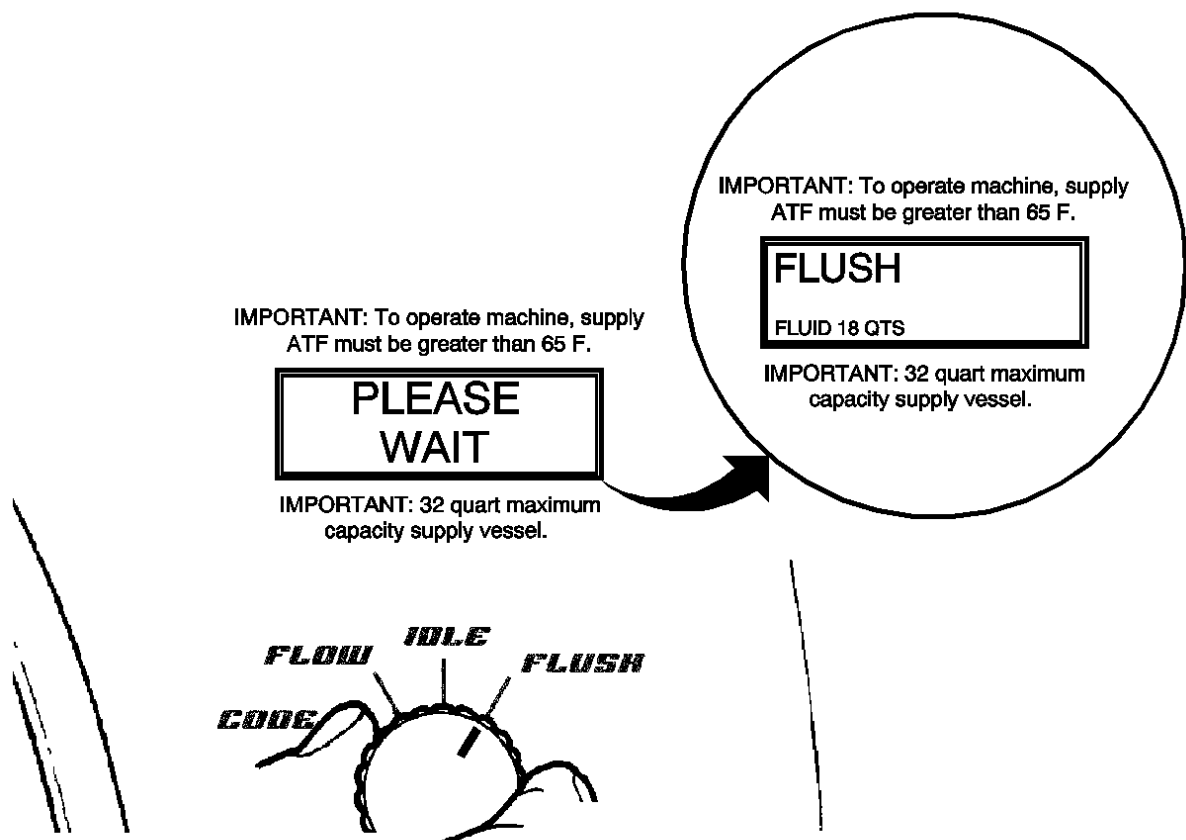


Fig. 10: View Of Main Function Switch FLUSH Position

Courtesy of GENERAL MOTORS COMPANY

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

IDLE

FLUID 16 QTS @ 075F

IMPORTANT: 32 quart maximum
capacity supply vessel.

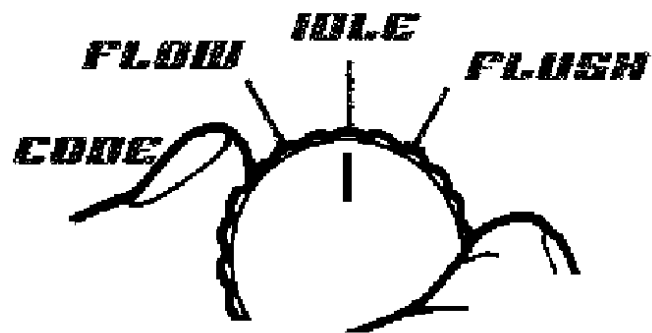


Fig. 11: View Of Main Function Switch IDLE Position

Courtesy of GENERAL MOTORS COMPANY

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

Forward Flush

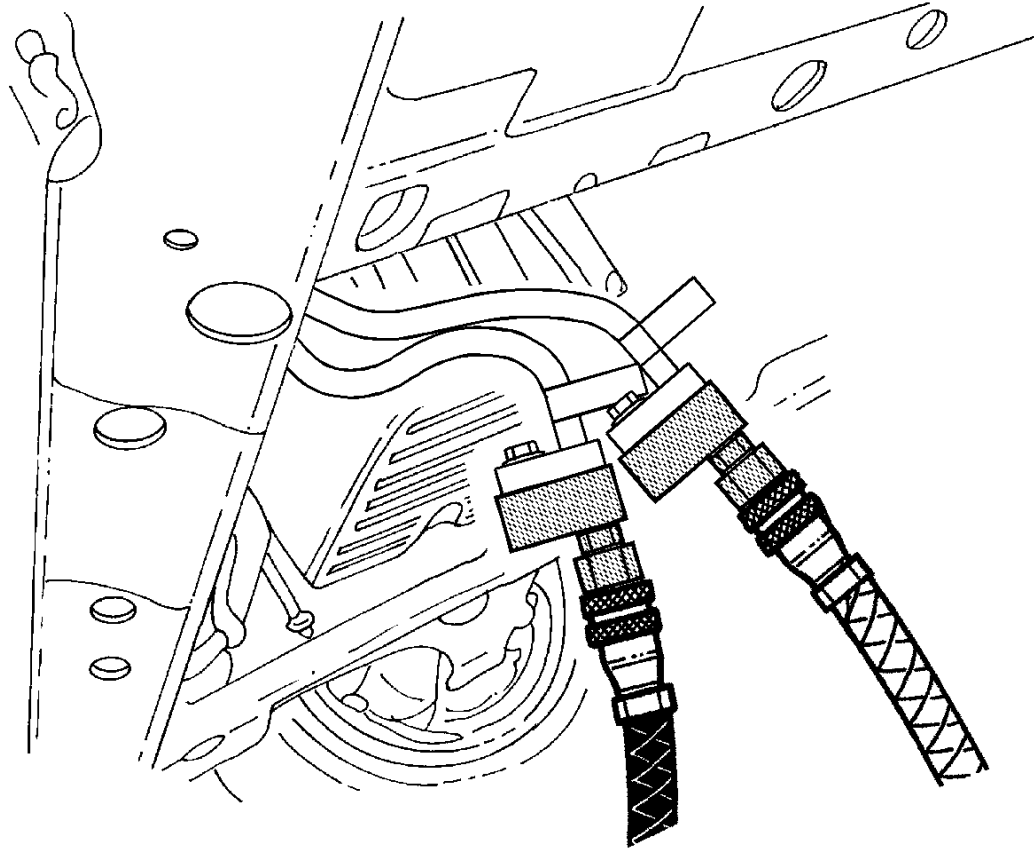


Fig. 12: Identifying Supply And Waste Hoses
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLUSH

FLUID 18 QTS

IMPORTANT: 32 quart maximum
capacity supply vessel.

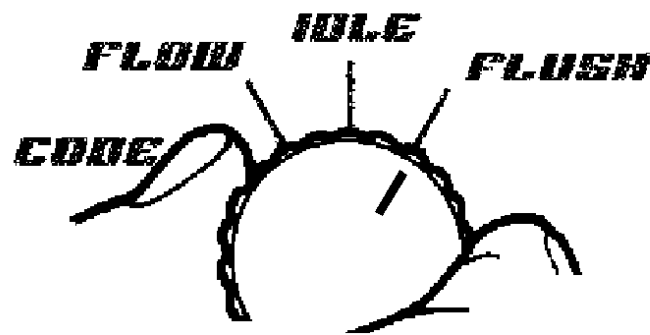


Fig. 13: View Of Main Function Switch FLUSH Position

Courtesy of GENERAL MOTORS COMPANY

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

Flow Test

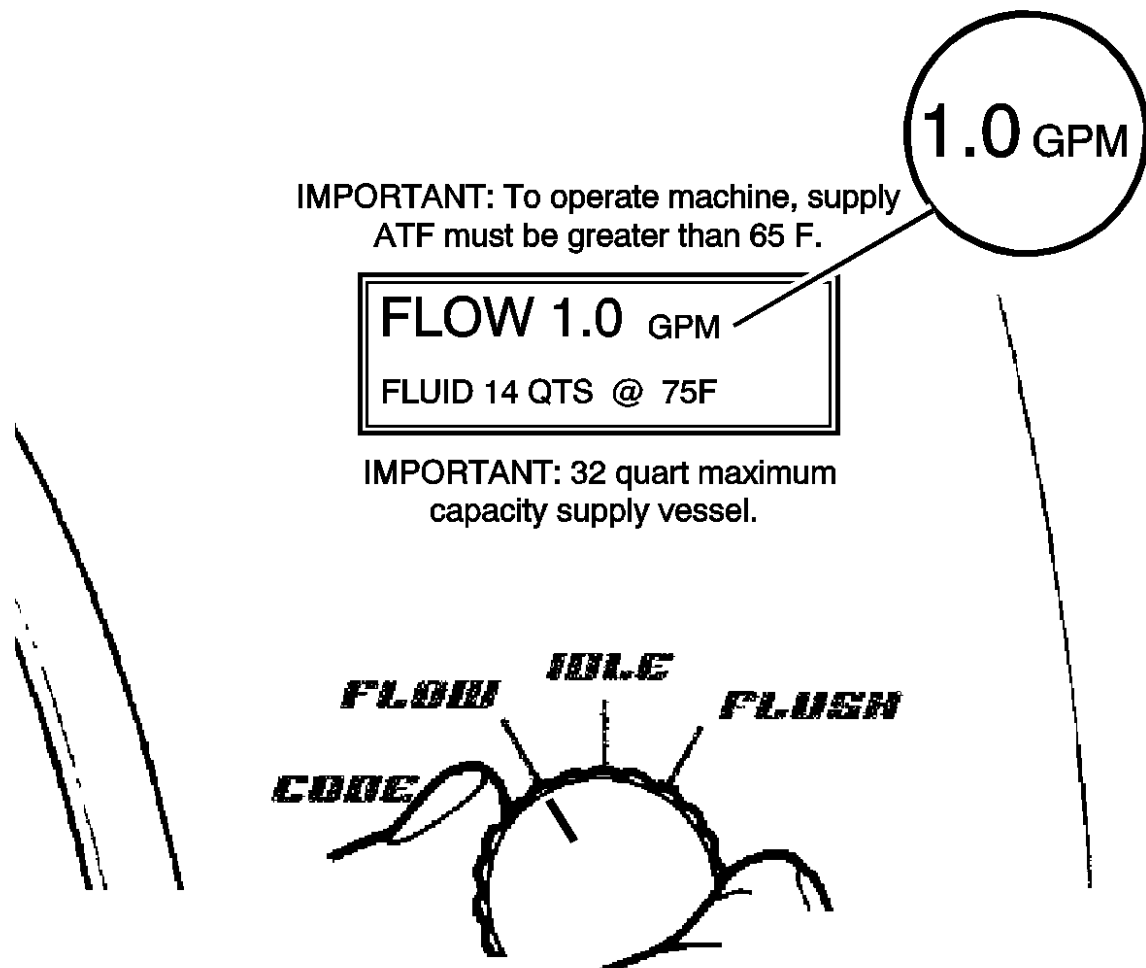


Fig. 14: View Of Main Function Switch FLOW Position

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the operation manual.

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate; this is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
 - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil cooling system is functioning properly. Perform Code Recording Procedure.
 - If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.
3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.
 1. Replace the transmission oil cooler.

2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
3. Perform Code Recording Procedure.

Code Recording Procedure

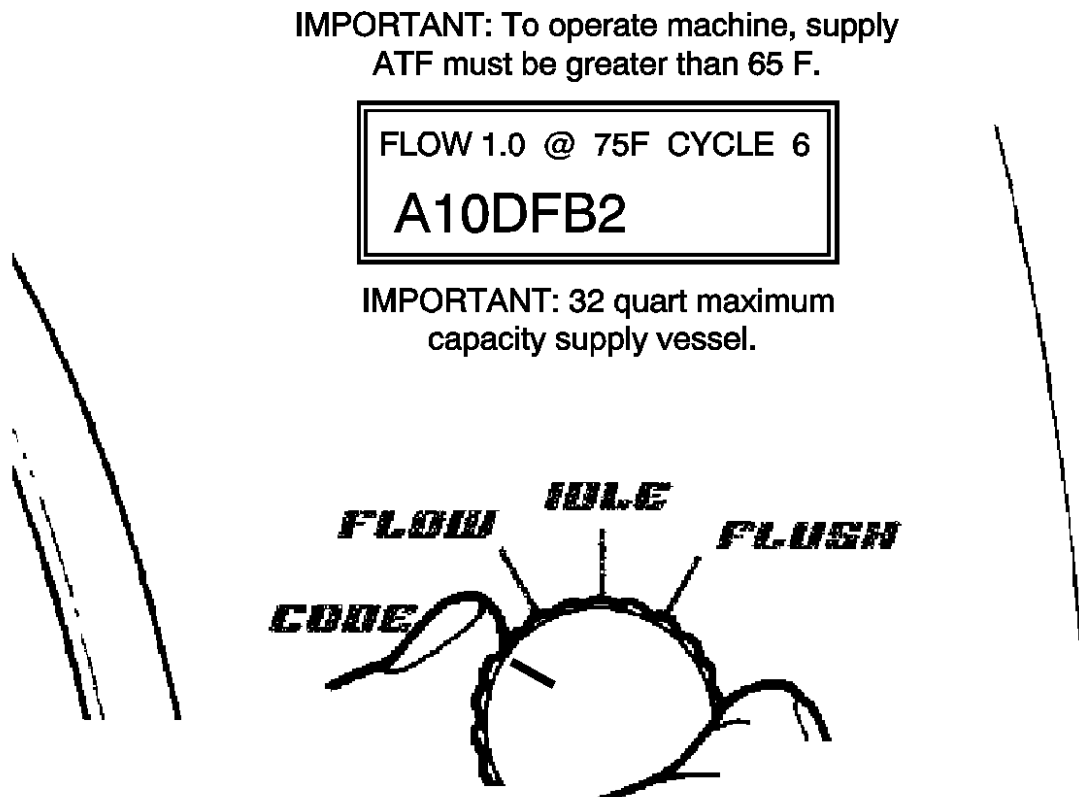


Fig. 15: View Of Main Function Switch CODE Position

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- If power is interrupted prior to the recording of the seven-character code, the code will be lost and the flow rate test will need to be repeated.
- The flow test must run for a minimum of 8-10 seconds and be above 0.5 GPM for a code to be generated.

1. Turn the main function switch to the CODE position.
2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

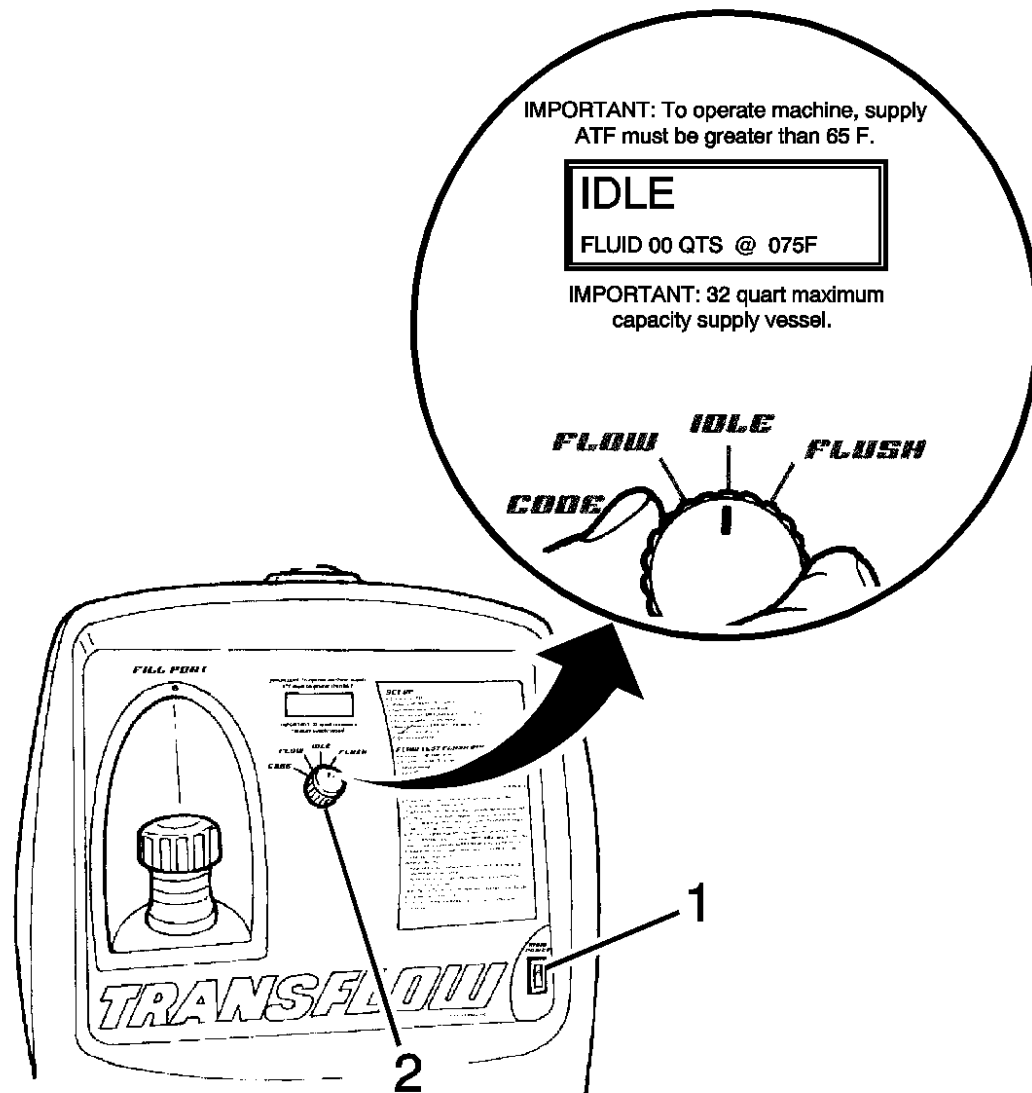


Fig. 16: View Of Main Power Switch & Main Function Switch

Courtesy of GENERAL MOTORS COMPANY

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.
2. Turn the main power switch (1) to the OFF position.

NOTE:

- A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water separator.
- If the fluid in the DT-45096 transmission oil cooling system flush and flow test tool is different than what is used in the transmission, use compressed air to blow the residual transmission fluid out of the oil cooler and lines.

3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

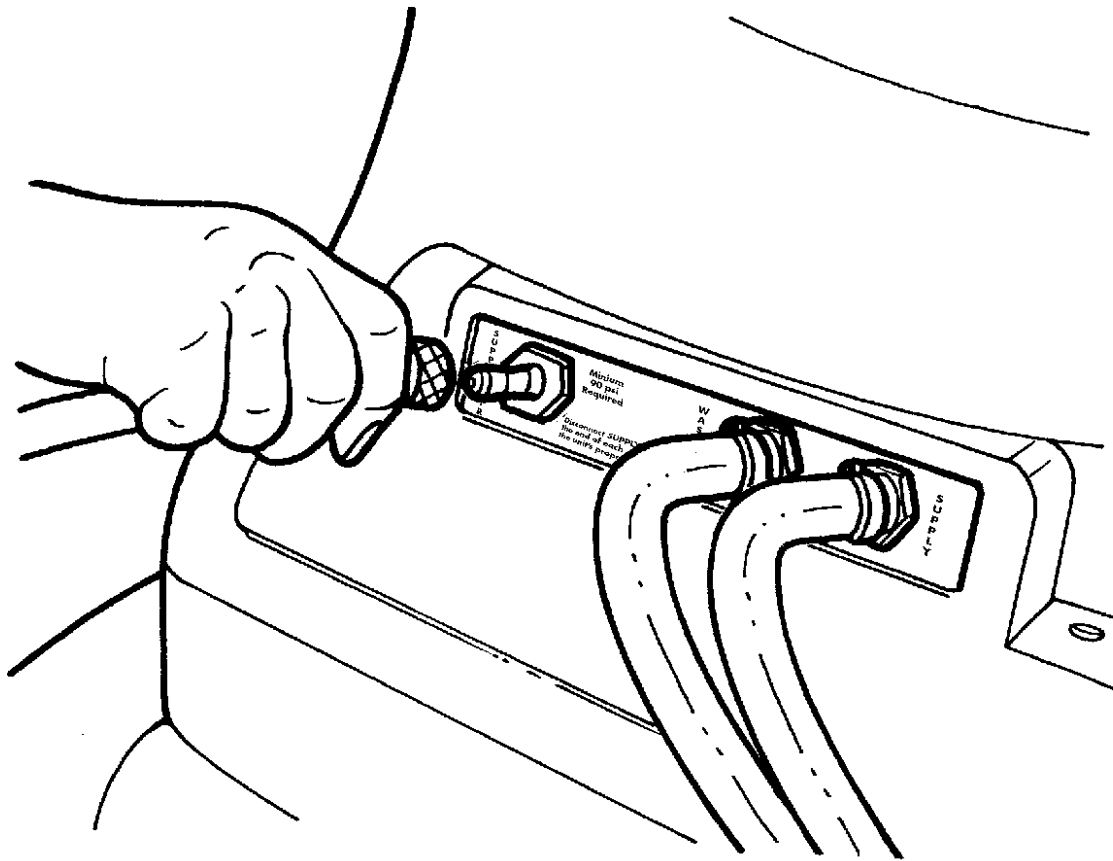


Fig. 17: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the air supply hose from **DT-45096** flush and flow test tool.
5. Remove **DT-45096-55** cooler flush adapter and install the fluid cooler bypass valve.
6. Remove **DT-45096-50** adapters.
7. Attach cooler lines to the transmission.
8. Dispose of the waste automatic transmission fluid in accordance with all applicable federal, state, and local requirements.

REPAIR INSTRUCTIONS

TRANSMISSION FLUID AUXILIARY COOLER REPLACEMENT

Removal Procedure

1. Remove Air Conditioning Condenser & Air Conditioning Condenser Bracket [Air Conditioning](#)

Condenser Replacement

2. Disconnect Transmission Fluid Cooler Thermal Bypass Valve@Transmission Fluid Auxiliary Cooler
Transmission Fluid Cooler Thermal Bypass Valve Replacement

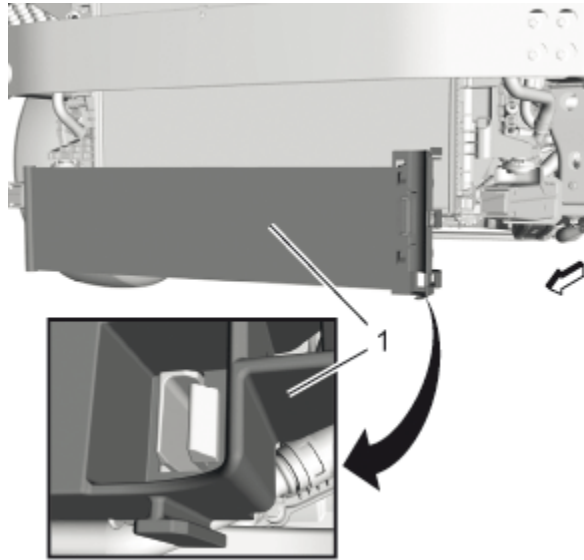


Fig. 18: Transmission Fluid Auxiliary Cooler
Courtesy of GENERAL MOTORS COMPANY

3. Remove Transmission Fluid Auxiliary Cooler (1) @Radiator

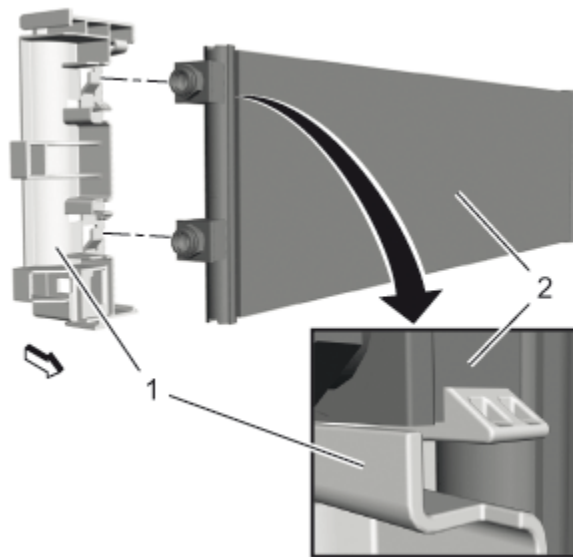


Fig. 19: Transmission Fluid Auxiliary Cooler And Air Conditioning Condenser Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: Depress 2 tabs to release transmission fluid auxiliary cooler from the air condition condenser bracket.

4. Remove Transmission Fluid Auxiliary Cooler (2) @Air Conditioning Condenser Bracket (1)

Installation Procedure

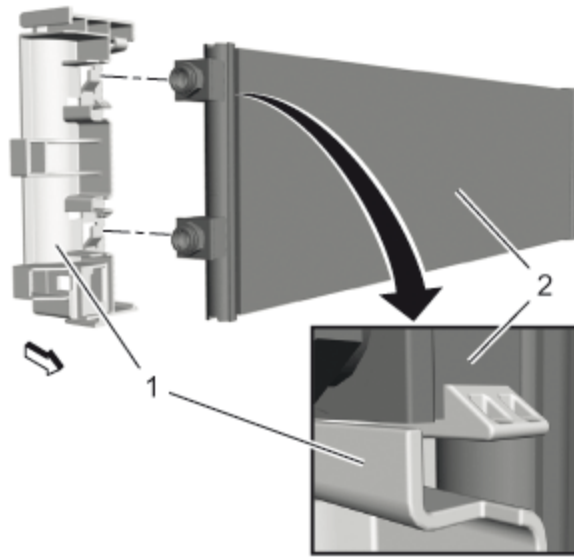


Fig. 20: Transmission Fluid Auxiliary Cooler And Air Conditioning Condenser Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Install Transmission Fluid Auxiliary Cooler (2) @Air Conditioning Condenser Bracket (1)

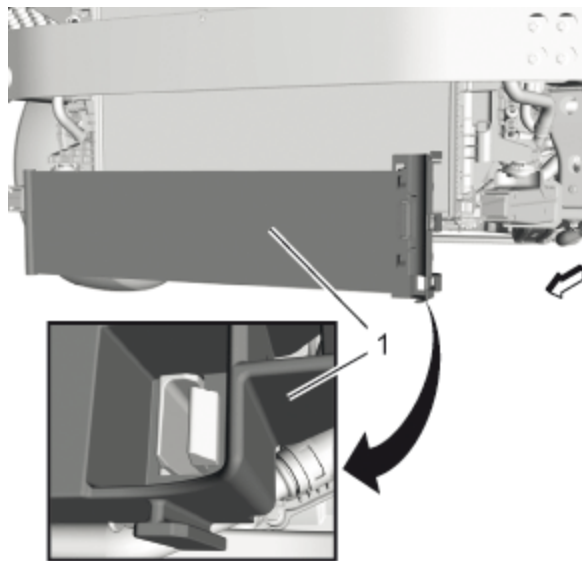


Fig. 21: Transmission Fluid Auxiliary Cooler
Courtesy of GENERAL MOTORS COMPANY

2. Install Transmission Fluid Auxiliary Cooler (1) @Radiator
3. Connect Transmission Fluid Cooler Thermal Bypass Valve@Transmission Fluid Auxiliary Cooler
[Transmission Fluid Cooler Thermal Bypass Valve Replacement](#)
4. Install Air Conditioning Condenser & Air Conditioning Condenser Bracket [Air Conditioning Condenser Replacement](#)
5. Fill the transmission to the proper level with NEW transmission fluid. [Transmission Fluid Drain and Fill](#)

TRANSMISSION FLUID COOLER THERMAL BYPASS VALVE REPLACEMENT

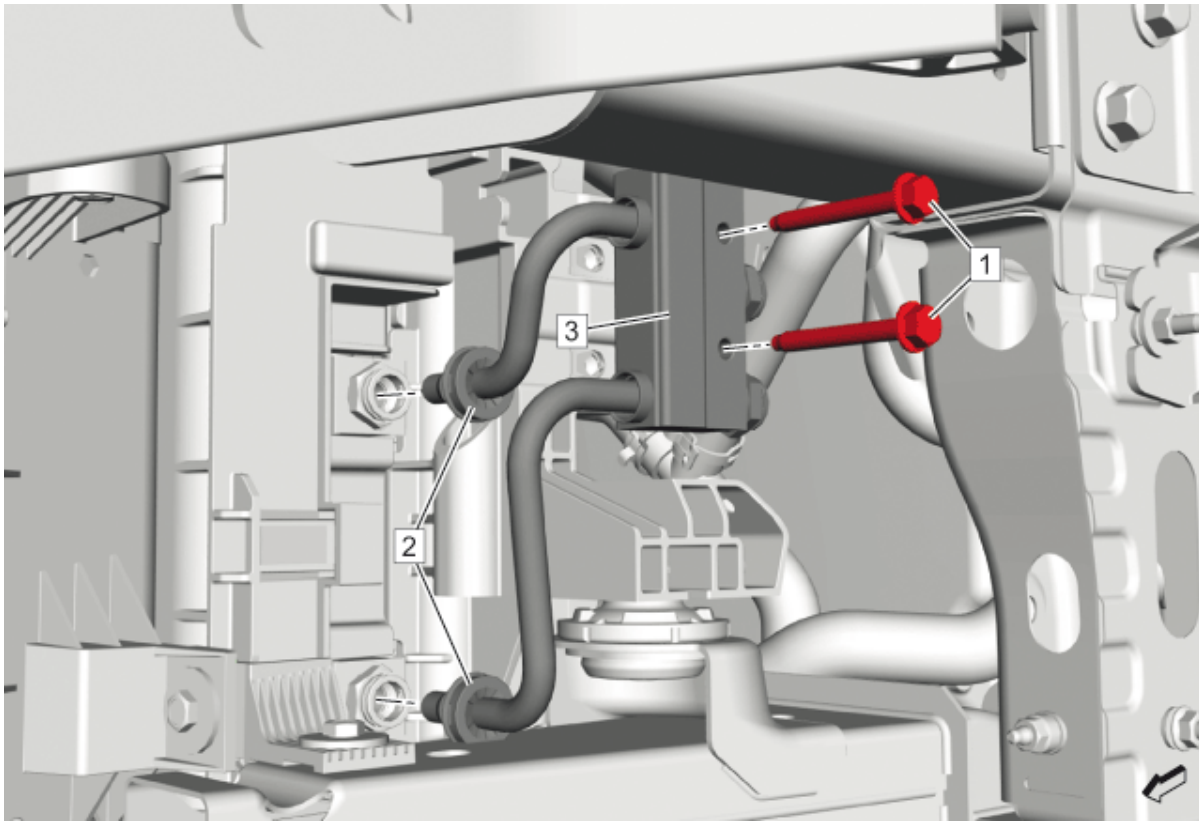


Fig. 22: Transmission Fluid Cooler Thermal Bypass Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Front Bumper Fascia Removal and Installation</u> - Disconnect Transmission Fluid Cooler Outlet Pipe@Transmission Fluid Cooler Thermal Bypass Valve <u>Transmission Fluid Cooler Outlet Pipe Replacement</u> - Disconnect Transmission Fluid Cooler Inlet Pipe@Transmission Fluid Cooler Thermal Bypass Valve <u>Transmission Fluid Cooler Inlet Pipe Replacement</u>	
1	Transmission Fluid Cooler Thermal Bypass Valve Bolt (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Tighten 9 N.m (80 lb in)
2	Transmission Fluid Cooler Thermal Bypass Valve Quick Connect Fitting (Qty: 2) Procedure Place a container beneath the bypass valve to catch spilling transmission fluid.

Callout	Component Name
	2. Disconnect Quick Connect Fitting@Transmission Fluid Auxiliary Cooler <u>Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection.</u>
3	Transmission Fluid Cooler Thermal Bypass Valve Procedure After installation is finished fill the transmission to the proper level. Refer to <u>Transmission Fluid Drain and Fill</u> .

TRANSMISSION FLUID COOLER HOSE/PIPE QUICK-CONNECT FITTING DISCONNECTION AND CONNECTION

Special Tools

GE-41623 Cooler Quick Connect Tool

For equivalent regional tools, refer to Special Tools.

Removal Procedure

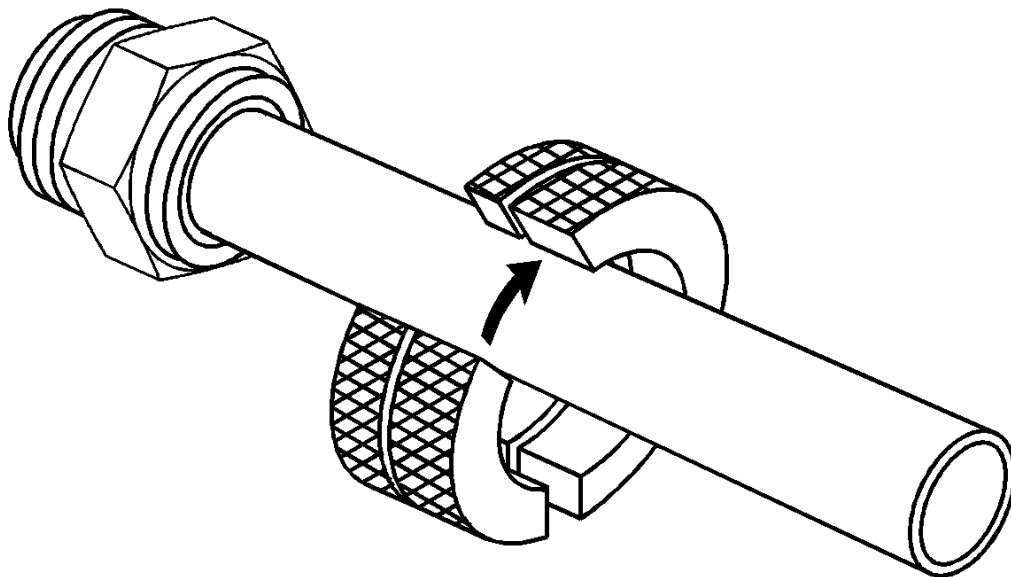


Fig. 23: Generator Cooling Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Install the **GE-41623** cooler quick connect tool onto the transmission oil cooler (TOC) pipe.

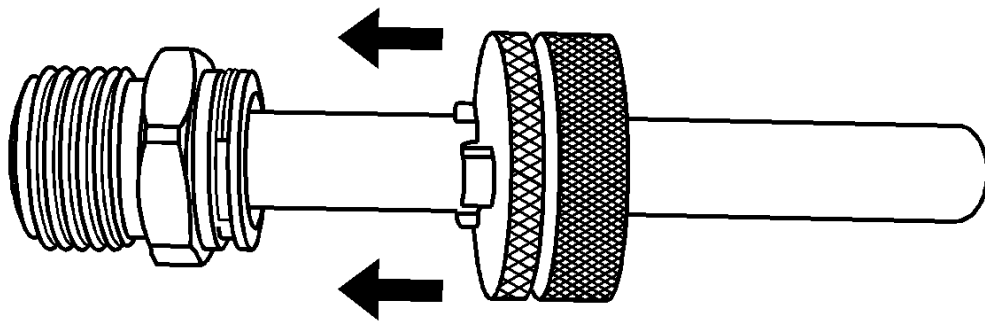


Fig. 24: Sliding J 41623-B Toward Generator Cooling Inlet Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

2. Slide the **GE-41623** cooler quick connect tool toward the TOC pipe fitting.

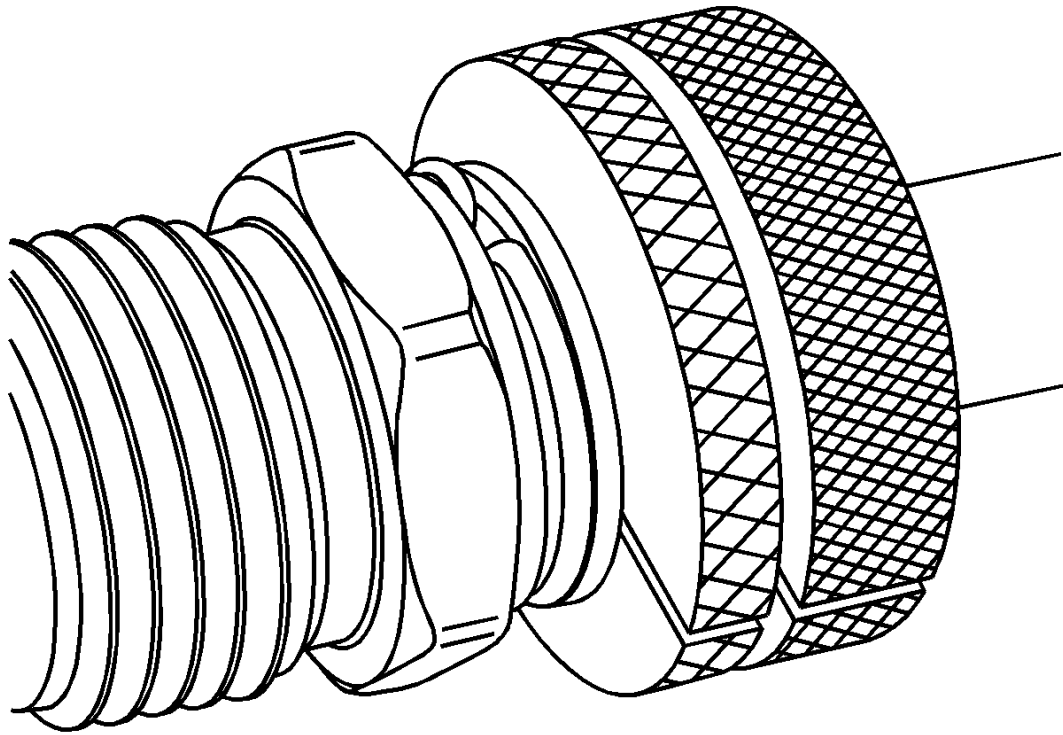


Fig. 25: Rotating J 41623-B On Coolant Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Rotate the GE-41623 cooler quick connect tool to engage the TOC pipe fitting's retainer slots.

The GE-41623 cooler quick connect tool should be nearly flush with the fitting.

3. Connect the **GE-41623** cooler quick connect tool onto the TOC pipe fitting.

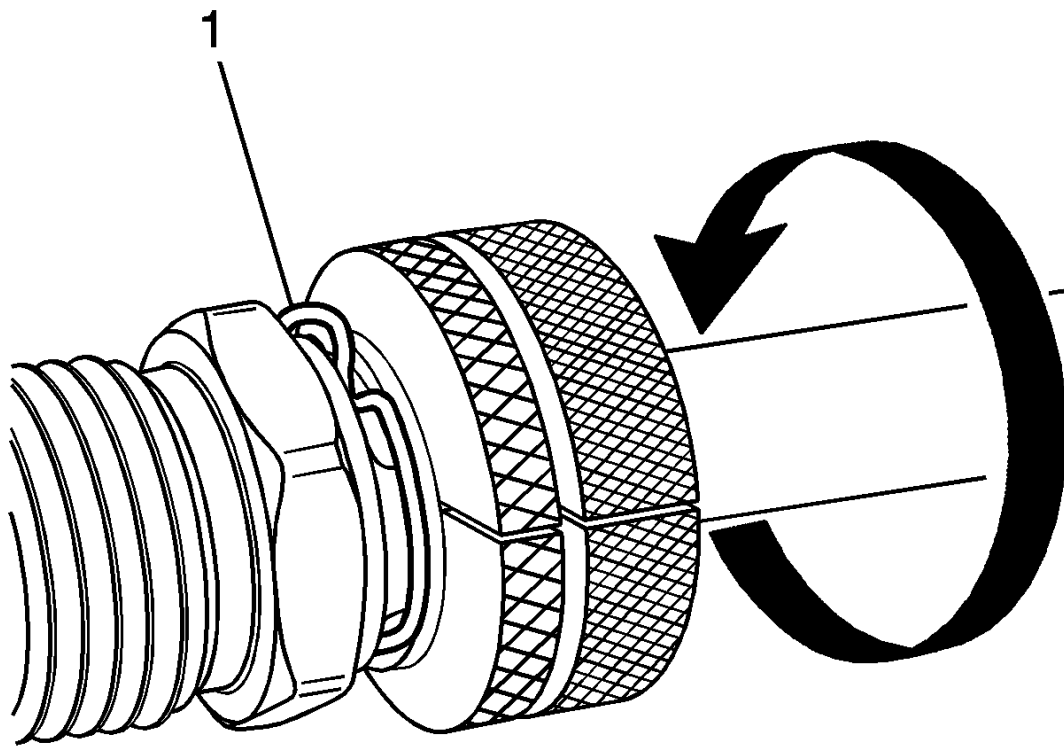


Fig. 26: Identifying Retainer Clip

Courtesy of GENERAL MOTORS COMPANY

4. Rotate the **GE-41623** cooler quick connect tool until the retainer clip (1) rises above the fitting retainer seat.

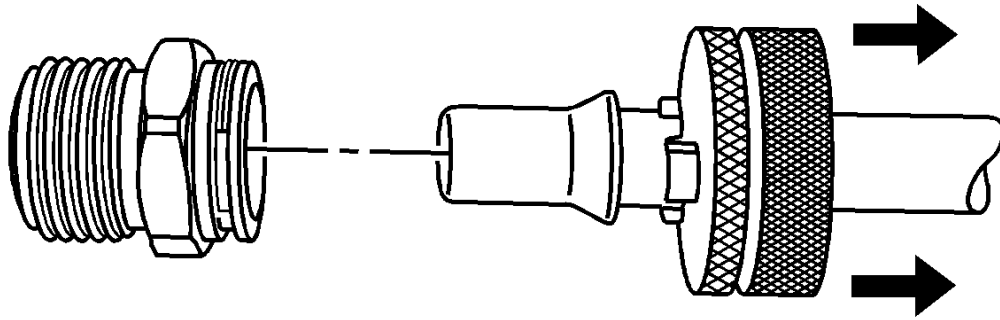


Fig. 27: Generator Cooling Inlet Pipe

Courtesy of GENERAL MOTORS COMPANY

5. Pull back on the TOC pipe to disengage the pipe from the TOC pipe fitting.
6. Remove the **GE-41623** cooler quick connect tool from the TOC pipe.

Installation Procedure

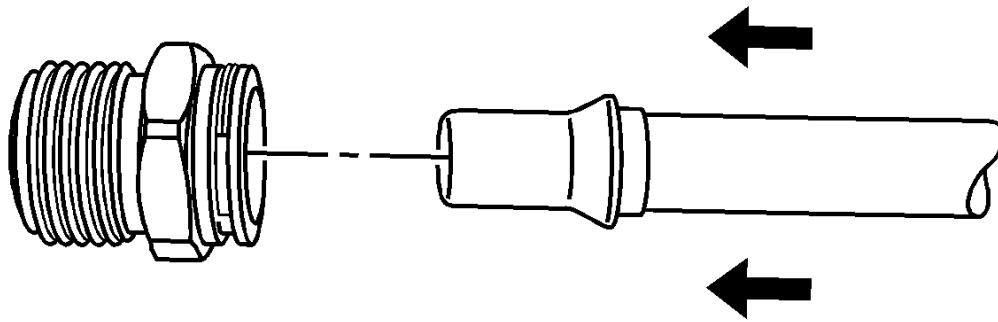


Fig. 28: View Of Generator Cooling Inlet Pipe & Generator Cooling Inlet Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: Inspect the TOC pipe fitting and retaining clip for signs of wear or damage.
Replace the components if necessary.

1. Install the TOC pipe into the TOC pipe fitting.

A distinct snap should be heard or felt when assembling the TOC pipe to the fitting.

2. To ensure the cooler line is properly installed, give the cooler pipe a gentle pull.

TRANSMISSION FLUID COOLER PIPE FITTING REPLACEMENT

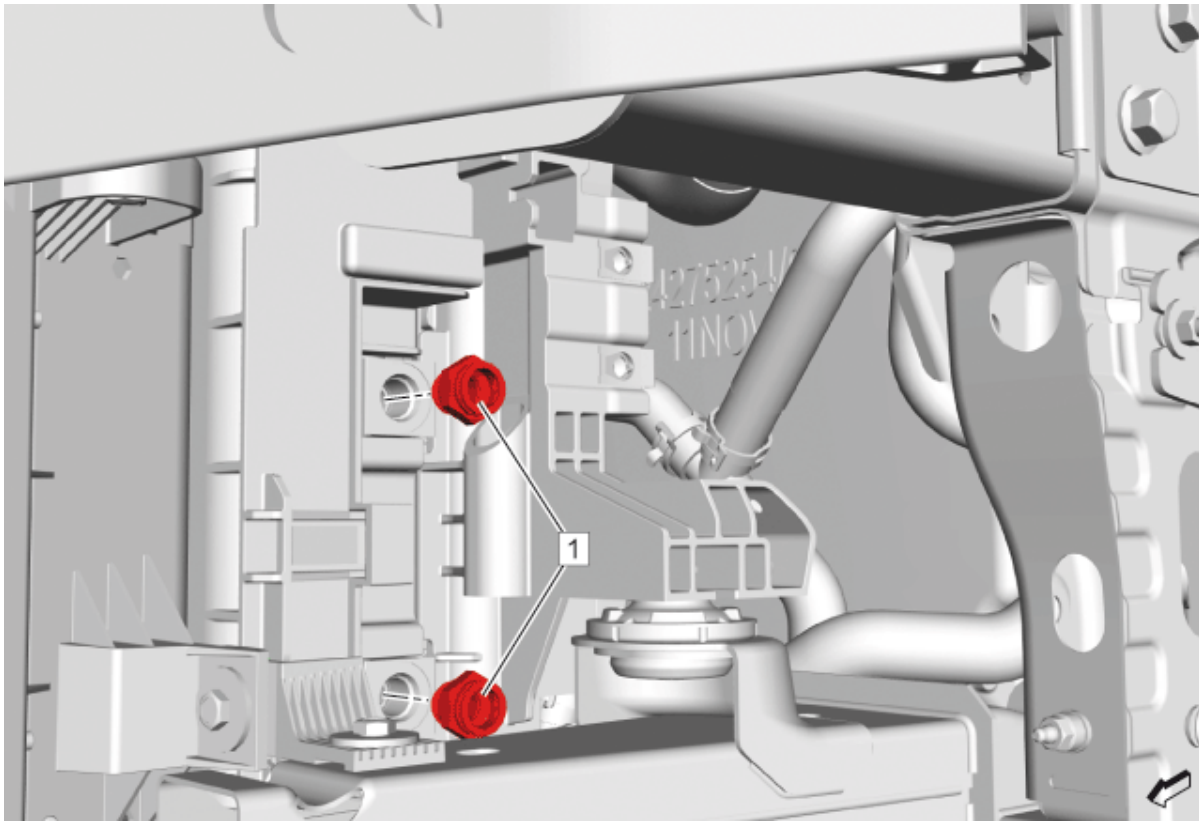


Fig. 29: Transmission Fluid Cooler Pipe Fitting

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. <u>Front Bumper Fascia Removal and Installation</u> 2. Disconnect Transmission Fluid Cooler Thermal Bypass Valve@Transmission Fluid Auxiliary Cooler <u>Transmission Fluid Cooler Thermal Bypass Valve Replacement</u>	
1	Transmission Fluid Cooler Pipe Fitting (Qty: 2) CAUTION: <u>Fastener</u> <u>Caution</u> Procedure 1. Fill the transmission to the proper level with NEW transmission fluid. <u>Transmission Fluid Drain and Fill</u> 2. Inspect for transmission fluid leaks. NOTE: The correct thread engagement

Callout	Component Name
	is critical. Cross-threaded fittings can achieve proper tightness and still leak. Tighten 11 N.m (97 lb in)

TRANSMISSION FLUID COOLER INLET PIPE REPLACEMENT

Removal Procedure

1. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#) - Left Side
2. Remove [Front Bumper Fascia Removal and Installation](#)

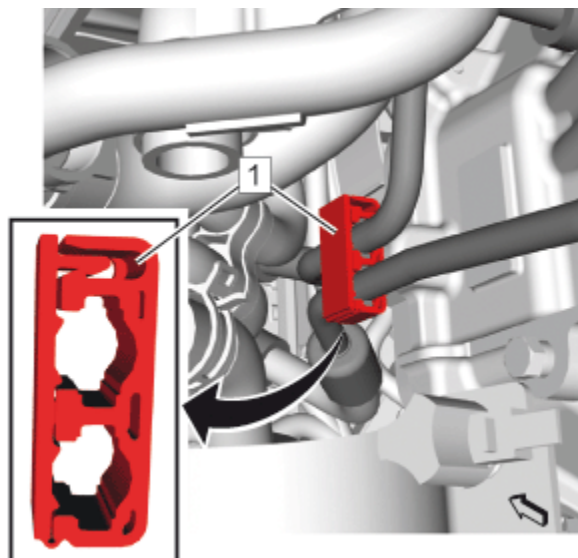


Fig. 30: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

3. Remove Clip (1)

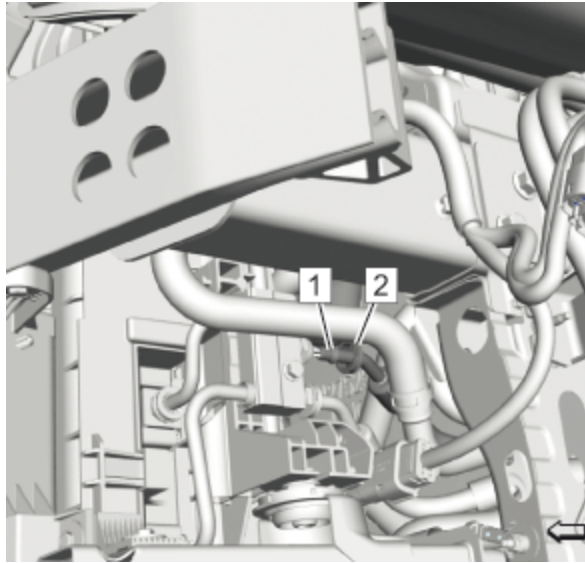


Fig. 31: Transmission Fluid Cooler Pipe Connector Cap

Courtesy of GENERAL MOTORS COMPANY

4. Remove Transmission Fluid Cooler Pipe Connector Cap (2)
5. Place a container beneath the transmission fluid cooler inlet pipe (1) to catch spilling transmission fluid.
6. Disconnect Transmission Fluid Cooler Inlet Pipe@Transmission Fluid Cooler Thermal Bypass Valve
Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection

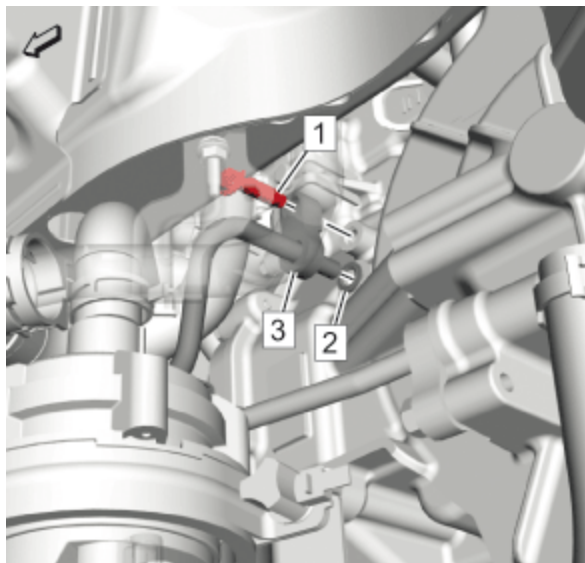


Fig. 32: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer

Courtesy of GENERAL MOTORS COMPANY

7. Place a container beneath the transmission fluid cooler inlet pipe (3) to catch spilling transmission fluid.
8. Remove Transmission Fluid Cooler Pipe Bolt (1)
9. Disconnect Transmission Fluid Cooler Inlet Pipe
10. Remove Sealing Washer (2) and DISCARD
11. Remove the transmission fluid cooler inlet pipe from the vehicle.

Installation Procedure

1. Position the transmission fluid cooler inlet pipe onto the vehicle.

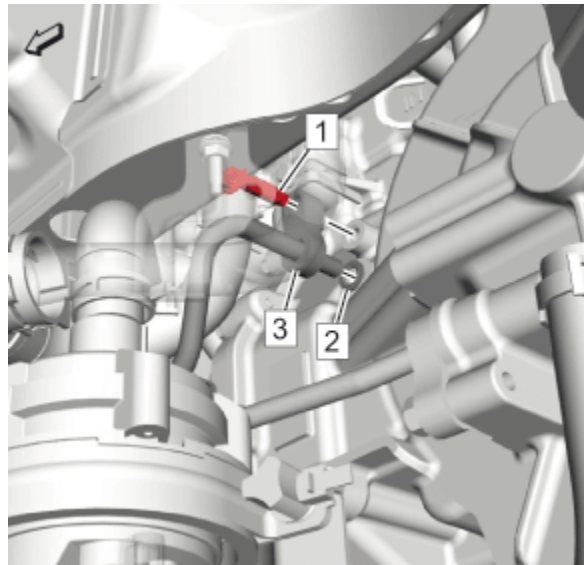


Fig. 33: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW sealing washer.(2)
3. Connect Transmission Fluid Cooler Inlet Pipe (3)
4. Install Transmission Fluid Cooler Pipe Bolt (1) and tighten 22 N.m (16 lb ft)

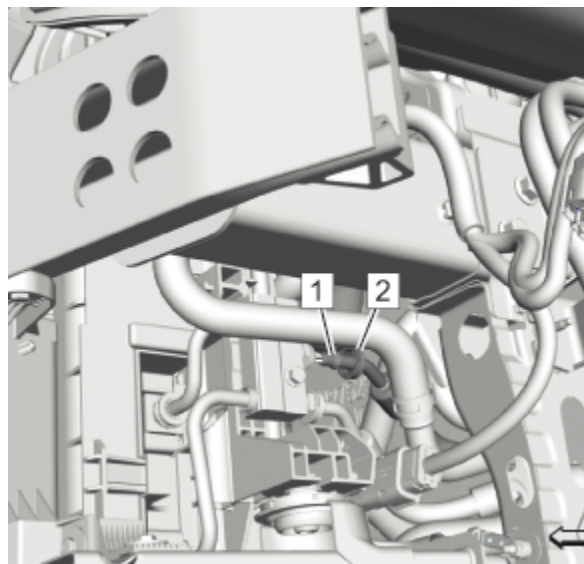


Fig. 34: Transmission Fluid Cooler Pipe Connector Cap
Courtesy of GENERAL MOTORS COMPANY

5. Connect Transmission Fluid Cooler Inlet Pipe (1) @Transmission Fluid Cooler Thermal Bypass Valve
Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection
6. Install Transmission Fluid Cooler Pipe Connector Cap (2)

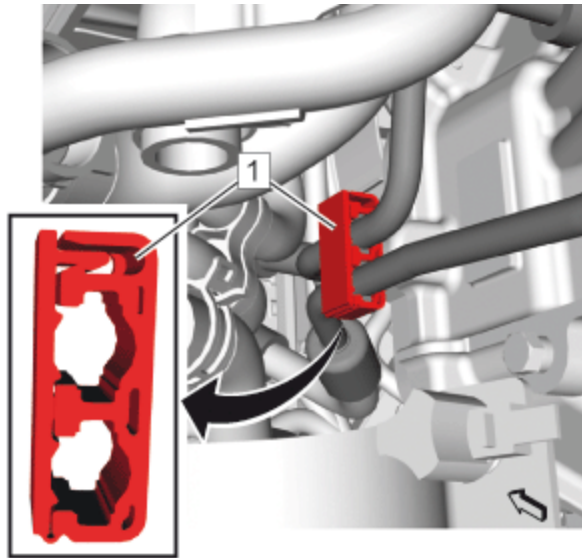


Fig. 35: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

7. Install Clip (1)
8. Install [Front Bumper Fascia Removal and Installation](#)
9. Install [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#) - Left Side

TRANSMISSION FLUID COOLER OUTLET PIPE REPLACEMENT

Removal Procedure

1. Remove [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#) - Left Side
2. Remove [Front Bumper Fascia Removal and Installation](#)
3. Remove [Generator Control Module Coolant Pump Replacement](#)

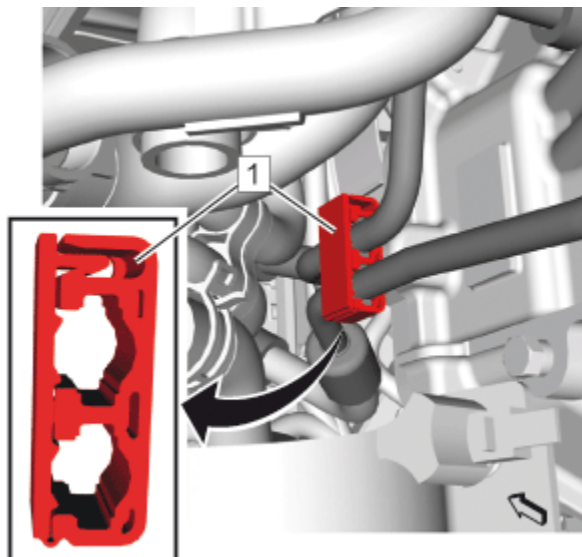


Fig. 36: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

NOTE: Reposition the generator control module coolant pump hoses as necessary for access.

4. Remove Clip (1)

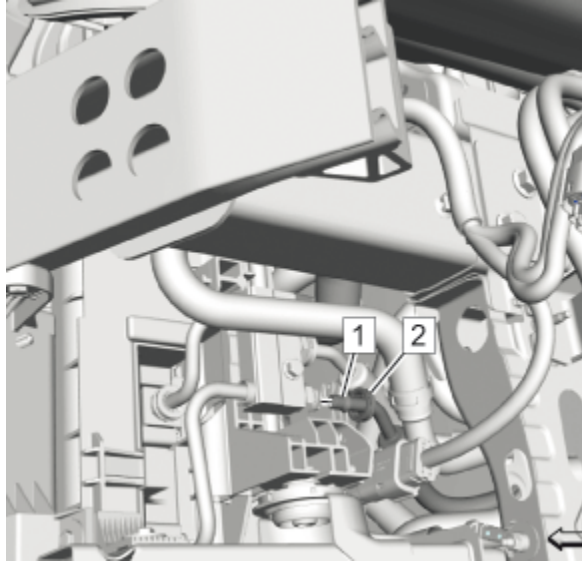


Fig. 37: Transmission Fluid Cooler Pipe Connector Cap

Courtesy of GENERAL MOTORS COMPANY

5. Remove Transmission Fluid Cooler Pipe Connector Cap (2)

6. Place a container beneath the transmission fluid cooler outlet pipe (1) to catch spilling transmission fluid.

7. Disconnect Transmission Fluid Cooler Outlet Pipe@Transmission Fluid Cooler Thermal Bypass Valve

Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection

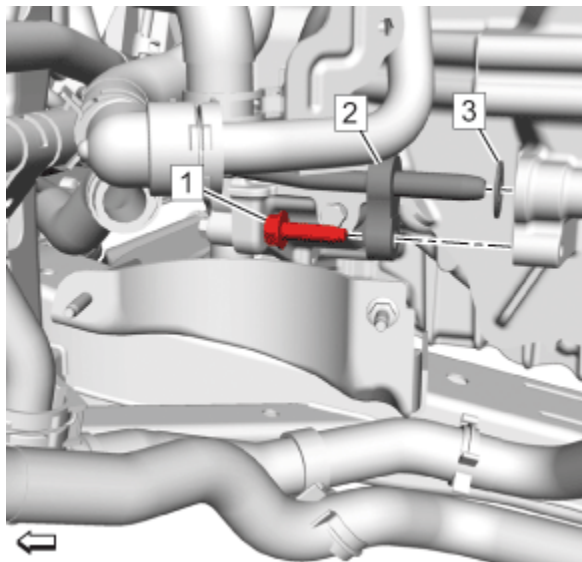


Fig. 38: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer

Courtesy of GENERAL MOTORS COMPANY

8. Place a container beneath the transmission fluid cooler outlet pipe (2) to catch spilling transmission fluid.
9. Remove Transmission Fluid Cooler Pipe Bolt (1)
10. Disconnect Transmission Fluid Cooler Outlet Pipe
11. Remove Sealing Washer(3) and DISCARD
12. Remove the transmission fluid cooler outlet pipe from the vehicle.

Installation Procedure

1. Position the transmission fluid cooler outlet pipe onto the vehicle.

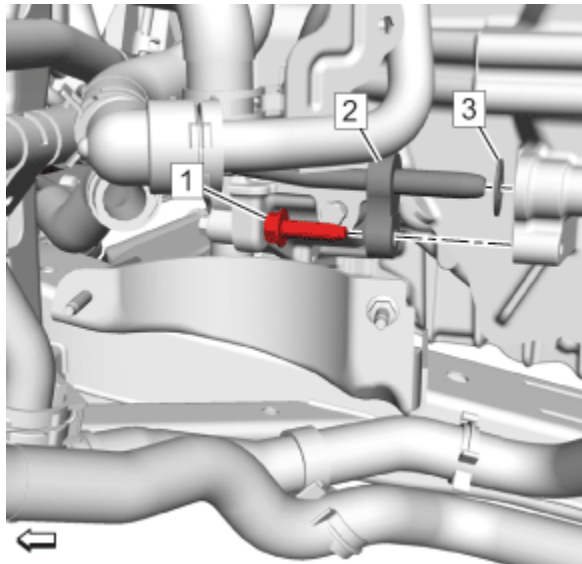


Fig. 39: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW sealing washer.(3)
3. Connect Transmission Fluid Cooler Outlet Pipe (2)
4. Install Transmission Fluid Cooler Pipe Bolt (1) and tighten 22 N.m (16 lb ft)

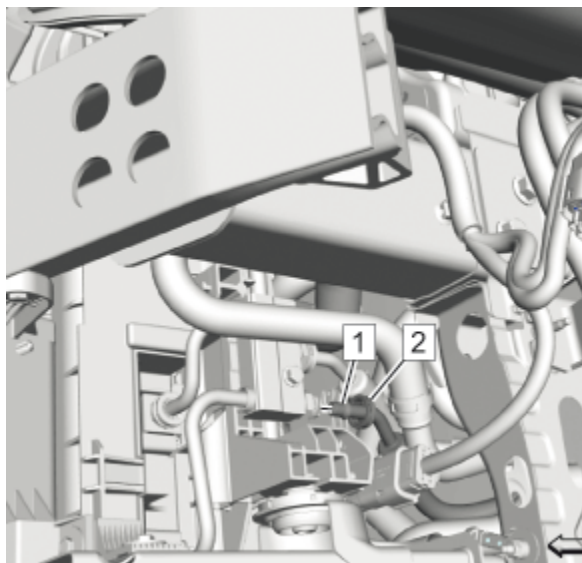


Fig. 40: Transmission Fluid Cooler Pipe Connector Cap

Courtesy of GENERAL MOTORS COMPANY

5. Connect Transmission Fluid Cooler Outlet Pipe@Transmission Fluid Cooler Thermal Bypass Valve (1)
Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection
6. Install Transmission Fluid Cooler Pipe Connector Cap (2)

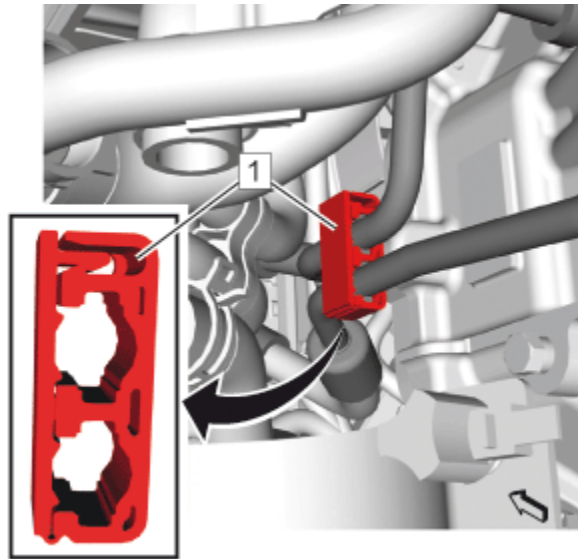


Fig. 41: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

7. Install Clip (1)
8. Install Generator Control Module Coolant Pump Replacement
9. Install Front Bumper Fascia Removal and Installation
10. Install Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side) - Left Side

TRANSMISSION FLUID COOLER INLET AND OUTLET PIPE REPLACEMENT

Removal Procedure

1. Remove Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side) - Left Side
2. Remove Front Bumper Fascia Removal and Installation

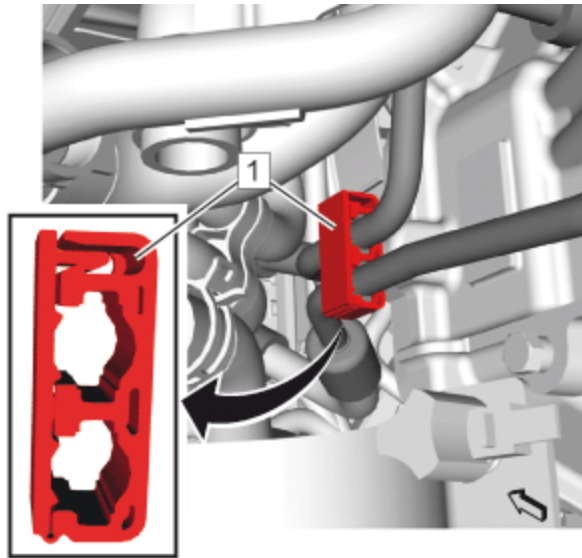


Fig. 42: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

3. Remove Clip (1)

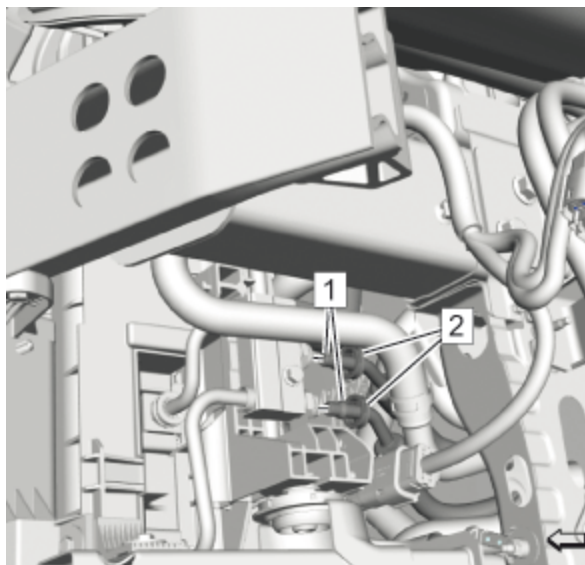


Fig. 43: Transmission Fluid Cooler Pipe Connector Cap

Courtesy of GENERAL MOTORS COMPANY

4. Remove Transmission Fluid Cooler Pipe Connector Cap (2)
5. Place a container beneath the transmission fluid cooler inlet and outlet pipe (1) to catch spilling transmission fluid.
6. Disconnect Transmission Fluid Cooler Inlet and Outlet Pipe [Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection](#)

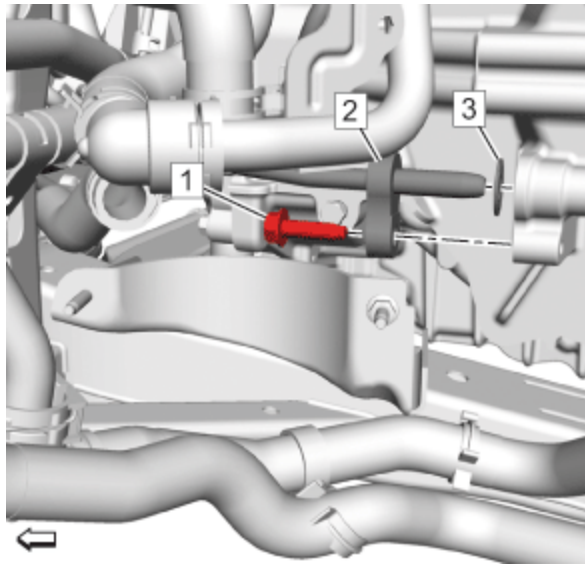


Fig. 44: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

7. Place a container beneath the transmission fluid cooler outlet pipe (2) to catch spilling transmission fluid.
8. Remove Transmission Fluid Cooler Pipe Bolt (1)
9. Disconnect Transmission Fluid Cooler Outlet Pipe
10. Remove Sealing Washer (3) and DISCARD

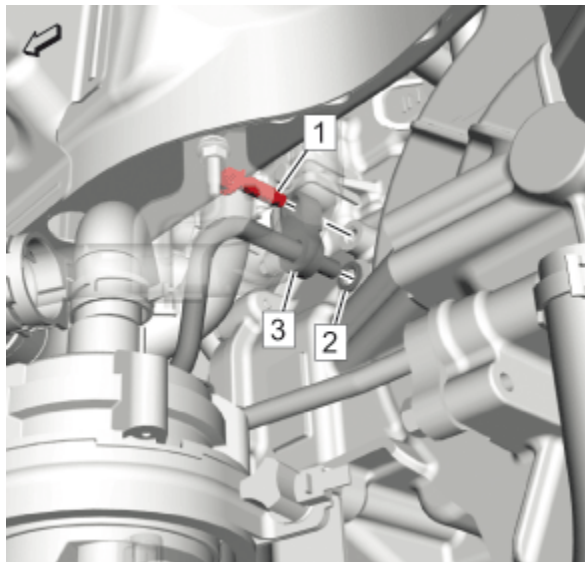


Fig. 45: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

11. Place a container beneath the transmission fluid cooler inlet pipe (3) to catch spilling transmission fluid.
12. Remove Transmission Fluid Cooler Pipe Bolt (1)
13. Disconnect Transmission Fluid Cooler Inlet Pipe
14. Remove Sealing Washer (2) and DISCARD
15. Remove the transmission fluid cooler inlet and outlet pipe from the vehicle.

Installation Procedure

1. Position the transmission fluid cooler inlet and outlet pipe onto the vehicle.

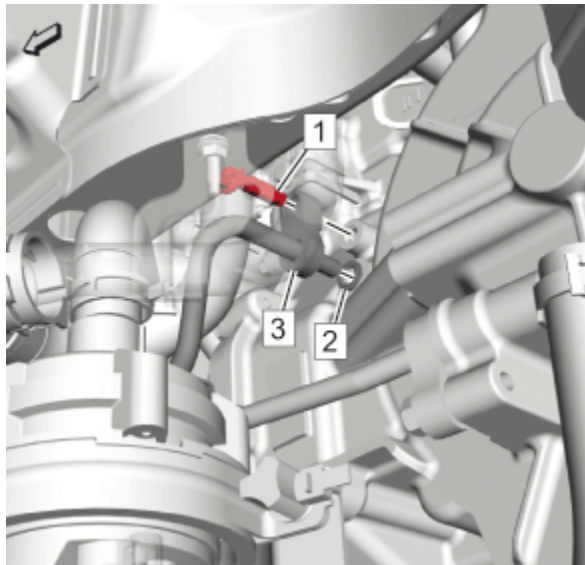


Fig. 46: Transmission Fluid Cooler Inlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW sealing washer.(2)
3. Connect Transmission Fluid Cooler Inlet Pipe (3)

CAUTION: Fastener Caution

4. Install Transmission Fluid Cooler Pipe Bolt (1) and tighten 22 N.m (16 lb ft)

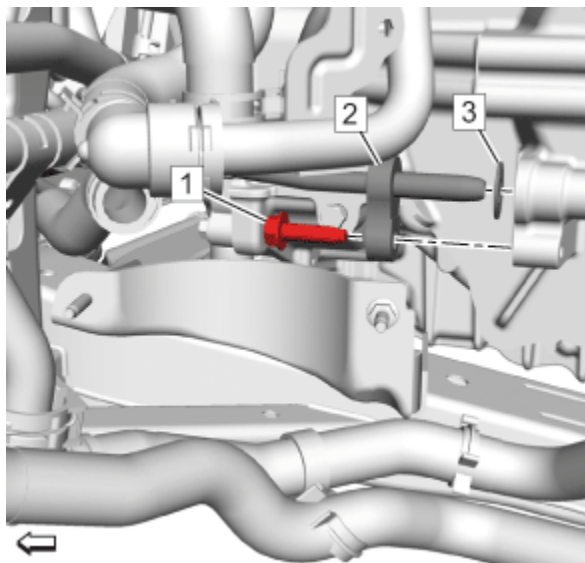


Fig. 47: Transmission Fluid Cooler Outlet Pipe, Bolt And Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

5. Install a NEW sealing washer.(3)
6. Connect Transmission Fluid Cooler Outlet Pipe (2)

7. Install Transmission Fluid Cooler Pipe Bolt (1) and tighten 22 N.m (16 lb ft)

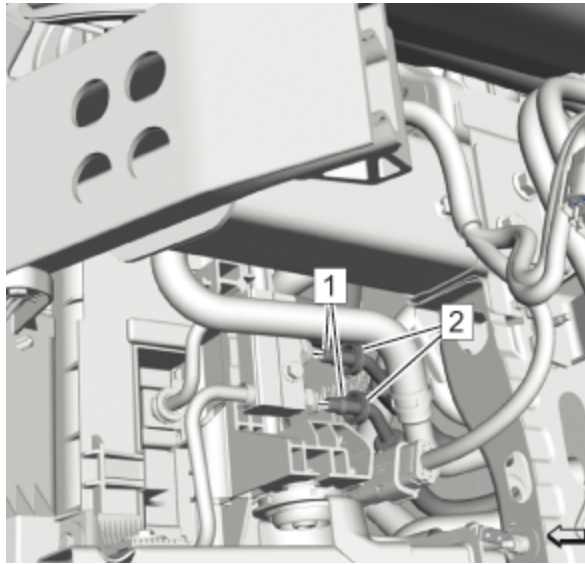


Fig. 48: Transmission Fluid Cooler Pipe Connector Cap

Courtesy of GENERAL MOTORS COMPANY

8. Connect Transmission Fluid Cooler Inlet and Outlet Pipe (1) **Transmission Fluid Cooler Hose/Pipe Quick-Connect Fitting Disconnection and Connection**
9. Install Transmission Fluid Cooler Pipe Connector Cap (2)

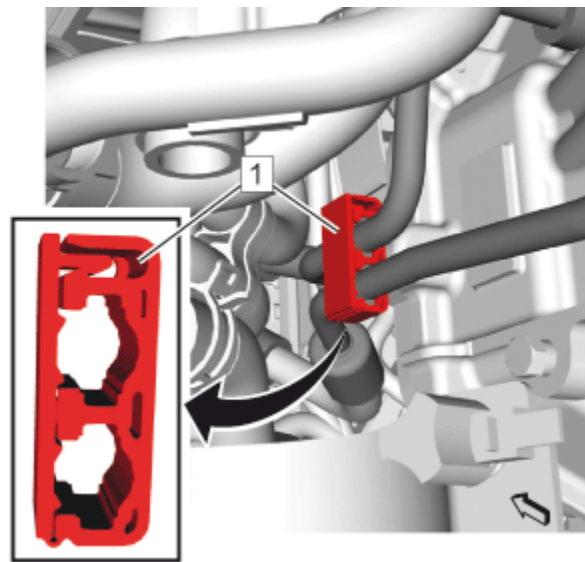


Fig. 49: View Of Clip

Courtesy of GENERAL MOTORS COMPANY

10. Install Clip (1) -
11. Install **Front Bumper Fascia Removal and Installation**
12. Install **Front Wheelhouse Liner Replacement (Left Side) Front Wheelhouse Liner Replacement (Right Side)** - Left Side

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

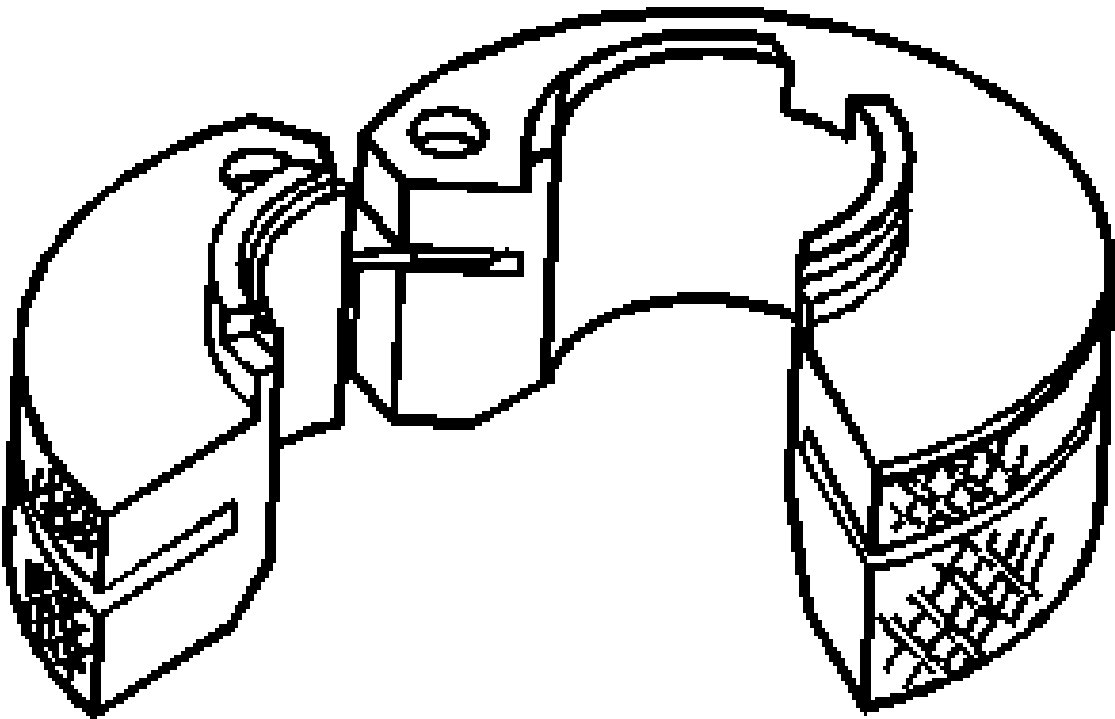
Illustration	Tool Number/ Description
	DT 41623-B GE 41623-B J 41623-B Cooler Quick Connect Tool

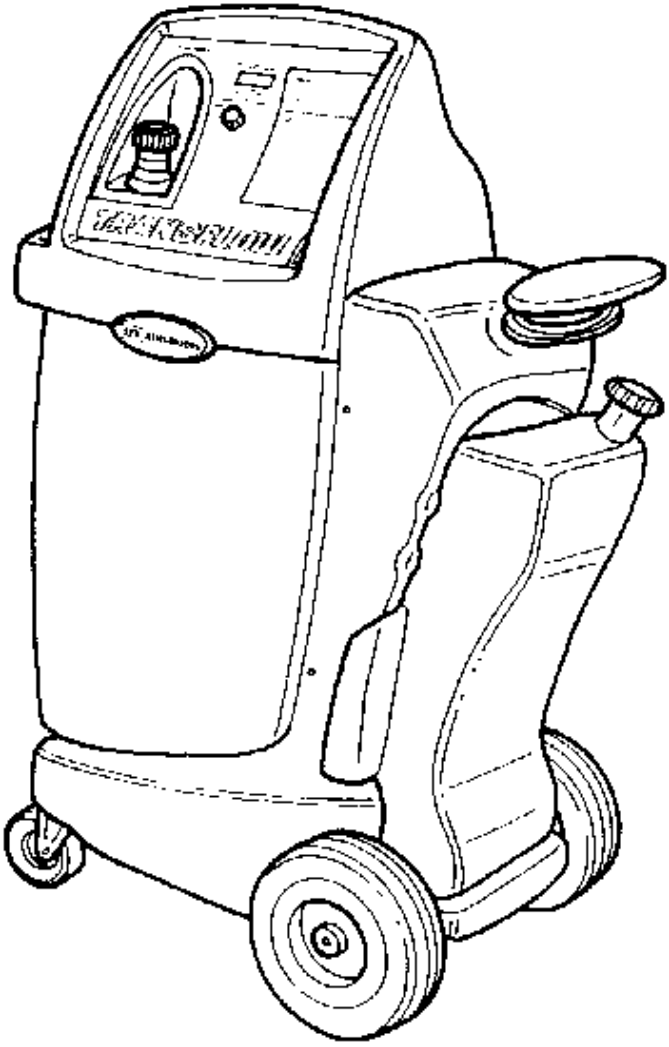
Illustration	Tool Number/ Description
	DT 45096 J 45096 Transmission Oil Cooling System Flush and Flow Test Tool

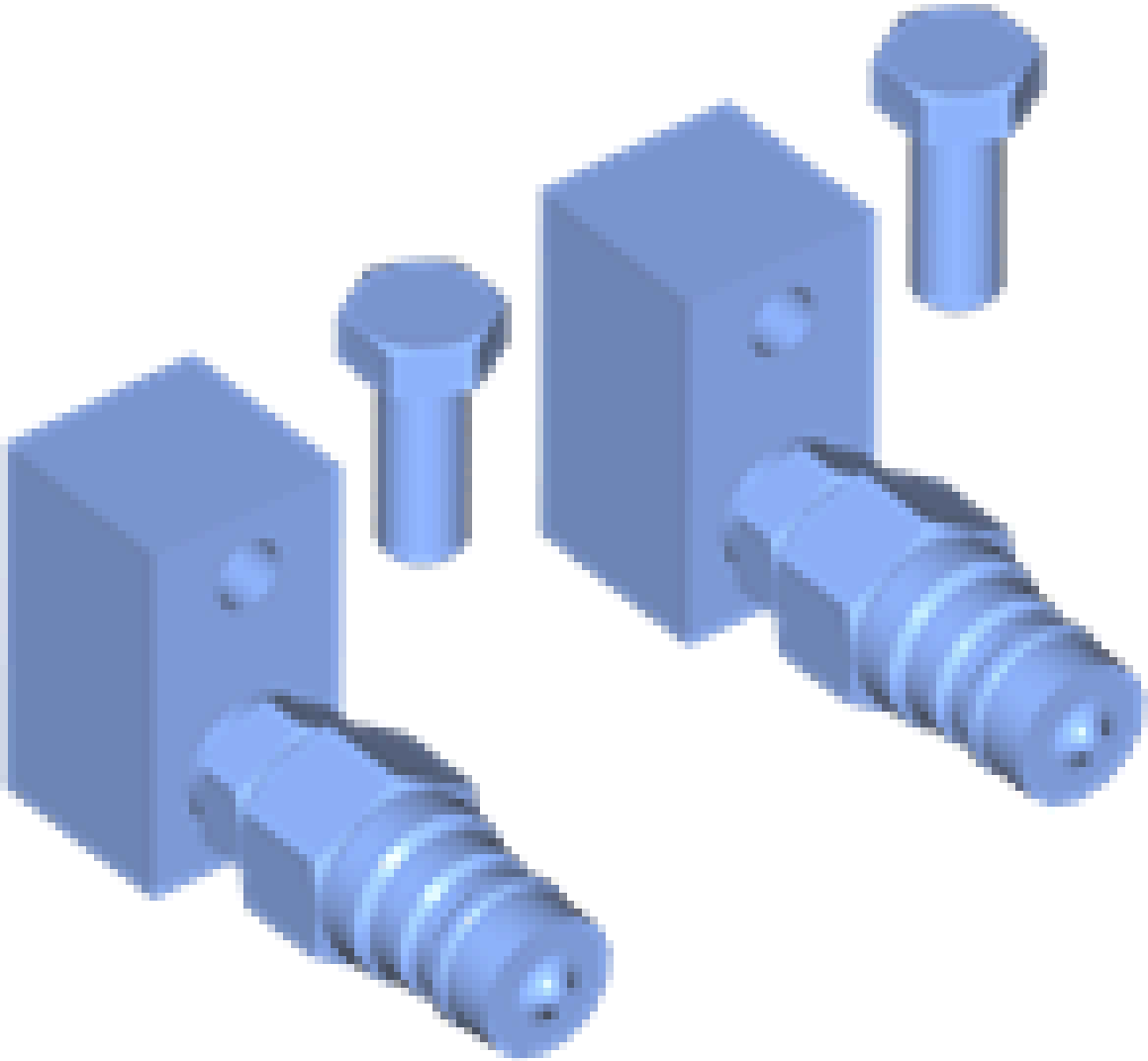
Illustration	Tool Number/ Description
	DT 45096-50 J 45096-50 Transmission Cooler Flush Adapter

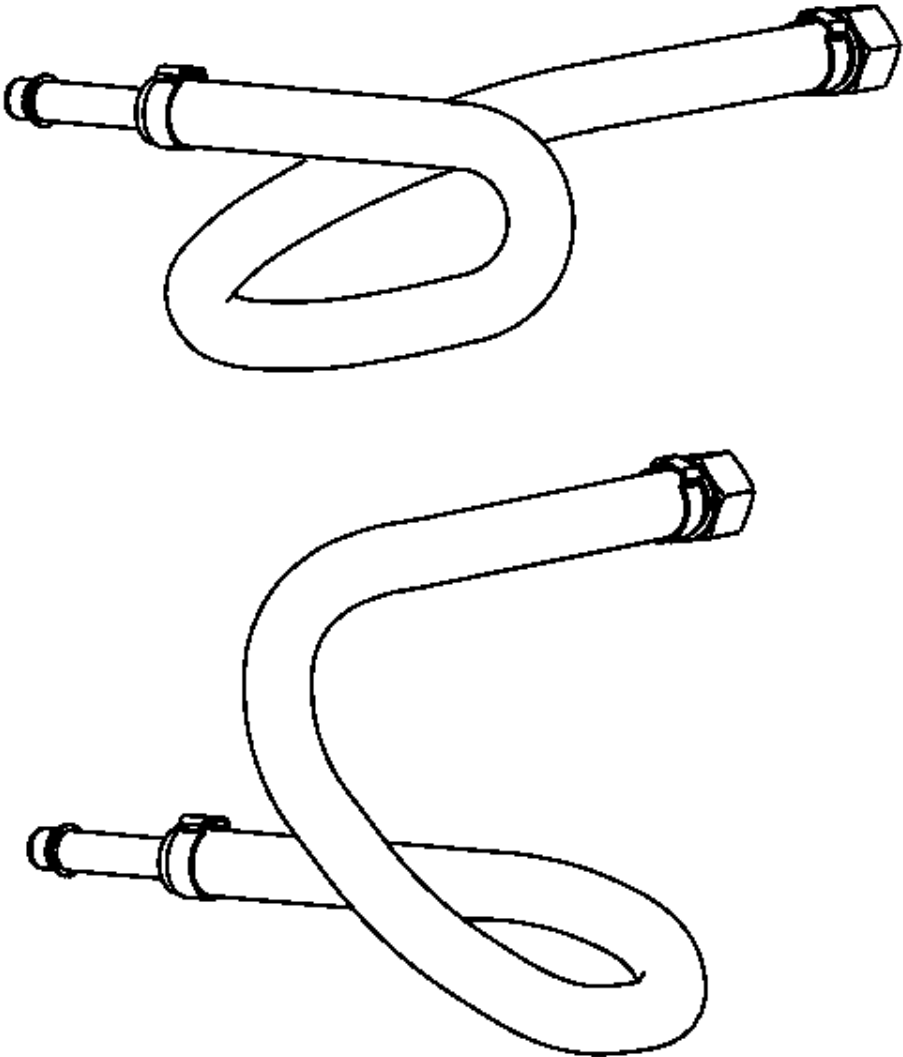
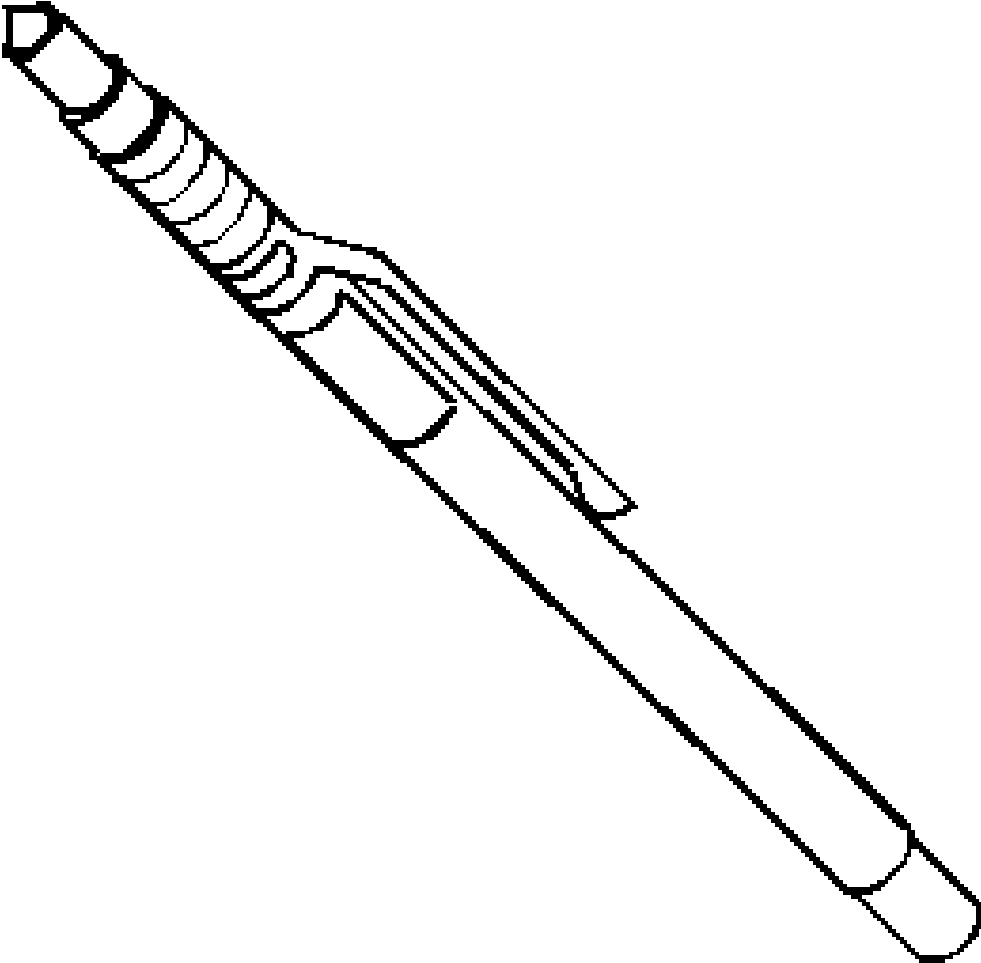
Illustration	Tool Number/ Description
	DT 45096-55 J 45096-55 Transmission Cooler Flush Adapter

Illustration	Tool Number/ Description
	GE-24731 J-24731 Tempilstick

Article GUID: A00884688

DRIVELINE/AXLE
Wheel Drive Shafts - Volt

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	
Wheel Drive Shaft Washer	
Wheel Drive Shaft Retaining Ring	

Single Use Threaded Fastener/Component Tightening Specifications

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>	
Application	Specification
	Metric (English)
Wheel Drive Shaft Nut	
• First Pass:	150 N.m (111 lb ft)
• Second Pass:	Loosen 45 degrees
• Final Pass:	250 N.m (184 lb ft)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
Wheel Drive Shaft Inner and Outer Joint	Grease	Refer to Electronic Parts Catalog

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - WHEEL DRIVE SHAFTS

IMPORTANT: Complete the following steps prior to beginning the wheel drive shaft diagnosis.

1. Review the [Vibration Diagnosis, Starting Point, and Correction](#) .
2. Perform the [Vibration Analysis - Road Testing \(EL-38792-A Electronic Vibration Analyzer\) Vibration Analysis - Road Testing \(CH-51450-NVH Oscilloscope\)](#) in order to effectively diagnose the concern.
3. Review the system operation in order to become familiar with the system function. Refer to [Wheel Drive Shafts Description and Operation](#)

Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the wheel drive shafts or other rotating components.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Thoroughly inspect the entire wheel drive shaft for visible damage, leaking joint seals, and missing seal clamps.
- Inspect the wheel drive shaft seals for cuts, tears, or other damage which may allow the loss of lubricant and the entry of contaminants.

Symptom List

After performing the Visual/Physical Inspection and no visual signs of damage or other interference impairing the wheel drive shaft function is apparent, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the joints manually. Any binding or otherwise impeded movement of the joints may indicate damage which could contribute to the concern. Refer to the following:

- [Click Noise In Turns](#)
- [Clunk When Accelerating from Coast](#)
- [Clunk Noise When Accelerating During Turns](#)
- [Shudder or Vibration During Acceleration](#)

CLICK NOISE IN TURNS

A click noise occurring during turns may be caused by a worn or damaged wheel drive shaft outer joint. This may be more apparent while simultaneously turning and accelerating. This click is caused by wear and/or damage to the constant velocity joint bearings and/or races. Commonly, this damage or wear is caused by the loss of lubricating grease from the constant velocity joint and the entry of foreign material or contaminants.

Carefully inspect the wheel drive shaft seals for cuts, tears or other damage which may allow the lubricating grease to escape. The loss of this grease will cause damage to the wheel drive shaft constant velocity joint in a very short period of time.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the outer joint manually. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK WHEN ACCELERATING FROM COAST

A clunk noise occurring when accelerating from coast or a standing start may be caused by a worn or damaged wheel drive shaft inner joint. The common cause of wheel drive shaft inner joint damage is the loss of lubricating grease and/or the presence of foreign material and contaminants in the joint. This usually occurs as a result of a torn or damaged inner joint seal.

Carefully inspect the wheel drive shaft seal for cuts, tears or other damage that may allow the loss of the lubricating grease and/or the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Do not allow the joint to separate from the wheel drive shaft bar. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK NOISE WHEN ACCELERATING DURING TURNS

A clunk noise that occurs while accelerating during turns may be caused by wear and/or damage to the inboard and the outboard joints in combination. The loss of lubricant and/or the presence of contaminants can cause damage to the internal components of the joints.

Carefully inspect the joint seals for cuts, tears or other damage. Joint seals that are damaged may allow lubricant leakage and the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the joints manually. Do not allow the joints to separate from the wheel drive shaft bar. Any binding or impeded movement of the joints may indicate damage which could contribute to the concern.

SHUDDER OR VIBRATION DURING ACCELERATION

In order to diagnose a shudder or vibration during acceleration, refer to [Vibration Diagnosis, Starting Point, and Correction](#) .

REPAIR INSTRUCTIONS

FRONT WHEEL DRIVE SHAFT REPLACEMENT

Special Tools

- **CH-28733-B** Wheel Hub and Driveshaft Remover
- **DT-51504** Seal Protector
- **EN-45059** Angle Meter

Equivalent regional tools: [Special Tools](#)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Remove the front tire and wheel assemblies. Refer to [Tire and Wheel Removal and Installation](#) .
3. Remove Front Compartment Splash Shield. Refer to [Front Compartment Splash Shield Replacement](#)
4. Remove Front Wheelhouse Liner. Refer to [Front Wheelhouse Liner Replacement \(Left Side\)](#) [Front Wheelhouse Liner Replacement \(Right Side\)](#)
5. Remove Stabilizer Shaft Link. Refer to [Stabilizer Shaft Link Replacement](#)

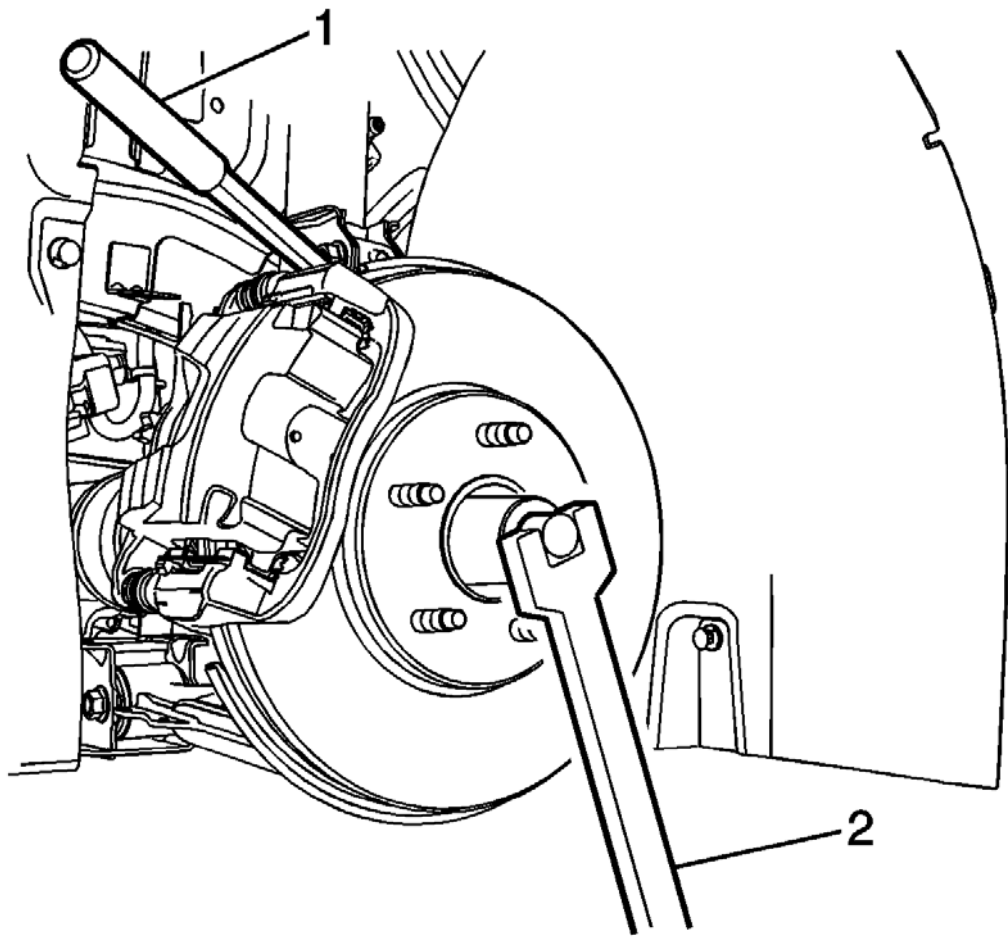


Fig. 1: Holding Brake Rotor From Turning Using Drift
Courtesy of GENERAL MOTORS COMPANY

6. Insert a drift or a punch (1) in the brake rotor cooling fins.
7. Rotate the brake rotor until the drift or punch is resting against the brake caliper mounting bracket.
8. Using a breaker bar and the proper size socket (2), loosen the wheel drive shaft nut.

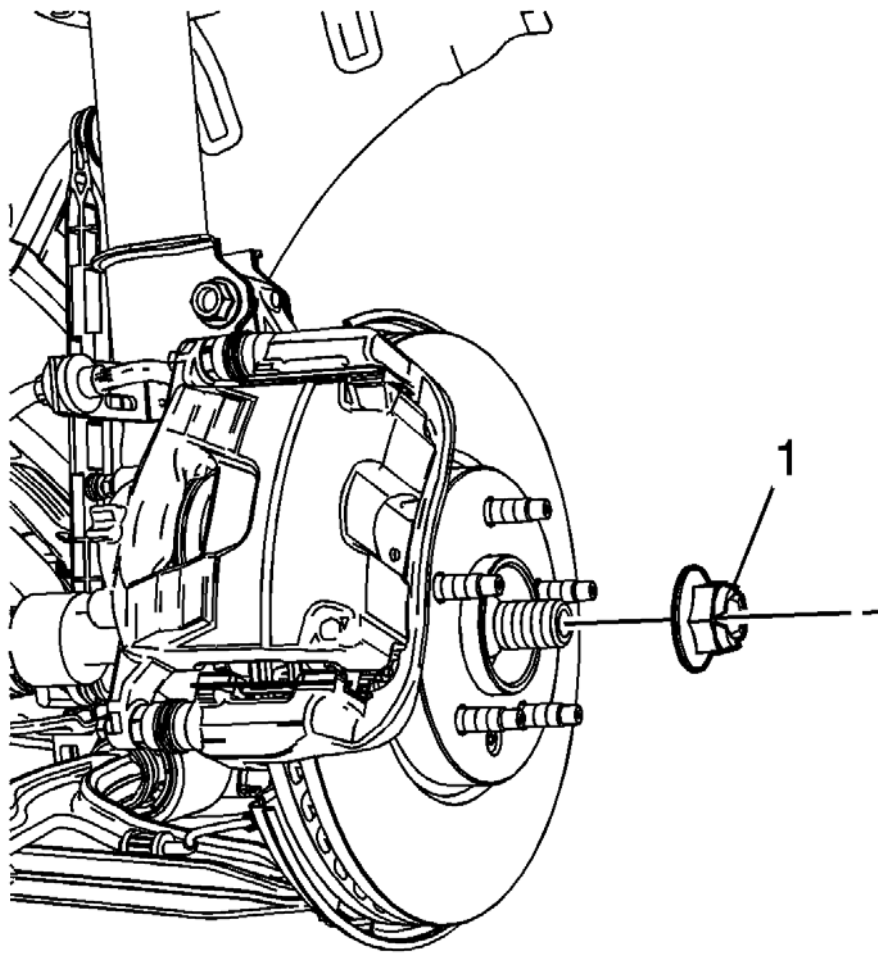


Fig. 2: Wheel Drive Shaft Nut

Courtesy of GENERAL MOTORS COMPANY

9. Remove and DISCARD Wheel Drive Shaft Nut (1)

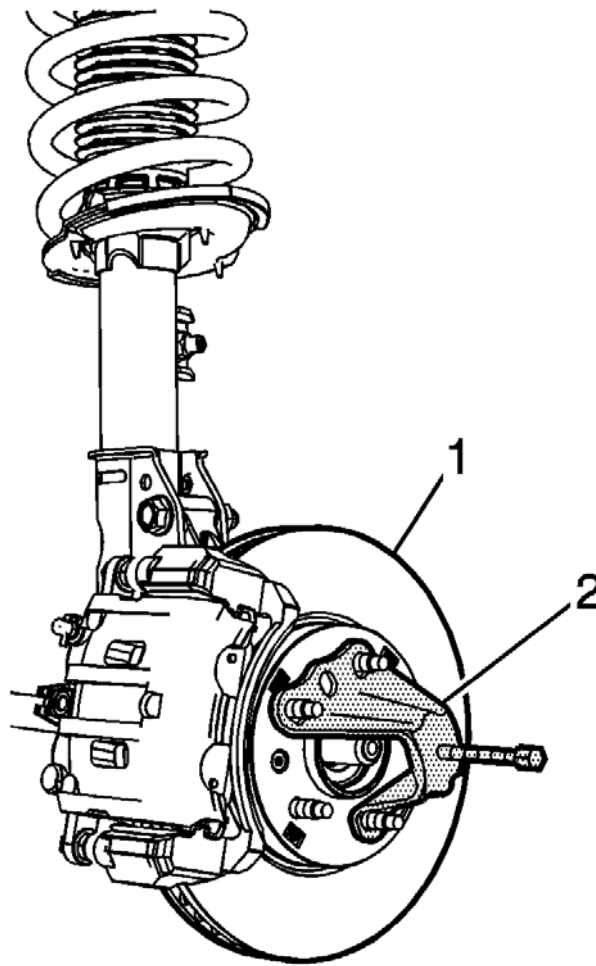


Fig. 3: Separating Wheel Drive Shaft From Wheel Hub/Bearing
Courtesy of GENERAL MOTORS COMPANY

10. Using the **CH-28733-B** remover (2), separate the wheel drive shaft from the front wheel hub (1).
11. Disconnect the outer tie rod from the steering knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#).
12. Remove the lower control arm ball joint from the steering knuckle. Refer to [Steering Knuckle Replacement](#)

NOTE: Position a drain pan under the transmission when servicing the wheel drive shaft.

13. With the aide of an assistant, move the front knuckle assembly to the side.

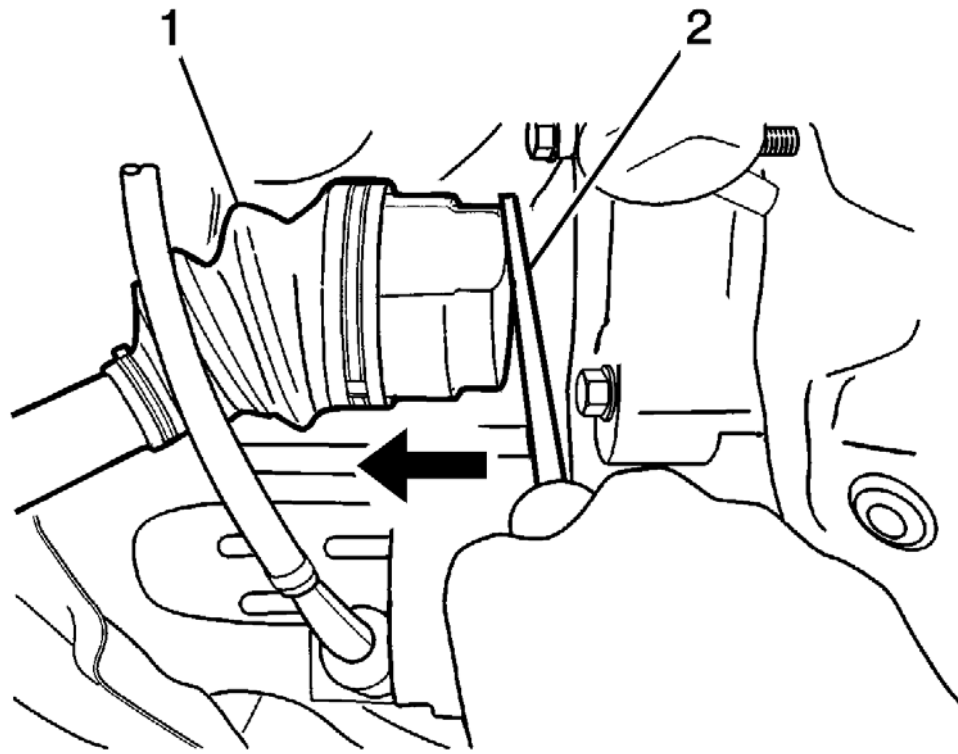


Fig. 4: Removing Wheel Drive Shaft Using Large Flat Bladed Tool
Courtesy of GENERAL MOTORS COMPANY

14. Using a large flat bladed screwdriver or pry bar (2), remove the wheel drive shaft (1) from the differential.

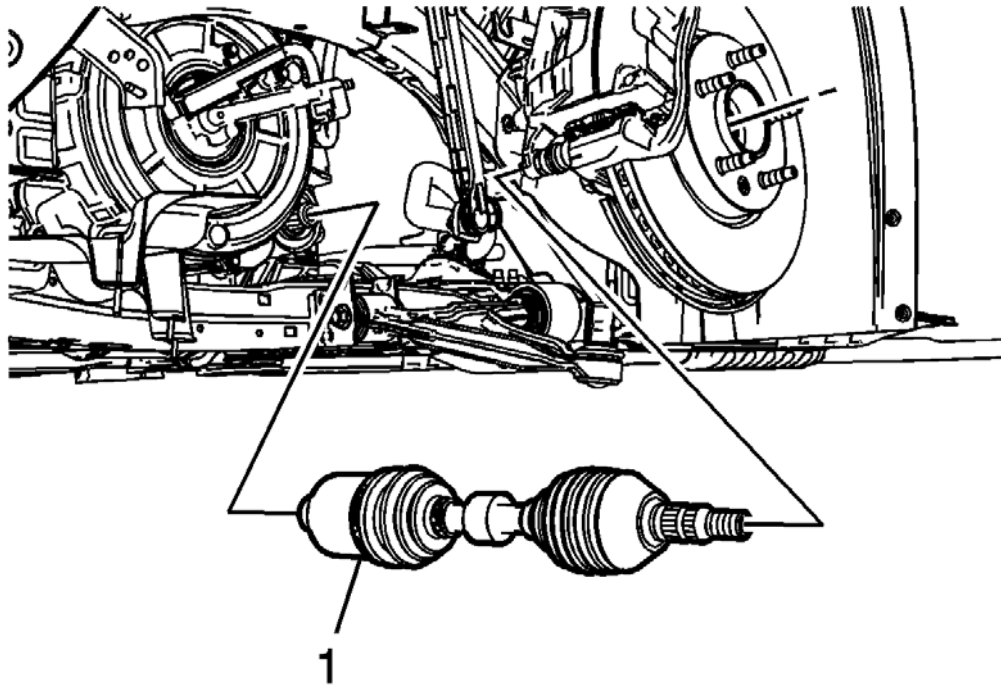


Fig. 5: Wheel Drive Shaft

Courtesy of GENERAL MOTORS COMPANY

15. Remove Wheel Drive Shaft (1) @ Vehicle

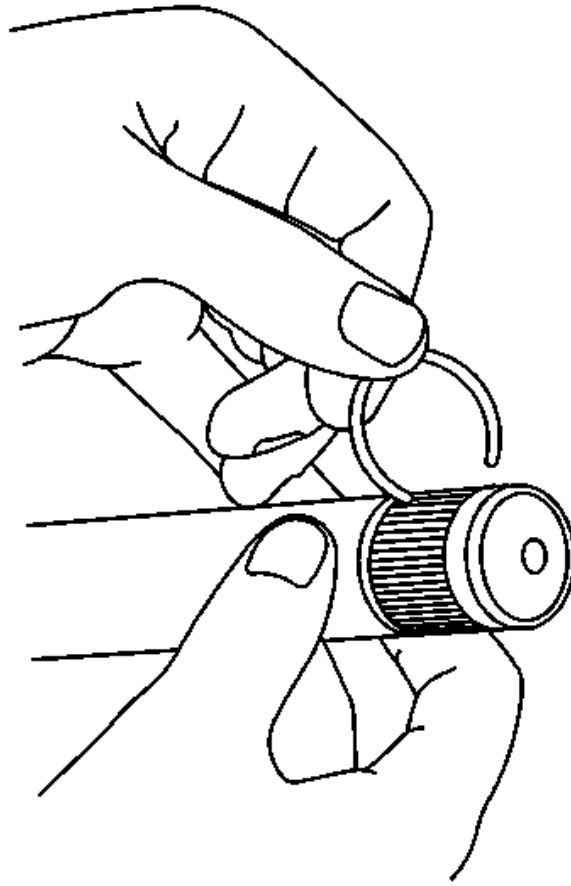


Fig. 6: Axle Shaft Retaining Ring

Courtesy of GENERAL MOTORS COMPANY

16. DISCARD the retaining ring.

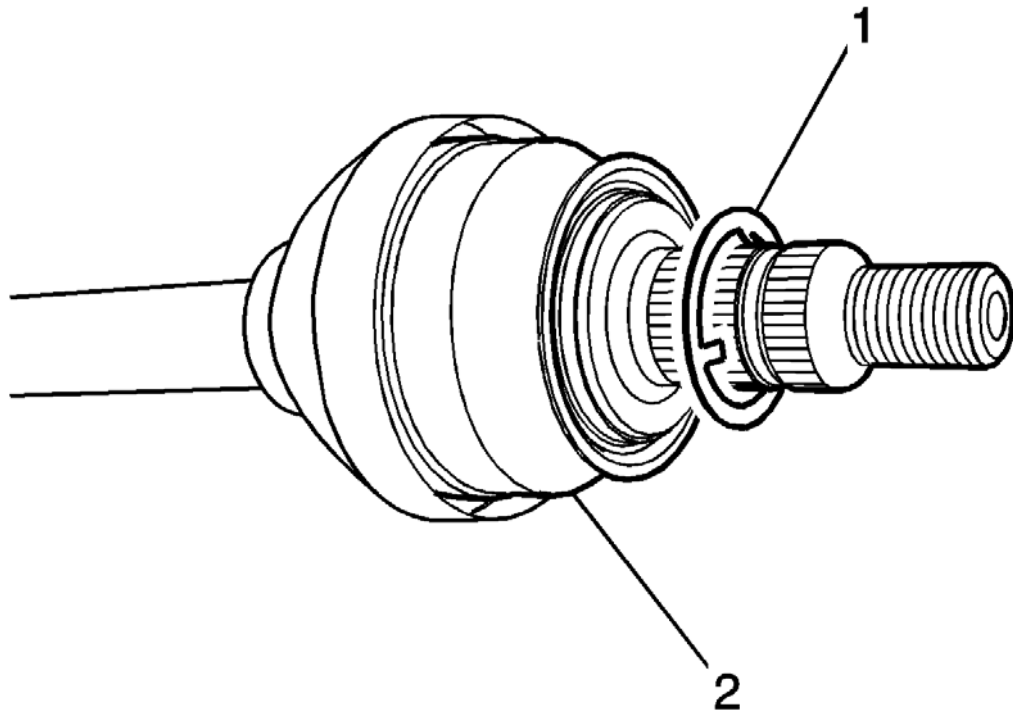


Fig. 7: Wheel Drive Shaft And Washer

Courtesy of GENERAL MOTORS COMPANY

NOTE: If there is no washer on the wheel drive shaft, install a NEW washer.

17. Remove and DISCARD the washer (1) from the front wheel drive shaft (2).

Installation Procedure

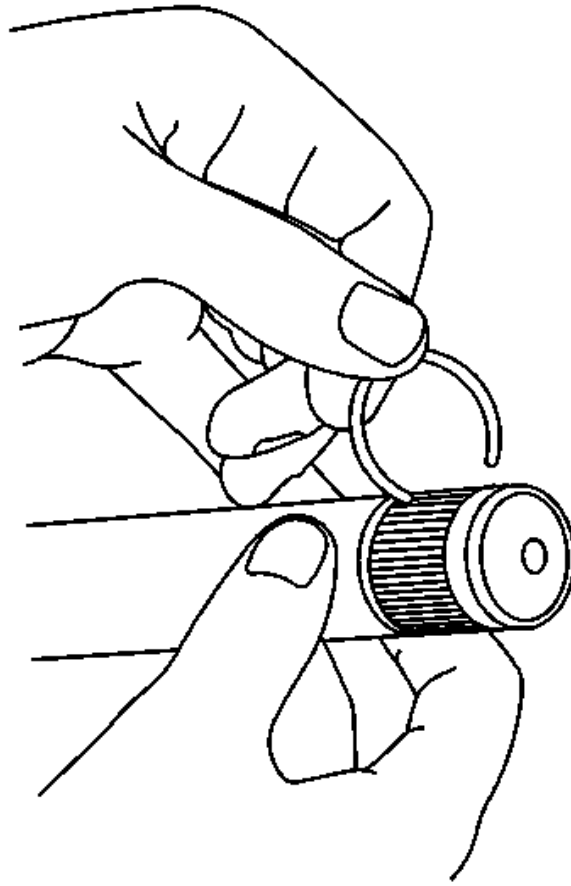


Fig. 8: Axle Shaft Retaining Ring

Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW retaining ring to the front wheel drive shaft inner joint. Start to pull the ring from the front wheel drive shaft inner joint end down to the ring groove.

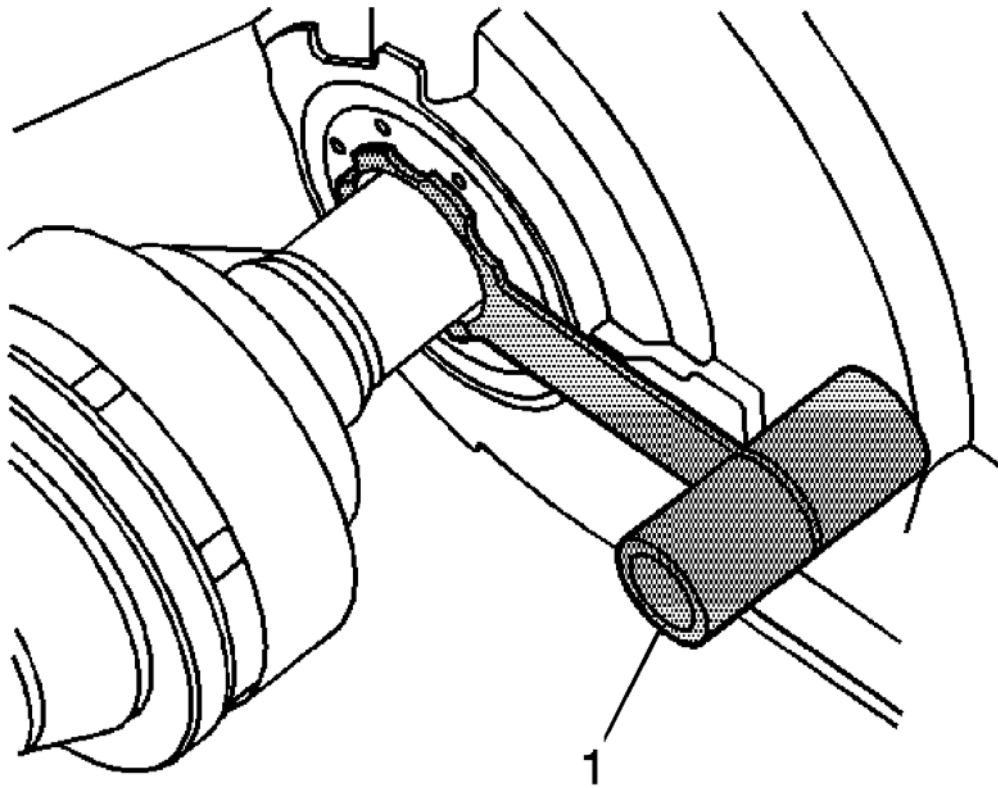


Fig. 9: Differential Output Shaft Seal Protector

Courtesy of GENERAL MOTORS COMPANY

CAUTION: DT-6332/DT-51504 or equivalent must be installed into the front wheel drive shaft oil seal prior to removing and installing the front wheel drive shaft. Failure to use the DT-6332/DT-51504 may cause the spline of the front wheel drive shaft to cut the front wheel drive shaft oil seal. Damage to the front wheel drive shaft oil seal will result in lubricant leaks.

2. Install the **DT-51504** protector (1) into the differential.

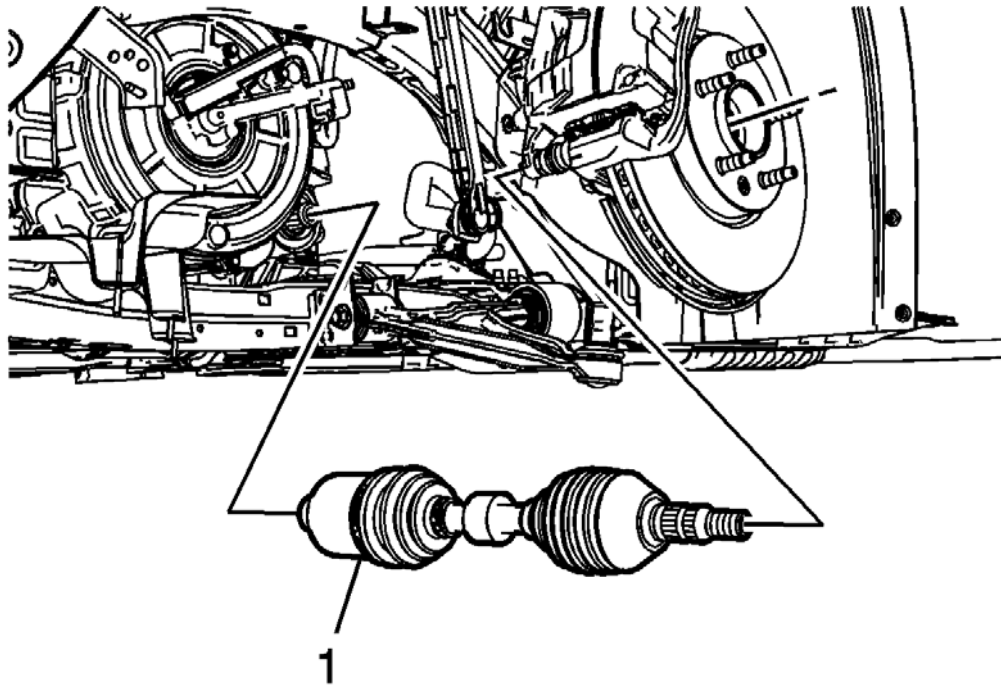


Fig. 10: Wheel Drive Shaft

Courtesy of GENERAL MOTORS COMPANY

3. Install the wheel drive shaft into the differential until the retaining ring is fully seated. (1)
4. With the aide of an assistant, move the front knuckle assembly into the proper position.
5. Install the wheel drive shaft in the front wheel hub.
6. Install the lower control arm ball joint to the steering knuckle. Refer to [Steering Knuckle Replacement](#) .
7. Connect the outer tie rod to the steering knuckle. Refer to [Steering Linkage Outer Tie Rod Replacement](#) .
8. Install Stabilizer Shaft Link. Refer to [Stabilizer Shaft Link Replacement](#)

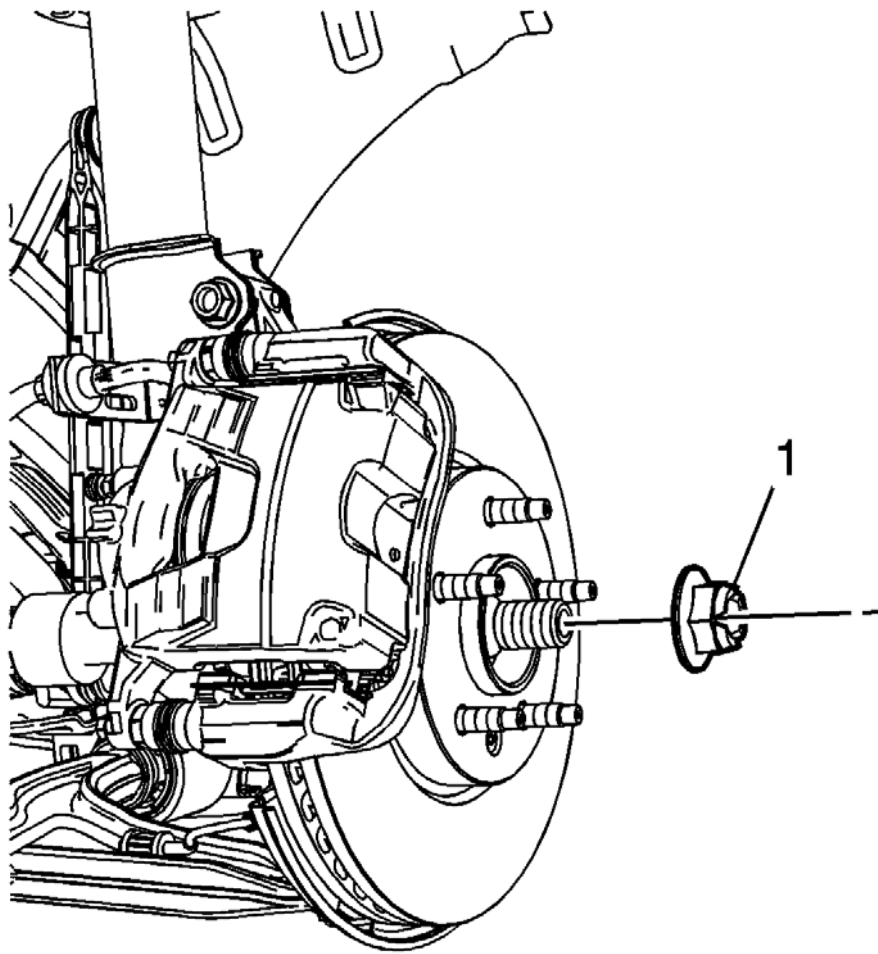


Fig. 11: Wheel Drive Shaft Nut

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT tighten.

9. Loosely install Wheel Drive Shaft Nut (1)

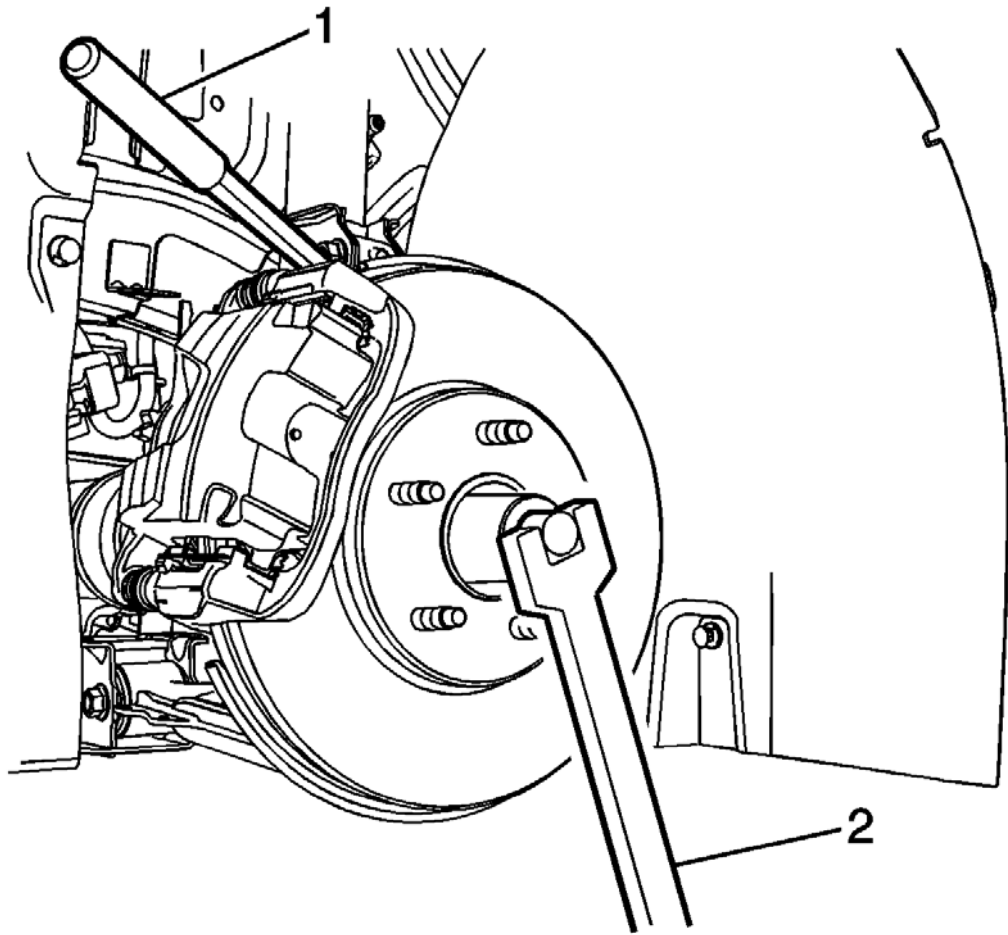


Fig. 12: Holding Brake Rotor From Turning Using Drift
Courtesy of GENERAL MOTORS COMPANY

10. Insert a drift or a punch (1) in the brake cooling fin.
11. Rotate the brake rotor until the drift or the punch is rest against the brake caliper mounting bracket.
12. Tighten Wheel Drive Shaft Nut
 1. First Pass: 150 N.m (111 lb ft)
 2. Second Pass: - Loosen 45 degrees, use the **EN-45059** meter
 3. Final Pass: 250 N.m (184 lb ft)
13. Install Front Wheelhouse Liner. Refer to [**Front Wheelhouse Liner Replacement \(Left Side\)**](#) [**Front Wheelhouse Liner Replacement \(Right Side\)**](#)
14. Install Front Compartment Splash Shield. Refer to [**Front Compartment Splash Shield Replacement**](#)
15. Install the front tire and wheel assemblies. Refer to [**Tire and Wheel Removal and Installation**](#) .
16. Lower the vehicle.

DESCRIPTION AND OPERATION

WHEEL DRIVE SHAFTS DESCRIPTION AND OPERATION

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

- A front wheel drive shaft tripot joint (inner joint)
- A front wheel drive shaft constant velocity joint (outer joint)
- A front wheel drive shaft

The front wheel drive shaft connects the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joint.

The front wheel drive shaft tripot joint is completely flexible. The front wheel drive shaft tripot joint can move in and out.

The front wheel drive shaft constant velocity joint is flexible, but the front wheel drive shaft constant velocity joint cannot move in and out.

Boots And Clamps

The front wheel drive shaft constant velocity joint and the front wheel drive shaft tripot joint boots in the front wheel drive axle are made of a thermoplastic material.

The clamps in the front wheel drive axle are made of stainless steel.

The boot provides the following functions:

- Protection of the internal parts of the front wheel drive shaft constant velocity joint and the front wheel drive shaft tripot joint

The boot protects the grease from the following sources of damage:

- Harmful atmospheric conditions, such as extreme temperatures or ozone gas
- Foreign material, such as dirt or water
- Allows angular movement and the axial movement of the front wheel drive shaft tripot joint
- Allows angular movement of the front wheel drive shaft constant velocity joint

NOTE: Protect the boots from sharp tools and from the sharp edges of the surrounding components. Any damage to the boots or the clamps will result in leakage. Leakage will allow water to leak into the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joints. Leakage will also allow grease to leak out of the front wheel drive shaft tripot joints and the front wheel drive shaft constant velocity joints. Leakage may cause noisy front wheel drive axle operation and eventual failure of the internal components.

The clamps provide a leak proof connection for the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joint at the following locations:

- The housing
- The front wheel drive shaft

The thermoplastic material performs well under normal conditions and normal operation. However, the material is not strong enough to withstand the following conditions:

- Abusive handling
- Damage from sharp objects, such as sharp tools or any sharp edges of the surrounding components in the vehicle

Front Wheel Drive Shaft Tripot Joint (Inner Joint)

The front wheel drive shaft tri-pot joint is made with the tripot design without an over-extension limitation retainer.

The joint is constructed as follows for vehicles that are equipped with an automatic transmission:

- The left front wheel drive axle has a female spline. The female spline installs over a stub shaft that protrudes from the transaxle.
- The right front wheel drive axle has a female spline. The right front wheel drive axle uses barrel type snap rings in order to interlock with the intermediate shaft.

Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

The front wheel drive shaft constant velocity joint is made with the Rzeppa joint design.

The shaft end (which mates with the knuckle/hub) has a helical spline. The helical spline ensures a tight, press-type fit.

This design prevents end play between the hub bearing and the front wheel drive axle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
--------------	----------------------------

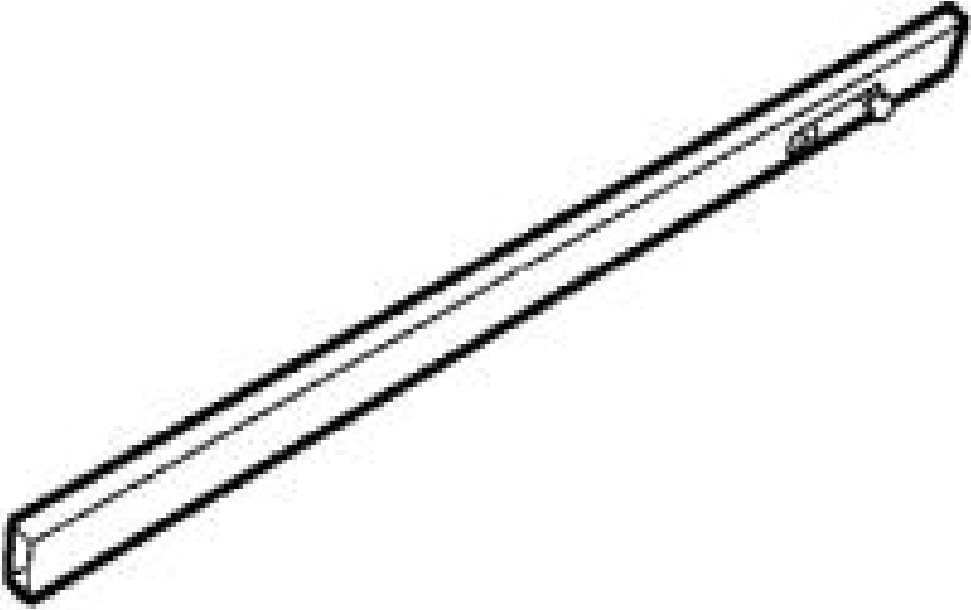
Illustration	Tool Number/Description
	EN-956-1 KM-956-1 Extension

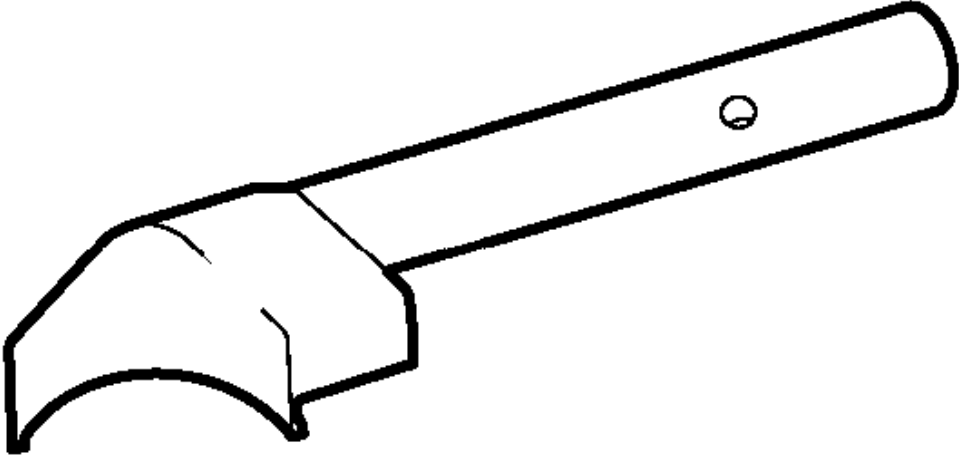
Illustration	Tool Number/Description
	CH-6003 KM-6003 J-330087-A Axle Shaft Remover

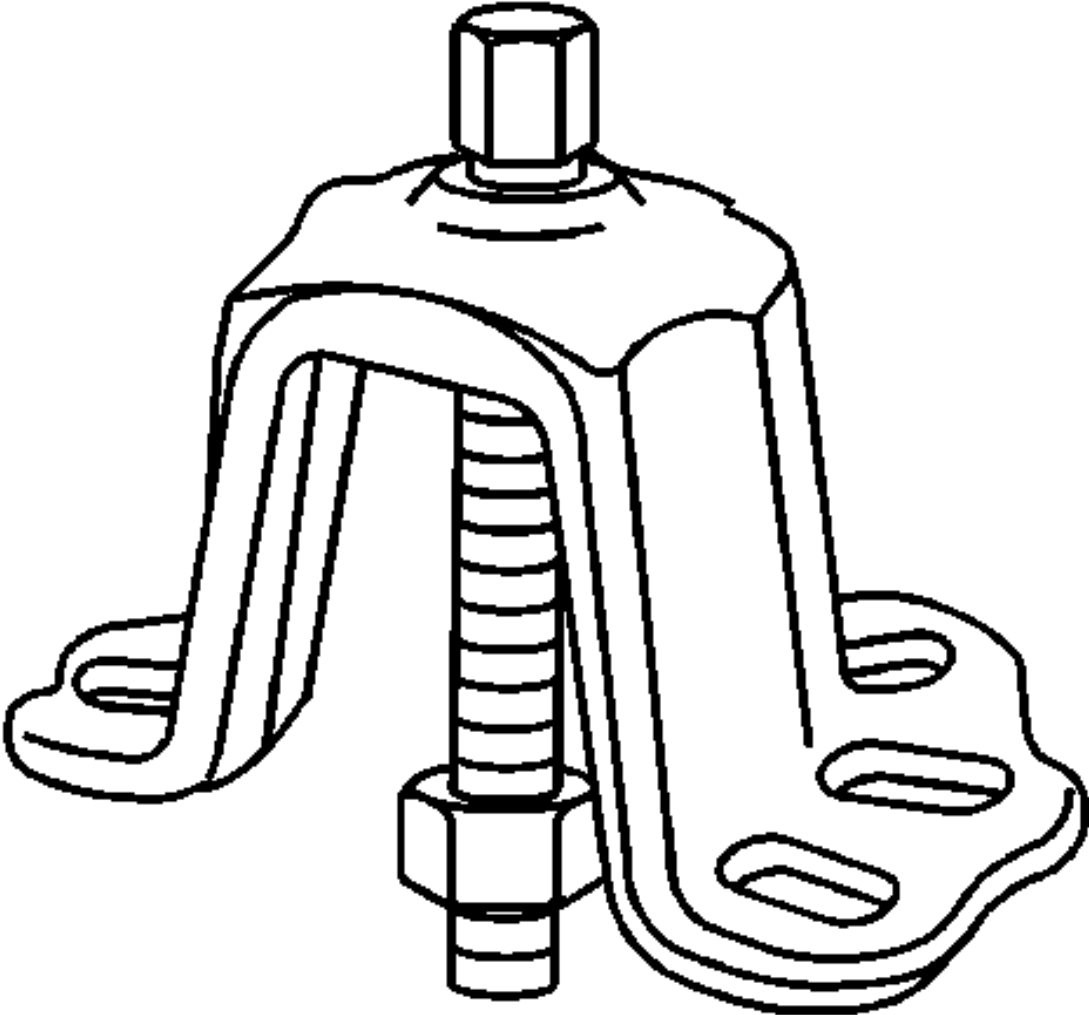
Illustration	Tool Number/Description
	CH 28733-B J 28733-B Wheel Hub and Driveshaft Remover

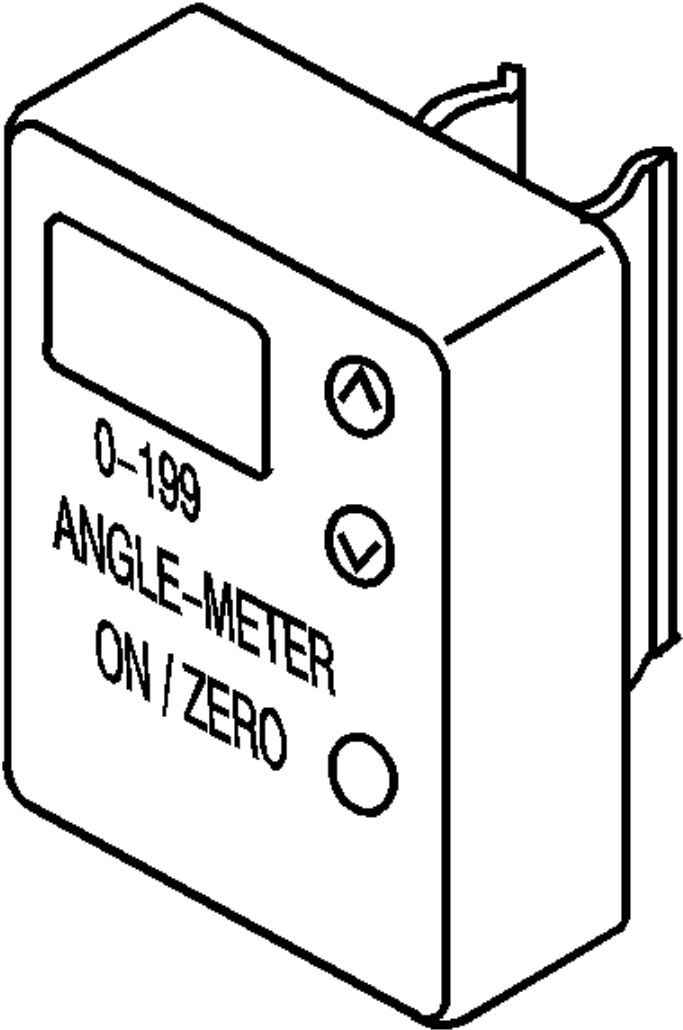
Illustration	Tool Number/Description
	EN-45059 J-45059 Angle Meter

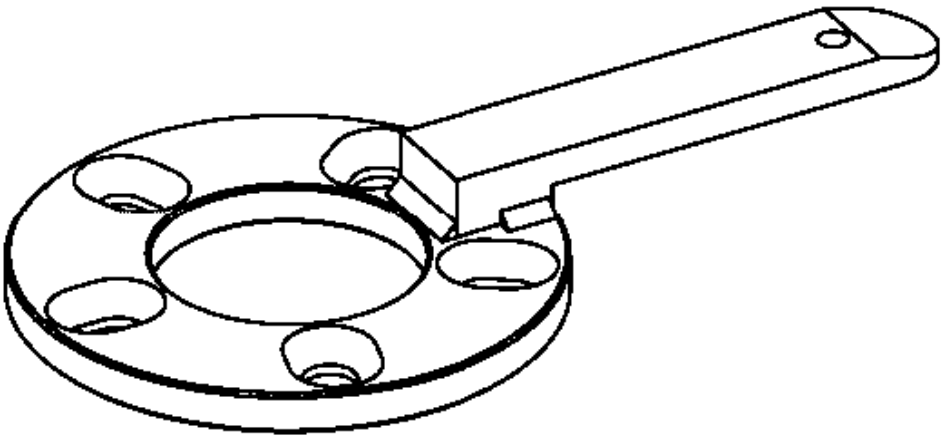
Illustration	Tool Number/Description
	CH-49376 Holding Wrench

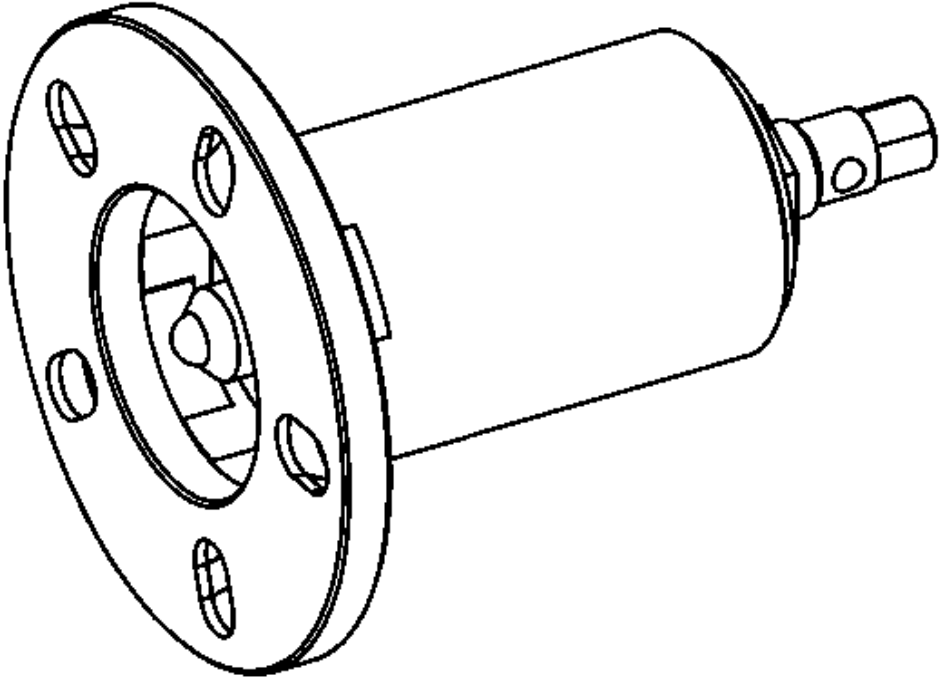
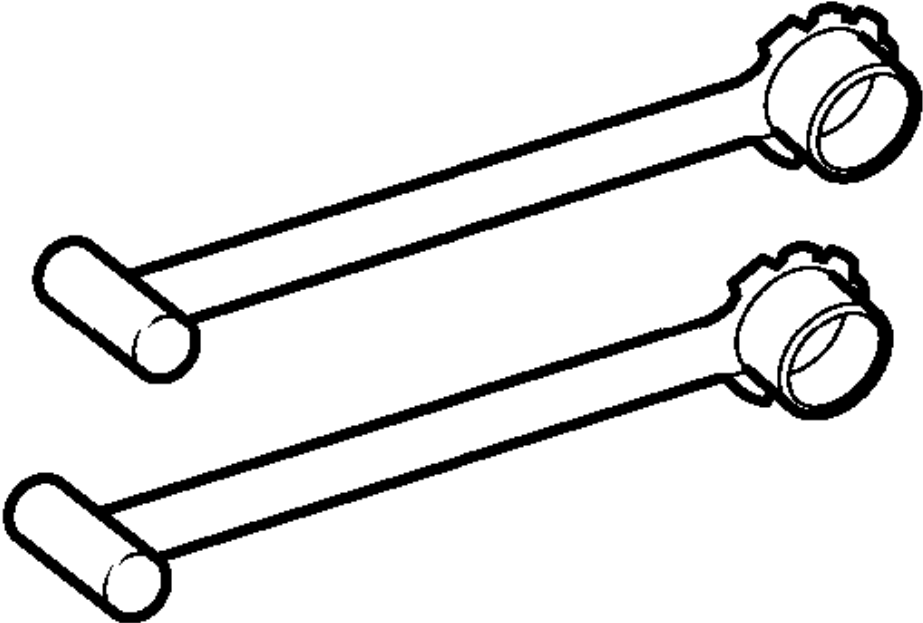
Illustration	Tool Number/Description
	CH-49400 J-42129 Hub Spindle Remover

Illustration	Tool Number/Description
	DT-51504 DT-6332 KM-6332 J-44396 J-44394-A Seal Protector

Article GUID: A00884724

SYSTEM WIRING DIAGRAMS

Chevrolet - Volt

ACTIVE BODYWORKS

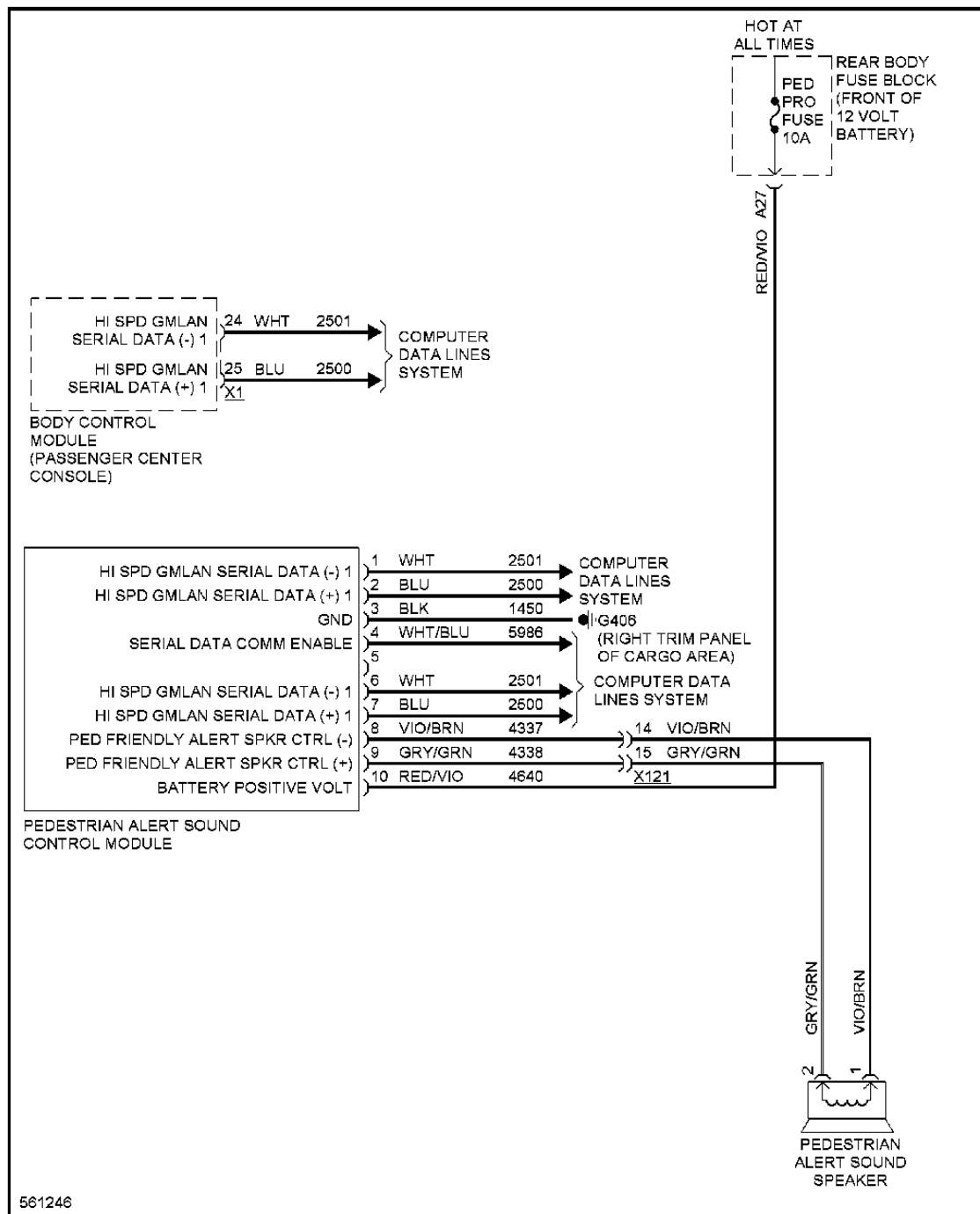


Fig. 1: Active Bodyworks Circuit

AIR CONDITIONING

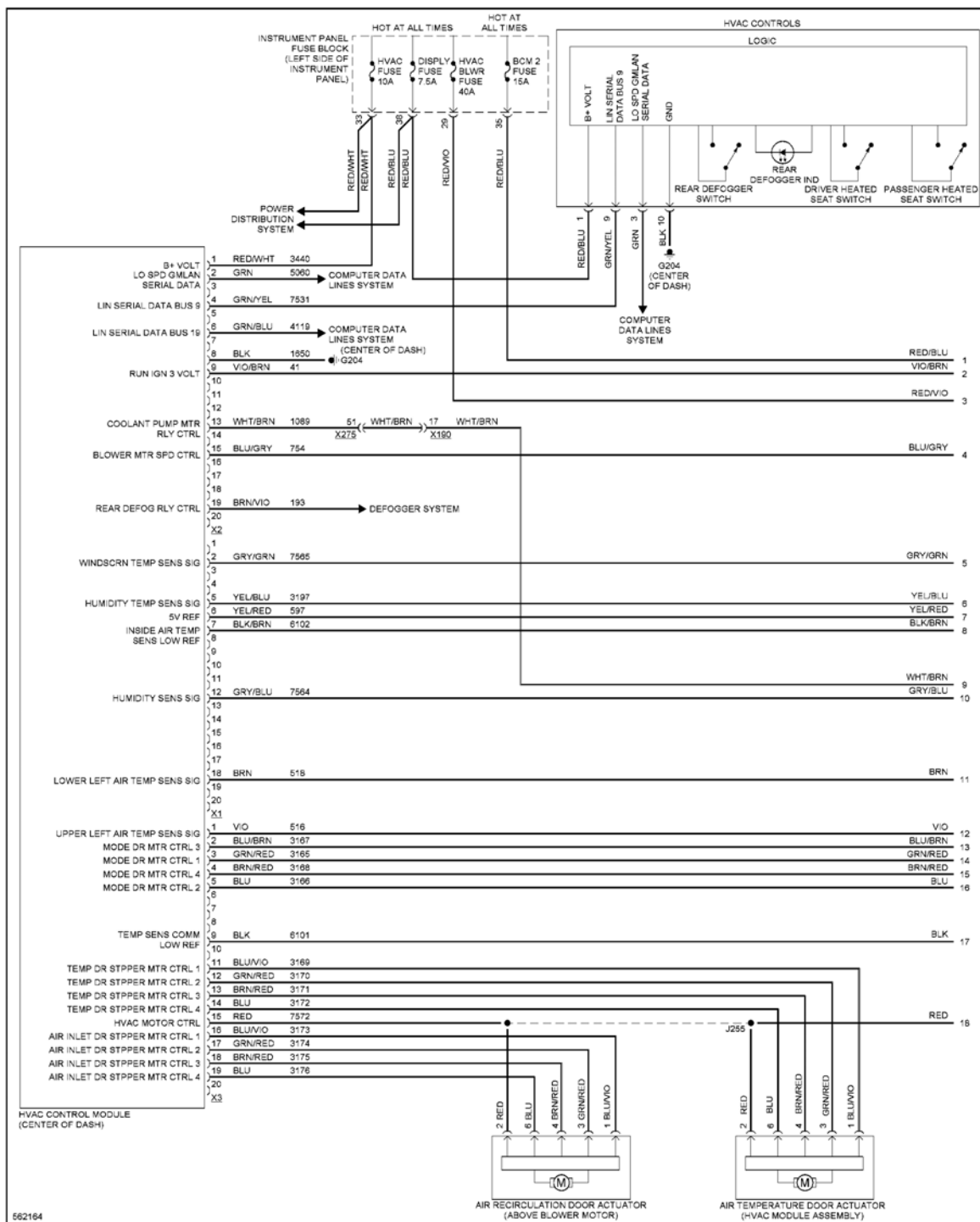


Fig. 2: Automatic A/C Circuit (1 of 6)

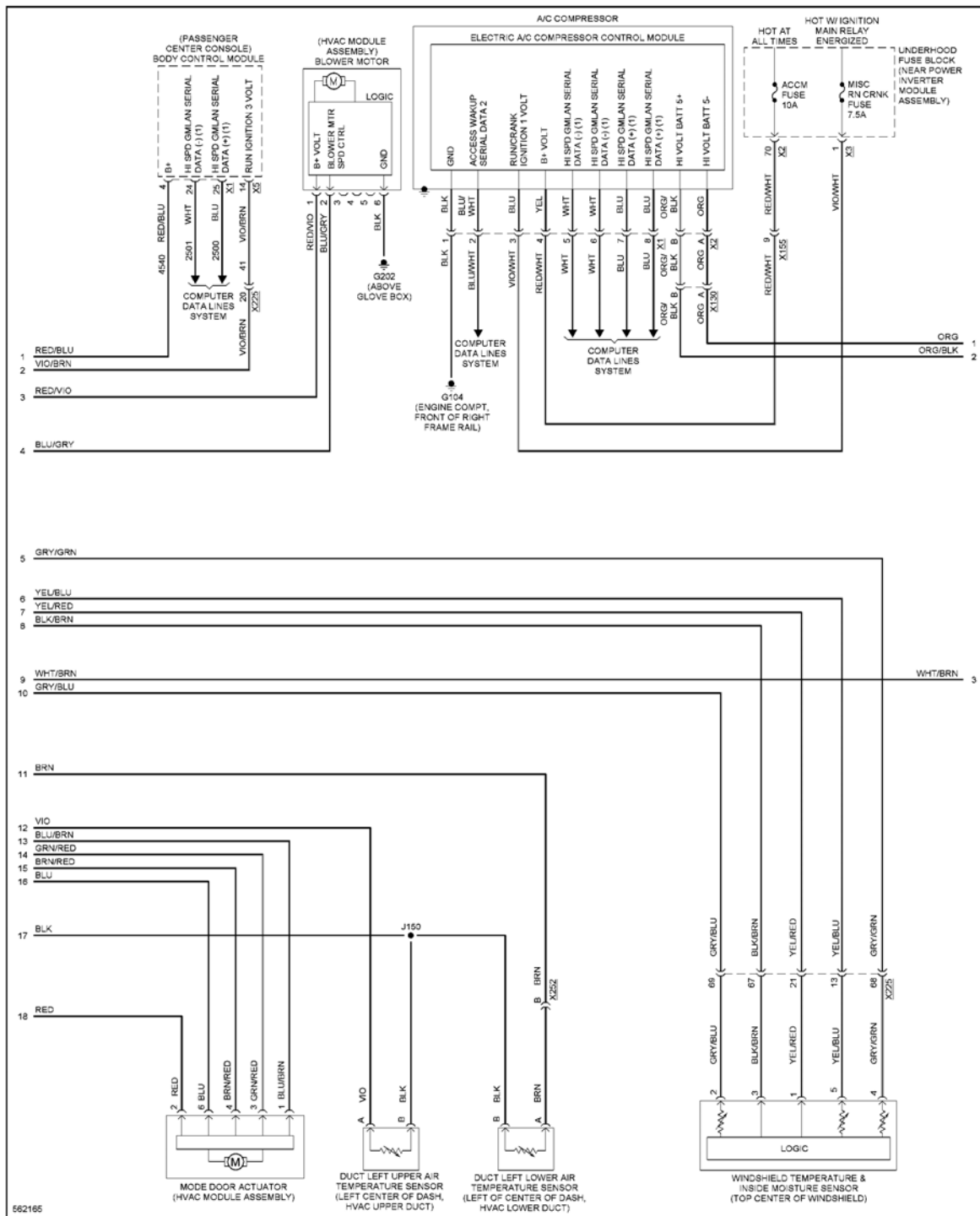


Fig. 3: Automatic A/C Circuit (2 of 6)

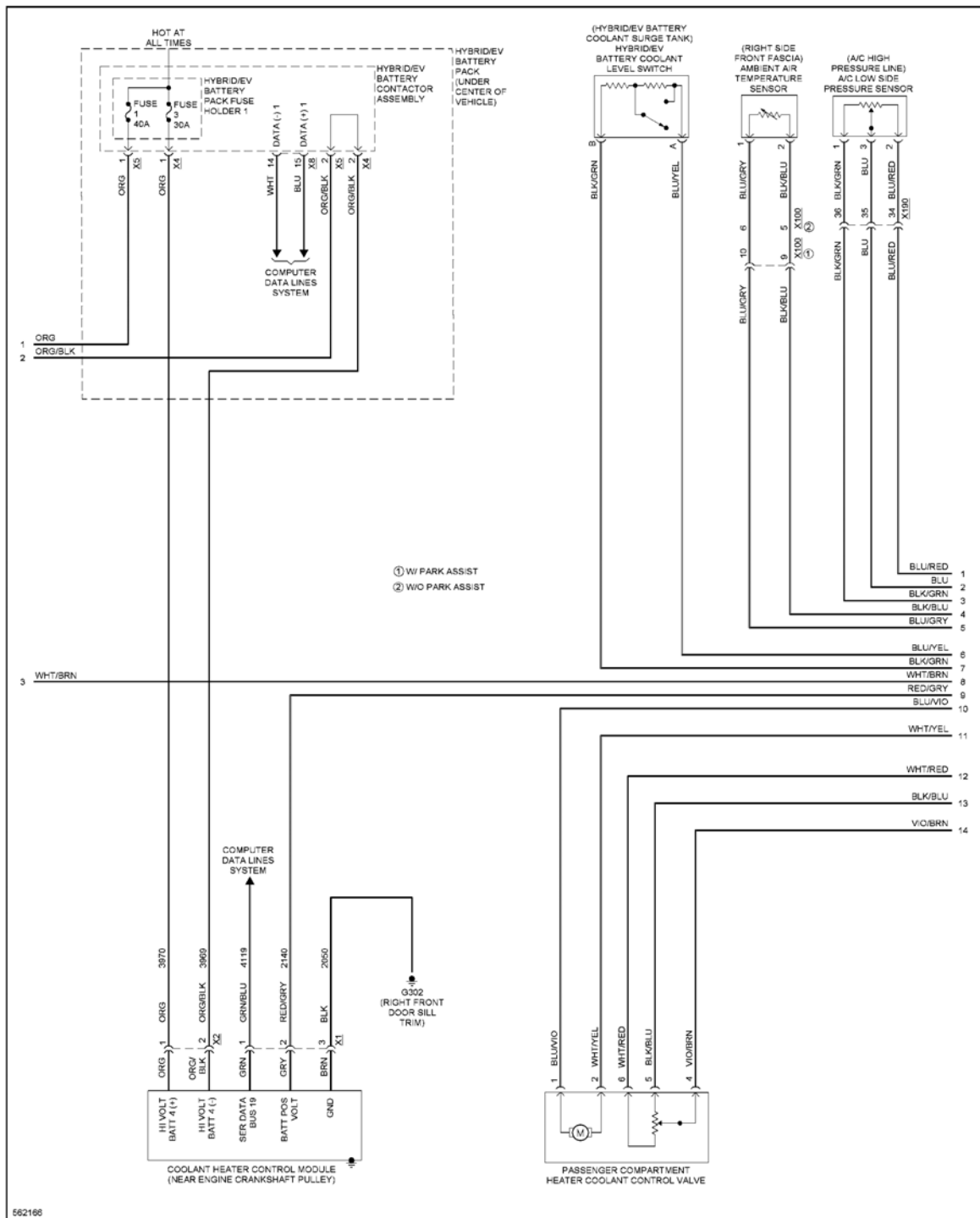


Fig. 4: Automatic A/C Circuit (3 of 6)

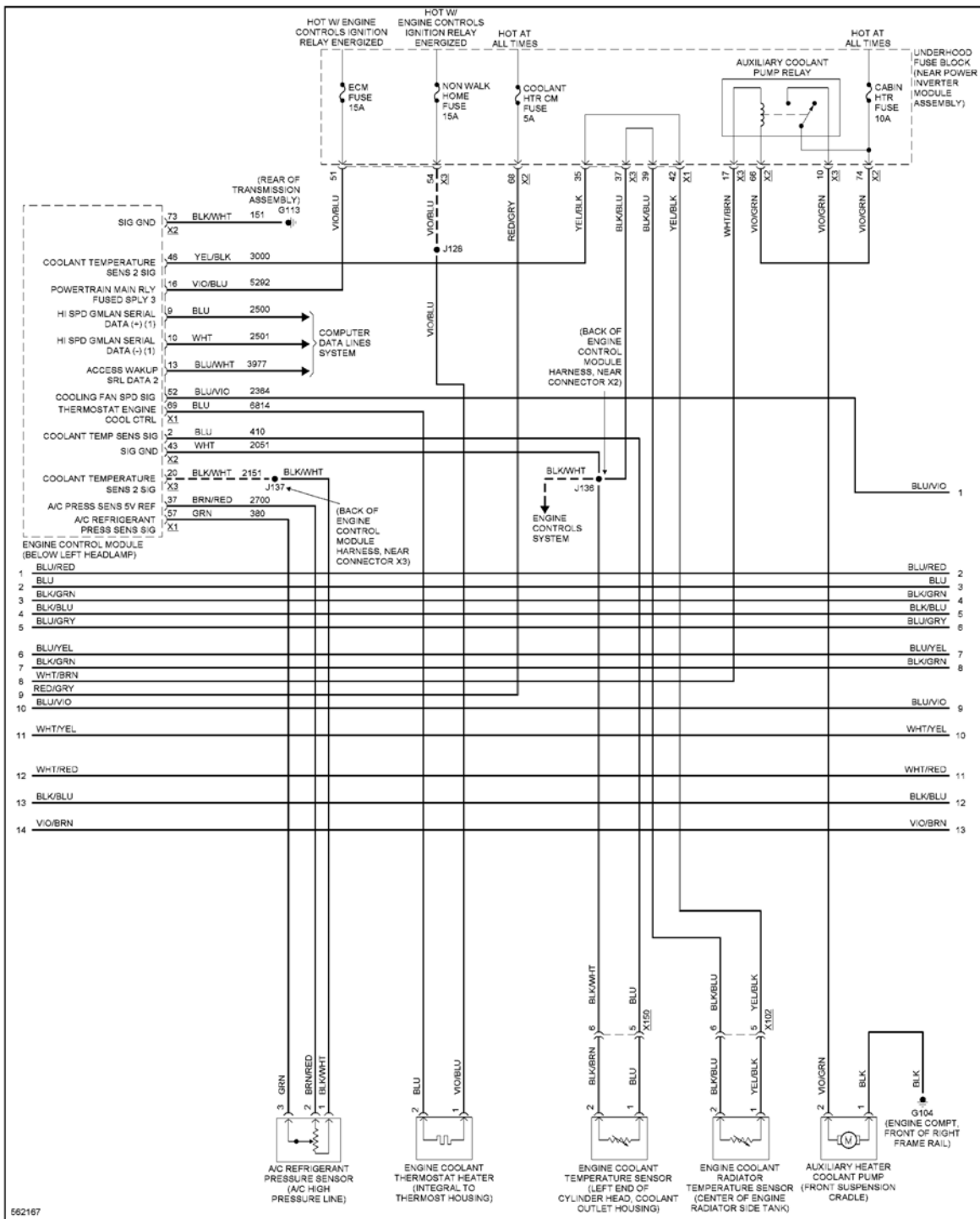


Fig. 5: Automatic A/C Circuit (4 of 6)

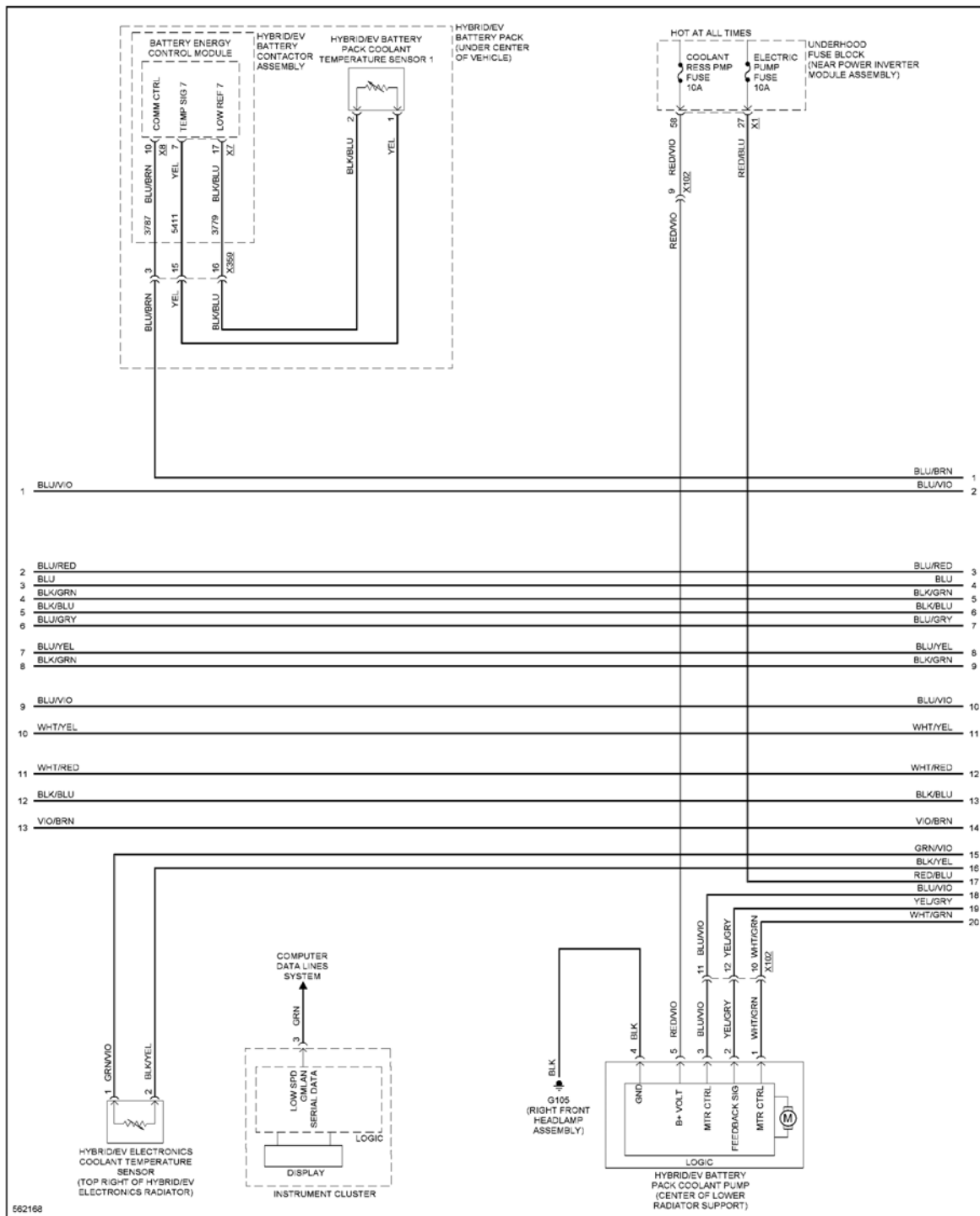
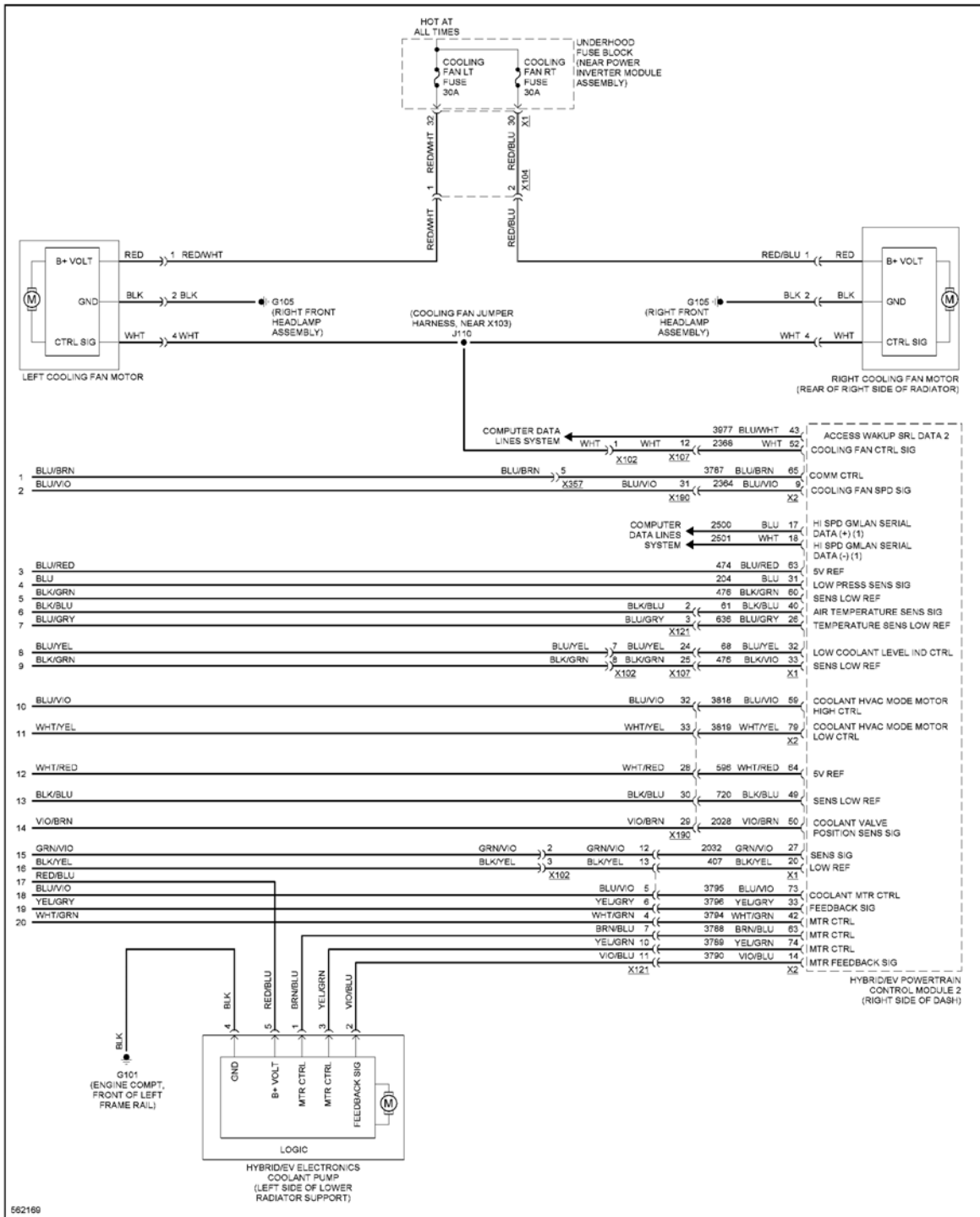


Fig. 6: Automatic A/C Circuit (5 of 6)



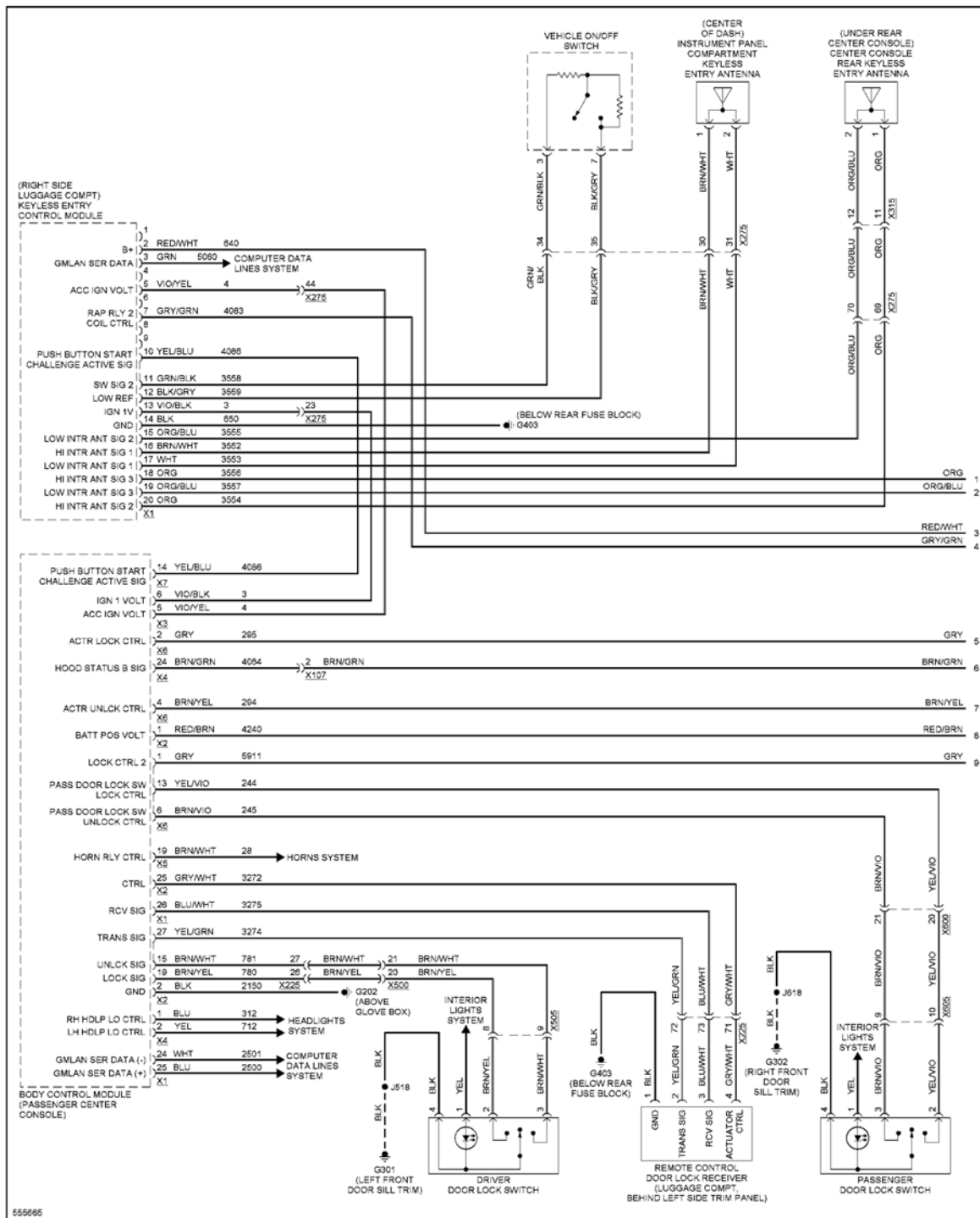


Fig. 10: Forced Entry Circuit, W/ Passive Keyless Entry (1 of 4)

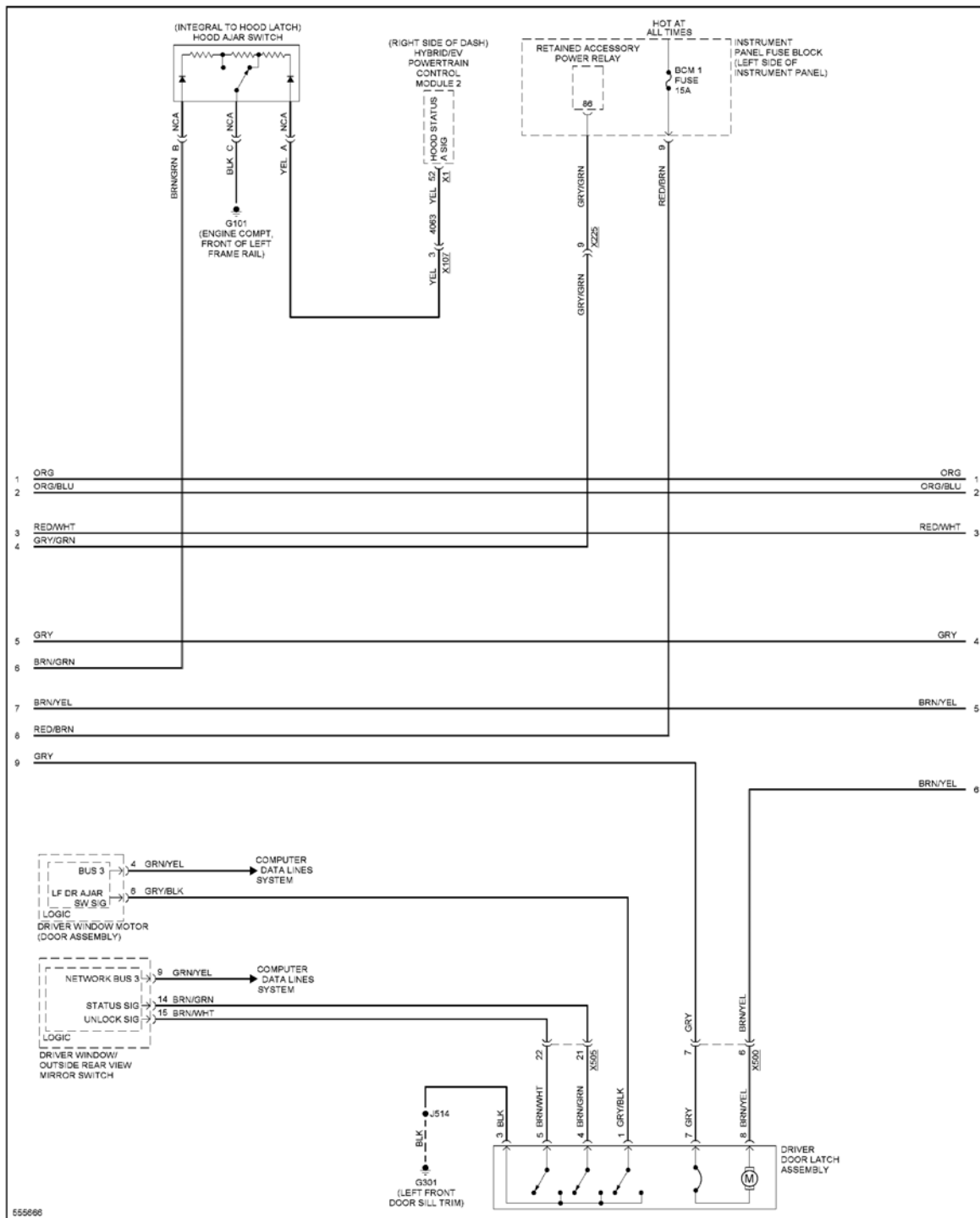


Fig. 11: Forced Entry Circuit, W/ Passive Keyless Entry (2 of 4)

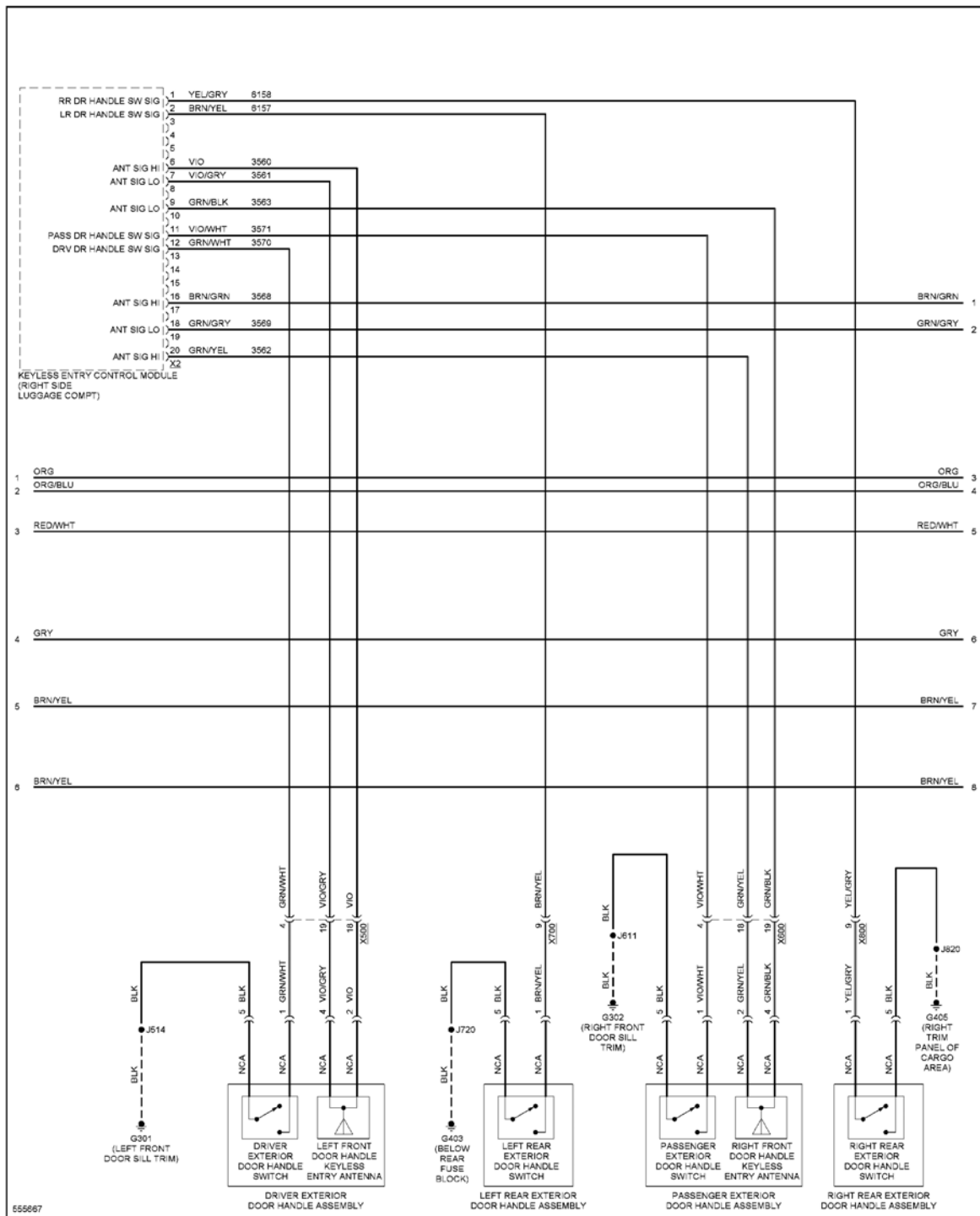


Fig. 12: Forced Entry Circuit, W/ Passive Keyless Entry (3 of 4)

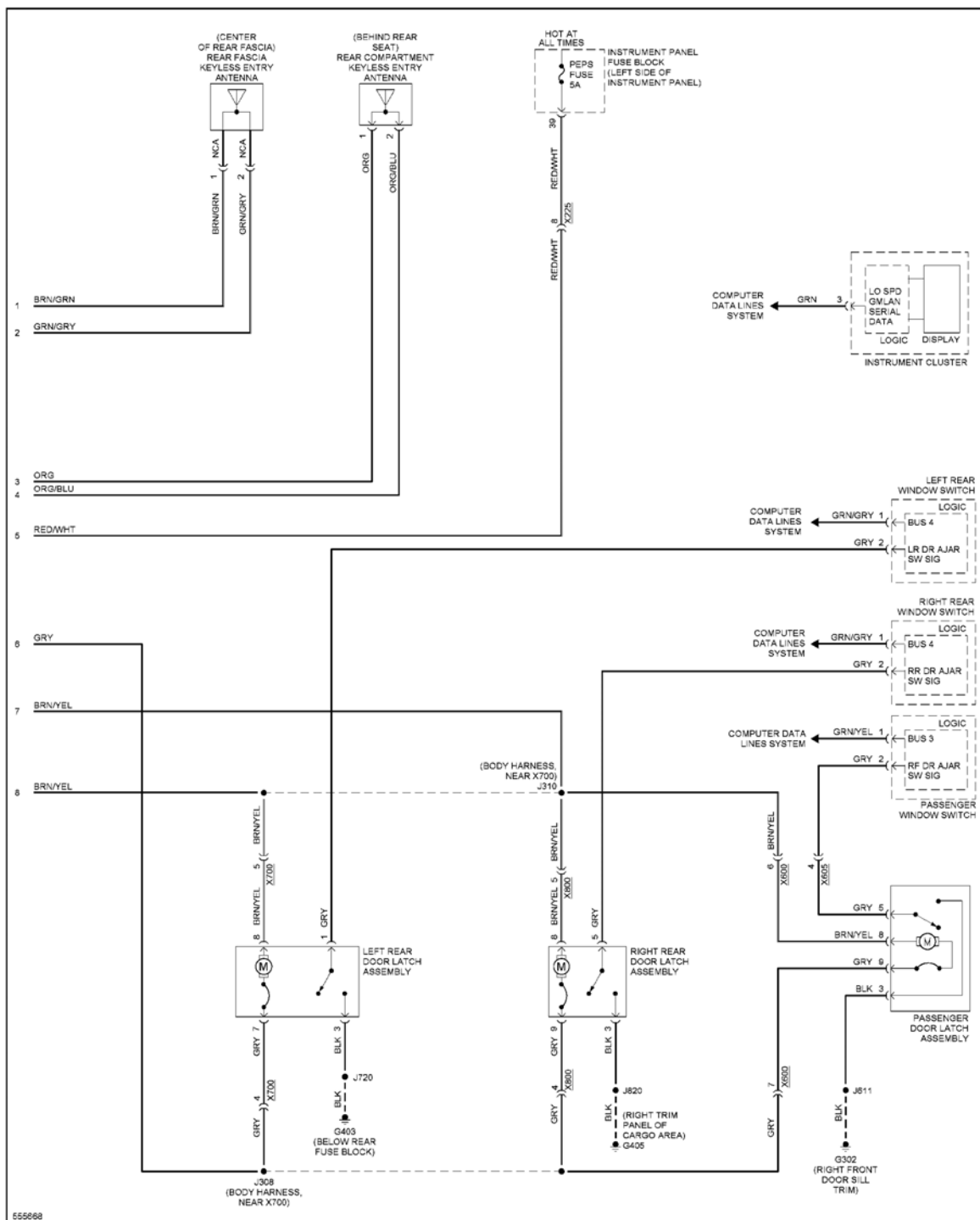


Fig. 13: Forced Entry Circuit, W/ Passive Keyless Entry (4 of 4)

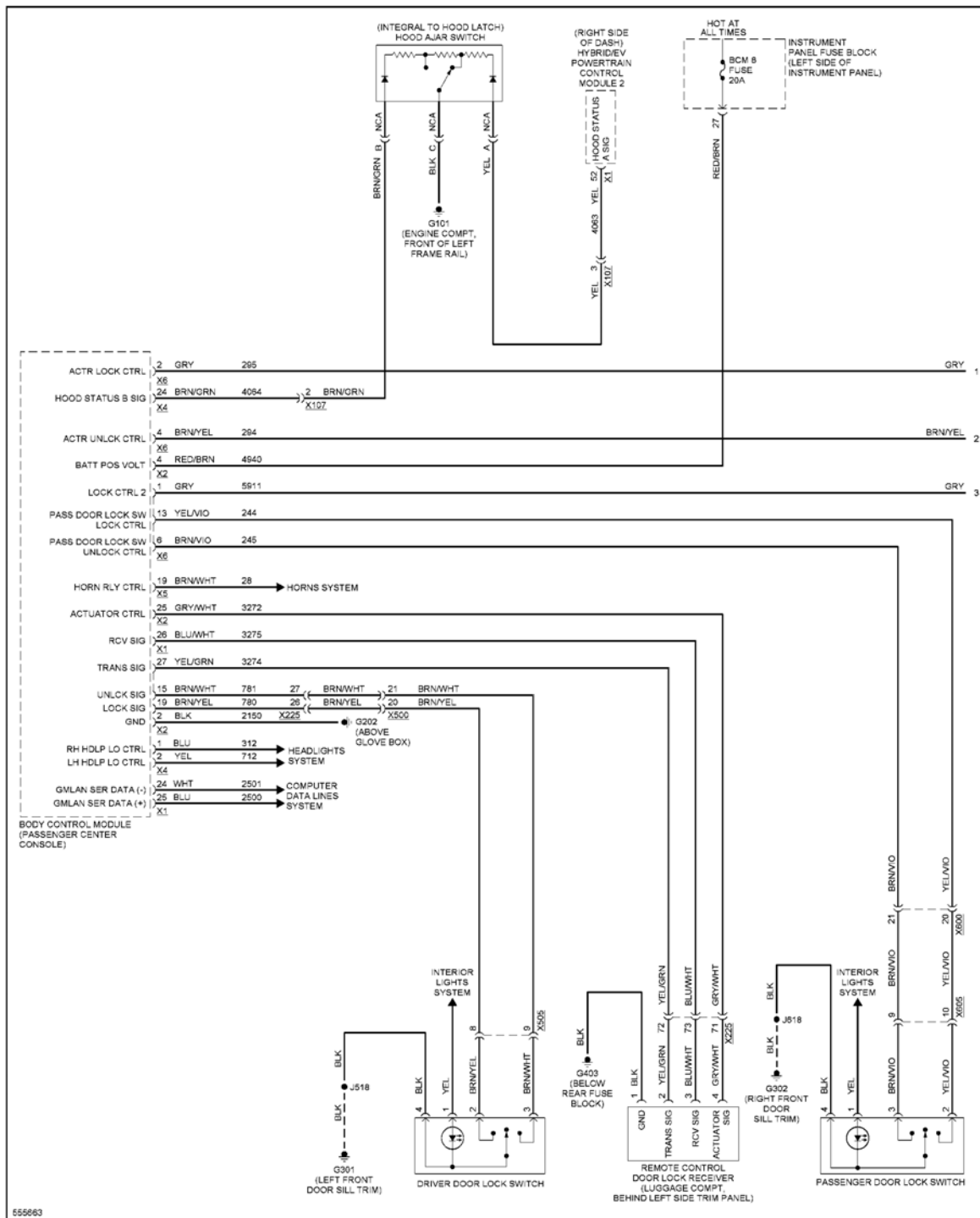


Fig. 14: Forced Entry Circuit, W/O Passive Keyless Entry (1 of 2)

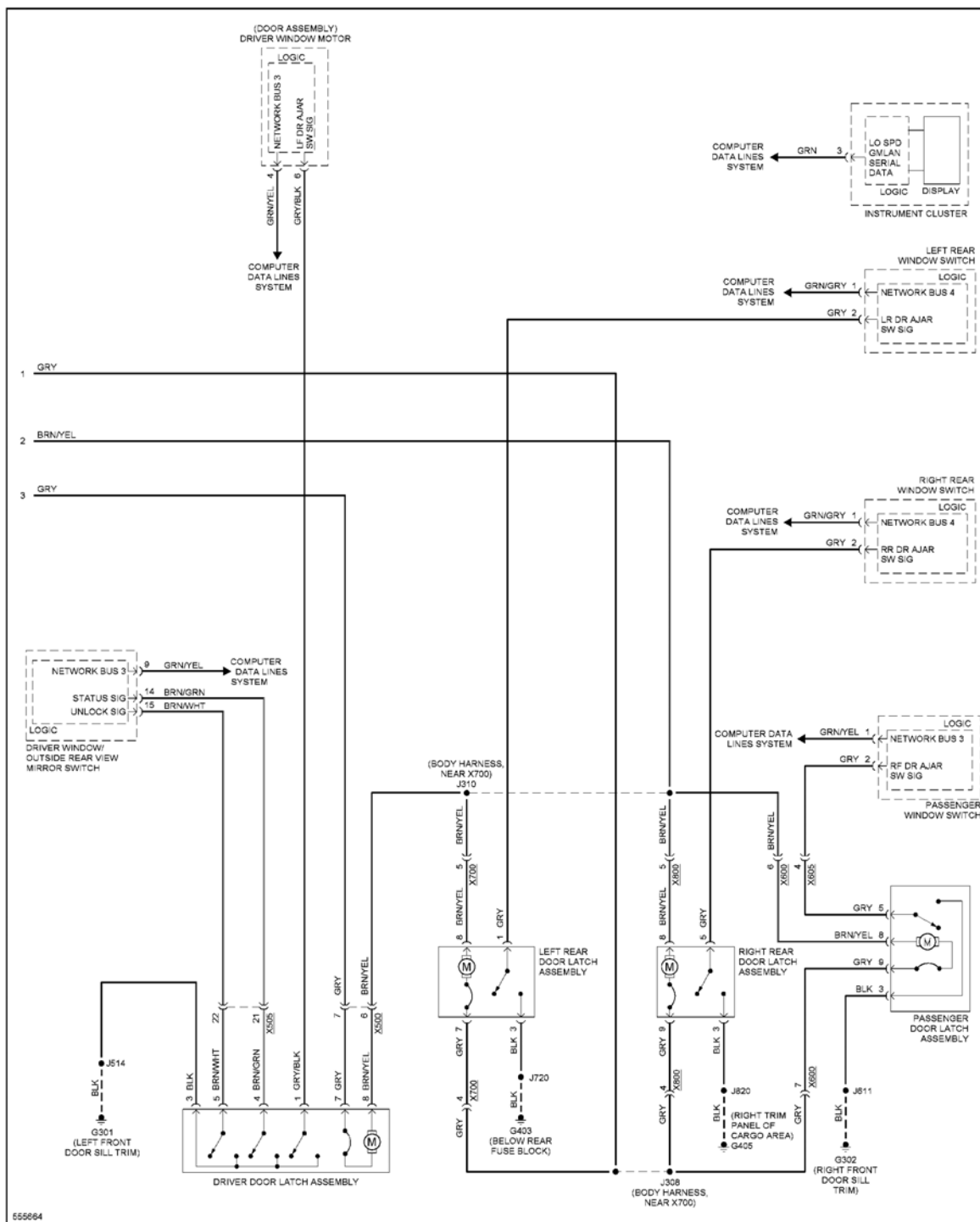


Fig. 15: Forced Entry Circuit, W/O Passive Keyless Entry (2 of 2)

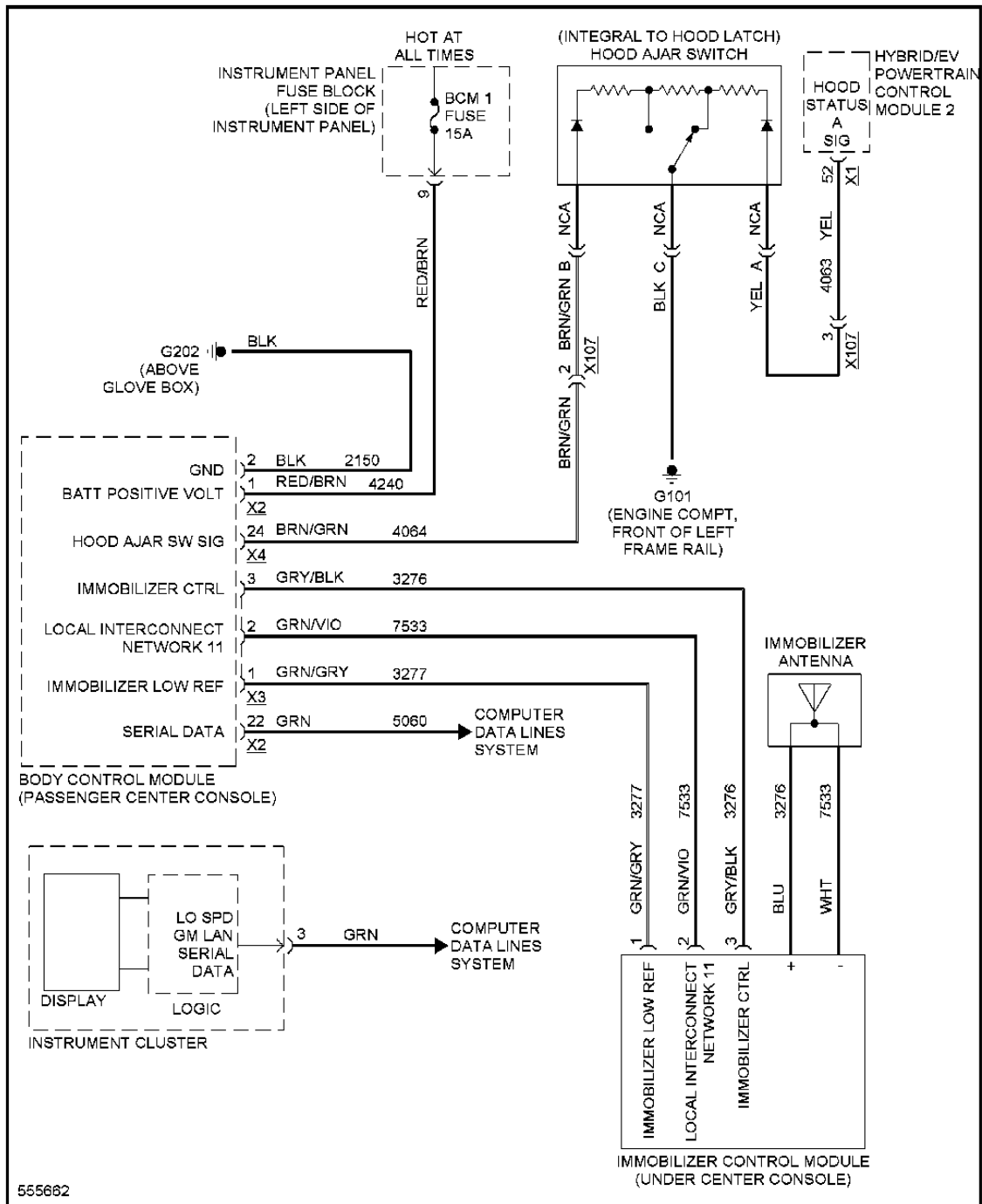
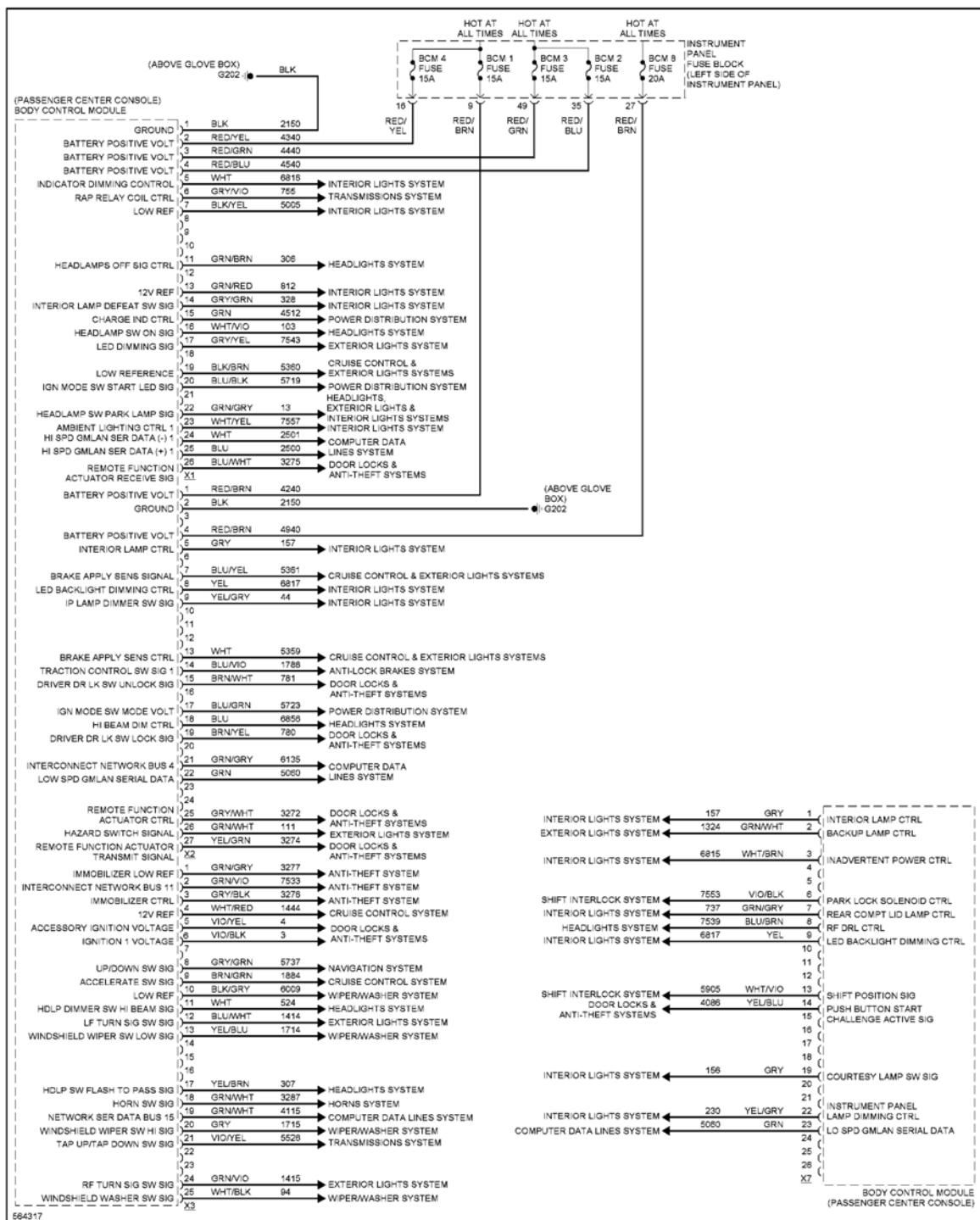


Fig. 16: Pass-Key Circuit

BODY CONTROL MODULES



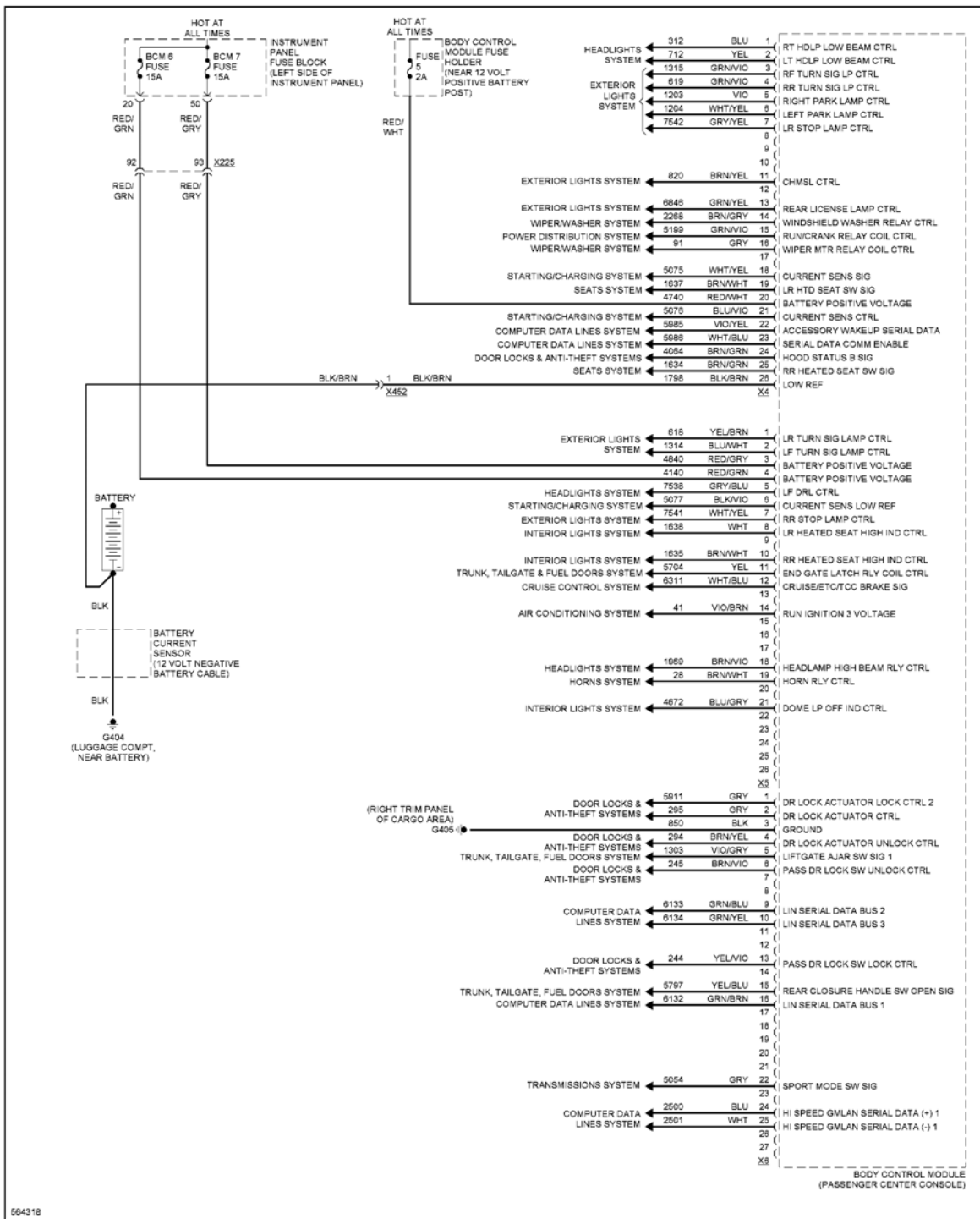


Fig. 18: Body Control Modules Circuit (2 of 2)

COMPUTER DATA LINES

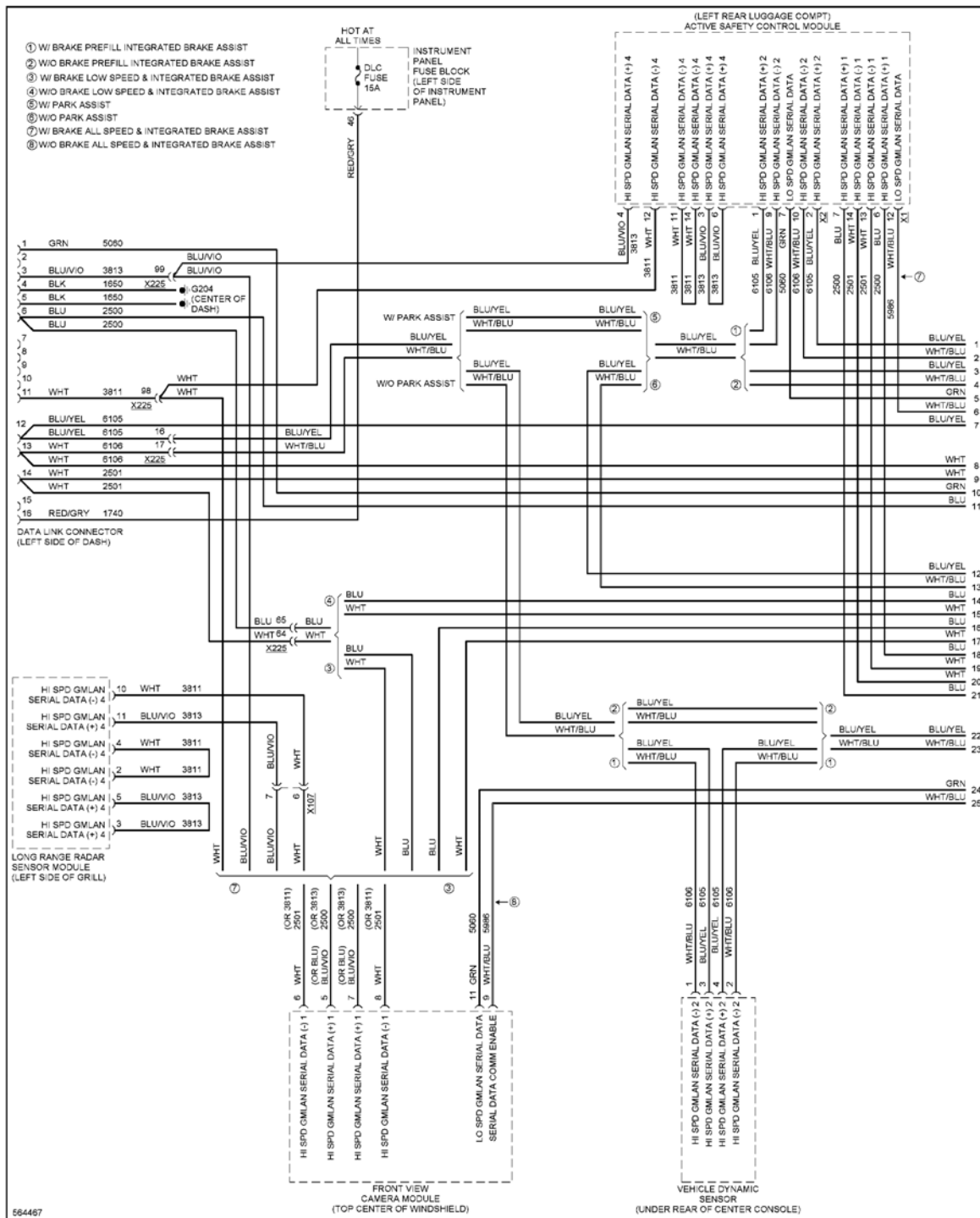


Fig. 19: Computer Data Lines Circuit (1 of 5)

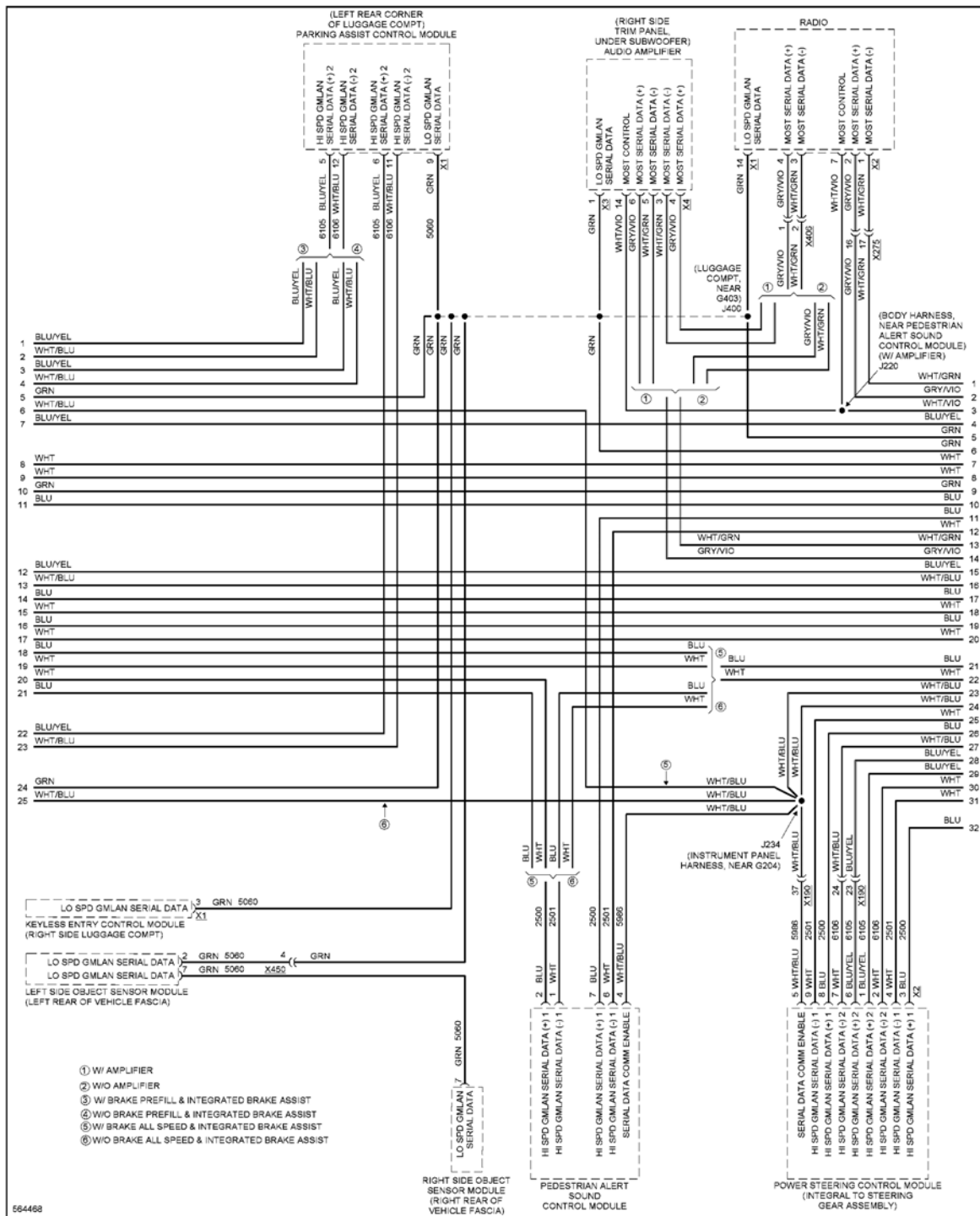


Fig. 20: Computer Data Lines Circuit (2 of 5)

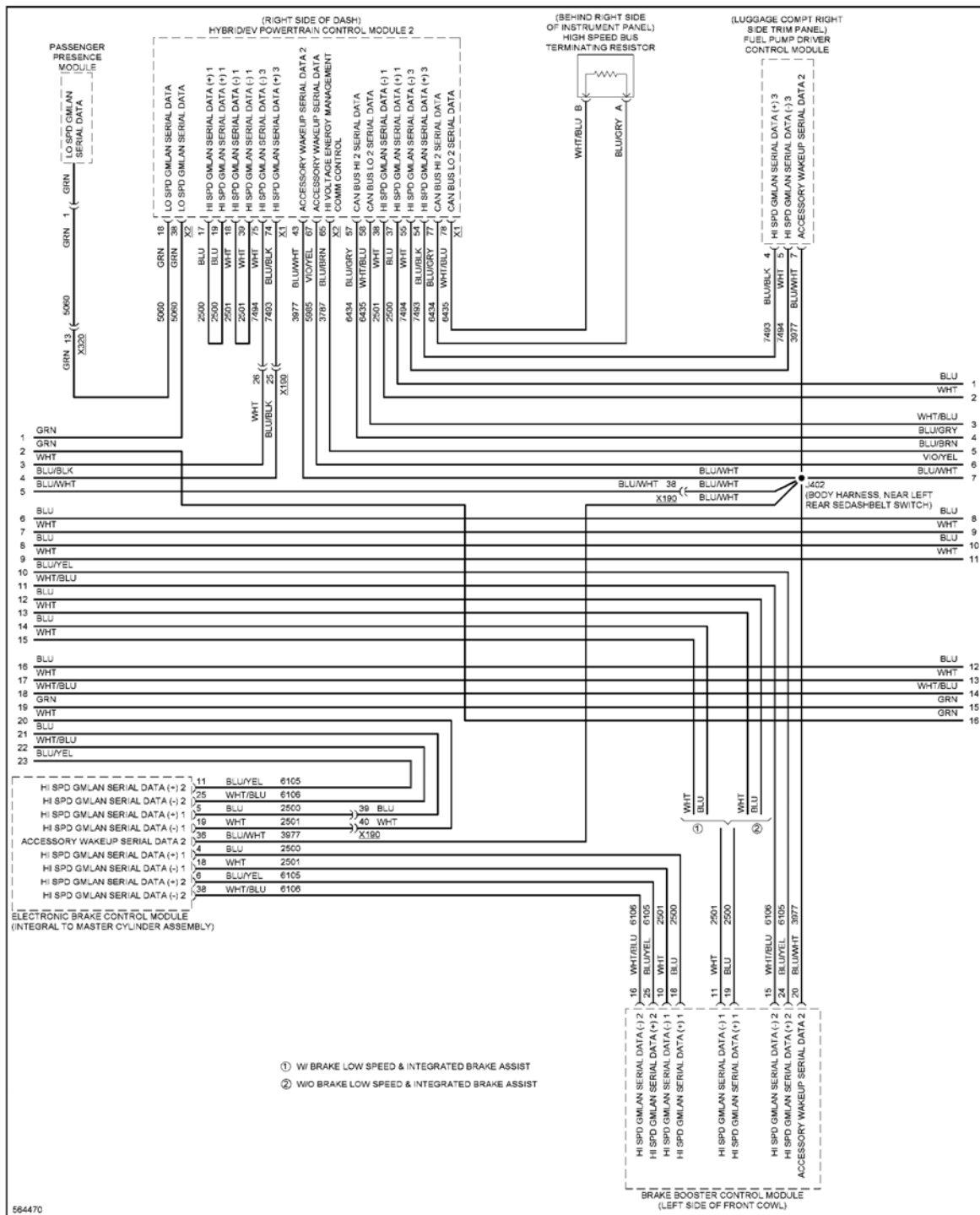


Fig. 22: Computer Data Lines Circuit (4 of 5)

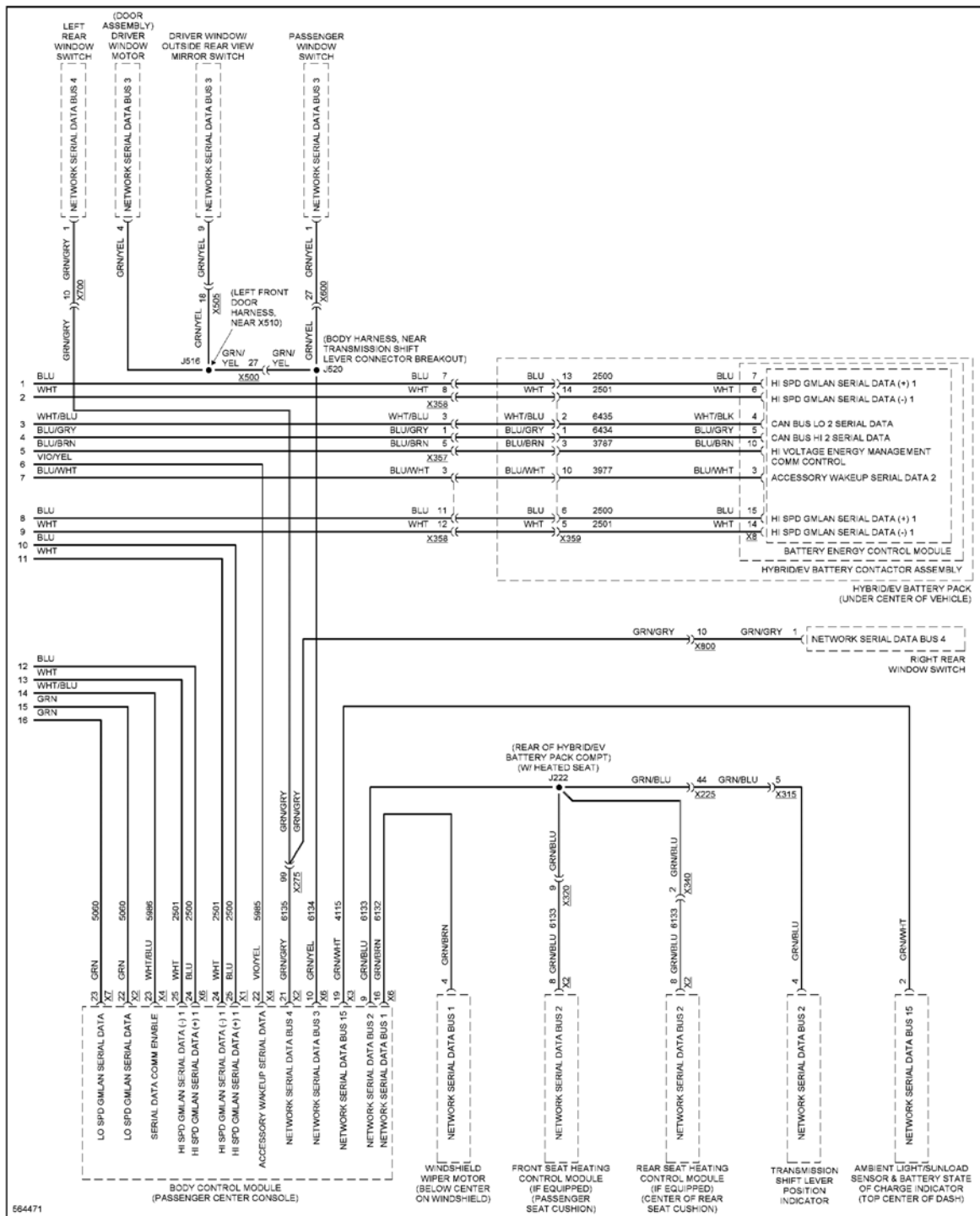


Fig. 23: Computer Data Lines Circuit (5 of 5)

COOLING FAN

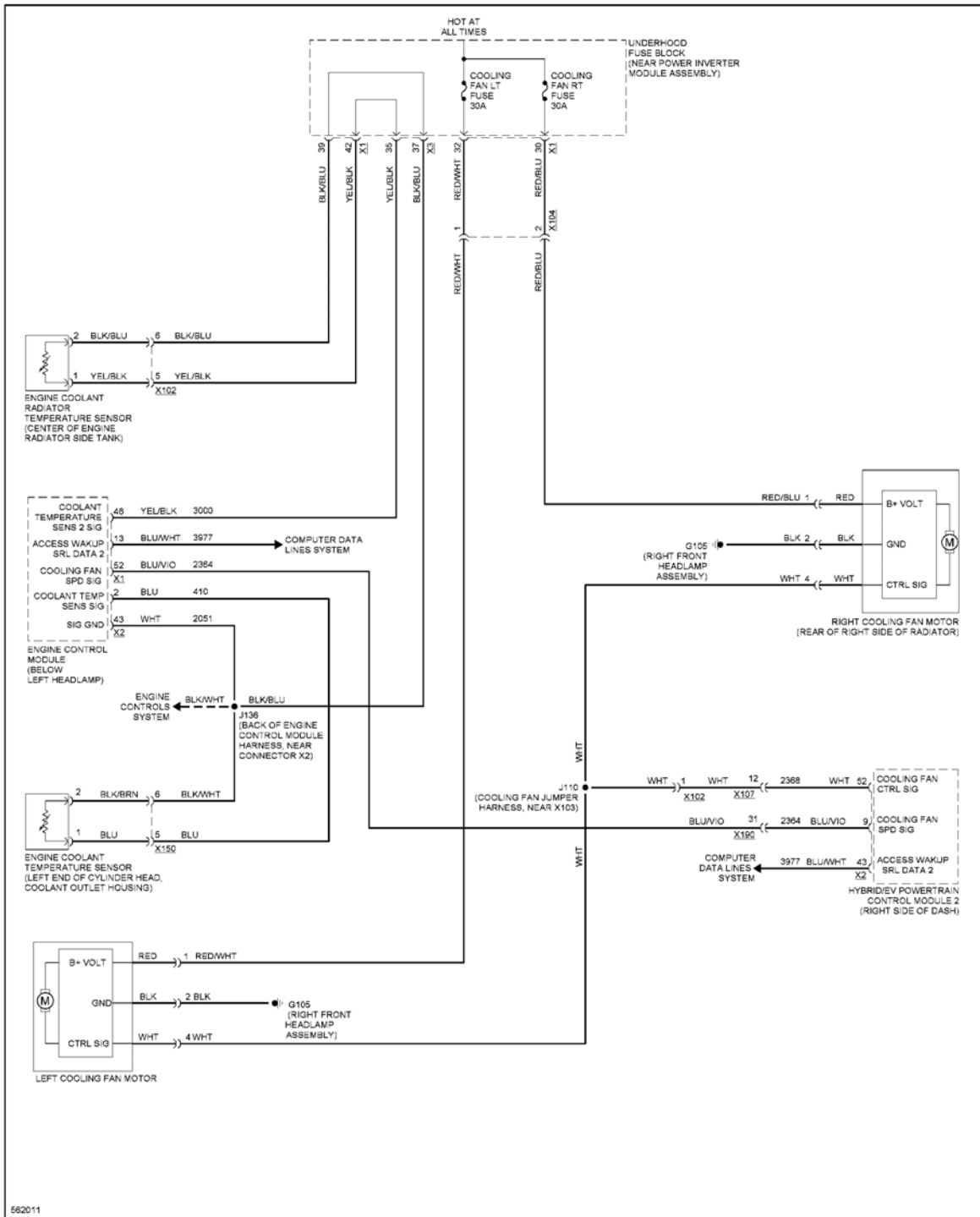
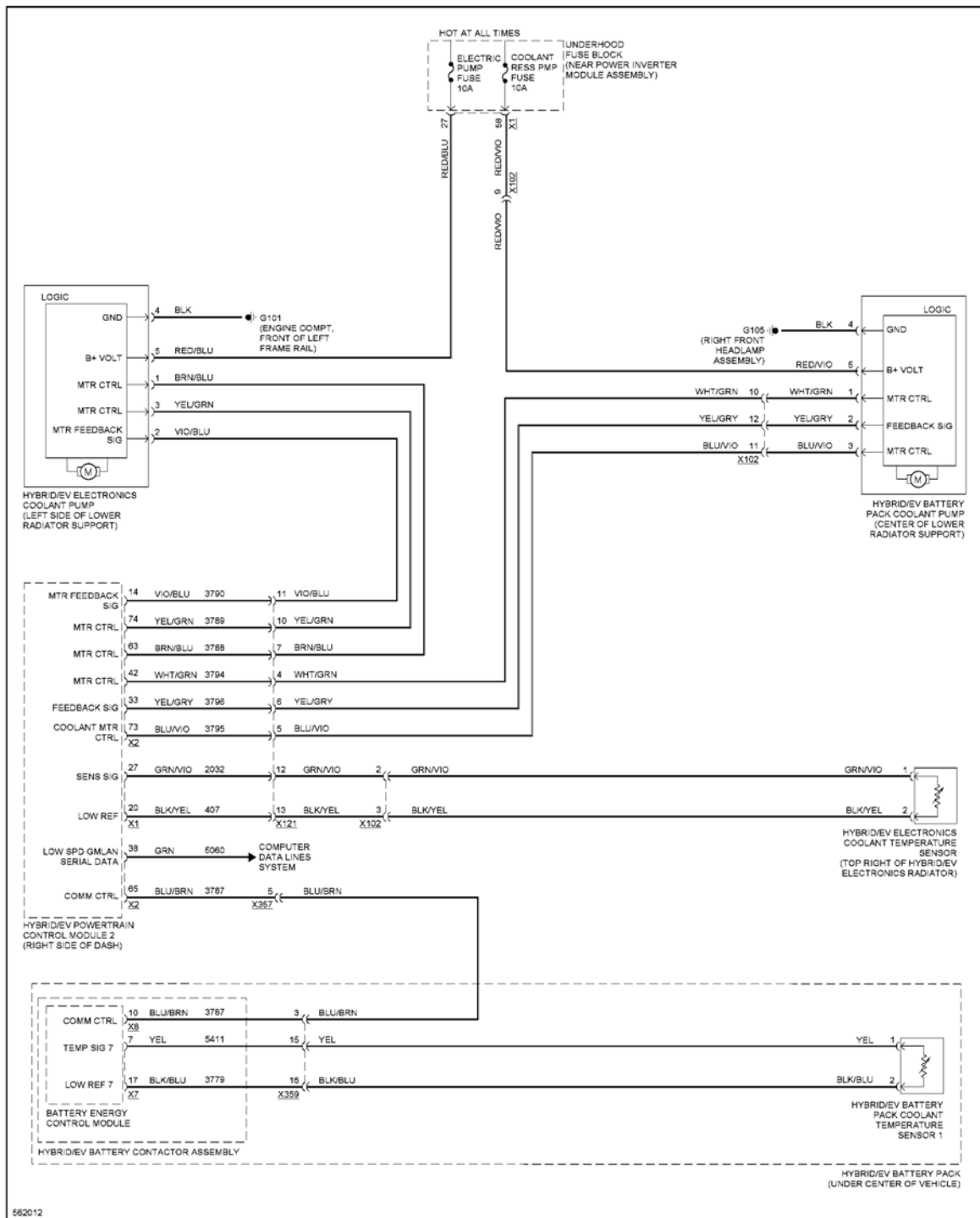


Fig. 24: Cooling Fan Circuit



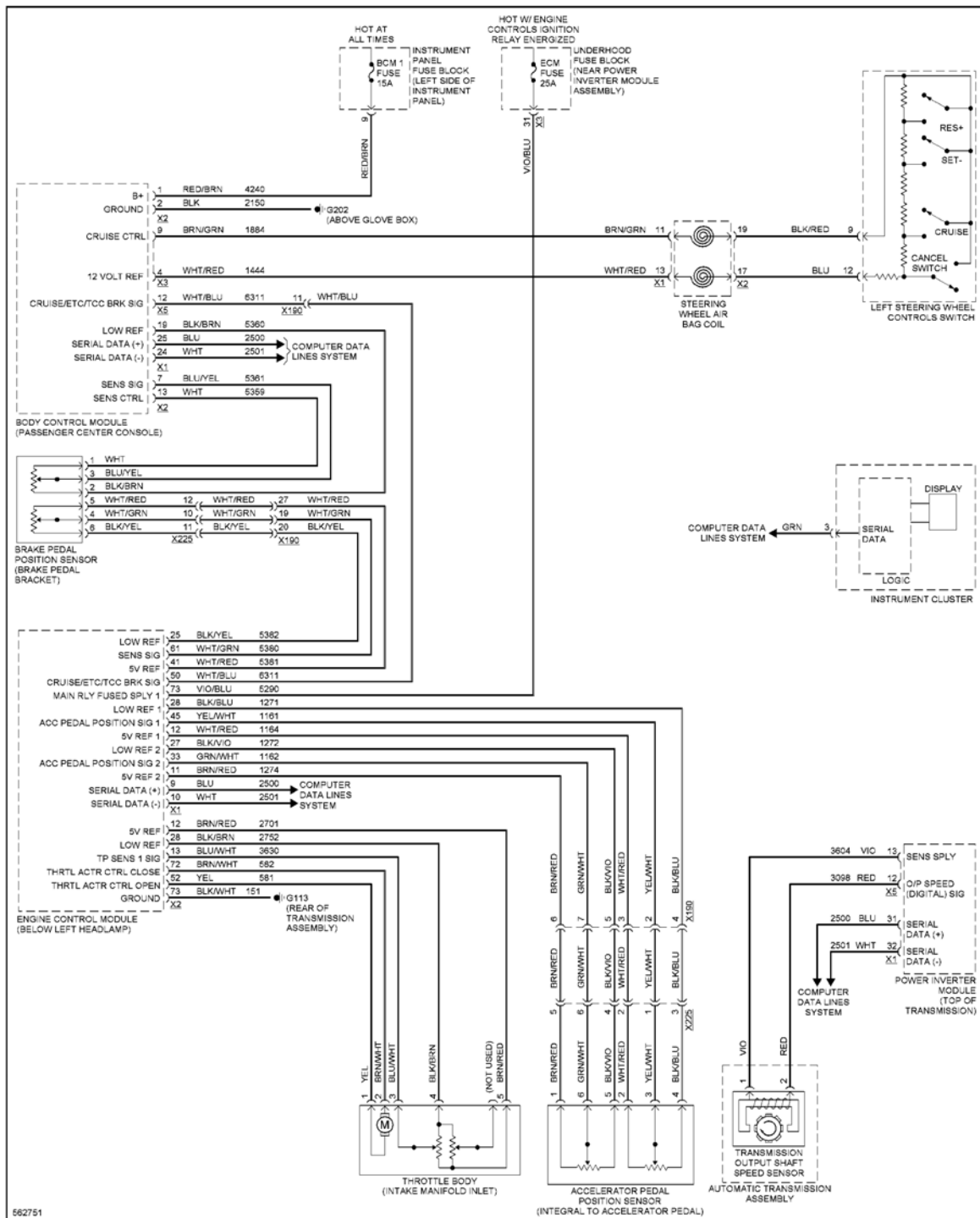


Fig. 26: Cruise Control Circuit

DEFOGGERS

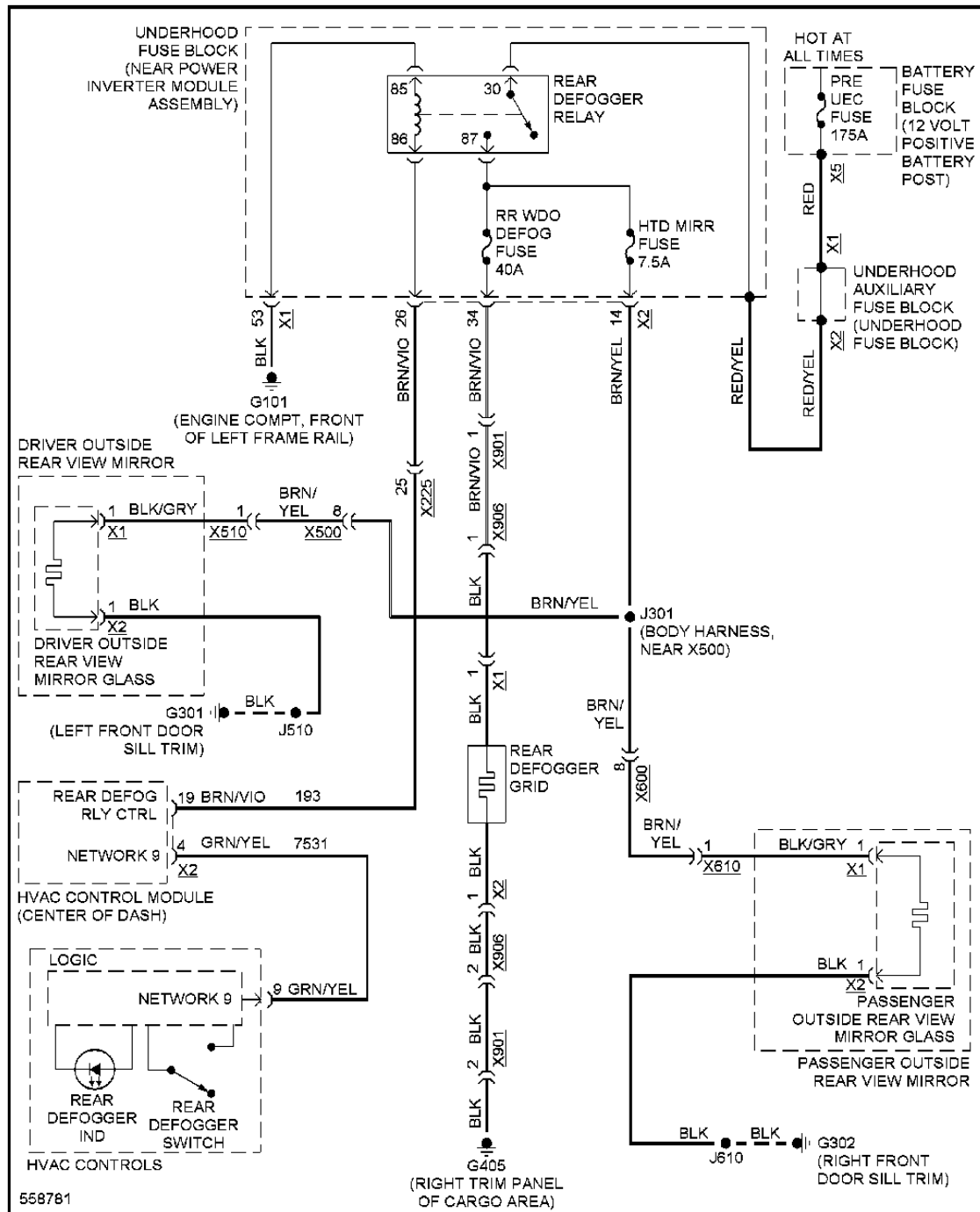


Fig. 27: Defoggers Circuit

ELECTRONIC POWER STEERING

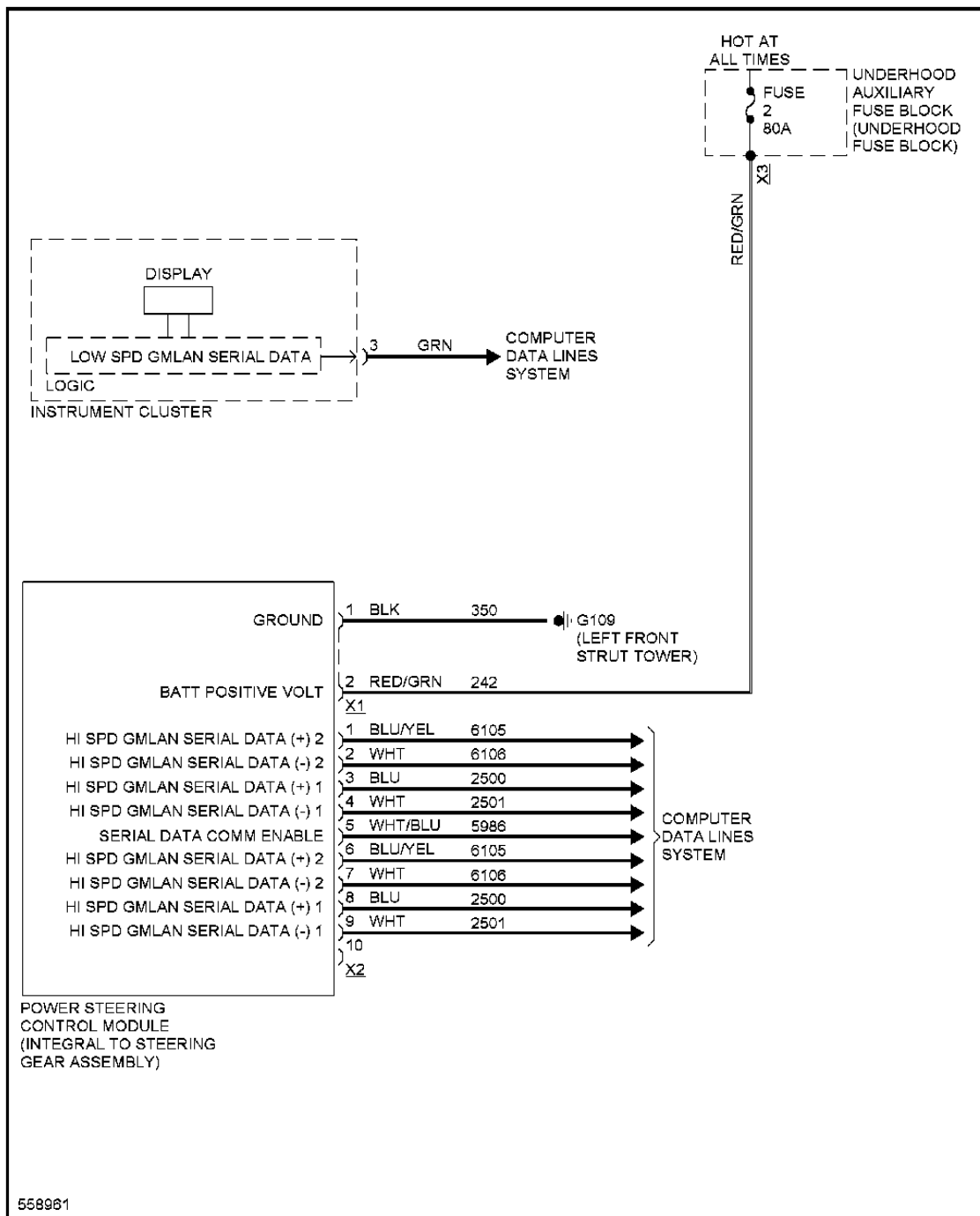


Fig. 28: Electronic Power Steering Circuit

ENGINE PERFORMANCE

1.5L VIN 5

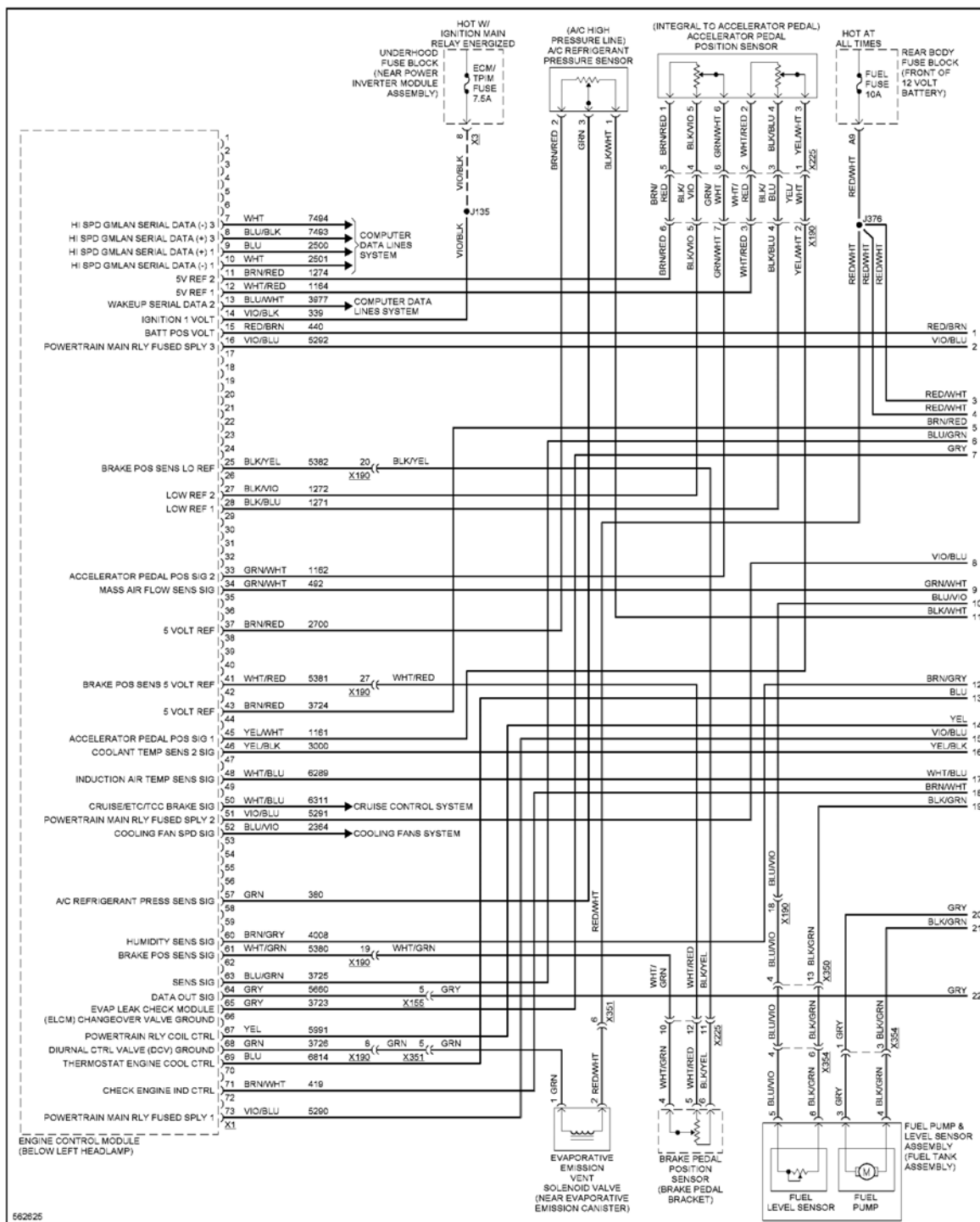


Fig. 29: 1.5L VIN 5, Engine Controls Circuit (1 of 7)

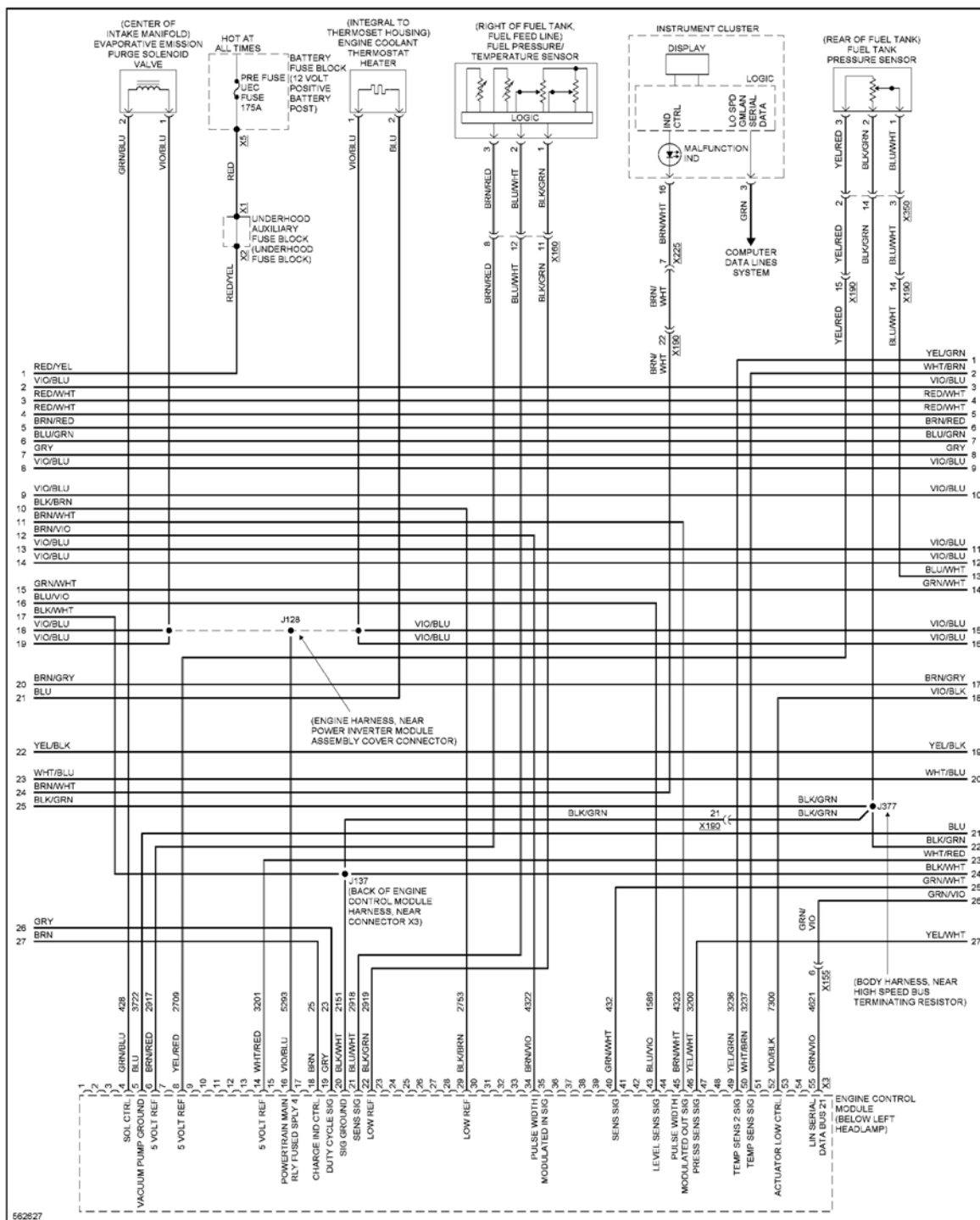


Fig. 31: 1.5L VIN 5, Engine Controls Circuit (3 of 7)

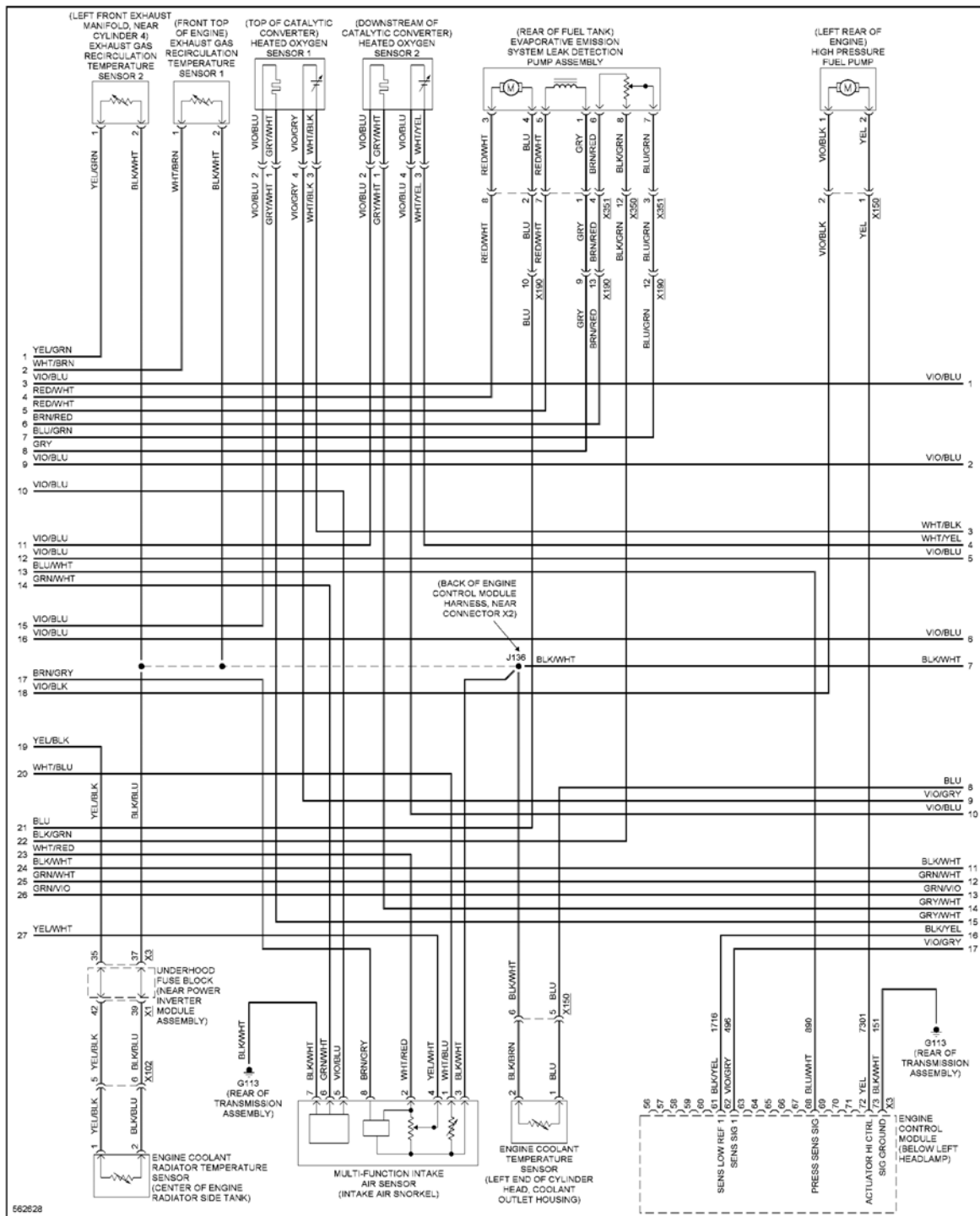


Fig. 32: 1.5L VIN 5, Engine Controls Circuit (4 of 7)

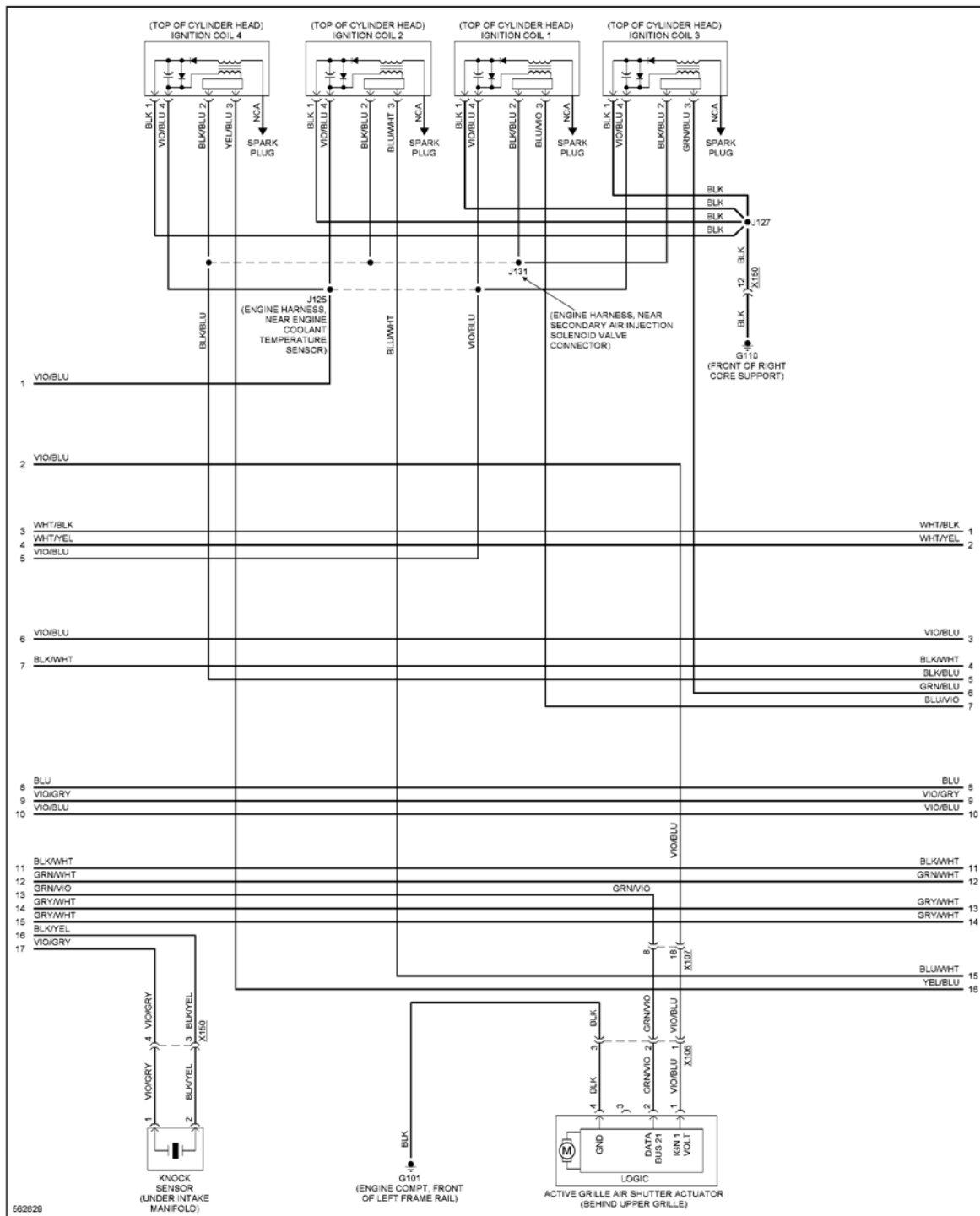


Fig. 33: 1.5L VIN 5, Engine Controls Circuit (5 of 7)

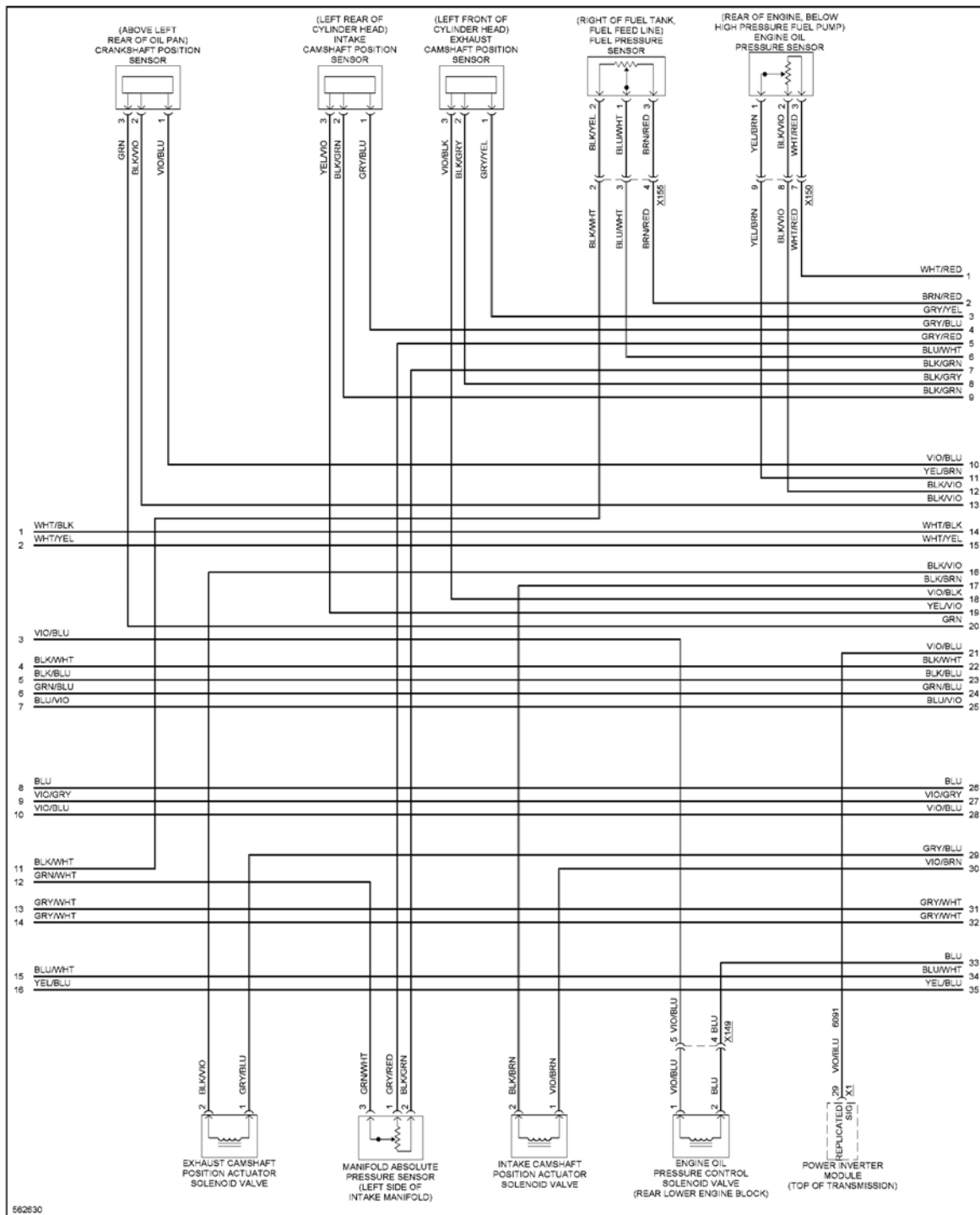


Fig. 34: 1.5L VIN 5, Engine Controls Circuit (6 of 7)

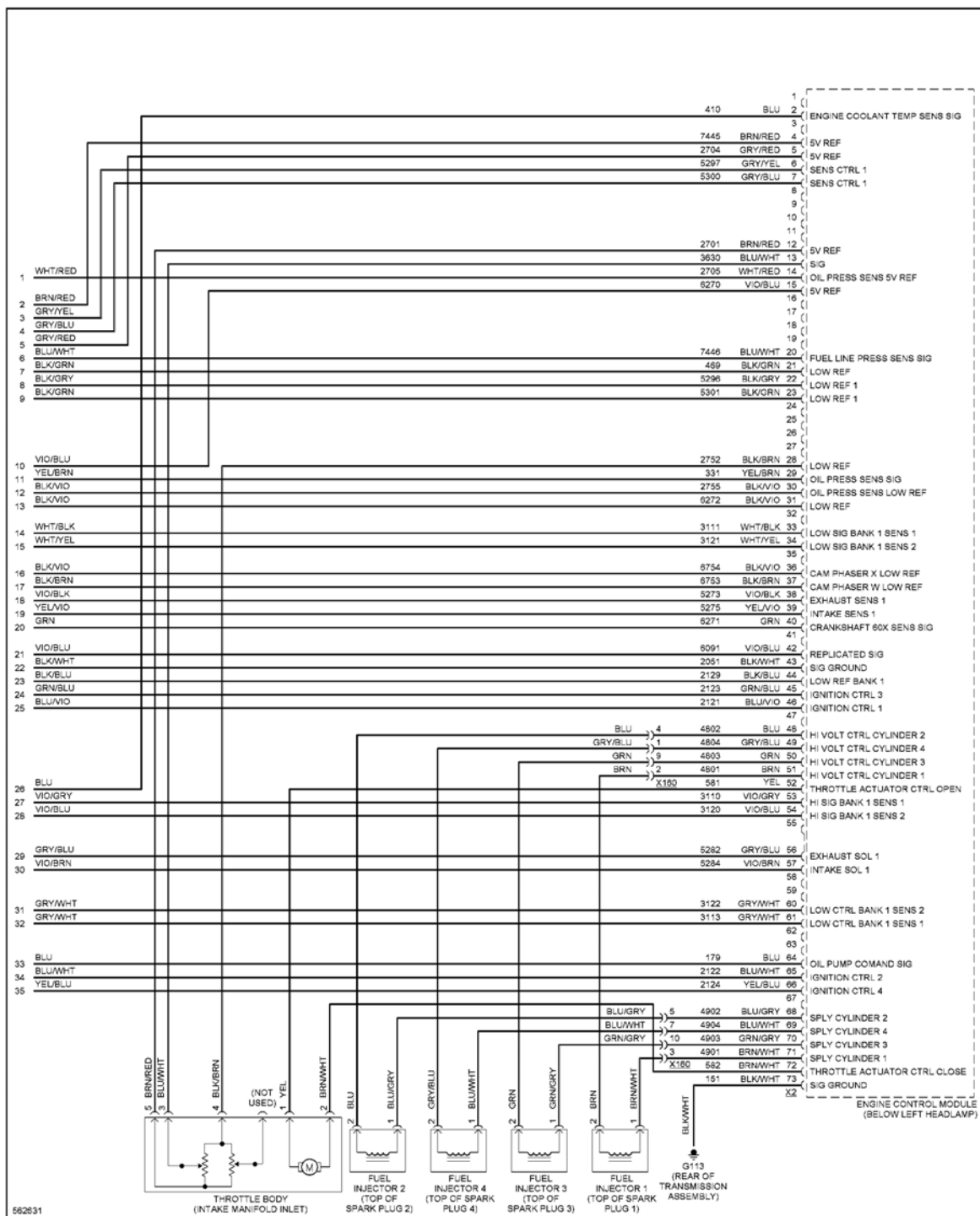


Fig. 35: 1.5L VIN 5, Engine Controls Circuit (7 of 7)

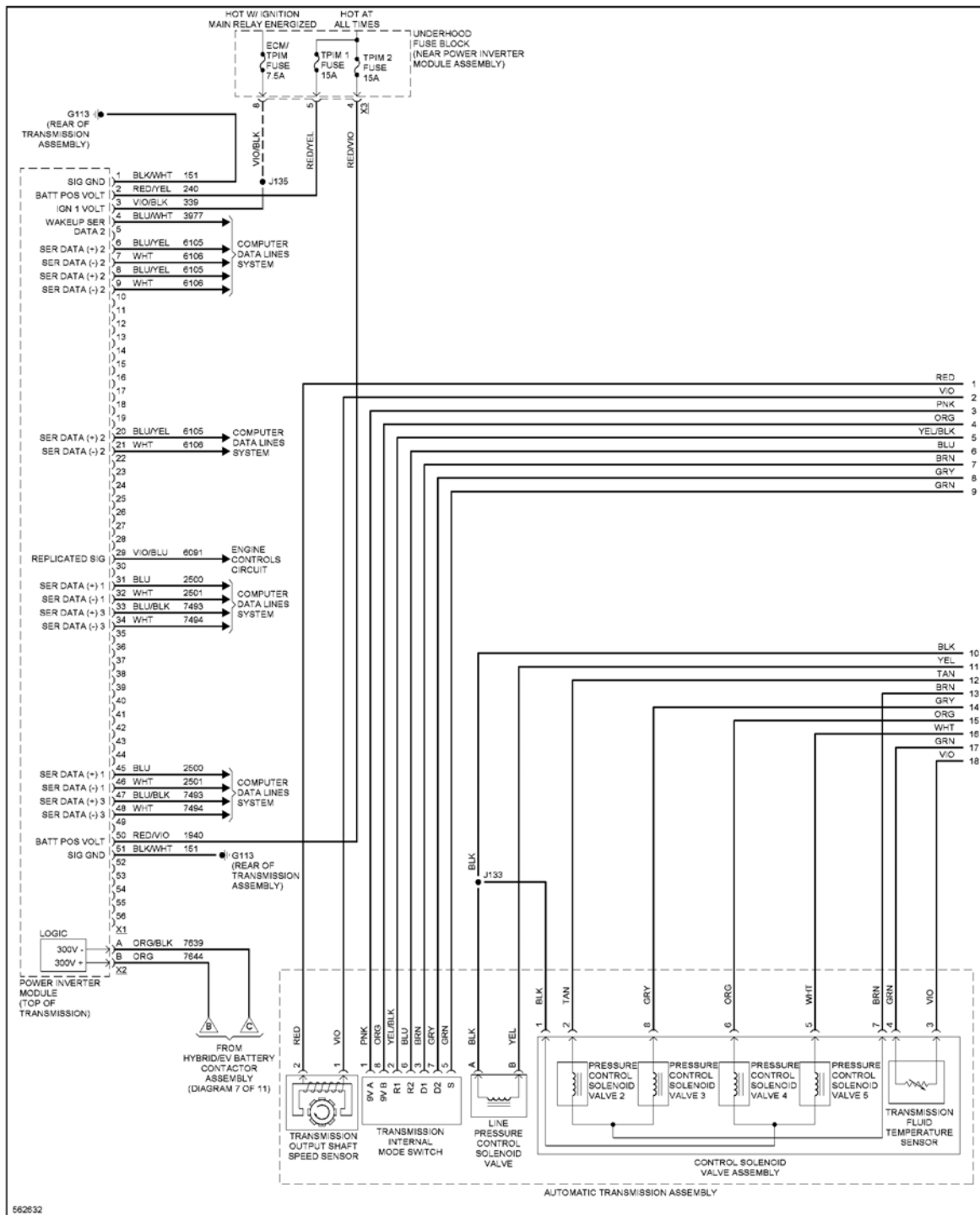


Fig. 36: 1.5L VIN 5, Hybrid System Circuit (1 of 11)

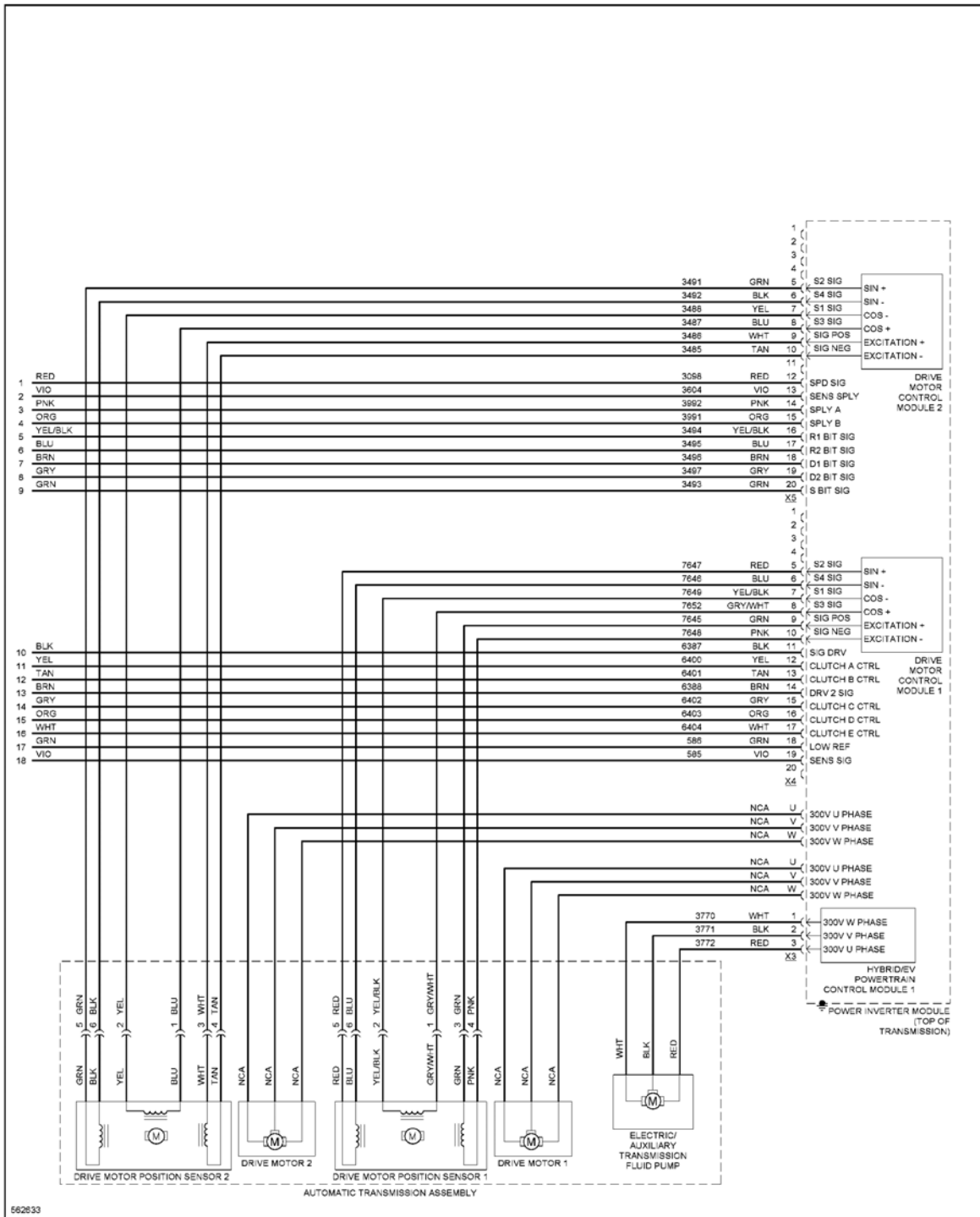


Fig. 37: 1.5L VIN 5, Hybrid System Circuit (2 of 11)



39 of 113

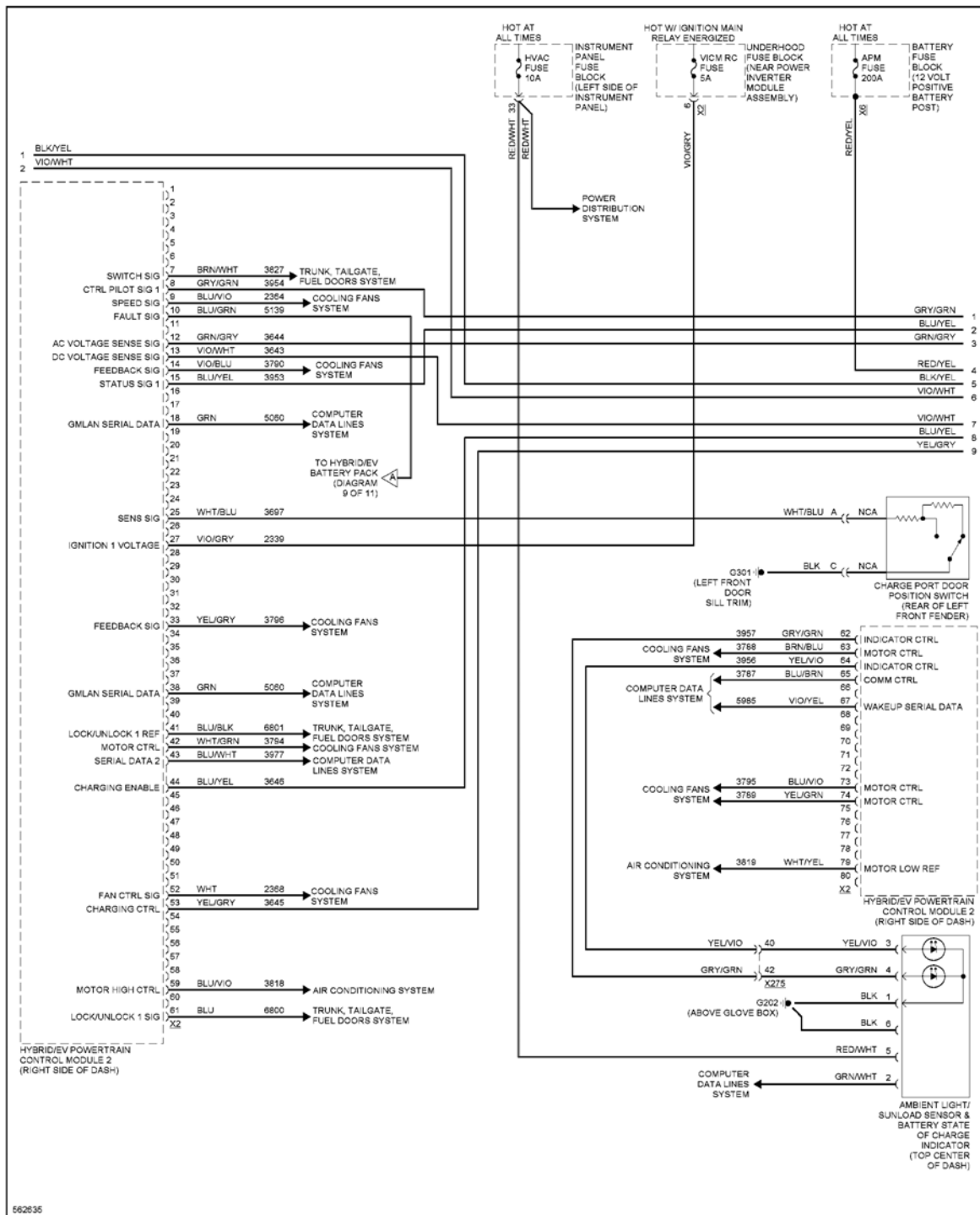


Fig. 39: 1.5L VIN 5, Hybrid System Circuit (4 of 11)

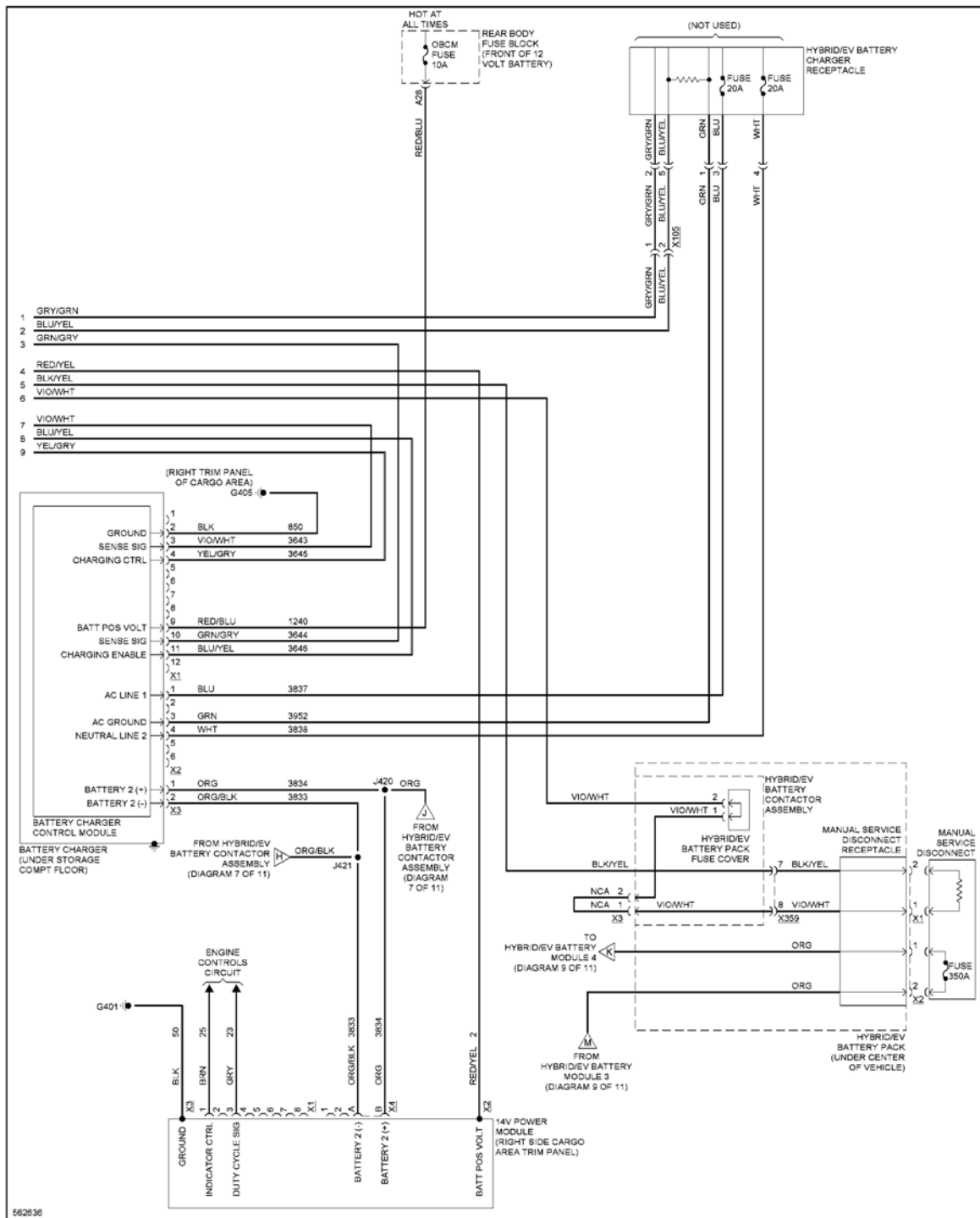


Fig. 40: 1.5L VIN 5, Hybrid System Circuit (5 of 11)

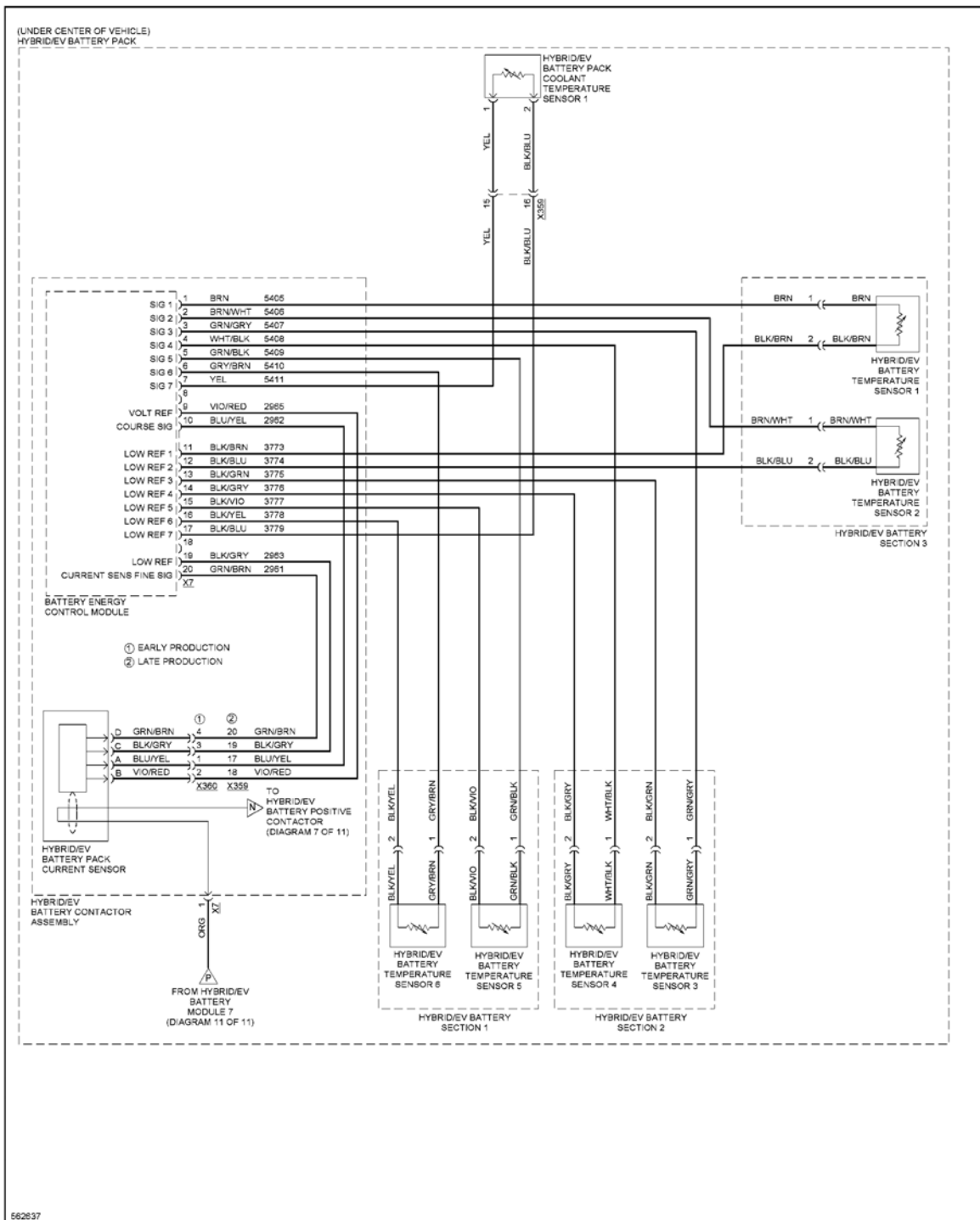


Fig. 41: 1.5L VIN 5, Hybrid System Circuit (6 of 11)

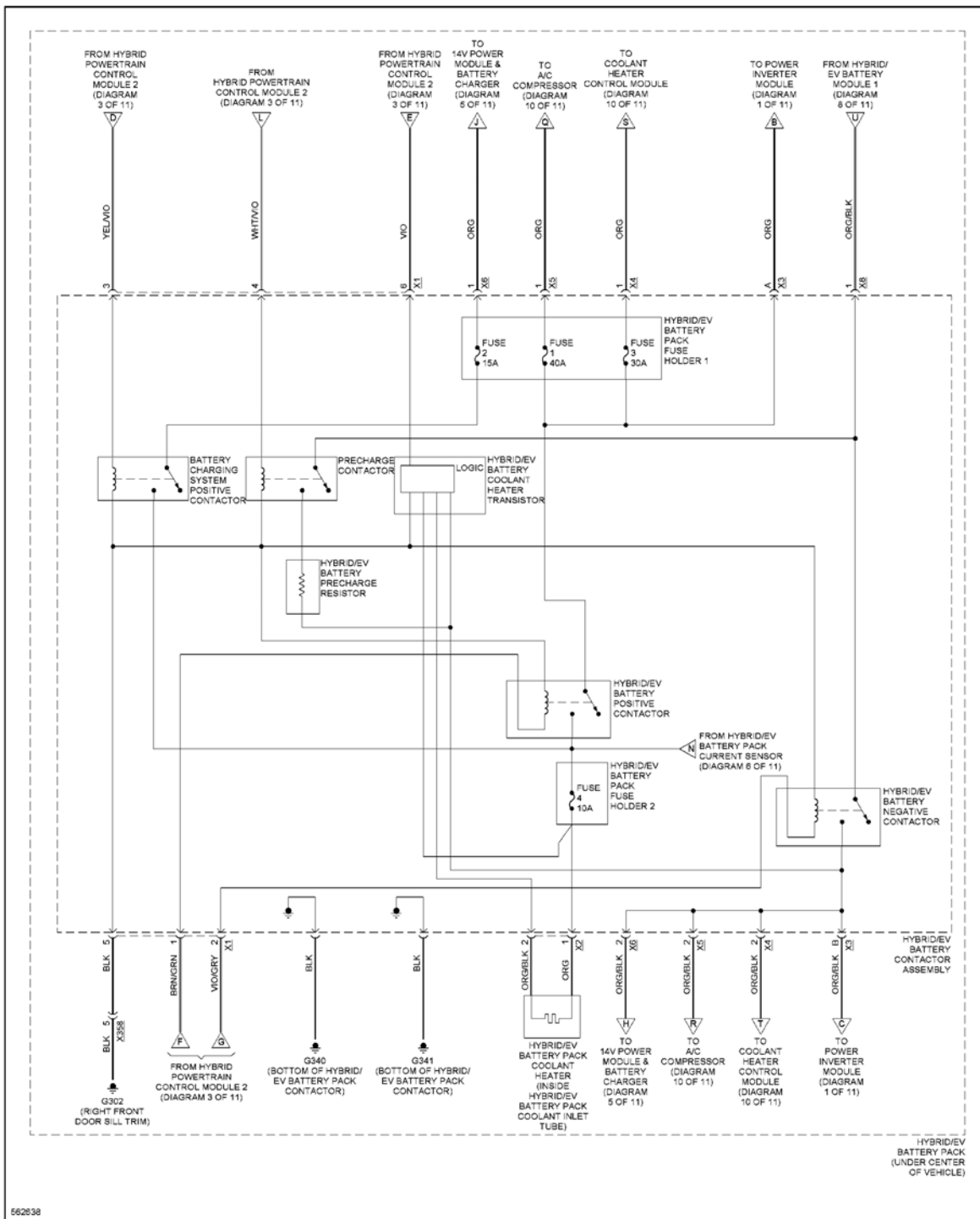


Fig. 42: 1.5L VIN 5, Hybrid System Circuit (7 of 11)

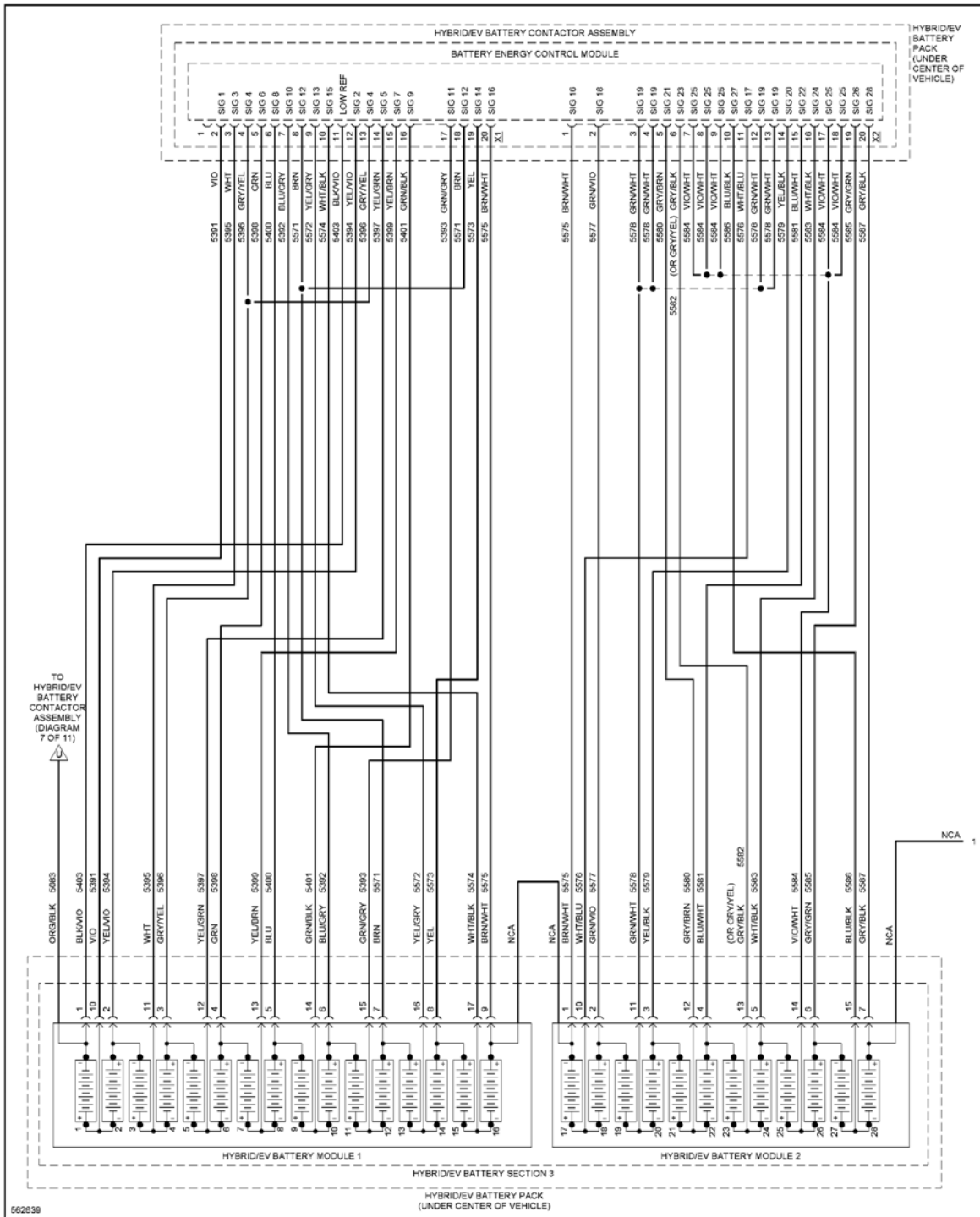


Fig. 43: 1.5L VIN 5, Hybrid System Circuit (8 of 11)

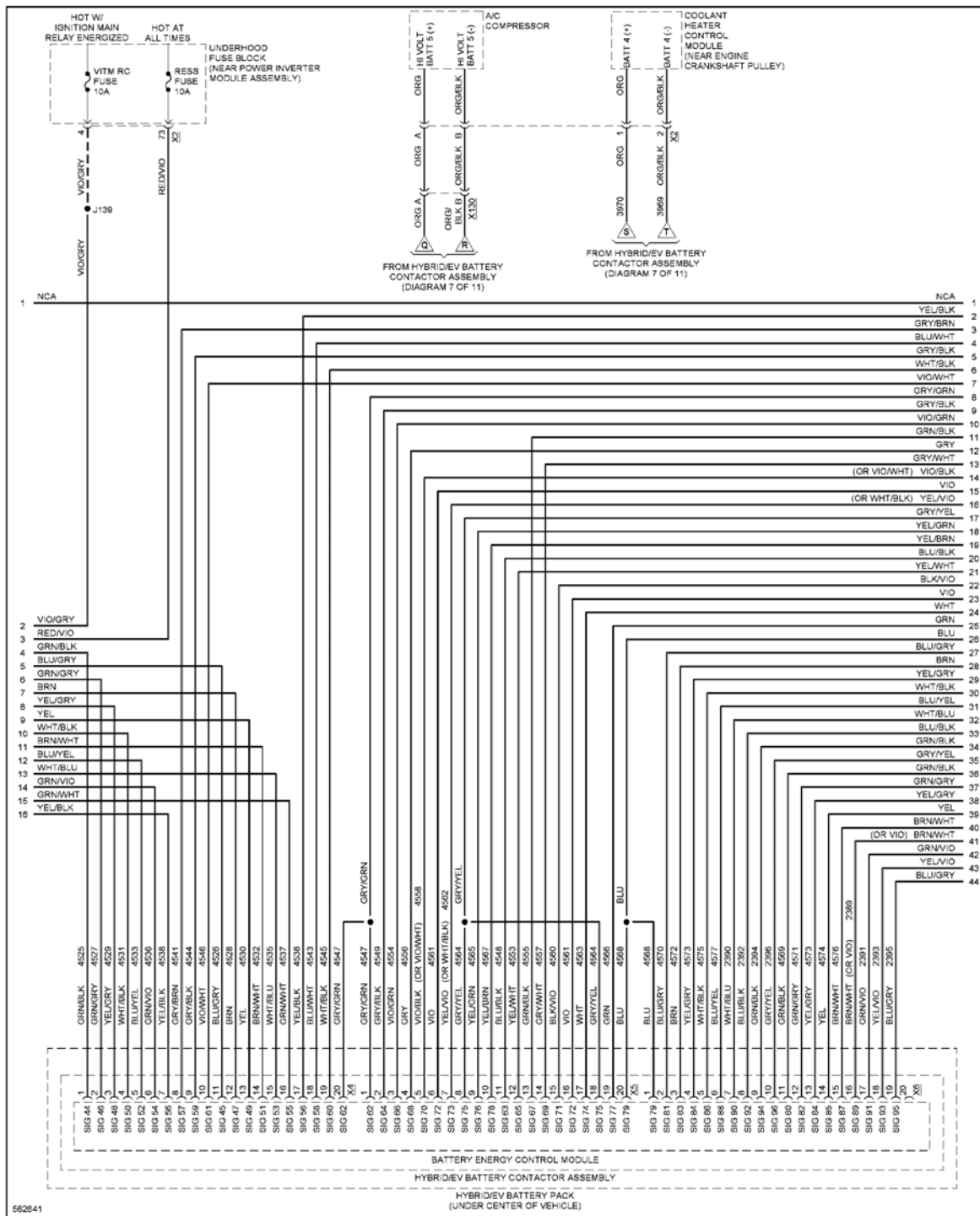


Fig. 45: 1.5L VIN 5, Hybrid System Circuit (10 of 11)

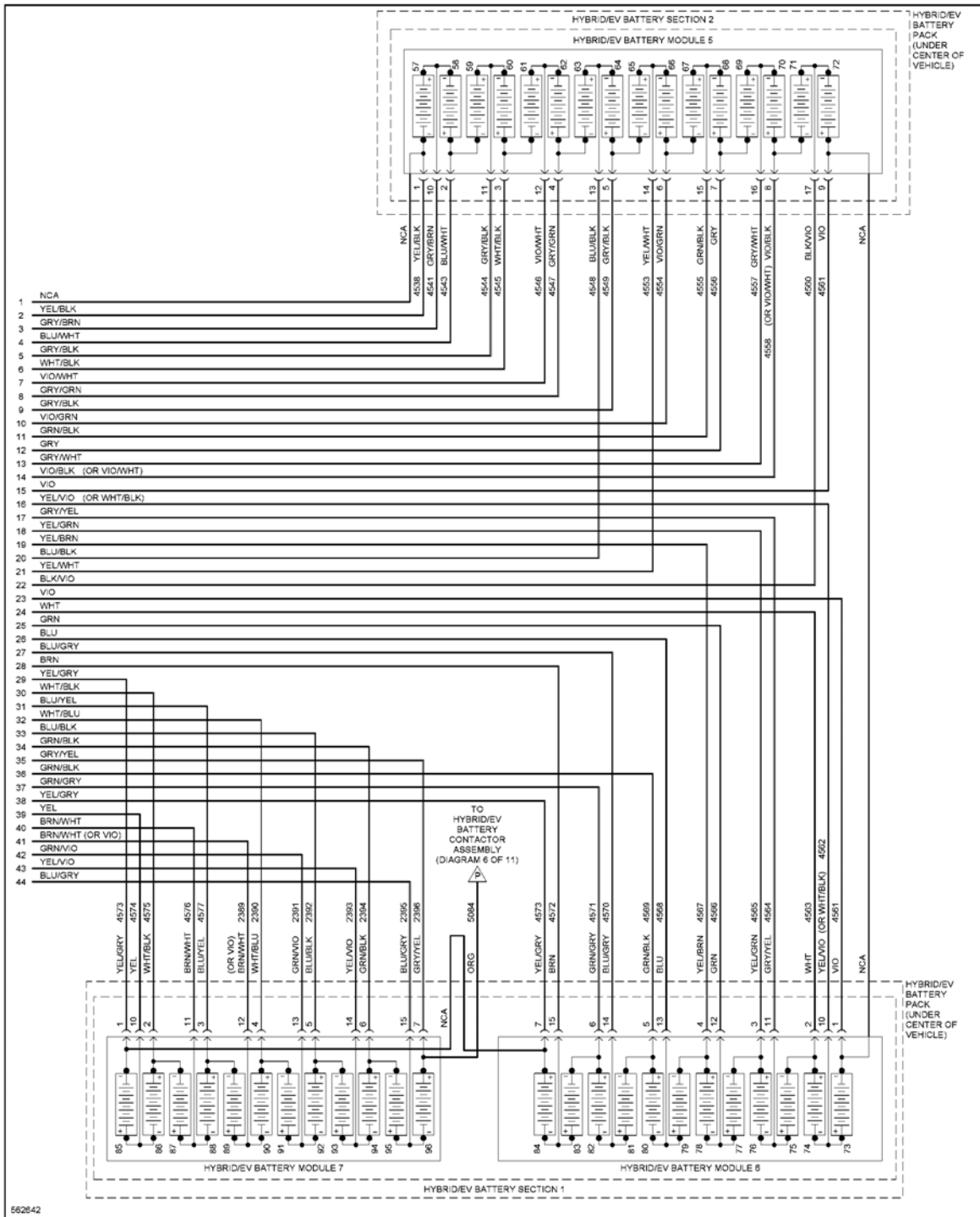


Fig. 46: 1.5L VIN 5, Hybrid System Circuit (11 of 11)

EXTERIOR LIGHTS



48 of 113

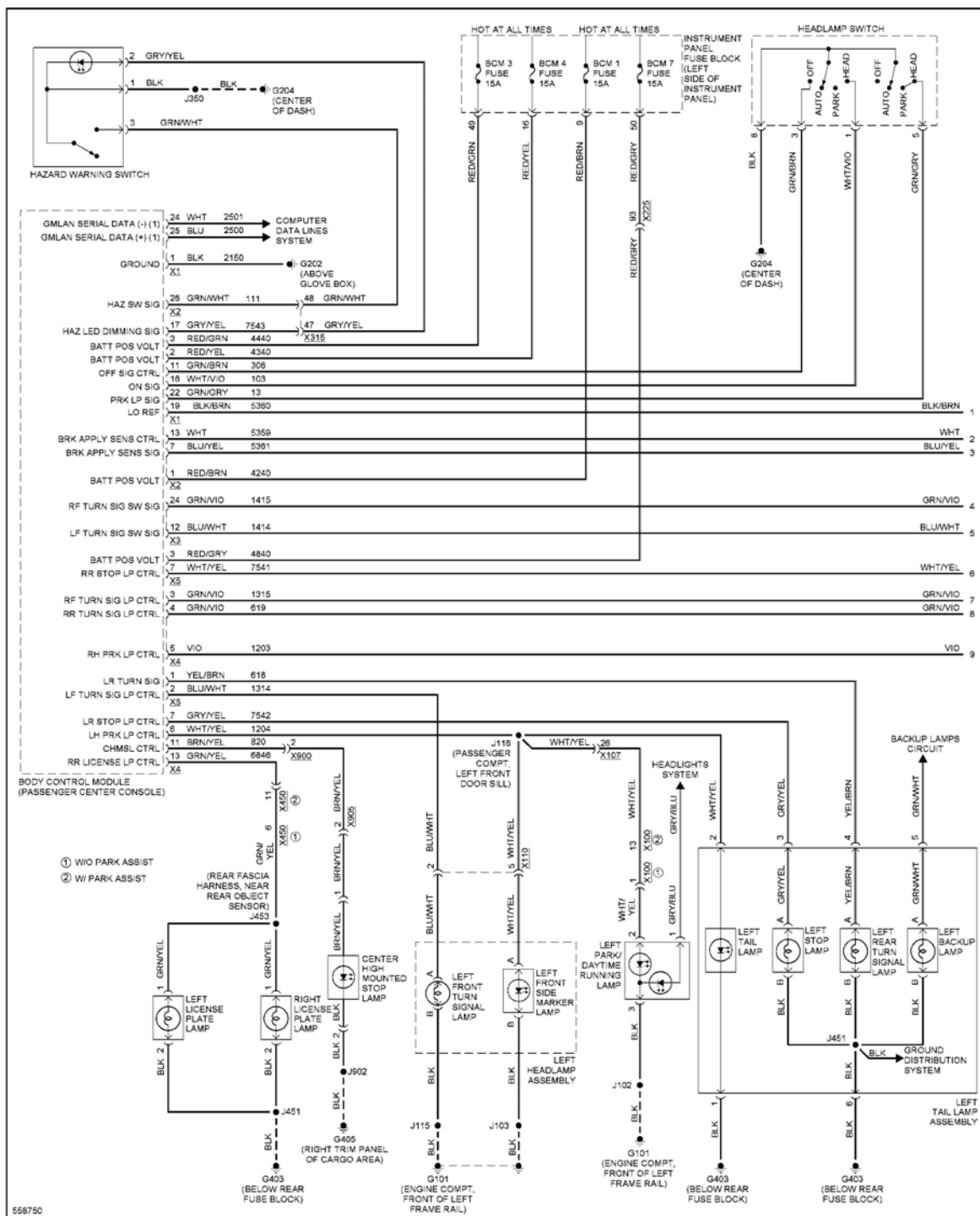


Fig. 48: Exterior Lamps Circuit (1 of 2)

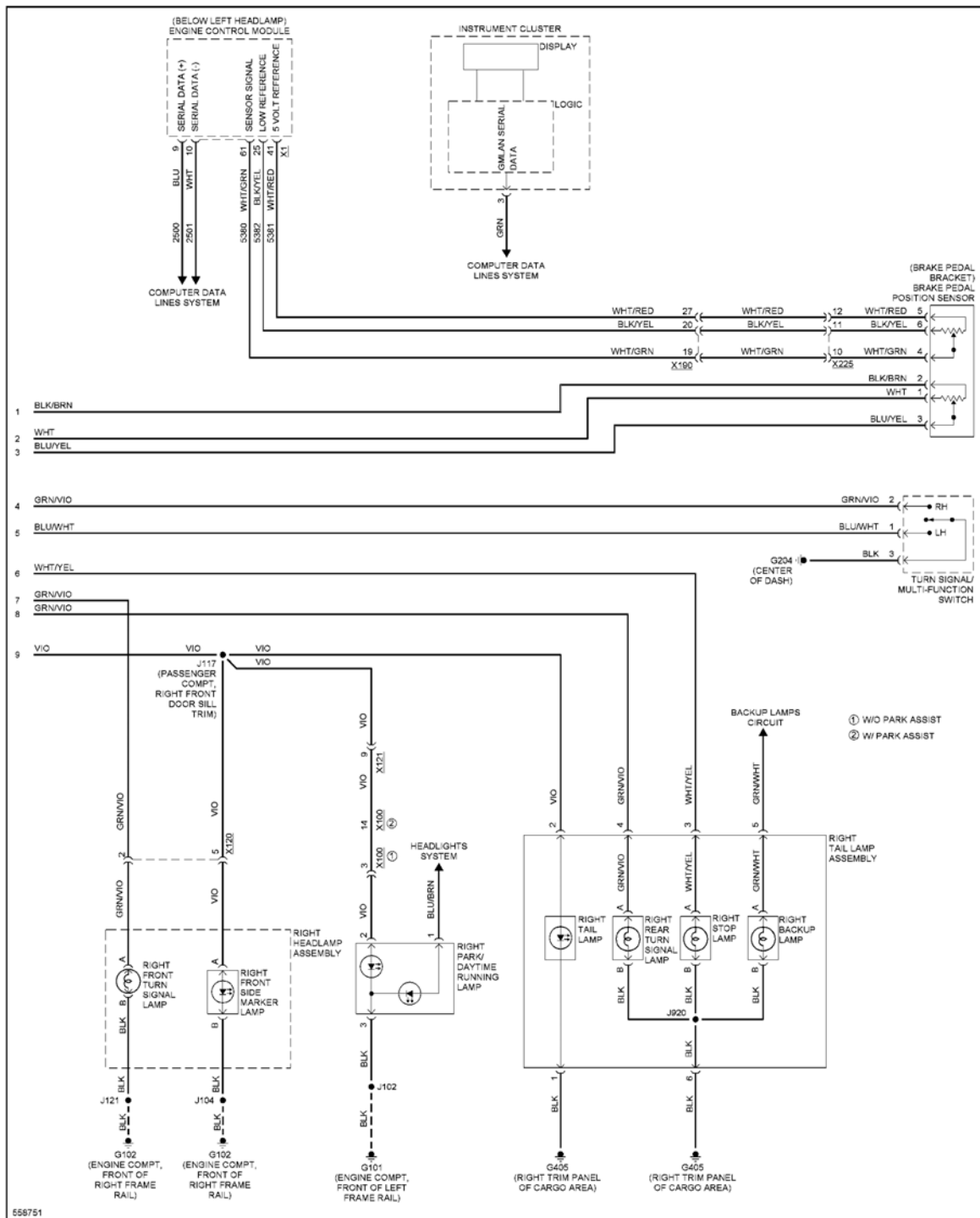


Fig. 49: Exterior Lamps Circuit (2 of 2)

GROUND DISTRIBUTION

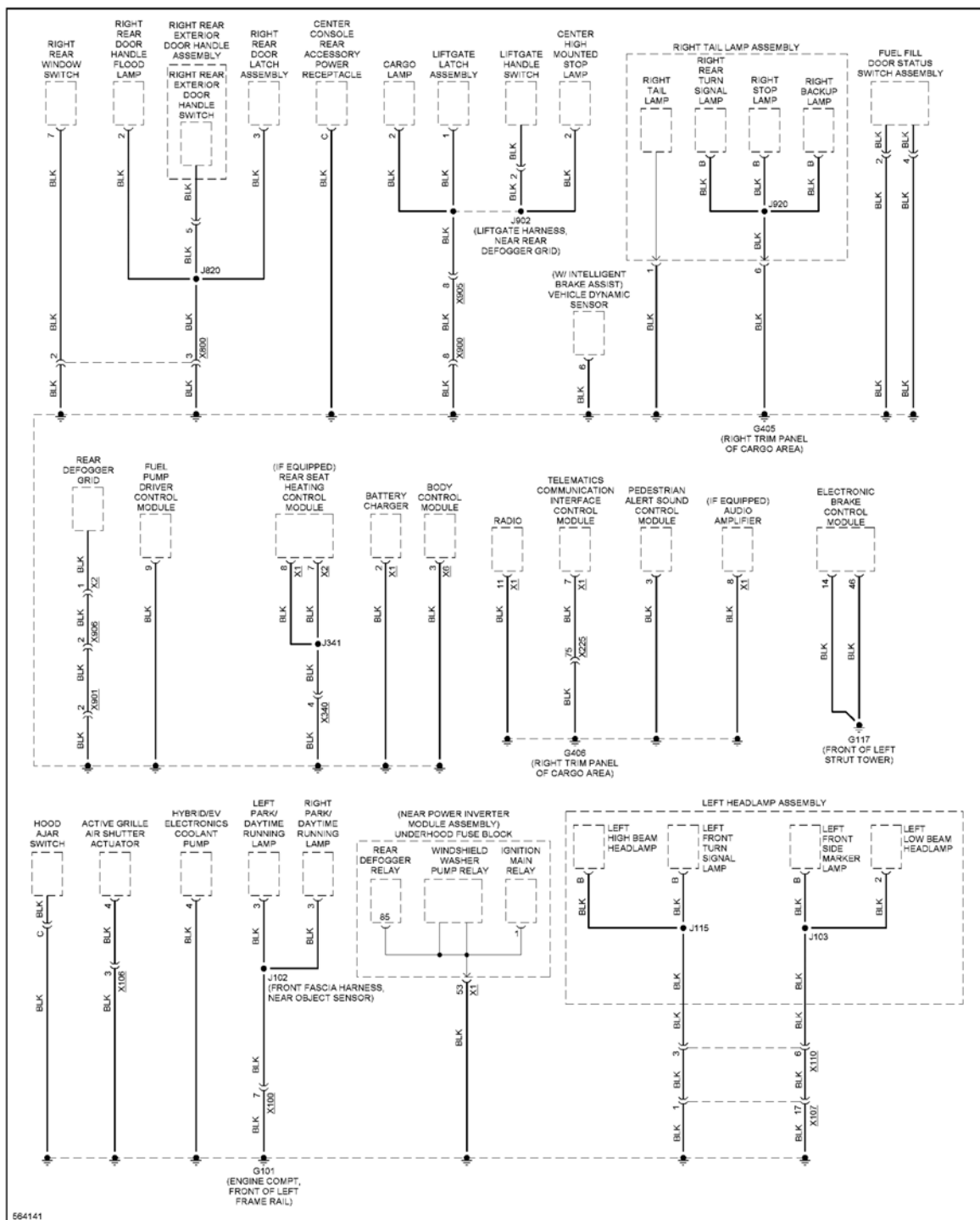


Fig. 50: Ground Distribution Circuit (1 of 5)

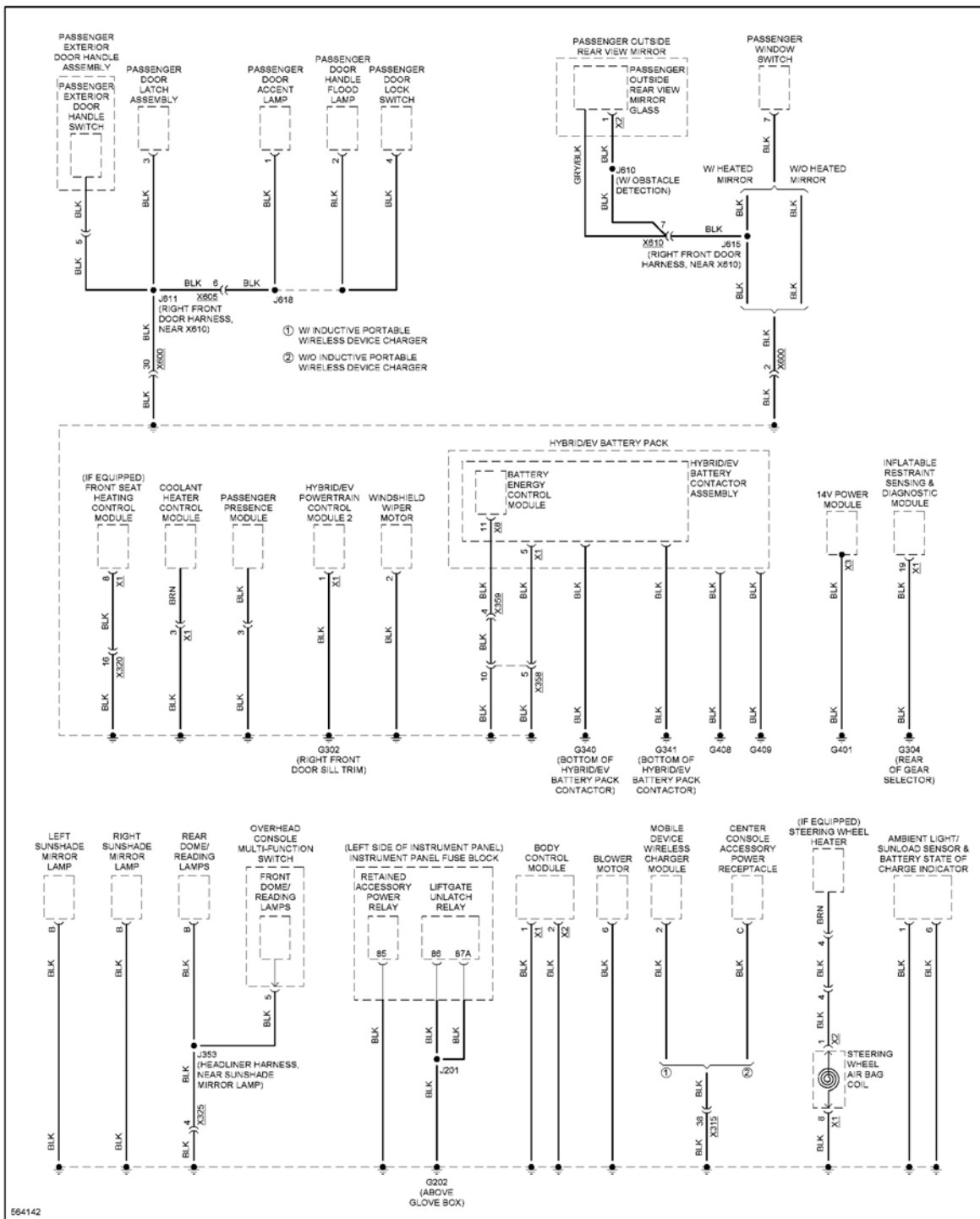


Fig. 51: Ground Distribution Circuit (2 of 5)

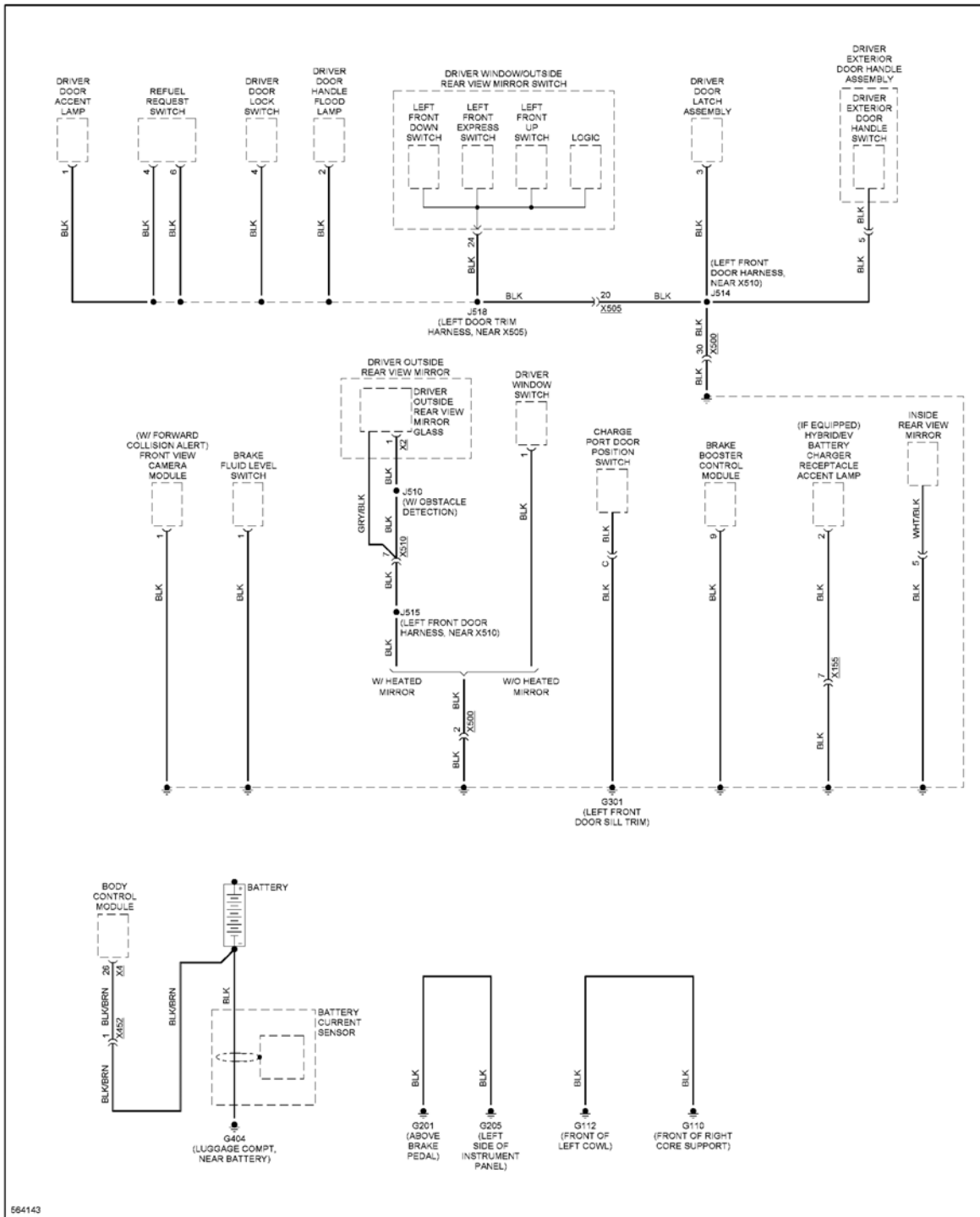


Fig. 52: Ground Distribution Circuit (3 of 5)

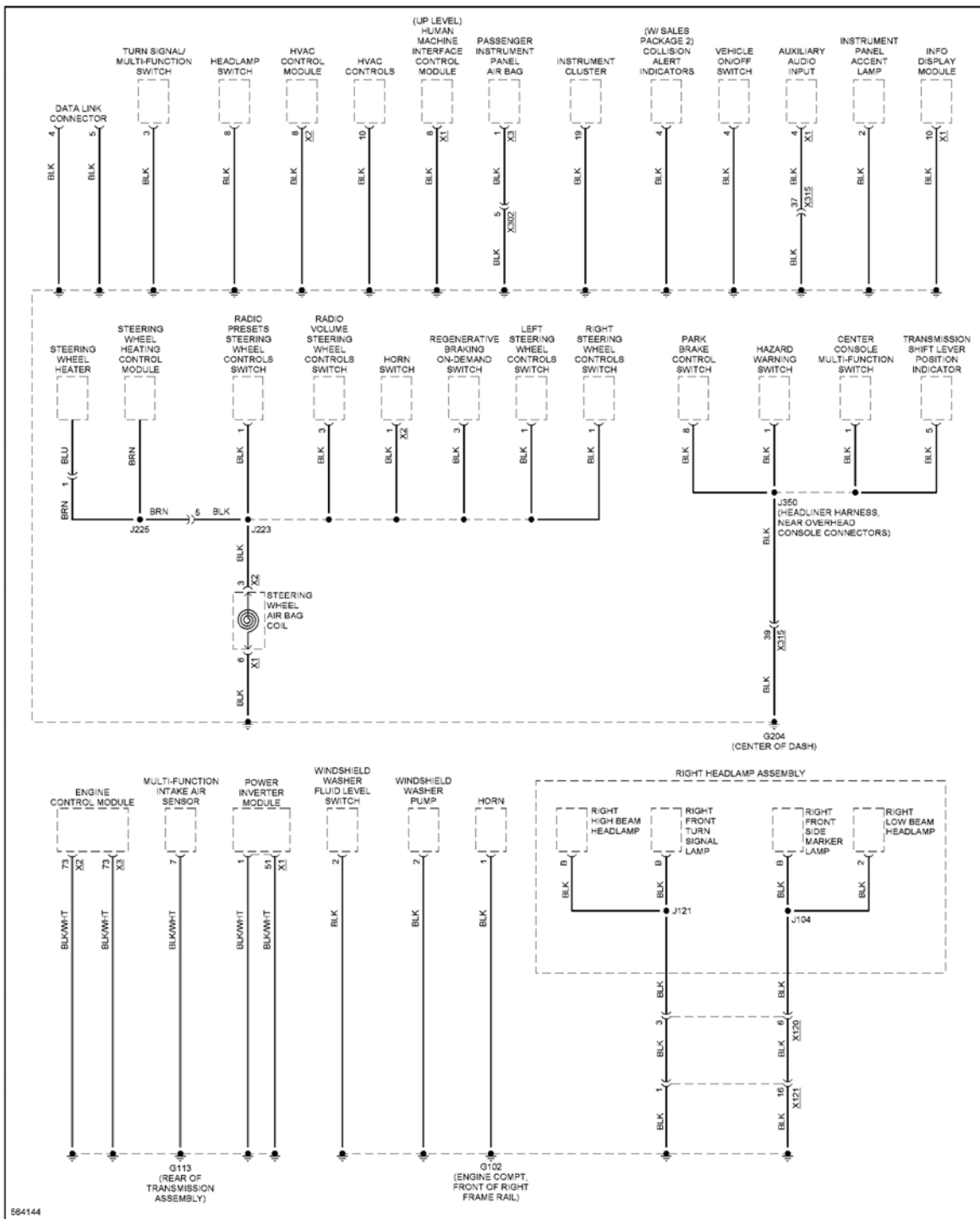


Fig. 53: Ground Distribution Circuit (4 of 5)

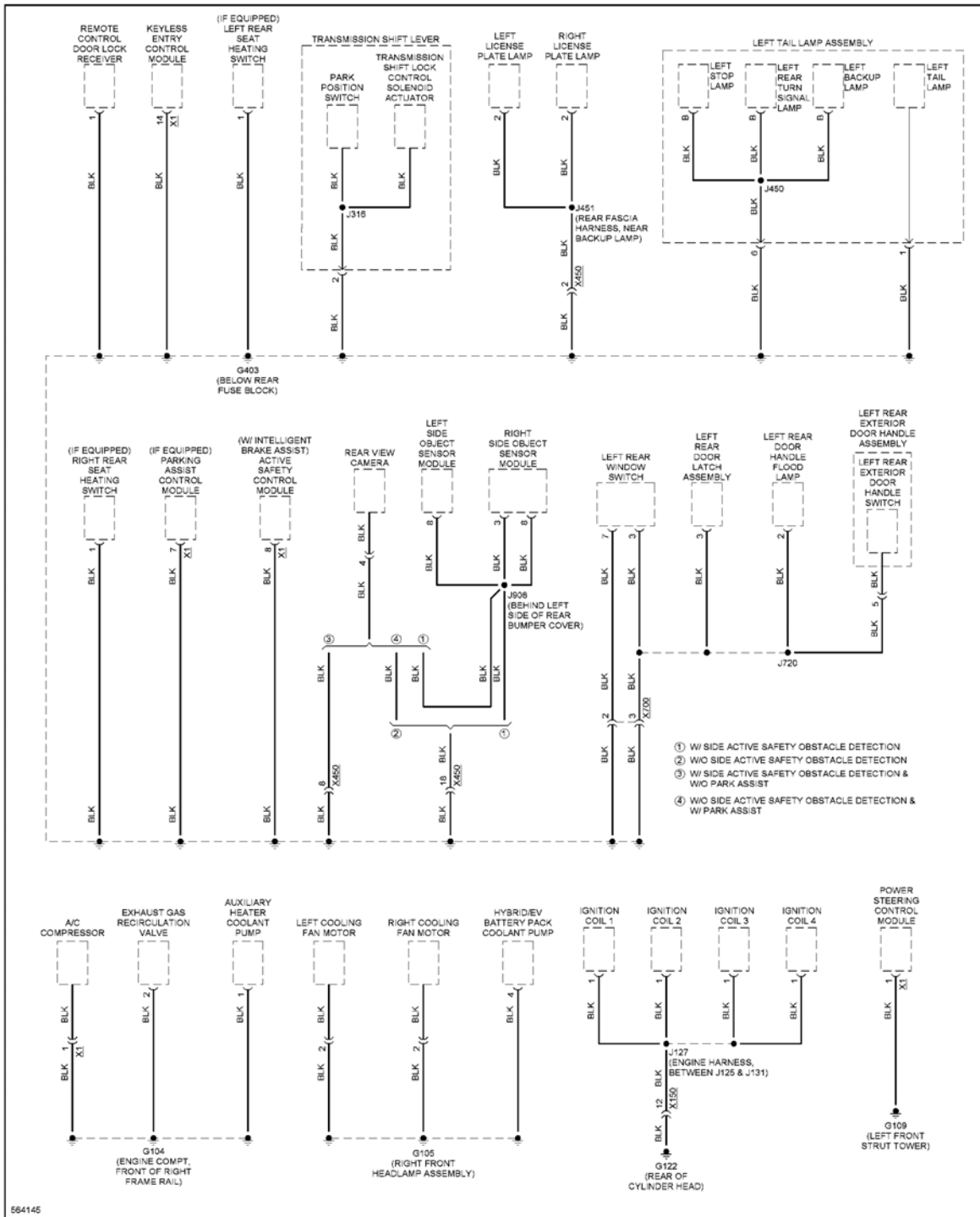


Fig. 54: Ground Distribution Circuit (5 of 5)

HEADLIGHTS

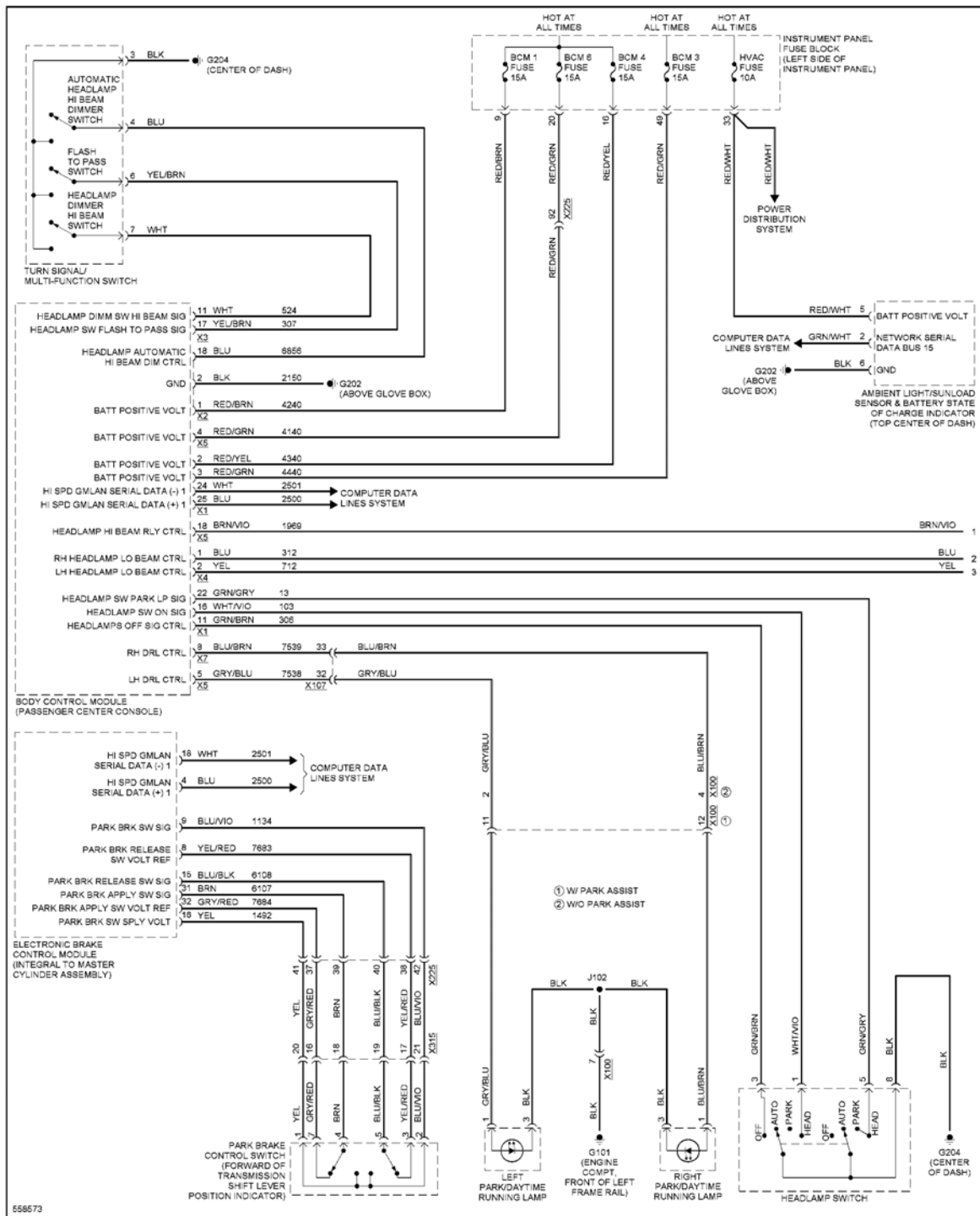


Fig. 55: Headlights Circuit (1 of 2)

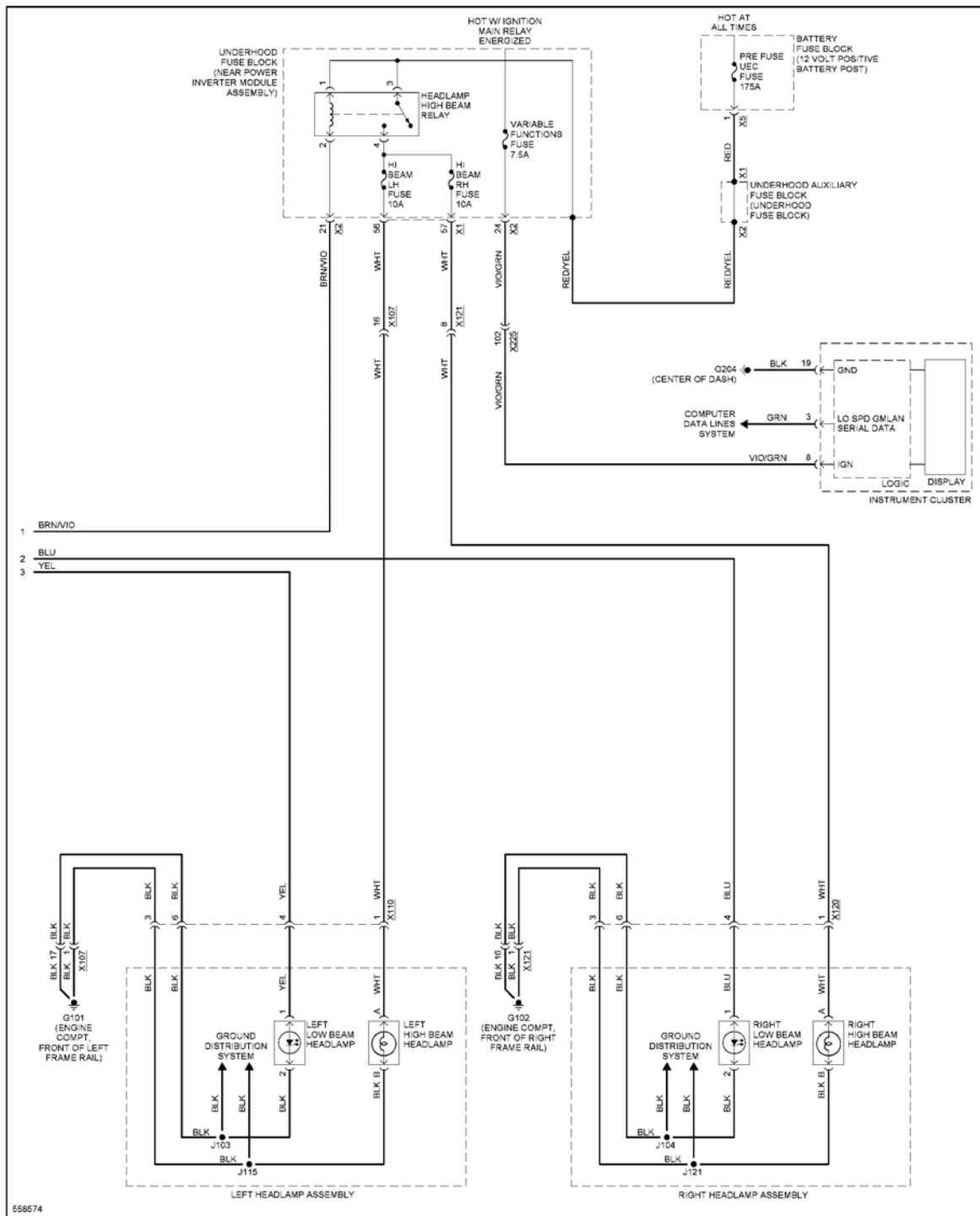


Fig. 56: Headlights Circuit (2 of 2)

HORN

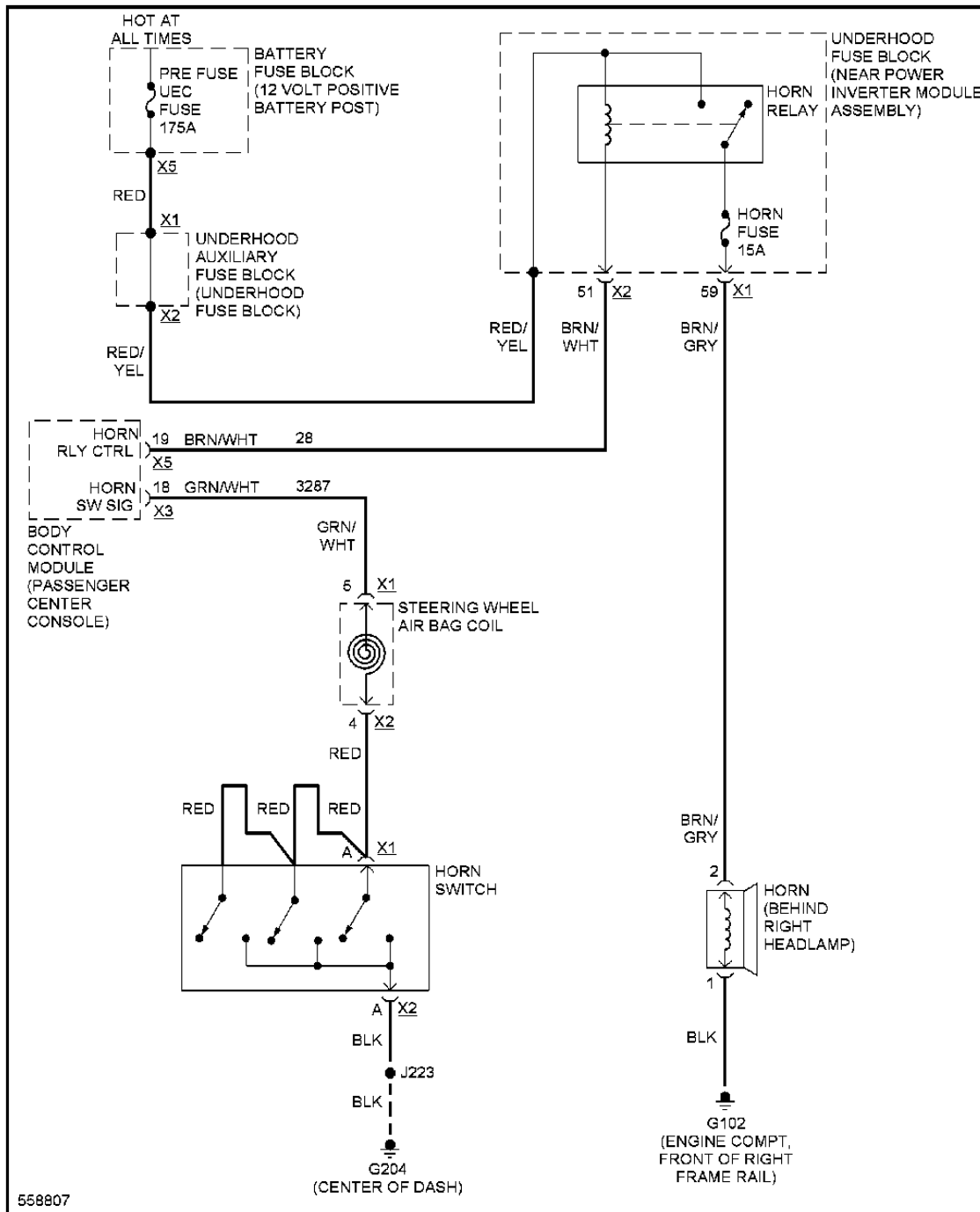


Fig. 57: Horn Circuit

INSTRUMENT CLUSTER

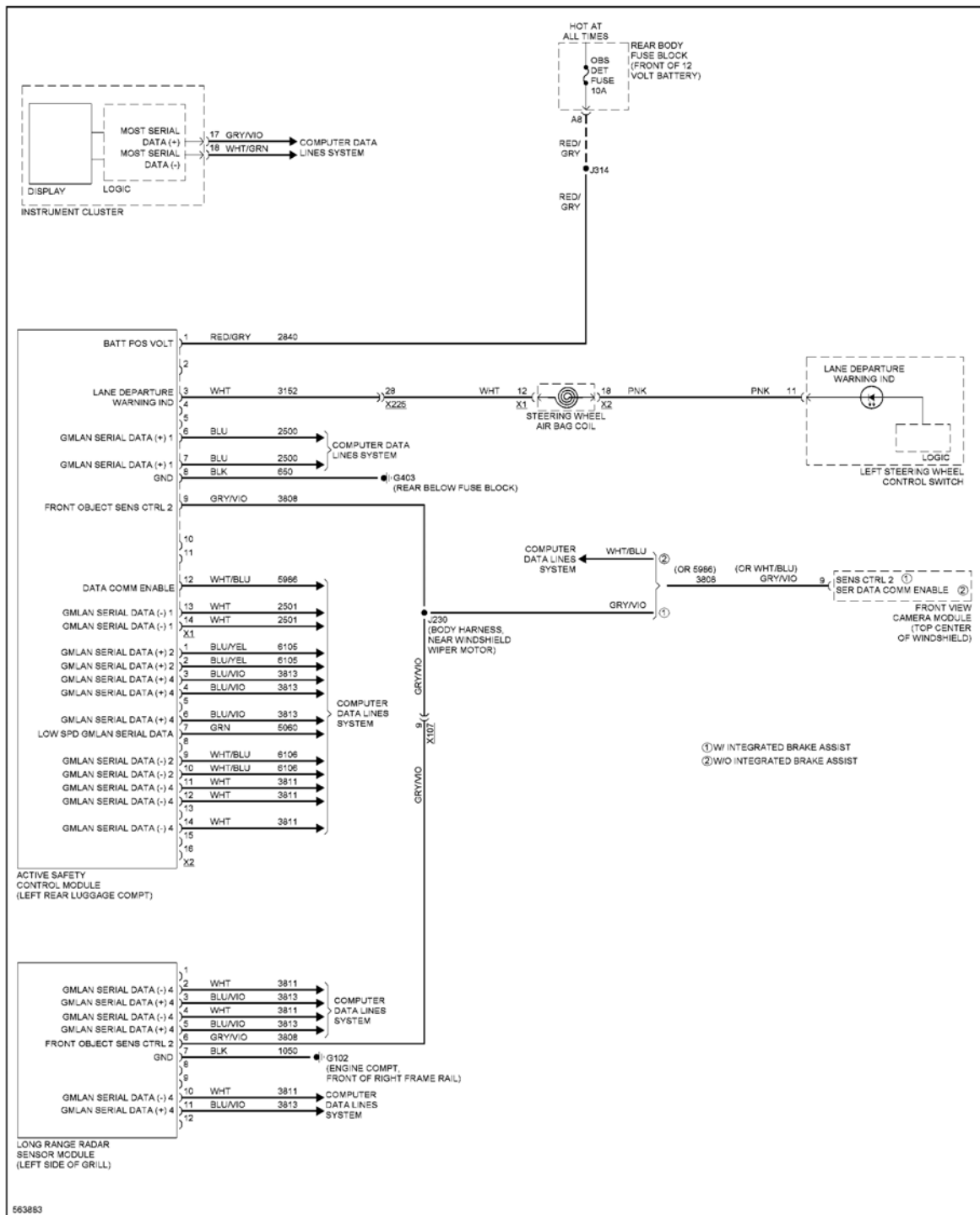


Fig. 58: Collision Avoidance Circuit

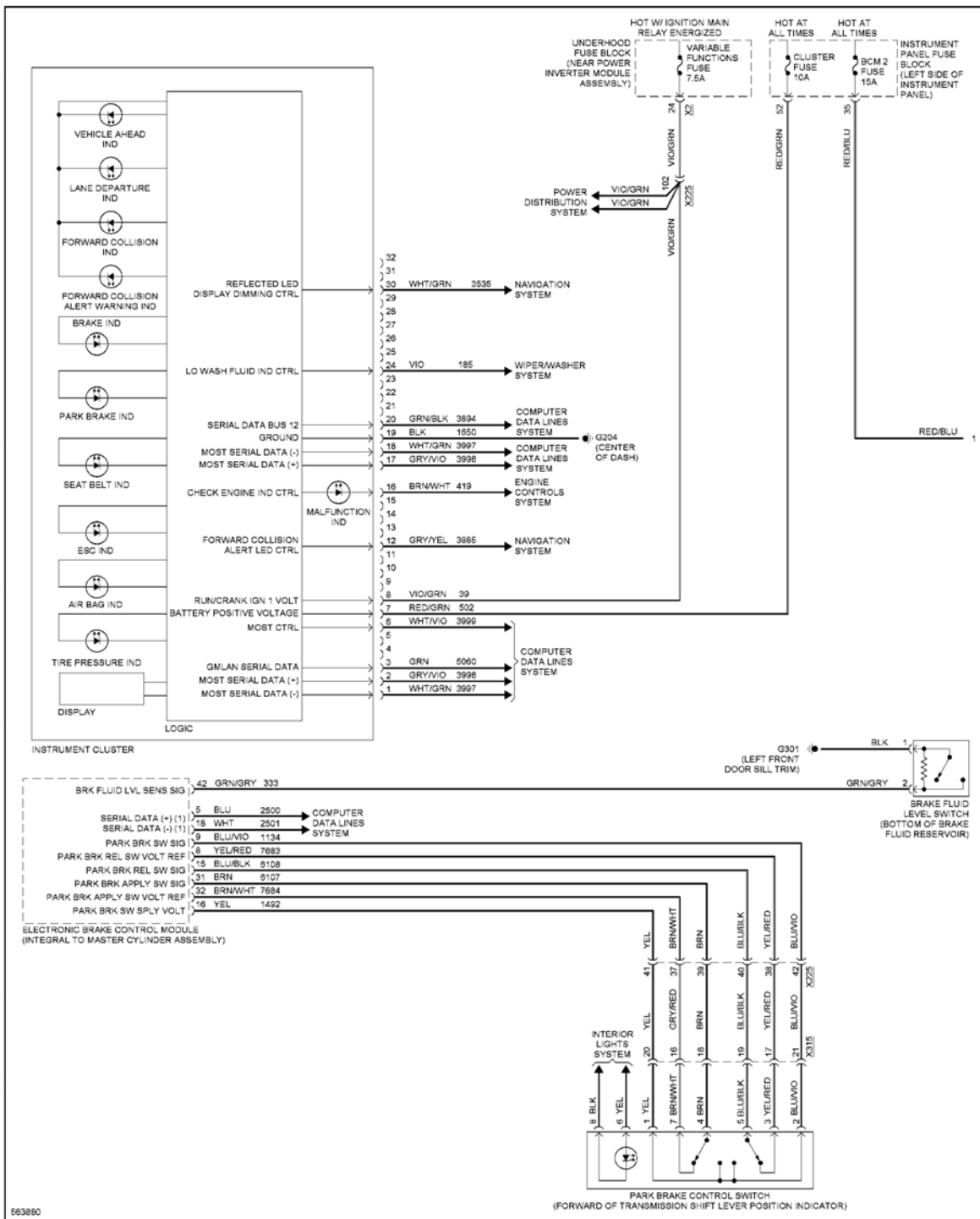


Fig. 59: Instrument Cluster Circuit (1 of 3)

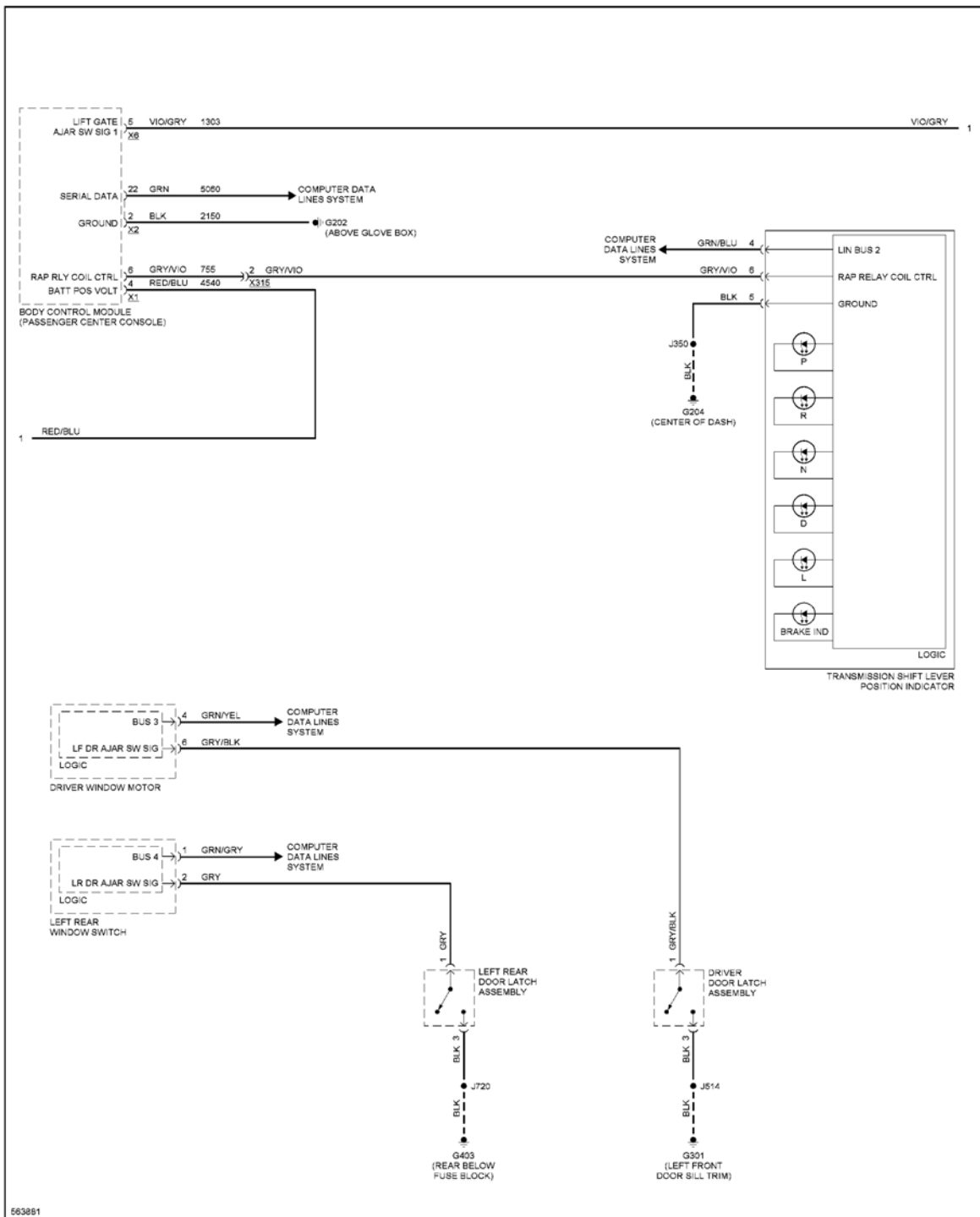


Fig. 60: Instrument Cluster Circuit (2 of 3)

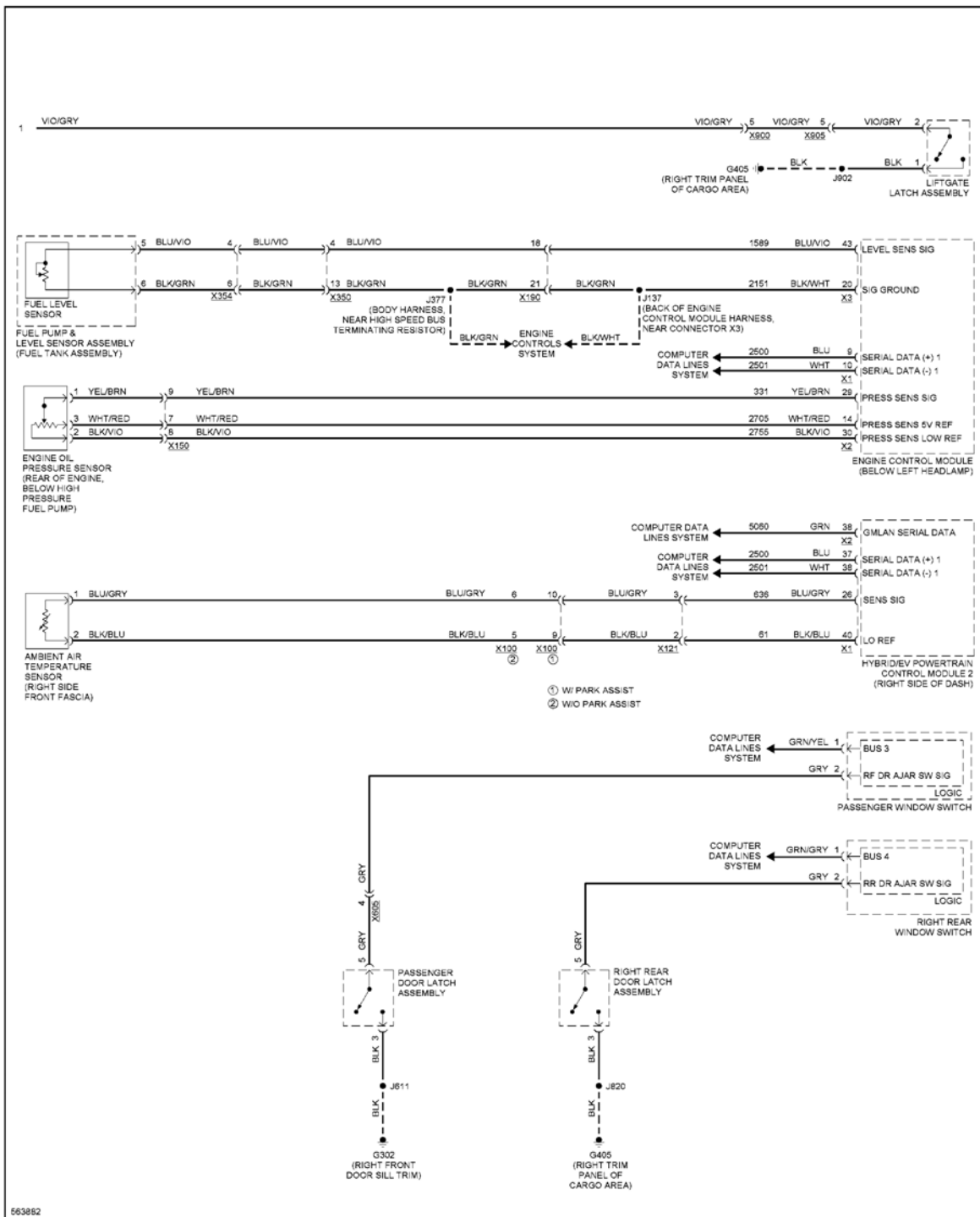


Fig. 61: Instrument Cluster Circuit (3 of 3)

INTERIOR LIGHTS

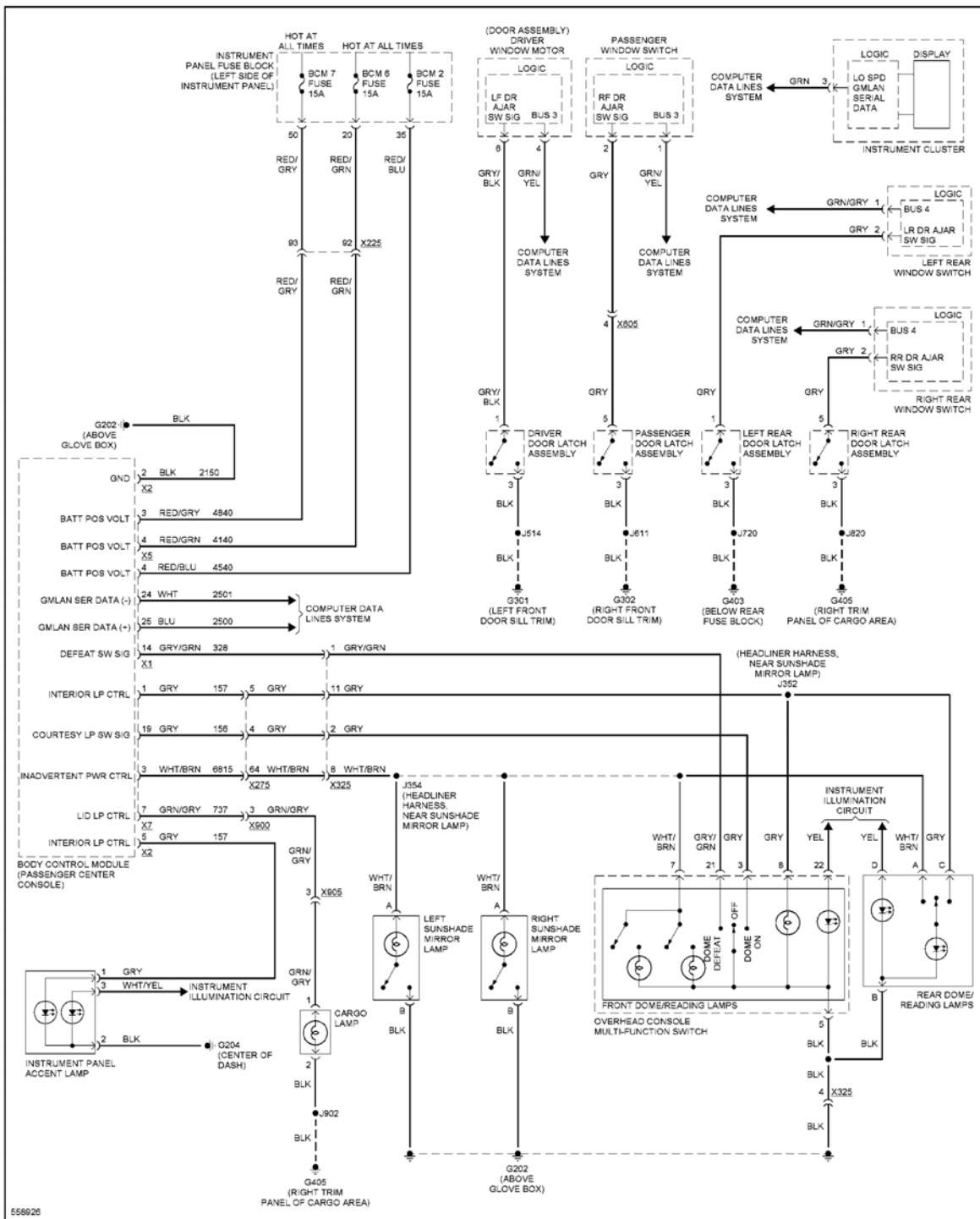


Fig. 62: Courtesy Lamps Circuit

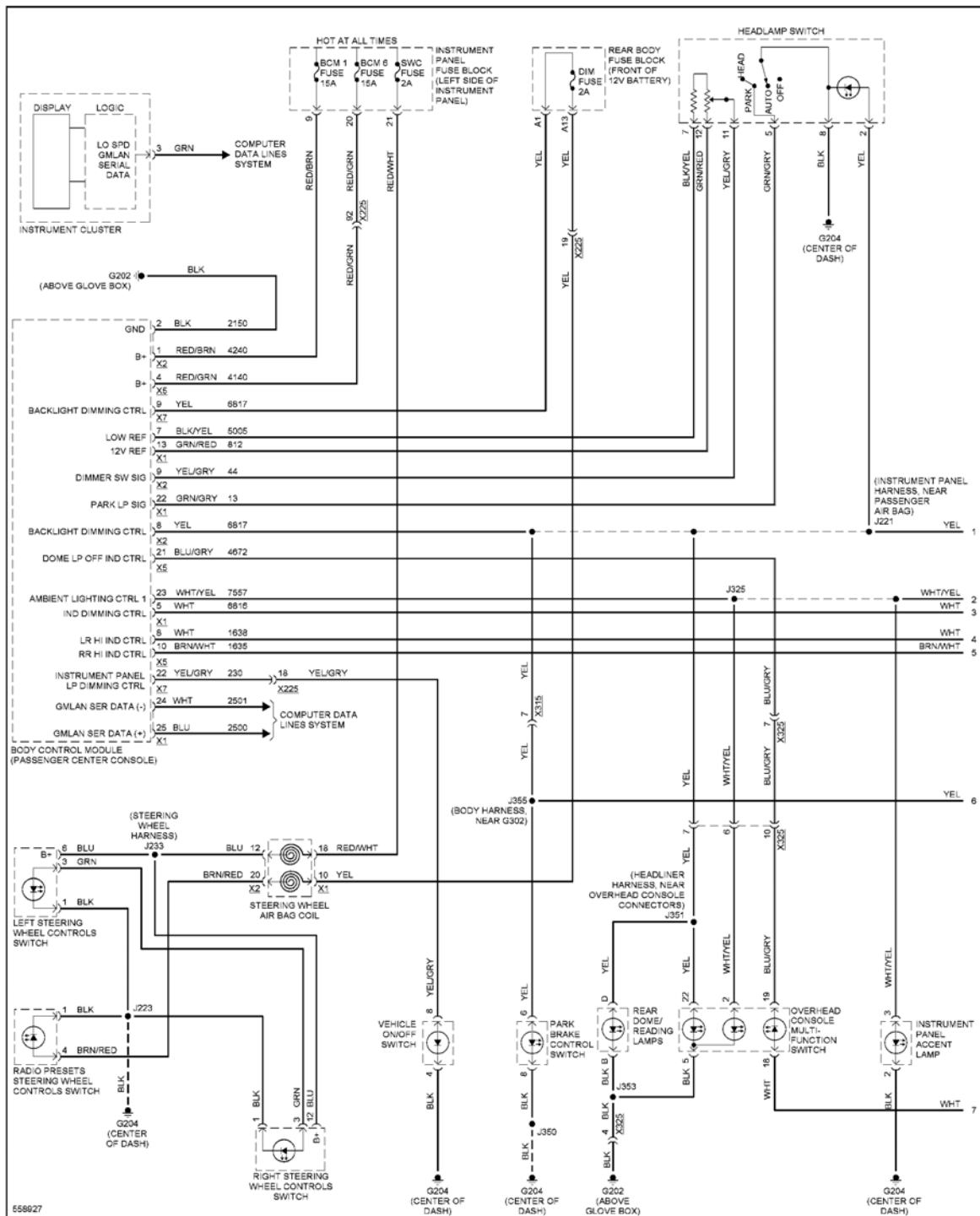


Fig. 63: Instrument Illumination Circuit (1 of 2)

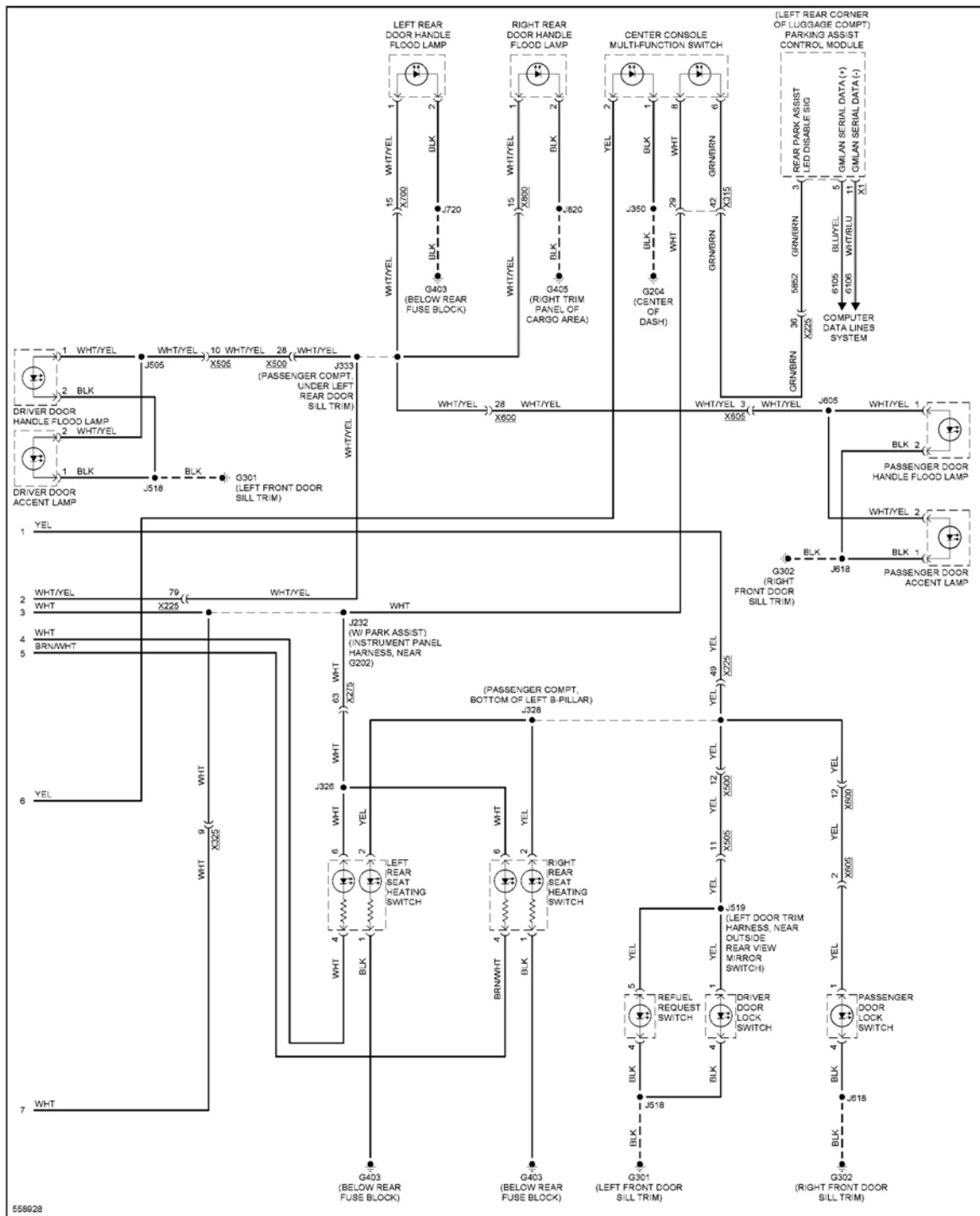


Fig. 64: Instrument Illumination Circuit (2 of 2)

NAVIGATION

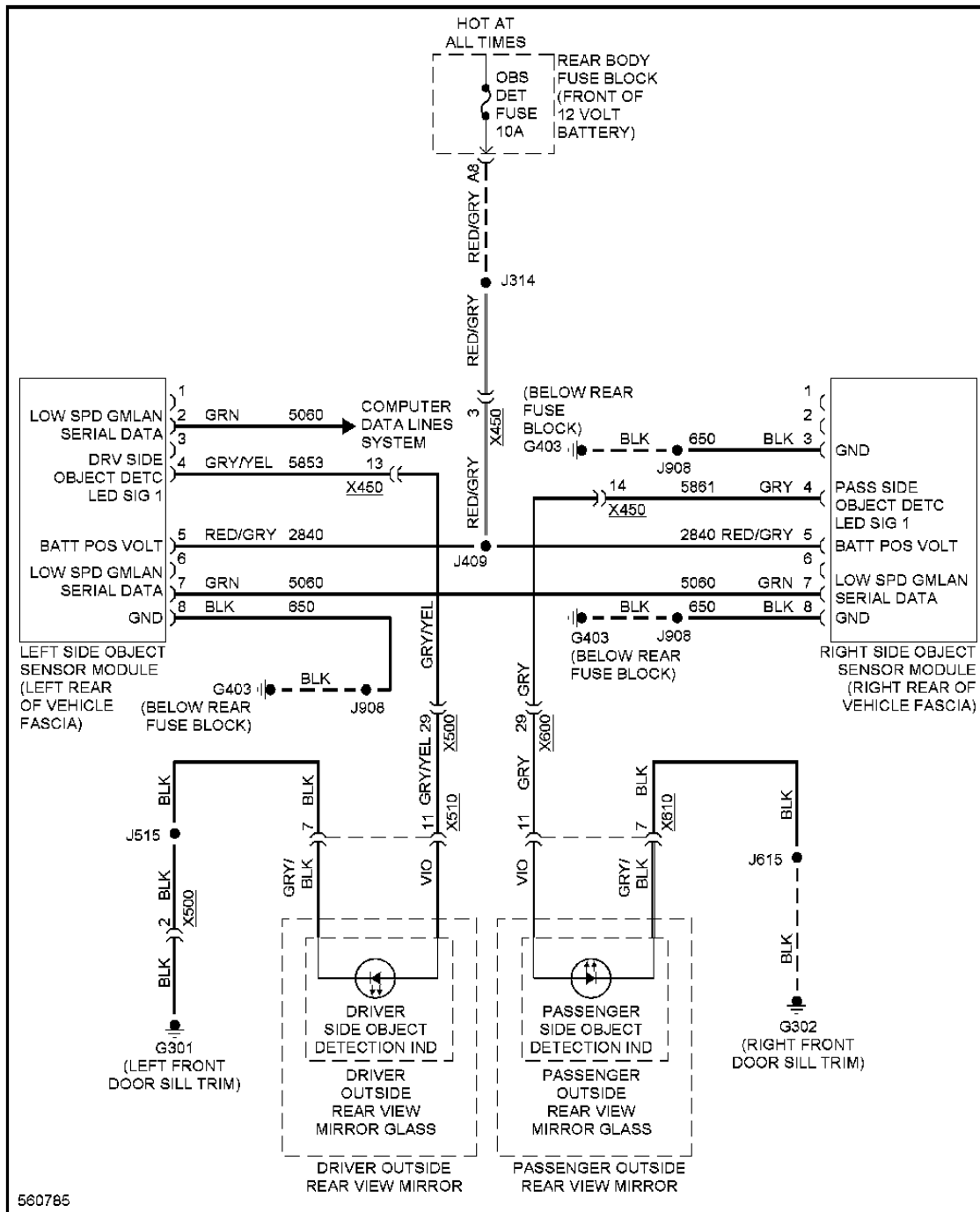


Fig. 65: Blind Spot Monitoring Circuit

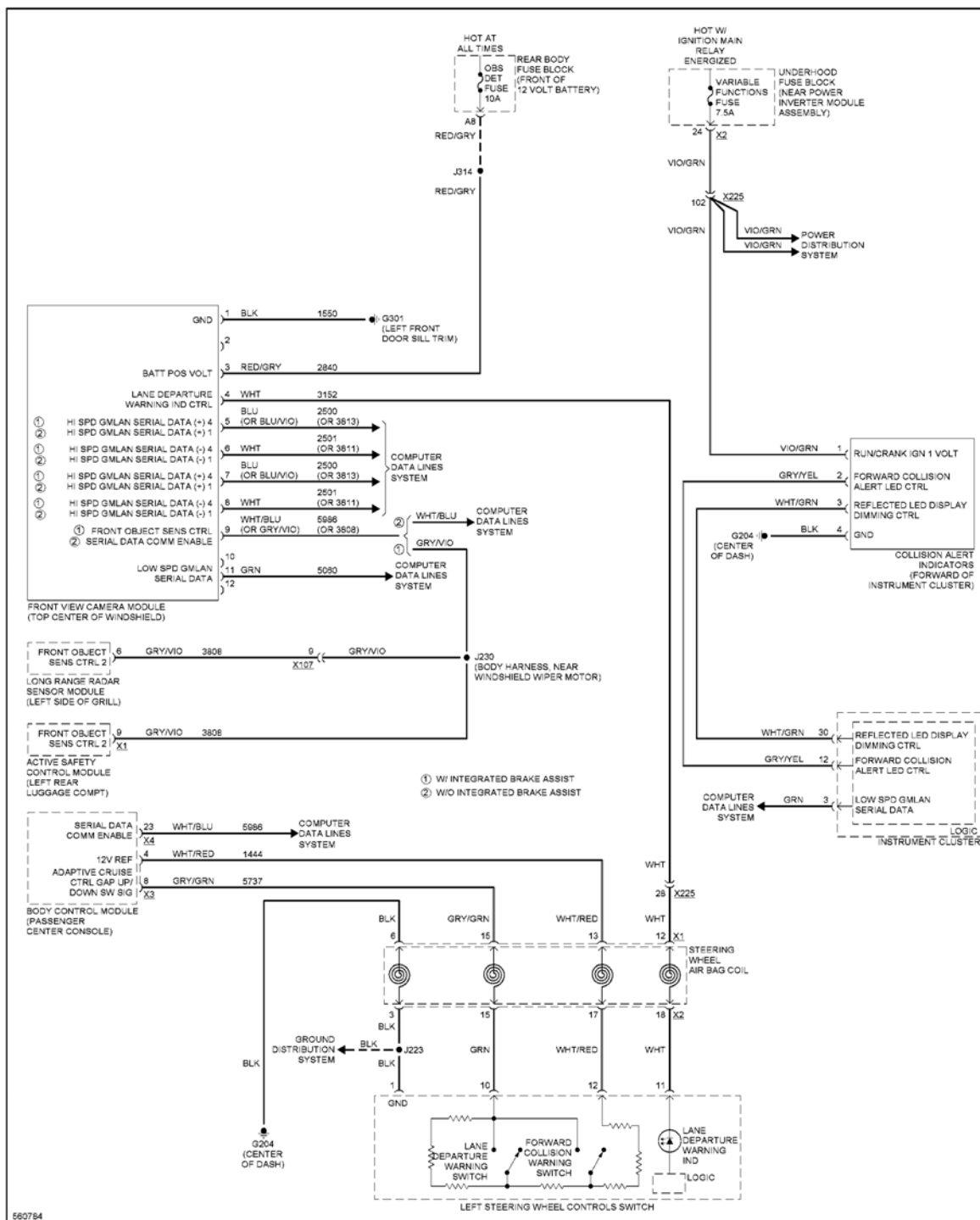


Fig. 66: Lane Departure Warning Circuit

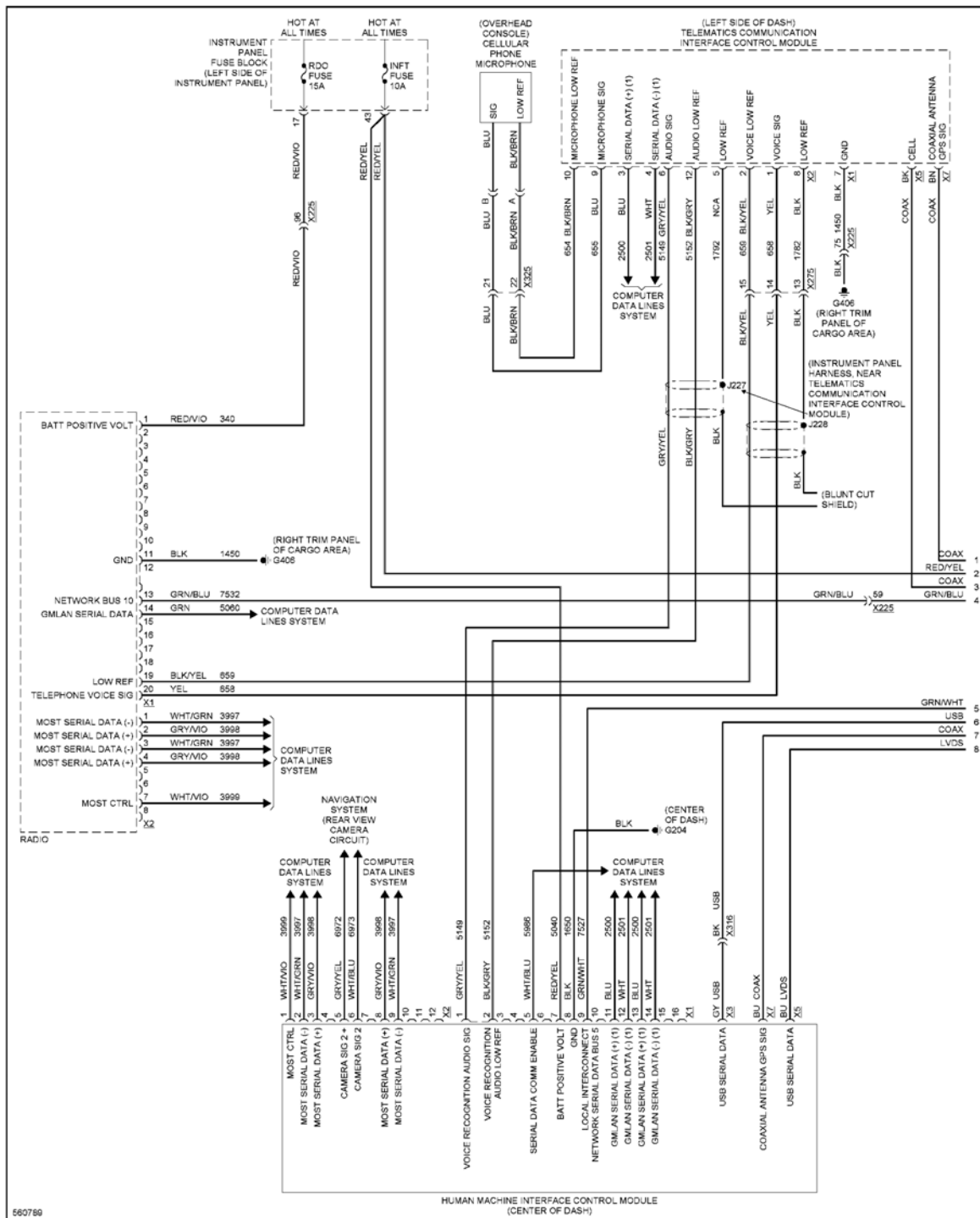


Fig. 67: Navigation Circuit, W/ Amplifier (1 of 4)

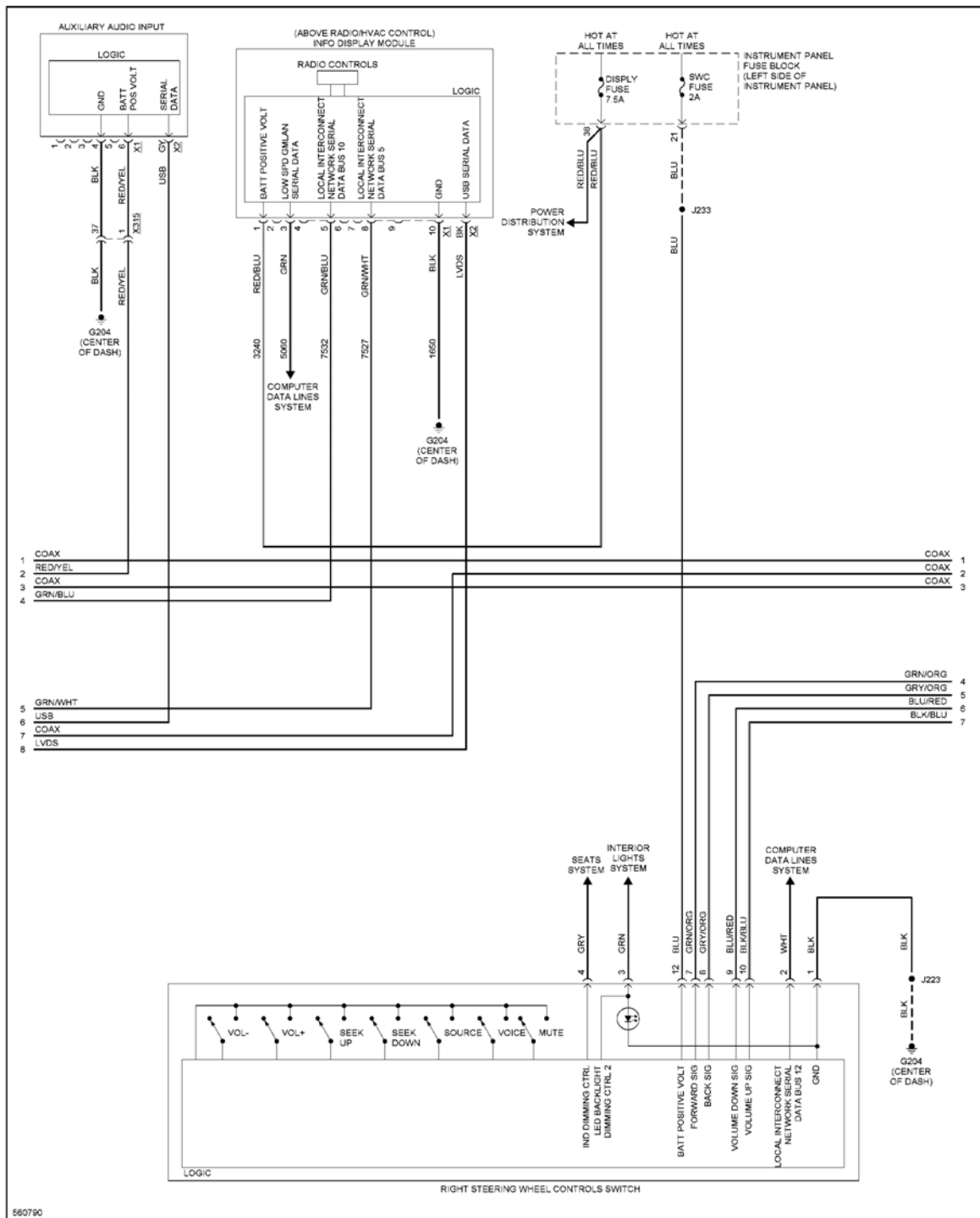


Fig. 68: Navigation Circuit, W/ Amplifier (2 of 4)

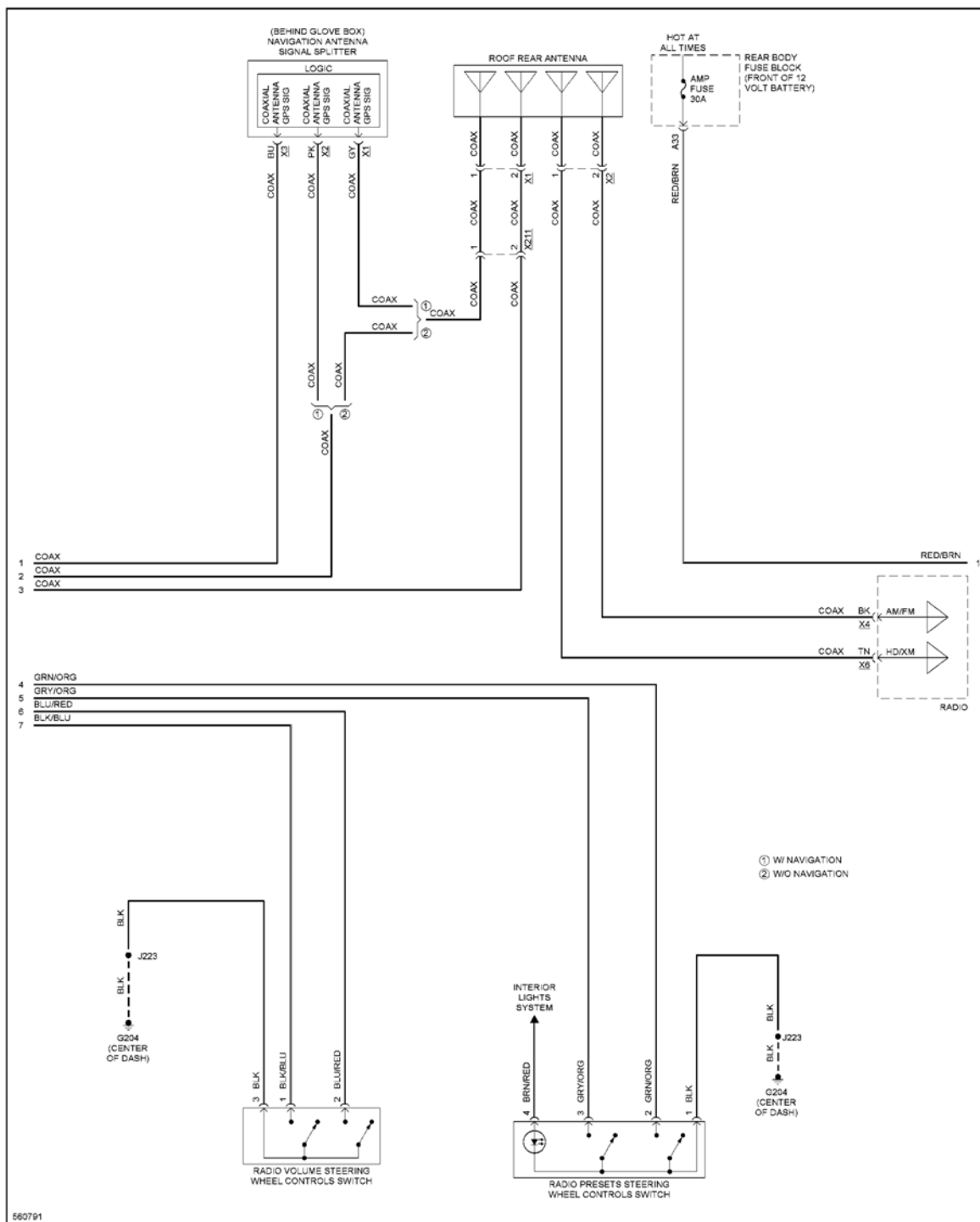


Fig. 69: Navigation Circuit, W/ Amplifier (3 of 4)

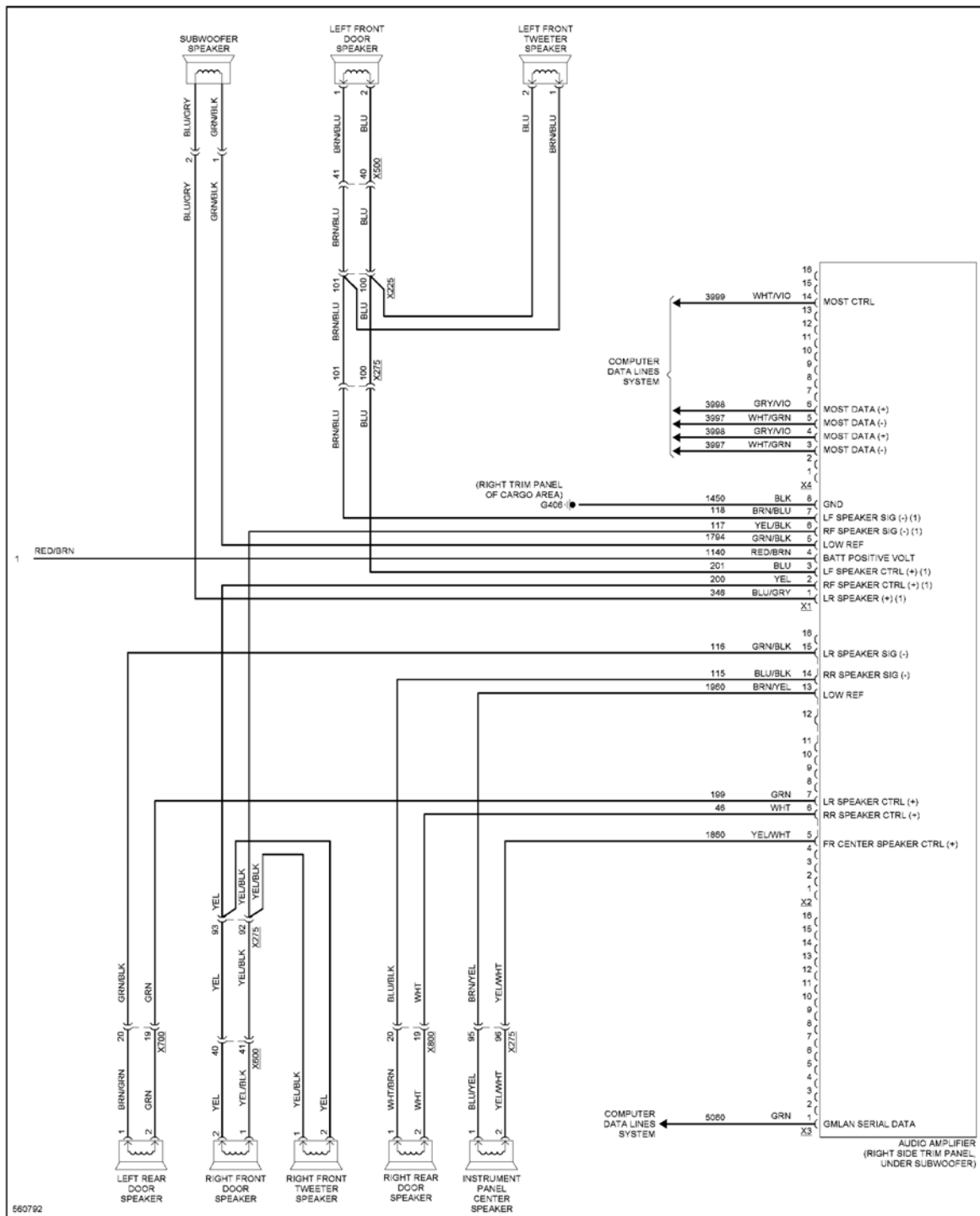


Fig. 70: Navigation Circuit, W/ Amplifier (4 of 4)

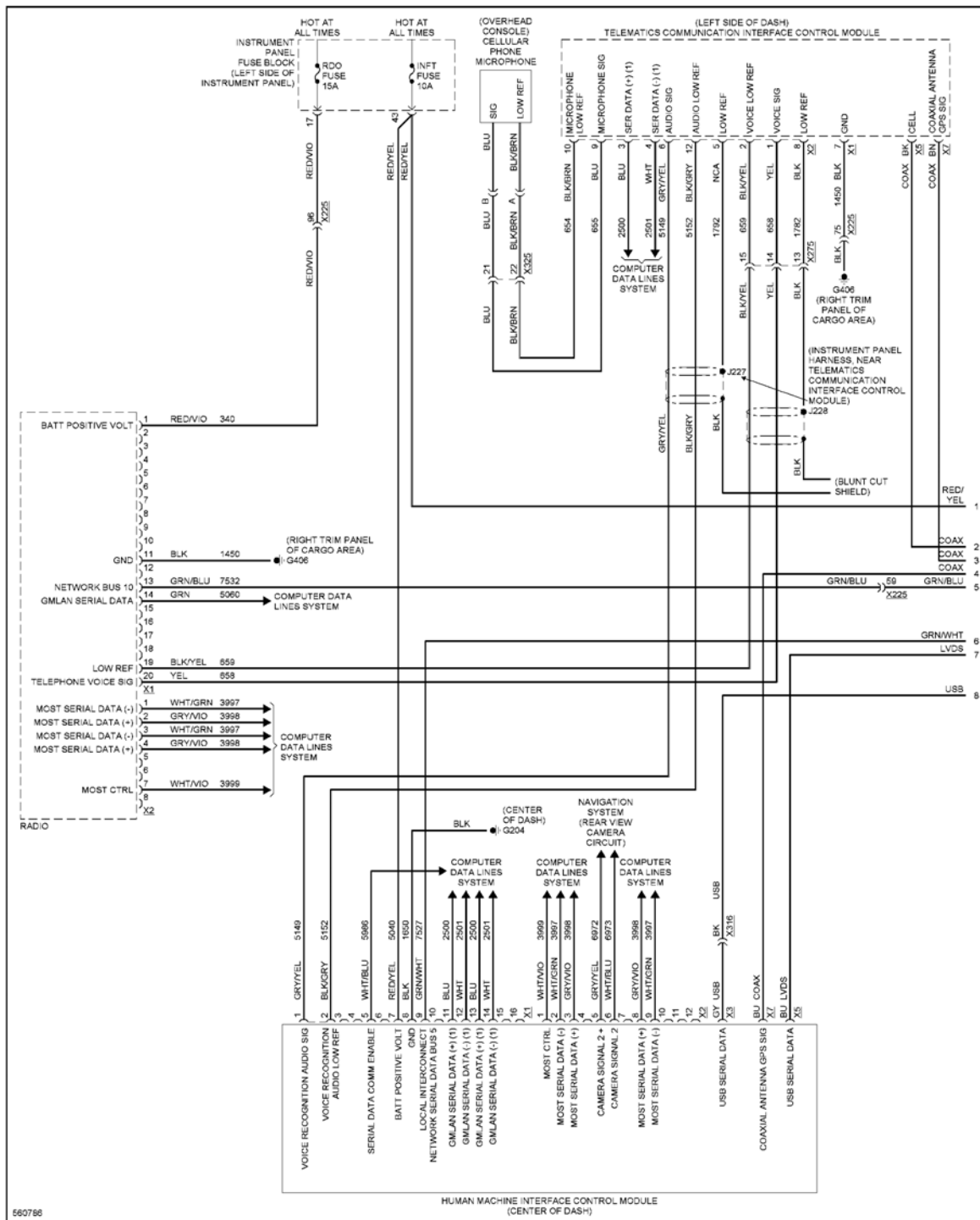


Fig. 71: Navigation Circuit, W/O Amplifier (1 of 3)

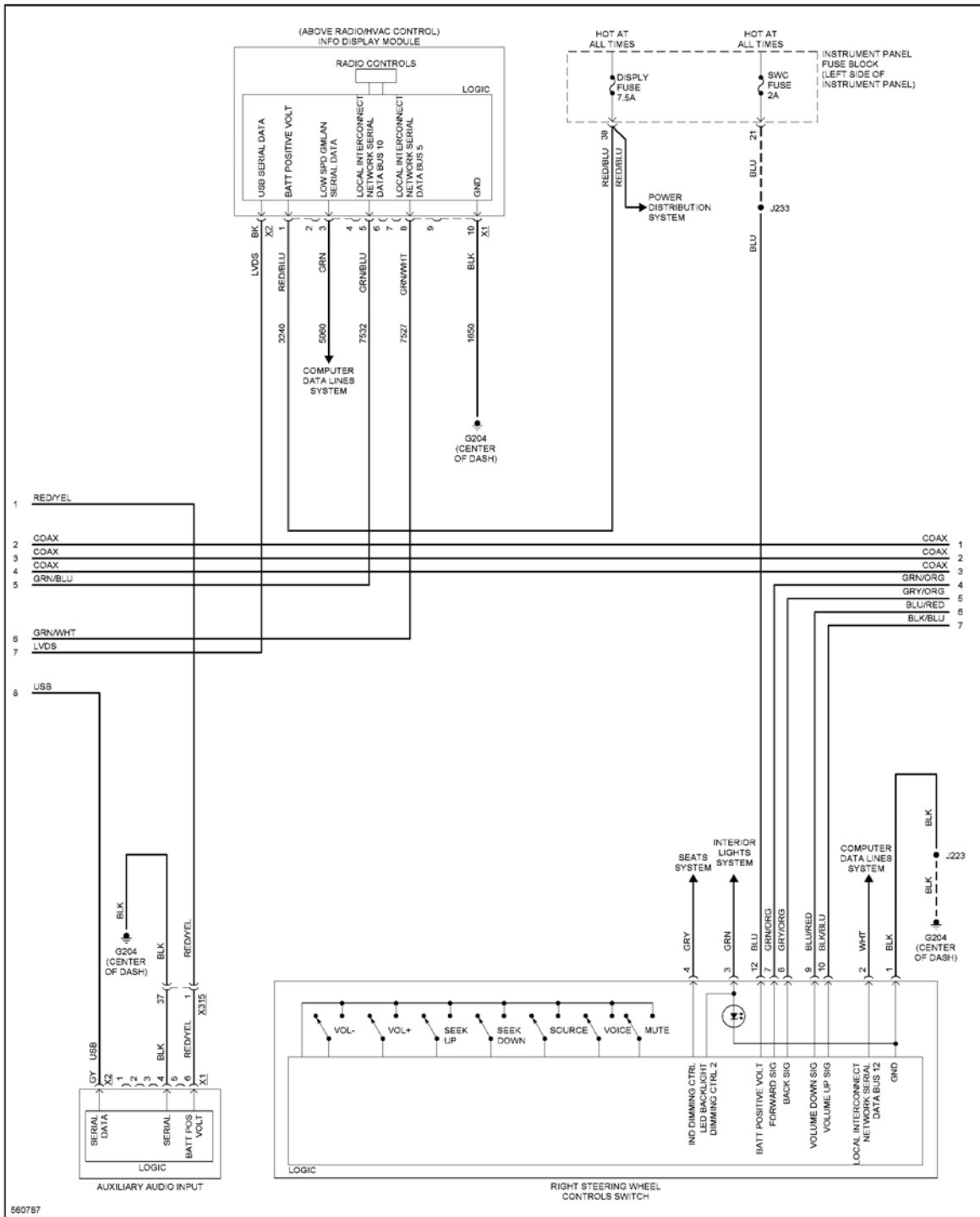


Fig. 72: Navigation Circuit, W/O Amplifier (2 of 3)

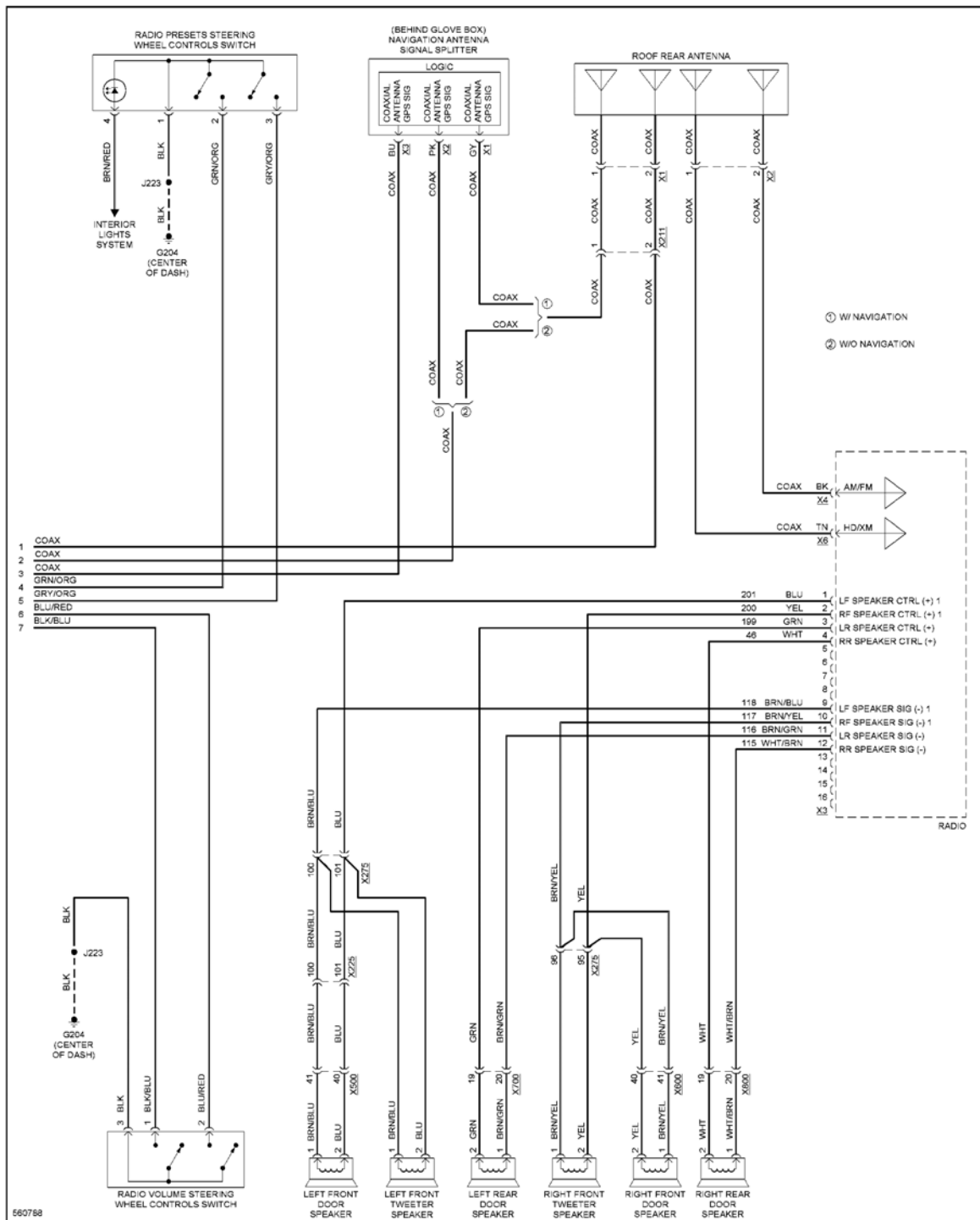


Fig. 73: Navigation Circuit, W/O Amplifier (3 of 3)

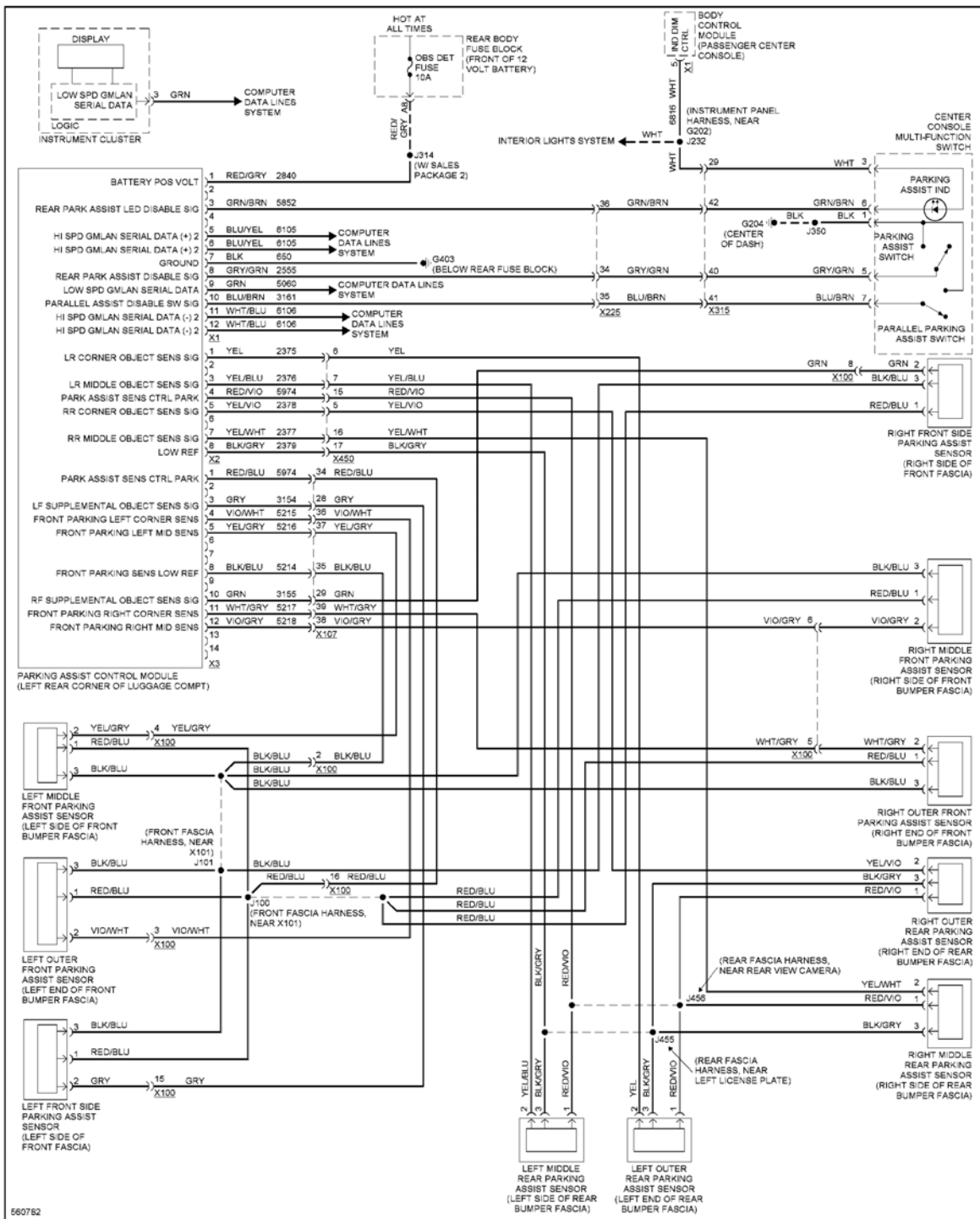


Fig. 74: Parking Assistant Circuit

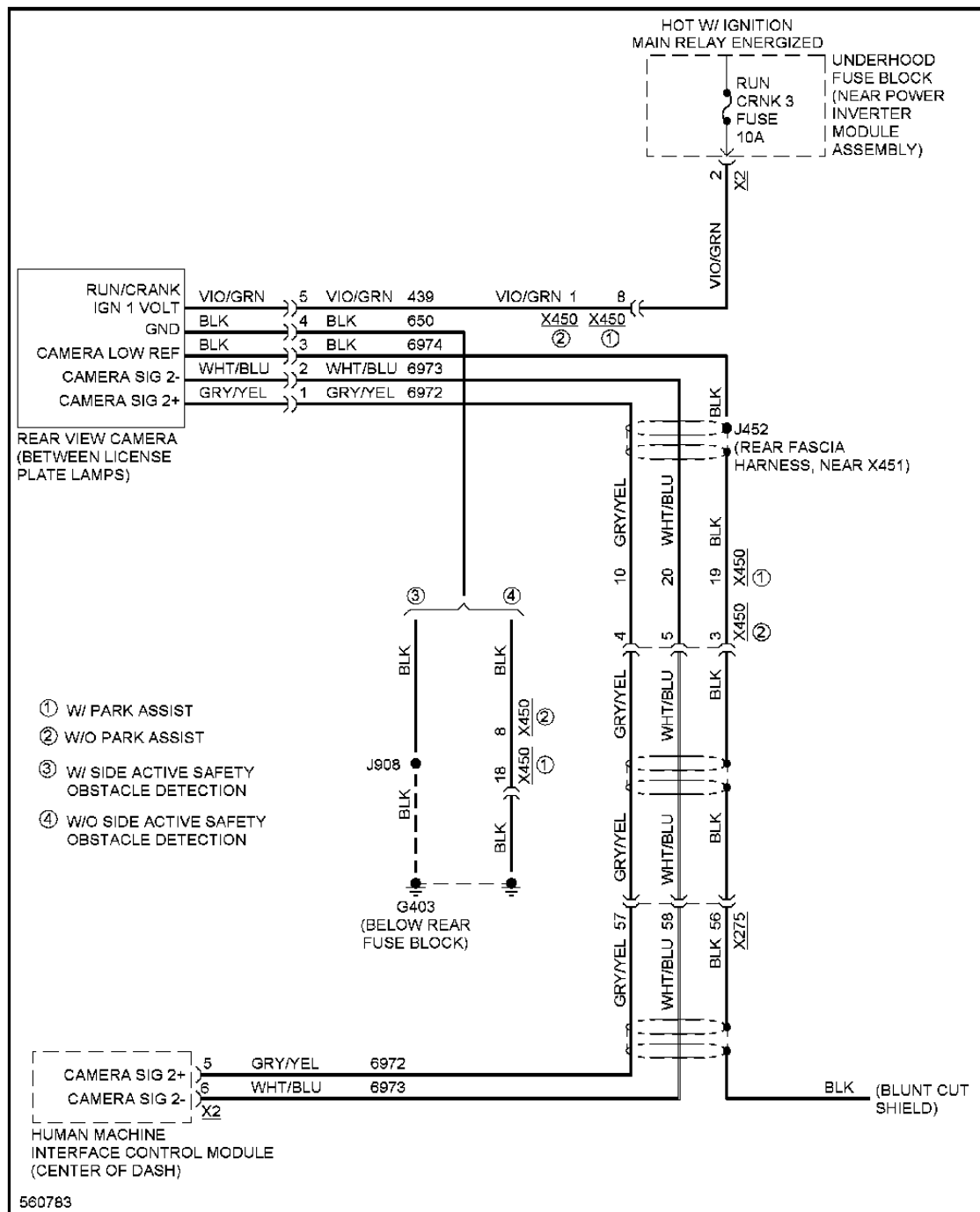


Fig. 75: Rear View Camera Circuit

POWER DISTRIBUTION

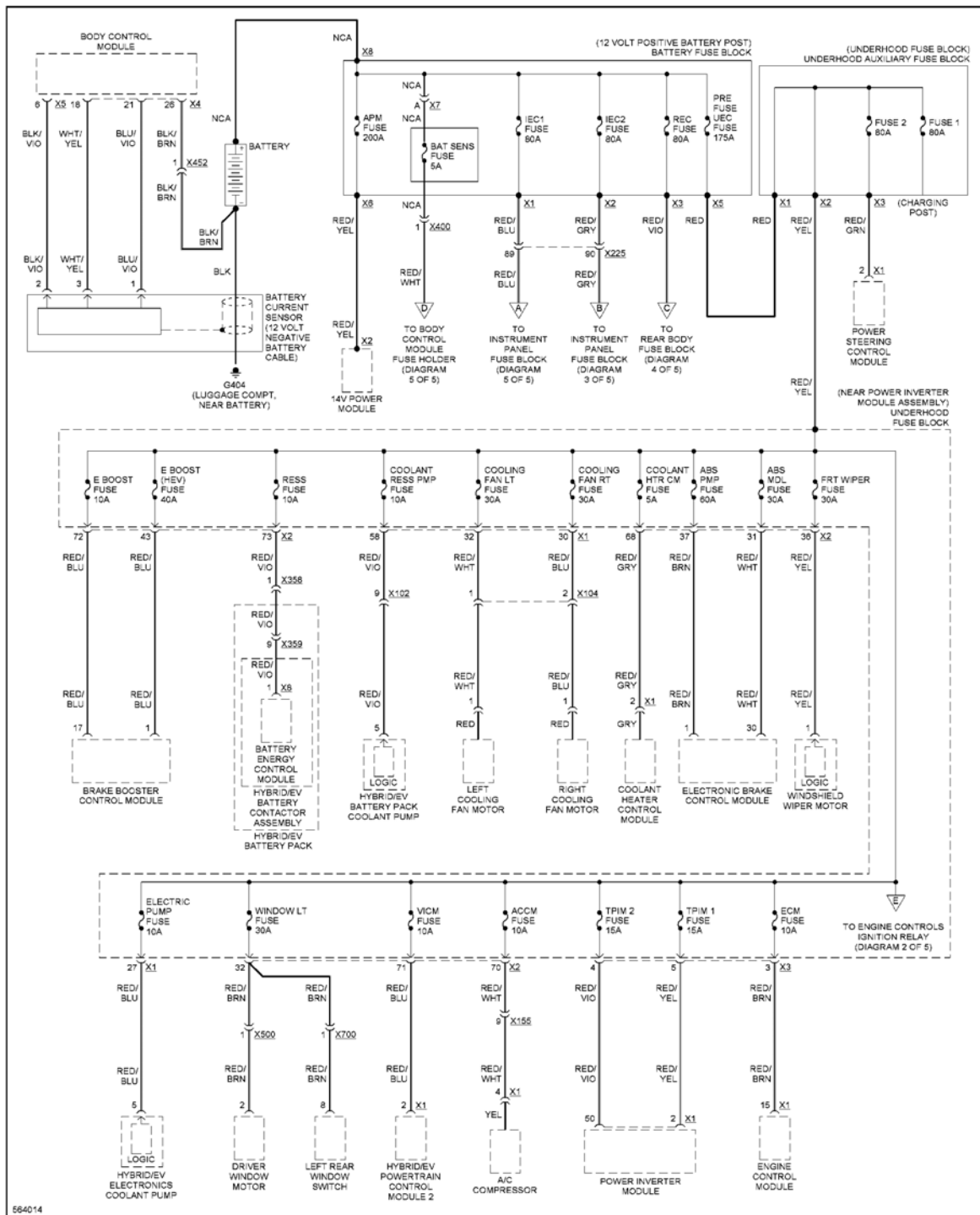


Fig. 76: Power Distribution Circuit (1 of 5)

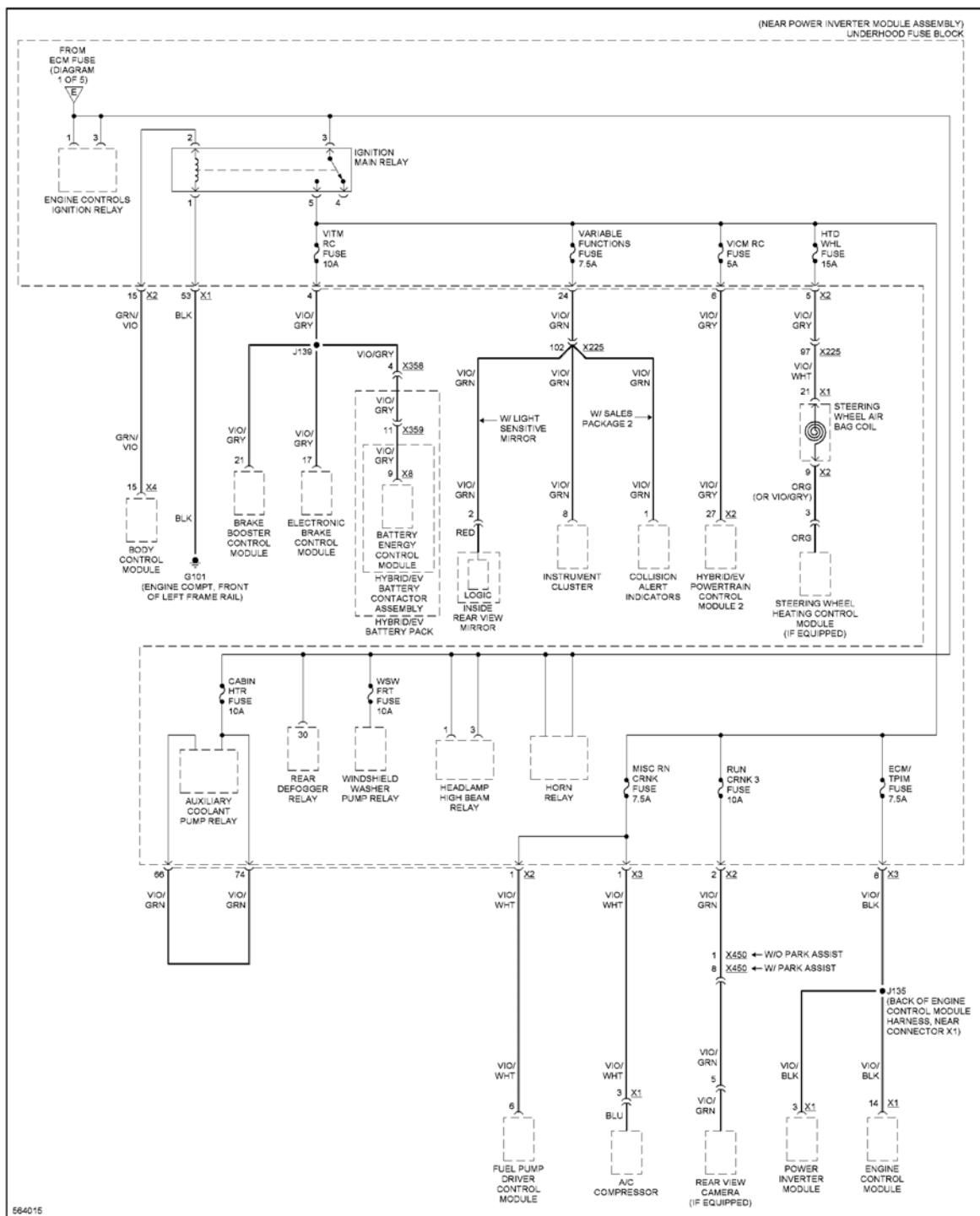


Fig. 77: Power Distribution Circuit (2 of 5)

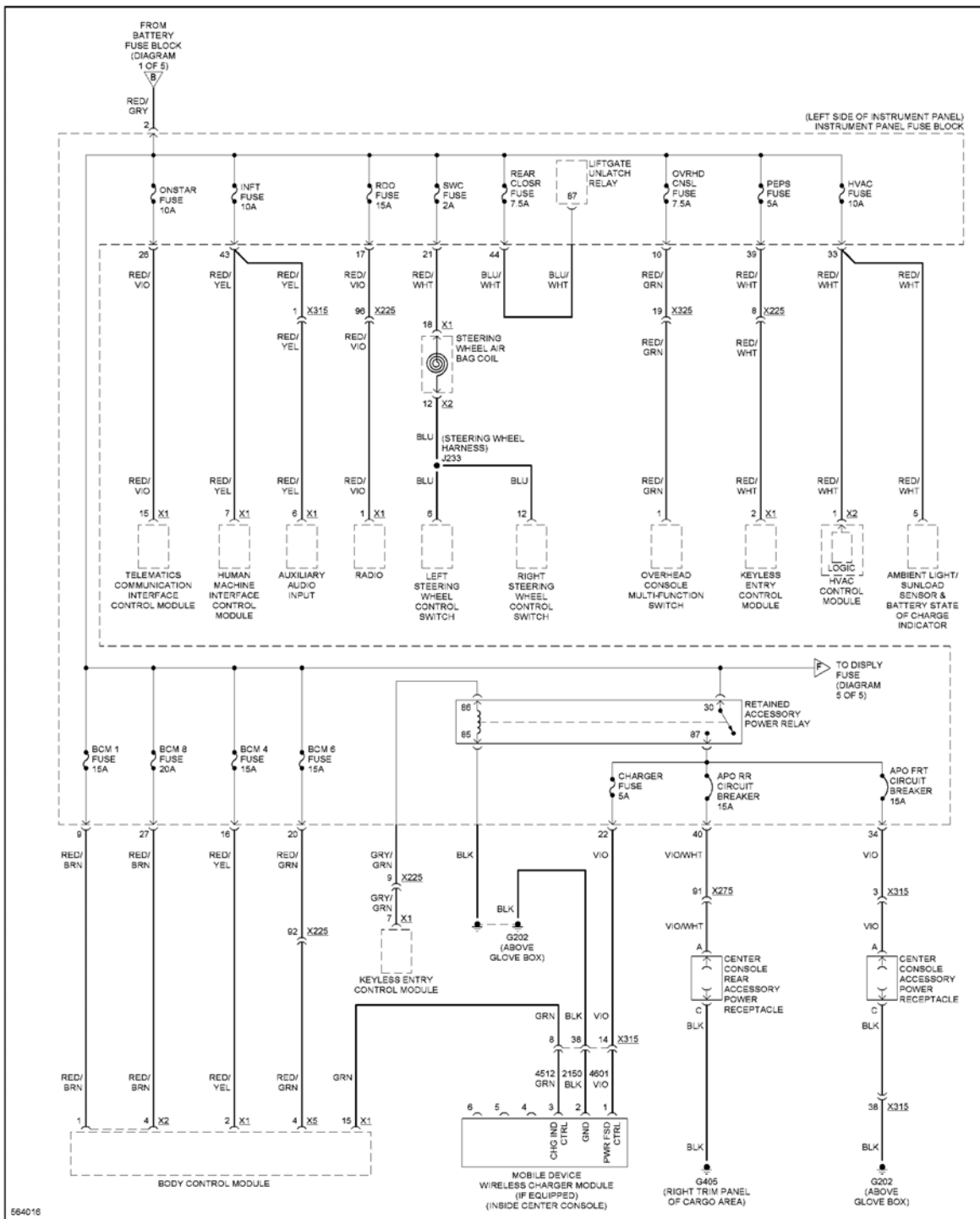


Fig. 78: Power Distribution Circuit (3 of 5)

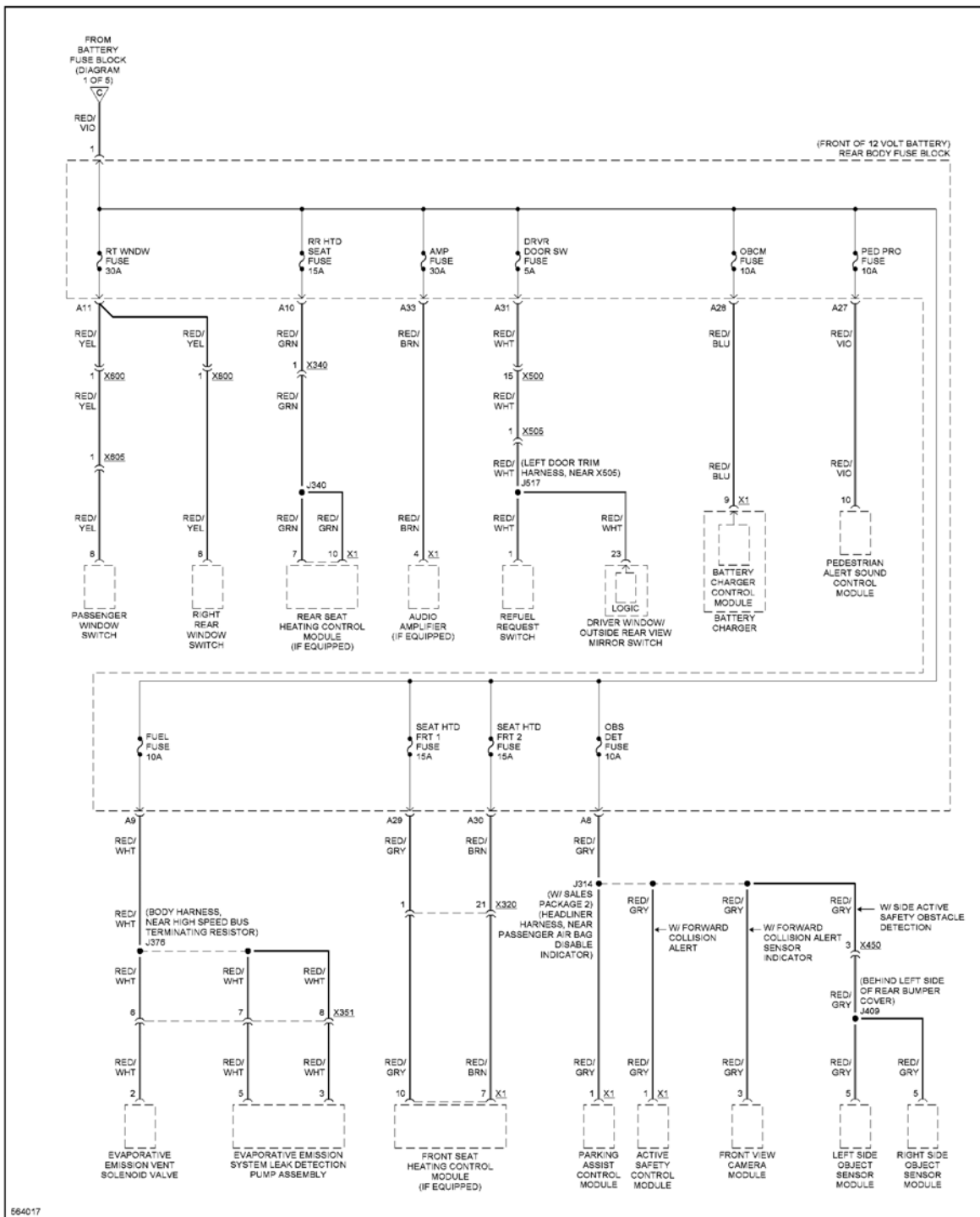


Fig. 79: Power Distribution Circuit (4 of 5)



POWER DOOR LOCKS

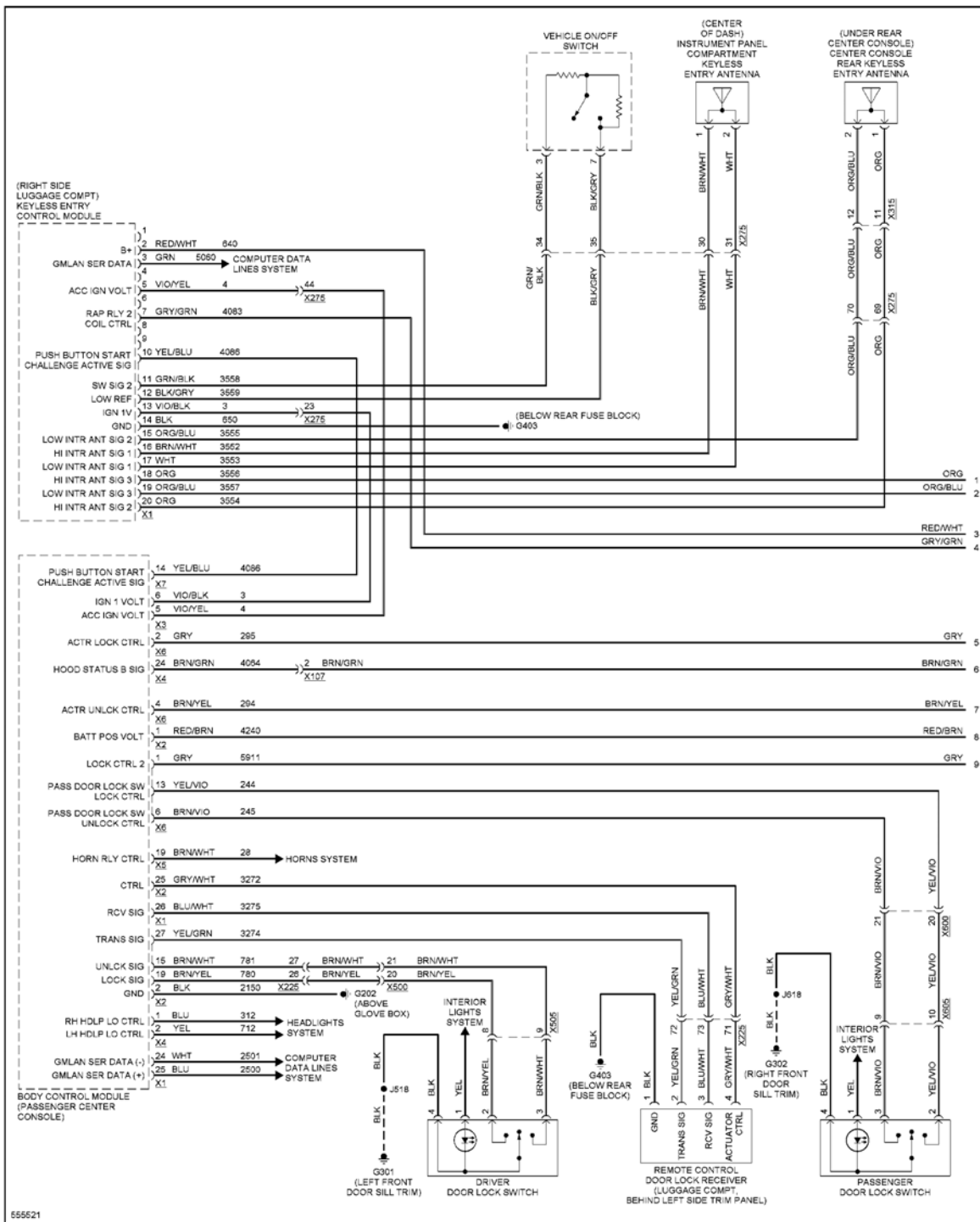


Fig. 81: Power Door Locks Circuit, W/ Passive Keyless Entry (1 of 4)

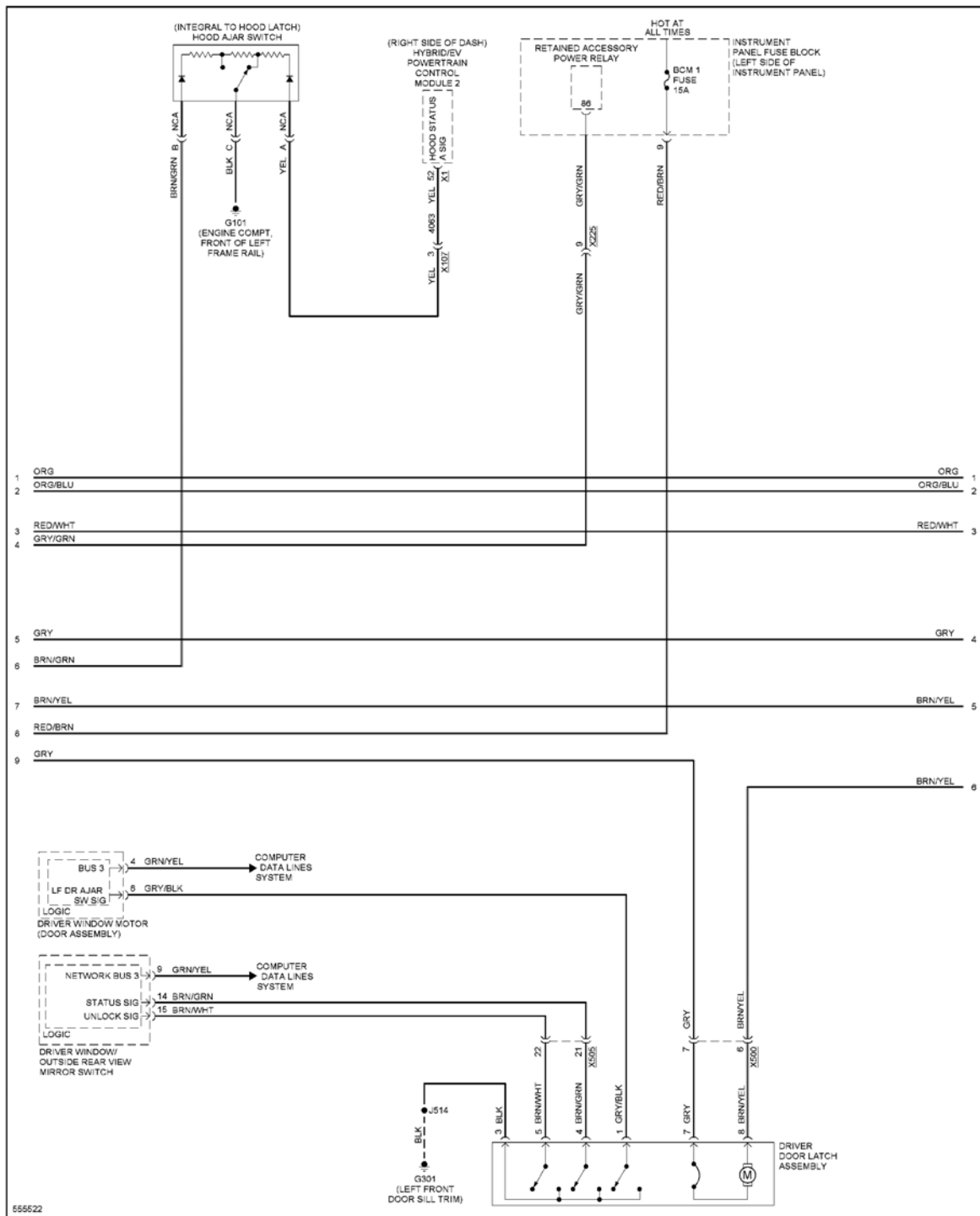


Fig. 82: Power Door Locks Circuit, W/ Passive Keyless Entry (2 of 4)

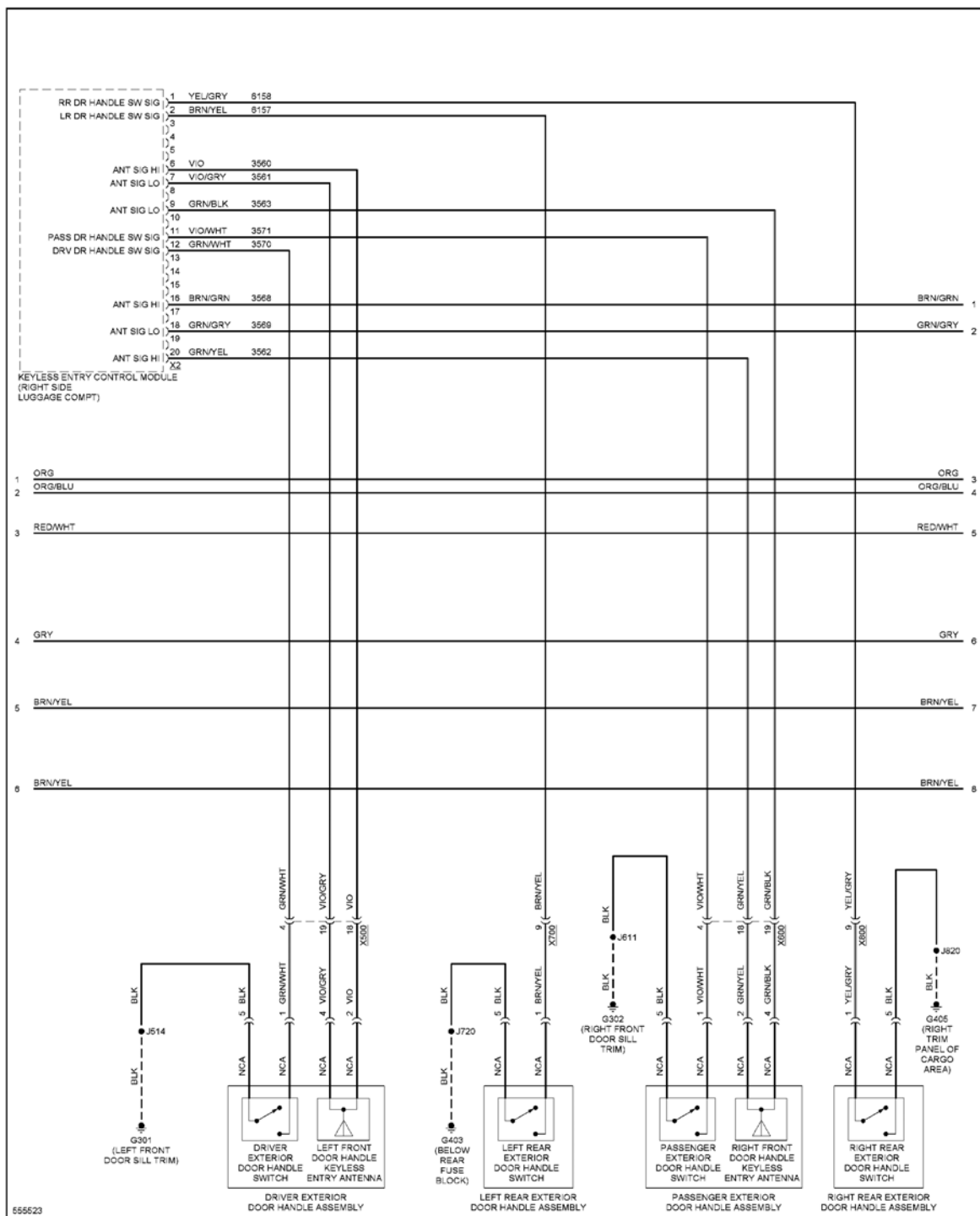


Fig. 83: Power Door Locks Circuit, W/ Passive Keyless Entry (3 of 4)

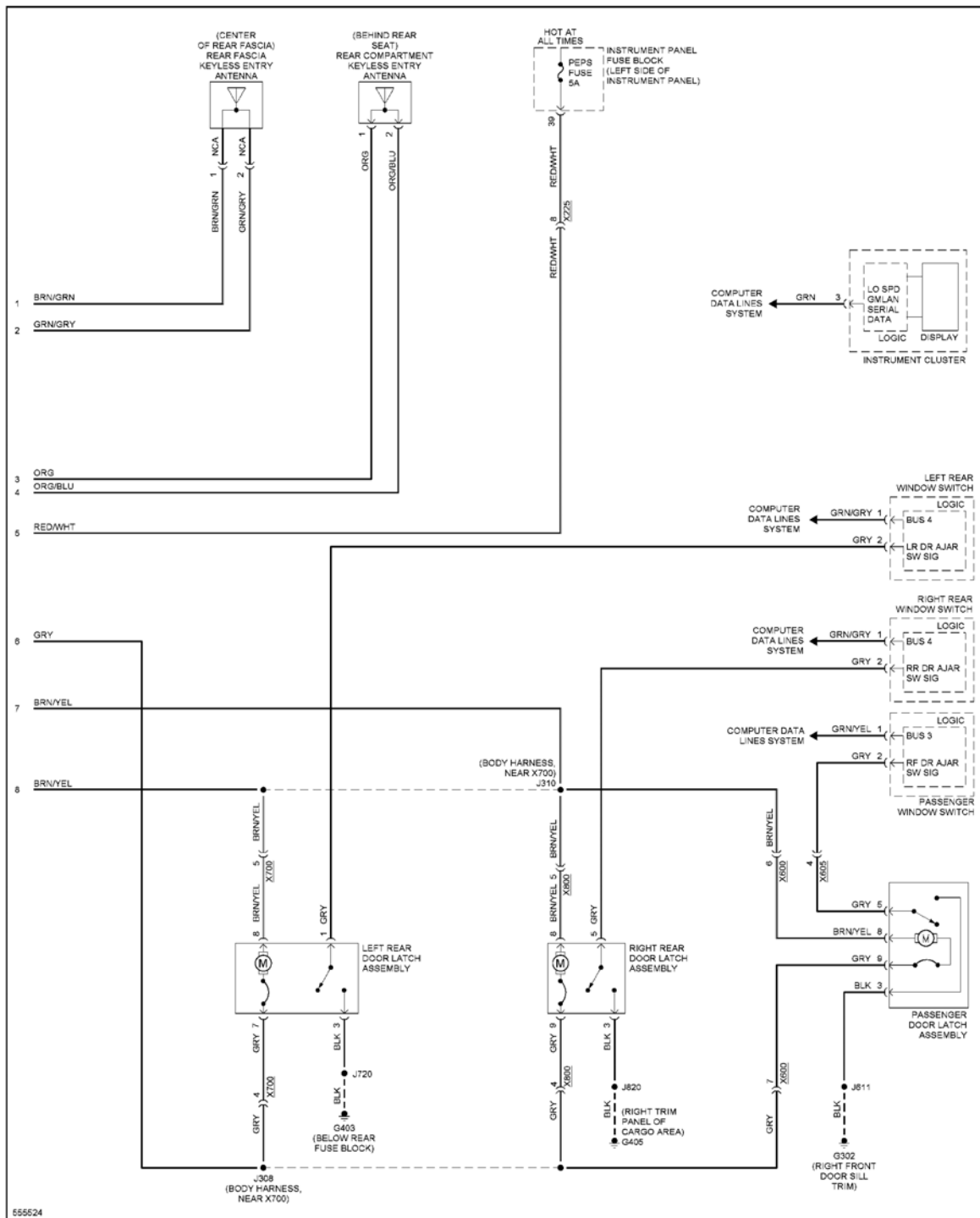


Fig. 84: Power Door Locks Circuit, W/ Passive Keyless Entry (4 of 4)

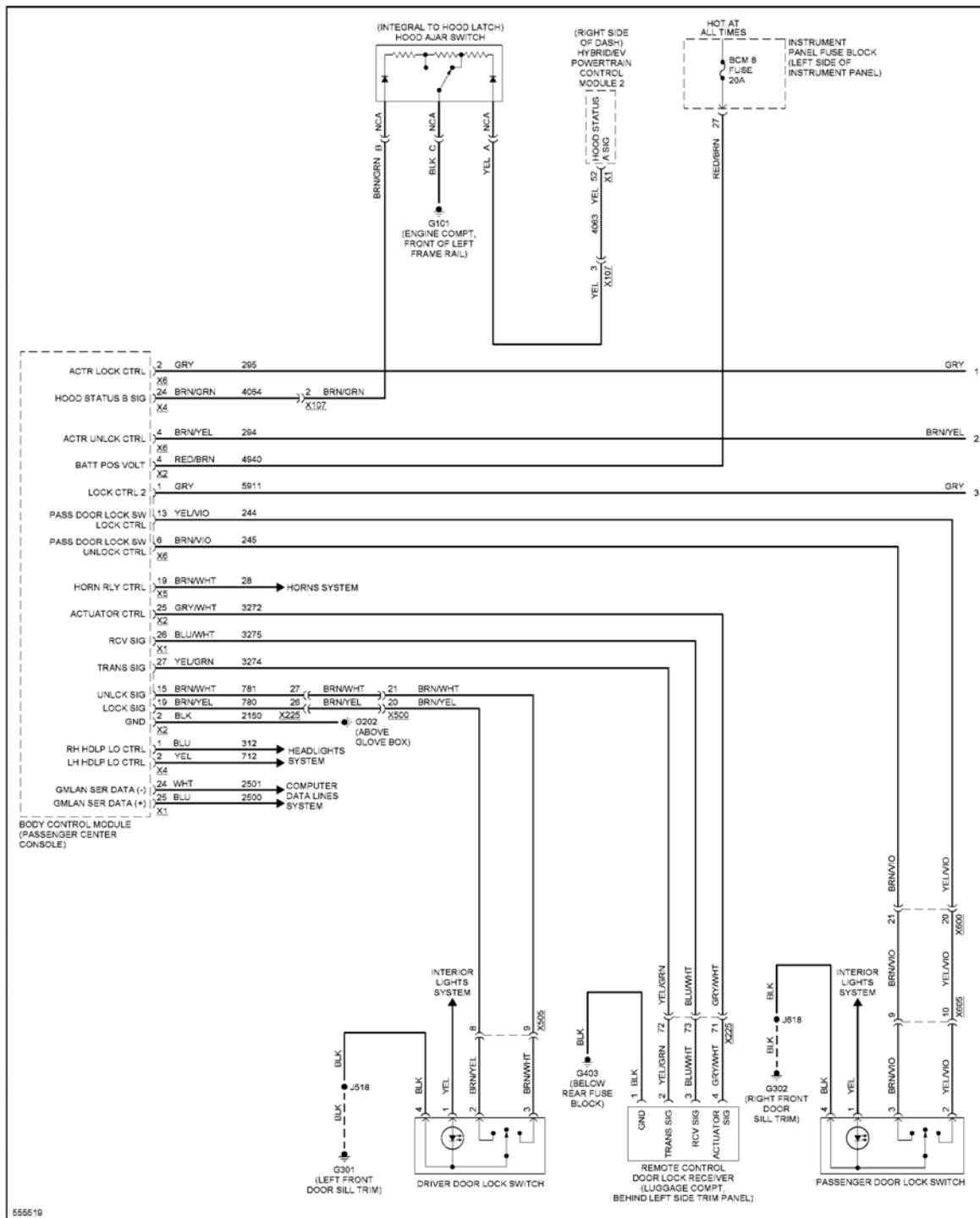
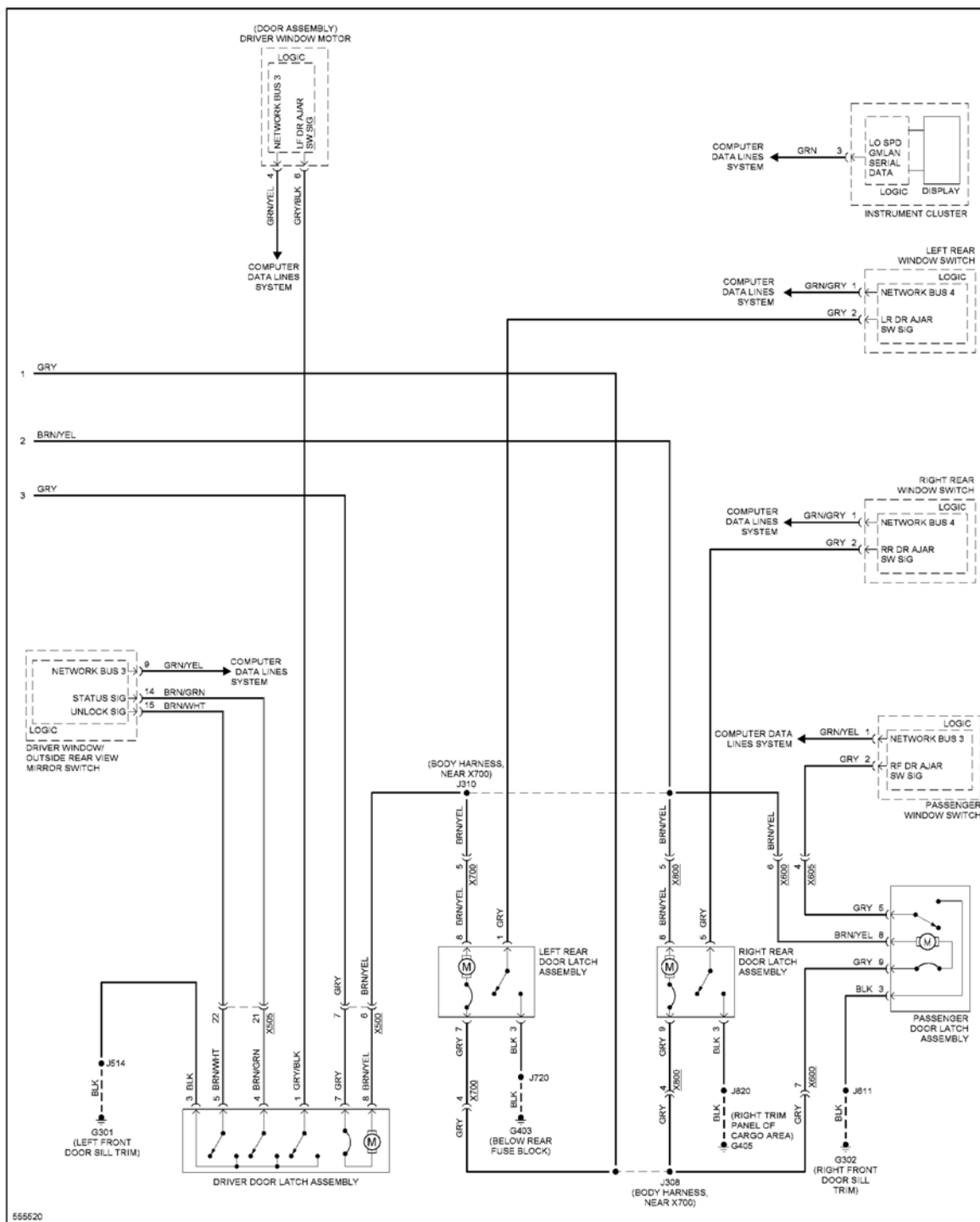


Fig. 85: Power Door Locks Circuit, W/O Passive Keyless Entry (1 of 2)





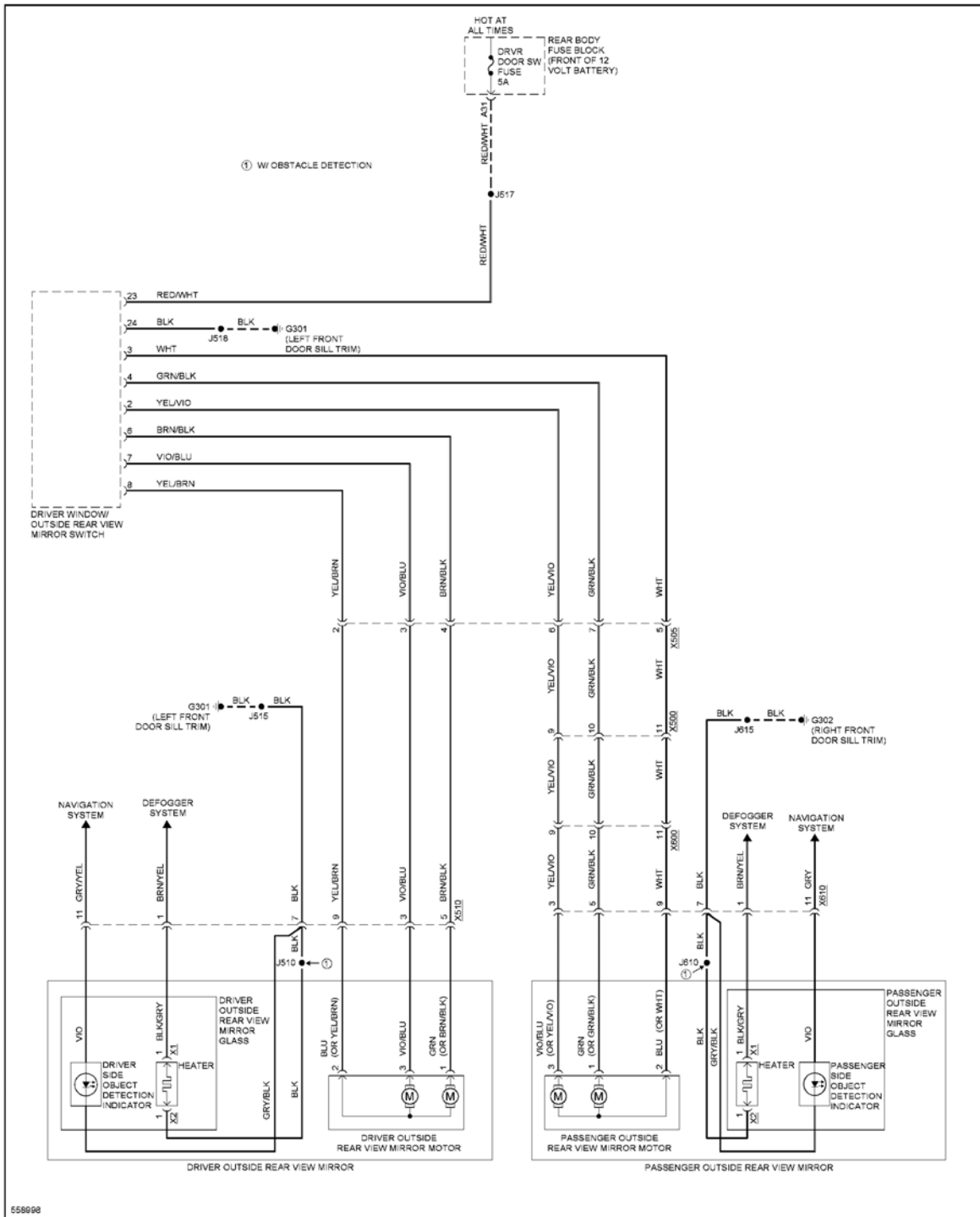


Fig. 88: Power Mirrors Circuit

POWER SEATS

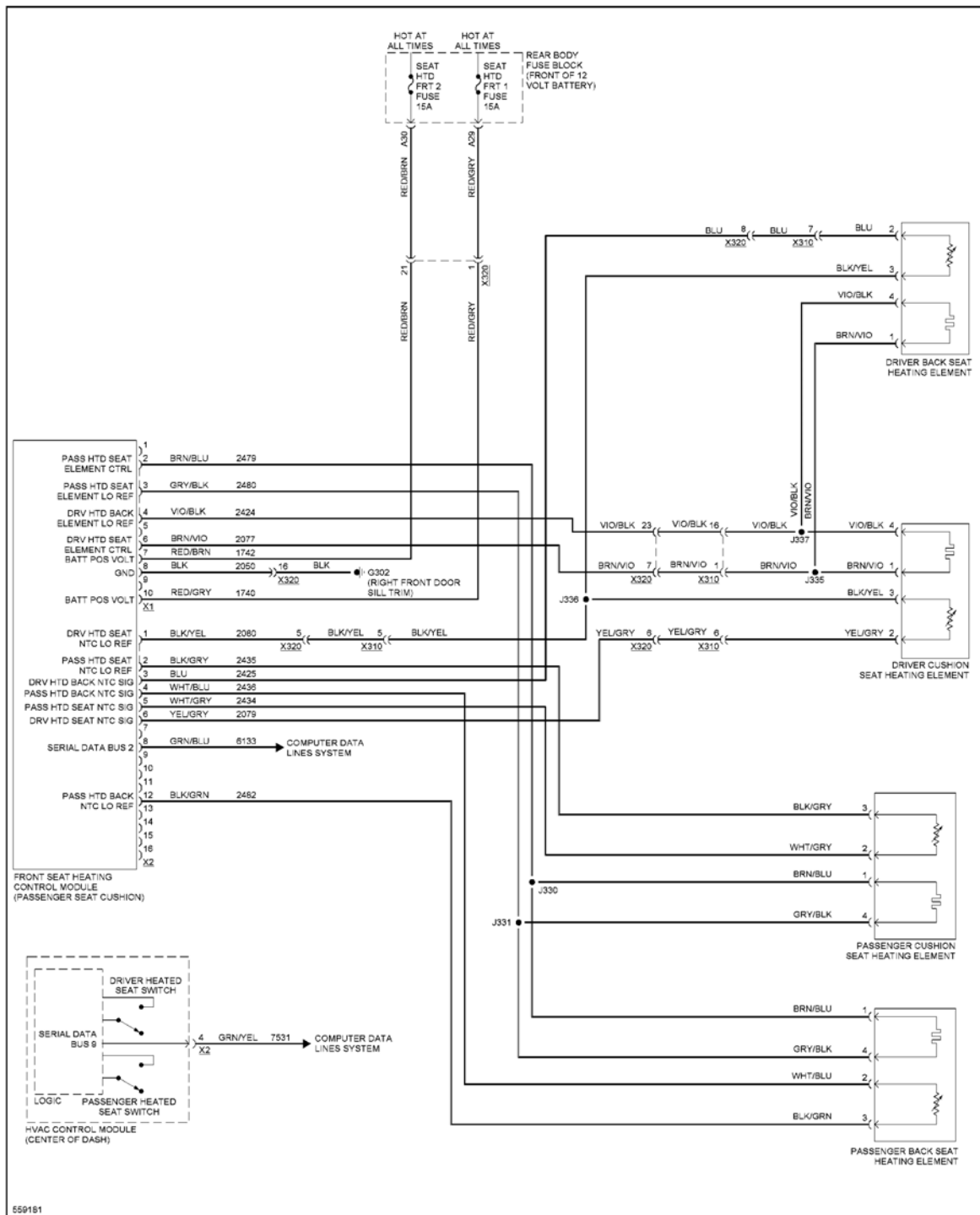


Fig. 89: Front Heated Seats Circuit

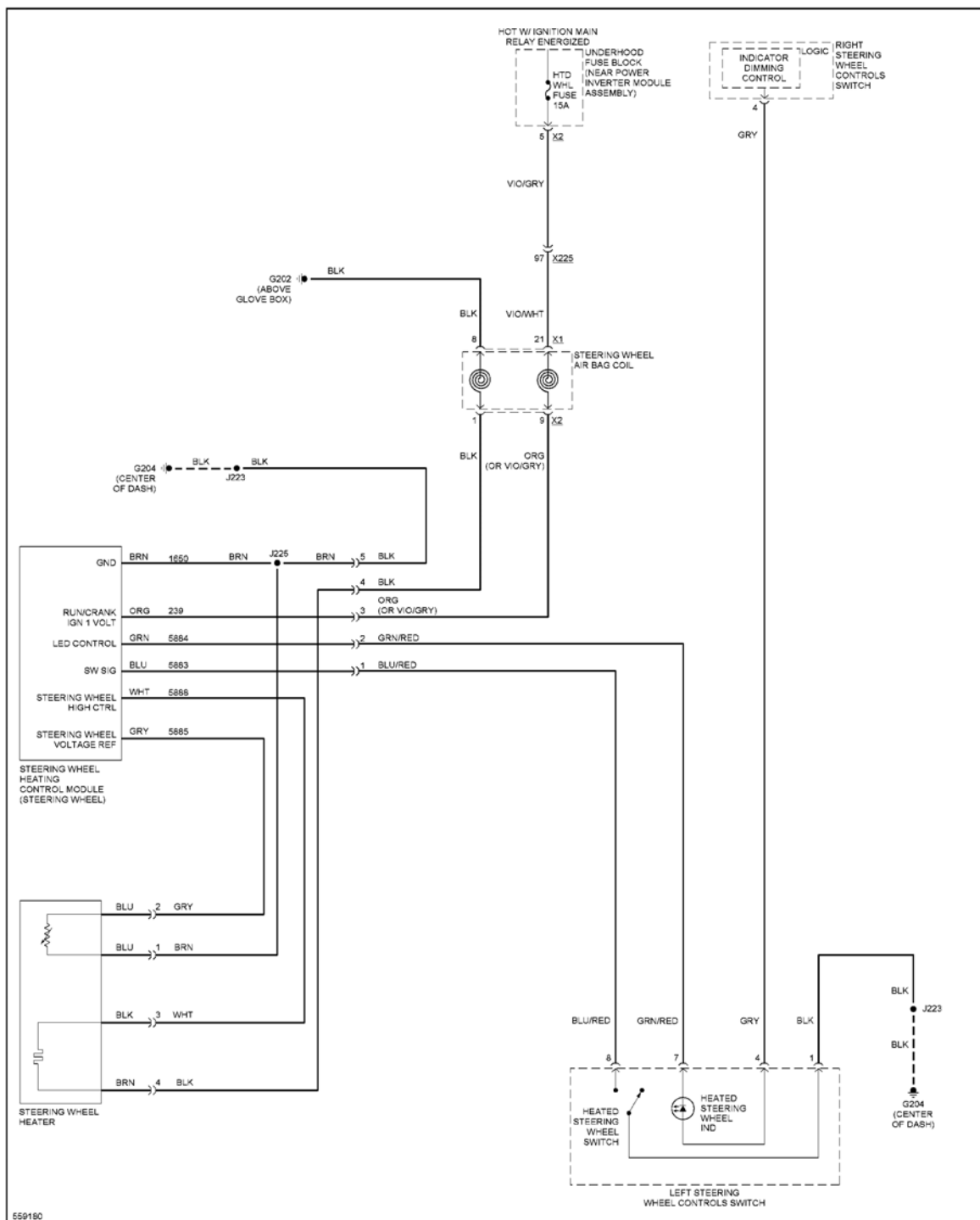


Fig. 90: Heated Steering Wheel Circuit



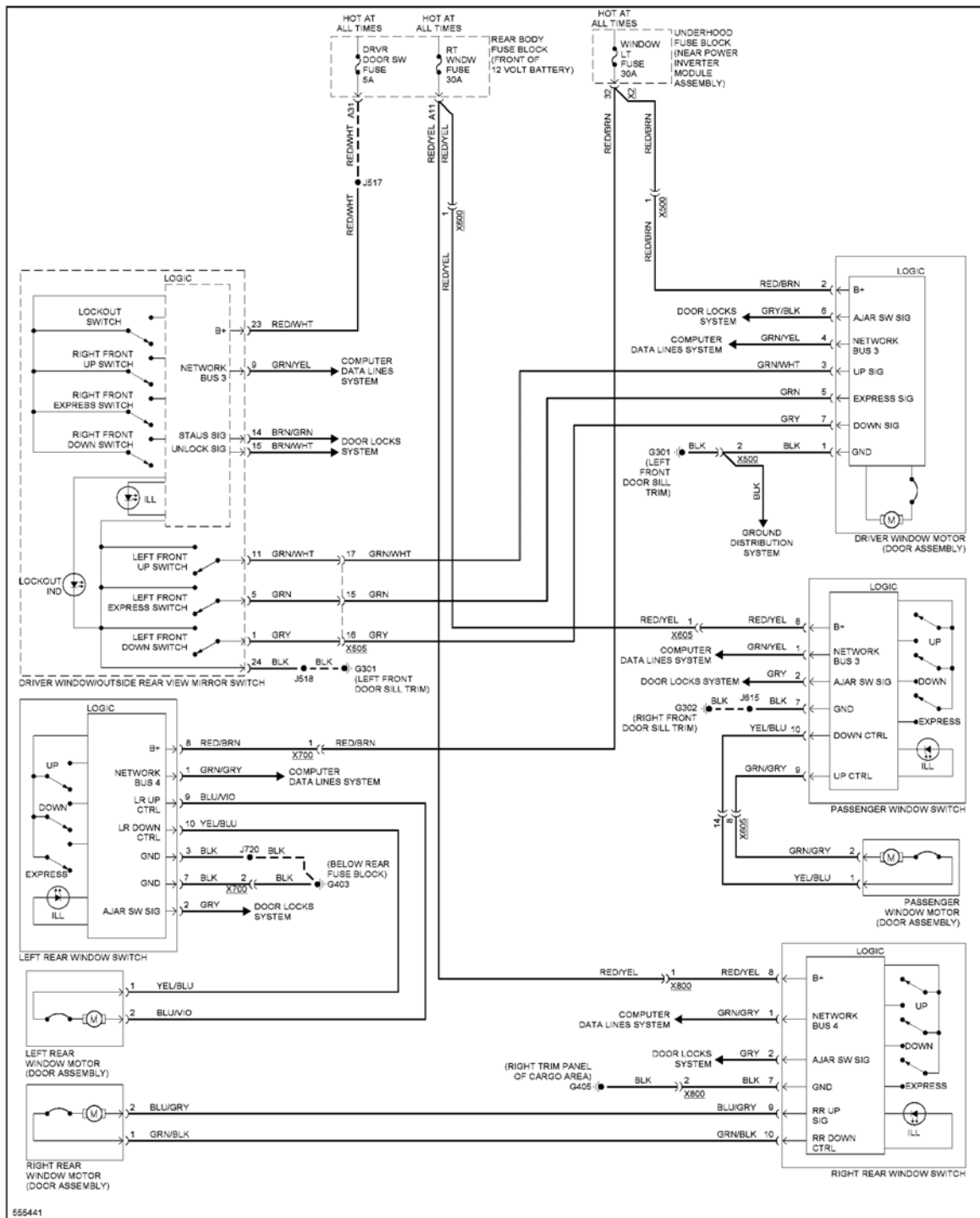


Fig. 92: Power Windows Circuit

RADIO

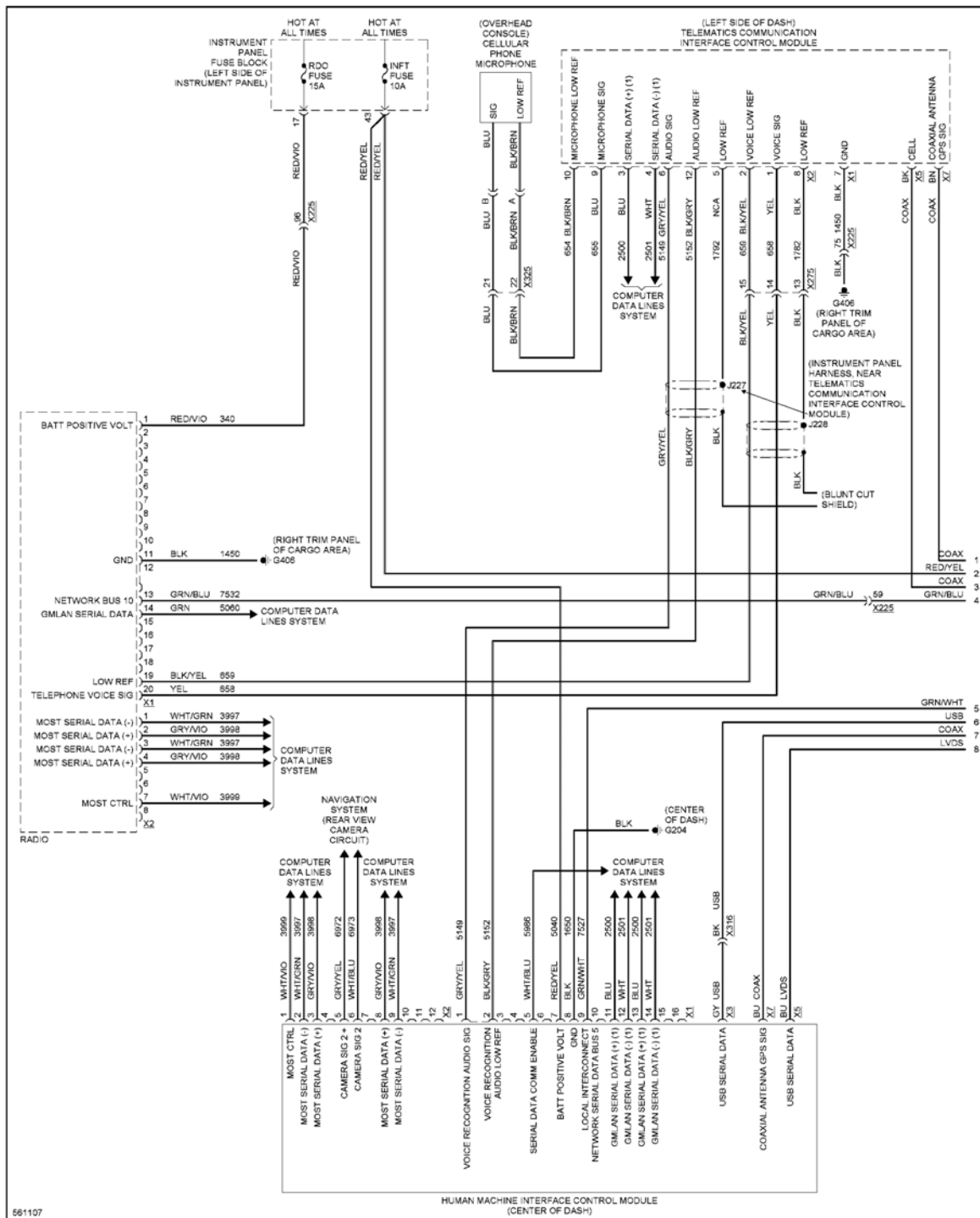


Fig. 93: Radio Circuit, W/ Amplifier (1 of 4)

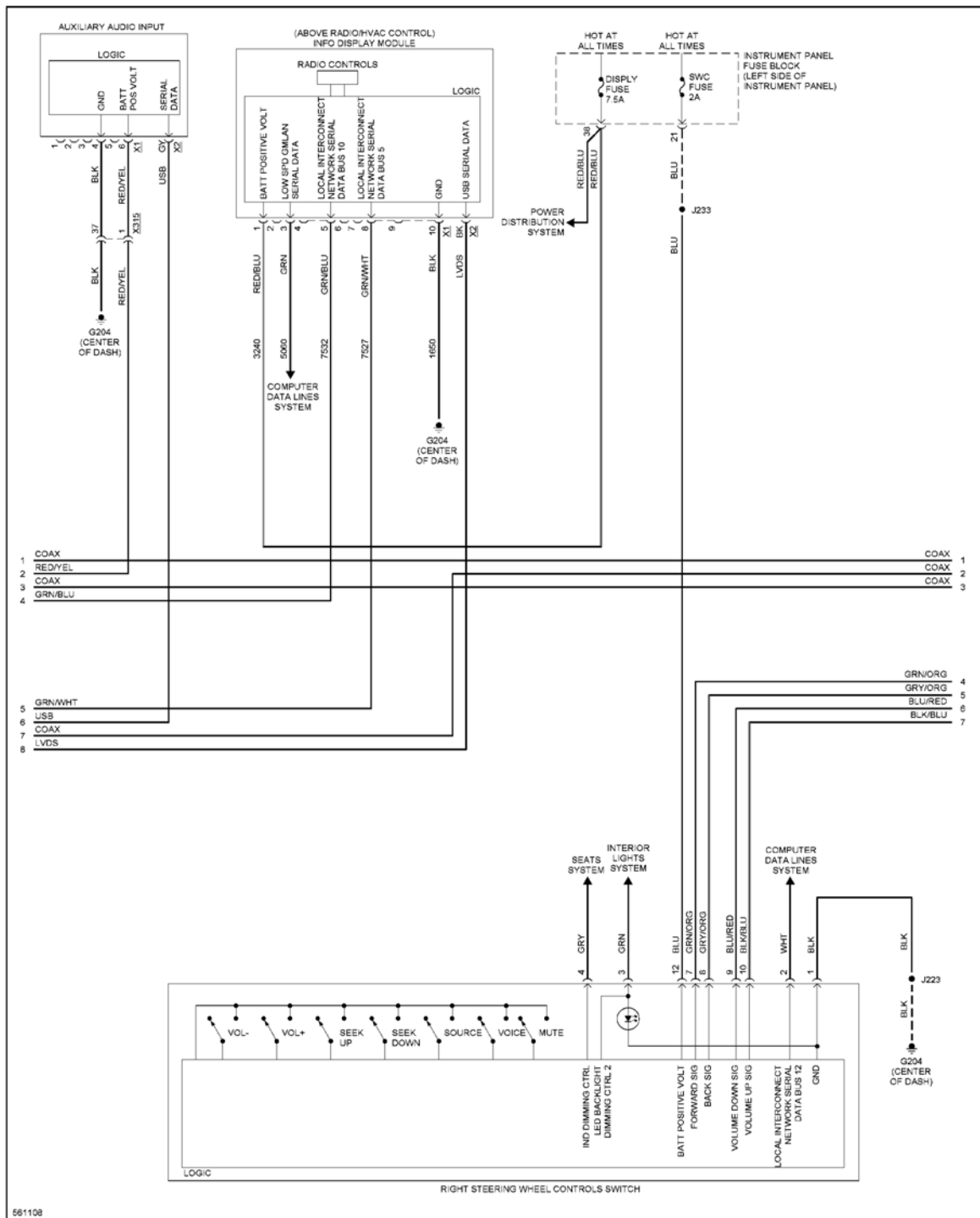


Fig. 94: Radio Circuit, W/ Amplifier (2 of 4)

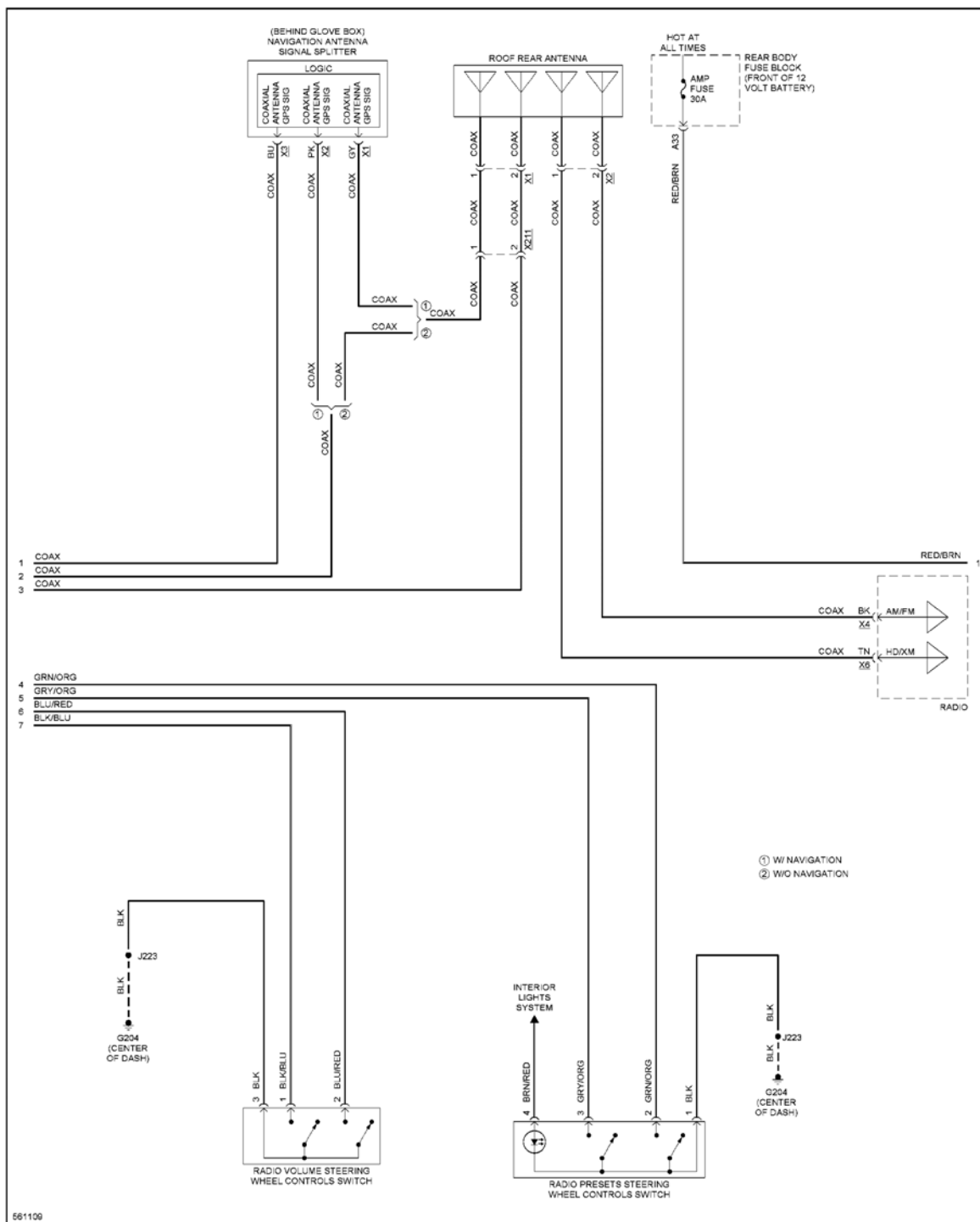


Fig. 95: Radio Circuit, W/ Amplifier (3 of 4)

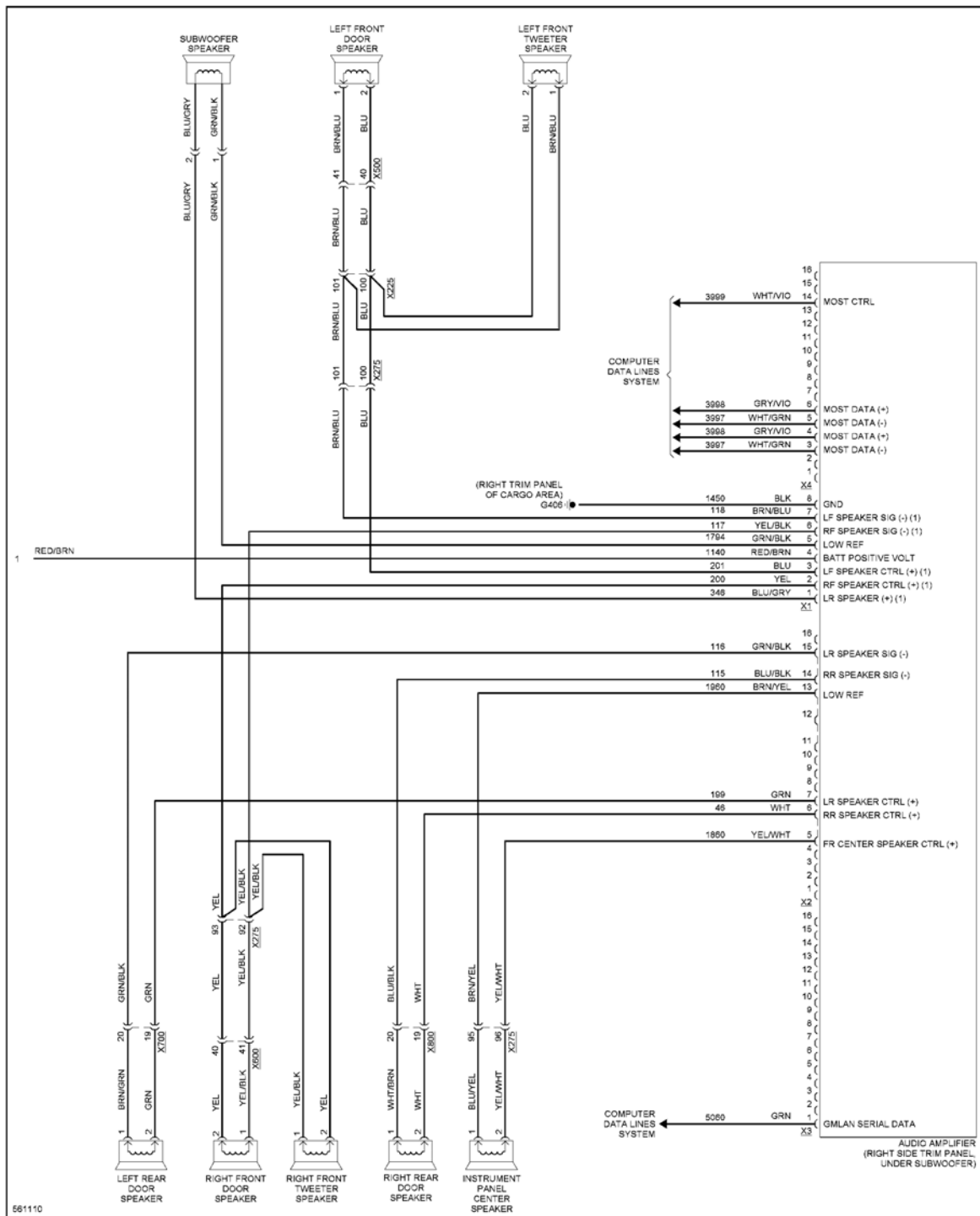


Fig. 96: Radio Circuit, W/ Amplifier (4 of 4)

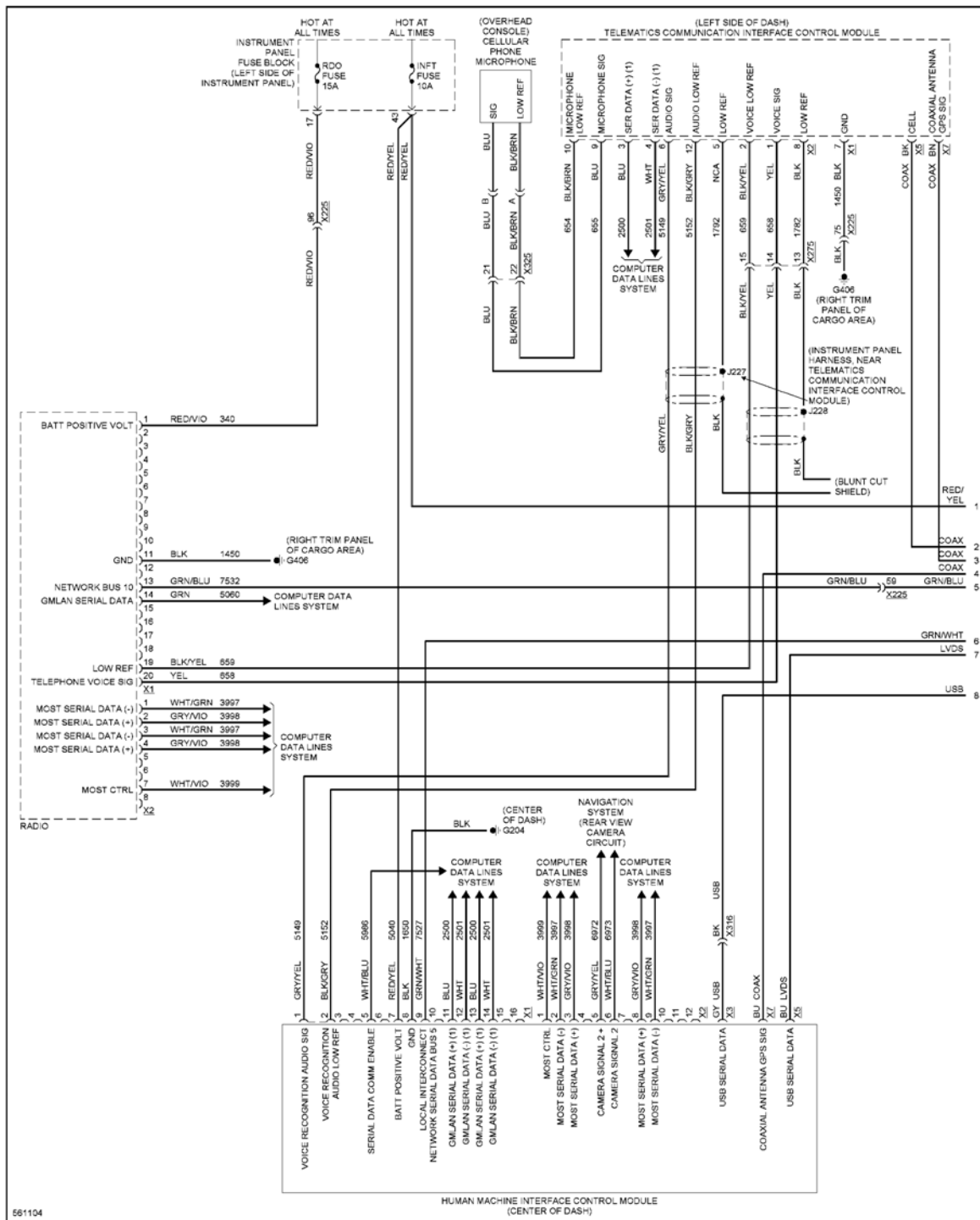


Fig. 97: Radio Circuit, W/O Amplifier (1 of 3)

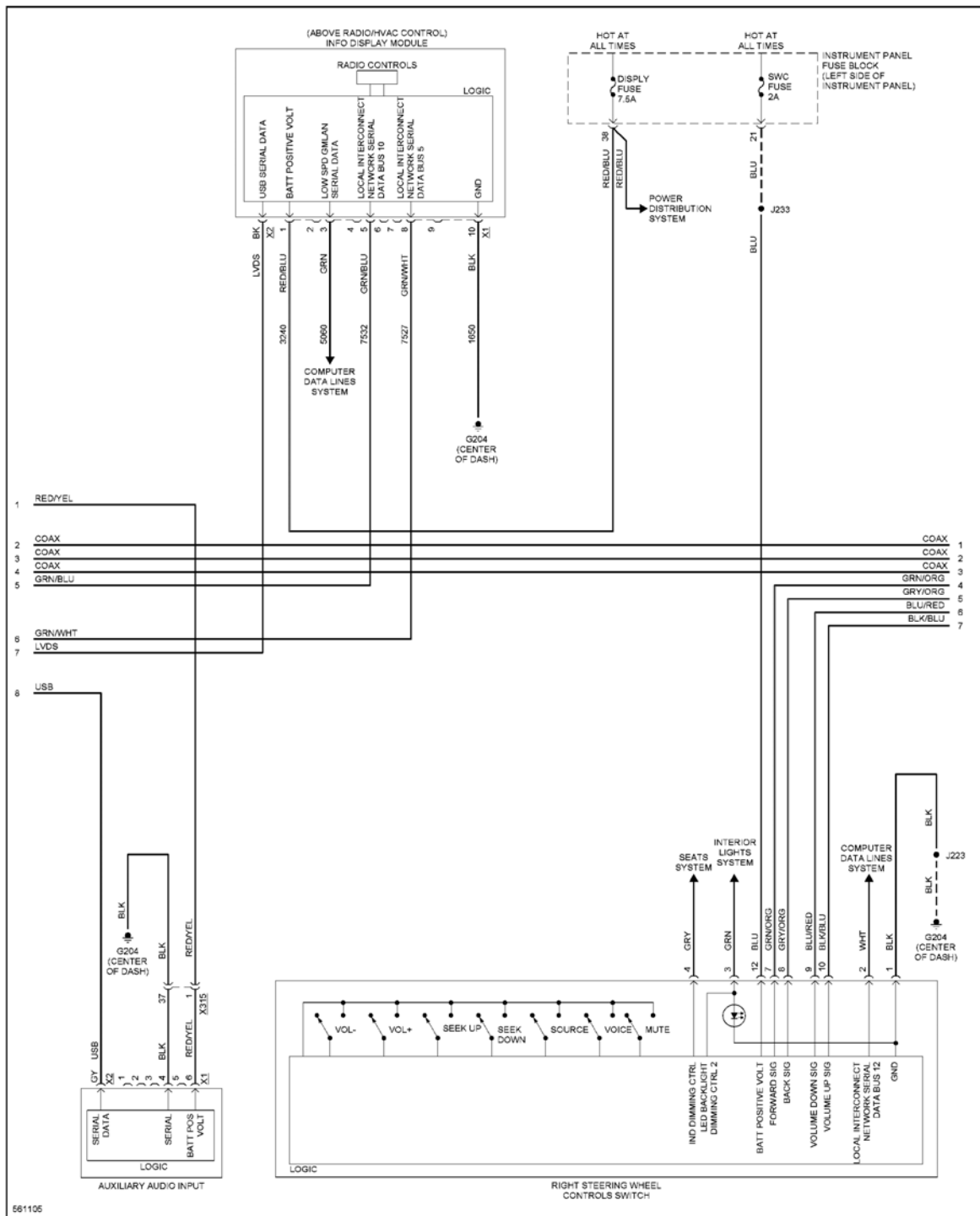
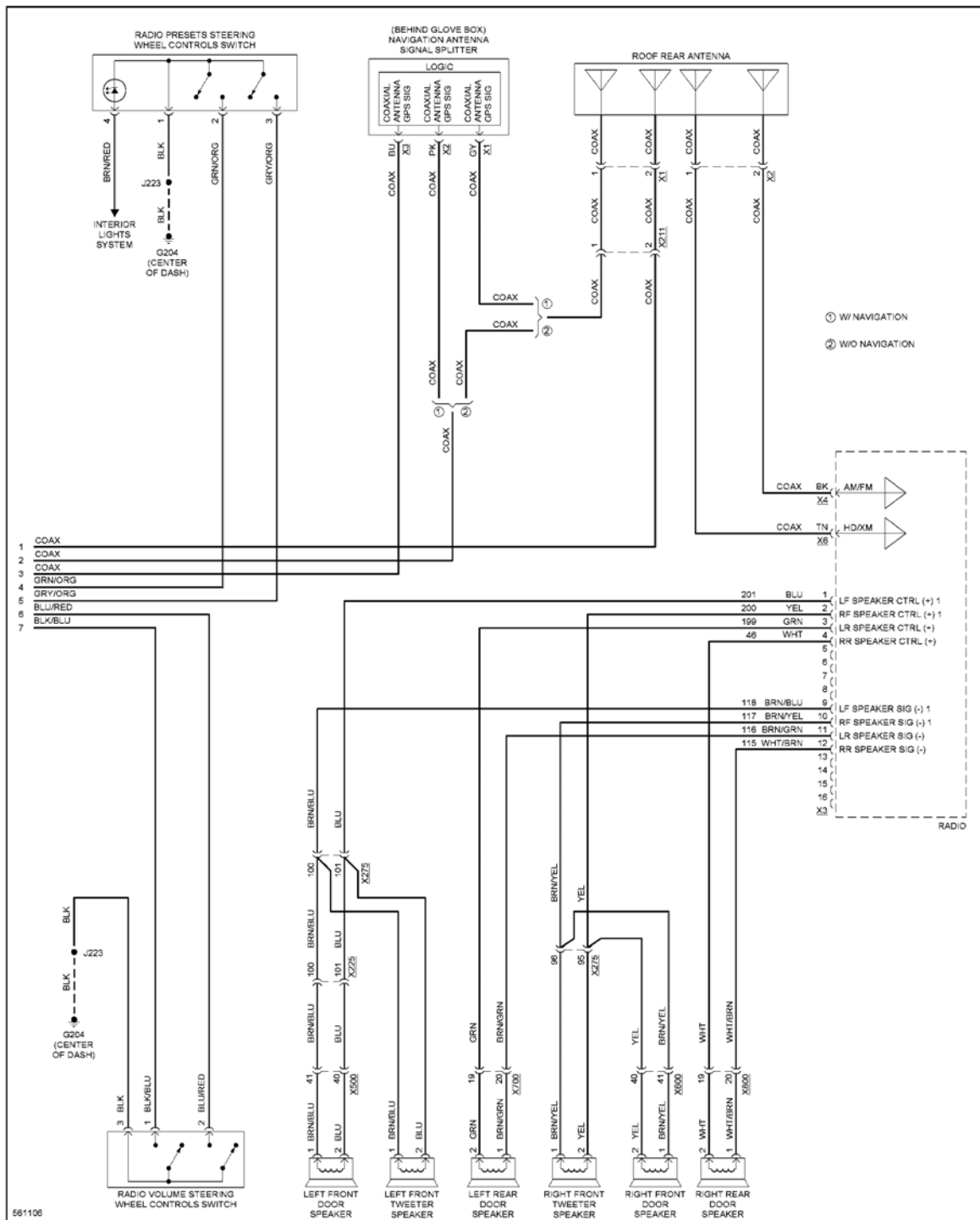


Fig. 98: Radio Circuit, W/O Amplifier (2 of 3)



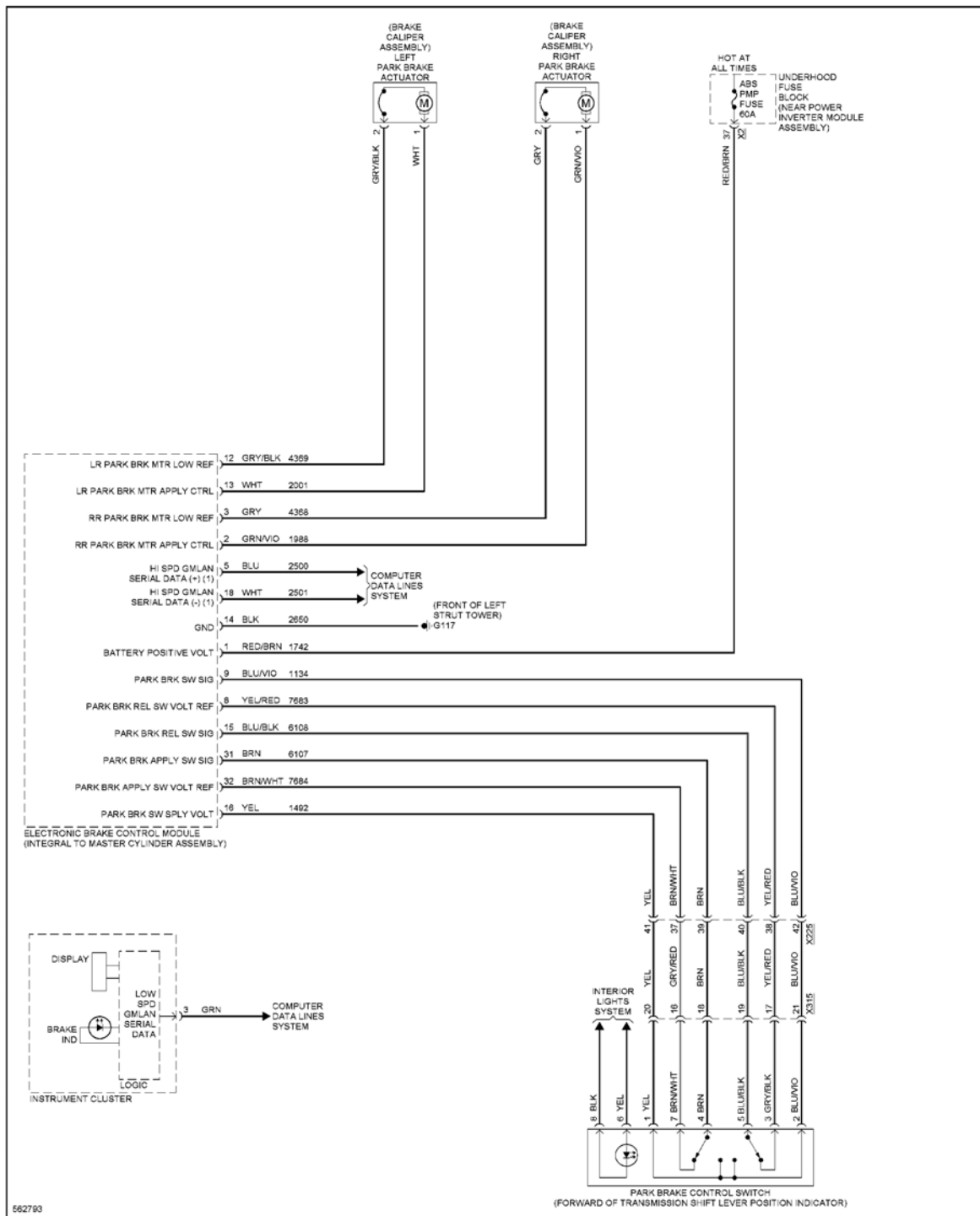


Fig. 100: Park Brake System Circuit

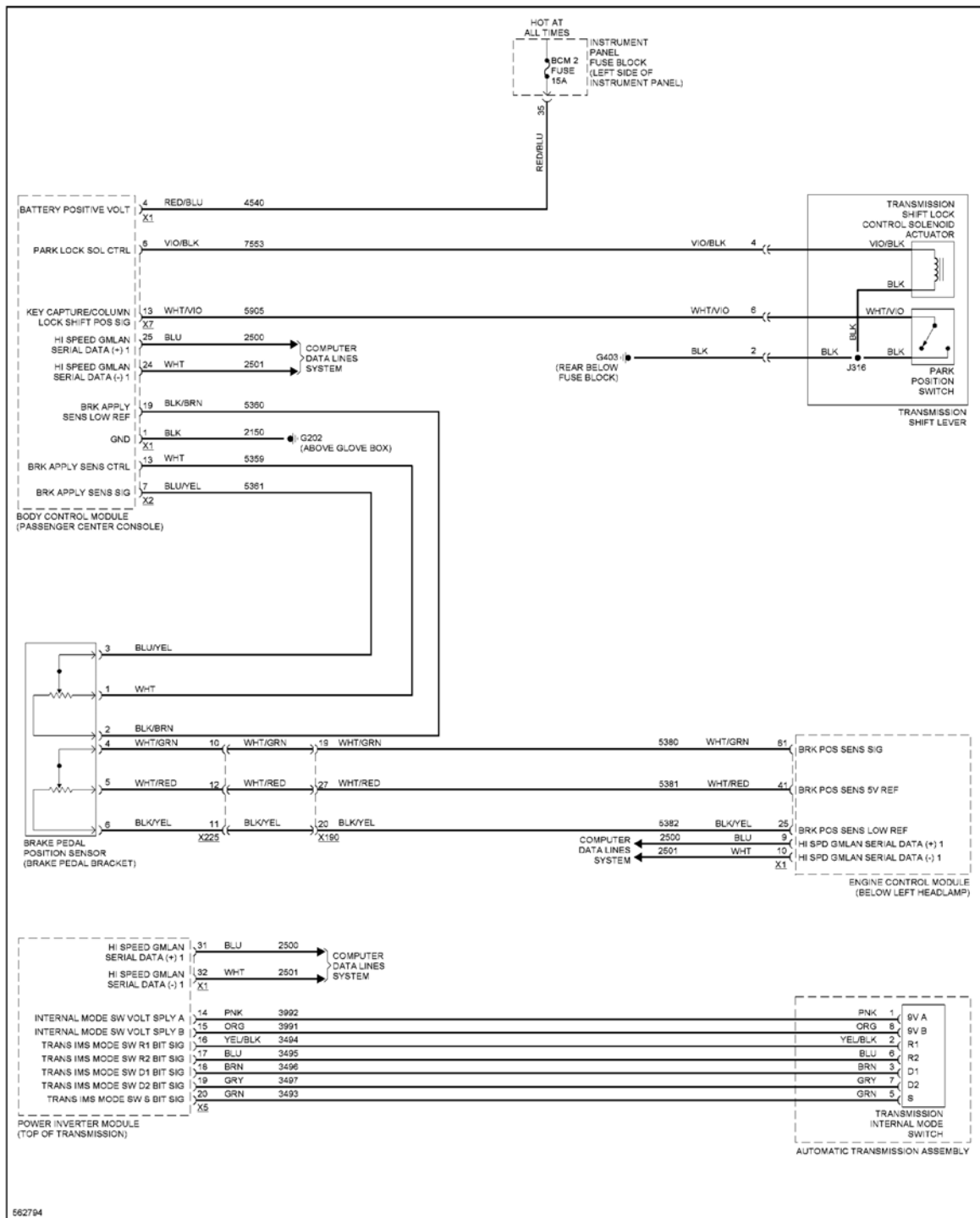


Fig. 101: Shift Interlock Circuit

SUPPLEMENTAL RESTRAINTS

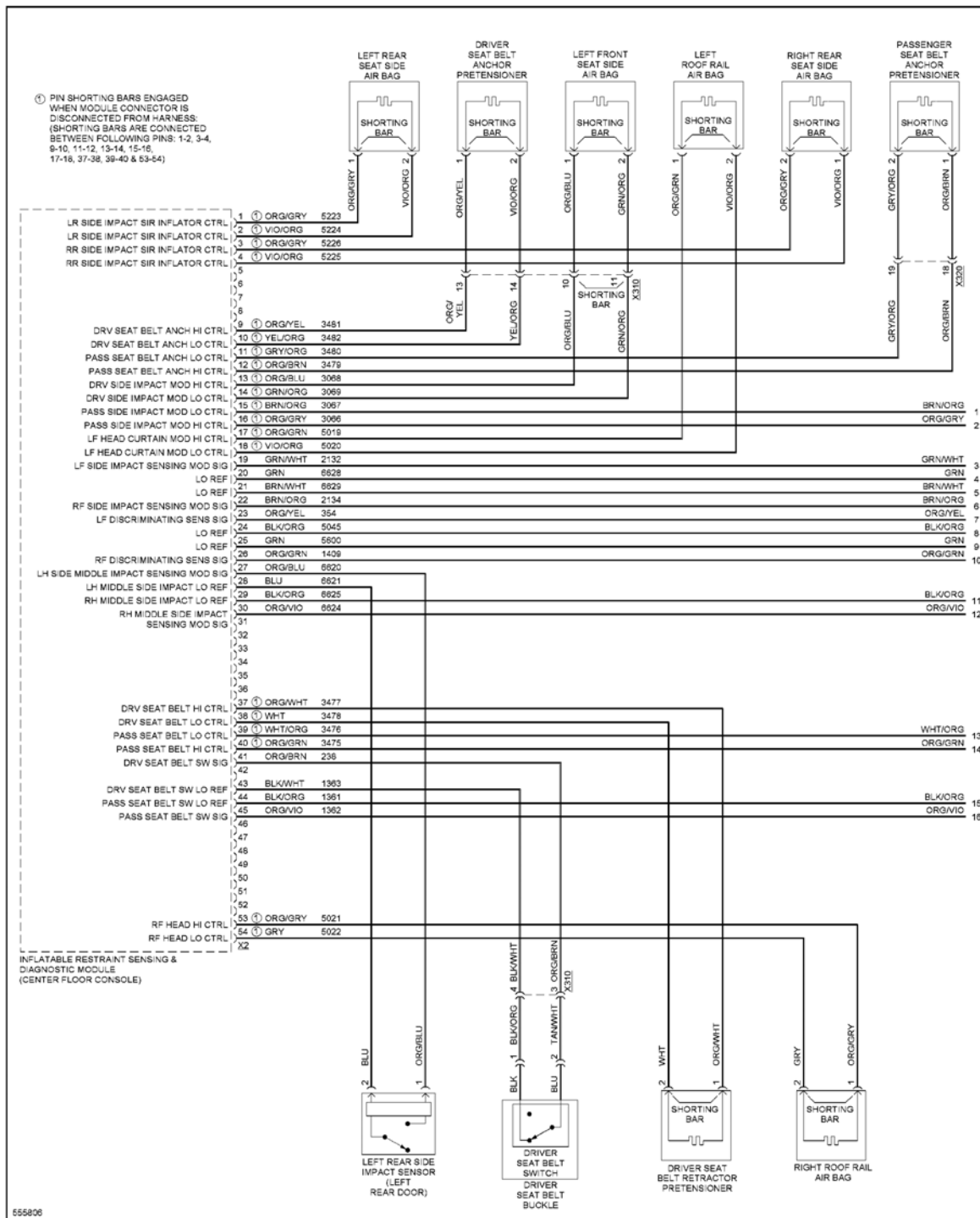


Fig. 102: Supplemental Restraints Circuit (1 of 3)

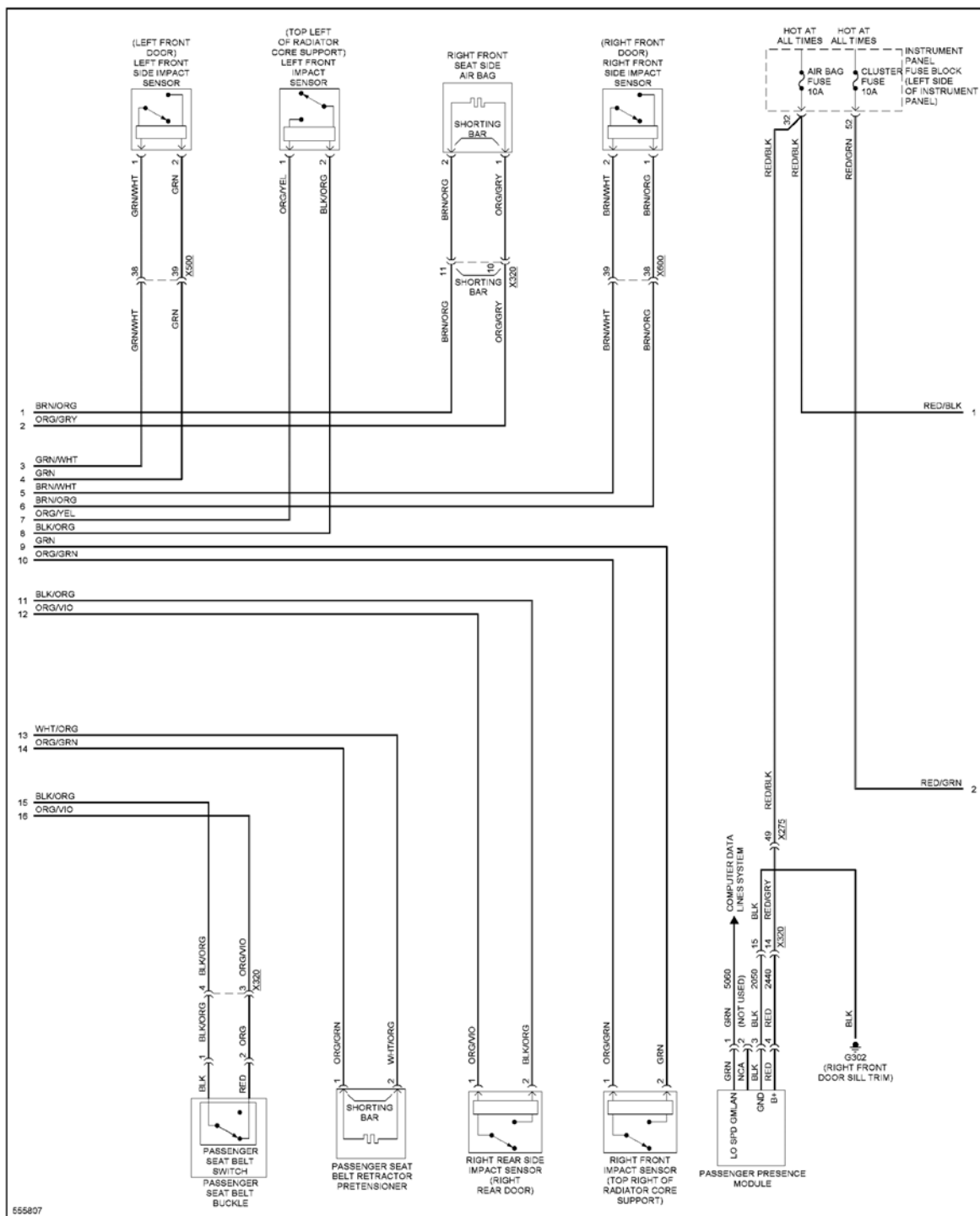


Fig. 103: Supplemental Restraints Circuit (2 of 3)

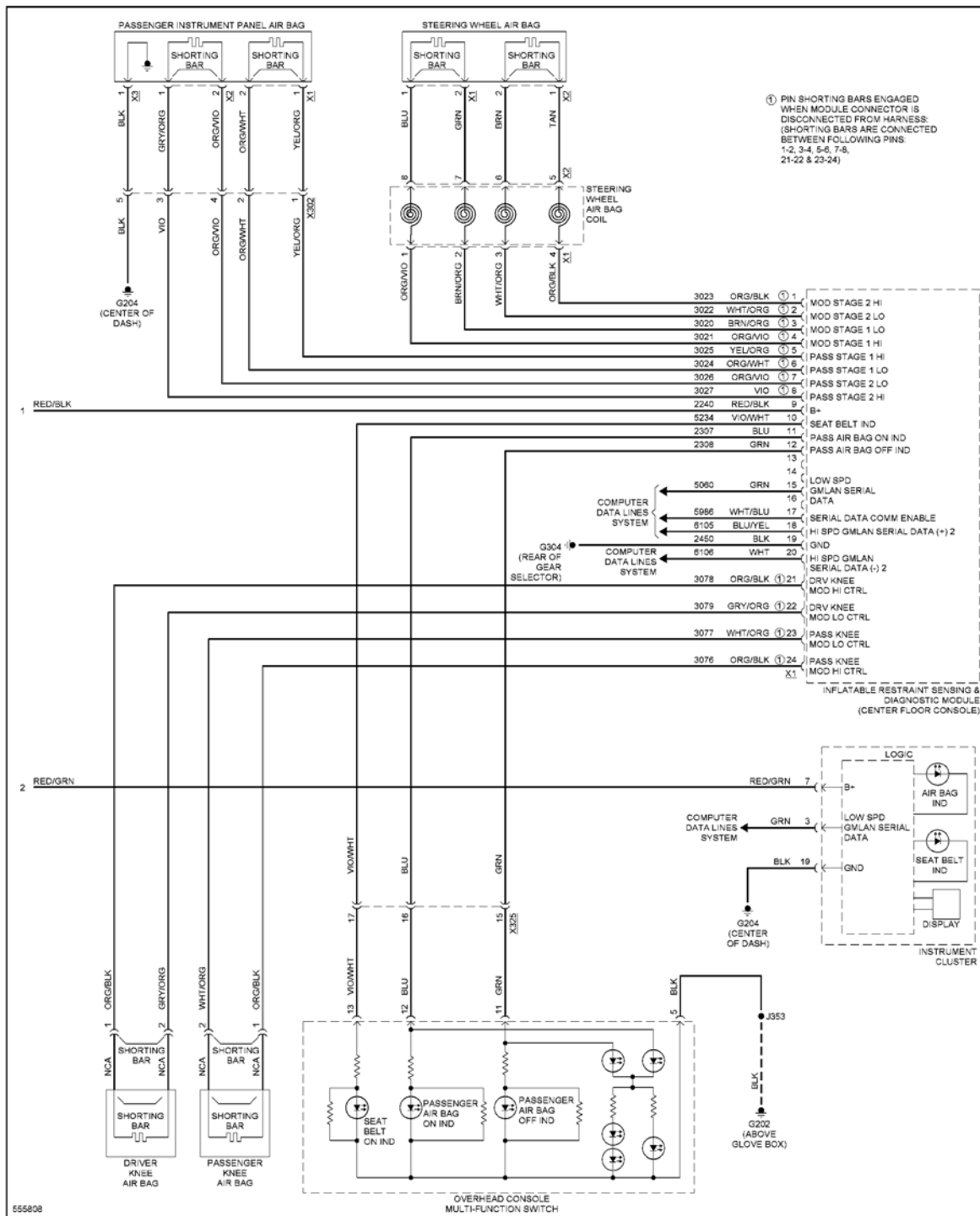


Fig. 104: Supplemental Restraints Circuit (3 of 3)

TRANSMISSION

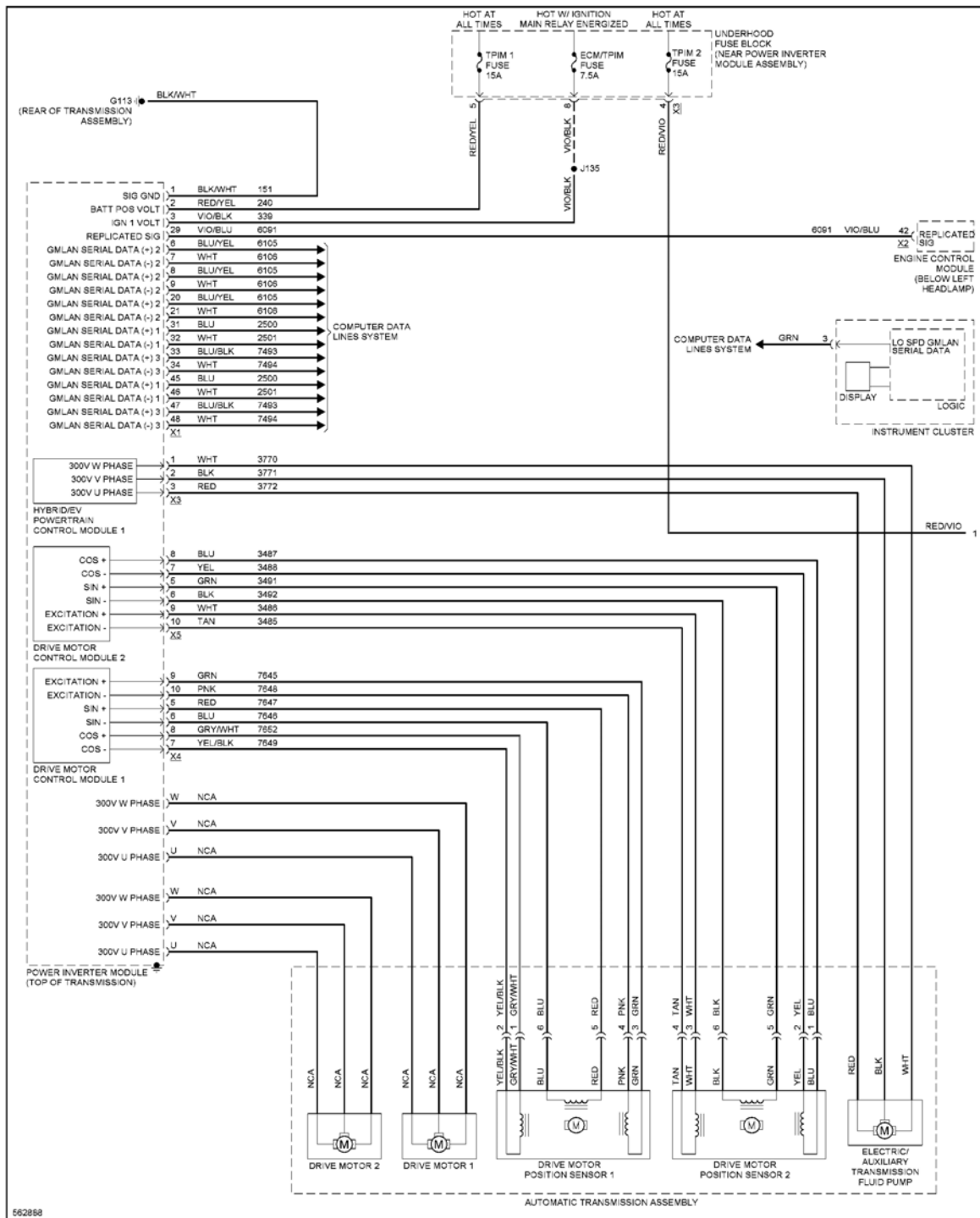


Fig. 105: Transmission Circuit (1 of 3)

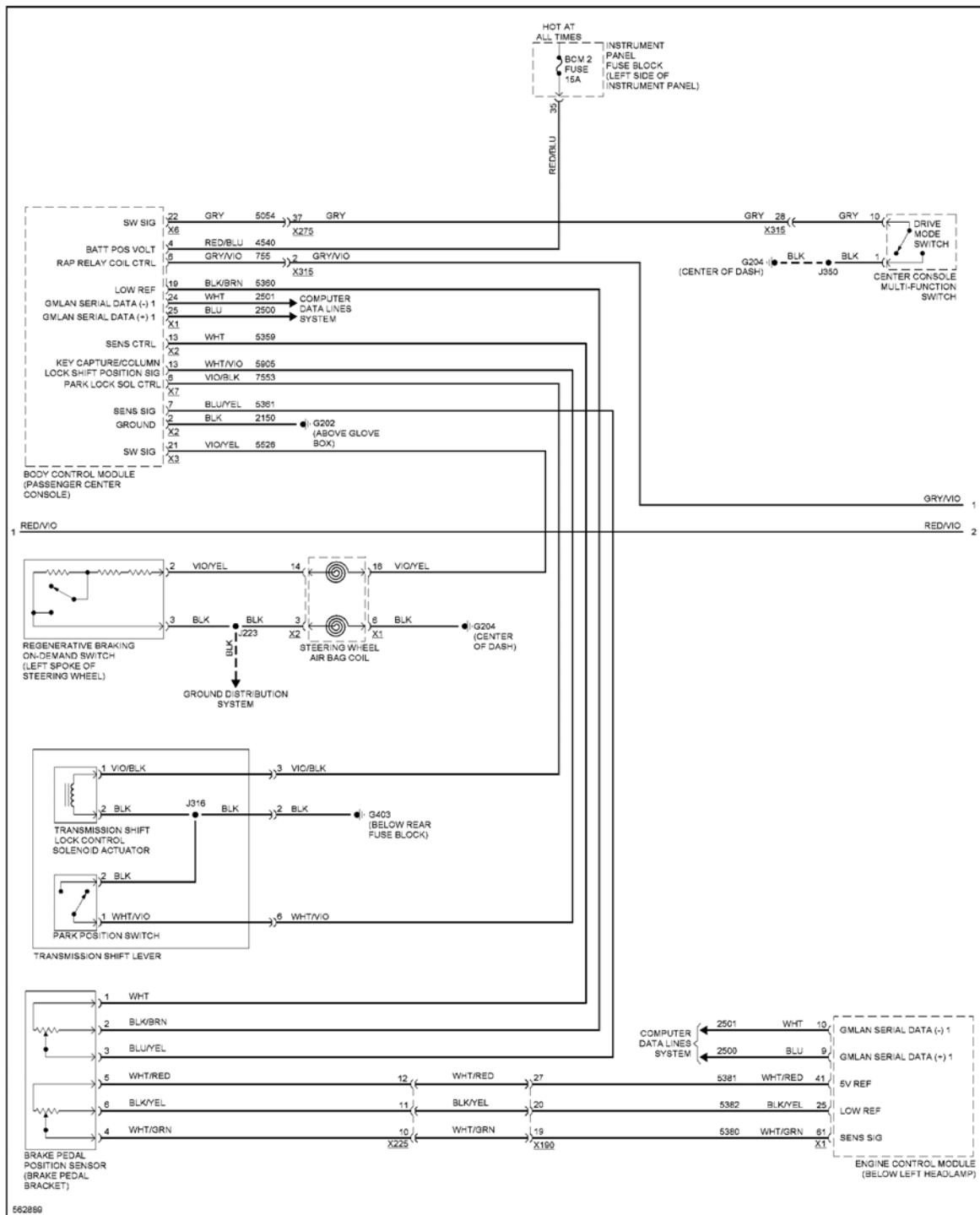


Fig. 106: Transmission Circuit (2 of 3)

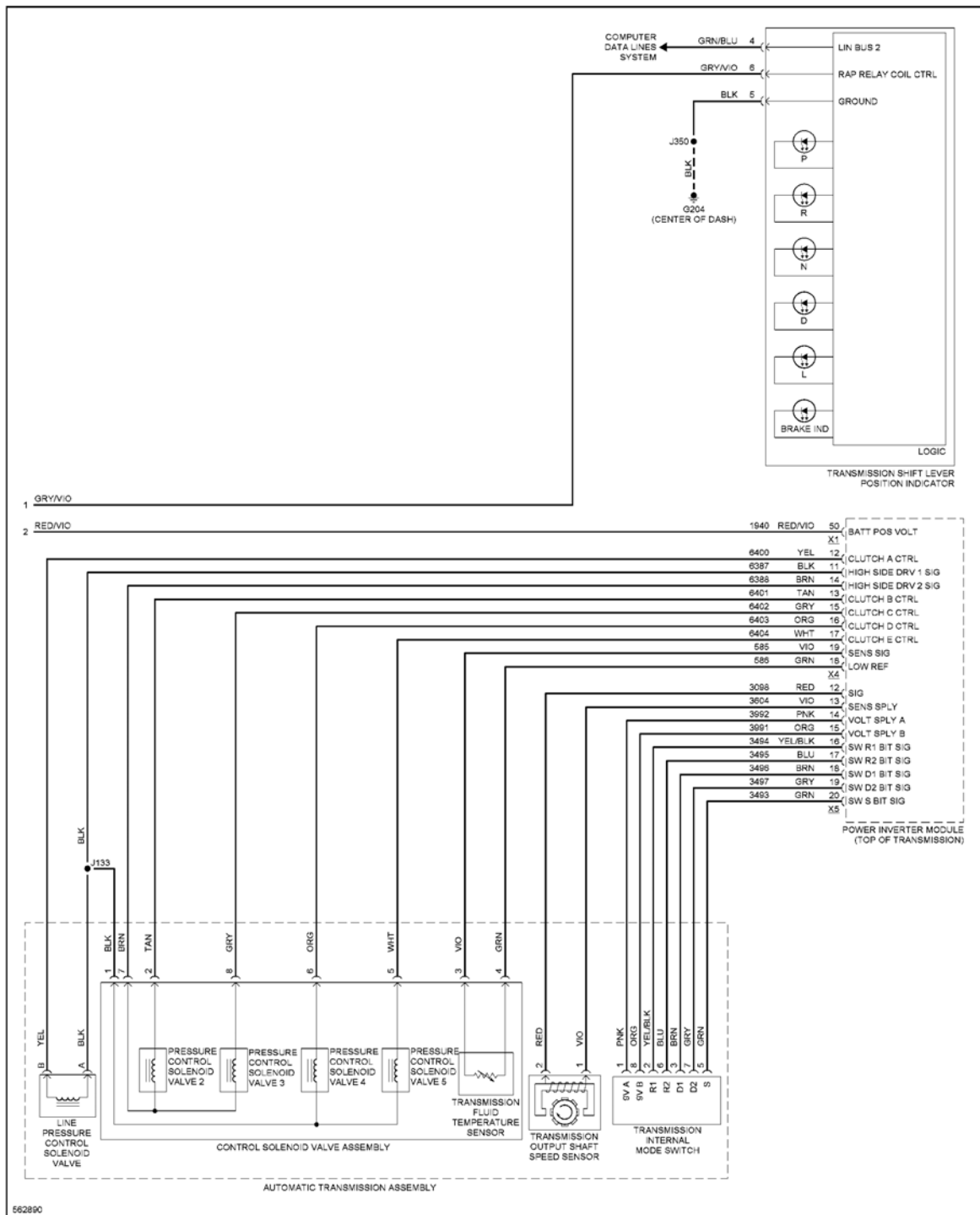


Fig. 107: Transmission Circuit (3 of 3)

TRUNK, TAILGATE, FUEL DOOR

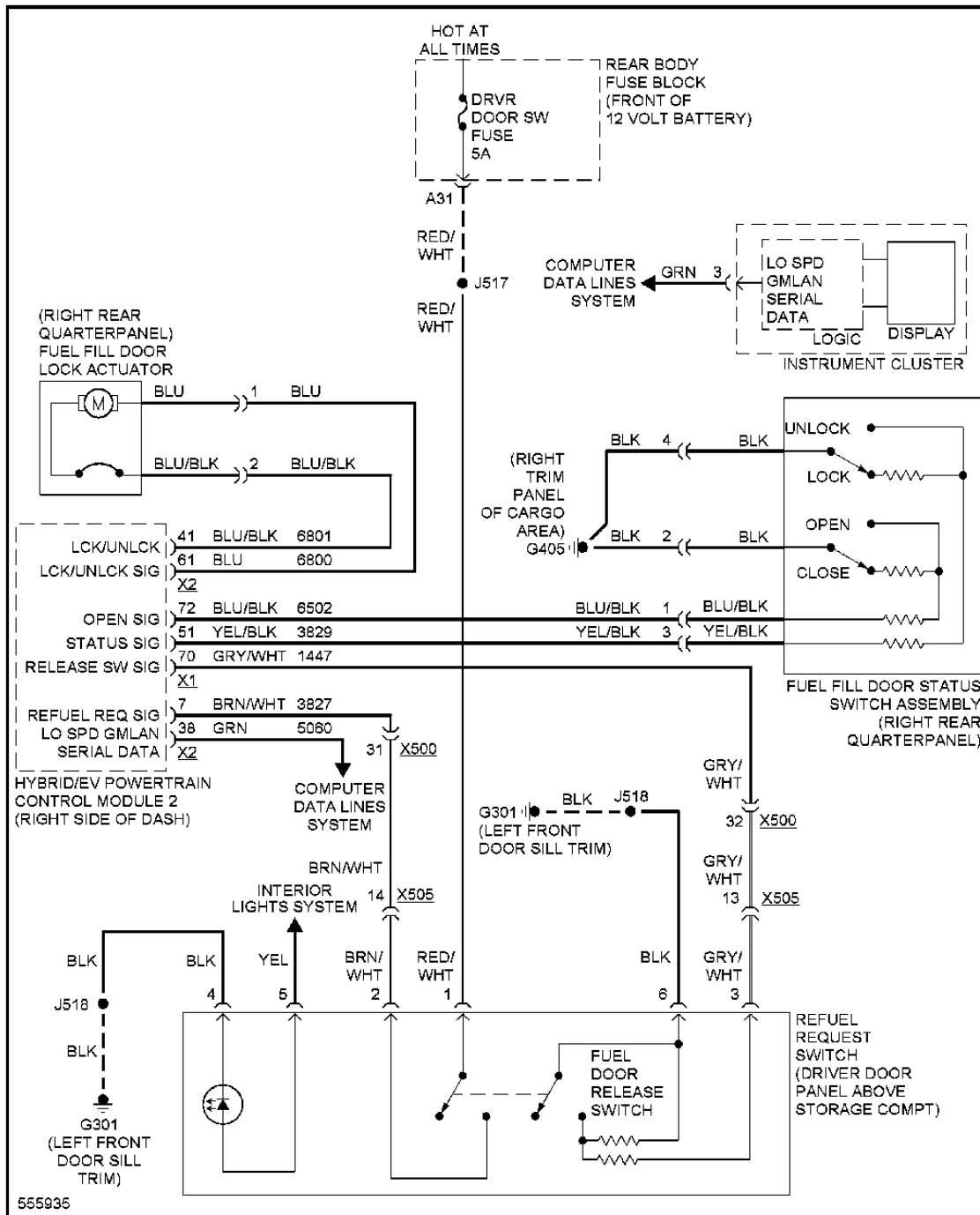


Fig. 108: Fuel Door Release Circuit

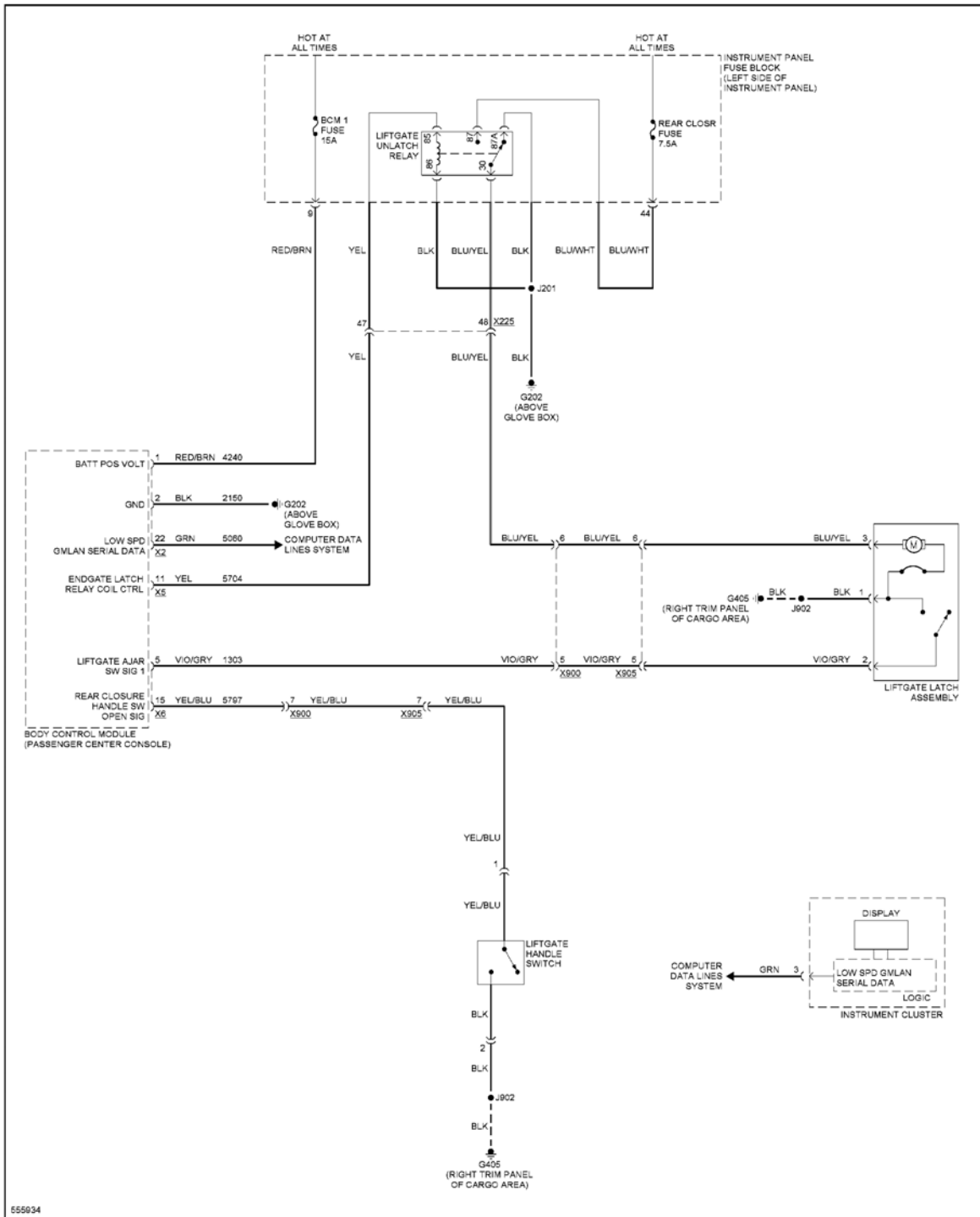


Fig. 109: Liftgate Release Circuit

WARNING SYSTEMS

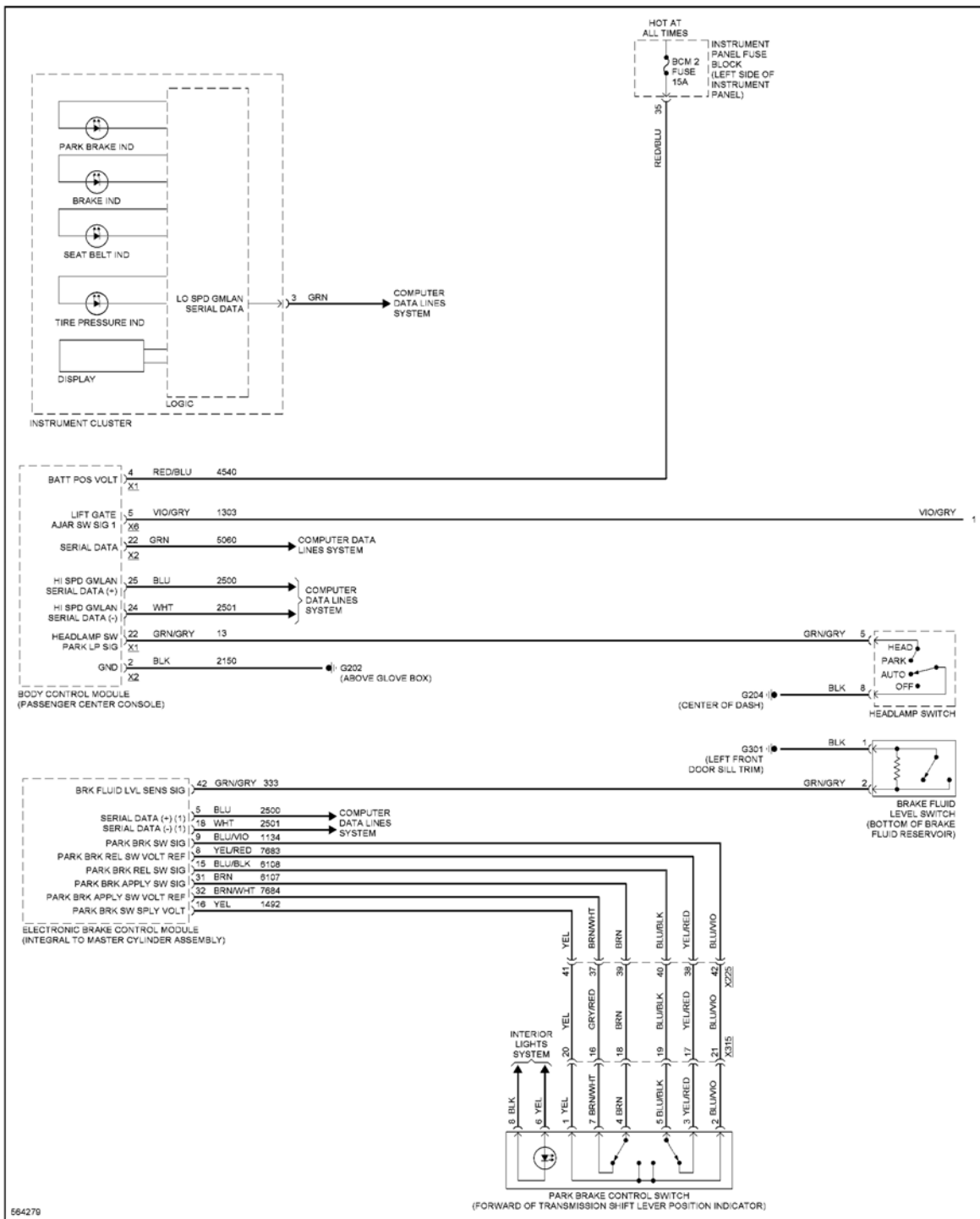


Fig. 110: Warning Systems Circuit (1 of 2)

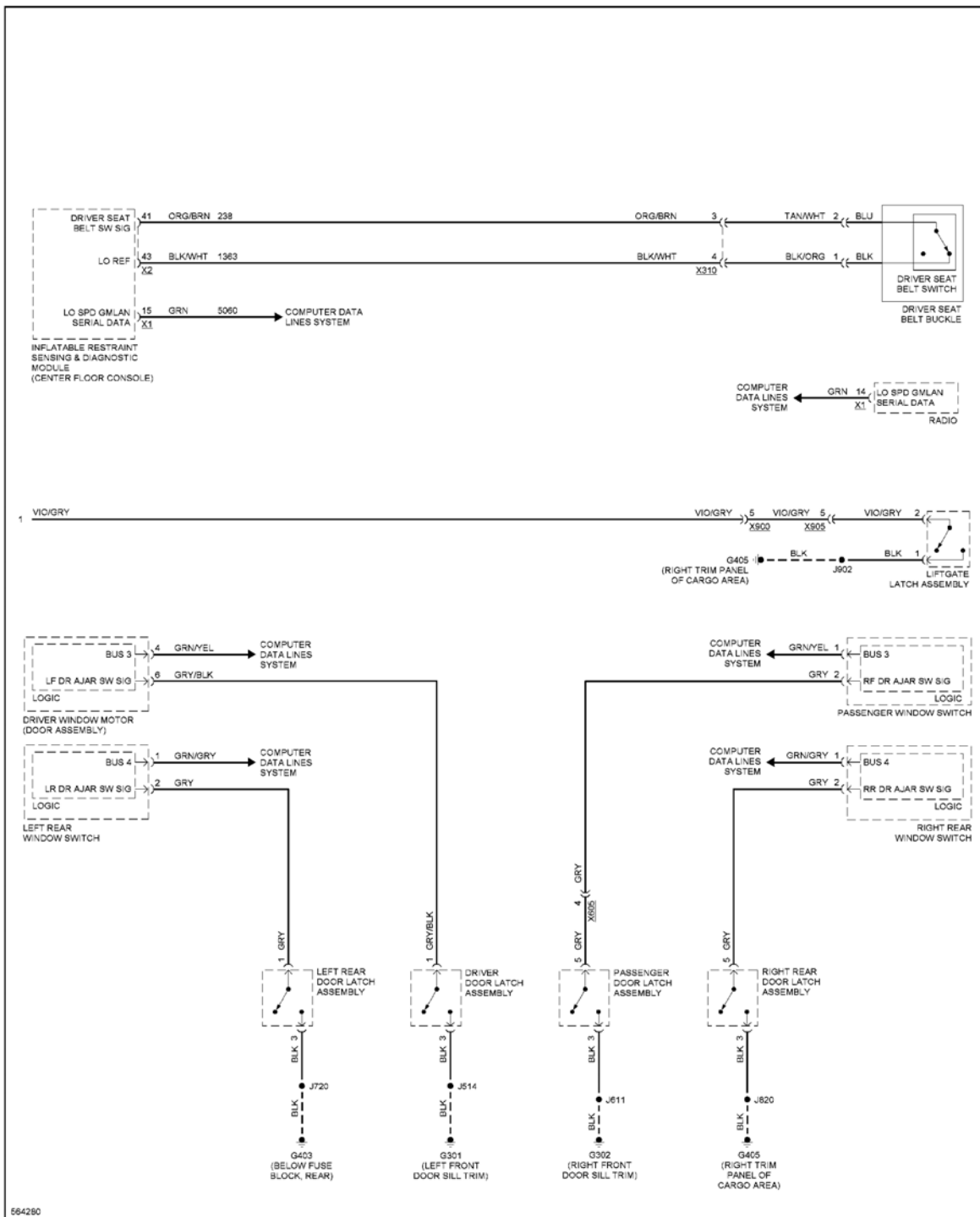


Fig. 111: Warning Systems Circuit (2 of 2)

WIPER/WASHER

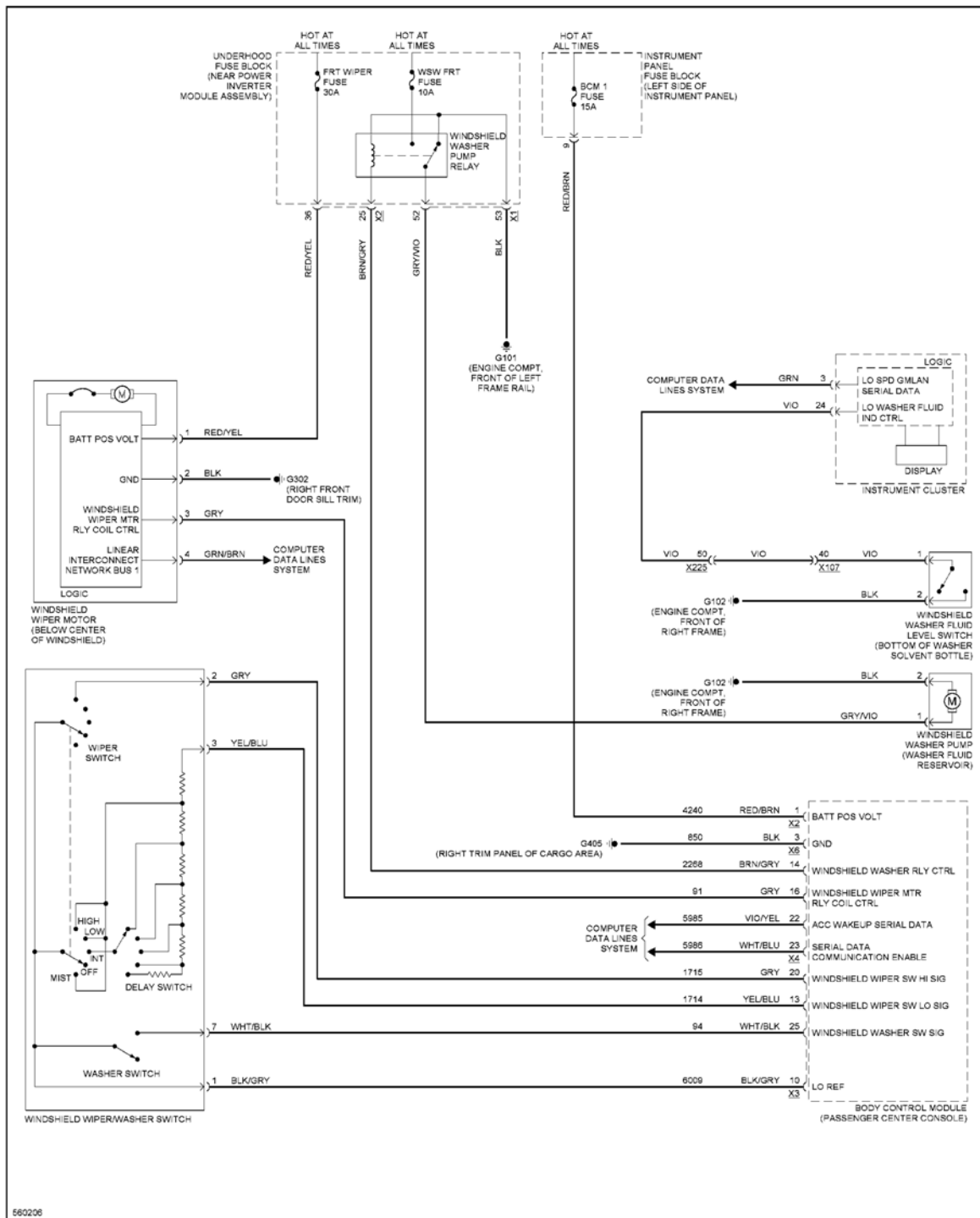


Fig. 112: Wiper/Washer Circuit

GENERAL INFORMATION

Using Wiring Diagrams

INTRODUCTION

Obtains wiring diagrams and technical service bulletins, containing wiring diagram changes, from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use. All system wiring diagrams are available in color format and may be viewed and or printed in color or black and white, depending on your program settings and available printer hardware.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today, the majority of diagrams follow a much improved format, which permits space for internal switch details, and component and ground locations.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

WIRING DIAGRAM COLOR ABBREVIATIONS

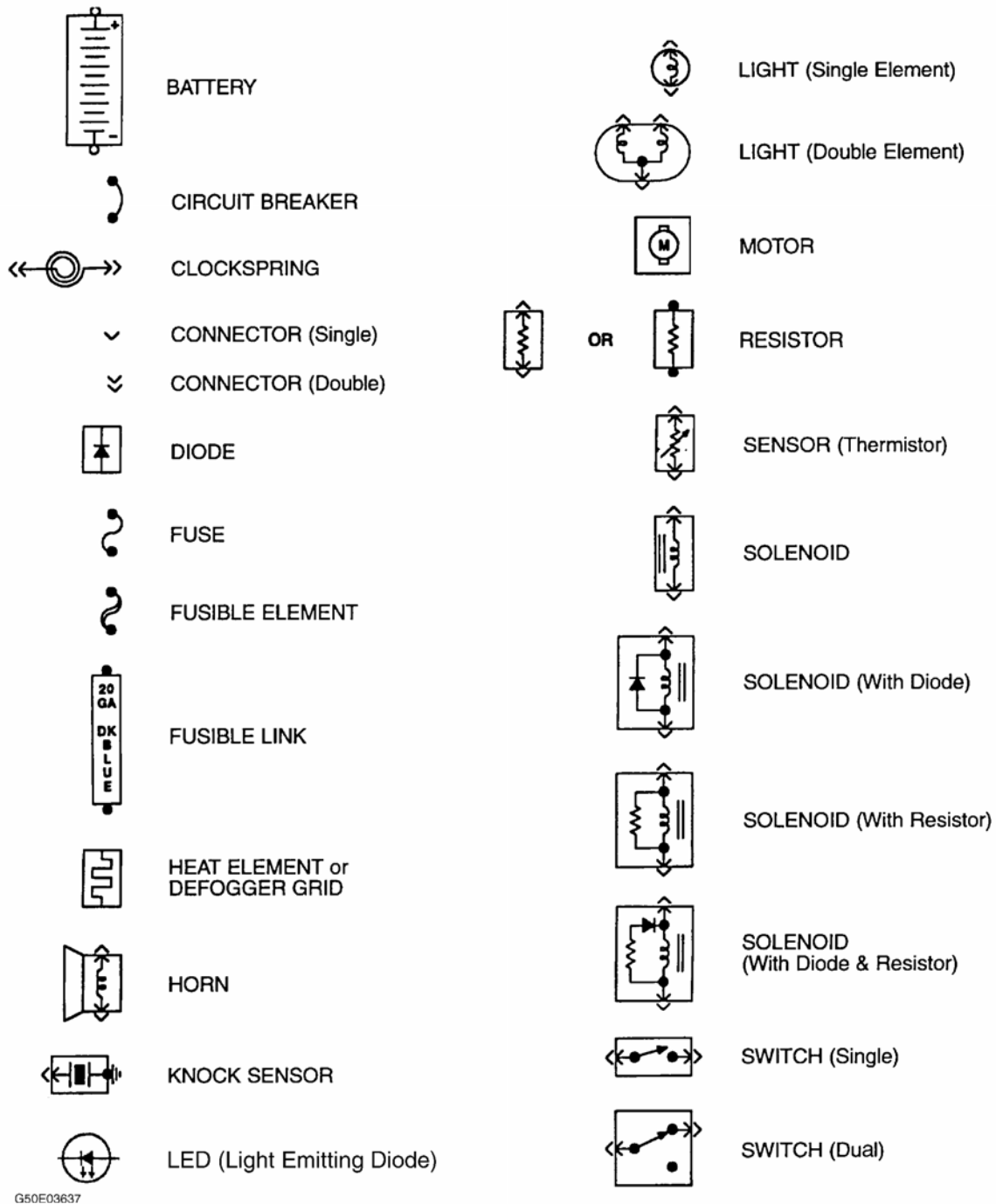
COLOR ABBREVIATIONS

Color	Normal	Optional	Misc. Euro Models
-------	--------	----------	-------------------

Color	Normal	Optional	Misc. Euro Models
Black	BLK	BK	B
Blue	BLU	BU	U
Brown	BRN	BN	N
Clear	CLR	CR	L
Dark Blue	DK BLU	DK BU	-
Dark Green	DK GRN	DK GN	-
Green	GRN	GN	G
Gray	GRY	GY	S
Light Blue	LT BLU	LT BU	-
Light Green	LT GRN	LT GN	-
Orange	ORG	OG	O
Pink	PNK	PK	K
Purple	PPL	PL	P
Red	RED	RD	R
Tan	TAN	TN	-
Violet	VIO	VI	-
White	WHT	WT	W
Yellow	YEL	YL	Y

WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.



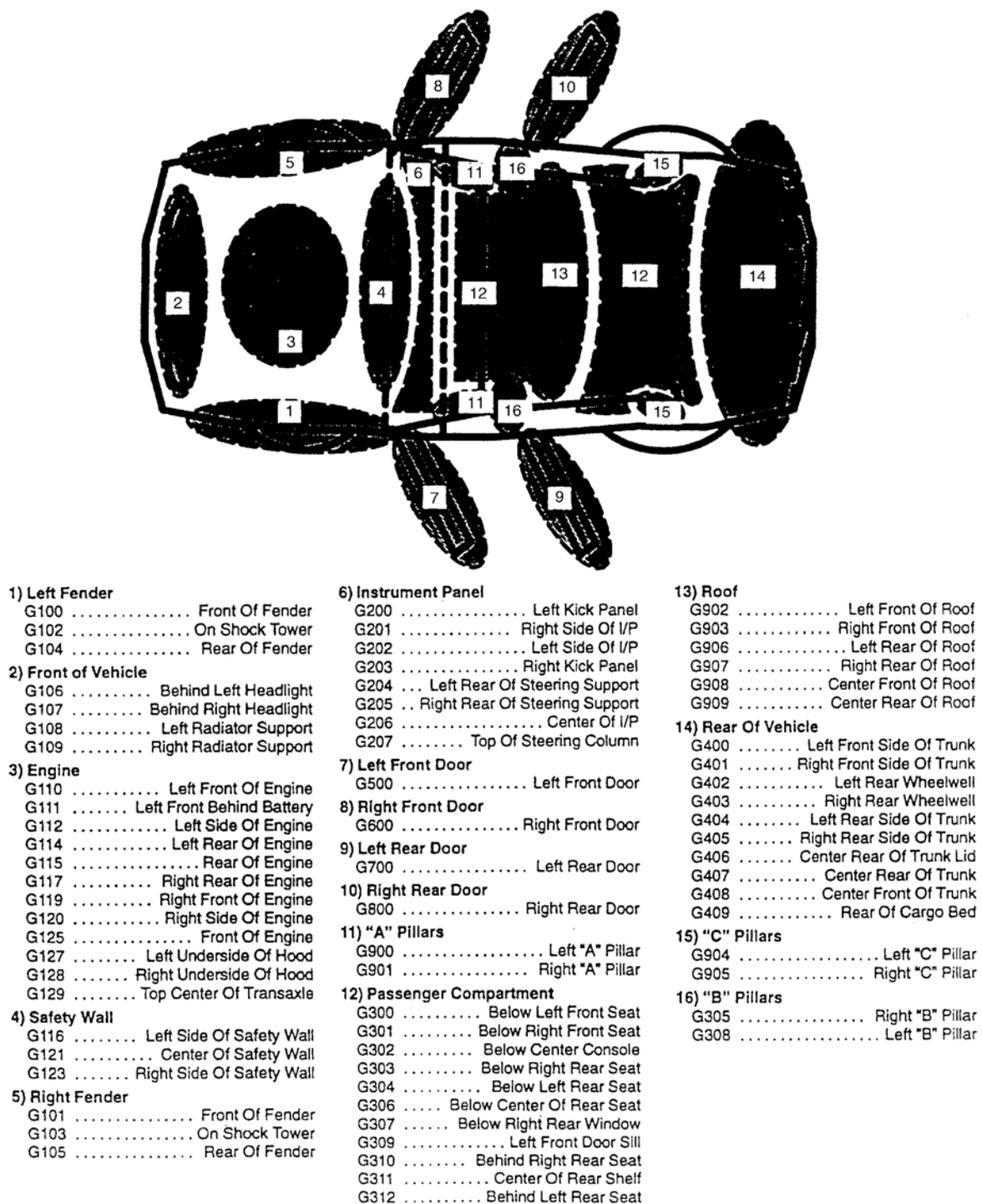
G50E03637

Fig. 1: Identifying Standard Wiring Diagram Symbols

WIRING DIAGRAM GROUND NUMBER LOCATIONS

NOTE: The following illustration depicts standardized ground numbers and locations to be used in conjunction with wiring diagrams applying to 2001 and prior model years only. See [Fig. 2](#). Wiring diagrams applying to newer

model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer model year wiring diagrams.



G00027307

Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located.

Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance

Component	Wiring Diagram
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems
Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance

Component	Wiring Diagram
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution
Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry

Component	Wiring Diagram
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance
Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters

Component	Wiring Diagram
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights
SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti- Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights

Component	Wiring Diagram
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems

Article GUID: A00130983